

Control of DC Motors

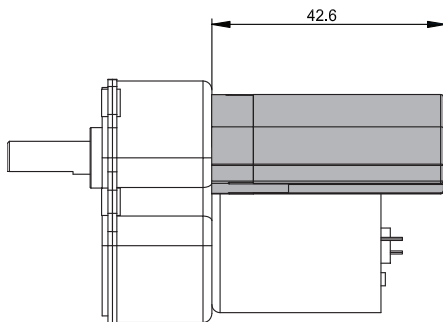
Absolute Encoder

Issue 03:CN3815

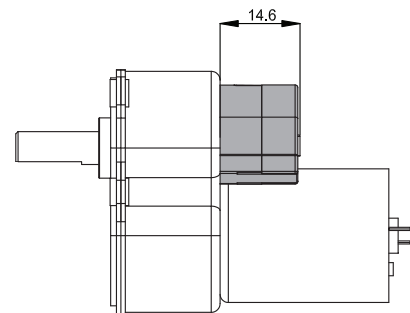
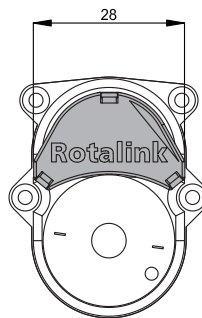


Rotalink

Miniature Motors, Transmission and Control



Multi-turn unit



Single-turn unit

Our absolute output shaft encoders provide accurate positional information unaffected by power loss and self correcting in the face of electrical interference. They operate via contact-less magnetic technology providing either a linear analogue output (Rail-Rail, 0-5V*) or reliable 10-bit/32-bit positional data sent via a differential SSI (synchronous serial interface).

The single-turn absolute encoder operates through the full 360° of rotation and accurately monitors its position indefinitely without power.

The multi-turn operates to a maximum of 32000 revolutions whilst still providing the full resolution of 10-bits per 360° and is fitted with an integral rechargeable battery to provide full position monitoring for up to 100 hours when main power is removed. The use of an extended SSI interface with the multi-turn unit allows the customer the option of programming of zero position and maximum rotation limits as well as resetting any error codes.

Differential Signals:

All inputs/outputs other than the analogue output operate via a differential system to improve noise immunity compared to a standard single ended signal. This benefit is derived from the fact that external electromagnetic interference (EMI) tends to affect wires equally. Using a single ended signal, noise could cause a 0V signal to be raised to a 5V signal. With a dual ended signal both signals have their voltages raised (0V to 5V and 5V to 10V), but there remains a difference between the signals and therefore the data can be interpreted correctly unaffected by the EMI event. Whilst this improves noise immunity and allows much longer lead lengths, it does result in a slightly more complicated system to implement. There are 2 main ways to make use of differential signalling, either use a RS-422 driver chip, or for a lower cost (with lower noise immunity) solution simply connect the negative inputs to 2.5V and use standard 5V single levels on the positive input. This results in a +/- 2.5V voltage swing rather than the +/-5V single available with the RS-422 driver.

* Due to saturation effects of the OPAMP output transistors the actual analogue response will be rounded towards the supply rails. i.e. the voltage will never quite reach 0V or 5V.

General Specification

Supply Voltage	5Vdc
Output	Differential SSI or 5V Analogue
Max. Rev. Count	1rev. single-turn 32000rev. multi-turn
Position retention	no limit single-turn upto 100 hours multi-turn
Angle Resolution	0.35° (10 bit)
Accuracy	±1.5°
Maximum SSI frequency	1Mhz
Connector	10 Way Molex

Contact:

www.rotalink.com
info@rotalink.com
 T: +44 (0)1460 72000

Rotalink Limited
 Cropmead, Crewkerne
 Somerset TA18 7HQ, UK

www.rotalink.com

Control of DC Motors

Absolute Encoder

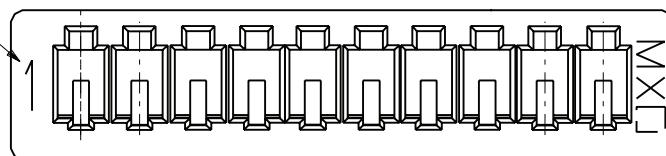
Issue 03:CN3815



Single-turn encoder

Circuit 1	SSI Data out+
Circuit 2	SSI Data out-
Circuit 3	SSI Chip select+
Circuit 4	SSI Chip select-
Circuit 5	SSI Clock+
Circuit 6	SSI Clock-
Circuit 7	Factory only (leave open)
Circuit 8	Vin (5V)
Circuit 9	GND (0V)
Circuit 10	Analogue Output

Circuit number



Zero Position (Single-turn)

The physical angle of the output shaft in relation to the electrical 'zero position' is factory set by Rotalink. Whilst we can set this angle to a flat or other shaft feature, this involves additional setting time and due to tolerances of the interface between output shaft and customer parts, may not provide the perceived accuracy. If the encoder is being used with a microprocessor the following method can be used to maximise accuracy: Use an absolute encoder with a 'random' zero position. Physically move the customer part to the required 'zero position' and fix to Rotalink unit. Read absolute position from the encoder with the microprocessor and save value to nonvolatile memory. A simple subtraction (current position - save position) will then result in the required absolute position.

10-bit Single-turn Absolute Position over Analogue output

On the single-turn encoder the analogue output is available alongside the SSI output. Output is a simple 0V-5V output. The SSI interface is required to make use of the status information (see SSI section below).

10-bit Single-turn Absolute Position over 16-bit Synchronous Serial Interface (SSI)

The serial data transmission for the single-turn encoder makes use of 16-bits. The first 10-bits provide the position data, the final 6 bits provide status information and a parity check. The timing is outlined below.

D9:D0 - absolute angular position data (MSB clocked out first)

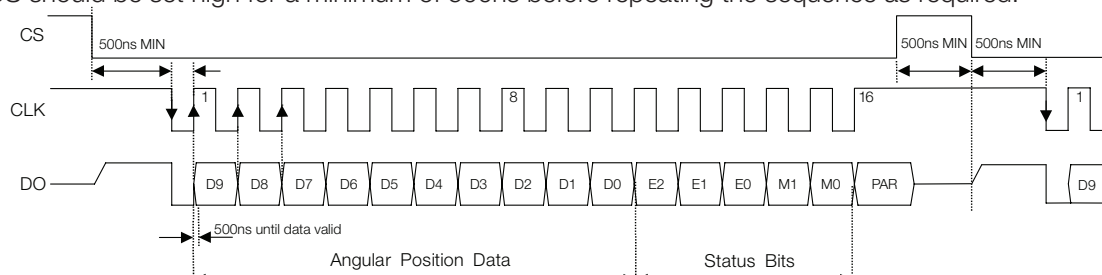
E2 - high indicates valid positional data

E1:E0 - both low indicates valid positional data

M1:M0 - if both these bits are 1 positional data not valid

PAR - bit to aid detection of transmission error. Transmission error if value of all bits is odd

The default condition of the Encoder is Chip select (CS) high, Clock (CLK) high, and data out (DO) set to tri-state. Setting the CS low initiates a position read. A minimum pause of 500ns is required before correct data is available, at this point the clock can start with the data being available from the first rising edge of the clock pulse (allowing for rise times). After the parity has been read the CS should be set high for a minimum of 500ns before repeating the sequence as required.



This drawing and any information, descriptions and know how contained herein (altogether "the drawing") are confidential and are the sole property of Rotalink Limited. Rotalink Limited owns all copyright, design right and all other intellectual property in the drawing and neither the drawing nor any part of it may be disclosed, loaned, copied, used for manufacturing or in relation to tenders or used for any other purpose without the express written permission of Rotalink Limited.

The contents of this data sheet are intended as reference material not product specification and are subject to alteration without prior notice. Please contact our sales team for detailed information.

Control of DC Motors

Absolute Encoder

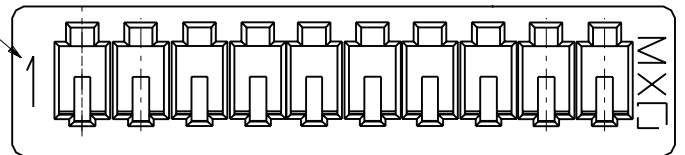
Issue 03:CN3815



Multi-turn encoder

Circuit 1	SSI Data out+
Circuit 2	SSI Data out-
Circuit 3	SSI Data in+
Circuit 4	SSI Data in-
Circuit 5	SSI Clock+
Circuit 6	SSI Clock-
Circuit 7	Factory only (leave open)
Circuit 8	Vin (5V)
Circuit 9	GND (0V)
Circuit 10	Analogue Output

Circuit number



Zero Position (Multi-turn)

In both analogue and SSI mode the zero position can be set by the customer to their application specific requirements. Encoders supplied by Rotalink will have a random 'zero position' ready to be set by the customer.

10-bit Multi-turn Absolute Position over Analogue output

On the multi-turn absolute encoder the output must be selected as either analogue or SSI at time of order. When in analogue mode the SSI differential inputs are used for resetting the zero position and clearing errors (such as power failure errors). Analogue output is a simple 0V-5V output with the maximum turn count and angle equally distributed across 10-bits. This makes the analogue output unsuitable for high rotation counts. For a system with 1024 revolutions the smallest resolution would be one whole output revolution.

Please note the inputs / outputs below are differential inputs when SSI+ is held high(5V) SSI- should be held low(0V). Please refer to the 'Differential Signals' section on the first page for further details.

Set position: By default the reset position is set to zero, however if required the SSI mode can be used (see SSI section Below) to set this reset position to a particular rotation count (useful if the movement away from the reset Position is in a CCW direction)
To set position, hold SSI Clock+ low (0V), position will then be set to the reset position when SSI Clock+ is Returned to high (5V)

Overflow: The multi-turn encoder is set with a default count of 5 turns, this count can be modified using the SSI mode (see SSI section below). The SSI Data out signal is used to indicate if the encoder has overflowed its maximum rotation count. SSI Data out+ will be high (5V) if there has been an overflow. Whilst the encoder will attempt to monitor shaft position in this state, output position cannot be guaranteed. This overflow flag will be reset when the 'Set position' detailed above is used.

Change mode: When running in analogue mode the encoder can be placed into SSI mode using the following sequence. First ensure SSI Clock+ is high (5V). Hold SSI data in+ at 0V for 0.9 to 1.1 seconds then hold SSI data in+ high (5V) for 0.4 to 0.6 seconds before returning SSI data in+ to high (5V). Encoder will now be operating via the SSI interface.

Control of DC Motors

Absolute Encoder

Issue 03:CN3815



26-bit Multi-turn Absolute Position over 32-bit Synchronous Serial Interface (SSI)

The multi-turn absolute encoder makes use of an enhanced SSI interface to allow both the reception of position data and the sending of set up commands. Send and receive operate concurrently over a 32-bit clock pulse train.

Data out:

The first 16-bits provide the number of rotations, the next 10-bits provide the angular position data, there are two unused bits then the final 4 bits provide status information and a parity check. The timing is outlined below.

R25:R10 - number of rotations (MSB clocked out first)

A9:A0 - absolute angular position data (MSB clocked out first)

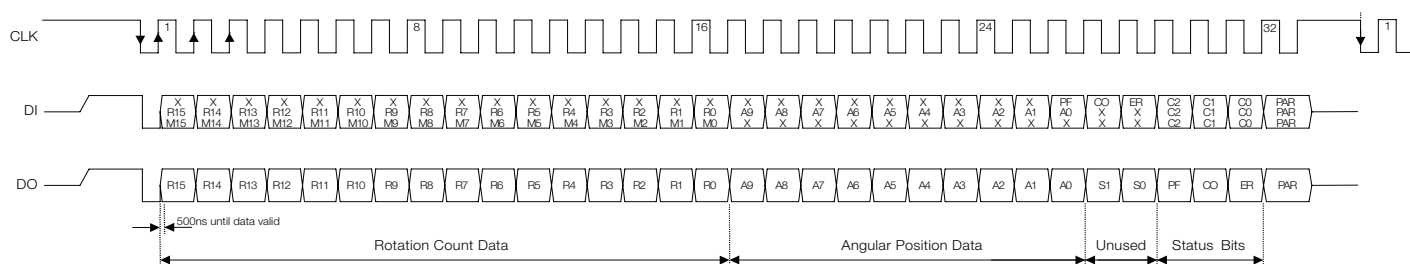
S1:S0 - unused, data should be ignored

PF - high indicates power has failed

CO - high indicates counter overflow

ER - low indicates valid positional data

PAR - bit to aid detection of transmission error. Transmission error if value of all bits is odd



Data in:

The format of the setup data has 3 variants, the final 4 bits transferred are made up of a parity bit and 3 'command' bits.

These 3 bits control the interpretation of the data that precedes them. The first 16-bits provide the number of rotations (either reset or maximum), the next 10-bits provide the angular reset position data and bits 4 to 6 provide the means to clear the error states indicated above. The table below outlines the various options.

31	24	20	16	12	8	4	0		
Rotation Count Value				Angle Value or Flags			C2:C0	PAR	
<Ignored>				<Ignored>			000	PAR	
<Ignored>				<Ignored>		PF CO ER	001	PAR	
Reset Rotation Count Value [R15:0]				Reset Angle Value[A9:0]			<Ignore>	010	PAR
Maximum Rotation Count Value [M15:M0]				<Ignored>				011	PAR
<Ignored>				Change to Analogue Mode [AN11:0]				100	PAR
<Ignored>				<Ignored>				1XX	PAR

R15:R0 - reset rotation count to this value (MSB clocked out first)

M15:M0 - maximum rotation count - effects CO and analogue output scaling (MSB clocked out first)

AN11:0 - send block of 100101001101 followed by 001110010011 to change mode to Analogue output

A9:0 - reset angle to this value (MSB clocked out first)

PF - write high to clear power failure error

CO - write high to clear counter overflow error

ER - write high to clear positional data error

PAR - bit to aid detection of transmission error. Transmission error if value of all bits is odd