



Features

- 18 – 48Vdc Input Voltage
- 4 x Bridge Sensor Interfaces
- 6 x RTD Temp. Sensor Interfaces
- 2 x 0-5V Analog Inputs
- 3 x Digital GPIO
- High temperature rated – 177°C
- Pressure rated board – 700bar
- CAN bus Interface
- CNC Machined aluminium housing
- High shock and vibration resistance
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Product Description

NSE AI-200 is a high performance, high temperature analogue interface board designed to interface the most common sensor types used in downhole wireline, drilling tools, industrial and automotive applications.

NSE AI-200 has an embedded firmware that allows interfacing of a wide variety of sensors. An open protocol interface combined with NSE or Customer software allows easy setup and configuration. NSE AI-200 can also be set up to have a customer defined behaviour.

The controller PCB layout is designed with ruggedness in mind. A CNC machined aluminium chassis provides maximum mechanical support to allow the board to operate in an environment where very high shock and vibration may occur. The board has rugged, high temperature connectors.

The board is conformal coated and rated for operation in up to 177deg / 700bar ambient pressure environments, allowing it to be located close to the actual sensors. With only 4 input wires (power x 2 and CAN bus x 2), wiring to the board is simple and flexible, and the number of feedthrough pins (and cost) in a system can be reduced significantly.

1 Product Specification

1.1 Electrical Specifications

Parameter	Conditions / Comments	Min	Typ	Max	Unit
SUPPLY VOLTAGE					
Input Voltage Range	<i>Specified operational range</i>	18		48	V _{dc}
Current consumption	<i>24Vdc Input - No bridges or sensors connected</i>		25		mA
DIFFERENTIAL BRIDGE INPUTS					
Sensor Input channels	<i>Differential</i>		4		Ch.
Bridge Excitation voltage			5		V _{DC}
Bridge Excitation current limit			220		mA
Bridge Resistance	<i>Min. Allowed bridge res.</i>	100			Ω
Input Gain	<i>Configurable 2^N, N=0-7</i>	1		128	
ADC Resolution	<i>Note – Actual Noise free resolution is lower</i>			24	Bits
ADC Sampling Rate	<i>Channel 1 and 4</i>		6		Sps
ADC Sampling Rate	<i>Channel 2 and 3</i>		112		Sps
RESISTANCE SENSING INPUTS (RTD)					
Sensor Input channels			6		Ch.
Measurement range	<i>Gain = 1</i>	0		2200	Ohm
Input Gain	<i>Configurable 2^N, N=0-7</i>	1		128	Bits
ADC Resolution	<i>Note – Actual Noise free resolution is lower</i>		24		Bits
ADS Sampling rate	<i>Channel 1 – 6</i>		6		Sps
SINGLE-ENDED ANALOG INPUT					
Sensor Input Channels			2		Ch.
Sensor Input Voltage Range	<i>Internal -3dB 1.3kHz LP filter</i>	0		5	V
ADC Resolution				12	Bits
ADC Sampling Rate				600	Sps
DIGITAL GPIO					
GPIO channels	<i>100k pull-up to 5V</i>		3		ch
GPIO Input Low Level		0		0.6	V
GPIO Input High Level		2.4		5.5	V

MECHANICAL DIMENSIONS					
Chassis Length			185		mm
Chassis Width			27		mm
Chassis Height			11		mm
CANBUS INTERFACE*					
Baud Rate		83.3	125	250	kbits/s
ENVIRONMENTAL					
Operating pressure range			700	1000	bar
Ambient temperature	Min and Max Temperature on the surface of outer housing given that thermal resistance is within the specification	-20		177	°C
Thermal Resistance	Surface of OUTER HOUSING to NSE UNIT *Refer to the Section "Thermal properties" for further definition			0.5	°C/W
OPERATIONAL LIFETIME					
Expected Lifetime	< 125°C Ambient Temperature	2000			Hours
	125 - 150°C (4 x acc. factor)	500			Hours
	150- 177°C (8 x acc. factor)	250			Hours

* Note - Baudrate is configurable.

1.2 Thermal properties

The AI-200 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.



1.3 Conformal Coating

This product is delivered with high temperature Parylene Coating

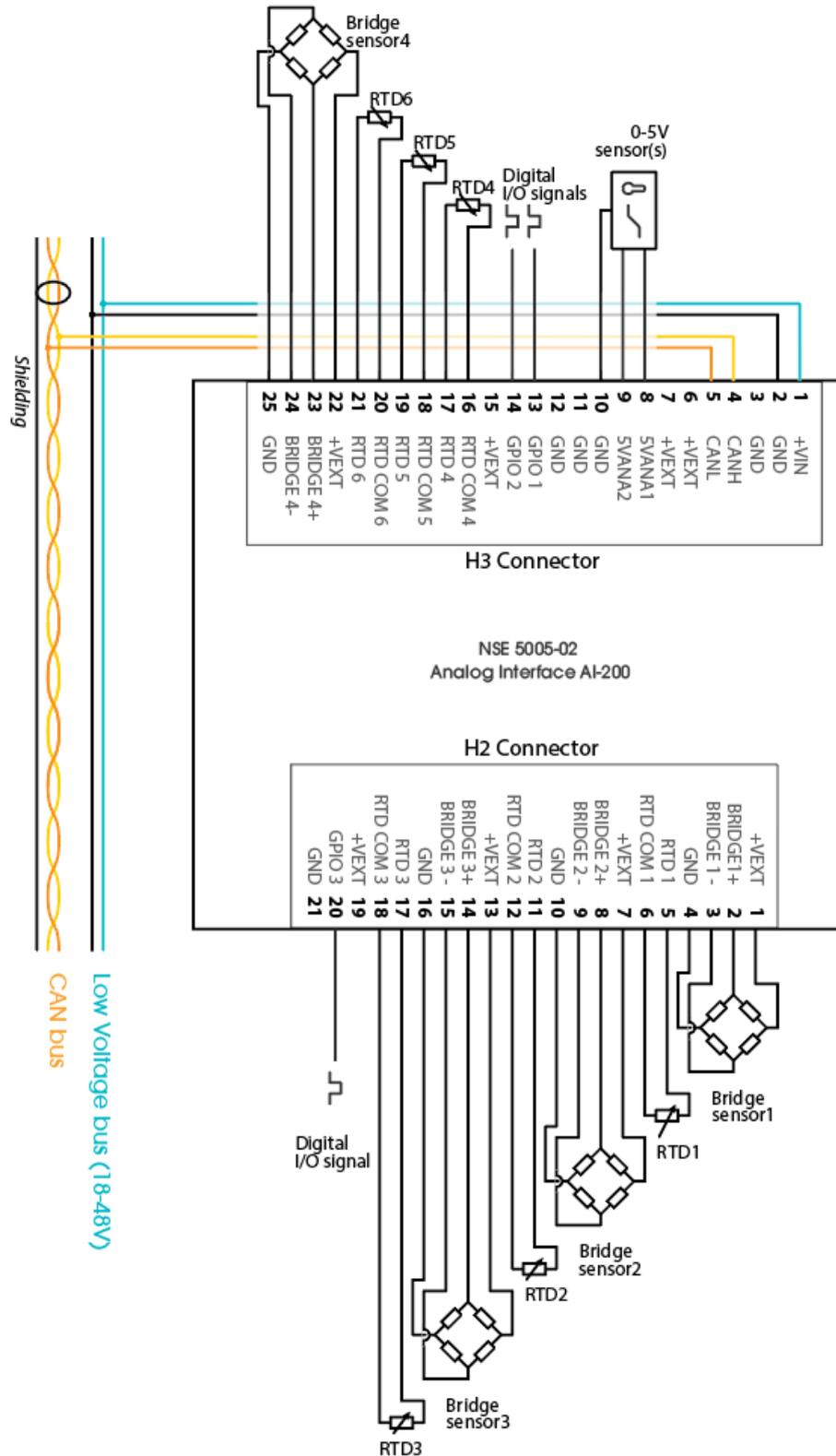
1.4 Environmental requirements

The AI-200 must be installed in dry air at atmospheric pressure (1atm) or in an oil type approved by NSE if the unit is to be used in a pressurized environment.

2 Connections

2.1 Overview

Note that the color of wires in the illustration may not reflect the colors on actual wiring.



2.2 H2 Connector information

AI-200 Connector: **Glenair 891-008-21P-BRT 21 pin Nano-D connector**
 Mating connector: **Glenair 891-002-21SA2-0B7-12J-MC273**

2.3 H2 Pin assignment

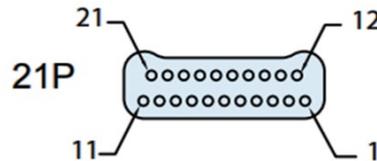
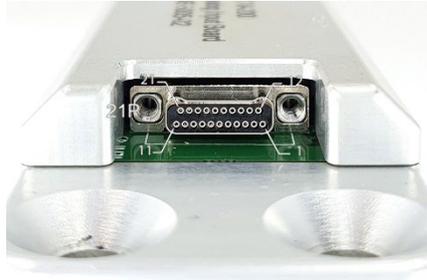


Illustration shows face view of the connector on the AI-200 board (Looking into to the connector).

2.4 H2 Signals

PIN	SIGNAL	Polarity	Description
1	+VEXT		+5V Excitation Voltage
2	BRIDGE 1 +	+	Bridge + input Channel 1
3	BRIDGE 1 -	-	Bridge - input Channel 1
4	GND		Ground
5	RTD 1	+	RTD CH 1
6	RTD COM 1	-	RTD RETURN CH 1
7	+VEXT		+5V Excitation Voltage
8	BRIDGE 2 +	+	Bridge + input Channel 1
9	BRIDGE 2 -	-	Bridge - input Channel 1
10	GND		Ground
11	RTD 2	+	RTD CH 2
12	RTD COM 2	-	RTD RETURN CH 2
13	+VEXT		+5V Excitation Voltage
14	BRIDGE 3 +	+	Bridge + input Channel 3
15	BRIDGE 3 -	-	Bridge - input Channel 3
16	GND		Ground
17	RTD 3	+	RTD CH 3
18	RTD COM 3	-	RTD RETURN CH 3
19	+VEXT		+5V Excitation Voltage
20	GPIO 3		GPIO 3
21	GND		Ground

2.5 H3 Connector information

AI-200 Connector: **Glenair 891-008-25PA2-BRT 25 pin Nano-D connector**
 Mating connector: **Glenair 891-002-25SA2-0B7-12J-MC273**

2.6 H3 Pin assignment

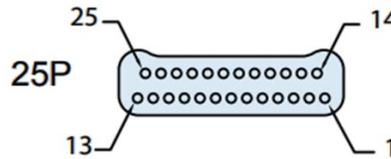
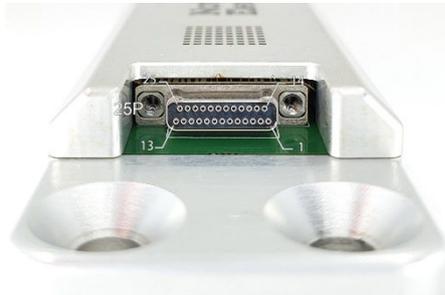


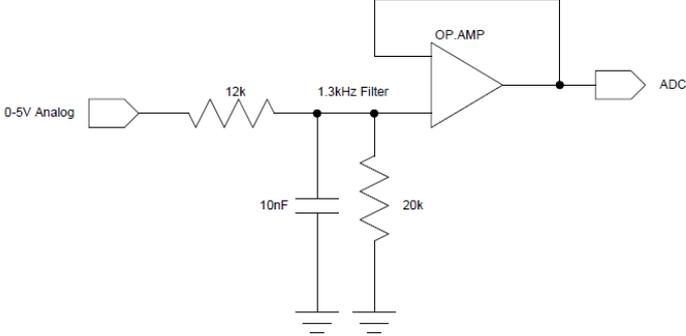
Illustration shows face view of the connector on the AI-200 board (Looking into to the connector).

2.7 H3 Signals

PIN	SIGNAL	Polarity	Description
1	+VIN		+18-48V Input Voltage
2	GND		Ground
3	GND		Ground
4	CANH		CANBus High
5	CANL		CANBus Low
6	+VEXT		+5V Excitation Voltage
7	+VEXT		+5V Excitation Voltage
8	5VANA1	+	0-5V Analog Input Ch1
9	5VANA2	+	0-5V Analog Input Ch2
10	GND		Ground
11	GND		Ground
12	GND		Ground
13	GPIO1		GPIO 1
14	GPIO2		GPIO 2
15	+VEXT		+5V Excitation Voltage
16	RTD COM 4	-	RTD RETURN CH 4
17	RTD 4	+	RTD CH 4
18	RTD COM 5	-	RTD RETURN CH 5
19	RTD 5	+	RTD CH 5
20	RTD COM 6	-	RTD RETURN CH 6
21	RTD 6	+	RTD CH 6
22	+VEXT		+5V Excitation Voltage
23	BRIDGE 4+	+	Bridge + input Channel 4
24	BRIDGE 4-	-	Bridge - input Channel 4
25	GND		Ground

3 Features

Feature	Description
<p>Communication Interface</p>	<p>The controller has CAN bus communication interface. On-board CAN termination is software selectable.</p>
<p>Sensor Bridge Interface</p>	<p>Bridge excitation voltage is 5V.</p> <p>Bridge input common mode range is 5V when input gain is 1.</p> <p>The analog front end input gain is configurable to be 1, 2, 4, 8, 16, 32, 64 or 128 for the bridge inputs. Default gain is set to 128 in firmware.</p> <div data-bbox="603 683 1401 1153" data-label="Diagram"> </div> <p style="text-align: center;"><i>Analog front end input circuit</i></p>
<p>Resistance Sensing Inputs</p>	<p>The board has 6 channels that can be used for resistor sensing inputs. Max resistance that can be measured is 2200ohms with the <i>gain = 1</i>.</p> <p>The maximum resistance that can be measured will be reduced with higher gain settings (so 1100ohms for <i>gain = 2</i> and further up).</p> <p>Typically, the resistance sensing inputs are being used to measure temperature by connecting RTD's. The AI-200 has scaling registers that can be used to scale the output to show temperature readings (rather than resistance).</p>

<p>Single Ended Analog Interface (0-5V input)</p>	<p>The board has 2 x single ended, 0-5V analog inputs.</p> <p>The input buffer has a 1.3kHz -3dB low pass filter.</p>  <p style="text-align: center;"><i>0-5V Analog Input Circuit</i></p>
<p>Digital GPIO</p>	<p>Each digital GPIO pin can be configured to be either output or input pins. The digital IO pins have a weak 100k pull-up to 5V.</p>
<p>Board temperature sensing</p>	<p>The board has an embedded temperature sensor that be read out through the CAN communication interface.</p>
<p>Output Excitation Voltage</p>	<p>The boards +5V_{DC} output excitation voltages can be used to power external devices such as limit switches, strain gauges or other external sensors.</p> <p>The output excitation voltage is current limited to prevent board or system failure in case of a sensor fault.</p>
<p>Internal voltage and current sensing</p>	<p>The board input voltage- and current is measured and can be read out through the CAN bus interface</p>

4 Firmware

The embedded firmware features all the necessary functions to configure the AI-200 board and to read out its measurements. Setup of the board is stored in a non-volatile memory that can also easily be down- and uploaded to a computer in order to save and restore defined configurations.

4.1 Reference documents

Protocol:

Doc: NSE-5000-013 - NSE Embedded Protocol Description

Register description:

Doc: NSE-500502-013 - Register Description AI-200

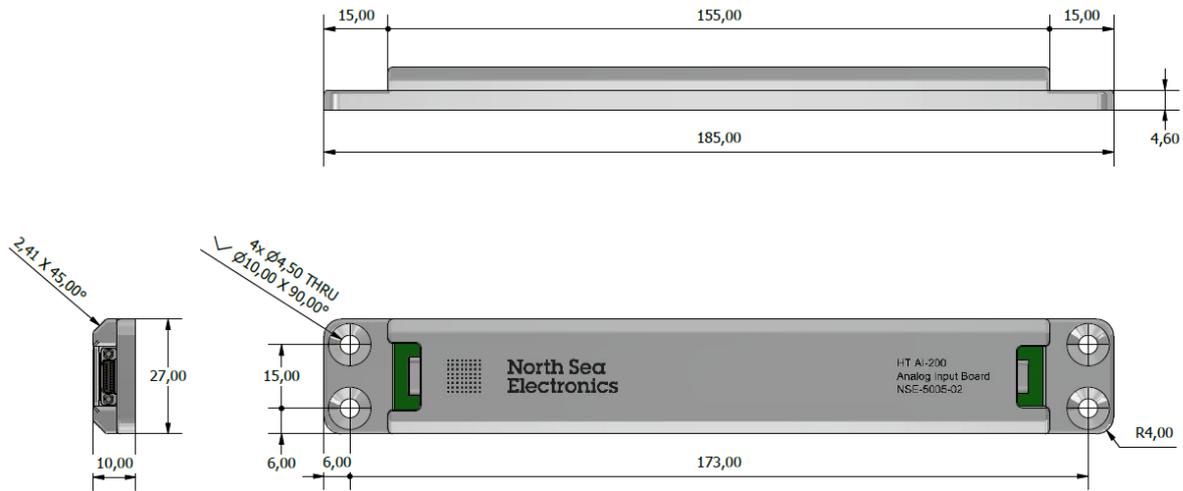
4.2 Control parameters

Parameter(s)	Setting(s)
Periodic messages	Two independent fully configurable periodic data set. Each of these data set can contain up to 21 selectable status registers and be transmitted at interval between 10ms and 65 seconds.
GPIO	Three separate GPIO's with selectable direction (Input or Output) and output (0 / 1) control.
Excitation voltage	Enabling and disabling of 5V excitation voltage source
Resistor Sensing Channel Parameters	All six resistor sensing channels have 4 controllable registers each. <ol style="list-style-type: none"> Scaling register: enables the AI 200 to output different unit (mΩ, °C, °F, LUX or other) - default unit is mΩ. Offset register: possibility to modify/eliminate offset PGA register: Selectable gain 1,2,4,8,16,32,64 or 128 Filter factor: Configurable digital low pass filtering
Differential Bridge Parameters	All four bridge channels have 4 controllable registers each. <ol style="list-style-type: none"> Scaling register: enables the AI 200 to output different unit (mV, LUX, psi, BAR or other) - default unit is uV. Offset register: Possibility to modify/eliminate offset PGA register: Selectable gain 1,2,4,8,16,32,64 or 128 Filter factor: <i>Configurable digital low pass filtering</i>
Communication	CAN Address, baud rate, node ID
Other Parameters	Other control and configuration parameters. Refer to register description for a full overview of parameters

4.3 Feedback parameters

Parameter(s)	Readout
Currents	Input Current (for diagnostics and current limit)
Voltages	Input voltage, excitation voltage, and internally measured voltages (for diagnostics)
Temperatures	Internal and external (RTD) temperatures
Differential Bridge	4 differential bridge channels readings
Resistor sensor	6 resistor sensing channels readings
Single ended input	2 single ended channels readings
Other Parameters	Other feedback parameters. Refer to register description for a full overview of parameters

5 Mechanical Dimensions



Consult NSE for CAD / STEP Model.

6 Datasheet Revision History

REV	DATE	DESCRIPTION	PREP	APPR
A	28.10.2019	Initial	EEN	RFY
B	08.05.2020	Updated mechanical Fixed single ended ADC samplings rate unit (OLY) Updated feature descriptions and datasheet template	RFY	
C	28.11.2023	Corrected overview drawing and pinout table. Pin 6 and 7 on H3 is Vext+ (Not GND)	EEN	RFY

7 Ordering

7.1 Order code

Order code:		NSE-5005	-02
Category	NSE-5005	= NSE Analog Node Boards	
Model	-02	= AI-200	
No Options			

7.2 Where to buy

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