Title

HUBBUS

FOUR CHANNEL ANALOGUE TRANSMITTER

TYPE HBTX4A

USER MANUAL

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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

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1 Introduction

1.1 BACKGROUND 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 four channel analogue transmitter (HBTX4A). It provides an overview and a detailed description of the installation, use and operation of the HubBus four channel analogue 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.

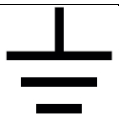
WARNING: The HubBus power source "Line-Ext" switch above the configuration port connector should be switched to the RIGHT side (Ext) if using an external power supply.

WARNING: If the HBTX4A is used in a manner not specified by Austdac then the protection provided by the HBTX4A 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 HBTX4A.
- 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 HBTX4A. The user should not open or disassemble the HBTX4A.

2.3.2 STORAGE, INSTALLATION, USE AND MAINTAINANCE REQUIREMENTS

The HBTX4A 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 HBTX4A should be inspected for the following;

- Any external damage to the enclosure.

The HBTX4A may be installed in any orientation.

The HBTX4A 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 HBTX4A should be mounted to a stable surface avoiding areas under constant vibration and shock.

3 Overview

3.1 GENERAL DESCRIPTION

The HubBus four channel analogue transmitter is part of a family of products that form an Austdac HubBus distributed I/O system. The HBTX4A can transmit up to four 0-20mA or 0.0-2.0VDC analogue values over the HubBus network.

Figure 1: HubBus Four Channel Analogue Transmitter

The four analogue inputs are galvanically isolated from the HubBus network port.

The HBTX4A can be configured using a laptop computer running HubBus configuration software and a small plug in programming adaptor or Austdac's HubBus Handheld programmer. All four analogue 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. Each analogue input may also have it's under range, hysteresis, digital fault channels and trip alarms configured by the user. Five trip points are configurable for each of the inputs along with independent under or over reading alarms, hysteresis and output channels.

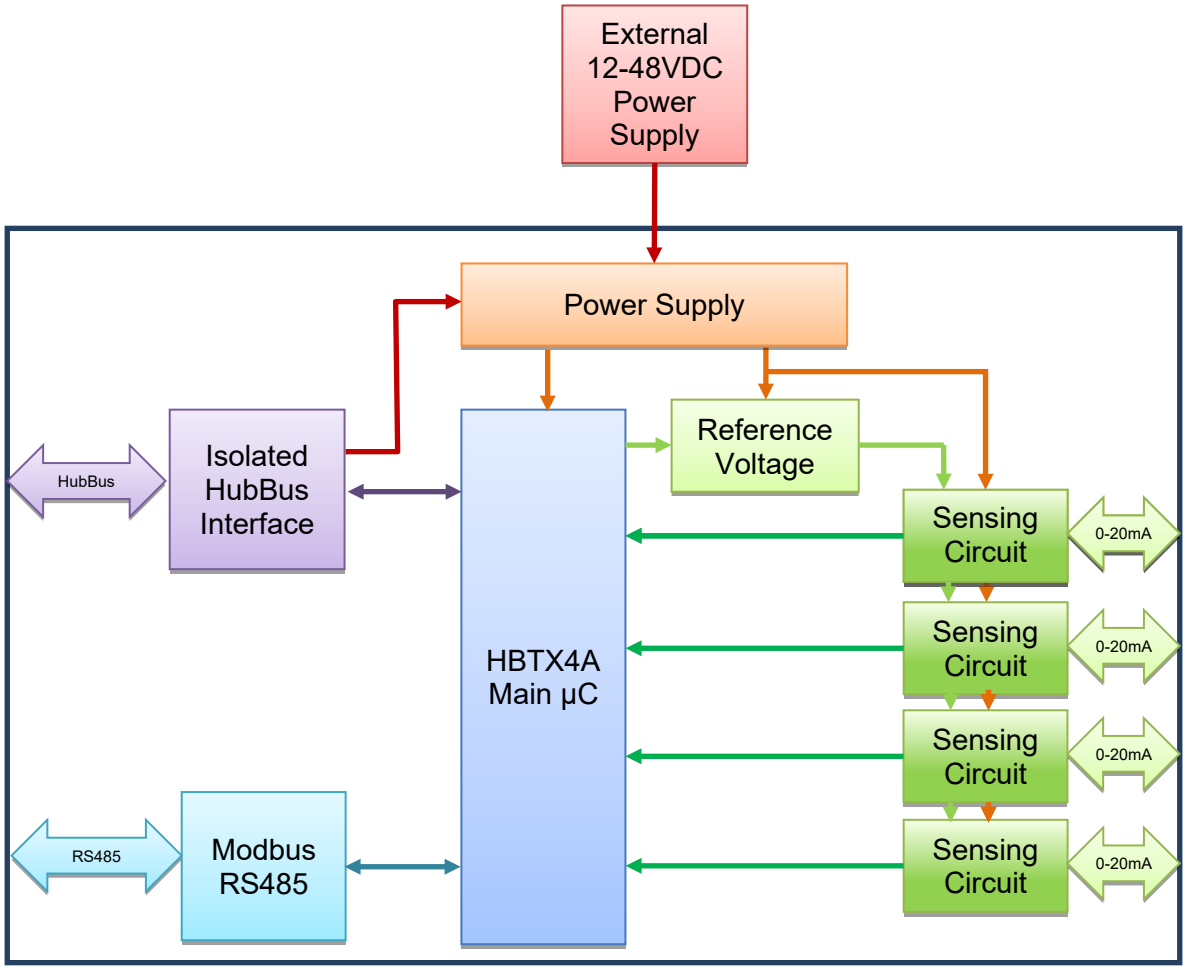


Figure 2: HubBus Four Channel Analogue Transmitter Block Diagram

3.2 OPERATION

Each of the four channel analogue transmitters' inputs takes four analogue inputs and transmits them onto the connected HubBus network using the Datalink protocol. The analogue inputs are converted to a twelfth bit value ready for transmission on the configured HubBus channel.

The analogue input is also monitored for under range signal level; if the input signal is below the configured level then a fault is generated. This fault can be transmitted as a digital signal on any valid HubBus channel address. In addition to fault channels, five alarm points may be configured to trigger at configurable current (or voltage) levels at either above or below the trigger level.

A hysteresis level can be configured for each input to stop fault and alarm signals from chattering because of minor fluctuations on the analogue signal.

All configurable aspects of the four channel analogue transmitter can be programmed via the configuration port. The transmitter will auto configure and operate with the number of channels and pulse bandwidth being transmitted by the channel generator.

4 Installation

4.1 ENCLOSURE

The HBTX4A should be mounted in a host enclosure providing protection against dust and moisture. A minimum ingress protection of IP54 is recommended.

4.2 MOUNTING

The HBTX4A should be mounted on an NS 35 DIN rail.

Optionally, a 16-position DIN rail connector can be inserted in the DIN rail. This serves to establish automatic contact from device to device. The bus connector carries HubBus, Modbus and power.

4.3 TERMINALS

All connections to the HBTX4A are via screw connection with tension sleeve terminals around the base of the DIN rail mounting enclosure.

- Maximum cross section of solid core conductor: 2.5mm^2
- Maximum cross section of stranded conductor with ferrule: 2.5mm^2
- Minimum cross section of solid core conductor: 0.2mm^2
- Minimum cross section of stranded conductor with ferrule: 0.25mm^2

4.4 WIRING

Ensure that any relay contact wiring is separated from the HubBus wiring by at least 50mm.

5 Front Panel

5.1 OUTER

As viewed with the top cover in place.

Figure 3: Front panel

5.1.1 LEDS

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

5.1.1.1 STAT

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

Table 1: STAT LED

5.1.1.2 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 2: SYNC LED

5.1.1.3 +V

Colour	Flash Rate	Description
GREEN	Solid	External power source good.

Table 3: +V LED

5.1.1.4 Rx

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

Table 4: Rx LED

5.1.1.5 Tx

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

Table 5: Tx LED

5.1.1.6 (1)

Colour	Flash Rate	Description
YELLOW	Solid	One of the configured alarm points for input 1 has tripped for either under or over voltage/current.
YELLOW	Fast	Under range fault.
YELLOW	Slow	Input circuit fault detected.

Table 6: (1) LED

5.1.1.7 (2)

Colour	Flash Rate	Description
YELLOW	Solid	One of the configured alarm points for input 2 has tripped for either under or over voltage/current.
YELLOW	Fast	Under range fault.
YELLOW	Slow	Input circuit fault detected.

Table 7: (2) LED

5.1.1.8 (3)

Colour	Flash Rate	Description
YELLOW	Solid	One of the configured alarm points for input 3 has tripped for either under or over voltage/current.
YELLOW	Fast	Under range fault.
YELLOW	Slow	Input circuit fault detected.

Table 8: (3) LED

5.1.1.9 (4)

Colour	Flash Rate	Description
YELLOW	Solid	One of the configured alarm points for input 4 has tripped for either under or over voltage/current.
YELLOW	Fast	Under range fault.
YELLOW	Slow	Input circuit fault detected.

Table 9: (4) LED

5.2 INNER

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

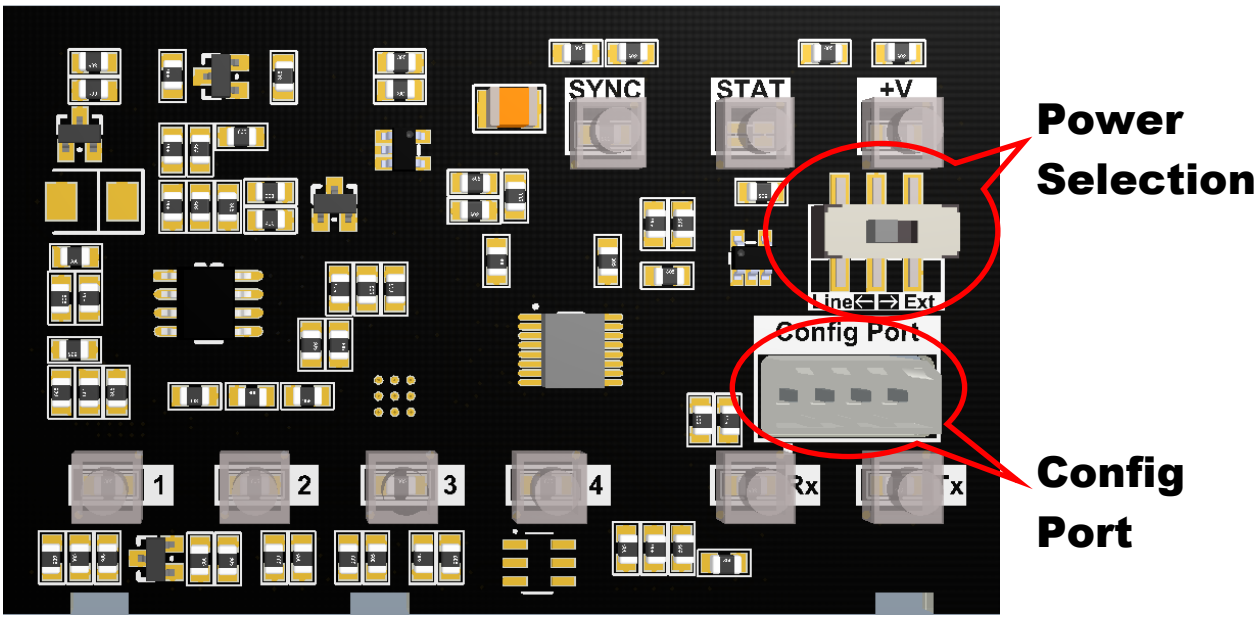


Figure 4: Display and interface board

5.2.1 Power Source Selection

Power source selection:

A. HubBus line powered

B. External power supply

5.2.2 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.

6 Terminals

6.1 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.

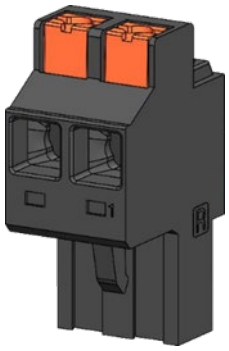


Figure 5: Terminal Plug

6.2 LAYOUT

HBTX4A					
13	+	Input 1	HubBus Signal	Signal+	1
14	V-I			Signal-	2
15	-				
16	+	Input 2			
17	V-I				
18	-				
19	+	Input 3	RS485 Modbus	A+	7
20	V-I			B-	8
21	-			COM	9
22	+	Input 4	N/A		10
23	V-I		Power Input	+V	11
24	-			0V	12

Table 10: HBTX4A Terminals

6.2.1 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.

Recommended: 24VDC @ 0.5A

Operating Range: 10-48VDC

HubBus

HubBus terminals for interfacing to the HubBus network. This port is electrically isolated from all the other terminals on the HBTX4A module.

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

6.2.2 MODBUS

This is an RS485 MODBUS port at 19,200bps used for configuration. The HBTX4A 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.

6.2.3 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

6.2.4 Analogue Input Terminals (1 to 4)

Each analogue input is provided with three terminals for the connection of field wiring. Each input can accept a voltage or current type signal depending on the way the field wiring is terminated at the transmitter. For voltage type input signals the '+' and '-' input terminals are used as shown for input one in Figure 6 below. For current type signals the '+' and '-' input terminals are also used with an added link between the '+' and 'I-to-V' terminals as shown for channel four in Figure 6 below. By linking the '+' and 'I-to-V' terminals a 100Ω current to voltage converting resistor is connected across the input of the transmitter.

Input	Terminal	Signal	Description
Input 1	13	+	Input 1 High or positive terminal
	14	I-to-V	Input 1 current to voltage conversion resistor input
	15	-	Input 1 Low or negative terminal
Input 2	16	+	Input 2 High or positive terminal
	17	I-to-V	Input 2 current to voltage conversion resistor input
	18	-	Input 2 Low or negative terminal
Input 3	19	+	Input 3 High or positive terminal
	20	I-to-V	Input 3 current to voltage conversion resistor input
	21	-	Input 3 Low or negative terminal
Input 4	22	+	Input 4 High or positive terminal
	23	I-to-V	Input 4 current to voltage conversion resistor input
	24	-	Input 4 Low or negative terminal

Table 11: Analogue input terminal details

Note:

The analogue inputs are galvanically isolated from the HubBus network port; it is important that the connect equipment 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.

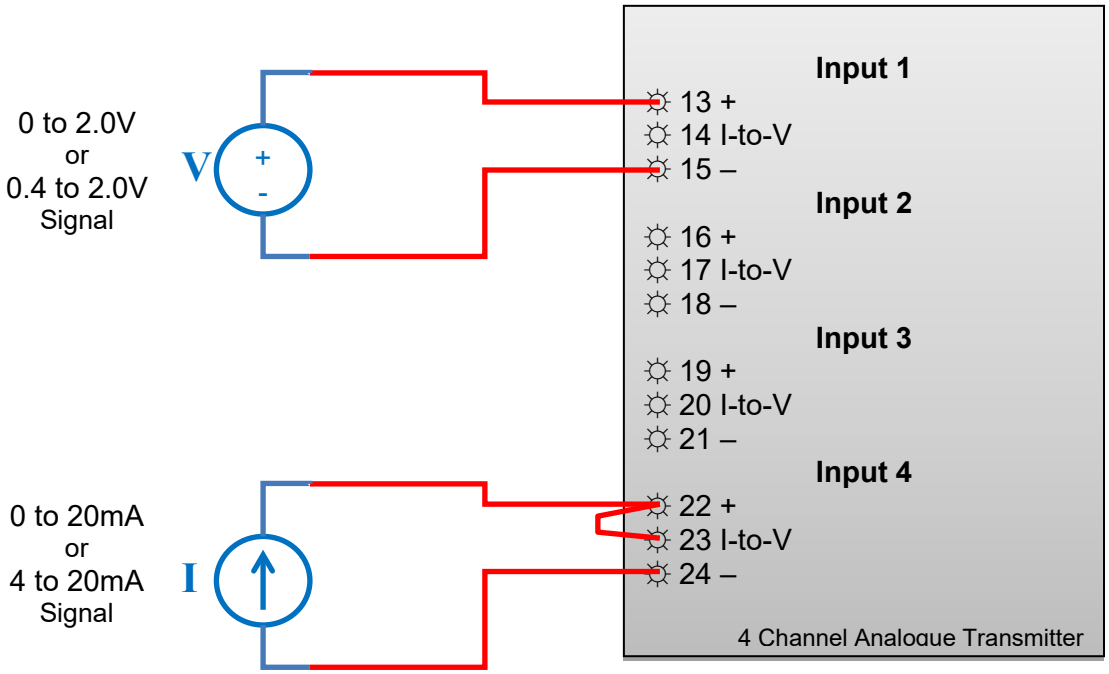


Figure 6: Connection diagram for current and voltage input sources

6.2.4.1 Voltage Mode Input Impedance

The input impedance is determined by the input resistor network and is approximately 100kΩ. The source impedance at each of the two input terminals must be nearly equal to maintain good common-mode rejection. Source impedances greater than 800Ω are not recommended, even if they are perfectly matched. Adding equal resistors greater than 800Ω can cause a mismatch in the total resistor ratios, degrading CMR.

7 Configuration and Parameters

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

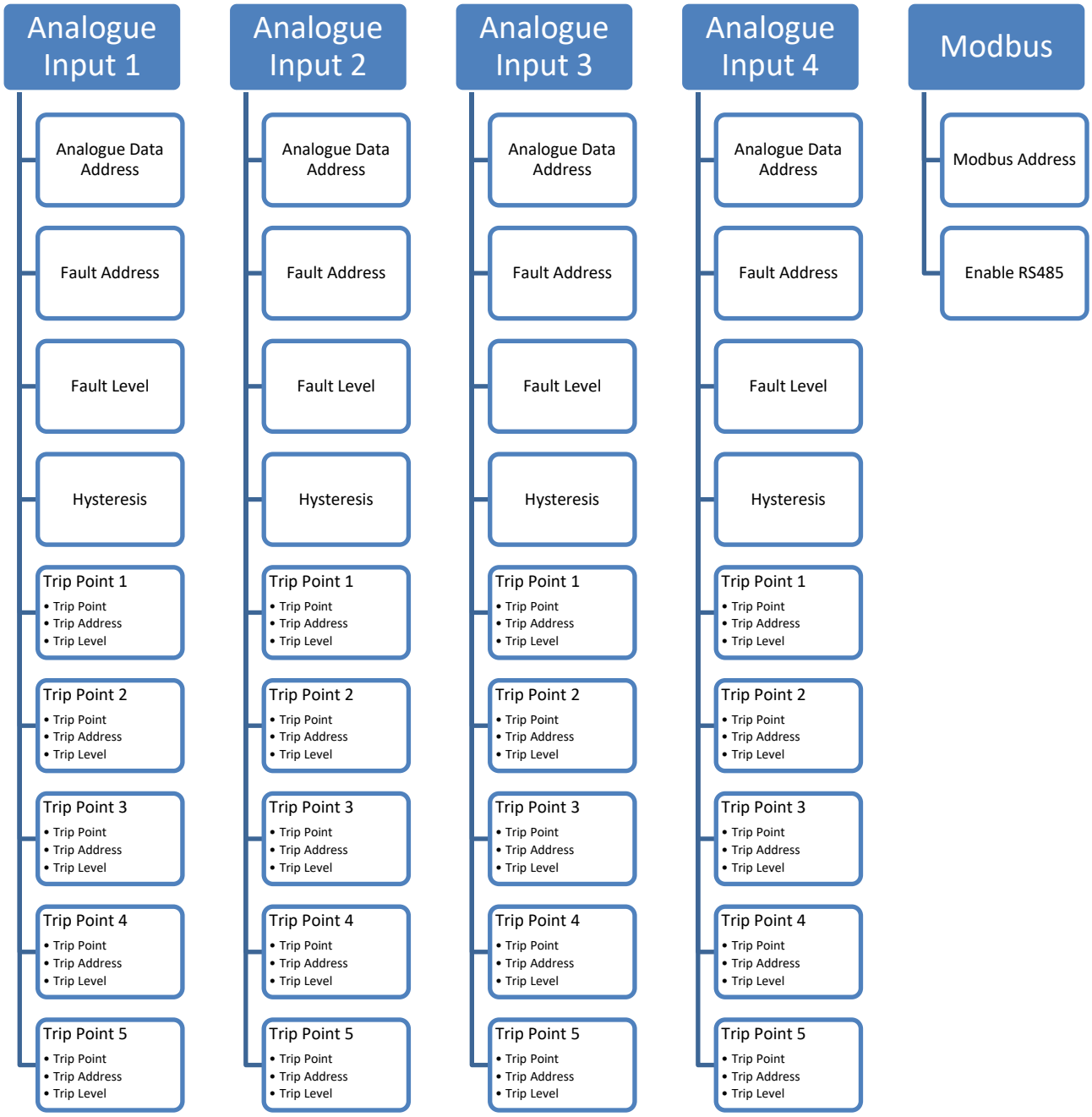
7.1 CONFIGURATION PROCESS

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.**

7.2 PARAMETER OVERVIEW



7.3 ANALOGUE INPUT PORTS

The following describes the parameters available for each of the four analogue input ports.

7.3.1 Analogue Data 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 12: Parameter – HubBus Analogue Transmission Address

7.3.1 Under-range Fault Alarm Channel

Digital channel for transmission of under-range faults. The fault signals are generated when and analogue input falls below a preconfigured fault level. The alarm should be disabled if the input port is not in use.

Limit	Value (channels)
Minimum	Disabled
Maximum	2048
Default	Disabled

Table 13: Parameter – HubBus Analogue Input Fault Address

7.3.1 Under-range Fault Alarm Level

Used to configure the under-range fault trigger point for each of the analogue inputs. The fault trigger point allows the analogue transmitter to detect input signals that are out of range (less than 4mA) or open circuit. The fault level is entered as a µA level for example 3800. This would cause a fault to be generated whenever the input signal fell below 380mV for a 0.4 to 2.0V input signal or 3.80mA for a 4 to 20mA signal.

Limit	Value (mA)
Disable	0.000
Minimum	0.001
Maximum	3.999
Default	Disabled

Table 14: Parameter – HubBus Analogue Input Fault Level

7.3.2 Alarm and Trip Hysteresis

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

For example, if the trip point is set for 10mA and higher, then with no hysteresis minor fluctuations between 9.990mA to 10.000mA would cause alarms to be triggered constantly. So, for the given example, if a hysteresis of 0.1mA (100uA) is

used then the alarm would trigger once the input reaches and exceeds 10mA but would not reset (clear) until the input dropped below 9.900mA. The input would then have to reach 10.000mA again before the alarm would then be triggered once more.

A hysteresis value is set separately for each analogue input and has a resolution of 1µA (0.001mA) and may be set from 0µA to 1000µA (1mA).

Limit	Value (mA)
Minimum	0.000
Maximum	1.000
Default	0.050

Table 15: Parameter – Analogue input alarm and trip point hysteresis

7.3.3 Trip Points

There are five trip points configurable for each analogue input port. The parameters for the trip points are as follows:

7.3.3.1 Trip Value

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

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

Table 16: Parameter – Temperature trip point hysteresis

7.3.3.2 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)
Disabled	0
Minimum	1
Maximum	2048
Default	Disabled

Table 17: Parameter – HubBus Analogue Trip Transmission Address

7.3.3.3 Trip Level

Defines the trip range as above or below the set trip value.

If set to “Above” the HBTX4A will transmit:

- Logical 1 if the analogue value of the input port is at or above the trip point value.

- Logical 0 if the analogue value of the input port is at or below the trip point value (less the hysteresis value if it had previously been in alarm).

Likewise, if set to “Below” the HBTX4A will transmit:

- Logical 1 if the analogue value of the input port is at or below the trip point value.
- Logical 0 if the analogue value of the input port is above the trip point value (plus the hysteresis value if it had previously been in alarm).

Limit	Parameter	Value (channels)
Unit	1	1
Minimum	0	Disabled
	1	Below
Maximum	2	Above
Default	0	Disabled

Table 18: Parameter – HubBus Analogue Trip Level

7.1 MODBUS PARAMETERS

These are the Modbus parameters.

7.1.1 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 19: Parameter – Modbus Address

7.1.2 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 20: Parameter – RS485 Enable

8 MODBUS

8.1 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

8.2 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

8.2.1 Device Identification

Type: Holding Registers

Register Name	Start Address	Number of registers	Read / Write	Description
Module Name	1024	4	R	"HBTX4A"
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 21: Modbus Registers – Device identifier

8.2.2 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
Input 1	1065	1	R	U16	Y	1	1	Input port 1 in µA
Input 2	1066	1	R	U16	Y	1	1	Input port 2 in µA
Input 3	1067	1	R	U16	Y	1	1	Input port 3 in µA
Input 4	1068	1	R	U16	Y	1	1	Input port 4 in µA

Count 1	1069	1	R	U16	Y	1	1	ADC count for port 1
Count 2	1070	1	R	U16	Y	1	1	ADC count for port 2
Count 3	1071	1	R	U16	Y	1	1	ADC count for port 3
Count 4	1072	1	R	U16	Y	1	1	ADC count for port 4
V Supply / Monitor	1073	1	R	U16	Y	1	1	mV Ext Power Supply

Table 22: Modbus Registers – Information Data

Displayed value = (DATA / HIGH) * SCALE

8.2.3 HubBus Digital

N/A

8.2.4 HubBus Datalink

N/A

9 Specifications

General	
Name	HubBus Four Channel Analogue Transmitter
Type	HBTX4A
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 consumption	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
Input Alarm/Trip Status	4 front panel LED
Analogue Inputs	
Number of inputs	4
Input current range	0-20mA, 4-20mA
Input voltage range	0-2.0V, 0.4-2.0V
Input current to voltage conversion resistance	100Ω ± 0.1%
Data Resolution	0.01mA / 1mV
Trip Points	5 per input
Trip Level	Above or Below set point with configurable hysteresis

Table 23: Specifications