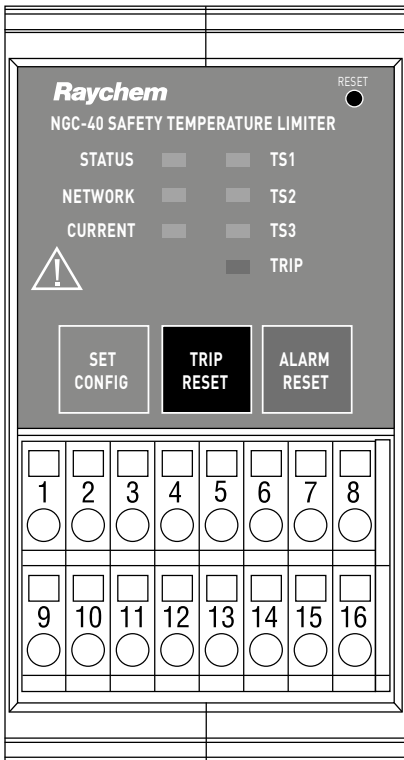


# **Raychem** NGC-40-SLIM

SAFETY TEMPERATURE LIMITER FOR USE  
WITH THE RAYCHEM NGC-40 SYSTEM





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## 1 INTRODUCTION

Please read all instructional literature carefully and thoroughly before starting. Refer to the inside front cover for the listing of Liabilities and Warranties. NOTICE: The information contained in this document is subject to change without notice. Please read these Operating Instructions before commissioning the instrument. Keep the operating instructions in a place that is accessible to all users at all times. Please assist us to improve these operating instructions, where necessary. We are always grateful for your suggestions. Should any difficulties arise during start-up, you are asked not to carry out any unauthorized manipulations on the instrument as this could affect your warranty rights! Please contact the nearest Pentair Industrial Heat Tracing Solutions subsidiary or the head office. If any servicing is required, the instrument must be returned to the head office.

### 1.1 Certification

Pentair Industrial Heat Tracing Solutions certifies that this product meet its published specifications at the time of shipment from the Factory.

### 1.2 Warranty

This Pentair product is warranted against defects in material and workmanship for a period of 12 months from the date of installation or 30 months maximum from the date of shipment, whichever occurs first. During the warranty period, Pentair will, at its option, either repair or replace products that prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by Pentair. The Buyer shall prepay shipping charges to Pentair and Pentair shall pay shipping charges to return the product to the Buyer. However, the Buyer shall pay all shipping charges, duties, and taxes for products returned to Pentair from another country.

Pentair warrants that the software and firmware designated by Pentair for use with a product will execute its programming instructions properly when installed on that product. Pentair does not warrant that the operation of the hardware, or software, or firmware will be uninterrupted or error-free.

### 1.3 Limitation of warranty

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by the Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the specifications for the product, or improper installation.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. PENTAIR DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

### 1.4 Exclusive remedies




THE REMEDIES PROVIDED HEREIN ARE THE BUYER'S SOLE AND EXCLUSIVE REMEDIES. PENTAIR SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

### 1.5 Statement of compliance

This equipment has been tested and found to comply with the low voltage directive 2006/95/EC and the electromagnetic compatibility directive 2004/108/EC. These limits are defined to provide reasonable protection against harmful interference in a residential installation (technical data mentions industrial application). This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorientate or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

1.6 CE declaration of conformity

 <b>PENTAIR</b>	<b>EC Declaration of Conformity</b> <b>EG Konformitätserklärung</b> <b>CE Déclaration de Conformité</b>									
<p>We / Wir / Nous,  <b>PENTAIR THERMAL MANAGEMENT BELGIUM N.V.</b>  <b>Romeinse straat 14, 3001 Leuven / Belgium – Belgien - Belgique</b>          Hereby declare that the products... / Erklären, dass die Produkte... / Déclarons, que les produits...</p> <p>Electronic Temperature control System with Safety temperature limiter: Raychem NGC-40          Elektronischer Temperaturregelsysteme mit Sicherheitstemperatur Begrenzer: Raychem NGC-40          Thermostat électronique: Système avec limiteur de température de sécurité: Raychem NGC-40</p> <h2 style="text-align: center;">Raychem NGC-40-SLIM</h2> <p>...which is the subject of this declaration, is in conformity with the following standard(s) or normative documents          ...auf welche sich diese Erklärung bezieht, mit der/den folgenden Norm(en) oder normativen Dokumenten übereinstimmt          ...auxquels cette déclaration se rapporte, sont conformes aux norme(s) ou aux documents normatifs suivants</p> <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:50%; vertical-align: top;">                 Terms of the Directive(s) and Approval Data...                  Richtlinien, Normen und Zulassungen...                  Prescription de la directive et données de référence d'approbation...             </td> <td style="width:50%; vertical-align: top;">                 Title and/or No. and date of issue of the standard /                  Titel und/oder Nr. sowie Ausgabedatum der Norm /                  Titre et/ou No. ainsi que date d'émission des normes             </td> </tr> <tr> <td style="vertical-align: top;"> <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:20%; vertical-align: top;">                     2004/108/CE                      2004/108/EG                      2004/108/EC                 </td> <td style="width:80%; vertical-align: top;">                     Electromagnetic compatibility                      Elektromagnetische Verträglichkeit                      Compatibilité électromagnétique                 </td> </tr> </table> </td> <td style="vertical-align: top;"> <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:50%; vertical-align: top;">                     Emission:                      * EN 55014-1:2006                      * EN 55011:2007                      * EN/ IEC 61000-6-3:2006                      EN / IEC 61326:2002                 </td> <td style="width:50%; vertical-align: top;">                     Immunity / Immunité /                      Verträglichkeit                      * EN 61000-6-2:2005                      * EN 55014-2:1997                      EN/ IEC 61326:2002                 </td> </tr> </table> </td> </tr> </table> <p>Harmonized standards are marked with (*)</p> <p>The technical documentation required to demonstrate that the products meet the requirements of the above EC directives has been compiled and is available for inspection by relevant enforcement authorities.</p> <p>Die technische Dokumentation, die zur Gewährleistung der Einhaltung der EG Richtlinien benötigt wird, wurde erstellt und liegt zur Überprüfung durch eine autorisierte Stelle bereit.</p> <p>La documentation technique exigée pour démontrer que les produits répondent aux exigences des directives CE ci-dessus a été compilée et est disponible pour l'inspection par des autorités chargées de l'application appropriée.</p> <div style="text-align: center;">   <b>Pentair Thermal Management</b>  <b>Romeinsestraat 14</b>  <b>B-3001 Leuven</b>  <b>Belgium</b> </div> <p>The CE mark was first applied in 2010.          Leuven, December 2<sup>nd</sup>, 2014</p> <hr style="width: 20%; margin-left: 0;"/> <p>Gerry De Blick          Product Certification and Compliance</p>			Terms of the Directive(s) and Approval Data... Richtlinien, Normen und Zulassungen... Prescription de la directive et données de référence d'approbation...	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### 1.7 Area of use

Raychem NGC-40-SLIM limiters are used for temperature limiting of electrical heaters in industrial and potentially explosive atmospheres. The Raychem NGC-40-SLIM is a safety temperature limiter. Raychem NGC-40-SLIM units are approved for use in non-hazardous areas. Where needed the temperature sensor of the unit can be placed in Zone 1, Zone 2, Zone 21 and Zone 22 when the sensor is hazardous area approved.

### 1.8 Safety instructions

During operation, do not leave this Instruction Manual or other objects inside the enclosure. Use the limiter only for its intended purpose and operate it only in clean, undamaged condition. Do not make any modifications to the temperature controller and limiter that are not expressly mentioned in this installation manual.



Whenever work is done on the temperature limiter, be sure to observe the national safety and accident prevention regulations and the safety instructions given in this Instruction Manual.

### 1.9 Conformity with standards

Raychem NGC-40-SLIM units meet the requirements of the following functional safety standards and are developed, manufactured and tested in accordance with state-of-the-art engineering practice.

Title	Comment	Standard	Explanation
Functional Safety	The temperature limiter meets SIL 2 functional safety requirements	EN 61508-1 to 2	
Electro Magnetic Compatibility	Complies to applicable EU directives	EN-61326:2002	Interference emission: Class B, immunity to interference: to Industrial requirements
New Approach Directives		Harmonized Standards	
Electrical Safety	Low Voltage Directive (LV)	Test voltages according to EN 60730-1 table 13.2	EN 60730-1 Automatic electrical controls for household and similar use – Part 1: General requirements
	Low Voltage Directive (LV)	EN61010-1:2004	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: general requirements
2004/108/EC	Electromagnetic compatibility (EMC)	EN61000-6-3:2006 EN61000-6-2:2005 EN55011:2007 EN61010-1:2004	
Vibration		IEC 60068-2-6 Edition 7.0 2007-12	Frequency 10-55 Hz, @ 0.35MM(0 – Pk), Sweep Rate: 10 ct/Min, Total: 10 Sweep Cycles/Axis, Duration: 49Min/Axis
Shock		IEC 60068-2-27 Edition 4 2008-02	Acceleration 50g, half sine-wave, 11 msec duration 3 pulses in 6 directions

Table 1: Standards overview.

### 1.10 Approvals and certifications

Functional safety according to Baseefa 10SR0109 SIL 2 IEC 61508-1-1998 & IEC 61508-2-2000



(Russia, Kazakhstan, Belarus)

For other countries contact your local Pentair representative.

## 2 TECHNICAL DATA

### 2.1 Product Description

The NGC-40-SLIM module is used as safety temperature limiter within the NGC-40 control and monitoring system. The module has one output for the contactor, one alarm output and one digital input. The alarm output can be used to control an external annunciator. The digital input can be used for resetting the limiter remotely. The module has 3 temperature inputs which can be used all in case of a three phase heat-tracing system. The limiter is equipped as smart limiter where the current measurements are done in the associated controller. The front panel of the SLIM module has LED indicators for various status conditions. The front panel also provides "Set Config", "Trip Reset" and "Alarm Reset" buttons.

#### 2.1.1 Tools Required

- Small flat-blade screwdriver

#### 2.1.2 Additional Materials required

- Power supply 24 Vdc @100 mA per NGC-40-SLIM, CE Certified
- Custom built CAN cables with RJ-45 connections
- CAN Bus Termination Block (part nr.: 10392-043)

#### 2.1.3 Kit Contents

Item	Quantity	Description
NGC-40-SLIM	1	Safety Temperature Limiter
INSTALL-171	1	Raychem NGC-40-SLIM installation instructions

#### 2.1.4 General information

- Supply voltage 24 Vdc  $\pm$  10%
- Internal power consumption < 2.4 W per NGC-40-SLIM module
- Ambient operating temperature 0°C to 65°C (32°F to 149°F)
- Ambient storage temperature -40°C to 75°C (-40°F to 167°F)
- Environment PD2, CAT III
- Max. Altitude 2,000 m (6,562 ft)
- Humidity 5 – 90% non condensing
- Mounting Din Rail – 35 mm

#### 2.1.5 Measuring range

Temperature range limiter from +70°C to +500°C (158°F to 932°F)

#### 2.1.6 Electromagnetic Compatibility

##### 2.1.6.1 Emissions

EN 61000-6-3, Emission standard for residential, commercial and light industrial environments

##### 2.1.6.1 Immunity

EN 61000-6-2, Immunity standard for industrial environments

#### 2.1.7 Temperature Sensors

Type: 100  $\Omega$  platinum RTD, 3-wire,  $\alpha$  = 0.00385 ohms/ohm/°C. Can be extended with a 3-conductor shielded cable of 20  $\Omega$  maximum per conductor

Quantity: 3 per NGC-40-SLIM module

#### 2.1.8 Alarm Relay

Dry contact relay (voltage free). Relay contact rated 250 V / 3 A, 50/60 Hz (CE). Alarm relay is programmable. NO or NC can be configured.

#### 2.1.9 Contactor Output Relay.

Relay contact rated 250 V / 3 A, 50/60 Hz (CE)

### 2.1.10 Digital Input

Digital input is used for resetting the safety temperature limiter remotely. The Digital Input will be for connection to external dry (voltage free) contactor or DC voltage. The input would be 5 – 24 VDC/1mA max with 100 ohms of loop resistance and configured as active low.

### 2.1.11 CAN Networking Port

Type: 2-wire isolated CAN-based peer to peer network. Isolated to 24 Vdc – verified by 500 Vrms dielectric withstand test

- Connection: Two 8-pin RJ-45 connectors (both may be used for Input or Output connections)
- Protocol: Proprietary NGC-40
- Topology: Daisy chain, terminate with TTC, CAN termination block (see Figure 8).
- Cable length: 10 m (33 ft) maximum
- Quantity: Up to 80 modules per network segment
- Address Unique, factory assigned

### 2.1.12 Connection terminals

Wiring terminals Cage clamp, 0.5 to 2.5 mm<sup>2</sup> (24 to 12 AWG)  
Housing: Size 45.1 mm (1.78 in) wide x 87 mm (3.43 in) high x 106.4 mm (4.2 in) deep  
Outputs

- Form-A 250 Vac/3A dry contact (voltage-free) alarm relay, programmable for steady or flashing on alarm.
- Form-A 250 Vac/3A contactor coil drive relay. This output is used in conjunction with the terminals to provide switched LINE voltage to an external contactor coil.

### 2.1.13 Raychem NGC-40 Safety Limiter

Product name: Raychem NGC-40-SLIM  
Part number: 1244-010700

### 2.1.14 Raychem NGC-40-SLIM accessories and associated components

Product name	Part number
Raychem NGC-40-HTC	10730-003
Raychem NGC-40-HTC3	10730-004
Raychem NGC-40-IO	10730-001
Raychem NGC-40-BRIDGE	10730-002
Raychem NGC-40-PTM	10730-005
MONI-RMC-PS24	972049-000



## 2.1.15 Dimensions

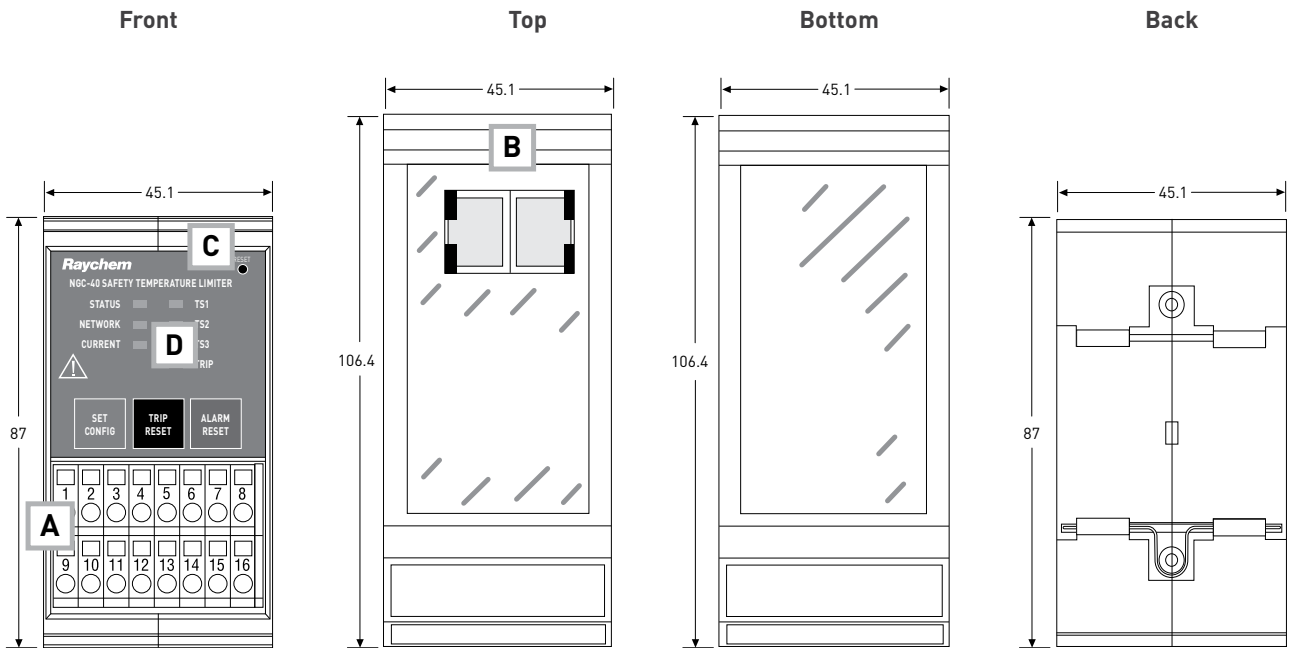


Figure 1: Dimensions Raychem NGC-40-SLIM module

A: WIRING TERMINALS:

Term	Limiter Module
1	Output relay
2	Output relay
3	Alarm relay
4	Alarm relay
5	--
6	TS1 common
7	TS1 sense
8	TS1 source
9	TS2 common
10	TS2 sense
11	TS2 source
12	TS3 common
13	TS3 sense
14	TS3 source
15	Digital In +

Table 2: Wiring terminals

B: CAN BUS/MODULE POWER

C: RESET

D: STATUS - LEDS

State	Status	Network	Current	LED			Trip
				TS 1	TS 2	TS 3	
OFF	No Power		No current	No alarm	No alarm	No alarm	Not Tripped
RED	Device-reset alarm is active						Tripped
GRN	Normal operation, no internal faults	Flicker on receipt of CAN packet	Current				
YEL	In Boot Loader mode	Flicker on transmission of CAN packet					
Flash RED	Internal Fault: • Lost calibration			TS 1 sensor failure alarm	TS 2 sensor failure alarm	TS 3 sensor failure alarm	
Flash GRN							
Flash YEL	Tripper and non-latching						
Flash RED/GRN	Factory unlock / un-calibrated						
Flash RED/YEL							
Flash YEL/GRN							

Table 3: LED status of Raychem NGC-40-SLIM module

Note: For the SLIM module, when ALL LEDs are flashing red, the unit has lost factory calibration, cannot be communicated with, and must be returned to the factory for repair/replacement.

### 2.2 Mounting and wiring NGC-40-SLIM module

**Mounting the NGC-40-SLIM**

Each NGC-40-SLIM mounts on a DIN35 rail.

**MOUNTING:** Insert the rear bottom of the module into the DIN rail, then push up and inwards to engage the clip.

**Removal:** Push the module upwards to disengage the clip, then rotate the module toward you.

Figure 2: Mounting Raychem NGC-40-SLIM module onto DIN rail

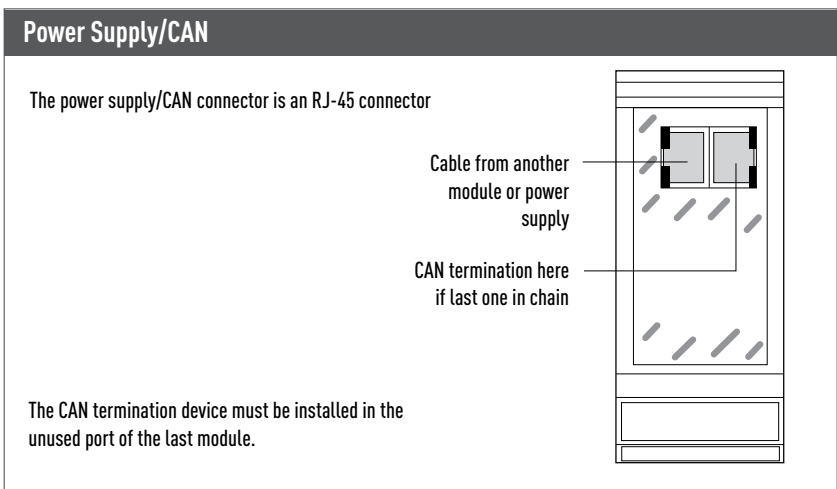
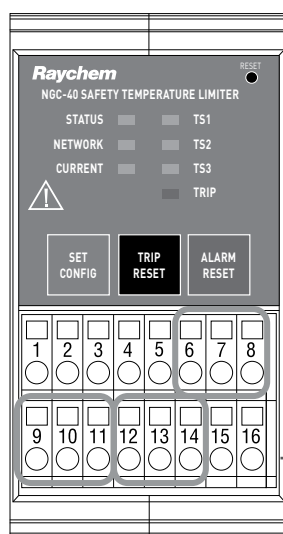


Figure 3: Power via CAN cable connector

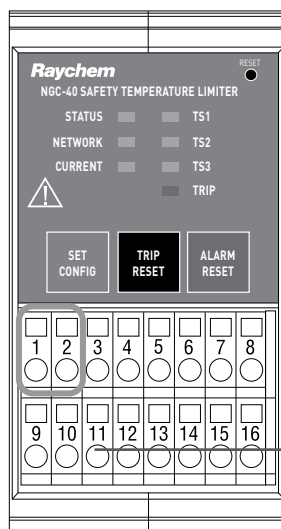
### RTD Terminals



	Sensor 1	Sensor 2	Sensor 3
Common (white)	6	9	12
Sense (red)	7	10	13
Source (red)	8	11	14

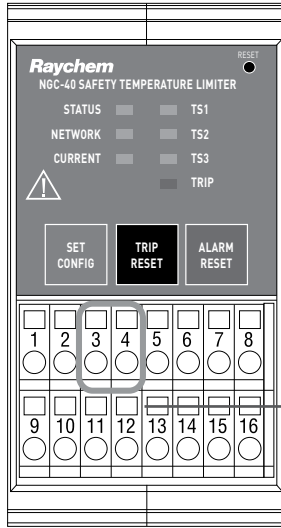
The RTD field wires must be terminated on a panel-mounted terminal block. The RTD cable shield from the field terminal block to the HTC module should be terminated at the earth ground bar located near the module.

Figure 4: Temperature sensor connections to terminals



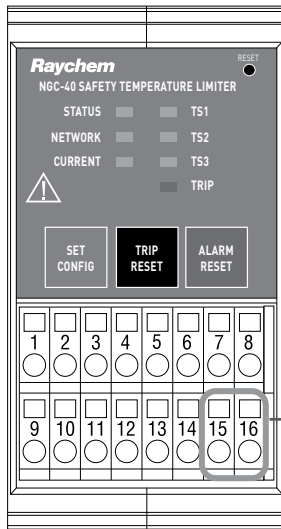
Contactor Relay  
 Contactor relay uses terminal 1 and 2, Form A, NO dry contact, rated at 250 Vac max, 3 A.  
 Contact is energized & closed during normal conditions and will open upon a trip or power failure condition.

Figure 5: Contactor terminals



Alarm via Digital Output  
 Alarm relay using terminal 3 and 4,  
 Form A, NO dry contract, rated at 250V max, 3 A.  
 Contact is energized & open during normal conditions and  
 will close upon an alarm condition.

Figure 6: Alarm terminals



Trip reset (Digital Input )  
 Terminal 15 and 16.  
 100 Ω max loop resistance or 5-24 Vdc @ 1 mA maximum

Figure 7: Trip reset digital input

### NGC-40 CAN Bus Connections for up to 10 Modules

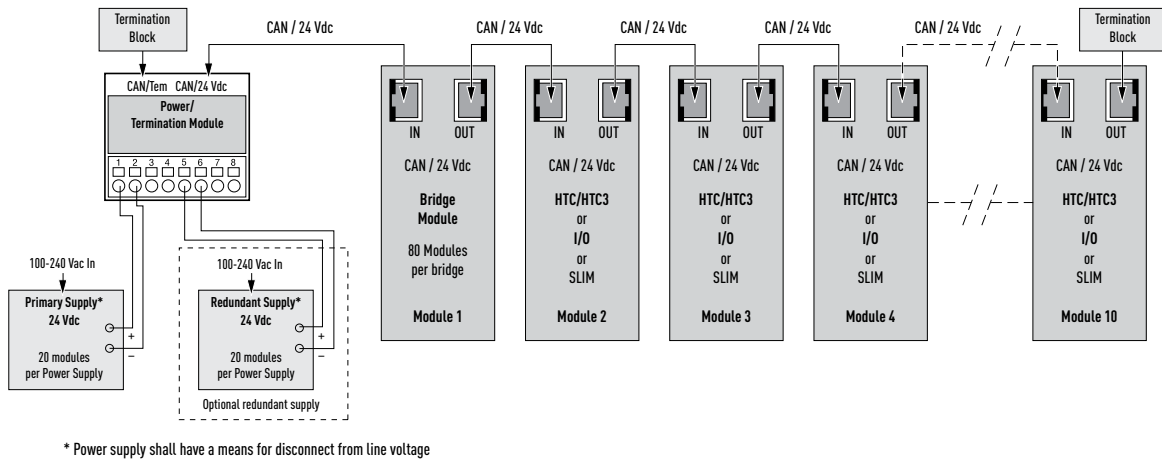


Figure 8: CAN network connections for up to 10 modules

### NGC-40 CAN Bus Connections for up to 20 Modules

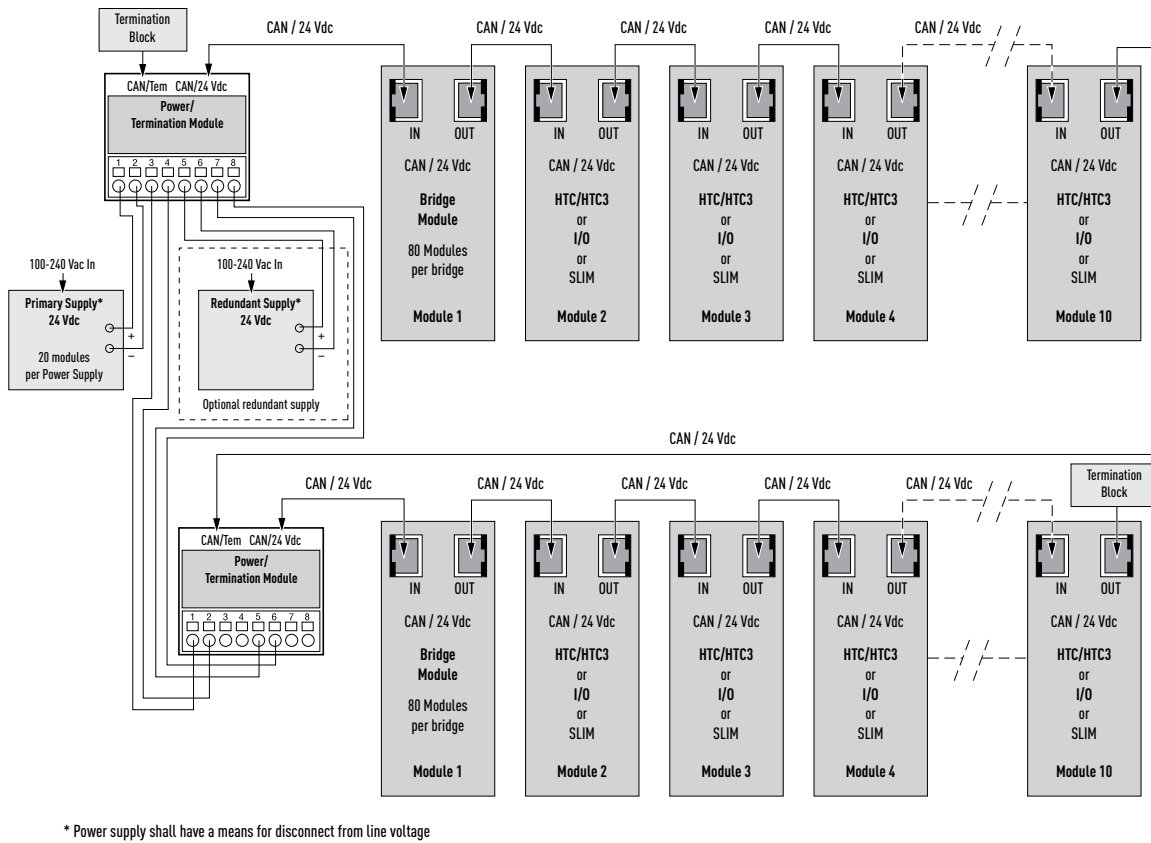
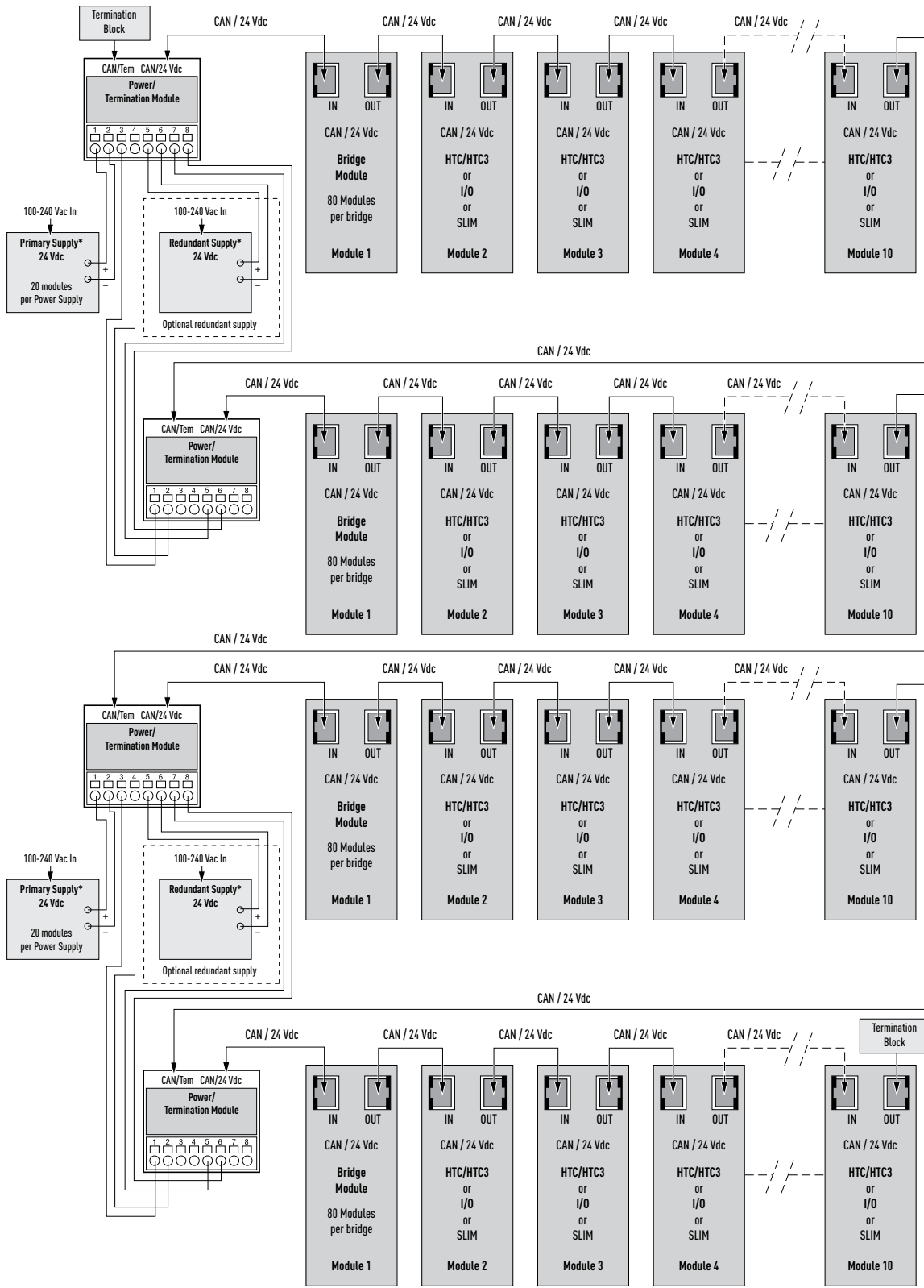


Figure 9: CAN network connections for up to 20 modules

# NGC-40 CAN Bus Connections for up to 40 Modules



\* Power supply shall have a means for disconnect from line voltage

Figure 10: CAN network connections for up to 40 modules

The location of the SLIM module is free to choose after the bridge module. Via configuration tools the limiter will be linked to the associated controller.

### 3 SAFETY INSTRUCTIONS FOR RAYCHEM NGC-40-SLIM

#### 3.1 Area of use

Safety temperature limiters are required in all 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.

Typical examples of such installations could be surface heating installations in Hazardous area Zone 1

#### 3.2 Safety function of temperature limiter in Raychem NGC-40-SLIM

The safety function will invoke, when the permissible temperature limit is reached or in case a fault occurs (such as probe break, probe short-circuit, component failure, or supply failure) even when the process conditions are within the permissible temperature range. In all these cases the equipment is immediately switched off. If the fault is no longer present, than the safety temperature function must be manually reset before the unit goes back to normal operation. Raychem NGC-40-SLIM units can be reset by means of a Trip Reset push button, an external hardwired signal or via dedicated software. The output of the unit will only be enabled when all conditions are safe; meaning that the temperature measured by the limiter RTD has dropped below the limiter set point and when there are no other faults being detected. In other words, the unit will only reset after the normal operating conditions have returned.

#### 3.3 Temperature limiter (schematic)

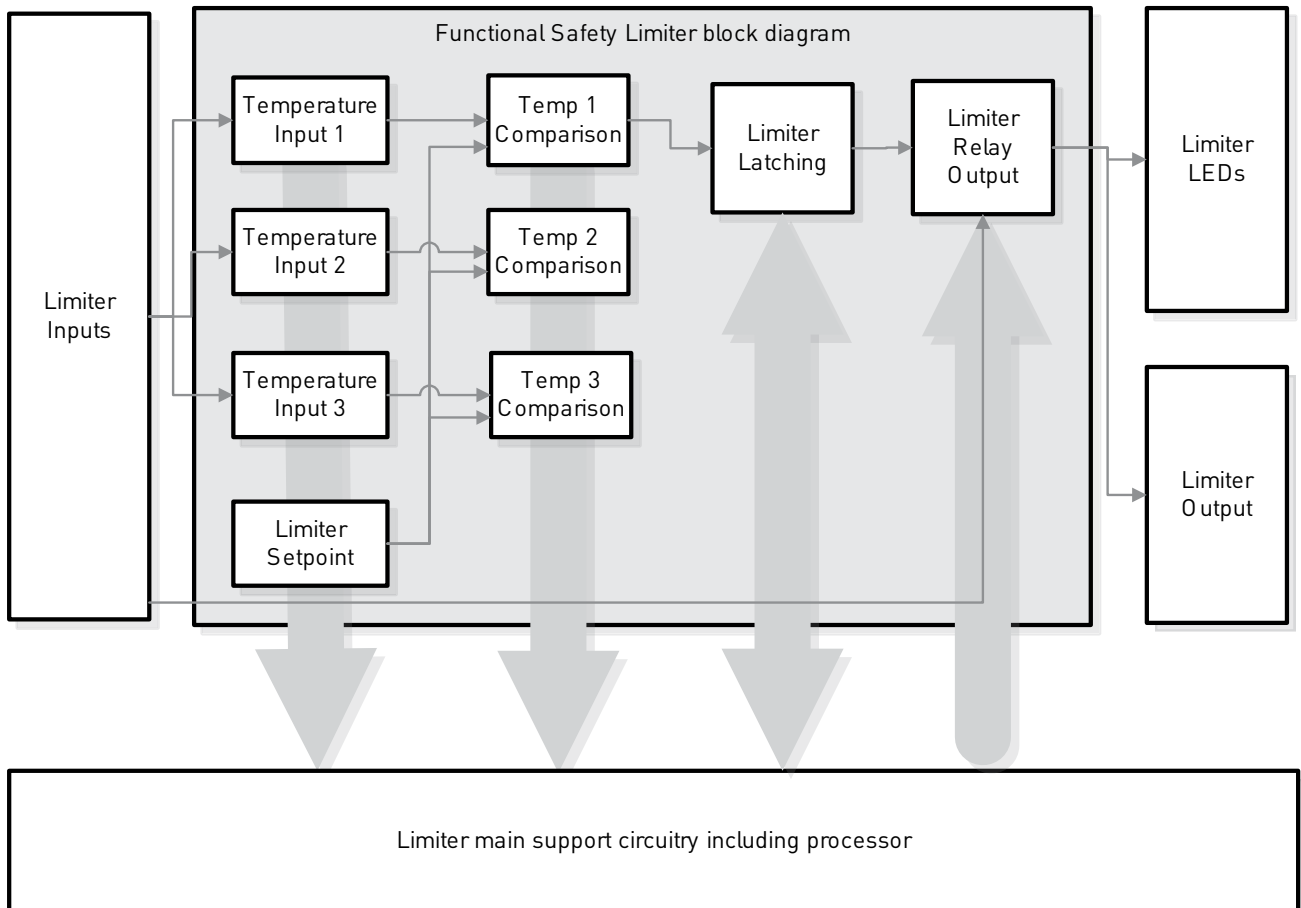


Figure 11: Safety Temperature Limiter block diagram

### 3.4 Reset Safety Temperature Limiter

The safety temperature limiter is designed such that after the temperature limiter has tripped the device needs to be reset manually. Resetting is possible only after the normal, safe operating conditions have returned. In order to RESET the limiter after it has tripped, the user needs to press the Trip Reset pushbutton as is shown in Figure 12. Alternatively the safety temperature limiter can be reset via Raychem Supervisor, Raychem TOUCH 1500. Refer to the operating manual of the specific units for more detailed instructions on how to use these devices.

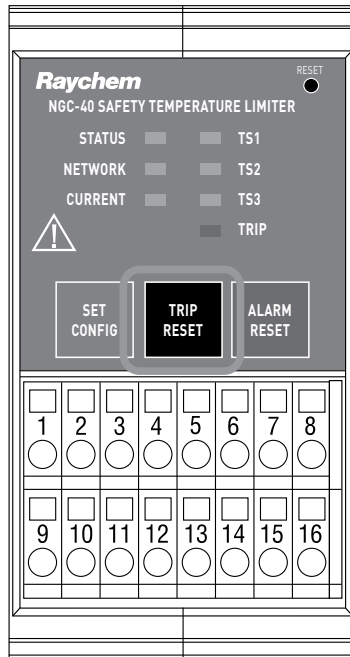


Figure 12: "Trip Reset" button

### 3.5 Temperature setting secured and locked to prevent manipulation

The lock out temperature (set point) of the safety temperature limiter must be set in such a way that maximum T-class temperature cannot be exceeded. The surface temperature of the heat-tracing cables is limited to the temperature applicable in this T class -5 K for temperatures below or equal to 200°C or -10 K for temperatures greater than 200°C. Refer to section 3.7 below for the procedure to change the safety limiter set point. The safety temperature limiter operates totally independent of the temperature control system and has its own temperature inputs (RTD Limiter). In case of a defect to any part of the Raychem NGC-40-SLIM unit the device shall be de-energized before replacing the defective equipment.

### 3.6 Changing limiter set point

Changing the set point of the limiter requires the combination of the SET CONFIG button on the SLIM and an external user interface.

### 3.7 Procedure to write new temperature set point to limiter

In order to write a new set point to the safety temperature limiter a safety procedure needs to be followed. Changing the set point of the temperature limiter requires the combination of the limiter "Set Config" button and a programming device. For a programming device one can use; Raychem Supervisor software or the Raychem TOUCH 1500.

The procedure to change the limiter set point is the same for all user interfaces. The configuration software will write the new set point to the input buffer of the Raychem NGC-40-SLIM controller only when the "Set Config" button is pressed. The limiter set point button needs to be activated within a certain time after the buffer has been loaded with the new set point.

If the button has not been pressed before the programming window is elapsed, the buffer will be emptied and the old value remains unchanged. Once the new set point has been written the new, or in case the write procedure was not successful, the old set point will be read back by the programming device as confirmation to the user. After changing the limiter set point the user shall verify whether the set point has been updated correctly. Each time after the limiter set point has been altered a functional test as per paragraph 3.9 should be performed.



### 3.8 Functional test

The Raychem NGC-40-SLIM units meet the requirements of SIL2 (see paragraph 3.13 for more details) accordingly to IEC 61508-1:1998 and IEC 61508-2:2000. In this standard it is stipulated that in order to guarantee safe and reliable operation the units need to be subjected to a functional test at regular intervals. In the case of the Raychem NGC-40-SLIM this is set at 12 months (1 year) intervals. These tests must be performed according to the guidelines provided. When the operational lifetime has expired, the systems no longer conform to the requirements of their SIL certification.

Type	SIL level	Proof check interval	Unit Lifetime
NGC-40-SLIM	2	1 year	25 years

Table 4: Functional test

Apart from the scheduled test intervals a functional test is to be performed after every malfunction of the system and each time the limiter set point has been changed.

### 3.9 Functional test description

In general the functional test always starts from the “normal” state, meaning that there should not be any alarms present on the unit and the Limiter tripped LED (“Trip”) on the display of the unit should not be lit. In case the Limiter tripped LED is ON then the unit should be reset before the functional test is performed.

### 3.10 Functional test procedure

The following steps should be executed as part of the functional test. Repeat this test for all sensors connected to the limiter module.

- Disconnect one of the leads of the temperature sensor of the limiter RTD.
- The red alarm LED “Trip” should light up and the output of the unit should switch OFF.
- Re-establishing the sensor connection has no immediate effect. Switch off the mains supply of the unit and leave the power off for one minute. Powering up the unit again should not reset the limiter.
- After the Limiter “Trip Reset” button is been pressed, the Limiter Tripped alarm will go away and switch the output on. (Assuming the measured temperature is below the set point temperature and there are no other faults)
- Install a wire bridge, short cutting the limiter sensor terminals
- The red alarm LED “Trip” should light up and the output of the unit should switch OFF.
- Removing the wire bridge has no immediate effect.
- Switch off the mains supply of the unit and leave the power off for one minute. Powering up the unit again should not reset the safety limiter.
- Only after the Limiter reset button has been pressed will the Limiter Tripped alarm go away and switch the output on. (Assuming the measured temperature is below the set point temperature and there are no other faults)
- Disconnect the RTD(s) from NGC-40-SLIM module.
- The red alarm LED “Trip” should light up and the output of the unit should switch OFF.
- Connect decade boxes to the RTD terminals to simulate the measured temperature. (The decade box simulates the resistance of the PT100 sensor)
- Set each of the decade box resistance values below the trip point resistance value (for a relationship between PT100 resistance value and temperature curve see appendix A).
- Reset the limiter. The limiter trip alarm will go away and switch the output on.
- Increase the resistance of decade box 1 up till 5 degrees below the limiter trip point. The limiter shall not trip.
- Increase the resistance of decade box 1 slowly to 5 degrees above the limiter trip point.
- The red alarm LED “Trip” should light up and the output of the unit should switch OFF.
- Decrease the resistance of decade box 1 slowly to 5 degrees below the limiter trip point.
- Reset the limiter. The limiter trip alarm will go away and switch the output on.
- After performing all functional tests reconnect the RTD sensor(s) to the NGC-40-SLIM module and reset the limiter. The limiter trip alarm will go away and switch the output on.

### 3.11 Test in the event of a fault

In the event of a system fault, the limiter switches off the load. This condition is indicated by the LED "TRIP" which will light up. The fault is signalled simultaneously by the alarm relay which changes state. Press the "TRIP RESET" button (at least 2 sec) until the limiter tripped LED is off. If the safety circuit remains open, the system and the RTD circuit have to be checked.

Press the "TRIP RESET" button again. If the limiter remains inhibited after pressing the reset button the unit should be replaced.

### 3.12 Safety Integrity level

The safety integrity level of the Raychem NGC-40-SLIM is SIL2. The SIL level can be achieved by determining the following safety related parameters:

- PFDavg: The average probability of the hazardous failure of a safety function when it is demanded;
- HFT: The hardware fault tolerance;
- SFF: The fraction of non-hazardous (i.e. safe) failures

See for details on the Raychem NGC-40-SLIM table xx.

Type	SIL level	Proof check	Unit lifetime
NGC-40-SLIM	2	1 year	25 years

Table 5 : SIL level conformity matrix

### 3.13 Safety integrity of the Raychem NGC-40-SLIM hardware

According to IEC 61508-2:2000, a distinction must be made between Type A systems and type B systems. A sub-system can be viewed as a Type A system if, for the components that are necessary in order to achieve the safety function:

- The failure mode of all components that are used is adequately defined, and
- The response of the sub-system in fault conditions can be completely determined,
- Reliable failure data based on field experience are available for the sub-system, to demonstrate that the assumed failure rates for recognized and unrecognized hazardous failures can be achieved.

A sub-system can be viewed as a Type B system if, for the components that are necessary in order to achieve the safety function:

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

The Raychem NGC-40-SLIM corresponds to a Type A system.

### 3.14 PFDavg safety function

The limiter sensor, limiter electronics and the limiter relay together form the safety related system that performs a safety function. The "average probability of the hazardous failure of a safety function for the entire safety-related system" (PFDavg) is usually divided among the subsystems. An external device e.g. 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 level	Architecture	Proof check interval	MTTR (hrs)	PFD avg.	HTF	SFF
Raychem NGC-40-SLIM	SIL 2	1oo1D	1 year	24	3.918E-03	0 (1oo1)	94.65%

Table 6: Safety Integrity level

MTTR = Mean time to repair

### 3.15 SIL related to SFF and HFT

The following table presents the achievable safety integrity level (SIL), depending on the safe failure fraction (SFF) and the hardware failure tolerance (HFT) for Type A safety-related subsystems. Table 7 is valid for the Raychem NGC-40-SLIM:

Safe failure fraction (SFF)	Hardware fault tolerance (HFT) for Type A		
	0	1	2
SFF < 60%	SIL 1	SIL 2	SIL 3
60 < SFF < 90 %	SIL 2	SIL 3	SIL 4
90% < SFF < 99%	SIL 3	SIL 4	SIL 4
99% < SFF	SIL 3	SIL 4	SIL 4

Table 7: Relation SFF to HFT

### 3.16 Safety related system characteristics

The failure types of; sensor break, sensor short, sensor misconnected and random hardware failure are permanently monitored.

### 3.17 Response in operation and fault conditions

The response in operation and fault conditions is described in the operating manual. The necessary functional tests are described in paragraph 3.10 of this operating manual. The test to be applied in a fault condition is described in paragraph 3.11 of this operating manual. A functional test must be carried out after commissioning, repair to the safety system, or an alteration of safety-related parameters. If a fault is detected in the course of a functional test, then measures must be implemented to restore the reliable functionality of the safety system. This can, for instance, be achieved through replacement of the control unit. It is recommended that the tests that have been carried out are all appropriately documented.

#### IMPORTANT NOTICE

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 Pentair representative for more instructions. A list of worldwide representations can be found on the last page of this document or on [www.pentairthermal.com](http://www.pentairthermal.com).

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