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STAC5

Hardware Manual



- **STAC5-S-N120**
- **STAC5-S-E120**
- **STAC5-S-N220**
- **STAC5-S-E220**
- **STAC5-Q-N120**
- **STAC5-Q-E120**
- **STAC5-Q-N220**
- **STAC5-Q-E220**
- **STAC5-IP-N120**
- **STAC5-IP-E120**
- **STAC5-IP-N220**
- **STAC5-IP-N220**

920-0026 Rev. D 5/4/2020

Applied Motion Products
A MOONS' COMPANY

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Introduction

Thank you for selecting an Applied Motion Products motor control. We hope our dedication to performance, quality and economy will make your motion control project successful.

Features

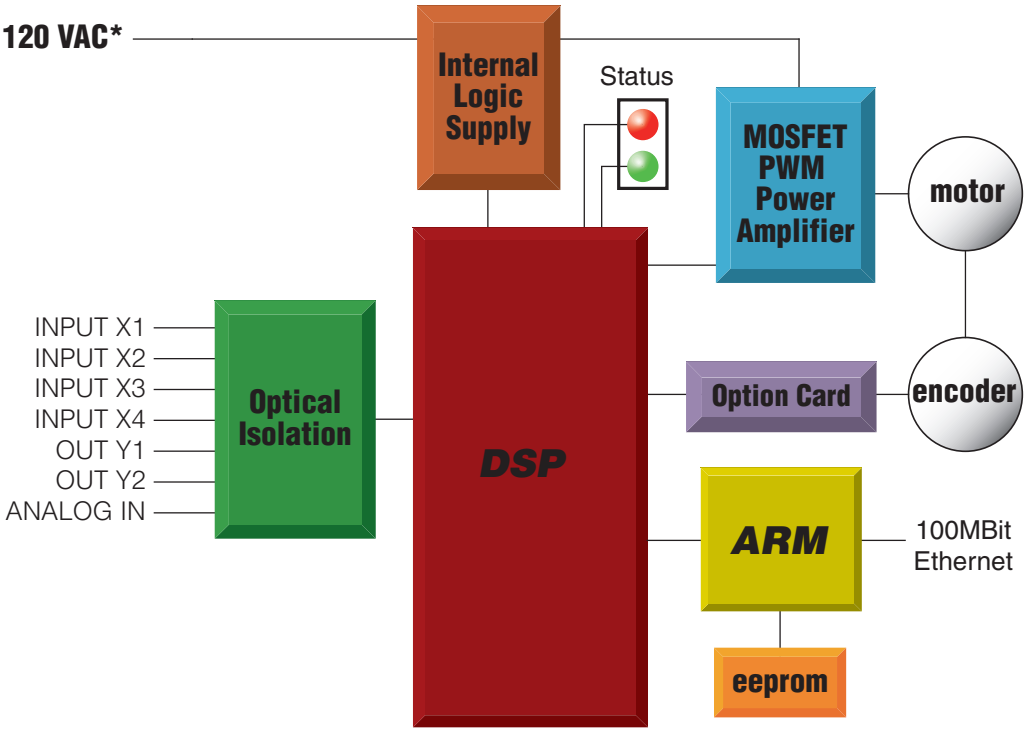
- Programmable, microstepping digital step motor driver in compact package
- STAC5-120 models operate from 120VAC
- STAC5-220 operates from 220VAC
- Ethernet 100 MBit communication
- Optional Ethernet/IP protocol communication
- Operates in velocity or position mode
- Accepts analog signals, digital signals, and Ethernet commands
- Optional encoder feedback
- STAC5-120 provides motor current up to 5 amps/phase (peak of sine)
- STAC5-220 provides motor current up to 2.55 amps/phase (peak of sine)
- -S: four optically isolated digital inputs, two optically isolated digital outputs
- -Q, -IP: twelve optically isolated digital inputs, six optically isolated digital outputs
- ±10 volt analog input for speed and position control. Can also be configured for 0 to 10V, ±5V or 0 to 5V signal ranges.

List of STAC5 Model Numbers

STAC5-S-N120
STAC5-S-E120
STAC5-S-N220
STAC5-S-E220
STAC5-Q-N120
STAC5-Q-E120
STAC5-Q-N220
STAC5-Q-E220
STAC5-IP-N120
STAC5-IP-E120
STAC5-IP-N220
STAC5-IP-E220

An "E" in the model number indicates the inclusion of the optional Encoder Feedback connector.
An "N" in the model number indicates no encoder feedback connector on the drive.

Block Diagram (-S Models)



*220 VAC for STAC5-220

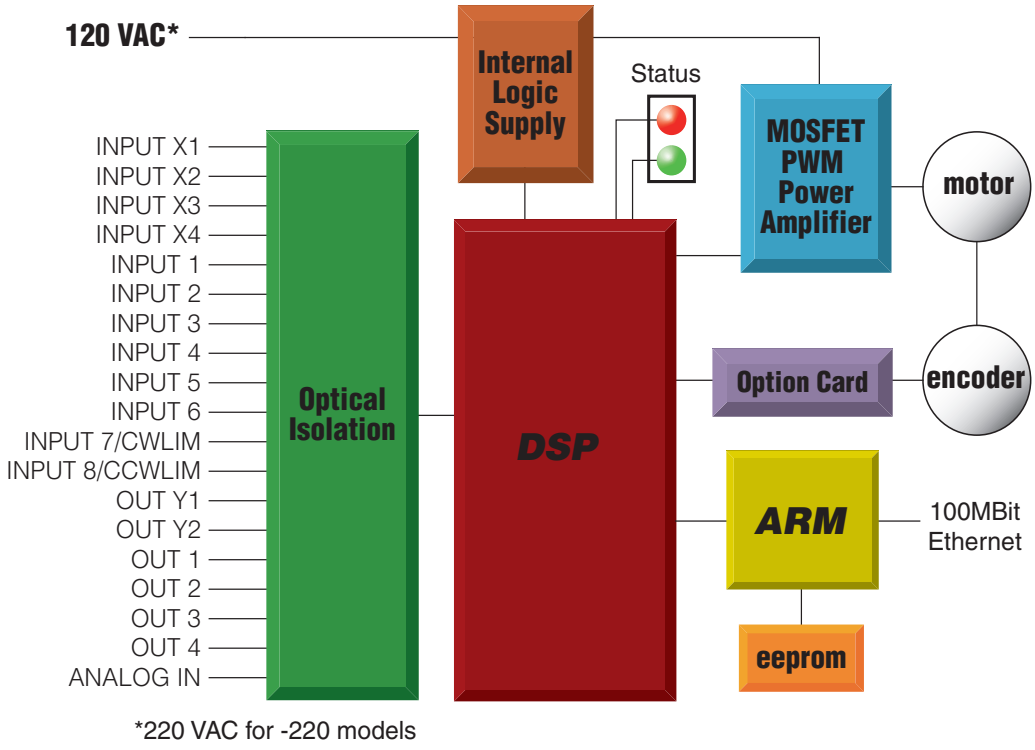
Input and Output Functions

IN/OUT1 Connector					
X1	**X2**	**X3**	**X4**	**Y1**	**Y2**
Step	Direction	Alarm Reset	Speed Change	Fault	Brake
CW Pulse	CCW Pulse	Enable Motor	GP	GP	Motion
A Quadrature	B Quadrature	GP			Tach
Run/Stop					GP
CW Limit	CCW Limit				
CW Jog	CCW Jog				
GP	GP				

Notes

I/O functions are configured using ST Configurator software and/or SCL commands.
GP indicates general purpose (controlled by SCL commands)
For more details, see page 12

Block Diagram (-Q and -IP Models)



Input and Output Functions

IN/OUT1 Connector					
X1	**X2**	**X3**	**X4**	**Y1**	**Y2**
Step	Direction	Alarm Reset	Speed Change	Fault	Brake
A Quadrature	B Quadrature	Enable Motor	GP	GP	
CW Pulse	CCW Pulse	GP			GP
Run/Stop					
GP	GP				

IN/OUT2 Connector (OPT2)											
IN1	**IN2**	**IN3**	**IN4**	**IN5**	**IN6**	**IN7**	**IN8**	**OUT1**	**OUT2**	**OUT3**	**OUT4**
CW Jog	CCW Jog	GP	GP	GP	GP	CW Limit	CCW Limit	Motion	GP	GP	GP
						GP	GP	GP			
								Tach			

Notes

I/O functions are configured using ST Configurator software and/or SCL & Q commands.
GP indicates general purpose (controlled by SCL or Q commands)
For more details, see page 13

Getting Started

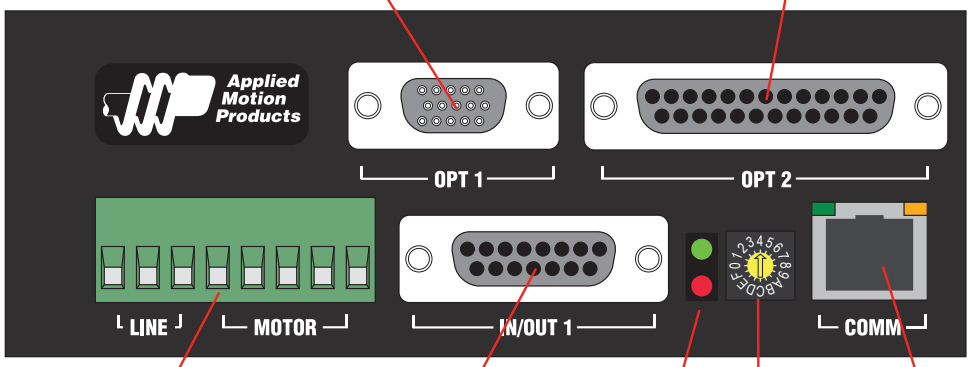
This manual describes the use of four different drive models. What you need to know and what you must have depends on the drive model. For all models, you'll need the following:

- 120VAC or 220VAC power.
- a compatible step motor
- a small flat blade screwdriver for tightening the connectors (included).
- a personal computer running Microsoft Windows 7, 8, 10, Vista, XP, 32-bit, 64-bit with an Ethernet port.
- A CAT5 Ethernet cable (not included).

If you've never used a STAC5 drive before you'll need to get familiar with the drive and the set up software before you try to deploy the system in your application. We strongly recommend the following:

1. For -S and -IP drives, download and install the *ST Configurator™* software application from www.applied-motion.com/software. For -Q drives, download and install the *ST Configurator™* and *Q Programmer™*
2. Launch the software by clicking Start...Programs...Applied Motion...
3. Connect the drive to your PC using Ethernet and set the IP address (see Connecting to the PC).
4. Connect the drive to the AC power (see Connecting AC Power).
5. Connect the drive to the motor (see Connecting the Motor).
6. Apply power to the drive.
7. Set the IP address of the software to match the drive.

The connectors and other points of interest are illustrated below. Depending on your drive model and application, you'll need to make connections to various parts of the drive. These are detailed later in the manual.



HD-15 connector
• optional encoder feedback

DB-25 connector
-Q , -IP only
• 8 digital inputs
• 4 digital outputs

RJ45 connector
• Ethernet

screw terminal connector
• motor
• AC power

DB-15 connector
• 4 digital inputs
• 2 digital outputs
• analog input

Rotary Switch
• IP address and/or configuration select

LEDs
• status & error codes

Connecting the Drive to Your PC using Ethernet

This process requires three steps

- Physically connect the drive to your network (or directly to the PC)
- Set the drive's IP address
- Set the appropriate networking properties on your PC.

Note: the following pages are an excerpt from the "eSCL Communication Reference Guide". For more information, please read the rest of the guide.

Addresses, Subnets, and Ports

Every device on an Ethernet network must have a unique IP address. In order for two devices to communicate with each other, they must both be connected to the network and they must have IP addresses that are on the same subnet. A subnet is a logical division of a larger network. Members of one subnet are generally not able to communicate with members of another unless they are connected through special network equipment (e.g. router). Subnets are defined by the choices of IP addresses and subnet masks.
If you want to know the IP address and subnet mask of your PC, select Start…All Programs…Accessories…Command Prompt. Then type "ipconfig" and press Enter. You should see something like this:

```
Windows IP Configuration

Ethernet adapter Local Area Connection:

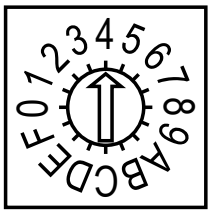
        Connection-specific DNS Suffix  . :
        IP Address. . . . . . . . . . . . : 192.168.0.22
        Subnet Mask . . . . . . . . . . . : 255.255.255.0
        Default Gateway . . . . . . . . . : 192.168.0.254
```

If your PC's subnet mask is set to 255.255.255.0, a common setting known as a Class C subnet mask, then your machine can only talk to another network device whose IP address matches yours in the first three octets. (The numbers between the dots in an IP address are called octets.) For example, if your PC is on a Class C subnet and has an IP address of 192.168.0.20, it can talk to a device at 192.168.0.40, but not one at 192.168.1.40. If you change your subnet mask to 255.255.0.0 (Class B) you can talk to any device whose first two octets match yours. Be sure to ask your system administrator before doing this. You network may be segmented for a reason.

Your drive includes a 16 position rotary switch for setting its IP address. The factory default address for each switch setting is shown in the table to the right.

Settings 1 through E can be changed using the ST Configurator software (use Quick Tuner for servo drives). Setting 0 is always "10.10.10.10", the universal recovery address. If someone were to change the other settings and not write it down or tell anyone (I'm not naming names here, but you

IP Address*	
0	10.10.10.10
1	192.168.1.10
2	192.168.1.20
3	192.168.1.30
4	192.168.0.40
5	192.168.0.50
6	192.168.0.60
7	192.168.0.70
8	192.168.0.80
9	192.168.0.90
A	192.168.0.100
B	192.168.0.110
C	192.168.0.120
D	192.168.0.130
E	192.168.0.140
F	DHCP



know who I'm talking about) then you will not be able to communicate with your drive. The only way to "recover" it is to use the universal recovery address.

Setting F is "DHCP", which commands the drive to get an IP address from a DHCP server on the network. The IP address automatically assigned by the DHCP server may be "dynamic" or "static" depending on how the administrator has configured DHCP. The DHCP setting is reserved for advanced users.

Your PC, or any other device that you use to communicate with the drive, will also have a unique address.

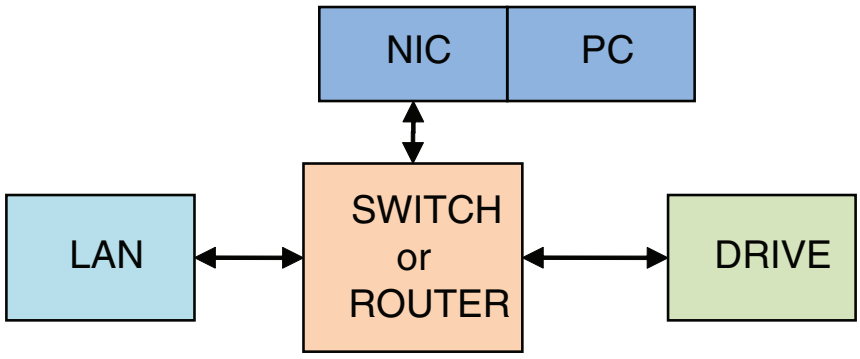
On the drive, switch settings 1 through E use the standard class B subnet mask (i.e. "255.255.0.0"). The mask for the universal recovery address is the standard class A (i.e. "255.0.0.0").
One of the great features of Ethernet is the ability for many applications to share the network at the same time. Ports are used to direct traffic to the right application once it gets to the right IP address. The UDP eSCL port in our drives is 7775. To send and receive commands using TCP, use port number 7776. You'll need to know this when you begin to write your own application. You will also need to choose an open (unused) port number for your application. Our drive doesn't care what that is; when the first command is sent to the drive, the drive will make note of the IP address and port number from which it originated and direct any responses there. The drive will also refuse any traffic from other IP addresses that is headed for the eSCL port. The first application to talk to a drive "owns" the drive. This lock is only reset when the drive powers down.

If you need help choosing a port number for your application, you can find a list of commonly used port numbers at http://www.iana.org/assignments/port-numbers.

One final note: Ethernet communication can use one or both of two "transport protocols": UDP and TCP. eSCL commands can be sent and received using either protocol. UDP is simpler and more efficient than TCP, but TCP is more reliable on large or very busy networks where UDP packets might occasionally be dropped.

Option 1: Connect a Drive to Your Local Area Network

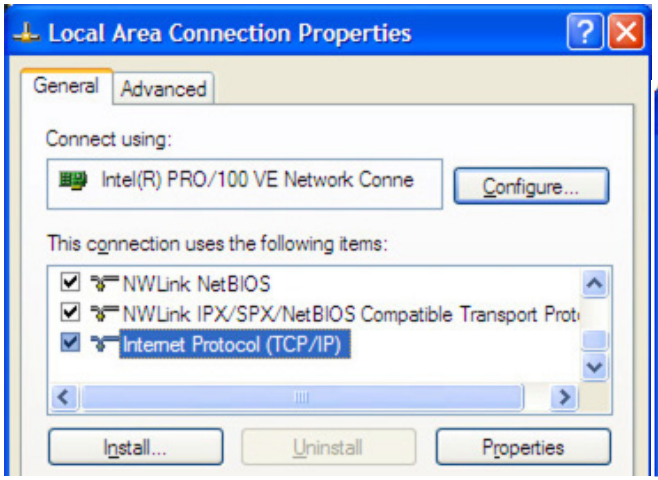
If you have a spare port on a switch or router and if you are able to set your drive to an IP address that is compatible with your network, and not used by anything else, this is a simple way to get connected. This technique also allows you to connect multiple drives to your PC. If you are on a corporate network, please check with your system administrator before connecting anything new to the network. He or she should be able assign you a suitable address and help you get going.

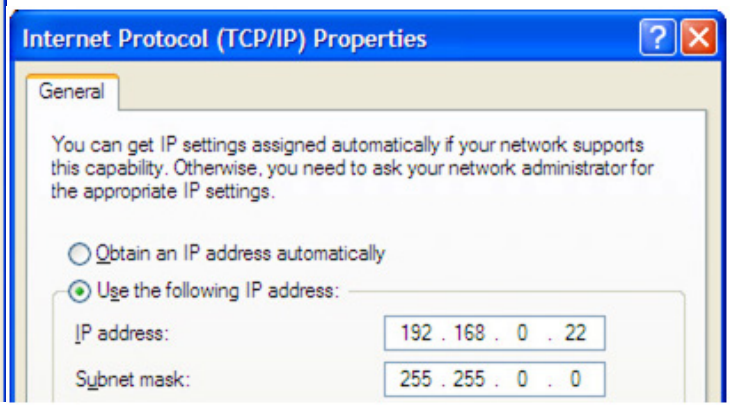


If you are not sure which addresses are already used on your network, you can find out using "Angry IP scanner", which can be downloaded free from http://www.angryip.org/w/Download. But be careful: an address might appear to be unused because a computer or other device is currently turned off. And many networks use dynamic addressing where a DHCP server assigns addresses "on demand". The address you choose for your drive might get assigned to something else by the DHCP server at another time.
Once you've chosen an appropriate IP address for your drive, set the rotary switch according the address table above. If none of the

default addresses are acceptable for your network, you can enter a new table of IP addresses using *Configurator*. If your network uses addresses starting with 192.168.0, the most common subnet, you will want to choose an address from switch settings 4 through E. Another common subnet is 192.168.1. If your network uses addresses in this range, the compatible default selections are 1, 2 and 3.
If your PC address is not in one of the above private subnets, you will have to change your subnet mask to 255.255.0.0 in order to talk to your drive. To change your subnet mask:

1. On Windows XP, right click on "My Network Places" and select properties. On Windows 7, click Computer. Scroll down the left pane until you see "Network". Right click and select properties. Select "Change adapter settings"
2. You should see an icon for your network interface card (NIC). Right click and select properties.
3. Scroll down until you see "Internet Properties (TCP/IP)". Select this item and click the Properties button. On Windows 7 and Vista, look for "(TCP/IPv4)"
4. If the option "Obtain an IP address automatically" is selected, your PC is getting an IP address and a subnet mask from the DHCP server. Please cancel this dialog and proceed to the next section of this manual: "Using DHCP".
5. If the option "Use the following IP address" is selected, life is good. Change the subnet mask to "255.255.0.0" and click OK.

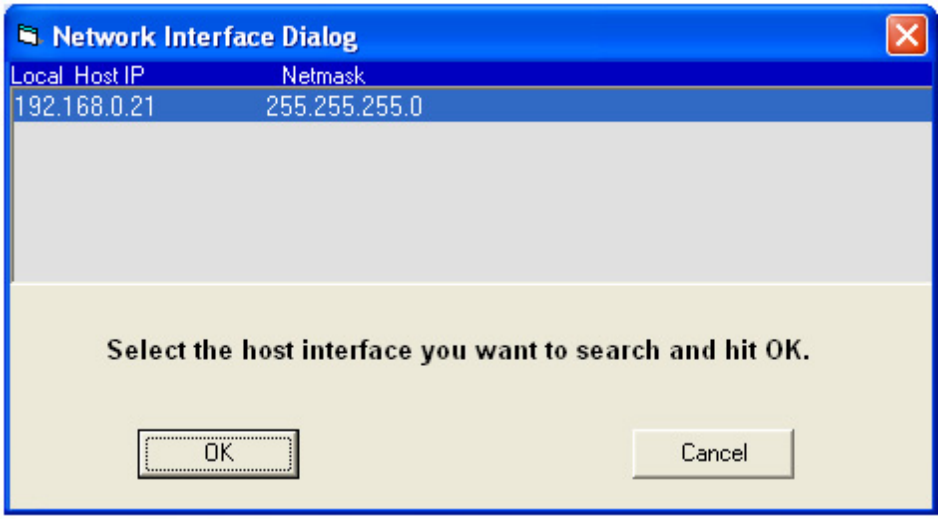




Using DCHP

If you want to use your drive on a network that where all or most of the devices use dynamic IP addresses supplied by a DHCP server, set the rotary switch to "F". When the drive is connected to the network and powered on, it will obtain an IP address and a subnet mask from the server that is compatible with your PC. The only catch is that you won't know what address the server assigns to your drive. Ethernet Configurator can find your drive using the Drive Discovery feature, as long as your network isn't too large. With the drive connected to the network and powered on, select Drive Discovery from the Drive menu.

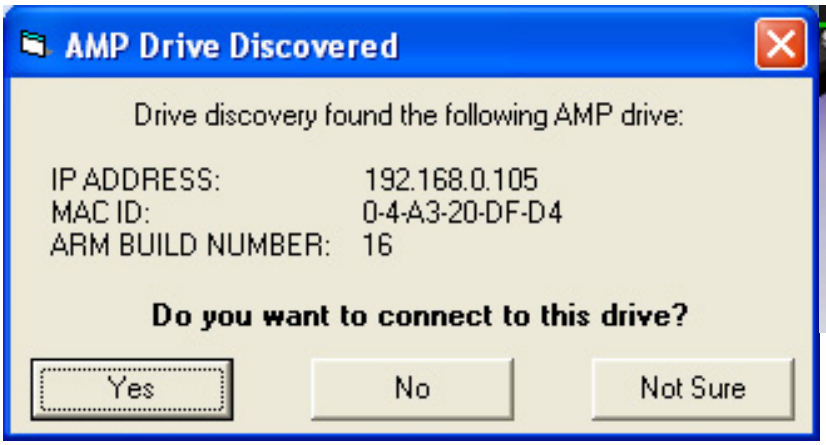
You will see a dialog such as this:

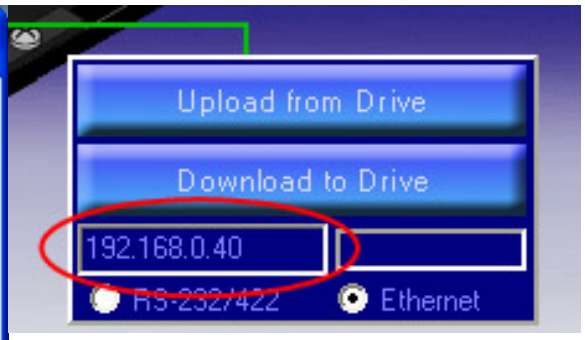


Normally, Drive Discovery will only detect one network interface card (NIC), and will select it automatically. If you are using a laptop and have both wireless and wired network connections, a second NIC may appear. Please select the NIC that you use to connect

to the network to which you've connected your drive. Then click OK. Drive Discovery will notify you as soon as it has detected a drive.

If you think this is the correct drive, click Yes. If you're not sure, click Not Sure and Drive Discovery will look for additional drives on you network. Once you've told Drive Discovery which drive is yours, it will automatically enter that drive's IP address in the IP address text box so that you are ready to communicate.

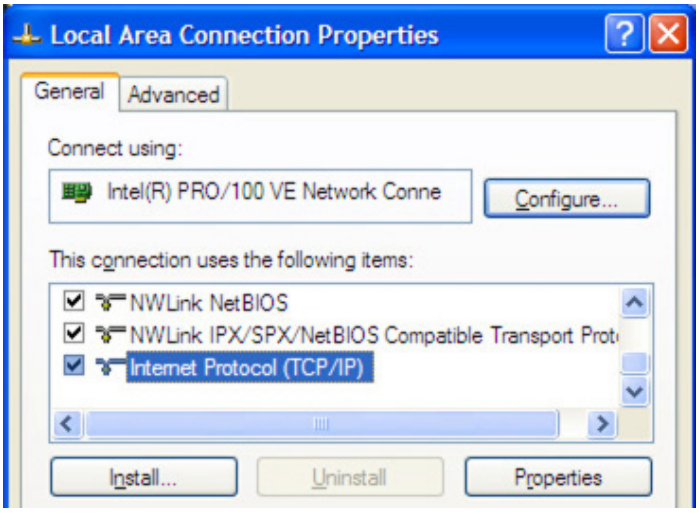




Option 2: Connect a Drive Directly to Your PC

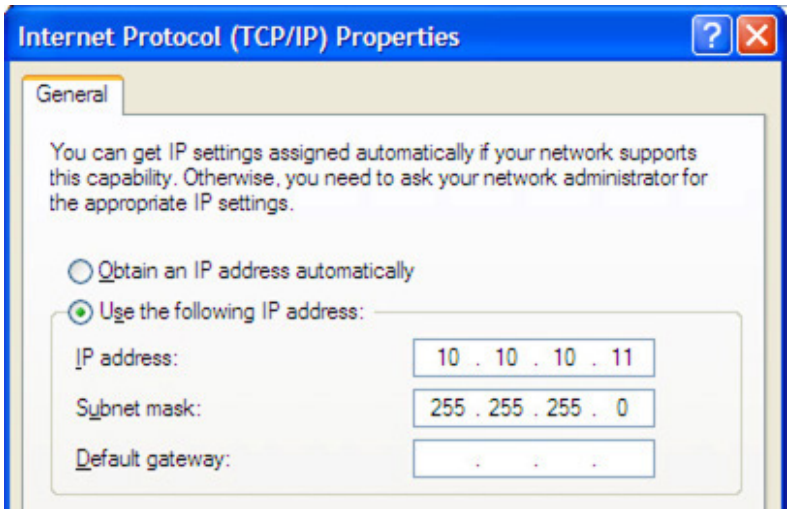
It doesn't get much simpler than this:

1. Connect one end of a CAT5 Ethernet cable into the LAN card (NIC) on your PC and the other into the drive. You don't need a special "crossover cable"; the drive will automatically detect the direct connection and make the necessary physical layer changes.
2. Set the IP address on the drive to "10.10.10.10" by setting the rotary switch at "0".
3. To set the IP address of your PC:
   a. On Windows XP, right click on "My Network Places" and select properties.
   b. On Windows 7, click Computer. Scroll down the left pane until you see "Network". Right click and select properties. Select "Change adapter settings"
4. You should see an icon for your network interface card (NIC). Right click and select properties.
   a. Scroll down until you see "Internet Properties (TCP/IP)". Select this item and click the Properties button.



   b. On Windows 7 and Vista, look for "(TCP/IPv4)"

5. Select the option “Use the following IP address”. Then enter the address “10.10.10.11”. This will give your PC an IP address that is on the same subnet as the drive. Windows will know to direct any traffic intended for the drive’s IP address to this interface card.
6. Next, enter the subnet mask as “255.255.255.0”.
7. Be sure to leave “Default gateway” blank. This will prevent your PC from looking for a router on this subnet.
8. Because you are connected directly to the drive, anytime the drive is not powered on your PC will annoy you with a small message bubble in the corner of your screen saying “The network cable is unplugged.”



Option 3: Use Two Network Interface Cards (NICs)

This technique allows you to keep your PC connected to your LAN, but keeps the drive off the LAN, preventing possible IP conflicts or excessive traffic.

1. If you use a desktop PC and have a spare card slot, install a second NIC and connect it directly to the drive using a CAT5 cable. You don’t need a special “crossover cable”; the drive will automatically detect the direct connection and make the necessary physical layer changes.
2. If you use a laptop and only connect to your LAN using wireless networking, you can use the built-in RJ45 Ethernet connection as your second NIC.
3. Set the IP address on the drive to “10.10.10.10” by setting the rotary switch at “0”.
4. To set the IP address of the second NIC:
   a. On Windows XP, right click on “My Network Places” and select properties.
   b. On Windows 7, click Computer. Scroll down the left pane until you see “Network”. Right click and select properties. Select “Change adapter settings”
5. You should see an icon for your newly instated NIC. Right click again and select properties.
   a. Scroll down until you see “Internet Properties (TCP/IP)”. Select this item and click the Properties button.
   b. On Windows 7 and Vista, look for “(TCP/IPv4)”
6. Select the option “Use the following IP address”. Then enter the address “10.10.10.11”. This will give your PC an IP address that is on the same subnet as the drive. Windows will know to direct any traffic intended for the drive’s IP address to this interface card.
7. Next, enter the subnet mask as “255.255.255.0”. Be sure to leave “Default gateway” blank. This will prevent your PC from looking for a router on this subnet.
8. Because you are connected directly to the drive, anytime the drive is not powered on your PC will annoy you with a small message bubble in the corner of your screen saying “The network cable is unplugged.”

Connecting AC Power

Using the connector supplied connect to the AC supply per the diagram below. Use 16 AWG wire for Line (L) and Neutral (N). Use 14 AWG for Earth Ground (⏚).

Care should always be taken when working with high voltages.

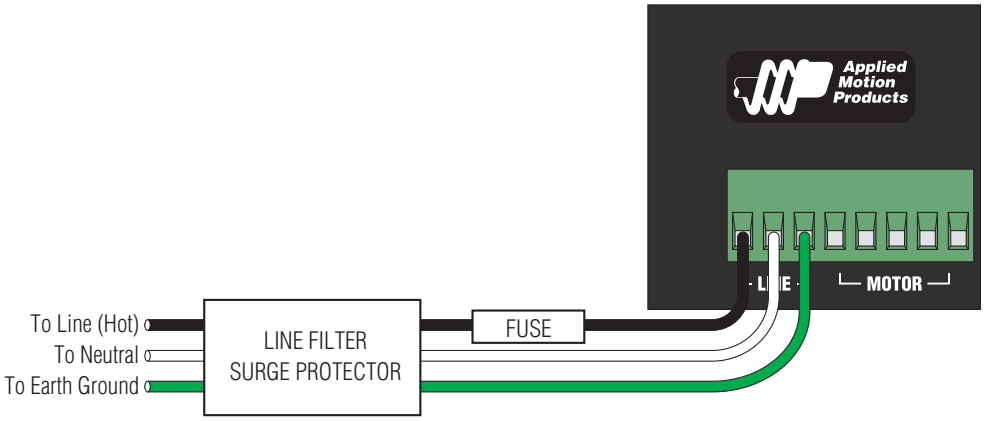
In regions where the single-phase supply is higher, an auto transformer can be used to drop the voltage to the correct level.

Fusing

The STAC5-120 contains an internal 8A fast acting fuse. The STAC5-220 contains an internal 3.5A fast acting fuse. If an external fuse is desired, we recommend a 6A fast acting fuse for the 120V STAC5 and a 3 amp fast acting fuse for the 220V version.

Line Filter

For applications requiring CE EMC compliance, a Corcom 6ET1 line filter is required in series with the AC input.



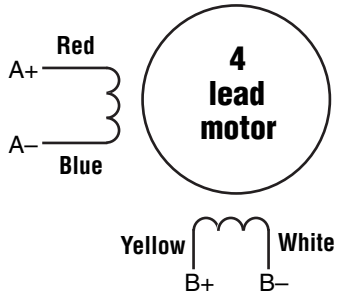
Connecting the Motor

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

Note: it is highly recommended that you use a motor with a shielded cable with the STAC5. Always connect the cable drain wire to the drive's ⏚ terminal (next to the A+ terminal)

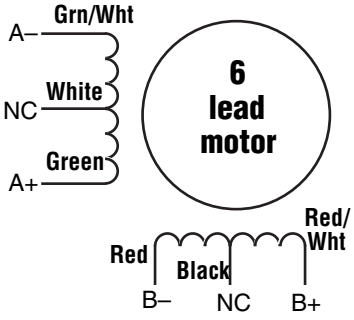
The recommended Applied Motion motors for the STAC5 include shielded cables. See the Recommended Motors section for a list of part numbers. The recommended motors should be connected to 120V drives in parallel, and to 220V drives in series, according to the diagram below.

Be sure to connect the cable shield for safety and to minimize electrical interference.
Four lead motors can only be connected one way. Please follow the sketch at the right.

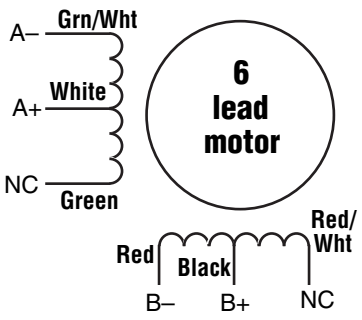


4 Leads

Six lead motors can be connected in series or center tap. In series mode, motors produce more torque at low speeds, but cannot run as fast as in the center tap configuration. In series operation, the motor should be operated at 30% less than the rated current to prevent overheating. Winding diagrams for both connection methods are shown below. NC means not connected.



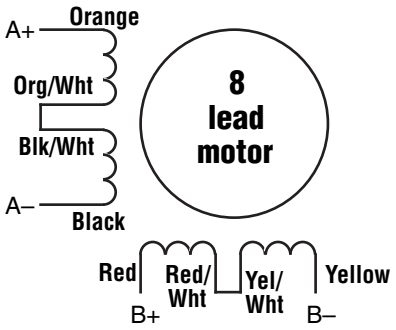
6 Leads Series Connected



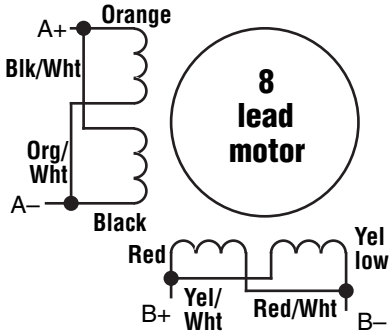
6 Leads Center Tap Connected

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 wiring diagrams for eight lead motors without shielded cables are shown below.

HT34-695/696/697

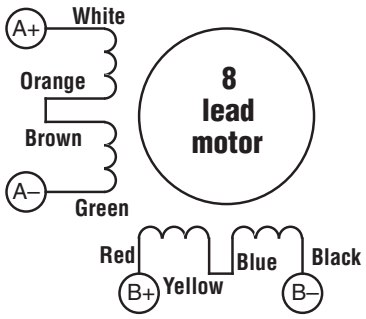


8 Leads Series Connected

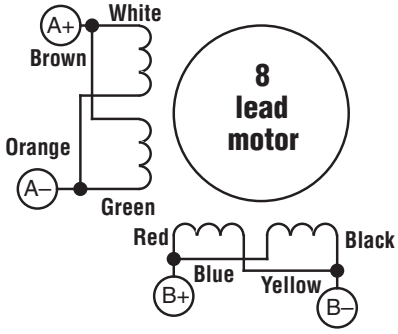


8 Leads Parallel Connected

HT23-552/553/554
HT34-495/496/497 (Not recommended for new applcation)



8 Leads Series Connected



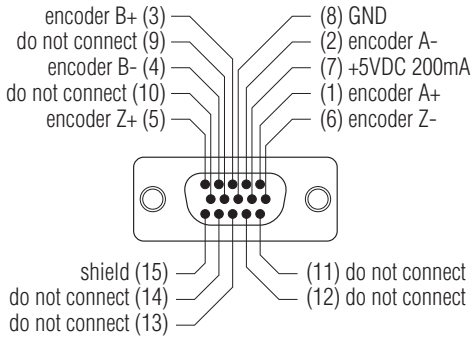
8 Leads Parallel Connected

Connecting an Encoder (Requires the Encoder Feedback option)

The motors recommended for use with STAC5 drives are available with rear-shaft mounted encoders. Note: remember to always order a double-shaft motor if you need an encoder option. The mating cables available for these encoders come with an HD-15 connector on one end that connects directly to the optional encoder connector on the STAC5, and a mating connector on the other end that connects directly to the encoder. Simply connect the cable between the encoder and the drive and you're done. For applications where you might use your own encoder, you'll need to connect to the STAC5 drive's encoder connector using the pin assignments below.

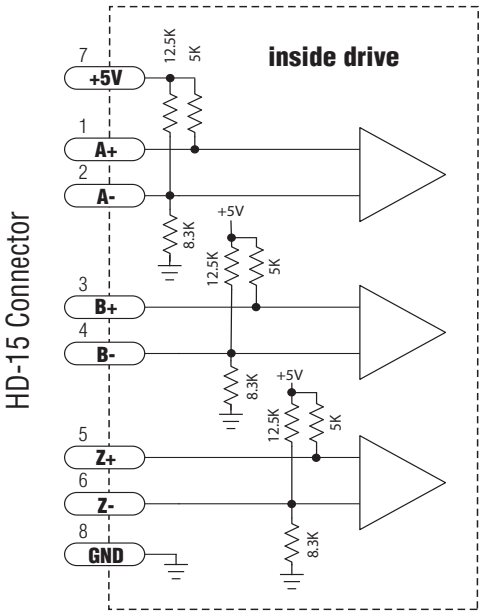
If you are using an encoder with single ended outputs, shame on you. Differential connections are far less sensitve to electrical interference and life is too short to waste time deciphering the bizarre problems that can occur with a poor quality encoder. That said, single ended encoders should be connected to the A+ and B+ terminals. Leave A- and B- unconnected. They are internally biased to the proper voltage for best results. You'll also need to select the "single ended" box in the encoder button of *ST Configurator™* or the drive will think you have a broken encoder wire. That's another good reason to use a differential encoder, the STAC5 can detect a broken wire or bad signal and alert you to the problem.

The encoder connections use a HD-15 connector, which you must connect to your encoder as shown below. Recommended mating connectors are listed at the back of the manual.



Front View

Pin Assignments (facing drive)



Internal Circuit

IO Functions (-S model)

Pulse & Direction mode (control mode 7)

IN/OUT1 Connector					
X1	**X2**	**X3**	**X4**	**Y1**	**Y2**
Step	Direction	Alarm Reset		Fault	Brake
CW Pulse	CCW Pulse	Enable Motor			Motion
A Quadrature	B Quadrature				Tach

Velocity (Oscillator) mode (control modes 11-18)

IN/OUT1 Connector					
X1	**X2**	**X3**	**X4**	**Y1**	**Y2**
Run/Stop	Direction	Alarm Reset	Speed Change	Fault	Brake
		Enable Motor			Motion
					Tach

Streaming Commands (SCL) mode (control modes 21-24)

IN/OUT1 Connector					
X1	**X2**	**X3**	**X4**	**Y1**	**Y2**
CW Limit	CCW Limit	Alarm Reset	Speed Change	Fault	Brake
CW Jog	CCW Jog	Enable Motor	GP	GP	Motion
GP	GP	GP			Tach
					GP

Notes

I/O functions are configured using ST Configurator software and/or SCL commands.
GP indicates general purpose (controlled by SCL commands)
X1 functions as Step or CW Pulse or A Quadrature in Pulse & Direction mode (control mode 7)
X1 functions as Step or CW Pulse or A Quadrature in control mode 21 when FE command is active
X1 functions as Run/Stop in some velocity modes (control modes 12, 14, 16 and 18)
X2 functions as Direction or CCW Pulse or B Quadrature in control mode 7
X2 functions as Direction or CCW Pulse or B Quadrature in control mode 21 when FE command is active
X2 is the direction input for all velocity modes
X4 is the speed change input for some velocity modes (control modes 13, 14, 17 and 18)
Jog inputs are active in control mode 21 when using the WI command if enabled by the JE command
Limits are active in control modes 21 - 24 if enabled by the DL command or by ST Configurator

Additional I/O details:

IN/OUT1 Connector						
	X1	**X2**	**X3**	**X4**	**Y1**	**Y2**
Voltage range	5 to 24	5 to 24	5 to 24	5 to 24	30 max	30 max
Speed range	2 MHz	2 MHz	Low	Low	Low	Low
Digital filter option	Y	Y	Y	Y	N/A	N/A

IO Functions (-Q and -IP models)

Pulse & Direction mode (control mode 7)

IN/OUT1 Connector					
X1	**X2**	**X3**	**X4**	**Y1**	**Y2**
Step	Direction	Alarm Reset		Fault	Brake
A Quadrature	B Quadrature	Enable Motor			
CW Pulse	CCW Pulse				

IN/OUT2 Connector (OPT2)											
IN1	**IN2**	**IN3**	**IN4**	**IN5**	**IN6**	**IN7**	**IN8**	**OUT1**	**OUT2**	**OUT3**	**OUT4**
						CW Limit	CCW Limit	Motion			
								Tach			

Velocity (Oscillator) mode (control modes 11-18)

IN/OUT1 Connector					
X1	**X2**	**X3**	**X4**	**Y1**	**Y2**
Run/Stop	Direction	Alarm Reset	Speed Change	Fault	Brake
A Quadrature	B Quadrature	Enable Motor			

IN/OUT2 Connector (OPT2)											
IN1	**IN2**	**IN3**	**IN4**	**IN5**	**IN6**	**IN7**	**IN8**	**OUT1**	**OUT2**	**OUT3**	**OUT4**
						CW Limit	CCW Limit	Motion			
								Tach			

Streaming Commands (SCL) mode (control modes 21-24)

IN/OUT1 Connector					
X1	**X2**	**X3**	**X4**	**Y1**	**Y2**
GP	GP	Alarm Reset	GP	Fault	Brake
		Enable Motor		GP	GP
		GP			

IN/OUT2 Connector (OPT2)											
IN1	**IN2**	**IN3**	**IN4**	**IN5**	**IN6**	**IN7**	**IN8**	**OUT1**	**OUT2**	**OUT3**	**OUT4**
CW Jog	CCW Jog	GP	GP	GP	GP	CW Limit	CCW Limit	Motion	GP	GP	GP
						GP	GP	Tach			
								GP			

Q Program mode (control modes 21-24)

IN/OUT1 Connector					
X1	**X2**	**X3**	**X4**	**Y1**	**Y2**
GP	GP	Alarm Reset	GP	Fault	Brake
		Enable Motor		GP	GP
		GP			

continued on next page

IN/OUT2 Connector (OPT2)											
IN1	**IN2**	**IN3**	**IN4**	**IN5**	**IN6**	**IN7**	**IN8**	**OUT1**	**OUT2**	**OUT3**	**OUT4**
CW Jog	CCW Jog	GP	GP	GP	GP	CW Limit	CCW Limit	Motion	GP	GP	GP
						GP	GP	Tach			
								GP			

Additional I/O details:

IN/OUT1 Connector						
	X1	**X2**	**X3**	**X4**	**Y1**	**Y2**
Voltage range	5 to 24	5 to 24	5 to 24	5 to 24	30 max	30 max
Speed range	2 MHz	2 MHz	Low	Low	Low	Low
Digital filter option	Y	Y	Y	Y	N/A	N/A

IN/OUT2 Connector (OPT2)												
	IN1	**IN2**	**IN3**	**IN4**	**IN5**	**IN6**	**IN7**	**IN8**	**OUT1**	**OUT2**	**OUT3**	**OUT4**
Voltage range	5-24	5-24	12-24	12-24	12-24	12-24	5-24	5-24	30 max	30 max	30 max	30 max
Speed range	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Digital filter option	Y	Y	N	N	N	N	Y	Y	N/A	N/A	N/A	N/A

Notes

I/O functions are configured using ST Configurator software and/or SCL commands.
GP indicates general purpose (controlled by SCL or Q commands)
X1 functions as Step or CW Pulse or A Quadrature in Pulse & Direction mode (control mode 7)
X1 functions as Step or CW Pulse or A Quadrature in control mode 21 when FE command is active
X1 functions as Run/Stop in some velocity modes (control modes 12, 14, 16 and 18)
X2 functions as Direction or CCW Pulse or B Quadrature in control mode 7
X2 functions as Direction or CCW Pulse or B Quadrature in control mode 21 when FE command is active
X2 is the direction input for all velocity modes
X4 is the speed change input for some velocity modes (control modes 13, 14, 17 and 18)
Jog inputs are active in control mode 21 when using the WI command if enabled by the JE command
Limits are active in control modes 21 - 24 if enabled by the DL command or by ST Configurator

Connecting Input Signals

The STAC5 drives have four types of inputs.

• High speed digital inputs for step & direction commands or encoder following, 5-24 volt logic. These inputs, X1/STEP and X2/DIR are available on all models. They can also be used to connect sensors and other types of devices. The connection can be sourcing, sinking or differential.

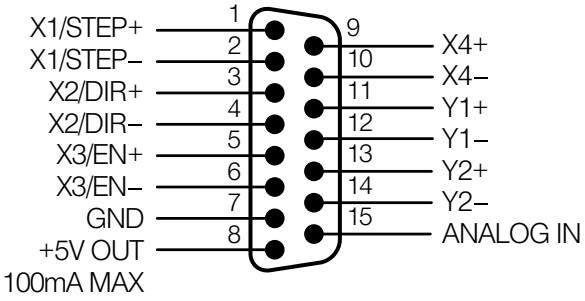
• Lower speed digital inputs for other signals, 5 - 24 volt logic, accepting sourcing, sinking of differential signals. All drives contains at least two of these inputs: X3/EN and X4. -Q and -IP models include four additional lower speed, differential inputs, IN1, IN2, IN7 and IN8.

• 12-24V lower speed single ended inputs which accept sourcing or sinking inputs. These four inputs, IN3-IN6 are only present on -Q models.

• Analog input for analog speed and positioning modes, included on all drives. Can be configured for 0-10V, 0-5V, ±10V or ±5V, with or without offset.

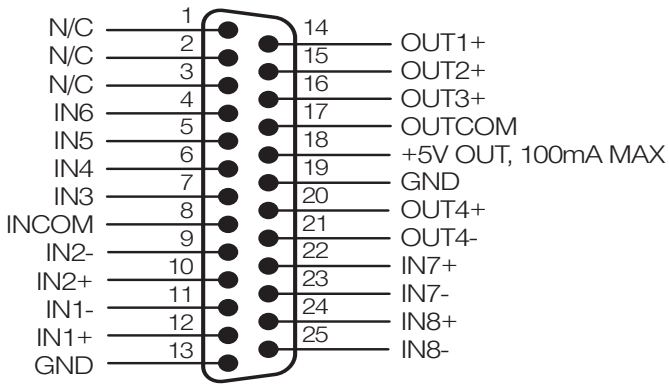
Connector Pin Diagrams

IN/OUT 1



This connector is included on all models.

IN/OUT 2

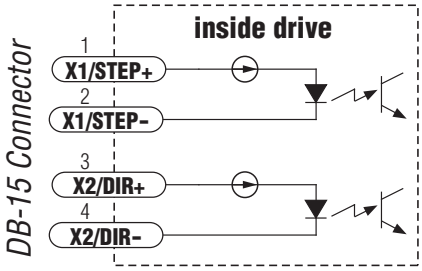


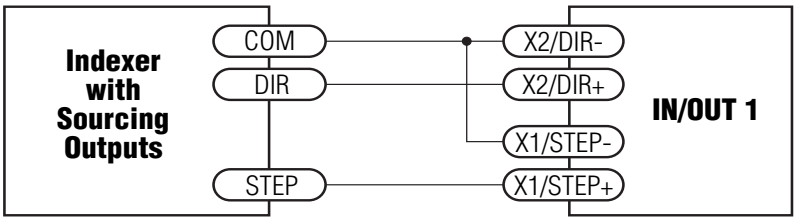
This connector is standard on -Q and -IP models.

High Speed Digital Inputs

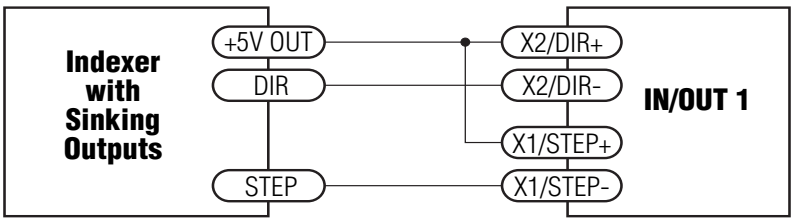
All STAC5 drives include two high speed inputs called STEP and DIR. They accept 5-24 volt single-ended or differential signals, up to 2 MHz. Normally these inputs connect to an external controller that provides step & direction command signals. You can also connect a master encoder to the high speed inputs for following applications. Or you can use these inputs with *Wait Input, If Input, Feed to Sensor, Seek Home* and other such commands.

Connection diagrams follow.

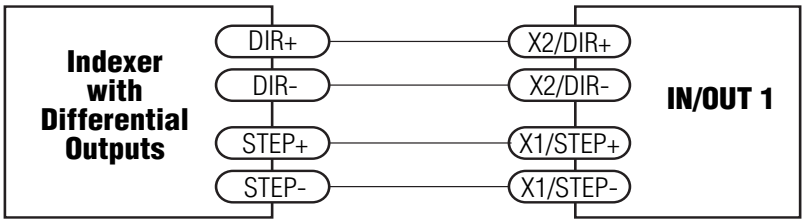




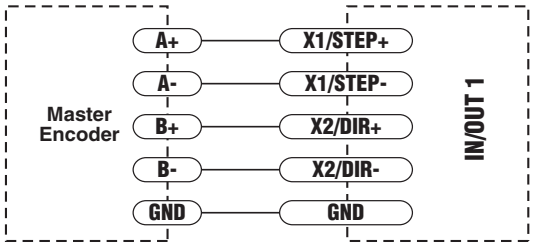
Connecting to indexer with Sourcing Outputs



Connecting to Indexer with Sinking Outputs



Connecting to Indexer with Differential Outputs
(Many high speed indexers have differential outputs)

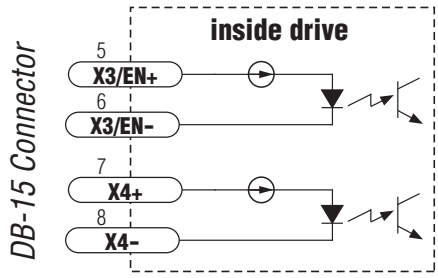


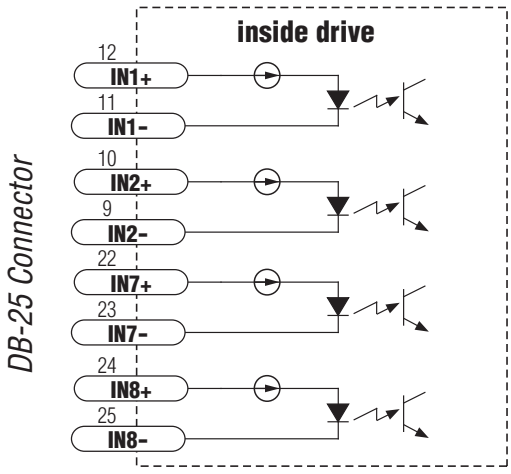
Wiring for Encoder Following
(Encoder power can be supplied from the +5V OUT terminal on IN/OUT 1 if the encoder requires no more than 100mA)

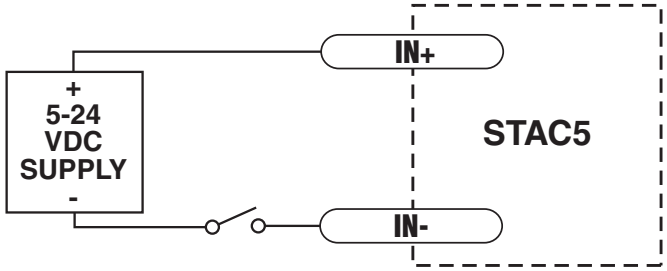
Lower Speed, Differential Digital Inputs

All STAC5 drives include two lower speed inputs called X3/EN and X4. They accept 5-24 volt single-ended or differential signals, but only at lower speeds than STEP and DIR. You can use these inputs with *Wait Input, If Input, Feed to Sensor, Seek Home* and other such commands. -Q models include four additional differential inputs on the IN/OUT2 (OPT2) connector called IN1, IN2, IN7 and IN8. IN1 and IN2 can be used for connection to sensors and other devices. IN7 and IN8 are normally used for end of travel limit switches, but can be used for registration sensors, etc.

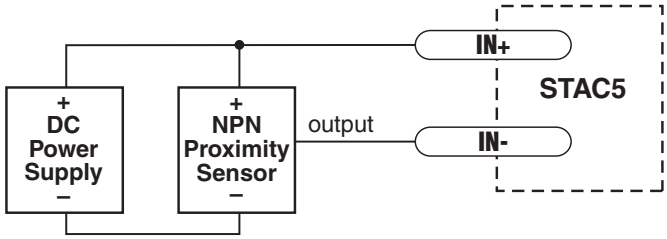
Connection diagrams follow.



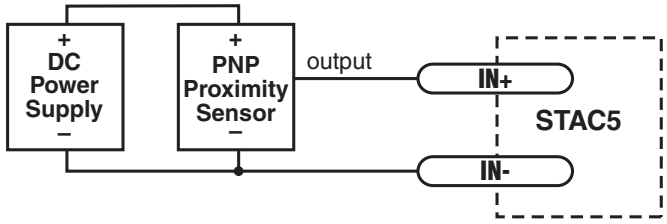




Connecting a Mechanical Switch to Low Speed Differential Inputs



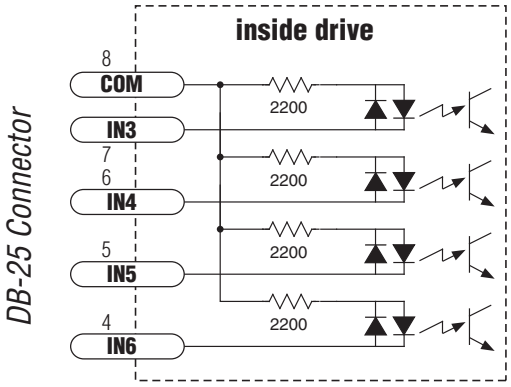
Connecting an NPN Proximilty Sensor to Low Speed Differential Inputs



Connecting a PNP Proximilty Sensor to Low Speed Differential Inputs

Single Ended Digital Inputs

The -Q and -IP drives include four single ended, optically isolated input circuits that can be used with sourcing or sinking signals, 12 to 24 volts. This allows connection to PLCs, sensors, relays and mechanical switches. Because the input circuits are isolated, they require a source of power. If you are connecting to a PLC, you should be able to get power from the PLC power supply. If you are using relays or mechanical switches, you will need a 12-24 V power supply. This also applies if you are connecting the inputs to the programmable outputs of an Si product from Applied Motion.

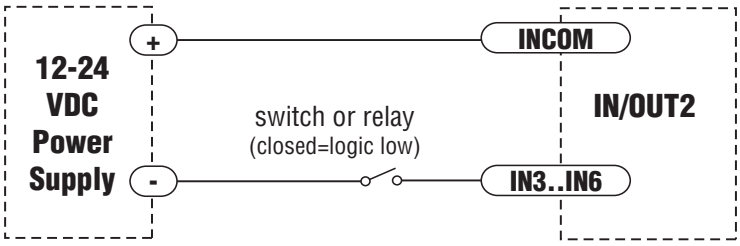


What is COM?

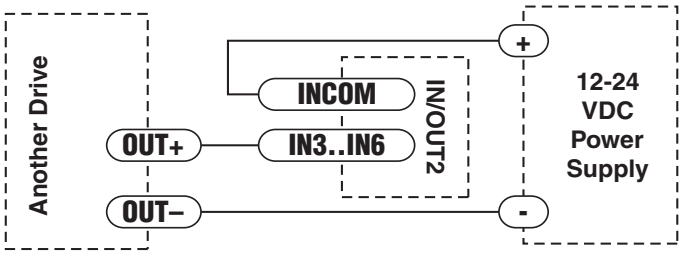
"Common" is an electronics term for an electrical connection to a common voltage. Sometimes "common" means the same thing as "ground", but not always. In the case of the STAC5 drives, if you are using sourcing (PNP) input signals, then you will want to connect COM to ground (power supply -). If you are using sinking (NPN) signals, then COM must connect to power supply +.

Note: If current is flowing into or out of an input, the logic state of that input is low or closed. If no current is flowing, or the input is not connected, the logic state is high or open.

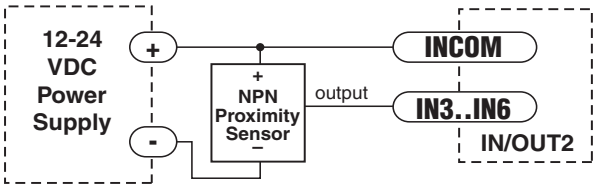
The diagrams on the following pages show how to connect the inputs to various commonly used devices.



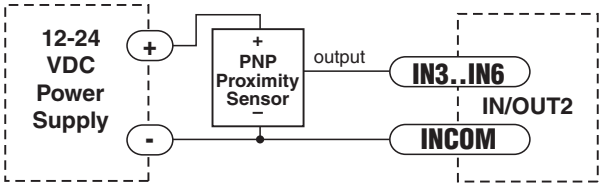
Connecting an Input to a Switch or Relay



Connecting another drive to the STAC5
(When output closes, input goes low).



Connecting an NPN Type Proximity Sensor to an input
(When prox sensor activates, input goes low).

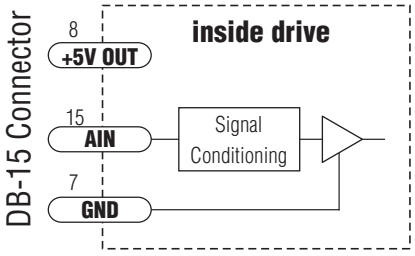


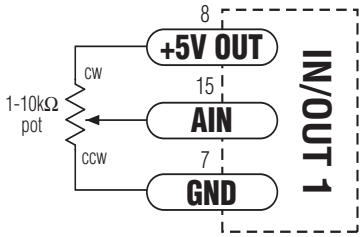
Connecting a PNP Type Proximity Sensor to a an input
(When prox sensor activates, input goes low).

Analog Input

The STAC5 drives feature one analog input. It can accept a signal range of 0 to 5 VDC, ±5 VDC, 0 to 10 VDC or ±10 VDC. The drive can be configured to operate at a speed or position that is proportional to the analog signal.

Use the *ST Configurator* software to set the signal range, offset, deadband and filter frequency.

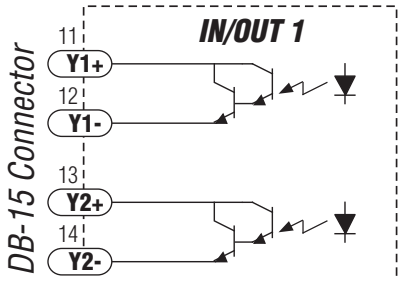




Connecting a Potentiometer to the Analog Input

Programmable Outputs

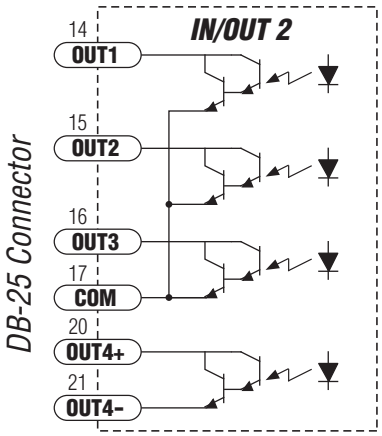
The STAC5-S drives feature two digital outputs. These outputs can be set to automatically control a motor brake, to signal a fault condition, to indicate when the motor is moving or to provide an output frequency proportional to motor speed (tach signal). Or the outputs can be turned on and off by program instructions like Set Output. -Q and -IP drives include four additional programmable outputs.

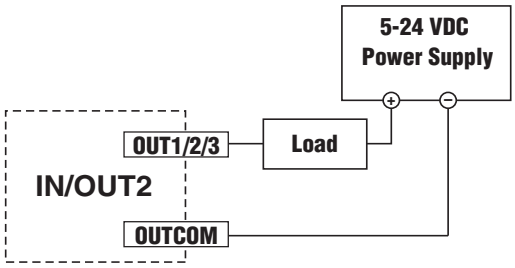


The outputs can be used to drive LEDs, relays and the inputs of other electronic devices like PLCs and counters. For Y1, Y2 and OUT4, the "+" (collector) and "-" (emitter) terminals of each transistor are available at the connector. This allows you to configure each output for current sourcing or sinking. OUT1, OUT2 and OUT3 can only sink current. The COM terminal must be tied to power supply (-).

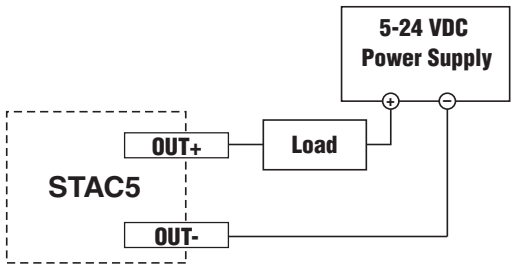
Diagrams of each type of connection follow.

Do not connect the outputs to more than 30VDC.
The current through each output terminal must not exceed 100 mA.

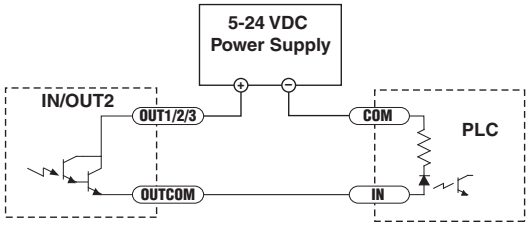




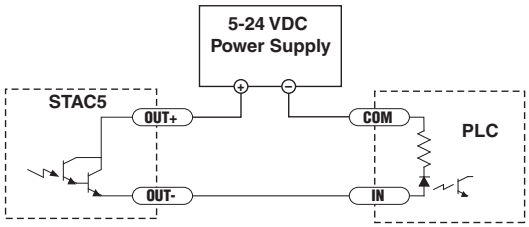
Sinking Output Using OUT1, OUT2 or OUT3



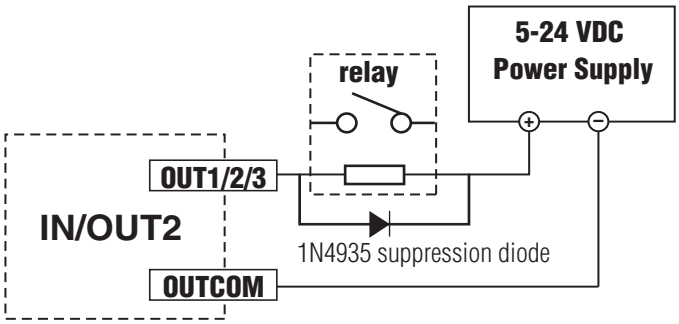
Sinking Output Using Y1, Y2 or OUT4



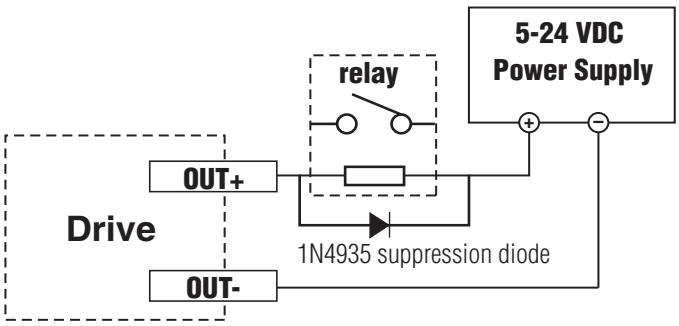
Sourcing Output Using OUT1, OUT2 or OUT3



Sourcing Output Using Y1, Y2 or OUT4



Driving a Relay OUT1, OUT2 or OUT3



Driving a Relay Using Y1, Y2, or OUT4

Recommended Motors (120V Models)

All motors should be connected in parallel when used with the STAC5-120.

Part Number	Holding Torque		Drive Current Setting	Length		Rotor Inertia
	oz-in	N-m	amps	in	mm	g-cm²
HT23-552	84.4	0.60	1.5	1.71	43.8	120
HT23-553	167	1.18	1.5	2.16	54.8	300
HT23-554	255	1.80	1.8	3.05	77.5	480
HT34-695/495	555	3.92	5.0	3.11	79	1600
HT34-696/496	1110	7.84	5.0	4.63	117.5	3200
HT34-697/497	1694	11.96	5.0	6.14	156	4800

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.

Recommended Motors (220V Models)

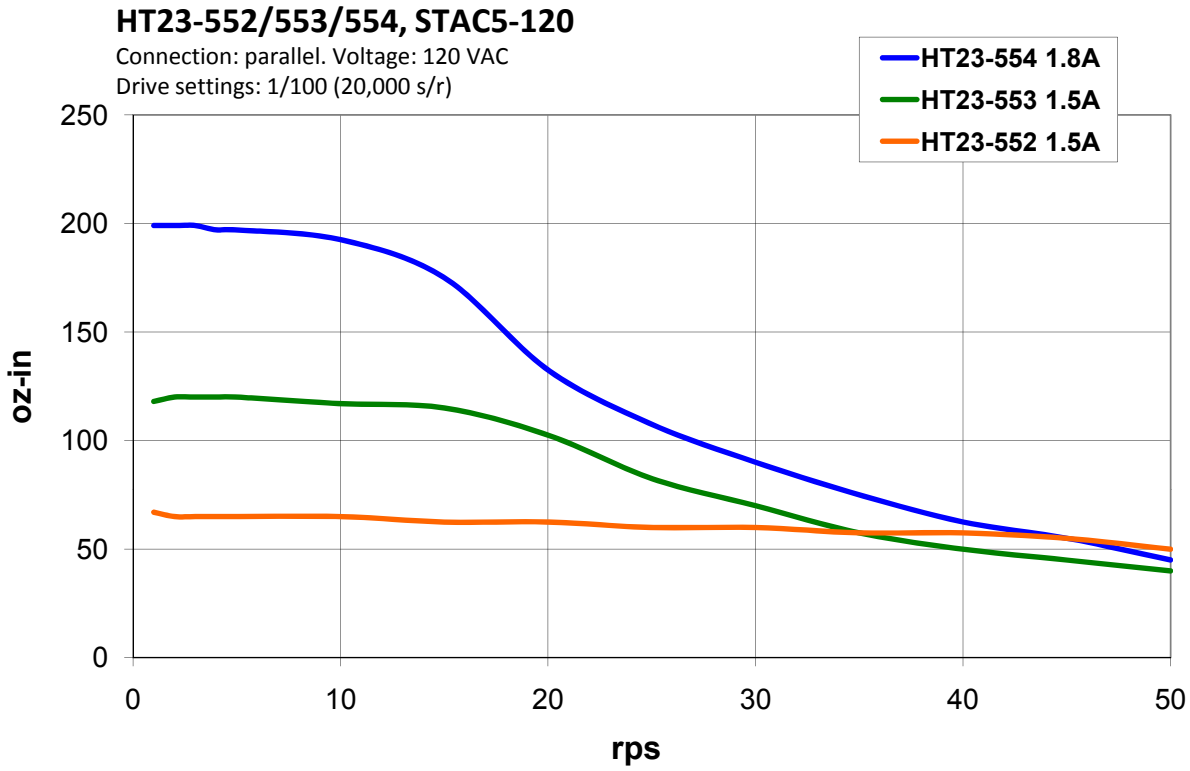
All motors should be connected in series when used with the STAC5-220.

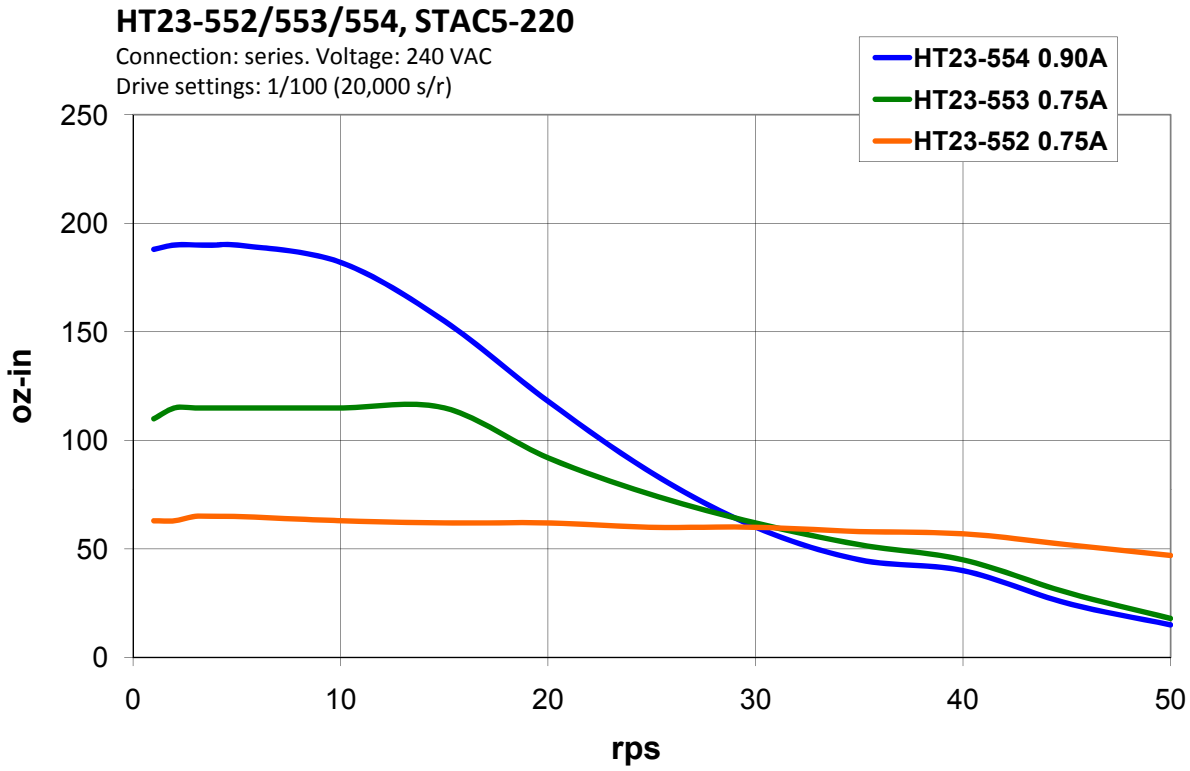
Part Number	Holding Torque		Drive Current Setting	Length		Rotor Inertia
	oz-in	N-m	amps	in	mm	g-cm²
HT23-552	84.4	0.60	0.75	1.71	43.8	120
HT23-553	167	1.18	0.75	2.16	54.8	300
HT23-554	255	1.80	0.90	3.05	77.5	480
HT34-695/495	555	3.92	2.55	3.11	79	1600
HT34-696/496	1110	7.84	2.55	4.63	117.5	3200
HT34-697/497	1694	11.96	2.55	6.14	156	4800

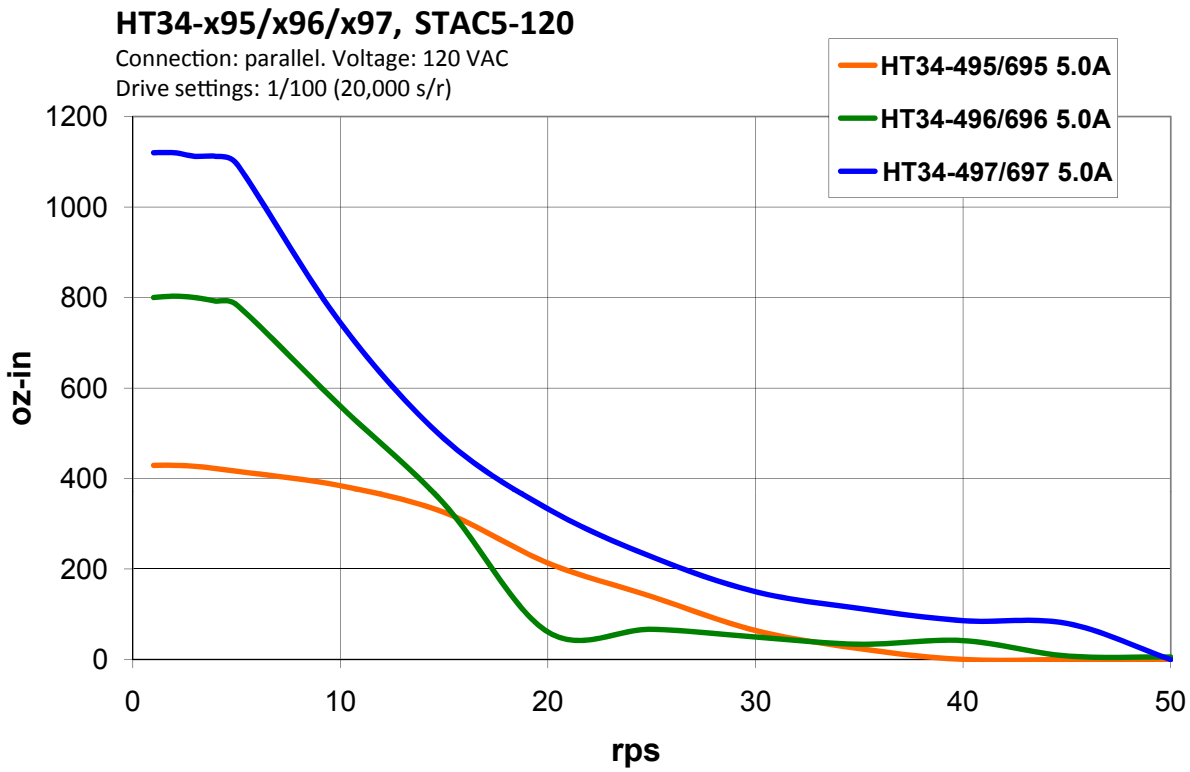
Note: The "Drive Current Setting" shown here differs from the rated current of each motor because the rated current is RMS and the drive current setting is peak sine. If you are using a motor not listed here, for best results set the drive current at the motor's rated current x 1.2.

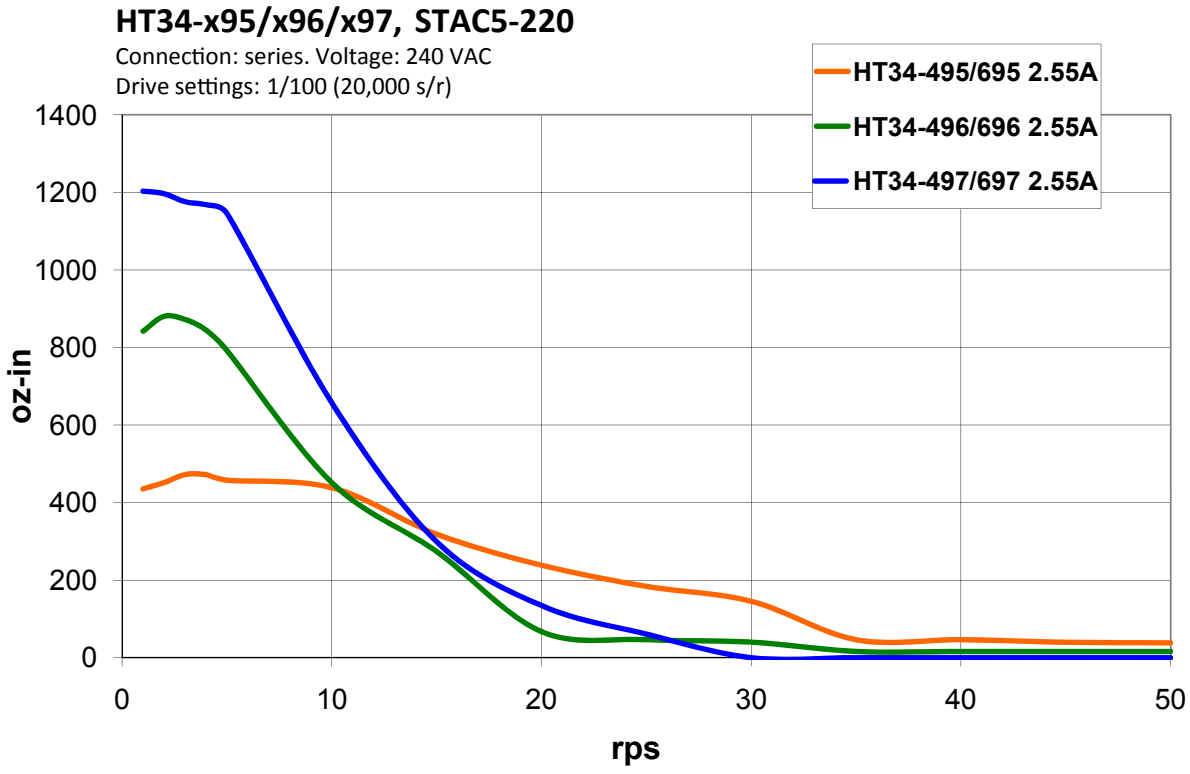
Torque-Speed Curves

Note: all torque curves were measured at 20,000 steps/rev.






HT34-x95/x96/x97, STAC5-120
Connection: parallel. Voltage: 120 VAC
Drive settings: 1/100 (20,000 s/r)
HT34-495/695 5.0A
HT34-496/696 5.0A
HT34-497/697 5.0A
oz-in
1200
1000
800
600
400
200
0
0
10
20
30
40
50
rps


HT34-x95/x96/x97, STAC5-220
Connection: series. Voltage: 240 VAC
Drive settings: 1/100 (20,000 s/r)
HT34-495/695 2.55A
HT34-496/696 2.55A
HT34-497/697 2.55A
oz-in
1400
1200
1000
800
600
400
200
0
0
10
20
30
40
50
rps

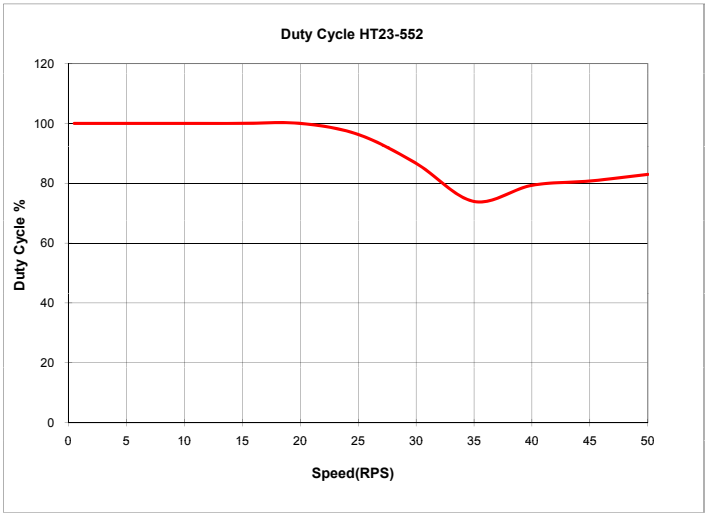
Motor Heating

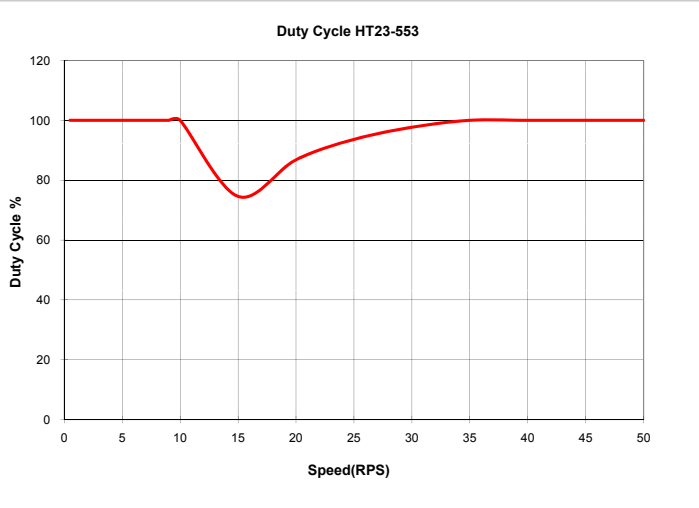
Step motors convert electrical power from the driver into mechanical power to move a load. Because step motors are not perfectly efficient, some of the electrical power turns into heat on its way through the motor. This heating is not so much dependent on the load being driven but rather the motor speed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

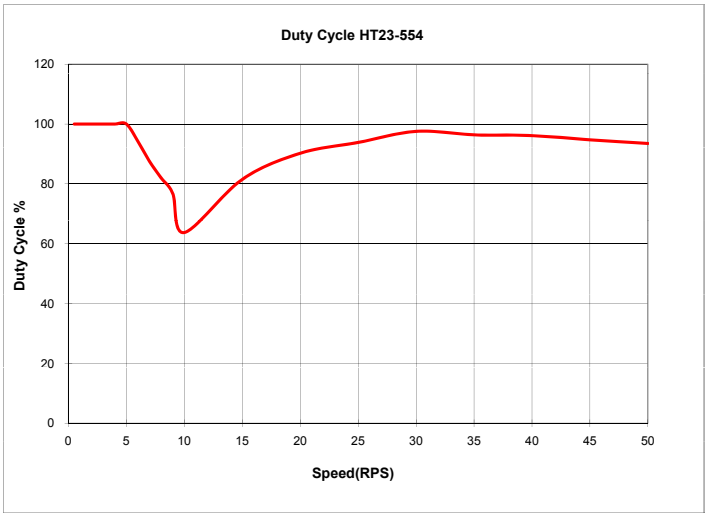
We have characterized the recommended motors in our lab and provided curves showing the maximum duty cycle versus speed for each motor and drive. Please refer to these curves when planning your application.

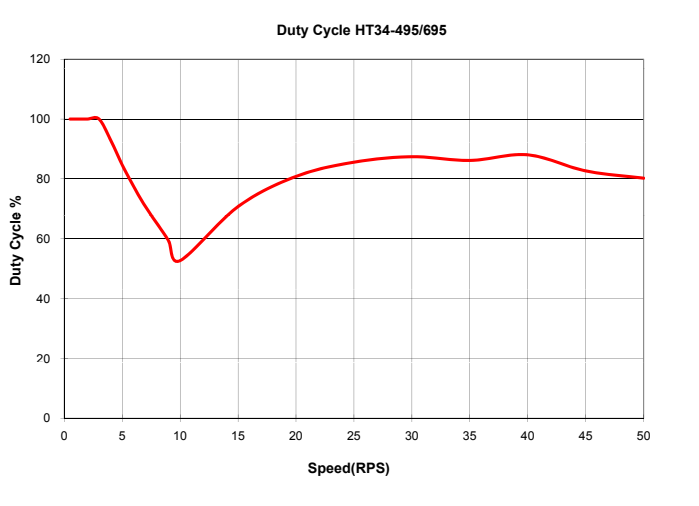
Please also keep in mind that a step motor typically reaches maximum temperature after 30 to 45 minutes of operation. If you run the motor for one minute then let it sit idle for one minute, that is a 50% duty cycle. Five minutes on and five minutes off is also 50% duty. However, one hour on and one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

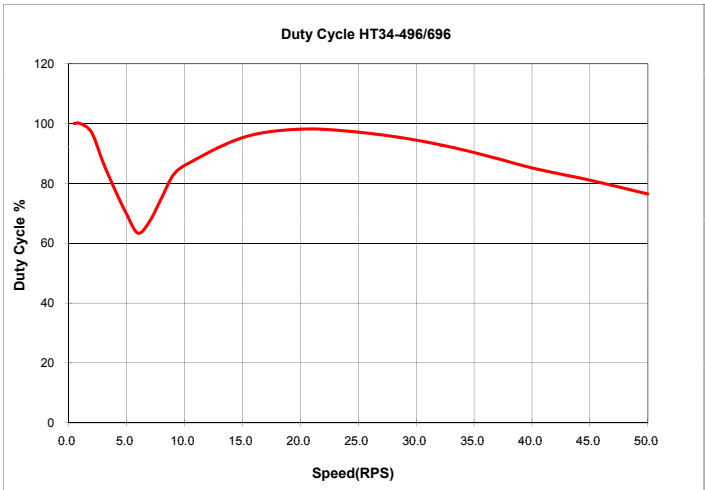
The actual temperature of the motor depends on how much heat is conducted, convected or radiated out of it. Our measurements were made in a 40°C (104°F) environment with the motor mounted to an aluminum plate sized to provide a surface area consistent with the motor power dissipation. Your results may vary.

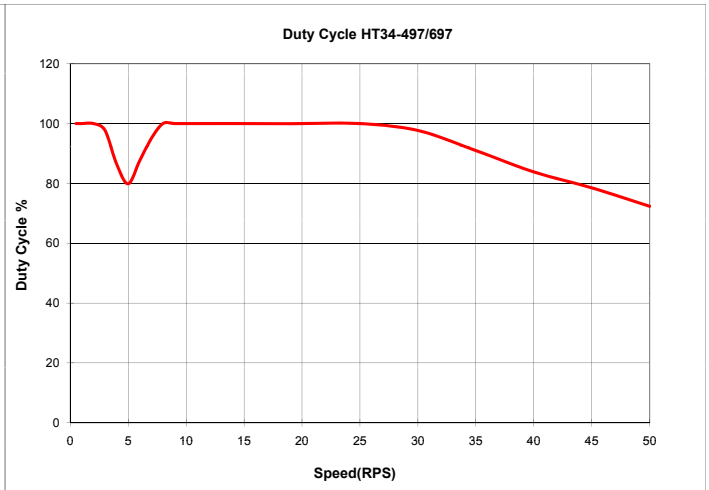












Drive Heating

While STAC5 drivers efficiently transmit power between the AC power and motor, they do generate some heat in the process. This will cause the temperature of the drive to rise above the surrounding air temperature and may also require that the drive be mounted to a heat conducting metal surface.

For those who wish to calculate the power dissipation and temperature rise, the following information is provided:

1. drive power dissipation P_d versus motor (see tables below)

drive thermal constant R_Q

The final drive case temperature is given by

$$T_c = T_a + R_Q * P_d$$

where T_a is the ambient temperature of the surrounding air. The case of the drive should not be allowed to exceed 70°C or the life of the product could be reduced.

Drive thermal constant (with drive mounted on a 15.75" x 15.75" steel plate, .040" thick): R_Q =0.87°C/W

Max Loss vs Motor STAC5-120

Motor	Current	Loss (W)
HT23-552	1.5	9.61
HT23-553	1.5	8.99
HT23-554	1.8	10.34
HT34-695/495	5	28.2
HT34-696/496	5	24.5
HT34-697/497	5	24.5

Max Loss vs Motor STAC5-220

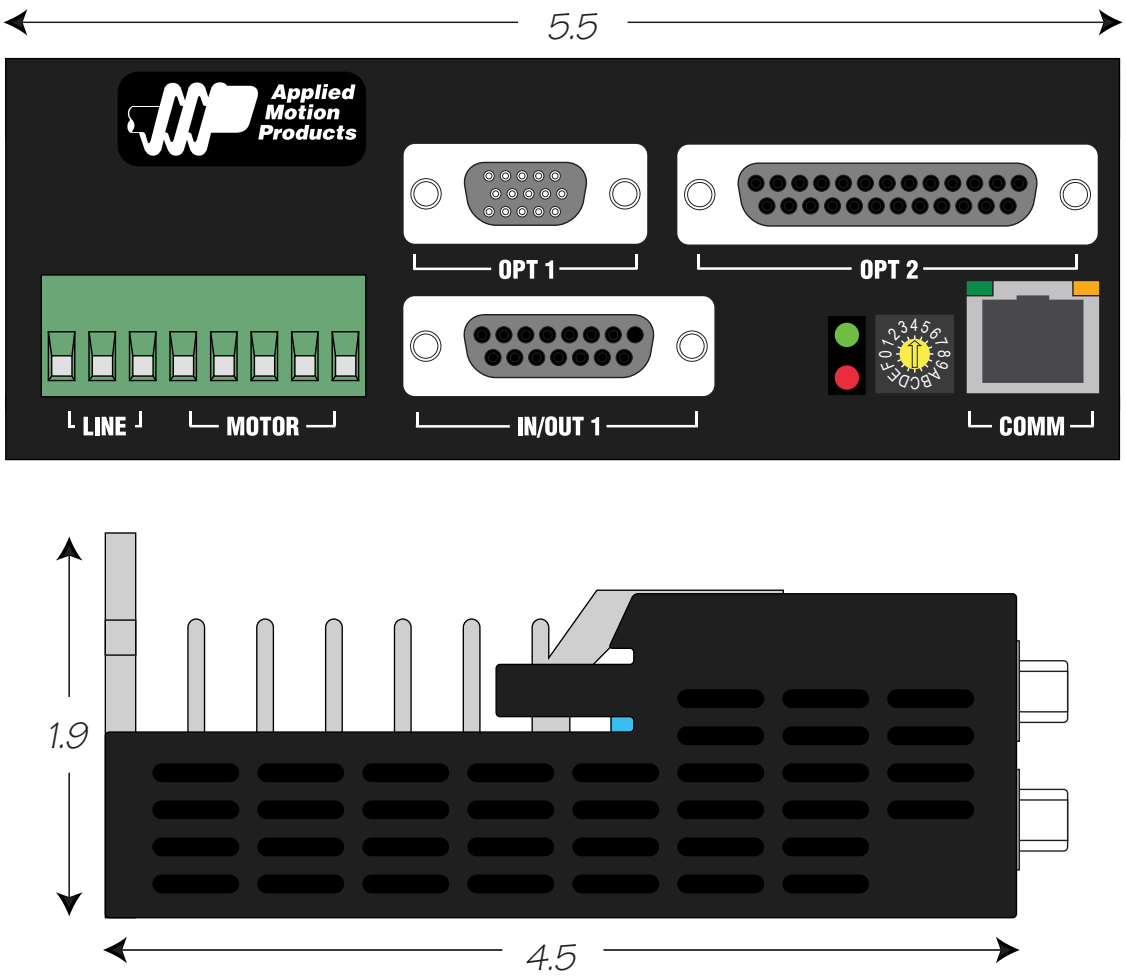
Motor	Current	Loss (W)
HT23-552	0.75	10.2
HT23-553	0.75	10.4
HT23-554	0.90	12.1
HT34-695/495	2.55	18.6
HT34-696/496	2.55	17.6
HT34-697/497	2.55	20.8

Mounting the Drive

Use #6 screws to mount your drive. If possible, 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, then forced airflow from a fan may be required to prevent the drive from overheating.

- ***Never use your drive in a space where there is no air flow or where other devices cause the surrounding air to be more than 40°C.***
- ***Never put the drive where it can get wet or where metal or other electrically conductive particles can get on the circuitry.***
- ***Always provide air flow around the drive. When mounting multiple STAC5 drives near each other, maintain at least one half inch of space between drives.***

Mechanical Outline



Technical Specifications

AMPLIFIER TYPE	Digital MOSFET, dual H-bridge, 4 quadrant
CURRENT CONTROL	4 state PWM at 16 KHz
OUTPUT CURRENT	STAC5-120: 0.5-5.0 amps/phase (peak of sine) in 0.01 amp increments STAC5-220: 0.5-2.55 amps/phase (peak of sine) in 0.01 amp increments
POWER SUPPLY	STAC5-120: 94-135 VAC, 50/60 Hz STAC5-220: 94-245 VAC, 50/60 Hz
PROTECTION	Over-voltage, under-voltage, over-temp, motor/wiring shorts (phase-to-phase, phase-to-ground), internal amplifier shorts
MOTOR INDUCTANCE	STAC5-120: 5-20 mH STAC5-220: 20-60 mH
MOTOR REGENERATION	Built-in regeneration circuit, 10 watts max.
IDLE CURRENT REDUCTION	Reduction range of 0-90% of running current after delay selectable in milliseconds
MICROSTEP RESOLUTION	Software selectable from 200 to 51200 steps/rev in increments of 2 steps/rev
MICROSTEP EMULATION	Performs high resolution stepping by synthesizing fine microsteps from coarse steps. Reduces jerk and extraneous system resonances. (Step & direction mode only).
ANTI-RESONANCE (Electronic Damping)	Raises the system damping ratio t0 eliminate midrange instability and allow stable operation throughout the speed range and improves settling time.
TORQUE RIPPLE SMOOTHING	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.
COMMUNICATION INTERFACE	Ethernet 100BASE-T, supports TCP and UDP
ENCODER INTERFACE	For connecting to motor-mounted encoder. Used to provide stall detection and stall prevention with static position maintenance. Differential line receivers, up to 2 MHz.
INPUTS/OUTPUTS: S, Q and IP models	X1, X2 inputs: Optically isolated, differential, 5-24 VDC logic (2.5V switching threshold), minimum pulse width = 250 nsec, maximum pulse frequency = 2 MHz, 2 usec minimum set up time for direction signal, maximum current = 10 mA. X3, X4 inputs: Optically isolated, differential, 5-24 VDC logic (2.5V switching threshold), 50 usec minimum pulse width, maximum current = 10 mA. Y1, Y2 outputs: Optical darlington, sinking or sourcing, 30 VDC max, 100 mA max, voltage drop = 1.2V max at 100 mA. Analog input: Single-ended. Range is software selectable 0-5, +/-5, 0-10, or +/-10 VDC. Software configurable offset, deadband, and filtering. Resolution is 12 bits (+/- 10 volt range), 11 bits (+/-5 or 0-10 volt range), or 10 bits (0-5 volt range). 100 kohms internal impedance.

INPUTS/OUTPUTS: Q and IP models only	Q and IP models have the same I/O as above plus the following: IN1, IN2, IN7, IN8 inputs: Optically isolated, differential, 5-24 VDC logic (2.5V switching threshold), 50 usec minimum pulse width, maximum current = 10 mA. IN3-IN6 inputs: Optically isolated, single-ended, shared common emitter, sinking or sourcing, 12-24 VDC logic, 2200 ohms, maximum current = 10 mA. OUT1-OUT3 outputs: Optical darlington, single-ended, shared common, sinking, 30 VDC max, 100 mA max, voltage drop = 1.2V max at 100 mA. OUT4 output: Optical darlington, sinking or sourcing, 30 VDC max, 100 mA max, voltage drop = 1.2V max at 100 mA.
NON-VOLATILE STORAGE	Drive configuration and Q program are stored in FLASH memory onboard the DSP.
AGENCY APPROVALS	"RoHS CE EN61800-3:2004, EN61800-5-1:2003 UL 508c"
HUMIDITY	90% max, non-condensing
AMBIENT TEMPERATURE	0 to 40 °C (32 to 104 °F) with adequate ventilation
DIMENSIONS	2.0 x 4.5 x 5.5 inches overall
WEIGHT	22.4 oz (630 g)

Mating Connectors and Accessories

Mating Connectors

Motor/power supply:
8 way combined motor/power connector: Phoenix contact 1757077
3 way AC power connector: Phoenix Contact 1757022
5 way motor connector: Phoenix contact 1757048
IN/OUT1: DB-15 male. AMP P/N 5-747908-2. Shell Kit AMP P/N 5-748678-2. Included.
IN/OUT2: DB-25 male. AMP P/N 5-747912-2. Shell Kit AMP P/N 5-748678-3. Included.
Optional encoder feedback: HD-15 male. Norcomp P/N 180-015-102-001. Shell Kit AMP P/N 5-748678-1. Not included.

Accessories

Breakout Box for DB-25 Connector: BOB-1, includes cable

Screw terminal connectors with housings that mate directly to the D-Sub connectors on the drive:
DB-25, Phoenix Contact P/N 2761622
DB-15, Phoenix Contact P/N 2761606
HD-15 (encoder), Phoenix Contact P/N 5604602
These connectors are not available from Applied Motion. You must purchase them from a Phoenix distributor.

Mating Cable for IN/OUT2 connector with "flying leads"
Black Box P/N: BC00702
This cable is not available from Applied Motion. You must purchase it from Black Box.
Useful for custom wired applications. This shielded cable has a DB-25 connector on each end. You can cut off the female end to create a 6 foot "DB-25 to flying lead cable".
It'll be easier to wire if you get the cable color chart from Black Box's web site.

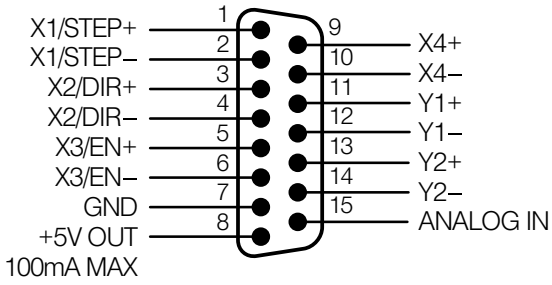
Alarm Codes

In the event of an error, the green LED on the main board will flash one or two times, followed by a series of red flashes. The pattern repeats until the alarm is cleared.

Code	Error
solid green	no alarm, motor disabled
flashing green	no alarm, motor enabled
1 red, 1 green	motor stall (optional encoder only)
1 red, 2 green	move attempted while drive disabled
2 red, 1 green	ccw limit
2 red, 2 green	cw limit
3 red, 1 green	drive overheating
3 red, 2 green	internal voltage out of range
3 red, 3 green	blank Q segment
4 red, 1 green	power supply overvoltage or excess regen
4 red, 2 green	power supply undervoltage
4 red, 3 green	flash memory backup error
5 red, 1 green	over current / short circuit
6 red, 1 green	open motor winding
6 red, 2 green	bad encoder signal (optional encoder only)
7 red, 1 green	serial communication error
7 red, 2 green	flash memory error

Connector Diagrams

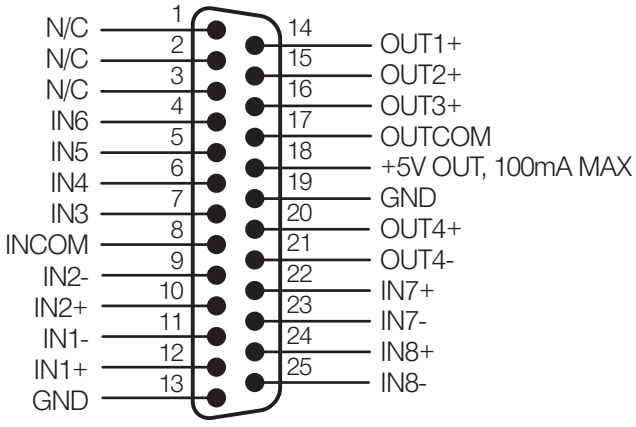
IN/OUT 1



This connector is included on all models.

DB-15 I/O Connector

IN/OUT 2



This connector is standard on -Q and -IP models.

DB-25 I/O Connector

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