Elexant 4010i/4020i

Raychem

User Manual



chemelex

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1. OVERVIEW

1.1 Introduction

This manual provides information pertaining to the installation, operation, testing, adjustment and maintenance of the Raychem Elexant 4010i/4020i Heat Tracing Controllers.

Additional copies of this user manual may be ordered separately through your Chemelex representative or online at chemelex.com using the document number H60624.

1.1.1 Product Overview

This section contains an overview of the Elexant 4010i/4020i Heat Trace Controller. It introduces the product variants and main features of the product line, which will be explored in further detail later in this manual.

The two major variants of the Elexant 4000 series controllers are the 4010i and the 4020i. The 4010i models are designed for single circuit operation, and installed individually in an enclosure with an integrated Electro-mechanical Relay (EMR) or Solid-State Relay (SSR). The 4020i models are DIN rail mounted and designed for multi circuit operation (multiple controllers in the same enclosure) connected to external EMR or SSR as the application requires.

1.1.1.1 Description

The Elexant 4010i/4020i series electronic heat tracing controllers control, monitor, and communicate alarms and data for one heating circuit. The unit supports the option of direct field installation in Class 1, Division 2 and Zone 2 areas. It is available with a solid-state relay (SSR) output for use in hazardous areas or with electromechanical relay (EMR) output for use in ordinary (non-hazardous) areas.

1.1.1.2 Elexant 4010i/4020i Series Variants

P/N	Type	Description
10380-001	4010i-EMR-FW	Elexant 4010i EMR Controller in Fiberglass Enclosure with Window
10380-002	4010i-SSR-FW	Elexant 4010i 4010i SSR Controller in Fiberglass Enclosure with Window
10380-003	4010i-EMR-SW	Elexant 4010i EMR Controller in Stainless Steel Enclosure with Window
10380-004	4010i-SSR-SW	Elexant 4010i SSR Controller in Stainless Steel Enclosure with Window
10380-007	4010i-EMR-IS-SW	Elexant 4010i EMR Controller with IS (Intrinsically Safe) Barrier in Stainless Steel Enclosure with Window
10380-008	4010i-SSR-IS-SW	Elexant 4010i SSR Controller with IS (Intrinsically Safe) Barrier in Stainless Steel Enclosure with Window
10380-015	4010i-MOD	Elexant 4010i Module (replacement)
10380-016	4010i-MOD-IS	Elexant 4010i Module with IS (Intrinsically Safe) Barrier (replacement)
10380-009	4010i-EMR-IS-FW (EMEA)	Elexant 4010i EMR Controller with IS (Intrinsically Safe) Barrier in Fiberglass Enclosure with Window (European Version Only)
10380-010	4010i-SSR-IS-FW (EMEA)	Elexant 4010i SSR Controller with IS (Intrinsically Safe) Barrier in Fiberglass Enclosure with Window (European Version Only)
10380-011	4010i-EMR-IS-SW (EMEA)	Elexant 4010i EMR Controller with IS (Intrinsically Safe) Barrier in Stainless Steel Enclosure with Window (European Version Only)
10380-012	4010i-SSR-IS-SW (EMEA)	Elexant 4010i SSR Controller with IS (Intrinsically Safe) Barrier in Stainless Steel Enclosure with Window (European Version Only)

Table 1 - Elexant 4010i Variants

P/N	Type	Description
10380-020	4020i-MOD	Elexant 4020i Module
10380-021	4020i-MOD-IS	Elexant 4020i Module with IS (Intrinsically Safe) Barrier
10380-022	4020i-MOD-IS-LIM	Elexant Module with IS (Intrinsically Safe) Barrier and Limiter
10380-024	4020i-MOD-3P-IS	Elexant 4020i 3 Phase Module with IS (Intrinsically Safe) Barrier

Table 2 - Elexant 4020i Variants

1.1.2 Product Features

A detailed description of the available features of the Elexant 4010i/4020i may be found later in this manual. Highlights of the specific features follow.

1.1.2.1 Local Configuration

The Elexant 4010i/4020i is configured with an intuitive touch-screen user interface which allows the user to configure the product to suit their application and monitor its feedback. It allows saving/restoring multiple configuration profiles through the USB interface. This simplifies the process of commissioning and firmware upgrading. See Section 3.1 to 3.9 for more details.

1.1.2.2 Alarms

The Elexant 4010i/4020i controller generates different types of alarms to draw the user's attention to any event that does not fall within the defined limits of normal operation. See Sections 3.5 and 5.9 for a detailed description of different types of alarms generated by the Elexant 4010i/4020i controller.

1.1.2.3 Control

The Elexant 4010i/4020i supports several control mode algorithms as listed below. There are options to alarm or override the mode using external inputs (Hand/Off/Auto operation for example). In addition, external Contactors, SSRs and Analog SSRs are supported.

Control Modes:

- On / Off (Deadband)
- Proportional (Available only with solid state switching devices)
- PASC (Proportional Ambient Sensing Control)
- Always ON
- Always OFF

The Elexant 4010i/4020i controller also supports Power Limiting, Circuit Breaker Protection, Temperature Sensor Fail On/Off, Load Shedding and several other features.

See Section 3.1.1 and 3.1.2 for a detailed description of these modes.

1.1.2.4 Monitoring

The Elexant 4010i/4020i measures a variety of parameters including temperature and electrical heat trace current(s) to ensure system integrity. See Section 3.2 for a detailed description of these parameters.

1.1.2.5 Maintenance Data

The Elexant 4010i/4020i system logs the maximum and minimum temperatures, current, ground fault, voltages and other measurements experienced on a circuit for the purpose of troubleshooting or gathering data for future design criteria. In addition the system logs accumulated data for Heater On Time, Power, and others. See Section 3.2.3 for a detailed description of Maintenance Data.

1.1.2.6 Protection

The Elexant 4010i/4020i offers multiple protection functions including ground-fault protection, output switch protection, safety limiter and circuit breaker protection. See Section 3.1.3.2 for a detailed description of these protection functions.

1.1.2.7 Communication

Elexant 4010/4020i units come equipped with RS485 and Ethernet ports and can be readily connected to a host PC running Windows based Raychem Supervisor software for central programming, status review, and alarm annunciation or to a distributed control system (DCS). Elexant 4010/4020i units support the Modbus protocol either by Modbus RTU or by Modbus/TCP. An optional module can be included on some controller variants to allow Profibus communication. See Section 3.3 for more details.

1.2 Vital Information

This manual is a guide for the setup and operation of the Elexant 4010i/4020i Heat Tracing Controllers.

IMPORTANT: All information, including illustrations, is believed to be reliable. Users, however, should independently evaluate the suitability of each product for their particular application.

Chemelex makes no warranties as to the accuracy or completeness of the information and disclaims any liability regarding its use.

Chemelex only obligations are those in the Chemelex Thermal Standard Terms and Conditions of Sale for this product, and in no case will Chemelex or its distributors be liable for any incidental, indirect, or consequential damages arising from the sale, resale, use, or misuse of the product. Specifications are subject to change without notice. In addition, Chemelex reserves the right to make changes—without notification to Buyer—to processing or materials that do not affect compliance with any applicable specification.

1.3 Technical Support

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2. INSTALLATION AND WIRING

2.1 Initial Inspection

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been verified for completeness and the equipment has been checked mechanically and electrically. If the shipment is incomplete or shows visible damage, notify the nearest Chemelex representative.

2.2 Operator Safety Considerations

The Elexant 4010i/4020i controllers using Solid State Relays are suitable for Class 1, Division 2, Groups A, B, C, and D hazardous areas and is IEC Ex/ATEX Zone 2 approved. Variants using EMR are suitable for
non-hazardous areas only.

Refer to the Elexant 4010i Installation Manual (H59271) and the Elexant 4020i Installation Manual (H59270) for more details.

2.3 Elexant 4010i/4020i Assembly

The figure below displays the different physical assemblies for 1-Phase (Elexant 4010i) and 3-Phase (Elexant 4020i) variants of the unit.

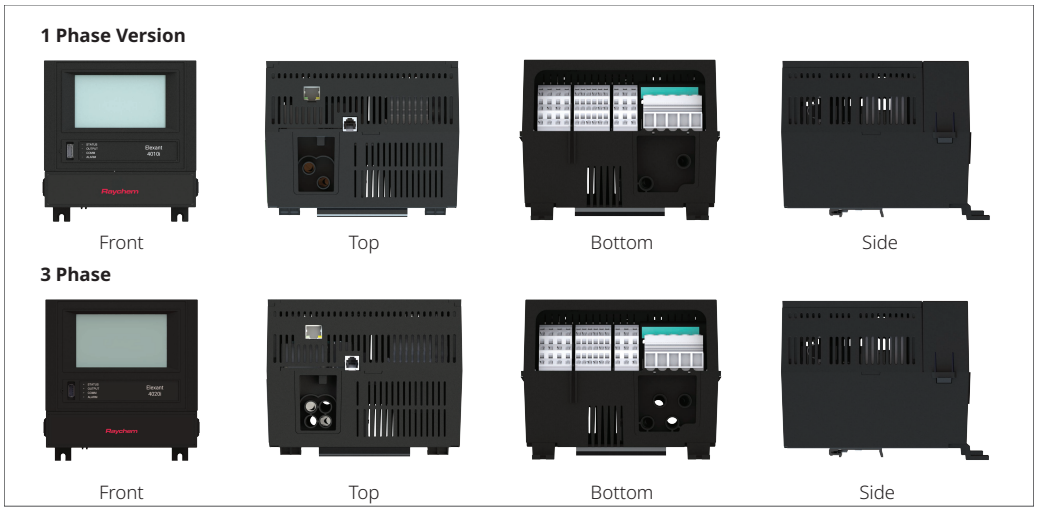


Figure 1 - The Elexant 4010i/4020i Assembly

2.4 Connection and Indicators

The figure below displays the various connections and indicators for the Elexant 4010i/4020i unit.

CONNECTIONS AND INDICATORS

A. TB1 Wiring

Terminals	Function
1	TS1 (White)
2	TS1 (Red)
3	TS1 (Red)
4	TS2 (White)
5	TS2 (Red)
6	TS2 (Red)
7	TS3 (White)
8	TS3 (Red)
9	TS3 (Red)
10	TS Lim (White)
11	TS Lim (Red)
12	TS Lim (Red)

B. TB2 Wiring

Terminals	Function
1	TC3+
2	TC2+
3	TC1+
4	TC3–
5	TC2–
6	TC1–
7	– No Connect
8	SSR–
9	SSR+
10	DIGITAL INPUT (COM)
11	DIGITAL INPUT 1
12	DIGITAL INPUT 2
13	RS485 IN+
14	RS485 IN–
15	RS485 COM
16	RS485 OUT+
17	RS485 OUT–
18	RS485 COM

C. TB3 Wiring

Terminals	Function
1	24V+ OUT
2 ⚠	Limiter Relay
3 ⚠	Output Relay
4	24V COM
5 ┐	External Jumper Required
6 ┘	External Jumper Required
7 ⚠	Alarm_NC
8 ⚠	Alarm _COM
9 ⚠	Alarm_NO

D. TB4 Wiring

Terminals	Function
1 ⚠	EGND
2 ⚠	POWER IN (L1)
3 ⚠	POWER IN (L2/N)
4 ⚠	L1 ACV Sense
5 ⚠	L2/N ACV Sense

⚠ WARNING: Shock Hazard. Disconnect from live voltage prior to accessing terminals

E. Status LEDs

Status:	Indicates status of Elexant 4020i module
Off	No power
Green	Normal operation, no internal faults
Red	Device Reset
Flash R/G	Unlocked/Calibrated
Output	Shows status of switched output
COMM	
Flash Green	Receive Active
Flash Red	Transmit Active
Alarm	
Red	Illuminates when an alarm is tripped

F. USB Connector

G. Ethernet Connection



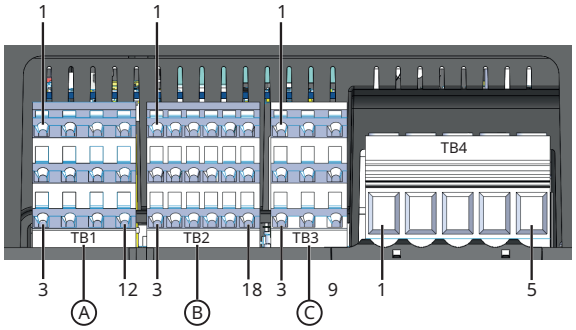


Figure 2 - Connections and Indicators

2.5 Mounting/Removal Procedures

2.5.1 Elexant 4010i mounting/removal procedure

Mounting and removal of the Elexant 4010i and 4010i-IS should only be attempted by trained personnel. If this is needed, contact Chemelex Technical Support (See Section 1.3).

2.5.2 Elexant 4020i mounting/removal procedure

2.5.2.1 Elexant 4020i mounting procedure

Insert the rear top of the module into the DIN rail, then push down and inwards to engage the clip.

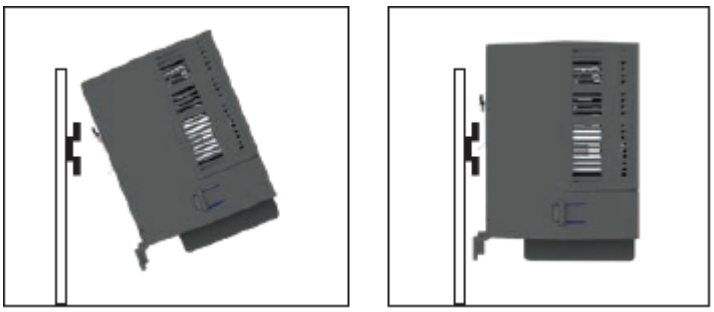


Figure 3 - Mounting the Elexant 4020i Unit

2.5.2.2 Elexant 4020i removal procedure

Push the module downwards to disengage the clip, then rotate the module towards yourself.

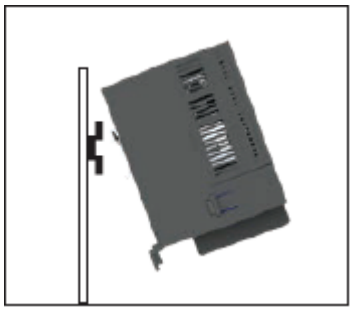


Figure 4 - Removing the Elexant 4020i

2.6 Wiring and Interfaces

2.6.1 Input Power

The input power connection is made at the screw terminals on TB-4. The incoming field earth/ground connection should be terminated on the field terminal block located on the mounting plate in the enclosure. Connect earthing or grounding wire to terminal 1 of TB-4, Line 1 to terminal 2 of TB-4, Line 2 or neutral to terminal 3 of TB-4 as shown in the figure below. For Elexant 4010i assemblies, the module earthing/grounding wire will be pre-wired at the Factory.

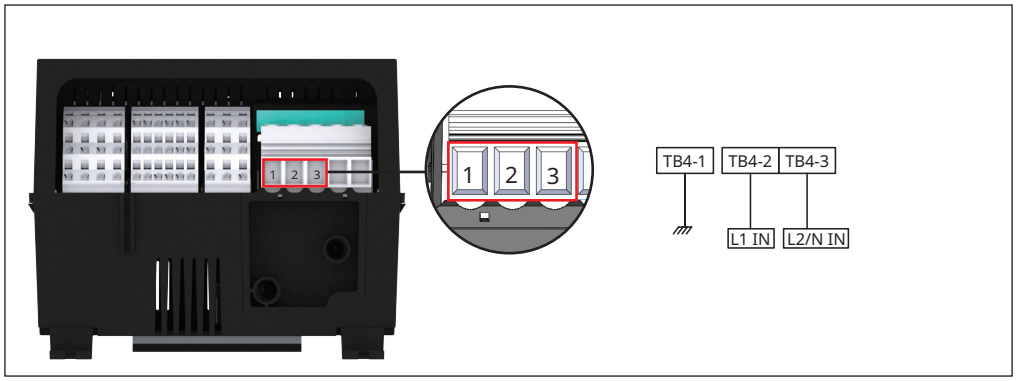


Figure 5 - Input Power

2.6.2 Load Connections:

This section applies only to Elexant 4010i-Mod units.

Connections are made to the load using screw terminals on TB4. All variants use the same output connection.

Load ground terminations are to be made on the field terminal block located on the mounting plate in the enclosure.

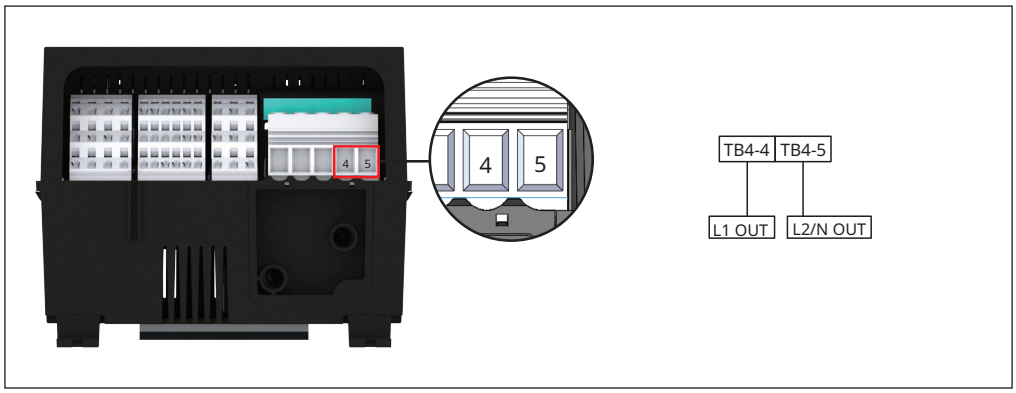


Figure 6 – Elexant 4010i - Load Connections

2.6.3 AC Voltage Sense

This section applies only to Elexant 4020i units.

These input terminals are used to sense the load voltage and may be directly connected to the load or may be fed from an external step-down transformer. Connect either Line to Neutral (L-N) or Line to Line (L-L) of the load power for AC Voltage sensing features (277 VAC Maximum). Line 1 and Line 2 for ACV Sense are input to terminals 4 and 5 of TB-4 respectively as shown in the figure below.

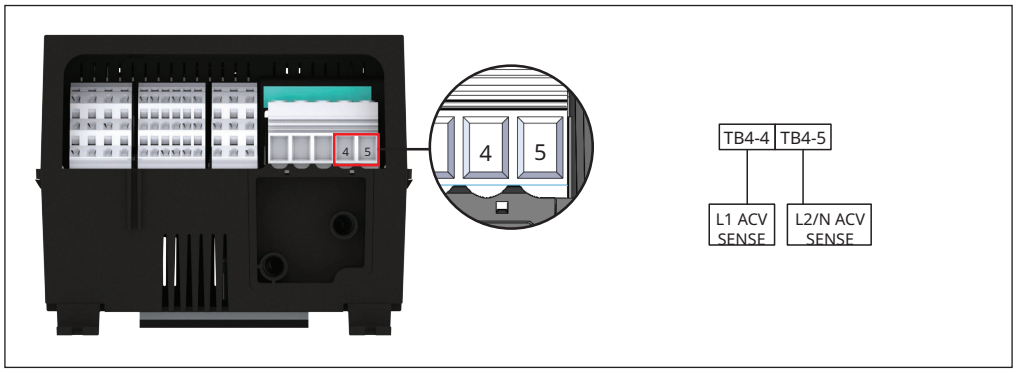


Figure 7 – Elexant 4020i - AC Voltage Sense

2.6.4 RS-485 IN

RS-485 IN along with RS-485 OUT are used for setting up series RS-485 communications connections when using multiple controller modules.

Wiring for the RS-485 data connections may be terminated directly on the module TB-2 terminal blocks as shown or on panel mounted terminal blocks. Shielded cables should not be terminated on terminals of TB2. Terminate RS-485 cable shields on panel mounted field terminals as shown in the figure below.

Note: For best performance, an additional third signal ground wire is connected between TB2-15 (COM) and the signal ground of the upstream device. This wiring method will reduce noise induced through ground potential differences.

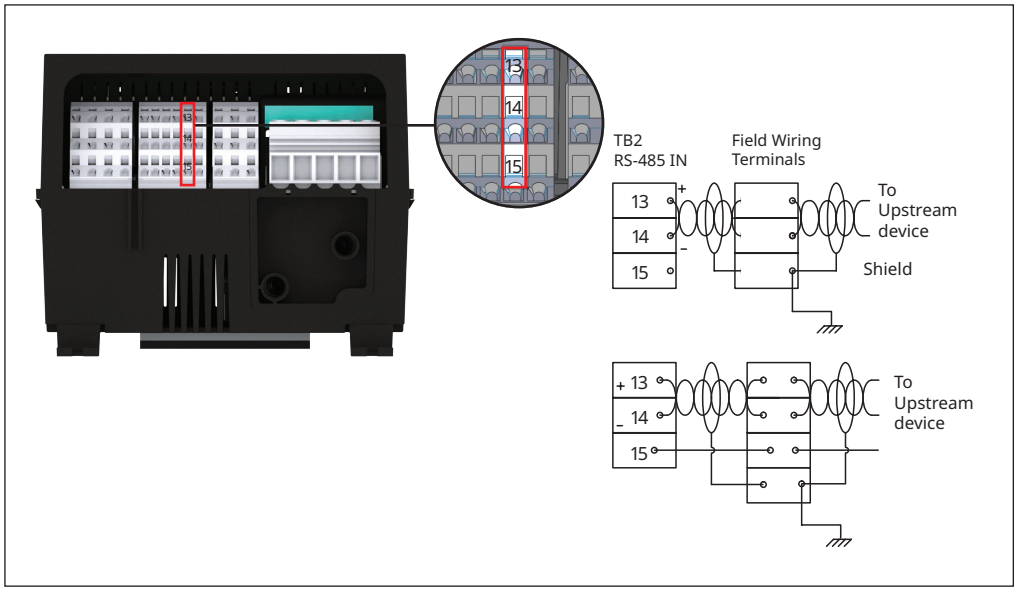


Figure 8 - RS-485 IN

2.6.5 RS-485 OUT

Wiring for the RS-485 data connections may be terminated directly on the module TB-2 terminal blocks as shown or on panel mounted terminal blocks. Shielded cables should not be terminated on terminals of TB2. Terminate RS-485 cable shields on panel mounted field terminals as shown in the figure below.

Note

- Install a 120 Ohm termination resistor as shown if this is the last device in the communication bus.

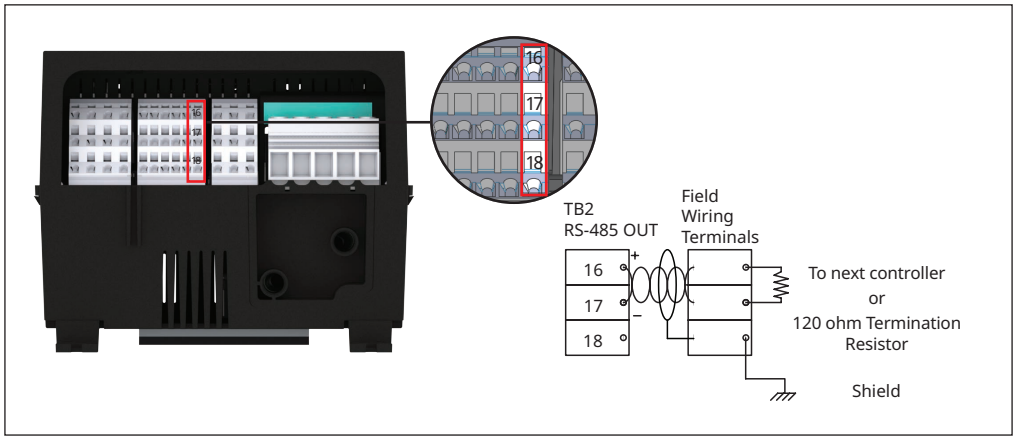


Figure 9 - RS-485 Out

2.6.6 Ethernet

An Ethernet communications connection can be made via the RJ45 connector using a CAT 5E cable. The RJ45 port is available at the top of the unit as shown in the following figure.

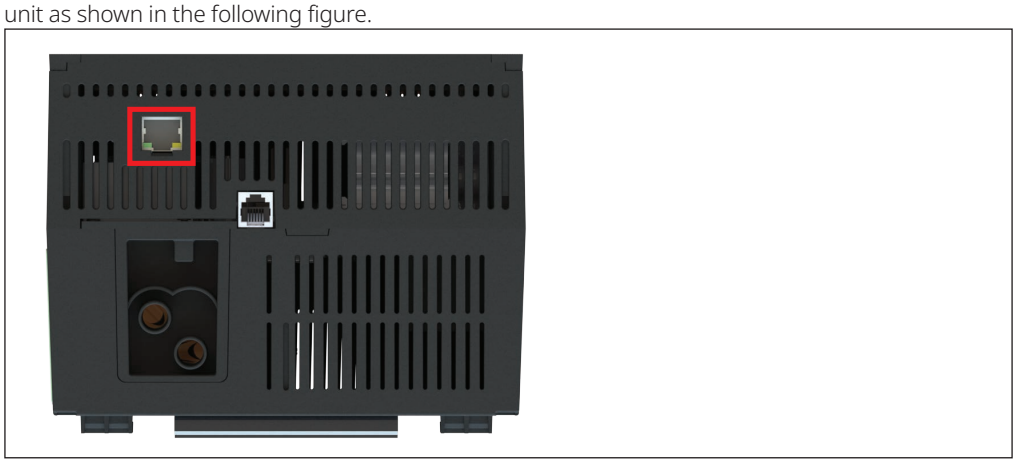


Figure 10 - Ethernet port

2.6.7 USB Connector

The USB connector on the front of the unit can be used to import/export User Settings to simplify the commissioning process and for updating the controller firmware.

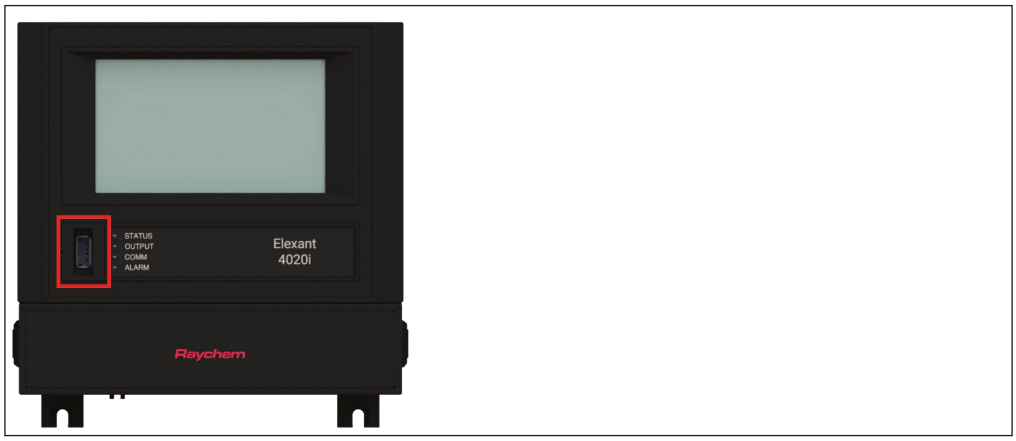


Figure 12 - USB Port on the Elexant 4010i/4020i

2.6.8 Reset Button

The reset button is located just left of the USB port. This reset button can be used to force a controller reset or Graphical User Interface (GUI) calibration if the GUI becomes un-useable. See Section 5.14.4 for detailed instructions on GUI calibration.



Figure 13 - Reset button on the Elexant 4010i/4020i

2.6.9 3-Wire RTD Connections

RTD (Resistance Temperature Device) field wires may be terminated on terminal block TB-1 (terminals 1 to 12). A non-limiter version of the controller can accept up to three 3-wire RTD inputs and a limiter version of the controller can accept up to four 3-wire RTD inputs. Connections are the same for all of the three 3-wire RTD inputs and optional fourth input for the Limiter. Terminate all cable shields on external panel mounted field terminal blocks.

Note: If a unit has a Limiter, the Limiter's RTD must be connected and operational for the control output to work. See Section 4.1 for a detailed description of the Safety Limiter.

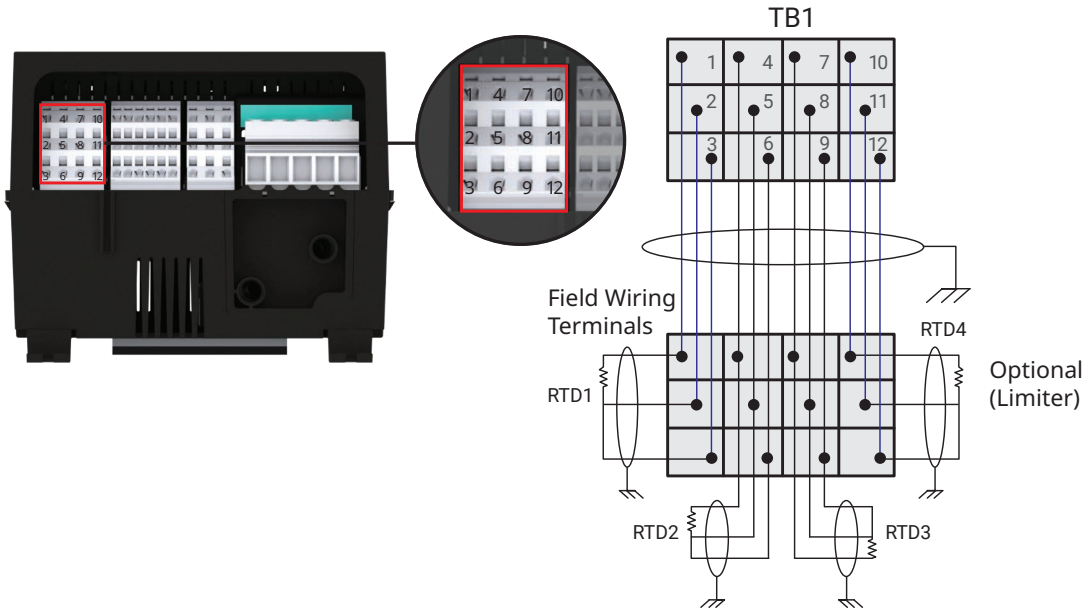


Figure 14 - 3-wire RTD connections

2.6.10 2-Wire RTD Connections

RTD (Resistance Temperature Device) field wires may be terminated on block TB-1 (terminals 1 to 9). A maximum of three 2-wire RTD inputs can be connected. Connections are the same for all of the three 2-wire RTD inputs. Terminate all cable shields on external panel mounted field terminal blocks.

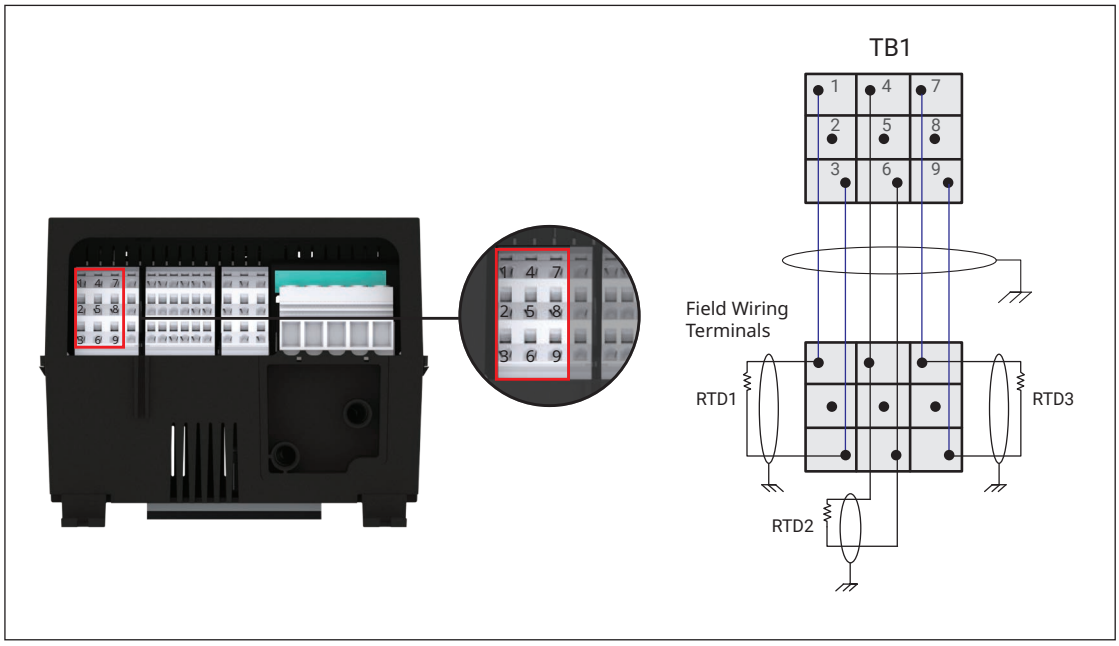


Figure 15 - 2-Wire RTD connections

2.6.11 4-20 mA Connections

Wiring for 4-20 mA connections may be terminated on terminal block TB-2 (terminals 1 to 6).
Connections are the same for all of the three 4-20 mA channels. Terminate all cable shields on external panel mounted field terminal blocks.

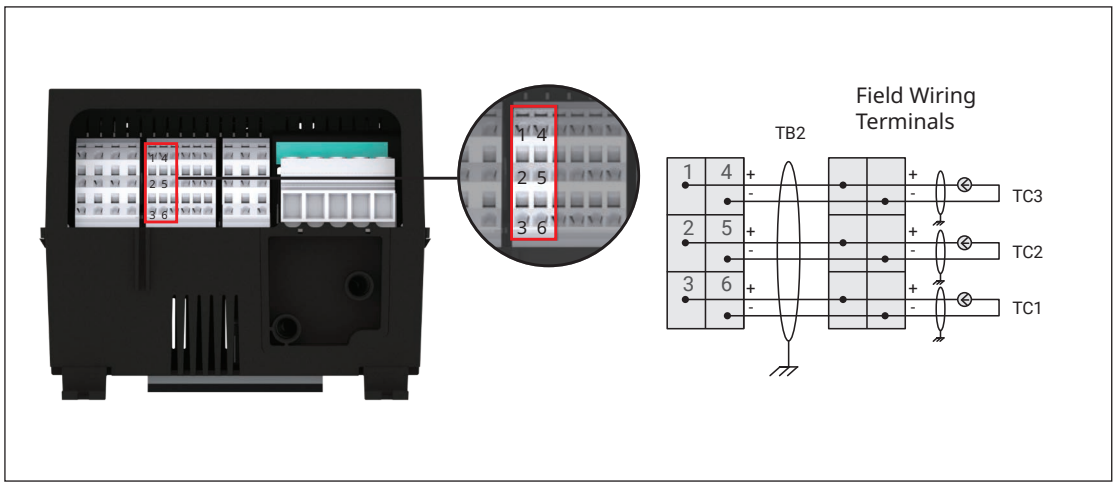


Figure 16 - Elexant 4-20 mA Connections

2.6.12 Connections to SSRs

The control output connections to SSRs are made using TB2 (terminals 8 and 9). Note the polarity of the output connections.

CAUTION: Shock hazard, disconnect from live voltage before accessing terminals.

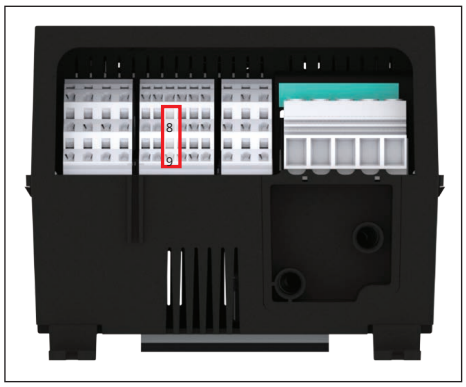


Figure 17 - Terminals 8 and 9 on TB2

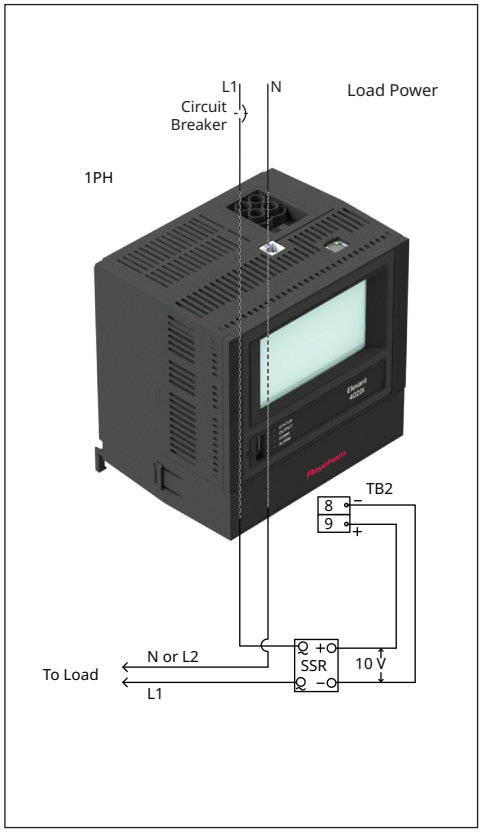


Figure 18 – Elexant 4020i Single Phase One Pole - Connections to SSR

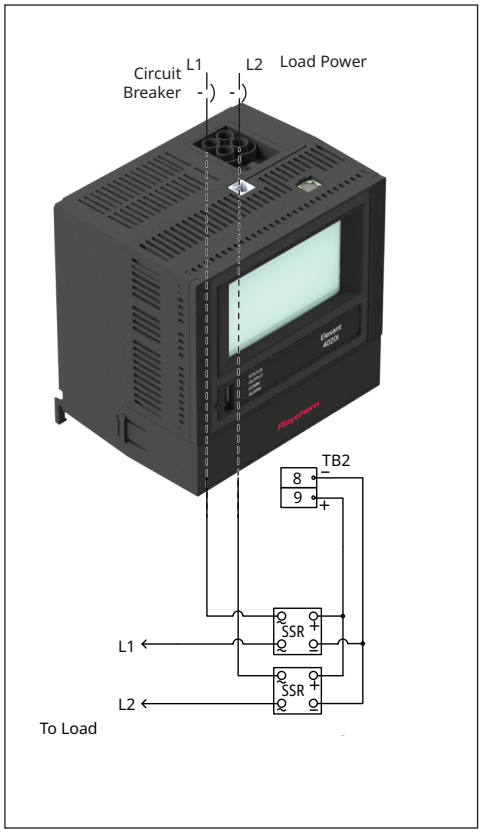


Figure 19 – Elexant 4020i Single Phase Two Pole - Connections to SSRs

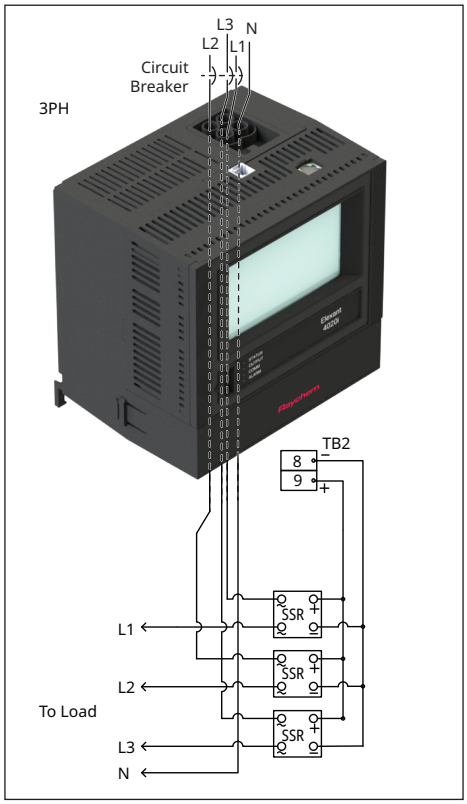


Figure 20 – Elexant 4020i Three Phase - Connections to SSRs

2.6.13 Alarm Relay

The alarm relay (terminals 7,8,9 of TB3) is energized in the normal state (when there are no alarms), and configured as Fail Safe. The alarm relay connections provide a Form C dry contact, rated at 277 V maximum (3 A).

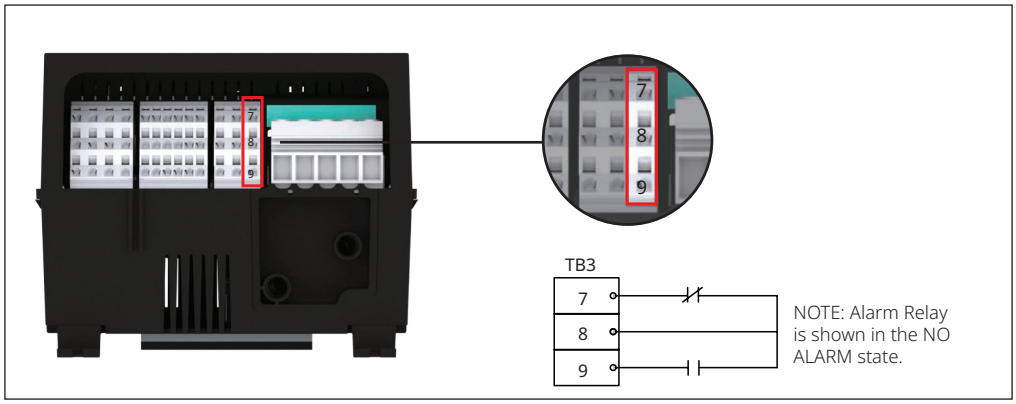


Figure 21 - Alarm Relay

2.6.14 Digital Inputs

The Elexant 4010i/4020i provides multi-purpose inputs (terminals 10,11,12 of TB2) for connection to external dry (voltage-free) contacts or DC voltages for extending the functionality of the controller. Digital Inputs support a maximum of 100 Ohm loop resistance or may be used with 0 to 24 VDC @ 1 mA maximum voltages.

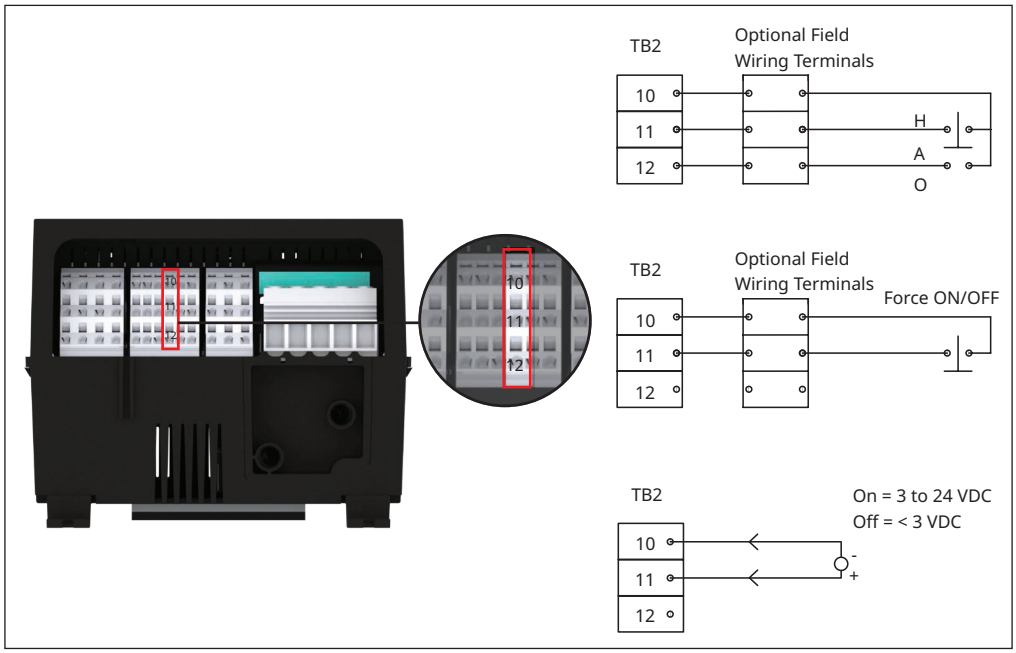


Figure 22 - Digital Inputs

2.6.15 AUX 24V Output

The 24V DC output (terminals 1, 4 of TB3) may be used to connect peripheral equipment, if required. The Aux 24V output has a rating of 24Vdc, max load of 250mA @ 40°C, de-rated to 165mA @ 60°C.

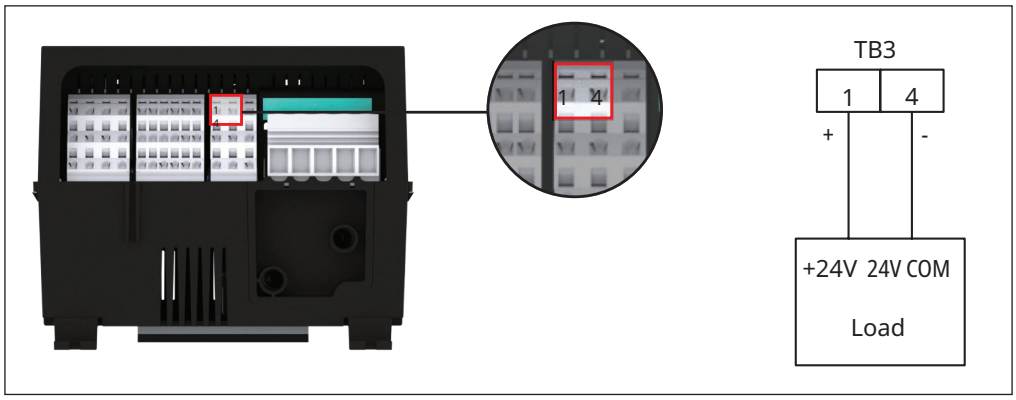


Figure 23 - AUX 24V Output

2.6.16 Limiter Relay Output

When using optional Limiter variants, the Limiter Relay output (Terminal 2 of TB3) drives an external limiter contactor coil. Note that this is a wet contact, and provides an output voltage derived from the incoming module power. The Limiter contactor is placed in line with the load connections to ensure that when the Limiter has tripped, the Limiter contactor will interrupt the power to the load heating circuit. See Chapter 4.1 for detailed description of limiter functionality.

Note: Limiter Relay Output is not available on Elexant 4010i units.

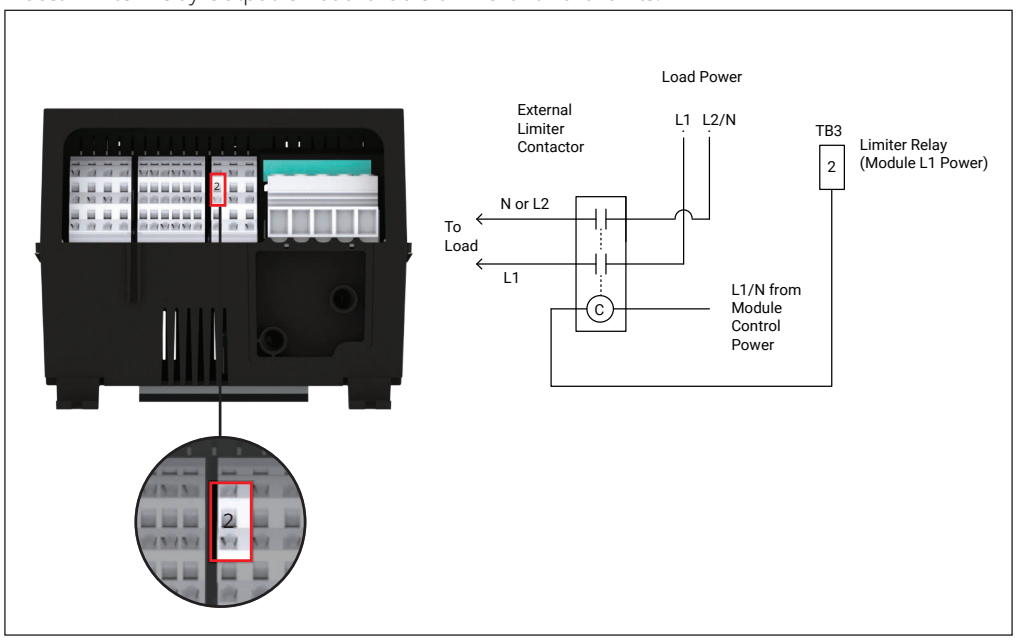


Figure 24 – Elexant 4020i - Limiter Relay Connections

2.6.17 Contactor Output

When used, the Contactor output (Terminal 3 of TB3) drives the load contactor. Note that this is a wet contact, and provides an output voltage derived from the incoming module power. The load contactor is placed in line with the load connections.

Note: When using Limiter modules, the Limiter output (see Section 2.6.17) also needs to be energized in order for the Electric Heat-Tracing (EHT) to be powered.

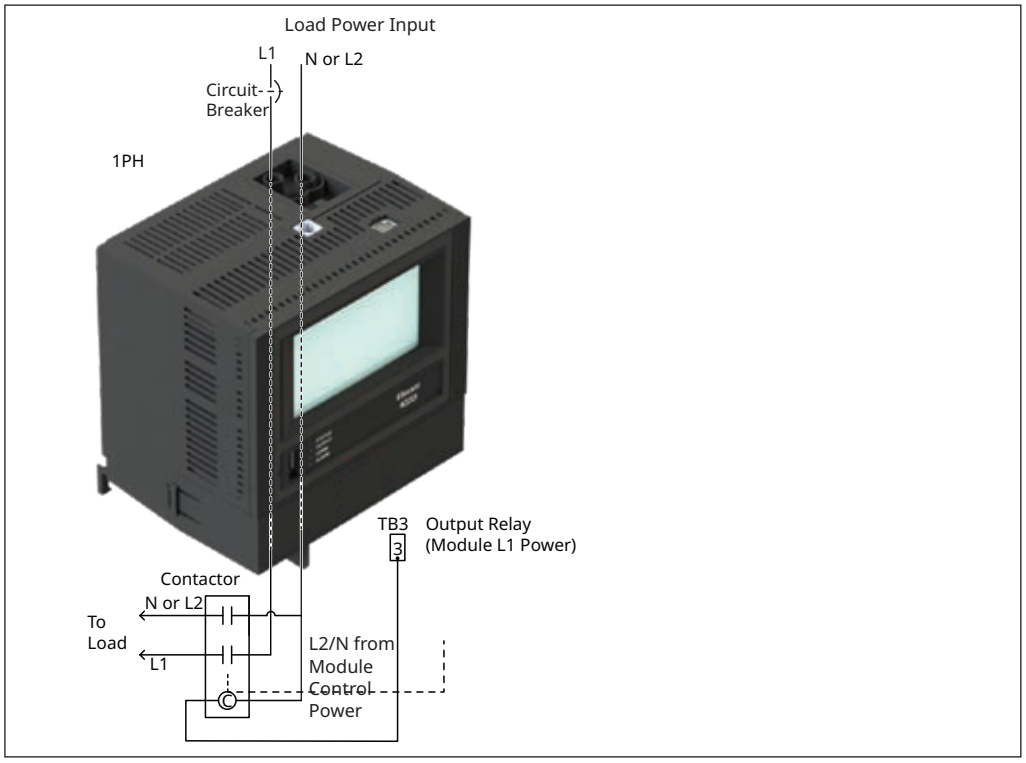


Figure 25 – Elexant 4020i Single Phase - Contactor Output Connections

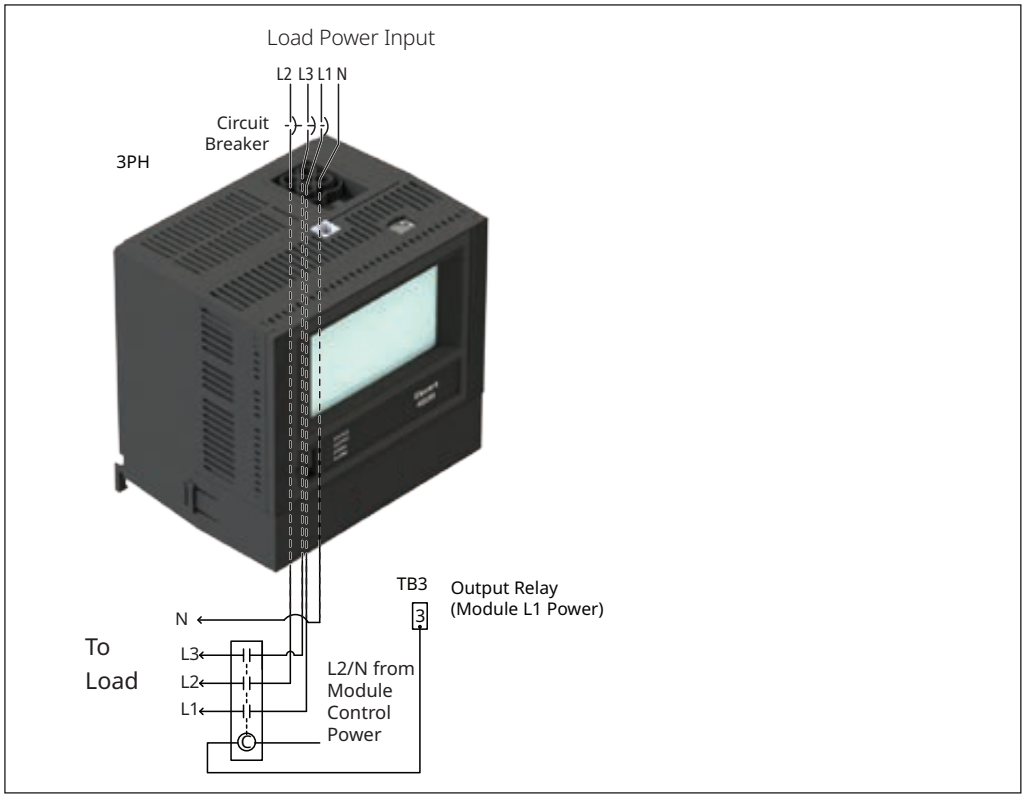


Figure 26 – Elexant 4020i Three Phase - Contactor Output Connections

3. PRODUCT OPERATIONS

3.1 Control Features

This section describes the control features available in the Elexant 4010i/4020i controllers and how to set their associated parameters.

3.1.1 Output Type

The Elexant 4010i/4020i controller supports both Electro-Mechanical Relay (EMR) and Solid-State Relay (SSR) outputs.

WARNING: Ensure that the Output Type is correctly chosen for your installation.

3.1.1.1 Contactor Output (Default)

This contactor output type is used for EMR variants of Elexant 4010i and Elexant 4020i that are connected to contactors. The output is inhibited from changing its state for two seconds after a previous state change. As a result, this output type is incompatible with algorithms and features that rely on rapid switching, but helps prolong the switch life.

Available Control Algorithms: On/Off, PASC, Always On, Always Off.

Available Protection Algorithms: High Temperature Cut-out, Low Temperature Cut- out, Ground Fault Trip.

3.1.1.2 SSR Output

Solid-State Relay (SSR) control is appropriate for applications requiring rapid switching. This includes installations using all common electric heat tracing cables, including series, parallel, self-regulating and constant wattage types, and applications requiring equipment protection algorithms. When using the SSR Output control type, the Contactor Output is held in a user defined state continually, unless the SSR fails. In that case, the Contactor output is switched to the opposite state. This allows the Contactor output to be used to control a secondary switching device to turn off the load.

Available Control Algorithms: On/Off, PASC, Proportional, Always On, Always Off.

Available Protection Algorithms: Output Limiting, Switch (SSR) Protection, Circuit Breaker Protection, High Temperature Cut-out, Low Temperature Cut-out, Ground Fault Trip.

3.1.1.3 Analog SSR

This output may be used to control an external analog device using a 0-10VDC signal that is proportional to a 0-100% output duty cycle. This signal is designed for integration with external switching devices. Therefore, features that require the knowledge of the switch state at a given moment in time are disabled under this output type.

Available Control Algorithms: On/Off, PASC, Proportional, Always On, Always Off.

Available Protection Algorithms: High Temperature Cut-out, Low Temperature Cut-out, Ground Fault Trip.

3.1.2 Control Mode Algorithms

This section describes the different control mode algorithms available in the Elexant 4010i/4020i and how to set their associated parameters.

3.1.2.1 On/Off (Default)

The controller monitors the temperature of the heating circuit and compares it to the setpoint temperature. If the measured temperature is above the control temperature setpoint by more than the Deadband value, the output is turned off. If the control temperature falls below the control temperature setpoint, the output is turned on. When the control sensor temperature is within the dead band, the output does not change its state.

Control Sensor Temperature	Output State
Setpoint + deadband	Off
Setpoint or below	On
Within deadband	No change

Table 3 - On/Off Control Status

3.1.2.2 PASC (Proportional Ambient Sensing Control)

The PASC algorithm maintains the temperature of the device being heated using the ambient temperature, while minimizing energy consumption and wear on the contactor. It uses the measured ambient temperature, desired maintain temperature, minimum ambient temperature assumption used during design, and size of the smallest pipe diameter to calculate how long the heater should be on or off to maintain a near-constant pipe temperature.

PASC takes advantage of the fact that the heat loss from a pipe is proportional to the temperature difference between pipe and the ambient air. This is true regardless of heater type, insulation type, or pipe size. Once the heat tracing and insulation on a pipe has been designed to balance heat input with heat loss and maintain a particular temperature, the main variable in controlling the pipe temperature becomes the ambient air temperature.

This approach greatly reduces the amount of energy used in ambient temperature control applications versus traditional ambient temperature control.

3.1.2.3 Proportional

The Proportional algorithm monitors the temperature of the heating circuit and compares it to the setpoint temperature. If the measured temperature is at or below the setpoint temperature, then power is applied to the heat trace circuit with a duty cycle of 100%. If the temperature is equal to or greater than the setpoint temperature + proportional band, then the relay output will have a duty cycle of 0%. The temperature is constantly monitored, and the output duty cycle is adjusted proportionally once per second.

Control Sense Temperature	Duty Cycle
Setpoint + proportional band	0%
Setpoint + proportional band / 2	50%
Setpoint	100%

Table 4 - Proportional Control vs Duty Cycle

Note: When using Solid State Relay (SSR) and Analog SSR modes to precisely control the power applied to a heating circuit, the output may be switched on/off very rapidly. Therefore, the proportional control mode should not be used with EMR (contactor) output types.

3.1.2.4 Always On

The controller output is permanently switched on and power is applied to the heat trace circuit.

3.1.2.5 Always Off

The controller output is permanently switched off and power is removed from the heat trace circuit.

3.1.3 Output Overrides

This section lists situations where the normal control decision can be overridden: e.g. Digital Input (Hand/Off/Auto), Load Shedding, Temperature Cut-out, Protection Trips, Start-up delay, Configuration Loss, and Limiter Trip.

The list of overrides in the order of increasing priority is given below:

Priority	Status	Description
0	Normal	Heat trace is behaving according to the chosen control algorithm
1	Always On	The Always On control mode is in use. (See Section 3.1.2.4)
2	Trace Test	Trace test is currently active. (See Section 5.10.4.6)
3	Always Off	The Always Off control mode is in use. (See Section 3.1.2.5)
4	Load Shed Active	The load shedding feature is active. (See Section 3.1.3.2.8)
5	Load Shed Failsafe	Load shedding failsafe is active. (See Section 3.1.3.2.8)
6	Force Off	The digital input is forcing the controller off. (See Section 3.1.3.1)
7	Force On	The digital input is forcing the controller on. (See Section 3.1.3.1)
8,9	----	N/A
10	Temp Limit Cut out	Either the high or low temperature limit cut out has shut the controller off. (See Section 3.1.3.2.1 or 3.1.3.2.2)
11	Switch Failure	The switch failure alarm is active, and the output is inhibited.
12	SSR Overcurrent	The SSR exceeds its rated current by more than the protection algorithm will allow.

Priority	Status	Description
13	Ground Fault CT Failure	The ground fault current transformer is damaged, and the controller is unable to determine whether a ground fault exists. The output is inhibited.
14	Ground Fault Tripped	The ground fault exceeded its trip setpoint and the output is inhibited.
15	Start Up Delay	During the start-up period, the output is inhibited.
16	Lost Config	The internal memory of the controller is damaged, and its settings are lost. The unit should be returned to the factory.
17	Limiter Trip	The safety limiter has tripped. The output is de-energized.

Table 5 - Output Overrides

3.1.3.1 Digital Input (Default: Not Used)

The Digital Input allows simple external devices to extend the functionality of the controller. The 24V tolerant digital input (which can also accept 5V logic levels or dry contacts), asserts an alarm or overrides the control algorithm to force the output on or off. It also supports HOA (Hand/Off/Auto) functionality.

Use of a digital input overrides normal control. Other overrides have a higher priority. If the switch does not produce the desired output override, check the trace control status to determine the cause.

See Section 3.1.3 - Output Overrides for a list of overrides in increasing priority for more details.

All overrides of higher priority than the digital input switch the output off.

WARNING: Do not rely on this feature when performing any electrical work on the system. Always switch off power and use proper lock out/tag out procedures to ensure a safe work condition.

3.1.3.2 Equipment Protection

The Elexant 4010i/4020i offers multiple protection functions including the following:

3.1.3.2.1 High Temperature Cut-out (Default: Disabled)

The High Temperature Cut-out protection algorithm may be used to limit the temperature of the heating cable by using additional temperature sensors. When the High Temperature Cut-out Setpoint is reached by any individual sensor configured for high temperature cutout, the Elexant 4010i/4020i's output is turned off regardless whether or not the Control Temperature has reached the Control Temperature Setpoint. Use this protection algorithm to prevent the heating cable surface temperature from exceeding a desired temperature.

Note: This High Temperature Cut-out is not the same as the safety temperature cutout offered by the Limiter option. This Cut-out feature uses the same sensors and control circuitry that are used for the main control functionality. For applications that require independent Cut-out functionality, use an Elexant 4020i with integrated Limiter option. Refer to Section 3.1.3.2.7 Safety Limiter for more details.

3.1.3.2.2 Low Temperature Cut-out (Default: Disabled)

The Low Temperature Cut-Out protection algorithm prevents the heating cable from being powered on while temperatures drop below the minimum acceptable temperature for the heating cable. If the measured temperature is below the Low Temperature Cut-Out Setpoint, the control output will be turned OFF until the measured temperature returns to a value above the Low Temperature Cut-Out value.

3.1.3.2.3 Ground Fault Trip (Default: Enabled)

The Elexant 4010i/4020i includes ground fault (earth leakage) detection to protect connected equipment from excessive ground fault current.

The Ground Fault Trip setpoint is used to set the upper limit value for allowable ground fault leakage current. If the Ground Fault Trip setpoint is exceeded, the power to the heating circuit will be disconnected.

The ground fault protection implementation conforms to UL 1053. This standard is for equipment protection, and is not a human safety device for ground faults.

3.1.3.2.4 Output Limiting (Default: None)

The Output Limiting protection algorithms are used to limit the output of the controller to a specified value based on average current, average power, or output duty cycle. The controller measures the voltage and current of the tracing circuit and controls the output switch to limit the amount of power or current applied to the trace.

The Output Limiting feature is only available when the Solid State Relay (SSR) Output Type is selected.

3.1.3.2.5 Circuit Breaker Limiting (Default: Disabled)

The Circuit Breaker Limiting protection algorithm is used to minimize circuit breaker nuisance tripping due to temporary in-rush current caused by the EHT circuit. The circuit breaker limiting feature is always enabled when using an SSR output switch.

3.1.3.2.6 Solid State Relay Switch Protection (Default: Disabled)

The SSR Switch Protection algorithm may be used to protect an SSR from damage due to temporary in-rush current caused by the heating cable.

3.1.3.2.7 Safety Limiter

The Safety Limiter provides an independent high temperature cut-out capability suitable for use in safety critical applications. It disconnects power to the heating circuit, preventing the EHT system from
exceeding a safe temperature level. The safety limiter functionality is only available on the LIM model. See Section 4.1 for additional details.

3.1.3.2.8 Load Shedding (Default Settings: Disabled)

The Load Shedding feature may be used to force off the output of one or more controllers in order to reduce energy consumption and avoid peak demand surcharges, or remove power from heating circuits which may be subjected to steam cleaning.

Load shedding override may be programmed and initiated only by a Modbus Master such as PC with Raychem Supervisor software. This mode overrides the temperature control and forces the
output of the control module to remain off until reset by the Modbus Master.

Up to 8 load shedding groups (zones) may defined, with each controller allowing association with one or more load shedding groups. Once a load shedding command has been initiated for a particular group, each controller associated with that group will go into load shedding mode.

If the controller is a member of a zone where load shedding is active, the output of the controller is held in the off state until one of following three conditions occurs:

1. The Modbus Master that initiated load shedding issues a load shedding command to terminate load shedding mode.
2. Communications are interrupted between the controller and the Modbus Master (e.g. a damaged communications wire). If the communication ceases for a specified timeout value (60s to 600s), the controller will return to normal operation.
3. Failsafe operation begins. See Section 5.6.6 for details on Load Shedding Failsafe Operation.

3.2 MONITORING

This section describes the various parameters that are used by the Elexant 4010i/4020i to ensure EHT system integrity.

3.2.1 Temperature

The following sections contain the configuration parameters and each of the measured and calculated temperatures that the Elexant 4010i/4020i Monitor Module provides to the user.

3.2.1.1 Control Temperature (Default settings: Lowest, Fail Off, TS1)

Purpose: This is the temperature that the controller uses to determine whether its output switch should be on or off. The temperature can be aggregated into the lowest or average of the configured sensors. Depending on the number of sensors installed and configured, the CONTROL TEMPERATURE may be derived from any combination of the temperature sensors or 4-20 mA inputs.

See Section 5.1.1 for further details regarding the Control Temperature settings.

3.2.1.2 TS X Temperature Reading (TS1, TS2, TS3)

Purpose: This temperature is the measured value from the controller's specific temperature sensor input (TS X where X = sensor input 1, 2, or 3 as appropriate). Depending on the TS CONTROL MODE, it may be used to determine the CONTROL TEMPERATURE or only used as a monitoring input. The device detects and reports each sensors' status – as: Valid (temperature detected), Not Ready (during start-up), Failed (no valid reading), Open circuit (some or all of the sensor leads are open), or Short Circuit (some or all of the sensor leads have been shorted to each other).

IMPORTANT: If the TS X input is not being used by the controller, the TS X TEMPERATURE is not displayed.

3.2.1.3 Control/ Monitor Toggle

Purpose: This parameter selects the use of the sensor for control or monitoring purposes. When the sensor is configured for control, its reading is aggregated into the CONTROL TEMPERATURE and can trigger control decisions or High or Low temperature alarms. When the sensor is configured to monitor, it provides a temperature reading for reference.

TS1 Default: Control
TS2 Default: Monitor
TS3 Default: Monitor

3.2.1.4 Temperature Limiting

Purpose: Each sensor can be configured for High or Low Limit Cut-out where its reading will be used to make override decisions when the measured temperature exceeds the related setpoints. See Section 3.1.3.2.1 and 3.1.3.2.2 for details on High and Low Cut-out.

3.2.1.5 Tag

Purpose: This parameter is a 40-character tag that may assigned to each temperature sensor input for easy identification.

Range: Alpha-numeric characters, 40 max.

Default: Elexant 4010i/4020i-TSx--xxxxxx.

Example: Elexant 4010i/4020i-TS1-123456

3.2.1.6 Type

Purpose: This parameter is used to denote the type of RTD that is being used as a Temperature Sensor. Valid selections are: None, 3-wire 100-Ohm Platinum, 2-wire 100-Ohm Nickel Iron, a 2-wire 100-Ohm Nickel RTD, or a 4-20 mA input.

TS1 Default: 3-wire 100-Ohm Platinum
TS2 Default: None
TS3 Default: None

3.2.1.7 Lead Resistance

Purpose: This parameter is applicable only to 2-wire 100-Ohm Nickel Iron and 2-wire 100-Ohm Nickel RTDs. Since a 2-wire RTD has no compensation for lead resistance, entering a value will allow the
temperature reading to be corrected to compensate for this lead resistance.

Range: 0 to 20 Ohms.

Default: 0 Ohms.

3.2.1.8 High/Low Temperature Alarm Settings

Note: see Section 3.5.2 for more details on alarm functionality.

a. Enable

Purpose: This parameter is used to enable or disable the activation of the High/Low Alarms.

High Temperature Alarm Defaults:

TS1: Disabled
TS2: Disabled
TS3: Disabled

Low Temperature Alarm Defaults:

TS1: Enabled
TS2: Disabled
TS3: Disabled

b. Latch

Purpose: This parameter is used to configure the behavior of the High/Low Alarm conditions. Disabling the Latch function will allow the alarm to self-clear once the alarm condition has resolved. Enabling
latching will keep the alarm active until it is reset by the user or the controller is reset (by a cycling the power on/off for example).

High Temperature Alarm Latch Defaults:

TS1: Disabled
TS2: Disabled
TS3: Disabled

Low Temperature Alarm Latch Defaults:

TS1: Disabled
TS2: Disabled
TS3: Disabled

c. Setpoint

Purpose: This parameter is used to enter a temperature value at which the controller sets the High/Low Alarm indicator.

Range: –200°C to 700°C.

Default High Alarm Setpoint: 100°C.
Default Low Alarm Setpoint: 5°C.

d. Filter

Purpose: Filter is the minimum amount of time that a High/Low Alarm condition must exist before the controller sets the High/Low Alarm indicator.

Range: 0 to 59940 seconds.

Default: 0 Seconds

3.2.1.9 Failure Alarm Settings

e. Enable

Purpose: This parameter is used to enable the controller to indicate when the unit is unable to measure a valid temperature due to a sensor open or short circuit condition. See Section 3.5 for more details.

TS1 Default: Enabled
TS2 Default: Disabled
TS3 Default: Disabled

f. Latch

Purpose: This parameter is used to configure the latching behavior of the Failure Alarm indicator.

TS1 Default: Enabled
TS2 Default: Enabled
TS3 Default: Enabled

3.2.1.10 Control Temperature Fail Mode (Default settings: Fail Off)

Purpose: In the event that the controller cannot read a valid temperature from any of its control temperature inputs, the output state of the controller can be configured for one of the following modes:

Mode	Description
Off	The controller output remains off until at least one valid control temperature reading is restored.
On	The controller output remains on until at least one valid control temperature reading is restored.
Fixed%	The controller output is held at a fixed duty cycle until at least one valid control temperature reading is restored. When this mode is selected an additional control will appear to allow the user to enter the desired duty cycle, as shown in Section 5.4.3
Last%	The controller output is held at the same duty cycle that existed at the moment of the failure. This state continues until at least one valid control temperature reading is restored.

Table 6- Control Temperature Fail Modes

3.2.2 Electrical

This section describes the electrical setting options for the Elexant 4010i/4020i modules.

3.2.2.1 Trace Current

Trace current represents the load current in the EHT circuit.

Trace current can be inferred from Line Current and Heater Configuration. For single phase loads, the line current is equal to the trace current. For 3-phase loads, the Line Current is the current flowing through the ungrounded load conductors. All three line currents are monitored when using a 3-phase variant of the Elexant 4020i.

3.2.2.2 Current Turns Ratio

The controller also allows the user to adjust the Current Turns Ratio for applications where a control module is monitoring a load through an external step-up or step-down current transformer. The ratio is multiplied with the actual current measured to display the adjusted reading to the user. See Section 5.8.1.2 for more details.

3.2.2.3 Ground Fault Current

Purpose: Ground fault is an inadvertent connection between an energized conductor and ground, and may create a hazardous condition. These types of faults may be due to incorrect installation, damaged system components/insulation, ingress or moisture or other factors. If the Elexant 4010i/4020i controller detects any leakage currents (ground faults) in the load, it will indicate the level in milliamps.

If a ground fault condition is detected upon start-up of a new installation, it is likely due to a wiring error or damaged cable. To verify this condition:

Check that all load conductors (including neutrals) return through the controller and are not connected directly to the distribution panel. This can be a common problem if the installation is a retrofit situation.

On paralleled circuits, be certain that ALL neutrals return through the controller. The late addition of a circuit may not be obvious.

Use the monitoring feature available in the Elexant 4010i/4020i user interface (Section 5.8.2) to view the measured ground fault current. If this value is at the maximum that the controller can measure (500mA), it is usually an indication that the wiring is incorrect. If the value shown is less than 500 mA then an actual ground fault condition may exist.

IMPORTANT: The controller monitors the integrity of the ground fault (GF) detection transformer and associated wiring with a periodic internal test. If the test detects a failure, the controller will disconnect the output and report a GF CT failure alarm. If this condition occurs, the controller must be replaced.

IMPORTANT: To minimize nuisance alarms, the controller will not report a leakage current of less than 10 mAmps.

Ground-Fault Trip

The Ground-Fault Trip function will cause the controller output to be latched off and the GFI Trip Alarm to be activated when the measured ground fault exceeds the allowable ground-fault leakage current trip setpoint.

Procedure: If trip action is desired when a GF condition is detected, adjust the GF Trip current to the desired value and enable the GFI Trip Alarm. To disable ground-fault tripping, disable the alarm.

IMPORTANT: The GFI Trip Alarm must be enabled in order to adjust the GF Trip Current level.

Default: ENABLED

A ground-fault alarm may mean the heating cable has been damaged or improperly installed and must not be ignored. Sustained electrical arcing or fire can result. To minimize the risk of fire if a GF condition has been detected, shut off the power to the heating cable and repair the system immediately.

IMPORTANT: In order to safely implement a ground-fault trip function, all non-grounded power conductors must be opened upon detection of a ground-fault condition. Multi-pole switch configurations should be used on non-neutral based power systems.

Ground Fault Turns Ratio

The controller also allows the user to adjust the Ground Fault Turns Ratio for applications where a control module is monitoring GF using an external step-up or step-down current transformer. The ratio is multiplied with the actual ground fault current measured to display the adjusted reading to the user. See Section 5.8.2.2 for more details.

3.2.2.4 Trace Voltage

Trace voltage (the voltage supplied to the EHT) is measured and may used to trigger alarms when the unit is operating at voltages lesser/higher than the design. In addition, the controller also measures and reports the power line frequency.

The Elexant 4010i modules measure voltage based on the incoming power that is used to power both the controller and the EHT load to a max of 277Vac.

Elexant 4020i modules provide a set of input terminals for voltage sensing. These may be directly connected to voltages of up to 277Vac. The inputs may also be connected to higher voltages by using an external step-down transformer.

Voltage Turns Ratio

The Voltage Turns Ratio adjusts voltage readings for applications where a control module is measuring voltage using an external step-up or step-down transformer, or is being powered from a source with a different voltage level than the trace voltage. The Voltage Turns Ratio value can be used to multiply or divide the Trace Voltage value reaching the unit. See Section 5.8.3.2 for more details.

3.2.2.5 Trace Resistance

Trace resistance is used to generate alarms when heater resistance levels have increased/decreased from the NOMINAL RESISTANCE setting by more than the selected amount (1 – 100% in case of low resistance values, 1 – 250% in case of high resistance values).

Trace Resistance is calculated (in Ohms) using the average adjusted voltage reading divided by the average adjusted current reading. If the controller's output switch is on, but no current is present, the RESISTANCE will read "N/A." See Section 5.8.4 for more details.

IMPORTANT: If the controller's output switch is off; the RESISTANCE will always display the last resistance which was calculated while the output switch was last on.

3.2.2.6 Trace Power

Trace power provides an indication of the average power being consumed by the EHT circuit.

IMPORTANT: The control module calculates load power by multiplying the average adjusted voltage reading by the average adjusted current reading. Both the VOLTAGE TURNS RATIO and the CURRENT TURNS RATIO affect the trace power reading.

3.2.3 Device Maintenance

These parameters include internal accumulators and Maximum/Minimum records to assist with maintenance of the heat trace installation. These parameters can be reset at any time through the GUI or the communications ports.

3.2.3.1 Cycle Count

This data indicates the total number of off-to-on transitions a contactor has made since the last time the CONTACTOR CYCLE COUNTER was reset. This serves as a method to perform preventative maintenance on the contactor according to the manufacturer's specifications. This value is written to the controller's non-volatile memory once every 24 hours or whenever any maintenance data is reset by the user.

IMPORTANT:

- The CONTACTOR CYCLE COUNTER is only indicated if the SWITCH CONTROL MODE is set to either DEADBAND or PROPORTIONAL AMBIENT CONTACTOR.
- Note: Once the CONTACTOR CYCLE COUNTER reaches 999,999,999 it will stop counting until it is reset.

3.2.3.2 Hours in Use

This data is used to indicate the total hours of use of the controller since its initial operation. It may be useful to log the amount of time a particular controller has been in operation for the purposes of
maintenance planning or reliability testing. The value of this accumulator is written to the controller's non-volatile memory once every 24 hours or whenever any maintenance data is reset by the user.

3.2.3.3 Heater ON Time

This data is used to indicate the number of hours that the EHT output has spent in the on state.

3.2.3.4 Hours Since Reset

This data is used to indicate the number of hours that have passed since the unit was last powered on or the maintenance data was reset.

3.2.3.5 Trace Power

This parameter indicates the power used by the EHT and includes an accumulator that records the total power the circuit has used since the last time the reading was reset.

3.2.3.6 Device Reset

This alarm is set when the controller software starts. Possible causes include:

1. Power to unit has been interrupted.
2. A transient has caused the unit to restart.
3. An internal condition has caused the unit to restart.

3.2.3.7 Max/Min

The controller stores the Maximum and Minimum readings for the following parameters:

Temperature (Control, TS1, TS2, TS3)

Trace Current

Trace Voltage

Ground Fault Current

These readings inform the operator of the highest and lowest readings the controller has detected during operation.

3.2.3.8 Preventative Maintenance

The controller includes a feature to manually run a Trace Test. This will apply power to the heating circuit for a period of time (default is 180 seconds) and then turn it off.

Autocycle is similar to Trace Test. It applies power to the heating circuit for 30 seconds at the selected interval, typically 8 hours.

Both Trace Test and Autocycle serve to verify the heating circuit integrity. Unlike Autocycle, Trace Test can be run at any time. Both force the output to be ON, assuming there are no higher priority overrides inhibiting this (e.g. Ground Fault, Current Transformer Failure).

IMPORTANT: The Elexant 4020i Safety Limiter units meet the requirements of SIL2 as set out in IEC61508:2010. In accordance with this standard, units must be subjected to a functional test after commissioning, at regular intervals, in order to guarantee safe and reliable operation. The functional test procedure is covered in Section 4.1.9.

3.2.4 External Devices

3.2.4.1 Digital Input

The Digital Input allows simple external devices to extend the functionality of the controller. It offers the option to alarm or override the electrical heat-tracing mode from an external device and can be configured in the following ways:

- None (Default): No action taken or no device connected.
- Force On when input is open or closed (Open/closed is also configurable).
- Force Off when input is open or closed (Open/closed is also configurable).
- Alarm when input is open or closed (Open/closed is also configurable).
- Hand/Off/Auto – this allows connection of an HOA switch that can be used to configure the controller output as follows:
  - Hand - manually override the normal control output decision and turn the output on
  - Off – manually override the normal control output decision and turn the output off.
  - Auto – no override, control output decision is made by the controller as per normal operation.

3.3 COMMUNICATION

The Elexant 4010i/4020i can be connected to a network via Modbus or Profibus to provide remote connectivity to the controller. This enables the user to view and edit the controller's configuration, alarm status, and view real-time data from a remote location.

3.3.1 Modbus

The industry-standard master-slave Modbus RTU protocol is used with RS-485 communications, and Modbus/TCP is supported for use with Ethernet connections.

3.3.1.1 RS-485

The Modbus RTU protocol on an RS-485 link may be used to communicate with devices such as the Raychem TOUCH 1500 or Raychem Supervisor. The RS-485 configuration parameters and defaults are shown below.

Variable	Description	Default	Range/Options
Address	Modbus Station Address used to identify the unit.	1	1 to 247
Baud	Baud Rate - the rate at which communications occur on the network.	9600	9600, 19200, 38400, 57600
Parity	Defines the type of parity bit to be used with any of the three serial communications ports.	None	None, Odd, Even
Stop Bits	Defines the number of stop bits used with any of the three serial communications ports.	1	1, 2
Transmit Delay	Sets the time the unit will wait after it receives a message before it replies.	20	0 to 5000 ms

Table 7- RS485 Settings

3.3.1.2 Ethernet

A 10/100Mbps Ethernet LAN connection may be used by the Elexant 4010i/4020i for communicating with remote devices using the Modbus/TCP protocol. An Ethernet connection can be made via the RJ45 connector at the top of the unit. Configuration parameters and defaults are shown below.

Variable	Description	Default	Range/Options
Enable DHCP	Allows the unit to use Dynamic Host Configuration Protocol	Enabled	Enabled, Disabled
Network Address	Defines the Ethernet Port IP Address.	192.168.1.100	0 to 255 for each address field.
Network Mask	A 32-bit number that masks the network address and divides it into network address and host address.	255.255.255.0	0 to 255 for each mask field.

Table 8 - Ethernet Settings

3.4 DEVICE INFORMATION

3.4.1 Information

The following important identifying information is available:

- Device Tag – 40 character user configurable alphanumeric string to identify the individual controller. See Section 5.6.7.1 for further information.
- Model – The manufactured configuration of the control module (see Section 1.1.1.2 - Product Configurations for model identification information).
- Serial Number – uniquely identifies a device from manufacture through operation.
- Manufacture Date – useful in determining maintenance needs.
- Firmware Version – the current firmware version.
- Limiter Version – the firmware version on the limiter (if applicable).

3.5 Alarms

The Elexant 4010i/4020i alerts the user to any occurrence that falls outside the defined limits of normal function. Alarms are enunciated using the GUI (see Alarm indications table, Section 3.5.3) and with a dry contact relay (See Section 3.5.1). Active alarms are also reported over the communication interfaces. See Section 3.3 for different communication protocols supported.

Active alarms can be cleared via the GUI (see Section 5.9).

3.5.1 Alarm Relay Modes

The alarm relay is a Form C dry contact relay that indicates the presence or absence of alarms. The relay is configured as fail-safe and will create an alarm condition if the controller loses power. It supports
connections for remote annunciation or local indication equipment (lights, horns, etc.).

The alarm relay offers three modes of operation to support a range of attached equipment.

Normal: In the event of an alarm, the relay de-energizes. It stays in the de-energized state until all alarms are cleared. When no alarms are present, the alarm relay is energized.

Flash: An alarm causes the relay to energize and de-energize each second. When there are no alarms present, the alarm relay is held in the energized state.

Toggle: If an alarm is present, the alarm relay is held in a de-energized state. If a new alarm event
happens, the alarm relay is energized for a short period, and de-energized again. The alarm relay returns to an energized state when no alarms remain.

3.5.2 Alarm Functionality

Alarms have a basic set of configuration options in common, although not all alarms allow all configuration options.

The basic settings of an alarm are as follows:

Enable: The enable option sets whether a condition or event generates an alarm. The setup of the heat trace system determines which alarms should be enabled or disabled. Other alarm settings do not apply when an alarm is disabled.

Latch: For alarm conditions that are intermittent, latching keeps an alarm active even after the root cause is no longer present. If an alarm is latched, it must be manually cleared after the root cause for the alarm is no longer present.

Setpoint: Some alarms are triggered by an event, while others occur when a value crosses a threshold. The Setpoint sets the threshold at which the parameter triggers the alarm.

Filter: For some parameters, an alarm condition is only important if it is present for more than a defined period of time. The filter setting sets the time a condition must be present before it causes an alarm.

3.5.3 Alarm Sources

The monitored process parameters trigger an alarm if they move beyond the defined setpoints. Important events that impact the function of the device, will also trigger alarms. The table below describes the conditions that trigger each type of alarm.

Main Screen	Page	Alarm Source	Description
Control Setup	Control Temp	Control Temperature High	The control temperature is above the control high temperature setpoint.
		Control Temperature Low	The control temperature is below the control low temperature setpoint.
		Control Temperature Failure	There is no valid control temperature reading.
	Output Limiting	Output Limiting	The output duty cycle is being limited due to the load power or current being higher than the power or current limit setpoint.
		SSR Overcurrent (Line *x*)	The output is off because the measured current has exceeded the SSR rating for an extended period of time.
		Circuit Breaker Limiting	The output duty cycle is being limited because the measured current exceeds the circuit breaker time-current curve.
	Load Shedding Misc.	Load Shed Comm Failure	The load shed source communication has timed out.
		Contactor Count	The number of contactor cycles has exceeded the cycle count setpoint.
		Heater On Time	The heater on time has exceeded the heater ON time setpoint.
		External Input	The Digital Input is configured to Alarm and an alarm condition has been triggered.
Temperature	Temp Sensor *x*	Temperature Sensor *x* High	Sensor *x*'s measured temperature exceeds the sensor high temperature setpoint.
		Temperature Sensor *x* Low	Sensor *x*'s measured temperature is below the sensor low temperature setpoint.
		Temperature Sensor x Failure	Sensor *x* is not indicating a valid temperature.
	Temp Limiting	High Limit Cut-out	The output is turned off because a temperature sensor is above the high limit cut-out setpoint.
		Low Limit Cut-out	The output is turned off because a temperature sensor is below the low limit cut-out setpoint.
Electrical	Trace Current	High Trace Current (Line *x*)	The measured trace current exceeds the high current setpoint.
		Low Trace Current (Line *x*)	The measured trace current is below the low current setpoint.
	Ground Fault	High Ground Fault	The measured ground fault current exceeds the high GF setpoint.
		Ground Fault Trip	The output is off because the measured ground fault current exceeds the GF trip setpoint.
		Ground Fault CT Failure	There is a problem with the controller's internal GF sensing circuitry.
	Trace Voltage	High Trace Voltage	The measured voltage exceeds the high voltage setpoint.
		Low Trace Voltage	The measured voltage is below the low voltage setpoint
	Trace Resistance	High Trace Resistance (Line *x*)	The calculated trace resistance exceeds the high resistance setpoint.
		Low Trace Resistance (Line *x*)	The calculated trace resistance is below the low resistance setpoint.
Safety Limiter (Optional)	Setup	Safety Limiter Trip	The limiter has tripped.
		Safety Limiter Configuration Failure	The configuration in the limiter cannot be recovered, and defaults are being used.
		Safety Limiter Comm Failure	The limiter is not communicating with the main processor.
		Safety Limiter Sensor Failure	The limiter output is off because it cannot measure a valid temperature.
Global	-	Low Storage Capacity	The internal memory is reaching its end of life. The control module should be replaced.
		Device Reset	The controller was reset.
		User Configuration Lost	User settings were lost and replaced with defaults.
		Maintenance Data Lost	The maintenance data was lost and reset to 0.
		User Profile x Lost	The user profile x was lost, and replaced with a default profile.
		Factory Configuration Lost	The factory configuration (including calibration) was lost and replaced with default values.
		Switch Failure Alarm (Line x)	The controller has detected an output switch has failed in the closed position.

Table 9 - Alarm Sources

3.6 Profiles

The Elexant 4010i/4020i has the ability to load and save configuration profiles on demand, helping to simplify the commissioning process. Almost all of the configurable values are saved as part of a profile. The profiles are divided into following 5 types:

1. **Default –** Load the default Factory settings. See Appendix A for more details.
2. **Process –** This profile loads settings appropriate for control based on direct measurement of the process temperature (line sensing). See Appendix A for more details.
3. **Ambient –** This profile loads settings that are appropriate for control based on ambient temperature (ambient sensing). This profile uses the PASC algorithm default settings. See Appendix A for more details.
4. **User 1 –** Allows the user to name the profile and both load and save the settings on demand.
5. **User 2 –** Allows the user to name a second profile and both load and save the settings on demand.

NOTE: User Profiles can be loaded from and saved to a USB storage device. In addition, current controller settings can be saved to a profile, or active controller settings can be loaded from a profile. The device automatically displays the choice of loading/saving profiles whenever a USB is plugged in.

IMPORTANT: On an Elexant 4020i Limiter variant, loading the profile may also result in a new Limiter setpoint being loaded. The operator will need to press the Set Config button on the controller being configured in order for the device to accept the new setpoint. See Section 4.1.5.2 for details.

3.7 Internal Memory

The controller has an internal memory to store accumulated Maintenance data, user profiles, and user settings.

Maintenance data is only saved to non-volatile memory once every 24 hours, therefore up to 24 hours of data may be lost if power to the controller is turned off before the unit saves any accumulated information. Maintenance data is stored within 5 seconds if any maintenance data is reset.

All other settings, including user profiles, can take up to 5 seconds to be stored in internal memory. Loss of power immediately after making a change can cause the change to be lost.

The internal memory is designed in such a way that it will not be corrupted if power is lost while a setting is being saved.

The controller will notify the user if any part (user, maintenance, profile 1, profile 2, factory) of the settings are lost. If factory settings are lost, the unit must be replaced. As a precautionary measure, the loss of either the factory or user data will prevent the device from turning on the heat trace.

The Low Storage Capacity alarm indicates that this memory is nearing its end of life, so plans should be made to replace the controller.

3.8 Graphical User Interface (GUI)

The Elexant 4010i/4020i has an integrated resistive touch screen to provide accessible and intuitive interaction with the controller. The GUI can be set to display its text in five languages (English, French, German, Spanish, and Russian). The controller can be configured and monitored using the GUI. See Section 5.1 for more details.

3.9 LED Status Indicators

The front panel of the Elexant 4010i/4020i Heat Trace Controller has 4 LED indicators to indicate conditions.

LED	STATUS	DESCRIPTION
STATUS	OFF	No power/Faulty LED
	Flashing Red/Green	Calibrated / Unlocked
	Flashing Yellow/Green	Uncalibrated / Locked
	Flashing Yellow/Red	Uncalibrated / Unlocked
	Solid Red	Device Reset Alarm Active
	Solid Green	Normal Operation/No Internal Fault
OUTPUT	OFF	Control Output OFF
	Solid Orange	Control Output ON 100%
	Flashing Orange	Output Duty Cycle Mode
COMM	OFF	No Communication
	Flashing Green	Receive Active
	Flashing Red	Transmit Active
ALARM	OFF	No Alarm
	Solid Red	Alarm Condition

Table 10 - LED Status Indicators

3.10 GUI Screen Saver Mode

The Elexant 4010i/4020i controller has a built-in screen saver feature that automatically turns on every hour after the device is powered up. When the screen saver is activated, the idle screen shows an alternate version of the display for 1 minute in which it flips the state of every pixel on the screen.

4. SAFETY LIMITER

4.1 Safety Limiter

The safety limiter option (-LIM option of the Elexant 4020i, see Table 2 - Elexant 4020i Variants) provides a redundant high temperature cut-out mechanism, suitable for use in safety critical applications. It disconnects power from the heater, preventing the system from exceeding a safe temperature level.

4.1.1 Safety Function of the Limiter in the Elexant 4020i

The safety function is invoked when the temperature limit is reached, or in the event of a fault (such as probe break, probe short-circuit, component failure, or supply failure) even when the process conditions are within the permissible temperature range. The safety function disconnects power to the attached equipment without delay.

Power may be restored to the attached equipment by manually resetting the safety function after the temperature returns below the permissible limit and no fault is present. The safety function may be reset using the TRIP RESET button on the front of the unit, or by using the product GUI, or through supervisory software connected via the communication ports.

In specific circumstances where there is no current flowing through the heat trace during the over-temperature event, a feature called Intelligent Limiting (if enabled) will allow the limiter to reset itself once the temperature returns below the permissible limit and no fault is present.

4.1.2 Area of Use

Safety limiters are used in areas where thermal processes need to be prevented from overheating, and where the system must be set to a safe operating condition in the event of a fault. A typical example of such an installation is surface heating in a hazardous area.

4.1.3 Block Diagram

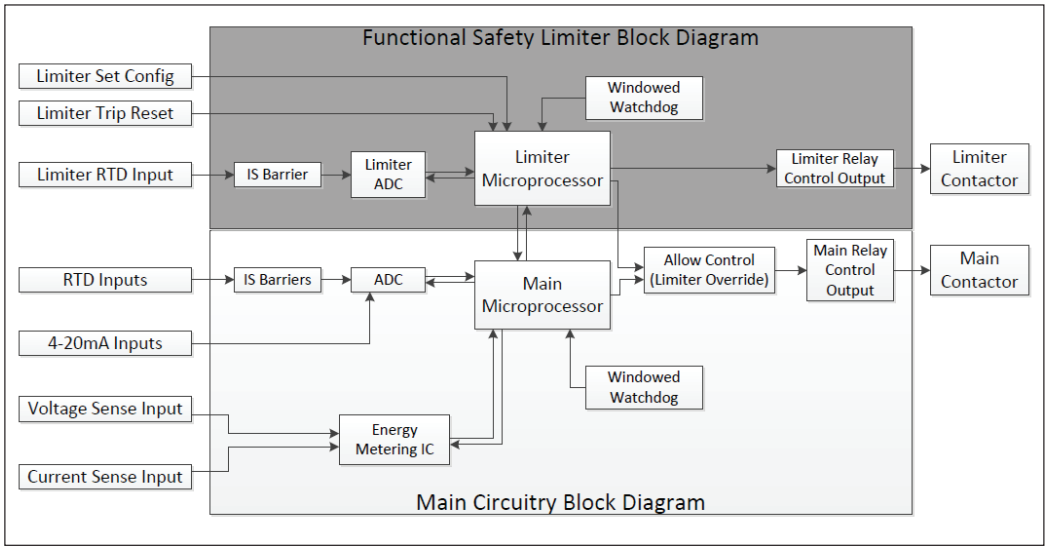


Figure 27 - Safety Limiter Block Diagram

4.1.4 Resetting the Safety Limiter

The safety limiter is designed such that after it has tripped, resetting it is possible only after the normal, safe operating conditions are returned. If the Intelligent Limiting feature is enabled and there was no current flowing through the heat trace at the time of the over-temperature condition, the safety limiter will reset itself. If Intelligent Limiting is disabled, or if there was current present in the heat trace during the over-temperature condition, then the device will need to be reset manually.

In order to manually reset the limiter after it has tripped, the user needs to press the TRIP RESET button (shown in the Figure below). Alternatively, the limiter can be reset via the touch screen interface, or remotely using Raychem Supervisor. Refer to the operating manual for Raychem Supervisor for detailed instructions on how to remotely reset a safety limiter.



Figure 28 - Elexant 4020i-MOD-IS-LIM Front Panel

4.1.5 Setting the Temperature Set Point

4.1.5.1 Choosing a Set Point

The lock out temperature (set point) of the safety limiter must be set in such a way that the maximum allowable temperature of the equipment is not exceeded. For example, the surface temperature of a heat-tracing cable in a hazardous area cannot exceed the local maximum temperature allowed based on the classification rating (T-rating) of the area. The set point should be the maximum allowed temperature less 5 K for temperatures below or 200°C, or less 10 K greater than 200°C.

4.1.5.2 Configuring the Set Point

Modifying the set point requires physical access to the Elexant 4020i device. The lock out set point may be configured with the touch screen interface of the device or with Raychem
Supervisor if its user interface is physically close to the 4020i device. The procedure to modify the limiter set point is the same for all user interfaces. Use your preferred configuration method to enter the set point and then press the SET CONFIG button on the Elexant device to confirm the set point change.

The SET CONFIG button must be pressed within 30 seconds after the new setpoint has been entered. If the button is not pressed before this time interval has elapsed, the new value is discarded and the old set point value remains unchanged. Once the new set point has been saved, the new (or in case the save procedure was not successful, the old) set point is read back and displayed confirmation to the user.

4.1.6 Main Output Interlock

When the safety limiter output is off, for any reason, an internal signal overrides the output of the main output switch, to force it off. The main output can only be switched on if the limiter temperature sensor is connected, and the measured temperature is below the limiter set point. There is no user action required for this feature, and it cannot be disabled.

Although the limiter overrides the main output, the heater must be connected such that both outputs can disconnect power from the heater. Bypassing one of these outputs does not allow the system to achieve a SIL2 safety rating for this element.

4.1.7 Internal Diagnostic

The internal power to the limiter circuit is continually monitored by the limiter microprocessor. Any detected instability is reported to the user via an alarm on the product GUI. There is no known effect on the safety function in the presence of a detected power failure. As a precaution, if the limiter power failure warning is persistent or recurring regularly, follow the instructions in Section 4.1.14– Response to Fault Conditions.

4.1.8 Functional Test

The Elexant 4020i Safety Limiter units meet the requirements of SIL2 (see Section 4.1.12 PFDavg Safety Function for more details) as set out in IEC61508:2010. In accordance with this standard, units are subjected to a functional test after commissioning and at regular intervals, in order to guarantee safe and reliable operation. The test interval for the safety limiter can be set to 1, 10 or 20 years, depending on the application. The functional test procedure is described in Section 4.1.9 – Functional Test Procedure. Conformance to the SIL certification is limited to the 20-year lifetime of the unit.

Type	Safety Integrity Level	Systematic Capability	Proof Check Interval	Unit Lifetime
4020i-Mod-IS-LIM	SIL 2	SC 2	1, 10, or 20 years	20 years

Table 11 - Functional Test

4.1.9 Functional Test Procedure

The functional test is performed after commissioning and at regular intervals over its operational lifetime, to ensure it is still capable of carrying out its intended safety function. This check requires a voltmeter capable of reading the output heater voltage, and a short length of wire (5 cm / 2 in).

Setup the functional test using these steps:

1. Disable Intelligent Limiting.
2. Reset any limiter-related trips.
3. Clear all alarms.
4. Status on main screen of the GUI is “Normal”.
5. Ensure the controller output (and the Output LED) are on. The Control Mode can be switched to “Always ON” if required.
6. Setup check: Measure the voltage to the heater at the limiter contactor output relay, to verify the output is ON.

Execute the functional test by performing the following steps:

1. Disconnect one of the limiter RTD leads (sensors).
2. Result: The red Alarm LED lights up and the Output LED of the unit switches off. The Safety Limiter page shows “TRIPPED!” in the status box.
3. Check for OFF: Measure the voltage to the heater at the limiter contactor output relay, to verify the output is off.
4. Reconnect the limiter RTD (sensor). Wait about 10 seconds for the temperature reading to return.
5. Press the TRIP RESET button.
6. Clear the alarms in the Alarms screen.
7. The orange Output LED is now on, the red Alarm LED is off.
8. Check for ON: Measure the voltage to the heater at the limiter contactor output relay, to verify the output is on.
9. Install a wire bridge between TB1 position 10 and TB2 position 12 to simulate a short across the limiter RTD (sensor). Wait about 10 seconds for the short to be detected.
10. Result: The red Alarm LED lights up and the Output LED of the unit switches off. The Safety Limiter page shows “TRIPPED!” in the status box.
11. Check for OFF: Measure the voltage to the heater at the limiter contactor output relay, to verify the output is off.
12. Remove the wire bridge. Wait for 10 seconds for the temperature reading to return.
13. Press the TRIP RESET button.

14. Clear the alarms.
15. The orange Output LED is now on, and the red Alarm LED is off.
16. Check for ON: Measure the voltage to the heater at the limiter contactor output relay, to verify the output is on.

Clean up steps:

1. Return Intelligent Limiting to its original setting.
2. Return the control algorithm to its previous setting if it was changed to force the output on.

4.1.10 Test in the event of a Fault

In the event of a system fault, the device is designed to fail safe whenever possible. If the limiter output does not close, even after pressing the TRIP RESET button, check the RTD Status and Switch Status of the Safety Limiter in the Safety Limiter's Maintenance page, and any active alarms. If no issues are indicated in these locations, or the error cannot be resolved by the installer, the unit may need to be replaced. See Section 1.3 for Chemelex Customer Care contact information.

4.1.11 Determining Safety Integrity of the Elexant 4020i-Mod-IS-LIM

The Elexant 4020i-Mod-IS-LI is a Type B system, as defined in IEC61508-2:2010.

A sub-system is a Type B system when all of the following apply:

1. The failure mode of at least one component that is used is not adequately defined.
2. The response of the sub-system in fault conditions cannot be completely determined.
3. No adequately reliable failure data, based on field experience is available for the subsystem, to support the assumed failure rates for recognized and unrecognized hazardous failures.

The Elexant 4020i Limiter variant meets the requirements for Systematic Capability (SC) 2. The following table presents the achievable Safety Integrity Level (SIL), depending on the Safe Failure Fraction (SFF) and the Hardware Fault Tolerance (HFT) for Type B safety-related subsystems.

The table below is valid for the Elexant 4020i-MOD-IS-LIM:

SFF of an element	Hardware Fault Tolerance		
	0	1	2
< 60%	Not Allowed	SIL 1	SIL 2
60% - 90%	SIL 1	SIL 2	SIL 3
90% - 99%	SIL 2	SIL 3	SIL 3
≥ 99%	SIL 3	SIL 3	SIL 3

Table 12 - Maximum SIL for Type B with SC 2

The Elexant 4020i-MOD-IS-LIM is at HFT of 0, SIL2 (90% - 99%) for Type B safety-related subsystems.

4.1.12 PFDavg Safety Function

The limiter temperature sensor, limiter electronics and the limiter relay together form the safety related system that performs the safety function. The "average probability of the hazardous failure of a safety function for the entire safety related system" (PFDavg) is divided among the subsystems. An external device such as an external power contactor installed in a panel is specific to the installation, and shall in accordance with the standards for the safety loop, be considered separately.

Type	SIL [1]	Architecture	MTTR [2] (hrs)	HFT [3]	SFF [4]	Proof Check Interval (years)	PFD avg. [6]
4020i-Mod-IS-LIM	SIL 2	1oo1	8	0 (1oo1) [5]	98.91%	1	1.64E-05
						10	1.64E-04
						20	3.28E-04

Table 13- Safety Integrity Level

Safety Integrity Level

[1] SIL = Safety Integrity Level

[2] MTTR = Mean Time to Repair

[3] HFT = Hardware Fault Tolerance

[4] SFF = Safe Failure Fraction

[5] 1oo1 = One out of One

[6] PFD = Probability of Failure on Demand

4.1.13 System Failure Modes

When using the Elexant 4020i Limiter variant in a safety critical application, it is necessary to consider the failure mode of all elements, and the probabilities of those failures, in order to understand their possible effect, and what mitigation may be necessary. The table below summarizes the failure modes of this element.

Description	Failure Mode	Detected/ Undetected	Safe/ Dangerous/ No Change	1year Probability	10 Year Probability	25 Year Probability
Loss of redundancy	One of the relay outputs is always closed. The other output still functions normally.	Undetected	Dangerous	3.88E-04	3.87E-03	9.65E-03
Internal signal short	A trip is reset silently, or without user intervention. A forced Trip clears on its own, or can't be forced.	Detected Undetected	Dangerous Dangerous	3.60E-04 4.00E-05	3.59E-03 4.00E-04	8.96E-03 1.00E-03
Output short	The limiter output relay (but not the main output override) is stuck in the ON position regardless of the temperature.	Detected Undetected	Dangerous Dangerous	8.15E-03 7.41E-04	7.85E-02 7.38E-03	1.85E-01 1.84E-02
Unreported Internal Power Diagnostic Failure	No change to operation. Reported power failure has no known effect.	Undetected	No Change	1.21E-03	1.20E-02	2.97E-02

Table 14- Failure Modes

4.1.14 Response to Fault Conditions

In case a failure of the safety system is detected, either during operation or during routine maintenance when executing a function test, the unit should be switched off and taken out of service. Defects in the safety system cannot be repaired in the field. Defective units are to be replaced and returned to the manufacturer for investigation. Please contact your nearest Chemelex representative for more instructions. Information about the unit, including the device serial number, and limiter firmware version, may be requested by the Chemelex representative. This information is available via the Info screen on the product GUI (Section 5.3). A list of worldwide representatives can be found on www.chemelex.com.

5. GRAPHICAL USER INTERFACE

5.1 Home Screen

The Home Screen is the main menu for the Elexant4010i/4020i User Interface. The user can go back to the Main Screen (see Section 5.2.1) from here, view the Information about the device or select one of the icons to view the corresponding functionality.



Figure 29 - Home Screen

5.1.1 Control Setup



Figure 30 – Control Setup

Touch this icon to navigate to the Control Setup Screen. This screen allows the user to set configuration parameters for the Temperature setpoint, Control mode, Output type, Load Shedding, and other
Miscellaneous settings. The details are covered in Section 5.4.

5.1.2 Temperature



Figure 31 - Temperature Icon

Touch this icon to navigate to the GUI screen for Temperature Sensors. In this screen, the user can monitor the actual temperatures being read by the sensors as well as set the type of sensors being used, the circuit tag, and the configuration for the alarms related to the temperature sensors. The details are covered in Section 5.7.1.

5.1.3 Electrical



Figure 32 - Electrical Icon

Touch this icon to navigate to the GUI screen for Electrical parameters. This screen allows the user to monitor the Trace Current, Voltage, and Resistance, as well as Ground Fault levels. The user can also set the Alarm configurations for these parameters. The details are covered in Section 5.8.

5.1.4 Alarms



Figure 33 - Alarms Icon

Touch this icon to navigate to the GUI screen for Alarms. Here, the user can see the list of active alarms present in the device. The Alarm page also allows resetting of any alarms. The details are covered in Section 5.9.

5.1.5 Maintenance



Figure 34 - Maintenance Icon

Touch this icon to navigate to the GUI screen for Maintenance information. In this screen, the user can see the current temperatures of each controller sensor, measured voltage, power, and current, along with several other min/max parameters tracked by the device. The Maintenance page also allows the user to reset this information. The details are covered in Section 5.10.

5.1.6 Profiles



Figure 35 - Profiles Icon

Touch this icon to navigate to the GUI screen to access configuration Profiles. This screen allows the user to load and save configuration settings which simplify the commissioning process. The details are covered in Section 5.11.

5.1.7 Network



Figure 36 - Network

Touch this icon to navigate to the GUI screen for Modbus and Ethernet communication settings. On Profibus controllers, configuration settings will also be available in this screen. The details are covered in Section 5.12.

5.1.8 Safety Limiter



Figure 37 - Safety Limiter Icon

Touching this icon allows the user to configure settings of the SIL (Safety Integrity Level) 2 certified Safety Limiter. This is only available in the Elexant 4020i-IS-LIM variants. The details are covered in Section 5.13.

5.1.9 User Interface



Figure 38 - User Interface

Touching this icon navigates to the screen that allows configuring the controller passcode, language and the temperature units (˚C or ˚F). The details are covered in Section 5.14.

5.1.10 Info



Figure 39 - Info

Touching this icon navigates to the Information screen, which displays information about the specific unit, such as Model, Firmware version, Manufacture Date, Serial Number and the Limiter Version
(if applicable). The details are covered in Section 5.3.

5.2 Main Screen

The Main Screen is shown when the user touches the back button in the Home screen. The screen is also automatically displayed after 300 seconds of inactivity on any other screen.

5.2.1 Main Screen: Single Phase Controllers

The Main Screen is divided into 3 main areas as listed below:

a. The top left area displays the alarm status. Touching this area will cause the display to jump directly to the Alarm Screen.
b. The top right area displays information related to the temperature.
c. The lower half of the area displays the electrical information and trace status.

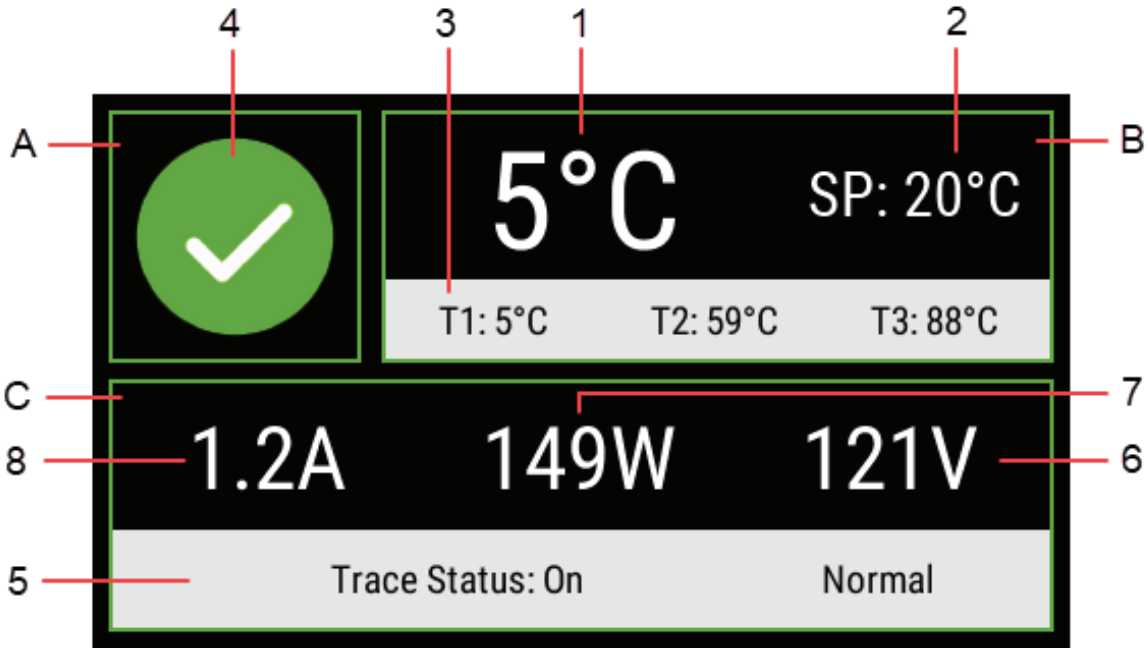


Figure 40 - Main Screen for Single Phase Controller

The details of the Main Screen are listed below:

1. Control Temperature
2. Control Setpoint
3. Temperature Sensors 1, 2, 3
4. Alarm Status
5. Trace Status
6. Trace Voltage
7. Trace Power
8. Trace Current

5.2.2 Alarm Status

The alarm status is indicated by one of the three different states:

	**No Alarms-**	This icon is shown when there are no alarms. Touching this icon navigates to the Alarm page.
	**New Alarms –**	This icon shows the new alarm count and the entire screen flashes to alert the user. Touching this icon navigates to the Alarm page.
	**Acknowledge Alarms –**	This icon shows that alarms are present. The symbol is Static (not flashing) and is shown once the user has viewed the active alarms and will continue to be shown until all alarms are cleared and reset. Touching this icon navigates to the Alarm page.

Figure 41 - Alarm Status

5.2.3 Trace Status

Trace Status can be used to diagnose why the EHT is not behaving as expected. The possible values are shown in the table below in order of increasing priority. In situations where more than one status criteria are active, the high priority status takes precedence.

Precedence in increasing order	Status	Description
1	Normal	Heat trace output is behaving according to the chosen control algorithm
2	Always On	The Always On control mode is in use.
3	Trace Test	Trace test is currently active. (See Section 5.10.4.6)
4	Always Off	The Always Off control mode is in use.
5	Load Shed Active	The load shedding feature is active. (See Section 5.6.5)
6	Load Shed Failsafe	Load shedding failsafe is active.
7	Force Off	The digital input is forcing the control output off. (See Section 5.6.7.4)
8	Force On	The digital input is forcing the control output on. (See Section 5.6.7.4)
9	Temp Limit Cut out	Either the high or low temperature limit cut out has shut the control output. (See Section 5.7.2)
10	Switch Failure	The switch failure alarm is active, and the output is inhibited.
11	SSR Overcurrent	The SSR protection algorithm has detected load current in excess of the SSR ratings.
12	Ground Fault CT Failure	The ground fault detection circuitry has malfunctioned and the controller is unable to determine whether a ground fault exists. The output is inhibited.
13	Ground Fault Tripped	The ground fault exceeded its trip setpoint and the output is inhibited.
14	Start Up Delay	During the start-up period, the output is inhibited.
15	Lost Config	The internal memory of the controller is damaged, and its settings have been lost. The unit should be returned to the factory.
16	Limiter Trip	The safety limiter has tripped. The output is inhibited.

Table 15 - Trace Status Values

5.2.4 Main Screen: Three-phase Controller

The main screen for a 3-phase Elexant 4020i variant is shown below:

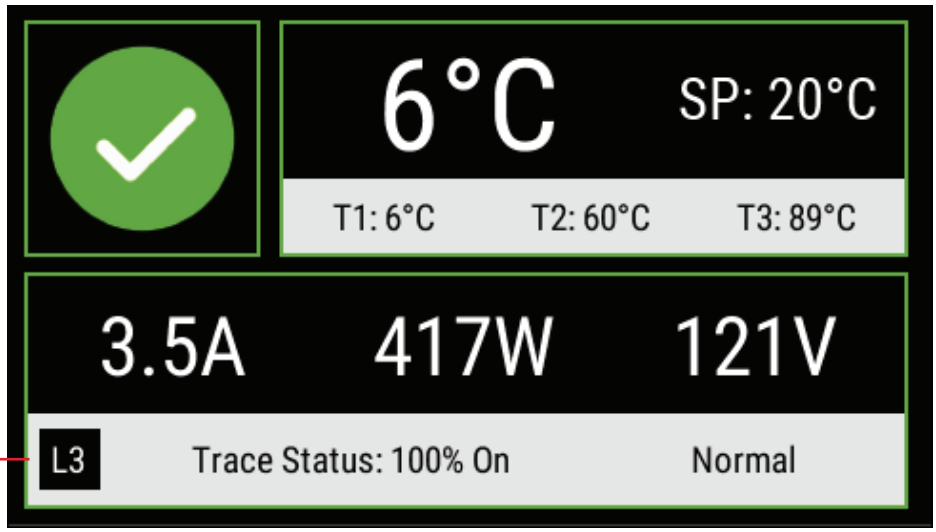


Figure 42 - 3-phase Main Screen

The Main Screen of the Three- phase Controller is similar to the Single- phase Controller except that it includes a phase indicator. This indicator cycles through each one of the three monitored phases with updated current and power values.

5.3 Information Screen

The Information Screen displays information about the specific unit, such as Model, Firmware version, Manufacture Date, Serial Number and the Limiter Version (if applicable).

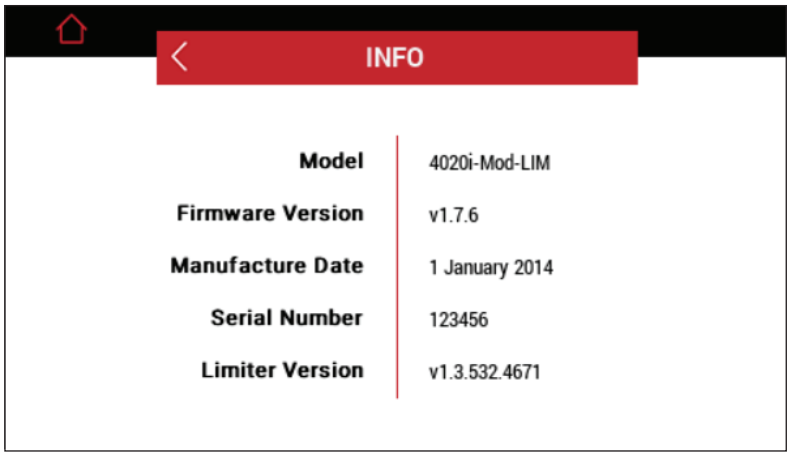


Figure 43 - Information Screen

This screen can be displayed by touching the Info button on the main screen. Touching the back button returns the display to the Main Screen.

5.4 Control Setup

The Control Setup page is divided into five tabs, as described in the following sub-sections.

Purpose: This is the temperature that the controller uses to determine whether its output switch should be on or off.

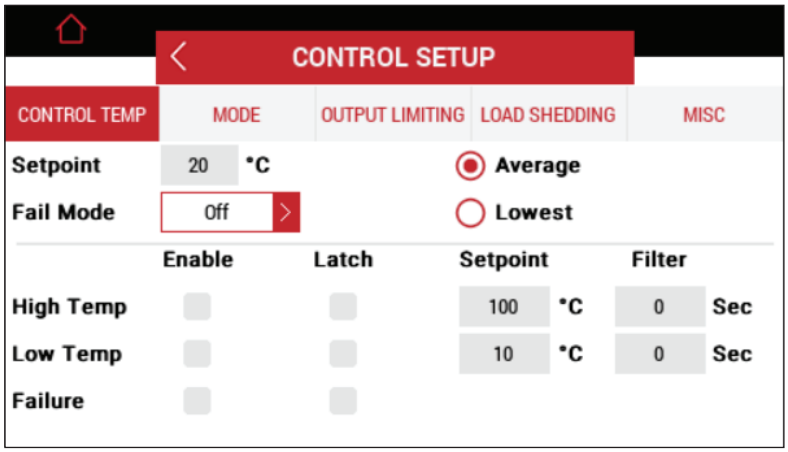


Figure 44 - Control Setup Page

The following settings can be configured:

5.4.1 Control Temp Setpoint



Figure 45 - Control Temp Setpoint Setting

Purpose:

This is the temperature value at which the controller will maintain the circuit temperature. This value is compared to the temperature measured by the control temperature sensor(s), and the power to the EHT is turned on or off, in accordance to the user-selected algorithm.

Range: –200 to 700°C.

Procedure:

Touching the text box next to **Setpoint** will bring up the numeric entry keypad as shown below. Enter the desired value using the numeric keypad and touch the ✓ button to set the new value.

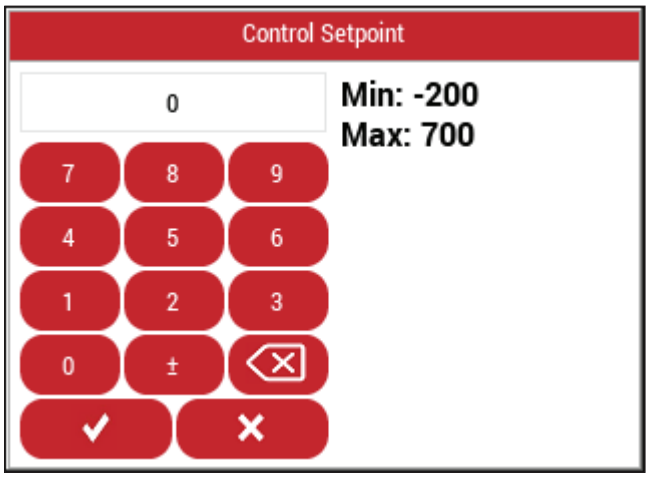


Figure 46 - Numeric Entry Key Pad

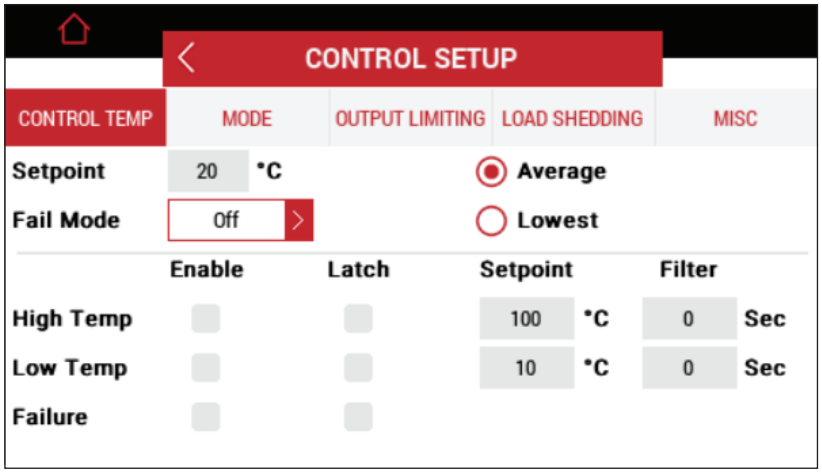


Figure 47 - Control Temp Setup Page

5.4.2 Control Temp Aggregation Mode



Figure 48 - Control Temp Aggregation Mode

Purpose:

This setting configures how temperature from multiple sensors will be combined into the control temperature reading.

Options:

Average: Selecting this option will cause the output of the unit to be controlled using the average of all valid temperature readings from any temperature sensors configured to be used for control.

Lowest: Selecting this option will cause the output of the unit to be controlled using the lowest of all valid temperature readings from any temperature sensors configured to be used for control.

Procedure:

Select one of the two radio buttons (Average/Lowest).

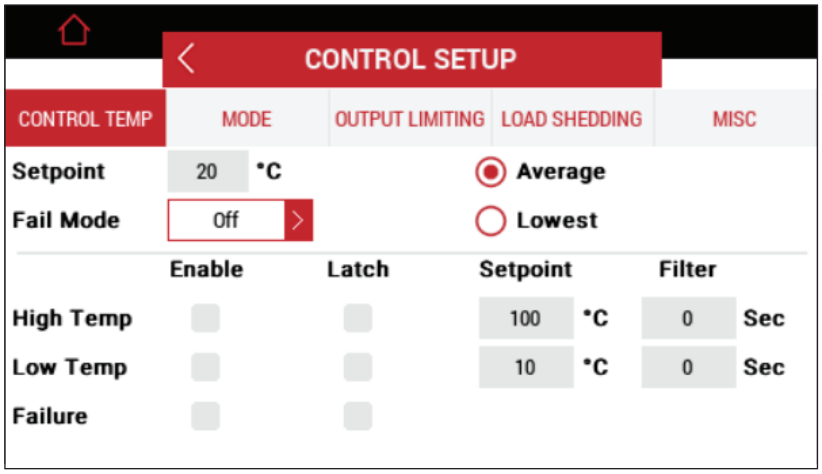


Figure 49 - Control Temp Setup Page

5.4.3 Temperature Failure Mode



Figure 50 - Temperature Fail Mode Setting

Purpose:

This setting defines the output state of the controller in the case of a sensor failure.

Options:

Mode	Description
Off	The heat trace remains off until a control sensor is restored to working condition.
On	The heat trace remains on until a control sensor is restored to working condition.
Fixed%	The heat trace output is held at a fixed duty cycle until a control sensor is restored to working condition. When this mode is selected, an additional field will appear to allow the user to enter the desired duty cycle, as shown in Section 5.4.3
Last%	The heat trace output is held at the same duty cycle that existed at the moment of the failure. This state continues until a control sensor is restored to working condition.

Table 16 - Fail Modes

Procedure:

Select Fail Mode from the combo box options.

If Fixed % mode is selected, enter desired output duty cycle.

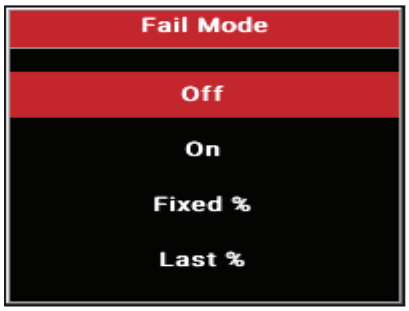


Figure 51 - Temperature Fail Mode

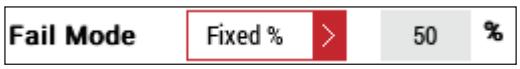


Figure 52 - Fixed % Fail Mode

5.4.4 Control Temperature Alarms

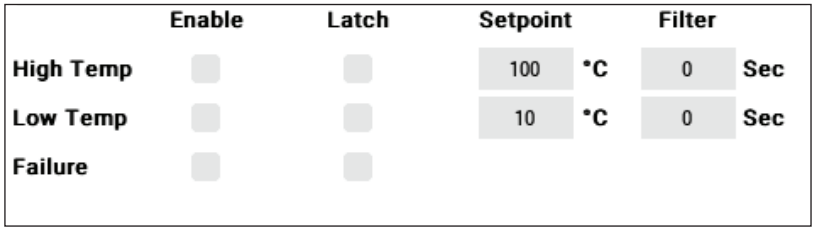


Figure 53 - Control Temperature Alarms

Purpose:

The settings for the following alarms can be configured using the lower half of the Control Temp page as shown above.

Options:

- High Temp
- Low Temp
- Failure

Procedure:

Touch the appropriate Enable check box to turn on/off the corresponding Alarm indication or touch the corresponding Latch check box to configure a latching or a non-latching type of alarm. When the latching is selected, the alarm will need to be manually reset each time the corresponding alarm occurs.

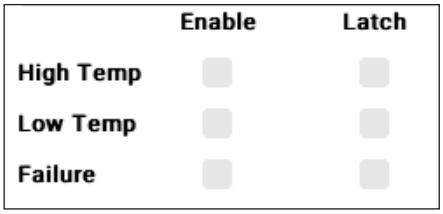


Figure 54 - Control Temperature Alarms Settings

Touching the text box next to **Setpoint** *or* **Filter** will display the numeric entry keypad. Enter the desired value using the numeric keypad and touch the ✓ button to set the new value.

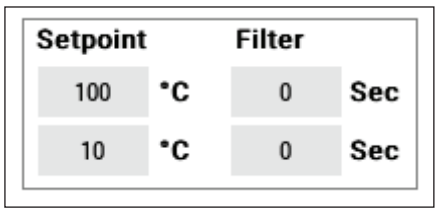


Figure 55 - Control Temperature Alarm/Filter Settings

Filter: When the temperature exceeds the High Temperature Setpoint or drops below the Low Temperature Setpoint, the unit only triggers an alarm if the corresponding High/Low alarm condition has been present for the filter period. If immediate alarm output is required for an alarm condition, then the corresponding filter value should be set to 0.

Alarm	Description	Default Value	Range	Filter
High Temperature	This alarm is active when the control temperature surpasses the value of High Temperature Setpoint. This condition is monitored by the temperature sensor(s) selected for control.	100°C	–200°C to 700°C	0 to 59940 seconds.
Low Temperature	This alarm is active when the control temperature is below the value of Low Temperature Setpoint. This condition is monitored by the temperature sensor(s) selected for control.	5°C	–200°C to 700°C	0 to 59940 seconds.
Failure	This alarm is active when no valid control temperature reading is available.	E,L	E/D	N/A

Table 17 - Control Temperature Alarms

5.5 Control Mode Page

This page provides access to the settings that govern the control algorithm and output switch. The controls displayed vary considerably depending on the selections made.

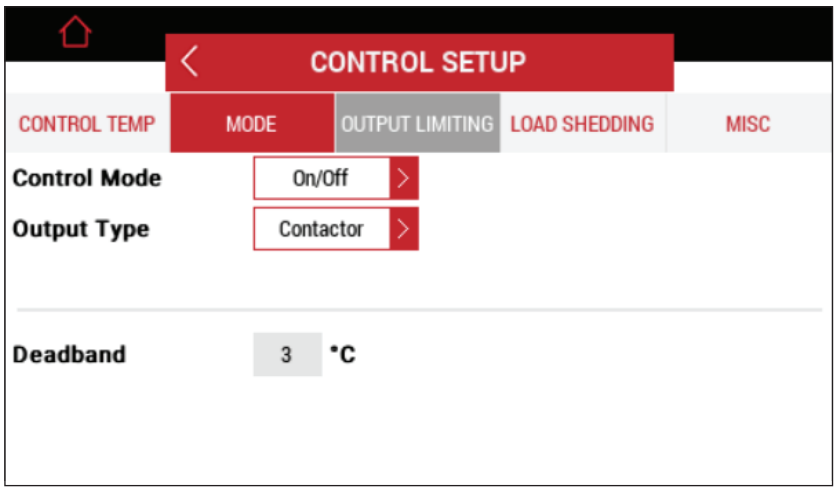


Figure 56 – Elexant 4010i/4020i Single Phase - Control Mode Page

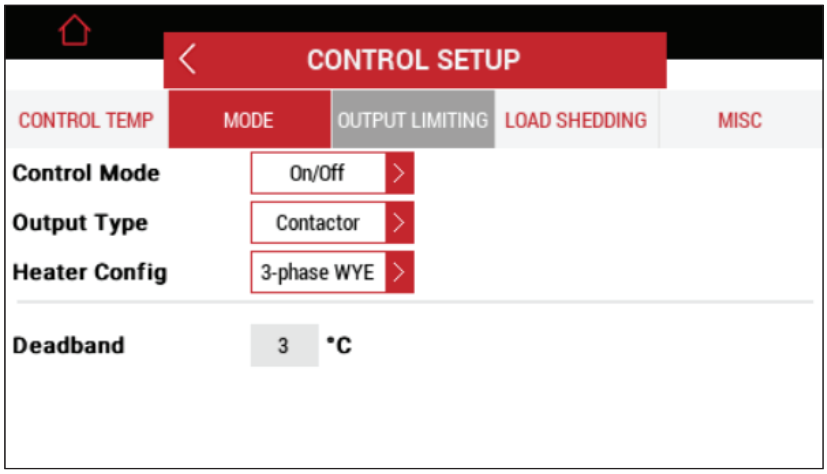


Figure 57 - Elexant 4020i Three Phase - Control Mode Page

5.5.1 Control Mode



Figure 58 - Control Mode Setting

Purpose:

To set the control mode for the controller.

Options:

The options are described in the table below:

Control Mode	Description	Algorithm Settings
On/Off	In this mode the controller monitors the temperature of the heat trace circuit and compares it to the Control Setpoint temperature plus the deadband value. The output is turned off if the control temperature is more than the Setpoint plus the deadband value otherwise the output is turned on.	Deadband
PASC	This proprietary algorithm uses the measured ambient temperature, desired maintain temperature, minimum ambient temperature and size of the smallest pipe diameter to determine the optimum duty cycle and cycle period to maintain the temperature, minimize energy consumption and prolong the switch life.	Minimum Ambient Minimum Pipe Diameter Power Adjust
Proportional	This algorithm constantly monitors the control sensor temperature and adjusts the output duty cycle proportionally, whenever the temperature falls within the 0% to 100% band. Note: This mode is incompatible with the Contactor Output Type.	Proportional Band
Always On	The output is permanently switched on irrespective of the control temperature.	None
Always Off	The output is permanently switched off irrespective of the control temperature.	None

Table 18 - Control Modes

Procedure:

Touch the combo box and select the control mode from the list.

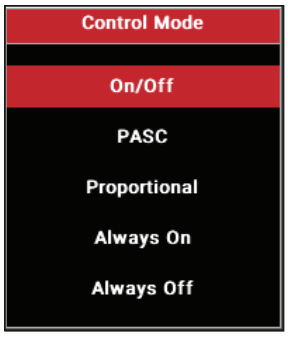


Figure 59 - Control Mode

5.5.2 Algorithm Settings

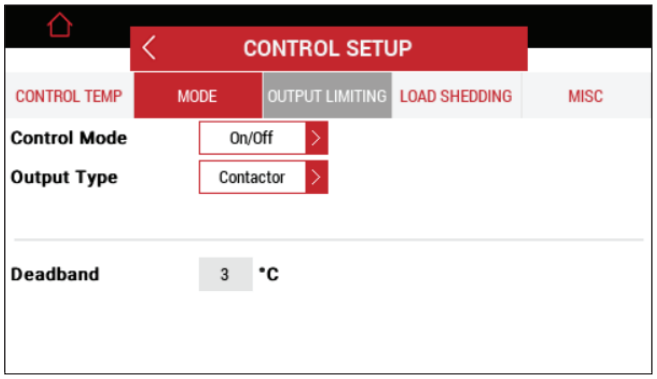


Figure 60 - Deadband Setting

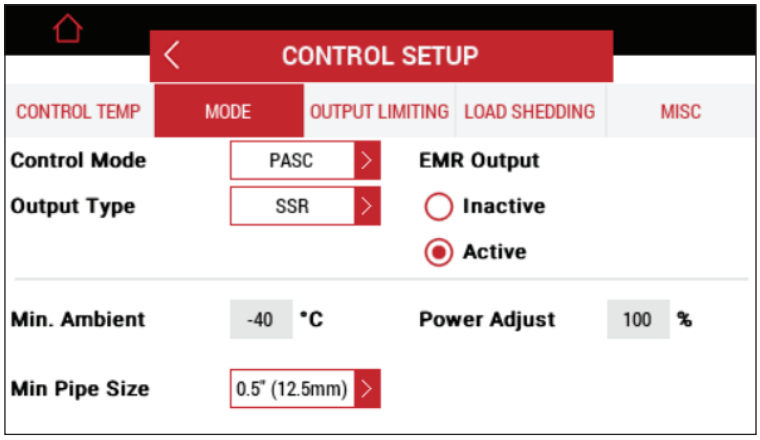


Figure 61 - PASC Parameters Settings

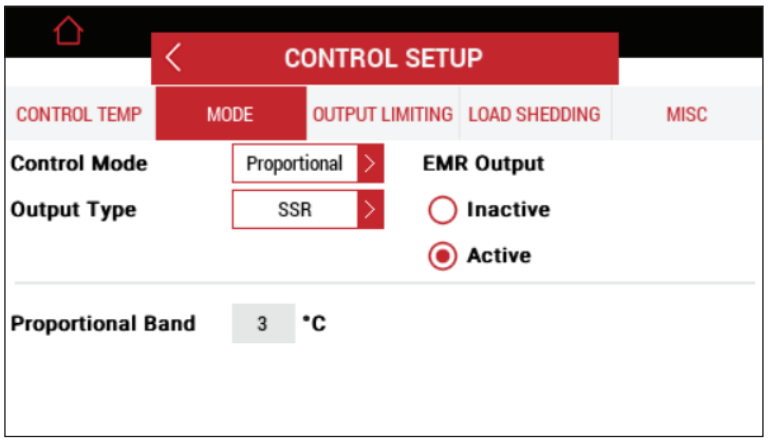


Figure 62 - Proportional Band Setting

Purpose:

To select the Control Algorithm

Options:

Setting	Description	Default	Range
Deadband	The hysteresis band within the On/Off algorithm.	3°C	1°C to 50°C
Minimum Ambient	The minimum ambient temperature at which the heat trace design should be able to maintain the pipe at the control setpoint temperature. This is typically the minimum design temperature. This setting applies only to PASC mode.	–40°C	–73°C to 51°C
Minimum Pipe Diameter	The minimum pipe diameter of the heat trace circuit. Use the smallest pipe diameter of any grouped pipes. This setting applies only to PASC mode.	0.5" (12.5mm)	0.5" (12.5mm) / 1.0" (25mm) / 2.0" (50mm)
Power Adjust	This value can be used to fine tune the PASC algorithm and reduce or increase the output duty cycle calculated by the PASC algorithm.	100%	10% to 200%
Proportional Band	This value represents the proportional band within the Proportional algorithm.	2°C	1°C to 50°C.

Table 19 - Control Algorithms

Procedure:

Select an algorithm and configure accordingly.

5.5.3 Output Type



Figure 63 - Output Type Setting

Purpose:

To select the type of Output that matches the output switch type connected to the controller.

Options:

Output Type	Description
Contactor	This output type should be selected when an EMR is the attached output device.The output is inhibited from changing its state for two seconds after a previous state change to help prolong the life of the EMR. This output type is incompatible with algorithms that rely on rapid switching.
SSR	This output type controls an attached SSR output device, for precise control of the power, where the output may be switched on/off rapidly. When using this mode, the EMR Contactor Output is held in a state that can be defined by the user.
Analog SSR	A 0-10V signal is presented to drive external analog SSRs. The output value corresponds to the calculated 0-100% output duty cycle.

Table 20 - Output Type

See Section 3.1.1 for more details.

Procedure:

Select the Output Type from the drop-down list.

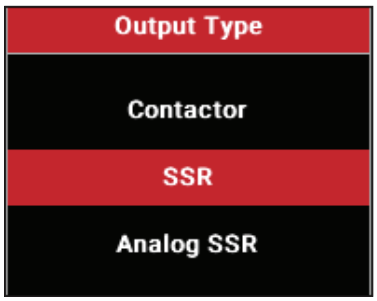


Figure 64 - Output Type

Select an Inactive or Active EMR Output state when using SSR output types.

Default EMR Output: Active

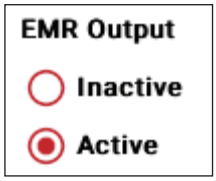


Figure 65 - EMR Output Setting

When using an SSR as the primary control output, the contactor output will be held in the configured state unless the SSR fails.

5.5.4 Heater Configuration

This section applies to Elexant 4020i 3-phase variants.

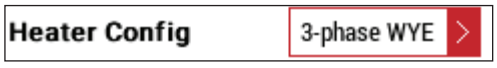


Figure 66 – Heater Configuration Selection

Purpose:

Selects the topology of the 3-phase heater to enable the controller to properly calculate trace power and trace resistance.

Table 21 lists various 3 phase heater configuration settings and wiring configurations that are used for the calculations of trace voltage and trace current.

Options:

- 3-Phase WYE
- 3-Phase DELTA

Procedure:

Select the Heater Configuration from the drop-down list. Ensure that the Voltage Measurement parameter is also set appropriately for the application – see Section 5.8.3.1.

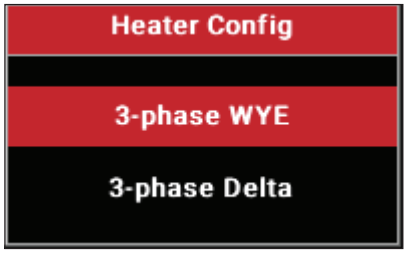


Figure 67 – Heater Configuration

Controller Voltage Sense onnection	Heater Configuration	Voltage Measurement Parameter Setting	Heater Configuration Parameter Setting	4020i Calculated Voltage	4020i Calculated Current
L-L[1]	L-L	L-L	Delta	Measured voltage	Measured current / √3
L-L	L-N	L-L	Wye	Measured voltage / √3	Measured current
L-N[2]	L-L	L-N	Delta	Measured voltage * √3	Measured current / √3
L-N	L-N	L-N	Wye	Measured voltage	Measured current

Table 21 – 3-Phase Heater Configuration Settings

[1] L-L: Line to Line

[2] L-N: Line to Neutral

5.6 Output Limiting Page

This page is available only when the Output Type is selected as SSR.

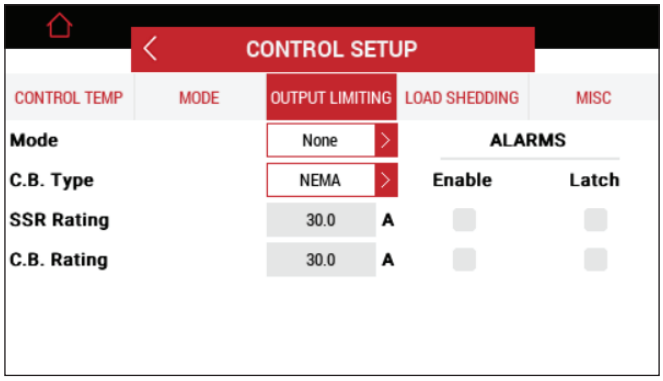


Figure 68 - Output Limiting Page

5.6.1 Output Limiting Mode

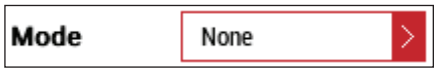


Figure 69 - Output Limiting Mode Setting

Purpose:

The output of the controller can be limited by Average power, Current or to a maximum duty cycle (Percent). The controller measures the voltage and current of the heat trace circuit and controls the output switch to limit the power or current applied to the EHT circuit.

Options:

- None
- Power
- Current
- Percent

Default: None

Procedure:

The Output Limiting parameters are set by selecting the Mode, setting the limit value and enabling the desired alarms.

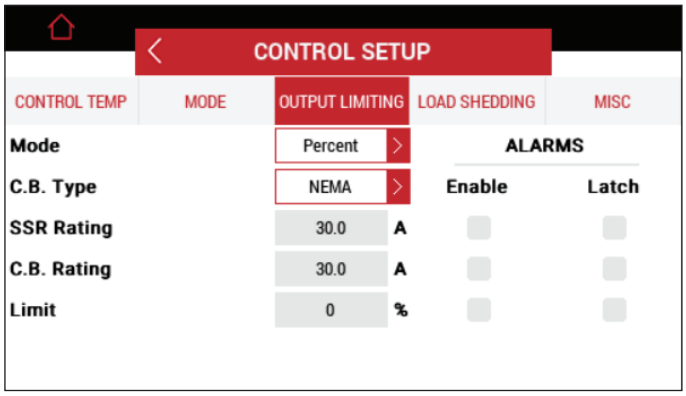


Figure 70 - Output Limiting Parameters

The Limit alarm, when enabled, only informs the user that the output limiting is active. It does not affect the output limiting behavior.

The maximum Power limiting supported by the Elexant 4010i/4020i is a function of the external Current Turns Ratio (see Section 5.8.1.2) and the external Voltage Turns Ratio (see Section 5.8.3.2).

The maximum current limiting supported by the Elexant 4010i/4020i is a function of the external Current Turns Ratio (see Section 5.8.1.2).

5.6.2 SSR Limiting (Switch Protection)



Figure 71 - SSR Rating Setting

Range: 20.0 A to 100.0 A for Current Turns Ratio 1:1

Default: 30.0 A

Purpose:

The SSR Limiting (Switch Protection) feature is available when an SSR output switch is used. It is intended to minimize the chance of damaging an SSR during unusual inrush current situations.

The SSR Rating alarm, if enabled, will only inform the user that switch limiting is active and an excessively high current condition is present.

The controller pulses its output switch for a small interval and reads the resulting current. If the measured current exceeds the SSR Rating setting, then the duty cycle of its output switch is reduced so that an average current, not exceeding the SSR Rating setting, is maintained.

IMPORTANT: This alarm should generally be left enabled. Currents in this range cannot be considered normal and should be investigated.

The maximum SSR Rating supported by the Elexant 4010i/4020i is a function of the external current turn ratio (see Section 5.8.1.2).

Procedure:

Touch the SSR Rating text box to display the numeric pad and set the numeric value.

Touch the Enable check box to turn on/off the Alarm indication or touch the Latch check box to configure a latching or a non-latching type of alarm. When the latching is selected, the alarm will need to be manually reset each time the corresponding alarm occurs.

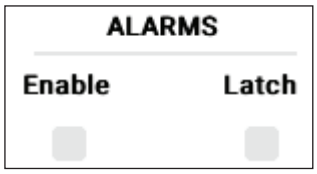


Figure 72 – SSR Limiting Alarm Settings

5.6.3 Circuit Breaker Limiting

5.6.3.1 C.B Type (Circuit Breaker Type)



Figure 73 – C.B Type

Purpose:

Selects the 'circuit breaker curve' to be used when performing circuit breaker current limiting. Each type of breaker has a different allowance for brief over-currents and this parameter must be selected to match the breaker used in the application.

Options:

- NEMA
- IEC B
- IEC C
- IEC D

Default: NEMA
Procedure:

Select the C.B Type from the drop –down list

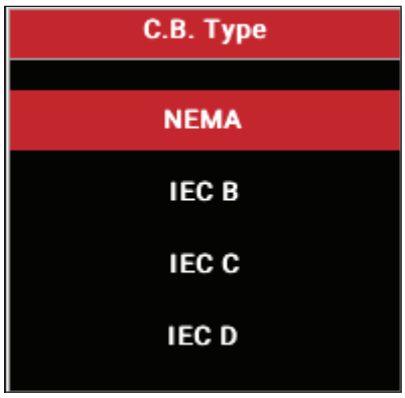


Figure 74 – C.B Type Selection

5.6.3.2 C.B Rating (Circuit Breaker Rating)



Figure 75 – C.B Rating Setting

Purpose:

The Circuit Breaker Rating setting helps prevent in-rush induced nuisance tripping of the circuit breaker immediately upstream of the controller. The Circuit Breaker Limiting alarm, if enabled, will only inform the user that circuit breaker limiting is active. .....

Range: 1.0 A to 100.0 A for Current Turns Ratio 1:1

Default: 30.0 A

IMPORTANT:

The maximum C.B Rating supported by the Elexant 4010i/4020i is a function of the external current turn ratio (see Section 5.8.1.2).

Procedure:

Touch the C.B Rating text box to display the numeric pad and set the numeric value.

Touch the Enable check box to turn on/off the Alarm indication or touch the Latch check box to configure a latching or a non-latching type of alarm. When the latching is selected, the alarm will need to be manually reset each time the corresponding alarm occurs.



Figure 76 – C.B Limiting Alarm Settings

5.6.4 Turns Ratio Dependent Settings

If the Output Limiting tab is flashing and the setpoint value in the Output Limiting page is highlighted in red, its setting is invalid. The user must adjust its setting within the correct range and verify the Current / Voltage Turns Ratio settings in the ELECTRICAL page. See Current / Voltage Turns Ratio in Section 5.8.1.2 and 5.8.3.2 for more details.

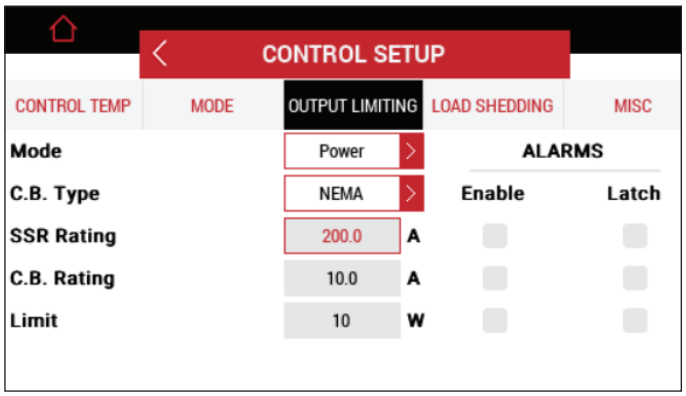


Figure 77 - Invalid SSR rating

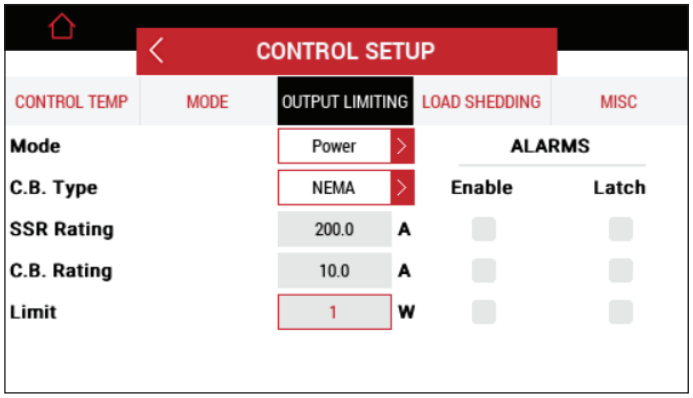


Figure 78 – Invalid Power Rating

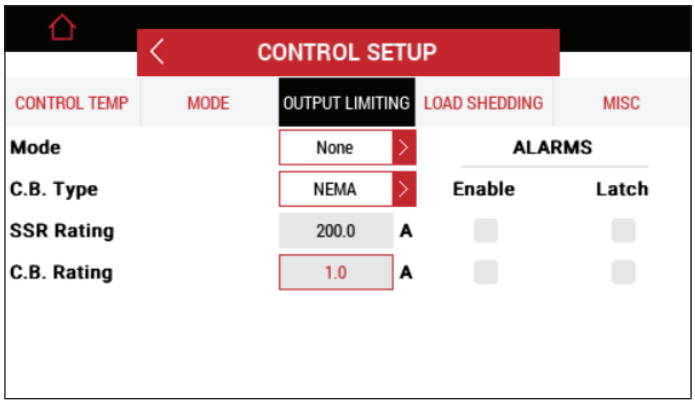


Figure 79 - Invalid Circuit Breaker Rating

5.6.5 Load Shedding Page

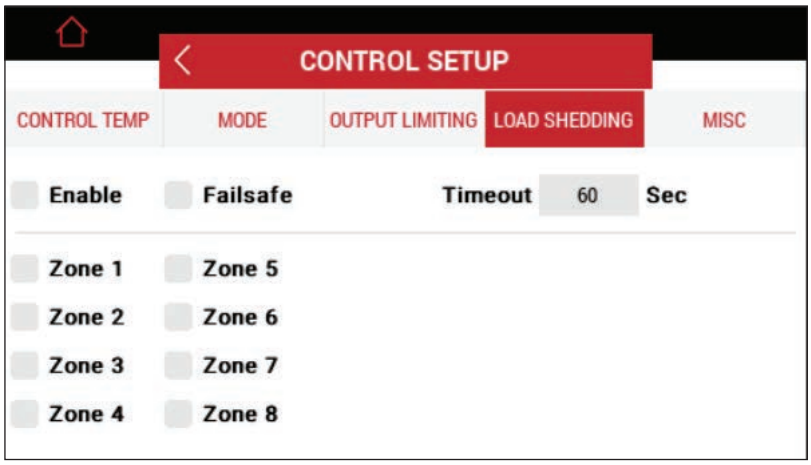


Figure 80 - Load Shedding Page

Purpose:

The Elexant 4010i/4020i controller may be put into a load shedding mode only after receiving a load shedding command issued from a Modbus Master. This mode overrides the temperature control and forces the output of the control module off until reset by the Modbus Master.

The Modbus Master issues a load shedding broadcast command to the control modules at least once every Timeout period. If the controller has this feature Enabled and does not receive the broadcast within the Timeout period, a LOAD SHEDDING COMM FAILURE ALARM is tripped.

Options:

A controller can be assigned up to 8 different load shedding zones.

Procedure:

The broadcast sent from the Modbus Master specifies which of these zones are to be load shed. If the controller is a member of a zone specified for load shedding, it will turn its output off. After this command has been received, the controller will continue to hold the output in the off state, until one of the following three conditions occur:

The Modbus Master that initiated load shedding issues a load shedding command to terminate load shedding mode.

Communications are interrupted between the controller and the Modbus Master, as in the case of a damaged communications wire. If the communication ceases for a specified Timeout value
(60s to 600s), the controller will return to normal operation.

Failsafe operation begins. See Section 5.6.6 for details on Load Shedding Failsafe Operation.

5.6.6 Load Shedding Failsafe Mode

Purpose:

Load Shedding Failsafe mode is used to protect the EHT circuit from freezing if the control output is off due to a load shedding command issued by the Modbus Master. Once the temperature of the TS used in the TS CONTROL MODE drops to that sensor's LOW TEMP ALARM setting, the control output will go ON and use the Low Temp Alarm setting as the temporary control setpoint.

Procedure:

Touch the Failsafe check box to enable Load Shedding Failsafe.

If the Failsafe parameter is enabled, then at least one Low Temperature Sensor Alarm must be enabled. If the alarm temperature exceeds the Control Setpoint Temperature, failsafe mode will be disabled. If the control temperature drops below the Control Temperature Low Alarm Setpoint, the output will turn on.

IMPORTANT: The controller returns to normal operation if communications between the Modbus Master and the controller is disrupted in any way. The controller does not perform a periodic autocycle test while operating in load shedding mode.

Default: Disable

5.6.7 Miscellaneous Page

Purpose:

The Miscellaneous page contains many different settings that are described below.

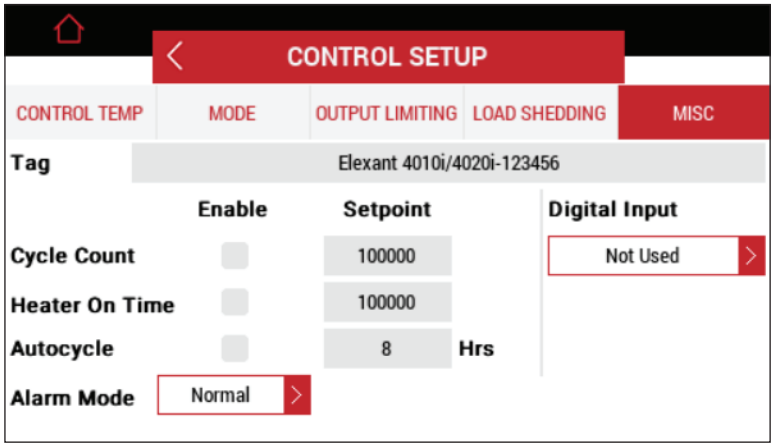


Figure 81 - Miscellaneous Page

Procedure:

Touch the field for which the value needs to be modified.

5.6.7.1 Controller Tag

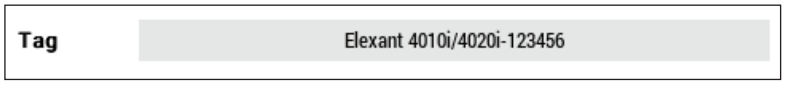


Figure 82 - Controller Tag Entry

Purpose:

This parameter is a 40-character tag assigned to the controller or EHT circuit for easy identification.

Range: Alpha-numeric characters.

Default: Elexant 4010i/4020i-xxxxxx.

5.6.7.2 Autocycle



Figure 83 - Autocycle Settings

Range: 1 to 750 Hours

Purpose:

The Autocycle interval is user programmable and periodically energizes the circuit for 30 seconds to detect any alarm conditions. Circuit alarms are be generated at the time of autocycle instead of when heat is required. This feature eliminates the need for a preventive maintenance program as these tests are performed at regular intervals by the controller.

Default: 8 Hours

5.6.7.3 Alarm Mode

Purpose:

The Alarm Mode defines the behavior of the alarm output.

1. **Normal:**

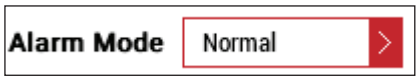


Figure 84 - Alarm Mode Normal Setting

The alarm output is active when an alarm condition exists, inactive when there is no alarm condition.

2. **Toggle:**



Figure 85 - Toggle Time Period Settings

The alarm output is active when an alarm condition exists and the alarm relay changes state for a period of time (the toggle time) whenever a new alarm is generated. The user may define the toggle time by entering the desired duration.

3. **Flash:**



Figure 86 - Flash Setting

The alarm relay opens and closes alternatively approximately once per second.

IMPORTANT: If the alarm output is used to drive a pilot light, it is recommended that Flash be selected to enable flashing operation. When the output is also configured for normally closed operation, the pilot light will be on steady for Normal operation, Flash in case of alarm and be extinguished due to a bulb failure or loss of power. If multiple alarm outputs from different controllers are wired in series (e.g. multi-point panels), set this parameter to *Normal* operation.

5.6.7.4 Digital Input

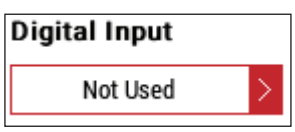


Figure 87 - Digital Input Setting

Purpose:

The digital input offers the option to generate an alarm or override the electrical heat-tracing mode using an external dry contact or DC voltage source. The digital input can be configured in the following ways:

- Not Used: no action taken
- Force On when input is open
- Force On when input is closed
- Force Off when input is open
- Force Off when input is closed
- Alarm when input is open
- Alarm when input is closed
- Hand/Off/Auto

Default: Not Used

5.6.7.5 Cycle Count Alarm



Figure 88 - Cycle Count Setting

Range: 1 to 1,000,000 cycles.

Default: 100000

Purpose:

This generates an alarm if the number of off-to-on transitions of a mechanical contactor reaches or exceeds the contactor count alarm setting. It serves as a reminder to perform preventive maintenance on the contactor when the contactor reaches the manufacturer's recommended maximum number of cycles.

Default: Enabled and set at 100,000 cycles.

5.6.7.6 Heater on Time



Figure 89 - Heater on Time Setting

Range: 1 to 250,000 hours

Default: 100000

Purpose:

This generates an alarm if the Heater ON time reaches or exceeds the set number of operational hours.

Default: Enabled and set at 100,000 hours.

5.7 Temperature Settings Page

This page provides access to the selection and settings of Temperature Sensor (x) and to Temperature Limiting features.

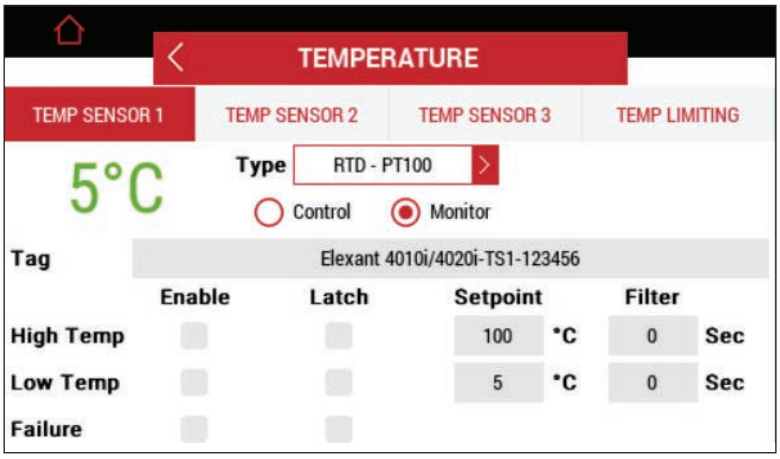


Figure 90 - Temperature Settings Page

5.7.1 Temp Sensor (x) Reading

Purpose:

This temperature is the value that the controller is reading from the temperature sensor connected to the corresponding temperature sensor input. Depending on the TS Control Mode, it may be used to determine the Control Temperature.

IMPORTANT: If the sensor device is not connected to the device at the terminal block, the TS(x) input reading is displayed as N/A

5.7.1.1 Control / Monitor

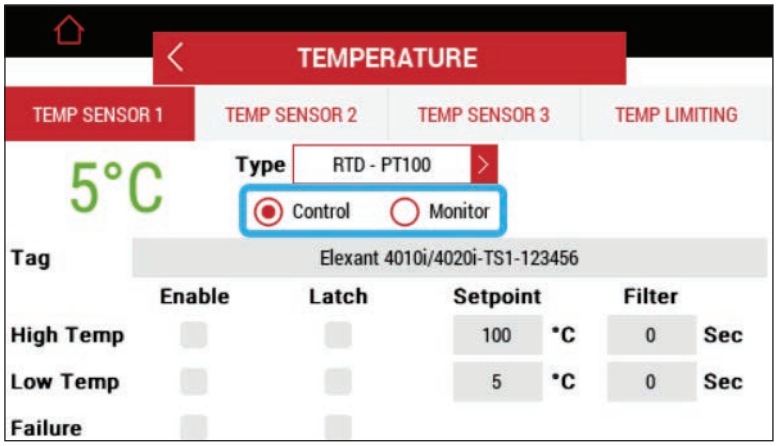


Figure 91 - Temperature Sensor Control Mode

Purpose:

These radio buttons allow the user to specify whether a sensor should be used for controlling or monitoring purposes.

Selecting Control enables the High Temperature and Low Temperature settings and displays the Control Temperature Alarm settings. As a Control Sensor, it will be used as part of the output control algorithm and contributes to the measurement for control sensor alarms.

Selecting Monitor disables the High Temperature and Low Temperature Settings.

Default: TS1: Control

TS2, TS3: Monitor

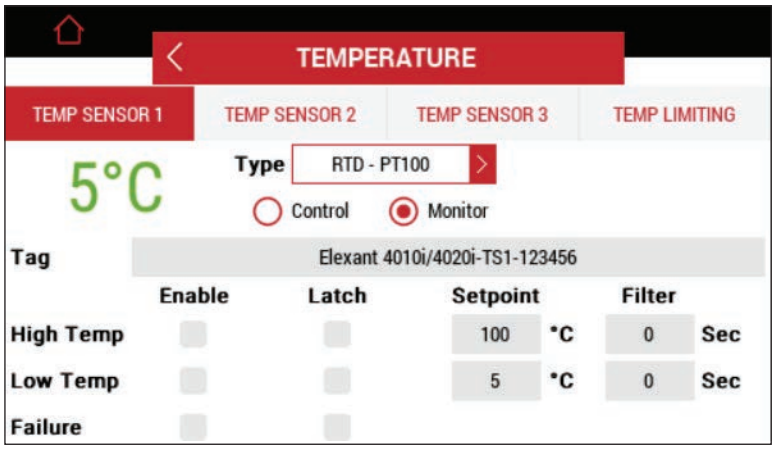


Figure 92 - Temperature Sensor Monitor Mode

5.7.1.2 Type

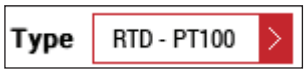


Figure 93 - Sensor Type Setting

Purpose:

This combo box defines the type of RTD that is being used as a Temperature Sensor.

The available selections for the temperature sensor type are:

- RTD-PT100
- RTD-NiFe100
- RTD – Ni100
- 4-20mA
- None

Default: TS1: 3-Wire 100-Ohm Platinum (Pt100).

TS2, TS3: None

5.7.1.3 Tag



Figure 94 - Tag Entry

Purpose: A 40-character tag may be assigned to a temperature sensor for easy identification of location, area, etc.

Default: The default value of the Tag is in the format Elexant 4010i/4020i-TSx- (where x is 1, 2, or 3 for the corresponding sensor).

5.7.1.4 Lead Resistance



Figure 95 - Lead Resistance Setting

Purpose:

When using 2-wire temperature sensors, a sensor lead resistance value may be entered, correcting the resistance measurement for better temperature measurement accuracy.

This value is only displayed for RTD-NiFe100 or RTD – Ni100 temperature sensors.

Range: 0.00 to 20.00 Ohms.

Default: 0 Ohms.



Figure 96 - Temperature Alarm Settings

Purpose:

When "Control" is selected, the alarm settings for the Temperature Sensor can be configured using the lower half of the page as shown above.

Procedure:

Touch the corresponding Enable check box to turn on/off the corresponding Alarm indication and touch the corresponding Latch check box to define a latching or a non-latching type. When the Latch is selected, the alarm will need to be manually reset each time the corresponding alarm occurs.

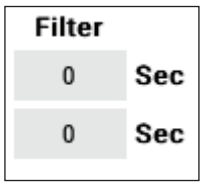


Figure 97 - Filter Setting

Filter: When the temperature exceeds the High Temperature Setpoint or drops below the Low Temperature Setpoint, the unit only triggers an alarm if the corresponding High/Low alarm condition is present for the "Filter" period. If immediate alarm output is required for an alarm condition, then the corresponding filter value should be set to 0.

Alarm Setpoint	Description	Default Value	Range	Filte (seconds)
High Temperature	This alarm is active when the sensor temperature has surpassed the value of the High Temperature Setpoint.	100°C	–200°C to 700°C	0 to 59940
Low Temperature	This alarm is active when the sensor temperature is below the value of Low Temperature Setpoint.	5°C	–200°C to 700°C	0 to 59940
Failure	This alarm is active when the temperature sensor has failed.	N/A	N/A	N/A

Table 22 - Temperature Alarm Settings

5.7.2 Temp Limiting

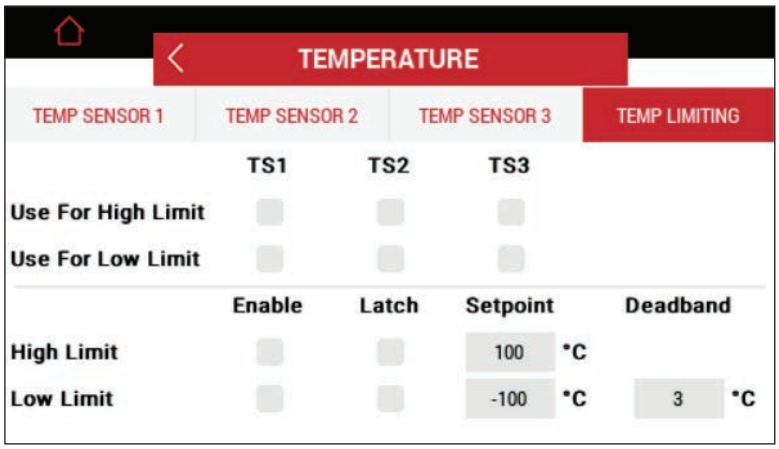


Figure 98 - Temp Limiting Settings Page

5.7.2.1 TS(x) Selection for High/Low Limit

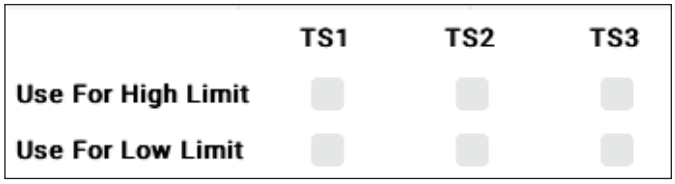


Figure 99 - TS(x) High/Low Limit Settings

Purpose:

The TS(x) check box allows user to select which sensors are used for High/Low Temperature Limiting. Touch the check box corresponding to the temperature sensor to enable temperature limiting.

5.7.2.2 High/Low Limit Cut-out Alarm Setpoints

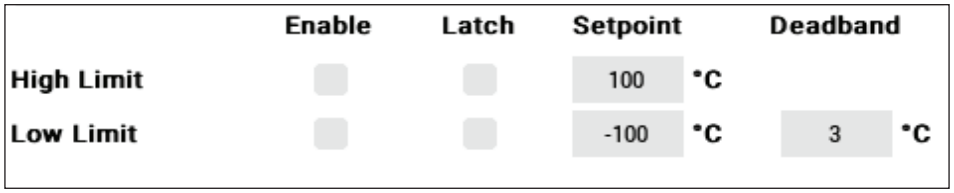


Figure 100 - High/Low Limit Cut-out Alarm Setpoints

Procedure:

Touch the corresponding **Enable** check box to turn on/off the corresponding Alarm indication and touch the corresponding Latch check box to indicate a latching or a non-latching type of alarm. When the latching is selected then the alarm needs to be manually reset each time the corresponding condition occurs.

The Setpoint values are for both High/Low Limit Cut-out and alarm.

Value	Description	Default Value	Range
High Limit	This value defines the High Limit Cut-out Setpoint for each of the 3 temperature sensors where the corresponding temperature sensor has High Limit Cut-out enabled. This overrides the Control Temperature Setpoint value and forces the controller output off if any one of the corresponding temperature sensors exceeds the High Limit Cut-out temperature setting.	700	–200°C to 700°C
Low Limit	This value defines the Low Limit Cut-out Setpoint for each of the 3 temperature sensors where the corresponding temperature sensor has Low Limit Cut-out enabled. This overrides the Control Temperature Setpoint value and forces the controller output off if any one of the corresponding temperature sensors falls below the Low Limit Cut-out temperature setting.	–70°C	–200°C to 700°C
Deadband (Low Limit only)	The hysteresis band used by the control algorithm for the Low-Limit setpoint when the non-latching mode is being used.	3°C	1°C to 50°C

Table 23 - High/Low Limit Cut-out Settings

5.8 Electrical Settings

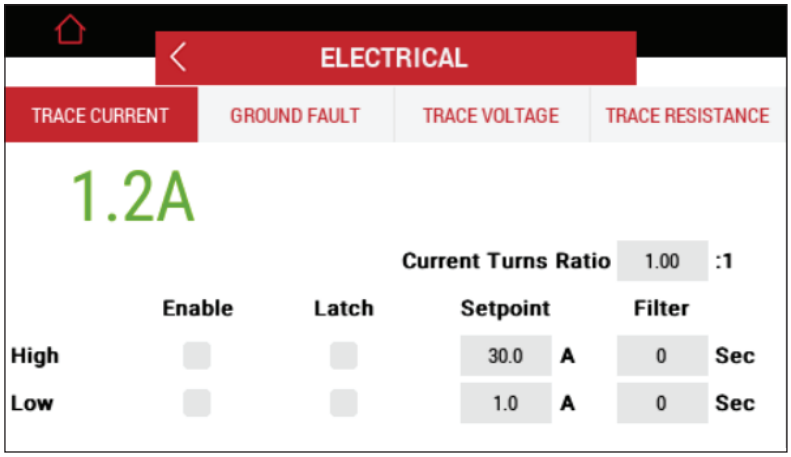


Figure 101 - Trace Current Settings for 1-Phase Heat Trace Circuit

This page displays the live value of the Trace Current associated with a heat trace circuit.

5.8.1.1 High/Low Trace Current Alarm Settings

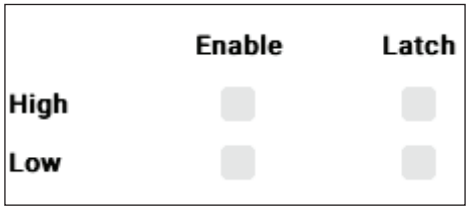


Figure 102 - High/Low Trace Current Alarm Settings

Procedure:

Touch an **Enable** check box to turn on/off the corresponding Alarm. Touch the corresponding **Latch** check box to select a latching or a non-latching alarm type. When **Latch** is selected, the alarm will to be manually reset each time the corresponding alarm occurs.

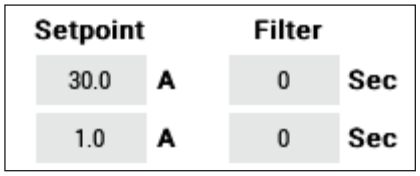


Figure 103 - High/Low Trace Current Setpoint & Filter Settings

Filter: When the current exceeds the High Current Setpoint or drops below the Low Current Setpoint, the controller will only trigger an alarm if the corresponding High/Low alarm condition is present for the duration of the filter period (0 - 28 seconds). If an immediate alarm output is required when an alarm condition occurs, then the corresponding filter value should be set to 0.

Values	Description	Default Value	Range
High Trace Current	This alarm is active when the trace current level has surpassed the value of High Trace Current Setpoint.	30.0 A	0.1 A to 100.0 A
Low Trace Current	This alarm is active when the trace current level has dropped below the value of Low Trace Current Setpoint.	1.0 A	0.1 A to 100.0 A

Table 24 - High/Low Trace Current Alarm Settings

In the case of a 3-phase controller; L1, L2 and L3 buttons are displayed in the top right corner of the page. Touching any of these buttons displays the corresponding settings for that Line current. Enabling the **Balanced 3 Phase** option disables individual High/Low Trace Current Alarms for phases 2 and 3, and uses the values for phase 1 for all three phases.

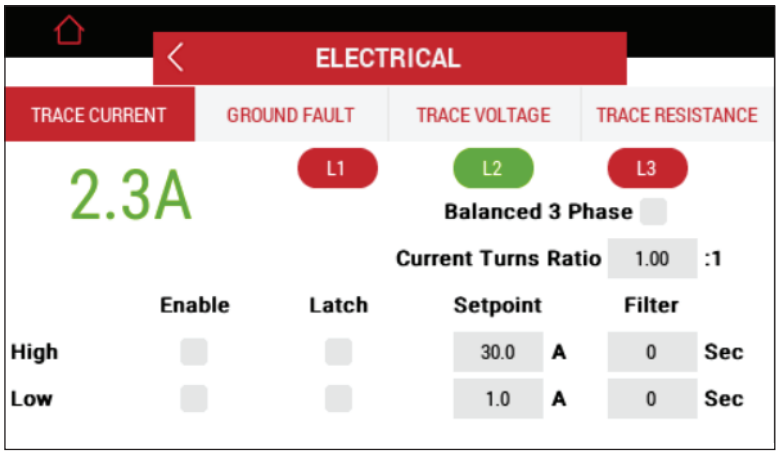


Figure 104 - Trace Current Page for 3-Phase Heat Trace Circuit

NOTE: If the Trace Current tab is flashing and the setpoint value is highlighted in red, its setting is invalid. Check the Current Turns Ratio and adjust its setting within the correct range.

5.8.1.2 Current Turns Ratio

Purpose:

The Current Turns Ratio adjusts current readings for applications where a control module is monitoring a load through an external step-up or step-down current transformer.

The highest Trace Current supported by the controller is a function of the external Current Turns Ratio. This field can be used to multiply or divide the Trace Current.

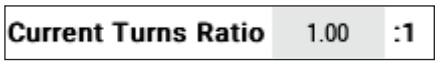


Figure 105 - Current Turns Ratio Setting

Range: 0.1 to 10A

Default: 1.00

Procedure:

Adjust the Current Turns Ratio (CTR) to equal the ratio of the primary to secondary windings of the external current transformer

After setting the Current Turns Ratio, compare the current indicated by the controller to the actual measured heat trace current and adjust the CTR until the two readings are as close as possible

IMPORTANT: When the Current Turns Ratio has been set appropriately, the control unit will calculate the heat trace circuit power using the adjusted current and voltage readings. Current alarms also use the adjusted current reading.

5.8.2 Ground Fault

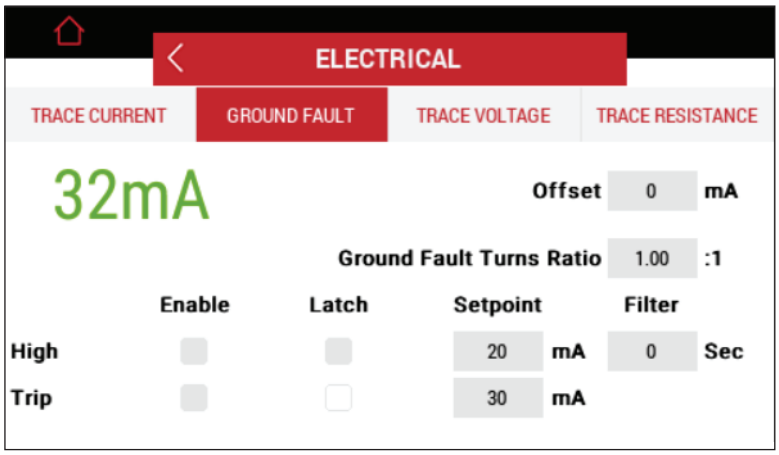


Figure 106 - Ground Fault Page

This page displays the live value of the Ground Fault (GF) Current associated with a heat trace circuit. The Elexant 4010i/4020i controller detects ground faults by summing the outgoing and return trace currents through an internal current transformer. Under normal operating conditions (no ground fault condition), this current will be zero. When there is a flow of current from one of the load conductors to ground, a ground fault condition occurs.

5.8.2.1 High/Trip Ground Fault Alarm Settings

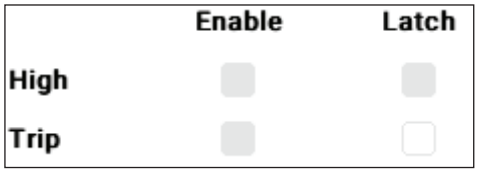


Figure 107 - High/Trip Ground Fault Alarm Settings

Procedure:

Touch the corresponding **Enable** check box to turn on/off the corresponding Alarm indication and touch the corresponding **Latch** check box to select a latching or a non-latching alarm type. When latching is selected, the alarm will need to be manually reset each time the corresponding alarm occurs.

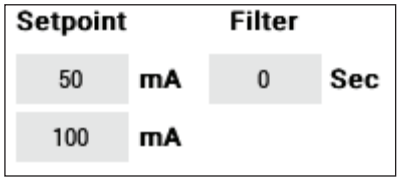


Figure 108 - High/Trip Ground Fault Setpoint & Filter Settings

Filter: When the Ground Fault current exceeds the High GF Setpoint, the controller will only trigger an alarm if the corresponding High GF condition is present for the duration of the filter period (0 - 28 seconds). If an immediate alarm indication is required, then the corresponding filter value should be set to 0.

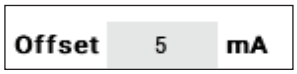


Figure 109 - Ground Fault Current Offset Setting

Offset: Ground Fault Offset may be used to remove inherent (background) ground fault readings in long line systems.

Values	Description	Default Value	Range
High Ground Fault Current	This alarm can be used to give a pre-warning on a circuit whose ground-fault current is increasing but is not yet at Ground Fault Trip Current Setpoint.	20 mA	10 mA to 500 mA
Ground Fault Trip Current	This alarm is generated when the ground-fault leakage current exceeds the Ground-Fault Trip Current Setpoint. Exceeding this limit will result in the output switch being latched off. Typically, GF Trip is set at a slightly higher value than the High GF Current Setpoint.	30 mA	10 mA to 500 mA
Offset	This value is used to remove any inherent ground faults that may be found in long line systems.	0 mA	0 mA to 100 mA

Table 25 - High/Trip Ground Fault Alarm Settings

NOTE: If the Ground Fault tab is flashing and the setpoint value is highlighted in red, its setting is invalid. Check the Ground Fault Turns Ratio and adjust its setting within the correct range.

5.8.2.2 Ground Fault Turns Ratio

Purpose:

The Ground Fault Turns Ratio may be used to adjust the Ground Fault Current readings in applications where a control module is monitoring the load through an external step-up or step-down current transformer.

The highest Ground Fault current tolerated by the controller is a function of the external Ground Fault Turns Ratio. This field can be used to



Figure 110 - Ground Fault Turns Ratio Setting

Range: 0.1 to 10

Default: 1.00

Procedure:

Adjust the Ground Fault Turns Ratio to equal the ratio of the primary to secondary windings of the external current transformer.

After setting the ground fault turns ratio, compare the Ground Fault Current indicated by the controller to the measured heat trace ground fault current and adjust until the two readings are as close as possible.

5.8.3 Trace Voltage

This page displays the live value of the Trace Voltage associated with a heat trace circuit.

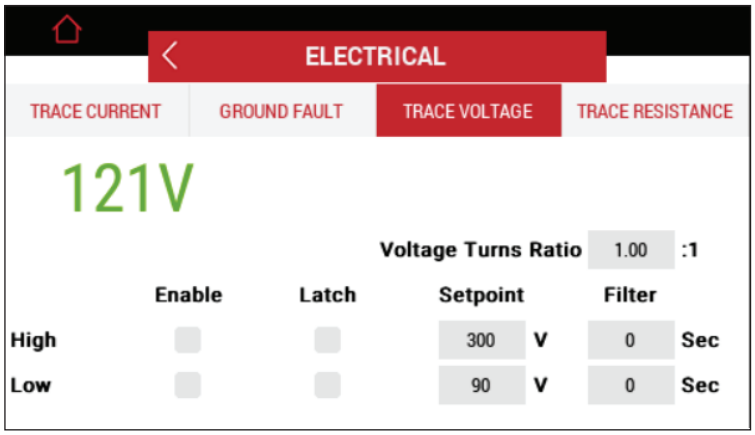


Figure 111 – Single Phase Trace Voltage Page

Trace voltage is used to generate alarms when the unit is operating at a voltage lesser/higher than the intended design, which can cause significant loss of/excess heater output.

5.8.3.1 High/Low Trace Voltage Alarm Settings

Procedure:

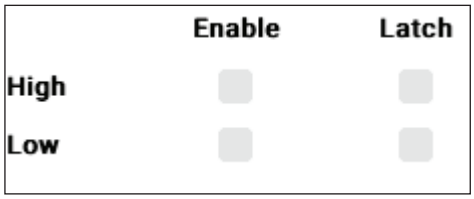


Figure 112 - High/Low Trace Voltage Settings

Touch the corresponding **Enable** check box to turn on/off the corresponding Alarm indication and touch the corresponding **Latch** check box to select a latching or a non-latching alarm type. When latching is selected the alarm will need to be reset manually each time the corresponding alarm has occurred.

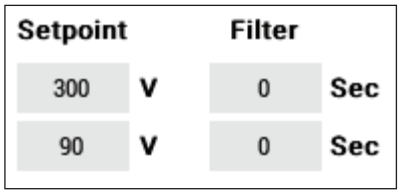


Figure 113 - High/Low Trace Voltage Setpoint & Filter Settings

Filter: When the voltage exceeds the High Voltage Setpoint or drops below the Low Voltage Setpoint, the unit only triggers an alarm if the corresponding High/Low alarm condition is present for the duration of the filter period (0 - 28 seconds). If an immediate alarm output is required, then the corresponding filter value should be set to 0.

Value	Description	Default Value	Range
Trace Voltage High - Setpoint	This alarm is generated when the voltage being monitored exceeds the defined High setpoint.	300 V	80 V to 300 V
Trace Voltage Low - Setpoint	This alarm is generated when the voltage being monitored drops below the defined Low setpoint.	90 V	80 V to 300 V

Table 26 - High/Low Trace Voltage Alarm Settings

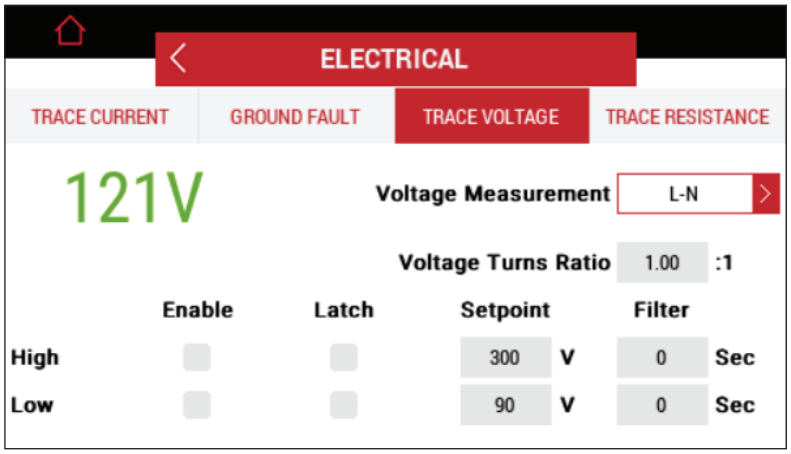


Figure 114 – 3 Phase Trace Voltage Page



Figure 115 - Voltage Measurement Setting

Value	Description	Default Value	Range
Voltage Measurement	This selection is only visible when using 3-phase variants of the Elexant 4010i/4020i controllers. It has two options: (i) L-N (Line to Neutral): Select this option when the trace voltage is being measured between Line and Neutral. (ii) L-L (Line to Line): Select this option when the trace voltage is being measured between phases. Note: Refer to Table 21 in Section 5.5.4 for detailed information regarding 3PH heater configuration settings and wiring configurations.	L-N	L-N L-L

Table 27 - Voltage Measurement

NOTE: If the Trace Voltage tab is flashing and the setpoint value is highlighted in red, its setting is invalid. Check the Voltage Turns Ratio and adjust its setting within the correct range.

5.8.3.2 Voltage Turns Ratio

Purpose:

The Voltage Turns Ratio adjusts voltage readings for applications where a control module is switching a load through a step-up or step-down transformer, or is being powered from a source with a differentvoltage level than the trace voltage.

The Voltage Turns Ratio value can be used to multiply or divide the Trace Voltage measured by the controller.

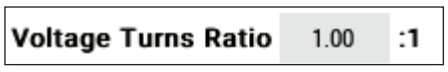


Figure 116 - Voltage Turns Ratio Setting

Range: 0.01 – 10.00V

Default: 1.00

Procedure:

- Adjust the Voltage Turns Ratio (VTR) to equal the ratio of the heating circuit voltage to the control module input voltage
- After setting the Voltage Turns Ratio, compare the voltage indicated by the controller to the actual measured heat trace voltage and adjust the VTR until the two readings are as close as possible

IMPORTANT: When the Voltage Turns Ratio has been set appropriately, the control unit will calculate the heating circuit power using the adjusted current and voltage readings. Voltage alarms also use the adjusted voltage reading.

5.8.4 Trace Resistance

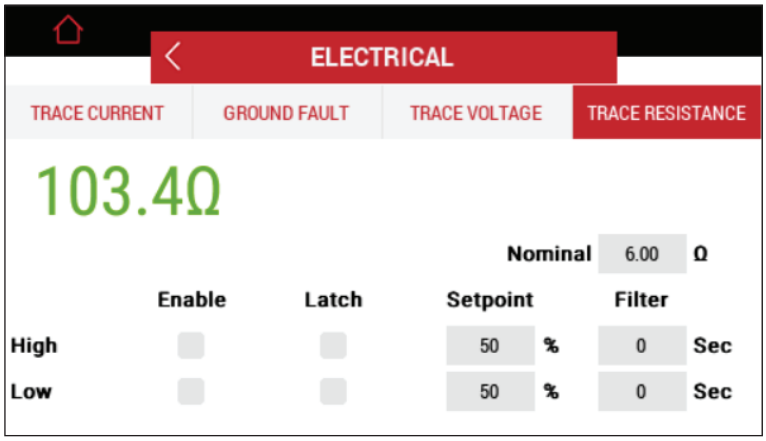


Figure 117 – Single Phase Trace Resistance Page

Trace resistance is used to generate alarms when the heat trace circuit is operating at a resistance that is either lower/higher than the nominal resistance. It can be used to effectively guard against accidental paralleling of heat trace circuits. Care must be taken when using this alarm with heating cables that exhibit a variable resistance with temperature.

5.8.4.1 High/Low Trace Resistance Alarm and Nominal Resistance Settings

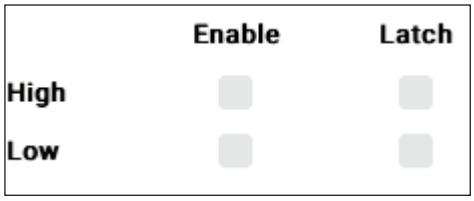


Figure 118 - High/Low Trace Resistance Settings

Procedure:

Touch the corresponding **Enable** check box to turn on/off the corresponding Alarm indication and touch the corresponding **Latch** check box to indicate a latching or a non-latching alarm type. When latching is selected, the alarm will need to be manually reset each time the corresponding alarm occurs.

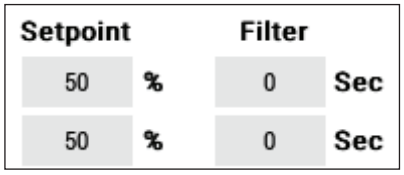


Figure 119 - Trace Resistance Setpoint & Filter Settings

Filter: When the resistance exceeds the High Resistance Setpoint or drops below the Low Resistance Setpoint, the controller will trigger an alarm if the corresponding High/Low alarm condition is present for the duration of the filter period (0 - 28 seconds). If an immediate alarm indication is desired, the corresponding filter value should be set to 0.

Values	Description	Default Value	Range
High Trace Resistance Deviation - Setpoint	Used to alarm heater resistance levels that have increased from the nominal resistance setting by more than the selected amount. This will also indicate an open or a high resistance connection. It may also be used to monitor a failed series-type cable or connection in 3-phase applications while minimizing nuisance alarms created by voltage fluctuations.	50%	1% to 250%
Low Trace Resistance Deviation - Setpoint	Used to alarm heater resistance levels that have fallen below the nominal resistance setting by more than the selected amount.	50%	1% to 50%

Table 28 - High/Low Trace Resistance Alarm Settings



Figure 120 - Nominal Trace Resistance Setting

Values	Description	Default	Range
Nominal Trace Resistance	Set this value to the nominal heat trace resistance.	6 Ohms	1 Ohms to 3000 Ohms

Table 29 - Nominal Trace Resistance Settings

In the case of a 3-phase controller; L1, L2 and L3 buttons are displayed in the top right corner of the page. Touching any of these buttons, displays the corresponding settings for that phase. Enabling the **Balanced 3 Phase** option disables individual High/Low Trace Resistance Alarms for phases 2 and 3, and uses the Phase 1 settings for all three phases.

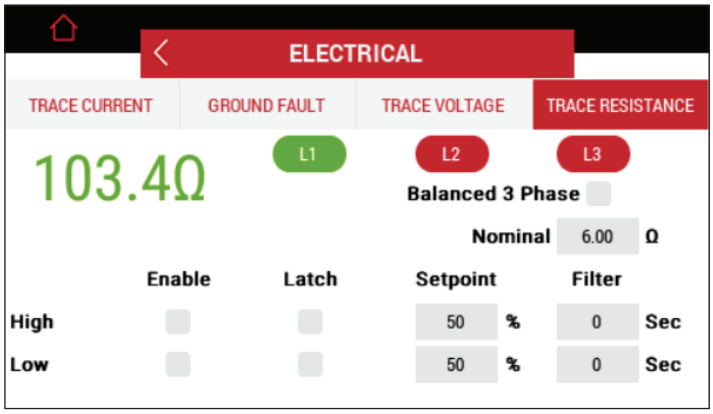


Figure 121 – 3 Phase Trace Resistance Page

5.9 Alarms

The Alarm page displays current active alarms and allows the user to select and reset a specified alarm or all alarms.

Monitored parameters trigger an alarm if they move beyond the defined setpoints. Important events that impact the function of the device, will also trigger alarms. See Section 3.5.3 for more details.

Procedure:



Figure 122 – Alarm Icon

Touch the Alarm Icon to open the Alarms page.

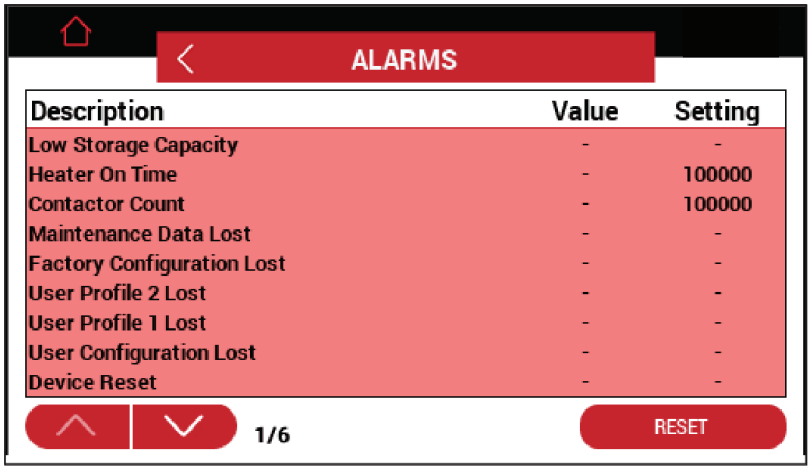


Figure 123 - Alarms Page

- Touch Up/Down button to go to the next page.
- To reset an Alarm, select the Alarm.

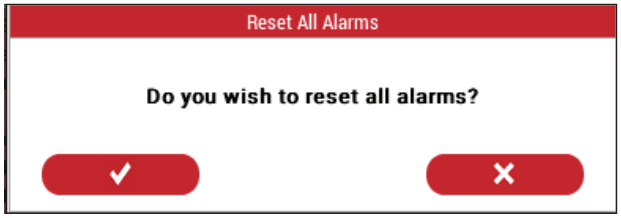
A Reset Alarm window will pop up.



Figure 124 – Reset Alarm Window

Click on button to confirm or click button to cancel.

To reset all alarms, touch RESET button.



Click on button to confirm or click button to cancel.

5.10 Maintenance Page

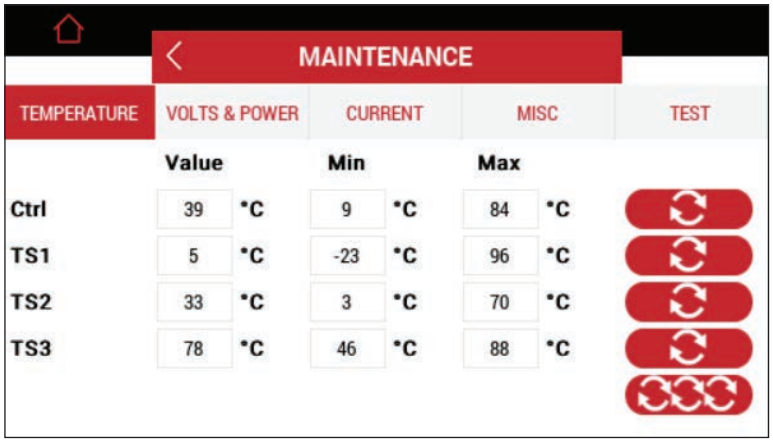


Figure 125 - Maintenance Page

The Maintenance page allows the user to view and reset the minimum and maximum recorded values of certain variables such as voltage, current, temperature, ground fault etc. The highest and lowest values measured since they were last reset are stored in the controller's memory.

NOTE: Maintenance data is stored until it is manually reset. After being reset, the measuring process restarts and stores new Minimum and Maximum values.

5.10.1 Temperature

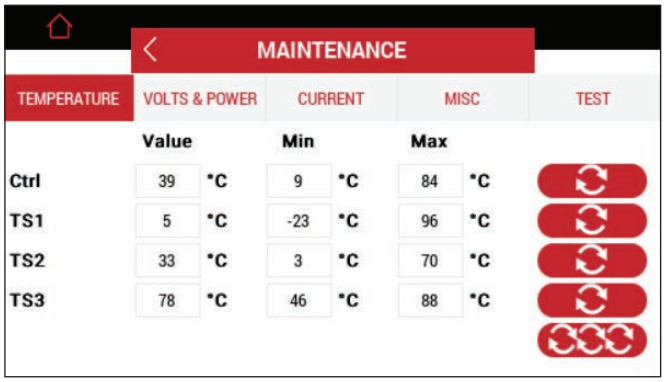


Figure 126 - Temperature page

This page displays the actual temperatures, minimum, and maximum values recorded by the controller, and sensors 1, 2, and 3. Touch the button to reset the corresponding maintenance data or touch the button to reset all the temperature maintenance data.

5.10.2 Volts and Power

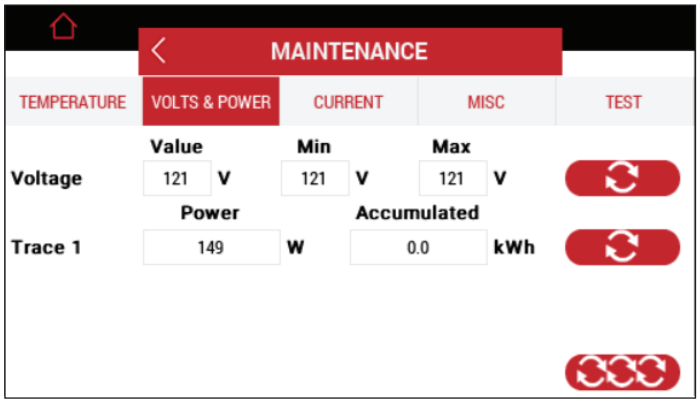


Figure 127 - Volts and Power for Single Phase Controller

This page displays the actual AC voltage, and the minimum and maximum voltage values recorded since the last time the values were reset. It also displays the Trace Power and Accumulated Power for the connected load. Accumulated Power is the total power consumption of the heat-tracing circuit since the last time the Power Accumulator was reset. Touch the button to reset the corresponding maintenance data or touch the button to reset all maintenance data.

In case of a 3-phase controller, data for each of the three phases will be displayed.

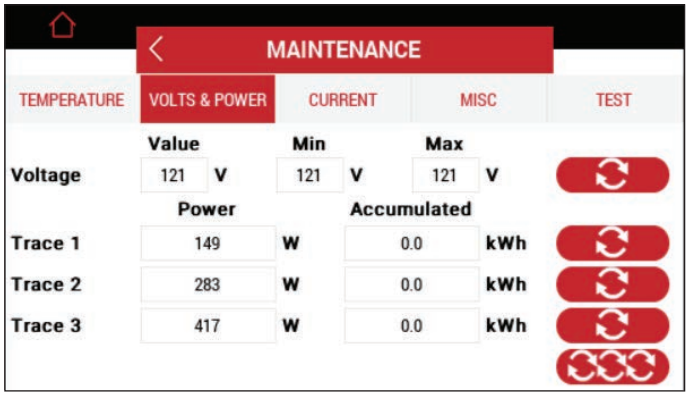


Figure 128 - Volts and Power for 3-Phase Controller

5.10.3 Current

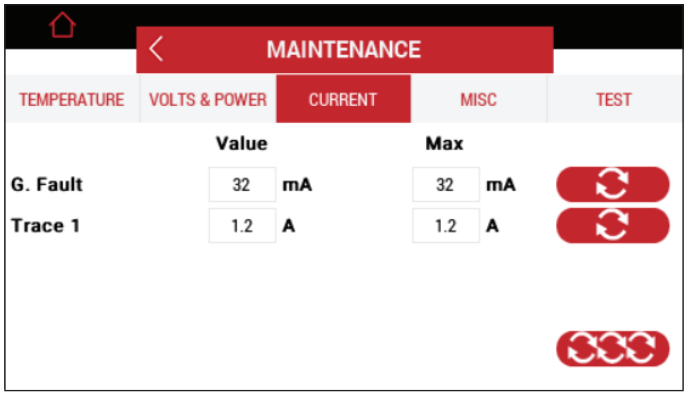


Figure 129 - Ground Fault & Trace Current Data for a 1-Phase Controller

This page displays the actual Ground Fault (GF) and Trace Current values, and the maximum values recorded since the last time they were reset. Touch the button to reset the corresponding maintenance data or touch button to reset all of the GF and Trace Current maintenance data. In the case of a 3-Phase controller, data for each of the three phases will be displayed.

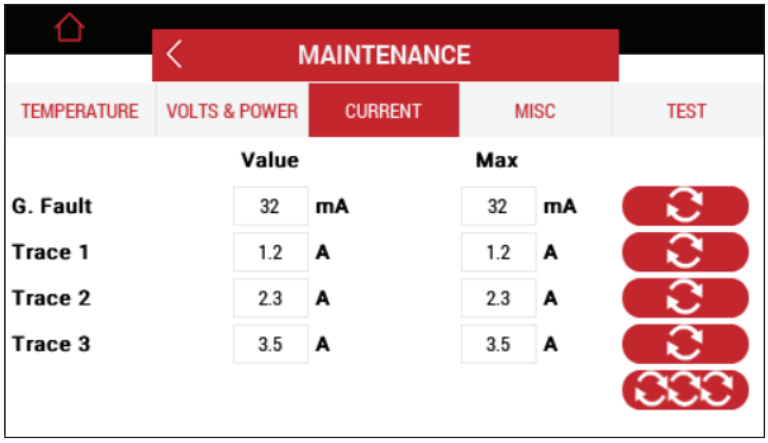


Figure 130 - Ground Fault & Trace Current Data for a 3-Phase Controller

5.10.4 Misc

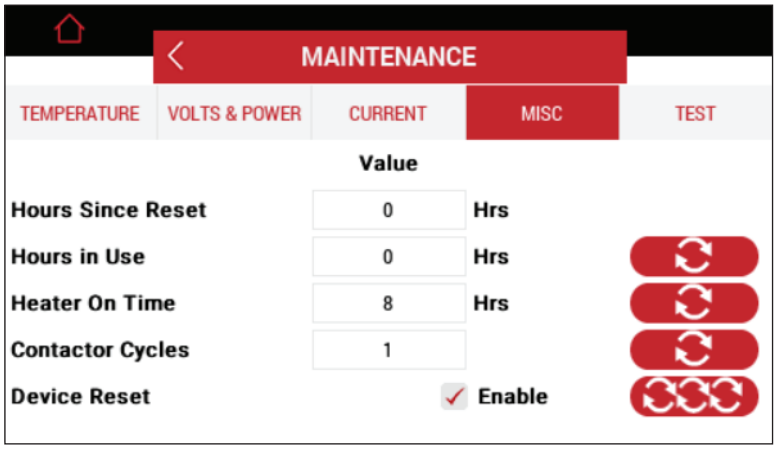


Figure 131 - Maintenance Miscellaneous Data

This page displays maintenance data for variables such as Contactor Cycles, Hours in Use, Heater On Time, Hours Since Reset, etc. Touch the button to reset the corresponding maintenance data or touch the button to reset all of the maintenance data on this page.

5.10.4.1 Contactor Cycles

This field indicates the total number of Off-to-On transitions a contactor has completed since the last time the Contactor Cycle Counter was reset. This can be used to indicate that it may be time to perform preventive maintenance on the contactor according to the manufacturer's specifications. This count value is written to the controller's non-volatile memory once every 24 hours or whenever **any maintenance is reset by the user.**

IMPORTANT: Once the contactor cycle count reaches 999,999,999; it will stop counting.

5.10.4.2 Hours in Use

This field is used to indicate the total number of hours in use of the controller since its initial operation. It may be useful to log the amount of time a particular controller has been in operation for the purposes of maintenance planning. The value of this accumulator is written to the controller's non-volatile memory once every 24 hours or whenever any maintenance data is reset by the user.

5.10.4.3 Heater ON Time

This field is used to indicate the number of hours that the heat trace has been in the energized state.

5.10.4.4 Hours Since Reset

This field is used to indicate the number of hours that have passed since the unit was last powered on.

5.10.4.5 Device Reset



Figure 132 - Device Reset

This field enables or disables the Device Reset Alarm which is used to indicate:

1. Power to the device has been interrupted and subsequently restored
2. A transient condition has caused the device's program to restart
3. An internal condition has caused the device's program to restart

5.10.4.6 Test (Trace Test)

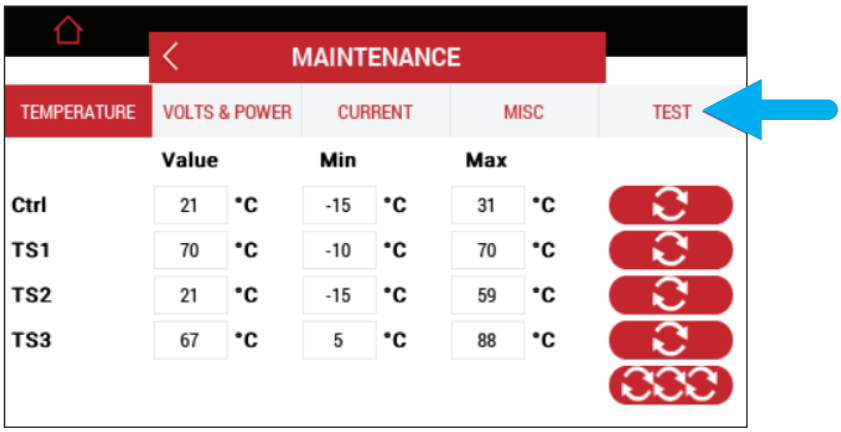


Figure 133 - Trace Test

Touching the Test (Trace Test) tab turns on the controller output for 180 seconds and then turns it off. During the test, the Test tab will count down the remaining time until the test terminates. Touching the Test tab during the test will terminate the test.

5.11 Profiles Page

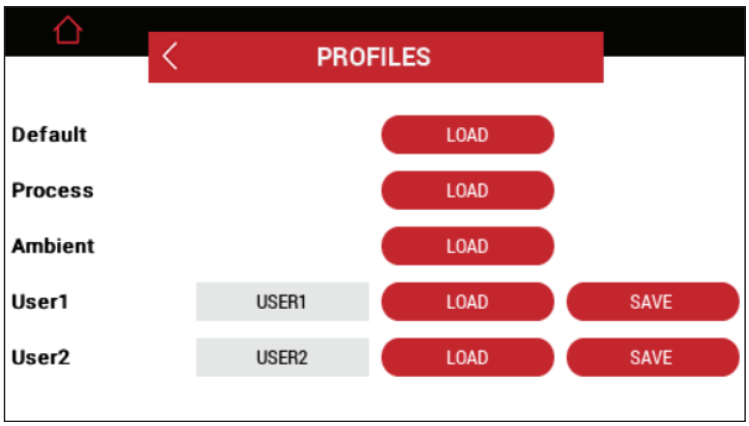


Figure 134 - Profile Page

The Elexant 4010i/4020i helps simplify the commissioning process by providing ability to load and save User Profiles from a USB flash drive.

Supported Profiles: (Refer to Section 3.6 for more details on specified profile default settings)

1. **Default –** This loads the preset factory settings which are equivalent to those in the Process profile (#2). See Appendix A for more details
2. **Process –** This profile loads settings appropriate for heating based on direct measurement of the process temperature (line sensing applications). See Appendix A for more details
3. **Ambient –** This profile loads settings that are appropriate for heating applications that use the ambient temperature to determine heating needs (ambient sensing). See Appendix A for more details
4. **User 1 –** Allows the user to assign a name to a custom profile and load/save the settings on demand
5. **User 2 –** Allows the user to assign a name to a second custom profile and load/save the settings on demand

NOTE: Loading from a USB flash drive stores the settings into a user profile. From there, they can then be loaded into the active settings of the controller. The active settings of the controller cannot be loaded from a USB file, without first loading the settings from that file into one of the two user profiles.

Procedure

Insert the USB flash drive into the USB port.

The controller will display the following dialog:

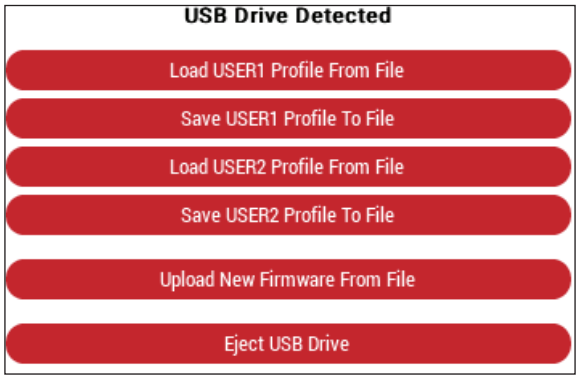


Figure 135 - USB Drive Detected Dialog

Touch the corresponding option to load or save the profiles for User1 and/or User 2 to/from the USB flash drive.

Load User(x) Profile from File:

Select the file to load and touch the single check mark ✓ to load the file or touch ✗ to cancel.

Save User(x) Profile to File:

Select the file to save and touch the single check mark ✓ to save the file.

If the file name already exists, the controller will display "Are you sure you wish to overwrite existing file?". Touch ✓ to confirm, or touch ✗ to cancel

Touch the **Eject USB Drive** to remove the USB drive.

5.12 Network Setup Page

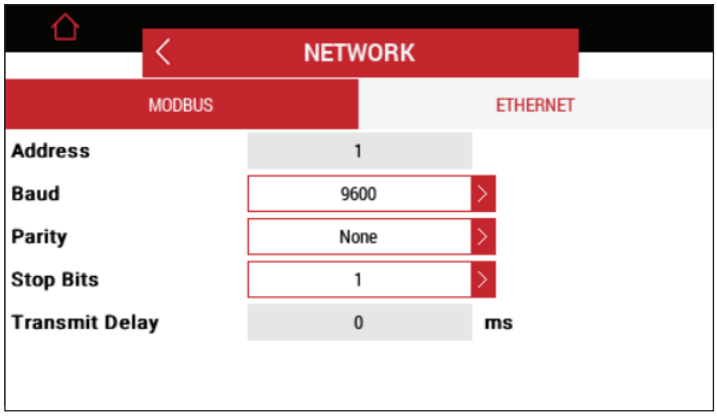


Figure 136 - Network Settings

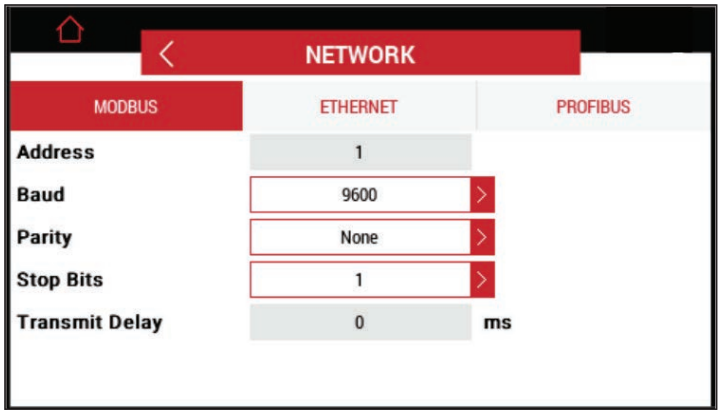


Figure 137 - Network Settings with Profibus Option

The Elexant 4010i/4020i can be connected to a communications network using RS-485 (Modbus), Ethernet (Modbus/TCP) or via the optional Profibus interfaces.

Note: Changing these settings may interrupt or disconnect systems that are currently communicating with this device.

5.12.1 Modbus

Modbus is an Industry standard master-slave protocol used communicate with other Modbus compatible devices.

5.12.2 RS-485

RS-485 can be used to communicate with other devices such as the Raychem TOUCH 1500, or a PC running RAYCHEM Supervisor.

Variable	Description	Default	Range/Options
Address	Modbus Station Address used to identify the controller.	1	1 to 247
Baud	The data rate at which communications occur on the serial network.	9600	9600, 19200, 38400, 57600
Parity	Defines the type of parity bit to be used with any of the three serial communications ports.	None	None, Odd, Even
Stop Bits	Defines the number of stop bits used with any of the three serial communications ports.	1	1, 2
Transmit Delay	Sets the time the controller will wait after it receives a message before it replies.	20	0 to 5000 msec

Table 30 - RS-485 Settings

5.12.3 Ethernet

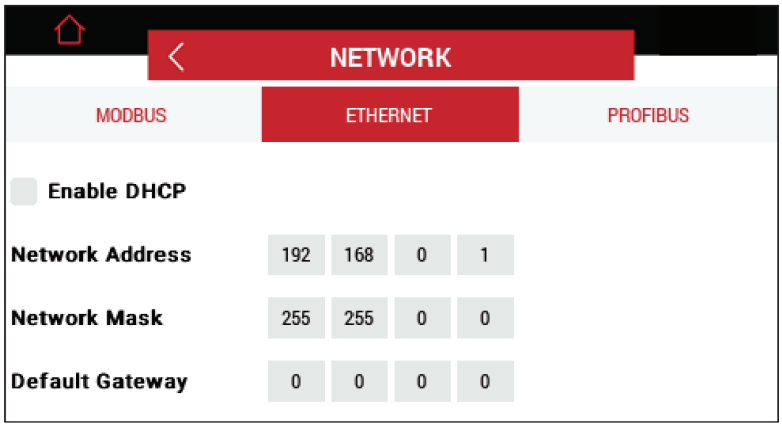


Figure 138 - Ethernet Settings

The Elexant 4010i/4020i controllers can also be connected to devices such as the Raychem TOUCH 1500, or a PC running RAYCHEM Supervisor using an Ethernet connection.

Variable	Description	Default	Range/Options
Enable DHCP	Allows the unit to use Dynamic Host Configuration Protocol	Enabled	Enabled, Disabled
Network Address	Defines the IP Address of the Ethernet port	192.168.1.100	0 to 255 for each address field.
Network Mask	A 32-bit number that masks the network address and divides it into network address and host address.	255.255.255.0	0 to 255 for each mask field.

Table 31 - Ethernet Settings

5.13 Safety Limiter Settings Page

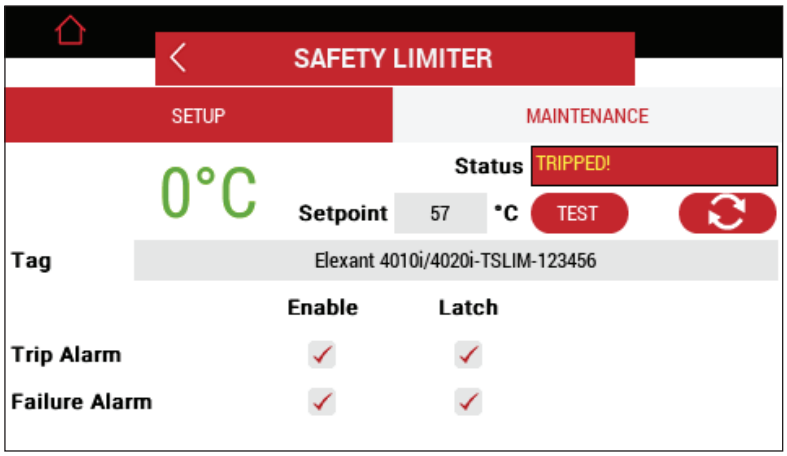


Figure 140 - Safety Limiter Settings

The Safety Limiter provides an independent high temperature cutout capability to ensure protection against over-heating of the EHT or the workpiece. It uses a separate temperature sensor input and controls an independent external contactor. If the measured temperature exceeds the setpoint, the Safety Limiter will open its output relay and de-energize the Heat Trace.

5.13.1 Safety Limiter Setup

Touch the corresponding **Enable** check box to turn on/off the corresponding Alarm indication and touch the corresponding **Latch** check box to select a latching or a non-latching alarm type. When latching is selected, then the alarm will need to be manually reset each time the corresponding alarm occurs.

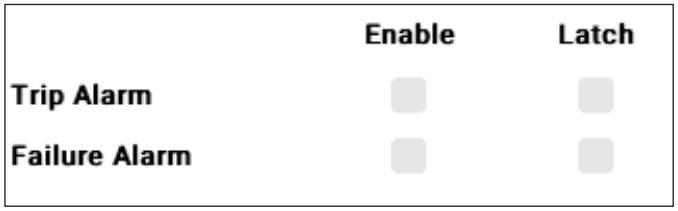


Figure 141 - Safety Limiter Alarm Setup

5.13.1.1 Safety Limiter Status

Purpose: This field shows the status of the Safety Limiter Output.

Values: OK, Tripped.



Figure 142 - Safety Limiter Status – OK



Figure 143 - Safety Limiter Status – Tripped

5.13.1.2 Safety Limiter Temperature



Figure 144 - Actual Temperature Reading

Purpose: This field shows the temperature measured by the Limiter RTD. If this value exceeds the Safety Limiter set point, the Safety Limiter will trip open. In the case where the Safety Limiter has tripped, a manual intervention is required to reset the trip condition. This is only possible once all process conditions have returned to a safe state.

5.13.1.3 Safety Limiter Temperature Setpoint



Figure 145 - Safety Limiter Temperature Setpoint

Purpose: This field displays the Safety Limiter temperature setpoint value.The value should be chosen in accordance with the Temperature Class of the area in which the heating application is installed or the maximum surface temperature allowed for the heating device, whichever is less.

Default: 50°C

Range: 50 to 600°C

Procedure:

Touch the Setpoint field to open a new dialog box with a numeric entry point. Touch the check mark to apply the new value, press the cross mark to cancel. After setting a new setpoint, the user must to press the button on the front panel of the controller to confirm the setpoint change. A page with a countdown prompts the user with instructions.

5.13.1.4 Tag



Figure 146 - Safety Limiter Tag Entry

Purpose: A 40-character tag may be assigned to the controller for easy identification of location, area etc.

Default: The default value of the Tag is in the format Elexant 4010i/4020i-TSLIM-[serial number]

5.13.1.5 Test and Reset

Touch the TEST button to test the Limiter's safety function. When the test safety function is activated, it disconnects the power to the EHT circuit. The safety function may be reset using the TRIP RESET button on the front of the unit, or by touching the button.

5.13.2 Safety Limiter Maintenance

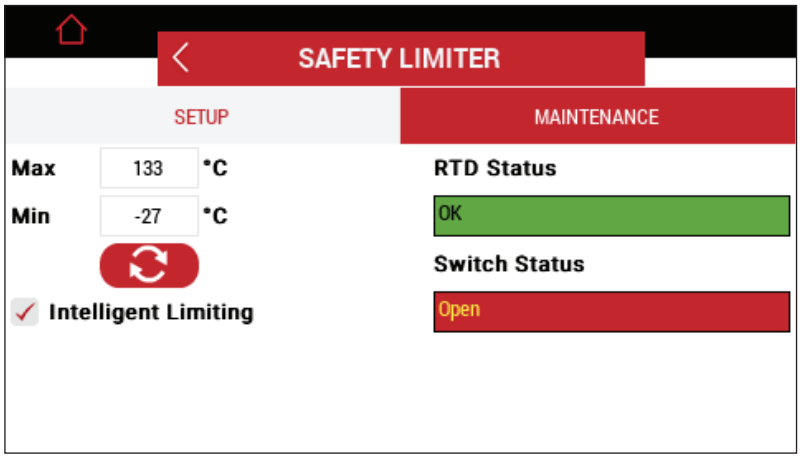


Figure 147 - Safety Limiter Maintenance

5.13.2.1 Minimum/Maximum Limiter Temperature

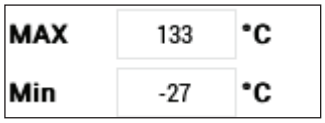


Figure 148 - Min/Max Limiter Temperature

Purpose: These fields store the minimum and maximum limiter temperatures that were recorded since the last reset of the Limiter maintenance data by the user. Touch  button to reset the maintenance data of the Safety Limiter.

5.13.2.2 RTD Status

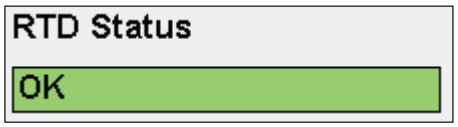


Figure 149 - RTD Status

Purpose: This field displays the status of the Limiter temperature sensor. The status can be one of the following:

OK – The limiter temperature sensor is reporting a valid temperature reading.

Failed Open– One or more leg of the RTD is not connected.

Failed Closed – The common leg of the RTD is shorted to either source or sense leg.

N/A - The Limiter RTD failed for a reason that cannot be determined (open/short cannot be differentiated when an IS barrier is installed)

5.13.2.3 Switch Status

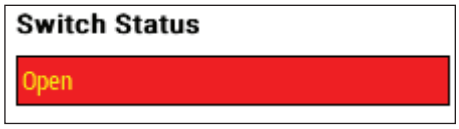


Figure 150 - RTD Status

Purpose: This field displays the status of the Limiter Switch. The status can be one of the following:

Latched Open – Latching is enabled and an alarm condition has occurred for the limiter. The user needs to manually reset the alarm.

Open – An alarm condition has detected by the Limiter and the switch is open. User intervention is not need to return the unit to normal operation once the condition has cleared.

OK – The output is closed.

5.13.2.4 Intelligent Limiting



Figure 151 - Intelligent Limiting Setting

Purpose:

This field enables or disables the Intelligent Limiting feature.

When Intelligent Limiting is disabled, the Safety Limiter will trip if the measured temperature rises above the Safety Limiter's setpoint, or in the event of a fault. Once the measured temperature returns below the permissible limit and there are no faults present, power can be restored to the heat trace circuit by
resetting the trip condition using the TRIP RESET button on the front of the unit.

When Intelligent Limiting is enabled, it allows the Safety Limiter to automatically reset itself once the temperature returns below the permissible limit if there is no current flowing through the heat trace
during the over-temperature event. A few of the scenarios are listed below:

6. When Intelligent Limiting is enabled, and the Heat Trace is energized when the trip temperature setpoint is exceeded, the limiter trips and needs to be manually reset once the temperature is below the setpoint.
7. When Intelligent Limiting is enabled, and the Heat Trace is de-energized when the trip temperature setpoint is exceeded, the limiter trips and will reset automatically once the temperature is below the setpoint.

5.14 User Interface Settings

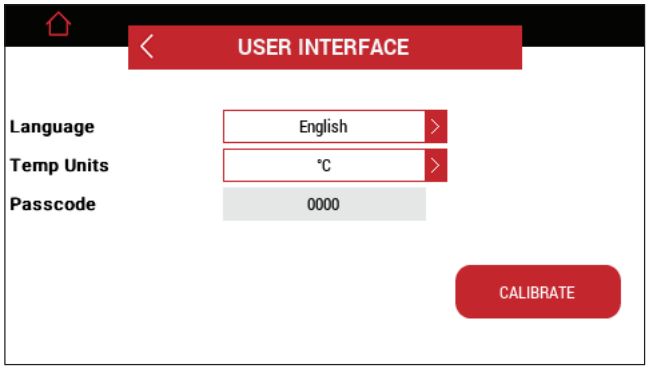


Figure 152 - User Interface Settings

This page allows the user to configure the unit to their personal preferences.

5.14.1 Language



Figure 153 - Language Setting

Purpose: This field allows the user to change the language of the Graphical User Interface (GUI).

Options: English, French, German, Spanish and Russian.

Default: English

5.14.2 Temperature Units



Figure 154 - Temperature Unit Setting

Purpose: This field allows the user to change the units used to display temperatures on the controller GUI.

Options: Degrees Celsius (°C), Degrees Fahrenheit (°F)

Default: Degrees Celsius (°C)

5.14.3 Passcode

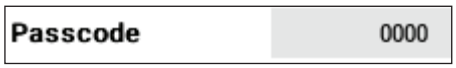


Figure 155 - Passcode Setting

Purpose: This is a four-digit, numeric field to stop unauthorized users from modifying the controller's configuration parameters using the touch screen.

Range: 0000 to 9999

Default: 0000

Procedure:

Touch the Passcode field and enter the desired passcode using the numeric keypad. A passcode of 0000 disables the lockout feature and allows all configuration parameters to be modified using the operator console without requiring a passcode. Setting the passcode to any other value will require the database to be unlocked by entering the correct passcode prior to modifying any of the controller's configuration parameters using the touch screen.

IMPORTANT: The PASSCODE can be edited only if it is set to 0 or the database has been unlocked by entering the proper passcode.

Passcode Recovery:

In case the passcode has been lost, click on the 

in the passcode keypad. This will pop a window as shown below.

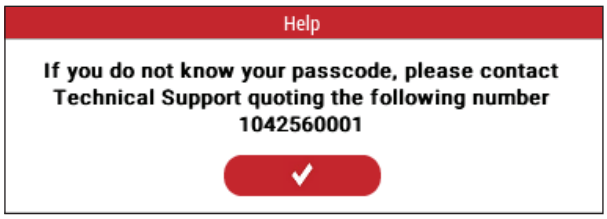


Figure 156 – Passcode Help

Contact Chemelex Technical Support (see Section 1.3) with the displayed number to get a temporary passcode. Note that this process is time sensitive – once the number above has been generated by the controller, you have:

- 24 hours to obtain a temporary passcode from Technical Support, and
- 48 hours to enter the temporary passcode into the controller.

5.14.4 Calibrate



Figure 157 - Calibrate Touch Interface

Purpose: Touching this button allows the user to re-calibrate the touch interface of the controller. The user will be asked to touch different points on the screen to complete the calibration process.

Procedure:

Touch and hold the first point on the GUI for 3 seconds.



Figure 158 - Calibrate GUI's Point 1

Touch and hold the second point on the GUI for 3 seconds.

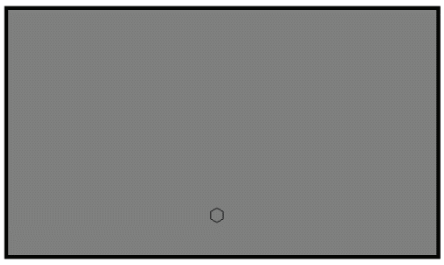


Figure 159 - Calibrate GUI's Point 2

Touch and hold the third point on the GUI for 3 seconds.



Figure 160 - Calibrate GUI's Point 3

Touch the button to complete the calibration.

NOTE: If the calibration is not completed correctly, the screen will turn red. A touch anywhere on the screen will bring back the calibration screen. Repeat the GUI calibration process.

FIRMWARE UPGRADE

6.1 Firmware Upgrade Procedure

This section describes the steps to upgrade the firmware on the Elexant 4010i/4020i Heat Trace Controller.

Procedure:

- Obtain the firmware update file and the passcode associated with the firmware update from Chemelex Technical Support.
- Save the updated firmware file to a USB flash drive.
- Insert the USB flash drive into the USB port on the front of the control module.
- The controller displays the following screen:

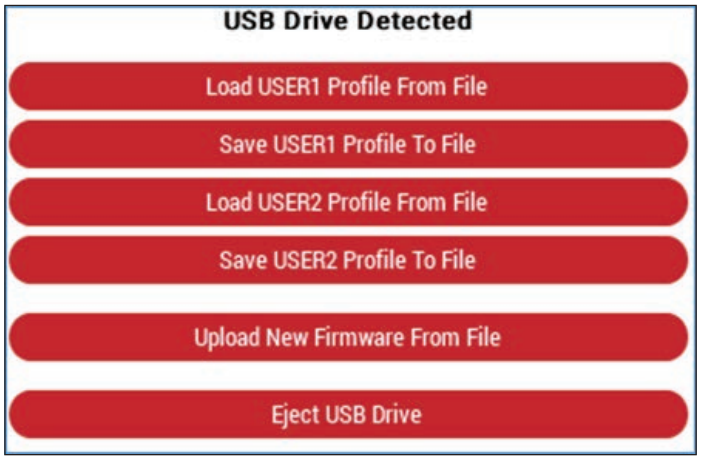


Figure 161 - USB Drive Detected Dialog

- Touch the **Upload New Firmware From File** button.
- The controller will display a dialog with the filenames of the various firmware versions (if applicable) available on the USB drive.
- Select the desired firmware file and touch the ✓ button to start the process of updating the firmware or the ✗ button to cancel.
- The controller will display a message "Please confirm that the firmware should be upgraded to this version". Touch the ✓ button to confirm and start the process or the ✗ button to cancel.
- A Passcode dialog will be displayed.
- Enter the passcode associated with the firmware update and touch the ✓ button.
- When the firmware upgrade is completed, touch the **Eject USB Drive** button to remove the USB flash drive.

TROUBLESHOOTING

7.1 Troubleshooting

Indication	Description	Possible Cause(s)	Corrective Action
No Display	No display indication	Power to controller is disconnected Circuit Breaker Trip Incorrect voltage to controller Wiring error Damaged screen	Connect power to controller Reset the circuit breaker Check supply voltage Correct wiring issue Return to factory for service
No Serial Communication	Cannot establish serial communications with the controller	Incorrect address parameter Incorrect protocol selected Baud rate incorrect Parity incorrect Wiring error RS-485 converter issue Incorrect PC's Com Port settings Incorrect software setup Termination resistor may be required	Set unique addresses on network Match protocol between devices Match baud rate between devices Match parity between devices Correct wiring issue Check settings or replace converter Set correct communication port Correct software setup to match controller communication settings Place 120 Ω termination resistor across RS-485 wiring on last controller
No Ethernet Communication	Cannot establish Ethernet communications with the controller	Incorrect IP settings Bad Ethernet cable Windows Firewall Faulty port on router/switch	Verify IP settings Replace Ethernet cable Turn off Windows Firewall Use different port on the Router/Switch
Un-responsive Touch Interface	Touch Interface doesn't respond to user's input	Touch interface out of calibration	Re-calibrate Touch Interface See Section 5.14.4.
Alarm won't clear	Alarm will not clear or reset	Alarm condition is still active	Check Alarm settings and investigate cause
No heat	Output doesn't turn on	Temperature sensor failure Incorrect temperature sensor(x) settings Incorrect Control Mode/Output Type settings Safety Limiter output tripped (for controller with –LIM option)	Check temperature sensor Check TS(x) settings Check Control Mode/Output Type settings Check Safety Limiter control status and reset the Safety Limiter

Table 33 – Troubleshooting

APPENDIX A

LIST OF ABBREVIATIONS

E – Enabled
D – Disabled
L – Latching
NL – Non-Latching

Table 34 – List of Abbreviations

PROFILES - DEFAULT SETTINGS

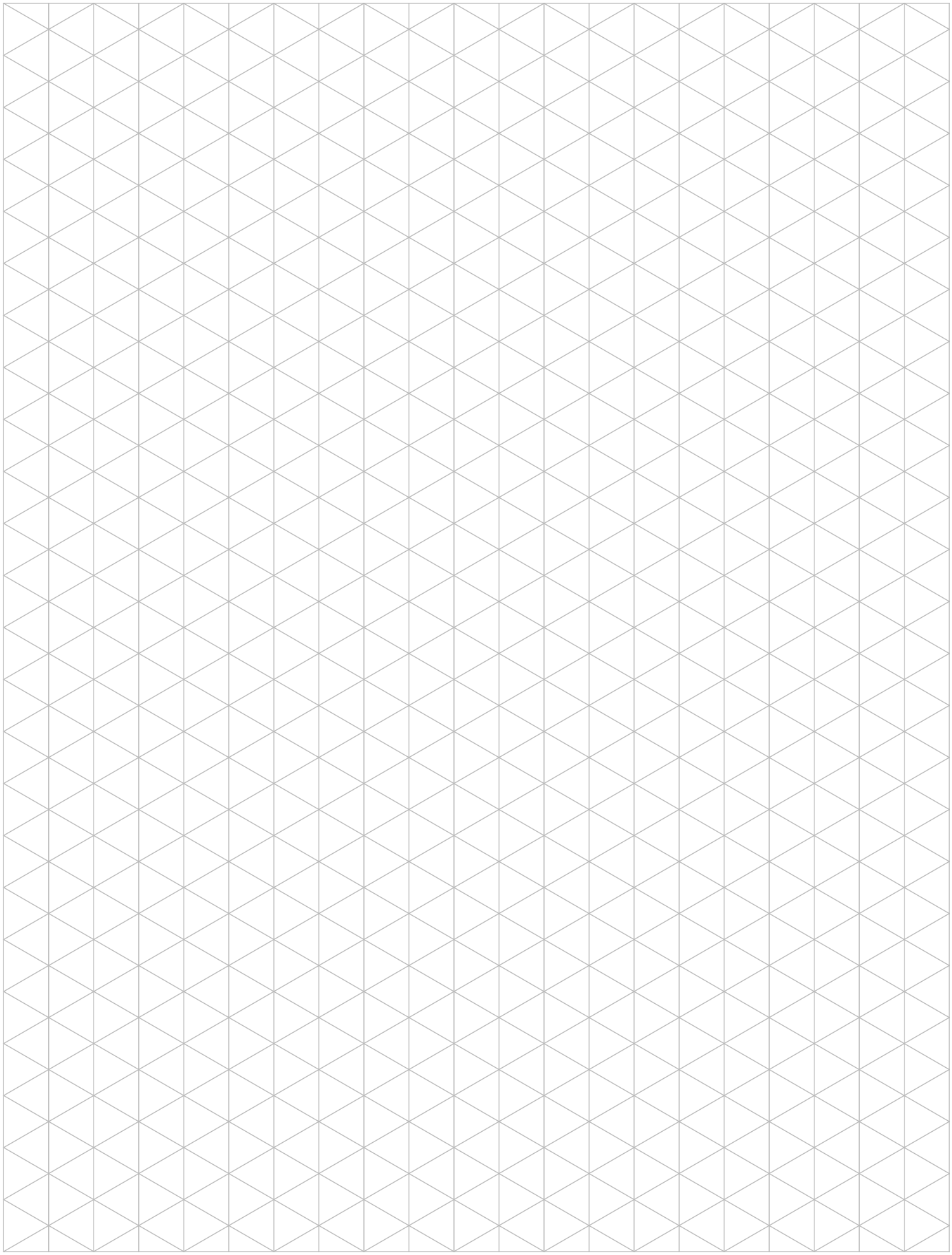
Configuration Page	Description	Default Profile		Process Profile		Ambient Profile	
		Default State	Default Setpoint /Value	Default State	Default Setpoint /Value	Default State	Default Setpoint /Value
Control Temp	Control Setpoint		20		20		5
	Fail Mode	OFF		OFF		OFF	
	Aggregation Mode	LOWEST		LOWEST		LOWEST	
	High Temp Alarm	D,NL	100	D,NL	100	D,NL	80
	High Temp Filter		0		0		300
	Low Temp Alarm	E,NL	5	E,NL	5	E,NL	-40
	Low Temp Filter	0	0	0	0		300
	Failure	E,L		E,L		E,L	
Control Mode	Control Mode	On/Off		On/Off		PASC	
	Output Type	Contactor		Contactor		Contactor	
	Dead band		3 C		3 C		3 C
	Min. Ambient	N/A		N/A		–40 C	
	Min. Pipe Size	N/A		N/A		0.5”(12.5mm)	
	Power Adjust	N/A		N/A		100%	
Load Shedding	Load Shedding	D		D		D	
	FailSafe	D		D		D	
	Timeout	60 Sec		60 Sec		60 Sec	
Misc	Cycle Count	E	100000	E	100000	E	100000
	Heater on Time	E	100000	E	100000	E	100000
	Autocycle	E	8	E	8	E	8
	Alarm Mode	Normal		Normal		Normal	
	Digital Input	Not used		Not used		Not used	

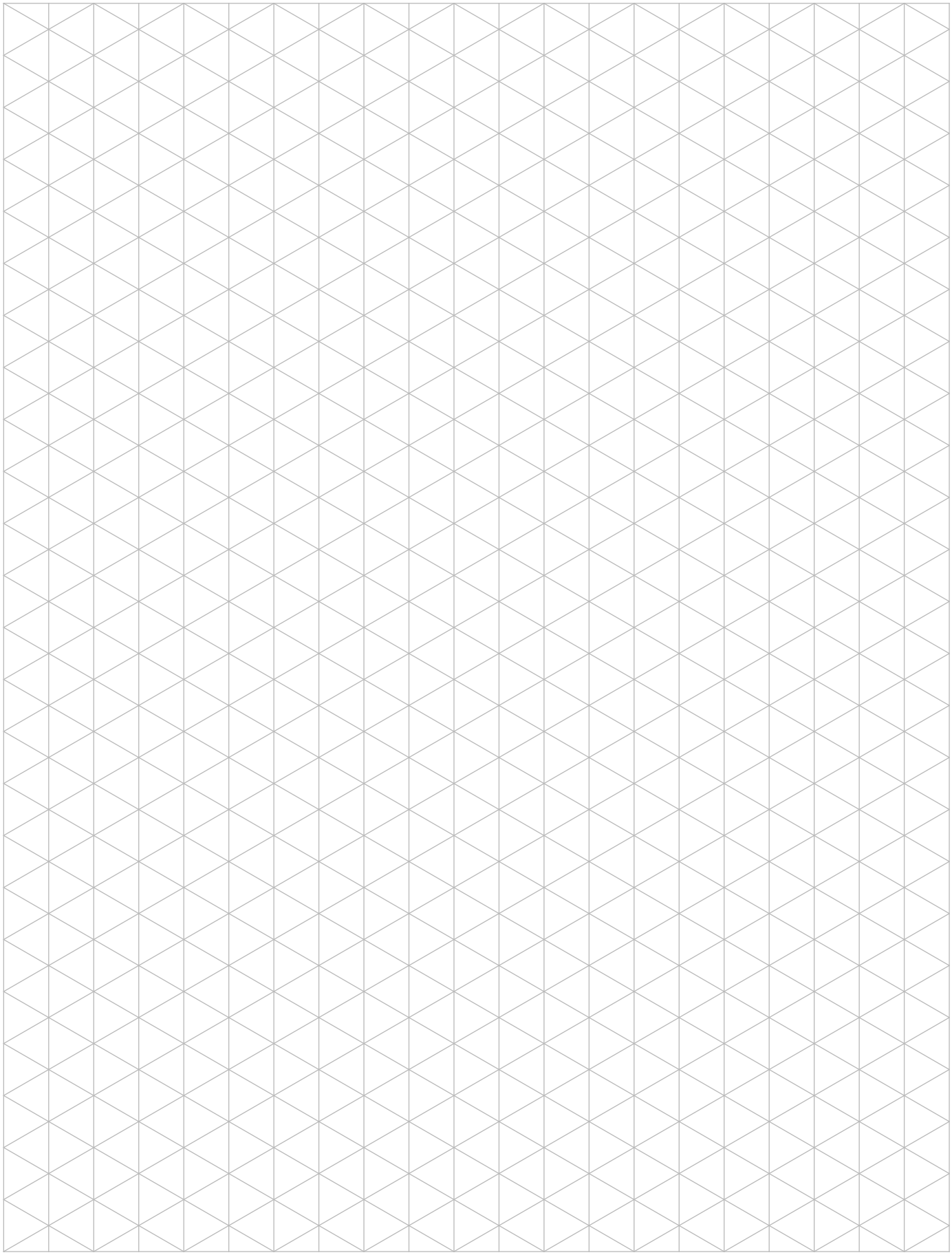
Configuration Page	Description	Default Profile		Process Profile		Ambient Profile	
		Default State	Default Setpoint /Value	Default State	Default Setpoint /Value	Default State	Default Setpoint /Value
Temperature Sensor (x)	TS1 Type	RTD-PT100		RTD-PT100		RTD-PT100	
	TS1 Mode	Control		Control		Control	
	TS1 High Temp Alarm	D,NL	100	D,NL	100	D,NL	80
	TS1 High Temp Filter		0		0		300
	TS1 Low Temp Alarm	E,NL	5	E,NL	5	E,NL	–40
	TS1 Low Temp Filter		0		0		300
	TS1 Failure	E,L		E,L		E,L	
	TS2 Type	None		None		None	
	TS2 Mode	Monitor		Monitor		Monitor	
Temperature Sensor (x)	TS2 High Temp Alarm	D,NL	100	D,NL	100	D,NL	80
	TS2 High Temp Filter		0		0		300
	TS2 Low Temp Alarm	D,NL	5	D,NL	5	D,NL	-40
	TS2 Low Temp Filter		0		0		300
	TS2 Failure	D,L		D,L		D,L	
	TS3 Type	None		None		None	
	TS3 Mode	Monitor		Monitor		Monitor	
	TS3 High Temp Alarm	D,NL	100	D,NL	100	D,NL	80
	TS3 High Temp Filter		0		0		300
	TS3 Low Temp Alarm	D,NL	5	D,NL	5	D,NL	–40
	TS3 Low Temp Filter	0	0	0	0		300
	TS3 Failure	D,L		D,L		D,L	
Temp Limiting	TS1 Use for High/Low Temp	D		D		D	
	TS2 Use for High/Low Temp	D		D		D	
	TS3 Use for High/Low Temp	D		D		D	
	High Limit Alarm	E,NL	700	E,NL	700	E,NL	200
	Low Limit Alarm	E,NL	-70	E,NL	-70	E,NL	–70
	Low Limit Deadband	3		3		3	

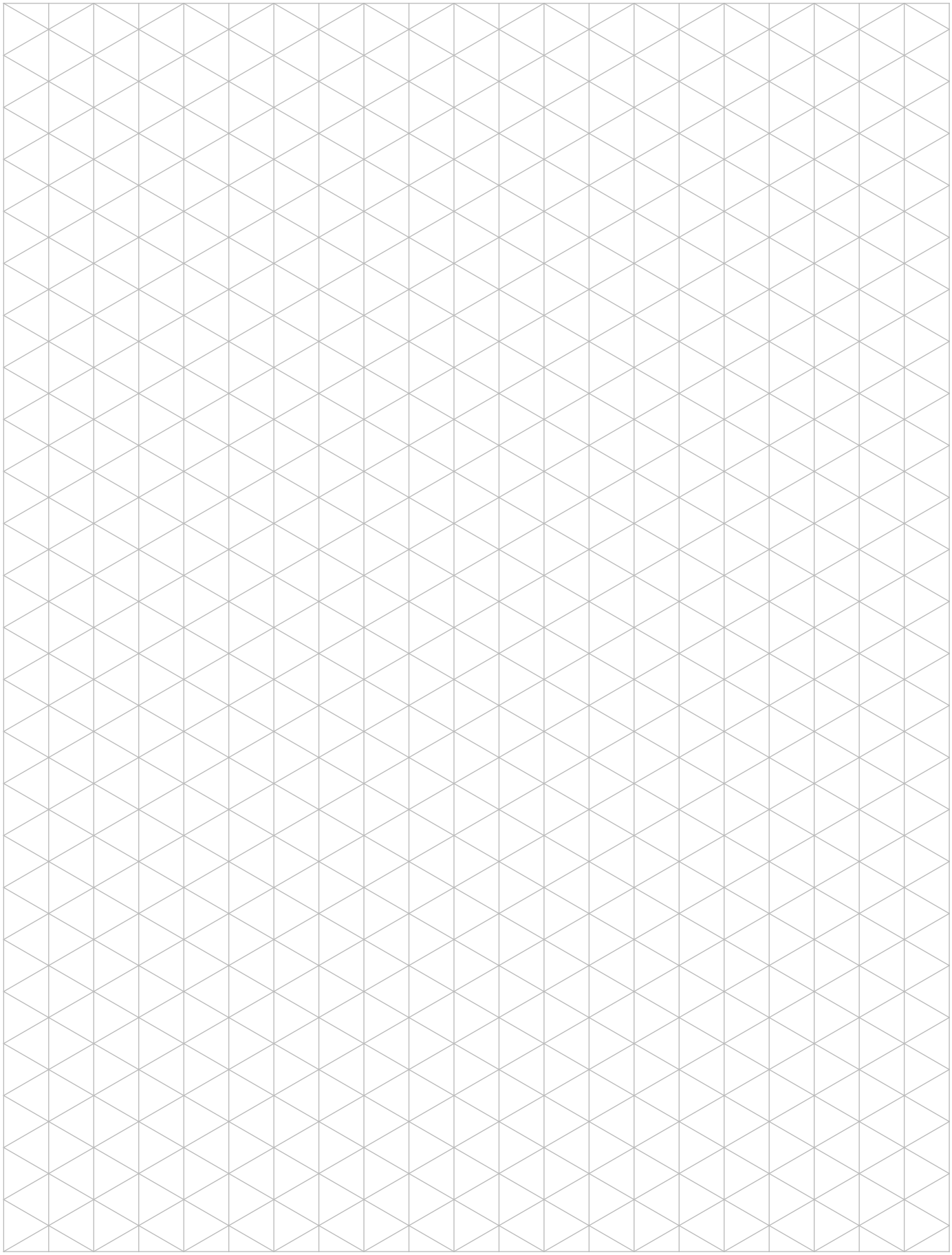
Configuration Page	Description	Default Profile		Process Profile		Ambient Profile	
		Default State	Default Setpoint /Value	Default State	Default Setpoint /Value	Default State	Default Setpoint /Value
Electrical Page	Trace Current						
	Current Turns Ratio		1		1		1
	High Alarm	D,L	30	D,L	30	D,L	30
	High Alarm Filter		0		0		0
	Low Alarm	E,L	1	E,L	1	E,L	1
	Low Alarm Filter		0		0		0
	Ground Fault						
	Ground Fault Ratio		1		1		1
	Offset		0		0		0
	High Alarm	E,L	20	E,L	20	E,L	20
	High Alarm Filter		0		0		0
	Trip Alarm	E,L	30	E,L	30	E,L	30
	Trace Voltage						
	Voltage Turns Ratio		1		1		1
	High Alarm	D,NL	300	D,NL	300	D,NL	300
	High Alarm Filter		0		0		0
	Low Alarm	E,NL	90	E,NL	90	E,NL	90
	Low Alarm Filter		0		0		0
	Trace Resistance						
	Nominal		6		6		6
	High Alarm	D,NL	50	D,NL	50	D,NL	50
	High Alarm Filter		0		0		0
	Low Alarm	D,NL	50	D,NL	D	D,NL	50
	Low Alarm Filter		0		0		0
Maintenance	Device Reset	D		D		D	
Network - Modbus	Address		_____		_____		_____
	Baud		9600		9600		9600
	Parity		N		N		N
	Stop Bits		1		1		1
	Transmit Delay		20 ms		20 ms		20 ms
Network - Ethernet	Enable DHCP	E		E		E	
	Network Address		192.168.1.100		192.168.1.100		192.168.1.100
	Network Mask		255.255.255.0		255.255.255.0		255.255.255.0
User Interface	Language		English		English		English
	Unit		C		C		C
	Passcode		0		0		0
Safety Limiter	Trip Alarm	E,NL	85	E,NL	85	E,NL	85
	Failure Alarm	E,L		E,L		E,L	
	Intelligent Limiting	E		E		E	

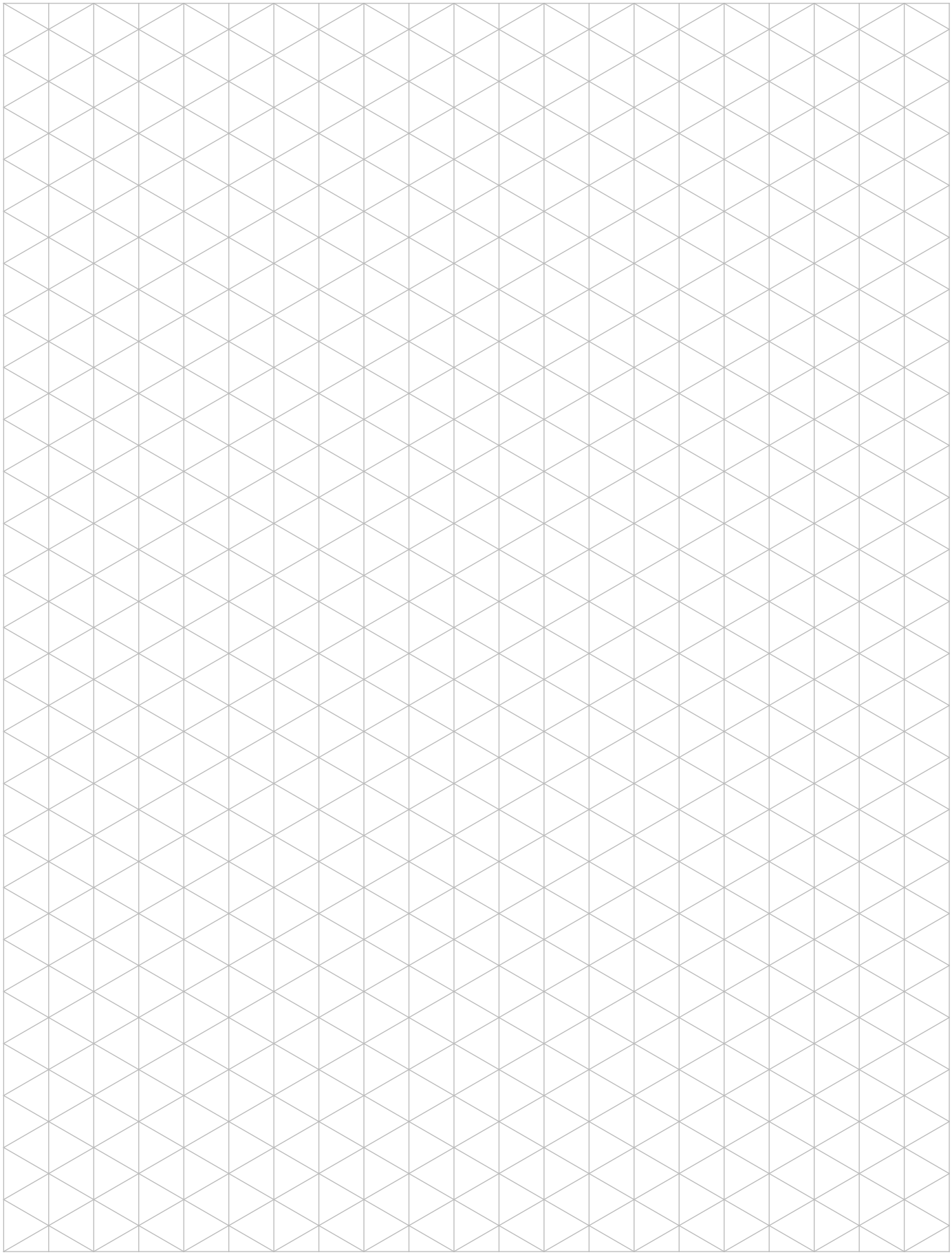
Table 35 - Profile Default Settings

Note: Network Modbus address setting remains unchanged.









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