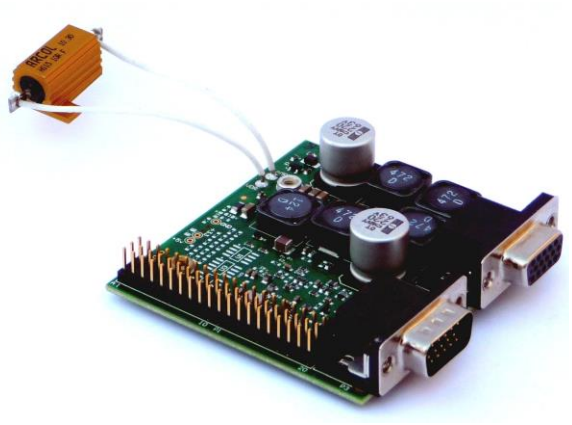


QCI-S2-IG-01

QCI-S2-IG

SilverSterling S2-IG

The SilverSterling™ is an OEM servo controller/driver for QuickSilver's line of NEMA 11, 17, 23, and 24 frame, high torque, direct drive hybrid servomotors, but is also capable of driving third party DC brush and voice coil motors, 3 phase brushless motors, open loop step motors, and the new Mosolver**™** hybrid servo with internal resolver functionality*. The SilverSterling controller/driver is available open framed (QCI-S2-IG-01) and enclosed (QCI-S2-IG), and a Dual controller version (QCI-S2-X2-IG).
They are designed to servo QCI's I-Grade motors through a single connector. This single cable solution allows for easy installations and simple cable routing.

QCI-S2-X2-IG

* The Mosolver capability is present in units with a serial number of 2S1950 and higher. These units have differential amplifiers added to interface with the Mosolver sense windings.

The SilverSterling features a 15 pin interface connector including 4 IO, CAN , RS-485, and system power input. Four IO lines are brought out to the 15 pin connector. These may be selected by means of jumpers on the 60 pin header if a secondary mezzanine PCB is not utilized. If the expansion PCB is used, then these connector pins are free to be used by the customer as assigned by the expansion PCB design.

The SilverSterling also features a 60 pin header to allow simple and direct connection to expansion boards for both future QuickSilver product extensions and OEM custom interface printed circuit boards, eliminating the need for an additional cable and housing.

The 60 pin expansion header includes the ability to bring power to the board as well as access to internal +12v, +5v, and +3.3v power supplies. Access is also provided to two SPI ports (one of which may alternately be used as 4 simple IO), the internal CAN port, 4 configurable analog/digital IO (12 bit A/D), one I2C port (which may be alternately used as 2 IO), A secondary serial port (or alternately 3 I/O), motor encoder signals, one Capture Input (which can also serve as general purpose IO) and an additional 11 general purpose IO. Four connections to the 15 pin control connector are also brought out to the interface connector.

To utilize additional I/O, SPI, I^2C, or secondary serial port brought out on the 60-pin header, requires custom firmware. Contact factory for firmware options.

Drive capability of each controller is two or three phase at 3.5A RMS / 5A peak. DC Drive capability is 6A (using both output phases connected in parallel).

System Overview

Point-to-Point Moves
- Relative or Absolute
- Velocity or Time Based
- S-Curve

Advanced Motion Profile Moves
- Profile Move Commands
- Register Based
  - Position/Accel/Decel/Vel
  - Modify On-the-Fly

Multi-Axis Linear Interpolation
- XYZ Coords Contained in Text File
- CANopen® used for local bus
- 1000+ Points Stored In NV Memory

Built-In Voltage Clamp
- Regenerative Braking Resistor

Program and Data Storage
- 32K Non-Volatile Memory:
- 2000-3000 Program Lines
- User Data Examples
  - CAM Tables
  - Motion Profiles
  - Lookup Tables

Electronic Slip Clutch/Brake
- Variable Torque
- Wind/Unwind Applications

Anti-Hunt™
- Optionally use Open Loop While Holding
- No Servo Dither While At Rest

Communications
- RS-485 @ up to 230K Baud
- ASCII,Binary,Modbus®,DMX512
- Host Control While Servo in Motion
- CANopen® (Rev 03 SW and higher)

Programming Language
- Easy, Menu Driven Interface
- Command Parameter Prompts
- No Syntax Errors
- User Namable I/O and Registers

Advance PVIA™ Servo Loop
- 100:1 Inertial Mismatch
- Direct Drive Oversized Inertial Loads
  - Flywheels/Belt Drives
  - Typically Without Gearheads
- More Stable Than PID

Digital 4 Quadrant Vector Drive
- DSP Driven for Reduced Noise

Multi-Task/Multi-Thread

Compatible with QCI Motor/Encoders
- NEMA 11 Frame
  - 4000 Counts/Rev Encoder
  - Up To 9 oz-in (continuous)
- NEMA 17 Frame
  - 8000 Counts/Rev Encoder
  - Up To 43 oz-in (continuous)
  - IP50 or IP65
- NEMA 23 Frame
  - 8000 Counts/Rev Encoder
  - Up To 300 oz-in (continuous)

Electrical Specifications

Configurations

The QCI-S2-IG and QCI-S2-IG-01 are single controller units. The QCI-S2-X2-IG contains two independent controllers in a single extruded heatsink; internally there are not connections between the two controllers, and the option of a mezzanine board is not available.

Input Power

Voltage

+12 VDC to +48 VDC, regulated. Device must be initialized for the actual operating voltage.

Reverse Polarity Protection

Reverse polarity protection is available on the SilverSterling. (Note, however, if power supply is not floating, connecting the V+ input to Ground will cause this potential to be present at the common connection to communications and I/O lines, which may damage these lines or that to which they are connected.

Input Current

4.5 Amps maximum for any input voltage, +12 VDC to +48 VDC per controller. Externally fuse with no larger than 8A slow blow.

Output Power

Output/Driver Current

5 Amp peak, 3.5A RMS x 2 phases ; 6 A maximum for DC motors (using both phases in parallel) per controller (restricted to 4.5 A input current - such as driving a lower voltage motor from a higher voltage supply).

* With Adequate Heatsink. (4.0A RMS x 2 phases typical 45C rise from 22C, ambient, 3.5A RMS x 2 typical 36C rise from 22C , using QCI-S2-IG heatsink with mounting feet horizontal, still air; Vertical orientation typically several degrees lower. Measurement on outside of heatsink, adjacent to driver.)

Maximum Output Power

200 Watts continuous power with adequate heat dissipation, 48V operation.

Encoder Interface

Designed to work with QCI's I-Grade motor/encoders. Quadrature differential signals are employed. Quadrature decoding used (i.e 2000 lines are decoded as 8000 counts.) Standard interface is 485 differential inputs. These same differential inputs are also used to interface to the Mosolver sense lines using the Encoder A, A-, B, B- inputs.

Inputs & Outputs

Digital Inputs
0 to +3.3 VDC. LVTTL level compatible.
On externally connected IO: Effective internal ~200K ohm pull-up impedance to +3.3 V. Inputs have a series 220 ohm / 3.3v protector to ground / Series 220 ohm ESD protection network. Do not exceed 5v on the inputs to prevent damage to the controller.
Internal IO present at header do not have additional protection; user must provide protection needed on expansion PCB.

Digital Output Voltage
0 / +3.3 VDC.

Digital Output Current
Sinking or Sourcing
2mA; (externally connected IO include a 440 series impedance).

Analog Inputs
0 to +3.3 VDC input signal range.
12 bit ADC resolution (single).
Analog signal is read every servo cycle (120 µsec.) and the converted analog data is processed through a 5 ms filter to reduce noise & transients.

Analog channel #1 corresponds to physical I/O #4.

Mezzanine Connector
A 60 pin mezzanine connector has been provided to allow for easy interface to a user specific printed circuit board. Note that the signals on this connector are not protected, and the user must add protection to their circuit board for signals used. If the mezzanine board is not used, pins 20C-20B, 19C-19B, 18C-18B, 17C-17B must be jumpered to access IO1-IO4 at the DB-15HD SIP connector. (These signals must be connected on the mezzanine board if these functions are wanted at the four IO pins, otherwise other functions can be routed to the four external connections. Note that the Mezzanine connector may be unstuffed on S2-IG units not having a Mezzanine board.

Clamp Resistor
The QCI-S2 comes with a built in regenerative voltage clamping circuit to prevent damage to the driver from regenerated power associated with stopping a load. The QCI-S2-IG-01 has this clamping resistor attached. The user is responsible for affixing this clamping resistor to a suitable heatsink when installing the PCB.

Communications

Serial Interface
RS-485 multi-drop, Reduced unit load accommodates up to 255 nodes.
Protected up to +/- 70v not operating, +/-30V operating.

Note: RS-485 requires a nominal 120 ohm ½ W termination resistor at each end of the network. This termination is not provided onboard and must be provided by the user. Note: Short runs may work adequately with a higher impedace termination. The S2-IG does not require a biased termination, but other attached devices may require a bias for proper operation.

Protocols
8-bit ASCII, 9-bit binary, Modbus®, and DMX512

Hardware Configuration Settings
Available Baud Rates: 2400, 4800, 9600, 19.2k, 28.8k, 57.6k, 115.2k or 230.4k
(250k only for DMX512)
Data Bits: 8 (9 bits for binary)
Stop Bits: 1.5 or 2
Parity Bit: None (Modbus supports None, Even, Odd)

CAN interface
The CAN bus connection is NOT isolated, but does include transceivers which have an extended +/- 80v fault protection range. The CANopen® communications protocol allows the unit to function as a master, slave, or peer on a CANopen network. See the SilverLode CANopen User Manual for details on the CANopen protocol. This protocol operates simultaneously and independently from the standard serial protocols.

Note that a 120 ohm ½ W termination resistor is required at each end of the CAN network (only two per system). This termination is not provided onboard the controller and must be provided by the user. For the CAN bus, this termination is not optional.

CANopen® and CiA® are registered community trade marks of CAN in Automation e.V.

STATUS LIGHTS

Three status lights are provided on each end of the box. Two sets of status lights are provided to make it easier to see them with the box mounted in different orientations. The Blue Power light indicates power is connected to the unit. The Red COMM LED indicates the unit is ready (no program running) by a dim level, it is off between communications if a program is running. It blinks brightly during each incoming communications frame. The Green Status light varies in intensity with the motor torque (negative torque dimmer, positive torque brighter); if Done Bit is configured the LED lights to indicate Done (See Set Done Bit command), is also used to blink error codes if a fault is detected (and the Done bit is not configured).

Environmental Specifications

Operational Temperature
-10 C to +75 C

Storage Temperature
- 40 C to +85 C

Humidity
Continuous specification is 95% RH non-condensing.

Shock
Limitation is approximately 50g/11ms.

Specifications subject to change without notice. See www.QuickSilverControls.com for current information.

Mounting the QCI-S2-IG-01

The Controller Driver is designed to be mounted between guides that support the edges of the PCB not having LEDs or connectors. The guides should not overlap more than .025 over the edge of the PCB. The driver IC is the tallest device on the back side of the board and defines the distance between the PCB and the heat sink. Two 4-40 nuts are positioned equally about and on the center line of the driver to allow access from the outside of the heatsink to pull the PCB tight to the heatsink. If the third mounting nut (adjacent to the mezzanine connector), an appropriate non-conductive spacer must be used to minimize twisting/flexing of the PCB. The connector plane of the motor and SIP connectors is the reference for alignment and the stabilizer for the connector end of the PCB.

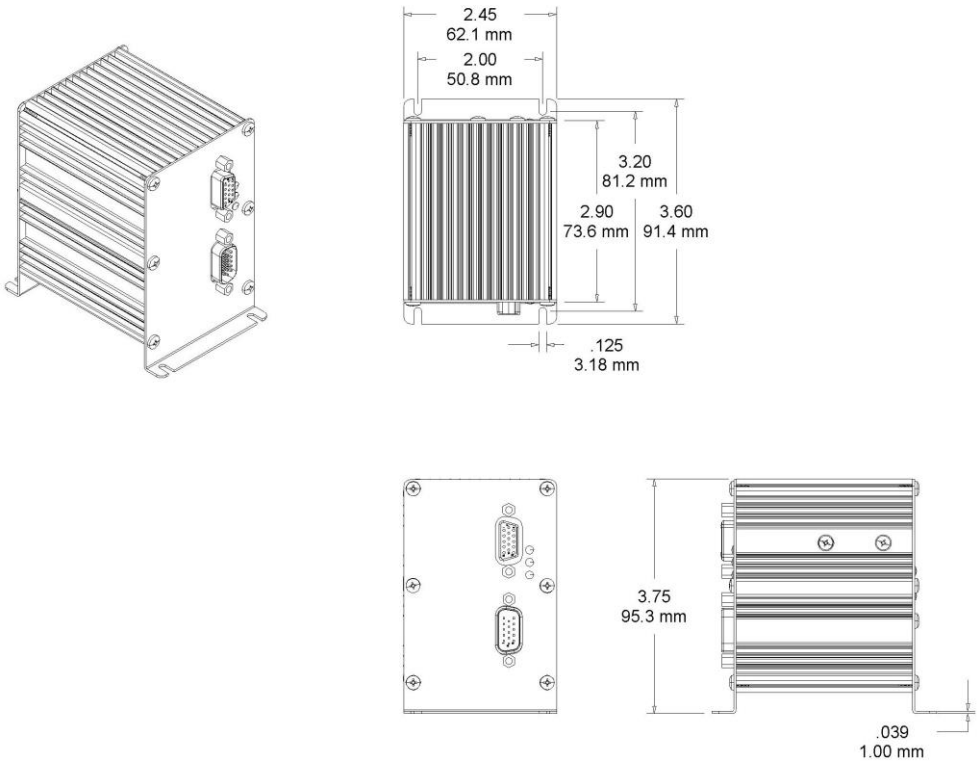
Mounting procedure: A thin layer of silicone thermal grease should first be applied to the exposed metal thermal contact of the driver IC. The driver chip should be held flat to the heatsink, and both screws tightened just finger tight (~2 in-oz). We suggest using at removable thread lock material (such as purple Loctite™) on the screws. Next, start any other mounting screws, such as the third mounting hole or the screws in the D-sub connectors.
Next tighten the two screws adjacent to the driver chip alternately with an ultimate torque of 20 in-oz (0.14Nm) using a torque watch. It is important to have the thermal interface side of the driver flat to the heatsink before tightening, as tightening a screw with the IC cocked results in a significant leverage which can damage the driver chip and distort the PCB, possibly breaking components and/or solder joints. Overtightening can also damage the driver and PCB.

Proper ESD handling techniques including grounding straps should be used while handling the open frame printed circuit board to prevent damage. The D-sub shells are grounded and should be the first contact to the PCB as an added protective measure.

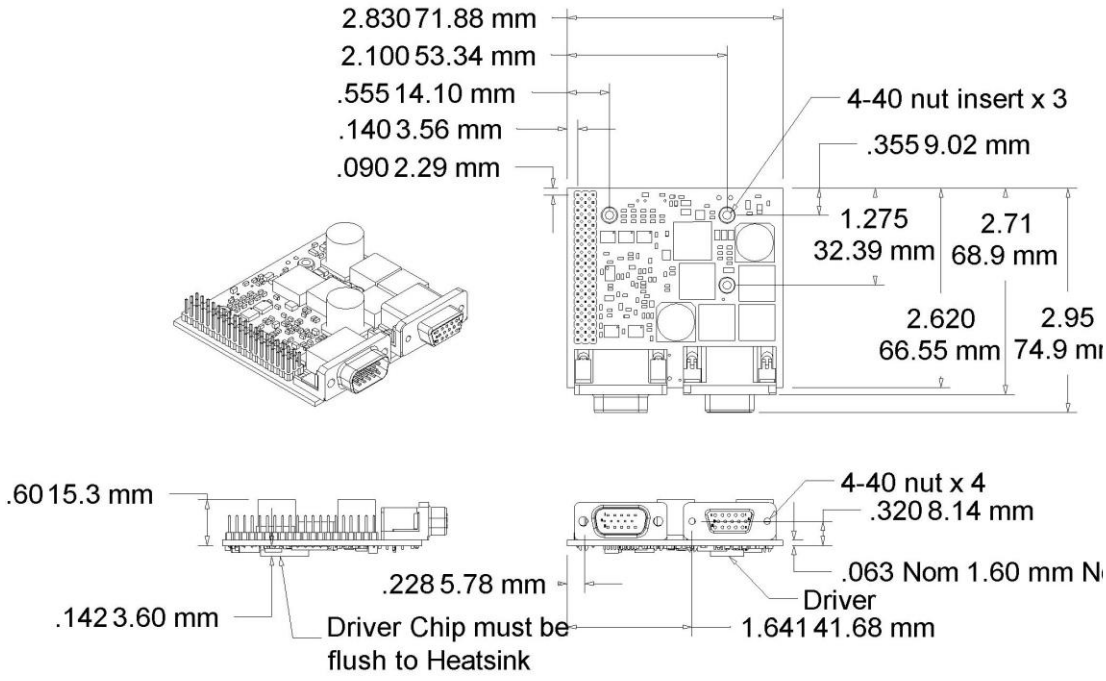
THE THERMAL PAD ON THE DRIVER IS INTERNALLY CONNECTED TO THE DRIVER SUBSTRATE AND NEEDS TO BE ATTACHED TO A GROUNDED HEATSINK. Connecting the mounting bracket for the D-sub connectors to the heatsink will provide the needed grounding path. Do not anodize the heatsink directly opposite the driver chip nor the screw holes!

Mechnical Dimensions

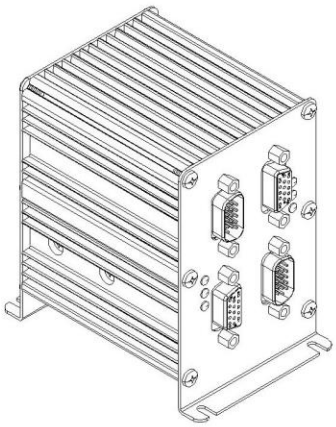
QCI-S2-IG

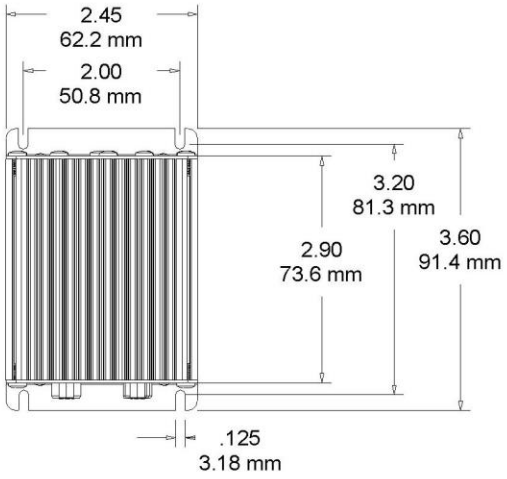


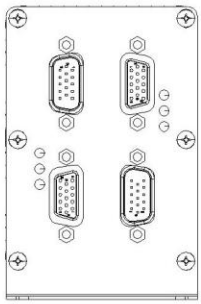
QCI-S2-IG-01

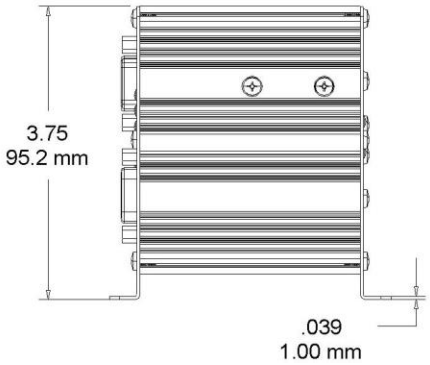


QCI-S2-X2-IG



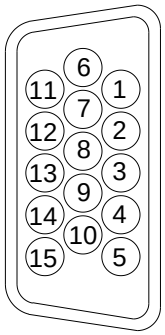

2.45
62.2 mm
2.00
50.8 mm
3.20
81.3 mm
2.90
73.6 mm
3.60
91.4 mm
.125
3.18 mm




3.75
95.2 mm
.039
1.00 mm

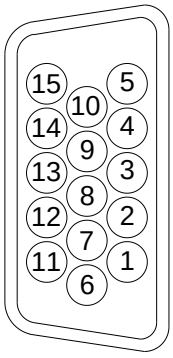
Connector Data

SilverSterling Interface Port (SIP)
This port provides Power, RS-485 serial communications, CAN communications, and four IO. It is not backwards compatible with the SilverDust or SilverNugget. The IO is nominally 0-3.3v and should be limited to no more than 5v to avoid damage. The CAN and RS485 have extended input voltage range to improve robustness. Power ground and logic ground are internally connected.

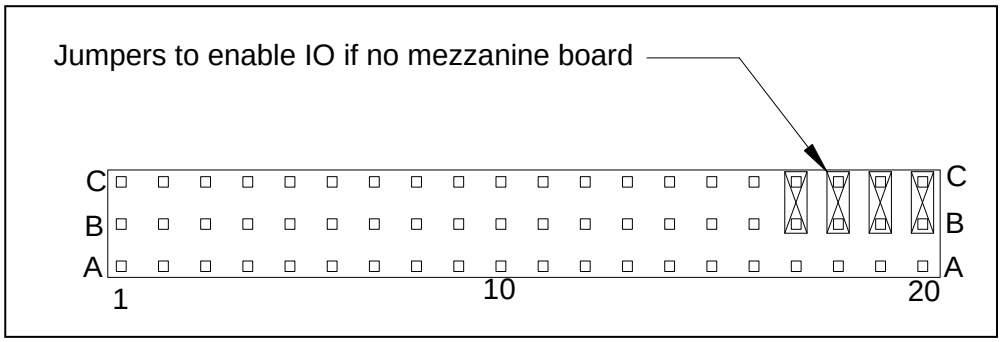


1	V+ (12-48 VDC)
2	RS-485A
3	+5V OUTPUT 100mA
4	I/O #3
5	CAN_H
6	POWER GROUND
7	V+ (12-48 VDC)
8	LOGIC GROUND
9	I/O #2
10	LOGIC GND (CAN GND)
11	POWER GROUND
12	RS-485B
13	I/O #1
14	I/O #4
15	CAN_L

Motor Interface
QuickSilver Controls recommends our QCI-C-D15P-D15S-nn (nn=length in feet) cable to interface between the motor and controller.



1	Motor B+
2	Chassis Ground
3	+ 5V Encoder Power
4	Encoder A -
5	Encoder B -
6	Motor A +
7	Motor B -
8	Encoder Z +
9	Encoder A +
10	Encoder Z -
11	Motor A -
12	Chassis Ground
13	Encoder B+
14	Encoder Ground
15	Motor Memory Access



Mezzanine Header
The Mezzanine Header provides access to additional signals when adding a customer feature board to the S2-IG (Contact factory for custom boards added to box), or S2-IG-01.

Four jumpers come standard on the S2-IG to connect the external IO (after input protection network) to the internal IO on the processor. Note that the signals on this connector are not protected and the user must add protection as needed to their customization board in order to use these signals.

Mezzanine Connector Pinout. Contact factory to use additional IO

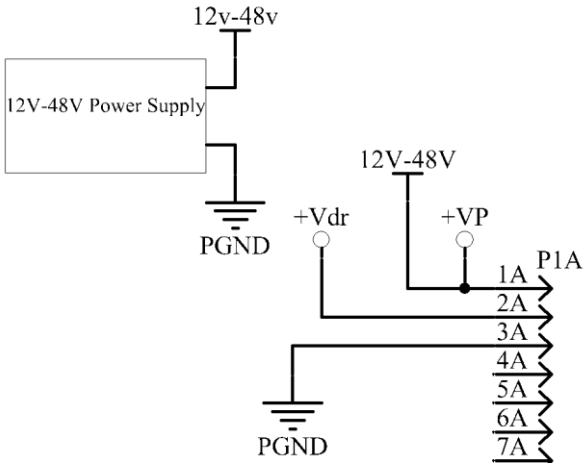
	A	B	C
1	+VP	VPsen	RxD_A - Primary serial port
2	+VDr = Internal driver voltage	+VDr = Internal driver voltage	TxD_A - Primary serial port
3	Power Ground (0v)	Power Ground (0v)	DE_A - Primary serial port
4	+12v @ 10mA	+5v @ 100mA	RxD_A ENA* (low to disable internal 485)
5	SPIA Slave In Master Out	TRST - RESERVED	SPIB Slave In Master Out or IO
6	SPIA Slave Out Master In	TDI - RED*	SPIB Slave Out Master In or IO
7	SPIA Clock	TDO - GREEN*	SPIB Clock or IO
8	SPIA Chip Select*	TMS - Output only	SPIB Chip Select* or IO
9	CSO A - Additional Chip select	+3.3v @ 100mA	RxD_B - Seconadary serial port or IO
10	CAN TX (internal signal)	TCLK - Reserved	TxD_B - Secondary serial port or IO
11	CAN RX (Internal signal)	SDAA - I2C or IO	DE_B - Secondary serial port or IO
12	Digital Ground	SCLA - I2C or IO	ENC_A - buffered from motor encoder
13	ADCINA2 - Digital IO or Analog	Digital Ground	ENC_B - buffered from motor encoder
14	ADCINB2 - Digital IO or Analog	GPIO1	ENC_Z - buffered from motor encoder
15	ADCINA4 - Digital IO or Analog	GPIO3	ENC_S - high speed capture of encoder or IO
16	ADCINB4 - Digital IO or Analog	GPIO14	CAP_1 - High speed capture or IO
17	No Connect	Internal IO4 ↔	To SIP pin 14 via protection network, ADC1 via protection
18	No Connect	Internal IO1 ↔	To SIP pin 13 via protection network
19	3.3v REF	Internal IO3 ↔	To SIP pin 4 via protection network
20	DRIVE ENABLE (pull low to disable)	Internal IO2 ↔	To SIP pin 9 via protection network

↔ Jumpered by default

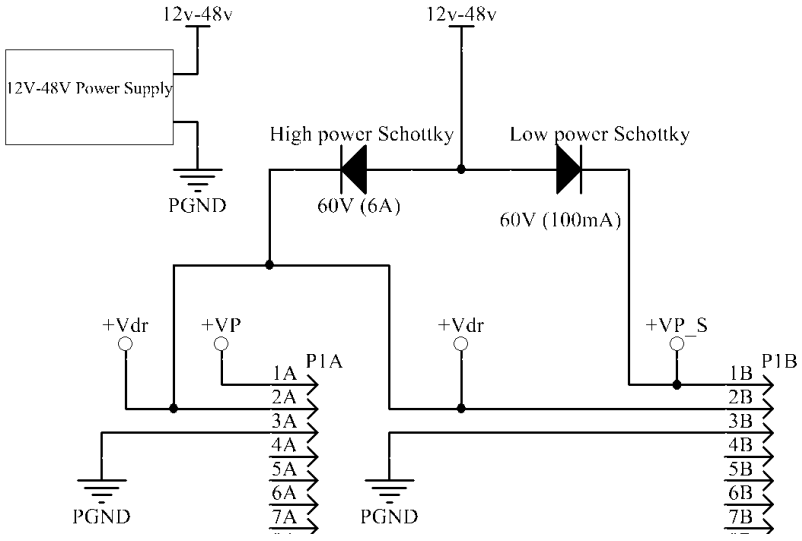
NOTE: GPIOXX pins refer to the processor pin naming convention. IOx pins follow the I/O numbering of the I/O commands within QuickControl.

Input Power via Mezzanine Connector

Two alternate configurations are available if providing power through the mezzanine connector.



The first configuration, shown right, connects the power supply input (12-48V) to Pin 1A referencing power ground on Pins 3A and 3B. Pin 1A connects directly to power pins 1 and 7 of the DB15HD SIP port. Note that the power is then available at the DB15HD SIP connector, so care needs to be taken to prevent anything from touching the supply on the exposed power pins. The connector pin's current rating must in consideration and must not be exceeded. The internal diodes isolate the supply from the regenerated power, allowing the clamp to operate.



The second configuration, shown right, connects the power supply input (12-48V) to +Vdr (Pins 2A & 2B) through a high power Schottky diode. The high power Schottky diode (60V/6A) keeps the internal driver regenerated power from causing the power supply to shut down and enables the clamp circuit to operate properly.

It is also necessary to connect a lower power Schottky diode (60V/100mA) from the input power supply to the +VP_S (Pin 1B) to enable proper clamp circuit operation. (Clamp will always be ON if this diode is not present!)

Power is isolated from DB15HD SIP port, pins 1&7 with this configuration.

Recommended Components

SilverSterling S2-IG Start-Up Materials
For first time users, QCI recommends purchasing the following items to aid with use of the S2-IG controller:

- 4’ DB15HD Motor I/F Cable (QCI-C-D15P-D15S-04)
- Breakout Module for SilverSterling (QCI-BO-S1)
- USB to RS485 converter (QCI-USB-RS485)
- Desired Motor

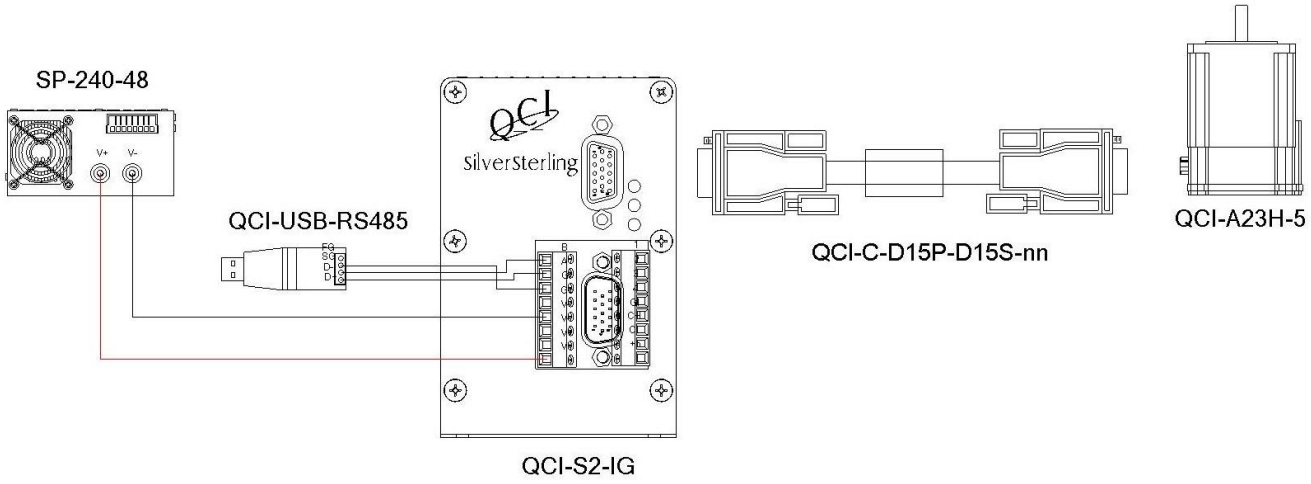
Optionally:

- 240W, +48V Power Supply (SP-240-48)
- Power Cable (QCI-C-ACP-FLY-6)

Software is free and available from our website.

See technical document QCI-TD072 on our website for details.

The Standard System detailed below shows a typical installation.
SilverSterling S2-IG System



Accessories:

1. Controller/Driver
SilverSterling S2-IG (QCI-S2-IG) is our standard closed frame controller/driver designed to servo QCI's I-Grade motors through a single connector.

2. Basic Breakout (QCI-BO-S1)
QCI recommends purchasing a breakout to simplify wiring power, RS-485 communication, CAN and 4 I/O. The breakouts connect directly to the SilverSterling's 15-pin interface port (SIP).

3. Motor I/F Cable
For standard system, this D-sub type cable goes between the motor and the controller. The generic part number is QCI-C-D15P-D15S-nn. Replace the last two digits "nn" with length of cable in feet (i.e. –10 for 10 feet). Standard lengths are 1, 2, 4, and 10 feet.

For IP65 system, a special IP65 cable goes in between the motor and the controller. The motors and cables are IP65, but not the controller/driver. The generic part number is QCI-C-D15P-T14S-nn. Replace the last two digits "nn" with length of cable in feet (i.e. –10 for 10 feet).

4. Motor
The SilverSterling S2 is capable of driving any NEMA 11, 17, 23 and 24 I-Grade motor/encoder. See the following datasheets for more information:

QCI-DS007: NEMA 17 I-Grade Motor/Encoder
QCI-DS008: NEMA 23 I-Grade Motor/Encoder
QCI-DS017: NEMA 11 M-Grade Motor/Encoder
QCI-DS028: NEMA 24 I-Grade Motor/Encoder
QCI-DS029: NEMA 23 Mosolver™

QCI-AN066: BEI voice coil motors with the SilverSterling

5. Power Supply
Power supply selection is motor dependent, but the following will work with all the 17 and 23 frame motors.

SP-240-48 (48V, 5A, 240 Watt)

Part Numbers

SilverSterling™ IG Controller/Drivers		
Driver	**Controller**	**Options**
QCI-S2-IG: 4 A RMS Per Phase • Best paired with I-Grade Motor/Encoders • 3.5A RMS per phase • 5A peak per phase • 4.5A @ 12v-48v • Included Clamp circuit and resistor.	IG – SilverSterling S2 IG • 4 TTL Inputs or Outputs • 1 Analog input (IO#4) • 1 PWM output (IO#2) ○ Use QCI-BO-S1A • ASCII, 9 bit Binary, Modbus®, DMX-512® • CANopen® (with Rev 03 sw) • DB15HD (pin): SIP Connector • DB15HD (socket): Motor I/F X2-IG • Two IG controllers in enclosure	**Blank** – in Heat Sink Enclosure **01** – Board Only • Requires user to properly heat sink. **V1** – Board Only • Motor Port with Vertical DB15HD connector • SMI Port with Right Angle DB15HD connector **V2** – Board Only • Motor Port with Right Angle DB15HD connector • SMI Port with Vertical DB15HD connector
Example: For IG board only		
QCI-S2	**IG**	**01**
Selection creates part number: **QCI-S2-IG-01**		

Example Part Numbers:
QCI-S2-IG
QCI-S2-IG-01
QCI-S2-IG-V1
QCI-S2-IG-V2
QCI-S2-X2-IG

Contact Information

QuickSilver Controls, Inc.
990 N Amelia Ave
San Dimas, CA 91773
909-599-6291 or (888) 660-3801
909-599-6289 FAX
www.QuickSilverControls.com