SilverNugget N3-IX – X Series Controller

The SilverNugget™ N3-IX is a servo motor controller/driver designed to operate QCI's line of NEMA 34 frame I-Grade, high torque, direct drive, hybrid servo motors through two motor interface cables, motor power and encoder feedback. The N3-IX includes a Controller/Indexer, Digital Driver, and Active Power Clamp. Serial communications and IO, as well as processor power are accessed through a High Density DB15 connector (SMI). CANopen is available on a separate DB 9 connector. Power and external Clamp resistor are available through a 5 pin 5W5 connector. The 15 pin SMI interface includes 7 I/O, all of which support both LVTTL and analog signals, and one of which also supports 0 to 10v analog input. 24v NPN/PNP inputs are accomplished by configuring the internal pull up/down resistor, which is configurable on each input. See TD091 for details. A hardware drive enable are also included. Communication is available via CANopen and RS-485 serial, which may be operated simultaneously. The driver is rated to 20A continuous per phase. The system is designed for use at +12 to +72 VDC for driver power and 12-48v for processor power.

The X series SilverNugget includes dual internal clamp circuits. An external primary clamp allows the clamp resistor to be connected externally to handle the required power level. A secondary internal clamp comes on at a slightly higher internal voltage to protect the driver if the primary clamp is not connected, and for those low inertia designs and or lower speeds, or which are not back-driven, the 50w internal clamp may eliminate the need for an external clamp resistor, according to the application. (Note: Dump resistors are 50W average, allow up to 250W for up to 5 seconds). The internal clamp may also be bypassed for use with batteries to allow capture of regenerated power.

Requires QuickControl v6.22 or greater to initialize and program controller.

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/Velocity
  - Modify On-the-Fly

Input/Output
- 7 LVTTL Digital I/O
  - Bi-Directional
  - Set While In Motion
  - 24V NPN/PNP TD091
- 7 Analog Inputs (Joystick)
- 1 Analog 0-10v Input
- 1 Output supports PWM out
- 1 Input supports PWM in
- Programmable Logic Switch out
- Secondary Encoder In
- Encoder Out (single ended and differential available)

Program and Data Storage
- 32K Non-Volatile Memory
- 2000-3000 Program Lines
- Expanded 8191 word program buffer
- 4K User Registers
- User Data Examples
  - CAM Tables
  - Motion Profiles
  - Lookup Tables

Electronic Gearing/Camming
- Follow External Signals
  - Encoder (A/B Quadrature)
  - Step and Direction
- Gearing plus Trapezoid motion
- Electronic Cam
  - Import Cam Table from File
- Gearing with extended precision:
  - A/B gearing
  - xxx.xxxxxxxx multiplier (8 places behind decimal point)

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

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
- Improvement Stability
- Simulated Viscous Inertial Damper
- 100:1 Inertial Mismatch
- Direct Drive Oversized Inertial Loads
  - Flywheels
  - Belt Drives
  - Typically eliminates need for Gearheads

Anti-Hunt™
- Optionally transition to open loop while in position – automatically changes back to full servo if position is disturbed.
- No Servo Dither While at Rest

Multi-Task/Multi-Thread
- Two programs plus a motion simultaneously
- Multiple background protection settings

Based on QCI's Hybrid Servo Motors:
QCI's NEMA 34 I-Grade Servo Motors
  - 16000 Counts/Rev Encoder
  - Up to 2600 oz-in (18.6 Nm) (continuous)

Electrical Specifications

Input Power

Processor Power
V+ Processor: +12 VDC to +48 VDC, regulated. Processor Power should have no larger than an 8A fuse to limit power.

Driver Power
V+ Driver: +12 VDC to +72 VDC. Device must be initialized for the actual operating voltage. Driver Power, Power Ground, Chassis Ground, Clamp+ and Clamp- are provided on a separate 5 pin 5W5 connector. Driver Power current is 20 Amps DC maximum for any input voltage. The Driver power should be fused with not more than a 25A slow blow fuse unless power supply current is limited to same or less.

The Driver Power is isolated from the processor power to minimize the influence of the high currents for the driver upon the input voltages.

The processor power and the driver power isolation
The processor power and driver power are galvanically isolated. The processor ground, the driver ground, and the chassis ground should be connected at the power supply, with the negative side of the power supply strapped to chassis ground at that point, for best noise characteristics.

Built-in Clamps
Two stages of Clamp circuits are built into the system. The primary clamp allows the clamp resistor to be mounted external to the system for easy heat elimination. This provides for very large inertias and for systems that are back driven. The secondary clamp provides up to 50W average clamping, and comes on at a slightly higher voltage than the primary clamp, actuating only if the primary clamp is not sufficient or is not connected (or opens). The secondary clamp includes over temperature monitoring to shut down the motor if the internal resistors are dissipating excessive energy. Connecting the V+ Clamp and the +VP signals together will bypass the internal clamp, allowing regenerated power to be used to recharge batteries, for example. Care must be taken to prevent overvoltage.

Output Power

Output/Driver Current
20 Amps continuous per phase, 25A Peak.

Maximum Output Power
800 Watts continuous power at nominal 25C ambient, 48V. May be derated at higher temperatures according to air flow.

Inputs & Outputs

Digital Inputs

0 to +3.3 VDC. LVTTL level compatible. All inputs have a light pull-up (~100k ohm to 3.3v). All I/O have an optional programmable pull-up/pull-down of 2.2 k ohm; the source to these resistors may also be floated if no pull-up or pull-down is needed. The seven IO are protected to +/- 40v.

5v output
Rated to 100mA. Do not back drive. Do not short out.

Digital Output Voltage
0 / +3.3 VDC.

Digital Output Current
Sinking or Sourcing: 2mA

Analog Inputs
All 7 I/O may be used as Analog Inputs: 0 to +3.3 VDC input signal range.
IO7 has a secondary circuit to handle 0 to +10v input signal range; the input protection will isolate the normal 3.3 v input channel allowing the 0 to 10v operation.
Resolution: 12 bits (before filtering)
Analog signals are read every servo cycle (120 µsec.) and the converted analog data is processed through a (default) 5 ms filter to reduce noise & transients.

Drive Enable Input
This hardware drive enable input must be connected to +10 VDC to +48 VDC for the drive electronics to be enabled. The Drive enable voltage is measured with respect to the processor power ground, not the driver power ground.

Communications

Serial Interface
RS-485 multi-drop, Reduced unit load accommodates up to 255 nodes.
Protected up to +/- 70v.

Note: RS-485 requires a nominal 120 ohm ½ W termination resistor at each end of the network for longer runs. This termination is not provided onboard and must be provided by the user.

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

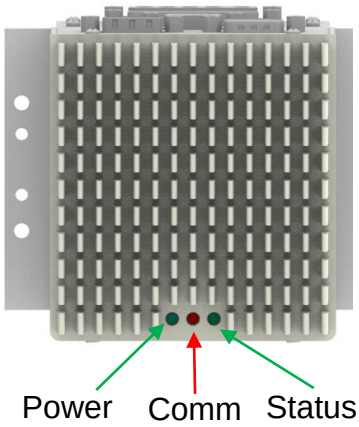
The CAN bus connection is not isolated, but does include transceivers which have an extended +/- 70v fault protection range. The CANopen® communications protocol allows the unit to function as a master, slave, or peer on a CANopen network. See the CANopen User Manual for details on the CANopen protocol. This protocol operates simultaneously and independently from the standard serial protocols. Designed to operate up to 1Mbit/sec.

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 operation, this termination is **not** optional.

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

STATUS LIGHTS

Three status lights are provided on the back of the SilverMax. The Comm LED (normally Red) 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 Status light (normally Green) 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). The Driver power present LED is normally Green; It becomes amber if driver is disabled (either by hardware or by software).



Environmental Specifications

Operational Temperature
-40 C to +70 C. Continuous torque curves taken at 20C; derating may be needed at higher temperatures. 100% torque requires motor affixed to thermally conductive structure, and may need air flow. Must be verified in final application.

Storage Temperature
- 40 C to +85 C

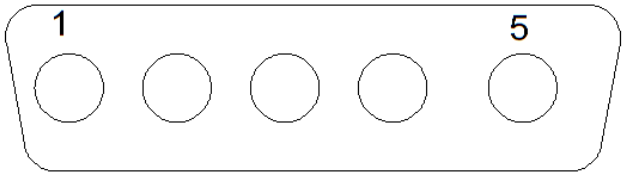
Humidity
Continuous specification is 95% RH non-condensing.

Shock
Limitation is approximately 50g/11ms.

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

Connector Data

Drive Power Connector

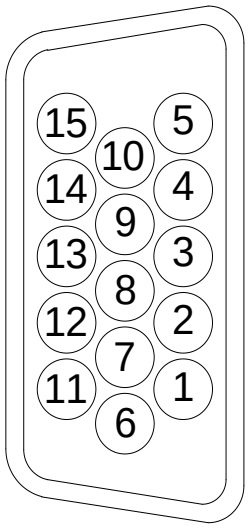


Pin	Signal	Wire color for QCI-EC-P10	
1	V+ Clamp	Yellow	External Clamp resistor (according to need)
2	V+ Driver	Red	Normal V+ connection
3	V- Clamp	Orange	External Clamp resistor (according to need)
4	V- Driver	Black	Normal V- Connection
5	Chassis Gnd	Drain1,2	

This connector is a 5W5 plug (pins). The power may be connected via the QCI-EC-P10 cable. The above colors correspond to this cable. A user supplied 5W5 socket may also be used. Current should be limited as describe in input power. The V- Driver and the Chassis Gnd should generally be connected together with the system chassis at the power supply for minimum noise in the system.

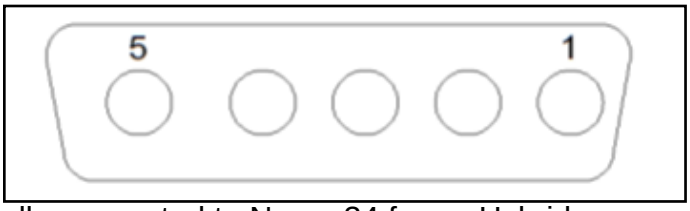
Encoder Interface

The Encoder Interface Connector is a DB15HD (socket) connector that carries the encoder feedback signals. P2 connects to a QuickSilver NEMA 34 frame I-Grade Motor/Encoder via a Motor Interface Cable (QCI-C-D15P-D15S-nn , nn=length).
This interface is 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. The encoder interface connector is also used to connect open collector hall sensor inputs for use with 3 phase brushless motors (internal pull-ups to 5v are provided).



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

Motor Drive Interface

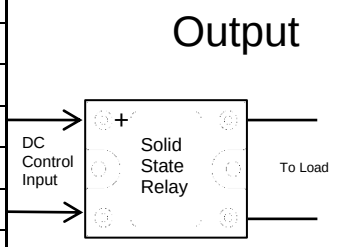


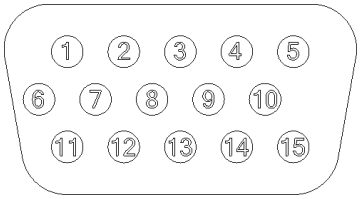
Pin 1: Phase A+
Pin 2: Phase A-
Pin 3: Phase B+
Pin 4: Phase B-
Pin 5: Chassis Ground/Shield
This connector is a 5W5 socket. It is normally connected to Nema 34 frame Hybrid-servo motors using a Motor Power Cable (QCD-C-D5P-D5S-nn, nn=length in feet)

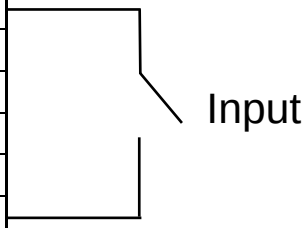
SilverLode Multi-Function Interface (SMI) Port

The SMI port is a DB15HD (pin) connector providing access to processor power input,I/O and serial communications. An SMI cable (QCI-C-EC-SMI-nn, nn=length) can be used to interface with Basic Breakout (QCI-BO-B4) or with Optical I/O Module, QCI-OPTMC-24.

P1	
Pin	Signal
1	Drive Enable
2	RS-485 A
3	+5v Out
4	I/O #3
5	I/O #6
6	Power Ground
7	V+
8	Logic Ground
9	I/O #2
10	I/O #5
11	Power Ground
12	RS-485 B
13	I/O #1
14	I/O #4
15	I/O #7



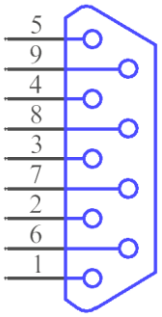




CAN interface

The CAN bus connection is not isolated, but does include transceivers which have an extended +/- 70v fault protection range.

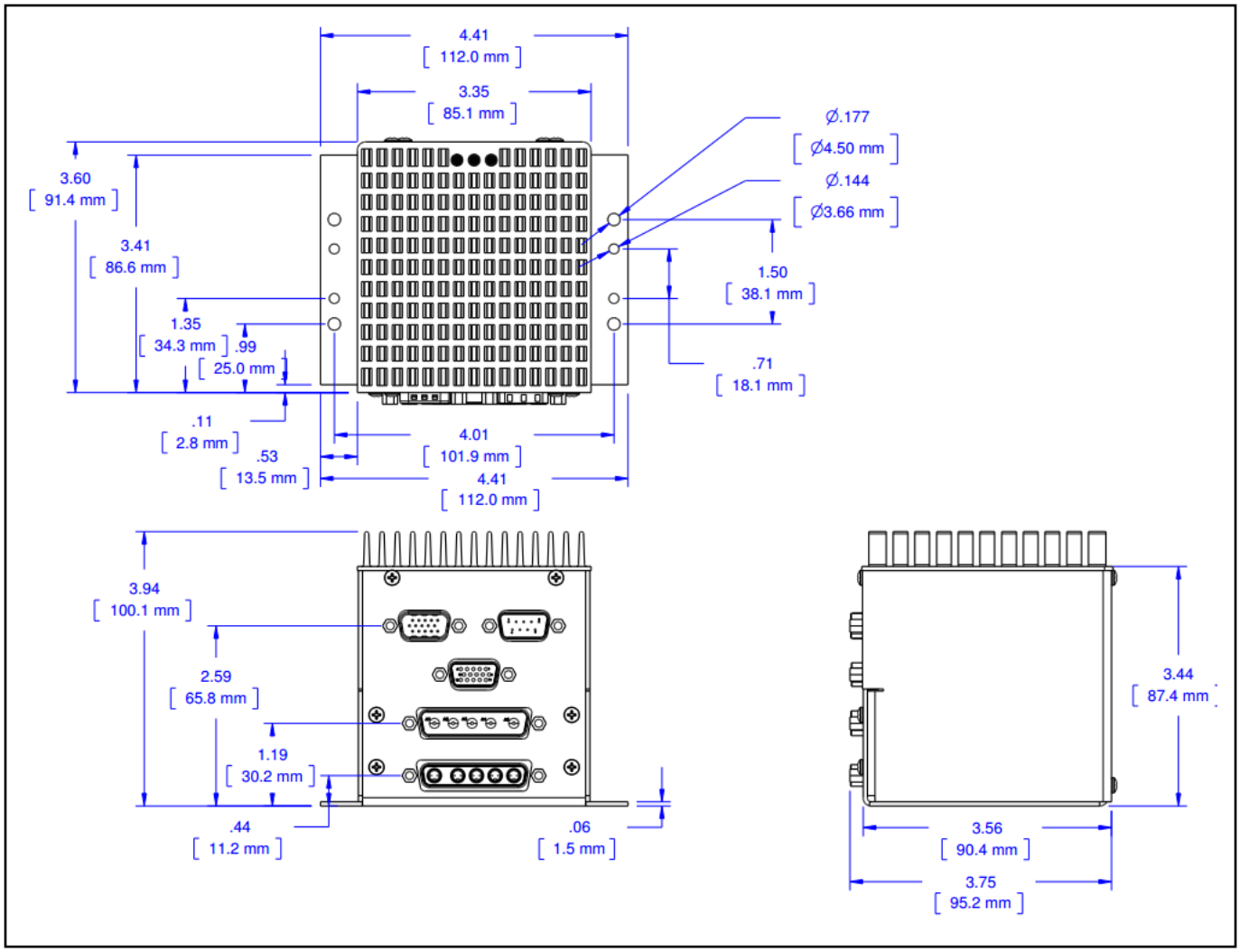
Note that a 120 ohm ½ W termination resistor is required at each end of the CAN network (only two per system). This termination is not provided onboard the controller and must be provided by the user. For the CAN bus operation, this termination is **not** optional.



Pin 2 = CAN-L
Pin 3 = GND
Pin 6 = GND
Pin 7 = CAN-H

The CANopen connections are made via a 9 pin male DSub connector.

Mechanical Dimensions



Recommended Components

SilverNugget IX Start-Up Materials

For first time users, QCI recommends purchasing the following items to aid with use of the SilverNugget N3 X-series servo controller/driver:

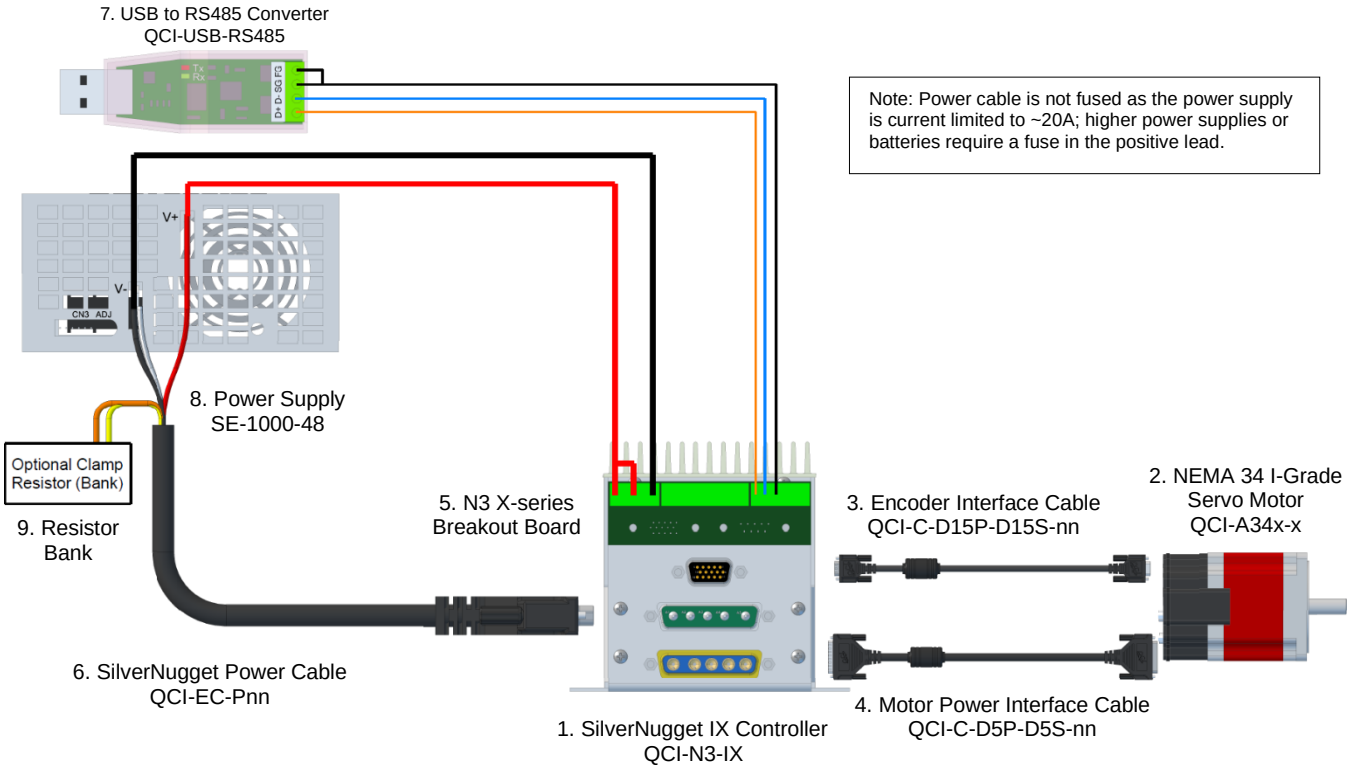
- SilverNugget N3 X-series Breakout Board (QCI-BO-X3)
- USB to RS485 converter (QCI-USB-RS485)
- Desired QCI NEMA 34 I-Grade Servo Motor
- 10’ Power cable (QCI-EC-P10)
- 10’ Motor Encoder Cable (QCI-D15P-D15S-10)
- 10’ Motor Drive Cable (QCI-D5P-D5S)

Optionally:
1000W, +48V Power Supply (SE-1000-48)

- Power Supply Cord w/ Flying Leads (QCI-C-ACP-FLY-6)
- 50W Clamp Resistors (QCI-R4-50) (may need multiple in series/parallel for needed dissipation – contact Support for more details)

Configuration Software: QuickControl™ is free and available from our website.

Typical System Setup



1. Controller/Driver - (QCI-N3-IX)

SilverNugget N3-IX is our standard closed frame controller with digital driver and integral clamp designed to servo QCI’s larger I-Grade motors through two interface cables.

2. NEMA 34 I-Grade Servo Motor
The SilverNugget N3-IX is capable of driving high power NEMA 34 I-Grade motor/encoder. See the following datasheet for more information:

QCI-DS009_QCI-A34 - 34 Frame Motors.

3. Encoder Interface Cable (QCI-C-D15P-D15S-nn)
Special twisted shielded cable to interface encoder feedback and access motor/encoder calibration stored in motor memory. 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 Power Interface Cable (QCI-C-D5P-D5s-nn)
For standard system, this D-sub type cable goes between the motor and the controller. The generic part number is QCI-C-D5P-D5S-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-D5P-T6Snn. Replace the last two digits “nn” with length of cable in feet (i.e. –10 for 10 feet).

5. SilverNugget N3 X-series Breakout (QCI-BO-X3)
The breakout board breaks out the SilverNugget N3’s processor power input, drive enable input, RS-485 communication lines, 7 LVTTL digital/analog I/Os, local +5v supply, and CAN bus onto pluggable terminal connector blocks.

6. SilverNugget N3 Input Power Cable (QCI-EC-P10)
This cable provides 4 power conductors for V+, V-, and clamp resistor, in addition to a chassis ground connection.

7. USB to RS485 Converter (QCI-USB-RS485)
USB-RS-485 converter provides a USB powered serial port with RS-485 signaling. See QCI-TD073 USB-RS485 Converter Setup Guide for information on network termination and shielding recommendations.

8. Power Supply
Power supply selection is motor dependent, but the following will work with all SilverNugget N3 X-series controllers.

SE-1000-48 (48V, 20A, 1000 Watt)
RSP-1000-48 (48V, 20A, 1000 Watt) – includes power factor correction.

7. External Regenerative Clamp Resistor Bank
Rapid deceleration of larger loads may require the use of the Primary Clamp circuit, requiring adding external power resistors between Clamp+ and Clamp-. Do not connect Clamp- to Clamp+ except through a clamp resistor of sufficient power rating. Resistance should be such that at operating voltage the resistor current will not exceed 20A when the clamp is active.

Changes from N3 E-series :
For users replacing SilverNugget E-series, see the N3 Product Change Notice for a full description of software and hardware changes.

Part Numbers

SilverNugget IX	
QCI-N3-IX	SilverNugget N3 X-Series I-Grade controller/driver for QCI NEMA 34 I-Grade Motor. A single firmware version handles varying encoder division (including none) and different encoder index styles; these are configured at initialization time. The single version firmware also handles ASCII, Modbus, 9Bit, DMX, CANopen.

Contact Information

QuickSilver Controls, Inc.
990 N Amelia Ave
San Dimas, CA 91773
+1 (909) 599-6291 or (888) 660-3801
+1 (909) 599-6289 FAX
www.QuickSilverControls.com