

SR30A SERIES BRUSHLESS SERVO AMPLIFIERS

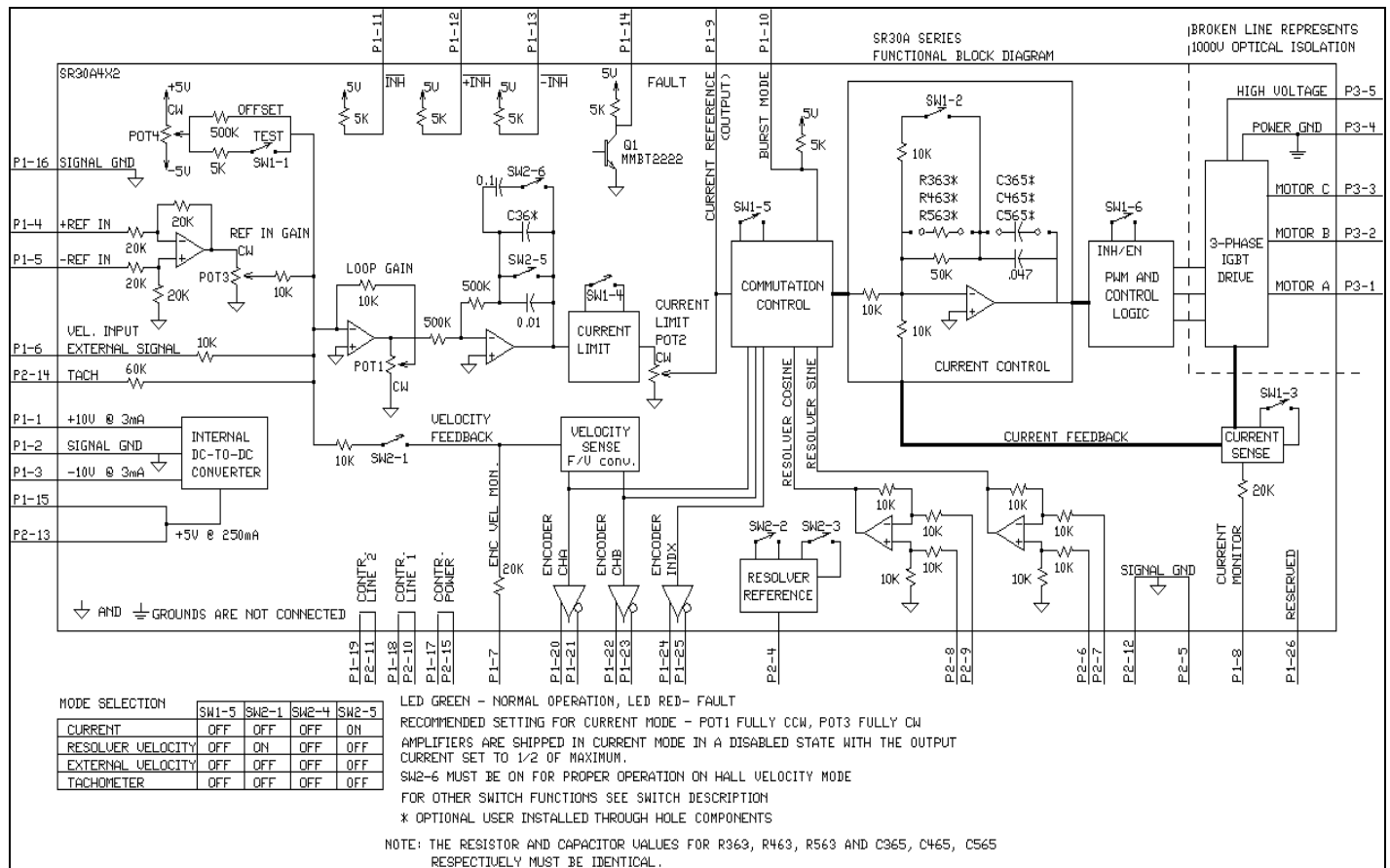
Models: SR10A40, SR30A40

FEATURES:

- Surface-mount technology
- Small size, low cost, ease of use
- Optical isolation, see block diagram
- DIP switch selectable modes:
current, resolver velocity
- Four quadrant regenerative operation
- Resolver interface for sinusoidal commutation
- Emulated encoder output
- Commutation Detection and Burst Mode
- Agency Approvals:



BLOCK DIAGRAM:



ADVANCED MOTION CONTROLS

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

DESCRIPTION: The SR30A Series PWM servo amplifiers are designed to drive brushless motors with 3 phase sine wave current. An on board digital controller generates the 3 phase sine wave signals from the resolver input. The encoder emulation outputs (A, B and I) continuously produce signals equivalent to a 1024 line encoder. All models are fully protected against over-voltage, under-voltage, over-current, over-heating and short-circuits. The SR30A series interface with a digital controller or can be used as a stand-alone drive. Only a single unregulated DC power supply is required. A 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:

POWER STAGE SPECIFICATIONS	MODEL	
	SR10A40	SR30A40
DC SUPPLY VOLTAGE	60 - 400 VDC	
PEAK CURRENT (2 sec. max., internally limited)	±10 A (7.1 Arms)	± 30 A (21.2 Arms)
MAXIMUM CONTINUOUS CURRENT (internally limited)	±5 A (3.5 Arms)	± 15 A (10.6 Arms)
MINIMUM LOAD INDUCTANCE*	600 µH	
SWITCHING FREQUENCY	20 kHz nominal	
HEATSINK (BASE) TEMPERATURE RANGE	0° to +65° C, disables if > 65° C	
POWER DISSIPATION AT CONT. CURRENT	100 W	300 W
OVER-VOLTAGE SHUT-DOWN (self reset)	425 V	
BANDWIDTH (load dependent)	2.5 kHz	

MECHANICAL SPECIFICATIONS	
POWER CONNECTOR: P3	Screw terminals
SIGNAL CONNECTORS: P1, P2	P1 is a 26 pin high density female D-sub connector and P2 is a 15 pin high density female D-sub connector.
SIZE	8.00 x 5.62 x 1.60 inches 203.2 x 142.9 x 40.7 mm
WEIGHT	2.12 lb. 0.99 Kg

* Low inductance motors require external inductors.

PIN FUNCTIONS:

CONNECTOR	PIN	NAME	DESCRIPTION / NOTES	I/O
P1	1	+10V @ 3 mA	For customer use	O
	2	SIGNAL GND	Reference ground	SGND
	3	-10V @ 3 mA	For customer use	O
	4	+REF	Differential reference input, maximum $\pm 15V$, 20K input resistance	I
	5	-REF		
	6	Velocity Input	Single ended reference input, external velocity signal, maximum $\pm 15V$, 10K input resistance	I
	7	Velocity Monitor	1 V = 1500 RPM	O
	8	Current Monitor	This signal is proportional to the RMS current in the motor leads; SR10A40: 1V=1.33 A SR30A40: 1V = 4 A	O
	9	Current Reference	This is the command signal to the internal current-loop. The maximum peak current rating of the amplifier always equals 7.25 V at this pin. SR10A40: SW1-3=ON, 7.25V=10A; SW1-3=OFF, 7.25V=5A. SR30A40: SW1-3=ON, 7.25V=30A; SW1-3=OFF, 7.25V=15A.	O
	10	Burst Mode Enable	Pull to ground to enable. See Burst Mode below.	I
	11	Inhibit/Enable	SW1-6 = ON Pull to ground to inhibit SW1-6 = OFF pull to ground to enable	I
	12	+Inhibit/Enable	If SW1-6=ON, pull P1-12 to ground to inhibit (+) amplifier output and P1-13 to inhibit (-) amplifier output. If SW1-6=OFF, pull P1-12 to ground to enable (+) amplifier output and P1-13 to enable (-) amplifier output. These inputs will NOT cause a fault condition or a red LED.	I
	13	-Inhibit/Enable		I
	14	Fault (LED red)	TTL level output. Becomes high during output short circuit, over-voltage, over temperature, inhibit, and during power-up reset. Fault condition indicated by red LED.	O
	15	+5V @ 250mA	For customer use. Note: the total current on P1-15 and P2-13 combined should not exceed 250 mA.	O
	16	SIGNAL GND	Reference ground	SGND
	17	Controller Power*	Connected to P2-15. For customer use	I
	18	Controller Line 1*	Connected to P2-10. For customer use	I
	19	Controller Line 2*	Connected to P2-11. For customer use	I
	20	Encoder Channel A+	Differential RS485 encoder output (1024 lines/rev)	O
	21	Encoder Channel A-		
	22	Encoder Channel B+	Differential RS485 encoder output (1024 lines/rev)	O
	23	Encoder Channel B-		
	24	Index+	Differential RS485 encoder output	O
	25	Index-		
	26	Reserved		

NOTE: All circuits on connectors P1 and P2 are optically isolated from all circuits on connector P3.

* No connection internal to the amplifier. See block diagram.

PIN FUNCTIONS:

CONNECTOR	PIN	NAME	DESCRIPTION / NOTES	I/O
P2	1	NC	No Connection	
	2	NC	No Connection	
	3	NC	No Connection	
	4	REF+	Differential Output. Resolver Reference. See SW2-2 for output parameters.	O
	5	REF-		
	6	SIN+	Differential Input. Resolver Sine	I
	7	SIN-		
	8	COS+	Differential Input. Resolver Cosine	I
	9	COS-		
	10	Controller Line 1*	Connected to P1-18. For customer use.	O
	11	Controller Line 2*	Connected to P1-19. For customer use.	O
	12	Signal GND	Reference ground	SGND
	13	+5V @ 250mA	For customer use. Note: the total current on P1-15 and P2-13 combined should not exceed 250 mA.	O
	14	TACH	Tachometer Input, 60 K Ω input resistance, ± 60 V max.	I
	15	Controller power*	Connected to P1-17. For customer use.	O
P3	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 VOLTAGE	DC power input	I

NOTE: All circuits on connectors P1 and P2 are optically isolated from all circuits on connector P3.

* No connection internal to the amplifier. See block diagram.

SWITCH FUNCTIONS:**BANK 1**

SWITCH	FUNCTION DESCRIPTION	SETTING	
		ON	OFF
1-1	Test / Offset controls the sensitivity of the "offset" pot. This is used as an on-board reference signal in test mode.	Test	Offset
1-2	Current loop gain*	Decrease	Increase
1-3	Current scaling. When OFF, this increases the sensitivity of the current sense thus reducing both peak and continuous current limit by 50%.	100%	50%
1-4	Continuous current reduction	Continuous / peak current limit ratio is 50%	Continuous / peak current limit ratio is 25%
1-5	Commutation Detection	Detect phase angle. See Commutation Detection below.	
1-6	INHIBIT/ENABLE	P1-11, 12, 13 : INHIBIT	P1-11, 12, 13 : ENABLE

* See item "6.3 Current Loop Adjustments" in section G for more information.

Units are shipped set for ½ current output via SW1-3=off and in the disabled state via SW1-6=off.

BANK 2

SWITCH	FUNCTION DESCRIPTION	SETTING	
		ON	OFF
2-1	Velocity feedback. This connects the internally generated velocity signal from the resolver.	On	Off
2-2	Resolver Reference Voltage	4.00 Vrms 0.5 transformation ratio	4.25 Vrms 0.47 transformation ratio
2-3	Resolver Reference Frequency	5 kHz	NA
2-4	Reserved		
2-5	Loop integrator. This capacitor normally ensures "error-free" operation in velocity mode by reducing the error signal (output of summing amplifier) to zero.	Disables the velocity / voltage loop integrator capacitor	Enables the velocity / voltage loop integrator capacitor
2-6	Integrator capacitor. This adjusts the value of the integrator capacitor in the velocity mode.	Increase	Decrease

Contact factory for additional resolver reference voltage and/or frequency options.

POTENTIOMETER FUNCTIONS:

POTENTIOMETER	DESCRIPTION	TURNING CW
Pot 1	This potentiometer is the loop gain adjustment in the velocity mode. Turn this pot fully CCW in current mode.	Increases loop gain
Pot 2	Current limit. This potentiometer adjusts both the continuous and peak current limit while maintaining a selected ratio.	Increases current limit
Pot 3	Reference in gain. This potentiometer adjusts the ratio between input signal and output variables (voltage, current, and velocity).	Increases reference input gain
Pot 4	Test / Offset. Used to adjust any imbalance in the input signal or in the amplifier. When SW1-1 (DIP switch) is ON, the sensitivity of this pot is greatly increased allowing it to be used as an on-board signal source for testing purposes.	N/A

TEST POINTS FOR POTENTIOMETERS: See section "G".

OPERATING MODE SELECTION:**FEEDBACK MODE**

The following operating modes can be selected by setting the DIP switches according to the following chart:

- Current mode
- Resolver velocity mode
- External velocity mode
- Tachometer mode

MODE	SW1-1	SW1-2	SW1-3	SW1-4	SW1-5	SW1-6	SW2-1	SW2-2	SW2-3	SW2-4	SW2-5	SW2-6
Current Mode	X	X	X	X	OFF	X	OFF	X	X	OFF	ON	OFF
Resolver Velocity Mode	X	X	X	X	OFF	X	ON	X	X	OFF	OFF	X
External velocity mode	X	X	X	X	OFF	X	OFF	X	X	OFF	OFF	X
Tachometer mode	X	X	X	X	OFF	X	OFF	X	X	OFF	OFF	X

X does not affect mode.

COMMUTATION DETECTION MODE (SW1-5):

In commutation detection mode the amplifier will automatically detect the optimum phase angle by performing a test move while monitoring motor position. Phase-offset and pole-counts are stored in non-volatile memory for further use. In this mode the motor shaft **MUST BE** de-coupled from the load and free to move. It is also recommended to secure the motor to avoid damage or injury. **CAUTION: Sudden motion will occur in Commutation Detection Mode. Do not activate commutation mode while the motor is attached to the load and do not touch the motor shaft during the test move.** To start commutation detection, follow the steps below.

1. Configure the amplifier for current mode (see table in block diagram)

2. Set the amplifier current limits to match the motor current specifications (see Current Limit Adjustments below). Failure to do so may severely damage the motor.
3. Apply a reference signal such that a current larger than the continuous current of the motor is commanded.
 - A. If the on-board test pot (Pot 4 with SW1-1 ON) is used as the reference signal, the pot must be turned CCW from the middle (0V Command) of the 14-turn pot.
 - B. If an external reference signal is used, this command signal must be a positive command (i.e. positive voltage into +REF must be positive referenced to Signal GND).
4. Power up the amplifier:
 - A. in a disabled state (via enable/disable input P1-11 or DIP-switch SW1-6),
 - B. with SW1-5 OFF,
 - C. and with P1-10 (Burst Mode) open.
5. Once the amplifier is fully powered (with LED red), set switch SW1-5 ON.
6. Enable the amplifier (the LED will remain red).
7. Pull P1-10 (Burst Mode) to ground. The LED will turn green. At this time the motor will make one and a half revolutions CW and one and a half revolutions CCW. If no motion occurs, power down and repeat from step 1.
8. Upon completion the amplifier will automatically disable (red LED).
9. To complete detection mode:
 - A. power off the amplifier,
 - B. set switch SW1-5 OFF,
 - C. and release P1-10 (Burst Mode).
 - D. remove command signal (set Pot 4 to middle if it was used in step 3A)
10. The amplifier is now operational.

BURST MODE (Pin P1-10)

In Burst Mode the amplifier will send an encoder pulse stream to the motion controller equal to the amount of pulses between the resolver datum and the actual motor position. This allows the motion controller to register the absolute motor position (within one motor revolution). The Burst Mode sequence is as follows:

1. Disable the amplifier.
2. Pull Burst Mode input to ground (can be done immediately after amplifier disable).
3. Upon Burst Mode input pull-down, the amplifier will first send a single index channel pulse and then 2 channel A and 2 channel B pulses (8 counts). The Burst Mode input must be pulled down for at least 2.1 milliseconds to ensure this initial stream.
4. Upon Burst Mode input release, the amplifier will stream the appropriate amount of pulses (from datum to actual position) with channel A leading channel B. This stream will complete in 15 milliseconds (channel line width is 3.4 microseconds).

Caution: motor shaft movement during Burst Mode will not be registered! The motor shaft must remain in position during Burst Mode in order to work properly!

APPLICATION NOTE: For proper operation, P1-6 and P2-14 must be connected to the signal ground if they are not being used.

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 at the same time. It has 12 active turns, one inactive turn at each end and is approximately linear. Thus, to adjust the current limit turn the potentiometer counter-clockwise to zero, then turn clockwise to the appropriate value. In many applications it is sufficient to use only the DIP-switches for current limit adjustments. SW1-3 reduces both peak and continuous current limit by 50% when OFF. SW1-4 reduces only the continuous current limit by 50% when OFF:

SW1-4	CONTINUOUS / PEAK CURRENT LIMIT RATIO
ON	50%
OFF	25%

P1-9 is the input to the internal current amplifier power stage. Since the output current is proportional to P1-9, 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 P1-9. 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 SW1-3=ON, peak rated amplifier current = 7.25 V. If SW1-3=OFF, $\frac{1}{2}$ peak rated amplifier current = 7.25 V. Example: using the SR30A40 with SW1-3=ON, 30A=7.25V and with SW1-3=OFF, 15A=7.25V.

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

ORDERING INFORMATION:

Model: SR10A40, SR30A40X

X indicates the current revision letter.

TYPICAL SYSTEM WIRING: See section "G".

The resolver connections must be made with individually shielded, twisted wire pairs for proper operation.

MATING CONNECTORS:

Manufacturer: AMP® (Tel: 1-800-522-6752)

Part numbers:

15 Pin plug 748364-1
26 Pin plug 748365-1

Pins 748333-2

Shell Kit (plastic with metal coating)

15 Pin 748677-1
26 Pin 748677-2

MOUNTING DIMENSIONS: See page F-13.