Features

- Wide Input range of 18 – 50Vdc
- Up to 1A input current
- Up to 50W output
- High temperature – 177degC
- High efficiency design
- Hall Interface
- Supports Sensorless Running
- CNC Machined aluminum housing
- CANbus Interface
- Coated version can be submerged in oil and operate in pressurized environments

Product Description

The NSE HT Nano Drive Motor Controller is a high performance, high temperature motor controller designed for applications that requires a full-featured controller with an extremely small size. It is targeted to downhole tools, wireline tools, drilling tools and other high performance industrial and automotive applications.

The NSE HT Nano Drive Motor Controller has an embedded firmware that allows sophisticated control of a wide variety of motors. An open protocol interface combined with NSE or customer software allows easy setup and configuration to most available Brushless DC motors. The controller can also be set up to have autonomous- and/or customer-defined behavior.

The controller has all the sensors and algorithms required to run closed-loop control of RPM, input power and output current (torque). It has hall encoder interface and a firmware setting decides which interface to be used. This feature, combined with its other configurable settings, increases the flexibility of the controller and allows the same controller to be used in a wide range of applications.

To operate reliably at high temperature the controller has high efficiency, reducing the dissipated power to a minimum. The logic and control section has low current consumption to further increase operational time in cases where the controller is run from battery.

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

1 Product Specification

Parameter	Conditions / Comments	Min	Typ	Max	Unit
SUPPLY VOLTAGE					
Input Voltage Range	*Specified operational range*	18		50	*Vdc*
Power consumption	*Stand By Mode*		0.7		*W*
DRIVE SECTION					
Commutation Mode			Trapezoid / FOC		
Speed Range	*4 pole motor*				
	Hall Encoder Feedback	0		12.000	*RPM*
	Sensorless	500		8.000	*RPM*
Input Current Range	*Maximum continuous input current over temperature range*	0		1	*A*
Input Current Sensor Range		0		+/-3	*A*
Motor Current Sensor Range		0		+/-2	*A*
PWM Switching Frequency range		16		64	*kHz*
FEEDBACK INTERFACE					
Motor Position Feedback	*Firmware Selectable*	Hall	or	Sensorless	
Hall Excitation Voltage		4.5	5	5.5	*Vdc*
Hall Excitation Current				50	*mA*
ONBOARD SENSOR					
Temperature		-20		190	*°C*
DIGITAL INPUT / ANALOG INPUT PINS					
Voltage Range		0		5	*V*
Pull up resistance	*Pulled up to 3.3V*		10		kΩ
MECHANICAL DIMENSIONS					
Chassis Width			20		*mm*
Chassis Length			113		*mm*
Chassis Height			11		*mm*
CANBUS INTERFACE*					
Bit Rate		83.3	125	250	*kbits/s*

ENVIRONMENTAL AND THERMAL				
Ambient temperature	*Min and Max Temperature on the surface of outer housing given that thermal resistance is within the specification*	-10	177	*°C*
Thermal Resistance	*Surface of OUTER HOUSING to NSE UNIT* **Refer to the Section "Thermal properties" for further definition*		0.5	*°C/W*
Pressure Rating Default			1	*Bar*
Pressure Rating Optional	*Note – must be ordered as a pressure rated unit. Ref. Order code.*		700	*Bar*
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 – Bit rate is configurable.*

2 Thermal properties

The NSE High Temperature Motor Controller 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.

2.1 Conformal Coating

This product is delivered with no conformal coating, except for the pressure rated versions that are conformal coated with high temperature Parylene Coating.

2.2 Environmental requirements

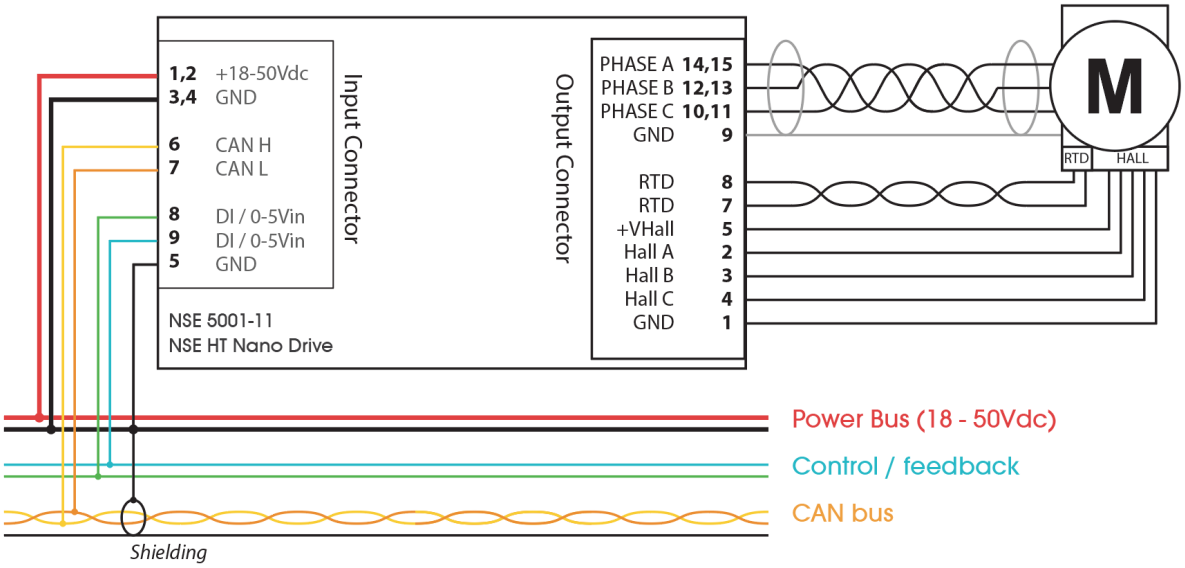
NSE boards must be installed in dry air at atmospheric pressure (1atm). Avoid humid atmosphere or under / overpressure. Refer to general NSE installation guidelines for more information.

Note that this unit can be ordered in a pressure rated version (ref. order code). Consult NSE for oil types if the unit is to be placed in pressure exposed enclosure.

3 Connections

3.1 Overview

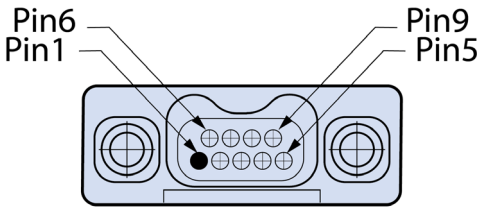
Note that color of wires in illustration may not reflect the colors on actual wiring.



3.2 Input connector

MCD Connector: Glenair 891-009-9SA2-BRT1T-534
Mating connector: Glenair Nano-D 9-pin pin connector

Pin	Signal name	Description / Function	Connector Pinout
1	+18-48	Input Power	Looking into the connector on the driver
2	+18-48	Input Power	
3	GND	Ground	
4	GND	Ground	
5	GND	Ground	
6	CANH	CAN High	
7	CAN L	CAN Low	
8	DI / 0-5V	Digital Input or 0-5V Analog	
9	DI / 0-5V	Input	
		Digital Input or 0-5V Analog Input	



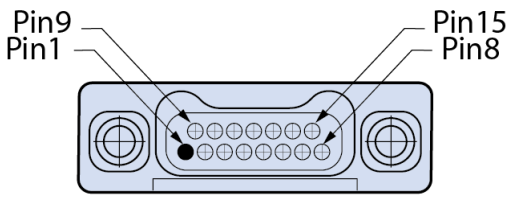
3.3 Output connector

MCD Connector: Glenair 891-009-15SA2-BRT1T-534
Mating connector: Glenair Nano-D 15-pin pin connector

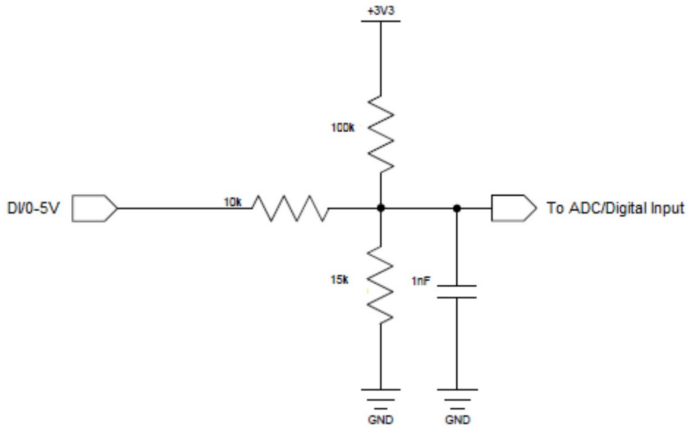
Pin	Signal name	Description / Function
1	GND	Ground
2	Hall A	Hall A
3	Hall B	Hall B
4	Hall C	Hall C
5	+VHall	+Hall Supply
6	GPIO2	GPIO2
7	-	Not Connected
8	-	Not Connected
9	GND	Ground
10	C	Motor Phase C
11	C	Motor Phase C
12	B	Motor Phase B
13	B	Motor Phase B
14	A	Motor Phase A
15	A	Motor Phase A

Connector Pinout

Looking into the connector
on the driver



4 Features

Feature	Description
Communication Interface	The controller can be delivered with either RS485 or CAN bus communication interface. The unit has no CAN termination resistor.
Input power filter	The controller has a power filter in order to reduce radiated noise from the driver during operation. Note however that this filter will not remove all ripple currents and voltages, so depending on the application – further power line filtering may be required. Consult NSE for more information on the power filter and noise characteristics
Control / Feedback signals	The controller has 2 pins dedicated to analog input control (such as using 0-5V for controlling speed) or they can be used as digital inputs (typical limit switches or start / stop signals).  *Digital Input / 0-5V input equivalent circuit.*
Hall interface	The controller has an integrated hall encoder interface. This is the most common interface for position feedback.
Voltage and current sensing	The controller has embedded sensors for both input voltage and current, and phase currents. In addition, it can sense the phase voltages and back EMF.
Temperature sensing	There is an embedded temperature sensor on the board. Temperature can be read out through the CAN communication interface. There is an external interface to an RTD sensor – either PT100 or PT1000. The choice of sensor is selectable through the communication interface. Typically, this sensor is used to monitor motor temperatures.

5 Firmware

The embedded firmware features all the necessary functions to set up and run most available Brushless DC motors. Setup of the controller 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.

5.1 Control parameters

Parameter(s)	Setting(s)
Run Control	Start / Stop
Drive/Feedback Mode	Hall-Encoder / Sensorless
Motor Configurations	Pole Pair, PWM frequency
Sensorless Configurations	Sensorless characteristics
Speed	Speed (RPM) setpoint
Input Current	Input current setpoint (correlate with input power for a fixed voltage input)
Phase Current	Phase current setpoint (correlate with torque)
Position setpoint	Position setpoint (if run in position control)
PID parameters	PID regulation settings
Startup parameters	Configuration for auto-start and stop at defined voltages
Alarm parameters	Configuration of alarm parameters
Communication	Bit rate, node ID
Other Parameters	Other control and configuration parameters. Refer to register description for a full overview of parameters

5.2 Feedback parameters

Parameter(s)	Readout
Drive state	Drive state (Hall / Sensorless), Regulation mode
RPM	Motor RPM
Currents	Input (power) and output (torque) currents
Voltages	Input voltage and internally measured voltages (for diagnostics)
Position	Position step counter
Temperatures	Internal and external (RTD) temperatures
Alarm	Alarm status
Other Parameters	Other feedback parameters. Refer to register description for a full overview of parameters

5.3 Alarm parameters

Parameter	Function
Under Voltage	Under voltage shutdown
Over Voltage	Over voltage shutdown
Input current	Shutdown if input current exceeds the defined limit
Phase current	Shutdown if the phase current (torque) exceeds the defined limit
Temperature	Shutdown if the temperature exceeds the defined limit
Under RPM	Shutdown if the RPM drops below threshold
Sensorless Stall	Shutdown if the sensorless algorithm detect stall of motor

5.4 Field Oriented Control

When running in sensorless mode the controller will use field oriented control with space vector modulation of the PWM in order to control the motor. In short this means that the control of the motor is done by regulating the phase current as an inner regulation loop, allowing the controller to respond immediately to any load changes on the motor.

Space vector modulation is regarded as the most efficient way of running the motor, and ensure that the motor is running smooth with low torque ripple and wear of the bearings.

When running with hall encoder feedback, the controller will run standard trapezoidal control of the motor.

5.5 Closed loop regulation

The controller has the ability to run closed loop control of a motor. All the parameters have a control loop and they are run simultaneously – so that the controller can regulate the speed of a motor at a certain RPM and until the torque reaches a defined level in which the torque control loop will take over the regulation.

Parameter	Function
Speed	Regulate the speed of the motor to the desired setpoint
Phase current	Control the phase currents of the motor. This correlates with the motor torque.
Input current	Control the input current of the motor. For a steady input voltage, regulating the input current will regulate the input power.
Position	If in position mode, the motor will go to the position setpoint, using the internal position counter (number of motor steps)

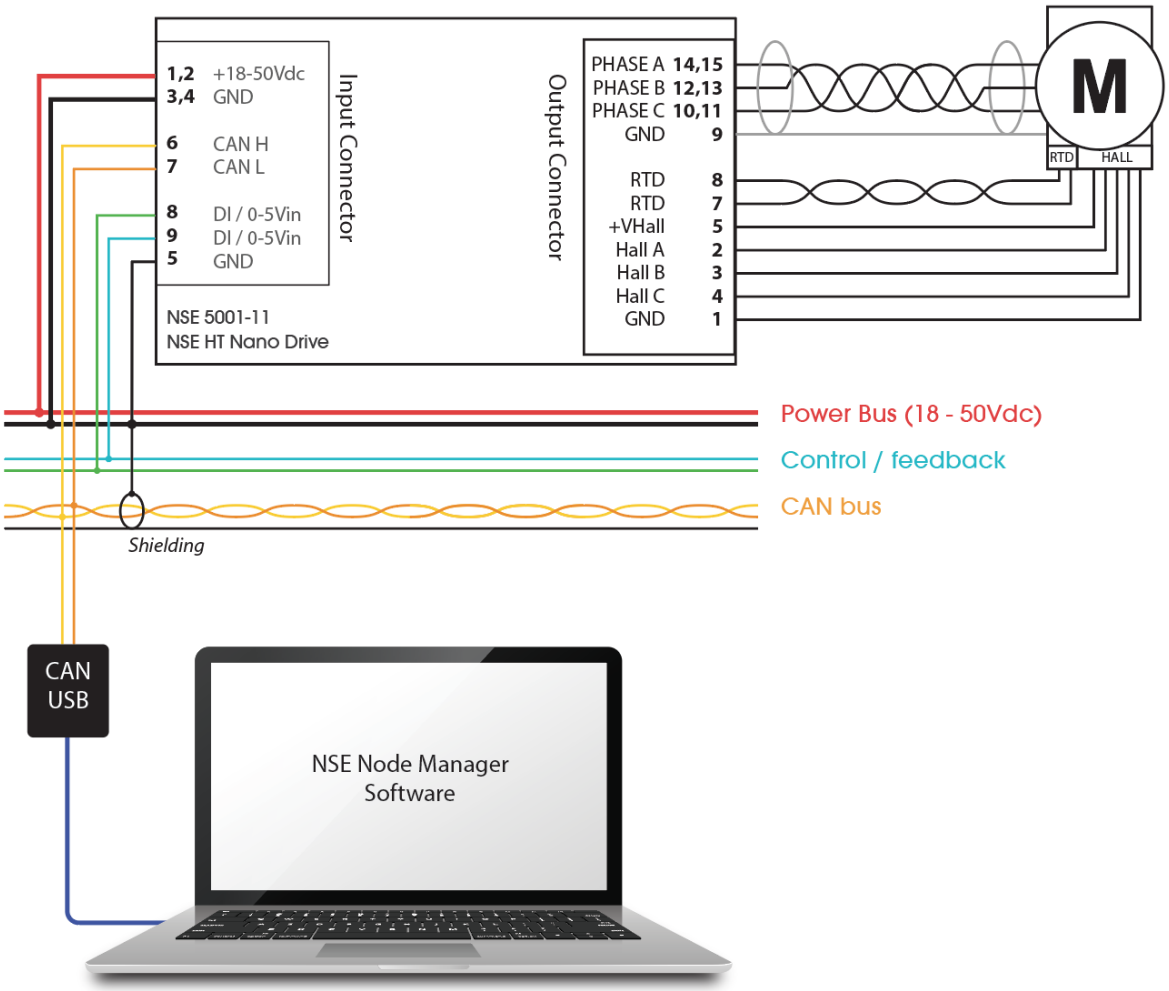
5.6 Bootloader

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.

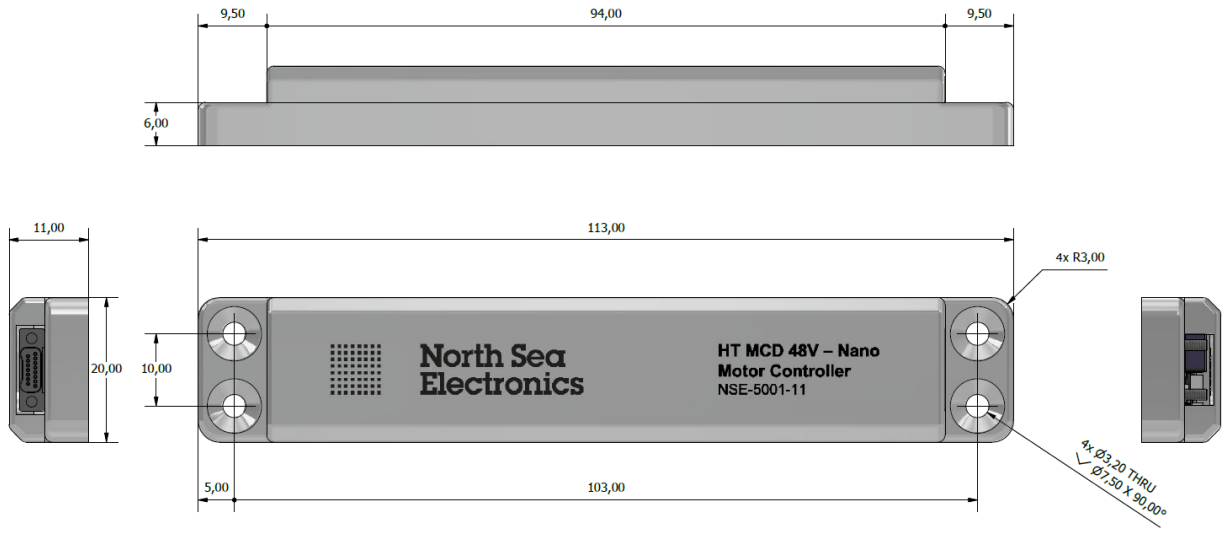
6 Graphical User Interface

The “NSE Node Manager” software (graphical user interface) is a free of charge software that can be used to set up and run the motors. This software uses the standard NSE protocol to communicate with the controller and allows the user to set up and run the system in a short time.

Using a USB to CANbus adapter and the “NSE Node Manager” software one can connect to the controller to control and set it up. Configuration profiles can easily be stored to the computer.



7 Mechanical Dimensions



8 Datasheet Revision History

REV	DATE	DESCRIPTION	PREP	APPR
A	08.06.2020	Initial Revision	RFY	GLK
B	15.11.2020	Updated connector pinout drawings	RFY	

9 Ordering

9.1 Order code

			Order code:	**NSE-5001**	**-07**	**-X**	**-Y**
Category	NSE-5001	= NSE Motor Controllers				
Model	-11	= HT NanoDrive				
Communication Interface	-A -B	= CAN Bus = RS485				
Pressure Rating	-P	= Pressure tested and rated = (No Designator) No pressure rating				

9.2 Where to buy

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