

Caution



- The product/system described in this documentation may be operated only by personnel qualified for the specific task in accordance with the relevant documentation.
- Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.



- Inspect wiring of equipment before each use. Replace damaged or frayed electrical cords immediately. Use a reliable power supply.
- Minimize the potential for dust, metallic particles, water or any chemical spills on or near the equipment.
- DO NOT disassemble or modify any part of the equipment.
- DO NOT use and/or install the equipment in places with the following conditions:
 - Humidity or temperature out of the specified range
 - vibration or shock
 - dust or corrosive gas or liquid
- DO NOT touch the cords, terminals or any electric part when the equipment power is on. Wait at least one minute after the power off to assure that all capacitors are discharged.

Hardware Parameters

Performance	Processor	Arm, Cortex M7
	Bit operation	4 μ s
	Word operation	4 μ s
	Single Floating-point Operation	4 μ s
	Double Floating-point Operation	7 μ s
	CPU startup modes	Cold start, Warm start
Memory	Configurable startup mode	Yes
	Load memory	4 MB
	Application memory	160 KB
	Retentive memory	4 KB
	M area memory	32 KB
	I area memory	8 KB
	Q area memory	8 KB
	G area memory	32 KB
I/O Expansion	Permanent memory	16 KB
	Supported modules	63, IM3XX Series
	Max digital I/O expansion count	1008
	I/O integrated in CPU	Yes, 13 DI, 16 DO
Digital Inputs	Emergency stop trigger	Yes
	Inputs count	13
	Type of digital input	Isolated transistor (both sinking and sourcing)
	Number of inputs group	1
	Type of input voltage	DC
	Rated voltage	24 V
	For signal "0"	-30 to 11 V
	For signal "1"	12 to 30 V
	Power consumption for signal "1"	72mW
	Configurable input delay	Yes. 0, 3, 7, 15, 30, 50, 100 ms
	Input impedance	8 k Ω
	Response time from "0" to "1"	20 μ s
	Response time from "1" to "0"	40 μ s
	Alternate functions	Yes. Fast Counter
	Stop actions	Yes. Shut Down, Keep Last Value

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Digital Outputs	Outputs count	16	
	Type of digital output	Isolated transistor (sinking)	
	Type of output voltage	DC	
	Operating voltage	5 to 30 V	
	Rated operating voltage	24 V	
	Rated max current	0.3 A	
	Delay time from "1" to "0"	20 μ s	
	Delay time from "0" to "1"	30 μ s	
	Stop action support	Yes. Shut Down, Keep Last Value, Output 1, Output Custom Value	
	PWM output:	Yes	
Frequency range	0.5 to 1000 Hz (duty cycle 5% ~ 95%)		
Min pulse duration	100 μ s		
Pulse train output:	Yes		
	Pulse period range	200 to 1310700 μ s	
Pulse count range	1 to 65535		
Frequency out output:	Yes		
	Pulse period range	4 to 1310700 μ s	
Device Elements	IEC-61131 data types	Yes	
	Arrays	Yes	
	Structures	Yes	
	User custom data type	Yes	
	Number of Tags	4096	
	Number of Organization Blocks (OBs)	<ul style="list-style-type: none"> Cyclic Programs: 1 Periodic Interrupts: 3 Startup Programs: 1 Stop Programs: 1 Emergency Stop Programs: 1 Time Of Day Interrupts: 1 	
	Number of functions (FCs)	32	
	Number of function blocks (FBs)	16	
	Engineering	Configuration / programming Software	Intelart Studio
		Programming languages	LAD, FBD
Interfaces	Number of RS-485 interfaces	1, 115200 bps	
	Number of RS-232 interfaces	1, 115200 bps	
	Number of Ethernet interfaces	1, 10/100 Mbps	
Power	Programming port	Ethernet	
	Voltage range	18 - 30V	
Ambient Conditions	Current range	300 - 700mA	
	Storage temperature	-15 to 75 °C	
	Operating temperature	0 to 55 °C	
Miscellaneous	Relative humidity	Max 90 %, No Condensation	
	Weight	Approx. 900g	
	Led indications	Yes. RUN: ON, Green, STOP: OFF, FAULT: Red	
	Backup battery lifetime	5 Years typical	

Digital Inputs

All digital inputs have a configuration for the input delay. The default value of the input delay is 0ms. The input delay is applicable to eliminate the bouncing effect of a mechanical switch. The inputs of the module have no alternate function.

Fast Counter

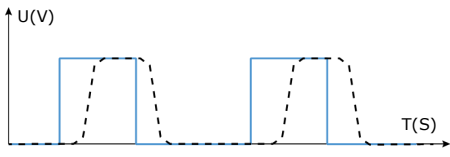
The first three channels can be used as a fast counter when a group alternate function sets as Fast Counter.

Digital Outputs

The outputs of the module can configure in order to execute another function.

Pulse width modulation (PWM)

The output channels are grouped in 3 clusters. Each group has its own PWM frequency setting in the properties window of the module. All groups PWM frequency vary from 0.5Hz to 1000Hz. When any alternate function of a group sets as PWM, a new property will be appeared in order to set the PWM frequency of that group. The pulse waveform is slightly wider than the ideal pulse waveform for a resistive load. The following figure shows the ideal PWM signal versus the actual signal waveform. The ideal signal is specified by the blue line and the actual waveform is figured by the dashed line. The duty cycle can vary from 0% to 100%. The minimum pulse duration is 100 μ s. For example, if you set the frequency of output PWM to 1000Hz (a period of 1000 μ s) and a duty cycle of 5%, this results a pulse duration of 50 μ s but the actual pulse duration will be 100 μ s.



Group 0	Group 1	Group 2
DQ00	DQ01	DQ02

Pulse train

The pulse train function generates a configurable PWM signal with duty cycle of 50% and specified pulse count. The period of the PWM signal is a factor of 200µs.

Stop action

Each output channel has a property named "StopAction" which determines the act of channel when PLC state changes to stop mode. Some options will be unreachable depending on the selected alternate function of the channel.

Alternate Function	Available Stop Actions
None	ShutDown, KeepLastValue, Output 1
Pulse Train	ShutDown, KeepLastValue, OutputCustomValue
PWM	ShutDown, KeepLastValue, OutputCustomValue

Address Space

The value of input channels and output channels and some configurations will be accessible via an address space. There are bunch of predefined mapped tags in order to read or write a value in the address space. The following table illustrates the type and purpose of each mapped tag.

Category	Name	Data Type	Address	Function
Input Space (I)				
Digital Inputs	DI00 ⋮ DI07	BOOL	%I0.0 ⋮ %I0.7	Gets the value of channel
	DI00_07	BYTE	%IB0	A wrapper to get first 8 digital input channel values as a byte
	DI08 ⋮ DI12	BOOL	%I1.0 ⋮ %I1.4	Gets the value of channel
	DI08_12	BYTE	%IB1	A wrapper to get second 5 digital input channel values as a byte
	DI00_12	WORD	%IW0	A wrapper to get all digital input channel values as a byte
Pulse Train	PulseReadyI00 ⋮ PulseReadyI02	BOOL	%I8.0 ⋮ %I8.2	Indicates accomplishment of pulse generating when the alternate function is set to "PulseTrain"
Fast Counter	FastRegI00 ⋮ FastRegI02	UINT	%IW2 ⋮ %IW6	Indicates the current holding value of fast counter channel
POTs	POT1	USINT	%IB14	Gets the current value of Potentiometer 1
	POT2	USINT	%IB15	Gets the current value of Potentiometer 2
Output Space (Q)				
Digital Outputs	DQ00 ⋮ DQ07	BOOL	%Q0.0 ⋮ %Q0.7	Sets or gets the value of channel when its alternative function is set to "None"
	DQ00_07	BYTE	%QB0	A wrapper to get first 8 digital output channel values as a byte
	DQ08 ⋮ DQ15	BOOL	%Q1.0 ⋮ %Q1.7	Sets or gets the value of channel when its alternative function is set to "None"
	DQ08_15	BYTE	%QB1	A wrapper to get second 8 digital output channel values as a byte
	DQ00_15	WORD	%QW0	A wrapper to get all digital output channel values as a byte
PWM	PwmDuty00	USINT	%QB2	Sets or gets the PWM duty cycle value when the alternate function is set to "PWM"
	PwmDuty01		%QB4	
	PwmDuty02		%QB6	

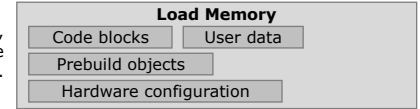
Pulse Train/ Frequency Output	PulseStart00	BOOL	%Q14.0	Starts the CH0 pulse generating process
	PulseStart01		%Q14.1	Starts the CH1 pulse generating process
	PulseStart02		%Q14.2	Starts the CH2 pulse generating process
	PulseParam00	UINT	%QW8	Sets or gets the value of pulse period for Pulse Train mode or pulse frequency for Frequency Output mode. Note that the value is a factor of 200µs. Example: if you set the value to 5 then the pulse
	PulseParam01		%QW10	
	PulseParam02		%QW12	
	PulseCount00	UINT	%QW2	Sets or gets the value of pulse count.
	PulseCount01		%QW4	
	PulseCount02		%QW6	

Memory Storages

This device uses several memory storages for different purposes. Each storage has a specific duty and should be considered by user.

Load memory

The load memory is a non-volatile memory for code blocks, user data, prebuild objects, media objects and hardware configuration. When these objects are downloaded to the CPU they are first saved into load memory. This memory is located on the device itself.



Application memory

The application memory is a volatile memory that contains the code and data structures. The application memory is integrated into the CPU and cannot be extended or moved. This memory also contains runtime-relevant parts of the program code.

Retentive memory

Retentive memory is a non-volatile memory for saving a limited quantity of data in the event of power failure. The tags that have been defined as retain are saved in retentive memory. These data is retained beyond a power-off or power failure. All other program tags are lost under these conditions and are set to their default values upon the operating mode transitions POWER ON to startup, and STOP to startup.

The content of retentive memory is deleted by the following actions:

- Memory reset because of a Cold Start
- Backup battery removal

NOTE

The low voltage in the backup battery causes the device to run in Cold Start mode.

M area memory

The M area memory is a volatile memory that contains all tags defined in external tag tables with an address starting by '%M' notation. This area mostly uses for communication protocols between devices such as Modbus, CAN etc. or some cases that a memory overlapping procedure is needed. Also this memory is usable for general programming.

I and Q area memory

The I and Q area memory is a volatile memory that contains all tags defined in external tag tables with an address starting by '%I' and '%Q' notation respectively. This area contains the values of all input/output areas of connected modules or the CPU itself. Addressing of I and Q area tags is a bit different from M area tags. All I and Q area tags address starts by a number that indicates the physical address of that area.

%I(Q) Physical address | Tag address

Example: the second digital input in the first module will be %I0.0.1 that indicates first module → second bit in first input byte. After the device is configured, in programming software > Plant Explorer > Device Configuration window all installed modules will be accessible.

Each module has a list that contains all I and Q tags with their physical address. By double click on the selected module the tags description list will be opened. There is a wizard in the list that can create all needed tags with their absolute address in an external tag table.

NOTE

In cases where the device has input area the CPU index will be 0 and modules index will be started by 1.

G area memory

The G area memory is a volatile memory that contains tags with different features from M area memory. These tags define in a global tag table (such as Default Tag Table) and can start with a user specified default value. There is no need to assign an address for a tag that defined in this area. The compiler calculates the correct address in compile time for G area and retained tag storages. Any tag of any data type in a global tag table can be marked as Retain. The retain tags value will be stored in retentive storage. Constant tags store in G area and their values never change after downloading program to the CPU.

NOTE

1- Any change in retain storage arrangement such as add/remove a retain tag or changing default value of a retain tag will be caused a Cold Start at the next startup of device after downloading user program to the CPU.

2- All defined tags in M, I and Q areas will start by IEC-61131 default values on a CPU start until the user program or CPU change those tag values.

Permanent memory

The permanent memory is a storage space for using in applications that need to keep the value of tags permanently and not be erased even on a Cold Start condition. Reading from or writing to this memory is different because of its EEPROM nature. There is an instruction in order to read from or write to this memory. You can write any type of data on this memory and read them back again.

WARNING

Writing on this memory cells is guaranteed until one million times. Use this memory only for saving configurations, important data or any type of data that does not need to be write frequently. For example, if the scan time of the CPU is 20 ms and a value was saved once per scan, the EEPROM would last a minimum of 20,000 seconds, which is less than 6 hours. On the other hand, if a value were saved once an hour, the EEPROM would last a minimum of 114 years. Typically, you should perform save operations at the occurrence of specific events that occur rather infrequently.

■ Communications

RS-485

This device provides a single RS-485 port for connection to the network. The maximum length of a network segment is determined by two factors:

Isolation (using an RS-485 repeater) and baud rate.

Isolation is required when you connect devices at different ground potentials. Different ground potentials can exist when grounds are physically separated by a long distance. Even over short distances, load currents of heavy machinery can cause a difference in ground potential.

Supported baud rates for the RS-485 port can vary from 1200 to 115200 b/s.

RS-232

This device provides a single RS-232 port for general purposes. Supported baud rates for the RS-232 port can vary from 1200 to 115200 b/s.

Ethernet

The I5H500 can be remotely configured, programmed and diagnosed via Ethernet using Intelart Studio. Also the device can communicate with another devices via Ethernet. Ethernet can be implemented to offer a wide range of application specific uses, such as switching, high-speed SCADA, fast connects, and redundant networks.

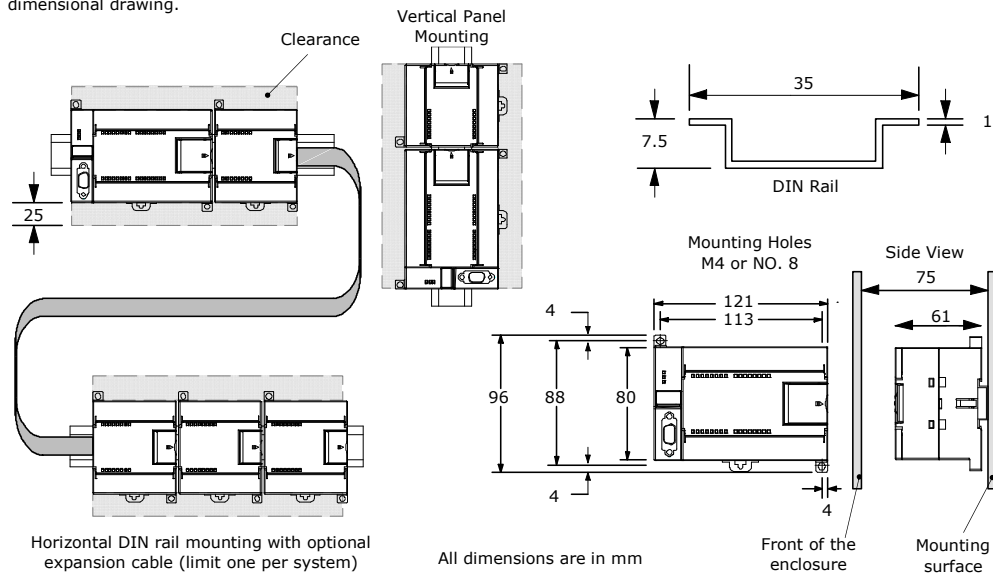
■ Diagnostic

There is 3 LED indicating the status of the device. The following table explains the states of the LED.

LED			Indicating	Solution
POWER (Green)	RUN (Green)	FAULT (Red)		
Off	Off	Off	Power missing or hardware failure.	Check the main power supply Verify that the module is installed correctly
On	Flashes	Off	The CPU is in transient to run mode and configuring its modules.	—
On	On	Off	The CPU is configured and is in RUN mode.	—
On	—	On	Indicates an error (communication error, configuration error etc.)	Verify that the module is installed correctly Check the type of error by Intelart Studio

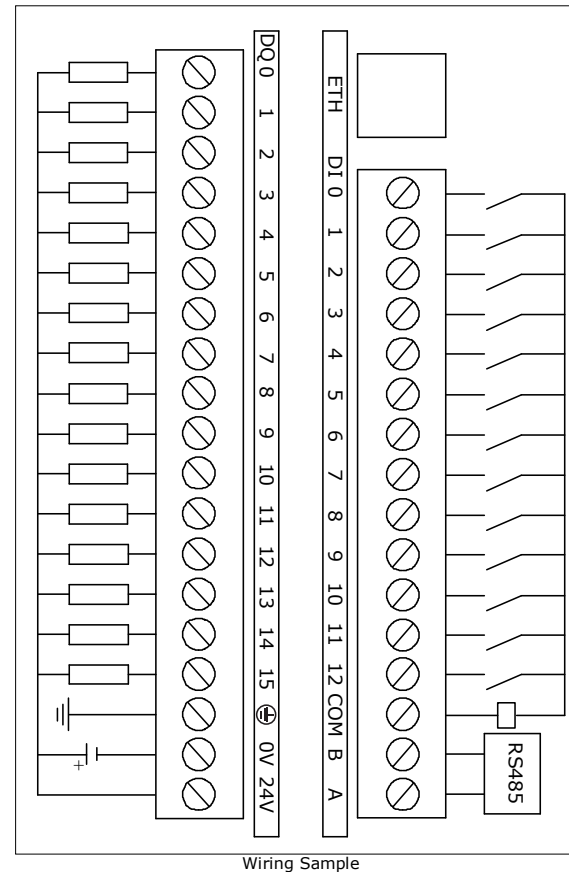
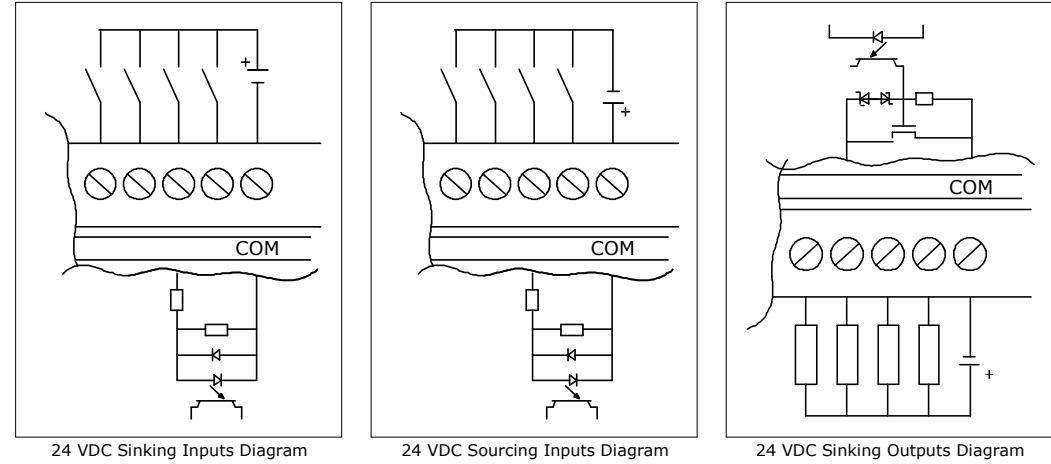
■ Dimensional Drawing

The dimensions of the module are available in this section. For install the module and its main device follow the below dimensional drawing.



■ Wiring

The following block diagram shows you information about wiring of the device.



COM Port 0	1	2	3	4	5	6	7	8	9
	Not applicable	RS-232 TXD	RS-232 RXD	Not applicable	Ground	Not applicable	Not applicable	Not applicable	Not applicable

■ Installing a CPU or an Expansion Module

In order to panel or rail mounting, follow the below steps.

DIN Rail Mounting

1. Secure the rail to the mounting panel every 75 mm.
2. Snap open the DIN clip (located on the bottom of the module) and hook the back of the module onto the DIN rail.
3. If you are using an expansion module, connect the expansion module ribbon cable into the expansion port connector under the access door.
4. Rotate the module down to the DIN rail and snap the clip closed. Carefully check that the clip has fastened the module securely onto the rail. To avoid damage to the module, press on the tab of the mounting hole instead of pressing directly on the front of the module.

Panel Mounting

1. Locate, drill, and tap the mounting holes (M4 or American Standard number 8), using the dimensions in previous section.
2. Secure the module(s) to the panel, using the appropriate screws.
3. If you are using an expansion module, connect the expansion module ribbon cable into the expansion port connector under the access door.

Removing a CPU or Expansion Module

1. Remove power from the CPU.
2. Disconnect all the wiring and cabling that is attached to the module.
3. If you have expansion modules connected to the unit that you are removing, open the access cover door and disconnect the expansion module ribbon cable from the adjacent modules.
4. Unscrew the mounting screws or snap open the DIN clip.
5. Remove the module.

NOTE

Using DIN rail stops could be helpful if your device is in an environment with high vibration potential or if the device has been installed vertically. If your system is in a high-vibration environment, then panel-mounting the device will provide a greater level of vibration protection.

■ Guidelines for Grounding and Wiring

Proper grounding and wiring of all electrical equipment is important to help ensure the optimum operation of your system and to provide additional electrical noise protection for your application and the device.

Prerequisites

Before you ground or install wiring to any electrical device, ensure that the power to that equipment has been turned off. Also, ensure that the power to any related equipment has been turned off. Ensure that you follow all applicable electrical codes when wiring the device and related equipment. Install and operate all equipment according to all applicable national and local standards. Contact your local authorities to determine which codes and standards apply to your specific case.

WARNING

Attempts to install or wire the device or related equipment with power applied could cause electric shock or faulty operation of equipment. Failure to disable all power to the device and related equipment during installation or removal procedures could result in death or serious injury to personnel, and/or damage to equipment. Always follow appropriate safety precautions and ensure that power to the device is disabled before attempting to install or remove the device or related equipment.

Always take safety into consideration as you design the grounding and wiring of your PLC system. Electronic control devices, such as the CPU, can fail and can cause unexpected operation of the equipment that is being controlled or monitored. For this reason, you should implement safeguards that are independent of the CPU to protect against possible personal injury or equipment damage.

WARNING

Control devices can fail in an unsafe condition, resulting in unexpected operation of controlled equipment. Such unexpected operations could result in death or serious injury to personnel, and/or damage to equipment. Use an emergency stop function, electromechanical overrides, or other redundant safeguards that are independent of the PLC.

Guidelines for Isolation

INTELART AC power supply boundaries and I/O boundaries to AC circuits have been designed and approved to provide safe separation between AC line voltages and low voltage circuits. These boundaries include double or reinforced insulation, or basic plus supplementary insulation, according to various standards. Components which cross these boundaries such as optical couplers, capacitors, transformers, and relays have been approved as providing safe separation. Isolation boundaries which meet these requirements have been identified in those product data sheets as having 1500VAC or greater isolation. This designation is based on a routine factory test of (2Ue + 1000VAC) or equivalent according to approved methods.

The sensor supply output, communications circuits, and internal logic circuits of a PLC with included AC power supply are sourced as SELV (safety extra-low voltage) according to EN 61131--2. These circuits become PELV (protective extra-low voltage) if the sensor supply M, or any other non-isolated M connection to the device is connected to ground. Other device M connections which may ground reference the low voltage are designated as not isolated to logic on specific product data sheets. Examples are RS485 communications port M, analog I/O M, and relay coil power M.

To maintain the SELV / PELV character of the PLC low voltage circuits, external connections to communications ports, analog circuits, and all 24V nominal power supply and I/O circuits must be powered from approved sources that meet the requirements of SELV, PELV, Class 2, Limited Voltage, or Limited Power according to various standards.

WARNING

Use of non-isolated or single insulation supplies to supply low voltage circuits from an AC line can result in hazardous voltages appearing on circuits that are expected to be touch safe, such as communications circuits and low voltage sensor wiring. Such unexpected high voltages could result in death or serious injury to personnel, and/or damage to equipment. Only use high voltage to low voltage power converters that are approved as sources of touch safe, limited voltage circuits.

Guidelines for Grounding the PLC

The best way to ground your application is to ensure that all the common and ground connections of your device and related equipment are grounded to a single point. This single point should be connected directly to the earth ground for your system. For improved electrical noise protection, it is recommended that all DC common returns be connected to the same single-point earth ground. Connect the 24 VDC sensor supply common (M) to earth ground.

All ground wires should be as short as possible and should use a large wire size, such as 2 mm² (14 AWG).

When locating grounds, remember to consider safety grounding requirements and the proper operation of protective interrupting devices.

Guidelines for Wiring the PLC

When designing the wiring for your PLC, provide a single disconnect switch that simultaneously removes power from the CPU power supply, from all input circuits, and from all output circuits. Provide overcurrent protection, such as a fuse or circuit breaker, to limit fault currents on supply wiring. You might want to provide additional protection by placing a fuse or other current limit in each output circuit.

Install appropriate surge suppression devices for any wiring that could be subject to lightning surges.

Avoid placing low-voltage signal wires and communications cables in the same wire tray with AC wires and high-energy, rapidly switched DC wires. Always route wires in pairs, with the neutral or common wire paired with the hot or signal-carrying wire.

Use the shortest wire possible and ensure that the wire is sized properly to carry the required current. The connector accepts wire sizes from 2 mm² to 0.3 mm² (14 AWG to 22 AWG). Use shielded wires for optimum protection against electrical noise. Typically, grounding the shield at the PLC gives the best results. When wiring input circuits that are powered by an external power supply, include an overcurrent protection device in that circuit. External protection is not necessary for circuits that are powered by the 24 VDC sensor supply from the device because the sensor supply is already current-limited.

To prevent loose connections, ensure that the wire is installed securely into the connector. To avoid damaging the connector, be careful that you do not over-tighten the screws. The maximum torque for the connector screw is 0.56 N-m (5 inch-pounds).

Guidelines for Inductive Loads

NOTE

For a communications network, the maximum length of the communications cable is 50 m without using a repeater. Some communications port on this device is non-isolated. Refer to technical data for more information.

You should equip inductive loads with suppression circuits to limit voltage rise when the control output turns off. Suppression circuits protect your outputs from premature failure due to high inductive switching currents. In addition, suppression circuits limit the electrical noise generated when switching inductive loads.

NOTE

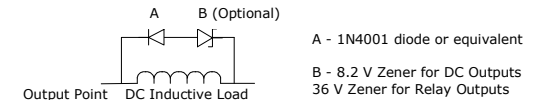
The effectiveness of a given suppression circuit depends on the application, and you must verify it for your particular use. Always ensure that all components used in your suppression circuit are rated for use in the application.

DC Outputs and Relays That Control DC Loads

The DC outputs have internal protection that is adequate for most applications. Since the relays can be used for either a DC or an AC load, internal protection is not provided.

The figure shows a sample suppression circuit for a DC load.

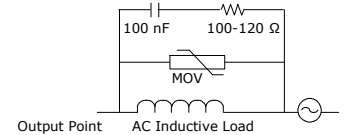
In most applications, the addition of a diode (A) across the inductive load is suitable, but if your application requires faster turn-off times, then the addition of a Zener diode (B) is recommended. Be sure to size your Zener diode properly for the amount of current in your output circuit.



AC Outputs and Relays That Control AC Loads

The AC outputs have internal protection that is adequate for most applications. Since the relays can be used for either a DC or an AC load, internal protection is not provided.

The figure shows a sample suppression circuit for an AC load. When you use a relay or AC output to switch 115V/230V AC loads, place resistor/capacitor networks across the AC load as shown in this figure. You can also use a metal oxide varistor (MOV) to limit peak voltage. Ensure that the working voltage of the MOV is at least 20% greater than the nominal line voltage.



WARNING

When relay expansion modules are used to switch AC inductive loads, the external resistor/capacitor noise suppression circuit must be placed across the AC load to prevent unexpected machine or process operation. See the above Figure.

Guidelines for Lamp Loads

Lamp (Resistive) loads are damaging to relay contacts because of the high turn-on surge current. This surge current will nominally be 10 to 15 times the steady state current for a Tungsten lamp. A replaceable interposing relay or surge limiter is recommended for lamp loads that will be switched a large number of times during the lifetime of the application.