EUROSHIELD RF LEAK DETECTOR 4F-130

USER'S GUIDE

EUROSHIELD OY

SF-27510 Eura, Finland
Tel. International +358 38 506 31
National (938) 506 31
Telefax +358 38 512 33

A-15
EUROSHIELD RF LEAK DETECTOR
MAGNETIC ATTENUATION METHOD

Magnetic attenuation is measured at four frequencies in accordance with MIL-STD-285 or NSA-65-6.

The antenna power supply is automatically kept constant to compensate for fluctuations in battery supply voltage, frequency changes due to adjustments, and changes in the resonance of the antenna circuit caused by the presence of pieces of metal.

**Attenuation and frequency calibration**

Calibrate the meter in free space as follows: Switch on the receiver and the transmitter and place them as shown in figure 1 or 2 depending on the method of measurement used. A gap corresponding to the thickness of the wall should be left between the measuring tips. Choose the measuring frequency and push the calibration knob on the receiver and calibration will take place automatically.

**Measuring magnetic attenuation according to NSA:**

Place the receiver and the transmitter as shown in figure 1 at the point to be measured with the receiver inside the enclosure and the transmitter outside. The attenuation value may now be read from the meter.

**Measuring magnetic attenuation according to MIL-STD-285:**

Place the transmitter and the receiver at the point to be measured as shown in figure 2. Turn the antenna of the transmitter and the receiver until the minimum attenuation reading is obtained. The minimum reading indicates shielding at that point.

The antenna can be turned downward for storage and transportation.

Weight of receiver 1.8 kg.
Weight of transmitter 1.7 kg.
•Without batteries.
EUROSHIELD 4F-130 RF LEAK DETECTOR

USER'S GUIDE

CONTENTS

1 GENERAL INFORMATION.................................................2
  1.1 Introduction
  1.2 Purpose and use of Euroshield Leak Detector
  1.3 MIL-STD-285
  1.4 NSA-65-6
  1.5 Maintenance aspect

2 UNPACKING AND SET-UP...............................................4
  2.1 Unpacking and physical inspection
  2.2 Battery installation

3 TECHNICAL SPECIFICATIONS.........................................5
  3.1 Functional description
  3.2 Physical description
  3.3 Storage and operating environment
  3.4 Specifications
  3.5 Safety precautions
  3.6 Warranty
  3.7 Repair and maintenance

4 PRINCIPLE OF OPERATION..............................................8
  4.1 Transmitter
  4.2 Receiver

5 MEASUREMENT PROCEDURE..............................................9
  5.1 Measuring in accordance to MIL-STD-285
  5.2 Measuring in accordance to NSA 65-6

6 CALIBRATION AND PERFORMANCE VERIFICATION.......................10
  6.1 Calibration procedure
  6.2 Performance verification test

7 MAINTENANCE..........................................................12
  7.1 Troubleshooting table

8 FUNCTIONAL DIAGRAM................................................13
1 GENERAL INFORMATION

1.1 Introduction

During acceptance of a shielded enclosure generally a report is presented with measurement data which is relevant for the particular shielding effectiveness of the enclosure. There are two methods for testing the shielding effectiveness that have long been accepted:

a) MIL-STD-285
b) NSA 65-6

1.2 Purpose and use of Euroshield Leak Detector

The EUROSHIELD RF leak detector was designed to simplify the check-out of the performance for a shielded enclosure. With the possibility of generating four frequencies, the technician is able to check the shielding effectiveness very quickly.

The test system consists of two items, a transmitter and a receiver part. The test frequencies transmitted were chosen in such a way that a complete attenuation curve can be generated starting from 10 kHz which is the most important and most degrading magnetic field section, and up to 10 MHz.

1.3 MIL-STD-285

MIL-STD-285 originally was part of a governmental specification (MIL-S-4957A) for screen mesh enclosures. It was prepared in the early 1950's to procure some wire mesh screen rooms for a research project. The testing portion was later published as MIL-STD-285.

The test methods specified by this document became the standard for determining the performance of all RF shielded enclosures. These test methods provide the technician with antenna placements for conducting reference level measurements, a detailed measurement procedure and a description of test equipment to be used.

During last 30 years the test procedures changed somewhat, with a major change of the advancement in test equipment. The attenuation requirements were 70 dB for magnetic fields for 150...200 kHz, 100 dB for 200 kHz...18 MHz in the electric field and 100 dB at 400 MHz.
1.4 NSA 65-6

In 1964, the NSA published NSA 65-6. This document was a general specification issued to standardize the requirements for the agency's RF shielded enclosures. A test procedure for measuring the shielding effectiveness for the enclosures was also included. The procedures are basically the same as those in MIL-STD-285, with some slight variances. The antenna positioning specification for magnetic field measurements were coaxial instead of coplanar.

1.5 Maintenance aspect

During the lifetime of a shielded enclosure it is of good practice to perform any kind of maintenance on the enclosure. Practically spoken the weakest points in the enclosure are the openings and entrance. When people carry in equipment, damage may be caused to seams and the door sealing springs, and the shielding properties may be derated. With the EUROSHIELD RF LEAK DETECTOR it is very easy to do tests both in the laboratory and field purposes.
2 UNPACKING AND SET-UP

2.1 Unpacking and physical inspection

Examine the shipping package before unpacking the equipment. If the carton has been damaged, check with care if the equipment was damaged and retain the shipping carton.

Check that the equipment is complete as listed on the packing list. Examine the contents of the carrying case visually. If any damage is evident, notify the carrier and your local Euroshield Representative, or the factory.

2.2 Battery installation

Install the batteries as in Fig. 2.2.

Figure 2.2 Battery installation.
3 TECHNICAL SPECIFICATIONS

3.1 Functional description

The Euroshield Leak Detector set 4F-130 consists of two units; the Transmitter and the Receiver. Both assemblies are completely solid state in design, hand-held and easy-to-use.

The transmitter generates a magnetic field at four operating frequencies: 10 kHz, 156 kHz, 1 MHz and 10 MHz. During calibration the receiver searches for the strongest signal in the frequency spectrum between 40 and 200 Hz (intermediate frequency).

The magnetic field strength obtained during the measurement of shielding effectiveness is compared to the magnetic field strength during calibration. The display shows the relative magnitudes of the fields in dB units.

3.2 Physical description

The carrying case is a standard travel case with dimensions 455 mm x 185 mm x 385(h) mm. The entire system, including the carrying case weights 8 kg without the batteries.

The transmitter and the receiver are encapsulated with an aluminium case with grey surface paint.

The system includes the following units:
1 pc transmitter
1 pc receiver
2 pcs measuring rods
1 pc carrying case
1 pc User’s guide
1 pc screw driver

3.3 Storage and operating environment

Storage temperature: -5°C ... +45°C. Keep the leak detector in a dry place. Make sure that the transmitter and the receiver are in correct position in the carrying case = backs against each other!

The Euroshield Leak Detector 4F-130 can operate over the temperature range from 0°C to +40°C. However, during the measurement the temperature may not vary more than 3 C. Therefore before measurement a warm-up period (2 min) may be needed if the leak detector was taken in from a cold temperature.
3.4 Specifications

EUROSHIELD RF LEAK DETECTOR 4F-130

Frequency range
- 10.165 kHz
- 156.085 kHz
- 1.000165 MHz
- 9.999835 MHz

Attenuation range
- 0 ... 130 dB

Attenuation accuracy
- +/- 1.5 dB

Display
- Analog display

LED indication
- Battery check

Antenna
- Electrically shielded
- 12 inch (30 cm) loop

Receiver power supply
- 6 x 1.5 Volt battery

Receiver weight
- 1.8 kg

Transmitter power supply
- 6 x 1.5 Volt battery

Transmitter weight
- 1.7 kg

Dimensions
- 275 x 150 x 48 mm (LxWxH)

Accessories
- Carrying case, 2 pcs rods of 300 mm

Battery life
- 10 hrs

Temperature range
- 0 ... +40°C

Storage temperature
- -5 ... +45°C
3.5 Safety precautions

Remove the batteries and place them in the carrying case when travelling by aircraft.

Never store the detector for prolonged periods with the batteries installed or battery leakage may cause damage. Do not use the instrument when the battery check is flashing or does not light.

3.6 Warranty

Euroshield Oy warrants each new instrument to be free from defects in material and workmanship, effective after delivery to the original purchaser as follows:

Electrical and Electronic Measuring Equipment... 1 Year

Repair or replacement (at our option) without charge (FOB factory) will be effected when our examination satisfactorily indicates that defects are due to materials or workmanship. Warranty returns must first be authorized by the factory.

If the instruments or any portion thereof has been abused, misused, damaged by accident or negligence, or if any serial number or seal has been removed or altered, the warranty is void. Euroshield is not liable for incidental or consequential damages, and the warranty is in lieu of all other warranties.

3.7 Repair and Maintenance

Instruments may be returned only on prior authorization from the Representative or the factory. Validity of warranty will be determined by the factory.

Additional service information is available at our address:

EUROSHIELD OY
SF-27510 Eura
Finland
tel. (+358) 38 50631
fax (+358) 38 51233
4 PRINCIPLE OF OPERATION

4.1 Transmitter

The transmitter antenna consists of 2 loop antennas which are inside the same covering tube (Electric field shield).

RF currents through these loops depend on the frequency in use and will be approximately as follows:

- 10 MHz.......110 mA
- 1 MHz.......450 mA
- 150 kHz.......800 mA
- 10 kHz.......1.3 A

4.2 Receiver

The receiver is planned to measure the relative field strength at four frequencies: 10 MHz, 1 MHz, 150 kHz and 10 kHz.

The receiver starts off with only one crystal oscillator. By digital division, the 5 MHz clock frequency needed for the CPU is achieved as well as the local oscillator frequencies for each frequency to be received.

The receiver antenna consists of three 2-turn loop antennas which are inside the same covering tube and connected in series over separating coils.

During calibration the microprocessor searches for the strongest peak in the intermediate frequency amplifier spectrum, using FFT. The 8-bit A/D transformer takes 64 samples. For the calculation of the shielding level the processor compares only the peak frequency found and memorized during calibration.
5 MEASUREMENT PROCEDURE

For the meter calibration, see chapter 3.

5.1 Measuring in accordance to MIL-STD-285

![Figure 5.1](image)

Place the transmitter and the receiver at the antenna point to be measured as shown in Fig. 5.1. Turn the antenna of the transmitter and the receiver until a minimum attenuation reading is obtained. The minimum reading indicates shielding at that point.

5.2 Measuring in accordance to NSA 65-6

![Figure 5.2](image)

Place the transmitter and the receiver at the point to be measured as shown in Fig. 5.2. Hereby is the receiver part of the test system inside the enclosure and the transmitter is outside. The attenuation value may now be read from the meter.
6 CALIBRATION AND PERFORMANCE VERIFICATION

6.1 Calibration procedure

The meter is to be calibrated in free space as follows:

1. Switch on the power in the transmitter and the receiver.

2. Wait about 2 minutes to have the transmitter and the receiver warmed up and to achieve a stable state for calibration. If the unit has been in room temperature long enough, no stand-by period is required.

3. Depending on the measurement method used place the transmitter and the receiver as in Figure 1 (NSA 65-6) or Figure 2 (MIL-STD-283).

4. Use the 30 cm measuring rods supplied with the meter to be sure of the correct distance between the transmitter and the receiver. A gap corresponding to the thickness of the wall should be left between the rods. Note that the minimum calibration distance is 60 cm. A shorter distance may lead to incorrect calibration.

5. Choose the measuring frequency by setting the transmitter frequency selector into the desired position. Push the calibration knob of the receiver, and calibration will take place automatically. Note that the receiver seeks the signal of the transmitter by using a sequence of frequencies 10 MHz - 10 kHz - 1 MHz - 156 kHz. When the correct frequency was found the indicator needle shows the last frequency, and returns to show zero dB attenuation.

6. Note that if the temperature drops below 0°C the calibration of the very sensitive receiver is affected.
6.2 Performance verification test

To verify the performance you need an oscilloscope and frequency counter. The following procedure is used to check the operation:

TRANSMITTER

1. Measure the voltages of antenna loops using oscilloscope, and set the output stage voltage to 5 V. You should read the following peak-to-peak voltages:
   - 10 kHz: 0.8...1.5 Vpp
   - 156 kHz: 6...10 Vpp
   - 1 MHz: 25...35 Vpp

   For 10 MHz, use a separate measuring antenna (2 loops of 100 mm). The voltage should read 8...10 V.

2. Check the frequencies with the counter. Adjust the 1 MHz and 10 MHz frequencies by using trimmer capacitors. The frequency shall be correct with 10 Hz accuracy.

3. Measure the current of transmitter antenna. See chapter 4.1.

RECEIVER

1. Start the receiver by setting the power on. The needle shall start seeking the signal using a sequence of frequencies 10 MHz - 10 kHz - 1 MHz - 156 kHz.

2. Verify the clock frequency of the CPU by using the frequency counter. The frequency should read exactly 5 MHz. Adjust the correct frequency by using the trimmer capacitor of the CPU circuit. Check that the intermediate frequency is 165 Hz at 1 MHz and 10 MHz frequencies.

3. Find the maximum reading of the A/D converter input at 10 kHz by using oscilloscope and by tuning the ferrite coil of input stage.

4. Check the operation at different frequencies by calibrating the receiver. Then switch off the transmitter. You should now read the maximum attenuation.
7 MAINTENANCE

7.1 Troubleshooting

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Reason</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>No LED indication on the transmitter or receiver</td>
<td>No batteries/worn batteries</td>
<td>Insert new batteries</td>
</tr>
<tr>
<td>The receiver will not be calibrated</td>
<td>Transmitter fault</td>
<td>Check the power and the frequency of the transmitter</td>
</tr>
<tr>
<td>The receiver will not be calibrated at one frequency</td>
<td>Component/tuning fault in the receiver</td>
<td>Check the performance of the receiver</td>
</tr>
<tr>
<td>The needle hits at left end of the display</td>
<td>Negative voltage generation</td>
<td>Check the performance of the receiver</td>
</tr>
<tr>
<td>Incorrect reading</td>
<td>Too short or long calibration distance</td>
<td>New calibration at 60 cm distance</td>
</tr>
</tbody>
</table>
FUNCTIONAL DIAGRAM

A-29 / A-30