MITSUBISHI UNIVERSITY

L Series Advanced

TRPLC702A

MITSUBISHI ELECTRIC

L Series Advanced Training Manual

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Revision History

Rev.	Date	Revision Notes
*	09/13/2010 C. Kellock	Internal, new manual created
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Class Introduction

Welcome to the L Series Advanced training course.

Course Objectives

By the end of this training course, the student should be able to:

- Utilize the special input functions of the built-in I/O.
- Perform pulse output motion control.
- Operate the L6DSPU display module.
- Configure and operate data logging.

Prerequisites

It is strongly recommended that the student attend the PLC Basics (GX Works2) and L Series Programming (GX Works2) classes before attending this course. This course will concentrate on the programming and use of the special functions of the L Series controllers, and does not contain a discussion of PLC addressing, address types, or hardware configuration.

Course Duration

This course is designed for a 2 day class length.

Course Description

LESSON 1 – Built-In Inputs and Outputs

This lesson explains the dedicated functions of the built-in inputs and outputs.

LESSON 2 – Pulse Positioning

This lesson introduces the high speed pulse output functions for position control.

LESSON 3 – High Speed Counter

This lesson introduces the high speed counter input functions.

LESSON 4 – Display Module

This lesson details the use of the L6DSPU display module.

LESSON 5 – Data Logging

This lesson demonstrates data logging capabilities of the L Series.

List of Relevant Manuals

Hardware Manuals

SH(NA)080888	L I/O Module User's Manual
SH(NA)080889	LCPU User's Manual (Function Explanation, Program Fundamentals)
SH(NA)080890	LCPU User's Manual (Hardware, Design, Maintenance, Inspection)
SH(NA)080891	LCPU User's Manual (Built-In Ethernet Function)
SH(NA)080892	LCPU User's Manual (Built-In I/O Function)
SH(NA)080893	LCPU User's Manual (Data Logging Function)

Programming Manuals

SH(NA)080782	Q/L/FX Structured Programming Manual (Fundamentals)
SH(NA)080783	Q/L Structured Programming Manual (Common Instructions)
SH(NA)080784	Q/L Structured Programming Manual (Application Functions)
SH(NA)080785	Q/L Structured Programming Manual (Special Instructions)
SH(NA)080809	Q/L Programming Manual (Common Instructions)

GX Works2 Manuals

SH(NA)080779	GX Works2 Version 1 Operating Manual (Common)
SH(NA)080780	GX Works2 Version 1 Operating Manual (Simple Project)
SH(NA)080781	GX Works2 Version 1 Operating Manual (Structured Project)
SH(NA)080787	GX Works2 Version 1 Beginner's Manual (Simple Project)
SH(NA)080788	GX Works2 Version 1 Beginner's Manual (Structured Project)
SH(NA)080921	GX Works2 Operating Manual (Intelligent Function Module)

LESSON 1 – Built-In Inputs and Outputs

This lesson introduces the functions available to the built-in inputs and outputs on the L Series processors.

Lesson Objectives

At the conclusion of this lesson, you will be able to…

- Understand the functions of the built-in inputs and outputs.
- Configure built-in input and output special functions.

1.1 Introduction

The L Series processors come with 16 built-in inputs and 8 built-in outputs.

The inputs can be configured for several different special functions, including:

- General purpose inputs
- High speed inputs
- Interrupt inputs
- Pulse catch inputs
- High speed counter

The outputs can also be configured for special functions, such as:

- General purpose outputs
- High speed counter coincidence outputs
- High speed pulse output

Notes

Different functions can be assigned to each of the input points. Only one function can be assigned to any one input. The list of input functions and their valid input points is shown below.

○: Selectable, ×: No combination

External input signal	Function				
	General-purpose input	Interrupt input	Pulse catch	High-speed counter	Positioning
X0(High-speed)	○	○*1	○	Counter CH1 A Phase*1	×*3
X1(High-speed)	○	○*1	○	Counter CH1 B Phase*1	×*3
X2(High-speed)	○	○*1	○	Counter CH2 A Phase*1	×*3
X3(High-speed)	○	○*1	○	Counter CH2 B Phase*1	×*3
X4(High-speed)	○	○	○	Counter CH1 Z Phase*2	Axis #1 Zero Signal*2
X5(High-speed)	○	○	○	Counter CH2 Z Phase*2	Axis #2 Zero Signal*2
X6(Standard)	○	○	○	Counter CH1 Function Input*2	Axis #1 External Command Signal*2
X7(Standard)	○	○	○	Counter CH2 Function Input*2	Axis #2 External Command Signal*2
X8(Standard)	○	○	○	Counter CH1 Latch Counter*2	Axis #1 Drive Module READY Signal*2
X9(Standard)	○	○	○	Counter CH2 Latch Counter*2	Axis #2 Drive Module READY Signal*2
XA(Standard)	○	○	○	×*3	Axis #1 Near-point Dog Signal*2
XB(Standard)	○	○	○	×*3	Axis #2 Near-point Dog Signal*2
XC(Standard)	○	○	○	×*3	Axis #1 Upper Limit Signal*2
XD(Standard)	○	○	○	×*3	Axis #2 Upper Limit Signal*2
XE(Standard)	○	○	○	×*3	Axis #1 Lower Limit Signal*2
XF(Standard)	○	○	○	×*3	Axis #2 Lower Limit Signal*2

*1 When using CH1 for the high-speed counter function, X0 and X1 cannot be used as interrupt inputs. Also, when using CH2 for the high-speed counter function, X2 and X3 cannot be used as interrupt inputs.
Other functions such as the general-purpose input can be used.

*2 When this signal is not required, the input signal can be used for other functions such as the general-purpose input.

*3 When the corresponding function (the high-speed counter function or positioning function) is selected at function selection, this signal is not used for the function. The input signal can be used for other function such as the general-purpose input.

Any of the optional functions, such as the positioning axis upper and lower limits, are not required. If that function is not being used, the input can be configured for any other available function.

Inputs X0 through X5 can be wired as normal inputs or for differential line driver inputs for use with the high speed counter functions.

Notes

The same is true for the built-in outputs. Only one function can be assigned to any one output at a time, and any output not being used for a special function can be assigned as a general output.

○: Selectable, ×: No combination

External output signal	Function		
	General-purpose output	High-speed Counter	Positioning
Y0	○	CH1 Coincidence Output No.1*1	×*3
Y1	○	CH2 Coincidence Output No.1*1	×*3
Y2	○	CH1 Coincidence Output No.2*2	Axis #1 Deviation Counter Clear*1
Y3	○	CH2 Coincidence Output No.2*2	Axis #2 Deviation Counter Clear*1
Y4	○	×*3	Axis #1 CW/PULSE/A Phase Output*1
Y5	○	×*3	Axis #2 CW/PULSE/A Phase Output*1
Y6	○	×*3	Axis #1 CCW/SIGN/B Phase Output*1
Y7	○	×*3	Axis #2 CCW/SIGN/B Phase Output*1

*1 This signal must be used depending on parameter settings.
When this signal is not used, the output signal can be used for the general-purpose output function.

*2 When this signal is not used, the output signal can be used for the general-purpose output function.

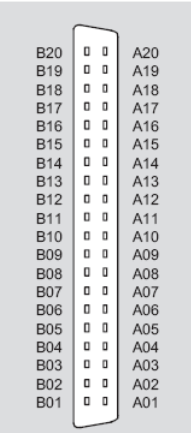
*3 When the corresponding function (the high-speed counter function or positioning function) is selected at function selection, this signal is not used for the function. The output signal can be used for the general-purpose output function.

Notes

1.2 Input and Output Wiring

The built-in inputs and outputs are accessed via the 40-pin connector on the front right of the CPU. There are several options for connecting to this connector.

The connections are made as shown below.

Terminal layout	Pin number	Signal name*1	Pin number	Signal name*1
 Viewed from the front of the module	B20	IN0-24V	A20	IN2-24V
	B19	IN0-DIFF	A19	IN2-DIFF
	B18	IN0-COM	A18	IN2-COM
	B17	IN1-24V	A17	IN3-24V
	B16	IN1-DIFF	A16	IN3-DIFF
	B15	IN1-COM	A15	IN3-COM
	B14	IN4-24V	A14	IN5-24V
	B13	IN4-DIFF	A13	IN5-DIFF
	B12	IN4-COM	A12	IN5-COM
	B11	INCOM	A11	INCOM
	B10	IN6	A10	IN7
	B09	IN8	A09	IN9
	B08	INA	A08	INB
	B07	INC	A07	IND
	B06	INE	A06	INF
	B05	OUT0	A05	OUT1
	B04	OUT2	A04	OUT3
	B03	OUT4	A03	OUT5
	B02	OUT6	A02	OUT7
	B01	OUTCOM	A01	OUTCOM

*1 For signal names when using the positioning function or high-speed counter function, refer to the following.
Positioning function: Page 46, Section 7.2.1
High-speed counter function: Page 182, Section 8.2.1

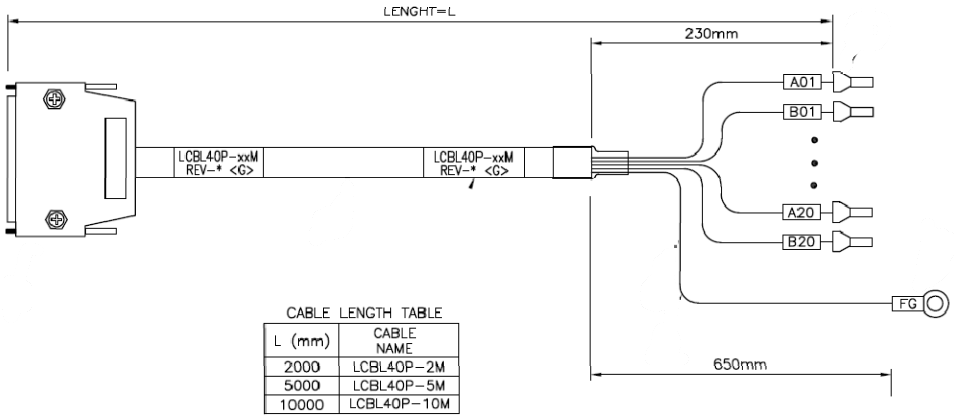
Specifications for the inputs and outputs can be found in the manual.

Notes

This connection can be made with the **A6CON1, A6CON2, A6CON3,** or **A6CON4** connectors by the user.

The standard A6TB* and AC*TB CANNOT be used with the LCPU built-in inputs and outputs

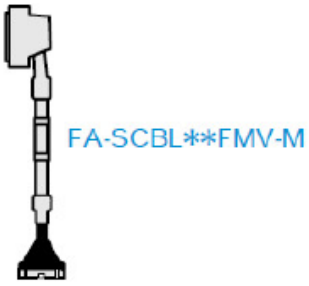
Mitsubishi also offers the **LCBL40P-2M, LCBL40P-5M,** and **LCBL40P-10M** cables, which will connect each pin of the connector to a loose ferruled wire. This cable can be used with any standard terminal blocks.

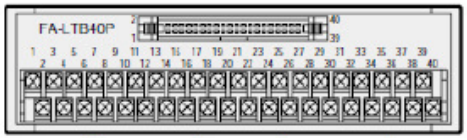


CABLE LENGTH TABLE

L (mm)	CABLE NAME
2000	LCBL40P-2M
5000	LCBL40P-5M
10000	LCBL40P-10M

Another option is the **FA-LTB40P** terminal block and **FA-SCBL05FMV-M**, (0.5 meter), **FA-SCBL10FMV-M** (1 meter), **FA-SCBL15FMV-M** (1.5 meter), or **FA-SCBL20FMV-M** (2 meter) cables. Together, the cable and terminal block provide a screw terminal connection for each point on the connector.

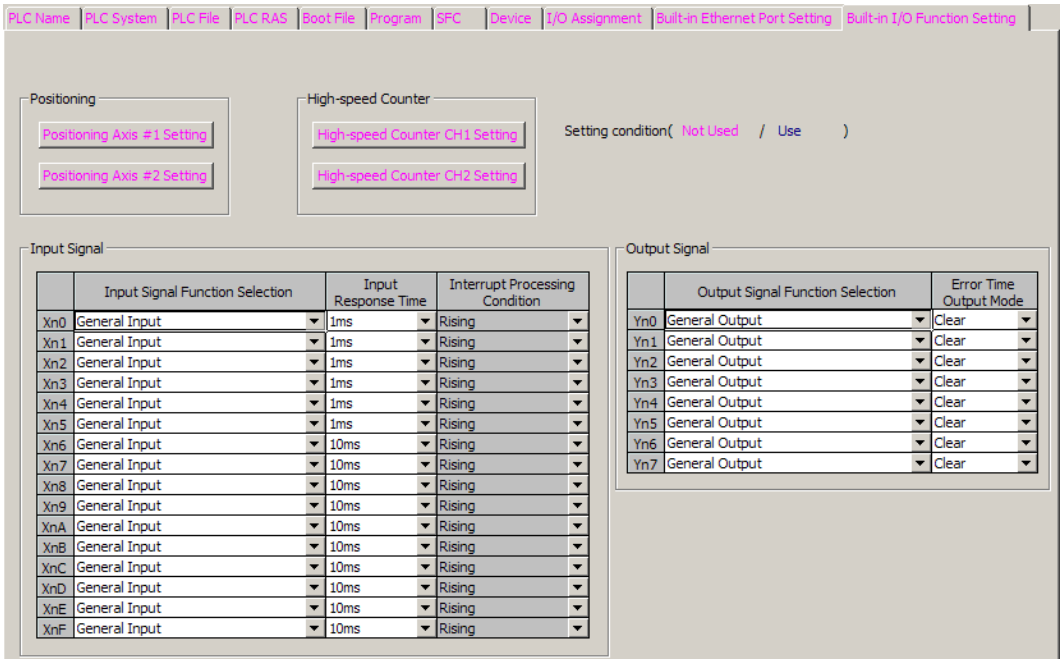




Notes

1.3 Basic Configuration

The configuration of the built-in input and output functions is done in the PLC Parameters. In Parameters, there is a separate tab called Built-In I/O Function Setting. On this tab, settings are made to determine the function associated with each built-in input or output point.



As with all other parameter settings, the pink colored text means nothing has been changed from defaults. Once changes are made, text turns dark blue.

At the top of this screen are 4 buttons to configure the positioning output and high speed counter input channels. At the bottom left of this window, functions can be assigned to the inputs. At the bottom right of the window, functions are assigned to the outputs.

By default, all inputs and outputs are configured as general inputs or outputs. This makes them perform like any other input or output point on the PLC.

Notes

Input configuration is done in the three columns on the bottom left. In the first column, select from the list of available input functions. Note that the list will vary based on the input number being edited.

In the second column, set the input response time. Inputs X0 through X5 have high speed input capabilities, with a response time adjustable from as slow as 1ms to as fast as 0.01ms. Inputs X6 through XF have normal input speed, with a response time set between 0.1ms and 70ms. The default setting is 1ms for the high speed inputs and 10ms for the normal speed inputs. Notice this column may be grayed out, depending on the function selected for this input.

The interrupt processing condition will be discussed shortly.

Output configuration is done in the two columns in the bottom right. In the first column, select from the list of available output functions, which is dependent on the output being edited.

The second column determines output state at the time of a PLC error. For each output, the choices are clear and hold. If clear is selected, which is the default, the output will turn off if the PLC detects an error and stops processing. If hold is selected, the output will remain in its last programmed state until the PLC is reset or returned to the run mode.

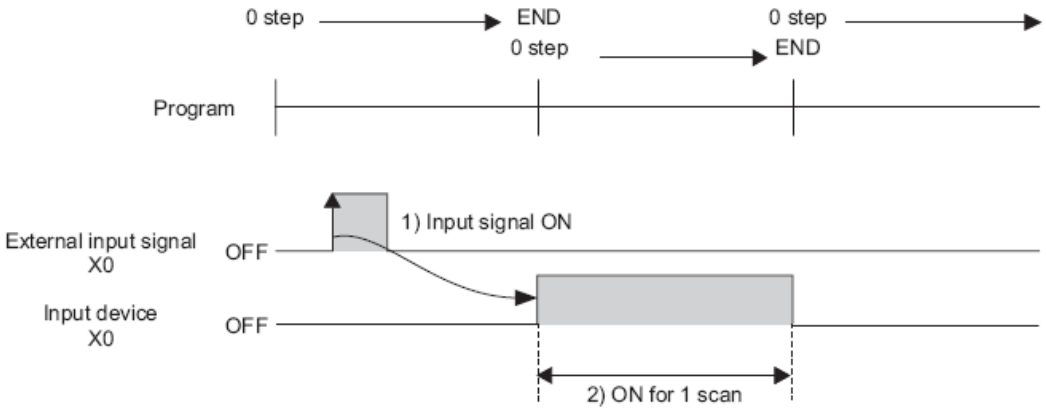
Notes

1.4 Pulse Catch Inputs

Pulse catch inputs are useful for detecting inputs which do not remain on for an entire PLC scan. With previous products, if the PLC scan was 30ms and the input was only on for 3ms, there was no way for the PLC to capture it and hold the status for the start of the next scan. So the PLC simply did not recognize pulses which are less than one scan long.

When an input is configured for pulse catch, the PLC will watch for input pulses which are less than one PLC scan in length. It will then turn on the input inside the PLC for one complete scan, allowing the program to operate as if the input remained on long enough to be detected normally.

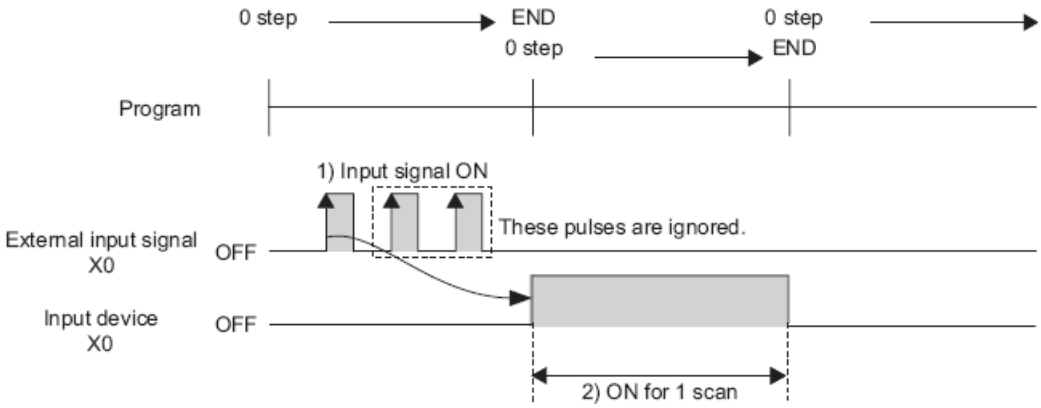
Below is an example of the pulse catch function's basic operation.



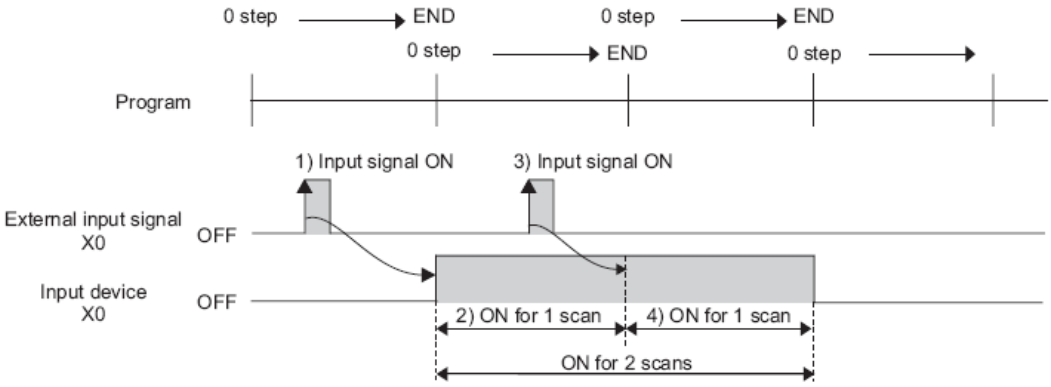
The pulse catch function is still dependent upon the input response time setting. If the input response time is too slow, it is still possible that pulses will be missed. The pulse must remain on for a minimum of the input response time.

Notes

If multiple pulses are detected within a single scan cycle, the input to the PLC will only be turned on for one scan, effectively ignoring more than the first pulse in any given PLC scan cycle.

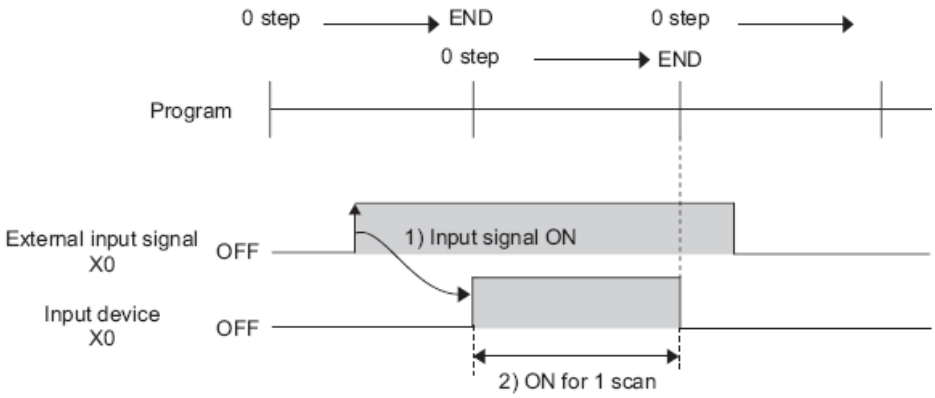


If pulses are detected in consecutive scans, the input to the PLC will remain on for multiple consecutive scans.



Notes

When a pulse input remains on for more than one scan, the program will only be provided with a one scan pulse. So the input in the program may turn off before the physical input turns off.



Inputs configured as pulse catch inputs should not be used as direct inputs (DX) in the program. They should also not be accessed with the input refreshing instructions, such as RFS, COM, CCOM, and MTR.

Notes

1.5 Interrupt Inputs

Interrupt inputs are used to interrupt the process immediately when an input is detected.

Interrupts can be configured to operate on the rising edge of an input, falling edge of an input, or both edges of an input.

By default, interrupt numbers and priorities are assigned as follows:

I/O signals	Interrupt pointer	Priority *1
X0	I0	5
X1	I1	6
X2	I2	7
X3	I3	8
X4	I4	9
X5	I5	10
X6	I6	11
X7	I7	12
X8	I8	13
X9	I9	14
XA	I10	15
XB	I11	16
XC	I12	17
XD	I13	18
XE	I14	19
XF	I15	20

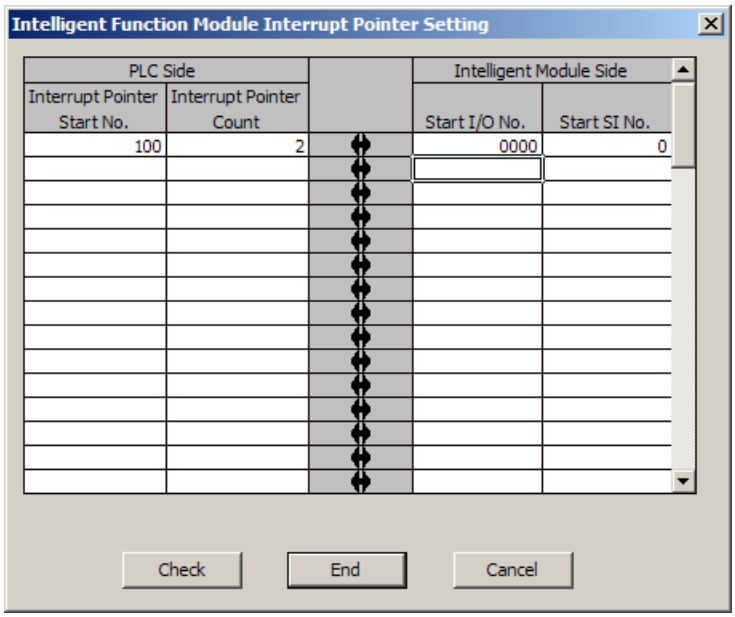
*1 The priority 1 to 4 are used for interrupt pointers I28 to I31 (interrupt by build-in timers)

As indicated below the table above, interrupts 28 through 31 are the timed system interrupts. They have higher priority levels than the input interrupts.

Notes

So if input X0 is configured for interrupt input on the rising edge, when X0 turns on, interrupt I0 in the PLC program will execute, regardless of the current point in the scan cycle.

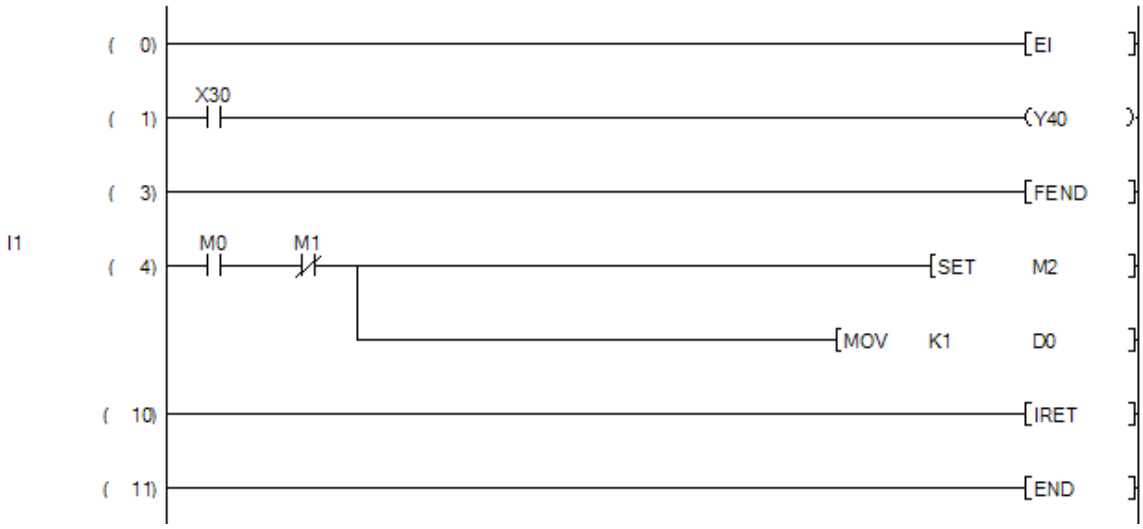
It is possible to change the interrupt numbers mentioned in the table above. This can be done in the PLC Parameters, under PLC System, at the button labeled Interrupt Pointer Setting. On this screen, it is possible to change the starting interrupt number, as shown below.



In order to allow interrupts to execute in the program, the command **EI** must be included in the program to enable interrupts. The **DI** command can be used to disable interrupts. The **IMASK** command can also be used enable or disable certain interrupts.

Notes

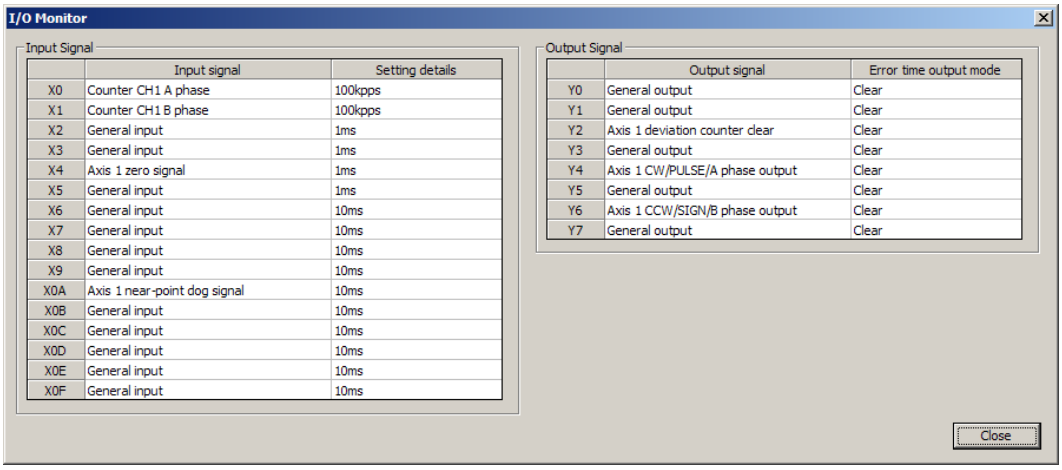
Interrupt logic is placed at the end of the program, in similar fashion to subroutine programs. They appear after the **FEND** command. Interrupts are started by an interrupt pointer number, such as **I0**, and finished with an interrupt return command, **IRET**. An example of interrupt logic is shown below.



Notes

1.6 Monitor Tool

In the Tool menu, under Built-In I/O Monitor, there is a tool called I/O Monitor. This tool will show the configured status of the built-in inputs and outputs on the L Series CPU. This shows the configuration of the I/O as running in the CPU, as defined by the PLC Parameters.



Notes

LESSON 2 – Pulse Positioning

This lesson explains the built-in pulse positioning output capabilities in the L Series.

Lesson Objectives

At the conclusion of this lesson, you will be able to…

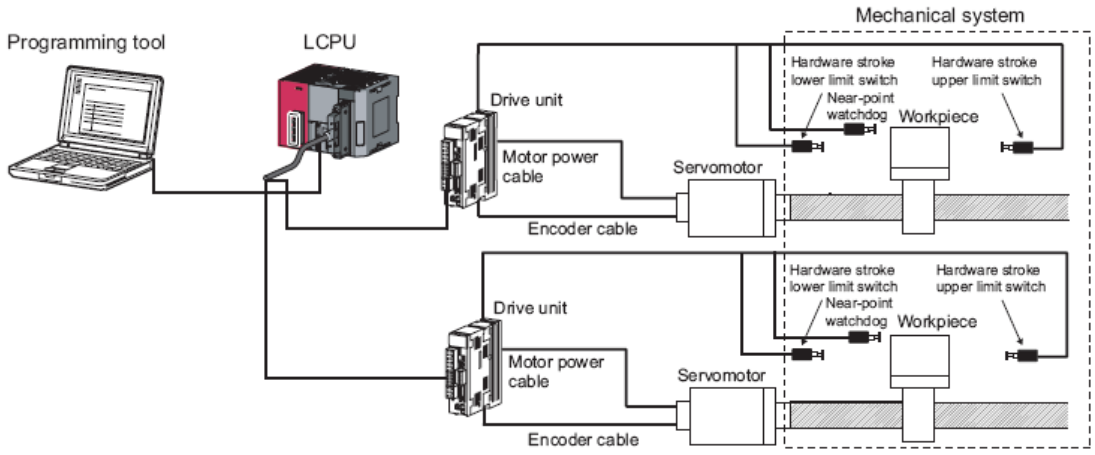
- Understand the capabilities of the built-in pulse outputs.
- Configure pulse positioning parameters.
- Write programs using the dedicated pulse positioning commands.

2.1 Introduction

Pulse train outputs can be used to control a servo or stepper amplifier. The speed of the pulses and the number of pulses determine both the distance to move and the speed at which to move.

This type of position control requires a servo or stepper controller designed to take a high speed pulse input for control. Mitsubishi offers this capability in the current MR-E and MR-J3-A servo families, as well as many legacy servo products. Many third party servo or stepper controllers can also be supported in this method.

There are a number of commands found in the CPU dedicated to pulse motion control. These commands will be covered in detail in this lesson.



Notes

The L Series CPU offer 2 channels of high speed pulse output in the standard CPU. These 2 channels offer some basic functions, as shown in the list below.

- 200KHz pulse output speed
- Open collector transistor outputs
- Origin point return (homing), with home position search function
- Control of target speed and position
- Software and hardware end of travel limit options
- Simple jogging control
- Absolute positioning function

More detailed specifications can be found in the LCPU User's Manual (Built-In I/O Function) manual in section 7.4.

The table below shows all of the dedicated special relays and special registers devoted to the high speed pulse output functions of the L Series.

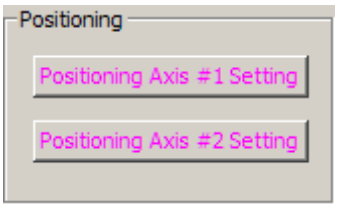
Special relay number		Name	Special register number		Name
Axis 1	Axis 2		Axis 1	Axis 2	
SM1840	SM1860	Axis ☐ busy	SD1840	SD1860	Axis ☐ current feed value
SM1841	SM1861	Axis ☐ positioning completion	SD1841	SD1861	
SM1842	SM1862	Axis ☐ OPR request	SD1842	SD1862	Axis ☐ current speed
SM1843	SM1863	Axis ☐ completed	SD1843	SD1863	
SM1844	SM1864	Axis ☐ speed 0	SD1844	SD1864	Axis ☐ axis operation status
SM1845	SM1865	Axis ☐ error	SD1845	SD1865	Axis ☐ error code
SM1846	SM1866	Axis ☐ warning	SD1846	SD1866	Axis ☐ warning code
SM1847	SM1867	Axis ☐ start in busy status	SD1847	SD1867	Axis ☐ external I/O signals
SM1848	SM1868	Axis ☐ start instruction	SD1848	SD1868	Axis ☐ movement amount after near-point dog ON
SM1850	SM1870	Axis ☐ error reset	SD1849	SD1869	
SM1851	SM1871	Axis ☐ OPR request off	SD1850	SD1870	Axis ☐ data No. of positioning being executed
SM1852	SM1872	Axis ☐ speed/position switching	—		—

Notes

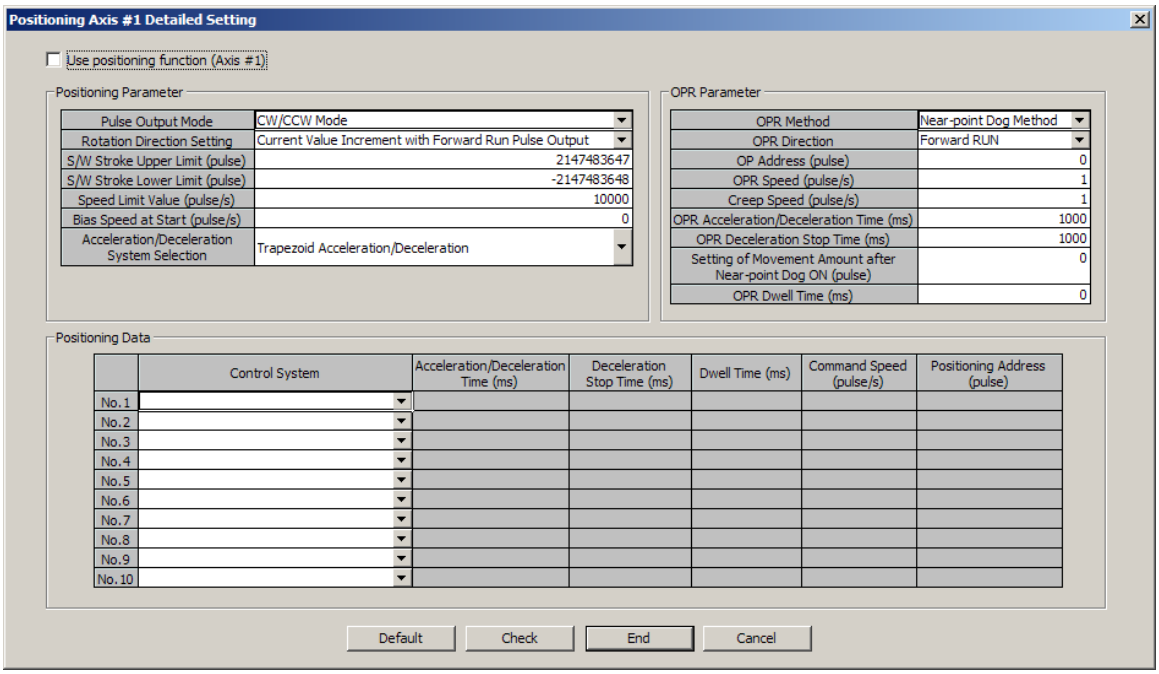
2.2 Configuration

Before the pulse output function can be used, there are settings to be made in the PLC parameters. These settings are found on the Built-In I/O Functions tab in the PLC parameters.

In the top left of the tab, there are two buttons used to configure the settings of the two pulse output channels. They are called Axis #1 and Axis #2. Pink text indicates that the values inside are all at defaults, while blue text indicates that there have been changes made in that window.



Clicking one of these buttons will display the configuration window for the output axis. The first setting at the top is a check box to enable the positioning function for this channel. This box must be checked for the settings made on this screen to be active.



Notes

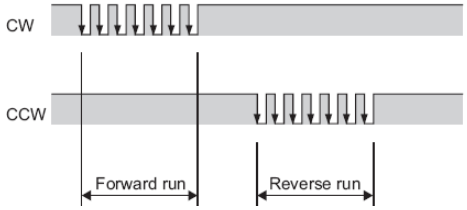
In the top left portion of the window, some basic positioning settings are made. The chart below shows these setting items, their valid setting ranges, as well as their default values.

Setting item	Setting range	Default
Pulse Output Mode	CW/CCW Mode	CW/CCW Mode
	PULSE/SIGN Mode	
	A Phase/B Phase Mode (Multiple of 1)	
	A Phase/B Phase Mode (Multiple of 4)	
Rotation Direction Setting	Current Value Increment with Forward Run Pulse Output	Current Value Increment with Forward Run Pulse Output
	Current Value Increment with Forward Run Pulse Output	
S/W Stroke Upper Limit (pulse)	-2147483648 to 2147483647	2147483647
S/W Stroke Lower Limit (pulse)		-2147483648
Speed Limit Value (pulse/s)	1 to 200000	10000
Bias Speed at Start (pulse/s)	0 to 200000	0
Acceleration/Deceleration System Selection	Trapezoid Acceleration/Deceleration	Trapezoid Acceleration/Deceleration
	S-curve Acceleration/Deceleration	

The choices for pulse output mode are shown below.

CW/CCW mode

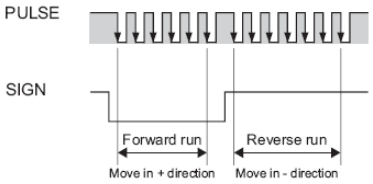
Forward run feed pulses (CW) are output when the motor is rotating forward. Reverse run feed pulses (CCW) are output when the motor is rotating in reverse.



PULSE/SIGN mode

Forward/reverse control is based on on/off of the direction sign (SIGN).

- The direction sign becomes LOW when the motor is rotating forward.
- The direction sign becomes HIGH when the motor is rotating in reverse.

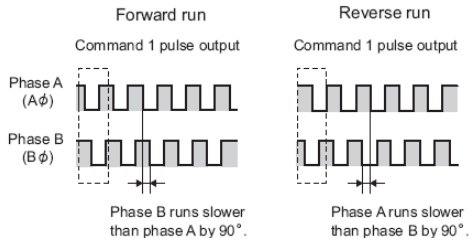


Notes

A phase/B phase mode (multiple of 1), A phase/B phase mode (multiple of 4)

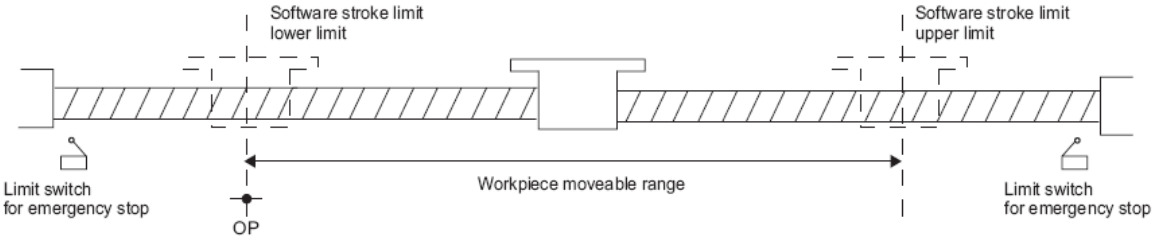
Forward/reverse control is based on the difference between phase A (Aϕ) and phase B (Bϕ).

- Phase B lags phase A by 90° when the motor is rotating forward.
- Phase A lags phase B by 90° when the motor is rotating in reverse.
- When "A Phase/B Phase Mode (Multiple of 1)" is set



The second setting determines of the motor should spin clockwise or counter-clockwise when forward pulses are input.

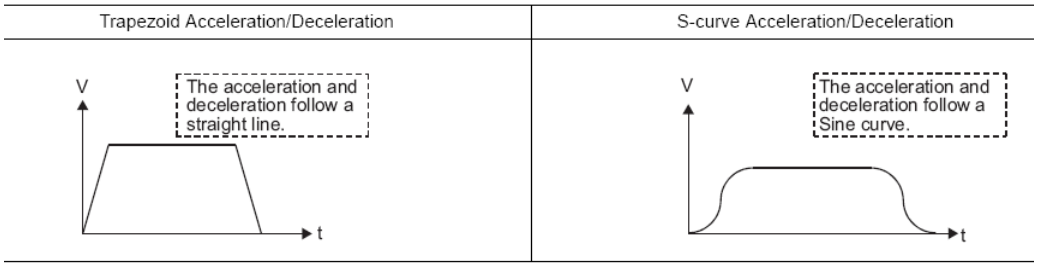
The third and fourth settings configure a set of software end of travel limits to prevent movement beyond the extents of the connected system. These are optional, and are typically configured inside of any hardware limit switches installed on the system. An example is shown below.



The next settings are speed limits. The speed limit value (set in pulses per second) can be used to restrict the maximum speed of an output. The bias speed at start (also set in pulses per second) can be used to set a minimum starting speed. This setting is typically used with stepper motors which need a minimum speed to start smoothly.

Notes

The last setting in the positioning parameters is for the acceleration and deceleration type. The choices are trapezoidal and S-curve acceleration and deceleration, as shown below.



The settings in the upper right of the window set the home position return configuration. This data is used to establish a home reference point for absolute positioning. The settings and their default values are listed below.

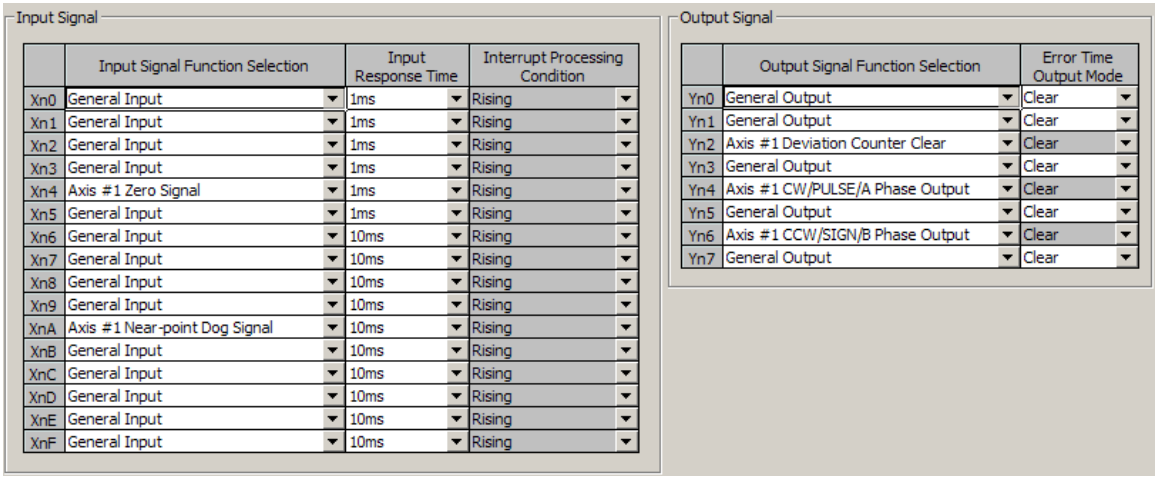
Setting item	Setting range	Default
OPR Method	Near-Point Dog Method	Near-Point Dog Method
	Stopper 1	
	Stopper 2	
	Stopper 3	
	Count 1	
	Count 2	
	No Method	
OPR Direction	Forward RUN	Forward RUN
	Reverse RUN	
OP Address (pulse)	-2147483648 to 2147483647	0
OPR Speed (pulse/s)	1 to 200000	1
Creep Speed (pulse/s)		
OPR Acceleration/Deceleration Time (ms)	0 to 32767	1000
OPR Deceleration Stop Time (ms)		
Setting of Movement Amount after Near-point Dog ON (pulse)	0 to 2147483647	0
OPR Dwell Time (ms)	0 to 65535	

There are 6 methods offered for establishing the zero reference point. More detail will follow later in this lesson.

Notes

The remainder of the setting window is dedicated to storing 10 different movement profiles which can be called from a command in the controller program. The types of movements and their parameters will be discussed later in this lesson.

Once the parameters are set, certain inputs and outputs will be automatically adjusted to their respective signals for the positioning control function, as shown below.



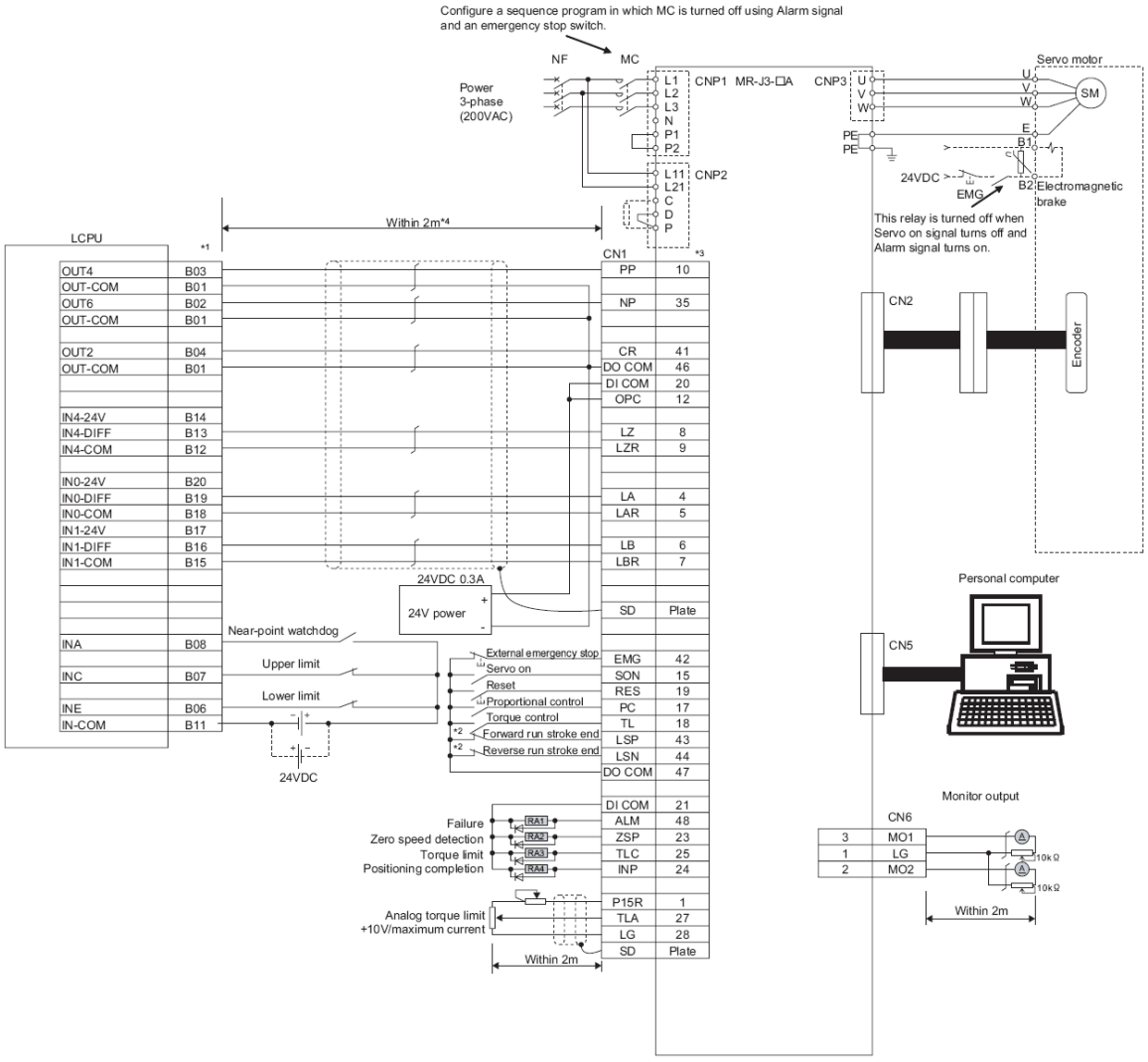
There are other signals which can be configured based on the needs of the application. The quick reference list below shows which inputs and outputs are used for the positioning functions.

Positioning	
Axis#1	**Axis#2**
X4	X5
X6	X7
X8	X9
XA	XB
XC	XD
XE	XF
Y2	Y3
Y4	Y5
Y6	Y7

Notes

2.3 Connections

The diagram below shows the basic connections for an MR-J3-A series servo amplifier and an L Series CPU.



The pin numbers shown above for the LCPU are for axis 1. The pin numbers are different for axis 2. Axis 2 signals are found at the same numbers on the A set of pins in the connector.

Notes

2.4 Servo Parameters

The configuration of the servo amplifier is done in parameters. These parameters can be accessed via the MR Configurator software package. The MR Configurator package is a suite of individual servo parameter software tools for the various models of Mitsubishi servo amplifier.

Depending on which family of servo amplifiers is being used, there are different components of the MR Configurator package.

MR Configurator Titles

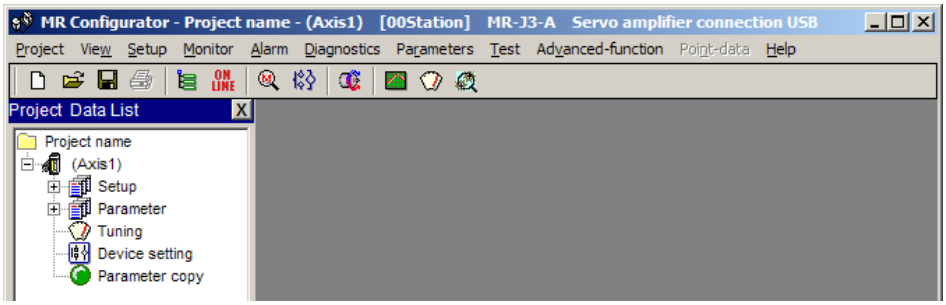
Servo Family	SW
MR-J2	81E
MR-E	154E
MR-J2S	161E
MR-J3	221E

For this class, we will use SETUP221. The software can be started from the Start menu, under MELSOFT Application, under MR Configurator, by selecting SETUP221.

The other packages are located in the Start menu, under MELSERVO, under SETUP_Software.

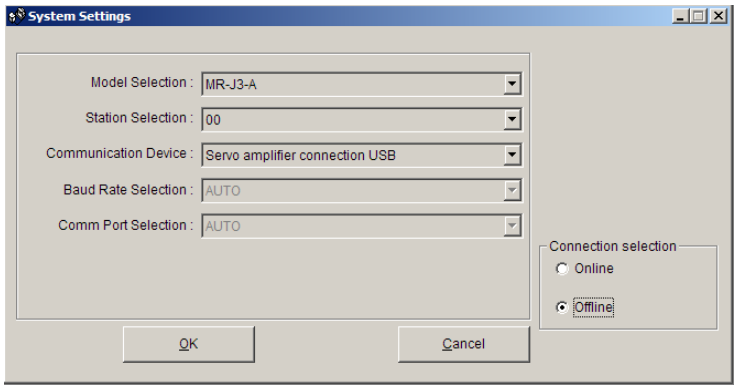
Notes

Once the software is started, a window similar to the one below will be shown.



Across the top of the screen are drop-down menus and toolbar buttons allowing access to the various options of the software. On the left hand side is the project data list window, which is where the configuration data for the axis is displayed in a tree structure.

Under the Setup option is the system settings list, which is where the type of servo amplifier and communication method is chosen. Click on the + next to Setup in the system settings list on the left. Then double click on the System Settings button to open the System Settings dialog. This dialog can also be accessed from the drop-down menus by selecting Setup and then System Settings. Once selected, the following dialog box is displayed.



For this class, select ‘MR-J3-A’ and ‘Servo amplifier connection USB’. Ensure that the USB cable is connected and drivers have been properly installed, and then click OK.

Notes

The parameters on the MR-J3 units are broken into several groups. Each group is dedicated to a certain portion of the configuration. This division of the parameter list applies to both the MR-J3-*A and MR-J3-*B series amplifiers.

The MR-J3-*A units have 144 parameters (of which 44 are non-user adjustable, for manufacturer settings only).

Parameter group	Main description
Basic setting parameters (No. PA ☐☐)	When using this servo amplifier in the position control mode, make basic setting with these parameters.
Gain/filter parameters (No. PB ☐☐)	Use these parameters when making gain adjustment manually.
Extension setting parameters (No. PC ☐☐)	When using this servo amplifier in the speed control mode or torque control mode, mainly use these parameters.
I/O setting parameters (No. PD ☐☐)	Use these parameters when changing the I/O signals of the servo amplifier.

The complete list of parameters for the J3-A models can be found in Chapter 5 of the MR-J3-A Servo Amplifier Instruction Manual.

When viewing the parameter list in the manual, there is a complete table showing all of the parameters in that group. The list also shows what the default value is for each parameter. It is important to note that many of the parameters are only valid when using the amplifier in a specific mode, so not all parameters will be applicable to all control systems. Detailed descriptions of each parameter and its settings are found in the same chapter immediately after the list.

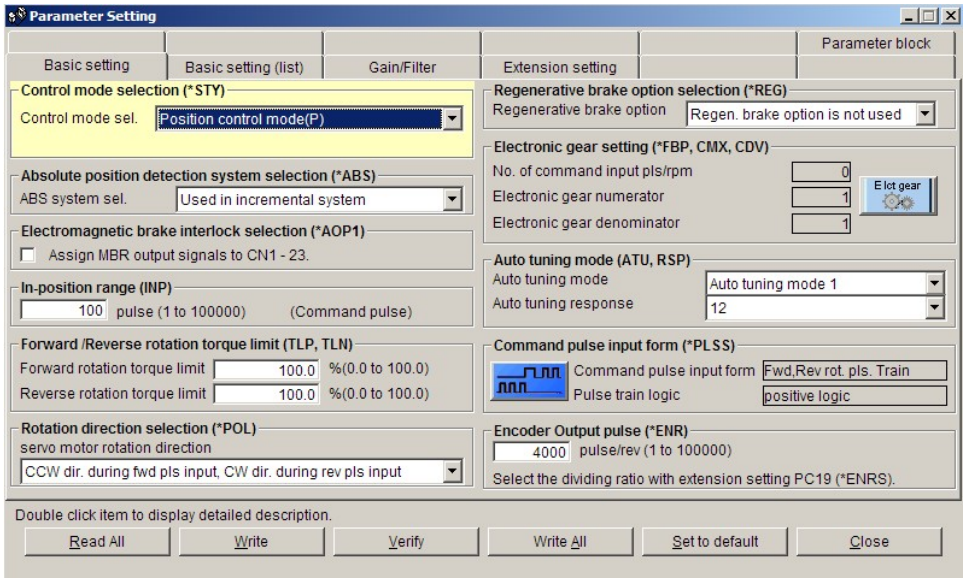
Any parameter shown in the manual or the MR Configurator parameter window whose name is prefixed with an asterisk (*) requires that power to the amplifier be reset for changes to take effect.

Notes

To access the parameters via MR Configurator, click on the + next to Parameters, and then double click on any of the parameter groups. The parameters can also be accessed via the Parameters drop down menu, with the 'Parameter List' option.

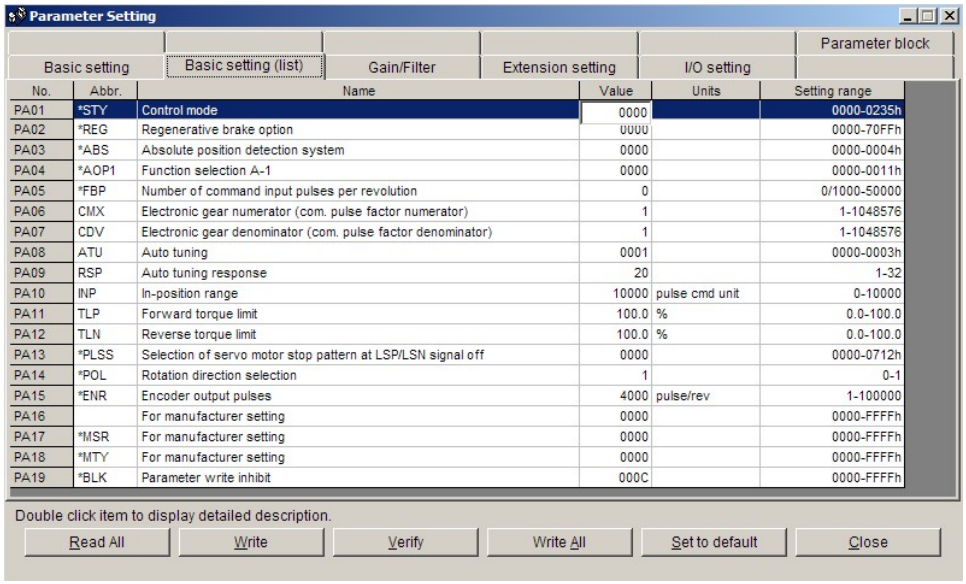
Once selected, this brings up a page with numerous tabs allowing access to the various parameter settings in the amplifier. Each tab offers a different set of data.

PAxx parameters are on the 'Basic setting' tab.



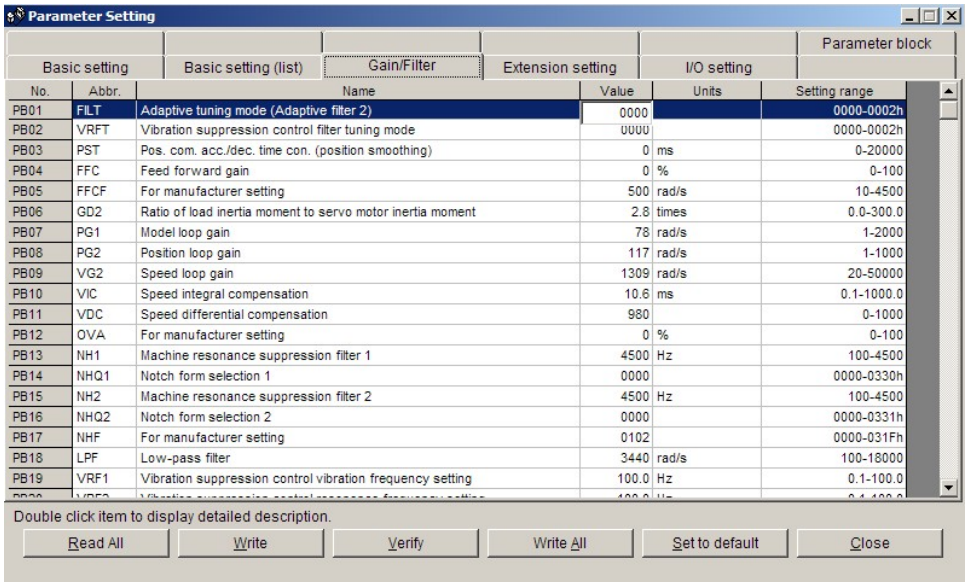
Notes

'Basic setting (list)' shows these parameters listed in order.



No.	Abbr.	Name	Value	Units	Setting range
PA01	*STY	Control mode	0000		0000-0235h
PA02	*REG	Regenerative brake option	0000		0000-70FFh
PA03	*ABS	Absolute position detection system	0000		0000-0004h
PA04	*AOP1	Function selection A-1	0000		0000-0011h
PA05	*FBP	Number of command input pulses per revolution	0		0/1000-50000
PA06	CMX	Electronic gear numerator (com. pulse factor numerator)	1		1-1048576
PA07	CDV	Electronic gear denominator (com. pulse factor denominator)	1		1-1048576
PA08	ATU	Auto tuning	0001		0000-0003h
PA09	RSP	Auto tuning response	20		1-32
PA10	INP	In-position range	10000	pulse cmd unit	0-10000
PA11	TLP	Forward torque limit	100.0	%	0.0-100.0
PA12	TLN	Reverse torque limit	100.0	%	0.0-100.0
PA13	*PLSS	Selection of servo motor stop pattern at LSP/LSN signal off	0000		0000-0712h
PA14	*POL	Rotation direction selection	1		0-1
PA15	*ENR	Encoder output pulses	4000	pulse/rev	1-100000
PA16		For manufacturer setting	0000		0000-FFFFh
PA17	*MSR	For manufacturer setting	0000		0000-FFFFh
PA18	*MTY	For manufacturer setting	0000		0000-FFFFh
PA19	*BLK	Parameter write inhibit	000C		0000-FFFFh

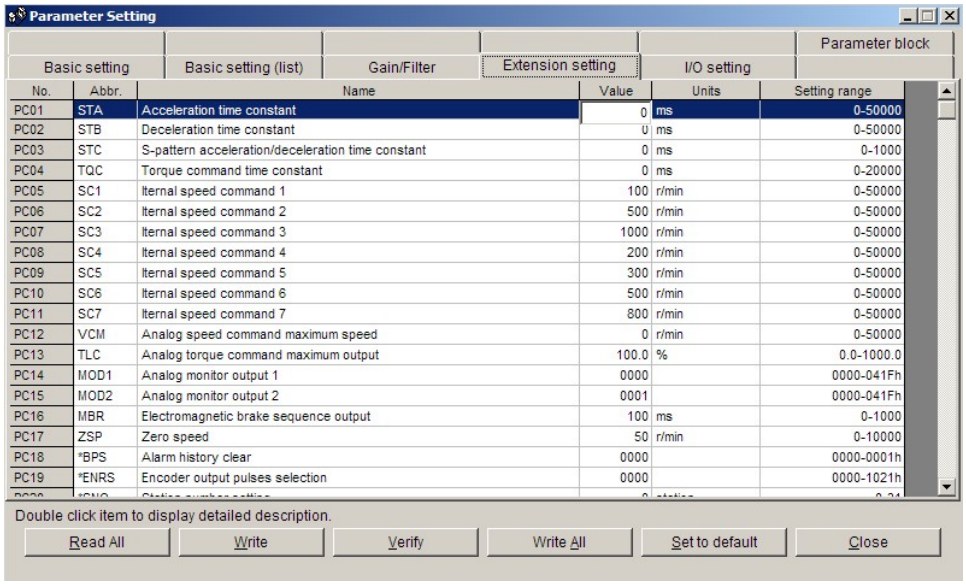
PBxx parameters are found on the 'Gain/Filter' tab.



No.	Abbr.	Name	Value	Units	Setting range
PB01	FILT	Adaptive tuning mode (Adaptive filter 2)	0000		0000-0002h
PB02	VRFT	Vibration suppression control filter tuning mode	0000		0000-0002h
PB03	PST	Pos. com. acc./dec. time con. (position smoothing)	0	ms	0-20000
PB04	FFC	Feed forward gain	0	%	0-100
PB05	FFCF	For manufacturer setting	500	rad/s	10-4500
PB06	GD2	Ratio of load inertia moment to servo motor inertia moment	2.8	times	0.0-300.0
PB07	PG1	Model loop gain	78	rad/s	1-2000
PB08	PG2	Position loop gain	117	rad/s	1-1000
PB09	VG2	Speed loop gain	1309	rad/s	20-50000
PB10	VIC	Speed integral compensation	10.6	ms	0.1-1000.0
PB11	VDC	Speed differential compensation	980		0-1000
PB12	OVA	For manufacturer setting	0	%	0-100
PB13	NH1	Machine resonance suppression filter 1	4500	Hz	100-4500
PB14	NHQ1	Notch form selection 1	0000		0000-0330h
PB15	NH2	Machine resonance suppression filter 2	4500	Hz	100-4500
PB16	NHQ2	Notch form selection 2	0000		0000-0331h
PB17	NHF	For manufacturer setting	0102		0000-031Fh
PB18	LPF	Low-pass filter	3440	rad/s	100-18000
PB19	VRF1	Vibration suppression control vibration frequency setting	100.0	Hz	0.1-100.0

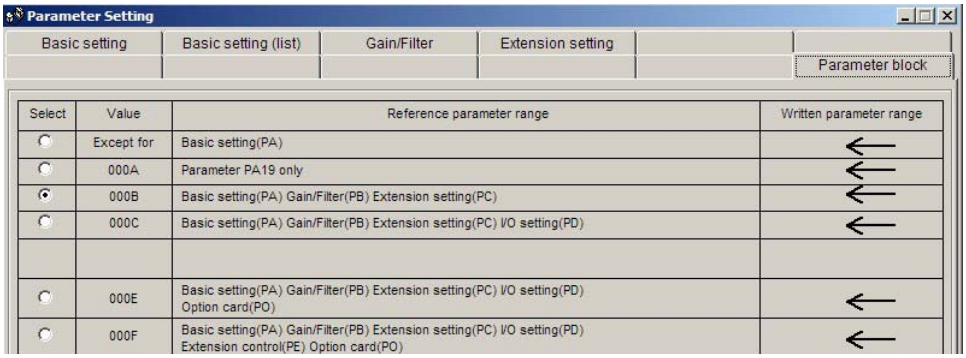
Notes

PCxx parameters can be modified on the ‘Extension Setting’ tab.



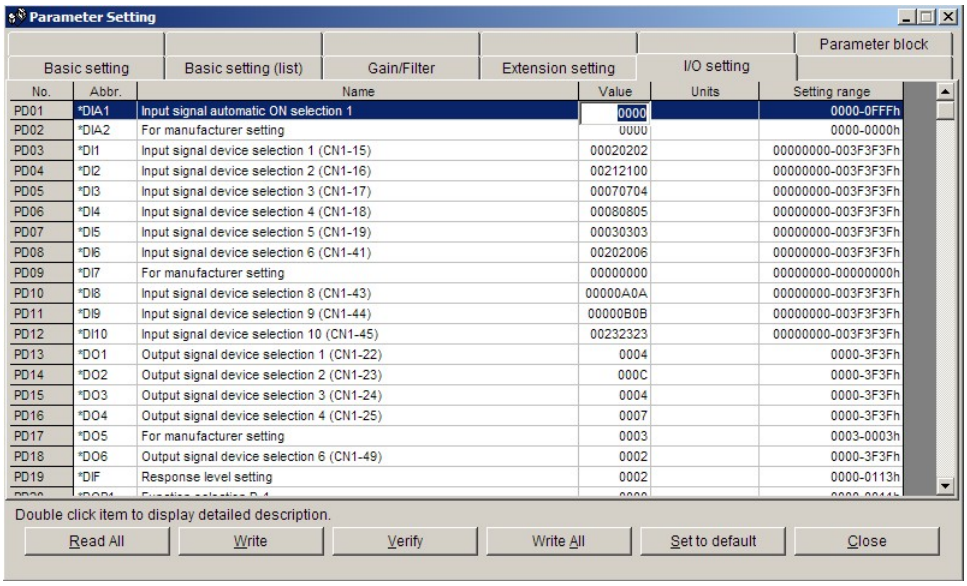
In order to access the PDxx parameters, a change must be made to the parameter block tab. Parameter block limits the parameter set available for modification. This is to prevent unauthorized changes to parameters. This setting adjusts parameter PA19.

The default setting allows to the PAxx, PBxx, and PCxx parameters. This must be changed to allow access to PDxx parameters.



Notes

Once this change has been made, there will be a new tab called I/O setting. This tab will show the PDxx parameters.



No.	Abbr.	Name	Value	Units	Setting range
PD01	*DIA1	Input signal automatic ON selection 1	0000		0000-0FFFh
PD02	*DIA2	For manufacturer setting	0000		0000-0000h
PD03	*DI1	Input signal device selection 1 (CN1-15)	00020202		00000000-003F3F3Fh
PD04	*DI2	Input signal device selection 2 (CN1-16)	00212100		00000000-003F3F3Fh
PD05	*DI3	Input signal device selection 3 (CN1-17)	00070704		00000000-003F3F3Fh
PD06	*DI4	Input signal device selection 4 (CN1-18)	00080805		00000000-003F3F3Fh
PD07	*DI5	Input signal device selection 5 (CN1-19)	00030303		00000000-003F3F3Fh
PD08	*DI6	Input signal device selection 6 (CN1-41)	00202006		00000000-003F3F3Fh
PD09	*DI7	For manufacturer setting	00000000		00000000-00000000h
PD10	*DI8	Input signal device selection 8 (CN1-43)	00000A0A		00000000-003F3F3Fh
PD11	*DI9	Input signal device selection 9 (CN1-44)	00000B0B		00000000-003F3F3Fh
PD12	*DI10	Input signal device selection 10 (CN1-45)	00232323		00000000-003F3F3Fh
PD13	*DO1	Output signal device selection 1 (CN1-22)	0004		0000-3F3Fh
PD14	*DO2	Output signal device selection 2 (CN1-23)	000C		0000-3F3Fh
PD15	*DO3	Output signal device selection 3 (CN1-24)	0004		0000-3F3Fh
PD16	*DO4	Output signal device selection 4 (CN1-25)	0007		0000-3F3Fh
PD17	*DO5	For manufacturer setting	0003		0003-0003h
PD18	*DO6	Output signal device selection 6 (CN1-49)	0002		0000-3F3Fh
PD19	*DIF	Response level setting	0002		0000-0113h

Notes

2.5 EXERCISE – Positioning Configuration

Servo Parameter Setting

Based on the default parameters, this servo amplifier will be configured for positive and negative pulses in position mode.

For this class, the following parameters should be set:

- PA05 set to 16,384 to change input to 16,384 pulses per revolution
- PA14 set to 1 for clockwise pulses forward rotation
- PD01 set to 0C00 to force on LSP/LSN

Once these parameters are updated, the power will need to be cycled to the amplifier for the changes to take effect.

CPU Parameter Setting

Make the following settings in the PLC Parameters

- Enable positioning axis 1
- Speed limit to 100,000 pulses/sec
- Set OPR Method to No Method
- Set X4 to Axis 1 Zero Signal
- Set X6 to Axis 1 External Command Signal
- Set XA to Axis 1 Near Point Dog Signal
- Set XC to Axis 1 Upper Limit (optional)
- Set XE to Axis 1 Lower Limit (optional)

Notes

Wiring

The following signals will have to be wired so that our positioning system can operate properly.

- +24VDC to terminal 20 or 21 on servo amplifier
- 0VDC to terminal 46 or 47 on servo amplifier
- Jumper between 42 (EMG) and 46/47 (DOCOM) to bypass E-stop
- Jumper between 12 (OPC) and 20/21 (DICOM) for open collector input
- PLC B11 (DICOM) to servo amplifier terminal 46/47 (DOCOM)
- PLC B10 (IN6) via NO switch to amplifier terminal 20/21 (DICOM)
- PLC B08 (INA) via NO switch to amplifier terminal 20/21 (DICOM)
- PLC B07 (INC) via NC switch to amplifier terminal 20/21 (DICOM)
    - Only required if XC is set to Axis 1 Upper Limit
- PLC B06 (INE) via NC switch to amplifier terminal 20/21 (DICOM)
    - Only required if XE is set to Axis 1 Lower Limit
- PLC B05 (OUT0) to amplifier terminal 15 (SON)
- PLC B04 (OUT2) to amplifier terminal 41 (CR)
- PLC B03 (OUT4) to amplifier terminal 10 (PP)
- PLC B02 (OUT6) to amplifier terminal 35 (NP)
- PLC B01 (OUTCOM) to amplifier terminal 46/47 (DOCOM)

Notes

2.6 Jogging

Jogging is the process of moving the axis forward or backward without a commanded target position. Typically jogging is used to manually position an axis.

With the L Series CPU, there is a dedicated command used to jog the servo axis. This command is called **IPJOG1** for axis 1 and **IPJOG2** for axis 2. This command requires 2 parameters, as shown below.

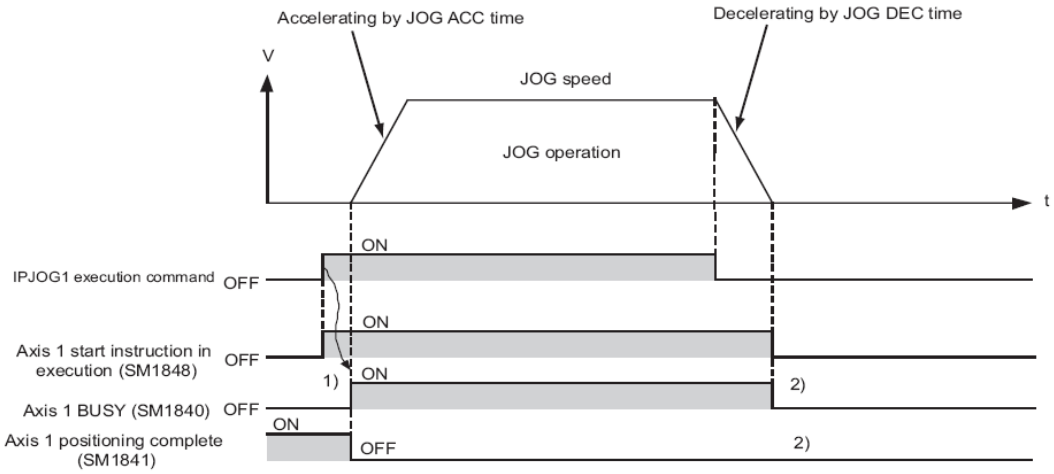
The first parameter sets the head address for a series of 4 control words. Values must be set in these control words for the command to operate properly. The command word data is shown below.

Device	Setting data	Setting range	Set by
S1	JOG speed	0 to 200000 (pulse/s)*1	User
S1 + 1			
S1 + 2	JOG ACC time	0 to 32767 (ms)	
S1 + 3	JOG DEC time		

The second parameter is a bit address to indicate forward or reverse. If the bit is off, the axis will jog forward. If the bit is on, the axis will jog in reverse.

Notes

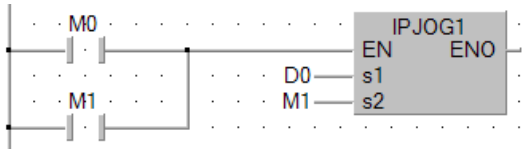
Basic operation of the IPJOG1 command and associated signals are shown below.



In the example programs below, M0 is used to jog the axis forward. M1 is used to jog the axis in reverse. The control data is stored in D0 through D3.

Standard Ladder

Structured Ladder



Notes

2.7 EXERCISE – Jogging

Using the addresses as indicated on the operator interface screen, write the program to jog axis 1 forward and reverse.

Using the addresses sown on the operator interface terminal, write logic in the program to turn on Y0 for servo on. If Y0 is off, servo will not move.

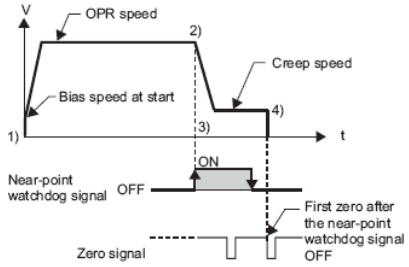
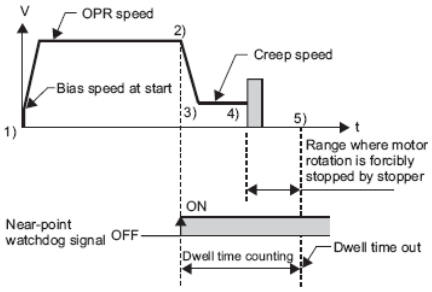
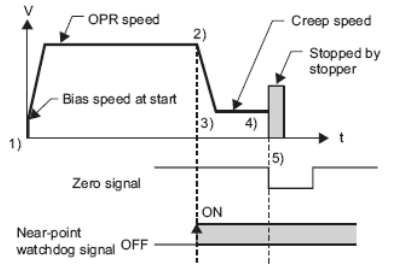
Download and test the program.

Notes

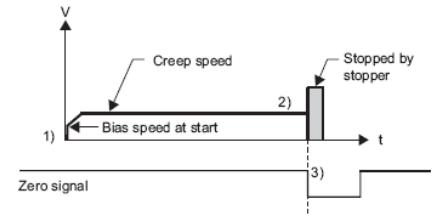
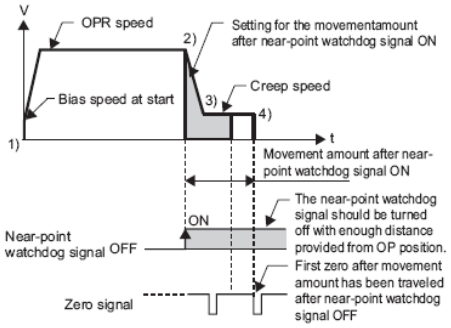
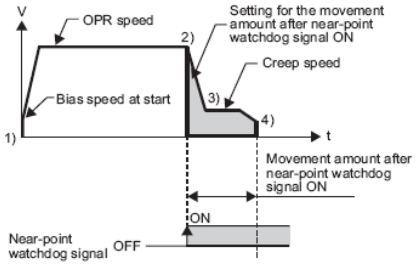
2.8 Homing

Homing is the process of returning the servo to a known starting position. In the manuals this is called 'Origin Point Return' or OPR. The L Series processor offers 2 types of origin point return.

The first method of OPR is called 'Machine OPR'. L Series CPU offers 6 different methods of Machine OPR. An example of each method is shown below.

<table>
<tr><td colspan="2">Near-point dog method</td></tr>
<tr><td> 
</td><td>1) Start of machine OPR.
↓
2) The axis starts to decelerate upon detection of turning on of the near-point dog.
↓
3) The axis decelerates to the creep speed and moves at the creep speed thereafter.
↓
4) Pulse output from the LCPU stops when the first zero signal is issued after the near-point dog has turned off, and machine OPR is complete.</td></tr>
<tr><td colspan="2">Stopper 1</td></tr>
<tr><td> 
</td><td>1) Start of machine OPR.
↓
2) The axis starts to decelerate upon detection of turning on of the near-point dog.
↓
3) The axis decelerates to the creep speed and moves at the creep speed thereafter.
↓
4) The axis contacts the stopper at the creep speed and stops.
↓
5) Upon elapse of the OPR dwell time after the near-point dog has turned on, pulse output from the LCPU stops and machine OPR is complete.</td></tr>
<tr><td colspan="2">Stopper 2</td></tr>
<tr><td> 
</td><td>1) Start of machine OPR.
↓
2) The axis starts to decelerate upon detection of turning on of the near-point dog.
↓
3) The axis decelerates to the creep speed and moves at the creep speed thereafter.
↓
4) The axis contacts the stopper at the creep speed and stops.
↓
5) When the zero signal is detected, pulse output from the LCPU stops and machine OPR is complete.</td></tr>
</table>

Notes

<table>
<tr><td colspan="2">Stopper 3</td></tr>
<tr><td> 
</td><td>1) Start of machine OPR.
↓
2) The axis contacts the stopper at the creep speed and stops.
↓
3) When the zero signal is detected, pulse output from the LCPU stops and machine OPR is complete.</td></tr>
<tr><td colspan="2">Count 1</td></tr>
<tr><td> 
</td><td>1) Start of machine OPR.
↓
2) The axis starts to decelerate upon detection of turning on of the near-point dog.
↓
3) The axis decelerates to the creep speed and moves at the creep speed thereafter.
↓
4) Pulse output from the LCPU stops at the first zero signal after the near-point dog has turned on and the axis has moved the distance set by "Movement amount after near-point dog ON", and the machine OPR is complete.</td></tr>
<tr><td colspan="2">Count 2</td></tr>
<tr><td> 
</td><td>1) Start of machine OPR.
↓
2) The axis starts to decelerate upon detection of turning on of the near-point dog.
↓
3) The axis decelerates to the creep speed and moves at the creep speed thereafter.
↓
4) Pulse output from the LCPU stops after the axis has moved the distance set by "Movement amount after near-point dog ON" (the axis starts to decelerate from the creep speed over the OPR deceleration stop time), and the machine OPR is complete.</td></tr>
</table>

Machine OPR performs the actual movement to the home position and setting of the home position based on the method selected from the choices above.

The second method is called Fast OPR, which simply returns to the home reference position which has already been defined by Machine OPR.

More detail on any of these options can be found in the LCPU User's Manual (Built-In I/O Functions) in section 7.6.

Notes

There are several parameters related to OPR. They are listed below.

- The first parameter sets the origin point return mode, selected from the 6 options above.

- The second setting determines if homing is performed in the forward or reverse direction. Most commonly, homing is performed in the reverse direction.

- The third setting is used as an offset for the home position. When the homing finishes, this value will be stored to the current position. Typically this value can remain at zero, unless some offset is required to the home position.

- The next two parameters set up the two speeds used for homing. The OPR speed is the faster of the two speeds, used for quick movement to the home position switch. The creep speed is the slower one, used to zero in on the home position. The speed values must follow the following condition:

  Bias speed at start ≦ Creep speed ≦ OPR speed ≦ Speed limit

- There are two parameters for acceleration and deceleration times. The first parameter is used for both acceleration and deceleration during an OPR movement, including ramp up to speed and down to creep speed. The second is used as the 'decelerate to stop' at the end of the OPR movement.

- The 'Setting of Movement Amount after Near-point Dog ON (pulse) is used to set the distance to move after the leading edge of the home position switch when using the Count 1 or Count 2 methods of OPR.

- The last parameter sets the dwell time for OPR. This is used at the 'decelerate to stop' during Stopper 1 mode of OPR, or at the 'decelerate to stop' when the OPR retry function is enabled.

Notes

The input and output signals which are required for each origin point return mode are shown below.

○: Wiring required, △: Wire as necessary, —: Wiring not required

I/O signal	OPR method						
	Near-point dog method	Stopper 1	Stopper 2	Stopper 3	Count 1	Count 2	No method
Zero Signal	○	—*1	○	○	○	—*1	—*1
Near-point Dog Signal	○	○	○	—*1	○	○	—*1
Deviation Counter Clear Signal	○	○	○	○	○	—*1	—*1
External Command Signal*1	—	—	—	—	—	—	—
CW/PULSE/A Phase Output	○	○	○	○	○	○	—*1
CCW/SIGN /B Phase Output	○	○	○	○	○	○	—*1
Drive Unit Ready Signal*1	△	△	△	△	△	△	—
Upper Limit Signall*1*2	△	△	△	△	△	△	△
Lower Limit Signal*1*2	△	△	△	△	△	△	△

*1 When this signal is not required, it can be used for other functions such as the general-purpose input and general-purpose output.

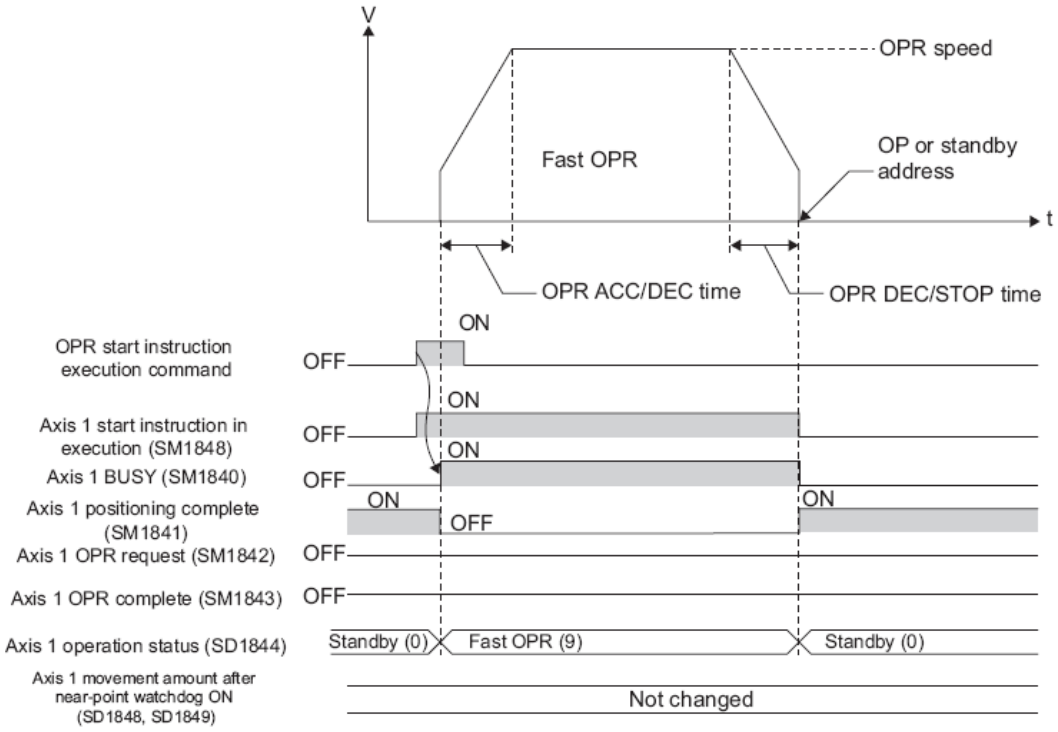
*2 These signals are required when the OPR retry function or hardware stroke limit function is used.

When the origin point has not yet been determined, SM1482 will be turned on by the system. This address will turn off when the Machine OPR completes.

If home position is not required for the application, SM1842 can be turned off manually in the user's program. To do this, the programmer should set SM1851 to on, verify that SM1842 is turned off, and then reset SM1851.

Notes

The second method of OPR function is called ‘Fast OPR’, which is used to simply return to an already defined home position. Effectively it is an absolute movement to the home position. The diagram below shows how a fast OPR operates. Notice this command does not make use of the OPR Request (SM1842) or OPR Complete (SM1843) bits.

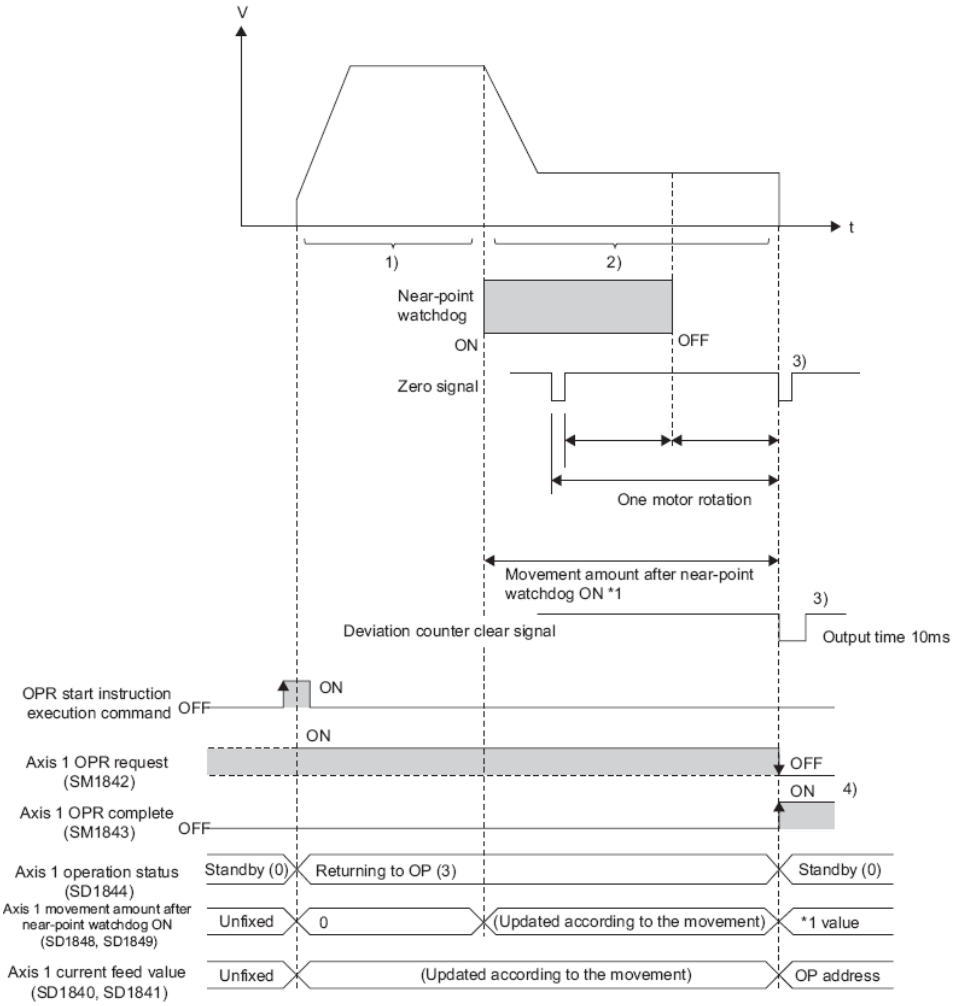


An error will be generated if a Fast OPR is attempted without the Machine OPR being performed.

Fast OPR can also be performed to a specified address. This address can be specified in the configuration of the homing command.

Notes

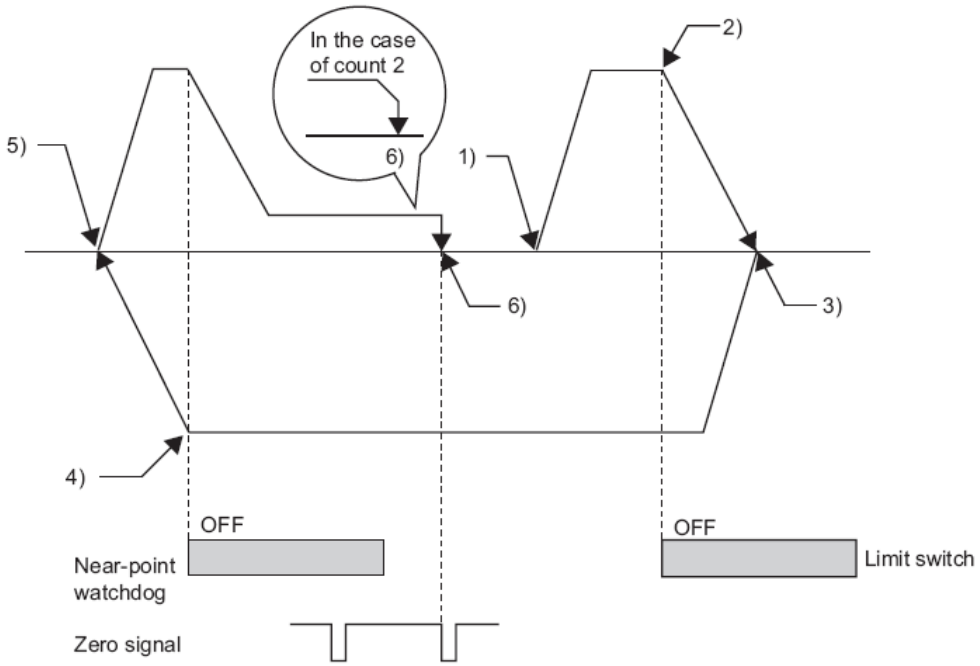
In the example below, the 'Near-Point Dog Method' is selected for OPR. In this method, the system will begin to move in the home direction, ramping up to the OPR speed. It will continue in this direction until the near-point dog input turns on. At this time, it will decelerate to the creep speed. It will continue to run at the creep speed until the near-point dog input turns off. At that point, it will continue to move at the creep speed until the zero pulse from the encoder is input. When the servo zero pulse is input, the motion will stop, the deviation counter clear signal will be output for 10ms. The OPR complete signal will turn on, and the OPR Request signal will turn off.



Notes

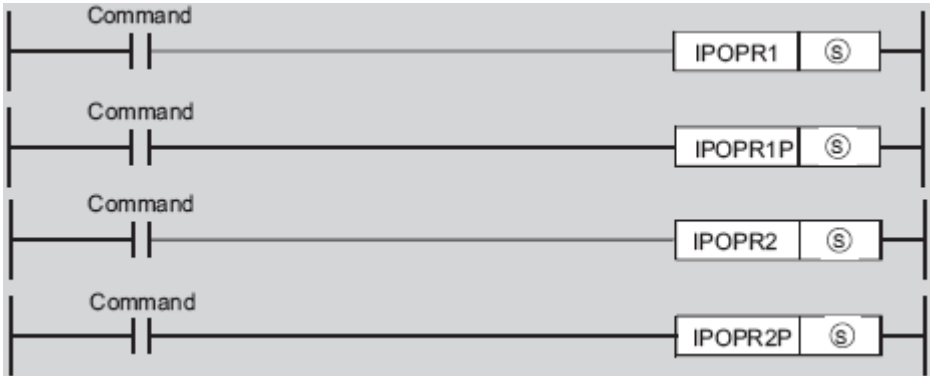
There is a special feature of OPR which can allow the controller to ‘search’ for the dog signal in the event that a limit switch is reached without finding the dog signal. This feature is called ‘OPR Retry’. This function is always enabled when using the Near-Point Dog method, Count 1 method, or Count 2 method when limit switches for end of travel are enabled.

OPR starts as configured (1). If the axis reaches the end of travel limit switch before it detects the dog signal (2), it will decelerate to a stop and wait for the configured dwell time. It will then being to move in the reverse direction (3). After it finds the trailing edge of the dog signal (4), it will decelerate to a stop. After the configured dwell time, it will resume motion in the forward direction (5) at the OPR speed and perform homing as normal, and set the OPR position (6).



Notes

The commands **IPOPR1, IPOPR1P, IPOPR2**, and **IPOPR2P** are used to perform the homing of the axis. The commands ending in P are the pulsed versions of the commands not ending in P.

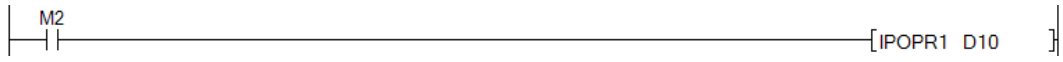


This command only takes one parameter, which is the first of 3 addresses to be used for control data. The control data is allocated as shown below. The control words should be written prior to executing the IPOPR command.

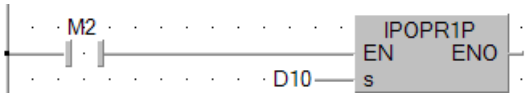
Device	Item	Setting data	Setting range	Set by
Ⓢ	Original position return type	1: Machine OPR 2: Fast OPR (OP address) 3: Fast OPR (standby address)	1 to 3	User
Ⓢ+ 1 Ⓢ+ 2	Standby address (This address is set only when fast OPR (standby address (3)) is specified for original position return type)	—	-2147483648 to 2147483647 (pulses) (Other than standby address (3) is ignored)	

An example is shown below. When M2 is activated, the homing routine specified in D10 will begin to execute.

Standard Ladder



Structured Ladder



Notes

2.9 EXERCISE – Origin Point Return

This exercise will establish the origin point return.

Change the positioning parameters to include the following:

- Near-point Dog Method
- Reverse direction
- OPR speed 25,000
- Creep speed 2,500

Write the homing command for axis 1. Operate the program with the operator interface terminal, and verify that the OPR Request bit turns off, and the OPR Complete bit turns on.

Experiment with all 3 homing methods. Don't forget to set a standby address for mode 3.

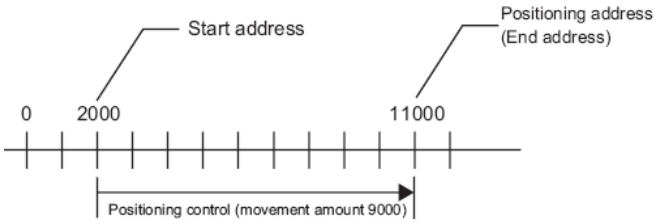
Notes

2.10 Positioning Profiles

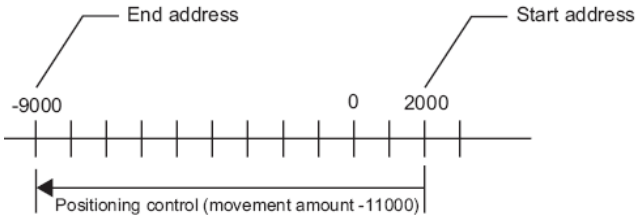
There are several positioning profiles available with the pulse output function. They are:

- Position control (incremental or absolute)
- Speed/position switching control (forward or reverse)
- Current value change
- Speed control (forward or reverse)

Position control moves the servo by an indicated number of pulses. In absolute mode, this movement is in reference to the home position. The example below shows a movement to a specific location of 11000.

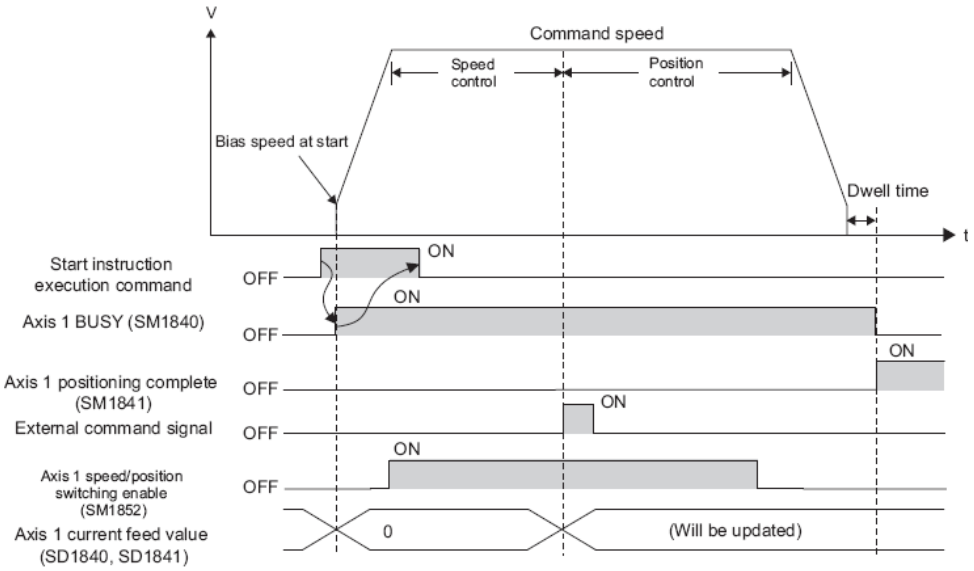


In incremental mode, this movement is in reference to the starting position. The example below shows an incremental movement of -11000 pulses. The end position is -9000, since starting position was 2000.



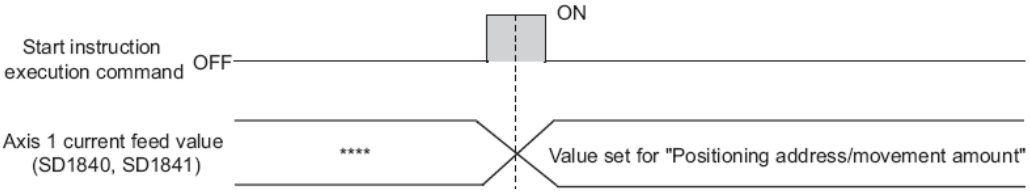
Notes

Speed/position switching is a combination movement. The movement begins as a speed control command. Upon the input of the external command signal, it will become a positioning movement. It will move the specified movement distance and stop.



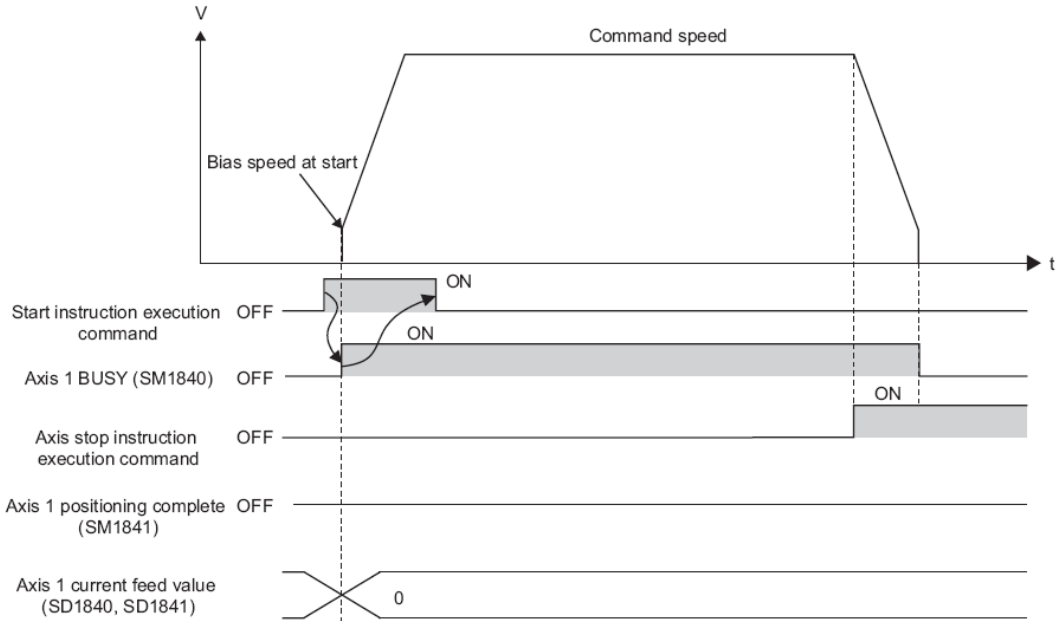
During the speed control portion of the movement, the current feed value is set to zero and not updated. Once the positioning portion of the control begins, the position will be updated.

Current value change simply changes the value in the current position registers to the specified value.



Notes

Speed control simply runs the motor at a specified speed.



During the speed control portion of the movement, the current feed value is set to zero and not updated. Once started, the stop command must be issued to stop the axis.

Notes

2.11 Positioning Table

In the PLC parameters, the table allows for up to 10 entries to be created for each axis. An example of the table is shown below.

	Control System	Acceleration/Deceleration Time (ms)	Deceleration Stop Time (ms)	Dwell Time (ms)	Command Speed (pulse/s)	Positioning Address (pulse)
No. 1						
No. 2						
No. 3						
No. 4						
No. 5						
No. 6						
No. 7						
No. 8						
No. 9						
No. 10						

To enter a command into the table, select a control system from the first column's drop-down selection list. Each type of positioning task will require certain columns of data be set in that line of the table. The required settings are shown below for each control system selection.

○: Must be set, △: Set as necessary, —: Need not be set

Positioning data	Control system			
	Position control	Speed control	Speed/position switching control	Current value change
Acceleration/Deceleration Time	○	○	○	—
Deceleration Stop Time	○	○	○	—
Dwell Time	△	△	△	△
Command Speed	○	○	○	—
Positioning Address/Movement Amount	○	—	○	○

Notes

2.12 Positioning Commands

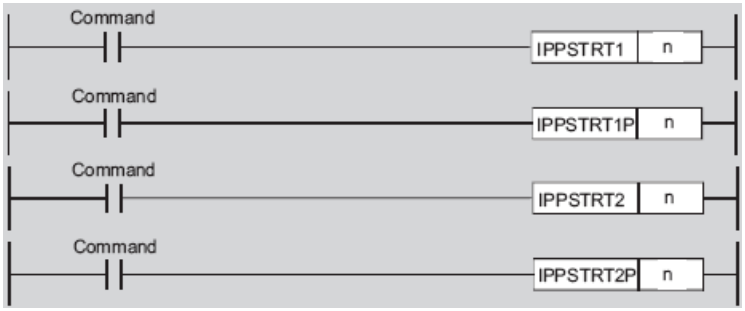
There are a variety of dedicated commands in the L Series CPUs for use with the built-in positioning function. The complete list is shown below, with brief descriptions for each command. Notice there are different commands for axis 1 and axis 2.

Instruction		Description
Axis 1	Axis 2	
IPPSTRT1(P)	IPPSTRT2 (P)	Start operation based on the desired data number specified from among "Positioning data" Nos. 1 to 10 set beforehand using the programming tool.
IPDSTRT1(P)	IPDSTRT2 (P)	Start positioning with data stored in the device specified by control data and subsequent devices, without using "Positioning data" Nos. 1 to 10 set beforehand using the programming tool.
IPSIMUL(P)		Start positioning using the specified "Positioning data" number for Axis 1, and positioning using the specified "Positioning data" number for Axis 2, simultaneously.
IPOPR1(P)	IPOPR2 (P)	Start OPR of the specified axis based on the specified method.
IPJOG1	IPJOG2	JOG operation of the specified axis is started.
IPABRST1	IPABRST2	Perform absolute position restoration of the specified axis.
IPSTOP1	IPSTOP2	Stop the operating axis.
IPSPCHG1(P)	IPSPCHG2(P)	Change the speed of the specified axis.
IPTPCHG1(P)	IPTPCHG2(P)	Change the target position of the specified axis.

The jogging and OPR commands have already been discussed.

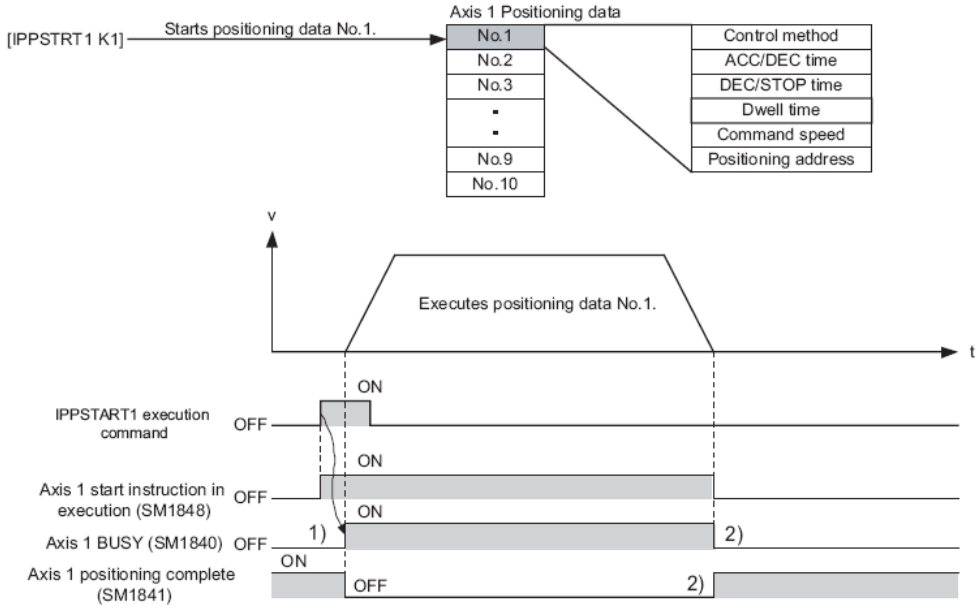
Notes

The **IPPSTRT1** and **IPPSTRT2** commands are used to execute one of the table entries, as configured in the PLC parameters. There are a total of 10 entries for each axis. These commands are available as pulsed commands.



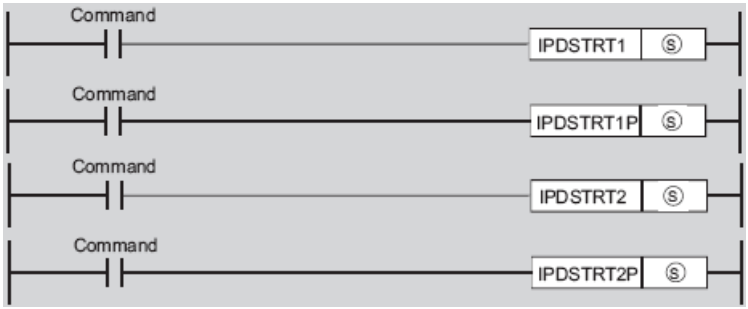
This command takes one parameter, which is the table entry number to execute. It can be specified as a numeric constant or a register address.

The basic operation of a table movement command is shown below. The example is based on executing table entry 1.



Notes

To execute a motion which is not based on table entries, the **IPDSTRT1** and **IPDSTRT2** commands are available.



These commands take one parameter, which is the head address of 8 words of control data. The values should be written to each of these registers prior to executing the command.

Device	Item	Setting data	Setting range	Set by
Ⓢ	Control System	1: Position control (ABS) 2: Position control (INC) 3: Speed/position switching control (forward RUN) 4: Speed/position switching control (reverse RUN) 5: Current value change 6: Speed control (forward RUN) 7: Speed control (reverse RUN)	1 to 7	User
Ⓢ + 1	Acceleration/ deceleration time	—	0 to 32767 (ms)	
Ⓢ + 2	Deceleration stop time	—	0 to 32767 (ms)	
Ⓢ + 3	Dwell time	—	0 to 65535 (ms)*1	
Ⓢ + 4	Command speed	—	0 to 200000 (pulse/s)*2	
Ⓢ + 5				
Ⓢ + 6	Positioning address/ movement amount	—	-2147483648 to 2147483647 (pulses)	
Ⓢ + 7				

*1 In the program, enter the set values as follows:
1 to 32767: Enter as decimals.
32768 to 65535: Convert to hexadecimals and enter the resulting hexadecimals.

*2 If the set value of command speed is outside 0 to 200000, the axis may operate at the speed limit.

Notes

The **IPSIMUL** command will start a table entry on both axes at the same time. It requires 2 parameters, which are the table entry numbers to execute for each axis.

The number of the table entry to execute on each axis can be specified in a data register or as a direct numeric value.

IPABRST1 and **IPABRST2** commands are used to read the absolute encoder position from a connected servo amplifier. This process requires 3 inputs and 3 outputs, and works with the MR-J2S-A and MR-J3-A series amplifiers in absolute mode.

The first parameter is the first of the input addresses, and the second parameter is the first of the output addresses. The tables below show which signals those inputs and outputs equate to.

Device	Item	Setting data	Setting range	Set by
Ⓢ	Signal loaded from the servo amplifier	ABS transmission data bit 0	0,1	User
Ⓢ + 1		ABS transmission data bit 1		
Ⓢ + 2		ABS transmission data ready		

Device	Item	Setting data	Setting range	Set by
Ⓓ	Signal output to the servo amplifier	Servo on	—	System
Ⓓ + 1		ABS transfer mode		
Ⓓ + 2		ABS request flag		

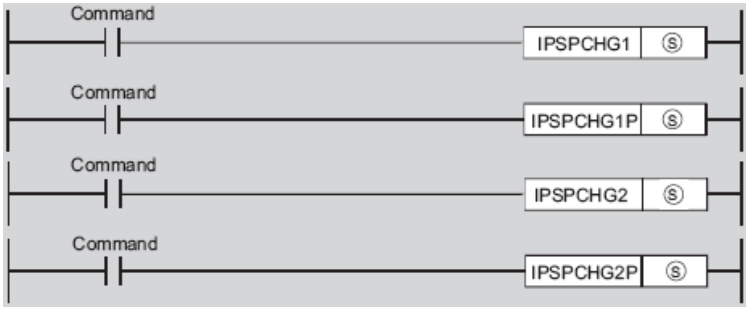
Notes

The next 3 commands are all used to modify a movement already started. These commands can force a stop, change the speed, or change the target position.

The **IPSTOP1** and **IPSTOP2** commands are used to stop an active motion axis. These commands do not require any parameters.

The stop commands can be used as long as an axis is not at stop, in deceleration, or in error. The command bit should remain on at least 2ms to be properly detected. If a command to stop is active when a movement task is started, an error will be generated and no motion will occur.

The **IPSPCHG1** and **IPSPCHG2** commands can be used to change the speed of an active movement. One parameter sets the head of 4 control words. This command is available in a pulsed form.



This command can be used as long as the axis is in motion, not stopped, not decelerating to stop, or in error.

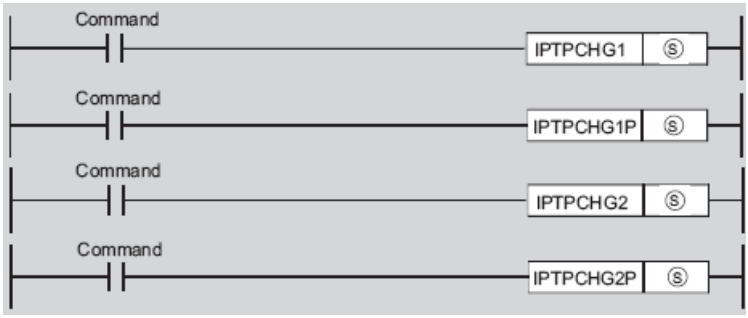
Notes

The control words establish the acceleration at speed change, deceleration at speed change, and new speed for the movement.

Device	Setting data	Setting range	Set by
Ⓢ	ACC/DEC time at speed change	0 to 32767 (ms)	User
Ⓢ + 1	DEC/STOP time at speed change		
Ⓢ + 2	New speed value	0 to 200000 (pulse/s)*1	
Ⓢ + 3			

*1 If the set new speed value is outside 0 to 200000, the axis may operate at the speed limit.

The last command allows the target position to be changed while a movement is active. **IPTPCHG1** and **IPTPCHG2** are used to adjust the length of the current movement. This command can be pulsed.



It requires one parameter, which is the 32-bit value of the new target. This value can be specified as a numeric value, or as a PLC address storing the 32-bit value.

Device	Setting data	Setting range	Set by
Ⓢ	Target position change value	-2147483648 to 2147483647 (pulses)	User
Ⓢ + 1			

Two or more commands should not be executed on the same axis at the same time. A second command attempting to access an axis already in use will result in an axis error.

Notes

2.13 EXERCISE – Positioning Table

Create at least 2 positioning entries in the table in the PLC Parameters. Make at least one positioning task (incremental or absolute) and a speed control task.

Using the addresses shown on the operator interface terminal, write the program to start a positioning task on axis 1.

NOTE: To use speed/position switching, be sure to set X6 to Axis 1 External Command Signal. Wire a normally open momentary switch to the input. Without this external input, speed/position switching will not occur.

NOTE: When speed control commands are used, remember to add the IPSTOP1 command to the program to stop the axis.

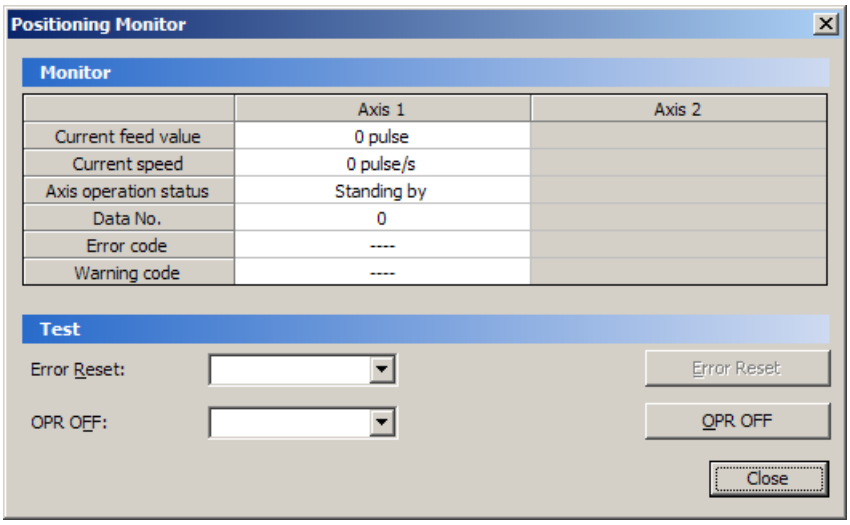
Download and test this program. Change task numbers and execute the command again to ensure proper operation.

After the positioning tasks from the table are tested and operational, add the program required to execute a control task without using the table. Download and test this new application.

Notes

2.14 Monitoring Tools

GX Works2 has a built-in utility for monitoring the status of the built-in positioning function. Under the Tool menu, select Built-In I/O Monitor Tool, and then Positioning Monitor.

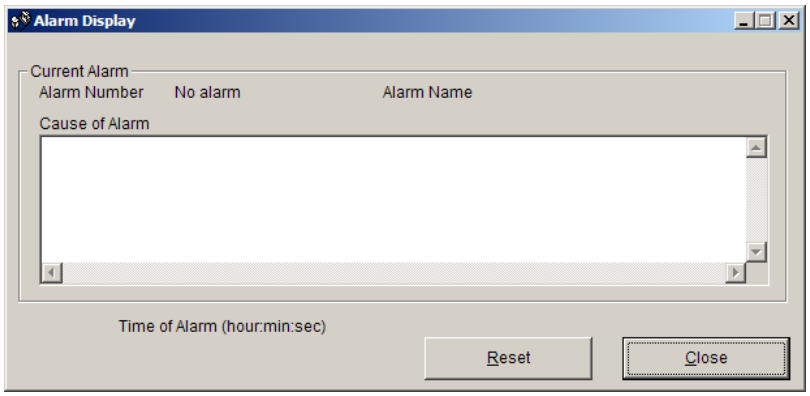


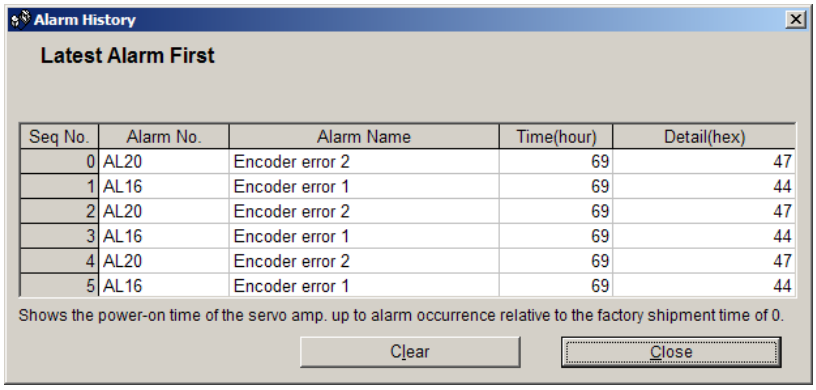
On this screen, the current values of feed value, speed, operational status, error code, and warning code are displayed. Only the axes which are configured will be displayed on this screen.

At the bottom of this screen are tools to reset an error code, or turn off the OPR Request flag. Select the axis number from the drop-down list, and then click the button on the right.

Notes

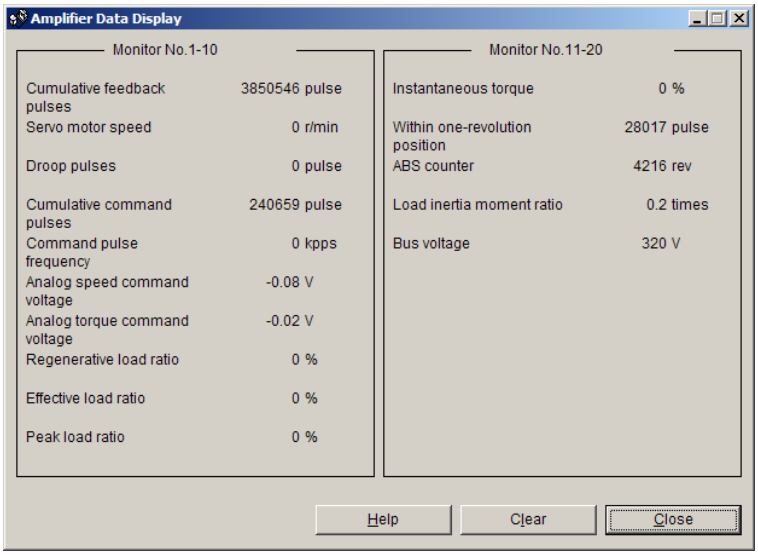
MR Configurator also has tools for monitoring the status of the MR-J3 servo amplifiers. On the Alarm menu, Display shows the current alarm, and History displays a history of the most recent alarms.





Notes

From the Monitor menu, select Display All to display to screen below.

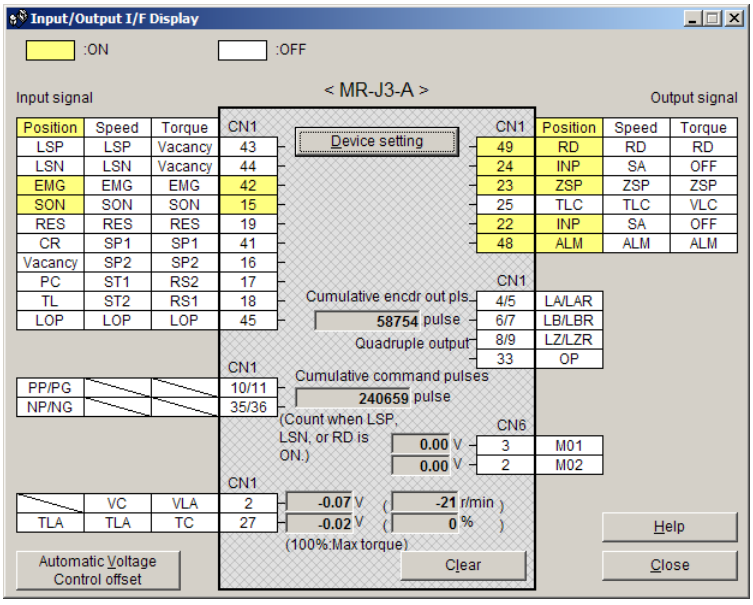


On this screen, basic monitor data for the amplifier is displayed. Information includes cumulative pulses, motor speed, droop pulses, command pulses, load ratios, torque, and bus voltage among others.

Notes

Another screen shows the status of the inputs and outputs. This screen is called Input/Output I/F Display. This screen offers a quick view of all inputs and outputs, as well as showing encoder pulses and command pulses.

It shows the on/off status of the various inputs and outputs using a yellow color. Each output shows 3 values next to it, specific to the position, speed, or torque control mode application of those outputs. The name of the mode at the top of the columns will highlight to display the current mode, and the active inputs and outputs will highlight in that column.



Notes

LESSON 3 – High Speed Counter

This lesson explains the built-in functions for high speed counter input in the L Series.

Lesson Objectives

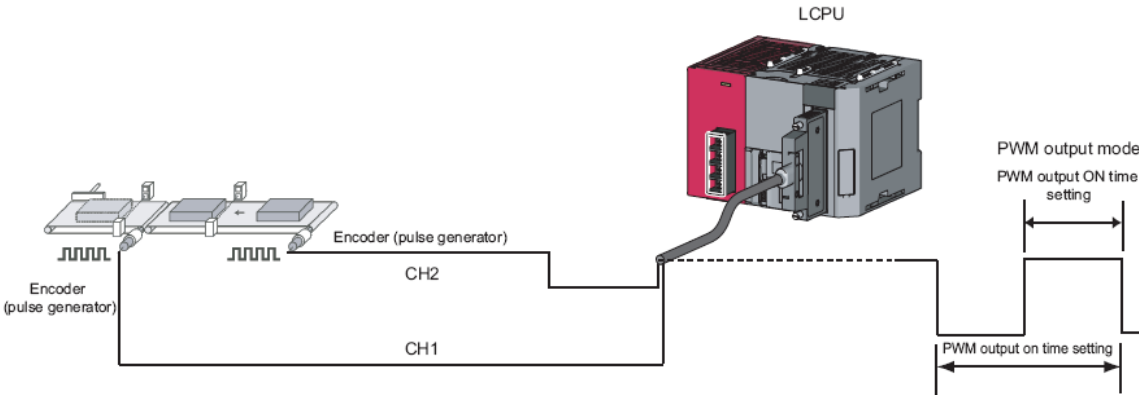
At the conclusion of this lesson, you will be able to…

- Understand the capabilities of the built-in high speed counter inputs.
- Configure a high speed counter.
- Set parameters and write a program to control a high speed counter input.

3.1 Introduction

Typical PLC inputs are limited in speed by the processing time of the PLC scan. For this reason, it is not possible to count pulse inputs which are less than 1 scan long. High speed pulse inputs operate outside the PLC scan, and so are not limited to the length of the pulse. High speed pulse inputs in the L Series can reach speeds of 200,000 pulses per second.

A typical example application for a high speed pulse input is a rotary encoder on a spinning servo motor. The motor encoder outputs a series of pulses, and the number of pulses per revolution is fixed. As the motor spins faster, the pulses become shorter and closer together. The MR-J3 series amplifiers can output up to 65,535 pulses per revolution.



Notes

The current pulse count for a high speed pulse input is stored in a 32-bit location in the CPU. There are dedicated commands which are used to operate on this data without the limitations of the PLC scan time.

Some basic specifications of the high speed counter are shown here.

- 2 individual channels offering up to 200K pps input speed
- 24VDC or differential line driver inputs accepted
- 1-phase or 2-phase input pulse formats supported
- 2 coincidence output points per channel

More detailed specifications can be found in the LCPU User's Manual (Built-In I/O Function) manual in section 8.9.

The table below shows all of the dedicated special relays and special registers devoted to the high speed counter functions of the L Series.

Special relay number		Name	Special register number		Name
CH1	CH2		CH1	CH2	
SM1880	SM1900	CH□ counter value greater (No.1)	SD1880	SD1900	CH□ current value
SM1881	SM1901	CH□ counter value coincidence (No.1)	SD1881	SD1901	
SM1882	SM1902	CH□ counter value smaller (No.1)	SD1882	SD1902	CH□ status monitor
SM1883	SM1903	CH□ counter value greater (No.2)	SD1883	SD1903	CH□ external I/O status monitor
SM1884	SM1904	CH□ counter value coincidence (No.2)	SD1884	SD1904	CH□ operation mode monitor
SM1885	SM1905	CH□ counter value smaller (No.2)	SD1885	SD1905	CH□ counter type monitor
SM1886	SM1906	CH□ external preset (phase Z) request detection	SD1886	SD1906	CH□ selected counter function
SM1887	SM1907	CH□ error	SD1887	SD1907	CH□ error code
SM1888	SM1908	CH□ warning	SD1888	SD1908	CH□ warning code
SM1890	SM1910	CH□ coincidence signal No.1 reset command	—		—
SM1891	SM1911	CH□ coincidence signal No.2 reset command			
SM1892	SM1912	CH□ coincidence output enable command			
SM1893	SM1913	CH□ preset command			
SM1894	SM1914	CH□ count down command			
SM1895	SM1915	CH□ count enable command			
SM1896	SM1916	CH□ selected counter function start command			
SM1897	SM1917	CH□ external preset (phase Z) request detection reset command			
SM1898	SM1918	CH□ pulse measurement start command			
SM1899	SM1919	CH□ error reset command			

Notes

3.2 Operating Modes

There are five basic operating modes for the built-in high speed counters. They are shown below.

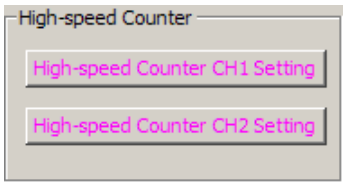
- Normal Mode
  - Used for simple general-purpose high speed input counting.
  - Offers some sub-functions including ring counter, sampling counter, count enable and disable, and coincidence input
- Frequency Measurement Mode
  - Pulses are counted and a frequency is calculated based on the speed of the incoming pulses
- Rotation Speed Measurement Mode
  - Pulses are counted and a rotation speed is calculated based on a specified number of pulses per revolution
- Pulse Measurement Mode
  - The on or off width of pulses is measured
- Pulse Width Modulation Mode
  - Pulses are output on the coincidence output

A complete list of functions and which modes they are available in is shown in the LCPU User's Manual (Built-In I/O Function) manual in section 8.1.

Notes

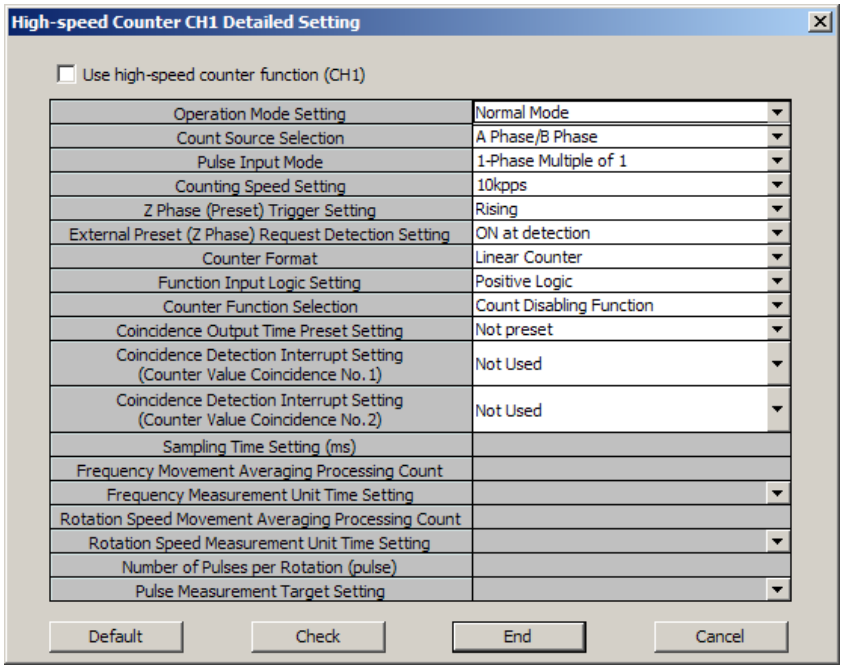
3.3 Configuration

Before the high speed counter functions can be used, there are settings to be made in the PLC parameters. These settings are found on the Built-In I/O Function Setting tab as previously discussed.



At the top center of the tab, there are two buttons used to configure the settings of the two channels of high speed counter function, labeled as CH1 and CH2. As with other parameters, the pink text color indicates settings are at the factory default. The text on the button will turn blue once settings have been made.

By clicking on one of the buttons, the configuration for that high speed counter channel will be displayed as a pop-up window. The first setting at the top is a check box to enable the high speed counter function for this channel. This box must be checked for the settings made on this screen to be active. The next 4 settings determine the operating mode of the counter. All settings after the first 4 are specific to the operating mode selection.



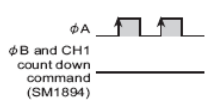
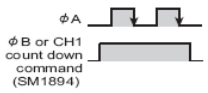
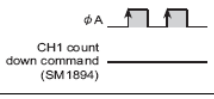
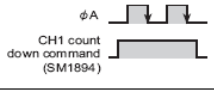
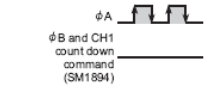
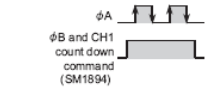
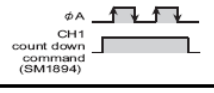
Notes

The first setting on this tab determines the operating mode of the high speed counter.

The second setting specifies where the pulses will come from. The choices include A/B phase encoder pulses, internal clock pulses, or another channel.

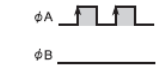
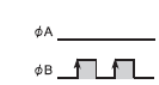
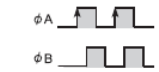
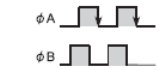
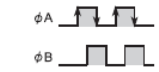
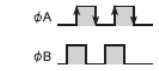
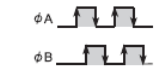
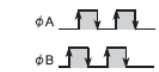
The third setting sets the pulse input mode. See the tables below for setting options.

Single Phase

Pulse input mode	Count timing		
1-Phase Multiple of 1	For counting up		Counts on the rising edge (↑) of ϕA. Both ϕB and CH1 count down command (SM1894) are off.
	For counting down		Counts on the falling edge (↓) of ϕA. Either ϕB or CH1 count down command (SM1894) is on.
1-Phase Multiple of 1 (A Phase Only)	For counting up		Counts on the rising edge (↑) of ϕA. CH1 count down command (SM1894) is off.
	For counting down		Counts on the falling edge (↓) of ϕA. CH1 count down command (SM1894) is on.
1-Phase Multiple of 2	For counting up		Counts on the rising edge (↑) and the falling edge (↓) of ϕA. Both ϕB and CH1 count down command (SM1894) are off.
	For counting down		Counts on the rising edge (↑) and the falling edge (↓) of ϕA. Either ϕB or CH1 count down command (SM1894) is on.
1-Phase Multiple of 2 (A Phase Only)	For counting up		Counts on the rising edge (↑) and the falling edge (↓) of ϕA. CH1 count down command (SM1894) is off.
	For counting down		Counts on the rising edge (↑) and the falling edge (↓) of ϕA. CH1 count down command (SM1894) is on.

Notes

2 Phase

Pulse input mode	Count timing		
CW/CCW	For counting up		Counts on the rising edge (↑) of ϕA. ϕB ιστ οϕϕ.
	For counting down		ϕA is off. Counts on the rising edge (↑) of ϕB.
2-Phase Multiple of 1	For counting up		Counts on the rising edge (↑) of ϕA while ϕB is off.
	For counting down		Counts on the falling edge (↓) of ϕA while ϕB is off.
2-Phase Multiple of 2	For counting up		Counts on the rising edge (↑) of ϕA while ϕB is off. Counts on the falling edge (↓) of ϕA while ϕB is on.
	For counting down		Counts on the rising edge (↑) of ϕA while ϕB is on. Counts on the falling edge (↓) of ϕA while ϕB is off.
2-Phase Multiple of 4	For counting up		Counts on the rising edge (↑) of ϕA while ϕB is off. Counts on the falling edge (↓) of ϕA while ϕB is on. Counts on the rising edge (↑) of ϕB while ϕA is on. Counts on the falling edge (↓) of ϕB while ϕA is off.
	For counting down		Counts on the rising edge (↑) of ϕA while ϕB is on. Counts on the falling edge (↓) of ϕA while ϕB is off. Counts on the rising edge (↑) of ϕB while ϕA is off. Counts on the falling edge (↓) of ϕB while ϕA is on.

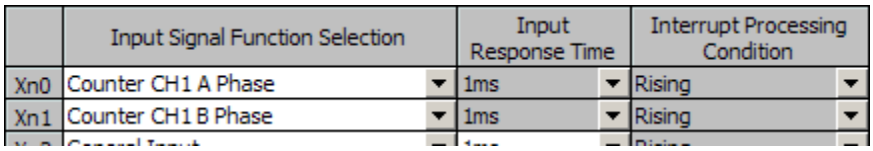
The next setting determines the maximum pulse input speed, and is selectable as shown below depending on the pulse input mode selected.

Counting speed	Available pulse input mode
10kpulse/s	All
50kpulse/s	All
100kpulse/s	All other than "2-Phase Multiple of 1"
200kpulse/s	1-Phase Multiple of 2 1-Phase Multiple of 2 (A Phase Only) 2-Phase Multiple of 4

The remaining settings are dependent on the operating mode selected, and will be discussed with each operating mode.

Notes

Once the check box is checked to use the high speed counter function, the inputs for the A and B phase will be reconfigured in the Built-In I/O Function Setting page of the parameters.



Only the A and B phase inputs have been set. If the other input or output functions are desired, the inputs and outputs must be set for the function required. The quick reference list below shows which inputs and outputs are used by the high speed counter functions.

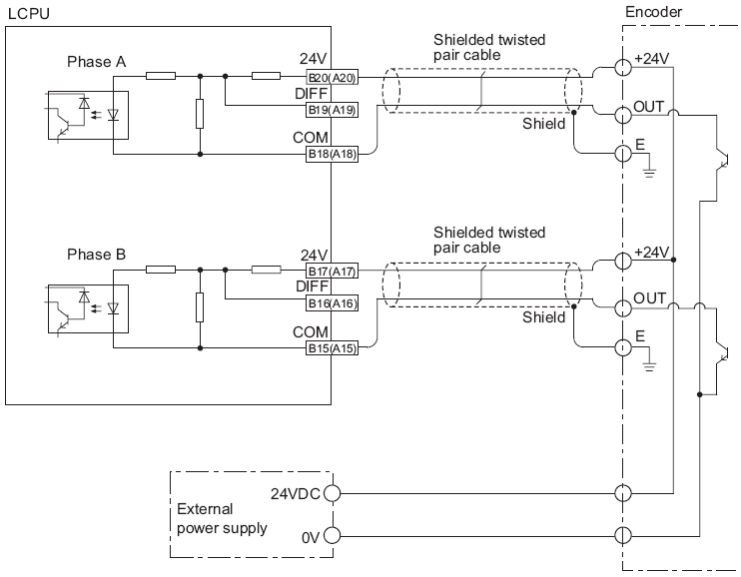
High-speed Counter	
CH1	CH2
X0	X2
X1	X3
X4	X5
X6	X7
X8	X9
Y0	Y1
Y2	Y3

For details of which function is associated to which signal, review the table in Lesson 1.1 of this training manual.

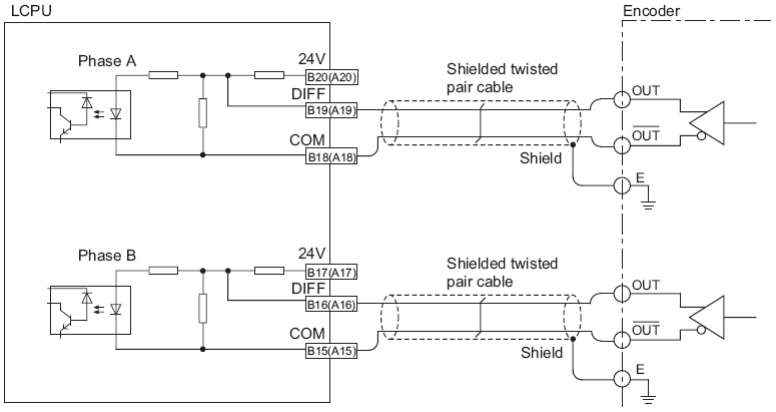
Notes

3.4 Connections

The example below shows the wiring required to connect an open collector output type encoder (24VDC) to the L Series built-in high speed inputs.



The example below shows the wiring required to connect a differential line driver encoder to the L Series CPU.



Details on wiring the other associated signals can be found in the manual.

Notes

3.5 EXERCISE – Counter Configuration

For this exercise, use the servo amplifier as the pulse input to the PLC. The servo will be commanded in speed mode to demonstrate pulses coming into the high speed counter.

Based on the servo parameters configured earlier, the servo will output 4000 pulses per revolution. This value can be adjusted in MR Configurator by changing parameter PA15.

CPU Parameter Setting

Make the following settings in the PLC Parameters

- Enable high-speed counter channel 1
- Set pulse input mode to 2-Phase Multiple of 2
- Set Counting Speed Setting to 100Kpps

Add the following wires to the wiring already completed in Lesson 2.

- PLC terminal B16 to servo amplifier terminal 4 (LA)
- PLC terminal B15 to servo amplifier terminal 5 (LAR)
- PLC terminal B19 to servo amplifier terminal 6 (LB)
- PLC terminal B18 to servo amplifier terminal 7 (LBR)
- PLC terminal B13 to servo amplifier terminal 8 (LZ)
- PLC terminal B12 to servo amplifier terminal 9 (LZR)

Notes

3.6 Dedicated Instructions

There are a series of dedicated instructions in the L Series CPU related to the high speed counter functions. The complete list of commands is shown below, with a quick description. Note there are different commands for channel 1 and channel 2.

Instruction		Description
CH1	CH2	
ICCNTRD1(P)	ICCNTRD2(P)	Stores the current counter value in the special register.
ICRNGWR1(P)	ICRNGWR2(P)	Sets the upper limit value and lower limit value of a ring counter.
ICPREWR1(P)	ICPREWR2(P)	Sets a preset value (a value to replace another).
ICLTHRD1(P)	ICLTHRD2(P)	Stores a latch counter value.
ICSMPRD1(P)	ICSMPRD2(P)	Stores a sampling count value.
ICCOVWR1(P)	ICCOVWR2(P)	Sets a coincidence output No.n point.
ICFCNT1	ICFCNT2	Measures frequency.
ICRCNT1	ICRCNT2	Measures rotation speed.
ICPLSRD1(P)	ICPLSRD2(P)	Stores a measured pulse value.
ICPWM1	ICPWM2	Outputs PWM waveforms.

More detail on each command can be found in the LCPU User's Manual (Built-In I/O Function). The commands will be discussed as used with each function.

Notes

3.7 Normal Mode

There are a variety of counter options in the normal mode. The table to the right shows the various functions of a normal mode counter as well as a brief description of each function.

Item		Description
Linear counter function		Counts pulses within the range of -2147483648 to 2147483647 and detects an overflow or an underflow if the count range is exceeded.
Ring counter function		Repeatedly counts pulses within the range of the upper limit value to the lower limit value of ring counter.
Preset function		Overwrites CH1 current value (SD1880, SD1881) of a counter with a set value.
Coincidence output function		Compares a set value with CH1 current value (SD1880, SD1881) of a counter and outputs on or off signal.
	Preset at coincidence output function	Overwrites CH1 current value (SD1880, SD1881) of a counter with a set value on the rising edge of Counter value coincidence (No.n) signal.
	Coincidence detection interrupt function	Starts an interrupt program when CH1 current value (SD1880, SD1881) and a set value match.
Latch counter function		Latches CH1 current value (SD1880, SD1881) of a counter on the rising edge of Latch counter input signal.
Counter function selection	Latch counter function	Latches CH1 current value (SD1880, SD1881) of a counter on the rising edge of CH1 selected counter function start command (SM1896) or Function input signal.
	Count disable function	Stops counting while CH1 count enable command (SM1895) is on.
	Sampling counter function	Counts pulses input during the specified sampling period.
	Count disable/preset function	Performs the count disable function and the preset function without switching the function.
	Latch counter/preset function	Performs the latch counter function and the preset function without switching the function.
Internal clock function		Counts clock frequencies generated by the LCPU.

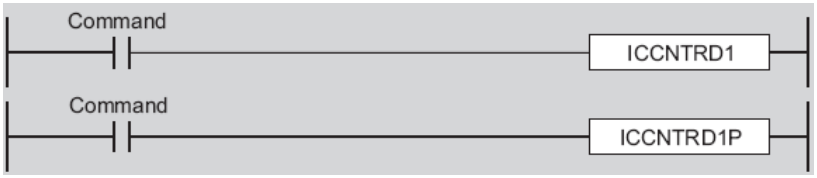
Notes

There are several settings which apply to normal mode. They are shown below.

Z Phase (Preset) Trigger Setting	Rising
External Preset (Z Phase) Request Detection Setting	ON at detection
Counter Format	Linear Counter
Function Input Logic Setting	Positive Logic
Counter Function Selection	Count Disabling Function
Coincidence Output Time Preset Setting	Not preset
Coincidence Detection Interrupt Setting (Counter Value Coincidence No. 1)	Not Used
Coincidence Detection Interrupt Setting (Counter Value Coincidence No. 2)	Not Used

The **ICCNTRD1** and **ICCNTRD2** commands are used to read the current value of the channel into its dedicated SD addresses. These addresses are not automatically refreshed; this command must be used to update the value.

This command can be pulsed. It can only be used when the counter is configured for normal mode, and can be used regardless of the sub-functions of normal mode.



When this command is active, the current value of CH1 will be stored to SD1880-SD1881 or CH2 will be stored to SD1900-SD1901.

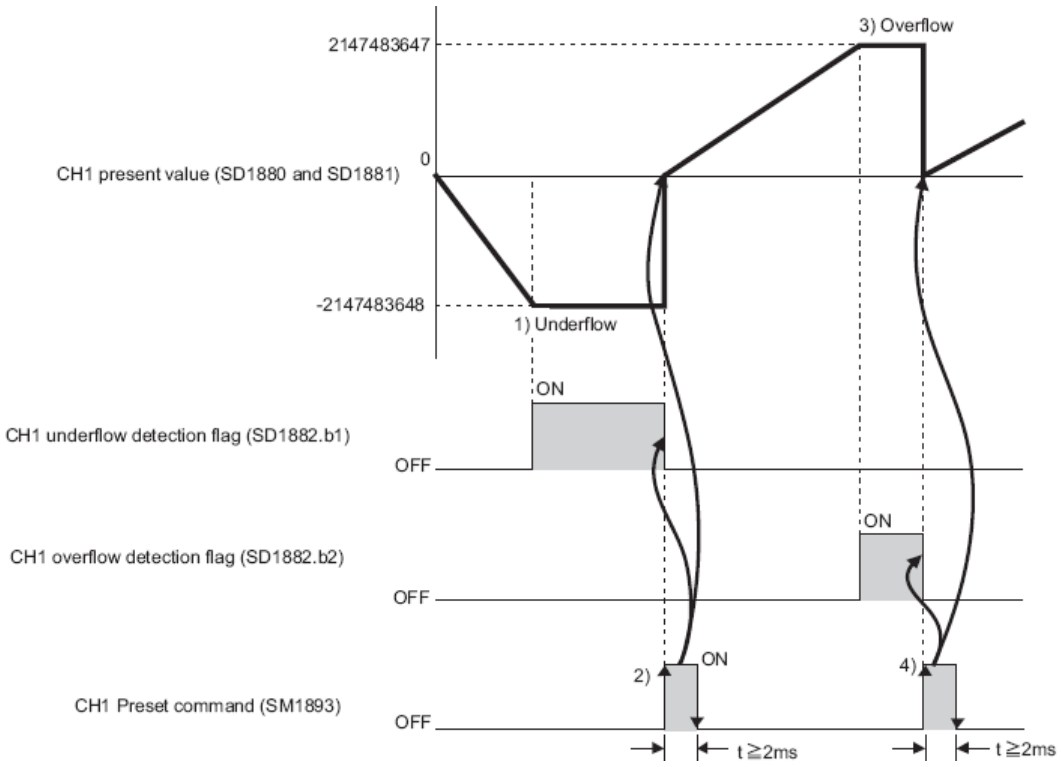
The count enable bit must be on for the counter to count. Bit SM1895 (CH1) or SM1915 (CH2) are the count enable bits.

Notes

3.7.1 Linear Counter Function

The linear counter function simply counts up and down based on the incoming pulses. The count range is limited to the extents of a 32-bit numerical value, which are -2,147,483,648 to 2,147,483,647.

This function will detect if the number extends outside that range either too high or too low and turn on a bit to indicate this overflow or underflow. The dedicated addresses for those bits are shown below. While in this overflow or underflow condition, further pulses are not counted, and the current value remains unchanged.



Notes

3.7.2 EXERCISE – Linear Counter

Configure the counter as previously discussed.

Write the code required in the PLC program to enable the counter and read the current value.

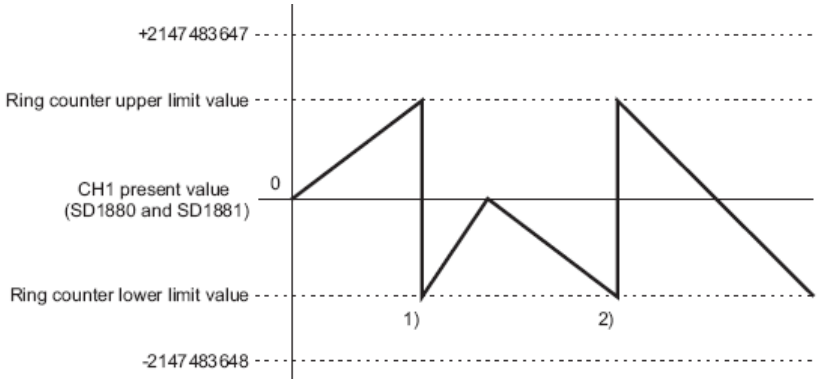
Using the servo programs from earlier, jog the servo forward and backward or run positioning tasks, and verify that the counter is counting.

Remember to turn on SM1895 to enable the counter.

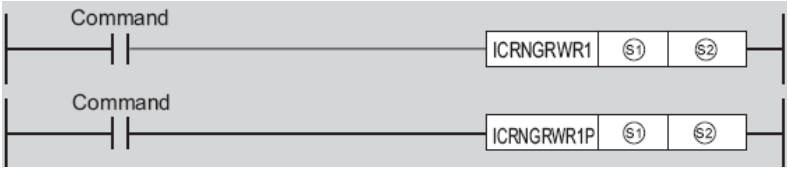
Notes

3.7.3 Ring Counter Function

The ring counter function does not overflow in the same fashion as the linear counter. Instead, the value will wrap around to the opposite limit. The upper and lower limits of the ring values are configured by the programmer.



The **ICRNGWR1** and **ICRNGWR2** commands are used to set the upper and lower limits of the ring counter function. This command can only be used when the ring counter function is enabled on the normal mode counter.



This command takes 2 parameters, which are the low limit and high limit of the ring counter. These can be 32-bit numeric values, or they can refer to data registers with 32-bit data in them. The lower limit must be lower than the upper limit, or an error will occur.

The new settings made with this command only take effect on the rising edge of the count enable (SM1895) signal.

Notes

3.7.4 EXERCISE – Ring Counter

Change the parameter settings on the counter to operate in the ring counter mode.

Add logic to the program to set the limits for the ring counter from the addresses shown on the operator interface terminal.

Test the program with the following steps.

- Turn off the count enable signal
- Set upper and lower limits
- Run the ICRNGWR1(P) instruction
- Test operation of the controller using jog of servo

Notes

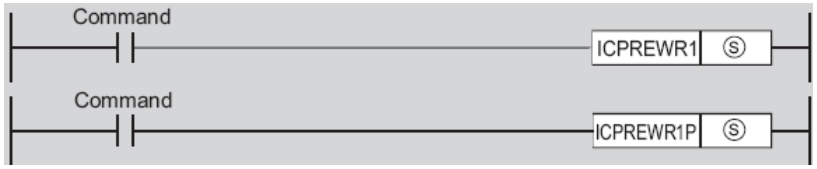
3.7.5 Preset Function

The preset function is used to overwrite the current value of a channel with a specified value.

There are 5 methods of preset available.

- Preset by phase Z input
  - Rising edge, falling edge, both edges, while on
- Preset by program
  - Relay SM1893 in program
- Preset at coincidence output function
  - Option to preset at coincidence output
- Preset by count disable/preset function
  - Option to preset at count disable
- Preset by latch counter/preset function
  - Option to preset at latch count

The commands **ICPREWR1** and **ICPREWR2** can be used to overwrite the preset value in a counter channel. This command can be pulsed. This command is only available when the counter operates in normal mode.



This command requires one parameter, which is the 32-bit value to be stored into the channel's current value. It can be a number or a reference to a register.

Notes

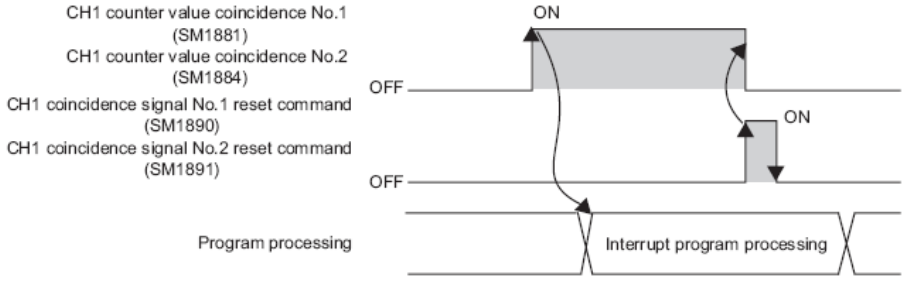
3.7.6 Coincidence Output Function

The coincidence output function can be used to trigger an action when the current value of a channel reaches a specified value. 2 coincidence points can be configured for each channel. The coincidence point values are configured with the **ICCOVWR1** and **ICCOVWR2** commands.

When a match is detected, an interrupt program in the CPU can be triggered. The interrupt number defaults as shown below, but can be customized if desired.

I Number	Interrupt factor
I0	Coincidence detection of CH1 coincidence output No.1 point setting
I1	Coincidence detection of CH1 coincidence output No.2 point setting
I2	Coincidence detection of CH2 coincidence output No.1 point setting
I3	Coincidence detection of CH2 coincidence output No.2 point setting

Once the coincidence detection relay is turned on, it must be manually reset, as shown below, or it will not detect the next coincidence value.



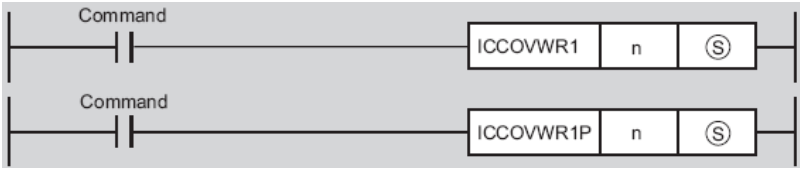
Coincidence output function has 3 settings in the high speed counter settings.

Coincidence Output Time Preset Setting	Not preset
Coincidence Detection Interrupt Setting (Counter Value Coincidence No. 1)	Not Used
Coincidence Detection Interrupt Setting (Counter Value Coincidence No. 2)	Not Used

Notes

When the Coincidence Output Time Preset Setting is set to Preset, coincidence detection is enabled. Each of the coincidence points 1 and 2 can be enabled or disabled individually with the next 2 parameter settings.

The **ICCOVWR1** and **ICCOVWR2** commands are used to set the counter values to match for coincidence function.



Each command takes 2 parameters. The first parameter is the coincidence point number to set. This can be 1 or 2, or can reference a register with the number 1 or 2 in it. The second parameter is the 32-bit value for the counter to match. It can also be set directly or to a register value.

3.7.7 Special Functions

There are a variety of special functions which can be used with the count methods discussed.

These functions are all used by the function input signal (X6 for CH1 or X7 for CH2), so only one function can be selected for each channel. Settings for the logic type and function assigned to the function input are shown below.

Function input logic settings is used to determine if the function input is a normally open (positive) or normally closed (negative) switch.

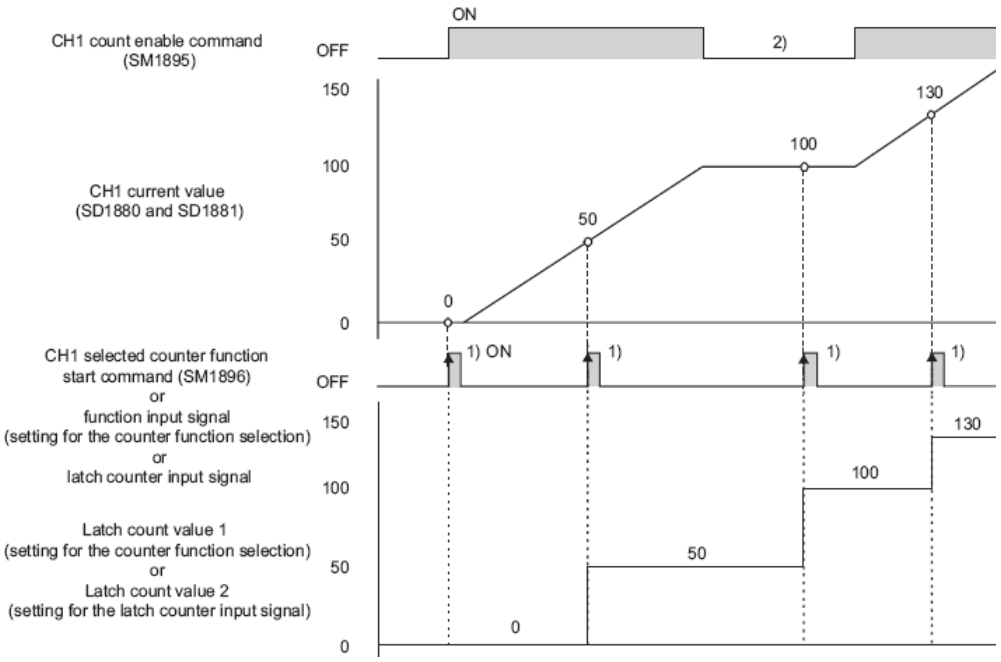
Notes

There are 5 functions which can be configured to use the function input.

- Latch count function
- Count disable function
- Sampling counter function
- Count disable/preset combines the count disable and preset functions
- Latch count/preset combines the latch count and preset functions

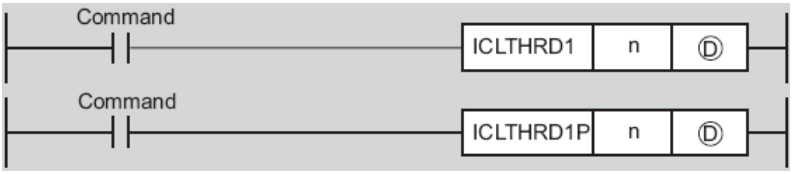
These functions can also be used with the special relay SM1896 (for CH1) or SM1916 (for CH2) except for count disable/preset and latch count/preset, which cannot use the SM bits.

Latch count function stores the current value of the counter on the rising edge of the function input.



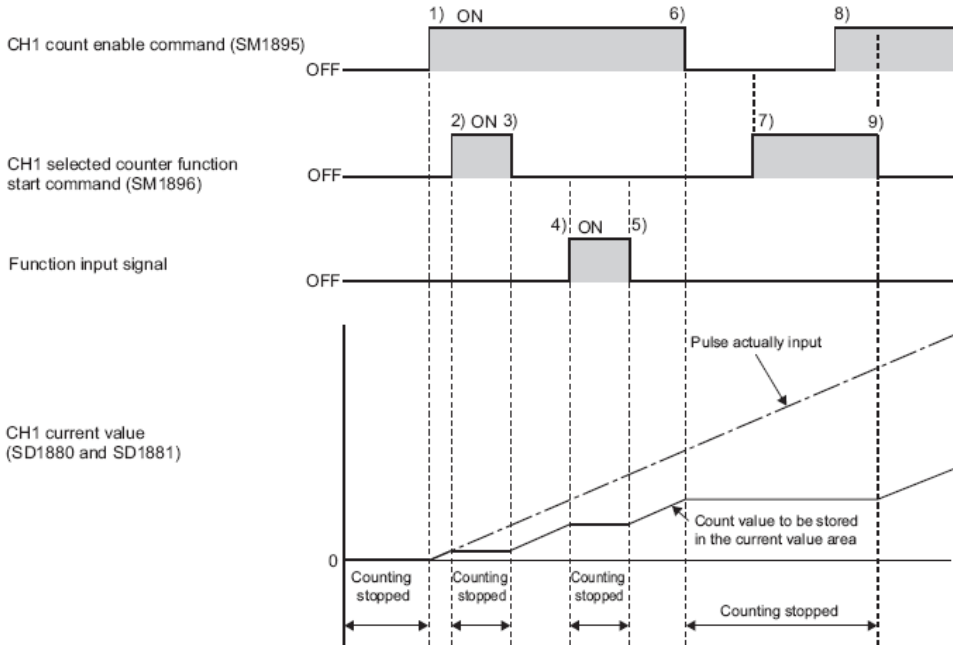
Notes

The **ICLTHRD1** and **ICLTHRD2** commands are used to read the latch counter value from the high speed counter into registers. The latch counter function must be enabled for this command to operate.



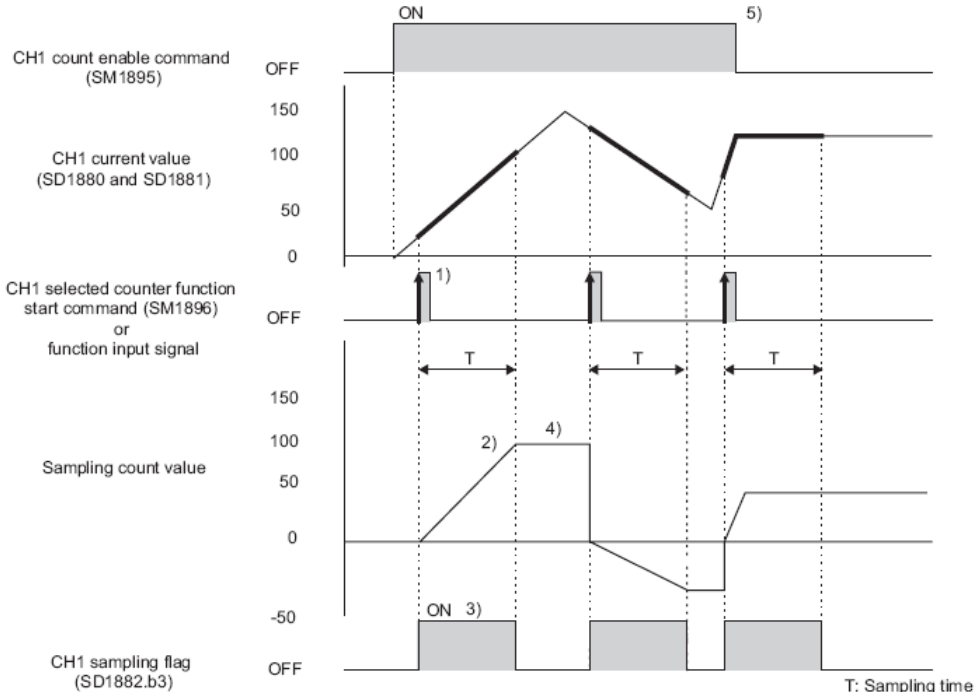
This command takes 2 parameters. The first parameter is the number of the latch value to store (1 or 2). The second parameter is the destination address for the value read from the latch counter.

Count disable stops the counter from counting while the function input is on. Counting will resume as soon as the function input turns off.



Notes

Sampling counter function is used to read pulses during a specified window of time.

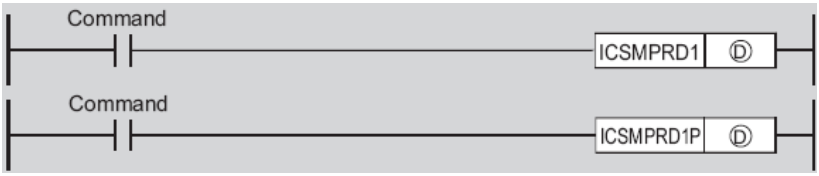


When sampling counter function is selected, the time period is set in the high speed counter settings.

Sampling Time Setting (ms)	10

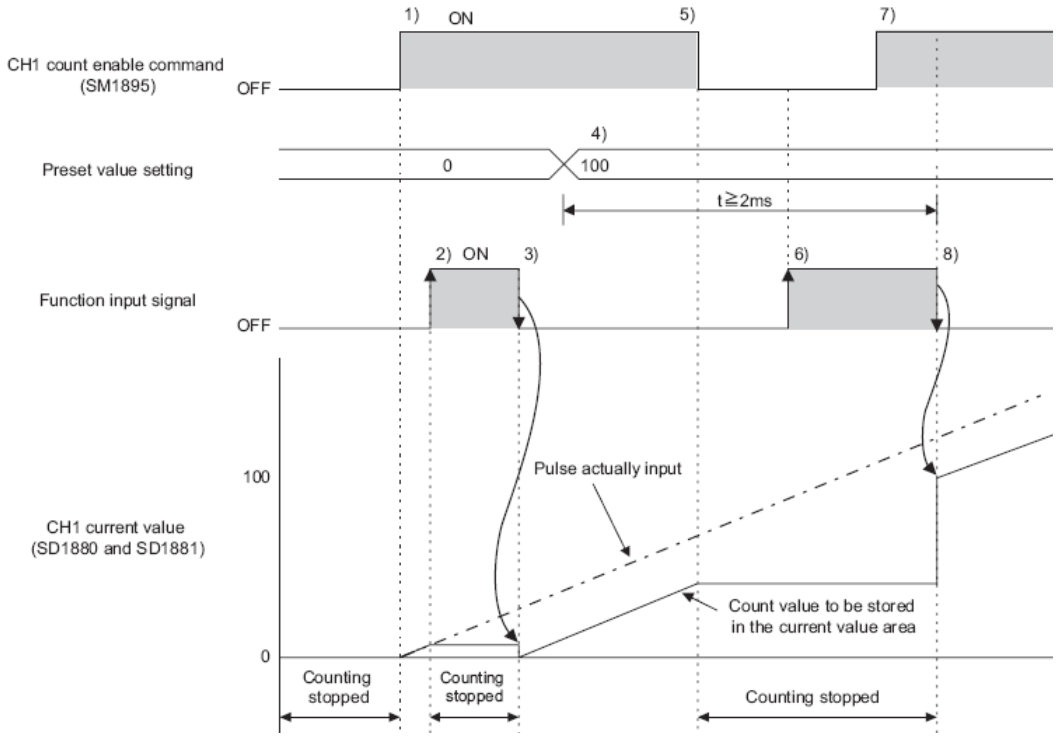
Notes

The **ICSMPRD1** and **ICSMPRD2** commands are used to read the results of a sample period. This command can only be used when the sampling counter function is enabled. This command can be pulsed.



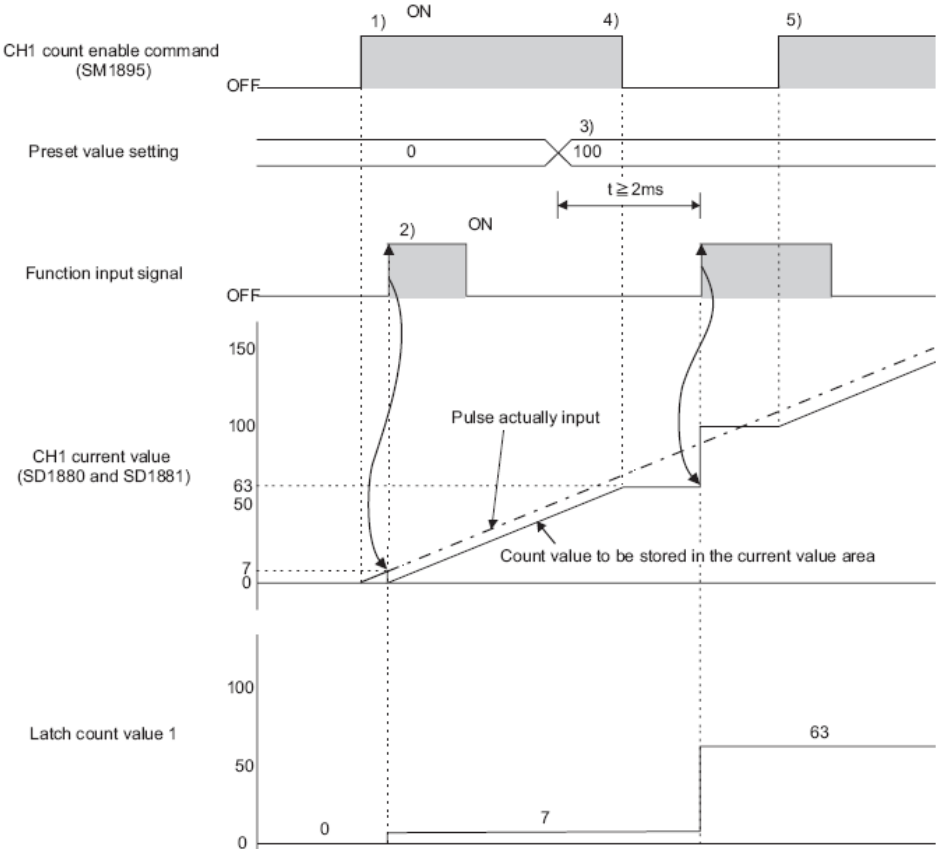
The command requires only one parameter, which is the destination address for the results of the sample read.

The count disable/preset function combines the functions of count disable (while function input is on) and preset (falling edge of function input).



Notes

The latch count/preset function stores a value and resets the current value to the preset at the rising edge of the function input signal.

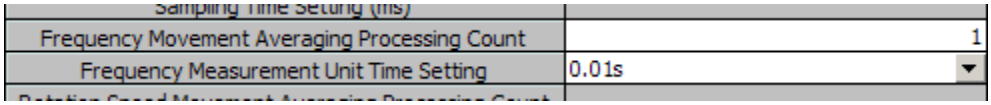


Notes

3.8 Frequency Measurement Mode

In the frequency measurement mode, the speed of the incoming pulses is measured.

There are two basic settings to be made for this function. They are shown below.



This function can use moving average processing, which will smooth the unevenness of readings by averaging multiple readings. This will take between 1 and 100 readings and then output an averaged result.

The second setting is for measurement time units, and can be set for 0.01 seconds, 0.1 seconds, or 1 second. The maximum frequency detectable changes based on this selected time value.

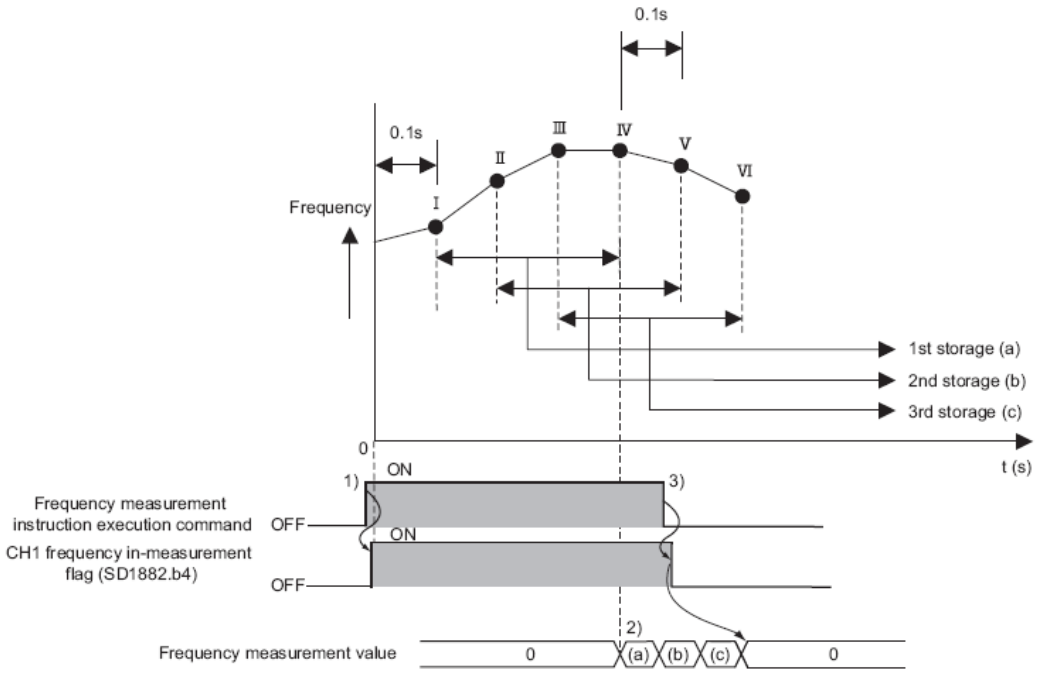
Time unit	Minimum frequency that can be measured
1s	1Hz
0.1s	10Hz
0.01s	100Hz

The commands **ICFCNT1** and **ICFCNT2** are used to read a frequency value. These commands are constantly driven while the frequency is to be read. This command is only available in the frequency measurement mode.

This command requires one parameter, which is the target for the result of the frequency measurement function. This result is a 32-bit number.

Notes

An example of frequency measurement is shown below. This example shows a frequency measurement with moving average of 4 readings and a sample time of 0.1 seconds.



- Once the frequency command is executed, samples are taken on 0.1 second increments
- Once 4 readings are taken, the measurement value is set for the first time
- Each additional sample is averaged with 3 previous reading and updates the measured value

Notes

3.9 EXERCISE – Frequency Measurement Mode

Change the parameter settings on the counter to operate in the frequency measurement mode.

Add logic to the program to enable frequency measurement and display the frequency value using the addresses shown on the operator interface terminal.

Test the program with the following steps.

- Turn off the count enable signal
- Run the ICFCNT1 instruction
- Test operation of the controller using jog of servo

Notes

3.10 Rotation Speed Measurement Mode

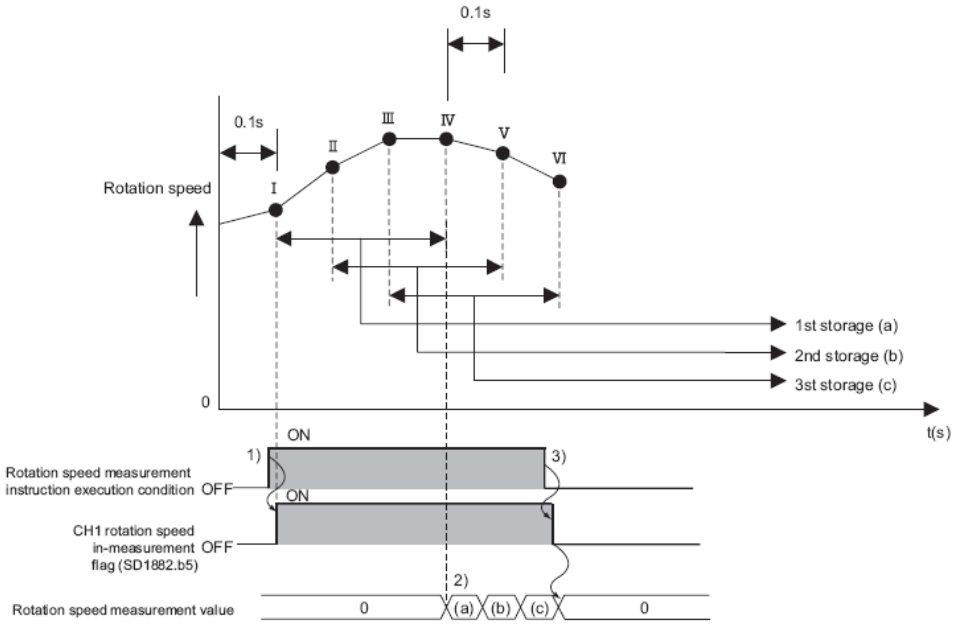
In the rotation speed measurement mode, the incoming pulses are used, along with a configured number of pulses per revolution, to determine the rotation speed of an axis.

There are 3 basic settings for rotation speed measurement mode.

Rotation Speed Movement Averaging Processing Count	1
Rotation Speed Measurement Unit Time Setting	0.01s
Number of Pulses per Rotation (pulse)	1

The first 2 settings are the same as frequency measurement mode. The third setting configures the number of pulses per revolution. It can be set from 1 to 200,000.

The example below shows a rotation speed measurement taking 4 samples at 0.1s increments. The number of pulses detected will be divided by the number of pulses per revolution and a rotation speed value will result.



Notes

The commands **ICRCNT1** and **ICRCNT2** are used to read a rotation speed value. These commands are constantly driven while the rotation speed is to be read. This command is only available in the rotation speed measurement mode.

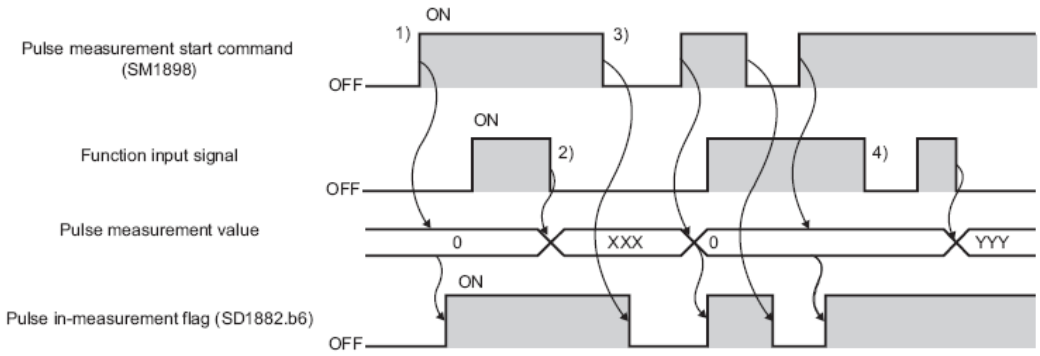
This command requires one parameter, which is the target for the result of the rotation speed measurement function. This result is a 32-bit number.

3.11 Pulse Measurement Mode

In pulse measurement mode, the width of the on or off pulse input to the function input is measured.

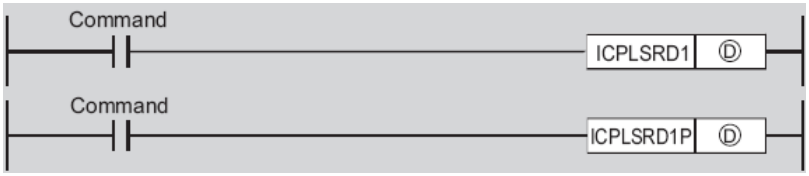
There is only one additional setting to be made for pulse measurement mode, and that determines if the on time or off time is being measured.

The example below shows how this mode operates. While the function input is on and the command is enabled, the function input is monitored. When it turns on, the measurement begins. When it turns off, the value will be stored based on how long it was on. If the pulse measurement start command turns off during a measurement, no result is returned for that measurement.



Notes

The commands **ICPLSRD1** and **ICPLSRD2** are used to read a measured pulse value. This command is only available in the pulse measurement mode. This command can be pulsed.



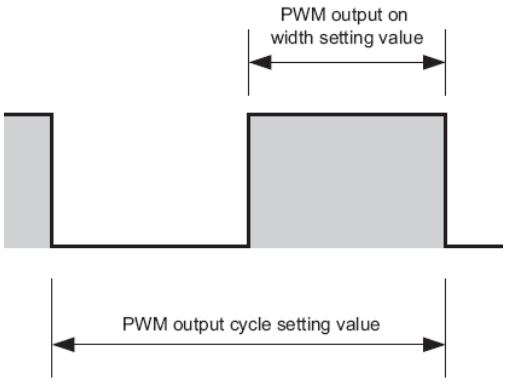
This command requires one parameter, which is the target for the result of the pulse measurement function. This result is a 32-bit number.

3.12 PWM Output Mode

In the PWM Output mode, pulse width modulated wave forms at up to 200KHz can be output on the Coincidence Output 1 signal.

To output a PWM signal, two values are required. The first value is the length of the ON portion of the pulse. The second value is the total length of the pulse. The table and diagram below demonstrate this setting.

Setting item	Setting range	Description
PWM output on width setting value	0 or 10 to 10000000 (0.1μs)	Set the on width of output pulses.
PWM output cycle setting value	50 to 10000000 (0.1μs)	Set a cycle of output pulses.



Notes

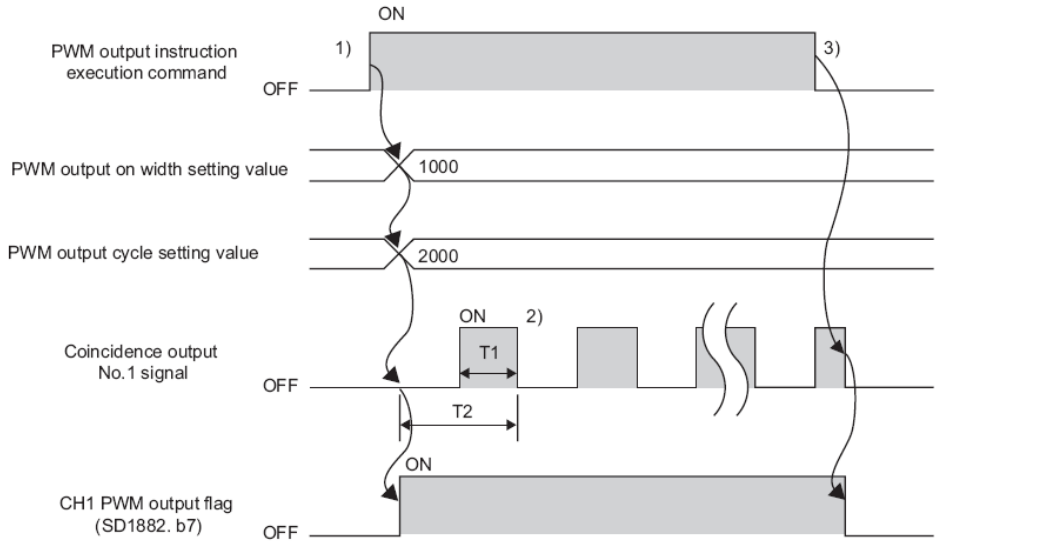
These values need to be set so that the output cycle value is greater than the on width value.

The **ICPWM1** and **ICPWM2** commands are used to generate the PWM output. These commands are only available in the PWM output mode.

The commands require 2 parameters. The first parameter sets the pulse on width. The second parameter sets the output cycle value. Both can be fixed numeric values or reference data registers. Both are 32-bit values.

The on value MUST be smaller than the cycle time value, or an error will be generated.

The basic operation of PWM output mode is shown below.

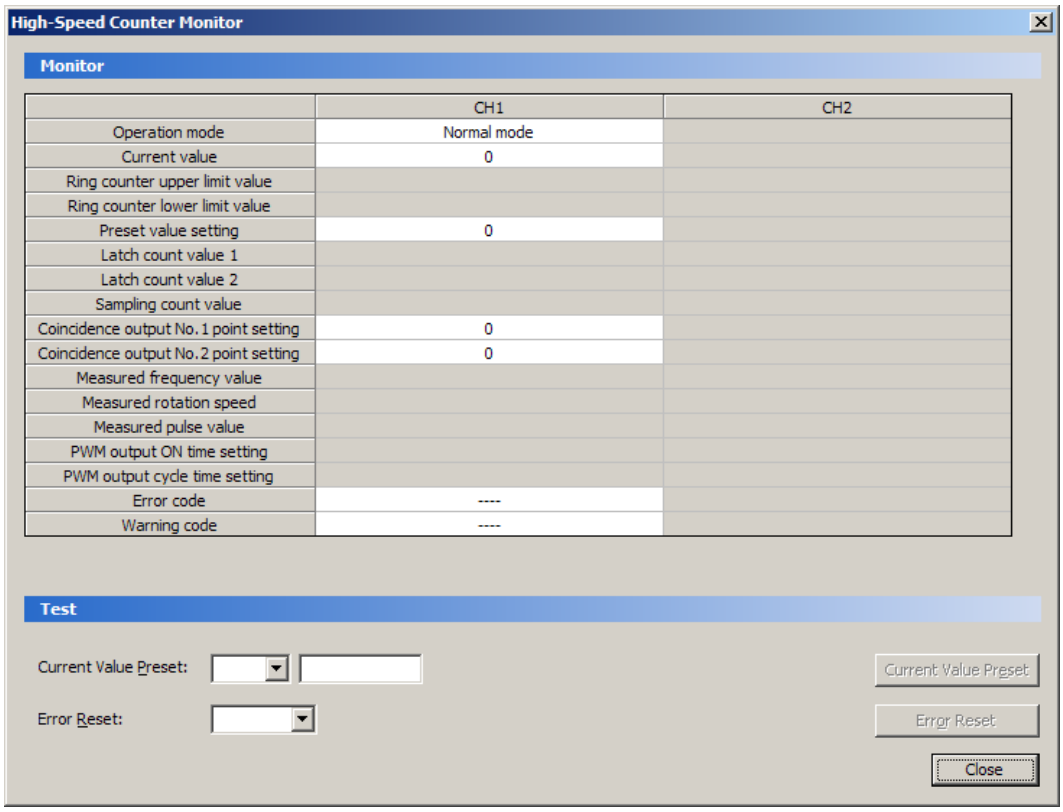


T1: PWM output on width setting valu
T2: PWM output cycle setting value

Notes

3.13 Monitoring Tools

GX Works2 has a built-in utility for monitoring of the high speed counter channels. Under the Tool menu, select Built-In I/O Monitor, and then select High Speed Counter Monitor.



On this screen, the current value, configured operation mode, error and warning codes are all displayed. Only the channels which are enabled will display data.

At the bottom of the screen are tools to change the current value, or reset the error on the channel. To change the current value of a channel, select the channel number in the drop-down list, enter a value in the white field, and click Current Value Preset. To reset an error, select the channel number from the list, and click Error Reset.

Notes

LESSON 4 – Display Module

This lesson demonstrates the capabilities of the display module on the L Series.

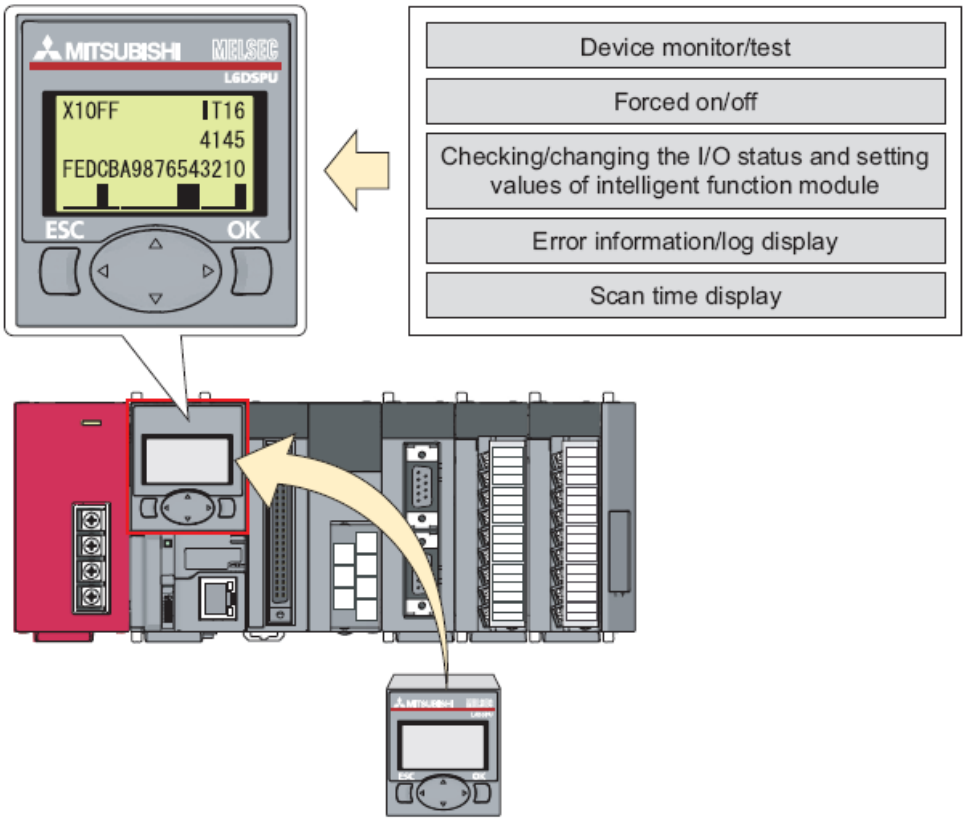
Lesson Objectives

At the conclusion of this lesson, you will be able to…

- Navigate the menus on the L6DSPU display module.
- Create a user program to put messages on the display.

4.1 Introduction

The L Series controllers offer an optional display module. This display module has some basic capabilities as shown below.



Notes

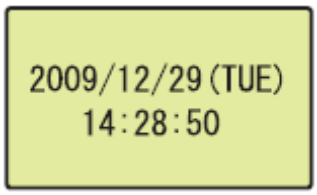
The display module is optional. The CPU comes with a blank plastic cover on the mounting location for the display module.

Some basic specifications on the display module are listed below.

- 4 line x 16 character display screen
- 4 arrow keys for easy menu navigation
- OK button to select menu options
- ESC button to return to previous display
- English or Japanese display selectable
- 2 color backlight (green/red)

The display module should never be installed or removed when the CPU is powered up. Only add or remove the module with the power off.

When no other screen display is active, the display will show the processor's real time clock, as shown below. All of these screens use the green backlight by default.



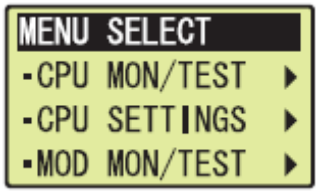
When no button is pressed in the set period of time, the backlight will turn off automatically. If a button is pressed, a user message is displayed, or a PLC error occurs, the backlight will turn back on automatically.

Details on the operation of the menus and their functions can be found in the LCPU Module User's Manual (Function Explanation, Program Fundamentals) in Chapter 4.

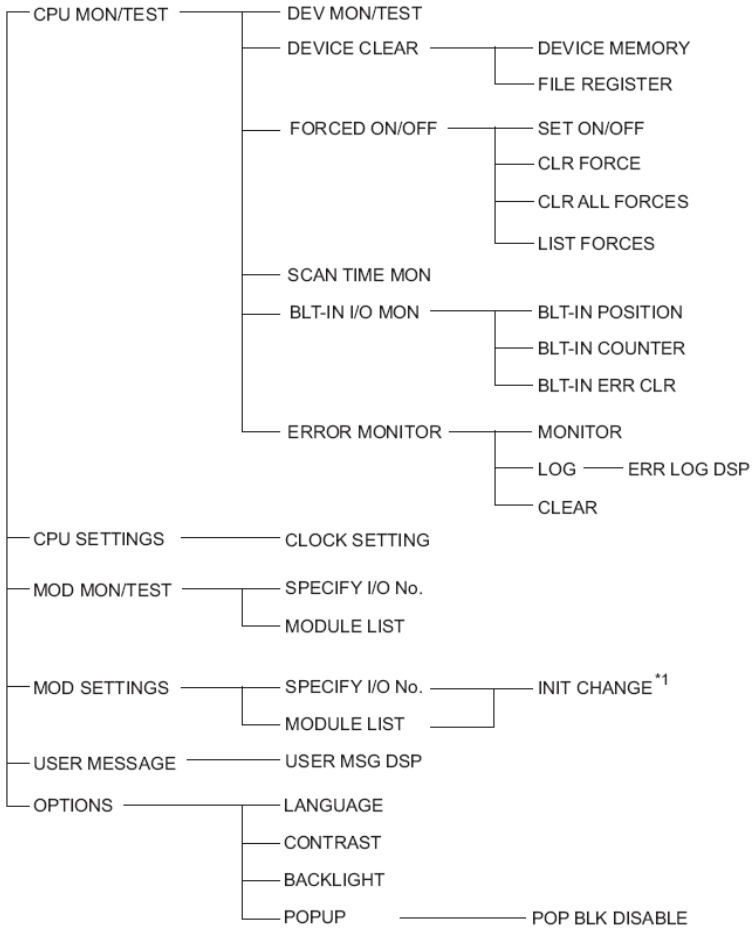
Notes

4.2 Menu Tree

Pressing and of the arrow keys or the OK key will cause the main menu to be displayed.



Below is the menu tree for the display module.



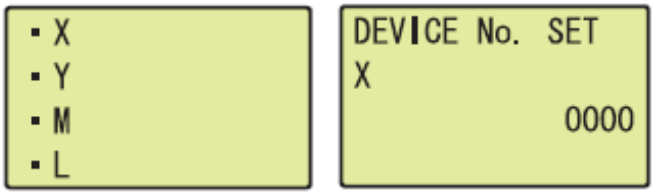
Notes

4.3 Device Monitor/Test

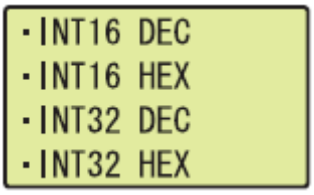
It is possible through the display module to monitor internal memory areas of the PLC. Both bit and word addresses can be monitored, and in different formats.

From the CPU MON/TEST menu, select DEV MON/TEST. This will open a screen displaying one memory address.

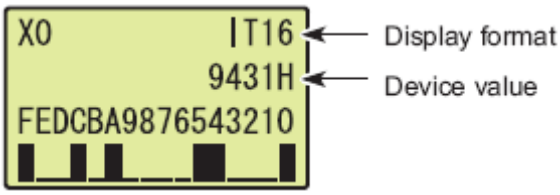
To change the memory area and address being displayed, use the left arrow key. Select the memory area from the list. Then enter an address on the next screen.



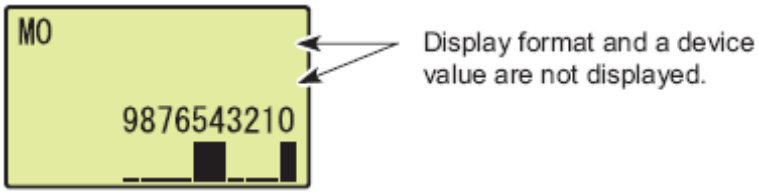
To change the display format, use the right arrow key. Select the display type from the list and press the OK button.



For bit addresses allocated in hexadecimal, a numeric value will be displayed as well as 16 consecutive bits across the bottom of the screen. It does not matter if 16-bit or 32-bit are selected for display format.

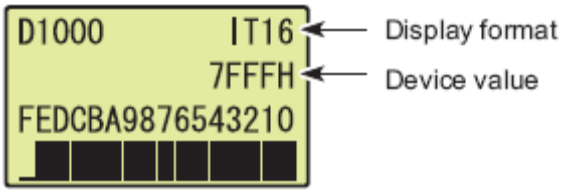


When a bit device displayed is addressed in decimal, such as memory relays, the display will show 10 bits at once.

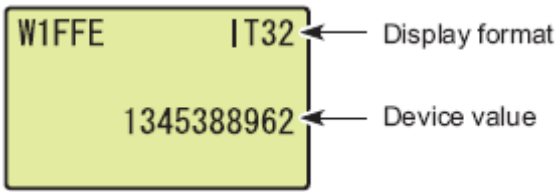


Notes

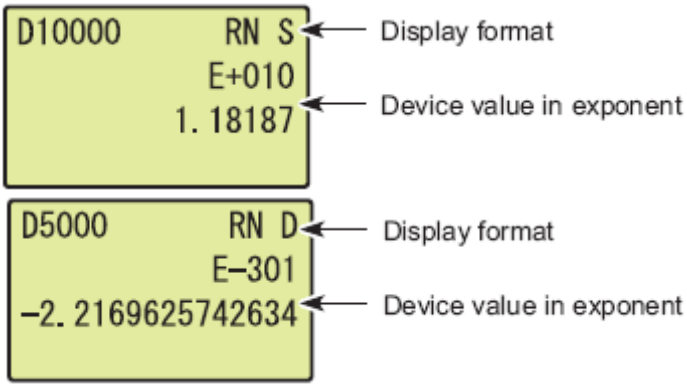
For word devices shown as 16-bit, the display is similar, showing all 16 bits within the word and a numeric value.



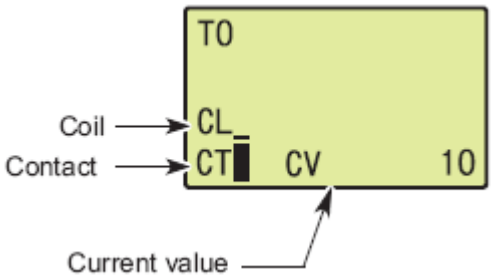
For word devices shown as 32-bit values, no individual bits will be displayed, but the numeric value will be displayed.



Data can also be displayed in the floating point format, both single precision and double precision.

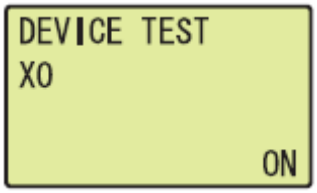


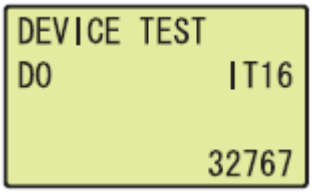
Timers and counter are shown on a single screen, including the completion contact, the operation coil, and the current value.

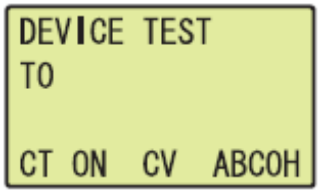


Notes

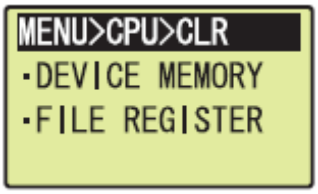
Device test can be used to change the status of a bit or the value of a register. Press the OK button. Then select the address to be changed, and then press the OK button again. Change the status of a bit or the current digit of a register with the up and down arrows. Move the cursor left of right within a word value with the arrow keys. When finished, hit the OK key to store the updated data.

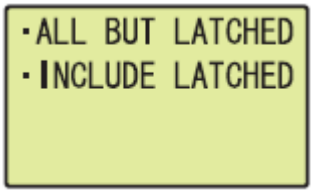


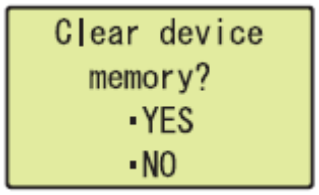


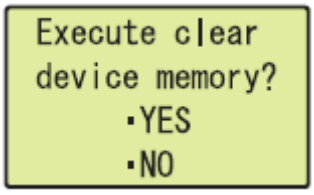


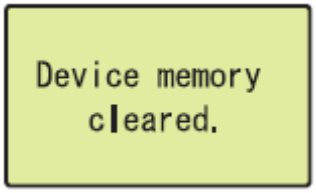
It is also possible to perform a clear of the device memory or file registers with the DEVICE CLEAR option in the CPU MON/TEST menu. Two options exist to clear device memory or file registers. When performing device memory clear, it is possible to select to include or not include the latched devices. There are 2 confirmation screens to ensure this function is not used accidentally.











Notes

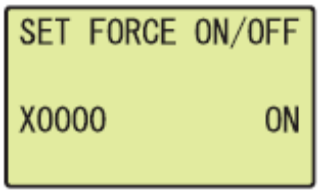
4.4 Forced I/O Registration

The CPU's built-in Forced Input/Output Registration function can be accessed from the display unit. This allows the override of physical inputs and outputs. Up to 32 devices (X and Y only) can have their status overridden by the forced I/O functions.

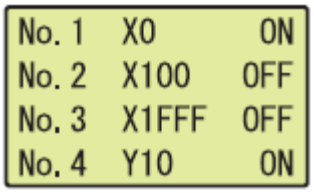
The Forced I/O Registration concept is covered in the L Series Programming (GX Works2) training class.

To access the utility, go to the CPU MON/TEST menu, select FORCED ON/OFF. From that menu, 4 choices can be accessed.

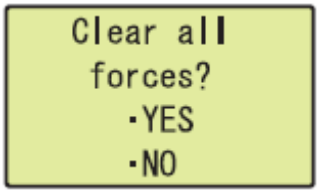
On the SET ON/OFF screen, use the up and down arrow keys to switch the device to be forced. Then use the left and right arrow keys to move to the ON/OFF status, and the up and down arrow keys to change the on/off status. Press OK to register the setting.



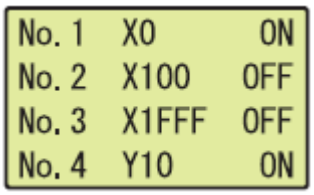
On the CLR FORCE screen, use the up and down arrows to move up and down in the list of active forces, and press the OK button to clear the selected address from the force list.



The CLR ALL FORCES screen will erase all active forces in the CPU. Select YES with the arrow keys, and press OK to confirm.



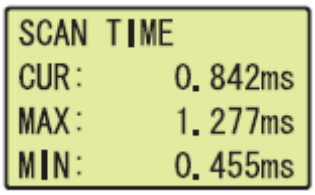
The LIST FORCES screen will be identical to the screen used to clear forces, but the list is static and cannot be changed.



Notes

4.5 Scan Time Monitor

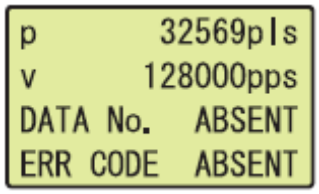
The display module can show a scan time monitor for the CPU as well. This screen shows the current, minimum, and maximum scan times. This screen is accessed from the CPU MON/TEST menu. It displays scan time in milliseconds, with 3 decimal places.



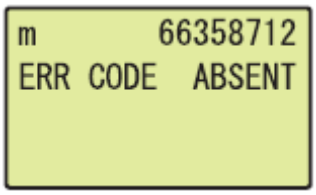
4.6 Built-In I/O Function Monitor

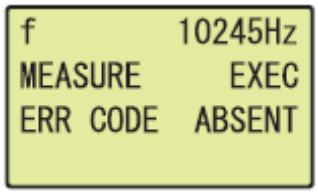
There are screens designed specifically for checking the status of the built-in positioning function and built-in high speed counter function. These are accessed from the CPU MON/TEST menu, under BLT-IN I/O MON.

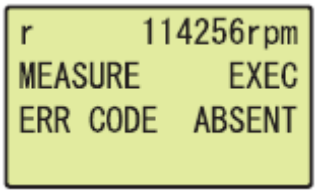
From the BLT-IN POSITION menu option, a screen will allow selection of the axis number to monitor (AXIS #1 or AXIS #2). The value on the first line is the current position value. The value on the second line is the current pulse output speed. The third line indicates that data number being executed.



The BLT-IN COUNTER menu offers a selection for channel (CH1 or CH2). After selecting a channel, one of 3 monitoring functions can be chosen. The current value, pulse frequency, or rotation speed of the high speed counter channel can be displayed. Those 3 screens are shown below.







It is also possible to clear an error on one of the built-in I/O function channels through the display module. Select BLT-IN ERR CLR, then select the counter channel or positioning axis, press OK, and then select YES and press OK.

Notes

4.7 PLC Error Display

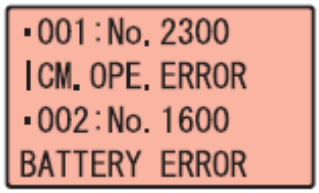
When a CPU error is detected, the backlight on the screen will turn red. The screen will display detailed information about the current PLC error.

3 screens are used to display one PLC error message, as shown below.

Screen 1 is the error information. It includes the error code number, error message, and timestamp for the error occurrence. In the top right corner, it shows page number 1 of 3.

Screen 2 is the error common information. This includes information on the file or memory area where the error occurred.

Screen 3 is the detailed information about the error. This could contain the parameter number for a parameter error, or file name and step number for a program error.



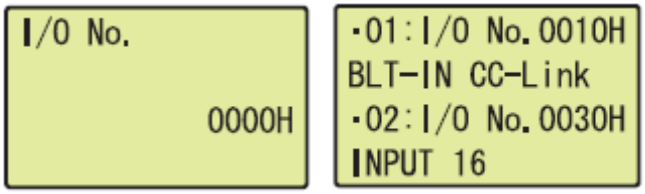
It is also possible to display all of the errors in the CPU's error history via the display module. From the main menu, select CPU MON/TEST, then select ERROR MONITOR, and then LOG. The only option on this screen is ERR LOG DSP, which will show the error list. The errors will be shown 2 per screen, and the arrow keys can be used to scroll the display. Selecting any one of the errors and pressing OK will allow access to the 3 screen mentioned above for that error.

Active errors can be cleared from the display unit as well, as long as the error condition has been resolved. ERROR MONITOR menu, select CLEAR. This will display the active errors and allow one to be selected to be cleared. Select YES on the confirmation screen, and the error will be cleared and a dialog will indicate the error is cleared.

Notes

4.8 Module Monitor/Test

From the MOD MON/TEST menu, a module can be selected by specifying the head address using SPECIFY I/O No. It can also be selected from a list using the MODULE LIST option.



Only intelligent modules can be monitored with this utility. Monitoring of discrete input or output modules was already covered in the CPU Monitor/Test section.

The next menu offers BUF MEM MON/TES for monitoring or modifying buffer memory data. Buffer memory address can be entered in decimal or hexadecimal.

Display format can be adjusted as discussed in the CPU monitor/test functions. The device test function allows changing of data in buffer memory locations, and also functions as previously discussed.

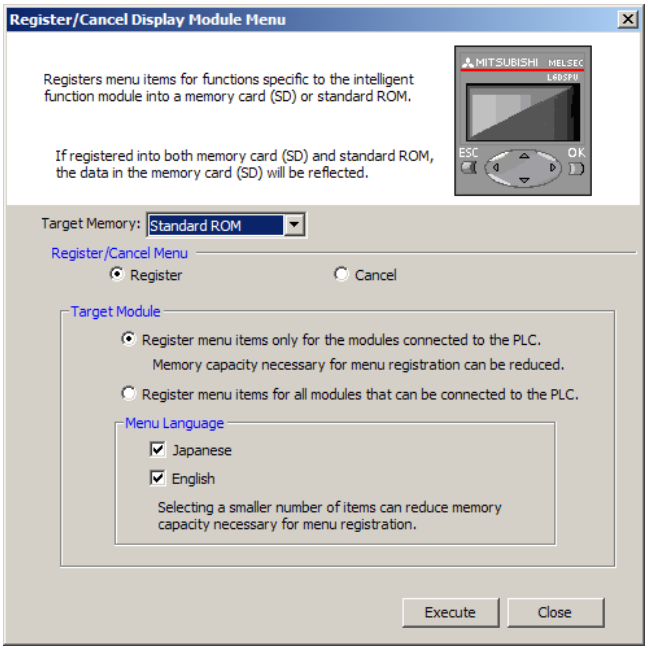
Notes

4.9 Module Settings

It is possible to change initial setting values for intelligent modules through the display module. These changes are registered to the CPU when power is cycled or the CPU is reset. They can also be registered by switching the CPU from STOP to RUN twice. The settings which can be made and the menus which will appear vary depending on the intelligent function module.

This utility can only be used while the PLC is in the STOP mode.

Before these menus can be used, the required screens must be loaded into the PLC. They can be stored on the SD card or the Standard ROM drive. To load the menus, go to the Online menu in GX Works2, select “Register/Cancel Display Module Menu…”.

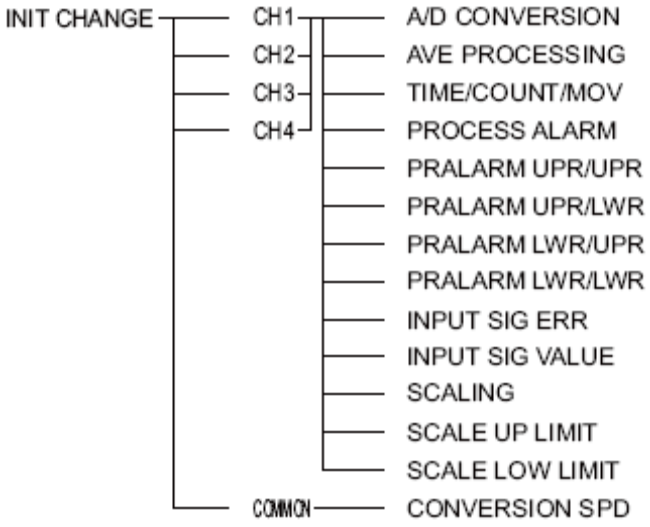


On this screen, the target memory location can be set. Another setting offers to register or cancel registered menus. The last settings select to register only the menus for the currently selected modules, or for all modules, and in which languages.

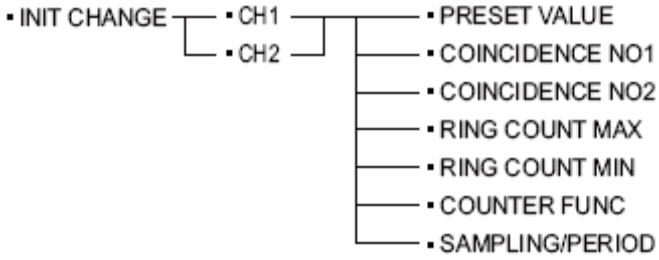
Notes

It is also important that the modules have been configured in GX Works2 with the intelligent function module utilities. If the intelligent module parameters have not been downloaded to the CPU, there will be no file for the display module to edit.

The menus available for any intelligent module will be listed in the manual for that intelligent module. The example shown below is a menu tree from the L60AD4 analog input module.



The menu tree below is for the LD62 or LD62D high speed counter input modules.



Examples of each of the available screens are also shown in the manual for the intelligent module.

Notes

4.10 EXERCISE – Intelligent Module Setting

The equipment in the training class should be provided with at least one intelligent module attached. Register the appropriate files to the SD memory card to allow the adjustment of this module's initial settings.

Select either register of all intelligent module screens, or just the ones for modules which are connected to the class equipment.

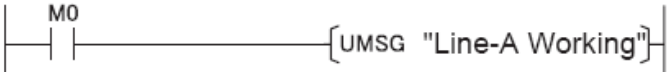
Once the screens are downloaded, use the menus to look at or modify the initial settings for the intelligent modules connected to the controller.

Notes

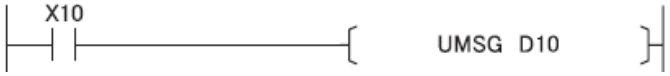
4.11 User Message

By using the UMSG instruction in the PLC program, user-defined messages up to 128 characters long can be displayed on the display module. The user message will be displayed on the rising edge of the command signal attached to the UMSG command.

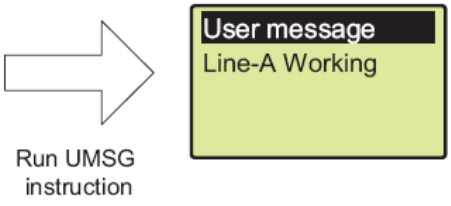
The UMSG instruction takes only one parameter. This is the string of text to be displayed. It can be referenced directly by including a string of text in double quotes.



It can also be specified as the first register storing the ASCII string. The string will be stored in consecutive registers, and must be terminated with a 00 hex terminator code.

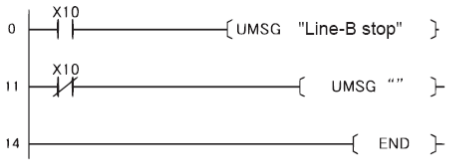


	b15 to b8	b7 to b0
D10	4CH (i)	69H (L)
D11	6EH (e)	65H (n)
D12	2DH (A)	41H (-)
D13	20H (w)	77H ( )
D14	6FH (r)	72H (o)
D15	6BH (i)	69H (k)
D16	6EH (g)	67H (n)
D17	00H	

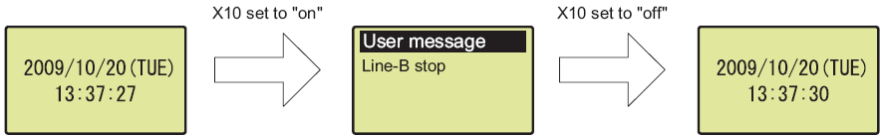


Notes

To clear a message, execute a UMSG instruction with a blank string.



[Action]



If more than one UMSG instruction is active, the last one in the program will be displayed.

This command will generate a PLC error if the terminator code is not found before the last valid data register address, or if the string exceeds 128 characters.

To clear a user message on the display module, such as to access the menus, press and hold the ESC key on the display module. This is useful if the signal to display the message is continually being sent from the program. This will turn on the popup blocking feature.

To restore popup display, on the display module, go to the OPTIONS menu, select POPUP, and then POP BLK DISABLE. A screen will ask to enable popups. Selecting yes will allow the popup display to function again.

If popup blocking is on, user messages will not be automatically displayed on the screen when activated. Instead, user messages are viewed in the USER MESSAGE menu by selecting USER MSG DSP. From this screen, the operator can view the active user message.

It is not possible with the UMSG instruction to directly control the color of the display module's backlight. However, turning on any F bit in the PLC will turn the backlight red, just as a PLC error will. To return the backlight to green, reset the F bit.

Notes

4.12 EXERCISE – User Message

Create logic in the PLC to display one of 3 user messages.

- User message 1 will be a text value specified in the PLC program
- User message 2 will be a string from a display field on the operator interface
- User message 3 will be the blank string used to cancel a displayed user message

A switch is provided on the screen to activate a fault annunciator (F relay) to change the backlight color. Write code in the PLC to set or reset the F bit from this switch. Note the backlight colors.

Notes

LESSON 5 – Data Logging

This lesson introduces and demonstrates the data logging capacity built into the L Series processors.

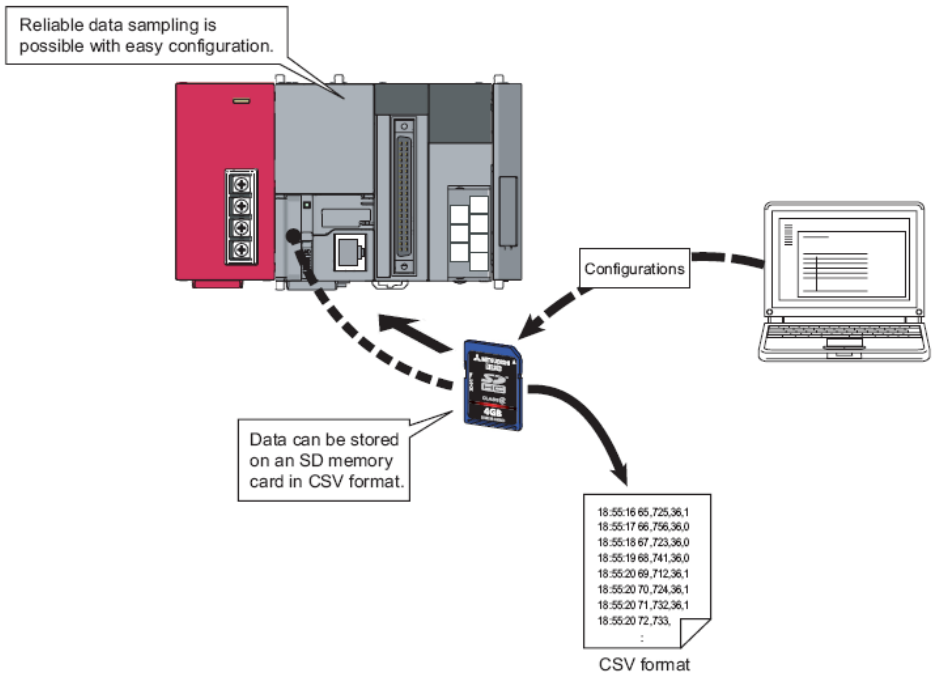
Lesson Objectives

At the conclusion of this lesson, you will be able to…

- Use the configuration tool to configure data logging.
- View the results of data logging.
- Configure an SD memory card to provide another user with automatic logging settings.

5.1 Introduction

The L Series controllers offer a built in function for data logging. Using this utility, data can be logged in the CPU at high speed, to an SD memory card, and can be retrieved and viewed at a later time on a PC.



Notes

Some of the basic features of the built-in logging function are:

- Data can be logged every PLC scan or on a millisecond based time scale as quickly as 1ms intervals
- Data can be stored before and after a trigger point, allowing data from before an alarm condition occurs to be saved for review during the troubleshooting process
- Logging is configured with an easy-to-use software package on the PC
- Large amounts of data can be logged, stored to the SD memory card (sizes of up to 4GB are supported)
- A logging setting file can be written to an SD card, and the log can be started automatically when the card is placed into a CPU

Specifications for the system are shown below.

Item			Specification
Number of data logging settings			10
Data storage location			Standard ROM (configuration files only), SD memory card
Logging type			• Continuous logging • Trigger logging
Data sampling	Sampling interval		• Each scanning cycle • Time specification • Condition specification (Device specification, Step No. specification)
	No. of data sampling points		Up to 1280 (128 points per setting)
	AND conjunction		In the Sampling interval setting, Device and Step No. under "Condition specification" can be specified in combination (AND conjunction).
Data processing	Trigger logging	Trigger condition	• Condition specification (Device change specification, Step No. specification) • When trigger instruction executed • When data logging trigger activated
		AND conjunction	In the Trigger setting, Device data change and Step No. under "Condition specification" can be specified in combination (AND conjunction).
		Trigger logging range	Data of the specified number of records are logged before and after a trigger.
		Number of triggers	1
		Number of trigger logging records	Up to 1000000

Notes

File output	File Name	Up to 48 one-byte characters can be used for the following. • File number (serial number) • Character string (name) • Date and time
	File format	CSV file
	Data type	• Bit • Word (unsigned) • Word (signed) • Double word (unsigned) • Double word (signed) • FLOAT [single precision] • FLOAT [double precision] • Character string: 1 to 256 characters • Numeric string: 1 to 256 bytes
	Data output format (CSV file)	• Decimal format • Hexadecimal format • Exponential format

Item			Specification
Handling of output files	File switching	File switching timing	• No. of records • File size
		Number of saved files	1 to 65535
Others	Data logging operation at transition to RUN		Specify the operation at the time of status change, from power on to RUN, from reset to RUN, or from STOP to RUN, after registration of the data logging setting.
	Auto logging by inserting an SD memory card		By inserting an SD memory card (to which data logging settings have been written), data logging automatically starts.
	File access		The FTP server function allows saving and deletion of data logging files from an SD memory card installed in the CPU module to a personal computer.

There are 2 basic types of logging available.

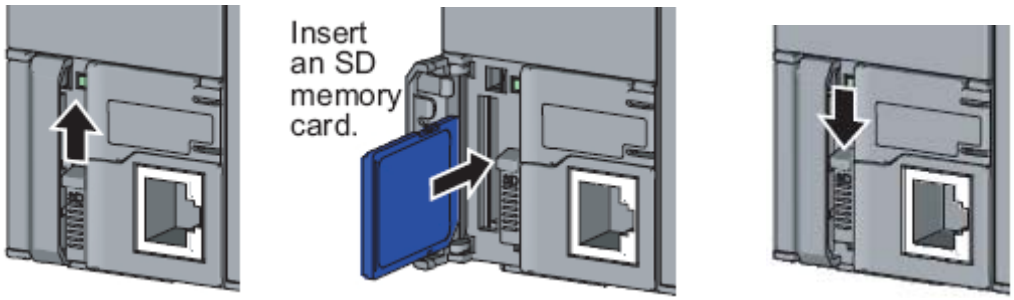
- In the continuous mode, data is constantly monitored and logged based on the configuration settings. This mode runs as long as the controller is in the RUN mode.
- In the trigger mode, some trigger condition tells the logging to begin, and a number of samples already stored are saved, along with a configured number of new samples, and then logging is stopped.

Notes

5.2 Data Storage

The data from the logging function is stored to the PLC's SD memory card. The card must be installed, and the write protect switch must be off.

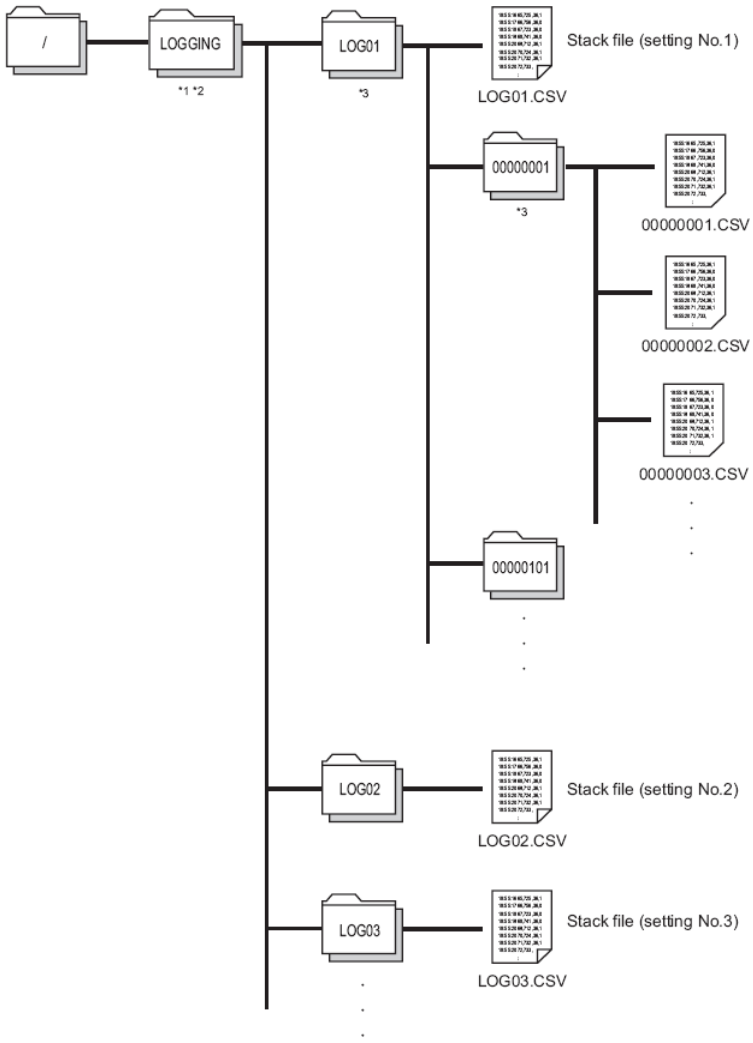
- Turn the memory card access switch off (up)
- Insert an SD memory card
- Turn the memory card access switch on (down)



The module will write stored data to a CSV format text file.

Notes

The directory structure on the memory card will be designed as shown below.



*1 The folder name is fixed.
*2 Do not create any file or folder under the LOGGING folder using a personal computer.
*3 Delete unnecessary folders by using the SD memory card installed in the personal computer.

Other directories can be created, and other files can be stored to the card, even files the PLC will not require, such as PDF files, CAD drawings, etc. But no other files should be added to the LOGGING directory.

Notes

5.3 Dedicated Addresses

There are special data registers and special relays dedicated to the execution and monitoring of the data logging function in the LCPU.

The table below shows the special relays dedicated to the built-in data logging function. More detail on these addresses can be found in the LCPU User's Manual (Hardware Design, Maintenance, and Inspection).

Number	Name	Number	Name
SM604	Memory card in-use flag	SM1950 to SM1957	Data logging setting No.2 (Data structure is the same as that of data logging setting No.1)
SM624	Drive 3/4 in-use flag		
SM841	Auto logging status	SM1960 to SM1967	Data logging setting No.3 (Data structure is the same as that of data logging setting No.1)
SM1940	Data logging setting No.1 Data logging preparation	SM1970 to SM1977	Data logging setting No.4 (Data structure is the same as that of data logging setting No.1)
SM1941	Data logging setting No.1 Data logging start	SM1980 to SM1987	Data logging setting No.5 (Data structure is the same as that of data logging setting No.1)
SM1942	Data logging setting No.1 Data logging execution	SM1990 to SM1997	Data logging setting No.6 (Data structure is the same as that of data logging setting No.1)
SM1943	Data logging setting No.1 Data logging end	SM2000 to SM2007	Data logging setting No.7 (Data structure is the same as that of data logging setting No.1)
SM1944	Data logging setting No.1 Data logging trigger	SM2010 to SM2017	Data logging setting No.8 (Data structure is the same as that of data logging setting No.1)
SM1945	Data logging setting No.1 After data logging trigger	SM2020 to SM2027	Data logging setting No.9 (Data structure is the same as that of data logging setting No.1)
SM1946	Data logging setting No.1 Data logging error	SM2030 to SM2037	Data logging setting No.10 (Data structure is the same as that of data logging setting No.1)
SM1947	Data logging setting No.1 Saving to SD memory card		

These bits will allow the programmer to start, stop, trigger, or detect an error on the data logging functions. Each of the 10 data log configurations has its own dedicated bits.

Notes

The table below shows the special registers. As above, more detail on these can be found in the manual.

Number	Name	Number	Name
SD604	Memory card use conditions	SD1950 to SD1956	Data logging setting No.2 (Data structure is the same as that of data logging setting No.1)
SD616	Free space in drive 2 (memory card ROM)	SD1960 to SD1966	Data logging setting No.3 (Data structure is the same as that of data logging setting No.1)
SD617			
SD624	Drive 3/4 use conditions	SD1970 to SD1976	Data logging setting No.4 (Data structure is the same as that of data logging setting No.1)
SD1940	Data logging setting No.1 Latest file No. (2 words)	SD1980 to SD1986	Data logging setting No.5 (Data structure is the same as that of data logging setting No.1)
SD1941			
SD1942	Data logging setting No.1 Oldest file No. (2 words)	SD1990 to SD1996	Data logging setting No.6 (Data structure is the same as that of data logging setting No.1)
SD1943		SD2000 to SD2006	Data logging setting No.7 (Data structure is the same as that of data logging setting No.1)
SD1944	Data logging setting No.1 Free buffer space (1 word)	SD2010 to SD2016	Data logging setting No.8 (Data structure is the same as that of data logging setting No.1)
SD1945	Data logging setting No.1 Processing timeout count (1 word)	SD2020 to SD2026	Data logging setting No.9 (Data structure is the same as that of data logging setting No.1)
SD1946	Data logging setting No.1 Data logging error cause (1 word)	SD2030 to SD2036	Data logging setting No.10 (Data structure is the same as that of data logging setting No.1)

These numeric values can allow the programmer to monitor free space on the memory card, see what the names are of the oldest and newest files, and look at any active error code. Each of the data log configurations has its own dedicated registers.

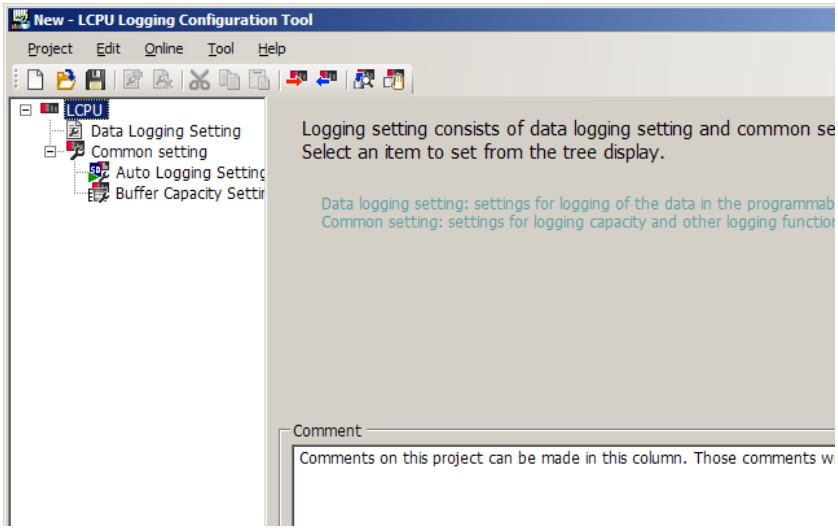
Notes

5.4 Logging Configuration Tool

The LCPU Logging Configuration Tool software is provided on the CD with the GX Works2 programming software. It can also be downloaded from the www.meau.com website.

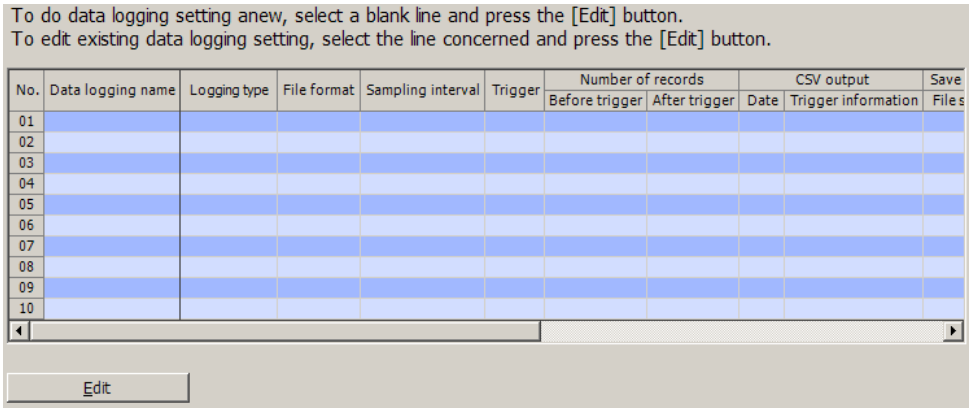
Once installed, the software can be started from the Start menu, under Programs, MELSOFT Application, Logging Function. It can also be called from within GX Works2 from the Tool menu.

The software will open with a new blank project. The main screen is shown below.



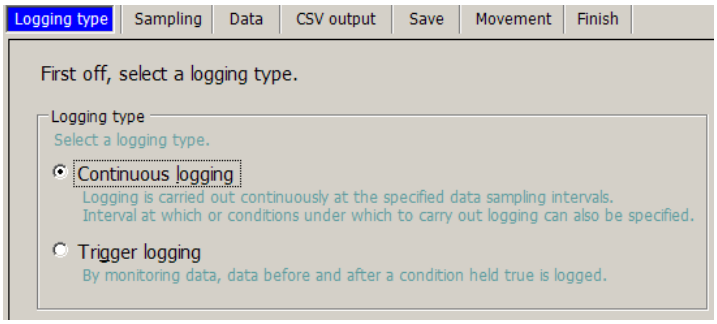
Notes

Click on Data Logging Setting in the left navigation window to display the list of configured data logging settings.



To create a new data logging configuration, clock on one of the empty lines and press the Edit button. This will begin a step-by-step configuration wizard. The screens shown below will be to configure a continuous logging type.

On the first screen, select continuous logging or trigger logging, and then click Next.



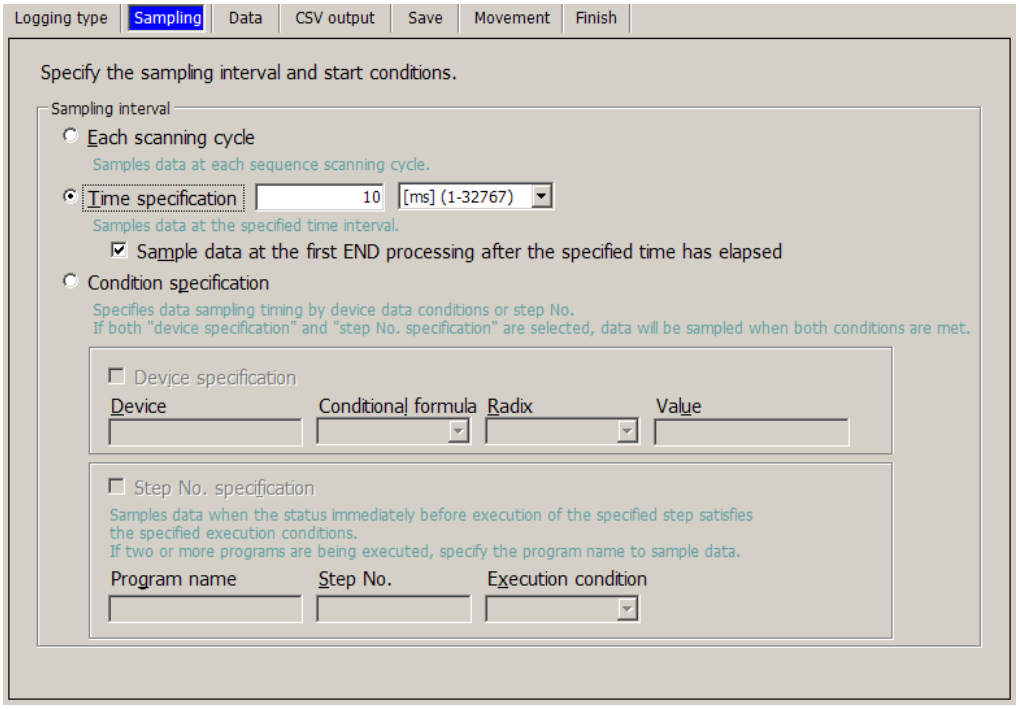
The colored tabs along the top show the current position in the wizard.

Notes

5.5 Continuous Logging

The following settings demonstrate setup of a continuous logging function.

The second screen determines the interval between samples.



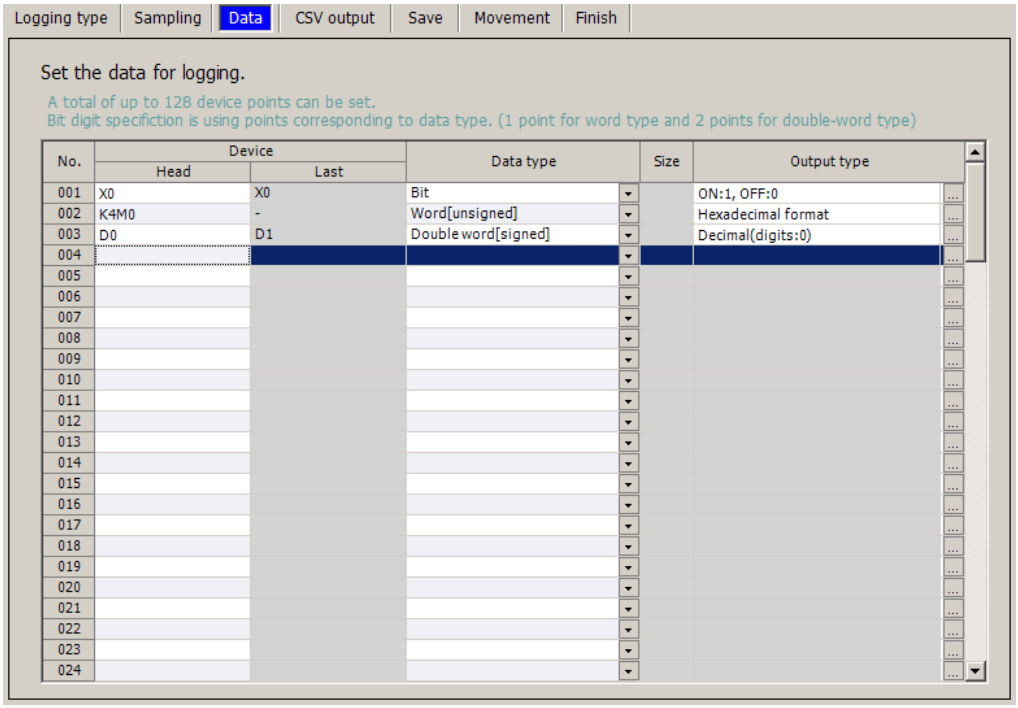
The following choices are available:

- Every PLC scan
- Time period, specified in milliseconds, from 1 to 32,767
- Device specification, offering rising or falling edge of a bit or a numeric value changing or equal to a preset value
- Step number specification, which allows the log entry to be tied to a specific program name and step number

Select the desired method and click Next.

Notes

The next screen allows the configuration of the data points to be logged. Up to 128 points can be configured here.

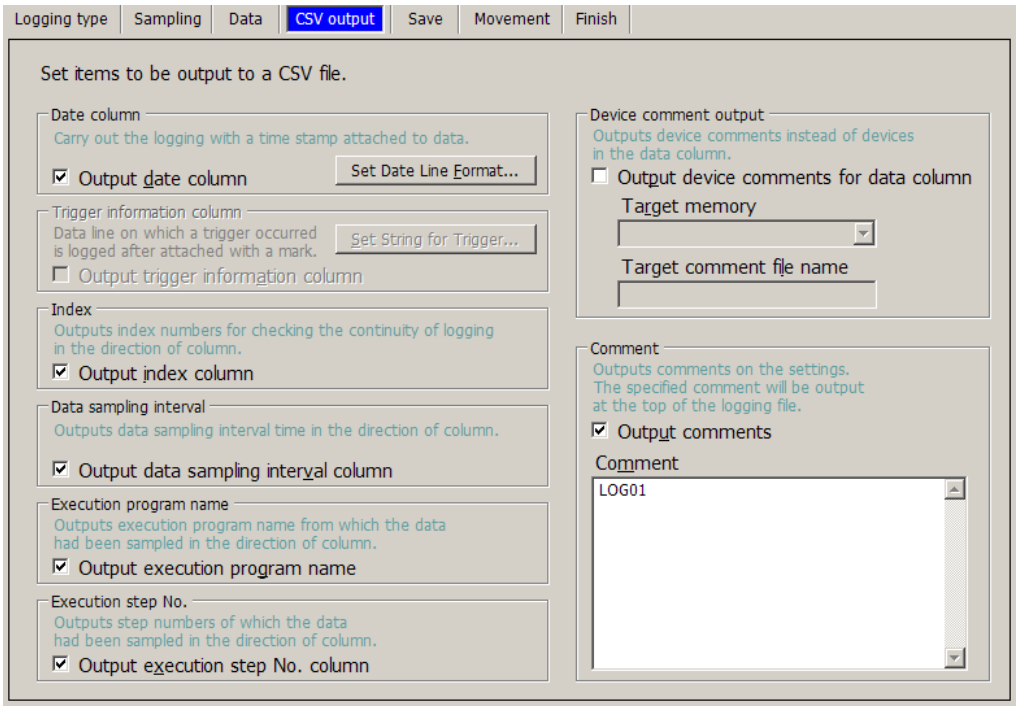


In the first column, the head address is set. Bit devices and word devices can be added to the log, as can the bit digit designation KaXb. The grayed out second column shows the last address used, such as in 32-bit numeric data. The third column sets the data type for the input data. The last column sets the format in which the data is to be output to the log file. This can be set to decimal, hexadecimal, or exponential.

Once the table has been completed, click Next.

Notes

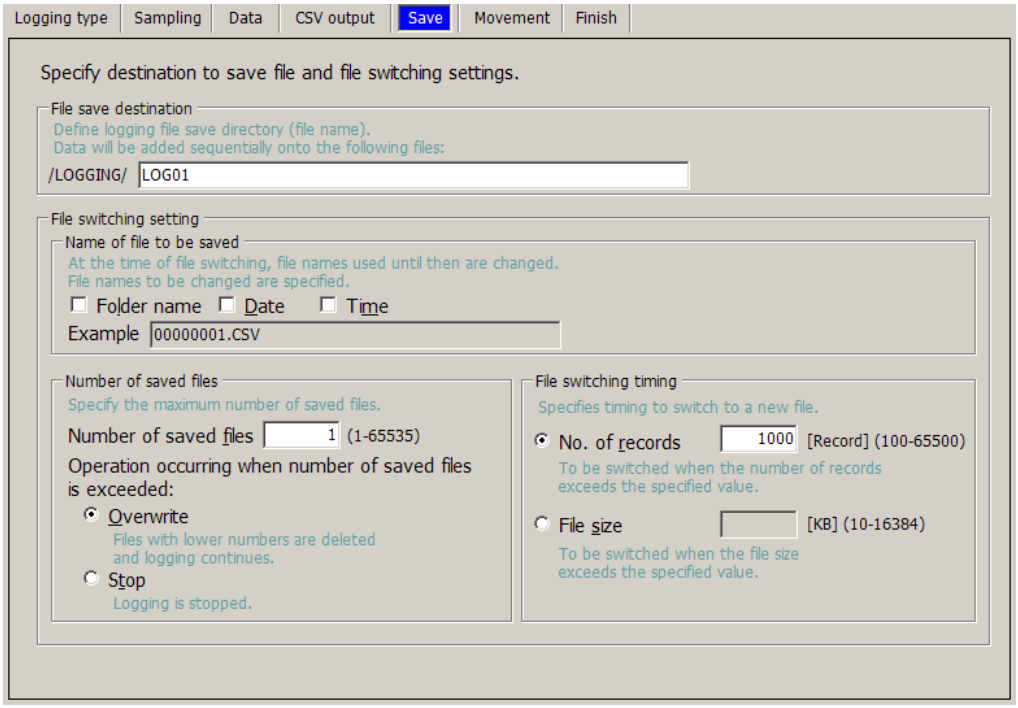
The CSV Output screen allows the setting of some items to be included or not included in the output file. There are check boxes to turn a number of items on and off in the output data.



When finished selecting these optional components, click Next.

Notes

The Save screen adjust the name of the saved files, the directory in which they are saved, and the number of files and records per file.



There are options to add the folder name, date, or time to the name of the newly created log files. This can be useful to determine which file contains the data from a given date or time.

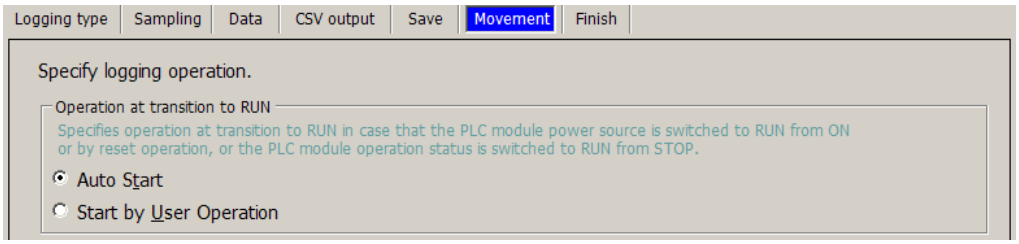
The number of files to be saved determines how many log files are retained on the memory card. The option below determines what to do once all of those files are filled. The choices are stop logging or delete the oldest file.

The file switch timing allows a setting for when to create a new file. It can be limited based on file size, or based on number of records in a file.

Once these options are set, click Next.

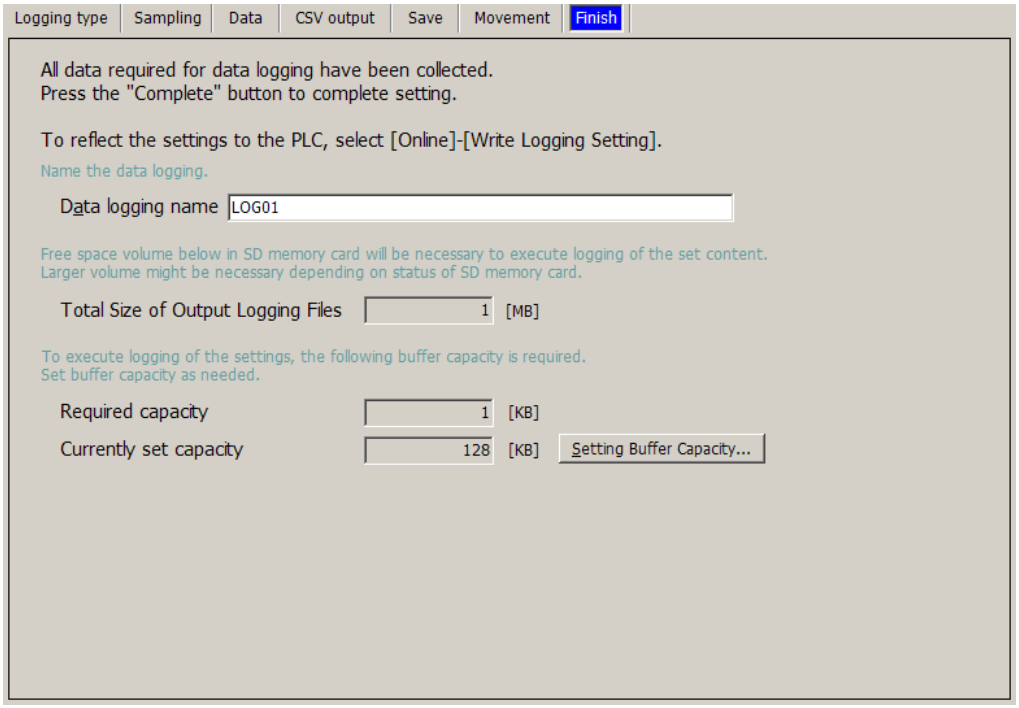
Notes

The Movement screen determines if the logging is to be automatically started when the CPU is powered up or switched from STOP to RUN.



If Start by User Operation is selected, the software will have to be used to start the logging operation.

The final screen indicates the settings are complete. From here, a name can be defined for the log. This screen also adjusts the buffer memory, and indicates the amount of space which will be required on the memory card based on the log configuration. The size of the buffer can be adjusted from here.

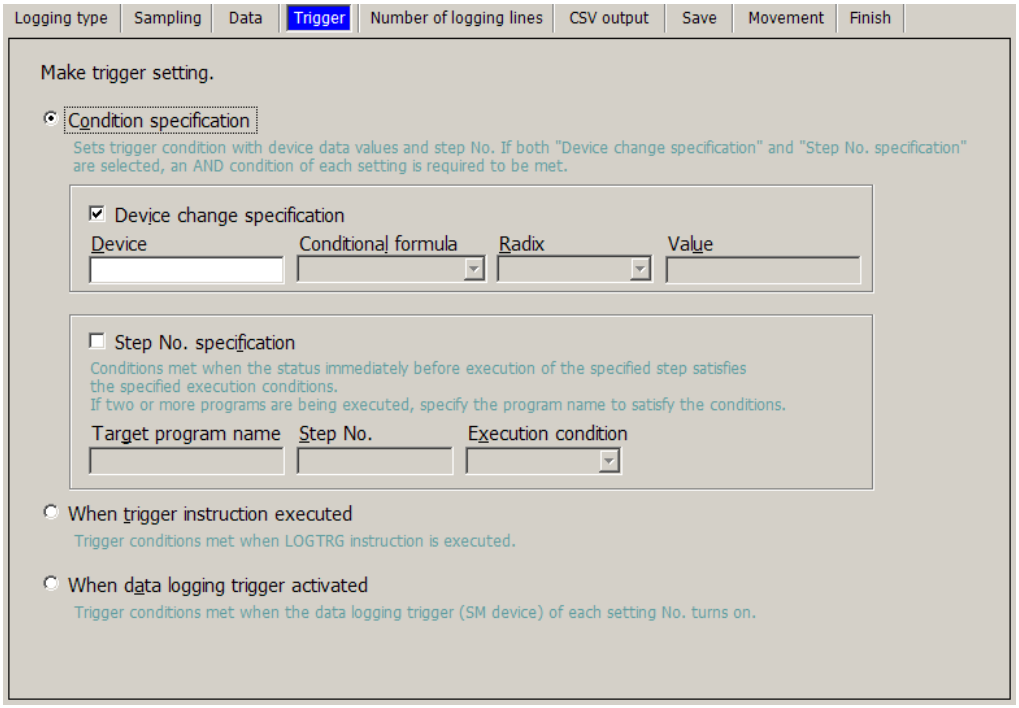


Notes

5.6 Trigger Logging

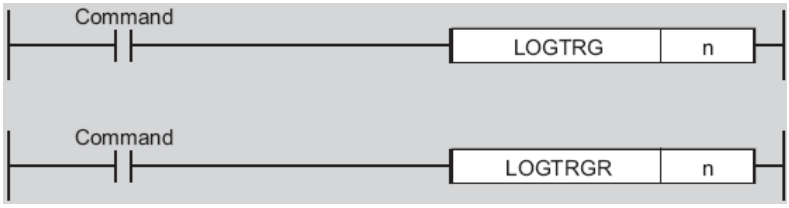
When setting up a trigger logging entry, the majority of the configuration is identical to the continuous logging function. There are 2 additional tabs for configuring the trigger and the number of samples to take. These screens appear right after the Data page where data to be logged is configured.

The first screen is the Trigger page. This page allows setting of the trigger condition. The trigger can be tied to a bit or word address, a program step number, the LOGTRG trigger instruction, or the SM bit associated with the trigger for each logging configuration.



Notes

The trigger could be configured for PLC command, in which case the **LOGTRG** command is used to issue the trigger. Once the trigger is activated, the **LOGTRGR** command will reset the trigger.

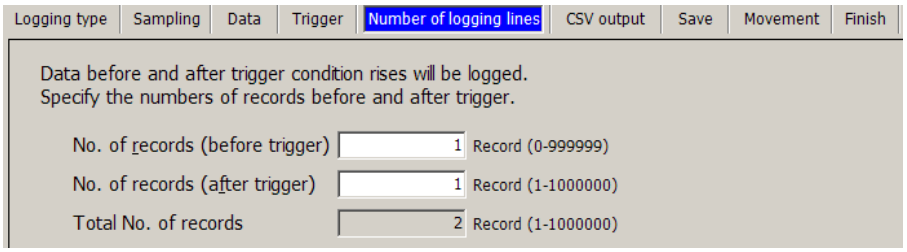


Each of these commands takes one parameter, which is the number of the log configuration to trigger or reset.

The other option for the trigger was the SM bit. Turning on the bit referenced in the table already discussed in this lesson.

Once the trigger condition is set, click Next to move to the next screen.

The second screen unique to the trigger logging function is the Number of Logging Lines. On this page, the number of values to store from before the trigger and the number of values to save after the trigger are configured.



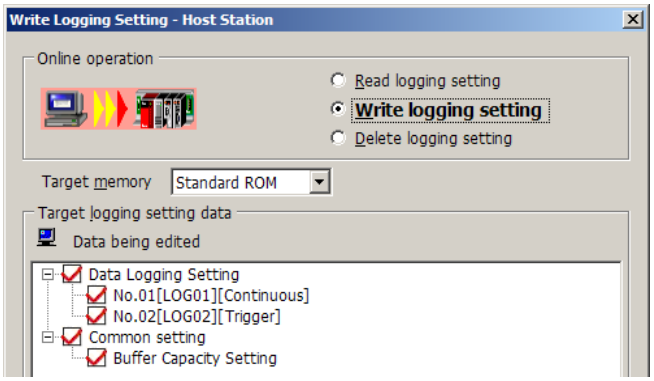
The total of both numbers cannot exceed 1,000,000. Within that number of samples, the count before and after can be adjusted freely.

All additional settings for the trigger logging are the same as already discussed.

Notes

5.7 Logging Operation

One of the first steps after configuration of the data logging function is to write that setting into the CPU. From the Online menu, select Write Logging Setting.

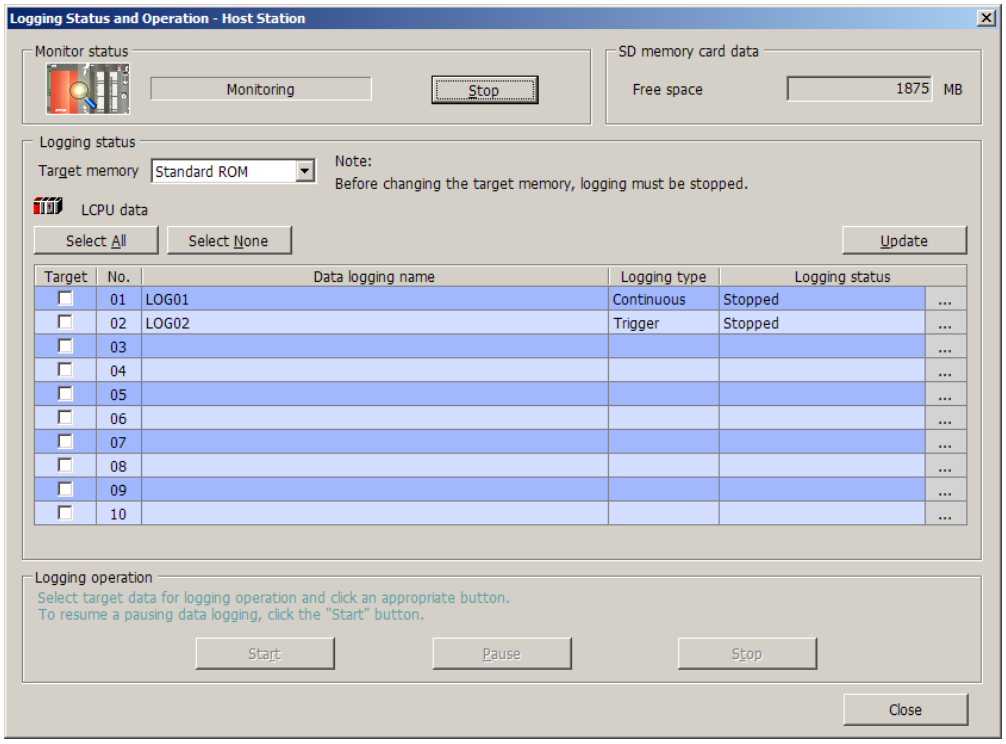


At the top of this window, the function to read, write, or delete can be adjusted. Next, the memory location to write the configuration is set. This defaults to the Standard ROM drive. The SD Memory Card can also be selected. At the bottom, the logging items to write are selected.

Notes

Logs which are already executing cannot be overwritten. Be sure to stop all logging before writing updated settings.

When the write completes, a warning message will remind the operator that downloading settings does not automatically start the logs. To do this, the Logging Status and Operation option is used from the Online menu.

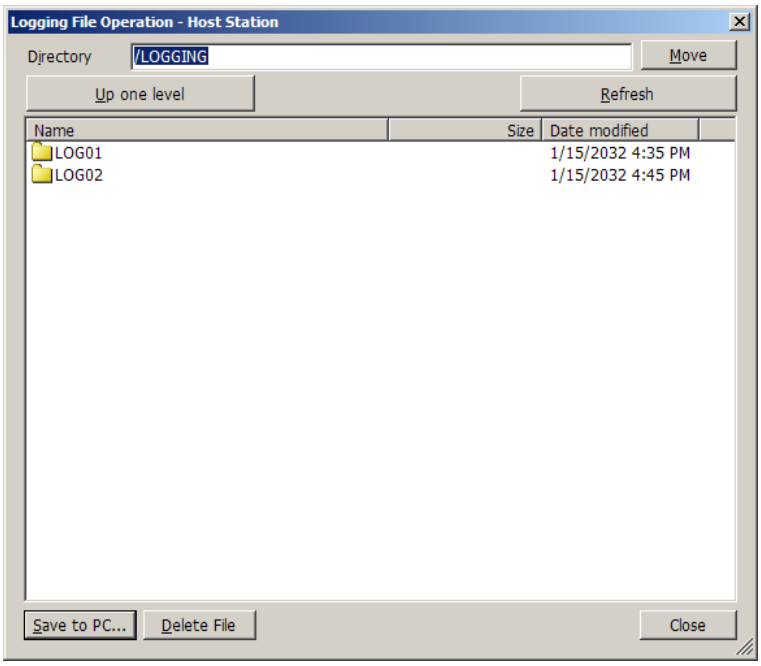


The top left corner shows the active monitoring status. The top right shows the amount of space available on the SD memory card.

The middle of the screen shows the current status of the configured logs. Check the box in front of a log to enable the buttons at the bottom of the screen. These buttons allow the start, stop, or pause of logging functions. Multiple log items can be checked at once.

Notes

To view the files on the memory card, copy them to the PC, or delete them, select Logging File Operation from the Online menu.



To navigate through the directories, double click on a directory name. To go back a directory, use the Up One Level button at the top. To save files to the PC, select Save to PC. Files can be deleted from the memory card with the Delete File button.

Notes

5.8 EXERCISE – Data Logging

Download the program provided by the instructor into the PLCs. Verify operation of the conveyors and graph data.

The addresses of the data used in the program which may be usable in the data logs include:

- Bits
  - M0, M1, M10, M11
  - Y0, Y1, Y2, Y3
- Words
  - T0, T1, T2, T3, T4, T5
  - D0, D1, D2, D3, D4, D5, D6, D20, D21, D22, D23, D24

Configure the following data logs:

- Configure one log for continuous logging
  - Log data every 100ms
  - Select data to log from list above
  - Save 10 files of 10000 entries
- Configure one log for trigger logging
  - Use M0 as trigger
  - Log every 10ms
  - Log all data related to the conveyors
  - Store at least 2000 samples (20 seconds)

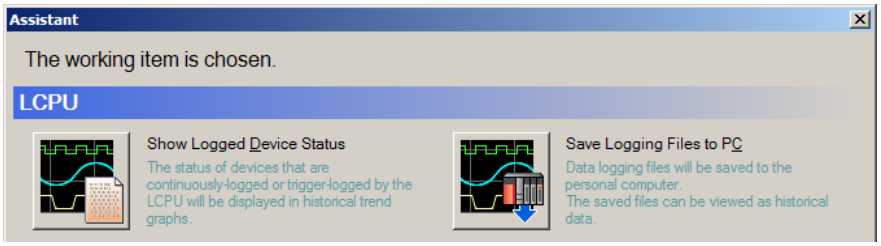
Download these settings to the Standard ROM drive and test operation.

Notes

5.9 GX Log Viewer

The GX Log Viewer tool can be used to view the logs created by the PLC logging function. This tool can be used for the LCPU built-in logging function and for the Q Series High Speed Data Logger Module.

When GX Log Viewer is started, there is an assistant screen displayed. This screen can be removed with the check box at the bottom of the screen. This shows all available functions. The L Series functions are at the top.



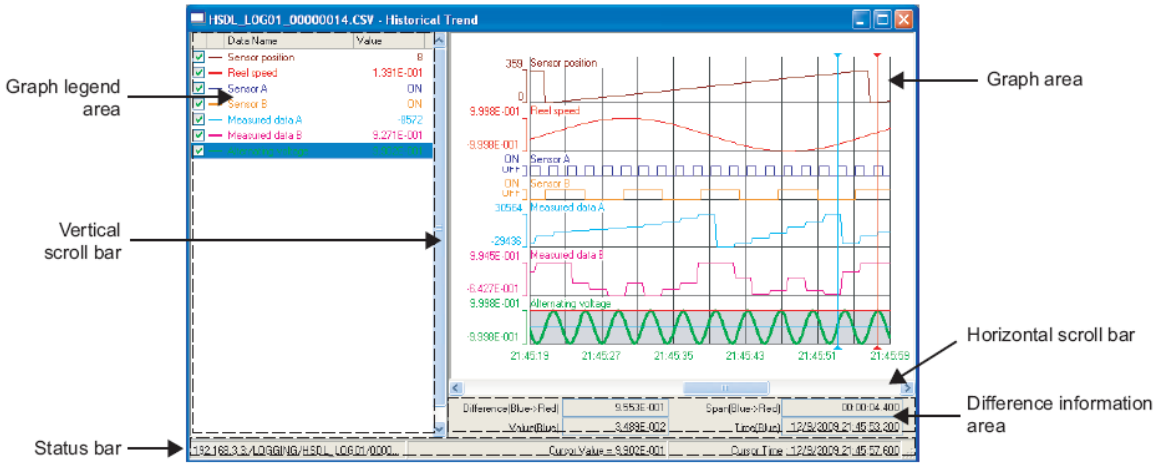
Select Show Logged Device Status and a window will open to verify transfer settings for communication with the PLC. Next is a screen showing the available logs in the CPU's memory card. This screen is identical to the one shown previously to view files on the memory card.

Browse through the directories and select one of the log files, then click Open File.

Files can also be opened from the local PC with the File menu. This allows graphing of data already uploaded from the PLC, or from a memory card installed into the PC.

Notes

Once the log file is opened, the historical trend graph will open by default. Below is an example of the layout of the historical trend graph window.



The graph data and display options can be modified through the Graph View menu, or from buttons on the toolbars. Some of the things which can be changed include:

- Display or not display of the graph legend on the left
- Display of multiple cursors
- Selection of objects from log to graph
- Display of values at cursor bar beside cursor bar
- Save and restore of display customization

Scaling and other functions can be changed through the Graph Operation menu. These settings include:

- Graph align/superimpose for numeric data
- Move cursor to specific sample
- Adjust scaling and time scale information

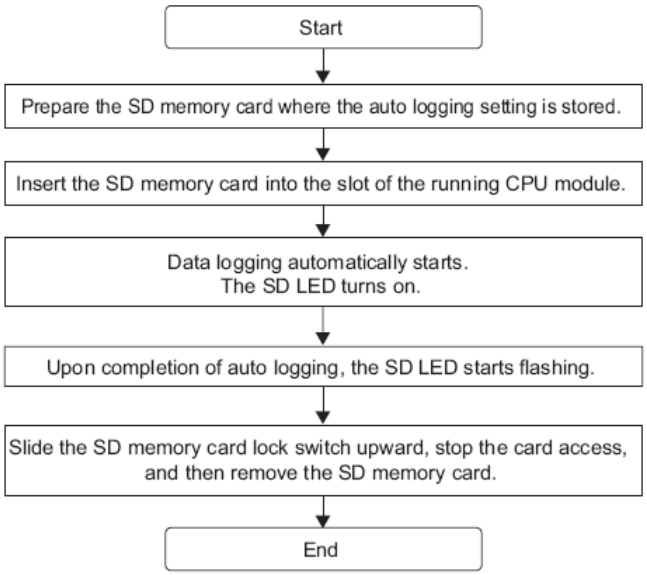
The data being used in GX Log Viewer can be saved as a CSV files from the File menu. It can also be printed from the File menu. There is also an option to save a snapshot of graph data as an image file.

Notes

5.10 Automatic Logging from SD Card

By writing automatic logging settings to an SD memory card, it is possible to send an SD card on site, insert it into a running CPU, and have data logging start automatically. Both continuous and trigger logging modes are possible.

The basic procedure is shown below.

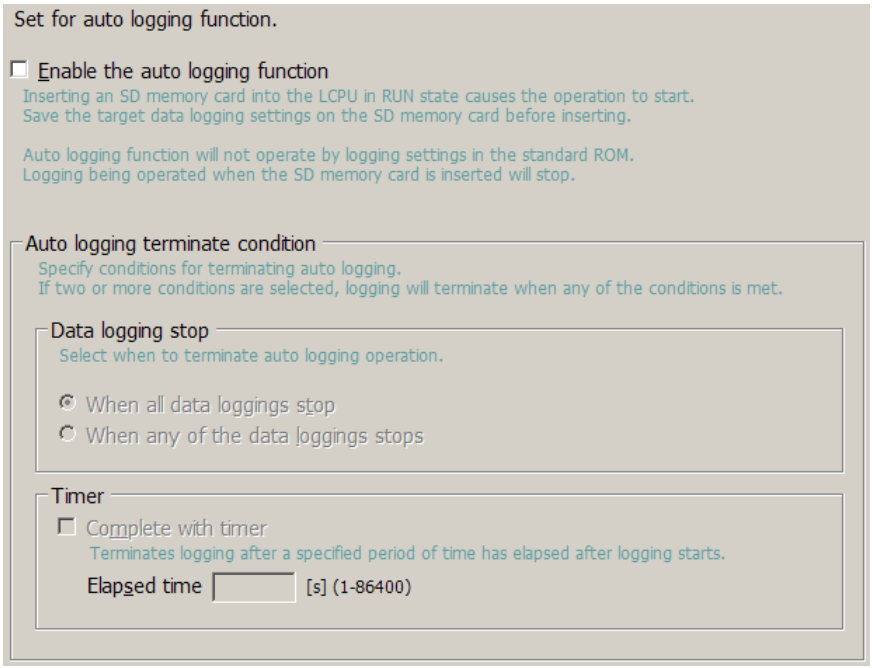


The conditions to indicate completion of auto logging can be set to either data logging stop or timer mode. When data logging stop is selected, this can be triggered by the completion of the specified number of samples in a trigger logging, the completion of the number of saved files in continuous logging, or the data logging being stopped from the configuration tool. In timer mode, samples will be stored for a specified time period and then completed.

Once automatic logging finishes, resetting the PLC or powering it off and on will not cause the automatic logging to begin again. To restart, remove the card and reinsert it.

Notes

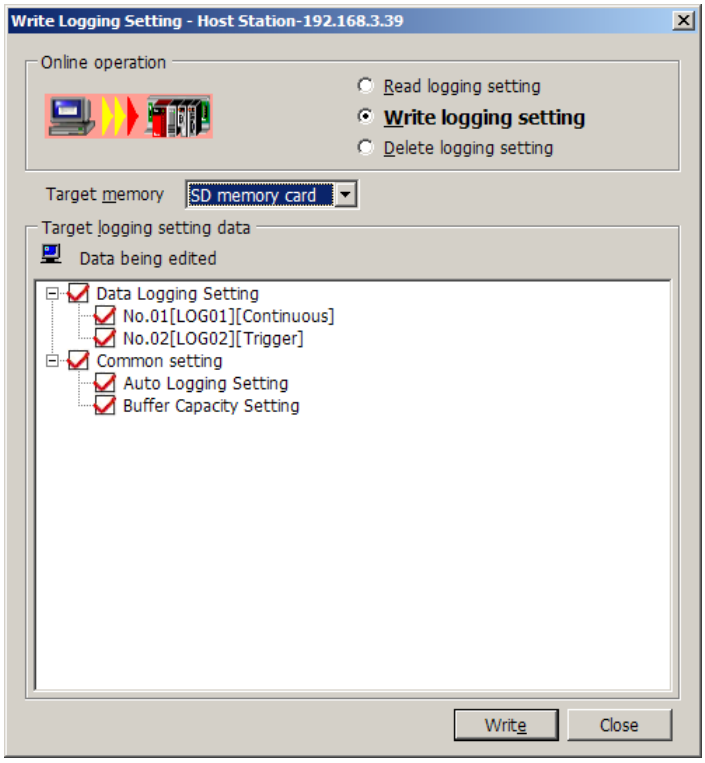
To enable to automatic logging function, open the Auto Logging Setting under the Common Setting list in the navigation tree in the Logging Configuration Tool. Check the box at the top to enable automatic logging, and then select the termination condition below.



If logging was active from a logging configuration stored to the Standard ROM drive, it will be stopped when the SD card with the automatic logging settings is installed into the CPU.

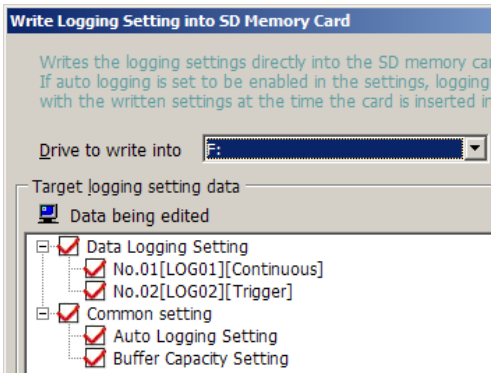
Notes

To write automatic logging settings to an SD card, insert the SD card into the CPU, and select Write Logging Setting from the online menu. Change the target memory from Standard ROM to SD Memory Card, and the check box for automatic logging settings will be displayed.



Notes

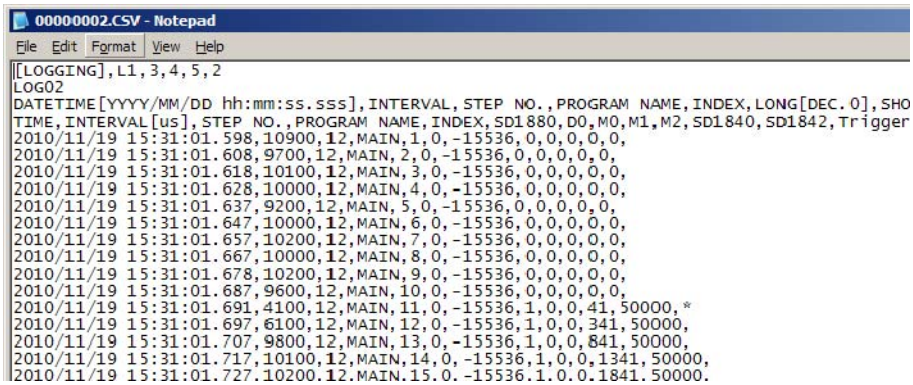
The configuration can also be written directly to an SD memory card, without the PLC, using the Write Logging Setting into SD Memory Card option in the Project menu. This way a PLC is not required to write the memory card, instead it is installed to the computer running the configuration tool.



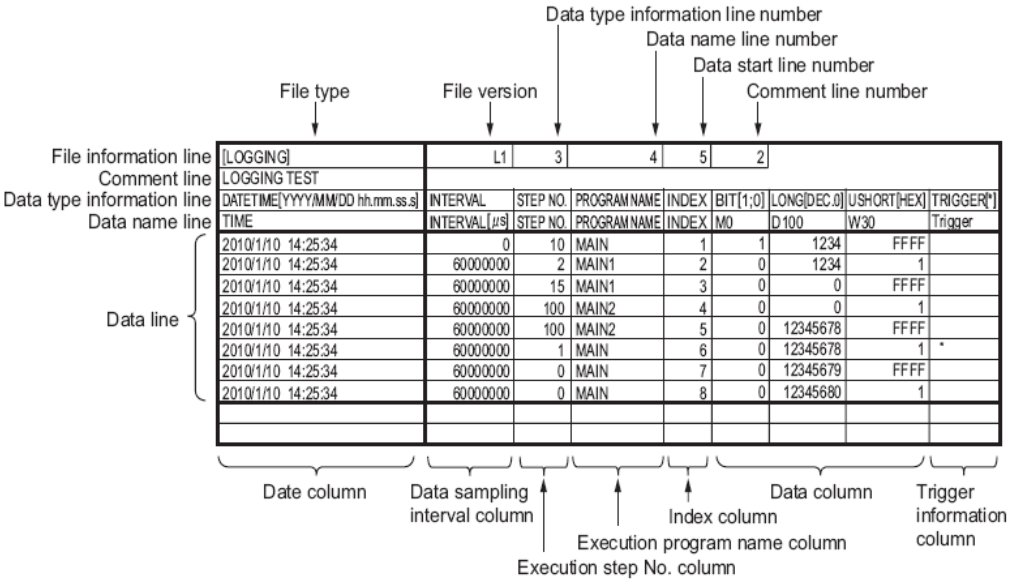
Notes

5.11 CSV File Format

The CSV file format is used to store logging data. CSV stands for Comma Separated Values, which indicates that the data for each column is separated by a comma. This is a text based format, so there is no formatting or colors, borders, cell dimensions, or any other display data stored within. Microsoft Excel or other spreadsheet programs can import a CSV format file. An example of a section of a CSV file is shown below (opened in Notepad to see raw data format).



Below is an explanation of the output data format.

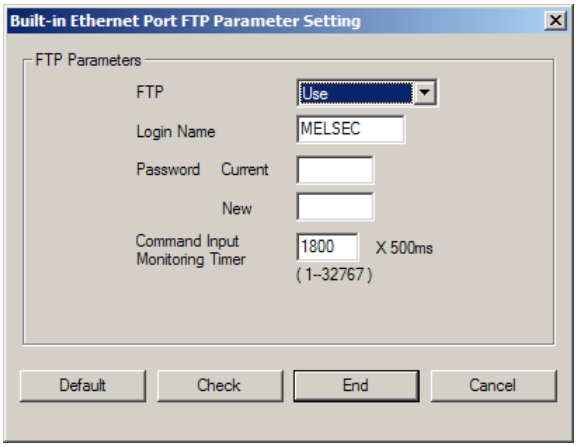


Notes

5.12 FTP Access

It is possible to connect to the controller over Ethernet and read the log files using a standard FTP (file transfer protocol) client. Windows includes a command line utility for FTP access, or there are a variety of Windows-based FTP clients which will display an Explorer-like interface for browsing directories and files.

FTP access is disabled by default. It must be enabled by the programmer in the Built-In Ethernet section of the PLC parameters. There is a button near the middle of the right side of the parameter settings labeled FTP Setting.



To enable the FTP function, change the FTP setting to Use. A user name and password must be specified to access the FTP server. The last setting determines how long a user can be inactive (in half seconds) before they are automatically disconnected. The default is 15 minutes (1800 x 500ms).

More detail on FTP clients can be found in the manual for the selected program.

For Windows command line FTP utility, type FTP and then the IP address of the CPU. Prompts will ask for user name and password, which are both case sensitive. Once logged in, the prompt will read **ftp>** and you can use the FTP commands to browse the drives and copy files.

Notes