# SilverDust QCI-D2-IGM Datasheet

The SilverDust™ QCI-D2-IGM is an OEM hybrid servo controller & driver for QuickSilver's line of NEMA 17 and 23 frame, high torque, direct drive servomotors. The D2-IGM is designed to servo QCI's I-Grade motors through a single cable which allows for easy installations and simplifies cable routing.

The SilverDust D2-IGM controller is designed with a compact DIN mount to save cabinet space. They are great for multi-axis systems.

The Ethernet option adds easy networking capability.


**QCI-D2-IGM**

- 16 isolated 24V I/O
- 7 LVTTL I/O
- CANopen®.
- External Encoder Outputs

**QCI-D2-IGM-E**

- IGM plus Ethernet.

**QCI-D2-IGM replaces QCI-D2-IGB and QCI-D2-IG8*
***QCI-D2-IGM-E replaces QCI-D2-IG8-E*

**Requires QuickControl v6.28 or greater to initialize and program SilverDust D2-IGM.**

# 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

Input/Output
- 16 5-24V Digital I/O
  - Bi-Directional
  - Isolated
  - Set While In Motion
- 7 LVTTL Digital I/O
  - Use for QCI-BO-B52 24V I/O
- 4 Analog Inputs (Joystick)
- Analog Output Option
- Programmable Limit Switch (PLS)
- Secondary Encoder In
- Encoder Out

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

Electronic Gearing/Camming
- Follow Encoder (A/B Quadrature) or Step and Direction
- Dynamic Gear Ratios
  - Integer Ratios 32767:1 to 1:32767
  - Decimal Ratios to 7 Places
- Electronic Cam
  - Import Tables From Text File
  - Over 2500 Points
  - Multiple Tables

Communications
- RS-485/RS-232 @ 230K Baud
- ASCII,Binary,Modbus®,DMX512
- CANopen®
- Ethernet (TCP/IP, Modbus TCP)
- Host Control While Servo in Motion

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 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)
  - IP50 or IP65

# Electrical Specifications

## Input Power

**Voltage**
+12 VDC to +48 VDC, regulated. The controller must be initialized for the actual operating voltage using Initialization Wizard.

**Over-Voltage Protection**
Voltages exceeding +55 VDC will permanently damage the controller/driver electronics. All controllers include an onboard clamp circuit and braking resistor to dissipate excess current developed during re-generative braking (stopping).

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

**Input Current**
4 Amps maximum for any input voltage, +12 VDC to +48 VDC.

## Output Power

**Output/Driver Current**
Amps Per Phase: 3.5 Continuous/ 4.5 Peak with adequate heat dissipation (heat sink).

**Maximum Output Power**
150 Watts continuous power with adequate heat dissipation.

## Encoder Interface

From Motor Encoder: Quadrature (Differential)

From External (Secondary) Encoder: Quadrature (Single-ended)
This external encoder can be used for dual loop or electronic gearing applications.
Note, CANopen® encoders may also be used through the CANopen communication bus.

## Inputs & Outputs

**Standard I/O**
7 I/O (1-7)

**Digital Inputs**
0 to +3.3 VDC. LVTTL level compatible.
Effective internal 200K ohm impedance to +3.3 V.

**Digital Output Voltage**
0 / +3.3 VDC.

**Digital Output Current**
Sinking or Sourcing
I/O 1, 4, 5, 7 outputs 4 mA MAX
I/O 2 and 3 outputs 2 mA MAX
I/O 6 outputs 8 mA MAX

**I/O Over-Voltage Protection**
An over-voltage limiter protects each standard I/O line up to 30 volts. Applying voltages greater than 30 volts will permanently damage the I/O.

**Analog Inputs**
0 to +3.3 VDC input signal range.
10 bit ADC resolution (single).
11 bit ADC resolution (differential).
Analog inputs 1 to 4 are mapped to share digital I/O lines 4 to 7.
Each input has an effective internal 200K ohm impedance to +3.3 VDC.
Analog signals are read every servo cycle (120 µsec.) and the converted analog data is processed through a 5 ms filter to reduce noise & transients.

**Analog Output**
Available on I/O 2, but requires Basic Breakout w/ Analog Output (QCI-BO-B1A). See technical document QCI-TD048.

**Driver Enable Inputs**
10-48 Volts optically isolated differential inputs

## Extended I/O

16 I/O (101-116)

**Input Power**
An internal isolated +5V power supply drives the extended I/O circuitry. The +5v power supply is powered from the main power source through an isolated step-up transformer.

**Input**
Isolated from processor / driver power.
0 to 5-36 VDC.
0-1V: Logic Low
2V-36V: Logic High

**Output Current**
Outputs are open drain and can sink up to 250mA per channel continuously. If the load draws more than the specified current, the I/O line will go into current/thermal limit mode causing the FET to turn off automatically.

**I/O Over-Voltage Protection**
Each I/O line will clamp at approximately 40-50 volts. Applying more than 40 volts may permanently damage the I/O lines.

## Communications

**Hardware Interfaces**
RS-232, RS-232 multi-drop, RS-485 multi-drop (software selectable)
Ethernet (IGM-E). This is a bridge from Ethernet to RS-485 (E-485 Bridge). The E-485 Bridge provides a bridge from Ethernet to the SilverDust RS-485 network. See Technical Document "QCI-TD056 E-485 Bridge-Ethernet".

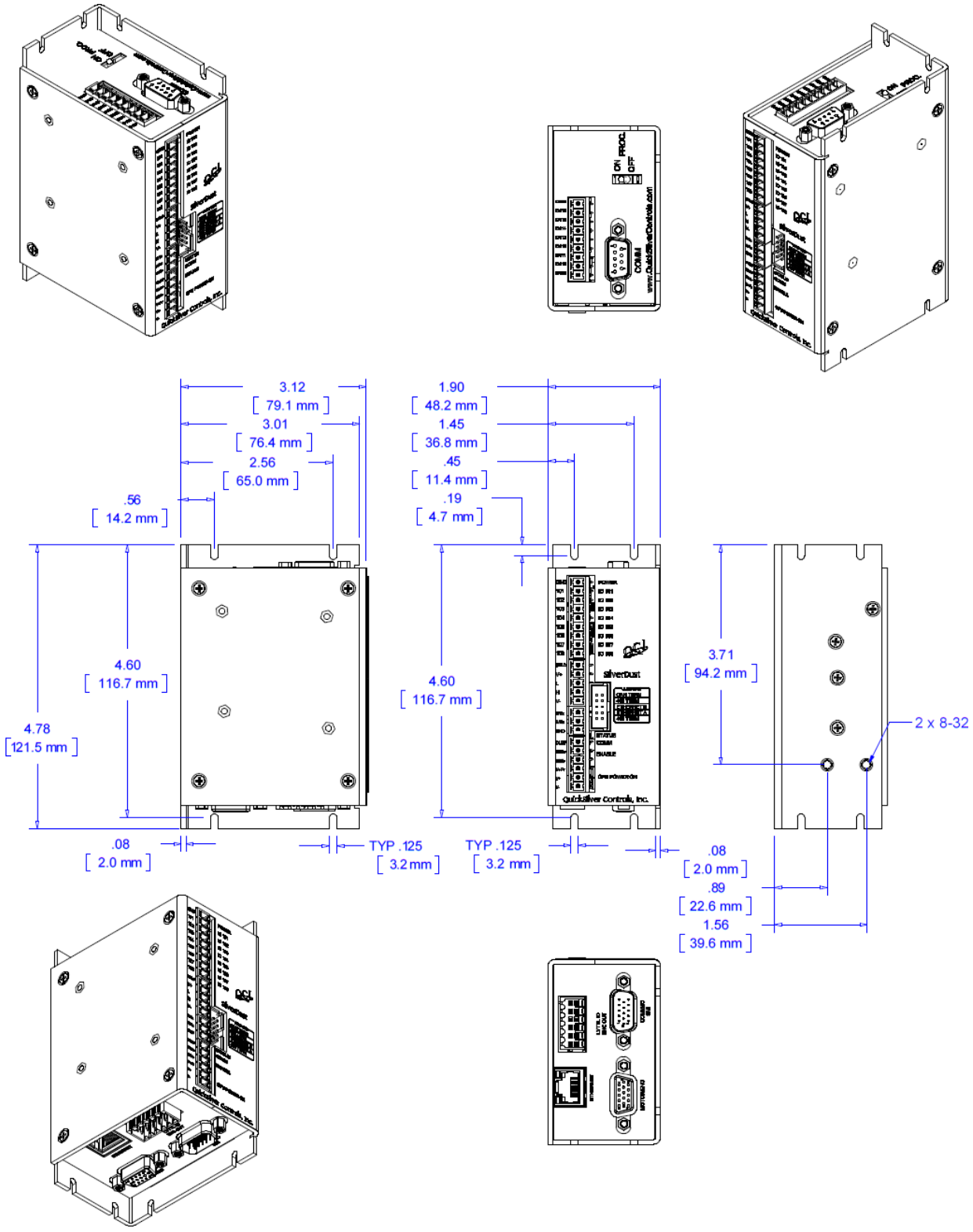
**Protocols**
8-bit ASCII, 9-bit binary, Modbus® RTU, or Modbus® TCP.

**Hardware Configuration Settings**
Available Baud Rates: 2400, 4800, 9600, 19.2k, 28.8k, 57.6k, 115.2k or 230.4k
Data Bits: 8
Stop Bits: 1.5 or 2
Parity Bit: None

**Controller Area Network (CAN)**
See CANopen User Manual for hardware and software details.

# Mechanical Specification

### QCI-D2-IGM




Note: See our website for 2D drawings and 3D models.

# Environmental Specifications

**Operational Temperature**
-10 C to +80 C

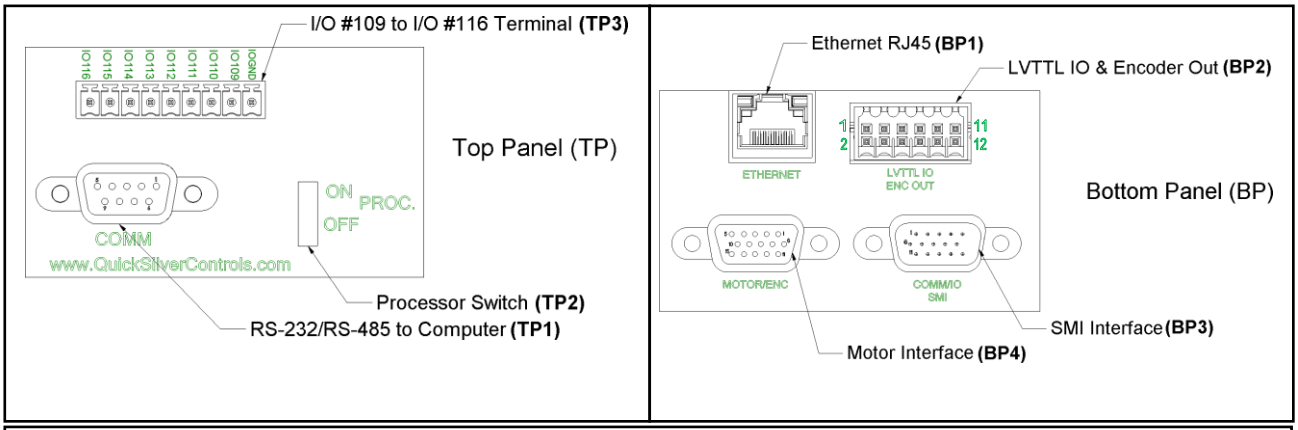
**Storage Temperature**
**- 40 C to +85 C**

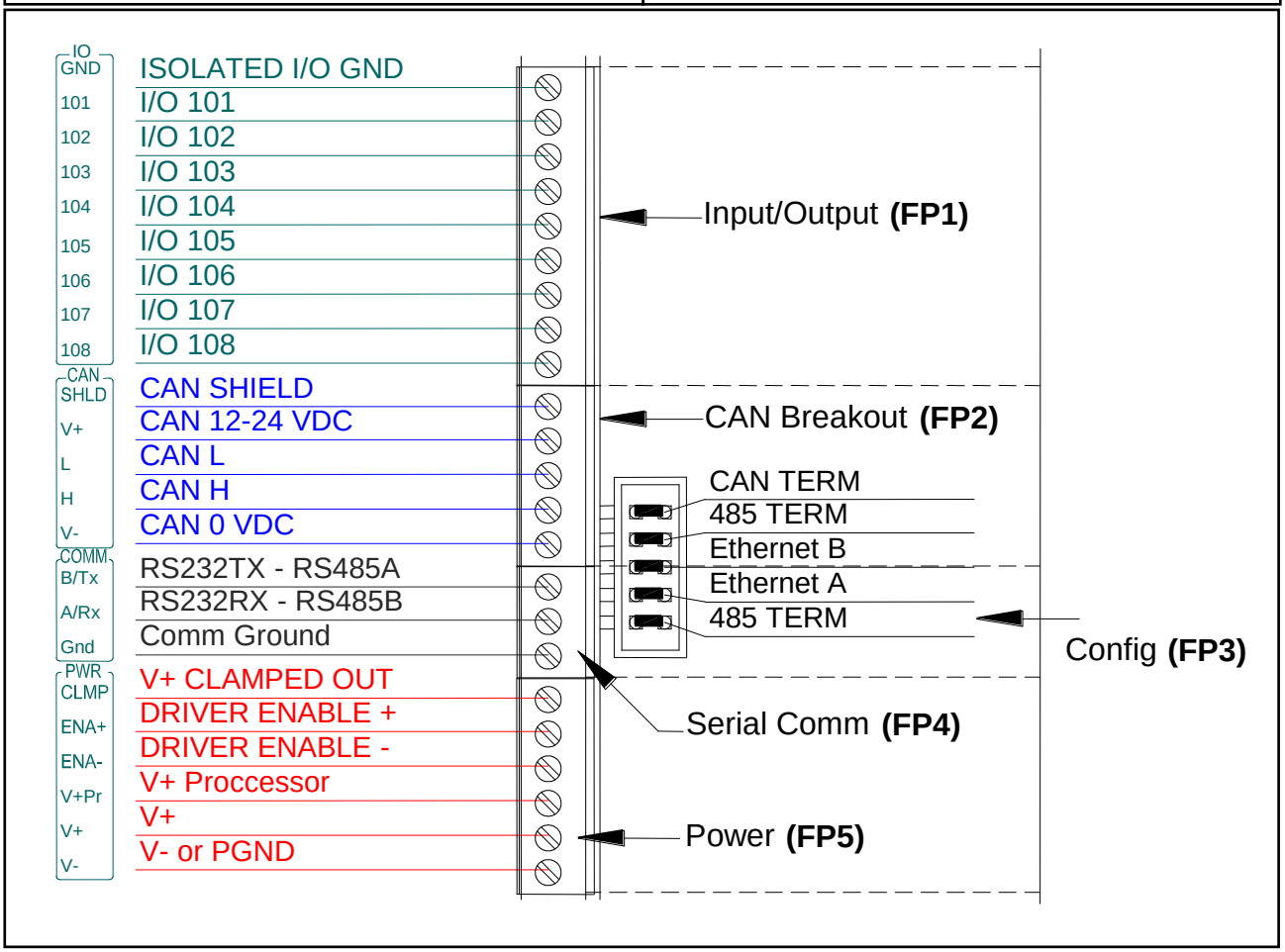
**Humidity**
Continuous specification is 95% RH non-condensing.

**Shock**
Limitation is approximately 50g/11ms.

**IP Rating**
IP20 with cables attached.

# Connector Data



**F**ront **P**anel **(FP)**

**(FP1)** I/O #101 to #108 Interface Breakout
**(FP2)** CAN Interface Breakout
**(FP3)** Ethernet Configuration/Termination Interface
**(FP4)** Communication Interface Breakout
**(FP5)** Power Interface Breakout

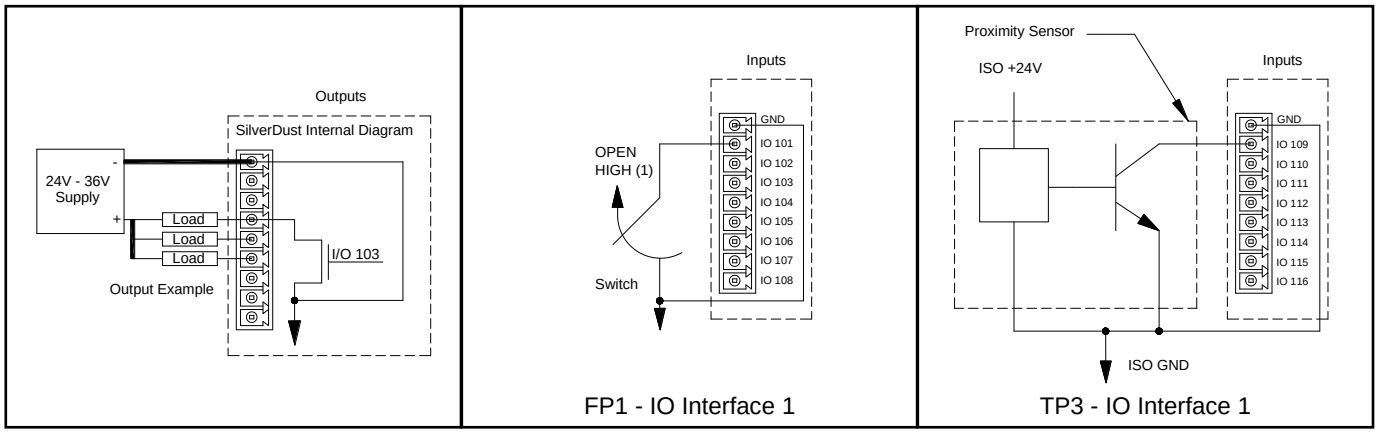
**T**op **P**anel **(TP)**

**(TP1)** RS-232/485 to Computer
**(TP2)** Processor Switch
**(TP3)** I/O #109 to #116 Interface Breakout

**B**ottom **P**anel **(BP)**

**(BP1)** Ethernet Interface - Optional
**(BP2)** LVTTL IO & Encoder Output Breakout
**(BP3)** SMI Interface
**(BP4)** Motor Interface

**(FP1 & TP3) I/O Interface Breakout**




Sinking Output configuration
ON or LOW = closed circuit
OFF or HIGH = open circuit

**Using the extended I/Os as an Input:**
All extended I/Os default to inputs.

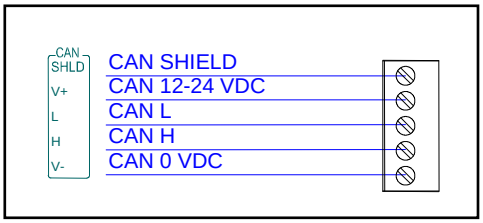
| | | |
|---|---|---|
| 2– 36 Volts = HIGH | LED = OFF | QuickControl Display: Green |
| 0 to 1v LOW | LED = ON | QuickControl Display: RED |

Each I/O is pulled up internally to a diode isolated +5 Volts, as well as to the associated LED through a resistor to the diode isolated +5v. An output driving one of these inputs requires a minimum of 4mA sinking current (LED + Pull-up resistor).

**Commands to Use the I/Os as an Output:**
Set Output Bit (**SOB**): Sets output HIGH (driver transistor is off)
Clear Output Bit (**COB**): Sets output LOW (driver transistor is on)
Configure I/O (**CIO**): Sets output HIGH/LOW/Tristate High and Tristate = OFF, Low=ON
Configure I/O, Immediate Mode (**CII**): Same as CIO, but executable from host even while a program is running.

**See SilverLode Command Reference for more details on these commands.**

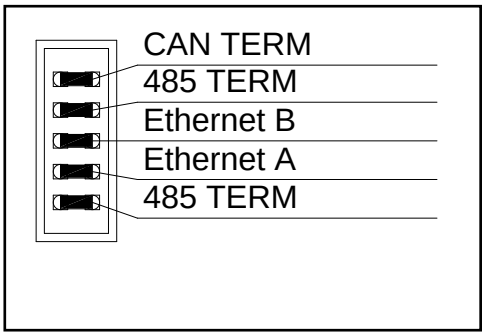
### (FP2) CAN Interface Breakout




**Controller Area Network (CAN)**
This high-speed up to 1-megabit/s bus allows for register and I/O sharing as well as interface to 3rd party CANopen devices (i.e. encoders, I/O modules,…). See SilverLode CANopen User Manual.

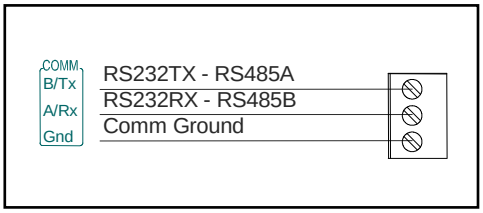
Note: CAN V+ only connects to BP2 and is provided for external wiring convenience only.

### (FP3) Ethernet Configuration / Termination Interface



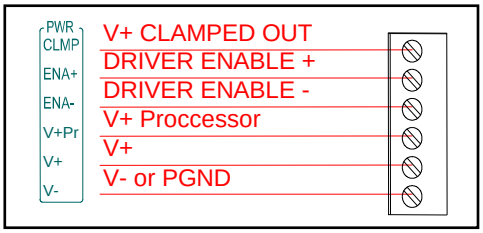

- CAN requires termination at both ends of the bus. Jumper "**CAN Terminate**" to terminate the bus.
- Jumper both "RS-485 Terminate" for RS-485 termination. This provides a biased termination for the bus.
- Jumper both "**Ethernet Jumper**" and both "**RS-485 Terminate"** for Ethernet.
- See Technical Document "QCI-TD056 E-485 Bridge-Ethernet".

### (FP4) Communication Interface Breakout



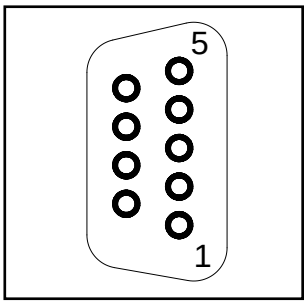

Standard RS-232/RS-485 connections broken out to terminals for easy wiring.

### (FP5) Power Interface Breakout




The two main items are V+ & V-, normally from the main power supply. V+Pr is a separate power input to keep the processor alive for certain applications. ENA+ and ENA- are inputs to an optically isolated drive enable. If Driver Enable is not needed, jumper ENA+ to CLMP and ENA- to V-. CLMP is a fused 150 mA output. CLMP = V+ minus 0.3V.

### (TP1) RS-232/RS-485 to Computer




Pinout

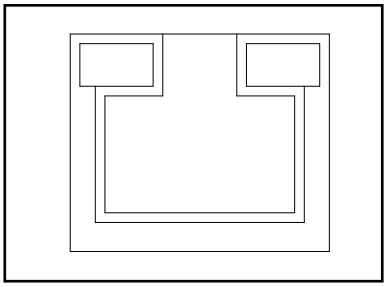
2 RS-232RX – RS-485A
3 RS-232TX – RS-485B
5 Communication Ground

All the rest are No Connect.

### (TP2) Processor Switch

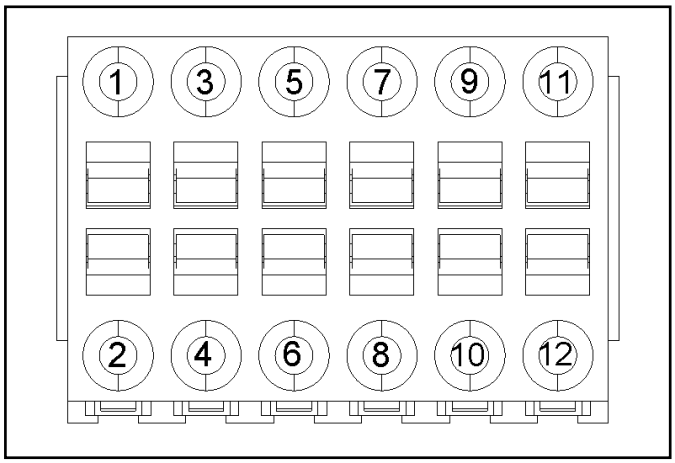
The Processor Switch turns on and off the power to the processor. The main power to the SilverDust should be OFF before connecting or disconnecting the system. The Processor Switch does **NOT** disconnect main power. It also does not turn off the power to the E-485 Bridge (bridge from Ethernet to RS-485) or to the 485-biased termination; this allows an E-485 Bridge to be shared with multiple 485 units.

### (BP1) E-485 Bridge - Optional



The E-485 Bridge is optional. The E-485 Bridge option provides a bridge from Ethernet to RS-485, communicating to one or more units via the 485 communications lines. Note, E-485 Bridge acts as the one and only “host” for a network of controllers. While the E-485 Bridge is being used, no other host can communication over the RS-285/RS-232 line. See Technical Document “QCI-TD056 E-485 Bridge-Ethernet”.

### (BP2) LVTTL I/O & Encoder Output




| LVTTL & Encoder Output Connector Pinout | |
|---|---|
| Pin | Signal |
| 1 | IO #1 |
| 2 | IO #2 |
| 3 | IO #3 |
| 4 | IO #4 |
| 5 | IO #5 |
| 6 | IO #6 |
| 7 | IO #7 |
| 8 | +5v Output (0.1 A) |
| 9 | Logic Ground |
| 10 | Encoder B Output |
| 11 | Encoder A Output |
| 12 | Encoder Z Output |

Connector Manufacture: On-Shore Technology
Connector Part Number: OSTVX121131

Mating Connector Part Number: OSTVW121030

- Wire range: 18-28 AWG
- Wire strip length: 7-8 mm

**LVTTL I/O**
This connector breakouts the standard LVTTL I/O #1 through I/O#7. I/Os are +5v compliant, 3.3V input, and 3.3V output. These I/O can also be configured as analog inputs from 0-3.3V at 10-bit resolution. Refer to ARI and ACR commands.

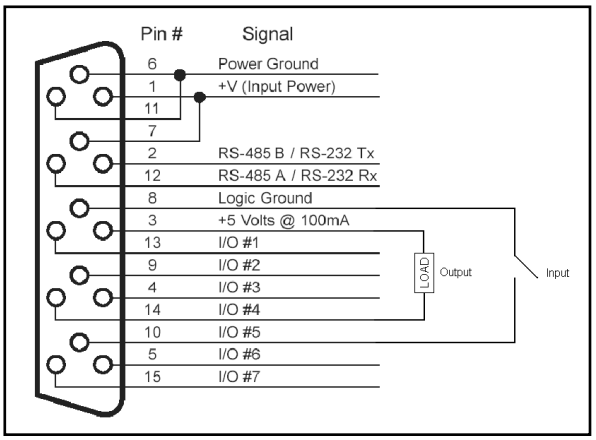
Note: I/O #1 through I/O#7 can also be accessed via the DB15HD SMI port. See section BP3 below.

**Encoder Outputs**
The connector also outputs single-ended quadrature motor encoder signals. Encoder Out A, B, and Z are buffered single-ended replicates of the differential signals from the motor encoder. They are in Quadrature format, with the index in a 49/50 format.

Note: Encoder output signals are NOT protected.

**Secondary Encoder Input or Step and Direction Inputs**
Use I/O #4, #5, and #6 to connect a secondary external encoder (channels A, B, and Z, respectively) or Step and Direction signals onto I/O #4 and #5, respectively. If these I/O are used as encoder inputs or step and directions inputs, they are NOT available for general purpose I/O function. Refer to SEE command.

### (BP3) SilverLode Multi-function Interface (SMI) Port




These signals provide power, communications and 3.3v IO signals (digital and analog).

NOTE: QCI has many modules capable of breaking out these signals. For example:

- Basic Breakouts (QCI-BO-B, QCI-BO-B1)
- Basic Breakout w/ Analog Out (QCI-BO-B1A)
- Breakout w/ 24V IO - 5in 2out (QCI-BO-B52)
- 24V Optical I/O Module (QCI-OPTMC-24)*
  *Requires QCI-EC-SMI-nn cable

See technical documents on our website for details.

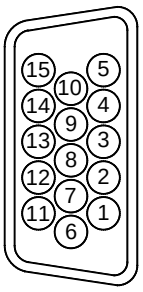
This port provides QuickSilver's basic Power, Communication, standard I/O for easy connectivity in large systems. The SMI port is standard on all our controllers which helps make new products backward compatible with older ones. See above sections for details on these signals.

Power inputs are diode OR'ed into power inputs from the Power Interface Breakout. Apply power from either port is OK.

Note: Encoder Inputs described in LVTTL I/O connector uses I/O # 4, 5, and 6 listed here. If these I/O are used for electronic gearing, they are **NOT** available for general purpose I/O function.

**Note: Communication lines RS-485A / RS-232 RX, RS-485B / RS-232 TX, and LOGIC GROUND are all internally connected between the SMI port and the respective pins on the front side connector (FP4).**

### (BP4) Motor Interface




| | |
|---|---|
| 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 |

QCI recommends our QCI-C-D15P-D15S-nn (nn = length) cable to interface between the motor and the controller. Note: 01, 02, 04, and 10-foot cables are standard lengths.

The Motor I/F Breakout (QCI-BO-M1) can be used to breakout these signals. See Technical Document QCI-TD057 "Motor I/F Breakout - QCI-BO-M1".

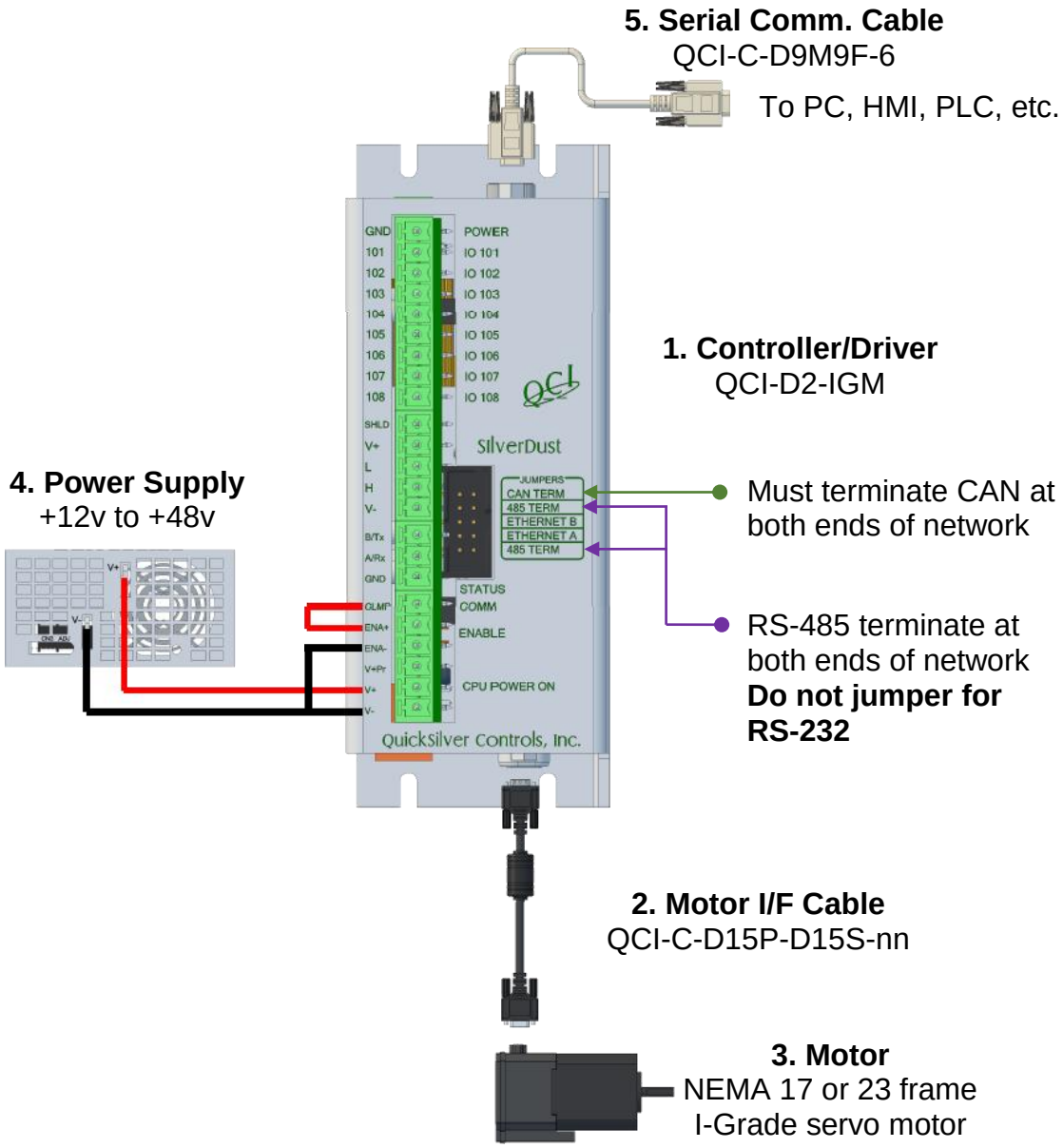
## Recommended Components

**SilverDust IGM Parts List**

For first time users, QCI recommends ordering the following items:

- SilverDust D2 (QCI-D2-IGM)
- Communication Cable (QCI-C-D9M9F-6)
- 4' DB15HD Motor I/F Cable (QCI-C-D15P-D15S-04)
- DIN Rail Bracket (QCI-DIN1)
- QCI-RSP-320-48
- QCI-C-ACP-FLY-6

## Typical SilverDust IGM System



**1. Controller/Driver**
Standard controller/driver is a QCI-D2-IGM. Ethernet controller/drive is a QCI-D2-IGM-E.

**2. Motor I/F Cable**
For standard systems, 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 stock 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).

**3. Motor**
The SilverDust D2 is designed to drive any NEMA 17 or 23 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

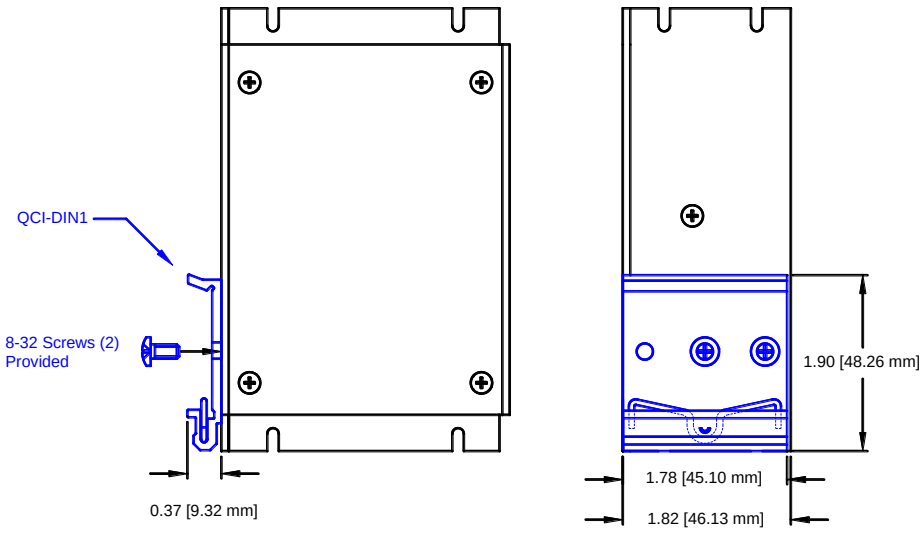
**4. Power Supply**
Power supply selection is motor dependent, but the following will work with all the 17 and 23 frame motors.

RSP-320-48 (48V, 6.7A, 320 Watt)

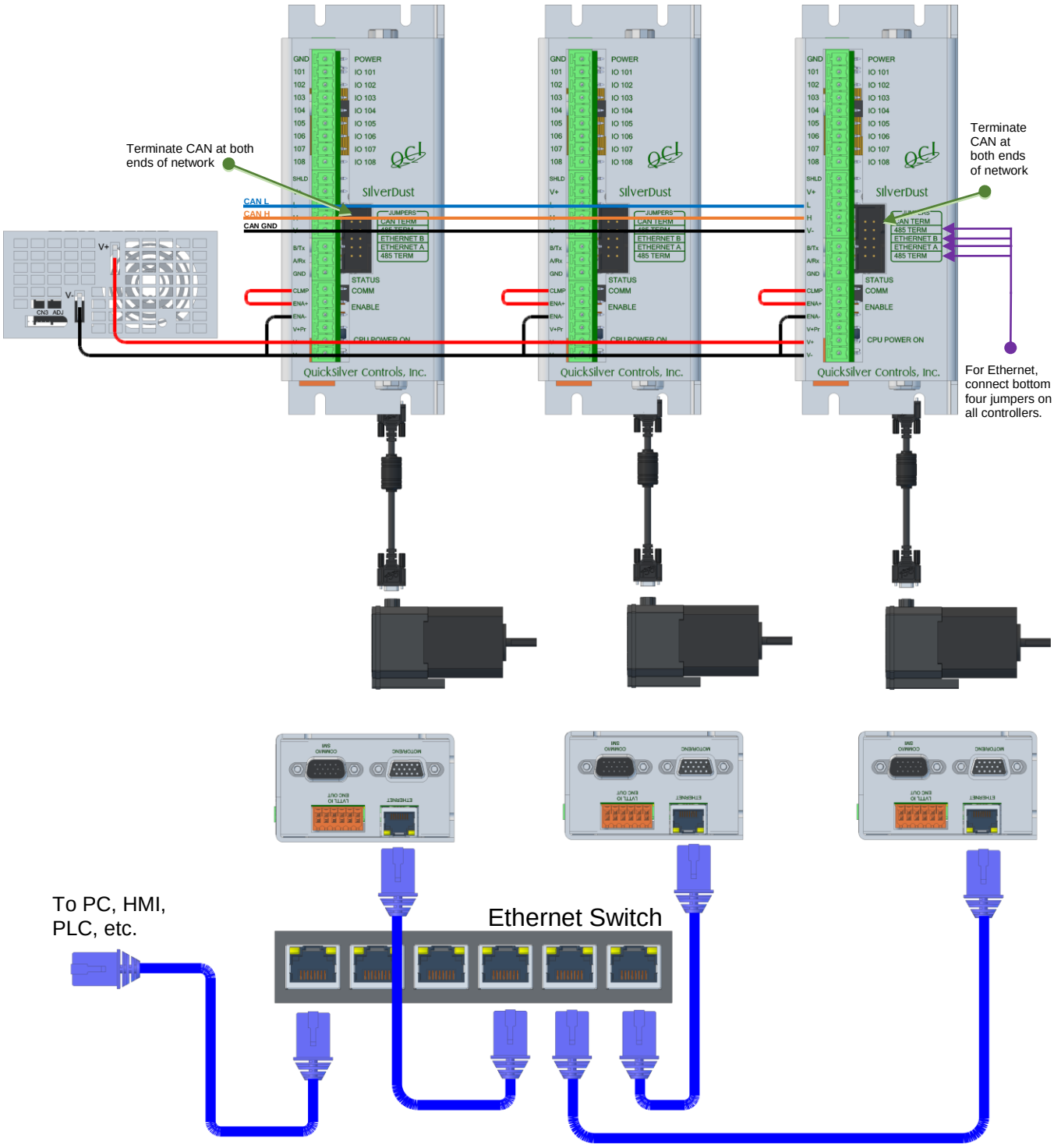
**5. Serial Communication Cable**
Standard straight through 9-pin DSUB serial communication cable to communicate with an external host via RS-232.

QCI-C-D9M9F-6

**6. Din Rail Mount (Optional)**
The DIN Rail Bracket (QCI-DIN1) is an optional kit for DIN mountable applications. See below.

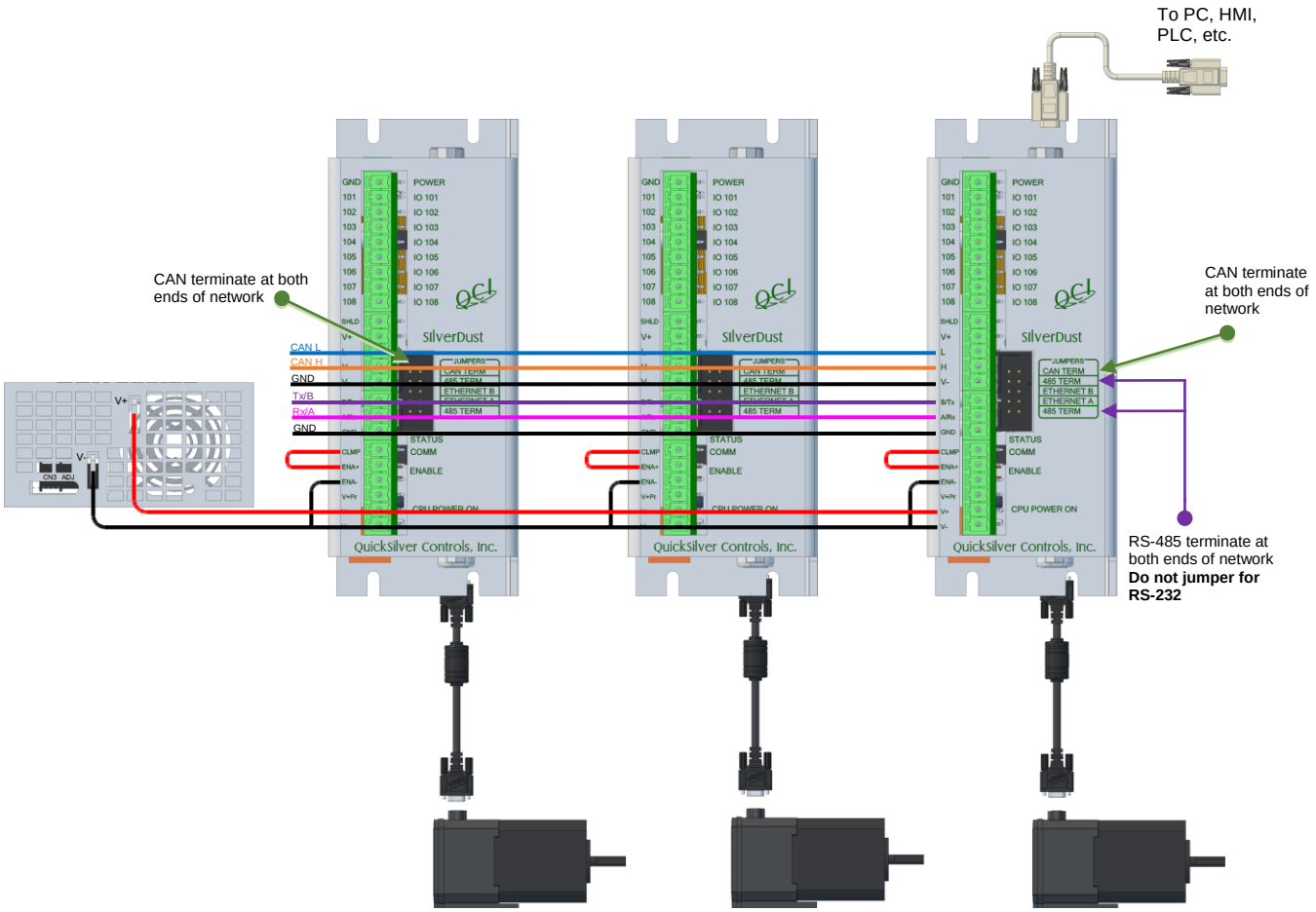


# Multi-Axis Setup - Ethernet and CAN



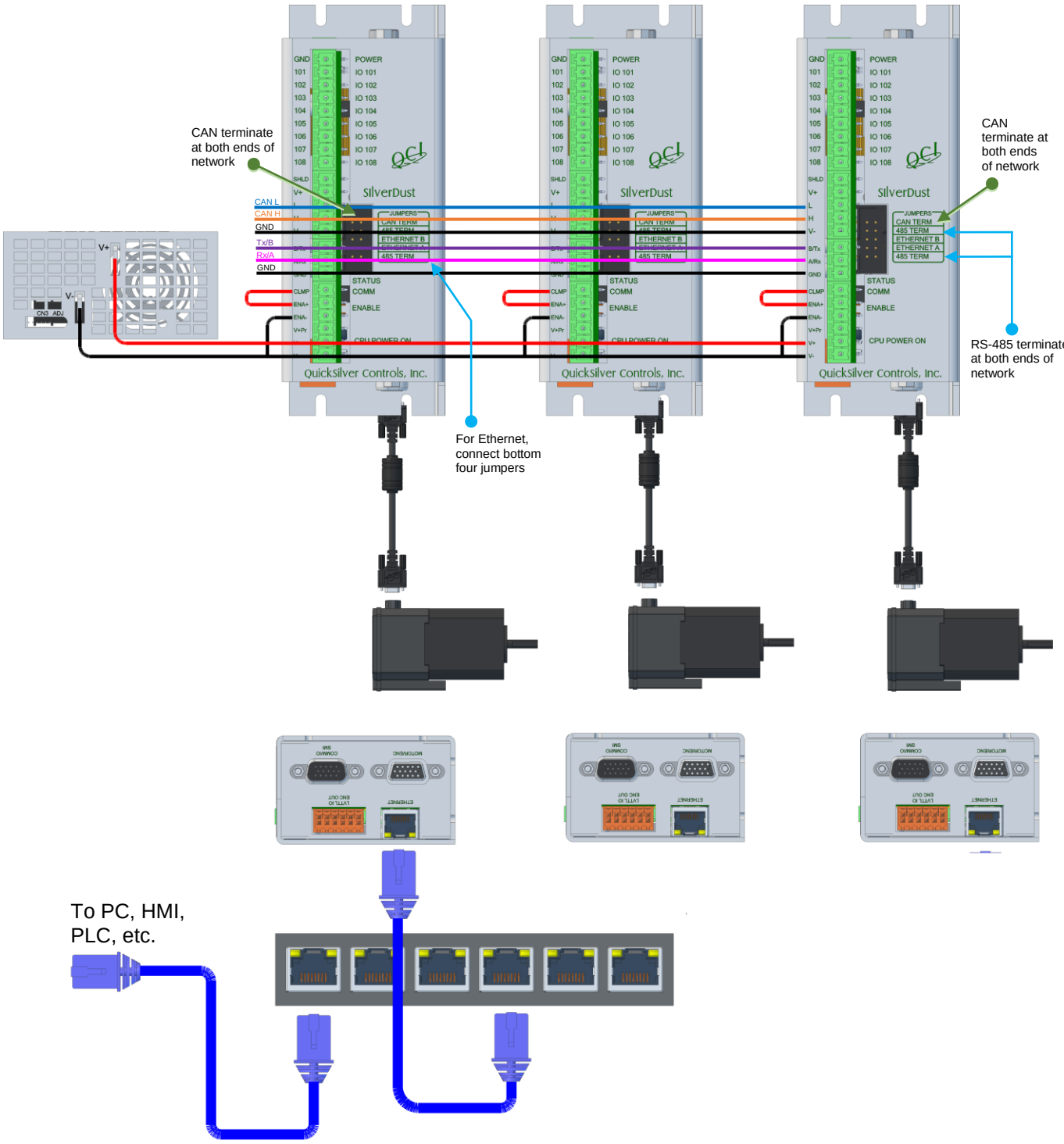

The above configuration shows a three-axis system with each axis having its own E-485 Bridge. CAN is configured as an inter-axis communications network to provide coordination and data sharing between axis. Each axis has a unique IP address (for Ethernet) and a unique Unit ID (for CANopen). The router/switch provides communication between the PC and all the SilverDust units. For Ethernet, connect bottom four jumpers on all controllers. Connect CAN termination at both ends of network. See Tech. Doc. “QCI-TD056 E-485 Bridge-Ethernet”.

# Multi-Axis Setup - Serial and CAN




This configuration provides communications between an external PC, HMI, PLC via serial communications. If using RS-485 serial interface, connect 485 termination jumpers at both ends of the 485 network. These jumpers should be removed for multi-drop RS-232 operation. The serial port is used to command and monitor the individual units. The CAN bus provides a CANopen link between the multiple axis. This may be used to coordinate axes and to share data and/or IO; the axes may be configured as peer-to-peer or master-slave, or a mix as desired. Connect CAN termination both ends of the CAN network.

# Multi-Axis Setup - E-485 Bridge (Ethernet), Serial and CAN




This configuration shows a three-axis system, consisting of one QCI-D2-IGM-E with two QCI-D2-IGM controllers. The E-485 Bridge provides a bridge between Ethernet and RS-485, providing communications to all 485 connected controllers. One Ethernet connection using one IP address communicates with a whole network of QuickSilver servo controllers.

Note: The Ethernet may be directly connected to the PC/HMI/PLC using a “cross-over” cable.
Note: The 485 bus is terminated at both ends of the network via the 485 terminator jumpers.

Note: CAN is shown configured to provide multi-axis coordination with data and IO sharing. The CAN bus is terminated at both ends of the CAN bus via the CAN terminate jumper.

This configuration provides a low-cost network solution. In addition, only one Ethernet cable from the control cabinet goes back to the control room. Any monitoring and control can be done virtually anywhere in the world through the Internet. See Technical Document “QCI-TD056 E-485 Bridge-Ethernet”.

## CAN Networks vs. Ethernet Networks

Ethernet uses Carrier Sense Multiple Access – Collision Detection (CSMA-CD) scheme to send and receive data. Each time data is sent, there is a certain probability that two or more units will begin transmitting at the same time, resulting in a collision. This requires each of the units involved in the collision to “back off” for a random period of time before resending their data. As a result, data sent and received are not deterministic in time due to the collision detection – retry scheme.

True real-time servo data sent and received in a multi-axis network must be deterministic. QuickSilver CANopen provides the real-time data transmission capabilities to the network. CANopen uses an arbitration method to send and receive messages instead of collision detection. Each time data is sent, all units having data to send start by sending their message Identifier information, while monitoring to see if their message is the highest priority message being asserted. If a higher priority message is detected, the unit with the lower priority message stops transmitting until the bus is not busy. This is done ***without*** disrupting the highest priority message. The user can select the message priority, and therefore the order in which the messages will transverse the bus. If the user takes care to not overload the bus, the messages will be delivered in a timely manner. Therefore, CANOpen communication is deterministic. The combination of CAN as a deterministic local data bus and Ethernet as an API bus provide the complete communication solution.

## Modbus TCP

Modbus TCP requires a different Ethernet chip and therefore must be specified at time of order. See the Part Number below for details. Use of Modbus TCP is described in Application Note “QCI-AN028 Modbus TCP”.

# Part Numbers

| SilverDust™ IGM Controller/Driver | | |
|---|---|---|
| **DRIVER** | **CONTROLLER** | **OPTIONS** |
| **QCI-D2** - 3.5 Amp<br>• For 23 Frame and Smaller<br>• 3.5 Amps per Phase Continuous*<br>• 4.5 Amp Peak<br>• Input Power:<br>• 4A@12V-48V<br><br>* Depending on heat sink (25C ambient). | **IGM**– SilverDust D2 IGM<br>• 16 x 5-24V, Isolated I/O<br>• 7 x TTL Inputs or Outputs (use QCI-BO-B52 for 24V I/O)<br>• 4 Analog Inputs (Joystick)<br>• Analog Output Option (use QCI-BO-B1A)<br>• RS-232 or RS-485<br>• ASCII, Binary, Modbus®<br>• Encoder Output<br>• CANopen®<br>• Voltage Clamp And Resistor<br>• Drive Enable<br>• DB15HD (pin): SMI Port<br>• DB15HD (socket): Motor I/F including motor power and encoder | **Blank** – Standard<br>• DIN compatible<br>**E** – Ethernet<br>• RJ45 Connector<br>**EM** – Modbus TCP<br>• Ethernet w/Modbus TCP<br>**D –** DMX512<br><br>For multiple options, list fields in alphabetical order |
| To create a part number, choose one from each column above.<br>For a SilverDust IGM with Ethernet and Modbus TCP<br>Contact Factory for Ethernet IP options | | |
| **QCI-D2** | **IGM** | **EM** |
| This selection creates the part number: **QCI-D2-IGM-EM** | | |

# 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