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HIGH PERFORMANCE MOTORS & DRIVES

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(978) 988-9800
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Rev D

MA900

SC900 Family Hardware Reference Manual

Single Axis Resolver Based Brushless Servo Drives

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1 Overview of the SC900 Family

Introduction

This manual describes a family of economical, high performance, medium power single axis servo drives meant to go with resolver equipped brushless 3-phase permanent magnet motors. The SC900 family is focused on medium to large volume OEM applications but can be easily applied in end user applications.

In addition to industry standard capabilities and protection features, the SC900 family includes many state of the art industry leading features:

Features

- All digital DSP-based control including the current loops.
- All system and application parameters set in software
- Digital auto-tuning for easy and predictable set-up
- Advanced patented Digital Resolver to Digital (DRDC) converter with standard 5.3 are minute absolute accuracy and 24 bit position resolution. U.S. Patent Number 5,162,798.
- Advanced Signature Series sinusoidal current control for low shaft torque ripple and uniform control dynamics at all shaft speeds.
- Modular construction with a user removable option card allowing easy configuration.
  - RS-232/485 serial interface
  - SERCOS fiber optic multi-axis interface
  - Single axis programmable positioning
  - Removable Personality parameters
  - Field upgrade of drive software
- Analog, incremental digital, serial, or optionally SERCOS digital fiber optic command sources for shaft torque, velocity, or position control.
- 16 different emulated quadrature encoder output resolutions up to 16,384 PPR.

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Standard Features

In addition to the above distinctive features The SC900 family's many industry standard features include:

- Four base models covering 7.5 to 60 Amp peak
- Integral power supply with totally enclosed panel mount packaging
- Single resolver motor feedback survives hostile environments
- Extensive protection circuits and diagnostics to ease set-up
- IGBT power stage with inaudible high frequency PWM
- Combined with Pacific Scientific's R series, S series, and PMA series brushless permanent magnet servo motors the available peak torque ranges from 10 lb-in to 800 lb-in (1.1 to 90 Nm)
- UL Recognized-508C - File number 150845.
- CSA equivalent to UL 508
- ISO 9001

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Option Cards

Option cards extend the base SC900 functionality and allow the operating adjustments and parameters to be set. These "personality" adjustments/parameters can be stored in the base SC900's non-volatile EEPROM memory or in the Option card's non-volatile EEPROM memory. If the personality is stored in the base SC900, then the Option card can be removed after setting the parameters and a blank panel substituted to lower the installed cost or to prevent un-authorized changing of drive personality in the field. Available Option Cards include:

OC900-001	Blank panel to cover option slot
OC930-001-00	Serial Communications Option Card RS-232 or RS-485 to set parameters
OC940-001-01	SERCOS Option Card Industry standard LAN fiber optic interface for command and to set parameters
OC950-50x-01	Standard Single Axis Programmable Positioning Option Card
OC950-60x-01	Enhanced Single Axis Programmable Positioning Option Card

If the above Option Cards do not do have the desired functionality contact the factory for a list of the latest available Option Cards.

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2 Model Identification

2.1 Basic Servo Drive Package Order Numbering System

S C 9 0 3 N N - 0 0 1 - 0 1

SC9 = Servo Drive Family Designation

0 = Command Interface Option Card Designation

0 = No option card installed, No communications/setup interface Analog or Incremental Digital Command

3 = OC930-001-00 installed, RS-232/485 Serial Communications/Setup Analog, Incremental Digital, or Serial Command

4 = OC940-001-01 installed, SERCOS Communications & Control

5 = OC950-50x-01 installed, Single Axis Programmable Positioning

3 = Power Level

2 = 3.75 A cont. @ 25 °C, 7.5 A pk.

3 = 7.5 A cont. @ 25 °C, 15.0 A pk.

4 = 15 A cont. @ 25 °C, 30.0 A pk.

5 = 30 A cont. @ 50 °C, 60.0 A pk.

NN = Accessories and Cooling Options

Nx = No accessories

xN = No fan, convection cooled

Ax = Basic connector kit, manual(s)

Tx = TB adapter connector kit, manual(s)

x2 = 240 Vac Fan cooled

x1 = 120 Vac Fan cooled

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- 001 = Customization Code

001 = Standard Unit

501 = Standard Firmware, 32kx8 NVRAM

502 = Standard Firmware, 128kx8 NVRAM

503 = Standard Firmware, 32kx8 NVRAM and PacLAN

504 = Standard Firmware, 128kx8 NVRAM and PacLAN

601 = Enhanced Firmware, 32kx8 NVRAM

602 = Enhanced Firmware, 128kx8 NVRAM

603 = Enhanced Firmware, 32kx8 NVRAM and PacLAN

604 = Enhanced Firmware, 128kx8 NVRAM and PacLAN

XYZ = Factory Assigned Hardware Customization

- 01 = Firmware Version (Factory Assigned)

- 01 = Base Servo Software Type

Example Order Numbers

Order #	Model #	Description
SC933TN-001-01	SC903-001-01	15 Amp peak standard servo drive
	OC930-001-00	Serial Port Option Card, 930 Dialogue 3.5" floppy for PC
	CA903-TB	TB adapter SC903 connector kit
	MA900	*SC900 Family Hardware Reference Manual*
	MA930	*OC930 Hardware and Software Reference Manual*
SC904AN-001-01	SC904-001-01	30 Amp peak standard servo drive
	CA904	Basic SC904 connector kit
	MA900	*SC900 Family Hardware Reference Manual*
SC932NN-001-01	SC902-001-01	7.5 Amp peak standard servo drive
	OC930-001-00	Serial Port Option Card
SC954NN-503-01	SC904-001-01	30 A peak standard drive
	OC950-503-01	Programmable Option Card with 32Kx8 NVRAM and PacLAN™

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2.2 SC900 Accessories

Plug-In Cards

OC900-001	Blank option panel to cover an unused option card slot.
OC900-002-01	Option card with the latest SC900 base servo drive software. This option card allows easy plug-infield upgrades of the SC900 base servo drive's software for applications that do not need any option card functions. This option card can also allow removable personality functionality.
OC930-001-0x	SC900 Serial Communications option card to provide RS-232/485 communications for SC900 setup or for command. Suffix -00 is standard, -01 includes SC900 base servo drive software upgrade. This option card also allows removable personality functionality. Includes 3 ½" floppy disk for 930 Dialogue; the PC communications software.
OC940-001-01	SC900 SERCOS interface option card to provide command and setup over the industry standard SERCOS fiber optic ring.
OC950-50x-01	Standard Programmable Positioning option card to provide programmable single axis motion control.
OC950-60x-01	Enhanced Programmable Positioning option card to provide programmable single axis motion control. The Enhanced version of the OC950 supports additional features, including MODBUS, Allen-Bradley DF-1 Communications, and Camming functionality.

Connector Mate Kits

CA90x	Screw terminal and d-subminiature mates for the SC90x servo drive. x = 2, 3, 4, or 5 to indicate base drive power level.
CA90x-TB	Screw terminal and d-subminiature terminal block adapter mates for the SC90x servo drive. x = 2, 3, 4, or 5 to indicate base drive power level.

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Forced Air Cooling

OF902-00x	Bottom mounting force air cooling fan and bracket accessory kit for the SC9x2. Option suffix -002 is the standard 240 Vac 50/60 Hz model and suffix -001 is a 120 Vac 60 Hz model.
OF903-00x OF904-00x	Bottom mounting force air cooling fan and bracket accessory kit for the SC9x3 or the SC9x4. Option suffix -002 is the standard 240 Vac 50/60 Hz model and suffix -001 is a 120 Vac 60 Hz model. **Note:** *The SC9x5 always comes with an integral 240 Vac 50/60 Hz fan.*

Manual and Documentation Kits

MA900	*SC900 Family Hardware Reference Manual* for the SC900 series basic servo drives.
MA930	*OC930 Hardware and Software Reference Manual* for the OC930 Serial Communications Option Card.
MA940	*OC940 Hardware and Software Reference Manual* for the OC940 SERCOS Interface Option Card.
MA950-IDE	*OC950 Installation and Hardware Reference Manual* and 950BASIC Reference Manual for the OC950 Single Axis Programmable Positioning Option Card. Includes 3 ½" PC floppy for 950IDE Integrated Development Environment.

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3 Electrical Specifications

3.1 Output Power Specifications

	SC9x2	SC9x3	SC9x4	SC9x5
Peak Output Current (0-p)				
5 seconds, up to full 50°C	7.5A	15A	30A	60A
Continuous Output Current (0-p)				
25°C Convection Cooling	3.75A	7.5A	15A	30A
50°C Forced Air Cooling	3.75A	7.5A	15A	30A
50°C Convection Cooling	2.5A	5.0A	10A	30A
Peak Output Power @ 240 VAC*				
1 second, up to full 50°C	2.2kW	4.5kW	9kW	18kW
Continuous Output Power				
@ 240 VAC three phase				
25°C Convection Cooling	1.1kW	2.2kW	4.5kW	9kW
50°C Forced Air Cooling	1.1kW	2.2kW	4.5kW	9kW
50°C Convection Cooling	0.75kW	1.5kW	3.0kW	N/A*
@ 240 VAC single phase**				
25°C Convection Cooling	0.80kW	1.6kW	2.3kW	N/A
50°C Forced Air Cooling	0.80kW	1.6kW	2.3kW	N/A
50°C Convection Cooling	0.55kW	1.1kW	1.5kW	N/A

*The SC9x5 always comes with an integral 240 Vac 50/60 Hz fan.

**For standard 120 VAC single-phase operation derate the Peak and Continuous Output Power ratings by 50%. Consult factory for 120 VAC bus voltage doubled customization specifications. Although possible, single phase operation of the SC9x4 and SC9x5 is not recommended.

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3.1 Output Power Specifications (Cont'd)

	SC9x2	SC9x3	SC9x4	SC9x5
Power Stage Efficiency @ P_{cont}	95%	96%	97%	97%
Shunt Regulator Power				
Peak Power (300 mSec)	3.0kW	6.0kW	12kW	20kW
Continuous Power				
25°C Convection Cooling	20W	30W	100W	200W
50°C Forced Air Cooling	25W	50W	125W	200W
50°C Convection Cooling	20W	20W	100W	200W
Maximum External Regen Duty Cycle	16%	12%	6%	10%
Bus Capacitance Energy Absorption				
From 320V Nominal Bus	15J	15J	30J	50J
Output Current Ripple Freq f_s	----------20 kHz----------			
Minimum Motor Inductance l-l	4.0mH	2.0mH	1.0mH	0.5mH
Maximum Motor Inductance l-l	4H	2H	1H	0.5H
Maximum Motor Power Cable Length	----------50 m/164ft----------			

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3.2 Input Power Specifications

The drive is capable of direct line operation. All units are fully isolated and do not require external isolation transformers. Also, the inrush current on the connection to the line is internally limited to a safe level for the drive. There are no voltage selection or ranging switches required to operate within the specified voltage input ranges. It is the responsibility of the user to supply appropriate fuses or circuit breakers in the J1 AC Power motor power lines to comply with local electrical codes.

The control input power required depends on the option card plugged in and the load on user +5 Vdc. It should be between 15 and 30 Watt. The ac input motor power depends on output power and the losses in the power stage. The control power input has a single UL/CSA rated fuse in line with one of the ac line inputs.

SC900 Control Power Supply

Input Voltage Range	90 to 264 VAC, 47 - 440 Hz single phase or 130 to 370 Vdc	
Ride Through Time For AC Line Drop	90 VAC 50 Hz	>1 50 Hz cycle
	120 VAC 60 Hz	>2.5 60 Hz cycles
	240 VAC 60 Hz	>10 60 Hz cycles

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SC900 Motor ac Power Supply

Model Number	Voltage Range	Phases	Transformer Suggested kVA	Maximum AC Line* kVA
SC9x2	90-264 Vac	1 or 3	2 to 3 kVA	100 kVA
SC9x3	90-264 Vac	1 or 3	3 to 4 kVA	100 kVA
SC9x4	180-264 Vac	3	3 to 6 kVA	250 kVA
SC9x5	180-264 Vac	3	5 to 10 kVA	500 kVA

*Maximum AC Line is specified to limit the line surges coupled to the drive.

Bus Voltage (nominal, standard drive)

240 VAC Three Phase Input . . . . 320 VDC

120 VAC Single Phase Input . . . 155 VDC

SC900 Inrush Current & Fusing

Model Number	Inrush Peak Current	Inrush Pulse Width	Fuse Type	Manufacturer, Part Number
SC9x2	140 A 0-p	3 msec	15 A 250 V Time Delay	Bussmann, MDA-15
SC9x3	340 A 0-p	2 msec	20 A 250 V Time Delay	Bussmann, MDA-20
SC9x4	340 A 0-p	2 msec	30 A 250 V Slo-Blo	Littlefuse, FLM 30
SC9x5	Operating current		30 A 250 V Slo-Blo	Littlefuse, FLM 30

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3.3 Performance Characteristics

Note: *Unless otherwise specified, the below specifications are worst case limits and apply over the specified operating ambient temperature and over the specified operating line voltage.*

Motor Current Control

Motor Phase Current Waveform	Back EMF Matched Pseudo Sine
Motor Shaft Torque (Ignoring motor magnetic saturation)	
Peak	$(K_t 0\text{-}p)*\sqrt{3}/2$ *(Drive IPeak 0-p)
Instantaneous	$(K_t 0\text{-}p)*\sqrt{3}/2$ *IFB
Bandwidth	
Maximum Bandwidth	1.5 kHz
Recommended Bandwidth	1.0 kHz
Bandwidth Variation For Fixed Motor L	± 10%
Bandwidth Variation For ± 25%	
Ac Line Variation	± 2%
Update Period	62.5 µsec
Recommended Motor Electrical Frequency	< 400 Hz

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Analog Command

Maximum Differential Range	±13.5 Volts
Maximum Single Ended Range	±21 Volts
Full Scale Tolerance	±5% (worst case)
	±1% (typical)
Linearity	0.1% Full Scale
Monotonic to	$< 2^{-16}$ Full Scale
S/N Ratio Referred to Full Scale	
Full A/D Bandwidth	14 bits
150 Hz A/D Bandwidth	16 bits
10 Hz A/D Bandwidth	18 bits
Offset	Adjustable to 0
Maximum Unadjusted Offset	50 mV
Offset Drift	250 µV/°C typ.
CMRR	> 30 dB @ 60 Hz

Digital Position Commands

Modes	Quadrature Encoder, Step & Direction, or Up & Dn Count
Maximum Input Rate For Fast Decode	
Quadrature Decode Max Line Frequency	800 kHz
Step/Dir Decode Max Step Frequency	800 kHz
Up/Dn Count Max Frequency	800 kHz
Minimum Fast Decode Pulse Width	0.6 µSec
Fast Decode Direction Setup Time	0.6 µSec
Fast Decode Direction Hold Time	0.6 µSec
Relative Timing For Filtered Decode	4, 8, or 16 to 1 e.g. Max Step Freq 800, 200, 100, or 50 kHz

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Velocity Loop

Maximum Stable Bandwidth	> 400 Hz
Update Period	250 µSec
Range	0 to 21,000 RPM
Command Resolution	< 0.001 RPM
Velocity Loop Compensation Parameters	
KVP Range (Depends on Ipeak)	0 to 12.6 (I_{peak})(1/rad/sec)
KVP Resolution	16 bit
KVI Range	0 to > 200 Hz
KVI Resolution	16 bit
ARF0* Range	0.01 to > 1e5 Hz
ARF1* Range	0.01 to > 1e5 Hz
ARZ0* Range	0 to > 1e5 Hz or off
ARZ1* Range	20 to > 1e5 Hz or off
CMDGAIN Range	0 to ±15,000 RPM/V
	0 to ±10(I_{peak}) V^{-1}
CMDGAIN Resolution	≥ 16 bit mantissa

*ARx0 set to a negative number allows complex poles/zeros. In this case, ARx1 becomes the Q and the corresponding |ARx0| is the frequency in Hz.

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Position Loop

Maximum Stable Bandwidth	> 100 Hz
Update Period	1 mSec
Position Range	0 to ± 32768 Rev
Position Error Range	0 to ± 4500 Rev
Command Resolution	2^{-16} Rev = 0.33 arc min
Position Loop Compensation Parameters	
KPP Range	0 Hz to > 150 Hz
KPP Resolution	16 bit
KVFF Range	0 to 199.9%
KVFF Resolution	16 bit

General

Max Delay Ac Line To Control Supply On	0.75 Sec
Max Delay Ac Line To Fully Operational	2.0 Sec
	Fully operational by “A” of “PACSCI” LED status message

Environmental

Operating Ambient Temperature Convection Cooling:	
Full I_{peak} /2 continuous rating	0°C to 25°C
Linearly derate I_{peak} /2 continuous rating per (1 - (T - 25°C)/75°C)	25°C to 60°C
Operating Ambient Temperature Forced Air Cooling:	
Full I_{peak} /2 continuous rating	0°C to 50°C
Linearly derate I_{peak} /2 continuous rating per (1 - (T - 50°C)/30°C	50°C to 60°C
Storage Temperature	-40°C to 70°C
Humidity, non-condensing	10% to 90%
Altitude	1600 m (5280 feet)

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3.4 Resolver Feedback Specifications

Note: *Unless otherwise specified, the below specifications are worst case limits and apply over the specified operating ambient temperature and over the specified operating line voltage.*

Resolver Position Signal

Resolution/Rev	24 bits = 0.0013 arc min
Repeatability	$< \pm 2^{-18}$ Rev = ±0.08 arc min rms
Noise	
No Filtering	$< 2^{-16}$ Rev rms = 0.3 arc min rms
150 Hz Single Pole Filtered	$< 2^{-17}$ Rev rms = 0.16 arc min rms
10 Hz Single Pole Filtered	$< 2^{-19}$ Rev rms = 0.04 arc min rms
dc Offset Temperature Drift	$< 2^{-18}$ Rev/°C = 0.08 arc min/°C
Absolute Accuracy	
Drive only	$\pm 2^{-12}$ Rev = ±5.3 arc min
Drive with 20 arc min resolver	$\pm 2^{-9.75}$ Rev = ±25 arc min
Software Update Time	1 mSec

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Resolver Velocity Signal

Resolution	< 0.001 RPM
Quanta	= 0.0143 RPM
Noise	
No Filtering	< 3 RPM rms
150 Hz Single Pole Filtered	< 0.6 RPM rms
10 Hz Single Pole Filtered	< 0.06 RPM rms
DC Accuracy	
Typical @ 25°C	±0.01%
Worst case	±0.05%
Ripple	
Drive only	0.75% p-p at 1000 RPM
Drive with 20 arc min resolver	3% p-p at 1000 RPM
Offset	< 0.0001 RPM
Software Update Time	250 µSec

Emulated Encoder Output Signals

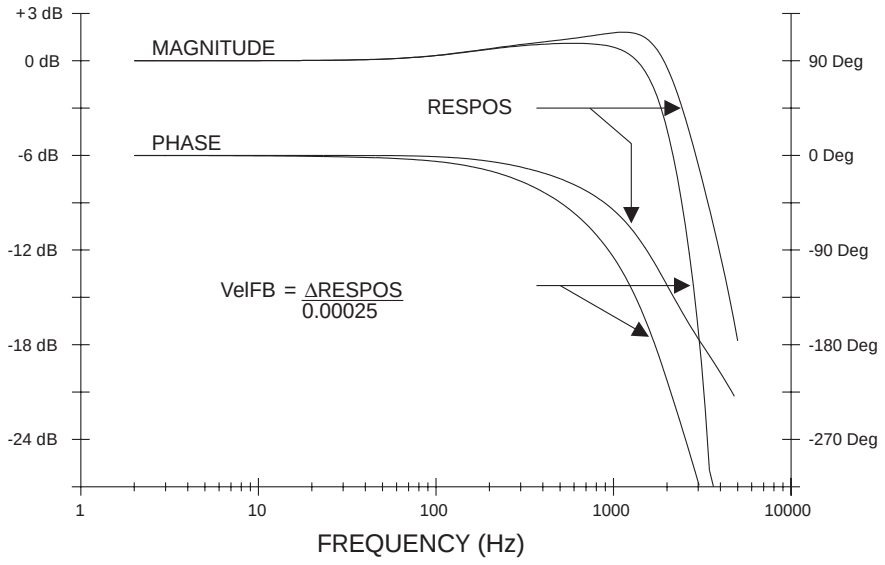
Available Resolutions (PPR)	
Binary	128, 256, 512, 1024, 2048, 4096, 8192, 16384
Decimal	125, 250, 500, 1000, 2000, 4000, 8000, 16000
Maximum Output Line Frequency	833 kHz
Max Recommended Speed @ 16384 PPR	2900 RPM
Max Recommended Speed @ 4096 PPR	11600 RPM
Marker Pulse Width	≈ 1 Quadrature Pulse

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General

-3 dB Bandwidth	> 1500 Hz
-45° Phase Lag	> 400 Hz
Resolver Excitation Frequency	6510.42 Hz
Max Tracking Rate	> 48600 RPM
Max Recommended Rate	25 kRPM
Max Tracking Acceleration	> $16x10^6$ RPM/Sec
Maximum Feedback Cable Length	50 m/164 ft

Nominal Frequency Response



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4 I/O Terminations

Introduction

Except for the power connections on the SC9x4 and the SC9x5 all terminations are two piece pluggable connections. Also, all connectors are unique such that a cable can not be plugged into the wrong location or plugged in backwards.

In the list below an overbar on a signal name means that the signal is active low logic. For example, "$\overline{\text{Enable}}$" enables the drive when this input is pulled low and disables the drive when it is high.

Earth Ground

Chassis Grounding Stud, M5-12 with nut and lock washer. SC9x5s have fixed terminal block connection for grounding.

SC900 Power Board Connectors

J1

AC POWER

SC9x2/3 7.5 mm Pluggable TB

SC9x4 7.62 mm Fixed TB

SC9x5 DIN Rail Fixed TB

Pin	Description
1	240 VAC / 120 VAC (Input)
2	240 VAC / 120 VAC (Input)
3	240 VAC (Input)
4	CHASSIS GROUND
5	240 VAC / 120 VAC CONTROL POWER (Input)
6	240 VAC / 120 VAC CONTROL POWER (Input)

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J2 MOTOR POWER

SC9x2/3 7.5 mm Pluggable TB

SC9x4 7.62 mm Fixed TB

SC9x5 DIN Rail Fixed TB

Pin	Description
1	MOTOR CASE GROUND
2	MOTOR PHASE T (Output)
3	MOTOR PHASE S (Output)
4	MOTOR PHASE R (Output)

J5 REGENERATION INTERFACE

SC9x2/3/4 5 mm Fixed TB

Pin	Description
1	REGEN RESISTOR (Output)
2	+ BUS (Output)
3	- BUS (Output)

SC9x5 DIN Rail Fixed TB

Pin	Description
1	- BUS (Output)
2	INT/EXT REGEN RESISTOR (Output)
3	INT REGEN RESISTOR (Output)
4	+ BUS/EXT RESISTOR (Output)

SC9x5 normal operation shorts J5-2 to J5-3

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SC900 Base Servo Drive User I/O Connections

J3 FEEDBACK

5.0 mm Pluggable TB

Pin	Description
1	RESOLVER S1 SIN + (Input)
2	RESOLVER S3 SIN - (Input)
3	RESOLVER S2 COS + (Input)
4	RESOLVER S4 COS - (Input)
5	SHIELD (I/O RTN)
6	RESOLVER R1 EXCITATION (Output)
7	RESOLVER R2 EXCITATION RTN (Output)
8	MOTOR PTC (Input)
9	MOTOR PTC RTN (Input)

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J4 COMMAND I/O

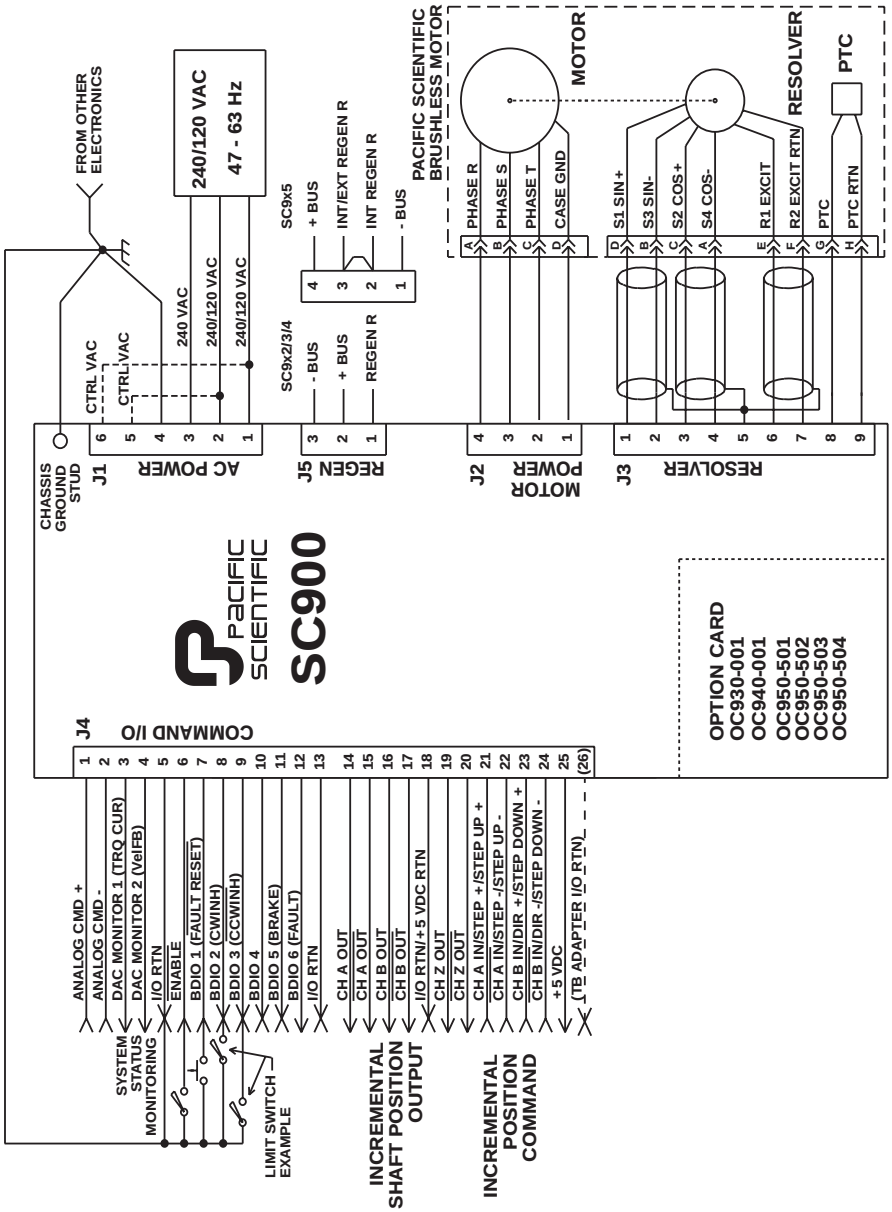
25 Position D subminiature male

Default functions for BDIOs are listed in ( ).

Pin	Description	Pin	Description
1	ANALOG CMD + (Input)	14	CH A OUT
2	ANALOG CMD - (Input)	15	$\overline{\text{CH A OUT}}$
3	DAC MONITOR 1 (Output)	16	CH B OUT
4	DAC MONITOR 2 (Output)	17	$\overline{\text{CH B OUT}}$
5	I/O RTN	18	I/O RTN/+5 VDC RTN
6	$\overline{\text{ENABLE}}$ (Input)	19	CH Z OUT (Output)
7	BDIO 1 ($\overline{\text{Fault Reset}}$) (Bi-directional)	20	$\overline{\text{CH Z OUT}}$ (Output)
8	BDIO 2 ($\overline{\text{CwInh}}$) (Bi-directional)	21	CH A IN (STEP +) (STEP UP +) (Input)
9	BDIO 3 ($\overline{\text{CcwInh}}$) (Bi-directional)	22	$\overline{\text{CH A IN}}$ (STEP -) (STEP UP -) (Input)
10	BDIO 4 (Mapped Off) (Bi-directional)	23	CH B IN (DIR +) (STEP DOWN +) (Input)
11	BDIO 5 (Brake) (Bi-directional)	24	$\overline{\text{CH B IN}}$ (DIR -) (STEP DOWN -) (Input)
12	BDIO 6 (Fault) (Bi-directional)	25	+5 VDC (200 mA max) (Output)
13	I/O RTN	(26)	I/O RTN on optional TB adapter mate

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Drive Wiring Diagram



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4.1 I/O Definitions

Earth Ground

Chassis Ground Stud

This input provides a point for the user to connect the drive to earth ground for safety. On the SC9x5 connection is to a fixed terminal block position.

J1 AC Power

240 VAC / 120 VAC

These terminals connect the 240/120 VAC power provided by the user to the drive's power output stage bus to drive the motor.

240 VAC / 120 VAC Control Power

These terminals connect the 240/120 VAC power provided by the user to the drive's control voltage power supply.

Chassis Ground

Convenience connector point for the user to connect the drive to earth ground. Directly connected to the chassis and thus to the Chassis Ground Stud. Note that local electrical code may require using the Earth Ground Chassis stud for this function.

Note: *The control voltage for the SC900 controllers is input to a switching power supply. This input will accept voltages ranging from 120 to 240 Vac. Separate control power inputs are required on the SC9x2, SC9x3 and SC9x4 controllers. In the SC9x5 the control voltage inputs can be switched to the motor supply input power using the AC switch. Having separate control and motor supply inputs permit controller electronics operation independent of high voltage motor power.*

AC switch

The AC switch **only applies to the SC9x5**.

Note: *The switch is mounted on the right side of the drive.*

Switch Position	Explanation
Ext	Control power from J1-5, J1-6
Int	Control power from J1-1, J1-2 (J1-5, J1-6 open)

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J2 Motor Power

Motor Phase R, S, T	These three terminations provide the 3-phase power output to the brushless motor.
Motor Case Ground	This termination provides a convenient point for the motor ground connection and motor power wire shield. Local electrical code may require using the Earth Ground Chassis stud for this function.

J5 Regeneration Interface

Regen Resistor, - Bus, + Bus SC9x2, 3, 4	These terminals connect the internal shunt regulator resistor or provide the connection points for an external resistor or external capacitor bank to absorb regenerated energy from the motor. Note that the SC9x5s have an additional terminal and when using the internal regeneration resistor, as shipped from the factory, terminals 2 and 3 are shorted together.
- Bus, Internal Regen Resistor, Internal/External Regen Resistor, + Bus SC9x5	An external regeneration resistor goes from + BUS to REGEN R (INT/EXT REGEN R for SC9x5) and a capacitor bank connects to + BUS and - BUS. When using an external regeneration resistor make sure that the internal resistor is disconnected and that the external resistance follows the chart below within ± 10%.

Model #	Resistance
SC9x2	50 Ω
SC9x3	25 Ω
SC9x4	12.5 Ω
SC9x5	8 Ω

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Internal Resistors

The table below lists values for internal resistors.

Model	Resistance	Pacific Scientific #
SC9x2	50 Ω, 55 W Ohmite F55J50R	350-150000-00
SC9x3	25 Ω, 55 W Ohmite F55J25R	350-150000-25
SC9x4	25 Ω, 95 W Milwaukee 16-96-25C	352-125000-00
SC9x5	8 Ω, 375 W rib, Milwaukee 18-168-8R	352-080000-00

Note: *The two resistors in the 9x4 are wired in parallel.*

J3 Resolver

Resolver S1, S2, S3, S4 Inputs

These connections provide the inputs for the resolver's sine/cosine outputs. Differential inputs with 75 Vμsec common mode impulse range and 25 kΩ input impedance.

Resolver R1 Excitation, R2 Excitation RTN Outputs

These connections provide the resolver excitation output. 9.2 V rms at 6510.42 Hz 75 mA rms maximum load. These outputs are fully short circuit protected to I/O COMMON or to each other at room temperature (25°C), but at ambient temperatures above 50°C shorts longer than 5 minutes may cause damage.

Motor PTC, PTC RTN Inputs

These two inputs are intended to connect to a positive temperature coefficient thermistor or normally closed thermostatic switch imbedded in the motor windings. When the resistance between these terminals becomes greater than 6.2 kΩ the drive will fault and indicate a Motor Over Temperature fault. This circuit directly interfaces with Pacific Scientific's standard motor PTC.

Note: *PTC RTN is connected to I/O RTN.*

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J4 Command I/O

Analog CMD (+), (-) Inputs J4-1, 2

These inputs accept the analog command from the user. This is a differential input to an A/D. It has a maximum single ended input range with respect to I/O RTN on either input of ± 21V and an input impedance of 50kΩ. The full scale differential command input range is ± 13.5 V. The offset and single pole low pass bandwidth of this signal is adjustable via a software setup parameter. When used as a motion command the gain from this input is also adjustable via a software setup parameter.

DAC Monitor 1, 2 Outputs J4-3, 4

These analog outputs are general purpose monitor points. The output range is ± 5 V with a resolution of 10V/256 = 0.039 V. The source impedance is 1 kΩ, which yields a maximum short circuit to I/O RTN current of ± 5 mA. These outputs are updated at the VELOCITY LOOP update rate. There is a 10 kHz analog LPF on these outputs.

Each DAC MONITOR can be mapped by software to be one of a number of internal variables. The scale factor and the frequency of a single low pass filter pole are software adjustable on each output by the DM1Gain, DM1F0 and DM2Gain, DM2F0 software parameters for DAC Monitor 1 and 2 respectively. Variables marked with a "*" are not range clamped and are allowed to wrap around when the signal exceeds the output dac's voltage range. The other variables will clamp at maximum when they exceed the analog voltage range. The table on the following page lists the defined signal mappings.

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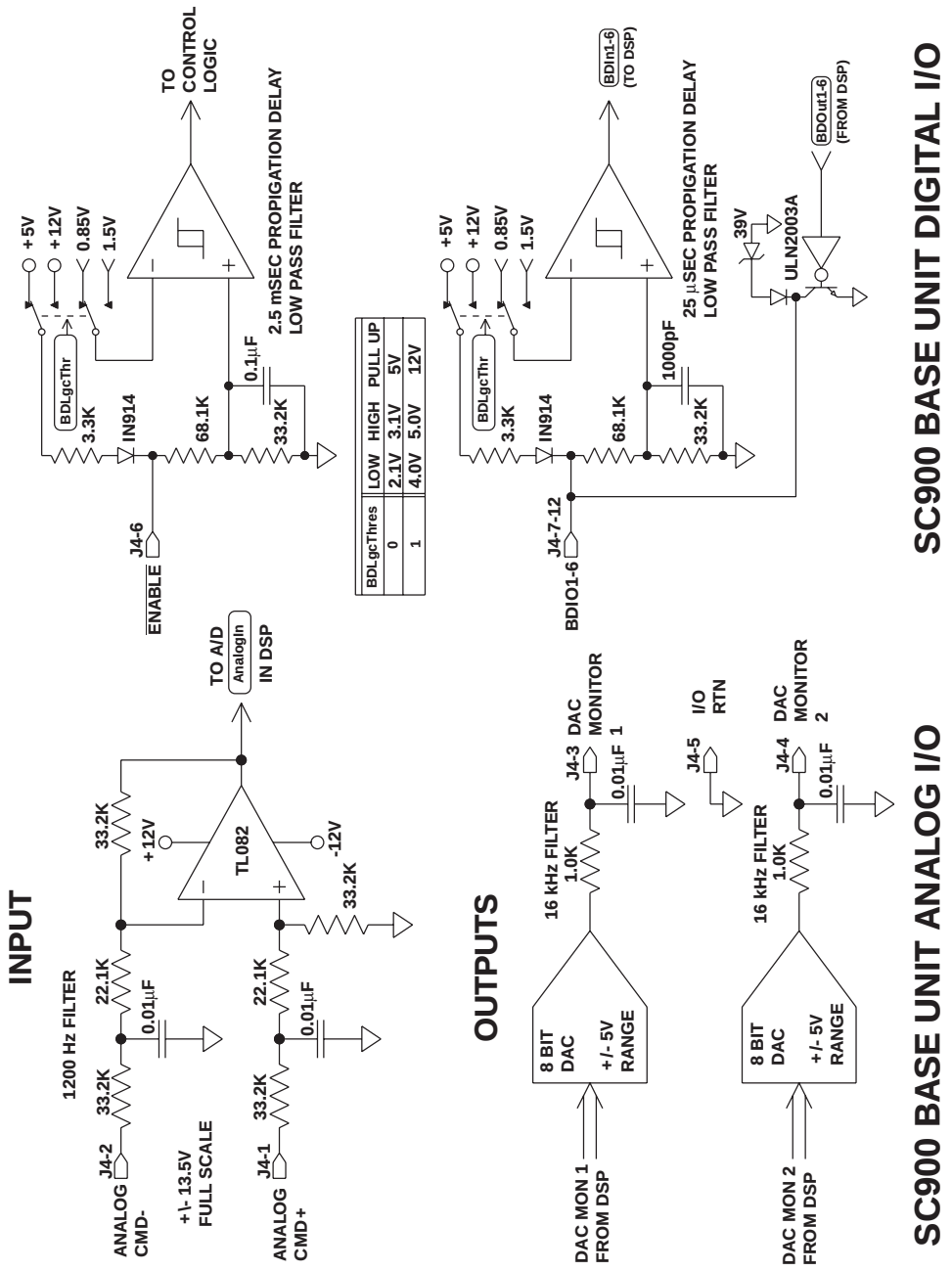
Dac Monitor List Table

DMxMap	Variable	Description	DAC Out Units
0	AnalogOutx	Actual Analog Output Command	V/V
1	VelFB	Measured Velocity (DM2 Default)	1 V/kRPM
2	VelCmdA	Actual Velocity Command (VelCmdA)	1 V/kRPM
3	VelErr	Velocity Error	1 V/kRPM
4	FVelErr	Compensated Velocity Error	1 V/kRPM
5	Position	Measured Position*	1 V/Rev
6	PosError	Position Error*	1 V/Rev
7	PosCommand	Commanded Position*	1 V/Rev
8	Icmd	Commanded Torque Current	1 V/A
9	IFB	Measured Torque Current (DM1 Default)	1 V/A
10	AnalogIn	Filtered A/D Input	1 V/V
11	EncFreq	Encoder Frequency	1 V/Hz
12	EncPos	Encoder Position*	10 V/4096 Cnts
13	ItFilt	Filtered Output Current Amplitude	1 V/100%
14	HSTemp	Measured Heat Sink Temperature	1 V/°C
15		Commutation Electrical Angle*	1 V/Cycle
16	IR	Motor Phase R Output Current	1 V/A
17	IS	Motor Phase S Output Current	1 V/A
18	IT	Motor Phase T Output Current	1 V/A
19		Motor Phase R Voltage Duty Cycle	1 V/100%
20		Motor Phase S Voltage Duty Cycle	1 V/100%
21		Motor Phase T Voltage Duty Cycle	1 V/100%
22	VBus	Drive Bus Voltage	1 V/V
23	ResPos	Resolver Absolute Position*	1 V/Rev
24		Commanded non-torque current	1 V/A
25		Measured non-torque current	1 V/A
26		Torque Voltage Duty Cycle	1 V/100%
27		Non-torque Voltage Duty Cycle	1 V/100%
28	VelCmd	Velocity Command (VelCmd)	1 V/kRPM
65536	No change to variable selection, turn range clamp off		
65537	No change to variable selection, turn range clamp on		

*These variables are allowed to wrap around when the signal exceeds the output voltage range.

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J4 Analog and Digital I/O Interface Schematics



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J4 Command I/O Continued

I/O RTN J4-5, 13, 18	This terminal is signal common for the analog and digital inputs and outputs.
$\overline{\text{Enable}}$ Input J4-6	This input is used to enable the drive and is active low. The output stage is disabled when this input is inactive. There is a 3.3 kΩ resistor and diode in series to the internal pull up voltage. A minimum drive sink capability of 5 mA is recommended and the maximum external pull up voltage is 30 VDC with respect to I/O RTN. This signal is detected with 1 V p-p hysteresis and a selectable center point for the logic trip thresholds which also selects the pull up voltage. With the BDLgcThr parameter set to 0 the trip voltages are 2.1 and 3.1 volts with 5 volt nominal pull-up while with BDLgcThr set to 1 the trip voltages are 4.0 and 5.0 with a 12 volt nominal pull-up. This input is filtered with a 2 mSec time constant low pass filter to prevent false triggering from noise.
BDIO 1, 2, 3, 4, 5, 6 Bi-directional J4-7, 8, 9, 10, 11, 12	These six I/O connections are user programmable discrete inputs or outputs. As outputs they are open collector with 30 volt with respect to I/O RTN and 100 mA current sinking maximum ratings. These outputs are not short circuit proof. BDIO 6 has a higher maximum current sinking rating of 200 mA. As inputs these signals are detected with 1 V p-p hysteresis and a selectable center point for the logic trip thresholds. With the BDLgcThr parameter set to 0 the trip voltages are 2.1 and 3.1 volts with 5 volt nominal pull up while with BDLgcThr set to 1 the trip voltages are 4.0 and 5.0 with a 12 volt nominal pull up. These inputs are filtered in hardware with a 20 μSec time constant low pass filter for noise suppression. On each line there is a 3.3 kΩ resistor and a diode in series to the internal pull up voltage. A minimum drive sink capability of 5 mA is recommended to fully pull these inputs to a logic low. During AC power down or during the power up reset period these lines are held in the open collector state.

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J4 Command I/O Continued

BDIO 1, 2, 3, 4, 5, 6 Bi-directional J4-7, 8, 9, 10, 11, 12

Each of the BDIOs is set and read by software every 2 mSec. Each one can be configured to be any of the available functions and the configuration can be changed on the fly via digital communications to an Option Card. The user's default configuration is stored in the non-volatile memory. The present state of each of these lines as well as the state of commanded outputs can be read via digital communications on an Option Card. The logic polarity of these signals is also software programmable. That is, an input or an output can be defined to be active low or active high. For edge triggered functions the active edge is programmable.

The list below describes the subset of the available functions and the mappings used as the factory defaults for each of the BDIOs.

$\overline{\text{Fault Reset}}$ Input

BDIO 1: This input is used to reset the amplifier following a fault. This input is programmed active low so that an open circuited input does not activate the function. During Fault Reset active the output stage is disabled and the reset condition will be held in hardware for approximately 0.1 sec after Fault Reset is returned inactive.

$\overline{\text{Cwlnh}}$ Input

BDIO 2: This input prevents further motion in the clockwise shaft motion direction. If the shaft is already moving in the clockwise direction, then the motor will decelerate to zero velocity with the maximum torque allowed by the user set output current limits. This input will have no effect on motion in the counterclockwise direction. This input is programmed active low so that an open circuited input does not activate the function. This input is useful for a clockwise over travel limit switch.

Status display will alternate between "8 " and "¬" when the limit input is affecting motion.

$\overline{\text{Ccwlnh}}$ Input

BDIO 3: Analogous to the $\overline{\text{CwInh}}$ input, except that this input prevents counterclockwise motion. Status display alternates between "8 " and "⌐".

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J4 Command I/O Continued

Input Mapped Off	**BDIO 4:** Input Mapped Off
Brake Output	**BDIO 5:** This output is high (i.e. open collector) when the control power is off, or when control voltage is on and the drive is disabled (Enabled = 0). This output is pulled low otherwise. This output is intended to drive a normally open relay that in turn powers a mechanical brake on the motor shaft for applications that require a positive shaft lock when the servo drive is off.
Fault Output	**BDIO 6:** This output is high (i.e. open collector) when the drive is faulted or has no control power. This line can be used to indicate a problem with the drive.
CH A OUT CH A OUT, CH B Out, CH B Out Outputs J4-14, 15, 16, 17	These two output pairs are differential TTL incremental position signals generated by the Resolver feedback electronics. These outputs are quadrature encoder to emulate an optical encoder. The resolution of these signals, i.e. the emulated line count, is set by the EncOut parameter. These outputs are buffered by 26LS31 type RS-422 compatible line drivers. Maximum recommended load current is ± 20 mA, which corresponds to a minimum line-to-line load resistance of 100 Ω. This drive capacity corresponds to 10 RS-422 compatible inputs such as the SC900 encoder inputs. These outputs are indefinitely short circuit (to I/O RTN) proof.
CH Z OUT CH Z OUT Outputs J4-19, 20	These two terminals function as a differential, TTL marker pulse. The output pulse occurs once per motor shaft revolution starting at resolver position = 0 and its width is approximately one quadrature encoder width. This output comes from an 26LS31 type RS-422 compatible line driver. Maximum recommended load current is ± 20 mA, which corresponds to a minimum line-to-line load resistance of 100 Ω. This drive capacity corresponds to 10 RS-422 compatible inputs such as the SC900 encoder inputs. This output is indefinitely short circuit (to I/O RTN) proof.

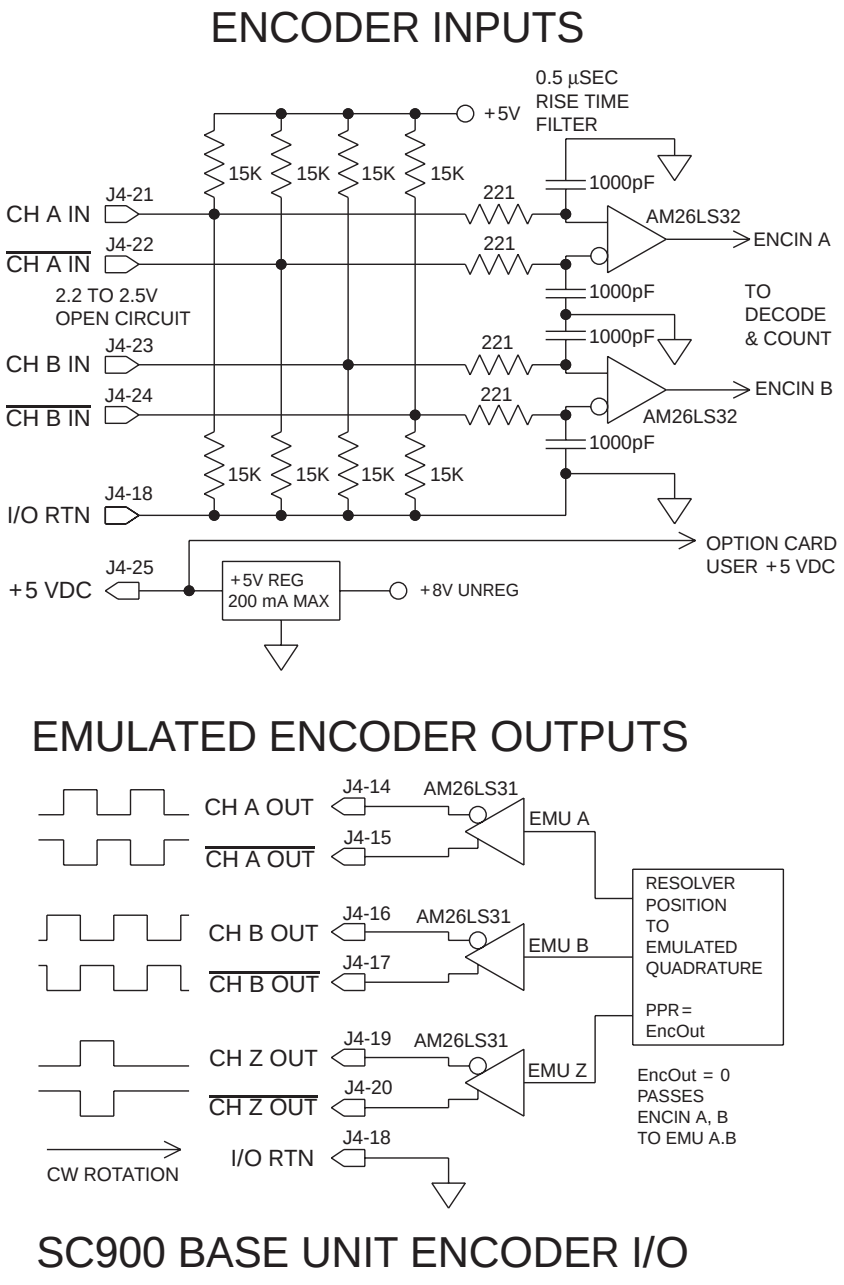
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J4 Command I/O Continued

Encoder Inputs	CH A IN, $\overline{\text{CH A IN}}$, CH B IN, $\overline{\text{CH B IN}}$, Step +, Step -, Dir +, Dir -, Step Up +, Step Up -,Step Dn +, Step Dn -
J4-21, 22, 23, 24	These inputs are used as a quadrature encoder, step and direction, or up and down count format incremental signal source. The decoding mode is set by the EncMode parameter. The scale factor of this incremental position command input is fully adjustable with software parameters. Full decoding speed or more noise immune slow speed decoding is software selectable. These two input pairs are differential and are detected by 26LS32 type RS-422 compatible line receivers. As differential inputs, the recommended common mode range is $< \pm 7$ V with respect to I/O RTN and the guaranteed differential voltage logic thresholds are $> \pm 0.2$ V. Recommended drivers should be able to source and sink 3 mA to/from these inputs. Each of these inputs have internal bias networks to allow easy connection to single ended sources. When an input is open circuited it will bias itself to between 2.2 and 2.5 V, thus the remaining input pair terminal will have a single ended guaranteed logic low for inputs < 2.0 V and a guaranteed logic high for inputs 2.7V. These levels are compatible with a TTL driver combined with a pull up resistor. Pull up resistor should be 470Ω.
+5 VDC, +5 VDC RTN Output J4-25, 18	These two connections provide an auxiliary power supply for the user. This output is 5 Vdc ± 5% and is I/O RTN short circuit protected. This supply goes to the Option Card and may also appear on an Option Card I/O connection point. For example, the +5 VDC on the OC930 J31 connector. The maximum load limit for all connections to this supply is 200 mA.

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J4 Encoder I/O Interface Schematics Diagram



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5 Operating Without an Option Card

The SC900 base servo drive can operate with or without an Option Card. However, the drive is shipped from the factory unconfigured; with null parameters. Therefore, the first step in using a drive is to set the parameters by configuring the drive. All of the adjustments are saved in non-volatile Personality EEPROM. The EEPROM has a minimum life of 100,000 writes with 1,000,000 being typical. If cost economy or the security of preventing parameter changes in the field is desired, then the base SC900 can have parameters stored in its non-volatile memory via an Option Card and then the Option Card removed. When a drive powers up it will always load the parameters from the internal non-volatile memory. If there is an Option Card plugged in at power up and the internal non-volatile memory is unconfigured, then the drive will check the parameter memory on the Option Card and if it is configured will load it instead. This allows the drive's parameter personality to reside on the removable Option Card which allows easy replacement of a broken base servo and keeping the custom parameters of that axis without down loading from a PC again. If the internal non-volatile memory is not configured and there is no Option Card or the Option Card non-volatile memory is also unconfigured the drive will display "*UC*" on the status LED and will not allow the power output to be enabled.

For additional information on configuring a base SC900 to operate without an Option card plugged in, see the *MA930 – OC930 Hardware and Software Reference Manual*.

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6 Diagnostics and Protection Circuits

Introduction

The drive is fully protected against “normal” abuse and has a 7 segment LED visible on the front panel to indicate drive status. The base servo drive has the following specific protections:

- Output motor short circuit protection line-to-line and line-to-neutral.
- Interface to Pacific Scientific's standard motor PTC or a normally closed thermostat to sense motor over temperature.
- Internal monitoring of the power stage heat sink temperature for drive over temperature.
- Bus over voltage detection.
- Bus under voltage fault with adjustable threshold.
- Incorporating the measured heat sink temperature there is an excessive current I*t fault. This fault limits the peak current time and intelligently changes the continuous current fault trip dependent on the measured heat sink temperature to limit the continuous output current.
- Control voltage under voltage detection.
- The auxiliary +5V output is short circuit to I/O RTN protected.
- All control outputs are short circuit to I/O RTN protected.
- When a drive is powered up without valid Personality parameters the power stage cannot be enabled and no damage occurs to the drive.
- If there is an Option Card plugged in at power up, then the drive will fault if the Option Card is unplugged while the power is still on.
- The digital signal processor has a watchdog/throughput fault to help detect drive software errors.

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The following sequence will occur when the protection circuits generate a fault. The fault source is latched, the output stage is disabled, the Fault mappable output function is activated, and the status display indicates the appropriate blinking fault code. Faults are cleared by activating the Fault Reset input or by cycling the 120/240 VAC Control Power.

The table on the following page lists the status display codes shown on the System Status LED. In the basic product, the LED decimal point is not used; it is reserved for use with Option Card accessories. A quick blinking display implies a hard fault. If an entry is not specifically listed as blinking then the display is steady and if listed as just blinking then the display blinks quickly. If an entry shows multiple characters then the characters alternately flash between the two values with unequal blank display pauses between to help indicate the intended character order.

See the following table for a detailed list of system status LED codes.

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Status LED Code List

Status Code	Description
0	No faults, power stage disabled, control voltage OK.
8	No faults, power stage enabled, control voltage OK.
8r Alternating	No faults, power stage enabled, CcwInh active preventing CCW motion.
8¬ Alternating	No faults, power stage enabled, CwInh active preventing CW motion.
8n Alternating	No faults, power stage enabled, CwInh and CcwInh both active preventing motion.
1 Blinking	Velocity feedback (VelFB) over speed
	To further identify this fault see software variable ExtFault:
	ExtFault = 1 |VelFB| > 21038 RPM
	ExtFault = 2 |VelFB| > max(VelLmtxx)*1.5
2 Blinking	Motor over temperature
3 Blinking	Drive over temperature
4 Blinking	Drive I*t
5 Blinking	SC9x3: Line-neutral over current
6 Blinking	Control ±12 V under voltage
7 Blinking	Output over current or Bus over voltage
9 Blinking	Shunt regulator overload
A Blinking	Bus over voltage detected by DSP
b Blinking	Auxiliary +5V low
C Blinking	Not assigned
d Blinking	Not assigned
*E	Processor throughput fault

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Status Code	Description
*E Blinking	Control power ac line dip or power up self test failure
	To further identify this fault see software variable ExtFault:
	ExtFault = 1 Calibration data corrupted
	ExtFault = 2 Excessive dc offset in current feedback sensor
	ExtFault = 3 DSP incompletely reset by line power dip
	ExtFault = 6 Excessive dc offset in Analog Command A/D
	ExtFault = 7 Unable to determine option card type
	ExtFault = 8 DSP stack overflow
	ExtFault = 10 Software and control card ASIC incompatible
	ExtFault = 11 Actual Model not same as stored in NV memory
	ExtFault = 12 Unable to determine power stage
	ExtFault = 15 RAM failure
	ExtFault = 16 Calibration RAM failure
E 1 Alternating	Bus under voltage, bus voltage VBusThresh*
E 2 Alternating	Ambient temperature too low
E 3 Alternating	Encoder commutation alignment failed (Only for CommSrc = 1)
E 4 Alternating	Software and non-volatile memory versions not compatible
*E 5 Alternating	Control card hardware not compatible with software version
E 6 Alternating	Drive transitioned from unconfigured to configured while enabled
E 7 Alternating	Two AInNull events too close together
F 1 Alternating	Position following error fault
F 3 Alternating	Parameter memory error
	To further identify this fault see software variable ExtFault:
	ExtFault = 13 Control card non-volatile parameters corrupt
	ExtFault = 14 Option card non-volatile parameters corrupt
U C Alternating	Unconfigured drive

*These fault states can not be reset with the Fault Reset function and require the line control power to be cycled.

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Status LED Troubleshooting

Status Code	Possible Cause
1 Blinking	Loose or open circuit wiring to the resolver feedback connector J3. Actual motor speed exceeded 1.5 * (Max Of |VelLmtLo| or |VelLmtHi|) or 21,038 RPM which is the over speed trip level.
	For Encoder velocity feedback (RemoteFB = 2) check that EncIn is set properly to correctly scale the VelFB units.
2 Blinking	Loose or open circuit wiring to motor PTC thermal sensor (J3-8, J3-9). High ambient temperature at motor.
	Insufficient motor heat sinking from motor mounting.
	Operating above the motor's continuous current rating.
	Inoperative cooling fan.
3 Blinking	High drive ambient temperature. Restriction of cooling air due to insufficient space around unit.
	Operating above the drive's continuous current rating.
	Inoperative cooling fan.
	Note: *See HSTemp, ItFilt, and ItF0 for information on measuring thermal margin in an application.*
4 Blinking	Mechanically jammed motor. Motion profile accelerations too high.
	Machine load on the motor increased perhaps by a friction increase.
	Problem with wiring between drive and motor yielding improper motion.
	Drive and/or motor under sized for application.
	Note: *See HSTemp, ItFilt, and ItF0 for information on measuring thermal margin in an application.*
5 Blinking	Motor power wiring (J2-2, 3, or 4) short circuit line-to-ground/neutral.
	Motor power cable length is enough longer than the data sheet specification to cause excessive motor line to earth ground/neutral capacitance.
6 Blinking	Insufficient control ac voltage on J1-5 to J1-6.
	External short on signal connector.
	Internal drive failure.

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Status Code	Possible Cause
7 Blinking	Motor power wiring (J2-2, 3, or 4) short circuit line-to-line or line-to-ground/neutral. Internal motor winding short circuit.
	Insufficient motor inductance causing output over current faults.
	KIP or KII improperly set causing excessive output current overshoots.
	Motor ac power input voltage too high.
	Disconnected regeneration resistor on J5.
	External regeneration resistor ohmage too large yielding Bus Over Voltage fault.
9 Blinking	Excessive regen in application.
	Improper external regen wiring or components on J5.
A Blinking	Actual bus over voltages are usually, but not always, detected and displayed as a blinking 7 fault. See that entry for more information.
b Blinking	Short circuited wiring on the output (J4-25).
	Load exceeds the current rating of this supply.
E Solid	Drive hardware failure or drive software bug.
E Blinking	See the status variable ExtFault for further information about the exact failure.
E 1 Alternating	Check the measured bus voltage VBus and the fault threshold VBusThresh to make sure they are consistent.
E 2 Alternating	Ambient temperature is below drive specification. Drive's internal temperature sensor has a wiring problem.
E 3 Alternating	Problems with encoder feedback wiring to J4 when CommSrc = 1. Load inertia more than 100 times the motor inertia leading to settling times long compared to the 2 second encoder commutation alignment; artificially extend the alignment time by pulsing the hardware enable (J4-6).
E 4 Alternating	OC930-001-01 (drive software upgrade card) was used to set up an old drive. Then either no or a standard OC930-001-00 (no software upgrade option card) is installed, resulting in the old software being used in the drive.

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Status Code	Possible Cause
E 5 Alternating	Attempt to upgrade the drive's software will not work. Contact factory for upgrade details.
	Resolver wiring error. Remove J2 and J3 connectors. Cycle power. If fault is now a "2", then correct resolver excitation wiring.
	Internal failure. Return to factory for repair.
E 6 Alternating	Unconfigured drive (Status LED alternates U, C after power up) was fully configured with the drive motor power enable active. This fault can be reset or the control ac power cycled to get the drive-motor operating.
E 7 Alternating	The AInNull function was re-activated too soon after going inactive. This can be caused by switch bounce on the input pin mapped to activate AInNull.
F 1 Alternating	The motor is either stalled or partially jammed.
	The value for PosErrorMax is set too sensitive for the loop tuning and commanded motion profiles.
F 3 Alternating	Glitch while last saving the NV parameters. Swapped option card has corrupted NV memory contents. Hardware problem with the NV memory. See ExtFault status variable to determine whether NV memory corruption is inside the drive or on the option card. Re-Download parameters to restore drive operation.

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7 Power Up/Down Sequencing

Upon power up, the 7 segment Status LED will display "*P A C S C I*", pause, "- ", pause, the digital communications address, if any, in HEX, any Option Card specific display, and then the Status LED will display the appropriate operational state. However, the drive is fully functional in less time than it takes for the power up message. Proper operation typically commences less than 2.0 seconds after the control power is up. This time roughly corresponds to the drive being fully operational by the time the "*A*" in "*P A C S C I*" is on the display. The power up booting of the drive software is somewhat analogous to that on a desk top PC with the drive like a hard disc and the Option card like a floppy. If the drive has no Option Card or the Option Card itself has no drive software on it, then the drive uses the software on the Control Card. However, if there is an Option Card plugged in that does have drive software on it then the drive will use that software and the Status LED power up message will include " o P t " after the hex communications address. This capability allows an Option Card to fully re-program the base servo drive as needed or allows a standard Option Card to be bought with the latest base drive software to field upgrade an older such. Examples of drive software upgrade Option Cards are OC900-002-01 and OC930-001-01.

The drive and motor behave in a well defined manner without damage to the drive during intermittent or transient AC line conditions. The system also behaves well when only the bus or only the control AC input voltages are powered and/or intermittent. The drive can be safely powered up in any sequence with any of the control inputs in any state and when the power up reset time is over the drive will immediately begin the appropriate operation. For example, with the Enable input hard wired to I/O RTN and the motor and control AC power applied simultaneously, the power stage will enable and the drive will control the shaft immediately after the power up reset time of less than 2.0 sec is over. If there is a fault upon power up, the drive will go from power up reset to the fault state immediately without enabling the drive.

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Although safe, it is not recommended that the motor bus power be applied with the control power already statically on and the drive enabled when the motor inductance is near the drive's minimum inductance specification. If this sequence is applied with a motor having the drive's minimum inductance the drive may fault on over current. Either apply both motor and control power simultaneously or if control power is already on apply motor bus power with the drive disabled.

The diagnostic information displayed by the 7-segment LED is available over the digital communications link if applicable.

When power is removed from the drive the drive will continue operating until a control supply voltage fault or a bus voltage fault is detected.

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8 PC User Interface

The IBM PC and compatibles user interface utility for the SC900 with OC930 Option Card runs under Microsoft Windows 3.1 or Windows95 and is called 930WIN.EXE.

MA930

The following procedures illustrate how to install and launch the utility with brief instructions. For complete information on this utility please see the *MA930 – OC930 Hardware and Software Reference Manual*.

Installing 930WIN.EXE

To install 930 Dialogue for Windows:

Insert the 930 Dialogue for Windows diskette in your disk drive (A: or B:). Start Windows and choose **Run** from the **File Menu** of Program Manager. At the Command Line, type **A:\setup** (or B:\setup) and press **Enter** or click on **OK**.

Starting 930WIN

To begin using 930 Dialogue for Windows, open the 930WIN Group in Program Manager, if not already open. Double click on the 930WIN icon to launch the program.

Once in the utility, go to the **Options** Menu and select **Port Configuration** to specify a serial port for communication. At this point the software is fully installed, configured, and ready for use.

SC900 drives are shipped from the factory in the Unconfigured state. When they are first powered up they will flash "UC" and will not run a motor. Drives are easily configured with the 930WIN.EXE utility.

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9 Mounting Specifications

The SC900 packaging is totally enclosed single axis panel mount. The figures on the next pages gives the key dimensions for use in physically mounting the product. When mounting multiple units on one panel there should be at least 20 mm (0.75") of air space on the sides and 40 mm (1.5") or air space above and below the unit.

When mounting multiple drives in a row some customers have found the stiffness of the drive and their mounting panel to be too low. To increase the mounted mechanical integrity, connect to the threaded insert on the top front edge.

The overall drive panel dimensions and the mounted depth not including mating connectors is listed in the below chart. The extra depth for mating connectors is 1.0" or less.

Model	Height	Width	Depth
SC9x2	370 mm/14.5"	60 mm/2.35"	218 mm/8.6"
SC9x3	370 mm/14.5"	76 mm/3.25"	218 mm/8.6"
SC9x4	370 mm/14.5"	114 mm/4.5"	218 mm/8.6"
SC9x5	425 mm/16.75"	229 mm/9.0"	269 mm/10.6"

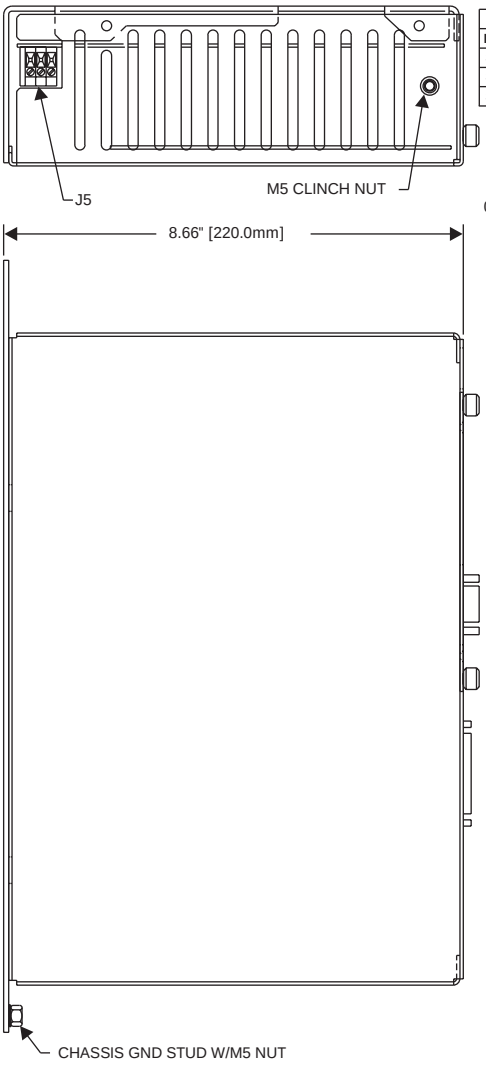
The OF90x optional fans mount below the units and are slightly larger than the 93 mm (3.65") width and 25 mm (1.0") thickness of the fan itself.

Model	Weight
SC9x2	1.6 kg/4.7 lb
SC9x3	3.2 kg/8.52 lb
SC9x4	3.5 kg/9.32 lb
SC9x5	12.7 kg/34 lb

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Drive Mechanical Outlines

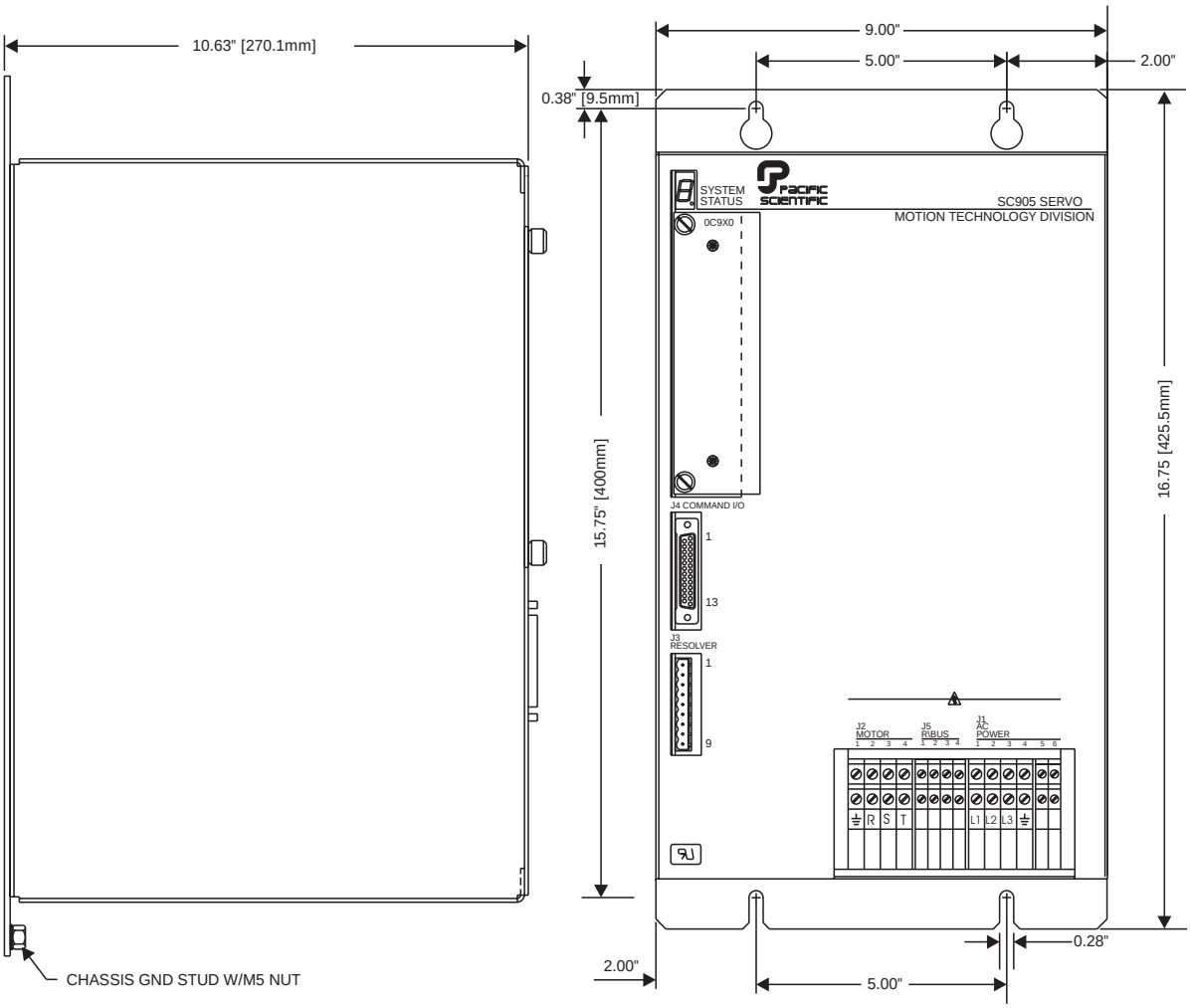
SC9X2/SC9X3/ SC9X4



DIMENSIONS LEGEND				
MODEL	PEAK	A	B	C
SC9X2	7.5A	2.25" [57.2mm]	1.12" [28.6mm]	N/A
SC9X3	15A	3.25" [76.2mm]	1.50" [38.1mm]	N/A
SC9X4	30A	3.20" [81.4mm]	1.60" [40.6mm]	4.52" [114.8mm]

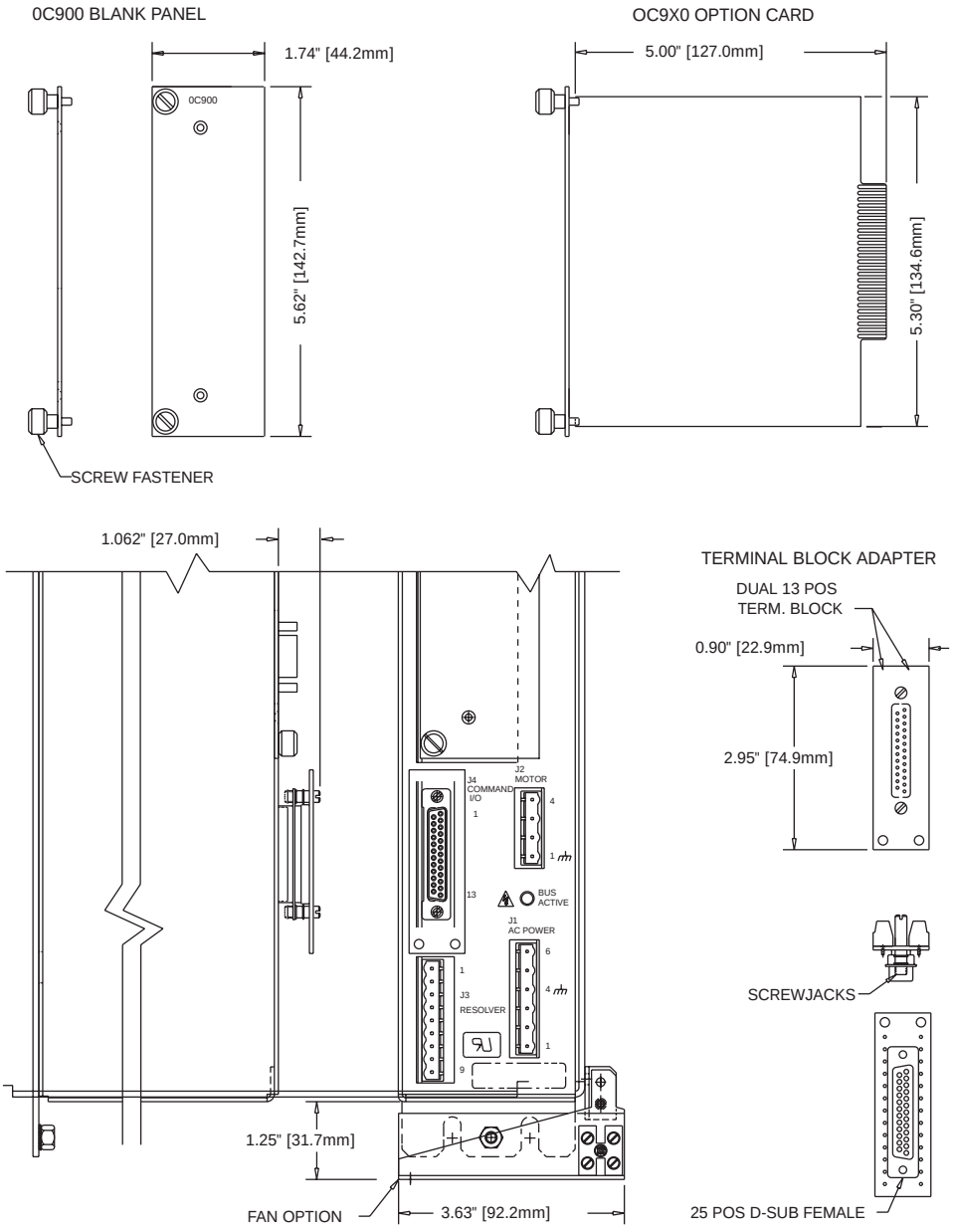
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SC9X5



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SC900 Family Options



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