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<td>EtherCAT</td>
</tr>
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<td>EtherCAT</td>
</tr>
<tr>
<td>STF06-EC</td>
<td>EtherCAT</td>
</tr>
<tr>
<td>STF06-EC</td>
<td>EtherCAT</td>
</tr>
</tbody>
</table>
1 Introduction

Thank you for selecting the Applied Motion Products STF series stepper drive. The STF series are high performance fieldbus control stepper drive which also integrates with built-in motion controller. The STF EtherCAT drive can operate as a standard EtherCAT slave using CANopen over EtherCAT (CoE).

EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

1.1 Features

- Programmable, filed bus controlled stepper motor drive in compact package
- Operating DC voltage range:
  - STF03 12-48V
  - STF05 24-48V
  - STF06 12-48V
  - STF10 24-70V
- 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
- CANopen over EtherCAT (CoE) with full support of CiA402.
- Supported modes: Profile Position, Profile Velocity, Cyclic Synchronous Position and Homing; as well as Applied Motion Products Q program mode
- Dual port RJ45 connector for EtherCAT communication
- RS-232 port for drive configuration
- STF03 output current: max 3A/phase (peak-of-sine)
- STF05 output current: max 5A/phase (peak-of-sine)
- STF06 output current: max 6A/phase (peak-of-sine)
- STF10 output current: max 10A/phase (peak-of-sine)
- I/O
  - 8 optically isolated digital inputs, 5-24VDC high level voltage
  - 4 optically isolated digital outputs, max 30V/100mA sink or source current
1.2 Block Diagram

STF EtherCAT Block Diagram

- Power Supply
  - STF03 12-48VDC
  - STF05 24-48VDC
  - STF06 12-48VDC
  - STF10 24-70VDC

- EMC Filter
- DC Input Power Converter
- Internal Logic Supply
- Mosfet PWM Power Amplifier
- Over Current Det.
- Motor
- X1+, X1-, X2+, X2-
- X3+, X3-, X4+, X4-
- X5, X6, X7, X8, XCOM
- Single Ended Input Isolation
- Digital Filter
- Software Filter
- Y1, Y2, Y3, YCOM, Y4+, Y4-
- Output Optical Isolation
- Digital Filter
- Software Filter

- DSP
- LED
- RS-232
- EtherCAT
- EtherCAT ID
- S1 (MSD)
- S2 (LSD)
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:

- An appropriate power supply, see the section below entitled “Choose a Power Supply” for help in choosing the right one.
- A compatible stepper motor, please see the section below entitled “Recommended Motor”
- A small flat blade screwdriver for tightening the connectors screw (included)
- A PC running Microsoft Windows XP / Vista / Windows 7 / Windows 8 / Windows 10 (32-bit or 64-bit) operation system
- A CAT5 cable for EtherCAT daisy chain connection (included)
- A RS-232 cable for configuration (included)
- Optional I/O cable 3004-348 (Sold separately)

Install STF Configurator software (Available from Applied Motion Products website)

2.1 Installing Software

- Download the STF Configurator Software from the Applied Motion Products website and install it.
- Launch the software by clicking Start...Programs...Applied Motion Products...STF Configurator
- Connect the drive to the RS-232 port of the PC. Select right COM port in the software. See Section “Choosing the Right COM Port”
- If the PC does not have an RS-232 serial port, a USB to RS-232 Serial Converter will be needed. We recommend using a USB-serial adapter, model 3004-235 from Applied Motion Products.
- Connect the drive to the power supply.
- Connect the motor to the drive.
- Apply power to the drive.
- The software will recognize the drive & display the model & firmware version.

The connectors and other points of interest are illustrated below:
2.2 Connect the drive to the PC with the RS-232 communication Cable

Connector J3 is an RS-232 interface for connecting the drive to PC. Use the STF Configurator software to configure drive parameters, monitor the status of the drive, and perform motor motion test.

STF05/10-EC  
STF03/06-EC

2.3 Choosing the Right COM Port

Open the “Device Manager” on the PC. There may or may not be a “Ports” selection. Connect the RS-232 communication cable to the PC. The connected COM port should then be displayed. Choose this new COM(n) port in the STF Configurator software.

If the PC does not have an RS-232 serial port, a USB to RS-232 Serial Converter will be needed. We recommend using a USB-serial adapter, model 3004-235 from Applied Motion Products.
2.4 Connecting the Power Supply

- Connect power supply “+” terminal to the drive terminal labeled “V+”.
- Connect power supply “-” terminal to the drive terminal labeled “V-”.
- STF03 accepts DC voltage range from 12 – 48VDC
- STF05 accepts DC voltage range from 24 – 48VDC
- STF06 accepts DC voltage range from 12 – 48VDC
- STF10 accepts DC voltage range from 24 – 70VDC

**Warning**: DO NOT reverse the wires

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

![Power Connector Diagram]

Ensure a proper earth ground connection by using the screw on the left side of the chassis.

![STF EtherCAT Hardware Diagram]

Please read “choosing a power supply” for more details.
2.5 Choosing A Power Supply

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

2.5.1 Voltage

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

**STF03/06**

The STF03/06 drive extended range of operation voltage can be as low as 11VDC minimum to as high as 53VDC maximum. When operation below 11VDC, the STF03/06 series will work unstable. The supply input cannot go blow 11VDC for reliable operation, otherwise under voltage alarm will be triggered. STF03/06 drive will stop working when this alarm is triggered.

If a regulated power supply is used, and that is near the driver maximum voltage of 53VDC, a voltage clamp may be required to prevent the voltage over 53VDC which will occurs a overvoltage fault. When using an unregulated power supply, make sure the no-load voltage of the supply does not exceed the maximum input voltage 53VDC.

**STF05/10**

The STF05/10 drive extended range of operation voltage can be as low as 18VDC minimum to as high as 75VDC maximum for STF10 and 53VDC maximum for STF05. When operation below 18VDC, the STF05/10 series will work unstable. The supply input cannot go blow 18VDC for reliable operation, otherwise under voltage alarm will be triggered. STF05/10 drive will stop working when this alarm is triggered.

For STF10 drives, If a regulated power supply is used, and that is near the driver maximum voltage of 75VDC, a voltage clamp may be required to prevent the voltage over 75VDC which will occurs a overvoltage fault. When using an unregulated power supply, make sure the no-load voltage of the supply does not exceed the maximum input voltage 75VDC.

For STF05 drives, If a regulated power supply is used, and that is near the driver maximum voltage of 53VDC, a voltage clamp may be required to prevent the voltage over 53VDC which will occurs a overvoltage fault. When using an unregulated power supply, make sure the no-load voltage of the supply does not exceed the maximum input voltage 53VDC.

2.5.2 Current

The maximum supply current you could ever need is the sum of the two phase currents. However, you will generally need a lot less than that, depending on the motor type, voltage, speed and load conditions. That's because the STF drives use switching amplifiers, converting 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 you'll need from the power supply. A motor running from a 48 volt supply can be expected to draw only half the supply current that it would with a 24 volt supply.

We recommend the following selection procedure:

1. If you plan to use only a few drives, get a power supply with at least twice the rated phase current of the motor.
2. If you are designing for mass production and must minimize cost, get one power supply with more than twice the rated current of the motor. Install the motor in the application and monitor the current coming out of the power supply and into the drive at various motor loads. This will tell you how much current you really need so you can design in a lower cost power supply.
2.6 Connecting the motor

For Applied Motion Products’ stepper motor, please connect black, green, red, blue wires to drive’s A+, A-, B+ and B- correspondingly.

Never connect or disconnect the motor while the power is on.

If using a non-Applied Motion Products motor, please refer to your motor specs for wiring information. Do not connect it until you have configured the drive for that motor.

Four lead motors can only be connected one way. Please follow the sketch at the right.

Eight lead motors can also be connected in two ways: series and parallel. As with six lead motors, series operation gives you less torque at high speeds, but may result in lower motor losses and less heating. In series operation, the motor should be operated at 30% less than the unipolar rated current. The motors recommended in this manual should be connected in parallel. The wiring diagrams for eight lead motors are shown on the following page.
2.7 Connecting the EtherCAT

Dual RJ-45 connectors 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.

2.7.1 EtherCAT Status Indicator LEDs

The LEDs are used for indicating status of the EtherCAT. STF05/10-EC have two Link/Activity LEDs (one for each RJ-45 Ethernet connector) and two status LEDs (RUN and ERR). STF03/06-EC's four EtherCAT indicator LEDs are above the connector J3.

<table>
<thead>
<tr>
<th>LED</th>
<th>Color</th>
<th>Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link/Activity</td>
<td>Green</td>
<td>OFF</td>
<td>No Ethernet connection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ON</td>
<td>Ethernet is connected</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Flickering</td>
<td>Activity on line</td>
</tr>
<tr>
<td>RUN</td>
<td>Green</td>
<td>OFF</td>
<td>Initialization state</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blinking</td>
<td>Pre-operational state</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Single Flash</td>
<td>Safe-operational state</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ON</td>
<td>Operational state</td>
</tr>
<tr>
<td>ERR</td>
<td>Red</td>
<td>OFF</td>
<td>No error</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blinking</td>
<td>General error</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Single Flash</td>
<td>Sync error</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Double Flash</td>
<td>Watch dog error</td>
</tr>
</tbody>
</table>

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
2.8 Setting the EtherCAT Node ID

STF-EC supports three methods to set and read the EtherCAT Node ID (Alias ID):

2.8.1 Set by rotary switches

When the drive’s ID is configured to be set by rotary switches in STF Configurator software, two decimal rotary switches on the drive are used to set a nonzero value (range 1–99) as the EtherCAT node Alias ID.

For example, if switch S1 is 1 and switch S2 is 2, then the drive’s EtherCAT node Alias ID is set to 12.

ID value set by rotary switches takes effect when power of drive turns on.

2.8.2 Assigned by master controller

When the drive’s ID is configured to be assigned by master controller in STF Configurator software, the master controller can set the EtherCAT node Alias ID to address 0004h of SII (Slave Information Interface) EEPROM. The drive can get this ID value from SII EEPROM address 0004h after power up.

2.8.3 Read rotary switches setting by AL Status Code

3 Inputs and Outputs

STF series drive inputs and outputs include:

- 8 optically isolated digital inputs, 5–24VDC for high level voltage
- 4 optically isolated digital outputs, maximum voltage 30V, maximum sinking or sourcing current 100mA

I/O Connector Diagram
3.1  Digital Inputs

3.1.1  X1, X2, X3 and X4 Digital Inputs

X1, X2: optically isolated, differential, 5-24VDC for high level voltage, minimum pulse width 250ns, maximum pulse frequency 2MHz

X3, X4: optically isolated, differential, 5-24VDC for high level voltage, minimum pulse width 100μs, maximum pulse frequency 5KHz

- 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.

Please use STF Configurator software for X1, X2, X3 and X4 function configuration.

Following graphs shows some common connection methods for the inputs:

- Connecting the inputs to a Switch or Relay

- Connecting the inputs to a 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 for high level voltage, minimum pulse width 100μs, maximum pulse frequency 5KHz

- X5 can be used as motor enable 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 or touch Probe 1 trigger input.
- X8 can be used as general purpose input or touch Probe 2 trigger 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. 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 be connected to the power supply +.

Use STF Configurator software for X5, X6, X7 and X8 function configuration.

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

3.2.1 Y1, Y2, Y3 Digital Outputs

- Y1 can be used as alarm output, motion status output or general purpose output.
- Y2 can be used as brake output, motion status output or general purpose output.
- Y3 can be used as tach-out, timing signal output (50 pulses/revolution), motion status output or general purpose output.

Please use STF Configurator software for Y1, Y2, and Y3 function configuration.

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!
3.2.2 Y4 Digital Output

Y4 can be used as motion status output or general purpose output.

Please use **STF Configurator** software for Y4 function configuration.

Following graphs shows 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.
4 Mounting the Drive

Use the M3 or M4 screw to mount the STF series drive. The drive should be securely fastened to a smooth, flat metal surface that will help conduct heat away from the chassis. If this is not possible, forced airflow from a fan maybe 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 STF drives near each other, maintain at least 2cm of space between drives.
5 Reference Materials

5.1 Drive Mechanical Outlines (unit mm)
### 5.2 Technical Specifications

#### Power Amplifier

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amplifier Type</strong></td>
<td>Dual H-Bridge, 4 Quadrant</td>
</tr>
<tr>
<td><strong>Current Control</strong></td>
<td>4 state PWM at 20 KHz</td>
</tr>
</tbody>
</table>
| **Output Current**               | STF03: 0.1 - 3.0A/phase (peak-of-sine) in 0.01 Amp increments  
                                      STF05: 0.1 - 5.0A/phase (peak-of-sine) in 0.01 Amp increments  
                                      STF06: 0.1 - 6.0A/phase (peak-of-sine) in 0.01 Amp increments  
                                      STF10: 0.1 - 10.0A/phase (peak-of-sine) in 0.01 amp increments |
| **Rated input voltage range**    | STF03: 12 - 48VDC                                 |
|                                  | STF05: 24 - 48VDC                                 |
|                                  | STF06: 12 - 48VDC                                 |
|                                  | STF10: 24 - 70VDC                                 |
| **Absolute maximum input voltage range** | STF03: 10 - 53VDC     |
|                                  | STF05: 18 - 53VDC                                 |
|                                  | STF06: 10 - 53VDC                                 |
|                                  | STF10: 18 - 75VDC                                 |
| **Protection**                   | Over voltage, under voltage, over temp, over current, open winding, communication cable disconnection |
| **Idle Current Reduction**       | Reduction range of 0 - 90% of running current after a delay selectable in milliseconds |

#### Controller

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anti-Resonance</strong></td>
<td>Raises the system-damping ratio to eliminate midrange instability and allow stable operation throughout the speed range of the motor</td>
</tr>
<tr>
<td><strong>Torque Ripple Smoothing</strong></td>
<td>Allows for fine adjustment of phase current waveform harmonic content to reduce low-speed torque ripple in the range of 0.25 to 1.5 rps</td>
</tr>
<tr>
<td><strong>Auto Test &amp; Auto Setup</strong></td>
<td>Auto test and setup at power on (ie. motor resistance, and capacitance) to optimize your system performance.</td>
</tr>
<tr>
<td><strong>Non-Volatile Storage</strong></td>
<td>Configurations are saved in FLASH memory on-board the DSP</td>
</tr>
<tr>
<td><strong>Operation Mode</strong></td>
<td>EtherCAT (CoE) with full support of CiA402, Support PP, PV, CSP&amp;HM mode, and Applied Motion Products own Q mode</td>
</tr>
</tbody>
</table>

#### Digital Input

- X1, X2: Optically isolated, differential, 5-24VDC for high level voltage, minimum pulse width = 250ns, maximum pulse frequency = 2MHz
- X3, X4: Optically isolated, differential, 5-24VDC for high level voltage, minimum pulse width = 100μs, maximum pulse frequency = 5KHz
- X5 ~ X8: Optically isolated, single-ended, 5-24VDC for high level voltage, minimum pulse width = 100μs, maximum pulse frequency = 5KHz

#### Digital Output

- Y1 ~ Y4: Optically isolated, maximum voltage 30V, maximum sinking or sourcing current 100mA

#### Communication Port

- Dual port Ethernet (RJ45 connector) and RS-232 (RS-232 serial port for configuration)

#### Physical

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ambient Temperature</strong></td>
<td>0-40°C (32-104°F) (when mounted to a suitable heat sink)</td>
</tr>
<tr>
<td><strong>Humidity</strong></td>
<td>90% non-condensing</td>
</tr>
</tbody>
</table>
5.3 Recommended Motor

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Holding Torque</th>
<th>Current Setting</th>
<th>Resistance</th>
<th>Inductance</th>
<th>Inertia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>oz-in</td>
<td>kg-cm</td>
<td>amps</td>
<td>ohms</td>
<td>mH</td>
</tr>
<tr>
<td>HT11-012/212</td>
<td>7.0</td>
<td>0.50</td>
<td>1.2</td>
<td>1.4</td>
<td>1.4</td>
</tr>
<tr>
<td>HT11-013/213</td>
<td>15.0</td>
<td>1.08</td>
<td>1.2</td>
<td>2.0</td>
<td>2.6</td>
</tr>
<tr>
<td>5014-042/842</td>
<td>26.0</td>
<td>1.87</td>
<td>1.2</td>
<td>4.3</td>
<td>5.5</td>
</tr>
<tr>
<td>HT17-068/268 #</td>
<td>31.4</td>
<td>2.26</td>
<td>1.6</td>
<td>2.1</td>
<td>2.8</td>
</tr>
<tr>
<td>HT17-071/271 #</td>
<td>51.0</td>
<td>3.67</td>
<td>2.0</td>
<td>1.7</td>
<td>3.6</td>
</tr>
<tr>
<td>HT17-075/275 #</td>
<td>62.8</td>
<td>4.52</td>
<td>2.0</td>
<td>1.7</td>
<td>3.0</td>
</tr>
<tr>
<td>HT23-394/594 #</td>
<td>76.6</td>
<td>5.52</td>
<td>3.4</td>
<td>0.7</td>
<td>1.4</td>
</tr>
<tr>
<td>HT23-398/598 #</td>
<td>177</td>
<td>12.7</td>
<td>5.0</td>
<td>0.4</td>
<td>1.2</td>
</tr>
<tr>
<td>HT23-401/601 #</td>
<td>264</td>
<td>19.0</td>
<td>5.0</td>
<td>0.5</td>
<td>1.6</td>
</tr>
<tr>
<td>HT23-603</td>
<td>354</td>
<td>25.48</td>
<td>6.0</td>
<td>0.5</td>
<td>2.2</td>
</tr>
<tr>
<td>HT24-100</td>
<td>123.2</td>
<td>8.87</td>
<td>3.36</td>
<td>0.73</td>
<td>1.6</td>
</tr>
<tr>
<td>HT24-105</td>
<td>177</td>
<td>12.74</td>
<td>4.8</td>
<td>0.43</td>
<td>1.1</td>
</tr>
<tr>
<td>HT24-108</td>
<td>354</td>
<td>25.48</td>
<td>4.8</td>
<td>0.65</td>
<td>2.4</td>
</tr>
<tr>
<td>HT34-486 #</td>
<td>1200</td>
<td>86.4</td>
<td>9.7</td>
<td>0.27</td>
<td>2.2</td>
</tr>
<tr>
<td>HT34-487 #</td>
<td>1845</td>
<td>133</td>
<td>10.0</td>
<td>0.27</td>
<td>2.4</td>
</tr>
<tr>
<td>HT34-504</td>
<td>396.5</td>
<td>28.55</td>
<td>7.56</td>
<td>0.24</td>
<td>1.7</td>
</tr>
<tr>
<td>HT34-505</td>
<td>849.6</td>
<td>61.18</td>
<td>7.56</td>
<td>0.33</td>
<td>2.7</td>
</tr>
<tr>
<td>HT34-506</td>
<td>1260</td>
<td>90.75</td>
<td>6.72</td>
<td>0.63</td>
<td>5.4</td>
</tr>
</tbody>
</table>

Note: The “Drive Current Setting” shown here differs from the rated current of each motor because the rated current is RMS and the drive current setting is peak sine. If you are using a motor not listed here, for best results set the drive current at the motor’s rated current x 1.2.

# Indicates values are with motor connected in Parallel.

5.4 Torque Speed curves
**HT17**
24 VDC power supply, 20000 steps/rev, all motors connected in parallel

![Graph showing performance of HT17 motors with 24 VDC power supply.]

**HT17**
48 VDC power supply, 20000 steps/rev, all motors connected in parallel

![Graph showing performance of HT17 motors with 48 VDC power supply.]

HT23
24 VDC power supply, 20000 steps/rev, all motors connected in parallel

HT23
48 VDC power supply, 20000 steps/rev, all motors connected in parallel
HT24
24 VDC power supply, 20000 steps/rev

HT24
48 VDC power supply, 20000 steps/rev
HT34-485/486/487
24 VDC power supply, 20000 steps/rev, all motors connected in parallel

HT34-485/486/487
48 VDC power supply, 20000 steps/rev, all motors connected in parallel
HT34-485/486/487
80 VDC power supply, 20000 steps/rev, all motors connected in parallel

HT34-504/505/506
24 VDC power supply, 20000 steps/rev, all motors connected in parallel
HT34-504/505/506
48 VDC power supply, 20000 steps/rev, all motors connected in parallel

![Graph](image1.png)

HT34-504/505/506
60 VDC power supply, 20000 steps/rev, all motors connected in parallel

![Graph](image2.png)
5.5 Motor Heating

Step motors convert electrical power from the driver into mechanical power to move a load. Because step motors are not perfectly efficient, some of the electrical power turns into heat on its way through the motor. This heating is not so much dependent on the load being driven but rather the motor speed and power supply voltage. There are certain combinations of speed and voltage at which a motor cannot be continuously operated without damage.

We have characterized the recommended motors in our lab and provided curves showing the maximum duty cycle versus speed for each motor at commonly used power supply voltages. Please refer to these curves when planning your application.

Please also keep in mind that a step motor typically reaches maximum temperature after 30 to 45 minutes of operation. If you run the motor for one minute then let it sit idle for one minute, that is a 50% duty cycle. Five minutes on and five minutes off is also 50% duty. However, one hour on and one hour off has the effect of 100% duty because during the first hour the motor will reach full (and possibly excessive) temperature.

The actual temperature of the motor depends on how much heat is conducted, convected or radiated out of it. Our measurements were made in a 40°C (104°F) environment with the motor mounted to an aluminum plate sized to provide a surface area consistent with the motor power dissipation. Your results may vary.
HT11-013/213 Max Duty Cycle vs Speed
24 VDC, 1.2A, 40°C Ambient
Mounted on 3.5” dia x .125” Aluminum Plate

HT17-068 Max Duty cycle vs Speed
24 VDC, 1.60 Amps @40°C Ambient
on 4.75 x 4.75 x .25 Aluminum Plate

HT17-068 Max Duty cycle vs Speed
48 VDC, 1.60 Amps 40°C Ambient
on 4.75 x 4.75 x .25 Aluminum Plate

HT17-071 Max Duty Cycle vs Speed
24 VDC, 2.0 Amps 40°C Ambient
on 4.75 x 4.75 x .25 Aluminum Plate

HT17-071 Max Duty cycle vs Speed
48 VDC, 2.0 Amps 40°C Ambient
on 4.75 x 4.75 x .25 Aluminum Plate
HT17-071 Max Duty cycle vs Speed
48 VDC, 2.0 Amps 40°C Ambient
on 4.75 x 4.75 x .25 Aluminum Plate

HT17-075 Max Duty cycle vs Speed
48 VDC, 2.0 Amps 40°C Ambient
on 4.75 x 4.75 x .25 Aluminum Plate

HT23-394 Max Duty Cycle vs Speed
24 VDC, 3.4 Amps, 40°C Ambient
on 6.4 x 6.4 x .25 Aluminum Plate

HT23-398 Max Duty cycle vs Speed
24VDC, 5.0A, 40°C Ambient
on 6.4 x 6.4 x .25 Aluminum Plate

HT23-394 Max Duty Cycle vs Speed
48 VDC, 3.4 Amps, 40°C Ambient
on 6.4 x 6.4 x .25 Aluminum Plate

HT23-398 Max Duty cycle vs Speed
48VDC, 5.0A, 40°C Ambient
on 6.4 x 6.4 x .25 Aluminum Plate
HT23-401 Max Duty cycle vs Speed
24 VDC, 5.0 Amps, 40°C Ambient
on 6.4 x 6.4 x .25 Aluminum Plate

HT23-401 Max Duty cycle vs Speed
48 VDC, 5.0 Amps 40°C Ambient
on 6.4 x 6.4 x .25 Aluminum Plate

HT34-485 Max Duty cycle vs Speed
48 VDC, 10.0 Amps 40°C Ambient
on 10 x 10 x .5 Aluminum Plate

HT34-485 Max Duty cycle vs Speed
80 VDC, 10.0 Amps 40°C Ambient
on 10 x 10 x .5 Aluminum Plate

HT34-486 Max Duty cycle vs Speed
48 VDC, 10.0 Amps 40°C Ambient
on 10 x 10 x .5 Aluminum Plate

HT34-486 Max Duty cycle vs Speed
80 VDC, 10.0 Amps 40°C Ambient
on 10 x 10 x .5 Aluminum Plate

HT34-487 Max Duty cycle vs Speed
48 VDC, 10.0 Amps 40°C Ambient
on 10 x 10 x .5 Aluminum Plate

HT34-487 Max Duty cycle vs Speed
80 VDC, 10.0 Amps 40°C Ambient
on 10 x 10 x .5 Aluminum Plate
## 5.6 Alarm Code

<table>
<thead>
<tr>
<th>Code</th>
<th>Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>solid green</td>
<td>no alarm, motor disabled</td>
</tr>
<tr>
<td>flashing green</td>
<td>no alarm, motor enabled</td>
</tr>
<tr>
<td>1 red, 2 green</td>
<td>move while disabled</td>
</tr>
<tr>
<td>2 red, 1 green</td>
<td>CCW limit</td>
</tr>
<tr>
<td>2 red, 2 green</td>
<td>CW limit</td>
</tr>
<tr>
<td>3 red, 1 green</td>
<td>drive over temperature</td>
</tr>
<tr>
<td>3 red, 2 green</td>
<td>internal voltage bad</td>
</tr>
<tr>
<td>3 red, 3 green</td>
<td>blank Q segment</td>
</tr>
<tr>
<td>4 red, 1 green</td>
<td>over voltage</td>
</tr>
<tr>
<td>4 red, 2 green</td>
<td>under voltage</td>
</tr>
<tr>
<td>5 red, 1 green</td>
<td>over current</td>
</tr>
<tr>
<td>6 red, 1 green</td>
<td>open motor winding</td>
</tr>
<tr>
<td>7 red, 1 green</td>
<td>communication error</td>
</tr>
</tbody>
</table>

NOTE: Items in bold italic represent Drive Faults, which automatically disable the motor.
6 Accessories (Sold Separately)

6.1 Mating Connector (included in drive package)

STF05/10

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Part Number</th>
<th>Vendor</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>Power &amp; Motor Connector</td>
<td>2EDGK-5.08-06P-13-1000AH</td>
<td>DEGSON</td>
<td>1</td>
</tr>
<tr>
<td>J2</td>
<td>I/O Connector Housing</td>
<td>501646-2000</td>
<td>Molex</td>
<td>1</td>
</tr>
<tr>
<td>J2</td>
<td>I/O Connector Crimp</td>
<td>501648-1000</td>
<td>Molex</td>
<td>20</td>
</tr>
</tbody>
</table>

STF03/06

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Part Number</th>
<th>Vendor</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>Power &amp; Motor Connector</td>
<td>BCP-381-6 BK</td>
<td>Phoenix</td>
<td>1</td>
</tr>
<tr>
<td>J2</td>
<td>I/O Connector Housing</td>
<td>501646-2000</td>
<td>Molex</td>
<td>1</td>
</tr>
<tr>
<td>J2</td>
<td>I/O Connector Crimp</td>
<td>501648-1000</td>
<td>Molex</td>
<td>20</td>
</tr>
</tbody>
</table>

6.2 I/O Cable (Sold separate)

<table>
<thead>
<tr>
<th>P/N</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>3004-348</td>
<td>0.3m, 1m, 2m,</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Assignment</th>
<th>Description</th>
<th>Color</th>
<th>Pin No.</th>
<th>Assignment</th>
<th>Description</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>X1+</td>
<td>X1 Digital Input</td>
<td>Blue/White</td>
<td>11</td>
<td>X7</td>
<td>X7 Digital Input</td>
<td>Yellow</td>
</tr>
<tr>
<td>2</td>
<td>X1-</td>
<td></td>
<td>Blue/Black</td>
<td>12</td>
<td>X8</td>
<td>X8 Digital Input</td>
<td>Green</td>
</tr>
<tr>
<td>3</td>
<td>X2+</td>
<td>X2 Digital Input</td>
<td>Green/White</td>
<td>13</td>
<td>SHIELD</td>
<td>Shield</td>
<td>Shield</td>
</tr>
<tr>
<td>4</td>
<td>X2-</td>
<td></td>
<td>Green/Black</td>
<td>14</td>
<td>XCOM</td>
<td>X5-X8 Digital Input COM</td>
<td>Red</td>
</tr>
<tr>
<td>5</td>
<td>X3+</td>
<td>X3 Digital Input</td>
<td>Yellow/White</td>
<td>15</td>
<td>Y1</td>
<td>Y1 Digital Output</td>
<td>Brown</td>
</tr>
<tr>
<td>6</td>
<td>X3-</td>
<td></td>
<td>Yellow/Black</td>
<td>16</td>
<td>Y2</td>
<td>Y2 Digital Output</td>
<td>Gray</td>
</tr>
<tr>
<td>7</td>
<td>X4+</td>
<td>X4 Digital Input</td>
<td>Orange/White</td>
<td>17</td>
<td>Y3</td>
<td>Y3 Digital Output</td>
<td>White</td>
</tr>
<tr>
<td>8</td>
<td>X4-</td>
<td></td>
<td>Orange/Black</td>
<td>18</td>
<td>YCOM</td>
<td>Y1-Y3 Digital Output COM</td>
<td>Black</td>
</tr>
<tr>
<td>9</td>
<td>X5</td>
<td>X5 Digital Input</td>
<td>Blue</td>
<td>19</td>
<td>Y4+</td>
<td>Y4 Digital Output</td>
<td>Purple/White</td>
</tr>
<tr>
<td>10</td>
<td>X6</td>
<td>X6 Digital Input</td>
<td>Purple</td>
<td>20</td>
<td>Y4-</td>
<td>Y4 Digital Output</td>
<td>Purple/Black</td>
</tr>
</tbody>
</table>
6.3 Others

Power Supply

Regeneration Clamp

P/N: RC880

When using a regulated power supply you may encounter a problem with regeneration. The kinetic energy caused by regeneration is transferred back to the power supply. This can trip the overvoltage protection of a switching power supply, causing it to shut down. Applied Motion Products offers the RC880 “regeneration clamp” to solve this problem. If in doubt, use an RC880 for the first installation. If the “regen” LED on the RC880 never flashes, you don’t need the clamp.

USB Serial Adapter

P/N:3004-235

Power Supplies

<table>
<thead>
<tr>
<th>P/N</th>
<th>Power</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>PS150A24</td>
<td>150W</td>
<td>24VDC</td>
</tr>
<tr>
<td>PS320A48</td>
<td>320W</td>
<td>48VDC</td>
</tr>
<tr>
<td>PS480D72</td>
<td>480</td>
<td>72VDC</td>
</tr>
</tbody>
</table>
7 Contacting Applied Motion Products

404 Westridge Dr.
Watsonville, CA 95076, USA
1-800-525-1609
www.applied-motion.com