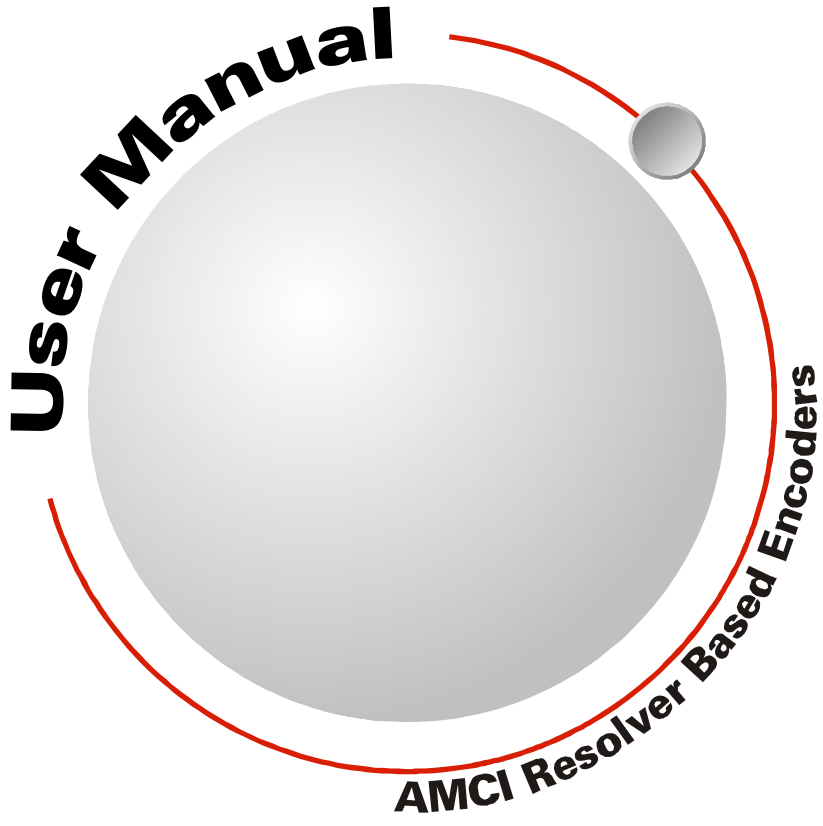
ADVANCED MICRO CONTROLS INC.

Manual #: 940-0D101

NR25
Networked Resolver for PROFIBUS



PROFI PROCESS FIELD BUS BUS

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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The information contained within this manual is subject to change without notice.

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Returns Policy

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.

24 Hour Technical Support Number

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.

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We Want Your Feedback

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*

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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 NR25 Networked Resolver encoders. It is written for the engineer responsible for incorporating the NR25 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.

Applicable Units

This manual to a PROFIBUS NR25 transducers with firmware version 1.7+.

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 6.0+ to open it. If you decide to print out this manual, all chapters contain an even number of pages which allows you to easily print out a single chapter on a duplex (two-sided) printer

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 6.0 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.

Trademarks and Other Legal Stuff

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Revision Record

This manual, 940-0D101 is the second release of this manual. It was released on May 25th, 2012. It adds AMCI part numbers to BUS-IN and BUS-OUT mating connectors.

Revision History

940-0D101: 05/25/2012 Mating connector update.

940-0D100: 12/08/2011 Initial Release.

Where to Go From Here

This manual contains information that is of interest to everyone from engineers to operators. 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	*INTRODUCTION TO THE NR25*	Intended for anyone new to the NR25 Networked Resolver encoder, this chapter gives a basic overview of the unit, including an explanation of its programmable features. The chapter also explains the NR25 part numbering system.
2	*INSTALLATION*	This chapter is intended for the engineer or technician responsible for installing and wiring the NR25 Networked Resolver encoder. Information in this chapter includes mechanical drawings, installation guidelines and connector pinout.
3	*CONFIGURING A PROFIBUS NR25*	This chapter is intended for anyone responsible for configuring the NR25 either before or after actual installation. It covers the data transferred to the NR25 with the DDLM_Set_PRM communications function.
4	*DATA TRANSFER*	This chapter covers the format of the data transferred between the Profibus Master and the NR25 when using the DDLM_Data_Exchange communication function.
5	*DIAGNOSTIC INFORMATION*	This chapter covers the format of the data transferred between the Profibus Master and the NR25 when using the DDLM_Slave_Diag communication function.

Notes

CHAPTER 1
INTRODUCTION TO THE NR25

Overview

The NR25 is a new line of heavy-duty resolver based encoder products from AMCI. The initial offerings in this line communicated over a standard Ethernet network and now the line has been expanded to include the Profibus network and protocol. This manual only covers the Profibus version of the NR25.

Figure 1.1 NR25 Resolver Based Encoder

The NR25 series is composed of absolute single- or multi-turn sensors in an IP67 rated, 2.5 inch diameter package. All NR25 Networked Resolvers offer a maximum single turn position resolution of 16 bits, which is programmable from 1 to 65,536 counts per turn. Two multi-turn units are available in addition to the single turn NR25. One encodes 4,096 turns (12 bit + 16 bit = 28 bit encoder) and the other encodes 16,384 turns (14 bit + 16 bit = 30 bit encoder).

All Profibus NR25 units use the Decentralized Periphery profile, "Profibus-DP", which is the most commonly used Profibus profile. Specifically, the NR25 Profibus encoders were designed using the *Profibus Encoder Profile V1.1* specification, order number 3.062.

A flange mount unit with end connectors is shown in figure 1.1. The following mounting styles are available:

- Size 25 standard flange mount with 3/8", 1/4", or 10mm shafts
- Size 25 standard servo mount with 3/8", 1/4", or 10mm shafts
- Blind shaft mount for 3/8", 1/2", 10mm, and 12mm shafts, mounting bracket designed for 63mm B.C.
- AMCI face mount with 5/8" shaft for high radial and axial loads

The body material is either aluminum with a powder coat finish or 316 stainless steel for use in caustic environments. Outline drawings of all of the packing options are available in the Outline Drawings section of the ***INSTALLATION*** chapter, starting on page 15.

Every Profibus NR25 resolver based encoder is configurable, and programmable, over its Profibus interface. Configuration is accomplished by using the NR25's GSD files that are available on the AMCI website. The GSD files allow your Profibus Master to configure the NR25 to one of three classes. Depending on the class that you choose, programmable parameters allow you to set the count direction, the number of counts per turn, the format of the velocity data, and preset the position data to any value within its range.

- **Class 1 –** Mandatory class that only allows you to change the direction of rotation for increasing counts. The resolution is fixed at 65,536 counts per turn and on multi-turn units, the number of turns to reach the full scale count is fixed at 4,096 turns for 28 bit units and 16,384 turns for 30 bit units.
- **Class 2 –** Optional class that is fully defined by the specification. Parameters to set the count direction, counts per turn, full scale count, and preset value are available with this class.
- **AMCI 2 –** Optional class in the specification that allows the manufacturer to add additional functionality. AMCI 2 class offers all of the functionality of Class 2, and offers rotational velocity data in a programmable format.

All NR25 resolver based encoders have two status LED's to help you determine the operating state of the device. These LED's are always located on the back cover of the NR25.

- **Device Status –** Operating status of the NR25 itself
- **Bus Status –** Operating state of the Profibus hardware and protocol state.

Electrical Specifications

Operating Voltage (External Supply)

10Vdc to 30Vdc (24Vdc nominal)

Power Requirements

1.4W max.
55mA @ 24Vdc typical

Interface

Galvanically isolated RS-485 driver, per Profibus-DP 2.0 standard. (DIN19245 part 3)

Protocol References

Profibus Specification Ed. 1.0
PNO Order No. 0.032

Profibus Encoder Profile V1.1
PNO Order No: 3.062
Supports Class 1, Class 2, and manufacturer-specific enhancements

Single Turn Resolution

Programmable from 1 to 65,536 counts per turn (16 bit resolution max.)

Multi-turn Resolution

4,096 turns (12 bit) or 16,384 (14 bit)

Code Sequence (Count Direction)

Default of CW increasing when looking at the shaft.

Programmable to CCW increasing over the Profibus interface.

Preset Position

When using Class 2 or AMCI 2 configurations, the position can be preset to any value within its range over the Profibus interface. Internal Position Offset can be stored in Flash memory and will then be retrieved and applied on power up.

Mechanical Specifications

Package Style

2.5 inch housing with flange, servo, or hub shaft mounting

Connector Location

End

Housing

Powder coated aluminum or 316 stainless steel

Mechanical Specifications (cont'd)

Shaft

0.250", 0.375", 0.625", or 10 mm
Blind shaft with 0.375", 0.500", 10mm or 12mm hole

Max. Starting Torque @ 25°C

2.0 oz-in: 0.250", 0.375", and 10 mm 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 10 mm shafts
7.00 X 10^{-4}: All blind shafts
8.50 X 10^{-4}: 0.625" shaft

Max. Operating Speed

6000 RPM max.

Max. Shaft Loading (0.625" shaft)

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

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

Max. Shaft Loading (All other shafts)

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

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

Environmental Specifications

Operating Temperature

–4°F to +167°F (–20°C to +75°C)

Shock

50g, 11 millisecond duration

Vibration

20g, 5 to 2000Hz

Enclosure Rating

IP67

Approximate Weight

2.0lbs. (0.91kg) 0.625" shaft - Aluminum Body
3.8lbs. (1.73kg) 0.625" shaft - 316 Steel Body
1.4lbs. (0.65kg) All other shafts - Aluminum Body
2.9lbs. (1.32kg) All other shafts - 316 Steel Body

Connector Placements

Figure 1.2 shows the placement of the connectors and Status LED's on all end connect Profibus NR25's.

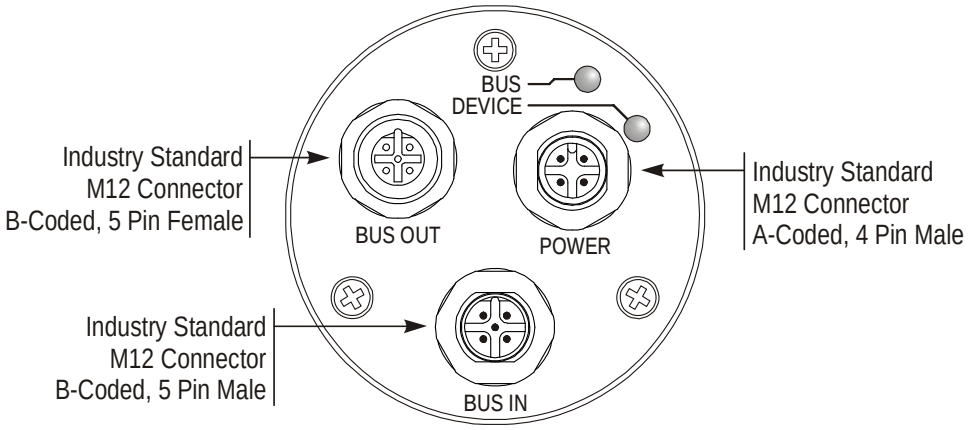


Figure 1.2 Status LED's and Connectors

Status LED's

As shown in figure 1.2 above, the NR25 has two status LED's on the rear cover. The tables below list the various states of the LED's and their meaning.

'BUS' LED State	'DEVICE' LED State	Definition
Off	Off	No Power
Off	On	Normal Operation / Data Exchange Mode
On	Off	1) No communications 2) NR25 has not received data for an extended period of time. Possible bus line interruption.
On	On	1) NR25 is operational, but has not received any configuration data since power up. Possible bus line interruption or wiring error. 2) Position Error (Alarm message bit 0 on.) 3) Offset value cannot be read from Flash Memory. (Alarm message bits 4 and 5 on.)
On	Flashing	Parameter or Configuration Error. Invalid data or incorrect data length was received by the NR25.
Flashing	On	1) New address received from Profibus Master. 2) Invalid Preset Value was received. (Value out of range or invalid command bits.)
Synchronous Flashing		Address cannot be read from Flash Memory on power up. Default address of 123 is presently being used.
Alternate Flashing		Fatal Internal Error. Cycle power to the NR25. If the error persists, unit must be returned to AMCI for repairs.

Table 1.1 Network Status LED States

Part Number Description

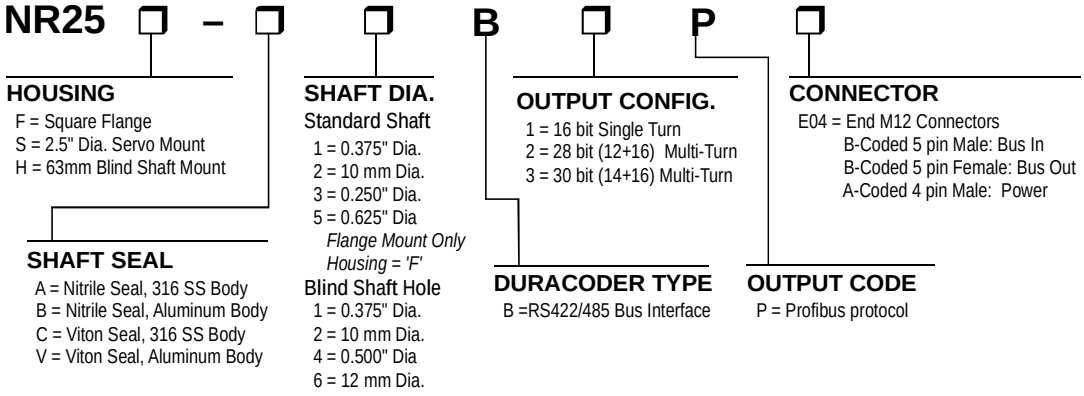


Figure 1.3 Part Number Description

DP-V0 Encoder Profile

All Profibus NR25 encoders use the Decentralized Periphery profile, "Profibus-DP", which is the most commonly used Profibus profile. Specifically, the NR25 Profibus encoders were designed using the *PROFIBUS Profile for Encoders, PROFIBUS PROFILE, Order No. 3.062* specification.

DP-V0 Encoder Classes

The Profibus Encoder Profile specification defines two classes of operation for an encoder. The first class is mandatory and the other is optional.

Class 1

This mandatory class defines a basic encoder. A Class 1 encoder provides position data to the Profibus Master and the Master can only program the Code Sequence parameter, which sets the direction of increasing counts.

Class 1 NR25:

- Single turn units provide a 16 bit position value. Multi-turn units provide a 32 bit position value.
- Resolution is fixed at 16 bits per turn (65,536 counts per turn).
- 28 bit multi-turn units must complete 4,096 turns $\{2^{\wedge(28-16)}\}$ before the position returns to zero.
- 30 bit multi-turn units must complete 16,384 turns $\{2^{\wedge(30-16)}\}$ before the position returns to zero.
- The only parameter available is the *Code Sequence* parameter, which sets the direction of increasing counts.
- 16 bytes of Diagnostic data is available to the Profibus Master.

Class 2

This optional class adds additional functionality to a Class 1 encoder. This class is completely defined in the profile specification, which means that all Class 2 encoders will function in exactly the same way.

Class 2 NR25:

- Single turn units provide a 16 bit position value. Multi-turn units provide a 32 bit position value.
- Counts per turn is programmed using the *Measuring Units per Revolution* (MUR) parameter.
- On multi-turn units, the total number of counts that must be completed before the position returns to zero is programmed with the *Total Measuring Range* (TMR) parameter.
- The *Code Sequence* parameter, which sets the direction of increasing counts, is available.
- The *Preset* parameter allows you to set the encoder position without rotating the shaft.
- 57 bytes of Extended Diagnostic data is available to the Profibus Master.

AMCI Optional Class

The 3.062 PROFIBUS Profile for Encoders allows manufacturers to define additional custom classes. AMCI defines a third class in our NR25 encoders that allows you to transmit velocity data as well control the amount of diagnostic data is transmitted to the Profibus master.

AMCI 2

This class adds additional functionality to a Class 2 encoder. This class is allowed, but not defined, in the profile specification. This class allows Profibus vendors to add unique functionality to their products.

AMCI 2 NR25:

- Single turn units provide a 16 bit position value. Multi-turn units provide a 32 bit position value.
- Counts per turn is programmed using the *Measuring Units per Revolution* (MUR) parameter.
- On multi-turn units, the total number of counts that must be completed before the position returns to zero is programmed with the *Total Measuring Range* (TMR) parameter.
- The *Code Sequence* parameter, which sets the direction of increasing counts, is available.
- The *Preset* parameter allows you to set the encoder position without rotating the shaft.
- An AMCI 2 class encoder outputs velocity data in addition to position data.
- Velocity data can be scaled to one of four formats with the *Velocity Measuring Units* parameter.
- An AMCI 2 class encoder can be programmed to output 16 bytes of Diagnostic data or 57 bytes of Extended Diagnostic data. The 16 bytes are the same as the Class 1 data, while the 57 bytes are the same as the Class 2 data.

GSD File

AMCI provides three different GSD files, and the one that you will use is based on the resolution of your unit. The files are available on our website at:

- ***http://www.amci.com/gsd-files/amci-nr25-profibus.zip***

The zip file contains all three GSD files.

- For 16 bit, single turn NR25 encoders: Use NR250D7E-S16.gsd
- For 28 bit, multi-turn NR25 encoders: Use NR250D7E-M28.gsd
- For 30 bit, multi-turn NR25 encoders: Use NR250D7E-M30.gsd

Programmable Parameters

The parameters that can be programmed on the NR25 depends on the encoder class you set in the GSD file used to configure the NR25.

Code Sequence

This parameter is available in all three classes (Class 1, Class 2, and AMCI 2), and is the only parameter available in Class 1. This parameter allows you to set the direction of shaft rotation needed to produce increasing counts. A value of “0” sets the direction of increasing counts to clockwise when looking at the shaft. A value of “1” sets the direction of increasing counts to counter-clockwise when looking at the shaft. The factory default value is clockwise increasing counts.

Measuring Units Per Revolution (MUR)

Only available in Class 2 and AMCI 2, this parameter sets the number of counts per turn and can range from 2 to 65,536 for single turn NR25 encoders, and from 1 to 65,536 for multi-turn encoders.

Programmable Parameters (continued)

Total Measurement Range (TMR)

Only available in Class 2 and AMCI 2, this parameter sets the number of counts the NR25 will output before the position returns to zero. The following restrictions apply:

TMR ≤ MUR: MUR/TMR must be an integer value. These values divide a full rotation into multiple parts. For example, MUR = 36,000, TMR = 6,000. Position will change from 0 to 5999 for every 60° of rotation.

TMR ≥ MUR: (Multi turn units only) TMR must equal MUR * 2^n, where ($0 \le n \le 12$) for 28 bit NR25 encoders and ($0 \le n \le 14$) for 30 bit NR25 encoders. The number of turns encoded by an NR25 must be a power of two. Therefore, the Total Measurement Range must be the number of turns multiplied by the Measure Units per Revolution.

Preset Value

Only available in Class 2 and AMCI 2, this parameter allows you to preset the position to any value in its range without rotating the shaft. The minimum value for this parameter is zero. Its maximum value is equal to (TMR–1). This parameter can optionally be stored in non-volatile Flash memory and applied on power up.

Velocity Format

When configured to use the AMCI 2 class, the NR25 reports velocity data as well as position data over the network. This parameter uses two bits and sets the units of measure for the velocity data. This parameter has four fixed values.

- **00** = pulses/second
- **01** = pulses/100 milliseconds
- **10** = pulses/10 milliseconds
- **11** = RPM

The velocity data will always be scaled by the ***Measuring Units Per Revolution (MUR)*** parameter. For example, if the MUR equals 5,000 and the Velocity Format is set to "pulses/second", then a velocity value of 5,000 means that the NR25 is rotating at one revolution per second.

Effects of Reversing Count Direction

Changing the ***Code Sequence*** parameter changes the way the position value is calculated. When you reverse the count direction, the position changes from your current position value to (Maximum number of counts – current position value). For example, assume a 30 bit NR25 with its default of 65,536 counts per turn. If the current position value is 100,000 and you change the code Sequence parameter, the current position will change to (2^{30} – 100,000 = 1,073,741,824 – 100,000) = 1,073,641,824. Most applications do not require you to change the count direction after the machine is setup, so the Code Sequence parameter should be set before the position value is preset.

Changing the Code Sequence parameter on your machine while maintaining the current position value is a three step process that is only available when using Class 2 or AMCI 2 functionality. First, read and store the current position value from the NR25. Second, change the *Code Sequence* parameter. Third, write the stored position value back to the NR25 as a preset value.

CHAPTER 2
INSTALLATION

This chapter is intended for the engineer or technician responsible for installing and wiring the NR25 networked resolver encoder. Information in this chapter includes mechanical drawings, installation guidelines and connector pinout.

Servo Mount Outline Drawing

Aluminum Body, End Connect

( ) = Dimensions in millimeters

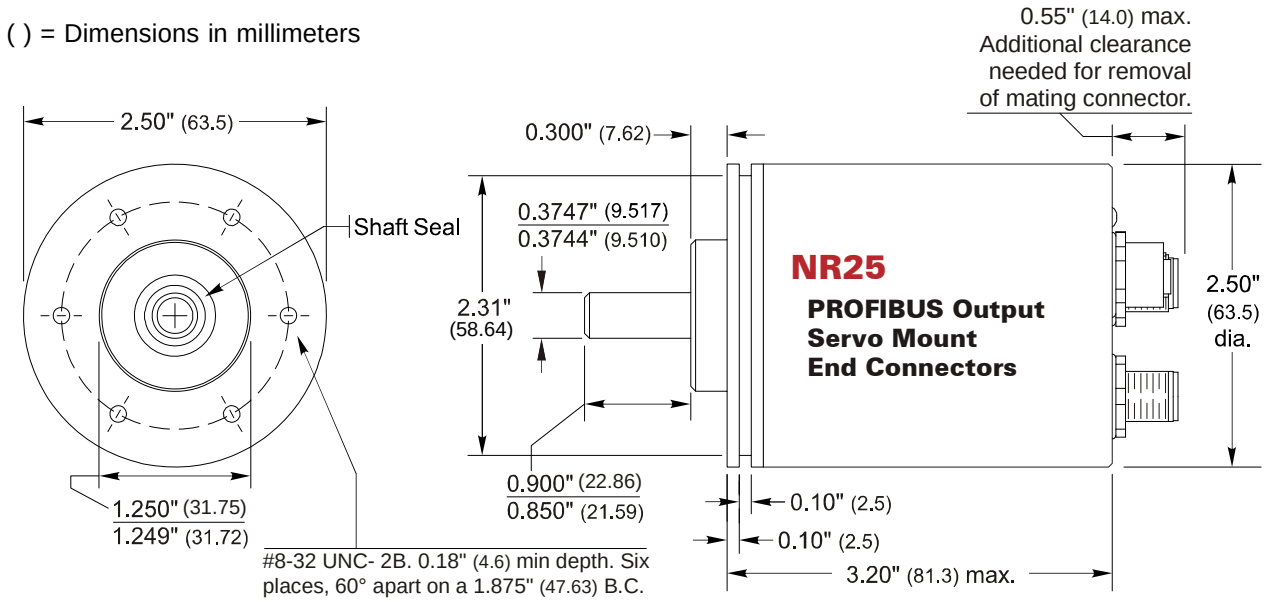


Figure 2.1 Servo Mount, End Connector, Aluminum Body Outline Drawing

Stainless Steel Body, End Connect

( ) = Dimensions in millimeters

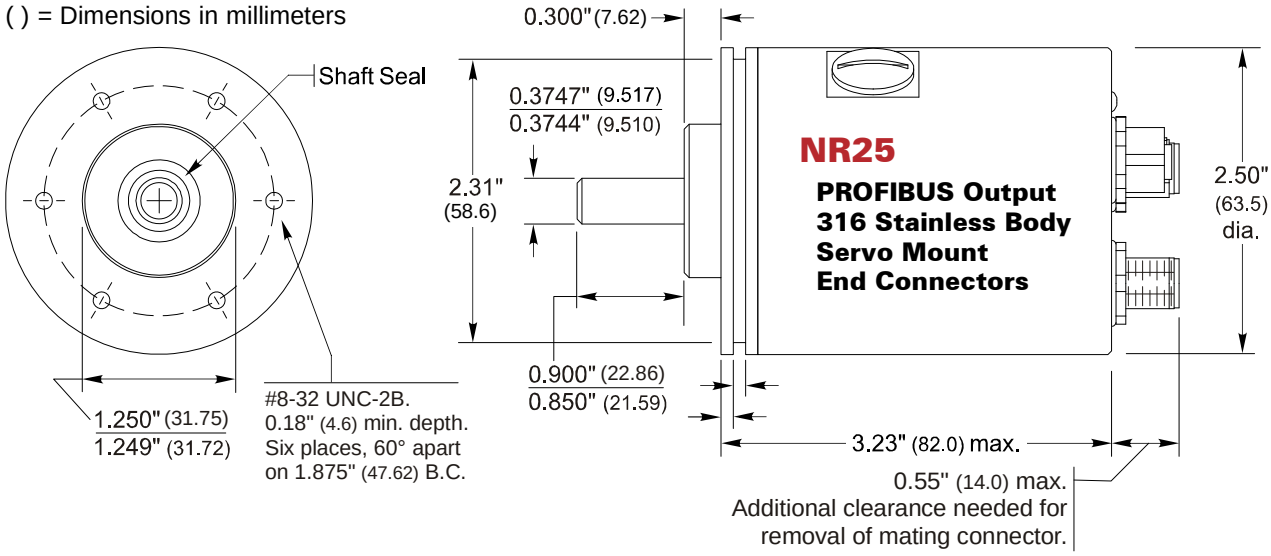
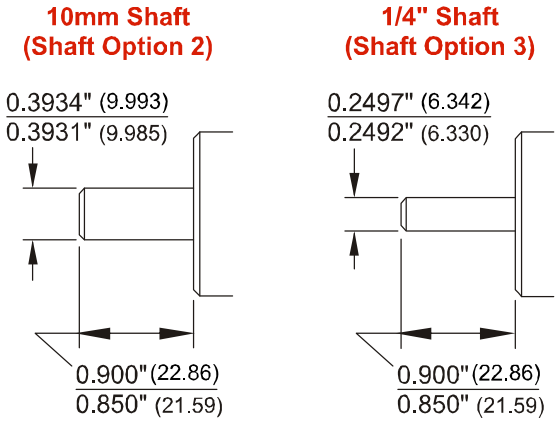


Figure 2.2 Servo Mount, End Connector, SS Body Outline Drawing

Servo Mount Outline Drawings (continued)

Alternate Shafts



() = Dimensions in mm

Figure 2.3 Servo Mount Alternate Shafts

Shaft Loading

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 bearings will statistically last longer if you can limit shaft loading below the given values. Consider using the 5/8" shaft NR25 if your shaft loading is expected to be greater than the values given below. Outline drawings for the 5/8" shaft NR25 can be found starting on page 19.

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

Table 2.1 Servo Mount Shaft Loading

Flange Mount Outline Drawings

Aluminum Body, End Connect

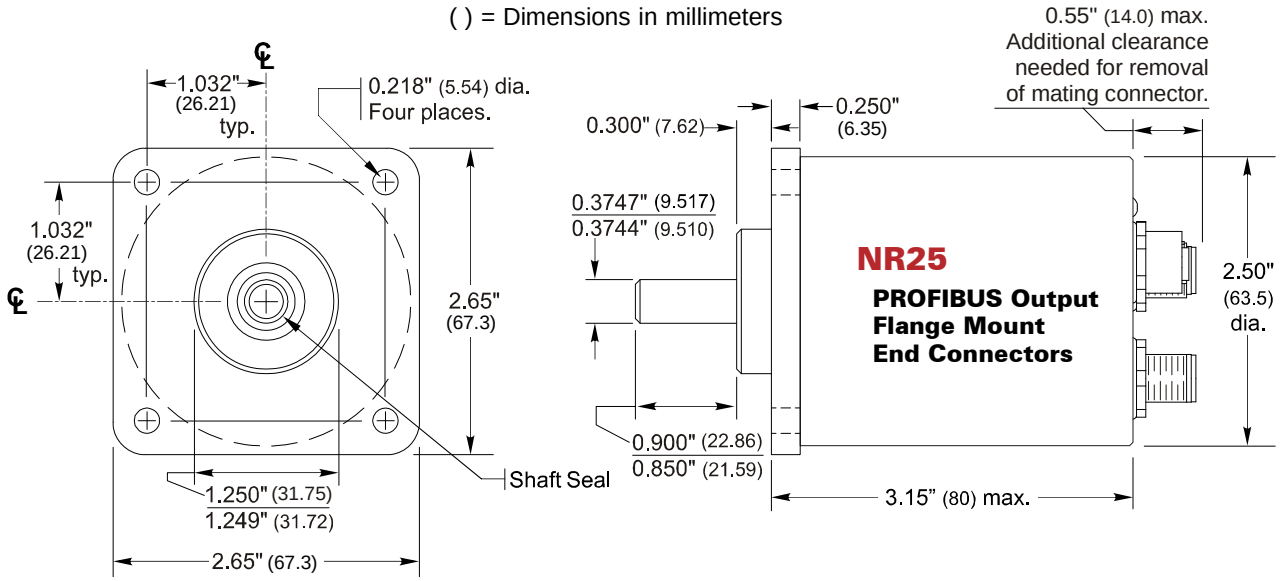


Figure 2.4 Flange Mount, End Connector, Aluminum Body Outline Drawing

Stainless Steel Body, End Connect

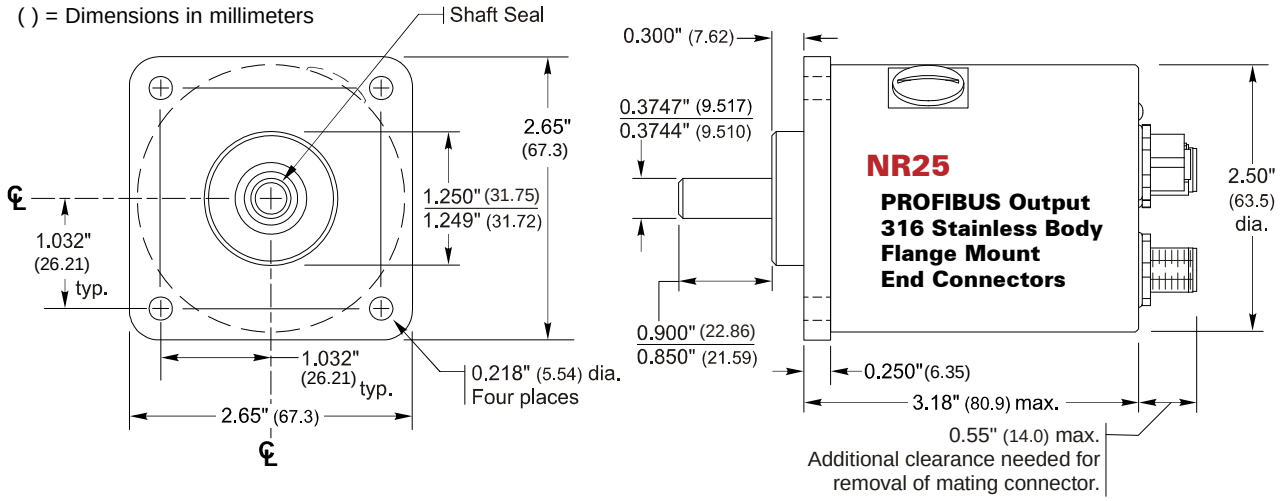
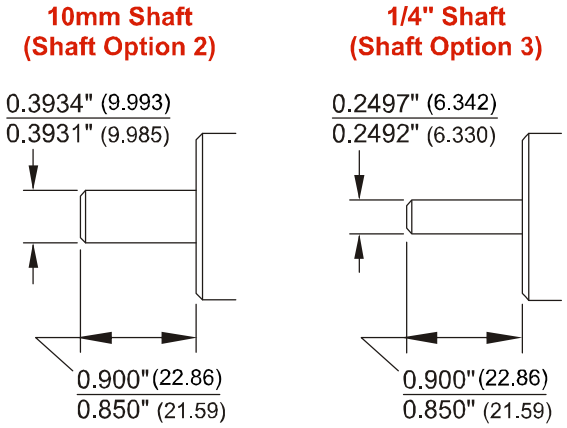


Figure 2.5 Flange Mount, End Connector, Stainless Steel Body Outline Drawing

Flange Mount Outline Drawings (continued)

Alternate Shafts



() = Dimensions in mm

Figure 2.6 Flange Mount Alternate Shafts

Shaft Loading

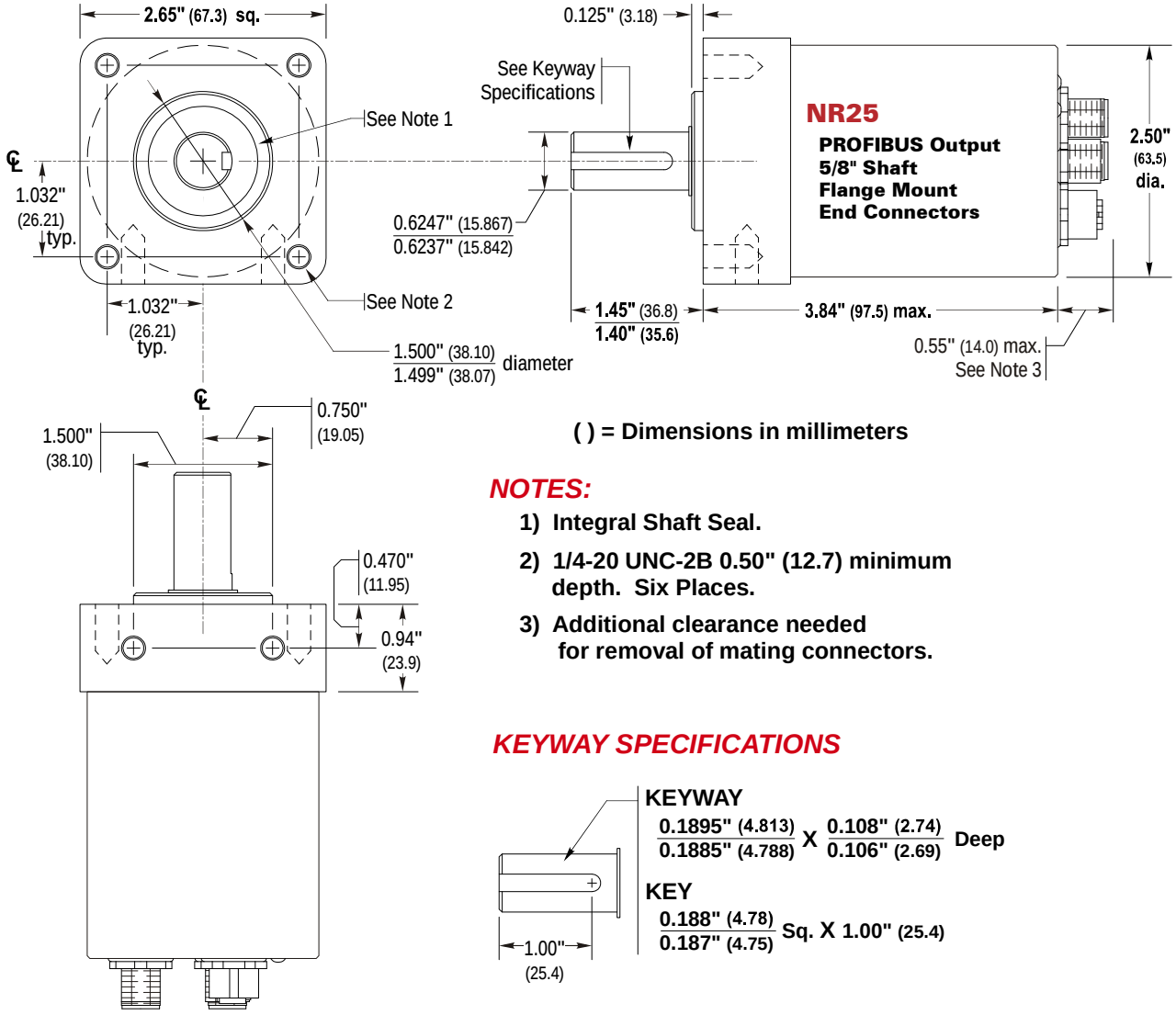
Limit shaft loading to the following values. These values statistically yield an L10 life of $2X10^9$ revolutions. (Statistically, only 10% of the bearings will have failed after $2X10^9$ revolutions.) Shaft loading has an exponential effect on bearing life. The bearings will statistically last longer if you can limit shaft loading below the given values. Consider using the 5/8" shaft NR25 if your shaft loading is expected to be greater than the values given below. Outline drawings for the 5/8" shaft NR25 can be found starting on page 19.

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

Table 2.2 Flange Mount Shaft Loading

Flange Mount Outline Drawings (continued)

5/8" Shaft, Aluminum Body, End Connect



( ) = Dimensions in millimeters

NOTES:

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

KEYWAY SPECIFICATIONS

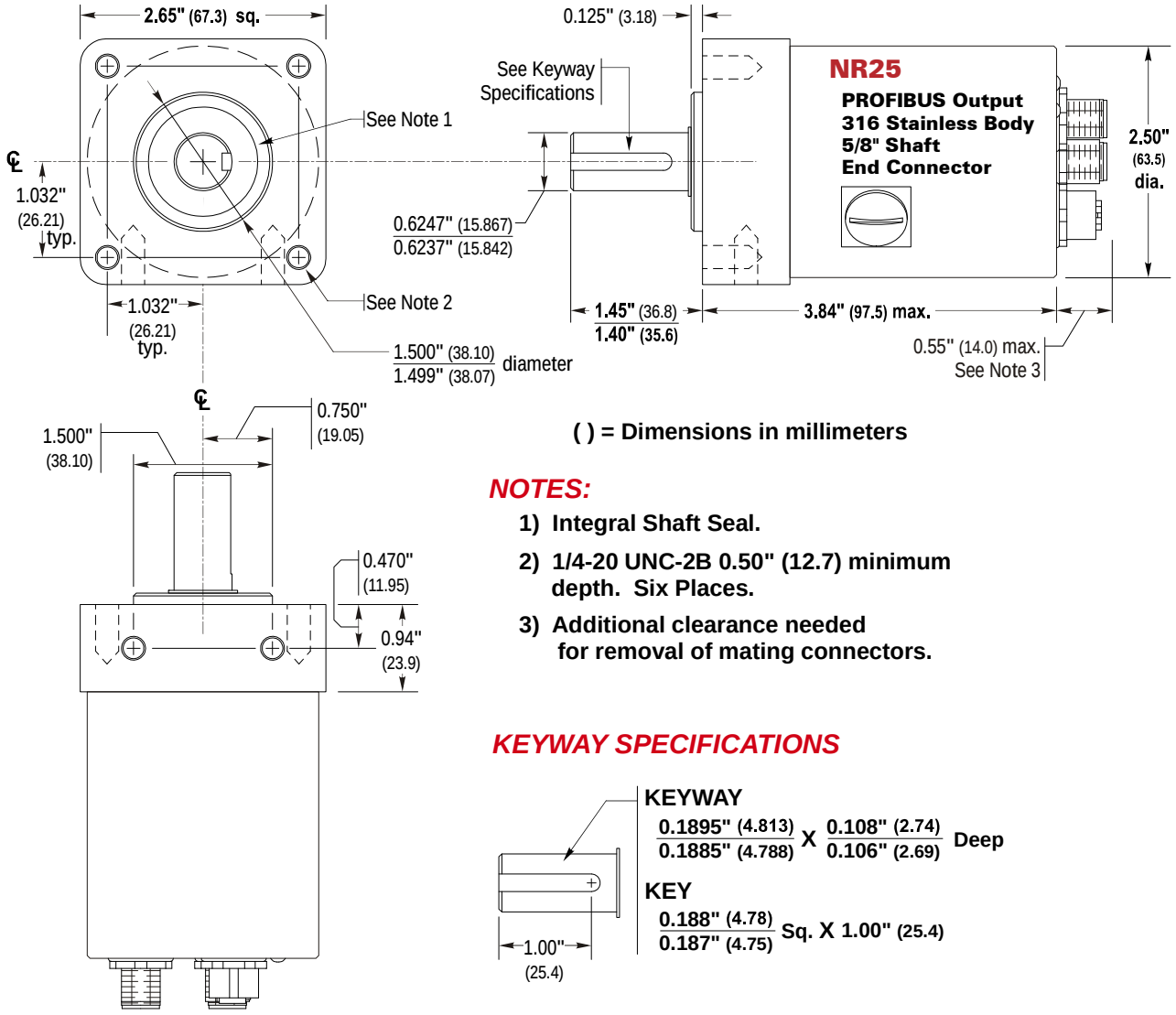
KEYWAY
0.1895" (4.813) / 0.1885" (4.788) X 0.108" (2.74) / 0.106" (2.69) Deep

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

Figure 2.7 5/8" Shaft, Flange Mount, End Connect, Aluminum Body Outline Drawing

Flange Mount Outline Drawings (continued)

5/8" Shaft, Stainless Steel Body, End Connect



NOTES:

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

KEYWAY SPECIFICATIONS

Figure 2.8 5/8" Shaft, Flange Mount, End Connect Outline Drawing

Shaft Loading

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 bearings will statistically last longer if you can limit shaft loading below the given values.

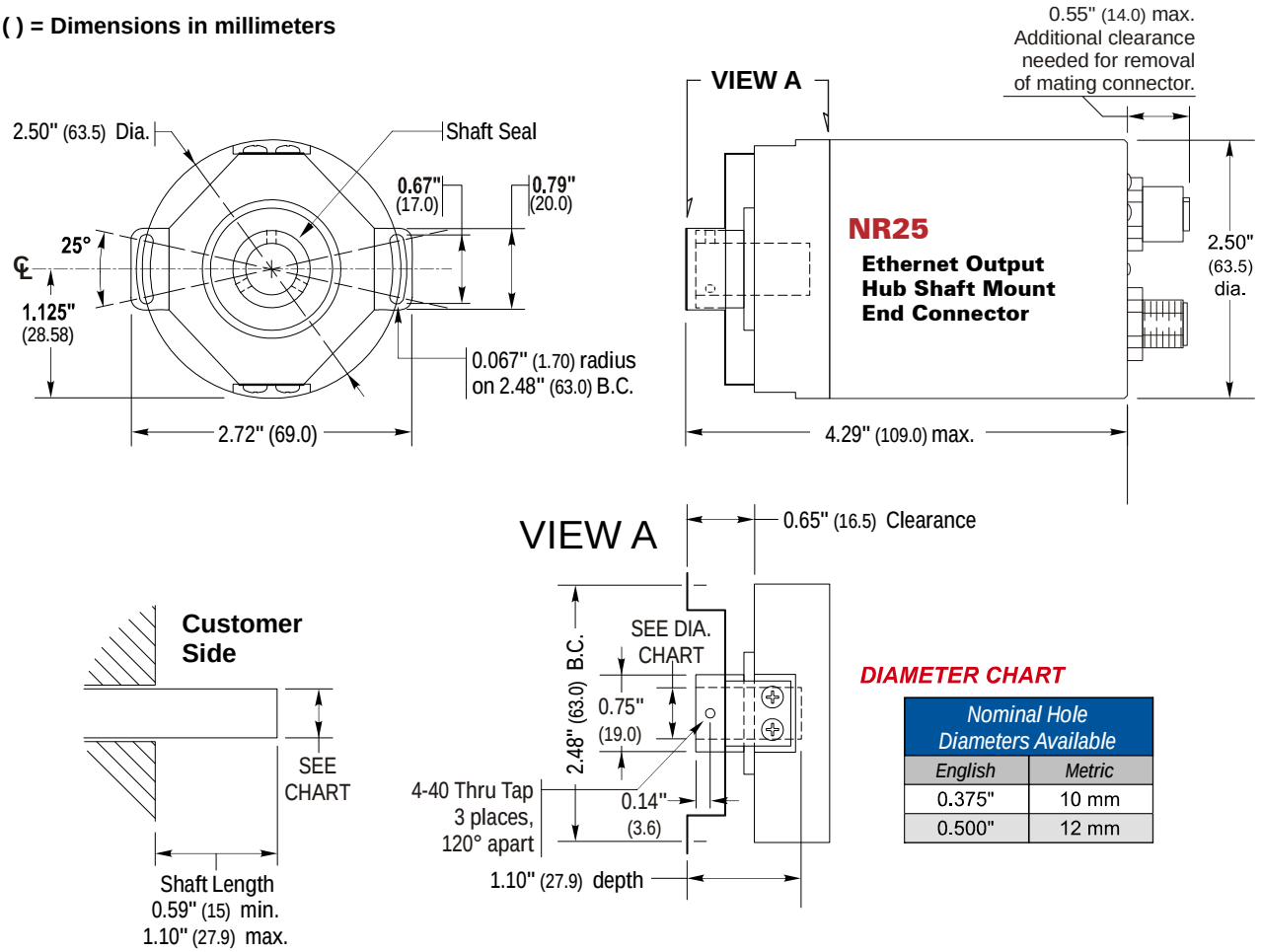
Radial Load	Axial Load
100 lbs. (445 N)	50 lbs. (222 N)

Table 2.3 Flange Mount, 5/8" Shaft Loading

Hub Shaft Mount Outline Drawings

Aluminum Body, End Connect

( ) = Dimensions in millimeters



DIAMETER CHART

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

Figure 2.9 Hub Shaft Mount, End Connect Outline Drawing

Hub Shaft Mount Outline Drawings (Continued)

Stainless Steel Body, End Connect

( ) = Dimensions in millimeters

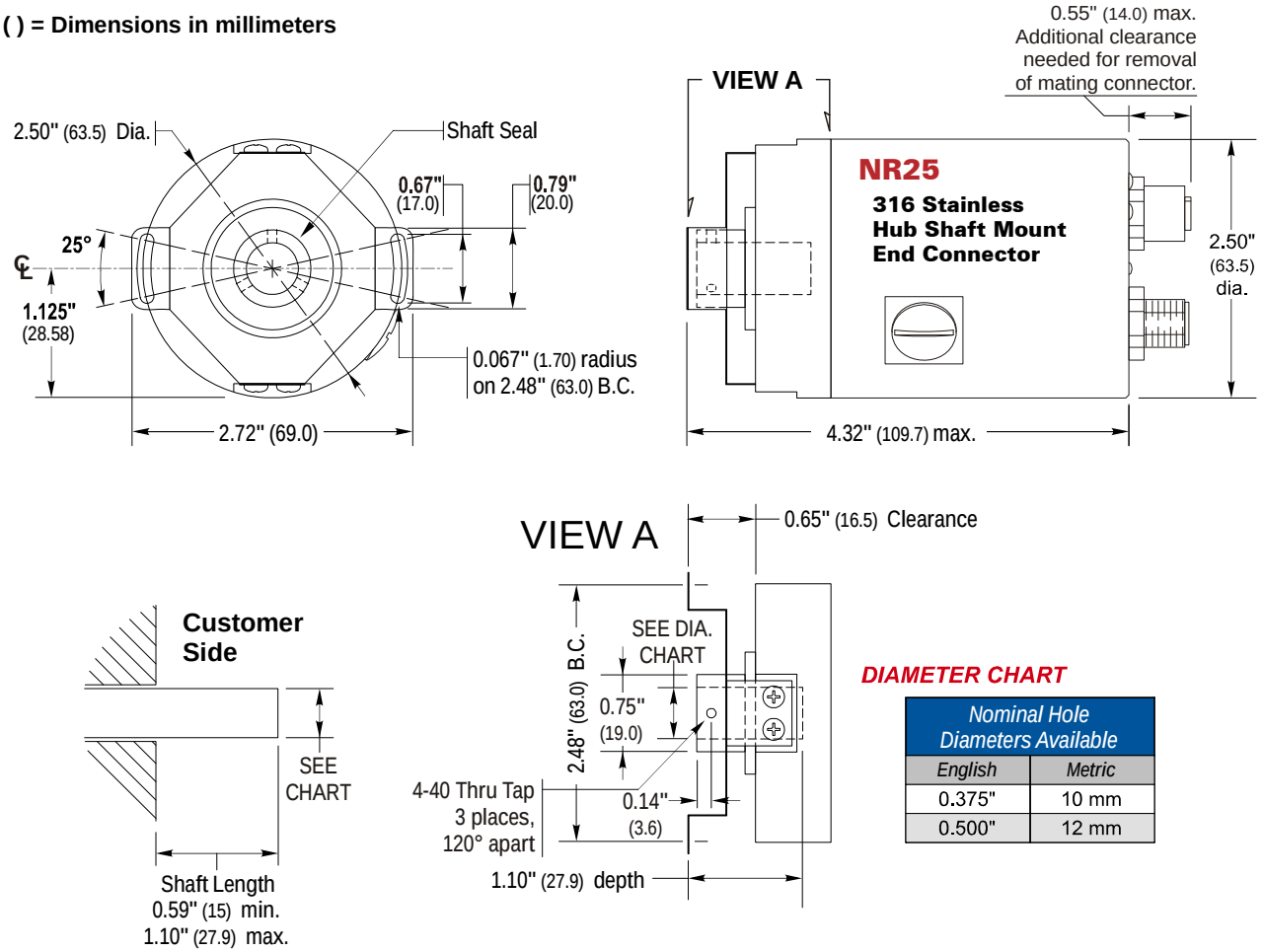


Figure 2.10 Hub Shaft Mount, End Connect Outline Drawing

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 2.4 Available Blind Shaft Diameters

Shaft Loading

The load that the NR25 presents *to* your input shaft, which is equal to the load presented to the NR25 *by* your input shaft, is difficult to calculate and depends 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 NR25 is important.

Connector Pinouts

The diagram below shows the pinouts of the Profibus NR25 connectors. Unused connectors must be capped for the unit to retain its IP67 rating.

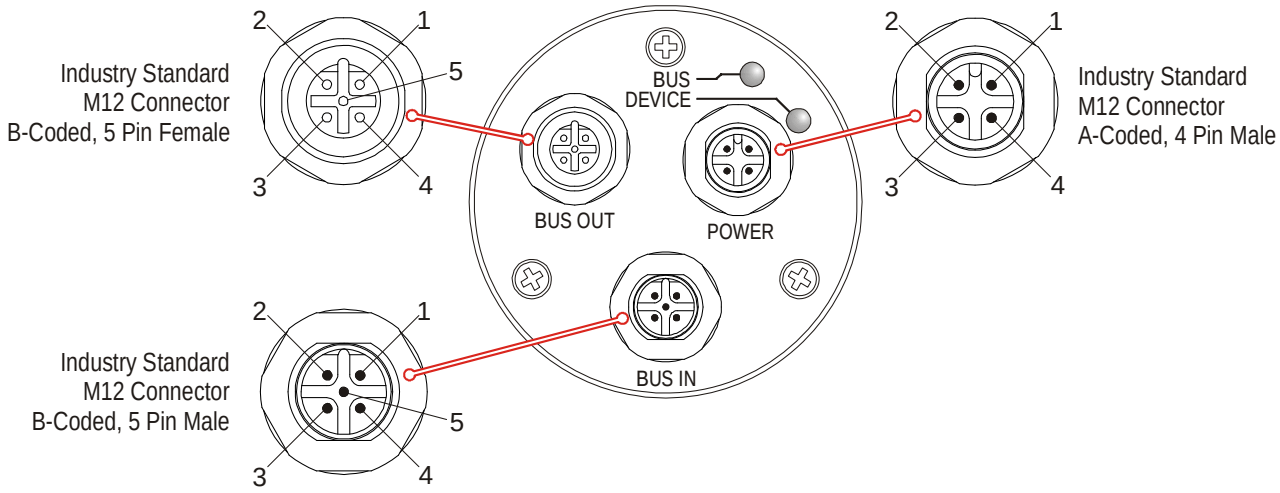


Figure 2.11 Connector Pinout

The following table lists the pinouts of the three connectors used on the Profibus NR25 units.

		Pin Number				
		1	2	3	4	5
Connector	Bus In	Not Connected	BUS-A line (–RxD/TxD) {green}	Not Connected	BUS-B line (+RxD/TxD) {red}	Not Connected
	Bus Out	BUS_VDC (isolated)	BUS-A line (–RxD/TxD) {green}	BUS_GND (isolated)	BUS-B line (+RxD/TxD) {red}	Not Connected
	Power	Vin (24Vdc nom.)	Not Connected	0V (Power Supply Common)	Not Connected	Not Available

Table 2.5 Profibus Connector Pin Outs

Compatible Wiring

There are many different suppliers of Profibus interconnections. Installing a pre-assembled and tested cordset is the most common way to wire a Profibus system. For those companies wishing to make their own cables, cable and connectors are also available from a wide variety of suppliers. A small sampling of companies is given below.

Cordsets

- Phoenix Contact: http://www.phoenixcontact.com
- Turck Inc.: http://www.turck.com or http://www.turck-usa.com
- Lumberg Automation: http://www.lumberg-automationusa.com

Compatible Wiring (continued)

Cables

- Belden Inc. http://www.belden.com (Belden part # 3079A or 3079E are suggested)
- Phoenix Contact: http://www.phoenixcontact.com (Phoenix Contact part # 2744652)

Connectors

AMCI uses Binder connectors in our Profibus NR25 units. The table below lists the Binder part number of the straight and right angle mating connectors for the BUS IN and BUS OUT connectors.

NOTE These mating connectors are "same source" suggestions, which means that you are not required to use them. Any industry standard M12 B-coded 5 pin connector will mate with the NR25 BUS IN and BUS OUT connectors.

AMCI #	Binder #	Description
MS-38	99-0436-110-05	BUS IN mating connector, B-coded, female, straight. Screw terminal connections. 6 to 8 mm dia. cable. Plastic body. IP67 rated when properly installed.
	99-0436-165-05	BUS IN mating connector, B-coded, female, right-angle. Screw terminal connections. 6 to 8 mm dia. cable. Plastic body. IP67 rated when properly installed.
MS-39	99-0437-105-05	BUS OUT mating connector, B-coded, male, straight. Screw terminal connections. 6 to 8 mm dia. cable. Plastic body. IP67 rated when properly installed.
	99-0437-145-05	BUS OUT mating connector, B-coded, male, right-angle. Screw terminal connections. 6 to 8 mm dia. cable. Plastic body. IP67 rated when properly installed.

Table 2.6 Suggested Mating Connectors - BUS IN/OUT

The table below lists the mating connectors for the POWER connector on the Profibus NR25. This straight connector is directly available from AMCI under the given part number.

NOTE These mating connectors are "same source" suggestions, which means that you are not required to use them. Any industry standard M12 A-coded 4 pin connector will mate with the NR25 POWER connector.

AMCI #	Binder #	Description
MS-29	99-0430-12-04	Power mating connector, A-coded, female, straight. Screw terminal connections. 6 to 8 mm dia. cable. Plastic body, IP67 rated when properly installed.
	99-0430-52-04	Power mating connector, A-coded, female, right-angle. Screw terminal connections. 6 to 8 mm dia. cable. Plastic body, IP67 rated when properly installed.

Table 2.7 Suggested Mating Connectors - POWER

Profibus Terminators

The Profibus must be terminated on both ends for proper operation. If the NR25 is the last unit on the line, a bus terminator must be installed on the BUS OUT connector for proper operation. Note that only the BUS OUT connector on the NR25 has the additional signals required to terminate the Profibus network. The BUS IN cannot be used to terminate the network. As with connectors and cordsets, there are several suppliers that manufacturer a Profibus Terminator. One such supplier is Phoenix Contact.

- Phoenix Contact: http://www.phoenixcontact.com (Phoenix Contact part # 1507803)

CHAPTER 3
CONFIGURING A PROFIBUS NR25

This chapter gives an overview of how to address a Profibus NR25 and configure it for your application. This information is set with the DDLM_Set_PRM communications function.

GSD File

The first step in commissioning a Profibus NR25 encoder is installing the GSD file on your Profibus Master software. This file allows you to easily choose the class of your encoder and configure its parameters. AMCI provides three different GSD files, and the one you will use is based on the resolution of your NR25 encoder. The files are available on our website at:

- ***http://www.amci.com/gsd-files/amci-nr25-profibus.zip***

The zip file contains all three GSD files.

- For 16 bit, single turn NR25 encoders: Use NR250D7E-S16.gsd
- For 28 bit, multi-turn NR25 encoders: Use NR250D7E-M28.gsd
- For 30 bit, multi-turn NR25 encoders: Use NR250D7E-M30.gsd

You must register the GSD file with the configuration software of your Profibus Master. Please refer to the documentation for your Profibus Master software to determine how to accomplish this.

Addressing the NR25

Every device attached to a Profibus master must have its own unique address. The NR25 has a factory default address of '123' and this address can be changed when you configure the NR25. Please refer to your Profibus master software to determine how to accomplish this.

Configuring the NR25

Once the GSD file is installed and the NR25 address is set, use the software of your Profibus Master to configure your NR25. These values are written down to the NR25 at system startup using the *DDLM_Set_Prm* communication function. Once these parameter are written down to the NR25, it will enter its normal mode of operation. Data transferred in this mode is explained in the next chapter, ***DATA TRANSFER***, starting on page 27.

Choosing the NR25 Class

The first thing to do when configuring the NR25 is to choose its class. Figure 3.1 shows a typical screen where you choose the class you want for the NR25.

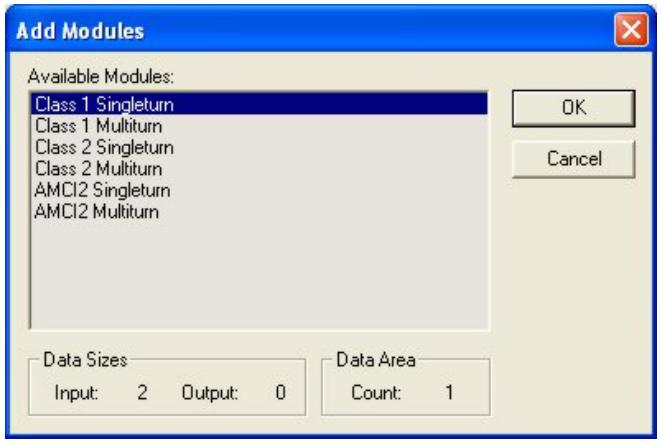


Figure 3.1 Selecting the NR25 Class

Configuring the NR25 (continued)

Setting Configuration Parameters

The class you choose defines the configuration parameters that are available to you. Figure 3.2 shows a typical screen where you set the parameter values. In this example, double clicking on a parameter value allows you to change it. Your software may operate differently.

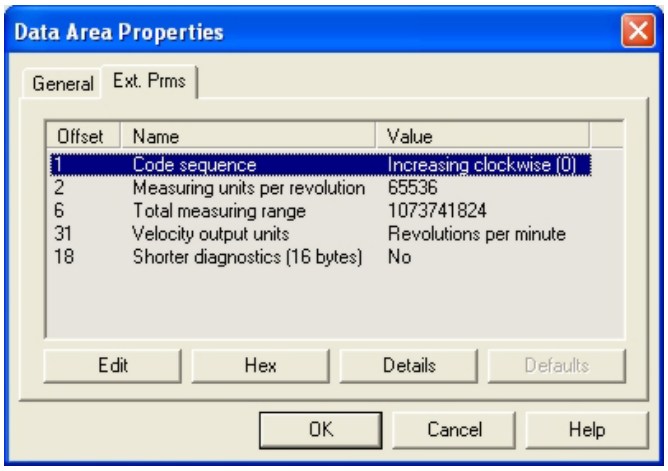


Figure 3.2 Setting Configuration Values

Configuration Parameter Values

The following table lists the available configuration parameters, the device classes they are available in, their data type, and their valid ranges. A detailed explanation of all of the parameters can be found in the ***Programmable Parameters*** section of chapter 1, starting on page 13.

Parameter	Class	Data Type	Ranges
Code Sequence	All	Bit	0 = CW increasing (Default) 1 = CCW increasing
Class 2 Functionality	Class 2 only	Bit	0 = Class 2 Functionality Disabled 1 = Class 2 Functionality Enabled (Default)
Measuring Units per Revolution (MUR)	Class 2 and AMCI 2	Unsigned 32 bit	Single turn: 2 to 65,536 Multi-turn: 1 to 65,536 Default = 2^{16} = 65,536
Total Measuring Range (TMR)	Class 2 and AMCI 2 only	Unsigned 32 Bit	*If TMR<=MUR*, MUR/TMR must be integer value. *If TMR>MUR*, TMR/MUR must be in {2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096} For 30 bit units, TMR/MUR can also be in {8192, 16384} Default = 2^{16}= 65,536 for single turn units = 2^{28} = 268,435,456 for 28 bit units = 2^{30} = 1,073,741,824 for 30 bit units
Shorter Diagnostics	AMCI 2 only	Bit	0 = Disabled (57 byte Extended Diagnostics) (Default) 1 = Enabled (16 byte Class 1 Diagnostics)
Velocity Control	AMCI 2 only	2 Bits	00 = Counts/second 01 = Counts/100 milliseconds 10 = Counts/10 milliseconds 11 = Revolutions/minute (Default)

Table 3.1 Configuration Parameter Values

CHAPTER 4
DATA TRANSFER

This chapter describes the data transferred by the NR25 when using the *DDLM_Data_Exchange* communication function. This mode is used to read position data from the NR25. If the programmed class supports it, the NR25 will report velocity data and allow you to apply a position preset value.

Identifier Bytes

Identifier Bytes are used to determine the number of I/O words used by the NR25. The Profibus NR25 encoders use various combinations of the $D0_{16}$, $D1_{16}$, $E0_{16}$, $F0_{16}$, and $F1_{16}$ Identifier Bytes as shown in the table below.

Class	Identifier	Inputs	Outputs	Use
Class 1 Single turn	$D0_{16}$	1	0	16 bit Position Data (Input)
Class 1 Multi-turn	$D1_{16}$	2	0	32 bit Position Data (Input)
Class 2 Single Turn	$F0_{16}$	1	1	16 bit Position Data (Input)
	$E0_{16}$	0	1	32 bit Preset Value (Output)
Class 2 Multi-turn	$F1_{16}$	2	2	32 bit Position Data (Input) 32 bit Preset Value (Output)
AMCI 2 Single turn	$F1_{16}$	2	2	32 bit Position Data (Input) 32 bit Preset Value (Output)
	$D0_{16}$	1	0	16 bit Velocity Data (Input)
AMCI 2 Multi-turn	$F1_{16}$	2	2	32 bit Position Data (Input) 32 bit Preset Value (Output)
	$D0_{16}$	1	0	16 bit Velocity Data (Input)

16 Bit Position Data ($D0_{16}$ or $F0_{16}$)

Single turn position data for Class 1 and Class 2 encoders is transmitted in a 16 bit word. The position data is right aligned in the data field.

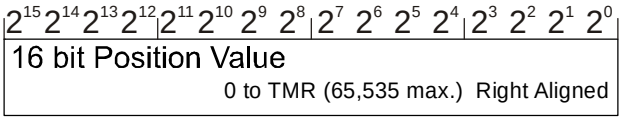


Figure 4.1 16 bit Position Format

32 Bit Position Data ($D1_{16}$ or $F1_{16}$)

Single turn position data for the AMCI 2 class, and multi-turn position data for all classes, is transmitted in a 32 bit word. The position data is right aligned in the data field. The AMCI 2 class offers two status bits in the position data, at bit locations 30 and 31.

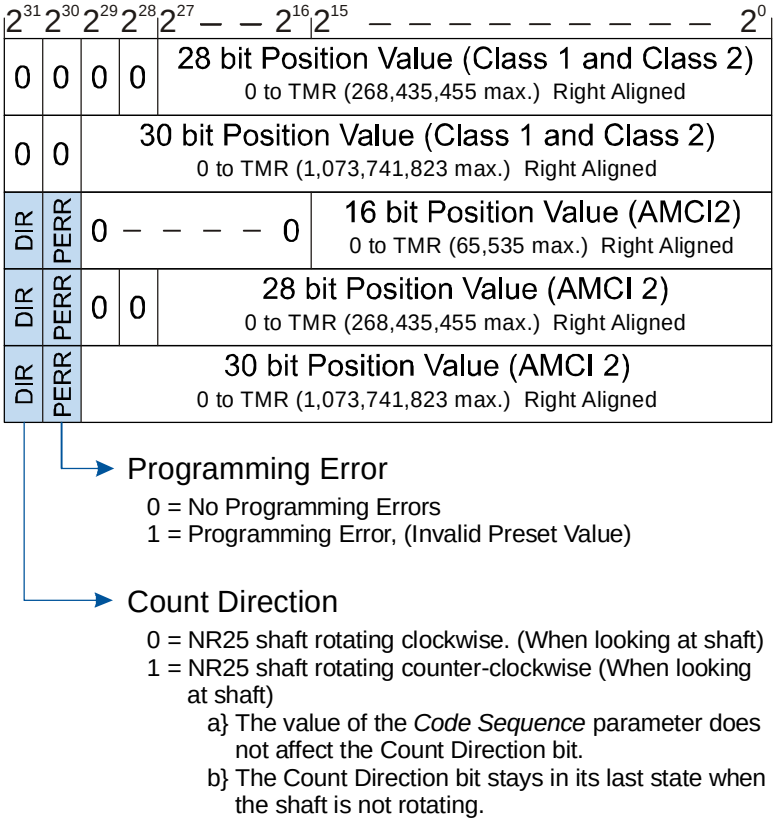


Figure 4.2 32 Bit Position Value

16 Bit Velocity Data ($D0_{16}$)

Sixteen bit velocity data is available when the NR25 encoder is configured as AMCI 2 Class. The velocity data is right aligned in the data field.

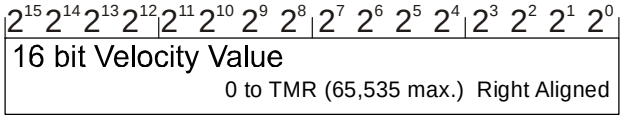


Figure 4.3 16 bit Velocity Format

- The velocity data is always a positive scalar value with a maximum of 65,535.
- If you need to know the direction of rotation, use the Count Direction bit that is available as bit 31 of the AMCI 2 Class position data.
- If the velocity value exceeds 65,535, the NR25 will leave the velocity data at this value. ($FFFF_{16}$).

Position Preset ($F0_{16}$/$E0_{16}$ or $F1_{16}$)

The Class 2 and AMCI 2 classes give you the ability to offset the mechanical position of the encoder over the network. This allows you to bring the position value to a known machine position without physically rotating the shaft of the encoder. There are three different preset functions available, and they are controlled by the Preset Control Bits.

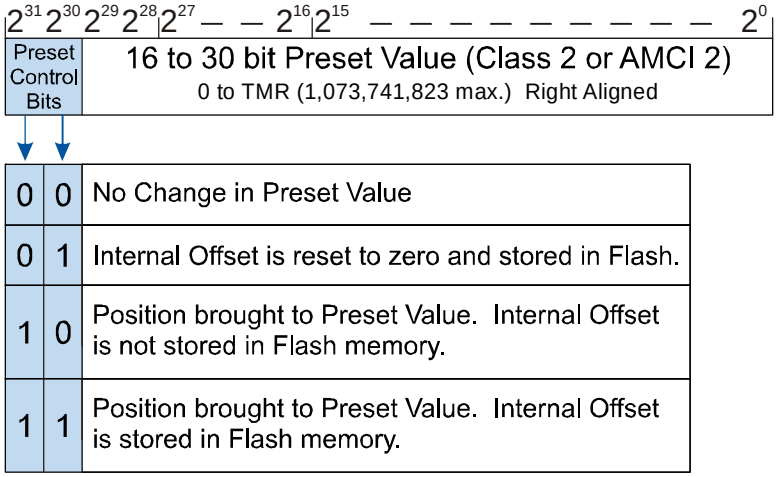


Figure 4.4 Position Preset Value Format

- The Position Preset function should only be used when the encoder is at standstill.
- When the Preset Control Bits are set to their "01" pattern, the Internal Offset is reset to zero and the NR25 begins to output the actual mechanical position of the encoder. The Internal Offset value is available in the Extended Diagnostics information. The format of the ***Extended Diagnostics*** information is described starting on page 33.
- The internal Flash memory is limited to 10,000 write cycles. If you are periodically presetting the position, or if you home the machine and preset the position on every power up, consider using the "10" bit pattern for the Preset Control Bits which does not store the Internal Offset in Flash memory.

Notes

CHAPTER 5
DIAGNOSTIC INFORMATION

This chapter describes the data transfer ed by the NR25 when using the *DDLM_Slave_Diag* communication mode. This mode is used to read diagnostic information from the NR25.

Diagnostic Length

NR25 devices will transmit either 16 bytes of diagnostic information or 57 bytes.

Shorter Diagnostics

Shorter Diagnostics refers to the 16 bytes of diagnostic information.

- NR25 encoders that are configured as Class 1 devices only offer the Shorter Diagnostics information.
- NR25 encoders that are configured as Class 2 devices only offer the Extended Diagnostics information.
- NR25 encoders that are configured as AMCI 2 devices can be configured to transmit Shorter Diagnostics information by setting the Shorter Diagnostics bit in the configuration data. See the ***Configuration Parameter Values*** section starting on page 26 for more information. This length is compatible with previous Profibus-DP versions and is required for proper operations with older Profibus Masters.

Extended Diagnostics

Extended Diagnostics refers to the 57 bytes of diagnostic information. The first sixteen bytes of this extended information is the same as the Shorter Diagnostics information.

- NR25 encoders that are configured as Class 2 devices only offer the Extended Diagnostics information.
- NR25 encoders that are configured as AMCI 2 devices transmit the Extended Diagnostic information by default. They can be configured to transmit the Shorter Diagnostics information as explained above.

Shorter Diagnostics

All classes transmit the following sixteen bytes of diagnostic information. If the NR25 is transmitting the fifty-seven byte Extended Diagnostics, forty-one additional bytes are transmitted.

Function	Data Type	Octet (Byte)	Typical Value	Description
Station Status 1	Bit	1	Determined by PROFIBUS-DP Specification	
Station Status 2	Bit	2		
Station Status 3	Bit	3		
Diagnostic Master Address	Bit	4		
PNO Identification Number	Bit	5-6	0x0D:7E	AMCI's ID assigned by PNO
Extended Diagnostic Header	String	7	0x0A or 0x33	Diagnostics length in bytes (10 or 51)
Alarm Bits	String	8	0x00	0x00 = No errors. See description below
Operating Status	String	9	Varies	See description below.
Encoder Type	String	10	0x00, 0x01	0x00 = Single turn Abs. 0x01 = Multi-turn Abs.
Single Turn Resolution	$UInt_{32}$	11-14	0x00:01:00:00	Hardware resolution of 65,536 counts per turn
# of Distinguishable Revolutions	$UInt_{16}$	15-16	0x10:00 or 0x40:00	0x1000 = 4,096 turns (28 bit), 0x4000 = 16,386 turns (30 bit)

Table 5.1 Shorter Diagnostics Format

Shorter Diagnostics (continued)

Alarm Bits (Octet 8)

- **Bit 0: Position Error -** Set to "1" to indicate an error in the position value. This error is displayed on the Status LED's by having both LED's on. This error can only be cleared by cycling power to the NR25.
- **Bit 4: Memory Error -** Set to "1" to indicate an error in reading from or writing to the Flash memory. The NR25 will continue to operate, but some of the values that are stored in Flash memory, such as the network address and offset value may be incorrect. This error can only be reset by cycling power to the NR25. If the error persists, contact AMCI Technical Support for assistance.
- **Bit 5: Offset Error -** Set to "1" to indicate an error in reading the Position Offset value from Flash memory. This error is displayed on the Status LED's by having both LED's on. This error can be cleared by presetting the position and saving the resulting offset to Flash, or clearing the Position Offset. See ***Position Preset (F016/E016 or F116)*** on page 29 for more information on presetting the position. If the error persists after presetting the position or clearing the offset, contact AMCI Technical Support for assistance.

Operating Status Bits (Octet 9)

- **Bit 0: Code Sequence -** Present value of Code Sequence parameter bit. "0" = Increasing counts with clockwise rotation. "1" = Increasing counts with counter-clockwise rotation.
- **Bit 1: Class 2 Functionality -** Set to "0" to indicate that Class 2 functionality is presently not available. This is set for all Class 1 devices and Class 2 devices when the Class 2 functionality is disabled. This bit is set to "1" to indicate that Class 2 functionality is available.
- **Bit 2: Commissioning Diagnostics -** Not used, always set to "0".
- **Bit 3: Scaling Function Status -** Not used, always set to "0".
- **Bit 6: AMCI 2 Enabled -** Set to "1" to indicate that the NR25 is configured as an AMCI 2 class device. Set to "0" when the NR25 is configured for Class 1 or Class 2. (If this bit is reset, use Bit 1: Class 2 Functionality to determine which class the NR25 is configured for.)

Extended Diagnostics

Table 5.2 on the following page lists the additional bytes that are transfer ed when the NR25 transmits Extended Diagnostic information.

NOTE The bytes shown in Table n.n are in addition to the Shorter Diagnostics data that is always transmitted. Refer to the previous section, ***Shorter Diagnostics*** for a description of the first sixteen bytes (octets) of the Extended Diagnostics data.

Function	Data Type	Octet (Byte)	Typical Value	Description
Shorter Diagnostics	Varies	1-16		Shorter Diagnostics. See Table 5.1
Additional Alarms	String	17	0x00	No additional Alarms are supported
Supported Alarms	String	18-19	0x00, 0x31	Supports Position Error, Memory Error, and Offset Error alarms. Actual alarms are in octet 8.
Warnings	String	20-21	0x00, 0x00	Warnings are not used by NR25
Supported Warnings	String	22-23	0x00, 0x00	No additional Warnings are supported
Profile Version	String	24-25	0x01, 0x01	Version 1.1 at release of the manual
Software Version	String	26-27	0x01, 0x01	Version 1.1 at release of the manual
Operating Time	$UInt_{32}$	28-31	0xFF:FF:FF:FF	Function not used. Set to 0xFFFFFFFF per Profibus-DP specification
Offset Value	Int_{32}	32-35	0x00:00:00:00 to 0x3F:FF:FF:FF	Current Position Offset based on last Preset command. Octet 35 is LSB.
Manufacturer Offset Value	Int_{32}	36-39	0x00:01:00:00	Hardware Offset. (Factory Set) Octet 39 is LSB.
Programmed Measuring Units per Revolution	$UInt_{32}$	40-43	0x00:00:00:01 to 0x00:01:00:00	User programmed MUR. Octet 43 is LSB.
Programmed Total Measuring Range	$UInt_{32}$	44-47	0x00:00:00:01 to 0x40:00:00:00	User programmed TMR. Octet 47 is LSB.
Serial Number	String	48-57	0x2A:2A:2A:2A	Function not used. Set to ASCII '****' per Profibus-DP specification.
Reserved for Future Definitions		58-61		

Table 5.2 Extended Diagnostics Format

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