Title

HUBBUS

SINGLE PORT CHANNEL GENERATOR

TYPE HBSPCG

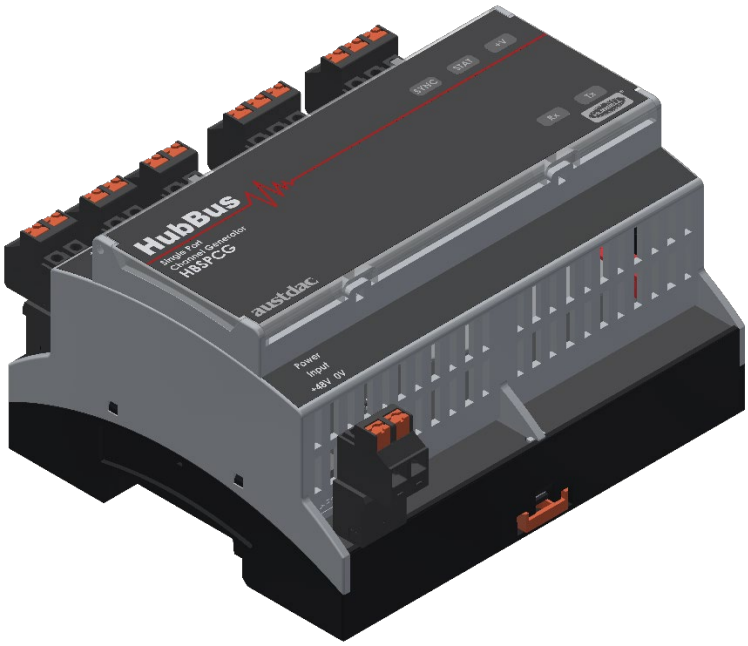
USER MANUAL

Document Number

125-251-12

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 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 single port channel generator (HBSPCG). It provides an overview and a detailed description of the installation, use and operation of the HubBus single port channel generator.

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 (125-267-12) 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.

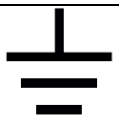
WARNING: The channel generator power supply must not be shared with any other module. All other HubBus modules and equipment must be galvanically isolated from the HubBus power supply.

WARNING: If the HBSPCG is used in a manner not specified by Austdac then the protection provided by the HBSPCG 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 HBSPCG.
- 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 HBSPCG. The user should not open or disassemble the HBSPCG. The HBSPCG should be returned to Austdac for servicing and repair.

2.3.2 STORAGE, INSTALLATION, USE AND MAINTAINANCE REQUIREMENTS

The HBSPCG 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 HBSPCG should be inspected for the following;

- Any external damage to the enclosure.

The HBSPCG may be installed in any orientation.

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

3 Overview

3.1 GENERAL DESCRIPTION

HubBus Single Port Channel Generator generates the HubBus signal, senses incoming transmissions and interfaces to the outside world.

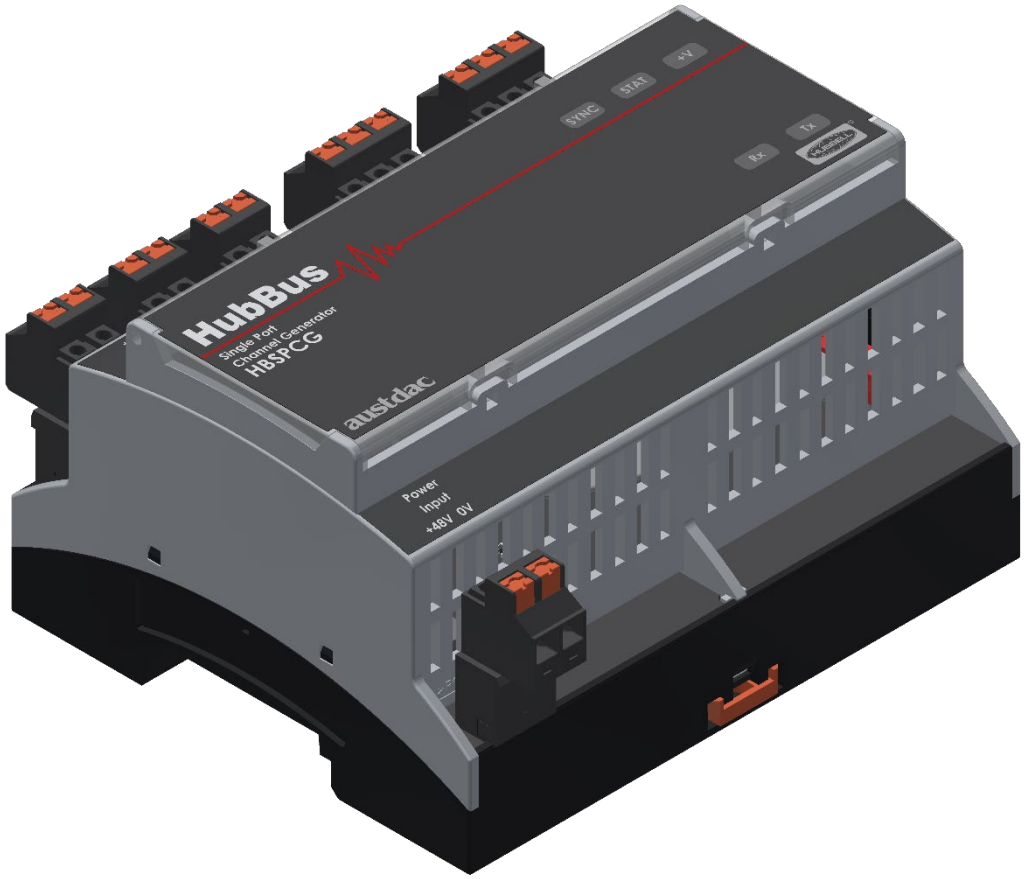


Figure 1: HubBus Single Port Channel Generator

The channel generator requires a 48VDC power supply with at least a 3A capacity to drive the HubBus network. This channel generator handles 2048 unique digital or 1024 analogue channels.

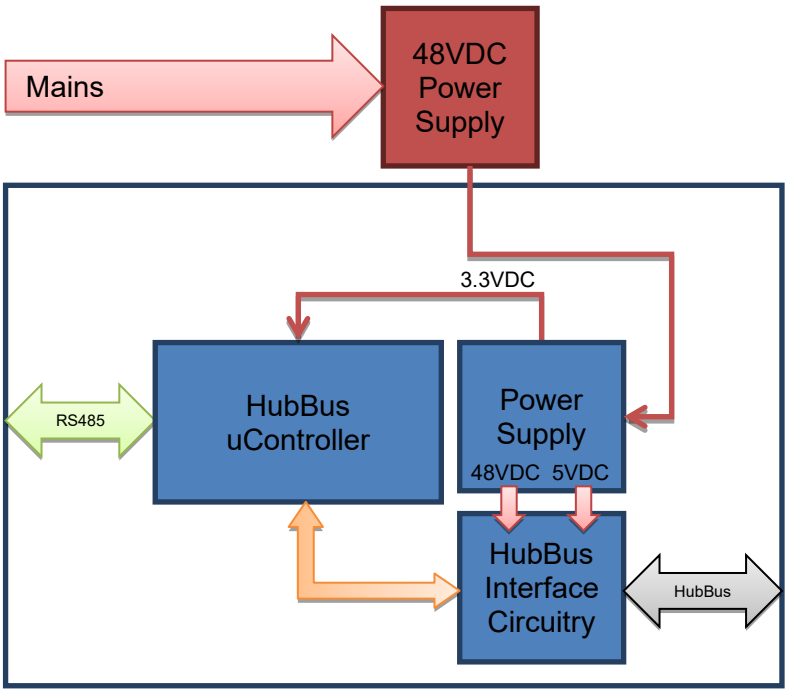


Figure 2: Single Port Controller Block Diagram

3.2 OPERATION

3.2.1 HubBus Signal Line Initialisation

If all the self-diagnostic routines report a healthy state the HubBus channel generator will bring up the HubBus signal line. The first stage of the line initialisation holds the signal line voltage at the high level (48VDC) for approximately 10 seconds to pre-charge the line and the devices on the line. This period is indicated with a fast flashing of the HubBus status indicator on the front panel of the channel generator. After this period, the HubBus communication signal will be transmitted onto the line.

3.2.2 Fault Detection and Recovery

The following conditions are monitored by the channel generator for correct operation of the HubBus system.

3.2.2.1 External Power Supply

Correct operating voltage is in the range of 24VDC to 48VDC. Fault is indicated on the front panel ('+V' LED) and in Modbus registers.

3.2.2.2 HubBus Line Voltages

The high-level voltage is approximately (within 1VDC) of the external supply voltage (nominally 48VDC) and the signal low level voltage is 5VDC.

Failure of either of these levels is indicated on the front panel ('STAT' LED) and in Modbus registers.

3.2.2.3 HubBus Line Faults

As well as under and over voltage detection, HubBus line current and line short circuit conditions are also monitored. The front panel ('STAT' LED) will indicate a problem and further information is in the Modbus registers.

3.2.3 Modbus Communication

Modbus is used for both configuration of the channel generator and receiving HubBus status of line devices. If a fault has been detected within the channel generator there are several registers which may be used to help diagnose any issues.

Status of the following items is available:

- External power supply voltage. Should be the same as the selected power supply (24-48VDC)
- HubBus signal line voltage. Should be close (within 1VDC) to the input power supply voltage.
- HubBus signal line current. Dependant on line loading, capable of up to 2A but typical figures of <500mA should be seen.
- HubBus signal line voltage low level voltage. Should be 5VDC.
- Channel generator restarted indicator. Indicates the channel generator has been restarted, flag cleared once it is read.
- Signal line power OK. Signal line voltage is within specified limits (24 to 48VDC).
- Signal line power fault. Indicates an over current (>3A) or short circuit condition.

See Table 19 below for Modbus register details.

4 Installation

4.1 ENCLOSURE

The HBSPCG 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 HBSPCG 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 HBSPCG are via cage clamp style 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.

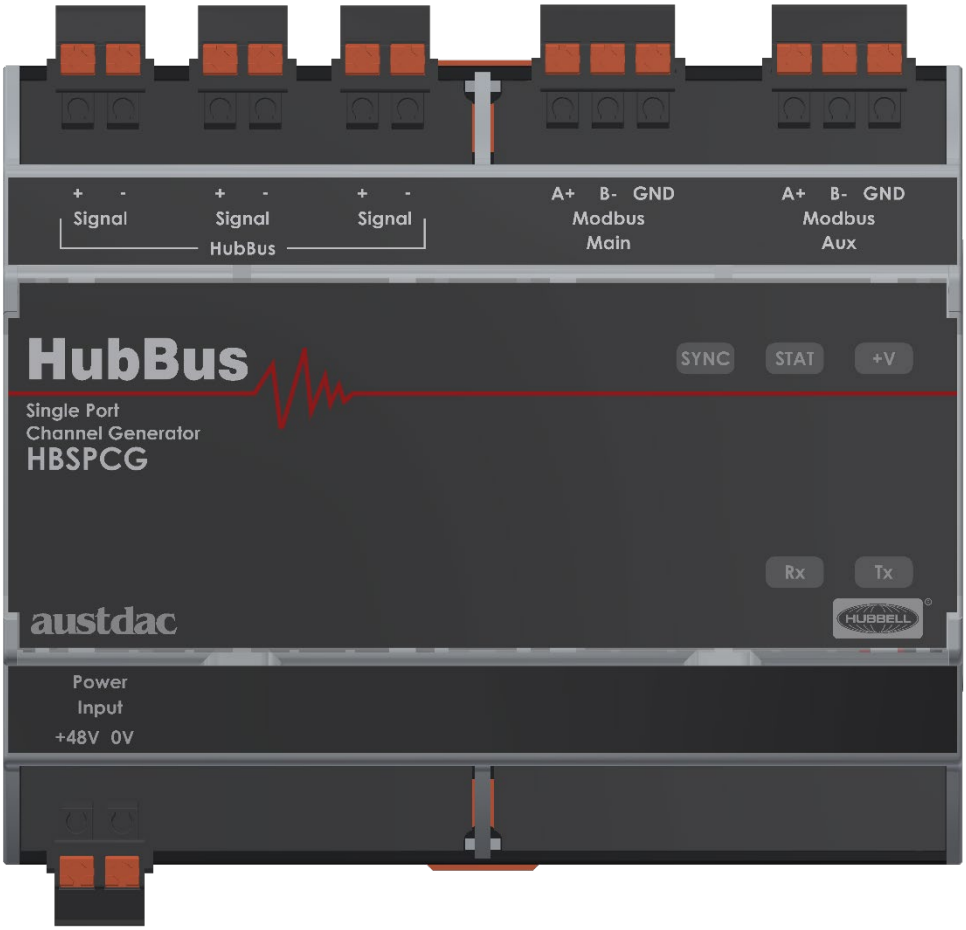


Figure 3: Front panel

5.1.1 LEDS

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

5.1.1.1 SYNC

Colour	Flash Rate	Description
YELLOW	Fast Flash	HubBus line pre-charge state.
YELLOW	Slow Flash	Synchronisation pulse transmitted.

Table 1: SYNC LED

5.1.1.2 STAT

Colour	Flash Rate	Description
GREEN	Solid	HubBus line power good. Indicator off if voltage to HubBus line less than 24VDC.
RED	Solid	HubBus line power fault. On if there is a short circuit, over current or over voltage

		condition on the HubBus line.

Table 2: STAT LED

5.1.1.3 +V

Colour	Flash Rate	Description
GREEN	Solid	Power input ≥ 24VDC
RED	Solid	Power input < 24VDC

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

5.2 INNER

Channel generator display board as viewed with the housing top cover opened.

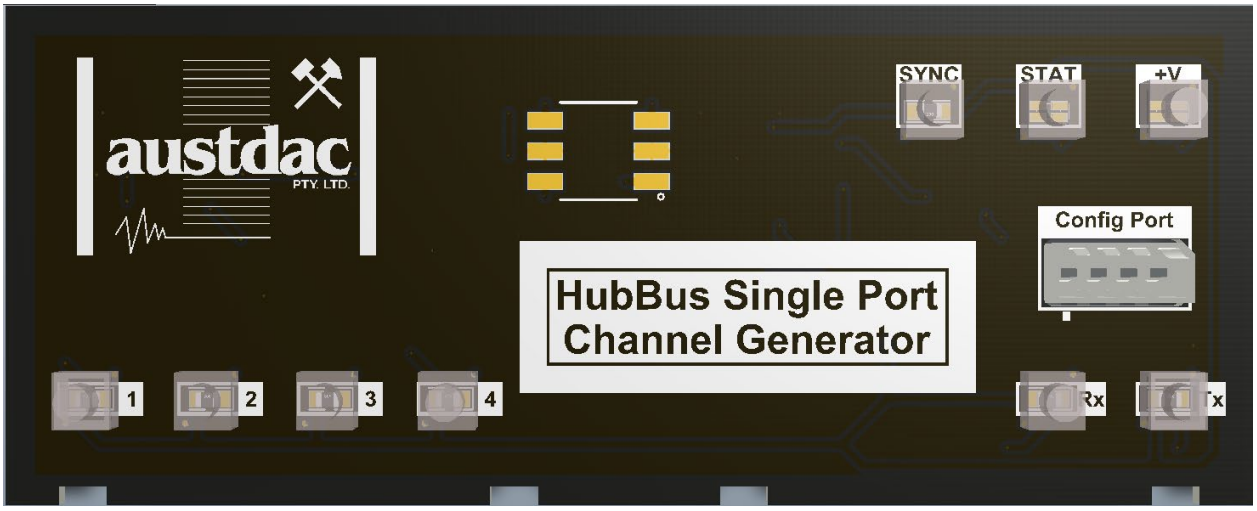


Figure 4: Display and interface board

5.2.1 Decimal rotary switch

Not used.

5.2.2 Config Port

Four pin TTL level configuration 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.

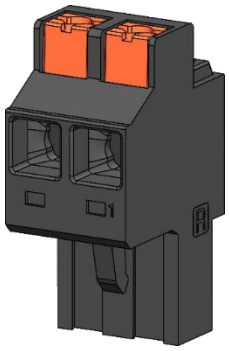


Figure 5: Terminal Plug

6.2 LAYOUT

HBSPCG					
17	+48V	Power In	HubBus	Signal+	1
18	0V			Signal-	2
			HubBus	Signal+	4
				Signal-	5
			HubBus	Signal+	7
				Signal-	8
			RS485 MAIN	A+	9
				B-	10
				COM	11
			RS485 AUX	A+	14
				B-	15
				COM	16

Table 6: HBSPCG Pin-outs

6.2.1 Power

Any industrial rated power supply, providing galvanic isolation from other equipment, may be used. The power supply is to only be used for the channel generator. Any other modules or equipment must be supplied from another source.

Operating Range: 24-48VDC @ 3A

Recommended: 48VDC @ 3A (Omron S8VK-G24048)

6.2.2 HubBus

Three HubBus terminals are available. All terminals are on the same HubBus port, the additional terminals are provided for ease of wiring. The Signal -ve line must not be tied to any common, 0V, ground or Earth points.

6.2.3 MODBUS

For monitoring and configuration. This is a 2-wire RS485 MODBUS port.

Baud Rate: 19,200bps.

Data Bits: 8

Parity: Even

Stop Bits: 1

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 (24VDC)
- RS485 MODBUS
- HubBus Signal

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

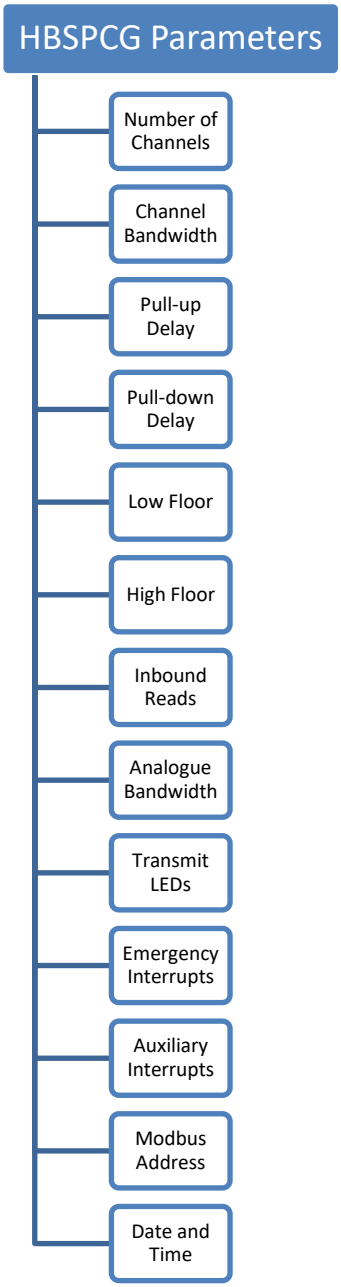


Figure 6: HBSPCG Parameters

7.2.1 Number of channels

Allocates the number of channels the channel generator will transmit. This ranges from 64 to 2048 channels in increments of 64 channels. The greater the number of channels, the longer the system response time shall be.

Limit	Value (channels)
Minimum	64
Maximum	2048
Step	64
Default	256

Table 7: Parameter – Number of Channels

7.2.2 Channel/Pulse bandwidth

Bandwidth of each control and channel pulse. Faster (smaller) bandwidths may be used on small length and low capacitance cables. Longer cable lengths will require slower (larger) bandwidths. Note that reducing the time available to a pulse will impact on detection threshold levels and the minimum number samples required.

Limit	Value (µs)
Minimum	1200
Maximum	4800
Step	600
Default	2400

Table 8: Parameter – Channel Pulse Bandwidth

7.2.3 Pull-down delay

Amount of time after the high voltage driver is turned off that the line is allowed to self-discharge before the line is pulled down by the low voltage level driver.

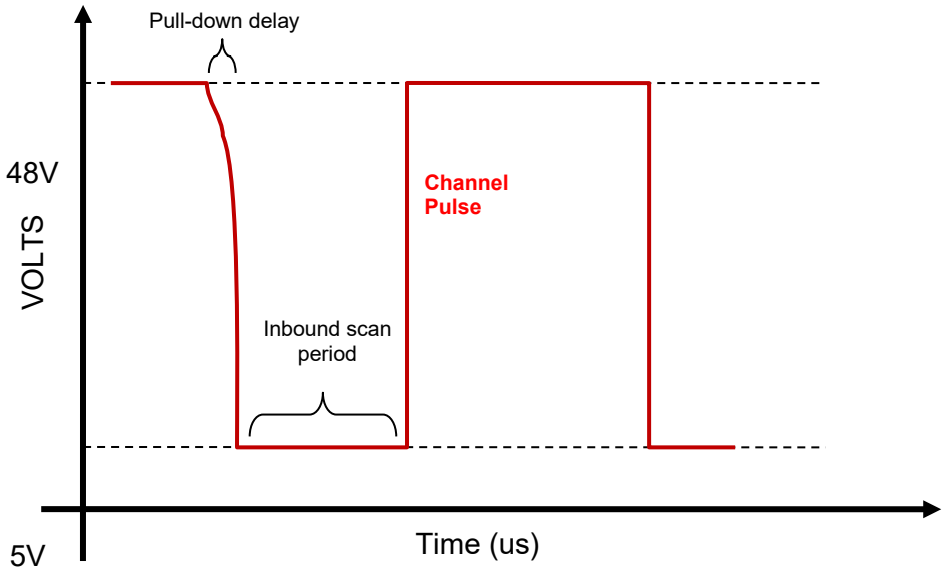


Figure 7: Pull-down delay

This time will also impact the amount of time remaining for the channel generator to detect any inbound transmissions from line devices as the inbound detection does not start until after the line is pulled down.

Limit	Value (µs)
Minimum	0

Maximum	310
Step	31
Default	62

Table 9: Parameter - Pull-down delay

7.2.4 Pull-up delay

Amount of time after the low voltage driver is turned off that the line is allowed to float before the line is pulled up by the high voltage level driver.

Limit	Value (µs)
Minimum	0
Maximum	310
Step	31
Default	62

Table 10: Parameter - Pull-up delay

7.2.5 Inbound Signal Detection Floors

While the pulse is at the low voltage level, the current drawn on the line is used to determine the state of the inbound transmission. This current is sensed in two separate circuits; high side (supply side) and low side (0V side).

For an inbound signal to be considered a valid transmission one side must meet an upper (higher) floor level and the other line may have a reduced floor level which it must meet. These levels are configurable via the following parameter settings in the channel generator.

A single minimum floor level is configurable by setting the lower floor limit to 0. Note that this configuration is insufficient to differentiate between valid incoming transmissions and signals affected by noise.

7.2.5.1 Upper Floor

This is the higher of the two floor levels. Only one side (or one line) needs to be higher than this set level.

If this parameter is set lower than the lower floor limit, then it is essentially ignored and both lines only need to exceed the lower floor limit to be considered valid inbound transmissions.

Limit	Value (mV)
Minimum	0
Maximum	2500
Step	1
Default	2000

Table 11: Parameter - Inbound upper floor

7.2.5.2 Lower Floor

This is the lower of the two floor levels. Both sides (both lines) must be higher than this level.

If this level is set higher than the upper floor parameter, then only this parameter is taken into consideration (i.e. both lines must be higher than the set level) in determining valid inbound transmissions.

Limit	Value (mV)
Minimum	0
Maximum	2500
Step	1
Default	1400

Table 12: Parameter - Inbound lower floor

7.2.6 Inbound Reads

Number of samples to be used in calculating the average of the inbound current. This average value for each of the two lines is compared against the upper and lower floor parameters described above.

Limit	Value (samples)
Minimum	1
Maximum	16
Step	1
Default	6

Table 13: Parameter - Inbound samples

7.2.7 Analogue Bandwidth

Number of channels used for analogue transmissions. System designers must ensure adjacent flowing channels are not being used by other devices if more than 1 channel is being used for analogue transmission.

Limit	Bits	Value (channels/pulses per cycle)
Minimum	2	1/2 (Default)
	8	4/8
Maximum	16	8/16

Table 14: Parameter - Analogue bandwidth

A selection of 1, will require 8 transmission cycles to transmit an analogue value, 4 channels will require 2 cycles and using 8 channels will transmit an entire analogue value in a single transmission cycle.

7.2.8 Emergency Interrupt

Emergency interrupt feature enable. See HubBus system manual 125-250-12 for detailed explanation of operation.

Value	Meaning
Enable	Emergency Interrupt Enabled
Disable	Emergency Interrupt Disabled
Default	Disabled

Table 15: Parameter – Emergency Interrupt Enable

7.2.9 Auxiliary Interrupt

Auxiliary interrupt feature enable. See HubBus system manual 125-250-12 for detailed explanation of operation.

Value	Meaning
Enable	Emergency Interrupt Enabled
Disable	Emergency Interrupt Disabled
Default	Disabled

Table 16: Parameter – Auxiliary Interrupt Enable

7.2.10 Modbus Address

Set the Modbus address for the main and auxiliary Modbus RS485 ports.

Limit	Value
Minimum	1
Maximum	247
Default	10

Table 17: Parameter – Modbus Address

7.2.11 Date/Time

Set real-time clock time and date. The real-time clock is used for data and event logging in the channel generator. See the HubBus Handheld Programmer type HHP1-H user manual (125-198-12) for setting time and date parameters.

8 MODBUS

8.1 PHYSICAL LAYER

Mode:	2-wire RS485
Protocol:	Modbus RTU
Baud Rate:	19200
Data Bits:	8
Stop Bits:	1
Parity:	Even
Address:	10 (default)

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	“HBSPCG”
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	N/A, returns 0.0
F/W CRC Sub-ass.1	1039	1	R	N/A, returns 0
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 18: 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
+5V	1065	1	R	U16	Y	4062	12	Power Supply (V)
HubBus V	1066	1	R	U16	Y	2948	60	Line Voltage (V)
HubBus I	1067	1	R	U16	Y	4095	3472	Line Current (A)
Supply	1068	1	R	U16	Y	2948	60	Main Supply Voltage (V)
+12V	1069	1	R	U16	Y	4062	12	Not Available
Status	1070	1	R	U16	Y	-	-	Bit 0:Restart Bit 1:Line power OK

								Bit 2:Line power fault Bit 3:Emergency Inter Bit 4:Auxiliary Inter
Tick	1071	1	R	U16	Y	65,535	1	HubBus tick counter. May be use as heartbeat counter.
Inbound current (Sig+)	1072	1	R	U16	Y	65,475	100	Inbound current high side.
Inbound current max (Sig-)	1073	1	R	U16	Y	65,475	100	Inbound current low side.
Inbound current (Sig+)	1074	1	R/W	U16	Y	65,475	100	Maximum inbound current high side. Write any data to register to reset.
Inbound current max (Sig-)	1075	1	R/W	U16	Y	65,475	100	Maximum inbound current low side. Write any data to register to reset.
Emergency Interrupt Count	1076	1	R	U16	Y	2048	1	Number of emergency interrupt pulses detected
Auxiliary Interrupt Count	1076	1	R	U16	Y	2048	1	Number of auxiliary interrupt pulses detected
+3v3	1078	1	R	U16	Y	4040	9	3v3 Power Supply
+3v6	1079	1	R	U16	Y	4040	9	3v6 Power Supply
Time/Date	20117	2	R	U32	Y	-	-	Time/Date in UTC format.

Table 19: Modbus Registers - Information Data

Displayed value = (DATA / HIGH) * SCALE

8.2.3 HubBus Digital

Each Modbus register contains status data for four HubBus channels. Modbus addressing starts at register 1 through to 512. Each HubBus channels state is represented in 4 bits. These bits are as follows:

- Health: Transmitting ‘ON’ or ‘OFF’, else not transmitting or in ‘FAULT’
- Fault: Transmitting ‘FAULT’ state, else not transmitting, ‘ON’ or ‘OFF’
- Online: Transmitter present if ‘ON’, ‘OFF’ or ‘FAULT’
- Input: Transmitting ‘ON’ state

Type: Holding Registers

8.2.3.1 Inbound

Modbus Register	Channel	Bit	Status
n *where n = 1..512*	(n x 4) - 3	0	Health
		1	Fault
		2	Online
		3	Input
	(n x 4) - 2	4	Health

		5	Fault
		6	Online
		7	Input
	(n x 4) - 1	8	Health
		9	Fault
		10	Online
		11	Input
	(n x 4) - 0	12	Health
		13	Fault
		14	Online
		15	Input

Table 20: Modbus Registers - HubBus Channel Status

8.2.3.2 Outbound

N/A

8.2.4 HubBus Datalink

Registers contain 16-bit value.

8.2.4.1 Inbound

Channel	Modbus Register	Number of registers	Read / Write
1	2001	1	R
2	2002	1	R
n	2000 + n	1	R
2047	4047	1	R
2048	4048	1	R

Table 21: Modbus Registers - HubBus Analogue Data

8.2.4.2 Outbound

N/A

8.2.5 High Resolution Inbound Current Graph

Up to 64 samples of the inbound current for the first control channel (cycle bit) for both the Sig+ and Sig- lines.

The sampled channel may be changed by writing to the given holding register.

Sample data is at approximately 9µs intervals, giving a total of approximately 576µs of inbound current data,

8.2.5.1 Sig- Data

Description	Value
Start Modbus Register Address	10,513

End Modbus Register Address	10,577
Read/Write	R
Number of Registers	64
Value Minimum	0
Value Maximum	4095

Table 22: Modbus Registers – Inbound High-Resolution Sig-

8.2.5.2 Sig+ Data

Description	Value
Start Modbus Register Address	11,025
End Modbus Register Address	11,089
Read/Write	R
Number of Registers	64
Value Minimum	0
Value Maximum	4095

Table 23: Modbus Registers – Inbound High-Resolution Sig+

8.2.5.3 Sample Channel

Description	Value
Modbus Register Address	20,119
Read/Write	R/W
Minimum	0 (cycle bit)
Maximum	2048
Default	0

Table 24: Modbus Registers – Inbound High-Resolution Sample Channel

8.2.6 Inbound Acquisition Time

Registers contain a 16-bit value in 1us resolution of the time taken for an inbound signal to be detected on the given channel. Time is from the falling edge of the channel pulse till the moment an inbound signal is considered valid.

Only the first 128 channels are sampled and recorded.

This feature is for field engineers' system diagnostic purposes only. It is advised that units placed at various positions along the signal line are addressed in the first 128 channels.

8.2.6.1 Inbound

Channel	Modbus Register	Number of registers	Read / Write
1	10001	1	R
2	10002	1	R
n	10000 + n	1	R
127	10127	1	R
128	10128	1	R

Table 25: Modbus Registers – Inbound Acquisition Time

8.2.6.2 Outbound

N/A

9 Specifications

General	
Name	HubBus Single Port Channel Generator
Type	HBSPCG
Interface	
Number of HubBus ports	1 driver with dual line detection circuits
Number of HubBus terminals	3
Bus channels	64 to 2048 (with 64 channel increments)
Bus protocol	Dual pulse alternating on cycles
Display	Optional external touchscreen (HMI)
RS485	1 x Modbus 2 wire (isolated port)
Configuration	TTL, 19,2k/8/1/E
Physical	
Dimensions	108mm (W) x 63mm (D) x 90mm (H)
Mass	170g
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 temperatures 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	24-48VDC (p-p)
Unit loads	320 minimum (over 16km)
Bus current limit	3A (auto reset)
Bus speed	Adjustable (1.2ms to 4.8ms/pulse)
Bus pulse duty cycle (low/high)	50-67%
Power supply voltage	24-48VDC
Power supply current consumption	3A maximum @ 48VDC
	3A maximum @ 24VDC
Status	
Significant event log	2MB (65,000 event) rotary buffer
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

Table 26: Specifications