2-AXIS DIGITAL SERVOAMPLIFIER
for BRUSHLESS/BRUSH MOTORS

Control Modes
- Current (torque, force)

Opto-Isolated Command Interface (per channel)
- ±10V Current control input
- Enable input
- Buffered encoder outputs A/B/X
- Digital outputs (4 total: programmable for use by either channel)

Communications
- RS-232

Feedback
- Digital Quad A/B encoder with +5V control:
  Incremental encoders + digital Halls
  Yaskawa Sigma-Mini motors
  Panasonic Minas-A motors

Dimensions: mm [in]
- 167 x 99 x 30 [6.58 x 3.9 x 1.17]

Model	Ip	Ic	Vdc
ASP-055-04-X2	4	3	20 - 55

DESCRIPTION

The *ASP-055-04-X2* is a dual-channel digital high-performance amplifier for current (torque) control of brushless motors. It operates as a stand-alone amplifier accepting ±10 Vdc analog signals from an external motion controller.

Amplifier commissioning is fast and simple using CME 2™ software operating under Windows® and communicating with the *ASP-055-04-X2* via an RS-232 link.

Controller interface signals are optically isolated from amplifier circuits. These include the ±10 Vdc current control signals, axis-enable signals, digital status outputs, and buffered A/B/X encoder signals.

In addition to the standard quad A/B encoder + digital Hall feedback, the amplifier also supports motor models from Yaskawa and Panasonic that encode the Hall signals to reduce the wire-count in the feedback cables.

Amplifier power is transformer-isolated DC from regulated or unregulated power supplies.

GENERAL SPECIFICATIONS

Test conditions: Load = Wye connected load: 2 mH + 2 Ω line-line. Ambient temperature = 25°C, +HV = HV_{max}

MODEL	ASP-055-04-X2	
OUTPUT POWER (PER CHANNEL)		
Peak Current	4 (2.83)	Adc (Arms), ±5%
Peak time	1 Sec	
Continuous current	3 (2.12)	Adc (Arms) per phase
INPUT POWER		
HVmin~HVmax	+20 to +55	Vdc, Transformer-isolated
Input current	8.5	Adc
PWM OUTPUTS		
Type	3-phase MOSFET inverter, 15 kHz center-weighted PWM, space-vector modulation	
PWM ripple frequency	30 kHz	
DIGITAL CONTROL		
Digital Control Loops	Current, 100% digital loop control	
Sampling rate (time)	Current loop: 15 kHz (66.7 µs)	
Commutation	Sinusoidal, field-oriented control for brushless motors	
Modulation	Center-weighted PWM with space-vector modulation	
Bandwidths	Current loop: 2.5 kHz typical, bandwidth will vary with tuning & load inductance	
HV Compensation	Changes in bus voltage do not affect bandwidth	
Minimum load inductance	200 µH line-line	
ISOLATED COMMAND INPUTS (PER CHANNEL)		
Analog torque reference	±10 Vdc, Differential, 200 kΩ impedance	
ISOLATED ENABLE INPUTS		
Number	2: One Enable input for each channel	
Type	Opto-isolated with commoned anodes. Inputs source current into current-sinking controller outputs	
Voltage	24 Vdc compatible	
ISOLATED DIGITAL OUTPUTS		
Number	4: Programmable functions	
Type	Opto-isolated NPN Darlington transistor with commoned cathodes. Outputs sink current from loads connected to +Vdc	
Ratings	50 mAdc max, +30 Vdc max.	
ISOLATED BUFFERED ENCODER OUTPUTS (PER CHANNEL)		
Type	A/B/X digital quadrature, differential,	
Electrical	26C31 differential line driver	
ENCODER FEEDBACK (PER CHANNEL)		
Type	A/B/X digital quadrature, differential, Yaskawa Sigma-Mini SGMM and similar models with incremental encoders Panasonic Minas-A and similar models with incremental encoders	
Frequency	5 MHz line frequency, or 20 Mcounts/sec after quadrature	
Power	+5 Vdc @ 250 mA per channel. Power can be switched on/off for encoder control.	
Electrical	26C32 differential line receiver with 121 Ω line terminators	
DIGITAL HALLS FEEDBACK (PER CHANNEL)		
Type	Hall signals, digital, single-ended, 120 degree phase difference between U-V-W	
Electrical	10 kΩ pull-up to +5 Vdc, 10 kΩ / 3.3 nF low-pass filter to 74HC14 Schmitt trigger	
RS-232 PORT		
Signals	RxD, TxD, Gnd in 6-position, 4-contact RJ-11 style modular connector.	
Mode	Full-duplex, serial communication port for amplifier setup and control, 9,600 to 115,200 Baud	
Protocol	ASCII or Binary format	
STATUS INDICATORS		
Number	2	
Amplifier Status	Bicolor LED, axis status indicated by color, and blinking or non-blinking condition	
PROTECTIONS		
HV Overvoltage	+HV > HVmax, Amplifier outputs turn off until +HV < HVmax (See Input Power for HVmax)	
HV Undervoltage	+HV < +20 Vdc, Amplifier outputs turn off until +HV > +20 Vdc	
Amplifier over temperature	Heat plate > 70°C, Amplifier outputs turn off	
Short circuits	Output to output, output to ground, internal PWM bridge faults	
I2T Current limiting	Programmable: continuous current, peak current, peak time	
MECHANICAL & ENVIRONMENTAL		
Size (mm[in])	167 x 99 x 30 [6.58 x 3.9 x 1.17]	
Weight	0.94 lb (0.43 kg)	
Ambient temperature	0 to +45°C operating, -40 to +85°C storage	
Humidity	0 to 95%, non-condensing	
Contaminants	Pollution degree 2	
Environment	IEC68-2: 1990	

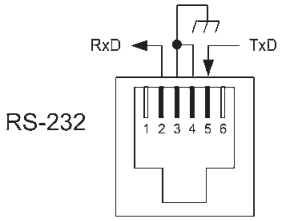
CME 2™ SOFTWARE

Amplifier setup is fast and easy using CME 2™ software. All of the operations needed to configure the amplifier are accessible through this powerful and intuitive program. Auto-phasing of brushless motor Hall sensors and phase wires eliminates "wire and try". Connections are made once and CME 2™ does the rest thereafter. Encoder wire swapping to establish the direction of positive motion is eliminated.

Motor data can be saved as .ccm files. Amplifier data is saved as .ccx files that contain all amplifier settings plus motor data. This eases system management as files can be cross-referenced to ampifiers. Once an amplifier configuration has been completed systems can be replicated easily with the same setup and performance.

RS-232 COMMUNICATIONS

The *ASP-055-04-X2* is configured via a three-wire, full-duplex RS-232 port that operates from 9600 to 115,200 Baud. CME 2™ provides a graphic user interface (GUI) to set up all of the amplifierss features via a computer serial port. Connections to the RS-232 port are through J7 , an RJ-11 style connector. Signal format is full-duplex, 3-wire using RxD, TxD, and Gnd. The Serial Cable Kit (SER-CK) contains a modular cable, and an adapter that connects to a 9-pin, Sub-D serial port connector (COM1, COM2, etc.) on PC's and compatibles.



J7: RS-232 PORT

RJ-11 style, 6 position, 4 contact
Cable: 6-conductor modular type

J7 SIGNAL	PIN
No Connect	1
RxD Input	2
Signal Ground	3
Signal Ground	4
TxD Output	5
No Connect	6

AMP STATUS LED

Bi-color LEDs gives the state of each axis by changing color, and either blinking or remaining solid. The possible color and blink combinations are:

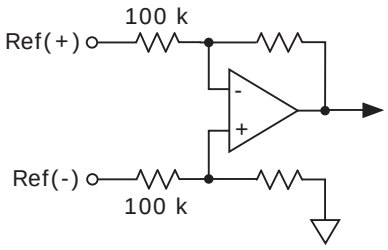
- *Green/Solid*: Axis OK and enabled. Will run in response to reference inputs.
- *Green/Slow-Blinking*: Axis OK but NOT-enabled. Will run when enabled.
- *Red/Solid*: Transient fault condition. Axis will resume operation when fault is removed.
- *Red/Blinking*: Latching fault. Operation will not resume until axis is Reset

Fault conditions:

- Phasing error (current position is >60° electrical from Hall angle)
- Short-circuits from output to output
- Short-circuits from output to ground
- Internal short circuits
- Amplifier over-temperature

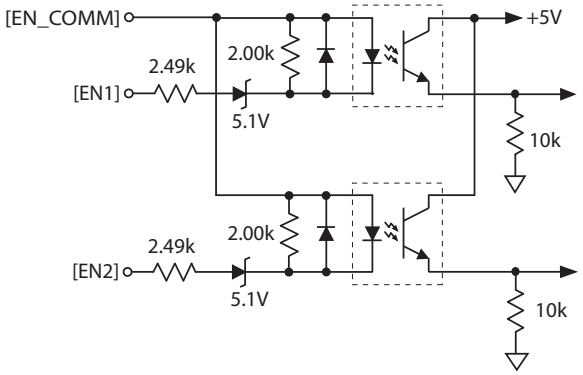
Faults are programmable to be either transient or latching

CURRENT CONTROL REFERENCE INPUTS



ENABLE INPUTS

The inputs are are common-anode opto-isolators that are 24 Vdc compatible. With the [ENABLE_COMM] connected to +24 Vdc, the [EN1] or [EN2] signals are then grounded by current-sinking outputs on the controller to enable the amplifier channels.

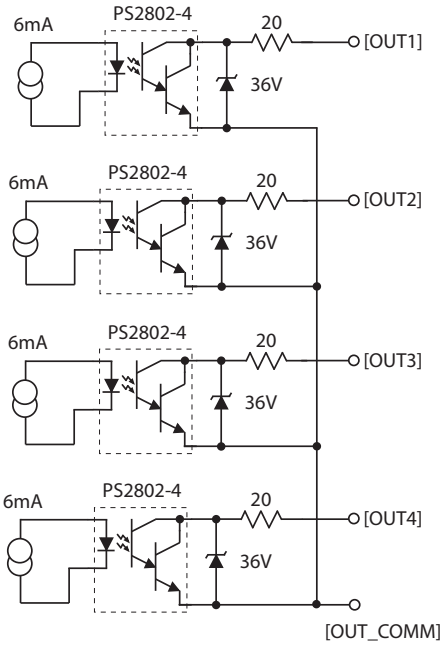


DIGITAL OUTPUTS

The outputs are opto-isolated NPN Darlington transistors with common emitters that can sink up to 50 mAdc from loads connected to positive voltage sources. Functions are programmable, as are the active levels (ON or OFF when True). Each output can be assigned to either axis and individually programmed to functions that include:

- Amplifier fault
- Motor brake
- PWM sync
- Program control
- Custom event
  - Axis fault
  - Overtemperature
  - Motor phasing error
  - HV over-voltage
  - HV under-voltage
  - Short-circuit
  - Current-limited
  - Voltage-limited
  - Hardware-disabled
  - Software-disabled
  - Motor brake active
  - PWM outputs inactive

When configured as a Custom Event, the output will go active when any of the events becomes true. When active, the output can be configured as on or off. The output can also be set to latching, or non-latching.



GROUNDING CONSIDERATIONS

Power, motor feedback, and RS-232 circuits in the amplifier share a common circuit-ground (HV Return on J1-3 & J1-6, and Signal Ground on J4-13 & J5-13). Connections to the analog reference inputs, digital inputs, and digital outputs are optically isolated from HV return. Amplifier ground should, in turn, connect to an earthing conductor at some point so that the whole system is referenced to "earth".

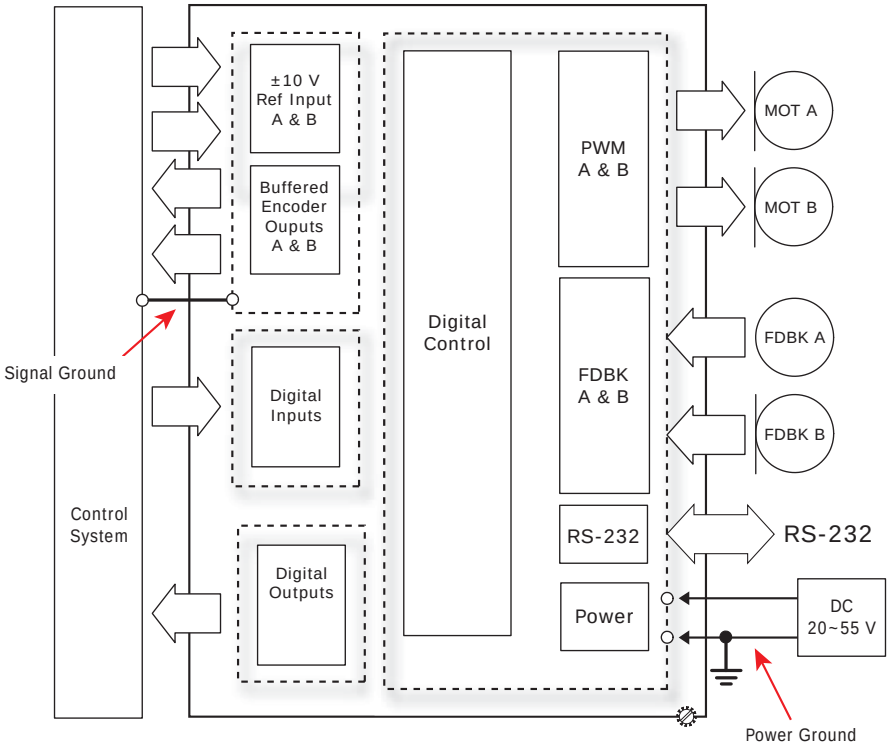
Because current flow through conductors produces voltage-drops across them, it is best to connect the amplifier HV Return to system earth, or circuit-common through the shortest path, and to leave the power-supply floating. In this way, the power supply (-) terminal connects to ground at the amplifier HV Return terminals, but the voltage drops across the cables will not appear at the amplifier ground, but at the power supply negative terminal where they will have less effect.

Motor phase currents are balanced, but currents can flow between the PWM outputs, and the motor cable shield. To minimize the effects of these currents on nearby circuits, the cable shield should connect to Frame Gnd on the motor connectors J2-1 & J3-1.

The amplifier case does not connect to any amplifier circuits. Connections to the case (Frame Ground) are provided on all of the connectors. Cables to these connectors should be shielded for CE compliance, and the shields should connect to the Frame Ground terminals. When installed, the amplifier case should connect to the system chassis. This maximizes the shielding effect of the case, and provides a path to ground for noise currents that may occur in the cable shields.

For CE compliance and operator safety, the amplifier should be earthed by using external tooth lockwashers under the mounting screws. These will make contact with the aluminum chassis through the anodized finish to connect the chassis to the equipment frame ground.

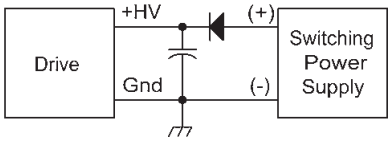
AMPLIFIER ISOLATION AND GROUNDS



POWER SUPPLIES

ASP-055-04-X2 operates typically from transformer-isolated, unregulated DC power supplies. These should be sized such that the maximum output voltage under high-line and no-load conditions does not exceed the amplifiers maximum voltage rating. Power supply rating depends on the power delivered to the load by the amplifier. In many cases, the continuous power output of the amplifier is considerably higher than the actual power required by an incremental motion application.

Operation from regulated switching power supplies is possible if a diode is placed between the power supply and amplifier to prevent regenerative energy from reaching the output of the supply. If this is done, there must be external capacitance between the diode and amplifier.

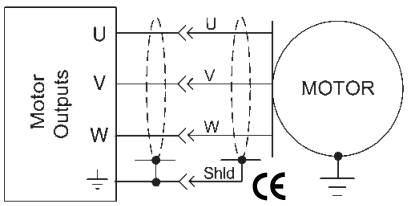


MOUNTING & COOLING

ASP-055-04-X2 has slots for mounting to panels at 0° or 90°. Cooling is by conduction from amplifier heatplate to mounting surface, or by convection to ambient.

MOTOR PHASE CONNECTIONS

The axis outputs are three-phase PWM inverters that convert the DC buss voltage (+HV) into three sinusoidal voltage waveforms that drive the motor phase-coils. Cable should be sized for the continuous current rating of the amplifier. Motor cabling should use twisted, shielded conductors for CE compliance, and to minimize PWM noise coupling into other circuits. The motor cable shields should connect to motor frame and the amplifier frame ground terminal (J2-1 or J3-1) for best results.



CE = Shielded cables required for CE compliance

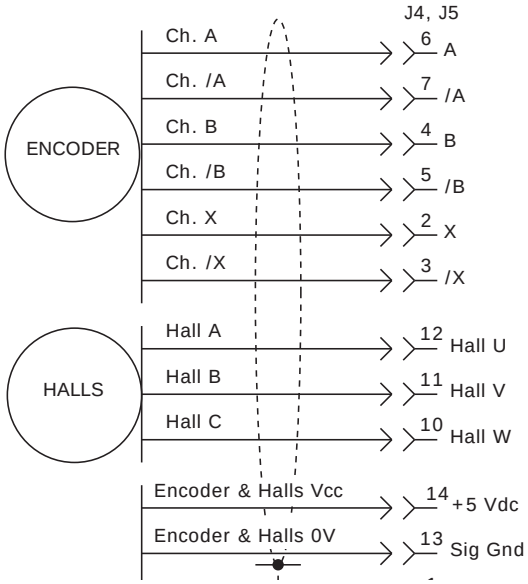
FEEDBACK CONNECTIONS

The ASP-055-04-X2 supports three types of brushless motor feedback:

- Incremental encoder and digital Halls
- Panasonic Midas-A incremental encoders
- Yaskawa Sigma Mini incremental encoders

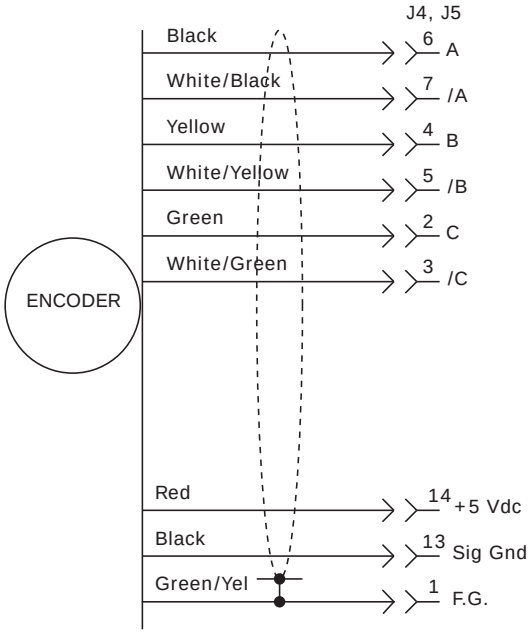
INCREMENTAL ENCODER AND DIGITAL HALLS

These CME 2 screens show the Basic Setup for a generic, incremental encoder and digital Halls motor. In this example, a 2000 line encoder is shown.



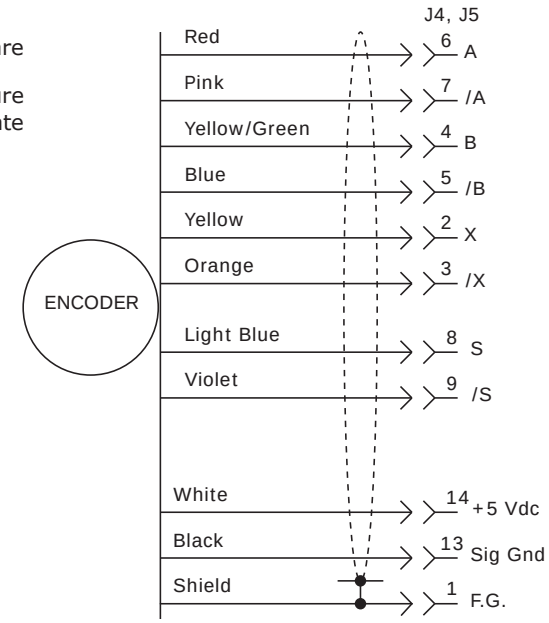
YASKAWA SIGMA MINI MOTOR FEEDBACK

These CME 2 screens show the Basic Setup for the Sigma Mini motors with incremental encoders.



PANASONIC MINAS-A MOTOR FEEDBACK

Panasonic motor Basic Setup is shown in these CME 2 screens. The encoders are 2500 line, or 10,000 counts after quadrature per revolution.
Panasonic Minas-A motors use an 11-wire interface that has the A & B quadrature channels, an X index channel, and a fourth RX channel that contains encoder Hall state information. As in the Yaskawa motor, the Hall data is decoded in the amplifier.



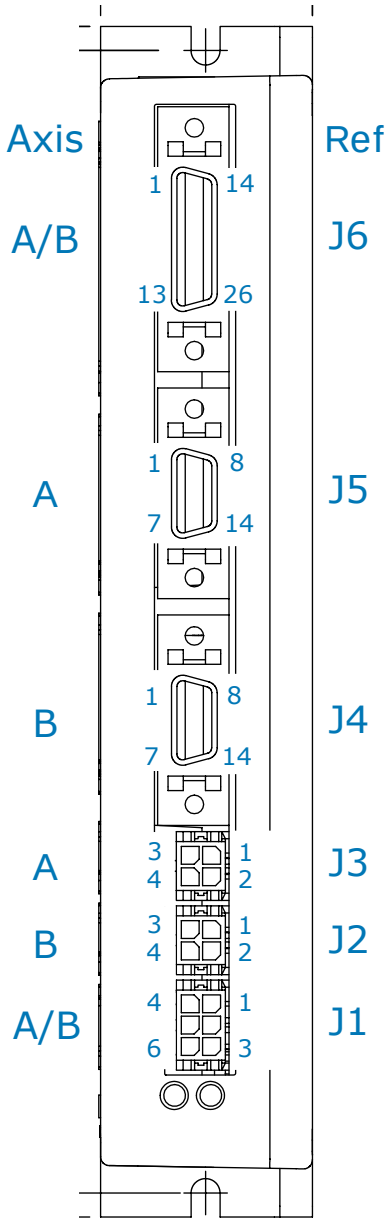
CONNECTORS

J6 SIGNAL	PIN
Frame Ground	1
[OUT4]	2
Axis A Ref(+)	3
Axis A Ref(-)	4
Axis B Ref(+)	5
Axis B Ref(-)	6
Signal Ground	7
Axis A Buff Enc Out X	8
Axis A Buff Enc Out /X	9
Axis A Buff Enc Out B	10
Axis A Buff Enc Out /B	11
Axis A Buff Enc Out A	12
Axis A Buff Enc Out /A	13

J4 & J5 SIGNALS	PIN
Frame Ground	1
Encoder Ch. X	2
Encoder Ch. /X	3
Encoder Ch. B	4
Encoder Ch. /B	5
Encoder Ch. A	6
Encoder Ch. /A	7

J6 CABLE CONNECTOR:

Rugged
Plug: Molex 52306-2619
Backshell: Molex 54331-0261
Standard
Plug: 3M 10126-3000VE
Backshell: 3M 10326-52F0-008



PIN	J6 SIGNAL
14	[OUT1]
15	[OUTPUT_COMM]
16	[OUT2]
17	[OUT3]
18	[ENABLE_A]
19	[ENABLE_B]
20	[ENABLE_COMM]
21	Axis B Buff Enc Out X
22	Axis B Buff Enc Out /X
23	Axis B Buff Enc Out B
24	Axis B Buff Enc Out /B
25	Axis B Buff Enc Out A
26	Axis B Buff Enc Out /A

PIN	J4 & J5 SIGNALS
8	Encoder Ch. S
9	Encoder Ch. /S
10	Hall W
11	Hall V
12	Hall U
13	Power Ground
14	Encoder +5 Vdc

J4 & J5 CABLE CONNECTORS:

Rugged
Plug: Molex 54306-1419
Backshell: Molex 54331-0141
Standard
Plug: 3M 10114-3000VE
Backshell: 3M 10314-52F0-008

J2 & J3 SIGNALS	PIN		J2 & J3 SIGNALS
Motor U	3	1	Frame Ground
Motor V	4	2	Motor W

J2 & J3 CABLE CONNECTORS:

Shell: Molex 43025-0400
Contacts (4): Molex 43030

J1 SIGNAL	PIN		J1 SIGNAL
Frame Ground	4	1	Frame Ground
+HV	5	2	+HV
Power Ground	6	3	Power Ground

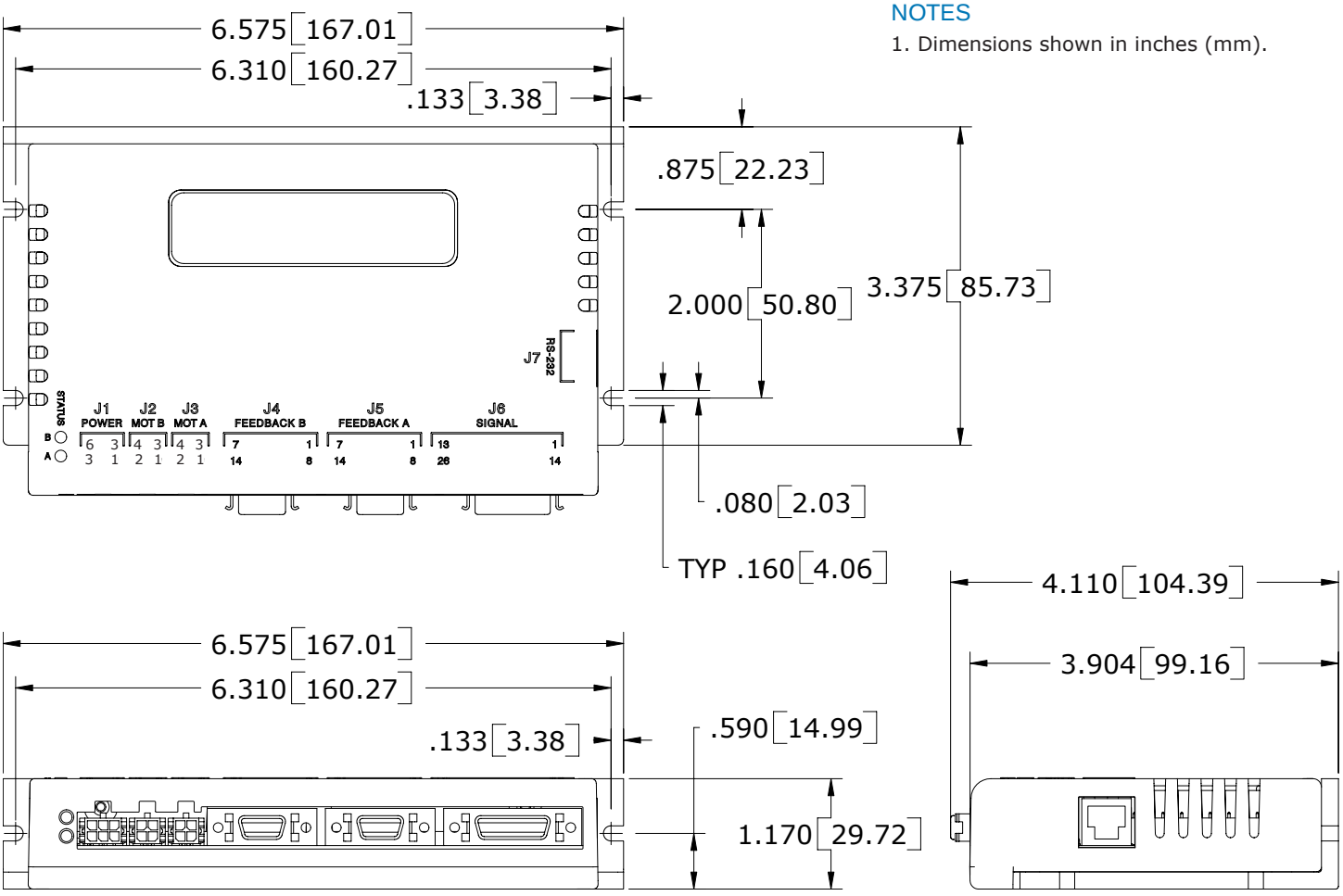
J1 CABLE CONNECTOR:

Shell: Molex 43025-0600
Contacts (6): Molex 43030

J1,J2,J3 TOOLS:

Hand Crimper:
Molex 63811-2800
Contact Extractor:
Molex 11-03-0043

DIMENSIONS



NOTES

1. Dimensions shown in inches (mm).

Weights:

Amplifier: 0.94 lb (0.43 kg)

MASTER ORDERING GUIDE

PART NUMBER	DESCRIPTION
ASP-055-04-X2	Dual-channel Current-mode amplifier, 55 Vdc, 3/4 A
SER-CK	RS-232 Cable Kit
CME 2	CD with CME 2 Configuration Software

ORDERING INSTRUCTIONS

Example: Order 1 amplifier
and associated components:

Qty	Item	Remarks
1	ASP-055-04-X2	Dual current-mode amplifier
1	SER-CK	Serial Cable Kit
1	CME2	CME 2™ CD

ACCESSORIES

PART NUMBER	DESCRIPTION
ASP-X2-CK	Connector kit, solder cup connectors
ASP-HK	Heatsink kit (for field assembly, with hardware)