SilverNugget N2 I-Grade

The SilverNugget is a servo controller/driver for NEMA 17 & 23 frame microstep motors.

System Overview

Special Functions
- Electronic Gearing/Caming
- 100:1 Inertial Mismatch
- Anti-Hunt™: Eliminates servo dither.
- Multi-Tasking (Run Programs During Motions)
- Position & Velocity Using Analog Input
- Variable Torque Brake (Eliminates Slip Clutches)

Memory Size
- Program Buffer: 200 words
- Non-Volatile: 32K bytes Thousands of program lines and data storage.

Analog Inputs
- 4 Inputs (0 To +5 Volts)
- Continuous And Single Readings
- Can Be Used For Motion Control

Digital I/O
- 7 I/O Lines (All TTL Level)
- I/O Can Be Programmed For Input Or Output

Servo Cycle Rate
- 120 microseconds = 8.33 kHz

Maximum Rotational Speed
- 4000 RPM

General Commands
- Conditional Jumps
- Wait On Inputs
- Delay Timer
- Program Call And Return
- Math Functions: Add, Sub, Mult, Div
- Logic Functions: AND, OR, XOR
- Storing And Loading User Data
- Load And Run Other Programs

Motion Commands
- Move Relative And Absolute
- Linear & S-Curve Acceleration & Deceleration
- Velocity Mode
- Torque Mode
- Step And Direction Input
- Complex Profiles (Change Position, Velocity, Acceleration Or Deceleration On The Fly)

Initialization Commands
- RS-232 Or RS-485
- Serial Baud Rate
- Address Number For Network Operation
- All Digital I/O As Inputs or Outputs
- Servo Control Constants
- Torque Limits
- Motor Shutdown Conditions & Recovery
- Input Voltage
- Over Voltage & Under Voltage Detection
- Over Temperature
- Error Limits
- End of Travel Limits
- Multi-Tasking Enable/Disable
- Driver Enable/Disable

Read Status & Info Commands
- Errors Conditions
- Internal Conditions
- I/O States
- Data Registers
- Position, Velocity, Target Etc.

Electrical Specifications

Input Power

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

Over-Voltage Protection
None available. Voltages exceeding +55 VDC will permanently damage the controller/driver electronics. Supply inputs may require active voltage clamping for aggressive braking/deceleration motions or applications with high inertial loads. See the Voltage Clamp Module technical document, (QCI-TD017), for more information on the voltage clamp.

Reverse Polarity Protection
None available. Connecting supply voltage in reverse can damage controller and the driver circuitry. However, limiting the supply current externally, to 5 Amps or less, will greatly minimize the chance of hardware failure.

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

Output Power

Output/Driver Current
3.5 Amps continuous per phase *; 4.5 Amps peak per phase *.
* With Adequate Heat Sink.

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

Encoder Interface

Primary Encoder Resolutions
2000 Lines = 8000   counts/revolution
Designed to work exclusively with QCI's I-Grade motor/encoders.

Inputs & Outputs

Digital Inputs
0 or +5 VDC. TTL level only. Active low (sinking).
Inputs 1, 2 and, 3 have internal 4.7K ohm pull-up resistors to the +5 V.
Inputs 4, 5, 6, and 7 have an effective internal 200K ohm impedance to +5 V.

Digital Output Voltage
0 or +5 VDC. TTL level only

Digital Output Current
Sinking or Sourcing
All 7 I/Os 5 mA MAX

I/O Over-Voltage Protection
Each I/O line is double protected with parallel MOV clamping devices followed by series over-voltage limiting.

External (Secondary) Encoder Maximum Bandwidth
1 million counts per second

Analog Inputs
0 to +5.0 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 +5 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.

Communications

Hardware Interfaces
RS-232, RS-232 multi-drop, or RS-485 multi-drop (software selectable).

Protocols: 8-bit ASCII, 9-bit binary, or Modbus®

Communication Line Protection
Each line have MOV clamping devices for protection.

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
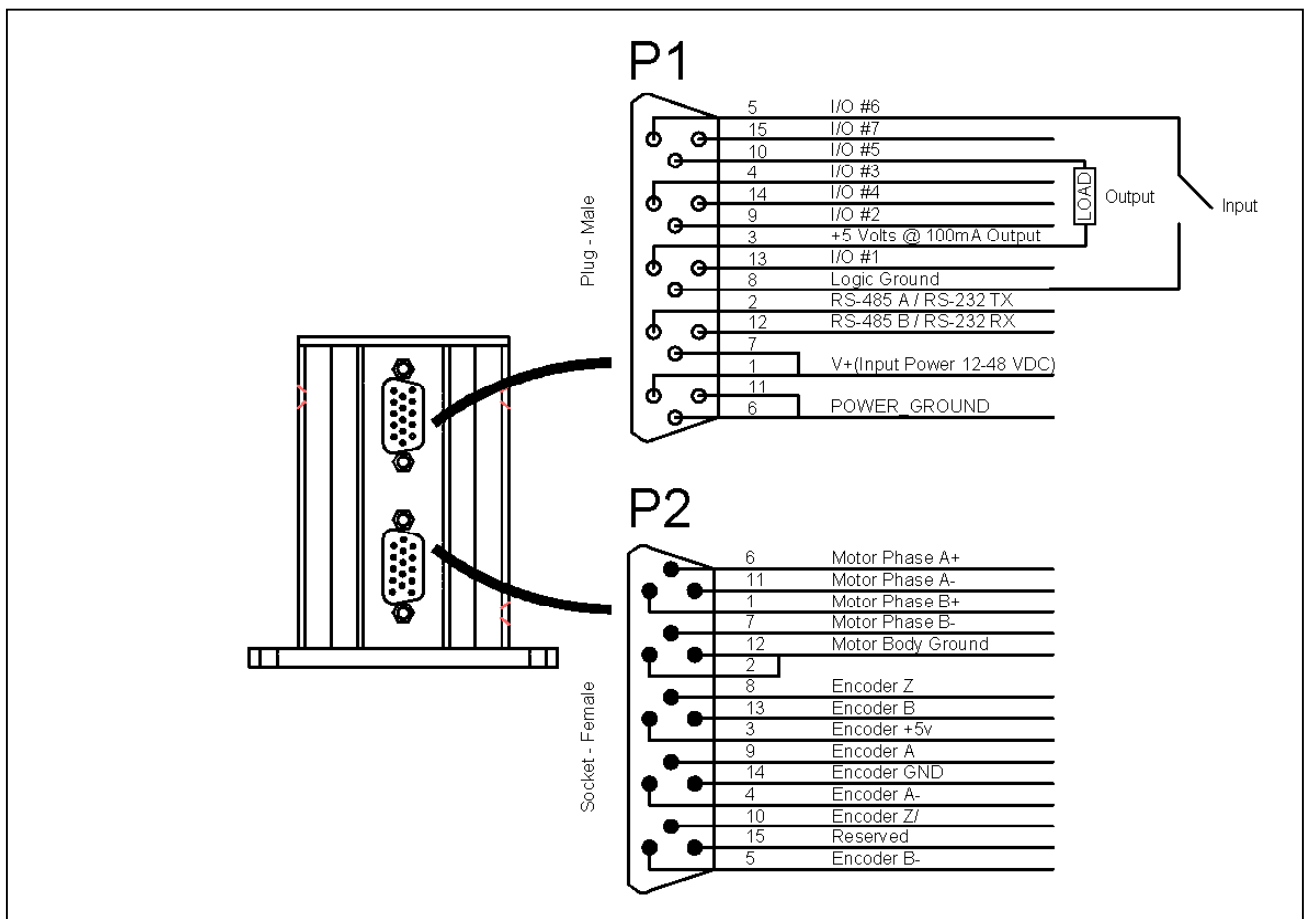
QuickSilver Controls, Inc.

Connector Data

SilverLode Multi-Function Interface (SMI) Port (P1)
The SMI port is a DB15HD (pin) connector containing input power, I/O and communications. Any QCI breakout with an SMI port can be connected to this port via an SMI cable (QCI-EC-SMI-nn). Alternately, the Basic Breakout (QCI-BO-B) attaches directly to the SMI port (no cable).

Motor Interface Connector (P2)
The Motor Interface Connector is a DB15HD (socket) connector that carries the motor driver signals and the encoder feedback signals. P2 connects to a QuickSilver NEMA 17 or 23 frame QuickSilver's I-Grade Motor/Encoder via a Motor Interface Cable (QCI-C-D15P-D15S-nn, nn=length).
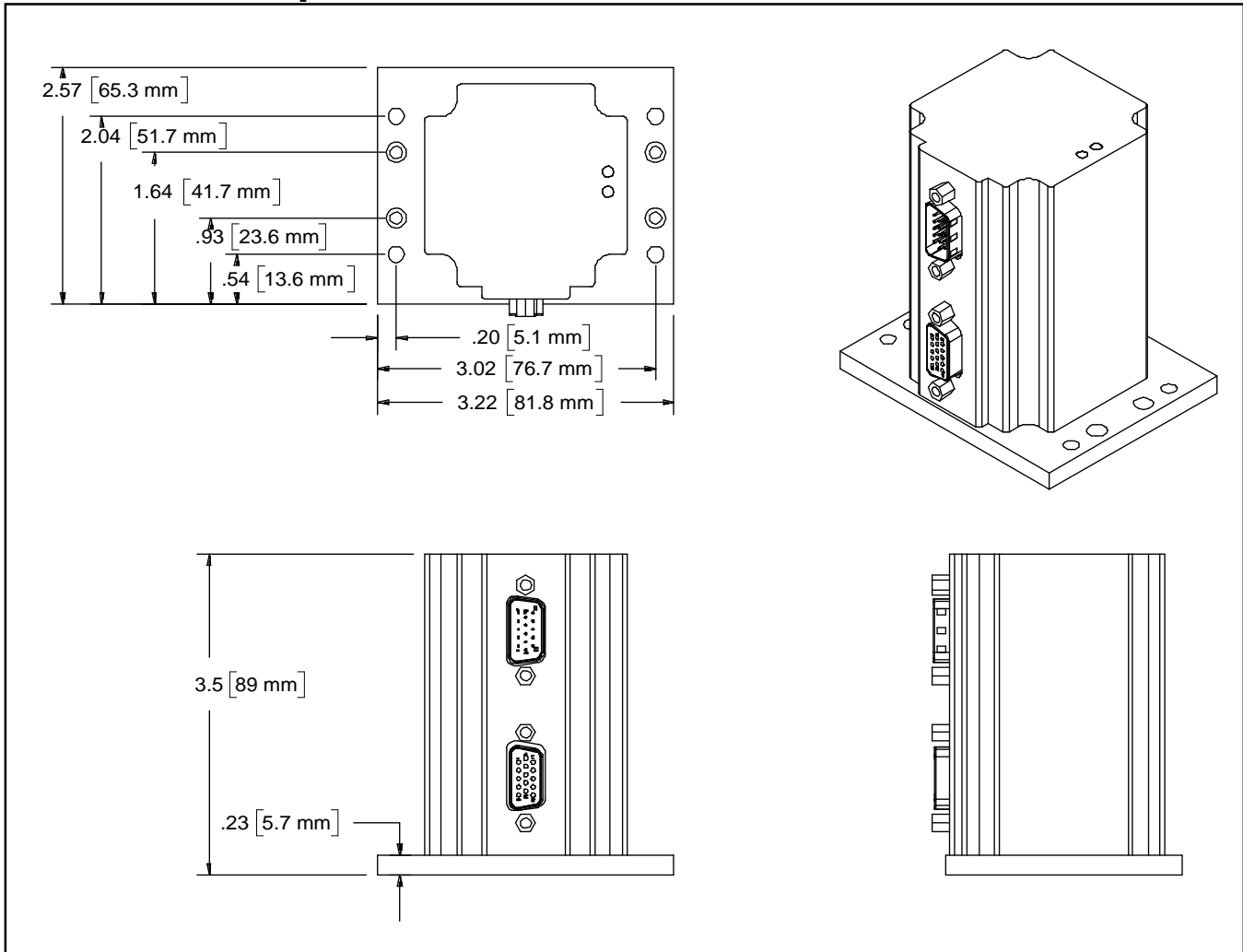

P1 (Plug - Male)

Pin	Signal
5	I/O #6
15	I/O #7
10	I/O #5
4	I/O #3
14	I/O #4
9	I/O #2
3	+5 Volts @ 100mA Output
13	I/O #1
8	Logic Ground
2	RS-485 A / RS-232 TX
12	RS-485 B / RS-232 RX
7	
1	V+(Input Power 12-48 VDC)
11	
6	POWER_GROUND

P2 (Socket - Female)

Pin	Signal
6	Motor Phase A+
11	Motor Phase A-
1	Motor Phase B+
7	Motor Phase B-
12	Motor Body Ground
2	
8	Encoder Z
13	Encoder B
3	Encoder +5v
9	Encoder A
14	Encoder GND
4	Encoder A-
10	Encoder Z/
15	Reserved
5	Encoder B-

P1 Signal Comments:
- +V Input Power and Power Ground lines 1, 7, 6, and 11 are not reverse bias protected.
- I/O lines 1, 2, and 3 each has a 4.7k Ohm pull-up resistor connected to the internal +5 VDC 100mA power supply.
- I/O lines 4 thru 7 each have a 200k-Ohm effective pull-up impedance to the internal +5 VDC power supply.
- All Grounds are tied common to the case.

P2 Signal Comments:
- All motor phase signals are 12-48 volts depending on voltage supply inputs.
- All encoder related signals are TTL levels.

Mechanical Specifications

2.57 [65.3 mm]

2.04 [51.7 mm]

1.64 [41.7 mm]

.93 [23.6 mm]

.54 [13.6 mm]

.20 [5.1 mm]

3.02 [76.7 mm]

3.22 [81.8 mm]

3.5 [89 mm]

.23 [5.7 mm]

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
IP50 with cables attached.
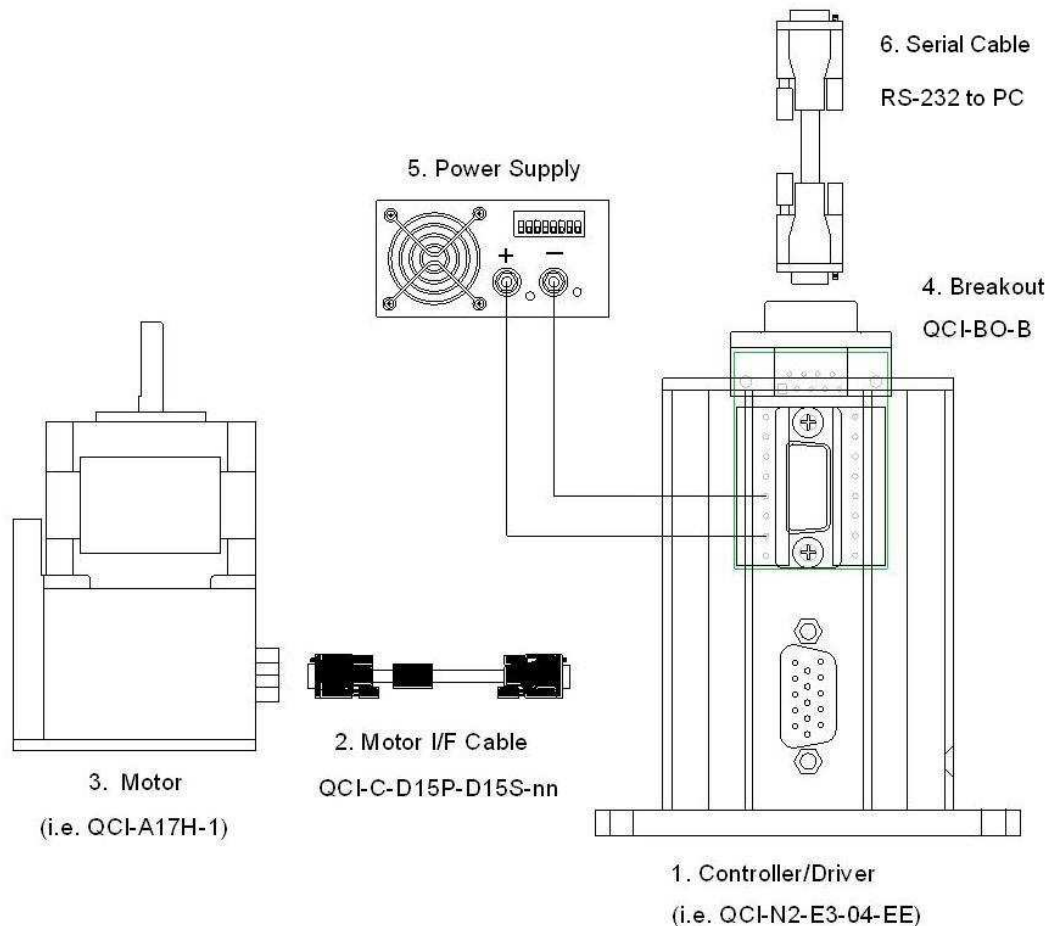
Recommended Components

Start-Up Kit
For first time users, QCI recommends purchasing the QCI-SKB-N2 Start-Up Kit which includes:

- SilverNugget N2 (QCI-N2-E3-04-EE) & Datasheet (QCI-DS005)
- QuickControl Software CD (QCI-QC)
- User Manual & Command Reference (QCI-SLM)
- Basic Breakout Module (QCI-BO-B) & Tech Doc (QCI-TD036)
- Communication Cable (QCI-C-D9M9F-6)
- 4' DB15HD Motor I/F Cable (QCI-C-D15P-D15S-4)
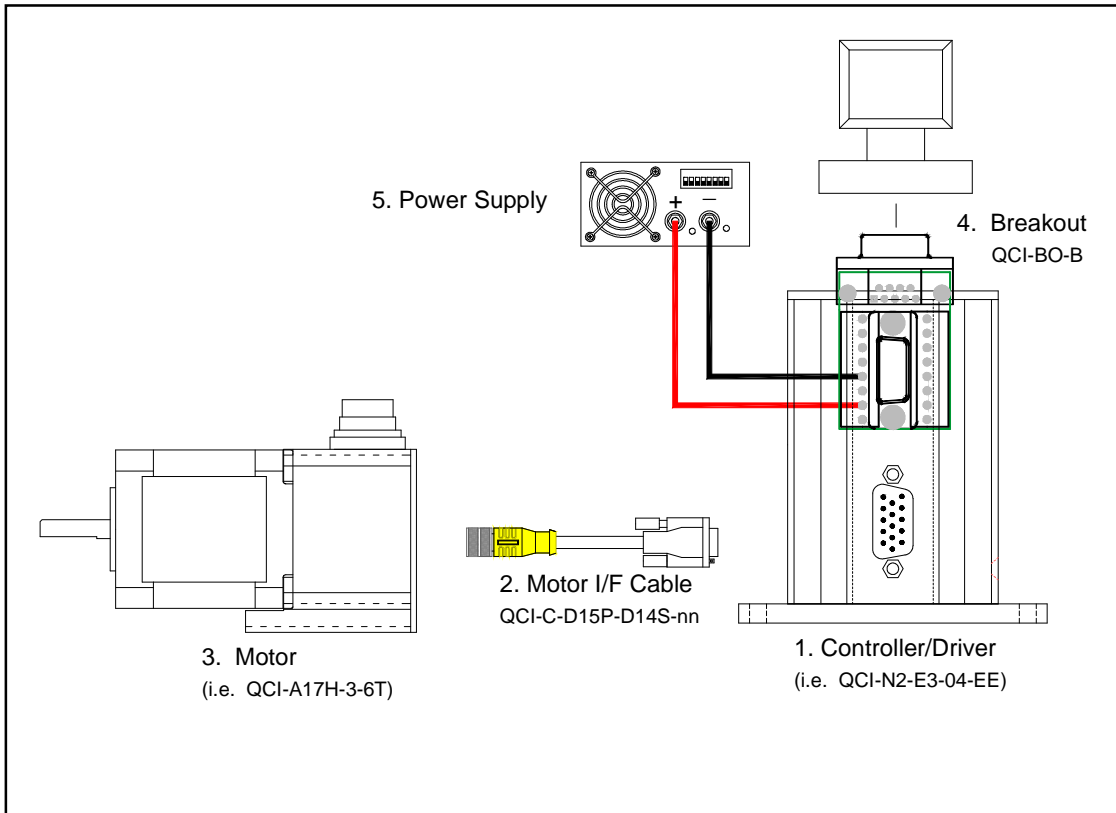- Start-Up Kit Setup Instructions (QCI-TD042)

With this Start-Up kit, a power supply, and a motor/encoder, you will have everything you need to get started. See technical document QCI-TD042 on our website for details.

The Standard System detailed below uses the QCI-SKB-N2.

Typical System Setup:

6. Serial Cable
RS-232 to PC

5. Power Supply

4. Breakout
QCI-BO-B

2. Motor I/F Cable
QCI-C-D15P-D15S-nn

3. Motor
(i.e. QCI-A17H-1)

1. Controller/Driver
(i.e. QCI-N2-E3-04-EE)

IP65 System

5. Power Supply

4. Breakout
QCI-BO-B

2. Motor I/F Cable
QCI-C-D15P-D14S-nn

3. Motor
(i.e. QCI-A17H-3-6T)

1. Controller/Driver
(i.e. QCI-N2-E3-04-EE)

1. Controller/Driver
The standard controller driver is QCI-N2-E3-04-EE. All other options are application dependent.

2. Motor I/F Cable
For standard system, 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, 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 SilverNugget N2 is capable of driving any A 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. Basic Breakout (QCI-BO-B or QCI-BO-B52)
QCI recommends purchasing a breakout to simplify wiring power, communications and I/O. QuickSilver offers several breakouts (see our website), but the simplest is our Basic Breakout (QCI-BO-B). To convert the 7 TTL I/O to 5 24V isolated inputs and 2 open collector outputs, select the QCI-BO-B52.

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

S-210-48 (48V, 4.4A, 210 Watt)

Other Recommendations

SilverLode User Manual & Command Reference (QCI-SLM)
For beginning and brand new users, please see chapter 1 User Manual for getting started instructions. The SilverLode user manual is in a textbook format. It begins with the fundamentals of use and progresses into advanced topics that are application oriented. Any new user can follow the material in a natural progression of product usage. In addition, there are exercises throughout the text that provide users a hands-on approach toward understanding the topics better. The manual is thorough, but not exhaustive. Users that explore this material fully and complete the exercises should gain the ability to operate, program, and prototype any SilverLode servo system into working applications.

Both the user manual and command reference are available for download on our website. QuickSilver also sell hard copies of the SilverLode User Manual & Command Reference set under part number QCI-SLM**.**

Clamp Module (optional)
Some rapid acceleration and deceleration applications may require a clamp module. See technical document QCI-TD017 on our website for more details.

QuickControl Software
QuickControl® allows developers to quickly program and operate all SilverLode family of products using a standard PC running Windows (9x, Me, NT, 2K, or XP). Communication to the SilverLode controller/driver products is accomplished from the PC's serial port (i.e. COM1 or COM2). QuickControl also provides tools for uploading and downloading programs and user data. Data can be typed in manually or import from text files. Documentation features include remarks, line labels, namable registers and I/Os.

Part Numbers

SilverNugget™ N2 I-Grade Controller/Drivers			
DRIVER	**CONTROLLER**	**OPTION**	**MOTOR INTERFACE**
QCI-N2 - 3.5 Amps • For 23 Frame and Smaller • 3.5 Amps per Phase Continuous * • 4.5 Amps Peak * Depending on heat sink (25C ambient).	**E3**– Standard • 8 bit ASCII or 9 bit binary protocols **E7** - Driver Enable **M3, M7** – Modbus® • Same as E3 or E7 except 9 bit binary protocol replaced with Modbus® protocol **F2** – Same as E3 except incoming encoder is divided by 2 to emulate a 4000CPR encoder **F7** – Save as F2 except with Driver Enable	**04** – I-Grade • SilverLode Multi-Function Interface (SMI) Port • DB15 (socket) I-Grade Interface for encoder signals.	**EE -** Standard I-Grade Interface for connection to I-Grade Motor / Encoders.
To create a part number, choose one from each column above.			
QCI-N2	**E3**	**04**	**EE**
This selection creates the part number: **QCI-N2-E3-04-EE**			

Contact Information

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