



Title

# HUBBUS

## FOUR CHANNEL DIGITAL RECEIVER

### TYPE HBRX4D

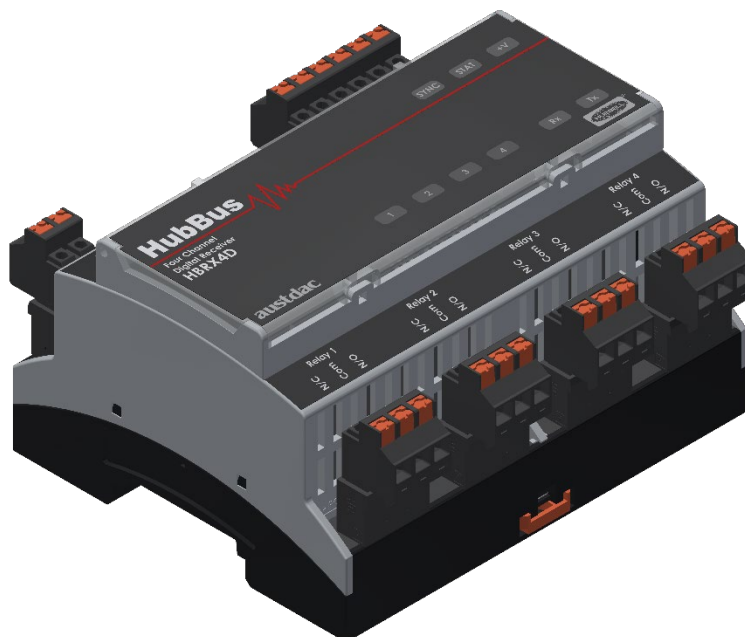
### USER MANUAL

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# 01



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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 digital receiver (HBRX4D). It provides an overview and a detailed description of the installation, use and operation of the HubBus four channel digital receiver.

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 MUST be switched to the RIGHT side (Ext).



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



**WARNING:** Operating the HBRX4D below the specified minimum switching requirements will result in intermittent and unreliable operation of the output relay contacts.



**WARNING:** Operating the HBRX4D above its maximum switching capabilities will result in unreliable operation of the output relay contacts and possibly result in welded or open circuit contacts.







**WARNING:** If the HBRX4D is used in a manner not specified by Austdac then the protection provided by the HBRX4D 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 HBRX4D.
- Mains supply fluctuations are not to exceed  $\pm 10\%$  of the nominal supply voltage.

### 2.3.1 USER ACCESS

There are no user serviceable parts within the HBRX4D. The user should not open or disassemble the HBRX4D.

### 2.3.2 STORAGE, INSTALLATION, USE AND MAINTAINANCE REQUIREMENTS

The HBRX4D 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 HBRX4D should be inspected for the following;

- Any external damage to the enclosure.

The HBRX4D may be installed in any orientation.

The HBRX4D 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.

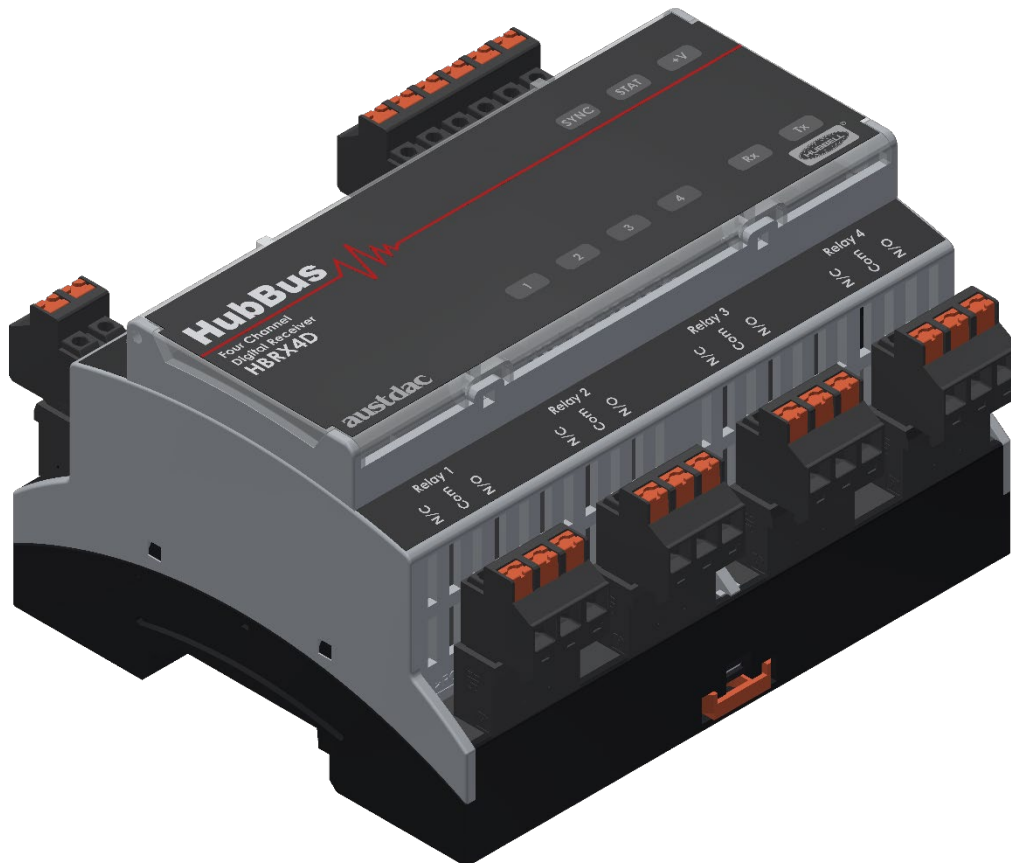
The HBRX4D should be mounted to a stable surface avoiding areas under constant vibration and shock.



## 3 Overview

### 3.1 GENERAL DESCRIPTION

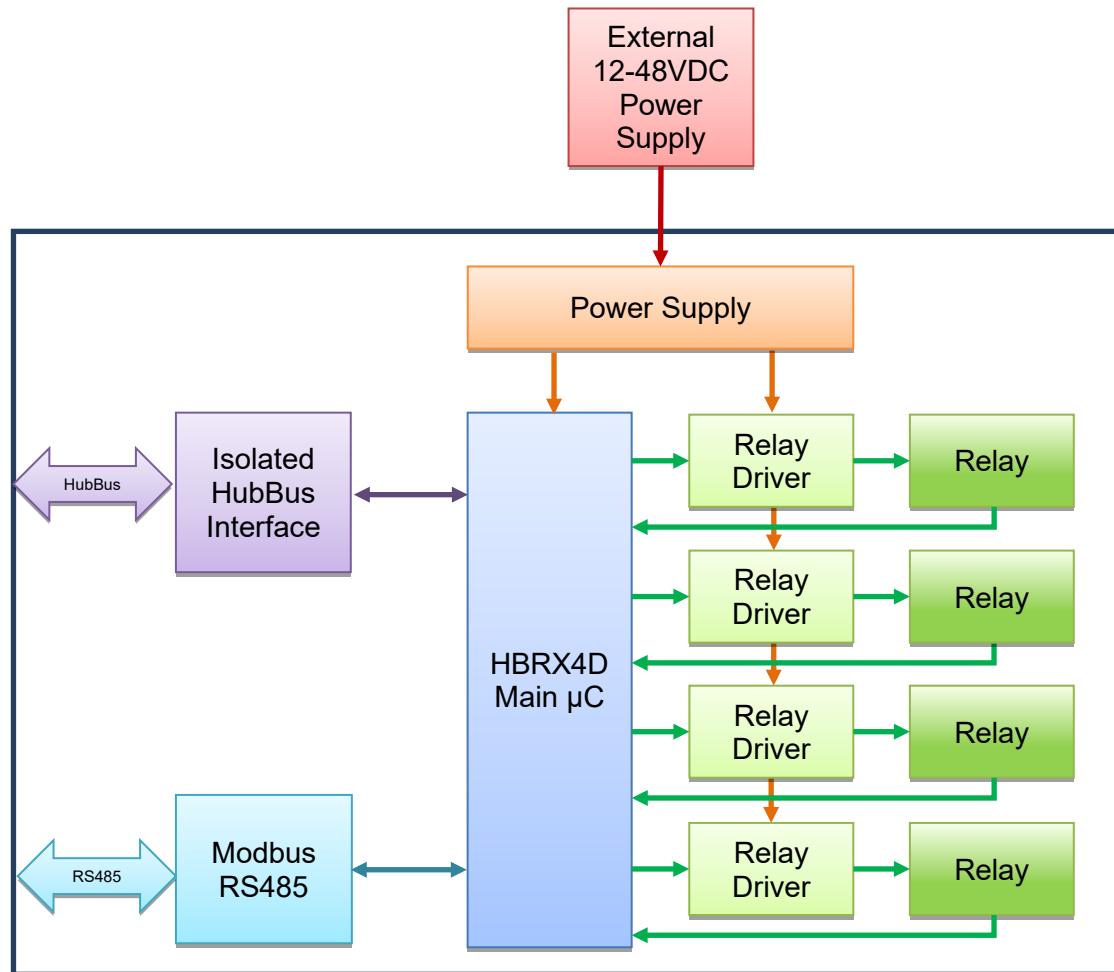
HubBus four channel receiver with digital (relay) outputs. The HBRX4D can receive from just a few (from 1) through to many digital (up to 2048) signals (ON, OFF or FAULT) from a HubBus network to control the four relay outputs directly or via complex multi-term logic functions.



**Figure 1: HubBus four channel digital receiver**

The digital receiver has four output relays controlled by up to six logic resolvers capable of implementing OR, AND, NOR and NAND logic functions. Each resolver has an independently configurable output ON and OFF delay filter to allow implementation of simple timer functions.

For safety each relay output uses active driver circuitry such that a failure in any part of the driver circuit will lead to the relay output failing to the safe mode (de-energised state). Additionally, the physical positions of the relays are also monitored to detect other dangerous failure modes such as frozen contacts.



**Figure 2: HubBus Four Channel Receiver Block Diagram**

## 3.2 OPERATION

### 3.2.1 Fault Monitoring and Prevention

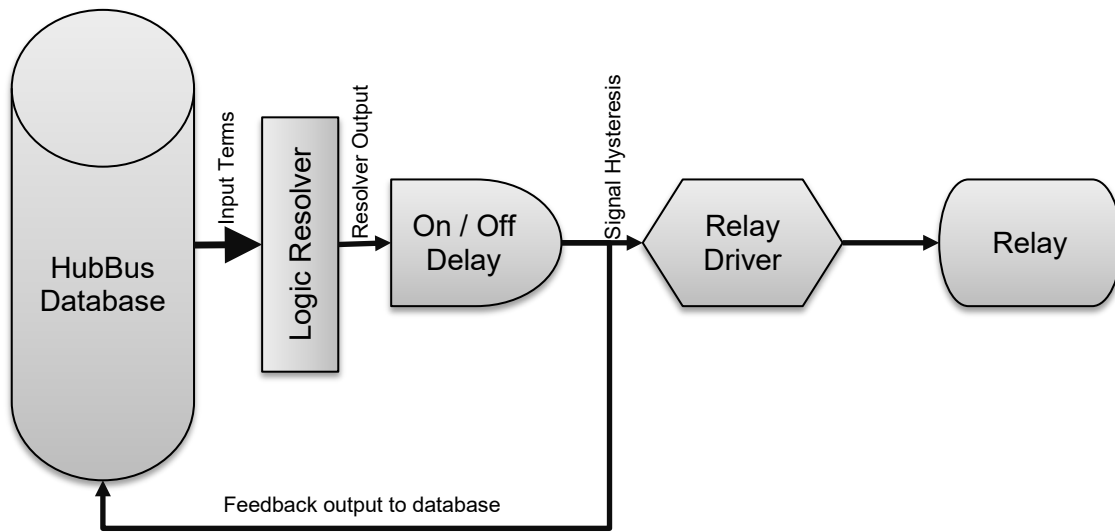
The HBRX4D has advanced firmware and hardware features for increased safety and reliability in preventing an undesired state of the relay outputs.

The relays are driven by a dynamic signal driven by firmware only if all internal diagnostics indicate that the hardware is in correct working order. In addition to this the HBRX4D has a second set of force guided contacts which are used to indicate the current state of the relay contacts. If a fault is detected and the relays are potentially in a 'stuck' state then a fault alarm is transmitted on the HubBus network. Another relay may be used to trip on a fault condition to shut-down the system under control.

### 3.2.2 Logic Resolvers

The HBRX4D digital receiver has six configurable multi-term logic resolvers of which four drive relay outputs. These logic resolvers are typically used to implement

functions for emergency stop or remote isolation. The available basic logic functions are 'OR', 'AND', 'NAND' and 'NOR'.



**Figure 3: Multi-term logic layout and function**

Each logic resolver may use the maximum number of input terms equal to the maximum number of HubBus channels (i.e. 2048). The input terms for each channel may be specified as 'ON', 'OFF' or 'FAULT'. Channels assigned for Datalink (multi-channel transmission) should not be used as input terms of the logic functions as unpredictable results will be obtained.

The output of the logic resolver may have hysteresis or delay applied before being applied to the relay or HubBus output. The on and off filter times may be independently configured from 100ms to minutes in 100ms steps. These delays are used to stop intermittent signals from causing inadvertent trips and alarms. The filter on time ensures that the output from the logic resolver must be on for the 'on' filter period before the relay output will be asserted. The filter off time ensures that the output from the logic resolver must be off for the 'off' filter period before the relay output will be negated.

The filtered logic resolver output may also be sent back onto the HubBus channel database for transmission and use in further logic operations or to be read via the MODBUS interface.

If the relay output is required to be operated from a single HubBus channel then a single-term 'AND' or 'OR' logic function should be implemented.

When logic resolver outputs are fed back into the HubBus channel database the designer should ensure that these feedback channels are not modified by other field devices or via the MODBUS interface.

## 4 Installation

### 4.1 ENCLOSURE

The HBRX4D 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 HBRX4D 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 HBRX4D are via push-in spring connection with tension sleeve terminals around the base of the DIN rail mounting enclosure.

- Maximum cross section of solid core conductor:  $2.5\text{mm}^2$
- Maximum cross section of stranded conductor with ferrule:  $2.5\text{mm}^2$
- Minimum cross section of solid core conductor:  $0.2\text{mm}^2$
- Minimum cross section of stranded conductor with ferrule:  $0.25\text{mm}^2$

### 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.

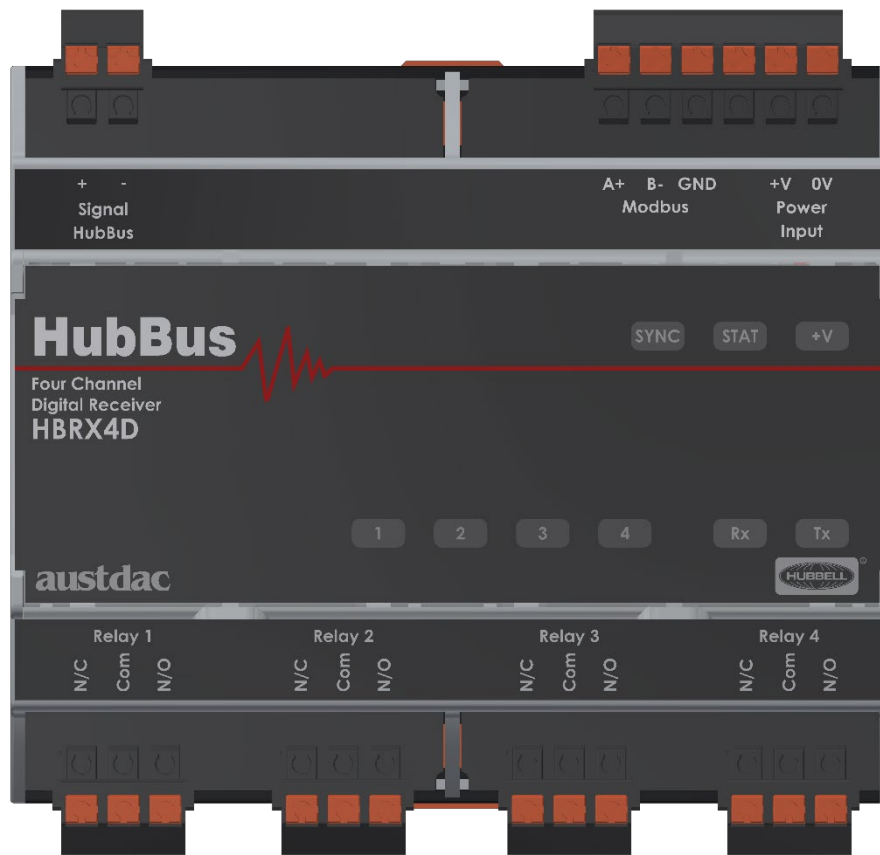


Figure 4: Front panel

#### 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	Relay 1 energised
YELLOW	Fast	Relay 1 fault detected

**Table 6: (1) LED**

### 5.1.1.7 (2)

Colour	Flash Rate	Description
YELLOW	Solid	Relay 2 energised
YELLOW	Fast	Relay 2 fault detected

**Table 7: (2) LED**

### 5.1.1.8 (3)

Colour	Flash Rate	Description
YELLOW	Solid	Relay 3 energised
YELLOW	Fast	Relay 3 fault detected

**Table 8: (3) LED**

### 5.1.1.9 (4)

Colour	Flash Rate	Description
YELLOW	Solid	Relay 4 energised
YELLOW	Fast	Relay 4 fault detected

**Table 9: (4) LED**

## 5.2 INNER

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

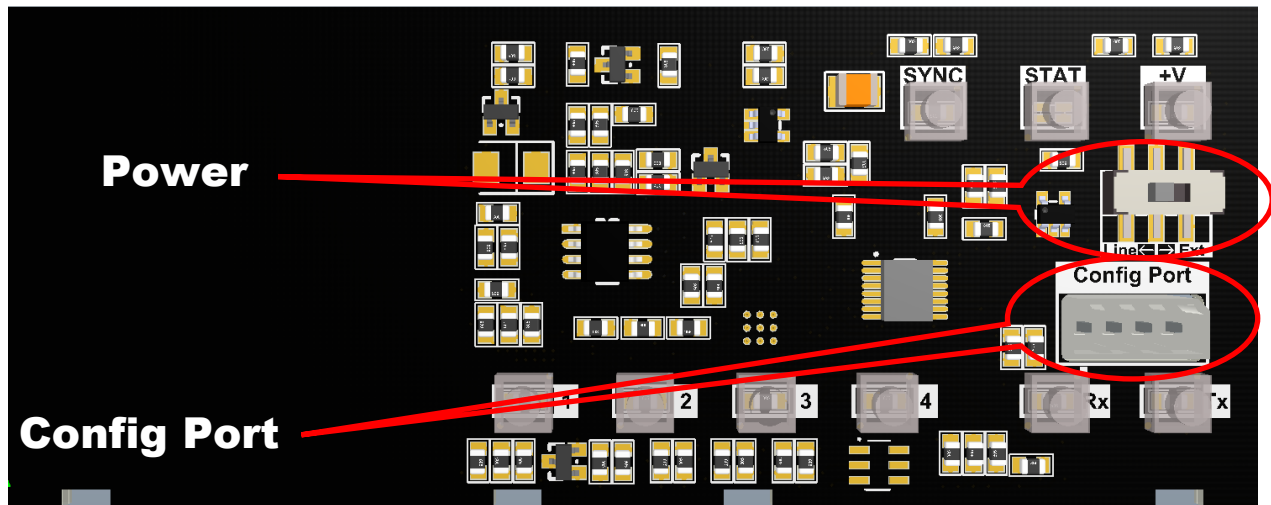


Figure 5: Display and interface board

### 5.2.1 Power Source Selection

Power source selection:

- A. HubBus line powered
- B. External power supply

This switch is not applicable or functional on the HBRX4D as it must be powered from an external power supply. It is not capable of being line powered.

### 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 either a 90° free hanging push-in spring terminal plug.

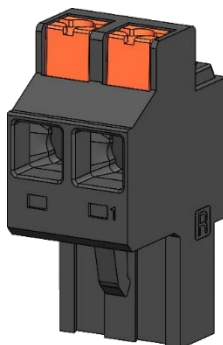


Figure 6: Terminal Plug

### 6.2 LAYOUT

HBRX4D					
17	N/C	Relay 1	HubBus	Signal+	1
18	COM			Signal-	2
19	N/O				
22	N/C	Relay 2			
23	COM				
24	N/O				
25	N/C	Relay 3			
26	COM				
27	N/O				
			RS485 Modbus	A+	11
				B-	12
				COM	13
30	N/C	Relay 4	Power Input		14
31	COM			+V	15
32	N/O			0V	16

Table 10: HBRX4D 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.

Operating Range: 10-48VDC

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



### 6.2.2 HubBus

HubBus terminals for interfacing to the HubBus network. This port is electrically isolated from all the other terminals on the HBRX4D module.



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

### 6.2.3 MODBUS

This is an RS485 MODBUS port at 19,200bps used for configuration. The HBRX4D 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.

### 6.2.4 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

### 6.2.5 Relay Terminals (1 to 4)

This output is a general purpose relay output with normally open and normally closed contact sets. Control logic may be configured with 1 to many HubBus channels using 'OR' or 'AND' logic.

The user must ensure that the relay contacts are not subjected to transient loads such as back EMF from a coil, relay or contactor or high transient current loads such as capacitive loads. Transient voltages must not exceed 500V.

The status of the relay is also available as a front panel LED indication, as a HubBus channel or as a MODBUS status.

## 7 Configuration and Parameters

The following are descriptions of the system and device parameters. They may only be configured using the Austdac Hand-Held Programmer type HHP1-H. Refer to the “HHP1-H Handheld Programmer User Manual” (125-198-12) for further information.

### 7.1 CONFIGURATION PROCESS

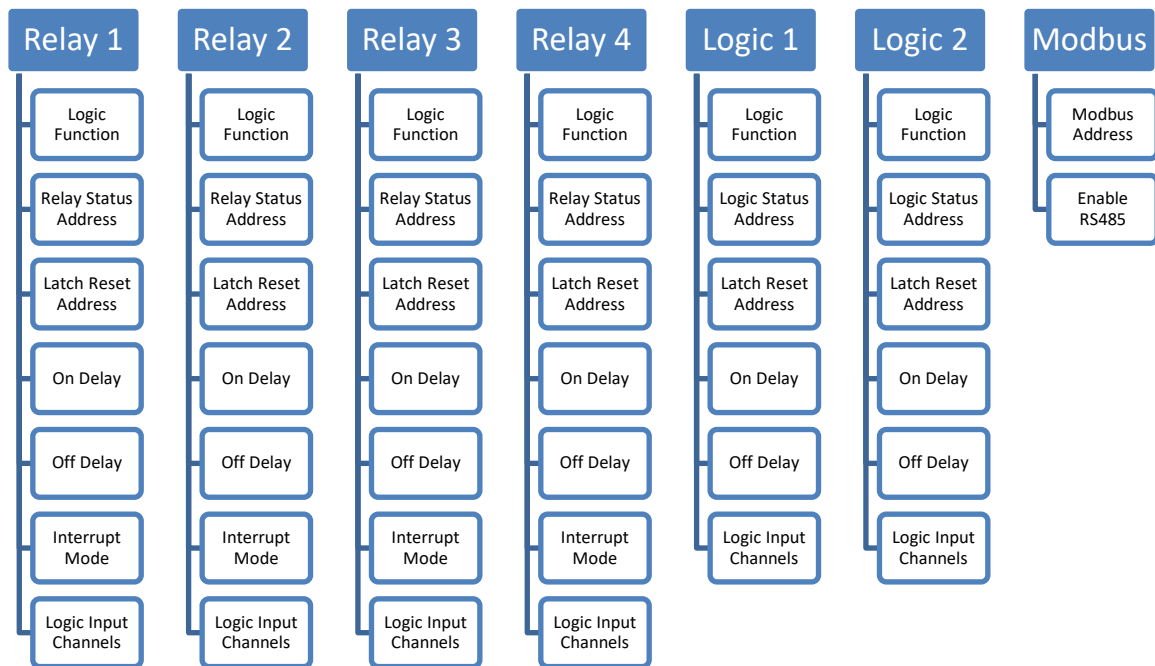
This unit may be used in a safety function. Only the Austdac Handheld programmer, type HHP1-H, may be used to configure the HubBus safety devices.

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 SUMMARY



### 7.2.1 Relay Parameters

The following describes the parameters available for each of the four physical relays and the two virtual logic resolvers.

#### 7.2.1.1 Logic Function

Logic function associated with each logic resolver.

Default	Value
Yes	Disabled
	AND
	OR
	NAND
	NOR

Table 11: Parameter – Logic Function

#### 7.2.1.2 Relay (Logic) Status HubBus Output Address

Feedback or returned value from the logic resolver to be transmitted by the HBRX4D and/or used as input to other logic functions.

Limit	Value (channels)
Minimum	0 (Disabled)
Maximum	2048
Default	Disabled

Table 12: Parameter – HubBus Output Address

### 7.2.1.3 Latch Reset Address

If enabled with a HubBus address, the relay will not re-energise after a trip or restart until it has seen a transition from OFF (0) to ON (1) on the configured HubBus channel. All input logic must be in a state that will allow for energisation of the output and then only after the transition of the latch reset channel from OFF-to-ON, will the output be energised.

Limit	Value (channels)
Minimum	0 (Disabled)
Maximum	2048
Default	Disabled

**Table 13: Parameter – HubBus Latch Reset Address**

### 7.2.1.4 On Delay

The OFF-to-ON hysteresis (or persistence delay) period for the given logic resolver. The delay can be assigned a value from 0.1 seconds through to 300 seconds (5 minutes). The functional logic has to be true for this period before the state is applied to the relay and/or HubBus output channel as selected in the previous section.

Limit	Value (seconds)
Minimum	0
Maximum	300
Step	0.1
Default	0

**Table 14: Parameter – Logic On Delay**

### 7.2.1.5 Off Delay

The ON-to-OFF hysteresis (or persistence delay) period for the given logic resolver. The delay can be assigned a value from 0.1 seconds through to 300 seconds (5 minutes). The functional logic has to be false for this period before the state is applied to the relay and/or HubBus output channel as selected in the previous section.

Limit	Value (seconds)
Minimum	0
Maximum	300
Step	0.1
Default	0

**Table 15: Parameter – Logic Off Delay**

### 7.2.1.6 Channels

The logic resolver may equate (have input defined for) up to 2048 channels. Each channel input may have one of 4 states defined as the input term.

- Ignore: Logic resolver ignores this channel when resolving the term.
- OFF: The digital input is in the 'off', inactivated or reset state.
- ON: The digital input is in the 'on', activated or locked-out state.
- Fault: The digital input is in the 'fault' state or not transmitting.

Parameter	Value	Description
Don't Care/Ignore	-	Not included in logic function
ON	1	Locked-out/Activated
OFF	0	Reset
Fault/Missing	X	Fault state

**Table 16: Parameter – Channel Logic Values**

### 7.2.1.7 Examples

The following are some basic logic function examples.

#### **Example 1**

- Channels: 10, 20, 30, 40 and 50 all ON.
- Logic Function: AND
- Logic term: 10(ON).20(ON).30(ON).40(ON).50(ON)

#### **Example 2**

- Channels: 10, 20, 30, 40 all ON and 50 OFF.
- Logic Function: AND
- Logic term: 10(ON).20(ON).30(ON).40(ON).50(OFF)

#### **Example 3**

- Channels: Any of 10, 20, 30, 40 or 50 are ON.
- Logic Function: OR
- Logic term: 10(ON)+20(ON)+30(ON)+40(ON)+50(ON)

#### **Example 4**

- Channels: Any of 10, 20, 30 or 40 are ON or 50 is OFF.
- Logic Function: OR
- Logic term: 10(ON)+20(ON)+30(ON)+40(ON)+50(OFF)

## 7.2.2 Modbus Parameters

These are the Modbus parameters.

### 7.2.2.1 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**

### 7.2.2.2 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**

## 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	"HBRX4D"
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**

## 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
Relay1	1065	1	R	U16	Y	1	1	Relay State 0 = De-energised 1 = Energised 2 = Relay Fault
Relay2	1066	1	R	U16	Y	1	1	
Relay3	1067	1	R	U16	Y	1	1	
Relay4	1068	1	R	U16	Y	1	1	



Logic 1	1069	1	R	U16	Y	1	1	4 = Logic Fault
Logic 2	1070	1	R	U16	Y	1	1	
External Power	1071	1	R	U16	Y	1	1	External line power
+5V0	1072	1	R	U16	Y	1	1	5V rail
+7V0	1073	1	R	U16	Y	1	1	7V rail
+3V3/3V6	1074	1	R	U16	Y	1	1	Combined 3v3 and 3v6 diagnostic

**Table 20: 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

<b>General</b>	
Name	HubBus Four Channel Digital Receiver
Type	HBRX4D
<b>Interface</b>	
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
<b>Physical</b>	
Dimensions	108mm (W) x 63mm (D) x 90mm (H)
Mass	250g
Mounting	DIN EN 60715 / TS35
Ingress protection	IP20
Enclosure material	PC (Polycarbonate) V0 (UL94)
Enclosure colour	RAL 7032 Grey / RAL 9005 Black
<b>Terminals</b>	
Terminals	90° free hanging push-in spring terminal plug
Terminal Cross Section	2.5mm <sup>2</sup>
Terminal Pitch	5.08mm
Terminal Material	PA V0 (UL94)
Terminal Colour	Black
<b>Environment</b>	
Operating Temperature	-20°C to 50°C
Storage Temperature	-20°C to 80°C
Humidity	80% to temps. up to 31°C decreasing linearly to 50%rH at 40°C max 80% rH, non-condensing
Pollution Degree	2
Installation Category	1
Altitude	2000m
<b>Electrical</b>	
Bus voltage	12 to 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	400mA maximum @ 10VDC 150mA maximum @ 24VDC 100mA maximum @ 48VDC
<b>Status</b>	
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
Relay Status	4 front panel LED
<b>Logic Resolver</b>	
Number	4 with Relay and HubBus output + 2 with HubBus output
Logic Functions	AND, OR, NAND, and NOR
Channel Terms	N/A, ON, OFF or FAULT
<b>Relays</b>	
Type	EN50205 type B
Contacts	2 x CO with force guided contacts (2 <sup>nd</sup> set for safety diagnostics)
Contact material	Ag-Cu-Ni + 0.2µm AU
Terminals	NO - COM - NC

Type of contact	Notched crown	
Electr. life AC1 (360cycles/h)	approx.100000	
Inrush current max.	15A for 20ms	
Minimum switching voltage	5VAC/DC	
Minimum switching current	4mA	
Minimum switching power	50mW(VA)	
Maximum switching voltage	50VDC 250VAC	
Maximum switching current	Resistive	3A @ 250VAC 2A @ 50VDC
	Pilot Duty	3A @ 250VAC 800mA @ 50VDC 2A @ 24VDC
Maximum switching power	2000W(VA)	
Contact resistance	$\leq 100\text{m}\Omega$ / 28V / 100mA	
Insulation	Double or reinforced @ 250VAC, Tested at 4000V/50Hz/1min	

**Table 21: Specifications**