Technical Information

Preface

This document contains technical information about the Scancon *eCODE* series of encoders.
The document is generic and does not cover any particular encoder version. For common data on the *eCODE* series of encoders, please refer to the ***eCODE* 1024 Series** and the ***eCODE* 2048 Series** datasheets. For data on a particular *eCODE* encoder version, please refer to the individual datasheets. For a detailed description of the command set for the *eCODE* communication protocol, please refer to the ***eCODE* Protocol Description** (under preparation).

Overview

The Scancon *eCODE* encoders are a series of optical semi-absolute multiturn encoders.

The encoders are available in two versions; the *eCODE* 1024 series and the *eCODE* 2048 series. The main differences between the two series are the resolution and the maximum rotation speed. The *eCODE* 2048 series allows a higher resolution at the expense of a lower maximum rotation speed whereas the *eCODE* 1024 series will allow a higher rotational speed but a lower resolution.

The *eCODE* series are communicating encoders that communicate over a standard RS485 serial interface and therefore do not need any specialized hardware. Only four wires are needed for power and communication. All communication is handled by a powerful microprocessor which ensures low latency and short cycle time.

The encoders in this series use a precision interpolating optical system which provides high resolution and accuracy. All data from the interpolating system are processed by the microprocessor insuring that all position data is accurate and recent within a few microseconds.

The *eCODE* series implements several programmable functions including resolution, direction of rotation and preset/reset functions. It also implements diagnostic functions with warning and error status.

The *eCODE* series of encoders can be delivered in a broad range of encoder housings with both shaft and hollow shaft options of various dimensions including Explosion Proof versions.

Semi-absolute Encoders

The *eCODE* series is based on incremental encoders which will need to be calibrated after each power-up, thus the term semi-absolute. After the encoder is calibrated all functionality is identical to a "true" absolute encoder

Semi-absolute encoders do have both advantages and disadvantages.

Advantages are:

- Higher reliability because of simpler construction.
- Considerably smaller size as there is no need for gear-trains for the multi-turn part.
- Possibility for large hollow bores limited only by the construction of the encoder itself.
- High flexibility as almost all functionality is handled by a microprocessor.
- Lower price because of simpler construction.

The most prominent and possibly only disadvantage is that the encoder must be calibrated after every power-up before it can report a true absolute position. There will be applications where this calibration is inconvenient or not possible and where a semi-absolute encoder is not well suited.

The *eCODE* encoders have internal functions to assist in the calibration procedure.

Interface

In contrast to many commonly used fast communication encoders that use variants of the SSI (**S**ynchronous **S**erial **I**nterface), the *eCODE* series uses a UART (**U**niversal **A**synchronous **R**eceiver/**T**ransmitter) for communicating over an RS485 interface. The communication is performed as half duplex. All common baud rates can be selected to a maximum of 3.68 Mbaud.

The asynchronous serial interface has several advantages over the synchronous serial interface:

- No clock skew that needs to be adjusted with high communication rates over long cables.
- No specialized hardware in the master controller as most modern microprocessors implement a sophisticated built-in UART.
- Only four wires (total) are needed for both power and communication.

The main disadvantages for the asynchronous serial interface are the start/stop bits used for synchronization and the fixed frame format (often byte). These will waste valuable transmission time. For the same bit rate they will use a little longer transmission time.

Protocol

Encoders in the *eCODE* series utilize the ***eCODE* Protocol** and the **Modbus RTU Protocol**.

The *eCODE* protocol consists of three sub-protocols:

- ***eCODE*-P2P** is a fast single master/single slave point-to-point protocol for real-time applications. The data format for the *eCODE*-P2P protocol is binary. With its low latency and low request cycle time this protocol is particularly well suited for closed-loop motor control and other applications where a fast response from a single encoder is needed.

- ***eCODE*-FB** is a fast single master/multiple slaves field-bus protocol for close to real-time applications. The data format for the *eCODE*-FB protocol is binary. This protocol has low latency but due to the extra overhead of communicating with several slave devices, this protocol should be used as a real-time protocol only when a few slave devices are connected.

  The *eCODE*-FB protocol can address up to 247 slave devices.

- ***eCODE*-ASCII** is a single master/multiple slaves field-bus protocol. The data format for the *eCODE*-ASCII protocol is ASCII. The protocol is much more detailed then the two former protocols and with many more commands/options. Since an ASCII protocol is "human readable", it is well suited in applications where communication debugging and tracing is desired and where fast response is not important.

  The *eCODE*-ASCII protocol can address up to 247 slave devices.

All three sub-protocols implement commands for changing between the protocols "on the fly".

The **Modbus protocol** is a widely used field-bus protocol originally proposed by Modicon but subsequently released for public use. It is now being maintained by the Modbus-IDA organization. Additional information on the Modbus protocol can be found on www.modbus.org.

Programmable Functions

The *eCODE* series of encoders implements several programmable functions/parameters.
The programmable functions are implemented in all protocols including the Modbus protocol.
All programmable parameters are saved in a non-volative memory (E^2Prom) and therefore need to be set only once. However, it is possible for the master to change any parameter during operation.

The encoders will, as a minimum, implement the following programmable functions/parameters.

- **Resolution:** The number of steps in the single-turn part of the position can be set to any value from 1 to the maximum number of steps per revolution. The maximum number of steps per

revolution is 262,144 for the *eCODE* 1024 series and 524,288 for the *eCODE* 2048 series. Changing the resolution for the single-turn part does not change the resolution for the multi-turn part of the position.

- **Direction of Rotation:** The direction of rotation can be set to clockwise (CW) and counter clockwise (CCW). Changing the direction of rotation affects both the single-turn and the multi-turn part of the position.
- **Min. and Max. Limits:** The encoder will constantly compare its present position to a minimum and a maximum value. The outcome of the comparison will be reflected in a status word that can be read by the master controller at any time.
- **Position Preset and Reset:** The present position of the encoder can be preset to any value within its total measuring range including the multi-turn part. Resetting the position is accomplished by presetting it to 0. The encoder can be calibrated by placing the encoder (the moveable part) at a known position and performing at preset to that position.
- **Calibration Position:** This is the position the encoder will be set to when the Calibration Assistance function is performed.
- **Calibration Assistance:** The encoder implements calibration assistance that can be used if a position preset/reset is not accurate enough. The procedure is that the encoder (the moveable part) is positioned at a place where the next internal index pulse merged with the interpolated value will come at the exact position the encoder shall be calibrated to. The encoder is then slowly rotated while the master controller is requesting the status word. When the "calibrated" field of the status word is set, the encoder is calibrated to the Calibration Position as described above.
- **Communication Protocol:** It is possible to shift between available protocols and sub-protocols.
- **Device Address:** The device address can be set to any value between 1 and 247. The device address is only relevant for field-bus protocols.
- **Baud Rate:** The baud rate can be set to any common value between 19,200 baud and 3.68 Mbaud. Be aware that the master will temporarily lose contact to the device until the master has changed to the new baud rate.
- **Termination Resistor:** The built-in 120Ω termination resistor of the encoder can be switched on or off. For the *eCODE*-P2P protocol it should always be switched on. For the *eCODE*-FB and *eCODE*-ASCII protocol it should be switched on only for the last device in the chain. Note that the master must always have a termination resistor of 120Ω.

- **User Information:** A number of memory fields will be available to the user/implementer for freely storing information. Each field will have a length of 16 bytes and any information, binary or ASCII, can be stored and later retrieved by the master.

Diagnostic Functions

The *eCODE* series of encoders implements several diagnostic functions/measurements. During operation, the encoder will constantly measure important encoder parameters and compare them to fixed limits. The results of the comparison will be reported to a status word that can be read at any time by the master controller. The status word will contain both warning and error fields.

The encoder will measure the following parameters:

- **Temperature:** The temperature inside the encoder is measured and compared to a maximum and a minimum limit. If the temperature is close to the limits, a warning will be set in the status word. If the temperature is outside limits, an error will be set in the status word.
- **Supply Voltage:** The supply voltage to the encoder is measured and compared to a maximum and a minimum limit. If the supply voltage is close to the limits, a warning will be set in the status word. If the supply voltage is outside limits, an error will be set in the status word. This measurement is particularly important in order to assure that the supply voltage drop is not too high over long cable lengths.
- **Light Intensity:** The light intensity of the internal scanning LED is measured and compared to a minimum limit. If the intensity is below this limit, an error will be set in the status word. This measurement will also be used to determine if the LED is degrading faster than expected thus indicating a future potential problem. This will be set as a warning in the status word.
- **Operational Time Counter:** The encoder implements an operational time counter that is running whenever the encoder is powered. The time counter will count the total operating time and not just the time since last power-up. The operational time is not a part of the status word but will need a separate request.

Connection Options

The *eCODE* series of encoders can be delivered with cable outlet or connector outlet. The cable outlet is primarily intended for use with the *eCODE*-P2P protocol whereas the connector outlet should be used for daisy-chaining several encoders when using field-bus protocols. All cables should be high quality, 2 x 2 wire, twisted-pairs with screen.

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