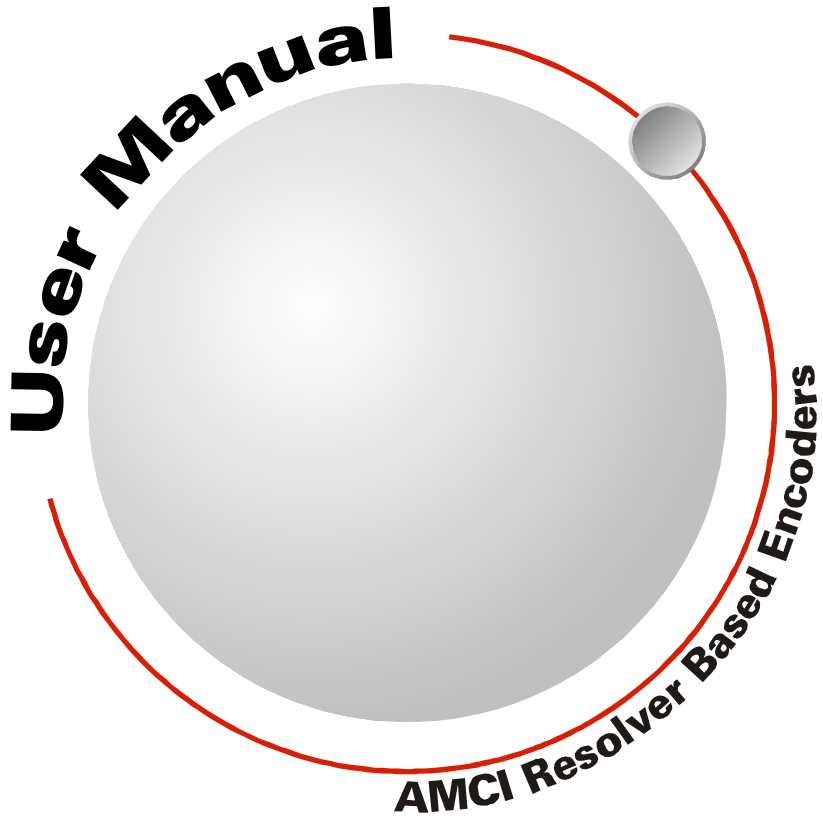
ADVANCED MICRO CONTROLS INC.

Manual #: 940-0D142

DC60
Multi-turn
Analog Output
DuraCoder



GENERAL INFORMATION

Important User Information

The products and application data described in this manual are useful in a wide variety of different applications. Therefore, the user and others responsible for applying these products described herein are responsible for determining the acceptability for each application. While efforts have been made to provide accurate information within this manual, AMCI assumes no responsibility for the application or the completeness of the information contained herein.

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All equipment being returned to AMCI for repair or replacement, regardless of warranty status, must have a Return Merchandise Authorization number issued by AMCI. Call (860) 585-1254 with the model number and serial number (if applicable) along with a description of the problem during regular business hours, Monday through Friday, 8AM - 5PM Eastern. An "RMA" number will be issued. Equipment must be shipped to AMCI with transportation charges prepaid. Title and risk of loss or damage remains with the customer until shipment is received by AMCI.

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24 Hour technical support is available on this product. If you have internet access, start at www.amci.com. Product documentation and FAQ’s are available on the site that answer most common questions.

If you require additional technical support, call (860) 583-1254. Your call will be answered by the factory during regular business hours, Monday through Friday, 8AM - 5PM Eastern. During non-business hours an automated system will ask you to enter the telephone number you can be reached at. Please remember to include your area code. The system will page an engineer on call. Please have your product model number and a description of the problem ready before you call.

Waste Electrical and Electronic Equipment (WEEE)

At the end of life, this equipment should be collected separately from any unsorted municipal waste.

Table of Contents

Notes

About this Manual

Read this chapter to learn how to navigate through this manual and familiarize yourself with the conventions used in it. The last section of this chapter highlights the manual's remaining chapters and their target audience.

Audience

This manual explains the installation and operation of AMCI's DC60 series of multi-turn resolver based encoders with analog outputs. It is written for the engineer responsible for incorporating the DC60 into a design as well as the engineer or technician responsible for its actual installation.

Applicable Units

This manual is applicable to all DC60 multi-turn encoders with analog outputs. All of these units offer sixteen bit position resolution and can be ordered to encode from 1 to 1,024 turns. Outputs include multiple voltage and current options.

Navigating this Manual

This manual is designed to be used in both printed and on-line forms. Its on-line form is a PDF document, which requires Adobe Acrobat Reader version 7.0+ to open it. You are allowed to select and copy sections for use in other documents. If you own Adobe Acrobat Reader version X+ or Adobe Acrobat version 7.0 +, you are allowed to add notes and annotations. If you decide to print out this manual, all sections contain an even number of pages which allows you to easily print out a single chapter on a duplex (two-sided) printer.

Manual Conventions

Three icons are used to highlight important information in the manual:

NOTES highlight important concepts, decisions you must make, or the implications of those decisions.

CAUTIONS tell you when equipment may be damaged if the procedure is not followed properly.

WARNINGS tell you when people may be hurt or equipment may be damaged if the procedure is not followed properly.

The following table shows the text formatting conventions:

Format	Description
Normal Font	Font used throughout this manual.
Emphasis Font	Font used for parameter names and the first time a new term is introduced.
Cross Reference	When viewing the PDF version of the manual, clicking on a blue cross reference jumps you to referenced section of the manual.
HTML Reference	When viewing the PDF version of the manual, clicking on a red cross reference opens your default web browser to the referenced section of the AMCI website if you have Internet access.

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Revision Record

This manual, 940-0D142 is the third release of this manual. It was first released on March 27th, 2019.

Revision History

940-0D142: 03/27/2019 Corrected servo mount outline drawings. Added several clarification notes.

940-0D141: 05/17/2016 Updated connector pinout, wiring diagram, power requirements, and the descriptions of the Status LED and Preset to Zero feature.

940-0D140: 11/13/2015 Initial Release

Manual Layout

You will most likely read this manual for one of two reasons:

- If you are curious about the DC60, this manual contains the information you need to determine if the DC60 is the right product for your application. Chapter 1, DC60 Specifications, was written for you. The chapter contains all of the information you will need to fully specify the DC60 product in your application.
- If you need to install and use the DC60, then the rest of the manual is written for you. To simplify installation and configuration, the rest of the manual is broken down into *tasks*. Using the DC60 requires you to complete two tasks, and the manual is broken down into sections that explain how to complete each one.

Chapter Title	Chapter Description	Starting Page
DC60 Specifications	Complete specifications of the DC60 products.	7
Physical Installation	Task instructions that give you the information and steps needed to physically install an DC60 encoder on your machine.	13
Wire Power and I/O	Task instructions that give you the information and steps needed to wire power and I/O connections to the DC60. These instructions are applicable to both bench top and machine wiring.	17

DC60 SPECIFICATIONS

Overview

The DC60 is a new line of heavy-duty resolver based encoder products from AMCI. The first units to be released in this line are absolute multi-turn encoders that offer a current or voltage analog output.

Units can be ordered with a full scale output over any number of turns between 1 and 1,024. The analog output has sixteen bit resolution regardless of the number of turns encoded.

A flange mount unit with its connector on the end is shown in figure 1. The following mounting styles are available:

- 2.5 inch flange mount
- 58 mm servo mount

The following shaft options are available with both mounting styles

- 0.375" dia x 0.884" long, w/ 0.047" x 0.77" flat
- 0.250" dia x 0.884" long, w/ 0.033" x 0.77" flat
- 6 mm dia x 10.25 mm long, w/ 0.3 mm x 9.5 mm flat
- 10 mm dia x 20.25 mm long, w/ 0.5 mm x 19.5 mm flat

The following current outputs are available:

- 4 to 20 mA
- 0 to 20 mA

The following voltage output is available:

- 0 to +10 Vdc

Figure 1 DC60 Resolver Based Encoder

An industry standard M12, 8 pin, A-coded, male connector is used as the power and I/O connector. Both end (axial) and side (radial) connector placement options are available. The body material of the DC60 units is aluminum with a powder coat finish. Outline drawings of all of the packing options are available in the ***Outline Drawings*** section of the manual starting on page 14.

Part Number Description

DC60 □□ – □ □ □ □□□□ □

MOUNTING
F1 = 2.65" Square Flange
S1 = 58mm Servo Mount

SHAFT SEAL
B = Nitrile Seal, Aluminum Body
V = Viton Seal, Aluminum Body

SHAFT DIA.
1 = 0.375" dia.①
3 = 0.250" dia.②
4 = 6 mm dia.③
6 = 10 mm dia.④

OUTPUT TYPE
C = Current Output
V = Voltage Output

OUTPUT CODING
Output Type = "C"
1 = 4 to 20 mA
2 = 0 to 20 mA
Output Type = "V"
1 = 0 to +10 Vdc

OUTPUT PERIOD
0001 to 1024:
# of turns for full scale output

CONNECTOR
E = End Connector
S = Side Connector

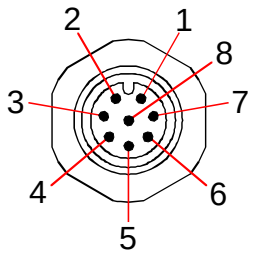
Notes:
① 0.375" dia x 0.884" long, w/ 0.047" x 0.77" flat
② 0.250" dia x 0.884" long, w/ 0.033" x 0.77" flat
③ 6 mm dia x 10.25 mm long, w/ 0.3 mm x 9.5 mm flat
④ 10 mm dia x 20.25 mm long, w/ 0.5 mm x 19.5 mm flat

Figure 2 Part Number Description

Connector Location and Pinout

M12 Connector

An eight pin, A-coded, male M12 connector is used on these DC60 units. It is located on the back or side of the unit. This connector is the Turck *eurofast FS 8* or equivalent. The pinout for the connector is shown below.



Turck FS 8 or equ.

Pin	Single Ended Outputs
1	+DC Power Input
2	DC Return (GND)
3	Preset to Zero Input
4	No Function, Attach to DC Return
5	Analog Output
6	No Function, Attach to DC Return
7	Direction Control Input
8	DC Return (GND)

Figure 3 I/O Connector Pinout

Pin 1: +DC Power Input: Input pin to power the DuraCoder. Requires a 10 to 30Vdc power supply at a maximum of 3.0 watts. This power draw does not include the current through the analog output.

Pins 2 and 8: DC Return: The return for the DC power supply and ground reference for both the digital inputs and the analog output signal. Pins 2 and 8 are internally connected.

Pin 3: Preset to Zero Input: This pin is internally tied high to the +DC Input Power, (Pin 1) through a pull up resistor. A high-to-low transition on this pin will preset the analog output to its minimum value. (In the case of a 4 to 20 mA output, the output becomes 4 mA. In the case of a 0 to 10 Vdc Output, the output becomes 0 Vdc.) Therefore, this pin must be pulsed to ground (Pins 2 or 8) to preset the position. This input is heavily filtered to prevent an accidental preset during normal operation, so the minimum pulse duration is 2,000 milliseconds.

NOTE All DC60 encoders use a nonvolatile memory technology known as F-RAM. Unlike older memory technologies such as EEPROM, F-RAM does not have a limit on the number of times the memory can be written to. You can preset the position as often as necessary in your application.

Pins 4 and 6: No Function: These pins can be left open if you are fabricating a custom cable. If a cordset is used, these pins should be tied to DC Return (pins 2 and 8) for normal operation to prevent them from picking up any electrical noise in the environment.

Pin 5: Analog Output: This pin is the analog output and it is referenced to DC Return (pins 2 and 8).

Pin 7: Direction Control: This pin controls which direction the shaft must rotate in to increase the analog output. The default is CW increasing output when looking at the shaft. If you are fabricating a custom cable and want CW increasing output, this pin can be left open or attached to +DC Power Input (pin 1). Connecting this pin to DC Return (pins 2 or 8), forces the output to increase with CCW rotation. If using a molded cordset, connect the wire on this pin to either +DC Input Power or DC Return for normal operation. Do not leave the wire floating.

Mating Connector and Cordsets

The following mating connector is available from AMCI. Note that any commercially available M12 connectors with the proper coding and contacts can be used.

AMCI #	Description
MS-37	Female, A-coded, 8 contacts. Screw terminal connections. 6 to 8 mm dia. cable. Maximum 20 AWG wire dia. Straight, IP67 rated when properly installed.

Table 1 Available Mating Connectors

AMCI offers the following cordset for use with the DC60.

AMCI #	Description
CNFL-5M	Molded cordset. 5 meters in length. Straight M12 8 pin A-coded to flying leads IP67 rated when properly installed.

Table 2 Available Cordsets

Status LED

Each DC60 has a Status LED on its rear cover. Figure 4 shows an end connect unit. The LED is in the same location on side connect units. This LED indicates whether or not output is driving a load (cable break detection) and gives a rough indication of the value of the analog output when it is driving a load. Table 3 shows the different blink patterns.

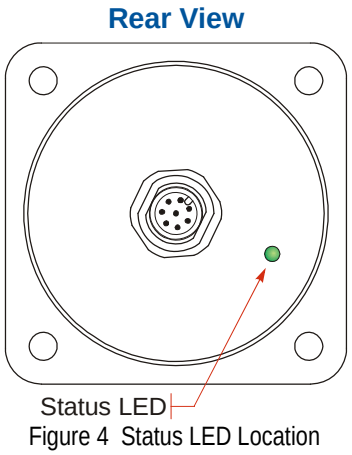


Figure 4 Status LED Location

Blink Pattern	Description
Alternating Red/Green	The DC60 is not driving a load. Most common causes are a mis-wiring or brake in the cable.
Blinking Green 50% duty cycle	The DC is driving a load and the shaft is rotating. The LED is on for 1 second, off for 1 second.
Blinking Green 10 to 90% duty cycle	When the analog output is at its minimum, the duty cycle will be 10%. When the analog output is at its maximum, the duty cycle will be 90%. The period is two seconds, so the minimum on time is 0.2 seconds.

Table 3 Status LED Blink Patterns

On power up, the LED turns on red briefly during self-test.

Output Load Calculations

Voltage Output DuraCoder

A voltage output DuraCoder can drive an output load of 2 kΩ or greater. If the output load is greater that 10 kΩ, consider installing a 10 kΩ resistor in parallel with the input terminals for greater noise immunity.

Current Output DuraCoder

The maximum load that can be driven by a current output DuraCoder depends on the power supply voltage applied to the +DC Power Input (Pin 1). For input voltages up to 15 Vdc, the maximum load is 475 Ω. For input voltages greater than or equal to 15 Vdc, the formula for determining the maximum load is given below along with a simple graph of the curve.

$$RLOAD_{MAX} = \frac{\text{(+DC Input Voltage) – 2.5Vdc}}{\text{0.020A}}$$

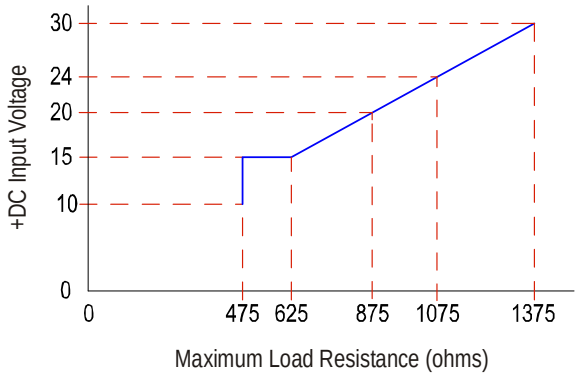


Figure 5 Maximum Load Resistance - Current Output

Electrical Specifications

Operating Voltage

10 Vdc to 30 Vdc maximum

Power Requirements

1.0 W max.
30 mA @ 24 Vdc typical
Value is the operating power and does not include current supplied by the analog output.

Position Resolution

16 bit (1 part in 65,536)

Position Accuracy

±10 arc-minutes

Position Update Time

1.6 milliseconds

Maximum Output Settling Time

50 microseconds when switching between minimum and maximum outputs

Direction of Increasing Counts

Default CW looking at shaft

Can be set to CCW increasing by shorting the Direction Control Input pin (pin 7) to DC Return.

Zero Position

Can be set by pulsing the Preset to Zero Input pin (pin 3) from DC Return to open circuit or +DC Power. Minimum pulse width of 2,000 milliseconds.

Mechanical Specifications

Package Style

60 mm housing with flange or servo mounting

Mechanical Specifications (continued)

Connector Location

End

Housing

Powder coated aluminum

Available Shafts

0.250", 0.375", 6 mm, or 10 mm.
All shafts have flats.

Max. Starting Torque @ 25°C

2.0 oz-in (1.41 N·cm)

Moment of Inertia

6.0×10^{-4} oz-in-sec^2 (43.2×10^{-6} kg-cm-sec^2)

Max. Operating Speed

6000 RPM max.

Max. Shaft Loading

Axial: 20 lbs. (89 N)
Radial: 40 lbs. (178 N)

At specified max. loads, minimum bearing life is $2X10^9$ revolutions.

Environmental Specifications

Operating Temperature

–40°F to +185°F (–40°C to +85°C)

Shock

50g, 11 millisecond duration

Vibration

20 g, 5 to 2000 Hz

Enclosure Rating

IP67

Approximate Weight

1.3 lbs. (0.59 kg)

Notes

PHYSICAL INSTALLATION

This section is intended for the engineer or technician responsible for installing the DC60 resolver based encoder. Information in this chapter includes installation guidelines, information about online CAD files, and mechanical drawings.

1.1 Installation Guidelines

1.1.1 Electrostatic Discharge Prevention

Electrostatic discharge can damage the DC60 if the discharge is through the I/O connector. Follow these guidelines when handling the unit.

1) Touch a grounded object to discharge static potential before handling the unit.
2) Work in a static-safe environment whenever possible.
3) Do not touch the pins of the I/O connector.
4) Do not disassemble the unit

1.1.2 Suitable Environment

The DC60 has an IP67 environmental rating and can be installed in most industrial environments, including areas subject to washdown spray and temporary immersion.

NOTE The IP67 rating is contingent on the proper installation of the mating connector.

1.1.3 Shaft Loading

A flexible coupler should be used when connecting a DC60 to a drive shaft, because any mismatch in shaft alignment will result in large radial or axial loading on the shaft of the encoder. Limit shaft loading to the following values. These values statistically yield an L10 life of $2X10^9$ revolutions. (Statistically, only 10% of the bearings will have failed after $2X10^9$ revolutions.) Shaft loading has an exponential effect on bearing life. The effect is actually cubic. Cutting a shaft load in half will result in an eight fold increase in bearing life.

Radial Load	Axial Load
40 lbs. (178 N)	20 lbs. (88 N)

Table 1.1 DC60 Maximum Shaft Loading Specifications

1.1.4 A Note on Cable Direction

All of the dimensional drawings in the ***Outline Drawings*** section (1.3), show the direction that the cable exits when using right angle connectors. Use this information to properly route cables when designing the DC60 mounting.

1.2 Availability of CAD Drawings

CAD drawing for all DC60 devices are available on the AMCI website.

1.3 Outline Drawings

1.3.1 Flange Mount, Aluminum Body, End Connect

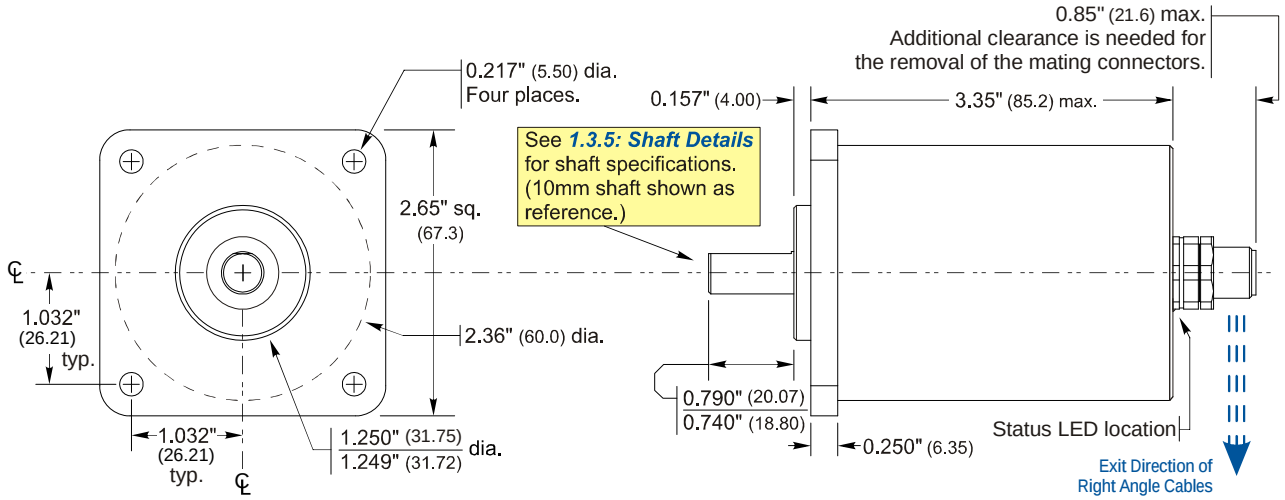


Figure 1.1 Flange Mount, End Connector Outline Drawing

1.3.2 Flange Mount, Aluminum Body, Side Connect

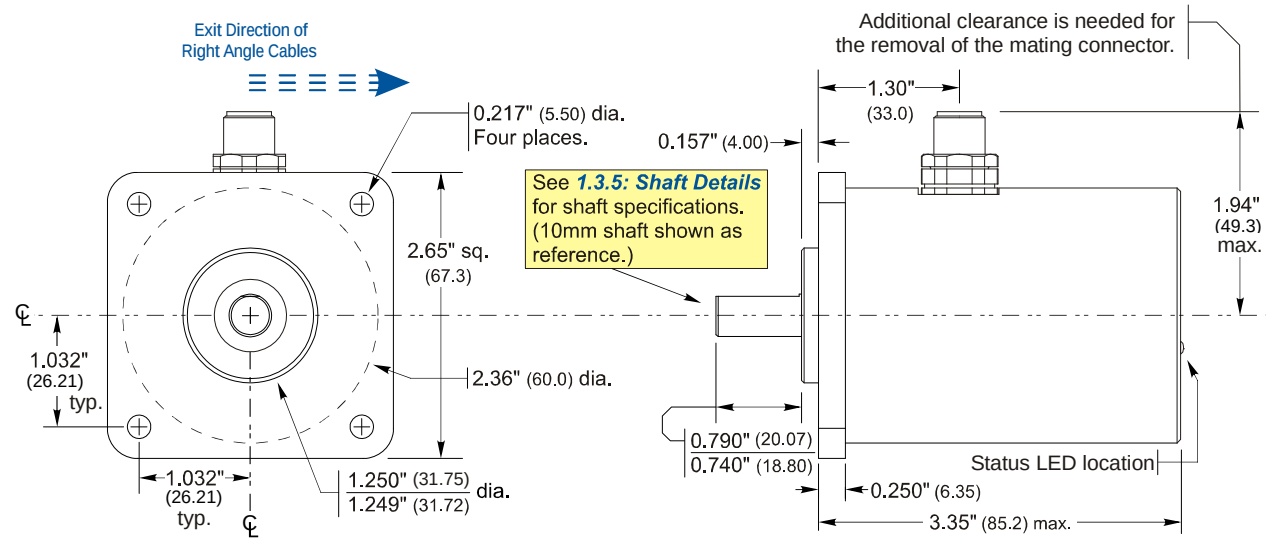


Figure 1.2 Flange Mount, Side Connector Outline Drawing

1.3 Outline Drawings (continued)

1.3.3 Servo Mount, Aluminum Body, End Connect

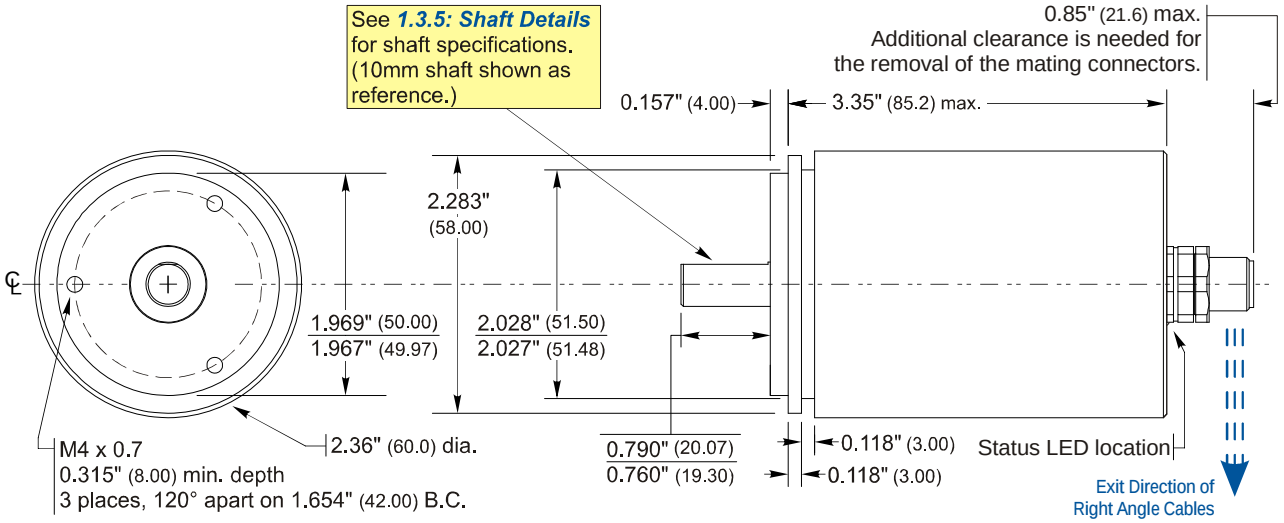


Figure 1.3 Servo Mount, End Connector Outline Drawing

1.3.4 Servo Mount, Aluminum Body, Side Connect

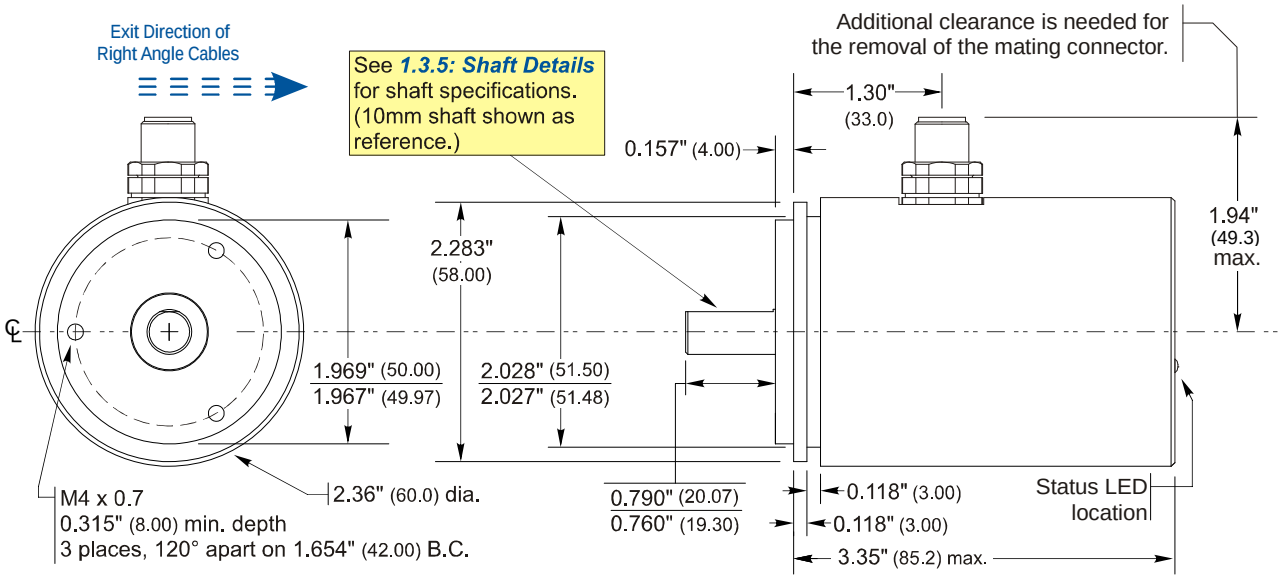


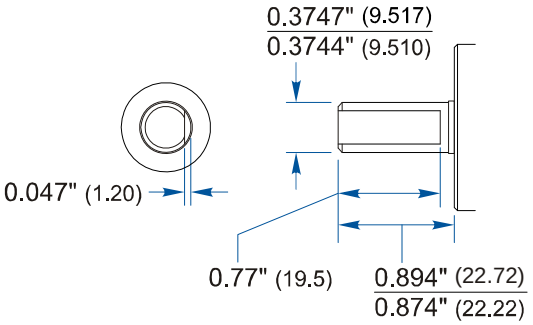
Figure 1.4 Servo Mount, Side Connector Outline Drawing

1.3 Outline Drawings (continued)

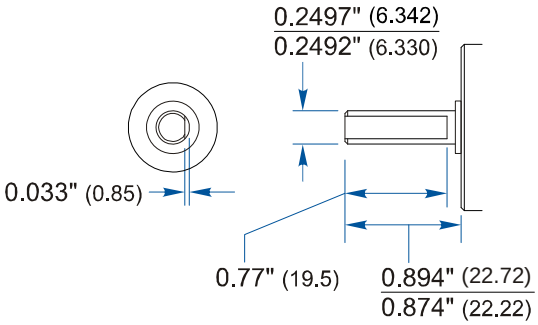
1.3.5 Shaft Details

The figure below shows the pilot of a flange mount nose. Listed dimensions are identical for the servo mount option.

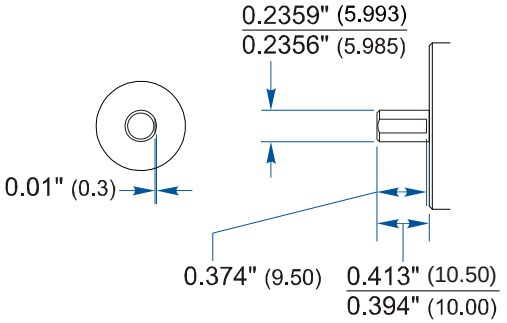
0.375" Shaft (Shaft Option 1)



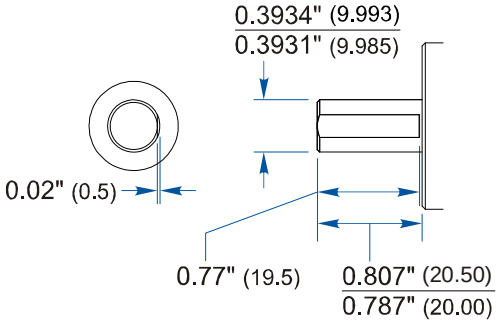
0.250" Shaft (Shaft Option 2)



6 mm Shaft (Shaft Option 4)



10 mm Shaft (Shaft Option 4)



() = Dimensions in mm

Figure 1.5 Shaft Details

2.1 Wiring Guidelines

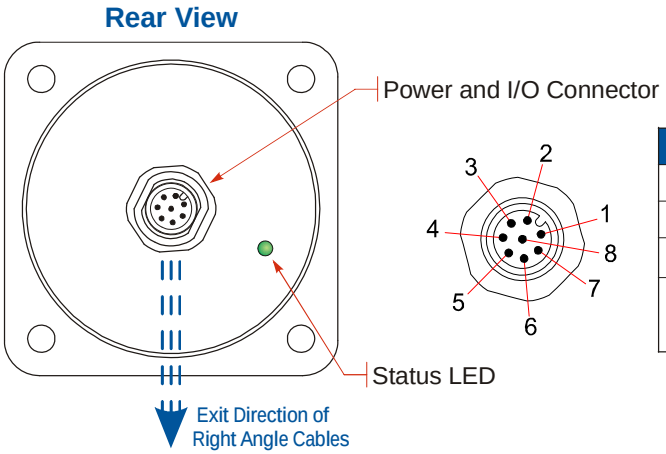
The DC60 requires a power supply of 10 to 30 Vdc, (12 to 24 Vdc nominally). Power requirement is 1.0 watts maximum, with 30 mA @ 24Vdc typical. This power draw does not include the current through the analog output.

- Signals from the DC60 are low voltage, low power signals. Cables should not be run with high power AC or DC cabling.
- Signal cable can be run in conduits with other low power AC and DC signal cables. Ideally, cable will be run in metal conduit that is bonded along its entire length.
- Signal cable should not be run in parallel with high power AC or DC cabling to minimize capacitive coupling of electrical noise. If they must be run in parallel, separate them as much as possible.
- If a signal cable must cross high power AC or DC cabling, it should do so at a right angle to minimize inductive coupling of electrical noise.

2.2 Connector Location and Pinout

2.2.1 Connector Pinout

Figure 2.1 below shows the location of the power and I/O connector location as well as the connector pinout.



Pin	Description	Pin	Description
1	+DC Power Input	5	Analog Output
2	DC Return (GND)	6	Factory Programming. Attach to DC Ground.
3	Preset to Zero Input		
4	No Function. Attach to DC Return.	7	Direction Control Input
		8	DC Return (GND)

Figure 2.1 DC60 Connector Placement

Pin 1: +DC Power Input: Input pin to power the DuraCoder. Requires a 10 to 30Vdc power supply at a maximum of 3.0 watts. This power draw does not include the current through the analog output.

Pins 2 and 8: DC Return: The return for the DC power supply and ground reference for both the digital inputs and the analog output signal.

Pin 3: Preset to Zero Input: This pin is internally tied high to the +DC Input Power, (Pin 1) through a pull up resistor. A high-to-low transition on this pin will preset the analog output to its minimum value. (In the case of a 4 to 20 mA output, the output becomes 4 mA. In the case of a 0 to 10 Vdc Output, the output becomes 0 Vdc.) Therefore, this pin must be pulsed to ground (Pins 2 or 8) to preset the position. This input is heavily filtered to prevent an accidental preset during normal operation, so the minimum pulse duration is 2,000 milliseconds.

NOTE All DC60 encoders use a nonvolatile memory technology known as F-RAM. Unlike older memory technologies such as EEPROM, F-RAM does not have a limit on the number of times the memory can be written to. You can preset the position as often as necessary in your application.

2.2 Connector Location and Pinout (continued)

2.2.1 Connector Pinout (continued)

Pins 4 and 6: No Function: These pins can be left open if you are fabricating a custom cable. If a cordset is used, these pins should be tied to DC Return (pins 2 and 8) for normal operation to prevent them from picking up any electrical noise in the environment.

Pin 5: Analog Output: This pin is the analog output and it is referenced to DC Return (pins 2 and 8).

Pin 7: Direction Control: This pin controls which direction the shaft must rotate in to increase the analog output. The default is CW increasing output when looking at the shaft. If you are fabricating a custom cable and want CW increasing output, this pin can be left open or attached to +DC Power Input (pin 1). Connecting this pin to DC Return (pins 2 or 8), forces the output to increase with CCW rotation. If using a molded cordset, connect the wire on this pin to either +DC Input Power or DC Return for normal operation. Do not leave the wire floating.

2.2.2 Right Angle Cable Exit Direction

When designing a mounting solution for the DC60, be aware of the cable exit direction when using right angle mating connectors. Figure 2.1 above shows the direction of the cable when using AMCI, TRUCK, or Phoenix Contact cordsets.

2.2.3 Mating Connectors and Cordsets

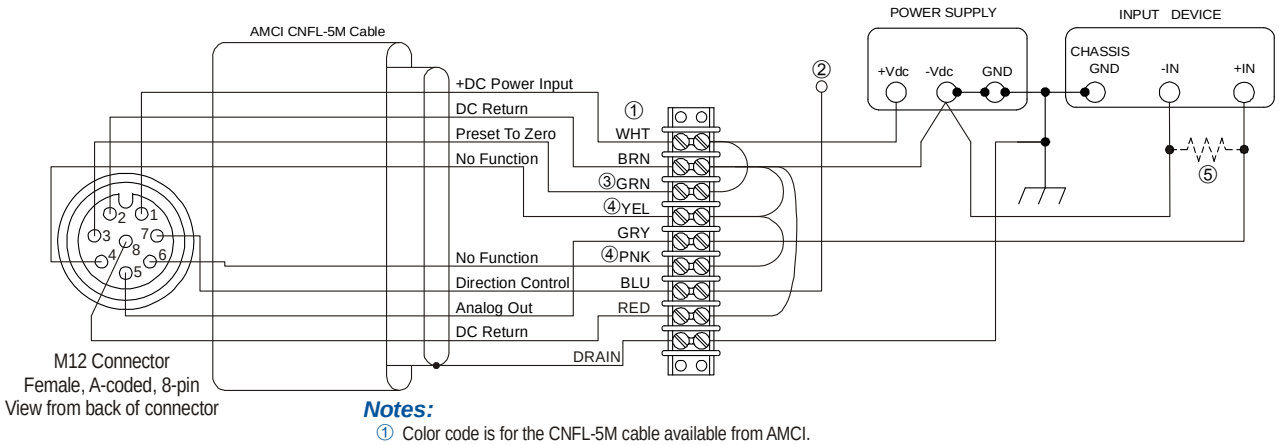
AMCI offers the following mating connector and cordsets that mate with the NR60 power connector. Note that the power connector will mate with any connector or cordset that follows the M12, 4 pin, A-coded standard.

AMCI #	Description
MS-37	Screw terminal connections. 6 to 8 mm dia. cable. 20 AWG max. Straight, IP67 rated when properly installed.
CNFL-5M	Molded cordset. 5 meters in length. Straight M12 8 pin A-coded to flying leads IP67 rated when properly installed.

Table 2.1 Compatible Connectors and Cordsets

2.3 Sample Wiring Diagram

The diagram below shows how to wire a DC60 encoder using the CNFL-5M cable from AMCI.



Notes:

① Color code is for the CNFL-5M cable available from AMCI.
② The Direction Control pin should be tied to +DC Power for CW increasing output or DC Return for CCW increasing output.
③ The Preset to Zero pin should be attached to +DC Power Input for normal operation.
④ No Function pins should be grounded for normal operation.
⑤ For voltage output, if input impedance exceeds 10 kohm, consider installing a 10 kohm resistor to improve noise immunity.

Figure 2.2 Sample Wiring Diagram

Notes

ADVANCED MICRO CONTROLS INC.

20 GEAR DRIVE, TERRYVILLE, CT 06786 T: (860) 585-1254 F: (860) 584-1973

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