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All specifications are subject to change without notice
1. **PREFACE**

1.1 **Version : 1.0 April 2016**

1.2 **APPLICABLE DOCUMENTS**
   - DF-150 Electric Encoder data sheet

2. **SAFETY**

2.1 **SAFETY issues**

2.2 **ESD notes**

Although the DF-150 Electric Encoder is insensitive to ESD and parasitic capacitive coupling from adjacent AC voltages, we highly recommend to enable a discharge path with <20 kΩ between the machine shaft and the electronics ground.

Shielding: the Electric Encoder housing material is non-conductive polymer – ULTEM, the internal ground (return) path of the 5V power supply IS NOT CONNECTED to the cable shielding. We highly recommend grounding the cable shielding through the connector body or by other means.

Note: During high-speed rotation, bearings may isolate the shaft from its grounding. It is essential the shaft remain grounded using a sustainable method during such high-speed operations.
3. PRODUCT OVERVIEW

3.1 OVERVIEW

The DF-150 absolute position Electric Encoder™ is a revolutionary position sensor originally developed for harsh environment critical applications. Currently it performs in a broad range of applications, including defense, homeland security, aerospace, and medical and industrial automation.

The Electric Encoder™ non-contact technology relies on an interaction between the measured displacement and a space/time modulated electric field. The DF-150 Electric Encoder™ is semi-modular, i.e., its rotor and stator are separate, with the stator securely housing the rotor.

3.2 INSTALLATION FLOW CHART

(1) Encoder stator
(2) Encoder rotor
(3) Encoder cable

Mechanical mounting

Electric installation

Mounting verification

Electric / SW compensation

Calibration
3.3 Encoder Mounting

Typical encoder installation includes:

- **Encoder stator (1)** – Encoder stator, mounting centralization holes (1a)
- **Encoder rotor (2)** – Encoder rotor, shaft mounting hole (2a) and centralization hole (2b)
- **Encoder seating / stator (host machine) (3)** – with appropriate

The encoder stator is connected to the application static section and should be centralized by the circumference step (A), 2 pins (B) fixed by [6] six screws (1a), the encoder rotor should be fixed by [4] four screws and centralized by 2 pins (2b).
ENCODER STATOR / ROTOR RELATIVE POSITION

For proper performance the air gap should be 0.6mm +/- 0.1mm.

Proper mounting will ensure correct amplitude level of
Fine channel 200 - 500mV
Coarse channel 200 - 500mV

Proper rotor mounting can be verified by using the Encoder Explorer tools "signal analyzer" or "Mechanical installation verification"
4. **UNPACKING**

4.1 **STANDARD ORDER**

The package of the standard DF-60 contains the encoder with 250mm shielded cable AWG30.

**OPTIONAL ACCESSORIES:**

1. **MP-01014**, DF-150, 0.6mm filler gauge
2. **RJ-DF-150**, DF-150 demo jig
3. **EAPK008**, Kit, encoder mounting screws (3 screws M2x6)
4. **CNV-0003**, RS-422 to USB converter (with USB internal 5V power supply path)
5. **ELECTRICAL INTERCONNECTION**

This chapter reviews the steps required to electrically connect the DF-150 with digital interface (SSi or BiSS-C).

**CONNECTING THE ENCODER**

The DF-150 operates has two operational modes:

(i) **Absolute Position over SSi or BiSS-C**: This is the power-up default mode.

(ii) **Configuration and setup mode**: This service mode provides access via USB to a PC running Netzer Encoder Explorer application (on MS Windows 7/8). Communication is via Netzer Communication Protocol (NCP) over RS-422 using the same set of wires. Use the following pin assignment to connect the encoder to a 9-pin D-type connector to the RS-422/USB converter CNV-0003.

![Diagram of electrical interconnection](image)

**SSi / BiSS interface wires color code**

<table>
<thead>
<tr>
<th>Description</th>
<th>Color</th>
<th>Function</th>
<th>Pin No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clock +</td>
<td>Grey</td>
<td>Clock</td>
<td></td>
</tr>
<tr>
<td>Clock -</td>
<td>Blue</td>
<td>Clock</td>
<td>2</td>
</tr>
<tr>
<td>Data -</td>
<td>Yellow</td>
<td>Data</td>
<td>4</td>
</tr>
<tr>
<td>Data +</td>
<td>Green</td>
<td>Data</td>
<td>3</td>
</tr>
<tr>
<td>GND</td>
<td>Black</td>
<td>Ground</td>
<td>5</td>
</tr>
<tr>
<td>+5V</td>
<td>Red</td>
<td>Power supply</td>
<td>8</td>
</tr>
</tbody>
</table>

(1) DF-60 encoder with SSi / BiSS interface.
(2/3) RS-422 / USB converter (CAT No. CNV-00003)
5.3 ELECTRICAL CONNECTION AND GROUNDING
The DF-150 does NOT come with specified cable and connector, however, do observe grounding consideration:
[1] The cable shield does not connect to the power supply return line.
[2] Ground the host shaft to avoid interference from the host system, which could result in encoder internal noise.

Note: 4.75 to 5.25 VDC power supply required

6. SOFTWARE INSTALLATION
The Electric Encoder Explorer (EEE) software:
- Verifies Mechanical Mounting Correctness
- Offsets Calibration
- Sets up general and signal analysis

This chapter reviews the steps associated with installing the EEE software application.

6.1 MINIMUM REQUIREMENTS
- Operating system: MS windows 7, 32 / 64 bit
- Memory: 4MB minimum
- Communication ports: USB 2
- Windows .NET Framework, V4 minimum

6.2 INSTALLING THE SOFTWARE
Run the Electric Encoder™ Explorer file found on our website: Encoder Explorer Sw Tools.
7. **MOUNTING VERIFICATION**

Perform mounting verification before calibration to ensure optimal performance by selecting [Verification] on the main screen of the Encoder Explorer or by using the signal analyzer under “Tools.”

7.1 **STARTING THE ENCODER EXPLORER**

Make sure to complete the following tasks successfully:

- Mechanical Mounting
- Electrical Connection
- Connecting Encoder for Calibration
- Encoder Explorer Software Installation

Run the Electric Encoder Explorer tool (EEE). Ensure proper communication with the encoder:

(a) The status bar indicates successful communication.
(b) Encoder data displays in the Encoder data area. (CAT No., serial No.)
(c) The position dial display responds to shaft rotation.

7.2 **MECHANICAL INSTALLATION VERIFICATION**

The Mechanical Installation Verification provides procedures to ensure proper mechanical mounting by collecting raw data of the coarse and fine channels during rotation.

(d) Select [Mechanical Mounting Verification] on the main screen.
**DF-150 Rotary Electric Encoder**

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**Preface**

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**Product Overview**

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**(e)** Select [Start] to initiate the data collection.
**(f)** Rotate the shaft for data collecting of the fine/coarse channels.
**(g)** At the end of successful verification, SW shows “Correct Mechanical Installation.”

**(h)** If SW indicates “Incorrect Mechanical Installation,” place the mechanical shims below the rotor, as presented in paragraph 3.3 - “Rotor Relative Position.”
(i) Tools --> Signal analyzer, amplitude fine tuning option with the UP / DOWN keys to the nominal amplitude level, save the level by the “set” option. This process available for the fine / coarse and medium channels.

In case the reading data (blue dots) are not evenly distributed on a thin circle, you may experience "noise" in your installation (check shaft/stator grounding).
8. CALIBRATION

8.1 Offset Calibration

For optimal performance of the DF-150 Electric Encoder, the inevitable DC offset of the sine and cosine signals must be compensated over the operational sector. After successfully completing the Mounting Verification procedure:

(a) Select [Calibration] on the main screen.

(b) Start the data acquisition while rotating the shaft.

The progress bar (c) indicates the collection progress. Rotate the axis consistently during data collection—covering the working sector of the application end to end—by default the procedure collects 500 points over 75 seconds. Rotation speed is not a parameter during data collection. Data collection indication shows for the fine/coarse channels, a clear “thin” circle appears in the center (d) (e) with some offset.

![Diagram showing offset compensated Fine / Coarse Channel]
8.2 CAA CALIBRATION
The following calibration aligns the coarse/fine channel by collecting data from each point of both channels.
Select [Continue to CAA Calibration]

In the CAA angle calibration window, select the relevant option button from the measurement range options (a):
- Full mechanical rotation – shaft movement is over 10deg - recommended.
- Limited section – define operation of the shaft in a limited angle defined by degrees in case of <10deg
- Free sampling modes – define the number of calibration points in the total number of points in the text box. The system displays the recommended number of points by default. Collect a minimum of nine points over the working sector.

- Click the [Start Calibration] button (b)
- The status (c) indicates the next required operation; the shaft movement status; the current position, and the next target position to which the encoder should be rotated.
- Rotate the shaft/encoder to the next position and click the [Continue] button (c) - the shaft should be in STAND STILL during the data collection. Follow the indication/interactions during the cyclic process for positioning the shaft --> stand still --> reading calculation.
- Repeat the above step for all defined points. Finish (d)
- Click the [Save and Continue] button (e).

The last step saves the offsets CAA parameters, completing the calibration process.
8.3 Setting the Encoder Zero Point
The zero position can be defined anywhere in the working sector.
- Rotate the shaft to the desired zero mechanical position.
- Select “Set Current Position” as zero by using the relevant option, and click [Finish].

8.4 Jitter Test
Perform a jitter test to evaluate the quality of the installation; the jitter test presents the reading statistics of absolute position readings (counts) over time. Common jitter should be up +/- three counts; higher jitter may indicate system noise.
DF-150 Rotary Electric Encoder

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