**V120-22-RA22**

**Graphic Operator Panel & Programmable Logic Controller**

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

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**Power supply**

- **24VDC**
- Permissible range: 20.4VDC to 28.8VDC with less than 10% ripple
- Maximum current consumption: 250mA@24VDC

**Digital inputs**

- 12 pnp (source) or npn (sink) inputs. See Note 1.
- Nominal input voltage: 24VDC. See Note 2.
- Input voltages for pnp (source): 0-5VDC for Logic ‘0’
- Input voltages for npn (sink): 17-28.8VDC or 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

**High-speed counter**

Specifications below apply when inputs are wired for use as a high-speed counter input/shaft encoder. See Notes 3 and 4.

- Resolution: 32-bit
- Input frequency: 10kHz max.
- Minimum pulse: 40μs

**Notes:**
1. All 12 inputs can be set to pnp (source) or npn (sink) via a single jumper and appropriate wiring.
2. nnp (sink) inputs use voltage supplied from the controller’s power supply.
3. 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.
4. 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.

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**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.
Analog Inputs
Two 14-bit, multi-range inputs: 0-10V, 0-20mA, 4-20mA

Conversion method
Voltage to Frequency

Input impedance
12.77KΩ for voltage
371Ω for current

Isolation
None

Normal mode
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)

Fast mode
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:
1. Inputs #5 and #6 can each function as an analog input, related to signal 0V, in accordance with jumper settings and wiring connections.
2. The analog value can also indicate faults, as shown below:

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

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.

Thermocouple inputs
Two differential inputs:

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)

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
0.5 hour typically.

±1°C / ±1.8°F repeatability

Notes:
1. Thermocouple #0: use Input #10 as positive input & Input #9 as negative input.
2. The device can also use temperature within the range of -5 to 56mV, at resolution of 0.01mV. The device can also measure raw value frequency.

Table 1: input ranges

<table>
<thead>
<tr>
<th>Type</th>
<th>Temperature range</th>
<th>Wire color</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ANSI (USA)</td>
<td>BS 1843 (UK)</td>
</tr>
<tr>
<td>mV</td>
<td>-5 to 56mV</td>
<td>-</td>
</tr>
<tr>
<td>B</td>
<td>200 to 1820°C (300 to 3276°F)</td>
<td>+ Grey</td>
</tr>
<tr>
<td>E</td>
<td>-200 to 750°C (-328 to 1382°F)</td>
<td>+ Violet</td>
</tr>
<tr>
<td>J</td>
<td>-200 to 760°C (-328 to 1400°F)</td>
<td>+ White</td>
</tr>
<tr>
<td>K</td>
<td>-200 to 1250°C (-328 to 2282°F)</td>
<td>+ Yellow</td>
</tr>
<tr>
<td>N</td>
<td>-200 to 1300°C (-328 to 2372°F)</td>
<td>+ Orange</td>
</tr>
<tr>
<td>R</td>
<td>0 to 1768°C (32 to 3214°F)</td>
<td>+ Black</td>
</tr>
<tr>
<td>S</td>
<td>0 to 1768°C (32 to 3214°F)</td>
<td>+ Black</td>
</tr>
<tr>
<td>T</td>
<td>-200 to 400°C (-328 to 752°F)</td>
<td>+ Blue</td>
</tr>
</tbody>
</table>

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 connection

Notes:
- Shields should be connected at the signals’ source.
### RTD inputs

- **Input ranges**: -200 to 600°C (-328 to 1100°F) to 1 to 320 ohms
- **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:**
1. PT 100 #0: use Input #9 & Input #10, related to CM signal (Input #11).
2. To use inputs as PT100, set the relevant jumpers and use appropriate wiring.

#### Analog outputs

- **Type**: Two 12-bit analog outputs: 0-10V, 4-20mA.
- **Load impedance**: 1KΩ minimum - voltage
- **Galvanic isolation**: None
- **Conversion time**: 12-bit (4096 units)
- **Linearity error**: Synchronized to scan time
- **Operational error limits**: ±0.2%

**Notes:**
Each analog output range is defined by wiring, jumpers and within the controller’s software.

### Relay outputs

- **Type**: 8 relays (in 2 groups) (See Note 1)
- **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
- **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 to each inductive DC load.
- an RC snubber circuit in parallel with each inductive AC load.

**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.
<table>
<thead>
<tr>
<th>Graphic Display</th>
<th>STN, LCD display</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illumination backlight</td>
<td>LED, yellow-green, software-controlled</td>
</tr>
<tr>
<td>Display resolution</td>
<td>128x64 pixels</td>
</tr>
<tr>
<td>Keypad</td>
<td>Sealed membrane</td>
</tr>
<tr>
<td>Number of keys</td>
<td>16</td>
</tr>
<tr>
<td>Program</td>
<td></td>
</tr>
<tr>
<td>Application memory</td>
<td>448K</td>
</tr>
<tr>
<td>Memory Bits (coils)</td>
<td>4096</td>
</tr>
<tr>
<td>Memory Integers (registers)</td>
<td>2048</td>
</tr>
<tr>
<td>Long Integers (32 bit)</td>
<td>256</td>
</tr>
<tr>
<td>Double Word (32 bit unsigned)</td>
<td>64</td>
</tr>
<tr>
<td>Floats</td>
<td>24</td>
</tr>
<tr>
<td>Timers</td>
<td>192</td>
</tr>
<tr>
<td>Counters</td>
<td>24</td>
</tr>
<tr>
<td>Data Tables</td>
<td>120K (RAM) / 64K (FLASH)</td>
</tr>
<tr>
<td>HMI displays</td>
<td>Up to 255</td>
</tr>
<tr>
<td>Execution time</td>
<td>0.8μs for bit operations</td>
</tr>
</tbody>
</table>

**I/O expansion port**

Up to 128 additional I/Os, including digital & analog I/Os, temperature and weight inputs and more. (Number of I/Os may vary according to expansion model)

**Miscellaneous**

<table>
<thead>
<tr>
<th>Clock (RTC)</th>
<th>Real-time clock functions (Date and time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery back-up</td>
<td>7 years typical at 25°C, battery back-up for RTC and system data, including variable data</td>
</tr>
<tr>
<td>Battery</td>
<td>Coin type, 3V lithium battery, CR2450</td>
</tr>
<tr>
<td>Weight</td>
<td>317g (11.2 oz)</td>
</tr>
<tr>
<td>Operational temperature</td>
<td>-20 to 60°C (-4 to 140°F)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>0 to 50°C (32 to 122°F)</td>
</tr>
<tr>
<td>Relative Humidity (RH)</td>
<td>5% to 95% (non-condensing)</td>
</tr>
<tr>
<td>Mounting method</td>
<td>DIN-rail mounted (IP20/NEMA1), Panel mounted (IP65/NEMA4X)</td>
</tr>
</tbody>
</table>

**RS232/RS485 serial ports**

Used for:
- Application Download/Upload
- Application Testing (Debug)
- Connect to GSM or standard telephone modem:
  - Send/receive SMS messages
  - Remote access programming
- RS485 Networking

**RS232 (see note)**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2 ports</td>
<td></td>
</tr>
</tbody>
</table>

**RS485 (see note)**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2 ports</td>
<td></td>
</tr>
</tbody>
</table>

Note:
- RS232/RS485 is determined by jumper settings and wiring.
- Refer to the controller’s User Guide regarding communications.
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)**

<table>
<thead>
<tr>
<th>To use as</th>
<th>JP5</th>
<th>JP6</th>
<th>JP7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal digital inputs*</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Thermocouple input</td>
<td>B</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>(See Note 1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PT100 input</td>
<td>B</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>(See Note 2)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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)**

<table>
<thead>
<tr>
<th>To use as</th>
<th>JP1</th>
<th>JP2</th>
<th>JP3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal digital inputs*</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Thermocouple input</td>
<td>B</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>(See Note 1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PT100 input</td>
<td>B</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>(See Note 2)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**

<table>
<thead>
<tr>
<th>To use as</th>
<th>JP11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal digital input*</td>
<td>A</td>
</tr>
<tr>
<td>CM signal for PT100 inputs</td>
<td>B</td>
</tr>
</tbody>
</table>

### Analog (Voltage/Current) Inputs

**Inputs # 5-6**

**JP8, JP9**

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

<table>
<thead>
<tr>
<th>To use as</th>
<th>JP8</th>
<th>JP9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal digital input*</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Analog input - voltage</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Analog input - current</td>
<td>B</td>
<td>B</td>
</tr>
</tbody>
</table>

**JP4, JP10**

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

<table>
<thead>
<tr>
<th>To use as</th>
<th>JP4</th>
<th>JP10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal digital input*</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Analog input - voltage</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Analog input - current</td>
<td>B</td>
<td>B</td>
</tr>
</tbody>
</table>

*Default factory setting*
**V120-22-RA22** I/O Jumper Settings

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

<table>
<thead>
<tr>
<th>To use as</th>
<th>JP12</th>
</tr>
</thead>
<tbody>
<tr>
<td>npn (sink)</td>
<td>A</td>
</tr>
<tr>
<td>pnp (source)*</td>
<td>B</td>
</tr>
</tbody>
</table>

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

### JP13
**Analog output #0**

<table>
<thead>
<tr>
<th>To use as</th>
<th>JP13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage*</td>
<td>A</td>
</tr>
<tr>
<td>Current</td>
<td>B</td>
</tr>
</tbody>
</table>

### JP14
**Analog output #1**

<table>
<thead>
<tr>
<th>To use as</th>
<th>JP14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage*</td>
<td>A</td>
</tr>
<tr>
<td>Current</td>
<td>B</td>
</tr>
</tbody>
</table>

*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):** Thermocouple input
- **Universal Input #2 (Input #6):** Voltage input related to 0V
- **Universal Input #3 (Input #5):** Normal npn, 24VDC digital input

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

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

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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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