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APRIL 2007

Specifications in this manual can be changed without prior notice.



# Advanced Diagnostic System

Manual

**Part No 640005 Ver 2.0**

**LEINE  LINDE**

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## GENERAL

Leine & Linde's ADS system has been developed to permit the early detection of fault functions internally in rotating incremental pulse encoders.

The system is based on a rapid logic in conjunction with a micro-processor which continuously monitors the encoder's functions and is thus able to detect a fault function at an early stage. This takes place at such an early stage that the encoder can continue to perform its function in the majority of cases, and replacement of the encoder can take place subsequently during a planned maintenance shutdown.

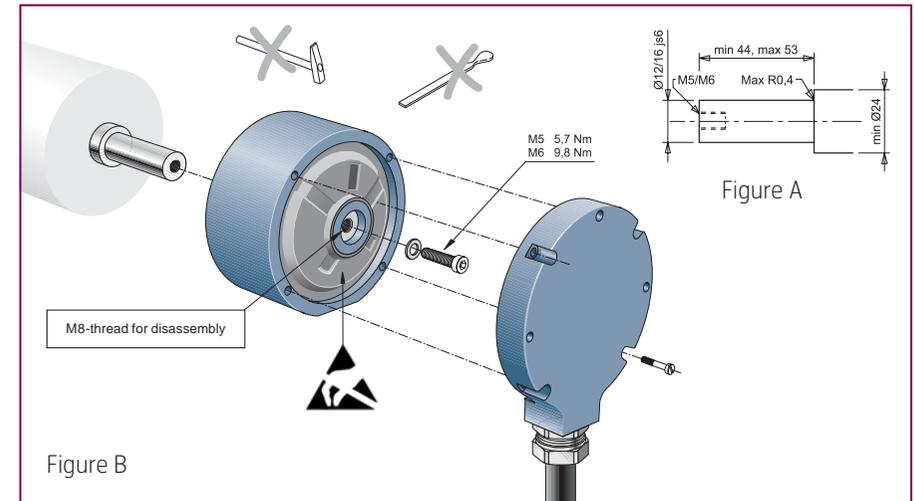
The main control system receives a message from the encoder about a detected fault function via a signal at the encoder's alarm output. This alarm signal is sent to the operator who, with the help of a PC and the analysis software of the diagnostic system, can communicate with the encoder and establish the cause of the indicated fault. The operator is also informed of the frequency, internal temperature and operating period at the time of the fault. External faults can also be detected. The internal signals in the encoder are compared with the signal that is generated in the cable. It is possible in this way, for example, to detect an overload of the output signals from the encoder. The analysis software can also be used to obtain information about the total operating time and the max./min. operating temperature.

## INSTALLATION OF ENCODER

**Important!! When the cover of the encoder is removed, and if there is a risk that you will come into contact with the electronics, or in conjunction with the connection of cables, a grounding wrist strap or similar must be worn in order to equalize the potential and to protect the encoder in this way against ESD discharges which may damage the encoder.**

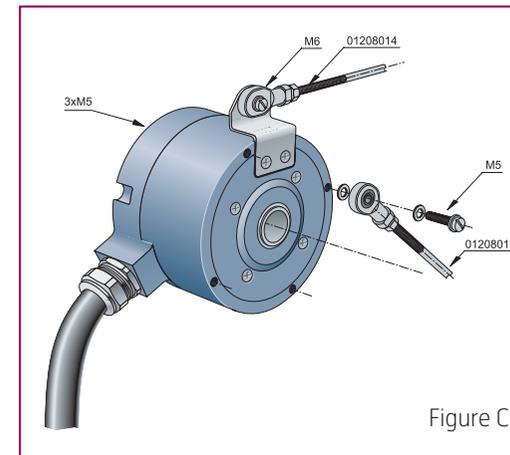
Incremental encoders of model 861 are designed for assembly directly on the drive shaft with a torque arm to prevent rotation of the encoder. This permits simple and rapid assembly and makes the encoder insensitive to axial movement of the drive shaft.

There are two alternative shaft diameters for the encoders: Ø 12 mm or Ø 16 mm. The encoder is insulated from the drive shaft in order to prevent currents from finding their way out from the drive shaft through the encoder with resulting damage to the bearings in both the motor and the encoder. The drive shafts must be made in accordance with Figure A, and it is important for the radial run-out on the drive shaft to be minimized, since a radial run-out on the shaft gives an angular error from the encoder and causes vibrations which can reduce the service life of the encoder.



## Assembly

The encoder is passed onto the drive shaft and is secured by pressing the front edge of the hollow shaft with an o-ring against the abutment on the drive shaft when the retaining screw is tightened; see Figure B.



The torque arm can be fitted in various ways, and there are holes with an M5 thread on both the rear and the front end of the encoder. It is also possible to have an extra torque arm angle with an M6 thread fitted to the encoder. Account should be taken of the fact that the mechanical angular error reduces if a torque arm is fitted perpendicular to the centre of the encoder and with the greatest possible distance from the centre.

The formula for calculating the mechanical angular error is:

$\Delta\rho_{mek} = \pm 90 / \pi \times K / R$ , where K is the radial run-out of the encoder and R is the distance between the torque arm bracket and the centre of the encoder; see Figure C.

To obtain the total angular error, the mechanical angular error must be added to the resolution fault in the electrical specification.

We recommend that the radial run-out measured on the encoder should not exceed 0.1 mm.

Calculation example:

The encoder has 2048 ppr, the torque arm is fitted to the torque arm bracket 69.5 mm from the centre of the encoder, and the measured radial run-out on the encoder is 0.06 mm.

The mechanical angular error according to the formula is:

$$\Delta\rho_{mek} = \pm 90 / \pi \times 0.06 / 69.5 = \pm 0.025^\circ$$

The maximum encoder fault according to the specification is  $\pm 50^\circ$ el, and it is  $360^\circ$ el on each pulse, which gives:

$$\Delta\rho_{el} = \pm 360 / 2048 \times 50 / 360 = \pm 0.024^\circ$$

$$\text{Max. total angular error } \Delta\rho = \pm 0.025 + 0.024 = \pm 0.049^\circ$$

It is also important for the torque arm to be fitted so that it is free from play. Play in the torque arm of  $\pm 0.03$  mm is equivalent to run-out on the encoder of 0.06 mm and, as the above calculation example shows, this results in a significant angular error.

## Disassembly

The hole for the retaining screw has an M8 thread, so that the M8 screw can be used to pull the encoder from the drive shaft if it has become stuck.

## Electrical connection

If the encoder is supplied without a cable, the electrical connection must be made inside the encoder on the screw terminal block. The functions of the various screw terminal blocks are shown on the encoder label. If the encoder is supplied with a cable or connector, information about colours, pins and functions are also shown on the encoder label.

Specification of screw terminal block:

Cable cross-section: 0.14 – 1.5 mm<sup>2</sup> or AWG 26 – 16

Wire end sleeve cross-section: 0.25 – 1 mm<sup>2</sup>

Stripping length: 6 mm

Tightening torque: 0.5 – 0.6 Nm

The connection of the cable gland is effected in accordance with the exploded view in Figure D. It is important to use a screened chassis ground at both ends in order to obtain the best EMC performance.

## Alarm output

In the event of a fault in the encoder, an alarm signal is given at an optically isolated output. The alarm signal is active if an interruption occurs at the output. If a fault is detected, an interruption at the output occurs for 500-600 ms. If the fault remains, the signal is toggled between an active 500-600 ms and an inactive 200-300 ms. In this way, an interruption in the supply voltage can be separated from the alarm signal from the encoder. See Figure E.

Since the alarm signal is given on an optically isolated output, the system which receives the alarm signal can be galvanically separated from the other electronics. Example of connection: See Figure F.

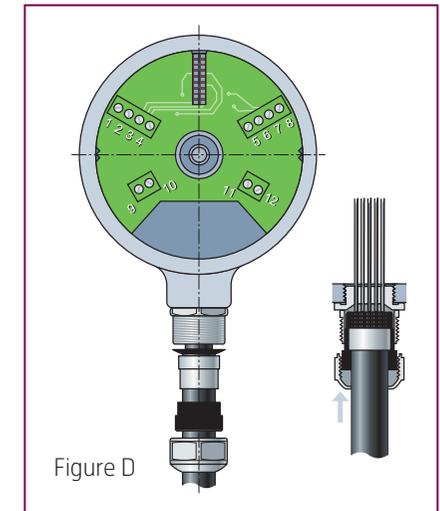


Figure D

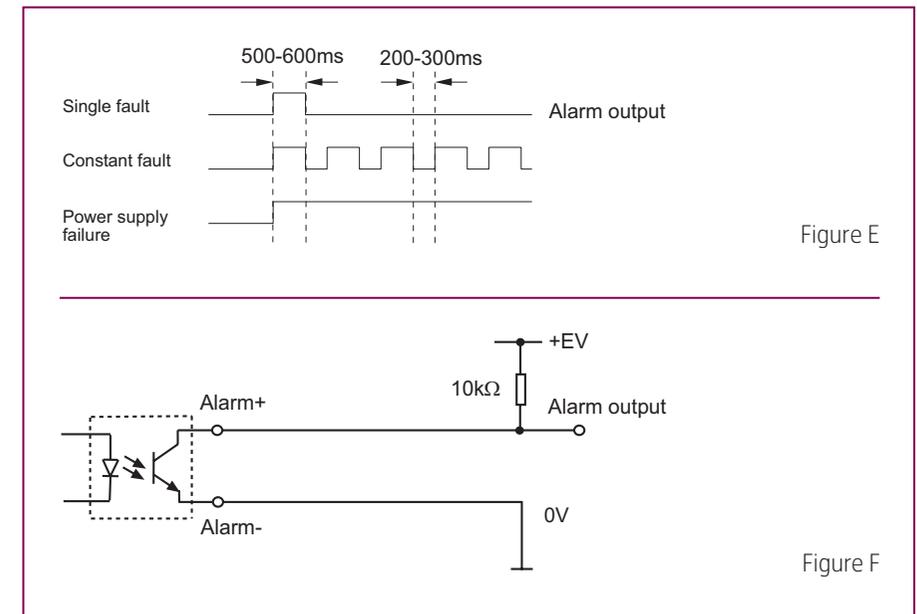
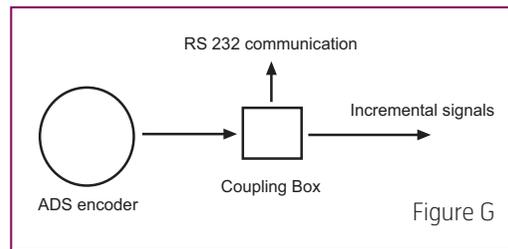


Figure E

Figure F

## RS-232 communication

The analysis software is supplied with connection cabling with which a PC is connected to the encoder through the serial port. We recommend that PC communication should not be connected during operation.



If the encoder is supplied with cabling, we recommend that the connection to the PC should be effected via a D-SUB connector (9-pole female), for example in a terminal box in accordance with Figure G.

Cable colour	Function	Pin D-sub
Grey / Pink	Rxd	3
Red / Blue	Txd	2
Blue	0 V	5
	Connected to one another	4
		6
		8

A standard extension cable, 9-pole D-sub male to 9-pole D-sub female, can be used between the PC and the above connection.

Note that the length between the encoder and the PC must not exceed 10 m.

## ADS PC SOFTWARE

A PC program with which information from the encoder about the operating conditions and any faults can be received is provided for communication with the ADS encoder. Your PC is connected to the encoder via the serial port using the special cable supplied or a standard RS-232 cable in accordance with the example in the Installation Specification. Communication takes place with an RS-232 interface. Note that the maximum cable length between the encoder and the PC is 10 m.

### Content

- Diskette with PC software. Part No. 01290021
- Manual Advanced Diagnostic System.
- RS-232 cable 9-pole D-sub female – connector to the encoder. Part No. 01209083

## System requirements

- PC with at least a 486 processor.
- Windows 95, 98 or NT.

## Installation

1. Insert the diskette in the diskette drive.
2. Select the diskette drive in the Program Manager.
3. Start the file.\setup.exe
4. Follow the instructions.

## Configuration of software

1. Start \Diagnostik.exe  
Select settings.  
See Figure H.
2. Set the COM port that you are using.  
Set the frequency with which you require the information to be updated for repeated updating.  
Indicate the language that you wish to use, Swedish or English.  
It is also possible to communicate via a modem installed in Windows and an RS-232 modem via the telephone line. The software then calls the indicated telephone number and starts the communication when the "Online" key is pressed. We recommend a maximum updating speed of 1.0 s when a modem is in use.  
See Figure I.



Figure H



Figure I

## Receiving information from the encoder

1. Connect an RS-232 cable between the encoder and the serial port on your PC, and switch on the power supply to the encoder.
2. Press "Online", and information about the encoder part number and serial number, the versions of the hardware and software and the resolution are then displayed in the information window.
3. Press "Rep. update", and information about the operating time, the frequency of the incremental signals and the temperature internally in the encoder are then displayed. The information is updated at the speed entered in the configuration of the software. The highest and lowest measured temperatures are also displayed. The lowest temperature is updated only if the temperature is below 0°C. The highest temperature internally in the encoder must not exceed 100°C (ambient temperature + ca. 20°C self-heating), and the lowest must not be below -20°C. See Figure J.

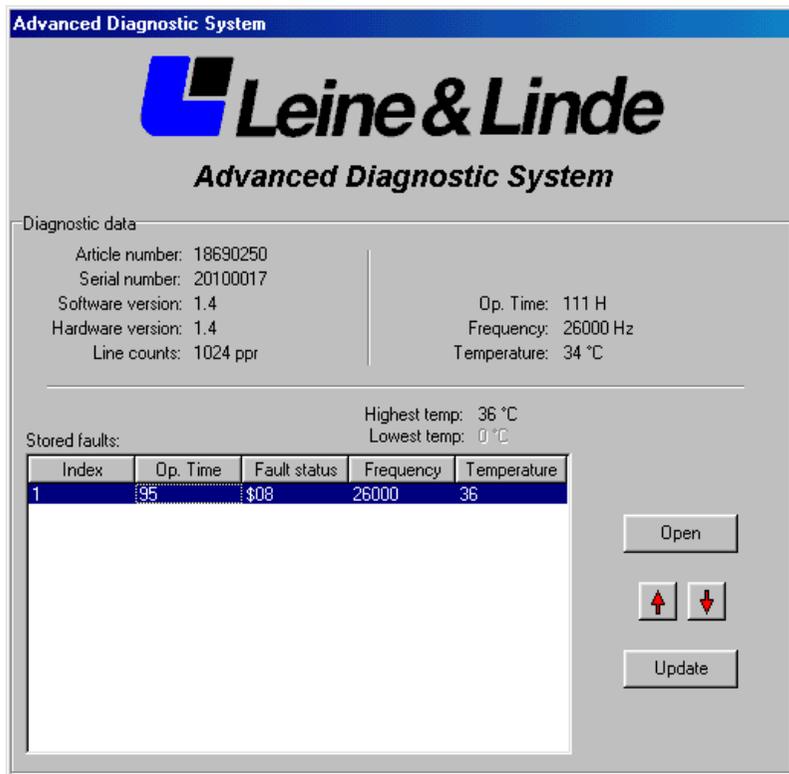


Figure J

Any faults that are detected are displayed under "Stored faults". Mark the fault by clicking with the mouse cursor on the fault and click on "Open" to obtain more detailed information about the fault.

The fault is presented together with the operating time, frequency and the internal temperature when the fault is first detected. The same fault is stored only on a single occasion unless another fault is stored subsequently. Sufficient memory capacity is available for the storage of 13 faults, and only the latest faults is stored if a greater number of faults occur.

## Faults

### 1. Fault status 04, State transition fault.

The change of state at channel 1 and 2 is normally changed in accordance with the green arrows, see Figure K, and the alarm signal is activated if the state is changed in accordance with the red arrows.

Cause: This fault can occur if the encoder is rotated too fast, if the optics is damaged or if the bearings are worn out.

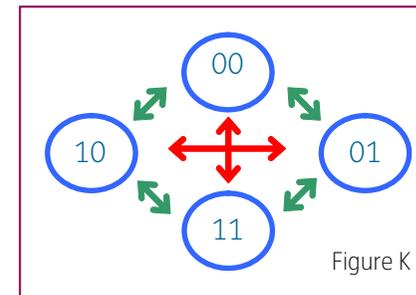


Figure K

### 2. Fault status 08, Zero pulse absent.

This is activated if no zero pulse is obtained before the ADS system has counted twice the resolution the encoder shall have. The encoder must be rotated through one additional revolution from the point at which the zero pulse is absent before the fault is activated. This is the case if the encoder is rotated in the direction that was determined for the first counting pulse after the zero pulse. If the direction of rotation is changed so that counting goes towards 0, and if a zero pulse is absent at 0, the alarm signal will be activated directly.

Cause: This fault can occur if the optics or the electronics are damaged or if the bearings are worn out.

3. **Fault status 10, Missing incremental pulses.**

All increments between 2 zero pulses is checked, and the resolution must then be the encoder's resolution or 0. The fault often occurs in conjunction with 04, Condition fault, see Point 1.

Cause: This fault can occur if the optics is damaged or if the bearings are worn out.

4. **Fault status 20, Incremental overflow (too many pulses).**

All increments between 2 zero points is checked, and the resolution must then be the encoder's resolution or 0.

Cause: This fault can occur if the optics are faulty or damaged. Electromagnetic disturbances in the environment, which exceed the relevant standards, can also give rise to this fault.

5. **Fault status 30, Failure in LED unit.**

Monitoring of the function of the LED unit.

Cause: This fault occurs if the electronics are damaged.

6. **Fault status 40, Faulty output signal for the incremental signals.**

The incremental signals internally in the encoder are compared with the signals that are sent out on the cable. If these signals do not match, the encoder will operate normally internally, but the signal that is sent out from the encoder will not be correct or will be absent.

External incremental signals are not checked at a signal frequency higher than 40 kHz, since there is a risk that an alarm signal will be given even if no fault has occurred.

Cause: This fault occurs if the electronics are damaged, if the encoder outputs are overloaded or short-circuited, if the ambient temperature is too high or as a consequence of some other fault in the optics.

7. **Fault status 80, Faulty output signal for the zero pulse.**

The zero pulse signal internally in the encoder is compared with the signal that is sent out on the cable. If these signals do not match, the encoder will operate normally internally, but the signal that is sent out from the encoder will not be correct or will be absent.

The external zero pulse is not checked at a signal frequency higher than 40 kHz, since there is a risk that an alarm signal will be given even if no fault has occurred.

Cause: This fault occurs if the electronics are damaged, if the encoder outputs are overloaded or short-circuited, or if the ambient temperature is too high.

## ACCESSORIES

Description	Part number
Torque arm M5	01208013
Torque arm M6	01208014