Features

- Up to 600Vdc input voltage
- Up to 7.5A input current
- Up to 3600W output power
- High temperature – 177degC
- Short-circuit protection
- Hall-effect or Resolver interface
- Support sensorless running
- Compact and rugged aluminum housing
- CANbus or RS485 interface
- Field Oriented Control (FOC)
- High shock and vibration resistance

Product Description

The HT 600V Brushless DC Motor Controller MKIII is a high performance, high temperature motor controller designed for applications that require a compact and ruggedized full featured controller. It is targeted downhole wireline applications and drilling tools. It is also very well suited for other industrial and automotive applications.

The HT 600V Brushless DC Motor Controller MKIII comes with an embedded firmware that allows sophisticated control of a wide variety of motors. An open interface protocol combined with NSE or 3rd party/customer software allow 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 HT 600V Brushless DC Motor Controller MKIII has all the sensors and algorithms required to run closed loop control of RPM, input power and output current (torque). The controller has integrated both resolver and hall encoder interface integrated. The desired interface can be selected through the communication interface. This feature, combined with its other easily configurable settings, increases the flexibility of the controller and allows the same controller to be used in a wide range of applications and tools.

In order 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 in order to further reduce power consumption and optimize the lifetime of the unit.

The 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 very high shock and vibration environment may occur. The board has rugged, high temperature connectors.

1 Product Specification

1.1 Electrical Specifications

Parameter	Conditions / Comments	Min	Typ	Max	Unit
SUPPLY VOLTAGE					
Input High Voltage	*Specified operational range*	0		600	*Vdc*
Input High Voltage shutdown	*Max voltage before shutdown*		650		*Vdc*
Input Transient Voltage	*< 1sec*			800	*V*
Input Current to driver stage	*Note de-rating @ temperature*			7.5	*Adc*
Low voltage supply	*Logic supply voltage input*	20		36	*Vdc*
Low voltage Current consumption	*Standby @ 28Vdc Input* *Running @ 28Vdc Input* **Depend on connected resolver*	30 40		40 60*	*mA* *mA*
DRIVE SECTION					
Commutation Mode	*Resolver – Ref. fw. section* *Sensorless – Ref. fw. section* *Hall Feedback*		FOC FOC Trapez.		
Speed Range	*2 pole motor – Resolver* *2 pole motor - Hall Encoder* *2 pole motor – Sensorless* **Depend on motor characteristics*	0 0 700*		16.000 16.000 16.000*	*RPM* *RPM* *RPM*
Output Phase Current	*Max continuous output current*	0		8	*A*
Input Current Sensor Range		0		8	*A*
Motor Current Sensor Range		0		+/-8	*A*
PWM Switching Frequency range		16		48	*kHz*
FEEDBACK INTERFACE					
Motor Position Feedback	*Firmware Selectable*	Hall /	Resolver /	Sensorless	
Hall Excitation Voltage		4	5	5.5	*Vdc*
Hall Excitation Current				20	*mA*
Resolver Excitation Voltage		3.5	4	5	*Vp-p*
Resolver Excitation Current				20	*mA rms*
Resolver Excitation Frequency	*Firmware Selectable*	10		20	*kHz*
Resolver Feedback Signal	*Minimum signal strength*	3			*Vp-p*
EXTERNAL TEMPERATURE SENSOR					
Sensor Type	*RTD - firmware selectable.*		PT100 / PT1000		
Temperature Range		-20		200	*°C*

MECHANICAL DIMENSIONS					
Chassis Length			281.5		*mm*
Chassis Width			37.0		*mm*
Chassis Height			27.7		*mm*
CANBUS INTERFACE*					
Baud Rate		83.3	125	250	*kbits/s*
RS485 INTERFACE*					
Baud Rate		38.4	38.4	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*	-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 - the unit can be ordered with either CAN bus or RS485 interface. Baudrate is configurable.*

1.2 Thermal properties

The NSE HT 600V BLDC 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.

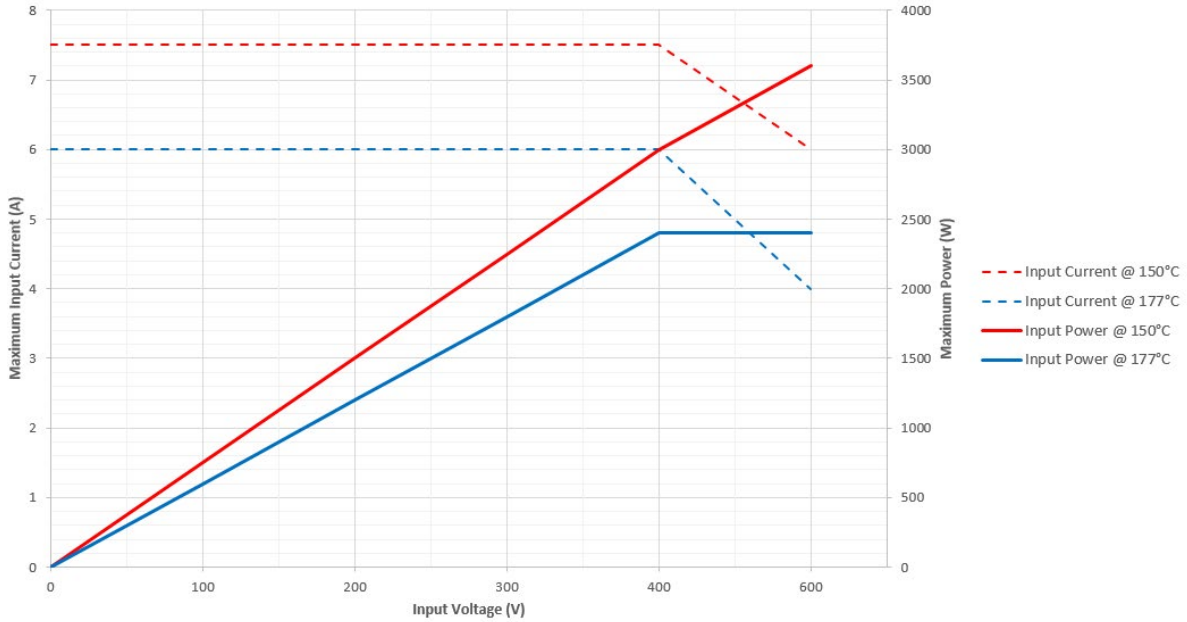
1.3 Conformal Coating

This product is delivered with no conformal coating.

1.4 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.

1.5 Input power rating

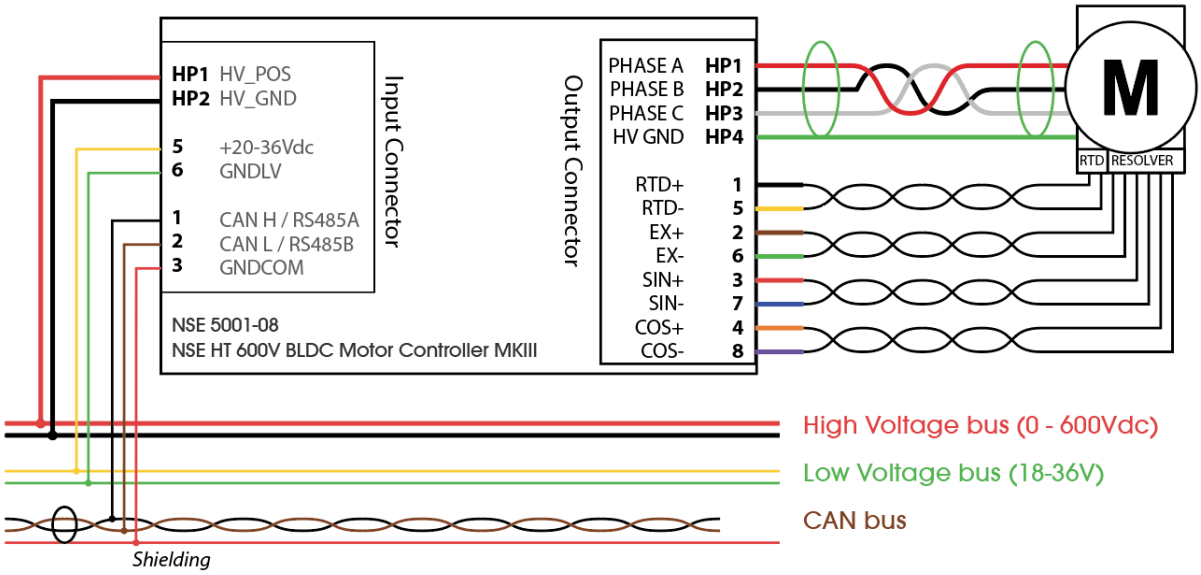


Input power and current rating for 177degC and 150degC.

2 Connections

2.1 Overview

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

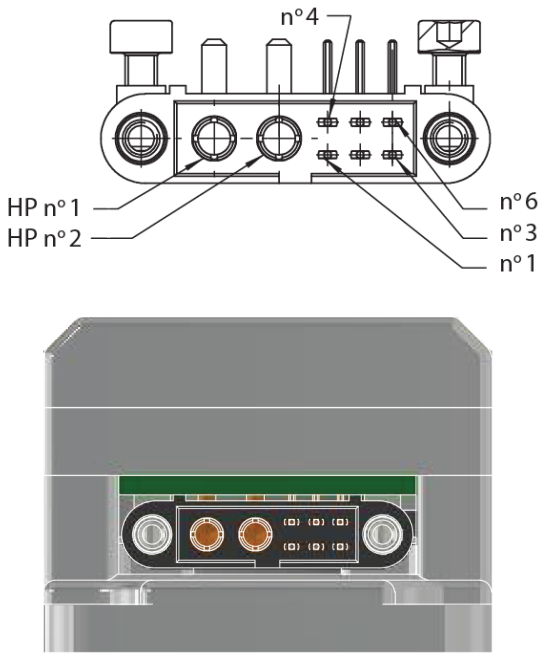


2.2 Input Connector

Motor Controller Connector: **Nicomatic 221V06F26-0200-3400CMM**
Mating connector: **Nicomatic 222S06M16-0200-4310**
NSE connector kit: **NSE-5001-12-CON-1**

Pin	Signal name	Description / Function	NSE Connector kit wire type	NSE Connector kit wire color
HP1	VIN	Supply Voltage Positive In	120cm 20AWG 600V	RED
HP2	GNDLV	Supply Voltage Ground	120cm 20AWG 600V	BLACK
1	CAN H/A	CAN High / RS485 A(1)	120cm 26AWG 600V	BLACK
2	CAN L/B	CAN Low / RS485 B(1)	120cm 26AWG 600V	BROWN
3	GNDCOM	Communication Ground	120cm 26AWG 600V	RED
4	V_boot	*Res. Do Not Connect	120cm 26AWG 600V	ORANGE
5	+20-36V	Low volt. supply - POS	120cm 26AWG 600V	YELLOW
6	GNDLV	Low volt. Supply – GND	120cm 26AWG 600V	GREEN

1) Device only support one type of communication interface depending on HW configuration i.e. CAN or RS485

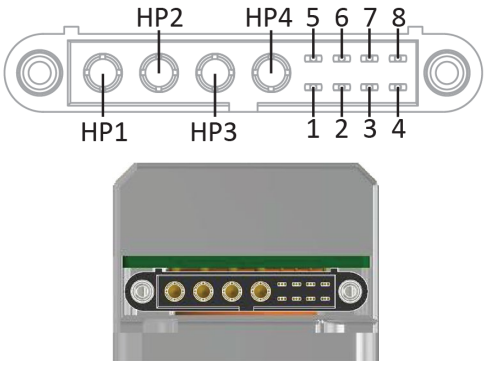
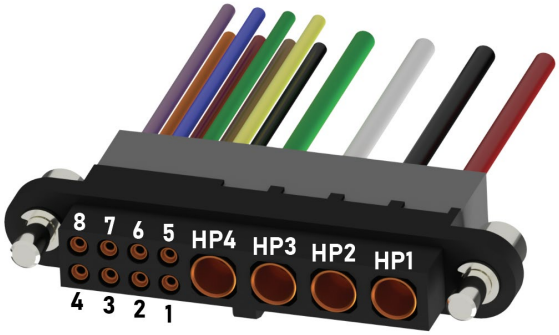
MCD connector	Mating cable connector
	

2.3 Output connector

A firmware setting determines if the controller is configured for Resolver or Hall Encoder feedback. Depending on the configuration, the signal pins will have different assignment. Make sure to choose pinout that correlates with the encoder feedback of your motor.

Motor Controller Connector: **Nicomatic 221V08F26-0400-3400CMM**
Mating connector: **Nicomatic 222S08M16-0400-4310**
NSE connector kit: **NSE-5001-12-CON-1**

Pin	Signal name	Description / Function	NSE Connector kit wire type	NSE Connector kit wire color
HP1	PHASE A	Motor Phase A	120cm 20AWG 600V	RED
HP2	PHASE B	Motor Phase B	120cm 20AWG 600V	BLACK
HP3	PHASE C	Motor Phase C	120cm 20AWG 600V	WHITE
HP4	HV_GND	HV GND	120cm 20AWG 600V	GREEN
Resolver feedback signal pin (1-8) assignments				
1	RTD+	RTD terminal 1 (PT100/1000)	120cm 26AWG 600V	BLACK
5	RTD-	RTD terminal 2 (PT100/1000)	120cm 26AWG 600V	YELLOW
2	EX+	Resolver Excitation positive	120cm 26AWG 600V	BROWN
6	EX-	Resolver Excitation negative	120cm 26AWG 600V	GREEN
3	SIN+	Resolver Sine Pos. Feedback	120cm 26AWG 600V	RED
7	SIN-	Resolver Sine Neg. Feedback	120cm 26AWG 600V	BLUE
4	COS+	Resolver Cos Pos. Feedback	120cm 26AWG 600V	ORANGE
8	COS-	Resolver Cos Neg. Feedback	120cm 26AWG 600V	VIOLET
Hall Encoder feedback signal pin (1-8) assignments				
1	RTD+	RTD terminal 1 (PT100/1000)	120cm 26AWG 600V	BLACK
5	RTD-	RTD terminal 2 (PT100/1000)	120cm 26AWG 600V	YELLOW
2	+5V	5V Hall sensor Supply	120cm 26AWG 600V	BROWN
6	GND	GND Hall Sensor Supply	120cm 26AWG 600V	GREEN
3	HALL A	Hall A Feedback	120cm 26AWG 600V	RED
7	HALL B	Hall B Feedback	120cm 26AWG 600V	BLUE
4	HALL C	Hall C Feedback	120cm 26AWG 600V	ORANGE
8	N.C	Not Connected	120cm 26AWG 600V	VIOLET

MCD connector	Mating cable connector
	

3 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. However, the interface is galvanically isolated and there is noise filter on the communication interface.
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
Output Common mode filter	In order to reduce the output EMI of the controller it has a built-in Common mode filter on the phases outputs.
Hall and resolver interface	The controller has both resolver and hall interface integrated. The desired interface can be set through the communication interface. Refer to the connector pinout for connections.
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 are two embedded temperature sensors (logic section and transistor temperature). These can both 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.
Short circuit protection	The output phases are protected by a dedicated short circuit protection mechanism. This is a hardware circuit that will detect a short circuit condition and immediately turn of the output transistors in order to protect the drive and the motor.

4 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.

4.1 Control parameters

Parameter(s)	Setting(s)
Run Control	Start / Stop
Drive / Feedback Mode	Resolver / Hall-Encoder / Sensorless
Motor Configurations	Pole Pair, Resolver settings, PWM frequency
Sensorless Configurations	Senorless 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 autostart- and stop at defined voltages
Alarm parameters	Configuration of alarm parameters
Communication	CAN Address, baudrate, node ID
Other Parameters	Other control and configuration parameters. Refer to register description for a full overview of parameters

4.2 Feedback parameters

Parameter(s)	Readout
Drive state	Drive state (Resolver / 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

4.3 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 transistor 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
Short Circuit	Shutdown if the controller detect a short circuit

4.4 Control mode

When running in resolver- or sensorless mode the controller will use field oriented control (FOC) 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.

4.5 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)

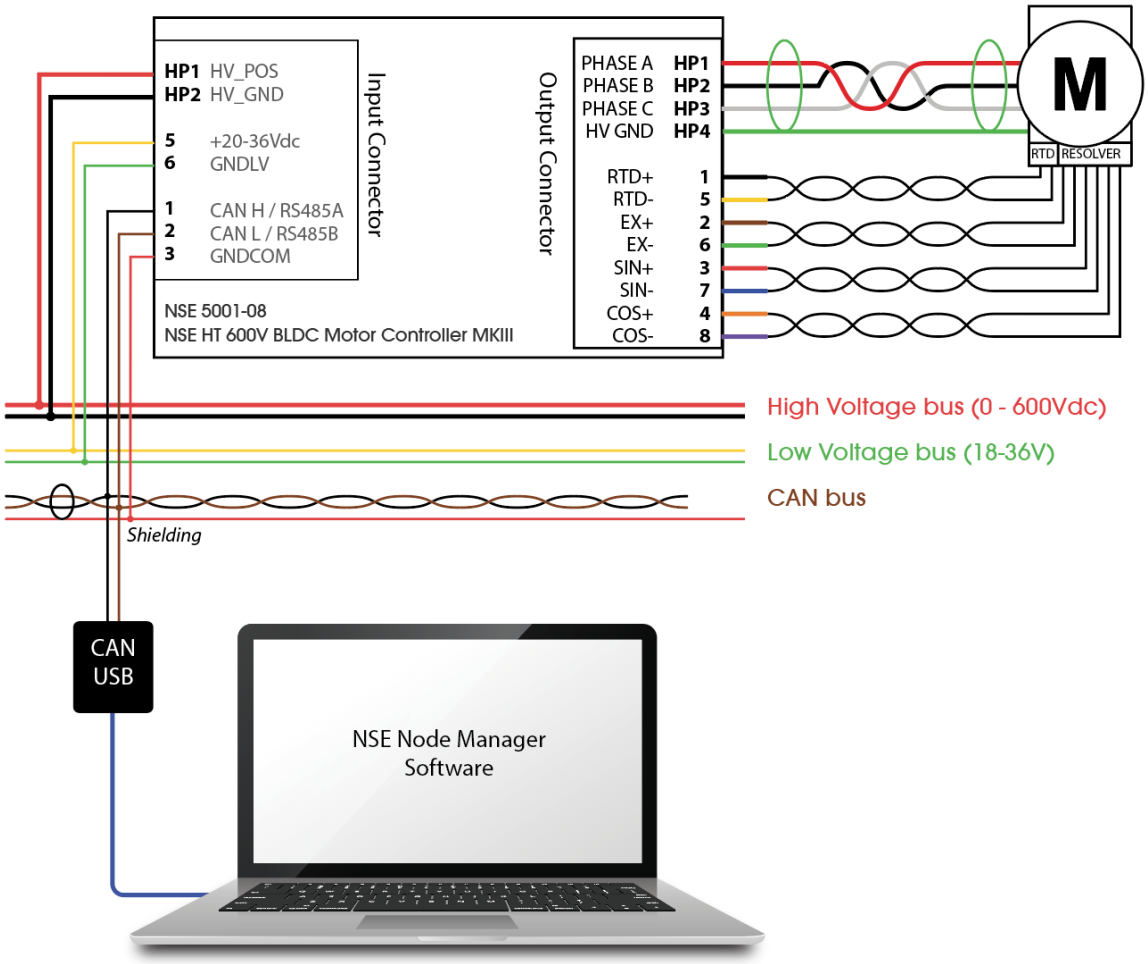
4.6 Bootloader

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.

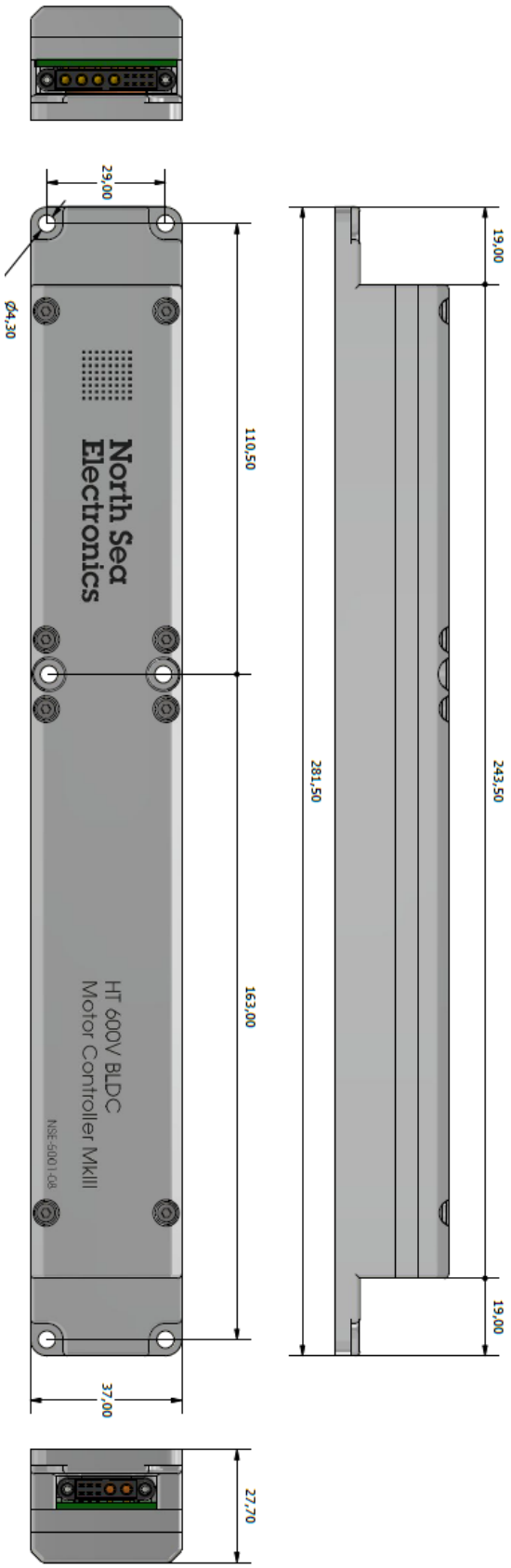
5 Graphical User Interface

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.



6 Mechanical Dimensions



7 Datasheet Revision History

REV	DATE	DESCRIPTION	PREP	APPR
A	04.05.2020	Initial release	RFY	GLK
B	27.05.2021	Updated with cable kit and wire color information	RFY	GLK
C	12.07.2021	Corrected wrong pinout on overview drawing	RFY	GLK

8 Ordering

8.1 Order code

		Order code:	**NSE-5001**	**-08**	**-X**
Category	NSE-5001	= NSE Motor Controllers			
Model	-08	= 600V MKIII High Temperature controller			
Communication Interface	-A -B	= CAN Bus = RS485			

8.2 Where to buy

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