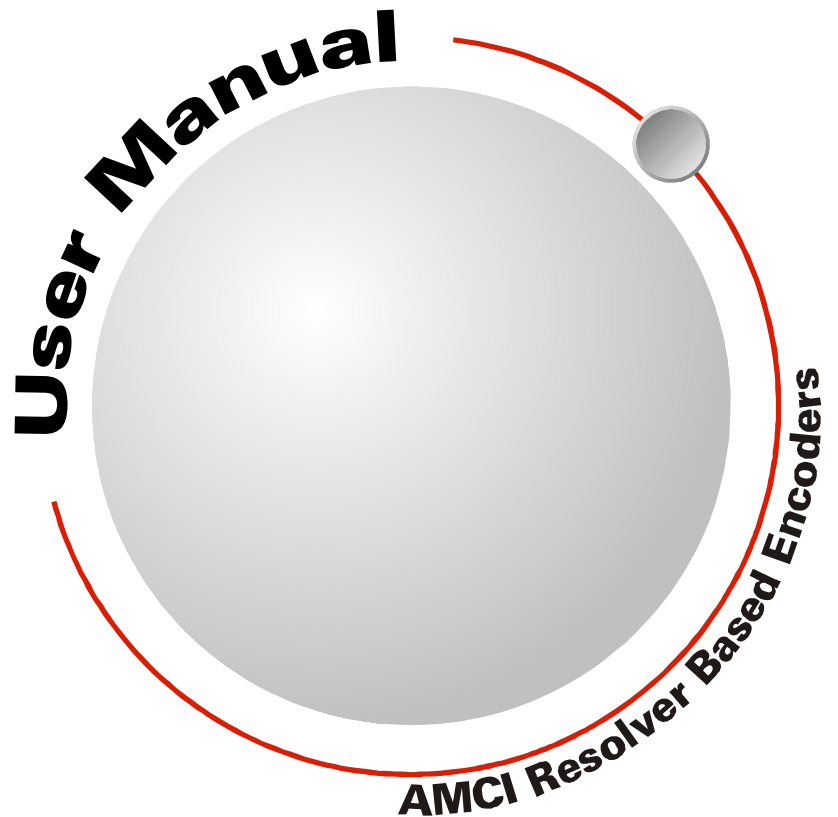


NR25

Networked Resolver for PROFIBUS



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.

UNDER NO CIRCUMSTANCES WILL ADVANCED MICRO CONTROLS, INC. BE RESPONSIBLE OR LIABLE FOR ANY DAMAGES OR LOSSES, INCLUDING INDIRECT OR CONSEQUENTIAL DAMAGES OR LOSSES, ARISING FROM THE USE OF ANY INFORMATION CONTAINED WITHIN THIS MANUAL, OR THE USE OF ANY PRODUCTS OR SERVICES REFERENCED HEREIN.

No patent liability is assumed by AMCI, with respect to use of information, circuits, equipment, or software described in this manual.

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

This manual is copyright 2011 by Advanced Micro Controls Inc. You may reproduce this manual, in whole or in part, for your personal use, provided that this copyright notice is included. You may distribute copies of this complete manual in electronic format provided that they are unaltered from the version posted by Advanced Micro Controls Inc. on our official website: www.amci.com. You may incorporate portions of this documents in other literature for your own personal use provided that you include the notice "Portions of this document copyright 2011 by Advanced Micro Controls Inc." You may not alter the contents of this document or charge a fee for reproducing or distributing it.

Standard Warranty

ADVANCED MICRO CONTROLS, INC. warrants that all equipment manufactured by it will be free from defects, under normal use, in materials and workmanship for a period of [18] months. Within this warranty period, AMCI shall, at its option, repair or replace, free of charge, any equipment covered by this warranty which is returned, shipping charges prepaid, within eighteen months from date of invoice, and which upon examination proves to be defective in material or workmanship and not caused by accident, misuse, neglect, alteration, improper installation or improper testing.

The provisions of the "STANDARD WARRANTY" are the sole obligations of AMCI and excludes all other warranties expressed or implied. In no event shall AMCI be liable for incidental or consequential damages or for delay in performance of this warranty.

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.

If you require additional technical support, call (860) 583-7271. 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.

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

TABLE OF CONTENTS

General Information

| | |
|--|---|
| Important User Information | 2 |
| Standard Warranty | 2 |
| Returns Policy | 2 |
| 24 Hour Technical Support Number | 2 |
| We Want Your Feedback | 2 |

About this Manual

| | |
|--|---|
| Audience | 5 |
| Applicable Units | 5 |
| Navigating this Manual | 5 |
| Manual Conventions | 6 |
| Trademarks and Other Legal Stuff | 6 |
| Revision Record | 6 |
| Revision History | 6 |
| Where to Go From Here | 7 |

Chapter 1: Introduction to the NR25

| | |
|------------------------------------|----|
| Overview | 9 |
| Electrical Specifications | 10 |
| Mechanical Specifications | 10 |
| Environmental Specifications | 10 |
| Connector Placements | 11 |
| Status LED's | 11 |
| Part Number Description | 12 |
| DP-V0 Encoder Profile | 12 |
| DP-V0 Encoder Classes | 12 |
| Class 1 | 12 |
| Class 2 | 12 |
| AMCI 2 | 13 |
| GSD File | 13 |
| Programmable Parameters | 13 |
| Code Sequence | 13 |
| Measuring Units | |
| Per Revolution (MUR) | 13 |
| Total Measurement | |
| Range (TMR) | 14 |
| Preset Value | 14 |
| Velocity Format | 14 |

| | |
|--|----|
| Effects of Reversing Count Direction | 14 |
|--|----|

Chapter 2: Installation

| | |
|--|----|
| Servo Mount Outline Drawing | 15 |
| Aluminum Body, End Connect | 15 |
| Stainless Steel Body, | |
| End Connect | 15 |
| Alternate Shafts | 16 |
| Shaft Loading | 16 |
| Flange Mount Outline Drawings | 17 |
| Aluminum Body, End Connect | 17 |
| Stainless Steel Body, | |
| End Connect | 17 |
| Alternate Shafts | 18 |
| Shaft Loading | 18 |
| 5/8" Shaft, Aluminum Body, | |
| End Connect | 19 |
| 5/8" Shaft, Stainless Steel Body, | |
| End Connect | 20 |
| Shaft Loading | 20 |
| Hub Shaft Mount Outline Drawings | 21 |
| Aluminum Body, End Connect | 21 |
| Stainless Steel Body, | |
| End Connect | 22 |
| Available Shaft Diameters | 22 |
| Shaft Loading | 22 |
| Connector Pinouts | 23 |
| Compatible Wiring | 23 |
| Cordsets | 23 |
| Cables | 24 |
| Connectors | 24 |
| Profibus Terminators | 24 |

Chapter 3: Configuring a Profibus NR25

| | |
|--|----|
| GSD File | 25 |
| Addressing the NR25 | 25 |
| Configuring the NR25 | 25 |
| Choosing the NR25 Class | 25 |
| Setting Configuration Parameters | 26 |
| Configuration Parameter Values | 26 |

Chapter 4: Data Transfer

| | |
|---|----|
| Identifier Bytes | 27 |
| 16 Bit Position Data (D016 or F016) | 27 |
| 32 Bit Position Data (D116 or F116) | 28 |
| 16 Bit Velocity Data (D016) | 28 |
| Position Preset (F016/E016 or F116) | 29 |

Chapter 5: Diagnostic Information

| | |
|--------------------------------------|----|
| Diagnostic Length | 31 |
| Shorter Diagnostics | 31 |
| Extended Diagnostics | 31 |
| Shorter Diagnostics | 31 |
| Alarm Bits (Octet 8) | 32 |
| Operating Status Bits (Octet 9) | 32 |
| Extended Diagnostics | 33 |

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

The release of this manual coincides with the release of 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. |
| <i>Emphasis Font</i> | Font used the first time a new term is introduced. |
| <i>Cross Reference</i> | When viewing the PDF version of the manual, clicking on the cross reference text jumps you to referenced section. |

Trademarks and Other Legal Stuff

The AMCI logo is a registered trademark of Advanced Micro Controls Inc. “Adobe” and “Acrobat” are registered trademarks of Adobe Systems Incorporated.

All other trademarks contained herein are the property of their respective holders.

Revision Record

This manual, 940-0D100 is the first release of this manual. It was released on December 8th, 2011.

Revision History

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

ABOUT THIS MANUAL

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 | <i>INTRODUCTION TO THE NR25</i> | 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 | <i>INSTALLATION</i> | 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 | <i>CONFIGURING A PROFIBUS NR25</i> | 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 | <i>DATA TRANSFER</i> | 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 | <i>DIAGNOSTIC INFORMATION</i> | 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

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.

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.



Figure 1.1 NR25 Resolver Based Encoder



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-sec²)

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 2X10⁹ revolutions.

Max. Shaft Loading (All other shafts)

Axial: 20lbs. (89N)

Radial: 40lbs. (178N)

At specified max. loads, minimum bearing life is 2X10⁹ 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.

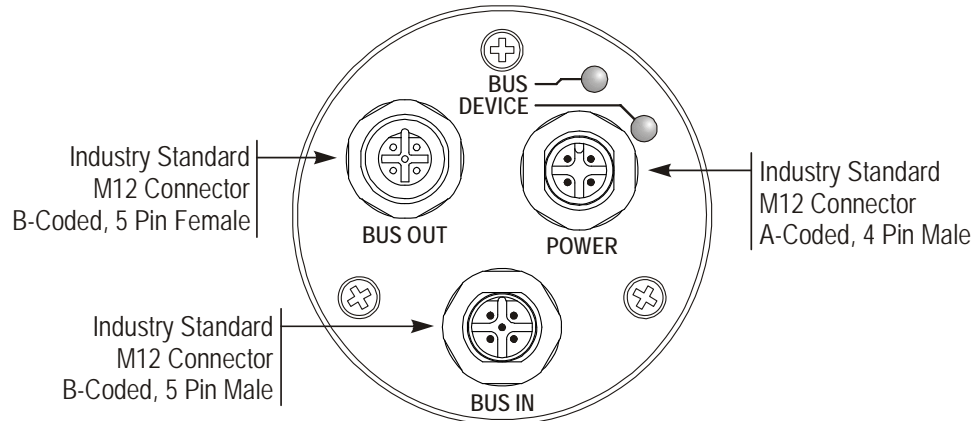


Figure 1.2 Status LED's and Connectors

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

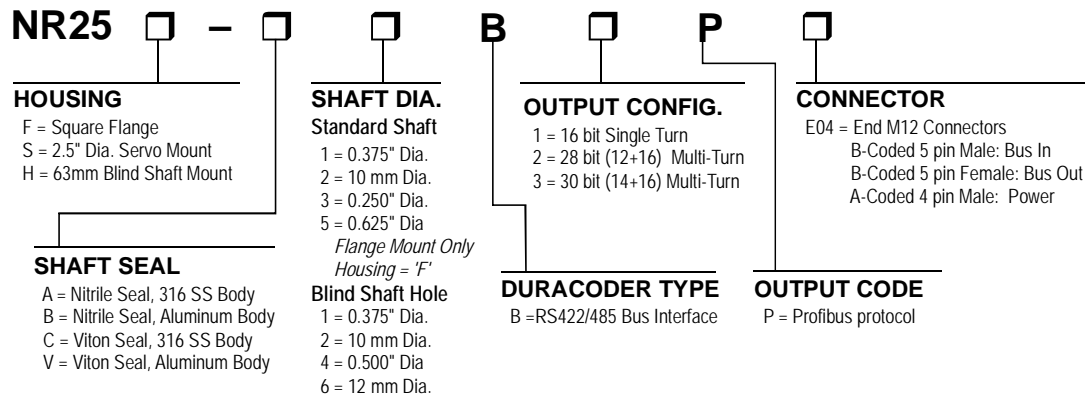


Figure 1.3 Part Number Description

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 $\{2^{(28-16)}\}$ before the position returns to zero.
- 30 bit multi-turn units must complete 16,384 turns $\{2^{(30-16)}\}$ 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:

$TMR \leq MUR$: 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.

$TMR \geq MUR$: (Multi turn units only) TMR must equal $MUR * 2^n$, where $(0 \leq n \leq 12)$ for 28 bit NR25 encoders and $(0 \leq n \leq 14)$ 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 $(\text{Maximum number of counts} - \text{current position value})$. 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

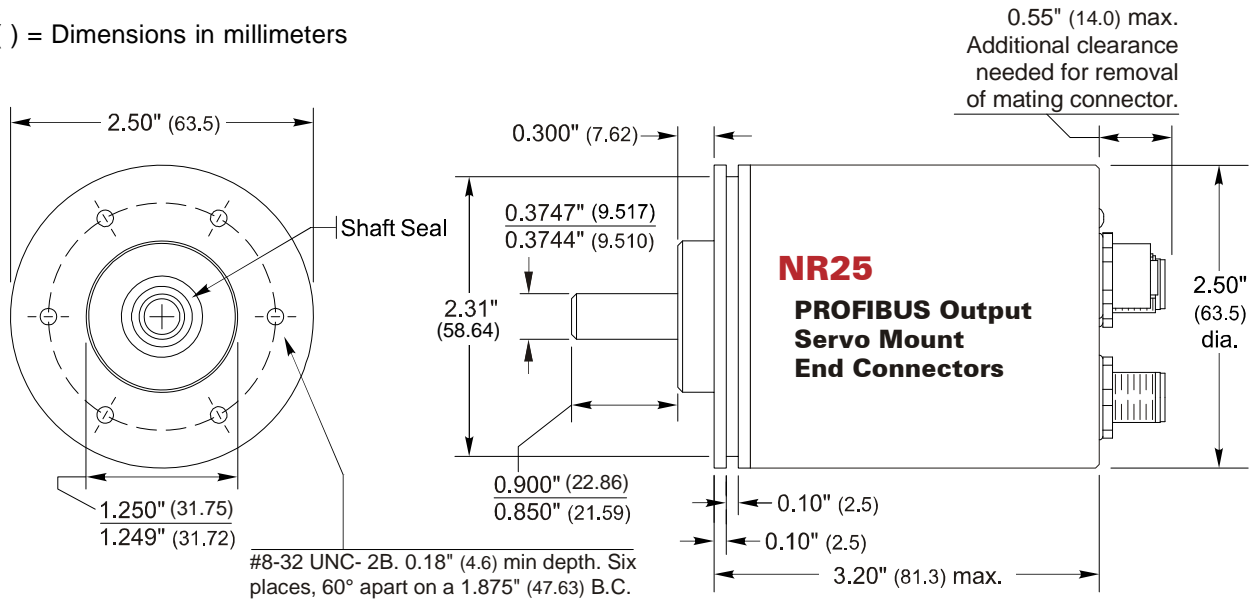


Figure 2.1 Servo Mount, End Connector, Aluminum Body Outline Drawing

Stainless Steel Body, End Connect

() = Dimensions in millimeters

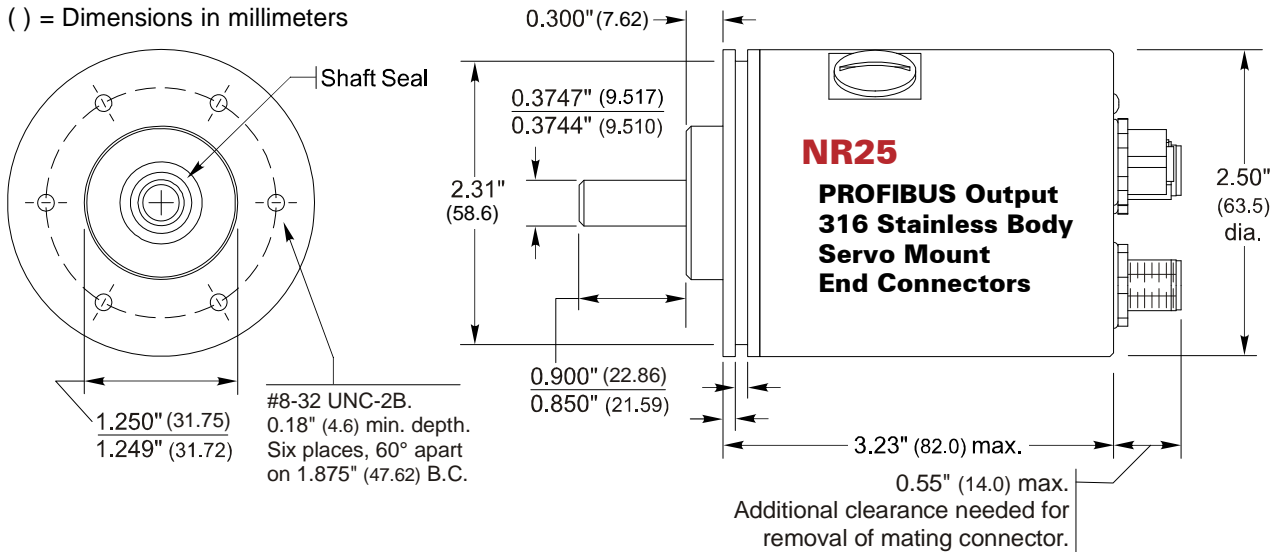


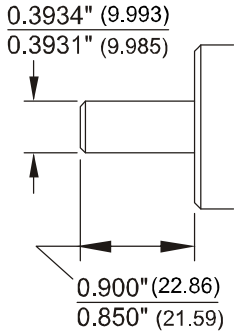
Figure 2.2 Servo Mount, End Connector, SS Body Outline Drawing



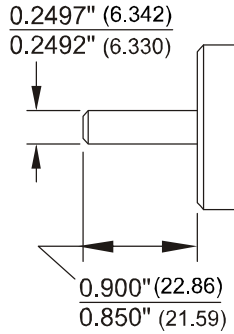
Servo Mount Outline Drawings (continued)

Alternate Shafts

**10mm Shaft
(Shaft Option 2)**



**1/4\" Shaft
(Shaft Option 3)**



() = 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 2×10^9 revolutions. (Statistically, only 10% of the bearings will have failed after 2×10^9 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

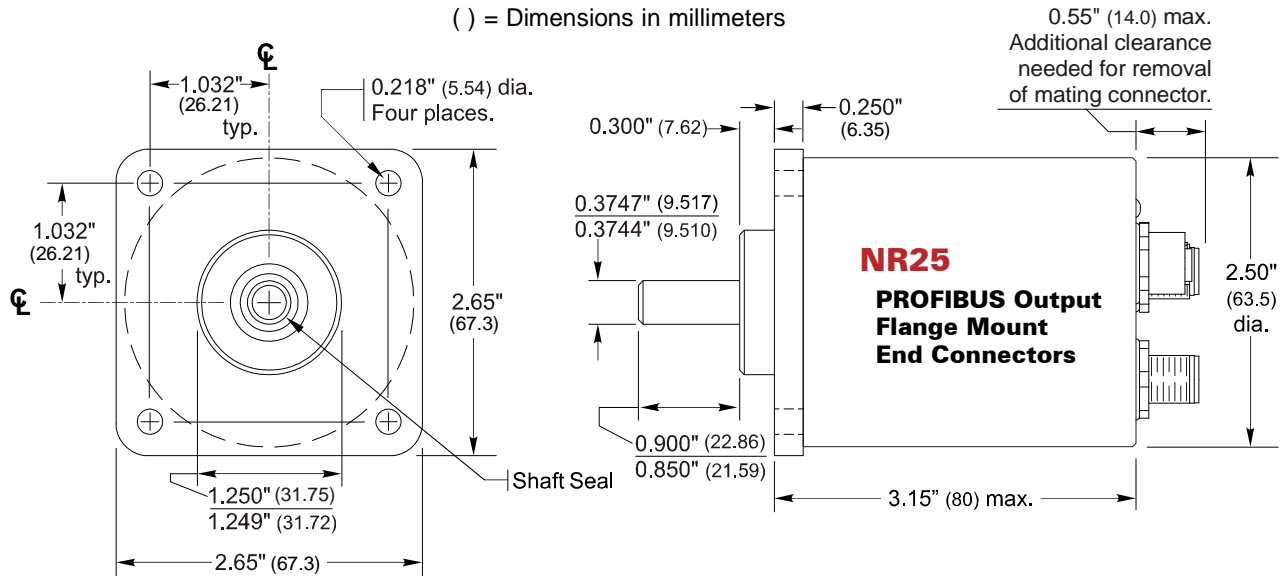


Figure 2.4 Flange Mount, End Connector, Aluminum Body Outline Drawing

Stainless Steel Body, End Connect

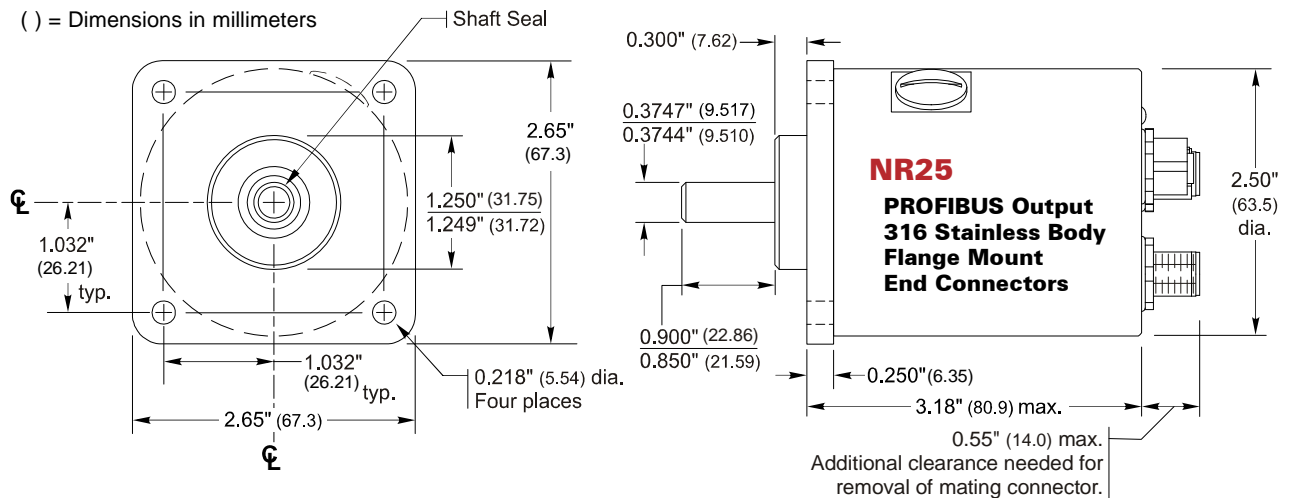


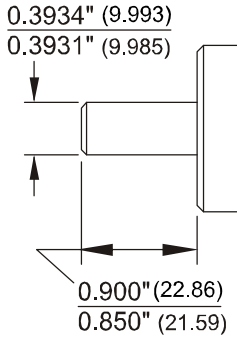
Figure 2.5 Flange Mount, End Connector, Stainless Steel Body Outline Drawing



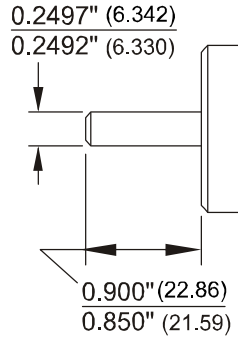
Flange Mount Outline Drawings (continued)

Alternate Shafts

**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 2×10^9 revolutions. (Statistically, only 10% of the bearings will have failed after 2×10^9 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

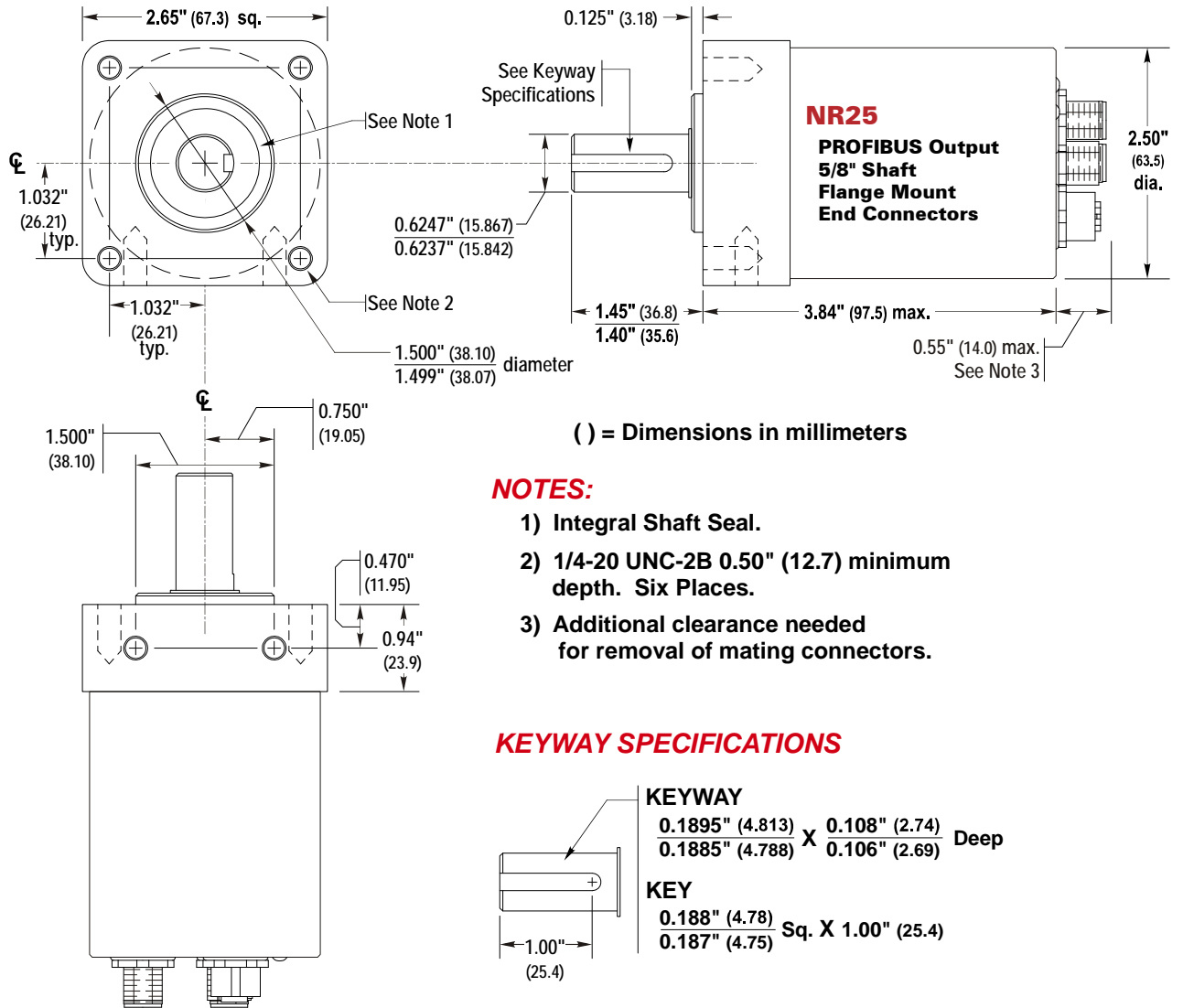


Figure 2.7 5/8" Shaft, Flange Mount, End Connect, Aluminum Body Outline Drawing



Flange Mount Outline Drawings (continued)

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

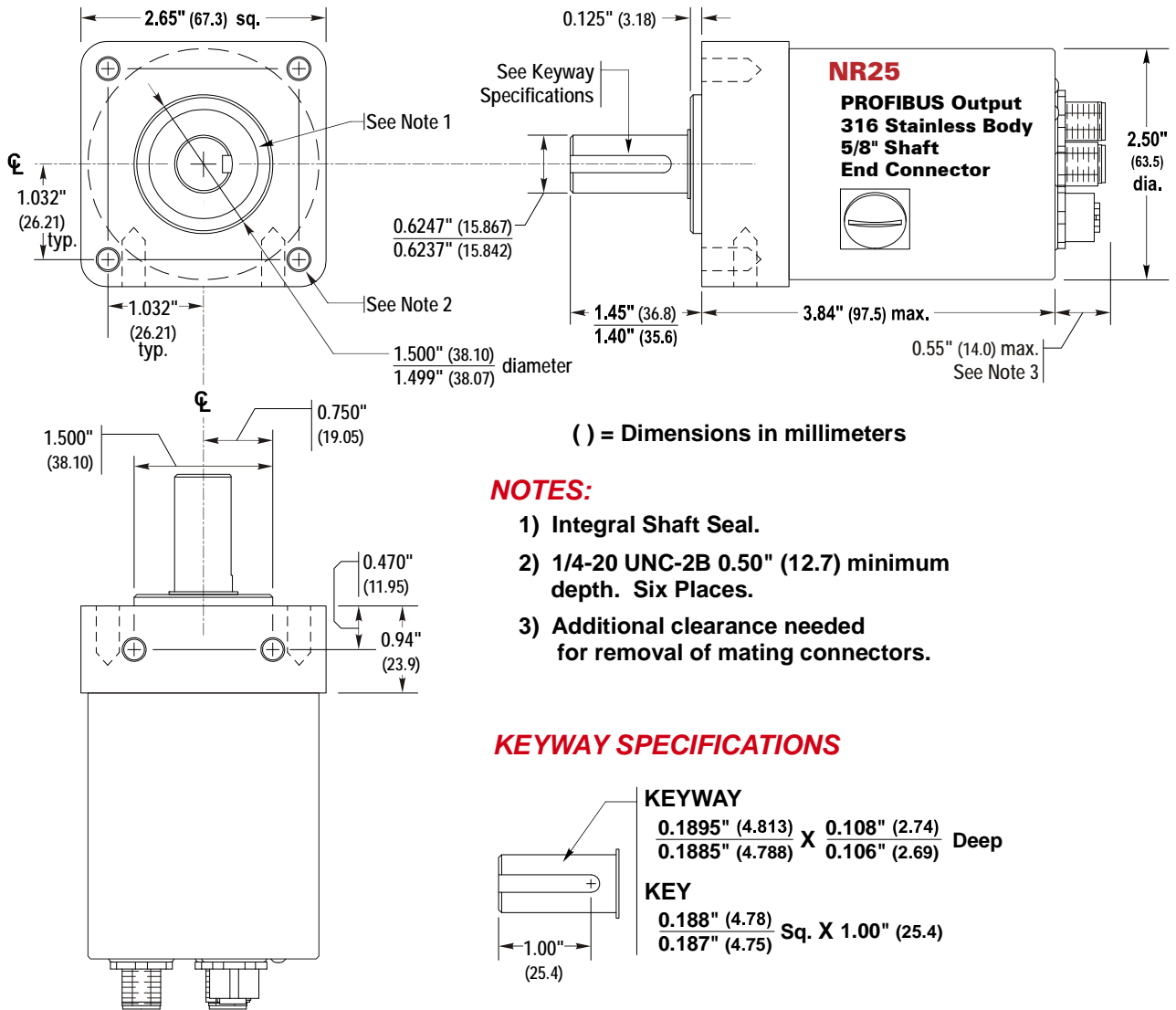


Figure 2.8 5/8" Shaft, Flange Mount, End Connect Outline Drawing

Shaft Loading

Limit shaft loading to the following values. These values statistically yield an L10 life of 2×10^9 revolutions. (Statistically, only 10% of the bearings will have failed after 2×10^9 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

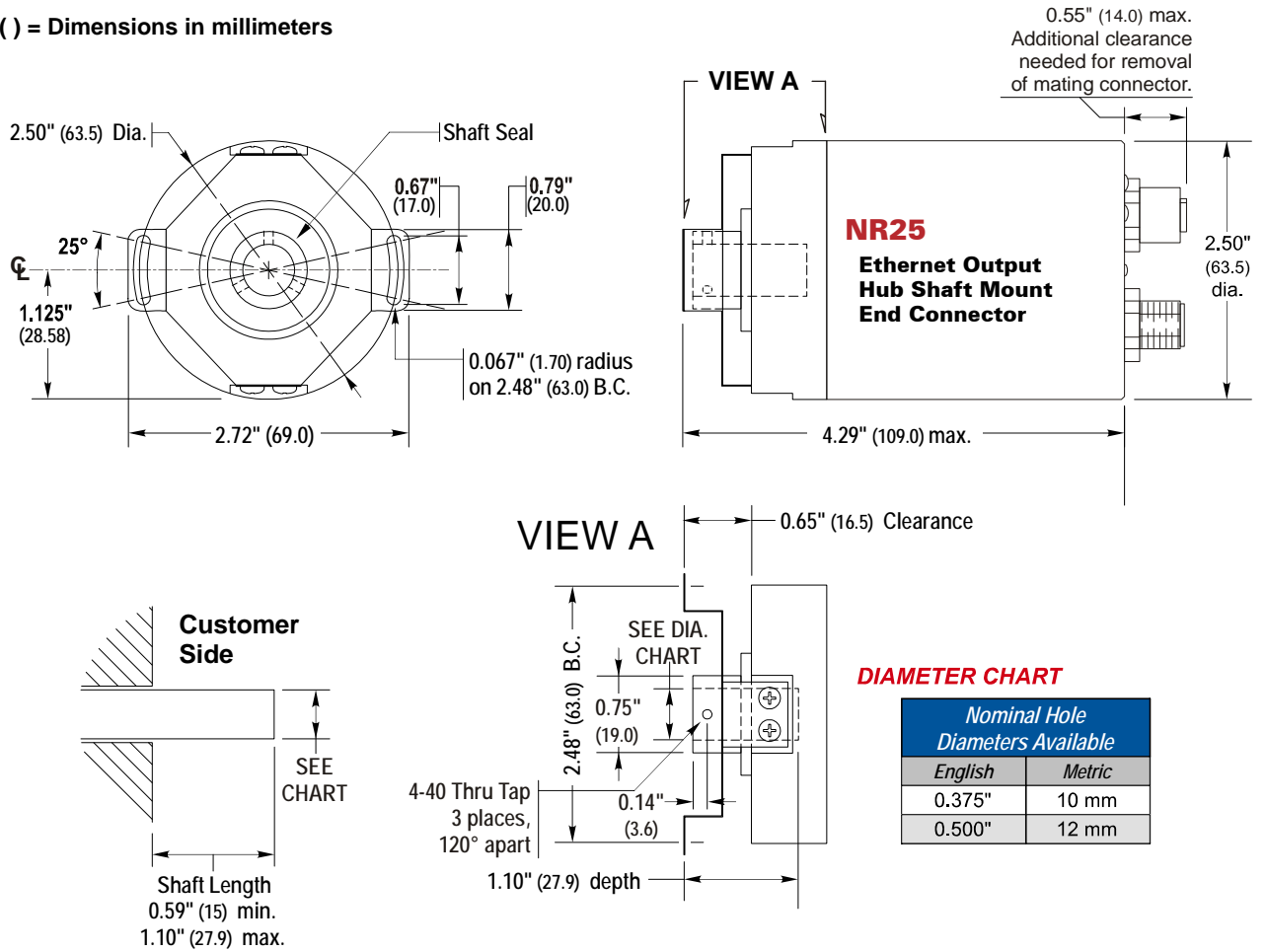


Figure 2.9 Hub Shaft Mount, End Connect Outline Drawing



Hub Shaft Mount Outline Drawings (Continued)

Stainless Steel Body, End Connect

() = Dimensions in millimeters

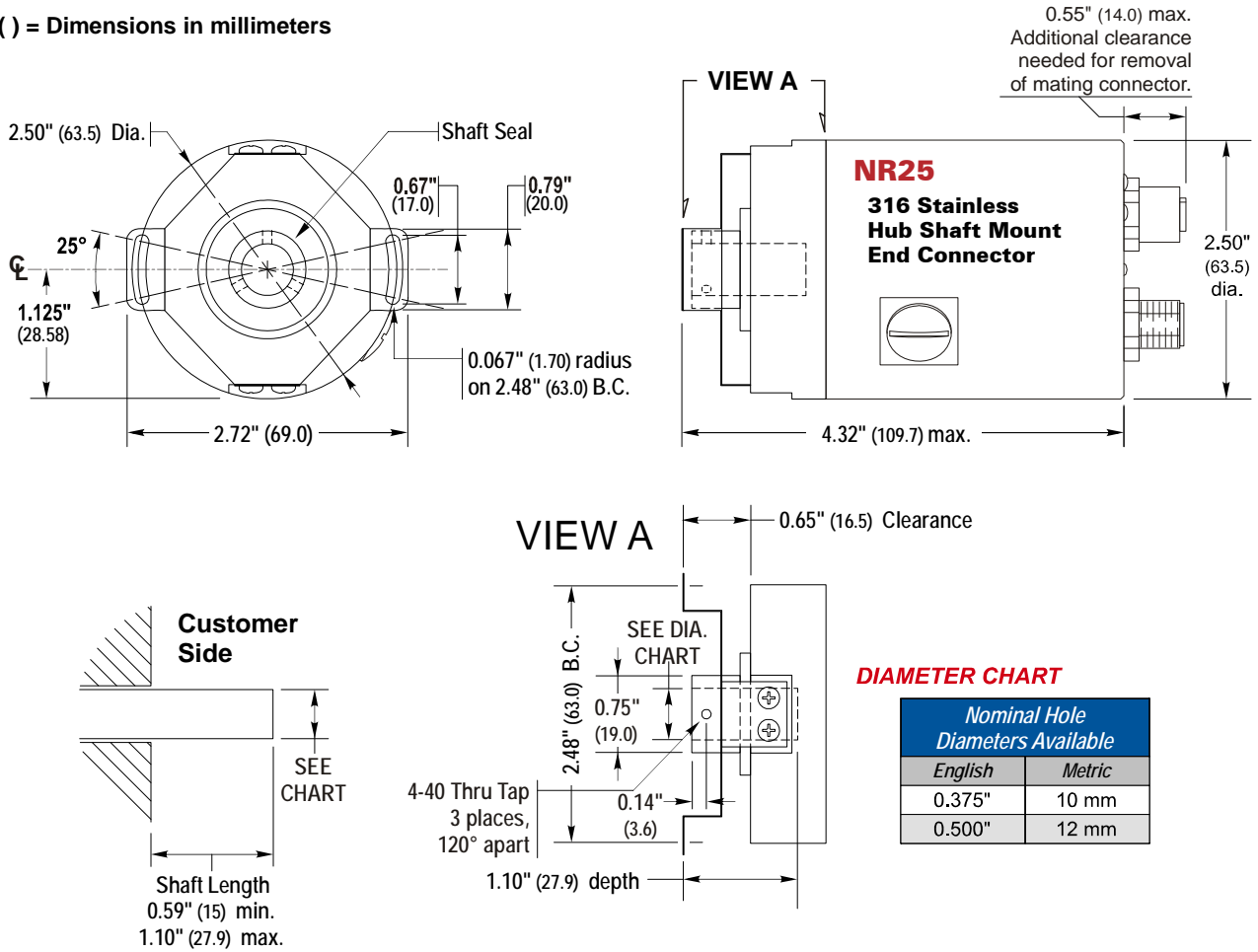


Figure 2.10 Hub Shaft Mount, End Connect Outline Drawing

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.

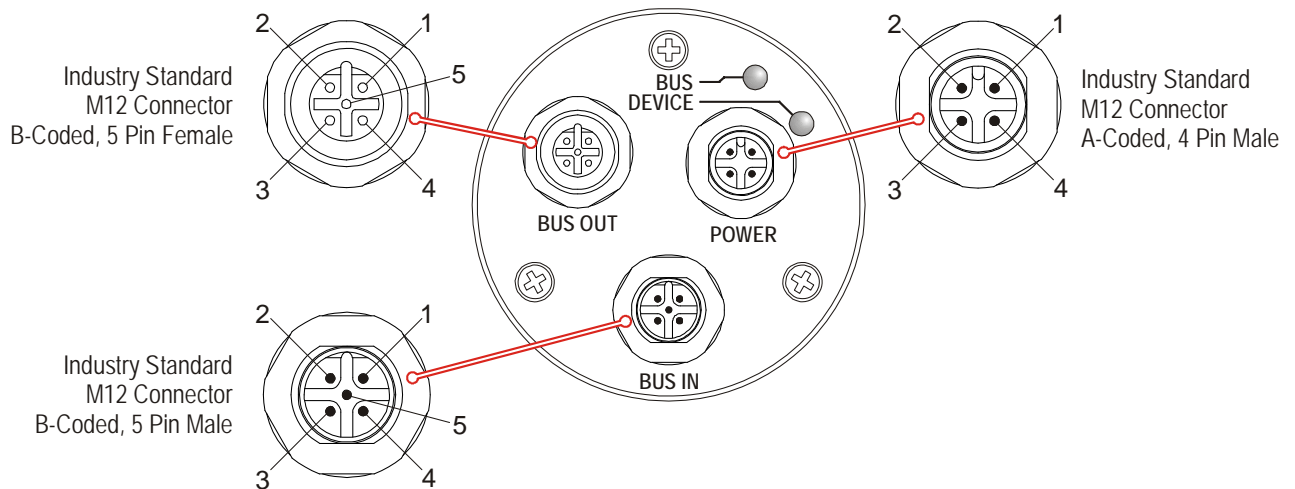


Figure 2.11 Connector Pinout

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.

| Binder # | Description |
|----------------|--|
| 99-0436-105-05 | BUS IN mating connector, B-coded, 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, right-angle. Screw terminal connections. 6 to 8 mm dia. cable. Plastic body. IP67 rated when properly installed. |
| 99-0437-105-05 | BUS OUT mating connector, B-coded, 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, straight. 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, 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, 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)

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

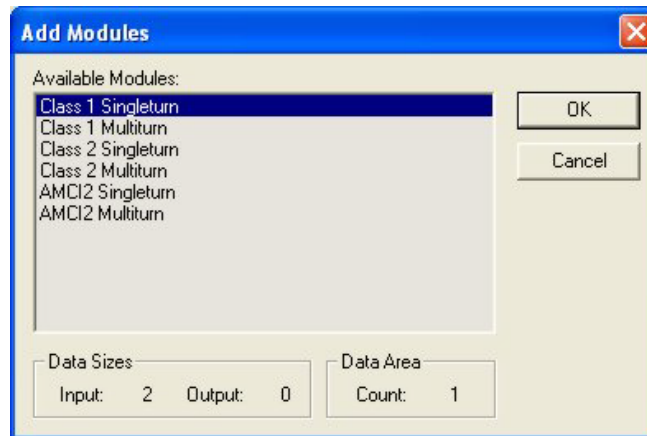


Figure 3.1 Selecting the NR25 Class

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.

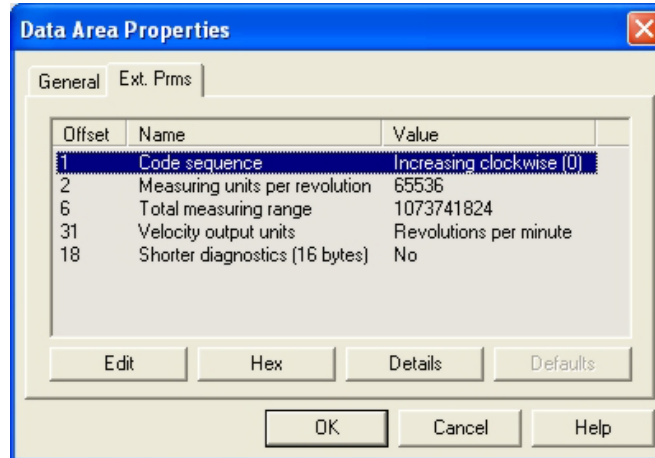


Figure 3.2 Setting Configuration Values

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 $TMR \leq MUR$, 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 *DDL_M_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.

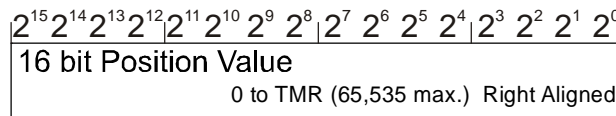


Figure 4.1 16 bit Position Format

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.

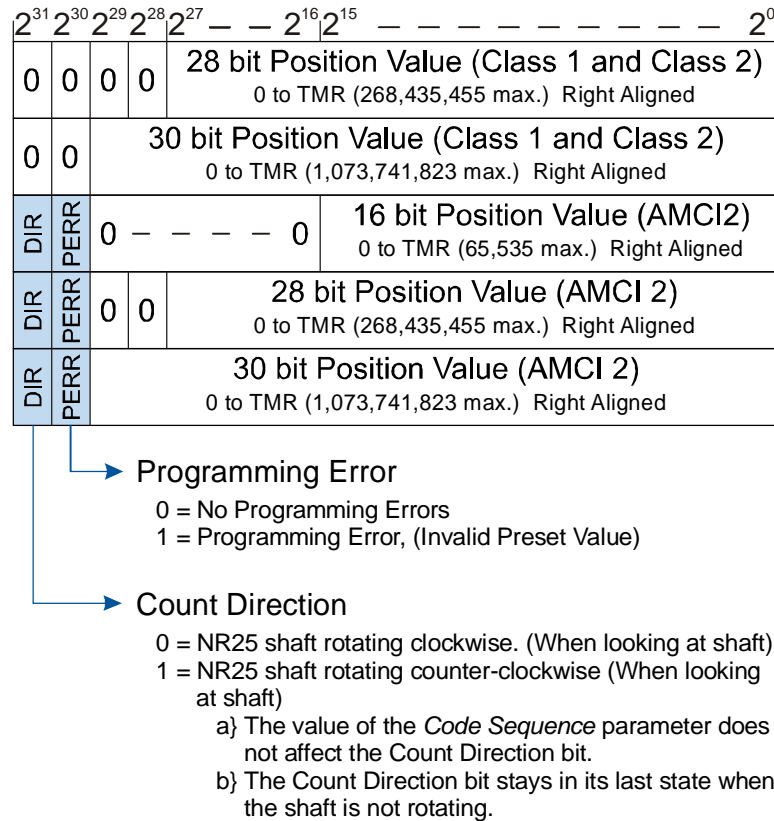


Figure 4.2 32 Bit Position Value

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.

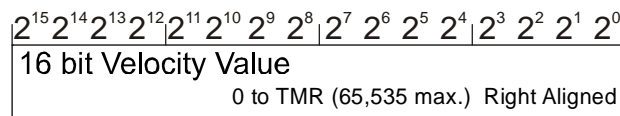


Figure 4.3 16 bit Velocity Format

- 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.

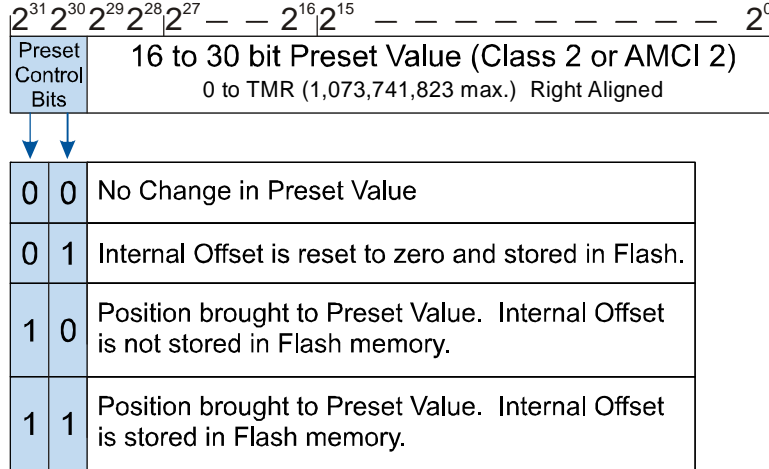


Figure 4.4 Position Preset Value Format

- 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

DIAGNOSTIC INFORMATION

This chapter describes the data transfer ed by the NR25 when using the *DDL_M_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 transferred 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



ADVANCED MICRO CONTROLS INC.

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

www.amci.com

LEADERS IN ADVANCED CONTROL PRODUCTS