Title

HUBBUS

TWO CHANNEL TEMPERATURE TRANSMITTER

TYPE HBTX2T

USER MANUAL

Document Number

125-254-12

Issue

01

Revision Control

01	Release	2020.10.28	NI	NI	PC
Issue	Details	Date	Written	Designed	Approved

Austdac Pty Ltd

Unit 1 / 42 Carrington Road
Castle Hill NSW 2154
Australia

PO Box 6486
Baulkham Hills Business Centre
NSW 2153
Australia

Phone: + 61 2 8851 5000
Fax: + 61 2 8851 5001
Website: www.austdac.com.au

TABLE OF CONTENTS

TABLES

FIGURES

1 Introduction

1.1 BACKGROUNG AND CONTEXT

HubBus is Austdac's long distance distributed I/O system used in a wide range of applications in non-hazardous environments. HubBus overcomes the limitations of other distributed I/O systems in terms of noise immunity from new variable frequency drives, number of channels for input and output devices, transmission distances on large overland conveyors and powering devices from the communications line.

1.2 PURPOSE

This document is the user's manual for the HubBus two channel temperature transmitter (HBTX2T). It provides an overview and a detailed description of the installation, use and operation of the HubBus two channel temperature transmitter.

This document does not contain detailed information concerning the operation of the HubBus system. Refer to the "HubBus System Description and Overview" user's manual (125-250-12) for detailed information on HubBus. Likewise, refer to the HubBus Safety Manual (125-NNN-12) for any functional safety related specifications.

2 Warnings and Precautions

2.1 WARNINGS

WARNING: The HubBus Signal -ve line must not be tied to any common, 0V, ground or Earth points.

WARNING: Do not use the same power supply as the channel generator. Any other modules or equipment must be galvanically isolated from the HubBus channel generators power source.

WARNING: The HubBus power source "Line-Ext" switch above the configuration port connector should be switched to the RIGHT side (Ext) if using an external power supply.

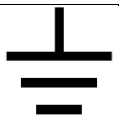
WARNING: If the PT100 has a foil sheath then this should be connected with pin 17/18 or 23/24 to earth. It should not be connected to return ground pin 16 or 22 (these pins are assigned for the return current of the PT100).

WARNING: If the HBTX2T is used in a manner not specified by Austdac then the protection provided by the HBTX2T may be impaired.

WARNING: This product may contain chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

2.2 SYMBOLS

Markings that may be used across the HubBus range of products to indicate precautions that must be taken to maintain safe operation of the system.

	Direct Current (DC) Supply
	Earth (ground) Terminal
	Caution, possibility of electric shock
	Caution (refer to user manual)

2.3 PRECAUTIONS

- Only qualified personnel shall install and service the HBTX2T.
- Mains supply fluctuations are not to exceed ±10% of the nominal supply voltage.

2.3.1 USER ACCESS

There are no user serviceable parts within the HBTX2T. The user should not open or disassemble the HBTX2T.

2.3.2 STORAGE, INSTALLATION, USE AND MAINTAINANCE REQUIREMENTS

The HBTX2T should only be installed, operated and maintained by qualified personnel in accordance with the condition of safe use as outlined in the certificate.

Ensure that all instructions and warnings are observed.

2.3.2.1 Storage

The specified storage temperature must be maintained during storage.

2.3.2.2 Installation and conditions of use

Prior to installation the HBTX2T should be inspected for the following;

- Any external damage to the enclosure.

The HBTX2T may be installed in any orientation.

The HBTX2T must be installed in a suitably certified IP54 or better enclosure or as required by legislation. The enclosure should provide adequate protection, from impact and ingress of dust and water.

The HBTX2T should be mounted to a stable surface avoiding areas under constant vibration and shock.

3 Overview

3.1 GENERAL DESCRIPTION

The HubBus two channel temperature transmitter is part of a family of products that form an Austdac HubBus distributed I/O system. The HBTX2T can transmit up to two temperature values over the HubBus network.

Figure 1: HubBus Two Channel Temperature Transmitter

The dual temperature inputs are designed to work with a standard two, three or four wire PT100 temperature sensors. Each of the temperature transmitters can be configured to operate in one of two temperature ranges, -10˚C to +100˚C or -20˚C to +200˚C. This makes the HBTX2T particularly suited to monitoring bearing or similar plant temperatures via the HubBus network without any requirements for additional power.

The HBTX2T can be configured using a laptop computer running HubBus configuration software and a small plug in programming adaptor or Austdac's HubBus Handheld programmer. Both temperature inputs can be programmed to transmit on any HubBus channel address. The number of channels used for transmission is determined by the HubBus channel generator. Two trip points are configurable for each of the temperature inputs with independent under or over temperature alarms, hysteresis and output channels.

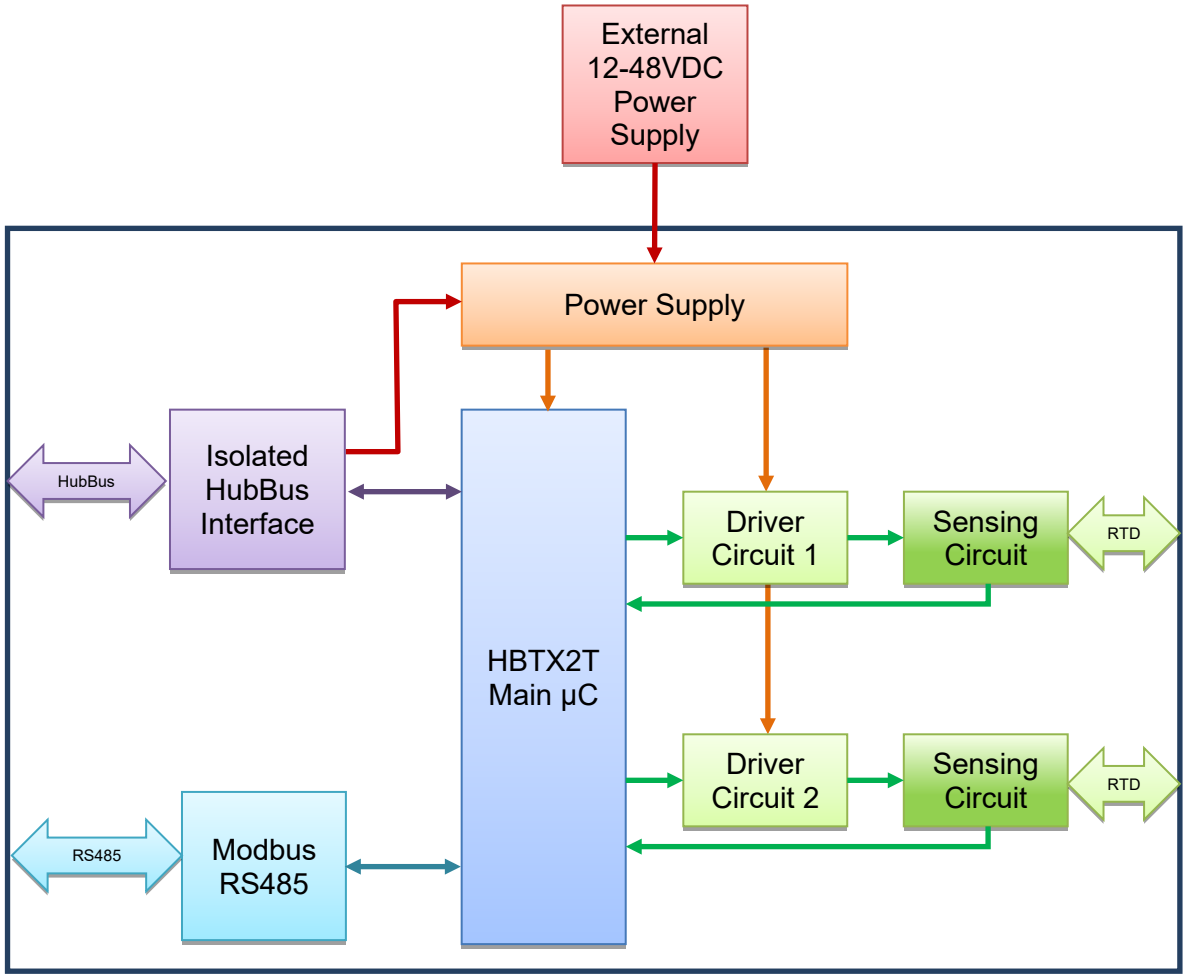


Figure 2: HubBus Two Channel Temperature Transmitter Block Diagram

3.2 OPERATION

Each of the two channel temperature transmitter's inputs takes a PT100 sensor and transmits it onto the connected HubBus network using the Datalink protocol. The temperature input is converted to a twelfth bit value ready for transmission on the configured HubBus channel.

The PT100 sensor is a two, three or four wire resistor that varies its resistance according to the surrounding temperature. The sensor has a resistance of 100Ω at 0ºC. The sensor resistance increases with temperature. The PT100 sensor will work with 2 wires but this two-wire connection affects measurement accuracy by adding resistance in series with the RTD. An additional third wire to the RTD allows compensation for the wire resistance. The only restriction is that the main connecting wires have the same characteristics. A four-wire sensor enables Kelvin sensing, which eliminates the effect of voltage drops in the two connecting wires.

The HBTX2T carries out three-wire lead compensation on three and four-wire sensors, two-wire sensors will work with the transmitter but no compensation is possible. Use three or four-wire sensors for better accuracy. The figure below shows three and four wire PT100 sensors and typical lead identifications.

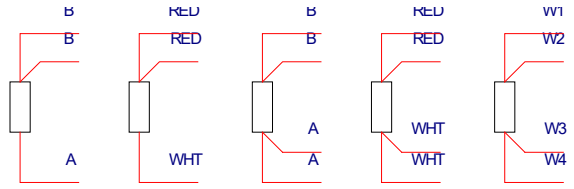


Figure 3: PT100 sensors and typical lead identifications

The HBTX2T temperature transmitter functions by driving a constant current through the PT100 sensor. This current will cause a voltage to appear across the sensor proportional to the sensor temperature.

TEMPERATURE (°C)	SENSOR RESISTANCE (Ω)	INPUT VOLTAGE (mV)
-20	92	18.4
-10	96	19.2
0	100	20.0
+10	104	20.8
+20	108	21.6
+30	112	22.4
+40	115	23.0
+50	119	23.8
+100	138	27.6
+150	157	31.4
+200	176	35.2

Table 1: HBTX2T Temperature vs. Input voltage

The table above shows some typical temperatures versus sensor resistances and HBTX2T input voltages.

The temperature input is also monitored for under and over temperature by comparing it to configured set points. The under or over temperature alarm can be transmitted as a digital signal on any valid configurable HubBus channel address.

A hysteresis level can be configured for each input to stop the set point alarms from chattering because of minor fluctuations on the temperature signal from the sensor.

All configurable aspects of the temperature transmitter can be programmed via the configuration port. The transmitter will automatically configure to the number of channels and pulse bandwidth of the connected HubBus network.

4 Front Panel

4.1 OUTER

As viewed with the top cover in place.

Figure 4: Front panel

4.1.1 LEDS

LED indicators give a quick overview of current system operational state.

4.1.1.1 STAT

Note: Only active if external power source is used. Not active if unit is line powered.

Colour	Flash Rate	Description
GREEN	Flash	Communication to HubBus interface active and sync pulse detected.
RED	Solid	Lost communication to HubBus interface.

Table 2: STAT LED

4.1.1.2 SYNC

Colour	Flash Rate	Description
YELLOW	Single	HubBus Sync pulse detected. Driven by the HubBus interface.
	Double	HubBus interface board lost communication to main module. Check line power switch.

Table 3: SYNC LED

4.1.1.3 +V

Note: Only active if external power source is used. Not active if unit is line powered.

Colour	Flash Rate	Description
GREEN	Solid	External power source good.

Table 4: +V LED

4.1.1.4 Rx

Colour	Flash Rate	Description
BLUE	Flash	MODBUS Receive, persistence of 100ms

Table 5: Rx LED

4.1.1.5 Tx

Colour	Flash Rate	Description
BLUE	Flash	MODBUS Transmit, persistence of 100ms

Table 6: Tx LED

4.1.1.6 (1)

Note: Only active if external power source is used. Not active if unit is line powered.

Colour	Flash Rate	Description
YELLOW	Solid	One of the configured alarm points for input 1 has tripped for either under or over temperature.
YELLOW	Fast	Fault detected or missing sensor on input 1.

Table 7: (1) LED

4.1.1.7 (2)

Note: Only active if external power source is used. Not active if unit is line powered.

Colour	Flash Rate	Description
YELLOW	Solid	One of the configured alarm points for input 2 has tripped for either under or over temperature.
YELLOW	Fast	Fault detected or missing sensor on input 2.

Table 8: (2) LED

4.2 INNER

Module display board as viewed with the housing top cover opened.

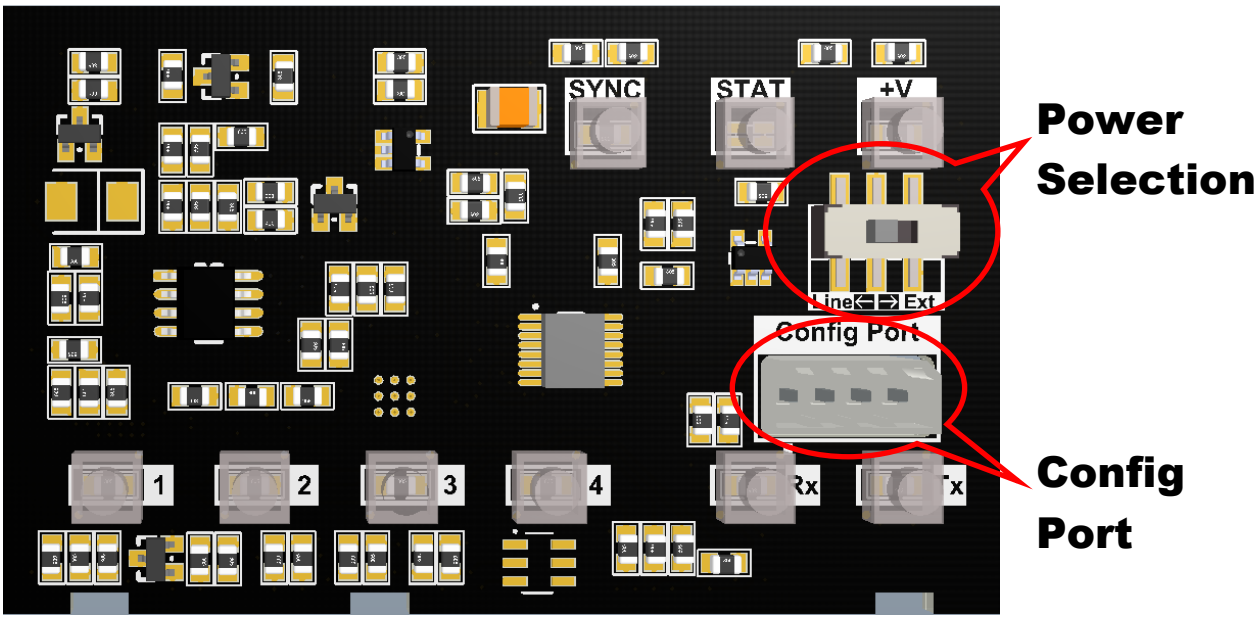


Figure 5: Display and interface board

4.2.1 Power Source Selection

Power source selection:

A. HubBus line powered

B. External power supply

4.2.2 Config Port

Four pin TTL level configuration port. This has the HubBus Modbus interface. Using this port disables the watchdog (monitor) and the RS485 port.

5 Terminals

5.1 TYPE

The PCB terminal connector is a Phoenix Contact style with 5.08mm pitch. Austdac supplies the module with a 90˚ free hanging push-in spring terminal plug .

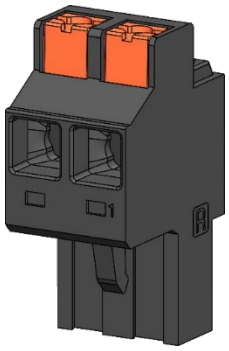


Figure 6: Terminal Plug

5.2 LAYOUT

HBTX2T					
13	Drive	Channel 1	HubBus	Signal+	1
14	+Sense			Signal-	2
15	-Sense				
16	GND				
17	EARTH	EARTH			
18	EARTH				
19	Drive	Channel 2	RS485	A+	7
20	+Sense			B-	8
21	-Sense			COM	9
22	GND				10
23	EARTH	EARTH	Power	+12VDC	11
24	EARTH			0VDC	12

Table 9: HBTX2T Terminals

5.2.1 Power

Any industrial rated power supply may be used. Other modules (except for the channel generator) or equipment may be supplied from the same source.

Operating Range: 10-48VDC

Recommended: 24VDC @ 5A (Omron S8VK-G24024)

5.2.2 HubBus

HubBus terminals for interfacing to the HubBus network. This port is electrically isolated from all the other terminals on the HBTX2T module.

The common line must not be tied to any other 0V, ground or Earth points.

5.2.3 MODBUS

This is an RS485 MODBUS port at 19,200bps used for configuration. The HBTX2T is considered a slave device on the MODBUS network and therefore must be interrogated by a master device. Refer to the configuration section of this manual for instructions on setting network addresses etc.

Port is disabled when the front panel configuration port is active.

This port is galvanically isolated from the HubBus network.

5.2.4 DIN Rail Bus

To eliminate inter-module wiring a DIN-rail bus system may be used with the HubBus modules. The DIN rail bus is used to distribute the following:

- HubBus module auxiliary power (10-48VDC)
- RS485 MODBUS
- HubBus Signal

5.2.5 Temperature Input Terminals (1 to 2)

The temperature input is provided with four terminals for the connection of the PT100 sensor. The HBTX2T temperature input will accept two, three or four wire PT100 sensors. Terminals 17-18 and 23-24 are provided for connecting of earth to shunt away transients and noise (use minimum 2.5mm^2 conductors for this connection).

Input	Terminal	Signal	Description
Input 1	13	Drive	200uA current drive output
	14	+Sense	+ve sense input
	15	-Sense	-ve sense input (Not implemented on HBTX2T)
	16	Gnd	Ground return
	17	Earth	EMC Earth connection
	18	Earth	EMC Earth connection
Input 2	19	Drive	200uA current drive output
	20	+Sense	+ve sense input
	21	-Sense	-ve sense input (Not implemented on HBTX2T)
	22	Gnd	Ground return
	23	Earth	EMC Earth connection
	24	Earth	EMC Earth connection

Table 10: Temperature input terminal details

Note:

- The +Sense terminals (14 and 20) are linked to the Drive terminals (13 and 19 respectively) for two wire PT100 sensors only.
- The –Sense input is not implemented on the HBTX2T. Terminals 15 and 21 provide a place to terminate the –Sense wire of a four wire sensor. No additional compensation is provided beyond that of a three wire sensor.
- The temperature input is galvanically isolated from the HubBus network port; it is important that the sensor and its wiring are isolated from Earth or ground to minimise the possibility of producing faults on the HubBus network. The common mode noise rejection capabilities of the HubBus network are significantly compromised along with the dual inbound current detection if the HubBus network is connected to earth or ground.

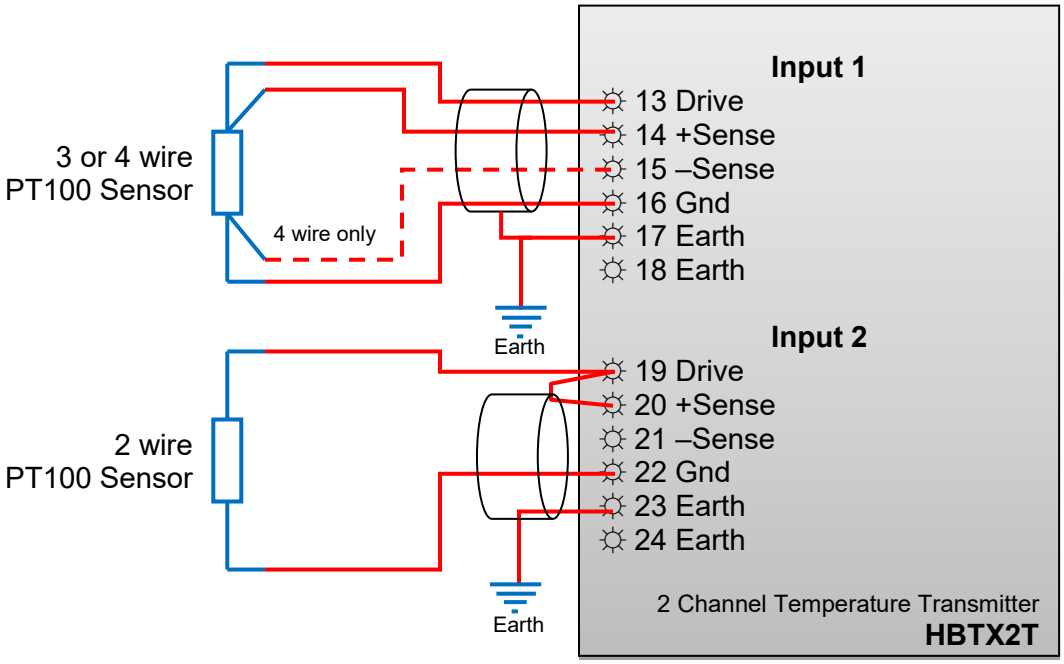


Figure 7: Connection diagram for 2, 3 and 4 wire PT100 sensors

Figure 8: Typical 3 wire PT100 sensor

6 Configuration and Parameters

The following are descriptions of system and device parameters. They are accessed via MODBUS parameters described in the following section.

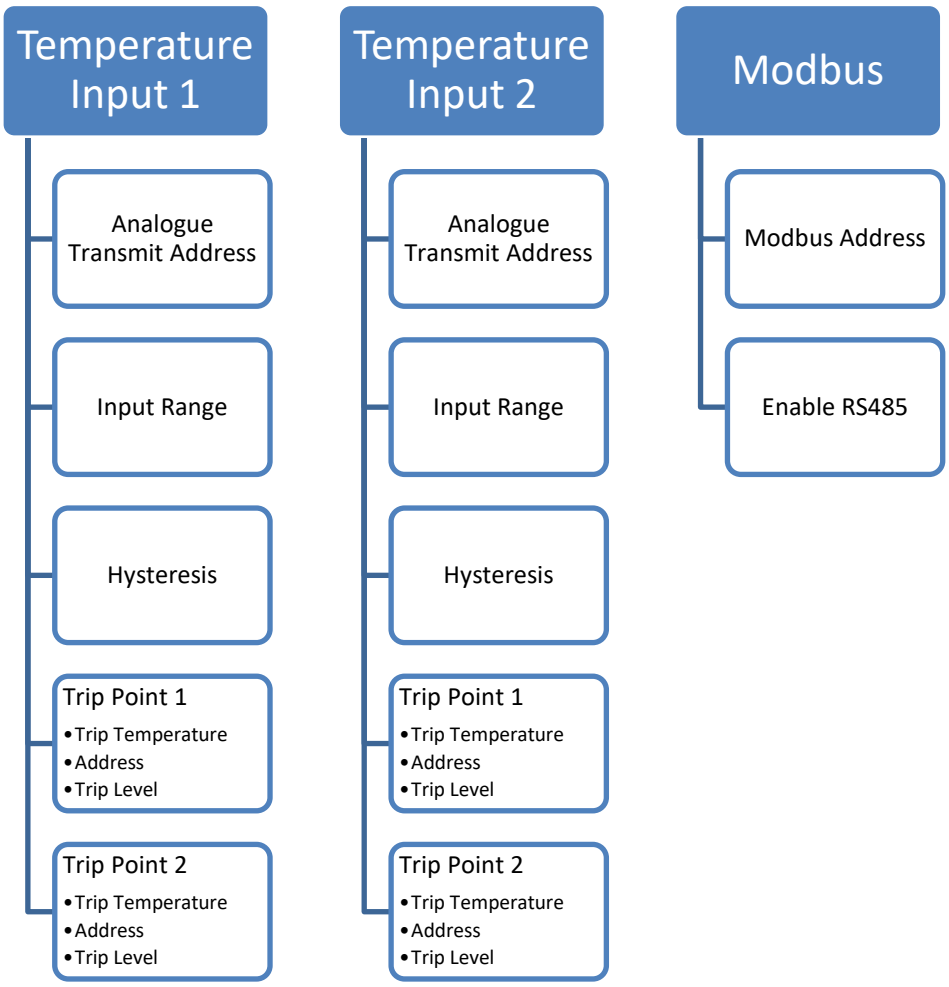
6.1 CONFIGURATION PROCESS

Configuration of safety devices follow the below process:

1. Enter the configuration option when the HHP1-H is connected to the device.
2. Scroll to the desired parameter to be modified.
3. The handheld will display the current value to the displayed parameter.
4. Press [ENTER] key to modify the parameter
5. Modify the parameter to the desired value.
    a. Press [MENU] to cancel and revert to the previous configured value.
    b. Press [ENTER] to accept the new value and send to device.
6. The value will be checked by the handheld and the device. If there are any problems an error message will be displayed on the handheld indicating the type of problem.
7. The new parameter value will be sent back to the handheld for visual confirmation by the user.
8. The user will be prompted to:
    a. Save the value by pressing the [ENTER] key, or
    b. Revert back to the original value by pressing the [MENU] key
9. The handheld will now display the parameter value as store in non-volatile memory in the device.

Note:	**Prior to disconnecting the handheld programmer, the user should verify all safety parameters are correct and document any changes made. Before restarting the system after making changes to safety parameters the safety functions must be validated.**

6.2 PARAMETER OVERVIEW



6.3 TEMPERATURE INPUT PORTS

The following describes the parameters available for each of the two temperature input ports.

6.3.1 Analogue Transmit Channel

First channel over which the 16-bit value will be transmitted over the HubBus network. The number of channels used (1, 4 or 8) for the transmission is determined by the configuration of the channel generator.

Limit	Value (channels)
Minimum	Disabled
Maximum	2048
Default	Disabled

Table 11: Parameter – HubBus Temperature Transmission Address

6.3.2 Temperature Input Range

The range parameter selects the measurement range of the HBTX2T input port. The HBTX2T has two temperature measurement ranges referred to as normal and wide.

The definition of the ranges is given in the following table:

Range	Temperature
Normal (Default)	-10˚C to +100˚C
Wide	-20˚C to +200˚C

Table 12: Parameter – Temperature Range

6.3.3 Trip Hysteresis

This parameter is used to configure the trip point hysteresis for each temperature input. The hysteresis value is used to stop the trip point alarms from switching on and off with minor temperature fluctuations around the set temperature trip points.

For example if the temperature trip point is set for 65.0˚C and higher then with no hysteresis minor fluctuations between 64.9˚C to 65.0˚C would cause alarms to be triggered constantly. So for the given example, if a hysteresis of 0.5˚C is used then the alarm would trigger once the temperature reaches and exceeds 65.0˚C but would not reset (clear) until the temperature dropped below 64.5˚C. The temperature would then have to reach 65.0˚C degrees again before the alarm would then be triggered once more.

A hysteresis value is set separately for each temperature input and has a resolution of 0.1˚C and may be set from 0.0˚C to 10.0˚C.

Limit	Value (˚C)
Step	0.1
Minimum	0.0
Maximum	10.0
Default	0.5

Table 13: Parameter – Temperature trip point hysteresis

6.3.4 Trip Points

There are two trip points configurable for each temperature input channel. The parameters for the trip points are as follows:

6.3.4.1 Trip Temperature

The temperature at which the trip alarm is transmitted. Parameter has a resolution of 1˚C.

Limit	Value (˚C)
Steps	1
Minimum	-20
Maximum	200
Default	0

Table 14: Parameter – Temperature trip point hysteresis

6.3.4.2 Alarm Address

HubBus channel that the trip alarm is transmitted.

An alarm state or trip state is transmitted as a logical 1 and non-alarm or non-trip state is transmitted as a logical 0.

Limit	Value (channels)
Minimum	Disabled
Maximum	2048
Default	Disabled

Table 15: Parameter – HubBus Temperature Trip Transmission Address

6.3.4.3 Trip Level

Defines the trip level as above or below the trip temperature.

If set to “Above” the HBTX2T will transmit:

- Logical 1 if the temperature is at or above the trip point temperature.
- Logical 0 if the temperature is at or below the trip point temperature less the hysteresis value.

Likewise, if set to “Below” the HBTX2T will transmit:

- Logical 0 if the temperature is at or above the trip point temperature plus the hysteresis value.
- Logical 1 if the temperature is at or below the trip point temperature.

Value
Below
Above
Disabled (Default)

Table 16: Parameter – HubBus Temperature Trip Level

6.4 MODBUS PARAMETERS

These are the Modbus parameters.

6.4.1 Modbus Address

Modbus address parameter, care must be taken not to have multiple devices with the same address on the bus.

Limit	Value (seconds)
Minimum	1
Maximum	247
Step	1
Default	10

Table 17: Parameter – Modbus Address

6.4.2 RS485 Enable

This should only be enabled when the unit is not being used for a safety function. It enables the Modbus RS485 port on the terminal connector and DIN rail bus.

Value	Meaning
Enabled	Port enabled
Disabled	Port disabled
Default	Disabled

Table 18: Parameter – RS485 Enable

7 MODBUS

7.1 PHYSICAL LAYER

Mode:	[Terminals] 2-wire RS485
	[Configuration Port] TTL
Protocol:	Modbus RTU
Baud Rate:	19200
Data Bits:	8
Stop Bits:	1
Parity:	Even
Address:	10

7.2 MODBUS REGISTERS

Register Limits:

- Code 1 / Read Coils: 256 bits
- Code 2 / Read Discrete Input: 256 bits
- Code 3 / Read Holding Registers: 64 words
- Code 4 / Read Input Registers: 64 words
- Code 15 / Write Multiple Coils: 256 bits
- Code 16 / Write Multiple Registers: 64 words

Modbus Address: 10

Message delay: 10ms

7.2.1 Device Identification

Type: Holding Registers

Register Name	Start Address	Number of registers	Read / Write	Description
Module Name	1024	4	R	“HBTX2T”
Module Identifier	1028	4	R	N/A, returns “”
Austdac Serial No.	1032	4	R	Austdac format serial number in the following format: “YYMMnnnn”
F/W Ver. Main	1036	1	R	Firmware version of the main microcontroller, most significant byte is the major and the least significant byte is the minor version number.
F/W CRC Main	1037	1	R	Returns 16-bit CRC signature of main firmware.
F/W Ver. Sub-ass.1	1038	1	R	Firmware version of the HubBus interface and display board, most significant byte is the major and the least significant byte is the minor version number.
F/W CRC Sub-ass.1	1039	1	R	Returns 16-bit CRC signature of the HubBus interface and display board.
F/W Ver. Sub-ass.2	1040	1	R	N/A, returns 0.0
F/W CRC Sub-ass.2	1041	1	R	N/A, returns 0
F/W Ver. Sub-ass.3	1042	1	R	N/A, returns 0.0
F/W CRC Sub-ass.3	1043	1	R	N/A, returns 0
Unique ID Main	1044	4	R	Unique identifier (64 bit). Comes from 1-wire device.
Unique ID Sub-ass.1	1048	4	R	N/A, returns 0
Unique ID Sub-ass.2	1052	4	R	N/A, returns 0
Unique ID Sub-ass.3	1056	4	R	N/A, returns 0
Protocol Version	1060	1	R	HubBus MODBUS configuration protocol version.

Table 19: Modbus Registers – Device identifier

7.2.2 Information

These are the MODBUS registers for direct access to the given information data.

Type: Holding Registers

Register Name	Data Address	Number of registers	Read / Write	Type	Volatile	High	Scale	Description
Temp 1	1065	1	R	U16	Y	1	1/10	Temp input 1 = x10 ˚C
Temp 1 Raw	1067	1	R	U16	Y	1	1	Raw ADC Value

Temp 2	1066	1	R	U16	Y	1	1/10	Temp input 2 = x10 ˚C
Temp 2 Raw	1068	1	R	U16	Y	1	1	Raw ADC Value
Mon Ext Power Supply	1069	1	R	U16	Y	1	1	External supply level

Table 20: Modbus Registers – Information Data

Displayed value = (DATA / HIGH) * SCALE

7.2.3 HubBus Digital

N/A

7.2.4 HubBus Datalink

N/A

8 Specifications

General	
Name	HubBus Two Channel Temperature Transmitter
Type	HBTX2T
Interface	
Number of HubBus terminals	1
Bus channels	Adaptive (up to 2048)
Bus protocol	Dual pulse alternating on cycles
Bus connection	Galvanically Isolated
RS485	1 x Modbus 2 wire (isolated port)
Configuration	TTL, 19,2k/8/1/E
Physical	
Dimensions	72mm (W) x 63mm (D) x 90mm (H)
Mass	120g
Mounting	DIN EN 60715 / TS35
Ingress protection	IP20
Enclosure material	PC (Polycarbonate) V0 (UL94)
Enclosure colour	RAL 7032 Grey / RAL 9005 Black
Terminals	
Terminals	90˚ free hanging push-in spring terminal plug
Terminal Cross Section	2.5mm^2
Terminal Pitch	5.08mm
Terminal Material	PA V0 (UL94)
Terminal Colour	Black
Environment	
Operating Temperature	-20ºC to 50ºC
Storage Temperature	-20ºC to 80ºC
Humidity	80% to temps. up to 31ºC decreasing linearly to 50%rH at 40ºC max 80% rH, non-condensing
Pollution Degree	2
Installation Category	1
Altitude	2000m
Electrical	
Bus voltage	12-48VDC (p-p)
Unit load	1
Bus current consumption	10mA maximum @ 12-48VDC
Bus speed	Auto configurable (1.2ms to 4.8ms/pulse)
Power supply voltage	10 to 48VDC
Power supply current	10mA maximum @ 10-48VDC
Status	
Modbus Activity	2 front panel LED
Controller healthy indication	1 front panel LED
Power healthy indication	1 front panel LED
Bus healthy indication	1 front panel LED
Temp Alarm/Trip Status	2 front panel LED
Temperature Inputs	
Number of inputs	2
Sensor Type	PT100 (2 wire, 3wire or 4wire)
Temperature Range	-10˚C to +100˚C or -20˚C to +200˚C
Sensor drive current	200µA
Data Resolution	0.1˚C
Accuracy	±1˚C
Temperature Drift	Normal ≤ 0.5˚C, Wide ≤ 1.0˚C
Trip Points	2 per input
Trip Level	Above or Below set point with configurable hysteresis

Table 21: Specifications