

Temperature Controller SC-F71 Installation Manual

Thank you for purchasing this product. In order to achieve maximum performance and ensure proper operation of the instrument, carefully read all the instructions in this manual. Please place the manual in a convenient location for easy reference. This manual describes installation and wiring of SC-F71 controllers.

For detailed handling procedures and key operations, refer to the **SC-F71 Instruction Manual**.

WARNING

- To prevent injury to persons, damage to the instrument and the equipment, a suitable external protection device shall be required.
- All wiring must be completed before power is turned on to prevent electric shock, fire or damage to the instrument and the equipment.
- This instrument must be used in accordance with the specifications to prevent fire or damage to the instrument and the equipment.
- This instrument is not intended for use in locations subject to flammable or explosive gases.
- Do not touch high-voltage connections such as power supply terminals, etc. to avoid electric shock.
- TLV is not responsible if this instrument is repaired, modified or disassembled by other than factory-approved personnel. Malfunction may occur and warranty is void under these conditions.

CAUTION

- This product is intended for use with industrial machines, test and measuring equipment. (It is not designed for use with medical equipment and nuclear energy plant.)
- This is a Class A instrument. In a domestic environment, this instrument may cause radio interference, in which case the user may be required to take additional measures.
- This instrument is protected from electric shock by reinforced insulation. Provide reinforced insulation between the wire for the input signal and the wires for instrument power supply, source of power and loads. Be sure to provide an appropriate surge control circuit respectively for the following:
 - If input/output or signal lines within the building are longer than 30 meters
 - If input/output or signal lines leave the building, regardless the length.
- This instrument is designed for installation in an enclosed instrumentation panel. All high-voltage connections such as power supply terminals must be enclosed in the instrumentation panel to avoid electric shock to operating personnel.

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2. MOUNTING

WARNING

To prevent electric shock or instrument failure, always turn off the power before mounting or removing the instrument.

2.1 Mounting Cautions

- This instrument is intended to be used under the following environmental conditions. (IEC 61010-1)
 - [OVERVOLTAGE CATEGORY II, POLLUTION DEGREE 2]
- Use this instrument within the following environment conditions:
 - Allowable ambient temperature: -10 to +55 °C
 - Allowable Ambient Humidity Range:
 - 5 to 95% RH (absolute humidity: MAX. W. C 29g/m³ dry air at 101.3 kPa)
 - Installation environment conditions:
 - Indoor use
 - Altitude up to 2000 m
 - Short-term temporary overvoltage: 1440 V
 - Long-term temporary overvoltage: 490 V
- Avoid the following conditions when selecting the mounting location:
 - Rapid changes in ambient temperature which may cause condensation.
 - Corrosive or inflammable gases.
 - Direct vibration or shock to the mainframe.
 - Water, oil, chemicals, vapor or steam splashes.
 - Excessive dust, salt or iron particles.
 - Excessive induction noise, static electricity, magnetic fields or noise.
 - Direct air flow from an air conditioner.
 - Exposure to direct sunlight.
 - Excessive heat accumulation.
- Mount this instrument in the panel considering the following conditions:
 - Ensure at least 50 mm space on top and bottom of the instrument for maintenance and operating environment.
 - Do not mount this instrument directly above equipment that generates large amount of heat (heaters, transformers, semi-conductor functional devices, large-wattage resistors).
 - If the ambient temperature rises above 55 °C, cool this instrument with a forced air fan, cooler, etc. Cooled air should not blow directly on this instrument.
 - In order to improve safety and the immunity to withstand noise, mount this instrument as far away as possible from high voltage equipment, power lines, and rotating machinery.
 - High voltage equipment: Do not mount within the same panel.
 - Power lines: Separate at least 200 mm.
 - Rotating machinery: Separate as far as possible.
 - For correct functioning mount this instrument in a horizontal position.
- In case this instrument is connected to a supply by means of a permanent

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- All precautions described in this manual should be taken to avoid damage to the instrument or equipment. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.
- All wiring must be in accordance with local codes and regulations.
- To prevent instrument damage as a result of failure, protect the power line and the input/output lines from high currents with a suitable overcurrent protection device with adequate breaking capacity such as a fuse, circuit breaker, etc.
- A malfunction in this product may occasionally make control operations impossible or prevent alarm outputs, resulting in a possible hazard. Take appropriate measures in the end use to prevent hazards in the event of malfunction.
- Prevent metal fragments or lead wire scraps from falling inside instrument case to avoid electric shock, fire or malfunction.
- Tighten each terminal screw to the specified torque found in the manual to avoid electric shock, fire or malfunction.
- For proper operation of this instrument, provide adequate ventilation for heat dissipation.
- Do not connect wires to unused terminals as this will interfere with proper operation of the instrument.
- Turn off the power supply before cleaning the instrument.
- Use a soft, dry cloth to remove stains from the instrument. Do not use a volatile solvent such as paint thinner to clean the instrument. Deformation or discoloration may occur.

To avoid damage to the instrument display, do not rub with an abrasive material or push the front panel with a hard object.

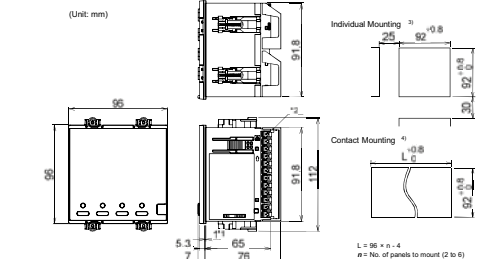
NOTICE

- This manual assumes that the reader has a fundamental knowledge of the principles of electricity, process control, computer technology and communications.
- The figures, diagrams and numeric values used in this manual are only for explanation purpose.
- TLV is not responsible for any damage or injury that is caused as a result of using this instrument, instrument failure or indirect damage.
- TLV is not responsible for any damage and/or injury resulting from the use of instruments made by imitating this instrument.
- Periodic maintenance is required for safe and proper operation of this instrument. Some components have a limited service life, or characteristics that change over time.
- Every effort has been made to ensure accuracy of all information contained herein. TLV makes no warranty, expressed or implied, with respect to the accuracy of the information. The information in this manual is subject to change without prior notice.
- No portion of this document may be reprinted, modified, copied, transmitted, digitized, stored, processed or retrieved through any mechanical, electronic, optical or other means without prior written approval from TLV.
- Various symbols are used on the equipment, and they have the following meaning:
 - ⋮ Alternating current
 - ⊘ Reinforced insulation
 - ⚠ Safety precaution

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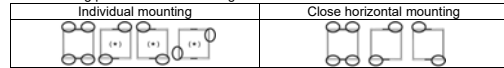
connection, a switch or circuit-breaker shall be included in the installation. This shall be in close proximity to the equipment and within easy reach of the operator. It shall be marked as the disconnecting device for the equipment.

2.2 Dimensions



- Rubber packing (waterproof/dustproof type)
- Terminal cover
- To keep the instrument as waterproof as possible, make sure that the panel surface has no burr or distortion where the hole is to be cut out.
- Remove the gasket. When the SC-F71 is mounted closely protection will be compromised and they will not meet IP65 standards. Panel thickness: 1 to 10 mm (When mounting multiple SC-F71 controllers close together, the panel strength should be checked to ensure proper support.)

The mounting position of the mounting brackets



(*): Not waterproof/dustproof when mounting two SC-F71.

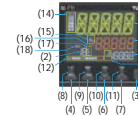
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This symbol is used where the instruction manual needs to be consulted for the safety of both the operator and the equipment. Carefully read the cautions in this manual before using the instrument.

Notice regarding the Export Trade Control Order (Japan)

The intended application and end user should be checked to make sure this product will not be used in weapons of mass destruction, military applications or military equipment etc. Take precautions not to allow this product to be illegally exported, even in the case of reselling or distribution.

1. PARTS DESCRIPTION



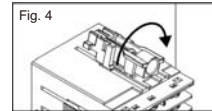
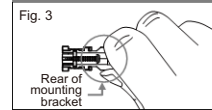
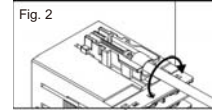
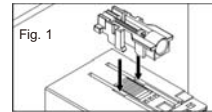
To avoid damage to the instrument, never use a sharp object to press keys.

(1) Measured value (PV) display [Yellow-green]	Displays Measured value (PV) or various parameter symbols.
(2) Memory area display [White]	Displays the memory area No. (1 to 16)
(3) Loader communication connector	Setting and monitoring on a computer (PC) is possible if the controller is connected with a cable to a PC via the USB communication converter COM-KG or COM-K2 (sold separately). The communication software PROTEM™ must be installed on the PC. *Consult TLV ** Download links can be found at tlv.com/
(4) SET key	Used for calling up parameters and set value registration.
(5) Shift key	Shifts digits when settings are changed. Used to switch the modes.
(6) Down key	Decreases numerals.
(7) Up key	Increases numerals.
(8) R SET key	The parameters can be scrolled backwards.
(9) MONI key	Used to switch screens. When the MONI key is pressed while any screen other than Monitor & SV setting mode is displayed, the screen returns the PVS/SV Monitor.
(10) AREA key	When the AREA key is pressed, the screen is switched to the Memory area transfer screen.
(11) FUNC key	The selected function can be assigned to this key ¹⁾ for a direct access to it.
(12) OUT1 to 3 lamp [White]	Lights when Outputs 1 to 3 (OUT1 to 3) ²⁾ are turned on.
DO1 to 4 lamp [White]	Lights when Digital outputs 1 to 4 (DO1 to 4) ²⁾ are turned on.
(12) ALM lamp [Red]	Lights when any of the following occurs. <ul style="list-style-type: none"> Event 1 to 4 Input error ³⁾ of input 1 or 2

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2.3 Mounting and Removal Procedures

- Mounting procedures
 - Prepare the panel cutout as specified in 2.2 Dimensions.
 - Insert the instrument through the panel cutout.
 - Insert the mounting bracket into the mounting groove of the instrument. (Fig. 1) Make sure not to push forward when mounting the bracket.
 - After inserting the mounting bracket, tighten the screw for the mounting bracket with a Phillips screwdriver. (Fig. 2) After inserting the tip of the screwdriver, turn once only.
 - The other mounting bracket(s) should be installed in the same way as described in 3 to 4.
- Removal procedures
 - Turn the power OFF.
 - Remove the wiring.
 - Loosen the screw of the mounting bracket.
 - Remove the mounting bracket by holding it (Fig. 3) and twisting it out from the instrument (Fig. 4).
 - The other mounting bracket(s) should be removed in the same way as described in 3 and 4.
 - Pull out the instrument from the mounting cutout while holding the front panel frame of this instrument.



- Use long-nose pliers to remove the mounting brackets from the instrument that is installed in a narrow space or installed closely to each other in a vertical position.

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(13) Set value (SV) display [Orange]	Displays Set value (SV) or various parameter set values.
(14) MV display lamp [White]	PV1 Lights when the Input 1_Measured value (PV) is displayed on the PV display unit. PV2 Lights when the Input 2_Measured value (PV) is displayed on the PV display unit.
Manual (MAN1) mode lamp [White]	Lights when Input 1 is in Manual (MAN) mode. When lit, the SV display unit shows an Input 1_Manual manipulated output value.
Manual (MAN2) mode lamp [White]	Lights when Input 1 is in Manual (MAN) mode. When lit, the SV display unit shows an Input 1_Manual manipulated output value.
AT1 lamp [White]	Flashes when Autotuning (AT) is activated on Input 1. (After AT is completed: AT lamp will go out) Lights when Startup tuning (ST) is activated on Input 1. (After ST is completed: AT lamp will go out)
AT2 lamp [White]	Flashes when Autotuning (AT) is activated on Input 2. (After AT is completed: AT lamp will go out) Lights when Startup tuning (ST) is activated on Input 2. (After ST is completed: AT lamp will go out)
Remote (REM) mode lamp [White]	Lights in Remote (REM) mode. When lit, the SV display unit shows a remote setting input value.
(15) SV display lamp [White]	Lights when the SV display unit shows a Set value (SV).
PV2 display lamp [White]	PV2 Lights when the Input 2_Measured value (PV) is displayed on the SV display unit.
(16) Set lock display [White]	Lights when the settings are locked.
(17) Displays the ramp status [White]	SV ramp status is displayed; (rise, soak, fall)
(18) AREA display lamp [White]	Lights when Memory area is displayed.
(19) Manipulated output value (MV) display [White]	Displays either manipulated output value (MV) or memory area soak time input values ¹⁾ .
(20) MV display lamp [White]	Lights when Manipulated output value (MV) is displayed on the MV display.
H:M:S display lamp [White]	Lights when time (hour:minute:second) is displayed on the MV display.
CT 1/2 display lamp [White]	Not used (Unit)

¹⁾ Functions are configured in the Engineering mode. Refer to the SC-F71 Instruction Manual [Parameter/Function] (172-65710M) for details.
²⁾ Outputs, such as control output, retransmission output, event output, are assigned to Outputs 1 to 3 (OUT1 to 3) and Digital outputs 1 to 4 (DO1 to 4). (Control output can be assigned to OUT1 to 3 only.) Outputs are assigned in Engineering mode. Refer to the SC-F71 Instruction Manual [Parameter/Function] (172-65710M) for details.
³⁾ Disabled when shipped from factory. Light conditions are configured in the Engineering mode. Refer to the SC-F71 Instruction Manual [Parameter/Function] (172-65710M) for details.

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3. WIRING

WARNING

To prevent electric shock or instrument failure, do not turn on the power until all wiring is completed. Make sure that the wiring is correct before applying power to the instrument.

CAUTION

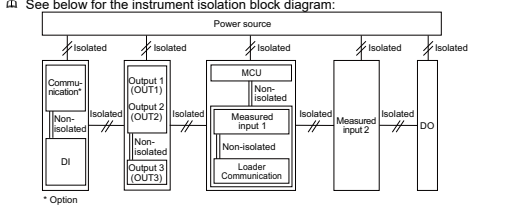
When checking instrument operation after wiring, avoid using CA150 (Yokogawa Electric Corporation) to prevent malfunction due to incorrect operation. If CA150 must be used, turn on the CA150 before connecting to the instrument.

3.1 Wiring Cautions

- For thermocouple input, use the appropriate compensation wire.
- For RTD input, use low resistance lead wire with no difference in resistance between the three lead wires.
- Signal connected to Voltage input and Current input shall be low voltage defined as "SELV" circuit per IEC 60950-1.
- When Measured input 1 or Measured input 2 is used for Current input (including for remote setting input), make sure that the current input value including transient state is within the allowable input range (max. allowable current: 30 mA (max. allowable voltage between terminals: 2 V or less)) described in 4. Specifications. If the current value exceeds the allowable input range, the current sensing components of the controller may be damaged, causing the instrument to break. (In particular, when connecting a current generator/calibrator (specifications vary according to manufacturer) to the controller, make sure that the value is within the allowable input range immediately after sending the current output signal, including transient state).
- To avoid noise induction, keep input signal wire away from instrument power line, load lines and power lines of other electric equipment.
- If there is electrical noise in the vicinity of the instrument that could affect operation, use a noise filter.
 - Shorten the distance between the twisted power supply wire pitches to achieve the most effective noise reduction.
 - Always install the noise filter on a grounded panel. Minimize the wiring distance between the noise filter output and the instrument power supply terminals to achieve the most effective noise reduction.
 - Do not connect fuses or switches to the noise filter output wiring as this will reduce the effectiveness of the noise filter.
- Allow approximately 5 seconds for contact output when the instrument is turned on. Use a delay relay when the output line is used for an external interlock circuit.
- Power supply wiring must be twisted and have a low voltage drop.
- This instrument is not provided with an overcurrent protection device. For safety install an overcurrent protection device (such as a fuse) with adequate breaking capacity close to the instrument.

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- Fuse type: Time-lag fuse (Approved fuse according IEC 60127-2 and/or UL 248-14)
Fuse rating: Rated voltage 250 V AC
Rated current: 1 A (for 100 to 240 V AC type)
- Use the solderless terminal appropriate to the screw size.
Screw size: M3 × 7 (with 5.8 × 5.8 square washer)
Recommended tightening torque: 0.4 N·m
Applicable wire: Solid/twisted wire of 0.25 to 1.65 mm²
Specified dimension: Refer to Fig. at the right
Specified solderless terminal: Circular terminal with isolation V1.25 to M53
Manufactured by J.S.T. MFG CO., LTD.
- Make sure that during field wiring parts of conductors cannot come into contact with adjacent conductive parts.
- ▣ If solderless terminal lugs other than the recommended dimensions are used, terminal screws may not be tightened. In that case, bend each solderless terminal lug before wiring. If the terminal screw is forcibly tightened, it may be damaged.
- ▣ Up to two solderless terminal lugs can be connected to one terminal screw. The requirements of reinforced insulation can be still complied with in this condition. When actually doing this, place one solderless terminal lug over the other as illustrated right.
- ▣ When tightening a screw of the instrument, make sure to fit the screwdriver properly into the screw head mounted tilted or flat as shown in the right figure. Tightening the screw with excessive torque may damage the screw thread.
- ▣ See below for the instrument isolation block diagram:



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Input impedance: 1 MΩ or more (Low/High voltage input),
Approx. 50 Ω (max. allowable voltage: 2 V) (Current input)

RS bias: -Input span to +Input span

RS ratio: 0.001 to 9.999

RS digital filter (First order lag digital filter): 0.0 to 100.0 seconds (0.0: Filter OFF)

Allowable input range: -1.0 to +3.0 V (Low voltage input), -12 to +12 V (High voltage input), -20.0 to +30.0 mA (Current input)

Digital input (DI)

Number of input: MAX. 6 points (DI1 to DI6)

Input method: Dry contact input

OFF (Open state): 50 k or more

ON (Close state): 1 k or less

Contact current: 3.3 mA DC or less

Voltage at open: Approx. 5 V DC

Capture judgment time: Within 200 ms

Output

Relay contact output (DO1, DO2, DO3, DO4):
Contact type: a contact
Contact rating(Resistive load): 250 V AC 1 A, 30 V DC 0.5 A

Electrical life: 150,000 times or more (Rated load)
Mechanical life: 20 million times or more (Switching: 300 times/min)
Proportional cycle time: 0.1 to 100.0 seconds (When configured for control output)

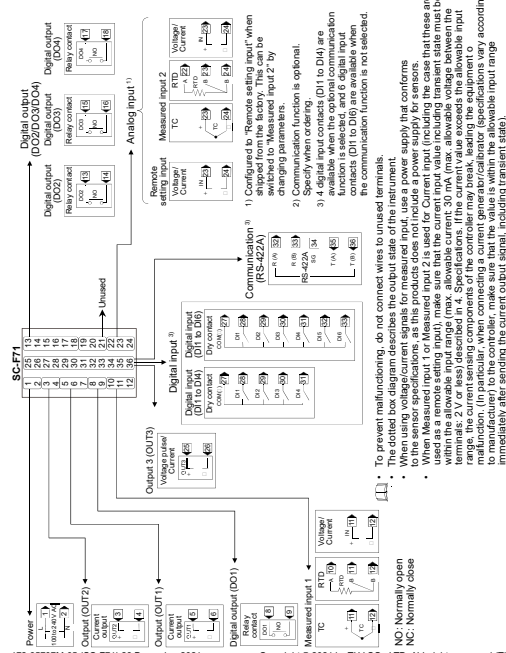
Voltage pulse output [OUT3]:
Output voltage: 0/14 V DC (Rated)
ON voltage: 12 to 17 V, OFF voltage: 0.5 V or less

Allowable load resistance: 600 Ω or more
Proportional cycle time: 0.1 to 100.0 seconds (When configured for control output)

Current output [OUT1, OUT2 and OUT3]:
Output current: 4 to 20 mA DC, 0 to 20 mA DC
Output range: 3.2 to 20.8 mA DC, 0 to 21 mA DC
Allowable load resistance: 500 Ω or more

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3.2 Terminal Configuration



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Communication

Interface: Based on RS-422A, EIA standard

Protocol: Based on the original communication protocol (ANSI X3.28-1976 subcategories 2.5 and A4), Modbus-RTU, PLC communication (MAPMAN)

General specifications

Power supply voltage: 85 to 264 V AC (Including power supply voltage variation) (Rated: 100 to 240 V AC)
Frequency variation: 50/60 Hz (-10 to +5%)

Power consumption: 100 to 240 V AC: 7.4 VA max. (at 100 V AC), 10.9 VA max. (at 240 V AC)

Rush current: 100 to 240 V AC: 5.6 A or less (at 100 V AC), 13.3 A or less (at 240 V AC)

Power failure: A power failure of 20 ms or less will not affect the control action

Memory backup: Backed up by non-volatile memory
Number of writing: Approx. One trillion (10¹²) times (FRAM)
Data storage period: Approx. 10 years

Weight: 300 g

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4. Specifications

Measured input

Number of input: 1 + 1 (Isolated between inputs) (Select function for input 2)
K, J, T, S, R, E, B, N (JIS C1602-1995), P, LI (NBS), W5Re/W26Re (ASTM-E988-96 [Reapproved 2002]), U, L (DIN43710-1985), PR40-20 (ASTM-E1751-00)

TC input: Pt100 (JIS C1604-1997), JPt100 (JIS C1604-1997, Pt100 of JIS C1604-1981)

Low voltage input: 0 to 10 mV DC, 0 to 100 mV DC
High voltage input: 0 to 1 V DC, 0 to 5 V DC, 1 to 5 V DC, 0 to 10 V DC, -5 to +5 V DC, -10 to +10 V DC

Current input: 0 to 20 mA DC, 4 to 20 mA DC

Input accuracy:

Input type	Input range	Accuracy
K, J, T, E, U, L ¹⁾	Less than 100 °C	±1.0 °C (Approximate value)
	+100 °C or more, less than +500 °C	±0.5 °C
	+500 °C or more	±0.2 % of Reading
S, R, N, P, LI, W5Re/W26Re ²⁾	Less than 0 °C	±2.0 °C
	0 °C or more, less than 1000 °C	±1.0 °C
	1000 °C or more	±0.1 % of Reading
B ²⁾	Less than 400 °C	±7.0 % (Approximate value)
	400 °C or more, less than 1000 °C	±1.4 °C
	1000 °C or more	±0.1 % of Reading
PR40-20 ²⁾	Less than 400 °C	±2.0 % (Approximate value)
	400 °C or more, less than 1000 °C	±1.0 °C
	1000 °C or more	±0.1 % of Reading
Pt100, JPt100	Less than 200 °C	±2.0 °C
	200 °C or more	±0.1 % of Reading
Voltage/Current input	0.00 to 50.00 °C	±0.1 % of span

The display accuracy is the above accuracy rounded up at the minimum resolution.
¹⁾ Accuracy is not guaranteed for less than -100 °C.
²⁾ Accuracy is not guaranteed for less than 400 °C for TC input type S, R, W5Re/W26Re B and PR40-20.

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Sampling cycle: 0.05 seconds
When Input 2 is configured for 2-loop control or cascade control: 0.1 seconds

Influence of signal source resistance (TC input): Approx. 0.18 μV/Ω (Converted depending on TC types)

Influence of input lead (RTD input): Approx. 0.006%/Ω of span (100 Ω or less per wire) If the resistance is 100 Ω or more, the measuring range may be limited.

Input impedance (Voltage/Current input): 1 MΩ or more (Low/High voltage input), Approx. 50 Ω (max. allowable voltage: 2 V) (Current input)

Measured current (RTD input): Approx. 1 mA

Action at input break: TC input and Low voltage input: Upscale or Downscale (selectable)
RTD input: Upscale
High voltage input and Current input: Downscale (Indicates value near 0)

Action at input short circuit: Downscale (RTD input: except 0.00 to 50.00 C range)
Upscale (RTD input: 0.00 to 50.00)

PV bias: -Input span to +Input span

PV ratio: 0.0 to 1.500

PV digital filter (First order lag digital filter): 0.0 to 100.0 seconds (0.0: Filter OFF)

Square root extraction function: Calculation method: Measured value = √(Input value) × (PV Ratio) + (PV Bias) (Voltage/Current input): PV low input cut-off: 0.00 to 25.00% of input span

Allowable input range: -1.0 to +3.0 V (TC/RTD/Low voltage input)
-12 to +12 V (High voltage input),
-20.0 to +30.0 mA (Current input)

Remote setting input

Number of input: 1 point (Isolated from PV)

Low voltage input: 0 to 10 mV DC, 0 to 100 mV DC
High voltage input: 0 to 1 V DC, 0 to 5 V DC, 1 to 5 V DC, 0 to 10 V DC, -5 to +5 V DC, -10 to +10 V DC

Current input: 0 to 20 mA DC, 4 to 20 mA DC

Input range: Programmable range

Sampling cycle: 0.05 seconds

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TLV EXPRESS LIMITED WARRANTY

Subject to the limitations set forth below, TLV CO., LTD., a Japanese corporation ("TLV"), warrants that products which are sold by it, TLV International Inc. ("TII") or one of its group companies excluding TLV Corporation (a corporation of the United States of America), (hereinafter the "Products") are designed and manufactured by TLV to conform to the specifications published by TLV for the corresponding part numbers (the "Specifications") and are free from defective workmanship and materials. The party from whom the Products were purchased shall be known hereinafter as the "Seller". With regard to products or components manufactured by unrelated third parties (the "Components"), TLV provides no warranty other than the warranty from the third party manufacturer(s), if any.

Exceptions to Warranty

This warranty does not cover defects or failures caused by:

1. improper shipping, installation, use, handling, etc., by persons other than TLV, TII or TLV group company personnel, or service representatives authorized by TLV; or
2. dirt, scale or rust, etc.; or
3. improper disassembly and reassembly, or inadequate inspection and maintenance by persons other than TLV or TLV group company personnel, or service representatives authorized by TLV; or
4. disasters or forces of nature or Acts of God; or
5. abuse, abnormal use, accidents or any other cause beyond the control of TLV, TII or TLV group companies; or
6. improper storage, maintenance or repair; or
7. operation of the Products not in accordance with instructions issued with the Products or with accepted industry practices; or
8. use for a purpose or in a manner for which the Products were not intended; or
9. use of the Products in a manner inconsistent with the Specifications; or
10. use of the Products with Hazardous Fluids (fluids other than steam, air, water, nitrogen, carbon dioxide and inert gases (helium, neon, argon, xenon and radon)), or
11. failure to follow the instructions contained in the TLV Instruction Manual for the Product.

Duration of Warranty

This warranty is effective for a period of one (1) year after delivery of Products to the first end user. Notwithstanding the foregoing, asserting a claim under this warranty must be brought within three (3) years after the date of delivery to the initial buyer if not sold initially to the first end user.

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