

SilverNugget N3 M-Grade

The SilverNugget is a servo controller/driver for NEMA 34 frame microstep motors.



SilverNugget NEMA 34 Frame Stepper Standalone Servo Controller and Driver Datasheet

Model Numbers: N3

Series: E1 and M1

All specifications listed in this datasheet are believed to be free of errors. They are subject to change without notice.

The SilverNugget is a highly compact motion controller and amplifier for driving high pole count micro step NEMA 34 frame motors. With the addition of a high-resolution encoder and a bipolar micro step motor, the SilverNugget provides a high performance rotary positioning system. The SilverNugget has two integrated cables for interfacing with the primary encoder as well as the micro step motor. Once connected, the QuickControl software will guide a user through the SilverNugget encoder alignment and configuration process.

SilverNugget is specifically designed to drive 100 poles, 1.8° degree step motors. To best utilize the capabilities of the SilverNugget, select a motor that has been optimized for micro stepping.

SilverNugget Series Descriptions

E1 - Series includes the following:

- 7 I/O lines, input/output programmable
Lines 4-7 will setup as 0-5 VDC analog inputs
- Selectable RS-232/RS-485 communications
- 8 bit ASCII or 9 bit binary protocols
- 32K byte internal nonvolatile memory
- 400 byte program execution buffer
- Differential Encoder configuration

M1 – Modbus® (no additional cost)

- Same as E1 except 9 bit binary protocol replaced with Modbus® protocol

Wiring and Cable Specifications

Encoder Feedback Connection: 8-Wire Encoder Cable

Designation	Wire Color	Wire Gauge
Encoder +5V	Red	26 AWG
Encoder Gnd	Black	26 AWG
Encoder A+	White	26 AWG
Encoder A-	Yellow	26 AWG
Encoder B+	Green	26 AWG
Encoder B-	Blue	26 AWG
Z+ (index +)	Orange	26 AWG
Z- (index -)	Brown	26 AWG

- For a back mounted encoder, the encoder's A Channel should lead B Channel when the front motor shaft rotates clockwise.

Encoder Cable Specifications

Nominal Cable Diameter =	0.25 inches
Minimum Bend Radius =	1.8 inches
Each Wire Pair Has A Shield	
Shields Connected To SilverNugget Case	

Driver Winding Signals: 4-Wire Motor Cable

Designation	Wire Color	Wire Gauge
Winding A+	Red	14 AWG
Winding A-	Yellow	14 AWG
Winding B+	Black	14 AWG
Winding B-	Orange	14 AWG
Drain †	Bare Wire	2x16 AWG ‡

Motor Cable Specifications

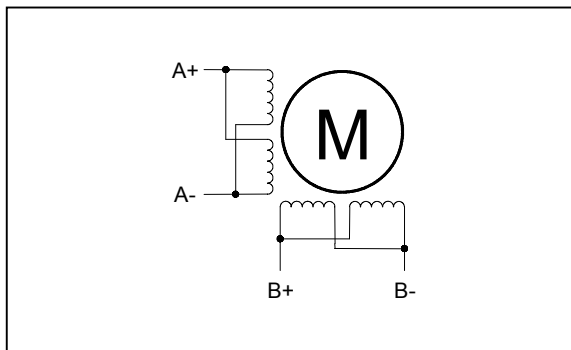
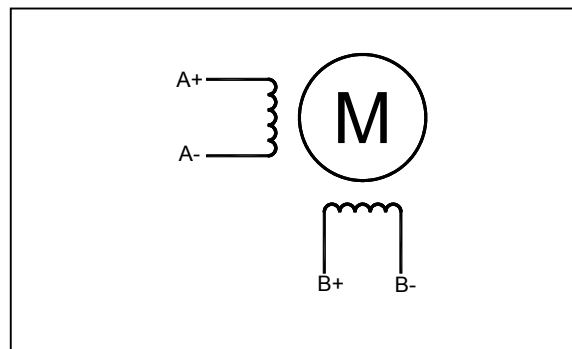
Nominal Cable Diameter =	0.4 inches
Minimum Bend Radius =	2.8 inches
Wire Pairs Are Not Shielded	
Each Wire Pair Wrapped with 16 AWG Drain Wire	

† The Drain is connected to the SilverNugget case. QCI recommends connecting the Drain to the motor chassis.

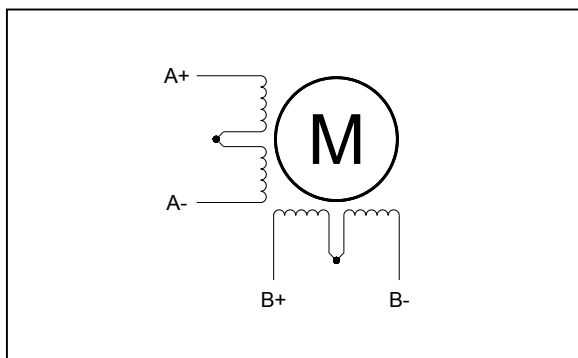
‡ The Drain is composed of two 16 AWG wires in parallel.

Stepper Motor Wiring Configuration

Ideally, the SilverNugget will be interfaced with a four wire bipolar motor. Then the SilverNugget four wire motor cable will match up with the leads from the micro-step motor. Although, the SilverNugget will work with motors that have more than 4 wires.



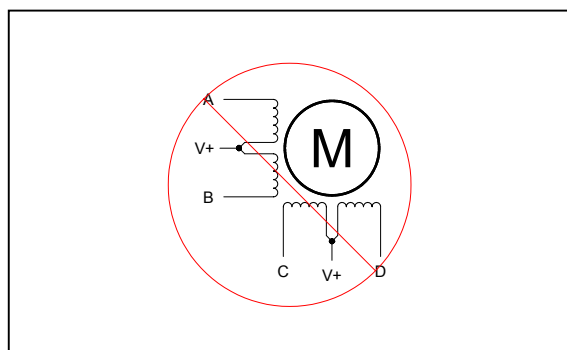
8 Wire Parallel Wiring Bipolar



8 Wire Series Wiring Bipolar Configuration

Some bipolar micro step motors are manufactured with 8 wires. Typically, an eight wire motor is wired in a parallel configuration for use with the SilverNugget. However, a series wiring configuration is acceptable. Either configuration is perfectly legitimate to obtain the best motor characteristics and achieve optimum performance.

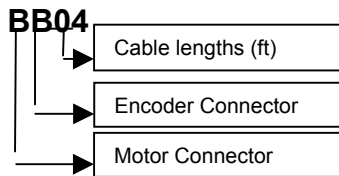
Unipolar motors are not compatible with the SilverNugget.



Unipolar Configuration

SilverNugget Cable Connector Options

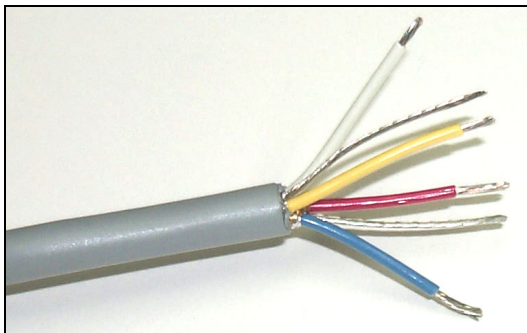
SilverNugget Part Number Cabling Interface Designation:



The first letter specifies the type of connector placed on the end of the motor cable. The second letter specifies the type of connector placed on the end of the encoder cable. Options for the motor and encoder cable are interchangeable. For example, ordering a SilverNugget, with the ABxx option, would mean the motor cable has flying leads and the encoder cable has a Molex connector.

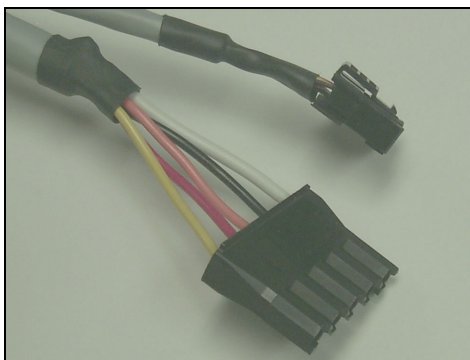
Cable lengths are available from 1 foot to 25 feet in one foot increments. For longer lengths, contact QCI Support.

A – Cable has flying leads.



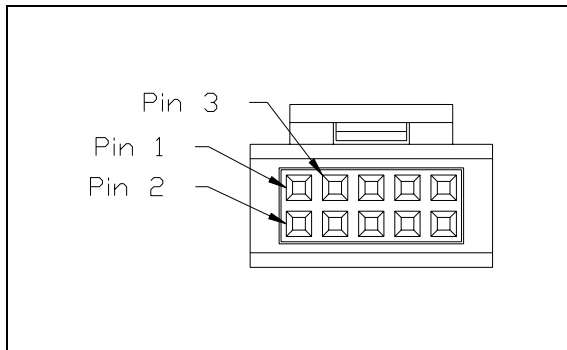
The AA option comes with flying leads on both the Motor and Encoder cables.

B – Molex Connector, with crimped pins, attached to end of cable.



The BB option (standard SilverNugget option) comes with a Molex connector on each cable.

B Option on Encoder Cable



Encoder Cable Connector Face View.

Encoder Cable Connector Pinout

Pin Number	Signal	Wire Color
1	Not Used	
2	Encoder Gnd	Black
3	Z- (Index -)	Brown
4	Z+ (Index +)	Orange
5	Encoder A-	Yellow
6	Encoder A+	White
7	Encoder +5V	Red
8	Not Used	
9	Encoder B-	Blue
10	Encoder B+	Green

- The B option for the encoder cable interfaces with a US Digital 10 pin, dual row differential encoder connector.

Encoder Cable Connector Part Numbers

Description	Molex Part #	Series	Total Used
Housing	15-04-5104	70013	1
Insert	22-55-2103	70450	1
Female Pins	16-02-0104	70058	8

Mating Connector Part Numbers

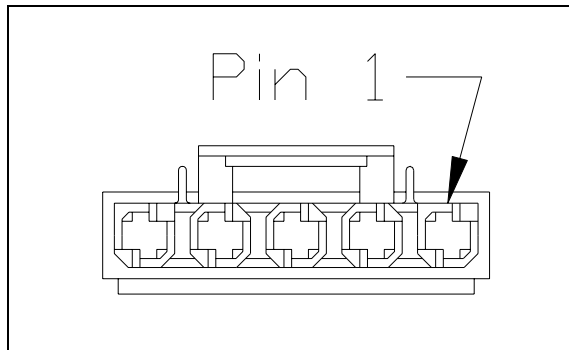
Description	Molex Part #	Series	Total Used
Housing	50-65-0010	70022	1
Insert	22-55-2103	70450	1
Male Pins	16-02-0117	70021	8

- The 70058 and 70021 series pins, with 26 AWG wire, are rated for 1.8 Amps each.

Recommended Crimping Tool

Description	Molex Part #
Crimper	11-01-0208

B Option on Motor Cable



Motor Cable Connector Face View.

Motor Cable Connector Pinout

Pin Number	Signal	Wire Color
1	Winding A-	Yellow
2	Winding A+	Red
3	Winding B-	Orange
4	Winding B+	Black
5	Chassis Gnd	White

- A short length (approx. 1 inch) of 16 AWG wire is soldered between the Drain and the Chassis Ground Pin on the SilverNugget B option motor connector.

Motor Cable Connector Part Numbers

Description	Molex Part #	Series	Total Used
Housing	44441-2005	44441	1
Female Pins	43375-1001	43375	5

Recommended Crimping Tool

Description	Molex Part #	Series
Crimper	63811-0500	63811

Mating Connector Part Numbers

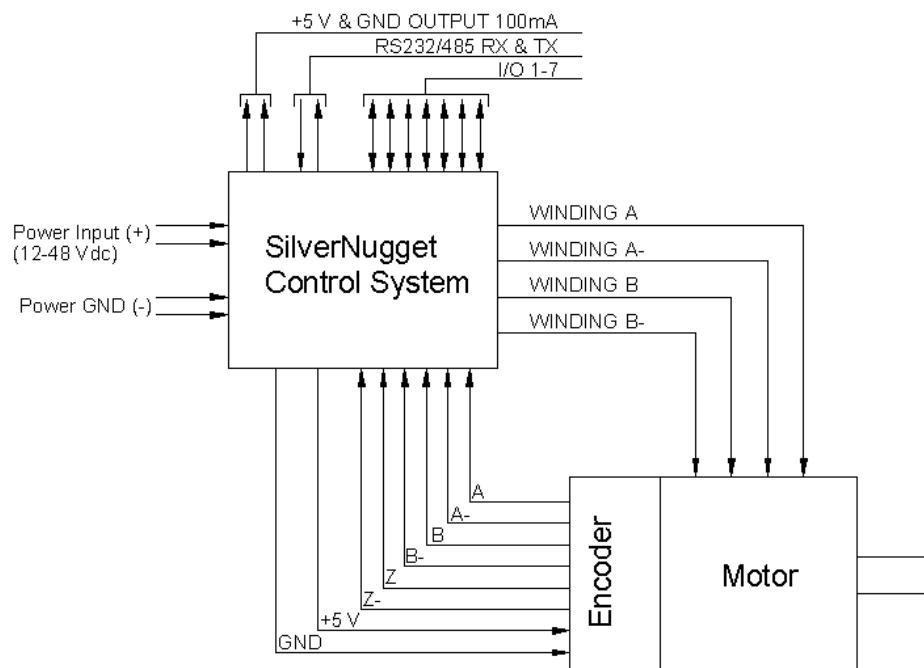
Description	Molex Part #	Series	Total Used
Housing	43680-2005	43680	1
Male Pins	43178-2002	43178	5

Recommended Crimping Tool

Description	Molex Part #	Series
Crimper	63811-0700	63811

- The 43375 and 43178 series pins, with 14 AWG wire, are rated for 18 Amps each.

Typical Wiring Diagram:



N3 SilverNugget Connector Data

Standard N3 SilverNugget servo controller/drivers are designed with two main connectors, a DB-15 for controller signals and a DB-3 for input power. Both are used when operating N3 SilverNugget servo systems. These are non-IP65 rated.

DB-15 Connector

This connector is found on all SilverNugget controller/drivers. On the N3 SilverNugget, it provides access to I/O lines, serial communications, controller power & the drive enable signal. It connects to all SilverMax DB-15 (SMI) cables for easy connection to many QCI Accessory Products.

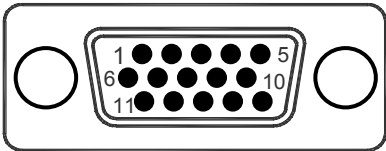
Technical Data (DB-15HD)

15-pin High Density D-subminiature, Plug (w/pins) type gender.

Crimp type contacts, Rated at 5 Amps per contact.

Max. wire gauge is 20 AWG, Shell size is a std. DB-9.

DB-15 Pin Layout
Front View on



Signal Comments:

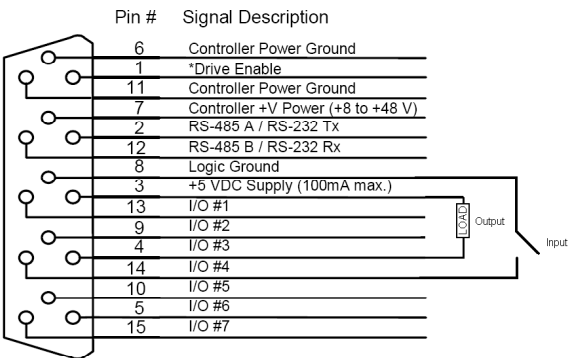
* Drive Enable operates from a DC voltage range of +10 to +48 to enable the servo drive. It is commonly connected to the +V driver power supply when not used independently.

Controller +V Power (pin 7) and both Controller Power Grounds (pins 6 & 11) must connect respectively to the +V and ground terminals of a +8 to +48 VDC supply.

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.

DB-15 Pin to Signal (N3 series)



DB-3 Connector

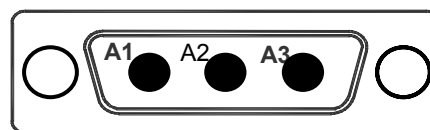
This high current connector is found on each N3 SilverNugget. It connects an external power source to the servo drive only. DB-3 power cables are offered by QCI, allowing easy connection to power sources.

Technical Details (DB-3W3)

3 contact D-subminiature, Socket (w/plugs) type gender.
Size 20 solder cup contacts, Max. wire guage is 12 AWG.

Rated at 20 Amps per contact, Shell size is std. DB-15.

DB-3 Plug Layout
Front View on SilverNugget



DB-3 Plug to Signal Assignments

Pin	Signal Description
A1	Chassis Ground †
A2	+V Power Input (+12 to 48 +VDC)
A3	Power Ground (Input) †

† N3 DB-3 Comments:

Power Ground (A3) & Chassis Ground (A1) are **not** internally shorted together.

+V Input Power and Power Ground are not reverse bias protected.

Electrical Specifications

Supply Power (Input)

Voltage: +12 VDC to +48 VDC, regulated.

Every SilverNugget must be initialized for the actual operating voltage.

Over-Voltage Protection: None available.

Voltages exceeding +55 VDC will permanently damage the controller/driver electronics. All N3 servo systems require active voltage clamping regardless of the deceleration profile. See the High Current Voltage Clamp technical document, QCI017TD, for information on the voltage clamp. For aggressive braking/deceleration motions or applications with high inertial loads, substantial power dissipation by the voltage clamp is required. Contact QuickSilver Controls for application specific recommendations.

Reverse Polarity Protection: Controller Input Power is reverse protected by a diode. None available for the Driver Input Power. Connecting supply voltage in reverse can damage the driver electronics. However, limiting the supply current externally, to 20 Amps or less, will greatly minimize the chance of hardware failure.

Input Current: 20 Amps maximum for any input voltage, +12 VDC to +48 VDC.

Digital Inputs & Outputs

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.

Outputs: 0 or +5 VDC. TTL level only. ± 5 milliamps (sinking or sourcing).

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

External Encoder Inputs

Maximum Bandwidth: 1 million counts per second from a secondary encoder.

Analog Inputs

0 to +5 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 usec.) and the converted analog data is processed through a 5 ms filter to reduce noise & transients.

Communications

Serial 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 is protected with MOV clamping devices.

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

Servo Control Specifications

Encoding Resolution (Primary)

500 Lines = 2000 counts/revolution (minimum recommended resolution)

1000 Lines = 4000 counts/revolution

2000 Lines = 8000 counts/revolution

4000 Lines = 16000 counts/revolution

(Encoder resolutions up to 128,000 counts/revolution are possible, but untested.)

Primary Encoder Index or Z Channel

QCI highly recommends obtaining an encoder with an Index or Z channel for use with the SilverNugget. The index allows the SilverNugget to perform minor alignment corrections while in motion. While the SilverNugget will work without an index signal, complications can arise. For example, some encoder manufacturers use the same optical reader for encoders with and without an index. Therefore, the Z channel can potentially output a signal even though there isn't a true index. Contact QCI Support for further information on using an encoder without an index.

Maximum Rotational Speed

4000 Revolutions per Minute; limited in controller software.

Maximum Allowable Output/Driver Current

18 Amps continuous per phase *; 24 Amps peak per phase *.

* With Adequate Heat Sink.

Maximum Output Power

800 Watts continuous power with adequate heat dissipation.

Servo Cycle Rate

120 microseconds = 8.33 kHz

Software Torque Control

Signed 16 bit control: 1 part in 32767

Internal Memory

Serial Communications Buffer Size: 10 words (20 bytes)

Program Buffer Size: 200 words (400 bytes)

Non-Volatile Memory Size:

32K bytes (16K words): Standard on all N3 servos.

Environmental Specifications

Temperature Specifications

Operational: -10 C to +70 C

Storage: - 40 C to +85 C

Humidity

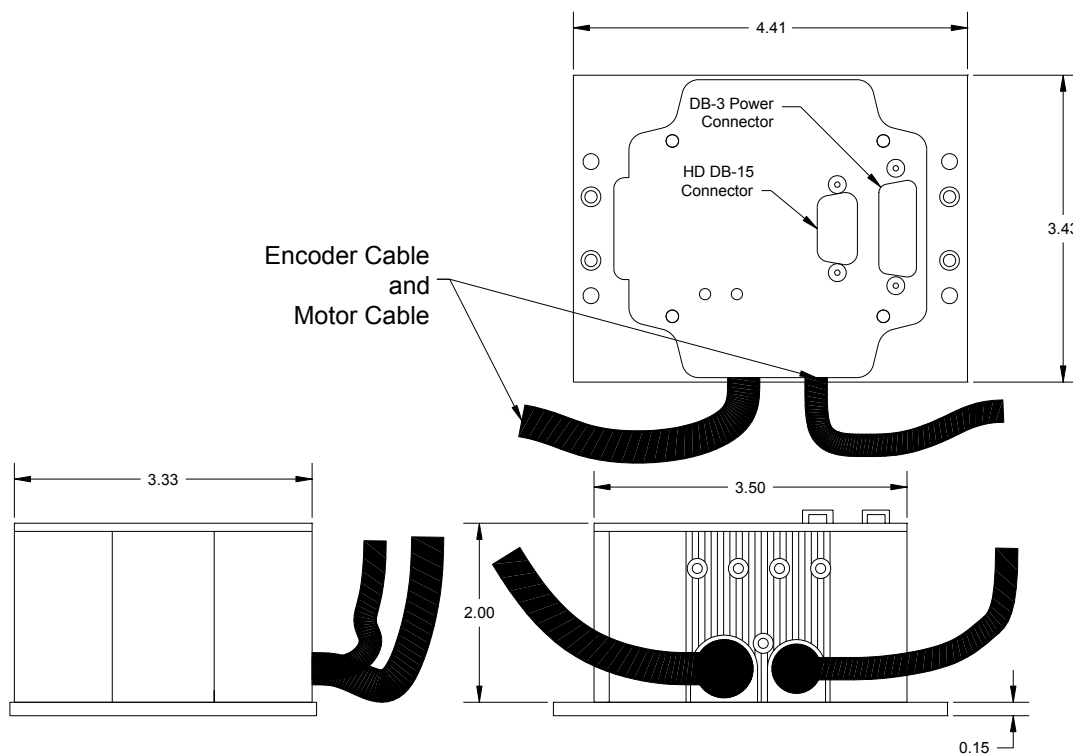
Continuous specification is 95% RH non-condensing.

Shock

Limitation is approximately 50g/11ms.

Mechanical Specifications

Mechanical Dimensions



Weight including Cables

1 pound, 9 ounces (approx.)