TRUST™
AUTOMATION, INC.

APPLICATIONS

TA320 MANUAL

Rev. D (09/00)

The following documentation provides descriptions and definitions of the operating parameters for the TA320 amplifier.

Setup

The TA320 can be configured for several drive options, including triple brush-motor drive, or as a single brush-motor drive in bridge mode. It can also be (factory) configured as a single-phase in a three-phase system; thus, effectively tripling the TA320's rated output. See the corresponding diagrams (pages 7-12) depicting different amplifier/motor combinations.

Amplification Mode

Torque

Torque mode is the most common mode of operation. In torque mode, the amplifier produces a current proportional to the command input voltage; the current produced is directly proportional to torque. The transconductance (Amps *per* Volt) is calculated by the following equation:

$$g_m = \frac{I_o}{V_c}$$

g_m = current gain (transconductance)
I_o = output current (use worst case)
V_c = command voltage

Example:

If: I_o desired = 3A, and V_c (max) = 10V

Then: $g_m = \frac{3}{10}$ or 0.3A *per* Volt

NOTE: Current output is limited by Ohm's law.

I_{max} is limited by the following equation, for a single-supply scenario:

$$I_{max} = \frac{\text{Bus voltage - 5V}}{\text{Motor Impedance in Ohms}}$$

205 Suburban Road ◆ San Luis Obispo, CA 93401
Phone: (805) 544-0761 ◆ Fax: (805) 544-4621
www.TrustAutomation.com

For a command-input voltage of ±10V, the output current settings are 3A, 6A, 9A, and 12A. These are also the current limits, in this mode. Custom current limits can be preset at the factory.

Velocity

In velocity mode, the amplifier produces a volt-age proportional to the command input voltage; the voltage produced is directly proportional to velocity. The equation for determining the output voltage for a given input is as follows:

$$V_{out} = \text{command voltage} * A_v$$

A_v = voltage gain (factory preset = 55)
V_c = command voltage

Example:

If: V_{out} desired = 100V, with A_v = 55

Then: $V_c = \frac{100}{55}$ or 1.8V

NOTE: Custom voltage gains (A_V=10–55) can be preset at the factory.

Drive Mode

Sinusoidal

Sinusoidal operation provides the smoothest output for commutating a DC brushless motor. In this mode, the TA320 is designed to accept two command-input signals (R & S phases) from a motion controller that is performing the commutation based upon encoder feedback. The TA320 derives the third (T) phase internally.

Trapezoidal

Trapezoidal operation is also available on the TA320. This is the sim-plest configuration to drive a brushless motor. In this mode, the motor's Hall sensors are connected to P2, and the command input signal

(±10V) is connected to one of the T-phase inputs (see datasheet or diagrams).

Command Signal Input

Described below are the different methods of providing a command signal(s) to the TA320. The TA320, and the controlled system, are protected from undesirable command signals driving the axis upon /Enable, potentially causing the axis to 'jump.' Protection is accomplished by preventing the TA320 from enabling if there is greater than ±1V at the inputs of either R, S, or T-phase inputs. If this condition occurs, a FAULT is generated; to clear, the command signal must be reduced to <±1V, and the /Enable line 'cycled'.

Command signal input is setup for ±10V.

Differential

If a differential input is desired, or required to eliminate potential noise susceptibility, signal connections to the TA320 are made via either the coaxial connectors (P6, P7, & P8), or via P5. Inputs are provided for all three amplifier phases.

Single-ended

Most systems operate satisfactorily with a single-ended command signal configuration. Many controllers only offer a single-ended output, with a common signal ground. The single-ended inputs are available on P1, P2, P5, and the coaxial connectors (P6, P7, & P8). Inputs are provided for all three amplifier phases.

NOTE: See diagrams for several command signal input connection options.

Current Limit

The TA320 current limit is set via S1 (see datasheet or diagrams for details), and can only be varied in torque mode. In torque mode, the current limit is the same as the transconductance setting. In voltage mode, the current limit is set at 13A.

205 Suburban Road ◆ San Luis Obispo, CA 93401
Phone: (805) 544-0761 ◆ Fax: (805) 544-4621
www.TrustAutomation.com

Thermal Limits

The TA320 is also thermally protected internally. At a heatsink temperature of 75°C, a FAULT output is generated; at a heatsink temperature of 90°C, the amplifier will disable.

Dynamic Transconductance Selection

A feature pioneered by Trust Automation, Dynamic Transconductance Selection (DTS) enables on-the-fly changes to the transconductance settings. This is accomplished by logically controlling the DTS bits D0 and D1 on connector P5. This feature is advantageous in frictionless systems (i.e. in an airbearing x-y system) where there is high inertia. This situation necessitates high currents upon start-of-motion or change-of-direction, but requires high precision, high-resolution control when at-speed.

Enable

One of the /Enable inputs must be pulled to AUX Ground, or logic *low**, for the TA320 to operate. The /Enable input is pulled-up internally (to AUX +5); therefore, if connection is lost to the /Enable input, the amplifier will disable. Opto-isolation is available when +5V is user-supplied at connector P1, P2, or P5. /Enable is available on connectors P1, P2, P3, and P5, and is referenced to AUX ground.

*A minimum sinking capability (I_{OL}) of 5mA is required.

NOTE: Logic *low* input minimum voltage (V_{IL}) is 0.8V; logic *high* input minimum voltage (V_{IH}) is 2.0V. See circuit in Figure 1.

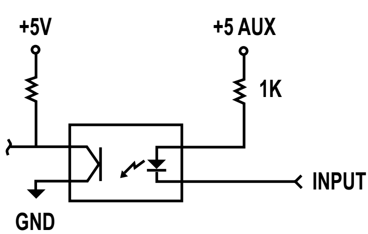


Figure 1 - Logic Input Circuit (Enable, DTS)

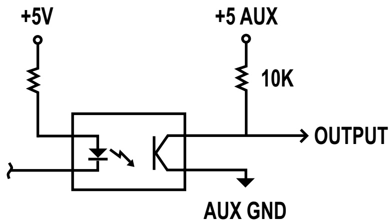


Figure 2 - Fault Output Circuit

Fault

The TA320 fault circuit will output a logic *low* or logic *high* upon over-current, illegal command signal*, or thermal overload. Opto-isolation is available when +5V is user-supplied at connector P1, P2, or P5. FAULT is available on connectors P1, P2, P3, and P5, and is referenced to AUX ground.

*Upon /Enable of the TA320, any command input greater than ±1V will generate a FAULT, and the amplifier will NOT be allowed to /Enable. (see Command Signal Input section)

NOTE: Logic *high* output minimum voltage (V_{OH}) is 2.5V; logic *low* output maximum voltage (V_{OL}) is 0.8V. See circuit in Figure 2.

Ground Connections

Unipolar power

When a single supply is used, the AUX ground (common to both command input and digital) *must* be isolated from power ground. This is necessary to prevent any ground loops from ensuing, consequently causing an amplifier failure. This is also recommended to prevent any power supply line perturbations from being conducted onto the command signal or logic control input and output circuitry.

205 Suburban Road ◆ San Luis Obispo, CA 93401
Phone: (805) 544-0761 ◆ Fax: (805) 544-4621
www.TrustAutomation.com

Connect the supply positive (+) to V+ and the supply negative (-) to V-. DO NOT connect power GND (P3-7).

Bipolar power

When two supplies are used, there are no ground connection restrictions. However, it is still recommended that the power and signal grounds be isolated (see unipolar section above).

Connect the positive supply positive (+) to V+, and the positive supply negative (-) to GND; connect the negative supply positive (+) to GND, and the negative supply negative (-) to
V-.

Command Signal & Logic

If a single-ended command input signal connection is used, verify the TA320's AUX ground is common to the logic ground (i.e. /Enable, Fault), and signal ground on the controller.

Power Supply

Either a single (unipolar) or dual (bipolar) power supply can be used to power the TA320 amplifier. A regulated switcher-type supply is suitable for most applications, due to their small size and availability. However, if there is the utmost concern for noise interference, a linear power supply, regulated or unregulated is recommended. If an unregulated supply is chosen, verify that the voltage supplied, at either V+ *or* V-, does not exceed the absolute maximum supply voltage of ±80V.

Power Dissipation Calculations

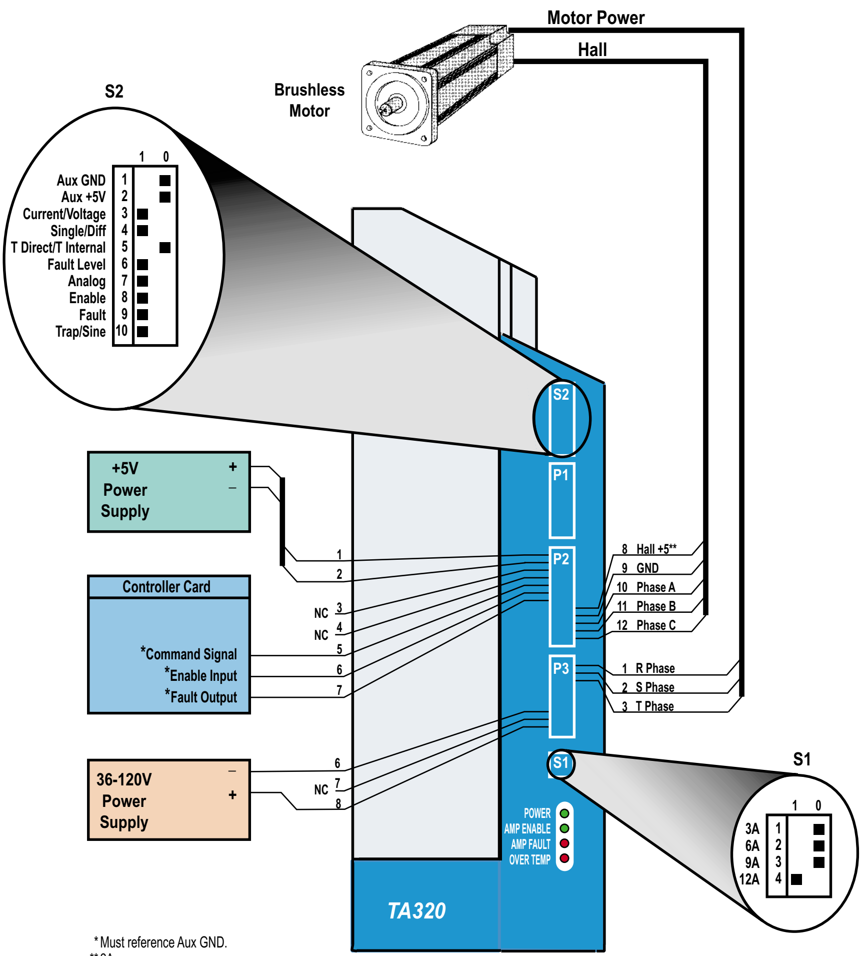
Since the TA320 operates in linear mode, voltage *not* applied to the motor, is dropped across the amplifier. Heat generated, by the amplifier, is directly proportional to this voltage drop multiplied by the motor current. Heat dissipation is an especially critical factor when the motor is in a stalled condition (low motor voltage, high current). The TA320 is limited to a maximum of 600W continuous dissipation, and 1200W peak dissipation

(0.5 sec). To determine an application's potential heat dissipation at the amplifier, use the following equation:

$$P_D = I_{motor} (V_{supply} - V_{motor})$$

P_D = power dissipated by the amplifier
I_{motor} = motor current (use worst case)
V_{supply} = total supply voltage
V_{motor} = voltage across motor (during worst-case condition)

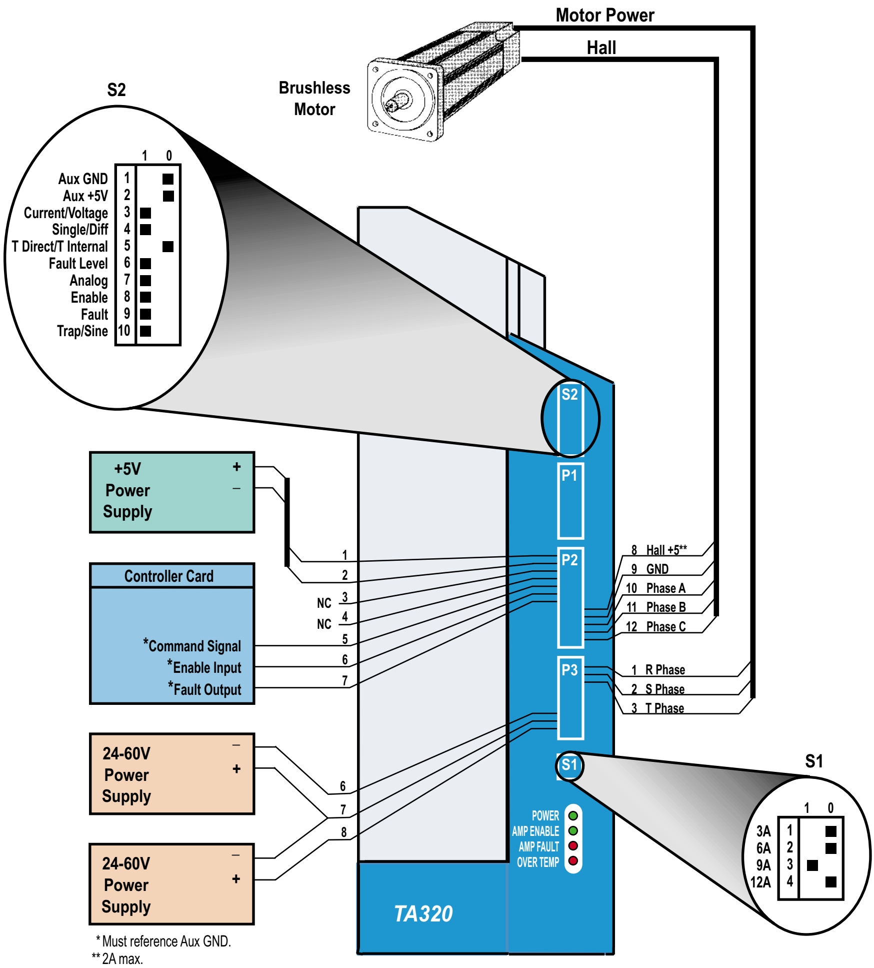
205 Suburban Road ◆ San Luis Obispo, CA 93401
Phone: (805) 544-0761 ◆ Fax: (805) 544-4621
www.TrustAutomation.com



*Must reference Aux GND.
**2A max.

NOTE: Drawing does not depict connections of a positional or velocity feedback mechanism.

Diagram 320-01	Parameter	Setting
This diagram depicts the TA320 operating in trapezoidal and torque (current) mode, it is set for a fixed current limit of 12A, and logic lines are optically isolated (requires user-supplied 5V supply).	Drive Mode	Trap
	Amplification Mode	Torque
	Logic Optoisolation	Yes
	Fault Output Active	High
	Current Limit	12A
	Transconductance	1.2A/V

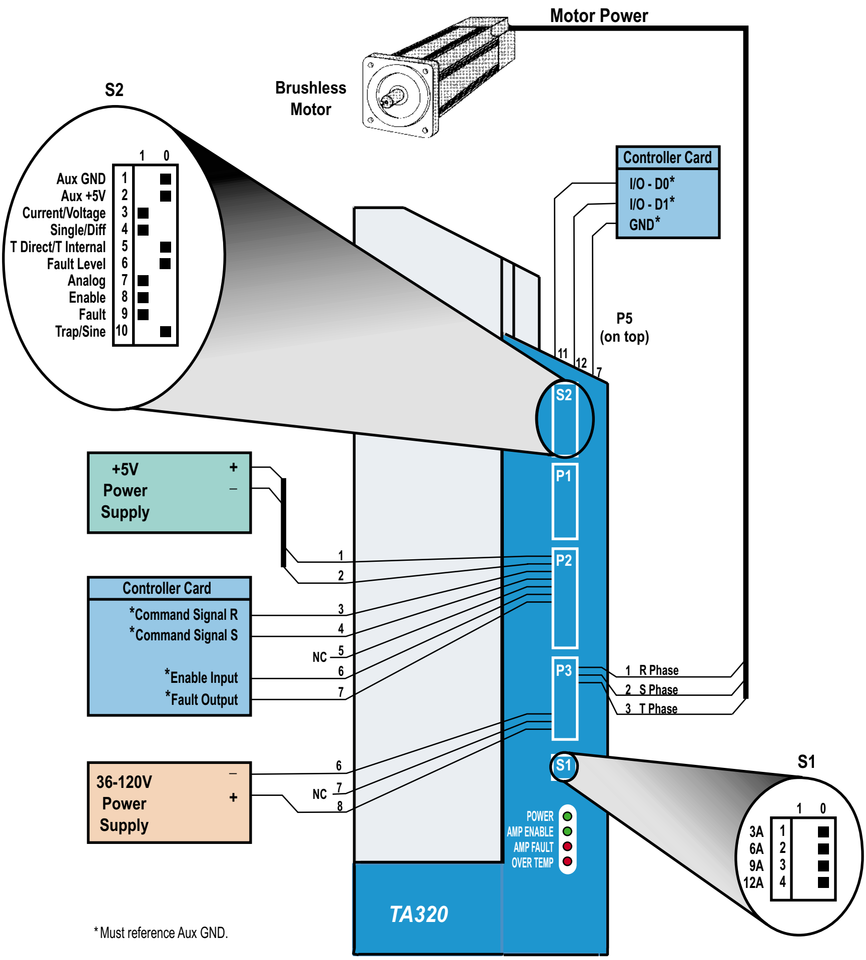


* Must reference Aux GND.
** 2A max.

NOTE: Drawing does not depict connections of a positional or velocity feedback mechanism.

Diagram 320-02	Parameter	Setting
This diagram depicts the TA320 operating in trapezoidal and torque (current) mode, it is set for a fixed current limit of 9A, and logic lines are optically isolated (requires user-supplied 5V supply).	Drive Mode	Trap
	Amplification Mode	Torque
	Logic Optoisolation	Yes
	Fault Output Active	High
	Current Limit	9A
	Transconductance	0.9A/V

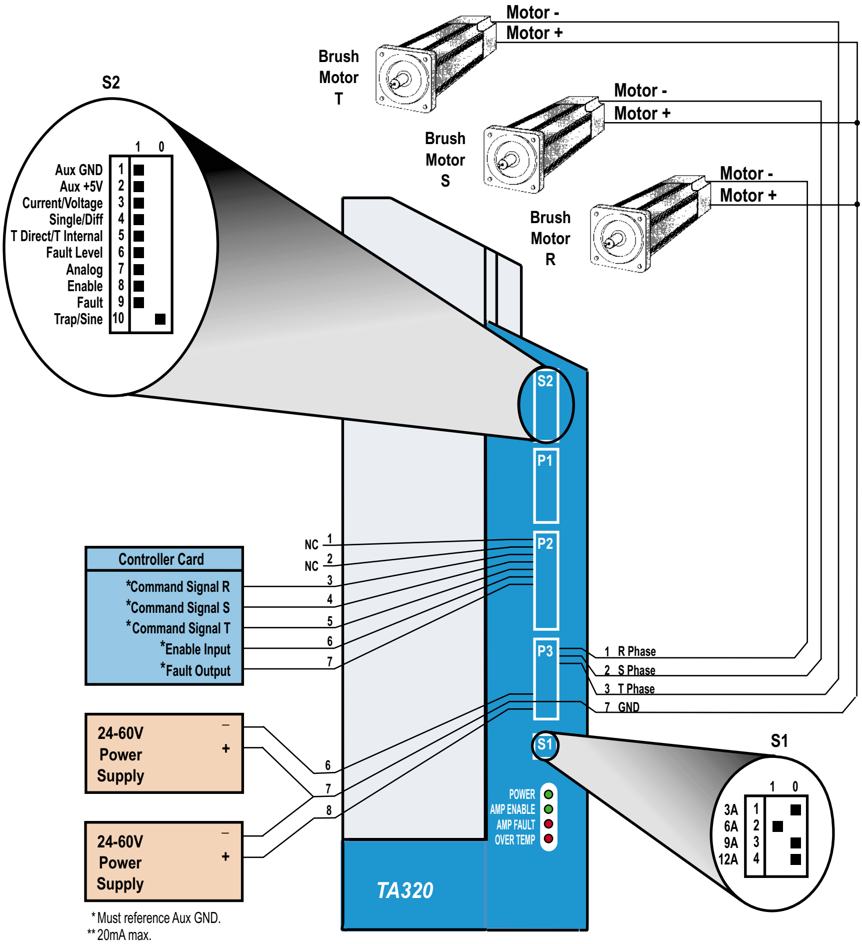
TRUST™ AUTOMATION, INC.
205 Suburban Road ◆ San Luis Obispo, CA 93401
Phone: (805) 544-0761 ◆ Fax: (805) 544-4621
www.TrustAutomation.com



NOTE: Drawing does not depict connections of a positional or velocity feedback mechanism.

Diagram 320-03	Parameter	Setting
This diagram depicts the TA320 operating in sinusoidal and torque (current) modes, powered from a single power supply. The current limit is set via DTS at P5-11 and P5-12. The logic lines are optically-isolated (requires user-supplied 5V supply).	Drive Mode	Sine
	Amplification Mode	Torque
	Logic Optoisolation	Yes
	Fault Output Active	Low
	Current Limit	DTS
	Transconductance	DTS

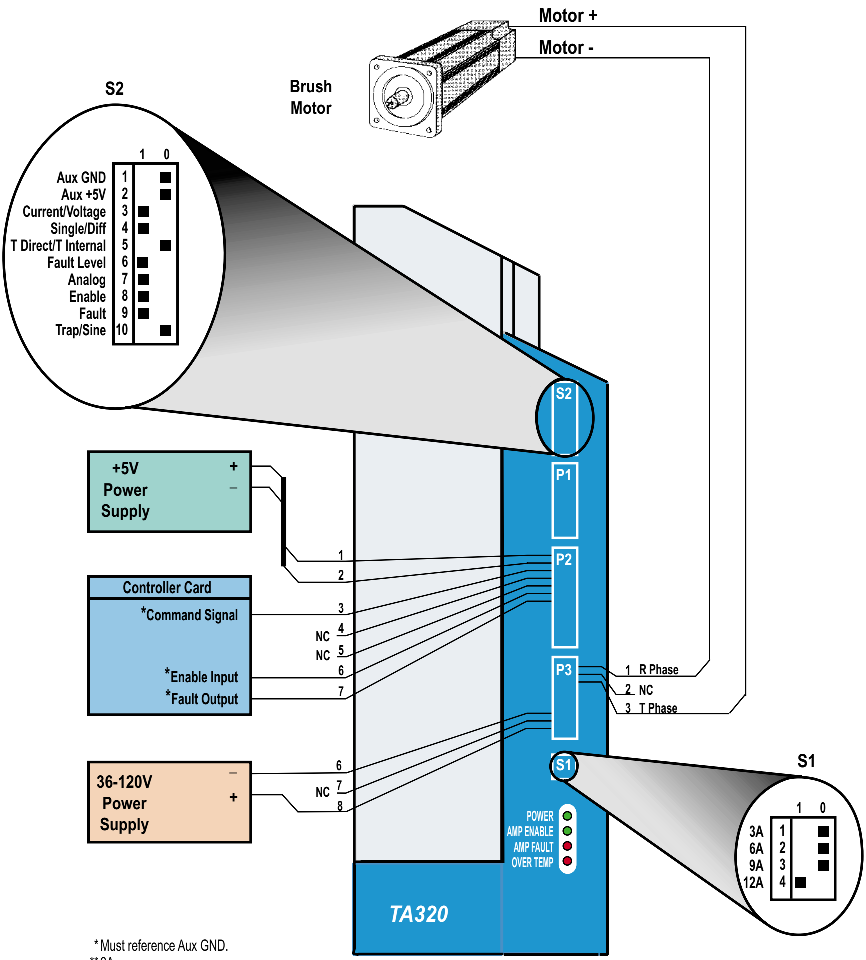
D0	D1	I_o
0	0	3
1	0	6
0	1	9
1	1	12



* Must reference Aux GND.
** 20mA max.

NOTE: 1. Drawing does not depict connections of a positional or velocity feedback mechanism.
2. Dual supplies required for the above configuration.

Diagram 320-04	Parameter	Setting
This diagram depicts the TA320 powering three brush-type motors, operating in torque (current) mode, powered from dual power supplies. The current limit is set for 6A (for each axis). The logic lines are not optically-isolated.	Drive Mode	Sine
	Amplification Mode	Torque
	Logic Optoisolation	No
	Fault Output Active	High
	Current Limit	6A
	Transconductance	.6A/V



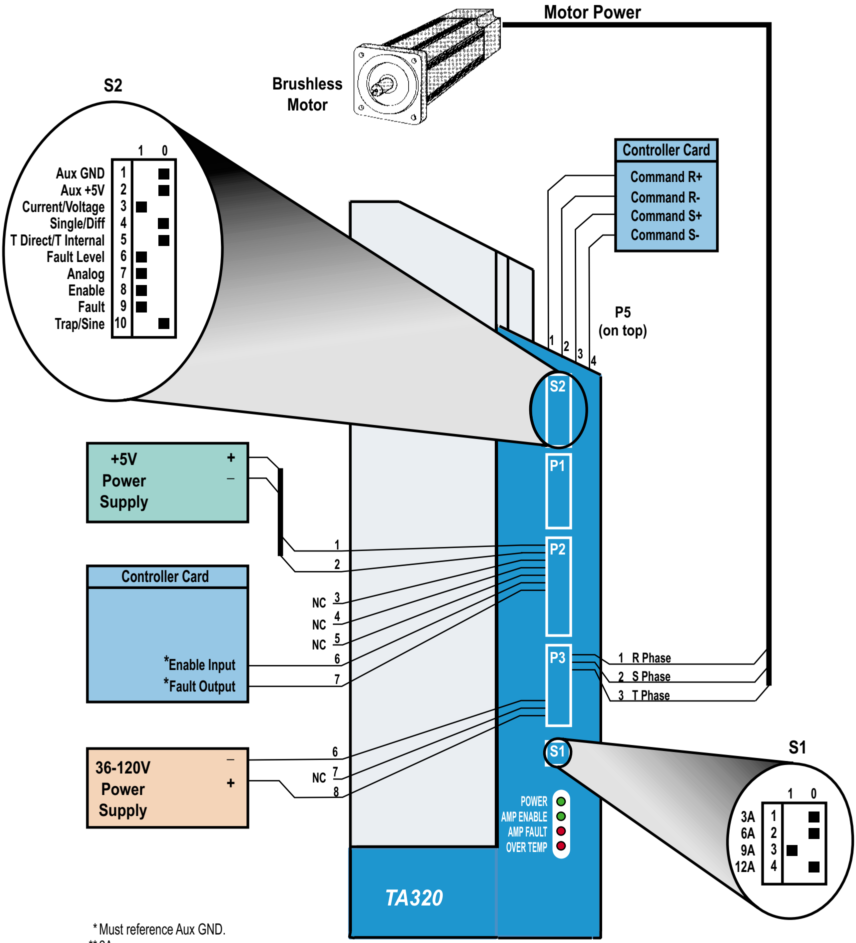
* Must reference Aux GND.
** 2A max.

NOTE: Drawing does not depict connections of a positional or velocity feedback mechanism.

Diagram 320-05	Parameter	Setting
This diagram depicts the TA320 powering one brush-type motor connected in bridge-mode. It is operating in torque (current) mode, and powered from a single power supply. The current limit is set for 12A, and the logic lines are optically-isolated (requires user-supplied 5V supply)	Drive Mode	Sine
	Amplification Mode	Torque
	Logic Optoisolation	Yes
	Fault Output Active	High
	Current Limit	12A
	Transconductance	1.2A/V

205 Suburban Road ◆ San Luis Obispo, CA 93401
Phone: (805) 544-0761 ◆ Fax: (805) 544-4621
www.TrustAutomation.com

TRUST™ AUTOMATION, INC.



* Must reference Aux GND.
** 2A max.

NOTE: Drawing does not depict connections of a positional or velocity feedback mechanism.

Diagram 320-06	Parameter	Setting
This diagram depicts the TA320 operating in sinusoidal and torque (current) modes, powered from a single power supply. The command signals, R & S, are connected differentially at P5. The current limit is set for 9A, and the logic lines are optically-isolated (requires user-supplied 5V supply).	Drive Mode	Sine
	Amplification Mode	Torque
	Logic Optoisolation	Yes
	Fault Output Active	High
	Current Limit	9A
	Transconductance	.9A/V