TX9042

Programmable Sensor Controller

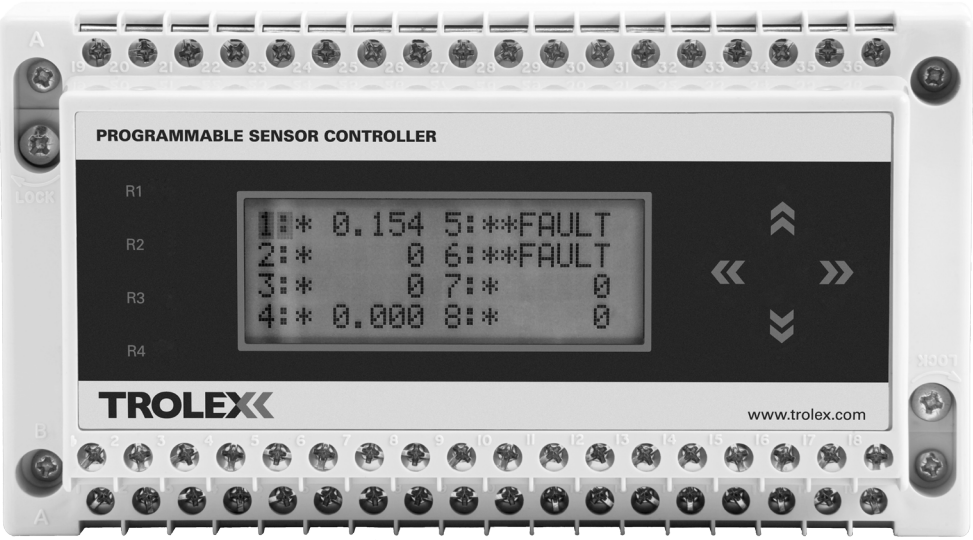
User Manual

TROLEX

TX9042 Programmable Sensor Controller (PSC)

Contents

1. Product Overview



TX9042.55	Up to 8 analogue or digital inputs. Up to 16 On/Off inputs RS485 data communications Data logging facility for up to 26,000 input readings per channel

1.1 Operating Features

- Up to eight channels of analogue or digital inputs or sixteen on/off inputs
- Input and output functions are programmed directly using the keypad
- RS485 data protocol for integrating multi-point sensor collecting into mine wide systems
- Accepts analogue or digital inputs from a variety of source types
- Simple to use, just four keys to programme the TX9042 PSC, no special software and no software programming skills required
- Full functional compatibility with the entire range of Trolex sensors
- Up to 32 TX9042 PSC can be connected to a single mine wide data system

1.2 Application

The TX9042 Programmable Sensor Controller (PSC) is for sensor management and data communications in arduous industrial environments and hazardous areas. It is suitable for use in SIL 1 and SIL 2 applications, in accordance with any conditions or restrictions.

The uses of the TX9042 PSC include:

- Underground machinery protection
- Environmental monitoring using a combination of gas sensors and flow sensors
- Gas detection systems
- Conveyor control
- Pump and compressor monitoring
- Machine condition monitoring
- Fan vibration monitoring
- ITP monitoring
- On-board underground machinery monitoring
- Plant protection
- Data collection from groups of diverse sensors
- Area network sensor collection and monitoring

The data logging facility can be used to record operational trends and to analyse periods where serious incidents may have occurred. All data acquired can also be transmitted over a communication link to a remote point. The system can also be used for collecting sensor information from several distributed monitoring stations on a mine wide sensor network. Up to 32 sensor collectors can be networked on a data link and communicated to a central control and monitoring computer via the data link.

Intrinsically Safe:	**Supply Voltage:**
TX9042.55	12 V dc from an approved intrinsically safe power source

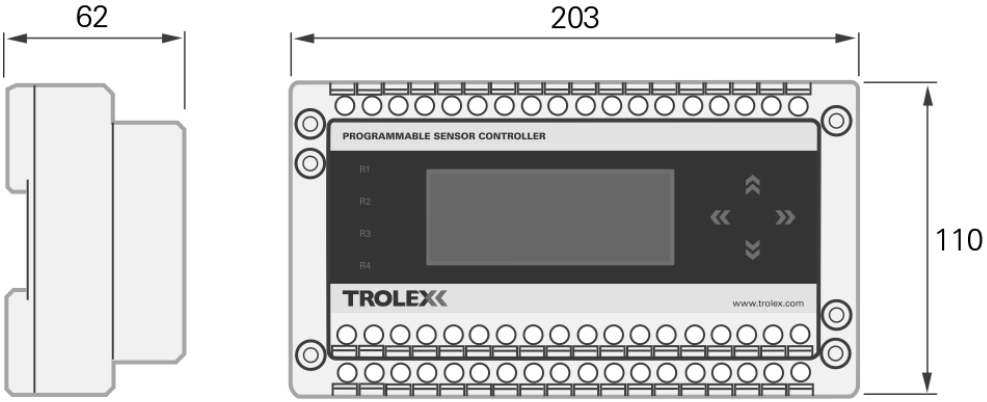
1.3 Product Options

TX9042 PSC	General Purpose	Mining Ex ia
12 V dc	-	TX9042.55

1.3.1 TX9042 PSC Input Module Types

Input Module Description	Mining Ex ia Order Code
Current - 0 to 20 mA	P5423.516
Current - 4 to 20 mA	P5423.508
Voltage - 0 to 2 V	P5423.514
Voltage - 0.4 to 2 V	P5423.509
Voltage - 0 to 10 V	P5423.515
Flow TX6023 - not lo limited	P5423.552
Flow TX6023 - lo limited	P5423.553
Flow TX6023 - 4 to 20 mA lo limited	P5423.556
Thermocouple - K type	P5423.539
Thermocouple - I/R -50 to +400°C	P5423.527
PT100 - -50 to +200°C	P5423.510
PT100 - -50 to +400°C	P5423.513
KTY21 - -50 to +150°C	P5423.519
KTY81 - -50 to +150°C	P5423.511
KTY84 - 0 to +300°C	P5423.512
Flow TX6022 - Flow	P5423.528
Flow TX6022 - Pressure	P5423.518
ac RMS - 500 Hz to 10 kHz - TX5630	P5423.506.01
ac RMS - 15 to 100 Hz - TX5630	P5423.506.02

1.4 Dimensions



All dimensions in mm

1.5 Technical Information

Display accuracy	+/-0.25% (analogue channels)
Setpoint accuracy	+/-0.5%
Ambient temperature limits	-10 to +50°C
Electrical connections	4 mm barrier/clamp terminals
Housing material	ABS
Nett weight	800 g
Environmental protection	Must be housed in a protective metal enclosure to comply with Intrinsically Safe requirements
Information display	LCD screen 20 characters x 4 lines 6 mm high characters
Mounting	DIN rail
Microprocessor	Microprocessor controlled menu operation, with non-volatile data retention and 10 bit analogue to digital conversion (analogue channels)
Setpoints	2 per channel plus Fault signal

Output relays	4 encapsulated reed relays with function programming
Relay contact rating	200 V 0.25 A 3 W absolute maximum **Checkpoint** Circuits switched by the contacts of the output relays MUST emanate from a certified Intrinsically Safe power source and the circuit parameters must be within Intrinsically Safe requirements.
Setpoint adjustment	0 to 99% of full scale
Hysteresis adjustment	0 to 99%
Power on delay adjustment	0 to 255 seconds for each channel
Output delay adjustment	0 to 18 hours for each setpoint in one second steps
Input update period adjustment	0 to 60 seconds for each channel in 0.05 second steps
Engineering units menu	V, mV, mA, °C, °F, °K, g, kg, mbar, bar, Pa, kPa, PSI, %, ppm, %RH, mm, m, mm/s, m^3/s, rpm, pps, Hz, kHz, secs, m:s, h:m, m/s, m^3/H, m^3/m, A, l/m, g/m, l/s, g/s, l/h and g/h
Fault signal	Open or short circuit signal line or sensor fault, will generate a fault signal, the fault will be identified and displayed on the LCD screen
Data communications	RS485 Modbus
Data logging	Up to 26,000 readings with on-demand down loading

1.6 Electrical Details

TX9042.55 - Programmable Sensor Controller (PSC)	
Supply voltage:	12 V dc +20%/-2.5% at 125 mA
Output:	Modbus protocol
Type of sensor:	Flammable
Supply current:	125 mA at 12 V
Relay:	200 V 0.25 A 3 W absolute maximum

Checkpoint
Circuits switched by the contacts of the output relays MUST emanate from a certified Intrinsically Safe power source and the circuit parameters must be within Intrinsically Safe requirements.

2. Certification

2.1 Europe (ATEX)

Ex Certificate number:	Baseefa 03ATEX0292X
Ex Certification code:	I M1 Ex ia I Ma

2.1.1 Special Conditions for Safe Use

1. The TX9042 Programmable Sensor Controller (PSC) must be mounted in a secondary enclosure as shown on drawing P5423.02 or in an alternative metal enclosure (not light alloys) which is appropriately certified as providing a degree of protection of IP54.

2. Up to 11 RS485 Communications Modules (in separate TX9042 Programmable Sensor Controllers (PSC)) may be daisy-chained together (ie. terminals B1 all linked together, terminals B2 all linked together and terminals B3 all linked together). Provided that the number of daisy-chained TX9042 PSCs is reduced to 10, these communications lines may be connected to unspecified safe area equipment via an appropriately certified shunt zener diode safety barrier (dual channel ac), whose output parameters do not exceed the following per channel:

   Uo = 9 V, Io = 100 mA, Po = 225 mW
   OR
   Uo = 12 V, Io = 80 mA, Po = 240 mW

   eg. suitably certified MTL761, MTL766 to BAS01ATEX7202 or MTL7761ac, MTL7766ac to BAS01ATEX7217.

   For the purposes of this certificate, these shunt safety barriers may be considered equivalent to Category I (M1) equipment.

   The cable parameters shall not exceed the following:

   Cc = 2.8 µF
   Lc/Rc = 222 µH/ohm

3. For the purpose of this certificate, a P+F inductive sensor to PTB00ATEX2048X to Category II 1G EEx ia IIC T6 connected to terminals T1 to T4 of a Digital Input Module may be considered equivalent to Category I M1. In this instance, the power supply selected to power the TX9042 PSC must have an output voltage not exceeding 16 V.

2.1.2 General Conditions of Use

Prior to installation, it is essential that user refers to the above certificate to ensure that the termination and cable parameters are fully complied with and are compatible with the application. Copies of certificates are available from Trolex.

CE ATEX Directive (94/9/EC)

EMC Directive (2004/108/EC)

2.2 Russia (GOST-R)

Ex Certificate number:	POCC GB.ME92.B02874
Ex Certification code:	PO Ex ia I X

2.2.1 General Conditions of Use

Prior to installation, it is essential that user refers to the above certificate for any special conditions for safe use. The user must ensure that the termination and cable parameters are fully complied with and are compatible with the application. Copies of certificates are available from Trolex.

2.3 South Africa (MASC)

Ex Certificate number:	MASC M/11-359X
Ex Certification code:	Ex ia I

2.3.1 Special Conditions for Safe Use

1. The TX9042 Programmable Sensor Controller (PSC) must be mounted in a secondary enclosure as shown on drawing P5423.02 or in an alternative metal enclosure (not light alloys) which is appropriately certified as providing a degree of protection of IP54.

2. Up to 11 RS485 Communications Modules (in separate TX9042 Programmable Sensor Controllers) may be daisy-chained together (ie. terminals B1 all linked together, terminals B2 all linked together and terminals B3 all linked together). Provided that the number of daisy-chained TX9042 PSCs is reduced to 10, these communications lines may be connected to unspecified safe area equipment via an appropriately certified shunt zener diode safety barrier (dual channel ac), whose output parameters do not exceed the following per channel:

   Uo = 9 V, Io = 100 mA, Po = 225 mW
   OR
   Uo = 12 V, Io = 80 mA, Po = 240 mW

   eg. suitably certified MTL761, MTL766 to BAS01ATEX7202 or MTL7761ac, MTL7766ac to BAS01ATEX7217.

   For the purposes of this certificate, these shunt safety barriers may be considered equivalent to Category I (M1) equipment.

   The cable parameters shall not exceed the following:

   Cc = 2.8 µF
   Lc/Rc = 222 µH/ohm

3. For the purpose of this certificate, a P+F inductive sensor to PTB00ATEX2048X to Category II 1G EEx ia IIC T6 connected to terminals T1 to T4 of a Digital Input Module may be considered equivalent to Category I M1. In this instance, the power supply selected to power the TX9042 PSC must have an output voltage not exceeding 16 V.

2.3.2 General Conditions of Use

Prior to installation, it is essential that user refers to the above certificate to ensure that the termination and cable parameters are fully complied with and are compatible with the application. Copies of certificates are available from Trolex.

2.4 Australia (ANZEx)

ANZEx

Ex Certificate number: ANZEx 06.3057X

Ex Certification code: Ex ia I

2.4.1 Conditions of Safe Use

1. Prior to installation, it is essential that user refers to the above certificate to ensure that the termination and cable parameters are fully complied with and are compatible with the application. Copies of certificates are available from Trolex.

2. Up to 6 RS485 Communications Modules (in separate TX9042 Programmable Sensor Controllers (PSC)) may be daisy-chained together (ie. terminals B1 all linked together, terminals B2 all linked together and terminals B3 all linked together). Provided that the number of daisy-chained TX9042 PSCs is reduced to 5, these communications lines may be connected to unspecified safe area equipment via an appropriately certified shunt zener diode safety barrier (dual channel ac), whose output parameters do not exceed the following per channel:

   Uo = 9 V, Io = 100 mA, Po = 225 mW
   OR
   Uo = 12 V, Io = 80 mA, Po = 240 mW

   eg. suitably certified MTL761, MTL766 to BAS01ATEX7202 or MTL7761ac, MTL7766ac to BAS01ATEX7217.

The cable parameters shall not exceed the following:

Cc = 2.8 µF
Lc/Rc = 222 µH/ohm

2.5 USA (MSHA)

MSHA IS Evaluation number: IA-17501-0

2.5.1 Conditions of Use

Prior to installation, it is essential that user refers to the above document for any specific conditions of use. The user must ensure that the termination and cable parameters are fully complied with and are compatible with the application. Copies of certificates are available from Trolex.

3. Functional Safety

3.1 Overview of Safety Integrity Level

The following instructions are applicable when the TX9042 Programmable Sensor Controller (PSC) is used as an element in a safety instrumented function that is specified to achieve a Safety Integrity Level (SIL), eg. SIL 1, 2, etc.

The reliability of the TX9042 Programmable Sensor Controller (PSC) has been independently assessed in accordance with IEC 61508 for use in SIL applications. The compliance with IEC 61508 includes hardware reliability (probabilistic type failures) and measures to address systematic type failures.

The information that follows forms the 'Safety Manual' required by IEC 61508-2 and is intended to allow correct product selection, system integration, installation, operation and maintenance to enable the SIL specified for the safety instrumented function to be achieved and maintained, as far as the TX9042 Programmable Sensor Controller (PSC) is concerned.

The actual SIL will depend on many system considerations that are outside the scope of the TX9042 Programmable Sensor Controller (PSC) and will rely on personnel who are competent in the functional safety aspects of the various lifecycle activities mentioned above.

3.2 SIL Suitability

The versions and configurations of the TX9042 Programmable Sensor Controller (PSC) identified in Table 1 in Section 3.3 below and are suitable for use in safety functions that have a specified Safety Integrity Level (SIL) in accordance with IEC 61508 or IEC 61511 up to and including:

SIL 2 - when used in a 'Low Demand' safety function [1]
with proof test interval of 3 months
SIL 1 - when used in a 'Low Demand' safety function [1]
with proof test interval of 12 months
SIL 1 - when used in a 'High Demand' safety function [1]

The functional safety data in Tables 1 and 2 in Section 3.3 must be taken into account by integrators and end-users, including compliance with the restrictions in use (Section 3.4) and all other provisions and conditions in this User Manual.

System integrators and end users responsible for other lifecycle phases (system specification, integration, installation, commissioning, operation, maintenance, etc) need to perform assessments on the complete scope of their activities to ensure a target SIL for the safety function is and continues to be met.

[1] Low Demand and High Demand modes of operation are defined in IEC 61508-4, 3.5.16

3.3 Summary of the Verified Functional Safety Data

The product, configuration and Safety Manual that have been assessed are shown in Table 1.

Product Information	Details
Product identification	TX9042.55 Programmable Sensor Controller
Product specification	See Section 1.5 of this User Manual
Product configuration	4 to 20 mA input conditioning modules fitted OR 0.4 to 2 V input conditioning modules fitted To achieve SIL the TX9042 with 4 to 20 mA or 0.4 to 2 V input conditioning modules fitted, **must** be configured to de-energise an output channel relay if either the input signal transitions a pre-determined alarm threshold or an internal fault is indicated. Neither the display nor the RS-485 data link are part of the specified safety function.
System configuration	Monitoring of signals from devices configured as 2/3-wire current loop devices, 4-wire current inputs with separate power connection, or voltage inputs.
Element safety function	To de-energise an output channel relay (open relay contacts) if either the input signal transitions a pre-determined alarm threshold or an internal fault is indicated.
Safety Manual	See Section 3 of this User Manual

Table 1 Basic Element Information

The hardware failure data for the TX9042 element safety function based on an extensive analysis of field failure data with a 90% single sided confidence limit is shown in Table 2.

Parameter	Value
Dangerous failure rate (λ_D)	2.3E-06
Safe failure rate (λ_s)	N/R [1]
Safe failure fraction (SFF)	N/R [1]
Element type	Type B
Hardware fault tolerance (internal architecture)	0
Diagnostic coverage (DC)	60%
Diagnostic test interval	N/A [2]
Probability of Failure on Demand (PFD_{AVG}) [12 month proof test; 24hr MTTR]	1.0E-02 [2]
Probability of Failure on Demand (PFD_{AVG}) [3 month proof test; 24hr MTTR]	2.6E-03 [2]
Probability of dangerous Failure per Hour (PFH)	2.3E-06

Table 2 Hardware Failure Data

[1] Not required by Route 2_H

[2] To be conservative, no credit has been taken for the diagnostics

3.4 Conditions or Restrictions for use in SIL Applications

The sections of this User Manual shall be strictly complied with to ensure validity of the failure data and systematic safety integrity. The following additional restrictions and conditions apply when the unit is used in SIL applications:

1. The TX9042 must be repaired within the MTTR assumed in the PFD calculations shown in the table above if an internal fault is detected in the unit.
2. If the MTTR or the proof test interval (T_1) is different from those assumed in this User Manual, then the PFD_{AVG} must be re-calculated and the SIL capability re-verified accordingly (refer to the Safety Manual in Section 3.5 of this User Manual).

3. The display is for indication only and is not part of the safety function; likewise the RS485 communications are not part of the safety function.
4. The environmental limits are restricted to:
    - +20 to +40°C
    - relative humidity <90%
5. IEC 61508-2, 7.4.4.3.1c limits use to SIL 1 in high or continuous mode of operation when used in a non-redundant configuration.

3.5 Proof Test

Periodic Proof Tests of the element safety function must be carried out to identify any dormant failures, particularly when used in 'low demand' safety functions – refer to Section 6.1.4 of this User Manual, for the Proof Test procedure. Faults identified by this Proof Test must be repaired within the MTTR and the unit returned to full working order.

A suitable Proof Test interval (T_1) should be used in order to achieve the required average probability of failure on demand (PFD_{AVG}). A nominal interval of 8,760 hrs (1 year) and Mean Time To Repair (MTTR) of 24 hours has been used in the derivation of PFD_{AVG} for illustration purposes. If different values are used, the PFD_{AVG} for a non-redundant arrangement (i.e., where the safety function relies on a single element) can be re-calculated as follows:

$$PFD_{AVG} = (\lambda_{DU} + \lambda_{DD})\ t_{CE}$$

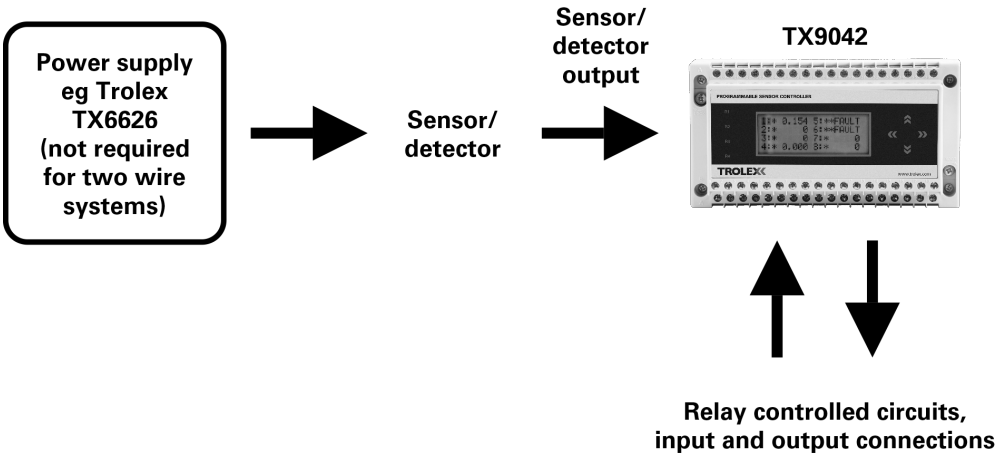
Where t_{CE} (the channel equivalent down time) = $(\lambda_{DU}/\lambda_D)\ (T_1/2 + MTTR) + (\lambda_{DD}/\lambda_D)\ MTTR$

For redundant arrangements refer to IEC 61508-6 for the equations.

Checkpoint
Those responsible for specifying proof testing of safety functions should refer to IEC 61508-6:2010 clause B.3.2.5 for considerations of the effect of non-perfect proof tests.

3.6 System Configuration Drawing

The illustration below shows how the TX9042 is to be used with other system elements.



4. Installation

4.1 Precautions

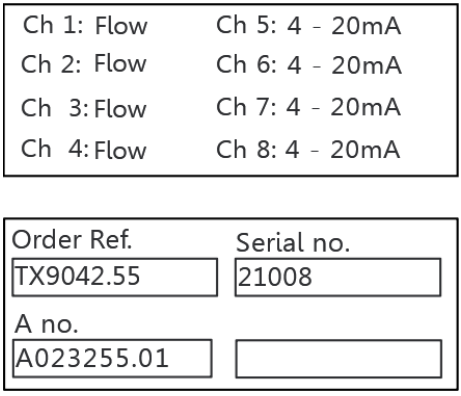
Do not disassemble the TX9042 PSC whilst in the hazardous area or use a TX9042 PSC that has a damaged housing in the hazardous area.

The TX9042 PSC must be installed within a metal protective enclosure to ensure compliance with certification requirements. It is permissible for the enclosure to incorporate a polycarbonate window to allow visibility of the TX9042 PSC LCD screen. However, window area may be no greater than 100 cm^2.

4.2 Labelling

When the TX9042 PSC is supplied fitted into a standard Trolex TX9204 metal enclosure, two channel identification labels will be fitted to the enclosure near to the connecting terminals. Connection details can also be viewed on the LCD screen, refer to Section 5.9.2.21 for details.

If a TX9042 PSC is supplied to be fitted into a customer supplied metal enclosure, the two channel identification labels will be provided loose and **must** be fitted adjacent to the connecting terminals in a visible position in order to comply with certification requirements.



Before installation check for the correct channel functions and supply voltage on the channel identification label on the rear of the TX9042 PSC housing.

4.3 Tools and Test Equipment Required

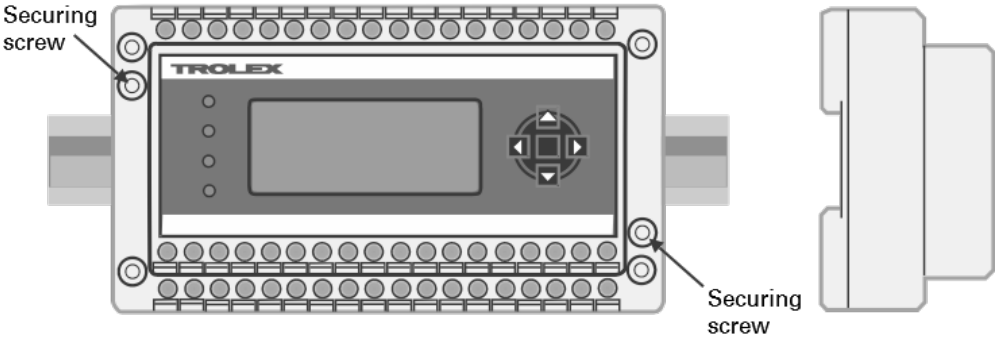
No special tools are needed to assemble or install the TX9042 PSC.

4.4 Mechanical Installation

The TX9042 PSC is installed on a TS35 low profile DIN rail as follows:

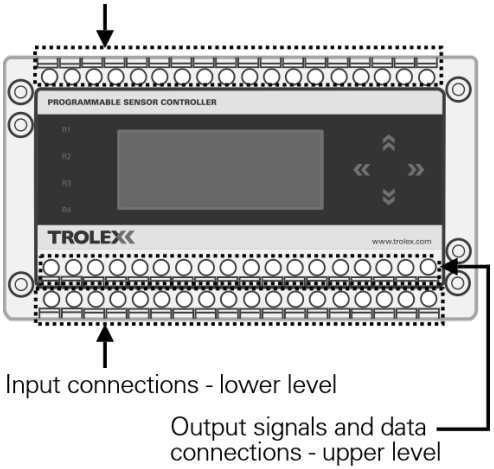
1. Loosen the two securing screws, one each at the end of the TX9042 PSC housing.
2. Swing the plastic tabs out of the way.
3. Locate the TX9042 PSC on the DIN rail.
4. Swing the plastic tabs so that they are behind the DIN rail flange.
5. Tighten the two securing screws.

Do not overtighten the two securing screws.



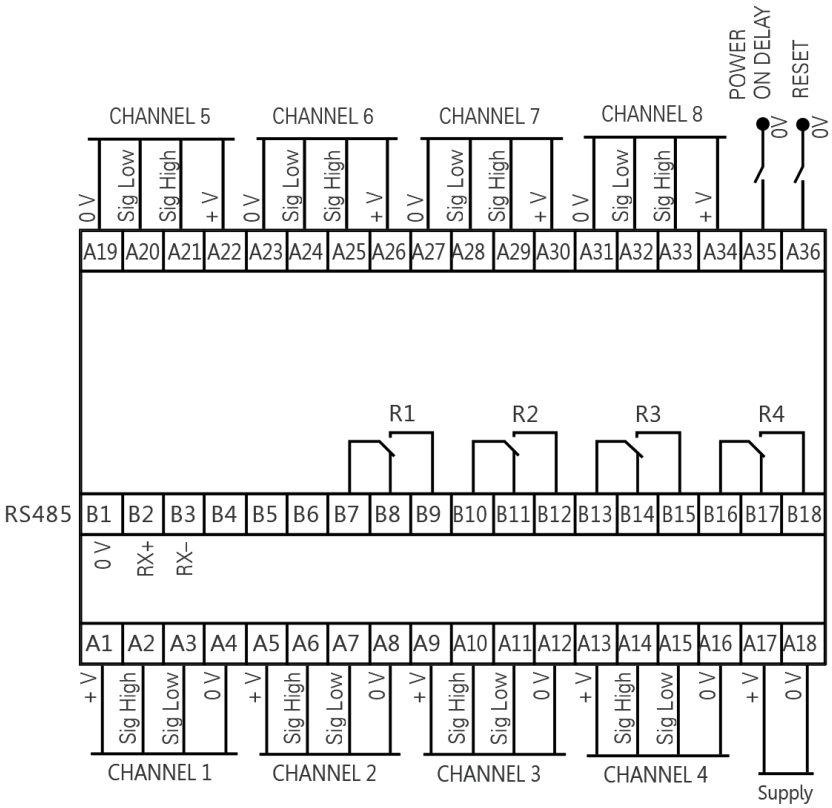
4.5 Connections

The terminals are divided on two horizontal planes. The lower level is used for all input connections and the upper level is used for output signals and data connections.



Each of the input channels has four connecting terminals available, and these are utilised in accordance with the type of input module that is fitted (refer to the diagram on the following page).

The sensor signal enters on terminals A2 and A3 and if a power supply is required to feed the sensor, then this is available at terminals A1 and A4. The input signal is fully floating and differential, giving high immunity to electrical interference.



The output contacts are shown with the relays de-energised in the alarm condition

Terminal A35 is used to control the **Power On Delay** function, see Section 5.9.1 for details, and the External Override facility. Terminal A36 is used to Reset any Latched relays, see Section 5.7.9 for details.

Circuits switched by the contacts of the output relays must emanate from a certified Intrinsically Safe power source and the circuit parameters must be within Intrinsically Safe requirements. The unit must be mounted in a protective metal enclosure to comply with Intrinsically Safe requirements.

Once input channels have been connected to the TX9042 PSC the channel identification labels **MUST** be completed. Any changes to the input channels **MUST** be recorded on the channel identification labels.

4.6 Input Channel Configuration

The duty of each of the eight input channels is determined by an interchangeable input conditioning module carried on the main I/O control card.

Each input conditioning module has calibration and functionality information stored in a non-volatile, EPROM. On power-up, the main processor reads this information and sets-up the channel accordingly. The eight input channels of the TX9042 PSC are configured during manufacture for the operational duty required. This is marked on the identification label on the rear of the housing, refer to Section 4.2 for details.

Input conditioning modules can be changed if required, refer to Section 4.6.4 for details. There are two categories of input module type:

- Analogue
- Digital

In total there are eleven possible input conditioning modules options for each channel:

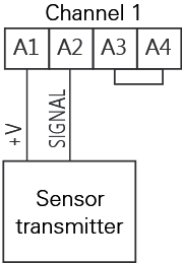
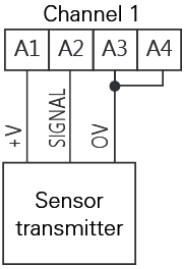
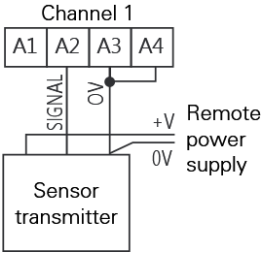
Analogue

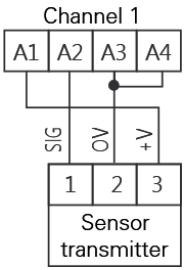
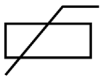
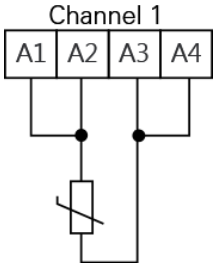
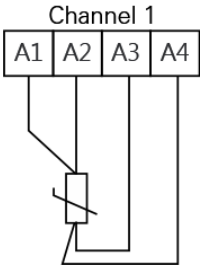
- Current
- Voltage
- Resistance Temperature Device
- Semi-conductor Temperature Device
- ac Voltage
- Strain Gauge
- Flow Module for TX6023/4
- Flow Module for TX6022
- Digital Pulse Processing

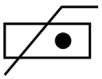
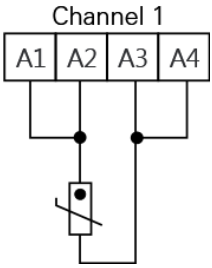
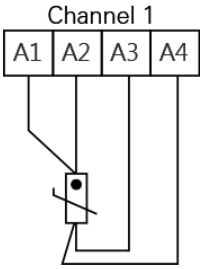
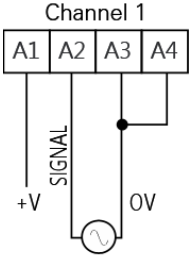
Digital

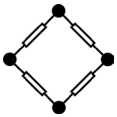
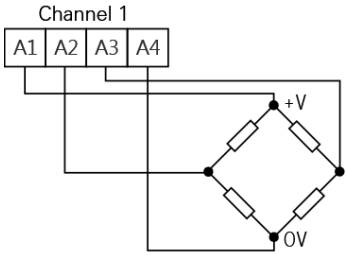
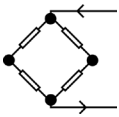
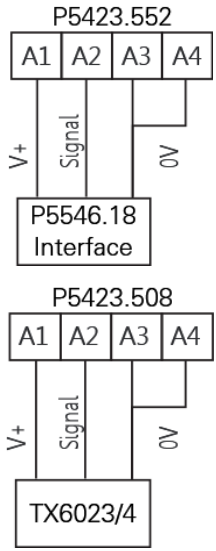
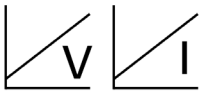
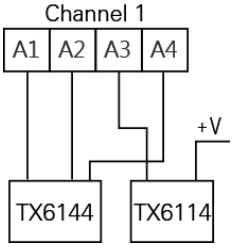
- Failsafe - digital
- Vortex Airflow Sensor - digital

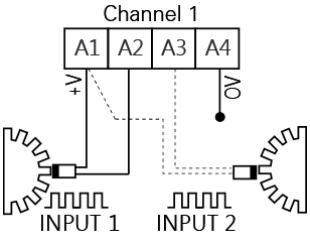
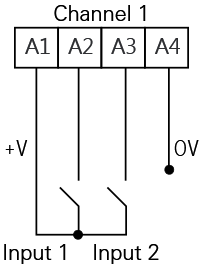
4.6.1 Analogue Input Modules

Type of Input	Range	Module Ref	Connections
Current 	0 to 20 mA 4 to 20 mA Impedance 110 R	P5423.516 P5423.508	2 wire loop powered  3 wire control powered  2 wire remote powered 

Type of Input	Range	Module Ref	Connections
Voltage  	0 to 2 V 0.4 to 2 V 0 to 10 V Impedance 100 K	P5423.514 P5423.509 P5423.515	
Resistance Temperature Device  Standardised to DIN43760 and BS 1904	PT100 -50 to +200°C -50 to +400°C	 P5423.510 P5423.513	2 wire  4 wire compensated 

Type of Input	Range	Module Ref	Connections
Semi-conductor Temperature Device  Linearised input	KTY81 -50 to +150°C KTY84 0 to +300°C KTY21-6 -50 to +150°C	P5423.511 P5423.512 P5423.519	2 wire  4 wire compensated 
ac Voltage  Load cells, ac generators, accelerometers, velocity sensors & power measuring instruments	ac RMS Acceleration 500 Hz to 10 kHz 0 to 7g (100 mV/g) ac RMS Velocity 15 Hz to 100 Hz 0 to 30 mm/sec (100 mV/g)	P5423.506.01 P5423.506.02	

Type of Input	Range	Module Ref	Connections
Strain Gauge  Load cells, pressure sensors, bridge circuits	2 mV/V (10 mV FS) 3 mV/V (15 mV FS) 10 mV/V (50 mV FS) 50 mV/V (250 mV FS) 100 mV/V (500 mV FS)	P5423.520.01 P5423.520.02 P5423.520.03 P5423.520.04 P5423.520.05	
Flow Module for TX6023/4  Gas sensors, load cells	For use with: TX6023 + P5546.18 TX6023 TX6024	P5423.552 P5423.553 P5423.554	
Flow Module for TX6022  Differential pressure sensors, line pressure	0.5 to 4.5 V and 4 to 20 mA	P5423.5528	

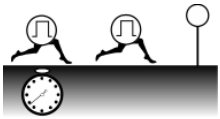
Type of Input	Range	Module Ref	Connections
Digital Pulse processing from proximity sensors, photosensors, contacts and pulse generating devices. On/Off switches	Dual Input NAMUR input DIN 19234 12 V version	P5423.523	2 proximity sensors  2 voltage free contacts 

4.6.2 Digital Input Modules

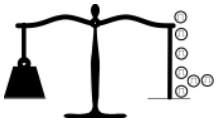
Digital input conditioning modules can be individually programmed into seven distinct operating modes:

Pulse Counter

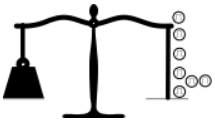
Pulse Interval



Pulse Frequency



Slip Frequency

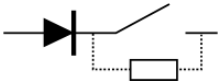
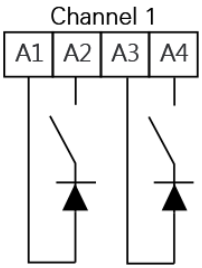
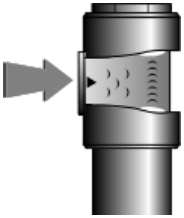
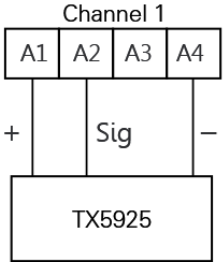


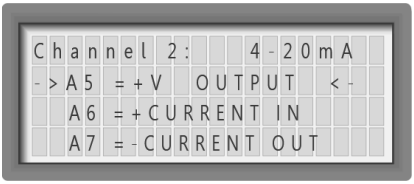
Differential Slip Frequency

Differential Frequency

Digital Level (On/Off)

Refer to Section 5.9.7 for details of Mode Setting for a Digital Input Module.

Type of Input	Range	Module Ref	Connections
Digital - Failsafe On/Off switches connected in series with a diode to give combined open circuit/short circuit sensor connection protection 	Voltage free contacts with series diode	P5423.522	2 voltage free contacts 
Digital (Vortex airflow sensor) TX5925 Vortex Airflow Sensor 	+5 V output TTL input	P5423.524	



4.6.3 Display of Connection Details

For convenience, input terminal connection details for any channel can be displayed on the LCD screen.

Refer to Section 5.9.2.21 for details.

4.6.4 Replacing an Input Module

The individual channel input conditioning modules are plug-in and can easily be replaced if required, by removing the rear panel of the housing.

The main processor will automatically be re-programmed for the new function of the replacement module.

Checkpoint
Channel input conditioning modules **MUST NOT** be replaced underground.

4.6.5 Cable Distance Calculation for Loop Powered 4 to 20 mA Sensors

Maximum cable distance:

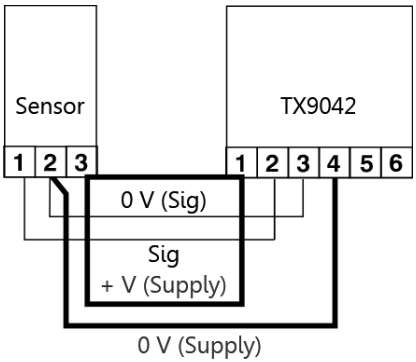
$$\frac{Vs - Vms}{0.02 \times R\ cable\ (km)}$$

Vs	=	Supply Voltage
Vms	=	Minimum Acceptable Sensor Voltage (eg. 16 V)
R cable	=	Total Resistance of Connecting Cable in ohms/km

4.6.6 Cable Distance for Voltage Inputs (0.4 to 2 V)

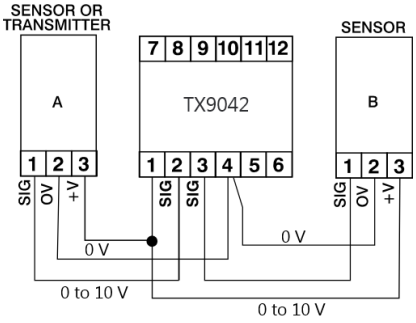
The input impedance of the input is very high, so cable distance is usually not a problem.

Voltage drop in the power supply line is the critical factor, particularly on a three wire system where the 0 V of the power supply line is common with the signal line. Use a 4 wire system on distances above 100 m.



4.6.7 Dual Input Signals (Differential)

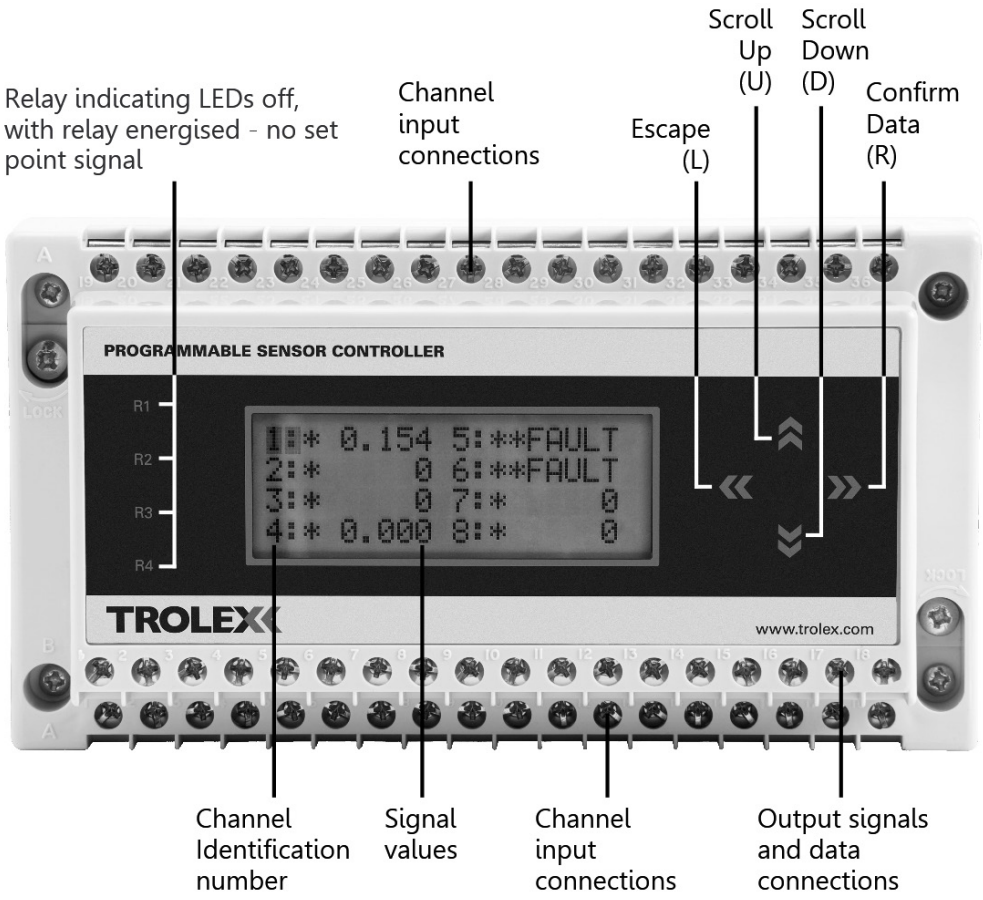
The differential input stage of a voltage input module also enables it to monitor two input signals simultaneously and respond to the difference between the two. This technique is frequently used to monitor differential temperature, differential pressure and differential speed.



Checkpoint
It is important that the two sensors or input signals are calibrated to the same operating parameters.

5. Setup and Calibration

5.1 Controls and Indicators



The programming and setting routines for the TX9042 Programmable Sensor Controller (PSC), have been designed for utmost simplicity and the programming system is completely menu driven. There is no special software programme or data input terminal, a PC is not necessary and no computer programming knowledge is required.

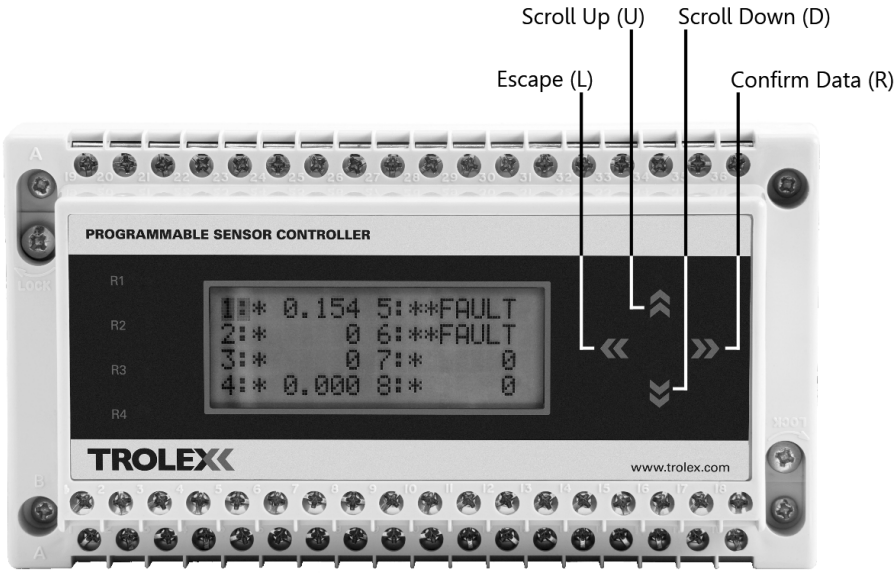
There are just 4 keys (the keypad) for controlling the complete operation and the LCD screen provides instructions throughout the programming process. All entries are verified on the LCD screen and incorrect or invalid entries are immediately brought to the attention of the user.

Each data entry on the keypad is acknowledged by a short bleep. Hold down the Scroll keys (**U** or **D**) for two seconds for rapid self keying.

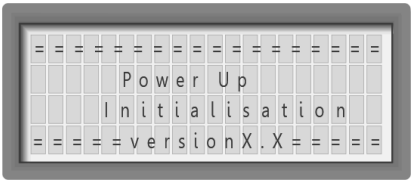
To use the TX9042 Programmable Sensor Controller (PSC) software and navigate between menus you must press the keypad keys:

Escape is the Left key - **L**
Confirm is the Right key - **R**
Scroll Up is the top key - **U**
Scroll Down is the bottom key - **D**

The use of these keys is abbreviated to **L**, **R**, **U** and **D** throughout this User Manual.

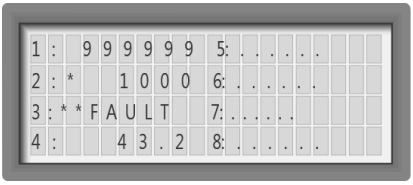


Checkpoint
The TX9042 PSC data memory is permanent. All settings are retained even in the event of power failure.



5.2 Power-up

When first switched on, the processor will initialise all the default values unless new values have previously been programmed. The LCD screen will display the version number of the software currently installed.



5.3 Signal Display

After ten seconds, the screen will switch to the **Signal Display** mode, displaying the status of all eight channels of input signal simultaneously.

Indicates that a set point has been exceeded on that channel. Refer to Section 5.9.3 for details.

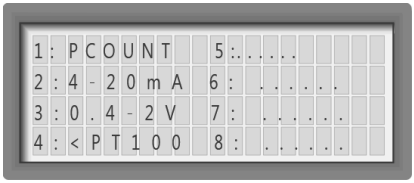
Indicates that a channel input module has not been fitted. Refer to Section 5.4 for details.

Indicates an input signal **Error** or system **Fault** on that channel. Refer to Sections 5.4 and 5.9.4 for details.

The flashing cursor frame over the channel identification number indicates that the particular channel is available for individual **Close-up** examination. Refer to Section 5.5 for details.

Any channels with **Power On Delay** (**POD**) programmed will initially show the length of delay in seconds. Refer to Section 5.9.1 for details. The displayed time will countdown until the **POD** period is complete, then the screen will revert to the appropriate input signal value in each case.

5.4 Reviewing the Input Module Configuration



The format of the operating data presented on each channel will be automatically determined by whichever input module is fitted.

The input module configuration and the operating mode of each channel can be reviewed from the **Signal Display**.

Press **U** and **D** to review the input module configuration.

Refer to Section 4.6 for details.

5.5 Close-up Information Display

Close-up 1 and **Close-up 2** will show more detailed information about a selected individual channel.

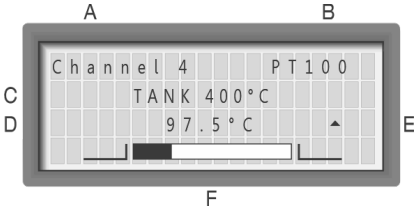
Press **U** or **D** to navigate the cursor to the selected channel.

Press **R** to confirm **Close-up 1** - (only possible if an input module is fitted on that channel).

Press **R** again for **Close-up 2**.

5.5.1 Close-up 1 Information Display

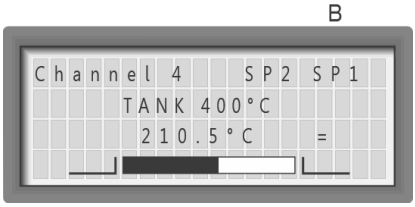
5.5.1.1 Close-up 1 Display for an Analogue Input Module



A: Channel identification - 1 to 8.

B: Type of input module (PT100) - this changes to indicate that a channel **Setpoint** has been exceeded, **SP1** and/or **SP2**.

C: User text entry for channel duty identification and other data such as **Full Scale** calibration (eg. tank 400°C).



D: Input signal value with appropriate engineering units.

E: Input signal tendency arrows

- **=** Steady unchanging input signal
- ▲ Rising tendency input signal
- ▼ Falling tendency input signal

Slowly changing sensor signals under suspicion may be assessed

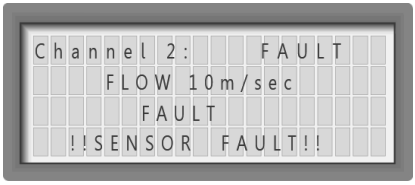
F: Input signal bar graph with limit markers, giving a magnitude comparison of the analogue signal level

Press **L** to escape and return to the **Signal Display**.

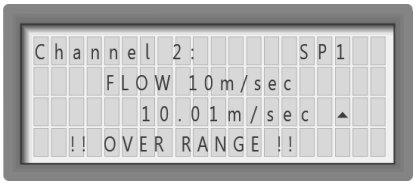
On an **Analogue** channel, **Close-Up 1** will also display information about any input signal **Error** condition that has occurred.

A signal that transgresses beyond its normal operating boundaries (ie. above 20 mA or below 4 mA on a 4 to 20 mA input) will initiate warnings at preset levels of discrepancy and trigger exclusive **Error** signals. Refer to Section 5.9.4 for details.

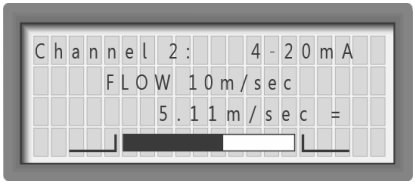
+5%
Signal exceptionally **High** (ie. 21 mA)



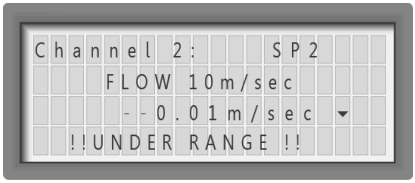
Scale
Signal **Over** normal scale value (ie. 20.01 mA)

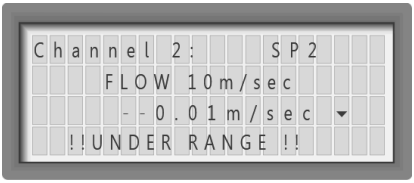


Normal
Normal operating range (ie. 0.4 to 2 V)



Minimum
Signal **Under** normal minimum value (ie. 3.99 mA) (applies to Signals with offset zero only)





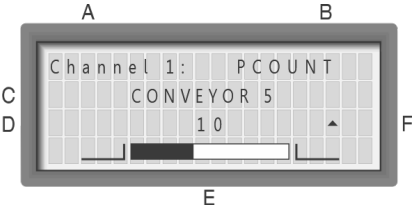
-5%

Signal exceptionally **Low** (ie. 3.8 mA).

Checkpoint

Digital signals are, by their nature, self monitoring, so this facility does not appear on digital channels.

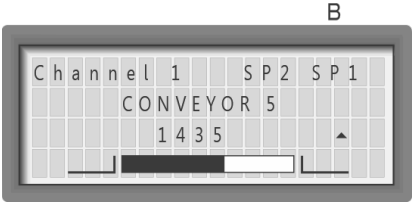
5.5.1.2 Close-up 1 Display for an Digital Input Module



A: Channel identification (1 to 8).

B: Programmed mode of the digital input module (**Pcount**). This changes to indicate that a channel setpoint has been exceeded (ie. **SP1** and/or **SP2**).

C: User text entry for channel duty identification. (Used to display dynamic function information in some digital modes).



D: Count or frequency to 10 digits (±9999999999).

E: Bar-graph of count or frequency with limit markers giving a magnitude comparison of the count or frequency level.

F: Last count sense indication.

= Reset or steady input signal

▲ Rising count or frequency.

▼ Falling count or frequency.

Slowly changing sensor signals under suspicion may be assessed.

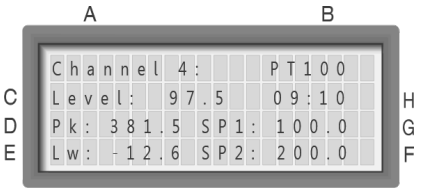
Press **R** to return to the **Signal Display**.

5.5.2 Close-up 2 Information Display

Close-up 2 will show information about the setpoint values and historical recorded data relating to the input signal.

From **Close-up 1** press **L** to display **Close-up 2**.

5.5.2.1 Close-up 2 Display for an Analogue Input Channel



A: Channel identification (1 to 8).

B: Type of input module (PT100). This changes to indicate that a channel setpoint has been exceeded (ie. **SP1** and/or **SP2**).

C: Input signal **Level**.

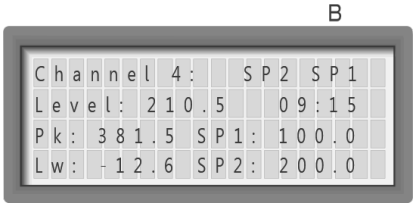
D: The previous **Peak** signal value recorded since last reset.

E: The previous **Lowest** signal value recorded since last reset.

F: The value of **Setpoint 2**.

G: The value of **Setpoint 1**.

H: 24 hour clock.

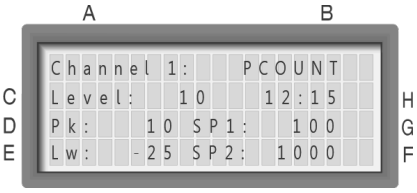


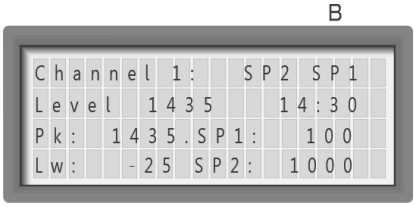
Press **R** to return to **Close-up 1**.

Press **L** to escape and return to the **Signal Display**.

5.5.2.2 Close-up 2 Display for a Digital Input Channel

Checkpoint
Not applicable for the Digital level mode.





A: Channel identification (1 to 8).

B: Programmed mode of the digital input module (**Pcount**). This changes to indicate that a channel setpoint has been exceeded (ie. **SP1** and/or **SP2**).

C: Count or frequency **Level**.

D: The previous **Peak** count or frequency recorded since last reset.

E: The previous **Lowest** count or frequency recorded since last reset.

F: The value of **Setpoint 2**.

G: The value of **Setpoint 1**.

H: 24 hour clock.

Press **R** to return to **Close-up 1**.

Press **L** to escape and return to the **Signal Display**.

5.6 Menu of Functions

5.6.1 Default Values

Initial default values are registered into the **Menu of Functions** during manufacture.

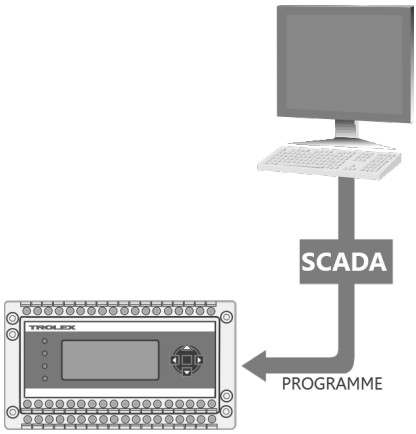
The standard values are shown in the bottom right hand corner of each menu function box. These values are entered during manufacture via the data communications link by a special PC based software routine.

POWER ON DELAY	
12	2 SECS

Non-standard default listings can also be entered. This facility can be used to quickly and conveniently programme specific custom operating functions into single or multiple units.

5.6.2 Programming the Operating Values

Normally, the operating values of the various functions in the menu are programmed by the user through the keypad to enter specific calibrations and selections to individual requirements.

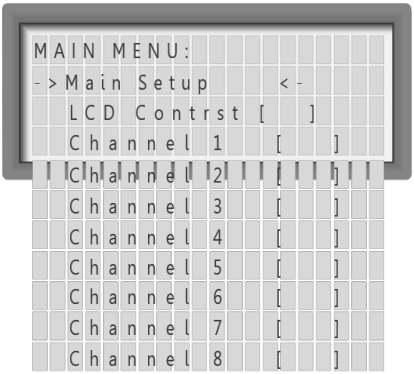


If the Programmable Sensor Controller is being used as part of a SCADA system, the same adjustments can be made from the keypad of the base station via the data communications link.

The special software required for this purpose is included as part of the SCADA graphic package provided.

User programmed operating values are permanently retained.

5.7 Main Menu



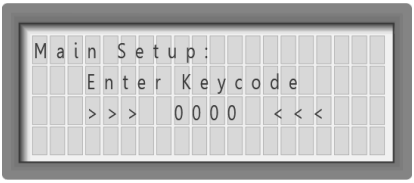
All the operating functions can be programmed through the keypad by entering the **Main Menu**.

5.7.1 Entering the Menu

Press **L** to enter the **Main Menu**.

Cursor arrows will indicate the first of the function options available in the **Main Menu**.

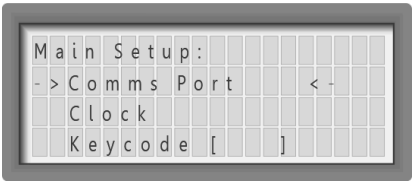
If enabled, the **Keycode Security** lockout will inhibit entry into the **Main Menu** until the correct entry code is confirmed. Refer to Section 5.7.5 for details.



Press **D** to navigate the cursor along the digits.

Press **U** to increment the number.

Press **R** to confirm the selection.



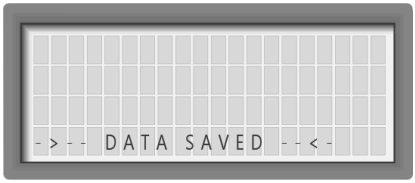
Press **L** to escape and return to the previous menu.

Press **U** or **D** to navigate up and down the menu to the preferred menu.

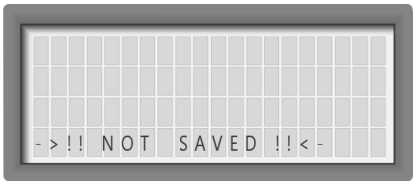
Press **R** to confirm the selection. (Previously programmed settings will be displayed alongside each item in a menu).

Function changes can now be programmed as described in the following sections.

Data Saved will flash briefly on the screen whenever a new value is entered during function programming.



Not Saved will flash briefly on the screen if a value is not entered during function programming.



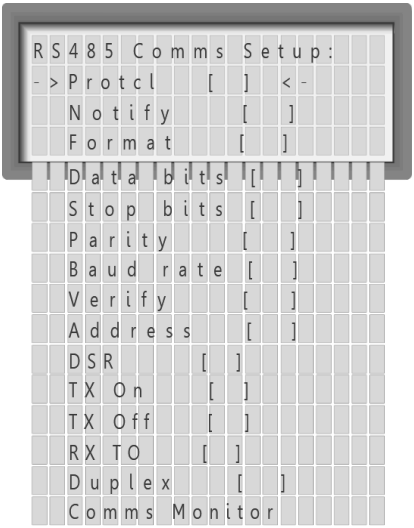
Checkpoint
The screen will automatically return to the Menu being used after a value or selection has been entered.

5.7.2 Escape/Return

Press **L** to escape and return to the previous menu from any position in the **Menu** sequence.

Each press of **L** will revert the screen one step back until the **Main Menu** is reached.

The screen will progressively step back at 5 second intervals if no keys are pressed.



5.7.3 Communications Setup

The characteristics required for the data communications output port can be entered. Datacomms output is RS485. Refer to Section 5.10 for details.

The selections available in some items of this menu list are dependent upon whichever protocol function is selected.

Press **U** or **D** to navigate up or down the menu to the preferred menu.

Press **R** to confirm the selection you have navigated to.

Press **U** or **D** to set the value or mode.

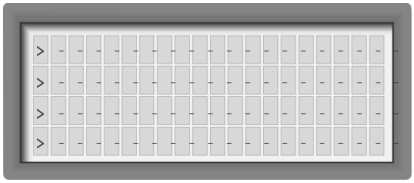
Press **R** to confirm the value or mode.

TxOn - this is the delay between the TX9042 PSC enabling the transmission line and sending data.

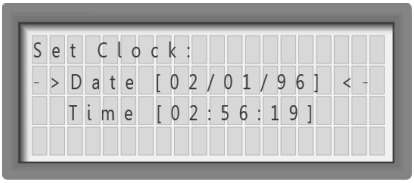
TxOff - this is the delay between the end of the received data and disabling of the receive buffer.

RxTO - this is the delay between receipt of last message and reset of the receive buffer.

Data Protocol	Modbus (Binary)	Modbus (ASCII)
Notify	N/A	N/A
Format	Binary	ASCII
Databits	8	7/8
Stopbits	1 to 2	
Parity	None/Odd/Even/Mark/Space	
Baud Rate	300/600/1200/2400/4800/9600/14400/ 19200/28800/57600/115000	
Verify	CRC16	Chksum
Address	1 to 65535	
DSR	Norm / TX High / TX Low	
TX On	0 to 99 ms	
RxTO	0 to 99 ms	
TX Off	0 to 99 ms	
Duplex	Half/Full	
Comm Monitor	Scrolling display of incoming data stream. Data stream can be stopped and started for closer analysis. Press **U** to **Stop** data stream Press **D** to **Start** data stream	



Checkpoint
Communication data protocol information and additional application data is available from the Trolex Technical Department.



5.7.4 Clock

Date and time information is used when readings are entered into the **Data Log**.

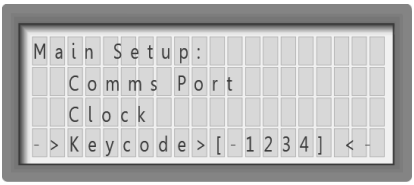
Press **U** or **D** to navigate to **Date** or **Time**.

Press **R** to confirm the selected function.

Press **D** to navigate the cursor across the digits.

Press **U** to change the value of the digit with the cursor underneath.

Press **R** to confirm the **Date** or **Time**.



5.7.5 Keycode Security

Access to menus can be prevented by enabling the **Keycode Security** function.

It is a selectable function, and the **Keycode** can be changed as and when required.

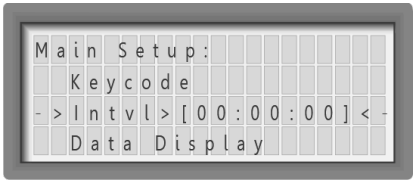
Press **D** to navigate the cursor across the digits.

Press **U** to change the value of the digit with the cursor underneath.

Press **R** to confirm the **Keycode**.

Checkpoint
If more than five invalid entries are attempted, access to the **Main Menu** will be denied for 30 mins. If you require this feature to be disabled, contact your local Trolex service agent or the Trolex Product Support Department: **service@trolex.com**

5.7.6 Interval Period of the Datalog



Each channel of the TX9042 PSC contains a 26,000 point data logging system. This can record the channel number and the **Time** and **Date** that an event occurs. The rate or time interval of recording data can be programmed and data is recorded on a first-in/first-out rolling log. Rapid logging is possible to closely capture critical shutdown routines or a catastrophic plant failure.

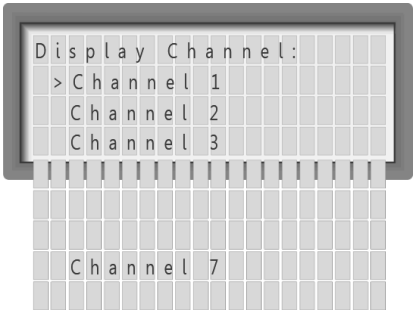
The **Interval** or frequency at which data is recorded in the log can be programmed in hours/minutes/seconds.

Press **D** to navigate the cursor along the digits.

Press **U** to change the value of the digit with the cursor underneath.

Press **R** to confirm the **Interval**.

5.7.7 Data Display Review of the Datalog

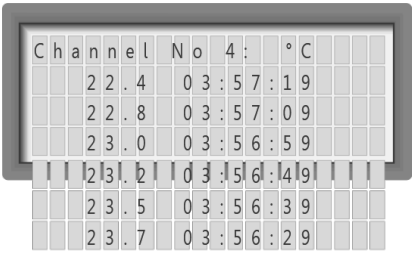


The data recorded in the log can be reviewed on the screen for individual channels.

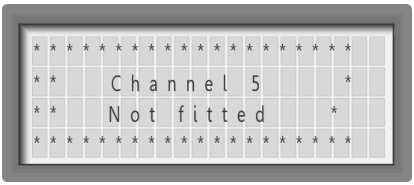
Press **U** or **D** to navigate up or down the **Channel List** to the required **Channel**.

Press **R** to confirm the selected **Channel**.

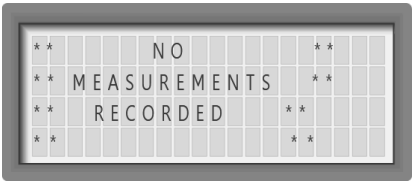
Press **U** or **D** to navigate up or down the **Log** to the required information.

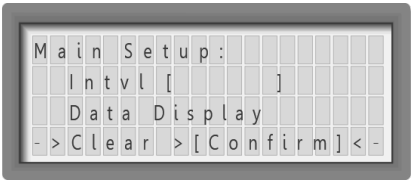


Press **R** to return to the **Channel List**.



Supplementary information is displayed momentarily where appropriate:





5.7.8 Clear the Data in the Datalog

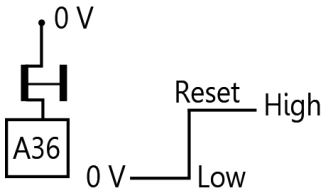
Press **R** to confirm the instruction to clear the **Data** in the **Datalog**.

5.7.9 Relay Reset Mode Options

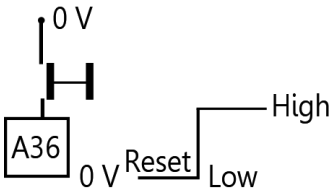
The four output relays, R1, R2, R3 and R4, can be programmed to latch in the alarm condition. Any relays that are latched can be reset in four different ways:

Off: Reset from an external contact or push-button is **not possible**. This mode is used on critical safety systems, where relays latched in the alarm condition, can only be reset by an authorised person who has access to the keypad of the controller.

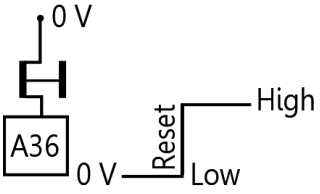
High: Any latched relays will be reset as long as the reset input is **High** (open contact), **and** the channel input signal has receded from the programmed setpoint level.

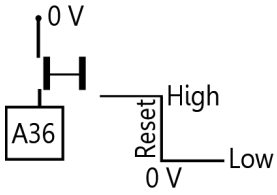


Low: Any latched relays will be reset as long as the reset input is **Low** (closed contact), **and** the channel input signal has receded from the programmed setpoint level.

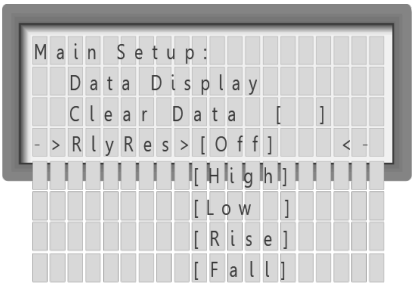


Rise: Any latched relays will be reset only as the reset input **Rises** (opening contact), **and** the channel input signal has receded from the programmed setpoint level.





Fall: Any latched relays will be reset only as the reset input **Falls** (closing contact), **and** the channel input signal has receded from the programmed setpoint level.



Press **U** or **D** to navigate to the mode of reset.

Press **R** to confirm the mode of reset.

Press **L** and **R** to reset any latched relays in all four modes.

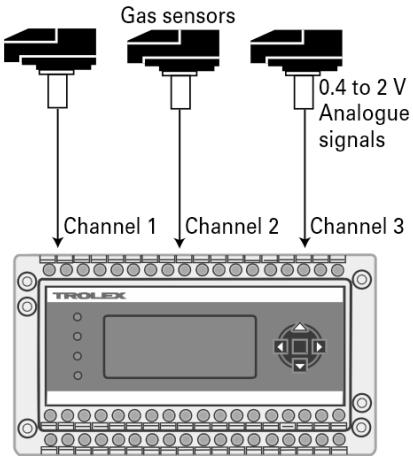
Checkpoint
The relay reset input does **not** affect display counts accumulated on a **Pulse Counting** channel.

5.7.10 Relay Voting

Each channel of the TX9042 PSC has two adjustable setpoint signals. Any, or all, of these can be matrix programmed to operate any, or all, of the four output relays, R1, R2, R3 and R4.

A **Voting** system can be superimposed on to this facility, whereby a selectable number of the setpoint signals must be present before the selected output relay will be operated.

Take the example of an environmental monitoring system which must protect against the catastrophic consequences of a flammable gas explosion.

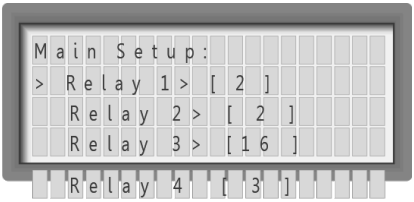


Flammable gas sensors can be installed to detect the presence of the gas and the signals from the sensor can be arranged to trigger setpoint alarm levels in the Programmable Sensor Controller and initiate power shutdown. However, due to the highly complex nature of the process, there are conflicting requirements.

On one hand, for safety reasons, the presence of the gas must be swiftly and unequivocally detected so, triple gas sensors can be fitted in each critical area to achieve this. Conversely, the impact of a false plant shutdown would be financially disastrous and must also be protected against.

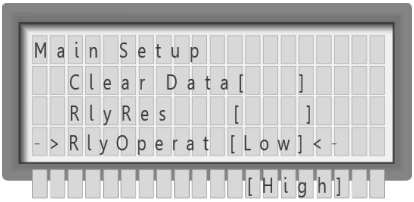
In this case, if a Two out of Three voting system is programmed into the Programmable Sensor Controller, the selected output relay will only respond when two or more alarm setpoints are activated together. This ensures that there is at least dual gas monitoring integrity on the plant (and normally, triple monitoring). On the other hand, plant shutdown will only occur when at least two gas sensors are in agreement, so indicating genuine danger.

The programming of this function is completely flexible. Any number of the setpoint signals can be matrixed to a single relay, enabling the selection of the **Voting** function from any two setpoint signals up to sixteen setpoint signals.



Press **U** or **D** to select the **Vote Number**.

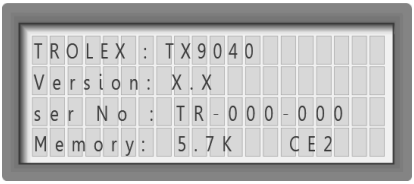
Press **R** to confirm.



5.7.11 Relay Operation

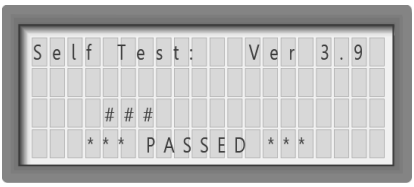
When relays are not allocated to a setpoint, **Relay Operation** allows the relays to be left in the de-energised or energised state.

Low = De-energised
High = Energised



5.7.12 Software Version

Product identification information is presented on the LCD screen, this includes the product reference, software version number, serial number, log data memory and input board type.

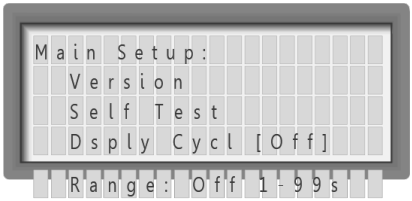


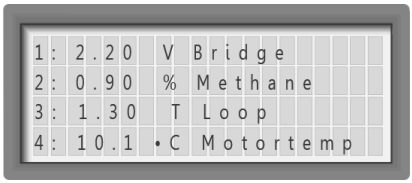
5.7.13 Self Test

This enables all the internal functions of the TX9042 PSC to be tested.

5.7.14 Display Cycling

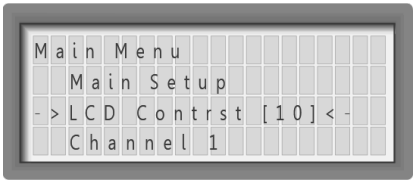
If the user requires more information on each of the inputs, the screen can be set to toggle between screens showing 4 inputs. The rate of toggle can be defined if this is set to zero, logging is disabled.





5.8 Contrast Control

The contrast of the LCD screen can be varied to compensate for the effect of local ambient light conditions.



Press **U** and **D** to increase or decrease the **Contrast** setting.

Press **R** to confirm the selected setting.

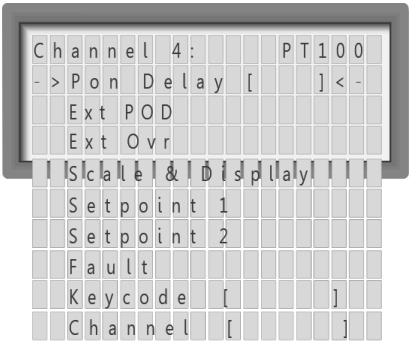
Checkpoint
1 is the minimum contrast setting and 15 is the maximum contrast setting.

5.9 Channel Function and Calibration

The operating characteristics of each channel can be individually programmed.

The menu procedure is the same for all eight channels but the contents of the menu will be different for **Analogue** input modules and **Digital** input modules.

Checkpoint
If enabled, the **Keycode Security** will prevent access into individual channels until the correct **Keycode** is entered.



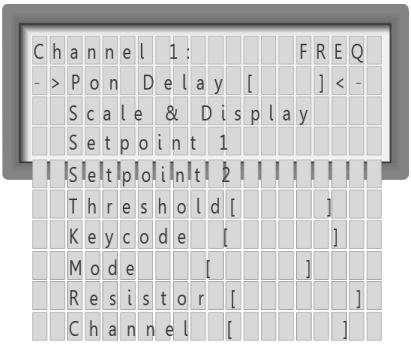
Press **U** or **D** to navigate to the mode of **Reset** required.

Press **R** to confirm the mode of **Reset**.

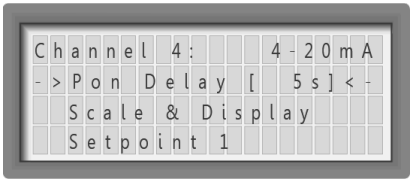
Checkpoint
Terminology in the menu will vary slightly where a digital input module is selected into the **Digital Level** mode.

This mode is used for simple **On/Off** inputs such as thermostats, limit switches or NAMUR proximity sensors.

See the **Menu of Functions** for individual menu listings. Refer to Section 5.6 for details.



5.9.1 Power On Delay (POD) Period



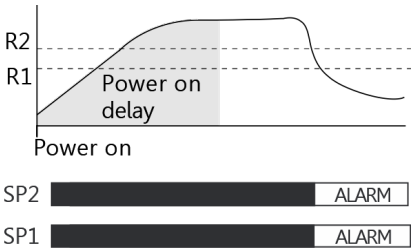
The setpoint alarm signals **SP1** and **SP2** can be inhibited for an adjustable time period, after the power is switched on. Each channel can be independently set.

This feature is useful for an initial start-up override when a machine is running up to speed or a process is stabilising.

Checkpoint
The range of configurable values is 0 to 255 seconds.

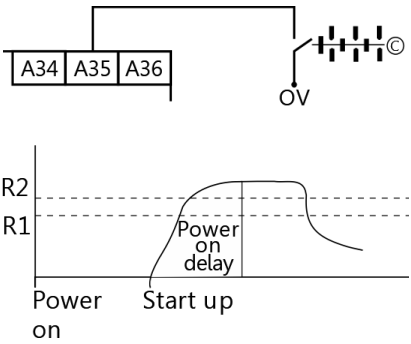
Press **U** or **D** to navigate through the digits to the required **POD Period** value.

Press **R** to confirm the **POD Period** value.

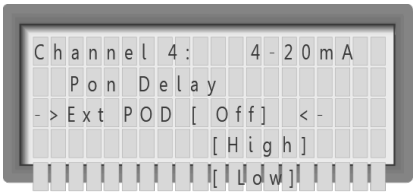


In a situation where the alarm signals need to be inhibited until after an operation has occurred, the **Ext POD** feature can be used.

A signal on terminal A35 prevents the internal POD timer from operating, at power on, until it is removed.



Once the unit is powered up, a signal on terminal A35 can be used to inhibit **SP1** and **SP2**. On release of the signal, **SP1** and **SP2** are further inhibited by the channel **POD** period.

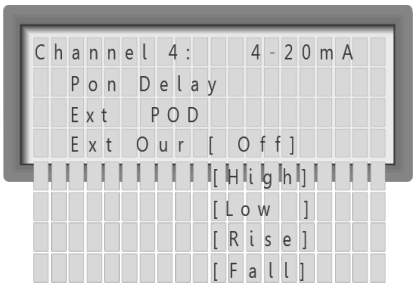


External **POD** can be selected as **Off**, **High** or **Low**.

Off = Disabled

High = Connect to + V to operate

Low = Connect to 0 V to operate



External override can be selected as Off, High Low, Rise or Full.

Off = Disabled

High = Connect to + V to operate

Low = Connect to 0 V to operate

Rise = Positive signal causes internal POD

Fall = Negative signal causes internal POD

5.9.2 Scale and Display Settings

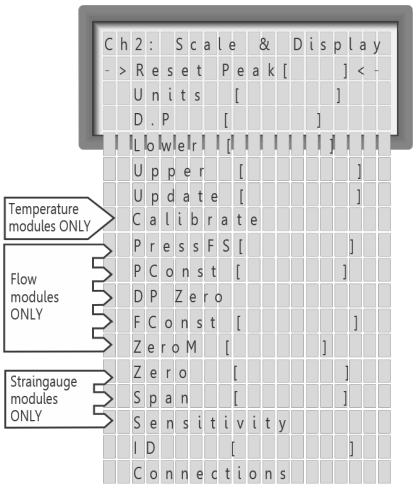
The various characteristics of the signal scale and display can be determined.

The contents of the menu will vary depending upon which type of input module is fitted on the channel being programmed.

Press **U** or **D** to navigate to the value required.

Press **R** to confirm the value selected.

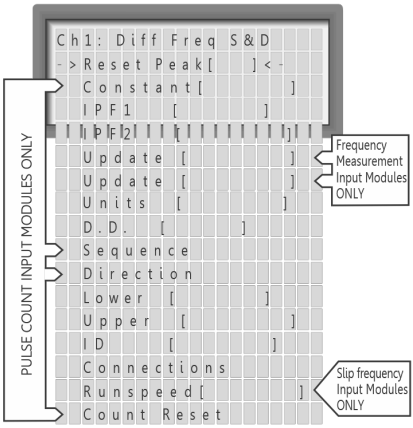
ANALOGUE INPUT MODULE



The contents of the menu for a digital input module will vary in relation to which of the sensor operating modes it is set into.

See the **Menu of Functions** for individual menu listings. Refer to Section 5.6 for details.

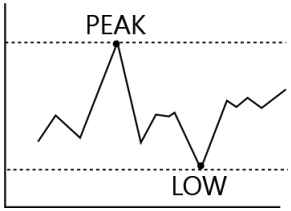
DIGITAL INPUT MODULE



5.9.2.1 Reset Peak

The previous maximum value (**Peak**) and minimum value (**Low**) that the signal has reached since the last occasion that it was reset.

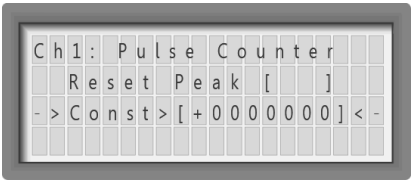
Dangerously **High** or **Low** sensor conditions may have occurred previously and this feature enables historic trends to be examined.



Stored values of previous **Peak** and **Low** (max/min) can be deleted.

Press **R** to select **Reset**.

Press **R** to confirm **Reset**.



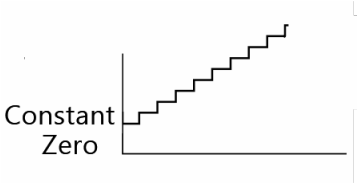
5.9.2.2 Constant

When a **Digital Input** module is selected into the **Pulse Counter** mode, an additional item called **Constant** will appear in the menu choice.

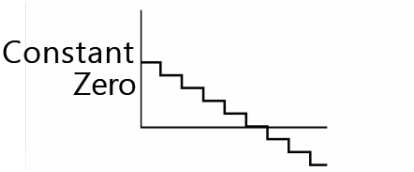
When counting pulses or batch counting, a fixed **Constant** can be added into the counting register to provide a displaced or elevated starting point as in the case of a tare value or correction factor. This can be a positive or negative quantity and can be applied to all three modes of counting.

It is permanent until re-programmed.

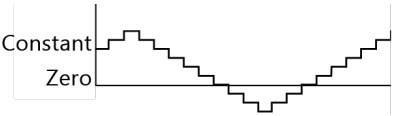
Upcount Mode
The count will start at the **Constant** and count up.



Downcount Mode
The count will start at the **Constant** and count down.



Bi-directional Count Mode
The count will start at the **Constant** and count up and/or down from it.



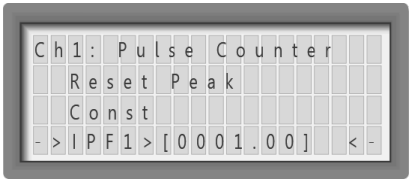
Press **D** to navigate the cursor across the digits.

Press **U** to change the value of the digit with the cursor underneath.

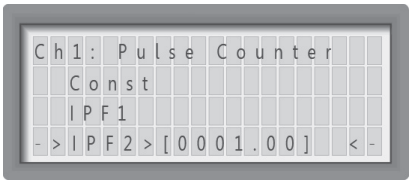
Press **R** to confirm the **Constant**.

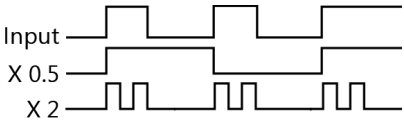
5.9.2.3 IPF 1 and IPF 2

Some modules of a **Digital** input module will show **IPF 1** (Input Pre-scale Factor no.1) in the menu.

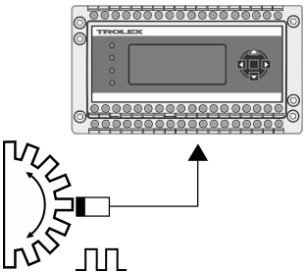


The modes that use two input counting devices will also show **IPF 2** relating to the second input.





Incoming pulses can be multiplied by a selectable pre-scale factor. This is useful for converting pulse rates from target wheels, flow sensors and measuring devices to the required scale factor, or for conversion to the appropriate engineering units.



Press **D** to navigate the cursor across the digits.

Press **U** to change the value of the digit with the cursor underneath.

Press **R** to confirm the **Input Pre-scale Factor**.

5.9.2.4 Update

The channel input signal is sampled at a pre-determined interval.

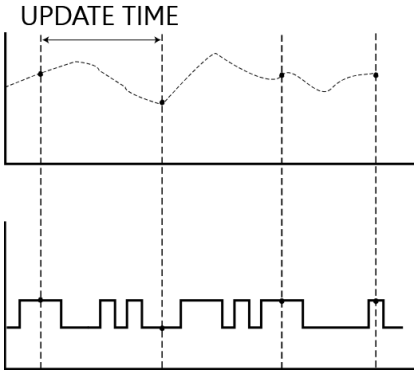
The value of an **Analogue** signal is averaged and updated at periodic intervals and the update period is adjustable. A low setting will give rapid reaction to the input signal and higher settings may be entered where damping of a fluctuating input is necessary, or simply as a means of applying a delay to the input. This is particularly appropriate in electrically noisy environments.

In the case of a **Pulse/Frequency input**, the microprocessor determines the frequency by counting or **Sampling** the number of pulses that occur during a timed period.

The longer this sample time is, the more accurate will be the resulting calculation, but there are constraints on this: If the sampling time is too long, the reaction time of the system may be unacceptable.

With frequency inputs, long sampling times on high pulse rates are not necessary to maintain accuracy, so a short sampling time can be used, bringing with it, a corresponding improvement in system reaction time. The sampling time is adjustable, making it possible for the user to set the optimum value for the application with the best accuracy. There is an added advantage:

If an input frequency is fluctuating rapidly, causing instability in the system, the sample time can be adjusted to provide some measure of damping or suppression.



For maximum accuracy, sampling takes place at the front end, prior to pre-scaling.

Press **U** or **D** to navigate to the value required.

Press **R** to confirm the value selected.

Checkpoint
Analogue levels are averaged between samples. Pulse frequencies are averaged between samples.

°C
°F
bar
mV
%
mm

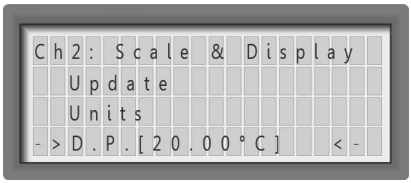
5.9.2.5 Units

A menu of more than 35 standard engineering units is available for adding on to the signal value display to represent the actual parameter being measured, ie. bar, mA, m/sec, °C, etc.

Checkpoint
Where a temperature input module is fitted, the choice will be limited to °C, °F or °K.

Press **U** or **D** to navigate to the units required.

Press **R** to confirm the units selected.



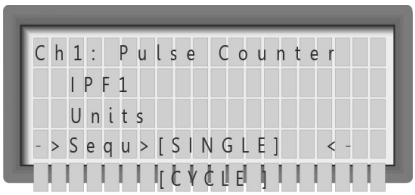
5.9.2.6 Decimal Point

Once the numerical value of the **Upper** and **Lower** limits of the display have been set, the decimal point can be navigated to any desired position within the number.

Press **U** or **D** to navigate the decimal point to the required position within the number.

Press **R** to confirm the location selected.

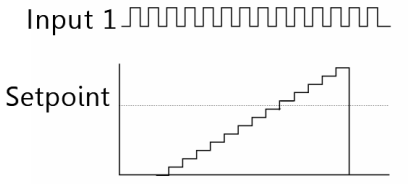
5.9.2.7 Sequence



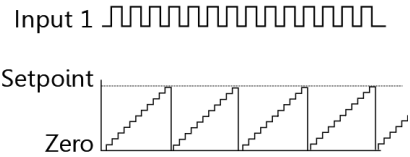
When a digital input module is selected into the **Pulse Counter** mode, an additional item called **Sequence** will appear in the menu choice.

The counting sequence of pulse counting can be determined.

Single - the counter will count indefinitely until reset, continuing to count beyond any programmed setpoints.



Cycle - the counter will count to a pre-programmed batch setpoint, then automatically reset and re-start the count cycle continuously.



Checkpoint
It is recommended that the relay operation should not be set for **Autoreset** in the **Cycle** mode because the resulting output signal would be too short for any practical use. The other modes available, **Latch**, **Toggle** and **Pulse** may be utilised to suit the control function.

Press **U** or **D** to navigate to **Single** or **Cycle** as required.

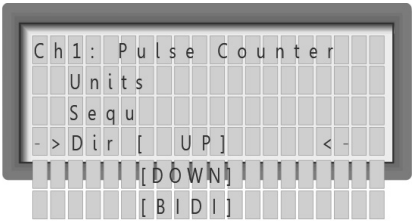
Press **R** to confirm the selection.

Checkpoint
The **Count** display can be reset by an impulse on input 2 or through the keypad.

Checkpoint
Any relays that are programmed to **Latch** can be reset by an impulse on input Terminal 36 or through the keypad.

5.9.2.8 Direction

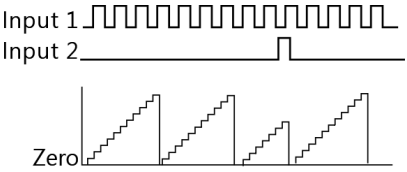
When a **Digital** input module is selected into the **Pulse Counter** mode, an additional item called **Direction** will appear in the menu choice.



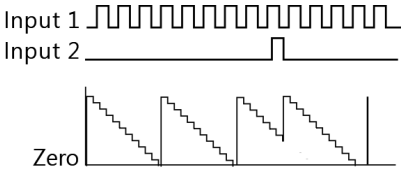
The **Direction** of pulse counting can be determined.

Press **U** or **D** to navigate to **Up**, **Down** or **Bidi** as required.

Press **R** to confirm the selection.

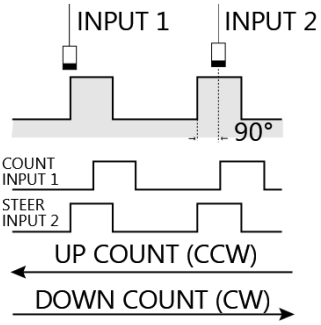


Up - count-up the pulses on Input 1 from zero, or from a **Constant** that has been entered. The display will show the number of pulses **Counted**.



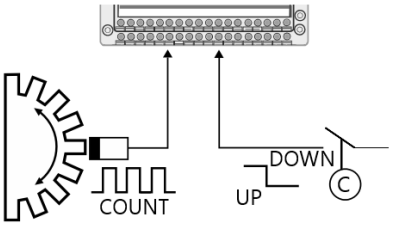
Down - count-down the pulses on Input 1 to zero, or from a **Constant** that has been entered. The display will show the number of counts **Remaining**.

Bidi - bidirectional counting uses both inputs; Input 1 to count the pulses from a toothed wheel or similar target, and Input 2 as the pulse steering input. The proximity sensors or similar should be positioned around the wheel to give a resultant signal overlap of about 90° of tooth angle. The counter of the sensor controller will be instructed to count up or down, dependent upon the state of Input 2 at the point of count transition.



Alternatively, a remote signal or contact can be used for pulse steering, such as auxiliary contacts on a forward/reverse motor contactor. The count will add or subtract pulses on Input 1, starting from zero, or from a **Constant** offset that has been programmed.

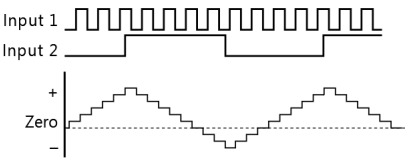
INPUT 2 LOW (OPEN OR O V) = UP
INPUT 2 HIGH (+ V) = DOWN COUNT



The display will show the resultant **Up/Down** counts in either the positive or negative sense.

To reset the Count Display:

	Upcount	Downcount	Bidirectional
Pulse on Input 2	Yes	Yes	No
Keypad	Yes	Yes	Yes

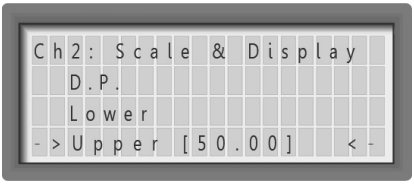


Checkpoint
If the count value to be reset has exceeded, and so activated, a programmed **Setpoint** value, the setpoint output will reset at the same time. Refer to Section 5.9.3.6 for details.

Checkpoint
Any relays that are programmed to **Latch** will not be reset. Refer to **Relay Reset Mode Options** in Section 5.7.9 for details.

5.9.2.9 Lower
5.9.2.10 Upper

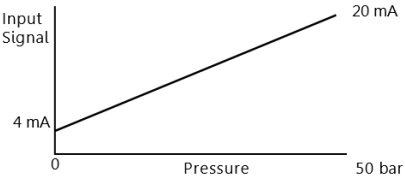
Independently adjustable, these two items are closely inter-related. They set the desired **Lower** limit and **Upper** limit of the display reading for a given input signal. This can be any numeric value through to any positive value. The indicating range from zero to full scale of the display can be programmed to show true unit values incorporating multiplication factors or zero offset values.



Press **D** to navigate the cursor along the digits to the required digit.

Press **U** to increment the digit to the required value.

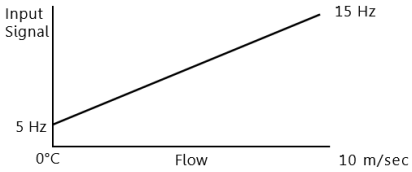
Press **R** to confirm the value selected.



The signal response between **Lower** and **Upper** will be assumed to be linear and signals from non conforming devices such as thermocouples will be automatically linearised to the appropriate standard.

Non linear relationships such as square law signals from differential pressure sensors and the polynominals can also be incorporated in software to specific requirements.

It is also possible to interrelate the signals between two separate channels to apply signal differential comparison, correction factors and compensation.



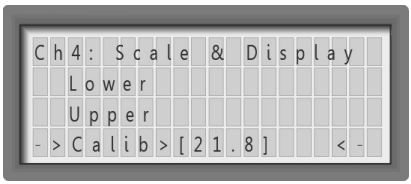
5.9.2.11 Calibrate (Temperature Input Module)

This function only appears in the menu when a temperature input module is fitted.

P5423.72/94	Platinum Resistance Device - PT100
P5423.74	Semiconductor Temperature Device - KTY81
P5423.76	Semiconductor Temperature Device - KTY84
P5423.253	Semiconductor Temperature Device - KTY21-6

It sometimes occurs that the temperature/ output signal relationship of the temperature sensing device being used is not known, or as in the case of a semiconductor sensor, the output is not precisely standardised from one device to the next. Cable length and size of conductor cores can also affect the calibration of the system.

The display can be calibrated, after installation, to concur with a known temperature applied to the sensor being used.



Press **R** to confirm the calibration mode.

The screen will show the apparent temperature being measured by the sensor.

Press **U** or **D** to increment the value displayed to concur with the temperature measured at the sensor.

Press **R** to confirm the value selected.

The linearity response of the input module will be automatically corrected, based around the new calibration point entered and the correction factor will be appropriate to whichever type of temperature input module is fitted.

A simple way to apply a known temperature to an installed sensor is to place it in a small cup of ice and calibrate the display to 0°C as described.

5.9.2.12 Pressure Full Scale (Flow Input Module for TX6022 only)

This function only appears in the menu when a flow input module is fitted for use with a TX6022 Liquid Flow Sensor. The full scale pressure of the line pressure sensor is entered here to allow the flow readings to be pressure compensated.

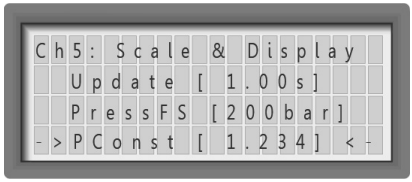
Press **R** to enter **Pressure Full Scale** mode.

Press **D** to navigate the cursor along the digits to the required digit.

Press **U** to increment the digits to the required value.

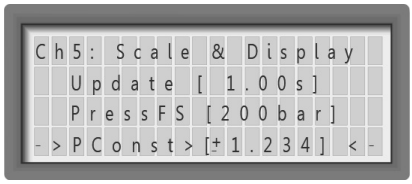
Press **R** to confirm the values selected.

5.9.2.13 Pressure Constant (Flow Input Module for TX6022 only)



This function only appears in the menu when a flow input module is fitted for use with a TX6022 Liquid Flow Sensor. The TX6022 Liquid Flow Sensor will be supplied with this calibration constant, which is then entered into the TX9042 PSC.

Press **R** to enter **Pressure Constant** mode.



Press **D** to navigate the cursor along the digits to the required digit.

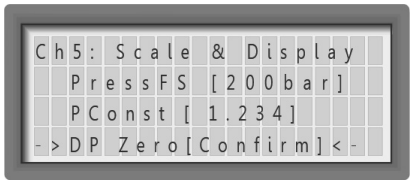
Press **U** to increment the digits to the required value.

Press **R** to confirm the values selected.

5.9.2.14 Differential Pressure (Flow Input Module)

This function only appears in the menu when a flow input module is fitted for use with a TX6022/3 Liquid Flow Sensor. The TX6022/3 Liquid Flow Sensor will be supplied with this calibration constant, which is then entered into the Programmable Sensor Controller.

Press **R** to enter **Pressure Constant** mode.



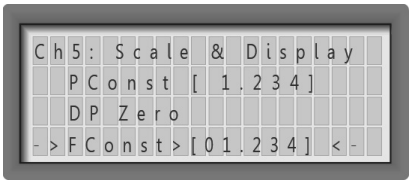
Press **D** to navigate the cursor along the digits to the required digit.

Press **U** to increment the digits to the required value.

Press **R** to confirm the values selected.

5.9.2.15 Flow Constant (Flow Input Module)

This function only appears in the menu when a flow input module is fitted for use with a TX6022/3 Liquid Flow Sensor. The TX6022/3 Liquid Flow Sensor will be supplied with this calibration constant, which is then entered into the Programmable Sensor Controller.



Press **R** to enter **Flow Constant** mode.

Press **D** to navigate the cursor along the digits to the required digit.

Press **U** to increment the digits to the required value.

Press **R** to confirm the values selected.

5.9.2.16 Zero Mask (Flow Input Module)

This function only appears in the menu when a flow input module is fitted for use with a TX6022/3 Liquid Flow Sensor. The sensing principle employed by the TX6022/3 Liquid Flow Sensor, means that a low flow reading may be indicated when in fact, no flow is present. This is usually caused by the weight of fluid on one side of the Differential Pressure sensor. This function allows the Programmable Sensor Controller to display zero flow until the flow exceeds the value entered in the zero mask register.

Press **R** to enter **Zero Mask** mode.

Press **D** to navigate the cursor along the digits to the required digit.

Press **U** to increment the digits to the required value.

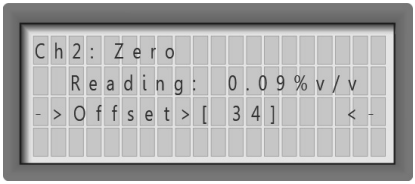
Press **R** to confirm the values selected.

5.9.2.17 Zero (Straingauge and STET Modules)

This function only appears in the menu when a straingauge module or PSU/Bridge module is fitted.

Press **R** to enter **Zero** mode.

Press **U** or **D** to increment the displayed value to a value that matches the zero reading on the straingauge.



Press **R** to confirm the value selected.

Checkpoint
This function can also be used to offset the reading from zero, to compensate for any system errors.

5.9.2.18 Span (PSU/Straingauge Module)

This function only appears in the menu when a PSU/Straingauge module is fitted.

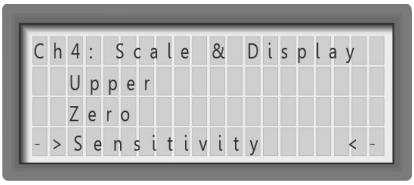
Press **R** to enter **Span** mode.

Press **U** or **D** to increment the displayed value to a value that matches the measured reading on the straingauge.

Press **R** to confirm the value selected.

Checkpoint

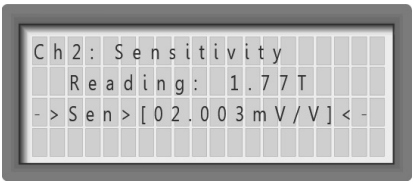
When the module is used to monitor methane from a Pellistor head, the display will latch at >5% methane and turn the power supply off. The screen will read:



5.9.2.19 Sensitivity (Straingauge Mode)

This function only appears in the menu when a Straingauge module is fitted.

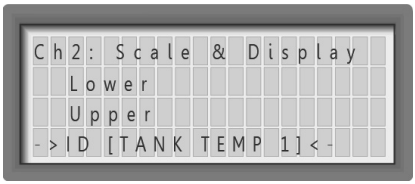
Press **R** to enter **Sensitivity** mode.



Press **U** or **D** to increment the displayed value to a value that matches the sensitivity of the straingauge being used.

Press **R** to confirm the value selected.

5.9.2.20 Identification



Channel identification text can be entered to denote the input duty, the location or the tag reference of the input device.

Up to 11 digits of text can be entered into the display and there is a menu of letters, numbers and symbols to choose from, thus enabling channel identification or location data to be entered.

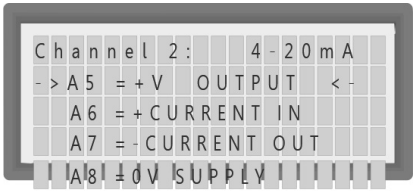
Checkpoint
User specified text may have been entered during manufacture.

Press **D** to navigate the cursor along the digits to the required digit.

Press **U** to increment the digits to the required value.

Press **R** to confirm the values selected.

5.9.2.21 Connections

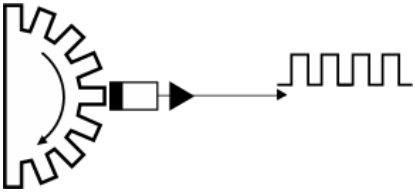


Terminal identification details are listed on the display for a particular channel input electrical connections.

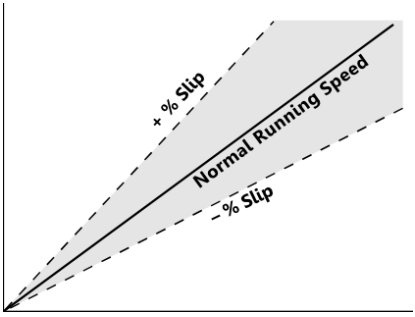
Press **U** or **D** to navigate through the data.

5.9.2.22 Run Speed

When a digital input is set to **Slip Frequency** mode, an additional menu item called **Run Speed** will be available.

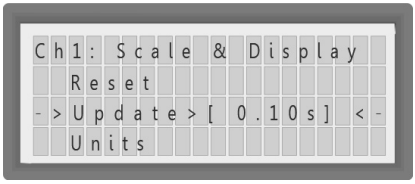


The **Slip Frequency** mode is most often used for monitoring the rotational speed of a machine shaft or speed measuring device by determining the pulse rate from a toothed wheel attached to the shaft.



Overspeed or underspeed can be detected and is assessed as a percentage or **Slip** related to the **Normal** running speed, eg. -5% **Slip Frequency** or 5% **Underspeed**. It is not always possible to know or measure the normal running speed of a machine, or it may be difficult to establish the speed/pulse relationship, particularly where gearing or belts are being used.

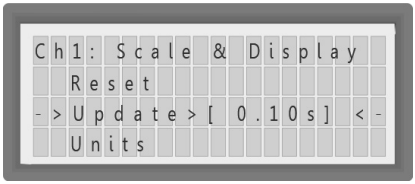
At this position in the menu, the screen will show the pulse frequency that is coming in from the shaft or sensor being monitored. This value can be stored and then automatically used as the **Normal Speed** reference when setting the **Slip** setpoint levels.



Press **R** to confirm the incoming pulse frequency.

The entered value of the **Pulse Frequency** can also be subsequently adjusted if required, to allow for loading factors or safety margins on the machine.

Press **D** to navigate the cursor along the digits to the required digit.



Press **U** to increment the digits to the required value.

Press **R** to confirm the values selected.

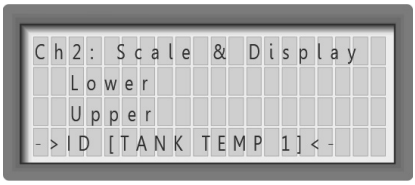
Checkpoint
The configurable range of Pulse Frequency is 0 to 9999999.

5.9.2.23 Count Reset

When a digital input module is set to **Pulse Count** mode, an additional item called **Count Reset** will be available in the menu.

Any counts accumulated in the register of a **Pulse Counting** channel can be individually reset to zero, or reset to a **Constant** that has been previously entered.

Press **R** to select **Reset**.



Press **R** to confirm **Reset**.

When **Upcounting** or **Downcounting**, the count can also be reset by an impulse on Input 2.

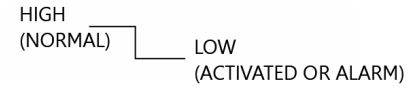
If the count value to be reset has exceeded, and therefore activated a programmed **Setpoint** value, **SP1** and/or **SP2**, the **Setpoint Output** will reset at the same time. Refer to Section 5.9.3.6 for details.

Any relays that are programmed to latch will not be reset. Refer to **Relay Reset Mode Options** in Section 5.7.9 for details.

5.9.3 Setpoint Characteristics

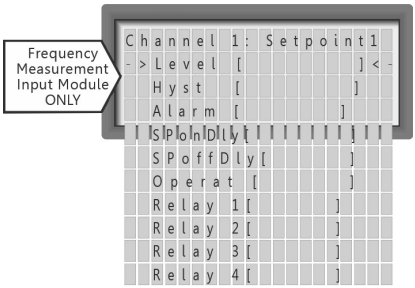
Each of the eight channels has two **Setpoint** signals or alarm points, **SP1** and **SP2**.

The various operating characteristics of each **Setpoint** can be individually determined.



Setpoint signals are **High** in the normal condition and switch to **Low** when activated, as a **Setpoint** is exceeded.

The **Setpoints** do not directly control the four output relays, R1, R2, R3 and R4, but can be matrix programmed to selectively initiate the four relays.



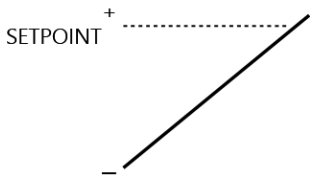
Press **U** or **D** to navigate to the menu required.

Press **R** to confirm the menu selected.

Checkpoint
The contents of the menu for a digital input module will vary slightly depending upon which of the seven operating modes it is set in. Refer to Section 5.9.7 for details.

5.9.3.1 Level

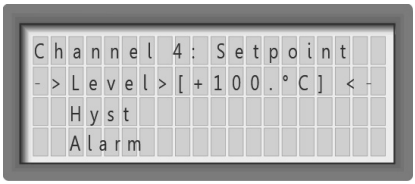
The operating level of the setpoint signal can be programmed. This can be set for any numerical value and the polarity can be positive or negative as required.



Press **D** to navigate the cursor along the digits to the required digit.

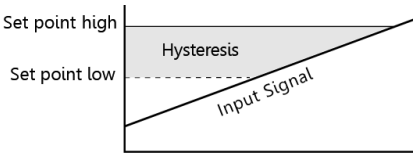
Press **U** to increment the digits to the required value.

Press **R** to confirm the **Setpoint** level.



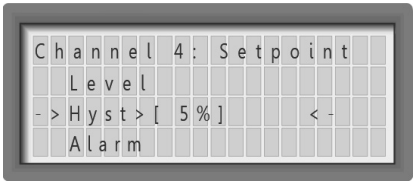
5.9.3.2 Hysteresis

Hysteresis is the deadband between the setpoint switching **On** and switching **Off** as the input signal rises and falls. This can be set as a percentage of the **Set Point Level**.



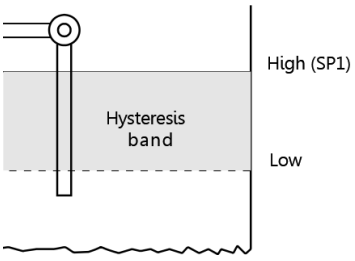
Press **U** or **D** to increment the hysteresis value.

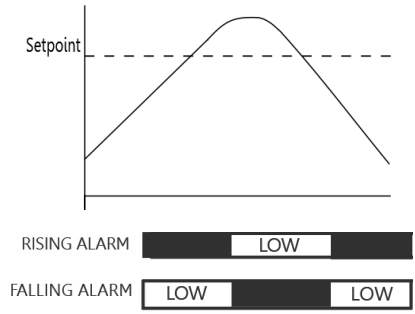
Press **R** to confirm the **Hysteresis** value.



A low value of hysteresis, say 5%, is often used to override fluctuating signal levels and to prevent hunting in closed loop control systems.

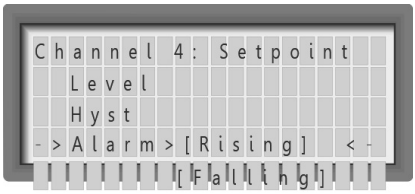
A high value of hysteresis can also be used as a control function when controlling the operation of pumps. The pump will start at high level (**SP1**) and continue pumping until low level is reached at the bottom of the hysteresis band.





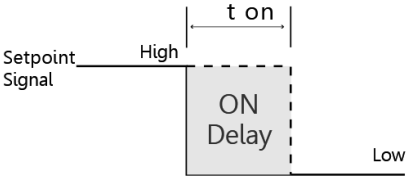
5.9.3.3 Alarm (Rising/Falling)

The setpoint signals can be arranged to occur on a rising input signal or a falling input signal. For example, when monitoring excess vibration or high gas concentration, the setpoint signals can be set to activate on a rising signal to give a failsafe alarm function. Conversely, when monitoring flow failure or low pressure, the setpoint signal can be set to activate on a falling signal.



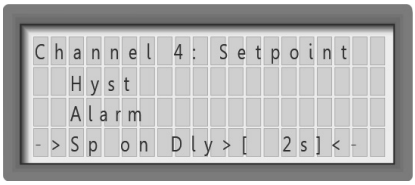
Press **U** or **D** to navigate to rising or falling as required.

Press **R** to confirm the selection.



5.9.3.4 Setpoint On Delay

The operation of the **Setpoint** signal can be delayed by an adjustable time period, **T1**. This is useful for alarm verification, to apply time delay in a process control action, or to override a spurious fluctuation of the input signal.



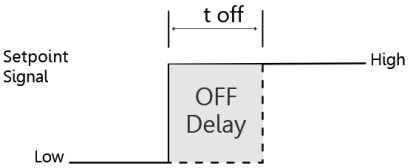
If the input signal falls below the setpoint before the programme time has elapsed, the timer will reset to zero, ready to start again.

Press **U** or **D** to navigate to the **Setpoint On Delay** value required.

Press **R** to confirm the value selected.

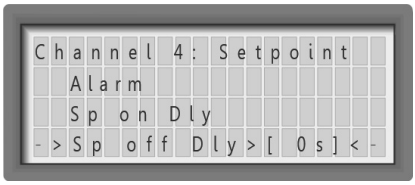
5.9.3.5 Setpoint Off Delay

The resetting of the **Setpoint** signal can also be delayed by an adjustable time period, **T2**.



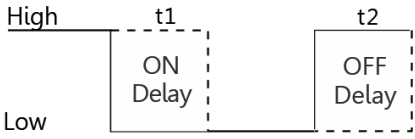
If the input signal exceeds the **Setpoint** before the programme time has elapsed, the timer will reset to zero, ready to start again.

Press **U** or **D** to navigate to the **Setpoint Off Delay** value required.



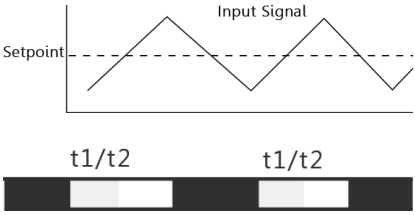
Press **R** to confirm the value selected.

Checkpoint
Both the **Setpoint On Delay** and the **Setpoint Off Delay** can be combined, if required, and are independently programmable. Refer to Sections 5.9.3.4 and 5.9.3.5 for details.



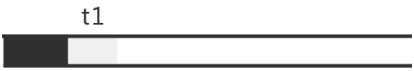
5.9.3.6 Operation

A set point signal can be set to function in four different ways.



Auto Reset - the **Setpoint** signal will go **Low** when the input signal exceeds the **Setpoint** value and will reset when the input signal recedes. **T1**/**T2** = any **Setpoint On Delay** and/or **Setpoint Off Delay** that is programmed. Refer to Sections 5.9.3.4 and 5.9.3.5 for details.

Checkpoint
The reset point will also be influenced by any hysteresis value that is programmed. Refer to Section 5.9.3.2 for details.

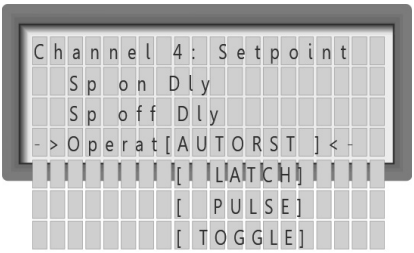


Latch Until Reset - the **Setpoint** signal will go **Low** when the input signal exceeds the **Setpoint** value and latch until reset. **T1** = any **Setpoint On Delay** that is programmed. Refer to Section 5.9.3.4 for details.

Refer to Section 5.7.9 for details of **Relay Reset Mode Options**.

Toggle - the setpoint signal will go **Low**/**High** alternately each time the setpoint value is exceeded. **T1**/**T2** = any **Setpoint On Delay** and/or **Setpoint Off Delay** that is programmed.

Pulse - the setpoint signal will give an impulse equal to the **T1** time each time the setpoint value is exceeded.

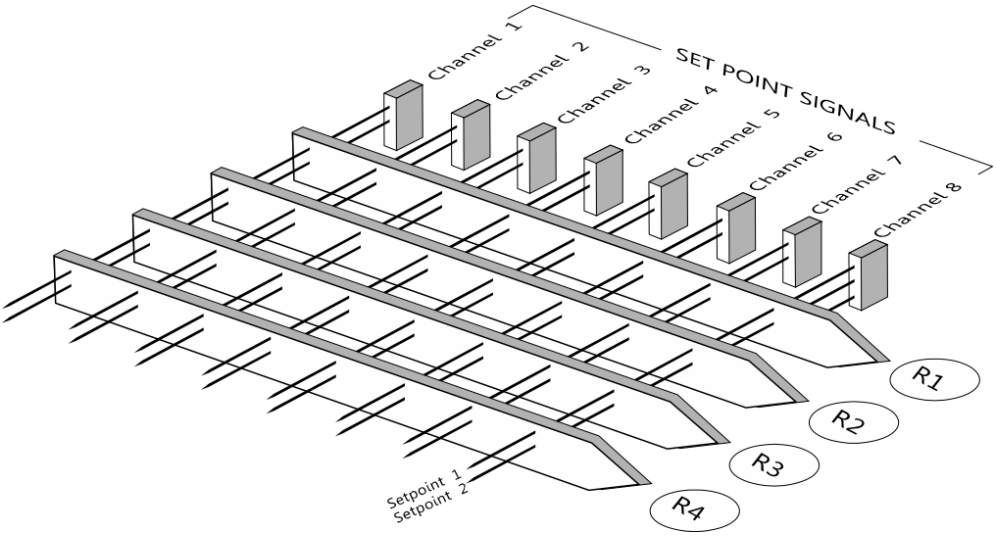


Press **U** or **D** to navigate to the required function.

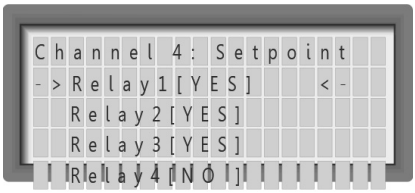
Press **R** to confirm the function selected.

5.9.3.7 Relays

The TX9042 PSC has four common output relays, R1, R2, R3 and R4.

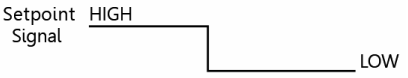


Any setpoint signal can be assigned to operate any one or all of the relays by selecting **Yes** or **No** in each case.



This enables alarm status groupings, selective shutdown routines and logic elementary functions to be created.

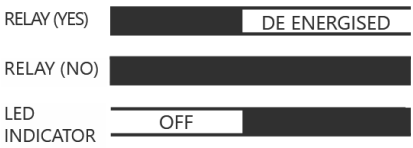
Press **U** or **D** to navigate to **Yes** or **No** as required.



Press **R** to confirm the selection.

Checkpoint

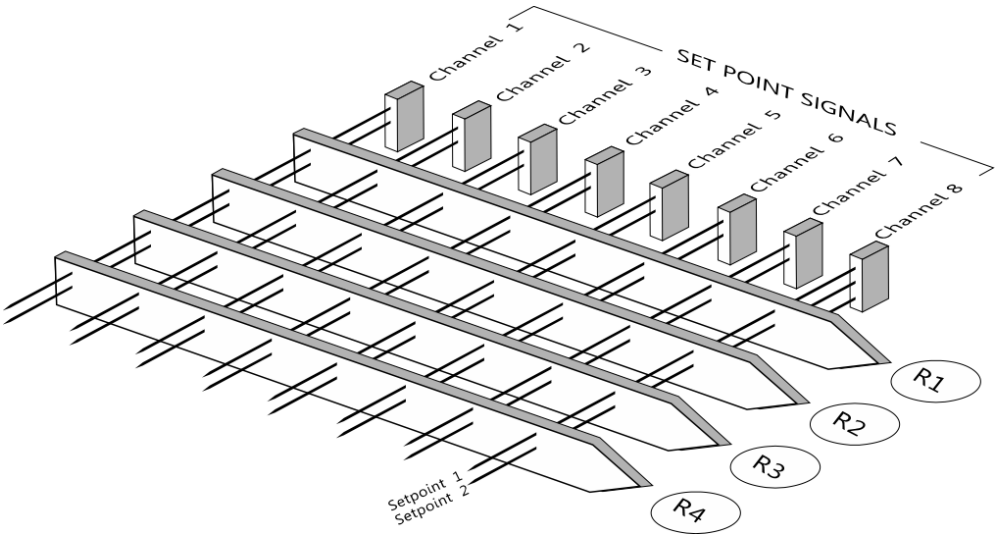
Any or all of the sixteen setpoint signals can be programmed for **Voting** operation with the output relays. Refer to Section 5.7.10 for details.



5.9.4 Fault Signal Alarm Assignation

Each of the 8 channels on the TX9042 PSC has a **Fault Output Signal** which triggers when a system fault is detected by the processor. Refer to Section 5.5 for details. The fault types are:

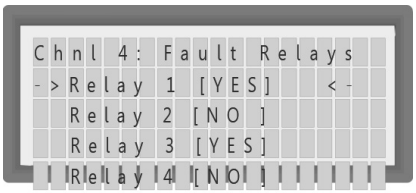
- Sensor Failure
- Input Signal Faults
- Loss of Signal



The **Fault** signal from each channel can be cross matrix programmed in the same way as the **Set Point** signals, to interface with any or all of the four output relays, R1, R2, R3 and R4.

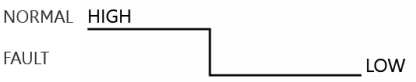
This way, it is possible to identify the character of the alarm without causing unnecessary shutdown, or giving a false alert.

This function **does not** work where a channel has been configured as a **Digital Input Channel**, except for a failsafe **Digital Input Channel**, as most digital input functions are self monitoring by their nature.



Press **U** or **D** to navigate to the relay required.

Press **R** to confirm the selection.



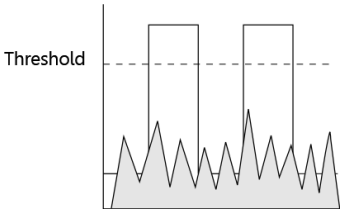
Press **U** or **D** to navigate to **Yes** or **No** as required.

Press **R** to confirm the selection.

5.9.5 Threshold Acceptance Level

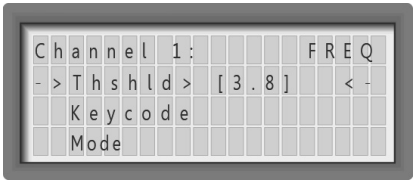
When a **Digital Input Module** is fitted, the **Threshold** selection will appear in the **Channel Menu**.

The input signal threshold voltage level can be set so that only pulse amplitudes above a preset magnitude will be accepted by the input.



Background noise or spurious interference can be eliminated in this way. This is particularly useful in a high speed, pulse processing system where a simple time delay on the pulse would be unacceptably slow.

Press **U** or **D** to navigate to the **Threshold Acceptance Level** value required.

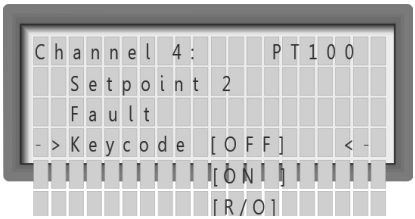


Press **R** to confirm the value selected.

5.9.6 Keycode Security for Each Channel - 1 to 8

The same **Keycode** number previously entered in the **Main Menu** can also be used to prevent unauthorised access to any individual channel function programming or to prevent disclosure of programmed parameters.

Each channel can be selectively inhibited so an operator can still have access to adjust other channels where this would be appropriate. Refer to Section 5.7.5 for details.



Press **U** or **D** to navigate to **On** or **Off** as required.

Press **R** to confirm the selection.

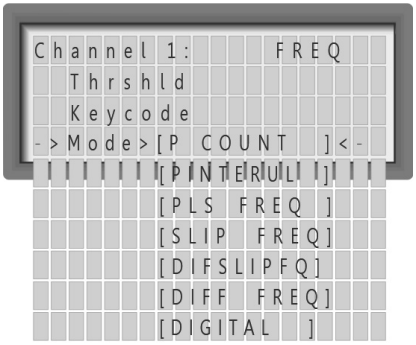
Checkpoint

Off	Programming available
On	Programming inhibited
R/O	Programming read only - parameters are displayed but cannot be changed

Checkpoint

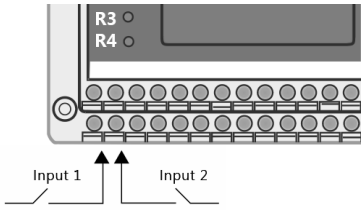
If more than three invalid entries are attempted, access to the channel function programming will be denied for 30 mins. If you require this feature to be disabled, contact the **Trolex Product Support Department**: **service@trolex.com**

5.9.7 Mode Setting for a Digital Input Module



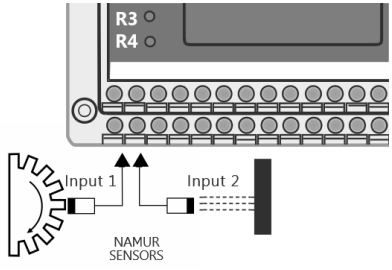
A channel fitted with a **Digital Input Module** will show an additional item called **Digital** in the **Channel Menu**.

A **Digital Input Module** can be set into seven different modes of **Pulse Processing Format** and one of these must be determined before programming of the various function characteristics can proceed.



The available modes of **Pulse Processing Format** are:

- Pulse Counter
- Pulse Interval
- Pulse Frequency
- Slip Frequency
- Differential Slip Frequency
- Differential Frequency
- Digital Level

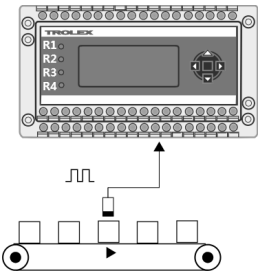


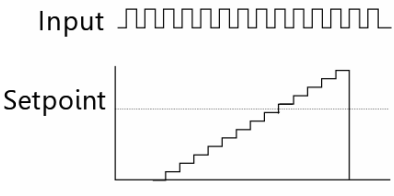
Press **U** or **D** to navigate to the required mode of **Pulse Processing Format**, there are seven modes available.

Press **R** to confirm the selection.

Pulses can be counted from contacts, NAMUR sensors or photosensors.

Input 1 is normally used for counting and **Input 2** for reset or count steering control.

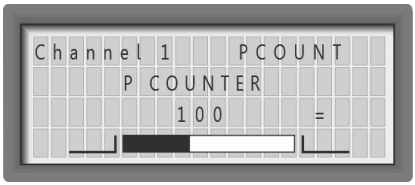




5.9.7.1 Pulse Counter

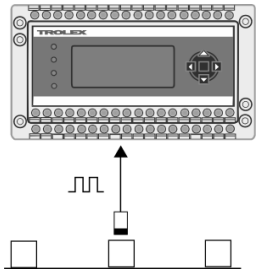
Pulses entering on **Input 1** will be totalled. Setpoint count values can be programmed.

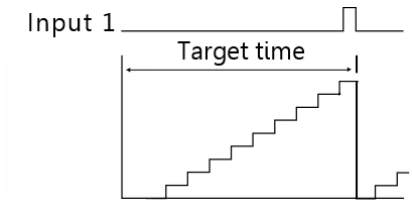
Counting can be **Upcount**, **Downcount** or **Bidirectional**. Refer to Section 5.9.2.8 for details.



Close-up 1 Display

Refer to Section 5.5.1 for details.





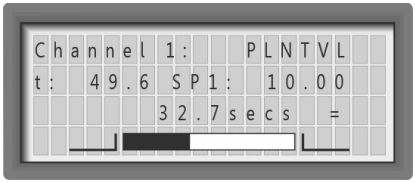
5.9.7.2 Pulse Interval

This mode measures the time interval between successive pulses on **Input 1** against a programmable target time.

If the interval time between pulses exceeds the programmed target time, the setpoint will be triggered.

This is useful for monitoring slow moving targets or rotating pans and drums or simply as a long delay time.

Close-up 1 Display
Additional dynamic function information is displayed in this mode. Refer to Section 5.5.1 for details.



T - Elapsed time from the last reset pulse on Input 1.

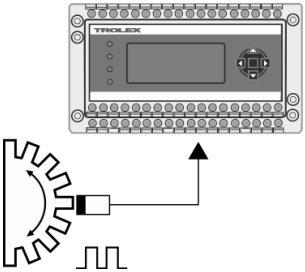
SP1 - **Setpoint 1** or target time (**Setpoint 2** can also be programmed as a second target time but is not displayed).

Time - Duration of the previous time interval in seconds (32.7 seconds).

Bar Graph - Progressive overview of the length of the time interval between each successive reset pulse on **Input 1**.

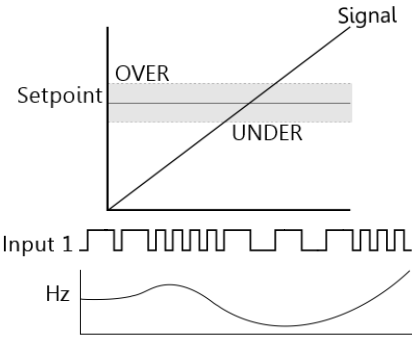
The bottom end of the bar graph (the estimated minimum interval period) is programmed by the **Lower** setup.

The top end of the bar graph (the estimated maximum interval period) is programmed by the **Upper** setup.

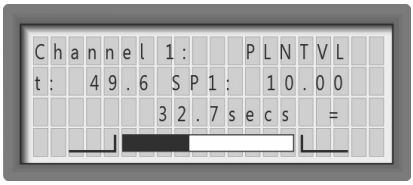


5.9.7.3 Pulse Frequency

The frequency level or pulse rate on **Input 1** is measured.



Setpoint levels are determined as an Absolute frequency. Feed rate monitoring, speed monitoring, flow rate, etc.



Close-up 1 Display

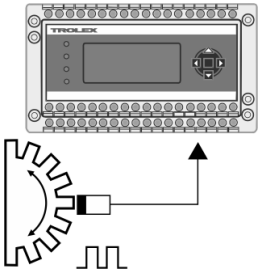
Refer to Section 5.5.1 for details.

Checkpoint

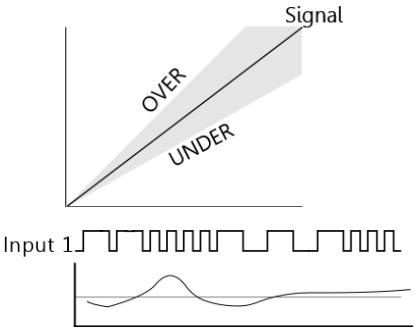
This mode is used for the Vortex Airflow Sensor input module.

5.9.7.4 Slip Frequency

The frequency level or pulse rate on **Input 1** is measured.



Setpoint levels are determined as a percentage of a programmed frequency setpoint, for example, the underspeed or overspeed of a machine can be expressed as a percentage of the normal running speed.



Close-Up 1 Display

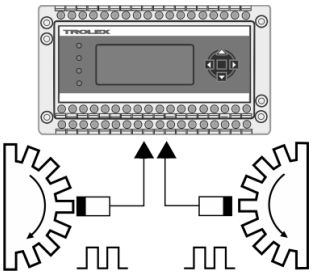
Additional dynamic information is displayed in this mode.

T1 - incoming frequency or pulse rate on **Input 1**.

Run - the programmed **Run** frequency.

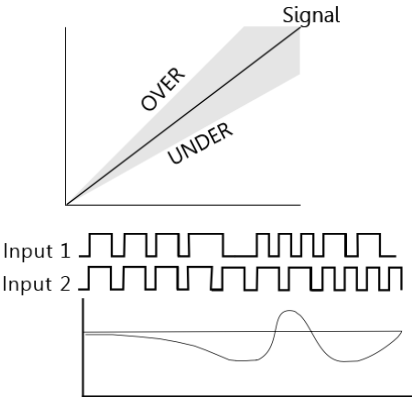
% - the percentage difference between **Input 1** and **Run**.

Bar Graph - also gives magnitude comparison of the percentage difference between **Input** and **Run**.

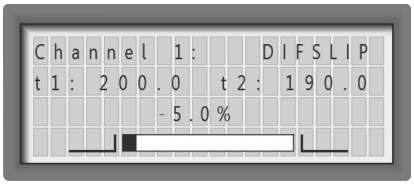


5.9.7.5 Differential Slip Frequency

The frequency level or pulse rate on **Input 1** is compared with the frequency level or pulse rate on **Input 2**.



Setpoint levels are determined as an absolute frequency difference.



Close-Up 1 Display

Additional dynamic information is displayed in this mode.

T1 - incoming frequency or pulse rate on **Input 1**.

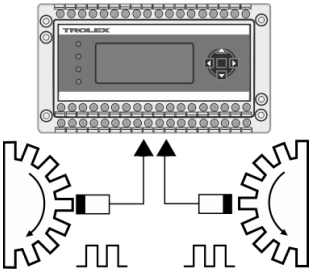
T2 - incoming frequency or pulse rate on **Input 2**.

% - the percentage difference between **Input 1** and **Input 2**, with respect to **Input 1**.

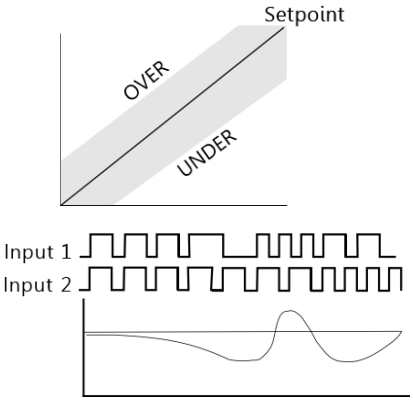
Bar Graph - overview of the percentage difference between **Input 1** and **Input 2**.

5.9.7.6 Differential Frequency

The frequency level or pulse rate on **Input 1** is measured.

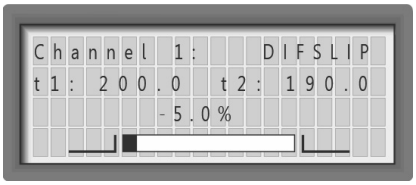


Setpoint levels are determined as an absolute frequency difference.



Close-Up 1 Display

Additional dynamic information is displayed in this mode.

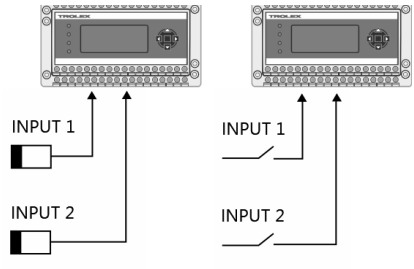


T1 - incoming frequency or pulse rate on **Input 1**.

Run - the programmed **Run** frequency.

% - the percentage difference between **Input 1** and **Input 2**.

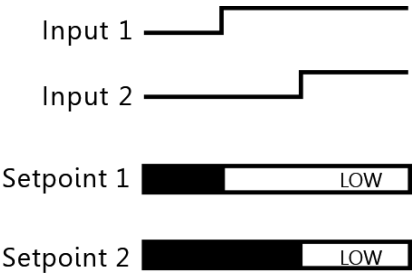
Bar Graph - Magnitude comparison of the frequency difference between **Input 1** and **Input 2**.



5.9.7.7 Digital Level

Inputs from simple **On**/**Off** switches, voltage free contacts, thermostats, pressure switches, limit switches and NAMUR proximity switches.

Each digital input module will accept two input switches, one on **Input 1** and one on **Input 2**, each of these inputs can be programmed independently for most of the standard functions.



Update time - input delay. Refer to Section 5.9.3.5 for details.

Identification text. Refer to Section 5.9.2.20 for details.

Terminal connections display. Refer to Section 5.9.2.21 for details.

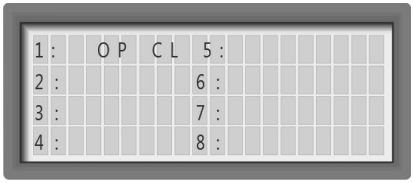
Alarm on high/low input - rising/falling alarm. Refer to Section 5.9.3.3 for details.

Setpoint delay - output delay. Refer to Section 5.9.3.4 for details.

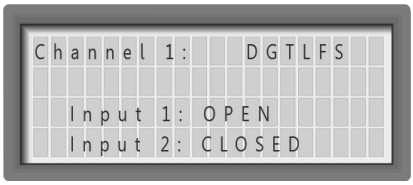
Operation - auto reset/latch/toggle/pulse. Refer to Section 5.9.3.6 for details.

Relay output assignation. Refer to Section 5.9.3.7 for details.

Signal Display
Input 1
Input 2



Close-Up 1 Display
The state of **Input 1** and **Input 2** is displayed as **Low** (**L**) or **High** (**H**).

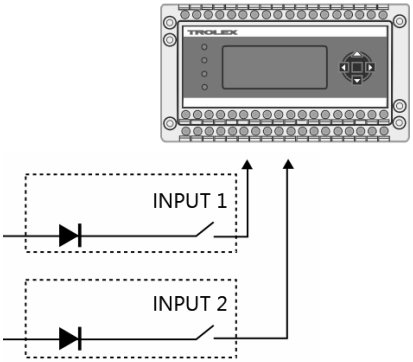


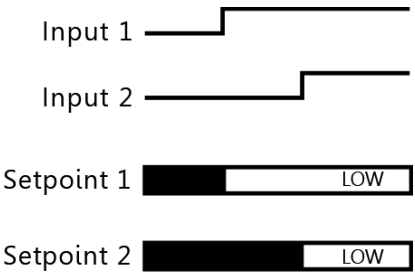
5.9.8 Setting a Digital Failsafe Input Module

A channel fitted with **Digital Failsafe** input module will show an additional item called **Resistor** in the channel menu.

The module will accept inputs from simple **On**/**Off** switches, voltage free contacts such as thermostats, pressure switches and limit switches, also providing a failsafe capability.

Each digital input module will accept two input switches, one on **Input 1**, the other on **Input 2** and each of these inputs can be programmed independently for most of the standard functions.





Identification text. Refer to Section 5.9.2.20 for details.

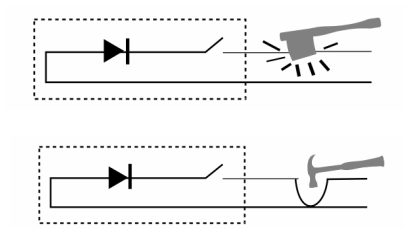
Terminal connections display. Refer to Section 5.9.2.21 for details.

Alarm on high/low input - rising/falling alarm. Refer to Section 5.9.3.3 for details.

Setpoint delay - output delay. Refer to Section 5.9.3.4 for details.

Operation - auto reset/latch/toggle/pulse. Refer to Section 5.9.3.6 for details.

Relay output assignation. Refer to Section 5.9.3.7 for details.

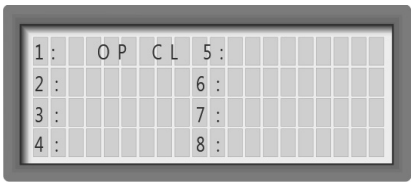


Short Circuit Detection

A diode connected in series with input contacts at the remote point will enable the TX9042 PSC to detect and identify an open short circuit connection in the sensor connecting cable.

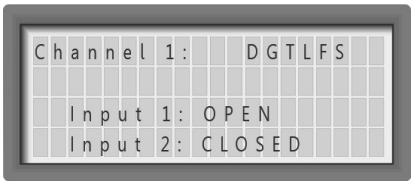
An open circuit cable connection such as a severed cable will appear as an open input contact, signifying an alarm in the normal way. A short circuit connection such as a crushed cable will short the diode that is connected in series with the remote input contact, initiating a **Fault** (**F**) indication and a **Fault** channel signal.

Signal Display
Input 1 - Input 2
Refer to Section 5.3 for details.

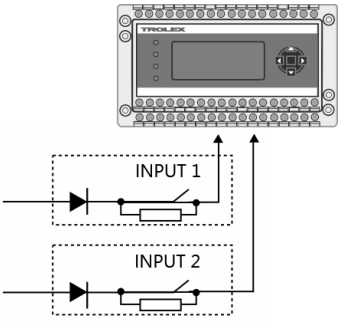


Input contact - **Open**: **OP**
Input contact - **Closed**: **CL**
Short circuit connection: **Fault** (***F**)
Open circuit connection: **Fault** (***F**)

Close-Up 1 Display
Refer to Section 5.5.1 for details.

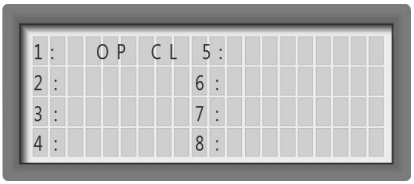


Short Circuit and Open Circuit Detection
The module can be programmed to individually identify both short circuit and open circuit conditions. If a resistor is also incorporated into the remote contact connection, the TX9042 PSC will be able to exclusively identify both failure modes of the connecting cable conditions.

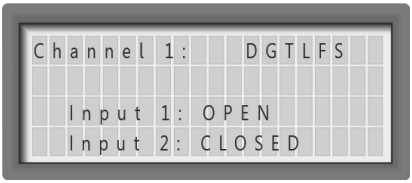


(Resistor value : 10K ohm)

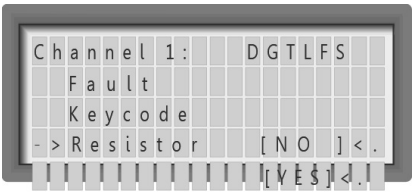
Signal Display
Input 1 - Input 2
Refer to Section 5.3 for details.



Input contact - **Open**: **OP**
Input contact - **Closed**: **CL**
Short circuit connection: **Fault** (***F**)
Open circuit connection: **Fault** (***F**)



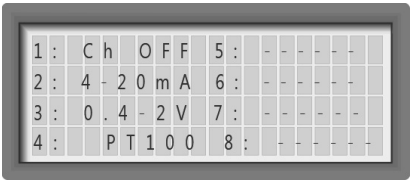
Close-Up 1 Display
Refer to Section 5.5.1 for details.



Press **U** or **D** to select the resistor state of **Yes** or **No** as required.

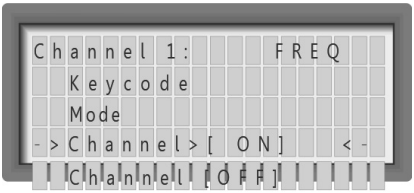
Press **R** to confirm the selection.

5.9.9 Channel Display Mode



Where a channel is out of operation or a system **Fault** has been diagnosed, the channel can be de-activated. This will be denoted on the **Signal Display** by **Ch OFF**.

Press **U** or **D** to navigate the **Channel Display Mode** to **On** or **Off** as required.



Press **R** to confirm the selection.

Checkpoint
The channel input will now have no effect on the two related set points **SP1** and **SP2** or the channel **Fault** signals.

5.10 Datacommunications

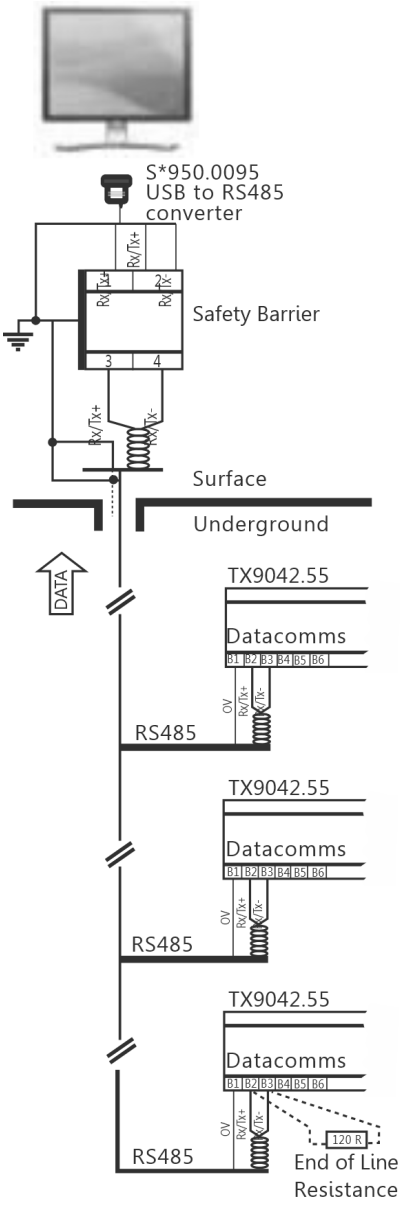
The TX9042 Programmable Sensor Controller (PSC) is equipped with RS485 datacommunications.

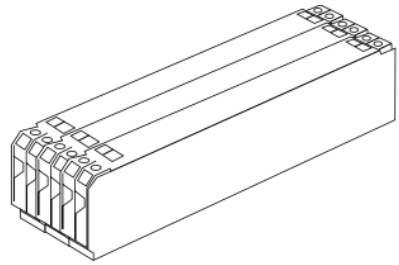
5.10.1 RS485

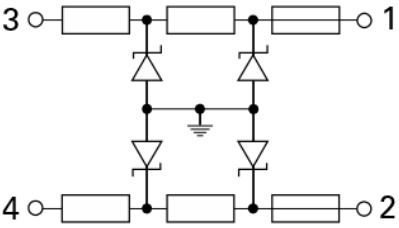
The RS485 communications module can be used for point to point or multidrop data communications up to 2 km operating distance.

Maximum total cable length	2 km
Maximum no. of TX9042 PSC per System	11
End of Line Resistance	120 ohm (between B2 & B3)
Recommended Cable Parameters	1.5 mm^2 with overall screen 1.5 mm^2 up to 2 km • 1 twisted pair for data • 0 V • Overall screen
Sensor Controller Datacomms Module	RS485 (55) TX9042

Data Protocol - the communications format setup can be individually programmed through the keypad for PC system compatibility and data protocol information is available from the **Trolex Technical Department**. Refer to Section 5.7.3 for details.







Checkpoint
When the data transmission system extends into a safe area, it must be used with an approved safety barrier to comply with intrinsic safety regulations.

Please contact the **Trolex Sales Team** for further information and advice on suitable safety barriers. **sales@trolex.com**

Up to 11 RS485 Communications Modules may be daisy-chained together, terminals B1 all linked together, terminals B2 all linked together and terminals B3 all linked together.

These communications lines may be connected to unspecified safe area equipment via a suitable shunt zener diode safety barrier. The cable parameters shall not exceed the following:

C = 2.8 µF
L/R = 222 µH/ohm

Please contact the **Trolex Sales Team** for further information and advice on suitable shunt zener diode safety barriers.
sales@trolex.com

6. Maintenance

6.1 TX9042 PSC Planned Preventative Maintenance

6.1.1 Introduction

To keep your TX9042 PSC in the best possible condition and fully working, Trolex strongly recommends that you carry out regular planned preventative maintenance and keep records of the maintenance carried out.

The planned preventative maintenance for the TX9042 PSC consists of tasks carried out at regular intervals. The tasks are listed in the maintenance schedule below:

Equipment Name	Task Type	Task Number	Interval
TX9042 PSC	Check	6.1.2	6 months
TX9042 PSC Battery	Replace	6.1.3	5 years
TX9042 PSC - only to be carried out if the TX9042 is installed in a SIL rated system.	Proof Test	6.1.4	3 months OR 12 months

6.1.2 TX9042 PSC - Check

Checkpoint
This maintenance task **CAN** be carried out underground.

1. Check the TX9042 PSC enclosure is securely attached. If the enclosure is not securely attached, resecure as necessary.

2. Check the TX9042 PSC enclosure for cracks, penetration, water ingress, signs of having been struck or other damage. Repair or replace the enclosure as necessary.
3. Check that the TX9042 PSC is securely attached to its enclosure. If the TX9042 PSC is not securely attached, resecure as necessary.
4. Check the exterior of the TX9042 PSC for cracks, penetration, water ingress, signs of having been struck or other damage.
5. Check the LCD screen is clear, can be easily read and is free from damage or defect.
6. Check the LCD screen shows no short circuit or open circuit conditions on any of the 8 channels.
7. Check that the Keypad **L**, **R**, **U** and **D** keys are free from damage or defect.
8. Check that the two terminal identification labels are securely attached, legible and free from damage or defect. Repair or replace the two labels as necessary.
9. Check all wires connected to the TX9042 PSC are secure within the terminals. Tighten any loose terminals as necessary.
10. If any part of the TX9042 PSC shows any signs of damage, defect, deformation or missing parts, immediately remove it from service and replace it with a working TX9042 PSC. Return the defective TX9042 PSC to your local Trolex service agent for repair and testing.
11. After the completion of all maintenance, update the maintenance records.

6.1.3 TX9042 PSC Battery - Replace

Checkpoint
This maintenance task **CANNOT** be carried out underground.

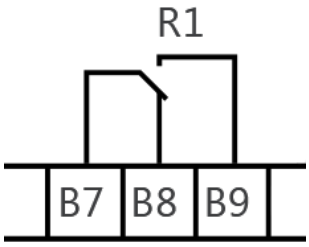
1. Remove the TX9042 PSC from service and replace it with a working TX9042 PSC.
2. Return the TX9042 PSC to your local Trolex service agent for battery replacement and testing.
3. After the completion of all maintenance, update the maintenance records.

6.1.4 TX9042 PSC - Proof Test

Checkpoint
This maintenance task **CAN** be carried out underground.

Checkpoint
A **Proof Test** must be carried out at regular intervals if the TX9042 PSC is being used in a SIL rated system. The interval of 3 months or 12 months depends upon the SIL rating and whether the safety function is defined as Low or High Demand. See Section 3 for further information.

1. Open the IP rated enclosure housing the TX9042 PSC.
2. Establish which input channels have a **4 to 20 mA** or **0.4 to 2 V** input **AND** are configured to de-energise an output channel relay, and which output channel relay it is. These are the input channels to be proof tested.



Relay shown de-energised

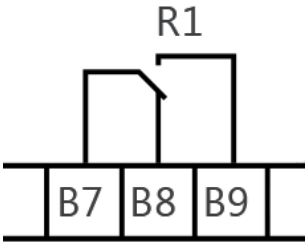
3. On one of the input channel(s) identified in the previous step, connect an Intrinsically Safe meter across the output channel relay terminals. See section 4.5 for details of relay terminal locations. Each relay has three terminals.

Checkpoint
Relay R1 - B7 common, B8 & B9
Relay R2 - B10 common, B11 & B12
Relay R3 - B13 common, B14 & B15
Relay R4 - B16 common, B17 & B18

4. The IS meter should be connected to the common terminal and the higher numbered terminal for the output channel relay being tested.
   Relay R1 - B7 and B9
   Relay R2 - B10 and B12
   Relay R3 - B13 and B15
   Relay R4 - B16 and B18
5. On the first input channel to be proof tested, apply a load or stimulus to the sensor or detector. The load or stimulus should be sufficient that it exceeds the programmed setpoint level for that input channel.

Checkpoint
How load or stimulus is applied to the sensor or detector, is the responsibility of the person responsible for SIL in the location where the TX9042 is installed. The determination of the correct load or stimulus, and how this is applied to the sensor or detector is beyond the scope of this User Manual.

6. As the load or stimulus exceeds the alarm threshold, observe that the reading on the IS meter fluctuates as the output channel relay de-energises.
7. If the IS meter reading fails to fluctuate, immediately remove the TX9042 PSC from service and replace it with a working TX9042 PSC. Return the defective TX9042 PSC to Trolex for repair and testing.
8. Remove the load or stimulus from the sensor or detector.
9. Reset the output channel relay.
10. Remove the IS meter connection from the higher numbered terminal and connect it to the middle numbered terminal of the output channel relay being tested.
    Relay R1 - B8
    Relay R2 - B11
    Relay R3 - B14
    Relay R4 - B17
11. Apply a load or stimulus to the sensor or detector. The load or stimulus should be sufficient that it exceeds the programmed setpoint level for that input channel.
12. As the load or stimulus exceeds the programmed setpoint level observe that the reading on the IS meter fluctuates as the output channel relay de-energises.
13. Remove the load or stimulus from the sensor or detector.
14. Reset the output channel relay.
15. Remove the IS meter connections from the output channel relay terminals.



Relay shown de-energised

16. Repeat the test for each input channel that has a **4 to 20 mA** or **0.4 to 2 V** input **AND** is configured to operate an output channel relay.
17. If the IS meter reading fails to fluctuate for any of the output channel relay tests, immediately remove the TX9042 PSC from service and replace it with a working TX9042 PSC. Return the defective TX9042 PSC to Trolex for repair and testing.
18. After the completion of all maintenance, update the maintenance records.

6.2 TX9042 PSC - Repair

Should your TX9042 PSC become damaged and require repair, immediately remove it from service, replace it with a working TX9042 PSC and contact your local Trolex service agent to arrange repair.

Checkpoint
If your TX9042 PSC is used in a SIL rated system it **can only** be repaired by Trolex.

6.3 Maintenance Records

Implement a planned preventative maintenance process and keep good maintenance records.

Consult your local Trolex service agent or the **Trolex Product Support Department**: **service@trolex.com** for help in implementing a planned preventative maintenance process. The Maintenance Log gives an example of a typical maintenance record system.

6.4 Maintenance Log

Order Reference: TX9042 Programmable Sensor Controller	
Serial Number:	Date Purchased:
Channel 1:	Channel 2:
Channel 3:	Channel 4:
Channel 5:	Channel 6:
Channel 7:	Channel 8:
Location:	

Date	Maint Task No.	Fault	Action	Return to Trolex	Comments

7. Disposal

Part of the ethos of Trolex is sustainable design. TX9042 PSC contains materials that can be recovered, recycled and reused.

At the end of its useful life ensure that the TX9042 PSC is recycled in accordance with local laws and bylaws for the geographic area where it is located. The end of its useful life is to be determined by the owner/operator of the equipment and not Trolex.

Ensure that the TX9042 PSC is recycled by a licenced waste handling organisation with the appropriate licences for handling electronic waste in the geographic area where the TX9042 PSC is located.

Checkpoint
Consult your local Trolex service agent or the Trolex Product Support Department if you require assistance:
service@trolex.com

Disclaimers

The information provided in this document contains general descriptions and technical characteristics of the performance of the product. It is not intended as a substitute for and is not to be used for determining suitability or reliability of this product for specific user applications. It is the duty of any user or installer to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use. Trolex shall not be responsible or liable for misuse of the information contained herein. If you have any suggestions for improvements or amendments, or find errors in this publication, please notify us at marketing@trolex.com.

All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only Trolex or its affiliates should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Trademarks

Document History

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