QuickStart

User Manual

BL3416E2-A04-AC120

Plug-n-Play Servo System
with analog drive, brushless motor and cables
(Continuous 16 lb-in, 4500 rpm)

v. 1.02

ADVANCED

Thank you for purchasing this QuickStart package!
QuickStart makes it easy to set up Advanced Motion Controls drives to get your system running quickly. The drive and motor have been matched with each other, the cables are custom made for this system and an interface board simplifies integration with your controller.

Remember, if you need us, we are here for you!
Our goal is to get you up and running as quickly as possible. If at any point you have a question, a team of applications engineers and our customer service staff are just a phone call away. We are available weekdays from 8am to 5pm Pacific Time at **805-389-1935**. We can also be contacted via email through our website www.a-m-c.com - go to "Contact Us".

4 steps to success!

1	2	3	4
Getting Started What's included with QuickStart and what to expect.	**5-Minute QuickStart** Lets spin the motor!	**Integrate QuickStart into your System** Get your machine working.	**Going into Production** Transitioning from prototype to production.

This manual has been laid out in four sections to guide you through the process of setting up and integrating your QuickStart system. By following each step in succession you will first be introduced to QuickStart, then hook up the system for a simple bench test, and then integrate QuickStart into your machine and finally transition into the production stage.

1
Getting Started

BL3416E2-A04-AC120

What to Expect

What is 'QuickStart'?
QuickStart is a system offering including: a drive, a motor, all necessary cables, and an interface board with screw terminal connections - all in one box ready for fast delivery!

What purpose does 'QuickStart' serve?
QuickStart is intended to introduce OEMs to Advanced Motion Controls servo drives and provide a positive first experience.

Why is Advanced Motion Controls offering a 'QuickStart' package?
We realize that many OEMs today are faced with trying to get their machinery to market using the fastest possible methods. Our solution is to provide a means by which motion control can be quickly proven.

How does 'QuickStart' benefit potential customers?
QuickStart is designed to make system prototyping easier to include Advanced Motion Controls' servo drives. The attraction to OEM's is a savings of time, money and the personnel needed to move from conception to production. Upon receipt, everything will plug in and operate within 5 minutes. All systems are initially configured in velocity or voltage mode to turn the motor shaft at 30 +/- 20 rpm. This is an indication that when put together, it works out of the box. No pots to tweak or software to configure!

Are the motors in the 'QuickStart' program available for individual resale?
Quite simply, not from Advanced Motion Controls. The motors in these packages are meant to represent what is commonly available from many different manufacturers. Your local Advanced Motion Controls representative can handle requests for motor model information for additional purchases.

How is 'QuickStart' pricing important to me?
Careful selection of systems incorporate popular Advanced Motion Control's drives in order to maximize exposure and minimize costs.

What other considerations should you know about 'QuickStart'?
Although it will be hard to find easy-to-configure systems like these at lower prices anywhere, QuickStart isn't intended for multiple, pre-packaged system selling. Initial exposure to Advanced Motion Controls' drives is the key. Each project will be followed up by our Sales department to determine overall progress and assist in determining the next step.

1
Getting Started

Package Contents

☐ Brushless Servo Drive	BX25A20AC
☐ Brushless NEMA 34 Motor w/encoder	MBL3416E2
☐ Screw Terminal Board	System Interface Board (SIB)
☐ Feedback / Commutation Cable (10 foot)	CBL-F01-10
☐ Motor Power Cable (10 foot)	CBL-P02-10
☐ Drive Power Cable	CBL-AC-IEC
☐ Drive Cable (1.5 foot)	CBL-D02
☐ Documentation	Quick Connect Sheet
	User Manual
	Brochure with CD ROM

Additional Requirements

Item	Notes
Power Source	**Requirements:** • **120VAC 60 Hz Single Phase** Acceptable Operating Range 30 – 125 VAC
Controller	+/-10V command signal.

2
5-Minute QuickStart

Let's spin the motor!

This quick setup procedure will get the motor moving in a short amount of time *without the need for a controller*. The drive has been pre-configured in **encoder velocity mode** with a slight offset. This will turn the motor at a slow steady speed on power-up to demonstrate operation. Once the system is shown to be operational, the next section **Integrating QuickStart into your System** will guide you through the process of integrating the system into your application.

Wiring

On page 7 you will find the cables and connections sheet. Use this as a reference when following the steps in this section.

Drive

Connect cable CBL-D02 to the P1 and P3 connectors on the drive. Connect the other end to the C2 connector on the system interface board (SIB).

Feedback

CBL-F01-10 is the feedback cable. Connect the black connectors and shield drain wire on this cable to the corresponding connectors on the motor. Connect the 15pin D-sub to the C1 connector on the System Interface Board (SIB).

Motor

Connect the white connector on the motor power cable CBL-P02-10 to the corresponding connector on the motor. Connect the green connector to the P2 connector on the drive.

Red	Motor A, P2-1
White	Motor B, P2-2
Black	Motor C, P2-3

CBL-AC-IEC supplies AC to the drive. Do not apply power at this time. An AC power strip or other switch can be used to make cycling power more convenient during testing.

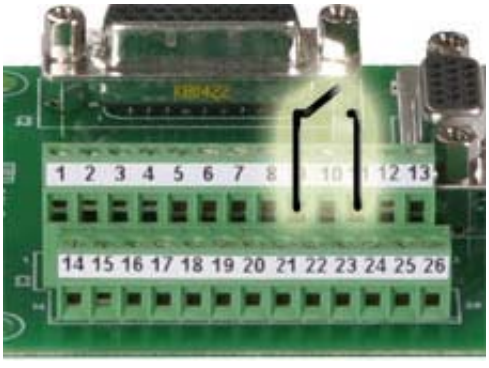
Grounding

Bring all ground wires to a central point ground such as a ground bus, ground plane or a single ground bolt. Also don't forget to ground the drive chassis! Use the silver screw marked PE on the case.

Motor Ground – The green wire coming from motor power cable is the motor chassis ground. If the motor case is already grounded through direct contact with the machine housing, then leave the green wire disconnected. Grounding the motor at both the green wire and at the motor case causes a ground loop that has been shown to disrupt the feedback signals. Choose one or the other.

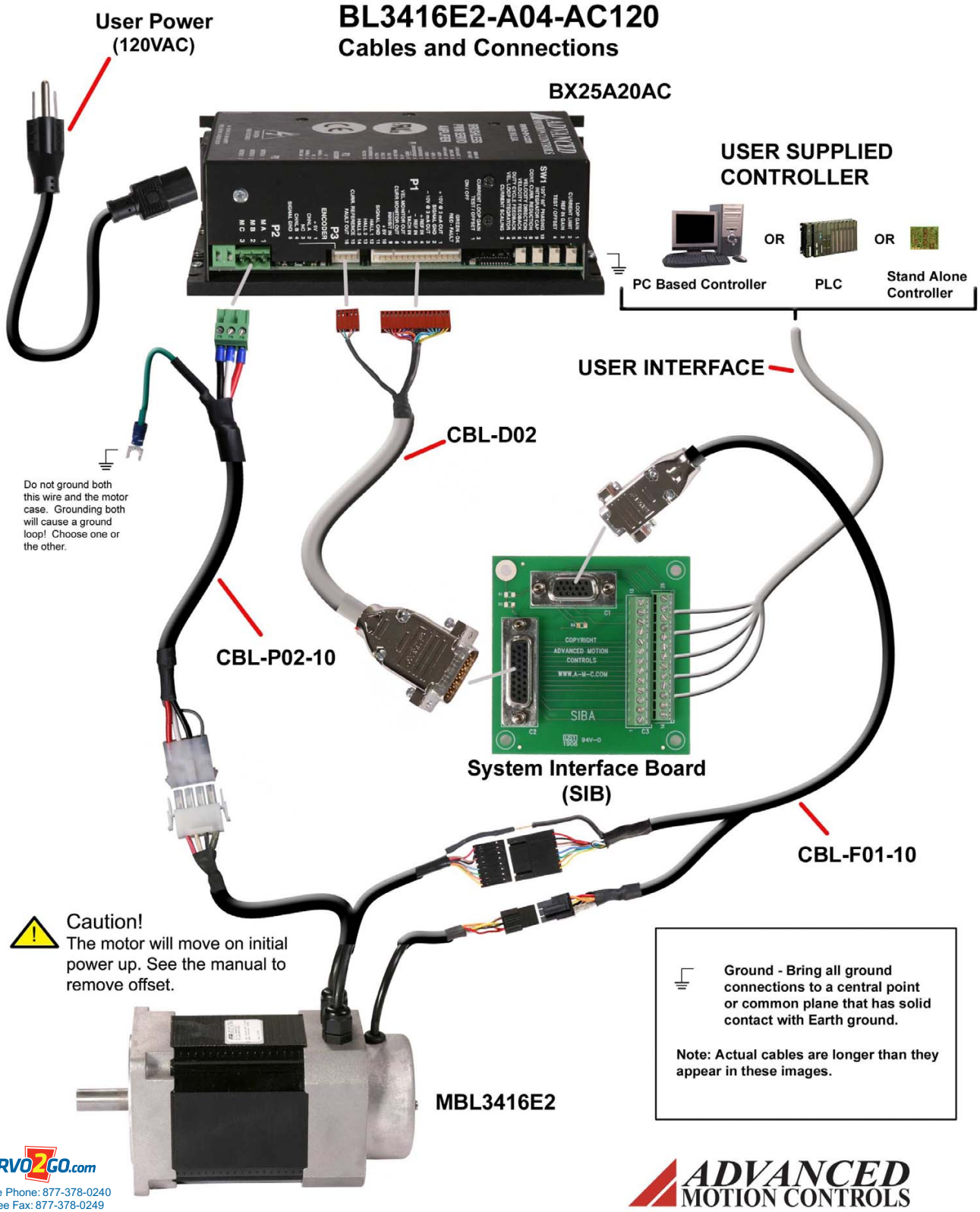
Inhibit Switch (optional for this section)

An inhibit switch (not included) can be connected between pins 9 and 11 on the Interface Board. This switch disables power to the motor until you are ready. Opening the switch Enables the drive, closing the switch Disables the drive.



Cautions

Unexpected motion – To avoid the motor from jumping unexpectedly and causing damage, the motor should be secured either with clamps or bolted down using its mounting holes.



ADVANCED MOTION CONTROLS

2
5-Minute QuickStart

Inhibit Line Test (optional) – Follow this step only if you installed the inhibit switch described in the wiring section on page 6. This is to verify that the optional inhibit switch is functioning and the drive is initially powered up in a disabled state.

1. Disconnect the motor power by unplugging the white connector on CBL-P02-10. *Unplugging this connection allows you to power up the system without the possibility of spinning the motor.*
2. Apply power to the drive. Toggle the inhibit switch and verify that you can cause the LED color to change from Red to Green. Set the switch so the LED is Red.
3. Remove power from the drive and reconnect the white connector on CBL-P02-10.

System Power Up

1. Apply power to the drive. *If an inhibit switch has been installed, enable the drive by toggling the inhibit switch so the LED turns Green.*
2. The motor should turn at a controlled speed.
3. If the motor turns then the system has been hooked up correctly. Remove power and continue to the next section. If not then go to **Troubleshooting**.
4. To stop the motor from turning, turn the Test/Offset switch (SW1-1) to the OFF position. Then use the offset pot (Pot 4) to set the speed to zero. The motor may continue to creep very slowly when in velocity mode. True zero speed can be achieved once a controller is used to close the loop around the servo drive.

Troubleshooting

LED not lit.	Verify that power has been applied to the drive.
Motor doesn't have holding torque	Verify that the LED is Green.
LED doesn't turn Green.	Verify all cables are connected. If an Inhibit Switch has been installed, toggle the Inhibit switch.
Motor doesn't turn but has holding torque	Turn Pot 4 (Test/Offset) in either direction. This will change the amount of offset in the drive.
Contact Factory - If you can't get the motor turning within a few minutes, please call and ask for technical support! 805-389-1935. We want to get you up and running quickly!	

3a Wiring
Integrate QuickStart into your System

The following instructions are a continuation of the **5-Minute QuickStart**. This section explains controller wiring, drive configuration, drive mounting, motor mounting, SIB mounting and load coupling.

Signal Ground

Almost all signals between the drive and the controller are referenced to signal ground. Without this reference, the drive and the controller would not be able to transmit signals to each other. To ensure that the signals between the drive and the controller are referenced to the same potential, the signal grounds on the controller and the drive must be connected together. This is especially important for:

- Single ended command signals
- Inhibit line
- Other inputs and outputs.

You will need to identify the signal ground on your controller and connect it to the signal ground on the drive. For your convenience, the Signal Ground is accessible at three locations on the SIB. However, to avoid ground loops there should only be one connection between the drive signal ground and the controller signal ground. Don't add a connection if there is already continuity between the two grounds.

Available Signal Ground Locations on the SIB

Controller	SIB
Signal Ground	C3-2 (SGND)
	C3-11 (SGND)
	C3-19 (SGND)

Command Signal

Command signal and mode selection are dictated by the capabilities of your controller and the desired operation of your system. Analog +/- 10V command signals are suited for torque and velocity modes

+/-10V Command Signal (Single Ended)

Signal	SIB	Available Drive Modes
SGND	C3-2 (SGND)	Torque Mode, Velocity Mode
Command	C3-4 (Ref+)	

+/-10V Command Signal (Differential)

Signal	SIB	Available Drive Modes
Command +	C3-4 (Ref+)	Torque Mode, Velocity Mode
Command -	C3-5 (Ref-)	

More Information on Mode Selection

Drive modes can be separated into three basic categories: Torque, Velocity and Position. The name of the mode describes what servo loops are being closed in the drive. They

don't describe the end-result of the operation. For example, a drive in Torque mode can still be in a positioning application if the external controller closes the position loop. In fact, most high performance positioning systems use a drive in torque mode with the controller closing the velocity and position loops.

The correct mode is determined by the requirements of the controller. Some controllers require that the drive be in torque mode. Other controllers require that the drive be in velocity mode. Check the documentation on your controller or contact the manufacturer of your controller to determine the correct mode for your drive.

Once the command signal and mode have been selected, connect the controller to the signals as indicated in the above tables. The proper gains and command settings must also be configured. This will be explained later in the configuration section.

Drive Inhibit (recommended)

The inhibit line is used to turn off power to the motor while the drive is still powered on. Sometimes this is necessary if power to the motor needs to be removed quickly or if the user needs to manually move the load in a freewheeling condition. If your controller has an inhibit function then we highly recommend that you use it.

Inhibit Connection

Controller	SIB
Inhibit	C3-9 Inhibit

Note: The inhibit input is configured to disable the drive when pulled low (active low). The control logic can be inverted by setting Switch 2-3 to the off position.

Continued…

3a Wiring
Integrate QuickStart into your System

Feedback

The feedback on the motor is an incremental encoder with two Channels (A and B) and an Index (I). The signals are differential but are compatible with single ended circuitry (simply leave the complimentary signals open A-, B- and I-). The resolution is 10000 counts per revolution (quadrature).

Power Requirements - Encoder power is supplied by the drive. 5VDC @ 125mA.

The screw terminals on the System Interface Board (SIB) provide easy access to the encoder signals.

Encoder Connection

Signal	SIB
SGND	C3-19
5VDC	C3-20
Channel A+	C3-21
Channel A-	C3-22
Channel B+	C3-23
Channel B-	C3-24
Channel I+	C3-25
Channel I-	C3-26

Drive Mounting

Mounting Dimensions can be found in the drive datasheet in the Appendix.

The drive can be mounted flat against the base plate or along the spine.

Mounting the drive flat on the base plate against a large thermally conductive surface for cooling will provide the most natural heat dissipation for the drive. A metal back plane in a cabinet on the machine often makes a good surface.

Drives mounted on the spine can be mounted next to each other. Maintain a minimum separation of 1 inch between drives to provide adequate convection cooling.

Note: Additional cooling may be necessary to dissipate the heat generated by the drive depending on ambient temperatures, duty cycle and natural ventilation.

Motor Mounting

Mounting Dimensions can be found in the motor datasheet in the Appendix.

The mounting surface must be stiff enough so it does not deflect when radial loads are applied to the motor shaft. The mounting surface should also have good thermal conductivity, especially if peak performance is demanded of the motor.

3a Wiring
Integrate QuickStart into your System

SIB Mounting
Mounting Dimensions can be found in the SIB datasheet in the Appendix.

The SIB can be mounted using the mounting holes or a DIN tray such as from Phoenix Contact. If using the mounting holes, standoffs must be used to keep the bottom of the SIB from shorting with the mounting surface.

Cable Routing
Cable Datasheets can be found in the Appendix.

QuickStart cables come with excellent shielding and make proper grounding easy. This makes proper cable routing less critical, however proper routing practices should still be followed.

Route cables to minimize length and minimize exposure to noise sources. The motor power wires are a major source of noise and the motor feedback wires are susceptible to receiving noise. This is why it is never a good practice to route the motor power wires close to the motor feedback wires even if they are shielded. Although both of these cables originate at the amplifier and terminate at the motor, try to find separate paths that maintain distance between the two. A rule of thumb for the minimum distance between these wires is 1cm for every 1m of cable length.

Grounding
Bring all ground wires to a central point ground such as a ground bus, ground plane or a single ground bolt. Also don't forget to ground the drive chassis! Use the silver screw marked PE on the case.

Motor Ground – The green wire coming from motor power cable is the motor chassis ground. If the motor case is already grounded through direct contact with the machine housing, then leave the green wire disconnected. Grounding the motor at both the green wire and at the motor case causes a ground loop that has been shown to disrupt the feedback signals. Choose one or the other.

Load Coupling
A non-rigid coupling must be used between the motor shaft and the load to minimize mechanical stress due to radial loads, axial loads or misalignment. If you feel that the radial load on the motor is excessive, you may want to consider connecting the motor to an idler shaft that is supported by pillow block bearings (or similar). Then the load can be coupled to the idler shaft without risking damage to the motor bearings.

Configuration

BX25A20AC Capabilities

Mode Category	Mode Name
Torque	Current
Velocity Estimation	Open Loop*
Velocity	Encoder Velocity
	Hall Velocity**

***** Open Loop Mode does not use direct feedback to close the velocity loop; therefore, it can't be considered a true velocity mode. Open Loop Mode produces velocity that is roughly proportional to the input command but is not as precise as using a Tachometer or Encoder.
****** Hall Velocity mode is not recommended with this system since Encoder Velocity mode is available with superior velocity control.

The correct mode is determined by the requirements of the controller. Some controllers require that the drive be in torque mode. Other controllers require that the drive be in velocity mode. Check the documentation on your controller or contact the manufacturer of your controller to determine the correct mode for your drive.

Advanced Motion Controls Analog Servo Drives are configured using Switches and Potentiometers. There is no software to download or configure.

The basic setup of these servo drives is straight forward and user friendly. These instructions will walk you through the steps necessary to configure your drive to your system:

- Configure the drive mode.
  - Torque Mode (page 14)
  - Velocity Mode (page 16)
    - Encoder Velocity
    - Hall Velocity
    - Open Loop

Torque Mode Configuration

The terms 'Torque Mode' and 'Current Mode' are synonymous. They can be interchanged and you may see either of these terms throughout this document and other motion control documents.

The Switches and Potentiometers set the mode on the drive. Use the Mode Selection Table for the correct configuration.

Mode Selection Table – Torque Mode

Switch Bank 1	**SW1-1**	Off
	SW1-2	On
	SW1-3	On
	SW1-4	On
	SW1-5	Off
	SW1-6	Off
	SW1-7	On
	SW1-8	On
	SW1-9	On
	SW1-10	On
Switch Bank 2	**SW2-1**	Off
	SW2-2	Off
	SW2-3	On
	SW2-4	On
	SW2-5	On
	SW2-6	On
Potentiometers	**Pot1** Loop Gain	Full CCW
	Pot2 Current Limit	Full CW
	Pot3 Reference Gain	Full CW
	Pot4 Offset	Mid (7 turns)

Current Limit with these settings – 12.5A continuous, 25A peak

** Potentiometer Instructions* – CW is the clockwise direction, CCW is the counterclockwise direction. Full CW or Full CCW means the pot has been turned to the end of its travel where it begins to click on every turn. These potentiometers have a 14 turn range before they start to click.

The number of potentiometer turns on the Mode Selection Table is referenced from the full counterclockwise position. To maintain consistency in the number of turns the initial starting point is defined as follows:

1. Turn the pot CCW until the pot begins to click on every turn.
2. Continue to slowly turn the pot CCW until the next click is heard, then stop.
3. Now turn the pot in the CW direction the number of turns indicated in the Mode Selection Table.

Gain Setting

The gain of the drive (amps out)/(volts in) can be adjusted using the Reference Gain Potentiometer, Pot 3. Turning the pot to the full clockwise position results in a gain of roughly 2.5A/V. Turning the pot counter clockwise reduces the gain down to a minimum of zero.

Velocity Mode Configuration

Velocity mode outputs a velocity that is proportional to a given input command. The gain can be expressed as (output velocity)/(input command). Common units could be (rpm)/(V) and (counts per second)/(V).

The three velocity modes available in this system offer varying degrees of performance. Starting with the highest performance, they are listed below.

Encoder Velocity
Uses the encoder as the velocity feedback. This mode is very accurate over the widest range of speeds.

Hall Velocity
This mode uses the Hall sensors for velocity feedback. This mode is not accurate at slow velocities, but as the speed increases beyond 1000 rpm this mode becomes more usable. This mode is popular in systems where the cost of an encoder is prohibitive and the operating velocity is above 1000 rpm.

Open Loop
This mode does not use any feedback to determine velocity. Velocity is estimated by the duty cycle of the PWM. Open Loop mode is the least accurate of these velocity modes.

The Switches and Potentiometers set the mode on the drive. Use the Mode Selection Table for the correct configuration.

Continued...

3b Configuration (Velocity Mode)
Integrate QuickStart into your System

The Switches and Potentiometers set the mode on the drive. Use the Mode Selection Table for the correct configuration.

Mode Selection Table – Velocity Mode

		Encoder Velocity	Hall Velocity	Open Loop
Switch Bank 1	**SW1-1**	Off	Off	Off
	SW1-2	On	On	On
	SW1-3	On	On	On
	SW1-4	Off	Off	Off
	SW1-5	Off	Off	On
	SW1-6	On	On	Off
	SW1-7	On	On	On
	SW1-8	On	On	On
	SW1-9	Off	On	Off
	SW1-10	On	On	On
Switch Bank 2	**SW2-1**	On	Off	Off
	SW2-2	Off	On	Off
	SW2-3	On	On	On
	SW2-4	On	On	On
	SW2-5	On	On	On
	SW2-6	On	On	On
Potentiometers	**Pot1** Loop Gain	8 turns	10 turns	9.5 turns
	Pot2 Current Limit	Full CW	Full CW	Full CW
	Pot3 Reference Gain	Full CW	Full CW	Full CW
	Pot4 Offset	Mid (7 turns)	Mid (7 turns)	Mid7(turns)

Current Limit with these settings – 12.5A continuous, 25A peak

* *Potentiometer Instructions* – CW is the clockwise direction, CCW is the counterclockwise direction. Full CW or Full CCW means the pot has been turned to the end of its travel where it begins to click on every turn. These potentiometers have a 14 turn range before they start to click.

The number of potentiometer turns on the Mode Selection Table is referenced from the full counterclockwise position. To maintain consistency in the number of turns the initial starting point is defined as follows:

1. Turn the pot CCW until the pot begins to click on every turn.
2. Continue to slowly turn the pot CCW until the next click is heard, then stop.
3. Now turn the pot in the CW direction the number of turns indicated in the Mode Selection Table.

Continued…

Loop Gain

Pot 1

In Velocity Mode the loop gain increases the responsiveness of the system. The loop gain settings in the mode selection table are a good starting point. However, once the drive is in the system, the loop gain will need to be adjusted to match the system dynamics.

To adjust the Loop Gain

- Turn the Loop Gain pot to the full counterclockwise position.
- Enable the drive
- Turn the Loop Gain pot clockwise.
- When the system begins to make a loud buzzing noise, turn the pot in the counterclockwise direction until the buzzing stops.
- Turn the pot one more turn in the counter clockwise position.

Reference Gain

Pot 3

The gain of the drive (velocity out)/(volts in) can be adjusted using the Reference Gain Potentiometer, Pot 3. Turning the pot clockwise increases the gain, while turning the pot counter clockwise decreases the gain.

4
Going into Production

Prototype to Production

Once you have completed your proof of concept you will be ready to design for production. If you decide that the QuickStart drive and motor are perfect for you then you're in luck. Both are popular off-the-shelf items that are readily available. Drives can be ordered directly from us and we can put you in touch with the appropriate motor supplier.

If your servo system requires a drive that better fits your application such as:

- Additional features
- Different power range
- Smaller size
- Different form factor such as 'plug in' style drives
- Network connectivity

Then our applications engineers can help optimize your system by selecting the best drive for your needs.

You will also be in contact with a local representative to help you with the selection of motors and other system components such as cables, gear boxes, slides, bearings and more.

Feedback

Your feedback is important to us. Your comments can make QuickStart better and help us improve our processes, technical support, customer support and product offering. Please go to www.a-m-c.com/feedback.html

Appendix

A. System Specifications

B. Drive

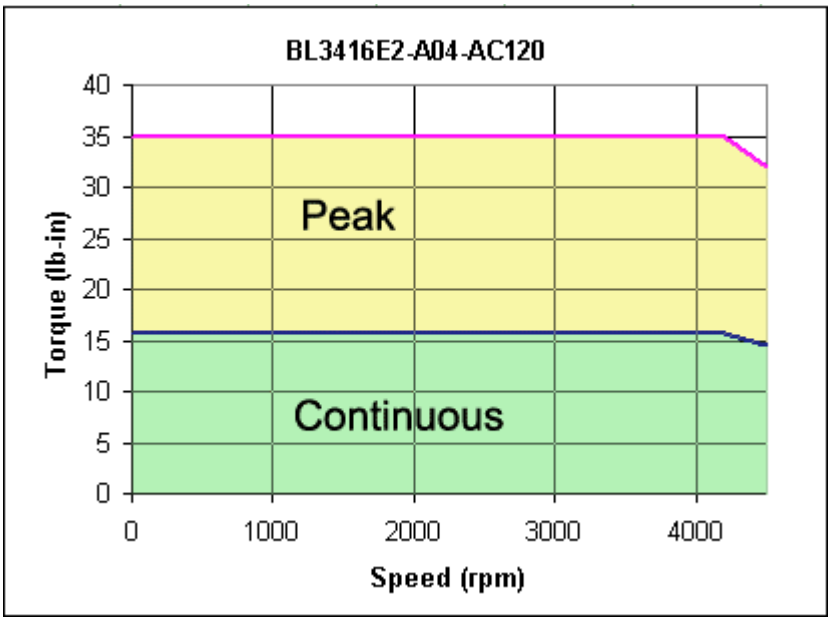
C. Motor

D. Cables

E. System Interface Board

System Specifications

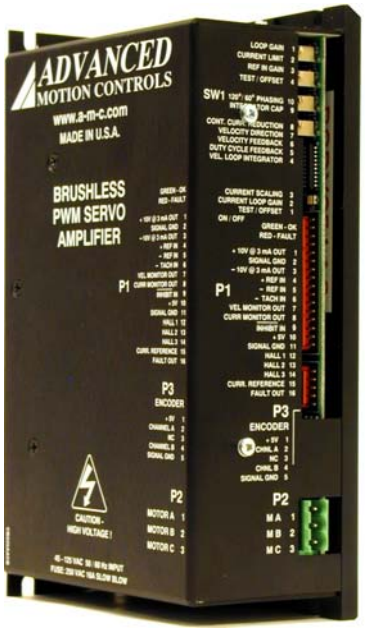
System Specifications

Torque – peak	35 lb-in, 3.975 Nm
Torque – continuous	15.63 lb-in, 1.77 Nm
Velocity Maximum	4500 rpm
Supply Voltage	120VAC
Encoder Resolution	10000 counts / rev
Speed Torque Curve	

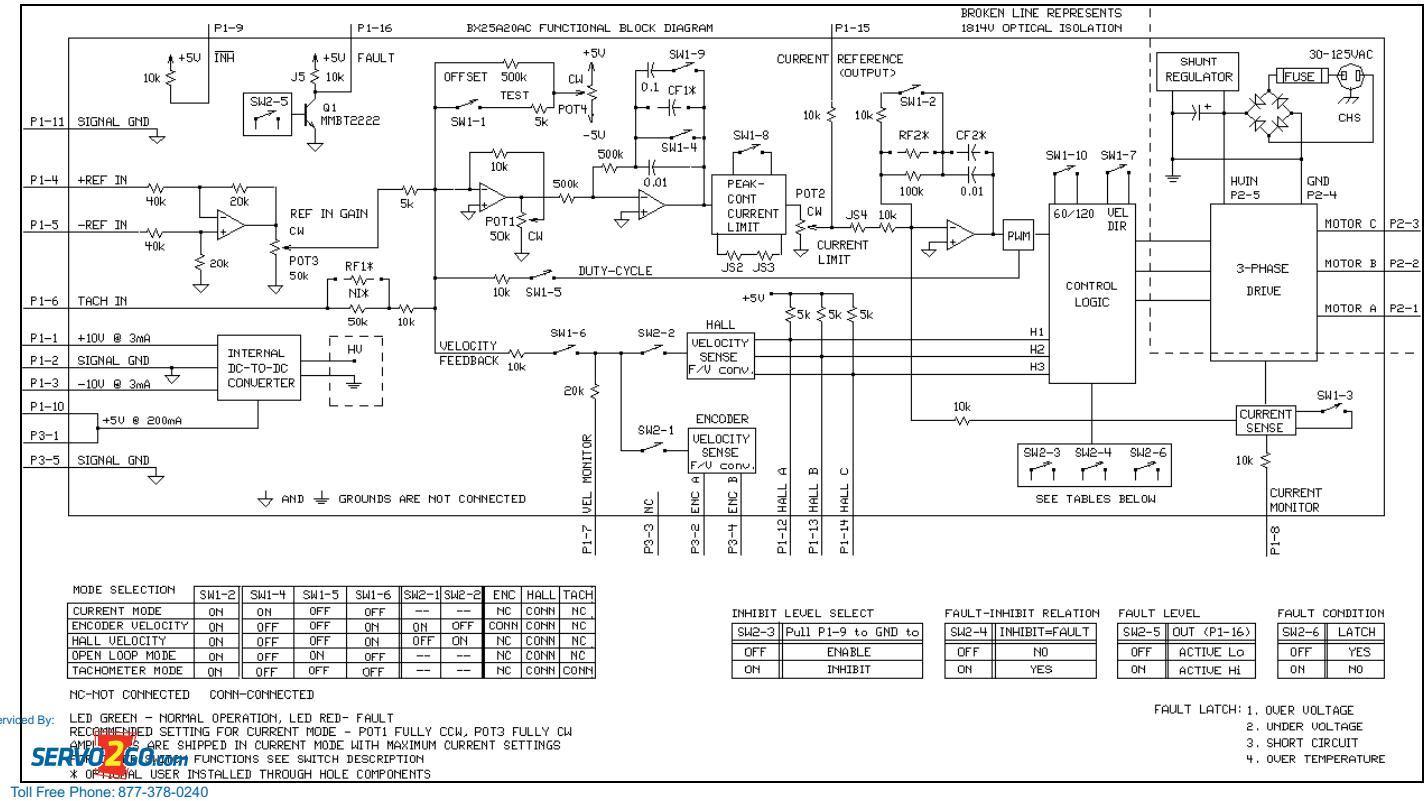
BX25A20AC SERIES BRUSHLESS SERVO AMPLIFIERS
Model: BX25A20AC
120VAC Single Supply Operation

FEATURES:

- Surface-mount technology
- Small size, low cost, ease of use
- Built-in shunt regulator
- DIP switch/jumper selectable modes: current, open loop, tachometer, HALL velocity and encoder velocity
- Latching/Non Latching fault, active hi/active low fault and inhibit /enable are dip switch selectable
- Four quadrant regenerative operation
- Agency approvals:



BLOCK DIAGRAM:



MODE SELECTION	SW1-2	SW1-4	SW1-5	SW1-6	SW2-1	SW2-2	ENC	HALL	TACH
CURRENT MODE	ON	ON	OFF	OFF	--	--	NC	CONN	NC
ENCODER VELOCITY	ON	OFF	OFF	ON	ON	OFF	CONN	CONN	NC
HALL VELOCITY	ON	OFF	OFF	ON	OFF	ON	NC	CONN	NC
OPEN LOOP MODE	ON	OFF	ON	OFF	--	--	NC	CONN	NC
TACHOMETER MODE	ON	OFF	OFF	OFF	--	--	NC	CONN	CONN

NC-NOT CONNECTED CONN-CONNECTED

INHIBIT LEVEL SELECT	
SW2-3	Pull P1-9 to GND to
OFF	ENABLE
ON	INHIBIT

FAULT-INHIBIT RELATION	
SW2-4	INHIBIT=FAULT
OFF	NO
ON	YES

FAULT LEVEL	
SW2-5	OUT (P1-16)
OFF	ACTIVE Lo
ON	ACTIVE Hi

FAULT CONDITION	
SW2-6	LATCH
OFF	YES
ON	NO

LED GREEN - NORMAL OPERATION, LED RED- FAULT
RECOMMENDED SETTING FOR CURRENT MODE - POT1 FULLY CCW, POT3 FULLY CW
AMPLIFIERS ARE SHIPPED IN CURRENT MODE WITH MAXIMUM CURRENT SETTINGS
* OPTIONAL USER INSTALLED THROUGH HOLE COMPONENTS

FAULT LATCH: 1. OVER VOLTAGE
2. UNDER VOLTAGE
3. SHORT CIRCUIT
4. OVER TEMPERATURE

ADVANCED MOTION CONTROLS
3805 Calle Tecate, Camarillo, CA 93012 Tel: (805) 389-1935, Fax: (805) 389-1165

DESCRIPTION: The BX25A20AC Series PWM servo amplifiers are designed to drive brushless DC motors at a high switching frequency. The BX25A20AC is fully protected against over-voltage, over-current, over-heating and short-circuits. This model interfaces with digital controllers or can be used as a stand-alone drive and requires only a single unregulated AC power supply. A single red/green LED and a single digital output indicate operating status. Loop gain, current limit, input gain and offset can be adjusted using 14-turn potentiometers. The offset adjusting potentiometer can also be used as an on-board input signal for testing purposes, when SW1 (DIP switch) is ON.

SPECIFICATIONS:

All BX25A20AC specifications are identical to the BX25A20 specifications (see BX30A series data sheets) except for:

	MODEL
POWER STAGE SPECIFICATIONS	**BX25A20AC**
SINGLE PHASE AC SUPPLY VOLTAGE	45 - 140 VAC @ 50-60 Hz
SHUNT RESISTOR	10 Ω @ 50 W
SHUNT SWITCH-ON VOLTAGE*	195 VDC
BUS CAPACITANCE	3600 μF
SHUNT FUSE (d=.25 inches, L=1.25 inches)	3 A Motor Delay rated @ 250 VAC
BUS FUSE (5x20 mm)	16 A slow-blow rated @ 250 VAC

MECHANICAL SPECIFICATIONS	
POWER CONNECTOR	Quick Disconnect
SIGNAL CONNECTOR	Molex connector
SIZE	7.35 x 4.23 x 2.45 inches 186.7 x 107.4 x 62.2 mm
WEIGHT	2.5 lb. 1.14 kg

* If the shunt regulator is disabled the shut down voltage is 205 VDC.

These amplifiers contain a rectifier bridge and filter capacitors to generate the DC bus internally from the AC input power. The DC bus voltage is 1.4 times AC voltage (RMS), e.g. 170 VDC from 120 VAC. During braking much of the stored mechanical energy is fed back into the power supply and charges the output capacitor to a higher voltage. If the charge reaches the amplifier's over-voltage shutdown point, output current and braking will cease. To ensure smooth braking of large inertial loads, a built-in "shunt regulator" is provided in this model. The shunt regulator will switch-on the internal power resistor when the bus voltage exceeds 195 VDC. This resistor then dissipates the extra energy of the DC bus.

ORDERING INFORMATION:

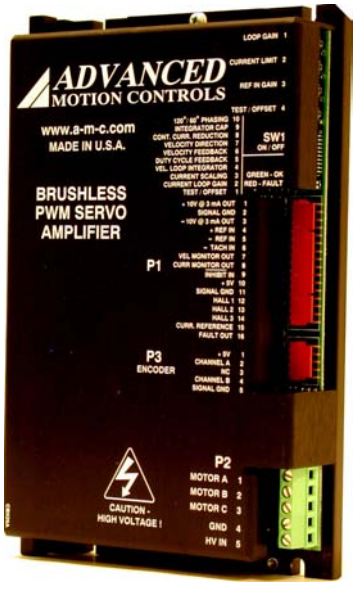
Model: BX25A20ACX

X (at the end) indicates the current revision letter.

TYPICAL SYSTEM WIRING: See section "G".

MOUNTING DIMENSIONS: See page F-11.

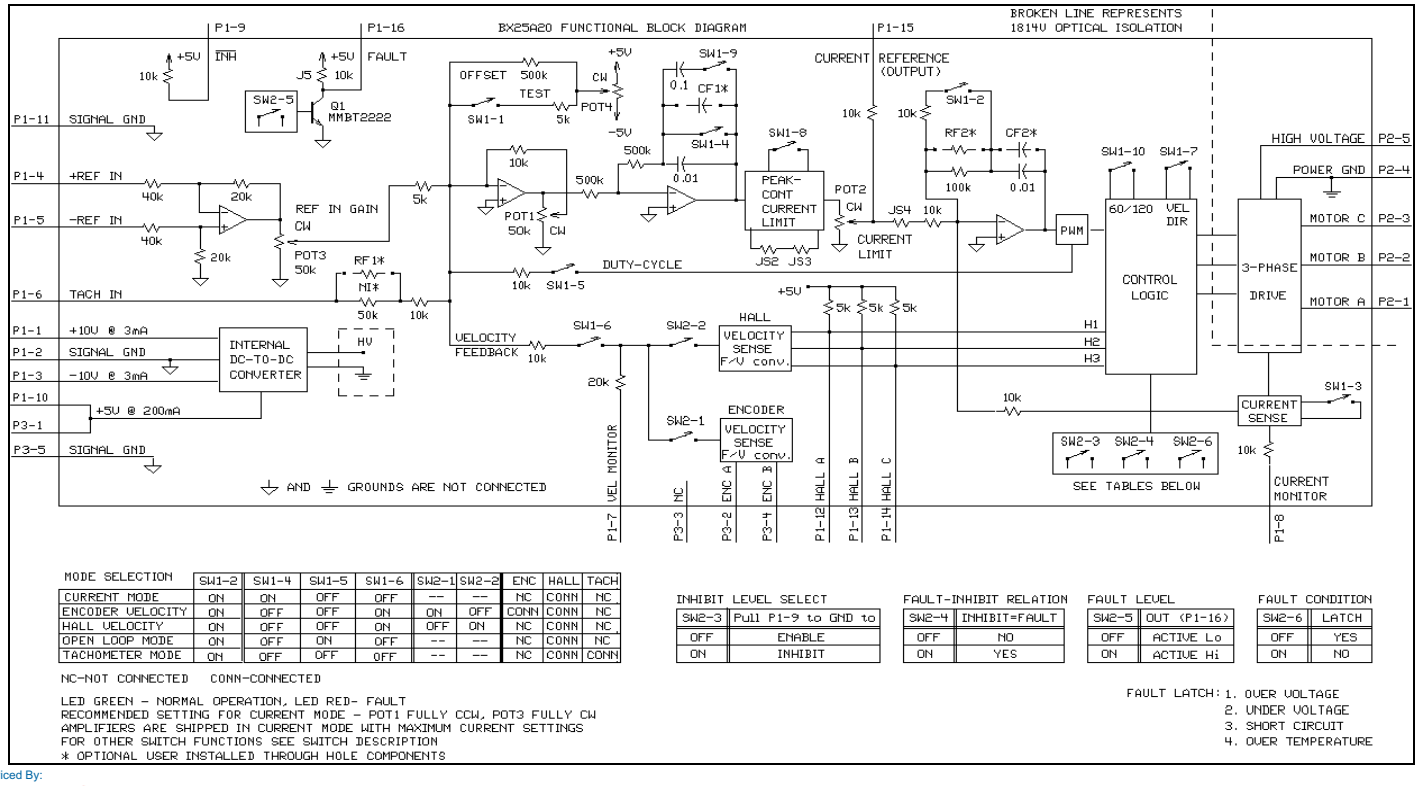
BX30A SERIES BRUSHLESS SERVO AMPLIFIERS
Model: BX25A20



FEATURES:

- Surface-mount technology
- Small size, low cost, ease of use
- DIP switch selectable modes: current, open loop, tachometer, Hall velocity and encoder velocity
- Latching/Non Latching fault, active hi/active low fault and inhibit /enable are dip switch selectable
- Four quadrant, regenerative operation
- Hall sensor commutation
- Agency Approvals:

BLOCK DIAGRAM:



MODE SELECTION	SW1-2	SW1-4	SW1-5	SW1-6	SW2-1	SW2-2	ENC	HALL	TACH
CURRENT MODE	ON	ON	OFF	OFF	--	--	NC	CONN	NC
ENCODER VELOCITY	ON	OFF	OFF	ON	ON	OFF	CONN	CONN	NC
HALL VELOCITY	ON	OFF	OFF	ON	OFF	ON	NC	CONN	NC
OPEN LOOP MODE	ON	OFF	ON	OFF	--	--	NC	CONN	NC
TACHOMETER MODE	ON	OFF	OFF	OFF	--	--	NC	CONN	CONN

NC-NOT CONNECTED CONN-CONNECTED

INHIBIT LEVEL SELECT	
SW2-3	Pull P1-9 to GND to
OFF	ENABLE
ON	INHIBIT

FAULT-INHIBIT RELATION	
SW2-4	INHIBIT=FAULT
OFF	NO
ON	YES

FAULT LEVEL	
SW2-5	OUT (P1-16)
OFF	ACTIVE Lo
ON	ACTIVE Hi

FAULT CONDITION	
SW2-6	LATCH
OFF	YES
ON	NO

LED GREEN - NORMAL OPERATION, LED RED- FAULT
RECOMMENDED SETTING FOR CURRENT MODE - POT1 FULLY CCW, POT3 FULLY CW
AMPLIFIERS ARE SHIPPED IN CURRENT MODE WITH MAXIMUM CURRENT SETTINGS
FOR OTHER SWITCH FUNCTIONS SEE SWITCH DESCRIPTION
* OPTIONAL USER INSTALLED THROUGH HOLE COMPONENTS

FAULT LATCH: 1. OVER VOLTAGE
2. UNDER VOLTAGE
3. SHORT CIRCUIT
4. OVER TEMPERATURE

ADVANCED MOTION CONTROLS
3805 Calle Tecate, Camarillo, CA 93012 Tel: (805) 389-1935, Fax: (805) 389-1165

DESCRIPTION: The BX30A Series PWM servo amplifiers are designed to drive brushless DC motors at a high switching frequency. They are fully protected against over-voltage, over-current, over-heating and short-circuits. All models interface with digital controllers or can be used as stand-alone drives. They require only a single unregulated DC power supply. A single red/green LED indicates operating status. Loop gain, current limit, input gain and offset can be adjusted using 14-turn potentiometers. The offset adjusting potentiometer can also be used as an on-board input signal for testing purposes when SW1 (DIP switch) is ON. These models can use quadrature encoder inputs or Hall sensors for velocity control.

SPECIFICATIONS:

	MODEL
POWER STAGE SPECIFICATIONS	**BX25A20**
DC SUPPLY VOLTAGE	60 - 200 V
PEAK CURRENT (2 sec. Max., internally limited)	± 25 A
MAX. CONTINUOUS CURRENT (internally limited)	± 12.5 A
MINIMUM LOAD INDUCTANCE*	250 µH
SWITCHING FREQUENCY	22 kHz ± 15%
HEATSINK (BASE) TEMPERATURE RANGE	0^{o} to $+65^{o}$ C, disables if > 65^{o} C
POWER DISSIPATION AT CONTINUOUS CURRENT	125 W
OVER-VOLTAGE SHUT-DOWN (self reset)	205 V
BANDWIDTH (load dependent)	2.5 kHz

MECHANICAL SPECIFICATIONS	
POWER CONNECTOR	Screw Terminals
SIGNAL CONNECTOR	Molex connector
SIZE	7.35 x 4.40 x 1.45 inches 186.7 x 111.7 x 36.8 mm
WEIGHT	1.5 lb. 0.68 kg

* Low inductance motors require external inductors.

PIN FUNCTIONS:

CONNECTOR	PIN	NAME	DESCRIPTION / NOTES	I/O
P1	1	+10V @ 3 mA OUT	For customer use	O
	2	SIGNAL GND	Reference ground	SGND
	3	-10V @ 3 mA OUT	For customer use	O
	4	+REF IN	Differential reference input, Maximum ±15 V, 40K input resistance	I
	5	-REF IN		
	6	-TACH IN	Tachometer input, max. ±60 VDC, 60K input resistance	I
	7	VELOCITY MONITOR OUT	Velocity monitor, 1 V = 25 kHz encoder frequency 1V=125 Hz Hall sensor frequency	O
	8	CURRENT MONITOR OUT	Proportional to motor current:, 1 V = 2 A when SW1-3 if off; , 1 V = 4 A when SW1-3 is on	O
	9	INHIBIT IN	This TTL level input signal turns off all power devices of the "H" bridge when pulled to ground with SW2-3=ON. If SW2-3 = OFF pulling this pin to ground will enable the amplifier. Inhibit will cause a fault condition and a red led if SW2-4 is on.	I
	10	+5V @ 200 mA	For customer use, power for HALL sensors, +5V @ 200 mA Note: the total current on P1-10 and P3-1 combined should not exceed 200 mA.	O
	11	SIGNAL GND	Reference ground for the Hall sensors	SGND
	12	HALL A	HALL sensor inputs, logic levels, Internal 5 KΩ pull-up. Maximum low level input is 1.5 V, minimum high level input is 3.5 V	I
	13	HALL B		
	14	HALL C		
	15	CURRENT REFERENCE OUT	Monitors the input signal connected directly to the internal current amplifier.7.25 V = max peak current. See current limit adjustment information below.	O
	16	FAULT OUT (LED red)	Transistor output. Open collector. Contact factory for higher pull up voltages. This output can sink or source 20 mA max. Active during output short circuit, over-voltage, over temperature and power-up reset. Fault condition indicated by red LED. Inhibit condition will indicate a fault if SW2-4 is on. Active high or low fault selected by SW2-5. Latching faults/non-latching faults selectable with SW2-6.	O
P2	1	MOTOR A	Motor phase A connection	O
	2	MOTOR B	Motor phase B connection	O
	3	MOTOR C	Motor phase C connection	O
	4	POWER GND	Power ground	PGND
	5	HIGH VOLT	DC power input	I
P3 ENCODER	1	+5V @ 200 mA	For customer use, power for the encoder, +5V @ 200 mA Note: the total current on P1-10 and P3-1 combined should not exceed 200 mA.	O
	2	ENC A	5V CMOS level quadrature encoder input	I
	3	NC	Not connected	
	4	ENC B	5V CMOS level quadrature encoder input	I
	5	SIGNAL GND	Reference gnd for encoder	SGND

SWITCH FUNCTIONS:

SWITCH	FUNCTION DESCRIPTION	SETTING	
		ON	OFF
1	Test / Offset. Sensitivity of the "offset" pot. Used as an on-board reference signal in test mode.	Test	Offset
2	Current loop gain	Decrease	Increase
3	Current scaling. When OFF, increases sensitivity of current sense thus reducing both peak and continuous current limit by 50%.	100%	50%
4	Loop integrator. This capacitor normally ensures "error-free" operation in velocity mode by reducing the error signal (output of summing amplifier) to zero.	Shorts out the velocity/voltage loop integrator capacitor	Velocity/voltage loop integrator operating
5	Internal duty-cycle feedback for open loop mode	On	Off
6	Velocity feedback. Connects the internally generated velocity signal. SW2-1 must also be on for encoder velocity mode and SW2-2 for Hall velocity mode.	On	Off
7	Velocity direction. Changes the polarity of the velocity monitor signal.		
8	Continuous current reduction. Reduces continuous current limit by 50%.	Continuous / peak current limit ratio is 50%	Continuous / peak current limit ratio is 25%
9	Integrator capacitor. Adjusts the value of the integrator capacitor in velocity mode.	Increase	Decrease
10	60/120 degree commutation phasing setting	120 degree phasing	60 degree phasing

SWITCH	FUNCTION DESCRIPTION	SETTING	
		ON	OFF
2-1 †	Encoder Velocity feedback. This connects the internally generated velocity signal from the encoder. For EVM SW6 must also be on.	Encoder velocity feedback enabled.	Encoder velocity feedback disabled.
2-2 †	Hall Velocity feedback. This connects the internally generated velocity signal from the Hall sensors. For HVM SW6 must also be on.	Hall sensor velocity feedback enabled.	Hall sensor velocity feedback disabled.
2-3	INHIBIT/ENABLE	P1-9 pull to ground to INHIBIT	P1-9, pull to ground to ENABLE
2-4	INHIBIT=FAULT	Inhibit condition will cause a fault level on P1-16 and a red LED	Inhibit condition will not cause a fault level on P1-16 or a red LED
2-5	ACTIVE FAULT LEVEL OF P1-16	ACTIVE HIGH	ACTIVE LOW
2-6	FAULT LATCH	Non Latching faults, once the fault clears the unit will enable again	Latching faults, fault condition must be removed and power must be cycled or inhibit line toggled to clear any fault condition

† Important Note: Amplifier will not operate properly with more than one switch ON due to multiple feedback signals. See block diagram.

POTENTIOMETER FUNCTIONS:

POTENTIOMETER	DESCRIPTION	TURNING CW
Pot 1	Loop gain adjustment in open loop & velocity modes. Turn this pot fully ccw in current mode.	Increases loop gain
Pot 2	Current limit. It adjusts both continuous and peak current limit maintaining selected ratio (50%).	Increases current limit
Pot 3	Reference gain. It adjusts the ratio between input signal and output variables (voltage, current, velocity).	Increases reference input gain
Pot 4	Test / Offset. Used to adjust any imbalance in the input signal or in the amplifier. When SW1 (DIP switch) is ON, the sensitivity of this pot is greatly increased thus it can be used as an on-board signal source for testing purposes. See section "G".	N/A

TEST POINTS FOR POTENTIOMETERS: See section "G".

OPERATING MODE SELECTION:

These modes can be selected by the DIP switches according to the chart in the functional block diagram:

- Current mode
- Open loop mode
- Tachometer mode
- Encoder velocity mode
- Hall Velocity mode

See section "G" for more information.

SET-UP: See section "G" for engineering and installation notes.

CURRENT LIMIT ADJUSTMENTS:

These amplifiers feature separate peak and continuous current limit adjustments. The current limit adjustment Pot 2 adjusts both peak and continuous current limit simultaneously. It has 12 active turns plus 1 inactive turn at each end and is approximately linear. Thus, to adjust the current limit turn the potentiometer fully counter-clockwise, then turn clockwise to the appropriate value.

In many applications it is sufficient to use only the DIP switches for current limit adjustments. SW3 reduces both peak and continuous current limit by 50% when OFF. SW8 reduces only the continuous current limit by 50% when OFF:

SW8	CONTINUOUS / PEAK CURRENT LIMIT RATIO
ON	50%
OFF	25%

P1-15 is the input to the internal current amplifier power stage. Since the output current is proportional to P1-15, the adjusted current limit can easily be observed at this pin without connecting the motor. Note that a command signal must be applied to the reference inputs to obtain a reading on P1-15. The maximum peak current value equals 7.25 V at this pin and the maximum continuous current value equals 3.63 V at this pin. If SW3=ON, peak rated amplifier current = 7.25 V. If SW3=OFF, ½ peak rated amplifier current = 7.25 V. Example: using the BX25A20 with SW3=ON, 25A=7.25V and with SW3=OFF, 12.5A=7.25V.

The actual current can be monitored at pin P1-8.

VELOCITY DIRECTION SWITCH (SW1-7):

In either Hall or Encoder Velocity Mode, the velocity feedback direction switch (SW1-7) allows the user to select the correct feedback polarity for proper operation. In one switch position, the motor will operate properly, but the opposite switch position will cause the motor to run away due to positive feedback. The correct switch position will not be the same for all applications. It may be either ON or OFF depending on wiring combination.

NOTE: If any of the BX25A20AC or BX30A series servo amplifiers are being used as a direct replacement for your B25A20AC, BE25A20AC, B30A or BE30A series in Hall or Encoder Velocity Mode, SW1-7 MUST be set in the OPPOSITE position for proper operation. Otherwise, the motor will run away.

ORDERING INFORMATION:

Model: BX25A20X

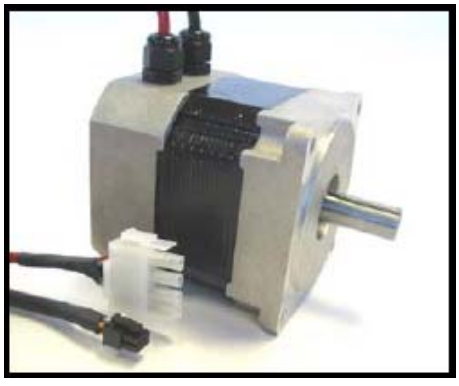
X (at the end) indicates the current revision letter.

TYPICAL SYSTEM WIRING: See section "G".

MOUNTING DIMENSIONS: See page F-35.

MBL3416E2 BRUSHLESS SERVO MOTOR

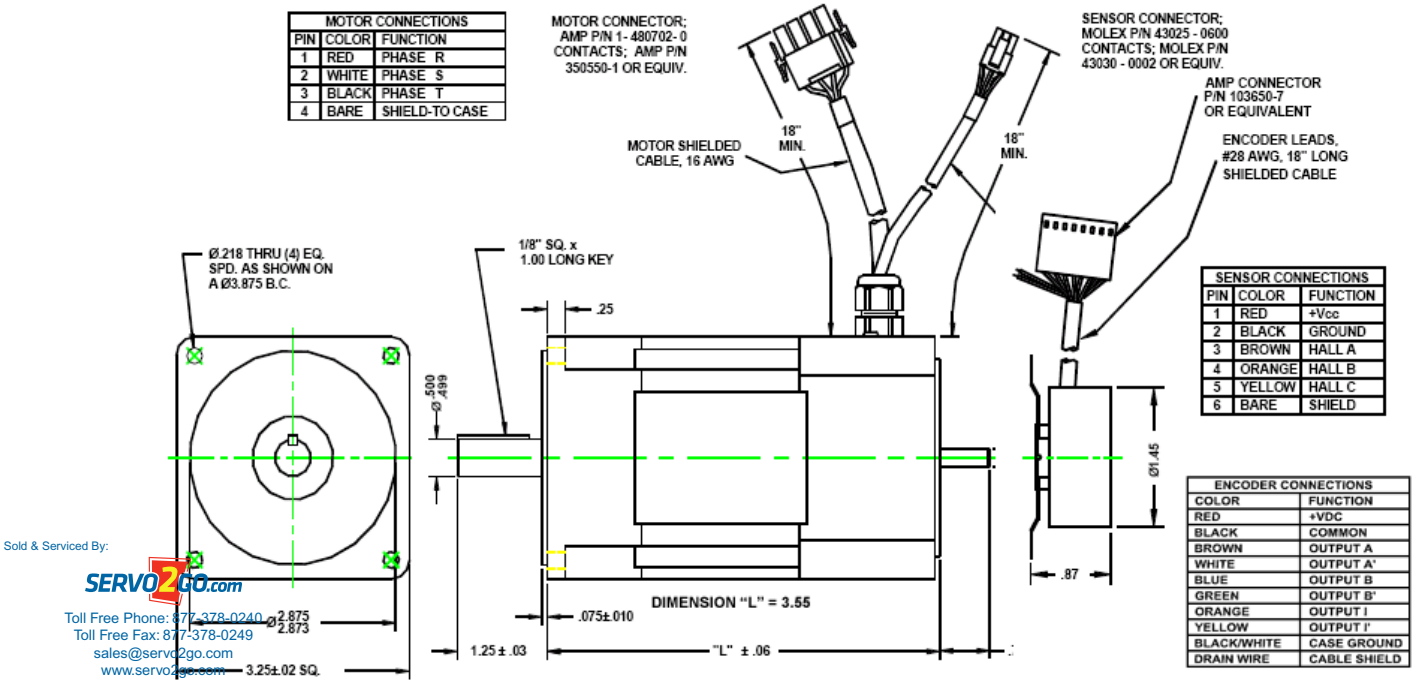
FEATURES:



- 3.25 Inch NEMA 34 w/ Heavy Duty Shaft
- Continuous Torques up to 15.63 lb-in
- Speeds up to 4500 rpm
- Voltage Rating up to 170 Vdc
- Integrated Hall Effect Commutation
- 30 Lb Radial Load Capacity, 1/2" from Front Face
- High Precision Optical Encoders – 10000 count

SPECIFICATIONS:

SPECIFICATIONS	UNITS	VALUE
CONTINUOUS TORQUE	Nm (lb-in)	1.77 (15.63)
PEAK TORQUE	Nm (lb-in)	5.3 (46.9)
SPEED @ RATED VOLTAGE	RPM	4500
RATED VOLTAGE	V dc	170
CONTINUOUS CURRENT	A	12.1
PEAK CURRENT	A	36.3
TORQUE CONSTANT	Nm / A (lb-in / A)	0.159 (1.40)
VOLTAGE CONSTANT	V / KRPM	16.6
RESISTANCE	ohms	0.224
INDUCTNACE	mH	1.08
INERTIA	kg-cm² (lb-in-s²)	2.034 (0.0018)
WEIGHT	Kg (lb)	3.54 (7.8)

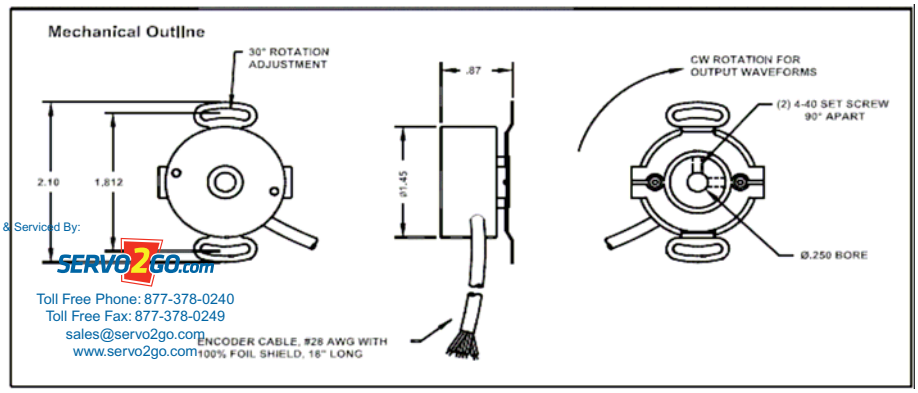


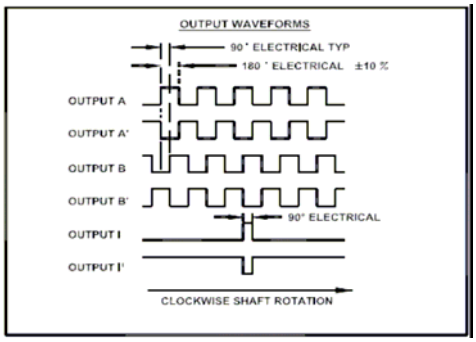
ENCODER:

ELECTRICAL SPECIFICATIONS	VALUE
INPUT VOLTAGE	5 VDC +/- 5%
INPUT CURRENT REQUIREMENTS	125 mA Typical @ 5 VDC Plus Interface Loads
INPUT RIPPLE	2% Peak to Peak @ 5 VDC
OUTPUT CIRCUITS	AM26LS31 RS 422A Line Driver
FREQUENCY RESPONSE	500 kHz
INCREMENTAL OUTPUT FORMAT	Quadrature with A leading B for CW rotation. Index Pulse centered over A.
SYMMETRY	180 Degrees +/- 10% Typical
MINIMUM EDGE SEPARATION	54 electrical degrees
COMMUTATION FORMAT	N/A
COMMUTATION ACCURACY	N/A

ENVIRONMENTAL SPECIFICATIONS	VALUE
STORAGE TEMPERATURE	-40 to 125° C
OPERATING TEMPERATURE	-20 to 100° C Typical
HUMIDITY	98% Non-Condensing
VIBRATION	20 G's @ 50 to 500 CPS
SHOCK	50 G's @ 11 ms duration

MECHANICAL SPECIFICATIONS	VALUE
LINE COUNT	2500 lines/revolution
MAXIMUM SHAFT SPEED	8000 RPM
THROUGH SHAFT DIAMETER	0.250" (-0.0000", +0.0005")
RADIAL SHAFT MOVEMENT	0.007" TIR
AXIAL SHAFT MOVEMENT	+/- 0.030" MAX
HOUSING	Carbon Fiber Composite (case ground via cable)
TERMINATION	15 conductor cable, 28 AWG, 18" long
MOUNTING	1.812" Bolt Circle
MOMENT OF INERTIAL	1.5×10^{-4} oz-in-s^2
ACCELERATION	1×10^5 Radians/s^2
ACCURACY	+/- 1.0 Arc Minutes





CBL-D02 DRIVE CABLE

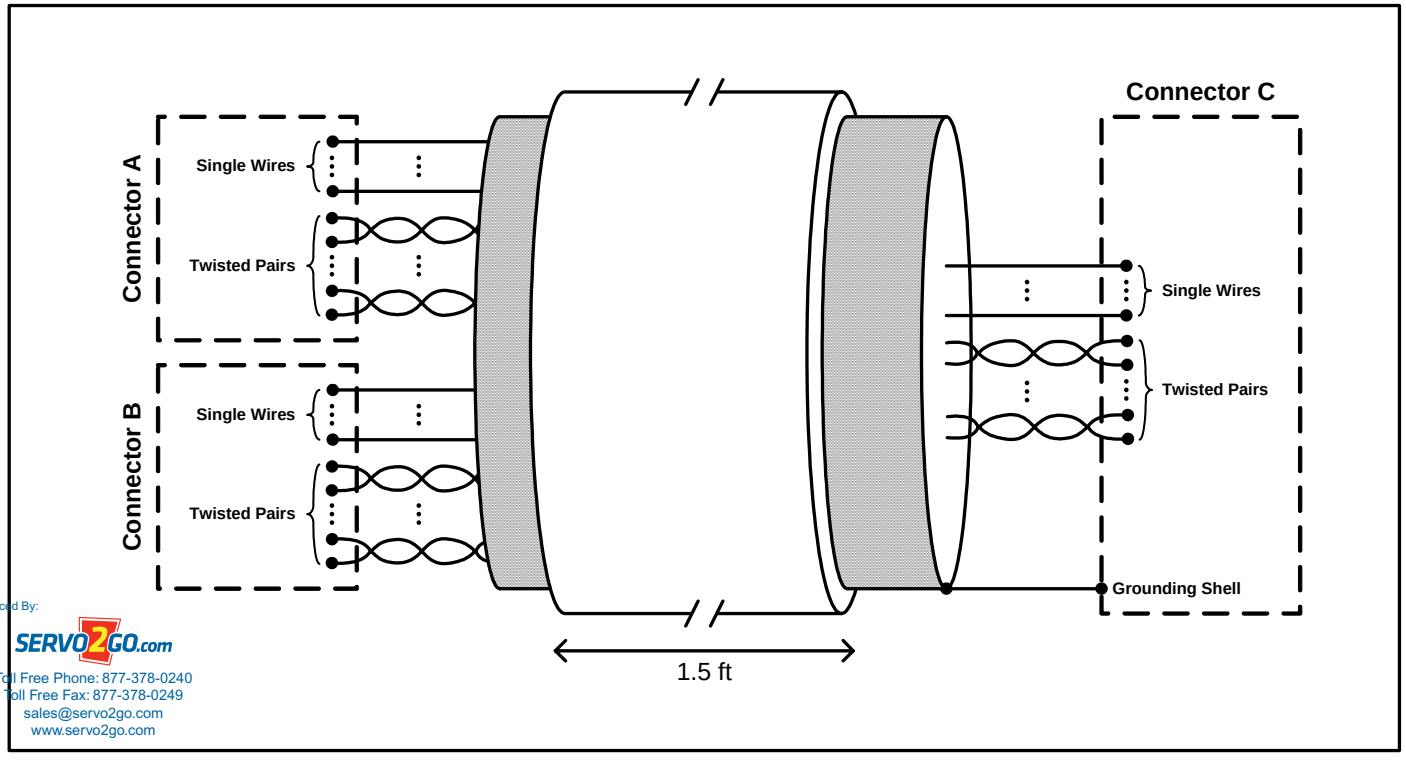
WIRING SPECIFICATIONS:

CABLE: CBL-D02						
Side 1		**Common**			**Side 2**	
Connector	**Contact**	**Wiring Scheme**		**Wire Color**	**Contact**	**Connector**
A **16-Pin Molex** Connector: P/N 22-01-3167 Terminals: P/N 08-50-0114	1	Single Wire	+REF OUT	yellow	1	**C** **26-Pin AMP (D-SUB)** Plug: P/N 748365-1 Housing: P/N 748677-2 Terminals: P/N 748333-4
	2	Single Wire	SGND	yellow/black	2	
	3	Single Wire	-REF OUT	blue	3	
	6	Single Wire	-TACH IN	blue/white	6	
	7	Single Wire	Velocity Monitor	black	7	
	8	Single Wire	Current Monitor	black/white	8	
	9	Single Wire	Inhibit	orange	9	
	12	Single Wire	Hall A	orange/white	12	
	13	Single Wire	Hall B	red	13	
	14	Single Wire	Hall C	red/white	14	
	15	Single Wire	Current Ref.	brown	15	
	16	Single Wire	Fault	brown/white	16	
	4	Twisted Pair	+REF IN	green	4	
	5		-REF IN	green/white	5	
	10	Twisted Pair	5V	purple	10	
	11		SGND	purple/white	11	
B **5-Pin Molex** Connector: P/N 22-01-3057	2	Single Wire*	Encoder A	pink/red	21	
	4	Single Wire*	Encoder B	green/black	23	
	1	Twisted Pair	5V	gray/black	20	
	5		SGND	gray	19	
-	-	Shield	Shield	-	Shell	

NOTE: For cables with only twisted pairs, single wires can be paired with other single or unused wires.

* Do NOT pair these two wires. If pairing is required, pair these wires with unused wires.

DIAGRAM:

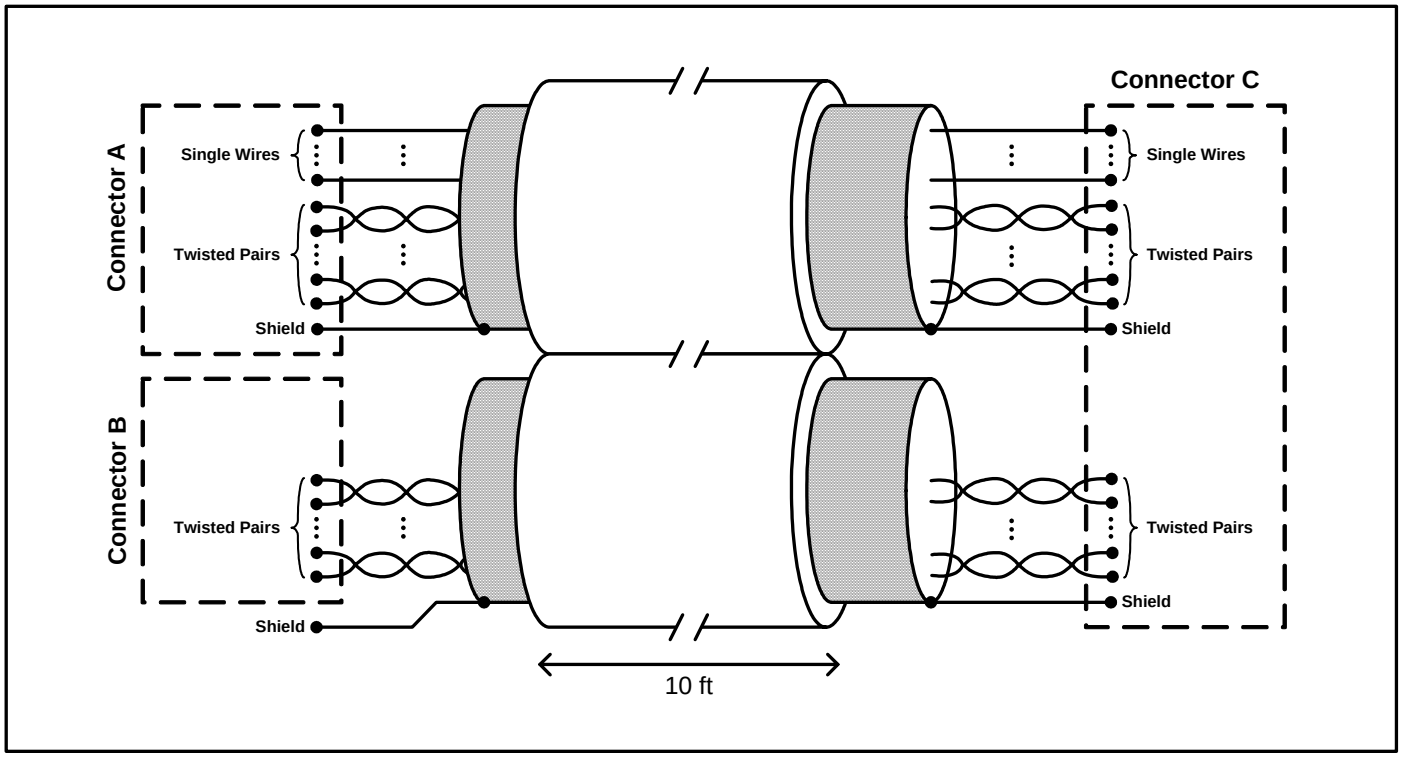


CBL-F01-10 FEEDBACK CABLE

WIRING SPECIFICATIONS:

CABLE: CBL-F01-10						
Side 1		**Common**			**Side 2**	
Connector	**Contact**	**Wiring Scheme**	**Function**	**Wire Color**	**Contact**	**Connector**
A **6-Pin Molex** Connector: P/N 43020-0601 Terminals: P/N 43031-0002	3	Single Wire	Hall A	Brown	1	**C** **15-Pin AMP (D-SUB)** Plug: P/N 748364-1 Housing: P/N 748677-1 Terminals: P/N 748333-4
	4	Single Wire	Hall B	Orange	2	
	5	Single Wire	Hall C	Yellow	3	
	1	Twisted Pair	5V	Red	13	
	2		SGND	Black	12	
	6	Shield	Shield	Sheer	12	
B **8-Pin Molex** Connector: P/N 70107-0007 Terminals: P/N 16-02-0077	3	Twisted Pair	A+	Brown	4	
	4		A-	White	5	
	5	Twisted Pair	B+	Blue	6	
	6		B-	Green	7	
	7	Twisted Pair	I+	Orange	8	
	8		I-	Yellow	9	
	1	Twisted Pair	5V	Red	15	
	2		SGND	Black	14	
	Flying Lead	Shield	Shield	-	14	

DIAGRAM:

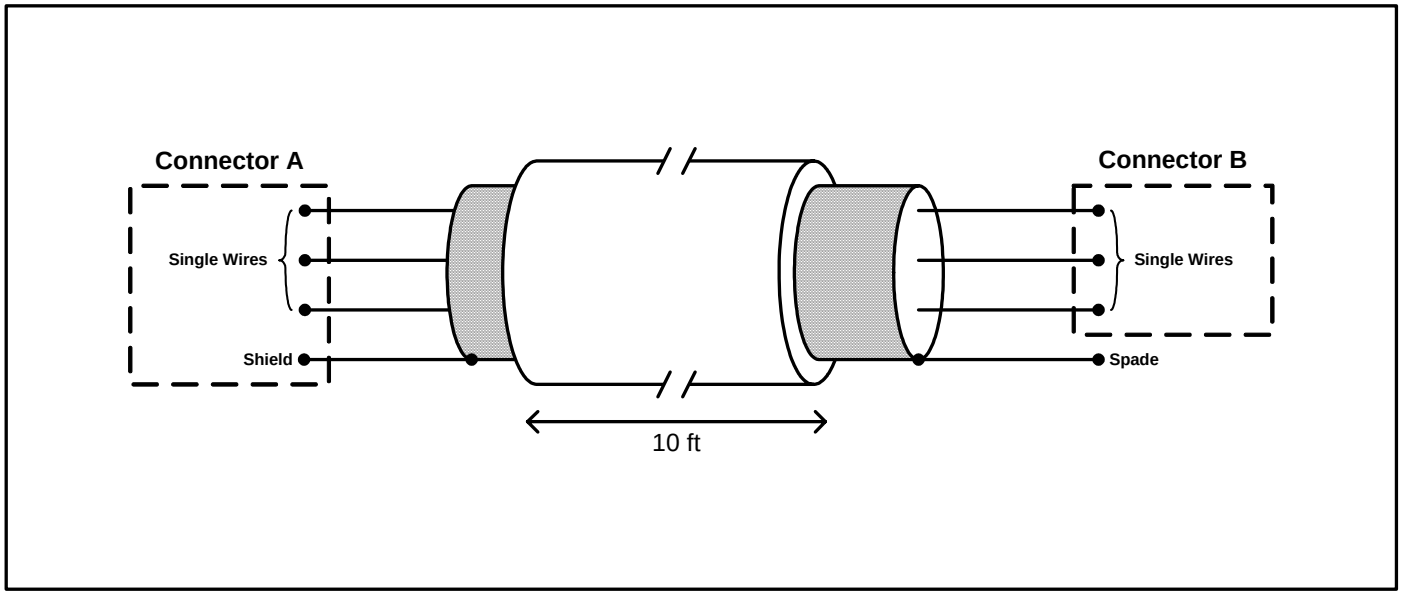


CBL-P02-10 POWER CABLE

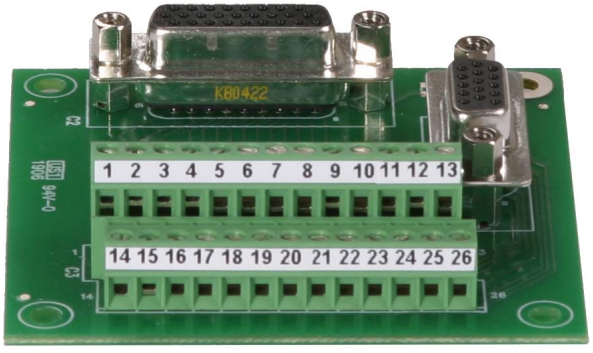
WIRING SPECIFICATIONS:

CABLE: CBL-P02-10						
Side 1		Common			Side 2	
Connector	Contact	Wiring Scheme	Function	Wire Color	Contact	Connector
A (4-Pin AMP) Connector, Terminals: P/N 1-480703-0, P/N 350873-1	1	Single Wire	Motor A	red	1	**B (3-Port Phoenix)** Connector: P/N 1757022
	2	Single Wire	Motor B	white	2	
	3	Single Wire	Motor C	black	3	
	4	Shield	Shield	grey	Spade	

DIAGRAM:



System Interface Board (SIB)



Dimensions	72mm x 72mm
C1 Connector	15 pin to motor
C2 Connector	26 pin to drive
C3 Connector	26 pin user interface.

C3 Pin Functions

Pin	Function
1	+10V 3mA
2	SGND
3	-10V 3mA
4	+Ref In
5	-Ref In
6	-Tach In
7	Vel Mon Out
8	Curr Mon Out
9	Inhibit
10	+5V
11	SGND
12	Hall 1
13	Hall 2
14	Hall 3
15	Curr Ref
16	Fault Out
17	
18	
19	SGND (Encoder)
20	5V (Encoder)
21	Encoder Channel A+
22	Encoder Channel A-
23	Encoder Channel B+
24	Encoder Channel B-
25	Encoder Channel I+
26	Encoder Channel I-