Description

The B100A40AC PWM servo drive is designed to drive brushless DC motors at a high switching frequency. A single red/green LED indicates operating status. The drive is fully protected against over-voltage, under voltage, over-current, over-heating and short-circuits across motor, ground and power leads. Furthermore, the drive can interface with digital controllers or be used stand-alone and requires only a single unregulated AC power supply. 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.

See Part Numbering Information on last page of datasheet for additional ordering options.

Power Range

Peak Current	100 A
Continuous Current	50 A
Supply Voltage	45 - 265 VAC

Features

- Four Quadrant Regenerative Operation
- Adjustable Acceleration/Deceleration Rate
- Adjustable Current Limits
- Differential Input Command
- Built in Shunt Regulator Circuit
- On-Board Test Potentiometer
- Offset Adjustment Potentiometer
- Adjustable Input Gain
- Selectable 120/60 Hall Commutation Phasing
- Hall Velocity Mode
- Encoder Velocity Mode
- Differential Encoder Feedback
- Built-in brake/shunt regulator
- Internal brake/shunt resistor

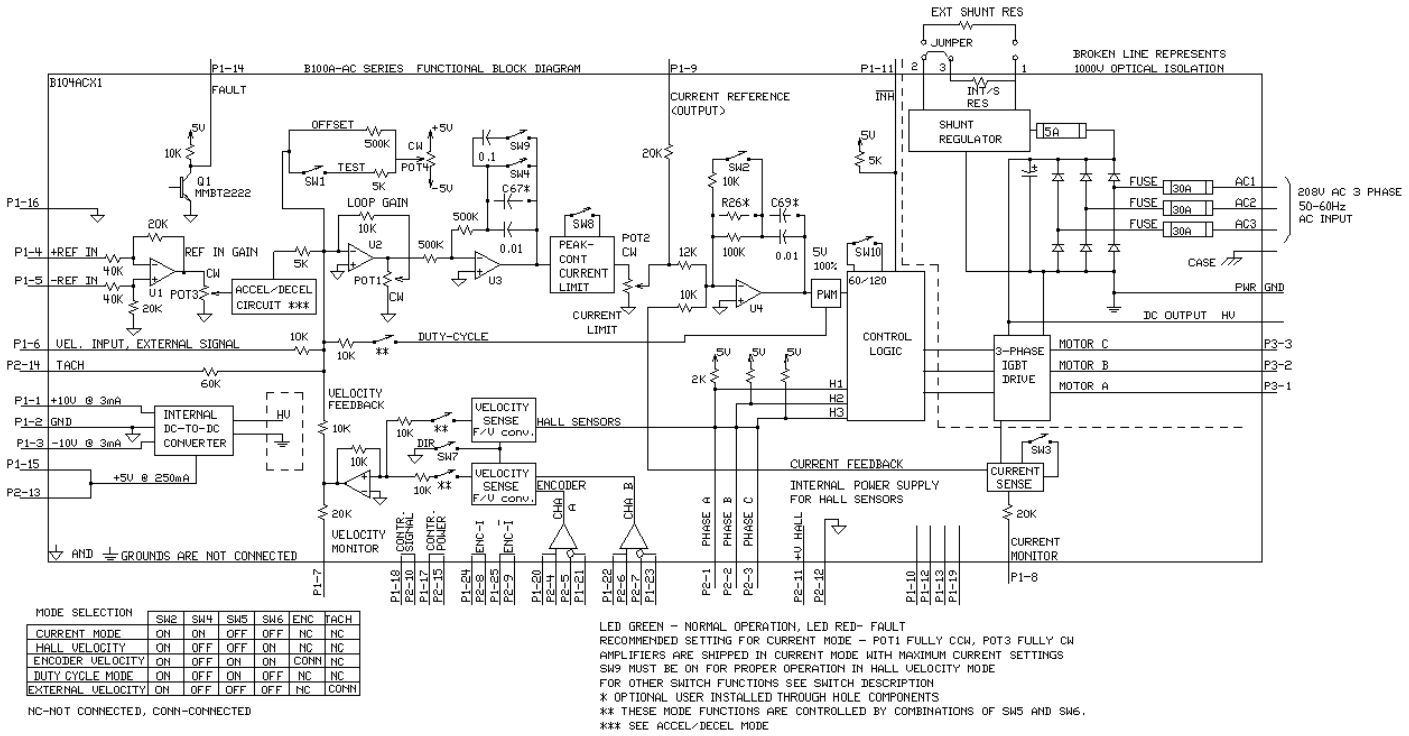
MODES OF OPERATION
- Current
- Duty Cycle (Open Loop)
- Hall Velocity
- Velocity

COMMAND SOURCE
- ±10 V Analog

FEEDBACK SUPPORTED
- Halls
- Incremental Encoder
- Tachometer (±60 VDC)

COMPLIANCES & AGENCY APPROVALS
- UL
- cUL
- CE Class A (LVD)
- CE Class A (EMC)
- RoHS

BLOCK DIAGRAM



MODE SELECTION	SW2	SW4	SW5	SW6	ENC	TACH
CURRENT MODE	ON	ON	OFF	OFF	NC	NC
HALL VELOCITY	ON	OFF	OFF	ON	NC	NC
ENCODER VELOCITY	ON	OFF	ON	ON	CONN	NC
DUTY CYCLE MODE	ON	OFF	ON	OFF	NC	NC
EXTERNAL VELOCITY	ON	OFF	OFF	OFF	NC	CONN

NC-NOT CONNECTED, CONN-CONNECTED

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
SW9 MUST BE ON FOR PROPER OPERATION IN HALL VELOCITY MODE
FOR OTHER SWITCH FUNCTIONS SEE SWITCH DESCRIPTION
* OPTIONAL USER INSTALLED THROUGH HOLE COMPONENTS
** THESE MODE FUNCTIONS ARE CONTROLLED BY COMBINATIONS OF SW5 AND SW6.
*** SEE ACCEL/DECEL MODE

Information on Approvals and Compliances	
cULus	US and Canadian safety compliance with UL 508c, the industrial standard for power conversion electronics. UL registered under file number E140173. Note that machine components compliant with UL are considered UL registered as opposed to UL listed as would be the case for commercial products.
CE	Compliant with European CE for both the Class A EMC Directive 2004/108/EC on Electromagnetic Compatibility (specifically EN 61000-6-4:2001, EN 61000-6-2:2001, EN 61000-3-2:2000, and EN 61000-3-3:1995/A1:2001) and LVD requirements of directive 2006/95/EC (specifically EN 60204-1), a low voltage directive to protect users from electrical shock.
RoHS COMPLIANCE	RoHS (Reduction of Hazardous Substances) is intended to prevent hazardous substances such as lead from being manufactured in electrical and electronic equipment.

SPECIFICATIONS

Power Specifications		
Description	Units	Value
AC Supply Voltage Range	VAC	45 - 265
DC Supply Voltage Range	VDC	60 - 400
DC Bus Over Voltage Limit	VDC	425
Maximum Peak Output Current[1]	A	100
Maximum Continuous Output Current	A	50
Maximum Continuous Output Power	W	19000
Maximum Power Dissipation at Continuous Current	W	1000
Internal Bus Capacitance	µF	2640
Internal Shunt Resistance	Ω	20
Internal Shunt Resistor Power Rating	W	180
Internal Shunt Resistor Turn-on Voltage	VDC	390
Minimum Load Inductance (Line-To-Line)[2]	µH	600
Low Voltage Supply Outputs	-	±10 VDC (3 mA), +5 VDC (250 mA), +6 VDC (30 mA)
Switching Frequency	kHz	15
Shunt Fuse	A	5
Bus Fuse	A	15
Control Specifications		
Description	Units	Value
Command Sources	-	±10 V Analog
Feedback Supported	-	Halls, Incremental Encoder, Tachometer (±60 VDC)
Commutation Methods	-	Trapezoidal
Modes of Operation	-	Current, Hall Velocity, Duty Cycle, Velocity
Motors Supported	-	Single Phase (Brushed, Voice Coil, Inductive Load), Three Phase (Brushless)
Hardware Protection	-	Invalid Commutation Feedback, Over Current, Over Temperature, Over Voltage, Short Circuit (Phase-Phase & Phase-Ground)
Primary I/O Logic Level	-	5V TTL
Internal Shunt Regulator	-	Yes
Internal Shunt Resistor	-	Yes
Mechanical Specifications		
Description	Units	Value
Agency Approvals	-	CE Class A (EMC), CE Class A (LVD), cUL, RoHS, UL
Size (H x W x D)	mm (in)	270.5 x 233.7 x 160.5 (10.6 x 9.2 x 6.3)
Weight	g (oz)	6660 (234.9)
Heatsink (Base) Temperature Range[3]	°C (°F)	0 - 65 (32 - 149)
Storage Temperature Range	°C (°F)	-40 - 85 (-40 - 185)
Form Factor	-	Panel Mount
C1 Connector	-	5-contact, 11.10 mm spaced, tri-barrier terminal block
C2 Connector	-	5-contact, 11.10 mm spaced, tri-barrier terminal block
P1 Connector	-	25-pin, female D-sub
P2 Connector	-	15-pin, female D-sub
P3 Connector	-	3-contact, 11.10 mm spaced, tri-barrier terminal block

Notes

1. Maximum duration of peak current is ~2 seconds. Peak RMS value must not exceed continuous current rating of the drive.
2. Lower inductance is acceptable for bus voltages well below maximum. Use external inductance to meet requirements.
3. Additional cooling and/or heatsink may be required to achieve rated performance.

PIN FUNCTIONS

C1 - Power Connector			
Pin	Name	Description / Notes	I/O
1	AC1	AC Supply Input (Single Or Three Phase)	I
2	AC2		I
3	AC3		I
4	NC	Not Connected (Reserved)	-
5	CASE GND	Case Ground	PE

C2 - Power Connector			
Pin	Name	Description / Notes	I/O
1	EXT SHUNT RES	External Shunt Resistor Connection. Connect resistor between this port and Shunt Resistor DC+.	-
2	SHUNT RES DC+	Shunt Resistor DC+. Connection for shunt resistor.	-
3	INT SHUNT RES	Internal Shunt Resistor. Jumper to Shunt Resistor DC+ to activate.	-
4	HIGH VOLTAGE	DC Bus Output	O
5	POWER GND		PGND

P1 - Signal Connector			
Pin	Name	Description / Notes	I/O
1	+10V 3mA OUT	±10 V @ 3 mA low power supply for customer use. Short circuit protected. Reference ground common with signal ground.	O
2	SIGNAL GND		SGND
3	-10V 3mA OUT		O
4	+REF IN	Differential Reference Input (±10 V Operating Range, ±15 V Maximum Input)	I
5	-REF IN		I
6	VEL INPUT	Single ended reference input for external velocity signal, range ±10 V (maximum ±15 V).	I
7	VEL MONITOR OUT	Velocity Monitor. Analog output proportional to motor speed. In Encoder Velocity mode, output is proportional to the encoder line frequency. In Hall Velocity mode, output is proportional to the electrical cycle frequency. Encoder Velocity scaling is 25 kHz/V. Hall Velocity scaling is 100 Hz/V.	O
8	CURR MONITOR OUT	Current Monitor. Analog output signal proportional to the actual current output. Scaling is 15.6 A/V by default but may be reduced to half this value by setting DIP switch SW-3 to OFF (see Hardware Settings section below). Measure relative to signal ground.	O
9	CURR REF OUT	Measures the command signal to the internal current-loop. This pin has a maximum output of ±7.25 V when the drive outputs maximum peak current. Measure relative to signal ground.	O
10	RESERVED	Reserved	-
11	$\overline{\text{INHIBIT IN}}$	TTL level (+5 V) inhibit/enable input. Leave open to enable drive. Pull to ground to inhibit drive. Inhibit turns off all power devices.	I
12	RESERVED	Reserved	-
13	RESERVED	Reserved	-
14	FAULT OUT	TTL level (+5 V) output becomes high when power devices are disabled due to at least one of the following conditions: inhibit, invalid Hall state, output short circuit, over voltage, over temperature, power-up reset.	O
15	+5V @ 250mA	±5 V @ 250 mA low power supply for customer use. Short circuit protected. Referenced to signal ground.	O
16	SIGNAL GND	Signal Ground	SGND
17	CTLR POWER	Controller Power. Pass-through to Port 2 (P2) for customer use.	I/O
18	CTLR SIGNAL	User Controller Signal. Pass-through to Port 2 (P2) for customer use.	I/O
19	RESERVED	Reserved	-
20	ENC CH A+	Differential Encoder Channel A Output. Pass-through from Port 2 (P2).	O
21	ENC CH A-		O
22	ENC CH B+	Differential Encoder Channel B Output. Pass-through from Port 2 (P2).	O
23	ENC CH B-		O
24	INDEX+	Differential Encoder Index Output. Pass-through from Port 2 (P2).	O
25	INDEX-		O

P2 - Feedback Connector			
Pin	Name	Description / Notes	I/O
1	HALL 1	Single-ended Hall/Commutation Sensor Inputs (+5 V logic level)	I
2	HALL 2		I
3	HALL 3		I
4	ENC. CH. A+	Differential Encoder Channel A Input (+5 V Logic Level)	I
5	ENC. CH. A-		I
6	ENC. CH. B+	Differential Encoder Channel B Input (+5 V Logic Level)	I
7	ENC. CH. B-		I
8	INDEX+	Differential Encoder Index Input (+5 V Logic Level)	I
9	INDEX-		I
10	CTLR SIGNAL	User Controller Signal. Pass-through to Port 1 (P1) for customer use.	I/O
11	+V HALL OUT	Low Power Supply For Hall Sensors (+6 V @ 30 mA). Referenced to signal ground. Short circuit protected.	O
12	GND	Signal Ground	SGND
13	+5V @ 250mA	±5 V @ 250 mA low power supply for customer use. Short circuit protected. Referenced to signal ground.	O
14	TACH	Negative Tachometer Input (Maximum ±60 V). Use signal ground for positive input.	I
15	CTLR POWER	Controller Power. Pass-through to Port 1 (P1) for customer use.	I/O

P3 - Motor Power Connector			
Pin	Name	Description / Notes	I/O
1	MOTOR A	Motor Phase A	O
2	MOTOR B	Motor Phase B	O
3	MOTOR C	Motor Phase C	O

HARDWARE SETTINGS

Switch Functions

Switch	Description	Setting	
		On	Off
1	Test/Offset. Switches the function of the Test/Offset pot between an on-board command input for testing or a command offset adjustment. OFF by default.	Test	Offset
2	Current loop proportional gain adjustment. ON by default.	Decrease	Increase
3	Current scaling. When OFF, increases sensitivity of current sense thus reducing both peak and continuous current limit by 50%. The scaling of the current monitor output signal becomes ½ its ordinary value when this switch is OFF.	Full-current	Half-current
4	Outer loop integration. Activates or deactivates integration. ON, by default, for current mode and OFF for other modes.	Inactive	Active
5	Mode selection. See mode selection table below.	-	-
6	Mode selection. See mode selection table below.	-	-
7	Velocity feedback polarity. Changes the polarity of the internal feedback signal and the velocity monitor output signal. Inversion of the feedback polarity may be required to prevent a motor run-away condition.	Standard	Inverted
8	Current ratio. Used to set continuous-to-peak current ratio. Default is ON.	Cont./Peak Ratio = 50%	Cont./Peak Ratio = 25%
9	Outer loop integral gain adjustment. It is recommended to leave this switch OFF for most applications, but ON for Hall Velocity Mode.	Decrease	Increase
10	Hall sensor phasing. Selects 120°/60° commutation phasing. ON by default.	120°	60°

Mode Selection Table

	SW4	SW5	SW6	Encoder	Tachometer
CURRENT	ON	OFF	OFF	Not Connected	Not Connected
DUTY CYCLE	OFF	ON	OFF	Not Connected	Not Connected
HALL VELOCITY*	OFF	OFF	ON	Not Connected	Not Connected
ENCODER VELOCITY*	OFF	ON	ON	Connected	Not Connected
TACHOMETER VELOCITY	OFF	OFF	OFF	Not Connected	Connected
EXTERNAL VELOCITY	OFF	OFF	OFF	Not Connected	Not Connected

* NOTE: See details of switch 7 and 9 for further Hall/Encoder Velocity configuration information.

Potentiometer Functions

Potentiometer	Description	Turning CW
1	Loop gain adjustment for duty cycle / velocity modes. Turn this pot fully CCW in current mode.	Increases gain
2	Current limit. It adjusts both continuous and peak current limit while maintaining their ratio.	Increases limit
3	Reference gain. Adjusts the ratio between input signal and output variables (voltage, current, or velocity).	Increases gain
4	Offset / Test. Used to adjust any imbalance in the input signal or in the amplifier. Can also be used as an on-board signal source for testing purposes.	Adjusts offset in negative direction
Note: Potentiometers are approximately linear and have 12 active turns with 1 inactive turn on each end.		

Jumper Settings

Jumper	Description	Configuration	
	SMT Jumper (0Ω Resistor)	Not Installed	Installed
J8	First of two jumpers used to enable adjustable accel/decel rate control. Both jumpers must be set appropriately. The default setting is installed (accel/decel disabled).	Enabled	Disabled
J9	Second of two jumpers used to enable adjustable accel/decel rate control. Both jumpers must be set appropriately. The default setting is not installed (accel/decel disabled).	Disabled	Enabled

Through-hole Components†

Location	Description
C67*	Velocity Loop Integrator. Through-hole capacitor that can be added for more precise velocity loop tuning. See section below on Tuning with Through-hole components for more details.
C69*	Current Loop Integrator. Through-hole capacitor that can be added for more precise current loop tuning. See section below on Tuning with Through-hole components for more details.
R26*	Current Loop Proportional Gain. Through-hole resistor that can be added for more precise current loop tuning. See section below on Tuning with Through-hole components for more details.
R907	First of two resistors used to set the deceleration rate.
R908	Second of two resistors used to set the deceleration rate.
R914	First of two resistors used to set the acceleration rate.
R915	Second of two resistors used to set the acceleration rate.

Tuning With Through-hole Components

In general, the drive will not need to be further tuned with through-hole components. However, for applications requiring more precise tuning than what is offered by the potentiometers and dipswitches, the drive can be manually modified with through-hole resistors and capacitors as denoted in the above table. By default, the through-hole locations are not populated when the drive is shipped. Before attempting to add through-hole components to the board, consult the section on loop tuning in the installation notes on the manufacturer's website. Some general rules of thumb to follow when adding through-hole components are:

- A larger resistor value will increase the proportional gain, and therefore create a faster response time.
- A larger capacitor value will increase the integration time, and therefore create a slower response time.

Proper tuning using the through-hole components will require careful observation of the loop response on a digital oscilloscope to find the optimal through-hole component values for the specific application.

Acceleration/Deceleration Setting Details

The acceleration and deceleration rates can be set independently using through-hole resistors at locations R914, R915, R907, R908 (see table below). The rates are based on + or – 10 Volts to the Reference inputs. The "Time" listed in the table below is the time it takes to reach the 10-Volt input. The ramping rates are linear with respect to time. For example, if the input were only 5 Volts, the time to ramp to this voltage would be half the time to ramp to 10 Volts. These locations are silk-screened on the PCB for easy identification.

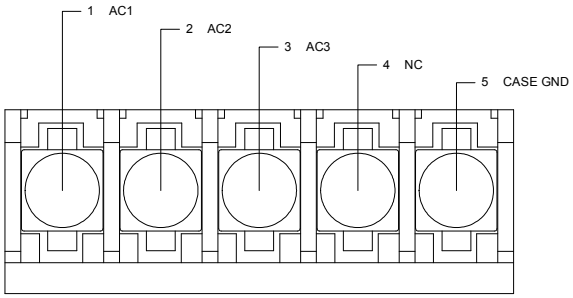
Time (s)	Acceleration		Deceleration	
	R914 (kΩ)	R915 (kΩ)	R907 (kΩ)	R908 (kΩ)
1	50	50	50	50
2	50	20	50	20
3*	**10**	**10**	**10**	**10**
4	500	20	500	20
5	50	5	50	5
6	500	10	500	10
7	50	2	50	2
8	50	1	50	1
9	20	0.1	20	0.1
10	100	0.1	100	0.1

* Default setting

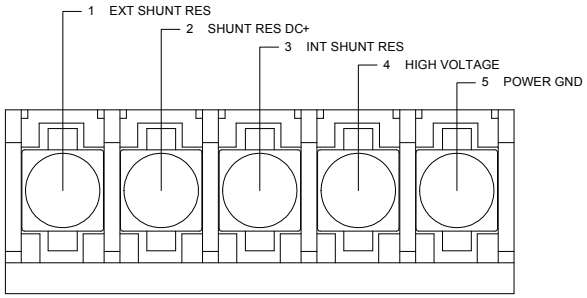
†**Note: Damage done to the drive while performing these modifications will void the warranty.**

MECHANICAL INFORMATION

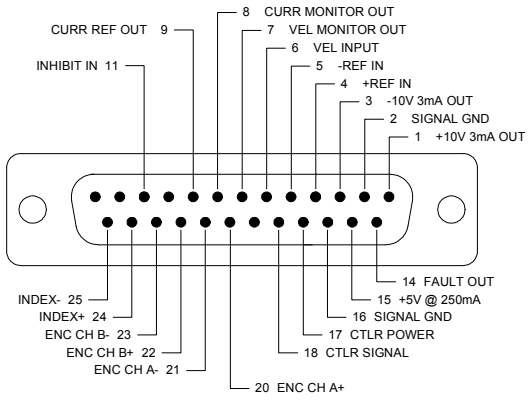
C1 - Power Connector		
Connector Information		5-contact, 11.10 mm spaced, tri-barrier terminal block
Mating Connector	Details	Not applicable
	Included with Drive	Not applicable



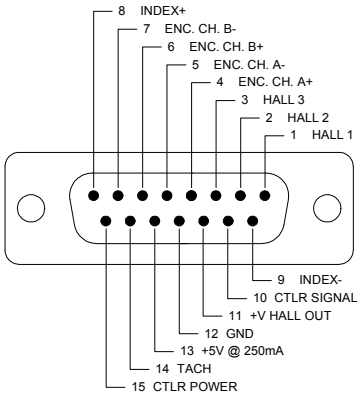
C2 - Power Connector		
Connector Information		5-contact, 11.10 mm spaced, tri-barrier terminal block
Mating Connector	Details	Not applicable
	Included with Drive	Not applicable



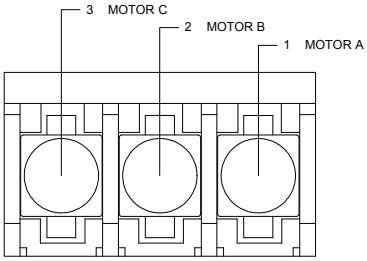
P1 - Signal Connector		
Connector Information		25-pin, female D-sub
Mating Connector	Details	TYCO: Plug P/N 5205208-1; Housing P/N 5745173-1; Terminals P/N 1658540-5 (loose) or 1658540-4 (strip)
	Included with Drive	No



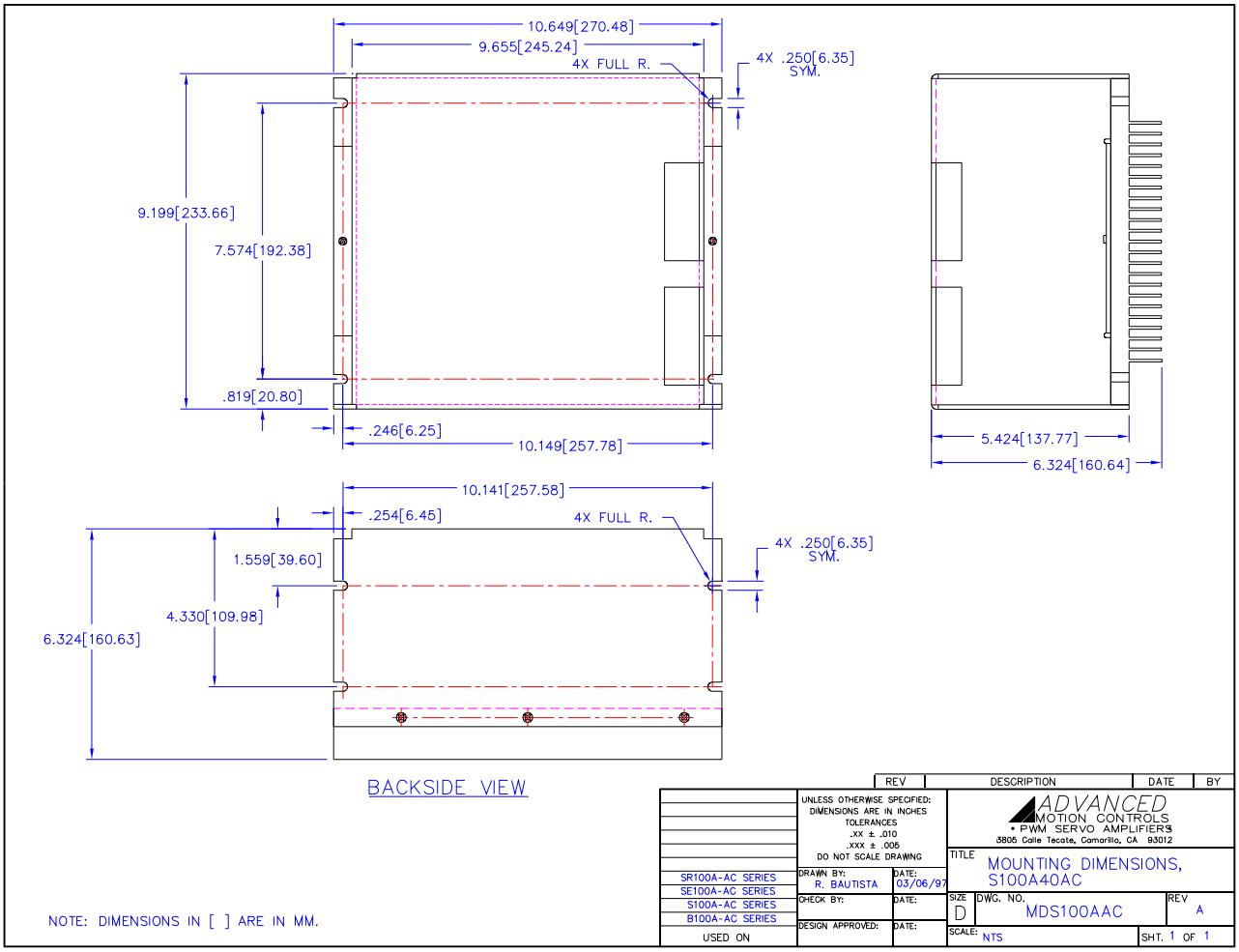
P2 - Feedback Connector		
Connector Information		15-pin, female D-sub
Mating Connector	Details	TYCO: Plug P/N 205206-3; Housing P/N 5745172-1; Terminals P/N 1658540-5 (loose) or 1658540-4 (strip)
	Included with Drive	No



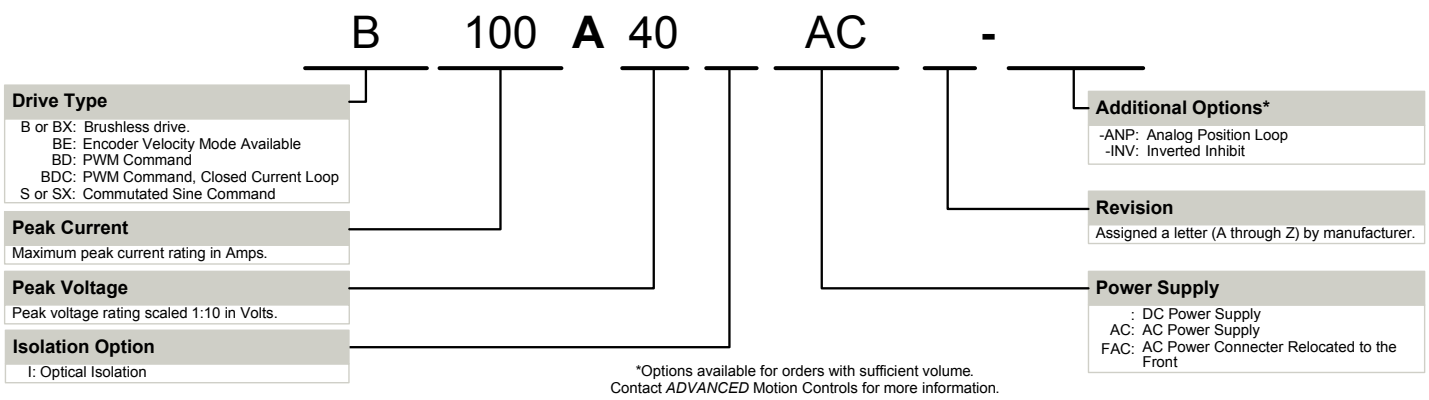
P3 - Motor Power Connector		
Connector Information		3-contact, 11.10 mm spaced, tri-barrier terminal block
Mating Connector	Details	Not applicable
	Included with Drive	Not applicable



MOUNTING DIMENSIONS



PART NUMBERING INFORMATION



ADVANCED Motion Controls analog series of servo drives are available in many configurations. Note that not all possible part number combinations are offered as standard drives. All models listed in the selection tables of the website are readily available, standard product offerings.

ADVANCED Motion Controls also has the capability to promptly develop and deliver specified products for OEMs with volume requests. Our Applications and Engineering Departments will work closely with your design team through all stages of development in order to provide the best servo drive solution for your system. Equipped with on-site manufacturing for quick-turn customs capabilities, *ADVANCED* Motion Controls utilizes our years of engineering and manufacturing expertise to decrease your costs and time-to-market while increasing system quality and reliability.

Examples of Modifications and Customized Products

- Integration of Drive into Motor Housing
- Mount OEM PCB onto Drive Without Cables
- Multi-axis Configuration for Compact System
- Custom PCB and Baseplate for Optimized Footprint
- RTV/Epoxy Components for High Vibration
- OEM Specified Connectors for Instant Compatibility
- OEM Specified Silkscreen for Custom Appearance
- Increased Thermal Limits for High Temp. Operation
- Integrate OEM Circuitry onto Drive PCB
- Custom Control Loop Tuned to Motor Characteristics
- Custom I/O Interface for System Compatibility
- Preset Switches and Pots to Reduce User Setup
- Optimized Switching Frequency
- Ramped Velocity Command for Smooth Acceleration
- Remove Unused Features to Reduce OEM Cost
- Application Specific Current and Voltage Limits

Feel free to contact Applications Engineering for further information and details.