

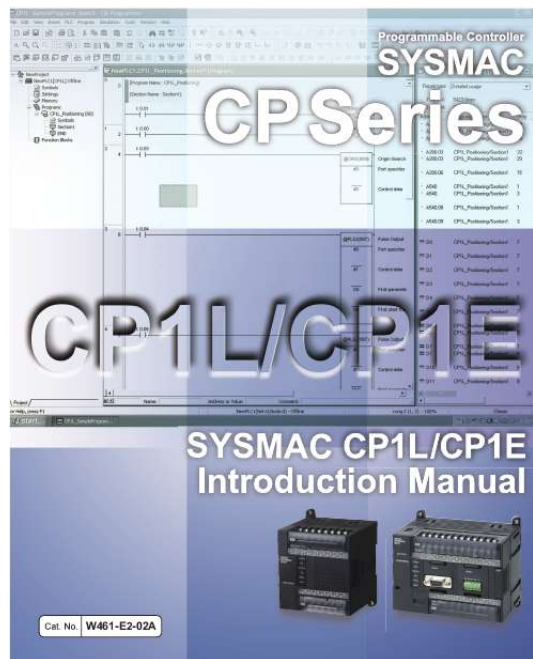


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You can read the recommendations in the user guide, the technical guide or the installation guide for OMRON CP1L. You'll find the answers to all your questions on the OMRON CP1L in the user manual (information, specifications, safety advice, size, accessories, etc.). Detailed instructions for use are in the User's Guide.

User manual OMRON CP1L
User guide OMRON CP1L
Operating instructions OMRON CP1L
Instructions for use OMRON CP1L
Instruction manual OMRON CP1L

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.....
.....
.....
.....

.....
.....
... 21 2-1 2-2 2-3 2-4 Organization of this Manual ..
.....

.....
.....
.....
.....

.....
.....
.....
.....

.....
.... About the Shutter Control System .
.....

.....
.....
.....
.....

.....
.....
.....
.....

.....
.....
.....
.....

I/O Allocation for the Shutter Control System

.....
.....
.....
.....

.....
.....
.....
.....

..... Example Ladder Program.

.....
.....
.....
.....

.....
.....
.....
.....

.....
.....
.....
.....

..... 22 24 26 28 SECTION 3 Mounting and Wiring..

.....
.....
.....
.....

.....
.....
.....
.....

.....
.....
.....
.....

.. 39 4-1 4-2 4-3 4-4 4-5 4-6 4-7 *Preparing for Programming*

.....
.....
.....
.....

.....
.....
.....
.....

.....
.....

... *Creating Ladder Programs* ..

.....
.....
.....
.....

.....
.....
.....
.....

.....
.....

Using CX-Programmer

.....
.....
.....
.....

.....
.....
.....
.....

.....
.....

... *Using the Help* ..

.....
.....
.....
.....

.....
.....
.....
.....

.....

.....
.....
.....

... *Inputting Programs*

.....
.....
.....

.....
.....
.....

.....
.....
.....

... *Saving/Loading Programs* ..

.....
.....

.....
.....
.....

.....
.....
.....

. *Editing Programs*

.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

... 40 45 48 51 53 74 77 SECTION 5 *Transferring and Debugging Programs*

.....
.....

... 83 5-1 5-2 *Going Online*..

.....

.....
.....
.....

.....
.....
.....

.....
.....
.....
.....
.....

..... *84 Adjusting/Debugging Online ...*

.....
.....
.....

.....
.....
.....
.....

.....
.....
.....
.....

.. *91 Appendix.....*

.....
.....
.....

.....
.....
.....
.....

.. *101 A-1 A-2 A-3 A-4 A-5 Channel/Relay Numbers ...*

.....
.....

.....
.....
.....
.....

.....
.....
.....
.....

Instructions

.....
.....

.....
.....
.....
.....

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.....
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..... *Inner Workings of CPIL/CPIE .*



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This manual provides information for programming and operating the Unit. Be sure to read this manual before attempting to use the Unit and keep this manual close at hand for reference during operation. WARNING It is extremely important that a PLC and all PLC Units be used for the specified purpose and under the specified conditions, especially in applications that can directly or indirectly affect human life. You must consult with your OMRON representative before applying a PLC System to the above-mentioned applications. 3 Safety Precautions Caution When power is ON or has just been turned OFF, do not touch the power supply, I/O terminals, or the surrounding areas. Doing so may result in burns. After turning the power OFF, wait for the unit to cool down sufficiently before touching it. Caution Secure the AC power supply line to the terminal block with a 0.5N-m of torque. Loosening the screw may result in a fire or malfunction.

Caution Before starting online editing, confirm that the extension of cycle time will have no adverse effects. Otherwise, input signals may not be read. 10 Caution With an CP1E E-type CPU unit or with an N-type CPU unit without a Battery, the contents of the DM Area (D) *, Holding Area (H), the Counter Present Values (C), the status of Counter Completion Flags (C), and the status of bits in the Auxiliary Area (A) related to clock functions may be unstable when the power supply is turned ON. *This does not apply to areas backed up to EEPROM using the DM backup function. If the DM backup function is being used, be sure to use one of the following methods for initialization.

1. Clearing All Areas to All Zeros Select [Clear Held Memory (HR/DM/CNT) to Zero] in the [Startup Data Read] area in the PLC Setup. 2. Clearing Specific Areas to All Zeros or Initializing to Specific Values Make the settings from a ladder program. If the data is not initialized, the unit or device may operate unexpectedly because of unstable data.

4 Application Precautions Caution Confirm that the facility will not be affected by changing to MONITOR or RUN mode. 11 Application Precautions 12 SECTION 1 CP1L/CP1E Overview This section introduces the types of CP1L and CP1E, as well as the part names used during operation. 1-1 CP1L/CP1E

Models

.....
.....
.....
.....

.....
.....
.....

.... 14 1-1-1 CP1L Models

.....
.....
.....

.....
.....
.....

14 1-1-2 CP1E Models.....

.....
.....

.....
.....

.....

.....

..... 15 1-2 Part Names and Functions

.....

.....

.....

.....

.....

.....

..... 17 1 1 CP1L/CP1E Overview CP1L/CP1E Overview 1-1 CP1L/CP1E Models CP1L programmable controller is a PLC package type, available with 10, 14, 20, 30, 40 or 60 I/O points. The CP1E includes E-type CPU Units (basic models) for standard control operations using basic, movement, arithmetic, and comparison instructions, and N-type CPU Units (application models) that supports connections to Programmable Terminals, Inverters, and Servo Drives. Each unit is available with 20,30 or 40 I/O points.

For application examples that use CP1L or CP1E, refer to appendix A-4 CP1L/CP1E Programming Examples. 1-1-1 CP1L Models 10-point I/O Units (CP1L-L10D -) · CPU unit has 6 input points and 4 output points. · CP-series expansion I/O units cannot be used to add I/O points. 20-point I/O Units (CP1L-L20D -) · CPU unit has 12 input points and 8 output points. · CP-series expansion I/O units can be used to add I/O points, up to a total of 60 I/O points. 14 SYSMAC CP1L/CP1E Introduction Manual 1-1 CP1L/CP1E Models 1 40-point I/O Units (CP1L-M40D -) · CPU unit has 24 input points and 16 output points. · CP-series expansion I/O units can be used to add I/O points, up to a total of 160 I/O points. 1 CP1L/CP1E Overview 1-1-2 CP1E Models 20-point I/O Units (CP1E-20D -) · CPU unit has 12 input points and 8 output points. · CP-series expansion I/O units cannot be used to add I/O points. E-type CPU Unit CP1E-E20DR-A N-type CPU Unit CP1E-N20D - SYSMAC CP1L/CP1E Introduction Manual 15 1 1-1 CP1L/CP1E Models 40-point I/O Units (CP1E-40D -) 1 CP1L/CP1E Overview · CPU unit has 24 input points and 16 output points. · CP-series expansion I/O units can be used to add I/O points, up to a total of 160 I/O points. E-type CPU Unit CP1E-E40DR-A N-type CPU Unit CP1E-N40D - 16 SYSMAC CP1L/CP1E Introduction Manual 1-2 Part Names and Functions 1 1-2 Part Names and Functions This section describes the part names and functions, using the CP1L 14-point I/O unit and CP1E 40point I/O unit as examples.



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1 CPIL/CP1E Overview CP1L14-point I/O Unit 1 2 3 10 23 4 5 6 8 IN 9 15 MEMORY 16 COMM 17 COMM 11 4 5 6 7 12 13 14 18 19 CP1E 40-point I/O Unit E-type CPU Unit CP1E-E40DR-A 8 1 9 2 3 7 13 14 11 12 N-type CPU Unit CP1E-N40D 21 6 20 10 (1) Memory cassette slot (only CP1L) Used to attach a memory cassette (15). Memory cassettes can be used to store backups for CP1L programs, parameters, and data memory. They also allow you to copy data to other CP1L units without using a programming tool (software).

(2) Peripheral USB port Used for connection to a computer. Computers can be used for programming and monitoring. (3) Analog adjuster Rotate to adjust the value for auxiliary area A642CH (CP1E: A642CH/ A643CH) to within the 0 to 255 range. Use to change timer and counter settings without using a programming tool (software). SYSMAC CP1L/CP1E Introduction Manual 17 1 1-2 Part Names and Functions 1 CP1L/CP1E Overview (4) External analog settings input connector (only CP1L) Takes an external input between 0 and 10V, and changes the value for auxiliary area A643CH to a value between 0 and 256.

This input is not isolated. (5) DIP switches (only CP1L) Used for settings such as write-permission on user memory, automatic transfers from memory cassettes, and tool bus use. For details, refer to 2-1 Part Names and Functions of CP Series CP1L CPU Unit User's Manual (W462). (6) Battery (only CP1L and CP1E N-type) Maintains the internal clock and RAM contents while the power supply is OFF. (7) Operation indicators Indicates the operating status of CP1L. Indicated statuses include power status, operating mode, errors, and peripheral USB communication status. (8) Power supply, ground, and input terminal block Used to connect the power supply line, ground line, and input lines. (9) Input indicators Lit when the corresponding input terminal contact is ON. (10) Option board slot Used to install an RS-232C option board (16) or an RS-422A/485 option board (17). · CP1L CPU units 14/20-point I/O units may have 1 serial communication option board installed.

30/40/60-point I/O units may have up to 2 serial communication option boards installed. · CP1E CPU units 30/40-point I/O units may have 1 serial communication option board installed. 20-point I/O units have no slot. (11) Expansion I/O unit connector Used to connect CP-series expansion I/O units and expansion units. · CP1L CPU units 14/20-point I/O units may have 1 expansion unit connected. 30/40/60-point I/O units may have up to 3 expansion units connected. 10-point I/O units have no expansion unit connected. · CP1E CPU units 30/40-point I/O units may have up to 3 expansion units connected. 20-point I/O units have no expansion unit connected. (12) Output indicators Lit when the corresponding output terminal contact is ON.

18 SYSMAC CP1L/CP1E Introduction Manual 1-2 Part Names and Functions 1 (13) External power supply and output terminal block · External power supply terminal: Units that use AC power supply have a 24VDC external power supply terminal with a maximum capacity of 300mA. This can be used as a service power supply for input devices. CP1E 20-point I/O units have no external power supply terminal. · Output terminals: Used to connect output lines. (14) DIN track mounting pin Used for mounting unit to a DIN track.

(15) Memory cassette (optional only for CP1L) Used to store data from the built-in flash memory. Insert into memory cassette slot (1). (16) RS-232C option board Insert into option board slot (10). CP1L 10-point I/O units, CP1E E-type units and CP1E N-type 20-point I/O units have no slot. (17) RS-422A/485 option board Insert into option board slot (10).

(18) LCD option board (only CP1L) Used to monitor various kinds of data and change the present values or settings without connecting the CX-Programmer. The specific timer switch can also be used which is not provided by the PLC. Insert into option board slot (10). 10-point I/O units have no slot. (19) Ethernet option board (only CP1L) Used to add an Ethernet port. Insert into option board slot (10). (20) Built-in RS-232C option board (only CP1E N-type) By connecting a PT, the controlled system can be monitored and data can be collected. (21) Built-in RS-232C communications status indicator (only CP1E N-type) Flashing when the built-in RS-232C port is in communication mode. 1 CPIL/CP1E Overview SYSMAC CP1L/CP1E Introduction Manual 19 1 1-2 Part Names and Functions Indicator Statuses 1 CPIL/CP1E Overview This section describes the operating statuses of CP1L and CP1E as displayed by the operation indicators. POWER RUN ERR/ALM INH PRPHL BKUP POWER (Green) RUN (Green) ERR/ALM (Red) Lit Not lit Lit Not lit Lit Not lit Lit Power is ON.

Power is OFF. CP1L/CP1E is executing a program in either RUN or MONITOR mode. Operation is stopped in PROGRAM mode, or stopped due to a fatal error. A fatal error (including FALS execution) or a hardware error (WDT error) has occurred. CP1L/CP1E operation will stop, and all outputs will be turned OFF. A non-fatal error (including FAL execution) has occurred. CP1L/CP1E operation will continue. Operation normal. The output OFF bit (A500.15) has turned ON.

All outputs will be turned OFF. Operation normal. Communication (either sending or receiving) is active on the peripheral USB port. Any other state. · CP1L CPU units · User program, parameter, or data memory is being written to or read from the built-in flash memory (backup memory).

· User program, parameter, data memory, DM defaults, or comment memory is being written to or read from the memory cassette. · User programs, parameters, and data memory are being restored following a PLC power-on. · CP1E CPU units The user program, parameters, or specified DM Area words are being written to the backup memory (built-in EEPROM). Note: Do not turn the PLC power supply OFF while this indicator is lit. Any other state.

Blinking Not lit INH (Yellow) PRPHL (Yellow) BKUP (Yellow) Lit Not lit Blinking Not lit Lit Not lit 20 SYSMAC CP1L/CP1E Introduction Manual SECTION 2 Designing Systems This section explains how to construct a CP1L (14-point I/O unit with AC power supply) system based on the shutter control system as an example. All subsequent sections are written based on the sample program used in this section. 2-1 Organization of this Manual

.....
.....
.....
.....

.. 22 2-2 About the Shutter Control System ...

.....
.....
.....

.. 24 2-2-1 Operation.....

.....
.....

.....
.....
.....
.....
.....
.....

.... 24 2-2-2 System Components

.....
.....
.....

.....
.....
.....

..... 25 2-3 I/O Allocation for the Shutter Control System ..

.....
.....
.....

. 26 2-4 Example Ladder Program

.....
.....
.....
.....

.....

.... 28 2 2 Designing Systems Designing Systems 2-1 Organization of this Manual Sections 2 through 5 of this manual explain the construction process of a CP1L system, from design to operation, using a shutter control system as an example.

Section contents are as follows: Section 2: Workflow from design to operation, shutter control system specifications, components, and I/O allocation.



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Section 3: CPIL installation, component wiring, and power testing. Section 4: Connecting CPIL to a computer, and creating ladder programs. Section 5: Setting PLC clock and PLC operation mode, transferring data from computer to CPIL, operation, adjustment, and debugging. Note Circuit configurations, wiring methods, and programs provided in this manual are given strictly as examples.

When constructing an actual system, check the specifications, performance, and safety of each component by referring to the respective manuals. 22 SYSMAC CPIL/CP1E Introduction Manual 2-1 Organization of this Manual 2 Workflow from Design to Operation The workflow for constructing a CPIL shutter control system is shown below. For details, refer to the respective sections of the manual. I/O allocation · Allocate relay numbers to sensors and switches Refer to 2-3 I/O Allocation for the Shutter Control System. 2 Designing Systems Preparing the equipment · Equipment preparation · Wire power supply and ground · Wire I/O devices Refer to 3-2 Mounting onto DIN Tracks and 3-3 Wiring Devices. Refer to 3-4 Power Testing CPIL. Supplying power to CPIL · Test PLC operation Refer to 4-1 Preparing for Programming. Preparing to write program · Install USB driver onto computer · Connecting CPIL to a computer Writing programs · Enter ladder programs in CX-Programmer · Compile · Save · Edit Refer to 4-2 Creating a Ladder Program, 4-3 Using CXProgrammer, 4-5 Inputting Programs, 4-6 Saving/ Loading Programs, and 4-7 Editing Programs. Refer to 5-1 Going Online. Going online with CPIL and the computer · Set the CPIL clock · Switch to PROGRAM mode.

· Transfer the program Refer to 5-2 Adjusting/Debugging Online. Online debugging · Monitor power · Force-set/force-reset commands · Online Editing Refer to 5-1 Going Online. Production run SYSMAC CPIL/CP1E Introduction Manual 23 2 2-2 About the Shutter Control System 2-2 About the Shutter Control System This section defines the operation and components of a shutter control system. 2 Designing Systems 2-2-1 Operation This section defines the operation of a shutter control system. A car approaches the shutter. · When a sensor detects 3 headlight flashes within 5 seconds, the shutter opens. · The shutter can also be opened, closed, and stopped with buttons. · When a sensor detects full car entrance into the garage, the shutter closes. · When pulling the car out of the garage, use the buttons to operate the shutter. 24 SYSMAC CPIL/CP1E Introduction Manual 2-2 About the Shutter Control System 2 2-2-2 System Components This section defines components to be used in the shutter control system.

The following components are to be used. PLC · CPIL (14-point I/O unit with AC power supply) 2 Designing Systems Equipment and Software for Programming · CX-Programmer · Computer · USB cable (A-B) Inputs ····· Shutter OPEN button : PB1 (A16-series, etc) Shutter STOP button : PB2 (A16-series, etc) Shutter CLOSE button : PB3 (A16-series, etc) Car detection sensor : SEN1 (E3G-series, etc) Headlight detection sensor : SEN2 Limit switch, turned ON when shutter is fully open : LS1 (WL-series, etc) Limit switch, turned ON when shutter is fully closed : LS2 (WL-series, etc) Outputs · Contact for activating the shutter escalation motor : MO1 · Contact for activating the shutter de-escalation motor : MO2 LS1 MO1 SEN2 MO2 LS2 PB1 PB2 PB3 SEN1 SYSMAC CPIL/CP1E Introduction Manual 25 2 2-3 I/O Allocation for the Shutter Control System 2-3 I/O Allocation for the Shutter Control System I/O relays on CPIL are allocated to contacts as defined by following. 2 Designing Systems Inputs Device OPEN button STOP button CLOSE button Car detection sensor Light detection sensor Upper limit LS Lower limit LS Contact PB1 PB2 PB3 SEN1 SEN2 LS1 LS2 Address 0.00 0.01 0.02 0.03 0.04 0.05 0.06 Outputs Device Escalation motor De-escalation motor Contact MO1 MO2 Address 100.00 100.01 100.02 100.03 100.04 100.05 100.06 100.07 100.08 100.09 100.10 100.11 100.12 100.13 100.14 100.15 100.16 100.17 100.18 100.19 100.20 100.21 100.22 100.23 100.24 100.25 100.26 100.27 100.28 100.29 100.30 100.31 100.32 100.33 100.34 100.35 100.36 100.37 100.38 100.39 100.40 100.41 100.42 100.43 100.44 100.45 100.46 100.47 100.48 100.49 100.50 100.51 100.52 100.53 100.54 100.55 100.56 100.57 100.58 100.59 100.60 100.61 100.62 100.63 100.64 100.65 100.66 100.67 100.68 100.69 100.70 100.71 100.72 100.73 100.74 100.75 100.76 100.77 100.78 100.79 100.80 100.81 100.82 100.83 100.84 100.85 100.86 100.87 100.88 100.89 100.90 100.91 100.92 100.93 100.94 100.95 100.96 100.97 100.98 100.99 100.00 100.01 100.02 100.03 100.04 100.05 100.06 100.07 100.08 100.09 100.10 100.11 100.12 100.13 100.14 100.15 100.16 100.17 100.18 100.19 100.20 100.21 100.22 100.23 100.24 100.25 100.26 100.27 100.28 100.29 100.30 100.31 100.32 100.33 100.34 100.35 100.36 100.37 100.38 100.39 100.40 100.41 100.42 100.43 100.44 100.45 100.46 100.47 100.48 100.49 100.50 100.51 100.52 100.53 100.54 100.55 100.56 100.57 100.58 100.59 100.60 100.61 100.62 100.63 100.64 100.65 100.66 100.67 100.68 100.69 100.70 100.71 100.72 100.73 100.74 100.75 100.76 100.77 100.78 100.79 100.80 100.81 100.82 100.83 100.84 100.85 100.86 100.87 100.88 100.89 100.90 100.91 100.92 100.93 100.94 100.95 100.96 100.97 100.98 100.99 100.00 100.01 100.02 100.03 100.04 100.05 100.06 100.07 100.08 100.09 100.10 100.11 100.12 100.13 100.14 100.15 100.16 100.17 100.18 100.19 100.20 100.21 100.22 100.23 100.24 100.25 100.26 100.27 100.28 100.29 100.30 100.31 100.32 100.33 100.34 100.35 100.36 100.37 100.38 100.39 100.40 100.41 100.42 100.43 100.44 100.45 100.46 100.47 100.48 100.49 100.50 100.51 100.52 100.53 100.54 100.55 100.56 100.57 100.58 100.59 100.60 100.61 100.62 100.63 100.64 100.65 100.66 100.67 100.68 100.69 100.70 100.71 100.72 100.73 100.74 100.75 100.76 100.77 100.78 100.79 100.80 100.81 100.82 100.83 100.84 100.85 100.86 100.87 100.88 100.89 100.90 100.91 100.92 100.93 100.94 100.95 100.96 100.97 100.98 100.99 100.00 100.01 100.02 100.03 100.04 100.05 100.06 100.07 100.08 100.09 100.10 100.11 100.12 100.13 100.14 100.15 100.16 100.17 100.18 100.19 100.20 100.21 100.22 100.23 100.24 100.25 100.26 100.27 100.28 100.29 100.30 100.31 100.32 100.33 100.34 100.35 100.36 100.37 100.38 100.39 100.40 100.41 100.42 100.43 100.44 100.45 100.46 100.47 100.48 100.49 100.50 100.51 100.52 100.53 100.54 100.55 100.56 100.57 100.58 100.59 100.60 100.61 100.62 100.63 100.64 100.65 100.66 100.67 100.68 100.69 100.70 100.71 100.72 100.73 100.74 100.75 100.76 100.77 100.78 100.79 100.80 100.81 100.82 100.83 100.84 100.85 100.86 100.87 100.88 100.89 100.90 100.91 100.92 100.93 100.94 100.95 100.96 100.97 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100.41 100.42 100.43 100.44 100.45 100.46 100.47 100.48 100.49 100.50 100.51 100.52 100.53 100.54 100.55 100.56 100.57 100.58 100.59 100.60 100.61 100.62 100.63 100.64 100.65 100.66 100.67 100.68 100.69 100.70 100.71 100.72 100.73 100.74 100.75 100.76 100.77 100.78 100.79 100.80 100.81 100.82 100.83 100.84 100.85 100.86 100.87 100.88 100.89 100.90 100.91 100.92 100.93 100.94 100.95 100.96 100.97 100.98 100.99 100.00 100.01 100.02 100.03 100.04 100.05 100.06 100.07 100.08 100.09 100.10 100.11 100.12 100.13 100.14 100.15 100.16 100.17 100.18 100.19 100.20 100.21 100.22 100.23 100.24 100.25 100.26 100.27 100.28 100.29 100.30 100.31 100.32 100.33 100.34 100.35 100.36 100.37 100.38 100.39 100.40 100.41 100.42 100.43 100.44 100.45 100.46 100.47 100.48 100.49 100.50 100.51 100.52 100.53 100.54 100.55 100.56 100.57 100.58 100.59 100.60 100.61 100.62 100.63 100.64 100.65 100.66 100.67 100.68 100.69 100.70 100.71 100.72 100.73 100.74 100.75 100.76 100.77 100.78 100.79 100.80 100.81 100.82 100.83 100.84 100.85 100.86 100.87 100.88 100.89 100.90 100.91 100.92 100.93 100.94 100.95 100.96 100.97 100.98 100.99 100.00 100.01 100.02 100.03 100.04 100.05 100.06 100.07 100.08 100.09 100.10 100.11 100.12 100.13 100.14 100.15 100.16 100.17 100.18 100.19 100.20 100.21 100.22 100.23 100.24 100.25 100.26 100.27 100.28 100.29 100.30 100.31 100.32 100.33 100.34 100.35 100.36 100.37 100.38 100.39 100.40 100.41 100.42 100.43 100.44 100.45 100.46 100.47 100.48 100.49 100.50 100.51 100.52 100.53 100.54 100.55 100.56 100.57 100.58 100.59 100.60 100.61 100.62 100.63 100.64 100.65 100.66 100.67 100.68 100.69 100.70 100.71 100.72 100.73 100.74 100.75 100.76 100.77 100.78 100.79 100.80 100.81 100.82 100.83 100.84 100.85 100.86 100.87 100.88 100.89 100.90 100.91 100.92 100.93 100.94 100.95 100.96 100.97 100.98 100.99 100.00 100.01 100.02 100.03 100.04 100.05 100.06 100.07 100.08 100.09 100.10 100.11 100.12 100.13 100.14 100.15 100.16 100.17 100.18 100.19 100.20 100.21 100.22 100.23 100.24 100.25 100.26 100.27 100.28 100.29 100.30 100.31 100.32 100.33 100.34 100.35 100.36 100.37 100.38 100.39 100.40 100.41 100.42 100.43 100.44 100.45 100.46 100.47 100.48 100.49 100.50 100.51 100.52 100.53 100.54 100.55 100.56 100.57 100.58 100.59 100.60 100.61 100.62 100.63 100.64 100.65 100.66 100.67 100.68 100.69 100.70 100.71 100.72 100.73 100.74 100.75 100.76 100.77 100.78 100.79 100.80 100.81 100.82 100.83 100.84 100.85 100.86 100.87 100.88 100.89 100.90 100.91 100.92 100.93 100.94 100.95 100.96 100.97 100.98 100.99 100.00 100.01 100.02 100.03 100.04 100.05 100.06 100.07 100.08 100.09 100.10 100.11 100.12 100.13 100.14 100.15 100.16 100.17 100.18 100.19 100.20 100.21 100.22 100.23 100.24 100.25 100.26 100.27 100.28 100.29 100.30 100.31 100.32 100.33 100.34 100.35 100.36 100.37 100.38 100.39 100.40 100.41 100.42 100.43 100.44 100.45 100.46 100.47 100.48 100.49 100.50 100.51 100.52 100.53 100.54 100.55 100.56 100.57 100.58 100.59 100.60 100.61 100.62 100.63 100.64 100.65 100.66 100.67 100.68 100.69 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100.13 100.14 100.15 100.16 100.17 100.18 100.19 100.20 100.21 100.22 100.23 100.24 100.25 100.26 100.27 100.28 100.29 100.30 100.31 100.32 100.33 100.34 100.35 100.36 100.37 100.38 100.39 100.40 100.41 100.42 100.43 100.44 100.45 100.46 100.47 100.48 100.49 100.50 100.51 100.52 100.53 100.54 100.55 100.56 100.57 100.58 100.59 100.60 100.61 100.62 100.63 100.64 100.65 100.66 100.67 100.68 100.69 100.70 100.71 100.72 100.73 100.74 100.75 100.76 100.77 100.78 100.79 100.80 100.81 100.82 100.83 100.84 100.85 100.86 100.87 100.88 100.89 100.90 100.91 100.92 100.93 100.94 100.95 100.96 100.97 100.98 100.99 100.00 100.01 100.02 100.03 100.04 100.05 100.06 100.07 100.08 100.09 100.10 100.11 100.12 100.13 100.14 100.15 100.16 100.17 100.18 100.19 100.20 100.21 100.22 100.23 100.24 100.25 100.26 100.27 100.28 100.29 100.30 100.31 100.32 100.33 100.34 100.35 100.36 100.37 100.38 100.39 100.40 100.41 100.42 100.43 100.44 100.45 100.46 100.47 100.48 100.49 100.50 100.51 100.52 100.53 100.54 100.55 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100.99 100.00 100.01 100.02 100.03 100.04 100.05 100.06 100.07 100.08 100.09 100.10 100.11 100.12 100.13 100.14 100.15 100.16 100.17 100.18 100.19 100.20 100.21 100.22 100.23 100.24 100.25 100.26 100.27 100.28 100.29 100.30 100.31 100.32 100.33 100.34 100.35 100.36 100.37 100.38 100.39 100.40 100.41 100.42 100.43 100.44 100.45 100.46 100.47 100.48 100.49 100.50 100.51 100.52 100.53 100.54 100.55 100.56 100.57 100.58 100.59 100.60 100.61 100.62 100.63 100.64 100.65 100.66 100.67 100.68 100.69 100.70 100.71 100.72 100.73 100.74 100.75 100.76 100.77 100.78 100.79 100.80 100.81 100.82 100.83 100.84 100.85 100.86 100.87 100.88 100.89 100.90 100.91 100.92 100.93 100.94 100.95 100.96 100.97 100.98 100.99 100.00 100.01 100.02 100.03 100.04 100.05 100.06 100.07 100.08 100.09 100.10 100.11 100.12 100.13 100.14 100.15 100.16 100.17 100.18 100.19 100.20 100.21 100.22 100.23 100.24 100.25 100.26 100.27 100.28 100.29 100.30 100.31 100.32 100.33 100.34 100.35 100.36 100.37 100.38 100.39 100.40 100.41 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.....
.....
.....

.....
.....
.....
.....

.....
.. 34 3-3-1 Connecting Power Supply and Ground Lines...

.....
..... 34 3-3-2 Connecting I/O Lines .

.....
.....
.....

.....
.....
.....

... 35 3-4 Power Testing CPIL

.....
.....
.....

.....
.....
.....

... 37 3 Mounting and Wiring 3-1 Installation Notes For improved reliability and maximized functionality, take the following factors into consideration when installing a CPIL system. Installation Location 3 Mounting and Wiring Do not install in the following locations: · Locations subject to ambient temperature lower than 0°C or higher than 55°C. · Locations subject to dramatic temperature changes, causing possible condensation. · Locations subject to relative humidity lower than 10%RH or higher than 90%RH.



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· Locations subject to corrosive or flammable gases. · Locations subject to excessive dust, salt, or metal powder.

· Locations subject to shock or vibration. · Locations exposed to direct sunlight. · Locations subject to water, oil, or chemical reagent splashes. Shield the system sufficiently when installing in the following locations: · Locations subject to static electricity and other forms of noise. · Locations subject to strong electromagnetic fields. · Locations subject to possible radioactive exposure. · Locations in close proximity to close to power lines. Installation into Cabinets and Control Panels When installing CPIL into a cabinet or control panel, ensure adequate environment resistance, as well as sufficient accessibility for operation and maintenance. Temperature Control The ambient operating temperature for CPIL is 0 to 55°C. The following precautions apply.

· Provide adequate space for air flow. · Do not install above equipment, which generates significant heat (i.e. heaters, transformers, high-capacity resistors). · If the ambient temperature is to exceed 55°C, install a cooling fan or air conditioner.

30 SYSMAC CPIL/CP1E Introduction Manual 3-1 Installation Notes 3 1 2 3 CPIL 3 Mounting and Wiring (1) Control panel (2) Fan (3) Louver Accessibility for Operation and Maintenance · For safety during operation and maintenance, separate the unit as far as possible from high-voltage equipment and power machinery. · For ease of operation, mount the unit onto the control panel at a height of 1,000 to 1,600mm. Caution When power is ON or has just been turned OFF, do not touch the power supply, I/O terminals, or the surrounding areas. Doing so may result in burns. After turning the power OFF, wait for the unit to cool down sufficiently before touching it.

Improving Noise Resistance · Avoid installing into a cabinet, which also has high-voltage equipment installed. · Secure at a distance of 200mm or more from power lines. Power Line 200mm min. CPIL 200mm min. · Properly ground the mounting plate between the unit and the mounting surface. SYSMAC CPIL/CP1E Introduction Manual 31 3 3-1 Installation Notes Mounting For heat dissipation, mount CPIL in the orientation shown below. 3 Mounting and Wiring External Dimensions W1 W2 85 8 110 100 90 4-4.5 Model CPIL-L10D CPIL-L14D CPIL-L20D CP1E- 20D CPIL-M30D CP1E- 30D CPIL-M40D CP1E- 40D CPIL-M60D - W1 66 86 86 86 130 130 150 150 195 W2 56 76 76 76 120 120 140 140 185 DIN Track Secure the DIN track onto the control panel, using at least 3 screws. · Use M4 screws at intervals of 210mm (6 holes) or less. Screw torque is 1.

2N-m. For details on installing CPIL, refer to SECTION 3 Installation and Wiring of CP Series CPIL CPU Unit User's Manual (W462) or SECTION 5 Installation and Wiring of CP Series CP1E CPU Unit Hardware User's Manual (W479). 32 SYSMAC CPIL/CP1E Introduction Manual 3-2 Mounting onto DIN Tracks 3 3-2 Mounting onto DIN Tracks This section explains how to mount CPIL onto a DIN track. 1. Pull out the DIN track mounting pin (1). 3 Mounting and Wiring 1 2. Hook the rear panel of CPIL onto the DIN track (1), as shown. CPIL 1 3. Push in the DIN track mounting pin (1) to secure CPIL. 1 SYSMAC CPIL/CP1E Introduction Manual 33 3 3-3 Wiring Devices 3-3 Wiring Devices This section explains how to wire CPIL (14-point I/O unit with AC power supply).

Protective Label 3 Mounting and Wiring Wire scraps may be scattered during wiring. To prevent them from entering the unit, leave the protective label (adhered on the top surface of the unit) on until wiring is done. When wiring is complete, remove the label to ensure proper heat dissipation. 3-3-1 Connecting Power Supply and Ground Lines This section explains how to wire the power and ground lines. Units with AC Power Supply Power and ground terminals (A) are located near the top of CPIL.

A Terminal block layout at (A) 4 1 NC NC NC NC 6.2mm max. 2 3 (1) Power supply terminal Supply 100 to 240VAC voltage at 50/60Hz. The acceptable supply voltage range is 85 to 264VAC. · Use separate circuits for the power supply circuit and the motor circuit, in order to prevent voltage drops due to starting currents and inrush currents from other equipment.

· Use a twisted-pair of power supply cables to prevent noise from the power supply line. Adding a 1:1 isolating transformer will further reduce electrical noise. 34 SYSMAC CPIL/CP1E Introduction Manual 3-3 Wiring Devices 3 · In consideration of voltage drops and allowable current, use the thickest electrical wire possible. (2) LG LG is a functional ground terminal (noise-filtered neutral terminal). To resolve errors and electrical shocks caused by noise, short the LG and GR terminals for a class D grounding (ground resistance of 100 or less). (3) GR GR is a protective ground terminal. To prevent electrical shocks, use a dedicated ground line (2mm² or thicker) for a class D grounding (ground resistance of 100 or less). · To prevent electrical shocks and noise, always ground the terminal with class D grounding (ground resistance of 100 or less). · If the power supply has a grounded phase, connect the grounded phase to the L2/N terminal. · Do not share the ground line with other equipment, or connect it to building structure beams.

The results may be unfavorable. (4) Recommended crimp terminal When wiring the AC power supply, use ring-type crimp terminals to prevent unintended disconnection. WARNING Secure the AC power supply line to the terminal block with 0.5N·m of torque. 3 Mounting and Wiring Loosening the screw may result in a fire or malfunction. 3-3-2 Connecting I/O Lines 14-point I/O Units CPIL has input terminals located at the top, and output terminals located at the bottom. 1 2 (1) Input terminal (2) Output terminal SYSMAC CPIL/CP1E Introduction Manual 35 3 3-3 Wiring Devices Wiring Inputs 1. Wire the inputs as shown, while referring to 2-3 I/O Allocation for the Shutter Control System. PB2 SEN1 LS1 (0.01) (0.

03) (0.05) 3 L1 L2/N COM 00 01 02 03 04 05 06 07 NC NC NC NC Mounting and Wiring PB1 PB3 SEN2 LS2 (0.00) (0.02) (0.04) (0.06) Wiring Outputs 1. Wire the outputs as shown, while referring to 2-3 I/O Allocation for the Shutter Control System. MO1 (100.00) + 00 01 MO2 (100.01) 02 03 04 05 NC NC COM COM COM COM For details on wiring, refer to 3-5-4 I/O Wiring for CPU Units with 14 I/O Points of CP Series CPIL CPU Unit User's Manual (W462) or 5-3-3 I/O Wiring of CP Series CP1E CPU Unit Hardware User's Manual (W479).

36 SYSMAC CPIL/CP1E Introduction Manual 3-4 Power Testing CPIL 3 3-4 Power Testing CPIL After wiring CPIL, perform a power test.



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Turning Power ON Supply power to CPIL, and then check the status with the indicators. 1. 2. 3. 4. Turn the power OFF for all components (escalation motor, de-escalation motor, etc.). Turn the power ON for CPIL. Wait 2 seconds for the CPIL to initialize.

Check the indicators on CPIL. If [POWER] and [RUN] are lit, CPIL is operating normally. POWER RUN ERR/ALM INH PRPHL BKUP 3 Mounting and Wiring Note When CPIL is turned ON, it will go into RUN mode automatically. 5. Turn the power OFF for CPIL. SYSMAC CPIL/CP1E Introduction Manual 37 3 3-4 Power Testing CPIL 3 Mounting and Wiring Note Battery · Using a battery The battery maintains the internal clock and retained regions of I/O memory while the power supply is OFF. If no battery is installed, or if the installed battery is running low, the internal clock will stop, and data in the retained regions of I/O memory will be lost. Data such as user programs and PLC system settings are not lost even when the power is OFF and no battery is installed. For details on replacing the battery, refer to 10-2 Replacing User-servicable Parts of CP Series CPIL CPU Unit User's Manual (W462) or 7-2 Replacing the Battery in N-type CPU Units of CP Series CP1E CPU Unit Hardware User's Manual (W479). · Battery-free operation If there is no need to reference the PLC clock and RAM data, CPIL can be used without a battery (battery-free operation).

For details, refer to 6-5 Battery-free Operation of CP Series CPIL CPU Unit User's Manual (W462). Caution With an CP1E E-type CPU unit or with an N-type CPU unit without a Battery, the contents of the DM Area (D) *, Holding Area (H), the Counter Present Values (C), the status of Counter Completion Flags (C), and the status of bits in the Auxiliary Area (A) related to clock functions may be unstable when the power supply is turned ON. *This does not apply to areas backed up to EEPROM using the DM backup function. If the DM backup function is being used, be sure to use one of the following methods for initialization. 1.

Clearing All Areas to All Zeros Select [Clear Held Memory (HR/DM/CNT) to Zero] in the [Startup Data Read] area in the PLC Setup. 2. Clearing Specific Areas to All Zeros or Initializing to Specific Values Make the settings from a ladder program. If the data is not initialized, the unit or device may operate unexpectedly because of unstable data. 38 SYSMAC CPIL/CP1E Introduction Manual SECTION 4 Creating Programs In this section, the steps for creating ladder programs essential to CPIL (14-point I/O unit with AC power supply) operation will be shown as an example, using CX-Programmer.

In creating the ladder program for the shutter control system, the basic functions of CX-Programmer will be explained. 4-1 Preparing for Programming.....

.....
.....
.....
.....

.. 40 4-1-1 What is CX-Programmer? ...

.....
.....
.....

..... 40 4-1-2 Connecting to a Computer and Installing the USB Driver ..

.41 4-2 Creating Ladder Programs.....

.....
.....
.....

... 45 4-2-1 Operation.....

.....
.....
.....

.....
.....
.....

..... 45 4-2-2 Ladder Program.....

.....
.....
.....

.....
.....
.....

..... 47 4-3 Using CX-Programmer...

.....
.....
.....
.....
.....
.....
.....

..... 48 4-3-1 Starting CX-Programmer

.....
.....
.....
.....
.....
.....

... 48 4-3-2 Operation Screens.....

.....
.....
.....
.....
.....
.....
.....

. 49 4-4 Using the Help

.....
.....
.....
.....
.....
.....
.....

. 51 4-5 Inputting Programs

.....
.....
.....
.....
.....
.....
.....

..... 53 4-5-1 Creating New Projects

.....
.....
.....
.....
.....
.....

..... 53 4-5-2 Inputting Contacts....

.....
.....
.....
.....
.....
.....

.....
.....
.....
..... 74 4-6-2 Saving Programs ...

.....
.....
.....
.....
.....
.....
.....
..... 75 4-6-3 Loading Programs ...

.....
.....
.....
.....
.....
.....
.....
..... 76 4-7 Editing Programs

.....
.....
.....
.....
.....
.....
.....
.....
.....

. 77 4-7-1 Editing I/O Comments

.....
.....
.....
.....
.....
.....
.....
..... 77 4-7-2 Inputting Rung Comments

.....
.....
.....
.....
.....
.....
.....
..... 78 4-7-3 Editing Rungs .

.... 80 4 Creating Programs 4-1 Preparing for Programming This section explains the necessary preparations, such as connecting CPIL to a computer and installing the USB driver, in order to begin creating ladder programs.

4-1-1 What is CX-Programmer? 4 Creating Programs CX-Programmer is a programming tool (software) for creating the ladder programs that are to be executed by CPIL. In addition to programming functions, it also offers other useful functions for CPIL setup and operation, such as debugging programs, address and values display, PLC setup and monitoring; and remote programming and monitoring via the network. CX-Programmer can be run on computers

running Windows 2000 (SP2 or later), XP or Vista (only CP1E). For details on installing CX-Programmer, refer to 1-1 Installation of CXProgrammer of CX-Programmer Introduction Guide (R132). For details on using CX-Programmer, refer to CX-Programmer Operation Manual (W446).

40 SYSMAC CP1L/CP1E Introduction Manual 4-1 Preparing for Programming 4 4-1-2 Connecting to a Computer and Installing the USB Driver To use CX-Programmer, you must connect CP1L to a computer, which has CXProgrammer installed. This section explains how to connect CP1L to a computer. The computer to be connected to must have CX-Programmer Ver.8.2 or later installed. You will also need a USB cable to connect CP1L to the computer. Furthermore, a USB driver must be installed for CP1L to be recognized by the computer. Items Required for Connection Operating system Software USB driver USB cable Windows 2000, XP or Vista (only CP1E) CX-One (i.e. CX-Programmer) Included with software USB 1.

1 (or 2.0) cable (A-B), 5m or shorter 4 Creating Programs Restrictions on USB Connections Due to limitations of the USB specifications, the following restrictions apply when connecting CP1L to a computer. · Only 1 CP1L can be connected to a computer at any given time. You cannot connect multiple CP1Ls simultaneously. · Do not disconnect the USB cable while the system is online. Before disconnecting the USB cable, switch the application to offline status. If the USB cable is disconnected while online, the following will occur: Simply reconnecting the USB cable will not restore CX-Programmer to online status. First switch CX-Programmer to offline status, reconnect the USB cable, and then switch CX-Programmer back to online status. SYSMAC CP1L/CP1E Introduction Manual 41 4-1 Preparing for Programming Connecting to a Computer and Installing the USB Driver This section explains how to connect CP1L to a computer running Windows XP. For details on connecting CP1L to a computer running Windows 2000 or Vista, refer to 1-3-1 Connecting with a Commercially Available USB Cable of CP Series CP1L CPU Unit User's Manual (W462) or 4-2-2 Installing the USB Driver of CP Series CP1E CPU Unit Hardware User's Manual (W479).

4 Creating Programs 1. 2. Turn the power ON for CP1L and the computer. Using a USB cable (2), connect the peripheral USB port (3) on CP1L to a USB port on the computer (1). 1 3 IN 2 L1 L2/N COM 00 01 02 03 04 05 06 07 NC NC NC NC BATTERY NC When the computer detects CP1L, the following message will be displayed.

The Found New Hardware Wizard dialog box will be displayed. This screen will be used to install the USB driver. Note The programming console is not available.



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23456 NC COM 00 COM 01 COM 02 COM 03 05 04 NC NC OUT 3. The following dialog box will be displayed.

Select one of the options and click [Next]. 42 SYSMAC CPIL/CP1E Introduction Manual 4-1 Preparing for Programming 4 4. The following dialog box will be displayed. Select [Install the software automatically (Recommended)] and click [Next]. 4 Creating Programs 5. Ignore the following dialog box if it is displayed and click [Continue Anyway]. 6. Click [Finish]. USB driver installation is now complete. p SYSMAC CPIL/CP1E Introduction Manual 43 4 4-1 Preparing for Programming Confirming Installation Confirm that the driver has been installed properly.

1. 2. On the desktop, select [Start], and then right-click [My Computer]. A context menu will be displayed. Select [Properties]. The System Properties dialog box will be displayed. Select the Hardware tab, and click [Device Manager]. The Device Manager dialog box will be displayed. Double-click [Universal Serial Bus controllers]. Confirm that [OMRON SYSMAC PLC Device] is displayed.

If so, the USB driver has been installed successfully. 4 Creating Programs 3. 4. 5. 6.

Close the Device Manager dialog box, and then the System Properties dialog box. If [OMRON SYSMAC PLC Device] is not displayed, reinstall the USB driver. For details on reinstalling the USB driver, refer to 1-3-1 Connecting with a Commercially Available USB Cable of CP Series CP1L CPU Unit User's Manual (W462) or 4-2-2 Installing the USB Driver of CP Series CP1E CPU Unit Hardware User's Manual (W479). 44 SYSMAC CPIL/CP1E Introduction Manual 4-2 Creating Ladder Programs 4 4-2 Creating Ladder Programs A ladder program can now be created for the example introduced in SECTION 2 System Design. First, however, the functions of the ladder program will be described.

4-2-1 Operation The ladder program to be created will open and close a garage shutter. For details on the example application, refer to 2-2-1 Operation. Entering the Garage 4 Creating Programs 2 2 1 3 The component functions and operations will be defined in detail below. (1) Push-buttons (A16-series, etc): · The shutter can be opened, closed, and stopped with buttons. · The OPEN and CLOSE buttons will continue operating the shutter even when they are not held down. A self-maintaining bit is used to achieve this. (2) Limit switches (WL/WLM-series, etc): · When the shutter is fully opened or fully closed, it will be stopped by a limit switch. · When the shutter is opening, the de-escalation motor will be interlocked to prevent damage. (3) Light detection sensor: · A light detection sensor detects light from headlights pointed at the garage. When 3 headlight flashes are detected by a counter instruction, the shutter escalation motor is activated.

· After the first headlight flash, a timer is activated by a timer instruction. After 5 seconds, a reset command is given to the counter instruction. · The present value of the counter instruction is retained even when CP1L is powered OFF. To prevent malfunction, a reset command is given to the counter instruction when CP1L is powered ON. SYSMAC CPIL/CP1E Introduction Manual 45 4 4-2 Creating Ladder Programs After Entering the Garage / Exiting the Garage 4 Creating Programs (1) Car detection sensor (E3G-series, etc): · A car detection sensor will detect full car entrance into the garage, and activate the shutter de-escalation motor. (2) Push-buttons (A16-series, etc): · When pulling the car out of the garage, use the buttons to operate the shutter. · When pulling the car out of the garage, a differentiated up contact should be used as the car detection sensor, so that the shutter does not close immediately upon fully opening. A ladder program will be set forth hereafter based on the description above. 46 SYSMAC CPIL/CP1E Introduction Manual 4-2 Creating Ladder Programs 4

4-2-2 Ladder Program The ladder program for the example application is shown below. 0.

04 Light detection sensor * 1 W0.00 Work area * 2 W0.00 TIM Work area 0.04 CNT Light detection sensor T0000 Timer C0000 Counter A200.11 P_First_Cycle C0000 Counter 0.

00 OPEN button 100.00 Escalation motor 0.02 CLOSE button 100.01 De-escalation motor 0.03 Car detection sensor * 8 First cycle flag * 7 0. 01 STOP button 0.05 Upper limit LS 100.01 100.00 * 5 Refer to 4-5-4 Inputting Timers. * 6 Refer to 4-5-5 Inputting Counters. * 7 Refer to 4-5-6 Inputting Auxiliary Areas. 0000 Counter * 6 #3 0000 Timer * 5 #50 * 1 Refer to Inputting Contacts of 4-5-2 Inputting Contacts. * 2 Refer to Inputting OR Circuits of 4-5-2 Inputting Contacts. * 3 Refer to Inputting Closed Contacts of 4-5-2 Inputting Contacts. * 4 Refer to 4-5-3 Inputting Output Coils.

T0000 Timer * 3 W0.00 Work area * 4 4 Creating Programs De-escalation Escalation motor motor 0.01 CLOSE button 0.06 Lower limit LS 100.00 Escalation motor 100.01 De-escalation motor * 8 Refer to 4-5-7 Inputting Differentiated Up Contacts. Creating the program in CX-Programmer will be explained in the next section. SYSMAC CPIL/CP1E Introduction Manual 47 4 4-3 Using CX-Programmer 4-3 Using CX-Programmer This section explains CX-Programmer start-up and operation screens. 4-3-1 Starting CX-Programmer 1. On the desktop, select [Start] - [All Programs] - [OMRON] - [CX-One] - [CXProgrammer] - [CX-Programmer].

CX-Programmer will start. The title screen will be displayed, followed by the main window. 4 Creating Programs Note For details on installing CX-Programmer, refer to Chapter 1 Overview and Installation of CX-One of CX-One Introduction Guide (R145). 48 SYSMAC CPIL/CP1E Introduction Manual 4-3 Using CX-Programmer 4 4-3-2 Operation Screens This section explains the functions available on the CX-Programmer main window. For details on using CX-Programmer, refer to CX-Programmer Operation Manual (W446).

Main Window 4 Creating Programs (1) Title bar Displays the data file name, created in CX-Programmer. (2) Main menu Used to select CX-Programmer functions. (3) Toolbars Displays icons for frequently used functions. Place the mouse cursor over an icon to display the corresponding function name. Select View - Toolbars from the main menu to show/hide toolbars.

Drag the toolbars to change their position. (4) Project tree / (6) Project workspace Used to manage programs and settings. Drag & drop items to copy the data. Select [View] - [Windows] - [Workspace] from the main menu to show/hide the workspace. (5) Section Programs can be split into and managed as multiple parts. (7) Diagram workspace Used to create and edit ladder programs. (8) I/O comment bar Displays the name, address/value, and I/O comment for the variable selected by the mouse cursor. SYSMAC CPIL/CP1E Introduction Manual 49 4 4-3 Using CX-Programmer 4 Creating Programs (9) Output window Select [View] - [Windows] - [Output] from the main menu to show/hide the output window.



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Displays the following information: Compile: Displays program check results. Find Report: Displays search results for contacts, instructions, and coils.

Transfer: Displays errors which occurred while loading a project file. (10) Status bar Displays information such as PLC name, offline/online status, and active cell position. If an online connection error or other errors occur and are recorded by the error log while online, a blinking red error message will be displayed. Select [View] [Windows] - [Status Bar] from the main menu to show/hide the status bar. Diagram Workspace 1 2 3 4 4 (1) Rung number (2)

Program address (3) Rung header If a rung is incomplete, a red line will be displayed to the right of its rung header. (4) Bus bar Information Window Displays basic shortcut keys used in CX-Programmer. Select [View] - [Windows] - [Information Window] from the main menu to show/hide the information window. 50 SYSMAC CP1L/CP1E Introduction Manual 4-4 Using the Help 4 4-4 Using the Help CX-Programmer Help provides information on the CX-Programmer screens, and explains all operations including basic functions, program creation, and monitoring. Instructions, as well as formats and operand functions, are also explained. Referencing CX-Programmer Help 1.

While using CX-Programmer, press the [F1] key. The help window will be displayed. 4 Creating Programs CX-Programmer Help can also be displayed in several other ways. From the Desktop Menu 1. On the desktop, select [Start] - [All Programs] - [OMRON] - [CX-One] - [CXProgrammer] - [CX-Programmer Help].

CX-Programmer Help will be displayed. SYSMAC CP1L/CP1E Introduction Manual 51 4 4-4 Using the Help From CX-Programmer 1. Select [Help] - [Help Contents] from the main menu. CX-Programmer Help will be displayed. 4 Referencing PLC Instruction Sets For details on instructions used in ladder programs, refer to PLC Instruction Sets.

Creating Programs From CX-Programmer 1. Select [Help] - [Instruction Reference] - [CS/CJ-Series] from the main menu. CP-Series PLC Instruction Sets will be displayed. While Creating Ladder Programs While creating an instruction in a ladder program in Smart Input Mode, press the [F1] Key to display the Instruction Reference page for the instruction being edited. 52 SYSMAC CP1L/CP1E Introduction Manual 4-5 Inputting Programs 4 4-5 Inputting Programs Using the commands available in CX-Programmer, create a program for the example application. 4-5-1 Creating New Projects When using CX-Programmer for the first time, you will need to create a new project. When creating a new project, you must set the target device type and CPU type for the program and data being created. This section explains how to make settings for the CP1L-L-type CPU unit as an example. 4 Creating Programs 1. Select [File] - [New] from the main menu.

The Change PLC dialog box will be displayed. 2. Select [CP1L] from the Device Type drop-down list. SYSMAC CP1L/CP1E Introduction Manual 53 4 4-5 Inputting Programs 3. Click [Settings]. The Device Type Settings dialog box will be displayed. 4 Creating Programs 4. Select the CPU from the CPU Type drop-down list. Click [OK]. The Device Type Settings dialog box will be closed.

54 SYSMAC CP1L/CP1E Introduction Manual 4-5 Inputting Programs 4 5. Confirm that [USB] is displayed for Network Type. Click [OK]. 4 Creating Programs The Change PLC dialog box will be closed. Main window for the new project will be displayed.

If [USB] is not displayed for Network Type, refer to 4-1-2 Connecting to a Computer and Installing the USB Driver and confirm that the USB driver has been installed properly. SYSMAC CP1L/CP1E Introduction Manual 55 4 4-5 Inputting Programs 4-5-2 Inputting Contacts Input a contact. For details on ladder programs, refer to 4-2-2 Ladder Program. Inputting Contacts 1. Press either the [L] or [C] key.

"LD 0.00" will be displayed. 4 Creating Programs 2. Press the [Enter] key. "Bit (1/1)" will be displayed and "0.00" will be displayed in reverse video. 3. Input address "4". Press the [Enter] key. "4" is entered.

The Comment dialog box will be displayed. 4. Input "Light detection sensor" as the I/O comment. Press the [Enter] key. A contact representing input from the light detection sensor will be displayed on the ladder program. Next, input an OR circuit. 56 SYSMAC CP1L/CP1E Introduction Manual 4-5 Inputting Programs 4 Inputting OR Circuits 1. Place the cursor on the program. Press the [Enter] key. A space for inserting an OR circuit will be created.

4 Creating Programs 2. Press the [W] key. "OR 0.05" will be displayed. 3.

Press the [Enter] key. "Bit (1/1)" will be displayed and "0.05" will be displayed in reverse video. 4. Input address "W0".

Press the [Enter] key. "W0" is entered. The Comment dialog box will be displayed. SYSMAC CP1L/CP1E Introduction Manual 57 4 4-5 Inputting Programs 5. Input "Work Area" as the I/O comment. Press the [Enter] key. An OR circuit representing the work area contact will be displayed. 4 Next, input a closed contact. Creating Programs Inputting Closed Contacts 1. Press the up arrow key.

The cursor is moved upward. 2. With the cursor in the up position, press the [/] key. "LDNOT W0.01" will be displayed. 3. 4. Press the [Enter] key. "Bit (1/1)" will be displayed and "W0.01" will be displayed in reverse video.

Input address "T0". Press the [Enter] key. 58 SYSMAC CP1L/CP1E Introduction Manual 4-5 Inputting Programs 4 "T0" is entered. The Comment dialog box will be displayed. 5.

Input "Timer" as the I/O comment. Press the [Enter] key. An AND circuit representing the timer closed contact will be displayed. 4 Creating Programs Next, input a work area output. SYSMAC CP1L/CP1E Introduction Manual 59 4 4-5 Inputting Programs 4-5-3 Inputting Output Coils Input an output coil for the work area.

1. Press the [O] key. "OUT 100.00" will be displayed. 4 Creating Programs 2. Press the [Enter] key. "Bit (1/1)" will be displayed and "100.00" will be displayed in reverse video. 3. Input address "W0".

Press the [Enter] key. "W0" is entered. The output coil input for the work area is complete with the I/O comment already entered. 60 SYSMAC CP1L/CP1E Introduction Manual 4-5 Inputting Programs 4 Next, input a timer instruction. Note Duplicated Coils Do not duplicate coils. If the same address is specified for multiple outputs, only the rung closer to the END instruction will be valid. This is because programs are executed sequentially from top to bottom. Invalid rungs caused by duplicated coils will be detected by CX-Programmer as an error.



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E.g.

A program with duplicated coils 4 Creating Programs The error may be resolved by modifying the program as shown below. SYSMAC CP1L/CP1E Introduction Manual 61 4 4-5 Inputting Programs 4-5-4 Inputting Timers 1. Press the [C] key. Input contact "W000". For details on inputting a contact, refer to 4-5-2 Inputting Contacts.

4 Creating Programs 2. Press the [T] Key. A list of instructions beginning with T will be displayed. 3. Press the [Enter] key. "Timer number (1/2)" will be displayed, and "0.0" will be displayed in reverse video. 62 SYSMAC CP1L/CP1E Introduction Manual 4-5 Inputting Programs 4 4. Input the timer number. "0" is already displayed, so press the [Enter] key. 4 Creating Programs 5. Input the timer set value. Input "#50" and then press the [Enter] key. The Comment dialog box will be displayed. "TIM 0 #50" indicates a 5.

0 second delay timer, with a timer completion flag of T0000. 6. Input "Timer" as the I/O comment. Press the [Enter] key. SYSMAC CP1L/CP1E Introduction Manual 63 4 4-5 Inputting Programs The timer instruction input is complete. 4 Creating Programs Next, input a counter instruction. 64 SYSMAC CP1L/CP1E Introduction Manual 4-5 Inputting Programs 4 4-5-5 Inputting Counters 1. Press the [C] key. Input contact "004". For details on inputting a contact, refer to 4-5-2 Inputting Contacts.

4 Creating Programs 2. Press the [C] Key. A list of instructions beginning with C will be displayed. Select the instruction from the list or input the mnemonic directly. SYSMAC CP1L/CP1E Introduction Manual 65 4 4-5 Inputting Programs 3.

Press the [Enter] key. "Counter number (1/2)" will be displayed, and "0.0" will be displayed in reverse video. 4 Creating Programs 4. Input the counter number. "0" is already displayed, so press the [Enter] key. 66 SYSMAC CP1L/CP1E Introduction Manual 4-5 Inputting Programs 4 5. Input the counter set value. Input "#3" and then press the [Enter] key. 4 Creating Programs The Comment dialog box will be displayed. "CNT 0 #3" indicates a decrementing counter starting at count 3, with a counter completion flag of C0000. SYSMAC CP1L/CP1E Introduction Manual 67 4 4-5 Inputting Programs 6. Input "Counter" as the I/O comment. Press the [Enter] key. 4 Creating Programs The counter instruction input is complete.

Next, input a reset input for the counter instruction. The timer contact (TIM 0000) will be used as the reset input. 68 SYSMAC CP1L/CP1E Introduction Manual 4-5 Inputting Programs 4 7. 8. Place the cursor below the contact created in step 1. Input contact "T0000". 4 Creating Programs 9. Press the [Ctrl] and the down arrow key 5 times simultaneously. When the cursor is positioned on the next rung, counter instruction input is complete. Next, input an auxiliary area.

SYSMAC CP1L/CP1E Introduction Manual 69 4 4-5 Inputting Programs 4-5-6 Inputting Auxiliary Areas Auxiliary area is a relay with a specific purpose. The first cycle flag will be ON for only 1 cycle after the PLC has been powered ON. Here, it will be used to reset the counter when CP1L is powered ON. 1. Press the [W] key.

Input an OR circuit contact "C0000". A space for inserting an OR circuit will be created. For details on inputting a contact, refer to 4-5-2 Inputting Contacts. 4 Creating Programs 2. 3.

4. Press the left arrow key. Press the [W] key. The Operand input box will be displayed. Input address "A20011". Press the [Enter] key. 70 SYSMAC CP1L/CP1E Introduction Manual 4-5 Inputting Programs 4 A first cycle flag will be displayed on the ladder program. 4 Creating Programs 4-5-7 Inputting Differentiated Up Contacts 1. While referring to 4-2-2 Ladder Programs, enter a ladder program, extending to de-escalation motor contact, "10001". 2.

3. 4. Press the [Enter] key. A space for inserting an OR circuit will be created. Press the [W] key. "OR 100.01" will be displayed. Input address "3". Press the [Enter] key. The Comment dialog box will be displayed.

SYSMAC CP1L/CP1E Introduction Manual 71 4 4-5 Inputting Programs 5. Input "Car detection sensor" as the I/O comment. Press the [Enter] key. A contact representing input from the car detection sensor will be displayed as an OR circuit. 4 Creating Programs 6.

Double-click contact "003". The Edit Contact dialog box will be displayed. 7. Click [Detail]. 8.

Select [Up] for Differentiation. Click [OK]. 72 SYSMAC CP1L/CP1E Introduction Manual 4-5 Inputting Programs 4 An upward arrow representing a differentiated up condition will be displayed on the contact. 4 Creating Programs Note The following instruction variations can be input. Upward differentiation (@) Downward differentiation (%) Immediate refreshing (!) END Instruction Example: Immediate refreshing (!) specified. The symbols indicating these instruction variations will be added to the beginning of the instruction whenever they are input regardless of whether the cursor is before (example: \LD), in the middle (example: LLD), or at the end (example: LD!) of the instruction. After an instruction has been entered, the variation can be changed as follows. @: Upward differentiation %: Downward differentiation !: Immediate refreshing Shift + 0: No differentiation 4-5-8 END Instruction Ladder programs must be terminated with an END instruction. When a new program is created in CX-Programmer, a section inclusive of an END instruction will be inserted automatically. Hence, there is no need to input an END instruction manually.

To confirm the ladder program containing only the END instruction, double-click the [END] section. SYSMAC CP1L/CP1E Introduction Manual 73 4 4-6 Saving/Loading Programs 4-6 Saving/Loading Programs Created ladder programs must be saved. This section explains how to check, save, and load ladder programs. 4-6-1 Compiling Programs By compiling, you can check for errors in the program. 4 Creating Programs 1. Select [Program] - [Compile All PLC Programs] from the main menu. The compilation is started. When the compilation is complete, program check results will be displayed in the output window.

2. If an error has been detected, double-click the error message in the output window.

The cursor is moved to where the error was detected. Correct the error. 74 SYSMAC CP1L/CP1E Introduction Manual 4-6 Saving/Loading Programs 4 4-6-2 Saving Programs Save the created ladder program. Programs are saved in groups for each project. 1.

Select [File] - [Save As] from the main menu. The Save CX-Programmer File dialog box will be displayed. 4 Creating Programs 2. Specify the save location, and input a file name.



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