

FM Limit Controller

E5CN-FR

Protect your operators, minimize scrap, and prevent damage to your equipment by implementing an easy to use limit controller that provides a fail-safe shutoff when the process variable (PV) exceeds or falls below the set point (SP).

- Connect to either of three options with the same model: Infrared temperature sensor, thermocouple, or platinum resistance thermometer.
- Reset limit outputs using event inputs (models that support event inputs).
- Communications functions are now provided for Modbus (RTU) or CompoWay/F communications protocols (models with communications functions).
- Water-resistant construction (NEMA4X for indoor use, equivalent to IP66).
- Conforms to FM (Factory Mutual) standards (FM3545/3810).
- Conforms to international standards including UL, CSA, and IEC safety standards and EMC.
- Easily see the status from a distance with PV display with two-color switching function.
- On-board power supply option is available for ES1B Infrared Thermosensor.

Note: Refer to *Precautions* on page 13.



Features

Complete FM Limit Controller Functionality

Trace Error Status

Check the maximum temperature during an error and the time lapsed since the error occurred using the "limit over continuation time" and "limit over max./min. value" measuring functions.

New Annunciator Output Warning Function

Hazard lights and buzzers on the devices alert the user of errors when limit over errors occur.

Reset Limit Outputs Using Event Inputs (Models with Event Inputs)

Limit outputs can be reset using event inputs, enabling multiple limit outputs to be reset altogether from a distance.

Input Error Output Function

Alarm signals are output if a sensor disconnection or other input error occurs, enabling application in equipment and facilities requiring safety design.

Basic Performance and Functionality as Easy as Temperature Controllers

Make Settings Easily with 11-segment Displays

The E5CN-FR uses an 11-segment display, the same as the E5CN. The alphabet is clearly displayed, eliminating the need to make parameter settings while having to decipher symbols, which was an inconvenience of previous general-purpose temperature controllers.

Easily Check Error Status Using the Two-color Switching Display

The PV display switches colors to enable status to be easily checked from a distance.

Multiple Inputs with a Single Controller

A single Controller supports both thermocouple and platinum-resistance thermometer inputs, eliminating the need to select models depending on the input. This contributes toward reducing the number of service parts required as well as decreasing inventory levels.

Model Number Structure

Model Number Legend

E5CN-FR **MT-500**
 1 2 3 4

1. **Output type**
FR: FM Limit output
2. **Number of alarms**
Blank: No alarm
2: Two alarms
3. **Option Unit**
M: Option Unit can be mounted
4. **Input type**
T: Thermocouple/platinum resistance thermometer (multi-input)

E53-CN **N**
 1

1. **Functions**
03: Communications
B: Two Event inputs
PB: Power supply and two event inputs
- Note:** Other Option Boards are not supported.

This data sheet is provided as a guideline for selecting products. Be sure to refer to the following user manuals for application precautions and other information required for operation before attempting to use the product.
 E5CN-FR Temperature Controller User's Manual (Cat. No. H133)

Ordering Information

Stock Note: Shaded models are normally stocked.

FM Limit Controllers with Temperature Sensor Inputs

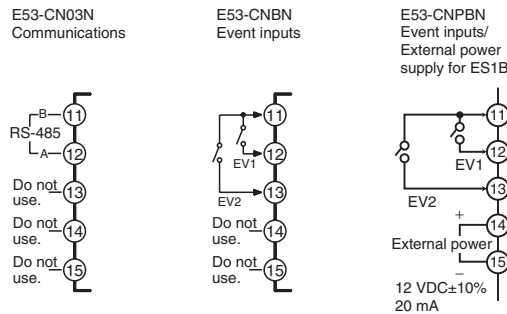
Size	Power supply voltage	Number of alarm points	Control outputs	Model
1/16 DIN 48 × 48 × 78 (W × H × D)	100 to 240 VAC	0	Limit output	E5CN-FRMT-500
		2	Limit output	E5CN-FR2MT-500

Option Units

The E5CN-FR provides optional functionality when one of the following Option Units is mounted.

Functions	Model
Communications	E53-CN03N
Two event inputs	E53-CNBN
Two event inputs External power supply for ES1B	E53-CNPBN

Note: These Option Units can be used for the new E5CN models/E5CN-FR models only.



Attach the appropriate terminal labels.

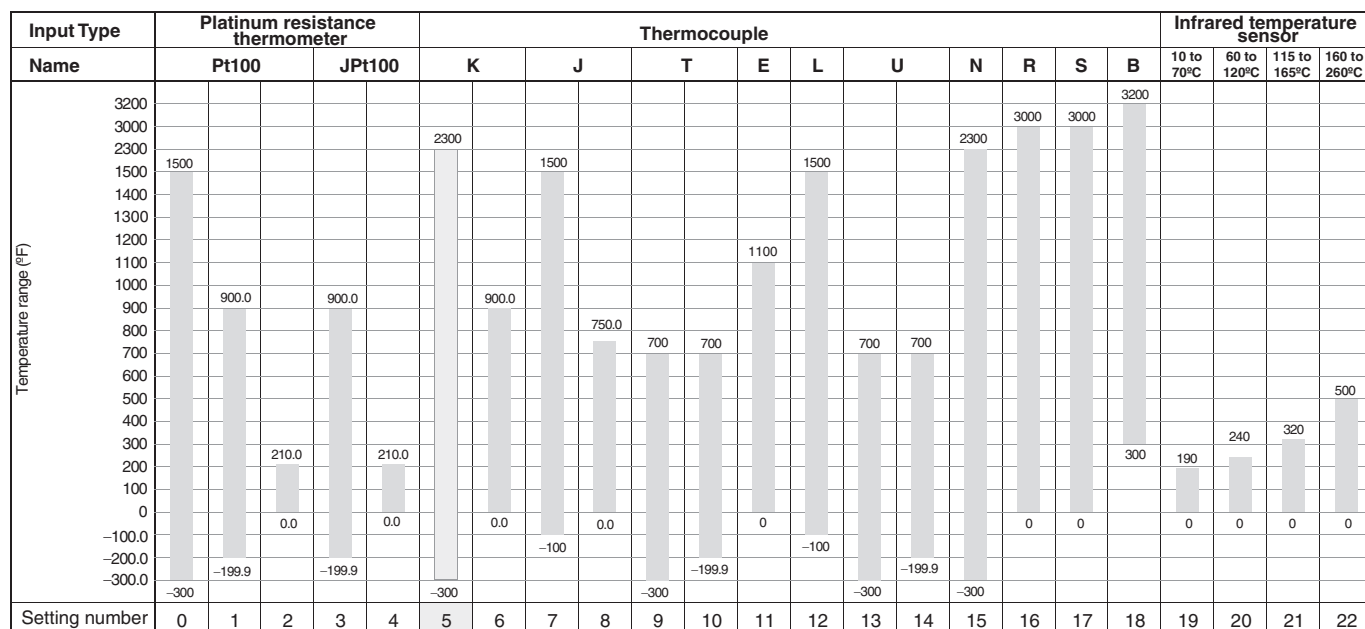
Specifications

■ Ratings

Item	Power supply voltage	100 to 240 VAC, 50/60 Hz
Operating voltage range	85% to 110% of rated supply voltage	
Power consumption	7.5 VA max.	
Sensor input	Models with temperature inputs Thermocouple: K, J, T, E, L, U, N, R, S, or B Platinum resistance thermometer: Pt100 or JPt100 Infrared temperature sensor: 10 to 70°C, 60 to 120°C, 115 to 165°C, or 160 to 260°C	
Control output	FM Limit output relay	SPST-NO, 250 VAC, 3 A (resistive load), electrical life: 100,000 operations, minimum applicable load: 5 V, 10 mA
Alarm output		SPST-NO, 250 VAC, 1 A (resistive load), electrical life: 100,000 operations, minimum applicable load: 1 V, 1 mA
Event input	Contact input	ON: 1 kΩ max., OFF: 100 kΩ min.
	Non-contact input	ON: Residual voltage: 1.5 V max., OFF: Leakage current: 0.1 mA max.
		Outflow current: Approx. 7 mA per point
External power supply for ES1B	12 VDC ±10%, 20 mA, Short-circuit protection provided.	
Setting method	Digital setting using front panel keys	
Indication method	11-segment digital display and individual indicators Character height: PV: 11 mm, SV: 6.5 mm	
Other functions	<ul style="list-style-type: none"> • Limit over continuation time measurement function • Limit over max./min. value measurement function • Annunciator output • Input error output • PV display two-color switching function • Input digital filter • Input compensation • Protection functions 	
Ambient operating temperature	-10 to 55°C (with no icing or condensation), for 3-year warranty: -10 to 50°C	
Ambient operating humidity	25% to 85%	
Storage temperature	-25 to 65°C (with no icing or condensation)	

■ Input Ranges

Thermocouples/Platinum Resistance Thermometers



The applicable standards for the input types are as follows:
K, J, T, E, N, R, S, B: IEC584-1
L: Fe-CuNi, DIN 43710-1985

U: Cu-CuNi, DIN 43710-1985
Pt100: IEC 751

Shaded settings are the default settings.

Sold by AA Electric 1-800-237-8274 Lakeland, FL • Lawrenceville, GA • East Rutherford, NJ www.aaelectriconline.com

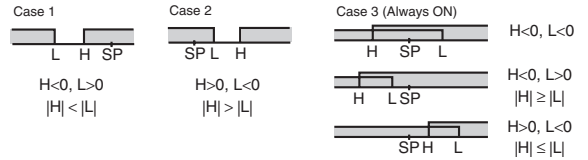
Alarm Types

Select alarm types out of the 12 alarm types listed in the following table.

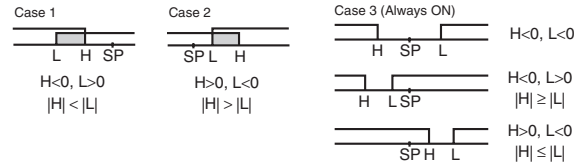
Set value	Alarm type	Alarm output operation	
		When X is positive	When X is negative
0	Alarm function OFF	Output OFF	
1 (See note 1.)	Upper- and lower-limit (deviation)		(See note 2.)
2	Upper limit (deviation)		
3	Lower limit (deviation)		
4 (See note 1.)	Upper- and lower-limit range (deviation)		(See note 3.)
5 (See note 1.)	Upper- and lower-limit with standby sequence (deviation)		(See note 4.)
6	Upper-limit with standby sequence (deviation)		
7	Lower-limit with standby sequence (deviation)		
8	Absolute-value upper-limit		
9	Absolute-value lower-limit		
10	Absolute-value upper-limit with standby sequence		
11	Absolute-value lower-limit with standby sequence		
12 (See note 6.)	Annunciator output	---	

Note: 1. With set values 1, 4 and 5, the upper and lower limit values can be set independently for each alarm type, and are expressed as "L" and "H."

2. Set value: 1, Upper- and lower-limit alarm



3. Set value: 4, Upper- and lower-limit range

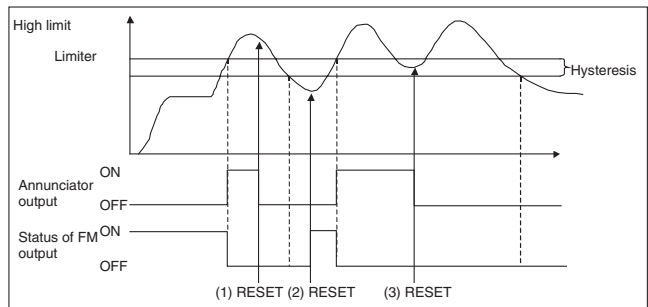


4. Set value: 5, Upper- and lower-limit with standby sequence For Upper- and Lower-Limit Alarm Described Above

- Case 1 and 2
Always OFF when the upper-limit and lower-limit hysteresis overlaps.
- Case 3: Always OFF

5. Set value: 5, Upper- and lower-limit with standby sequence Always OFF when the upper-limit and lower-limit hysteresis overlaps.

6. The annunciator output turns ON to inform users when a limit over occurs. This function is enabled by selecting 12 (annunciator output) for alarm 1 type. The annunciator output turns ON when a limit over occurs, and turns OFF for the RESET operation.



Set the alarm types for alarms 1 and 2 independently in the initial setting level. The default setting is 12 (annunciator) for alarm 1 type and 2 (upper limit) for alarm 2 type.

■ Characteristics

Indication accuracy	Thermocouple: (See note 1.) (±0.5% of indicated value or ±1°C, whichever is greater) ±1 digit max. Platinum resistance thermometer: (±0.5% of indicated value or ±1°C, whichever is greater) ±1 digit max.	
Hysteresis	0.1°C (°F) to 999.9°C (°F) in units of 0.1°C (°F)	
Alarm setting range	-1999 to 9999 (decimal point position depends on input type)	
Sampling period	250 ms	
Affect of signal source resistance	Thermocouple: 0.1°C/Ω max. (100 Ω max.) (See note 4.) Platinum resistance thermometer: 0.4°C/Ω max. (10 Ω max.)	
Insulation resistance	20 MΩ min. (at 500 VDC)	
Dielectric strength	2,000 VAC, 50 or 60 Hz for 1 min (between terminals with different charge)	
Vibration resistance	Malfunction	10 to 55 Hz, 20 m/s ² for 10 min each in X, Y, and Z directions
	Destruction	10 to 55 Hz, 0.75-mm single amplitude for 2 hrs each in X, Y, and Z directions
Shock resistance	Malfunction	100 m/s ² min., 3 times each in X, Y, and Z directions
	Destruction	300 m/s ² min., 3 times each in X, Y, and Z directions
Weight	Controller: Approx. 150 g, Mounting Bracket: Approx. 10 g	
Degree of protection	Front panel: NEMA4X for indoor use (equivalent to IP66) Rear case: IP20, Terminal section: IP00	
Memory protection	Non-volatile memory (number of writes: 1,000,000 operations)	
EMC	Emission Enclosure: EN55011 Group1 ClassA Emission AC Mains: EN55011 Group1 ClassA Immunity ESD: EN61000-4-2 4 kV contact discharge (level 2) 8 kV air discharge (level 3) Immunity RF-interference: EN61000-4-3 10 V/m (80-1000 MHz, 1.4-2.0 GHz amplitude modulated) (level 3) 10 V/m (900 MHz pulse modulated) Immunity Conducted Disturbance: EN61000-4-6 3 V (0.15 to 80 MHz) (level 2) Immunity Burst: EN61000-4-4 2 kV Power-line (level 3) 1 kV I/O signal-line (level 3) Immunity Surge: EN61000-4-5 1kV line to line Power line, output line (relay output) 2 kV line to ground Power line, output line (relay output) 1 kV line to ground Input line (communication) Immunity Voltage Dip/Interrupting: EN61000-4-11 0.5 cycle, 100% (rated voltage)	
Approved standards	FM-3545/3810 UL 61010C-1 CSA C22.2 No.1010.1	
Conformed standards	EN61326, EN61010-1, IEC61010-1 VDE0106 Part 100 (Finger protection), when the terminal cover is mounted.	

Note: 1. The indication of K thermocouples in the -200 to 1300°C range, T and N thermocouples at a temperature of -100°C max., and U and L thermocouples at any temperature is ±2°C ±1 digit maximum. The indication accuracy of the B thermocouple at a temperature of 400°C max. is not specified. The indication accuracy of the R and S thermocouples at a temperature of 200°C max. is ±3°C ±1 digit max.

2. B, R, and S sensors: 0.2°C/Ω max. (100 Ω max.)

■ Communications Specifications

Transmission line connection method	RS-485 multipoint
Communications	RS-485 (two-wire, half duplex)
Synchronization method	Start-stop synchronization
Baud rate	1200, 2400, 4800, 9600, 19200, or 38400 bps
Transmission code	ASCII
Data bit length	7 or 8 bits
Stop bit length	1 or 2 bits
Error detection	Vertical parity (none, even, odd) Block check character (BCC) with CompoWay/F or CRC-16 Modbus
Flow control	None
Interface	RS-485
Retry function	None
Communications buffer	40 bytes
Communications response wait time	0 to 99 ms Default: 20 ms

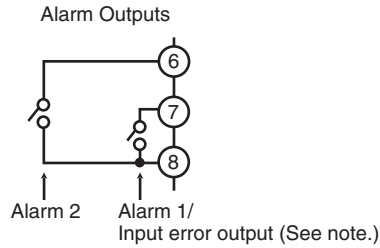
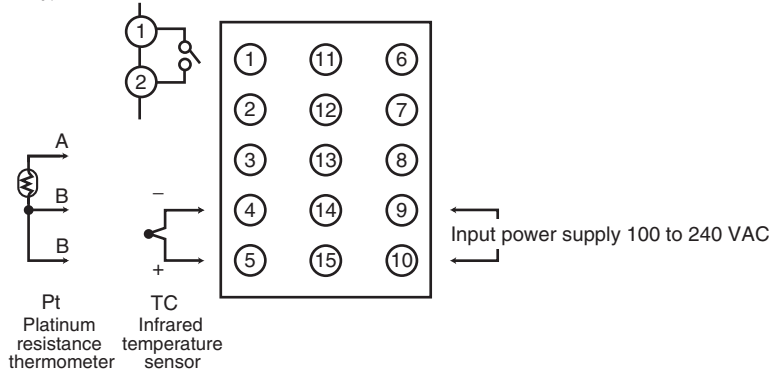
Note: The baud rate, data bit length, stop bit length, and vertical parity can be individually set using the Communications Setting Level.

External Connections

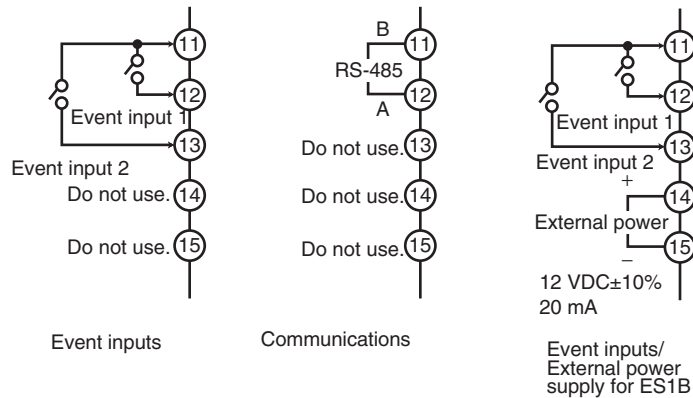
- Standard insulation is applied between any of the following: power supply terminals, input terminals, output terminals, and communications terminals (for models with communications). If reinforced insulation is required, provide additional insulation, such as spacial distance or material insulation, as defined by IEC 60664 suitable for the maximum operating voltage.
- Consult with your OMRON representative before using the external power supply for the ES1B for any other purpose.

E5CN-FR

Limit Output (Relay)

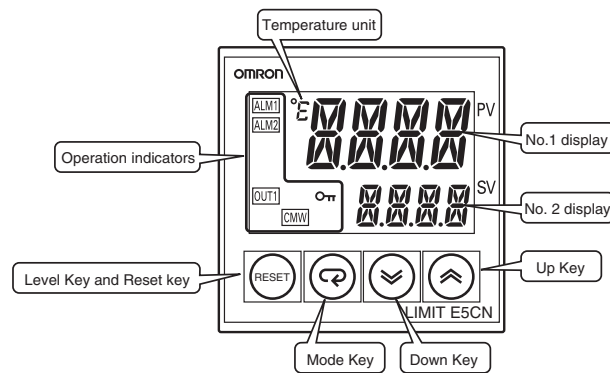


Note: Output when an input error output is enabled in the Advance Function Setting Level. If an input error output is enabled, the *ALM* operation indication on the front panel will not light and *5.ERR* will be displayed on the No. 1 display.



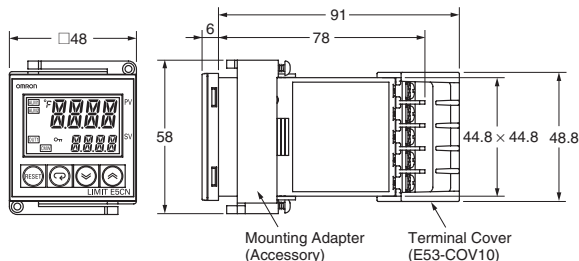
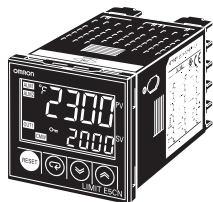
Nomenclature

E5CN-FR



Dimensions

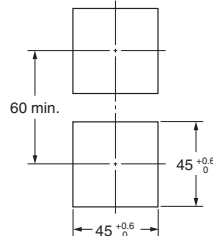
E5CN -FR Terminal Models



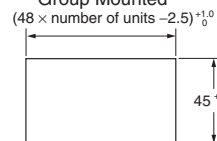
Note: The terminal block cannot be removed. The suffix “-500” is added to the model number of each Controller provided with a E53-COV10 Terminal Cover.

Panel Cutout

Mounted Separately



Group Mounted

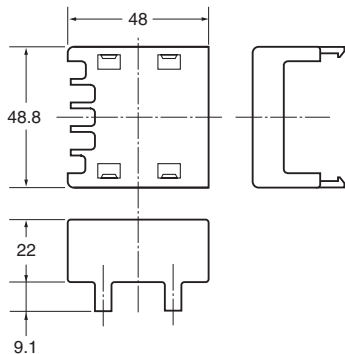
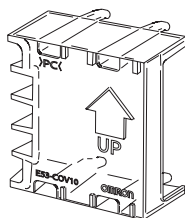


- Recommended panel thickness is 1 to 5 mm.
- Group mounting is not possible in the vertical direction. (Maintain the specified mounting space between Controllers.)
- To mount the Controller so that it is waterproof, insert the waterproof packing onto the Controller.
- When two or more Controllers are mounted, make sure that the surrounding temperature does not exceed the allowable operating temperature specified in the specifications.

Accessories

Terminal Cover

E53-COV10

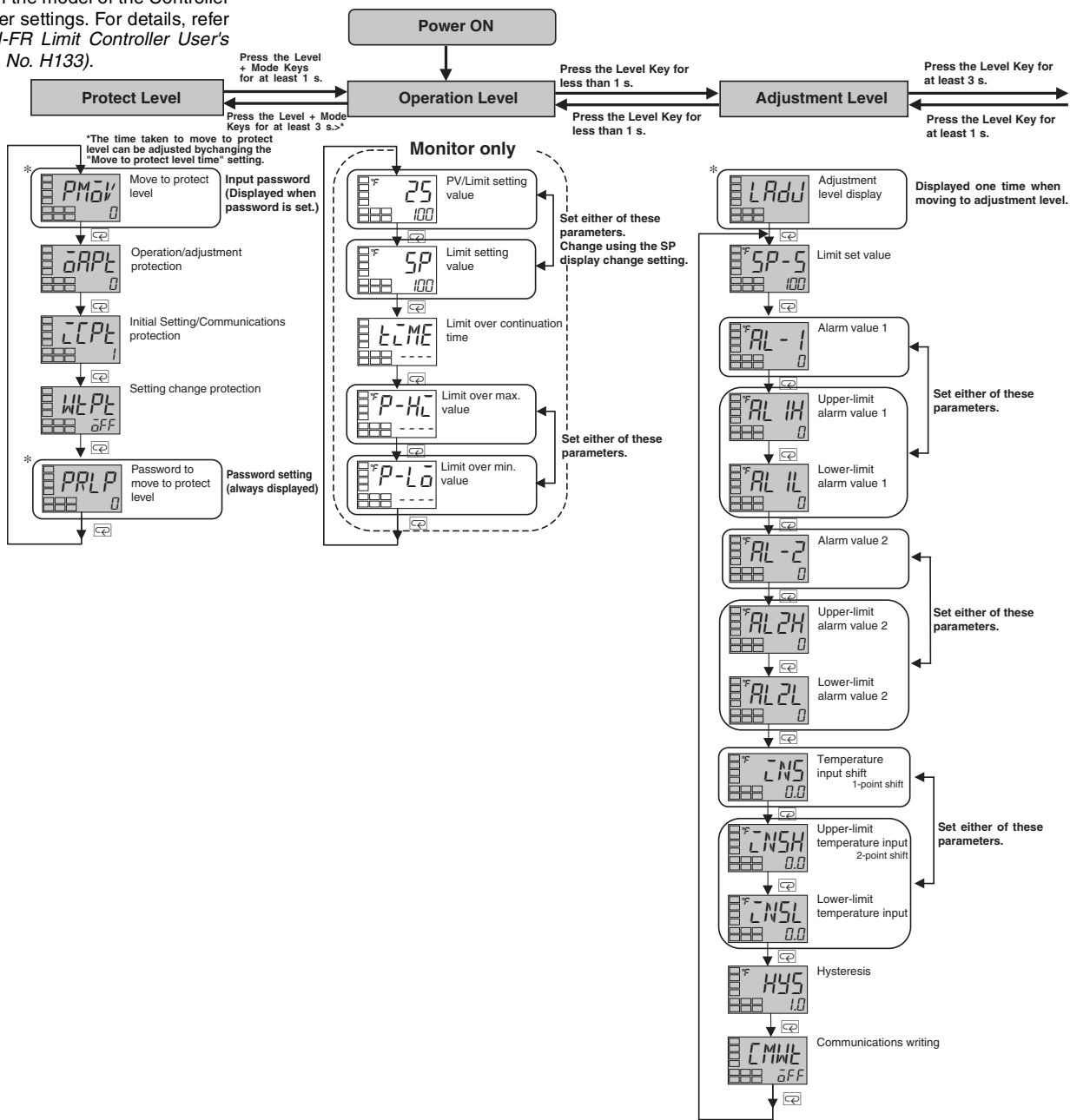


Note: The suffix “-500” is added to the model number of each Controller provided with a E53-COV10 Terminal Cover.

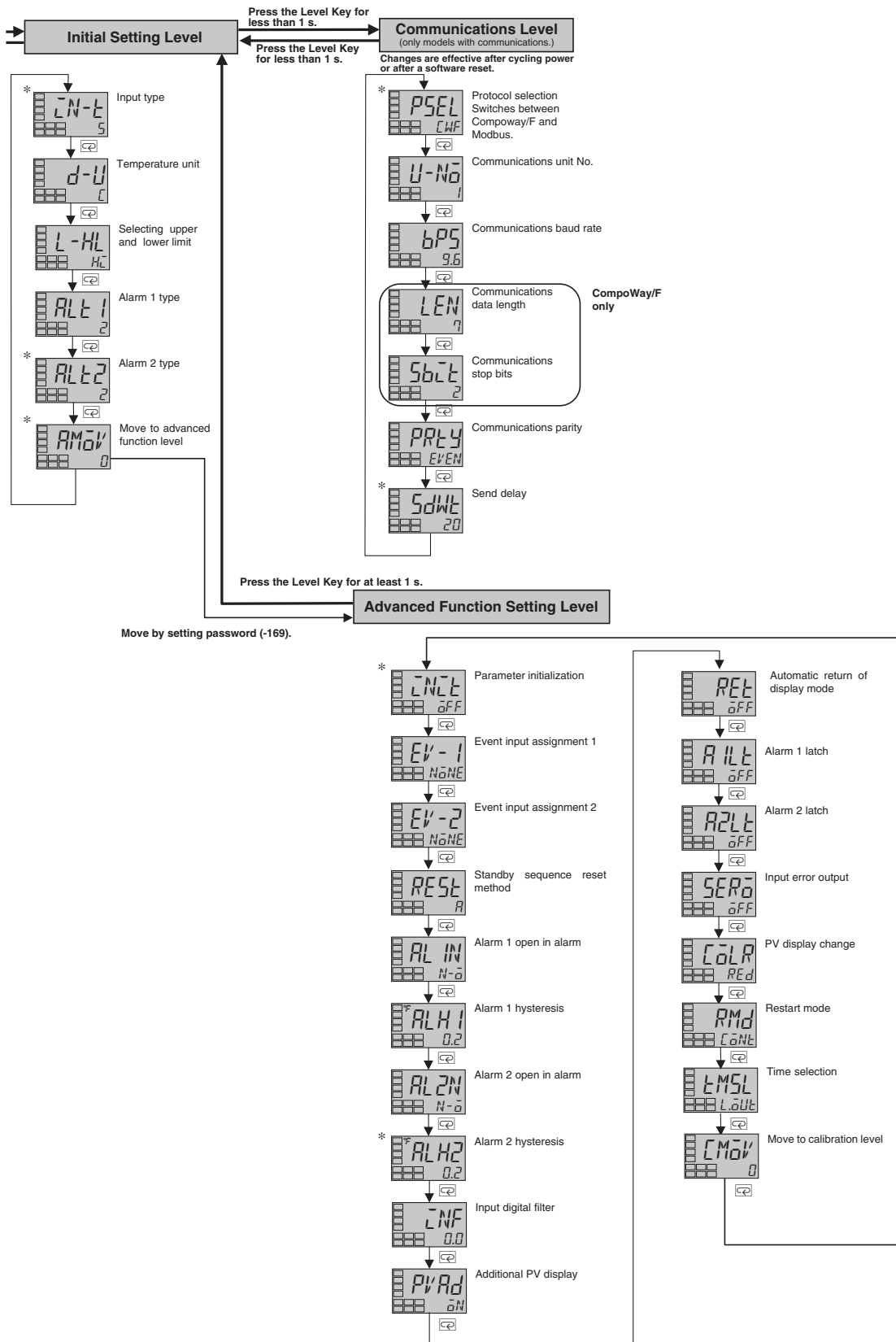
Sold by AA Electric 1-800-237-8274 Lakeland, FL • Lawrenceville, GA • East Rutherford, NJ www.aaelectriconline.com

Parameters

Some parameters are not displayed depending on the model of the Controller and parameter settings. For details, refer to the *E5CN-FR Limit Controller User's Manual (Cat. No. H133)*.

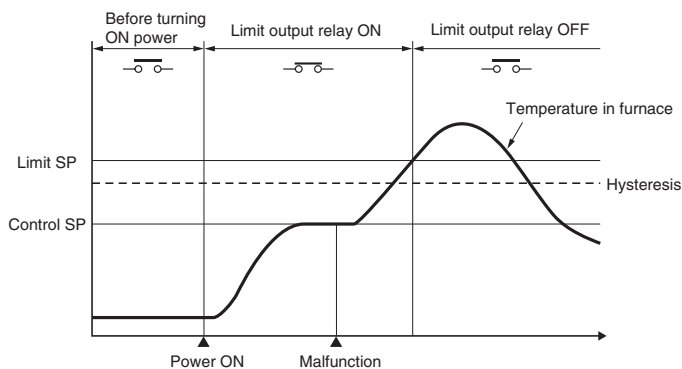


Sold by AA Electric 1-800-237-8274 Lakeland, FL • Lawrenceville, GA • East Rutherford, NJ www.aaelectriconline.com



FM Limit Controller Functions

When the measured temperature (PV) exceeds the limit SP, the limit output relay turns OFF and the OUT1 operation indicator turns ON. If the limit output relay turns OFF (limit alarm is ON), the limit output relay will remain off until the operator manually resets the FM Limit Controller.



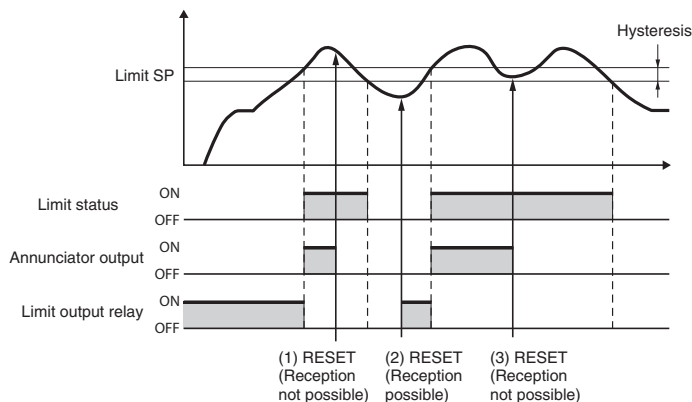
■ Selecting Upper/Lower Limit

- The upper/lower limit selection setting enables switching between upper limit and lower limit operation.
- The default setting is for upper limit operation.

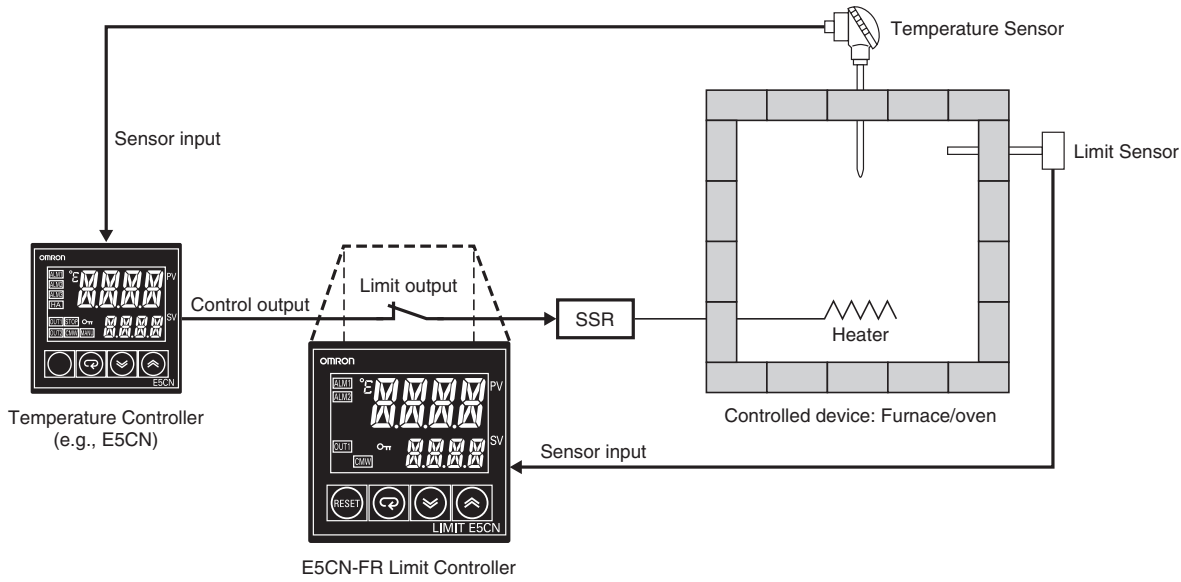
Select either upper limit or lower limit.

■ Resetting Limit Outputs

- Limit outputs can be reset by pressing the Level Key/Reset Key for 1 second min. while in the operation level.
- The limit output reset operation can be used to reset limit outputs and annunciator outputs.
- * When the limit status is OFF, the limit output is cleared and the limit output relay turns ON. When the limit status is ON (limit over status), limit outputs will not be reset.
- * The annunciator output turns OFF regardless of the limit status.
- * Event inputs used as reset inputs (for resetting limit outputs) can be received while in the operation level, adjustment level, or protect level.



■ Example of Typical Use



Application examples are for reference only. In actual application, confirm the functionality and safety of all equipment in advance. In particular, when considering an application requiring a high degree of safety, take into account all ratings, performance capacities, failsafe measures, and other safety measures required by the application, and consult with your OMRON representative to confirm specifications and capabilities.

Sold by AA Electric 1-800-237-8274 Lakeland, FL • Lawrenceville, GA • East Rutherford, NJ www.aaelectriconline.com

Precautions

⚠ CAUTION

Do not touch the terminals while power is being supplied. Doing so may occasionally result in minor injury due to electric shock.



Do not allow pieces of metal, wire clippings, or fine metallic shavings or filings from installation to enter the product. Doing so may occasionally result in electric shock, fire, or malfunction.



Do not use the product where subject to flammable or explosive gas. Otherwise, minor injury from explosion may occasionally occur.



Never disassemble, modify, or repair the product or touch any of the internal parts. Minor electric shock, fire, or malfunction may occasionally occur.



Caution: Risk of Fire and Electric Shock

- This product is UL listed as Open Type Process Control Equipment. It must be mounted in an enclosure that does not allow fire to escape externally.
- More than one disconnect switch may be required to de-energize the equipment before servicing.
- Signal inputs are SELV, limited energy.
- Caution: To reduce the risk of fire or electric shock, do not interconnect the outputs of different Class 2 circuits.



If the output relays are used past their rated load or life expectancy, contact fusing or burning may occasionally occur. Always consider the application conditions and the inrush current, and use the output relays within their rated load and electrical life expectancy. The life expectancy of output relays varies considerably with the output load and switching conditions.



Tighten the terminal screws to between 0.74 and 0.9 N·m. Loose screws may occasionally result in fire.



Set the parameters of the product so that they are suitable for the system. If they are not suitable, unexpected operation may occasionally result in property damage or accidents.



Warning: To reduce the risk of electric shock or fire, install in a Pollution Degree 2 environment (a controlled environment relatively free of contaminants).



A malfunction in the product may occasionally make control operations impossible or prevent alarm outputs, resulting in property damage to connected equipment and machinery. To maintain safety in the event of malfunction of the product, periodically check the Limit Controller's operation.



Precautions for Safe Use

- Do not use this product in the following places:
 - Places directly subject to heat radiated from heating equipment.
 - Places subject to splashing liquid or oil atmosphere.
 - Places subject to direct sunlight.
 - Places subject to dust or corrosive gas (in particular, sulfide gas and ammonia gas).
 - Places subject to intense temperature change.
 - Places subject to icing and condensation.
 - Places subject to vibration and large shocks.
- Use and store within the rated temperature and humidity ranges. Provide forced-cooling if required.
- To allow heat to escape, do not block the area around the product. Do not block the ventilation holes on the product.
- Be sure to wire properly with correct polarity of terminals.
- Use specified size (M3.5, width 7.2 mm or less) crimped terminals for wiring. Use wires with a gage of AWG24 to AWG14 (equal to cross-sectional areas of 0.205 to 2.081 mm²). (The stripping length is 5 to 6 mm.)
- Do not wire the terminals that are not used.
- Allow as much space as possible between the product and devices that generate a powerful high-frequency or surge. Separate the high-voltage or large-current power lines from other lines, and avoid parallel or common wiring with the power lines when you are wiring to the terminals.
- Use this product within the rated load and power supply.
- Make sure that the rated voltage is attained within two seconds of turning the power ON.
- Make sure the product has 30 minutes or more for warm up.
- A switch or circuit breaker must be provided close to the product. The switch or circuit breaker must be within easy reach of the operator, and must be marked as a disconnecting means for this unit.
- Always turn OFF the power supply before pulling out the interior of the product, and never touch nor apply shock to the terminals or electronic components. When inserting the interior of the product, do not allow the electronic components to touch the case.
- Do not use paint thinner or similar chemical to clean with. Use standard grade alcohol.
- Design the system (e.g., control panel) considering the 2 seconds of delay that the product's output to be set after power ON.
- The output may turn OFF when shifting to certain levels. Take this into consideration when performing control.
- Refer to the instruction sheet for installing Option Unit (E53-CN03N/E53-CNBN/E53-CNPBN).

Precautions for Correct Use

Service Life

- Use the Limit Controller within the following temperature and humidity ranges:
 Temperature: -10 to 55°C (with no icing or condensation)
 Humidity: 25% to 85%
 If the Controller is installed inside a control board, the ambient temperature must be kept to under 55°C, including the temperature around the Controller.
- The service life of electronic devices like Limit Controllers is determined not only by the number of times the relay is switched but also by the service life of internal electronic components. Component service life is affected by the ambient temperature: the higher the temperature, the shorter the service life and, the lower the temperature, the longer the service life. Therefore, the service life can be extended by lowering the temperature of the Limit Controller.
- When two or more Limit Controllers are mounted horizontally close to each other or vertically next to one another, the internal temperature will increase due to heat radiated by the Limit Controllers and the service life will decrease. In such a case, use forced cooling by fans or other means of air ventilation to cool down the Limit Controllers. When providing forced cooling, however, be careful not to cool down the terminals sections alone to avoid measurement errors.

Measurement Accuracy

- When extending or connecting the thermocouple lead wire, be sure to use compensating wires that match the thermocouple types.
- When extending or connecting the lead wire of the platinum resistance thermometer, be sure to use wires that have low resistance and keep the resistance of the three lead wires the same.
- Mount the Limit Controller so that it is horizontally level.
- If the measurement accuracy is low, check to see if input shift has been set correctly.

Waterproofing

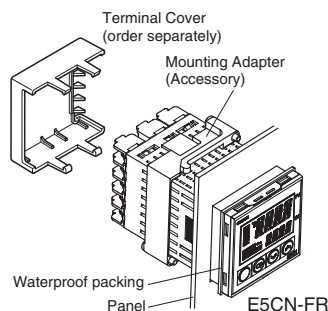
The degree of protection is as shown below. Sections without any specification on their degree of protection or those with IP□□ are not waterproof.

Front panel: NEMA4X for indoor use (equivalent to IP66)
 Rear case: IP20, Terminal section: IP00

Operating Precautions

- It takes approximately two seconds for the outputs to turn ON from after the power supply is turned ON. Due consideration must be given to this time when incorporating Limit Controllers in a sequence circuit.
- Avoid using the Controller in places near a radio, television set, or wireless installing. These devices can cause radio disturbances which adversely affect the performance of the Controller.

Mounting



Mounting to a Panel

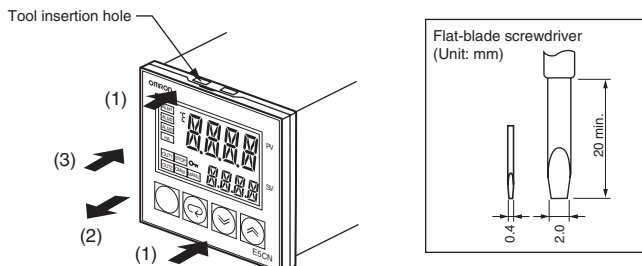
- To mount the Controller so that it is waterproof, insert the waterproof packing onto the Controller. Group mounting does not allow waterproofing. The waterproof packing is not required if waterproof is not necessary.
- Insert the E5CN-FR into the mounting hole in the panel.
- Push the adapter along the Controller body from the terminals up to the panel, and fasten it temporarily.
- Tighten the two fixing screws on the adapter. Alternately tighten the two screws a little at a time to keep them balanced. Tighten them to a torque of 0.29 to 0.39 N·m.

Attaching the Terminal Cover

Make sure that the "UP" letters on the E5CN-FR are at the top and insert the terminal cover into the holes at the top and bottom of the Controller.

Removing the Controller from the Case

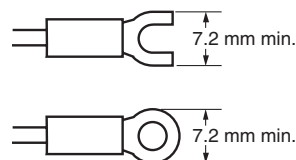
When carrying out maintenance on the Controller, the Controller can be removed from the case leaving the terminal leads attached. The Controller can be removed from the case only with the E5CN-FR.



- Insert the tool into the slots (one on the top and one on the bottom) and release the hooks.
- Insert the tool into the gap between the front panel and rear case and pull out the front panel slightly. Hold both sides of the front panel and draw out the Controller towards you. Do not apply unnecessary force.
- Before inserting the Controller, confirm that the sealing rubber is in place. Insert the Controller into the rear case until you hear a click. Press on the hooks on the top and bottom of the rear case to be sure that the hooks are securely locked in place. Be sure that electronic parts do not come in contact with the case.

Wiring Precautions

- Separate input leads and power lines to protect the Controller and its lines from external noise.
- Use wires of a thickness of AWG24 (0.205 mm²) to AWG14 (2.081 mm²). The exposed current-carrying part to be inserted into terminals must be 5 to 6 mm.
- We recommend using crimp terminals when wiring the terminals.
- Tighten terminal screws to a torque of 0.74 to 0.90 N·m.
- Use the following type of crimp terminals for M3.5 screws.



Related Product Information

■ Please use these products in combination with the FM Limit Controller.

Digital Temperature Controller E5CN/E5CN-U



This Best-selling General-purpose 48 × 48-mm Temperature Controller Is Now Better. USB-Serial Conversion Cable and Support Software Are Also Available.

Infrared Thermosensor ES1B



Achieve Low-cost Measurements with an Infrared Thermosensor.

Certain Terms and Conditions of Sale

1. **Offer; Acceptance.** These terms and conditions (these "Terms") are deemed part of all catalogs, manuals or other documents, whether electronic or in writing, relating to the sale of goods or services (collectively, the "Goods") by Omron Electronics LLC and its subsidiary companies ("Seller"). Seller hereby objects to any terms or conditions proposed in Buyer's purchase order or other documents which are inconsistent with, or in addition to, these Terms. Please contact your Omron representative to confirm any additional terms for sales from your Omron company.
2. **Prices.** All prices stated are current, subject to change without notice by Seller. Buyer agrees to pay the price in effect at time of shipment.
3. **Discounts.** Cash discounts, if any, will apply only on the net amount of invoices sent to Buyer after deducting transportation charges, taxes and duties, and will be allowed only if (i) the invoice is paid according to Seller's payment terms and (ii) Buyer has no past due amounts owing to Seller.
4. **Orders.** Seller will accept no order less than \$200 net billing.
5. **Governmental Approvals.** Buyer shall be responsible for, and shall bear all costs involved in, obtaining any government approvals required for the importation or sale of the Goods.
6. **Taxes.** All taxes, duties and other governmental charges (other than general real property and income taxes), including any interest or penalties thereon, imposed directly or indirectly on Seller or required to be collected directly or indirectly by Seller for the manufacture, production, sale, delivery, importation, consumption or use of the Goods sold hereunder (including customs duties and sales, excise, use, turnover and license taxes) shall be charged to and remitted by Buyer to Seller.
7. **Financial.** If the financial position of Buyer at any time becomes unsatisfactory to Seller, Seller reserves the right to stop shipments or require satisfactory security or payment in advance. If Buyer fails to make payment or otherwise comply with these Terms or any related agreement, Seller may (without liability and in addition to other remedies) cancel any unshipped portion of Goods sold hereunder and stop any Goods in transit until Buyer pays all amounts, including amounts payable hereunder, whether or not then due, which are owing to it by Buyer. Buyer shall in any event remain liable for all unpaid accounts.
8. **Cancellation; Etc.** Orders are not subject to rescheduling or cancellation unless Buyer indemnifies Seller fully against all costs or expenses arising in connection therewith.
9. **Force Majeure.** Seller shall not be liable for any delay or failure in delivery resulting from causes beyond its control, including earthquakes, fires, floods, strikes or other labor disputes, shortage of labor or materials, accidents to machinery, acts of sabotage, riots, delay in or lack of transportation or the requirements of any government authority.
10. **Shipping; Delivery.** Unless otherwise expressly agreed in writing by Seller:
 - a. Shipments shall be by a carrier selected by Seller;
 - b. Such carrier shall act as the agent of Buyer and delivery to such carrier shall constitute delivery to Buyer;
 - c. All sales and shipments of Goods shall be FOB shipping point (unless otherwise stated in writing by Seller), at which point title to and all risk of loss of the Goods shall pass from Seller to Buyer, provided that Seller shall retain a security interest in the Goods until the full purchase price is paid by Buyer;
 - d. Delivery and shipping dates are estimates only.
 - e. Seller will package Goods as it deems proper for protection against normal handling and extra charges apply to special conditions.
11. **Claims.** Any claim by Buyer against Seller for shortage or damage to the Goods occurring before delivery to the carrier must be presented in writing to Seller within 30 days of receipt of shipment and include the original transportation bill signed by the carrier noting that the carrier received the Goods from Seller in the condition claimed.
12. **Warranties.** (a) **Exclusive Warranty.** Seller's exclusive warranty is that the Goods will be free from defects in materials and workmanship for a period of twelve months from the date of sale by Seller (or such other period expressed in writing by Seller). Seller disclaims all other warranties, express or implied. (b) **Limitations.** SELLER MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, ABOUT NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OF THE GOODS. BUYER ACKNOWLEDGES THAT IT ALONE HAS DETERMINED THAT THE GOODS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE. Seller further disclaims all warranties and responsibility of any type for claims or expenses based on infringement by the Goods or otherwise of any intellectual property right. (c) **Buyer Remedy.** Seller's sole obligation hereunder shall be to replace (in the form originally shipped with Buyer responsible for labor charges for removal or replacement thereof) the non-complying Good or, at Seller's election, to repay or credit Buyer an amount equal to the purchase price of the Good; provided that in no event shall Seller be responsible for warranty, repair, indemnity or any other claims or expenses regarding the Goods unless Seller's analysis confirms that the Goods were properly handled, stored, installed and maintained and not subject to contamination, abuse, misuse or inappropriate modification. Return of any goods by Buyer must be approved in writing by Seller before shipment. Seller shall not be liable for the suitability or unsuitability or the results from the use of Goods in combination with any electrical or electronic components, circuits, system assemblies or any other materials or substances or environments. Any advice, recommendations or information given orally or in writing, are not to be construed as an amendment or addition to the above warranty.
13. **Damage Limits; Etc.** SELLER SHALL NOT BE LIABLE FOR SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR PRODUCTION OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE GOODS, WHETHER SUCH CLAIM IS BASED IN CONTRACT, WARRANTY, NEGLIGENCE OR STRICT LIABILITY. Further, in no event shall liability of Seller exceed the individual price of the Good on which liability is asserted.
14. **Indemnities.** Buyer shall indemnify and hold harmless Seller, its affiliates and its employees from and against all liabilities, losses, claims, costs and expenses (including attorney's fees and expenses) related to any claim, investigation, litigation or proceeding (whether or not Seller is a party) which arises or is alleged to arise from Buyer's acts or omissions under these Terms or in any way with respect to the Goods. Without limiting the foregoing, Buyer (at its own expense) shall indemnify and hold harmless Seller and defend or settle any action brought against Seller to the extent that it is based on a claim that any Good made to Buyer specifications infringed intellectual property rights of another party.
15. **Property; Confidentiality.** The intellectual property embodied in the Goods is the exclusive property of Seller and its affiliates and Buyer shall not attempt to duplicate it in any way without the written permission of Seller. Notwithstanding any charges to Buyer for engineering or tooling, all engineering and tooling shall remain the exclusive property of Seller. All information and materials supplied by Seller to Buyer relating to the Goods are confidential and proprietary, and Buyer shall limit distribution thereof to its trusted employees and strictly prevent disclosure to any third party.
16. **Miscellaneous.** (a) **Waiver.** No failure or delay by Seller in exercising any right and no course of dealing between Buyer and Seller shall operate as a waiver of rights by Seller. (b) **Assignment.** Buyer may not assign its rights hereunder without Seller's written consent. (c) **Amendment.** These Terms constitute the entire agreement between Buyer and Seller relating to the Goods, and no provision may be changed or waived unless in writing signed by the parties. (d) **Severability.** If any provision hereof is rendered ineffective or invalid, such provision shall not invalidate any other provision. (e) **Setoff.** Buyer shall have no right to set off any amounts against the amount owing in respect of this invoice. (f) As used herein, "including" means "including without limitation".

Certain Precautions on Specifications and Use

1. **Suitability of Use.** Seller shall not be responsible for conformity with any standards, codes or regulations which apply to the combination of the Good in the Buyer's application or use of the Good. At Buyer's request, Seller will provide applicable third party certification documents identifying ratings and limitations of use which apply to the Good. This information by itself is not sufficient for a complete determination of the suitability of the Good in combination with the end product, machine, system, or other application or use. The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of this Good, nor is it intended to imply that the uses listed may be suitable for this Good:
 - (i) Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this document.
 - (ii) Energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.
 - (iii) Systems, machines and equipment that could present a risk to life or property. Please know and observe all prohibitions of use applicable to this Good.

NEVER USE THE PRODUCT FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE SELLER'S PRODUCT IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.
2. **Programmable Products.** Seller shall not be responsible for the user's programming of a programmable Good, or any consequence thereof.
3. **Performance Data.** Performance data given in this catalog is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of Seller's test conditions, and the user must correlate it to actual application requirements. Actual performance is subject to the Seller's Warranty and Limitations of Liability.
4. **Change in Specifications.** Product specifications and accessories may be changed at any time based on improvements and other reasons. It is our practice to change part numbers when published ratings or features are changed or when significant construction changes are made. However, some specifications of the Good may be changed without any notice. When in doubt, special part numbers may be assigned to fix or establish key specifications for your application. Please consult with your Seller's representative at any time to confirm actual specifications of purchased Good.
5. **Errors and Omissions.** The information in this catalog has been carefully checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical or proofreading errors, or omissions.