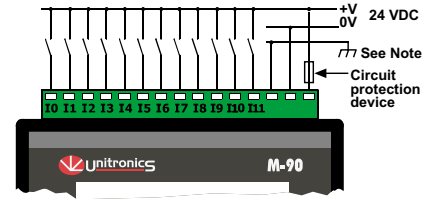


# M91-2-UA2

24 VDC, 12 pnp/npn digital inputs, \*2 universal inputs, high-speed counter/shaft encoder input, 10 transistor outputs, 2 analog outputs, I/O expansion port, RS232/RS485 port

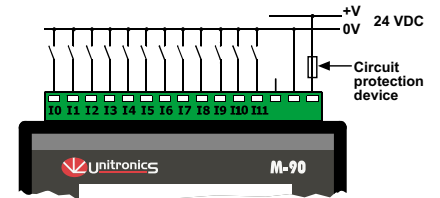
|  |  |
|--|--|
| <b>Power supply</b>                      | 24VDC  |
| Permissible range                        | 20.4VDC to 28.8VDC with less than 10% ripple   |
| Maximum current consumption              | 145mA@24VDC (pnp inputs)<br>250mA@24VDC (npn inputs)   |
| <b>Digital inputs</b>                    | 12 pnp (source) or npn (sink) inputs. See Note 1.  |
| Nominal input voltage                    | 24VDC.<br>See Note 2   |
| Input voltages for pnp (source)          | 0-5VDC for Logic '0'<br>17-28.8VDC for Logic '1'   |
| Input voltages for npn (sink)            | 17-28.8VDC/<2mA for Logic '0'<br>0-5VDC/>6mA for Logic '1'   |
| Input current                            | 8mA@24VDC  |
| Input impedance                          | 3KΩ  |
| 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 freq.                              | 10kHz max.   |
| Minimum pulse                            | 40μs   |

### Power supply, pnp (source) inputs

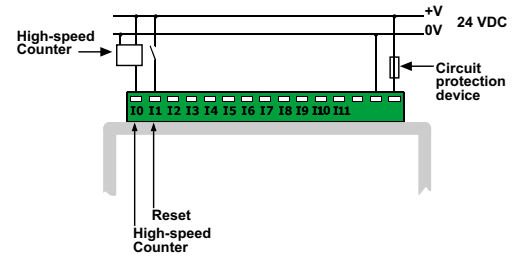


Note:  
To avoid electromagnetic interference, mount the controller in a metal panel/cabinet and earth the power supply. Earth the power supply signal to the metal using a wire whose length does not exceed 10cm. If your conditions do not permit this, do not earth the power supply.

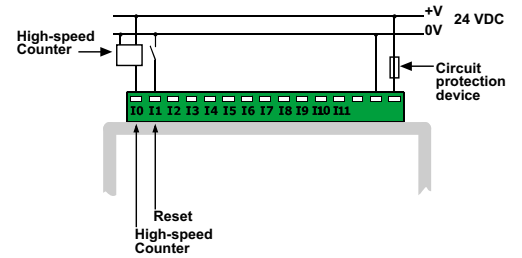
### npn (sink) inputs



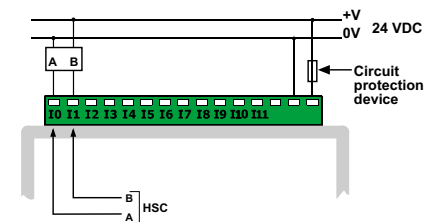
### pnp (source) high-speed counter



### npn (sink) high-speed counter



### Shaft encoder



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.

\* Certain inputs can function as normal digital inputs, analog inputs 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.



## Universal Inputs

| Analog Inputs              | Two 14-bit, multi-range inputs:<br>0-10V, 0-20mA, 4-20mA<br>See Note 1 |
|----------------------------|--|
| Conversion method          | Voltage to Frequency   |
| Input impedance            | >400K $\Omega$ for voltage<br>500 $\Omega$ for current                 |
| Isolation                  | None   |
| Resolution (except 4-20mA) | 14-bit (16384 units)   |
| Resolution at 4-20mA       | 3277 to 16383 (13557 units)  |
| Conversion time            | 100mSec minimum<br>(according to filter type)                          |
| Absolute max. rating       | $\pm 15V$ for voltage<br>$\pm 30mA$ for current                        |
| Linearity error            | 0.04% max. of full scale   |
| Error limit                | 0.4% of input value  |
| Status indication          | Yes, see Note 2  |

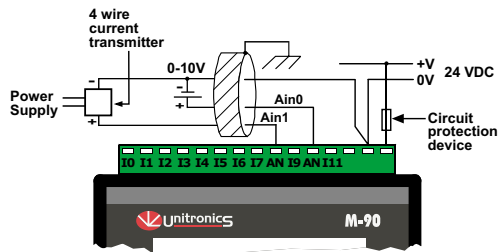
### Notes:

1. Input#8 and input#10 can be used as analog inputs, related to signal 0V, in accordance with jumper settings and wiring connections.

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

| Value | Possible Cause  |
|-------|---|
| -1    | Input value deviates <b>slightly below</b> the input range.         |
| 16384 | Input value deviates <b>slightly above</b> the input range          |
| 32767 | Input value deviates <b>greatly above or below</b> the input range. |

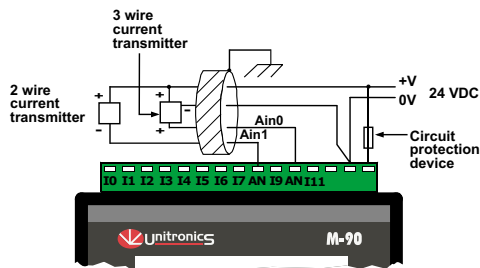
## Voltage / Current connection



### 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.

| Thermocouple inputs              | 2 differential inputs.<br>See Note 1.  |
|----------------------------------|--|
| Input type                       | Thermocouple   |
| 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<br>(according to filter type)                                    |
| Input impedance                  | >10M $\Omega$  |
| Cold junction compensation       | local, automatic   |
| Cold junction compensation error | $\pm 1.5^\circ C / \pm 2.7^\circ F$ maximum                                      |
| Absolute maximum rating          | $\pm 0.6$ VDC  |
| Linearity error                  | 0.04% max. of full scale   |
| Error limit                      | 0.4% of input value  |
| Status indication                | None   |
| Warm-up time                     | $\frac{1}{2}$ hour typically,<br>$\pm 1^\circ C / \pm 1.8^\circ F$ repeatability |

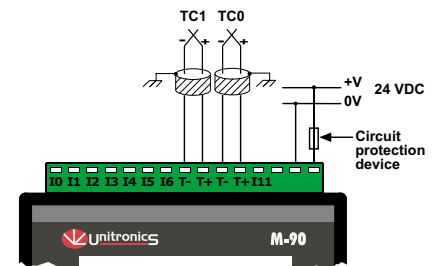
### Notes:

- 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.

Table 1: input ranges

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

## Thermocouple connection



### Note:

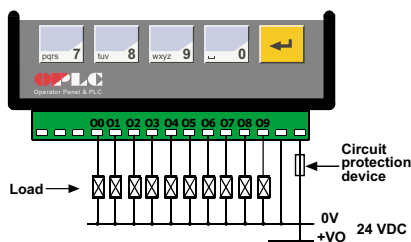
Shields should be connected at the signals' source.

|                                     |   |
|-------------------------------------|---|
| <b>Digital outputs</b>              | 10 pnp (source) outputs<br>24VDC                |
| Output type                         | P-MOSFET (open drain)                           |
| Isolation                           | None  |
| Output current                      | 0.5A max.<br>Total current: 3A max.             |
| Max. frequency for normal outputs   | 50Hz (resistive load)<br>0.5Hz (inductive load) |
| High speed output maximum frequency | 2kHz (resistive load)<br>See Note 1.            |
| Short circuit protection            | Yes   |
| Short indication                    | by software                                     |
| On voltage drop                     | 0.5VDC maximum                                  |
| <b>Power supply for outputs</b>     |   |
| Operating voltage                   | 20.4 to 28.8VDC                                 |
| Nominal operating voltage           | 24VDC   |

Note:

1. Output #0 and Output #1 may be used as high-speed outputs.

### Digital outputs connection

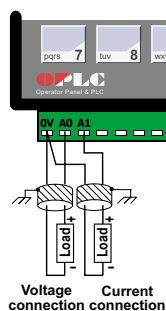


|                          |   |
|--------------------------|---|
| <b>Analog outputs</b>    | Two 12-bit analog outputs:<br>0-10V, 4-20mA, See note 1.    |
| Load impedance           | 1k $\Omega$ minimum—voltage<br>500 $\Omega$ maximum—current |
| Galvanic isolation       | None  |
| Resolution               | 12-bit (4096 units)   |
| Conversion time          | Synchronized to scan time                                   |
| Linearity error          | $\pm 0.1\%$   |
| Operational error limits | $\pm 0.2\%$   |

Note :

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

### Analog outputs connection



Notes:

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

|                |                             |
|----------------|-----------------------------|
| <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               | 12 $\mu$ sec. 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          | $\pm 20V$   |
| <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  |
| Baud rate               | 110 – 57600 bps                                     |
| Nodes                   | Up to 32  |

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, RTD and more. |
|---------------------------|--|

|                         |  |
|-------------------------|--|
| <b>Miscellaneous</b>    |  |
| Clock (RTC)             | Real-time clock functions (Date and Time).                   |
| Battery back-up         | 7 years typical battery back-up for RTC and system data.     |
| Weight                  | 270g. (9.82oz)   |
| 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)<br>Panel mounted (IP65/NEMA4X) |

The tables below show how to set a specific jumper to change the functionality of a specific input, or analog output. 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.

**JP2, JP3, JP6, JP8**  
**Input#9 and Input#10 (universal input no. 0)**

| To use as                              | JP2<br>for Input#10 | JP3<br>for Input#9 | JP6<br>for Input#10 | JP8<br>for Input#10 |
|--|---------------------|--------------------|---------------------|---------------------|
| Normal digital inputs                  | A                   | A                  | A                   | B                   |
| Thermocouple input*<br>(See Note 1)    | B                   | B                  | A                   | B                   |
| Analog input - voltage<br>(see Note 3) | B                   | A<br>See Note 2    | B                   | A                   |
| Analog input - current<br>(see Note 3) | B                   | A<br>See Note 2    | B                   | B                   |

Notes:

1. Thermocouple input is between Input#10 (T+) and Input#9 (T-).
2. When using Input#10 as analog input, Input#9 can be used as normal digital input.
3. Analog inputs are related to signal 0V.

**JP4, JP5, JP7, JP9**  
**Input#7 and Input#8 (universal input no. 1)**

| To use as                              | JP4<br>for Input#8 | JP5<br>for Input#7 | JP7<br>for Input#8 | JP9<br>for Input#8 |
|--|--------------------|--------------------|--------------------|--------------------|
| Normal digital inputs                  | A                  | A                  | A                  | B                  |
| Thermocouple input*<br>(See Note 1)    | B                  | B                  | A                  | B                  |
| Analog input - voltage<br>(see Note 3) | B                  | A<br>See Note 2    | B                  | A                  |
| Analog input - current<br>(see Note 3) | B                  | A<br>See Note 2    | B                  | B                  |

Notes:

1. Thermocouple input is between Input#8 (T+) and Input#7 (T-).
2. When using Input#8 as analog input, Input#7 can be used as normal digital input.
3. Analog inputs are related to signal 0V.

**JP10**  
**Input type (for all digital inputs) -**  
 see Note 1

| To use as     | JP10 |
|---------------|------|
| npn (sink)    | A    |
| pnp (source)* | B    |

Note:

1. Inputs# 0-6, input #11 and #7-10 when these are set as normal digital inputs.

\*Default factory setting

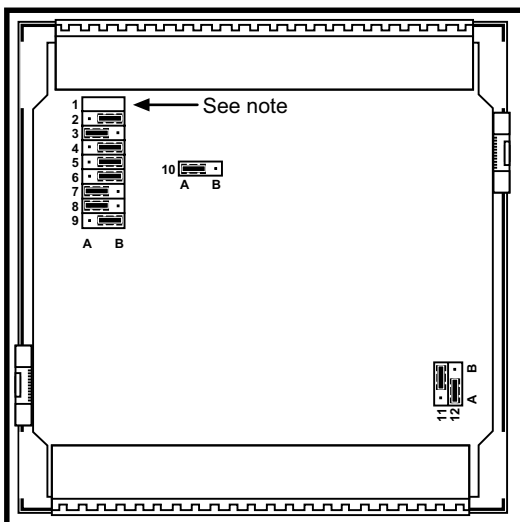
**JP12**  
Analog output #0

| To use as | JP12 |
|-----------|------|
| Voltage*  | A    |
| Current   | B    |

**JP11**  
Analog output #1

| To use as | JP11 |
|-----------|------|
| 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 #10): Voltage input, related to 0V
- Universal Input #1 (Input #7 and Input #8): Termocouple input
- Input#9: Normal npn, 24VDC digital input
- Input#0 to Input #6 and input #11: npn, 24VDC digital inputs.

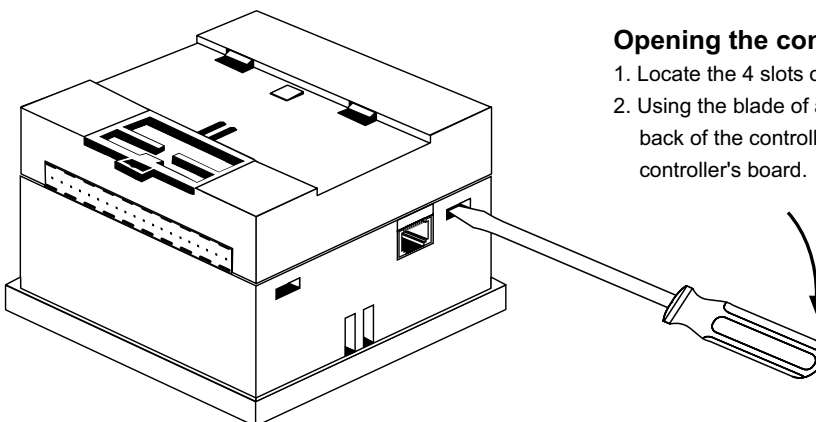
(Note that these inputs can only function as normal digital inputs.)

- Analog output #0: Voltage output
- Analog output #1: Current output

Note:  
Jumper #1 is reserved - do not use.

**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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