Standard RLL Instructions

In This Chapter...

Introduction

DL06 Micro PLCs offer a wide variety of instructions to perform many different types of operations. This chapter shows you how to use each standard Relay Ladder Logic (RLL) instruction. In addition to these instructions, you may also need to refer to the Drum instruction in Chapter 6, the Stage programming instructions in Chapter 7, PID in Chapter 8, LCD in Chapter 10 and programming for analog modules in D0-OPTIONS-M.

There are two ways to quickly find the instruction you need.

- If you know the instruction category (Boolean, Comparative Boolean, etc.), just use the title at the top of the page to find the pages that discuss the instructions in that category.
- If you know the individual instruction name, use the following table to find the page(s) that discusses the instruction.

Using Boolean Instructions

Do you ever wonder why so many PLC manufacturers always quote the scan time for a 1K Boolean program? Simple. Most programs utilize many Boolean instructions. These are typically very simple instructions designed to join input and output contacts in various series and parallel combinations. Our ***Direct***SOFT software is a similar program. It uses graphic symbols to develop a program; therefore, you don't necessarily have to know the instruction mnemonics in order to develop your program.

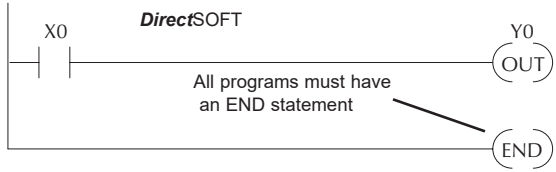
Many of the instructions in this chapter are not program instructions used in ***Direct***SOFT, but are implied. In other words, they are not actually keyboard commands, however, they can be seen in a Mnemonic View of the program once the ***Direct***SOFT program has been developed and accepted (compiled). Each instruction listed in this chapter will have a small chart to indicate how the instruction is used with ***Direct***SOFT and the HPP.

DS	Implied
HPP	Used

The following paragraphs show how these instructions are used to build simple ladder programs.

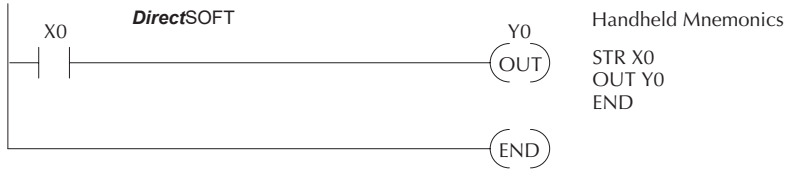
END Statement

All DL06 programs require an END statement as the last instruction. This tells the CPU that this is the end of the program. Normally, any instructions placed after the END statement will not be executed. There are exceptions to this, such as interrupt routines, etc. This chapter will discuss the instruction set in detail.



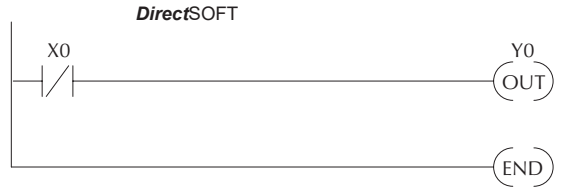
Simple Rungs

You use a contact to start rungs that contain both contacts and coils. The boolean instruction that does this is called a Store or, STR instruction. The output point is represented by the Output or, OUT instruction. The following example shows how to enter a single contact and a single output coil.



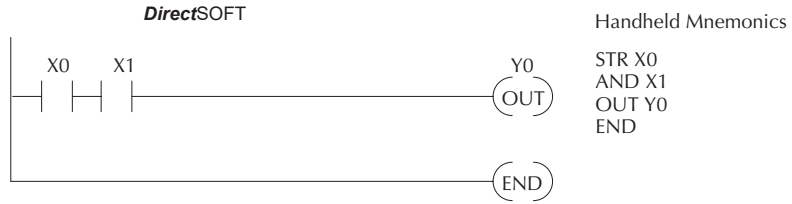
Normally Closed Contact

Normally closed contacts are also very common. This is accomplished with the Store Not, or STRN instruction. The following example shows a simple rung with a normally closed contact.



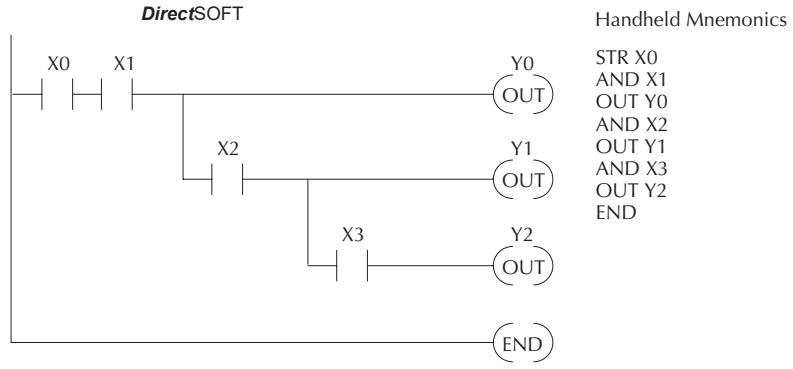
Contacts in Series

Use the AND instruction to join two or more contacts in series. The following example shows two contacts in series and a single output coil. The instructions used would be STR X0, AND X1, followed by OUT Y0.



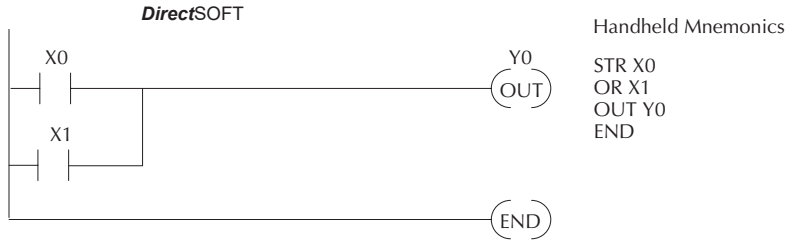
Midline Outputs

Sometimes, it is necessary to use midline outputs to get additional outputs that are conditional on other contacts. The following example shows how you can use the AND instruction to continue a rung with more conditional outputs.



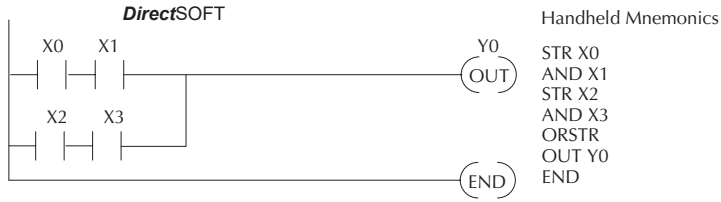
Parallel Elements

You may also have to join contacts in parallel. The OR instruction allows you to do this. The following example shows two contacts in parallel and a single output coil. The instructions would be STR X0, OR X1, followed by OUT Y0.



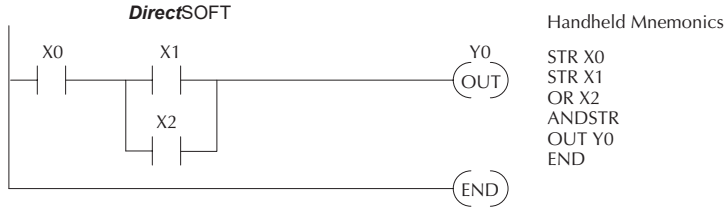
Joining Series Branches in Parallel

Quite often, it is necessary to join several groups of series elements in parallel. The Or Store (ORSTR) instruction allows this operation. The following example shows a simple network consisting of series elements joined in parallel.



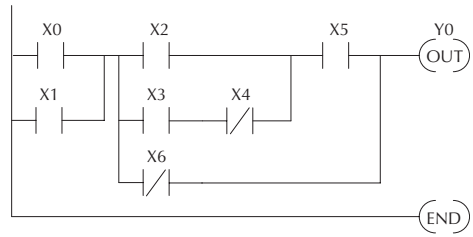
Joining Parallel Branches in Series

You can also join one or more parallel branches in series. The And Store (ANDSTR) instruction allows this operation. The following example shows a simple network with contact branches in series with parallel contacts.



Combination Networks

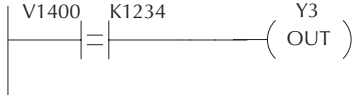
You can combine the various types of series and parallel branches to solve almost any application problem. The example at right shows a simple combination network.



Comparative Boolean

Some PLC manufacturers make it really difficult to do a simple comparison of two numbers. Some of them require you to move the data all over the place before you can actually perform the comparison. The DL06 Micro PLCs provide Comparative Boolean instructions that allow you to quickly and easily solve this problem. The Comparative Boolean provides evaluation of two BCD values using boolean contacts. The valid evaluations are: equal to, not equal to, equal to or greater than, and less than.

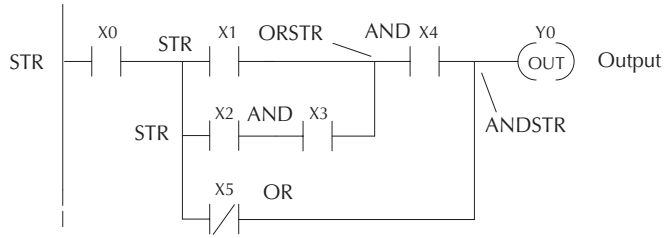
In the example, when the BCD value in V-memory location V1400 is equal to the constant value 1234, Y3 will energize.



Boolean Stack

There are limits to how many elements you can include in a rung. This is because the DL06 PLCs use an 8-level boolean stack to evaluate the various logic elements. The boolean stack is a temporary storage area that solves the logic for the rung. Each time the program encounters a STR instruction, the instruction is placed on the top of the stack. Any other STR instructions already on the boolean stack are pushed down a level. The ANDSTR, and ORSTR instructions combine levels of the boolean stack when they are encountered. An error will occur during program compilation if the CPU encounters a rung that uses more than the eight levels of the boolean stack.

The following example shows how the boolean stack is used to solve boolean logic.



STR X0

1	STR X0
2	
3	
4	

STR X1

1	STR X1
2	STR X0
3	
4	

STR X2

1	STR X2
2	STR X1
3	STR X0
4	

AND X3

1	X2 AND X3
2	STR X1
3	STR X0
4	

ORSTR

1	X1 or (X2 AND X3)
2	STR X0
3	

AND X4

1	X4 AND {X1 or (X2 AND X3)}
2	STR X0
3	

ORNOT X5

1	NOT X5 OR X4 AND {X1 OR (X2 AND X3)}
2	STR X0
3	

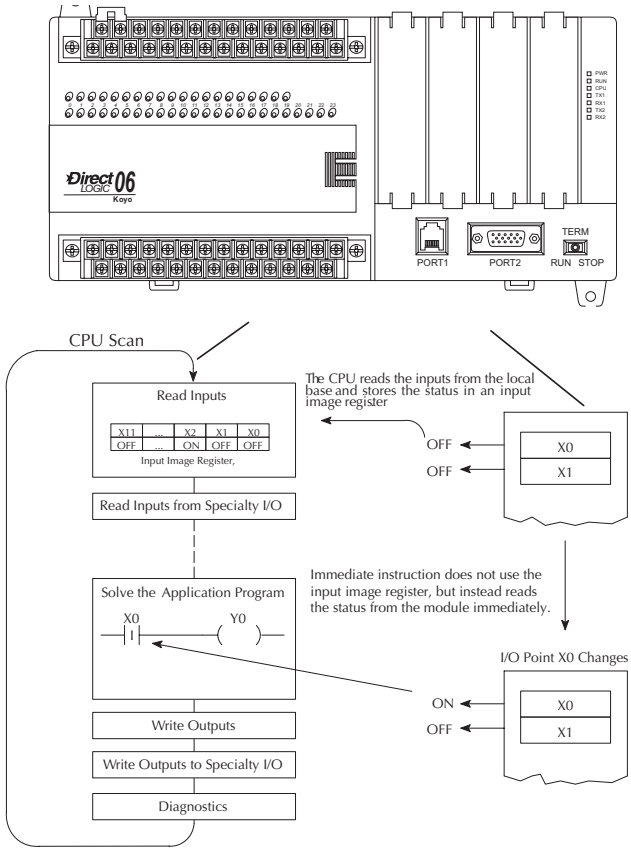
ANDSTR

1	XO AND (NOT X5 or X4) AND {X1 or (X2 AND X3)}
2	
3	

Immediate Boolean

The DL06 Micro PLCs can usually complete an operation cycle in a matter of milliseconds. However, in some applications you may not be able to wait a few milliseconds until the next I/O update occurs. The DL06 PLCs offer Immediate input and outputs which are special boolean instructions that allow reading directly from inputs and writing directly to outputs during the program execution portion of the CPU cycle. You may recall that this is normally done during the input or output update portion of the CPU cycle. The immediate instructions take longer to execute because the program execution is interrupted while the CPU reads or writes the I/O point. This function is not normally done until the read inputs or the write outputs portion of the CPU cycle.

***NOTE**: Even though the immediate input instruction reads the most current status from the input point, it only uses the results to solve that one instruction. It does not use the new status to update the image register. Therefore, any regular instructions that follow will still use the image register values. Any immediate instructions that follow will access the I/O again to update the status. The immediate output instruction will write the status to the I/O and update the image register.*

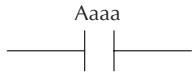


Boolean Instructions

Store (STR)

DS	Used
HPP	Used

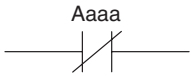
The Store instruction begins a new rung or an additional branch in a rung with a normally open contact. Status of the contact will be the same state as the associated image register point or memory location.



Store Not (STRN)

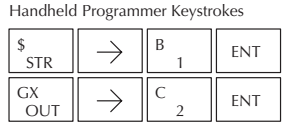
DS	Used
HPP	Used

The Store Not instruction begins a new rung or an additional branch in a rung with a normally closed contact. Status of the contact will be opposite the state of the associated image register point or memory location.

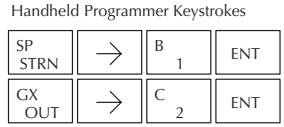


Operand Data Type		DL06 Range
	A	aaa
Inputs	X	0–777
Outputs	Y	0–777
Control Relays	C	0–1777
Stage	S	0–1777
Timer	T	0–377
Counter C	CT	0–177
Special Relay	SP	0–777

In the following Store example, when input X1 is on, output Y2 will energize.

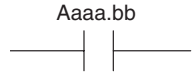


In the following Store Not example, when input X1 is off output Y2 will energize.



Store Bit-of-Word (STRB)

DS	Used
HPP	Used



The Store Bit-of-Word instruction begins a new rung or an additional branch in a rung with a normally open contact. Status of the contact will be the same state as the bit referenced in the associated memory location.

Store Not Bit-of-Word (STRNB)

DS	Used
HPP	Used

The Store Not instruction begins a new rung or an additional branch in a rung with a normally closed contact. Status of the contact will be opposite the state of the bit referenced in the associated memory location.

Operand Data Type		DL06 Range	
	A	aaa	bb
V-memory	B	See memory map	0 to 15
Pointer	PB	See memory map	0 to 15

These instructions look like the STR and STRN instructions only the address is different. Take note how the address is set up in the following Store Bit-of-Word example.

When bit 12 of V-memory location V1400 is on, output Y2 will energize.

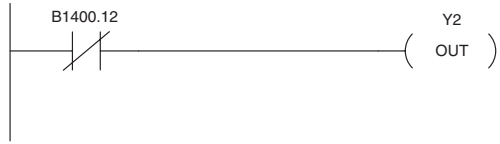
DirectSOFT

Handheld Programmer Keystrokes

STR	SHFT	B	→	V	1	4	0	0
→	K	1	2	ENT				
OUT	→	2	ENT					

In the following Store Not Bit-of-Word example, when bit 12 of V-memory location V1400 is off, output Y2 will energize.

DirectSOFT

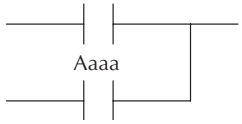


Handheld Programmer Keystrokes

STRN	SHFT	B	→	V	1	4	0	0
→	K	1	2	ENT				
OUT	→	2	ENT					

Or (OR)

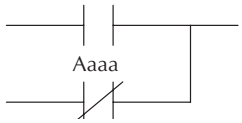
DS	Implied
HPP	Used



The Or instruction will logically OR a normally open contact in parallel with another contact in a rung. The status of the contact will be the same state as the associated image register point or memory location.

Or Not (ORN)

DS	Implied
HPP	Used

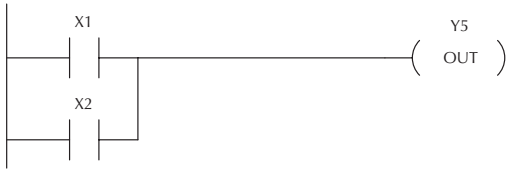


The Or Not instruction will logically OR a normally closed contact in parallel with another contact in a rung. The status of the contact will be opposite the state of the associated image register point or memory location.

Operand Data Type		DL06 Range
	A	aaa
Inputs	X	0-777
Outputs	Y	0-777
Control Relays	C	0–1777
Stage	S	0–1777
Timer	T	0–377
Counter	CT	0–177
Special Relay	SP	0-777

In the following Or example, when input X1 or X2 is on, output Y5 will energize.

DirectSOFT



Handheld Programmer Keystrokes

$ STR	→	B 1	ENT
Q OR	→	C 2	ENT
GX OUT	→	F 5	ENT

In the following Or Not example, when input X1 is on or X2 is off, output Y5 will energize.

DirectSOFT

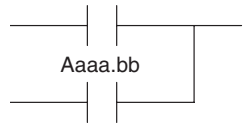
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT
R ORN	→	C 2	ENT
GX OUT	→	F 5	ENT

Or Bit-of-Word (OR)

DS	Implied
HPP	Used

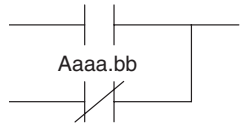
The Or Bit-of-Word instruction will logically OR a normally open contact in parallel with another contact in a rung. Status of the contact will be the same state as the bit referenced in the associated memory location.



Or Not Bit-of-Word (ORN)

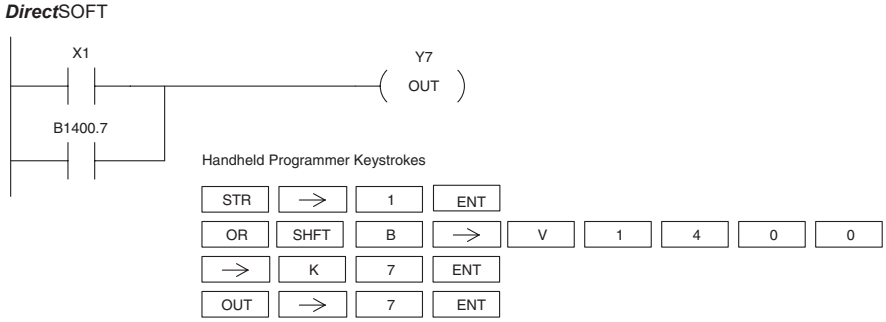
DS	Implied
HPP	Used

The Or Not Bit-of-Word instruction will logically OR a normally closed contact in parallel with another contact in a rung. Status of the contact will be opposite the state of the bit referenced in the associated memory location.

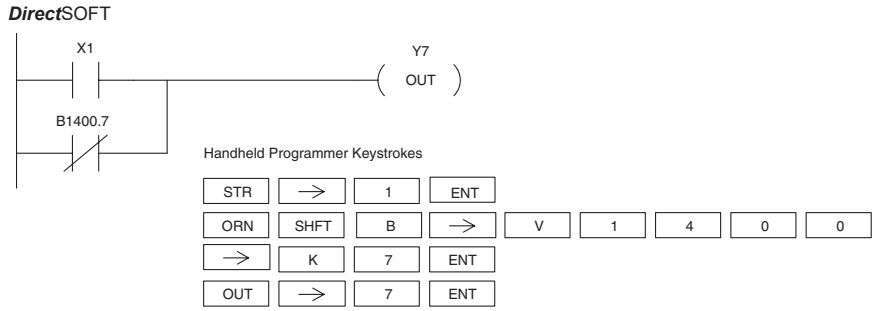


Operand Data Type		DL06 Range	
	A	aaa	bb
V-memory	B	See memory map	0 to 15
Pointer	PB	See memory map	0 to 15

In the following Or Bit-of-Word example, when input X1 or bit 7 of V1400 is on, output Y5 will energize.



In the following Or Bit-of-Word example, when input X1 is on or bit 7 of V1400 is off, output Y7 will energize.



AND (AND)

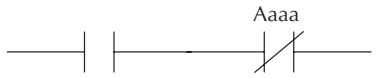
DS	Implied
HPP	Used

The AND instruction logically ands a normally open contact in series with another contact in a rung. The status of the contact will be the same state as the associated image register point or memory location.

AND NOT (ANDN)

DS	Implied
HPP	Used

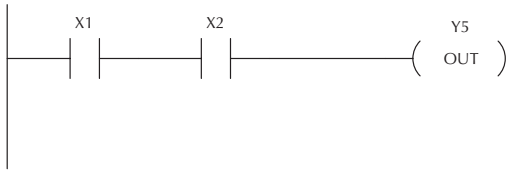
The AND NOT instruction logically ands a normally closed contact in series with another contact in a rung. The status of the contact will be opposite the state of the associated image register point or memory location



Operand Data Type		DL06 Range
	A	aaa
Inputs	X	0–777
Outputs	Y	0–777
Control Relays	C	0–1777
Stage	S	0–1777
Timer	T	0–377
Counter	CT	0–177
Special Relay	SP	0–777

In the following And example, when input X1 and X2 are on output Y5 will energize.

DirectSOFT

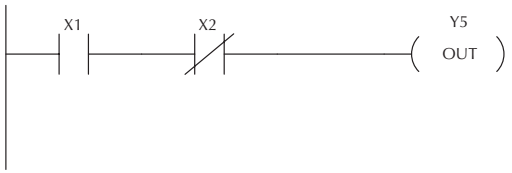


Handheld Programmer Keystrokes

$ STR	→	B 1	ENT
V AND	→	C 2	ENT
GX OUT	→	F 5	ENT

In the following And Not example, when input X1 is on and X2 is off output Y5 will energize.

DirectSOFT



Handheld Programmer Keystrokes

$ STR	→	B 1	ENT
W ANDN	→	C 2	ENT
GX OUT	→	F 5	ENT

AND Bit-of-Word (AND)

DS	Implied
HPP	Used

The And Bit-of-Word instruction logically ands a normally open contact in series with another contact in a rung. The status of the contact will be the same state as the bit referenced in the associated memory location.

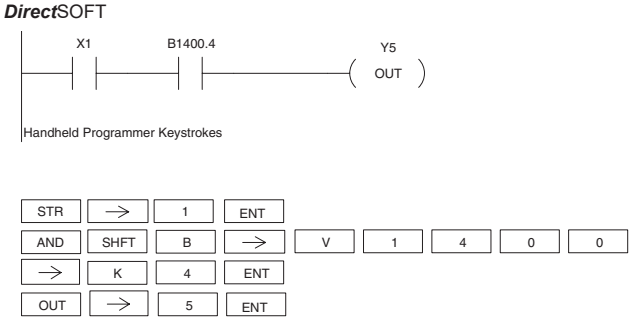
AND Not Bit-of-Word (ANDN)

DS	Implied
HPP	Used

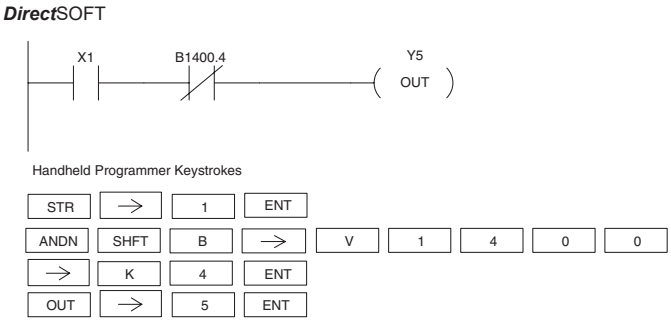
The And Not Bit-of-Word instruction logically ands a normally closed contact in series with another contact in a rung. The status of the contact will be opposite the state of the bit referenced in the associated memory location.

Operand Data Type		DL06 Range	
	A	aaa	bb
V-memory	B	See memory map	0 to 15
Pointer	PB	See memory map	0 to 15

In the following And Bit-of-Word example, when input X1 and bit 4 of V1400 is on output Y5 will energize.



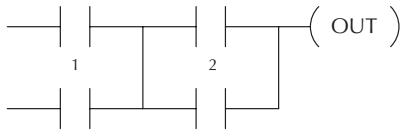
In the following And Not Bit-of-Word example, when input X1 is on and bit 4 of V1400 is off output Y5 will energize.



And Store (ANDSTR)

DS	Implied
HPP	Used

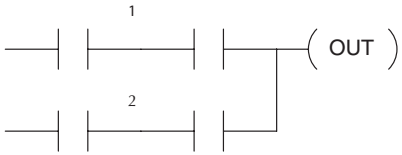
The And Store instruction logically ands two branches of a rung in series. Both branches must begin with the Store instruction.



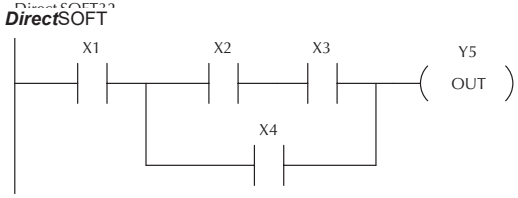
OR Store (ORSTR)

DS	Implied
HPP	Used

The Or Store instruction logically ORs two branches of a rung in parallel. Both branches must begin with the Store instruction.



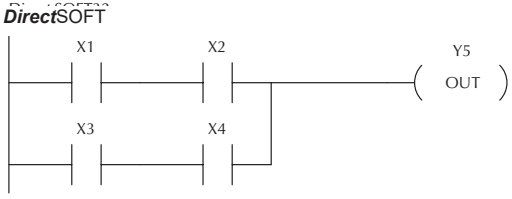
In the following And Store example, the branch consisting of contacts X2, X3, and X4 have been anded with the branch consisting of contact X1.



Handheld Programmer Keystrokes

$ STR	→	B 1	ENT
$ STR	→	C 2	ENT
V AND	→	D 3	ENT
Q OR	→	E 4	ENT
L ANDST	ENT		
GX OUT	→	F 5	ENT

In the following Or Store example, the branch consisting of X1 and X2 have been OR'd with the branch consisting of X3 and X4.



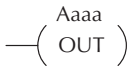
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT
V AND	→	C 2	ENT
$ STR	→	D 3	ENT
V AND	→	E 4	ENT
M ORST	ENT		
GX OUT	→	F 5	ENT

Out (OUT)

DS	Used
HPP	Used

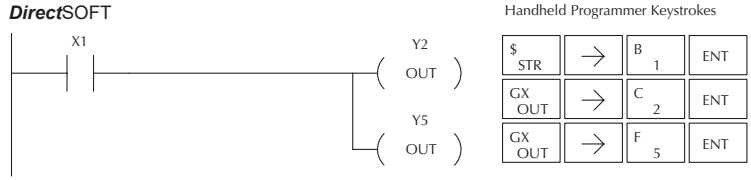
The Out instruction reflects the status of the rung (on/off) and outpu the discrete (on/off) state to the specified image register point or memo location.



Multiple Out instructions referencing the same discrete location should not be used since only the last Out instruction in the program will control the physical output point. Instead, use the next instruction, the Or Out.

Operand Data Type		DL06 Range
	A	aaa
Inputs	X	0–777
Outputs	Y	0–777
Control Relays	C	0–1777

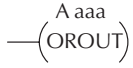
In the following Out example, when input X1 is on, output Y2 and Y5 will energize.



Or Out (OROUT)

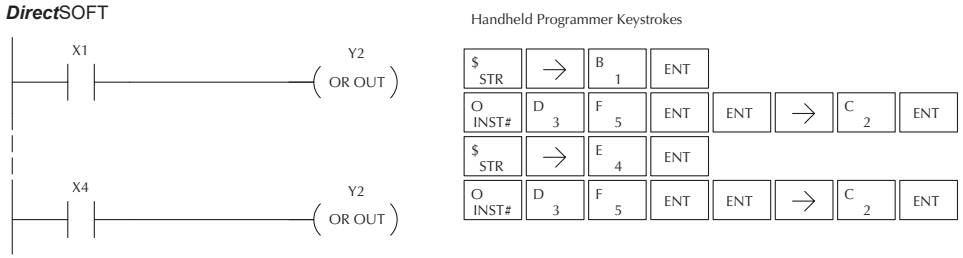
DS	Usied
HPP	Used

The Or Out instruction allows more than one rung of discrete logic to control a single output. Multiple Or Out instructions referencing the same output coil may be used, since *all* contacts controlling the output are logically OR'd together. If the status of *any* rung is on, the output will also be on.



Operand Data Type		DL06 Range
	A	aaa
Inputs	X	0–777
Outputs	Y	0-777
Control Relays	C	0–1777

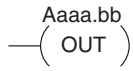
In the following example, when X1 or X4 is on, Y2 will energize.



Out Bit-of-Word (OUT)

DS	Used
HPP	Used

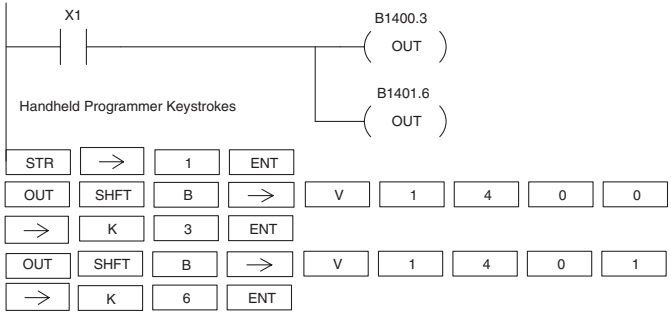
The Out Bit-of-Word instruction reflects the status of the rung (on/off) and outputs the discrete (on/off) state to the specified bit in the referenced memory location. Multiple Out Bit-of-Word instructions referencing the same bit of the same word generally should not be used since only the last Out instruction in the program will control the status of the bit.



Operand Data Type	DL06 Range		
	A	aaa	bb
V-memory	B	See memory map	0 to 15
Pointer	PB	See memory map	0 to 15

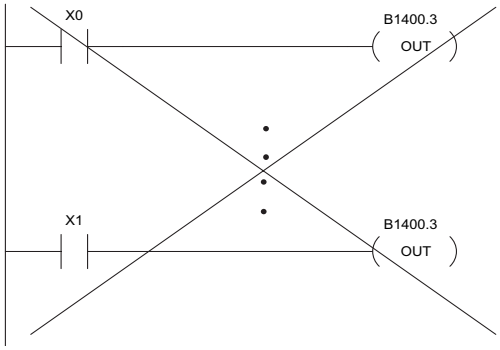
NOTE: *If the Bit-of-Word is entered as V1400.3 in* ***DirectSOFT****, it will be converted to B1400.3. Bit-of-Word can also be entered as B1400.3.*

DirectSOFT



In the following Out Bit-of-Word example, when input X1 is on, bit 3 of V1400 and bit 6 of V1401 will turn on.

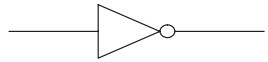
The following Out Bit-of-Word example contains two Out Bit-of-Word instructions using the same bit in the same memory word. The final state bit 3 of V1400 is ultimately controlled by the last rung of logic referencing it. X1 will override the logic state controlled by X0. To avoid this situation, multiple outputs using the same location must not be used in programming.



Not (NOT)

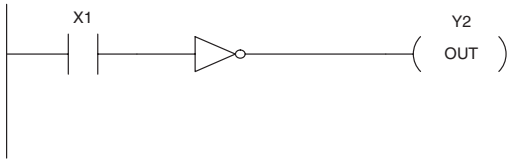
DS	Used
HPP	Used

The Not instruction inverts the status of the rung at the point of the instruction.



In the following example, when X1 is off, Y2 will energize. This is because the Not instruction inverts the status of the rung at the Not instruction.

DirectSOFT



Handheld Programmer Keystrokes

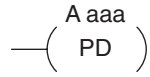
$ STR	→	B 1	ENT	
SHFT	N TMR	O INST#	T MLR	ENT
GX OUT	→	C 2	ENT	

NOTE: ***Direct***SOFT *Release 1.1i and later supports the use of the NOT instruction. The above example rung is merely intended to show the visual representation of the NOT instruction. The NOT instruction can only be selected in* ***DirectSOFT*** *from the Instruction Browser. The rung cannot be created or displayed in* ***Direct***SOFT *versions earlier than 1.1i.*

Positive Differential (PD)

DS	Used
HPP	Used

The Positive Differential instruction is typically known as a one shot. When the input logic produces an off to on transition, the output will energize for one CPU scan.



In the following example, every time X1 makes an Off-to-On transition, C0 will energize for one scan.

Operand Data Type		DL06 Range
	A	aaa
Inputs	X	0–777
Outputs	Y	0–777
Control Relays	C	0–1777

DirectSOFT

Handheld Programmer Keystrokes

$ STR	→	B 1	ENT			
SHFT	P CV	SHFT	D 3	→	A 0	

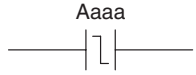
Store Positive Differential (STRPD)

DS	Used
HPP	Used

The Store Positive Differential instruction begins a new rung or an additional branch in a rung with a contact. The contact closes for one CPU scan when the state of the associated image register point makes an Off-to-On transition. Thereafter, the contact remains open until the next Off-to-On transition (the symbol inside the contact represents the transition). This function is sometimes called a "one-shot". This contact will also close on a program-to-run transition if it is within a retentive range.

Store Negative Differential (STRND)

DS	Used
HPP	Used



The Store Negative Differential instruction begins a new rung or an additional branch in a rung with a contact. The contact closes for one CPU scan when the state of the associated image register point makes an On-to-Off transition. Thereafter, the contact remains open until the next On-to-Off transition (the symbol inside the contact represents the transition).

NOTE: *When using* ***DirectSOFT****, these instructions can only be entered from the Instruction Browser.*

Operand Data Type		DL06 Range
	A	aaa
Inputs	X	0–777
Outputs	Y	0–777
Control Relays	C	0–1777
Stage	S	0–1777
Timer	T	0–377
Counter	CT	0–177

In the following example, each time X1 makes an Off-to-On transition, Y4 will energize for one scan.

DirectSOFT

Handheld Programmer Keystrokes

$ STR	SHFT	P CV	D 3	→	B 1	ENT
GX OUT	→	E 4	ENT			

In the following example, each time X1 makes an On-to-Off transition, Y4 will energize for one scan.

DirectSOFT

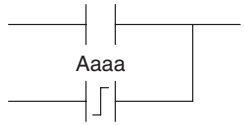
Handheld Programmer Keystrokes

$ STR	SHFT	N TMR	D 3	→	B 1	ENT
GX OUT	→	E 4	ENT			

Or Positive Differential (ORPD)

DS	Implied
HPP	Used

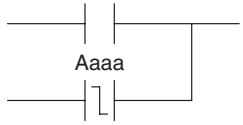
The Or Positive Differential instruction logically ors a contact in parallel with another contact in a rung. The status of the contact will be open until the associated image register point makes an Off-to-On transition, closing it for one CPU scan. Thereafter, it remains open until another Off-to-On transition.



Or Negative Differential (ORND)

DS	Implied
HPP	Used

The Or Negative Differential instruction logically ors a contact in parallel with another contact in a rung. The status of the contact will be open until the associated image register point makes an On-to-Off transition, closing it for one CPU scan. Thereafter, it remains open until another On-to-Off transition.

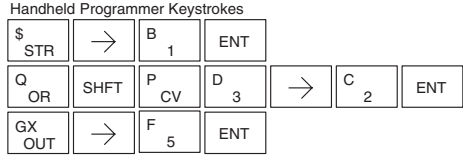


Operand Data Type		DL06 Range
	A	aaa
Inputs	X	0–777
Outputs	Y	0–777
Control Relays	C	0–1777
Stage	S	0–1777
Timer	T	0–377
Counter	CT	0–177

In the following example, Y 5 will energize whenever X1 is on, or for one CPU scan when X2 transitions from Off to On.

DirectSOFT

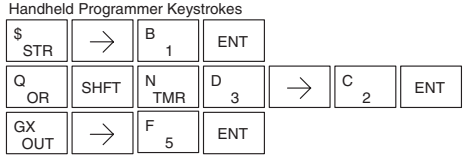
Handheld Programmer Keystrokes



In the following example, Y 5 will energize whenever X1 is on, or for one CPU scan when X2 transitions from On to Off.

DirectSOFT

Handheld Programmer Keystrokes



And Positive Differential (ANDPD)

DS	Implied
HPP	Used

The And Positive Differential instruction logically ands a normally open contact in series with another contact in a rung. The status of the contact will be open until the associated image register point makes an Off-to-On transition, closing it for one CPU scan. Thereafter, it remains open until another Off-to-On transition.

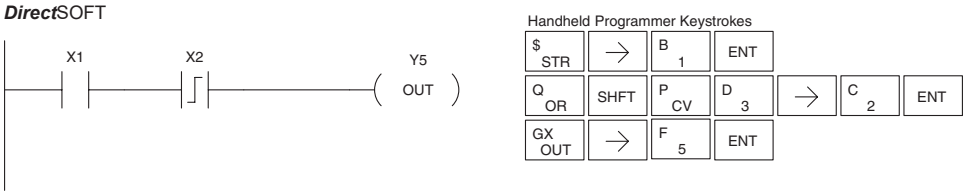
And Negative Differential (ANDND)

DS	Implied
HPP	Used

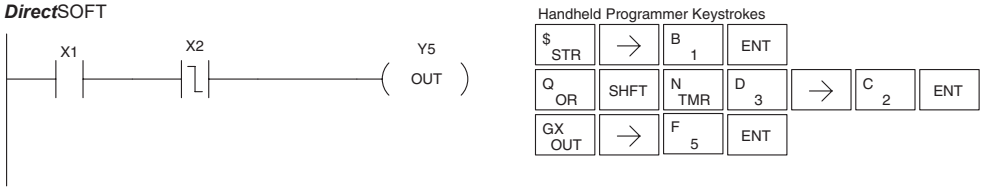
The And Negative Differential instruction logically ands a normally open contact in series with another contact 5-22in a rung. The status of the contact will be open until the associated image register point makes an On-to-Off transition, closing it for one CPU scan. Thereafter, it remains open until another On-to-Off transition.

Operand Data Type	DL06 Range
	A	aaa
Inputs	X	0–777
Outputs	Y	0–777
Control Relays	C	0–1777
Stage	S	0–1777
Timer	T	0–377
Counter	CT	0–177

In the following example, Y5 will energize for one CPU scan whenever X1 is on and X2 transitions from Off to On.



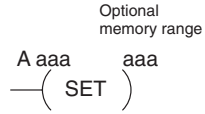
In the following example, Y5 will energize for one CPU scan whenever X1 is on and X2 transitions from On to Off.



Set (SET)

DS	Used
HPP	Used

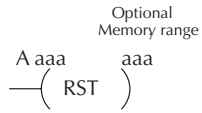
The Set instruction sets or turns on an image register point/memory location or a consecutive range of image register points/memory locations. Once the point/location is set it will remain on until it is reset using the Reset instruction. It is not necessary for the input controlling the Set instruction to remain on.



Reset (RST)

DS	Used
HPP	Used

The Reset instruction resets or turns off an image register point/memory location or a range of image registers points/memory locations. Once the point/location is reset, it is not necessary for the input to remain on.

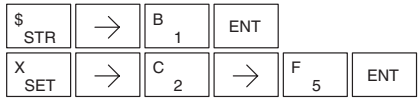


Operand Data Type		DL06 Range
	A	aaa
Inputs	X	0–777
Outputs	Y	0–777
Control Relays	C	0–1777
Stage	S	0–1777
Timer	T	0–377
Counter	CT	0–177

In the following example when X1 is on, Y2 through Y5 will energize.

DirectSOFT

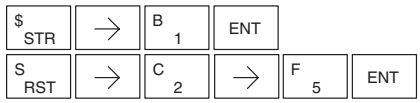
Handheld Programmer Keystrokes



In the following example when X1 is on, Y2 through Y5 will be reset or de–energized.

DirectSOFT

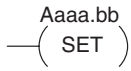
Handheld Programmer Keystrokes



Set Bit-of-Word (SET)

DS	Used
HPP	Used

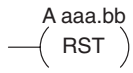
The Set Bit-of-Word instruction sets or turns on a bit in a V-memory location. Once the bit is set, it will remain on until it is reset using the Reset Bit-of-Word instruction. It is not necessary for the input controlling the Set Bit-of-Word instruction to remain on.



Reset Bit-of-Word (RST)

DS	Used
HPP	Used

The Reset Bit-of-Word instruction resets or turns off a bit in a V-memory location. Once the bit is reset it is not necessary for the input to remain on.



Operand Data Type		DL06 Range	
	A	aaa	bb
V-memory	B	See memory map	0 to 15
Pointer	PB	See memory map	0 to 15

In the following example when X1 turns on, bit 1 in V1400 is set to the on state.

DirectSOFT

Handheld Programmer Keystrokes

STR	→	1	ENT					
SET	SHFT	B	→	V	1	4	0	0
→	K	1	ENT					

In the following example, when X2 turns on, bit 1 in V1400 is reset to the off state.

DirectSOFT

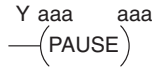
Handheld Programmer Keystrokes

STR	→	2	ENT					
RST	SHFT	B	→	V	1	4	0	0
→	K	1	ENT					

Pause (PAUSE)

DS	Used
HPP	Used

The Pause instruction disables the output update on a range of outputs. The ladder program will continue to run and update the image register. However, the outputs in the range specified in the Pause instruction will be turned off at the output points.

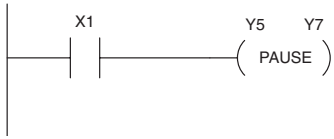


Operand Data Type	DL06 Range
	A	aaa
Outputs	Y	0–777

In the following example, when X1 is ON, Y5–Y7 will be turned OFF. The execution of the ladder program will not be affected.

DirectSOFT

DirectSOFT32



Since the D2–HPP Handheld Programmer does not have a specific Pause key, you can use the corresponding instruction number for entry (#960), or type each letter of the command.

Handheld Programmer Keystrokes

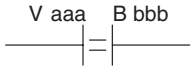
In some cases, you may want certain output points in the specified pause range to operate normally. In that case, use Aux 58 to over-ride the Pause instruction.

Comparative Boolean

Store If Equal (STRE)

DS	Implied
HPP	Used

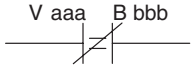
The Store If Equal instruction begins a new rung or additional branch in a rung with a normally open comparative contact. The contact will be on when Vaaa equals Bbbb .



Store If Not Equal (STRNE)

DS	Implied
HPP	Used

The Store If Not Equal instruction begins a new rung or additional branch in a rung with a normally closed comparative contact. The contact will be on when Vaaa does not equal Bbbb.

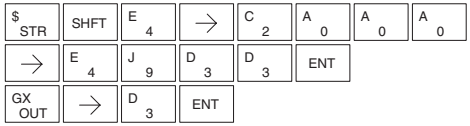


Operand Data Type		DL06 Range	
	B	aaa	bbb
V-memory	V	See memory map	See memory map
Pointer	P	See memory map	See memory map
Constant	K	—	0–9999

In the following example, when the BCD value in V-memory location V2000 = 4933, Y3 will energize.

DirectSOFT

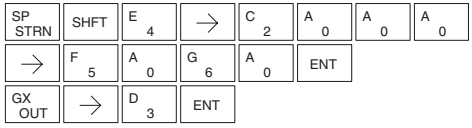
Handheld Programmer Keystrokes



In the following example, when the value in V-memory location V2000≠5060, Y3 will energize.

DirectSOFT

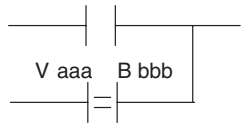
Handheld Programmer Keystrokes



Or If Equal (ORE)

DS	Implied
HPP	Used

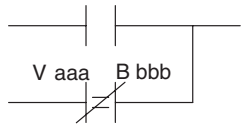
The Or If Equal instruction connects a normally open comparative contact in parallel with another contact. The contact will be on when Vaaa = Bbbb.



Or If Not Equal (ORNE)

DS	Implied
HPP	Used

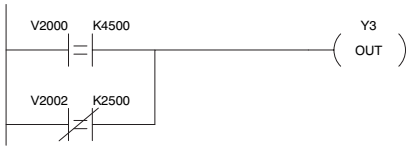
The Or If Not Equal instruction connects a normally closed comparative contact in parallel with another contact. The contact will be on when Vaaa does not equal Bbbb.



Operand Data Type		DL06 Range	
	B	aaa	bbb
V-memory	V	See memory map	See memory map
Pointer	P	See memory map	See memory map
Constant	K	—	0–9999

In the following example, when the BCD value in V-memory location V2000 = 4500 or V2002 ≠ 2500, Y3 will energize.

DirectSOFT



Handheld Programmer Keystrokes

$ STR	SHFT	E 4	→	C 2	A 0	A 0	A 0	→
E 4	F 5	A 0	A 0	ENT				
Q OR	SHFT	E 4	→	C 2	A 0	A 0	C 2	→
C 2	D 3	E 4	F 5	ENT				
GX OUT	→	D 3	ENT					

In the following example, when the BCD value in V-memory location V2000 = 3916 or V2002 ≠ 2500, Y3 will energize.

DirectSOFT

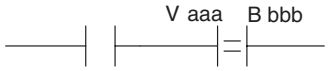
Handheld Programmer Keystrokes

$ STR	SHFT	E 4	→	C 2	A 0	A 0	A 0	→
D 3	J 9	B 1	G 6	ENT				
R ORN	SHFT	E 4	→	C 2	A 0	A 0	C 2	→
C 2	F 5	A 0	A 0	ENT				
GX OUT	→	D 3	ENT					

And If Equal (ANDE)

DS	Implied
HPP	Used

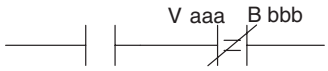
The And If Equal instruction connects a normally open comparative contact in series with another contact. The contact will be on when Vaaa = Bbbb.



And If Not Equal (ANDNE)

DS	Implied
HPP	Used

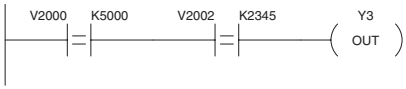
The And If Not Equal instruction connects a normally closed comparative contact in series with another contact. The contact will be on when Vaaa does not equal Bbbb.



Operand Data Type		DL06 Range	
	B	aaa	bbb
V-memory	V	See memory map	See memory map
Pointer	P	See memory map	See memory map
Constant	K	—	0–9999

In the following example, when the BCD value in V-memory location V2000 = 5000 and V2002 = 2345, Y3 will energize.

DirectSOFT

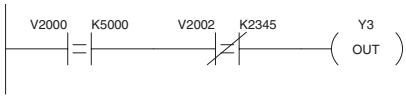


Handheld Programmer Keystrokes

$ STR	SHFT	E 4	→	C 2	A 0	A 0	A 0	→
F 5	A 0	A 0	A 0	ENT				
V AND	SHFT	E 4	→	C 2	A 0	A 0	C 2	→
C 2	D 3	E 4	F 5	ENT				
GX OUT	→	D 3	ENT					

In the following example, when the BCD value in V-memory location V2000 = 5000 and V2002 ≠ 2345, Y3 will energize.

DirectSOFT



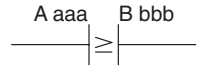
Handheld Programmer Keystrokes

$ STR	SHFT	E 4	→	C 2	A 0	A 0	A 0	→
F 5	A 0	A 0	A 0	ENT				
V AND	SHFT	E 4	→	C 2	A 0	A 0	C 2	→
C 2	D 3	E 4	F 5	ENT				
GX OUT	→	D 3	ENT					

Store (STR)

DS	Implied
HPP	Used

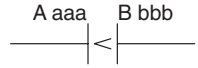
The Comparative Store instruction begins a new rung or additional branch in a rung with a normally open comparative contact. The contact will be on when Aaaa is equal to or greater than Bbbb.



Store Not (STRN)

DS	Implied
HPP	Used

The Comparative Store Not instruction begins a new rung or additional branch in a rung with a normally closed comparative contact. The contact will be on when Aaaa < Bbbb.

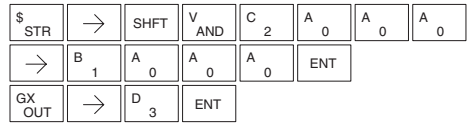


Operand Data Type		DL06 Range	
	A/B	aaa	bbb
V-memory	V	See memory map	See memory map
Pointer	p	See memory map	See memory map
Constant	K	—	0–9999
Timer	TA	0–377	
Counter	CTA	0–177	

In the following example, when the BCD value in V-memory location V2000 ≥ 1000, Y3 will energize.

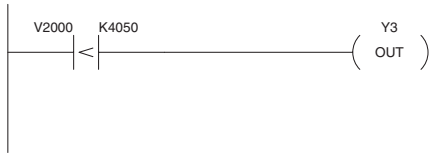
DirectSOFT

Handheld Programmer Keystrokes

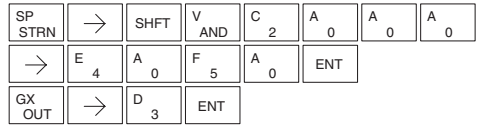


In the following example, when the value in V-memory location V2000 < 4050, Y3 will energize.

DirectSOFT



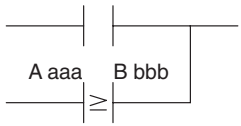
Handheld Programmer Keystrokes



Or (OR)

DS	Implied
HPP	Used

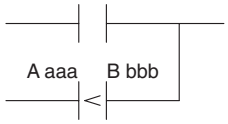
The Comparative Or instruction connects a normally open comparative contact in parallel with another contact. The contact will be on when Aaaa is equal to or greater than Bbbb.



Or Not (ORN)

DS	Implied
HPP	Used

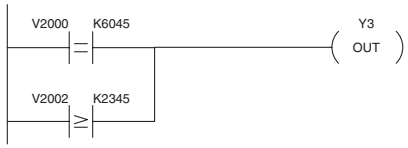
The Comparative Or Not instruction connects a normally closed comparative contact in parallel with another contact. The contact will be on when Aaaa < Bbbb.



Operand Data Type		DL06 Range	
	A/B	aaa	bbb
V-memory	V	See memory map	See memory map
Pointer	p	See memory map	See memory map
Constant	K	—	0–9999
Timer	TA	0–377	
Counter	CTA	0–177	

In the following example, when the BCD value in V-memory location V2000 = 6045 or V2002 ≥ 2345, Y3 will energize.

*Direct*SOFT

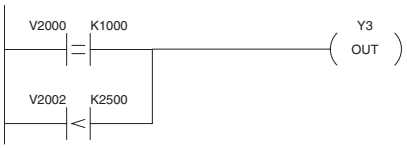


Handheld Programmer Keystrokes

$ STR	SHFT	E 4	→	C 2	A 0	A 0	A 0	→
G 6	A 0	E 4	F 5	ENT				
Q OR	→	SHFT	V AND	C 2	A 0	A 0	C 2	→
C 2	D 3	E 4	F 5	ENT				
GX OUT	→	D 3	ENT					

In the following example when the BCD value in V-memory location V2000 = 1000 or V2002 < 2500, Y3 will energize.

*Direct*SOFT



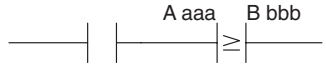
Handheld Programmer Keystrokes

$ STR	SHFT	E 4	→	C 2	A 0	A 0	A 0	→
B 1	A 0	A 0	A 0	ENT				
R ORN	→	SHFT	V AND	C 2	A 0	A 0	C 2	→
C 2	F 5	A 0	A 0	ENT				
GX OUT	→	D 3	ENT					

And (AND)

DS	Implied
HPP	Used

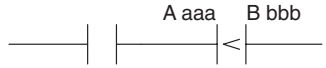
The Comparative And instruction connects a normally open comparative contact in series with another contact. The contact will be on when Aaaa is equal to or greater than Bbbb.



And Not (ANDN)

DS	Implied
HPP	Used

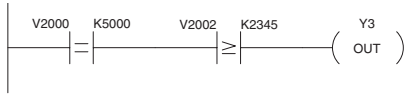
The Comparative And Not instruction connects a normally closed comparative contact in series with another contact. The contact will be on when Aaaa < Bbbb.



Operand Data Type		DL06 Range	
	A/B	aaa	bbb
V-memory	V	See memory map	See memory map
Pointer	p	See memory map	See memory map
Constant	K	—	0–9999
Timer	TA	0–377	
Counter	CTA	0–177	

In the following example, when the value in BCD V-memory location V2000 = 5000, and V2002 ≥ 2345, Y3 will energize.

DirectSOFT

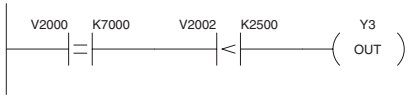


Handheld Programmer Keystrokes

$ STR	SHFT	E 4	→	C 2	A 0	A 0	A 0	→
F 5	A 0	A 0	A 0	ENT				
V AND	→	SHFT	V AND	C 2	A 0	A 0	C 2	→
C 2	D 3	E 4	F 5	ENT				
GX OUT	→	D 3	ENT					

In the following example, when the value in V-memory location V2000 = 7000 and V2002 < 2500, Y3 will energize.

DirectSOFT



Handheld Programmer Keystrokes

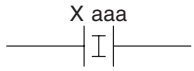
$ STR	SHFT	E 4	→	C 2	A 0	A 0	A 0	→
H 7	A 0	A 0	A 0	ENT				
W ANDN	→	SHFT	V AND	C 2	A 0	A 0	C 2	→
C 2	F 5	A 0	A 0	ENT				
GX OUT	→	SHFT	Y AND	D 3	ENT			

Immediate Instructions

Store Immediate (STRI)

DS	Implied
HPP	Used

The Store Immediate instruction begins a new rung or additional branch in a rung. The status of the contact will be the same as the status of the associated input point *at the time the instruction is executed*. The image register is not updated.



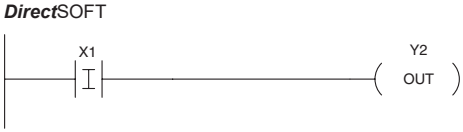
Store Not Immediate (STRNI)

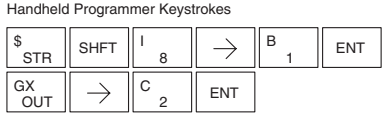
DS	Implied
HPP	Used

The Store Not Immediate instruction begins a new rung or additional branch in a rung. The status of the contact will be opposite the status of the associated input point *at the time the instruction is executed*. The image register is not updated.

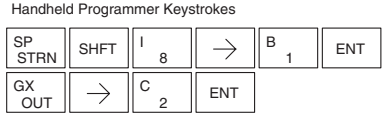
Operand Data Type		DL06 Range
		aaa
Inputs	X	0–777

In the following example, when X1 is on, Y2 will energize.





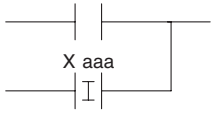
In the following example, when X1 is off, Y2 will energize.



Or Immediate (ORI)

DS	Implied
HPP	Used

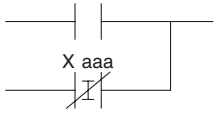
The Or Immediate connects two contacts in parallel. The status of the contact will be the same as the status of the associated input point *at the time the instruction is executed*. The image register is not updated.



Or Not Immediate (ORNI)

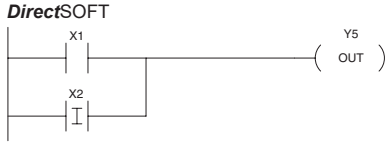
DS	Implied
HPP	Used

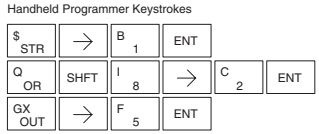
The Or Not Immediate connects two contacts in parallel. The status of the contact will be opposite the status of the associated input point *at the time the instruction is executed*. The image register is not updated.



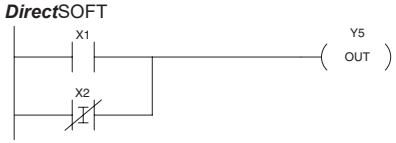
Operand Data Type		DL06 Range
		aaa
Inputs	X	0–777

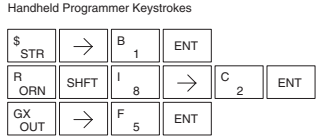
In the following example, when X1 or X2 is on, Y5 will energize.





In the following example, when X1 is on or X2 is off, Y5 will energize.

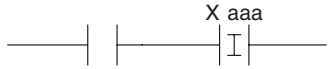




And Immediate (ANDI)

DS	Implied
HPP	Used

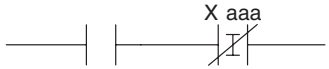
The And Immediate instruction connects two contacts in series. The status of the contact will be the same as the status of the associated input point *at the time the instruction is executed*. The image register is not updated.



And Not Immediate (ANDNI)

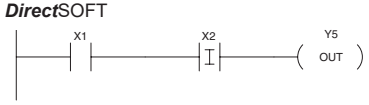
DS	Implied
HPP	Used

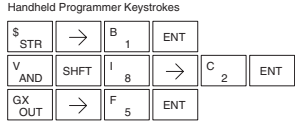
The And Not Immediate instruction connects two contacts in series. The status of the contact will be opposite the status of the associated input point *at the time the instruction is executed*. The image register is not updated.



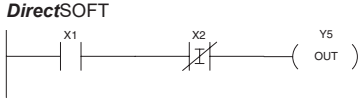
Operand Data Type		DL06 Range
		aaa
Inputs	X	0–777

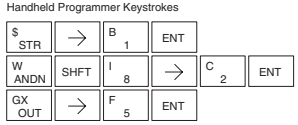
In the following example, when X1 and X2 are on, Y5 will energize.





In the following example, when X1 is on and X2 is off, Y5 will energize.

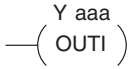




Out Immediate (OUTI)

DS	Used
HPP	Used

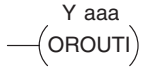
The Out Immediate instruction reflects the status of the rung (on/off) and outputs the discrete (on/off) status to the specified module output point and the image register *at the time the instruction is executed*. If multiple Out Immediate instructions referencing the same discrete point are used, it is possible for the module output status to change multiple times in a CPU scan. See Or Out Immediate.



Or Out Immediate (OROUTI)

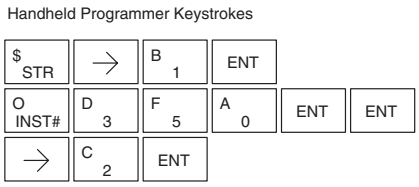
DS	Used
HPP	Used

The Or Out Immediate instruction has been designed to use more than 1 rung of discrete logic to control a single output. Multiple Or Out Immediate instructions referencing the same output coil may be used, since all contacts controlling the output are OR'd together. If the status of any rung is on *at the time the instruction is executed*, the output will also be on.

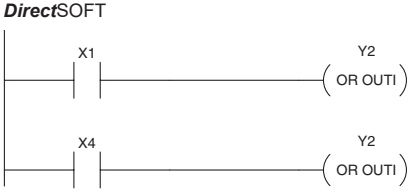


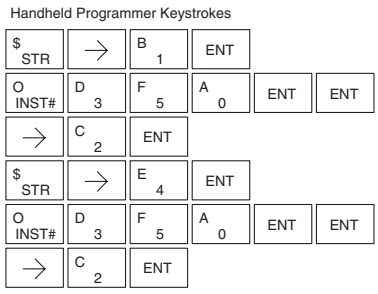
Operand Data Type		DL06 Range
		aaa
Outputs	Y	0–777

In the following example, when X1 is on, output point Y2 on the output module will turn on. For instruction entry on the Handheld Programmer, you can use the instruction number (#350) as shown, or type each letter of the command.



In the following example, when X1 or X4 is on, Y2 will energize.





Out Immediate Formatted (OUTIF)

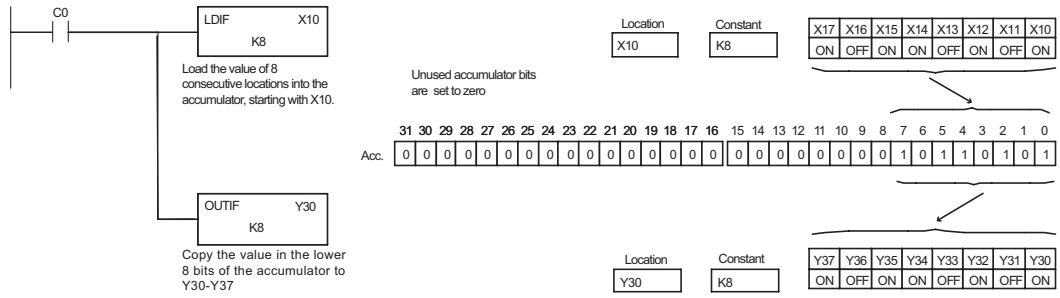
DS	Used
HPP	Used

The Out Immediate Formatted instruction outputs a 1–32 bit binary value from the accumulator to specified output points *at the time the instruction is executed*. Accumulator bits that are not used by the instruction are set to zero.

Operand Data Type		DL06 Range
		aaa
Outputs	Y	0-777
Constant	K	1-32

In the following example, when C0 is on,the binary pattern for X10 –X17 is loaded into the accumulator using the Load Immediate Formatted instruction. The binary pattern in the accumulator is written to Y30–Y37 using the Out Immediate Formatted instruction. This technique is useful to quickly copy an input pattern to outputs (without waiting for the CPU scan).

DirectSOFT



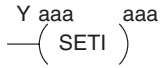
Handheld Programmer Keystrokes

$ STR	→	NEXT	NEXT	NEXT	NEXT	A 0	ENT				
SHFT	L ANDST	D 3	I 8	F 5	→	B 1	A 0	→	I 8	ENT	
GX OUT	SHFT	I 8	F 5	→	D 3	A 0	→	I 8	ENT		

Set Immediate (SETI)

DS	Used
HPP	Used

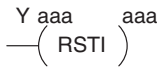
The Set Immediate instruction immediately sets, or turns on an output or a range of outputs in the image register and the corresponding output point(s) *at the time the instruction is executed*. Once the outputs are set, it is not necessary for the input to remain on. The Reset Immediate instruction can be used to reset the outputs.



Reset Immediate (RSTI)

DS	Used
HPP	Used

The Reset Immediate instruction immediately resets, or turns off, an output or a range of outputs in the image register and the output point(s) *at the time the instruction is executed.* Once the outputs are reset, it is not necessary for the input to remain on.

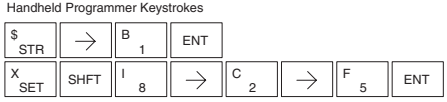


Operand Data Type		DL06 Range
		aaa
Ouputs	Y	0–777

In the following example, when X1 is on, Y2 through Y5 will be set on in the image register and on the corresponding output points.

DirectSOFT

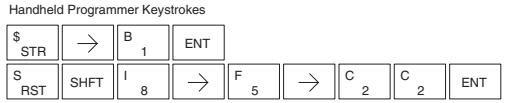
Handheld Programmer Keystrokes



In the following example, when X1 is on, Y5 through Y22 will be reset (off) in the image register and on the corresponding output module(s).

DirectSOFT

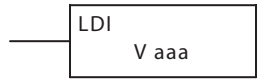
Handheld Programmer Keystrokes



Load Immediate (LDI)

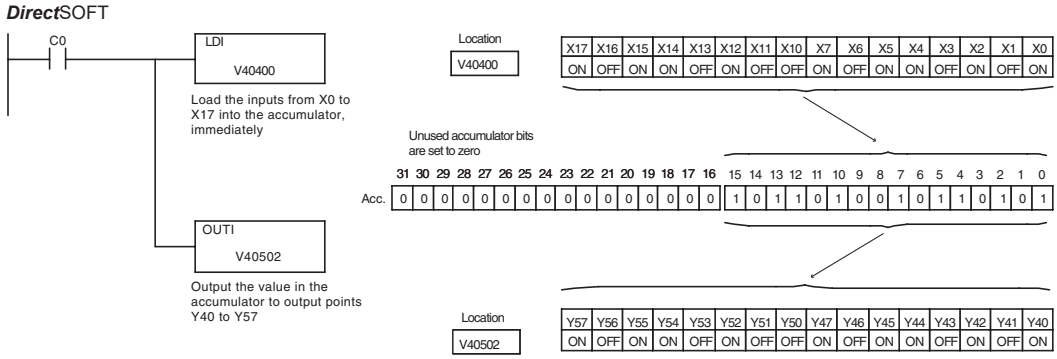
DS	Used
HPP	Used

The Load Immediate instruction loads a 16-bit V-memory value into the accumulator. The valid address range includes all input point addresses on the local base. The value reflects the current status of the input points *at the time the instruction is executed*. This instruction may be used instead of the LDIF instruction, which requires you to specify the number of input points.



Operand Data Type		DL06 Range
		aaa
Inputs	V	40400-40437

In the following example, when C0 is on, the binary pattern of X0–X17 will be loaded into the accumulator using the Load Immediate instruction. The Out Immediate instruction could be used to copy the 16 bits in the accumulator to output points, such as Y40–Y57. This technique is useful to quickly copy an input pattern to output points (without waiting for a full CPU scan to occur).



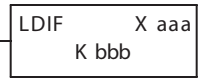
Handheld Programmer Keystrokes

$ STR	→	NEXT	NEXT	NEXT	NEXT	A 0	ENT		
SHFT	L ANDST	D 3	I 8	→	E 4	A 0	E 4	A 0	A 0	ENT
GX OUT	SHFT	I 8	→	NEXT	E 4	A 0	F 5	A 0	C 2	ENT

Load Immediate Formatted (LDIF)

DS	Used
HPP	Used

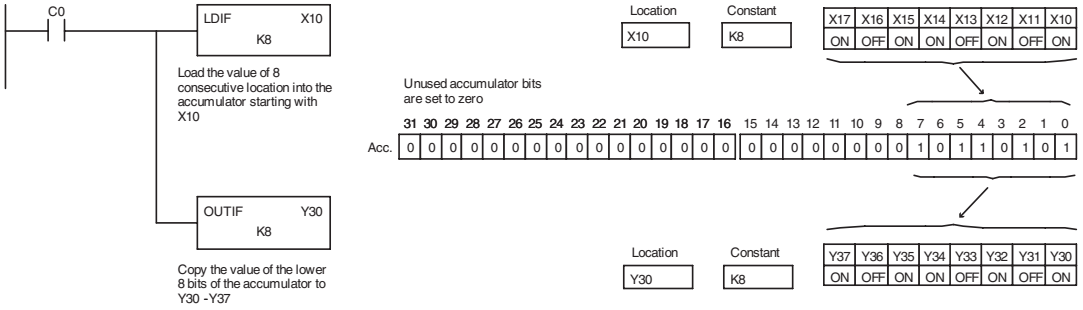
The Load Immediate Formatted instruction loads a 1–32 bit binary value into the accumulator. The value reflects the current status of the input module(s) *at the time the instruction is executed*. Accumulator bits that are not used by the instruction are set to zero.



Operand Data Type		DL06 Range	
		aaa	bbb
Inputs	X	0-777	- -
Constant	K	- -	1-32

In the following example, when C0 is on, the binary pattern of X10–X17 will be loaded into the accumulator using the Load Immediate Formatted instruction. The Out Immediate Formatted instruction could be used to copy the specified number of bits in the accumulator to the specified outputs on the output module, such as Y30–Y37. This technique is useful to quickly copy an input pattern to outputs (without waiting for the CPU scan).

***Direct*SOFT**



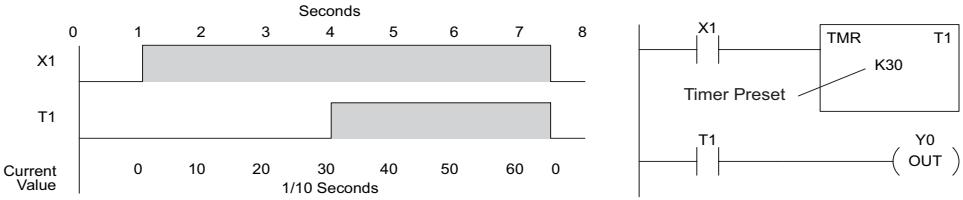
Handheld Programmer Keystrokes

$ STR	→	NEXT	NEXT	NEXT	NEXT	A 0	ENT			
SHFT	L ANDST	D 3	I 8	F 5	→	B 1	A 0	→	I 8	ENT
GX OUT	SHFT	I 8	F 5	→	D 3	A 0	→	I 8	ENT	

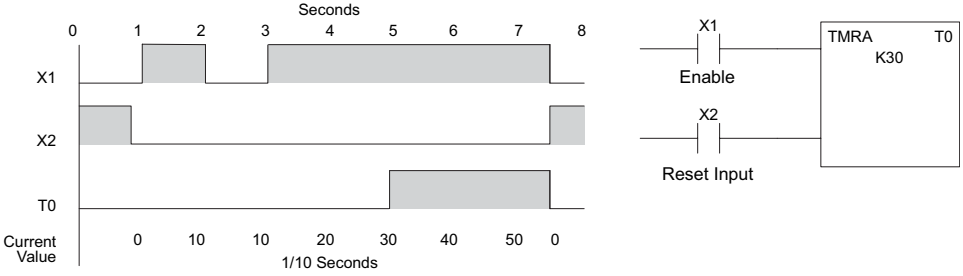
Timer, Counter and Shift Register Instructions

Using Timers

Timers are used to time an event for a desired period. The single input timer will time as long as the input is on. When the input changes from on to off, the timer current value is reset to 0. There is a tenth of a second and a hundredth of a second timer available with a maximum time of 999.9 and 99.99 seconds respectively. There is a discrete bit associated with each timer to indicate that the current value is equal to or greater than the preset value. The timing diagram below shows the relationship between the timer input, associated discrete bit, current value and timer preset.



There are those applications that need an accumulating timer, meaning it has the ability to time, stop, and then resume from where it previously stopped. The accumulating timer works similarly to the regular timer, but two inputs are required. The enable input starts and stops the timer. When the timer stops, the elapsed time is maintained. When the timer starts again, the timing continues from the elapsed time. When the reset input is turned on, the elapsed time is cleared and the timer will start at 0 when it is restarted. There is a tenth of a second and a hundredth of a second timer available with a maximum time of 9999999.9 and 999999.99 seconds respectively. The timing diagram below shows the relationship between the timer input, timer reset, associated discrete bit, current value and timer preset.

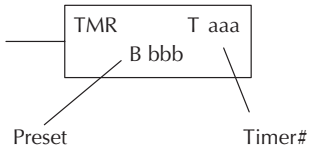


NOTE: *Decimal points are not used in these timers, but the decimal point is implied. The preset and current value for all four timers is in BCD format.*

Timer (TMR) and Timer Fast (TMRF)

DS	Used
HPP	Used

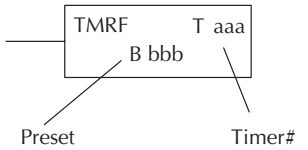
The Timer instruction is a 0.1 second single input timer that times to a maximum of 999.9 seconds. The Timer Fast instruction is a 0.01 second single input timer that times up to a maximum of 99.99 seconds. These timers will be enabled if the input logic is true (on) and will be reset to 0 if the input logic is false (off). Both timers use single word BCD values for the preset and current value. The decimal place is implied.



Instruction Specifications

Timer Reference (Taaa): Specifies the timer number.

Preset Value (Bbbb): Constant value (K) or a V-memory location specified in BCD.



Current Value: Timer current values, in BCD format, are accessed by referencing the associated V or T memory location*. For example, the timer current value for T3 physically resides in V-memory location V3.

Discrete Status Bit: The discrete status bit is referenced by the associated T memory location. Operating as a "timer done bit", it will be on if the current value is equal to or greater than the preset value. For example, the discrete status bit for Timer 2 is T2.

***NOTE**: A V-memory preset is required only if the ladder program or an Operator Interface unit must change the preset.*

Operand Data Type		DL06 Range	
	A/B	aaa	bbb
Timers	T	0–777	—
V-memory for preset values	V	—	400-677 1200–7377 7400–7577 10000-17777
Pointers (preset only)	P	—	400-677 1200–7377 7400–7577* 10000-17777
Constants (preset only)	K	—	0–9999
Timer discrete status bits	T/V	0–377 or V41100–41117	
Timer current values	V /T**	0–377	

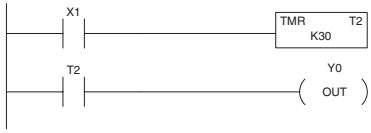
***NOTE:** *May be non-volatile if MOV instruction is used.*
*** With the HPP, both the Timer discrete status bits and current value are accessed with the same data reference. DirectSOFT uses separate references, such as "T2" for discrete status bit for Timer T2, and "TA2" for the current value of Timer T2.*

You can perform functions when the timer reaches the specified preset using the discrete status bit. Or, use comparative contacts to perform functions at different time intervals, based on one timer. The examples on the following page show these two methods of programming timers.

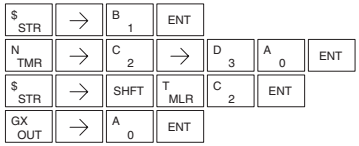
Timer Example Using Discrete Status Bits

In the following example, a single input timer is used with a preset of 3 seconds. The timer discrete status bit (T2) will turn on when the timer has timed for 3 seconds. The timer is reset when X1 turns off, turning the discrete status bit off and resetting the timer current value to 0.

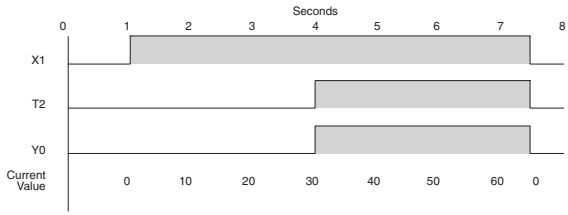
DirectSOFT



Handheld Programmer Keystrokes



Timing Diagram

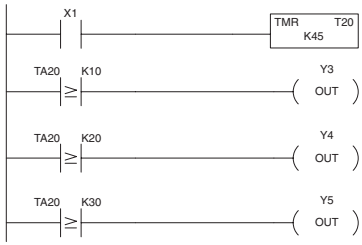


1/10th Seconds

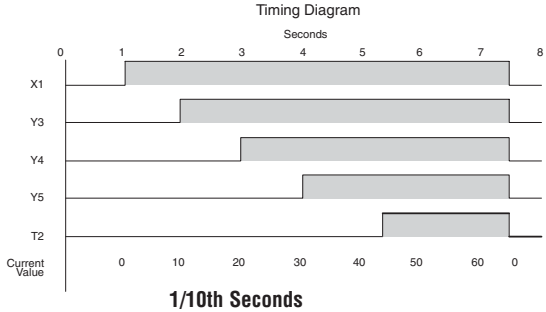
Timer Example Using Comparative Contacts

In the following example, a single input timer is used with a preset of 4.5 seconds. Comparative contacts are used to energize Y3, Y4, and Y5 at one second intervals respectively. When X1 is turned off, the timer will be reset to 0 and the comparative contacts will turn off Y3, Y4, and Y5.

DirectSOFT

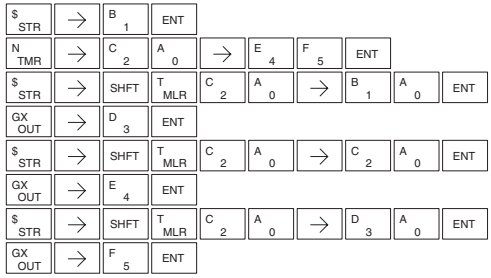


Timing Diagram



1/10th Seconds

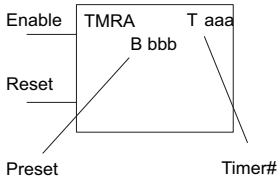
Handheld Programmer Keystrokes



Accumulating Timer (TMRA)

DS	Used
HPP	Used

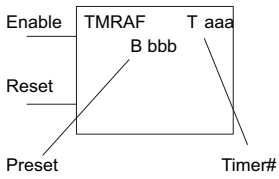
The Accumulating Timer is a 0.1 second two input timer that will time to a maximum of 9999999.9. *The TMRA uses two timer registers in V-memory.*



Accumulating Fast Timer (TMRAF)

DS	Used
HPP	Used

The Accumulating Fast Timer is a 0.01 second two-input timer that will time to a maximum of 99999.99. *The TMRA uses two timer registers in V-memory.*



Each timer uses two timer registers in V-memory. The preset and current values are in double word BCD format, and the decimal point is implied. These timers have two inputs, an enable and a reset. The timer starts timing when the enable is on and stops when the enable is off (without resetting the count). The reset will reset the timer when on and allow the timer to time when off.

Timer Reference (Taaa): Specifies the timer number.

Preset Value (Bbbb): Constant value (K) or V-memory.

Current Value: Timer current values are accessed by referencing the associated V or T memory location*. For example, the timer current value for T3 resides in V-memory, V3.

Discrete Status Bit: The discrete status bit is accessed by referencing the associated T memory location. Operating as a "timer done bit," it will be on if the current value is equal to or greater than the preset value. For example, the discrete status bit for timer 2 would be T2.

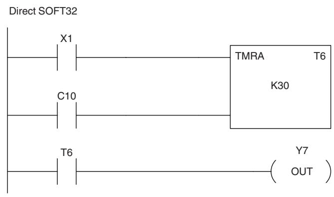
NOTE: *The accumulating timer uses two consecutive V-memory locations for the 8-digit value, therefore two consecutive timer locations. For example, if TMRA T1 is used, the next available timer number is T3.*
NOTE: *A V-memory preset is required if the ladder program or an OIP must be used to change the preset.*

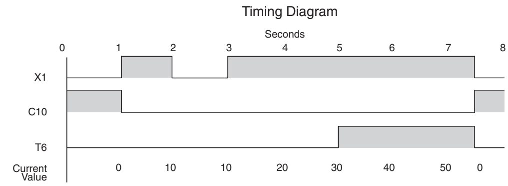
Operand Data Type		DL06 Range	
	A/B	aaa	bbb
Timers	T	0–777	—
V-memory for preset values	V	—	400-677 1200–7377 7400–7577 10000-17777
Pointers (preset only)	P	—	400-677 1200–7377 7400–7577* 10000-17777
Constants (preset only)	K	—	0–99999999
Timer discrete status bits	T/V	0–377 or V41100–41117	
Timer current values	V /T**	0–377	

NOTE: **May be non-volatile if MOV instruction is used.** With the HPP, both the Timer discrete status bits and current value are accessed with the same data reference. DirectSOFT uses separate references, such as "T2" for discrete status bit for Timer T2, and "TA2" for the current value of Timer T2.*

Accumulating Timer Example using Discrete Status Bits

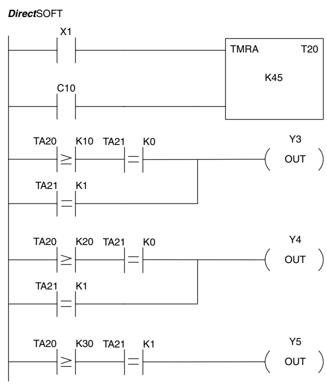
In the following example, a two input timer (accumulating timer) is used with a preset of 3 seconds. The timer discrete status bit (T6) will turn on when the timer has timed for 3 seconds. Notice, in this example, that the timer times for 1 second, stops for one second, then resumes timing. The timer will reset when C10 turns on, turning the discrete status bit off and resetting the timer current value to 0.

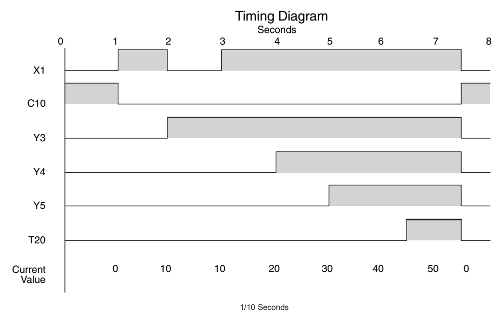


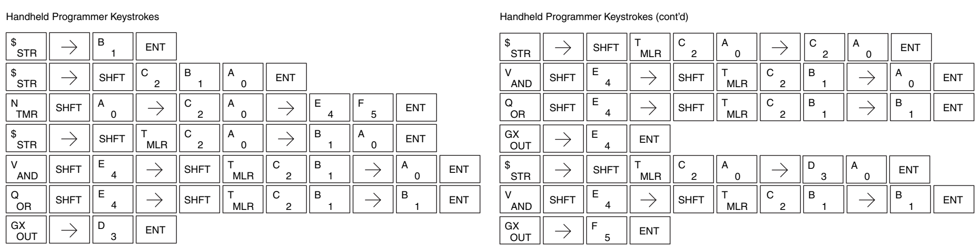


Accumulator Timer Example Using Comparative Contacts

In the following example, a single input timer is used with a preset of 4.5 seconds. Comparative contacts are used to energized Y3, Y4, and Y5 at one second intervals respectively. The comparative contacts will turn off when the timer is reset.



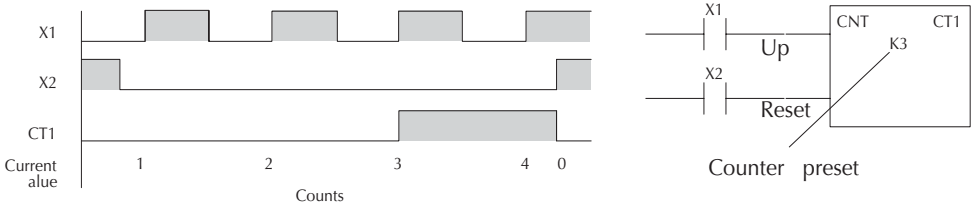




Using Counters

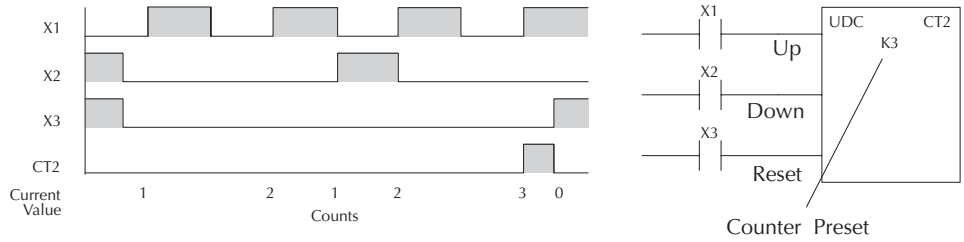
Counters are used to count events . The counters available are up counters, up/down counters, and stage counters (used with RLL*PLUS* programming).

The up counter (CNT) has two inputs, a count input and a reset input. The maximum count value is 9999. The timing diagram below shows the relationship between the counter input, counter reset, associated discrete bit, current value, and counter preset. The CNT counter preset and current value are bothe single word BCD values.

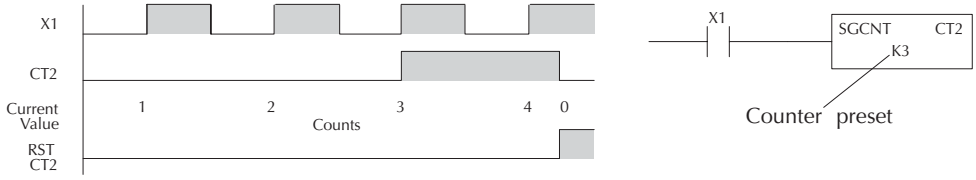


The up down counter (UDC) has three inputs, a count up input, count down input and reset input. The maximum count value is 99999999. The timing diagram below shows the relationship between the counter up and down inputs, counter reset, associated discrete bit, current value, and counter preset. The UDC counter preset and current value are both double word BCD values.

NOTE: *The UDC uses two consecutive V-memory locations for the 8-digit value, therefore, two consecutive timer locations. For example, if UDC CT1 is used, the next available counter number is CT3.*



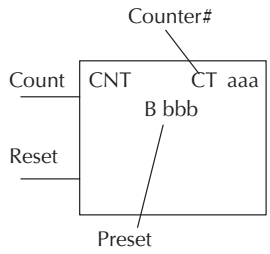
The stage counter (SGCNT) has a count input and is reset by the RST instruction. This instruction is useful when programming using the RLL*PLUS* structured programming. The maximum count value is 9999. The timing diagram below shows the relationship between the counter input, associated discrete bit, current value, counter preset and reset instruction.



Counter (CNT)

DS	Used
HPP	Used

The Counter is a two-input counter that increments when the count input logic transitions from Off to On. When the counter reset input is On, the counter resets to 0. When the current value equals the preset value, the counter status bit comes On and the counter continues to count up to a maximum count of 9999. The maximum value will be held until the counter is reset.



Instruction Specifications

Counter Reference (CTaaa): Specifies the counter number.

Preset Value (Bbbb): Constant value (K) or a V-memory location.

Current Values: Counter current values are accessed by referencing the associated V or CT memory locations.* The V-memory location is the counter location + 1000. For example, the counter current value for CT3 resides in V-memory location V1003.

Discrete Status Bit: The discrete status bit is accessed by referencing the associated CT memory location. It will be On if the value is equal to or greater than the preset value. For example the discrete status bit for counter 2 would be CT2.

***NOTE**: A V-memory preset is required if the ladder program or OIP must change the preset.*

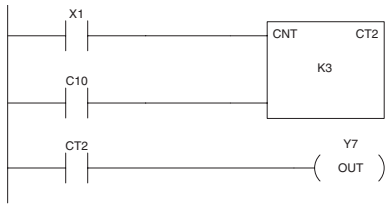
Operand Data Type		DL06 Range	
	A/B	aaa	bbb
Counters	CT	0–177	—
V-memory (preset only)	V	—	400-677 1200–7377 7400–7577 10000-17777
Pointers (preset only)	P	—	400-677 1200–7377 7400–7577* 10000-17777
Constants (preset only)	K	—	0–9999
Counter discrete status bits	CT/V	0–177 or V41140–41147	
Counter current values	V /CT**	1000-1177	

***NOTE:** *May be non-volatile if MOV instruction is used.*
*** With the HPP, both the Counter discrete status bits and current value are accessed with the same data reference. DirectSOFT uses separate references, such as "CT2" for discrete status bit for Counter CT2, and "CTA2" for the current value of Counter CT2.*

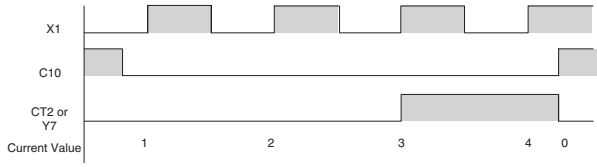
Counter Example Using Discrete Status Bits

In the following example, when X1 makes an Off-to-On transition, counter CT2 will increment by one. When the current value reaches the preset value of 3, the counter status bit CT2 will turn on and energize Y7. When the reset C10 turns on, the counter status bit will turn off and the current value will be 0. The current value for counter CT2 will be held in V-memory location V1002.

*Direct*SOFT



Counting diagram



Handheld Programmer Keystrokes

$ STR	→	B 1	ENT					
$ STR	→	SHFT	C 2	B 1	A 0	ENT		
GY CNT	→	C 2	→	D 3	ENT			

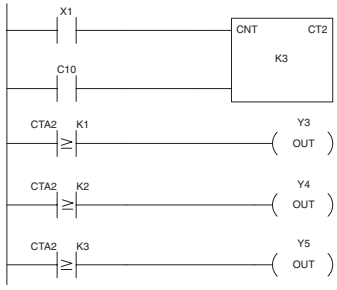
Handheld Programmer Keystrokes (cont)

$ STR	→	SHFT	C 2	SHFT	T MLR	C 2	ENT	
GX OUT	→	B 1	A 0	ENT				

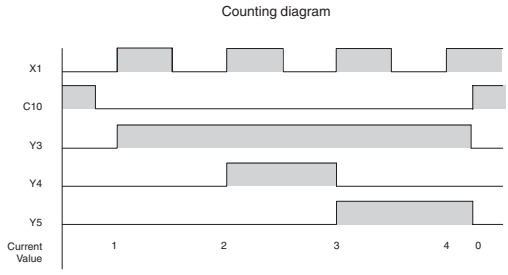
Counter Example Using Comparative Contacts

In the following example, when X1 makes an Off-to-On transition, counter CT2 will increment by one. Comparative contacts are used to energize Y3, Y4, and Y5 at different counts. When the reset C10 turns on, the counter status bit will turn off and the counter current value will be 0, and the comparative contacts will turn off.

*Direct*SOFT



Counting diagram



Handheld Programmer Keystrokes

$ STR	→	B 1	ENT					
$ STR	→	SHFT	C 2	B 1	A 0	ENT		
GY CNT	→	C 2	→	D 3	ENT			
$ STR	→	SHFT	C 2	SHFT	T MLR	C 2		
→	B 1	ENT						
GX OUT	→	D 3	ENT					

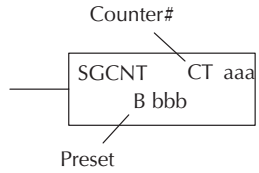
Handheld Programmer Keystrokes (cont)

$ STR	→	SHFT	C 2	SHFT	T MLR	C 2		
→	C 2	ENT						
GX OUT	→	E 4	ENT					
$ STR	→	SHFT	C 2	SHFT	T MLR	C 2		
→	D 3	ENT						
GX OUT	→	F 5	ENT					

Stage Counter (SGCNT)

DS	Used
HPP	Used

The Stage Counter is a single input counter that increments when the input logic transitions from off to on. This counter differs from other counters since it will hold its current value until reset using the RST instruction. The Stage Counter is designed for use in RLL*PLUS* programs but can be used in relay ladder logic programs. When the current value equals the preset value, the counter status bit turns on and the counter continues to count up to a maximum count of 9999. The maximum value will be held until the counter is reset.



Instruction Specifications

Counter Reference (CTaaa): Specifies the counter number.

Preset Value (Bbbb): Constant value (K) or a V-memory location.

Current Values: Counter current values are accessed by referencing the associated V or CT memory locations*. The V-memory location is the counter location + 1000. For example, the counter current value for CT3 resides in V-memory location V1003.

Discrete Status Bit: The discrete status bit is accessed by referencing the associated CT memory location. It will be on if the value is equal to or greater than the preset value. For example, the discrete status bit for counter 2 would be CT2.

NOTE: *In using a counter inside a stage, the stage must be active for one scan before the input to the counter makes a 0-1 transition. Otherwise, there is no real transition and the counter will not count.*

NOTE*: A V-memory preset is required only if the ladder program or an Operator Interface unit must change the preset.*

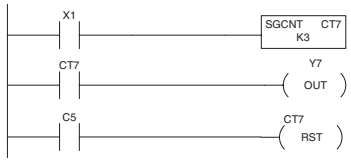
Operand Data Type		DL06 Range	
	A/B	aaa	bbb
Counters	CT	0–177	—
V-memory (preset only)	V	—	400-677 1200–7377 7400–7577 10000-17777
Pointers (preset only)	P	—	400-677 1200–7377 7400–7577* 10000-17777
Constants (preset only)	K	—	0–9999
Counter discrete status bits	CT/V	0–177 or V41140–41147	
Counter current values	V /CT**	1000-1177	

NOTE: **May be non-volatile if MOV instruction is used.*
*** With the HPP, both the Counter discrete status bits and current value are accessed with the same data reference. DirectSOFT uses separate references, such as "CT2" for discrete status bit for Counter CT2, and "CTA2" for the current value of Counter CT2.*

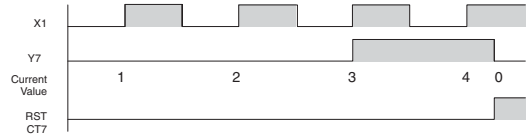
Stage Counter Example Using Discrete Status Bits

In the following example, when X1 makes an off-to-on transition, stage counter CT7 will increment by one. When the current value reaches 3, the counter status bit CT7 will turn on and energize Y7. The counter status bit CT7 will remain on until the counter is reset using the RST instruction. When the counter is reset, the counter status bit will turn off and the counter current value will be 0. The current value for counter CT7 will be held in V-memory location V1007.

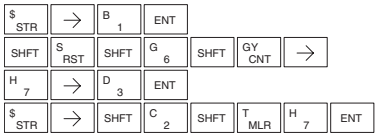
DirectSOFT



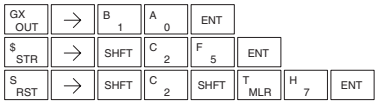
Counting diagram



Handheld Programmer Keystrokes



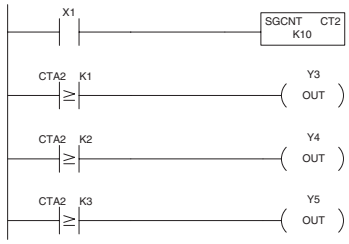
Handheld Programmer Keystrokes (cont)



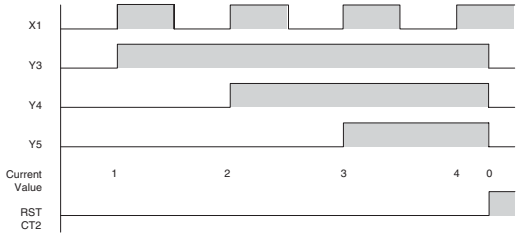
Stage Counter Example Using Comparative Contacts

In the following example, when X1 makes an off-to-on transition, counter CT2 will increment by one. Comparative contacts are used to energize Y3, Y4, and Y5 at different counts. Although this is not shown in the example, when the counter is reset using the Reset instruction, the counter status bit will turn off and the current value will be 0. The current value for counter CT2 will be held in V-memory location V1002 (CTA2).

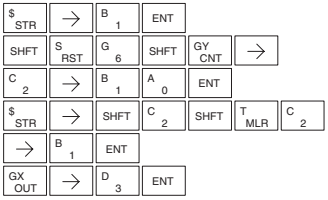
DirectSOFT



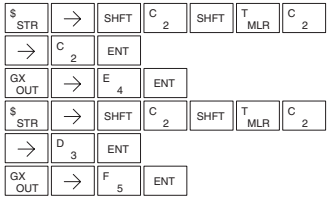
Counting diagram



Handheld Programmer Keystrokes



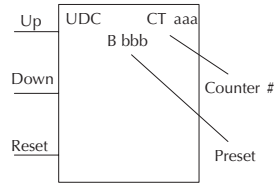
Handheld Programmer Keystrokes (cont)



Up Down Counter (UDC)

DS	Used
HPP	Used

This Up/Down Counter counts up on each off to on transition of the Up input and counts down on each off-to-on transition of the Down input. The counter is reset to 0 when the Reset input is on. The count range is 0–99999999. The count input not being used must be off in order for the active count input to function.



Caution: The UDC uses two V-memory locations for the 8 digit current value. This means that the UDC uses two consecutive counter locations. If UDC CT1 is used in the program, the next available counter is CT3.

Instruction Specification

Counter Reference (CTaaa): Specifies the counte number.

Preset Value (Bbbb): Constant value (K) or tw consecutive V-memory locations, in BCD.

Current Values: Current count is a double word value accessed by referencing the associated V or CT memory locations* in BCD. The V-memory location is the counter location + 1000. For example, the counter current value for CT5 resides in V-memory location V1005 and V1006.

Discrete Status Bit: The discrete status bit is accessed by referencing the associated CT memory location. Operating as a "counter done bit" it will be on if the value is equal to or greater than the preset value. For example the discrete status bit for counter 2 would be CT2.

NOTE: *The UDC uses two consecutive V-memory locations for the 8-digit value, therefore two consecutive timer locations. For example, if UDC CT1 is used, the next available counter number is CT3.*

NOTE: *A V-memory preset is required only if the ladder program or an Operator Interface unit must change the preset.*

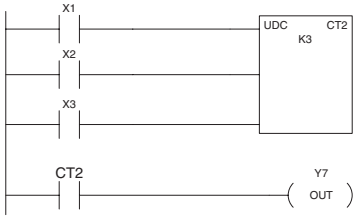
Operand Data Type		DL06 Range	
	A/B	aaa	bbb
Counters	CT	0–177	—
V-memory (preset only)	V	—	400-677 1200–7377 7400–7577 10000-17777
Pointers (preset only)	P	—	400-677 1200–7377* 7400–7577 10000-17777
Constants (preset only)	K	—	0–99999999
Counter discrete status bits	CT/V	0–177 or V41140–41147	
Counter current values	V /CT**	1000-1177	

NOTE: **May be non-volatile if MOV instruction is used.*
*** With the HPP, both the Counter discrete status bits and current value are accessed with the same data reference. DirectSOFT uses separate references, such as "CT2" for discrete status bit for Counter CT2, and "CTA2" for the current value of Counter CT2.*

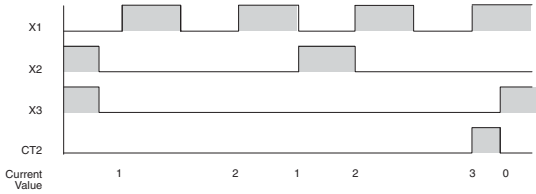
Up / Down Counter Example Using Discrete Status Bits

In the following example, if X2 and X3 are off, the counter will increment by one when X1 toggles from Off to On . If X1 and X3 are off, the counter will decrement by one when X2 toggles from Off to On. When the count value reaches the preset value of 3, the counter status bit will turn on. When the reset X3 turns on, the counter status bit will turn off and the current value will be 0.

DirectSOFT



Counting Diagram



Handheld Programmer Keystrokes

$ STR	→	B 1	ENT				
$ STR	→	C 2	ENT				
$ STR	→	D 3	ENT				
SHFT	U ISG	D 3	C 2	→	C 2		

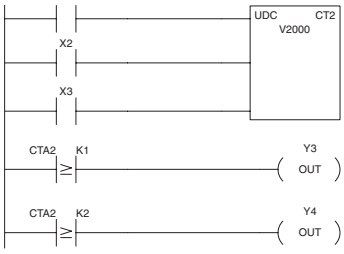
Handheld Programmer Keystrokes (cont)

→	D 3	ENT					
$ STR	→	SHFT	C 2	SHFT	T MLR	C 2	ENT
GX OUT	→	B 1	A 0	ENT			

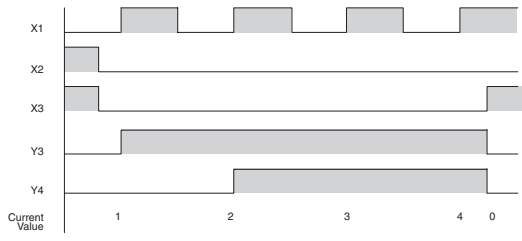
Up / Down Counter Example Using Comparative Contacts

In the following example, when X1 makes an off-to-on transition, counter CT2 will increment by one. Comparative contacts are used to energize Y3 and Y4 at different counts. When the reset (X3) turns on, the counter status bit will turn off, the current value will be 0, and the comparative contacts will turn off.

DirectSOFT



Counting Diagram



Handheld Programmer Keystrokes

$ STR	→	B 1	ENT				
$ STR	→	C 2	ENT				
$ STR	→	D 3	ENT				
SHFT	U ISG	D 3	C 2	→	C 2	→	
SHFT	V AND	C 2	A 0	A 0	A 0	ENT	
$ STR	→	SHFT	C 2	SHFT	T MLR	C 2	

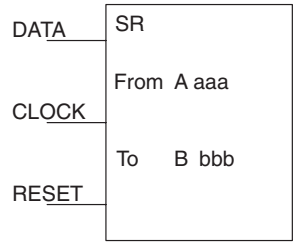
Handheld Programmer Keystrokes (cont)

→	B 1	ENT					
GX OUT	→	D 3	ENT				
$ STR	→	SHFT	C 2	SHFT	T MLR	C 2	
→	C 2	ENT					
GX OUT	→	E 4	ENT				

Shift Register (SR)

DS	Used
HPP	Used

The Shift Register instruction shifts data through a predefined number of control relays. The control ranges in the shift register block must start at the beginning of an 8 bit boundary and must use 8-bit blocks.



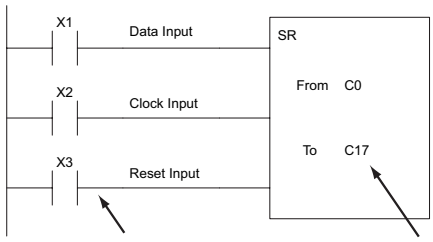
The Shift Register has three contacts.

- Data — determines the value (1 or 0) that will enter the register
- Clock — shifts the bits one position on each low to high transition
- Reset —resets the Shift Register to all zeros.

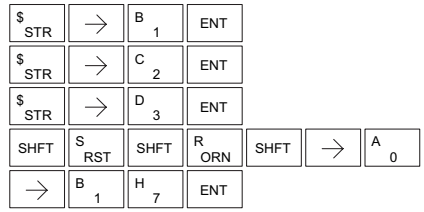
With each off-to-on transition of the clock input, the bits which make up the shift register block are shifted by one bit position and the status of the data input is placed into the starting bit position in the shift register. The direction of the shift depends on the entry in the From and To fields. From C0 to C17 would define a block of sixteen bits to be shifted from left to right. From C17 to C0 would define a block of sixteen bits to be shifted from right to left. The maximum size of the shift register block depends on the number of available control relays. The minimum block size is 8 control relays.

Operand Data Type	DL06 Range	
	A/B	aaa	bbb
Control Relay	C	0–1777	0–1777

DirectSOFT



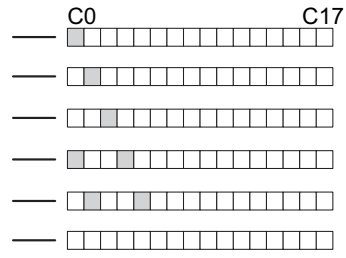
Handheld Programmer Keystrokes



Inputs on Successive Scans

Data	Clock	Reset
1	0-1-0	0
0	0-1-0	0
0	0-1-0	0
1	0-1-0	0
0	0-1-0	0
0	0	1

Shift Register Bits



Indicates ON

Indicates OFF

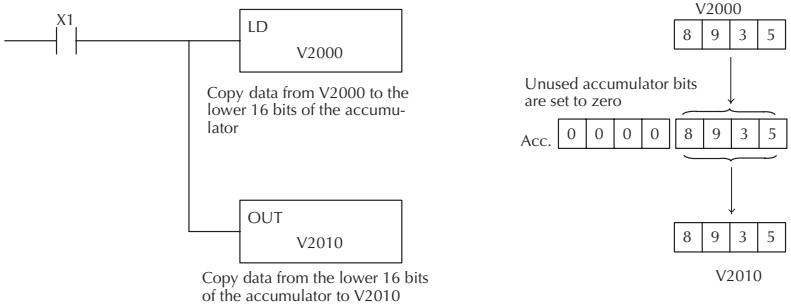
Accumulator/Stack Load and Output Data Instructions

Using the Accumulator

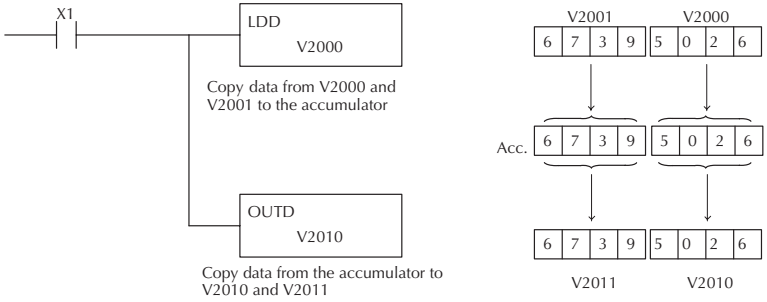
The accumulator in the DL06 internal CPUs is a 32-bit register which is used as a temporary storage location for data that is being copied or manipulated in some manner. For example, you have to use the accumulator to perform math operations such as add, subtract, multiply, etc. Since there are 32 bits, you can use up to an 8-digit BCD number. The accumulator is reset to 0 at the end of every CPU scan.

Copying Data to the Accumulator

The Load and Out instructions and their variations are used to copy data from a V-memory location to the accumulator, or to copy data from the accumulator to V-memory. The following example copies data from V-memory location V2000 to V-memory location V2010.

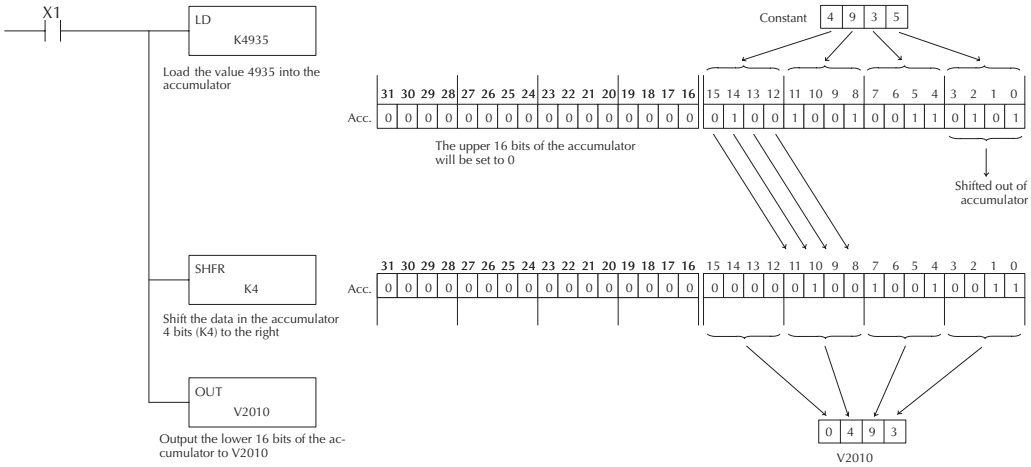


Since the accumulator is 32 bits and V-memory locations are 16 bits, the Load Double and Out Double (or variations thereof) use two consecutive V-memory locations or 8 digit BCD constants to copy data either to the accumulator from a V-memory address or from a V-memory address to the accumulator. For example, if you wanted to copy data from V2000 and V2001 to V2010 and V2011 the most efficient way to perform this function would be as follows:



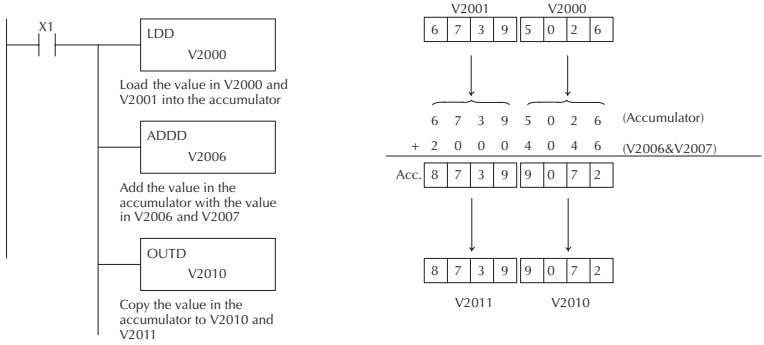
Changing the Accumulator Data

Instructions that manipulate data also use the accumulator. The result of the manipulated data resides in the accumulator. The data that was being manipulated is cleared from the accumulator. The following example loads the constant value 4935 into the accumulator, shifts the data right 4 bits, and outputs the result to V2010.



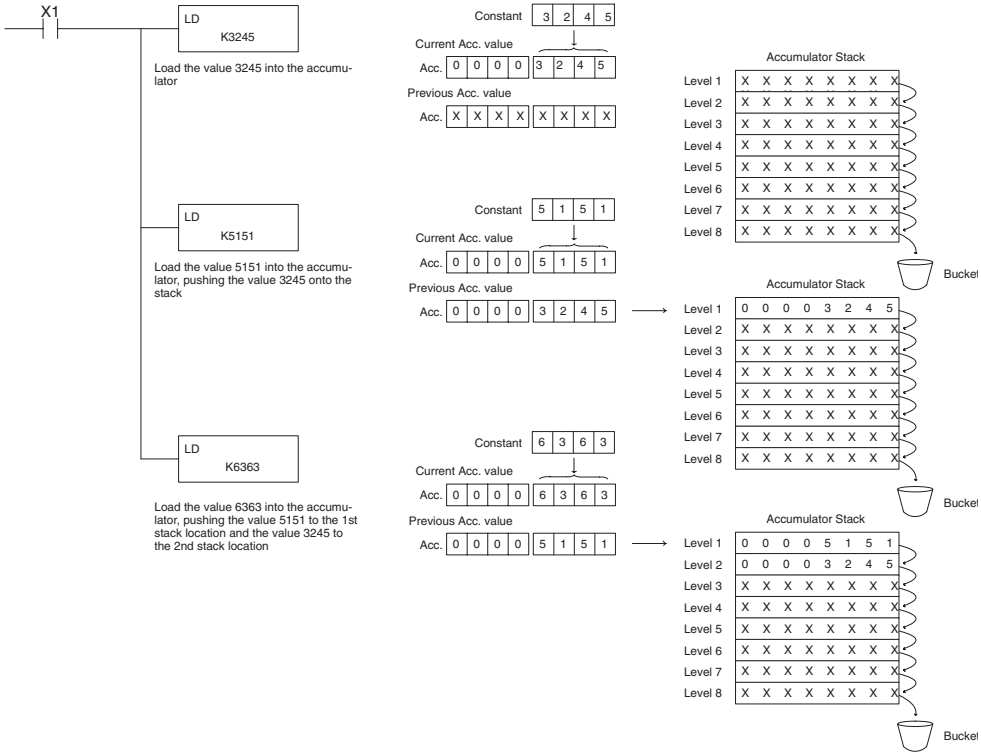
Some of the data manipulation instructions use 32 bits. They use two consecutive V-memory locations or an 8 digit BCD constant to manipulate data in the accumulator.

In the following example, when X1 is on, the value in V2000 and V2001 will be loaded into the accumulator using the Load Double instruction. The value in the accumulator is added with the value in V2006 and V2007 using the Add Double instruction. The value in the accumulator is copied to V2010 and V2011 using the Out Double instruction.

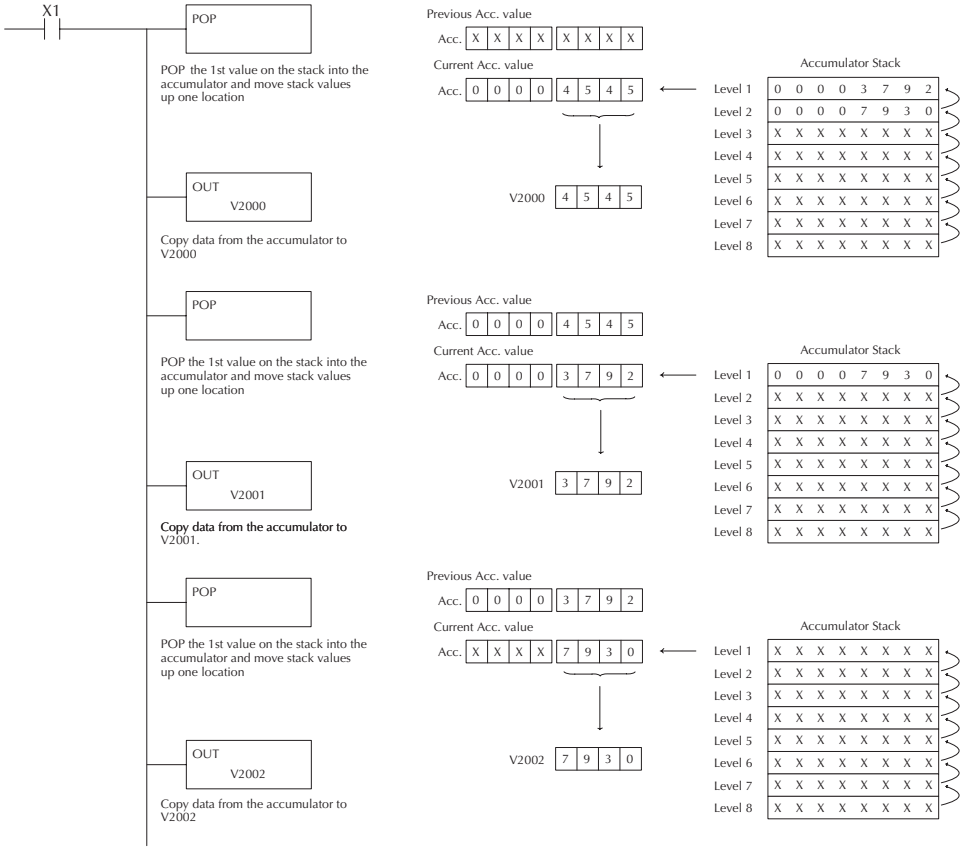


Using the Accumulator Stack

The accumulator stack is used for instructions that require more than one parameter to execute a function or for user-defined functionality. The accumulator stack is used when more than one Load instruction is executed without the use of an Out instruction. The first load instruction in the scan places a value into the accumulator. Every Load instruction thereafter without the use of an Out instruction places a value into the accumulator and the value that was in the accumulator is placed onto the accumulator stack. The Out instruction nullifies the previous load instruction and does not place the value that was in the accumulator onto the accumulator stack when the next load instruction is executed. Every time a value is placed onto the accumulator stack the other values in the stack are pushed down one location. The accumulator is eight levels deep (eight 32-bit registers). If there is a value in the eighth location when a new value is placed onto the stack, the value in the eighth location is pushed off the stack and cannot be recovered.



The POP instruction rotates values upward through the stack into the accumulator. When a POP is executed, the value which was in the accumulator is cleared and the value that was on top of the stack is in the accumulator. The values in the stack are shifted up one position in the stack.

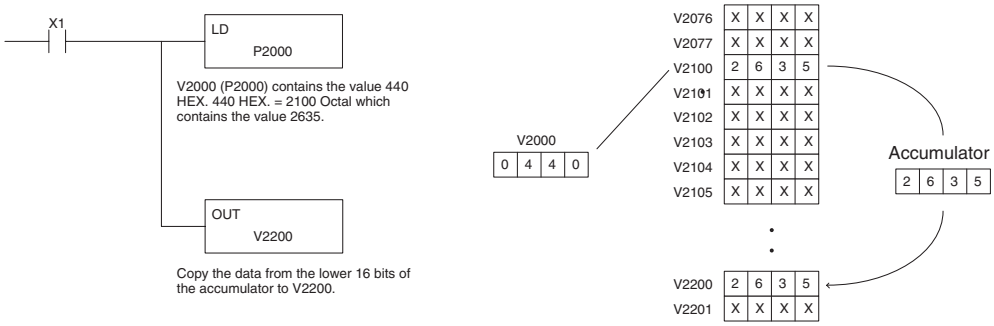


Using Pointers

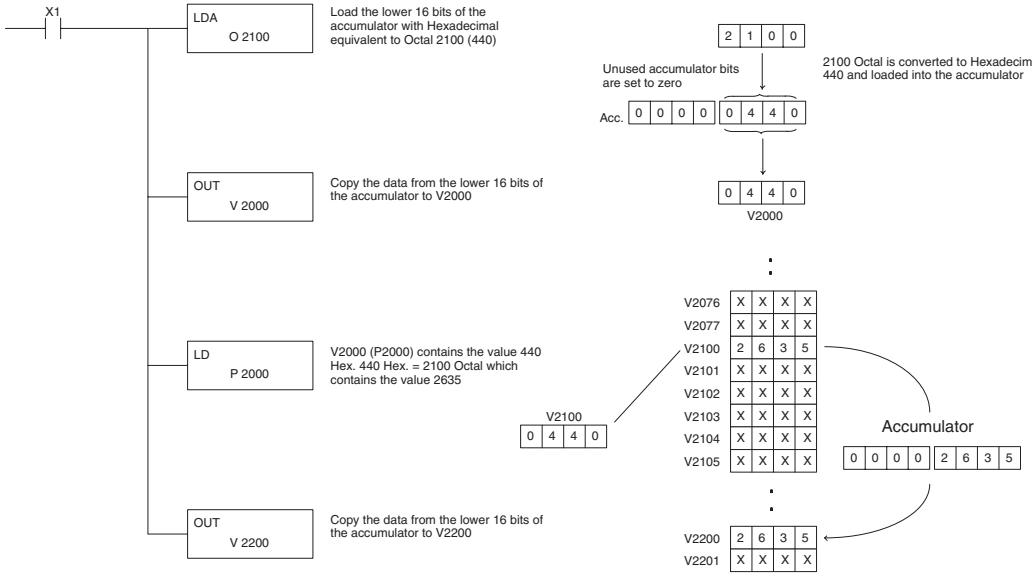
Many of the DL06 series instructions will allow V-memory pointers as operands (commonly known as indirect addressing). Pointers allow instructions to obtain data from V-memory locations referenced by the pointer value.

***NOTE**: DL06 V-memory addressing is in octal. However, the pointers reference a V-memory location with values viewed as HEX. Use the Load Address (LDA) instruction to move an address into the pointer location. This instruction performs the Octal to Hexadecimal conversion automatically.*

In the following example we are using a pointer operand in a Load instruction. V-memory location 2000 is being used as the pointer location. V2000 contains the value 440 which the CPU views as the Hex equivalent of the Octal address V-memory location V2100. The CPU will copy the data from V2100, which (in this example) contains the value 2635, into the lower word of the accumulator.



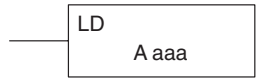
The following example is identical to the one above, with one exception. The LDA (Load Address) instruction automatically converts the Octal address to Hex.



Load (LD)

DS	Used
HPP	Used

The Load instruction is a 16 bit instruction that loads the value (Aaaa), which is either a V-memory location or a 4 digit constant, into the lower 16 bits of the accumulator. The upper 16 bits of the accumulator are set to 0.

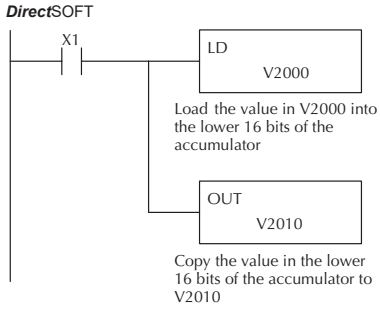


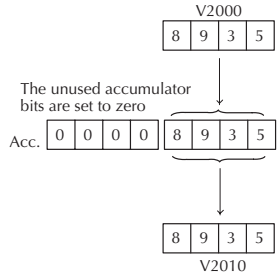
Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map
Constant	K	0–FFFF

Discrete Bit Flags	Description
SP53	On when the pointer is outside of the available range.
SP70	On anytime the value in the accumulator is negative.
SP76	On when any instruction loads a value of zero into the accumulator.

***NOTE**: Two consecutive Load instructions will place the value of the first load instruction onto the accumulator stack.*

In the following example, when X1 is on, the value in V2000 will be loaded into the accumulator and output to V2010.





Handheld Programmer Keystrokes

$ STR	→	B 1	X SET					
SHFT	L ANDST	D 3	→					
C 2	A 0	A 0	A 0	ENT				
GX OUT	→	SHFT	V AND	C 2	A 0	B 1	A 0	ENT

Load Double (LDD)

DS	Used
HPP	Used

The Load Double instruction is a 32-bit instruction that loads tl value (Aaaa), which is either two consecutive V-memory locations an 8 digit constant value, into the accumulator.

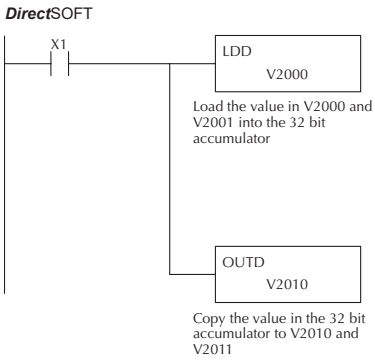
LDD
A aaa

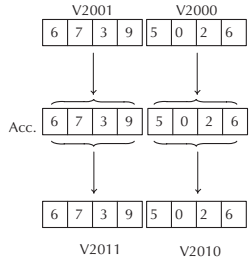
Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map
Constant	K	0–FFFFFFFF

Discrete Bit Flags	Description
SP53	On when the pointer is outside of the available range.
SP70	On anytime the value in the accumulator is negative.
SP76	On when any instruction loads a value of zero into the accumulator.

***NOTE**: Two consecutive Load instructions will place the value of the first load instruction onto the accumulator stack.*

In the following example, when X1 is on, the 32-bit value in V2000 and V2001 will be loaded into the accumulator and output to V2010 and V2011.





Handheld Programmer Keystrokes

$ STR	→	B 1	ENT	
SHFT	L ANDST	D 3	D 3	→
C 2	A 0	A 0	A 0	ENT
GX OUT	SHFT	D 3	→	
C 2	A 0	B 1	A 0	ENT

Load Formatted (LDF)

DS	Used
HPP	Used

The Load Formatted instruction loads 1–32 consecutive bits from discrete memory locations into the accumulator. The instruction requires a starting location (Aaaa) and the number of bits (Kbbb) to be loaded. Unused accumulator bit locations are set to zero.

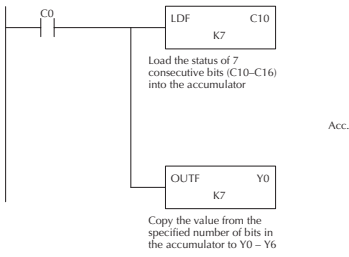
Operand Data Type	DL06 Range		
	A	aaa	bbb
Inputs	X	0–777	—
Outputs	Y	0–777	—
Control Relays	C	0–1777	—
Stage Bits	S	0–1777	—
Timer Bits	T	0–377	—
Counter Bits	CT	0–177	—
Special Relays	SP	0–777	—
Constant	K	—	1–32

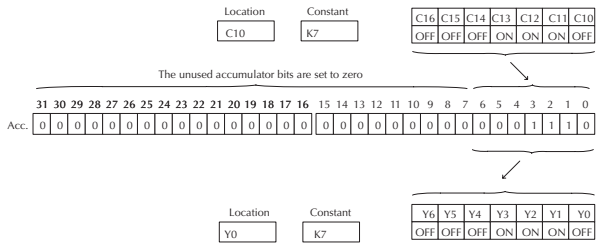
Discrete Bit Flags	Description
SP70	On anytime the value in the accumulator is negative.
SP76	On when any instruction loads a value of zero into the accumulator.

***NOTE**: Two consecutive Load instructions will place the value of the first load instruction onto the accumulator stack.*

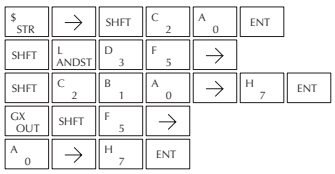
In the following example, when C0 is on, the binary pattern of C10–C16 (7 bits) will be loaded into the accumulator using the Load Formatted instruction. The lower 7 bits of the accumulator are output to Y0–Y6 using the Out Formatted instruction.

***Direct*SOFT**





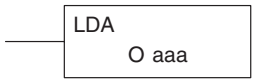
Handheld Programmer Keystrokes



Load Address (LDA)

DS	Used
HPP	Used

The Load Address instruction is a 16-bit instruction. It converts any octal value or address to the HEX equivalent value and loads the HEX value into the accumulator. This instruction is useful when an address parameter is required, since all addresses for the DL06 system are in octal.



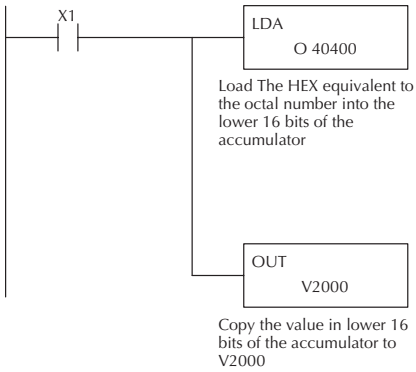
Operand Data Type		DL06 Range
		aaa
Octal Address	O	See memory map

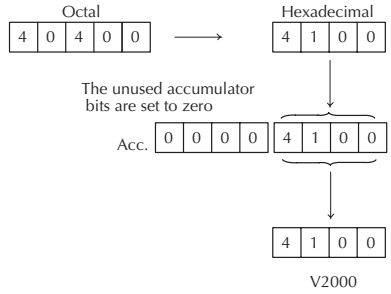
Discrete Bit Flags	Description
SP70	On anytime the value in the accumulator is negative.
SP76	On when any instruction loads a value of zero into the accumulator.

***NOTE**: Two consecutive Load instructions will place the value of the first load instruction onto the accumulator stack.*

In the following example, when X1 is on, the octal number 40400 will be converted to a HEX 4100 and loaded into the accumulator using the Load Address instruction. The value in the lower 16 bits of the accumulator is copied to V2000 using the Out instruction.

***Direct*SOFT**





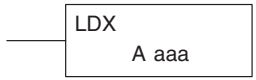
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT					
SHFT	L ANDST	D 3	A 0	→				
E 4	A 0	E 4	A 0	A 0	ENT			
GX OUT	→	SHFT	V AND	C 2	A 0	A 0	A 0	ENT

Load Accumulator Indexed (LDX)

DS	Used
HPP	Used

Load Accumulator Indexed is a 16-bit instruction that specifies a source address (V-memory) which will be offset by the value in the first stack location. This instruction interprets the value in the first stack location as HEX. The value in the offset address (source address + offset) is loaded into the lower 16 bits of the accumulator. The upper 16 bits of the accumulator are set to 0.



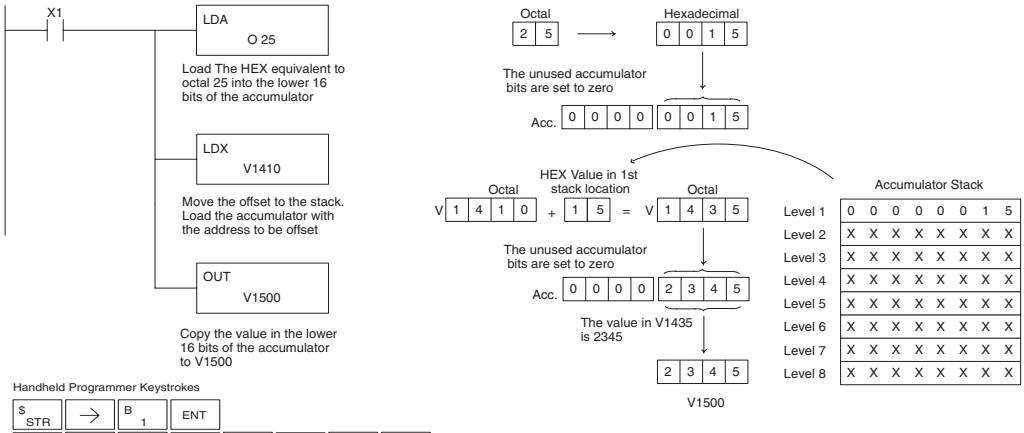
Helpful Hint: — The Load Address instruction can be used to convert an octal address to a HEX address and load the value into the accumulator.

Operand Data Type		DL06 Range	
A		aaa	aaa
V-memory	V	See memory map	See memory map
Pointer	P	See memory map	See memory map

Discrete Bit Flags	Description
SP53	On when the pointer is outside of the available range.
SP70	On anytime the value in the accumulator is negative.
SP76	On when any instruction loads a value of zero into the accumulator.

***NOTE**: Two consecutive Load instructions will place the value of the first load instruction onto the accumulator stack.*

In the following example, when X1 is on, the HEX equivalent for octal 25 will be loaded into the accumulator (this value will be placed on the stack when the Load Accumulator Indexed instruction is executed). V-memory location V1410 will be added to the value in the first level of the stack and the value in this location (V1435 = 2345) is loaded into the lower 16 bits of the accumulator using the Load Accumulator Indexed instruction. The value in the lower 16 bits of the accumulator is output to V1500 using the Out instruction.



Handheld Programmer Keystrokes

$ STR	→	B 1	ENT					
SHFT	L ANDST	D 3	A 0	→	C 2	F 5	ENT	
SHFT	L ANDST	D 3	X SET	→	B 1	E 4	B 1	A 0	ENT
GX OUT	→	PREV	PREV	PREV	B 1	F 5	A 0	A 0	ENT

Load Accumulator Indexed from Data Constants (LDSX)

DS	Used
HPP	Used

The Load Accumulator Indexed from Data Constants is a 16-bit instruction. The instruction specifies a Data Label Area (DLBL) where numerical or ASCII constants are stored. This value will be loaded into the lower 16 bits.

The LDSX instruction uses the value in the first level of the accumulator stack as an offset to determine which numerical or ASCII constant within the Data Label Area will be loaded into the accumulator. The LDSX instruction interprets the value in the first level of the accumulator stack as a HEX value.

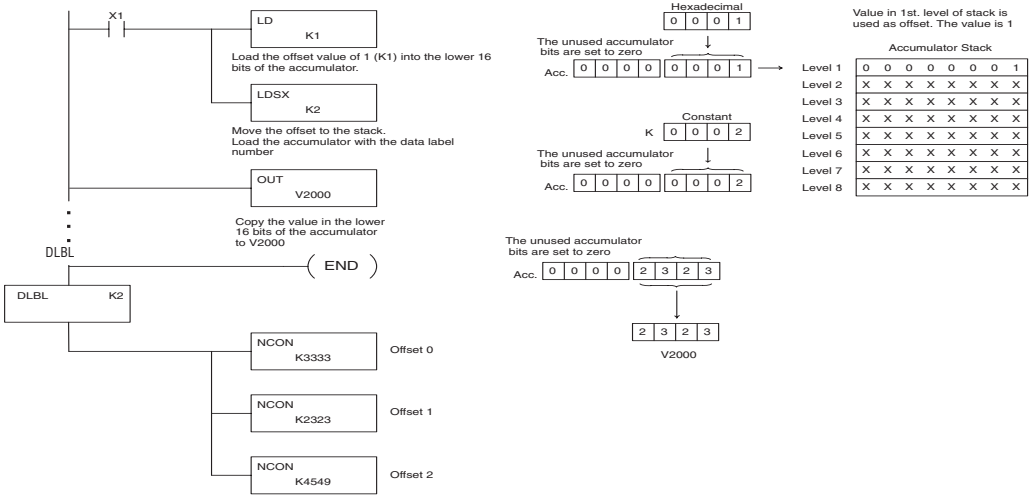
Helpful Hint: — The Load Address instruction can be used to convert octal to HEX and load the value into the accumulator.

Operand Data Type		DL06 Range
		aaa
Constant	K	1-FFFF

Discrete Bit Flags	Description
SP53	On when the pointer is outside of the available range.
SP70	On anytime the value in the accumulator is negative.
SP76	On when any instruction loads a value of zero into the accumulator.

***NOTE**: Two consecutive Load instructions will place the value of the first load instruction onto the accumulator stack.*

In the following example when X1 is on, the offset of 1 is loaded into the accumulator. This value will be placed into the first level of the accumulator stack when the LDSX instruction is executed. The LDSX instruction specifies the Data Label (DLBL K2) where the numerical constant(s) are located in the program and loads the constant value, indicated by the offset in the stack, into the lower 16 bits of the accumulator.



Handheld Programmer Keystrokes

$ STR	→	B 1	ENT											
SHFT	L ANDST	D 3	→	SHFT	K JMP	B 1	ENT							
SHFT	L ANDST	D 3	S RST	X SET	→	C 2	ENT							
SHFT	E 4	N TMR	D 3	ENT										
SHFT	D 3	L ANDST	B 1	L ANDST	→	C 2	ENT							
SHFT	N TMR	C 2	O INST#	N TMR	→	D 3	D 3	D 3	D 3	ENT				
SHFT	N TMR	C 2	O INST#	N TMR	→	C 2	D 3	C 2	D 3	ENT				
SHFT	N TMR	C 2	O INST#	N TMR	→	E 4	F 5	E 4	J 9	ENT				
GX OUT	→	SHFT	V AND	C 2	A 0	A 0	A 0	ENT						

Load Real Number (LDR)

DS	Used
HPP	N/A

The Load Real Number instruction loads a real number containe in two consecutive V-memory locations, or an 8-digit consta

```
LDR
    A aaa
```

Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map
Real Constant	R	$-3.402823E^{+38}$ to + $-3.402823E^{+38}$

Discrete Bit Flags	Description
SP70	On anytime the value in the accumulator is negative.
SP76	On when any instruction loads a value of zero into the accumulator.

*Direct*SOFT allows you to enter real numbers directly, by using the leading "R" to indicate a real number entry. You can enter a constant such as Pi, shown in the example to the right. To enter negative numbers, use a minus (–) after the "R".

```
LDR
    R3.14159
```

For very large numbers or very small numbers, you can use exponential notation. The number to the right is 5.3 million. The OUTD instruction stores it in V1400 and V1401.

```
LDR
    R5.3E6
OUTD
    V1400
```

These real numbers are in the IEEE 32-bit floating point format, so they occupy two V-memory locations, regardless of how big or small the number may be! If you view a stored real number in hex, binary, or even BCD, the number shown will be very difficult to decipher. Just like all other number types, you must keep track of real number locations in memory, so they can be read with the proper instructions later.

The previous example above stored a real number in V1400 and V1401. Suppose that now we want to retrieve that number. Just use the Load Real with the V data type, as shown to the right. Next we could perform real math on it, or convert it to a binary number.

```
LDR
    V1400
```

Out (OUT)

DS	Used
HPP	Used

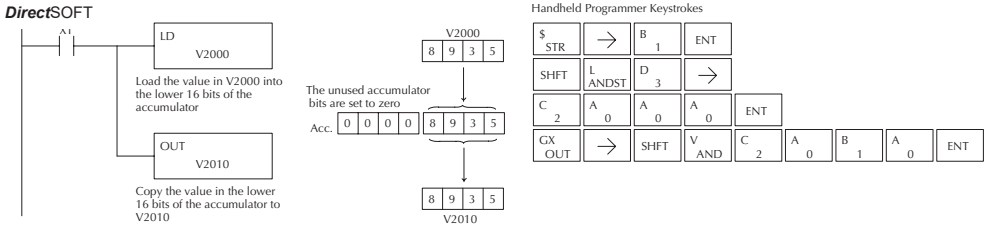
The Out instruction is a 16-bit instruction that copies the value in the lower 16 bits of the accumulator to a specified V-memory location (Aaaa).

```
OUT
  A aaa
```

Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map

Discrete Bit Flags	Description
SP53	On if CPU cannot solve the logic.

In the following example, when X1 is on, the value in V2000 will be loaded into the lower 16 bits of the accumulator using the Load instruction. The value in the lower 16 bits of the accumulator are copied to V2010 using the OUT instruction.



Out Double (OUTD)

DS	Used
HPP	Used

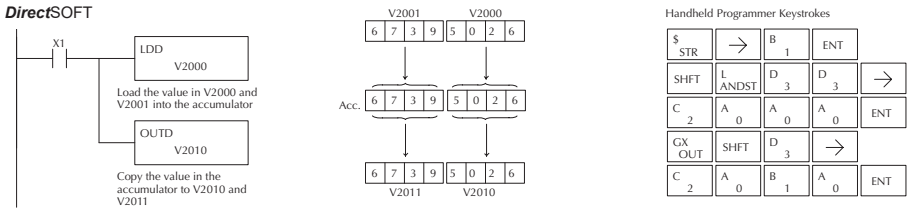
The Out Double instruction is a 32 bit instruction that copies th value in the accumulator to two consecutive V-memory locations at specified starting location (Aaaa).

```
OUTD
  A aaa
```

Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map

Discrete Bit Flags	Description
SP53	On if CPU cannot solve the logic.

In the following example, when X1 is on, the 32-bit value in V2000 and V2001 will be loaded into the accumulator using the Load Double instruction. The value in the accumulator is output to V2010 and V2011 using the OUTD instruction.



Out Formatted (OUTF)

DS	Used
HPP	Used

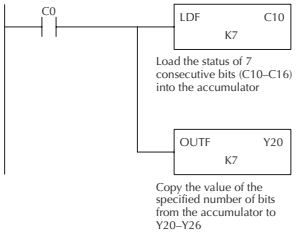
The Out Formatted instruction outputs 1–32 bits from the accumulator to the specified discrete memory locations. The instruction requires a starting location (Aaaa) for the destination and the number of bits (Kbbb) to be output.

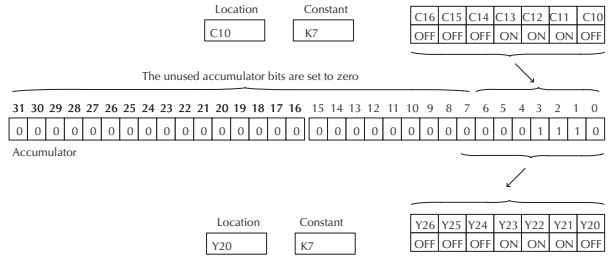
```
OUTF    A aaa
        K bbb
```

Operand Data Type	DL06 Range		
	A	aaa	bbb
Inputs	X	0–777	—
Outputs	Y	0–777	—
Control Relays	C	0–1777	—
Constant	K	—	1–32

In the following example, when C0 is on, the binary pattern of C10–C16 (7 bits) will be loaded into the accumulator using the Load Formatted instruction. The lower 7 bits of the accumulator are output to Y0–Y6 using the OUTF instruction.

DirectSOFT





Handheld Programmer Keystrokes

$ STR	→	SHFT	C 2	A 0	ENT		
SHFT	L ANDST	D 3	F 5	→			
SHFT	C 2	B 1	A 0	→	H 7	ENT	
GX OUT	SHFT	F 5	→				
A 0	→	H 7	ENT				

Pop (POP)

DS	Used
HPP	Used

The Pop instruction moves the value from the first level of the accumulator stack (32 bits) to the accumulator and shifts each value in the stack up one level.

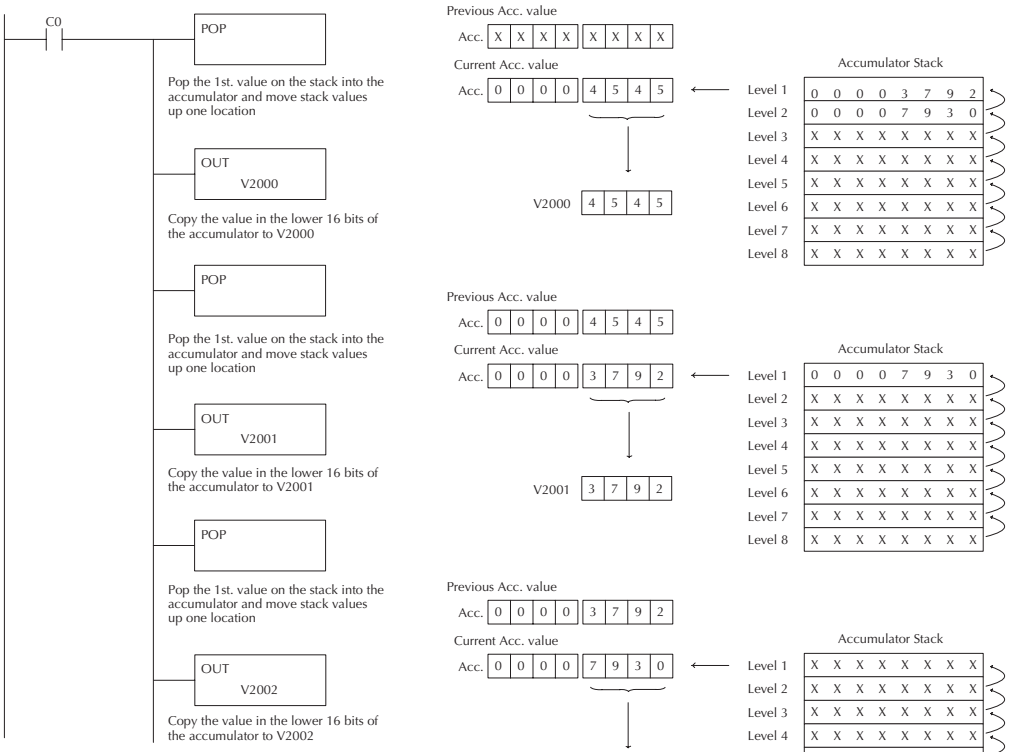
```
POP
```

Discrete Bit Flags	Description
SP63	ON when the result of the instruction causes the value in the accumulator to be zero.

Pop Instruction (cont'd)

In the example below, when C0 is on, the value 4545 that was on top of the stack is moved into the accumulator using the Pop instruction The value is output to V2000 using the OUT instruction. The next Pop moves the value 3792 into the accumulator and outputs the value to V2001. The last Pop moves the value 7930 into the accumulator and outputs the value to V2002. Please note if the value in the stack were greater than 16 bits (4 digits) the OUTD instruction would be used and 2 V-memory locations for each OUTD must be allocated.

DirectSOFT



Handheld Programmer Keystrokes

$ STR	→	SHFT	C 2	A 0	ENT			
SHFT	P CV	SHFT	O INST#	P CV	ENT			
GX OUT	→	SHFT	V AND	C 2	A 0	A 0	A 0	ENT
SHFT	P CV	SHFT	O INST#	P CV	ENT			
GX OUT	→	SHFT	V AND	C 2	A 0	A 0	B 1	ENT
SHFT	P CV	SHFT	O INST#	P CV	ENT			
GX OUT	→	SHFT	V AND	C 2	A 0	A 0	C 2	ENT

Out Indexed (OUTX)

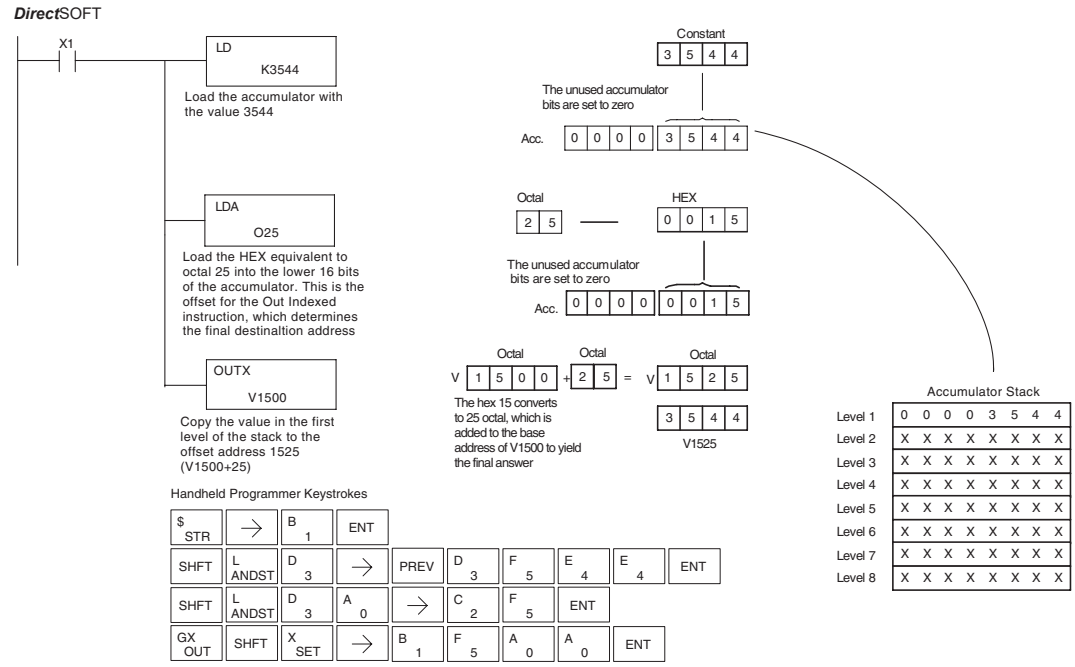
DS	Used
HPP	Used

The OUTX instruction is a 16 bit instruction. It copies a 16 bit or 4 digit value from the first level of the accumulator stack to a source address offset by the value in the accumulator(V-memory + offset).This instruction interprets the offset value as a HEX number. The upper 16 bits of the accumulator are set to zero.

Operand Data Type		DL06 Range
	A	**aaa**
V-memory	V	See memory map
Pointer	P	See memory map

Discrete Bit Flags	Description
SP53	On if CPU cannot solve the logic.

In the following example, when X1 is on, the constant value 3544 is loaded into the accumulator. This is the value that will be output to the specified offset V-memory location (V1525). The value 3544 will be placed onto the stack when the LDA instruction is executed. Remember, two consecutive LD instructions places the value of the first load instruction onto the stack. The LDA instruction converts octal 25 to HEX 15 and places the value in the accumulator. The OUTX instruction outputs the value 3544 which resides in the first level of the accumulator stack to V1525.



Out Least (OUTL)

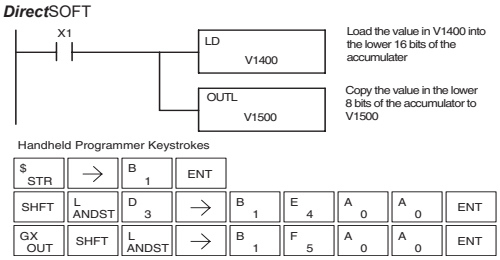
DS	Used
HPP	Used

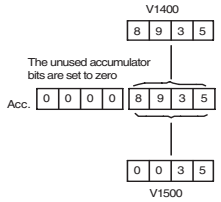
The OUTL instruction copies the value in the lower eight bits o the accumulator to the lower eight bits of the specified V-memory location (i.e., it copies the low byte of the low word of the accumulator).

```
OUTL
  A aaa
```

Operand Data Type	DL06 Range
	A	aaa
V-memory	V	See memory map

In the following example, when X1 is on, the value in V1400 will be loaded into the lower 16 bits of the accumulator using the LD instruction. The value in the lower 8 bits of the accumulator is copied to V1500 using the OUTL instruction.





Out Most (OUTM)

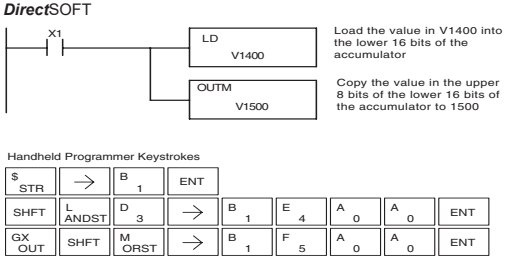
DS	Used
HPP	Used

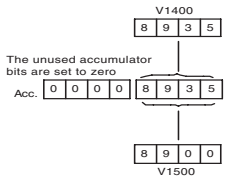
The OUTM instruction copies the value in the upper eight bits of the lower sixteen bits of the accumulator to the upper eight bits of the specified V-memory location (i.e., it copies the high byte of the low word of the accumulator).

```
OUTM
  A aaa
```

Operand Data Type	DL06 Range
	A	aaa
V-memory	V	See memory map

In the following example, when X1 is on, the value in V1400 will be loaded into the lower 16 bits of the accumulator using the LD instruction. The value in the upper 8 bits of the lower 16 bits of the accumulator is copied to V1500 using the OUTM instruction.



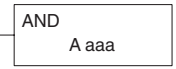


Logical Instructions (Accumulator)

And (AND logical)

DS	Used
HPP	Used

The AND instruction is a 16-bit instruction that logically ANDs the value in the lower 16 bits of the accumulator with a specified V-memory location (Aaaa). The result resides in the accumulator. The discrete status flag indicates if the result of the AND is zero.



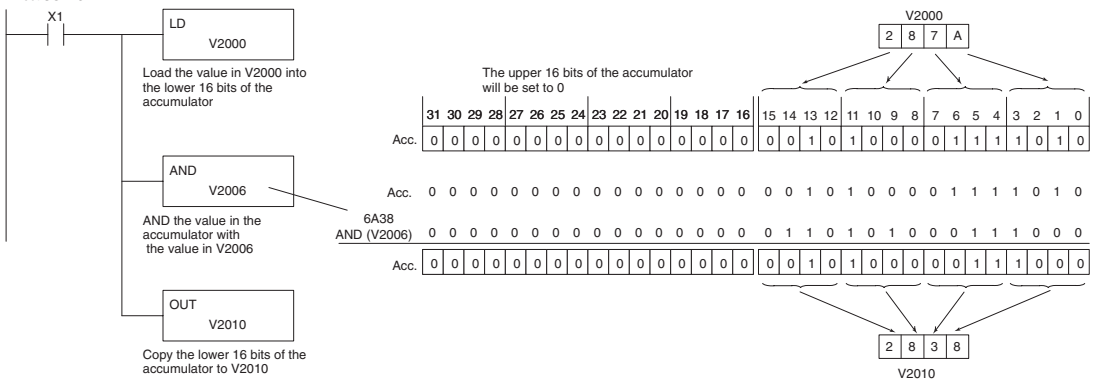
Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map

Discrete Bit Flags	Description
SP63	ON if the result in the accumulator is zero.
SP70	ON when the value loaded into the accumulator is zero.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the value in V2000 will be loaded into the accumulator using the LD instruction. The value in the accumulator is ANDed with the value in V2006 using the AND instruction. The value in the lower 16 bits of the accumulator is output to V2010 using the OUT instruction.

DirectSOFT



Handheld Programmer Keystrokes

$ STR	→	B 1	ENT					
SHFT	L ANDST	D 3	→	C 2	A 0	A 0	A 0	ENT
V AND	→	SHFT	V AND	C 2	A 0	A 0	G 6	ENT
GX OUT	→	SHFT	V AND	C 2	A 0	B 1	A 0	ENT

And Double (ANDD)

DS	Used
HPP	Used

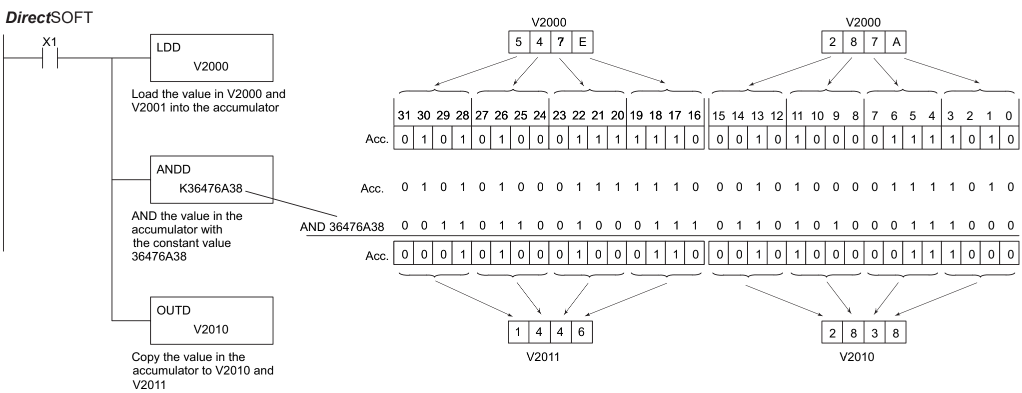
ANDD is a 32-bit instruction that logically ANDs the value in the accumulator with two consecutive V-memory locations or an 8 digit (max.) constant value (Aaaa). The result resides in the accumulator. Discrete status flags indicate if the result of the ANDD is zero or a negative number (the most significant bit is on).

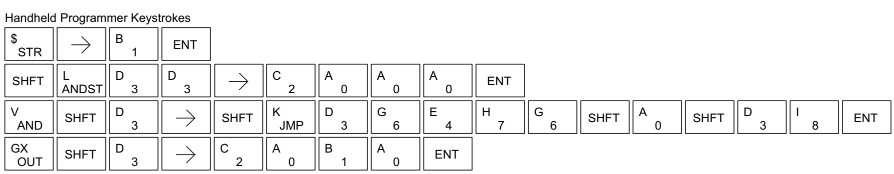
Operand Data Type		DL06 Range
		aaa
V-memory	V	See memory map
Pointer	P	See memory map
Constant	K	0–FFFFFFFF

Discrete Bit Flags	Description
SP63	ON if the result in the accumulator is zero.
SP70	ON if the result in the accumulator is negative

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the value in V2000 and V2001 will be loaded into the accumulator using the LDD instruction. The value in the accumulator is ANDed with 36476A38 using the ANDD instruction. The value in the accumulator is output to V2010 and V2011 using the OUTD instruction.

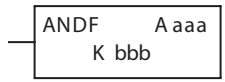




And Formatted (ANDF)

DS	Used
HPP	Used

The ANDF instruction logically ANDs the binary value in the accumulator with a specified range of discrete memory bits (1–32). The instruction requires a starting location (Aaaa) and number of bits (Kbbb) to be ANDed. Discrete status flags indicate if the result is zero or a negative number (the most significant bit =1).



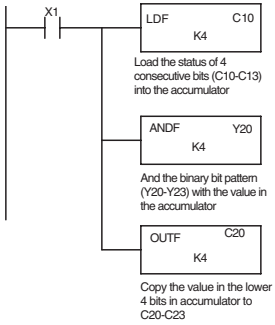
Operand Data Type		DL06 Range	
	B	aaa	bbb
Inputs	X	0-777	-
Outputs	Y	0-777	-
Control Relays	C	0-1777	-
Stage Bits	S	0-1777	-
Timer Bits	T	0-377	-
Counter Bits	CT	177	-
Special Relays	SP	0-777	-
Constant	K	-	1-32

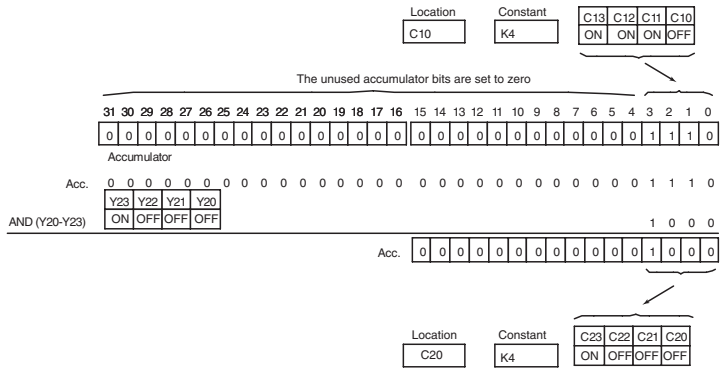
Discrete Bit Flags	Description
SP63	ON if the result in the accumulator is zero.
SP70	ON if the result in the accumulator is negative

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the LDF instruction loads C10–C13 (4 binary bits) into the accumulator. The accumulator contents is logically ANDed with the bit pattern from Y20–Y23 using the ANDF instruction. The OUTF instruction outputs the accumulator's lower four bits to C20–C23.

DirectSOFT





Handheld Programmer Keystrokes

$ STR	→	B 1	ENT												
SHFT	L ANDST	D 3	F 5	→	NEXT	NEXT	NEXT	NEXT	B 1	A 0	→	E 4	ENT		
V AND	SHFT	F 5	→	NEXT	C 2	A 0	→	E 4	ENT						
GX OUT	SHFT	F 5	→	PREV	PREV	C 2	A 0	→	E 4	ENT					

And with Stack (ANDS)

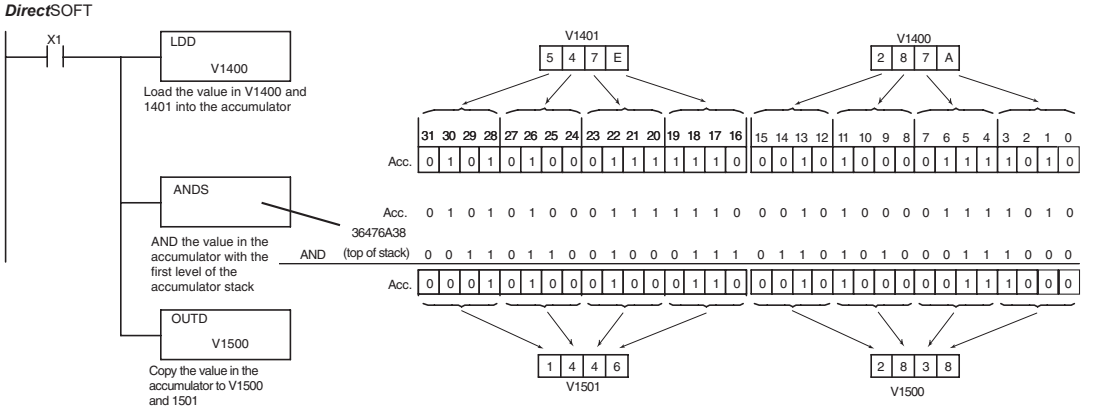
DS	Used
HPP	Used

The ANDS instruction is a 32-bit instruction that logically ANDs the value in the accumulator with the first level of the accumulator stack. The result resides in the accumulator. The value in the first level of the accumulator stack is removed from the stack and all values are moved up one level. Discrete status flags indicate if the result of the ANDS is zero or a negative number (the most significant bit is on).

Discrete Bit Flags	Description
SP63	ON if the result in the accumulator is zero.
SP70	ON if the result in the accumulator is negative

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the binary value in the accumulator will be ANDed with the binary value in the first level or the accumulator stack. The result resides in the accumulator. The 32-bit value is then output to V1500 and V1501.



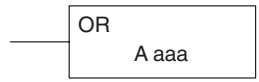
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT					
SHFT	L ANDST	D 3	D 3	→	B 1	E 4	A 0	A 0	ENT
V AND	SHFT	S RST	ENT					
GX OUT	SHFT	D 3	→	B 1	F 5	A 0	A 0	ENT

Or (OR)

DS	Used
HPP	Used

The Or instruction is a 16-bit instruction that logically ORs the value in the lower 16 bits of the accumulator with a specified V-memory location (Aaaa). The result resides in the accumulator. The discrete status flag indicates if the result of the OR is zero.



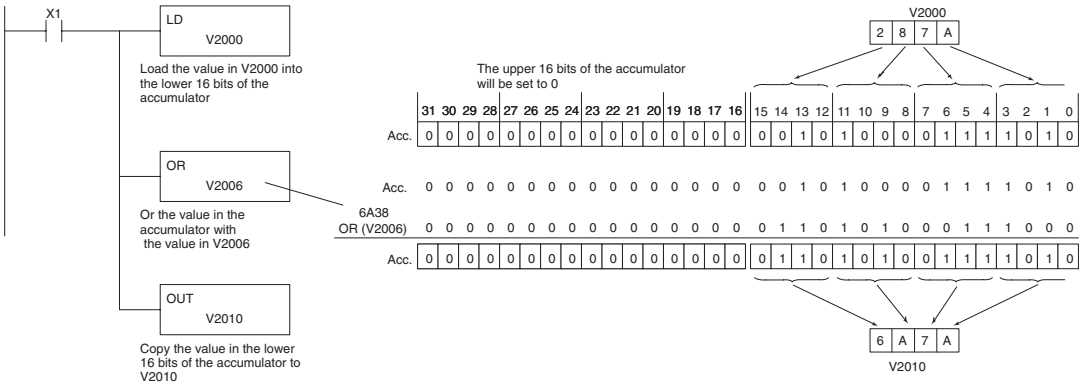
Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map

Discrete Bit Flags	Description
SP63	ON if the result in the accumulator is zero.
SP70	ON if the result in the accumulator is negative

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the value in V2000 will be loaded into the accumulator using the Load instruction. The value in the accumulator is OR'd with V2006 using the OR instruction. The value in the lower 16 bits of the accumulator is output to V2010 using the Out instruction.

DirectSOFT



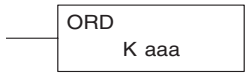
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT					
SHFT	L ANDST	D 3	→	C 2	A 0	A 0	A 0	ENT
Q OR	→	SHFT	V AND	C 2	A 0	A 0	G 6	ENT
GX OUT	→	SHFT	V AND	C 2	A 0	B 1	A 0	ENT

Or Double (ORD)

DS	Used
HPP	Used

ORD is a 32-bit instruction that logically ORs the value in the accumulator with the value (Aaaa), which is either two consecutive V-memory locations or an 8-digit (max.) constant value. The result resides in the accumulator. Discrete status flags indicate if the result of the ORD is zero or a negative number (the most significant bit is on).

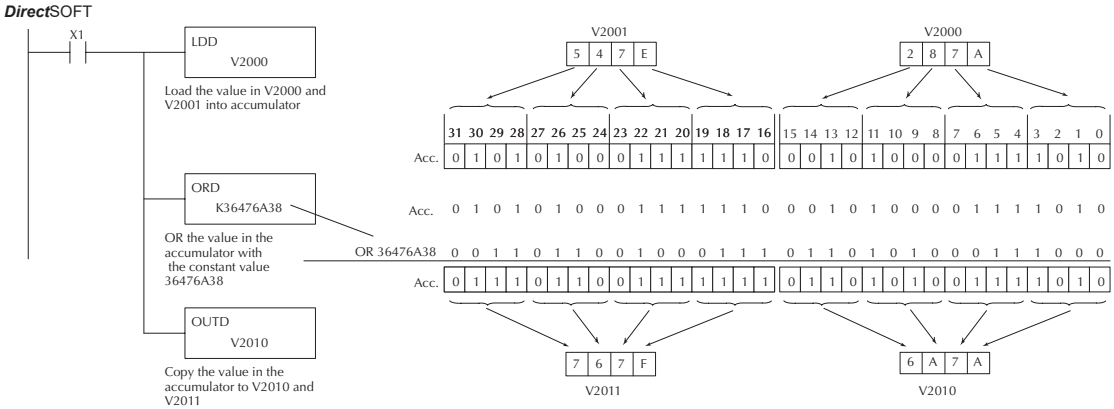


Operand Data Type		DL06 Range
		aaa
V-memory	V	See memory map
Pointer	P	See memory map
Constant	K	0–FFFFFFFF

Discrete Bit Flags	Description
SP63	ON if the result in the accumulator is zero.
SP70	ON if the result in the accumulator is negative

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the value in V2000 and V2001 will be loaded into the accumulator using the LDD instruction. The value in the accumulator is OR'd with 36476A38 using the ORD instruction. The value in the accumulator is output to V2010 and V2011 using the OUTD instruction.



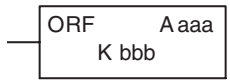
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT																
SHFT	L ANDST	D 3	D 3	→	C 2	A 0	A 0	A 0	ENT										
Q OR	SHFT	D 3	→	SHFT	K JMP	D 3	G 6	E 4	H 7	G 6	SHFT	A 0	SHFT	D 3	I 8	ENT			
GX OUT	SHFT	D 3	→	C 2	A 0	B 1	A 0	ENT											

Or Formatted (ORF)

DS	Used
HPP	Used

The ORF instruction logically ORs the binary value in the accumulator and a specified range of discrete bits (1–32). The instruction requires a starting location (Aaaa) and the number of bits (Kbbb) to be OR'd. Discrete status flags indicate if the result is zero or negative (the most significant bit =1).

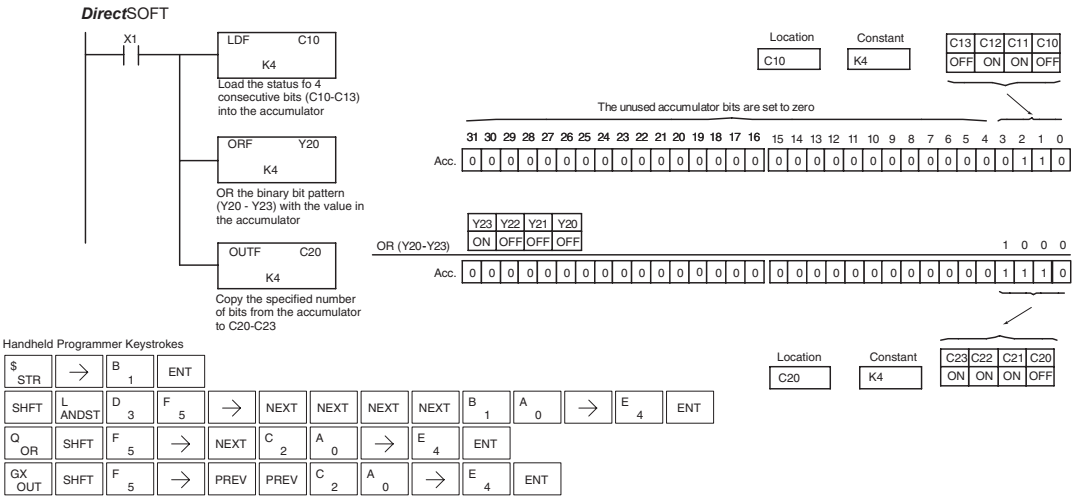


Operand Data Type		DL06 Range	
	A/B	aaa	bbb
Inputs	X	0-777	- -
Outputs	Y	0-777	- -
Control Relays	C	0-1777	- -
Stage Bits	S	0-1777	- -
Timer Bits	T	0-377	- -
Counter Bits	CT	0-177	- -
Special Relays	SP	0-777	- -
Constant	K	-	1-32

Discrete Bit Flags	Description
SP63	ON if the result in the accumulator is zero.
SP70	ON if the result in the accumulator is negative

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the LDF instruction loads C10–C13 (4 binary bits) into the accumulator. The ORF instruction logically ORs the accumulator contents with Y20–Y23 bit pattern. The ORF instruction outputs the accumulator's lower four bits to C20–C23.



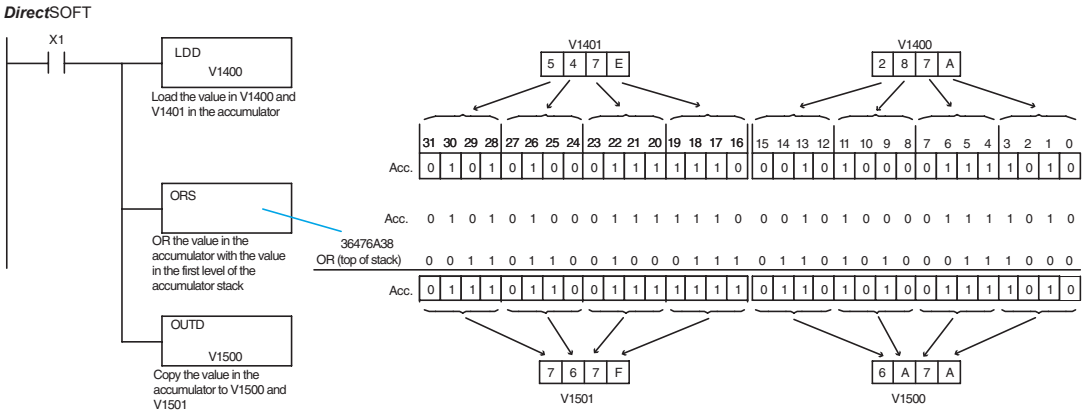
Or with Stack (ORS)

DS	Used
HPP	Used

The ORS instruction is a 32-bit instruction that logically ORs the value in the accumulator with the first level of the accumulator stack. The result resides in the accumulator. The value in the first level of the accumulator stack is removed from the stack and all values are moved up one level. Discrete status flags indicate if the result of the ORS is zero or a negative number (the most significant bit is on).

Discrete Bit Flags	Description
SP63	ON if the result in the accumulator is zero.
SP70	ON if the result in the accumulator is negative.

In the following example when X1 is on, the binary value in the accumulator will be OR'd with the binary value in the first level of the stack. The result resides in the accumulator.



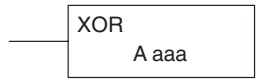
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT							
SHFT	L ANDST	D 3	D 3	→	B 1	E 4	A 0	A 0	ENT	
Q OR	SHFT	S RST	ENT							
GX OUT	SHFT	D 3	→	B 1	F 5	A 0	A 0	ENT		

Exclusive Or (XOR)

DS	Used
HPP	Used

The XOR instruction is a 16-bit instruction that performs an exclusive OR of the value in the lower 16 bits of the accumulator and a specified V-memory location (Aaaa). The result resides in the in the accumulator. The discrete status flag indicates if the result of the XOR is zero.



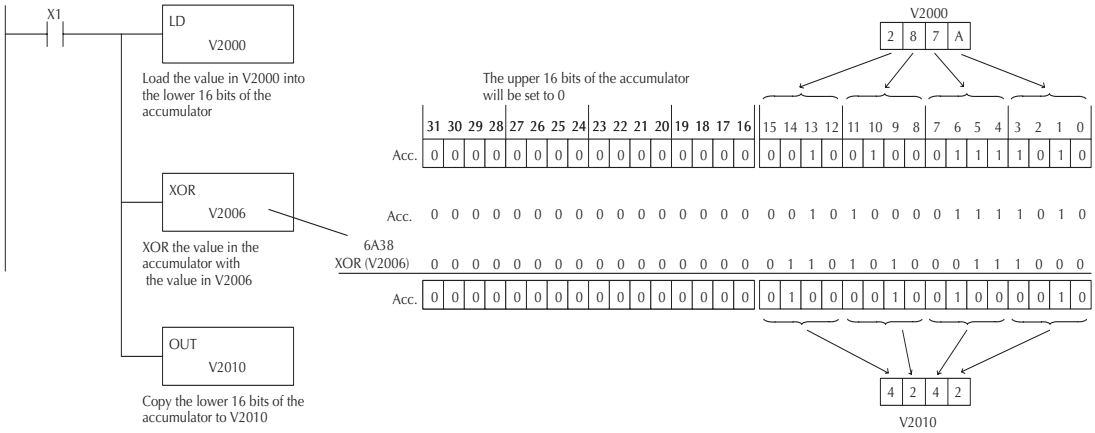
Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map

Discrete Bit Flags	Description
SP63	ON if the result in the accumulator is zero.
SP70	ON if the result in the accumulator is negative.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the value in V2000 will be loaded into the accumulator using the LD instruction. The value in the accumulator is exclusive OR'd with V2006 using the XOR instruction. The value in the lower 16 bits of the accumulator is output to V2010 using the OUT instruction.

DirectSOFT



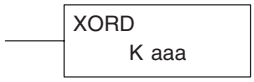
Handheld Programmer Keystrokes

$ STR	→	SHFT	X SET	B 1	ENT						
SHFT	L ANDST	D 3	→	SHFT	V AND	C 2	A 0	A 0	A 0	ENT	
SHFT	X SET	SHFT	Q OR	→	SHFT	V AND	C 2	A 0	A 0	G 6	ENT
GX OUT	→	SHFT	V AND	C 2	A 0	B 1	A 0	ENT			

Exclusive Or Double (XORD)

DS	Used
HPP	Used

The XORD is a 32-bit instruction that performs an exclusive OR of the value in the accumulator and the value (Aaaa), which is either two consecutive V-memory locations or an 8 digit (max.) constant. The result resides in the accumulator. Discrete status flags indicate if the result of the XORD is zero or a negative number (the most significant bit is on).

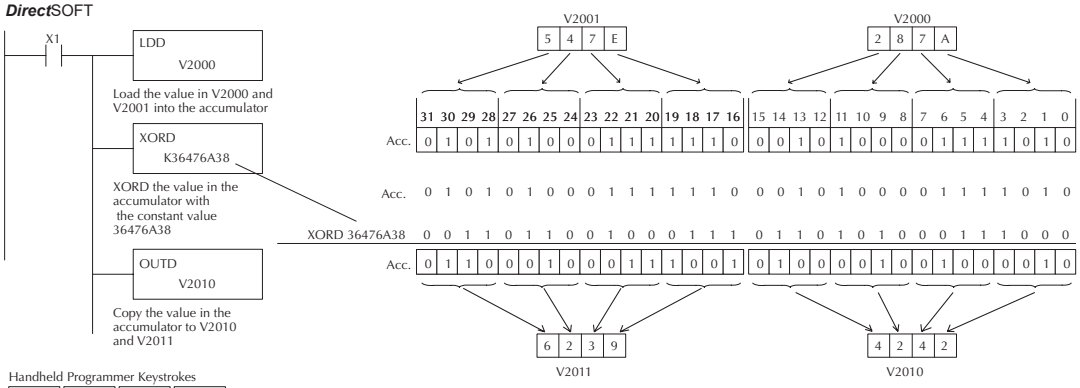


Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map
Constant	K	0–FFFFFFFF

Discrete Bit Flags	Description
SP63	ON if the result in the accumulator is zero.
SP70	ON if the result in the accumulator is negative

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the value in V2000 and V2001 will be loaded into the accumulator using the LDD instruction. The value in the accumulator is exclusively OR'd with 36476A38 using the XORD instruction. The value in the accumulator is output to V2010 and V2011 using the OUTD instruction.



Handheld Programmer Keystrokes

$ STR	→	B 1	ENT						
SHFT	L ANDST	D 3	D 3	→	C 2	A 0	A 0	A 0	ENT
SHFT	X SET	Q OR	SHFT	D 3	→	SHFT	K JMP		
D 3	G 6	E 4	H 7	G 6	SHFT	A 0	SHFT	D 3	I 8	ENT
GX OUT	SHFT	D 3	→	C 2	A 0	B 1	A 0	ENT		

Exclusive Or Formatted (XORF)

DS	Used
HPP	Used

The XORF instruction performs an exclusive OR of the bina value in the accumulator and a specified range of discr memory bits (1–32).

```
XORF    Aaaa
K bbb
```

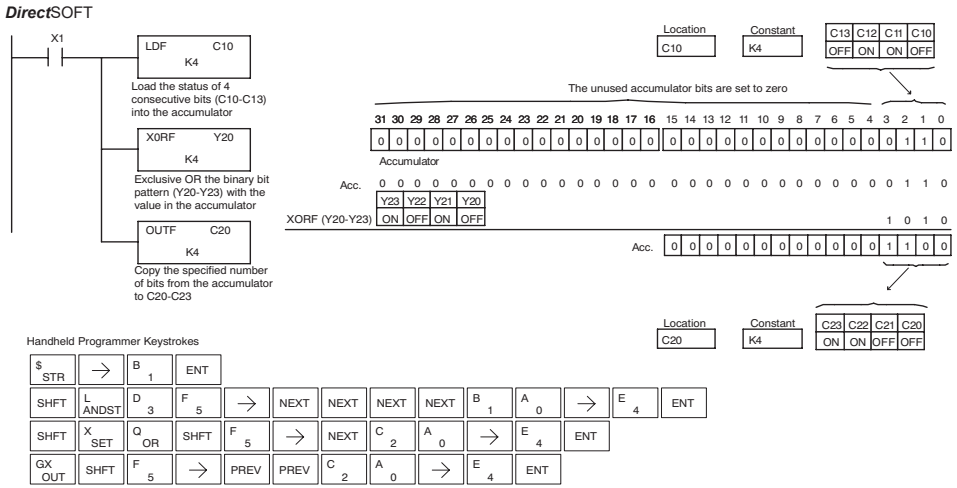
The instruction requires a starting location (Aaaa) and the number of bits (Bbbb) to be exclusive OR'd. Discrete status flags indicate if the result of the XORF is zero or negative (the most significant bit =1).

Operand Data Type		DL06 Range	
	A/B	aaa	bbb
Inputs	X	0-777	-
Outputs	Y	0-777	-
Control Relays	C	0-1777	-
Stage Bits	S	0-1777	-
Timer Bits	T	0-377	-
Counter Bits	CT	177	-
Special Relays	SP	0-777	-
Constant	K	-	1-32

Discrete Bit Flags	Description
SP63	ON if the result in the accumulator is zero.
SP70	ON if the result in the accumulator is negative

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the binary pattern of C10–C13 (4 bits) will be loaded into the accumulator using the LDF instruction. The value in the accumulator will be logically exclusive OR'd with the bit pattern from Y20–Y23 using the XORF instruction. The value in the lower 4 bits of the accumulator is output to C20–C23 using the OUTF instruction.



Exclusive Or with Stack (XORS)

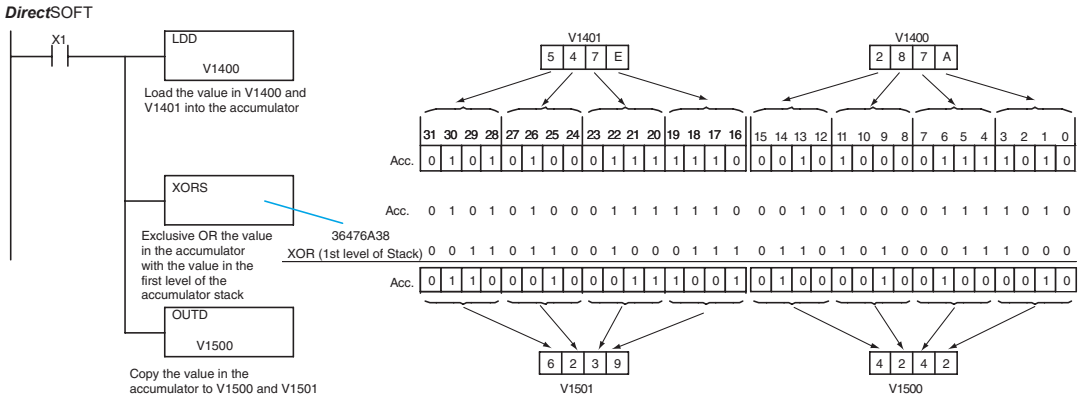
DS	Used
HPP	Used

The XORS instruction is a 32-bit instruction that performs an Exclusive Or of the value in the accumulator with the first level of the accumulator stack. The result resides in the accumulator. The value in the first level of the accumulator stack is removed from the stack and all values are moved up one level. Discrete status flags indicate if the result of the XORS is zero or a negative number (the most significant bit is on).

Discrete Bit Flags	Description
SP63	ON if the result in the accumulator is zero.
SP70	ON if the result in the accumulator is negative

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the value in V1400 and V1401 will be loaded into the accumulator using the LDD instruction. The binary value in the accumulator will be exclusively OR'd with 36476A38 using the XORS instruction. The value in the accumulator is output to V1500 and V1501 using the OUTD instruction.



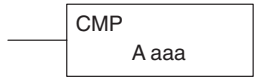
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT					
SHFT	L ANDST	D 3	D 3	→	B 1	E 4	A 0	A 0	ENT
SHFT	X SET	Q OR	SHFT	S RST	ENT			
GX OUT	SHFT	D 3	→	B 1	F 5	A 0	A 0	ENT

Compare (CMP)

DS	Used
HPP	Used

The CMP instruction is a 16-bit instruction that compares the value in the lower 16 bits of the accumulator with the value in a specified V-memory location (Aaaa). The corresponding status flag will be turned on indicating the result of the comparison. The data format for this instruction is BCD/Hex, Decimal and Binary.

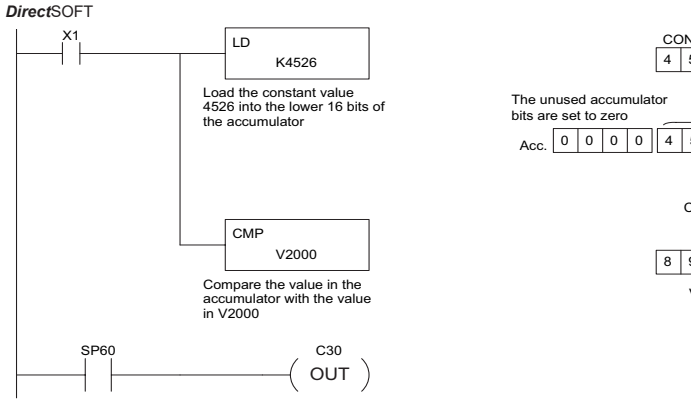


Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map

Discrete Bit Flags	Description
SP60	On when the value in the accumulator is less than the instruction value.
SP61	On when the value in the accumulator is equal to the instruction value.
SP62	On when the value in the accumulator is greater than the instruction value.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example when X1 is on, the constant 4526 will be loaded into the lower 16 bits of the accumulator using the LD instruction. The value in the accumulator is compared with the value in V2000 using the CMP instruction. The corresponding discrete status flag will be turned on indicating the result of the comparison. In this example, if the value in the accumulator is less than the value specified in the CMP instruction, SP60 will turn on, energizing C30.



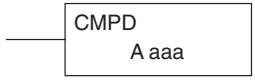
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT							
SHFT	L ANDST	D 3	→	SHFT	K JMP	E 4	F 5	C 2	G 6	ENT
SHFT	C 2	SHFT	M ORST	P CV	→	C 2	A 0	A 0	A 0	ENT
$ STR	→	SHFT	SP STRN	G 6	A 0	ENT				
GX OUT	→	SHFT	C 2	D 3	A 0	ENT				

Compare Double (CMPD)

DS	Used
HPP	Used

The Compare Double instruction is a 32–bit instruction that compares the value in the accumulator with the value (Aaaa), which is either two consecutive V-memory locations or an 8–digit (max.) constant. The corresponding status flag will be turned on indicating the result of the comparison. The data format for this instruction is BCD/Hex, Decimal and Binary.

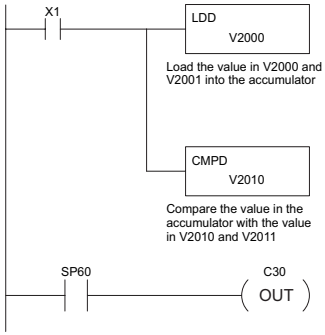


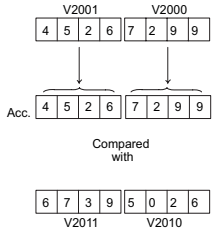
Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map
Constant	K	0–FFFFFFFF

Discrete Bit Flags	Description
SP60	On when the value in the accumulator is less than the instruction value.
SP61	On when the value in the accumulator is equal to the instruction value.
SP62	On when the value in the accumulator is greater than the instruction value.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the value in V2000 and V2001 will be loaded into the accumulator using the Load Double instruction. The value in the accumulator is compared with the value in V2010 and V2011 using the CMPD instruction. The corresponding discrete status flag will be turned on, indicating the result of the comparison. In this example, if the value in the accumulator is less than the value specified in the Compare instruction, SP60 will turn on energizing C30.





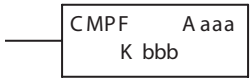
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT										
SHFT	L ANDST	D 3	D 3	→	C 2	A 0	A 0	A 0	ENT				
SHFT	C 2	SHFT	M ORST	P CV	D 3	→	C 2	A 0	B 1	A 0	ENT		
$ STR	→	SHFT	SP STRN	G 6	A 0	ENT							
GX OUT	→	SHFT	C 2	D 3	A 0	ENT							

Compare Formatted (CMPF)

DS	Used
HPP	Used

The Compare Formatted instruction compares the value in the accumulator with a specified number of discrete locations (1–32). The instruction requires a starting location (Aaaa) and the number of bits (Kbbb) to be compared. The corresponding status flag will be turned on, indicating the result of the comparison. The data format for this instruction is BCD/Hex, Decimal and Binary.



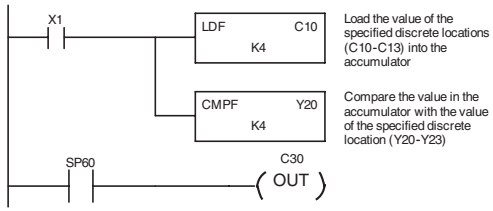
Operand Data Type	DL06 Range		
	A/B	aaa	bbb
Inputs	X	0-777	-
Outputs	Y	0-777	-
Control Relays	C	0-1777	-
Stage Bits	S	0-1777	-
Timer Bits	T	0-377	-
Counter Bits	CT	0-177	-
Special Relays	SP	0-777	-
Constant	K	-	1-32

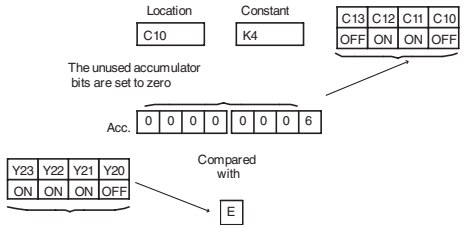
Discrete Bit Flags	Description
SP60	On when the value in the accumulator is less than the instruction value.
SP61	On when the value in the accumulator is equal to the instruction value.
SP62	On when the value in the accumulator is greater than the instruction value.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the Load Formatted instruction loads the binary value (6) from C10–C13 into the accumulator. The CMPF instruction compares the value in the accumulator to the value in Y20–Y23 (E hex). The corresponding discrete status flag will be turned on, indicating the result of the comparison. In this example, if the value in the accumulator is less than the value specified in the Compare instruction, SP60 will turn on energizing C30.

DirectSOFT





Compare with Stack (CMPS)

DS	Used
HPP	Used

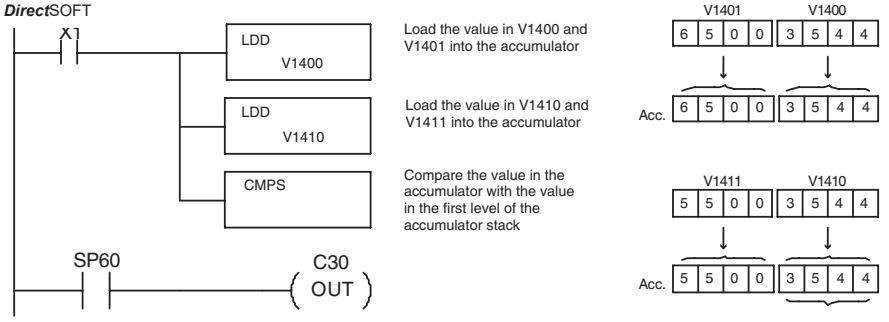
The Compare with Stack instruction is a 32-bit instruction that compares the value in the accumulator with the value in the first level of the accumulator stack. The data format for this instruction is BCD/Hex, Decimal and Binary.

The corresponding status flag will be turned on, indicating the result of the comparison. This does not affect the value in the accumulator.

Discrete Bit Flags	Description
SP60	On when the value in the accumulator is less than the instruction value.
SP61	On when the value in the accumulator is equal to the instruction value.
SP62	On when the value in the accumulator is greater than the instruction value.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the value in V1400 and V1401 is loaded into the accumulator using the Load Double instruction. The value in V1410 and V1411 is loaded into the accumulator using the Load Double instruction. The value that was loaded into the accumulator from V1400 and V1401 is placed on top of the stack when the second Load instruction is executed. The value in the accumulator is compared with the value in the first level of the accumulator stack using the CMPS instruction. The corresponding discrete status flag will be turned on indicating the result of the comparison. In this example, if the value in the accumulator is less than the value in the stack, SP60 will turn on, energizing C30.



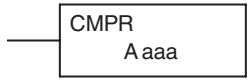
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT						
SHFT	L ANDST	D 3	D 3	→	B 1	E 4	A 0	A 0	ENT
SHFT	L ANDST	D 3	D 3	→	B 1	E 4	B 1	A 0	ENT
SHFT	C 2	SHFT	M ORST	P CV	S RST	ENT			
$ STR	PREV	G 6	A 0	ENT					
GX OUT	→	NEXT	NEXT	NEXT	SHFT	C 2	D 3	A 0	ENT

Compare Real Number (CMPR)

DS	Used
HPP	Used

The Compare Real Number instruction compares a real number value in the accumulator with two consecutive V-memory locations containing a real number. The corresponding status flag will be turned on, indicating the result of the comparison. Both numbers being compared are 32 bits long.

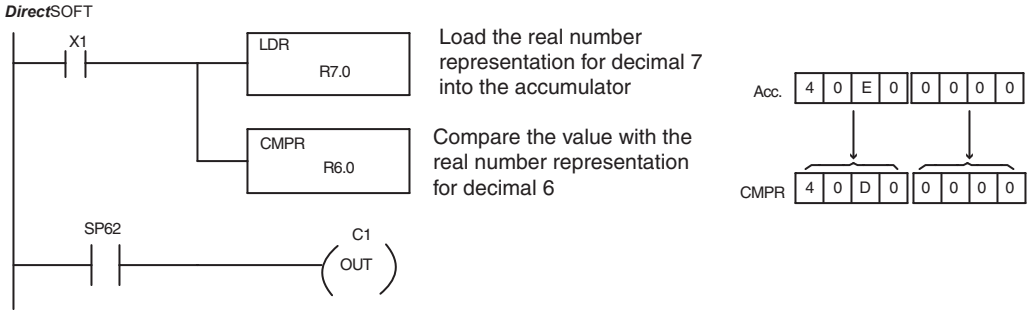


Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map
Constant	R	-3.402823E+ 038 to + -3.402823E+ 038

Discrete Bit Flags	Description
SP60	On when the value in the accumulator is less than the instruction value.
SP61	On when the value in the accumulator is equal to the instruction value.
SP62	On when the value in the accumulator is greater than the instruction value.
SP71	On anytime the V-memory specified by a pointer (P) is not valid

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the LDR instruction loads the real number representation for 7 decimal into the accumulator. The CMPR instruction compares the accumulator contents with the real representation for decimal 6. Since 7 > 6, the corresponding discrete status flag is turned on (special relay SP62), turning on control relay C1.

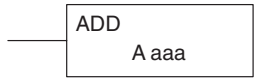


Math Instructions

Add (ADD)

DS	Used
HPP	Used

Add is a 16-bit instruction that adds a BCD value in the accumulator with a BCD value in a V-memory location (Aaaa). (You cannot use a constant as the parameter in the box.) The result resides in the accumulator.

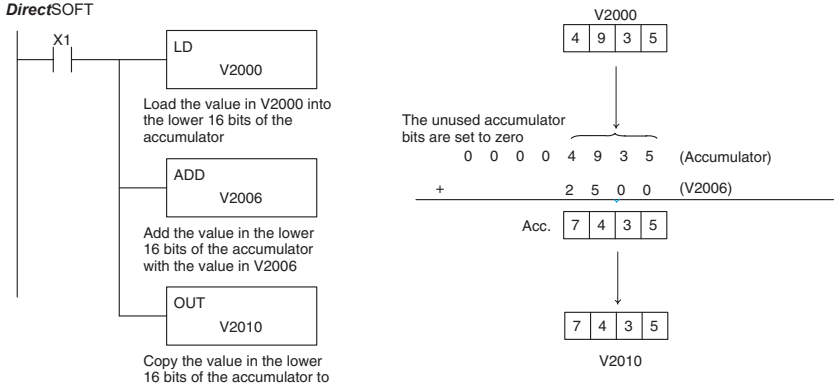


Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP66	On when the 16-bit addition instruction results in a carry.
SP67	On when the 32-bit addition instruction results in a carry.
SP70	On anytime the value in the accumulator is negative.
SP75	On when a BCD instruction is executed and a NON–BCD number was encountered.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the value in V2000 will be loaded into the accumulator using the Load instruction. The value in the lower 16 bits of the accumulator is added to the value in V2006 using the Add instruction. The value in the accumulator is copied to V2010 using the Out instruction.



Handheld Programmer Keystrokes

$ STR	→	B 1	ENT					
SHFT	L ANDST	D 3	→	C 2	A 0	A 0	A 0	ENT
SHFT	A 0	D 3	D 3	→	C 2	A 0	A 0	G 6	ENT
GX OUT	→	SHFT	V AND	C 2	A 0	B 1	A 0	ENT	

Add Double (ADDD)

DS	Used
HPP	Used

Add Double is a 32-bit instruction that adds the BCD value in the accumulator with a BCD value (Aaaa), which is either two consecutive V-memory locations or an 8–digit (max.) BCD constant. The result resides in the accumulator.

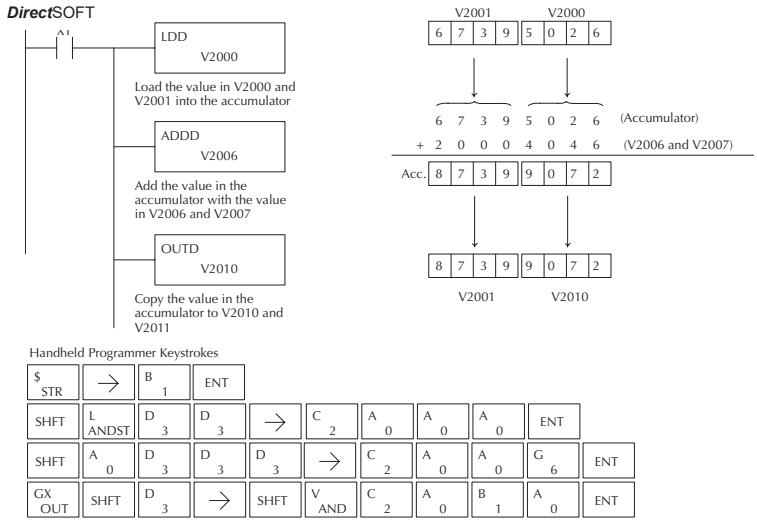
```
ADDD
 A aaa
```

Operand Data Type		DL06Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map
Constant	K	0–99999999

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP66	On when the 16-bit addition instruction results in a carry.
SP67	On when the 32-bit addition instruction results in a carry.
SP70	On anytime the value in the accumulator is negative.
SP75	On when a BCD instruction is executed and a NON–BCD number was encountered.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

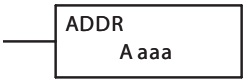
In the following example, when X1 is on, the value in V2000 and V2001 will be loaded into the accumulator using the Load Double instruction. The value in the accumulator is added with the value in V2006 and V2007 using the Add Double instruction. The value in the accumulator is copied to V2010 and V2011 using the Out Double instruction.



Add Real (ADDR)

DS	Used
HPP	Used

The Add Real instruction adds a real number in the accumulator with either a real constant or a real number occupying two consecutive V-memory locations. The result resides in the accumulator. Both numbers must be Real data type (IEEE floating point format).



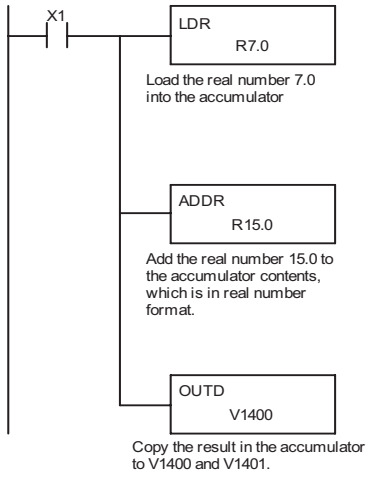
Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map
Constant	R	-3.402823E+ 38 to + -3.402823E+ 38

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On anytime the value in the accumulator is negative.
SP71	On anytime the V-memory specified by a pointer (P) is not valid.
SP72	On anytime the value in the accumulator is an invalid floating point number.
SP73	On when a signed addition or subtraction results in a incorrect sign bit.
SP74	On anytime a floating point math operation results in an underflow error.

NOTE: *Status flags are valid only until another instruction uses the same flag.*

NOTE*: The current HPP does not support real number entry with automatic conversion to the 32-bit IEEE format. You must use* ***Direct****SOFT for this feature.*

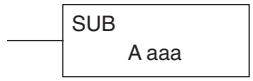
Direct*SOFT*



Subtract (SUB)

DS	Used
HPP	Used

Subtract is a 16-bit instruction that subtracts the BCD value (Aaaa) in a V-memory location from the BCD value in the lower 16 bits of the accumulator. The result resides in the accumulator.



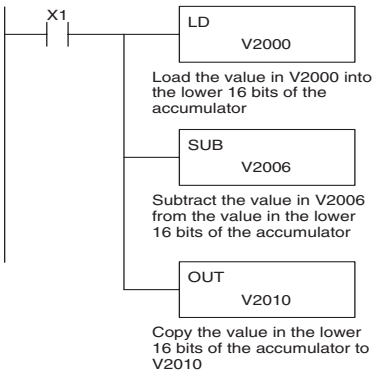
Operand Data Type		DL06Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map

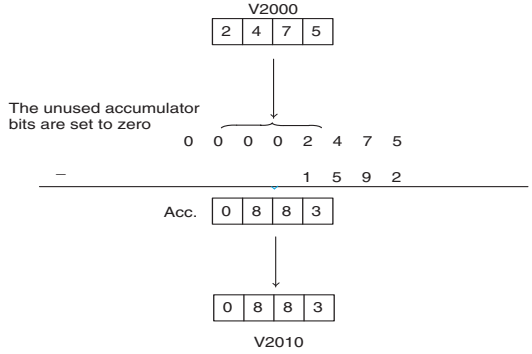
Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP64	On when the 16-bit subtraction instruction results in a borrow
SP65	On when the 32-bit subtraction instruction results in a borrow
SP70	On anytime the value in the accumulator is negative.
SP75	On when a BCD instruction is executed and a NON–BCD number was encountered.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the value in V2000 will be loaded into the accumulator using the Load instruction. The value in V2006 is subtracted from the value in the accumulator using the Subtract instruction. The value in the accumulator is copied to V2010 using the Out instruction.

DirectSOFT





Handheld Programmer Keystrokes

$ STR	→	B 1	ENT								
SHFT	L ANDST	D 3	→	C 2	A 0	A 0	A 0	ENT			
SHFT	S RST	U ISG	B 1	→	SHFT	V AND	C 2	A 0	A 0	G 6	ENT
GX OUT	→	SHFT	V AND	C 2	A 0	B 1	A 0	ENT			

Subtract Double (SUBD)

DS	Used
HPP	Used

Subtract Double is a 32-bit instruction that subtracts the BCD value (Aaaa), which is either two consecutive V-memory locations or an 8-digit (max.) constant, from the BCD value in the accumulator.

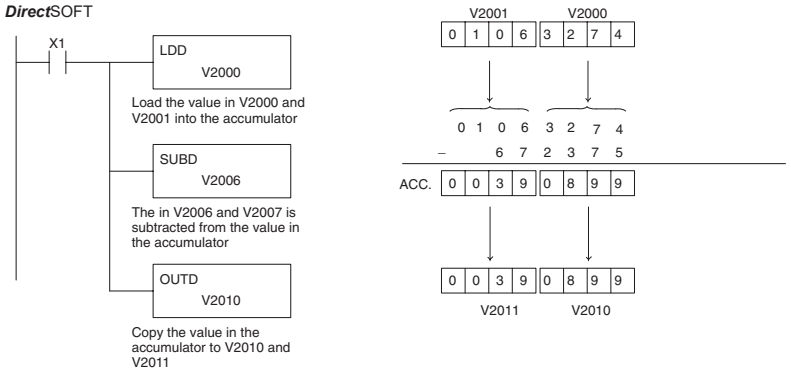
SUBD
A aaa

Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map
Constant	K	0–99999999

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP64	On when the 16- bit subtraction instruction results in a borrow
SP65	On when the 32-bit subtraction instruction results in a borrow
SP70	On anytime the value in the accumulator is negative.
SP75	On when a BCD instruction is executed and a NON–BCD number was encountered.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the value in V2000 and V2001 will be loaded into the accumulator using the Load Double instruction. The value in V2006 and V2007 is subtracted from the value in the accumulator. The value in the accumulator is copied to V2010 and V2011 using the Out Double instruction.



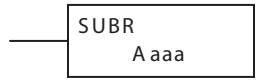
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT									
SHFT	L ANDST	D 3	D 3	→	C 2	A 0	A 0	A 0	ENT			
SHFT	S RST	SHFT	U ISG	B 1	D 3	→	C 2	A 0	A 0	G 6	ENT	
GX OUT	SHFT	D 3	→	C 2	A 0	B 1	A 0	ENT				

Subtract Real (SUBR)

DS	Used
HPP	N/A

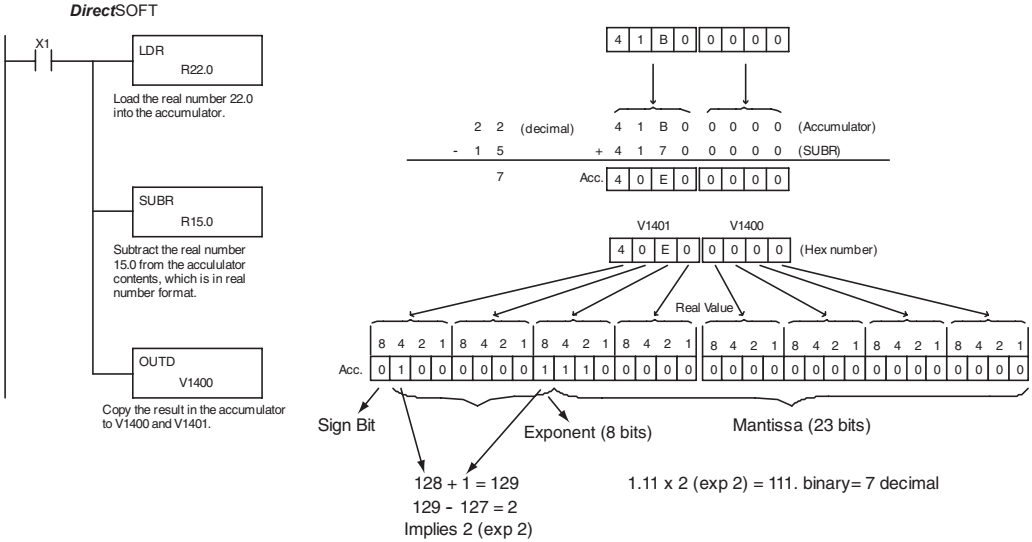
The Subtract Real is a 32-bit instruction that subtracts a real number, which is either two consecutive V-memory locations or a 32-bit constant, from a real number in the accumulator. The result is a 32-bit real number that resides in the accumulator. Both numbers must be Real data type (IEEE floating point format).



Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map
Constant	R	-3.402823E + 38 to+-3.402823E + 38

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On anytime the value in the accumulator is negative.
SP71	On anytime the V-memory specified by a pointer (P) is not valid.
SP72	On anytime the value in the accumulator is an invalid floating point number.
SP73	On when a signed addition or subtraction results in a incorrect sign bit.
SP74	On anytime a floating point math operation results in an underflow error.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

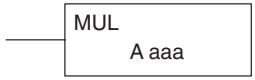


***NOTE**: The current HPP does not support real number entry with automatic conversion to the 32-bit IEEE format. You must use **Direct**SOFT for this feature*

Multiply (MUL)

DS	Used
HPP	Used

Multiply is a 16-bit instruction that multiplies the BCD value (Aaaa), which is either a V-memory location or a 4–digit (max.) constant, by the BCD value in the lower 16 bits of the accumulator The result can be up to 8 digits and resides in the accumulator.

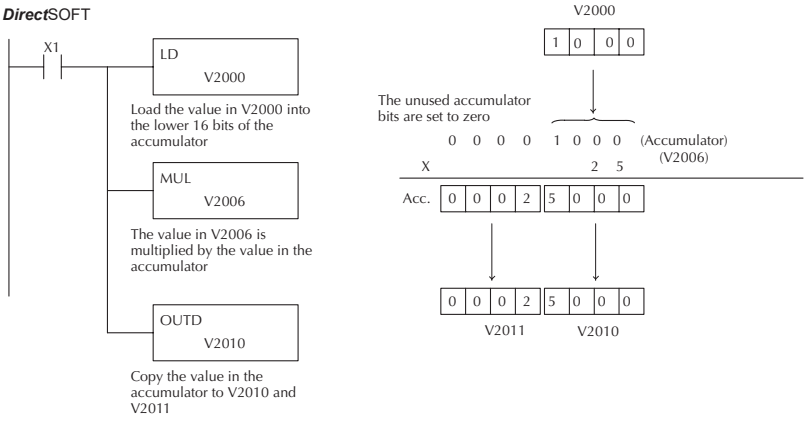


Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map
Constant	K	0–9999

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On anytime the value in the accumulator is negative.
SP75	On when a BCD instruction is executed and a NON–BCD number was encountered.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the value in V2000 will be loaded into the accumulator using the Load instruction. The value in V2006 is multiplied by the value in the accumulator. The value in the accumulator is copied to V2010 and V2011 using the Out Double instruction.



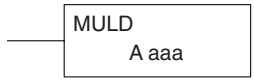
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT						
SHFT	L ANDST	D 3	→	C 2	A 0	A 0	A 0	ENT	
SHFT	M ORST	U ISG	L ANDST	→	C 2	A 0	A 0	G 6	ENT
GX OUT	SHFT	D 3	→	C 2	A 0	B 1	A 0	ENT	

Multiply Double (MULD)

DS	Used
HPP	Used

Multiply Double is a 32-bit instruction that multiplies the 8-digit BCD value in the accumulator by the 8-digit BCD value in the two consecutive V-memory locations specified in the instruction. The lower 8 digits of the results reside in the accumulator. Upper digits of the result reside in the accumulator stack.

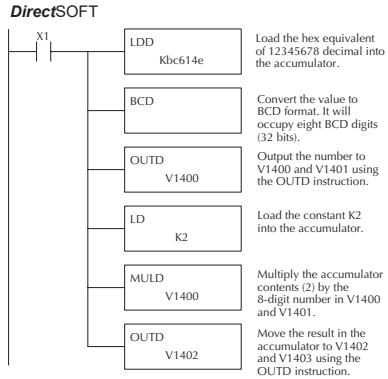


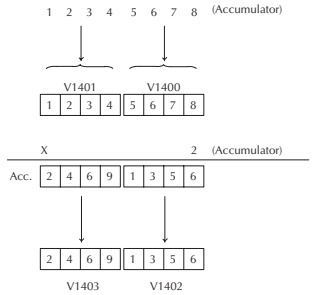
Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On anytime the value in the accumulator is negative.
SP75	On when a BCD instruction is executed and a NON–BCD number was encountered.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the constant Kbc614e hex will be loaded into the accumulator. When converted to BCD the number is ”12345678”. That number is stored in V1400 and V1401. After loading the constant K2 into the accumulator, we multiply it times 12345678, which gives us 24691356.





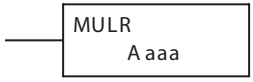
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT																					
SHFT	L ANDST	D 3	D 3	→	PREV	SHFT	B 1	C 2	SHFT	G 6	B 1	E 4	SHFT	E 4	ENT									
SHFT	B 1	C 2	D 3	ENT																				
GX OUT	SHFT	D 3	→	B 1	E 4	A 0	A 0	ENT																
SHFT	L ANDST	D 3	→	PREV	C 2	ENT																		
SHFT	M ORST	U ISG	L ANDST	D 3	→	B 1	E 4	A 0	A 0	ENT														
GX OUT	SHFT	D 3	→	B 1	E 4	A 0	C 2	ENT																

Multiply Real (MULR)

DS	Used
HPP	Used

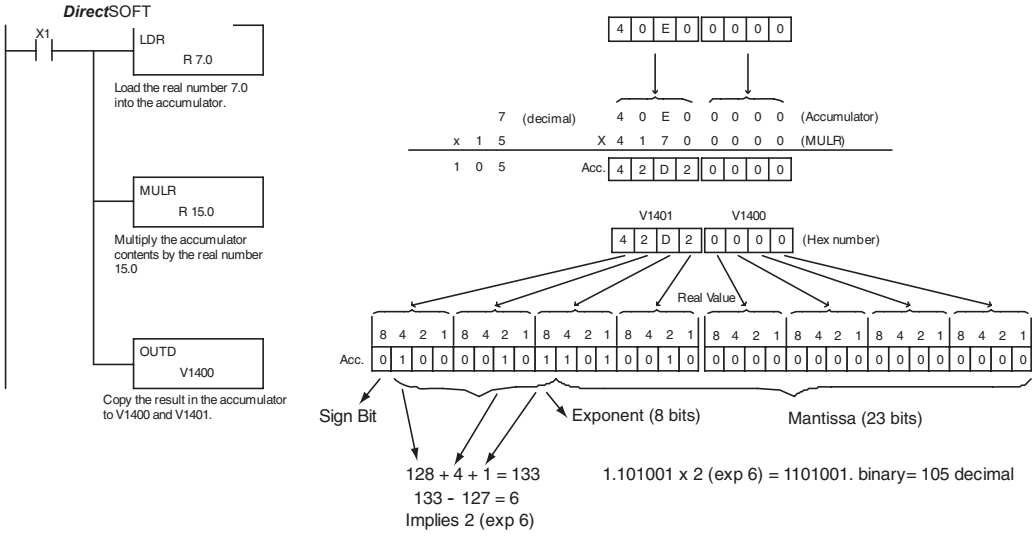
The Multiply Real instruction multiplies a real number in the accumulator with either a real constant or a real number occupying two consecutive V-memory locations. The result resides in the accumulator. Both numbers must be Real data type (IEEE floating point format).



Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map
Real Constant	R	-3.402823E +38 to + -3.402823E +38

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On anytime the value in the accumulator is negative.
SP71	On anytime the V-memory specified by a pointer (P) is not valid.
SP72	On anytime the value in the accumulator is an invalid floating point number.
SP73	On when a signed addition or subtraction results in an incorrect sign bit.
SP74	On anytime a floating point math operation results in an underflow error.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

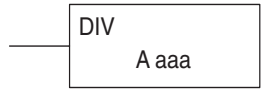


***NOTE**: The current HPP does not support real number entry with automatic conversion to the 32-bit IEEE format. You must use **Direct**SOFT for this feature.*

Divide (DIV)

DS	Used
HPP	Used

Divide is a 16-bit instruction that divides the BCD value in the accumulator by a BCD value (Aaaa), which is either a V-memory location or a 4-digit (max.) constant. The first part of the quotient resides in the accumulator and the remainder resides in the first stack location.

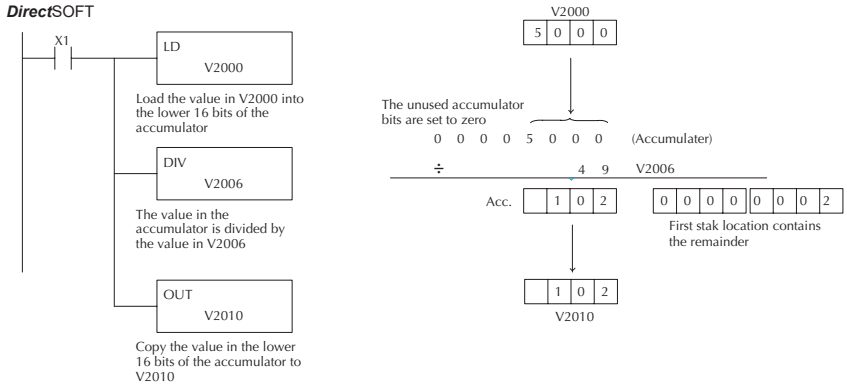


Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map
Constant	K	0–9999

Discrete Bit Flags	Description
SP53	On when the value of the operand is larger than the accumulator can work with.
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On anytime the value in the accumulator is negative.
SP75	On when a BCD instruction is executed and a NON–BCD number was encountered.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the value in V2000 will be loaded into the accumulator using the Load instruction. The value in the accumulator will be divided by the value in V2006 using the Divide instruction. The value in the accumulator is copied to V2010 using the Out instruction.



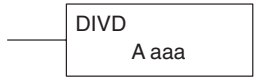
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT					
SHFT	L ANDST	D 3	→	C 2	A 0	A 0	A 0	ENT
SHFT	D 3	I 8	V AND	→	C 2	A 0	A 0	G 6	ENT
GX OUT	→	SHFT	V AND	C 2	A 0	B 1	A 0	ENT

Divide Double (DIVD)

DS	Used
HPP	Used

Divide Double is a 32-bit instruction that divides the BCD value in the accumulator by a BCD value (Aaaa), which must be obtained from two consecutive V-memory locations. (You cannot use a constant as the parameter in the box.) The first part of the quotient resides in the accumulator and the remainder resides in the first stack location.

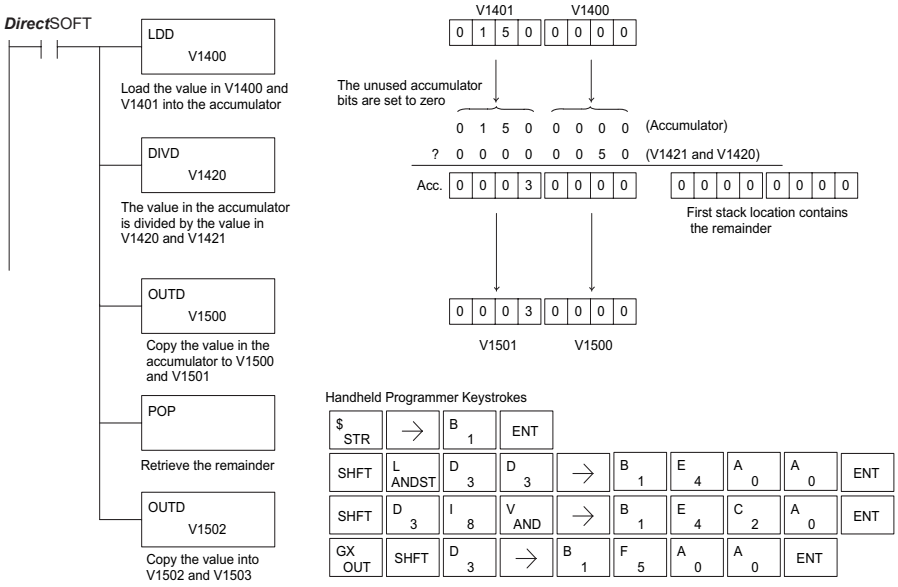


Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On anytime the value in the accumulator is negative.
SP75	On when a BCD instruction is executed and a NON–BCD number was encountered.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

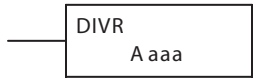
In the following example, when X1 is on, the value in V1400 and V1401 will be loaded into the accumulator using the Load Double instruction. The value in the accumulator is divided by the value in V1420 and V1421 using the Divide Double instruction. The first part of the quotient resides in the accumulator and the remainder resides in the first stack location. The value in the accumulator is copied to V1500 and V1501 using the Out Double instruction.



Divide Real (DIVR)

DS	Used
HPP	N/A

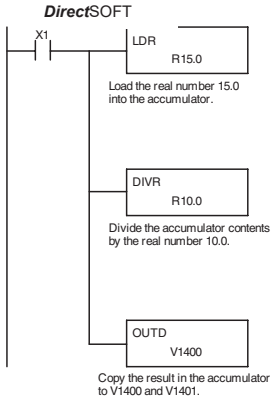
The Divide Real instruction divides a real number in the accumulator by either a real constant or a real number occupying two consecutive V-memory locations. The result resides in the accumulator. Both numbers must be Real data type (IEEE floating point format).

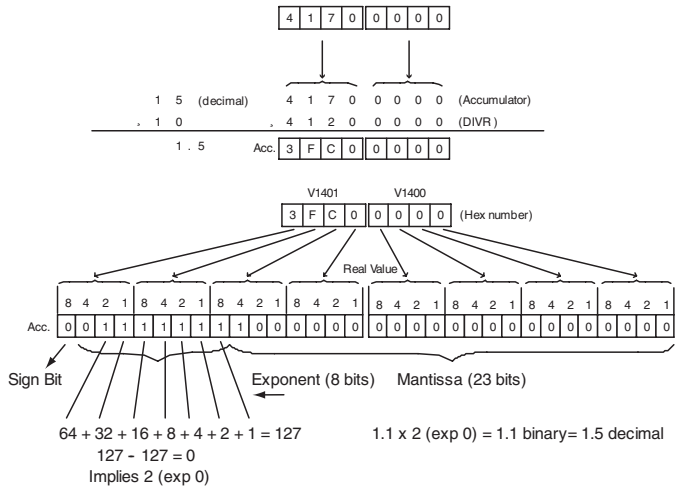


Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map
Real Constant	R	-3.402823E + 38 to + -3.402823E + 38

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On anytime the value in the accumulator is negative.
SP71	On anytime the V-memory specified by a pointer (P) is not valid.
SP72	On anytime the value in the accumulator is an invalid floating point number.
SP74	On anytime a floating point math operation results in an underflow error.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*



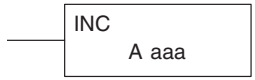


***NOTE**: The current HPP does not support real number entry with automatic conversion to the 32-bit IEEE format. You must use **Direct**SOFT for this feature.*

Increment (INC)

DS	Used
HPP	Used

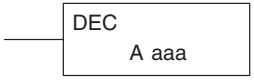
The Increment instruction increments a BCD value in a specified V-memory location by "1" each time the instruction is executed.



Decrement (DEC)

DS	Used
HPP	Used

The Decrement instruction decrements a BCD value in a specified V-memory location by "1" each time the instruction is executed.

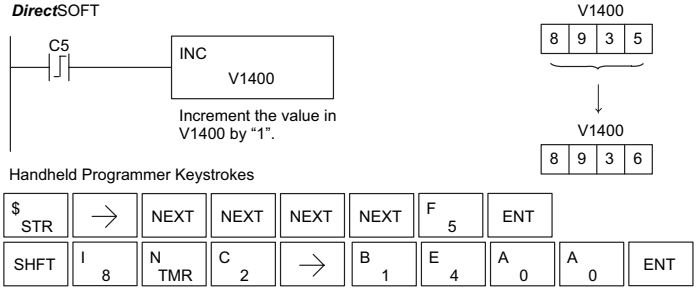


Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map

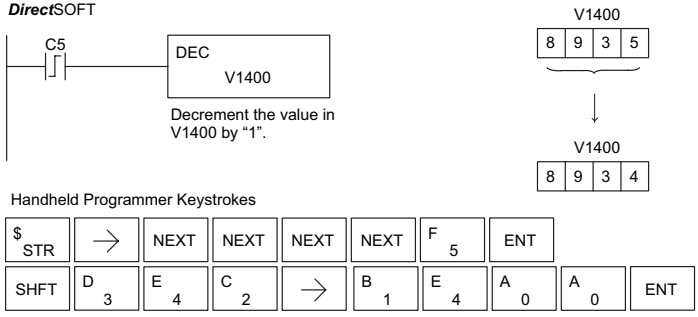
Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP75	On when a BCD instruction is executed and a NON–BCD number was encountered.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following increment example, when C5 makes an Off-to-On transition the value in V1400 increases by one.



In the following decrement example, when C5 makes an Off-to-On transition the value in V1400 is decreased by one.



Add Binary (ADDB)

DS	Used
HPP	Used

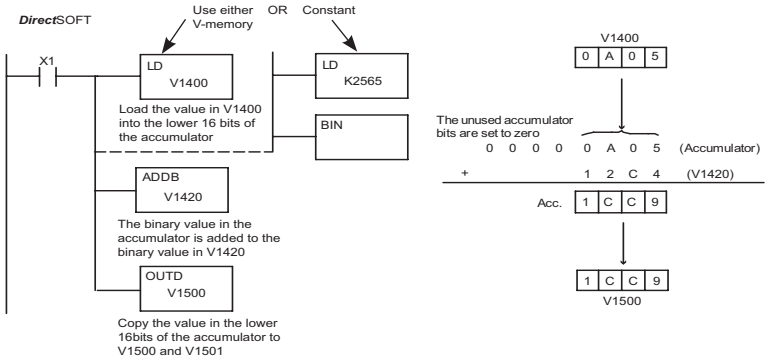
Add Binary is a 16-bit instruction that adds the binary value in the lower 16 bits of the accumulator with a binary value (Aaaa), which is either a V-memory location or a 16-bit constant. The result can be up to 32 bits and resides in the accumulator.

Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map
Constant	K	0-FFFF, h=65636

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP66	On when the 16-bit addition instruction results in a carry.
SP67	On when the 32-bit addition instruction results in a carry.
SP70	On anytime the value in the accumulator is negative.
SP73	On when a signed addition or subtraction results in an incorrect sign bit.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the value in V1400 will be loaded into the accumulator using the Load instruction. The binary value in the accumulator will be added to the binary value in V1420 using the Add Binary instruction. The value in the accumulator is copied to V1500 and V1501 using the Out Double instruction.



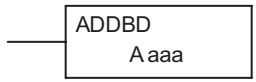
Handheld Programmer Keystrokes

STR	→	X(IN)	1	ENT							
SHFT	L	D	V	1	4	O	O	ENT			
SHFT	A	D	D	B	→	V	1	4	2	O	ENT
OUT	SHFT	D	→	V	1	5	O	O	ENT		

Add Binary Double (ADDBD)

DS	Used
HPP	Used

Add Binary Double is a 32-bit instruction that adds the binary value in the accumulator with the value (Aaaa), which is either two consecutive V-memory locations or an 8-digit (max.) binary constant. The result resides in the accumulator.

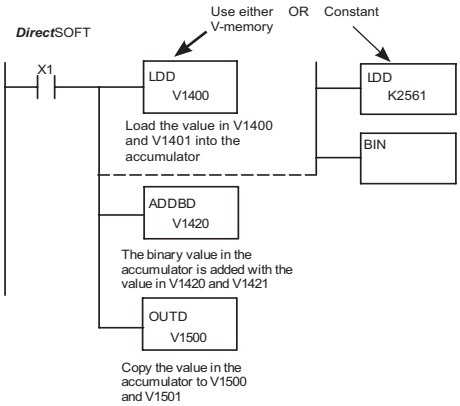


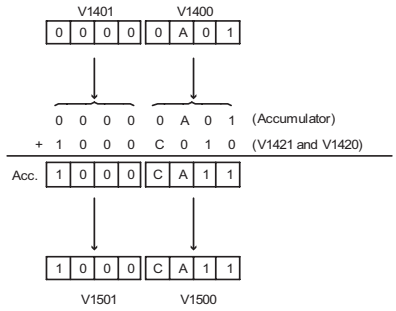
Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map
Constant	K	0-FFFF FFFF

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP66	On when the 16-bit addition instruction results in a carry.
SP67	On when the 32-bit addition instruction results in a carry.
SP70	On anytime the value in the accumulator is negative.
SP73	On when a signed addition or subtraction results in an incorrect sign bit.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the value in V1400 and V1401 will be loaded into the accumulator using the Load Double instruction. The binary value in the accumulator is added with the binary value in V1420 and V1421 using the Add Binary Double instruction. The value in the accumulator is copied to V1500 and V1501 using the Out Double instruction.





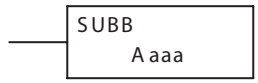
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT							
SHFT	L ANDST	D 3	D 3	→	B 1	E 4	A 0	A 0	ENT	
SHFT	A 0	D 3	D 3	B 1	D 3	→	B 1	E 4	C 2	A 0	ENT
GX OUT	SHFT	D 3	→	B 1	F 5	A 0	A 0	ENT		

Subtract Binary (SUBB)

DS	Used
HPP	Used

Subtract Binary is a 16-bit instruction that subtracts the binary value (Aaaa), which is either a V-memory location or a 4-digit (max.) binary constant, from the binary value in the accumulator. The result resides in the accumulator.

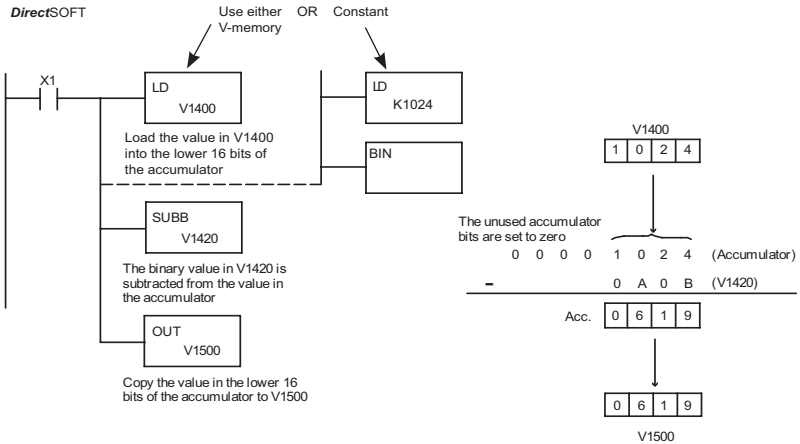


Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map
Constant	K	0-FFFF, h=65636

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP64	On when the 16-bit subtraction instruction results in a borrow.
SP65	On when the 32-bit subtraction instruction results in a borrow.
SP70	On anytime the value in the accumulator is negative.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

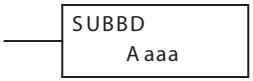
In the following example, when X1 is on, the value in V1400 will be loaded into the accumulator using the Load instruction. The binary value in V1420 is subtracted from the binary value in the accumulator using the Subtract Binary instruction. The value in the accumulator is copied to V1500 using the Out instruction.



Subtract Binary Double (SUBBD)

DS	Used
HPP	Used

Subtract Binary Double is a 32-bit instruction that subtracts the binary value (Aaaa), which is either two consecutive V-memory locations or an 8-digit (max.) binary constant, from the binary value in the accumulator. The result resides in the accumulator.

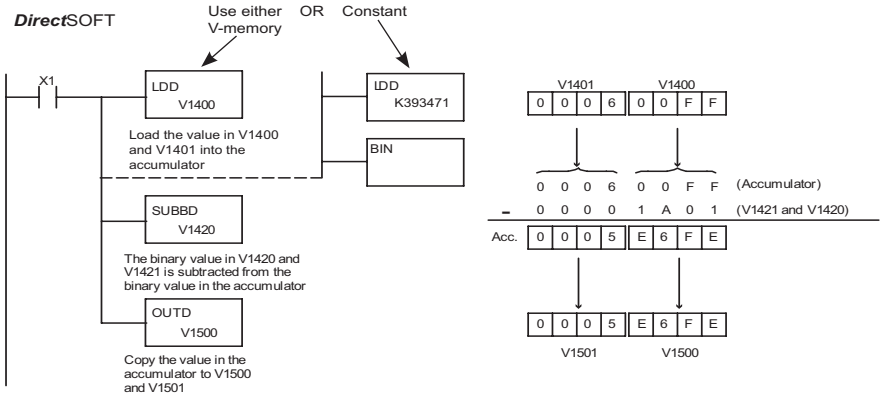


Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map
Constant	K	0-FFFF FFFF

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP64	On when the 16-bit subtraction instruction results in a borrow.
SP65	On when the 32-bit subtraction instruction results in a borrow.
SP70	On anytime the value in the accumulator is negative.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the value in V1400 and V1401 will be loaded into the accumulator using the Load Double instruction. The binary value in V1420 and V1421 is subtracted from the binary value in the accumulator using the Subtract Binary Double instruction. The value in the accumulator is copied to V1500 and V1501 using the Out Double instruction.



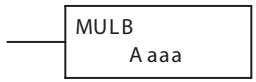
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT						
SHFT	L ANDST	D 3	D 3	→	B 1	E 4	A 0	A 0	ENT
SHFT	S RST	SHFT	U ISG	B 1	B 1	D 3	→	B 1	E 4	C 2	A 0	ENT
GX OUT	SHFT	D 3	→	B 1	F 5	A 0	A 0	ENT				

Multiply Binary (MULB)

DS	Used
HPP	Used

Multiply Binary is a 16-bit instruction that multiplies the binary value (Aaaa), which is either a V-memory location or a 4-digit (max.) binary constant, by the binary value in the accumulator. The result can be up to 32 bits and resides in the accumulator.

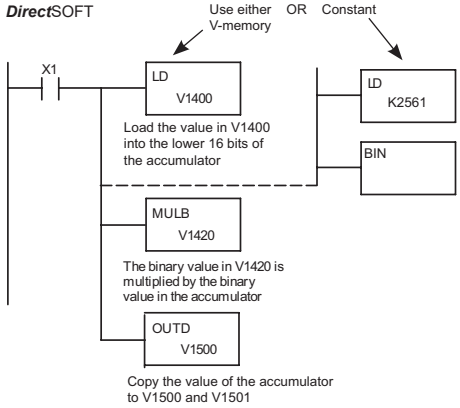


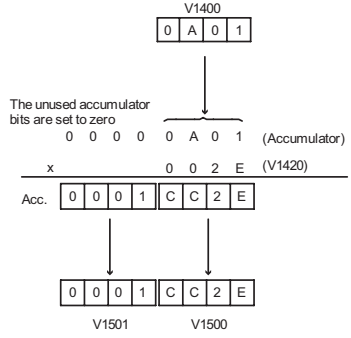
Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map
Constant	K	0-FFFF

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On anytime the value in the accumulator is negative.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the value in V1400 will be loaded into the accumulator using the Load instruction. The binary value in V1420 is multiplied by the binary value in the accumulator using the Multiply Binary instruction. The value in the accumulator is copied to V1500 using the Out instruction.





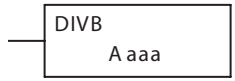
Handheld Programmer Keystrokes

STR	→	X	1	ENT						
SHFT	L	D	V	1	4	0	0	ENT		
SHFT	M	U	L	B	→	V	1	4	2	0	ENT
OUT	SHFT	D	→	V	1	5	0	0	ENT	

Divide Binary (DIVB)

DS	Used
HPP	Used

Divide Binary is a 16-bit instruction that divides the binary value in the accumulator by a binary value (Aaaa), which is either a V-memory location or a 16-bit (max.) binary constant. The first part of the quotient resides in the accumulator and the remainder resides in the first stack location.

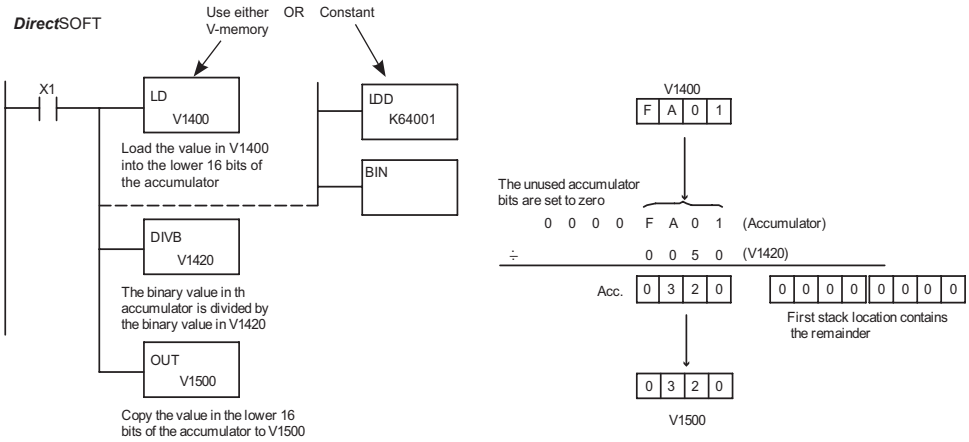


Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map
Constant	K	0-FFFF

Discrete Bit Flags	Description
SP53	On when the value of the operand is larger than the accumulator can work with.
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On anytime the value in the accumulator is negative.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the value in V1400 will be loaded into the accumulator using the Load instruction. The binary value in the accumulator is divided by the binary value in V1420 using the Divide Binary instruction. The value in the accumulator is copied to V1500 using the Out instruction.



Handheld Programmer Keystrokes

STR	→	X	1	ENT						
SHFT	L	D	V	1	4	0	0	ENT		
SHFT	D	I	V	B	→	V	1	4	2	0	ENT
OUT	SHFT	D	→	V	1	5	0	0	ENT	

Increment Binary (INCB)

DS	Used
HPP	Used

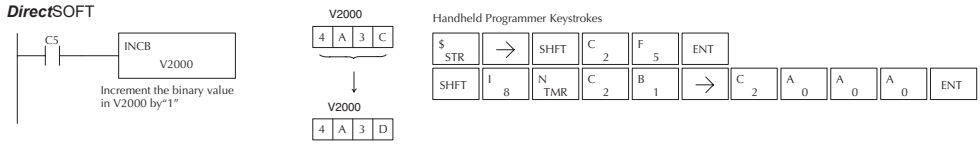
The Increment Binary instruction increments a binary value in a specified V-memory location by "1" each time the instruction is executed.

INCB
A aaa

Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.

In the following example when C5 is on, the binary value in V2000 is increased by 1.



Decrement Binary (DECB)

DS	Used
HPP	Used

The Decrement Binary instruction decrements a binary value in a specified V-memory location by "1" each time the instruction is executed.

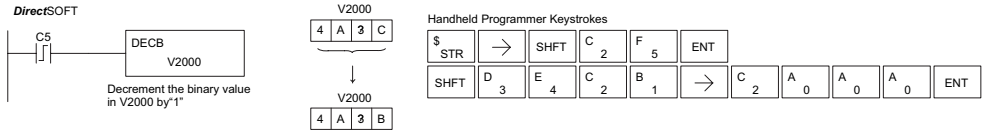
DECB
A aaa

Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example when C5 is on, the value in V2000 is decreased by 1.



Add Formatted (ADDF)

DS	Used
HPP	Used

Add Formatted is a 32-bit instruction that adds the BCD value in the accumulator with the BCD value (Aaaa) which is a range of discrete bits. The specified range (Kbbb) can be 1 to 32 consecutive bits. The result resides in the accumulator.

```
ADDF      A aaa
          K bbb
```

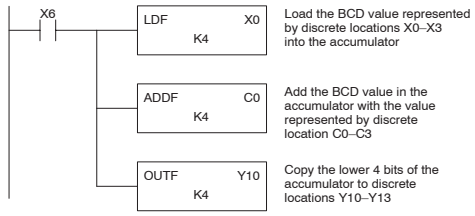
Operand Data Type		DL06 Range	
	A	aaa	bbb
Inputs	X	0–777	—
Outputs	Y	0–777	—
Control Relays	C	0–1777	—
Stage Bits	S	0–1777	—
Timer Bits	T	0–377	—
Counter Bits	CT	0–177	—
Special Relays	SP	0-137 320-717	—
Global I/O	GX	0-3777	—
Constant	K	—	1–32

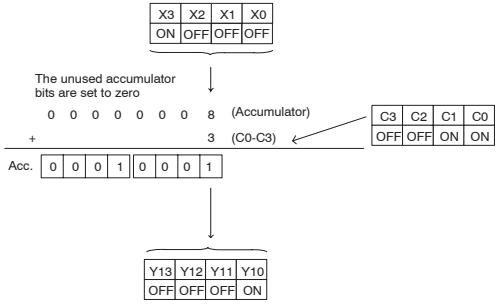
Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP66	On when the 16-bit addition instruction results in a carry.
SP67	On when the 32 bit addition instruction results in a carry.
SP70	On anytime the value in the accumulator is negative.
SP73	On when a signed addition or subtraction results in an incorrect sign bit.
SP75	On when a BCD instruction is executed and a NON-BCD number was encountered.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X6 is on, the BCD value formed by discrete locations X0–X3 is loaded into the accumulator using the LDF instruction. The BCD value formed by discrete locations C0–C3 is added to the value in the accumulator using the ADDF instruction. The value in the lower four bits of the accumulator is copied to Y10–Y13 using the OUTF instruction.

DirectSOFT





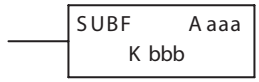
Handheld Programmer Keystrokes

$ STR	→	G 6	ENT												
SHFT	L ANDST	D 3	F 5	→	A 0	→	E 4	ENT							
SHFT	A 0	D 3	D 3	F 5	→	NEXT	NEXT	NEXT	NEXT	A 0	→	E 4	ENT		
GX OUT	SHFT	F 5	→	B 1	A 0	→	E 4	ENT							

Subtract Formatted (SUBF)

DS	Used
HPP	Used

Subtract Formatted is a 32-bit instruction that subtracts the BCD value (Aaaa), which is a range of discrete bits, from the BCD value in the accumulator. The specified range (Kbbb) can be 1 to 32 consecutive bits. The result resides in the accumulator.



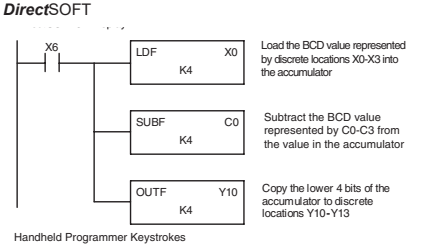
Operand Data Type		DL06 Range	
	A	aaa	bbb
Inputs	X	0–777	—
Outputs	Y	0–777	—
Control Relays	C	0–1777	—
Stage Bits	S	0–1777	—
Timer Bits	T	0–377	—
Counter Bits	CT	0–177	—
Special Relays	SP	0-137 320-717	—
Global I/O	GX	0-3777	—
Constant	K	—	1–32

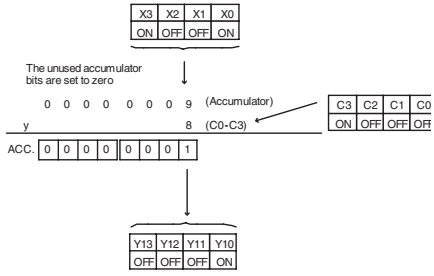
Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP64	On when the 16-bit subtraction instruction results in a borrow.
SP65	On when the 32 bit subtraction instruction results in a borrow
SP70	On any time the value in the accumulator is negative.
SP73	On when a signed addition or subtraction results in an incorrect sign bit.
SP75	On when a BCD instruction is executed and a NON-BCD number was encountered.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X6 is on, the BCD value formed by discrete locations X0–X3 is loaded into the accumulator using the LDF instruction. The BCD value formed by discrete location C0–C3 is subtracted from the BCD value in the accumulator using the SUBF instruction. The value in the lower four bits of the accumulator is copied to Y10–Y13 using the OUTF instruction.

DirectSOFT





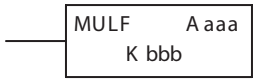
Handheld Programmer Keystrokes

$ STR	→	G 6	ENT												
SHFT	L ANDST	D 3	F 5	→	A 0	→	E 4	ENT							
SHFT	S RST	SHFT	U ISG	B 1	F 5	→	NEXT	NEXT	NEXT	NEXT	A 0	→	E 4	ENT	
GX OUT	SHFT	F 5	→	B 1	A 0	→	E 4	ENT							

Multiply Formatted (MULF)

DS	Used
HPP	Used

Multiply Formatted is a 16-bit instruction that multiplies the BCD value in the accumulator by the BCD value (Aaaa) which is a range of discrete bits. The specified range (Kbbb) can be 1 to 16 consecutive bits. The result resides in the accumulator.

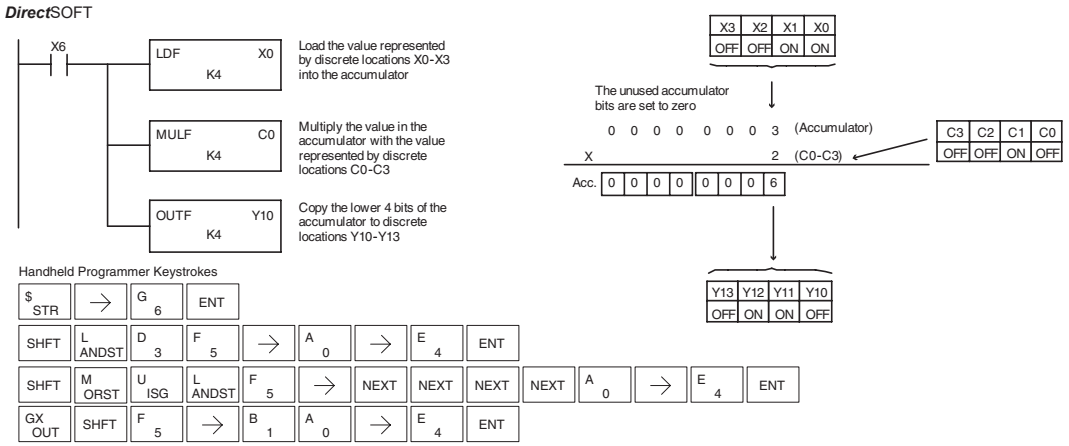


Operand Data Type		DL06 Range	
	A	aaa	bbb
Inputs	X	0–777	—
Outputs	Y	0–777	—
Control Relays	C	0–1777	—
Stage Bits	S	0–1777	—
Timer Bits	T	0–377	—
Counter Bits	CT	0–177	—
Special Relays	SP	0-137 320-717	—
Global I/O	GX	0-3777	—
Constant	K	—	1–16

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On any time the value in the accumulator is negative.
SP75	On when a BCD instruction is executed and a NON-BCD number was encountered.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

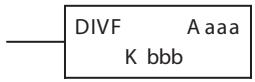
In the following example, when X6 is on, the value formed by discrete locations X0–X3 is loaded into the accumulator using the Load Formatted instruction. The value formed by discrete locations C0–C3 is multiplied by the value in the accumulator using the Multiply Formatted instruction. The value in the lower four bits of the accumulator is copied to Y10–Y13 using the Out Formatted instruction.



Divide Formatted (DIVF)

DS	Used
HPP	Used

Divide Formatted is a 16-bit instruction that divides the BCD value in the accumulator by the BCD value (Aaaa), a range of discrete bits. The specified range (Kbbb) can be 1 to 16 consecutive bits. The first part of the quotient resides in the accumulator and the remainder resides in the first stack location..



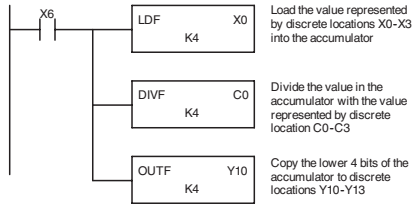
Operand Data Type	DL06 Range		
	A	aaa	bbb
Inputs	X	0–777	—
Outputs	Y	0–777	—
Control Relays	C	0–1777	—
Stage Bits	S	0–1777	—
Timer Bits	T	0–377	—
Counter Bits	CT	0–177	—
Special Relays	P	0-137 320-717	—
Global I/O	X	0-3777	—
Constant	K	—	1–16

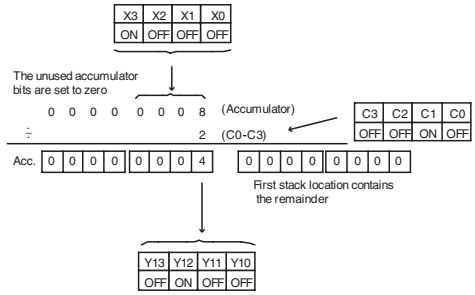
Discrete Bit Flags	Description
SP53	On when the value of the operand is larger than the accumulator can work with.
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On any time the value in the accumulator is negative.
SP75	On when a BCD instruction is executed and a NON-BCD number was encountered.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X6 is on, the value formed by discrete locations X0–X3 is loaded into the accumulator using the Load Formatted instruction. The value in the accumulator is divided by the value formed by discrete location C0–C3 using the Divide Formatted instruction. The value in the lower four bits of the accumulator is copied to Y10–Y13 using the Out Formatted instruction.

DirectSOFT





Handheld Programmer Keystrokes

$ STR	→	G 6	ENT																
SHFT	L ANDST	D 3	F 5	→	A 0	→	E 4	ENT											
SHFT	D 3	I 8	V AND	F 5	→	NEXT	NEXT	NEXT	NEXT	A 0	→	E 4	ENT						
GX OUT	SHFT	F 5	→	B 1	A 0	→	E 4	ENT											

Add Top of Stack (ADDS)

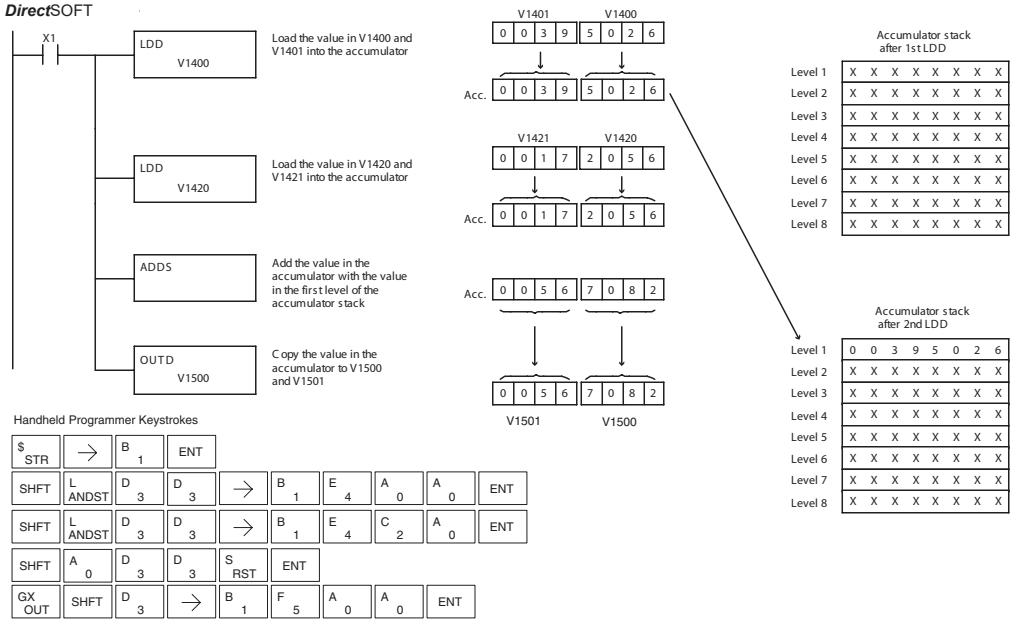
DS	Used
HPP	Used

Add Top of Stack is a 32-bit instruction that adds the BCD value in the accumulator with the BCD value in the first level of the accumulator stack. The result resides in the accumulator. The value in the first level of the accumulator stack is removed and all stack values are moved up one level.

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP66	On when the 16-bit addition instruction results in a carry.
SP67	On when the 32 bit addition instruction results in a carry.
SP70	On anytime the value in the accumulator is negative.
SP73	On when a signed addition or subtraction results in an incorrect sign bit.
SP75	On when a BCD instruction is executed and a NON-BCD number was encountered.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

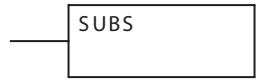
In the following example, when X1 is on, the value in V1400 and V1401 will be loaded into the accumulator using the Load Double instruction. The value in V1420 and V1421 is loaded into the accumulator using the Load Double instruction, pushing the value previously loaded in the accumulator onto the accumulator stack. The value in the first level of the accumulator stack is added with the value in the accumulator using the Add Stack instruction. The value in the accumulator is copied to V1500 and V1501 using the Out Double instruction.



Subtract Top of Stack (SUBS)

DS	Used
HPP	Used

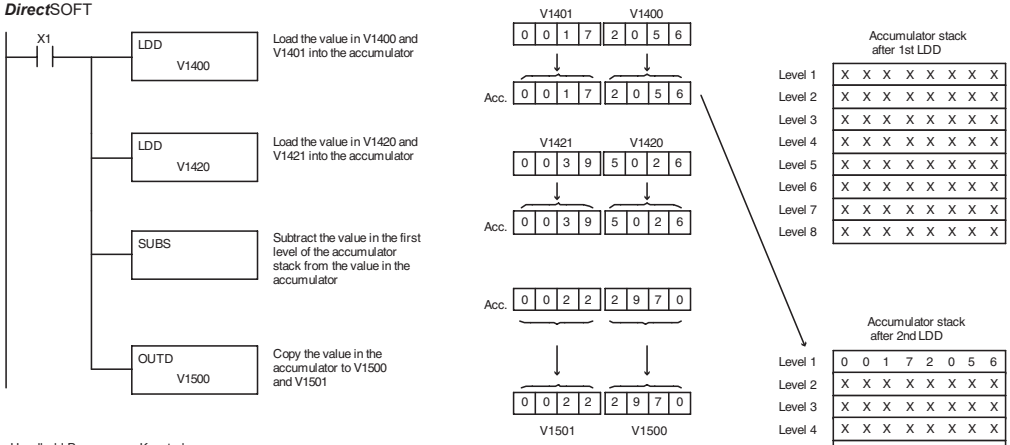
Subtract Top of Stack is a 32-bit instruction that subtracts the BCD value in the first level of the accumulator stack from the BCD value in the accumulator. The result resides in the accumulator. The value in the first level of the accumulator stack is removed and all stack values are moved up one level.



Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP64	On when the 16-bit subtraction instruction results in a borrow.
SP65	On when the 32 bit subtraction instruction results in a borrow.
SP70	On anytime the value in the accumulator is negative.
SP73	On when a signed addition or subtraction results in an incorrect sign bit.
SP75	On when a BCD instruction is executed and a NON-BCD number was encountered.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the value in V1400 and V1401 will be loaded into the accumulator using the Load Double instruction. The value in V1420 and V1421 is loaded into the accumulator using the Load Double instruction, pushing the value previously loaded into the accumulator onto the accumulator stack. The BCD value in the first level of the accumulator stack is subtracted from the BCD value in the accumulator using the Subtract Stack instruction. The value in the accumulator is copied to V1500 and V1501 using the Out Double instruction.



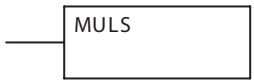
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT					
SHFT	L ANDST	D 3	D 3	→	B 1	E 4	A 0	A 0	ENT
SHFT	L ANDST	D 3	D 3	→	B 1	E 4	C 2	A 0	ENT
SHFT	S RST	SHFT	U ISG	B 1	S RST	ENT		
GX OUT	SHFT	D 3	→	B 1	F 5	A 0	A 0	ENT

Multiply Top of Stack (MULS)

DS	Used
HPP	Used

Multiply Top of Stack is a 16-bit instruction that multiplies a 4-digit BCD value in the first level of the accumulator stack by a 4-digit BCD value in the accumulator. The result resides in the accumulator. The value in the first level of the accumulator stack is removed and all stack values are moved up one level.

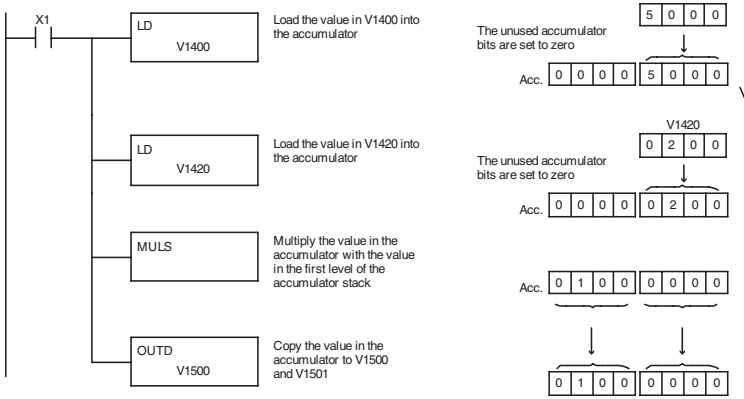


Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On any time the value in the accumulator is negative.
SP75	On when a BCD instruction is executed and a NON-BCD number was encountered.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the value in V1400 will be loaded into the accumulator using the Load instruction. The value in V1420 is loaded into the accumulator using the Load instruction, pushing the value previously loaded in the accumulator onto the accumulator stack. The BCD value in the first level of the accumulator stack is multiplied by the BCD value in the accumulator using the Multiply Stack instruction. The value in the accumulator is copied to V1500 and V1501 using the Out Double instruction.

***Direct*SOFT**



Accumulator stack after 1st LDD

Level 1	X	X	X	X	X	X	X	X
Level 2	X	X	X	X	X	X	X	X
Level 3	X	X	X	X	X	X	X	X
Level 4	X	X	X	X	X	X	X	X
Level 5	X	X	X	X	X	X	X	X
Level 6	X	X	X	X	X	X	X	X
Level 7	X	X	X	X	X	X	X	X
Level 8	X	X	X	X	X	X	X	X

Accumulator stack after 2nd LDD

Level 1	0	0	0	0	5	0	0	0
Level 2	X	X	X	X	X	X	X	X
Level 3	X	X	X	X	X	X	X	X
Level 4	X	X	X	X	X	X	X	X
Level 5	X	X	X	X	X	X	X	X
Level 6	X	X	X	X	X	X	X	X
Level 7	X	X	X	X	X	X	X	X
Level 8	X	X	X	X	X	X	X	X

Handheld Programmer Keystrokes

$ STR	→	B 1	ENT					
SHFT	L ANDST	D 3	→	B 1	E 4	A 0	A 0	ENT
SHFT	L ANDST	D 3	→	B 1	E 4	C 2	A 0	ENT
SHFT	M ORST	U ISG	L ANDST	S RST	ENT			
GX OUT	SHFT	D 3	→	B 1	F 5	A 0	A 0	ENT

Divide by Top of Stack (DIVS)

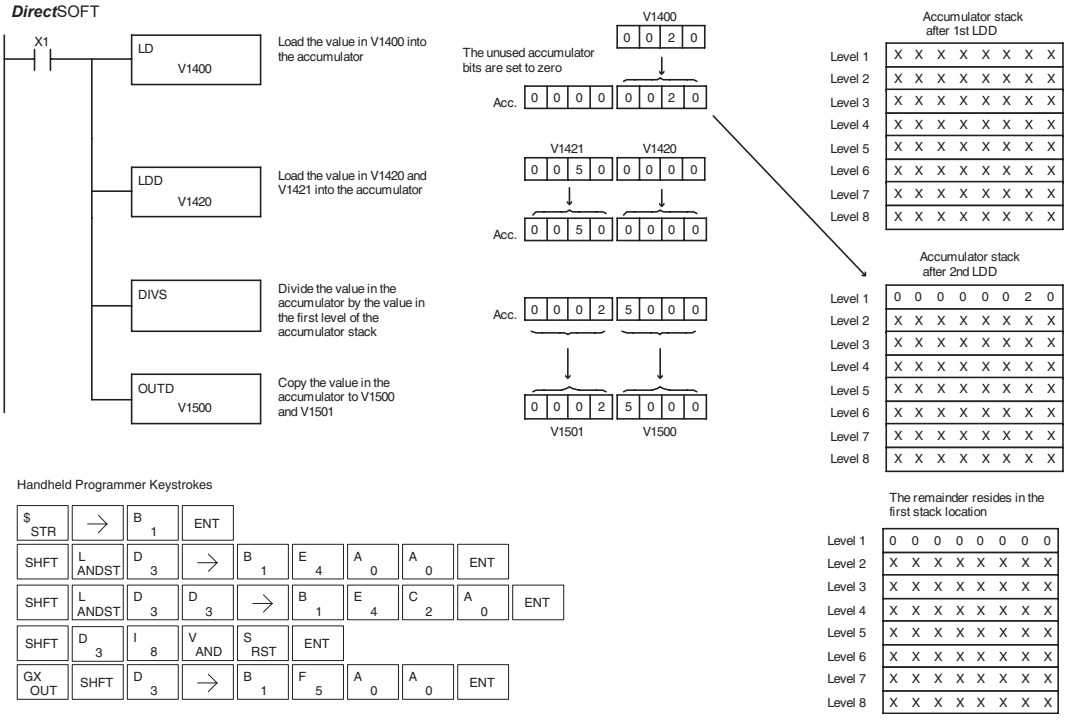
DS	Used
HPP	Used

Divide Top of Stack is a 32-bit instruction that divides the 8-digit BCD value in the accumulator by a 4-digit BCD value in the first level of the accumulator stack. The result resides in the accumulator and the remainder resides in the first level of the accumulator stack.

Discrete Bit Flags	Description
SP53	On when the value of the operand is larger than the accumulator can work with.
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On any time the value in the accumulator is negative.
SP75	On when a BCD instruction is executed and a NON-BCD number was encountered.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

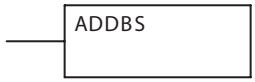
In the following example, when X1 is on, the Load instruction loads the value in V1400 into the accumulator. The value in V1420 is loaded into the accumulator using the Load Double instruction, pushing the value previously loaded in the accumulator onto the accumulator stack. The BCD value in the accumulator is divided by the BCD value in the first level of the accumulator stack using the Divide Stack instruction. The Out Double instruction copies the value in the accumulator to V1500 and V1501.



Add Binary Top of Stack (ADDBS)

DS	Used
HPP	Used

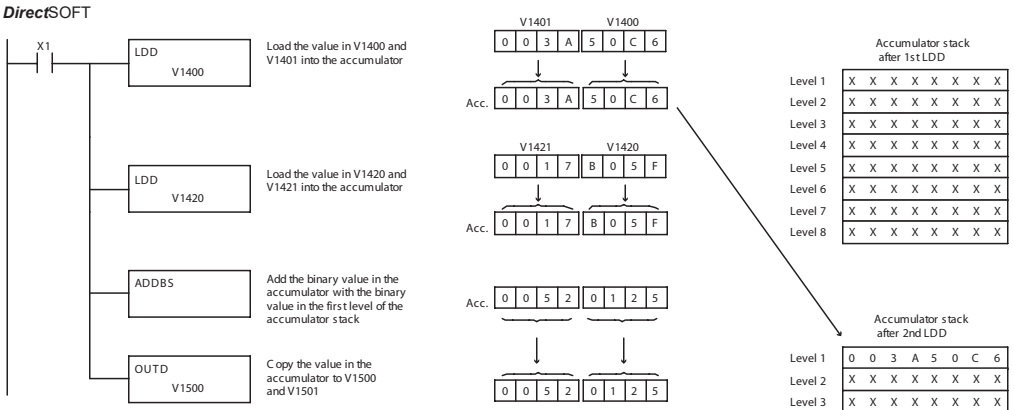
Add Binary Top of Stack instruction is a 32-bit instruction that adds the binary value in the accumulator with the binary value in the first level of the accumulator stack. The result resides in the accumulator. The value in the first level of the accumulator stack is removed and all stack values are moved.



Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP66	On when the 16-bit addition instruction results in a carry.
SP67	On when the 32 bit addition instruction results in a carry.
SP70	On anytime the value in the accumulator is negative.
SP73	On when a signed addition or subtraction results in an incorrect sign bit.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the value in V1400 and V1401 will be loaded into the accumulator using the Load Double instruction. The value in V1420 and V1421 is loaded into the accumulator using the Load Double instruction, pushing the value previously loaded in the accumulator onto the accumulator stack. The binary value in the first level of the accumulator stack is added with the binary value in the accumulator using the Add Stack instruction. The value in the accumulator is copied to V1500 and V1501 using the Out Double instruction.



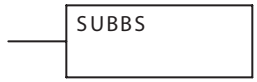
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT						
SHFT	L ANDST	D 3	D 3	→	B 1	E 4	A 0	A 0	ENT
SHFT	L ANDST	D 3	D 3	→	B 1	E 4	C 2	A 0	ENT
SHFT	A 0	D 3	D 3	B 1	S RST	ENT			
GX OUT	SHFT	D 3	→	B 1	F 5	A 0	A 0	ENT	

Subtract Binary Top of Stack (SUBBS)

DS	Used
HPP	Used

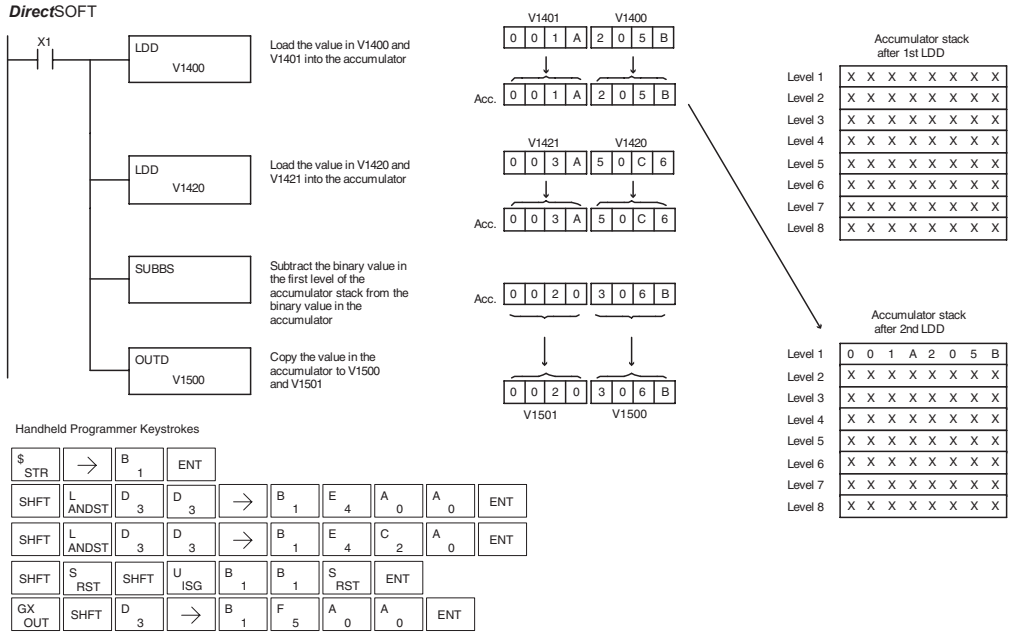
Subtract Binary Top of Stack is a 32-bit instruction that subtracts the binary value in the first level of the accumulator stack from the binary value in the accumulator. The result resides in the accumulator. The value in the first level of the accumulator stack is removed and all stack locations are moved up one level



Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP64	On when the 16-bit subtraction instruction results in a borrow.
SP65	On when the 32-bit subtraction instruction results in a borrow.
SP70	On any time the value in the accumulator is negative.
SP73	On when a signed addition or subtraction results in an incorrect sign bit.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the value in V1400 and V1401 will be loaded into the accumulator using the Load Double instruction. The value in V1420 and V1421 is loaded into the accumulator using the Load Double instruction, pushing the value previously loaded in the accumulator onto the accumulator stack. The binary value in the first level of the accumulator stack is subtracted from the binary value in the accumulator using the Subtract Stack instruction. The value in the accumulator is copied to V1500 and V1501 using the Out Double instruction.



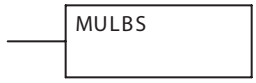
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT						
SHFT	L ANDST	D 3	D 3	→	B 1	E 4	A 0	A 0	ENT
SHFT	L ANDST	D 3	D 3	→	B 1	E 4	C 2	A 0	ENT
SHFT	S RST	SHFT	U ISG	B 1	B 1	S RST	ENT		
GX OUT	SHFT	D 3	→	B 1	F 5	A 0	A 0	ENT	

Multiply Binary Top of Stack (MULBS)

DS	Used
HPP	Used

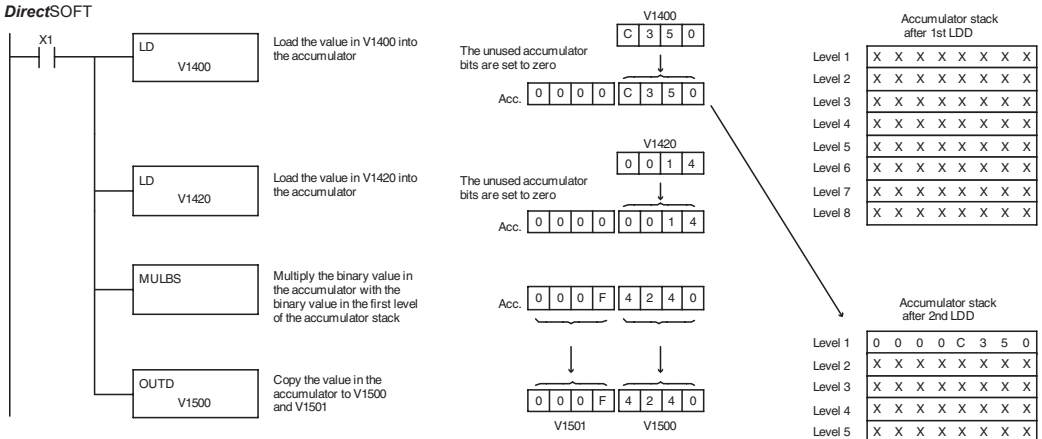
Multiply Binary Top of Stack is a 16-bit instruction that multiplies the 16-bit binary value in the first level of the accumulator stack by the 16-bit binary value in the accumulator. The result resides in the accumulator and can be 32 bits (8 digits max.). The value in the first level of the accumulator stack is removed and all stack locations are moved up one level



Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On any time the value in the accumulator is negative.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the Load instruction moves the value in V1400 into the accumulator. The value in V1420 is loaded into the accumulator using the Load instruction, pushing the value previously loaded in the accumulator onto the stack. The binary value in the accumulator stack's first level is multiplied by the binary value in the accumulator using the Multiply Binary Stack instruction. The Out Double instruction copies the value in the accumulator to V1500 and V1501.



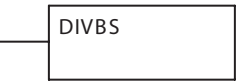
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT					
SHFT	L ANDST	D 3	→	B 1	E 4	A 0	A 0	ENT
SHFT	L ANDST	D 3	→	B 1	E 4	C 2	A 0	ENT
SHFT	M ORST	U ISG	L ANDST	B 1	S RST	ENT		
GX OUT	SHFT	D 3	→	B 1	F 5	A 0	A 0	ENT

Divide Binary by Top OF Stack (DIVBS)

DS	Used
HPP	Used

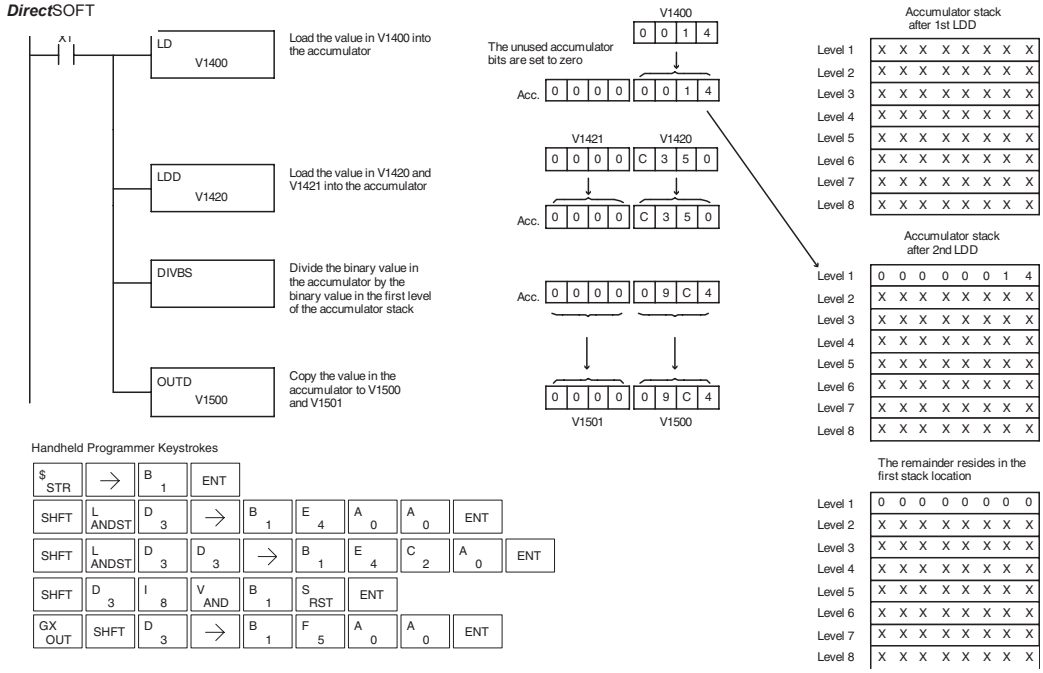
Divide Binary Top of Stack is a 32-bit instruction that divides the 32-bit binary value in the accumulator by the 16-bit binary value in the first level of the accumulator stack. The result resides in the accumulator and the remainder resides in the first level of the accumulator stack.



Discrete Bit Flags	Description
SP53	On when the value of the operand is larger than the accumulator can work with.
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On any time the value in the accumulator is negative.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the value in V1400 will be loaded into the accumulator using the Load instruction. The value in V1420 and V1421 is loaded into the accumulator using the Load Double instruction also, pushing the value previously loaded in the accumulator onto the accumulator stack. The binary value in the accumulator is divided by the binary value in the first level of the accumulator stack using the Divide Binary Stack instruction. The value in the accumulator is copied to V1500 and V1501 using the Out Double instruction.



Transcendental Functions

The DL06 CPU features special numerical functions to complement its real number capability. The transcendental functions include the trigonometric sine, cosine, and tangent, and also their inverses (arc sine, arc cosine, and arc tangent). The square root function is also grouped with these other functions.

The transcendental math instructions operate on a real number in the accumulator (it cannot be BCD or binary). The real number result resides in the accumulator. The square root function operates on the full range of positive real numbers. The sine, cosine and tangent functions require numbers expressed in radians. You can work with angles expressed in degrees by first converting them to radians with the Radian (RADR) instruction, then performing the trig function. All transcendental functions utilize the following flag bits.

Discrete Bit Flags	Description
SP53	On when the value of the operand is larger than the accumulator can work with.
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On anytime the value in the accumulator is negative.
SP72	On anytime the value in the accumulator is an invalid floating point number
SP73	On when a signed addition or subtraction results in an incorrect sign bit.
SP75	On when a real number instruction is executed and a non-real number encountered.

Sine Real (SINR)

DS	Used
HPP	N/A

The Sine Real instruction takes the sine of the real number stored in the accumulator. The result resides in the accumulator. Both the original number and the result must be Real data type (IEEE floating point format).

Cosine Real (COSR)

DS	Used
HPP	N/A

The Cosine Real instruction takes the cosine of the real number stored in the accumulator. The result resides in the accumulator. Both the original number and the result must be Real data type (IEEE floating point format)..

Tangent Real (TANR)

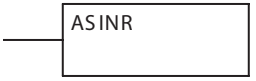
DS	Used
HPP	N/A

The Tangent Real instruction takes the tangent of the real number stored in the accumulator. The result resides in the accumulator. Both the original number and the result must be Real data type (IEEE floating point format).

Arc Sine Real (ASINR)

DS	Used
HPP	N/A

The Arc Sine Real instruction takes the inverse sine of the real number stored in the accumulator. The result resides in the accumulator. Both the original number and the result must be Real data type (IEEE floating point format).



Arc Cosine Real (ACOSR)

DS	Used
HPP	N/A

The Arc Cosine Real instruction takes the inverse cosine of the real number stored in the accumulator. The result resides in the accumulator. Both the original number and the result must be Real data type (IEEE floating point format).

Arc Tangent Real (ATANR)

DS	Used
HPP	N/A

The Arc Tangent Real instruction takes the inverse tangent of the real number stored in the accumulator. The result resides in the accumulator. Both the original number and the result must be Real data type (IEEE floating point format).

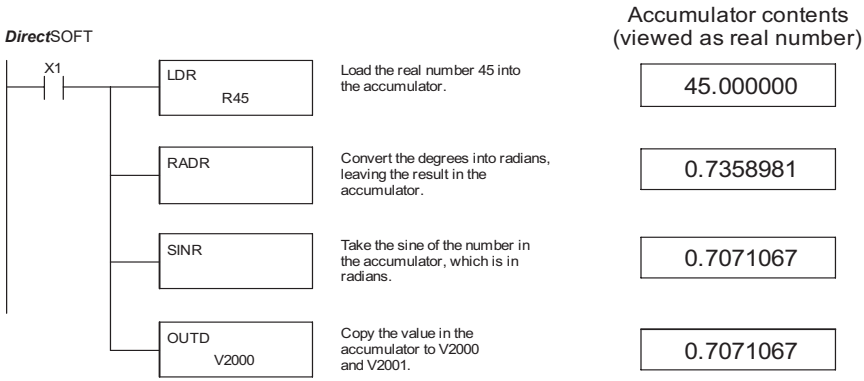
Square Root Real (SQRTR)

DS	Used
HPP	N/A

The Square Root Real instruction takes the square root of the real number stored in the accumulator. The result resides in the accumulator. Both the original number and the result must be Real data type (IEEE floating point format).

***NOTE**: The square root function can be useful in several situations. However, if you are trying to do the square-root extract function for an orifice flow meter measurement, as the PV to a PID loop, note that the PID loop already has the square-root extract function built in.*

The following example takes the **sine** of 45 degrees. Since these transcendental functions operate only on real numbers, we do an LDR (load real) 45. The trig functions operate only in radians, so we must convert the degrees to radians by using the RADR command. After using the SINR (Sine Real) instruction, we use an OUTD (Out Double) instruction to move the result from the accumulator to V-memory. The result is 32-bits wide, requiring the Out Double to move it.



***NOTE**: The current HPP does not support real number entry with automatic conversion to the 32-bit IEEE format. You must use **Direct**SOFT for entering real numbers, using the LDR (Load Real) instruction.*

Bit Operation Instructions

Sum (SUM)

DS	Used
HPP	Used

The Sum instruction counts number of bits that are set to "1" in th accumulator. The HEX result resides in the accumulator.

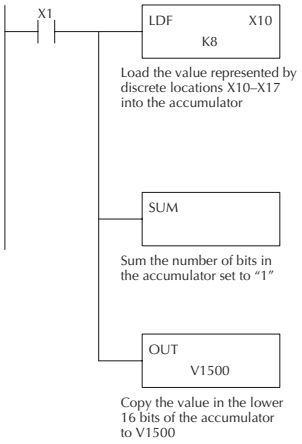
SUM

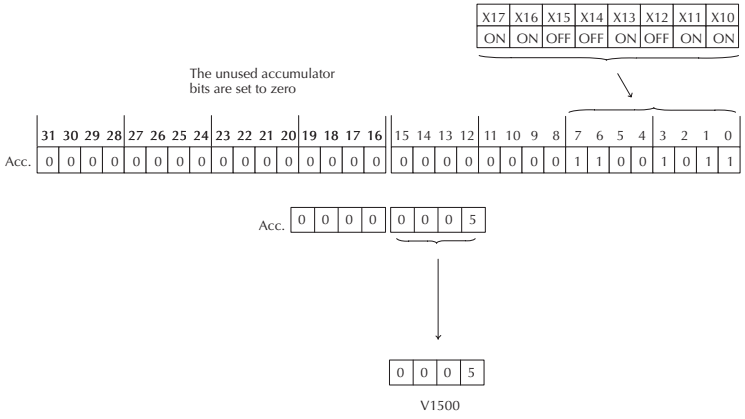
Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.

In the following example, when X1 is on, the value formed by discrete locations X10–X17 is loaded into the accumulator using the Load Formatted instruction. The number of bits in the accumulator set to "1" is counted using the Sum instruction. The value in the accumulator is copied to V1500 using the Out instruction.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

***Direct**SOFT*





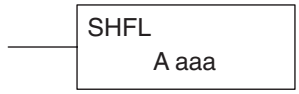
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT						
SHFT	L ANDST	D 3	F 5	→	B 1	A 0	→	I 8	ENT
SHFT	S RST	SHFT	U ISG	M ORST	→	ENT			
GX OUT	→	PREV	PREV	PREV	B 1	F 5	A 0	A 0	ENT

Shift Left (SHFL)

DS	Used
HPP	Used

Shift Left is a 32-bit instruction that shifts the bits in the accumulator a specified number (Aaaa) of places to the left. The vacant positions are filled with zeros and the bits shifted out of the accumulator are discarded.



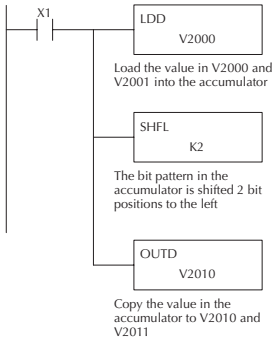
Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Constant	K	1-32

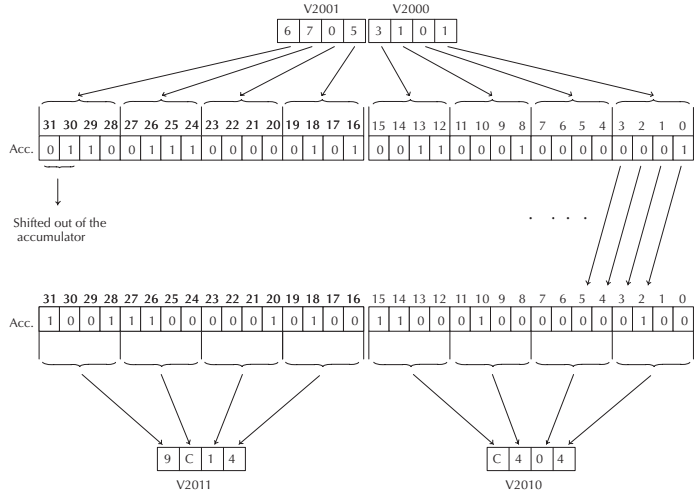
Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On anytime the value in the accumulator is negative.

In the following example, when X1 is on, the value in V2000 and V2001 will be loaded into the accumulator using the Load Double instruction. The bit pattern in the accumulator is shifted 2 bits to the left using the Shift Left instruction. The value in the accumulator is copied to V2010 and V2011 using the Out Double instruction.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

***Direct**SOFT*





Handheld Programmer Keystrokes

$ STR	→	B 1	ENT						
SHFT	L ANDST	D 3	D 3	→	C 2	A 0	A 0	A 0	ENT
SHFT	S RST	SHFT	H 7	F 5	L ANDST	→	C 2	ENT	
GX OUT	SHFT	D 3	→	C 2	A 0	B 1	A 0	ENT	

Shift Right (SHFR)

DS	Used
HPP	Used

Shift Right is a 32-bit instruction that shifts the bits in the accumulator a specified number (Aaaa) of places to the right. The vacant positions are filled with zeros and the bits shifted out of the accumulator are lost.

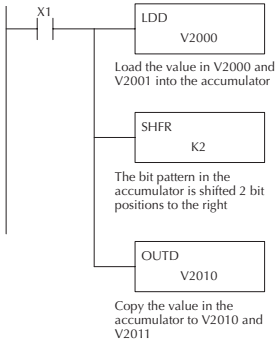
Operand Data Type	DL06 Range	
	A	aaa
V-memory	V	See memory map
Constant	K	1-32

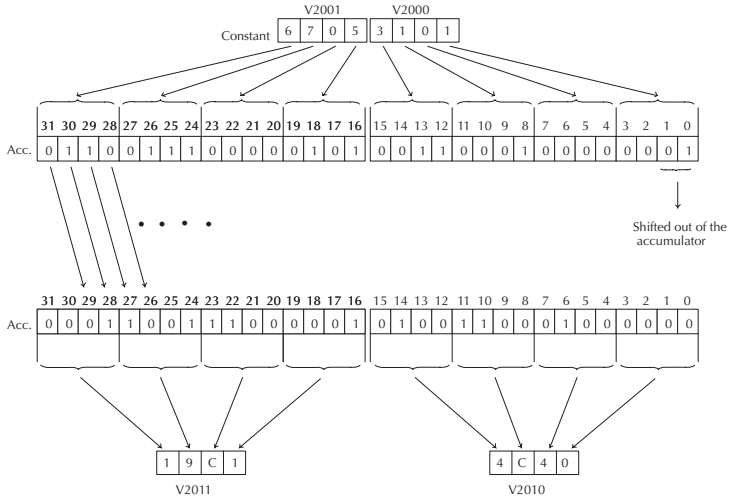
Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On anytime the value in the accumulator is negative.

In the following example, when X1 is on, the value in V2000 and V2001 will be loaded into the accumulator using the Load Double instruction. The bit pattern in the accumulator is shifted 2 bits to the right using the Shift Right instruction. The value in the accumulator is copied to V2010 and V2011 using the Out Double instruction.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*

***Direct**SOFT*





Handheld Programmer Keystrokes

$ STR	→	B 1	ENT						
SHFT	L ANDST	D 3	D 3	→	C 2	A 0	A 0	A 0	ENT
SHFT	S RST	SHFT	H 7	F 5	R ORN	→	C 2	ENT	
GX OUT	SHFT	D 3	→	C 2	A 0	B 1	A 0	ENT	

Rotate Left (ROTL)

DS	Used
HPP	Used

Rotate Left is a 32-bit instruction that rotates the bits in the accumulator a specified number (Aaaa) of places to the left.

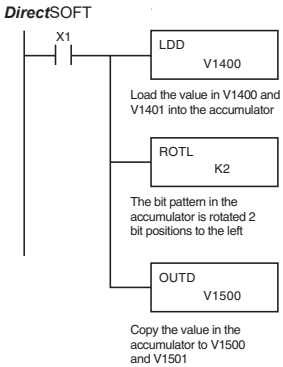
```
ROTL
 A aaa
```

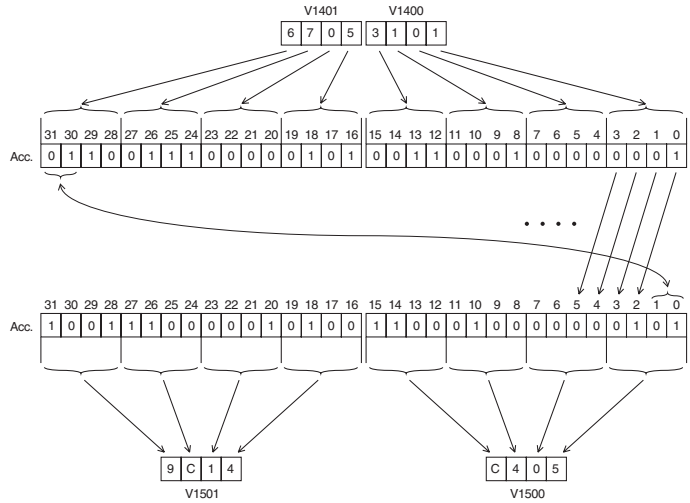
Operand Data Type		DL06 Range
	A	**aaa**
V-memory	V	See memory map
Constant	K	1-32

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On anytime the value in the accumulator is negative.

In the following example, when X1 is on, the value in V1400 and V1401 will be loaded into the accumulator using the Load Double instruction. The bit pattern in the accumulator is rotated 2 bit positions to the left using the Rotate Left instruction. The value in the accumulator is copied to V1500 and V1501 using the Out Double instruction.

***NOTE**: Status flags are valid only until another instruction uses the same flag.*





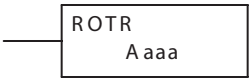
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT						
SHFT	L ANDST	D 3	D 3	→	B 1	E 4	A 0	A 0	ENT
SHFT	R ORN	O INST#	T MLR	L ANDST	→	C 2	ENT		
GX OUT	SHFT	D 3	→	B 1	F 5	A 0	A 0	ENT	

Rotate Right (ROTR)

DS	Used
HPP	Used

Rotate Right is a 32-bit instruction that rotates the bits in the accumulator a specified number (Aaaa) of places to the right.

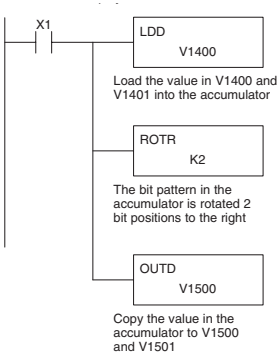


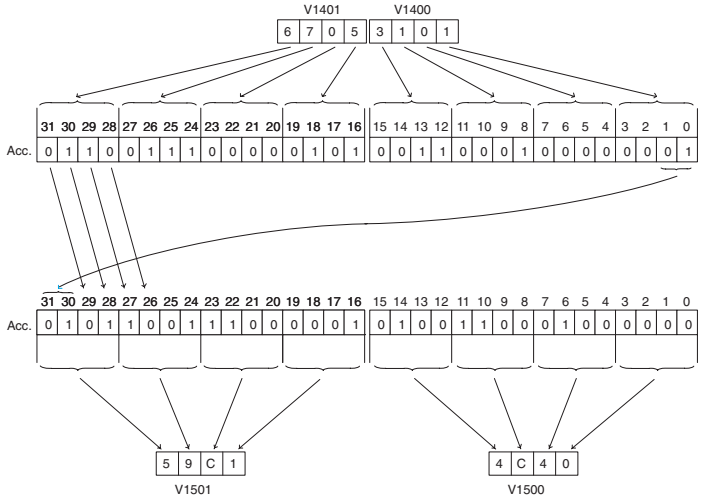
Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Constant	K	1-32

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On anytime the value in the accumulator is negative.

In the following example, when X1 is on, the value in V1400 and V1401 will be loaded into the accumulator using the Load Double instruction. The bit pattern in the accumulator is rotated 2 bit positions to the right using the Rotate Right instruction. The value in the accumulator is copied to V1500 and V1501 using the Out Double instruction.

DirectSOFT





Handheld Programmer Keystrokes

$ STR	→	B 1	ENT						
SHFT	L ANDST	D 3	D 3	→	B 1	E 4	A 0	A 0	ENT
SHFT	R ORN	O INST#	T MLR	R ORN	→	C 2	ENT		
GX OUT	SHFT	D 3	→	B 1	F 5	A 0	A 0	ENT	

Encode (ENCO)

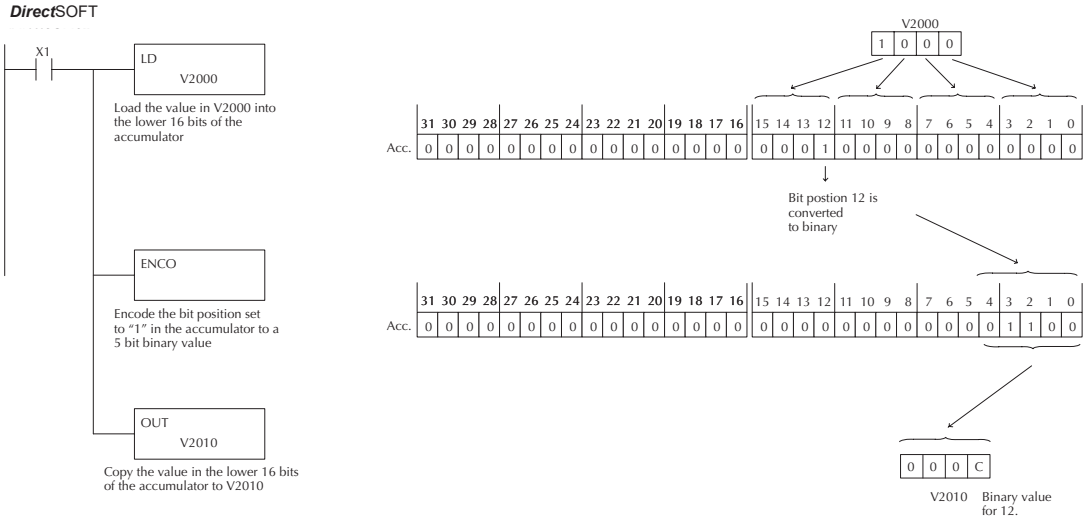
DS	Used
HPP	Used

The Encode instruction encodes the bit position in the accumulator having a value of 1, and returns the appropriate binary representation. If the most significant bit is set to 1 (Bit 31), the Encode instruction would place the value HEX 1F (decimal 31) in the accumulator. If the value to be encoded is 0000 or 0001, the instruction will place a zero in the accumulator. If the value to be encoded has more than one bit position set to a "1", the least significant "1" will be encoded and SP53 will be set on.

Discrete Bit Flags	Description
SP53	On when the value of the operand is larger than the accumulator can work with.

***NOTE**: The status flags are only valid until another instruction that uses the same flags is executed.*

In the following example, when X1 is on, The value in V2000 is loaded into the accumulator using the Load instruction. The bit position set to a "1" in the accumulator is encoded to the corresponding 5 bit binary value using the Encode instruction. The value in the lower 16 bits of the accumulator is copied to V2010 using the Out instruction.



Handheld Programmer Keystrokes

$ STR	→	B 1	ENT					
SHFT	L ANDST	D 3	→	C 2	A 0	A 0	A 0	ENT
SHFT	E 4	N TMR	C 2	O INST#	ENT			
GX OUT	→	SHFT	V AND	C 2	A 0	B 1	A 0	ENT

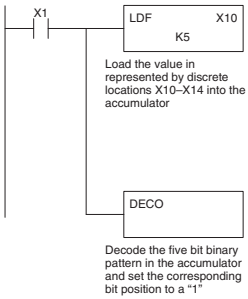
Decode (DECO)

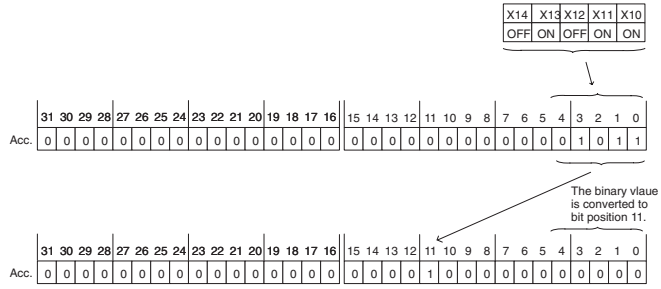
DS	Used
HPP	Used

The Decode instruction decodes a 5-bit binary value of 0–31 (0–1Fh) in the accumulator by setting the appropriate bit position to a 1. If the accumulator contains the value Fh (HEX), bit 15 will be set in the accumulator. If the value to be decoded is greater than 31, the number is divided by 32 until the value is less than 32 and then the value is decoded.

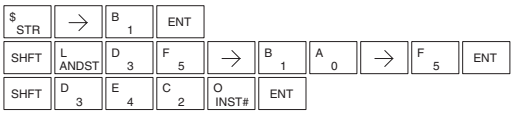
In the following example when X1 is on, the value formed by discrete locations X10–X14 is loaded into the accumulator using the Load Formatted instruction. The 5- bit binary pattern in the accumulator is decoded by setting the corresponding bit position to a "1" using the Decode instruction.

DirectSOFT





Handheld Programmer Keystrokes



Number Conversion Instructions (Accumulator)

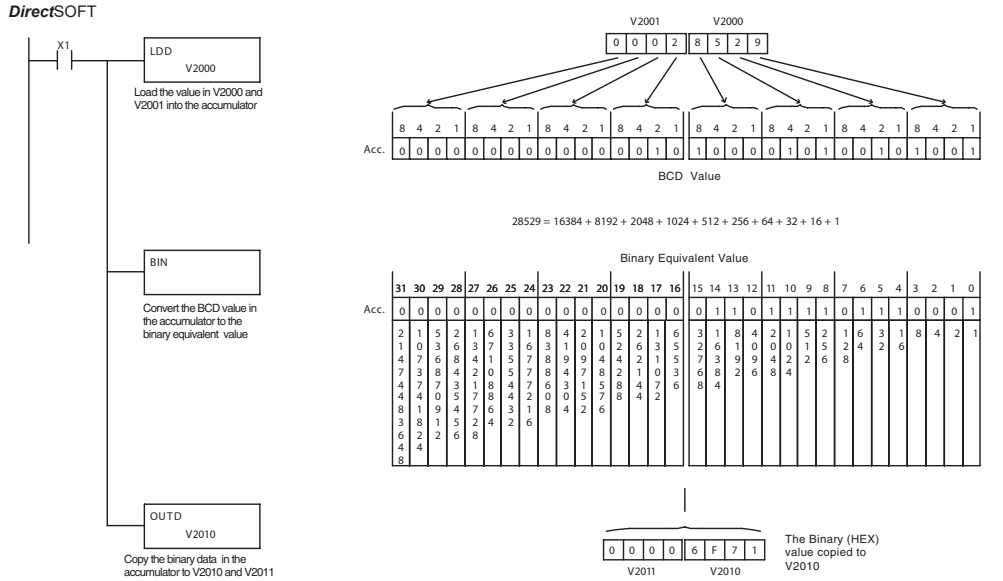
Binary (BIN)

DS	Used
HPP	Used

The Binary instruction converts a BCD value in the accumulator to the equivalent binary, or decimal, value. The result resides in the accumulator.

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On anytime the value in the accumulator is negative.
SP75	On when a BCD instruction is executed and a NON–BCD number was encountered.

In the following example, when X1 is on, the value in V2000 and V2001 is loaded into the accumulator using the Load Double instruction. The BCD value in the accumulator is converted to the binary (HEX) equivalent using the BIN instruction. The binary value in the accumulator is copied to V2010 and V2011 using the Out Double instruction. (The handheld programmer will display the binary value in V2010 and V2011 as a HEX value.)



Handheld Programmer Keystrokes

$ STR	→	B 1	ENT					
SHFT	L ANDST	D 3	D 3	→	C 2	A 0	A 0	A 0	ENT
SHFT	B 1	I 8	N TMR	ENT				
GX OUT	SHFT	D 3	→	C 2	A 0	B 1	A 0	ENT

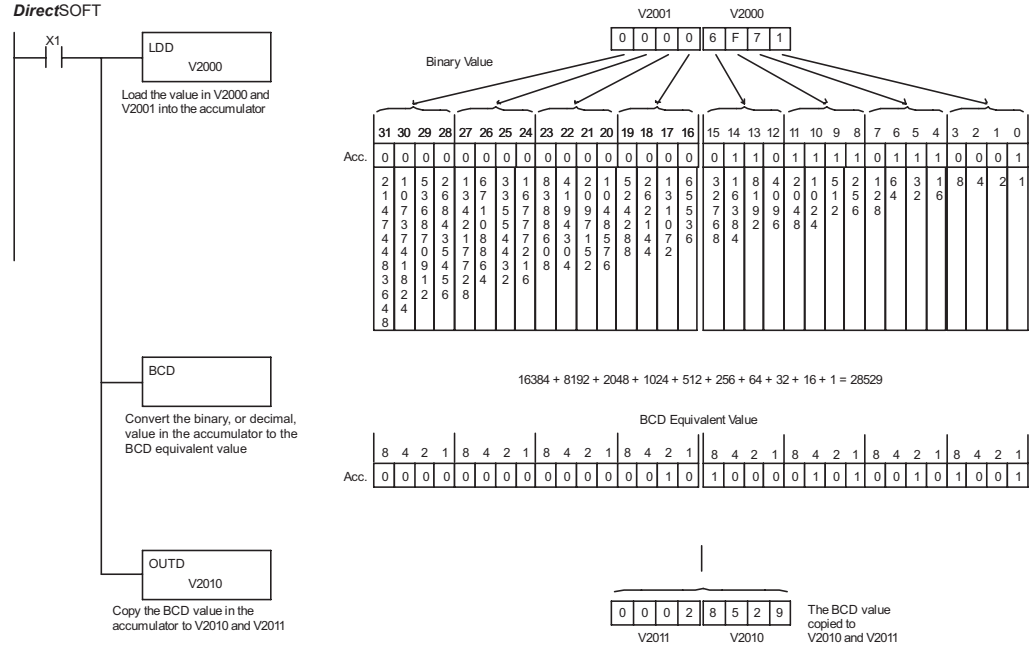
Binary Coded Decimal (BCD)

DS	Used
HPP	Used

The Binary Coded Decimal instruction converts a binary, or decimal, value in the accumulator to the equivalent BCD value. The result resides in the accumulator.

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On anytime the value in the accumulator is negative.

In the following example, when X1 is on, the binary, or decimal, value in V2000 and V2001 is loaded into the accumulator using the Load Double instruction. The value in the accumulator is converted to the BCD equivalent value using the BCD instruction. The BCD value in the accumulator is copied to V2010 and V2011 using the Out Double instruction.



Handheld Programmer Keystrokes

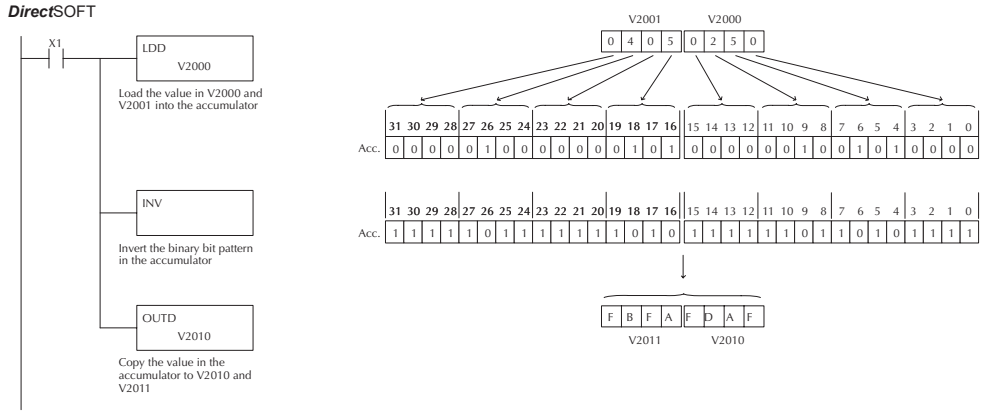
$ STR	→	B 1	ENT						
SHFT	L ANDST	D 3	D 3	→	C 2	A 0	A 0	A 0	ENT
SHFT	B 1	C 2	D 3	ENT					
GX OUT	SHFT	D 3	→	C 2	A 0	B 1	A 0	ENT	

Invert (INV)

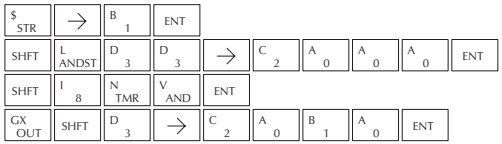
DS	Used
HPP	Used

The Invert instruction inverts or takes the one's complement of the 32-bit value in the accumulator. The result resides in the accumulator.

In the following example, when X1 is on, the value in V2000 and V2001 will be loaded into the accumulator using the Load Double instruction. The value in the accumulator is inverted using the Invert instruction. The value in the accumulator is copied to V2010 and V2011 using the Out Double instruction.



Handheld Programmer Keystrokes



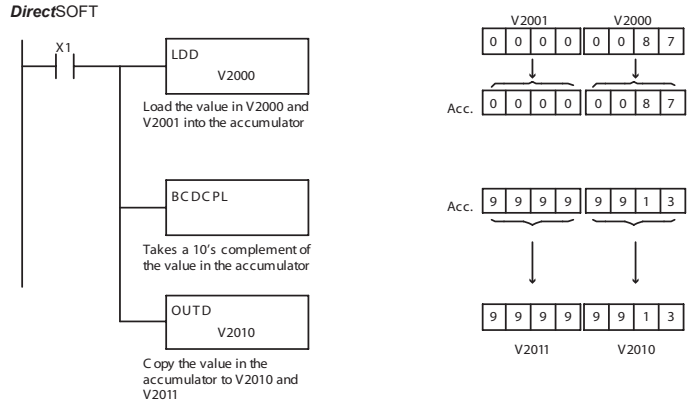
Ten's Complement (BCDCPL)

DS	Used
HPP	Used

The Ten's Complement instruction takes the 10's complement (BCD) of the 8 digit accumulator. The result resides in the accumulator. The calculation for this instruction is:

100000000
− accumulator
10's complement value

In the following example when X1 is on, the value in V2000 and V2001 is loaded into the accumulator. The 10's complement is taken for the 8 digit accumulator using the Ten's Complement instruction. The value in the accumulator is copied to V2010 and V2011 using the Out Double instruction.



Handheld Programmer Keystrokes

$ STR	→	B 1	ENT						
SHFT	L ANDST	D 3	D 3	→	C 2	A 0	A 0	A 0	ENT
SHFT	B 1	C 2	D 3	C 2	P CV	L ANDST	ENT		
GX OUT	SHFT	D 3	→	C 2	A 0	B 1	A 0	ENT	

Binary to Real Conversion (BTOR)

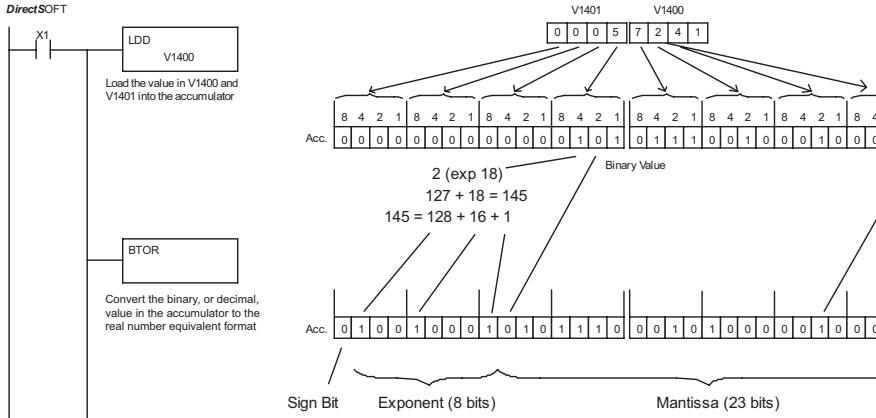
DS	Used
HPP	Used

The Binary-to-Real instruction converts a binary, or decimal, value in the accumulator to its equivalent real number (floating point) format. The result resides in the accumulator. Both the binary and the real number may use all 32 bits of the accumulator.

***NOTE**: This instruction only works with unsigned **binary, or decimal,** values. It will not work with signed decimal values.*

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On anytime the value in the accumulator is negative.

In the following example, when X1 is on, the value in V1400 and V1401 is loaded into the accumulator using the Load Double instruction. The BTOR instruction converts the binary, or decimal, value in the accumulator to the equivalent real number format. The binary weight of the MSB is converted to the real number exponent by adding it to 127 (decimal). Then the remaining bits are copied to the mantissa as shown. The value in the accumulator is copied to V1500 and V1501 using the Out Double instruction. The handheld programmer would display the binary value in V1500 and V1501 as a HEX value.



Handheld Programmer Keystrokes

$ STR	→	B 1	ENT						
SHFT	L ANDST	D 3	D 3	→	B 1	E 4	A 0	A 0	ENT
SHFT	B 1	T MLR	O INST#	R ORN	ENT				
GX OUT	SHFT	D 3	→	B 1	F 5	A 0	A 0	ENT	

Real to Binary Conversion (RTOB)

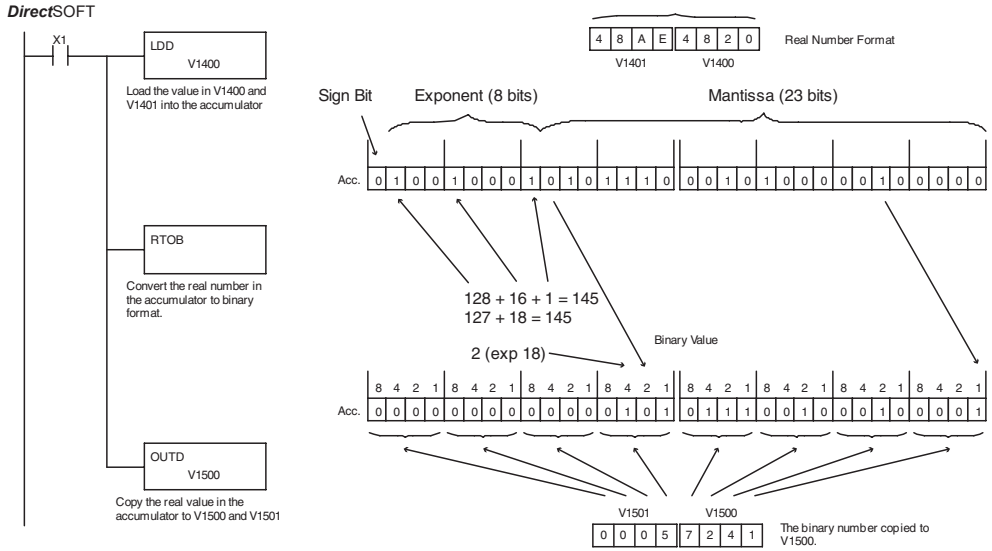
DS	Used
HPP	Used

The Real-to-Binary instruction converts the real number in the accumulator to a binary value. The result resides in the accumulator. Both the binary and the real number may use all 32 bits of the accumulator.

NOTE$_1$: *The decimal portion of the result will be rounded down (14.1 to 14; -14.1 to -15).*
NOTE$_2$: *if the real number is negative, it becomes a signed decimal value.*

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On anytime the value in the accumulator is negative.
SP72	On anytime the value in the accumulator is an invalid floating point number.
SP73	On when a signed addition or subtraction results in an incorrect sign bit.
SP75	On when a number cannot be converted to binary.

In the following example, when X1 is on, the value in V1400 and V1401 is loaded into the accumulator using the Load Double instruction. The RTOB instruction converts the real value in the accumulator the equivalent binary number format. The value in the accumulator is copied to V1500 and V1501 using the Out Double instruction. The handheld programmer would display the binary value in V1500 and V1501 as a HEX value.



Handheld Programmer Keystrokes

$ STR	→	B 1	ENT					
SHFT	L ANDST	D 3	D 3	→	B 1	E 4	A 0	A 0	ENT
SHFT	R ORN	T MLR	O INST#	B 1	ENT			
GX OUT	SHFT	D 3	→	B 1	F 5	A 0	A 0	ENT

Radian Real Conversion (RADR)

DS	Used
HPP	N/A

The Radian Real Conversion instruction converts the real degree value stored in the accumulator to the equivalent real number in radians. The result resides in the accumulator.

Degree Real Conversion (DEGR)

DS32	Used
HPP	N/A

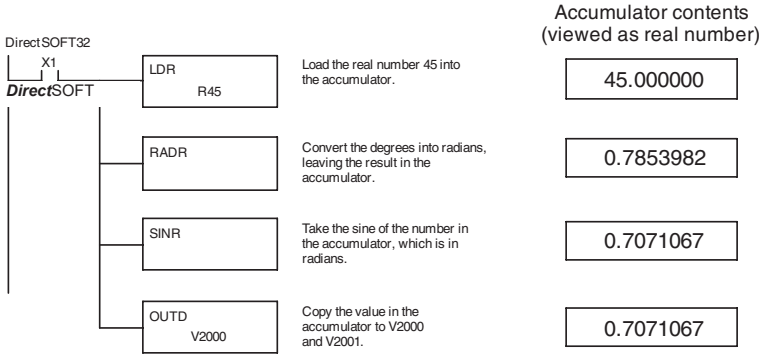
The Degree Real instruction converts the degree real radian value stored in the accumulator to the equivalent real number in degrees. The result resides in the accumulator.

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On anytime the value in the accumulator is negative.
SP72	On anytime the value in the accumulator is an invalid floating point number.
SP73	On when a signed addition or subtraction results in an incorrect sign bit.
SP75	On when a number cannot be converted to binary.

The two instructions described above convert real numbers into the accumulator from degree format to radian format, and vice-versa. In degree format, a circle contains 360 degrees. In radian format, a circle contains 2π (about 6.28) radians. These convert between both positive and negative real numbers, and for angles greater than a full circle. These functions are very useful when combined with the transcendental trigonometric functions (see the section on math instructions).

***NOTE**: The current HPP does not support real number entry with automatic conversion to the 32-bit IEEE format. You must use **Direct**SOFT for entering real numbers, using the LDR (Load Real) instruction.*

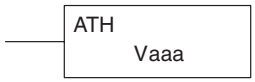
The following example takes the sine of 45 degrees. Since transcendental functions operate only on real numbers, we do an LDR (load real) 45. The trig functions operate only in radians, so we must convert the degrees to radians by using the RADR command. After using the SINR (Sine Real) instruction, we use an OUTD (Out Double) instruction to move the result from the accumulator to V-memory. The result is 32-bits wide, requiring the Out Double to move it.



ASCII to HEX (ATH)

DS	Used
HPP	N/A

The ASCII TO HEX instruction converts a table of ASCII values to a specified table of HEX values. ASCII values are two digits and their HEX equivalents are one digit. This means an ASCII table of four V-memory locations would only require two V-memory locations for the equivalent HEX table. The function parameters are loaded into the accumulator stack and the accumulator by two additional instructions. Listed below are the steps necessary to program an ASCII to HEX table function. The example on the following page shows a program for the ASCII to HEX table function.



Step 1: Load the number of V-memory locations for the ASCII table into the first level of the accumulator stack.

Step 2: Load the starting V-memory location for the ASCII table into the accumulator. This parameter must be a HEX value.

Step 3: Specify the starting V-memory location (Vaaa) for the HEX table in the ATH instruction.

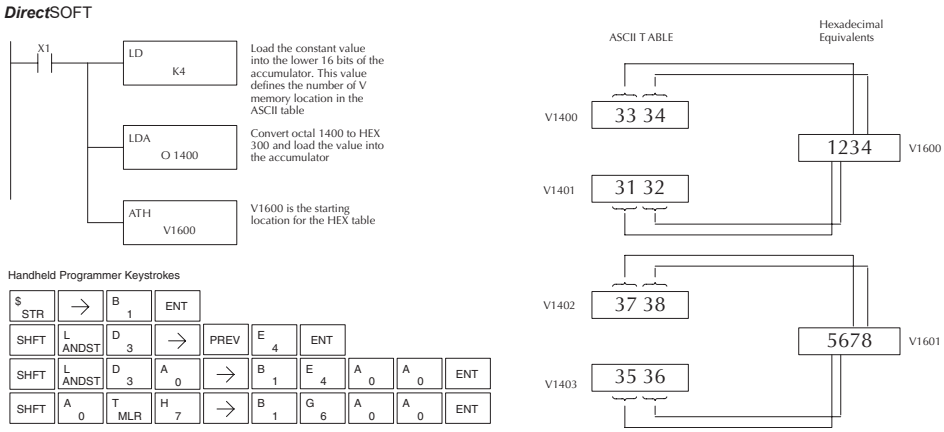
Helpful Hint: — For parameters that require HEX values when referencing memory locations, the LDA instruction can be used to convert an octal address to the HEX equivalent and load the value into the accumulator.

Operand Data Type		DL06 Range
		aaa
V-memory	V	See memory map

Discrete Bit Flags	Description
SP53	On when the value of the operand is larger than the accumulator can work with.

In the example on the following page, when X1 is ON the constant (K4) is loaded into the accumulator using the Load instruction and will be placed in the first level of the accumulator stack when the next Load instruction is executed. The starting location for the ASCII table (V1400) is loaded into the accumulator using the Load Address instruction. The starting location for the HEX table (V1600) is specified in the ASCII to HEX instruction. The table below lists valid ASCII values for ATH conversion.

ASCII Values Valid for ATH Conversion			
ASCII Value	Hex Value	ASCII Value	Hex Value
30	0	38	8
31	1	39	9
32	2	41	A
33	3	42	B
34	4	43	C
35	5	44	D
36	6	45	E
37	7	46	F



HEX to ASCII (HTA)

DS	Used
HPP	N/A

The HEX to ASCII instruction converts a table of HEX values to a specified table of ASCII values. HEX values are one digit and their ASCII equivalents are two digits.

This means a HEX table of two V-memory locations would require four V-memory locations for the equivalent ASCII table. The function parameters are loaded into the accumulator stack and the accumulator by two additional instructions. Listed below are the steps necessary to program a HEX to ASCII table function. The example on the following page shows a program for the HEX to ASCII table function.

Step 1: Load the number of V-memory locations in the HEX table into the first level of the accumulator stack.

Step 2: Load the starting V-memory location for the HEX table into the accumulator. This parameter must be a HEX value.

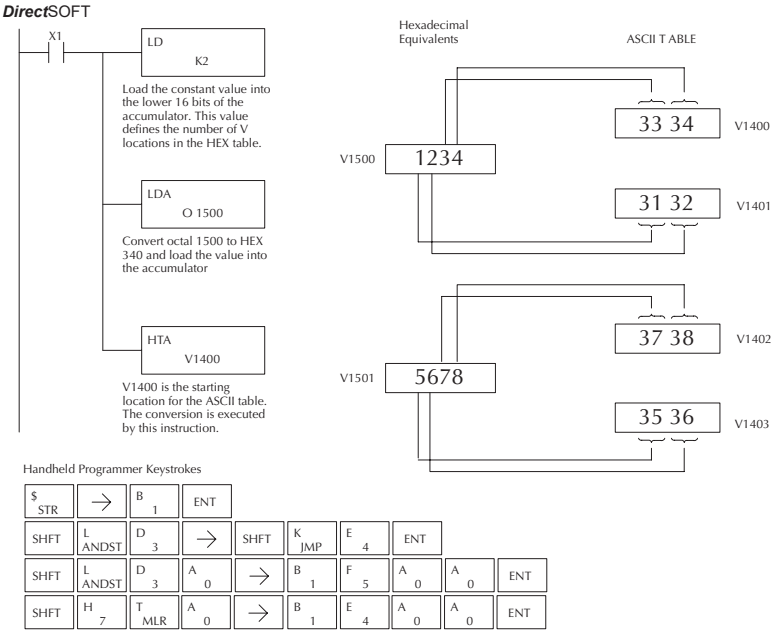
Step 3:Specify the starting V-memory location (Vaaa) for the ASCII table in the HTA instruction.

Helpful Hint: — For parameters that require HEX values when referencing memory locations, the LDA instruction can be used to convert an octal address to the HEX equivalent and load the value into the accumulator.

Operand Data Type		DL06 Range
		aaa
V-memory	V	See memory map

Discrete Bit Flags	Description
SP53	On when the value of the operand is larger than the accumulator can work with.

In the following example, when X1 is ON, the constant (K2) is loaded into the accumulator using the Load instruction. The starting location for the HEX table (V1500) is loaded into the accumulator using the Load Address instruction. The starting location for the ASCII table (V1400) is specified in the HEX to ASCII instruction.



The table below lists valid ASCII values for HTA conversion.

ASCII Values Valid for HTA Conversion			
Hex Value	ASCII Value	Hex Value	ASCII Value
0	30	8	38
1	31	9	39
2	32	A	41
3	33	B	42
4	34	C	43
5	35	D	44
6	36	E	45
7	37	F	46

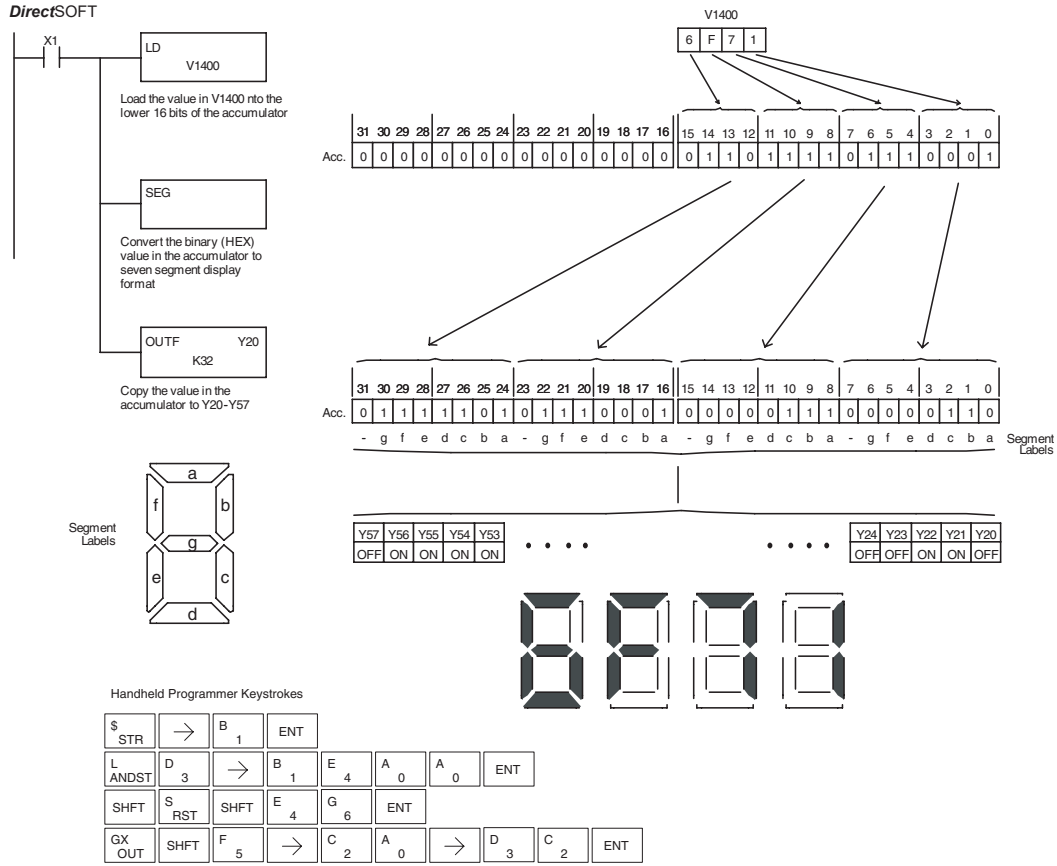
Segment (SEG)

DS	Used
HPP	Used

The BCD / Segment instruction converts a four digit HEX value in the accumulator to seven segment display format. The result resides in the accumulator.

SEG

In the following example, when X1 is on, the value in V1400 is loaded into the lower 16 bits of the accumulator using the Load instruction. The HEX value in the accumulator is converted to seven segment format using the Segment instruction. The bit pattern in the accumulator is copied to Y20–Y57 using the Out Formatted instruction.



Gray Code (GRAY)

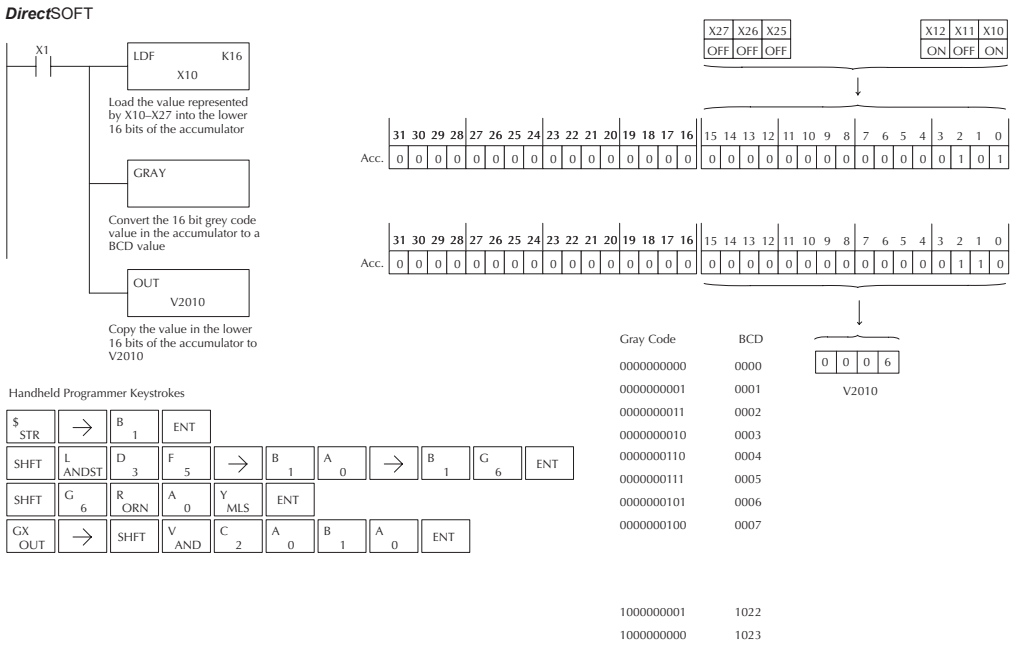
DS	Used
HPP	Used

The Gray code instruction converts a 16-bit gray code value to a BCD value. The BCD conversion requires 10 bits of the accumulator. The upper 22 bits are set to "0"

This instruction is designed for use with devices (typically encoders) that use the gray code numbering scheme. The Gray Code instruction will directly convert a gray code number to a BCD number for devices having a resolution of 512 or 1024 counts per revolution. If a device having a resolution of 360 counts per revolution is to be used, you must subtract a BCD value of 76 from the converted value to obtain the proper result. For a device having a resolution of 720 counts per revolution, you must subtract a BCD value of 152.

In the following example, when X1 is ON, the binary value represented by X10–X27 is loaded into the accumulator using the Load Formatted instruction. The gray code value in the accumulator is converted to BCD using the Gray Code instruction. The value in the lower 16 bits of the accumulator is copied to V2010.

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On anytime the value in the accumulator is negative.



Shuffle Digits (SFLDGT)

DS	Used
HPP	Used

The Shuffle Digits instruction shuffles a maximum of 8 digits, rearranging them in a specified order. This function requires parameters to be loaded into the first level of the accumulator stack and the accumulator with two additional instructions. Listed below are the steps necessary to use the shuffle digit function. The example on the following page shows a program for the Shuffle Digits function.

Step 1: Load the value (digits) to be shuffled into the first level of the accumulator stack.

Step 2: Load the order that the digits will be shuffled to into the accumulator.

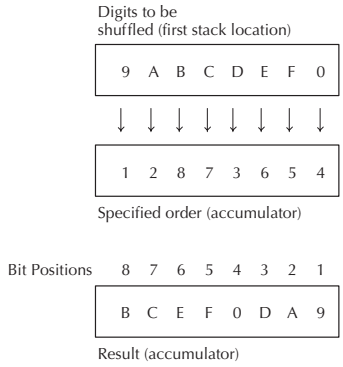
Step 3: Insert the SFLDGT instruction.

***NOTE**: If the number used to specify the order contains a 0 or 9–F, the corresponding position will be set to 0.*

Shuffle Digits Block Diagram

Discrete Bit Flags	Description
SP63	On when the result of the instruction causes the value in the accumulator to be zero.
SP70	On anytime the value in the accumulator is negative.

There are a maximum of 8 digits that can be shuffled. The bit positions in the first level of the accumulator stack define the digits to be shuffled. They correspond to the bit positions in the accumulator that define the order the digits will be shuffled. The digits are shuffled and the result resides in the accumulator.

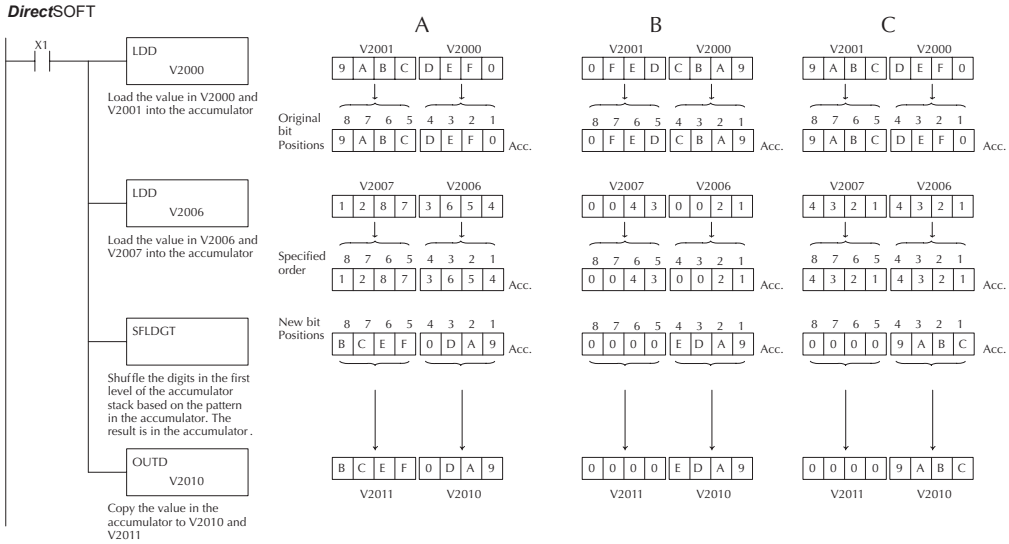


In the following example, when X1 is on, the value in the first level of the accumulator stack will be reorganized in the order specified by the value in the accumulator.

Example A shows how the shuffle digits works when 0 or 9–F is not used when specifying the order the digits are to be shuffled. Also, there are no duplicate numbers in the specified order.

Example B shows how the Shuffle Digits works when a 0 or 9–F is used when specifying the order the digits are to be shuffled. Notice when the Shuffle Digits instruction is executed, the bit positions in the first stack location that had a corresponding 0 or 9–F in the accumulator (order specified) are set to "0".

Example C shows how the Shuffle Digits works when duplicate numbers are used specifying the order the digits are to be shuffled. Notice when the Shuffle Digits instruction is executed, the most significant duplicate number in the order specified is used in the result.



Handheld Programmer Keystrokes

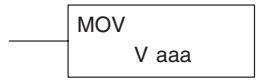
$ STR	→	B 1	ENT						
SHFT	L ANDST	D 3	D 3	→	C 2	A 0	A 0	A 0	ENT
SHFT	L ANDST	D 3	D 3	→	C 2	A 0	A 0	G 6	ENT
SHFT	S RST	SHFT	F 5	L ANDST	D 3	G 6	T MLR	ENT	
GX OUT	SHFT	D 3	→	C 2	A 0	B 1	A 0	ENT	

Table Instructions

Move (MOV)

DS	Used
HPP	Used

The Move instruction moves the values from a V-memory table to another V-memory table the same length (a table being a consecutive group of V-memory locations). The function parameters are loaded into the first level of the accumulator stack and the accumulator by two additional instructions. The MOV instruction can be used to write data to non-volatile V-memory (see Appendix F). Listed below are the steps necessary to program the MOV function.



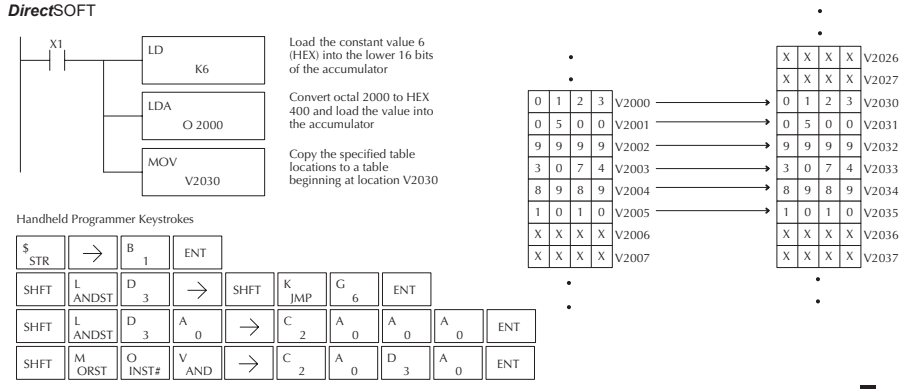
- Step 1 Load the number of V-memory locations to be moved into the first level of the accumulator stack. This parameter is a HEX value (KFFF max, 7777 octal, 4096 decimal).
- Step 2 Load the starting V-memory location for the locations to be moved into the accumulator. This parameter is a HEX value.
- Step 3 Insert the MOV instruction which specifies starting V-memory location (Vaaa) for the destination table.

Helpful Hint: — For parameters that require HEX values when referencing memory locations, the LDA instruction can be used to convert an octal address to the HEX equivalent and load the value into the accumulator.

Operand Data Type		DL06 Range
		aaa
V-memory	V	See memory map
Pointer	P	See memory map

Discrete Bit Flags	Description
SP53	On when the value of the operand is larger than the accumulator can work with.

In the following example, when X1 is on, the constant value (K6) is loaded into the accumulator using the Load instruction. This value specifies the length of the table and is placed in the first stack location after the Load Address instruction is executed. The octal address 2000 (V2000), the starting location for the source table, is loaded into the accumulator. The destination table location (V2030) is specified in the Move instruction.

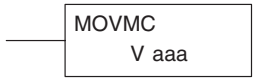


Move Memory Cartridge (MOVMC)

Load Label (LDLBL)

DS	Used
HPP	Used

The Move Memory Cartridge instruction is used to copy data between V-memory and program ladder memory. The Load Label instruction is *only* used with the MOVMC instruction when copying data *from* program ladder memory to V-memory.



To copy data between V-memory and program ladder memory, the function parameters are loaded into the first two levels of the accumulator stack and the accumulator by two additional instructions. Listed below are the steps necessary to program the MOVMC and LDLBL functions.

- Step 1: Load the number of words to be copied into the second level of the accumulator stack.
- Step 2: Load the offset for the data label area in ladder memory and the beginning of the V-memory block into the first level of the stack.
- Step 3: Load the *source data label* (LDLBL Kaaa) into the accumulator when copying data from ladder memory to V-memory. Load the *source address* into the accumulator when copying data from V-memory to ladder memory. This is where the value will be copied from. If the source address is a V-memory location, the value must be entered in HEX.
- Step 4: Insert the MOVMC instruction which specifies destination in V-memory (Vaaa). This is the copy destination.

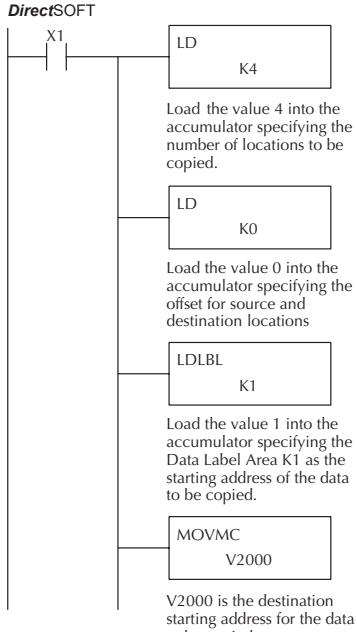
Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map

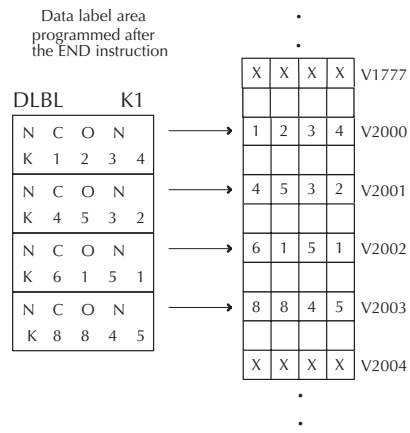
NOTE: *Refer to page 5-188 for an example.*

WARNING: The offset for this usage of the instruction starts at 0, but may be any number that does not result in data outside of the source data area being copied into the destination table. When an offset is outside of the source information boundaries, then unknown data values will be transferred into the destination table.

Copy Data From a Data Label Area to V-memory

In the example below, data is copied from a Data Label Area to V-memory. When X1 is on, the constant value (K4) is loaded into the accumulator using the Load (LD) instruction. This value specifies the length of the table and is placed in the second stack location after the next Load and Load Label (LDLBL) instructions are executed. The constant value (K0) is loaded into the accumulator, specifying the offset for the source and destination data. It is placed in the first stack location after the LDLBL instruction is executed. The source address where data is being copied from is loaded into the accumulator using the LDLBL instruction. The MOVMC instruction specifies the destination starting location and executes the copying of data from the Data Label Area to V-memory.





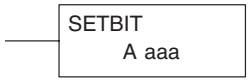
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT								
SHFT	L ANDST	D 3	→	SHFT	K JMP	E 4	ENT				
SHFT	L ANDST	D 3	→	SHFT	K JMP	A 0	ENT				
SHFT	L ANDST	D 3	L ANDST	B 1	L ANDST	→	B 1	ENT			
SHFT	M ORST	O INST#	V AND	M ORST	C 2	→	C 2	A 0	A 0	A 0	ENT

SETBIT

DS	Used
HPP	Used

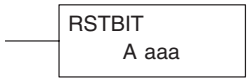
The Set Bit instruction sets a single bit to one within a range of V-memory locations.



RSTBIT

DS	Used
HPP	Used

The Reset Bit instruction resets a single bit to zero within a range of V-memory locations.



The following description applies to both the Set Bit and Reset Bit table instructions.

Step 1: Load the length of the table (number of V-memory locations) into the first level of the accumulator stack. This parameter must be a HEX value, 0 to FF.

Step 2: Load the starting V-memory location for the table into the accumulator. This parameter must be a HEX value. You can use the LDA instruction to convert an octal address to hex.

Step 3: Insert the Set Bit or Reset Bit instruction. This specifies the reference for the bit number of the bit you want to set or reset. The bit number is in octal, and the first bit in the table is number "0".

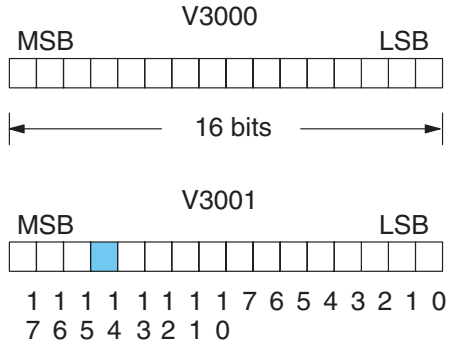
Helpful hint: — Remember that each V-memory location contains 16 bits. So, the bits of the first word of the table are numbered from 0 to 17 octal. For example, if the table length is six words, then 6 words = (6 x 16) bits, = 96 bits (decimal), or 140 octal. The permissible range of bit reference numbers would be 0 to 137 octal. SP 53 will be set if the bit specified is outside the range of the table.

Operand Data Type		DL06 Range
		aaa
V-memory	V	See memory map

Discrete Bit Flags	Description
SP53	On when the specified bit is outside the range of the table.

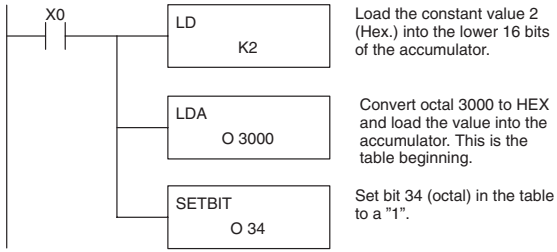
***NOTE**: Status flags are only valid until the end of the scan or until another instruction that uses the same flag is executed.*

For example, suppose we have a table starting at V3000 that is two words long, as shown to the right. Each word in the table contains 16 bits, or 0 to 17 in octal. To set bit 12 in the second word, we use its octal reference (bit 14). Then we compute the bit's octal address from the start of the table, so 17 + 14 = 34 octal. The following program shows how to set the bit as shown to a "1".



In this ladder example, we will use input X0 to trigger the Set Bit operation. First, we will load the table length (2 words) into the accumulator stack. Next, we load the starting address into the accumulator. Since V3000 is an octal number, we have to convert it to hex by using the LDA command. Finally, we use the Set Bit (or Reset Bit) instruction and specify the octal address of the bit (bit 34), referenced from the table.

DirectSOFT



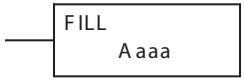
Handheld Programmer Keystrokes

$ STR	→	A 0	ENT						
SHFT	L ANDST	D 3	→	PREV	C 2	ENT			
SHFT	L ANDST	D 3	A 0	→	D 3	A 0	A 0	A 0	ENT
X SET	SHFT	B 1	I 8	T MLR	NEXT	D 3	E 4	ENT	

Fill (FILL)

DS	Used
HPP	Used

The Fill instruction fills a table of up to 255 V-memory locations with a value (Aaaa), which is either a V-memory location or a 4-digit constant. The function parameters are loaded into the first level of the accumulator stack and the accumulator by two additional instructions



Listed below are the steps necessary to program the Fill function.

Step 1: Load the number of V-memory locations to be filled into the first level of the accumulator stack. This parameter must be a HEX value, 0–FF.

Step 2: Load the starting V-memory location for the table into the accumulator. This parameter must be a HEX value.

Step 3: Insert the Fill instruction which specifies the value to fill the table with.

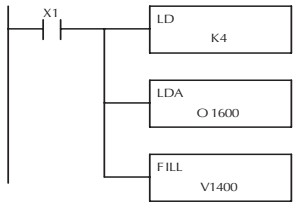
Helpful Hint: — For parameters that require HEX values when referencing memory locations, the LDA instruction can be used to convert an octal address to the HEX equivalent and load the value into the accumulator.

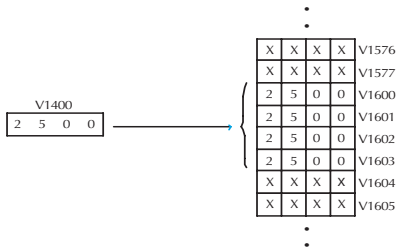
Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map
Constant	K	0–FF

Discrete Bit Flags	Description
SP53	On if the V-memory address is out of range.

In the following example, when X1 is on, the constant value (K4) is loaded into the accumulator using the Load instruction. This value specifies the length of the table and is placed on the first level of the accumulator stack when the Load Address instruction is executed. The octal address 1600 (V1600) is the starting location for the table and is loaded into the accumulator using the Load Address instruction. The value to fill the table with (V1400) is specified in the Fill instruction.

***Direct*SOFT**





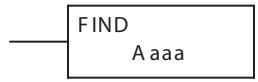
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT						
SHFT	L ANDST	D 3	→	PREV	E 4	ENT			
SHFT	L ANDST	D 3	A 0	→	B 1	G 6	A 0	A 0	ENT
SHFT	F 5	I 8	L ANDST	L ANDST	→	B 1	E 4	A 0	A 0	ENT

Find (FIND)

DS	Used
HPP	Used

The Find instruction is used to search for a specified value in a V-memory table of up to 255 locations. The function parameters are loaded into the first and second levels of the accumulator stack and the accumulator by three additional instructions.



Listed below are the steps necessary to program the Find function.

Step 1: Load the length of the table (number of V-memory locations) into the second level of the accumulator stack. This parameter must be a HEX value, 0–FF.

Step 2: Load the starting V-memory location for the table into the first level of the accumulator stack. This parameter must be a HEX value.

Step 3: Load the offset from the starting location to begin the search. This parameter must be a HEX value.

Step 4: Insert the Find instruction which specifies the first value to be found in the table.

Results:— The offset from the starting address to the first V-memory location which contains the search value (in HEX) is returned to the accumulator. SP53 will be set On if an address outside the table is specified in the offset or the value is not found. If the value is not found 0 will be returned in the accumulator.

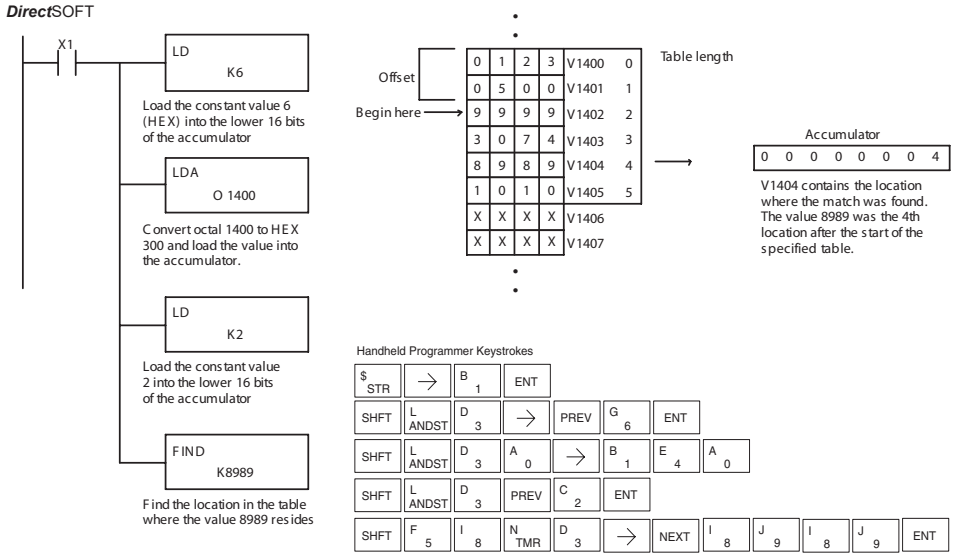
Helpful Hint: — For parameters that require HEX values when referencing memory locations, the LDA instruction can be used to convert an octal address to the HEX equivalent and load the value into the accumulator.

Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Constant	K	0–FF

Discrete Bit Flags	Description
SP53	On if there is no value in the table that is equal to the search value.

***NOTE**: Status flags are only valid until another instruction that uses the same flags is executed. The pointer for this instruction starts at 0 and resides in the accumulator.*

In the following example, when X1 is on, the constant value (K6) is loaded into the accumulator using the Load instruction. This value specifies the length of the table and is placed in the second stack location when the following Load Address and Load instruction is executed. The octal address 1400 (V1400) is the starting location for the table and is loaded into the accumulator. This value is placed in the first level of the accumulator stack when the following Load instruction is executed. The offset (K2) is loaded into the lower 16 bits of the accumulator using the Load instruction. The value to be found in the table is specified in the Find instruction. If a value is found equal to the search value, the offset (from the starting location of the table) where the value is located will reside in the accumulator.



Find Greater Than (FDGT)

The Find Greater Than instruction is used to search for the first occurrence of a value in a V-memory table that is greater than the specified value (Aaaa), which can be either a V-memory location or a 4-digit constant. The function parameters are loaded into the first level of the accumulator stack and the accumulator by two additional instructions. Listed below are the steps necessary to program the Find Greater Than function.

Step 1: Load the length of the table (up to 255 locations) into the first level of the accumulator stack. This parameter must be a HEX value, 0–FF.

Step 2: Load the starting V-memory location for the table into the accumulator. This parameter must be a HEX value.

Step 3: Insert the FDGT instruction which specifies the greater than search value. Results:— The offset from the starting address to the first V-memory location which contains the greater than search value (in HEX) which is returned to the accumulator. SP53 will be set On if the value is not found and 0 will be returned in the accumulator.

Helpful Hint: — For parameters that require HEX values when referencing memory locations, the LDA instruction can be used to convert an octal address to the HEX equivalent and load the value into the accumulator.

***NOTE**: This instruction does not have an offset, such as the one required for the FIND instruction.*

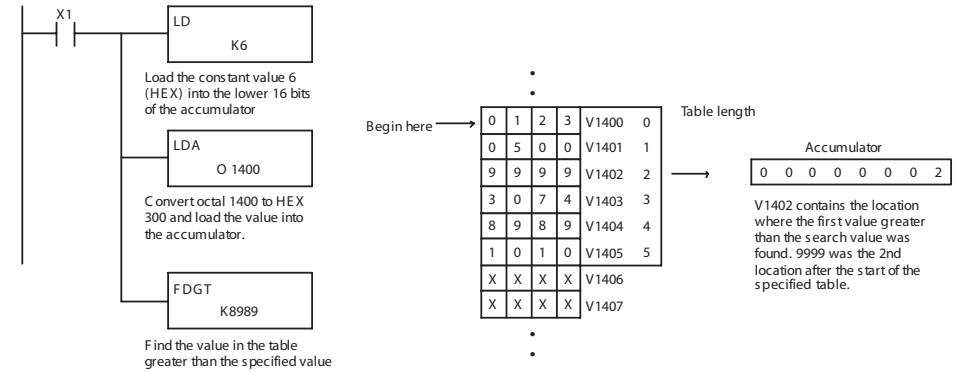
Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Constant	K	0–FF

Discrete Bit Flags	Description
SP53	On if there is no value in the table that is equal to the search value.

***NOTE**: Status flags are only valid until another instruction that uses the same flags is executed. The pointer for this instruction starts at 0 and resides in the accumulator.*

In the following example, when X1 is on, the constant value (K6) is loaded into the accumulator using the Load instruction. This value specifies the length of the table and is placed in the first stack location after the Load Address instruction is executed. The octal address 1400 (V1400) is the starting location for the table and is loaded into the accumulator. The Greater Than search value is specified in the Find Greater Than instruction. If a value is found greater than the search value, the offset (from the starting location of the table) where the value is located will reside in the accumulator. If there is no value in the table that is greater than the search value, a zero is stored in the accumulator and SP53 will come ON.

DirectSOFT



Handheld Programmer Keystrokes

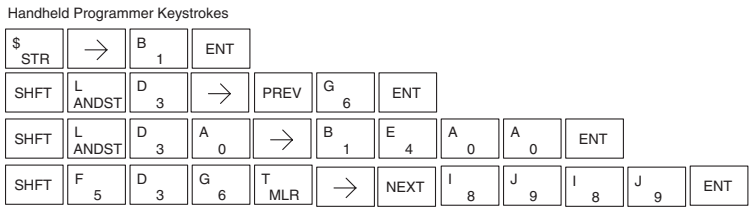
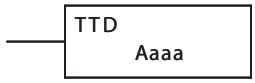


Table to Destination (TTD)

DS	Used
HPP	Used

The Table To Destination instruction moves a value from a V-memory table to a V-memory location and increments the table pointer by 1. The first V-memory location in the table contains the table pointer which indicates the next location in the table to be moved. The instruction will be executed once per scan provided the input remains on. The table pointer will reset to 1 when the value equals the last location in the table. The function parameters are loaded into the first level of the accumulator stack and the accumulator by two additional instructions.



Listed below are the steps necessary to program the Table To Destination function.

Step 1: Load the length of the data table (number of V-memory locations) into the first level of the accumulator stack. This parameter must be a HEX value, 0 to FF.

Step 2: Load the starting V-memory location for the table into the accumulator. (Remember, the starting location of the table is used as the table pointer.) This parameter must be a HEX value.

Step 3: Insert the TTD instruction which specifies destination V-memory location (Vaaa).

Helpful Hint: — For parameters that require HEX values when referencing memory locations, the LDA instruction can be used to convert an octal address to the HEX equivalent and load the value into the accumulator.

Helpful Hint: — The instruction will be executed every scan if the input logic is on. If you do not want the instruction to execute for more than one scan, a one-shot (PD) should be used in the input logic.

Helpful Hint: — The pointer location should be set to the value where the table operation will begin. The special relay SP0 or a one-shot (PD) should be used so the value will only be set in one scan and will not affect the instruction operation.

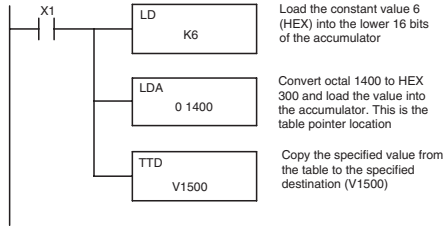
Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map

Discrete Bit Flags	Description
SP56	On when the table pointer equals the table length.

NOTE: *Status flags (SPs) are only valid until another instruction that uses the same flag is executed, or the end of the scan. The pointer for this instruction starts at 0 and resets when the table length is reached. At first glance it may appear that the pointer should reset to 0. However, it resets to 1, not 0.*

In the following example, when X1 is on, the constant value (K6) is loaded into the accumulator using the Load instruction. This value specifies the length of the table and is placed in the first stack location after the Load Address instruction is executed. The octal address 1400 (V1400) is the starting location for the source table and is loaded into the accumulator. Remember, V1400 is used as the pointer location, and is not actually part of the table data source. The destination location (V1500) is specified in the Table to Destination instruction. The table pointer (V1400 in this case) will be increased by "1" after each execution of the TTD instruction.

DirectSOFT

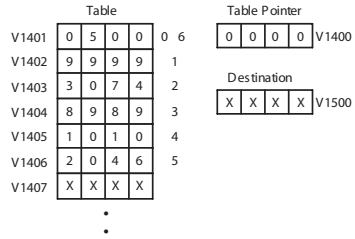


Handheld Programmer Keystrokes

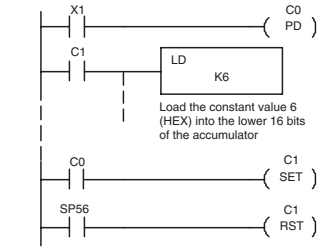
$ STR	→	B 1	ENT						
SHFT	L ANDST	D 3	→	PREV	G 6	ENT			
SHFT	L ANDST	D 3	A 0	→	B 1	E 4	A 0	A 0	ENT
SHFT	T MLR	T MLR	D 3	→	B 1	F 5	A 0	A 0	ENT

It is important to understand how the table locations are numbered. If you examine the example table, you'll notice that the first data location, V1401, will be used when the pointer is equal to zero, and again when the pointer is equal to six. Why? Because the pointer is only equal to zero before the very first execution. From then on, it increments from one to six, and then resets to one.

Also, our example uses a normal input contact (X1) to control the execution. Since the CPU scan is extremely fast, and the pointer increments automatically, the table would cycle through the locations very quickly. If this is a problem, you have an option of using SP56 in conjunction with a one-shot (PD) and a latch (C1 for example) to allow the table to cycle through all locations one time and then stop. The logic shown here is not required, it's just an optional method.

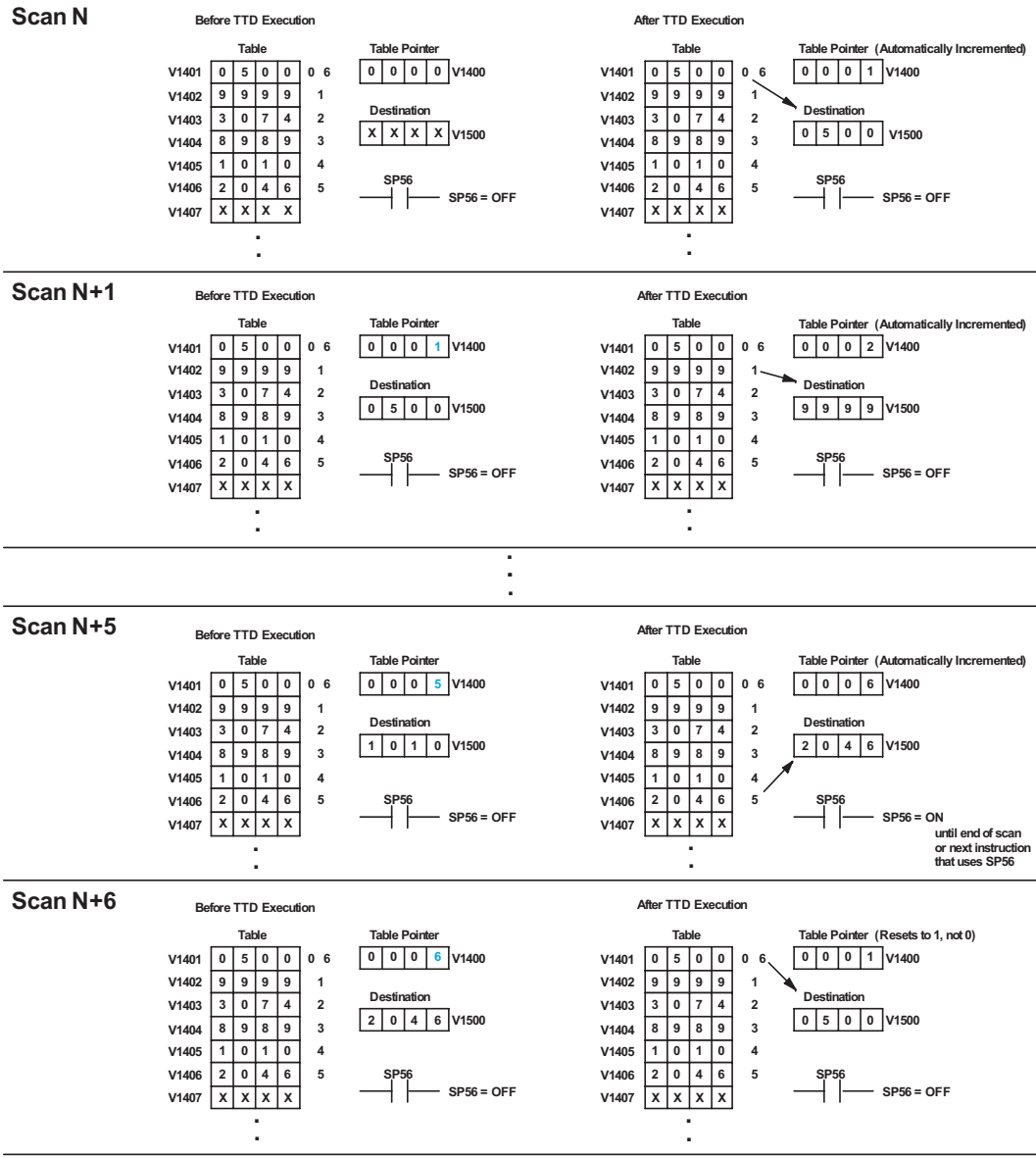


DirectSOFT (optional latch example using SP56)



Since Special Relays are reset at the end of the scan, this latch must follow the TTD instruction in the program

The following diagram shows the scan-by-scan results of the execution for our example program. Notice how the pointer automatically cycles from 0 – 6, and then starts over at 1 instead of 0. Also, notice how SP56 is only on until the end of the scan.



Remove from Bottom (RFB)

DS	Used
HPP	Used

The Remove From Bottom instruction moves a value from the bottom of a V-memory table to a V-memory location and decrements a table pointer by 1. The first V-memory location in the table contains the table pointer which indicates the next location in the table to be moved. The instruction will be executed once per scan provided the input remains on. The instruction will stop operation when the pointer equals 0. The function parameters are loaded into the first level of the accumulator stack and the accumulator by two additional instructions. Listed below are the steps necessary to program the Remove From Bottom function.

Step 1: Load the length of the table (number of V-memory locations) into the first level of the accumulator stack. This parameter must be a HEX value, 0 to FF.

Step 2: Load the starting V-memory location for the table into the accumulator. (Remember, the starting location of the table blank is used as the table pointer.) This parameter must be a HEX value.

Step 3: Insert the RFB instruction which specifies destination V-memory location (Vaaa).

Helpful Hint: — For parameters that require HEX values when referencing memory locations, the LDA instruction can be used to convert an octal address to the HEX equivalent and load the value into the accumulator.

Helpful Hint: — The instruction will be executed every scan if the input logic is on. If you do not want the instruction to execute for more than one scan, a one-shot (PD) should be used in the input logic.

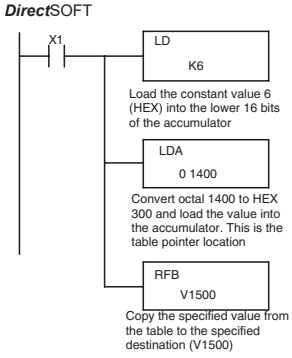
Helpful Hint: — The pointer location should be set to the value where the table operation will begin. The special relay SP0 or a one-shot (PD) should be used so the value will only be set in one scan and will not affect the instruction operation.

Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map

Discrete Bit Flags	Description
SP56	On when the table pointer equals zero..

***NOTE**: Status flags (SPs) are only valid until another instruction that uses the same flag is executed or the end of the scan The pointer for this instruction can be set to start anywhere in the table. It is not set automatically. You must load a value into the pointer somewhere in your program.*

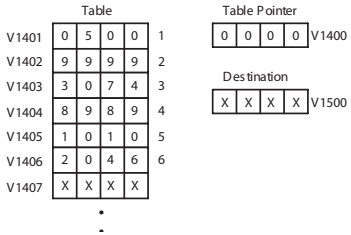
In the following example, when X1 is on, the constant value (K6) is loaded into the accumulator using the Load instruction. This value specifies the length of the table and is placed in the first stack location after the Load Address instruction is executed. The octal address 1400 (V1400) is the starting location for the source table and is loaded into the accumulator. Remember, V1400 is used as the pointer location, and is not actually part of the table data source. The destination location (V1500) is specified in the Remove From Bottom. The table pointer (V1400 in this case) will be decremented by "1" after each execution of the RFB instruction.



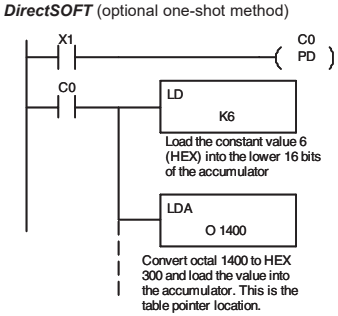
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT						
SHFT	L ANDST	D 3	→	PREV	G 6	ENT			
SHFT	L ANDST	D 3	A 0	→	B 1	E 4	A 0	A 0	ENT
SHFT	R ORN	F 5	B 1	→	B 1	F 5	A 0	A 0	ENT

It is important to understand how the table locations are numbered. If you examine the example table, you'll notice that the first data location, V1401, will be used when the pointer is equal to one. The second data location, V1402, will be used when the pointer is equal to two, etc.



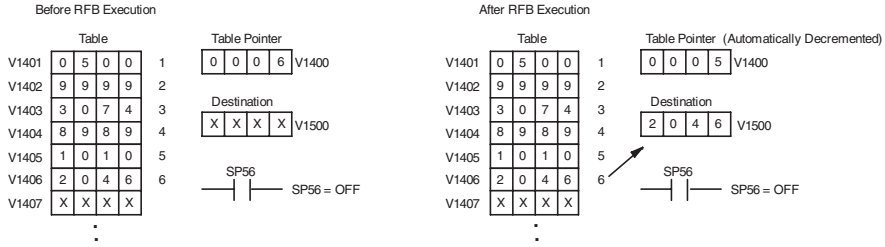
Also, our example uses a normal input contact (X1) to control the execution. Since the CPU scan is extremely fast, and the pointer decrements automatically, the table would cycle through the locations very quickly. If this is a problem for your application, you have an option of using a one-shot (PD) to remove one value each time the input contact transitions from low to high.



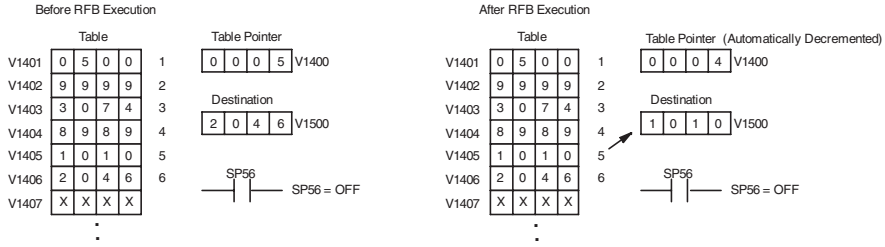
The following diagram shows the scan-by-scan results of the execution for our example program. Notice how the pointer automatically decrements from 6 to 0. Also, notice how SP56 is only on until the end of the scan.

Example of Execution

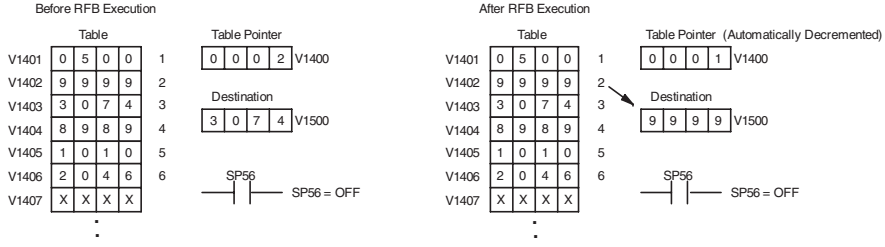
Scan N



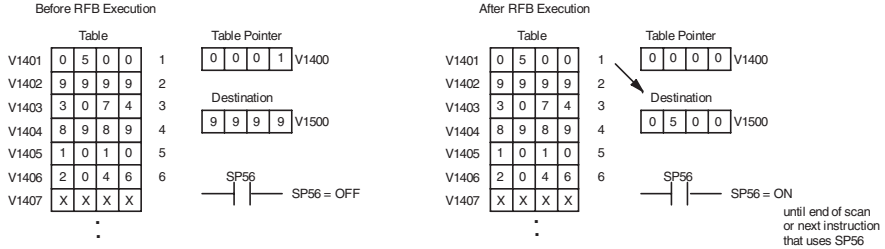
Scan N+1



Scan N+4



Scan N+5



Source to Table (STT)

DS	Used
HPP	Used

The Source To Table instruction moves a value from a V-memory location into a V-memory table and increments a table pointer by 1. When the table pointer reaches the end of the table, it resets to 1. The first V-memory location in the table contains the table pointer which indicates the next location in the table to store a value. The instruction will be executed once per scan, provided the input remains on. The function parameters are loaded into the first level of the accumulator stack and the accumulator with two additional instructions.

Listed below are the steps necessary to program the Source To Table function.

Step 1: Load the length of the table (number of V-memory locations) into the first level of the accumulator stack. This parameter must be a HEX value, 0 to FF.

Step 2: Load the starting V-memory location for the table into the accumulator. (Remember, the starting location of the table is used as the table pointer.) This parameter must be a HEX value.

Step 3: Insert the STT instruction which specifies the source V-memory location (Vaaa). This is where the value will be moved from.

Helpful Hint: — For parameters that require HEX values when referencing memory locations, the LDA instruction can be used to convert an octal address to the HEX equivalent and load the value into the accumulator.

Helpful Hint:— The instruction will be executed every scan if the input logic is on. If you do not want the instruction to execute for more than one scan, a one-shot (PD) should be used in the input logic.

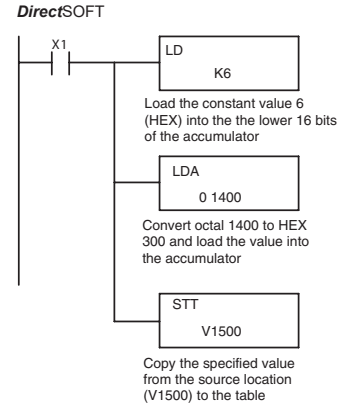
Helpful Hint: — The table counter value should be set to indicate the starting point for the operation. Also, it must be set to a value that is within the length of the table. For example, if the table is 6 words long, then the allowable range of values that could be in the pointer should be between 0 and 6. If the value is outside of this range, the data will not be moved. Also, a one-shot (PD) should be used so the value will only be set in one scan and will not affect the instruction operation.

Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map

Discrete Bit Flags	Description
SP56	On when the table pointer equals the table length.

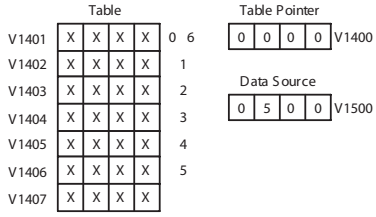
***NOTE**: Status flags (SPs) are only valid until another instruction that uses the same flag is executed, or the end of the scan. The pointer for this instruction starts at 0 and resets to 1 automatically when the table length is reached.*

In the following example, when X1 is on, the constant value (K6) is loaded into the accumulator using the Load instruction. This value specifies the length of the table and is placed in the first stack location after the Load Address instruction is executed. The octal address 1400 (V1400), which is the starting location for the destination table and table pointer, is loaded into the accumulator. The data source location (V1500) is specified in the Source to Table instruction. The table pointer will be increased by "1" after each time the instruction is executed.



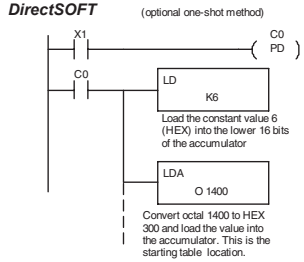
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT						
SHFT	L ANDST	D 3	→	PREV	G 6	ENT			
SHFT	L ANDST	D 3	A 0	→	B 1	E 4	A 0	A 0	ENT
SHFT	S RST	SHFT	T MLR	T MLR	→	B 1	F 5	A 0	A 0	ENT

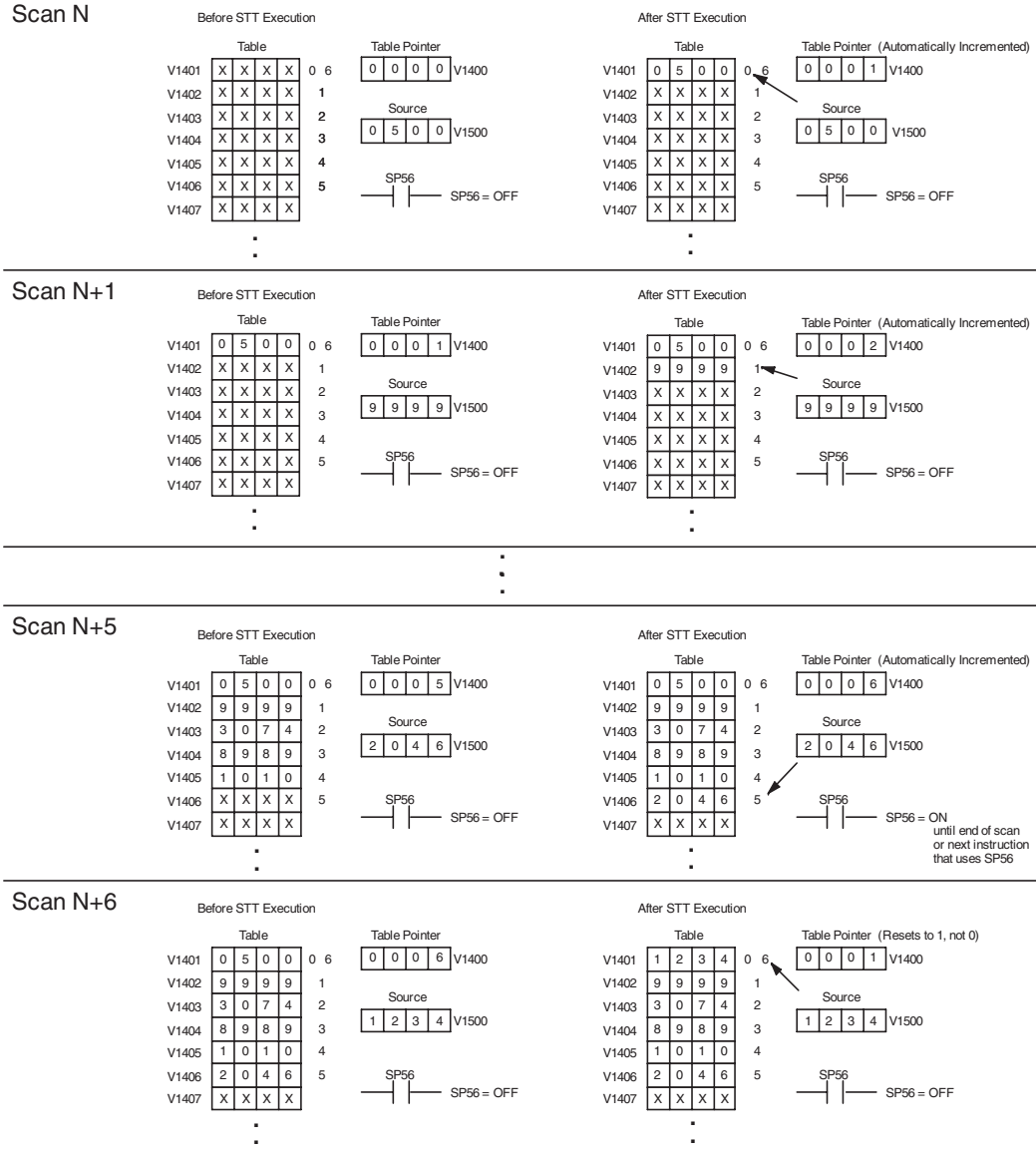


It is important to understand how the table locations are numbered. If you examine the example table, you'll notice that the first data storage location, V1401, will be used when the pointer is equal to zero, and again when the pointer is equal to six. Why? Because the pointer is only equal to zero before the very first execution. From then on, it increments from one to six, and then resets to one.

Also, our example uses a normal input contact (X1) to control the execution. Since the CPU scan is extremely fast, and the pointer increments automatically, the source data would be moved into all the table locations very quickly. If this is a problem for your application, you have an option of using a one-shot (PD) to move one value each time the input contact transitions from low to high.



The following diagram shows the scan-by-scan results of the execution for our example program. Notice how the pointer automatically cycles from 0 to 6, and then starts over at 1 instead of 0. Also, notice how SP56 is affected by the execution. Although our example does not show it, we are assuming that there is another part of the program that changes the value in V1500 (data source) prior to the execution of the STT instruction. This is not required, but it makes it easier to see how the data source is copied into the table.



Remove from Table (RFT)

DS	Used
HPP	Used

The Remove From Table instruction pops a value off a table and stores it in a V-memory location. When a value is removed from the table all other values are shifted up 1 location. The first V-memory location in the table contains the table length counter. The table counter decrements by 1 each time the instruction is executed. If the length counter is zero or greater than the maximum table length (specified in the first level of the accumulator stack) the instruction will not execute and SP56 will be On.

The instruction will be executed once per scan, provided the input remains on. The function parameters are loaded into the first level of the accumulator stack and the accumulator by two additional instructions. Listed below are the steps necessary to program the Remove From Table function.

Step 1: Load the length of the table (number of V-memory locations) into the first level of the accumulator stack. This parameter must be a HEX value, 0 to FF.

Step 2: Load the starting V-memory location for the table into the accumulator. (Remember, the starting location of the table is used as the table length counter.) This parameter must be a HEX value.

Step 3: Insert the RFT instructions which specifies destination V-memory location (Vaaa). This is where the value will be moved to.

Helpful Hint: — For parameters that require HEX values when referencing memory locations, the LDA instruction can be used to convert an octal address to the HEX equivalent and load the value into the accumulator.

Helpful Hint:— The instruction will be executed every scan if the input logic is on. If you do not want the instruction to execute for more than one scan, a one-shot (PD) should be used in the input logic.

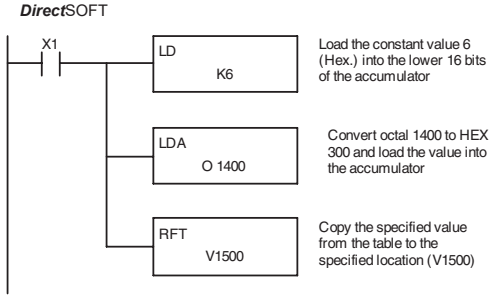
Helpful Hint: — The table counter value should be set to indicate the starting point for the operation. Also, it must be set to a value that is within the length of the table. For example, if the table is 6 words long, then the allowable range of values that could be in the table counter should be between 1 and 6. If the value is outside of this range or zero, the data will not be moved from the table. Also, a one-shot (PD) should be used so the value will only be set in one scan and will not affect the instruction operation.

Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map

Discrete Bit Flags	Description
SP56	On when the table pointer equals zero.

***NOTE**: Status flags (SPs) are only valid until another instruction that uses the same flag is executed, or the end of the scan The pointer for this instruction can be set to start anywhere in the table. It is not set automatically. You must load a value into the pointer somewhere in your program.*

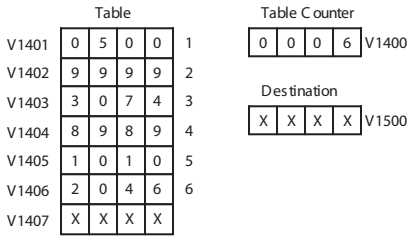
In the following example, when X1 is on, the constant value (K6) is loaded into the accumulator using the Load instruction. This value specifies the length of the table and is placed in the first stack location after the Load Address instruction is executed. The octal address 1400 (V1400) is the starting location for the source table and is loaded into the accumulator. The destination location (V1500) is specified in the Remove from Table instruction. The table counter will be decreased by "1" after the instruction is executed.



Handheld Programmer Keystrokes

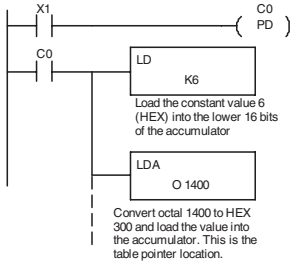
$ STR	→	B 1	ENT					
SHFT	L ANDST	D 3	→	PREV	G 6	ENT		
SHFT	L ANDST	D 3	A 0	→	B 1	E 4	A 0	A 0	ENT
SHFT	R ORN	F 5	T MLR	→	B 1	F 5	A 0	A 0	ENT

Since the table counter specifies the range of data that will be removed from the table, it is important to understand how the table locations are numbered. If you examine the example table, you'll notice that the data locations are numbered from the top of the table. For example, if the table counter started at 6, then all six of the locations would be affected during the instruction execution.

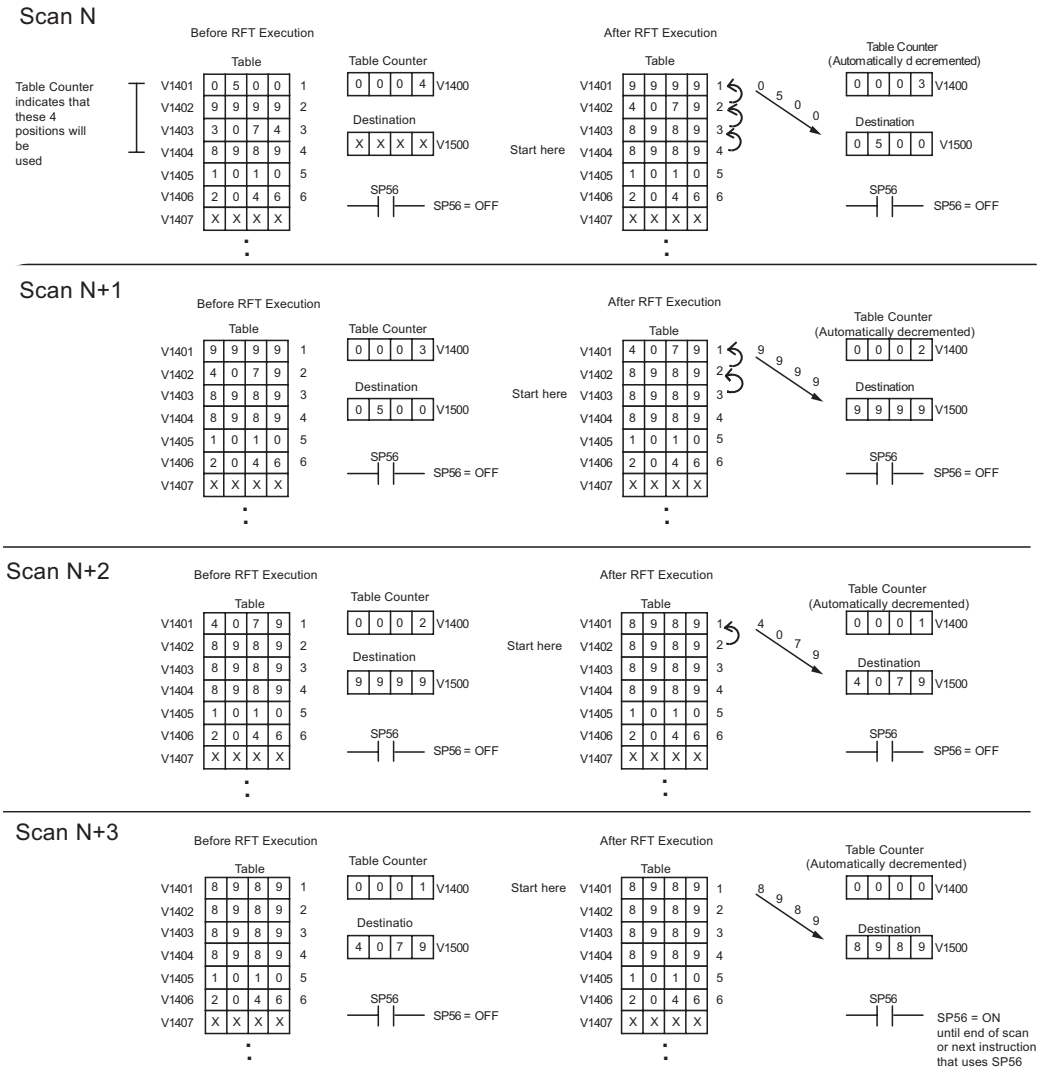


Also, our example uses a normal input contact (X1) to control the execution. Since the CPU scan is extremely fast, and the pointer decrements automatically, the data would be removed from the table very quickly. If this is a problem for your application, you have an option of using a one-shot (PD) to remove one value each time the input contact transitions from low to high.

DirectSOFT32 Display (optional one-shot method)



The following diagram shows the scan-by-scan results of the execution for our example program. In our example, we show the table counter set to 4, initially. (Remember, you can set the table counter to any value that is within the range of the table.) The table counter automatically decrements from 4 to 0 as the instruction is executed. Notice how the last two table positions, 5 and 6, are not moved up through the table. Also, notice that SP56, which comes on when the table counter is zero, is only on until the end of the scan.



Add to Top (ATT)

DS	Used
HPP	Used

The Add To Top instruction pushes a value on to a V-memory table from a V-memory location. When the value is added to the table all other values are pushed down 1 location.

The instruction will be executed once per scan, provided the input remains on. The function parameters are loaded into the first level of the accumulator stack and the accumulator by two additional instructions. Listed below are the steps necessary to program the Add To Top function.

Step 1: Load the length of the table (number of V-memory locations) into the first level of the accumulator stack. This parameter must be a HEX value, 0 to FF.

Step 2: Load the starting V-memory location for the table into the accumulator. (Remember, the starting location of the table is used as the table length counter.) This parameter must be a HEX value.

Step 3: Insert the ATT instructions which specifies source V-memory location (Vaaa). This is where the value will be moved from.

Helpful Hint:— The instruction will be executed every scan if the input logic is on. If you do not want the instruction to execute for more than one scan, a one-shot (PD) should be used in the input logic.

Helpful Hint: — For parameters that require HEX values when referencing memory locations, the LDA instruction can be used to convert an octal address to the HEX equivalent and load the value into the accumulator.

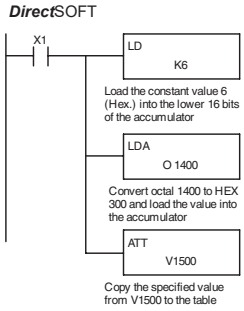
Helpful Hint: — The table counter value should be set to indicate the starting point for the operation. Also, it must be set to a value that is within the length of the table. For example, if the table is 6 words long, then the allowable range of values that could be in the table counter should be between 1 and 6. If the value is outside of this range or zero, the data will not be moved into the table. Also, a one-shot (PD) should be used so the value will only be set in one scan and will not affect the instruction operation.

Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map

Discrete Bit Flags	Description
SP56	On when the table pointer equal to the table size.

***NOTE**: Status flags (SPs) are only valid until another instruction that uses the same flag is executed or the end of the scan. The pointer for this instruction can be set to start anywhere in the table. It is not set automatically. You must load a value into the pointer somewhere in your program.*

In the following example, when X1 is on, the constant value (K6) is loaded into the accumulator using the Load instruction. This value specifies the length of the table and is placed in the first stack location after the Load Address instruction is executed. The octal address 1400 (V1400), which is the starting location for the destination table and table counter, is loaded into the accumulator. The source location (V1500) is specified in the Add to Top instruction. The table counter will be increased by "1" after the instruction is executed.



Handheld Programmer Keystrokes

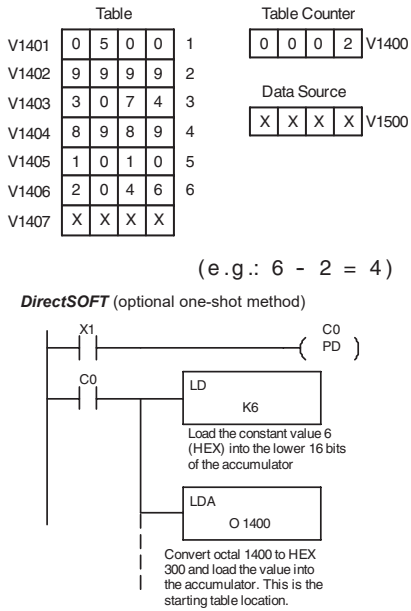
$ STR	→	B 1	ENT							
SHFT	L ANDST	D 3	→	PREV	G 6	ENT				
SHFT	L ANDST	D 3	A 0	→	B 1	E 4	A 0	A 0	ENT	
SHFT	A 0	T MLR	T MLR	→	B 1	F 5	A 0	A 0	ENT	

For the ATT instruction, the table counter determines the number of additions that can be made before the instruction will stop executing. So, it is helpful to understand how the system uses this counter to control the execution.

For example, if the table counter was set to 2, and the table length was 6 words, then there could only be 4 additions of data before the execution was stopped. This can easily be calculated by:

Table length – table counter = number of executions

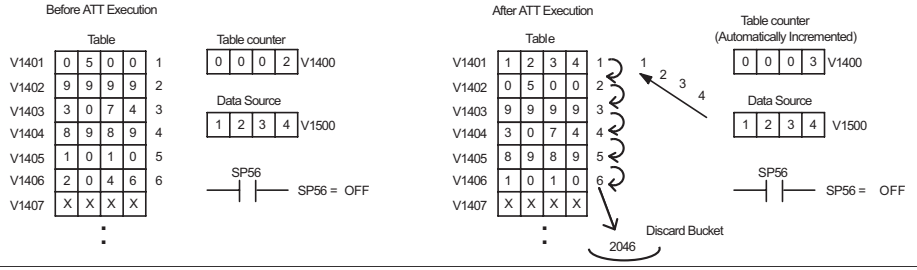
Also, our example uses a normal input contact (X1) to control the execution. Since the CPU scan is extremely fast, and the table counter increments automatically, the data would be moved into the table very quickly. If this is a problem for your application, you have an option of using a one-shot (PD) to add one value each time the input contact transitions from low to high.



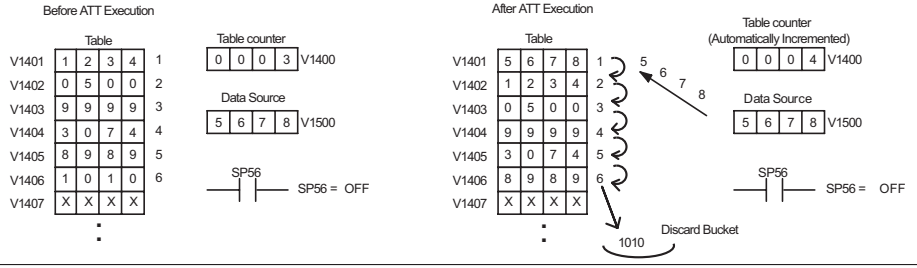
The following diagram shows the scan-by-scan results of the execution for our example program. The table counter is set to 2 initially, and it will automatically increment from 2 to 6 as the instruction is executed. Notice how SP56 comes on when the table counter is 6, which is equal to the table length. Plus, although our example does not show it, we are assuming that there is another part of the program that changes the value in V1500 (data source) prior to the execution of the ATT instruction.

Example of Execution

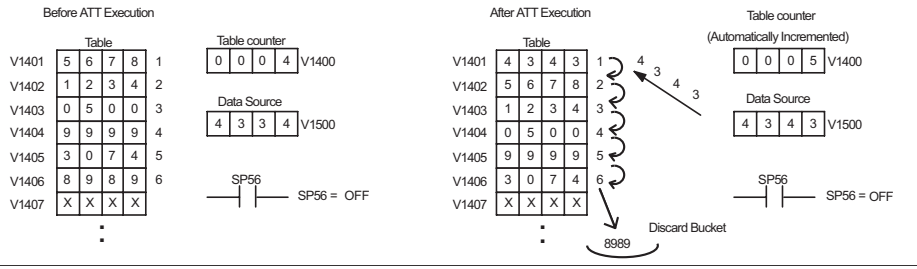
Scan N



Scan N+1



Scan N+2



Scan N+3

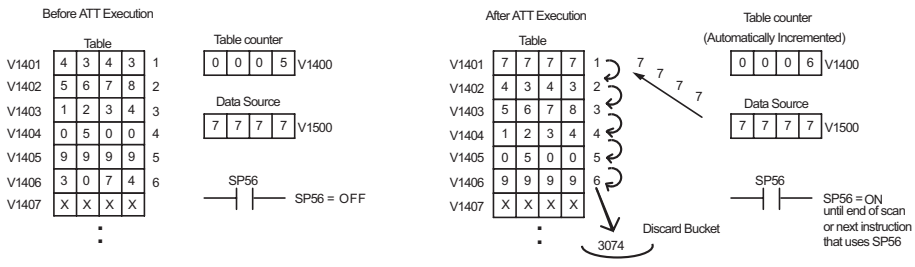


Table Shift Left (TSHFL)

DS	Used
HPP	Used

The Table Shift Left instruction shifts all the bits in a V-memory table to the left, the specified number of bit positions.

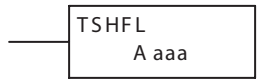
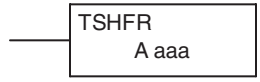


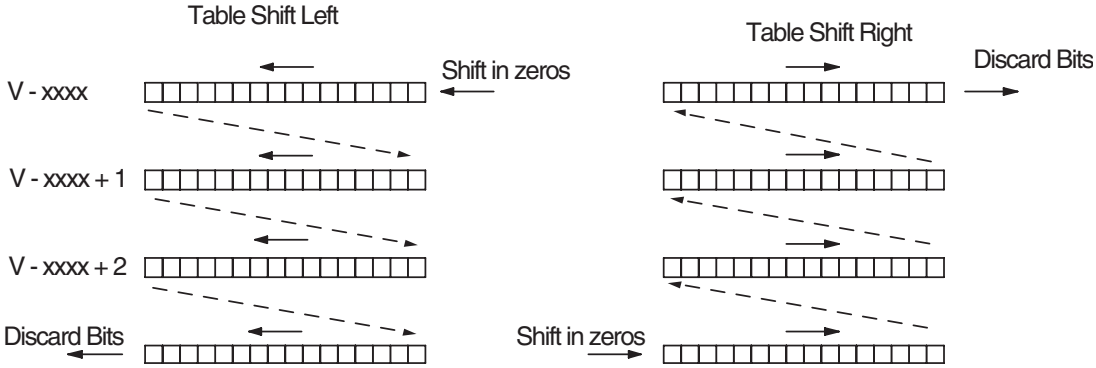
Table Shift Right (TSHFR)

DS	Used
HPP	Used

The Table Shift Right instruction shifts all the bits in a V-memory table to the right, a specified number of bit positions.



The following description applies to both the Table Shift Left and Table Shift Right instructions. A table is just a range of V-memory locations. The Table Shift Left and Table Shift Right instructions shift bits serially throughout the entire table. Bits are shifted out the end of one word and into the opposite end of an adjacent word. At the ends of the table, bits are either discarded, or zeros are shifted into the table. The example tables below are arbitrarily four words long.



Step 1: Load the length of the table (number of V-memory locations) into the first level of the accumulator stack. This parameter must be a HEX value, 0 to FF.

Step 2: Load the starting V-memory location for the table into the accumulator. This parameter must be a HEX value. You can use the LDA instruction to convert an octal address to hex.

Step 3: Insert the Table Shift Left or Table shift Right instruction. This specifies the number of bit positions you wish to shift the entire table. The number of bit positions must be in octal.

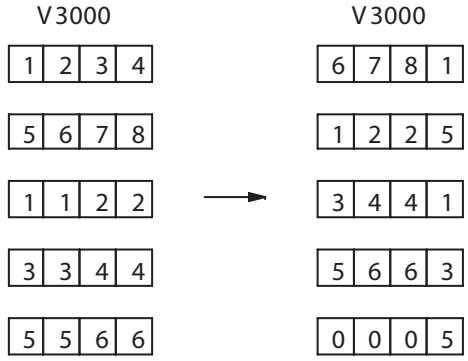
Helpful hint: — Remember that each V-memory location contains 16 bits. So, the bits of the first word of the table are numbered from 0 to 17 octal. If you want to shift the entire table by 20 bits, that is 24 octal. SP 53 will be set if the number of bits to be shifted is larger than the total bits contained within the table. Flag 67 will be set if the last bit shifted (just before it is discarded) is a "1".

Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map

Discrete Bit Flags	Description
SP53	On when the number of bits to be shifted is larger than the total bits contained within the table
SP67	On when the last bit shifted (just before it is discarded) is a **1**

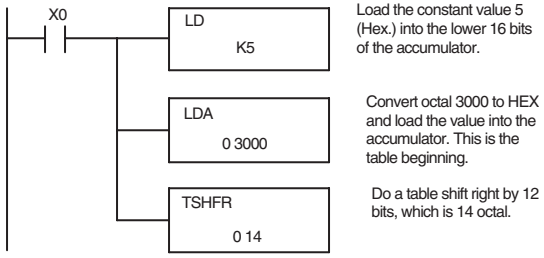
NOTE: *Status flags are only valid until the end of the scan or another instruction that uses the same flag is executed.*

The example table to the right contains BCD data as shown (for demonstration purposes). Suppose we want to do a table shift right by 3 BCD digits (12 bits). Converting to octal, 12 bits is 14 octal. Using the Table Shift Right instruction and specifying a shift by octal 14, we have the resulting table shown at the far right. Notice that the 2–3–4 sequence has been discarded, and the 0–0–0 sequence has been shifted in at the bottom.



The following ladder example assumes the data at V3000 to V3004 already exists as shown above. We will use input X0 to trigger the Table Shift Right operation. First, we will load the table length (5 words) into the accumulator stack. Next, we load the starting address into the accumulator. Since V3000 is an octal number, we have to convert it to hex by using the LDA command. Finally, we use the Table Shift Right instruction and specify the number of bits to be shifted (12 decimal), which is 14 octal.

DirectSOFT



Handheld Programmer Keystrokes

$ STR	→	A 0	ENT										
SHFT	L ANDST	D 3	→	PREV	F 5	ENT							
SHFT	L ANDST	D 3	A 0	→	D 3	A 0	A 0	A 0	ENT				
SHFT	T MLR	SHFT	S RST	H 7	F 5	R ORN	→	NEXT	B 1	E 4	ENT		

AND Move (ANDMOV)

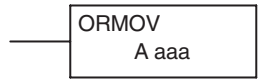
DS	Used
HPP	Used

The AND Move instruction copies data from a table to the specified memory location, ANDing each word with the accumulator data as it is written.

OR Move (ORMOV)

DS	Used
HPP	Used

The OR Move instruction copies data from a table to the specified memory location, ORing each word with the accumulator contents as it is written



Exclusive OR Move (XORMOV)

DS	Used
HPP	Used

The Exclusive OR Move instruction copies data from a table to the specified memory location, XORing each word with the accumulator value as it is written.

The following description applies to the AND Move, OR Move, and Exclusive OR Move instructions. A table is just a range of V-memory locations. These instructions copy the data of a table to another specified location, preforming a logical operation on each word with the accumulator contents as the new table is written.

Step 1: Load the length of the table (number of V-memory locations) into the first level of the accumulator stack. This parameter must be a HEX value, 0 to FF.

Step 2: Load the starting V-memory location for the table into the accumulator. This parameter must be a HEX value. You can use the LDA instruction to convert an octal address to hex.

Step 3: Load the BCD/hex bit pattern into the accumulator which will be logically combined with the table contents as they are copied.

Step 4: Insert the AND Move, OR Move, or XOR Move instruction. This specifies the starting location of the copy of the original table. This new table will automatically be the same length as the original table.

Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map

The example table to the right contains BCD data as shown (for demonstration purposes). Suppose we want to move a table of two words at V3000 and AND it with K6666. The copy of the table at V3100 shows the result of the AND operation for each word.

The program on the next page performs the ANDMOV operation example above. It assumes that the data in the table at V3000 – V3001 already exists. First we load the table length (two words) into the accumulator. Next we load the starting address of the source table, using the LDA instruction. Then we load the data into the accumulator to be ANDed with the table. In the ANDMOV command, we specify the table destination, V3100.

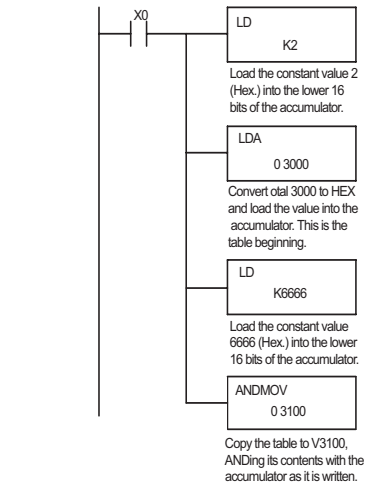
Handheld Programmer Keystrokes

$ STR	→	A 0	ENT						
SHFT	L ANDST	D 3	→	PREV	C 2	ENT			
SHFT	L ANDST	D 3	A 0	→	D 3	A 0	A 0	A 0	ENT
SHFT	L ANDST	D 3	→	PREV	G 6	G 6	G 6	G 6	ENT
V AND	SHFT	M ORST	O INST#	V AND	→	D 3	B 1	A 0	A 0	ENT

The example on top the right shows a table of two words at V3000 and logically ORs it with K8888. The copy of the table at V3100 shows the result of the OR operation for each word.

The program to the right performs the ORMOV example above. It assumes that the data in the table at V3000 – V3001 already exists. First we load the table length (two words) into the accumulator. Next we load the starting address of the source table, using the LDA instruction. Then we load the data into the accumulator to be OR'd with the table. In the ORMOV command, we specify the table destination, V3100.

DirectSOFT



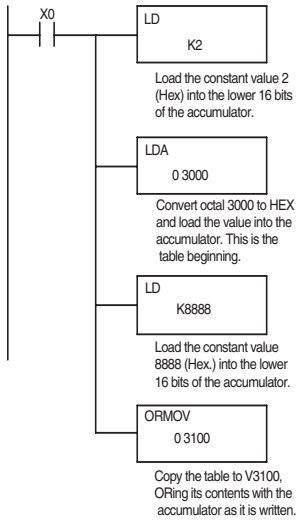
Handheld Programmer Keystrokes

$ STR	→	A 0	ENT						
SHFT	L ANDST	D 3	→	PREV	C 2	ENT			
SHFT	L ANDST	D 3	A 0	→	D 3	A 0	A 0	A 0	ENT
SHFT	L ANDST	D 3	→	PREV	I 8	I 8	I 8	I 8	ENT
Q OR	SHFT	M ORST	O INST#	V AND	→	D 3	B 1	A 0	A 0	ENT

The example to the right shows a table of two words at V3000 and logically XORs it with K3333. The copy of the table at V3100 shows the result of the XOR operation for each word.

The ladder program example for the XORMOV is similar to the one above for the ORMOV. Just use the XORMOV instruction. On the handheld programmer, you must use the SHFT key and spell "XORMOV" explicitly.

DirectSOFT



Find Block (FINDB)

DS	Used
HPP	N/A

The Find Block instruction searches for an occurrence of a specified block of values in a V-memory table. The function parameters are loaded into the first and second levels of the accumulator stack and the accumulator by three additional instructions. If the block is found, its starting address will be stored in the accumulator. If the block is not found, flag SP53 will be set.

Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
V-memory	P	See memory map

Discrete Bit Flags	Description
SP56	On when the specified block is not found.

The steps listed below are the steps necessary to program the Find Block function.

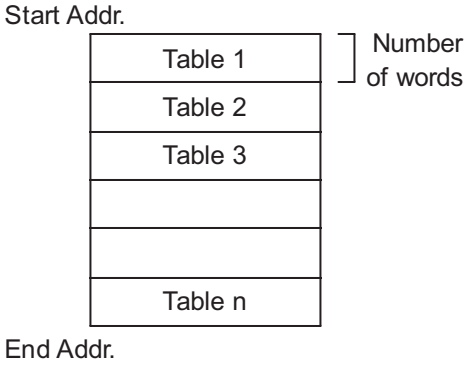
Step 1: Load the number of bytes in the block to be located. This parameter must be a HEX value, 0 to FF.

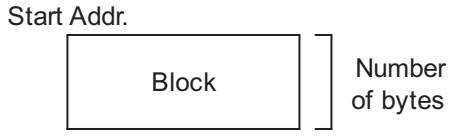
Step 2: Load the length of a table (number of words) to be searched. The Find Block will search multiple tables that are adjacent in V-memory. This parameter must be a HEX value, 0 to FF.

Step 3: Load the ending location for all the tables into the accumulator. This parameter must be a HEX value. You can use the LDA instruction to convert an octal address to hex.

Step 4: Load the table starting location for all the tables into the accumulator. This parameter must be a HEX value. You can use the LDA instruction to convert an octal address to hex.

Step 5: Insert the Find Block instruction. This specifies the starting location of the block of data you are trying to locate.

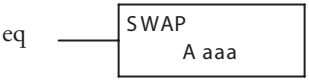




Swap (SWAP)

DS	Used
HPP	Used

The Swap instruction exchanges the data in two tables of eq length.



Step 1: Load the length of the tables (number of V-memory locations) into the first level of the accumulator stack. This parameter must be a HEX value, 0 to FF. Remember that the tables must be of equal length.

Step 2: Load the starting V-memory location for the first table into the accumulator. This parameter must be a HEX value. You can use the LDA instruction to convert an octal address to hex.

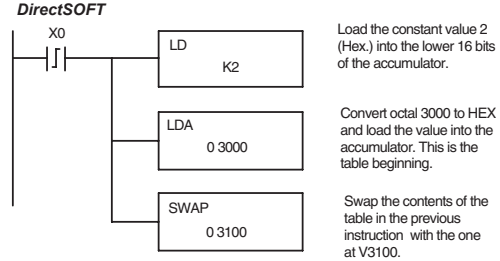
Step 3: Insert the Swap instruction. This specifies the starting address of the second table. This parameter must be a HEX value. You can use the LDA instruction to convert an octal address to hex.

Helpful hint: — The data swap occurs within a single scan. If the instruction executes on multiple consecutive scans, it will be difficult to know the actual contents of either table at any particular time. So, remember to swap just on a single scan.

Operand Data Type		DL06 Range
		aaa
V-memory	V	See memory map

The example to the right shows a table of two words at V3000. We will swap its contents with another table of two words at 3100 by using the Swap instruction. The required ladder program is given below.

The example program below uses a PD contact (triggers for one scan for off-to-on transition). First, we load the length of the tables (two words) into the accumulator. Then we load the address of the first table (V3000) into the accumulator using the LDA instruction, converting the octal address to hex. Note that it does not matter which table we declare "first", because the swap results will be the same.



Handheld Programmer Keystrokes

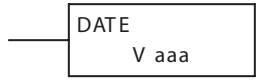
$ STR	SHFT	P CV	D 3	→	A 0	ENT			
SHFT	L ANDST	D 3	→	PREV	C 2	ENT			
SHFT	L ANDST	D 3	A 0	→	D 3	A 0	A 0	A 0	ENT
SHFT	S RST	SHFT	W ANDN	A 0	P CV	→	D 3	B 1	A 0	A 0	ENT

Clock/Calendar Instructions

Date (DATE)

DS	Used
HPP	Used

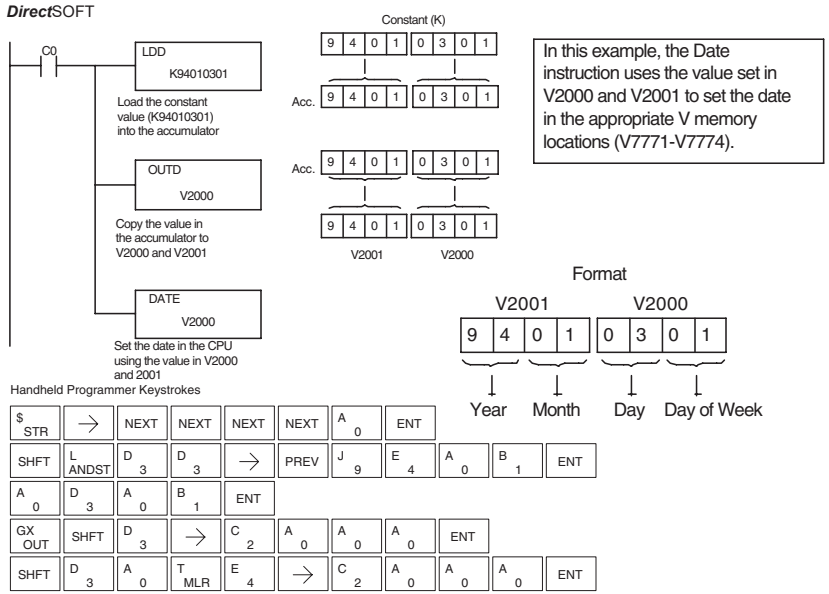
The Date instruction can be used to set the date in the CPU. The instruction requires two consecutive V-memory locations (Vaaa) to set the date. If the values in the specified locations are not valid, the date will not be set. The current date can be read from 4 consecutive V-memory locations (V7771–V7774).



In the following example, when C0 is on, the constant value (K94010301) is loaded into the accumulator using the Load Double instruction (C0 should be a contact from a one-shot (PD) instruction). The value in the accumulator is output to V2000 using the Out Double instruction. The Date instruction uses the value in V2000 to set the date in the CPU.

Date	Range	V-memory Location (BCD) (READ Only)
Year	0-99	V7774
Month	1-12	V7773
Day	1-31	V7772
Day of Week	0-06	V7771
The values entered for the day of week are: 0=Sunday, 1=Monday, 2=Tuesday, 3=Wednesday, 4=Thursday, 5=Friday, 6=Saturday		

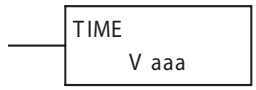
Operand Data Type		DL06 Range
		aaa
V-memory	V	See memory map



Time (TIME)

DS	Used
HPP	Used

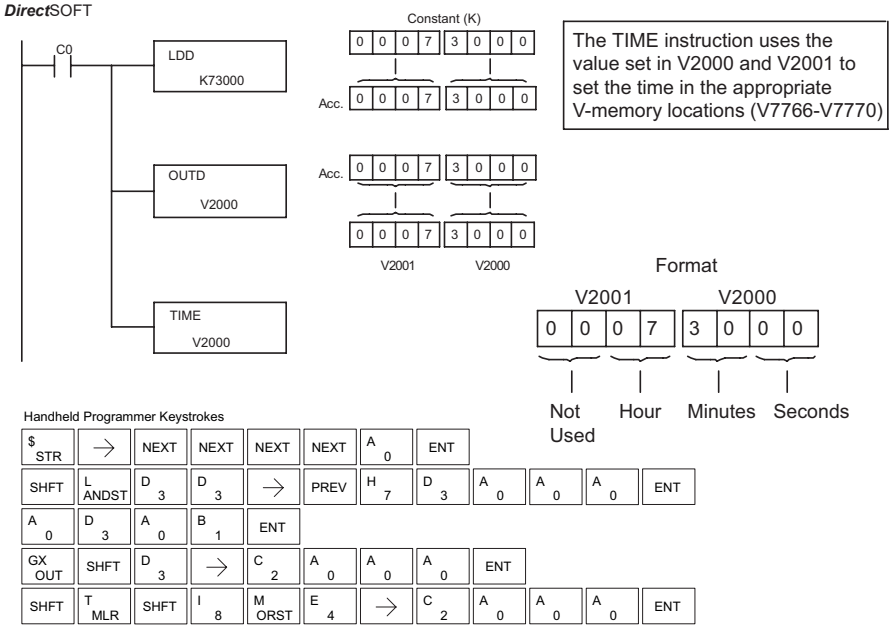
The Time instruction can be used to set the time (24 hour clock) in the CPU. The instruction requires two consecutive V-memory locations (Vaaa) which are used to set the time. If the values in the specified locations are not valid, the time will not be set. The current time can be read from memory locations V7747 and V7766–V7770.



Date	Range	VMemory Location (BCD) (READ Only)
1/100 seconds (10ms)	0-99	V7747
Seconds	0-59	V7766
Minutes	0-59	V7767
Hour	0-23	V7770

Operand Data Type		DL06 Range
		aaa
V-memory	V	See memory map

In the following example, when C0 is on, the constant value (K73000) is loaded into the accumulator using the Load Double instruction (C0 should be a contact from a one-shot (PD) instruction). The value in the accumulator is output to V2000 using the Out Double instruction. The Time instruction uses the value in V2000 to set the time in the CPU.



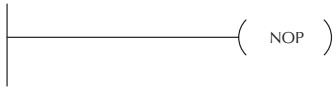
CPU Control Instructions

No Operation (NOP)

DS	Used
HPP	Used

The No Operation is an empty (not programmed) memory location.

*Direct*SOFT



Handheld Programmer Keystrokes

SHFT	N TMR	O INST#	P CV	ENT

End (END)

DS	Used
HPP	Used

The End instruction marks the termination point of the normal program scan. An End instruction is required at the end of the main program body. If the End instruction is omitted, an error will occur and the CPU will not enter the Run Mode. Data labels, subroutines and interrupt routines are placed after the End instruction. The End instruction is not conditional; therefore, no input contact is allowed.

*Direct*SOFT

Handheld Programmer Keystrokes

SHFT	E 4	N TMR	D 3	ENT

Stop (STOP)

DS	Used
HPP	Used

The Stop instruction changes the operational mode of the CPU from Run to Program (Stop) mode. This instruction is typically used to stop PLC operation in an error condition.

In the following example, when C0 turns on, the CPU will stop operation and switch to the program mode.

*Direct*SOFT

Handheld Programmer Keystrokes

$ STR	→	SHFT	C 2	A 0	ENT	
SHFT	S RST	SHFT	T MLR	O INST#	P CV	ENT

Discrete Bit Flags	Description
SP16	On when the DL06 goes into the TERM_PRG mode.
SP53	On when the DL06 goes into the PRG mode.

Reset Watch Dog Timer (RSTWT)

DS	Used
HPP	Used

The Reset Watch Dog Timer instruction resets the CPU scan timer. The default setting for the watch dog timer is 200ms. Scan times very seldom exceed 200ms, but it is possible. For/next loops, subroutines, interrupt routines, and table instructions can be programmed such that the scan becomes longer than 200ms. When instructions are used in a manner that could exceed the watch dog timer setting, this instruction can be used to reset the timer.

A software timeout error (E003) will occur and the CPU will enter the program mode if the scan time exceeds the watch dog timer setting. Placement of the RSTWT instruction in the program is very important. The instruction has to be executed before the scan time exceeds the watch dog timer's setting.

If the scan time is consistently longer than the watch dog timer's setting, the timeout value may be permanently increased from the default value of 200ms by AUX 55 on the HPP or the appropriate auxiliary function in your programming package. This eliminates the need for the RSTWT instruction.

In the following example, the CPU scan timer will be reset to 0 when the RSTWT instruction is executed. See the For/Next instruction for a detailed example.

DirectSOFT

Handheld Programmer Keystrokes

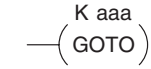
SHFT	R ORN	S RST	T MLR	W ANDN	T MLR	ENT

Program Control Instructions

Goto Label (GOTO) (LBL)

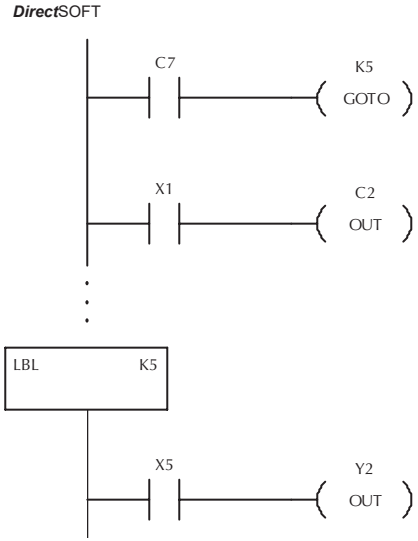
DS	Used
HPP	Used

The Goto / Label skips all instructions between the Goto and the corresponding LBL instruction. The operand value for the Goto and the corresponding LBL instruction are the same. The logic between Goto and LBL instruction is not executed when the Goto instruction is enabled. Up to 256 Goto instructions and 256 LBL instructions can be used in the program.



Operand Data Type		DL06 Range
		aaa
Constant	K	1-FFFF

In the following example, when C7 is on, all the program logic between the GOTO and the corresponding LBL instruction (designated with the same constant Kaaa value) will be skipped. The instructions being skipped will not be executed by the CPU.



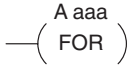
Handheld Programmer Keystrokes

$ STR	→	SHFT	C 2	H 7	ENT	
SHFT	G 6	O INST#	T MLR	O INST#	→	F 5	ENT
$ STR	→	B 1	ENT			
GX OUT	→	SHFT	C 2	C 2	ENT	
⋮						
SHFT	L ANDST	B 1	L ANDST	→	F 5	ENT
$ STR	→	F 5	ENT			
GX OUT	→	C 2	ENT			

For / Next (FOR) (NEXT)

DS	Used
HPP	Used

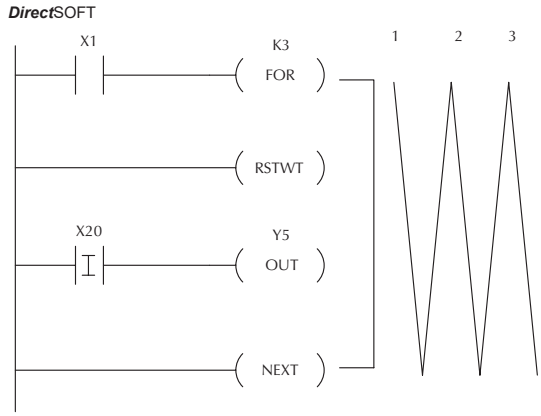
The For and Next instructions are used to execute a section of ladder logic between the For and Next instruction a specified numbers of times. When the For instruction is enabled, the program will loop the specified number of times. If the For instruction is not energized, the section of ladder logic between the For and Next instructions is not executed.



For / Next instructions cannot be nested. The normal I/O update and CPU housekeeping are suspended while executing the For / Next loop. The program scan can increase significantly, depending on the amount of times the logic between the For and Next instruction is executed. With the exception of immediate I/O instructions, I/O will not be updated until the program execution is completed for that scan. Depending on the length of time required to complete the program execution, it may be necessary to reset the watch dog timer inside of the For / Next loop using the RSTWT instruction.

Operand Data Type		DL06 Range
		aaa
V-memory	V	See memory map
Constant	K	1-9999

In the following example, when X1 is on, the application program inside the For / Next loop will be executed three times. If X1 is off, the program inside the loop will not be executed. The immediate instructions may or may not be necessary, depending on your application. Also, The RSTWT instruction is not necessary if the For / Next loop does not extend the scan time beyond the Watch Dog Timer setting. For more information on the Watch Dog Timer, refer to the RSTWT instruction.



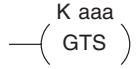
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT			
SHFT	F 5	O INST#	R ORN	→	D 3	ENT
SHFT	R ORN	S RST	T MLR	W ANDN	T MLR	ENT
$ STR	SHFT	I 8	→	C 2	A 0	ENT
GX OUT	→	F 5	ENT			
SHFT	N TMR	E 4	X SET	T MLR	ENT	

Goto Subroutine (GTS) (SBR)

DS	Used
HPP	Used

The Goto Subroutine instruction allows a section of ladder logic to be placed outside the main body of the program, to execute only when needed. There can be a maximum of 256 GTS instructions and 256 SBR instructions used in a program. The GTS instructions can be nested up to 8 levels. An error E412 will occur if the maximum limits are exceeded. Typically this will be used in an application where a block of program logic may be slow to execute and is not required to execute every scan. The subroutine label and all associated logic is placed after the End statement in the program. When the subroutine is called from the main program, the CPU will execute the subroutine (SBR) with the same constant number (K) as the GTS instruction which called the subroutine.



By placing code in a subroutine it is only scanned and executed when needed, since it resides after the End instruction. Code which is not scanned does not impact the overall scan time of the program.

Operand Data Type		DL06 Range
		aaa
Constant	K	1-FFFF

Subroutine Return (RT)

DS	Used
HPP	Used

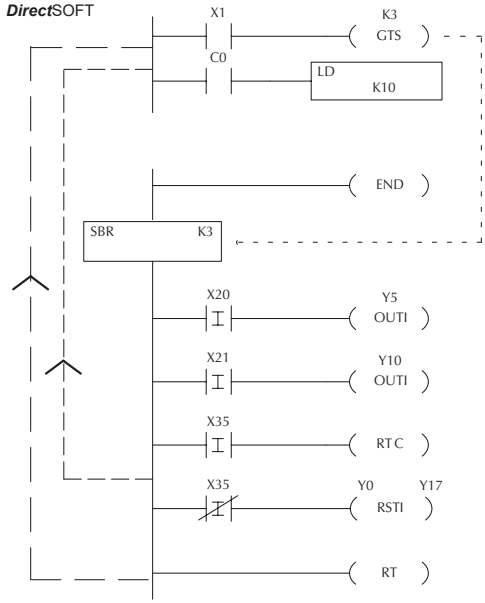
When a Subroutine Return is executed in the subroutine the CPU will return to the point in the main body of the program from which it was called. The Subroutine Return is used as termination of the subroutine. It must be the last instruction in the subroutine and is a stand alone instruction (no input contact on the rung).

Subroutine Return Conditional (RTC)

DS	Used
HPP	Used

The Subroutine Return Conditional instruction is an optional instruction used with an input contact to implement a conditional return from the subroutine. The Subroutine Return (RT) is still required for termination of the Subroutine.

In the following example, when X1 is on, Subroutine K3 will be called. The CPU will jump to the Subroutine Label K3 and the ladder logic in the subroutine will be executed. If X35 is on, the CPU will return to the main program at the RTC instruction. If X35 is not on, Y0–Y17 will be reset to off and the CPU will return to the main body of the program.



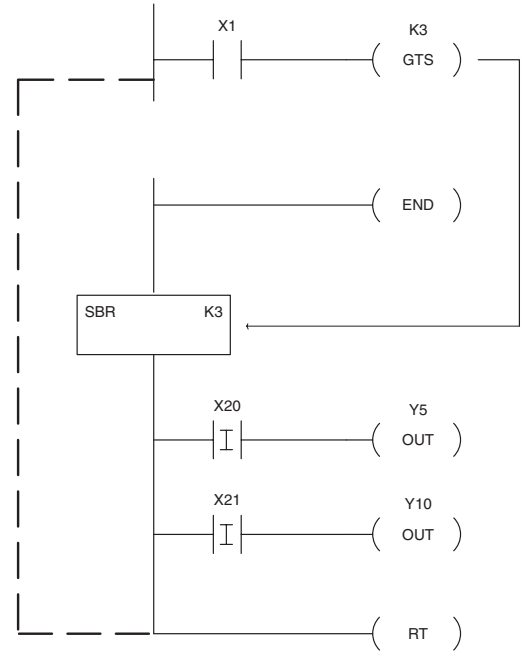
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT				
SHFT	G 6	T MLR	S RST	→	D 3	ENT	

SHFT	E 4	N TMR	D 3	ENT			
SHFT	S RST	SHFT	B 1	R ORN	→	D 3	ENT
$ STR	SHFT	I 8	→	C 2	A 0	ENT	
GX OUT	SHFT	I 8	→	F 5	ENT		
$ STR	SHFT	I 8	→	C 2	B 1	ENT	
GX OUT	SHFT	I 8	→	B 1	A 0	ENT	
$ STR	SHFT	I 8	→	D 3	F 5	ENT	
SHFT	R ORN	T MLR	C 2	ENT			
SP STRN	SHFT	I 8	→	D 3	F 5	ENT	
S RST	SHFT	I 8	→	A 0	→	B 1	H 7	ENT
SHFT	R ORN	T MLR	ENT				

In the following example, when X1 is on, Subroutine K3 will be called. The CPU will jump to the Subroutine Label K3 and the ladder logic in the subroutine will be executed. The CPU will return to the main body of the program after the RT instruction is executed.

DirectSOFT



Handheld Programmer Keystrokes

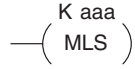
$ STR	→	B 1	ENT				
SHFT	G 6	T MLR	S RST	→	D 3	ENT	

SHFT	E 4	N TMR	D 3	ENT			
SHFT	S RST	SHFT	B 1	R ORN	→	D 3	ENT
$ STR	SHFT	I 8	→	C 2	A 0	ENT	
GX OUT	→	F 5	ENT				
$ STR	SHFT	I 8	→	C 2	B 1	ENT	
GX OUT	→	B 1	A 0	ENT			
SHFT	R ORN	T MLR	ENT				

Master Line Set (MLS)

DS	Used
HPP	Used

The Master Line Set instruction allows the program to control sections of ladder logic by forming a new power rail controlled by the main left power rail. The main left rail is always master line 0. When an MLS K1 instruction is used, a new power rail is created at level 1. Master Line Sets and Master Line Resets can be used to nest power rails up to seven levels deep.

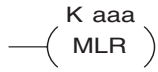


Operand Data Type		DL06 Range
		aaa
Constant	K	1-FFFF

Master Line Reset (MLR)

DS	Used
HPP	Used

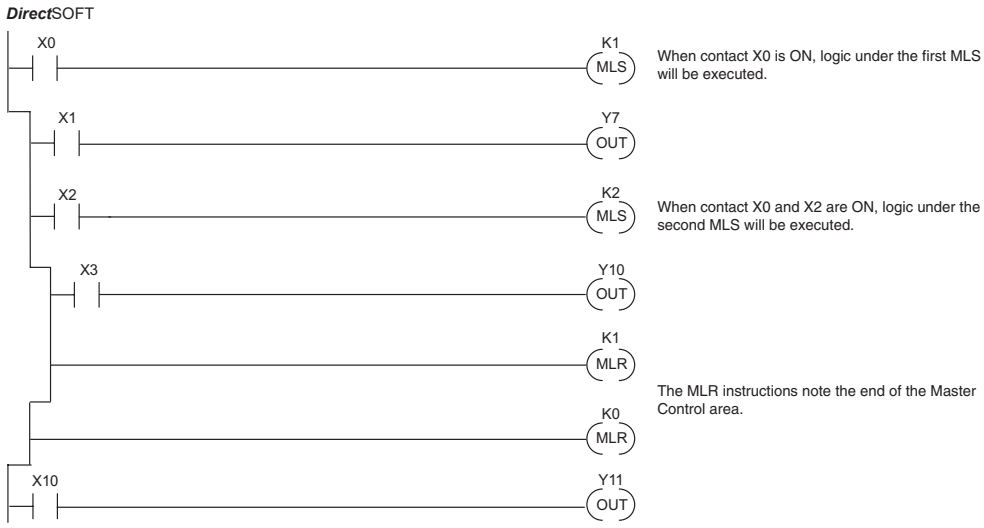
The Master Line Reset instruction marks the end of control for the corresponding MLS instruction. The MLR reference is one less than the corresponding MLS.



Operand Data Type		DL06 Range
		aaa
Constant	K	1-FFFF

Understanding Master Control Relays

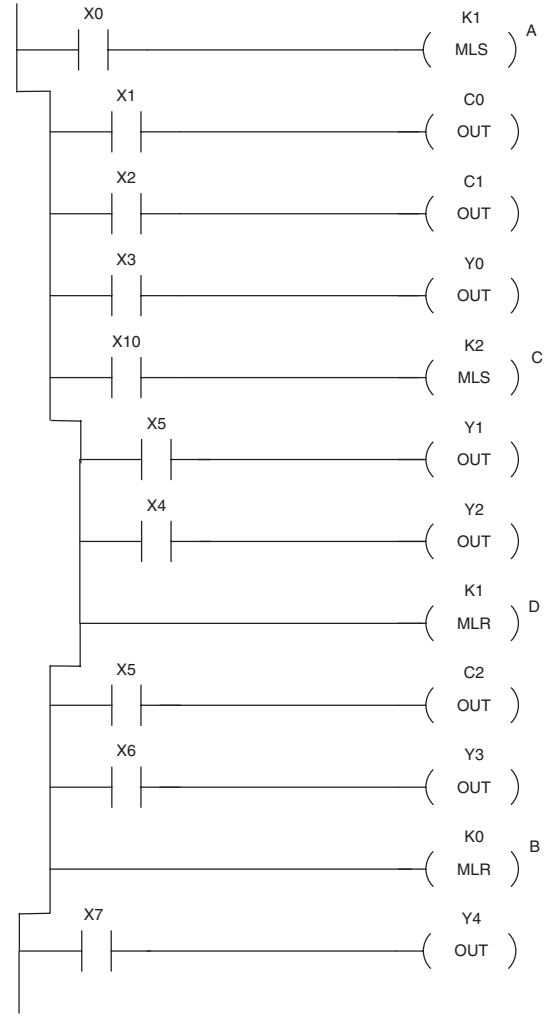
The Master Line Set (MLS) and Master Line Reset (MLR) instructions allow you to quickly enable (or disable) sections of the RLL program. This provides program control flexibility. The following example shows how the MLS and MLR instructions operate by creating a sub power rail for control logic.



MLS/MLR Example

In the following MLS/MLR example logic between the first MLS K1 (A) and MLR K0 (B) will function only if input X0 is on. The logic between the MLS K2 (C) and MLR K1 (D) will function only if input X10 and X0 is on. The last rung is not controlled by either of the MLS coils.

DirectSOFT



Handheld Programmer Keystrokes

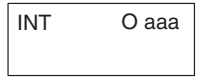
$ STR	→	A 0	ENT			
Y MLS	→	B 1	ENT			
$ STR	→	B 1	ENT			
GX OUT	→	SHFT	C 2	A 0	ENT	
$ STR	→	C 2	ENT			
GX OUT	→	SHFT	C 2	B 1	ENT	
$ STR	→	D 3	ENT			
GX OUT	→	A 0	ENT			
$ STR	→	B 1	A 0	ENT		
Y MLS	→	C 2	ENT			
$ STR	→	F 5	ENT			
GX OUT	→	B 1	ENT			
$ STR	→	E 4	ENT			
GX OUT	→	C 2	ENT			
T MLR	→	B 1	ENT			
$ STR	→	F 5	ENT			
GX OUT	→	SHFT	C 2	C 2	ENT	
$ STR	→	G 6	ENT			
GX OUT	→	D 3	ENT			
T MLR	→	A 0	ENT			
$ STR	→	H 7	ENT			
GX OUT	→	E 4	C 2	ENT		

Interrupt Instructions

Interrupt (INT)

DS	Used
HPP	Used

The Interrupt instruction allows a section of ladder logic to be placed below the main body of the program and executed only when needed. High-Speed I/O Modes 10, 20, and 40 can generate an interrupt. With Mode 40, you may select an external interrupt (input X0), or a time-based interrupt (3–999 ms).



Typically, interrupts are used in an application when a fast response to an input is needed or a program section must execute faster than the normal CPU scan. The interrupt label and all associated logic must be placed after the End statement in the program. When an interrupt occurs, the CPU will complete execution of the current instruction it is processing in ladder logic, then execute the interrupt routine. After interrupt routine execution, the ladder program resumes from the point at which it was interrupted.

See Chapter 3, the section on Mode 40 (Interrupt) Operation for more details on interrupt configuration. In the DL06, only one software interrupt is available. The software interrupt uses interrupt #00 (INT 0), which means the hardware interrupt #0 and the software interrupt cannot be used together. Hardware interrupts are labeled in octal to correspond with the hardware input signal (e.g. X1 will initiate INT 1).

Operand Data Type		DL06 Range
		aaa
Constant	O	1-FFFF

Interrupt Return (IRT)

DS	Used
HPP	Used

An Interrupt Return is normally executed as the last instruction in the interrupt routine. It returns the CPU to the point in the main program from which it was called. The Interrupt Return is a stand-alone instruction (no input contact on the rung).

Interrupt Return Conditional (IRTC)

DS	Used
HPP	Used

The Interrupt Return Conditional instruction is a optional instruction used with an input contact to implement a conditional return from the interrupt routine. The Interrupt Return is required to terminate the interrupt routine.

Enable Interrupts (ENI)

DS	Used
HPP	Used

The Enable Interrupt instruction is placed in the main ladder program (before the End instruction), enabling the interrupt. The interrupt remains enabled until the program executes a Disable Interrupt instruction.

Disable Interrupts (DISI)

DS	Used
HPP	Used

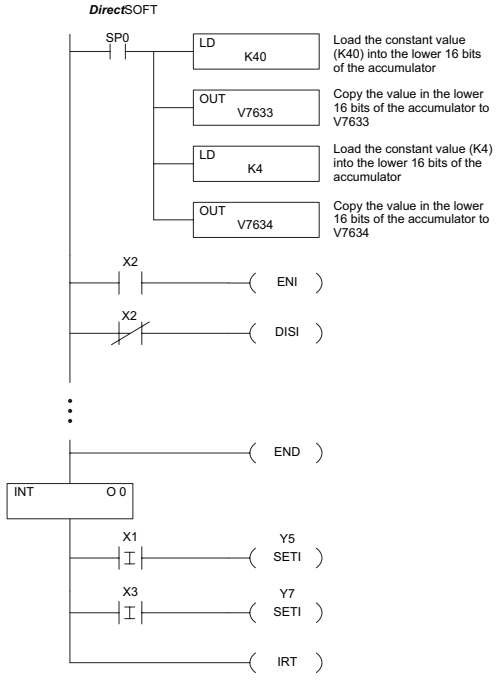
A Disable Interrupt instruction in the main body of the application program (before the End instruction) will disable the interrupt (either external or timed). The interrupt remains disabled until the program executes an Enable Interrupt instruction.

—(DISI)

External Interrupt Program Example

In the following example, we do some initialization on the first scan, using the first-scan contact SP0. The interrupt feature is the HSIO Mode 40. Then, we configure X0 as the external interrupt by writing to its configuration register, V7634. See Appendix E, Mode 40 Operation for more details.

During program execution, when X2 is on, the interrupt is enabled. When X2 is off, the interrupt will be disabled. When an interrupt signal (X0) occurs, the CPU will jump to the interrupt label INT O 0. The application ladder logic in the interrupt routine will be performed. The CPU will return to the main body of the program after the IRT instruction is executed.



Handheld Programmer Keystrokes

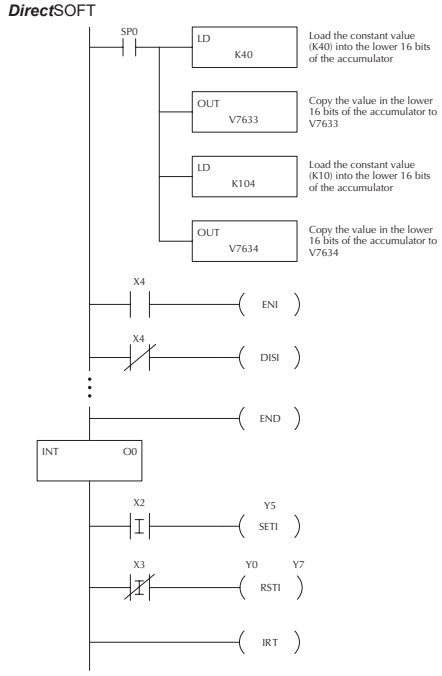
$ STR	→	SHFT	SP STRN	A 0	ENT					
SHFT	L ANDST	D 3	→	SHFT	K JMP	E 4	A 0	ENT		
GX OUT	→	SHFT	V AND	H 7	G 6	D 3	D 3	ENT		
SHFT	L ANDST	D 3	→	SHFT	K JMP	E 4	ENT			
GX OUT	→	SHFT	V AND	H 7	G 6	D 3	E 4	ENT		
$ STR	→	C 2	ENT							
SHFT	E 4	N TMR	I 8	ENT						
SP STRN	→	C 2	ENT							
SHFT	D 3	I 8	S RST	I 8	ENT					

SHFT	E 4	N TMR	D 3	ENT			
SHFT	I 8	N TMR	T MLR	→	A 0	ENT	
$ STR	SHFT	I 8	→	B 1	ENT		
X SET	SHFT	I 8	→	F 5	ENT		
$ STR	SHFT	I 8	→	D 3	ENT		
X SET	SHFT	I 8	→	H 7	ENT		
SHFT	I 8	R ORN	T MLR	ENT			

Timed Interrupt Program Example

In the following example, we do some initialization on the first scan, using the first-scan contact SP0. The interrupt feature is the HSIO Mode 40. Then we configure the HSIO timer as a 10 mS interrupt by writing K104 to the configuration register for X0 (V7634). See Appendix E, Mode 40 Operation for more details.

When X4 turns on, the interrupt will be enabled. When X4 turns off, the interrupt will be disabled. Every 10 mS the CPU will jump to the interrupt label INT O 0. The application ladder logic in the interrupt routine will be performed. If X3 is not on, Y0–Y7 will be reset to off and then the CPU will return to the main body of the program.



Handheld Programmer Keystrokes

$ STR	→	B 1	ENT						
SHFT	L ANDST	D 3	→	SHFT	K JMP	E 4	A 0	ENT	
GX OUT	→	SHFT	V AND	H 7	G 6	D 3	D 3	ENT	
SHFT	L ANDST	D 3	→	SHFT	K JMP	B 1	A 0	E 4	ENT
GX OUT	→	SHFT	V AND	H 7	G 6	D 3	E 4	ENT	
$ STR	→	E 4	ENT						
SHFT	E 4	N TMR	I 8	ENT					
SP STRN	→	E 4	ENT						
SHFT	D 3	I 8	S RST	I 8	ENT				

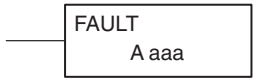
SHFT	E 4	N TMR	D 3	ENT			
SHFT	I 8	N TMR	T MLR	→	A 0	ENT	
$ STR	SHFT	I 8	→	C 2	ENT		
X SET	SHFT	I 8	→	F 5	ENT		
SP STRN	SHFT	I 8	→	D 3	ENT		
X SET	SHFT	I 8	→	A 0	→	H 7	ENT
SHFT	I 8	R ORN	T MLR	ENT			

Message Instructions

Fault (FAULT)

DS	Used
HPP	Used

The Fault instruction is used to display a message on the handheld programmer, the optional LCD display or in the *Direct*SOFT status bar. The message has a maximum of 23 characters and can be either V-memory data, numerical constant data or ASCII text.



To display the value in a V-memory location, specify the V-memory location in the instruction. To display the data in ACON (ASCII constant) or NCON (Numerical constant) instructions, specify the constant (K) value for the corresponding data label area.

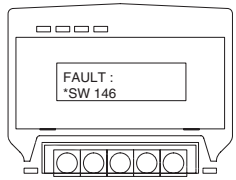
See Appendix G for the ASCII conversion table.

Operand Data Type		DL06 Range
		aaa
V-memory	V	See memory map
Constant	K	1-FFFF

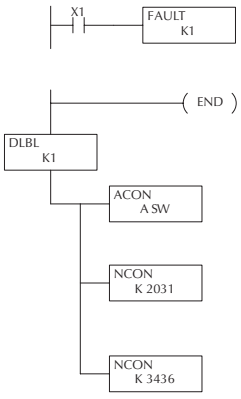
Discrete Bit Flags	Description
SP50	On when the FAULT instruction is executed

Fault Example

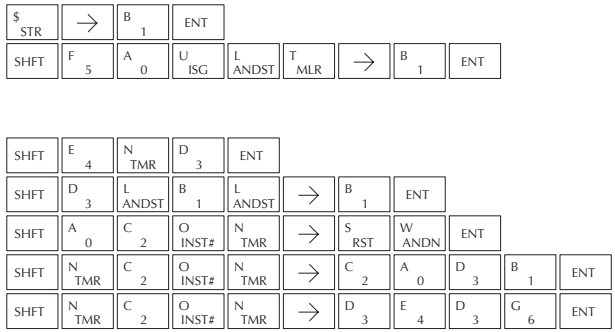
In the following example when X1 is on, the message SW 146 will display on the handheld programmer. The NCONs use the HEX ASCII equivalent of the text to be displayed. (The HEX ASCII for a blank is 20 a 1 is 31, 4 is 34 ...)



*Direct*SOFT



Handheld Programmer Keystrokes



Data Label (DLBL)

DS	Used
HPP	Used

The Data Label instruction marks the beginning of an ASCII/ numeric data area. DLBLs are programmed after the End statement. A maximum of 64 DLBL instructions can be used in a program. Multiple NCONs and ACONs can be used in a DLBL area.

```
DLBL
    K aaa
```

Operand Data Type		DL06 Range
		aaa
Constant	K	1-FFFF

DS	Used
HPP	Used

ASCII Constant (ACON)

```
ACON
    A aaa
```

The ASCII Constant instruction is used with the DLBL instruction to store ASCII text for use with other instructions. Two ASCII characters can be stored in an ACON instruction. If only one character is stored in a ACON a leading space will be inserted.

Operand Data Type		DL06 Range
		aaa
ASCII	A	0-9 A-Z

DS	Used
HPP	Used

Numerical Constant (NCON)

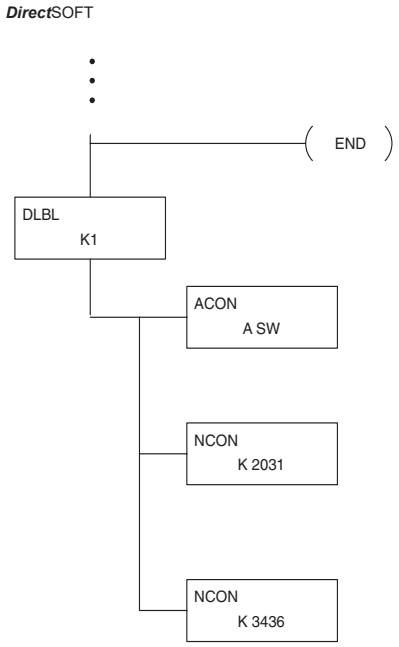
```
NCON
    K aaa
```

The Numerical Constant instruction is used with the DLBL instruction to store the HEX ASCII equivalent of numerical data for use with other instructions. Two digits can be stored in an NCON instruction.

Operand Data Type		DL06 Range
		aaa
Constant	K	1-FFFF

Data Label Example

In the following example, an ACON and two NCON instructions are used within a DLBL instruction to build a text message. See the FAULT instruction for information on displaying messages. The DV-1000 Manual also has information on displaying messages.



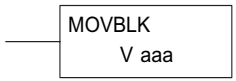
Handheld Programmer Keystrokes

SHFT	E 4	N TMR	D 3	ENT						
SHFT	D 3	L ANDST	B 1	L ANDST	→	B 1	ENT			
SHFT	A 0	C 2	O INST#	N TMR	→	S RST	W ANDN	ENT		
SHFT	N TMR	C 2	O INST#	N TMR	→	C 2	A 0	D 3	B 1	ENT
SHFT	N TMR	C 2	O INST#	N TMR	→	D 3	E 4	D 3	G 6	ENT

Move Block Instruction (MOVBLK)

DS	Used
HPP	Used

The Move Block instruction copies a specified number of words from a Data Label Area of program memory (ACON, NCON) to the specified V-memory location.

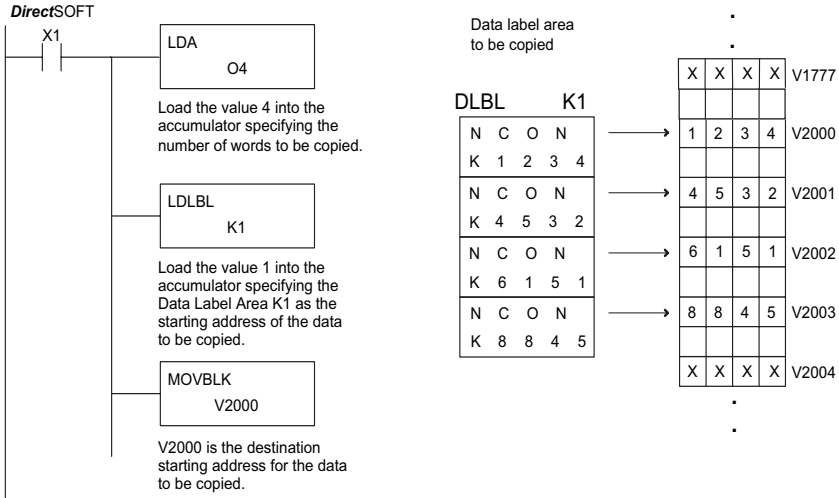


Below are the steps for using the Move Block function:

- Step 1: Load the number of words (octal) to be copied into the 1st level of the accumulator stack.
- Step 2: Load the source data label (LDLBL Kaaa) into the accumulator. This is where the data will be copied from.
- Step 3: Insert the MOVBLK instruction that specifies the V-memory destination. This is where the data will be copied to.

Copy Data From a Data Label Area to V-memory

In the example below, data is copied from a Data Label Area to V-memory. When X1 is on, the octal value (O4) is copied to the first level of the accumulator stack using the Load Address (LDA) instruction. This value specifies the number of words to be copied. Load Label (LDLBL) instruction will load the source data address (K1) into the accumulator. This is where the data will be copied from. The MOVBLK instruction specifies the destination starting location and executes the copying of data from the Data Label Area to V-memory.



Handheld Programmer Keystrokes

$ STR	→	B 1	ENT									
SHFT	L ANDST	D 3	A 0	→	E 4	ENT						
SHFT	L ANDST	D 3	L ANDST	B 1	L ANDST	→	B 1	ENT				
SHFT	M ORST	O INST#	V AND	B 1	L ANDST	K JMP	→	C 2	A 0	A 0	A 0	ENT

Print Message (PRINT)

DS	Used
HPP	N/A

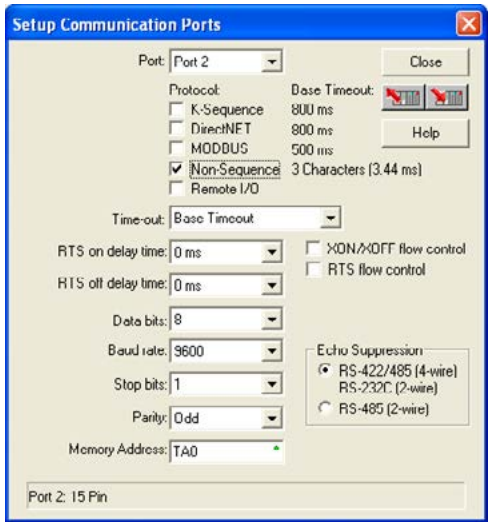
The Print Message instruction prints the embedded text or text/data variable message (maximum 128 characters) to the specified communications port (Port 2 on the DL06 CPU), which must have the communications port configured.

```
PRINT     A aaa
"Hello, this is a PLC message"
```

Operand Data Type		DL06 Range
		aaa
Constant	K	2

You may recall, from the CPU specifications in Chapter 3, that the DL06's ports are capable of several protocols. Port 1 cannot be configured for the non-sequence protocol. To configure port 2 using the Handheld Programmer, use AUX 56 and follow the prompts, making the same choices as indicated below on this page. To configure a port in *Direct*SOFT, choose the PLC menu, then Setup, then Setup Secondary Comm Port.

- **Port**: From the port number list box at the top, choose **Port 2**.
- **Protocol**: Click the check box to the left of **Non-sequence**, and then you'll see the dialog box shown below.



- **Baud Rate**: Choose the baud rate that matches your printer.
- **Stop Bits, Parity**: Choose number of stop bits and parity setting to match your printer.
- **Memory Address**: Choose a V-memory address for *Direct*SOFT to use to store the port setup information. You will need to reserve 66 contiguous words in V-memory for this purpose.

Before ending the setup, click the button indicated to send Port 2 configuration to the CPU, and click **Close**. See Chapter 3 for port wiring information, in order to connect your printer to the DL06.

Port 2 on the DL06 has standard RS232 levels, and should work with most printer serial input connections.

Text element – this is used for printing character strings. The character strings are defined as the character (more than 0) ranged by the double quotation marks. Two hex numbers preceded by the dollar sign means an 8-bit ASCII character code. Also, two characters preceded by the dollar sign is interpreted according to the following table:

#	Character code	Description
1	$$	Dollar sign ($)
2	$”	Double quotation (”)
3	$L or $l	Line feed (LF)
4	$N or $n	Carriage return line feed (CRLF)
5	$P or $p	Form feed
6	$R or $r	Carriage return (CR)
7	$T or $t	Tab

The following examples show various syntax conventions and the length of the output to the printer.

Example:

” ” Length 0 without character

”A” Length 1 with character A

” ” Length 1 with blank

” $” ” Length 1 with double quotation mark

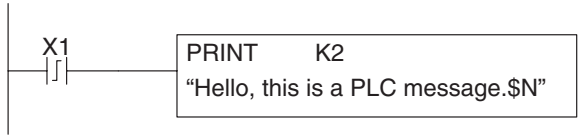
” $ R $ L ” Length 2 with one CR and one LF

” $ 0 D $ 0 A ” Length 2 with one CR and one LF

” $ $ ” Length 1 with one $ mark

In printing an ordinary line of text, you will need to include **double quotation** marks before and after the text string. Error code 499 will occur in the CPU when the print instruction contains invalid text or no quotations. It is important to test your PRINT instruction data during the application development.

The following example prints the message to port 2. We use a PD contact, which causes the message instruction to be active for just one scan. Note the $N at the end of the message, which produces a carriage return / line feed on the printer. This prepares the printer to print the next line, starting from the left margin.



Print the message to Port 2 when X1 makes an off-to-on transition.

V-memory element - this is used for printing V-memory contents in the integer format or real format. Use V-memory number or V-memory number with ":" and data type. The data types are shown in the table below. The Character code must be capital letters.

***NOTE**: There must be a space entered before and after the V-memory address to separate it from the text string. Failure to do this will result in an error code 499.*

#	Character code	Description
1	none	16-bit binary (decimal number)
2	: B	4 digit BCD
3	: D	32-bit binary (decimal number)
4	: D B	8 digit BCD
5	: R	Floating point number (real number)
6	: E	Floating point number (real number with exponent)

Example:

V2000 Print binary data in V2000 for decimal number

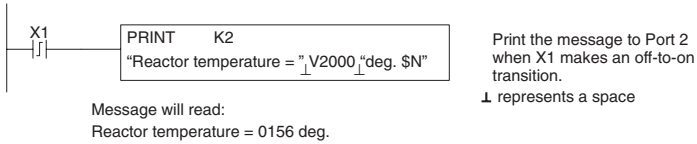
V2000 : B Print BCD data in V2000

V2000 : D Print binary number in V2000 and V2001 for decimal number

V2000 : D B Print BCD data in V2000 and V2001

V2000 : R Print floating point number in V2000/V2001 as real number

V2000 : E Print floating point number in V2000/V2001 as real number with exponent



Example: The following example prints a message containing text and a variable. The "reactor temperature" labels the data, which is at V2000. You can use the : B qualifier after the V2000 if the data is in BCD format, for example. The final string adds the units of degrees to the line of text, and the $N adds a carriage return / line feed.

V-memory text element - This is used for printing text stored in V-memory. Use the % followed by the number of characters after V-memory number for representing the text. If you assign "0" as the number of characters, the print function will read the character count from the first location. Then it will start at the next V-memory location and read that number of ASCII codes for the text from memory.

Example:

V2000 % 16 16 characters in V2000 to V2007 are printed.

V2000 % 0 The characters in V2001 to Vxxxx (determined by the number in V2000) will be printed.

Bit element

This is used for printing the state of the designated bit in V-memory or a relay bit. The bit element can be assigned by the designating point (.) and bit number preceded by the V-memory number or relay number. The output type is described as shown in the table below.

#	Data Format	Description
1	none	Print 1 for an ON state, and 0 for an OFF state
2	:BOOL	Print "TRUE" for an ON state, and "FALSE" for an OFF state
3	:ONOFF	Print "ON" for an ON state, and "OFF" for an OFF state

Example:

V2000 . 15 Prints the status of bit 15 in V2000, in 1/0 format

C100 Prints the status of C100 in 1/0 format

C100 : BOOL Prints the status of C100 in TRUE/FALSE format

C100 : ON/OFF Prints the status of C100 in ON/OFF format

V2000.15 : BOOL Prints the status of bit 15 in V2000 in TRUE/FALSE format

The maximum numbers of characters you can print is 128. The number of characters for each element is listed in the table below:

Element Type	Maximum Characters
Text, 1 character	1
16 bit binary	6
32 bit binary	11
4 digit BCD	4
8 digit BCD	8
Floating point (real number)	12
Floating point (real with exponent)	12
V-memory/text	2
Bit (1/0 format)	1
Bit (TRUE/FALSE format)	5
Bit (ON/OFF format)	3

The handheld programmer's mnemonic is "PRINT" followed by the DEF field.

Special relay flags SP116 and SP117 indicate the status of the DL06 CPU ports (busy, or communications error). See the appendix on special relays for a description.

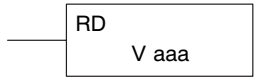
NOTE: *You must use the appropriate special relay in conjunction with the PRINT command to ensure the ladder program does not try to PRINT to a port that is still busy from a previous PRINT or WX or RX instruction.*

Intelligent I/O Instructions

Read from Intelligent Module (RD)

DS32	Used
HPP	Used

The Read from Intelligent Module instruction reads a block of data (1-128 bytes maximum) from an intelligent I/O module into the CPU's V-memory. It loads the function parameters into the first and second level of the accumulator stack and the accumulator by three additional instructions.



Listed below are the steps to program the Read from Intelligent module function.

Step 1: Load the base number (0-3) into the first byte and the slot number (0-7) into the second byte of the second level of the accumulator stack.

Step 2: Load the number of bytes to be transferred into the first level of the accumulator stack (maximum of 128 bytes).

Step 3: Load the address from which the data will be read into the accumulator. This parameter must be a HEX value.

Step 4: Insert the RD instruction which specifies the starting V-memory location (Vaaa) where the data will be read into.

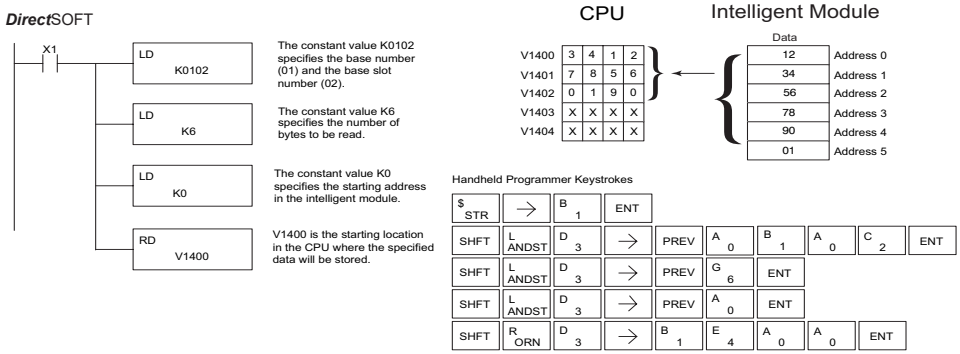
Helpful Hint: – Use the LDA instruction to convert an octal address to its HEX equivalent and load it into the accumulator when the HEX format is required.

Operand Data Type		DL06 Range
		aaa
V-memory	V	See memory map

Discrete Bit Flags	Description
SP54	On when RX, WX RD, WT instructions are executed with the wrong parameters.

NOTE: *Status flags are valid only until another instruction uses the same flag.*

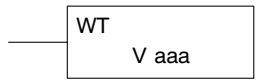
In the following example, when X1 is ON, the RD instruction will read six bytes of data from a intelligent module in base 1, slot 2, starting at address 0 in the intelligent module, and copy the information into V-memory locations V1400-V1402.



Write to Intelligent Module (WT)

DS32	Used
HPP	Used

The Write to Intelligent Module instruction writes a block of data (1-128 bytes maximum) to an intelligent I/O module from a block of V-memory in the CPU. The function parameters are loaded into the first and second level of the accumulator stack and the accumulator by three additional instructions.



Listed below are the steps to program the Read from Intelligent module function.

Step 1: Load the base number (0-3) into the first byte and the slot number (0-7) into the second byte of the second level of the accumulator stack.

Step 2: Load the number of bytes to be transferred into the first level of the accumulator stack (maximum of 128 bytes).

Step 3: Load the intelligent module address which will receive the data into the accumulator. This parameter must be a HEX value.

Step 4: Insert the WT instruction which specifies the starting V-memory location (Vaaa) where the data will be written from in the CPU.

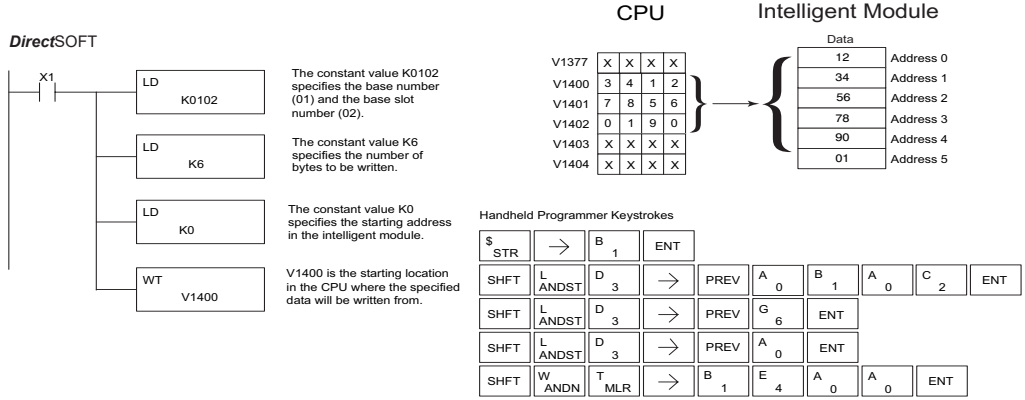
Helpful Hint: — Use the LDA instruction to convert an octal address to its HEX equivalent and load it into the accumulator when the HEX format is required.

Operand Data Type		DL06 Range
		aaa
V-memory	V	See memory map

Discrete Bit Flags	Description
SP54	On when RX, WX RD, WT instructions are executed with the wrong parameters.

NOTE: *Status flags are valid only until another instruction uses the same flag.*

In the following example, when X1 is on, the WT instruction will write six bytes of data to an intelligent module in base 1, slot 2,starting at address 0 in the intelligent module, and copy the data from V-memory locations V1400-V1402.

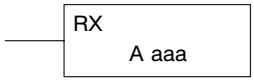


Network Instructions

Read from Network (RX)

DS32	Used
HPP	Used

The Read from Network instruction is used by the master device on a network to read a block of data from a slave device on the same network. The function parameters are loaded into the first and second level of the accumulator stack and the accumulator by three additional instructions.



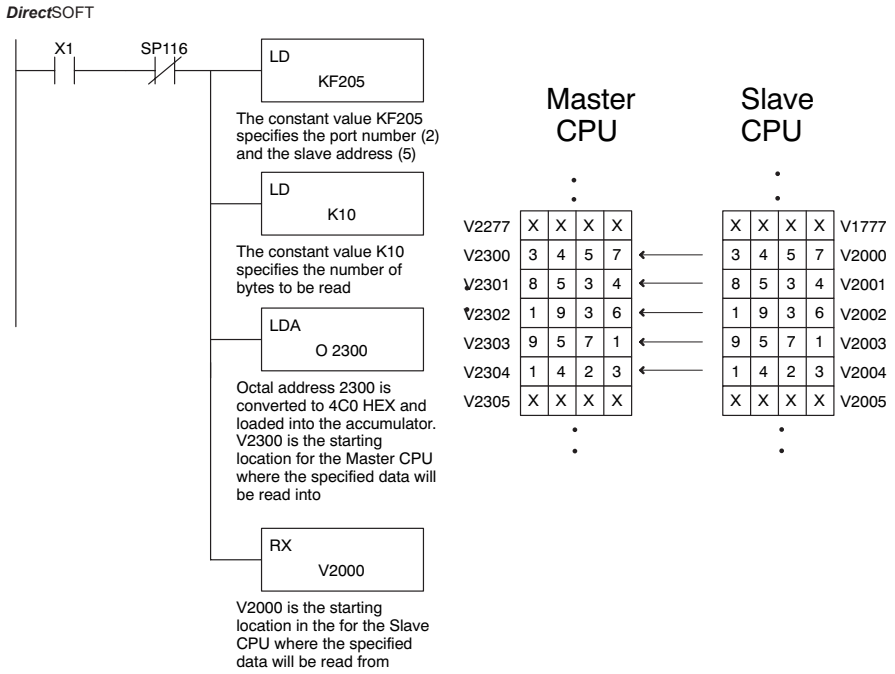
Listed below are the steps necessary to program the Read from Network function.

- Step 1: Load the slave address (0-- 90 BCD) into the first byte and the PLC internal port (KF2) or slot number of the master DCM or ECOM (0-- 7) into the second byte of the second level of the accumulator stack.
- Step 2: Load the number of bytes to be transferred into the first level of the accumulator stack.
- Step 3: Load the address of the data to be read into the accumulator. This parameter requires a HEX value.
- Step 4: Insert the RX instruction which specifies the starting Vmemory location (Aaaa) where the data will be read from in the slave.

Helpful Hint: — For parameters that require HEX values, the LDA instruction can be used to convert an octal address to the HEX equivalent and load the value into the accumulator.

Operand Data Type		DL06 Range
	A	**aaa**
V-memory	V	See memory map
Pointer	P	See memory map
Inputs	X	0–777
Outputs	Y	0–777
Control Relays	C	0–1777
Stage	S	0–1777
Timer	T	0–377
Counter	CT	0–177
Special Relay	SP	0–777
Program Memory	$	0–7680 (2K program mem.)

In the following example, when X1 is on and the port busy relay SP116 (see special relays) is not on, the RX instruction will access port 2 operating as a master. Ten consecutive bytes of data (V2000 – V2004) will be read from a CPU at station address 5 and copied into V-memory locations V2300–V2304 in the CPU with the master port.



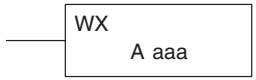
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT									
W ANDN	→	SHFT	SP STRN	B 1	B 1	G 6	ENT					
SHFT	L ANDST	D 3	→	SHFT	K JMP	SHFT	F 5	SHFT	C 2	A 0	F 5	ENT
SHFT	L ANDST	D 3	→	SHFT	K JMP	B 1	A 0	ENT				
SHFT	L ANDST	D 3	A 0	→	C 2	D 3	A 0	A 0	ENT			
SHFT	R ORN	X SET	→	C 2	A 0	A 0	A 0	ENT				

Write to Network (WX)

DS	Used
HPP	Used

The Write to Network instruction is used to write a block of data from the master device to a slave device on the same network. The function parameters are loaded into the accumulator and the first and second levels of the stack.



Listed below are the program steps necessary to execute the Write to Network function.

Step 1: Load the slave address (0–90 BCD) into the low byte and "F2" into the high byte of the accumulator (the next two instructions push this word down to the second layer of the stack).

Step 2: Load the number of bytes to be transferred into the accumulator (the next instruction pushes this word onto the top of the stack).

Step 3: Load the starting Master CPU address into the accumulator. This is the memory location where the data will be written from. This parameter requires a HEX value.

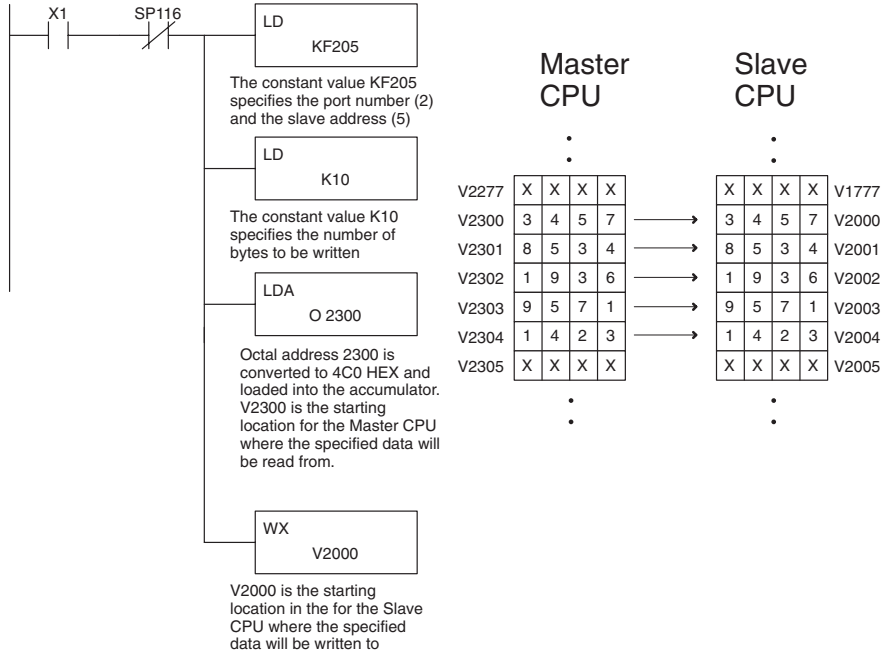
Step 4: Insert the WX instruction which specifies the starting V-memory location (Aaaa) where the data will be written to in the slave.

Helpful Hint: — For parameters that require HEX values, the LDA instruction can be used to convert an octal address to the HEX equivalent and load the value into the accumulator.

Operand Data Type		DL06 Range
	A	aaa
V-memory	V	See memory map
Pointer	P	See memory map
Inputs	X	0–777
Outputs	Y	0–777
Control Relays	C	0–1777
Stage	S	0–1777
Timer	T	0–377
Counter	CT	0–177
Special Relay	SP	0–777
Program Memory	$	0–7680 (2K program mem.)

In the following example, when X1 is on and the module busy relay SP116 (see special relays) is not on, the WX instruction will access port 2 operating as a master. Ten consecutive bytes of data are read from the Master CPU and copied to V-memory locations V2000–V2004 in the slave CPU at station address 5.

DirectSOFT



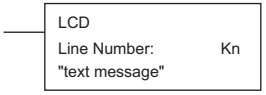
Handheld Programmer Keystrokes

$ STR	→	B 1	ENT												
W ANDN	→	SHFT	SP STRN	B 1	C 1	E 6	ENT								
SHFT	L ANDST	D 3	→	SHFT	K JMP	SHFT	F 5	SHFT	C 2	A 0	F 5	ENT			
SHFT	L ANDST	D 3	→	SHFT	K JMP	B 1	A 0	ENT							
SHFT	L ANDST	D 3	A 0	→	C 2	D 3	A 0	A 0	ENT						
SHFT	W ANDN	X SET	→	C 2	A 0	A 0	A 0	ENT							

LCD

DS	Used
HPP	N/A

When enabled, the LCD instruction causes a user-defined text message to be displayed on the LCD Display Panel. The display is 16 characters wide by 2 rows high so a total of 32 characters can be displayed. Each row is addressed separately; the maximum number of characters the instruction will accept is 16.



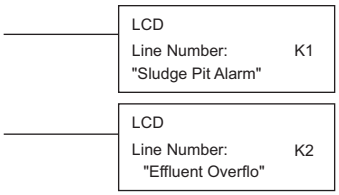
The text message can be entered directly into the message field of the instruction set-up dialog, or it can be located anywhere in user V-memory. If the text is located in V-memory, the LCD instruction is used to point to the memory location where the desired text originates. The length of the text string is also required.

From the *Direct*SOFT project folder, use the Instruction Browser to locate the LCD instruction. When you select the LCD instruction and click OK, the LCD dialog will appear, as shown in the examples. The LCD instruction is inserted into the ladder program via this set-up dialog box.

Display text strings can include embedded variables. Date and time settings and V-memory values can be embedded in the displayed text. Examples of each are shown.

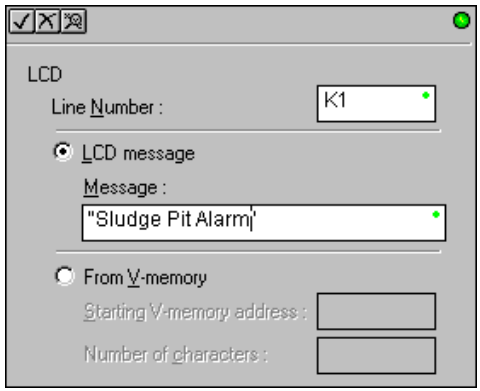
Direct Text Entry

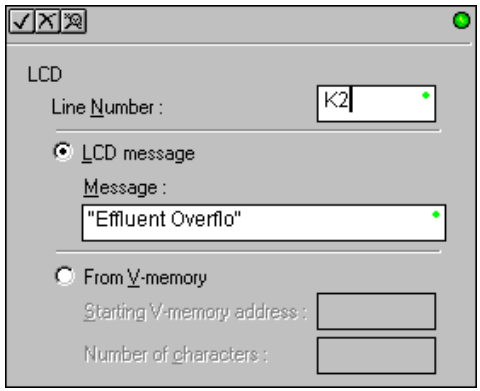
The two dialogs to the right show the selections necessary to create the two ladder instructions below. Double quotation marks are required to delineate the text string. In the first dialog, the text "Sludge Pit Alarm" uses sixteen character spaces and will appear on line 1 when the instruction is enabled. Note, the line number is K1. Clicking the "check" button causes the instruction to be inserted into the ladder program.



By identifying the second Line Number as K2, the text string "Effluent Overflow" will appear on the second line of the display when the second instruction is enabled.

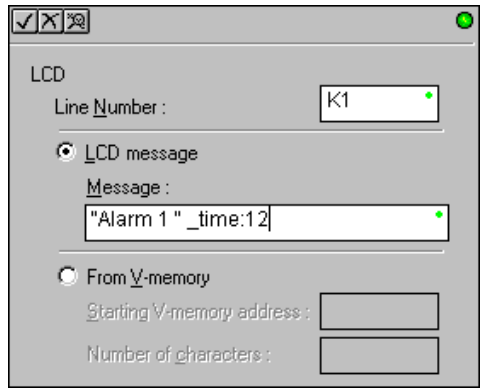
S	l	u	d	g	e		P	i	t		A	l	a	r	m
E	f	f	l	u	e	n	t		O	v	e	r	f	l	o



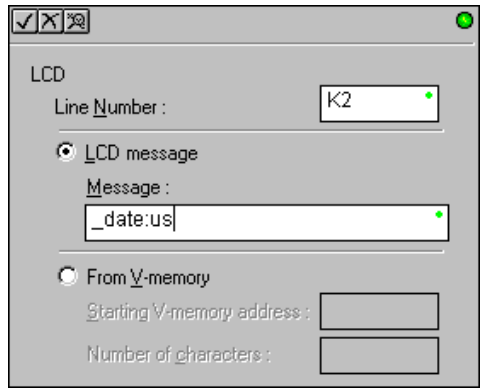


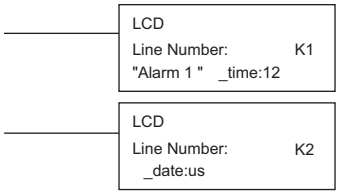
Embedding date and/or time variables

The date and/or time can be embedded in the displayed text by using the variables listed in the table below. These variables can be included in the **LCD message** field of the LCD dialog. In the example, the time variable (12 hour format) is embedded by adding _time:12. This time format uses a maximum of seven character spaces. The second dialog creates an instruction that prints the date on the second line of the display, when enabled.



Date and Time Variables and Formats		
_date:us	US format	MM/DD/YY
_date:e	European format	DD/MM/YY
_date:a	Asian format	YY/MM/DD
_time:12	12 hour format	HH:MMAM/PM
_time:24	24 hour format	HH:MM:SS

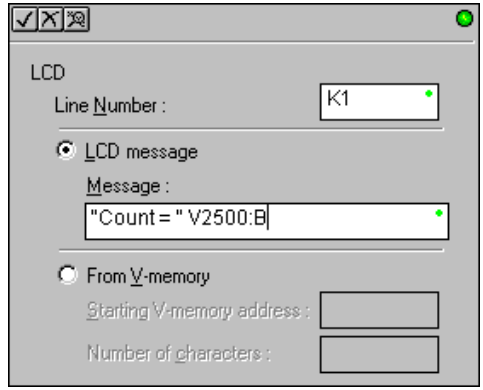


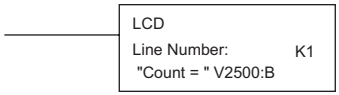


A	l	a	r	m		1			1	1	:	2	1	P	M
0	5	-	0	8	-	0	2								

Embedding V-memory data

Any V-memory data can be displayed in any one of six available data formats. An example appears to the right. A list of data formats and modifiers is on the next page. Note that different data formats require differing numbers of character positions on the display.





C	o	u	n	t		=		0	4	1	2				

Data Format Suffixes for Embedded V-memory Data

Several data formats are available for displaying V-memory data on the LCD. The choices are shown in the table below. A colon is used to separate the embedded V-memory location from the data format suffix and modifier. An example appears on the previous page.

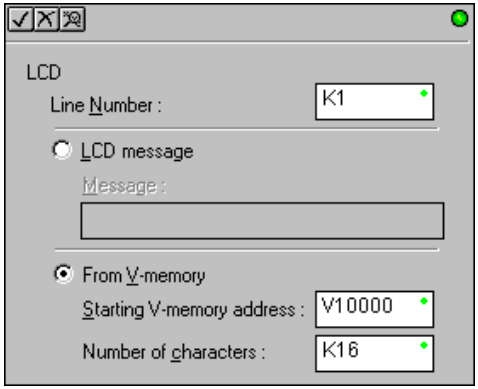
Data Format	Modifier	Example	Displayed Characters												
none (16-bit format)		V2000 = 0000 0000 0001 0010	1	2	3	4									
		V2000			1	8									
	[:S]	V2000:S	1	8											
	[:C0]	V2000:C0	0	0	1	8									
	[:0]	V2000:0			1	8									
:B (4 digit BCD)		V2000 = 0000 0000 0001 0010	1	2	3	4									
	[:B]	V2000:B	0	0	1	2									
	[:BS]	V2000:BS	1	2											
	[:BC0]	V2000:BC0	0	0	1	2									
	[:B0]	V2000:B0			1	2									
:D (32-bit decimal)		V2000 = 0000 0000 0000 0000	Double Word												
		V2001 = 0000 0000 0000 0001	1	2	3	4	5	6	7	8	9	10	11		
	[:D]	V2000:D							6	5	5	3	6		
	[:DS]	V2000:DS	6	5	5	3	6								
	[:DC0]	V2000:DC0	0	0	0	0	0	0	6	5	5	3	6		
	[:D0]	V2000:D0							6	5	5	3	6		
:DB (8 digit BCD)		V2000 = 0000 0000 0000 0000	Double Word												
		V2001 = 0000 0000 0000 0011	1	2	3	4	5	6	7	8					
	[:DB]	V2000:DB	0	0	0	3	0	0	0	0					
	[:DBS]	V2000:DBS	3	0	0	0	0								
	[:DBC0]	V2000:DBC0	0	0	0	3	0	0	0	0					
	[:DB0]	V2000:DB0				3	0	0	0	0					
:R (DWord floating point number)		V2001/V2000 = 222.11111	Double Word												
		(real number)	1	2	3	4	5	6	7	8	9	10	11	12	13
	[:R]	V2000:R				f	2	2	2	.	1	1	1	1	1
	[:RS]	V2000:RS	f	2	2	2	.	1	1	1	1	1			
	[:RC0]	V2000:RC0	f	0	0	0	2	2	2	.	1	1	1	1	1
	[:R0]	V2000:R0				f	2	2	2	.	1	1	1	1	1
:E (DWord floating point number with exponent)		V2001/V2000 = 222.1	Double Word												
		(real number)	1	2	3	4	5	6	7	8	9	10	11	12	13
	[:E]	V2000:E		f	2	.	2	2	1	0	0	E	+	0	2
	[:ES]	V2000:ES	f	2	.	2	2	1	0	0	E	+	0	2	
	[:EC0]	V2000:EC0	f	2	.	2	2	1	0	0	E	+	0	2	
	[:E0]	V2000:E0	f	2	.	2	2	1	0	0	E	+	0	2	
f = plus/minus flag (plus = no symbol, minus = -)															

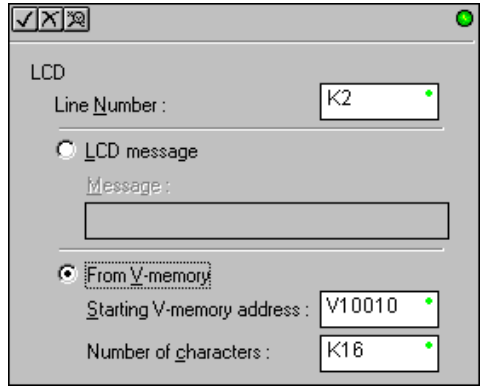
The S, C0, and 0 modifiers alter the presentation of leading zeros and spaces. S removes leading spaces and left justifies the result. C0 replaces leading spaces with leading zeros. 0 is a modification of C0. 0 eliminates any leading zeros in the C0 format version and converts them to spaces.

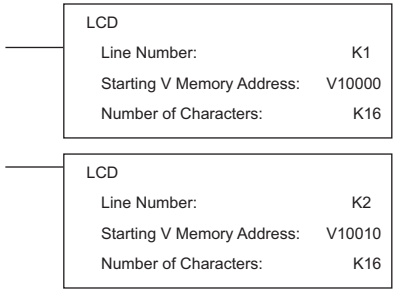
Text Entry from V-memory

Alternatively, text that resides in V-memory can be displayed on the LCD following the example on this page. The LCD dialog is used twice, once for each line on the display. The dialog requires the address of the first character to be displayed and the number of characters to be displayed.

For example, the two dialogs shown on this page would create the two LCD instructions below. When enabled, these instructions would cause the ASCII characters in V10000 to V10017 to be displayed. The ASCII characters and their corresponding memory locations are shown in the table below.







V10000	d	A
V10001	i	m
V10002		n
V10003	f	O
V10004	i	f
V10005	e	c
V10006		
V10007		
V10010	i	H
V10011	h	g
V10012	T	
V10013	m	e
V10014		p
V10015	l	A
V10016	r	a
V10017		m

A	d	m	i	n		O	f	f	i	c	e				
H	i	g	h		T	e	m	p		A	l	a	r	m	

MODBUS RTU Instructions

MODBUS Read from Network (MRX)

DS	Used
HPP	N/A

The MODBUS Read from Network (MRX) instruction is used by the DL06 network master to read a block of data from a connected slave device and to write the data into V–memory addresses within the master. The instruction allows the user to specify the MODBUS Function Code, slave station address, starting master and slave memory addresses, number of elements to transfer, MODBUS data format and the Exception Response Buffer.

CPU/DCM: select either CPU or DCM module for communications

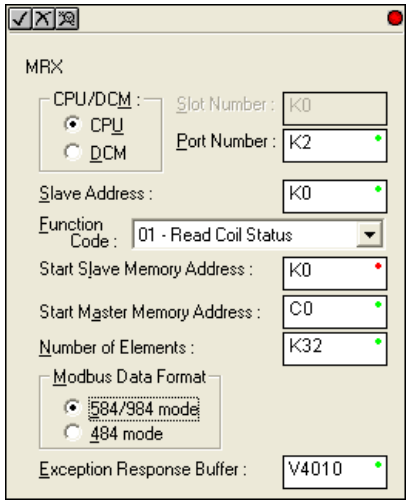
Slot Number: select PLC option slot number if using a DCM module.

Port Number: must be DL06 Port 2 (K2)

Slave Address: specify a slave station address (0–247)

Function Code: The following MODBUS function codes are supported by the MRX instruction:

- 01 – Read a group of coils
- 02 – Read a group of inputs
- 03 – Read holding registers
- 04 – Read input registers
- 07 – Read Exception status



Start Slave Memory Address: specifies the starting slave memory address of the data to be read. See the table on the following page.

Start Master Memory Address: specifies the starting memory address in the master where the data will be placed. See the table on the following page.

Number of Elements: specifies how many coils, inputs, holding registers or input register will be read. See the table on the following page.

MODBUS Data Format: specifies MODBUS 584/984 or 484 data format to be used

Exception Response Buffer: specifies the master memory address where the Exception Response will be placed (6-bytes in length). See the table on the following page. The exception response buffer uses 3 words. These bytes are swapped in the MRX/MWX exception response buffer V-memory so:

- V-Memory 1 Hi Byte = Function Code Byte (Most Significant Bit Set)
- V-Memory 1 Lo Byte = Address Byte
- V-Memory 2 Hi Byte = One of the CRC Bytes
- V-Memory 2 Lo Byte = Exception Code
- V-Memory 3 Hi Byte = 0
- V-Memory 3 Lo Byte = Other CRC Byte

MRX Slave Address Ranges

Function Code	MODBUS Data Format	Slave Address Range(s)
01 – Read Coil	484 Mode	1–999
01 – Read Coil	584/984 Mode	1–65535
02 – Read Input Status	484 Mode	1001–1999
02 – Read Input Status	584/984 Mode	10001–19999 (5 digit) or 100001–165535 (6 digit)
03 – Read Holding Register	484 Mode	4001–4999
03 – Read Holding Register	584/984 Mode	40001–49999 (5 digit) or 4000001–465535 (6 digit)
04 – Read Input Register	484 Mode	3001–3999
04 – Read Input Register	584/984 Mode	30001–39999 (5 digit) or 3000001–365535 (6 digit)
07 – Read Exception Status	484 and 584/984 Mode	N/A

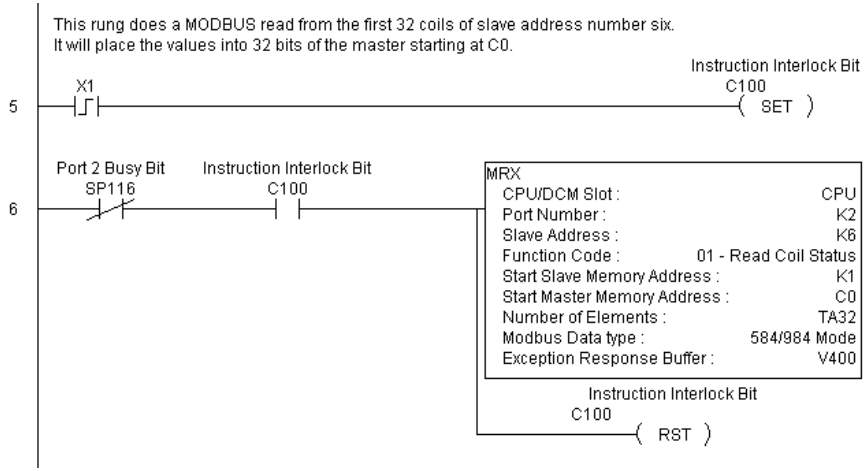
MRX Master Memory Address Ranges		
Operand Data Type		**DL06 Range**
Inputs	X	0–1777
Outputs	Y	0–1777
Control Relays	C	0–3777
Stage Bits	S	0–1777
Timer Bits	T	0–377
Counter Bits	CT	0–377
Special Relays	SP	0–777
V–memory	V	all
Global Inputs	GX	0–3777
Global Outputs	GY	0–3777

Number of Elements		
Operand Data Type		**DL06 Range**
V–memory	V	all
Constant	K	Bits: 1–2000 Registers: 1–125

Exception Response Buffer		
Operand Data Type		**DL06 Range**
V–memory	V	all

MRX Example

DL06 port 2 has two Special Relay contacts associated with it (see Appendix D for comm port special relays). One indicates “Port busy”(SP116), and the other indicates ”Port Communication Error”(SP117). The “Port Busy” bit is on while the PLC communicates with the slave. When the bit is off, the program can initiate the next network request. The “Port Communication Error” bit turns on when the PLC has detected an error. Use of this bit is optional. When used, it should be ahead of any network instruction boxes, since the error bit is reset when an MRX or MWX instruction is executed. Typically, network communications will last longer than 1 CPU scan. The program must wait for the communications to finish before starting the next transaction.



***NOTE**: See Chapter 4, page 4-21, for an RLL example using multiple Read and Write interlocks with MRX/MWX instructions.*

MODBUS Write to Network (MWX)

DS	Used
HPP	N/A

The MODBUS Write to Network (MWX) instruction is used to write a block of data from the network masters's (DL06) memory to MODBUS memory addresses within a slave device on the network. The instruction allows the user to specify the MODBUS Function Code, slave station address, starting master and slave memory addresses, number of elements to transfer, MODBUS data format and the Exception Response Buffer.

CPU/DCM: select either CPU or DCM module for communications

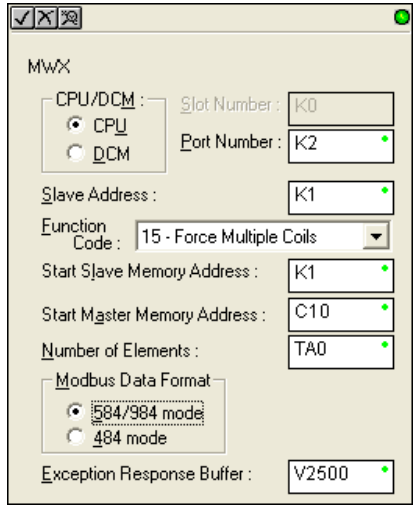
Slot Number: select PLC option slot number if using a DCM module

Port Number: must be DL06 Port 2 (K2)

Slave Address: specify a slave station address (0–247)

Function Code: MODBUS function codes supported by the MWX instruction:

- 05 – Force Single coil
- 06 – Preset Single Register
- 15 – Force Multiple Coils
- 16 – Preset Multiple Registers



Start Slave Memory Address: specifies the starting slave memory address where the data will be written

Start Master Memory Address: specifies the starting address of the data in the master that is to be written to the slave

Number of Elements: specifies how many consecutive coils or registers will be written to. This field is only active when either function code 15 or 16 is selected.

MODBUS Data Format: specifies MODBUS 584/984 or 484 data format to be used

Exception Response Buffer: specifies the master memory address where the Exception Response will be placed (6-bytes in length). See the table on the following page.The exception response buffer uses 3 words. These bytes are swapped in the MRX/MWX exception response buffer V-memory so:

- V-Memory 1 Hi Byte = Function Code Byte (Most Significant Bit Set)
- V-Memory 1 Lo Byte = Address Byte
- V-Memory 2 Hi Byte = One of the CRC Bytes
- V-Memory 2 Lo Byte = Exception Code
- V-Memory 3 Hi Byte = 0
- V-Memory 3 Lo Byte = Other CRC Byte

MWX Slave Address Ranges

MWX Slave Address Ranges		
Function Code	**MODBUS Data Format**	**Slave Address Range(s)**
05 – Force Single Coil	484 Mode	1–999
05 – Force Single Coil	584/984 Mode	1–65535
06 – Preset Single Register	484 Mode	4001–4999
06 – Preset Single Register	584/984 Mode	40001–49999 (5 digit) or 400001–465535 (6 digit)
15 – Force Multiple Coils	484 Mode	1–999
15 – Force Multiple Coils	585/984 Mode	1–65535
16 – Preset Multiple Registers	484 Mode	4001–4999
16 – Preset Multiple Registers	584/984 Mode	40001–49999 (5 digit) or 4000001–465535 (6 digit)

MWX Master Memory Address Ranges

MWX Master Memory Address Ranges		
Operand Data Type		**DL06 Range**
Inputs	X	0–1777
Outputs	Y	0–1777
Control Relays	C	0–3777
Stage Bits	S	0–1777
Timer Bits	T	0–377
Counter Bits	CT	0–377
Special Relays	SP	0–777
V–memory	V	all
Global Inputs	GX	0–3777
Global Outputs	GY	0–3777

MWX Number of Elements

Number of Elements		
Operand Data Type		**DL06 Range**
V–memory	V	all
Constant	K	Bits: 1–2000 Registers: 1–125

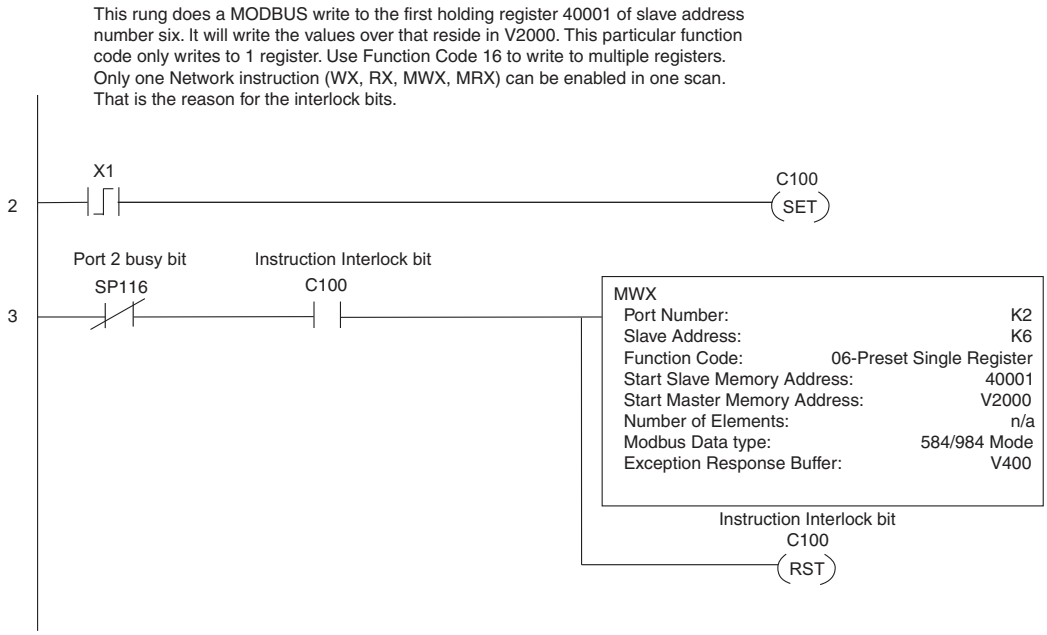
MWX Exception Response Buffer

Number of Elements		
Operand Data Type		**DL06 Range**
V–memory	V	all

MWX Example

DL06 port 2 has two Special Relay contacts associated with it (see Appendix D for comm port special relays). One indicates “Port busy”(SP116), and the other indicates ”Port Communication Error”(SP117). The “Port Busy” bit is on while the PLC communicates with the slave. When the bit is off, the program can initiate the next network request. The “Port Communication Error” bit turns on when the PLC has detected an error. Use of this bit is optional. When used, it should be ahead of any network instruction boxes since the error bit is reset when an MRX or MWX instruction is executed.

Typically, network communications will last longer than 1 CPU scan. The program must wait for the communications to finish before starting the next transaction.



***NOTE**: See Chapter 4, page 4-21, for an RLL example using multiple Read and Write interlocks with MRX/MWX instructions.*

ASCII Instructions

The DL06 CPU supports several instructions and methods that allow ASCII strings to be read into and written from the PLC communications ports. Specifically, port 2 on the DL06 can be used for either reading or writing raw ASCII strings, but cannot be used for both at the same time. The DL06 can also decipher ASCII embedded within a supported protocol (K–Sequence, *Direct*Net, Modbus) via the CPU port.

Reading ASCII Input Strings

There are several methods that the DL06 can use to read ASCII input strings.

1) ASCII IN (AIN) – This instruction configures port 2 for raw ASCII input strings with parameters such as fixed and variable length ASCII strings, termination characters, byte swapping options, and instruction control bits. Use barcode scanners, weight scales, etc. to write raw ASCII input strings into port 2 based on the (AIN) instruction's parameters.
2) Write embedded ASCII strings directly to V–memory from an external HMI or similar master device via a supported communications protocol using the CPU ports. The AIN instruction is not used in this case. 3) If a DL06 PLC is a master on a network, the Network Read instruction (RX) can be used to read embedded ASCII data from a slave device via a supported communications protocol using port 2. The RX instruction places the data directly into V–memory.

Writing ASCII Output Strings

The following instructions can be used to write ASCII output strings:

1) Print from V–memory (PRINTV) – Use this instruction to write raw ASCII strings out of port 2 to a display panel or a serial printer, etc. The instruction features the starting V–memory address, string length, byte swapping options, etc. When the instruction's permissive bit is enabled, the string is written to port 2.
2) Print to V–memory (VPRINT) – Use this instruction to create pre–coded ASCII strings in the PLC (i.e. alarm messages). When the instruction's permissive bit is enabled, the message is loaded into a pre–defined V–memory address location. Then the (PRINTV) instruction may be used to write the pre–coded ASCII string out of port 2. American, European and Asian Time/Date stamps are supported.

Additionally, if a DL06 PLC is a master on a network, the Network Write instruction (WX) can be used to write embedded ASCII data to an HMI or slave device directly from V–memory via a supported communications protocol using port 2.

Managing the ASCII Strings

The following instructions can be helpful in managing the ASCII strings within the CPUs V–memory:

ASCII Find (AFIND) – Finds where a specific portion of the ASCII string is located in continuous V–memory addresses. Forward and reverse searches are supported.

ASCII Extract (AEX) – Extracts a specific portion (usually some data value) from the ASCII find location or other known ASCII data location.

Compare V–memory (CMPV) – This instruction is used to compare two blocks of V–memory addresses and is usually used to detect a change in an ASCII string. Compared data types must be of the same format (i.e., BCD, ASCII, etc.).

Swap Bytes (SWAPB) – usually used to swap V–memory bytes on ASCII data that was written directly to V–memory from an external HMI or similar master device via a communications protocol. The AIN and AEX instructions have a built–in byte swap feature.

ASCII Input (AIN)

DS	Used
HPP	N/A

The ASCII Input instruction allows the CPU to receive ASCII strings through the specified communications port and places the string into a series of specified V–memory registers. The ASCII data can be received as a fixed number of bytes or as a variable length string with specified termination character(s). Other features include, Byte Swap preferences, Character Timeout, and user defined flag bits for Busy, Complete and Timeout Error.

AIN Fixed Length Configuration

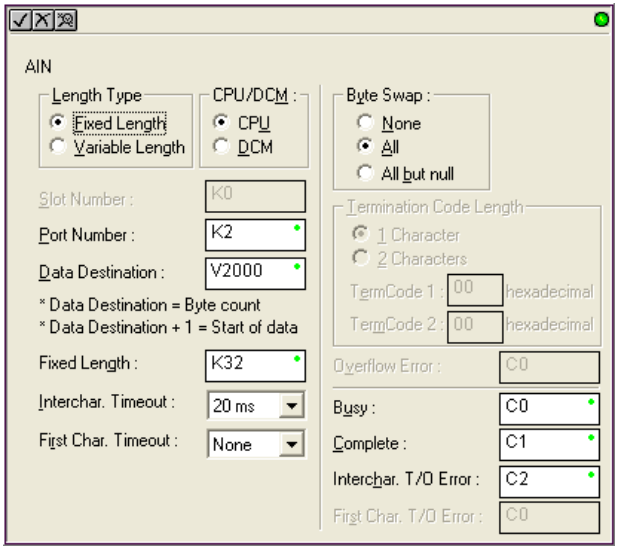
Length Type: select fixed length based on the length of the ASCII string that will be sent to the CPU port

Port Number: must be DL06 port 2 (K2)

Data Destination: specifies where the ASCII string will be placed in V–memory

Fixed Length: specifies the length, in bytes, of the fixed length ASCII string the port will receive

Inter–character Timeout: if the amount of time between incoming ASCII characters exceeds the set time, the specified Timeout Error bit will be set.



No data will be stored at the Data Destination V–memory location. The bit will reset when the AIN instruction permissive bits are disabled. 0ms selection disables this feature.

First Character Timeout: if the amount of time from when the AIN is enabled to the time the first character is received exceeds the set time, the specified First Character Timeout bit will be set. The bit will reset when the AIN instruction permissive bits are disabled. 0ms selection disables this feature.

Byte Swap: swaps the high–byte and low–byte within each V–memory register of the Fixed Length ASCII string. See the SWAPB instruction for details.

Busy Bit: is ON while the AIN instruction is receiving ASCII data

Complete Bit: is set once the ASCII data has been received for the specified fixed length and reset when the AIN instruction permissive bits are disabled.

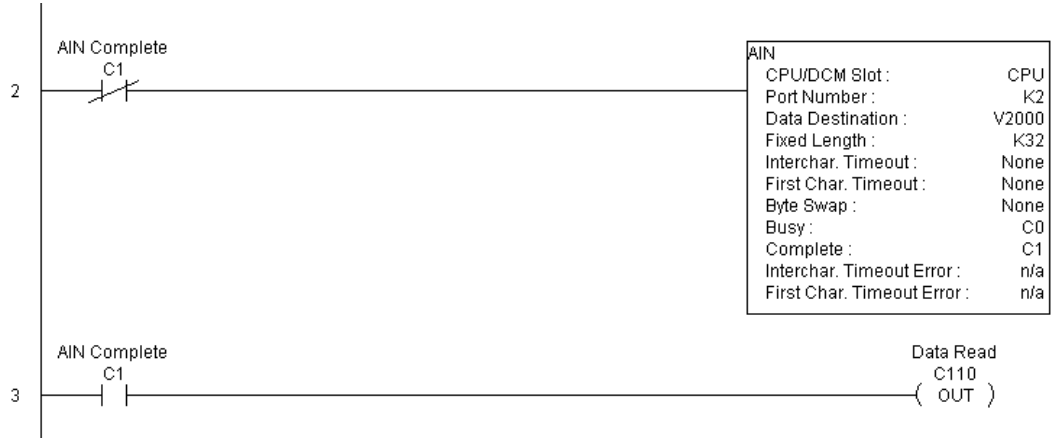
Inter–character Timeout Error Bit: is set when the Character Timeout is exceeded. See Character Timeout explanation above.

First Character Timeout Error Bit: is set when the First Character Timeout is exceeded. See First Character Timeout explanation above.

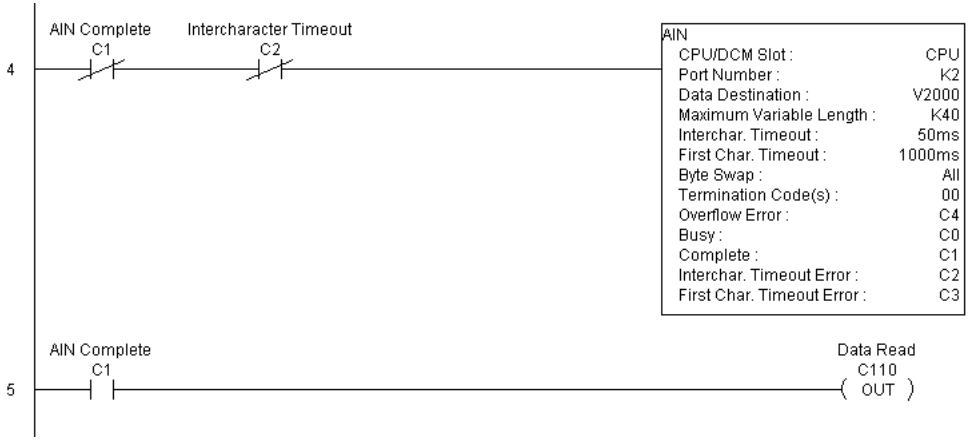
Parameter	
Data Destination	All V–memory
Fixed Length	K1–128
Bits: Busy, Complete, Timeout Error, Overflow	C0–3777

AIN Fixed Length Examples

Fixed Length example when the PLC is reading the port continuously and timing is not critical



Fixed Length example when character to character timing is critical



AIN Variable Length Configuration:

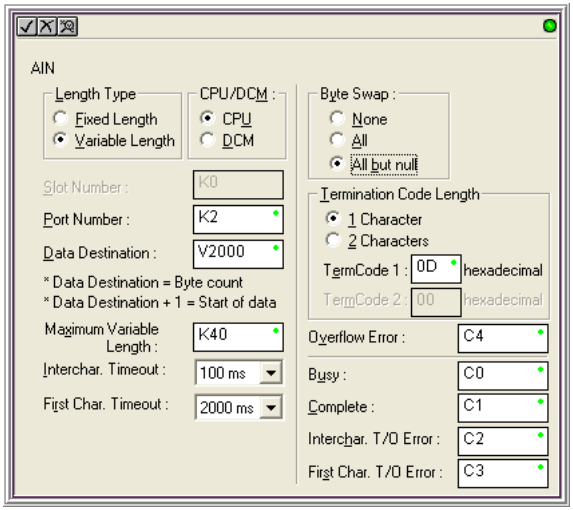
Length Type: select Variable Length if the ASCII string length followed by termination characters will vary in length

Port Number: must be DL06 port 2 (K2)

Data Destination: specifies where the ASCII string will be placed in V–memory

Maximum Variable Length: specifies, in bytes, the maximum length of a Variable Length ASCII string the port will receive

Inter–character Timeout: if the amount of time between incoming ASCII characters exceeds the set time, the Timeout Error bit will be set. No data will be stored at the Data Destination V–memory location.



The Timeout Error bit will reset when the AIN instruction permissive bits are disabled. 0ms selection disables this feature.

First Character Timeout: if the amount of time from when the AIN is enabled to the time the first character is received exceeds the set time, the specified First Character Timeout bit will be set. The bit will reset when the AIN instruction permissive bits are disabled. 0ms selection disables this feature.

Byte Swap: swaps the high–byte and low–byte within each V–memory register of the Variable Length ASCII string. See the SWAPB instruction for details.

Termination Code Length: consists of either 1 or 2 characters. Refer to Appendix G, ASCII Table.

Busy Bit: is ON while the AIN instruction is receiving ASCII data

Complete Bit: is set once the ASCII data has been received up to the termination code characters. It will be reset when the AIN instruction permissive bits are disabled.

Inter–character Timeout Error Bit: is set when the Character Timeout is exceeded. See Character Timeout explanation above.

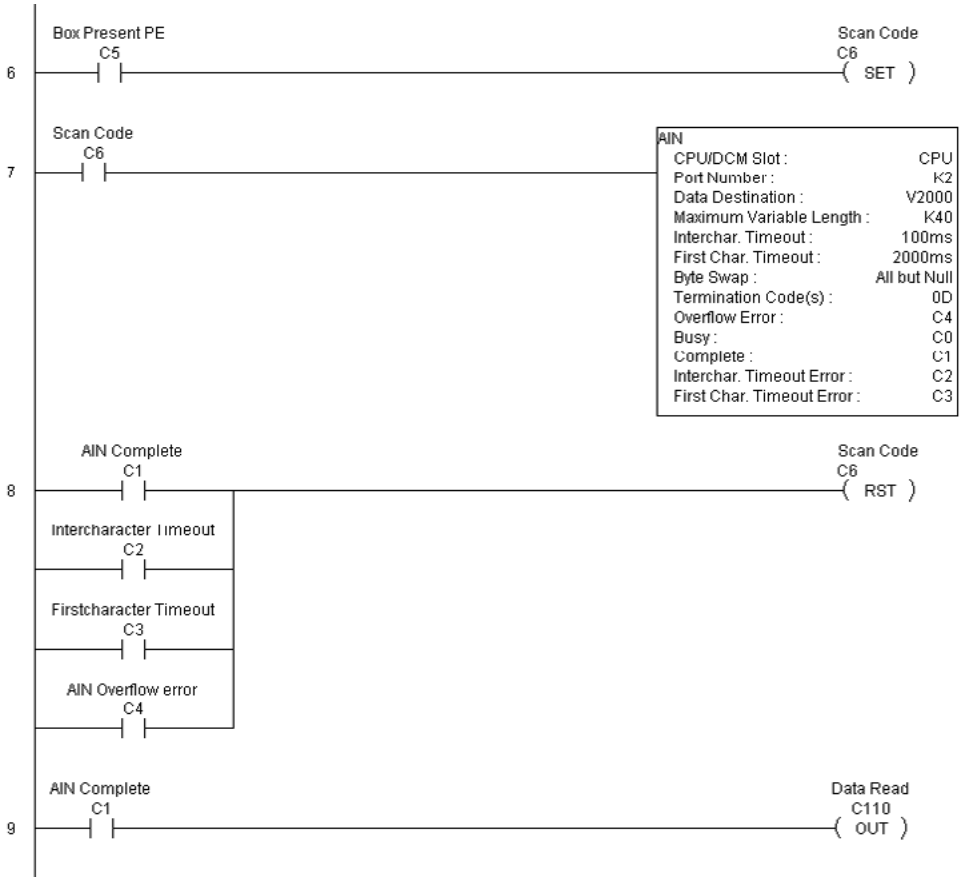
First Character Timeout Error Bit: is set when the First Character Timeout is exceeded. See First Character Timeout explanation above.

Overflow Error Bit: is set when the ASCII data received exceeds the Maximum Variable Length specified.

Parameter	
Data Destination	All V–memory
Fixed Length	K1–128
Bits: Busy, Complete, Timeout Error, Overflow	C0–3777

AIN Variable Length Example

AIN variable length example used to read barcodes on boxes (PE = photoelectric sensor)



ASCII Find (AFIND)

DS	Used
HPP	N/A

The ASCII Find instruction locates a specific ASCII string or portion of an ASCII string within a range of V–memory registers and places the string's Found Index number (byte number where desired string is found), in Hex, into a specified V–memory register. Other features include, Search Starting Index number for skipping over unnecessary bytes before beginning the FIND operation, Forward or Reverse direction search, and From Beginning and From End selections to reference the Found Index Value.

Base Address: specifies the beginning V–memory register where the entire ASCII string is stored in memory

Total Number of Bytes: specifies the total number of bytes to search for the desired ASCII string

Search Starting Index: specifies which byte to skip to (with respect to the Base Address) before beginning the search

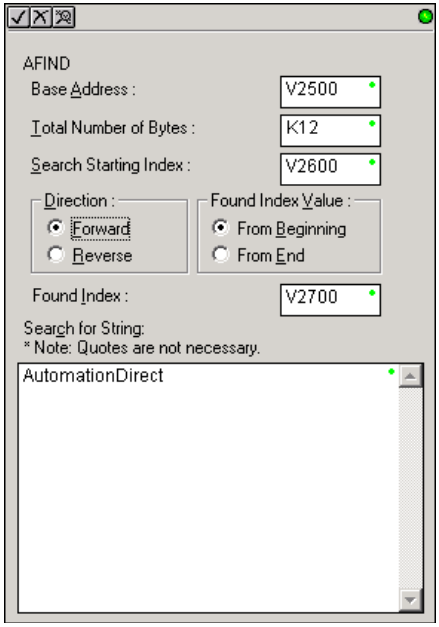
Direction: Forward begins the search from lower numbered V–memory registers to higher numbered V–memory registers. Reverse does the search from higher numbered V–memory registers to lower numbered V–memory registers.

Found Index Value: specifies whether the Beginning or the End byte of the ASCII string found will be loaded into the Found Index register

Found Index: specifies the V–memory register where the Found Index Value will be stored. A value of FFFF will result if the desired string is not located in the memory registers specified.

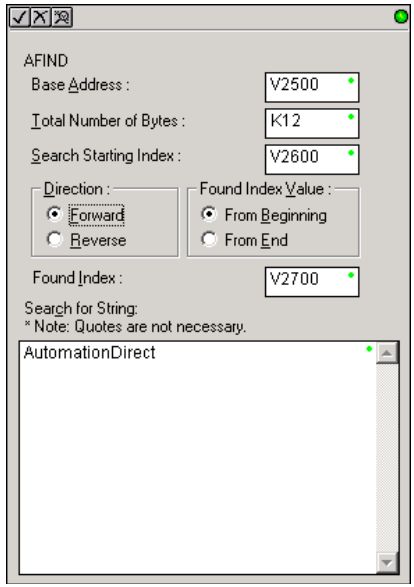
Search for String: up to 128 characters.

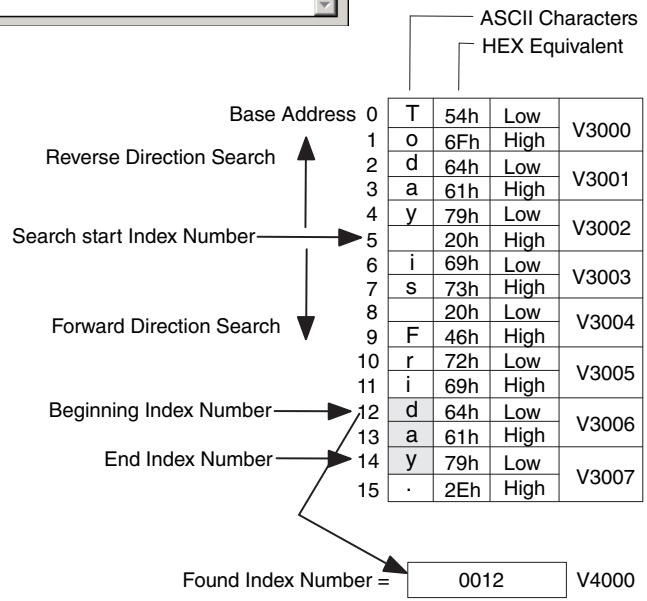
Parameter	DL06 Range
Base Address	All V–memory
Total Number of Bytes	All V–memory or K1–128
Search Starting Index	All V–memory or K0–127
Found Index	All V–memory



AFIND Search Example

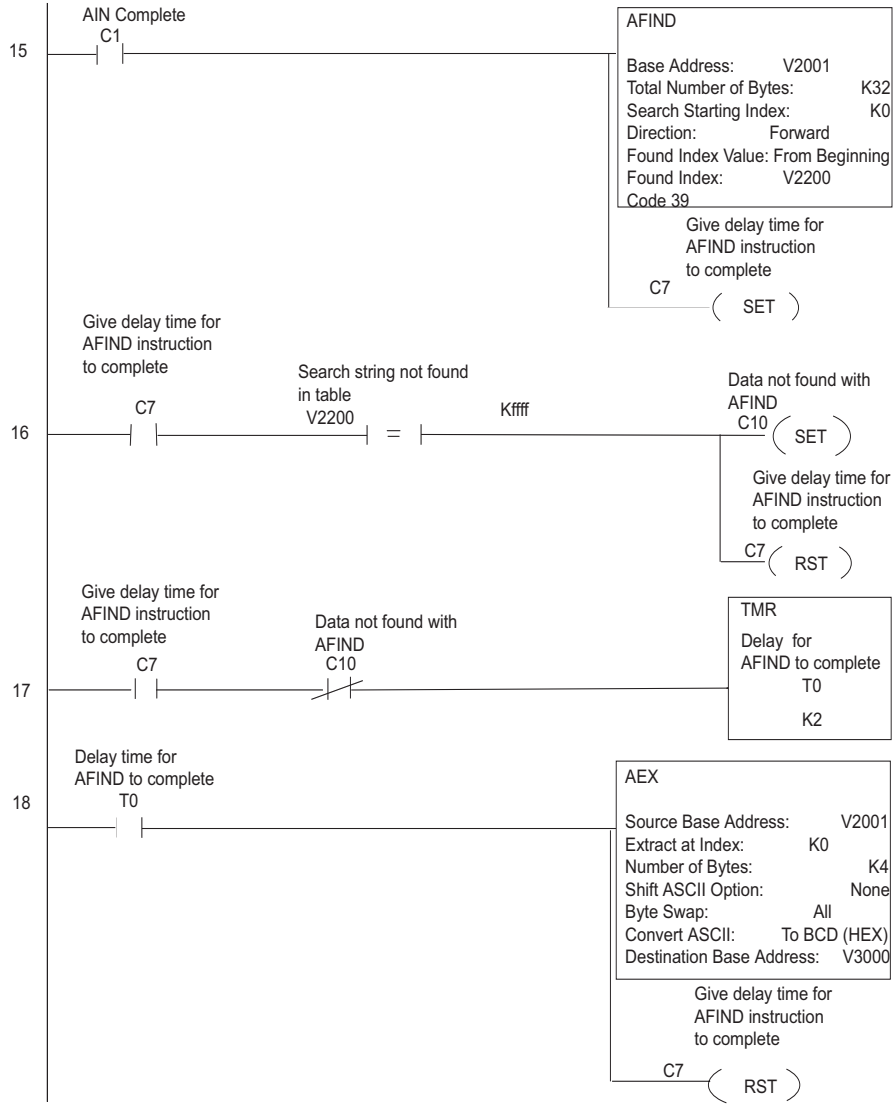
In the following example, the AFIND instruction is used to search for the "day" portion of "Friday" in the ASCII string "Today is Friday.", which had previously been loaded into V–memory. Note that a Search Starting Index of constant (K) 5 combined with a Forward Direction Search is used to prevent finding the "day" portion of the word "Today". The Found Index will be placed into V4000.





AFIND Example Combined with AEX Instruction

When an AIN instruction has executed, its Complete bit can be used to trigger an AFIND instruction to search for a desired portion of the ASCII string. Once the string is found, the AEX instruction can be used to extract the located string.



ASCII Extract (AEX)

DS	Used
HPP	N/A

The ASCII Extract instruction extracts a specified number of bytes of ASCII data from one series of V–memory registers and places it into another series of V–memory registers. Other features include, Extract at Index for skipping over unnecessary bytes before beginning the Extract operation, Shift ASCII Option, for One Byte Left or One Byte Right, Byte Swap and Convert data to a BCD format number.

Source Base Address: specifies the beginning V–memory register where the entire ASCII string is stored in memory

Extract at Index: specifies which byte to skip to (with respect to the Source Base Address) before extracting the data

Number of Bytes: specifies the number of bytes to be extracted

Shift ASCII Option: shifts all extracted data one byte left or one byte right to displace "unwanted" characters if necessary

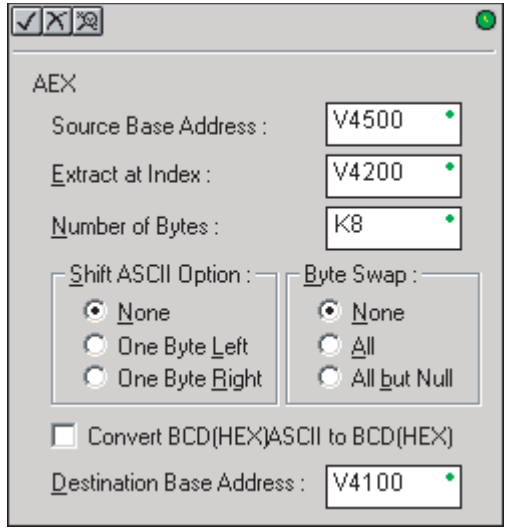
Byte Swap: swaps the high–byte and the low–byte within each V–memory register of the extracted data. See the SWAPB instruction for details.

Convert BCD(Hex) ASCII to BCD (Hex): if enabled, this will convert ASCII numerical characters to Hexadecimal numerical values

Destination Base Address: specifies the V–memory register where the extracted data will be stored

See the previous page for an example using the AEX instruction.

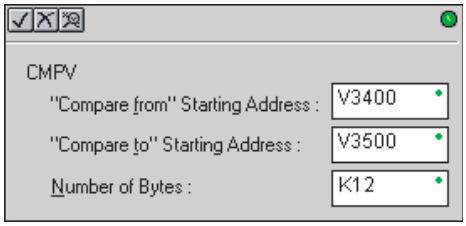
Parameter	DL06 Range	
Source Base Address	All V–memory	
Extract at Index	All V–memory or K0–127	
Number of Bytes "Convert BCD (HEX) ASCII" **not** checked	Constant range: K1–128	V-memory location containing BCD value: 1–128
Number of Bytes "Convert BCD (HEX) ASCII" checked	Constant range: K1–4	V-memory location containing BCD value: 1–4
Destination Base Address	All V–memory	



ASCII Compare (CMPV)

DS	Used
HPP	N/A

The ASCII Compare instruction compares two groups of V–memory registers. The CMPV will compare any data type (ASCII to ASCII, BCD to BCD, etc.) of one series (group) of V–memory registers to another series of V–memory registers for a specified byte length.



SP61 = 1, the result is equal
SP61 = 0, the result is not equal

"Compare from" Starting Address: specifies the beginning V–memory register of the first group of V–memory registers to be compared from.

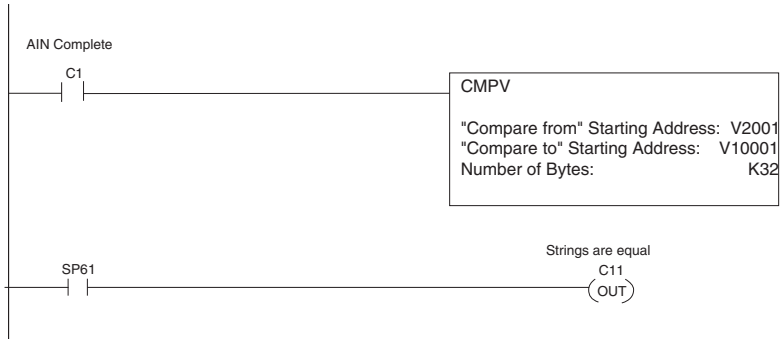
"Compare to" Starting Address: specifies the beginning V–memory register of the second group of V–memory registers to be compared to.

Number of Bytes: specifies the length of each V–memory group to be compared

Parameter	DL06 Range
Compare from Starting Address	All V–memory
Compare to Starting Address	All V–memory
Number of Bytes	K0–127

CMPV Example

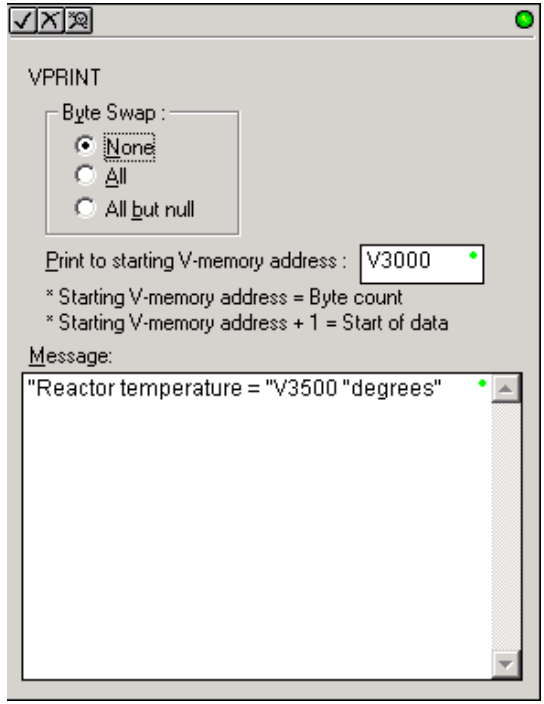
The CMPV instruction executes when the AIN instruction is complete. If the compared V–memory tables are equal, SP61 will turn ON.



ASCII Print to V–memory (VPRINT)

DS	Used
HPP	N/A

The ASCII Print to V–memory instruction will write a specified ASCII string into a series of V–memory registers. Other features include Byte Swap, options to suppress or convert leading zeros or spaces, and _Date and _Time options for U.S., European, and Asian date formats and 12 or 24 hour time formats.



Byte Swap: swaps the high–byte and low–byte within each V–memory register the ASCII string is printed to. See the SWAPB instruction for details.

Print to Starting V–memory Address: specifies the beginning of a series of V–memory addresses where the ASCII string will be placed by the VPRINT instruction.

Starting V–memory Address: the first V–memory register of the series of registers specified will contain the ASCII string's length in bytes.

Starting V–memory Address +1: the 2nd and subsequent registers will contain the ASCII string printed to V–memory.

Parameter	DL06 Range
Print to Starting V–memory Address	All V–memory

VPRINT Time/Date Stamping– the codes in the table below can be used in the VPRINT ASCII string message to "print to V–memory" the current time and/or date.

#	Character code	Date / Time Stamp Options
1	_date:us	American standard (month/day/2 digit year)
2	_date:e	European standard (day/month/2 digit year)
3	_date:a	Asian standard (2 digit year/month/day)
4	_time:12	Standard 12 hour clock (0–12 hour:min am/pm)
5	_time:24	Standard 24 hour clock (0–23 hour:min am/pm)

VPRINT V-memory element – the following modifiers can be used in the VPRINT ASCII string message to "print to V–memory" register contents in integer format or real format. Use V-memory number or V-memory number with ":" and data type. The data types are shown in the table below. The Character code must be capital letters.

__NOTE__: There must be a space entered before and after the V-memory address to separate it from the text string. Failure to do this will result in an error code 499.

#	Character code	Description
1	none	16-bit binary (decimal number)
2	: B	4 digit BCD
3	: D	32-bit binary (decimal number)
4	: D B	8 digit BCD
5	: R	Floating point number (real number)
6	: E	Floating point number (real number with exponent)

Examples:

V2000 Print binary data in V2000 for decimal number

V2000 : B Print BCD data in V2000

V2000 : D Print binary number in V2000 and V2001 for decimal number

V2000 : D B Print BCD data in V2000 and V2001

V2000 : R Print floating point number in V2000/V2001 as real number

V2000 : E Print floating point number in V2000/V2001 as real number with exponent

The following modifiers can be added to any of the modifies above to suppress or convert leading zeros or spaces. The character code must be capital letters.

#	Character code	Description
1	S	Suppresses leading spaces
2	C0	Converts leading spaces to zeros
3	0	Suppresses leading zeros

Example with V2000 = 0018 (binary format)

V–memory Register with Modifier	Number of Characters			
	1	2	3	4
V2000	0	0	1	8
V2000:B	0	0	1	2
V2000:B0	1	2		

Example with V2000 = sp sp18 (binary format) where sp = space

V–memory Register with Modifier	Number of Characters			
	1	2	3	4
V2000	sp	sp	1	8
V2000:B	sp	sp	1	2
V2000:BS	1	2		
V2000:BC0	0	0	1	2

VPRINT V-memory text element – the following is used for "printing to V–memory" text stored in registers. Use the % followed by the number of characters after V-memory number for representing the text. If you assign "0" as the number of characters, the function will read the character count from the first location. Then it will start at the next V-memory location and read that number of ASCII codes for the text from memory.

Example:

V2000 % 16 16 characters in V2000 to V2007 are printed.

V2000 % 0 The characters in V2001 to Vxxxx (determined by the number in V2000) will be printed.

VPRINT Bit element – the following is used for "printing to V–memory" the state of the designated bit in V-memory or a control relay bit. The bit element can be assigned by the designating point (.) and bit number preceded by the V-memory number or relay number. The output type is described as shown in the table below.

#	Data format	Description
1	none	Print 1 for an ON state, and 0 for an OFF state
2	: BOOL	Print "TRUE" for an ON state, and "FALSE" for an OFF state
3	: ONOFF	Print "ON" for an ON state, and "OFF" for an OFF state

Example:

V2000 . 15 Prints the status of bit 15 in V2000, in 1/0 format

C100 Prints the status of C100 in 1/0 format

C100 : BOOL Prints the status of C100 in TRUE/FALSE format

C100 : ON/OFF Prints the status of C100 in ON/OFF format

V2000.15 : BOOL Prints the status of bit 15 in V2000 in TRUE/FALSE format

The maximum numbers of characters you can VPRINT is 128. The number of characters required for each element, regardless of whether the :S, :C0 or :0 modifiers are used, is listed in the table below.

Element type	Maximum Characters
Text, 1 character	1
16 bit binary	6
32 bit binary	11
4 digit BCD	4
8 digit BCD	8
Floating point (real number)	3
Floating point (real with exponent)	13
V-memory/text	2
Bit (1/0 format)	1
Bit (TRUE/FALSE format)	5
Bit (ON/OFF format)	3

Text element – the following is used for "printing to V–memory" character strings. The character strings are defined as the character (more than 0) ranged by the double quotation marks. Two hex numbers preceded by the dollar sign means an 8-bit ASCII character code. Also, two characters preceded by the dollar sign is interpreted according to the following table:

#	Character code	Description
1	$$	Dollar sign ($)
2	$"	Double quotation (")
3	$Lor $l	Line feed (LF)
4	$N or $n	Carriage return line feed (CRLF)
5	$P or $p	Form feed
6	$R or $r	Carriage return (CR)
7	$T or $t	Tab

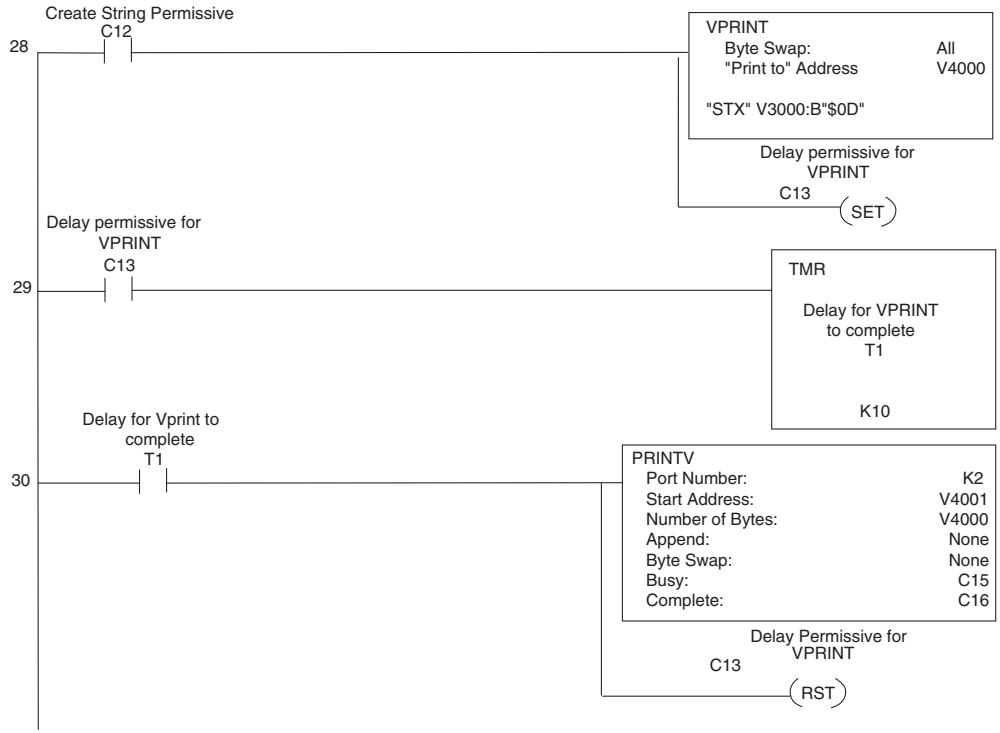
The following examples show various syntax conventions and the length of the output to the printer.

" "	Length 0 without character
"A"	Length 1 with character A
" "	Length 1 with blank
" $" "	Length 1 with double quotation mark
" $ R $ L "	Length 2 with one CR and one LF
" $ 0 D $ 0 A "	Length 2 with one CR and one LF
" $ $ "	Length 1 with one $ mark

In printing an ordinary line of text, you will need to include double quotation marks before and after the text string. Error code 499 will occur in the CPU when the print instruction contains invalid text or no quotations. It is important to test your VPRINT instruction data during the application development.

VPRINT Example Combined with PRINTV Instruction

The VPRINT instruction is used to create a string in V–memory. The PRINTV is used to print the string out of port 2.



ASCII Print from V–memory (PRINTV)

DS	Used
HPP	N/A

The ASCII Print from V–memory instruction will send an ASCII string out of the designated communications port from a specified series of V–memory registers for a specified length in number of bytes. Other features include user specified Append Characters to be placed after the desired data string for devices that require specific termination character(s), Byte Swap options, and user specified flags for Busy and Complete.

Port Number: must be DL06 port 2 (K2)

Start Address: specifies the beginning of series of V–memory registers that contain the ASCII string to print

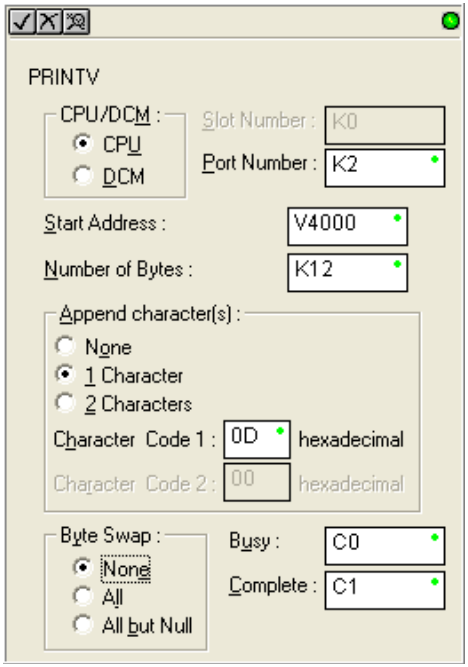
Number of Bytes: specifies the length of the string to print

Append Characters: specifies ASCII characters to be added to the end of the string for devices that require specific termination characters

Byte Swap: swaps the high–byte and low–byte within each V–memory register of the string while printing. See the SWAPB instruction for details.

Busy Bit: will be ON while the instruction is printing ASCII data

Complete Bit: will be set once the ASCII data has been printed and reset when the PRINTV instruction permissive bits are disabled.



See the previous page for an example using the PRINTV instruction.

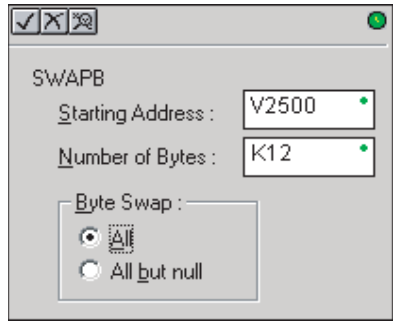
Parameter	DL06 Range
Port Number	Port 2 (K2)
Start Address	All V–memory
Number of Bytes	All V–memory or k1–128
Bits: Busy, Complete	C0–3777

ASCII Swap Bytes (SWAPB)

DS	Used
HPP	N/A

The ASCII Swap Bytes instruction swaps byte positions (high–byte to low–byte and low–byte to high–byte) within each V–memory register of a series of V–memory registers for a specified number of bytes.

- Starting Address: specifies the beginning of a series of V–memory registers the instruction will use to begin byte swapping
- Number of Bytes: specifies the number of bytes, beginning with the Starting Address, to byte swap.
- Byte Swap: All - swap all bytes specified. All but null - swap all bytes specified except the bytes with a null

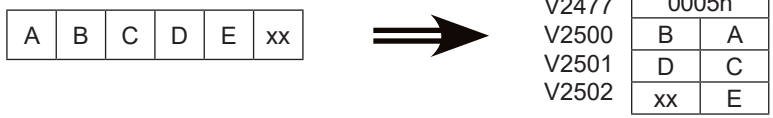


Parameter	DL06 Range
Starting Address	All V–memory
Number of Bytes	All V–memory or K1–128

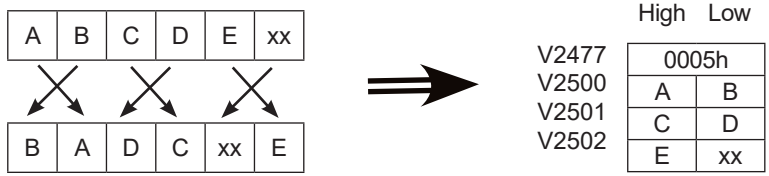
Discrete Bit Flags	Description
SP53	On if the CPU cannot execute the instruction.
SP71	On when a value used by the instruction is invalid.

Byte Swap Preferences

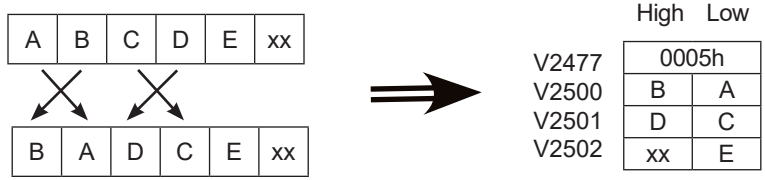
No Byte Swapping
(AIN, AEX, PRINTV, VPRINT)



Byte Swap All



Byte Swap All but Null



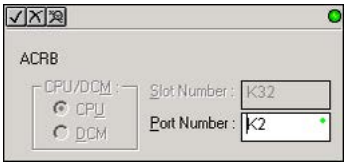
SWAPB Example

The AIN Complete bit is used to trigger the SWAPB instruction. Use a one–shot so the SWAPB only executes once.

ASCII Clear Buffer (ACRB)

DS	Used
HPP	N/A

The ASCII Clear Buffer instruction will clear the ASCII receive buffer of the specified communications port number. Port Number: must be DL06 port 2 (K2)



ACRB Example

The AIN Complete bit or the AIN diagnostic bits are used to clear the ASCII buffer.

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Intelligent Box (IBox) Instructions

The Intelligent Box Instructions (IBox) listed in this section are additional instructions made available when using *Direct*SOFT to program your DL06 PLC (the DL06 CPU requires firmware version v2.10 or later to use the new features in *Direct*SOFT). For more information on *Direct*SOFT and to download a free demo version, please visit our Web site at: www.automationdirect.com.

Analog Helper IBoxes		
Instruction	**Ibox #**	**Page**
Analog Input / Output Combo Module Pointer Setup (ANLGCMB)	IB-462	5-232
Analog Input Module Pointer Setup (ANLGIN)	IB-460	5-234
Analog Output Module Pointer Setup (ANLGOUT)	IB-461	5-236
Analog Scale 12 Bit BCD to BCD (ANSCL)	IB-423	5-238
Analog Scale 12 Bit Binary to Binary (ANSCLB)	IB-403	5-239
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Discrete Helper IBoxes		
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Memory IBoxes		
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Move Double Word (MOVED)	IB-201	5-255

Math IBoxes		
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ECOM100 Read Module ID (ECRDMID)	IB-720	5-298
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Analog Input/Output Combo Module Pointer Setup (ANLGCMB) (IB-462)

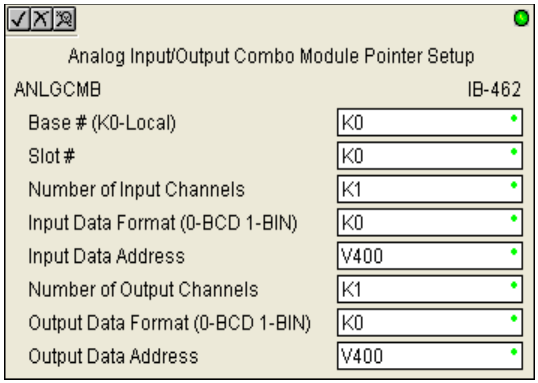
DS	Used
HPP	N/A

The Analog Input/Output Combo Module Pointer Setup instruction generates the logic to configure the pointer method for an analog input/output combination module on the first PLC scan following a Program to Run transition.

The ANLGCMB IBox instruction determines the data format and Pointer addresses based on the CPU type, the Base# and the module Slot#.

The Input Data Address is the starting location in user V-memory where the analog input data values will be stored, one location for each input channel enabled.

The Output Data Address is the starting location in user V-memory where the analog output data values will be placed by ladder code or external device, one location for each output channel enabled



Since the IBox logic only executes on the first scan, the instruction cannot have any input logic.

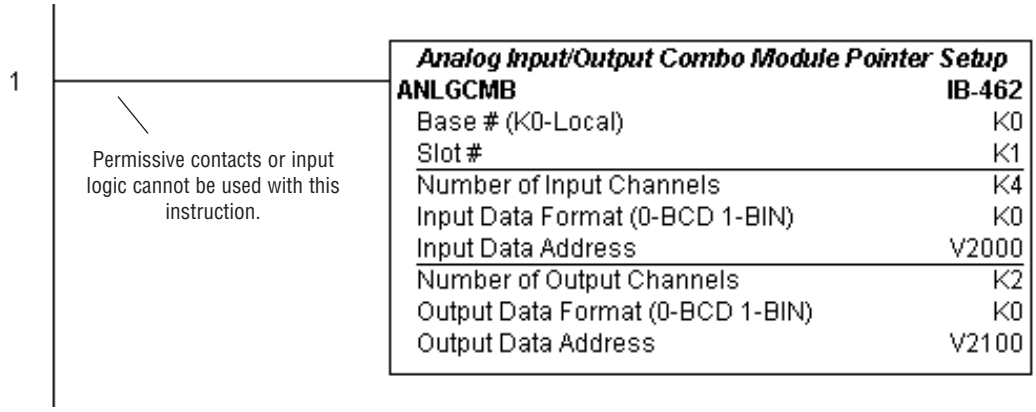
ANLGCMB Parameters

- Base # (K0-Local): must be 0 for DL06 PLC
- Slot #: specifies which PLC option slot is occupied by the analog module (1–4)
- Number of Input Channels: specifies the number of analog input channels to scan
- Input Data Format (0-BCD 1-BIN): specifies the analog input data format (BCD or Binary) - the binary format may be used for displaying data on some OI panels
- Input Data Address: specifies the starting V-memory location that will be used to store the analog input data
- Number of Output Channels: specifies the number of analog output channels that will be used
- Output Data Format (0-BCD 1-BIN): specifies the format of the analog output data (BCD or Binary)
- Output Data Address: specifies the starting V-memory location that will be used to source the analog output data

Parameter		DL06 Range
Base # (K0-Local)	K	K0 (local base only)
Slot #	K	K1-4
Number of Input Channels	K	K1-8
Input Data Format (0-BCD 1-BIN)	K	BCD: K0; Binary: K1
Input Data Address	V	See DL06 V-memory map - Data Words
Number of Output Channels	K	K1-8
Output Data Format (0-BCD 1-BIN)	K	BCD: K0; Binary: K1
Output Data Address	V	See DL06 V-memory map - Data Words

ANLGCMB Example

In the following example, the ANLGCMB instruction is used to setup the pointer method for an analog I/O combination module that is installed in option slot 2. Four input channels are enabled and the analog data will be written to V2000 - V2003 in BCD format. Two output channels are enabled and the analog values will be read from V2100 - V2101 in BCD format.



Analog Input Module Pointer Setup (ANLGIN) (IB-460)

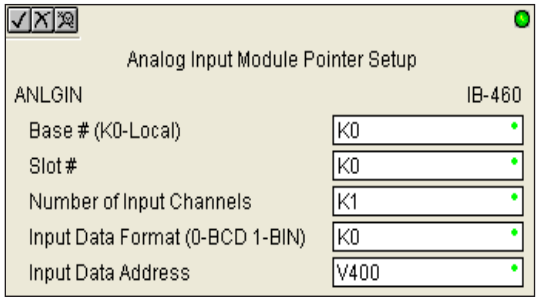
DS	Used
HPP	N/A

Analog Input Module Pointer Setup generates the logic to configure the pointer method for one analog input module on the first PLC scan following a Program to Run transition.

This IBox determines the data format and Pointer addresses based on the CPU type, the Base#, and the Slot#.

The Input Data Address is the starting location in user V-memory where the analog input data values will be stored, one location for each input channel enabled.

Since this logic only executes on the first scan, this IBox cannot have any input logic.



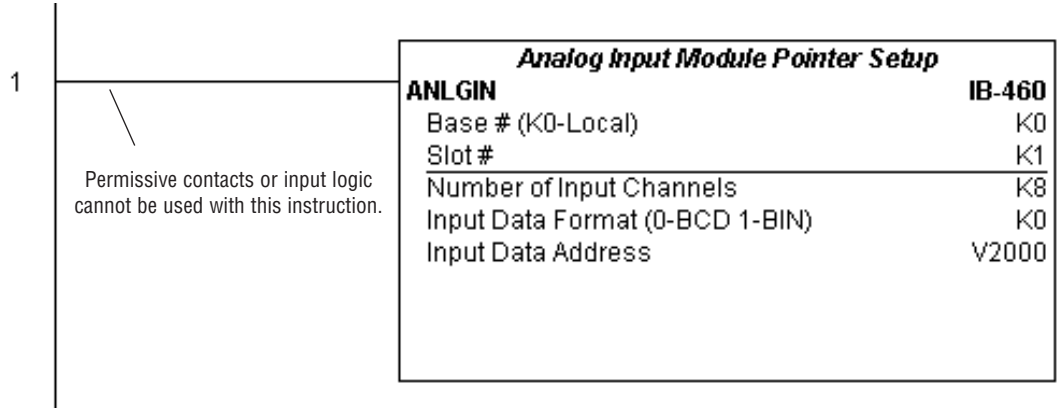
ANLGIN Parameters

- Base # (K0-Local): must be 0 for DL06 PLC
- Slot #: specifies which PLC option slot is occupied by the analog module (1–4)
- Number of Input Channels: specifies the number of input channels to scan
- Input Data Format (0-BCD 1-BIN): specifies the analog input data format (BCD or Binary) - the binary format may be used for displaying data on some OI panels
- Input Data Address: specifies the starting V-memory location that will be used to store the analog input data

Parameter		DL06 Range
Base # (K0-Local)	K	K0 (local base only)
Slot #	K	K1-4
Number of Input Channels	K	K1-8
Input Data Format (0-BCD 1-BIN)	K	BCD: K0; Binary: K1
Input Data Address	V	See DL06 V-memory map - Data Words

ANLGIN Example

In the following example, the ANLGIN instruction is used to setup the pointer method for an analog input module that is installed in option slot 1. Eight input channels are enabled and the analog data will be written to V2000 - V2007 in BCD format.



Analog Output Module Pointer Setup (ANLGOUT) (IB-461)

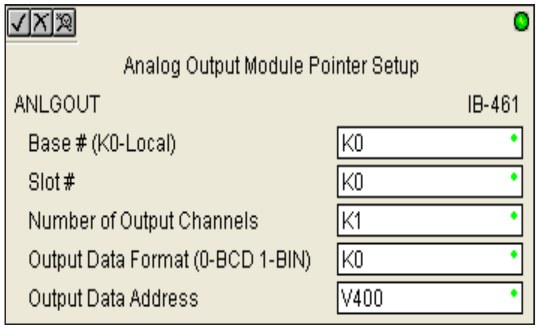
DS	Used
HPP	N/A

Analog Output Module Pointer Setup generates the logic to configure the pointer method for one analog output module on the first PLC scan following a Program to Run transition.

This IBox determines the data format and Pointer addresses based on the CPU type, the Base#, and the Slot#.

The Output Data Address is the starting location in user V-memory where the analog output data values will be placed by ladder code or external device, one location for each output channel enabled.

Since this logic only executes on the first scan, this IBox cannot have any input logic.



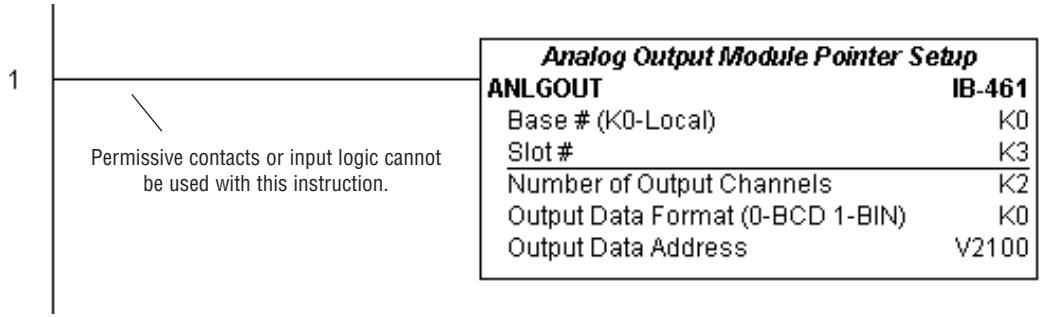
ANLGOUT Parameters

- Base # (K0-Local): must be 0 for DL06 PLC
- Slot #: specifies which PLC option slot is occupied by the analog module (1–4)
- Number of Output Channels: specifies the number of analog output channels that will be used
- Output Data Format (0-BCD 1-BIN): specifies the format of the analog output data (BCD or Binary)
- Output Data Address: specifies the starting V-memory location that will be used to source the analog output data

Parameter		DL06 Range
Base # (K0-Local)	K	K0 (local base only)
Slot #	K	K1-4
Number of Output Channels	K	K1-8
Output Data Format (0-BCD 1-BIN)	K	BCD: K0; Binary: K1
Output Data Address	V	See DL06 V-memory map - Data Words

ANLGOUT Example

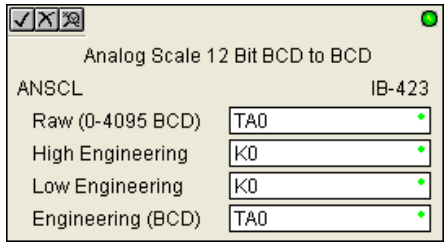
In the following example, the ANLGOUT instruction is used to setup the pointer method for an analog output module that is installed in option slot 3. Two output channels are enabled and the analog data will be read from V2100 - V2101 in BCD format.



Analog Scale 12 Bit BCD to BCD (ANSCL) (IB-423)

DS	Used
HPP	N/A

Analog Scale 12 Bit BCD to BCD scales a 12 bit BCD analog value (0-4095 BCD) into BCD engineering units. You specify the engineering unit high value (when raw is 4095), and the engineering low value (when raw is 0), and the output V-Memory address you want the to place the scaled engineering unit value. The engineering units are generated as BCD and can be the full range of 0 to 9999 (see ANSCLB - Analog Scale 12 Bit Binary to Binary if your raw units are in Binary format).



NOTE: *This IBox only works with unipolar unsigned raw values. It does NOT work with bipolar or sign plus magnitude raw values.*

ANSCL Parameters

- Raw (0-4095 BCD): specifies the V-memory location of the unipolar unsigned raw 0-4095 unscaled value
- High Engineering: specifies the high engineering value when the raw input is 4095
- Low Engineering: specifies the low engineering value when the raw input is 0
- Engineering (BCD): specifies the V-memory location where the scaled engineering BCD value will be placed

Parameter		DL06 Range
Raw (0-4095 BCD)	V,P	See DL06 V-memory map - Data Words
High Engineering	K	K0-9999
Low Engineering	K	K0-9999
Engineering (BCD)	V,P	See DL06 V-memory map - Data Words

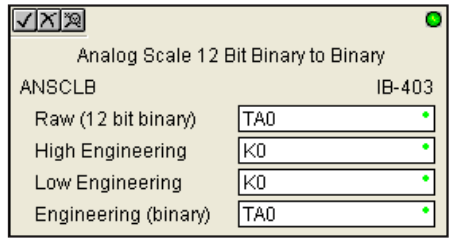
ANSCL Example

In the following example, the ANSCL instruction is used to scale a raw value (0-4095 BCD) that is in V2000. The engineering scaling range is set 0-100 (low engineering value - high engineering value). The scaled value will be placed in V2100 in BCD format.

Analog Scale 12 Bit Binary to Binary (ANSCLB) (IB-403)

DS	Used
HPP	N/A

Analog Scale 12 Bit Binary to Binary scales a 12 bit binary analog value (0-4095 decimal) into binary (decimal) engineering units. You specify the engineering unit high value (when raw is 4095), and the engineering low value (when raw is 0), and the output V-Memory address you want to place the scaled engineering unit value. The engineering units are generated as binary and can be the full range of 0 to 65535 (see ANSCL - Analog Scale 12 Bit BCD to BCD if your raw units are in BCD format).



***NOTE**: This IBox only works with unipolar unsigned raw values. It does NOT work with bipolar, sign plus magnitude, or signed 2's complement raw values.*

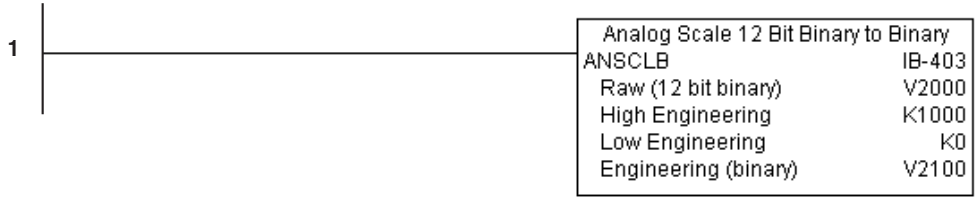
ANSCLB Parameters

- Raw (12 bit binary): specifies the V-memory location of the unipolar unsigned raw decimal unscaled value (12 bit binary = 0-4095 decimal)
- High Engineering: specifies the high engineering value when the raw input is 4095 decimal
- Low Engineering: specifies the low engineering value when the raw input is 0 decimal
- Engineering (binary): specifies the V-memory location where the scaled engineering decimal value will be placed

Parameter		DL06 Range
Raw (12 bit binary)	V,P	See DL06 V-memory map - Data Words
High Engineering	K	K0-65535
Low Engineering	K	K0-65535
Engineering (binary)	V,P	See DL06 V-memory map - Data Words

ANSCLB Example

In the following example, the ANSCLB instruction is used to scale a raw value (0-4095 binary) that is in V2000. The engineering scaling range is set 0-1000 (low engineering value - high engineering value). The scaled value will be placed in V2100 in binary format.



Filter Over Time - BCD (FILTER) (IB-422)

DS	Used
HPP	N/A

Filter Over Time BCD will perform a first-order filter on the Raw Data on a defined time interval. The equation is:

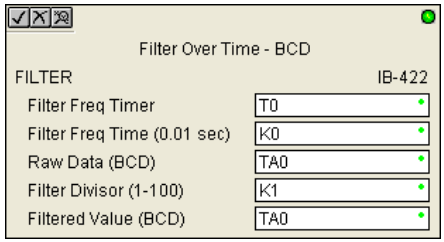
New = Old + [(Raw - Old) / FDC] where,

New: New Filtered Value

Old: Old Filtered Value

FDC: Filter Divisor Constant

Raw: Raw Data



The Filter Divisor Constant is an integer in the range K1 to K100, such that if it equaled K1 then no filtering would be done.

The rate at which the calculation is performed is specified by time in hundredths of a second (0.01 seconds) as the Filter Freq Time parameter. Note that this Timer instruction is embedded in the IBox and must NOT be used anywhere else in your program. Power flow controls whether the calculation is enabled. If it is disabled, the Filter Value is not updated. On the first scan from Program to Run mode, the Filter Value is initialized to 0 to give the calculation a consistent starting point.

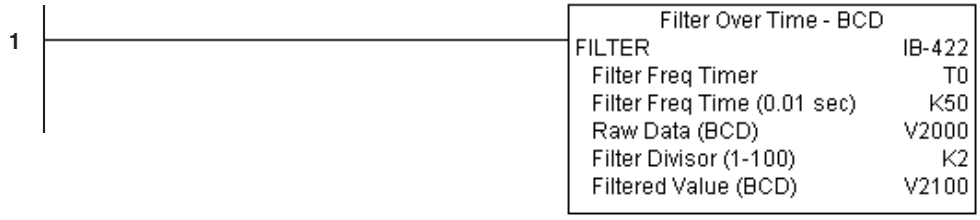
FILTER Parameters

- Filter Frequency Timer: specifies the Timer (T) number which is used by the Filter instruction
- Filter Frequency Time (0.01sec): specifies the rate at which the calculation is performed
- Raw Data (BCD): specifies the V-memory location of the raw unfiltered BCD value
- Filter Divisor (1-100): this constant used to control the filtering effect. A larger value will increase the smoothing effect of the filter. A value of 1 results with no filtering.
- Filtered Value (BCD): specifies the V-memory location where the filtered BCD value will be placed

Parameter		DL06 Range
Filter Frequency Timer	T	T0-377
Filter Frequency Time (0.01 sec)	K	K0-9999
Raw Data (BCD)	V	See DL06 V-memory map - Data Words
Filter Divisor (1-100)	K	K1-100
Filtered Value (BCD)	V	See DL06 V-memory map - Data Words

FILTER Example

In the following example, the Filter instruction is used to filter a BCD value that is in V2000. Timer(T0) is set to 0.5 sec, the rate at which the filter calculation will be performed. The filter constant is set to 2. A larger value will increase the smoothing effect of the filter. A value of 1 results with no filtering. The filtered value will be placed in V2100.



Filter Over Time - Binary (FILTERB) (IB-402)

DS	Used
HPP	N/A

Filter Over Time in Binary (decimal) will perform a first-order filter on the Raw Data on a defined time interval. The equation is

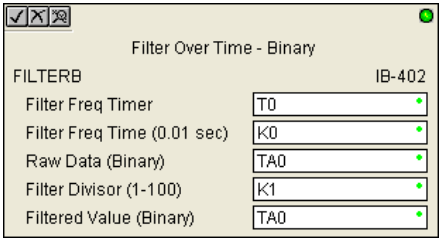
New = Old + [(Raw - Old) / FDC] where

New: New Filtered Value

Old: Old Filtered Value

FDC: Filter Divisor Constant

Raw: Raw Data



The Filter Divisor Constant is an integer in the range K1 to K100, such that if it equaled K1 then no filtering would be done.

The rate at which the calculation is performed is specified by time in hundredths of a second (0.01 seconds) as the Filter Freq Time parameter. Note that this Timer instruction is embedded in the IBox and must NOT be used any other place in your program. Power flow controls whether the calculation is enabled. If it is disabled, the Filter Value is not updated. On the first scan from Program to Run mode, the Filter Value is initialized to 0 to give the calculation a consistent starting point.

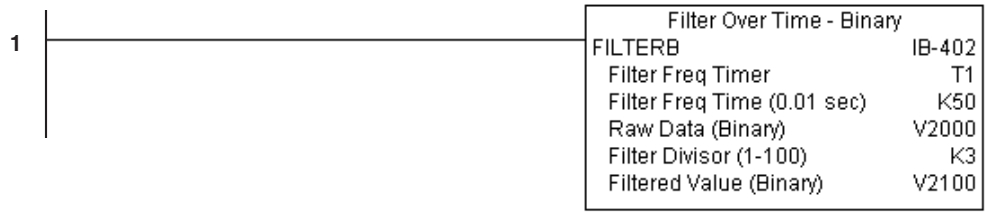
FILTERB Parameters

- Filter Frequency Timer: specifies the Timer (T) number which is used by the Filter instruction
- Filter Frequency Time (0.01sec): specifies the rate at which the calculation is performed
- Raw Data (Binary): specifies the V-memory location of the raw unfiltered binary (decimal) value
- Filter Divisor (1-100): this constant used to control the filtering effect. A larger value will increase the smoothing effect of the filter. A value of 1 results with no filtering.
- Filtered Value (Binary): specifies the V-memory location where the filtered binary (decimal) value will be placed

Parameter		DL06 Range
Filter Frequency Timer	T	T0-377
Filter Frequency Time (0.01 sec)	K	K0-9999
Raw Data (Binary)	V	See DL06 V-memory map - Data Words
Filter Divisor (1-100)	K	K1-100
Filtered Value (Binary)	V	See DL06 V-memory map - Data Words

FILTERB Example

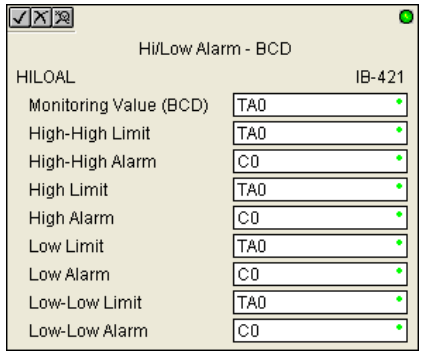
In the following example, the FILTERB instruction is used to filter a binary value that is in V2000. Timer (T1) is set to 0.5 sec, the rate at which the filter calculation will be performed. The filter constant is set to 3.0. A larger value will increase the smoothing effect of the filter. A value of 1 results with no filtering. The filtered value will be placed in V2100



Hi/Low Alarm - BCD (HILOAL) (IB-421)

DS	Used
HPP	N/A

Hi/Low Alarm - BCD monitors a BCD value V-Memory location and sets four possible alarm states, High-High, High, Low, and Low-Low whenever the IBox has power flow. You enter the alarm thresholds as constant K BCD values (K0-K9999) and/or BCD value V-Memory locations.



You must ensure that threshold limits are valid, that is HH >= H > L >= LL. Note that when the High-High or Low-Low alarm condition is true, that the High and Low alarms will also be set, respectively. This means you may use the same threshold limit and same alarm bit for the High-High and the High alarms in case you only need one "High" alarm. Also note that the boundary conditions are inclusive. That is, if the Low boundary is K50, and the Low-Low boundary is K10, and if the Monitoring Value equals 10, then the Low Alarm AND the Low-Low alarm will both be ON. If there is no power flow to the IBox, then all alarm bits will be turned off regardless of the value of the Monitoring Value parameter.

HILOAL Parameters

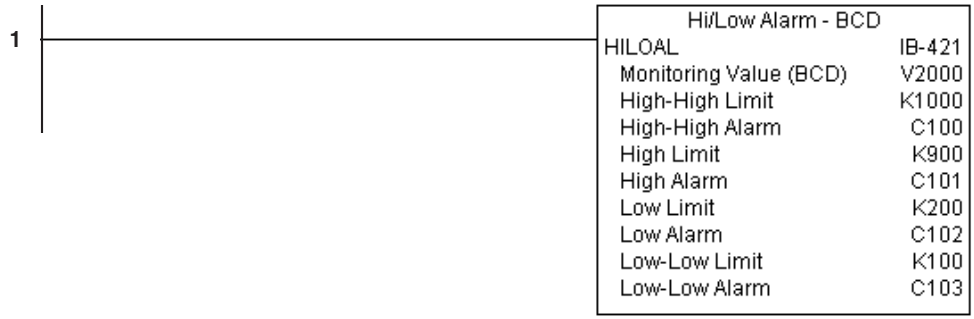
- Monitoring Value (BCD): specifies the V-memory location of the BCD value to be monitored
- High-High Limit: V-memory location or constant specifies the high-high alarm limit
- High-High Alarm: On when the high-high limit is reached
- High Limit: V-memory location or constant specifies the high alarm limit
- High Alarm: On when the high limit is reached
- Low Limit: V-memory location or constant specifies the low alarm limit
- Low Alarm: On when the low limit is reached
- Low-Low Limit: V-memory location or constant specifies the low-low alarm limit
- Low-Low Alarm: On when the low-low limit is reached

Parameter		DL06 Range
Monitoring Value (BCD)	V	See DL06 V-memory map - Data Words
High-High Limit	V, K	K0-9999; or see DL06 V-memory map - Data Words
High-High Alarm	X, Y, C, GX,GY, B	See DL06 V-memory map
High Limit	V, K	K0-9999; or see DL06 V-memory map - Data Words
High Alarm	X, Y, C, GX,GY, B	See DL06 V-memory map
Low Limit	V, K	K0-9999; or see DL06 V-memory map - Data Words
Low Alarm	X, Y, C, GX,GY,B	See DL06 V-memory map
Low-Low Limit	V, K	K0-9999; or see DL06 V-memory map - Data Words
Low-Low Alarm	X, Y, C, GX,GY, B	See DL06 V-memory map

HILOAL Example

In the following example, the HILOAL instruction is used to monitor a BCD value that is in V2000. If the value in V2000 meets/exceeds the high limit of K900, C101 will turn on. If the value continues to increase to meet/exceed the high-high limit, C100 will turn on. Both bits would be on in this case. The high and high-high limits and alarms can be set to the same value if one "high" limit or alarm is desired to be used.

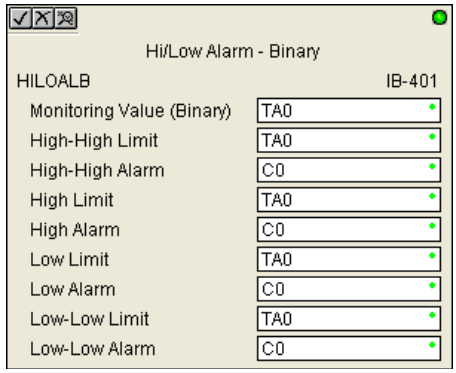
If the value in V2000 meets or falls below the low limit of K200, C102 will turn on. If the value continues to decrease to meet or fall below the low-low limit of K100, C103 will turn on. Both bits would be on in this case. The low and low-low limits and alarms can be set to the same value if one "low" limit or alarm is desired to be used.



Hi/Low Alarm - Binary (HILOALB) (IB-401)

DS	Used
HPP	N/A

Hi/Low Alarm - Binary monitors a binary (decimal) V-Memory location and sets four possible alarm states, High-High, High, Low, and Low-Low whenever the IBox has power flow. You enter the alarm thresholds as constant K decimal values (K0-K65535) and/or binary (decimal) V-Memory locations.



You must ensure that threshold limits are valid, that is HH >= H > L >= LL. Note that when the High-High or Low-Low alarm condition is true, that the High and Low alarms will also be set, respectively. This means you may use the same threshold limit and same alarm bit for the High-High and the High alarms in case you only need one "High" alarm. Also note that the boundary conditions are inclusive. That is, if the Low boundary is K50, and the Low-Low boundary is K10, and if the Monitoring Value equals 10, then the Low Alarm AND the Low-Low alarm will both be ON. If there is no power flow to the IBox, then all alarm bits will be turned off regardless of the value of the Monitoring Value parameter.

HILOALB Parameters

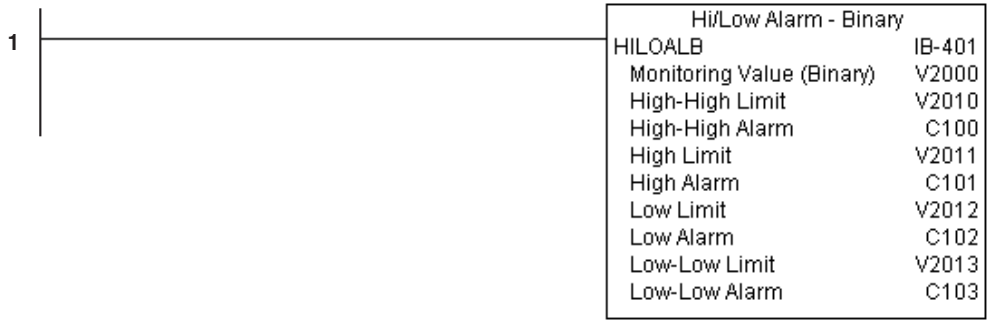
- Monitoring Value (Binary): specifies the V-memory location of the Binary value to be monitored
- High-High Limit: V-memory location or constant specifies the high-high alarm limit
- High-High Alarm: On when the high-high limit is reached
- High Limit: V-memory location or constant specifies the high alarm limit
- High Alarm: On when the high limit is reached
- Low Limit: V-memory location or constant specifies the low alarm limit
- Low Alarm: On when the low limit is reached
- Low-Low Limit: V-memory location or constant specifies the low-low alarm limit
- Low-Low Alarm: On when the low-low limit is reached

Parameter		DL06 Range
Monitoring Value (Binary)	V	See DL06 V-memory map - Data Words
High-High Limit	V, K	K0-65535; or see DL06 V-memory map - Data Words
High-High Alarm	X, Y, C, GX,GY, B	See DL06 V-memory map
High Limit	V, K	K0-65535; or see DL06 V-memory map - Data Words
High Alarm	X, Y, C, GX,GY, B	See DL06 V-memory map
Low Limit	V, K	K0-65535; or see DL06 V-memory map - Data Words
Low Alarm	X, Y, C, GX,GY,B	See DL06 V-memory map
Low-Low Limit	V, K	K0-65535; or see DL06 V-memory map - Data Words
Low-Low Alarm	X, Y, C, GX,GY, B	See DL06 V-memory map

HILOALB Example

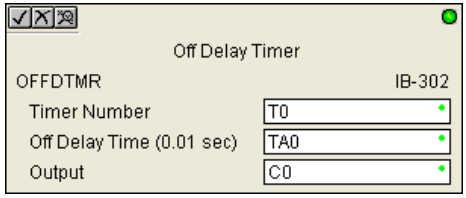
In the following example, the HILOALB instruction is used to monitor a binary value that is in V2000. If the value in V2000 meets/exceeds the high limit of the binary value in V2011, C101 will turn on. If the value continues to increase to meet/exceed the high-high limit value in V2010, C100 will turn on. Both bits would be on in this case. The high and high-high limits and alarms can be set to the same V-memory location/value if one "high" limit or alarm is desired to be used.

If the value in V2000 meets or falls below the low limit of the binary value in V2012, C102 will turn on. If the value continues to decrease to meet or fall below the low-low limit in V2013, C103 will turn on. Both bits would be on in this case. The low and low-low limits and alarms can be set to the same V-memory location/value if one "low" limit or alarm is desired to be used.



Off Delay Timer (OFFDTMR) (IB-302)

DS	Used
HPP	N/A



Off Delay Timer will delay the "turning off" of the Output parameter by the specified Off Delay Time (in hundredths of a second) based on the power flow into the IBox. Once the IBox receives power, the Output bit will turn on immediately. When the power flow to the IBox turns off, the Output bit WILL REMAIN ON for the specified amount of time (in hundredths of a second).

Once the Off Delay Time has expired, the output will turn Off. If the power flow to the IBox comes back on BEFORE the Off Delay Time, then the timer is RESET and the Output will remain On - so you must continuously have NO power flow to the IBox for AT LEAST the specified Off Delay Time before the Output will turn Off.

This IBox utilizes a Timer resource (TMRF), which cannot be used anywhere else in your program.

OFFDTMR Parameters

- Timer Number: specifies the Timer(TMRF) number which is used by the OFFDTMR instruction
- Off Delay Time (0.01 sec): specifies how long the Output will remain on once power flow to the Ibox is removed
- Output: specifies the output that will be delayed "turning off" by the Off Delay Time.

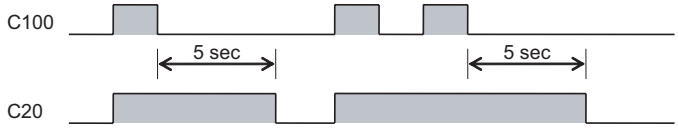
Parameter		DL06 Range
Timer Number	T	T0-377
Off Delay Time	K,V	K0-9999; See DL06 V-memory map - Data Words
Output	X, Y, C, GX,GY, B	See DL06 V-memory map

OFFDTMR Example

In the following example, the OFFDTMR instruction is used to delay the "turning off"of output C20. Timer 2 (T2) is set to 5 seconds, the "off-delay" period.

When C100 turns on, C20 turns on and will remain on while C100 is on. When C100 turns off, C20 will remain for the specified Off Delay Time (5s), and then turn off.

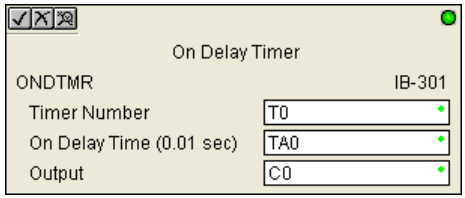
Example timing diagram



On Delay Timer (ONDTMR) (IB-301)

DS	Used
HPP	N/A

On Delay Timer will delay the "turning on" of the Output parameter by the specified amount of time (in hundredths of a second) based on the power flow into the IBox. Once the IBox loses power, the Output is turned off immediately. If the power flow turns off BEFORE the On Delay Time, then the timer is RESET and the Output is never turned on, so you must have continuous power flow to the IBox for at least the specified On Delay Time before the Output turns On.



This IBox utilizes a Timer resource (TMRF), which cannot be used anywhere else in your program.

ONDTMR Parameters

- Timer Number: specifies the Timer(TMRF) number which is used by the ONDTMR instruction
- On Delay Time (0.01sec): specifies how long the Output will remain off once power flow to the Ibox is applied.
- Output: specifies the output that will be delayed "turning on" by the On Delay Time.

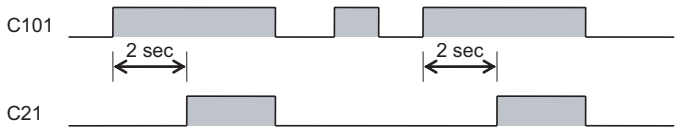
Parameter		DL06 Range
Timer Number	T	T0-377
On Delay Time	K,V	K0-9999; See DL06 V-memory map - Data Words
Output	X, Y, C, GX,GY, B	See DL06 V-memory map

ONDTMR Example

In the following example, the ONDTMR instruction is used to delay the "turning on" of output C21. Timer 1 (T1) is set to 2 seconds, the "on-delay" period.

When C101 turns on, C21 is delayed turning on by 2 seconds. When C101 turns off, C21 turns off immediately.

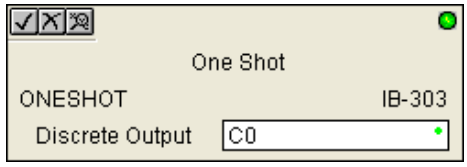
Example timing diagram



One Shot (ONESHOT) (IB-303)

DS	Used
HPP	N/A

One Shot will turn on the given bit output parameter for one scan on an OFF to ON transition of the power flow into the IBox. This IBox is simply a different name for the PD Coil (Positive Differential).



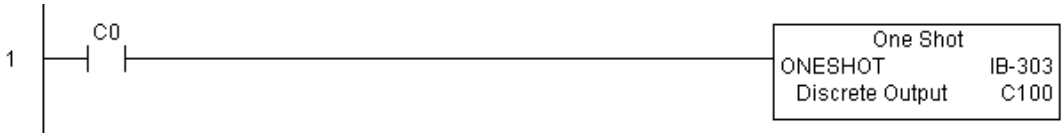
ONESHOT Parameters

- Discrete Output: specifies the output that will be on for one scan

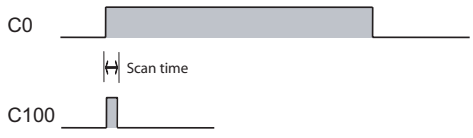
Parameter		DL06 Range
Discrete Output	X, Y, C	See DL06 V-memory map

ONESHOT Example

In the following example, the ONESHOT instruction is used to turn C100 on for one PLC scan after C0 goes from an off to on transition. The input logic must produce an off to on transition to execute the One Shot instruction.



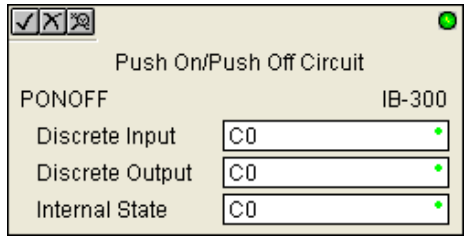
Example timing diagram



Push On / Push Off Circuit (PONOFF) (IB-300)

DS	Used
HPP	N/A

Push On/Push Off Circuit toggles an output state whenever its input power flow transitions from off to on. Requires an extra bit parameter for scan-to-scan state information. This extra bit must NOT be used anywhere else in the program. This is also known as a "flip-flop circuit". The PONOFF IBox cannot have any input logic.



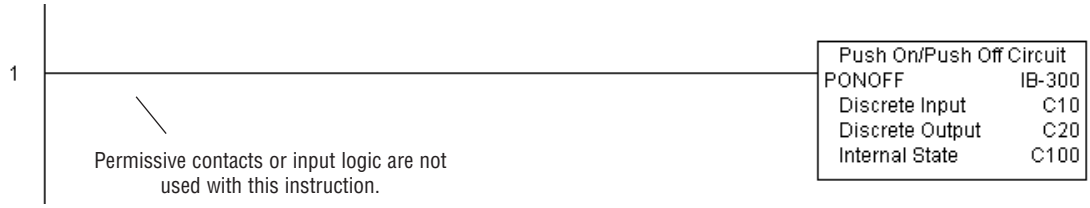
PONOFF Parameters

- Discrete Input: specifies the input that will toggle the specified output
- Discrete Output: specifies the output that will be "turned on/off" or toggled
- Internal State: specifies a work bit that is used by the instruction

Parameter		DL06 Range
Discrete Input	X,Y,C,S,T,CT,GX,GY,SP,B,PB	See DL06 V-memory map
Discrete Output	X,Y,C,GX,GY,B	See DL06 V-memory map
Internal State	X, Y, C	See DL06 V-memory map

PONOFF Example

In the following example, the PONOFF instruction is used to control the on and off states of the output C20 with a single input C10. When C10 is pressed once, C20 turns on. When C10 is pressed again, C20 turns off. C100 is an internal bit used by the instruction.



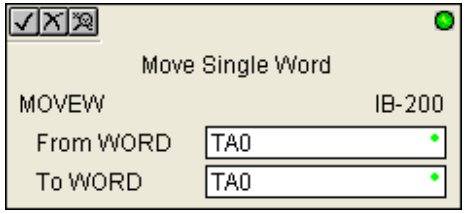
Move Single Word (MOVEW) (IB-200)

DS	Used
HPP	N/A

Move Single Word moves (copies) a word to a memory location directly or indirectly via a pointer, either as a HEX constant, from a memory location, or indirectly through a pointer

MOVEW Parameters

- From WORD: specifies the word that will be moved to another location
- To WORD: specifies the location where the "From WORD" will be move to



Parameter		DL06 Range
From WORD	V,P,K	K0-FFFF; See DL06 V-memory map - Data Words
To WORD	V,P	See DL06 V-memory map - Data Words

MOVEW Example

In the following example, the MOVEW instruction is used to move 16-bits of data from V2000 to V3000 when C100 turns on.

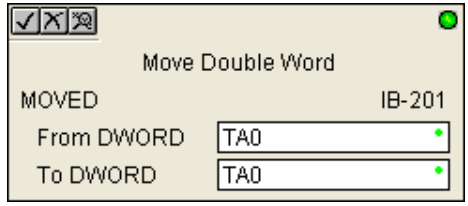
Move Double Word (MOVED) (IB-201)

DS	Used
HPP	N/A

Move Double Word moves (copies) a double word to two consecutive memory locations directly or indirectly via a pointer, either as a double HEX constant, from a double memory location, or indirectly through a pointer to a double memory location.

MOVED Parameters

- From DWORD: specifies the double word that will be moved to another location
- To DWORD: specifies the location where the "From DWORD" will be move to



Parameter		DL06 Range
From DWORD	V,P,K	K0-FFFFFFFF; See DL06 V-memory map - Data Words
To DWORD	V,P	See DL06 V-memory map - Data Words

MOVED Example

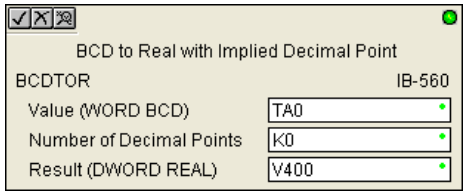
In the following example, the MOVED instruction is used to move 32-bits of data from V2000 and V2001 to V3000 and V3001 when C100 turns on.

BCD to Real with Implied Decimal Point (BCDTOR) (IB-560)

DS	Used
HPP	N/A

BCD to Real with Implied Decimal Point converts the given 4 digit WORD BCD value to a Real number, with the implied number of decimal points (K0-K4).

For example, BCDTOR K1234 with an implied number of decimal points equal to K1, would yield R123.4



BCDTOR Parameters

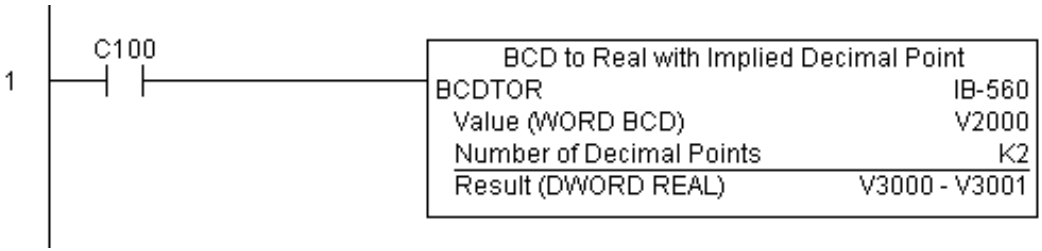
- Value (WORD BCD): specifies the word or constant that will be converted to a Real number
- Number of Decimal Points: specifies the number of implied decimal points in the Result DWORD
- Result (DWORD REAL): specifies the location where the Real number will be placed

Parameter		DL06 Range
Value (WORD BCD)	V,P,K	K0-9999; See DL06 V-memory map - Data Words
Number of Decimal Points	K	K0-4
Result (DWORD REAL)	V	See DL06 V-memory map - Data Words

BCDTOR Example

In the following example, the BCDTOR instruction is used to convert the 16-bit data in V2000 from a 4-digit BCD data format to a 32-bit REAL (floating point) data format and stored into V3000 and V3001 when C100 turns on.

K2 in the Number of Decimal Points implies the data will have two digits to the right of the decimal point.

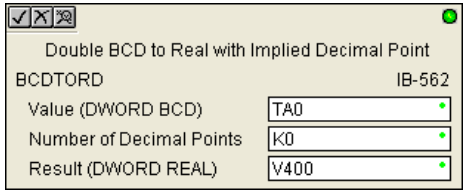


Double BCD to Real with Implied Decimal Point (BCDTORD) (IB-562)

DS	Used
HPP	N/A

Double BCD to Real with Implied Decimal Point converts the given 8 digit DWORD BCD value to a Real number, given an implied number of decimal points (K0-K8).

For example, BCDTORD K12345678 with an implied number of decimal points equal to K5, would yield R123.45678



BCDTORD Parameters

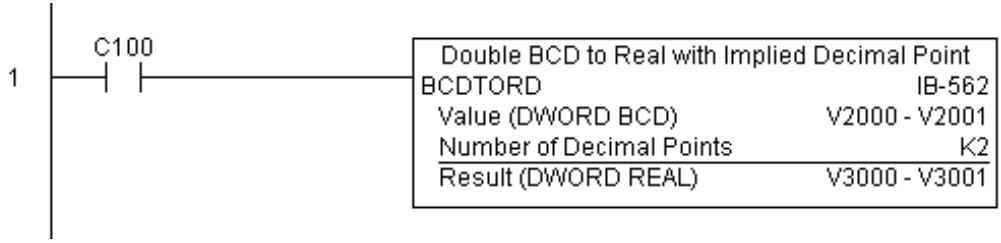
- Value (DWORD BCD): specifies the Dword or constant that will be converted to a Real number
- Number of Decimal Points: specifies the number of implied decimal points in the Result DWORD
- Result (DWORD REAL): specifies the location where the Real number will be placed

Parameter		DL06 Range
Value (DWORD BCD)	V,P,K	K0-99999999; See DL06 V-memory map - Data Words
Number of Decimal Points	K	K0-8
Result (DWORD REAL)	V	See DL06 V-memory map - Data Words

BCDTORD Example

In the following example, the BCDTORD instruction is used to convert the 32-bit data in V2000 from an 8-digit BCD data format to a 32-bit REAL (floating point) data format and stored into V3000 and V3001 when C100 turns on.

K2 in the Number of Decimal Points implies the data will have two digits to the right of the decimal point.

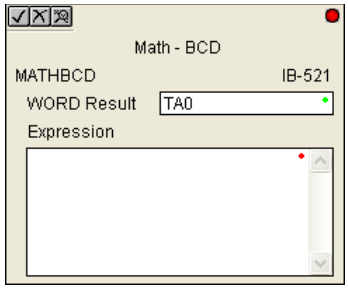


Math - BCD (MATHBCD) (IB-521)

DS	Used
HPP	N/A

Math - BCD Format lets you enter complex mathematical expressions like you would in Visual Basic, Excel, or C++ to do complex calculations, nesting parentheses up to 4 levels deep. In addition to + - * /, you can do Modulo (% aka Remainder), Bit-wise And (&) Or (|) Xor (^), and some BCD functions - Convert to BCD (BCD), Convert to Binary (BIN), BCD Complement (BCDCPL), Convert from Gray Code (GRAY), Invert Bits (INV), and BCD/HEX to Seven Segment Display (SEG).

Example: ((V2000 + V2001) / (V2003 - K100)) ' GRAY(V3000 & K001F)



Every V-memory reference MUST be to a single word BCD formatted value. Intermediate results can go up to 32 bit values, but as long as the final result fits in a 16 bit BCD word, the calculation is valid. Typical example of this is scaling using multiply then divide, (V2000 * K1000) / K4095. The multiply term most likely will exceed 9999 but fits within 32 bits. The divide operation will divide 4095 into the 32-bit accumulator, yielding a result that will always fit in 16 bits.

You can reference binary V-memory values by using the BCD conversion function on a V-Memory location but NOT an expression. That is BCD(V2000) is okay and will convert V2000 from Binary to BCD, but BCD(V2000 + V3000) will add V2000 as BCD, to V3000 as BCD, then interpret the result as Binary and convert it to BCD - NOT GOOD.

Also, the final result is a 16 bit BCD number and so you could do BIN around the entire operation to store the result as Binary.

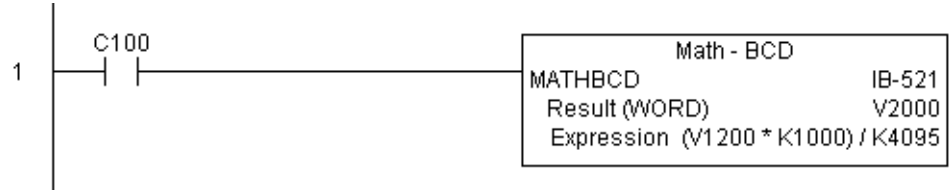
MATHBCD Parameters

- WORD Result: specifies the location where the BCD result of the mathematical expression will be placed (result must fit into 16 bit single V-memory location)
- Expression: specifies the mathematical expression to be executed and the result is stored in specified WORD Result. Each V-memory location used in the expression must be in BCD format.

Parameter		DL06 Range
WORD Result	V	See DL06 V-memory map - Data Words
Expression		Text

MATHBCD Example

In the following example, the MATHBCD instruction is used to calculate the math expression which multiplies the BCD value in V1200 by 1000 then divides by 4095 and loads the resulting value in V2000 when C100 turns on.

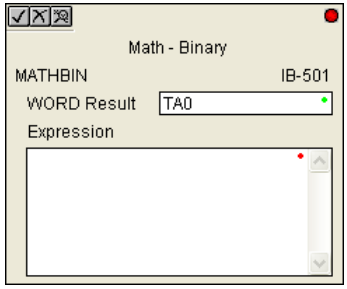


Math - Binary (MATHBIN) (IB-501)

DS	Used
HPP	N/A

Math - Binary Format lets you enter complex mathematical expressions like you would in Visual Basic, Excel, or C++ to do complex calculations, nesting parentheses up to 4 levels deep. In addition to + - * /, you can do Modulo (% aka Remainder), Shift Right (>>) and Shift Left (<<), Bit-wise And (&) Or (|) Xor (^), and some binary functions - Convert to BCD (BCD), Convert to Binary (BIN), Decode Bits (DECO), Encode Bits (ENCO), Invert Bits (INV), HEX to Seven Segment Display (SEG), and Sum Bits (SUM).

Example: ((V2000 + V2001) / (V2003 - K10)) SUM(V3000 & K001F)



Every V-memory reference MUST be to a single word binary formatted value. Intermediate results can go up to 32 bit values, but as long as the final result fits in a 16 bit binary word, the calculation is valid. Typical example of this is scaling using multiply then divide, (V2000 * K1000) / K4095. The multiply term most likely will exceed 65535 but fits within 32 bits. The divide operation will divide 4095 into the 32-bit accumulator, yielding a result that will always fit in 16 bits.

You can reference BCD V-Memory values by using the BIN conversion function on a V-memory location but NOT an expression. That is, BIN(V2000) is okay and will convert V2000 from BCD to Binary, but BIN(V2000 + V3000) will add V2000 as Binary, to V3000 as Binary, then interpret the result as BCD and convert it to Binary - NOT GOOD.

Also, the final result is a 16 bit binary number and so you could do BCD around the entire operation to store the result as BCD.

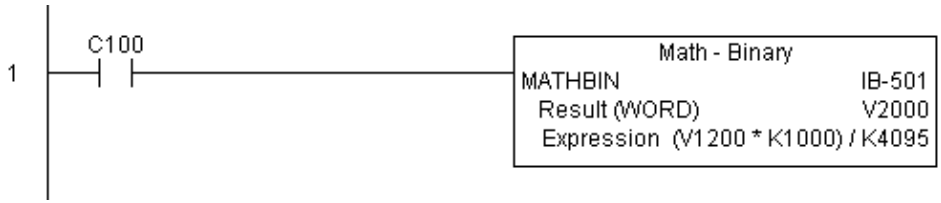
MATHBIN Parameters

- WORD Result: specifies the location where the binary result of the mathematical expression will be placed (result must fit into 16 bit single V-memory location)
- Expression: specifies the mathematical expression to be executed and the result is stored in specified WORD Result. Each V-memory location used in the expression must be in binary format.

Parameter		DL06 Range
WORD Result	V	See DL06 V-memory map - Data Words
Expression		Text

MATHBIN Example

In the following example, the MATHBIN instruction is used to calculate the math expression which multiplies the Binary value in V1200 by 1000 then divides by 4095 and loads the resulting value in V2000 when C100 turns on.



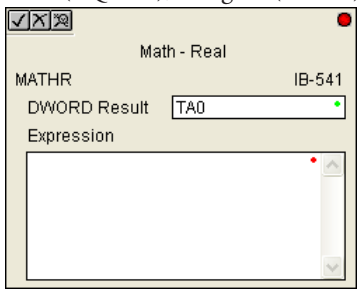
Math - Real (MATHR) (IB-541)

DS	Used
HPP	N/A

Math - Real Format lets you enter complex mathematical expressions like you would in Visual Basic, Excel, or C++ to do complex calculations, nesting parentheses up to 4 levels deep. In addition to + - * /, you can do Bit-wise And (&) Or (|) Xor (^), and many Real functions - Arc Cosine (ACOSR), Arc Sine (ASINR), Arc Tangent (ATANR), Cosine (COSR), Convert Radians to Degrees (DEGR), Invert Bits (INV), Convert Degrees to Radians (RADR), HEX to Seven Segment Display (SEG), Sine (SINR), Square Root (SQRTR), Tangent (TANR).

Example: ((V2000 + V2002) / (V2004 - R2.5)) SINR(RADR(V3000 / R10.0))

Every V-memory reference MUST be able to fit into double word Real formatted value.



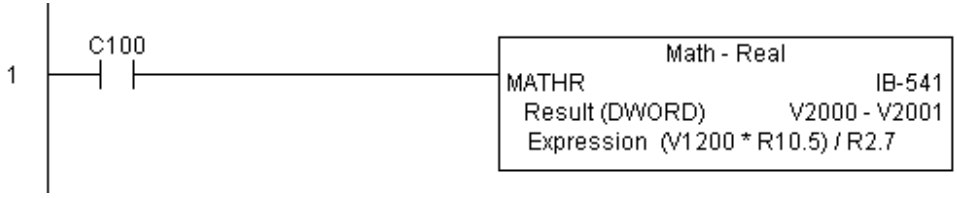
MATHR Parameters

- DWORD Result: specifies the location where the Real result of the mathematical expression will be placed (result must fit into a double word Real formatted location)
- Expression: specifies the mathematical expression to be executed and the result is stored in specified DWORD Result location. Each V-memory location used in the expression must be in Real format.

Parameter		DL06 Range
DWORD Result	V	See DL06 V-memory map - Data Words
Expression		Text

MATHR Example

In the following example, the MATHR instruction is used to calculate the math expression which multiplies the REAL (floating point) value in V1200 by 10.5 then divides by 2.7 and loads the resulting 32-bit value in V2000 and V2001 when C100 turns on.



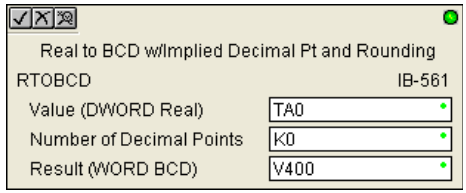
Real to BCD with Implied Decimal Point and Rounding (RTOBCD) (IB-561)

DS	Used
HPP	N/A

Real to BCD with Implied Decimal Point and Rounding converts the absolute value of the given Real number to a 4 digit BCD number, compensating for an implied number of decimal points (K0-K4) and performs rounding.

For example, RTOBCD R56.74 with an implied number of decimal points equal to K1, would yield 567 BCD. If the implied number of decimal points was 0, then the function would yield 57 BCD (note that it rounded up).

If the Real number is negative, the Result will equal its positive, absolute value.



RTOBCD Parameters

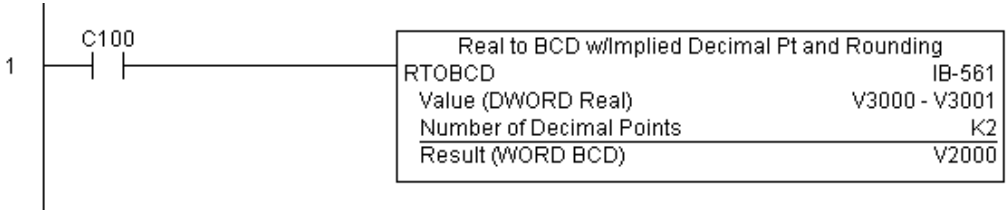
- Value (DWORD Real): specifies the Real Dword location or number that will be converted and rounded to a BCD number with decimal points
- Number of Decimal Points: specifies the number of implied decimal points in the Result WORD
- Result (WORD BCD): specifies the location where the rounded/implied decimal points BCD value will be placed

Parameter		DL06 Range
Value (DWORD Real)	V,P,R	R ; See DL06 V-memory map - Data Words
Number of Decimal Points	K	K0-4
Result (WORD BCD)	V	See DL06 V-memory map - Data Words

RTOBCD Example

In the following example, the RTOBCD instruction is used to convert the 32-bit REAL (floating point) data format in V3000 and V3001 to the 4-digit BCD data format and stored in V2000 when C100 turns on.

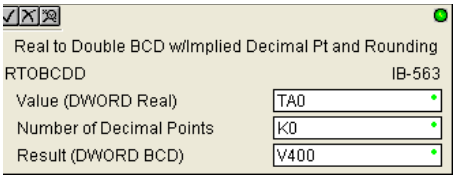
K2 in the Number of Decimal Points implies the data will have two implied decimal points.



Real to Double BCD with Implied Decimal Point and Rounding (RTOBCDD) (IB-563)

DS	Used
HPP	N/A

Real to Double BCD with Implied Decimal Point and Rounding converts the absolute value of the given Real number to an 8 digit DWORD BCD number, compensating for an implied number of decimal points (K0-K8) and performs rounding.



For example, RTOBCDD R38156.74 with an implied number of decimal points equal to K1, would yield 381567 BCD. If the implied number of decimal points was 0, then the function would yield 38157 BCD (note that it rounded up).

If the Real number is negative, the Result will equal its positive, absolute value.

RTOBCDD Parameters

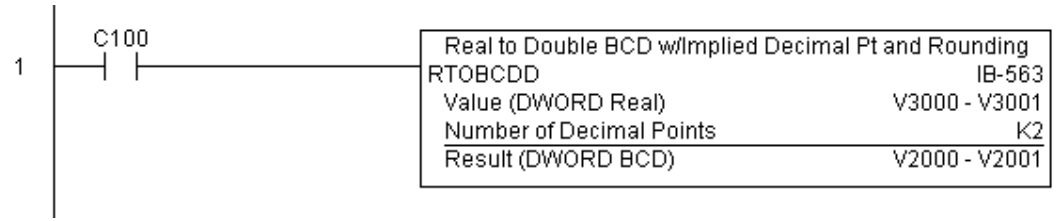
- Value (DWORD Real): specifies the Dword Real number that will be converted and rounded to a BCD number with decimal points
- Number of Decimal Points: specifies the number of implied decimal points in the Result DWORD
- Result (DWORD BCD): specifies the location where the rounded/implied decimal points DWORD BCD value will be placed

Parameter		DL06 Range
Value (DWORD Real)	V,P,R	R ; See DL06 V-memory map - Data Words
Number of Decimal Points	K	K0-8
Result (DWORD BCD)	V	See DL06 V-memory map - Data Words

RTOBCDD Example

In the following example, the RTOBCDD instruction is used to convert the 32-bit REAL (floating point) data format in V3000 and V3001 to the 8-digit BCD data format and stored in V2000 and V2001 when C100 turns on.

K2 in the Number of Decimal Points implies the data will have two implied decimal points.



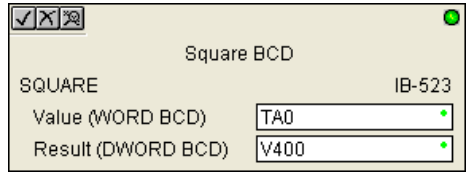
Square BCD (SQUARE) (IB-523)

DS	Used
HPP	N/A

Square BCD squares the given 4-digit WORD BCD number and writes it in as an 8-digit DWORD BCD result.

SQUARE Parameters

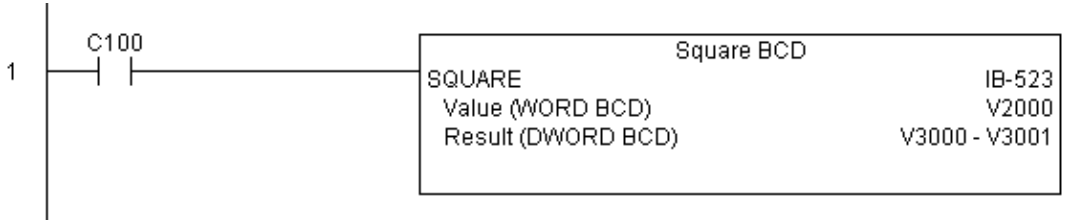
- Value (WORD BCD): specifies the BCD Word or constant that will be squared
- Result (DWORD BCD): specifies the location where the squared DWORD BCD value will be placed



Parameter		DL06 Range
Value (WORD BCD)	V,P,K	K0-9999 ; See DL06 V-memory map - Data Words
Result (DWORD BCD)	V	See DL06 V-memory map - Data Words

SQUARE Example

In the following example, the SQUARE instruction is used to square the 4-digit BCD value in V2000 and store the 8-digit double word BCD result in V3000 and V3001 when C100 turns on.



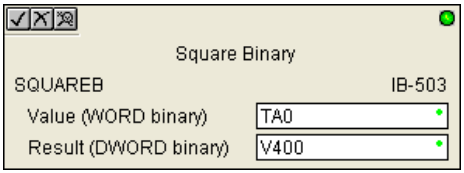
Square Binary (SQUAREB) (IB-503)

DS	Used
HPP	N/A

Square Binary squares the given 16-bit WORD Binary number and writes it as a 32-bit DWORD Binary result.

SQUAREB Parameters

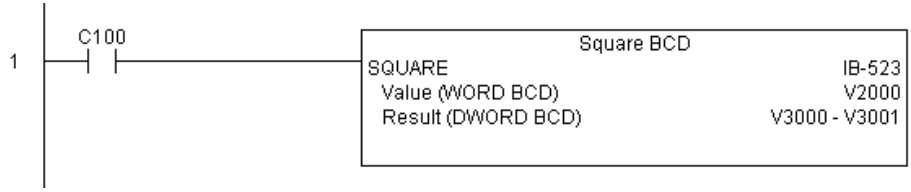
- Value (WORD Binary): specifies the binary Word or constant that will be squared
- Result (DWORD Binary): specifies the location where the squared DWORD binary value will be placed



Parameter		DL06 Range
Value (WORD Binary)	V,P,K	K0-65535; See DL06 V-memory map - Data Words
Result (DWORD Binary)	V	See DL06 V-memory map - Data Words

SQUAREB Example

In the following example, the SQUAREB instruction is used to square the single word Binary value in V2000 and store the 8-digit double word Binary result in V3000 and V3001 when C100 turns on.



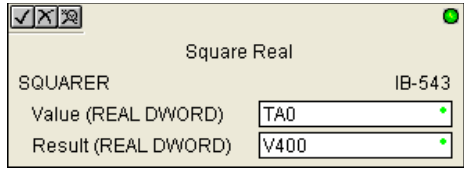
Square Real (SQUARER) (IB-543)

DS	Used
HPP	N/A

Square Real squares the given REAL DWORD number and writes it to a REAL DWORD result.

SQUARER Parameters

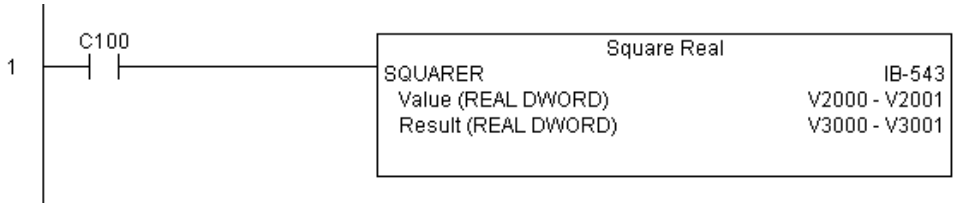
- Value (REAL DWORD): specifies the Real DWORD location or number that will be squared
- Result (REAL DWORD): specifies the location where the squared Real DWORD value will be placed



Parameter		DL06 Range
Value (REAL DWORD)	V,P,R	R ; See DL06 V-memory map - Data Words
Result (REAL DWORD)	V	See DL06 V-memory map - Data Words

SQUARER Example

In the following example, the SQUARER instruction is used to square the 32-bit floating point REAL value in V2000 and V2001 and store the REAL value result in V3000 and V3001 when C100 turns on.



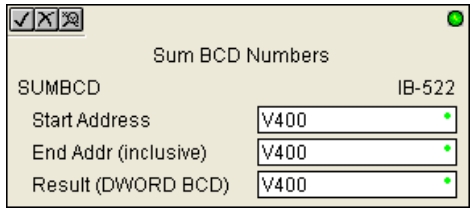
Sum BCD Numbers (SUMBCD) (IB-522)

DS	Used
HPP	N/A

Sum BCD Numbers sums up a list of consecutive 4-digit WORD BCD numbers into an 8-digit DWORD BCD result.

You specify the group's starting and ending V-memory addresses (inclusive). When enabled, this instruction will add up all the numbers in the group (so you may want to place a differential contact driving the enable).

SUMBCD could be used as the first part of calculating an average.



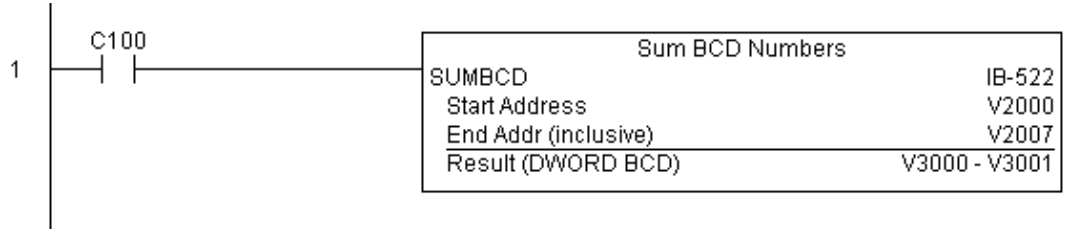
SUMBCD Parameters

- Start Address: specifies the starting address of a block of V-memory location values to be added together (BCD)
- End Addr (inclusive): specifies the ending address of a block of V-memory location values to be added together (BCD)
- Result (DWORD BCD): specifies the location where the sum of the block of V-memory BCD values will be placed

Parameter		DL06 Range
Start Address	V	See DL06 V-memory map - Data Words
End Address (inclusive)	V	See DL06 V-memory map - Data Words
Result (DWORD BCD)	V	See DL06 V-memory map - Data Words

SUMBCD Example

In the following example, the SUMBCD instruction is used to total the sum of all BCD values in words V2000 thru V2007 and store the resulting 8-digit double word BCD value in V3000 and V3001 when C100 turns on.



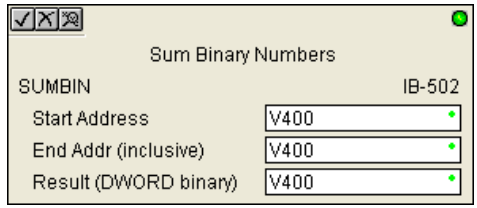
Sum Binary Numbers (SUMBIN) (IB-502)

DS	Used
HPP	N/A

Sum Binary Numbers sums up a list of consecutive 16-bit WORD Binary numbers into a 32-bit DWORD binary result.

You specify the group's starting and ending V-memory addresses (inclusive). When enabled, this instruction will add up all the numbers in the group (so you may want to place a differential contact driving the enable).

SUMBIN could be used as the first part of calculating an average.



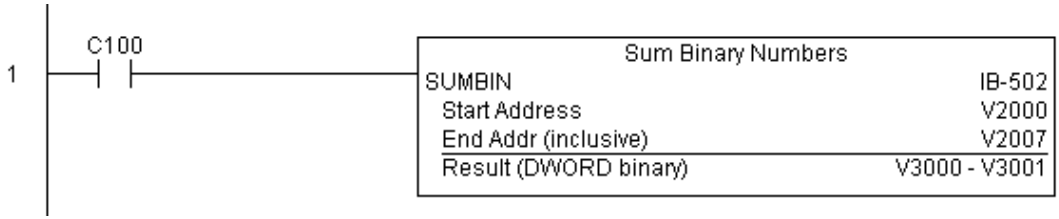
SUMBIN Parameters

- Start Address: specifies the starting address of a block of V-memory location values to be added together (Binary)
- End Addr (inclusive): specifies the ending address of a block of V-memory location values to be added together (Binary)
- Result (DWORD Binary): specifies the location where the sum of the block of V-memory binary values will be placed

Parameter		DL06 Range
Start Address	V	See DL06 V-memory map - Data Words
End Address (inclusive)	V	See DL06 V-memory map - Data Words
Result (DWORD Binary)	V	See DL06 V-memory map - Data Words

SUMBIN Example

In the following example, the SUMBIN instruction is used to total the sum of all Binary values in words V2000 thru V2007 and store the resulting 8-digit double word Binary value in V3000 and V3001 when C100 turns on.

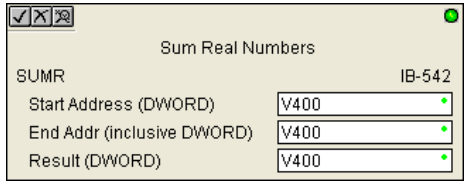


Sum Real Numbers (SUMR) (IB-542)

DS	Used
HPP	N/A

Sum Real Numbers sums up a list of consecutive REAL DWORD numbers into a REAL DWORD result.

You specify the group's starting and ending V- memory addresses (inclusive). Remember that Real numbers are DWORDs and occupy 2 words of V-Memory each, so the number of Real values summed up is equal to half the number of memory locations. Note that the End Address can be EITHER word of the 2 word ending address, for example, if you wanted to add the 4 Real numbers stored in V2000 thru V2007 (V2000, V2002, V2004, and V2006), you can specify V2006 OR V2007 for the ending address and you will get the same result.



When enabled, this instruction will add up all the numbers in the group (so you may want to place a differential contact driving the enable).

SUMR could be used as the first part of calculating an average.

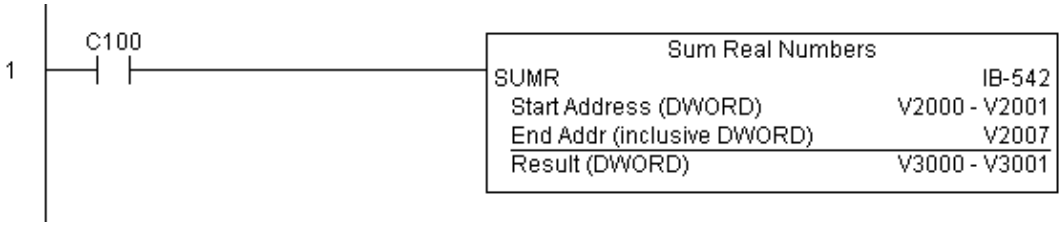
SUMR Parameters

- Start Address (DWORD): specifies the starting address of a block of V-memory location values to be added together (Real)
- End Addr (inclusive) (DWORD): specifies the ending address of a block of V-memory location values to be added together (Real)
- Result (DWORD): specifies the location where the sum of the block of V-memory Real values will be placed

Parameter		DL06 Range
Start Address (inclusive DWORD)	V	See DL06 V-memory map - Data Words
End Address (inclusive DWORD)	V	See DL06 V-memory map - Data Words
Result (DWORD)	V	See DL06 V-memory map - Data Words

SUMR Example

In the following example, the SUMR instruction is used to total the sum of all floating point REAL number values in words V2000 thru V2007 and store the resulting 32-bit floating point REAL number value in V3000 and V3001 when C100 turns on.



ECOM100 Configuration (ECOM100) (IB-710)

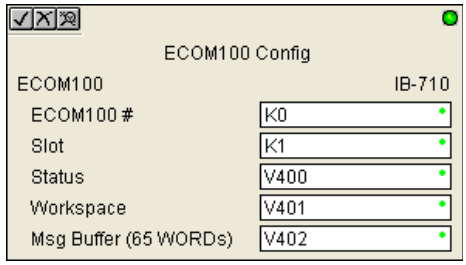
DS	Used
HPP	N/A

ECOM100 Configuration defines the parameters other ECOM100 IBoxes will use when working with this specific ECOM100 module. Each ECOM100 module that will be used with IBox instructions will require a unique ECOM1000 Configuration instruction. The addresses used become workspaces for the IBox instruction to use.

The addresses used in this instruction must not be used elsewhere in the program.

The instructions must be placed at the top of ladder, without a contact. The instruction will inherently run only once, on the first scan.

IBoxes ECEMAIL, ECRX, ECIPSUP and others require an ECOM100 Configuration before they will operate properly.



In order for MOST ECOM100 IBoxes to function, DIP switch 7 on the ECOM100 circuit board must be ON DIP switch 7 can remainOFF if ECOM100 Network Read and Write IBoxes (ECRX, ECWX) are the only IBoxes that will be used.

ECOM100 Configuration Parameters

- ECOM100#: specify a logical number to be associated with this particular ECOM100 module. All other ECxxxx IBoxes that need to reference this ECOM1000 module must reference this logical number
- Slot: specifies the option slot the module occupies
- Status: specifies a V-memory location that will be used by the instruction
- Workspace: specifies a V-memory location that will be used by the instruction
- Msg Buffer: specifies the starting address of a 65 word buffer that will be used by the module for configuration

Parameter		DL06 Range
ECOM100#	K	K0-255
Slot	K	K1-4
Status	V	See DL06 V-memory map - Data Words
Workspace	V	See DL06 V-memory map - Data Words
Msg Buffer (65 words used)	V	See DL06 V-memory map - Data Words

ECOM100 Example

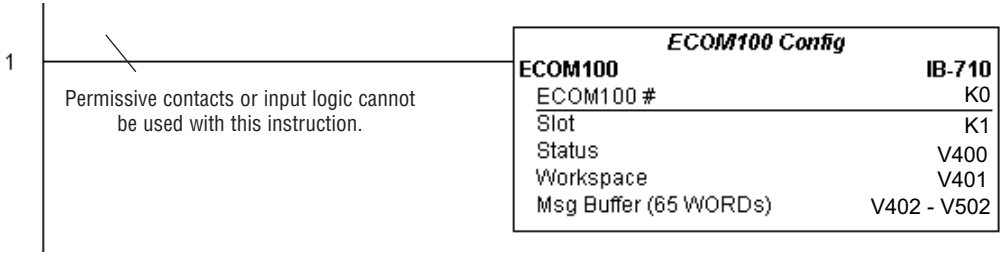
The ECOM100 Config IBox coordinates all of the interaction with other ECOM100 based IBoxes (ECxxxx). You must have an ECOM100 Config IBox for each ECOM100 module in your system. Configuration IBoxes must be at the top of your program and must execute every scan.

This IBox defines ECOM100# K0 to be in slot 3. Any ECOM100 IBoxes that need to reference this specific module (such as ECEMAIL, ECRX, ...) would enter K0 for their ECOM100# parameter.

The Status register is for reporting any completion or error information to other ECOM100 IBoxes. This V-Memory register must not be used anywhere else in the entire program.

The Workspace register is used to maintain state information about the ECOM100, along with proper sharing and interlocking with the other ECOM100 IBoxes in the program. This V-Memory register must not be used anywhere else in the entire program.

The Message Buffer of 65 words (130 bytes) is a common pool of memory that is used by other ECOM100 IBoxes (such as ECEMAIL). This way, you can have a bunch of ECEMAIL IBoxes, but only need 1 common buffer for generating and sending each EMail. These V-Memory registers must not be used anywhere else in your entire program.



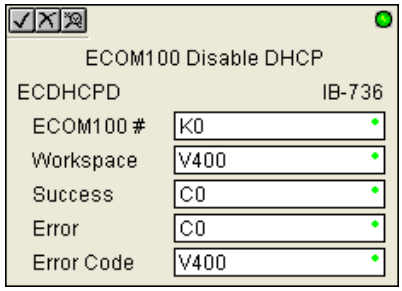
ECOM100 Disable DHCP (ECDHCPD) (IB-736)

DS	Used
HPP	N/A

ECOM100 Disable DHCP will setup the ECOM100 to use its internal TCP/IP settings on a leading edge transition to the IBox. To configure the ECOM100's TCP/IP settings manually, use the NetEdit3 utility, or you can do it programmatically from your PLC program using the ECOM100 IP Setup (ECIPSUP), or the individual ECOM100 IBoxes: ECOM Write IP Address (ECWRIP), ECOM Write Gateway Address (ECWRGWA), and ECOM100 Write Subnet Mask (ECWRSNM).

The Workspace parameter is an internal, private register used by this IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.

Either the Success or Error bit parameter will turn on once the command is complete. If there is an error, the Error Code parameter will report an ECOM100 error code (less than 100), or a PLC logic error (greater than 1000).



The "Disable DHCP" setting is stored in Flash-ROM in the ECOM100 and the execution of this IBox will disable the ECOM100 module for at least a half second until it writes the Flash-ROM. Therefore, it is HIGHLY RECOMMENDED that you only execute this IBox ONCE, on first scan. Since it requires a LEADING edge to execute, use a NORMALLY CLOSED SP0 (STR NOT First Scan) to drive the power flow to the IBox.

In order for this ECOM100 IBox to function, you must turn ON dip switch 7 on the ECOM100 circuit board.

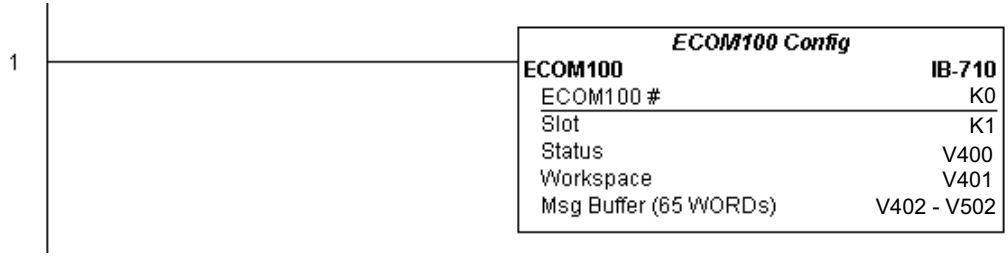
ECDHCPD Parameters

- ECOM100#: this is a logical number associated with this specific ECOM100 module in the specified slot. All other ECxxxx IBoxes that need to reference this ECOM100 module must reference this logical number
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the request is completed successfully
- Error: specifies a bit that will turn on if the instruction is not successfully completed
- Error Code: specifies the location where the Error Code will be written

Parameter		DL06 Range
ECOM100#	K	K0-255
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map
Error Code	V	See DL06 V-memory map - Data Words

ECDHCPD Example

Rung 1: The ECOM100 Config IBox is responsible for coordination/interlocking of all ECOM100 type IBoxes for one specific ECOM100 module. Tag the ECOM100 in slot 1 as ECOM100# K0. All other ECxxxx IBoxes refer to this module # as K0. If you need to move the module in the base to a different slot, then you only need to change this one IBox. V400 is used as a global result status register for the other ECxxxx IBoxes using this specific ECOM100 module. V401 is used to coordinate/interlock the logic in all of the other ECxxxx IBoxes using this specific ECOM100 module. V402-V502 is a common 130 byte buffer available for use by the other ECxxxx IBoxes using this specific ECOM100 module.



Rung 2: On the 2nd scan, disable DHCP in the ECOM100. DHCP is the same protocol used by PCs for using a DHCP Server to automatically assign the ECOM100's IP Address, Gateway Address, and Subnet Mask. Typically disabling DHCP is done by assigning a hard-coded IP Address either in NetEdit or using one of the ECOM100 IP Setup IBoxes, but this IBox allows you to disable DHCP in the ECOM100 using your ladder program. The ECDHCPD is leading edge triggered, not power-flow driven (similar to a counter input leg). The command to disable DHCP will be sent to the ECOM100 whenever the power flow into the IBox goes from OFF to ON. If successful, turn on C100. If there is a failure, turn on C101. If it fails, you can look at V2000 for the specific error code.

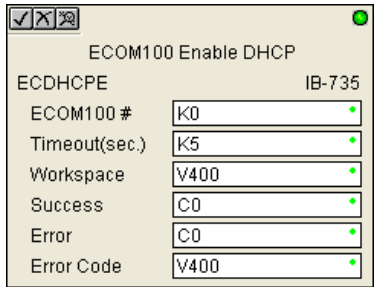
ECOM100 Enable DHCP (ECDHCPE) (IB-735)

DS	Used
HPP	N/A

ECOM100 Enable DHCP will tell the ECOM100 to obtain its TCP/IP setup from a DHCP Server on a leading edge transition to the IBox.

The IBox will be successful once the ECOM100 has received its TCP/IP settings from the DHCP server. Since it is possible for the DHCP server to be unavailable, a Timeout parameter is provided so that the IBox can complete, but with an Error (Error Code = 1004 decimal).

See also the ECOM100 IP Setup (ECIPSUP) IBox 717 to directly setup ALL of the TCP/IP parameters in a single instruction - IP Address, Subnet Mask, and Gateway Address.



The Workspace parameter is an internal, private register used by this IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.

Either the Success or Error bit parameter will turn on once the command is complete. If there is an error, the Error Code parameter will report an ECOM100 error code (less than 100), or a PLC logic error (greater than 1000).

The "Enable DHCP" setting is stored in Flash-ROM in the ECOM100 and the execution of this IBox will disable the ECOM100 module for at least a half second until it writes the Flash-ROM. Therefore, it is HIGHLY RECOMMENDED that you only execute this IBox ONCE, on first scan. Since it requires a LEADING edge to execute, use a NORMALLY CLOSED SP0 (STR NOT First Scan) to drive the power flow to the IBox.

In order for this ECOM100 IBox to function, you must turn ON dip switch 7 on the ECOM100 circuit board.

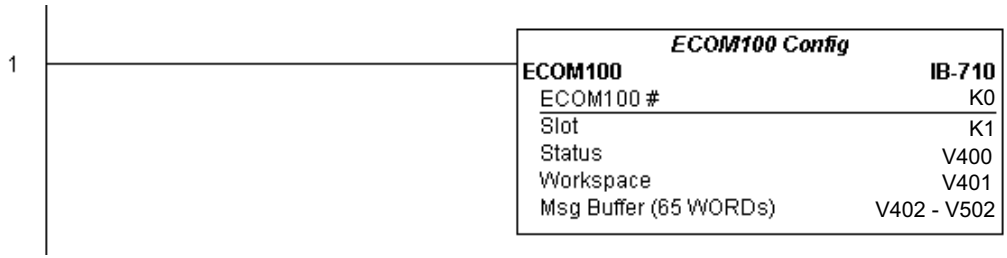
ECDHCPE Parameters

- ECOM100#: this is a logical number associated with this specific ECOM100 module in the specified slot. All other ECxxxx IBoxes that need to reference this ECOM100 module must reference this logical number
- Timeout(sec): specifies a timeout period so that the instruction may have time to complete
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the request is completed successfully
- Error: specifies a bit that will turn on if the instruction is not successfully completed
- Error Code: specifies the location where the Error Code will be written

Parameter		DL06 Range
ECOM100#	K	K0-255
Timeout (sec)	K	K5-127
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map
Error Code	V	See DL06 V-memory map - Data Words

ECDHCPE Example

Rung 1: The ECOM100 Config IBox is responsible for coordination/interlocking of all ECOM100 type IBoxes for one specific ECOM100 module. Tag the ECOM100 in slot 1 as ECOM100# K0. All other ECxxxx IBoxes refer to this module # as K0. If you need to move the module in the base to a different slot, then you only need to change this one IBox. V400 is used as a global result status register for the other ECxxxx IBoxes using this specific ECOM100 module.V401 is used to coordinate/interlock the logic in all of the other ECxxxx IBoxes using this specific ECOM100 module. V402-V502 is a common 130 byte buffer available for use by the other ECxxxx IBoxes using this specific ECOM100 module.



Rung 2: On the 2nd scan, enable DHCP in the ECOM100. DHCP is the same protocol used by PCs for using a DHCP Server to automatically assign the ECOM100's IP Address, Gateway Address, and Subnet Mask. Typically this is done using NetEdit, but this IBox allows you to enable DHCP in the ECOM100 using your ladder program. The ECDHCPE is leading edge triggered, not power-flow driven (similar to a counter input leg). The commands to enable DHCP will be sent to the ECOM100 whenever the power flow into the IBox goes from OFF to ON. The ECDHCPE does more than just set the bit to enable DHCP in the ECOM100, but it then polls the ECOM100 once every second to see if the ECOM100 has found a DHCP server and has a valid IP Address. Therefore, a timeout parameter is needed in case the ECOM100 cannot find a DHCP server. If a timeout does occur, the Error bit will turn on and the error code will be 1005 decimal. The Success bit will turn on only if the ECOM100 finds a DHCP Server and is assigned a valid IP Address. If successful, turn on C100. If there is a failure, turn on C101. If it fails, you can look at V2000 for the specific error code.

ECOM100 Query DHCP Setting (ECDHCPQ) (IB-734)

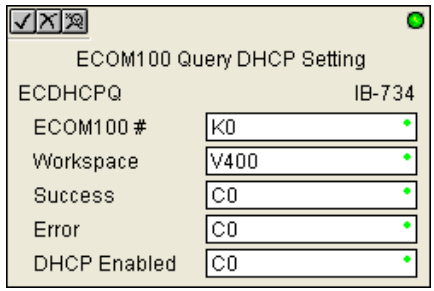
DS	Used
HPP	N/A

ECOM100 Query DHCP Setting will determine if DHCP is enabled in the ECOM100 on a leading edge transition to the IBox. The DHCP Enabled bit parameter will be ON if DHCP is enabled, OFF if disabled.

The Workspace parameter is an internal, private register used by this IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.

Either the Success or Error bit parameter will turn on once the command is complete.

In order for this ECOM100 IBox to function, you must turn ON dip switch 7 on the ECOM100 circuit board.



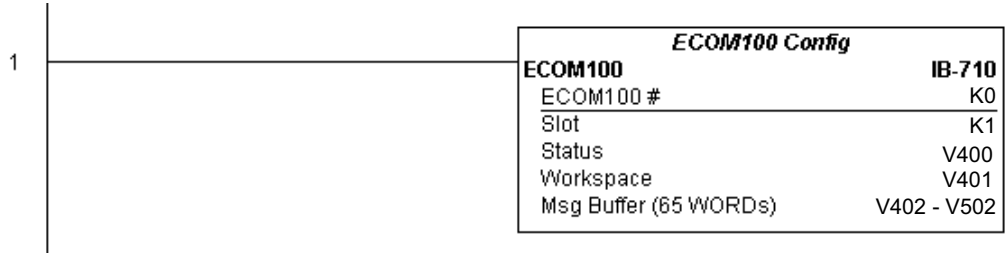
ECDHCPQ Parameters

- ECOM100#: this is a logical number associated with this specific ECOM100 module in the specified slot. All other ECxxxx IBoxes that need to reference this ECOM100 module must reference this logical number
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the instruction is completed successfully
- Error: specifies a bit that will turn on if the instruction is not successfully completed
- DHCP Enabled: specifies a bit that will turn on if the ECOM100's DHCP is enabled or remain off if disabled - after instruction query, be sure to check the state of the Success/ Error bit state along with DHCP Enabled bit state to confirm a successful module query

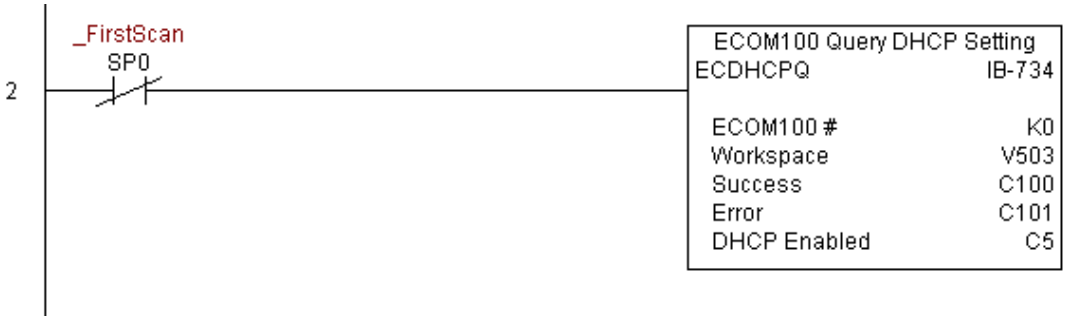
Parameter		DL06 Range
ECOM100#	K	K0-255
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map
DHCP Enabled	X,Y,C,GX,GY,B	See DL06 V-memory map

ECDHCPQ Example

Rung 1: The ECOM100 Config IBox is responsible for coordination/interlocking of all ECOM100 type IBoxes for one specific ECOM100 module. Tag the ECOM100 in slot 1 as ECOM100# K0. All other ECxxxx IBoxes refer to this module # as K0. If you need to move the module in the base to a different slot, then you only need to change this one IBox. V400 is used as a global result status register for the other ECxxxx IBoxes using this specific ECOM100 module.V401 is used to coordinate/interlock the logic in all of the other ECxxxx IBoxes using this specific ECOM100 module. V402-V502 is a common 130 byte buffer available for use by the other ECxxxx IBoxes using this specific ECOM100 module.



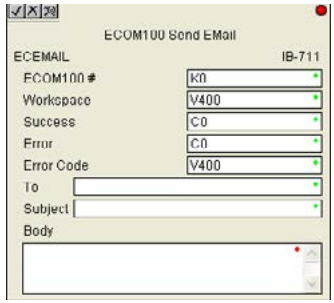
Rung 2: On the 2nd scan, read whether DHCP is enabled or disabled in the ECOM100 and store it in C5. DHCP is the same protocol used by PCs for using a DHCP Server to automatically assign the ECOM100's IP Address, Gateway Address, and Subnet Mask. The ECDHCPQ is leading edge triggered, not power-flow driven (similar to a counter input leg). The command to read (Query) whether DHCP is enabled or not will be sent to the ECOM100 whenever the power flow into the IBox goes from OFF to ON. If successful, turn on C100. If there is a failure, turn on C101.



ECOM100 Send E-mail (ECEMAIL) (IB-711)

DS	Used
HPP	N/A

ECOM100 Send EMail, on a leading edge transition, will behave as an EMail client and send an SMTP request to your SMTP Server to send the EMail message to the EMail addresses in the To: field and also to those listed in the Cc: list hard coded in the ECOM100. It will send the SMTP request based on the specified ECOM100#, which corresponds to a specific unique ECOM100 Configuration (ECOM100) at the top of your program.



The Body: field supports what the PRINT and VPRINT instructions support for text and embedded variables, allowing you to embed real-time data in your EMail (e.g. "V2000 = " V2000:B).

The Workspace parameter is an internal, private register used by this IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.

Either the Success or Error bit parameter will turn on once the request is complete. If there is an error, the Error Code parameter will report an ECOM100 error code (less than 100), an SMPT protocol error (between 100 and 999), or a PLC logic error (greater than 1000).

Since the ECOM100 is only an EMail Client and requires access to an SMTP Server, you MUST have the SMTP parameters configured properly in the ECOM100 via the ECOM100's Home Page and/or the EMail Setup instruction (ECEMSUP). To get to the ECOM100's Home Page, use your favorite Internet browser and browse to the ECOM100's IP Address, e.g. http://192.168.12.86

You are limited to approximately 100 characters of message data for the entire instruction, including the To: Subject: and Body: fields. To save space, the ECOM100 supports a hard coded list of EMail addresses for the Carbon Copy field (cc:) so that you can configure those in the ECOM100, and keep the To: field small (or even empty), to leave more room for the Subject: and Body: fields.

In order for this ECOM100 IBox to function, you must turn ON dip switch 7 on the ECOM100 circuit board.

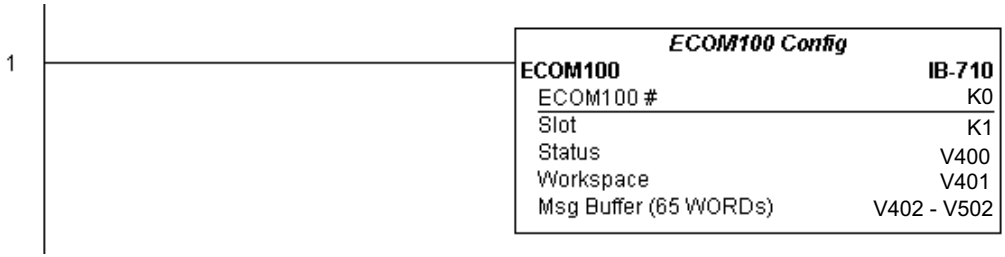
ECEMAIL Parameters

- ECOM100#: this is a logical number associated with this specific ECOM100 module in the specified slot. All other ECxxxx IBoxes that need to reference this ECOM100 module must reference this logical number
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the request is completed successfully
- Error: specifies a bit that will turn on if the instruction is not successfully completed
- Error Code: specifies the location where the Error Code will be written
- To: specifies an E-mail address that the message will be sent to
- Subject: subject of the e-mail message
- Body: supports what the PRINT and VPRINT instructions support for text and embedded variables, allowing you to embed real-time data in the EMail message

Parameter		DL06 Range
ECOM100#	K	K0-255
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map
Error Code	V	See DL06 V-memory map
To:		Text
Subject:		Text
Body:		See PRINT and VPRINT instructions

ECEMAIL Example

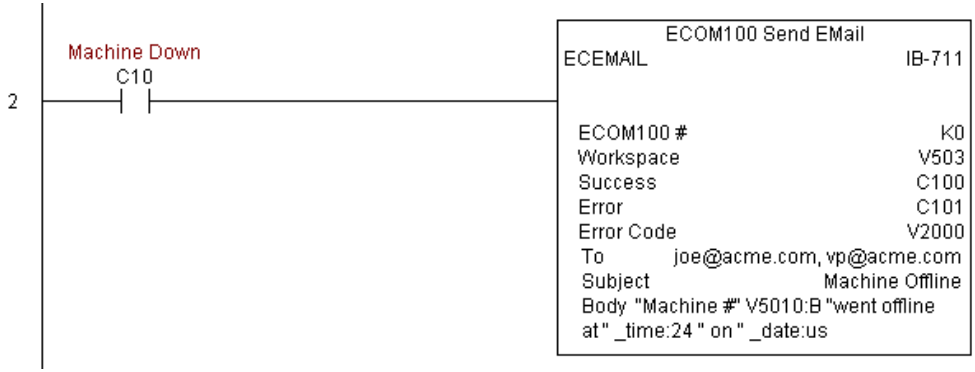
Rung 1: The ECOM100 Config IBox is responsible for coordination/interlocking of all ECOM100 type IBoxes for one specific ECOM100 module. Tag the ECOM100 in slot 1 as ECOM100# K0. All other ECxxxx IBoxes refer to this module # as K0. If you need to move the module in the base to a different slot, then you only need to change this one IBox. V400 is used as a global result status register for the other ECxxxx IBoxes using this specific ECOM100 module.V401 is used to coordinate/interlock the logic in all of the other ECxxxx IBoxes using this specific ECOM100 module. V402-V502 is a common 130 byte buffer available for use by the other ECxxxx IBoxes using this specific ECOM100 module.



Rung 2: When a machine goes down, send an email to Joe in maintenance and to the VP over production showing what machine is down along with the date/time stamp of when it went down.

The ECEMAIL is leading edge triggered, not power-flow driven (similar to a counter input leg). An email will be sent whenever the power flow into the IBox goes from OFF to ON. This helps prevent self inflicted spamming.

If the EMail is sent, turn on C100. If there is a failure, turn on C101. If it fails, you can look at V2000 for the SMTP error code or other possible error codes.



ECEMAIL Decimal Status Codes

This list of status codes is based on the list in the *ECOM100 Mock Slave Address 89 Command Specification*.

ECOM100 Status codes can be classified into four different areas based on its **decimal** value.

ECOM100 Status Code Areas	
0-1	Normal Status - no error
2-99	Internal ECOM100 errors
100-999	Standard TCP/IP protocol errors (SMTP, HTTP, etc)
1000+	IBox ladder logic assigned errors (SP Slot Error, etc)

For the ECOM100 Send EMail IBOX, the status codes below are specific to this IBox.

Normal Status 0 - 1

ECOMM100 Send EMAIL IBOX Status Codes	
0-1	Success - ECEMAIL completed successfully.
1	Busy - ECEMAIL IBOX logic sets the Error register to this value when the ECEMAIL starts a new request.

Internal ECOM100 Errors (2-99)

Internal ECOM 100 Errors (2-99)	
10-19	Timeout Errors - last digit shows where in ECOM100's SMTP state logic the timeout occurred; *regardless of the last digit*, the SMTP conversation with the SMTP Server timed out.
	SMTP Internal Errors (20-29)
20	TCP Write Error
21	No Sendee
22	Invalid State
23	Invalid Data
24	Invalid SMTP Configuration
25	Memory Allocation Error

ECEMAIL IBox Ladder Logic Assigned Errors (1000+)

ECEMAIL IBox Ladder Logic Assigned Errors (1000+)	
101	SP Slot Error - the SP error bit for the ECOM100's slot turned on. Possibly using RX or WX instructions on the ECOM100 and walking on the ECEMAIL execution. Use should use ECRX and ECX IBoxes.

ECEMAIL Decimal Status Codes

SMTP Protocol Errors - SMTP (100-999)

SMTP Protocol Errors - SMTP (100-999)	
Error	**Description**
1xx	Informational replies
2xx	Success replies
200	(Non-standard success response)
211	System status or system help reply
214	Help message
220	<domain> Service ready. Ready to start TLS
221	<domain> Service closing transmission channel
250	Ok, queuing for node <node> started. Requested mail action okay, completed
251	Ok, no messages waiting for node <node>. User not local; will forward to <forward-path>
252	OK, pending messages for node <node> started. Cannot VRFY user (e.g., info is not local), but will take message for this user and attempt delivery.
253	OK, messages pending messages for node <node> started
3xx	(re) direction replies
354	Start mail input; end with <CRLF>.<CRLF>
355	Octet-offset is the transaction offset.
4xx	client/request error replies
421	<domain> Service not available, closing transmission channel
432	A password transition is needed
450	Requested mail action not taken: mailbox unavailable. ATRN request refused.
451	Requested action aborted; local error in processing. Unable to process ATRN request now.
452	Requested action not taken: insufficient system storage
453	You have no mail
454	TLS is not available due to temporary reason. Encryption required for requested authentication mechanism.
458	Unable to queue messages for node <node>
459	Node <node> not allowed: <reason>
5xx	Server/process error replies
500	Syntax error, command unrecognized. Syntax error.
501	Syntax error in parameters or arguments
502	Command not implemented
503	Bad sequence of commands
504	Command parameter not implemented
521	<domain> does not accept mail
530	Access denied. Must issue a STARTTLS command first. Encryption required for requested authentication mechanism.

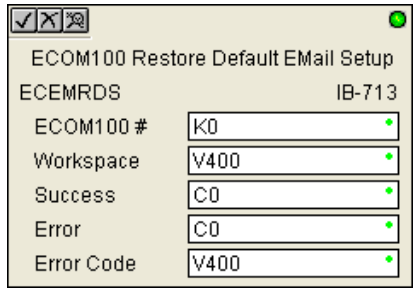
ECOM100 Restore Default E-mail Setup (ECEMRDS) (IB-713)

DS	Used
HPP	N/A

ECOM100 Restore Default EMail Setup, on a leading edge transition, will restore the original EMail Setup data stored in the ECOM100 back to the working copy based on the specified ECOM100#, which corresponds to a specific unique ECOM100 Configuration (ECOM100) at the top of your program.

When the ECOM100 is first powered up, it copies the EMail setup data stored in ROM to the working copy in RAM. You can then modify this working copy from your program using the ECOM100 EMail Setup (ECEMSUP) IBox. After modifying the working copy, you can later restore the original setup data via your program by using this IBox.

The Workspace parameter is an internal, private register used by this IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.



Either the Success or Error bit parameter will turn on once the command is complete. If there is an error, the Error Code parameter will report an ECOM100 error code (less than 100), or a PLC logic error (greater than 1000).

In order for this ECOM100 IBox to function, you must turn ON dip switch 7 on the ECOM100 circuit board.

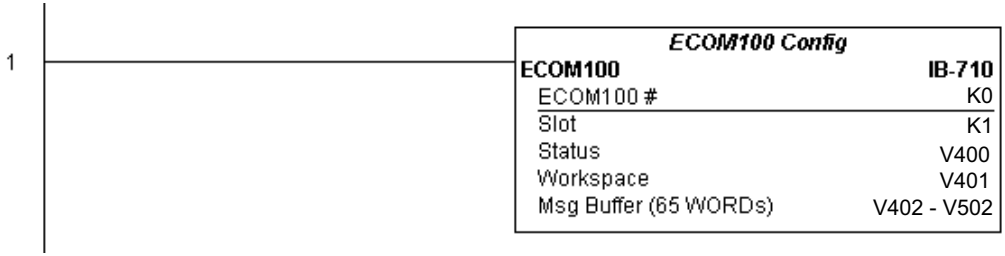
ECEMRDS Parameters

- ECOM100#: this is a logical number associated with this specific ECOM100 module in the specified slot. All other ECxxxx IBoxes that need to reference this ECOM100 module must reference this logical number
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the request is completed successfully
- Error: specifies a bit that will turn on if the instruction is not successfully completed
- Error Code: specifies the location where the Error Code will be written

Parameter		DL06 Range
ECOM100#	K	K0-255
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map
Error Code	V	See DL06 V-memory map - Data Words

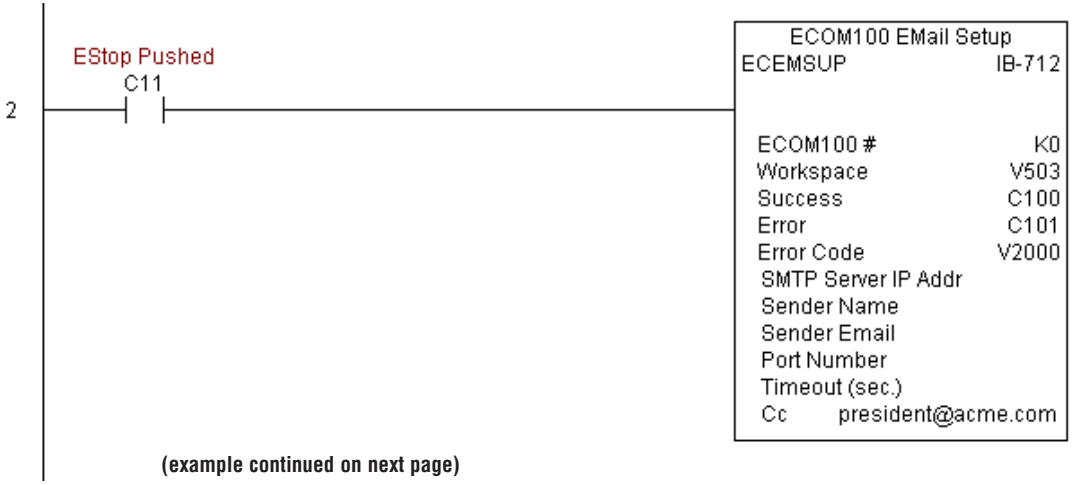
ECEMRDS Example

Rung 1: The ECOM100 Config IBox is responsible for coordination/interlocking of all ECOM100 type IBoxes for one specific ECOM100 module. Tag the ECOM100 in slot 1 as ECOM100# K0. All other ECxxxx IBoxes refer to this module # as K0. If you need to move the module in the base to a different slot, then you only need to change this one IBox. V400 is used as a global result status register for the other ECxxxx IBoxes using this specific ECOM100 module. V401 is used to coordinate/interlock the logic in all of the other ECxxxx IBoxes using this specific ECOM100 module. V402-V502 is a common 130 byte buffer available for use by the other ECxxxx IBoxes using this specific ECOM100 module.



Rung 2: Whenever an EStop is pushed, ensure that president of the company gets copies of all EMails being sent.

The ECOM100 EMail Setup IBox allows you to set/change the SMTP EMail settings stored in the ECOM100.



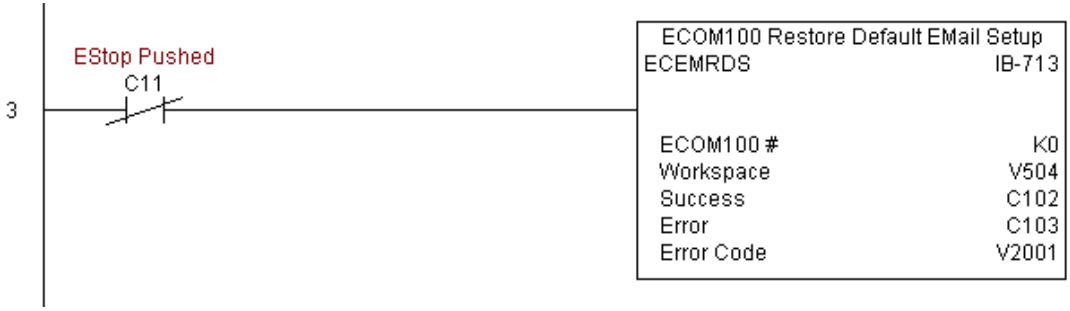
(example continued on next page)

ECEMRDS Example (cont'd)

Rung 3: Once the EStop is pulled out, take the president off the cc: list by restoring the default EMail setup in the ECOM100.

The ECEMRDS is leading edge triggered, not power-flow driven (similar to a counter input leg). The ROM based EMail configuration stored in the ECOM100 will be copied over the "working copy" whenever the power flow into the IBox goes from OFF to ON (the working copy can be changed by using the ECEMSUP IBox).

If successful, turn on C102. If there is a failure, turn on C103. If it fails, you can look at V2001 for the specific error code.

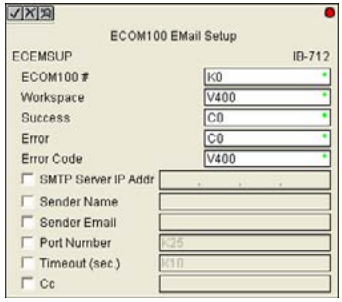


ECOM100 E-mail Setup (ECEMSUP) (IB-712)

DS	Used
HPP	N/A

ECOM100 E-Mail Setup, on a leading edge transition, will modify the working copy of the E-Mail setup currently in the ECOM100 based on the specified ECOM100#, which corresponds to a specific unique ECOM100 Configuration (ECOM100) at the top of your program.

You may pick and choose any or all fields to be modified using this instruction. Note that these changes are cumulative: if you execute multiple ECOM100 EMail Setup IBoxes, then all of the changes are made in the order they are executed. Also note that you can restore the original ECOM100 EMail Setup that is stored in the ECOM100 to the working copy by using the ECOM100 Restore Default EMail Setup (ECEMRDS) IBox.



The Workspace parameter is an internal, private register used by this IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.

Either the Success or Error bit parameter will turn on once the command is complete. If there is an error, the Error Code parameter will report an ECOM100 error code (less than 100), or a PLC logic error (greater than 1000).

You are limited to approximately 100 characters/bytes of setup data for the entire instruction. So if needed, you could divide the entire setup across multiple ECEMSUP IBoxes on a field-by-field basis, for example do the Carbon Copy (cc:) field in one ECEMSUP IBox and the remaining setup parameters in another.

In order for this ECOM100 IBox to function, you must turn ON dip switch 7 on the ECOM100 circuit board.

ECEMSUP Parameters

- ECOM100#: this is a logical number associated with this specific ECOM100 module in the specified slot. All other ECxxxx IBoxes that need to reference this ECOM100 module must reference this logical number
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the request is completed successfully
- Error: specifies a bit that will turn on if the instruction is not successfully completed
- Error Code: specifies the location where the Error Code will be written
- SMTP Server IP Addr: optional parameter that specifies the IP Address of the SMTP Server on the ECOM100's network
- Sender Name: optional parameter that specifies the sender name that will appear in the "From:" field to those who receive the e-mail
- Sender EMail: optional parameter that specifies the sender EMail address that will appear in the "From:" field to those who receive the e-mail

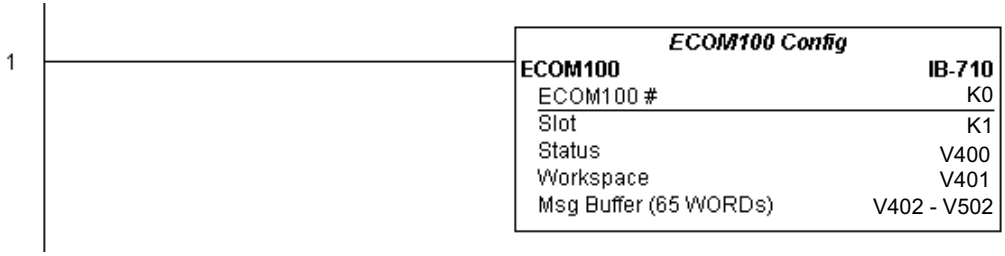
ECEMSUP Parameters (cont'd)

- Port Number: optional parameter that specifies the TCP/IP Port Number to send SMTP requests; usually this does not to be configured (see your network administrator for information on this setting)
- Timeout (sec): optional parameter that specifies the number of seconds to wait for the SMTP Server to send the EMail to all the recipients
- Cc: optional parameter that specifies a list of "carbon copy" Email addresses to send all EMails to

Parameter		DL06 Range
ECOM100#	K	K0-255
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map
Error Code	V	See DL06 V-memory map - Data Words

ECEMSUP Example

Rung 1: The ECOM100 Config IBox is responsible for coordination/interlocking of all ECOM100 type IBoxes for one specific ECOM100 module. Tag the ECOM100 in slot 1 as ECOM100# K0. All other ECxxxx IBoxes refer to this module # as K0. If you need to move the module in the base to a different slot, then you only need to change this one IBox. V400 is used as a global result status register for the other ECxxxx IBoxes using this specific ECOM100 module.V401 is used to coordinate/interlock the logic in all of the other ECxxxx IBoxes using this specific ECOM100 module. V402-V502 is a common 130 byte buffer available for use by the other ECxxxx IBoxes using this specific ECOM100 module.

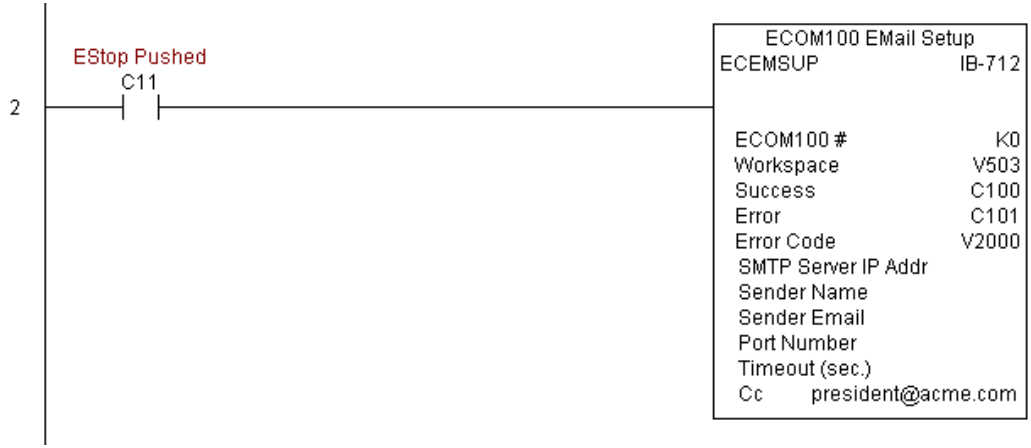


(example continued on next page)

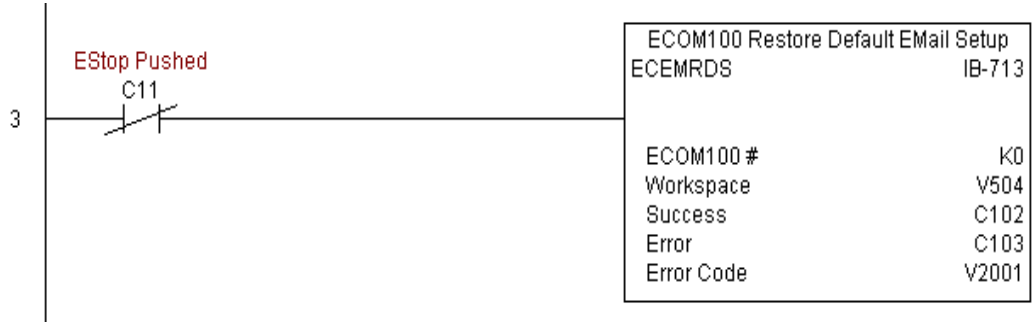
ECEMSUP Example (cont'd)

Rung 2: Whenever an EStop is pushed, ensure that president of the company gets copies of all EMails being sent.The ECOM100 EMail Setup IBox allows you to set/change the SMTP EMail settings stored in the ECOM100. The ECEMSUP is leading edge triggered, not power-flow driven (similar to a counter input leg). At power-up, the ROM based EMail configuration stored in the ECOM100 is copied to a RAM based "working copy". You can change this working copy by using the ECEMSUP IBox. To restore the original ROM based configuration, use the Restore Default EMail Setup ECEMRDS IBox.

If successful, turn on C100. If there is a failure, turn on C101. If it fails, you can look at V2000 for the specific error code.



Rung 3: Once the EStop is pulled out, take the president off the cc: list by restoring the default EMail setup in the ECOM100.



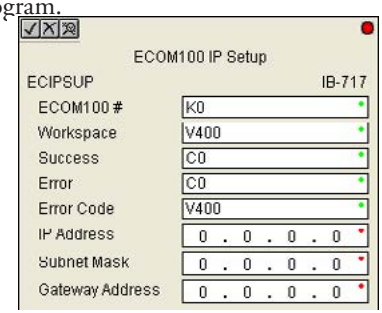
ECOM100 IP Setup (ECIPSUP) (IB-717)

DS	Used
HPP	N/A

ECOM100 IP Setup will configure the three TCP/IP parameters in the ECOM100: IP Address, Subnet Mask, and Gateway Address, on a leading edge transition to the IBox. The ECOM100 is specified by the ECOM100#, which corresponds to a specific unique ECOM100 Configuration (ECOM100) IBox at the top of your program.

The Workspace parameter is an internal, private register used by this IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.

Either the Success or Error bit parameter will turn on once the command is complete. If there is an error, the Error Code parameter will report an ECOM100 error code (less than 100), or a PLC logic error (greater than 1000).



This setup data is stored in Flash-ROM in the ECOM100 and will disable the ECOM100 module for at least a half second until it writes the Flash-ROM. Therefore, it is HIGHLY RECOMMENDED that you only execute this IBox ONCE on first scan. Since it requires a LEADING edge to execute, use a NORMALLY CLOSED SP0 (NOT First Scan) to drive the power flow to the IBox.

In order for this ECOM100 IBox to function, you must turn ON dip switch 7 on the ECOM100 circuit board.

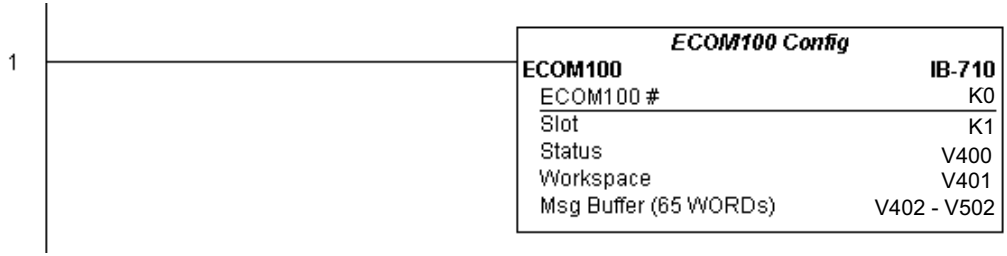
ECIPSUP Parameters

- ECOM100#: this is a logical number associated with this specific ECOM100 module in the specified slot. All other ECxxxx IBoxes that need to reference this ECOM100 module must reference this logical number
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the request is completed successfully
- Error: specifies a bit that will turn on if the instruction is not successfully completed
- Error Code: specifies the location where the Error Code will be written
- IP Address: specifies the module's IP Address
- Subnet Mask: specifies the Subnet Mask for the module to use
- Gateway Address: specifies the Gateway Address for the module to use

Parameter		DL06 Range
ECOM100#	K	K0-255
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map
Error Code	V	See DL06 V-memory map - Data Words
IP Address	IP Address	0.0.0.1. to 255.255.255.254
Subnet Mask Address	IP Address Mask	0.0.0.1. to 255.255.255.254
Gateway Address	IP Address	0.0.0.1. to 255.255.255.254

ECIPSUP Example

Rung 1: The ECOM100 Config IBox is responsible for coordination/interlocking of all ECOM100 type IBoxes for one specific ECOM100 module. Tag the ECOM100 in slot 1 as ECOM100# K0. All other ECxxxx IBoxes refer to this module # as K0. If you need to move the module in the base to a different slot, then you only need to change this one IBox. V400 is used as a global result status register for the other ECxxxx IBoxes using this specific ECOM100 module.V401 is used to coordinate/interlock the logic in all of the other ECxxxx IBoxes using this specific ECOM100 module. V402-V502 is a common 130 byte buffer available for use by the other ECxxxx IBoxes using this specific ECOM100 module.



Rung 2: On the 2nd scan, configure all of the TCP/IP parameters in the ECOM100:

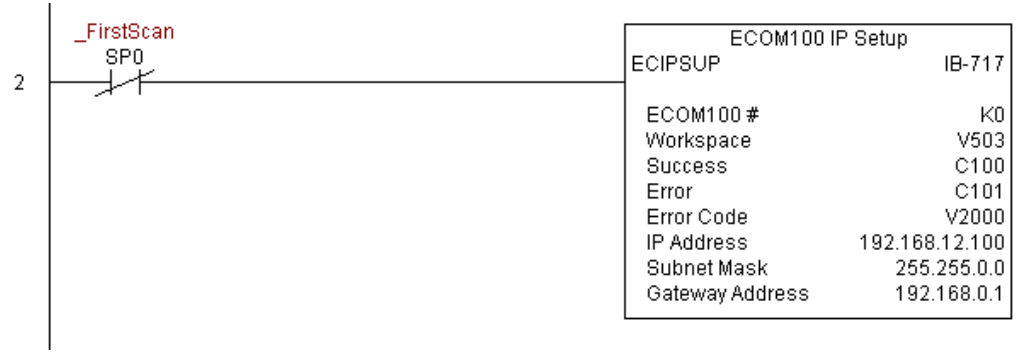
IP Address: 192.168. 12.100

Subnet Mask: 255.255. 0. 0

Gateway Address: 192.168. 0. 1

The ECIPSUP is leading edge triggered, not power-flow driven (similar to a counter input leg). The command to write the TCP/IP configuration parameters will be sent to the ECOM100 whenever the power flow into the IBox goes from OFF to ON.

If successful, turn on C100. If there is a failure, turn on C101. If it fails, you can look at V2000 for the specific error code.



ECOM100 Read Description (ECRDDES) (IB-726)

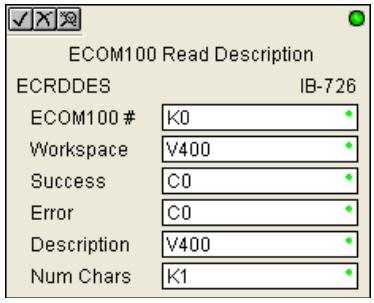
DS	Used
HPP	N/A

ECOM100 Read Description will read the ECOM100's Description field up to the number of specified characters on a leading edge transition to the IBox.

The Workspace parameter is an internal, private register used by this IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.

Either the Success or Error bit parameter will turn on once the command is complete.

In order for this ECOM100 IBox to function, you must turn ON dip switch 7 on the ECOM100 circuit board.



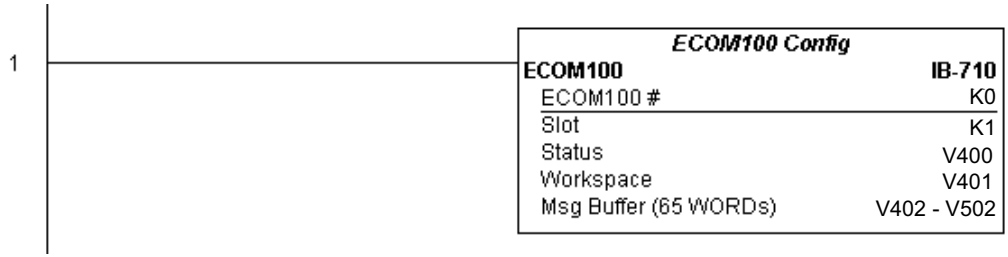
ECRDDES Parameters

- ECOM100#: this is a logical number associated with this specific ECOM100 module in the specified slot. All other ECxxxx IBoxes that need to reference this ECOM100 module must reference this logical number
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the request is completed successfully
- Error: specifies a bit that will turn on if the instruction is not successfully completed
- Description: specifies the starting buffer location where the ECOM100's Module Name will be placed
- Num Char: specifies the number of characters (bytes) to read from the ECOM100's Description field

Parameter		DL06 Range
ECOM100#	K	K0-255
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map
Description	V	See DL06 V-memory map - Data Words
Num Chars	K	K1-128

ECRDDES Example

Rung 1: The ECOM100 Config IBox is responsible for coordination/interlocking of all ECOM100 type IBoxes for one specific ECOM100 module. Tag the ECOM100 in slot 1 as ECOM100# K0. All other ECxxxx IBoxes refer to this module # as K0. If you need to move the module in the base to a different slot, then you only need to change this one IBox. V400 is used as a global result status register for the other ECxxxx IBoxes using this specific ECOM100 module.V401 is used to coordinate/interlock the logic in all of the other ECxxxx IBoxes using this specific ECOM100 module. V402-V502 is a common 130 byte buffer available for use by the other ECxxxx IBoxes using this specific ECOM100 module.



Rung 2: On the 2nd scan, read the Module Description of the ECOM100 and store it in V3000 thru V3007 (16 characters). This text can be displayed by an HMI.

The ECRDDES is leading edge triggered, not power-flow driven (similar to a counter input leg). The command to read the module description will be sent to the ECOM100 whenever the power flow into the IBox goes from OFF to ON.

If successful, turn on C100. If there is a failure, turn on C101.

ECOM100 Read Gateway Address (ECRDGWA) (IB-730)

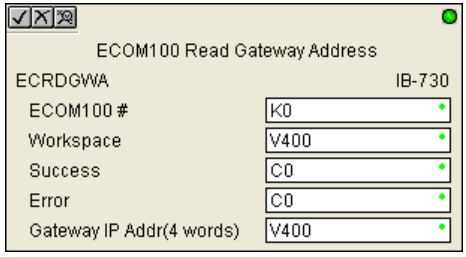
DS	Used
HPP	N/A

ECOM100 Read Gateway Address will read the 4 parts of the Gateway IP address and store them in 4 consecutive V-Memory locations in decimal format, on a leading edge transition to the IBox.

The Workspace parameter is an internal, private register used by this IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.

Either the Success or Error bit parameter will turn on once the command is complete.

In order for this ECOM100 IBox to function, you must turn ON dip switch 7 on the ECOM100 circuit board.



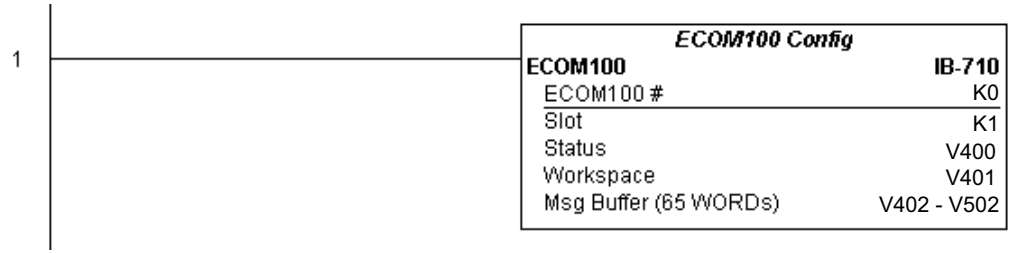
ECRDGWA Parameters

- ECOM100#: this is a logical number associated with this specific ECOM100 module in the specified slot. All other ECxxxx IBoxes that need to reference this ECOM100 module must reference this logical number
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the request is completed successfully
- Error: specifies a bit that will turn on if the instruction is not successfully completed
- Gateway IP Addr: specifies the starting address where the ECOM100's Gateway Address will be placed in 4 consecutive V-memory locations

Parameter		DL06 Range
ECOM100#	K	K0-255
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map
Gateway IP Address (4 Words)	V	See DL06 V-memory map - Data Words

ECRDGWA Example

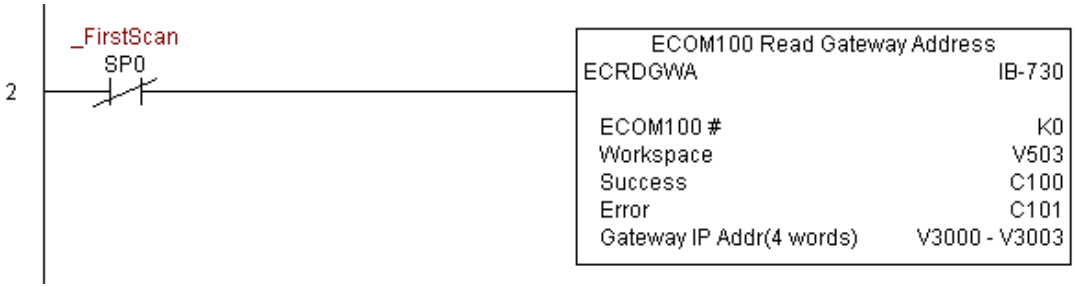
Rung 1: The ECOM100 Config IBox is responsible for coordination/interlocking of all ECOM100 type IBoxes for one specific ECOM100 module. Tag the ECOM100 in slot 1 as ECOM100# K0. All other ECxxxx IBoxes refer to this module # as K0. If you need to move the module in the base to a different slot, then you only need to change this one IBox. V400 is used as a global result status register for the other ECxxxx IBoxes using this specific ECOM100 module.V401 is used to coordinate/interlock the logic in all of the other ECxxxx IBoxes using this specific ECOM100 module. V402-V502 is a common 130 byte buffer available for use by the other ECxxxx IBoxes using this specific ECOM100 module.



Rung 2: On the 2nd scan, read the Gateway Address of the ECOM100 and store it in V3000 thru V3003 (4 decimal numbers). The ECOM100's Gateway Address could be displayed by an HMI.

The ECRDGWA is leading edge triggered, not power-flow driven (similar to a counter input leg). The command to read the Gateway Address will be sent to the ECOM100 whenever the power flow into the IBox goes from OFF to ON.

If successful, turn on C100. If there is a failure, turn on C101.



ECOM100 Read IP Address (ECRDIP) (IB-722)

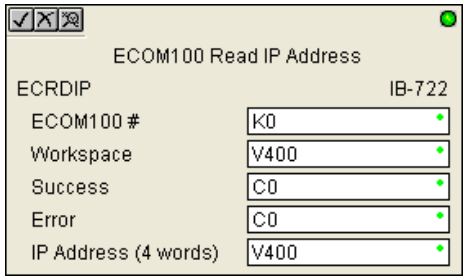
DS	Used
HPP	N/A

ECOM100 Read IP Address will read the 4 parts of the IP address and store them in 4 consecutive V-Memory locations in decimal format, on a leading edge transition to the IBox.

The Workspace parameter is an internal, private register used by this IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.

Either the Success or Error bit parameter will turn on once the command is complete.

In order for this ECOM100 IBox to function, you must turn ON dip switch 7 on the ECOM100 circuit board.



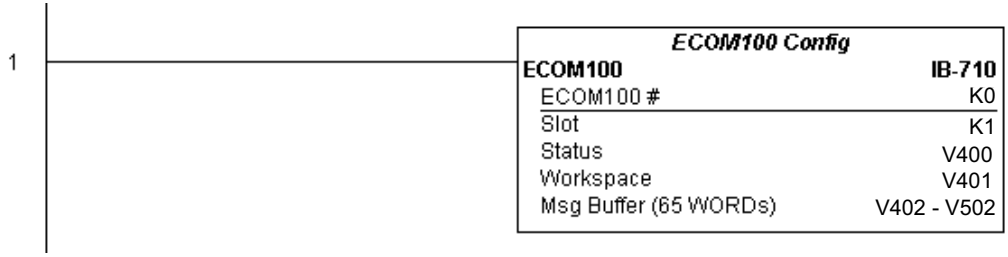
ECRDIP Parameters

- ECOM100#: this is a logical number associated with this specific ECOM100 module in the specified slot. All other ECxxxx IBoxes that need to reference this ECOM100 module must reference this logical number
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the request is completed successfully
- Error: specifies a bit that will turn on if the instruction is not successfully completed
- IP Address: specifies the starting address where the ECOM100's IP Address will be placed in 4 consecutive V-memory locations

Parameter		DL06 Range
ECOM100#	K	K0-255
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map
IP Address (4 Words)	V	See DL06 V-memory map - Data Words

ECRDIP Example

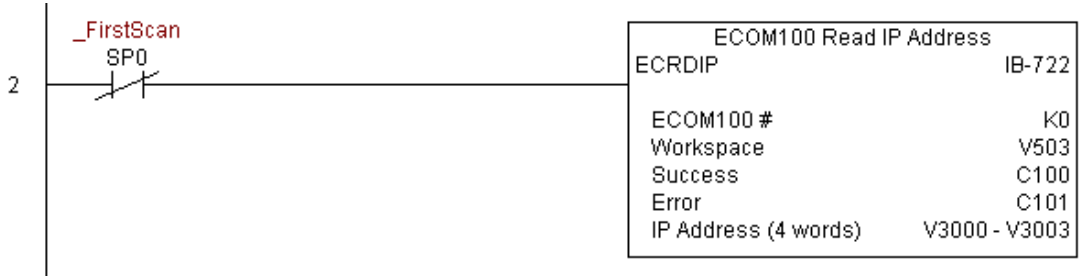
Rung 1: The ECOM100 Config IBox is responsible for coordination/interlocking of all ECOM100 type IBoxes for one specific ECOM100 module. Tag the ECOM100 in slot 1 as ECOM100# K0. All other ECxxxx IBoxes refer to this module # as K0. If you need to move the module in the base to a different slot, then you only need to change this one IBox. V400 is used as a global result status register for the other ECxxxx IBoxes using this specific ECOM100 module.V401 is used to coordinate/interlock the logic in all of the other ECxxxx IBoxes using this specific ECOM100 module. V402-V502 is a common 130 byte buffer available for use by the other ECxxxx IBoxes using this specific ECOM100 module.



Rung 2: On the 2nd scan, read the IP Address of the ECOM100 and store it in V3000 thru V3003 (4 decimal numbers). The ECOM100's IP Address could be displayed by an HMI.

The ECRDIP is leading edge triggered, not power-flow driven (similar to a counter input leg). The command to read the IP Address will be sent to the ECOM100 whenever the power flow into the IBox goes from OFF to ON.

If successful, turn on C100. If there is a failure, turn on C101.



ECOM100 Read Module ID (ECRDMID) (IB-720)

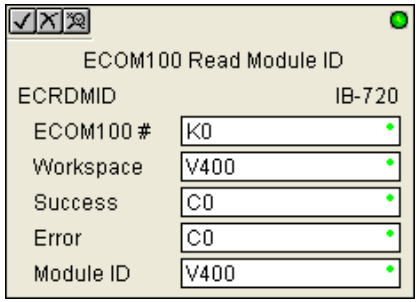
DS	Used
HPP	N/A

ECOM100 Read Module ID will read the binary (decimal) WORD sized Module ID on a leading edge transition to the IBox.

The Workspace parameter is an internal, private register used by this IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.

Either the Success or Error bit parameter will turn on once the command is complete.

In order for this ECOM100 IBox to function, you must turn ON dip switch 7 on the ECOM100 circuit board.



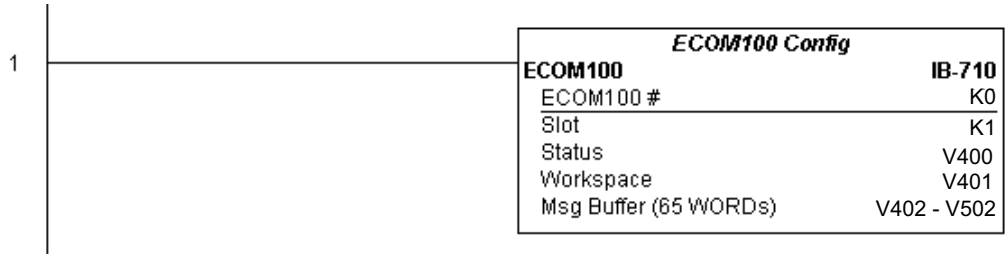
ECRDMID Parameters

- ECOM100#: this is a logical number associated with this specific ECOM100 module in the specified slot. All other ECxxxx IBoxes that need to reference this ECOM100 module must reference this logical number
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the request is completed successfully
- Error: specifies a bit that will turn on if the instruction is not successfully completed
- Module ID: specifies the location where the ECOM100's Module ID (decimal) will be placed

Parameter		DL06 Range
ECOM100#	K	K0-255
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map
Module ID	V	See DL06 V-memory map - Data Words

ECRDMID Example

Rung 1: The ECOM100 Config IBox is responsible for coordination/interlocking of all ECOM100 type IBoxes for one specific ECOM100 module. Tag the ECOM100 in slot 1 as ECOM100# K0. All other ECxxxx IBoxes refer to this module # as K0. If you need to move the module in the base to a different slot, then you only need to change this one IBox. V400 is used as a global result status register for the other ECxxxx IBoxes using this specific ECOM100 module. V401 is used to coordinate/interlock the logic in all of the other ECxxxx IBoxes using this specific ECOM100 module. V402-V502 is a common 130 byte buffer available for use by the other ECxxxx IBoxes using this specific ECOM100 module.



Rung 2: On the 2nd scan, read the Module ID of the ECOM100 and store it in V2000.

The ECRDMID is leading edge triggered, not power-flow driven (similar to a counter input leg). The command to read the module ID will be sent to the ECOM100 whenever the power flow into the IBox goes from OFF to ON.

If successful, turn on C100. If there is a failure, turn on C101.

ECOM100 Read Module Name (ECRDNAM) (IB-724)

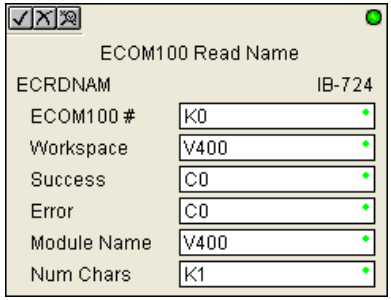
DS	Used
HPP	N/A

ECOM100 Read Name will read the Module Name up to the number of specified characters on a leading edge transition to the IBox.

The Workspace parameter is an internal, private register used by this IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.

Either the Success or Error bit parameter will turn on once the command is complete.

In order for this ECOM100 IBox to function, you must turn ON dip switch 7 on the ECOM100 circuit board.



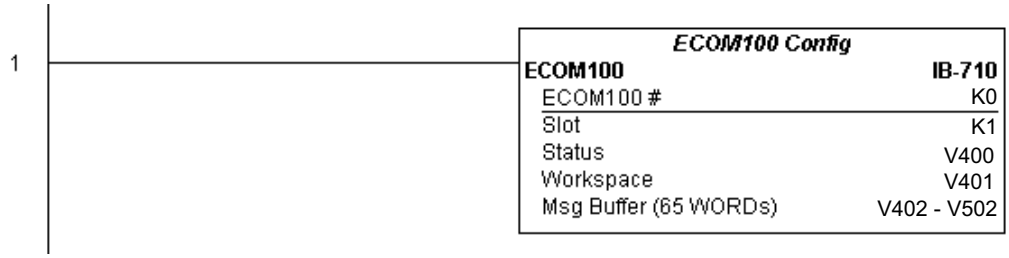
ECRDNAM Parameters

- ECOM100#: this is a logical number associated with this specific ECOM100 module in the specified slot. All other ECxxxx IBoxes that need to reference this ECOM100 module must reference this logical number
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the request is completed successfully
- Error: specifies a bit that will turn on if the instruction is not successfully completed
- Module Name: specifies the starting buffer location where the ECOM100's Module Name will be placed
- Num Chars: specifies the number of characters (bytes) to read from the ECOM100's Name field

Parameter		DL06 Range
ECOM100#	K	K0-255
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map
Module Name	V	See DL06 V-memory map - Data Words
Num Chars	K	K1-128

ECRDNAM Example

Rung 1: The ECOM100 Config IBox is responsible for coordination/interlocking of all ECOM100 type IBoxes for one specific ECOM100 module. Tag the ECOM100 in slot 1 as ECOM100# K0. All other ECxxxx IBoxes refer to this module # as K0. If you need to move the module in the base to a different slot, then you only need to change this one IBox. V400 is used as a global result status register for the other ECxxxx IBoxes using this specific ECOM100 module. V401 is used to coordinate/interlock the logic in all of the other ECxxxx IBoxes using this specific ECOM100 module. V402-V502 is a common 130 byte buffer available for use by the other ECxxxx IBoxes using this specific ECOM100 module.



Rung 2: On the 2nd scan, read the Module Name of the ECOM100 and store it in V3000 thru V3003 (8 characters). This text can be displayed by an HMI.

The ECRDNAM is leading edge triggered, not power-flow driven (similar to a counter input leg). The command to read the module name will be sent to the ECOM100 whenever the power flow into the IBox goes from OFF to ON.

If successful, turn on C100. If there is a failure, turn on C101.

ECOM100 Read Subnet Mask (ECRDSNM) (IB-732)

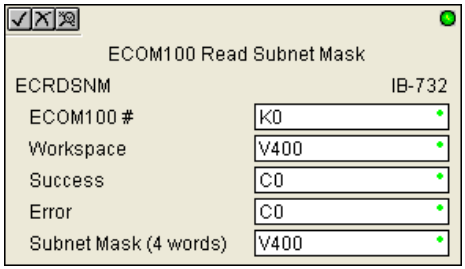
DS	Used
HPP	N/A

ECOM100 Read Subnet Mask will read the 4 parts of the Subnet Mask and store them in 4 consecutive V-Memory locations in decimal format, on a leading edge transition to the IBox.

The Workspace parameter is an internal, private register used by this IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.

Either the Success or Error bit parameter will turn on once the command is complete.

In order for this ECOM100 IBox to function, you must turn ON dip switch 7 on the ECOM100 circuit board.



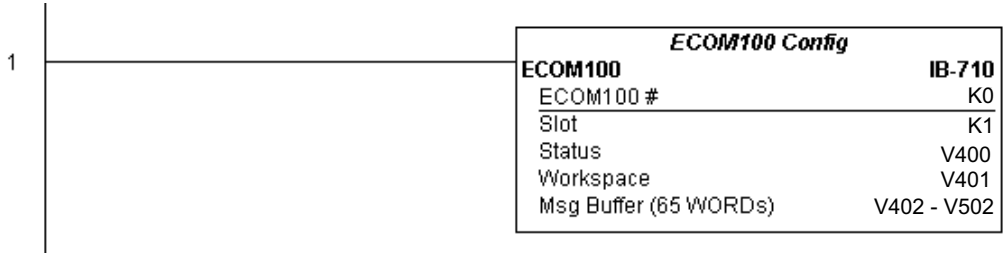
ECRDSNM Parameters

- ECOM100#: this is a logical number associated with this specific ECOM100 module in the specified slot. All other ECxxxx IBoxes that need to reference this ECOM100 module must reference this logical number
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the request is completed successfully
- Error: specifies a bit that will turn on if the instruction is not successfully completed
- Subnet Mask: specifies the starting address where the ECOM100's Subnet Mask will be placed in 4 consecutive V-memory locations

Parameter		DL06 Range
ECOM100#	K	K0-255
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map
Subnet Mask (4 Words)	V	See DL06 V-memory map - Data Words

ECRDSNM Example

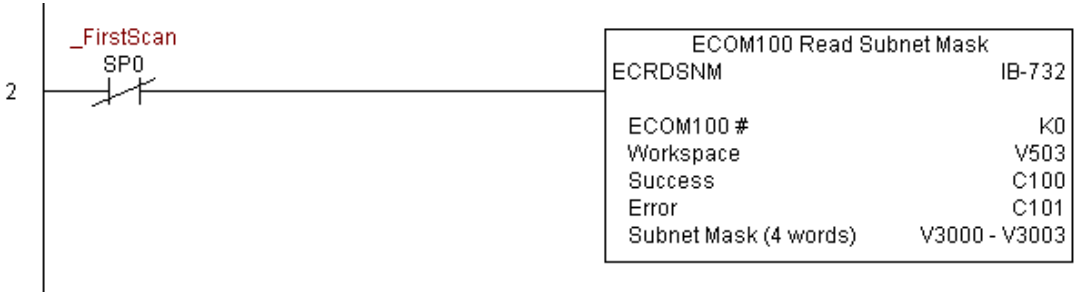
Rung 1: The ECOM100 Config IBox is responsible for coordination/interlocking of all ECOM100 type IBoxes for one specific ECOM100 module. Tag the ECOM100 in slot 1 as ECOM100# K0. All other ECxxxx IBoxes refer to this module # as K0. If you need to move the module in the base to a different slot, then you only need to change this one IBox. V400 is used as a global result status register for the other ECxxxx IBoxes using this specific ECOM100 module.V401 is used to coordinate/interlock the logic in all of the other ECxxxx IBoxes using this specific ECOM100 module. V402-V502 is a common 130 byte buffer available for use by the other ECxxxx IBoxes using this specific ECOM100 module.



Rung 2: On the 2nd scan, read the Subnet Mask of the ECOM100 and store it in V3000 thru V3003 (4 decimal numbers). The ECOM100's Subnet Mask could be displayed by an HMI.

The ECRDSNM is leading edge triggered, not power-flow driven (similar to a counter input leg). The command to read the Subnet Mask will be sent to the ECOM100 whenever the power flow into the IBox goes from OFF to ON.

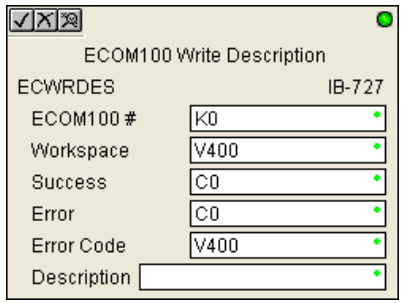
If successful, turn on C100. If there is a failure, turn on C101.



ECOM100 Write Description (ECWRDES) (IB-727)

DS	Used
HPP	N/A

ECOM100 Write Description will write the given Description to the ECOM100 module on a leading edge transition to the IBox. If you use a dollar sign ($) or double quote (“), use the PRINT/VPRINT escape sequence of TWO dollar signs ($$) for a single dollar sign or dollar sign-double quote ($”) for a double quote character.



The Workspace parameter is an internal, private register used by this IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.

Either the Success or Error bit parameter will turn on once the command is complete. If there is an error, the Error Code parameter will report an ECOM100 error code (less than 100), or a PLC logic error (greater than 1000).

The Description is stored in Flash-ROM in the ECOM100 and the execution of this IBox will disable the ECOM100 module for at least a half second until it writes the Flash-ROM. Therefore, it is HIGHLY RECOMMENDED that you only execute this IBox ONCE on first scan. Since it requires a LEADING edge to execute, use a NORMALLY CLOSED SP0 (STR NOT First Scan) to drive the power flow to the IBox.

In order for this ECOM100 IBox to function, you must turn ON dip switch 7 on the ECOM100 circuit board.

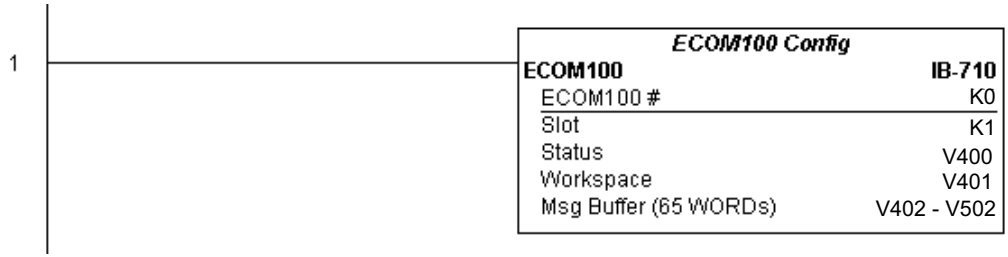
ECWRDES Parameters

- ECOM100#: this is a logical number associated with this specific ECOM100 module in the specified slot. All other ECxxxx IBoxes that need to reference this ECOM100 module must reference this logical number
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the request is completed successfully
- Error: specifies a bit that will turn on if the instruction is not successfully completed
- Error Code: specifies the location where the Error Code will be written
- Description: specifies the Description that will be written to the module

Parameter		DL06 Range
ECOM100#	K	K0-255
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map
Error Code	V	See DL06 V-memory map - Data Words
Description		Text

ECWRDES Example

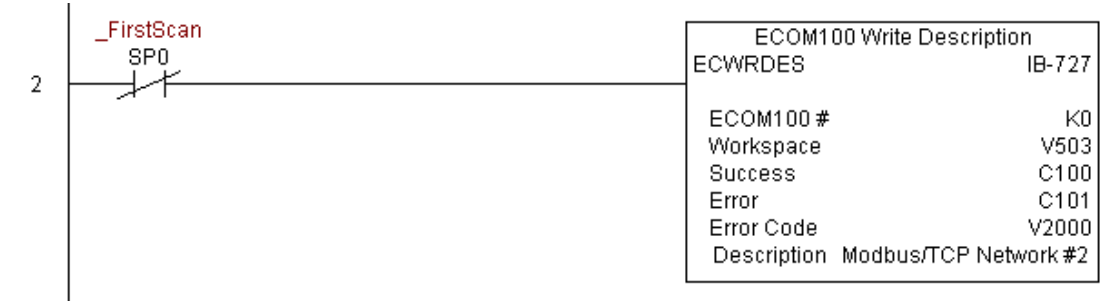
Rung 1: The ECOM100 Config IBox is responsible for coordination/interlocking of all ECOM100 type IBoxes for one specific ECOM100 module. Tag the ECOM100 in slot 1 as ECOM100# K0. All other ECxxxx IBoxes refer to this module # as K0. If you need to move the module in the base to a different slot, then you only need to change this one IBox. V400 is used as a global result status register for the other ECxxxx IBoxes using this specific ECOM100 module.V401 is used to coordinate/interlock the logic in all of the other ECxxxx IBoxes using this specific ECOM100 module. V402-V502 is a common 130 byte buffer available for use by the other ECxxxx IBoxes using this specific ECOM100 module.



Rung 2: On the 2nd scan, set the Module Description of the ECOM100. Typically this is done using NetEdit, but this IBox allows you to configure the module description in the ECOM100 using your ladder program.

The EWRDES is leading edge triggered, not power-flow driven (similar to a counter input leg). The command to write the module description will be sent to the ECOM100 whenever the power flow into the IBox goes from OFF to ON.

If successful, turn on C100. If there is a failure, turn on C101. If it fails, you can look at V2000 for the specific error code.



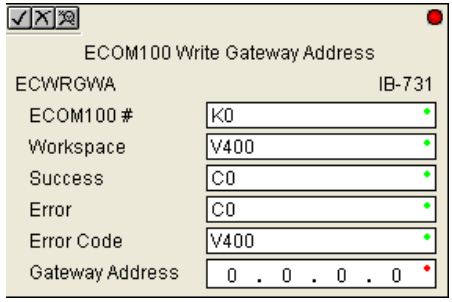
ECOM100 Write Gateway Address (ECWRGWA) (IB-731)

DS	Used
HPP	N/A

ECOM100 Write Gateway Address will write the given Gateway IP Address to the ECOM100 module on a leading edge transition to the IBox. See also ECOM100 IP Setup (ECIPSUP) IBox 717 to setup ALL of the TCP/IP parameters in a single instruction - IP Address, Subnet Mask, and Gateway Address.

The Workspace parameter is an internal, private register used by this IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.

Either the Success or Error bit parameter will turn on once the command is complete. If there is an error, the Error Code parameter will report an ECOM100 error code (less than 100), or a PLC logic error (greater than 1000).



The Gateway Address is stored in Flash-ROM in the ECOM100 and the execution of this IBox will disable the ECOM100 module for at least a half second until it writes the Flash-ROM. Therefore, it is HIGHLY RECOMMENDED that you only execute this IBox ONCE, on first scan. Since it requires a LEADING edge to execute, use a NORMALLY CLOSED SP0 (STR NOT First Scan) to drive the power flow to the IBox.

In order for this ECOM100 IBox to function, you must turn ON dip switch 7 on the ECOM100 circuit board.

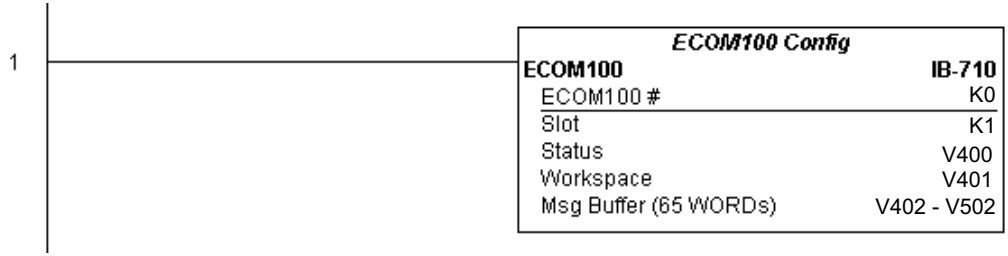
ECWRGWA Parameters

- ECOM100#: this is a logical number associated with this specific ECOM100 module in the specified slot. All other ECxxxx IBoxes that need to reference this ECOM100 module must reference this logical number
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the request is completed successfully
- Error: specifies a bit that will turn on if the instruction is not successfully completed
- Error Code: specifies the location where the Error Code will be written
- Gateway Address: specifies the Gateway IP Address that will be written to the module

Parameter		DL06 Range
ECOM100#	K	K0-255
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map
Error Code	V	See DL06 V-memory map - Data Words
Gateway Address		0.0.0.1. to 255.255.255.254

ECWRGWA Example

Rung 1: The ECOM100 Config IBox is responsible for coordination/interlocking of all ECOM100 type IBoxes for one specific ECOM100 module. Tag the ECOM100 in slot 1 as ECOM100# K0. All other ECxxxx IBoxes refer to this module # as K0. If you need to move the module in the base to a different slot, then you only need to change this one IBox. V400 is used as a global result status register for the other ECxxxx IBoxes using this specific ECOM100 module.V401 is used to coordinate/interlock the logic in all of the other ECxxxx IBoxes using this specific ECOM100 module. V402-V502 is a common 130 byte buffer available for use by the other ECxxxx IBoxes using this specific ECOM100 module.

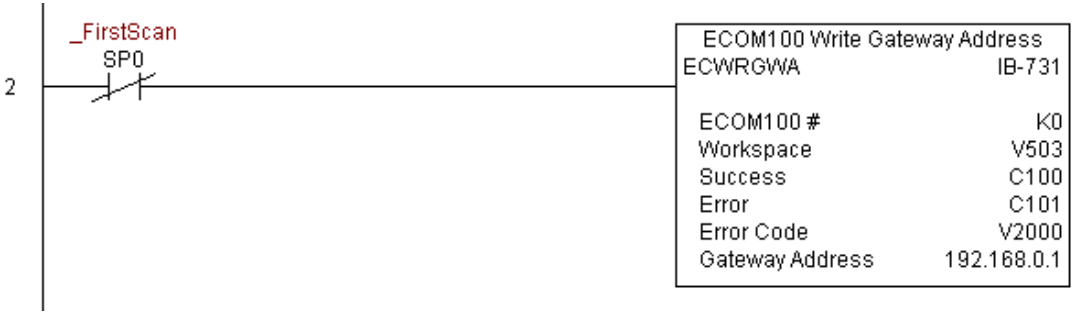


Rung 2: On the 2nd scan, assign the Gateway Address of the ECOM100 to 192.168.0.1

The ECWRGWA is leading edge triggered, not power-flow driven (similar to a counter input leg). The command to write the Gateway Address will be sent to the ECOM100 whenever the power flow into the IBox goes from OFF to ON.

If successful, turn on C100. If there is a failure, turn on C101. If it fails, you can look at V2000 for the specific error code.

To configure all of the ECOM100 TCP/IP parameters in one IBox, see the ECOM100 IP Setup (ECIPSUP) IBox.



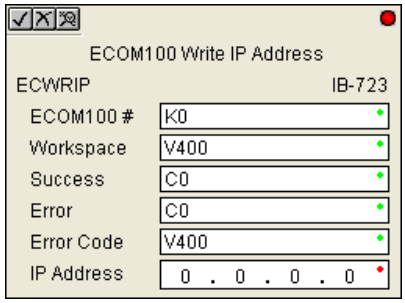
ECOM100 Write IP Address (ECWRIP) (IB-723)

DS	Used
HPP	N/A

ECOM100 Write IP Address will write the given IP Address to the ECOM100 module on a leading edge transition to the IBox. See also ECOM100 IP Setup (ECIPSUP) IBox 717 to setup ALL of the TCP/IP parameters in a single instruction - IP Address, Subnet Mask, and Gateway Address.

The Workspace parameter is an internal, private register used by this IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.

Either the Success or Error bit parameter will turn on once the command is complete. If there is an error, the Error Code parameter will report an ECOM100 error code (less than 100), or a PLC logic error (greater than 1000).



The IP Address is stored in Flash-ROM in the ECOM100 and the execution of this IBox will disable the ECOM100 module for at least a half second until it writes the Flash-ROM. Therefore, it is HIGHLY RECOMMENDED that you only execute this IBox ONCE on first scan. Since it requires a LEADING edge to execute, use a NORMALLY CLOSED SP0 (STR NOT First Scan) to drive the power flow to the IBox.

In order for this ECOM100 IBox to function, you must turn ON dip switch 7 on the ECOM100 circuit board.

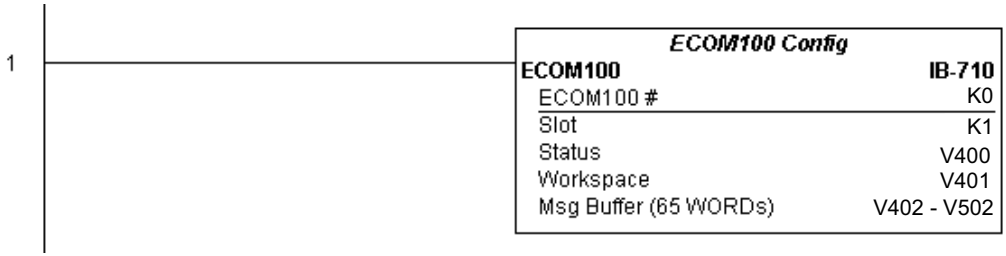
ECWRIP Parameters

- ECOM100#: this is a logical number associated with this specific ECOM100 module in the specified slot. All other ECxxxx IBoxes that need to reference this ECOM100 module must reference this logical number
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the request is completed successfully
- Error: specifies a bit that will turn on if the instruction is not successfully completed
- Error Code: specifies the location where the Error Code will be written
- IP Address: specifies the IP Address that will be written to the module

Parameter		DL06 Range
ECOM100#	K	K0-255
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map
Error Code	V	See DL06 V-memory map - Data Words
IP Address		0.0.0.1. to 255.255.255.254

ECWRIP Example

Rung 1: The ECOM100 Config IBox is responsible for coordination/interlocking of all ECOM100 type IBoxes for one specific ECOM100 module. Tag the ECOM100 in slot 1 as ECOM100# K0. All other ECxxxx IBoxes refer to this module # as K0. If you need to move the module in the base to a different slot, then you only need to change this one IBox. V400 is used as a global result status register for the other ECxxxx IBoxes using this specific ECOM100 module.V401 is used to coordinate/interlock the logic in all of the other ECxxxx IBoxes using this specific ECOM100 module. V402-V502 is a common 130 byte buffer available for use by the other ECxxxx IBoxes using this specific ECOM100 module.



Rung 2: On the 2nd scan, assign the IP Address of the ECOM100 to 192.168.12.100

The ECWRIP is leading edge triggered, not power-flow driven (similar to a counter input leg). The command to write the IP Address will be sent to the ECOM100 whenever the power flow into the IBox goes from OFF to ON.

If successful, turn on C100. If there is a failure, turn on C101. If it fails, you can look at V2000 for the specific error code.

To configure all of the ECOM100 TCP/IP parameters in one IBox, see the ECOM100 IP Setup (ECIPSUP) IBox.

ECOM100 Write Module ID (ECWRMID) (IB-721)

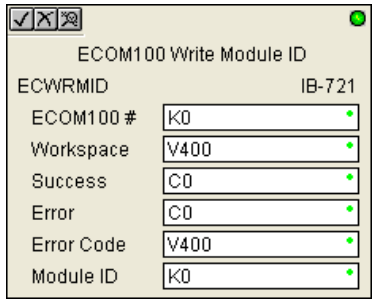
DS	Used
HPP	N/A

ECOM100 Write Module ID will write the given Module ID on a leading edge transition to the IBox

If the Module ID is set in the hardware using the dipswitches, this IBox will fail and return error code 1005 (decimal).

The Workspace parameter is an internal, private register used by this IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.

Either the Success or Error bit parameter will turn on once the command is complete. If there is an error, the Error Code parameter will report an ECOM100 error code (less than 100), or a PLC logic error (greater than 1000).



The Module ID is stored in Flash-ROM in the ECOM100 and the execution of this IBox will disable the ECOM100 module for at least a half second until it writes the Flash-ROM. Therefore, it is HIGHLY RECOMMENDED that you only execute this IBox ONCE on first scan. Since it requires a LEADING edge to execute, use a NORMALLY CLOSED SP0 (STR NOT First Scan) to drive the power flow to the IBox.

In order for this ECOM100 IBox to function, you must turn ON dip switch 7 on the ECOM100 circuit board.

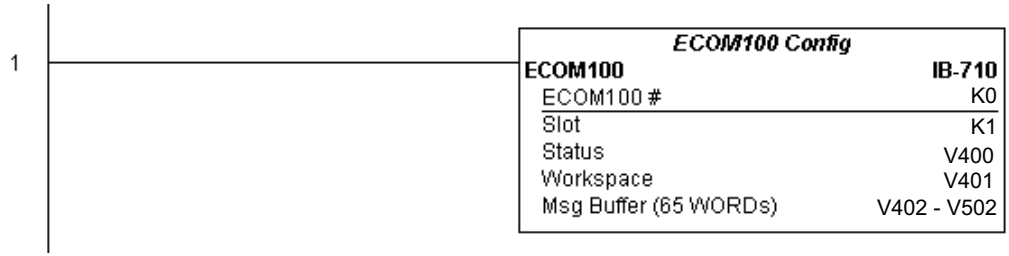
ECWRMID Parameters

- ECOM100#: this is a logical number associated with this specific ECOM100 module in the specified slot. All other ECxxxx IBoxes that need to reference this ECOM100 module must reference this logical number
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the request is completed successfully
- Error: specifies a bit that will turn on if the instruction is not successfully completed
- Error Code: specifies the location where the Error Code will be written
- Module ID: specifies the Module ID that will be written to the module

Parameter		DL06 Range
ECOM100#	K	K0-255
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map
Error Code	V	See DL06 V-memory map - Data Words
Module ID		K0-65535

ECWRMID Example

Rung 1: The ECOM100 Config IBox is responsible for coordination/interlocking of all ECOM100 type IBoxes for one specific ECOM100 module. Tag the ECOM100 in slot 1 as ECOM100# K0. All other ECxxxx IBoxes refer to this module # as K0. If you need to move the module in the base to a different slot, then you only need to change this one IBox. V400 is used as a global result status register for the other ECxxxx IBoxes using this specific ECOM100 module.V401 is used to coordinate/interlock the logic in all of the other ECxxxx IBoxes using this specific ECOM100 module. V402-V502 is a common 130 byte buffer available for use by the other ECxxxx IBoxes using this specific ECOM100 module.



Rung 2: On the 2nd scan, set the Module ID of the ECOM100. Typically this is done using NetEdit, but this IBox allows you to configure the module ID of the ECOM100 using your ladder program.

The EWRMID is leading edge triggered, not power-flow driven (similar to a counter input leg). The command to write the module ID will be sent to the ECOM100 whenever the power flow into the IBox goes from OFF to ON.

If successful, turn on C100. If there is a failure, turn on C101. If it fails, you can look at V2000 for the specific error code.

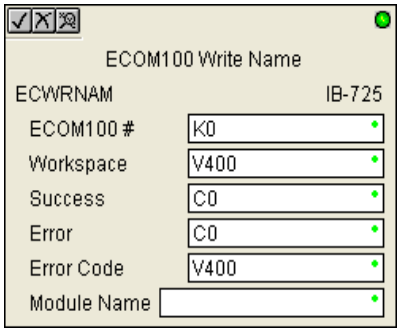
ECOM100 Write Name (ECWRNAM) (IB-725)

DS	Used
HPP	N/A

ECOM100 Write Name will write the given Name to the ECOM100 module on a leading edge transition to the IBox. If you use a dollar sign ($) or double quote (“), use the PRINT/VPRINT escape sequence of TWO dollar signs ($$) for a single dollar sign or dollar sign-double quote ($”) for a double quote character.

The Workspace parameter is an internal, private register used by this IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.

Either the Success or Error bit parameter will turn on once the command is complete. If there is an error, the Error Code parameter will report an ECOM100 error code (less than 100), or a PLC logic error (greater than 1000).



The Name is stored in Flash-ROM in the ECOM100 and the execution of this IBox will disable the ECOM100 module for at least a half second until it writes the Flash-ROM. Therefore, it is HIGHLY RECOMMENDED that you only execute this IBox ONCE on first scan. Since it requires a LEADING edge to execute, use a NORMALLY CLOSED SP0 (STR NOT First Scan) to drive the power flow to the IBox.

In order for this ECOM100 IBox to function, you must turn ON dip switch 7 on the ECOM100 circuit board.

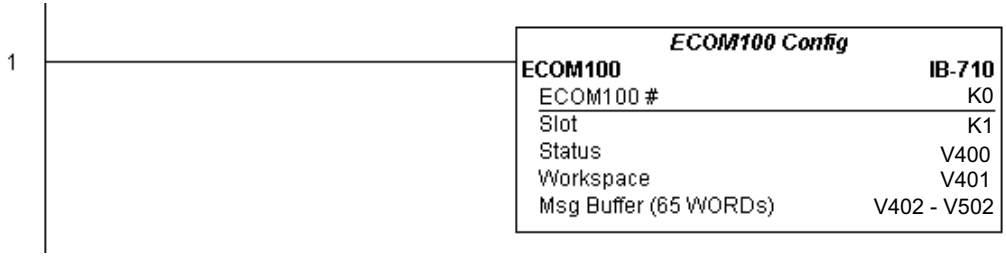
ECWRNAM Parameters

- ECOM100#: this is a logical number associated with this specific ECOM100 module in the specified slot. All other ECxxxx IBoxes that need to reference this ECOM100 module must reference this logical number
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the request is completed successfully
- Error: specifies a bit that will turn on if the instruction is not successfully completed
- Error Code: specifies the location where the Error Code will be written
- Module Name: specifies the Name that will be written to the module

Parameter		DL06 Range
ECOM100#	K	K0-255
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map
Error Code	V	See DL06 V-memory map - Data Words
Module Name		Text

ECWRNAM Example

Rung 1: The ECOM100 Config IBox is responsible for coordination/interlocking of all ECOM100 type IBoxes for one specific ECOM100 module. Tag the ECOM100 in slot 1 as ECOM100# K0. All other ECxxxx IBoxes refer to this module # as K0. If you need to move the module in the base to a different slot, then you only need to change this one IBox. V400 is used as a global result status register for the other ECxxxx IBoxes using this specific ECOM100 module.V401 is used to coordinate/interlock the logic in all of the other ECxxxx IBoxes using this specific ECOM100 module. V402-V502 is a common 130 byte buffer available for use by the other ECxxxx IBoxes using this specific ECOM100 module.



Rung 2: On the 2nd scan, set the Module Name of the ECOM100. Typically this is done using NetEdit, but this IBox allows you to configure the module name of the ECOM100 using your ladder program.

The EWRNAM is leading edge triggered, not power-flow driven (similar to a counter input leg). The command to write the module name will be sent to the ECOM100 whenever the power flow into the IBox goes from OFF to ON.

If successful, turn on C100. If there is a failure, turn on C101. If it fails, you can look at V2000 for the specific error code.

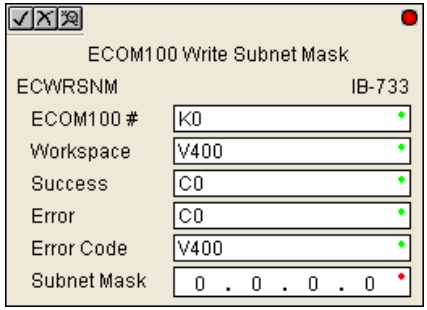
ECOM100 Write Subnet Mask (ECWRSNM) (IB-733)

DS	Used
HPP	N/A

ECOM100 Write Subnet Mask will write the given Subnet Mask to the ECOM100 module on a leading edge transition to the IBox. See also ECOM100 IP Setup (ECIPSUP) IBox 717 to setup ALL of the TCP/IP parameters in a single instruction - IP Address, Subnet Mask, and Gateway Address.

The Workspace parameter is an internal, private register used by this IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.

Either the Success or Error bit parameter will turn on once the command is complete. If there is an error, the Error Code parameter will report an ECOM100 error code (less than 100), or a PLC logic error (greater than 1000).



The Subnet Mask is stored in Flash-ROM in the ECOM100 and the execution of this IBox will disable the ECOM100 module for at least a half second until it writes the Flash-ROM. Therefore, it is HIGHLY RECOMMENDED that you only execute this IBox ONCE on first scan. Since it requires a LEADING edge to execute, use a NORMALLY CLOSED SP0 (STR NOT First Scan) to drive the power flow to the IBox.

In order for this ECOM100 IBox to function, you must turn ON dip switch 7 on the ECOM100 circuit board.

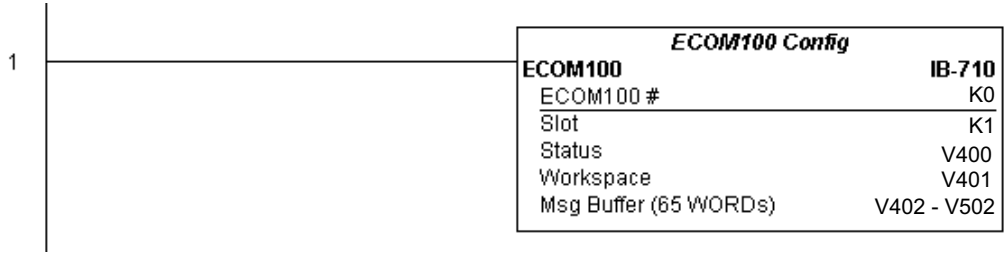
ECWRSNM Parameters

- ECOM100#: this is a logical number associated with this specific ECOM100 module in the specified slot. All other ECxxxx IBoxes that need to reference this ECOM100 module must reference this logical number
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the request is completed successfully
- Error: specifies a bit that will turn on if the instruction is not successfully completed
- Error Code: specifies the location where the Error Code will be written
- Subnet Mask: specifies the Subnet Mask that will be written to the module

Parameter		DL06 Range
ECOM100#	K	K0-255
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map
Error Code	V	See DL06 V-memory map - Data Words
Subnet Mask		Masked IP Address

ECWRSNM Example

Rung 1: The ECOM100 Config IBox is responsible for coordination/interlocking of all ECOM100 type IBoxes for one specific ECOM100 module. Tag the ECOM100 in slot 1 as ECOM100# K0. All other ECxxxx IBoxes refer to this module # as K0. If you need to move the module in the base to a different slot, then you only need to change this one IBox. V400 is used as a global result status register for the other ECxxxx IBoxes using this specific ECOM100 module.V401 is used to coordinate/interlock the logic in all of the other ECxxxx IBoxes using this specific ECOM100 module. V402-V502 is a common 130 byte buffer available for use by the other ECxxxx IBoxes using this specific ECOM100 module.



Rung 2: On the 2nd scan, assign the Subnet Mask of the ECOM100 to 255.255.0.0

The ECWRSNM is leading edge triggered, not power-flow driven (similar to a counter input leg). The command to write the Subnet Mask will be sent to the ECOM100 whenever the power flow into the IBox goes from OFF to ON.

If successful, turn on C100. If there is a failure, turn on C101. If it fails, you can look at V2000 for the specific error code.

To configure all of the ECOM100 TCP/IP parameters in one IBox, see the ECOM100 IP Setup (ECIPSUP) IBox.

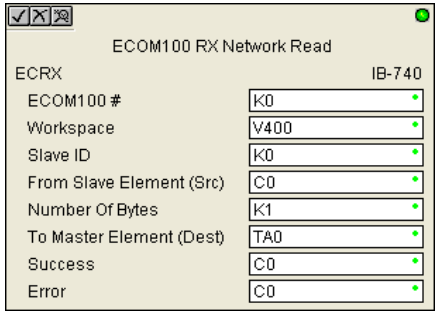
ECOM100 RX Network Read (ECRX) (IB-740)

DS	Used
HPP	N/A

ECOM100 RX Network Read performs the RX instruction with built-in interlocking with all other ECOM100 RX (ECRX) and ECOM100 WX (ECWX) IBoxes in your program to simplify communications networking. It will perform the RX on the specified ECOM100#'s network, which corresponds to a specific unique ECOM100 Configuration (ECOM100) IBox at the top of your program.

The Workspace parameter is an internal, private register used by this IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.

Whenever this IBox has power, it will read element data from the specified slave into the given destination V-Memory buffer, giving other ECOM100 RX and ECOM100 WX IBoxes on that ECOM100# network a chance to execute.



For example, if you wish to read and write data continuously from 5 different slaves, you can have all of these ECRX and ECWX instructions in ONE RUNG driven by SP1 (Always On). They will execute round-robin style, automatically.

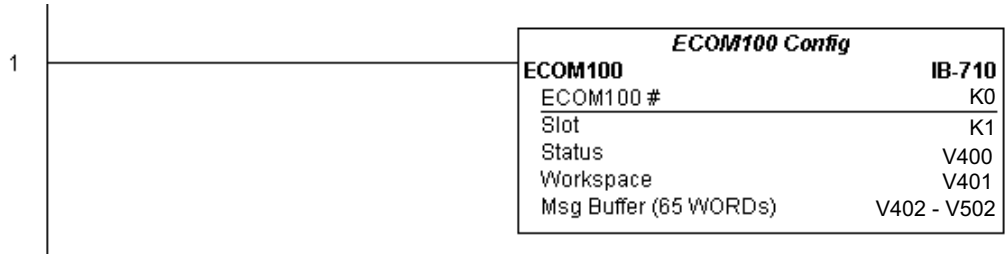
ECRX Parameters

- ECOM100#: this is a logical number associated with this specific ECOM100 module in the specified slot. All other ECxxxx IBoxes that need to reference this ECOM100 module must reference this logical number
- Workspace: specifies a V-memory location that will be used by the instruction
- Slave ID: specifies the slave ECOM(100) PLC that will be targeted by the ECRX instruction
- From Slave Element (Src): specifies the slave address of the data to be read
- Number of Bytes: specifies the number of bytes to read from the slave ECOM(100) PLC
- To Master Element (Dest): specifies the location where the slave data will be placed in the master ECOM100 PLC
- Success: specifies a bit that will turn on once the request is completed successfully
- Error: specifies a bit that will turn on if the instruction is not successfully completed

Parameter		DL06 Range
ECOM100#	K	K0-255
Workspace	V	See DL06 V-memory map - Data Words
Slave ID	K	K0-90
From Slave Element (Src)	X,Y,C,S,T,CT,GX,GY,V,P	See DL06 V-memory map
Number of Bytes	K	K1-128
To Master Element (Dest)	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map

ECRX Example

Rung 1: The ECOM100 Config IBox is responsible for coordination/interlocking of all ECOM100 type IBoxes for one specific ECOM100 module. Tag the ECOM100 in slot 1 as ECOM100# K0. All other ECxxxx IBoxes refer to this module # as K0. If you need to move the module in the base to a different slot, then you only need to change this one IBox. V400 is used as a global result status register for the other ECxxxx IBoxes using this specific ECOM100 module.V401 is used to coordinate/interlock the logic in all of the other ECxxxx IBoxes using this specific ECOM100 module. V402-V502 is a common 130 byte buffer available for use by the other ECxxxx IBoxes using this specific ECOM100 module.



(example continued on next page)

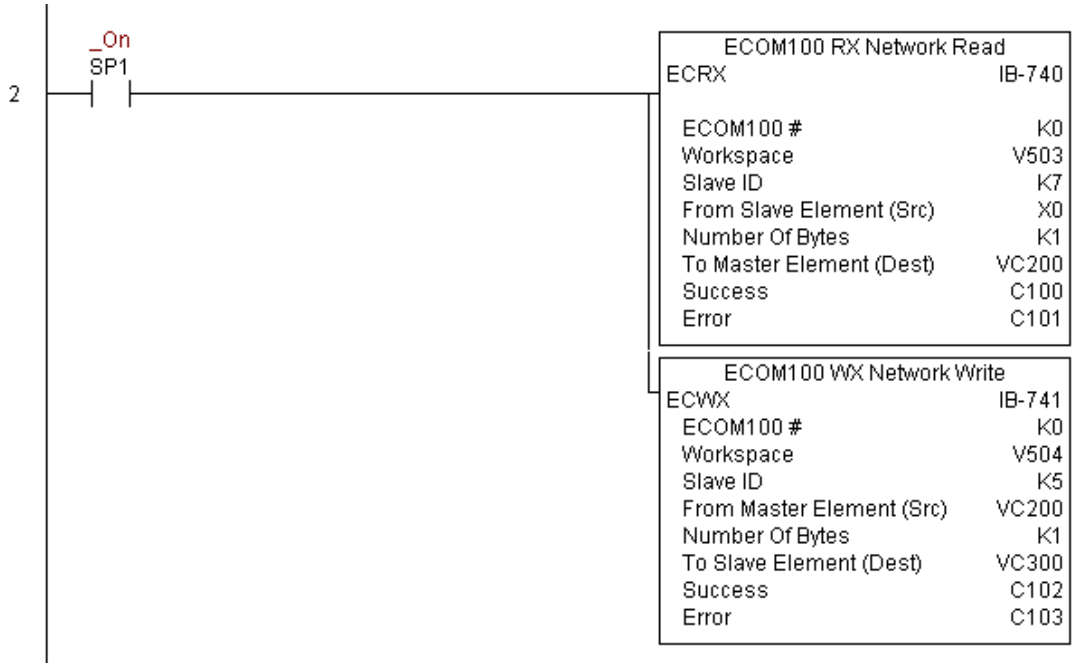
ECRX Example (cont'd)

Rung 2: Using ECOM100# K0, read X0-X7 from Slave K7 and write them to slave K5 as fast as possible. Store them in this local PLC in C200-C207, and write them to C300-C307 in slave K5.

Both the ECRX and ECWX work with the ECOM100 Config IBox to simplify all networking by handling all of the interlocks and proper resource sharing. They also provide very simplified error reporting. You no longer need to worry about any SP "busy bits" or "error bits", or what slot number a module is in, or have any counters or shift registers or any other interlocks for resource management.

In this example, SP1 (always ON) is driving both the ECRX and ECWX IBoxes in the same rung. On the scan that the Network Read completes, the Network Write will start that same scan. As soon as the Network Write completes, any pending operations below it in the program would get a turn. If there are no pending ECOM100 IBoxes below the ECWX, then the very next scan the ECRX would start its request again.

Using the ECRX and ECWX for all of your ECOM100 network reads and writes is the fastest the PLC can do networking. For local Serial Ports, DCM modules, or the original ECOM modules, use the NETCFG and NETRX/NETWX IBoxes.



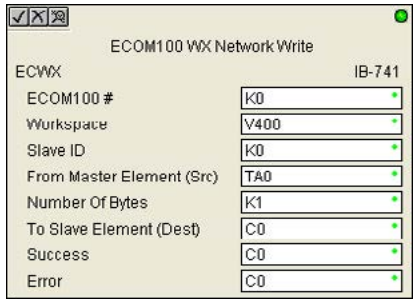
ECOM100 WX Network Write(ECWX) (IB-741)

DS	Used
HPP	N/A

ECOM100 WX Network Write performs the WX instruction with built-in interlocking with all other ECOM100 RX (ECRX) and ECOM100 WX (ECWX) IBoxes in your program to simplify communications networking. It will perform the WX on the specified ECOM100#'s network, which corresponds to a specific unique ECOM100 Configuration (ECOM100) IBox at the top of your program.

The Workspace parameter is an internal, private register used by this IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.

Whenever this IBox has power, it will write data from the master's V-Memory buffer to the specified slave starting with the given slave element, giving other ECOM100 RX and ECOM100 WX IBoxes on that ECOM100# network a chance to execute.



For example, if you wish to read and write data continuously from 5 different slaves, you can have all of these ECRX and ECWX instructions in ONE RUNG driven by SP1 (Always On). They will execute round-robin style, automatically.

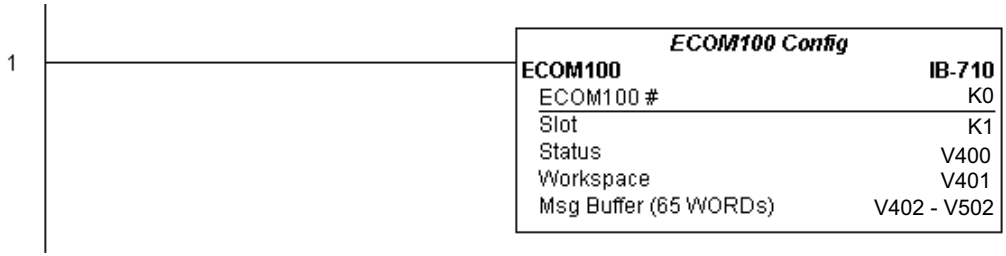
ECWX Parameters

- ECOM100#: this is a logical number associated with this specific ECOM100 module in the specified slot. All other ECxxxx IBoxes that need to reference this ECOM100 module must reference this logical number
- Workspace: specifies a V-memory location that will be used by the instruction
- Slave ID: specifies the slave ECOM(100) PLC that will be targeted by the ECWX instruction
- From Master Element (Src): specifies the location in the master ECOM100 PLC where the data will be sourced from
- Number of Bytes: specifies the number of bytes to write to the slave ECOM(100) PLC
- To Slave Element (Dest): specifies the slave address the data will be written to
- Success: specifies a bit that will turn on once the request is completed successfully
- Error: specifies a bit that will turn on if the instruction is not successfully completed

Parameter		DL06 Range
ECOM100#	K	K0-255
Workspace	V	See DL06 V-memory map - Data Words
Slave ID	K	K0-90
From Master Element (Src)	V	See DL06 V-memory map - Data Words
Number of Bytes	K	K1-128
To Slave Element (Dest)	X,Y,C,S,T,CT,GX,GY,V,P	See DL06 V-memory map
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map

ECWX Example

Rung 1: The ECOM100 Config IBox is responsible for coordination/interlocking of all ECOM100 type IBoxes for one specific ECOM100 module. Tag the ECOM100 in slot 1 as ECOM100# K0. All other ECxxxx IBoxes refer to this module # as K0. If you need to move the module in the base to a different slot, then you only need to change this one IBox. V400 is used as a global result status register for the other ECxxxx IBoxes using this specific ECOM100 module.V401 is used to coordinate/interlock the logic in all of the other ECxxxx IBoxes using this specific ECOM100 module. V402-V502 is a common 130 byte buffer available for use by the other ECxxxx IBoxes using this specific ECOM100 module.



(example continued on next page)

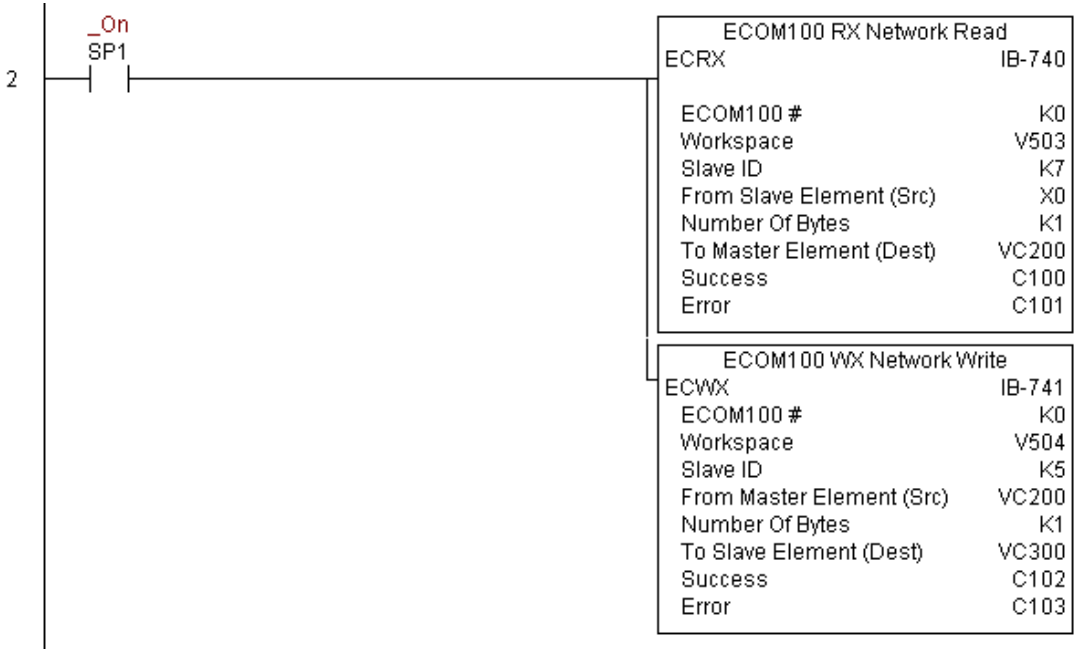
ECWX Example (cont'd)

Rung 2: Using ECOM100# K0, read X0-X7 from Slave K7 and write them to slave K5 as fast as possible. Store them in this local PLC in C200-C207, and write them to C300-C307 in slave K5.

Both the ECRX and ECWX work with the ECOM100 Config IBox to simplify all networking by handling all of the interlocks and proper resource sharing. They also provide very simplified error reporting. You no longer need to worry about any SP "busy bits" or "error bits", or what slot number a module is in, or have any counters or shift registers or any other interlocks for resource management.

In this example, SP1 (always ON) is driving both the ECRX and ECWX IBoxes in the same rung. On the scan that the Network Read completes, the Network Write will start that same scan. As soon as the Network Write completes, any pending operations below it in the program would get a turn. If there are no pending ECOM100 IBoxes below the ECWX, then the very next scan the ECRX would start its request again.

Using the ECRX and ECWX for all of your ECOM100 network reads and writes is the fastest the PLC can do networking. For local Serial Ports, DCM modules, or the original ECOM modules, use the NETCFG and NETRX/NETWX IBoxes.



NETCFG Network Configuration (NETCFG) (IB-700)

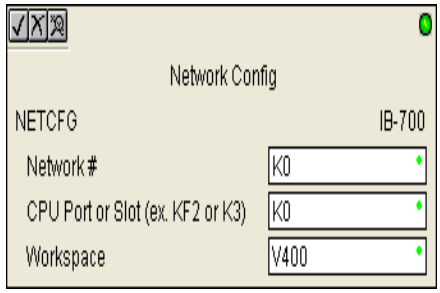
DS	Used
HPP	N/A

Network Config defines all the common information necessary for performing RX/WX Networking using the NETRX and NETWX IBox instructions via a local CPU serial port, DCM or ECOM module.

You must have the Network Config instruction at the top of your ladder/stage program with any other configuration IBoxes.

If you use more than one local serial port, DCM or ECOM in your PLC for RX/WX Networking, you must have a different Network Config instruction for EACH RX/WX network in your system that utilizes any NETRX/NETWX IBox instructions.

The Workspace parameter is an internal, private register used by the Network Config IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.



The 2nd parameter "CPU Port or Slot" is the same value as in the high byte of the first LD instruction if you were coding the RX or WX rung yourself. This value is CPU and port specific (check your PLC manual). Use KF2 for the DL06 CPU serial port 2. If using a DCM or ECOM module, use Kx, where x equals the slot where the module is installed.

Since this logic only executes on the first scan, this IBox cannot have any input logic.

NETCFG Parameters

- Network#: specifies a unique # for each ECOM(100) or DCM network to use
- CPU Port or Slot: specifies the CPU port number or slot number of DCM/ECOM(100) used
- Workspace: specifies a V-memory location that will be used by the instruction

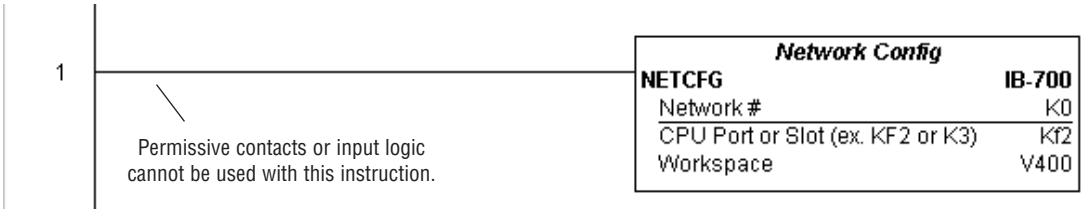
Parameter		DL06 Range
Network#	K	K0-255
CPU Port or Slot	K	K0-FF
Workspace	V	See DL06 V-memory map - Data Words

NETCFG Example

The Network Configuration IBox coordinates all of the interaction with other Network IBoxes (NETRX/NETWX). You must have a Network Configuration IBox for each serial port network, DCM module network, or original ECOM module network in your system. Configuration IBoxes must be at the top of your program and must execute every scan.

This IBox defines Network# K0 to be for the local CPU serial port #2 (KF2). For local CPU serial ports or DCM/ECOM modules, use the same value you would use in the most significant byte of the first LD instruction in a normal RX/WX rung to reference the port or module. Any NETRX or NETWX IBoxes that need to reference this specific network would enter K0 for their Network# parameter.

The Workspace register is used to maintain state information about the port or module, along with proper sharing and interlocking with the other NETRX and NETWX IBoxes in the program. This V-memory register must not be used anywhere else in the entire program.



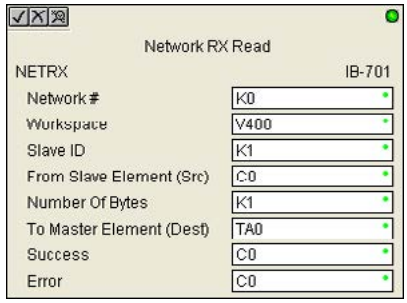
Network RX Read (NETRX) (IB-701)

DS	Used
HPP	N/A

Network RX Read performs the RX instruction with built-in interlocking with all other Network RX (NETRX) and Network WX (NETWX) IBoxes in your program to simplify communications networking. It will perform the RX on the specified Network #, which corresponds to a specific unique Network Configuration (NETCFG) at the top of your program.

The Workspace parameter is an internal, private register used by this IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.

Whenever this IBox has power, it will read element data from the specified slave into the given destination V-Memory buffer, giving other Network RX and Network WX IBoxes on that Network # a chance to execute.



For example, if you wish to read and write data continuously from 5 different slaves, you can have all of these NETRX and NETWX instructions in ONE RUNG driven by SP1 (Always On). They will execute round-robin style, automatically.

NETRX Parameters

- Network#: specifies the (CPU port's, DCM's, ECOM's) Network # defined by the NETCFG instruction
- Workspace: specifies a V-memory location that will be used by the instruction
- Slave ID: specifies the slave PLC that will be targeted by the NETRX instruction
- From Slave Element (Src): specifies the slave address of the data to be read
- Number of Bytes: specifies the number of bytes to read from the slave device
- To Master Element (Dest): specifies the location where the slave data will be placed in the master PLC
- Success: specifies a bit that will turn on once the request is completed successfully
- Error: specifies a bit that will turn on if the instruction is not successfully completed

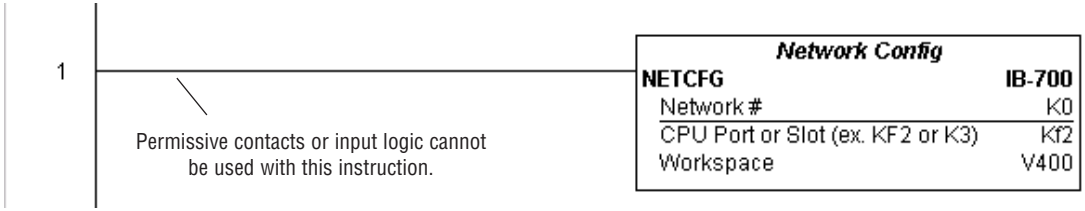
Parameter		DL06 Range
Network#	K	K0-255
Workspace	V	See DL06 V-memory map - Data Words
Slave ID	K, V	K0-90: See DL06 V-memory map
From Slave Element (Src)	X,Y,C,S,T,CT,GX,GY,V,P	See DL06 V-memory map
Number of Bytes	K	K1-128
To Master Element (Dest)	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map

NETRX Example

Rung 1: The Network Configuration IBox coordinates all of the interaction with other Network IBoxes (NETRX/NETWX). You must have a Network Configuration IBox for each serial port network, DCM module network, or original ECOM module network in your system. Configuration IBoxes must be at the top of your program and must execute every scan.

This IBox defines Network# K0 to be for the local CPU serial port #2 (KF2). For local CPU serial ports or DCM/ECOM modules, use the same value you would use in the most significant byte of the first LD instruction in a normal RX/WX rung to reference the port or module. Any NETRX or NETWX IBoxes that need to reference this specific network would enter K0 for their Network# parameter.

The Workspace register is used to maintain state information about the port or module, along with proper sharing and interlocking with the other NETRX and NETWX IBoxes in the program. This V-Memory register must not be used anywhere else in the entire program.



(example continued on next page)

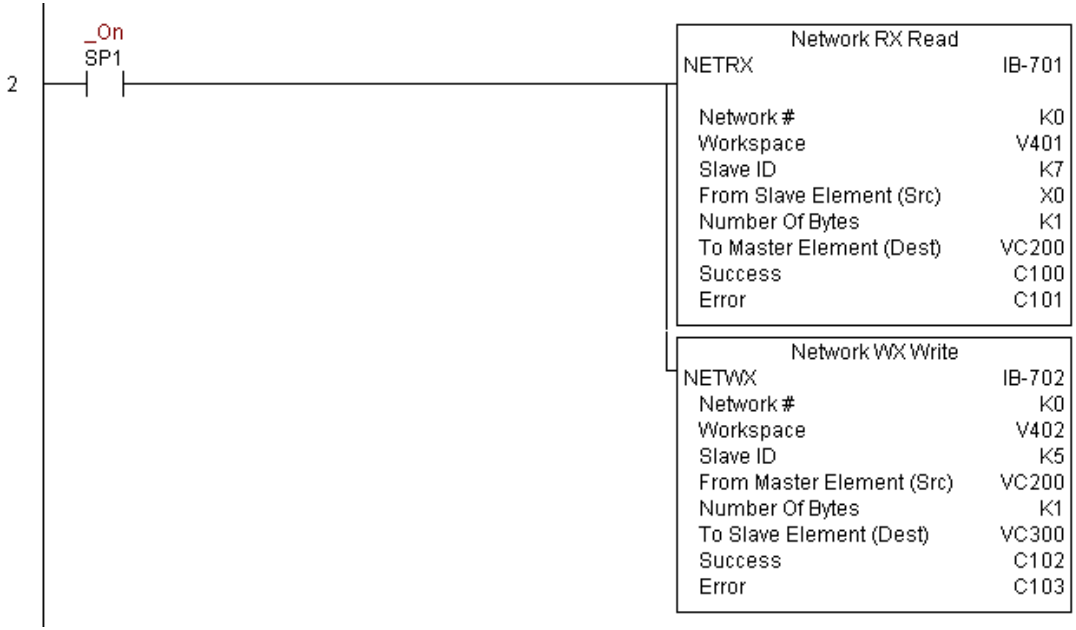
NETRX Example (cont'd)

Rung 2: Using Network# K0, read X0-X7 from Slave K7 and write them to slave K5 as fast as possible. Store them in this local PLC in C200-C207, and write them to C300-C307 in slave K5.

Both the NETRX and NETWX work with the Network Config IBox to simplify all networking by handling all of the interlocks and proper resource sharing. They also provide very simplified error reporting. You no longer need to worry about any SP "busy bits" or "error bits", or what port number or slot number a module is in, or have any counters or shift registers or any other interlocks for resource management.

In this example, SP1 (always ON) is driving both the NETRX and NETWX IBoxes in the same rung. On the scan that the Network Read completes, the Network Write will start that same scan. As soon as the Network Write completes, any pending operations below it in the program would get a turn. If there are no pending NETRX or NETWX IBoxes below this IBox, then the very next scan the NETRX would start its request again.

Using the NETRX and NETWX for all of your serial port, DCM, or original ECOM network reads and writes is the fastest the PLC can do networking. For ECOM100 modules, use the ECOM100 and ECRX/ECWX IBoxes.



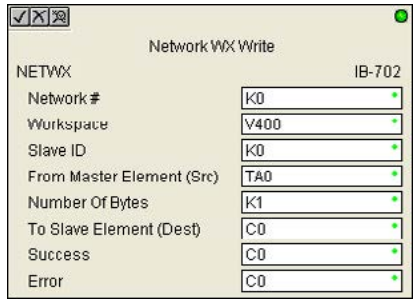
Network WX Write (NETWX) (IB-702)

DS	Used
HPP	N/A

Network WX Write performs the WX instruction with built-in interlocking with all other Network RX (NETRX) and Network WX (NETWX) IBoxes in your program to simplify communications networking. It will perform the WX on the specified Network #, which corresponds to a specific unique Network Configuration (NETCFG) at the top of your program.

The Workspace parameter is an internal, private register used by this IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.

Whenever this IBox has power, it will write data from the master's V-Memory buffer to the specified slave starting with the given slave element, giving other Network RX and Network WX IBoxes on that Network # a chance to execute.



For example, if you wish to read and write data continuously from 5 different slaves, you can have all of these NETRX and NETWX instructions in ONE RUNG driven by SP1 (Always On). They will execute round-robin style, automatically.

NETWX Parameters

- Network#: specifies the (CPU port's, DCM's, ECOM's) Network # defined by the NETCFG instruction
- Workspace: specifies a V-memory location that will be used by the instruction
- Slave ID: specifies the slave PLC that will be targeted by the NETWX instruction
- From Master Element (Src): specifies the location in the master PLC where the data will be sourced from
- Number of Bytes: specifies the number of bytes to write to the slave PLC
- To Slave Element (Dest): specifies the slave address the data will be written to
- Success: specifies a bit that will turn on once the request is completed successfully
- Error: specifies a bit that will turn on if the instruction is not successfully completed

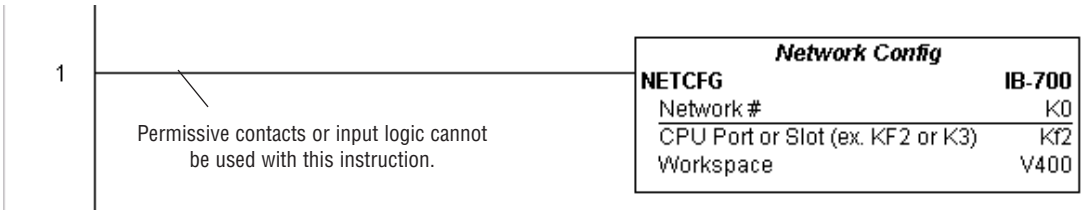
Parameter		DL06 Range
Network#	K	K0-255
Workspace	V	See DL06 V-memory map - Data Words
Slave ID	K,V	K0-90: See DL06 V-memory map
From Master Element (Src)	V	See DL06 V-memory map - Data Words
Number of Bytes	K	K1-128
To Slave Element (Dest)	X,Y,C,S,T,CT,GX,GY,V,P	See DL06 V-memory map
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map

NETWX Example

Rung 1: The Network Configuration IBox coordinates all of the interaction with other Network IBoxes (NETRX/NETWX). You must have a Network Configuration IBox for each serial port network, DCM module network, or original ECOM module network in your system. Configuration IBoxes must be at the top of your program and must execute every scan.

This IBox defines Network# K0 to be for the local CPU serial port #2 (KF2). For local CPU serial ports or DCM/ECOM modules, use the same value you would use in the most significant byte of the first LD instruction in a normal RX/WX rung to reference the port or module. Any NETRX or NETWX IBoxes that need to reference this specific network would enter K0 for their Network# parameter.

The Workspace register is used to maintain state information about the port or module, along with proper sharing and interlocking with the other NETRX and NETWX IBoxes in the program. This V-Memory register must not be used anywhere else in the entire program.



(example continued on next page)

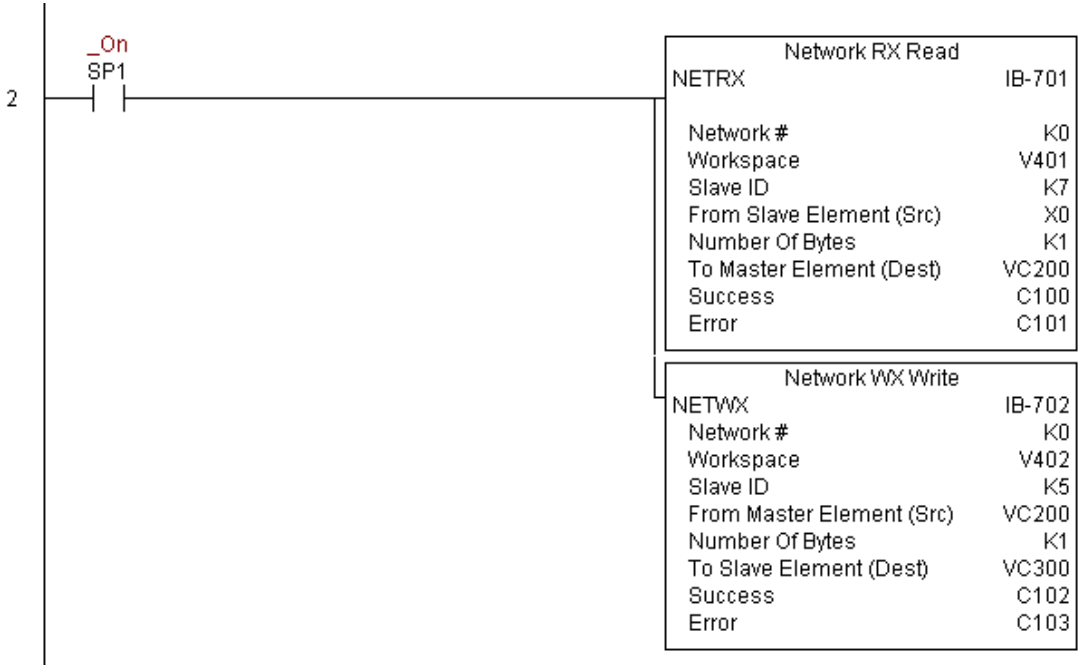
NETWX Example (cont'd)

Rung 2: Using Network# K0, read X0-X7 from Slave K7 and write them to slave K5 as fast as possible. Store them in this local PLC in C200-C207, and write them to C300-C307 in slave K5.

Both the NETRX and NETWX work with the Network Config IBox to simplify all networking by handling all of the interlocks and proper resource sharing. They also provide very simplified error reporting. You no longer need to worry about any SP "busy bits" or "error bits", or what port number or slot number a module is in, or have any counters or shift registers or any other interlocks for resource management.

In this example, SP1 (always ON) is driving both the NETRX and NETWX IBoxes in the same rung. On the scan that the Network Read completes, the Network Write will start that same scan. As soon as the Network Write completes, any pending operations below it in the program would get a turn. If there are no pending NETRX or NETWX IBoxes below this IBox, then the very next scan the NETRX would start its request again.

Using the NETRX and NETWX for all of your serial port, DCM, or original ECOM network reads and writes is the fastest the PLC can do networking. For ECOM100 modules, use the ECOM100 and ECRX/ECWX IBoxes.

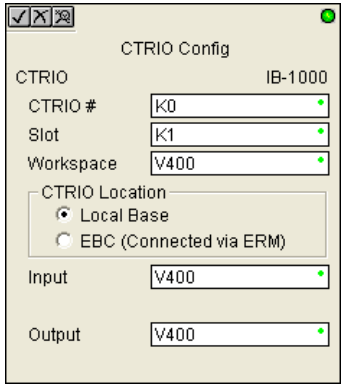


CTRIO Configuration (CTRIO) (IB-1000)

DS	Used
HPP	N/A

CTRIO Config defines all the common information for one specific CTRIO module which is used by the other CTRIO IBox instructions (for example, CTRLDPR - CTRIO Load Profile, CTREDRL - CTRIO Edit and Reload Preset Table, CTRRTLM - CTRIO Run to Limit Mode, ...).

The Input/Output parameters for this instruction can be copied directly from the CTRIO Workbench configuration for this CTRIO module. Since the behavior is slightly different when the CTRIO module is in an EBC Base via an ERM, you must specify whether the CTRIO module is in a local base or in an EBC base. The DL06 PLC only supports local base operation at this time.



You must have the CTRIO Config IBox at the top of your ladder/stage program along with any other configuration IBoxes.

If you have more than one CTRIO in your PLC, you must have a different CTRIO Config IBox for EACH CTRIO module in your system that utilizes any CTRIO IBox instructions. Each CTRIO Config IBox must have a UNIQUE CTRIO# value. This is how the CTRIO IBoxes differentiate between the different CTRIO modules in your system.

The Workspace parameter is an internal, private register used by the CTRIO Config IBox and MUST BE UNIQUE in this one instruction and MUST NOT be used anywhere else in your program.

Since this logic only executes on the first scan, this IBox cannot have any input logic.

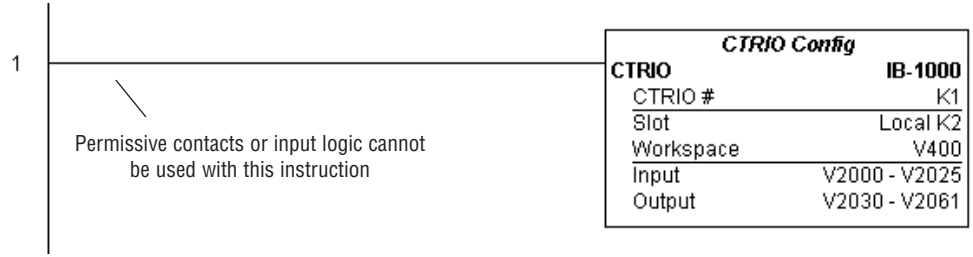
CTRIO Parameters

- CTRIO#: specifies a specific CTRIO module based on a user defined number
- Slot: specifies which PLC option slot the CTRIO module occupies
- Workspace: specifies a V-memory location that will be used by the instruction
- CTRIO Location: specifies where the module is located (local base only for DL06)
- Input: This needs to be set to the same V-memory register as is specified in CTRIO Workbench as 'Starting V address for inputs' for this unique CTRIO.
- Output: This needs to be set to the same V-memory register as is specified in CTRIO Workbench as 'Starting V address for outputs' for this unique CTRIO.

Parameter		DL06 Range
CTRIO#	K	K0-255
Slot	K	K1-4
Workspace	V	See DL06 V-memory map - Data Words
Input	V	See DL06 V-memory map - Data Words
Output	V	See DL06 V-memory map - Data Words

CTRIO Example

Rung 1: This sets up the CTRIO card in slot 2 of the local base. Each CTRIO in the system will need a separate CTRIO I-box before any CTRxxxx I-boxes can be used for them. The CTRIO has been configured to use V2000 through V2025 for its input data, and V2030 through V2061 for its output data.



CTRIO Add Entry to End of Preset Table (CTRADPT) (IB-1005)

DS	Used
HPP	N/A

CTRIO Add Entry to End of Preset Table, on a leading edge transition to this IBox, will append an entry to the end of a memory based Preset Table on a specific CTRIO Output resource. This IBox will take more than 1 PLC scan to execute. Either the Success or Error bit will turn on when the command is complete. If the Error Bit is on, you can use the CTRIO Read Error Code (CTRRDER) IBox to get extended error information.

Entry Type:

K0: Set

K1: Reset

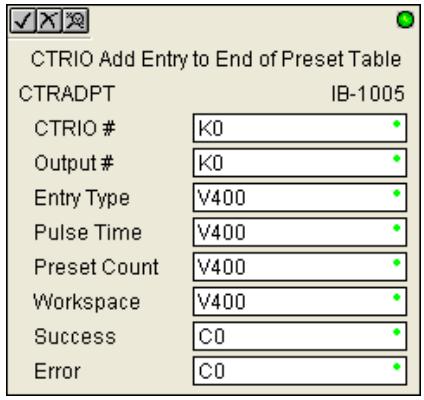
K2: Pulse On (uses Pulse Time)

K3: Pulse Off (uses Pulse Time)

K4: Toggle

K5: Reset Count

Note that the Pulse Time parameter is ignored by some Entry Types.



The Workspace register is for internal use by this IBox instruction and MUST NOT be used anywhere else in your program.

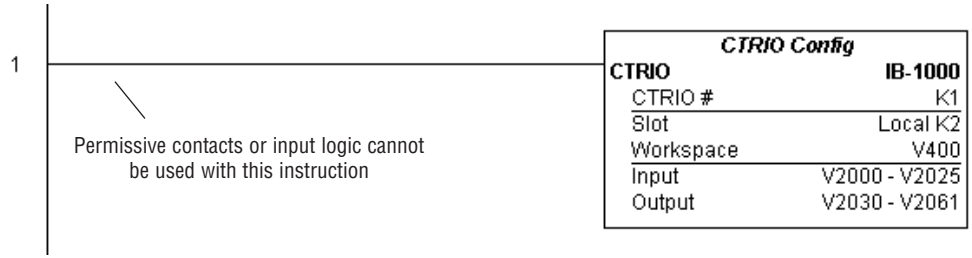
CTRAPT Parameters

- CTRIO#: specifies a specific CTRIO module based on a user defined number (see CTRIO Config)
- Output#: specifies a CTRIO output to be used by the instruction
- Entry Type: specifies the Entry Type to be added to the end of a Preset Table
- Pulse Time: specifies a pulse time for the Pulse On and Pulse Off Entry Types
- Preset Count: specifies an initial count value to begin at after Reset
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the instruction has successfully completed
- Error: specifies a bit that will turn on if the instruction does not complete successfully

Parameter		DL06 Range
CTRIO#	K	K0-255
Output#	K	K0-3
Entry Type	V,K	K0-5; See DL06 V-memory map - Data Words
Pulse Time	V,K	K0-65535; See DL06 V-memory map - Data Words
Preset Count	V,K	K0-2147434528; See DL06 V-memory map
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map

CTRADPT Example

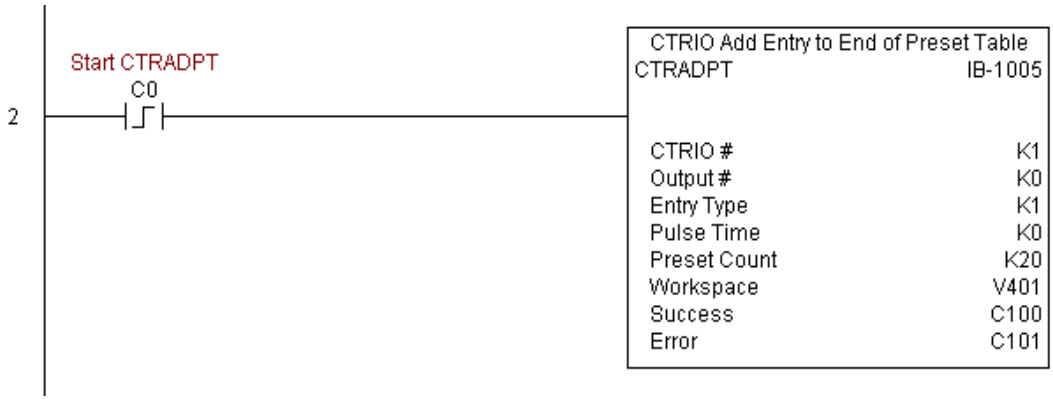
Rung 1: This sets up the CTRIO card in slot 2 of the local base. Each CTRIO in the system will need a separate CTRIO I-box before any CTRxxxx I-boxes can be used for them. The CTRIO has been configured to use V2000 through V2025 for its input data, and V2030 through V2061 for its output data.



Rung 2: This rung is a sample method for enabling the CTRADPT command. A C-bit is used to allow the programmer to control the command from Data View for testing purposes.

Turning on C0 will cause the CTRADPT instruction to add a new preset to the preset table for output #0 on the CTRIO in slot 2. The new preset will be a command to RESET (entry type K1=reset), pulse time is left at zero as the reset type does not use this, and the count at which it will reset will be 20.

Operating procedure for this example code is to load the CTRADPT_ex1.cwb file to your CTRIO, then enter the code shown here, change to RUN mode, enable output #0 by turning on C2 in Data View, turn encoder on CTRIO to value above 10 and output #0 light will come on and stay on for all counts past 10. Now reset the counter with C1, enable C0 to execute CTRADPT command to add a reset for output #0 at a count of 20, turn on C2 to enable output #0, then turn encoder to value of 10+ (output #0 should turn on) and then continue on to count of 20+ (output #0 should turn off).

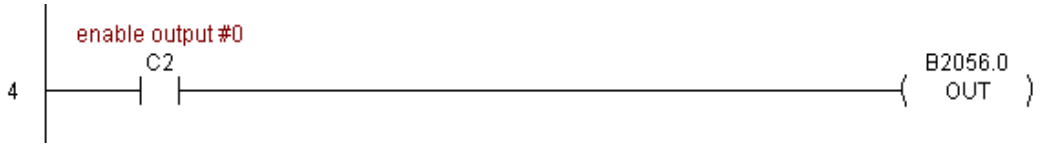


(example continued on next page)

CTRADPT Example (cont'd)

Rung 3: This rung allows the programmer to reset the counter from the ladder logic.

Rung 4: This rung allows the operator to enable output #0 from the ladder code.

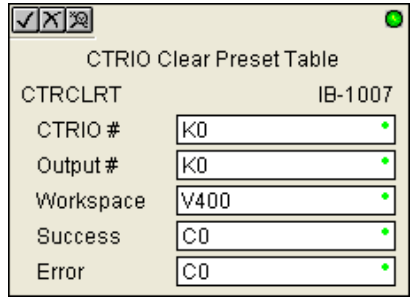


CTRIO Clear Preset Table (CTRCLRT) (IB-1007)

DS	Used
HPP	N/A

CTRIO Clear Preset Table will clear the RAM based Preset Table on a leading edge transition to this IBox. This IBox will take more than 1 PLC scan to execute. Either the Success or Error bit will turn on when the command is complete. If the Error Bit is on, you can use the CTRIO Read Error Code (CTRRDER) IBox to get extended error information.

The Workspace register is for internal use by this IBox instruction and MUST NOT be used anywhere else in your program.



CTRCLRT Parameters

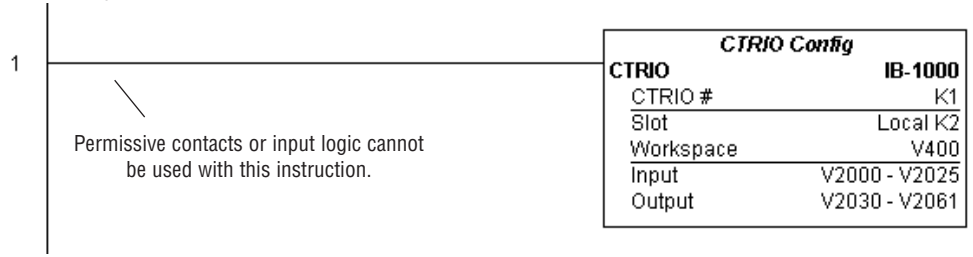
- CTRIO#: specifies a specific CTRIO module based on a user defined number (see CTRIO Config)
- Output#: specifies a CTRIO output to be used by the instruction
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the instruction has successfully completed
- Error: specifies a bit that will turn on if the instruction does not complete successfully

Parameter		DL06 Range
CTRIO#	K	K0-255
Output#	K	K0-3
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map

•

CTRCLRT Example

Rung 1: This sets up the CTRIO card in slot 2 of the local base. Each CTRIO in the system will need a separate CTRIO I-box before any CTRxxxx I-boxes can be used for them. The CTRIO has been configured to use V2000 through V2025 for its input data, and V2030 through V2061 for its output data.



Rung 2: This rung is a sample method for enabling the CTRCLRT command. A C-bit is used to allow the programmer to control the command from Data View for testing purposes.

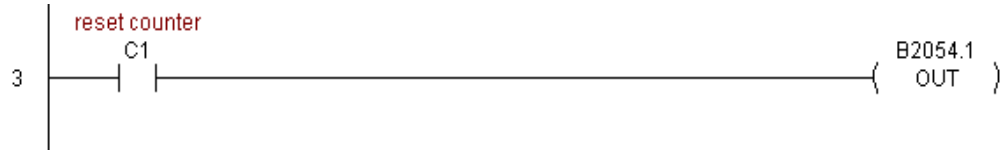
Turning on C0 will cause the CTRCLRT instruction to clear the preset table for output #0 on the CTRIO in slot 2.

Operating procedure for this example code is to load the CTRCLRT_ex1.cwb file to your CTRIO, then enter the code shown here, change to RUN mode, enable output #0 by turning on C2 in Data View, turn encoder on CTRIO to value above 10 and output #0 light will come on and stay on until a count of 20 is reached, where it will turn off. Now reset the counter with C1, enable C0 to execute CTRCLRT command to clear the preset table, turn on C2 to enable output #0, then turn encoder to value of 10+ (output #0 should NOT turn on).

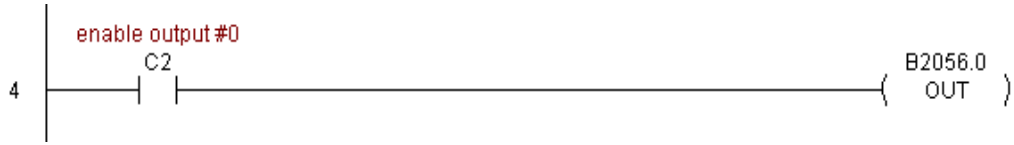
(example continued on next page)

CTRCLRT Example (cont'd)

Rung 3: This rung allows the programmer to reset the counter from the ladder logic.



Rung 4: This rung allows the operator to enable output #0 from the ladder code.



CTRIO Edit Preset Table Entry (CTREDPT) (IB-1003)

DS	Used
HPP	N/A

CTRIO Edit Preset Table Entry, on a leading edge transition to this IBox, will edit a single entry in a Preset Table on a specific CTRIO Output resource. This IBox is good if you are editing more than one entry in a file at a time. If you wish to do just one edit and then reload the table immediately, see the CTRIO Edit and Reload Preset Table Entry (CTREDRL) IBox. This IBox will take more than 1 PLC scan to execute. Either the Success or Error bit will turn on when the command is complete. If the Error Bit is on, you can use the CTRIO Read Error Code (CTRRDER) IBox to get extended error information.

Entry Type:

K0: Set

K1: Reset

K2: Pulse On (uses Pulse Time)

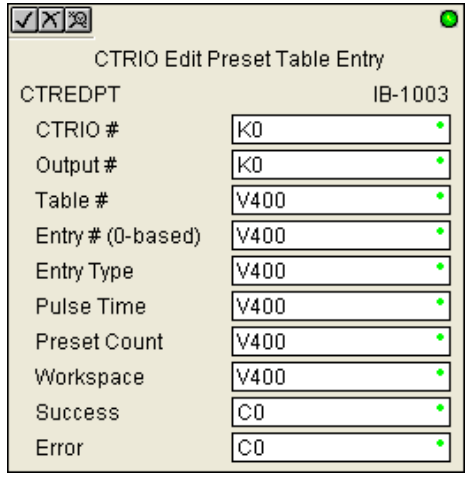
K3: Pulse Off (uses Pulse Time)

K4: Toggle

K5: Reset Count

Note that the Pulse Time parameter is ignore by some Entry Types.

The Workspace register is for internal use b this IBox instruction and MUST NOT be use anywhere else in your program.



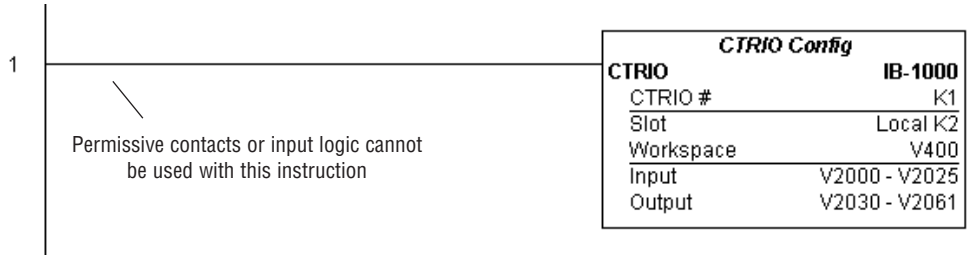
CTREDPT Parameters

- CTRIO#: specifies a specific CTRIO module based on a user defined number (see CTRIO Config Ibox)
- Output#: specifies a CTRIO output to be used by the instruction
- Table#: specifies the Table number of which an Entry is to be edited
- Entry#: specifies the Entry location in the Preset Table to be edited
- Entry Type: specifies the Entry Type to add during the edit
- Pulse Time: specifies a pulse time for the Pulse On and Pulse Off Entry Types
- Preset Count: specifies an initial count value to begin at after Reset
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the instruction has successfully completed
- Error: specifies a bit that will turn on if the instruction does not complete successfully
-

Parameter		DL06 Range
CTRIO#	K	K0-255
Output#	K	K0-3
Table#	V,K	K0-255; See DL06 V-memory map - Data Words
Entry#	V,K	K0-255; See DL06 V-memory map - Data Words
Entry Type	V,K	K0-5; See DL06 V-memory map - Data Words
Pulse Time	V,K	K0-65535; See DL06 V-memory map - Data Words
Preset Count	V,K	K0-2147434528; See DL06 V-memory map
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map

CTREDPT Example

Rung 1: This sets up the CTRIO card in slot 2 of the local base. Each CTRIO in the system will need a separate CTRIO I-box before any CTRxxxx I-boxes can be used for them. The CTRIO has been configured to use V2000 through V2025 for its input data, and V2030 through V2061 for its output data.



(example continued on next page)

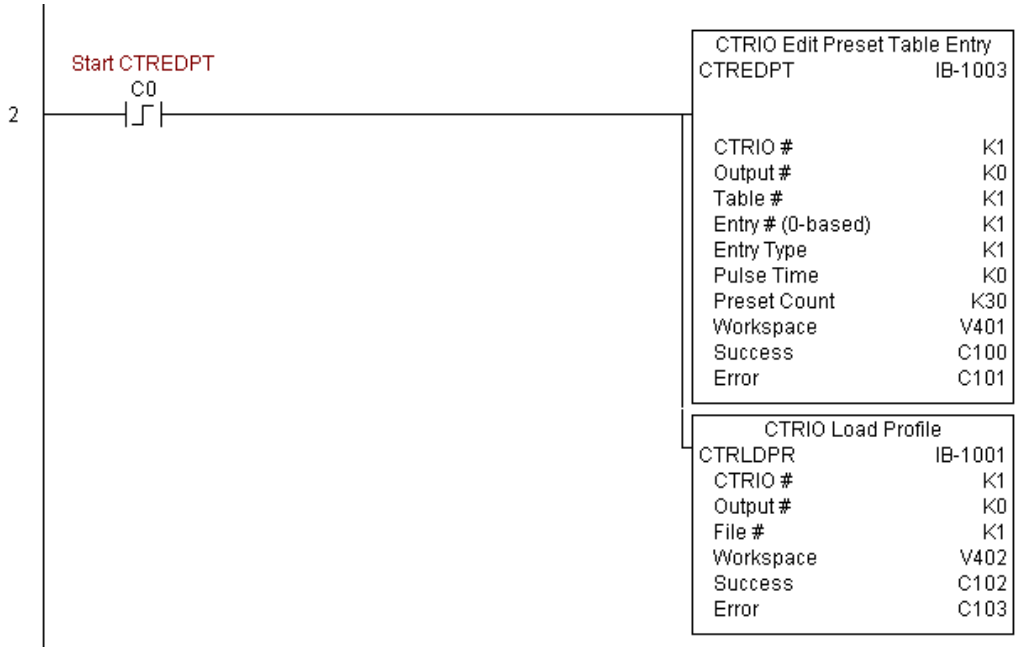
CTREDPT Example (cont'd)

Rung 2: This rung is a sample method for enabling the CTREDPT command. A C-bit is used to allow the programmer to control the command from Data View for testing purposes.

Turning on C0 will cause the CTREDPT instruction to change the second preset from a reset at a count of 20 to a reset at a count of 30 for output #0 on the CTRIO in slot 2.

Operating procedure for this example code is to load the CTREDPT_ex1.cwb file to your CTRIO, then enter the code shown here, change to RUN mode, enable output #0 by turning on C2 in Data View, turn encoder on CTRIO to value above 10 and output #0 light will come on and stay on until a count of 20 is reached, where it will turn off. Now reset the counter with C1, enable C0 to execute CTREDPT command to change the second preset, turn on C2 to enable output #0, then turn encoder to value of 10+ (output #0 should turn on) and then continue past a count of 30 (output #0 should turn off).

Note that we must also reload the profile after changing the preset(s), this is why the CTRLDPR command follows the CTREDPT command in this example.



(example continued on next page)

CTREDPT Example (cont'd)

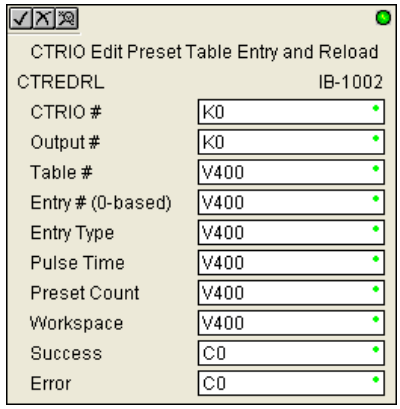
Rung 3: This rung allows the programmer to reset the counter from the ladder logic.

Rung 4: This rung allows the operator to enable output #0 from the ladder code.

CTRIO Edit Preset Table Entry and Reload (CTREDRL) (IB-1002)

DS	Used
HPP	N/A

CTRIO Edit Preset Table Entry and Reload, on a leading edge transition to this IBox, will perform this dual operation to a CTRIO Output resource in one CTRIO command. This IBox will take more than 1 PLC scan to execute. Either the Success or Error bit will turn on when the command is complete. If the Error Bit is on, you can use the CTRIO Read Error Code (CTRRDER) IBox to get extended error information.



Entry Type:

K0: Set

K1: Reset

K2: Pulse On (uses Pulse Time)

K3: Pulse Off (uses Pulse Time)

K4: Toggle

K5: Reset Count

Note that the Pulse Time parameter is ignored by some Entry Types.

The Workspace register is for internal use by this IBox instruction and MUST NOT be used anywhere else in your program.

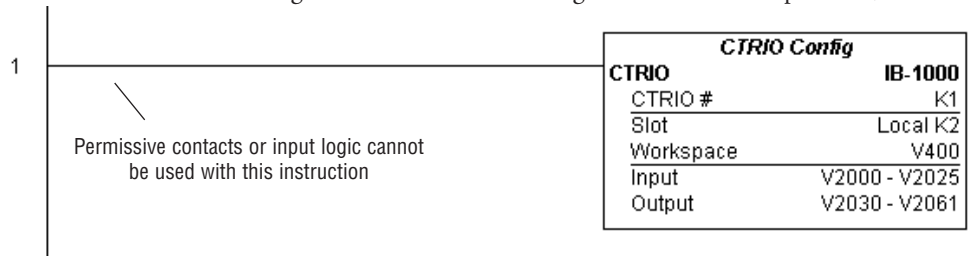
CTREDRL Parameters

- CTRIO#: specifies a specific CTRIO module based on a user defined number (see CTRIO Config Ibox)
- Output#: specifies a CTRIO output to be used by the instruction
- Table#: specifies the Table number of which an Entry is to be edited
- Entry#: specifies the Entry location in the Preset Table to be edited
- Entry Type: specifies the Entry Type to add during the edit
- Pulse Time: specifies a pulse time for the Pulse On and Pulse Off Entry Types
- Preset Count: specifies an initial count value to begin at after Reset
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the instruction has successfully completed
- Error: specifies a bit that will turn on if the instruction does not complete successfully
-

Parameter		DL06 Range
CTRIO#	K	K0-255
Output#	K	K0-3
Table#	V,K	K0-255; See DL06 V-memory map - Data Words
Entry#	V,K	K0-255; See DL06 V-memory map - Data Words
Entry Type	V,K	K0-5; See DL06 V-memory map - Data Words
Pulse Time	V,K	K0-65535; See DL06 V-memory map - Data Words
Preset Count	V,K	K0-2147434528; See DL06 V-memory map
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map

CTREDRL Example

Rung 1: This sets up the CTRIO card in slot 2 of the local base. Each CTRIO in the system will need a separate CTRIO I-box before any CTRxxxx I-boxes can be used for them. The CTRIO has been configured to use V2000 through V2025 for its input data, and V2030



through V2061 for its output data.

(example continued on next page)

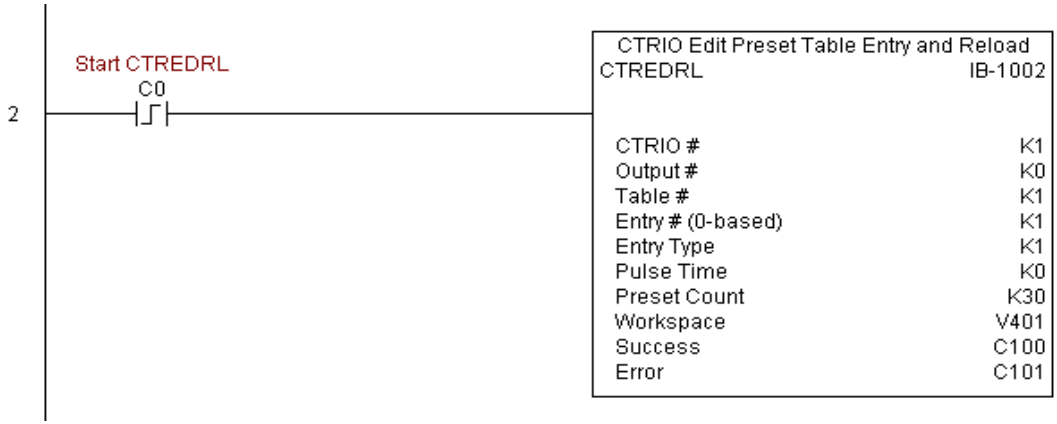
CTREDRL Example (cont'd)

Rung 2: This rung is a sample method for enabling the CTREDRL command. A C-bit is used to allow the programmer to control the command from Data View for testing purposes.

Turning on C0 will cause the CTREDRL instruction to change the second preset in file 1 from a reset at a value of 20 to a reset at a value of 30.

Operating procedure for this example code is to load the CTREDRL_ex1.cwb file to your CTRIO, then enter the code shown here, change to RUN mode, enable output #0 by turning on C2 in Data View, turn encoder on CTRIO to value above 10 and output #0 light will come on, continue to a count above 20 and the output #0 light will turn off. Now reset the counter with C1, enable C0 to execute CTREDRL command to change the second preset count value to 30, then turn encoder to value of 10+ (output #0 should turn on) and continue on to a value of 30+ and the output #0 light will turn off.

Note that it is not necessary to reload this file separately, however, the command can only change one value at a time.



(example continued on next page)

CTREDRL Example (cont'd)

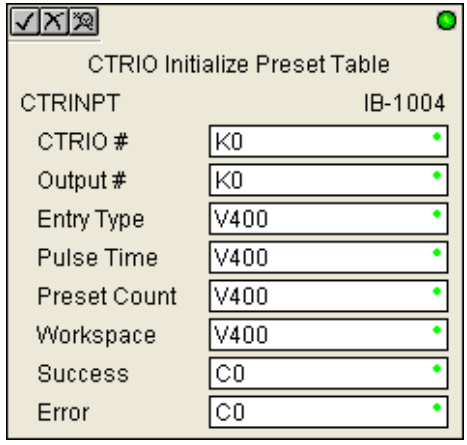
Rung 3: This rung allows the programmer to reset the counter from the ladder logic.

Rung 4: This rung allows the operator to enable output #0 from the ladder code.

CTRIO Initialize Preset Table (CTRINPT) (IB-1004)

DS	Used
HPP	N/A

CTRIO Initialize Preset Table, on a leading edge transition to this IBox, will create a single entry Preset Table in memory but not as a file, on a specific CTRIO Output resource. This IBox will take more than 1 PLC scan to execute. Either the Success or Error bit will turn on when the command is complete. If the Error Bit is on, you can use the CTRIO Read Error Code (CTRRDER) IBox to get extended error information.



Entry Type:

K0: Set

K1: Reset

K2: Pulse On (uses Pulse Time)

K3: Pulse Off (uses Pulse Time)

K4: Toggle

K5: Reset Count

Note that the Pulse Time parameter is ignored by some Entry Types.

The Workspace register is for internal use by this IBox instruction and MUST NOT be used anywhere else in your program.

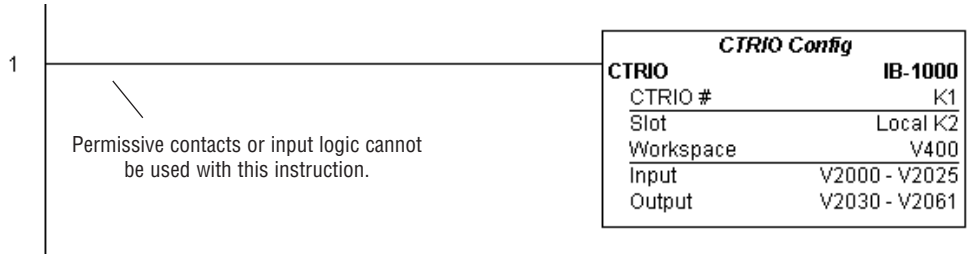
CTRINPT Parameters

- CTRIO#: specifies a specific CTRIO module based on a user defined number (see CTRIO Config Ibox)
- Output#: specifies a CTRIO output to be used by the instruction
- Entry Type: specifies the Entry Type to add during the edit
- Pulse Time: specifies a pulse time for the Pulse On and Pulse Off Entry Types
- Preset Count: specifies an initial count value to begin at after Reset
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the instruction has successfully completed
- Error: specifies a bit that will turn on if the instruction does not complete successfully
-

Parameter		DL06 Range
CTRIO#	K	K0-255
Output#	K	K0-3
Entry Type	V,K	K0-5; See DL06 V-memory map - Data Words
Pulse Time	V,K	K0-65535; See DL06 V-memory map - Data Words
Preset Count	V,K	K0-2147434528; See DL06 V-memory map
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map

CTRINPT Example

Rung 1: This sets up the CTRIO card in slot 2 of the local base. Each CTRIO in the system will need a separate CTRIO I-box before any CTRxxxx I-boxes can be used for them. The CTRIO has been configured to use V2000 through V2025 for its input data, and V2030 through V2061 for its output data.



(example continued on next page)

CTRINPT Example (cont'd)

Rung 2: This rung is a sample method for enabling the CTRINPT command. A C-bit is used to allow the programmer to control the command from Data View for testing purposes.

Turning on C0 will cause the CTRINPT instruction to create a single entry preset table, but not as a file, and use it for the output #0. In this case the single preset will be a set at a count of 15 for output #0.

Operating procedure for this example code is to load the CTRINPT_ex1.cwb file to your CTRIO, then enter the code shown here, change to RUN mode, enable output #0 by turning on C2 in Data View, turn encoder on CTRIO to value above 15 and output #0 light will not come on. Now reset the counter with C1, enable C0 to execute CTRINPT command to create a single preset table with a preset to set output #0 at a count of 15, then turn encoder to value of 15+ (output #0 should turn on).

(example continued on next page)

CTRINPT Example (cont'd)

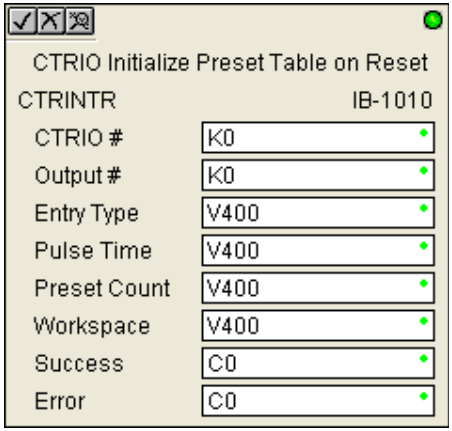
Rung 3: This rung allows the programmer to reset the counter from the ladder logic.

Rung 4: This rung allows the operator to enable output #0 from the ladder code.

CTRIO Initialize Preset Table (CTRINTR) (IB-1010)

DS	Used
HPP	N/A

CTRIO Initialize Preset Table, on a leading edge transition to this IBox, will create a single entry Preset Table in memory but not as a file, on a specific CTRIO Output resource.This IBox will take more than 1 PLC scan to execute. Either the Success or Error bit will turn on when the command is complete. If the Error Bit is on, you can use the CTRIO Read Error Code (CTRRDER) IBox to get extended error information.



Entry Type:

K0: Set

K1: Reset

K2: Pulse On (uses Pulse Time)

K3: Pulse Off (uses Pulse Time)

K4: Toggle

K5: Reset Count

Note that the Pulse Time parameter is ignored by some Entry Types.

The Workspace register is for internal use by this IBox instruction and MUST NOT be used anywhere else in your program.

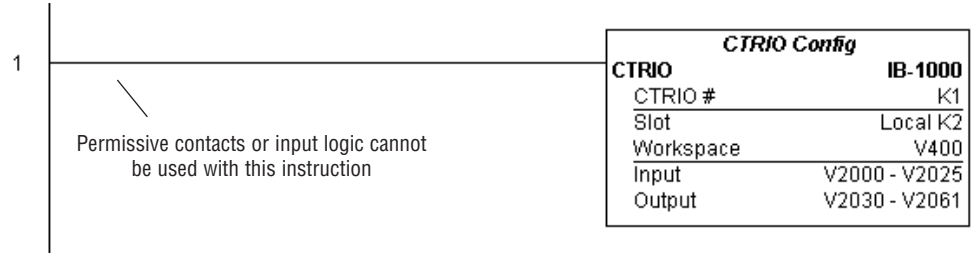
CTRINTR Parameters

- CTRIO#: specifies a specific CTRIO module based on a user defined number (see CTRIO Config Ibox)
- Output#: specifies a CTRIO output to be used by the instruction
- Entry Type: specifies the Entry Type to add during the edit
- Pulse Time: specifies a pulse time for the Pulse On and Pulse Off Entry Types
- Preset Count: specifies an initial count value to begin at after Reset
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the instruction has successfully completed
- Error: specifies a bit that will turn on if the instruction does not complete successfully

Parameter		DL06 Range
CTRIO#	K	K0-255
Output#	K	K0-3
Entry Type	V,K	K0-5; See DL06 V-memory map - Data Words
Pulse Time	V,K	K0-65535; See DL06 V-memory map - Data Words
Preset Count	V,K	K0-2147434528; See DL06 V-memory map
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map

CTRINTR Example

Rung 1: This sets up the CTRIO card in slot 2 of the local base. Each CTRIO in the system will need a separate CTRIO I-box before any CTRxxxx I-boxes can be used for them. The CTRIO has been configured to use V2000 through V2025 for its input data, and V2030 through V2061 for its output data.



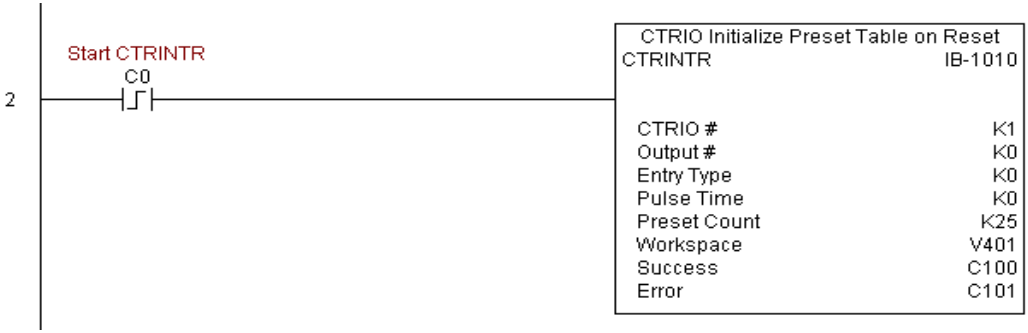
(example continued on next page)

CTRINTR Example (cont'd)

Rung 2: This rung is a sample method for enabling the CTRINTR command. A C-bit is used to allow the programmer to control the command from Data View for testing purposes.

Turning on C0 will cause the CTRINTR instruction to create a single entry preset table, but not as a file, and use it for output #0, the new preset will be loaded when the current count is reset. In this case the single preset will be a set at a count of 25 for output #0.

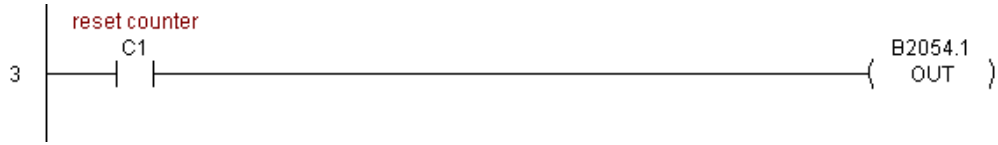
Operating procedure for this example code is to load the CTRINTR_ex1.cwb file to your CTRIO, then enter the code shown here, change to RUN mode, enable output #0 by turning on C2 in Data View, turn encoder on CTRIO to value above 10 and output #0 light will come on. Now turn on C0 to execute the CTRINTR command, reset the counter with C1, then turn encoder to value of 25+ (output #0 should turn on).



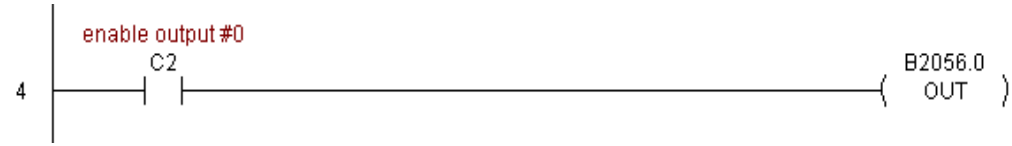
(example continued on next page)

CTRINTR Example (cont'd)

Rung 3: This rung allows the programmer to reset the counter from the ladder logic.



Rung 4: This rung allows the operator to enable output #0 from the ladder code.

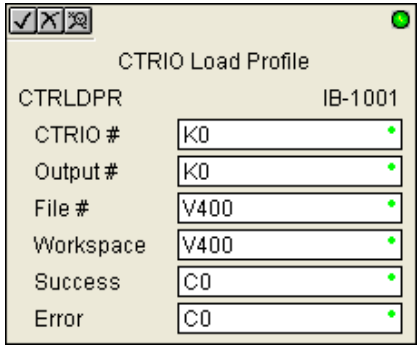


CTRIO Load Profile (CTRLDPR) (IB-1001)

DS	Used
HPP	N/A

CTRIO Load Profile loads a CTRIO Profile File to a CTRIO Output resource on a leading edge transition to this IBox. This IBox will take more than 1 PLC scan to execute. Either the Success or Error bit will turn on when the command is complete. If the Error Bit is on, you can use the CTRIO Read Error Code (CTRRDER) IBox to get extended error information.

The Workspace register is for internal use by this IBox instruction and MUST NOT be used anywhere else in your program.



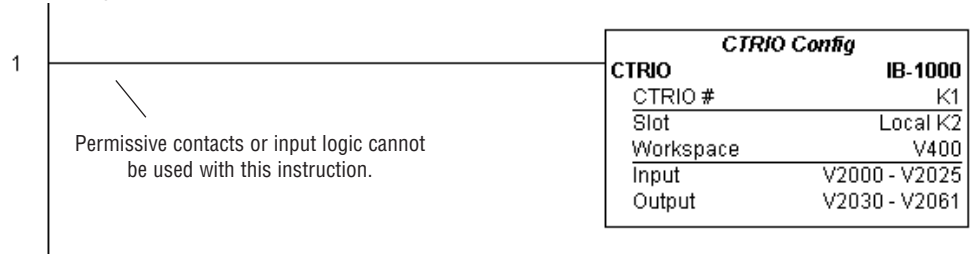
CTRLDPR Parameters

- CTRIO#: specifies a specific CTRIO module based on a user defined number (see CTRIO Config)
- Output#: specifies a CTRIO output to be used by the instruction
- File#: specifies a CTRIO profile File number to be loaded
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the instruction has successfully completed
- Error: specifies a bit that will turn on if the instruction does not complete successfully

Parameter		DL06 Range
CTRIO#	K	K0-255
Output#	K	K0-3
File#	V,K	K0-255; See DL06 V-memory map - Data Words
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map

CTRLDPR Example

Rung 1: This sets up the CTRIO card in slot 2 of the local base. Each CTRIO in the system will need a separate CTRIO I-box before any CTRxxxx I-boxes can be used for them. The CTRIO has been configured to use V2000 through V2025 for its input data, and V2030 through V2061 for its output data.



Rung 2: This CTRIO Load Profile IBox will load File #1 into the working memory of Output 0 in CTRIO #1. This example program requires that you load CTRLDPR_IBox.cwb into your Hx-CTRIO(2) module.

(example continued on next page)

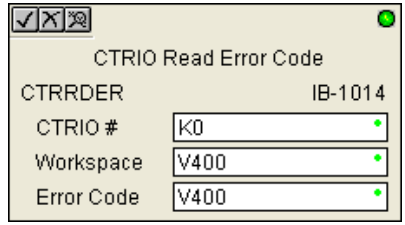
CTRLDPR Example (cont'd)

Rung 3: If the file is successfully loaded, set Profile_Loaded.

CTRIO Read Error (CTRRDER) (IB-1014)

DS	Used
HPP	N/A

CTRIO Read Error Code will get the decimal error code value from the CTRIO module (listed below) and place it into the given Error Code register, on a leading edge transition to the IBox



Since the Error Code in the CTRIO is only maintained until another CTRIO command is given, you must use this instruction immediately after the CTRIO IBox that reports an error via its Error bit parameter.

The Workspace register is for internal use by this IBox instruction and MUST NOT be used anywhere else in your program.

Error Codes:

0: No Error

100: Specified command code is unknown or unsupported

101: File number not found in the file system

102: File type is incorrect for specified output function

103: Profile type is unknown

104: Specified input is not configured as a limit on this output

105: Specified limit input edge is out of range

106: Specified input function is un configured or invalid

107: Specified input function number is out of range

108: Specified preset function is invalid

109: Preset table is full

110: Specified Table entry is out of range

111: Specified register number is out of range

112: Specified register is an unconfigured input or output

2001: Error reading Error Code - cannot access CTRIO via ERM

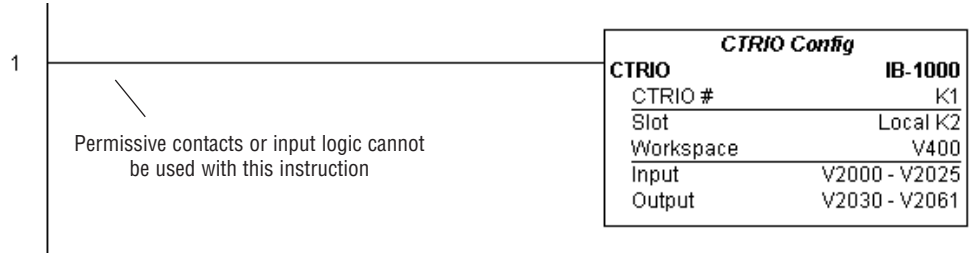
CTRRDER Parameters

- CTRIO#: specifies a specific CTRIO module based on a user defined number (see CTRIO Config)
- Workspace: specifies a V-memory location that will be used by the instruction
- Error Code: specifies the location where the Error Code will be written

Parameter		DL06 Range
CTRIO#	K	K0-255
Workspace	V	See DL06 V-memory map - Data Words
Error Code	V	See DL06 V-memory map - Data Words

CTRRDER Example

Rung 1: This sets up the CTRIO card in slot 2 of the local base. Each CTRIO in the system will need a separate CTRIO I-box before any CTRxxxx I-boxes can be used for them. The CTRIO has been configured to use V2000 through V2025 for its input data, and V2030 through V2061 for its output data.



Rung 2: This CTRIO Read Error Code IBox will read the Extended Error information from CTRIO #1. This example program requires that you load CTRRDER_IBox.cwb into your Hx-CTRIO(2) module.

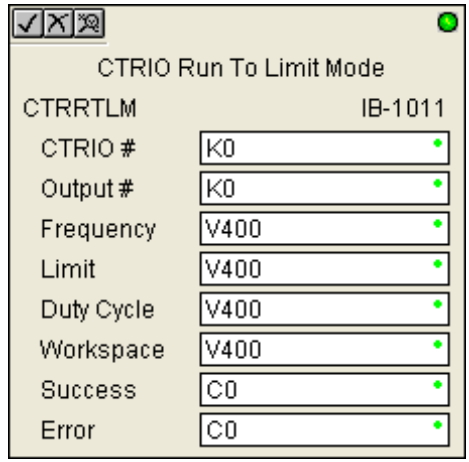
CTRIO Run to Limit Mode (CTRRTLM) (IB-1011)

DS	Used
HPP	N/A

CTRIO Run To Limit Mode, on a leading edge transition to this IBox, loads the Run to Limit command and given parameters on a specific Output resource. The CTRIO's Input(s) must be configured as Limit(s) for this function to work.

Valid Hexadecimal Limit Values:

K00 - Rising Edge of Ch1/C
K10 - Falling Edge of Ch1/C
K20 - Both Edges of Ch1/C
K01 - Rising Edge of Ch1/D
K11 - Falling Edge of Ch1/D
K21 - Both Edges of Ch1/D
K02 - Rising Edge of Ch2/C
K12 - Falling Edge of Ch2/C
K22 - Both Edges of Ch2/C
K03 - Rising Edge of Ch2/D
K13 - Falling Edge of Ch2/D
K23 - Both Edges of Ch2/D



This IBox will take more than 1 PLC scan to execute. Either the Success or Error bit will turn on when the command is complete. If the Error Bit is on, you can use the CTRIO Read Error Code (CTRRDER) IBox to get extended error information.

The Workspace register is for internal use by this IBox instruction and MUST NOT be used anywhere else in your program.

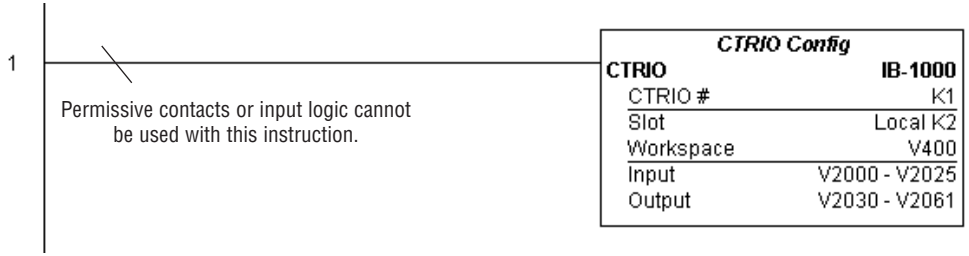
CTRRTLM Parameters

- CTRIO#: specifies a specific CTRIO module based on a user defined number (see CTRIO Config Ibox)
- Output#: specifies a CTRIO output to be used by the instruction
- Frequency: specifies the output pulse rate (H0-CTRIO: 20Hz - 25KHz / H0-CTRIO2: 20Hz - 250 KHz)
- Limit: the CTRIO's Input(s) must be configured as Limit(s) for this function to operate
- Duty Cycle: specifies the % of on time versus off time. This is a hex number. Default of 0 is 50%, also entering 50 will yield 50%. 50% duty cycle is defined as on half the time and off half the time
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the instruction has successfully completed
- Error: specifies a bit that will turn on if the instruction does not complete successfully

Parameter		DL06 Range
CTRIO#	K	K0-255
Output#	K	K0-3
Frequency	V,K	K20-20000; See DL06 V-memory map - Data Words
Limit	V,K	K0-FF; See DL06 V-memory map - Data Words
Duty Cycle	V,K	K0-99; See DL06 V-memory map - Data Words
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map

CTRRTLM Example

Rung 1: This sets up the CTRIO card in slot 2 of the local base. Each CTRIO in the system will need a separate CTRIO I-box before any CTRxxxx I-boxes can be used for them. The CTRIO has been configured to use V2000 through V2025 for its input data, and V2030 through V2061 for its output data.



Rung 2: This CTRIO Run To Limit Mode IBox sets up Output #0 in CTRIO #1 to output pulses at a Frequency of 1000 Hz until Llimit #0 comes on. This example program requires that you load CTRRTLM_IBox.cwb into your Hx-CTRIO(2) module.

(example continued on next page)

CTRRTLM Example (cont'd)

Rung 3: If the Run To Limit Mode parameters are OK, set the Direction Bit and Enable the output.

CTRIO Run to Position Mode (CTRRTPM) (IB-1012)

DS	Used
HPP	N/A

CTRIO Run To Position Mode, on a leading edge transition to this IBox, loads the Run to Position command and given parameters on a specific Output resource.

Valid Function Values are:

00: Less Than Ch1/Fn1

10: Greater Than Ch1/Fn1

01: Less Than Ch1/Fn2

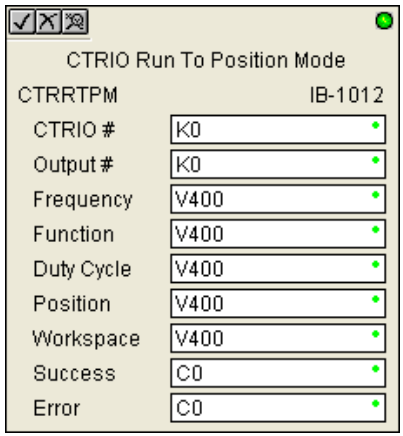
11: Greater Than Ch1/Fn2

02: Less Than Ch2/Fn1

12: Greater Than Ch2/Fn1

03: Less Than Ch2/Fn2

13: Greater Than Ch2/Fn2



This IBox will take more than 1 PLC scan to execute. Either the Success or Error bit will turn on when the command is complete. If the Error Bit is on, you can use the CTRIO Read Error Code (CTRRDER) IBox to get extended error information.

The Workspace register is for internal use by this IBox instruction and MUST NOT be used anywhere else in your program.

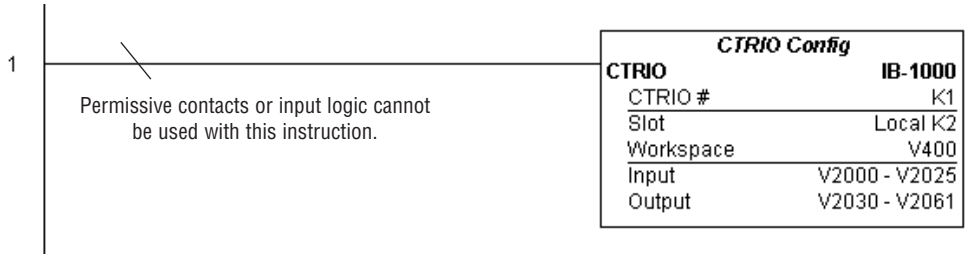
CTRRTPM Parameters

- CTRIO#: specifies a specific CTRIO module based on a user defined number (see CTRIO Config Ibox)
- Output#: specifies a CTRIO output to be used by the instruction
- Frequency: specifies the output pulse rate (H0-CTRIO: 20Hz - 25KHz / H0-CTRIO2: 20Hz - 250 KHz)
- Duty Cycle: specifies the % of on time versus off time. This is a hex number. Default of 0 is 50%, also entering 50 will yield 50%. 50% duty cycle is defined as on half the time and off half the time
- Position: specifies the count value, as measured on the encoder input, at which the output pulse train will be turned off
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the instruction has successfully completed
- Error: specifies a bit that will turn on if the instruction does not complete successfully

Parameter		DL06 Range
CTRIO#	K	K0-255
Output#	K	K0-3
Frequency	V,K	K20-20000; See DL06 V-memory map - Data Words
Duty Cycle	V,K	K0-99; See DL06 V-memory map
Position	V,K	K0-2147434528; See DL06 V-memory map
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map

CTRRTPM Example

Rung 1: This sets up the CTRIO card in slot 2 of the local base. Each CTRIO in the system will need a separate CTRIO I-box before any CTRxxxx I-boxes can be used for them. The CTRIO has been configured to use V2000 through V2025 for its input data, and V2030 through V2061 for its output data.



(example continued on next page)

CTRRTPM Example (cont'd)

Rung 2: This CTRIO Run To Position Mode IBox sets up Output #0 in CTRIO #1 to output pulses at a Frequency of 1000 Hz, use the 'Greater than Ch1/Fn1' comparison operator, until the input position of 1500 is reached. This example program requires that you load CTRRTPM_IBox.cwb into your Hx-CTRIO(2) module.

Rung 3: If the Run To Position Mode parameters are OK, set the Direction Bit and Enable the output.

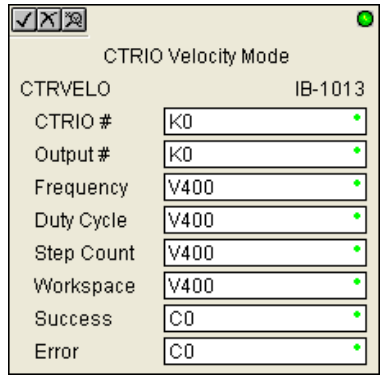
CTRIO Velocity Mode (CTRVELO) (IB-1013)

DS	Used
HPP	N/A

CTRIO Velocity Mode loads the Velocity command and given parameters on a specific Output resource on a leading edge transition to this IBox.

This IBox will take more than 1 PLC scan to execute. Either the Success or Error bit will turn on when the command is complete. If the Error Bit is on, you can use the CTRIO Read Error Code (CTRRDER) IBox to get extended error information.

The Workspace register is for internal use by this IBox instruction and MUST NOT be used anywhere else in your program.



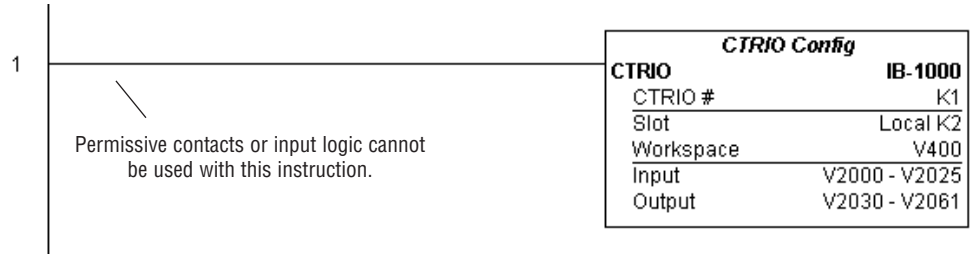
CTRVELO Parameters

- CTRIO#: specifies a specific CTRIO module based on a user defined number (see CTRIO Config Ibox)
- Output#: specifies a CTRIO output to be used by the instruction
- Frequency: specifies the output pulse rate (H0-CTRIO: 20Hz - 25KHz / H0-CTRIO2: 20Hz - 250 KHz)
- Duty Cycle: specifies the % of on time versus off time. This is a hex number. Default of 0 is 50%, also entering 50 will yield 50%. 50% duty cycle is defined as on half the time and off half the time
- Step Count: This DWORD value specifies the number of pulses to output. A Step Count value of -1 (or 0XFFFFFFFF) causes the CTRIO to output pulses continuously. Negative Step Count values must be V-Memory references.
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the instruction has successfully completed
- Error: specifies a bit that will turn on if the instruction does not complete successfully

Parameter		DL06 Range
CTRIO#	K	K0-255
Output#	K	K0-3
Frequency	V,K	K20-20000; See DL06 V-memory map - Data Words
Duty Cycle	V,K	K0-99; See DL06 V-memory map
Step Count	V,K	K0-2147434528; See DL06 V-memory map
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map

CTRVELO Example

Rung 1: This sets up the CTRIO card in slot 2 of the local base. Each CTRIO in the system will need a separate CTRIO I-box before any CTRxxxx I-boxes can be used for them. The CTRIO has been configured to use V2000 through V2025 for its input data, and V2030 through V2061 for its output data.



Rung 2: This CTRIO Velocity Mode IBox sets up Output #0 in CTRIO #1 to output 10,000 pulses at a Frequency of 1000 Hz. This example program requires that you load CTRVELO_IBox.cwb into your Hx-CTRIO(2) module.

(example continued on next page)

CTRVELO Example (cont'd)

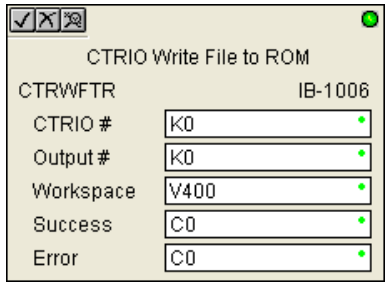
Rung 3: If the Velocity Mode parameters are OK, set the Direction Bit and Enable the output.

CTRIO Write File to ROM (CTRWFTR) (IB-1006)

DS	Used
HPP	N/A

CTRIO Write File to ROM writes the runtime changes made to a loaded CTRIO Preset Table back to Flash ROM on a leading edge transition to this IBox. This IBox will take more than 1 PLC scan to execute. Either the Success or Error bit will turn on when the command is complete. If the Error Bit is on, you can use the CTRIO Read Error Code (CTRRDER) IBox to get extended error information.

The Workspace register is for internal use by this IBox instruction and MUST NOT be used anywhere else in your program.



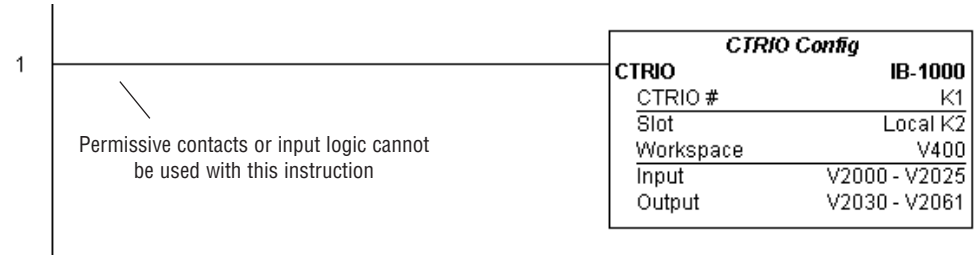
CTRWFTR Parameters

- CTRIO#: specifies a specific CTRIO module based on a user defined number (see CTRIO Config Ibox)
- Output#: specifies a CTRIO output to be used by the instruction
- Workspace: specifies a V-memory location that will be used by the instruction
- Success: specifies a bit that will turn on once the instruction has successfully completed
- Error: specifies a bit that will turn on if the instruction does not complete successfully

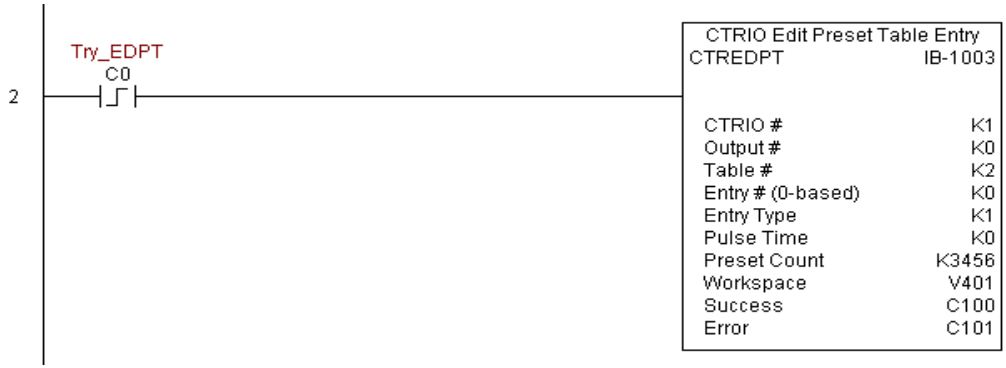
Parameter		DL06 Range
CTRIO#	K	K0-255
Output#	K	K0-3
Workspace	V	See DL06 V-memory map - Data Words
Success	X,Y,C,GX,GY,B	See DL06 V-memory map
Error	X,Y,C,GX,GY,B	See DL06 V-memory map

CTRWFTR Example

Rung 1: This sets up the CTRIO card in slot 2 of the local base. Each CTRIO in the system will need a separate CTRIO I-box before any CTRxxxx I-boxes can be used for them. The CTRIO has been configured to use V2000 through V2025 for its input data, and V2030 through V2061 for its output data.



Rung 2: This CTRIO Edit Preset Table Entry IBox will change Entry 0 in Table #2 to be a RESET at Count 3456. This example program requires that you load CTRWFTR_IBox.cwb into your Hx-CTRIO(2) module.



(example continued on next page)

CTRWFTR Example (cont'd)

Rung 3: If the file is successfully edited, use a Write File To ROM IBox to save the edited table back to the CTRIO's ROM, thereby making the changes retentive.