

# M91-2-RA22 Operator Panel & Programmable Logic Controller

24VDC, 12 digital inputs, including 2 analog inputs\*, 2 temperature measurement inputs\*\* and high-speed counter/shaft encoder input, 8 relay outputs, 2 analog outputs, I/O expansion port, RS232/RS485 port

<b>Power supply</b>	24VDC
Permissible range	20.4VDC to 28.8VDC with less than 10% ripple
Maximum current consumption	220mA@24VDC
<b>Digital inputs</b>	12 pnp (source) or npn (sink) inputs. See Note 1.
Nominal input voltage	24VDC See Notes 2.
Input voltages for pnp (source):	0-5VDC for Logic '0' 17-28.8VDC for Logic '1'
Input voltages for npn (sink):	17-28.8VDC/<1mA for Logic '0' 0-5VDC/>3mA for Logic '1'
Input current	3.7mA@24VDC
Input impedance	6.5KΩ
Response time (except high-speed inputs)	10mS typical
Galvanic isolation	None
Input cable length	Up to 100 meters, unshielded
<b>High-speed counter</b>	Specifications below apply when inputs are wired for use as a high-speed counter input/shaft encoder. See Notes 3 and 4.
Resolution	16-bit
Input frequency	10kHz max.
Minimum pulse	40μs

**Notes:**

- All 12 inputs can be set to pnp (source) or npn (sink) via a single jumper and appropriate wiring.
- nnp (sink) inputs use voltage supplied from the controller's power supply.
- Input #0 can function as either high-speed counter or as part of a shaft encoder. In each case, high-speed input specifications apply. When used as a normal digital input, normal input specifications apply.
- Input #1 can function as either counter reset, or as a normal digital input; in either case, specifications are those of a normal digital input. This input may also be used as part of a shaft encoder. In this case, high-speed input specifications apply.

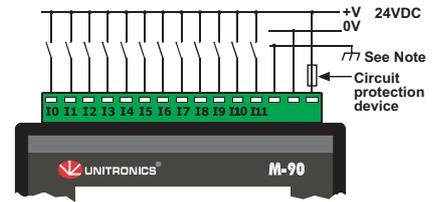
\* These inputs can function as normal digital inputs or analog inputs (voltage/current), in accordance with jumper settings and wiring connections.

\*\* These inputs can function as normal digital inputs, RTD, or thermocouple inputs, in accordance with jumper settings and wiring connections.

**Warnings:**

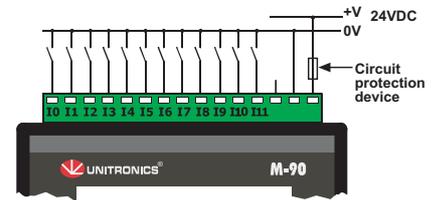
- Unused pins should not be connected. Ignoring this directive may damage the controller.
- Improper use of this product may severely damage the controller.
- Refer to the controller's User Guide regarding wiring considerations.
- Before using this product, it is the responsibility of the user to read the product's User Guide and all accompanying documentation.

**Power supply, pnp (source) inputs connection**

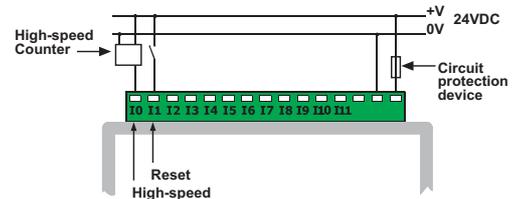


Note:  
To avoid electromagnetic interference, mount the controller in a metal panel/cabinet and earth the power supply. Earth the power supply signal to the metal using a wire whose length does not exceed 10cm. If your conditions do not permit this, do not earth the power supply.

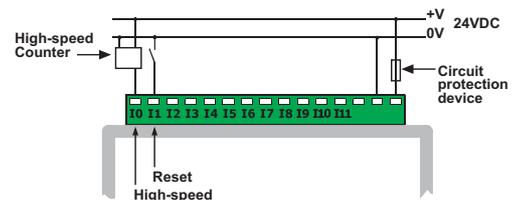
**nnp (sink) inputs connection**



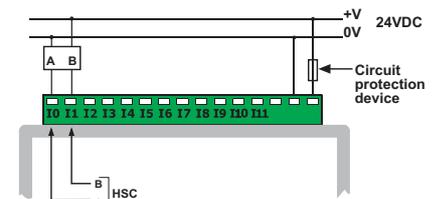
**pnp (source) high-speed counter connection**



**nnp (sink) high-speed counter connection**



**Shaft encoder connection**



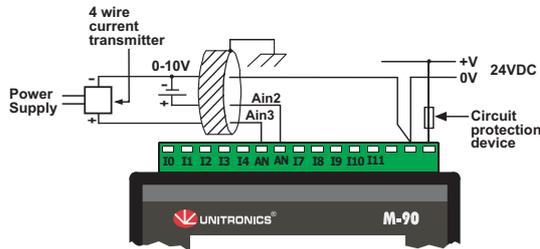
<b>Analog Inputs</b>	Two 14-bit, multi-range inputs: 0-10V, 0-20mA, 4-20mA See Note 1
Conversion method	Voltage to Frequency
Input impedance	12.77KΩ for voltage 37Ω for current
Isolation	None
<b>Normal mode</b>	
Resolution at 0-10V, 0-20mA	14-bit (16384 units)
Resolution at 4-20mA	3277 to 16383 (13107 units)
Conversion time	100mSec minimum per input (according to filter type)
<b>Fast mode</b>	
Resolution at 0-10V, 0-20mA	12-bit (4096 units)
Resolution at 4-20mA	819 to 4095 (3277 units)
Conversion time	30mSec minimum per input (according to filter type)
Absolute maximum rating	±15V for voltage ±30mA for current
Linearity error	0.04% maximum of full scale
Error limit	0.4% of input value
Status indication	Yes, see Note 2

Notes:

- Input #5 and input #6 can be used as analog inputs, related to signal 0V, in accordance with jumper settings and wiring connections.
- The analog value can also indicate faults, as shown below:

Value: 12-bit (Fast mode)	Value: 14-bit (Normal mode)	Input value deviates:
-1	-1	Slightly <b>below</b> the input range.
4096	16384	Slightly <b>above</b> the input range.
32767	32767	Greatly <b>above or below</b> the input range.

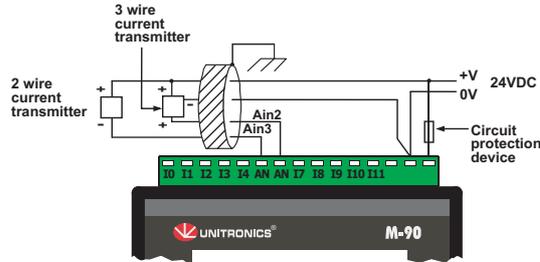
Voltage / Current connection



Notes:

- Shields should be connected at the signals' source.
- The 0V signal of the analog input must be connected to the controller's 0V.

Current connection



Notes:

- Shields should be connected at the signals' source.
- The 0V signal of the analog input must be connected to the controller's 0V.

<b>Thermocouple inputs</b>	Two differential inputs. See Note 1.
Input type	Thermocouple. See Note 2.
Input ranges	As shown in the table below
Isolation	None
Conversion method	Voltage to Frequency
Resolution	0.1°C / 0.1°F
Conversion time	100mSec minimum per input (according to filter type)
Input impedance	>10MΩ
Cold junction compensation	local, automatic
Cold junction compensation error	±1.5°C / ±2.7°F maximum
Absolute maximum rating	±0.6 VDC
Linearity error	0.04% maximum of full scale
Error limit	0.4% of input value
Status indication	None
Warm-up time	½ hour typically, ±1°C / ±1.8°F repeatability

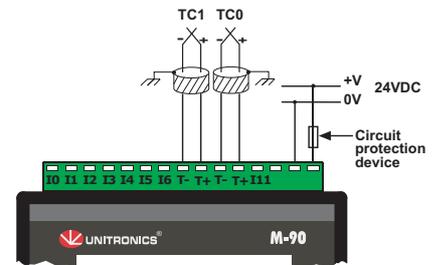
Notes:

- Thermocouple #0: use Input #10 as positive input & Input #9 as negative input. Thermocouple #1: use Input #8 as positive input & Input #7 as negative input. To use inputs as thermocouple, set the relevant jumpers and use appropriate wiring.
- The device can also measure voltage within the range of -5 to 56mV, at resolution of 0.01mV. The device can also measure raw value frequency.

Table 1: input ranges

Type	Temperature range	Wire color	
		ANSI (USA)	BS 1843 (UK)
mV	-5 to 56mV	-	-
B	200 to 1820°C (300 to 3276°F)	+ Grey - Red	+ None - Blue
E	-200 to 750°C (-328 to 1382°F)	+ Violet - Red	+ Brown - Blue
J	-200 to 760°C (-328 to 1400°F)	+ White - Red	+ Yellow - Blue
K	-200 to 1250°C (-328 to 2282°F)	+ Yellow - Red	+ Brown - Blue
N	-200 to 1300°C (-328 to 2372°F)	+ Orange - Red	+ Orange - Blue
R	0 to 1768°C (32 to 3214°F)	+ Black - Red	+ White - Blue
S	0 to 1768°C (32 to 3214°F)	+ Black - Red	+ White - Blue
T	-200 to 400°C (-328 to 752°F)	+ Blue - Red	+ White - Blue

Thermocouple connection



Note:

Shields should be connected at the signals' source.

RTD inputs	Two PT100 inputs. See Note 1.
Input range	-200 to 600°C (-328 to 1100°F) 1 to 320 ohm
Isolation	None
Measurement resolution	0.1°C / 0.1°F
Conversion method	Voltage to Frequency
Conversion time	300mSec minimum per input (according to filter type)
Input impedance	>10MΩ
Auxiliary current for PT100	150μA typical
Linearity error	0.04% max. of full scale
Error limit	0.4% of input value
Status indication	Yes, see Note 2

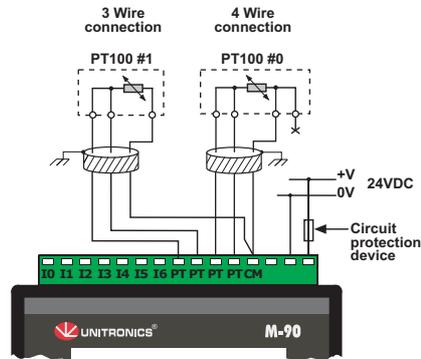
## Notes:

- PT100 #0: use Input #9 & Input #10, related to CM signal (Input #11).  
PT100 #1: use Input #7 & Input #8, related to CM signal (Input #11).  
To use inputs as PT100, set the relevant jumpers and use appropriate wiring.

- The analog value can also indicate faults, as shown below:

Value	Possible Cause
32767	Sensor is not connected to input, or value exceeds the permissible range
-32767	Sensor is short-circuited

## PT100 connection



## Note:

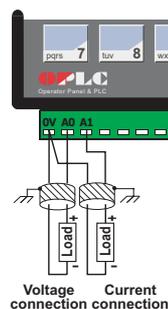
- Shields should be connected at the signals' source.
- 4 wire PT100 can be used by leaving one of the sense leads unconnected.

Analog outputs	Two 12-bit analog outputs: 0-10V, 4-20mA, See Note
Load impedance	1kΩ minimum - voltage 500Ω maximum - current
Galvanic isolation	None
Resolution	12-bit (4096 units)
Conversion time	Synchronized to scan time
Linearity error	±0.1%
Operational error limits	±0.2%

## Note :

Each analog output range is defined by wiring, jumpers and within the controller's software.

## Analog outputs connection



## Notes:

- Shields should be earthed, connected to the earth of the cabinet.
- The 0V signal of the analog outputs must be the same 0V used by the controller's power supply.

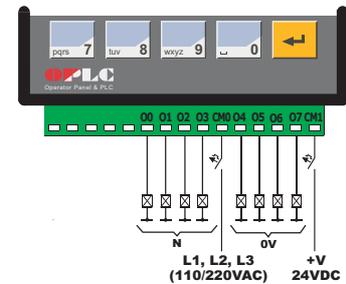
Relay outputs	8 relays (in 2 groups) See Note
Output type	SPST-NO (Form A)
Type of relay	Tyco PCN-124D3MHZ or compatible
Isolation	by relay
Output current (resistive load)	3A max per output 8A max total for common
Rated voltage	250VAC / 30VDC
Minimum load	1mA@5VDC
Life expectancy	100k operations at maximum load
Response time	10mS (typical)
Contact protection	External precautions required (see below)

## Note:

Outputs #0, #1, #2 and #3 share a common signal.  
Outputs #4, #5, #6 and #7 share a common signal.

## Relay outputs connection

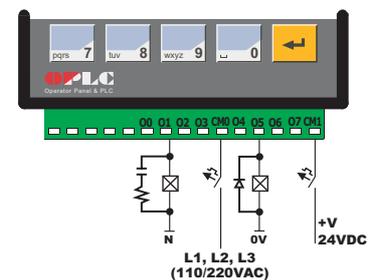
- Each Output group can be wired separately to either AC or DC as shown below.
- The power signals in the illustration below are isolated from the controller's power signals.



## Increasing Contact Life Span

To increase the life span of the relay output contacts and protect the device from potential damage by reverse EMF, connect:

- a clamping diode in parallel with each inductive DC load.
- an RC snubber circuit in parallel with each inductive AC load.



<b>Display</b>	STN, LCD display
Illumination	LED yellow-green backlight
Display size	2 lines, 16 characters long
Character size	5 x 8 matrix, 2.95 x 5.55mm
<b>Keypad</b>	Sealed membrane
Number of keys	15

<b>PLC program</b>	
Ladder Code Memory (virtual)	36K
Memory Bits (coils)	256
Memory Integers (Registers)	256
Timers	64
Execution time	12µsec. for bit operations
Database	1024 integers (indirect access)
HMI displays	80 user-designed displays
HMI variables	64 HMI variables are available to conditionally display and modify text, numbers, dates, times & timer values. The user can also create a list of up to 120 variable text displays, totaling up to 2K.

<b>RS232/RS485 serial port</b>	Used for: <ul style="list-style-type: none"> <li>• Application Download/Upload</li> <li>• Application Testing (Debug)</li> <li>• Connect to GSM or standard telephone modem: <ul style="list-style-type: none"> <li>- Send/receive SMS messages</li> <li>- Remote access programming</li> </ul> </li> <li>• RS485 Networking</li> </ul>
<b>RS232</b> (see note)	1 port
Galvanic isolation	None
Voltage limits	±20V
<b>RS485</b> (see note)	1 port
Input voltage	-7 to +12V differential max.
Cable type	Shielded twisted pair, in compliance with EIA RS485
Galvanic isolation	None
Nodes	Up to 32
Baud rate	110 – 57600 bps

## Note:

RS232/RS485 is determined by jumper settings and wiring as described in the document "M91 RS485 Port Settings" packaged with the controller.

<b>I/O expansion port</b>	Up to 96 additional I/Os, including digital & analog I/Os, temperature and weight inputs and more. (number of I/Os may vary according to expansion model)
<b>Miscellaneous</b>	
Clock (RTC)	Real-time clock functions (Date and Time).
Battery back-up	7 years typical at 25°C, battery back-up for RTC and system data, including variable data.
Weight	314g (11.1 oz.)
Operational temperature	0 to 50°C (32 to 122°F)
Storage temperature	-20 to 60°C (-4 to 140°F)
Relative Humidity (RH)	5% to 95% (non-condensing)
Mounting method	DIN-rail mounted (IP20/NEMA1) Panel mounted (IP65/NEMA4X)

The tables below show how to set a specific jumper to change the functionality of a specific input. To open the controller and access the jumpers, refer to the directions at the end of these specifications.

**Important:** Incompatible jumper settings and wiring connections may severely damage the controller.

## Temperature measurement Inputs

### Inputs # 7-10

#### JP5, JP6, JP7

#### Input #9 and Input #10 (universal input No.0)

To use as	JP5	JP6	JP7
Normal digital inputs*	A	A	A
Thermocouple input (See Note 1)	B	B	B
PT100 input (See Note 2)	B	A	B

Notes:

1. Thermocouple input is between Input #10 (T+) and Input #9 (T-).
2. PT100 input is connected to Input #9 and Input #10, related to CM signal (Input #11).

#### JP1, JP2, JP3

#### Input #7 and Input #8 (universal input No.1)

To use as	JP1	JP2	JP3
Normal digital inputs*	A	A	A
Thermocouple input (See Note 1)	B	B	B
PT100 input (See Note 2)	B	A	B

Notes:

1. Thermocouple input is between Input #8 (T+) and Input #7 (T-).
2. PT100 input is connected to Input #7 and Input #8, related to CM signal (Input #11).

#### JP11

#### Input #11

To use as	JP11
Normal digital input*	A
CM signal for PT100 inputs	B

## Analog (Voltage/Current) Inputs

### Inputs # 5-6

#### JP8, JP9

#### Input #6 (universal input No. 2)

To use as	JP8	JP9
Normal digital input*	A	A
Analog input - voltage	B	A
Analog input - current	B	B

#### JP4, JP10

#### Input #5 (universal input No. 3)

To use as	JP4	JP10
Normal digital input*	A	A
Analog input - voltage	B	A
Analog input - current	B	B

\*Default factory setting

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## Jumper Settings

### JP12 Input type (for all digital inputs) see Note

To use as	JP12
nnp (sink)	A
pnp (source)*	B

Note:

Inputs #0-4, and #5-11 when these are set as normal digital inputs.

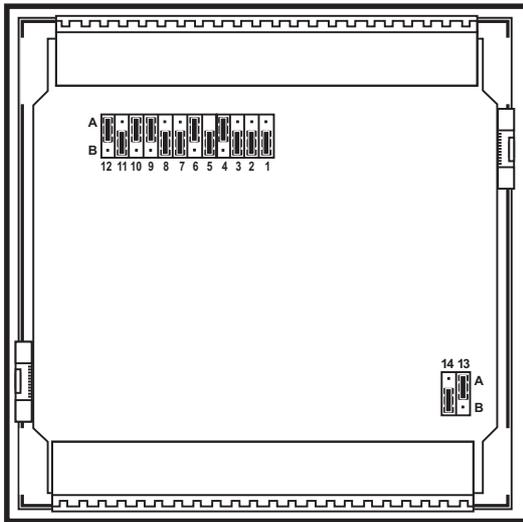
### JP13 Analog output #0

To use as	JP13
Voltage*	A
Current	B

### JP14 Analog output #1

To use as	JP14
Voltage*	A
Current	B

\*Default factory setting



**In this figure, the jumper settings will cause the inputs and the analog outputs to function as follows:**

Universal Input #0 (Input #9 and #10): PT100 input, related to the CM Signal (input#11)

Universal Input #1 (Input #7 and Input #8): Termocouple input

Universal Input #2 (Input #6): Voltage input related to 0V

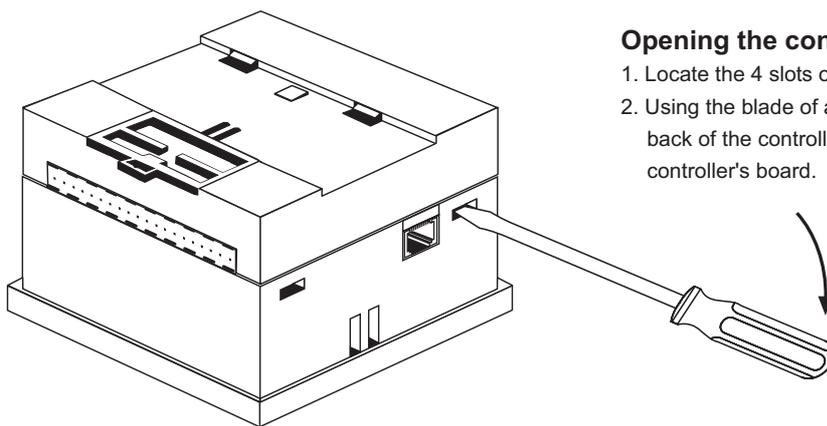
Universal Input #3 (Input #5): Normal npn, 24VDC digital input

Input#0 to Input #4: npn, 24VDC digital inputs.

(Note that these inputs can only function as normal digital inputs.)

Analog output #0: Voltage output

Analog output #1: Current output



### Opening the controller enclosure

1. Locate the 4 slots on the sides of the enclosure
2. Using the blade of a flat-bladed screwdriver, gently pry off the back of the controller as shown in the figure below, exposing the controller's board.

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