MicroLogix™ 1200 and MicroLogix 1500 Programmable Controllers

(Bulletins 1762 and 1764)

Purpose of This Document

This Document Update revises the following publication. Keep this Document Update for reference.

Publication Name	Publication Number
MicroLogix 1200 and MicroLogix 1500 Programmable Controllers Instruction Set Reference Manual	1762-RM001C-EN-P

This Document Update contains information about new features. These enhanced features are added to the controllers through a firmware upgrade for Series B or earlier controllers. This firmware upgrade is not required, except to allow you access to the new features. To use the new features, be sure your controller's firmware is at the following level:

Programmable Controller	Firmware Revision	Catalog Numbers
MicroLogix 1200	Series C, Revision A, FRN 4	1762-L24AWA, -L24BWA, - L24BXB, -L40AWA, -L40BWA and -L40BXB controllers
MicroLogix 1500	Series C, Revision A, FRN 6	1764-LSP, -LRP processors

To upgrade the firmware for a MicroLogix controller visit the MicroLogix web site at **http://www.ab.com/micrologix.**

RSLogix 500 programming software must be version 5.00.10 or higher.

New Features

The following new features are covered in this publication:

Floating Point (F) Data File

File Description

Floating point files contain IEEE-754 floating point data elements. One floating point element is shown below. You can have up to 256 of these elements in each floating point file.

Floating Point Data File Structure

Floating Point Element																															
31	**30**	**29**	**28**	**27**	**26**	**25**	**24**	**23**	**22**	**21**	**20**	**19**	**18**	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**09**	**08**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
S(1)	Exponent Value								Mantissa																						
High Word																Low Word														

(1) S = Sign Bit

Floating point numbers are represented using the IEEE-754 format, where:

- Bit 31 is the sign bit. This bit is set for negative numbers (note that negative zero is a valid value).
- Bits 23 to 30 are the exponent.
- Bits 0 to 22 are the mantissa.

The value represented by a 32-bit floating point number (not one of the exception values defined on page 3) is given by the following expression. Note the restoration of the suppressed most significant bit of the mantissa.

$(-1)^s \times 2^{e - 127} \times (1 + m)$

where:

s is the sign bit (0 or 1)

e is the exponent (1 to 254)

m is the mantissa ($0 \le f < 1$)

The valid range for floating point numbers is from -3.4028×10^{38} to $+3.4028 \times 10^{38}$.

Definitions

Overflow - occurs when the result of an operation produces an exponent that is greater than 254.

Underflow - occurs when the result of an operation produces an exponent that is less than one.

Floating Point Exception Values

Zero - represented by an exponent and a mantissa of zero. Both positive and negative zero are valid.

Denormalized - represented by an exponent of zero and a non-zero mantissa part. Since denormalized numbers have very small, insignificant values, they are treated as zero when used as source operand for most instructions. This reduces execution time. Denormalized numbers are not generated by the instructions (but are propagated by some instructions). Zero is generated on an underflow.

Infinity - represented by an exponent of 255 and a mantissa part of zero. Both positive and negative infinity are generated when operations overflow. Infinity is propagated through calculations.

NAN (not a number) - is represented by an exponent of 255 and a non-zero mantissa part. NANs are used to indicate results that are mathematically undefined such as 0/0 and adding plus infinity to minus infinity. All operations given a NAN as input must generate a NAN as output.

LSB Round-to-Even Rule

Floating point operations are rounded using the round-to-even rule. If the bits of the result to the right of the least significant bit (LSB) represent a value less than one-half of the LSB, then the result remains as is. If the bits to the right of the LSB represent a value greater than one-half of the LSB, the result is rounded up by adding one LSB. If the bits to the right of the LSB represent a value of exactly one-half LSB, the result is rounded up so that the LSB is an even number.

Addressing Floating Point Files

The addressing format for floating point data files is shown below.

Format	Explanation		
Ff:e	**F**	Floating Point file	
	f	File number	The valid file number range is from 8 (default) to 255.
	:	Element delimiter	
	e	Element number	The valid element number range is from 0 to 255.
Examples:	**F8:2** **F10:36**		**Floating Point File 8, Element 2** **Floating Point File 10, Element 36**

Data File Download Protection

Download File Protection can be applied to Floating Point Data Files. See page 2-6 of the *Instruction Set Reference Manual* for more information on protecting data files during download.

Programming Floating Point Values

The following table shows which instructions can use floating point data. The information in the table is in addition to the current information shown in the *Instruction Set Reference Manual*.

Mnemonic	Description	Manual Page	Considerations When Using Floating Point Data
Compare Instructions			
EQU GEQ GRT LEQ LES LIM NEQ	Equal Greater Than or Equal To Greater Than Less Than or EqualTo Less Than Limit Test Not Equal	9-2	When at least one of the operands is a Floating Data Point value: • For EQU, GEQ, GRT, LEQ, and LES - If either Source is NAN, then rung state changes to false. • For NEQ - If either Source is NAN, then rung state remains true.
Math Instructions			
ABS	Absolute Value	n/a	New Instruction - see page 16 of this Document Update.
ADD CLR DIV MUL NEG SQR SUB	Add Clear Divide Multiply Negate Square Root Subtract	10-2 and 10-3	When at least one of the operands is a Floating Data Point value: • If either Source is NAN, then the result is NAN. • All overflows result in infinity with the correct sign. • All underflows result in plus zero. • All denormalized Source values are treated as plus zero. • Results are always rounded using the Round to Even rule. • If Destination is an integer and the result is NAN or infinity, a saturated result (-32768 or +32767 for word or -2,147,836,648 or +2,147,836,647 for long word) is stored in Destination and the Math Overflow Selection Bit is ignored. • If Destination is an integer, the rounded result is stored. If an overflow occurs after rounding, a saturated result is stored in Destination and the Math Overflow Selection Bit is ignored. The saturated results are: – If Destination is an integer and the result is positive, overflow Destination is +32767 (word) or +2,147,483, 648 (long word). – If Destination is an integer and the result is negative, overflow Destination is -32767 (word) or -2,147,483, 648 (long word).
			Updates to Math Status Bits: • Carry - is reset • Overflow - Is set if the result is infinity, NAN, or if a conversion to integer overflows; otherwise it is reset. • Zero - Is set if the lower 31 bits of the Floating Point Data result is all zero's, otherwise it is reset. • Sign - Is set if the most significant bit of the Destination is set (bit 15 for word, bit 31 for long word or floating point data); otherwise it is reset. • Overflow Trap - The Math Overflow Trap Bit is only set if the Overflow bit is set. Otherwise, it remains in its last state.

Mnemonic	Description	Manual Page	Considerations When Using Floating Point Data
Move Instructions			
MOV	Move	13-1	When at least one of the operands is a Floating Data Point value: • The result is an exact copy of Source (preserving infinity, NAN, and denormalized values). • If Destination is an integer and Source is NAN or infinity, a saturated result (32767 for word or 2,147,836,647 for long word) is stored in Destination and the Math Overflow Selection Bit is ignored. • If Destination is an integer, the rounded result is stored. If an overflow occurs after rounding, a saturated result(32767 for word or 2,147,836,647 for long word) is stored in Destination and the Math Overflow Selection Bit is ignored. Updates to Math Status Bits: • Carry - is reset • Overflow - Is set if the result is infinity, NAN, or if a conversion to integer overflows; otherwise it is reset. • Zero - Is set if Destination is all zero's, otherwise it is reset. • Sign - Is set if the most significant bit of the Destination is set (bit 15 for word, bit 31 for long word or floating point data); otherwise it is reset. • Overflow Trap - The Math Overflow Trap Bit is only set if the Overflow bit is set. Otherwise, it remains in its last state.
File Instructions			
CPW	Copy Word	n/a	New Instruction - see page 14 of this Document Update.
FLL	Fill File	14-3	For Floating Point Data: • Source can be any IEEE-754 32-bit value. • Length can range from 1 to 64.
Communication Instructions			
MSG	Message	21-13	When using Floating Point Data: • Data Table Address/Offset - The Local File Type and Target File Type must both be Floating Point. NOTE: There are no special rules for sending or receiving floating point data. It is treated like any other data file type. • The Message Type must be 500CPU or PLC5. NOTE: The MicroLogix 1200 or MicroLogix 1500 can send or receive floating point data to or from SLC 500 and PLC-5 processors.

Programmable Limit Switch (PLS) File

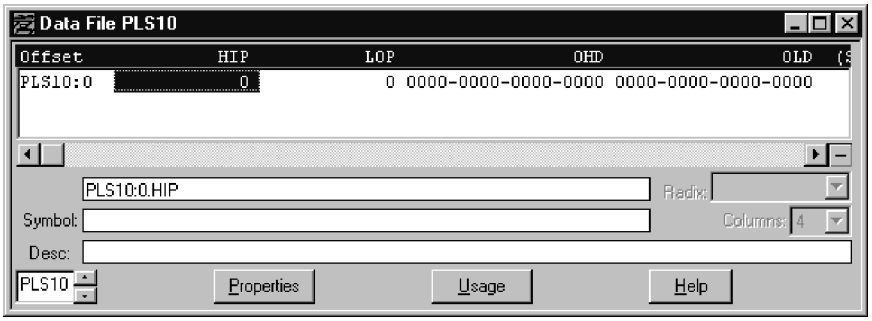
The Programmable Limit Switch function allows you to configure the High-Speed Counter to operate as a PLS (programmable limit switch) or rotary cam switch.

When PLS operation is enabled, the HSC (High-Speed Counter) uses a PLS data file for limit/cam positions. Each limit/cam position has corresponding data parameters that are used to set or clear physical outputs on the controller's base unit. The PLS data file is illustrated below.

IMPORTANT The PLS Function only operates in tandem with the HSC of a MicroLogix 1200 or 1500. To use the PLS function, an HSC must first be configured.

PLS Data File

Data files 9 to 255 can be used for PLS operations. Each PLS data file can be up to 256 elements long. Each element within a PLS file consumes 6 user words of memory. The PLS data file is shown below:



PLS Operation

When the PLS function is enabled, and the controller is in the run mode, the HSC will count incoming pulses. When the count reaches the first preset (High - HIP or Low - LOP) defined in the PLS file, the output source data (High - OHD or Low - OLD) will be written through the HSC mask.

At that point, the next preset (High - HIP or Low - LOP) defined in the PLS file becomes active.

When the HSC counts to that new preset, the new output data is written through the HSC mask. This process continues until the last

element within the PLS file is loaded. At that point the active element within the PLS file is reset to zero. This behavior is referred to as circular operation.

TIP The Output High Data (OHD) is only written when the High preset (HIP) is reached. The Output Low Data (OLD) is written when the low preset is reached.

TIP Output High Data is only operational when the counter is counting up. Output Low Data is only operational when the counter is counting down.

If invalid data is loaded during operation, an HSC error is generated (within the HSC function file). The error will not cause a controller fault. If an invalid parameter is detected, it will be skipped and the next parameter will be loaded for execution (provided it is valid).

You can use the PLS in Up (high), Down (low), or both directions. If your application only counts in one direction, simply ignore the other parameters.

The PLS function can operate with all of the other HSC capabilities. The ability to select which HSC events generate a user interrupt are not limited.

Addressing PLS Files

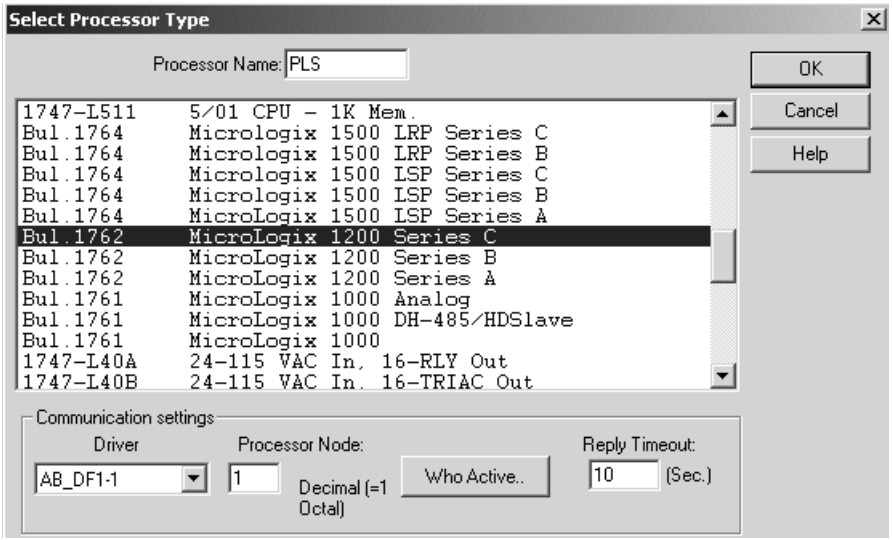
The addressing format for the PLS file is shown below.

Format	Explanation		
PLSf:e.s	**PLS**	Programmable Limit Switch file	
	f	File number	The valid file number range is from 9 to 255.
	:	Element delimiter	
	e	Element number	The valid element number range is from 0 to 255.
	.	Sub-Element delimiter	
	s	Sub-Element number	The valid sub-element number range is from 0 to 5
Examples:	**PLS10:2** **PLS12:36.5**		**PLS File 10, Element 2** **PLS File 12, Element 36, Sub-Element 5 (Output Low Source)**

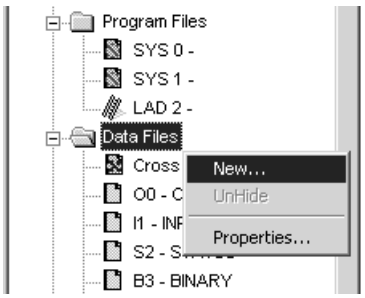
PLS Example

Setting up the PLS File

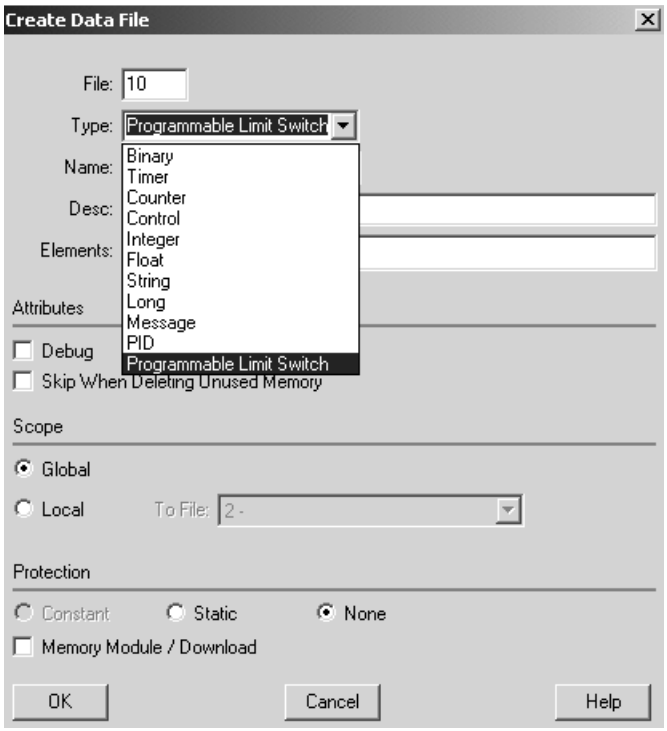
1. Using RSLogix 500, create a new project, give it a name and select the appropriate controller.



2. Right click on *Data Files* and select *New*.



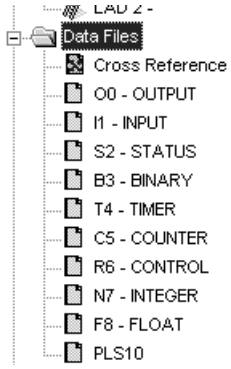
3. Enter a file number (9 to 255) and select *Programmable Limit Switch* as the type. A Name and/or Description may be entered as well, but is not required.



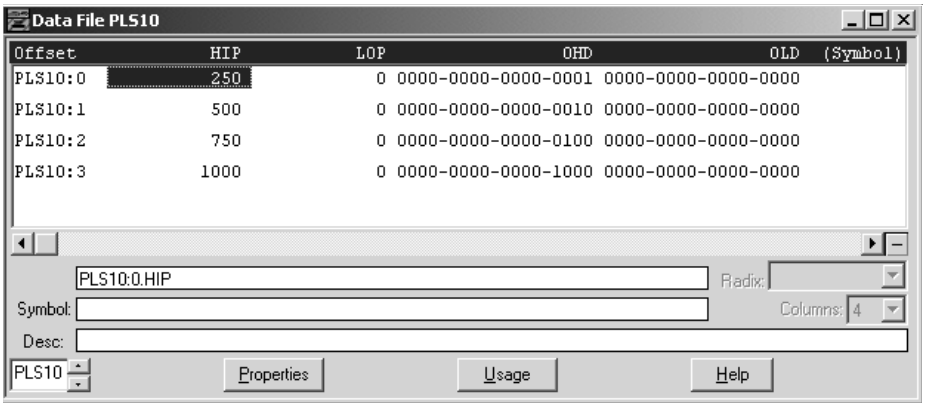
4. *Elements* refers to the number of PLS steps. For this example enter a value of 4.

If more steps are required at a later time, simply go to the properties for the PLS data file and increase the number of elements.

5. Under Data Files, *PLS10* should appear as shown to the left.



6. Double-click on *PLS10* under Data Files. For this example, enter the values as illustrated below.



PLS Data File Definitions:

Data	Description	Data Format
HIP	High Preset	32-bit signed integer
LOP	Low Preset	
OHD	Output High Data	16-bit binary (bit 15--> 0000 0000 0000 0000 <--bit 0)
OLD	Output Low Data	

Once the values above have been entered for HIP and OHD, the PLS is configured.

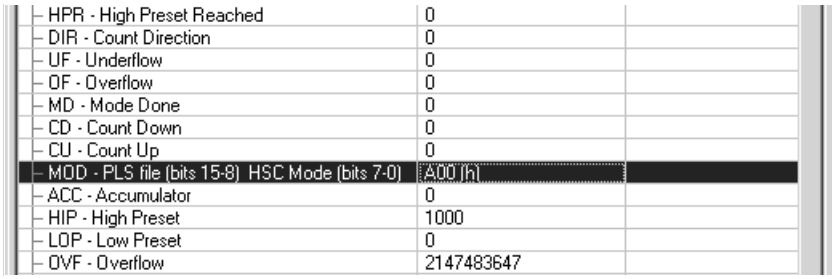
Configuring the HSC for Use with the PLS

1. Under Controller, double-click on *Function Files*.

2. For *HSC:0*, configure the HSC.MOD to use PLS10 and for the HSC to operate in mode 00.

IMPORTANT The value for MOD must be entered in Hexadecimal.

For example, PLS10 = 0A and HSC Mode = 00



PLS Operation for This Example

When the ladder logic first runs, HSC.ACC equals 0, therefore PLS10:0.OLD's data is sent through the HSC.OMB mask and sets all the outputs off.

When HSC.ACC equals 250, the PLS10:0.OHD is sent through the HSC.OMB mask and energizes the outputs.

This will repeat as the HSC.ACC reaches 500, 750, and 1000. Once completed, the cycle resets and repeats.

RTA - Real Time Clock Adjust

Instruction Type: output

Execution Time for the RTA Instruction

Controller	When Rung Is:	
	True	False
MicroLogix 1200	4.7 µs	3.7 µs
	556.2 µs (false-to-true transition)	
MicroLogix 1500	4.1 µs	2.6 µs
	426.8 µs (false-to-true transition)	

The RTA instruction is used to synchronize the controllers Real-Time Clock (RTC) with an external source. The RTA instruction will adjust the RTC to the nearest minute. The RTA instruction adjusts the RTC based on the value of the RTC Seconds as described below.

IMPORTANT The RTA instruction will only change the RTC when the RTA rung is evaluated true, after it was previously false (false-to-true transition). The RTA instruction will have no effect if the rung is always true or false.

RTA is set:

- If RTC Seconds are less than 30, then RTC Seconds is reset to 0.
- If RTC Seconds are greater than or equal to 30, then the RTC Minutes are incremented by 1 and RTC Seconds are reset to 0.

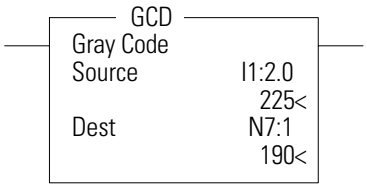
The following conditions cause the RTA instruction to have no effect on the RTC data:

- No RTC attached to the controller
- RTC is present, but disabled
- An external (via communications) message to the RTC is in progress when the RTA instruction is executed. (External communications to the RTC takes precedence over the RTA instruction.)

To re-activate the RTA instruction, the RTA rung must become false, and then true.

TIP There is only one internal storage bit allocated in the system for this instruction. Do not use more than one RTA instruction in your program.

GCD - Gray Code



Instruction Type: output

Execution Time for the GCD Instructions

Controller	When Rung Is:	
	True	False
MicroLogix 1200	9.5 µs	0.0 µs
MicroLogix 1500	8.2 µs	0.0 µs

The GCD instruction converts Gray code data (Source) to an integer value (Destination). If the Gray code input is negative (high bit set), the Destination is set to 32767 and the overflow flag is set.

Addressing Modes and File Types are shown in the following table:

GCD Instruction Valid Addressing Modes and File Types

For definitions of the terms used in this table see Using the Instruction Descriptions on page4-2.

Parameter	Data Files										Function Files									CS - Comms	IOS - I/O	Address Mode			Address Level			
	O	I	S	B	T, C, R	N	F	ST	L	MG, PD	RTC	HSC	PTO, PWM	STI	EII	BHI	MMI	DAT	TPI			Immediate	Direct	Indirect	Bit	Word	Long Word	Element
Source	•	•		•	•	•																	•	•		•		
Destination	•	•		•	•	•																	•	•		•		

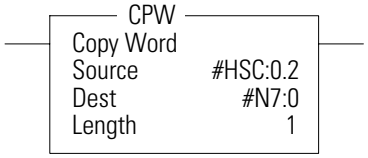
Updates to Math Status Bits

Math Status Bits

With this Bit:		The Controller:
S:0/0	Carry	always reset
S:0/1	Overflow	set if the Gray code input is negative, otherwise is reset
S:0/2	Zero Bit	set if the destination is zero, otherwise reset
S:0/3	Sign Bit	always reset
S:5/0	Overflow Trap	set if the Overflow Bit is set, otherwise reset

CPW - Copy Word

Instruction Type: output



Execution Time for the CPW Instruction

Controller	When Rung Is:	
	True	False
MicroLogix 1200	18.3 µs + 0.8 µs/word	0.0 µs
MicroLogix 1500	15.8 µs + 0.7 µs/word	0.0 µs

The CPW instruction copies words of data, in ascending order, from one location (Source) to another (Destination). Although similar to the File Copy (COP) instruction, the CPW instruction allows different source and destination parameters. Examples include:

- integer to long word
- long word to floating point
- long word to integer
- integer to PTO function file

Observe the following restrictions when using the CPW instruction:

- The length of the data transferred cannot exceed 128 words.
- Function files can be used for Source or Destination, but not both.
- When referencing either a PLS file or a function file, addressing must be specified to the sub-element level.
- You can reference a sub-element of bits in a function file containing a combination of read-only and read/write bits.
- You cannot directly reference the high word of a long word as an operand in the CPW instruction.
- A Major fault (003F) is generated if the execution of the instruction exceeds the data table space.
- A Major fault (0044) is generated if a write attempt fails to the RTC function file. This only occurs when attempting to write invalid data to the RTC function file. Examples of invalid data are: setting the Day of Week to zero or setting the Date to February 30th.

Addressing Modes and File Types are shown in the following table:

CPW Instruction Valid Addressing Modes and File Types

For definitions of the terms used in this table see Using the Instruction Descriptions on page4-2.

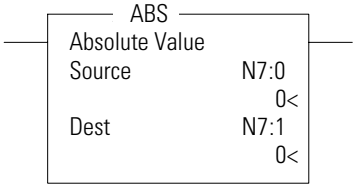
Parameter	Data Files										Function Files									PLS - Programmable L/S	CS - Comms	IOS - I/O	Address Mode[1]			Address Level			
	O	I	S	B	T, C, R	N	F	ST	L	MG, PD	RTC	HSC	PTO, PWM	STI	EII	BHI	MMI	DAT	TPI				Immediate	Direct	Indirect	Bit	Word	Long Word	Element
Source	•	•		•		•	•		•		•	•	•	•	•	•	•		•	•				•	•				•
Destination	•	•		•		•	•	•	•		•	•	•	•	•					•				•	•				•
Length																							•						

(1) See Important note about indirect addressing.

IMPORTANT You cannot use indirect addressing with: S, MG, PD, RTC, HSC, PTO, PWM, STI, EII, BHI, MMI, DAT, TPI, CS, IOS, and DLS files.

ABS - Absolute Value

Instruction Type: output



Execution Time for the ABS Instruction

Controller	When Rung Is:	
	True	False
MicroLogix 1200	3.8 µs	0.0 µs
MicroLogix 1500	3.1 µs	0.0 µs

The ABS instruction takes the absolute value of the Source and places it in the Destination. The data range for this instruction is -2,147,483,648 to 2,147,483,647 or IEEE-754 floating point value.

Source and Destination do not have to be the same data type. However, if the signed result does not fit in Destination, the following will occur.

ABS Result Does Not Fit in Destination

When Both Operands Are Integers	When At Least One Operand is Floating Point Data
• If the Math Overflow Selection Bit is clear, a saturated result (32767 for word or 2,147,836,647 for long word) is stored in the Destination. • If the Math Overflow Selection Bit is set, the unsigned truncated value of the result is stored in the Destination.	• The ABS instruction clears the sign bit. No operation is performed on the remaining bits. • If Destination is an integer and Source is NAN or infinity, a saturated result (32767 for word or 2,147,836,647 for long word) is stored in Destination and the Math Overflow Selection Bit is ignored. • If Destination is an integer, the rounded result is stored. If an overflow occurs after rounding, a saturated result (32767 for word or 2,147,836,647 for long word) is stored in Destination and the Math Overflow Selection Bit is ignored.

The following table shows how the math status bits are updated upon execution of the ABS instruction:

Updates to Math Status Bits

When Both Operands Are Integers	When At Least One Operand is Floating Point Data
• Carry - Is set if input is negative, otherwise resets. • Overflow - Is set if the signed result cannot fit in the Destination; otherwise it is reset. • Zero - Is set if Destination is all zero's, otherwise it is reset. • Sign - Is set if the most significant bit of the Destination is set, otherwise it is reset. • Overflow Trap - The Math Overflow Trap Bit is only set if the Overflow bit is set. Otherwise, it remains in its last state.	• Carry - Is reset. • Overflow - Is set if the signed result is infinity, NAN, or cannot fit in the Destination; otherwise it is reset. • Zero - Is set if Destination is all zero's, otherwise it is reset. • Sign - Is set if the most significant bit of the Destination is set, otherwise it is reset. • Overflow Trap - The Math Overflow Trap Bit is only set if the Overflow bit is set. Otherwise, it remains in its last state.

Addressing Modes and File Types are shown in the following table:

ABS Instruction Valid Addressing Modes and File Types

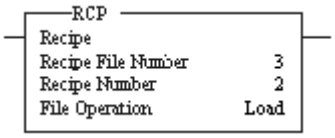
For definitions of the terms used in this table see Using the Instruction Descriptions on page4-2.

Parameter	Data Files										Function Files													Address Mode[1]			Address Level				
	O	I	S	B	T, C, R	N	F	ST	L	MG, PD	RTC	HSC	PTO, PWM	STI	EII	BHI	MMI	DAT	TPI	PLS - Programmable L/S	CS - Comms	IOS - I/O	Immediate	Direct	Indirect	Bit	Word	Long Word	Floating Point	Element
Source	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•		•	•	•	
Destination	•	•	•	•	•	•	•		•	•	•	•	•	•	•					•				•	•		•	•	•	•	

(1) See Important note about indirect addressing.

IMPORTANT You cannot use indirect addressing with: S, MG, PD, RTC, HSC, PTO, PWM, STI, EII, BHI, MMI, DAT, TPI, CS, IOS, and DLS files.

RCP - Recipe (MicroLogix 1500 only)



Instruction Type: output

Execution Time for the RCP Instruction

Controller	Operation	When Rung Is:	
		True	False
MicroLogix 1500	Load	30.7 µs + 7.9 µs/word + 13.8 µs/long word or floating point	0.0 µs
	Store	28.5 µs + 8.5 µs/word + 15.1 µs/long word or floating point	0.0 µs

The RCP file allows you to save custom lists of data associated with a recipe. Using these files along with the RCP instruction lets you transfer a data set between the recipe database and a set of user-specified locations in the controller file system.

When you create a recipe file, you chose whether to store the recipe data in User Program memory or Data Log Queue memory.

IMPORTANT The Data Log Queue option can only be used with 1764-LRP MicroLogix 1500 Series C or higher controllers. If you are using a 1764-LSP MicroLogix 1500 controller, you must select User Program.

The following reasons may help you chose which which type of memory to use:

- The advantage to using User Program memory is that you can save the recipe data to the controller's memory module. If you use Data Log Queue, you cannot save the recipe data to the controller's memory module.
- The adavantage to using Data Log Queue memory is that the recipe data will not consume User Program space. If you are not using the data logging function, choosing Data Log Queue memory allows you more memory (up to 48K bytes) for RCP files. *You can use the Data Log Queue for data logging and recipe data, but the total cannot exceed 48K bytes.*
- If you choose to use the Data Log Queue for one RCP file, all the RCP files in your project will also use the Data Log Queue memory space.

See step 2, "Create a RCP File" on page 19 for the recipe file procedure.

The RCP instruction uses the following parameters:

- Recipe File Number - this is the file number that identifies the custom list of addresses associated with a recipe.

- Recipe Number - specifies the number of the recipe to use. If the recipe number is invalid, a user fault (code 0042) is generated.
- File Operation - identifies whether the operation is a Load from the database or a Store to the database.

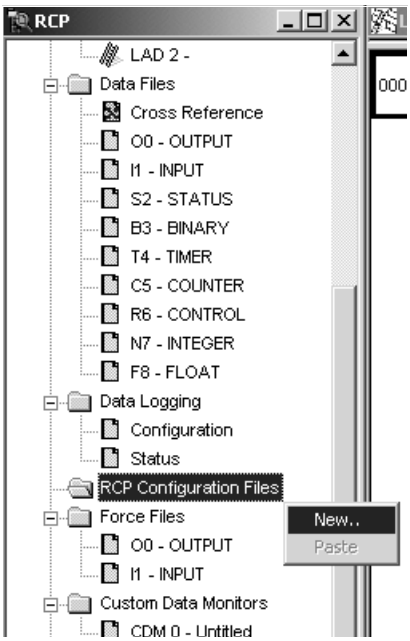
When executed on a True rung, the RCP instruction transfers data between the recipe database and the specified data locations.

Addressing Modes and File Types are shown in the following table:

RCP Instruction Valid Addressing Modes and File Types

For definitions of the terms used in this table see Using the Instruction Descriptions on page4-2.

Parameter	Data Files										Function Files									PLS - Programmable L/S	CS - Comms	IOS - I/O	Address Mode			Address Level				
	O	I	S	B	T, C, R	N	F	ST	L	MG, PD	RTC	HSC	PTO, PWM	STI	EII	BHI	MMI	DAT	TPI				Immediate	Direct	Indirect	Bit	Word	Long Word	Floating Point	Element
Recipe Number																							•							
File	•	•		•		•																	•	•			•			

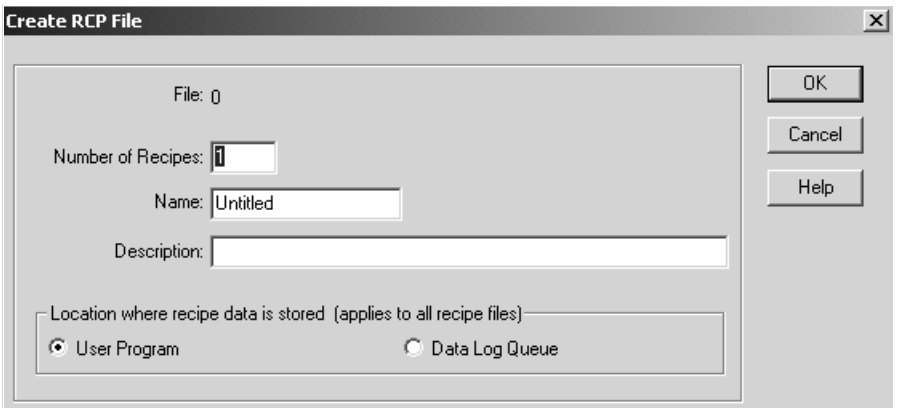


Recipe File and Programming Example

Configuring the RCP file

1. Using RSLogix 500, locate and select *RCP Configuration Files*. Right-click and select *New*.

2. Create a RCP File.



- File - This is the number identifying the RCP file. It is the *Recipe File Number* used in the RCP instruction in your ladder program and identifies the recipe database.

- Number of Recipes - This is the number of recipes contained in the RCP file. This can never be more than 256. This is the *Recipe Number* used in the RCP instruction in your ladder program.
- Name - This is a descriptive name for the RCP file. Do not exceed 20 characters.
- Description - This is the file description (optional).
- Location where recipe data is stored (applies to all recipe files) - This allows you to designate a memory location for your RCP files.
- User Program - You can allocate User Program (ladder logic) memory for recipe operations. Once User Program memory is assigned for recipe use, it cannot be used for ladder logic.

TIP User Program memory can be changed back from recipe operations to ladder logic.

IMPORTANT When User Program memory is used for recipe data, the usage is as follows:

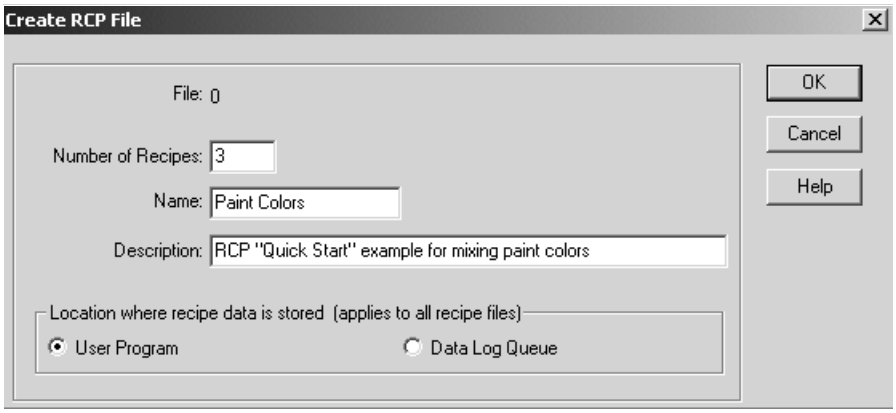
1K words of User Program memory =
5K words of recipe data memory

Like your ladder logic, the recipe data stored in User Program memory can be saved to the controller's memory module (1764-MM1, -MM2, -MM1RTC, -MM2RTC).

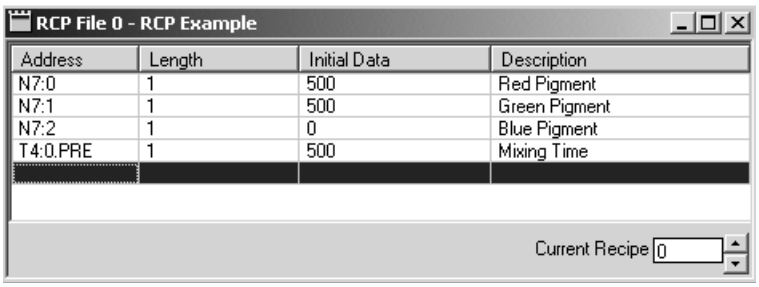
- Data Log Queue - For 1764-LRP processors, you can store recipe data in the data log memory space (48K bytes).

IMPORTANT While recipe data stored in User Program memory can be saved to the controller's memory module, recipe data stored in Data Log Queue memory cannot be saved to a memory module. Data Log Queue memory is battery-backed, but cannot be saved to a memory module.

3. Enter the RCP file parameters as shown below. When finished click on *OK*.

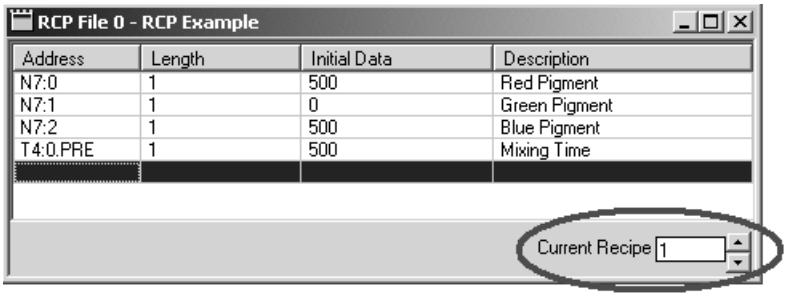


4. A new window will appear. In this window, enter the values as shown below.



5. Change the Current Recipe from 0 to 1. Notice the addresses were duplicated, but the data was not.

6. Enter the data for Recipe 1 as shown below.



7. Change from Recipe 1 to Recipe 2 and enter the following data.

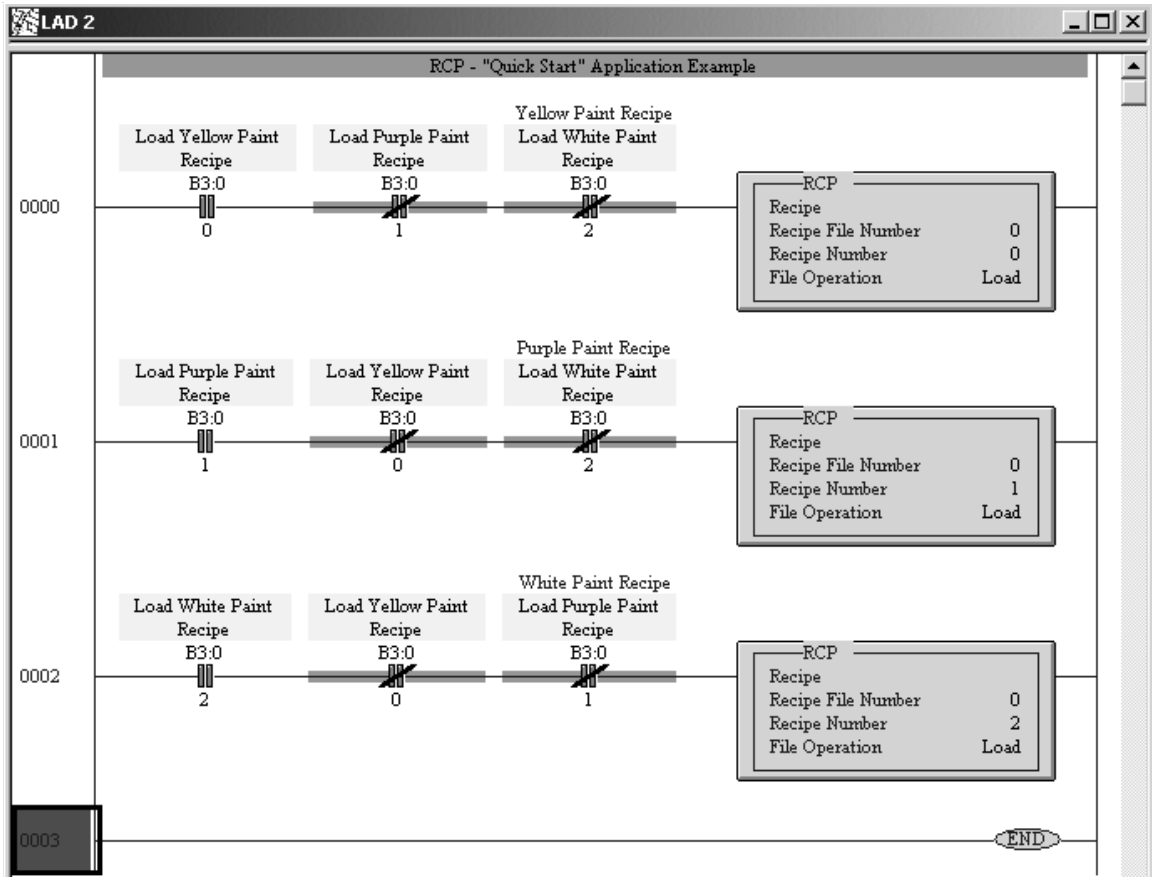
RCP File 0 - RCP Example

Address	Length	Initial Data	Description
N7:0	1	333	Red Pigment
N7:1	1	333	Green Pigment
N7:2	1	333	Blue Pigment
T4:0.PRE	1	1000	Mixing Time

Current Recipe 2

The Recipes are now configured.

8. Create the following ladder logic.



Application Explanation of Operation

When B3:0/0 is energized and B3:0/1 and B3:0/2 are de-energized, Recipe File 0:Recipe number 0 is executed loading the following values to create Yellow paint.

- N7:0 = 500
- N7:1 = 500
- N7:2 = 0
- T4:0.PRE = 500

When B3:0/1 is energized and B3:0/0 and B3:0/2 are de-energized, Recipe File 0:Recipe number 1 is executed loading the following values to create Purple paint.

- N7:0 = 500
- N7:1 = 0
- N7:2 = 500
- T4:0.PRE = 500

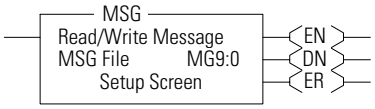
When B3:0/2 is energized and B3:0/0 and B3:0/1 are de-energized, Recipe File 0:Recipe number 2 is executed loading the following values to create White paint.

- N7:0 = 333
- N7:1 = 333
- N7:2 = 333
- T4:0.PRE = 1000

Monitor the N7 data file. Notice the values change after each bit is toggled.

This example describes *loading* values from a RCP file to data table addresses. However, note that by changing the RCP file operation from *Load* to *Store,* values can be loaded by ladder logic into the recipe database for each Recipe number.

MSG - Message



Instruction Type: output

Execution Time for the MSG Instruction

Controller	Rung Condition	When Rung Is:	
		True	False
MicroLogix 1200	Steady State True	20.0 µs	6.0 µs
	False-to-True Transition for Reads	230.0 µs	
	False-to-True Transition for Writes	264 µs + 1.6 µs per word	
MicroLogix 1500 1764-LSP	Steady State True	17.0 µs	6.0 µs
	False-to-True Transition for Reads	205.0 µs	
	False-to-True Transition for Writes	228 µs + 1.4 µs per word	
MicroLogix 1500 1764-LRP	Steady State True	17.0 µs	6.0 µs
	Communications via base unit or 1764-LRP comm port:		
	False-to-True Transition for Reads	234.0 µs	6.0 µs
	False-to-True Transition for Writes	257 µs + 1.4 µs per word	
	Communications via Compact I/O communication module, ie. 1769-SDN:		
	False-to-True Transition for Reads	206.0 µs	6.0 µs
	False-to-True Transition for Writes	234 µs + 1.4 µs per word	

The MicroLogix 1500 1764-LRP processor and the 1769-SDN scanner module now support backplane messaging. This new level of functionality allows the processor to read (get) or write (set) data to other devices on DeviceNet. This is also referred to as *Explicit Messaging*.

You can use two different types of messages to exchange information with the DeviceNet device. The type of message used is determined by the destination device. You can generate a PCCC message or a CIP message.

PCCC Messaging

PCCC stands for “Programmable Controller Communications Commands”. PCCC provides point to point and master/slave communications between devices. PCCC is an open protocol that is built into all Allen-Bradley controllers, and many other Allen-Bradley and third-party products.

There are a number of devices that support PCCC messaging over DeviceNet, including the 1761-NET-DNI (DNI). PCCC messaging allows program upload/download to occur over DeviceNet, and allows users to message across DeviceNet, just like they did using

DH-485 or DH+. If the DeviceNet network has DNI's, either device can initiate a PCCC message.

IMPORTANT Verify that your device supports PCCC messaging over DeviceNet.

CIP Messaging

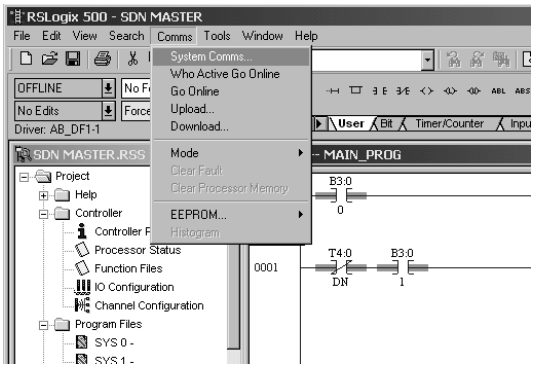
See CIP Generic on page 29.

Program Upload/Download

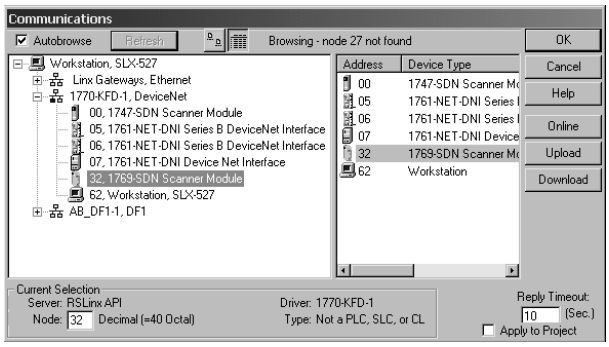
Before performing a program upload/download through the scanner, be sure that the module is properly installed in the system, and that a terminator is present at the end of the Compact I/O expansion bus.

IMPORTANT DeviceNet networks can operate at 125K, 250K or 500K baud. Depending on network size and communication activity, performing program upload and/or download operations while the network is controlling an application may impact control system performance. It is up to the user to know and understand how upload/download will impact their operations.

To perform program upload/download using RSLogix 500, select **Comms**. From the drop-down menu, select **System Comms**.



System Comms will generate an RSLinx screen similar to the example below.



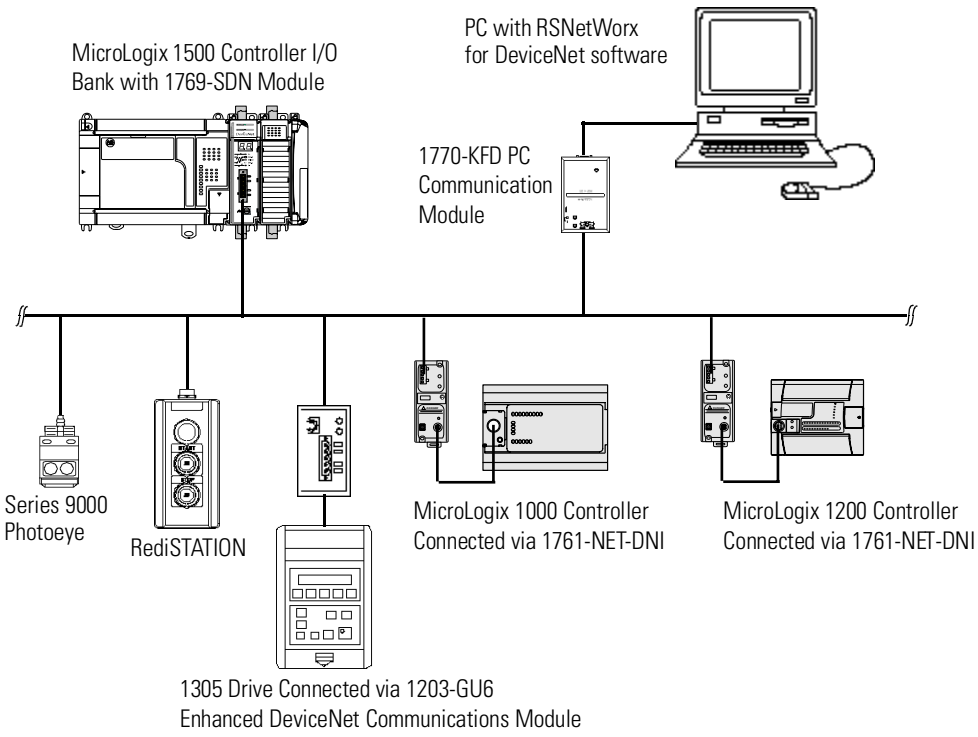
In this example, the DeviceNet interface is a 1770-KFD module. Selecting the 1770-KFD driver will show the devices on the DeviceNet network.

In this example, upload/download can be performed with the devices at nodes 5, 6, 7 and 32. Node 32 is a 1769-SDN. Simply highlight the 1769-SDN and then click on either the **upload** or **download** button on the right side of the screen.

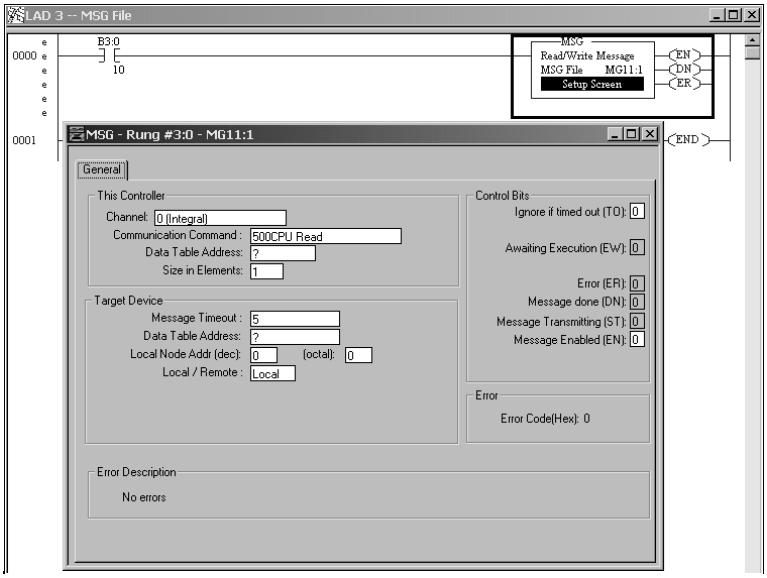
Configuring a Local DeviceNet Message

This section describes how to configure a local message using the scanner and a MicroLogix 1500 1764-LRP processor. An example network is shown below:

DeviceNet Network



Message Setup Screen



Rung 0 shows a standard RSLogix 500 message (MSG) instruction preceded by conditional logic.

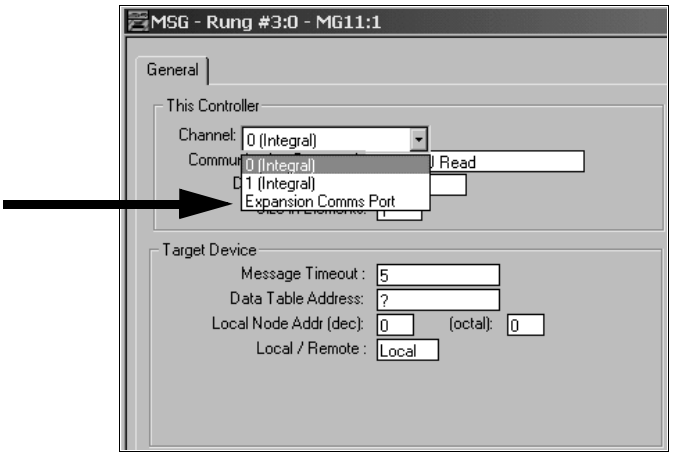
1. Access the message setup screen by double-clicking **Setup Screen**.

2. The RSLogix 500 Message Setup Screen appears. This screen is used to setup or monitor message parameters for “This Controller”, “Target Device”, and “Control Bits”. Descriptions of each of these sections follow.

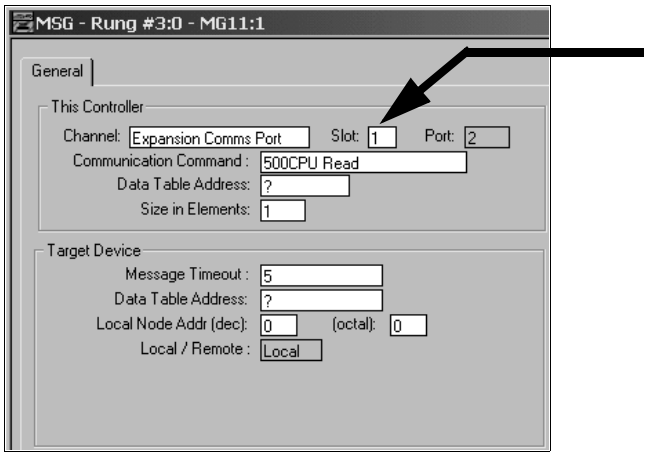
"This Controller" Parameters

Channel

The 1764-LRP supports three different pathways for messaging, channels 0 and 1 are RS-232 ports and are functionally identical to MicroLogix 1200 and MicroLogix 1500 1764-LSP controllers. The 1764-LRP also supports backplane communications through the **Expansion Communication Port** (ECP) as illustrated below.



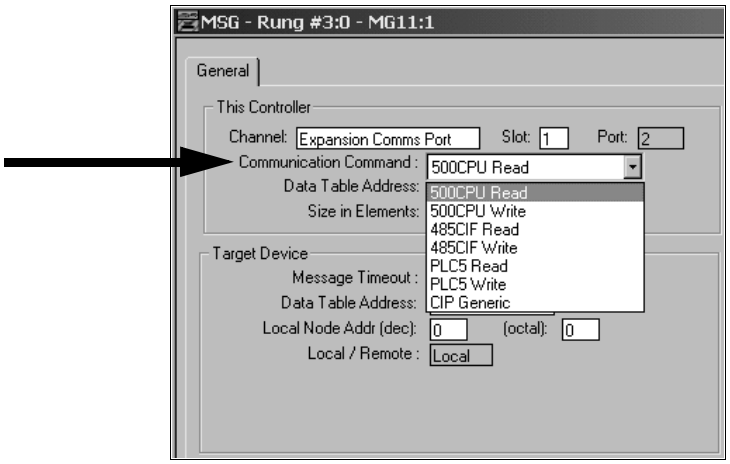
When ECP is chosen, you are able to select which **slot** position (1 to 16) the scanner resides in. The 1764-LRP processor can support up to two 1769-SDN scanner modules with full messaging functionality.



TIP

You can use multiple 1769-SDN scanner modules in a 1764-LRP MicroLogix 1500 system, but you can only message through the first two. A scanner physically positioned after the first two can only be used for I/O scanning.

Communication Command



The 1764-LRP processor supports the six standard types of **communications commands** (same as all other MicroLogix 1200 and 1500 controllers) and CIP Generic. When any of these six standard commands are chosen, you can initiate standard messages to destination devices connected to DeviceNet products that support PCCC messaging (including MicroLogix and SLC controllers using 1761-NET-DNI's, 1203-GU6 drive interface, and other MicroLogix 1500 controllers using 1769-SDN scanner modules). You can initiate reads, writes, program upload/download and online monitoring across DeviceNet. This is functionally identical to DH-485 and DH+ networking.

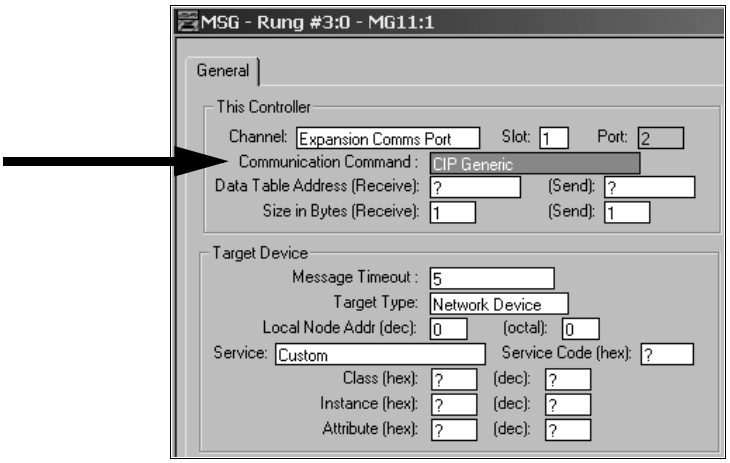
CIP Generic

CIP stands for "Control & Information Protocol". CIP is a newer and more versatile protocol than PCCC. It is an open protocol that is supported by newer Allen-Bradley controllers and third-party products.

CIP messaging is the native messaging format for DeviceNet. All DeviceNet devices are compliant with CIP messaging. The MicroLogix 1500 1764-LRP processor (Series C) has an enhanced message instruction that provides simple, easy to use CIP messaging.

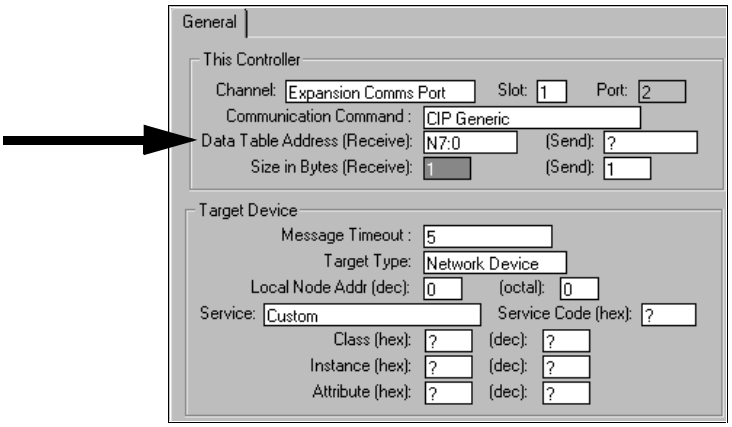
Selecting **CIP Generic** configures the message instruction to communicate with DeviceNet devices that do not support PCCC messaging. When CIP Generic is chosen, you will notice that a

number of message parameters change and many new ones become available depending upon the service selected.



Data Table Address (Receive and Send)

This value identifies the data file location within the 1764-LRP controller that will receive data from the DeviceNet device, and/or the starting data file location that will be sent to the destination DeviceNet device.

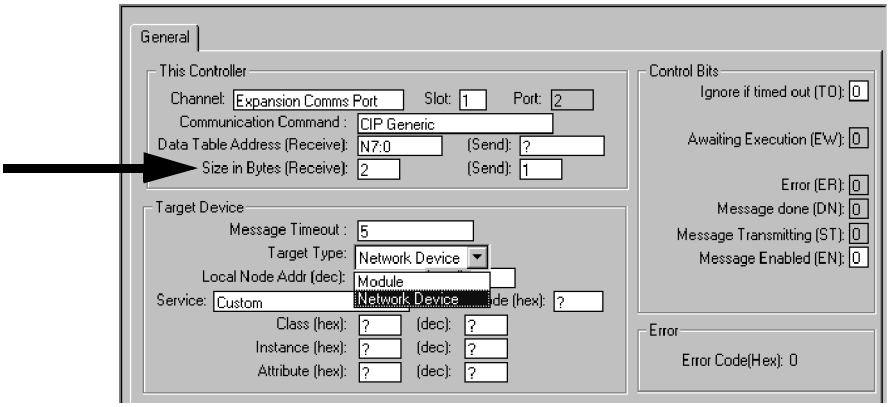


Size in Bytes (Receive and Send)

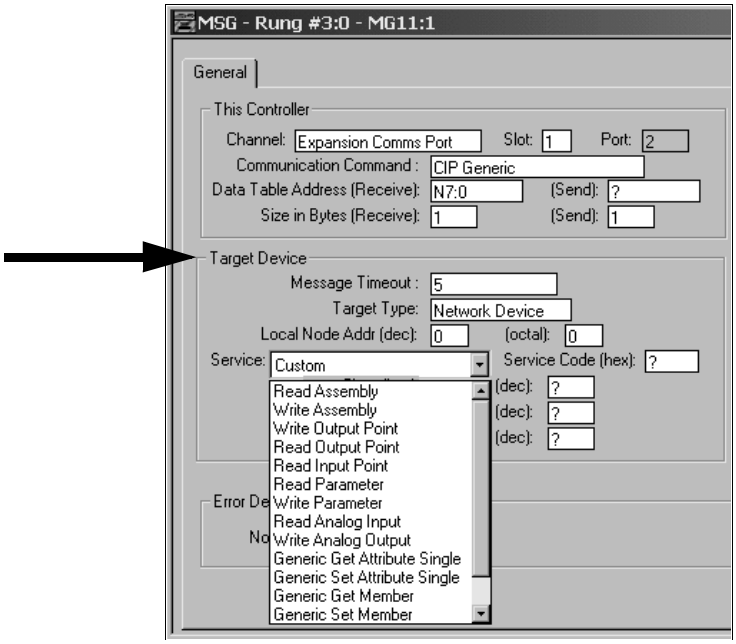
Since all data transmitted on DeviceNet is byte based, you must enter the number of bytes that will be received and sent. You must make sure that enough memory is available in the destination device. Word elements within 1764-LRP controllers contain 2 bytes each. These include Bit and Integer data files. Long word and Floating point elements contain 4 bytes each.

For receive, the Size in bytes entered must be greater than or equal to the number of bytes than the DeviceNet device will return. DeviceNet devices return a fixed number of bytes depending on the Class and Service. If more data is returned than expected, the message will error and no data will be written. If less data is returned than expected, the data will be written and the remainder of the bytes will be filled with zeros.

In the example screen shown below, **N7:0** will receive **2** bytes (1 word) of data.



Target Device



Message Timeout

Message timeout is specified in seconds. If the target does not respond within this time period, the message instruction will generate a specific error (see MSG Instruction Error Codes on page 34). The amount of time that is acceptable should be based on application requirements and network capacity/loading.

Target Type

You can select either **Module** or **Network Device**. If you need to message to a device on DeviceNet, select Network Device. If you need to message to a DeviceNet parameter on the scanner, select Module. This allows the control program access to module parameters.

TIP

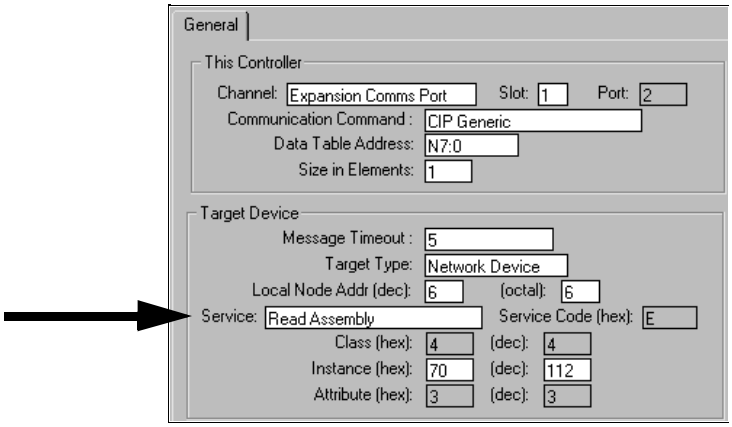
Note, many module parameters are not editable, and some can only be edited when the module is in Idle Mode.

Local Node address

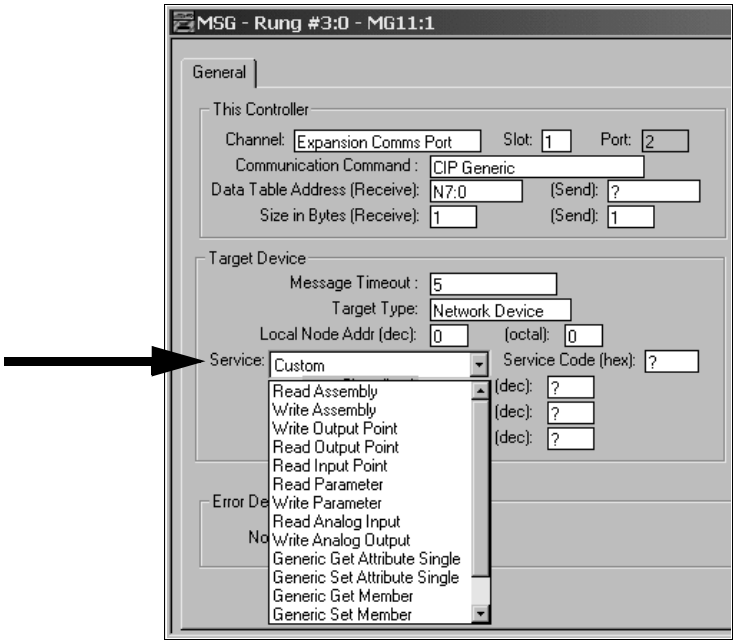
This is the target device's DeviceNet node number.

Service

DeviceNet uses services to provide specific messaging functions. A number of standard services with their corresponding parameters have been preconfigured for ease of use.



If you need to use a service that is not available, select one of the **Generic** services. The Generic service allows you to enter specific service code parameters. Information on what services a target device supports is usually provided in the device's documentation.



MSG Instruction Error Codes

When the processor detects an error during the transfer of message data, the processor sets the ER bit and enters an error code that you can monitor from your programming software.

Error Code	Description of Error Condition
02H	Target node is busy. NAK No Memory retries by link layer exhausted.
03H	Target node cannot respond because message is too large.
04H	Target node cannot respond because it does not understand the command parameters OR the control block may have been inadvertently modified.
05H	Local processor is off-line (possible duplicate node situation).
06H	Target node cannot respond because requested function is not available.
07H	Target node does not respond.
08H	Target node cannot respond.
09H	Local modem connection has been lost.
0BH	Target node does not accept this type of MSG instruction.
0CH	Received a master link reset (one possible source is from the DF1 master).
10H	Target node cannot respond because of incorrect command parameters or unsupported command.
12H	Local channel configuration protocol error exists.
13H	Local MSG configuration error in the Remote MSG parameters.
15H	Local channel configuration parameter error exists.
16H	Target or Local Bridge address is higher than the maximum node address.
17H	Local service is not supported.
18H	Broadcast is not supported.
21H	Bad MSG file parameter for building message.
30H	PCCC Description: Remote station host is not there, disconnected, or shutdown.
37H	Message timed out in local processor.
39H	Local communication channel reconfigured while MSG active.
3AH	STS in the reply from target is invalid.
40H	PCCC Description: Host could not complete function due to hardware fault.
45H	MSG reply cannot be processed. Either Insufficient data in MSG read reply or bad network address parameter.
50H	Target node is out of memory.
60H	Target node cannot respond because file is protected.
70H	PCCC Description: Processor is in Program Mode.
80H	PCCC Description: Compatibility mode file missing or communication zone problem.
90H	PCCC Description: Remote station cannot buffer command.
B0H	PCCC Description: Remote station problem due to download.
C0H	PCCC Description: Cannot execute command due to active IPBs.
D0H	One of the following: • No IP address configured for the network. • Bad command - unsolicited message error. • Bad address - unsolicited message error. • No privilege - unsolicited message error.
D1H	Maximum connections used - no connections available.
D2H	Invalid internet address or host name.
D3H	No such host / Cannot communicate with the name server.
D4H	Connection not completed before user–specified timeout.
D5H	Connection timed out by the network.

Error Code	Description of Error Condition
D7H	Connection refused by destination host.
D8H	Connection was broken.
D9H	Reply not received before user–specified timeout.
DAH	No network buffer space available.
E0H	Expansion I/O communication module error.
E1H	PCCC Description: Illegal Address Format, a field has an illegal value.
E2H	PCCC Description: Illegal Address format, not enough fields specified.
E3H	PCCC Description: Illegal Address format, too many fields specified.
E4H	PCCC Description: Illegal Address, symbol not found.
E5H	PCCC Description: Illegal Address Format, symbol is 0 or greater than the maximum number of characters support by this device.
E6H	PCCC Description: Illegal Address, address does not exist, or does not point to something usable by this command.
E7H	Target node cannot respond because length requested is too large.
E8H	PCCC Description: Cannot complete request, situation changed (file size, for example) during multi–packet operation.
E9H	PCCC Description: Data or file is too large. Memory unavailable.
EAH	PCCC Description: Request is too large; transaction size plus word address is too large.
EBH	Target node cannot respond because target node denies access.
ECH	Target node cannot respond because requested function is currently unavailable.
EDH	PCCC Description: Resource is already available; condition already exists.
EEH	PCCC Description: Command cannot be executed.
EFH	PCCC Description: Overflow; histogram overflow.
F0H	PCCC Description: No access.
F1H	Local processor detects illegal target file type.
F2H	PCCC Description: Invalid parameter; invalid data in search or command block.
F3H	PCCC Description: Address reference exists to deleted area.
F4H	PCCC Description: Command execution failure for unknown reason; PLC-3 histogram overflow.
F5H	PCCC Description: Data conversion error.
F6H	PCCC Description: The scanner is not able to communicate with a 1771 rack adapter. This could be due to the scanner not scanning, the selected adapter not being scanned, the adapter not responding, or an invalid request of a "DCM BT (block transfer)".
F7H	PCCC Description: The adapter is not able to communicate with a module.
F8H	PCCC Description: The 1771 module response was not valid size, checksum, etc.
F9H	PCCC Description: Duplicated Label.
FAH	Target node cannot respond because another node is file owner (has sole file access).
FBH	Target node cannot respond because another node is program owner (has sole access to all files).
FCH	PCCC Description: Disk file is write protected or otherwise inaccessible (off-line only).
FDH	PCCC Description: Disk file is being used by another application; update not performed (off-line only).
FFH	Local communication channel is shut down.

TIP

For 1770-6.5.16 DF1 Protocol and Command Set Reference Manual users: The MSG error code reflects the STS field of the reply to your MSG instruction.

- Codes E0 to EF represent EXT STS codes 0 to F.
- Codes F0 to FC represent EXT STS codes 10 to 1C.

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