Introduction

ADVANCED Motion Controls®' DigiFlex® Performance™ servo drives are capable of using many feedback devices, including absolute encoders.

These instructions outline the procedure that should be followed with a few additional notes specific to operating a motor with absolute feedback. For more detailed instructions for any of the procedures given (Loop Tuning, AutoCommutation, Phase Detect) see the DriveWare® Software Manual and Help Files.

ADVANCED Motion Controls offers servo drives that support BiSS-C, Endat 2.1/2.2 and Hiperface absolute encoders. Depending on the drive selected, a specific firmware payload may need to be installed. For questions regarding firmware, contact the factory.
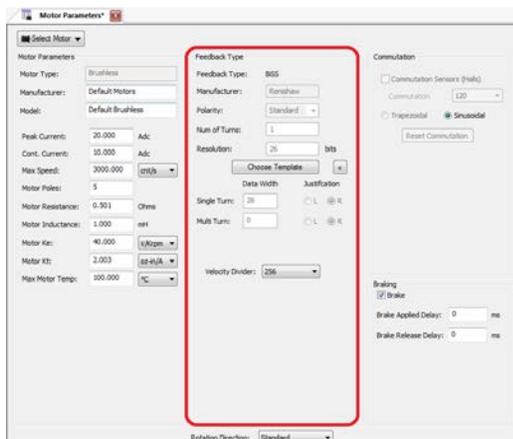
Configuration

The user interface within DriveWare will be similar for all styles of absolute devices with only minor differences.

Open the Motor Parameters window from the System Browser.
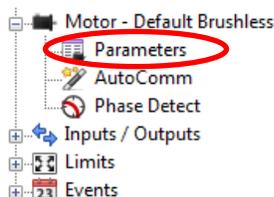
Locate the *Feedback Type* panel in the middle of the Motor Parameters window.

Useful Definitions

Velocity Divider: A scaling factor for the velocity feedback counts. This adjusts the useful range for velocity loop gains, and is particularly beneficial for high working resolution encoders. If the working resolution is between 16 bits and 25 bits, it is recommended to use the default velocity divider of 256. For working resolutions above 25 bits, select a velocity divider of 512.

Interpolation: The interpolation is configurable in powers of 2 from 1 to 512 lines per Sin/Cos cycle. Represents the Sin/Cos interpolation of the position loop which determines how many counts are defined per encoder cycle. The number of counts per cycle is the interpolation value multiplied by 4, giving an interpolated encoder resolution from 4 to 2048 counts per Sin/Cos cycle.

BiSS-C

For BiSS-C absolute devices, find the encoder data in the encoder datasheet. In this example will use a 16 bit Renishaw Resolute encoder.

RESOLUTE with *BiSS* serial comms is available with the following resolution optio

18 bit (262 144 counts per revolution, = 4.94 arc second)
26 bit (67 108 864 counts per revolution, = 0.019 arc second)
32 bit (4 294 967 296 counts per revolution, = 0.00030 arc second)
Note that 32 bit resolution is below the noise floor of the RESOLUTE encoder.

Click the *Choose Template* button, and select "Renishaw" from the available template options. Click *OK* in the *Choose Template* window.
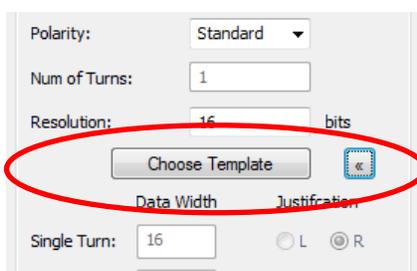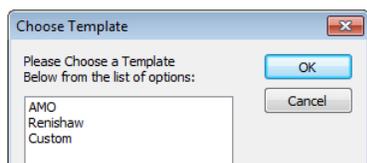
Note: Presets are available for Renishaw and AMO. There is also an option for a custom preset; contact the factory for more details.

Set the *Resolution* field to "16".
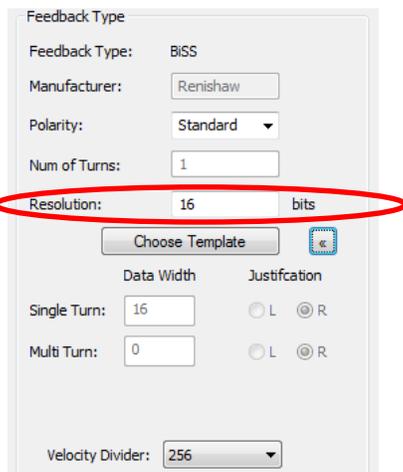
Set the appropriate velocity divider and commission the drive as described in the

DriveWare Software Manual or DriveWare Quick Reference Guide. For any terminology definitions, please see the help file within DriveWare.

Linear BiSS-C

The linear BiSS-C encoder in this example has options for multiple resolutions. DriveWare is able to use any of them but the parameters must be input correctly.

Resolution	1 (nm)	5 (nm)	50 (nm)
Maximum scale length (L) with 36 bit position word	10 m	10 m	10 m
Maximum scale length (L) with 32 bit position word	4.295 m	10 m	10 m
Maximum scale length (L) with 26 bit position word	67 mm	336 mm	3.355 m
Maximum reading speed	100 m/s	100 m/s	100 m/s

Follow the table below to input the proper data into DriveWare.

Resolution	Counts/mm	lines/mm
1nm	1000000	250000
5nm	200000	50000
50nm	20000	5000

For this example, a 1nm 32bit encoder is used. Input 250,000 lines/mm into the *Resolution* field and input 32 bits into the *Data Width* field as shown.
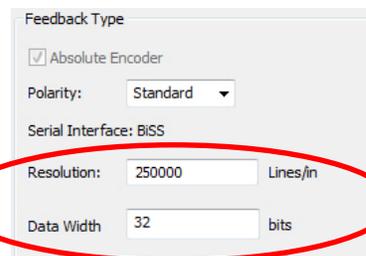
Set the appropriate velocity divider and commission the drive as described in the DriveWare Software Manual or DriveWare Quick Reference Guide. For any terminology definitions, please see the help file within DriveWare.

EnDat 2.2

For EnDat 2.2 encoders with a resolution less than 31 bits, find the resolution parameters in the encoder datasheet.

If the datasheet specifies a data word length different than position bits, be sure use the data word length. The example below shows 18bit position with 19bit data word. Use 19 bits for the single turn resolution.

Enter the parameters from the encoder datasheet into DriveWare as shown below.

For encoders with more than 31 bits of resolution, EnDat 2.2 feedback is limited by the drive to 31 bits total. The user must define the *Encoder Resolution* and *Working Resolution* separately.

If the encoder in use has more than 31 bits, enter the actual resolution into the *Encoder Resolution* section. However, since the drive can only utilize 31 bits total, the user has the option to decide how the bits are to be distributed to meet the requirements of the application. This is accomplished by choosing values for the

Singleturn and *Multiturn* working resolution, up to 31 bits total.

Locate the resolution parameters in the encoder datasheet.

Enter the *Encoder Resolution* in the appropriate fields. Make sure to use the data word length.

Select the *Working Resolution* based on importance in your application. This example is using 16 bits of *Singleturn* data and 15 bits of *Multiturn* data.

Set the appropriate velocity divider and commission the drive as described in the DriveWare Software Manual or DriveWare Quick Reference Guide. For any terminology definitions, please see the help file within DriveWare.

Linear EnDat 2.2

When using a linear EnDat 2.2 encoder, simply convert the encoder resolution to line/mm.

Absolute position values	EnDat 2.2
Ordering designation	EnDat 22
Resolution	0.001 µm (1 nm)

To convert from 1.0nm to line/mm follow the equations below.
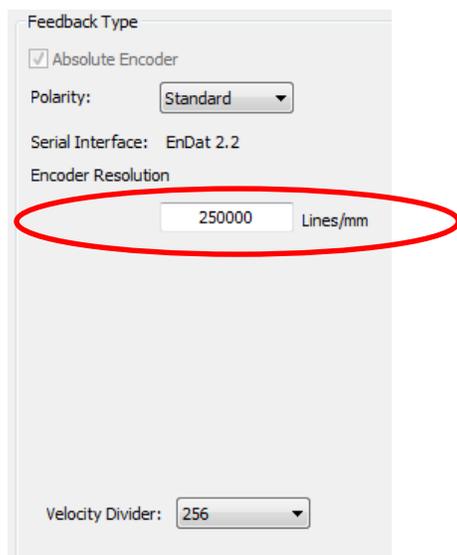
$$\frac{1 \text{ count}}{nm} = \frac{1,000,000 \text{ counts}}{mm}$$

Since this value is post quadature we must divide that number by 4 to convert to lines/mm

$$Encoder\ resolution = \frac{1,000,000 \text{ counts}}{4}$$

$$Encoder\ resolution = 250,000 \text{ lines/mm}$$

Once the resolution is converted to lines/mm, simply enter that value into the *Encoder Resolution* field in the *Feedback Type* panel.

Feedback Type
☑ Absolute Encoder
Polarity: Standard
Serial Interface: EnDat 2.2
Encoder Resolution
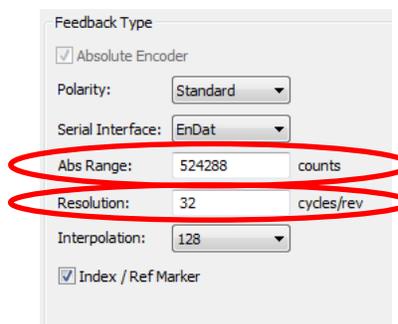250000   Lines/mm

Velocity Divider: 256

Set the appropriate velocity divider and commission the drive as described in the DriveWare Software Manual or DriveWare Quick Reference Guide. For any terminology definitions, please see the help file within DriveWare.

EnDat 2.1

Find the EnDat 2.1 encoder parameters on the encoder datasheet.

Enter the number of counts per revolution into the *Abs Range* field. This is the number of counts per 1 revolution of the encoder. This is independent of any Multiturn data the encoder may have. Input the resolution or line count of the 1Vpp Sin/Cos signals from the encoder into the *Resolution* field.

Interface	EnDat 2.1
Order designation*	EnDat01
Position values/revolution	524 288 (19 bits)
Revolutions	–
Elec. permissible speed/ Deviations[3)]	≤ 3000 min^{-1}/± 128 LSB ≤ 6000 min^{-1}/± 256 LSB
Calculation time t$_{cal}$ Clock frequency	≤ 8 µs ≤ 2 MHz
Incremental signals	1 V$_{PP}$
Line count	32
Cutoff frequency –3 dB	≥ 6 kHz typical

Feedback Type
☑ Absolute Encoder
Polarity: Standard
Serial Interface: EnDat
Abs Range: 524288   counts
Resolution: 32   cycles/rev
Interpolation: 128
☑ Index / Ref Marker

Set the appropriate velocity divider and commission the drive as described in the DriveWare Software Manual or DriveWare Quick Reference Guide. For any terminology definitions, please see the help file within DriveWare.

Hiperface

For Hiperface encoders, it is slightly more complicated to make sure parameters are input correctly. In this example, the encoder has the following parameters:

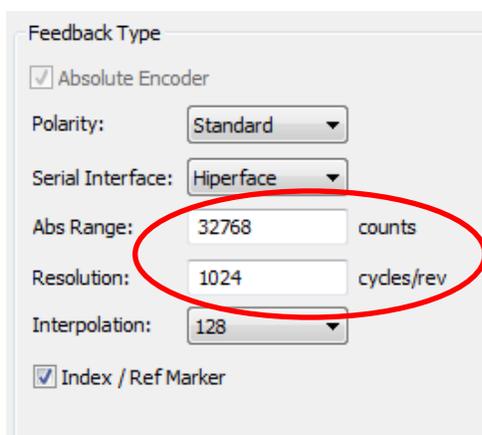| Performance	
Number of sine/cosine periods per revolution:	1,024
Number of the absolute ascertainable revolutions:	4,096 (Multiturn)
Total number of steps:	134,217,728

In DriveWare, the *Abs Range* is the number of counts for one revolution of the encoder. This requires the *Abs Range* to be calcuated by the equation below:

$$Abs\ Range = \frac{Total\ Steps}{Multiturn\ Revs}$$

$$Abs\ Range = \frac{134,217,728}{4096}$$

$$Abs\ Range = 32768\ \frac{Steps}{Revs}$$

The *Abs Range* and *Resolution* are then entered into the appropriate fields in DriveWare as seen below.

Set the appropriate velocity divider and commission the drive as described in the DriveWare Software Manual or DriveWare Quick Reference Guide. For any terminology definitions, please see the help file within DriveWare.