Features

- 4 OFF – Push-Pull channels
- IEPE interface for High-G accelerometer
- 1 x CAN bus interface
- 10 x 3.3V GPIO
- 1 x RTD Interface
- 4 x Bridge (2.5V) analog inputs
- 4 x Single ended (42V) analog inputs
- 1 x Low-G 3 axis accelerometer
- 1 x Onboard temperature sensor
- 1 x Onboard EEPROM for historical data
- 2 x UART TTL level interface
- Input voltage and current measurement
- High shock and vibration resistance

Product Description

The NSE PB200HT is a highly versatile processor board for demanding and high temperature applications. Its layout is targeted for downhole wireline and drilling tools or other industrial applications where high temperature may occur.

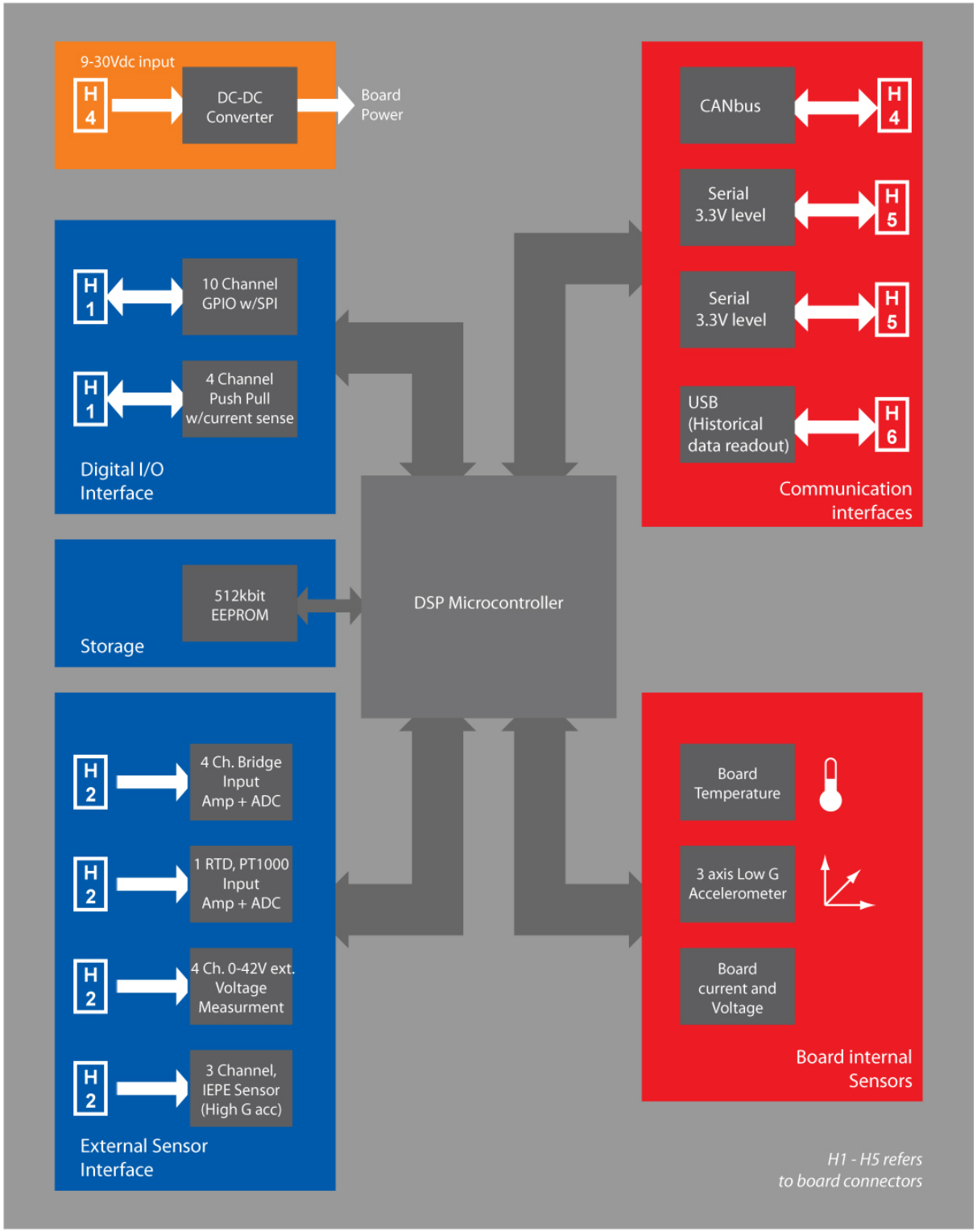
The processor board has several communications interfaces. CAN bus, UART and RS-485 (Optional) allow for connection to a wide range of peripheral units. Analog inputs for bridge sensors (pressure sensor, strain, and accelerations), RTD, single ended voltage measurement and IEPE sensors (typical accelerometers) means that it can be used to monitor the most common sensors one would meet in its typical environment.

It has Push-Pull outputs that allow for switching of relays, solenoids or other control units. The Push-Pull outputs will also measure the current for each channel, so advanced monitoring and fault detection can be set up. There are also ten general purpose IO pins (3.3V level).

The board has an embedded EEPROM that allow for logging of key data. On the edge of the processor board there is an USB connector. This connector allows for easy interface to the DSP microcontroller and logged data during service and setup (this interface cannot be operated in high temperature).

The processor board is laid out with ruggedness in mind. There are only low-profile components and the connectors are of military type “nano D”. If the board is to be operated in a very high shock and vibration environment it can be delivered with a custom aluminum bracket that will provide even more support for the components.

1 NSE PB200 HT Hardware overview



2 Product Specification

2.1 Electrical Specifications

Parameter	Conditions / Comments	Min	Typ	Max	Unit
MECHANICAL DIMENSIONS					
Length	*Including connector*		175		mm
Width			42		mm
Height			11		mm
TEMPERATURE RANGE					
Operating		-20		177	Deg C
Storage		0		40	Deg C
SUPPLY VOLTAGE					
Input Voltage	*(33V TVS Diode on Input)*	9		30	*Vdc*
Current consumption			~25		*mA*
INTEGRATED SENSORS					
Temperature sensor range		-40		180	*Deg C*
Temperature sensor error				±3	*Deg C*
Accelerometer number of axes			3		*X, Y, Z*
Accelerometer range		-2		2	*G*
Accelerometer resolution			12		*Bits*
Accelerometer offset error	*over full temperature range*			0.2	*g*
Accelerometer gain error				±5	*%FSE*
Input voltage measurement		10		42	*V*
Input voltage measurement error				±2	*V*
Board current measurement	*excluding push-pull currents*	0		50	*mA*
Board current measurement				±5	*mA*
IEPE INTERFACE					
Channels			3		
Channel current out			4		*mA*
Frequency range		5		6000	*Hz*
Input signal range		-5		5	*V*
ONBOARD MEMORY					
Memory size	*EEPROM*		512		*Kbits*
ANALOG INPUT					
RTD channels	*2-Wire PT1000*		1		
RTD Temperature range		0		360	*Deg C*
Bridge input channels	*Differential input*		4		
Bridge input gain		1		128	
Bridge resistance		100			*Ohms*
Bridge excitation voltage			2.5		*V*
ADC resolution			24		*Bits*
Sampling rate				7	*Sps*
Single-ended Channels					
Single-ended measurement range		0		42	*Vdc*
Single-ended ADC resolution				10	*Bits*
Bandwidth				130	*Hz*

GPIO (TTL)					
Number of GPIO pins	*3v3 logic*		10		
Onboard pull-up resistor value	*GPIO 1-7*		10		*kohm*
High voltage level input		2.6			*V*
Low voltage level input				0.7	*V*
PUSH-PULL DRIVER OUTPUT					
Channels			4		
Current rating	*Sourcing / Sinking*			0.8	*A*
Current measurement error				0.1	*A*
Supply Push-Pull Voltage		7		36	*Vdc*
COMMUNICATION					
UART channels			2		
UART baud rate		4800	38 400	230 800	*baud*
CAN bus channels			1		
CAN bus baud rate		83 333	125 000	500 000	*bps*
USB channels			1		
CONNECTORS					
H6	*Micro USB B*		USB		
H1	*Glenair 891-008-21P-A2-1-BRT1T*		21-PIN		
H2	*Glenair 891-009-15S-A2-1-BRT1T*		15-PIN		
H3	*Glenair 891-008-15P-A2-1-BRT1T*		15-PIN		
H4	*Glenair 891-009-9S-A2-1-BRT1T*		9-PIN		
H5	*Glenair 891-008-9P-A2-1-BRT1T*		9-PIN		

2.2 Thermal properties

The NSE PB200HT is designed to operate in a 177°C environment.

In a typical assembly, the **NSE UNIT** is mounted to a **MOUNTING PROFILE** that is located inside an **OUTER HOUSING**.

The **OUTER HOUSING** surface temperature should not rise above the specified maximum ambient temperature, and the mechanical design and interface between the **OUTER HOUSING, MOUNTING PROFILE** and the **NSE UNIT** should be such that the thermal resistance specification is achieved.

2.3 Conformal Coating

This product is delivered with no conformal coating.

2.4 Environmental requirements

NSE boards must be installed in dry air at atmospheric pressure (1atm). Avoid humid atmosphere or under / overpressure. Refer to general NSE installation guidelines for more information.

3 Peripherals

3.1 Integrated Sensors

3.1.1 Temperature sensor

The board temperature will be acquired.

3.1.2 Voltage measurement

The board input voltage will be acquired.

3.1.3 Current measurement

The current consumption of the board will be acquired. Current floating through the push-pull drivers will be measured by their respective current sensors.

3.1.4 Low G accelerometers

Low-G accelerometer data measuring X, Y and Z axis will be acquired. The accelerometer is a MEMS accelerometer and measurement range is ±2g. Low-G accelerometer data shall be tested over the full temperature range and measurements shall be within ±10% (from 0degC to 177degC).

The default accelerometer is an industrial temp accelerometer that NSE verifies for use up to 177degC. Even when we calibrate the accelerometer, it still has significant offset variations at higher temperature. It can serve well as an indicator for inclination and vibration, but it is not a precision device.

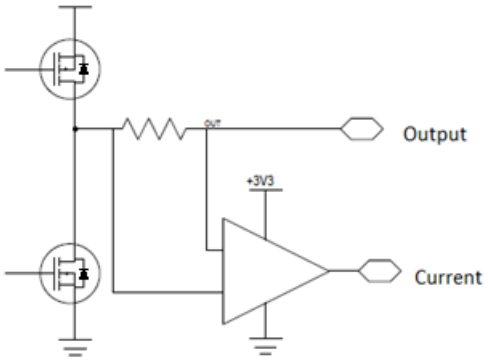
3.2 Digital I/O Interface

3.2.1 Push-Pull outputs

There are four Push-Pull output drivers that typically can be used for relay or solenoid switching. Refer to the “Board Specifications” for maximum current on the pin. The push-pull output equals the supply input voltage of the PB200.

3.2.1.1 Push-Pull current sensors

Each Push-Pull channel read out its current consumption and reports it to the micro controller. This allow for monitoring of the load and to detect potential faults when switching.



Push-Pull Driver

3.2.2 General Purpose IO (GPIO) and SPI interface

The 10 GPIO pins shall be configurable to be either inputs or outputs. The GPIO1-7 pins have a 10k pull-up resistor to 3.3V and a 3.6V zener protection. GPIO8 to 10 pins contains SPI pins. The SPI bus on GPIO8-10 is shared with the on-board temperature sensor and the HT EEPROM data bank. The GPIO pins are 3.3V tolerant input with logic high input>2.6V and logic low input<0.7V.

3.3 Analog and External Inputs

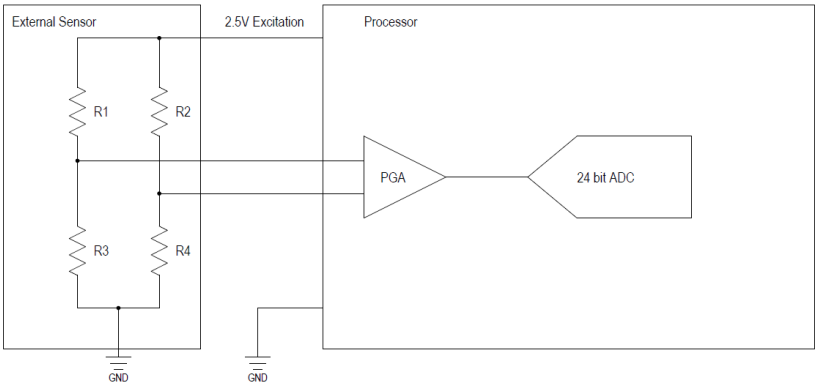
3.3.1 RTD

The board has an input for a 2-wire PT1000 sensor for external temperature measurements. Refer to the section “Board Specifications” for maximum and minimum temperature range of the 2-wire PT1000 element interface.

3.3.2 Differential Input Channels

The board has 4 differential input channels for measurements of bridge sensors (typically).
The channels have a configurable gain of 1, 2, 4, 8, 16, 32, 64 and 128, and the ADC resolution is 24bits. The default gain is set to 128 in FW.

The board also has a bridge excitation voltage pin, so interface to any bridge should be easy. See the figure below for more information.



Bridge Typical Connection

The bridge excitation voltage is 2.5V, and the minimum bridge resistance that can be applied is 100Ω. The bridge input common mode range is 2.5V when input gain is 1. Reference is made to the table below for Gain, Input range and common voltage range.

PGA GAIN	V_{in} Range	Vcm range
1	0-2.5V	$0.1V + \frac{\text{Vin} * \text{Gain}}{2} \leq \text{Vcm} \leq 3.2V - \frac{\text{Vin} * \text{Gain}}{2}$
2	0-1.25V	
4	0-0.625V	
8	0-0.3125V	
16	0-0.15625V	
32	0-0.078125V	
64	0-0.0390625V	
128	0-0.01953125V	

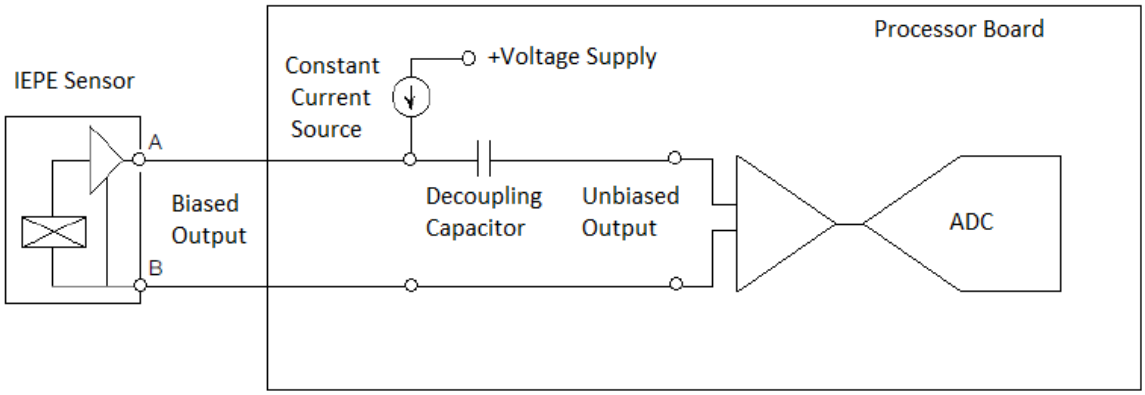
3.3.3 External Voltage Measurement

The board has 4 inputs for measuring single-ended external voltages in the range 0-42 Volt in addition to the onboard supply voltage measurement. This can typically be used for measuring battery voltages, voltage output sensor and similar.

3.3.4 IEPE Interface

The IEPE interface has 3 channels that each has an output excitation current. Refer to the section "**Error! Reference source not found.**" for bandwidth and signal range. The IEPE interface has been designed for use with the Endevco – 65-HT-10-R high g accelerometer, but will work with any sensor that can work within the excitation current and signal range offered by this interface.

Note that the output voltage from the Constant Current Source is limited by the input voltage to the board.



3.4 Data Communication

3.4.1 UART – 3.3V level

The processor board has a UART with 3.3V level in/outputs that can typically be set up for communications (through NSE wireline modem or other telemetry systems). Through this interface, the processor board can send status information on request, receive and execute commands from topside, and reply to commands when needed.

The processor board is not supplied with a default UART behavior. This has to be set up by NSE based on customer requirement or by FW developer.

3.4.2 CAN bus

The processor has a CAN bus interface for communications with CAN bus nodes. Typically the processor board will act like a master on a CAN bus network, acquiring data and sending commands to other CAN bus nodes. It can however be configured to other user defined behaviors.

The processor board is not supplied with a default CAN bus behavior. This has to be set up by NSE based on customer requirement or by FW developer.

3.4.3 USB – service connector

The processor board has a USB connection to allow the user to read out board temperature histogram, temperature trend for the board and other stored data. This USB interface is only available in room temp (the circuit is powered down during normal and high temperature operation).

The processor board is not supplied with a default logging behavior. This has to be set up by NSE based on customer requirement or by FW developer.

3.4.4 UART 2

A spare UART with 3.3V level in/outputs is available.

The processor board is not supplied with a default UART behavior. This has to be set up by NSE based on customer requirement or by FW developer.

3.5 Memory

The onboard memory is a 512 Kbit EEPROM. The memory can be used to store data during operation of the board. The EEPROM is a high temp variant that allow for storage of data even in max ambient temperature.

The processor board can even be set up to write a few bytes to the memory in the case of a power down situation. This can be data such as a critical analog value, relay or solenoid positions or time stamps.

The processor board is not supplied with a default memory read/write behavior. This has to be set up by NSE based on customer requirement or by FW developer.

4 Connections

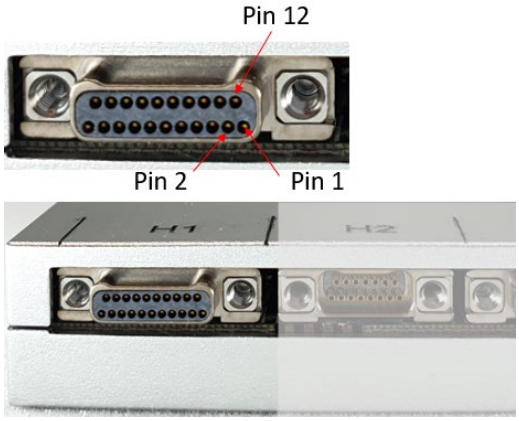
The board has 6 connectors – labeled H1 – H6:

4.1 Connector H1

Connector H1 is a Glenair 891-008-21P-A2-1-BRT1T 21-pin connector.

This connector has the push-pull outputs and the GPIO pins

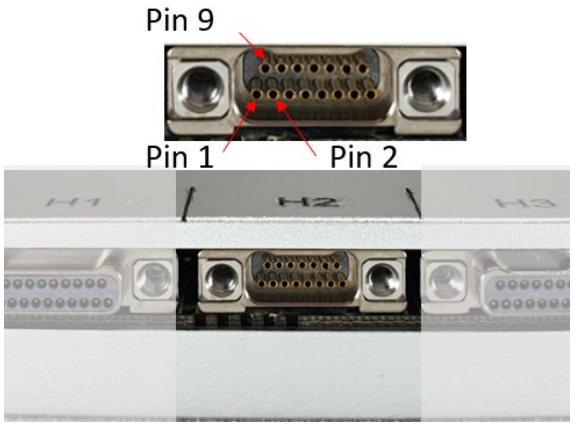
Pin	Signal name	Description / Function	Connector Pinout (Face View)
1	PPO1	Push-Pull output CH1	
2	PPO2	Push-Pull output CH2	
3	PPO3	Push-Pull output CH3	
4	PPO4	Push-Pull output CH4	
5	GPIO1	General Purpose I/O CH1	
6	GPIO2	General Purpose I/O CH2	
7	GPIO3	General Purpose I/O CH3	
8	GND	GROUND	
9	VPP	Supply Push-Pull Stage	
10	VPP	Supply Push-Pull Stage	
11	GPIO4	General Purpose I/O CH4	
12	GPIO5	General Purpose I/O CH5	
13	GPIO6	General Purpose I/O CH6	
14	GND	GROUND	
15	GND	GROUND	
16	GND	GROUND	
17	GPIO7	General Purpose I/O CH7	
18	GPIO8	SPI SCK	
19	GPIO9	SPI MOSI	
20	GPIO10	SPI MISO	
21	GND	GROUND	



4.2 Connector H2

Connector H2 is a Glenair 891-009-15S-A2-1 BRT1T 15 pin connector.

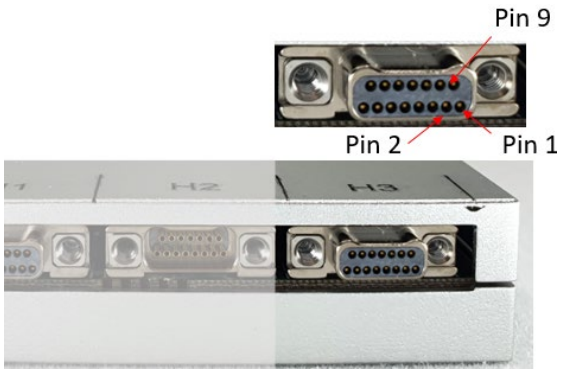
This connector as analog inputs (RTD, 3xdifferential bridge inputs)

Pin	Signal name	Description / Function	Connector Pinout (Face View)
1	RTD+	PT1000 supply	
2	RTD-	PT1000 return	
3	AGND	Analog GROUND	
4	+2.5V	Bridge Excitation Voltage – 2.5V	
5	Channel 1+	Differential Input Channel 1+	
6	Channel 1-	Differential Input Channel 1-	
7	AGND	Analog GROUND	
8	+2.5V	Bridge Excitation Voltage – 2.5V	
9	Channel 2+	Differential Input Channel 2+	
10	Channel 2-	Differential Input Channel 2-	
11	AGND	Analog GROUND	
12	+2.5V	Bridge Excitation Voltage – 2.5V	
13	Channel 3+	Differential Input Channel 3+	
14	Channel 3-	Differential Input Channel 3-	
15	AGND	Analog GROUND	

4.3 Connector H3

Connector H3 is a Glenair 891-008-15P-A2-1-BRT1T 15 pin connector.

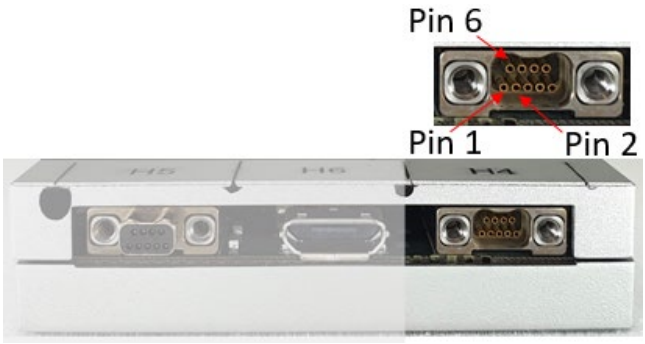
This connector as analog inputs (1xdifferential bridge input, IEPE Channels and external voltage measurements)

Pin	Signal name	Description / Function	Connector Pinout (Face View)
1	+2.5V	Bridge Excitation Voltage – 2.5V	
2	Channel 4+	Differential Input Channel 4+	
3	Channel 4-	Differential Input Channel 4-	
4	AGND	Analog GROUND	
5	IEPE 1	IEPE Interface CH1	
6	IEPE 2	IEPE Interface CH2	
7	IEPE 3	IEPE Interface CH3	
8	AGND	Analog GROUND	
9	Ext. Voltage1	External Voltage Measurement 1	
10	Ext. Voltage2	External Voltage Measurement 2	
11	Ext. Voltage3	External Voltage Measurement 3	
12	Ext. Voltage4	External Voltage Measurement 4	
13	GND	GROUND	
14	GND	GROUND	
15	GND	GROUND	

4.4 Connector H4

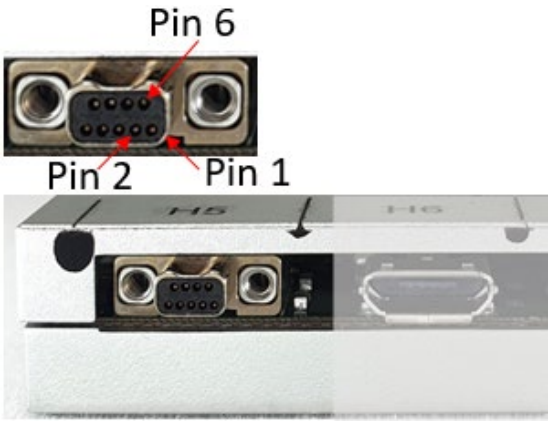
Connector H4 is a Glenair 891-009-9S-A2-1-BRT1T 9 pin connector.

This holds supply input and CAN bus.

Pin	Signal name	Description / Function	Connector Pinout (Face View)
1	VIN	Supply voltage input	
2	CANH	CAN high	
3	GND	GROUND	
4	GND	GROUND	
5	CANH	CAN high	
6	VIN	Supply voltage input	
7	CANL	CAN low	
8	GND	GROUND	
9	CANL	CAN low	

4.5 Connector H5

Connector H5 is a Glenair 891-008-9P-A2-1-BRT1T 9 pin connector. This holds UART interface, RS-485 (if mounted) and power out.

Pin	Signal name	Description / Function	Connector Pinout (Face View)
1	GND	GROUND	
2	RX1	UART RX Data	
3	TX1	UART TX Data	
4	+3.5V	+3.5V Output	
5	GND	GROUND	
6	B/TX2	RS-485 B or UART TX Data	
7	A/RX2	RS-485 A or UART RX Data	
8	Internal	For use with NSE telemetry	
9	Vout	For use with NSE telemetry	

4.6 Connector H6

Connector H6 is a standard USB micro B connector for reading of logged data

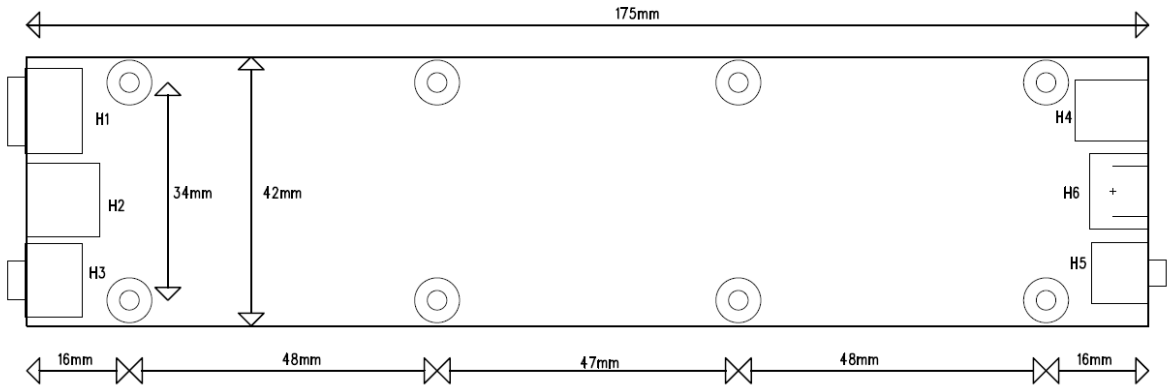
5 Firmware

The PB200 comes with a base NSE firmware included. The base firmware includes setting and reading of all onboard readings, inputs, and outputs.
Firmware for communicating with peripherals (protocols) for extended devices is not included.

5.1 Bootloader

The controller is provided with a bootloader that allows for easy updates of the firmware. NSE is constantly making improvements and adding features to its firmware-base and the bootloader allows the customer to upgrade a controller if desired.

6 Mechanical Dimensions



7 Datasheet Revision History

REV	DATE	DESCRIPTION	PREP	APPR
rE	24.06.2020	Updated template – updated connector descriptions Change of document number	OLY	RFY

8 Ordering

8.1 Order code

Order code:	**NSE-5003**	**-02**	**-X**	**-A**	**-A**	**-X**	
Category	NSE-5003	= NSE Processor Boards					
Model	-02	= PB200HT					
Communication Interface	-A -B	= CAN Bus = RS485					
Firmware opt.	-A	= Standard FW					
Hardware opt.	-A	= Standard HW					
Chassis Option	-A -B	= No Chassis = Alu Chassis					

8.2 Where to buy

Email: sales@nse.no
Web: www.nse.no
Phone: +47 406 48 400