Electronic Control Module

User Manual (Rev 1.9)

20/07/2017

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Introduction

The Electronic Control Module (ECM) is designed to be used as an adjustable electronic thermostat. The ECM is ideal for freeze protection and process temperature maintenance applications. By means of rotary switches, the user can adjust the temperature settings in either degrees Celsius (0°C to 500°C) or degrees Fahrenheit (32°F to 932°F). RTD (PT100/3wire) sensors are used to measure temperatures in the range of -60°C to 500°C (-76°F to 932°F) and, by applying positive or negative hysteresis (depending upon the type of ECM), heating loads are switched on/off to maintain desired set temperatures.

The ECM is manufactured with one of the three optional Physical communication layers: RS-485, CAN-Bus or 4-20mA. Using the 4-20mA passive current loop, temperature sensor faults and sensor temperatures are polled over the user selected temperature range. By using RS-485 and CAN-Bus, the ECM can be polled for reading/writing a range of parameters, including current faults and sensor temperature.

To ensure safe operation of the device in safety critical environments, various fault/alarm conditions have been determined and implemented to alert the control room by raising alarms in case of a fault. A fault LED is also present on the module which will flash at varying rates representing different faults, which can be useful for troubleshooting purposes when serial communication with the module is not possible or when 4-20mA communication protocol is used. The ECM is designed to be fail-safe. In case of a power failure, the load will be disconnected and alarms will be raised by de-energizing the alarm relay.

There are two types of mounting options available for the ECM: ECM Wall Mounted bracket (ECM-WP) with expediter and ECM Pipe Mount expediter (ECM-XP). Both types of mounting options permit two heating cables to enter and be connected within the enclosure.

ECM Specifications

General	
Area of use	Ordinary (non-classified) and Hazardous (classified) Areas
Approvals / certifications / Compliances	IECEx, ATEX, EMC
Operating/Control Voltage (ATEX/IECEx)	120Vac +10%/-10% 208Vac +10%/-10% 230Vac +10%/-10%
Operating/Control Voltage (industrial)	102 to 132Vac 188 to 228Vac 204 to 264Vac
Input Frequency	50-60 Hz
Power Consumption	8 to 11,5 W
Heater Load AC current Switching Rating	Up to 30A, see Table (2) SPST DPST
Load Relay Minimum Life Guaranty	100,000 Cycles
Alarm Relay AC Current Rating	2A
Alarm Relay Contact Voltage (ATEX/IECEx)	120Vac +10%/-10% 208Vac +10%/-10% 230Vac +10%/-10%
Alarm Relay Contact Voltage (industrial) Alarm Relay Contact	102 to 132Vac 188 to 228Vac 204 to 264Vac
Alarm Relay Minimum Life Guaranty	50,000 Cycles
Installation Category	II
Enclosure	
Protection Rating	See Enclosure spec sheet
Electrical Connection	Terminal Block
Ambient Operating Temperature	-60°C to 55°C (-76°F to 131°F)

Minimum Ambient Storage Temperature	-74°C (-101°F)
Temperature Parameters	
Temperature Units	°C/°F
Set Temperature Range using Rotary Switches (Maintain Temperature Range)	0°C to 500°C (32°F to 932°F)
Reset Options	Auto /Manual
Number of Temperature Sensor Inputs	1 or 2
Control Range	0°C to 500°C (32°F to 932°F)
Temperature Measuring Range	-60°C to 500°C (-76°F to 932°F)
Temperature Measurement Accuracy	-60° C to 0° C ± 2° C (-76°F to 32°F ± 3.6°F) 0° C to 500° C ± 1° C (32°F to 932°F ± 1.8°F)

	Standby Current				
Type	**C-relay (energized) (mA)**	**L-relay (energized) (mA)**	**Module (mA)**	**Total (relays energized) (mA)**	**Power consumption (W)**
ECM-CL	15-18	15-18	14-20	50	11,5
ECM-C	15-18	na	17-20	35	8
ECM-L	na	15-18	17-20	35	8

Heater Load AC Current Switching Rating		
Tamb. (°C)	Double Pole (DP) Current Rating (Amps)	Single Pole (SP) Current Rating (Amps)
15	30	30
20	29	30
25	28	30
30	26,4	30
35	24,8	30
40	23	30
45	21	30

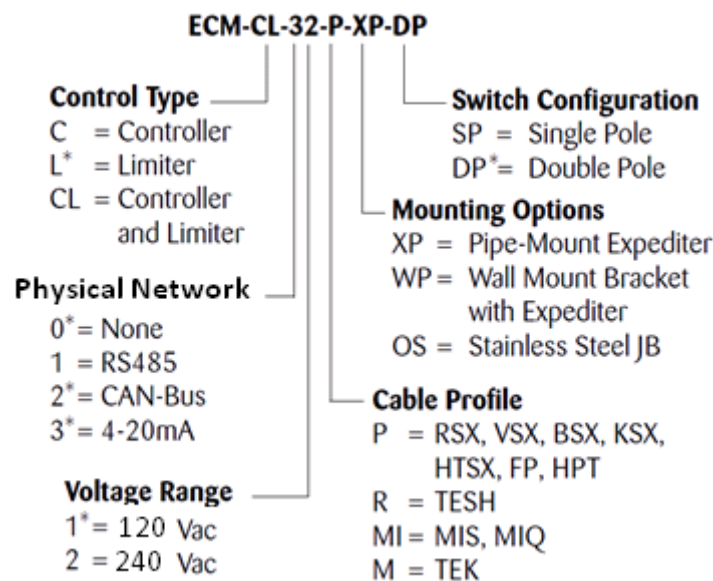| 50	19	25,8
55	17	20

Types of ECM

In order to suit a broad range of applications, three types of Electronic Control Module are manufactured. These modules vary in terms of the type of temperature control intended: positive hysteresis mode, negative hysteresis mode, or both.

The standard version of the ECM communicates on a physical network of RS485 by using a Mod-bus (RTU) protocol. Optional versions of the ECM offer suitability for CAN-Bus or 4-20mA output.

The classification of ECM is detailed below:

o **ECM-C:** Electronic Control Module, Controller only with Alarm contact capability. ECM-C controls the temperature to closely match the temperature set point (maintain temperature).

o **ECM-L:** Electronic Control Module, Limiter only with Alarm contact capability. ECM-L turns off the heater if the temperature exceeds the High Temperature Trip Value.

o **ECM-CL:** Electronic Control Module, Controller and Limiter with Alarm contact capability. ECM-CL combines the functionality of both ECM-C and ECM-L types.

Reference nomenclature for the product is given below:

ECM-CL-32-P-XP-DP

Control Type
C = Controller
L* = Limiter
CL = Controller and Limiter

Physical Network
0* = None
1 = RS485
2* = CAN-Bus
3* = 4-20mA

Voltage Range
1* = 120 Vac
2 = 240 Vac

Switch Configuration
SP = Single Pole
DP* = Double Pole

Mounting Options
XP = Pipe-Mount Expediter
WP = Wall Mount Bracket with Expediter
OS = Stainless Steel JB

Cable Profile
P = RSX, VSX, BSX, KSX, HTSX, FP, HPT
R = TESH
MI = MIS, MIQ
M = TEK

* = Optional

Detailed descriptions of all the modules are given in the coming sections of this manual.

Product Features

Wide operating Voltage Range: All the ECM modules can be operated within a wide operating voltage range of 264Vac to 204Vac at 50 Hz. For 120Vac supply versions, operating voltage range is 102Vac to 132Vac at 60 Hz.

Power LED: A green power LED is used to indicate that the ECM module is powered within the operating voltage range.

Under Voltage Protection: Under voltage protection circuitry is built into the ECM modules to avoid chattering of control and limiter relays.

Hardware Intrinsic Safety Consideration: The ECM is designed to use protection circuitry, including current limit and temperature fuses, to ensure intrinsic safety of external components.

Heater Switching: Mechanical relays are rated at 30Amps RMS continuous current. Both the controller and Limiter relays have an endurance of 100,000 electric cycles minimum.

Alarm Relay: Alarm relay with single pole alarm contact rated at 2Amps current, with a rated endurance of 50,000 cycles.

Broad Operating Ambient Temperature: The ECM module can operate at very low temperatures down to -60°C (-76°F) and up to 55°C (131°F). For applicable maximum current details, see Table 2.

Over-Temperature Protection: Thermal fuses rated at 114°C (237°F) are used to protect the control circuitry in case the internal circuit temperature of the device rises unexpectedly. In addition to this, an NTC temperature sensor monitors the internal circuit temperature and de-energizes the controller and limiter relays with Auto Reset in case the internal circuit temperature exceeds 85°C. The ECM will resume temperature control once the internal circuit temperature cools to 80°C.

Temperature Units: ECM Modules can be operated in one of the two available temperature units: degrees Celsius (°C) or degrees Fahrenheit (°F). The user can select the desired temperature unit by using the onboard temperature unit switch.

Wide Set Temperature Range: The user is given the flexibility to adjust the Maintain Temperature and High Temperature Trip Value for all the ECM module types in the range of 0°C to 500°C (32°F to 932°F). Even though the switches are labelled as set for the maximum value of 999, the ECM will raise an alarm if outside of the temperature range value for the selected temperature units.

Auto/Manual Reset: The Auto/Manual Reset switch is used to reset the limiter if the temperature exceeds the High Temperature Trip Value. A switch is used to select the AUTO or Manual Reset modes. Another way of resetting the ECM is by removing the power to the unit. When the user selects the Auto reset option, the limiter resets itself after the high temperature alarm is raised and the temperature comes within the safe control range.

Switch Position	Function Limiter
AUTO	= Automatic Reset
A	= Manual Reset
B	= Manual Reset

Note: In an ATEX hazardous area, a Manual Reset for the functionality of a Limiter is mandatory.

Temperature Measurement Range: Three wire, RTD PT100 temperature sensors are used to measure temperature in the range of -60°C to 500°C (-76°F to 932°F). The PT100 temperature sensor is used with a compensation circuitry to yield accurate temperature readings by accounting for wire resistance.

Temperature Measurement Accuracy: The accuracy for the temperature measurements are in the following ranges:

- -60°C to 0°C (-76°F to 32°F)   ±2°C (±3.6°F)
- 0°C to 55°C (32°F to 131°F)   ±1°C (±1.8°F)

Hardware Intrinsic Safety for the temperature sensors: Input for standard RTD elements is intrinsically safe.

Detection of Open/Short Circuit PT100 Sensor: The ECM is able to detect open/short circuit conditions of the PT100 sensor and can raise an alarm to alert the user so that sensor can be fixed.

Fault Detection: A broad range of alarm/fault conditions have been determined to ensure safe operating conditions and parameters for heating safely.

Fault LED: Onboard, red-colored fault LED is used to represent faults in the system by using distinctive flashing sequences. This allows users with hot work permits to make an initial assessment of the faults.

Communication Physical layers: ECM modules can be customized for one of the three available communication connections:

1: RS485 BUS, **2:** CAN-BUS and **3:** 4-20mA

Details of the communication protocols, along with the packet structure (RS485 BUS, CAN-BUS) are given in the ECM DCS Guide.

Certification/Approvals:

- IECEx
- ATEX
- EMC

Terminology

Maintain Temperatures (Controller Set Temperature)	The temperatures at which the heater load relay will switch on.
Temperature Control Band (Temperature Differential Value)	The value between the maintain temperature and switch-off temperature.
Alarm Control Band (Low alarm Controller) (Alarm Differential Value)	The value below the Maintain Temperature that the ECM will generate a temperature alarm.
Low Temperature Alarm	Maintain Temperature minus Alarm Control Band

Installation Requirements

The following installation requirements must be applied.

- Supply wiring shall be sized appropriately to adequately handle amperage requirements of the heat tracing circuits being controlled. Supply wire thickness is limited in size from 0.5 mm^2 to 16 mm^2 (20 to 6 AWG). Wire insulation shall be able to withstand up to 90°C.
- GFCI breakers must be installed on all circuits. The breakers shall be suitably located so that they are easily reached, and must be marked as the disconnecting device for the circuit(s) and ECM.

- To avoid static discharge, only clean the ECM with a damp cloth. If the interior of the ECM must be cleaned, ensure that the circuit is completely de-energized prior to attempting to clean.

- If the ECM is used or installed in such a manner that is contrary to this User Manual or to the Installation Guides provided by Thermon, the circuit protection provided by the ECM may be impaired.

ECM-C

The ECM-C (Controller) works on the principle of positive hysteresis control of the temperature. The product image and wiring diagram are given below:

ECM-C
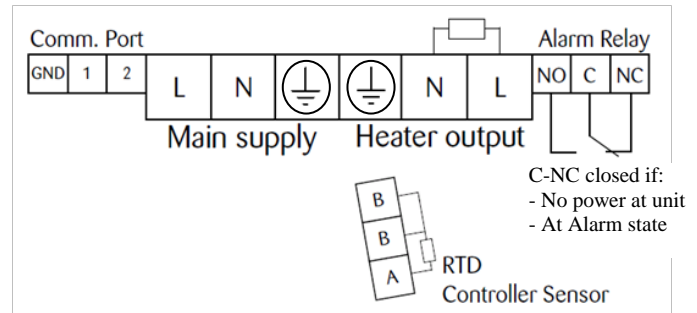
Wiring Diagram

ECM-C Operation

The ECM Controller controls the heater load by simple on/off operation of the Control Relay to ensure that the temperature of the process is maintained within the required Maintain Temperature range.

If the temperature of the RTD Controller Sensor is above the Maintain Temperature (adjusted using rotary switches) + Temperature Control Band, the Controller Relay will latch off and power to the heater load will be disconnected. In case the temperature drops below the maintain temperature minus the (Low) alarm control band, due to some other external factors, a Low Temperature Alarm will be raised by latching off the Alarm Relay. In this case, the Fault LED will also flash to indicate that the controller sensor temperature is at a critical value.

When the RTD Controller sensor reaches the Maintain Temperature the alarm will be turned off. The alarm contact will be energized and the Fault led will stop flashing.

In order to power the heater load again, the temperature of the RTD Controller Sensor has to be less than or equal to the Maintain Temperature.

Onboard Controls:

- The user has the option to select the Set Temperature in the range of $0°$ C to $500°$ C or 32°F to 932°F by selecting the appropriate Temperature Units.

- The Red Fault LED is used to indicate existing alarms detected by the ECM-C module using different delays and flash sequences. A list of faults and flash sequences for ECM-C is given at the end of this chapter. The Red Fault LED can be very useful in determining system faults when the 4-20mA communication protocol is used, as not all the faults are represented using 4-20mA current range.

- The Green Power LED is used to indicate that the unit is energized from the power terminal.

Usage Example

Parameter	Selected Value	Parameter Type
Temperature Units	°C	User selectable
Maintain Temperature	100°C	User selectable
Temperature Control Type	Offset	Factory settings
Temperature Control Band	3°C	Factory settings
Alarm Control Band	3°C	Factory settings
Resultant Parameters (Temperature values at which control and alarm relays are latched)		
Control Relay Latch OFF Temperature	103°C	
Temperature Value for raising Alarm (Alarm Threshold Value)	97°C	
Temperature Value for stopping Alarm	100°C	
Control Relay Latch ON Temperature	100°C	

On ECM-C power up, if the temperature detected by the RTD Controller Sensor is equal to or below $102°$ C, ECM-C will power the heater load. When the temperature of the RTD Controller Sensor is equal to or above $103°$ C (Maintain Temperature + Temperature Control Band), the Controller Relay will be

latched off after a specified delay (5 seconds) in order to turn off the heater. The delay used to turn a relay on or off is set by the factory.

Once the temperature of RTD Controller Sensor cools down to 100°C, the ECM-C will power the heater load again and resume the positive Temperature Control Band.

When the RTD sensor temperature drops below 100°C, the heater load will be powered on again. If, due to some external factor(s), the RTD sensor temperature drops below 97°C (Maintain Temperature minus Alarm control band) the Alarm Relay will latch off to raise an alarm. At the same time, the Fault LED will flash to indicate the type of fault.

ECM-C Faults

A range of faults are detected and are represented using the Fault LED. Faults are also logged in the ECM-C microprocessor's memory along with the operational time at which the fault was detected. When the ECM does not contain any fault condition, it will send 0x00 as the fault code when requested via the serial communication.

A list of faults is given on the next sheet.

ECM-C Faults

| No	Alarm Condition	Action	Control Relay	Alarm Relay	Current loop	Fault Code	Alarm LED (Flash, Delay(s),)	Self Resettable Function & Condition
1.	**System Fault, Software** (Software failure established in the microprocessor)	De-Energize Control Relay and Raise Alarm	De-Energized	De-Energized	Controller Sensor Temperature	0x11	(10, one)	Yes (if microprocessor resets) OR (Fault cleared using the serial comms)
2.	**RTD Controller Fault** (Controller RTD PT100 Open/Short[1])	De-Energize Control Relay and Raise Alarm	De-Energized	De-Energized	< 3.90mA / > 20.10mA	0x21	(2, one)	Yes (Sensor Repaired)
3.	**Invalid Maintain Temperature Min** (Controller Maintain Temperature Value < Min Maintain Temperature value in °F)	De-Energize Control Relay and Raise Alarm	De-Energized	De-Energized	Controller Sensor Temperature	0x41	(4, one)	Yes (Correct Maintain Temperature value)
4.	**Invalid Maintain Temperature Max** (Controller Maintain Temperature Value > Max Maintain Temperature value in °C/°F)	De-Energize Control Relay and Raise Alarm	De-Energized	De-Energized	Controller Sensor Temperature	0x42	(4, two)	Yes (Correct Maintain Temperature value)
5.	**Low Temperature Alarm** (Controller Sensor Temperature > (Controller Maintain Temperature Value - Low Temperature Alarm offset value))	Raise Alarm (Control Relay already Energized)	Already Energized	De-Energized	Controller Sensor Temperature	0x72	(7, two)	Yes (Sensor Temperature in differential range)
6.	**High Temperature Trip Internal** (Internal NTC Temperature >= Max Internal Circuit Temperature Threshold value)	De-Energize Control and Alarm Relays	De-Energized	De-Energized	Controller Sensor Temperature	0x81	(9, one)	Yes (Safe internal circuit temperature)
7.	**Low Voltage Shut Down** (Mains Supply 230, <190Vac / 120, <102Vac)[2]	ECM turned off and Alarm Relay will be De-Energized	De-Energized	De- Energized	--------	0x92	--------	Yes (Mains Supply = 204VAC/102VAC)
8.	Internal Circuit Temperature >= 100° C/212° F (**Hardware Failure**)	ECM will shut down and damaged permanently, Alarm Raised (fail safe)	De-Energized	De-Energized	--------	--------	--------	No

Occasionally open circuit and short circuit conditions of the RTD can be mixed.

[2] **The fault code will be logged in the microprocessor memory once the module powers up again. This fault indicates that the ECM has gone through a power cycle.**

ECM-L

The ECM-L (Limiter) works on the principle of negative hysteresis to control the temperature. The product image and wiring diagram are given below:
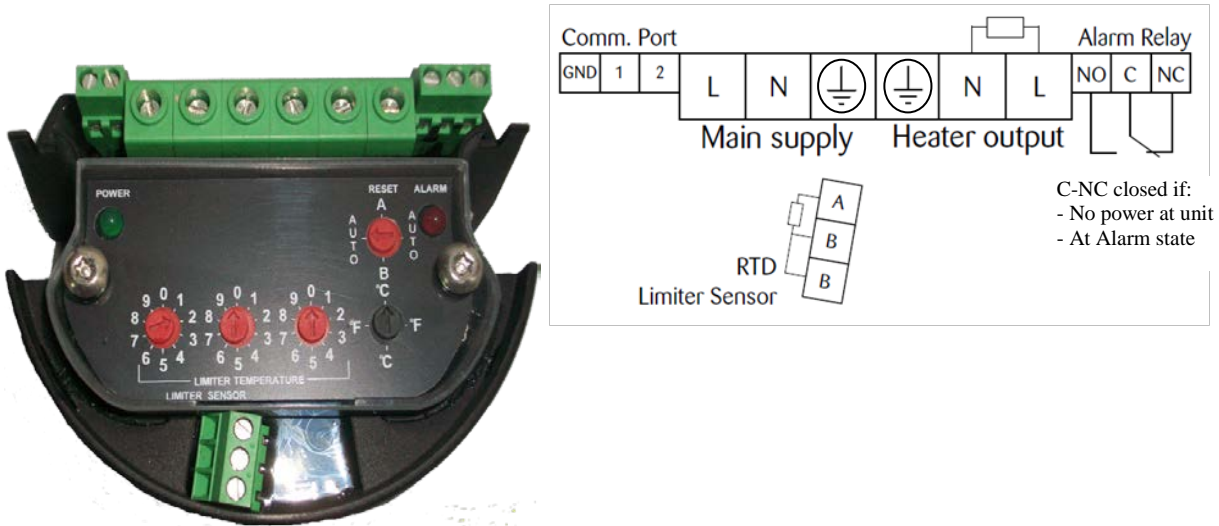
ECM-L   **Wiring Diagram**

ECM-L Operation

The ECM Limiter controls the heater load by simple on/off operation of the Limiter Relay to ensure that the temperature of the process never exceeds the High Temperature Trip value (adjusted using rotary switches), as assigned by the user.

Two microprocessors are used in ECM-L for dual redundancy purposes. The two microprocessors are linked by internal serial communication to constantly monitor the health of the other. This ensures that if one microprocessor fails, the other can alert the control room by raising an alarm. This adds an additional security feature to the ECM-L module which can be very useful in safety critical applications.

Auto/Manual Reset: Control of the Limiter Relay is based on latching off control with Auto or Manual Reset, subject to settings of the Reset Switch. This switch has 4 settings: two positions for Automatic (Auto) and two for Manual (A, B) reset.

When the temperature of the RTD Limiter Sensor exceeds the High Temperature Trip (adjusted using rotary switches) and position of the Reset Switch was selected to be A, or B (Manual), the Limiter Relay will latch off and power to the heater will be disconnected. At the same time an alarm will be raised to indicate that the RTD Limiter Sensor temperature has exceeded the temperature limit set by

the user. In this case, the Fault LED will also flash to indicate that the Limiter Sensor Temperature is at a critical value. In order to remove the High Temperature Trip Alarm after the temperature is in the safe range, the Manual Reset or Auto Reset must be selected using the Reset Switch rotate A to B, or B to A. Limiter reset can also be accomplished by power cycling the ECM without changing the Reset Switch, which will also remove the High Temperature Trip Alarm once the RTD Limiter sensor temperature is in the safe range.

When temperature of the RTD Limiter Sensor exceeds the High Temperature Trip value (adjusted using rotary switches) and position of the Reset Switch is in AUTO, the Limiter Relay will latch off and power to the heater will be disconnected. At the same time an alarm will be raised to indicate that the RTD Limiter Sensor temperature has exceeded the temperature limit set by the user. In this case, the Fault LED will also flash to indicate that the Limiter Sensor Temperature is at a critical value. The High Temperature Trip Alarm will be removed and the heater load will be powered again once the temperature of the RTD Limiter Sensor is less than or equal to the High Temperature Trip value minus the Negative Limiter Control Band value, assuming the Reset Switch is positioned to AUTO. At this point the fault has been removed and the Fault LED will stop flashing.

Onboard Controls:

- The user has the option to select the High Temperature Trip value in the range of $0°$ C to $500°$ C, or 32°F to 932°F by selecting appropriate Temperature Units.
- One Reset Switch is also present on the module for Auto or Manual reset in case the temperature of the RTD Limiter Sensor exceeds the High Temperature Trip value.
- The Red Fault LED is used to indicate existing faults detected by the ECM-L module by using different delays and flash sequences. A list of faults and flash sequences for ECM-L is given at the end of this chapter. The Fault LED can be very useful to determine system faults when 4-20mA current loop is being used as communication option, as not all the faults are represented using 4-20mA current range.
- The Green Power LED is used to indicate that the unit is energized from the power terminal.

Usage Example

Parameter	Selected Value	Parameter Type
Assuming no faults detected by the Controller microprocessor and Alarm Relay latched ON		
Temperature Units	°C	User selectable
High Temperature Trip value	200°C	User selectable
Reset Type	Auto	User selectable
Alarm Control Band Type	Offset	Factory settings
Alarm Control Band Value	10°C	Factory settings
Resultant Parameters (Temperature values at which control and alarm relays are latched)		
Limiter Relay Latch OFF Temperature		200°C
Temperature Value for raising Alarm (Alarm Threshold Value)		200°C
Temperature Value for stopping Alarm		190°C
Limiter Relay Latch ON Temperature		190°C

Upon power-up, the ECM-L will sense the temperature using the RTD Limiter Sensor. If that temperature is below 200°C, the ECM-L will power the heater load. When the temperature of the RTD Limiter Sensor is equal to or above 200°C (High Temperature Trip value), the Limiter and Alarm Relays will be latched off to raise an alarm after a specified delay (5 seconds). At the same time the Fault LED will also flash to indicate the type of fault.

When the temperature of the RTD Limiter sensor approaches 190°C, the High Temperature Trip Alarm will be removed and the heater load powered. At the same time the Fault LED will stop flashing.

The delay used to turn a relay on or off is set by the factory. A list of user-customized parameters and their ranges are given in the product specification section.

ECM-L

ECM-L Faults

A range of faults are detected and represented using the Fault LED. Faults are also logged in the EEPROM memory of both the Controller and the Limiter microprocessors along with the operational time at which the fault was detected. When the ECM does not contain any fault condition, it will send 0x00 as the fault code when requested via the serial communication.

A list of faults is given on the next sheet.

ECM-L Faults

No	Alarm Condition	Action	Limiter Relay	Alarm Relay	*Current loop (mA)	Fault Code	Alarm LED (Delay(s), Flash)	Self Resettable Function & Condition
1.	**System Fault, Software** (Software failure established in the microprocessor)	De-Energize *Limiter Relay and Raise Alarm	De-Energized	De-Energized	Limiter Sensor Temperature	0x11	(10, one)	Yes (if microprocessor resets) OR (Fault cleared using the serial comms)
2.	**System Fault, Communication** (Communication failure established between the microprocessors)	De-Energize *Limiter Relay and Raise Alarm	De-Energized	De-Energized	Limiter Sensor Temperature	0x12	(1, two)	Yes (if microprocessor resets) OR (Fault cleared using serial comms)
3.	**RTD Limiter Fault** (Limiter RTD PT100 Open/Short[1])	De-Energize Limiter Relay and Raise Alarm	De-Energized	De-Energized	< 3.90mA / > 20.10mA	0x31	(3, one)	Yes (Sensor Repaired)
4.	**Invalid High Temperature Trip 1 Min** (Limiter High Temperature Trip Value < Min High Temperature Trip value in °F)	De-Energize Limiter Relay and Raise Alarm	De-Energized	De-Energized	Limiter Sensor Temperature	0x51	(5, one)	Yes (Correct Maintain Temperature value)
5.	**Invalid High Temperature Trip 1 Max** (Limiter High Temperature Trip Value > Max High Temperature Trip value in °C/°F)	De-Energize Limiter Relay and Raise Alarm	De-Energized	De-Energized	Limiter Sensor Temperature	0x52	(5, two)	Yes (Correct Maintain Temperature value)
6.	**High Temperature Trip Internal** (Internal NTC Temperature >= Max Internal Circuit Temperature Threshold value)	De-Energize Limiter and Alarm Relays	De-Energized	De-Energized	Limiter Sensor Temperature	0x81	(9, one)	Yes (Safe internal circuit temperature)
7.	**High Temperature Trip Limiter** (Limiter Sensor Temperature >= Limiter Maintain Temperature)	De-Energize Limiter Relay and Raise Alarm	De-Energized	De-Energized	Limiter Sensor Temperature	0x82	(8, two)	Yes (Auto/Manual Reset OR Module Resets) AND (Limiter RTD Temperature = Limiter High Temperature Trip Value)
8.	**Low Voltage Shut Down** (Mains Supply 230, <190Vac / 120, <102Vac)[2]	ECM turned off and Alarm Relay will be De-Energized	De-Energized	De- Energized	--------	0x92	--------	Yes (Mains Supply = 204VAC/102VAC)
9.	Internal Circuit Temperature >= 100° C/212° F (**Hardware Failure**)	ECM will shut down and damaged permanently, Alarm Raised (fail safe)	De-Energized	De-Energized	--------	--------	--------	No

Occasionally open circuit and short circuit conditions of the RTD can be mixed.

[2]**The fault code will be logged in the microprocessor memory once the module powers up again. This fault indicates that the ECM has gone through a power cycle.**

* If system fault is detected by the Limiter microcontroller then the Limiter Relay will be De-energized along with the Alarm Relay. If system fault is detected by the Controller microcontroller then only the Alarm Relay will be De-energized.

ECM-CL

ECM-CL (Controller and Limiter) offers the flexibility of temperature control based on the principles of both positive and negative temperature hysteresis. The product image and wiring diagram is given in the figure below:

ECM-CL
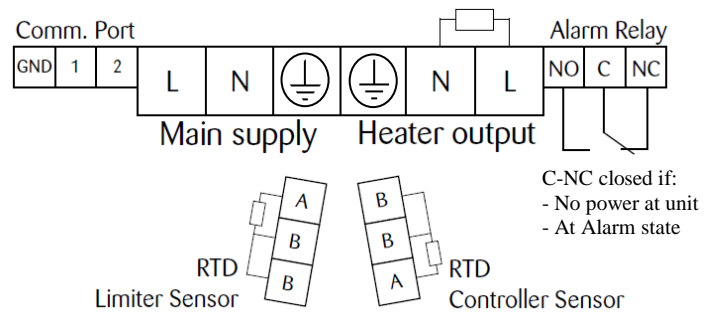
Wiring Diagram

ECM-CL Operation

The ECM Controller Limiter controls the heater load by simple on/off operation of both Controller and Limiter Relays. In this module, two relays are used to ensure that the temperature of process is maintained within the safe operating range.

In the ECM-CL, two microprocessors are used for dual redundancy. The two microprocessors are linked by internal serial communication to constantly monitor the health of the other. This ensures that if one microcontroller fails, the other microprocessor can alert the control room by raising the System Fault alarm. This adds an additional security feature to the ECM-CL module which can be very useful in safety critical applications.

In this manual, operation of the microprocessors is categorized as Controller for the control of Controller Relay, and Limiter for controlling Limiter Relay, as symbolized by the name of the product ECM-CL. The Limiter operates on the principle of negative temperature hysteresis where as the Controller implements positive temperature hysteresis for controlling temperature.

The Controller tries to maintain the process temperature within the safe temperature range by switching the control relay on or off. The Limiter acts as a watchdog by controlling the Limiter Relay so that the load heater can be turned off when the temperature has exceeded the maximum High Temperature Trip value of the limiter. In ECM-CL, the High Temperature Trip value of the limiter should be adjusted

higher than the Controller Set Temperature in order to ensure that the Limiter can restrict temperature rise by de-energizing the Limiter Relay.

Controller Operation:

See ECM-C Operation on page 11

Onboard Controls:

- The user has the option to select the Controller Maintain Temperature and Limiter High Temperatures Trip values independently in the range of 0° C to 500° C or 32°F to 932°F by selecting the appropriate Temperature Unit.
- One Reset Switch is also present on the module for Auto or Manual reset of the Limiter in case the temperature of the RTD Limiter Sensor exceeds the High Temperature Trip value.
- The Red Fault LED is used to indicate the existing fault detected by the ECM-CL module by using different delays and flash sequences. A list of faults and flash sequences for the ECM-CL is given at the end of this chapter. The Red Fault LED can be very useful in determining the system fault in the case of no communication option or when 4-20mA current loop is being used as a communication option (not all faults are represented using the 4-20mA current range).
- The Green Power LED is used to indicate that the ECM unit is energized from the power terminal.

Limiter Operation

See ECM-L Operation on page 18

ECM-CL Faults

A range of faults are detected and represented using the Fault LED. Faults are also logged in the EEPROM memory of both the Controller and the Limiter microprocessors along with the operational time at which the fault was detected. When the ECM does not contain any fault condition, it will send 0x00 as the fault code when requested via the serial communication.

A list of faults is given on the next sheet.

ECM-CL Faults

No	Alarm Condition	Action	Control Relay	Limiter Relay	Alarm Relay	Current loop	Fault Code	Alarm LED (Flash, Delay(s),)	Self Resettable Function & Condition
1.	**System Fault, Software (**Software failure established in the microprocessor)	De-Energize Limiter/Control Relay and Raise Alarm*	*De-Energized	*De-Energized	De- Energized	Controller Sensor Temperature	0x11	(10, one)	Yes (if microprocessor resets) OR (Fault cleared using the serial comms)
2.	**System Fault, Communication** (Communication failure established between the microprocessors)	De-Energize Limiter/Control Relay and Raise Alarm*	*De-Energized	*De-Energized	De-Energized	Controller Sensor Temperature	0x12	(1, two)	Yes (if microprocessor resets) OR (Fault cleared using serial comms)
3.	**RTD Controller Fault** (Controller RTD PT100 Open/Short[1])	De-Energize/Energize Control Relay and Raise Alarm	De-Energized/Energized	No Action	De-Energized	< 3.90mA / > 20.10mA	0x21	(2, one)	Yes (Sensor Repaired)
4.	**RTD Limiter Fault** (Limiter RTD PT100 Open/Short[1])	De-Energize/Energize Control Relay and Raise Alarm	No Action	De-Energized	De- Energized	Controller Sensor Temperature	0x31	(3, one)	Yes Sensor Repaired)
5.	**Invalid Maintain Temperature Min** (Controller Maintain Temperature Value < Min Maintain Temperature value in °F)	De-Energize Control Relay and Raise Alarm	De-Energized	No Action	De-Energized	Controller Sensor Temperature	0x41	(4, one)	Yes (Correct Maintain Temperature value)
6.	**Invalid Maintain Temperature Max** (Controller Maintain Temperature Value > Max Maintain Temperature value in °C/°F)	De-Energize Control Relay, Limiter Relay and Raise Alarm	De-Energized	De-Energized	De-Energized	Controller Sensor Temperature	0x42	(4, two)	Yes (Correct Maintain Temperature value)
7.	**Invalid High Temperature Trip 1 Min** (Limiter High Temperature Trip Value < Min High Temperature Trip value in °F)	De-Energize Limiter Relay and Raise Alarm	No Action	De-Energized	De-Energized	Controller Sensor Temperature	0x51	(5, one)	Yes (Correct High Temperature Trip value)
8.	**Invalid High Temperature Trip 1 Max** (Limiter High Temperature Trip Value > Max High Temperature Trip value in °C/°F)	De-Energize Control Relay, Limiter Relay and Raise Alarm	De-Energized	De-Energized	De-Energized	Controller Sensor Temperature	0x52	(5, two)	Yes (Correct High Temperature Trip value)
9.	**Invalid High Temperature Trip 2** (Limiter High Temperature Trip Value < Maintain Temperature Value)	De-Energize Control Relay, Limiter Relay and Raise Alarm	De-Energized	De-Energized	De-Energized	Controller Sensor Temperature	0x61	(6, one)	Yes (Correct Maintain Temperature value)
10.	**Low Temperature Alarm** (Controller Sensor Temperature > (Controller Maintain Temperature Value - Low Temperature Alarm offset value))	Raise Alarm (Control Relay already Energized)	Already Energized	No Action	De- Energized	Controller Sensor Temperature	0x72	(7, two)	Yes (Sensor Temperature in differential range)
11.	**High Temperature Trip Internal** (Internal NTC Temperature >= Max Internal Circuit Temperature Threshold value)	De-Energize Control Relay, Limiter Relay and Raise Alarm	De-Energized	De-Energized	De-Energized	Controller Sensor Temperature	0x81	(9, one)	Yes (Safe internal circuit temperature)
12.	**High Temperature Trip Limiter** (Limiter Sensor Temperature >= Limiter Maintain Temperature)	De-Energize Limiter Relay and Raise Alarm	De-Energized	De-Energized	De-Energized	Controller Sensor Temperature	0x82	(8, two)	Yes (Auto/Manual Reset OR Module Resets) AND (Limiter RTD Temperature = Limiter High Temperature Trip Value)
13.	**Low Voltage Shut Down** (Mains Supply 230, <190Vac / 120, <102Vac)[2]	ECM turned off and Alarm Relay will be De-Energized	De-Energized	De-Energized	De-Energized	Controller Sensor Temperature	0x92	--------	Yes (Mains Supply = 204VAC/102VAC)
14.	Internal Circuit Temperature >= 100° C/212°F (**Hardware Failure**)	ECM will shut down and damaged permanently, Alarm Raised (fail safe)	De-Energized	De-Energized	De-Energized	--------	--------	--------	No

[1] Occasionally open circuit and short circuit conditions of the RTD can be mixed.

[2] The fault code will be logged in the microprocessor memory once the module powers up again. This fault indicates that the ECM has gone through a power cycle.

*If System fault is detected by the Controller microcontroller then the Controller Relay will be De-energized along with the Alarm Relay. If system fault is detected by the Limiter microcontroller then the Limiter Relay will be De-energized along with the Alarm Relay.

ECM Faults and Alarm

All the ECM modules are designed to detect various potential faults which can arise due to different reasons such as: RTD sensor faults, operator error, microprocessor failure and software failures. If a fault is detected, it is logged into the internal memory (EEPROM) of the microprocessor along with the time[1] when the fault was detected. The EEPROM is able to store the last 20 faults detected by the ECM. The user can communicate with the module using RS485 BUS or CAN-BUS to request the current faults remotely for troubleshooting purposes.

A complete list of the fault codes for all the ECM types is given in their respective sections of the manual.

Every fault detected by the ECM is given a distinctive hexadecimal code which also determines the flashing sequence for the Fault LED. The user can easily determine a fault code from the flashing sequence of the Fault LED and by looking at the fault table for the respective ECM module. An example of determining the alarm from the LED flashing sequence is given in next section.

In the ECM-CL, Controller faults are given priority over Limiter faults when displayed using the Fault LED. When no Controller fault is present, Limiter faults will be displayed using the Fault LED. Prioritization of the Fault LED flashing sequence for different ECM modules is summarized in the following Table:

Module	Fault Priority for LED
ECM-C	Controller Faults
ECM-L	Limiter Faults
ECM-CL	Controller Faults. When no Controller Faults, Limiter Faults are given priority.

[1] Please note this is the operational time of the module under power.

Fault LED flashing sequence

The Red (Fault) LED is used to represent a fault detected by the ECM. The user can look at the Fault LED and, from the flash sequence and the delay between flash cycles, determine the cause of the fault.

Flash Cycle: In order to represent a range of faults using one Fault LED, the flash cycle is used. The flash cycle is the number of times the Fault LED flashes consecutively, with each flash being 0.25 seconds apart.

Flash Cycle Delay: The delay between one flash cycle of the Fault LED and the next, in multiples of one second.

An example for determining a fault from the flashing sequence of the Fault LED is given below:

ECM Module Type = ECM-CL Number of consecutive LED Flashes in one Flash Cycle = 7 Delay between each Flash cycle = 2 second
Fault Code = $0x N_2 N_1$ N_2 = **Number of LED Flashes** = 7 N_1 = **Flash Cycle Delay** = 2 **Fault Code = 0x72** From the ECM-CL fault code list, it can be determined that the High Temperature Alarm was raised by the controller.

ECM Parameter Customization and Programming

For customization and/or programming of parameters please contact Thermon.

ECM Configuration Parametersrs

No	Description	Min	Max	Default	Units
1	High Temperature Trip value for Internal Thermistor	0°C /32°F	85°C /185°F	85°C /185°F	°C / F
2	Temperature Differential Type	Temperature Offset	%	Temperature Offset	°C / F
3	Control/Limiter Temperature Control Band	3°C / 5°F	100°C / 212°F	3°C / 5°F	°C / F / %
4	Low Temperature Alarm offset value	3°C / 5°F	100°C / 212°F	3°C / 5°F	°C / F / %
5	Control/Limiter Relay ON Delay	0	60	5	Seconds
6	Control/Limiter Relay OFF Delay	0	60	5	Seconds
7	Alarm Relay ON Delay	0	60	10	Seconds
8	Alarm Relay OFF Delay	0	60	5	Seconds
9	Control RTD Open Circuit (Action on Control Relay)[1]	0	1	0	None
10	Control RTD Short Circuit (Action on Control Relay)[1]	0	1	0	None
11	4-mA Scaling Temperature	0°C /32°F	500°C /932°F	0°C /32°F	°C / F
12	20-mA Scaling Temperature	0°C /32°F	500°C /932°F	500°C /932°F	°C / F

[1] **Only Available in ECM-CL**

Chapter: ECM Configuration Parametersrs

Connection diagrams 4-20mA

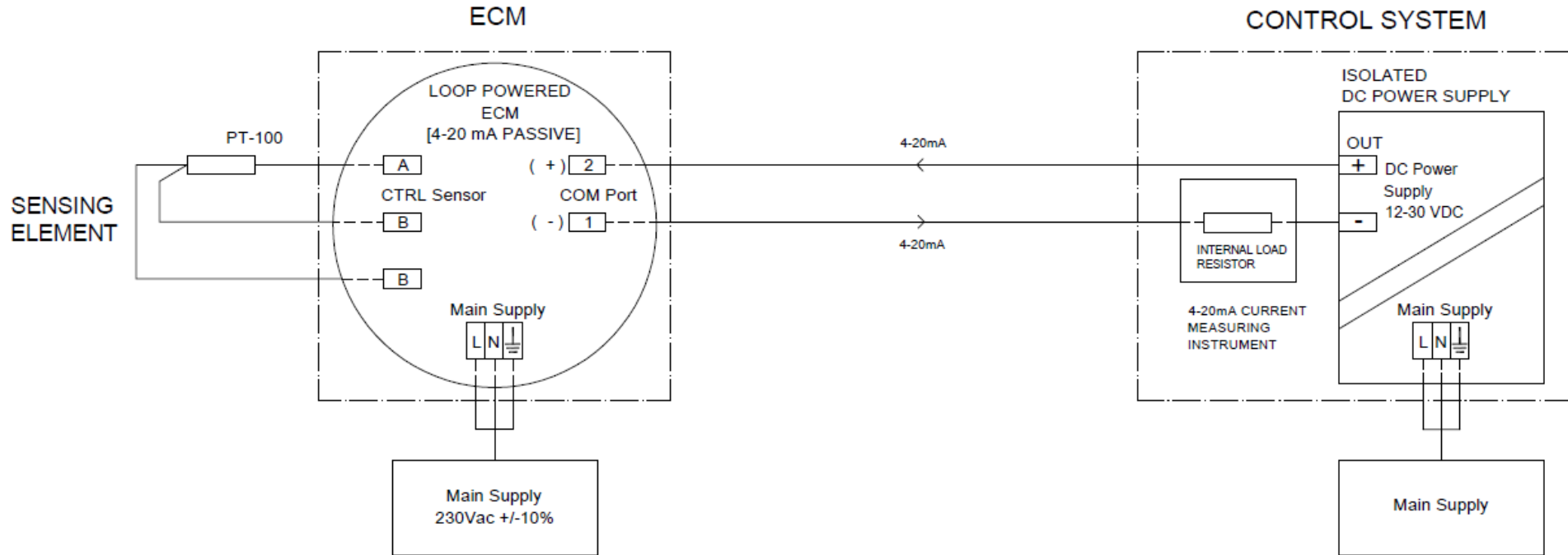## Option 1: Non-Isolated DC Power Supply [Requires Isolator)
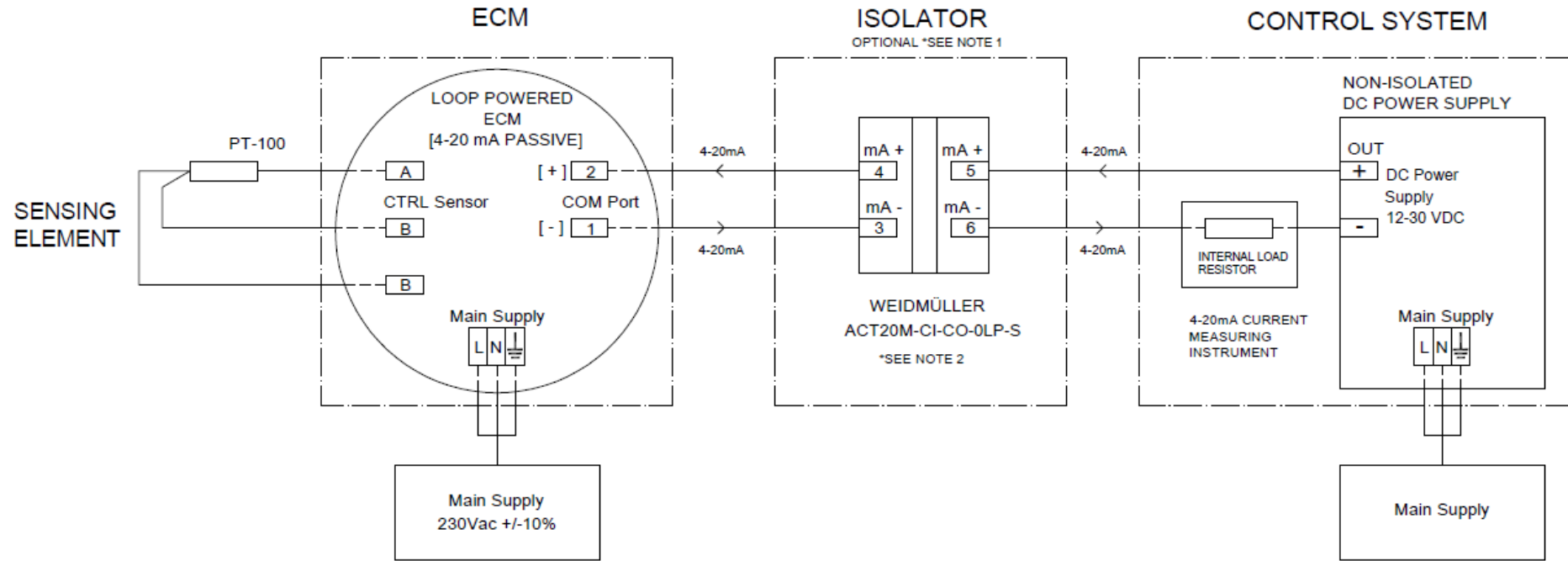
*NOTE 1   ECM 4-20mA CIRCUIT MUST BE ISOLATED
FROM THE MAIN SUPPLY.

*NOTE 2   Example: Weidmüller ACT20M-CI-CO-OLP-S
Equipment can be a different/similar type.

For Questions, Please contact Thermon.

Option 2: Isolated DC Power Supply [No Additional Isolator Required)

ECM

LOOP POWERED
ECM
[4-20 mA PASSIVE]

PT-100

SENSING
ELEMENT

CTRL Sensor

A

B

B

Main Supply

L N

(+) 2

COM Port

(-) 1

Main Supply
230Vac +/-10%

4-20mA

4-20mA

CONTROL SYSTEM

ISOLATED
DC POWER SUPPLY

OUT

+ DC Power
Supply
12-30 VDC

-

INTERNAL LOAD
RESISTOR

4-20mA CURRENT
MEASURING
INSTRUMENT

Main Supply

L N

Main Supply

*NOTE 1   ECM 4-20mA CIRCUIT MUST BE ISOLATED
FROM THE MAIN SUPPLY.

*NOTE 2   Example: Weidmüller ACT20M-CI-CO-OLP-S
Equipment can be a different/similar type.

For Questions, Please contact Thermon.

Connection diagrams 4-20mA