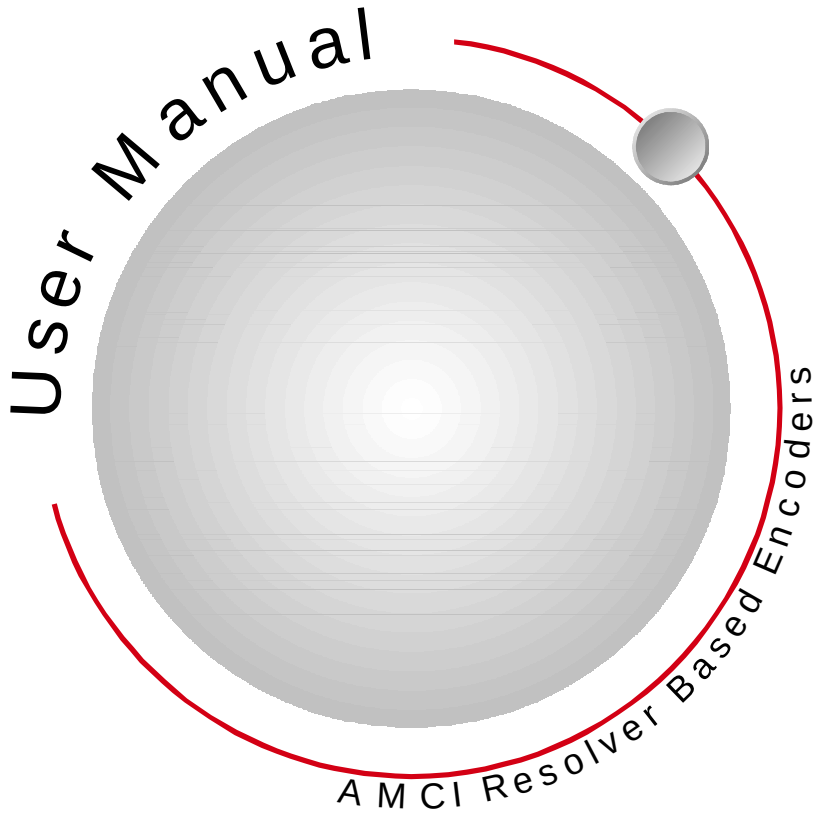
ADVANCED MICRO CONTROLS INC.

Manual #: 940-0D042

DC25
Absolute Digital Output DuraCoder



GENERAL INFORMATION

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Manuals at AMCI are constantly evolving entities. Your questions and comments on this manual are both welcomed and necessary if this manual is to be improved. Please direct all comments to: Technical Documentation, AMCI, 20 Gear Drive, Terryville CT 06786, or fax us at (860) 584-1973. You can also e-mail your questions and comments to *techsupport@amci.com*

TABLE OF CONTENTS

Notes

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 absolute digital output DuraCoders. It is written for the engineer responsible for incorporating the Absolute Digital DuraCoder into a design as well as the engineer or technician responsible for its actual installation. If there are any unanswered questions after reading this manual, call the factory. An applications engineer will be available to assist you.

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 4.0+ to open it.

Bookmarks of all the chapter names, section headings, and sub-headings are in the PDF file to help you navigate through it. The bookmarks should have appeared when you opened the file. If they didn't, press the F5 key on Windows platforms to bring them up.

Throughout this manual you will also find ***blue text that functions as a hyperlink*** in HTML documents. Clicking on the text will immediately jump you to the referenced section of the manual. If you are reading a printed manual, most links include page numbers.

The PDF file is password protected to prevent changes to the document. You are allowed to select and copy sections for use in other documents and, if you own Adobe Acrobat version 4.05 or later, you are allowed to add notes and annotations.

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 the first time a new term is introduced.
Cross Reference	When viewing the PDF version of the manual, clicking on the cross reference text jumps you to referenced section.

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Revision Record

This manual, 940-0D042 is the third release of the manual. It changes the format of the manual and specifies new shaft and mounting options. It was first released July 7, 2009.

Where to Go From Here

The table below gives a brief description of the content of each chapter to help you find the information you need to assist you in your job.

CHP NUM.	Chapter Title	Chapter Description
1	*THE ABSOLUTE DIGITAL DURACODER*	Intended for anyone new to the Absolute Digital DuraCoder, this chapter gives a basic overview of the unit. The chapter also explains the Absolute Digital DuraCoder part numbering system.
2	*INSTALLATION*	This chapter is intended for the engineer or technician responsible for installing and wiring the Absolute Digital DuraCoder. Information in this chapter includes mechanical drawings, installation guidelines and connector pinout.

CHAPTER 1

THE ABSOLUTE DIGITAL DURACODER

Absolute Digital DuraCoder Overview

DuraCoders are designed as direct replacements for optical encoders. Instead of being designed around a disk and optics, a DuraCoder uses a resolver as its primary shaft position sensor. Constructed in a manner similar to high precision motors, resolvers are absolute, single turn position sensors that are unsurpassed in terms of ruggedness and reliability. The resolver is an analog device whose outputs vary sinusodially as the shaft is rotated.

Figure 1.1 An Absolute Digital DuraCoder

Originally designed for military applications over 60 years ago, resolvers have gained popularity in many industrial markets from steel mills to packaging machines. If you are interested in learning more about resolvers, check out our website at: http://www.amci.com/tutorials/tutorials-what-is-resolver.asp.

The resolver's analog signals are decoded into a 12 bit position value by electronics incorporated into the DuraCoder. This 12 bit (4096 count), absolute position value is available as a parallel digital output. Several different output codes and voltage level outputs are available.

In addition to the actual position outputs, the Absolute Digital DuraCoders also offer two inputs. The Latch Input is used to control the when the position values update and the Direction Input controls the direction of rotation needed to produce increasing counts.

The Absolute Digital DuraCoder is available in a variety of industry standard size 25 optical encoder packages. A flange mount unit with a 3/8" shaft and a side connector is shown in figure 1.1. Servo mount and end connect units are also available. If your application requires you to mount the DuraCoder to a motor, a blind shaft mounting option is available as well. Finally, a face mount unit with a 5/8 inch shaft is available for applications that may be exposed to high shaft loads.

Outline drawings of all of the packing options is available in the *Outline Drawings* section of the ***INSTALLATION*** chapter, starting on page 13.

Part Numbering System

DC25 ❐ – ❐ ❐ ❐ ❐ ❐ ❐

HOUSING
F = Square Flange
S = 2.5" Dia. Servo Mount
H = 63mm Blind Shaft Mount

BEARING SEAL
B = Nitrile (standard)
V = Viton

SHAFT DIA.
Standard Shaft
1 = 0.375" Dia.
2 = 10mm Dia.
3 = 0.250" Dia.
5 = 0.625" Dia.
Flange Mount Only
Housing = 'F'
Blind Shaft Hole
1 = 0.375" Dia
2 = 10mm Dia.
4 = 0.500" Dia
6 = 12mm Dia.

DURACODER TYPE
A = Absolute Parallel, Level Update
B = Absolute Parallel, Edge Update

OUTPUT CODING
1 = 1,024 Count, Gray Code
2 = 1,024 Count, Binary
3 = 4,096 Count, Gray Code
4 = 4,096 Count, Binary
5 = 360 Count, BCD
6 = 1,000 Count, BCD
7 = 3,600 Count, BCD
8 = Field Programmable

B0002 to B4096
Factory Set, Binary
D0002 to D4096
Factory Set, BCD
G0002 to G4096
Factory Set, Gray Code

CONNECTOR
S = Side
E = End

OUTPUT CONFIG.
High True Outputs
A = Current Source, 24Vdc max.
B = Current Sink, 24Vdc max.
C = Current Sink with 10KΩ pullup to DuraCoder Input Voltage.
Low True Outputs
F = Current Source, 24Vdc max.
G = Current Sink, 24Vdc max.
H = Current Sink with 10KΩ pullup to DuraCoder Input Voltage.

Figure 1.2 Part Numbering System

Description of Outputs

Output Codecs

The Absolute Digital DuraCoder can output its data in 12 bit Natural Binary, 12 bit Gray Code, or 14 bit BCD formats. In Naturay Binary and Gray Code formats, the maximum output value is 4,095. For BCD format, the maximum output value is 3,999.

NOTE In new installations, the sole advantage of Gray Code over Natural Binary is that only one bit changes per count. This allows you to easily check the validity of the position data. This one bit change holds true only if your number of counts per turn is a power of two. (2, 4, 8, ... 4,096) If your number of counts per turn is not set to a power of two, the transition between your maximum count and zero will result in two or more bits changing in the data.

Output Update Control

Position data updates are controlled by a single pin named *Latch Control* and the type of control is set when the DuraCoder is ordered. Two types of position update control are available.

- **Level Sensitive –** The position data updates every 8 microseconds while the Latch Control pin is at a Logic 1 voltage or the pin is left open. The position data will freeze within 10 microseconds of this pin being driven to a Logic 0 voltage. The position data will begin to update within 40 microseconds once it is released from the Logic 0 voltage level. If the Latch Control pin is at a Logic 0 on power up, the outputs will all be in their zero state until the first positive transition.

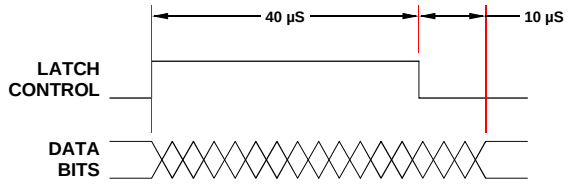


Figure 1.3 Level Sensitive Update

- **Edge Sensitive –** A Logic 0 → 1 or 1 → 0 transition on the Latch Control input will update the outputs within 40 microseconds. The output will then freeze until another valid transition. Transitions must be a minimum of 40 microseconds apart. (12.5 KHz at a 50% duty cycle maximum.) On power up, all of the outputs will be in their zero state until the first valid transition occurs. Position data will not be valid until this transition.

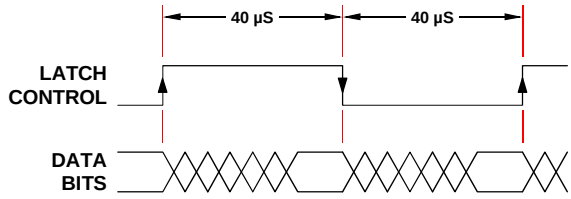


Figure 1.4 Edge Sensitive Update

Output Electrical Configurations

Three different electrical configurations are available for the outputs.

- **Open Collector Sourcing**
- **Open Collector Sinking**
- **Open Collector Sinking with a 10KΩ resistor to +Vin**

Full characteristics for the output are available in the ***Electrical Specifications*** section on the following page.

Outputs can be ordered as a High True Output or a Low True Output. The table below shows the states.

	High True		Low True	
	Logic 1	**Logic 0**	**Logic 1**	**Logic 0**
Open Collector Source Output	Conducts to VIN	High-Impedance	High-Impedance	Conducts to VIN
Open Collector Sink Output	High-Impedance	Conducts to GND	Conducts to GND	High-Impedance
Sink Output w/ 10KΩ Pullup	High-Impedance Pulled to VIN	Conducts to GND	Conducts to GND	High-Impedance Pulled to VIN

Figure 1.5 Output States

Electrical Specifications

Operating Voltage
4.75Vdc to 26.4Vdc

Power Requirements
1.5 W max.
60mA @ 24Vdc

Position Resolution
2 to 4,096 counts with Gray Code or Natural Binary output format.

2 to 4,000 counts with BCD output format

Position Update Control
Latch Control pin on connector that is factory set to either Level control or Edge control.

With Level control, the outputs update continuously while pin is at a logic 1 or open circuit. Outputs freeze when input tied to DC Return.

With Edge control, outputs update within 40 microseconds of a transition from logic 0 to logic 1 or logic 1 to logic 0. Transitions must occur at a minimum of 40 microseconds apart. (12.5KHz at 50% duty cycle)

Logic Level Input Voltages
Logic 0: 0Vdc to 30% of Operating Voltage.

Logic 1: 70% to 100% of Operating Voltage

Logic 0 = 0 to 7.2Vdc when operating at 24Vdc

Logic 1 = 16.8 to 24Vdc when operating at 24Vdc

Position Update Time
8 microseconds when using Level update control and the Latch Control pin has been at a logic 1 or open circuit for a minimum of 40 microseconds

Max. Output Settling Time
40 microseconds. Occurs on either transition when using Edge control or when Latch Control pin changes from Logic 0 to Logic 1 state when using Level control.

Direction of Increasing Counts
Default CCW looking at shaft

Can be set to CW increasing by shorting a pin to DC Return.

Output Types
Open Collector Sourcing, Open Collector Sinking, and Sinking with 10KΩ pull-up resistor.

On State Current
15mA maximum

On State Resistance
100Ω max. (1.5Vdc drop across driver at 15mA)

Leakage Current
5 microamps maximum

Environmental Specifications

Operating Temperature
-40°F to +185°F (-40°C to +85°C)

Shock
50g, 11 millisecond duration

Vibration
20g, 5 to 2000Hz

Enclosure Rating
IP67

Approximate Weight
2.0 lbs. (0.91 Kg) 0.625" shafts
1.4 lbs. (0.65 Kg) All other shafts

Mechanical Specifications

Package Style
2.5 inch aluminum housing with flange, servo, or blind shaft mounting

Connector Location
Side or End

Housing
Powder coated aluminum

Shaft
0.250", 0.375", 0.625", or 10mm

Blind Shaft with 0.375", 0.500", 10mm or 12 mm hole

Max. Starting Torque @ 25°C
2.0 oz-in: 0.250", 0.375", and 10mm shafts
6.0 oz-in: All blind shafts
6.0 oz-in: 0.625" shaft

Moment of Inertia (oz-in-sec^2)
6.00 X 10^{-4}: 0.250", 0.375", and 10mm shafts
7.00 X 10^{-4}: All blind shafts
8.50 X 10^{-4}: 0.625" shaft

Max. Operating Speed
6000 RPM

Max. Shaft Loading (0.625" shaft)
Axial: 50 lbs. (222 N)
Radial: 100 lbs. (445 N)
As specified max. loads, bearing life is 2X10^9 revolutions min.

Max. Shaft Loading (All other shafts)
Axial: 20 lbs. (222 N)
Radial: 40 lbs. (445 N)
As specified max. loads, bearing life is 2X10^9 revolutions min.

Notes

Setting Counts Per Turn

Most DuraCoders are ordered with the number of counts per turn set during assembly at AMCI. However, if your factory or application uses multiple DuraCoders with different counts per turn settings, it is possible to order a DuraCoder that is field programmable. Ordering a DuraCoder this way allow you to reduce the number of spares you need to stock.

DuraCoders with the following part numbers are field programmable:

- **DC25?-???8??**

  "?" characters are "Don't Care" terms and can be any value.

The procedure involves removing the back cover, adding or removing jumpers from a header, and putting the cover back on.

Required Tools

A clean, static-free work space, a #0 phillips head screwdriver, a utility knife, a small flat head screwdriver, and tweezers.

CAUTION This procedure must be done in a clean, static free environment. Failure to follow this caution may result in immediate damage to the electronics or a failure of the IP67 seal that could result in liquids entering the DuraCoder during operation.

Removing the Rear Cover

The first step in removing the rear cover is to remove the three black screws that hold the rear cover to the body. A #0 philips head screwdriver is recommended for removing the screws.

NOTE Each screw has a small o-ring under its head. These o-rings are important in maintaining the DuraCoder's IP67 rating. Place the screws in a clean area when disassembling the DuraCoder to prevent dirt and other debris from affecting the o-rings.

Once the screws are removed, you can *gently* remove the rear cover. If you have an end connect DuraCoder, take a good look at figure 2.1 before proceeding. The two most important things to note are the o-ring in the rear cover and the short length of the flexible PC Board from the connector to the DuraCoder electronics. You do not want to damage either of these as you remove the cover. Even if you have side connect DuraCoder, (see Figure 1.1 on page 7) you must use care to avoid damaging the o-ring seal on the cover.

You may need to use a utility knife to start separating the cover from the body, but a thumbnail can be used with a little practice. Once a gap between the cover and the body has been opened, you can use a small flathead screwdriver to finish removing the cover. Work around the perimeter of the cover while gently prying it off. Use care to avoid damaging the o-ring seal.

Figure 2.1 DuraCoder with Cover Removed

Setting Counts Per Turn (continued)

Setting Jumpers

As shown on figure 2.2 there are two headers on the DuraCoder. (These headers are also visible in figure 2.1.) The DuraCoder is programmed by changing the jumpers on the first fourteen pins of the larger header (STR1). Do not change the jumpers on pins 15-17 of STR1 or the two pins of STR2.

The jumpers are notched on one end. Make sure the jumper is placed on the header notched end first as shown in figure 2.3. Placing a jumper on upside down may damage the metal wipers in the jumper that may cause intermittent errors during use.

The first twelve pins of header STR1 are used to set the number of counts per turn. The jumpers represent a binary number where a jumper across the pins sets a logic 1 and a missing jumper sets a logic 0. You must set this number equal to (Counts Per Turn) – 1 for your application.

If you don't have a calculator to preform the decimal to binary conversion, use the table below to determine which jumpers should be installed. Start with your "(Counts per Turn)-1" value and subtract the largest possible number from the table. Place a jumper across the corresponding pins. Continue subtracting the next largest possible number from the remaining value and adding jumpers until you have a remainder of zero.

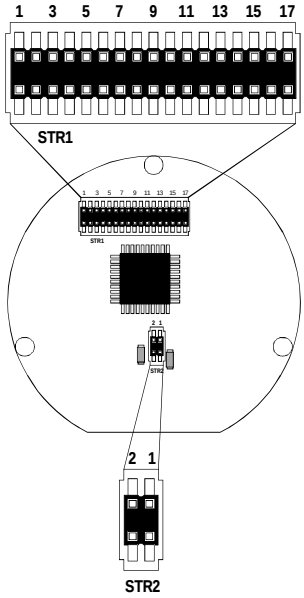


Figure 2.2 Header Locations

For example, assume you want 2,790 counts per turn. The jumpers must be set to equal 2,789.

2789 - 2048 = 741 (Jump pins 12)
741 - 512 = 229 (Jump pins 10)
229 - 128 = 101 (Jump pins 8)
101 - 64 = 37 (Jump pins 7)
37 - 32 = 5 (Jump pins 6)
5 - 4 = 1 (Jump pins 3)
1 - 1 = 0 (Jump pins 1)

Pins 11, 9,5, 4, 2 have their jumpers removed.

JMP.#	Weight	JMP.#	Weight
12	2,048	6	32
11	1,024	5	16
10	512	4	8
9	256	3	4
8	128	2	2
7	64	1	1

Table 2.1 Jumper Weight

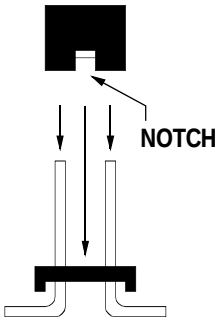


Figure 2.3 Jumper Orientation

Pins 13 and 14 of STR1 set the output code. Table 2.2 shows how to set these jumpers.

The remaining jumpers are configured at the factory and need not be changed.

Pin 13	Pin 14	Output Type
ON	ON	Binary Output
ON	OFF	Gray Code Output
OFF	ON	BCD Output
OFF	OFF	

Table 2.2 Jumper Weight

Replacing the Rear Cover

It is a fairly simple procedure to replace the rear cover. Simply set the rear cover on the back of the DuraCoder and rotate it until the screw holes line up with the standoffs that hold the PC board in place. Once you are sure the o-ring in the rear cover is not pinched, grasp the DuraCoder with your fingers holding the front of the unit and your thumbs on the rear cover. Press the rear cover into place with your thumbs. Rotate the rear cover as needed to align the holes with the standoffs and install the three rear cover screws. The screws should be tightened firmly, but not over tightened as this may damage the o-rings in their heads.

Flange Mount Outline Drawings

End Connector

( ) = Dimensions in millimeters

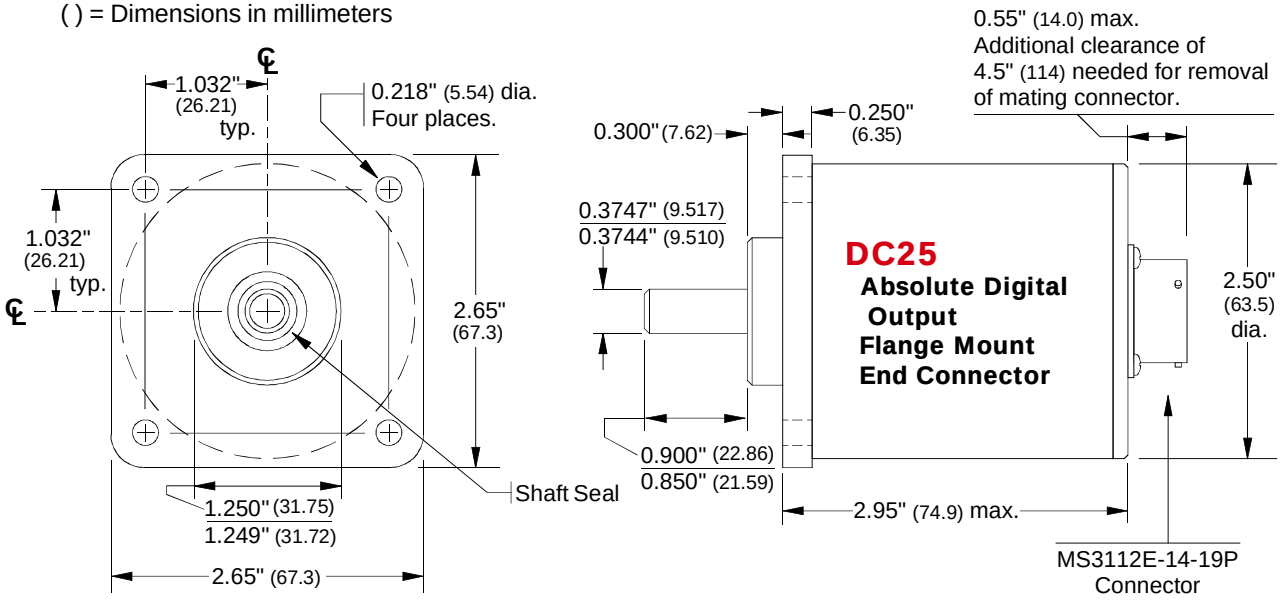


Figure 2.4 Flange Mount, End Connect Outline Drawing

Side Connector

( ) = Dimensions in millimeters

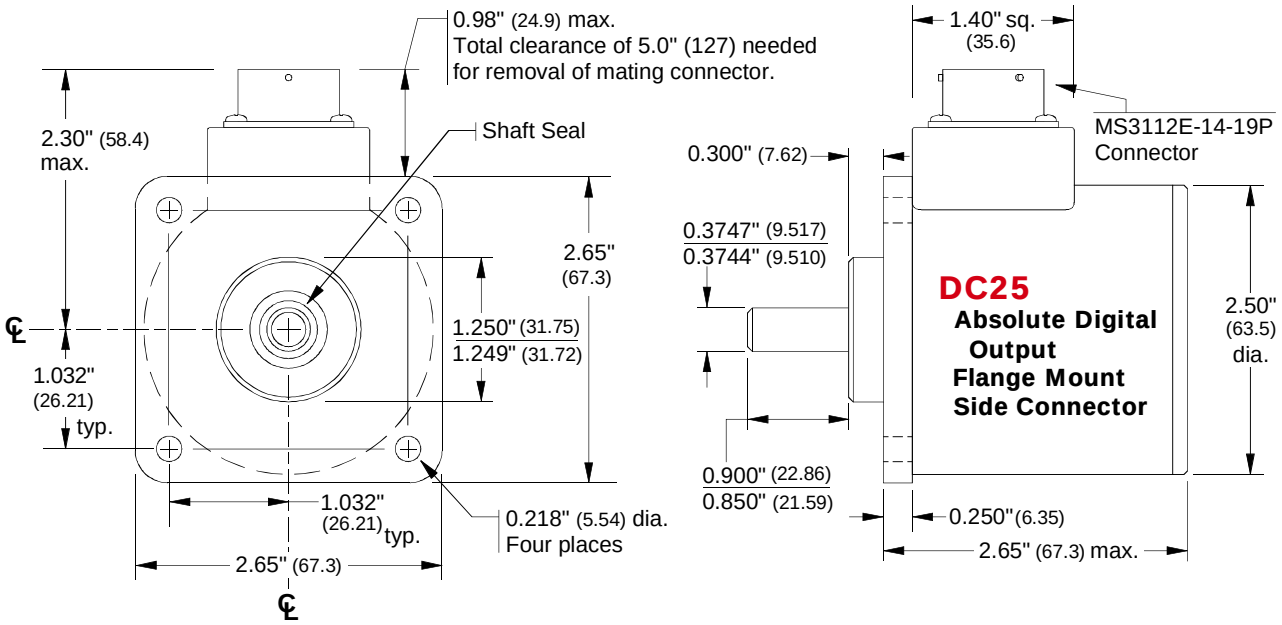
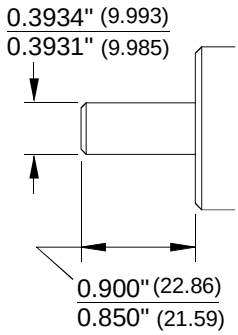


Figure 2.5 Flange Mount, Side Connect Outline Drawing

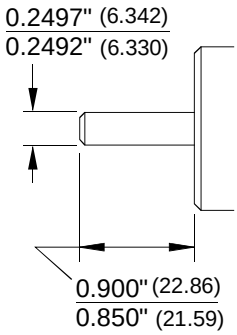
Flange Mount Outline Drawings (continued)

Alternate Shafts

10mm Shaft (Shaft Option 2)



1/4" Shaft (Shaft Option 3)



() = Dimensions in mm

Figure 2.6 Flange Mount Alternate Shafts

Shaft Loading

Limit shaft loading to the following values. These values statistically yield an L10 life of $2X10^9$ revolutions. (L10 life is a rating which means that statistically, only 10% of the bearings will have failed after $2X10^9$ revolutions.) Shaft loading has an exponential effect on bearing life. The bearings will statistically last longer if you can limit shaft loading below the given values. Consider using the 5/8" shaft DuraCoder from AMCI if your shaft loading is expected to be greater than the values given below. Outline drawings for the 5/8" shaft DuraCoders start on page 19.

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

Table 2.3 Flange Mount Shaft Loading

Servo Mount Outline Drawings

End Connector

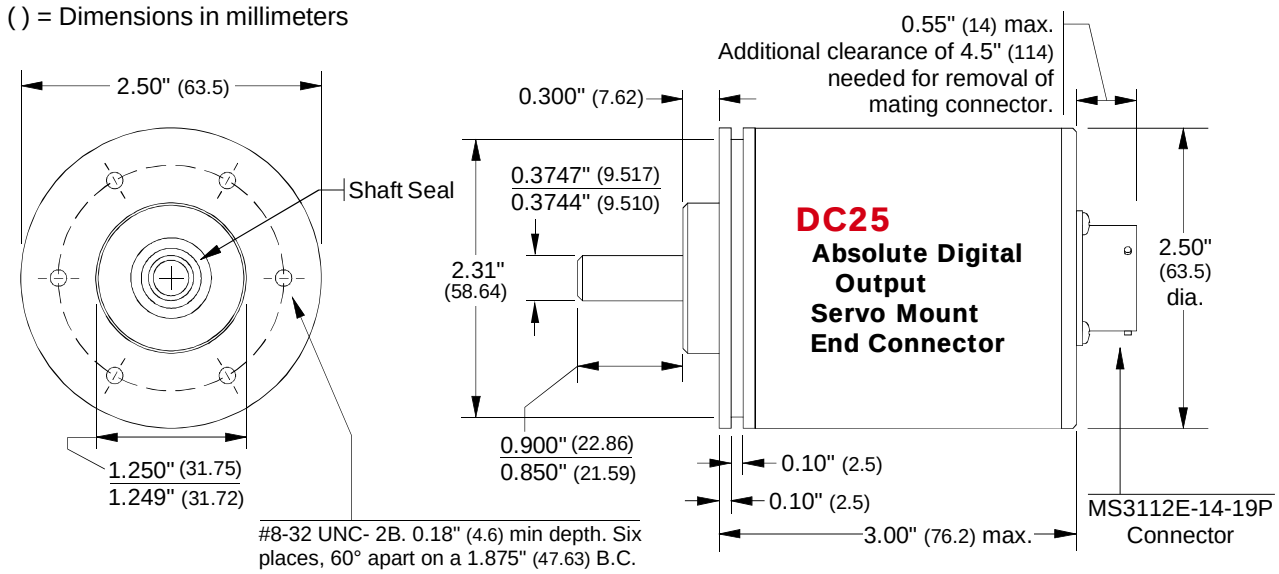


Figure 2.7 Servo Mount, End Connect Outline Drawing

Side Connector

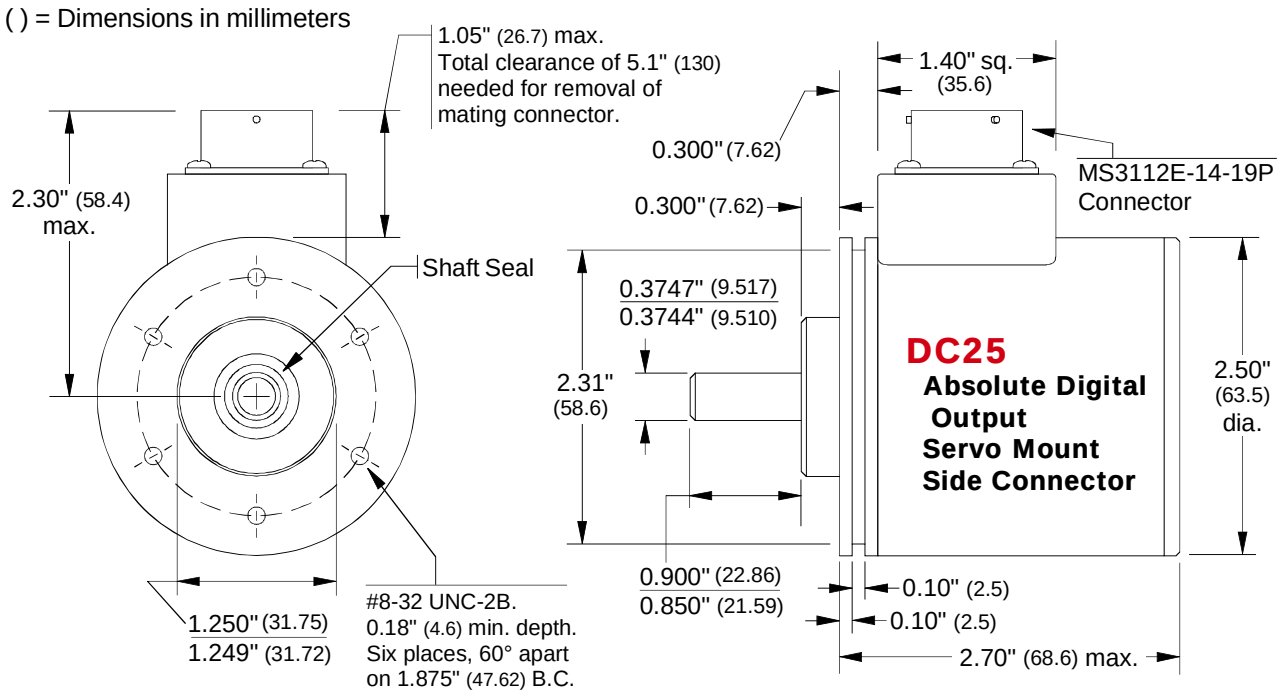
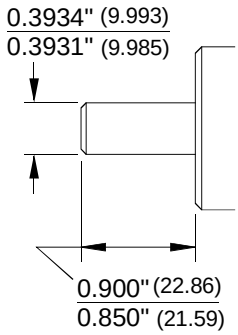


Figure 2.8 Servo Mount, Side Connect Outline Drawing

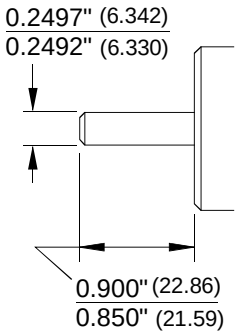
Servo Mount Outline Drawings (continued)

Alternate Shafts

10mm Shaft (Shaft Option 2)



1/4" Shaft (Shaft Option 3)



() = Dimensions in mm

Figure 2.9 Servo Mount Alternate Shafts

Shaft Loading

Limit shaft loading to the following values. These values statistically yield an L10 life of $2X10^9$ revolutions. (L10 life is a rating which means that statistically, only 10% of the bearings will have failed after $2X10^9$ revolutions.) Shaft loading has an exponential effect on bearing life. The bearings will statistically last longer if you can limit shaft loading below the given values. Consider using the 5/8" shaft DuraCoder from AMCI if your shaft loading is expected to be greater than the values given below. Outline drawings for the 5/8" shaft DuraCoders start on page 19.

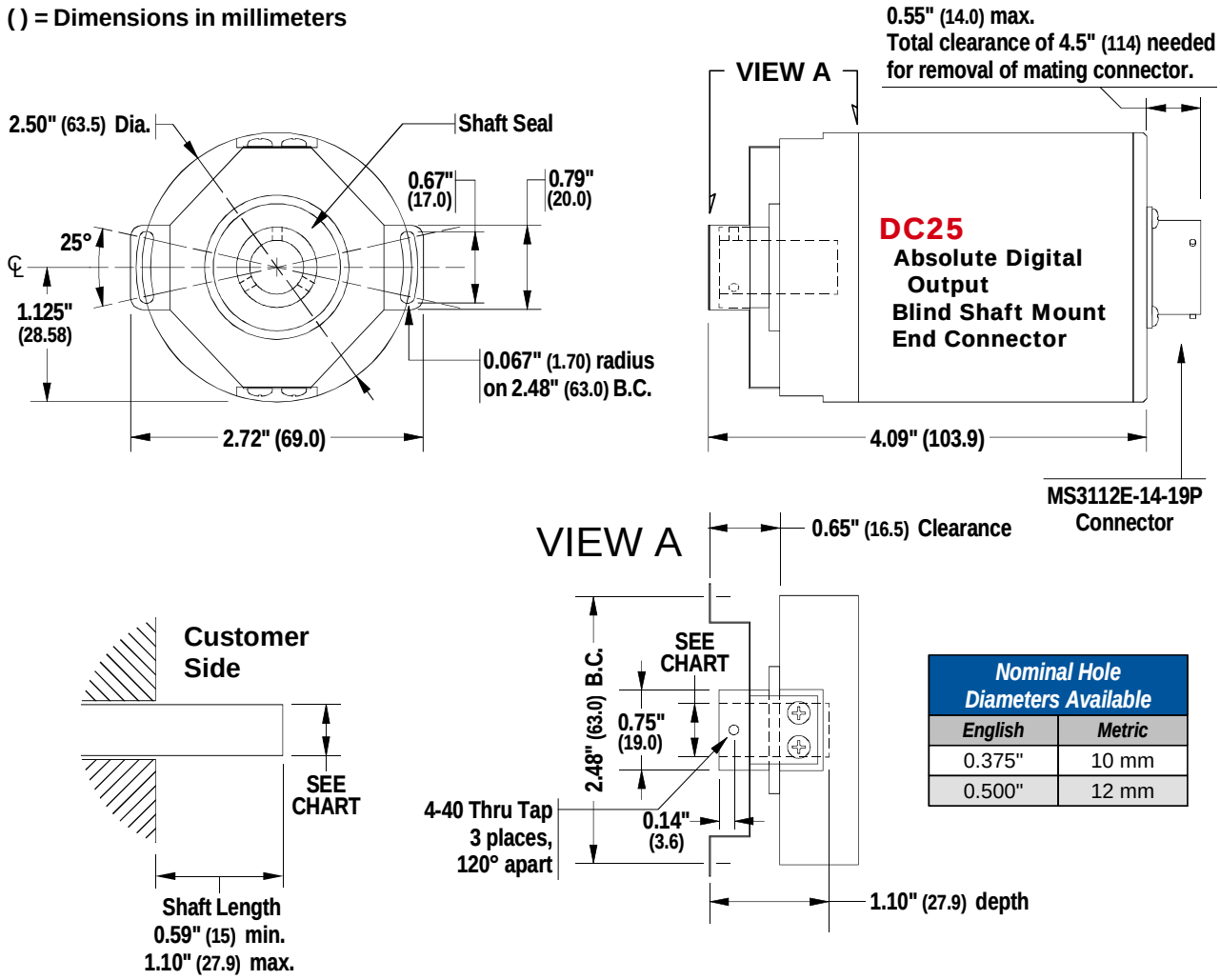
Radial Load	Axial Load
40 lbs. (178 N)	20 lbs. (88 N)

Table 2.4 Servo Mount Shaft Loading

Blind Shaft Mount Outline Drawings

End Connector

( ) = Dimensions in millimeters



Nominal Hole Diameters Available	
English	Metric
0.375"	10 mm
0.500"	12 mm

Figure 2.10 Blind Shaft Mount, End Connect Outline Drawing

Blind Shaft Mount Outline Drawings (continued)

Side Connector

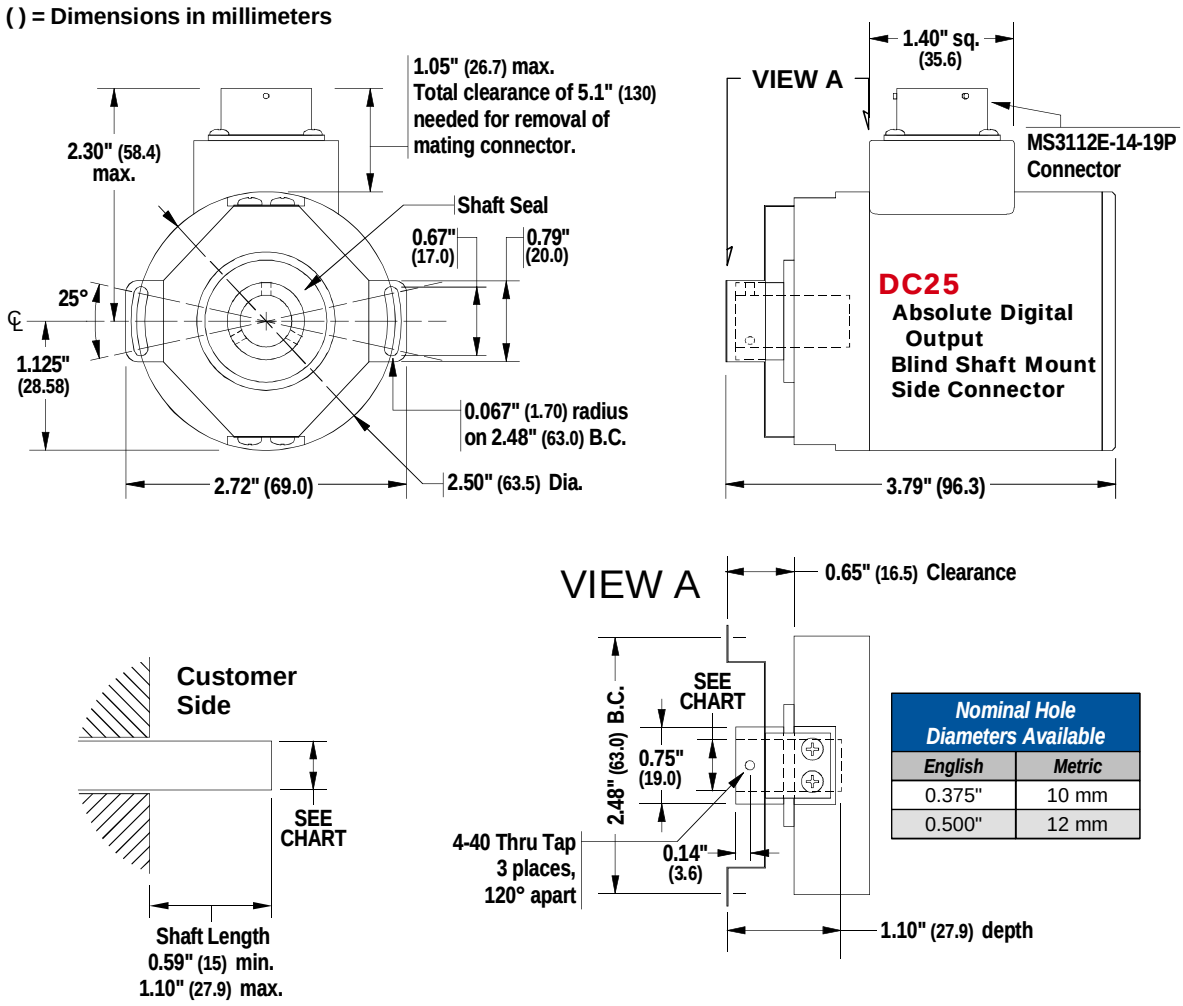


Figure 2.11 Blind Shaft Mount, Side Connect Outline Drawing

Available Shaft Diameters

The diameter of the drive shaft must be specified when ordering a blind shaft DuraCoder. Available options are given in the table below. Other diameter options may have become available after the release of this manual. Please check our website, *www.amci.com,* if you do not see the shaft diameter that fits your application.

Nominal Hole Diameters	
English	***Metric***
0.375"	10 mm
0.500"	12 mm

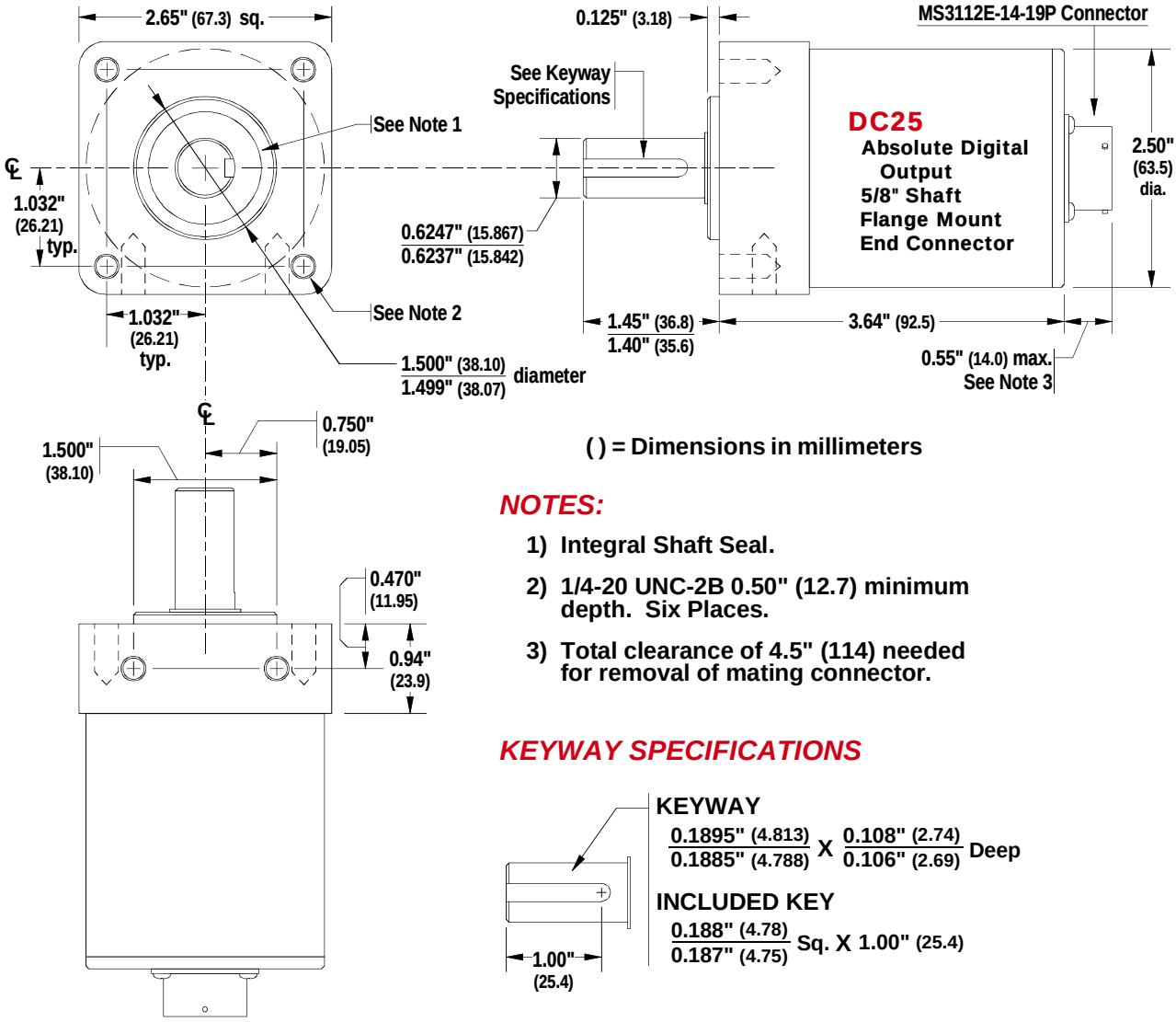
Table 2.5 Available Blind Shaft Diameters

Shaft Loading

The load that the Analog DuraCoder presents *to* your input shaft, which is equal to the load presented to the DuraCoder *by* your input shaft, is difficult to calculate and is dependent on the accuracy of the mounting. The flexible metal mounting bracket will be able to absorb most of the radial loading forces, but accurate mounting of the DuraCoder is still important.

5/8" Shaft Outline Drawings

End Connector



( ) = Dimensions in millimeters

NOTES:

1) Integral Shaft Seal.
2) 1/4-20 UNC-2B 0.50" (12.7) minimum depth. Six Places.
3) Total clearance of 4.5" (114) needed for removal of mating connector.

KEYWAY SPECIFICATIONS

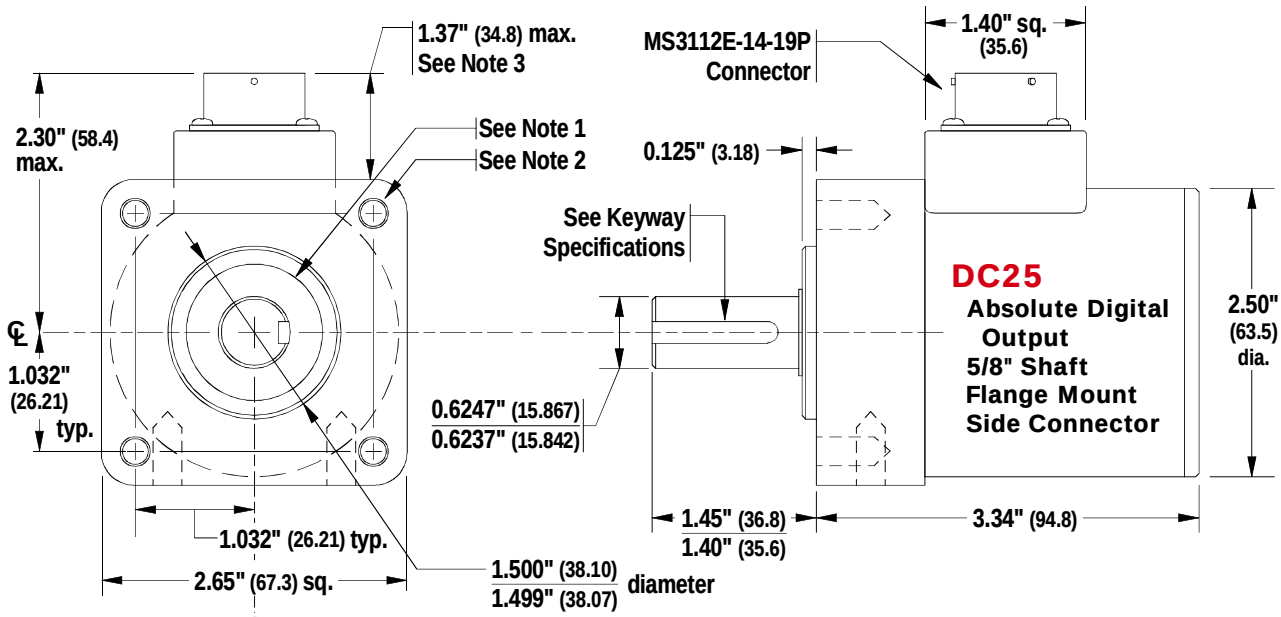
KEYWAY
0.1895" (4.813) / 0.1885" (4.788) X 0.108" (2.74) / 0.106" (2.69) Deep

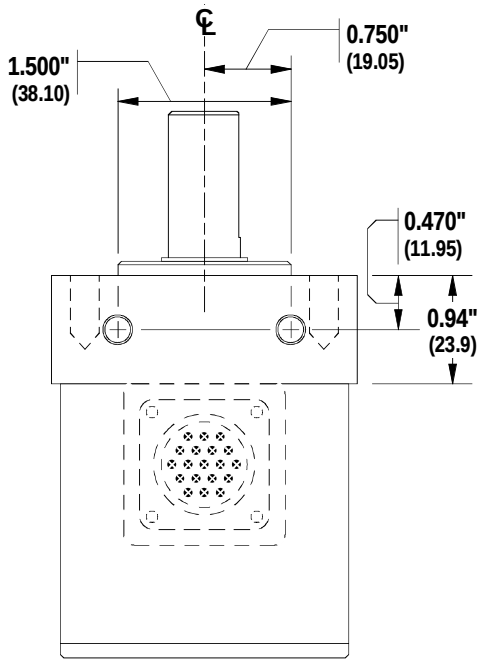
INCLUDED KEY
0.188" (4.78) / 0.187" (4.75) Sq. X 1.00" (25.4)

Figure 2.12 5/8" Shaft, Face Mount, End Connect Outline Drawing

5/8" Shaft Outline Drawings (continued)

Side Connector



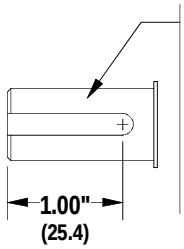


( ) = Dimensions in millimeters

NOTES:

1) Integral Shaft Seal.
2) 1/4-20 UNC-2B 0.50" (12.7) minimum depth. Six Places.
3) Total clearance of 5.0" (127) needed for removal of mating connector.

KEYWAY SPECIFICATIONS



KEYWAY

$\frac{0.1895"\ (4.813)}{0.1885"\ (4.788)}$ X $\frac{0.108"\ (2.74)}{0.106"\ (2.69)}$ Deep

INCLUDED KEY

$\frac{0.188"\ (4.78)}{0.187"\ (4.75)}$ Sq. X 1.00" (25.4)

Figure 2.13 Flange Mount, Side Connect Outline Drawing

5/8" Shaft Outline Drawings (continued)

Shaft Loading

Limit shaft loading to the following values. These values statistically yield an L10 life of $2X10^9$ revolutions. (L10 life is a rating which means that statistically, only 10% of the bearings will have failed after $2X10^9$ revolutions.) Shaft loading has an exponential effect on bearing life. The bearings will statistically last longer if you can limit shaft loading below the given values.

Radial Load	Axial Load
100 lbs. (445 N)	50 lbs. (222 N)

Table 2.6 Flange Mount Shaft Loading

Connector Pinout

Figure 2.14 shows the pin designations on the MS3112E-14-19P connector. AMCI sells a straight mating connector under the AMCI part number: MS-19.

AMCI does not supply factory made cables for the Absolute Digital DuraCoder because of the many possible configurations.

Pin R: Direction Control – This pin controls which direction the shaft must rotate to increment the position data. With this pin open circuit, position data increases with CCW rotation, looking at the shaft. Connecting this pin to Pin T, (DC Return), forces the position to increase with CW rotation, looking at the shaft.

NOTE If you want CW increasing counts, you must connect pins R and T at the connector. Do not run a cable pair from these pins and connect these pins at the other end of the cable.

Pin U: Latch Control – The Latch Control input is fully described in the section ***Output Update Control*** found on page 8. Briefly here, there are two types of position data update control:

- **Level Sensitive:** The outputs update every 8 microseconds when the pin is open circuit or at a logic 1 voltage level. The outputs will freeze within 10 microseconds when a logic 0 voltage is applied. When the input transitions between a logic 0 and a logic 1, the outputs will take approximately 40 microseconds before they begin to update.
- **Edge Sensitive:** The outputs update within 40 microseconds of a 0 → 1 or 1 → 0 transition on the input. The outputs then freeze until another valid transition. Transitions must be at least 40 microseconds apart, which yields a maximum frequency of 12.5KHz at a 50% duty cycle. All of the outputs will be at a logic 0 state on power up until the first valid transition occurs.

Pin S: Case GND – This pin should be used to tie the body of the DuraCoder to chassis ground *at the DuraCoder* if the unit is not grounded through its mounting. This pin is not to be used as the power supply return. The power supply must be wired to pins T (DC Return) and V (+DC Input).

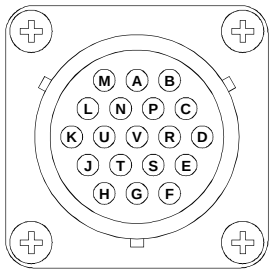


Figure 2.14 Connector Pinout

PIN	Function		
	Gray Code	Natural Binary	BCD (8421)
A	G(0)	2^0	1
B	G(1)	2^1	2
C	G(2)	2^2	4
D	G(3)	2^3	8
E	G(4)	2^4	10
F	G(5)	2^5	20
G	G(6)	2^6	40
H	G(7)	2^7	80
J	G(8)	2^8	100
K	G(9)	2^9	200
L	G(10)	2^{10}	400
M	G(11)	2^{11}	800
N	Not Used	Not Used	1000
P	Not Used	Not Used	2000
R	Direction Control	Direction Control	Direction Control
S	Case GND	Case GND	Case GND
T	DC Return	DC Return	DC Return
U	Latch Control	Latch Control	Latch Control
V	+DC Input	+DC Input	+DC Input

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