

SS-EC

Hardware Manual

Step-Servo EtherCAT Drive



Ether**CAT**® 



Table of Contents

1 Introduction	4
1.1 Features	4
1.2 Block Diagram	5
1.3 Safety Instructions	6
2 Getting Started	7
2.1 Installing the Software	7
2.2 Mounting the Drive	8
2.4 Choosing the Right COM Port	9
2.5 Connecting the Main Power Supply	9
2.6 Connecting the Auxiliary Power Supply	10
2.7 Choosing a Power Supply	10
2.7.1 Supply Voltage	10
2.7.2 Supply Current	10
2.7.3 Auxiliary Supply Voltage (Keep Alive Function)	21
2.7.3.1 Keep Alive Recovery with I/O Function	22
2.7.3.2 Keep Alive Recovery with the Master Controller	22
2.8 Connecting the Motor	23
2.9 Connecting the EtherCAT	24
2.9.1 EtherCAT Status Indicator LEDs	24
2.10 Connecting the STO	25
2.10.1 Safety Precautions	25
2.10.2 STO Internal Circuit Diagram	25
2.10.3 CN4 Connector diagram	25
2.10.4 STO Signal Definition	26
2.10.5 STO Connection Diagrams	26
3 Inputs and Outputs	27
3.1 Digital Inputs	28
3.1.1 X1, X2, X3 and X4 Digital Inputs	28
3.1.2 X5, X6, X7 and X8 Digital Inputs	29
3.3 Analog Inputs	32
3.4 Encoder output	32
4 Control Panel (LED display and keys)	33
4.1 Description of Control Panel	33
4.2 Mode Switch Control	33
4.3 LED display description	35
4.3.1 Decimal Point And Negative Sign Description	35
4.3.2 Parameter View Setting	35
4.3.3 Parameter Save Setting	35
4.3.4 Point To Point Motion Mode	35
4.3.5 Jog Mode	36
4.3.6 Control Panel Lock	36
4.4 Status Monitoring Selection Mode	36
4.5 Function Control Mode	38
4.5.1 Function Mode Description	38
4.5.2 Operation Flow Chart	39
4.6 Parameter Setting Mode	40
4.6.1 Parameter Setting Description	40
4.6.2 Parameter Editing Examples	41
4.6.3 Parameter list	42
4.7 Control Panel Lock	45

4.8 Warning And Fault Display	45
4.9 LED Character Reference.....	47
5 Reference Materials	48
5.1 Drive Mechanical Outlines.....	48
5.2 Drive Technical Specifications	49
5.3 Recommended Motors and Specifications.....	50
5.4 Motor Mechanical Outlines.....	52
5.5 Torque Curves.....	54
5.7 Drive Numbering System	56
6 Optional Accessories (Sold separately).....	57
6.1 Cables.....	57
6.2 Mating Connectors	59

1 Introduction

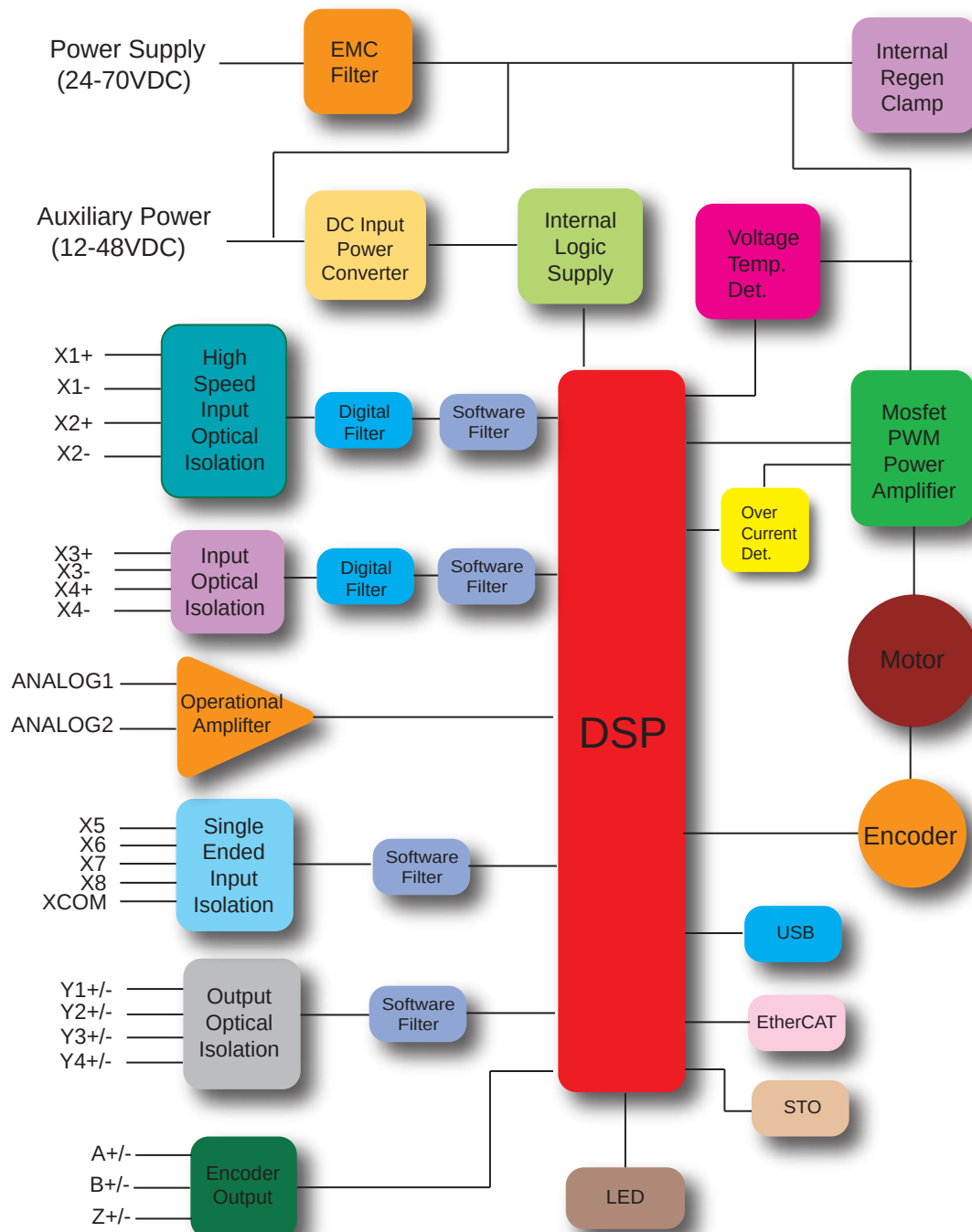
Thank you for selecting the Applied Motion Products SS-EC Step-Servo drive and motor. The SS-EC series combines servo technology with a stepper motor to create a product with exceptional features and broad capability. The SS-EC drive can operate as a standard EtherCAT slave using CANopen over EtherCAT (CoE).

1.1 Features

- Programmable, digital step-servo drive and motor package
- Operates from a 24 to 70 volt DC power supply
- Keep Alive function available with an auxiliary power supply, 12 - 48 VDC.
- CANopen over EtherCAT (CoE) with full support of CiA402. Based on the widely used 100BASE-TX cabling system and with a baud rate of 100Mbps full-duplex, EtherCAT enables high speed and highly reliable communication
- Supported modes: Profile Position, Profile Velocity, Profile Torque, Cyclic Synchronous Position, Cyclic Synchronous Velocity, and Homing; as well as Applied Motion Products own Q mode
- Dual port EtherCAT communication
- USB port for configuration
- Encoder resolution: 20000 counts/rev for HT17/23/24/34SS motor, 4096 counts/rev for HT11SS motor
- SS03-EC output current: continuous 3A, boost 4.5A
- SS05-EC output current: continuous 5A, boost 7.5A
- SS10-EC output current: continuous 10A, boost 15A
- 8 optically isolated digital inputs, 5-24VDC high level voltage
- 4 optically isolated digital outputs, max 30V/100mA sink or source current
- 2 analog inputs, can be configured to 0-5V, 0-10V, $\pm 5V$ or $\pm 10V$ signal ranges
- Differential encoder signal output (AOUT +/-, BOUT +/-, ZOUT +/-), 26C31 line driver, 20mA sink or source current
- Front panel with 4 keys and 5 digit LED display for setting parameters
- STO function

1.2 Block Diagram

SS EtherCAT Block Diagram



1.3 Safety Instructions

Only qualified personnel should transport, assemble, install, operate, or maintain this equipment. Properly qualified personnel are persons who are familiar with the transport, assembly, installation, operation, and maintenance of motors, and who meet the appropriate qualifications for their jobs.

To minimize the risk of potential safety problems, all applicable local and national codes regulating the installation and operation of equipment should be followed. These codes may vary from area to area and it is the responsibility of the operating personnel to determine which codes should be followed, and to verify that the equipment, installation, and operation are in compliance with the latest revision of these codes.

Equipment damage or serious injury to personnel can result from the failure to follow all applicable codes and standards. Applied Motion Products does not guarantee the products described in this publication are suitable for a particular application, nor do they assume any responsibility for product design, installation, or operation.

- Read all available documentation before assembly and operation. Incorrect handling of the products referenced in this manual can result in injury and damage to persons and machinery. All technical information concerning the installation requirements must be strictly adhered to.
- It is vital to ensure that all system components are connected to earth ground. Electrical safety is impossible without a low-resistance earth connection.
- This product contains electrostatically sensitive components that can be damaged by incorrect handling. Follow qualified anti-static procedures before touching the product.
- During operation keep all covers and cabinet doors shut to avoid any hazards that could possibly cause severe damage to the product or personal health.
- During operation, the product may have components that are live or have hot surfaces.
- Never plug in or unplug the Integrated Motor while the system is live. The possibility of electric arcing can cause damage.

Be alert to the potential for personal injury. Follow recommended precautions and safe operating practices emphasized with alert symbols. Safety notices in this manual provide important information. Read and be familiar with these instructions before attempting installation, operation, or maintenance. The purpose of this section is to alert users to the possible safety hazards associated with this equipment and the precautions necessary to reduce the risk of personal injury and damage to equipment. Failure to observe these precautions could result in serious bodily injury, damage to the equipment, or operational difficulty.

2 Getting Started

The following items are needed:

- A 24-70 volt DC power supply, see Section 2.7 “Choosing a Power Supply” for help in choosing the right one.
- An optional 12-48 volt DC power supply for Keep Alive function
- A compatible SS motor, see Section 5.3 “Recommended Motors and Specifications”
- A small flat blade screwdriver for tightening the connectors (included)
- A PC running Microsoft Windows XP, Windows 7, Windows 8/10 (32-bit or 64-bit) operating system
- A mini USB cable for configuration (included)
- *Step-Servo Quick Tuner* software (available from Applied Motion Products website)
- A CAT5 cable for EtherCAT daisy chain connection (included)
- An STO connector for CN4 connection (included)
- Optional motor extension cable
- Optional encoder extension cable
- Optional I/O cable

2.1 Installing the Software

Step-Servo Quick Tuner is the PC based software application used to configure and perform servo tuning, drive testing, and evaluation on Applied Motion Products step-servo products. System servo control gains, drive functionality, and I/O configuration are set with *Step-Servo Quick Tuner*. It also contains an oscilloscope function to help to set the servo control gains.

- Download the *Step-Servo Quick Tuner* 3.0.16.0822 version or later from the Applied Motion Products website and install it.
- Launch the software by clicking Start -- Programs -- Applied Motion Products
- Connect the drive to the PC with the mini USB cable. Select right COM port in the software. See Section 2.4 “Choosing the Right COM Port”.
- Connect the drive to the power supply.
- Connect the motor to the drive.

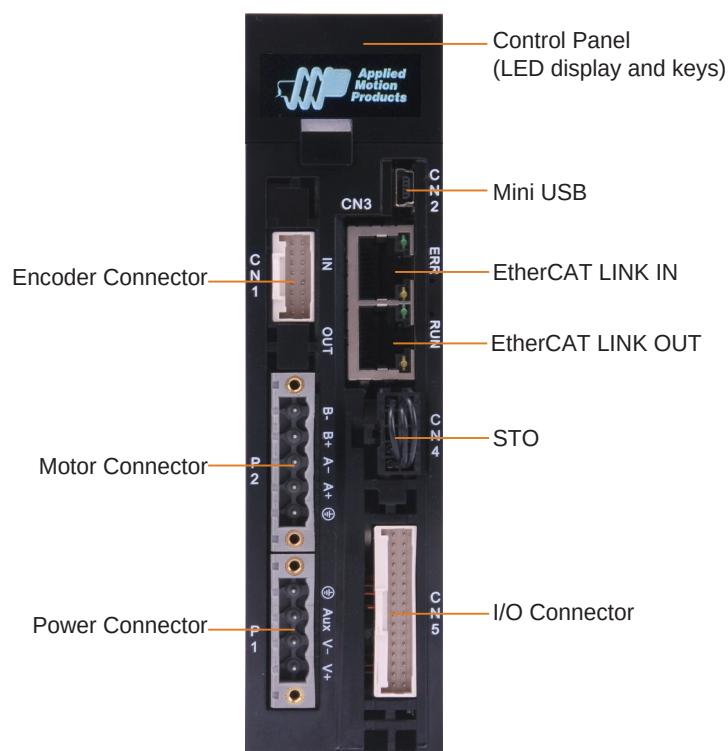
2.2 Mounting the Drive

Use M4 screws to securely mount the SS-EC series drive to a smooth, flat metal surface that will help to conduct heat away from the chassis. If a heat conducting surface is not available, forced airflow from a fan may be required to prevent the drive from overheating.



- Never use the drive in a place where there is no air flow or the surrounding air is more than 40°C.
- Never put the drive where it can get wet or where metal or other electrically conductive particle particles can get on the circuitry.
- Always provide air flow around the drive. When mounting multiple SS drives near each other, maintain at least 1.5cm of space between drives.

The connectors and other points of interest are illustrated below:

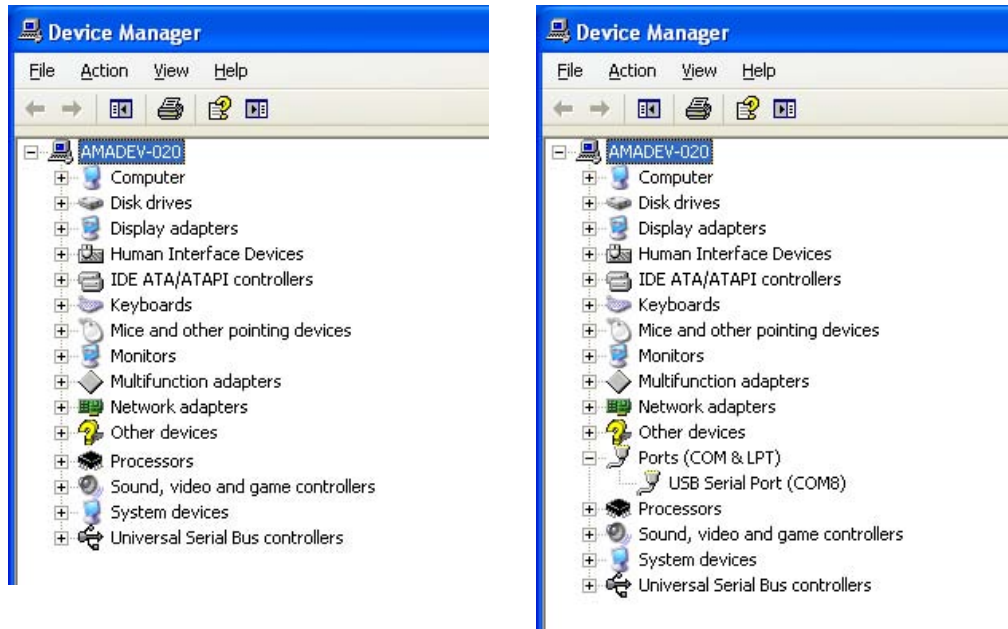


2.3 Connecting to the PC using mini USB

Port CN2 is used to connect the drive with PC. Use *Step-Servo Quick Tuner* software to configure the drive and perform servo tuning and drive testing.

2.4 Choosing the Right COM Port

Open the “Device Manager” on the PC. There may or may not be a “Ports” selection. Connect the mini USB cable to the PC. The connected COM port should then be displayed. Open *Step-Servo Quick Tuner* software, and choose the correspondent COM port.



2.5 Connecting the Main Power Supply

Connect power supply “+” terminal to the drive terminal labeled “V+”.

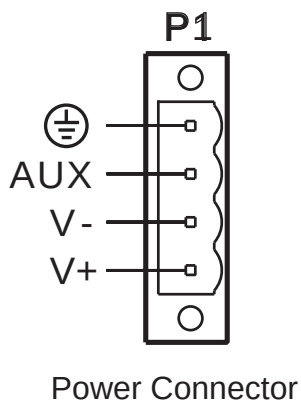
Connect power supply “-” terminal to the drive terminal labeled “V-”.

The SS-EC accepts DC voltage ranging from 24 to 70VDC



Warning: DO NOT reverse the “+” and “-” wires.

NOTE: DO NOT apply power until all connections to the drive have been made



Read Section 2.7 “Choosing a Power Supply” for more details.

2.6 Connecting the Auxiliary Power Supply

If the Keep Alive function is needed, an auxiliary power supply is required.

Connect the auxiliary power supply “+” terminal to the drive terminal labeled “AUX”.

Connect the auxiliary power supply “-” terminal to the drive terminal labeled “V-”.

The SS-EC auxiliary Power Supply input accepts DC voltage range from 12 to 48VDC.



Warning: DO NOT reverse the “+” and “-” wires.

NOTE: DO NOT apply power until all connections to the drive have been made

2.7 Choosing a Power Supply

The main considerations when choosing a power supply are the voltage and current requirements of the application.

2.7.1 Supply Voltage

The SS-EC is designed to give optimum performance at 24-48 volts DC. Choosing the voltage depends on the performance needed and the motor/drive heating that is acceptable and/or does not cause a drive over-temperature. Higher voltages will give higher speed performance but will cause the SS-EC to produce higher temperatures. Using power supplies with voltage outputs that are near the drive's maximum may significantly reduce the operational duty-cycle.

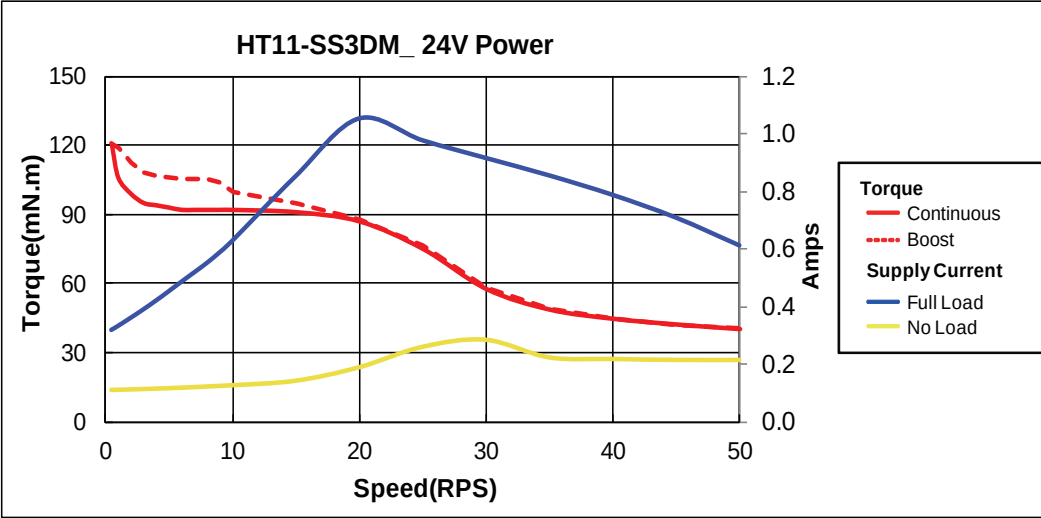
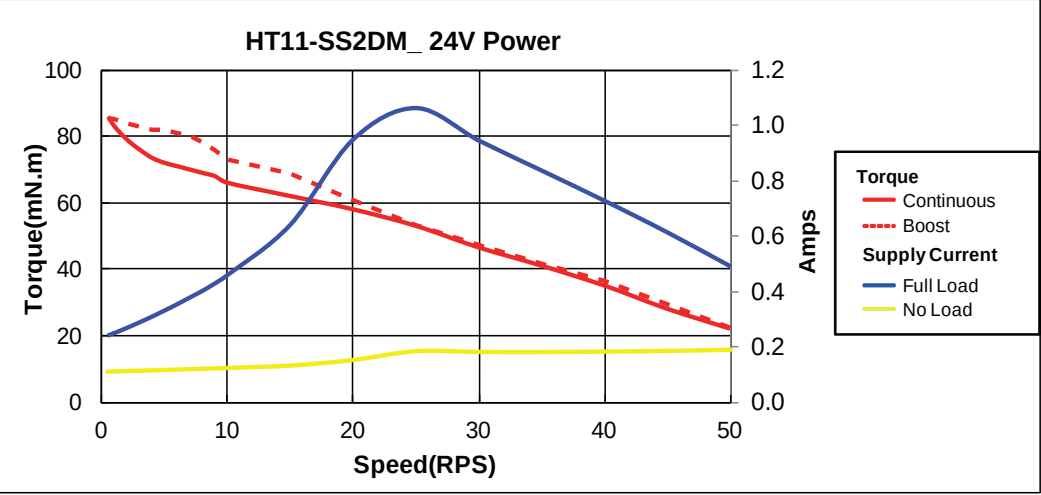
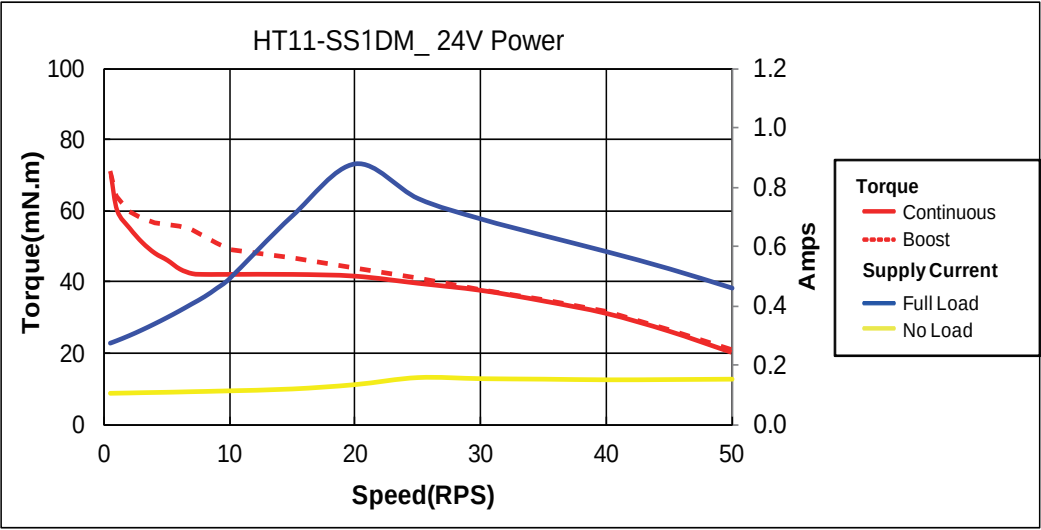
The extended range of operation can be as low as 18VDC minimum to as high as 75VDC maximum. When operating below 18VDC, the SS-EC may become unstable. The supply input cannot go below 18VDC for reliable operation. If the input supply drops below 18VDC the under voltage alarm will be triggered and the drive will stop working.

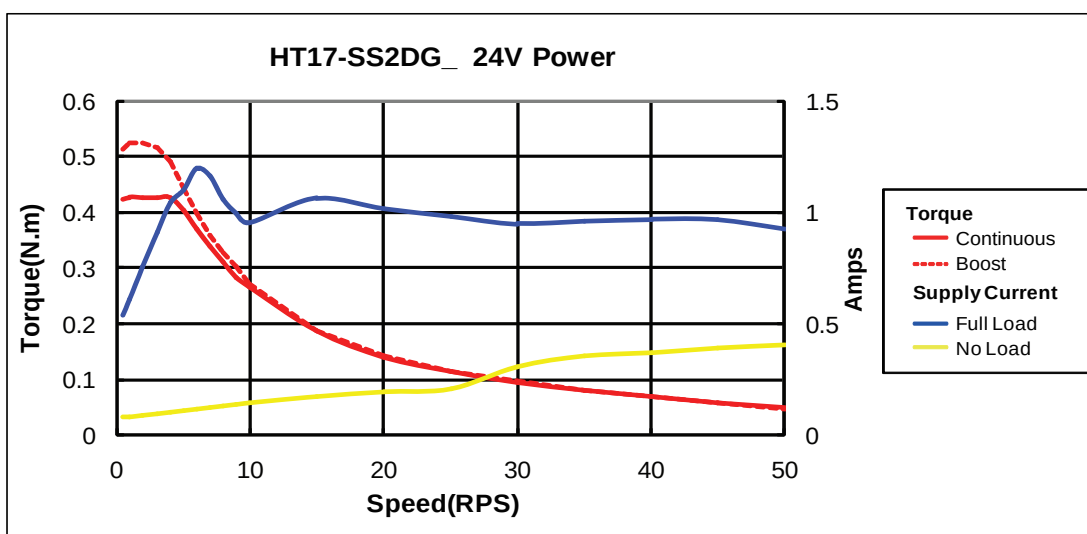
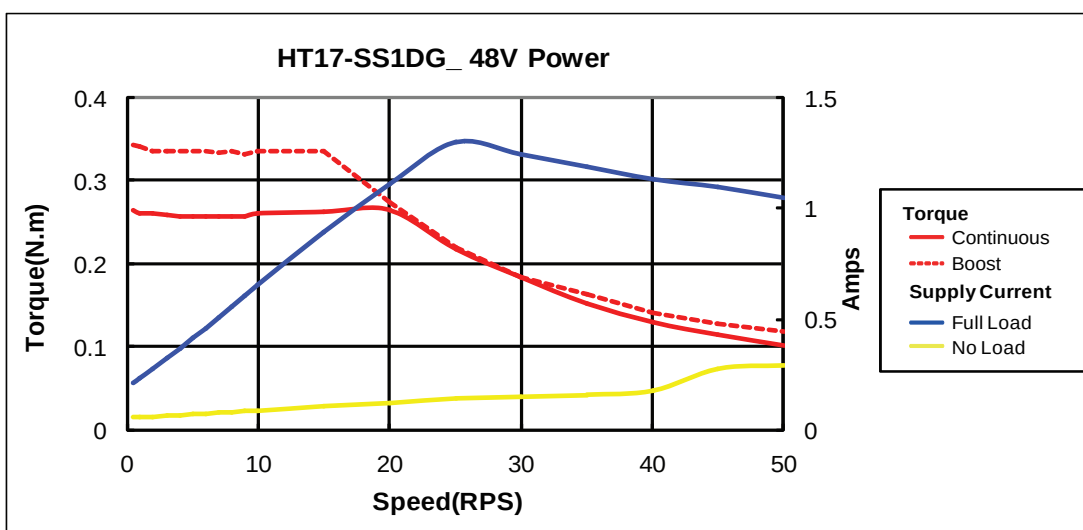
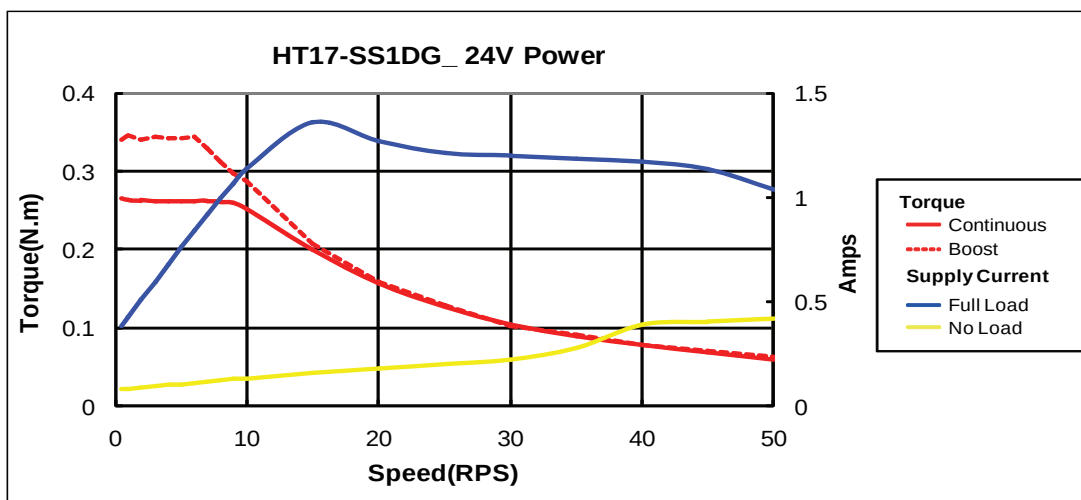
Absolute maximum power supply input is 75VDC at which point an over-voltage alarm and fault will occur. When using a power supply that is regulated and is near the drive maximum voltage of 75VDC, a voltage clamp may be required to prevent over-voltage when regeneration occurs. When using an unregulated power supply, make sure the no-load voltage of the supply does not exceed the drive's maximum input voltage of 75VDC.

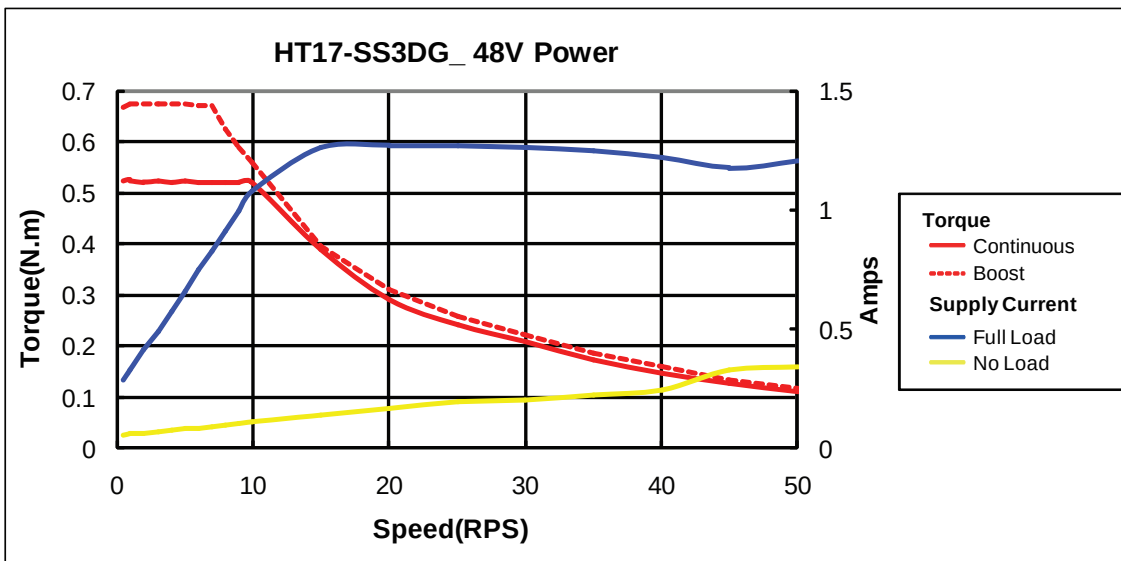
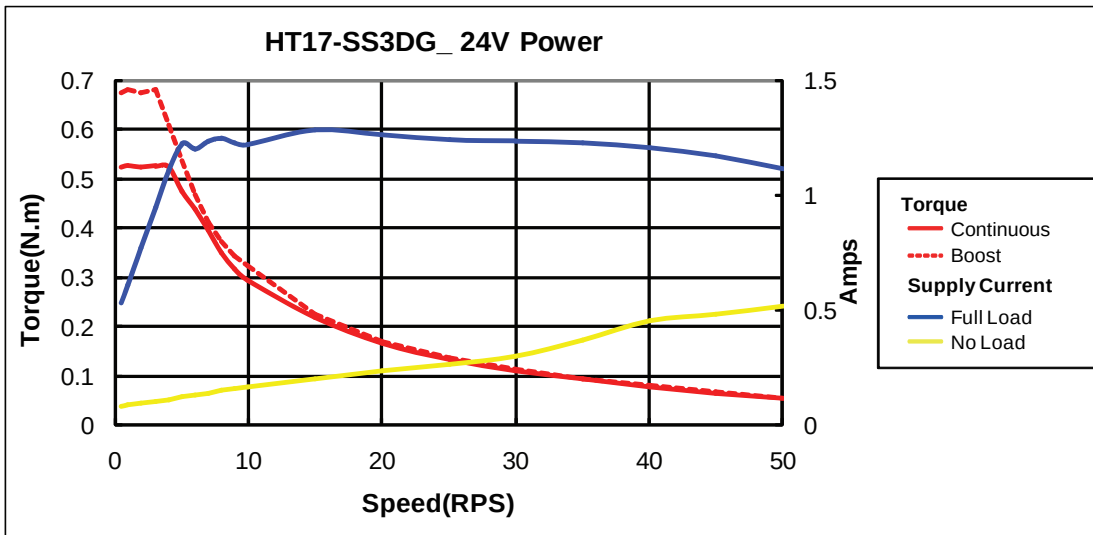
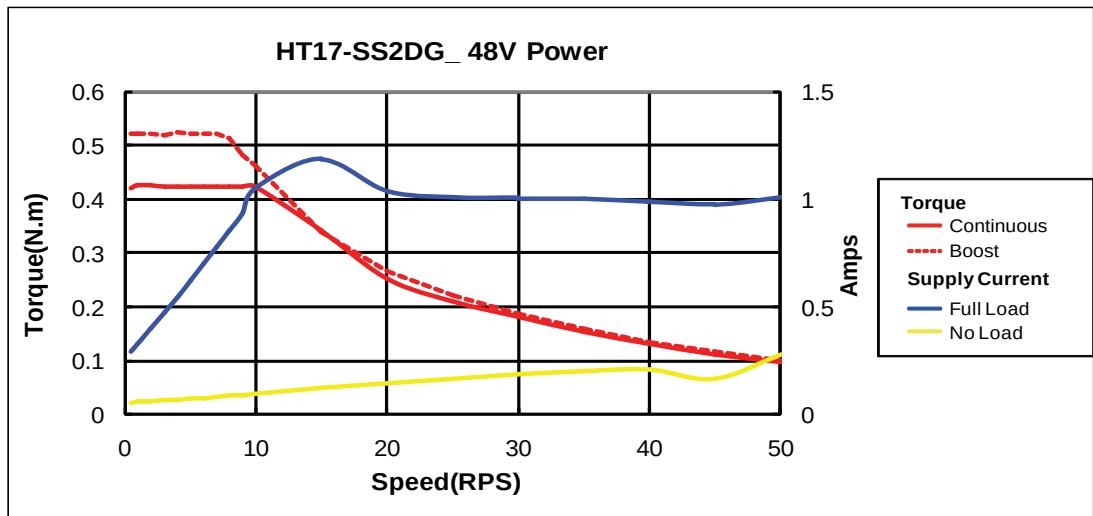
2.7.2 Supply Current

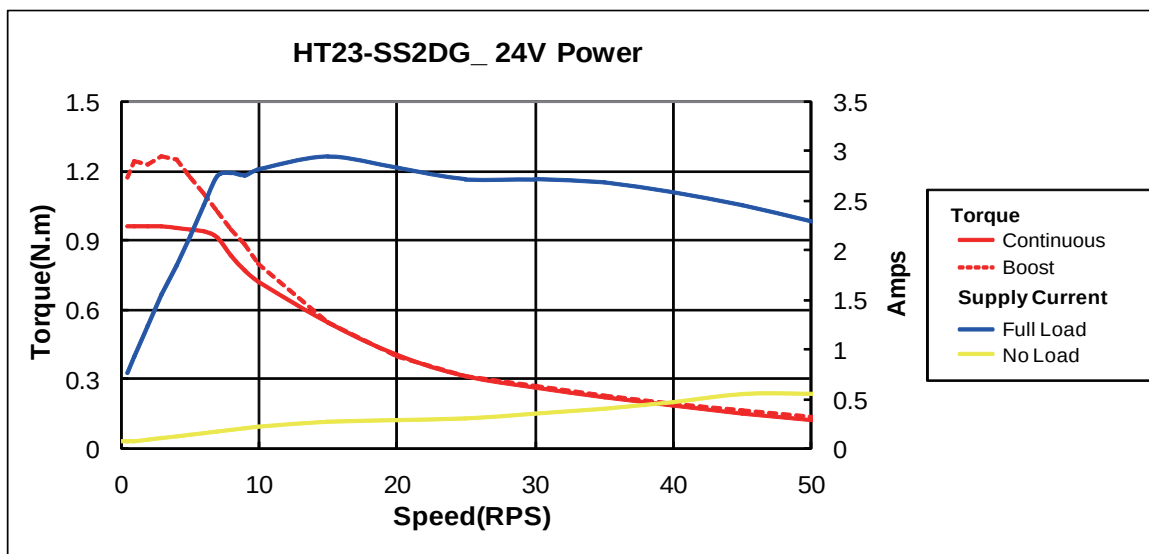
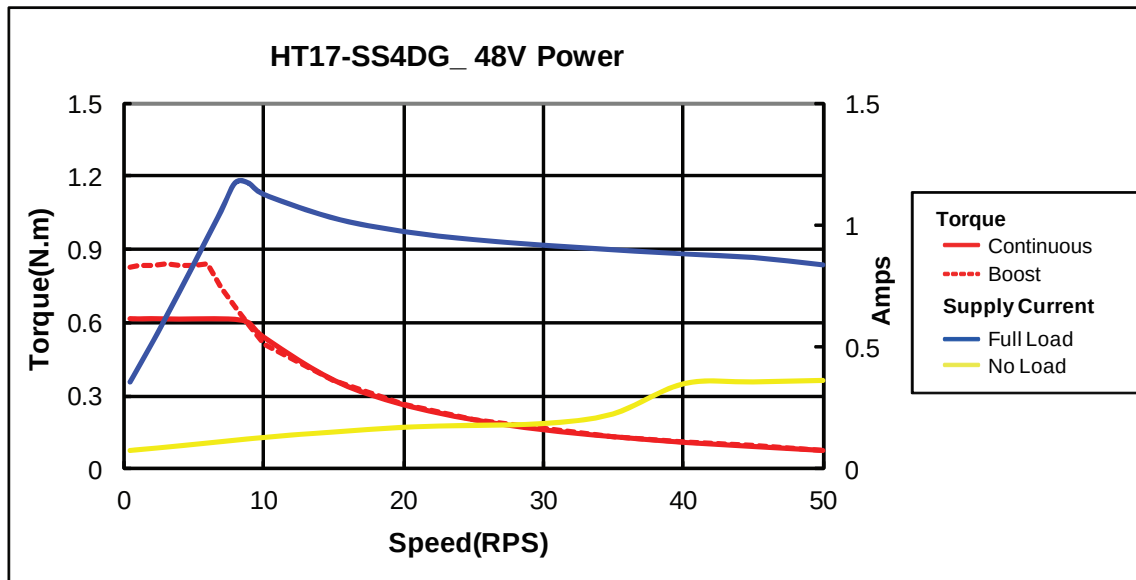
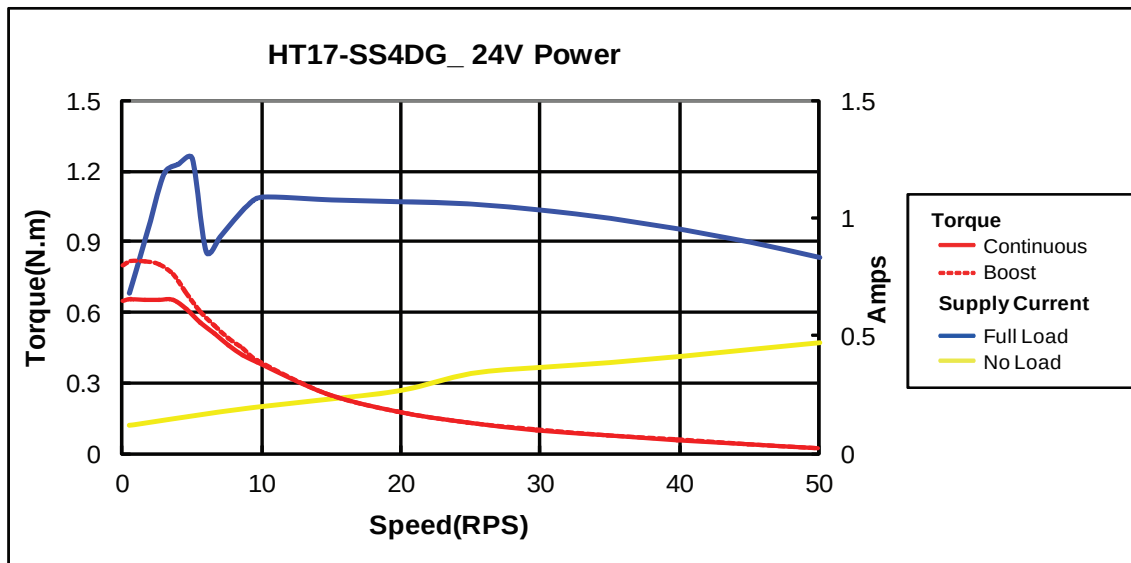
The maximum supply currents required by the SS-EC are shown in the charts below at different power supply voltage inputs. The SS-EC power supply current is lower than the winding currents because it uses switching amplifiers to convert a high voltage and low current into lower voltage and higher current. The more the power supply voltage exceeds the motor voltage, the less current will be required from the power supply.

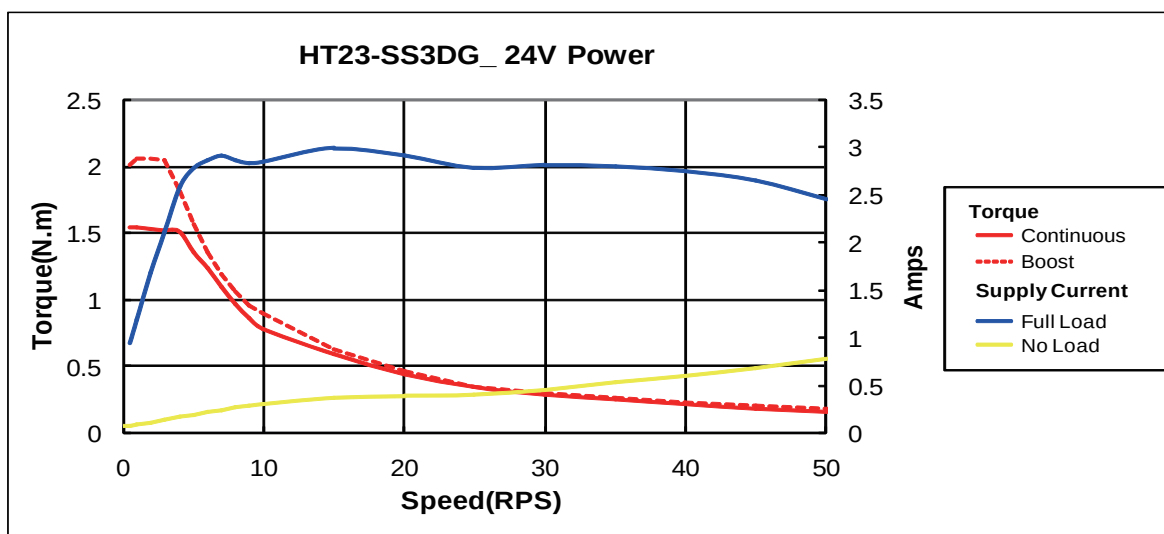
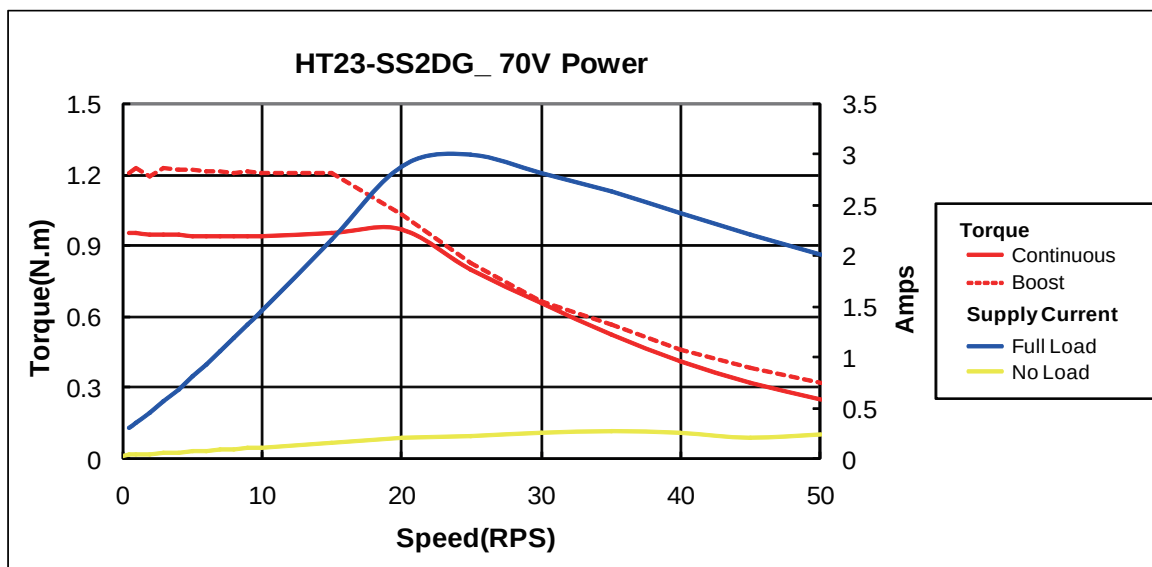
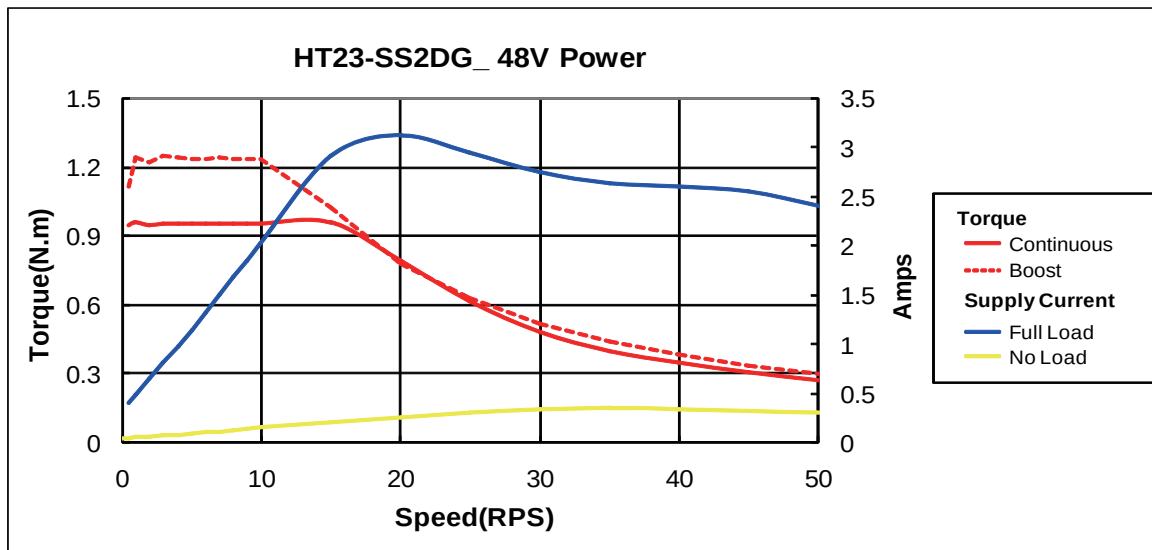
It is important to note that the current draw is significantly different at higher speeds depending on the torque load to the motor. Estimating how much current is necessary may require a good analysis of the load the motor will encounter.

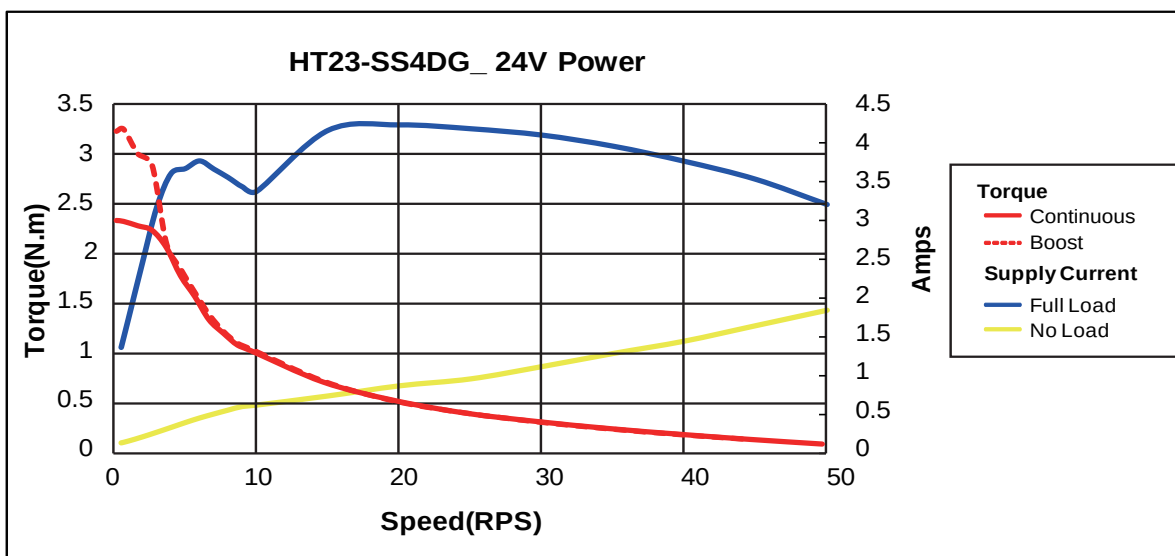
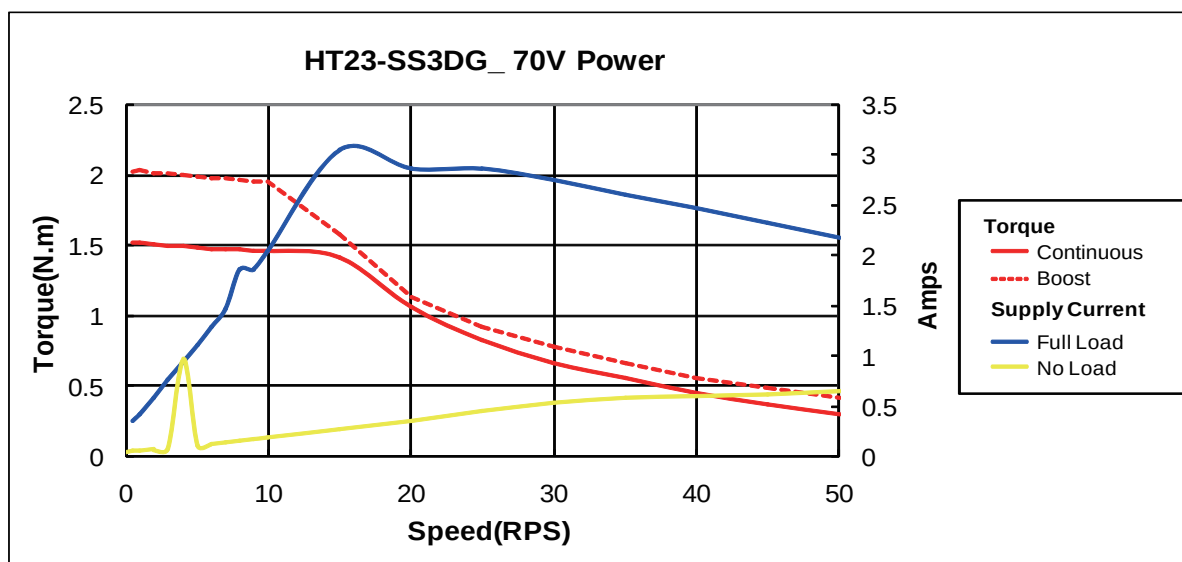
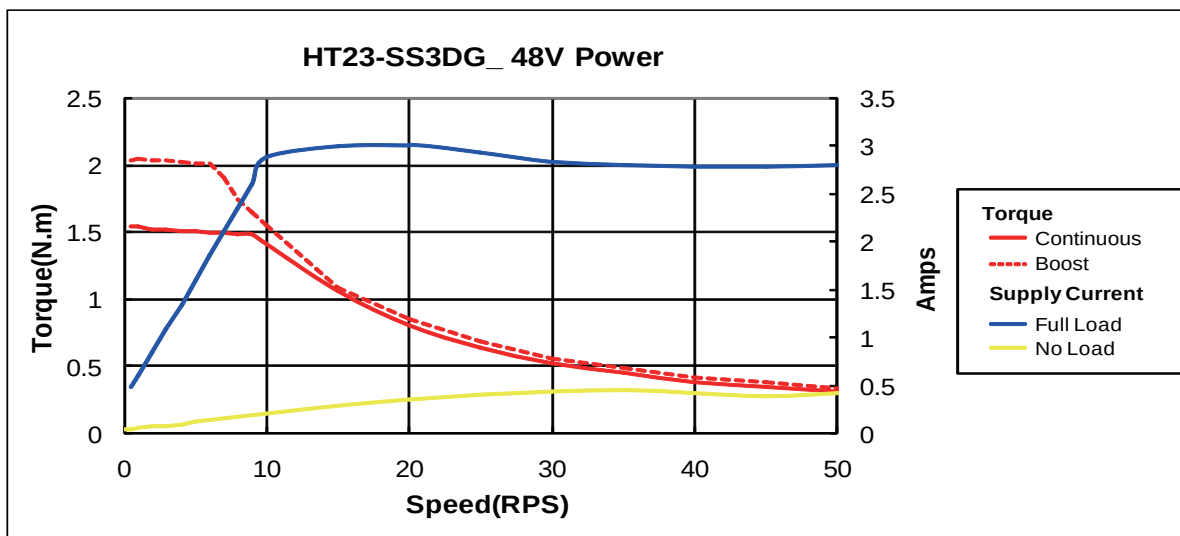


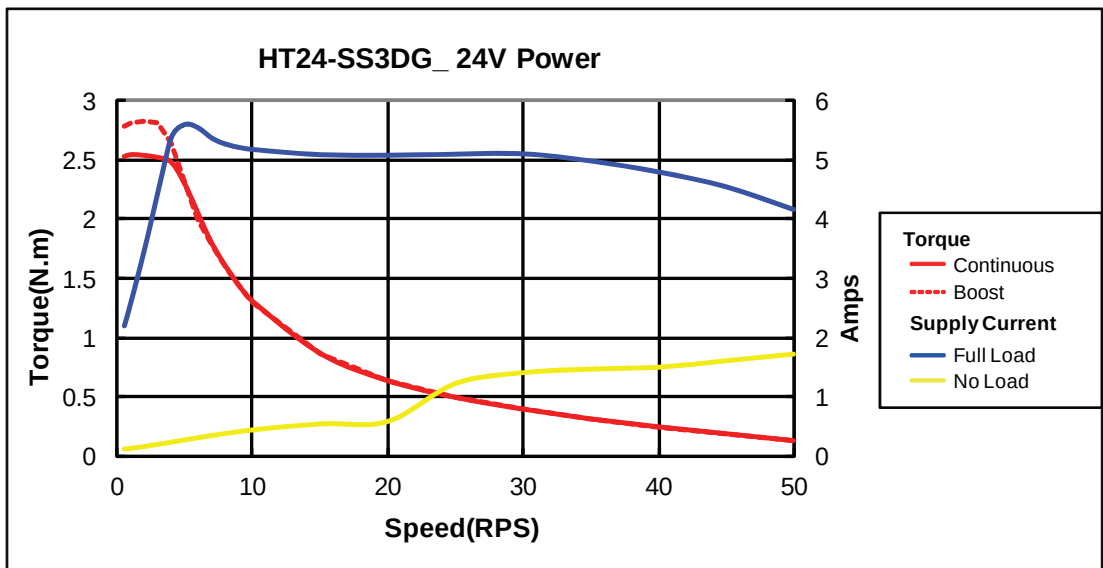
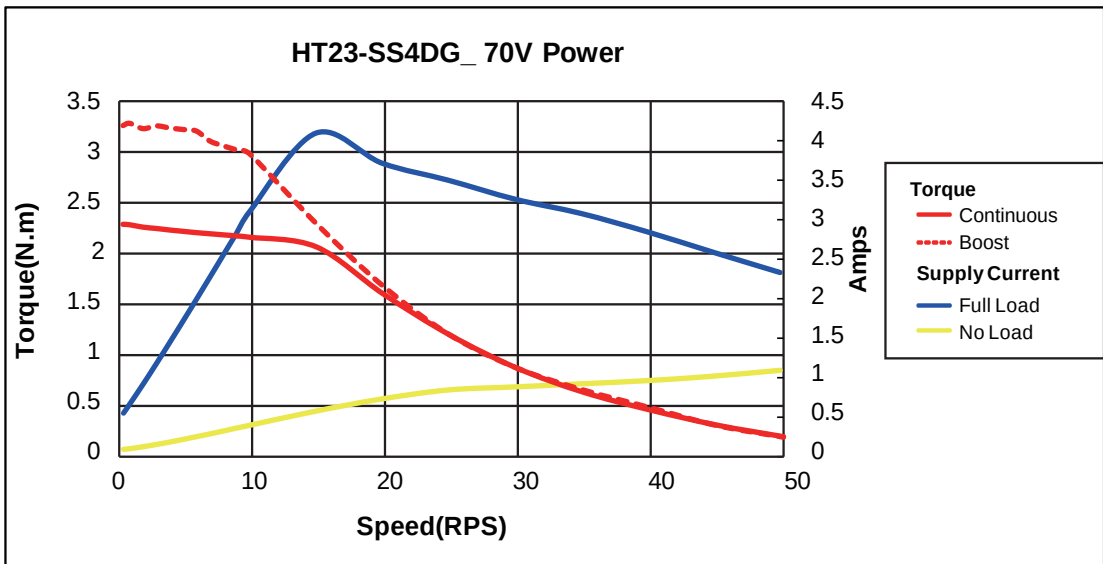
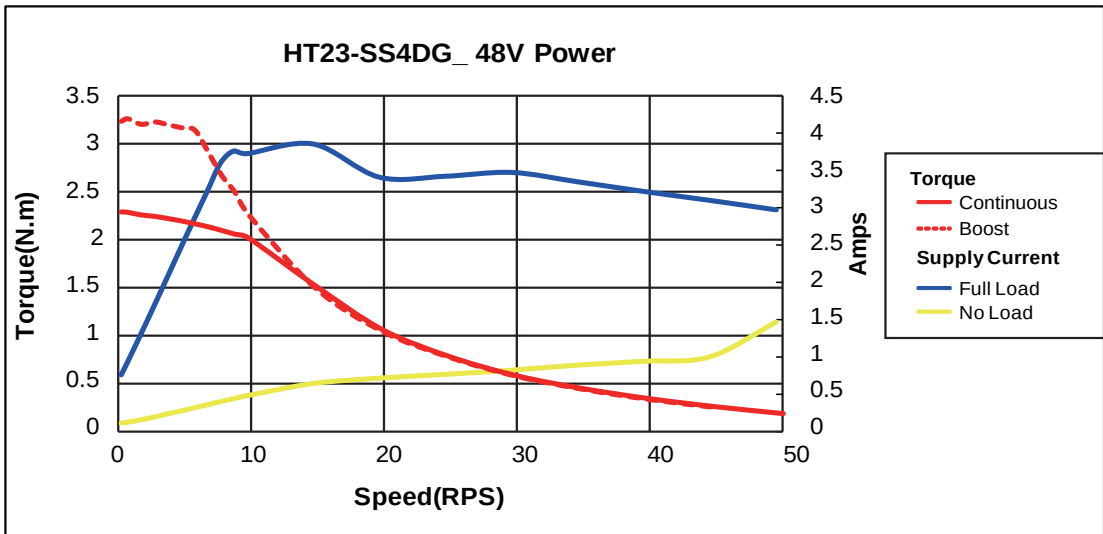


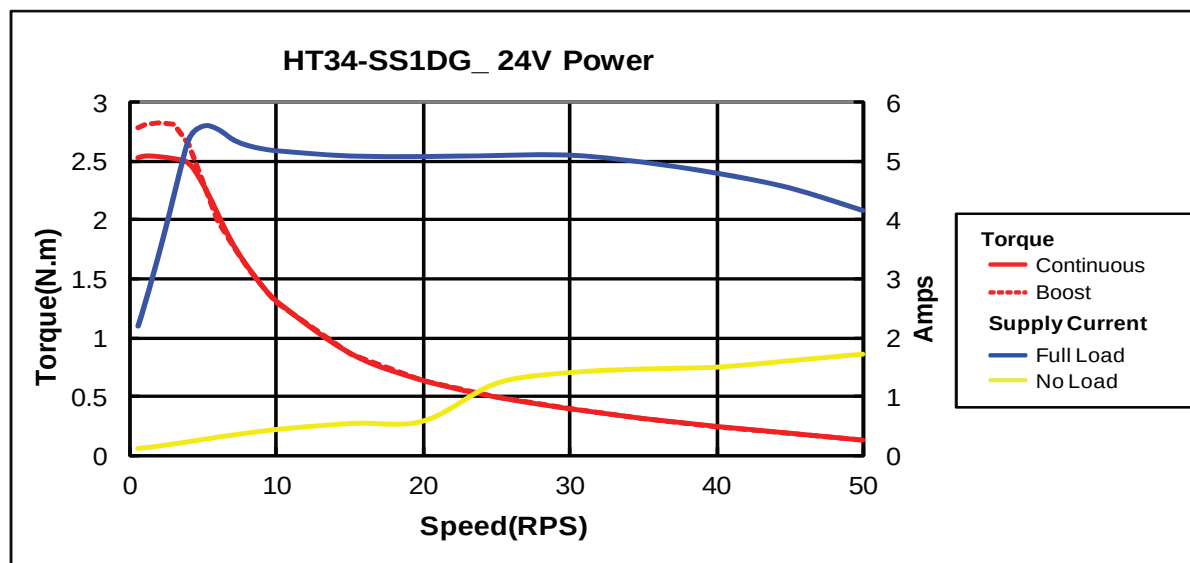
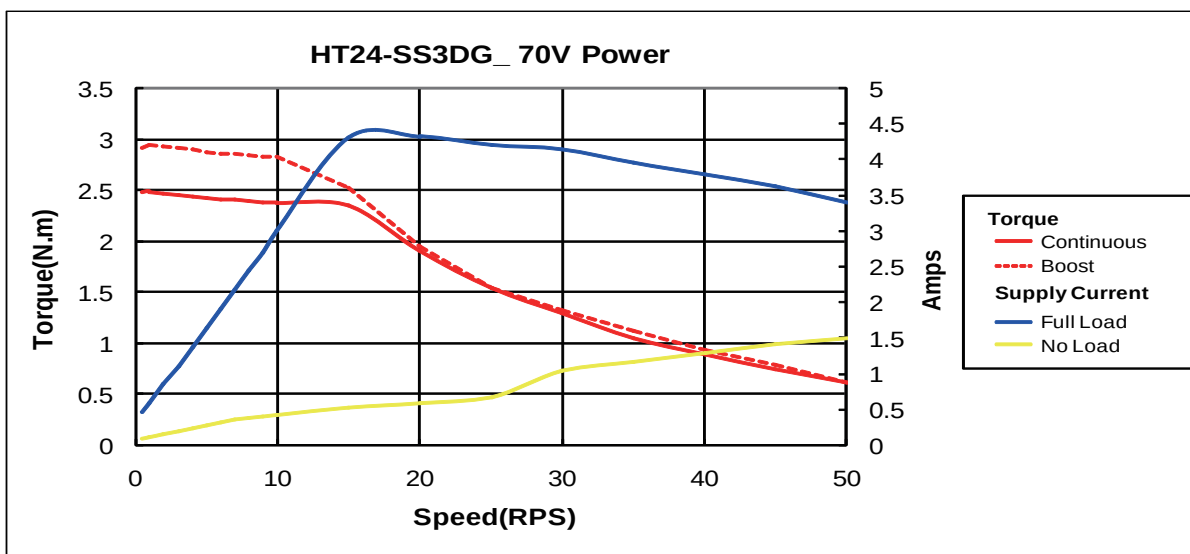
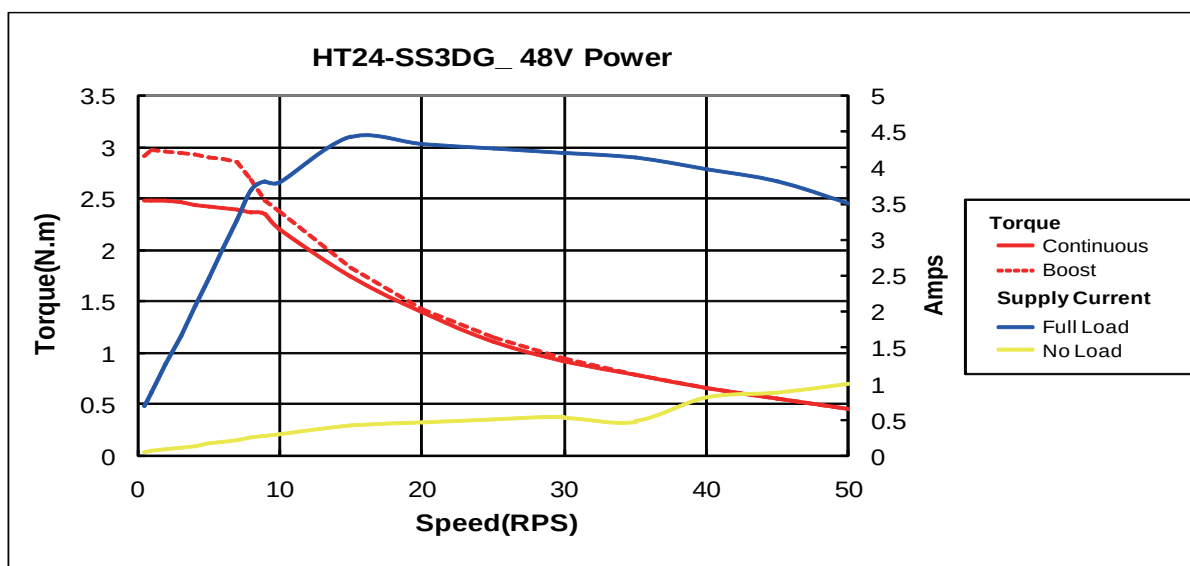


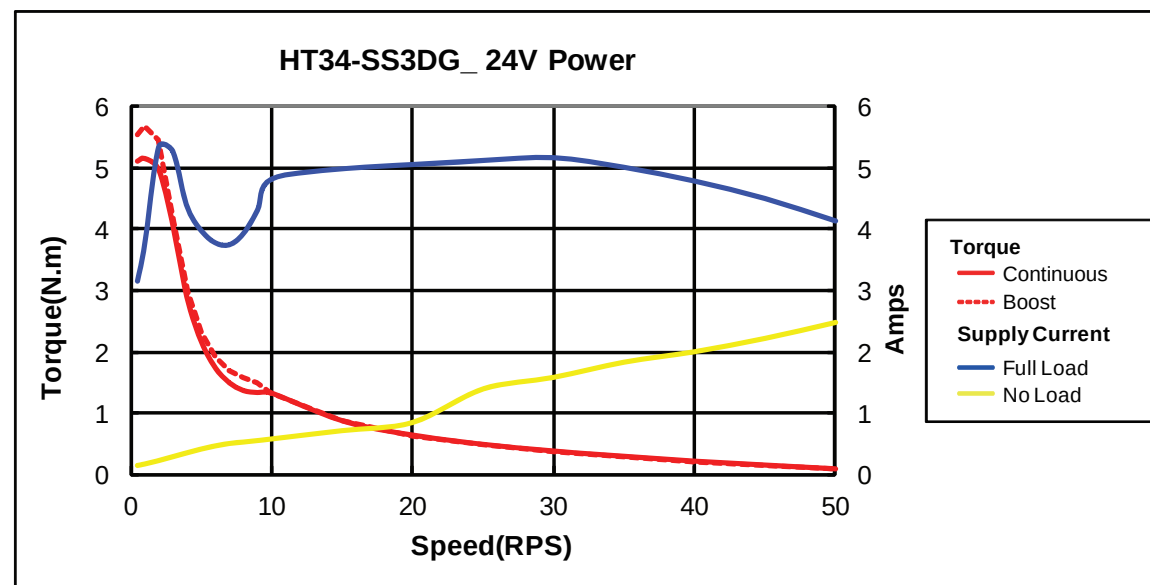
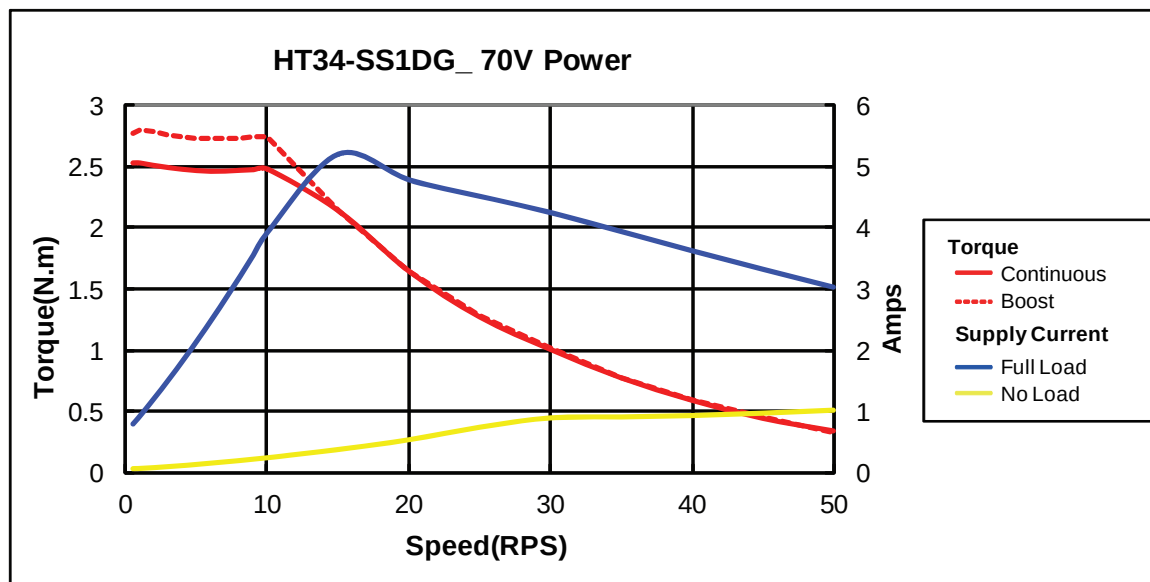
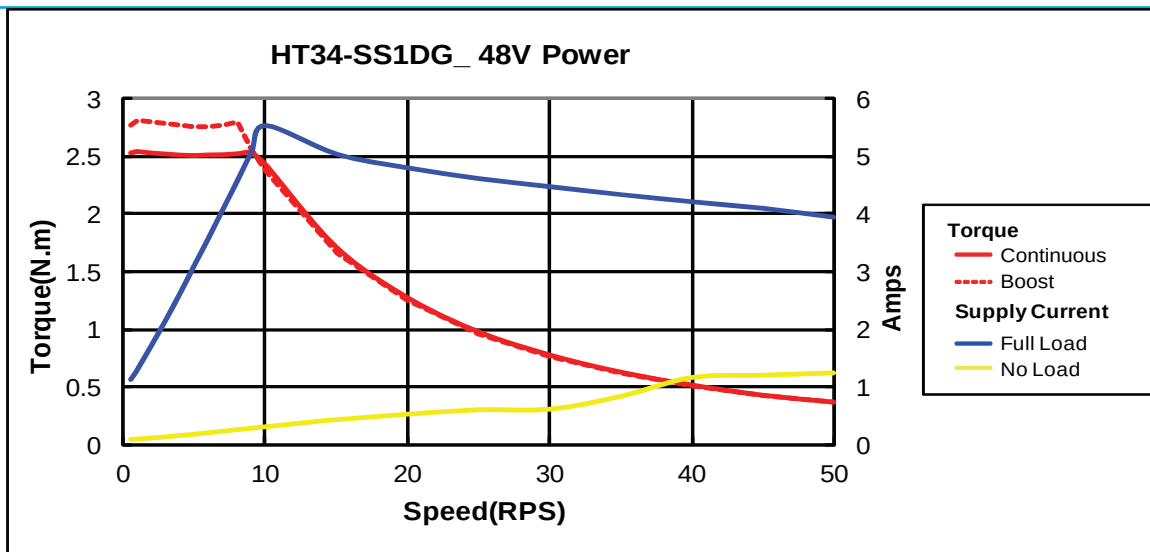


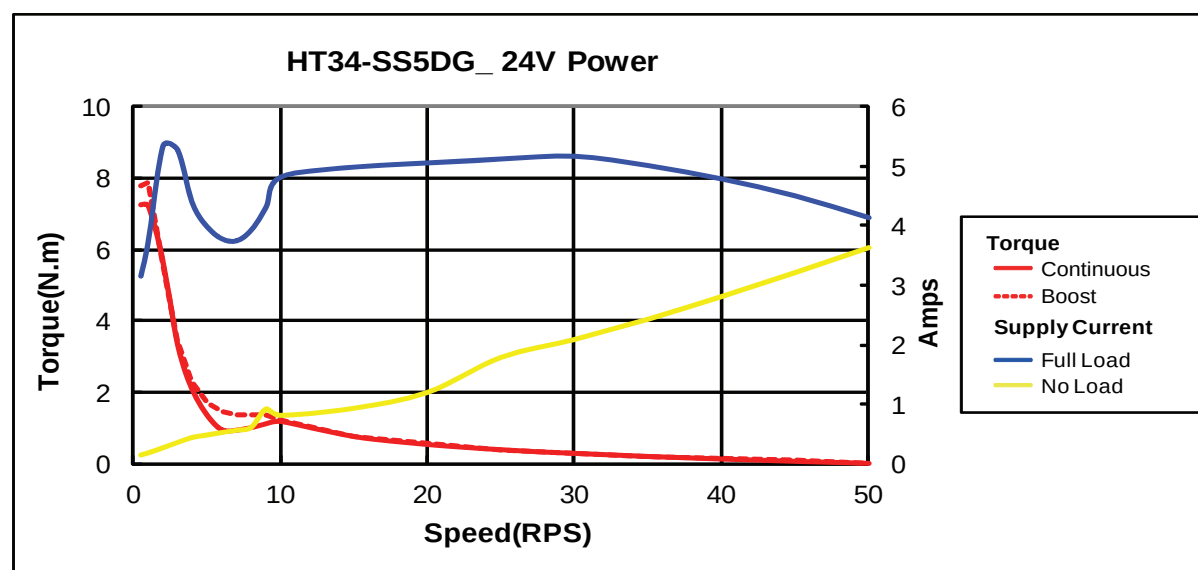
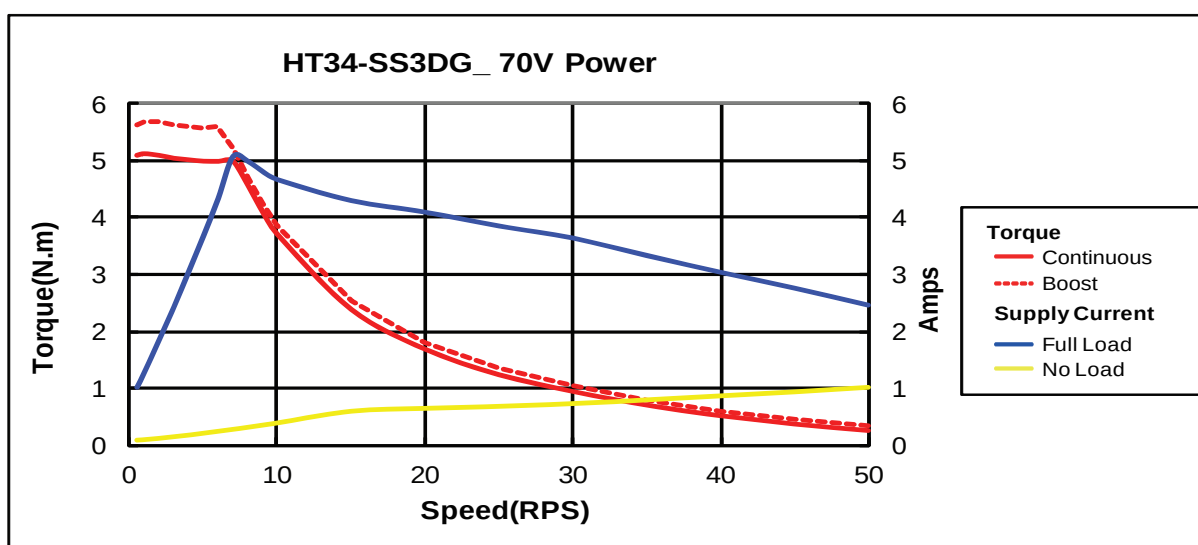
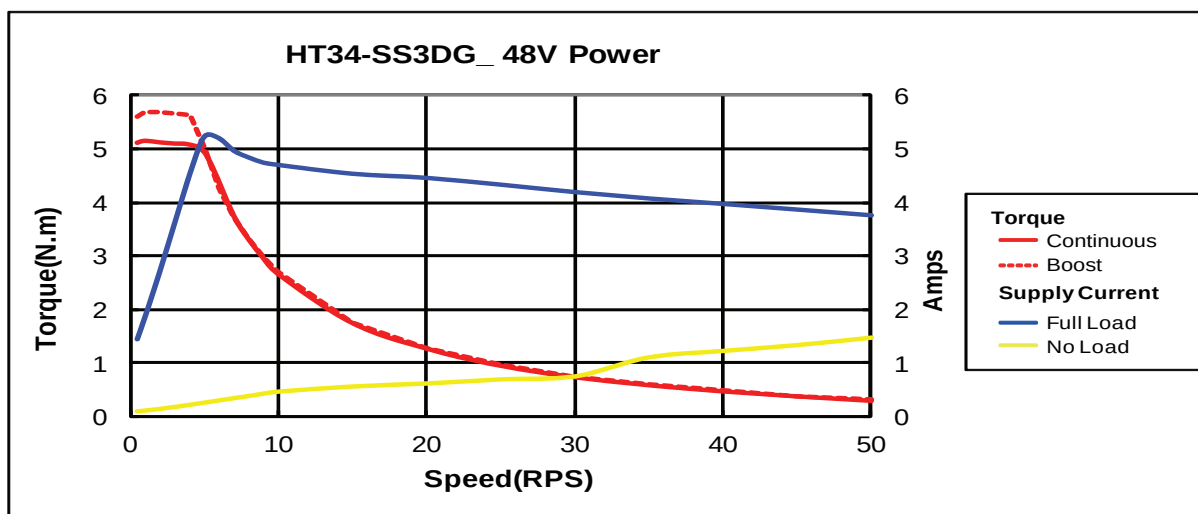


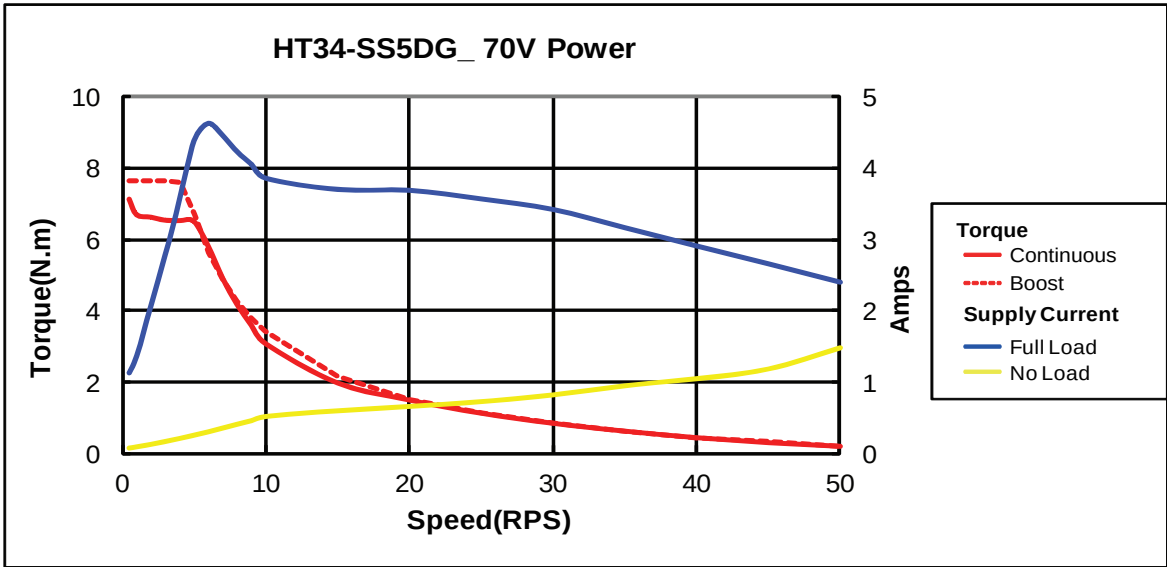












2.7.3 Auxiliary Supply Voltage (Keep Alive Function)

In addition to the main power supply input, the SS-EC also has an auxiliary power input (AUX power) for Keep Alive function of the drive. When the main power supply is off, the AUX power will keep the logic power on, allowing the drive to remember its state data (motor position, etc.). This allows the motor to resume operation from its previous position without a homing routine when the main power is switched back on.

If the main power is removed while the auxiliary power is still on and the drive is disabled, the drive will show a warning. The LED display will read  indicating under voltage. When the main power is restored, the drive will automatically clear the warning.

If the main power is removed while the auxiliary power is still on and the drive is enabled, the drive will show a fault. The LED display will read  indicating the internal voltage is out of range. When the main power is restored, the drive will not automatically clear the fault. It will need to be cleared by either the I/O alarm reset function or a clear fault command from the master controller.

2.7.3.1 Keep Alive Recovery with I/O Function

After the main power supply has been restored, the fault must be cleared. Use the alarm reset function through input 6 (X6) if configured for alarm reset function. (See Section 3.1.2 for configuring this input via the *Step-Servo Quick Tuner* software.) When an internal voltage out of range alarm occurs, the motor is disabled. Use the servo on function through input 5 (X5), also configurable via the software, to re-enable it.

Resume motion and normal program operation.

2.7.3.2 Keep Alive Recovery with the Master Controller

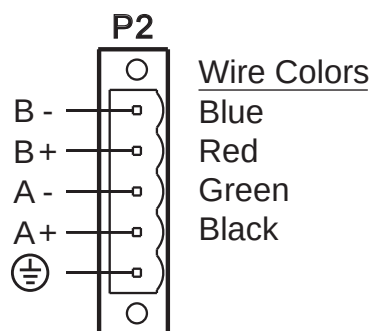
After the main power supply has been restored, the fault must be cleared. The master controller program can write 0x80 to Control Word (0x6040) to clear the fault. When an internal voltage out of range alarm occurs, the motor is disabled. The master controller program can write 0x0F to Control Word (0x6040) to enable the motor.

Resume motion and normal program operation.

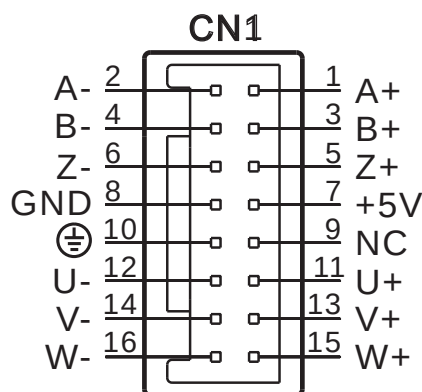
2.8 Connecting the Motor

The SS motors have two cables - the motor power cable, and the encoder feedback cable. Use the optional motor extension cable and/or encoder extension cable, or make extension cables using connector housing and crimps included in package if more length is needed. Connect the motor power cable's black, green, red and blue wires respectively to the drive's A+, A-, B+ and B- connections. Plug the encoder feedback cable into the encoder feedback connector on the drive.

DO NOT drag the motor by the cables as this may damage it.



Motor Connector



Encoder Feedback Connector

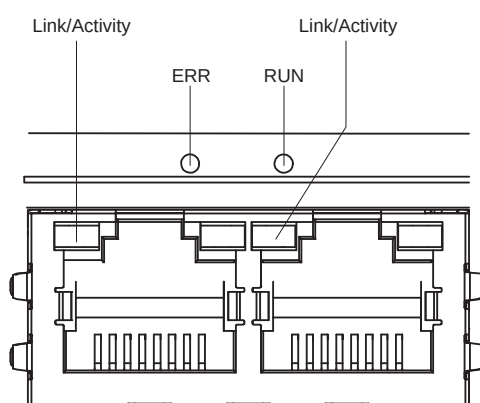
See Section 6 "Optional Accessories (Sold Separately)" for cables and mating connectors.

2.9 Connecting the EtherCAT

Dual RJ-45 connectors (connection CN3) accept standard Ethernet cables and are categorized as 100BASE-TX (100 Mb/sec) ports. CAT5 or CAT5e (or higher) cables should be used. The IN port connects to a master, or to the OUT port of an upstream node. The OUT port connects to a downstream node. If the drive is the last node on a network, only the IN port is used. No terminator is required on the OUT port.

2.9.1 EtherCAT Status Indicator LEDs

The LEDs are used for indicating status of the EtherCAT. There are two Link/Activity LEDs (one for each RJ-45 Ethernet connector) and two status LEDs (RUN and ERR).



LED indicator codes:

LED	Color	Status	Description
Link/Activity	Green	OFF	no Ethernet connection
		ON	Ethernet is connected
		Flickering	activity on line
RUN	Green	OFF	initialization state
		Blinking	pre-operational state
		Single Flash	safe-operational state
		ON	operational state
ERR	Red	OFF	no error
		Blinking	general error
		Single Flash	sync error
		Double Flash	watch dog error

Notes:

- Flickering: Rapid flashing with a period of approximately 50ms (10Hz)
- Blinking: Flashing with equal on and off periods of 200ms (2.5Hz)
- Single Flash: Repeating on for 200ms and off for 1s
- Double Flash: Two flashes with a period of 200ms followed by off for 1s

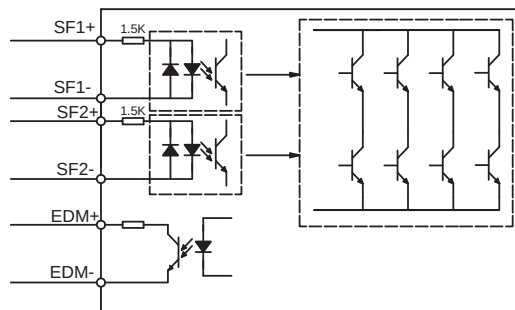
2.10 Connecting the STO

On the SS EtherCAT step-servo drives, the STO (Safe Torque Off) function is connected via port CN4. The STO function shuts off the motor's current turning off the motor output torque by forcibly turning off the signal of the drive's power transistor. This is done internally through the STO Input/Output signal circuit.

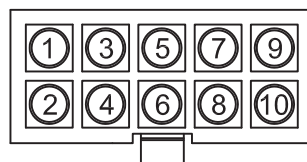
2.10.1 Safety Precautions

- If you want to bypass the STO function, make sure the pre-wired STO connector is plugged into CN4 on the drive correctly.
- When using the STO function, perform an equipment risk assessment to ensure that the system conforms to the safety requirements.
- Even when the STO function is enabled, the motor may move due to external force (e.g. gravitational force on the vertical axis). Make sure a holding brake is used in applications where this is possible.
- When the STO function engages and the torque is removed, the motor will be "free running", requiring more distance until the motion stops. Make sure this will not be a safety issue.
- When the STO function operates, it will turn off the current to the motor, but it does not turn off the power to the drive. Make sure to disconnect the power to the drive before performing any maintenance on it.
- After the STO function is triggered, the drive will have a fault alarm status, and the motor will remain disabled even after the STO function switch is plugged back in. To restore the system to normal operation, clear the fault alarm, and then enable the drive and motor.

2.10.2 STO Internal Circuit Diagram



2.10.3 CN4 Connector diagram

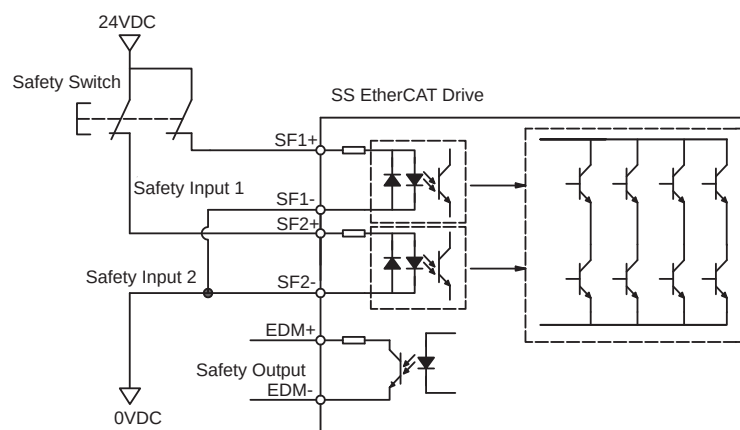


2.10.4 STO Signal Definition

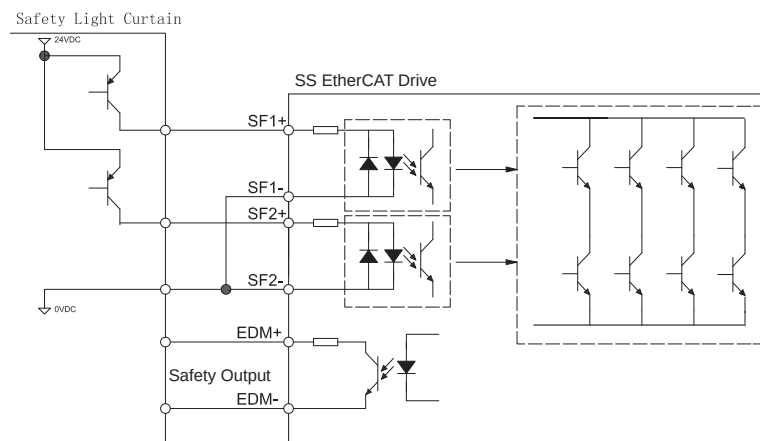
Signal	Symbol	Pin	Description	Control Mode
Safety Input SF1	SF1+	1	When SF1 has no input signal, e.g. the port is disconnected, SF1 will be considered OFF. The upper half of the internal power transistor will be shut off.	Compatible with all control modes
	SF1-	2		
Safety Input SF2	SF2+	3	When SF2 has no signal input, e.g. the port is disconnected, SF2 will be considered OFF. The upper half of the internal power transistor will be shut off.	
	SF2-	5		
Safety Output	EDM+	6	Output monitor signal used to check the safety function	
	EDM-	4		
Ground	DGND	7, 8	+5VDC power ground	
+5V power	+5V	9, 10	+5VDC power supply	

2.10.5 STO Connection Diagrams

Connection to safety switch



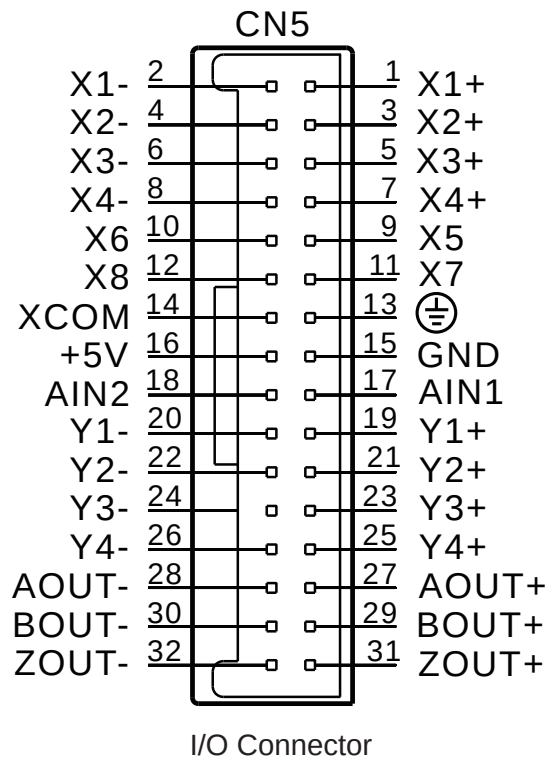
Safety light connection



3 Inputs and Outputs

The SS-EC drive's inputs and outputs include:

- 8 optically isolated digital inputs, 5-24VDC high level voltage
- 4 optically isolated digital outputs, max 30V/100mA sink or source current
- 2 analog inputs, can be configured to 0-5V, 0-10V, $\pm 5V$ or $\pm 10V$ signal ranges.
- Differential encoder signal output (AOUT +/-, BOUT +/-, ZOUT +/-), 26C31 line driver, 20mA sink or source current



3.1 Digital Inputs

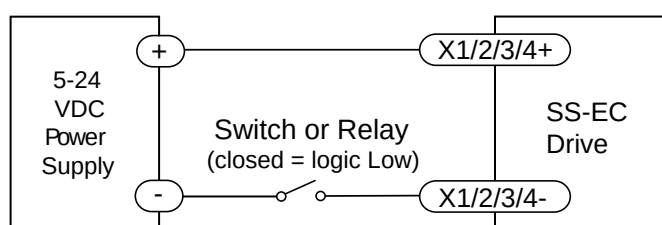
3.1.1 X1, X2, X3 and X4 Digital Inputs

X1, X2, X3 and X4: optically isolated, differential, 5-24VDC, minimum pulse width 250ns, maximum pulse frequency 2MHz

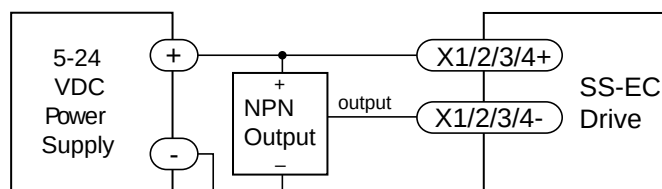
- X1 can be used as general purpose input.
- X2 can be used as general purpose input.
- X3 can be used as CW limit input or general purpose input.
- X4 can be used as CCW limit input or general purpose input.

Use *Step-Servo Quick Tuner* software for X1, X2, X3 and X4 function configuration.

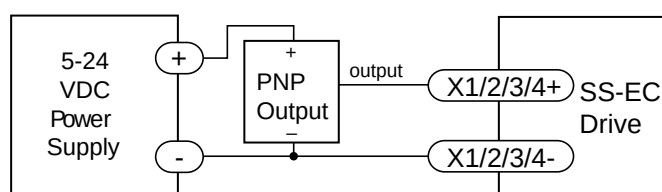
The following graphs show some common connection methods for the inputs:



Connecting the inputs to a switch or relay



Connecting the inputs to an NPN type output



Connecting the inputs to a PNP type output

3.1.2 X5, X6, X7 and X8 Digital Inputs

X5, X6, X7 and X8: optically isolated, single-ended, 5-24VDC, minimum pulse width 50µs, maximum pulse frequency 10KHz

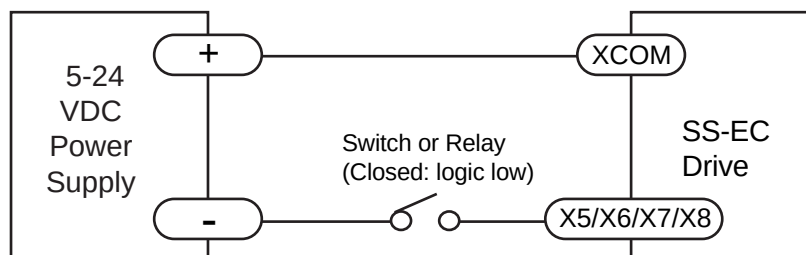
- X5 can be used as servo on input or general purpose input.
- X6 can be used as alarm reset input or general purpose input.
- X7 can be used as general purpose input.
- X8 can be used as general purpose input.

Because the input is an optically isolated circuit, a 5-24V power supply is needed. For example, you can use the power supply of the PLC when you are using a PLC control system, but if you want to connect a relay or mechanical switch to the input, you must need a power supply.

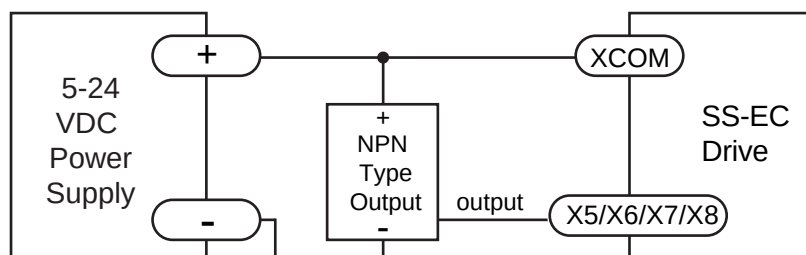
XCOM is an electronics term for a single-ended signal connection to a common voltage. In the case of SS series, if you are using a sourcing (PNP) input signals, you need to connect XCOM to the ground (power supply -), if you are using a sinking(NPN) input signals, the XCOM need to connect to the power supply +.

Use *Step-Servo Quick Tuner* software for X5, X6, X7 and X8 function configuration.

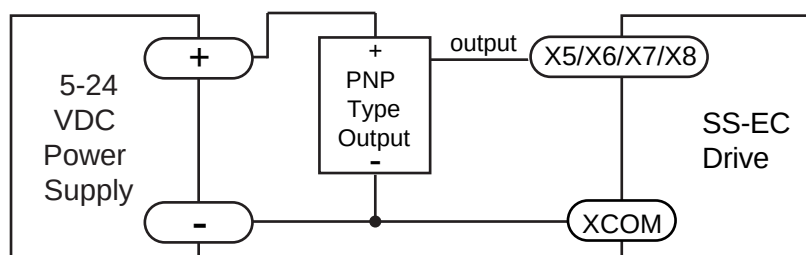
The following graphs show some common connection methods for the inputs:



Connecting to a switch or relay



Connecting an NPN type output to an input



Connecting a PNP type output to an input

3.2 Y1, Y2, Y3 and Y4 Digital Outputs

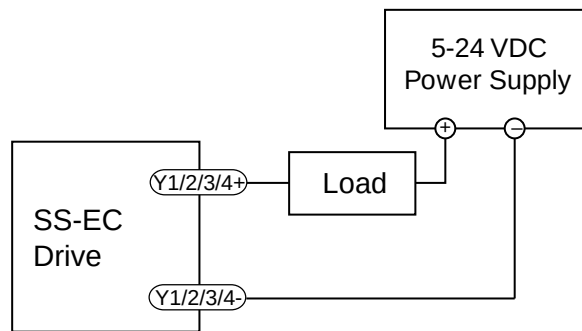
- Y1 can be used as an alarm signal output. It can also be used as a static in position signal output (static, checking in position when the motor is stopped), or as a dynamic in position signal output (dynamic, checking in position all the time).
- Y2 can be used as a tach signal output. Tach output produces pulses relative to the motor position with configurable resolution. It can also be used as a static in position signal output (static, checking in position when the motor is stopped), or as dynamic in position signal output (dynamic, checking in position all the time), or as a timing signal output (50 pulses per rotation).
- Y3 can be used as a signal output to release a brake. It can also be used as a static in position signal output (static, checking in position when the motor is stopped), or as a dynamic in position signal output (dynamic, checking in position all the time).
- Y4 can be used as a static in position signal output (static, checking in position when the motor is stopped), or as a dynamic in position signal output (dynamic, checking in position all the time).

Use *Step-Servo Quick Tuner* software for Y1, Y2, Y3 and Y4 function configuration.

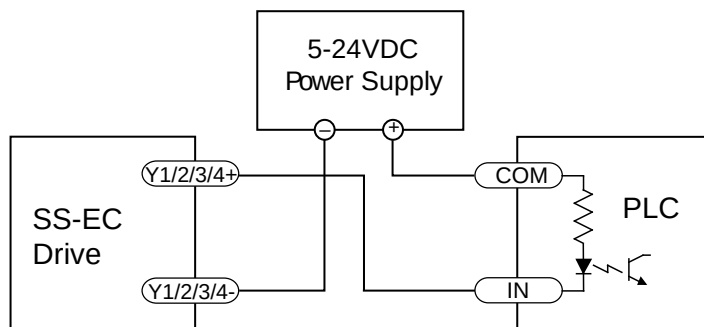
The following graphs show some common connection methods for the outputs:



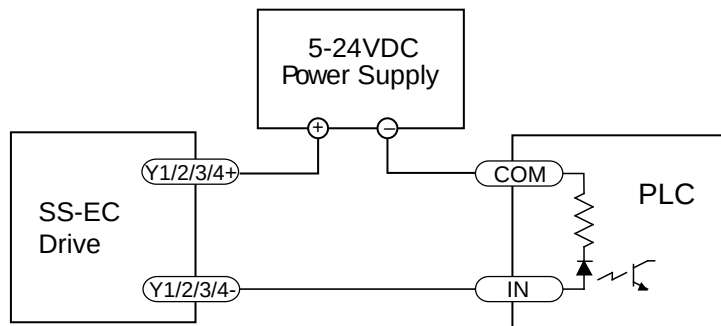
NOTE: Do not connect the outputs to more than 30VDC power supply. And the current of each output terminal must not exceed 100mA.



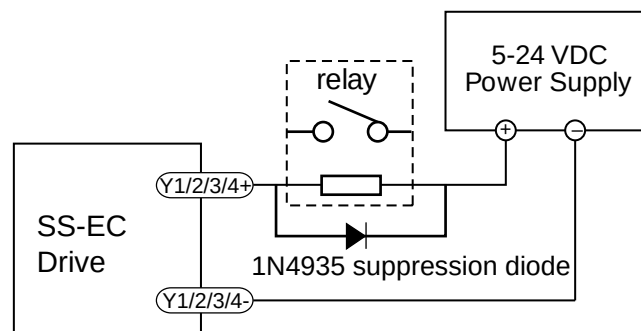
Connecting a sinking output



Connecting a sinking output to a PLC's input



Connecting a sourcing output to a PLC's input



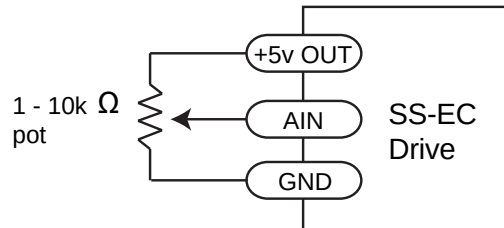
Driving a relay

3.3 Analog Inputs

The SS series drive has two analog signal inputs which can accept signal range of 0-5V, 0-10V, $\pm 5V$ or $\pm 10V$. The drive can be configured to operate at velocity mode or position mode that is proportional to the analog input.

Use *Step-Servo Quick Tuner* software to configure the input range, offset, deadband and noise filter frequency.

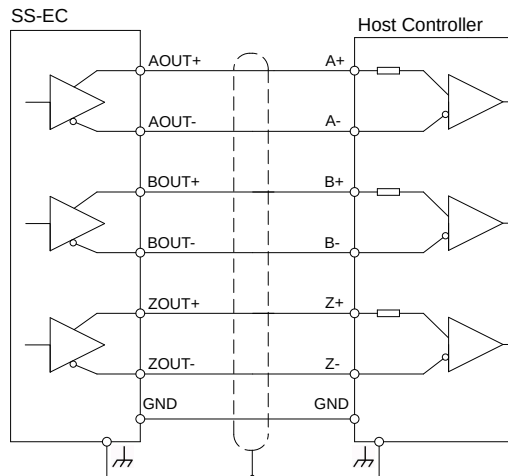
The SS series provides a +5V, 100mA limit power supply that can be used to power external devices such as potentiometer. For more precise readings use an external supply that can provide the desired accuracy.



Connecting a Potentiometer to an analog input

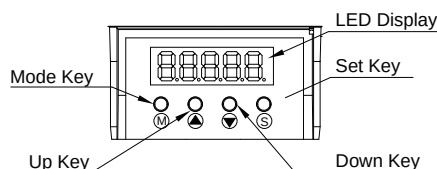
3.4 Encoder output

The SS-EC drive has differential encoder outputs (AOUT+, AOUT-, BOUT+, BOUT-, ZOUT+, ZOUT-), with 26C31 line driver, 20 mA sink or source current max. These signals can be connected to the motion controller to provide feedback of the motor position.



4 Control Panel (LED display and keys)

4.1 Description of Control Panel

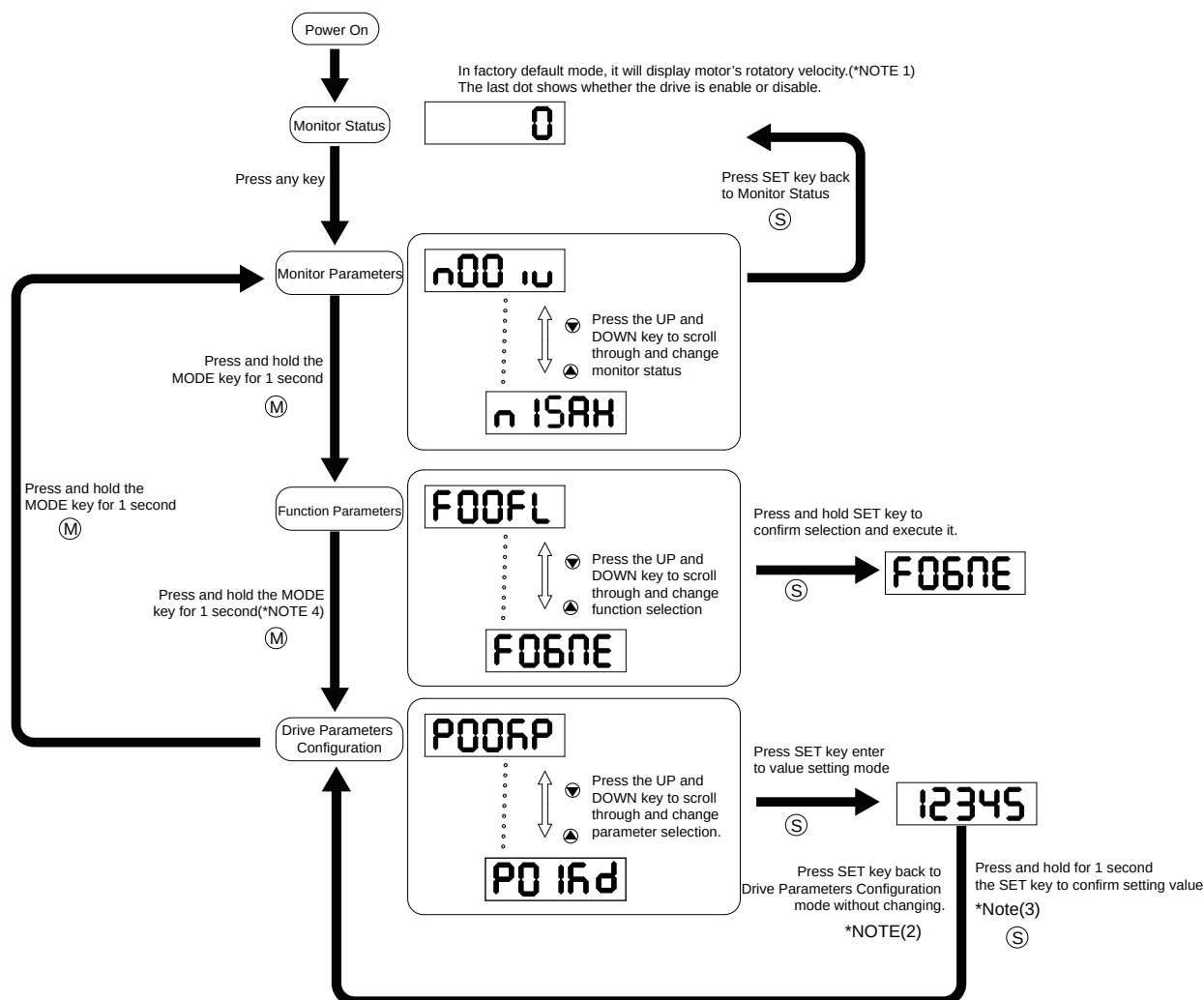


Symbol	Name	Details
	LED Display	The LED display (5 digits, 7 segments) show the drive's operating condition and warning codes, parameters and settings values.
	MODE Button	Press and hold the MODE button to change the LED display mode a) Monitoring selection mode b) Function selection mode c) Parameter setting mode When editing the parameters, press the MODE button to move the cursor to the left and then change the parameters by using the arrow keys.
	UP/DOWN Button	Press the UP or DOWN button to scroll through and change monitor codes, parameter groups and various parameter settings.
	SET Button	Press to enter a mode Press and hold to save parameters/settings

4.2 Mode Switch Control

- (1) Press the  button and the  button to change modes between status monitoring, function control, parameter setting.
- (2) If no warnings or faults have occurred, the drive will not go into warning and fault display mode.
- (3) If any warnings are detected by the drive, the LED display will immediately switch into warning or fault display mode. Pressing any key will switch back to the previous display mode.
- (4) When no button(s) on the control panel has been pressed for 20 seconds, the display will switch back to the previous status monitoring display mode.
- (5) In monitoring selection mode, function selection mode and parameter setting mode, when editing the parameters, press  to move the cursor to the left, then change the parameters by using the  buttons.
- (6) In status monitoring mode, press and hold the  button to lock the control panel. To unlock the panel, press and hold the  button again.

Control mode switch flowchart:



NOTE:

(1) When power is applied, the drive's display will show the customer defined monitoring mode. In factory default mode, it will display motor's rotatory velocity.

(2) In parameter setting mode, press the **[S]** button to exit the parameter setting mode and return to the parameter selection mode, any changes will not be saved.

(3) In parameter setting mode, press and hold the **[S]** button to confirm and apply the current parameter setting. This will take effect immediately. However, this change will not save to the drive's flash. If this parameter is required for permanent use, go to function mode

"F043A", and then press and hold the **[S]** button to save the parameter change.

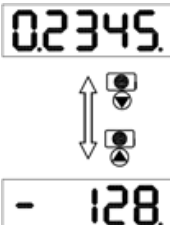
(4) When the drive is connected to the host computer with *Step-Servo Quick Tuner* on, the parameter setting mode CANNOT be accessed directly on the drive's control panel.

4.3 LED display description

4.3.1 Decimal Point And Negative Sign Description

LED display	Description
 negative sign motor enable sign	Negative sign: when the value to be displayed is a negative number ≥ -9999, the highest digit will display as a negative sign.  Decimal point: when the value to be displayed is a negative number ≤ -10000, a decimal point will be displayed. 

4.3.2 Parameter View Setting

LED display	Description
	There are only 5 digits on the LED display, when a value with more than 5 digits needs to be displayed, it will be shown in 2 segments. When the highest digit of a value is flashing, it means only the lower 5 digits are shown. Press  to display the upper 5 digits. The graph is showing '-12802345'

4.3.3 Parameter Save Setting

LED display	Description
	In parameter setting mode, pressing and holding the  button will save the change. 'Saved' will also be displayed on the LED.
	In parameter setting mode when the motor is rotating, pressing  and holding the  button will cause the LED display to show the status as "busy" meaning that the current parameter cannot be saved. Stop the motion of the motor and save the parameter again.

4.3.4 Point To Point Motion Mode

LED display	Description
	When the LED display reads "P-CW" it means the motor is rotating in a CW direction in the point-to-point mode
	When the LED display reads "P-CCW" it means the motor is rotating in a CCW direction in the point-to-point mode

4.3.5 Jog Mode

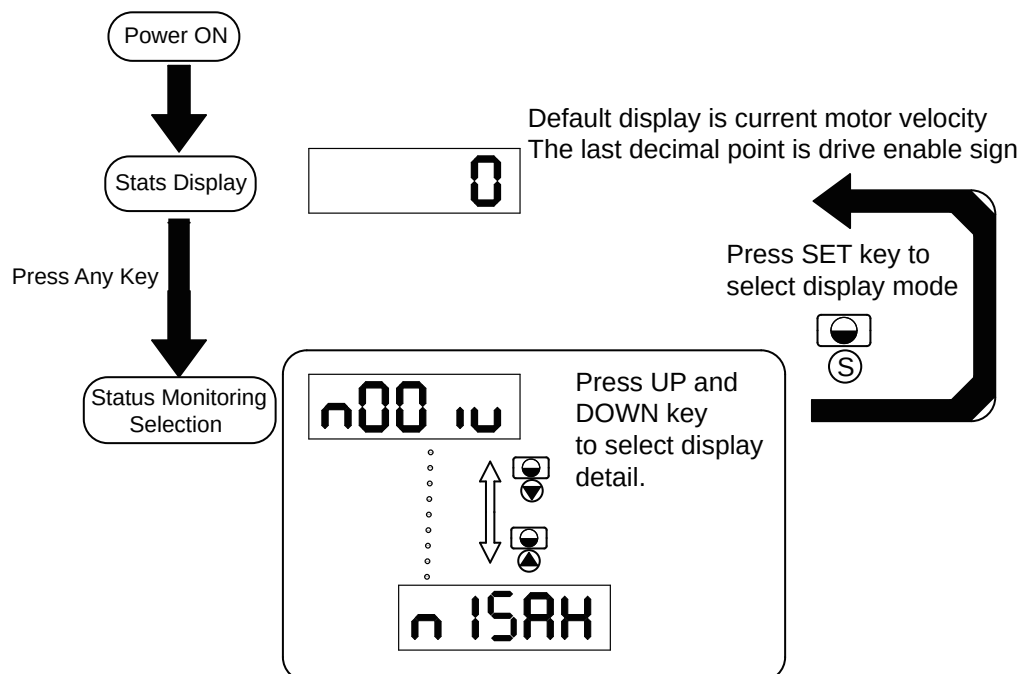
LED display	Description
	When the LED display reads "J--CW" it means the motor is rotating in a CW direction in JOG mode.
	When the LED display reads "J-CCW" it means the motor is rotating in a CCW direction in JOG mode

4.3.6 Control Panel Lock

LED display	Description
	This means the key panel is locked. Press and hold  for 1 second while in status monitoring mode to lock it.
	When the control panel is locked, press and hold  for 1 second to unlock it.

4.4 Status Monitoring Selection Mode

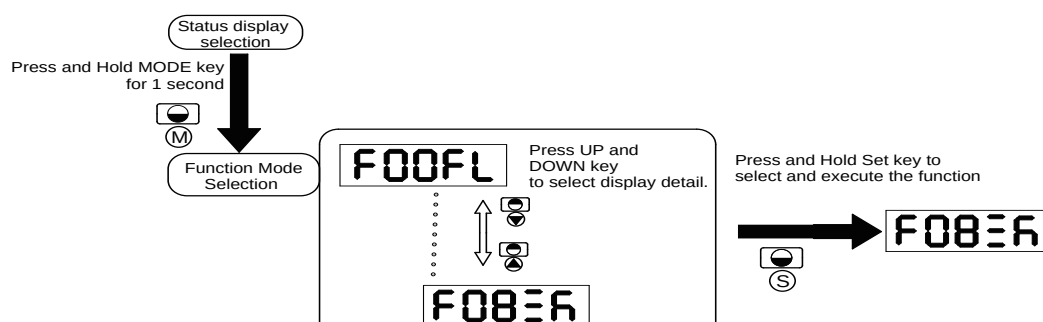
To change the status monitoring type, press  to enter monitoring selection mode, and then use   to make selections, and press  to confirm. Steps are shown as follows:



N mode selection and setting	LED display	Description	Unit
n-00	n00 iu	Motor Rotation Speed	RPM
n-01	n01 i4	Position Error	counts
n-02	n02 L3	Pulse Counter	counts
n-03	n03 iE	Encoder Counter	counts
n-04	n04 iP	Command Position Counter	counts
n-05	n05 it	Drive Temperature	x 0.1°C
n-06	n06 iU	DC Bus Voltage	x 0.1V
n-07	n07 dR	SCL Address	
n-08	n08 RH	Alarm History 1	
n-09	n09 RH	Alarm History 2	
n-10	n10 RH	Alarm History 3	
n-11	n11 RH	Alarm History 4	
n-12	n12 RH	Alarm History 5	
n-13	n13 RH	Alarm History 6	
n-14	n14 RH	Alarm History 7	
n-15	n15 RH	Alarm History 8	

4.5 Function Control Mode

In function control mode (display reads: F+parameter number), you can select functions for preoperational mode, restart the drive, enable or disable the drive, etc. In status monitoring mode, press and hold **M** for 1 second to enter function control mode. Press **▲** **▼** to select a function, and then press and hold **S** to confirm or execute the function. (NOTE: F-00(FL) and F-01(CJ) excepted).

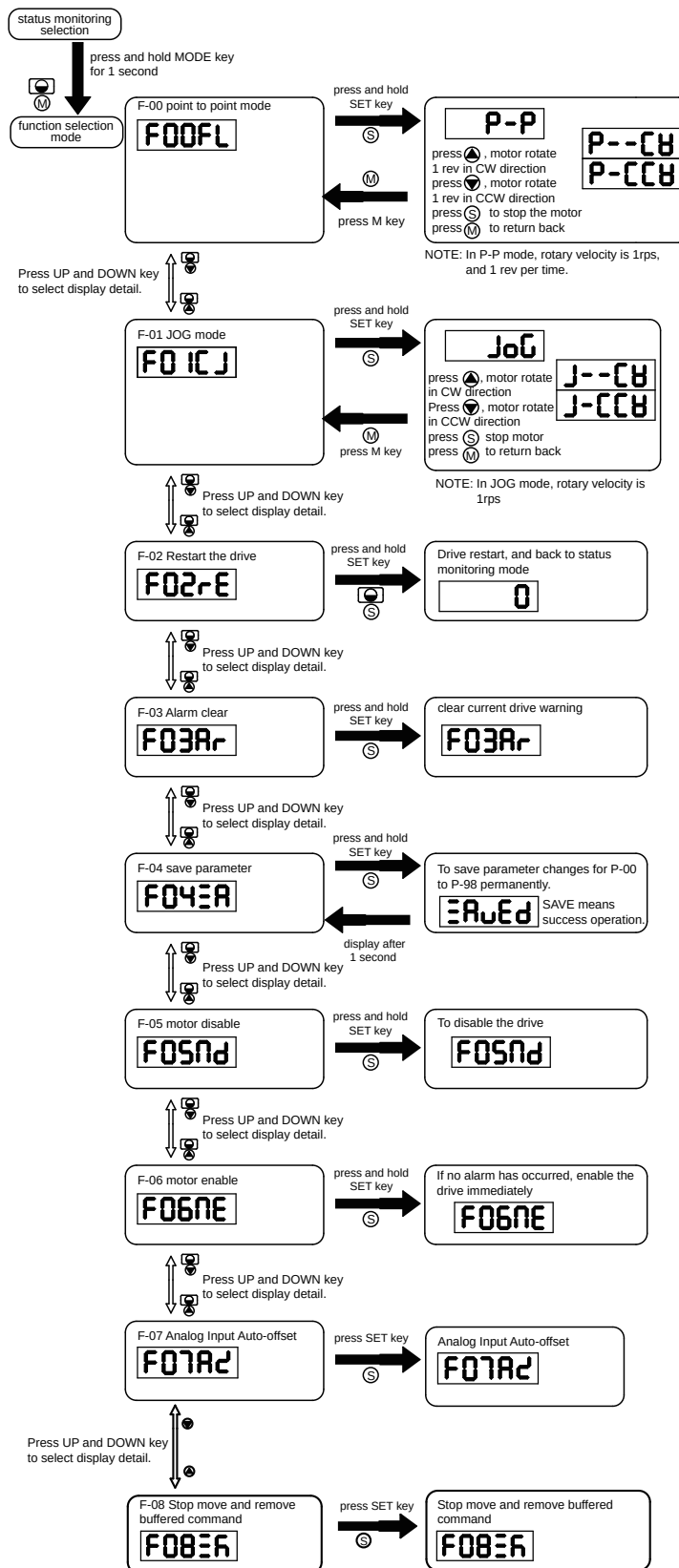


4.5.1 Function Mode Description

Function mode details are as follows:

Function mode number	LED display	Description
F-00	F00FL	point to point position mode:1rps, 1rev
F-01	F01CJ	JOG mode:JOG speed 1rps
F-02	F02rE	Restart the drive
F-03	F03Ar	Clear drive's current alarm
F-04	F04EAr	Save parameter changes for Pxx
F-05	F05Nd	Motor disable
F-06	F06nE	Motor enable
F-07	F07Ar	Activate the analog "auto offset" algorithm
F-08	F08E6	Stop move and remove buffered command

4.5.2 Operation Flow Chart

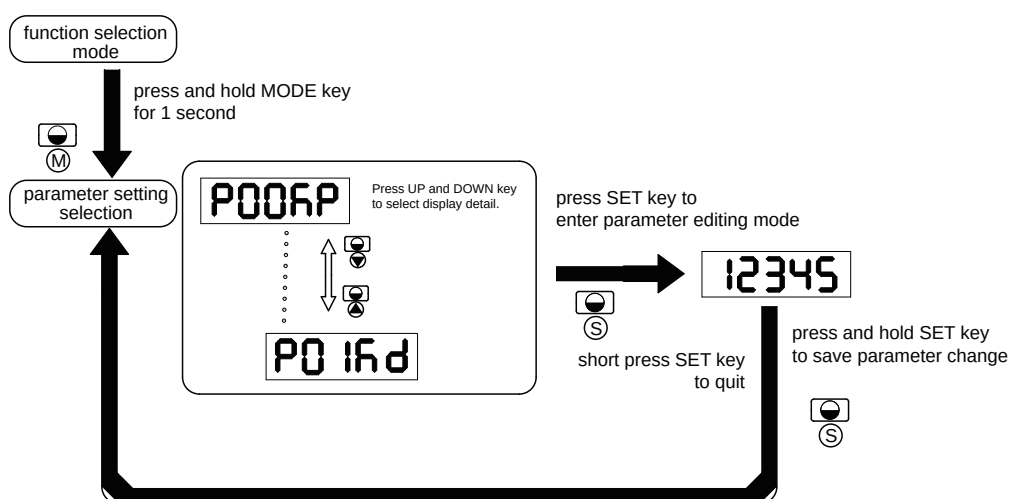


4.6 Parameter Setting Mode

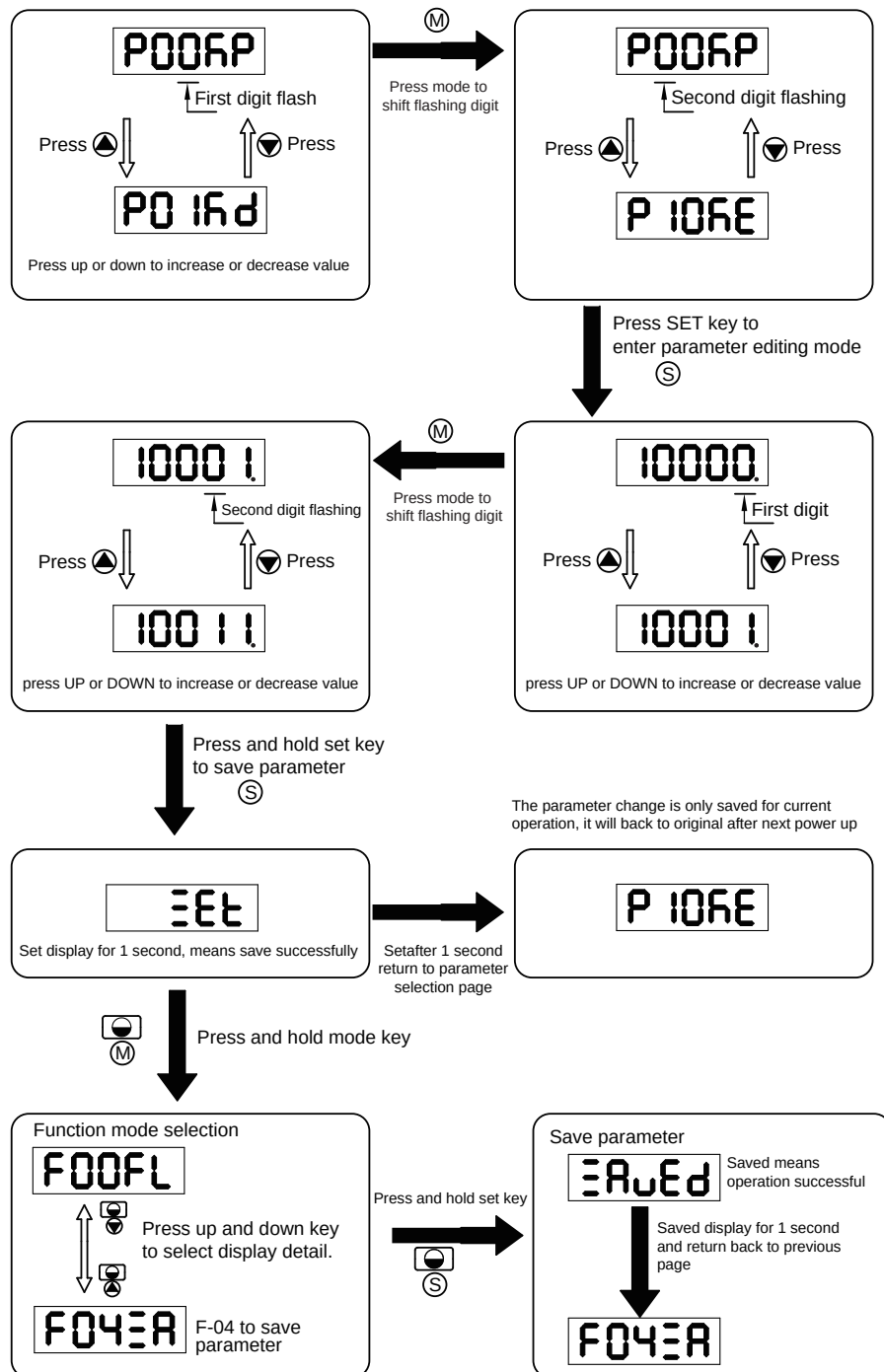
4.6.1 Parameter Setting Description

The parameter setting mode (P+parameter number) allows you to select, display and edit the necessary parameter. In function control mode, press and hold  for 1 second to enter parameter setting mode. Use   to select the required parameter, and press  to view or edit the parameter. Press  again to quit and no change will be saved. Press and hold

 for 1 second to save the parameter change. However this change will NOT be saved at the next power on. To save the parameter PERMANENTLY, go into function control mode (F+parameter number), and use F-04SA function.



4.6.2 Parameter Editing Examples



4.6.3 Parameter list

Refer to the *Host Command Reference* for command details.

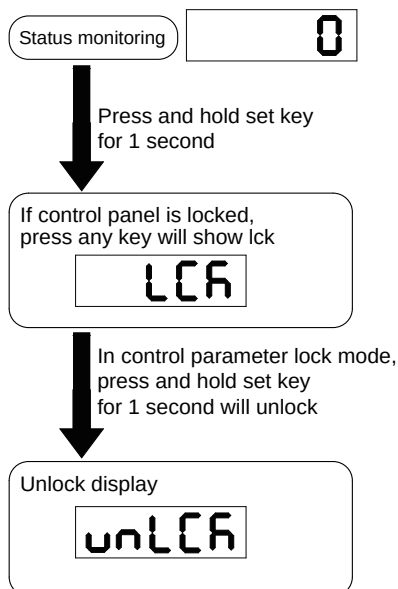
Parameter Number	SCL Command	LED Display	Function
P00	KP	P00KP	position loop proportional gain
P01	KD	P01KD	position loop differential gain
P02	KE	P02KE	differential filter
P03	VP	P03VP	velocity loop proportional gain
P04	VI	P04VI	velocity loop integrator gain
P05	-	P05L	reserved
P06	KK	P06KK	inertia feedforward gain
P07	KC	P07KC	overall filter
P08	SF	P08SF	step smoothing filter frequency
P09	CM	P09CM	command mode
P10	-	P10L	reserved
P11	PM	P11PM	power up mode
P12	JM	P12JM	jog mode
P13	GC	P13GC	current command (torque mode)
P14	CC	P14CC	continuous current
P15	CP	P15CP	peak current
P16	-	P16L	reserved
P17	HC	P17HC	hard stop current
P18	-	P18L	reserved
P19	VM	P19VM	maximum velocity
P20	AM	P20AM	maximum acceleration
P21	JS	P21JS	jog speed
P22	JA	P22JA	jog acceleration
P23	JL	P23JL	jog deceleration
P24	VE	P24VE	velocity
P25	AC	P25AC	acceleration

P26	DE	P26dE	deceleration
P27	VC	P27vC	velocity change
P28	JC	P28JC	velocity mode second speed
P29	-	P29JC	reserved
P30	-	P30JC	reserved
P31	-	P31JC	reserved
P32	-	P32JC	reserved
P33	-	P33JC	reserved
P34	-	P34JC	reserved
P35	-	P35JC	reserved
P36	ER	P36Er	encoder resolution
P37	-	P37E ,	reserved
P38	EG	P38EG	electronic gearing
P39	SZ	P39Sz	pulse mode setting
P40	PF	P40PF	position fault limit
P41	PL	P41PL	position limit for dynamic in position
P42	PD	P42PD	position limit for static in position
P43	PE	P43PE	in position timing
P44	TT	P44tT	pulse complete timing
P45	AP	P45AP	analog position gain
P46	AG	P46AG	analog velocity gain
P47	AN	P47An	analog torque gain
P48	-	P48A_u	reserved
P49	-	P49A_u	reserved
P50	AV	P50A_u	analog offset value
P51	AS	P51AS	analog scaling
P52	-	P52A_d	reserved
P53	-	P53A_d	reserved
P54	AD	P54Ad	analog deadband

P55	AF	P55AF	analog filter
P56	AT	P56At	analog threshold
P57	SI	P57E ,	enable input usage
P58	AI	P58A ,	alarm reset input usage
P59	DL	P59dL	define limit
P60	AO	P60Ao	alarm output
P61	BO	P61bo	brake output
P62	MO	P62no	motion output
P63	BD	P63bd	brake disengage delay
P64	BE	P64bE	brake engage delay
P65	FI	P65F ,	filter input for X5
P66	FI	P66F ,	filter input for X6
P67	FI	P67F ,	filter input for X7
P68	FI	P68F ,	filter input for X8
P69	-	P69P4	reserved
P70	-	P70H ,	reserved
P71	IF	P71IF	immediate format
P72	PR	P72Pr	protocol
P73	TD	P73td	transmit delay
P74	BR	P74br	baud rate
P75	-	P75dA	reserved
P76	CO	P76Co	node id
P77	-	P77Cb	reserved
P78	PK	P78Pk	parameter lock on control panel
P79	DD	P79dd	default display item of LEDs
P80	MA	P80MA	for advanced user only, not recommended
P81	ZT	P81zt	regen resistor peak time

4.7 Control Panel Lock

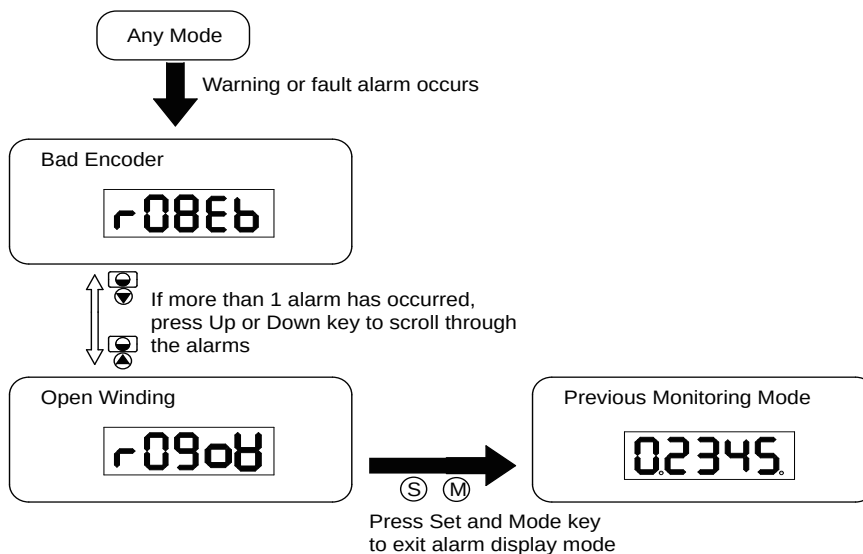
In order to prevent unauthorized or unintentional use of the key panel, a key panel lock is available on all SS-EC drives. When the lock feature is on, no function can be changed directly on drive's control panel.



4.8 Warning And Fault Display

If any of the following warnings are detected by the drive when power is applied, the LED display on the drive will immediately switch into warning or fault display mode.

If more than one warning is detected, you can scroll through by pressing the buttons. Press or to clear the warning display and return to the previous display mode.



LED display	Description
r0 lot	<i>Drive Over Temperature</i>
r02ur	<i>Internal Voltage Bad</i>
r03uH	<i>Over Voltage</i>
r04HC	<i>Highside Over Current</i>
r05LC	<i>Lowside Over Current</i>
r06rC	<i>Over Current Reading</i>
r08Eb	<i>Bad Encoder</i>
r09oH	<i>Open Winding</i>
r 10PL	<i>Position Limit</i>
r 11Lu	Under Voltage
r 13Lt	CCW Limit and CW Limit
r 14LL	CCW Limit
r 15JL	CW Limit
r 16CL	Current Foldback
r 17CE	Communication Error
r 18EF	Save Failed
r20to	<i>STO Activated</i>
r2 1rF	<i>Regen Failed</i>
r239E	Blank Q Segment
r24dd	Move while Disabled

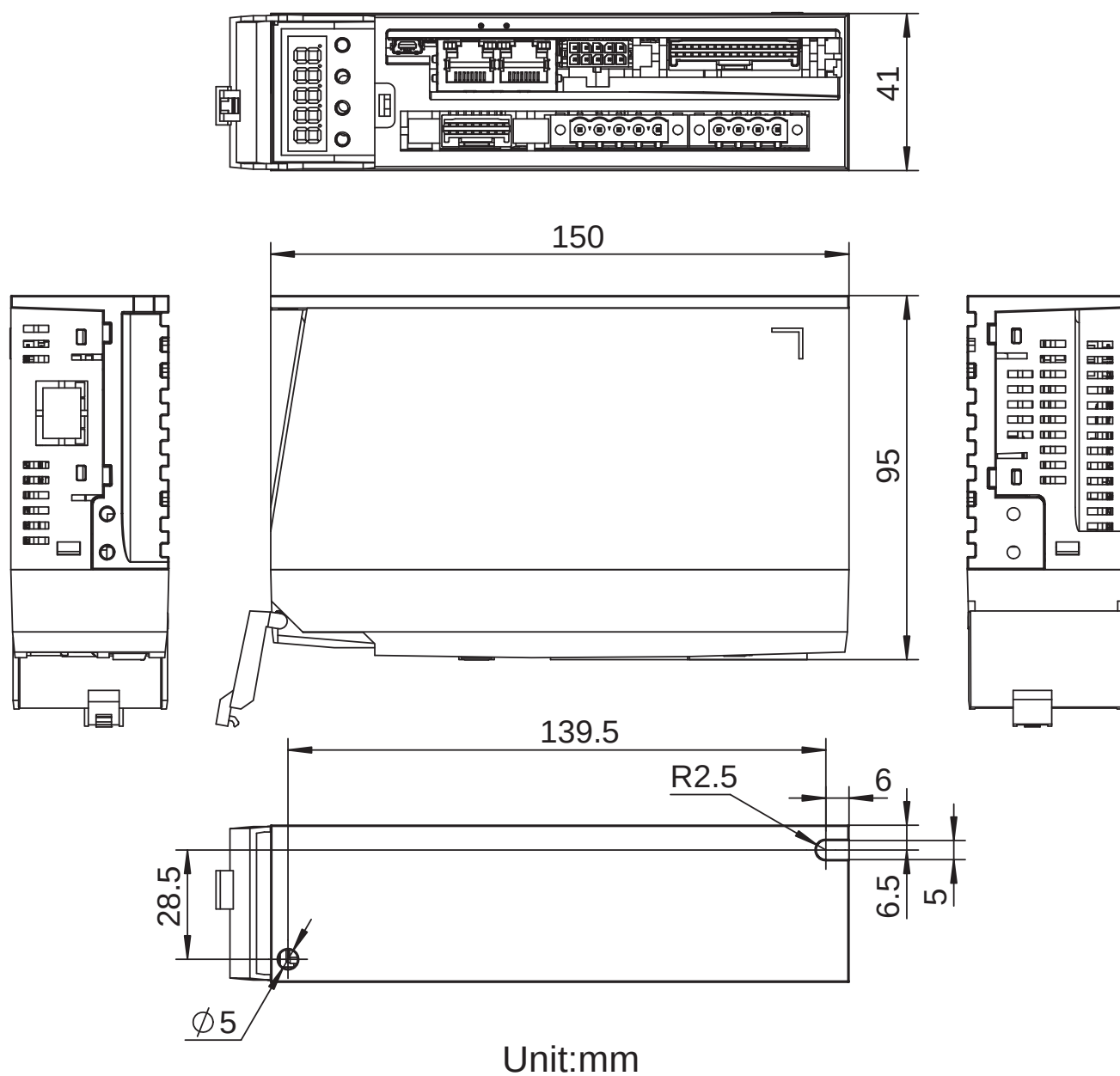
NOTE: Items in ***bold italic*** represent Drive Faults, which automatically disable the motor.

4.9 LED Character Reference

1	2	3	4	5	6	7	8	9	0
1	2	3	4	5	6	7	8	9	10
A	B	C	D	E	F	G	H	I	J
K	L	M	N	O	P	Q	R	S	T
U	V	W	X	Y	Z				
U	V	W	X	Y	Z				

5 Reference Materials

5.1 Drive Mechanical Outlines

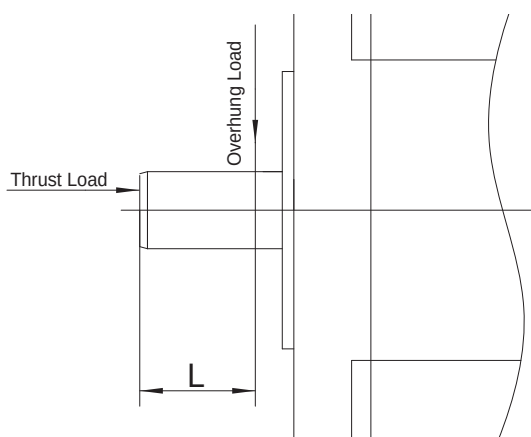


5.2 Drive Technical Specifications

Power Amplifier	
Amplifier Type	Dual H-Bridge, 4 Quadrant
Current Control	4 state PWM at 20 KHz
Output Current	SS03 Maximum continuous current 3A, boost current 4.5A (for 1.5s) Drive auto-sets the current limitation according to the attached motor
	SS05 Maximum continuous current 5A, boost current 7.5A (for 1.5s) Drive auto-sets the current limitation according to the attached motor
	SS10 Maximum continuous current 10A, boost current 15A (for 1.5s) Drive auto-sets the current limitation according to the attached motor
Power Supply	External 24 - 70 volt DC power supply required Absolute maximum input voltage range 18 - 75 VDC
Auxiliary Power Supply	External 12 - 48 volt DC power supply required
Protection	Over-voltage, under-voltage, over-temp, over-current, short circuit
Controller	
Microstep Resolution	Software selectable from 200 to 51200 steps/rev in increments of 2 steps/rev
Encoder Resolution	20000 counts/rev for HT17/23/24/34SS motor; 4096 counts/rev for HT11SS motor
Speed Range	Speeds up to 3600 rpm
Filters	Programmable hardware digital noise filter, software noise filter, smoothing filter, PID filter, notch filter
Non-Volatile Storage	Configurations are saved in FLASH memory on-board the DSP
Supported Protocol	CoE (CiA 402 Drive profile)
Supported Modes	Profile Position, Profile Velocity, Profile Torque, Cyclic Synchronous Position, Cyclic Synchronous Velocity, Homing, and Applied Motion Products own Q mode
Synchronization	SM Event, DC Sync Event
Digital Inputs	X1, X2, X3, X4: optically isolated, differential, 5-24VDC, minimum pulse width 250ns, maximum pulse frequency 2MHz X5, X6, X7, X8: optically isolated, single-ended input, 5-24VDC
Digital Output	Y1, Y2, Y3, Y4: optically isolated, open collector, 30 volts, 100 mA max, maximum pulse frequency 10 KHz
Analog Input	AIN1, AIN2: individually single-ended or together differential, input resolution 12-bit, software configured as 0-5 volts, 0-10 volts, ± 5 volts or ± 10 volts (AIN referenced to GND)
+5V Supply Output	+4.8 - 5 volts @ 100mA maximum
Communication	EtherCAT and mini USB for configuration
Environment	
Ambient Temperature	0 - 40°C (32 - 104°F) when mounted to a suitable heatsink
Humidity	90% non-condensing

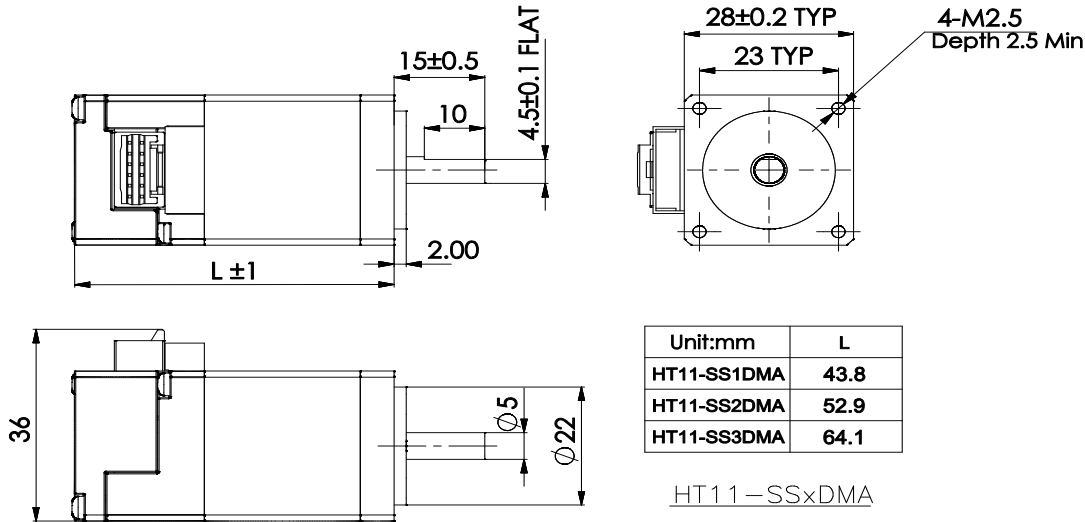
5.3 Recommended Motors and Specifications

Motor Part Number	Matching Drive	Holding Torque	Rotor Inertia	Encoder Resolution	Max. Speed	Mass	Frame Size	Permissible Shaft Load (N)					Permissible Thrust Load						
		N-m	G-cm ²	counts/rev	RPM	g	mm	Distance (L) from shaft end (mm)											
								0	5	10	15	20							
HT11-SS1DMA	SS03-EC-D	0.065	9	4096	3600	118	28	20	25	34	52	-	Less than the motor mass						
HT11-SS2DMA		0.08	12			168													
HT11-SS3DMA		0.125	18			218													
HT17-SS1DGB	SS03-EC-D or SS05-EC-D	0.3	38	390		42	35	44	58	85	-								
HT17-SS1DGA		0.3	38	390															
HT17-SS2DGB		0.5	57	440															
HT17-SS2DGA		0.5	57	440															
HT17-SS3DGB		0.6	82	520															
HT17-SS3DGA		0.6	82	520															
HT17-SS4DGB		0.75	123	760															
HT17-SS4DGA		0.75	123	760															
HT23-SS2DGB		SS05-EC-D	0.9	260								850		56	63	75	95	130	190
HT23-SS2DGA			0.9	260								850							
HT23-SS3DGB	1.5		460	1250															
HT23-SS3DGA	1.5		460	1250															
HT23-SS4DGA	2.5		365	1090															
HT24-SS3DGB	SS10-EC-D	2.5	900	1650		60	90	100	130	180	270								
HT24-SS3DGA		2.5	900	1650															
HT34-SS1DGA		3.5	915	2000		86	260	290	340	390	480								
HT34-SS3DGA		6.0	1480	3100															
HT34-SS5DGA		8.0	2200	4200															



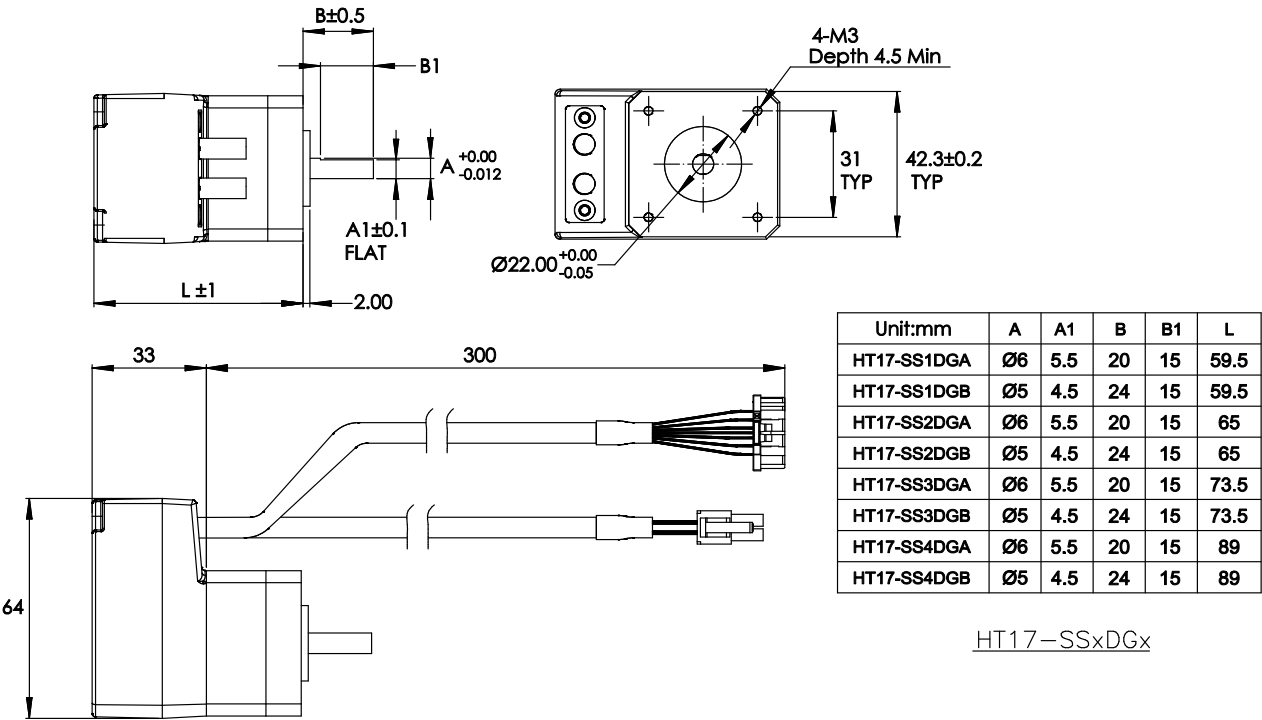
HT11-SS

unit: mm

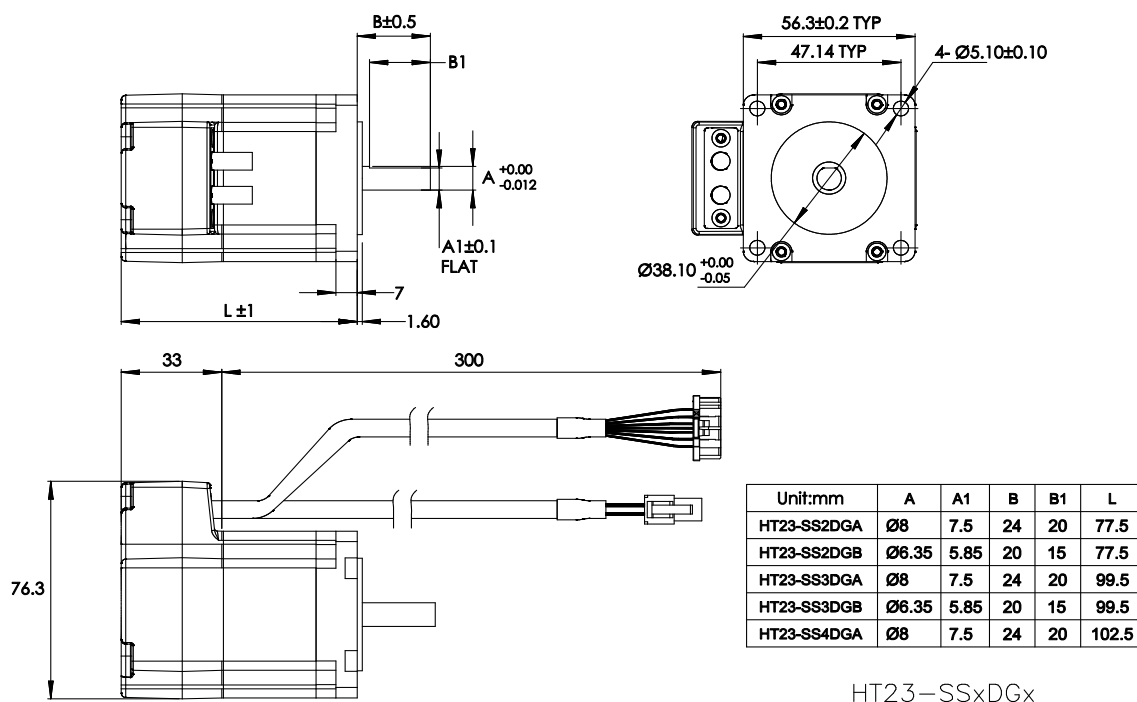


HT17-SS

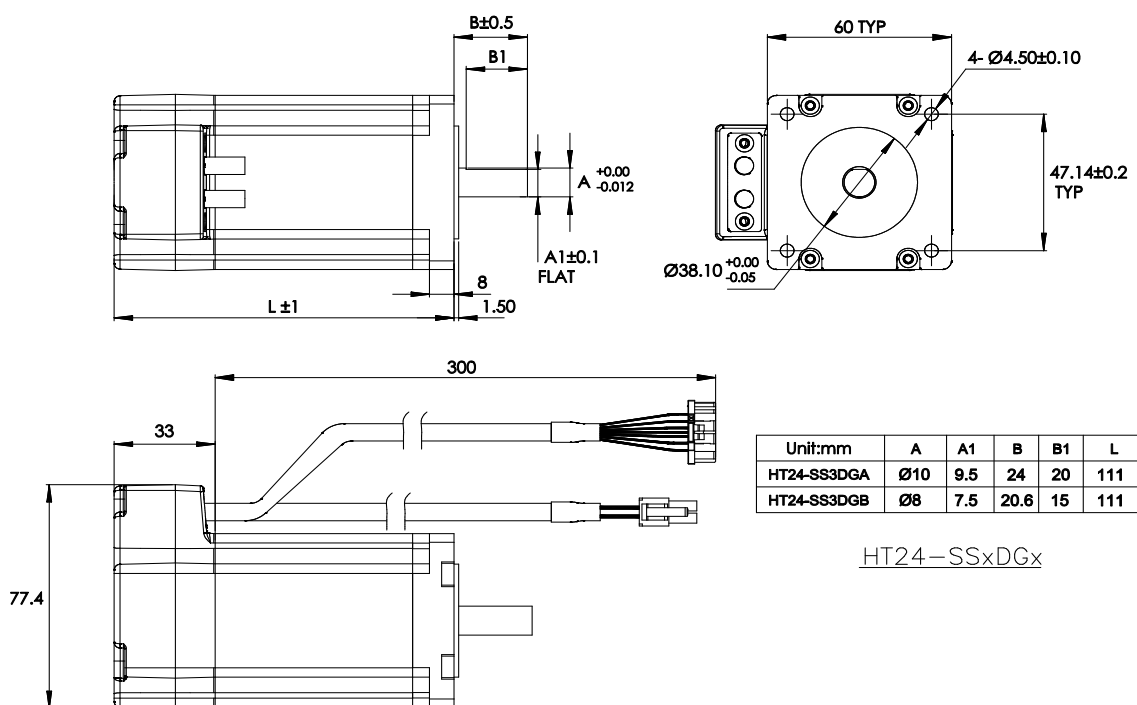
unit: mm



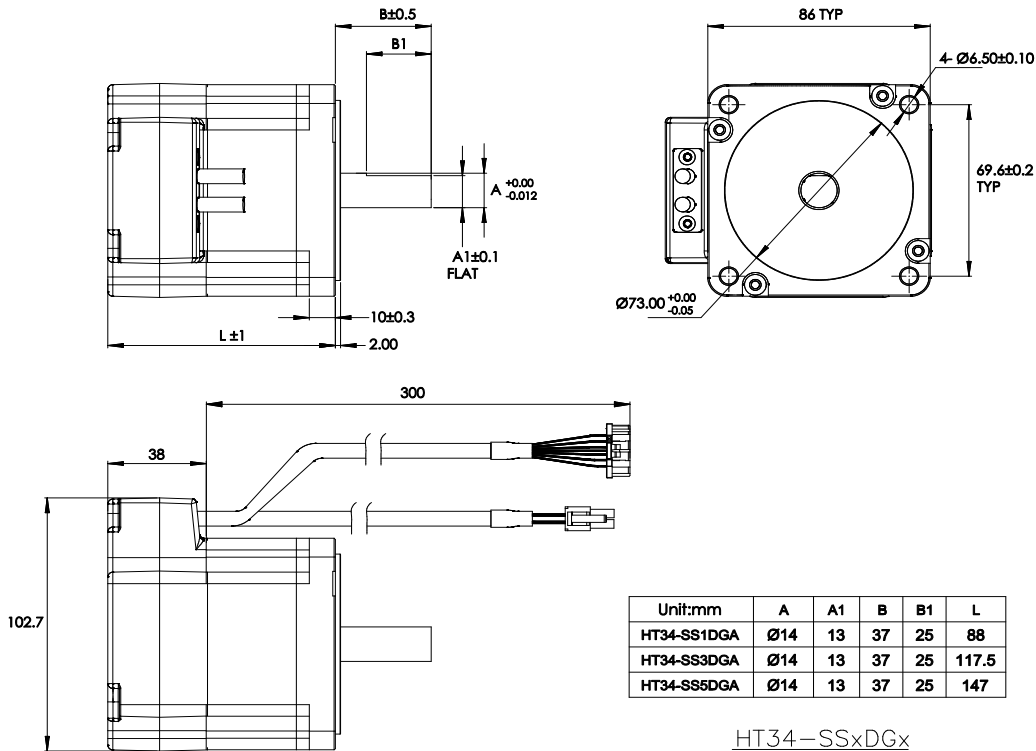
HT23-SS unit: mm



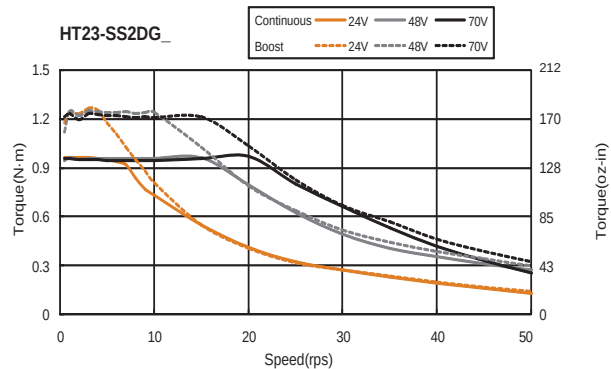
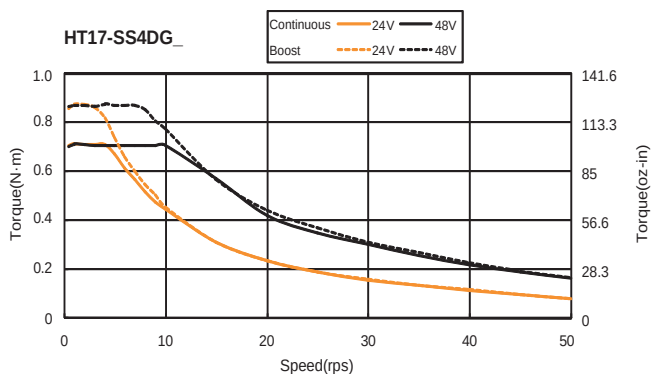
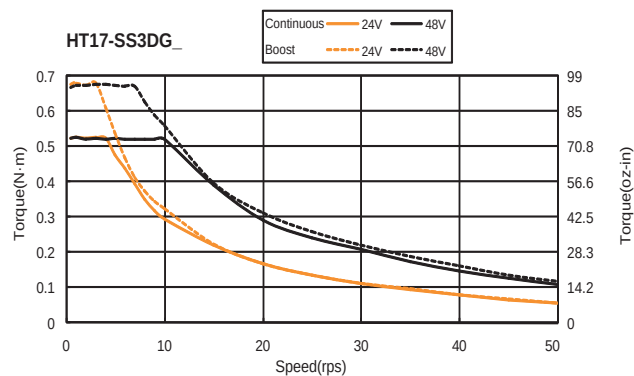
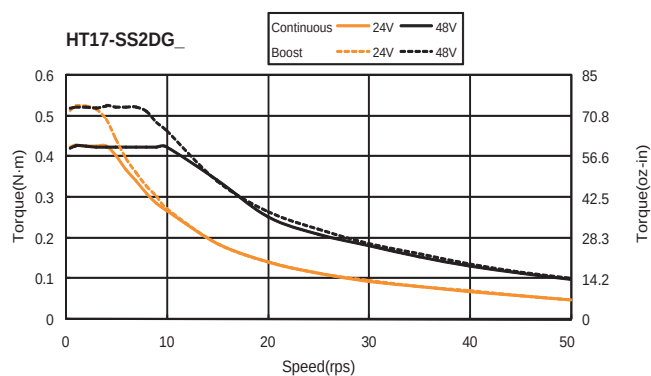
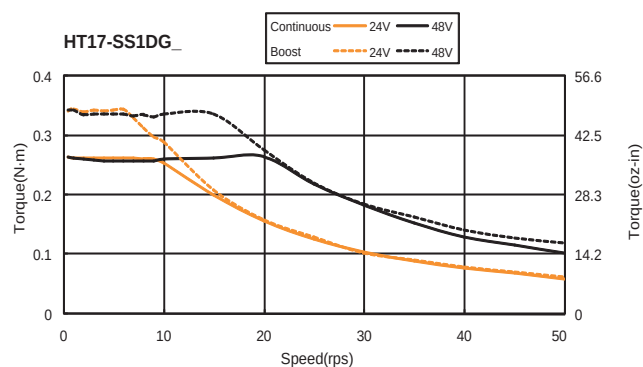
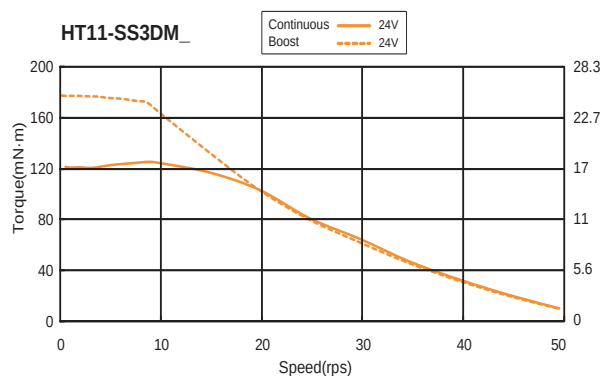
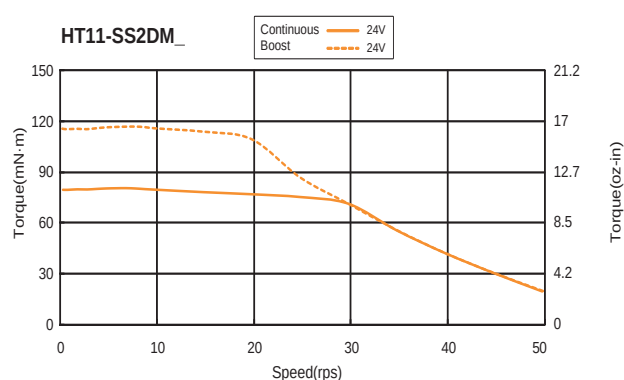
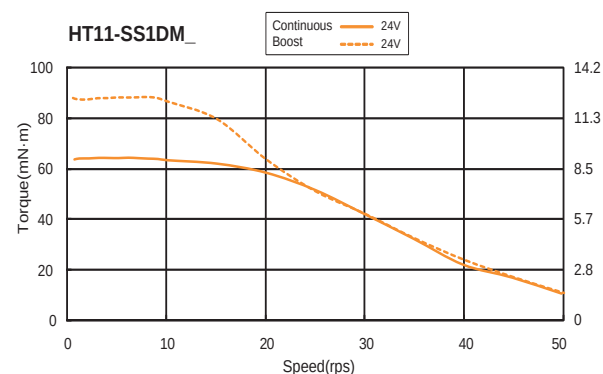
HT24-SS unit: mm

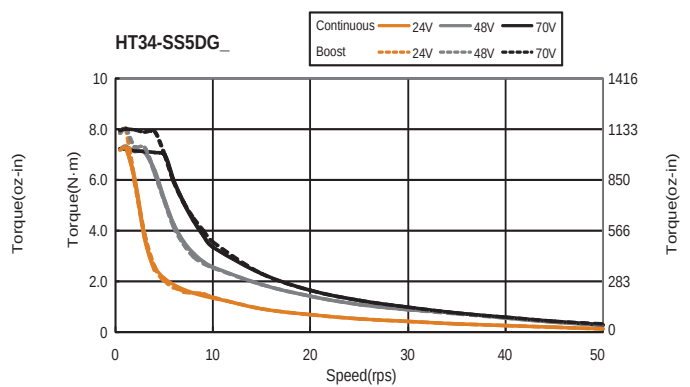
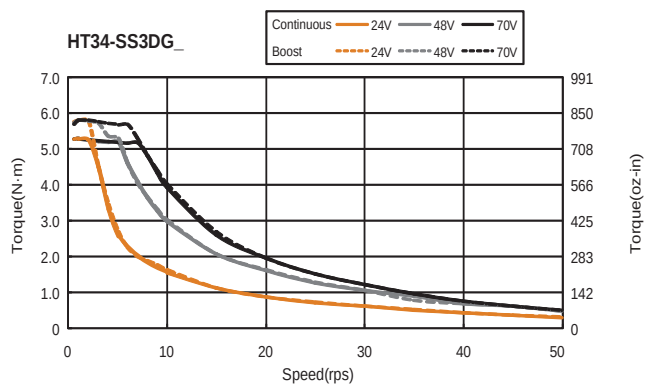
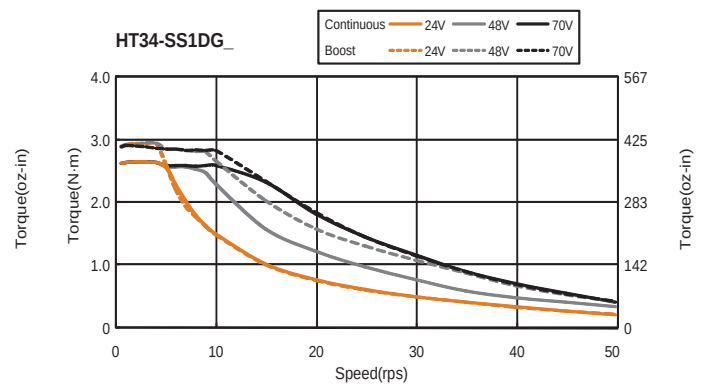
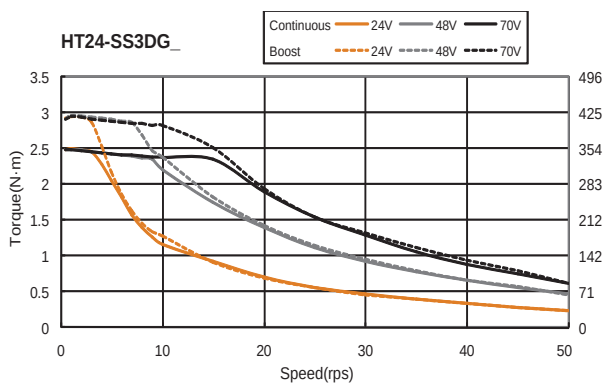
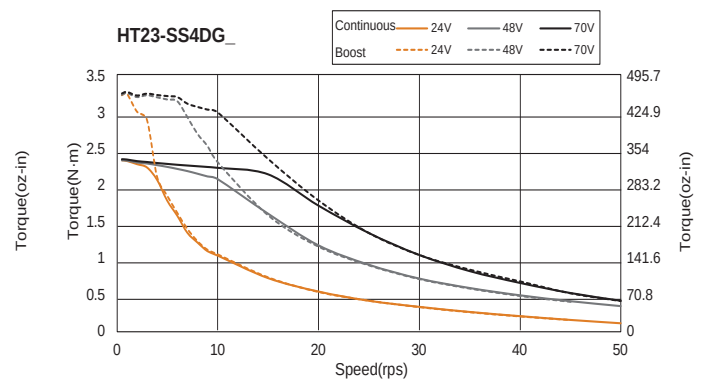
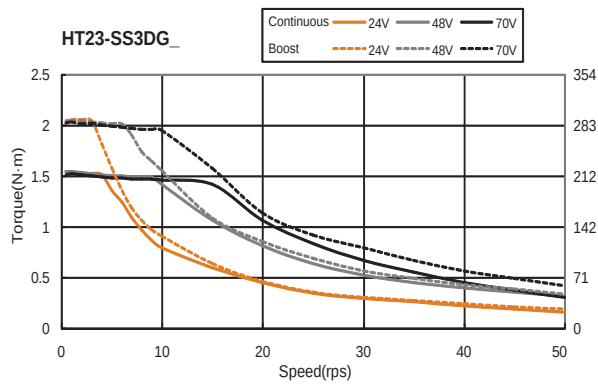


HT34-SS
unit: mm

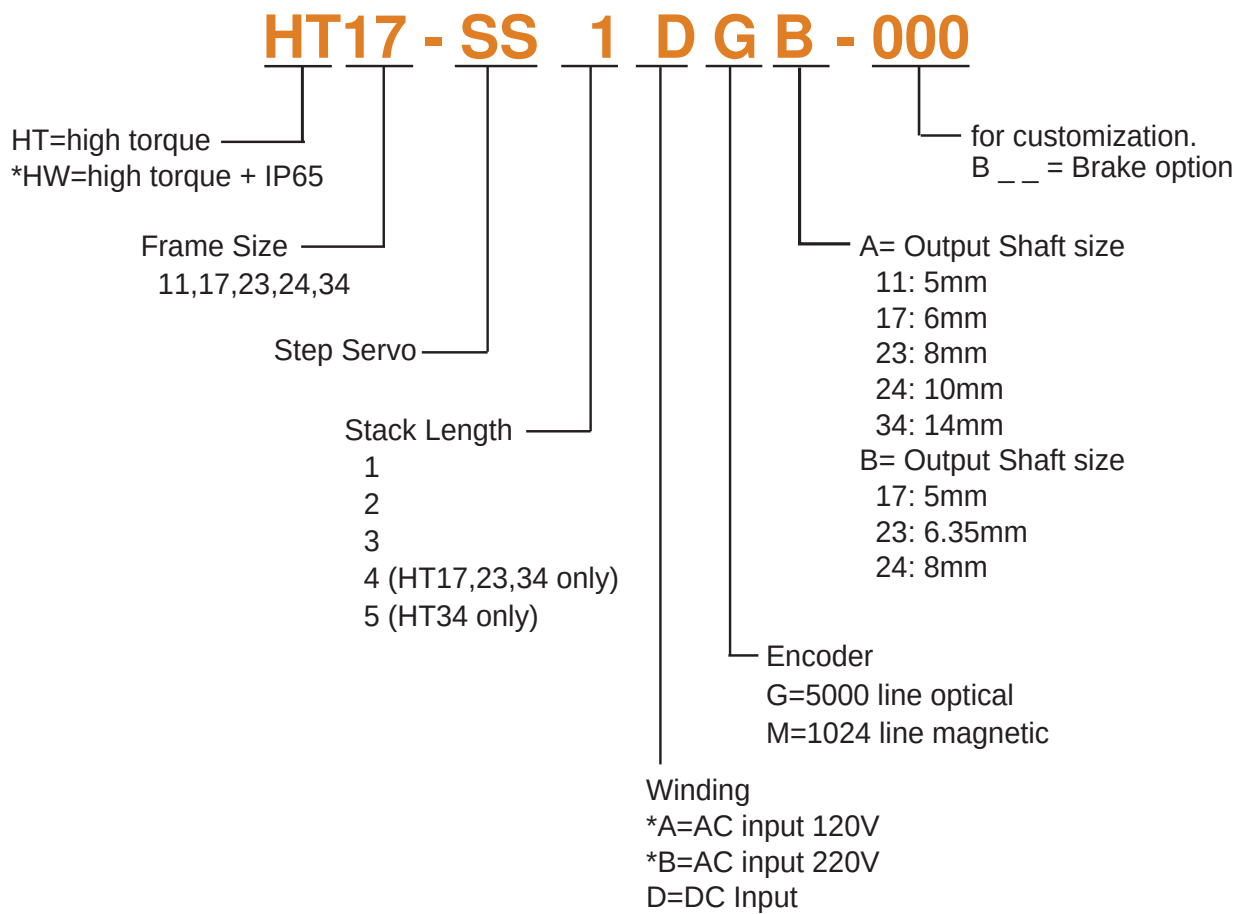


5.5 Torque Curves

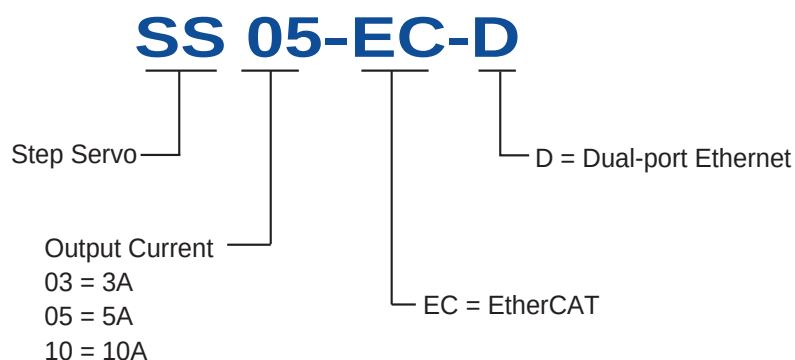




5.6 Motor Numbering System



5.7 Drive Numbering System

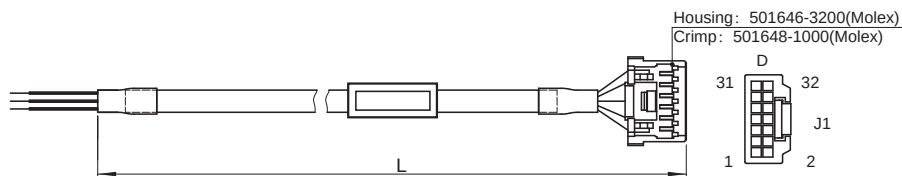


6 Optional Accessories (Sold separately)

6.1 Cables

I/O Cable

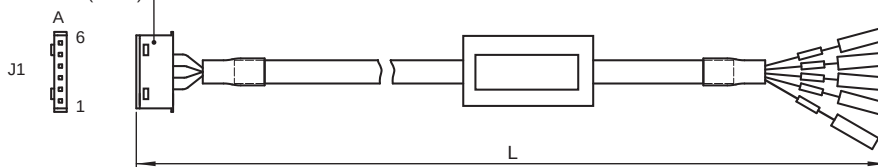
P/N	Length(L)
3004-340-2M	2M



Wiring Diagram			
PIN (J1)	Color (Signal)	PIN (J1)	Color (Signal)
1	Blue/White (X1+)	17	NC
2	Blue/Black (X1-)	18	NC
3	Green/White (X2+)	19	Brown/White (Y1+)
4	Green/Black (X2-)	20	Brown/Black (Y1-)
5	Red (X3+)	21	Gray/White (Y2+)
6	Orange (X3-)	22	Gray/Black (Y2-)
7	Blue (X4+)	23	Purple/White (Y3+)
8	Purple (X4-)	24	Purple/Black (Y3-)
9	Yellow (X5)	25	Pink (Y4+)
10	Green (X6)	26	Yellow/Green (Y4-)
11	Brown (X7)	27	Red/White (AOUT+)
12	Gray (X8)	28	Red/Black (AOUT-)
13	Shield	29	Orange/White (BOUT+)
14	White (XCOM)	30	Orange/Black (BOUT-)
15	Black (GND)	31	Yellow/White (ZOUT+)
16	NC	32	Yellow/Black (ZOUT-)

Motor Extension Cable between SS-EC drive and HT11SS motor

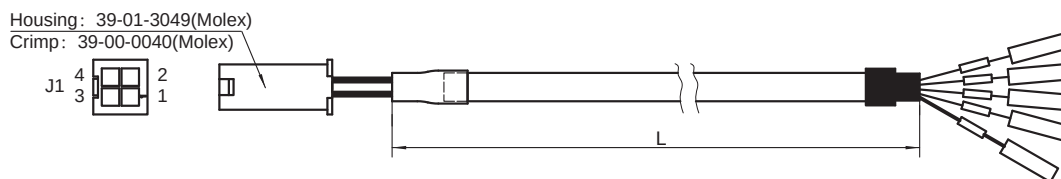
Housing: 51065-0600(Molex)
Crimp: 50212-8000(Molex)



P/N	Length(L)
3004-337-1M	1M
3004-337-3M	3M
3004-337-5M	5M
3004-337-10M	10M

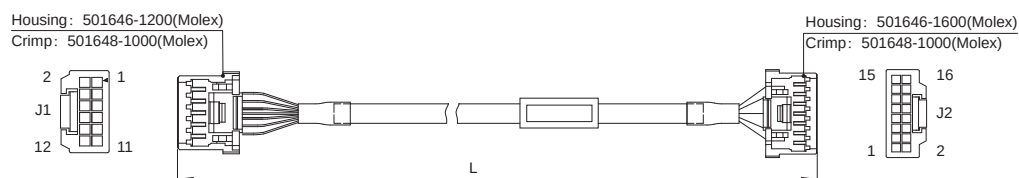
Wiring Diagram	
PIN(J1)	Color (Signal)
1	Blue(B-)
3	Red(B+)
4	Green(A-)
6	Black(A+)

Motor Extension Cable between SS-EC drive and HT17/23/24/34SS-N motor



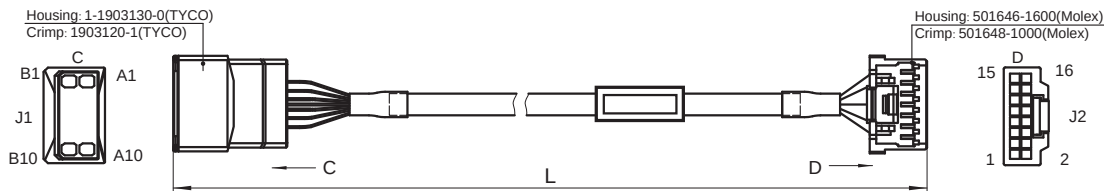
P/N	Length(L)	Wiring Diagram	
3004-336-1M	1M	PIN(J1)	Color (Signal)
3004-336-3M	3M	1	Blue(B-)
3004-336-5M	5M	2	Red(B+)
3004-336-10M	10M	3	Green(A-)
		4	Black(A+)

Encoder Extension Cable between SS-EC drive and HT11SS Motor



P/N	Length(L)	Wiring Diagram					
3004-339-1M	1M	PIN(J1)	Color (Signal)	PIN(J2)	PIN(J1)	Color (Signal)	PIN(J2)
3004-339-3M	3M	10	Blue(A+)	1		Brown(U+)	
3004-339-5M	5M	9	Blue/Black(A-)	2		Brown/Black(U-)	
3004-339-10M	10M	8	Green(B+)	3		Gray(V+)	
		7	Green/Black(B-)	4		Gray/Black(V-)	
		6	Yellow(Z+)	5	1	White(W+)	15
		5	Yellow/Black(Z-)	6	2	White/Black(W-)	16
		3	Red(+5V)	7	12	Shield	10
		4	Black(GND)	8			

Encoder Extension Cable between SS-EC drive and HT17/23/24/34SS-N Motor

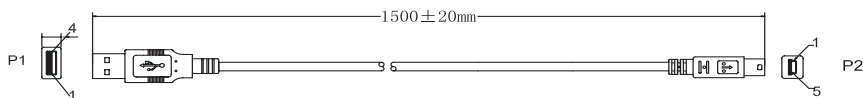


P/N	Length(L)
3004-338-1M	1M
3004-338-3M	3M
3004-338-5M	5M
3004-338-10M	10M

Wiring Diagram							
PIN (J1)	Color (Signal)	PIN (J2)	PIN (J1)	Color (Signal)	PIN (J2)		
A9	Blue (A+)	1	B5	Shield	10		
B9	Blue/Black (A-)	2	A4	Brown (U+)	11		
A8	Green (B+)	3	B4	Brown/Black (U-)	12		
B8	Green/Black (B-)	4	A3	Gray (V+)	13		
A7	Yellow (Z+)	5	B3	Gray/Black (V-)	14		
B7	Yellow/Black (Z-)	6	A2	White (W+)	15		
A6	Red (+5V)	7	B2	White (W+)	16		
B6	Black (GND)	8					

USB Cable

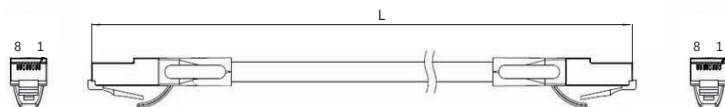
P/N	Length(L)
3004-316	1.5M



Network Cable

Common Type	Shielded Type	Length(L)
3004-341-0.3M	3004-342-0.3M	0.3M

3004-341-0.3M is included in the drive package.



6.2 Mating Connectors

Part	Description	Part Number	Vendor
P1	Power Connector	5435970	Phoenix Contact
P2	Motor Connector	5435983	
CN1	Encoder Connector	Housing: 501646-1600 Crimp Terminal: 501648-1000	Molex
CN4	STO Connector	Housing: 43025-1000 Crimp Terminal: 43030-0005	
CN5	I/O Connector	Housing: 501646-3200 Crimp Terminal: 501648-1000	



Applied Motion Products, Inc.
404 Westridge Drive Watsonville, CA 95076
Tel (831) 761-6555 (800) 525-1609
www.applied-motion.com