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PMM ER8000

User's Manual

EMI RECEIVER

9 kHz ÷ 30 MHz (option 00)

9 kHz ÷ 3000 MHz (option 01)

SERIAL NUMBER OF THE INSTRUMENT

You can find the Serial Number on the rear panel of the instrument.

Serial Number is in the form: 0000X00000.

The first four digits and the letter are the Serial Number prefix, the last five digits are the Serial Number suffix. The prefix is the same for identical instruments, it changes only when a configuration change is made to the instrument.

The suffix is different for each instrument.

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If the instrument is used in any other way than as described in this User's Manual, it may become unsafe.

Before using this product, the related documentation must be read with great care and fully understood to familiarize with all the safety prescriptions.

To ensure the correct use and the maximum safety level, the User shall know all the instructions and recommendations contained in this document.



This product is a **Safety Class I** instrument according to IEC classification and has been designed to meet the requirements of EN61010-1 (Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use).

In accordance with the IEC classification, the power supply of this product meets requirements **Safety Class II** and **Installation Category II** (having double insulation and able to carry out mono-phase power supply operations).

It complies with the requirements of **Pollution Class II** (usually only non-conductive pollution). However, occasionally it may become temporarily conductive due to condense on it.

The information contained in this document is subject to change without notice.

EXPLANATION OF ELECTRICAL AND SAFETY SYMBOLS :

 You now own a high-quality instrument that will give you many years of reliable service. Nevertheless, even this product will eventually become obsolete. When that time comes, please remember that electronic equipment must be disposed of in accordance with local regulations. This product conforms to the WEEE Directive of the European Union (2002/96/EC) and belongs to Category 9 (Monitoring and Control Instruments). You can return the instrument to us free of charge for proper environment friendly disposal. You can obtain further information from your local Narda Sales Partner or by visiting our website at www.narda-sts.it.



Warning, danger of electric shock



Earth



Read carefully the Operating Manual and its instructions, pay attention to the safety symbols.



Unit Earth Connection



Earth Protection



Equipotential

EXPLANATION OF SYMBOLS USED IN THIS DOCUMENT :



The **DANGER** sign draws attention to a serious risk to a person's safety, which, if not avoided, will result in death or serious injury. All the precautions must be fully understood and applied before proceeding.



The **WARNING** sign indicates a hazardous situation, which, if not avoided, could result in death or serious injury. All the precautions must be fully understood and applied before proceeding.



The **CAUTION** sign indicates a hazardous situation, which, if not avoided, could result in minor or moderate injury.



The **NOTICE** sign draws attention to a potential risk of damage to the apparatus or loss of data.



The **NOTE** sign draws attention to important information.

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⚠ WARNING**SAFETY RECOMMENDATIONS AND INSTRUCTIONS**

This unit has been designed and tested in Italy, according to IEC 348 standard and has left the manufacturer's premises in a state fully complying with the safety standards ; in order to maintain the unit in a safe state and to ensure safe operation, the following instructions must be reviewed and fully understood before operation.

- When the unit is to be permanently cabled, first connect an uninterruptible protective earth ground conductor before making any other connections.
- If the unit is to be connected to other equipment or accessories, prior to energizing either unit verify that a common ground exists between them.
- For permanently cabled unit without built-in fuses, automatic circuit breakers or similar protective facilities, the power supply line shall be provided with fuses or protections rated to the unit.
- Verify that the unit is set to match the available mains voltage and correct fuse rating is installed before applying power.
- The Safety Class I units provided with disconnectible AC supply cable and plug may only be operated from a power socket with protective earth ground connection.
- Any interruption or loosening of the protective earth ground conductor, either inside or outside the unit or in an extension cable will cause a potential shock hazard that could result in personal injury.
- The protective earth ground conductor shall not be interrupted intentionally.
- To avoid electrical shock do not remove protections or covers of the unit , refer to qualified NARDA Servicing Center for maintenance of the unit.
- To maintain adequate protection against fire hazard, replace fuses only with others of the same type and rating;
- Observe safety regulations and rules and also the additional safety instructions specified in this manual for prevention of accidents.



Dichiarazione di Conformità

EC Declaration of Conformity



In accordo alla Decisione 768/2008/EC, conforme alle direttive EMC 2014/30/UE, Bassa Tensione 2014/35/UE e RoHS 2011/65/UE, ed anche alle norme ISO/IEC 17050-1 e 17050-2.

In accordance with the Decision 768/2008/EC, compliant to the Directives EMC 2014/30/UE, Low Voltage 2014/35/UE and RoHS 2011/65/EU, also compliant to the ISO/IEC standard 17050-1 and 17050-2

Il costruttore

The manufacturer

narda Safety Test Solutions S.r.l. Socio Unico

Indirizzo

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I-17035 Cisano sul Neva (SV) - Italy

sulla base delle seguenti norme europee armonizzate, applicate con esito positivo:
based on the following harmonized European Standards, successfully applied:

EMC - Emissioni:

EMC - Emission:

EN 61326-1 (2013)

EMC - Immunità:

EMC - Immunity:

EN 61326-1 (2013)

Sicurezza:

Safety:

CEI EN 61010-1 (2010)

dichiara, sotto la propria responsabilità, che il prodotto:
declares, under its sole responsibility, that the product:

Descrizione

Description

EMI RECEIVER

Modello

Model

PMM ER8000

è conforme ai requisiti essenziali delle seguenti Direttive:

conforms with the essential requirements of the following Directives:

Bassa Tensione

Low Voltage

2014/35/EU

Compatibilità Elettromagnetica

EMC

2014/30/EU

RoHS

RoHS

2011/65/EU

Cisano sul Neva, 29 June 2020

Egon Stocca

General Manager

1 – General Information



1.1 Documentation

Enclosed with this manual are:

- a service questionnaire to send back to NARDA in case an equipment service is needed
- an accessories checklist to verify all accessories enclosed in the packaging.

1.2 Operating Manual Changes

Instruments manufactured after the printing of this manual may have a serial number prefix not listed on the title page; this indicates that instruments with different Serial Number prefix may be different from those documented in this manual.

1.3 Introduction to PMM ER8000

PMM ER8000 is a powerful EMI receiver, fully CISPR 16-1-1 compliant, to measure conducted and radiated interferences from 9 kHz up to 30 MHz (opt. 00), or even up to 3 GHz (opt. 01). All measurements performed by the PMM ER8000 are according to the most accepted standards like: IEC, CISPR, EN (EuroNorm), FCC, VDE,...

Thanks to its built-in Line Impedance Stabilization Network, PMM ER8000 is also suitable for characterizing and testing EUTs without the need of other ancillaries.

The PMM ER8000 has been designed adopting an innovative philosophy made possible only in the recent years by the availability of superior technology components. This equipment is fully digital but the input preselector and attenuator – and, of course, the LISN - and therefore combines into a pure EMI Receiver and Signal Analyzer the precision and accuracy of a numeric approach, with flexibility and user friendly approach typical of a modern instrument.

1.4 Instrument Items

PMM ER8000 includes the following items:

- EMI Receiver from 10 Hz up to 30 MHz (opt.00) or 10 Hz to 3000 MHz (opt.01)
- Soft carrying case
- AC/DC Converter with plug adapters;
- LISN Mains Cable
- N male to BNC female Adapter;
- BNC-BNC coaxial cable 2m length;
- RS232 cable, 2m;
- USB-RS232 serial converter;
- USB cable, 2m;
- Operating manual with return for repair form;
- PMM ER8000 Utility Software on Software Media;
- Certificate of Calibration;
- Return for Repair Form.

1.5 Optional accessories

PMM ER8000 can be used with several optional accessories, the most common being the following:

- PMM 9010-RMA Rack Mount Adapter for Rack 19";
- ER8000/GND Ground connection;
- 9010/CC Rigid Carrying Case;
- L2-16B: Two lines, Single phase, 16A LISN, (50Ω//5 Ω+50μH);
- L3-32: Four lines, 3-phase, 32A LISN, (50Ω//5 Ω+50μH);
- L3-64: Four lines, 3-phase, 64A LISN, (50Ω//5 Ω+50μH);
- L3-64/690: Four lines, 3-phase, 64A - 690Vac LISN, (50Ω//5 Ω+50μH);
- L3-100: Four lines, 3-phase, 100A LISN, (50Ω//5 Ω+50μH);
- L1-150M: Multi-standard Single line LISN, 150A (50Ω//1 Ω+5μH) (100 kHz to 200 MHz);
- L1-150M1: Multi-standard Single line LISN, 150A (50Ω//1 Ω+5μH) (10 kHz to 400 MHz);
- L1-500: Single line LISN, 500A (50Ω//5 Ω+50μH);
- L3-500: Four lines, 3-phase, LISN 500A (50Ω//5 Ω+50μH);
- SBRF4 RF Switching Box (Switching Box for LISNs and Loop Antennas)
- LISN Service Kit (AC-BNC adapter for LISNs verification and calibration)
- SHC-1/1000: 35 dB CISPR Voltage probe, 1500Ω;
- SHC-2/1000: 30 dB CISPR Voltage probe, 1500Ω;
- RA-01: Rod Antenna (9 kHz – 30 MHz);
- RA-01-MIL: Rod Antenna (9 kHz – 30 MHz);
- RA-01-HV: Rod Antenna (150 kHz – 30 MHz);
- BC-01: Biconical Antenna (30 – 200 MHz)
- BL-01: Biconical Log Periodic Antenna 30 MHz to 6 GHz
- LP-02: Log Periodic Antenna 200 MHz to 3 GHz
- LP-03: Log Periodic Antenna 800 MHz to 6 GHz
- LP-04: Log Periodic Antenna 200 MHz to 6 GHz
- TR-01: Antenna Tripod
- Antenna Set AS-02 (BC01+LP02+TR01)
- Antenna Set AS-04 (BC01+LP04+TR01)
- Antenna Set AS-07 (BL01+TR01)
- VDH-01: Van der Hoofden Test Head 20 kHz to 10 MHz
- RF-300 : Van Veen Loop

1.6 Other accessories

The PMM ER8000 can also be used with other accessories available on the market, like:

- LISNs, any type;
- Antennas and Loops;
- Near Field Probes;
- Various TEM/GTEM Cells;
- Triple Loop Antenna

1.7 Main Specifications

Table 1-1 lists the PMM ER8000 performance specifications.

The following conditions apply to all specifications:

- The ambient temperature shall be -5°C to 45°C

TABLE 1-1 Main Specifications	
Frequency	
Range	9 kHz to 30 MHz (Opt. 00) 9 kHz to 3 GHz (Opt. 01)
Resolution	1 Hz; 100Hz above 30 MHz (Opt. 01)
Reference frequency	< 2.5 ppm
Spectrum analysis method	FFT, size up to 8192, minimum overlap 89%
RF input	Z _{in} 50 Ω, N fem.
VSWR	
10 dB RF att.	< 1.2; < 2 above 1 GHz
0 dB RF att.	< 2
Attenuator	0 dB to 45 dB (5 dB steps)
Preamplifier gain	20 dB; 10 dB above 30 MHz Low saturation preamplifier (after preselector)
Pulse limiter	Built in (selectable) below 30 MHz
Max input level (without equipment damage)	
Sinewave AC	140 dBuV (2 W); 137 dBuV (1 W) above 30 MHz
Voltage pulse spectral density	176 dBuV/MHz below 150 kHz; 130 dBuV/MHz below 30 MHz; 97 dBuV/MHz below 1 GHz
Max. pulse voltage	200V (≤ 20 us)
Max. DC voltage	50V
Preselector	(Seven BP filters - 15 MHz BW to ADC)
Frequency ranges	9 kHz to 150 kHz 150 kHz to 15 MHz 15 MHz to 30 MHz 30 MHz to 96.6 MHz tracking (Opt. 01) 96.6 MHz to 311 MHz tracking (Opt. 01) 311 MHz to 1000 MHz tracking (Opt. 01) 1 GHz to 3 GHz (Opt. 01)
IF bandwidth	
6dB	100 Hz, 300 Hz 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz 1 MHz, 3 MHz
CISPR 16-1-1	200 Hz, 9 kHz, 120kHz, 1 MHz
Displayed Average Noise Level	
Preselector OFF, preamplifier OFF, Ht 1s	9 kHz to 150 kHz (200 Hz RBW) < -17 dBuV 0.15 MHz to 30 MHz (9 kHz RBW) < 0 dBuV 30 MHz to 300 MHz (120 kHz RBW) < 4 dBuV (Opt. 01) 300 MHz to 3 GHz (120 kHz RBW) < 10 dBuV (Opt. 01)
Preselector ON, preamplifier OFF, Ht 1s	9 kHz to 150 kHz (200 Hz RBW) < -14 dBuV 0.15 MHz to 30 MHz (9 kHz RBW) < 3 dBuV 30 MHz to 300 MHz (120 kHz RBW) < 1 dBuV (Opt. 01) 300 MHz to 3 GHz (120 kHz RBW) < 6 dBuV (Opt. 01)
Preselector ON, preamplifier ON, Ht 1s	9 kHz to 150 kHz (200 Hz RBW) < -27 dBuV 0.15 MHz to 30 MHz (9 kHz RBW) < -14 dBuV 30 MHz to 300 MHz (120 kHz RBW) < -5 dBuV (Opt. 01) 300 MHz to 3 GHz (120 kHz RBW) < 0 dBuV (Opt. 01)
Detectors	Peak, Quasi-Peak, Average, RMS, RMS-Average, C-Average. Smart Detector function above 30 MHz (Opt. 01)



Scan time	SWEEP MODE (CISPR: preselector ON, QP detector) ANALYZER MODE (preselector OFF, Peak detector, Hold time lowest)
A band (9 kHz to 150 kHz) 200 Hz RBW	< 2 s (Hold time 1 s) < 3 s (Hold time 2 s) < 50 ms (Ht 27 ms)
B band (150 kHz to 30 MHz) 9 kHz RBW	< 3 s (Hold time 1 s) < 5 s (Hold time 2 s) < 10 ms (Ht 525 us)
C band (30 MHz to 300 MHz) 120 kHz RBW	< 20 s (Hold time 1 s) < 40 s (Hold time 2 s) < 100 ms (Ht 32 us)
D band (300 MHz to 1 GHz) 120 kHz RBW	< 40 s (Hold time 1 s) < 80 s (Hold time 2 s) < 500 ms (Hold time 32 us)
E band (1 GHz to 3 GHz) 1 MHz RBW	< 160 s (Hold time 1 s) < 320 s (Hold time 2 s) < 400 ms (Hold time 4 us)
Level measuring time (Hold time)	CISPR 16-1-1 as default. 2 us to 120 s
Measurement accuracy S/N > 20 dB	9 kHz to 1 GHz ± 1.2 dB 1 to 3 GHz ± 1.6 dB
Recommended calibration interval	24 months
Main measure functions With free system SW PMM Emission Suite	Manual, spectrum analyser and sweep modes. Waterfall Standard and user definable limits Conversion and correction factors Control of DDA (Click) analyser, LISNs and other accessories. Auto diagnosis Test reporting
Units With free system SW PMM Emission Suite (80 to 200 dB selectable display dynamic range)	dBm, dBμV, dBμA, dBpW, dBμV/m, dBμA/m, dBpT
Demodulation	AM – FM Internal loudspeaker
I/O Interface	RS-232 DB9, USB 2.0 type B, User port DB15 (Drives PMM LISNs and accessories)
Operating temperature	-5° to 45°C
Power supply	10 - 15 Vdc, 2.5A with AC universal adapter/charger
Built-in LISN Measure frequency range Continuous rated output current Max permissible operating voltage AC supply frequency range CISPR equivalent circuit Test socket Line plug Artificial hand RF output	150 kHz to 30 MHz 16A 250Vac – 350Vdc DC to 60 Hz 50 Ω // (5 Ω + 50 uH) SCHUKO 2P+E IEC 60320 C20 4mm plug Internal receiver or BNC-f
Dimensions	235x105x300 mm
Weight	5.2 kg

1.8 Front Panel



Fig. 1-1 Front Panel

Legend from left to right:

-  : Switch ON pushbutton with integrated red/green LED which indicates the power status
- **Grid:** Speaker grid
- **RF Input connector:** Receiver Input
- **LEDs:** L1, L2 LISN lines and RF Input indications
- **AMN:** Artificial Mains Network: EUT Socket
- **Artificial Hand:** Standard 4 mm socket
- **Earth ground connector**

1.9 Rear Panel



Fig. 1-2 Rear Panel

Legend from left to right:

- **Product Label and Serial Number**
- **Mains socket to connect the EUT to the mains through the internal LISN.**
- **Product Label and Serial Number**
- **LISN OUT** LISN RF Output, BNC connector
- Fan** Cooling Fan controlled by firmware
- Power Supply** Power Supply Input to power the apparatus.
- **Earth ground connector**
- **USER PORT** User I/O Port
- **RS232** 9 pin, DB9 connector
- **USB** USB 2.0 Port

1.10 Functional Description

The PMM ER8000 features a completely new receiver architecture based on the most recent DSP and FPGA technology, as shown on the diagram below.

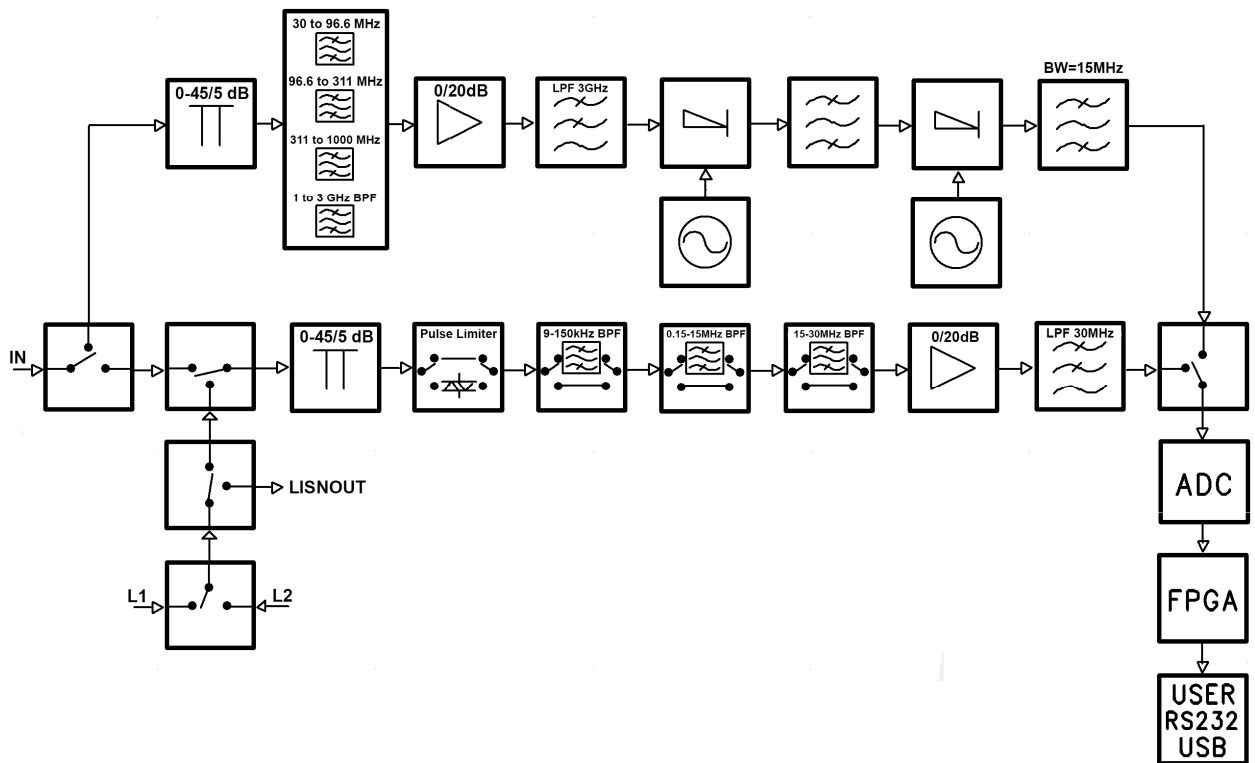


Fig. 1-3 PMM ER8000 Functional BLOCK Diagram

The input stage integrates a switch system able to select the signal source coming from the N panel connector or from the desired line of the internal LISN. Then, the path can go toward the blocks designed for conducted or radiated (\COND) measurements. The RF (Radiated) module is equipped with its own attenuator and preselection filters bank. The A to D conversion and processing stages are in common between conducted and radiated modules.

The stages designed for conducted measurements are able to handle frequencies at least from 9 kHz up to 30.1 MHz and the radiated module can handle frequencies from 28 up to 3000 MHz.

All the IF filters are numerically calculated by the FPGA-DSP so they are very stable and don't need frequent recalibration.



1.11 Ultra fast measurement: a unique feature of the PMM ER8000

In the CISPR bands A (9 kHz ÷ 150 kHz), B (150 kHz ÷ 30 MHz), C (30 ÷ 300 MHz) and D (300 ÷ 1000 MHz) the standards requires the use of specially shaped 200 Hz, 9 kHz, and 120 kHz RBW filters.

For example, in the CISPR band A (9 ÷ 150 kHz), the standards requires the use of a 200 Hz filter that is, by nature, a filter that implies a long measurement time: a complete scan may require even more than 10 minutes, depending on the detector in use.

Thanks to its architecture and to the large internal memory capability, the PMM ER8000 can take a “snapshot” of the whole band in just one second and, using a gap-less true built-in FFT capability, perfectly displays the complete band in all its details. This feature is not only useful to greatly increase the productivity of the test lab, but also to make better and more comprehensive analysis in case the disturbance to be evaluated is somehow intermittent and with an irregular repetition rate; its analysis with a traditional receiver could be hardly made in a proper way (even if an FFT capability is available: this feature needs a very comprehensive design), as irregular pulses could be lost during a usual sweep.

To be noted that during the FFT analysis, the PMM ER8000 makes use of internal filters mathematically modelled to the perfection using a FIR technique.

1.12 Emission measurements

All electric and electronic devices are potential generators of Electro-Magnetic Interference (EMI).

The term EMI thus refers to the electromagnetic energy emitted by a device which propagates itself along cables or through the air and couples with other devices that are present in the surroundings.

These electromagnetic fields (conducted or radiated interferences) may generate interfering currents and voltages into nearby equipment and therefore can cause possible malfunctions.

In order to prevent and control such interferences there are nowadays a number of national and international standards, like IEC and CISPR, which specifies limits and methods of tests. Moreover, within the European Union the application of several European Norms on Electromagnetic Compatibility is enforced by law and therefore the commercialization and use of all the electric and electronic equipment is subject to the measurement of the EMC characteristics, which must be within well defined limits.

The design approach adopted for the PMM ER8000 is that the instrument shall be innovative, full compliant with all the relevant standards and at the same time simple and reliable to use, to be the base building block for any possible emission system to measure and evaluate any electric or electronic device from the very first design stages to the final certification.

The need to precisely measure the conducted and radiated EMI noises forces the equipment manufactures to use reliable equipment to verify the limits imposed by the relevant standards and/or enforced by local rules.

In this view the PMM ER8000 receiver is the ideal solution from prototype debugging to final certification, as it fully meets all the performance criteria dictated by these standards, although it remains small, lightweight and very easy to use.

The PMM ER8000 Utility control software permits an immediate use of the instrument without any training or special difficulties: the operator can concentrate just on analyzing the measurement results.

Moreover, the PMM ER8000 software has also been designed for a fast and easy installation on any PC with the Windows™ operating system and with at least one free USB or Serial Port.

The device under test (DUT) must be installed according to the procedures indicated in the constructor's manual and normal operating conditions respected.

NOTICE

Be sure not to overload PMM ER8000: the input signal should not exceed the maximum level indicated in the specifications (see § 1.7) . Also do not apply any signal to RF LISN output connector.



1.13 Principle of operation

Differently from PMM 9010, which is a digital sweeping receiver based on a zero-lock-time, step-by-step NCO (numeric controlled oscillator), fast settling time FIR RBW filters followed by digital detectors - something faster than conventional receivers anyway - the ER8000 is a real-time gapless receiver based on FFT (Fast Fourier Transform) which evaluates N frequencies in a single shot.

Real time means that the FFT calculation must be as fast as the incoming data are sampled to achieve the result that no data are missed.

FFT itself would be not adequate for full compliant measurements without preventing:

- Aliasing effect, by adopting an appropriate input filter which suppresses the frequencies beyond the Nyquist limit.
- Spectrum leakage, due to the fact that observation of the input signal must be limited to a finite interval (an infinite series of subsequent finite intervals in our method). An appropriate time-windowing function is applied so that the spreading or leakage of the spectral components away from the correct frequencies is negligible.
- Picket fence effect, related to the resolution bias error that may cause in an FFT spectrum the peaks to be measured too low and the valleys too high in level. This phenomenon is avoided by adding a certain number of overlapped FFTs, calculated in parallel over almost the same input samples.

Thanks to these techniques the PMM ER8000 has no gaps and detects any CISPR pulse even at the lowest repetition rates.

The ER8000 processes 6 detectors x 1024 frequencies x 16 FFTs at once.

In this way it is possible, for example, to carry out a complete fully CISPR 16.1.1 compliant measurement with 2 seconds hold time over the A band (9 -150 kHz with a 200 Hz RBW filter), or with 1 second hold time over the B band (150 kHz – 30 MHz with a 9 kHz RBW filter) in less than 3 seconds.

2 - Installation

2.1 Introduction

This section provides the information needed to install your PMM ER8000. It includes the information pertinent to initial inspection and power requirements, connections, operating environment, instrument mounting, cleaning, storage and shipment.

2.2 Initial Inspection

When receiving the equipment, first inspect the shipping cardbox for any damages.

If the shipping box is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically.

2.3 Packing and Unpacking

Verify the availability of all the shipped items with reference to the shipping check list enclosed with the Operating Manual.

Notify any damage to the forwarder personnel as well as to your NARDA Representative.

NOTICE

To avoid further damage, do not turn on the instrument when there are signs of shipping damage to any portion of it.

2.4 Preparation for Use

WARNING

This is a Safety Class I apparatus, but it is also equipped with a protective/functional earth terminal on the rear panel. A good safety/functional ground connection should be provided before to operate the receiver.

2.5 AC/DC Power Supply

The power supply supplied with the receiver can work at either 50 Hz or 60 Hz with a supply voltage rated between 100 and 240 Volt.

It is supplied with different connectors to fit all the possible outlets in accordance with the various National standards.

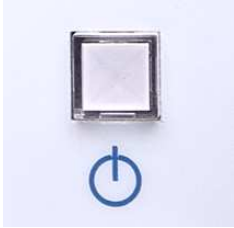


Battery charger: DC, 10 - 15 V, ~ 2500 mA
=> DC Connector

2.5.1 To replace the mains connector of AC/DC Power Supply

To replace the mains connector, simply remove the one installed on the Power supply sliding it off, and insert the one that fits the outlets in use.

2.5.2 Switch ON pushbutton with integrated led



To switch the unit ON, press the square button and keep it pressed till the led lights up, then release the button; the boot sequence takes place automatically.

When the led inside the button becomes green, the instrument is ready for use.



The led inside the button is red until the unit is ready.

2.6 Environment

The operating environment of the receiver is specified to be within the following limits:

- Temperature -5° to +45° C
- Humidity < 90% relative
- Altitude 4000 meters

The instrument should be stored and shipped in a clean, dry environment which is specified to be within the following limitations:

- Temperature -40° to + 50° C
- Humidity < 95% relative
- Altitude 15.000 meters

2.7 Return for Service

If the instrument should be returned to NARDA for service, please complete the service questionnaire enclosed with the Operating Manual and attach it to the instrument.

To minimize the repair time, be as specific as possible when describing the failure. If the failure only occurs under certain conditions, explain how to duplicate the failure.

If possible, reusing of the original packaging to ship the equipment is preferable.

In case other package should be used, ensure to wrap the instrument in heavy paper or plastic.

Use a strong shipping box and use enough shock absorbing material all around the equipment to provide a firm cushion and prevent movement in the shipping box; in particular protect the front panel.

Seal the shipping box securely.

Mark the shipping box FRAGILE to encourage careful handling.



Nowadays there are restrictions on the shipment of hazardous materials, eg. some types of lithium batteries.

Please, check the proper, safe, shipping mode, with the help of your courier, in the case the product is equipped with batteries.

2.8 Equipment Cleaning

Use a clean, dry, non abrasive cloth for external cleaning of the equipment.

NOTICE

To clean the equipment do not use any solvent, thinner, turpentine, acid, acetone or similar matter to avoid damage to external plastic or display surfaces.

2.9 Equipment ventilation

NOTICE

To allow correct equipment ventilation ensure that the vent grids on the rear panel and on the bottom of the receiver are free by any obstructing object.

2.10 Hardware Installation

PMM ER8000 is delivered from factory ready to use. Remove the receiver from its cardboard shipping box and keep the "ON" button pressed until the PW Led lights up (about 1 second), then release the button. To avoid unwanted starts, if the "ON" button is kept pressed for a too short time or for more then 2 seconds the instrument is switched automatically off.

After having been switched ON, the PMM ER8000 boots with its internal BIOS and runs the firmware which manages the receiver.

At the beginning the instrument performs a diagnostic test to check if everything is working properly.

The boot sequence is very fast and the receiver is ready to use in less than ten seconds after having pressed the ON button.

Just before the end of the boot up, you will see all the front panel LED's flashing ON and then only the Power green LED and the RF IN remain ON.

The receiver is now ready to operate.

Prepare the connection of the internal LISN or connect the output of any further LISN, or antenna, or absorbing clamp or any other transducers to the RF input.



When using a PMM LISN, it is possible to control from the receiver the lines of the LISN and automatically switch between them connecting a special cable between the User Port of the receiver and the LISN remote control input.

Push and keep pressed the “ON/OFF” button for more then 2 seconds to switch off the receiver.

2.11 Using an Artificial Mains Network (AMN or LISN)

The internal LISN is automatically controlled by the software and there is no need for any other connection or switch than the Mains line and the EUT plug. When the PMM ER8000 receiver is connected to an external LISN to perform conducted interference measurements of the EUT, the RF output of the LISN shall be connected to the RF input of the receiver (see Fig. 4-3 on page 4-4). In order to switch automatically between the lines of the LISN, it shall be connected to the User Port of the receiver thanks to the dedicated cable supplied with the LISN .

Using PMM ER8000 Software Utility it is possible to carry out an automatic measurements on all mains lines and get the worst case.

CAUTION

In order to avoid the unwanted tripping of the protection devices, an insulation transformer shall always be used between the mains supply and a LISN.

2.12 Using the Pulse Limiter

The built in pulse limiter is a useful device to protect the input of the receiver from transient over voltages. Sometime the conducted disturbances entering the receiver through the LISN are too high - even if they cannot be seen on the PMM ER8000 because they are out of measurement bandwidth - and the associate energy is high enough to damage the input circuit.

The pulse limiter shall be used only as a protection of the input from unexpected pulses.

NOTICE

When using an external Artificial Mains Network, to reduce the probability of damages caused by transient voltage pulses always disconnect the PMM ER8000 RF input before switching Equipment Under Test supply ON or OFF.

2.13 Using Current and Voltage Probes

When a LISN cannot be used – e.g. when measurements have to be made on terminals other than the mains ones, such as load or command terminals, sensitive to inserted capacities for example, or when LISNs of adequate current capabilities aren't available, or when the line voltage is too high – a current or voltage probe can be used.

The characteristics of these probes, and some advises on their uses, are given in §5 of CISPR 16-1-2.

The CISPR voltage probe contains a resistor with a minimum resistance of 1500 ohm, in series with a capacitor of negligible reactance vs. the resistance (in the 150 kHz to 30 MHz range), and it is insulated at least up to 1500V.

All these probes have an insertion loss and a frequency response that can be stored in the memory of the PMM ER8000, so that the actual readings of the receiver can be automatically corrected by these characteristics values.

2.14 Using Antennas and other Transducers

In the frequency range from 9 kHz to 30 MHz (opt.00) or 9 kHz to 3 GHz (opt.01) any other transducer can be used to pick-up and measure RF conducted and radiated emissions, like active and passive loop antennas, rod antennas, near field probes etc.

The characteristics of these transducers are usually specified in the relevant standards (e.g. Military or Automotive Standards).

Their use with PMM ER8000 is very easy, as it's enough to enter their response with the frequency into the memory of the receiver to have the readings automatically corrected. When the cable is not calibrated together with the transducer, even the cable loss can be entered.

2.15 The User Port

The PMM ER8000 features on the rear panel a programmable User Port that can be used to drive external devices or, more generally, to output signals and data.

The User Port can easily be programmed and managed; the connector has the following hardware connection:

PIN #	Signal
1	IN3
2	IN1
3	+ 12 VDC (max 50 mA)
4	OUT 0
5	OUT 2
6	Not Connected
7	Not Connected
8 and 9	IN 2
10	IN 0
11	GND
12	OUT 1
13	OUT 3
14	Not Connected
15	Not Connected

Data output (OUT 0 to OUT 3) and input (IN 0 to IN 3) are opto-coupled TTL level with max. 1 mA draining.

2.16 PMM L2-16A Remote Cable configuration for PMM ER8000



The following figure shows the LISN remote cable pin configuration. This cable is normally provided in L2-16A package, alternatively it can be requested to Narda or arranged locally.

The PMM L2-16A is no longer supported. Please, check the manufacturing status of the Narda products from the website at <http://www.narda-sts.it> or contact your Narda – PMM local Dealer

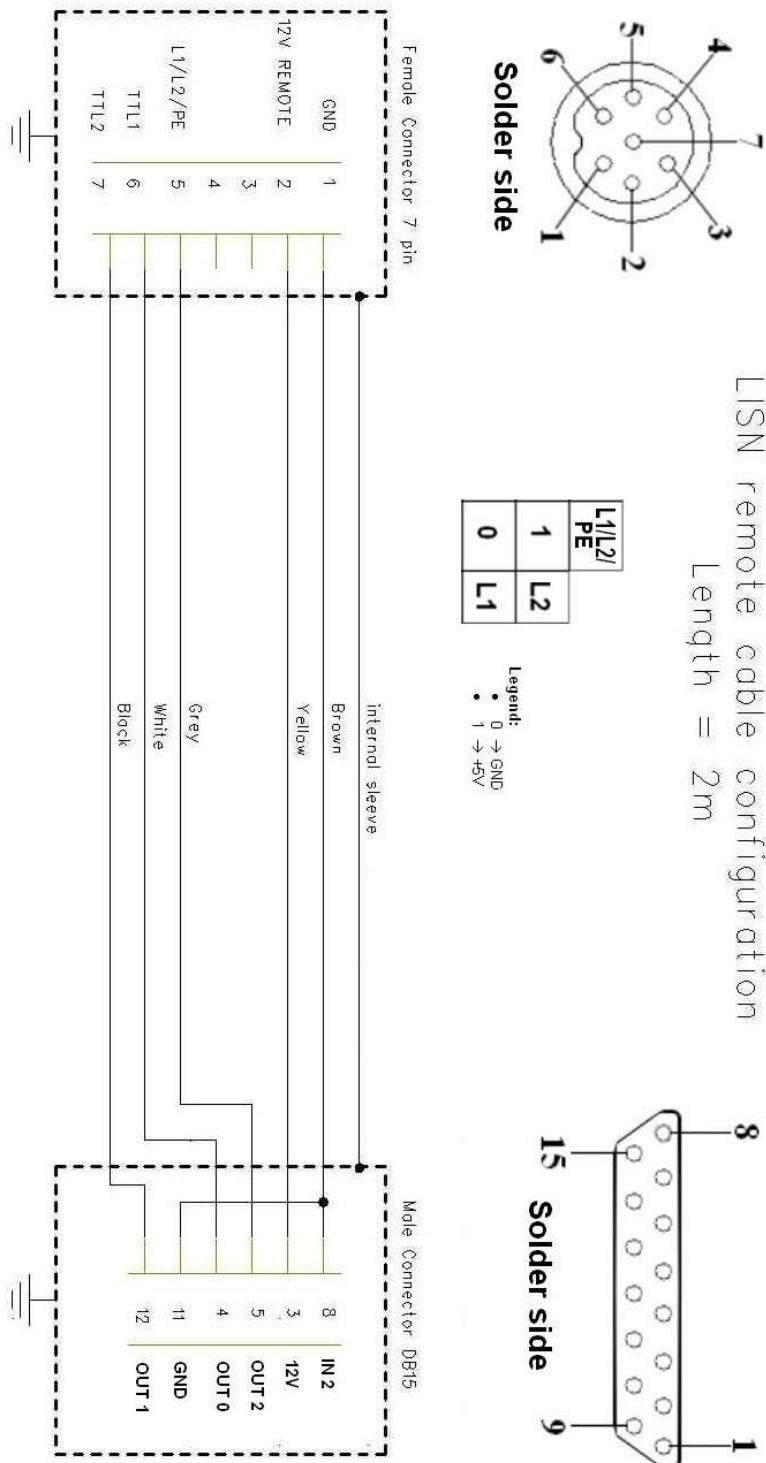


Fig. 2-1 PMM L2-16A remote cable configuration for PMM ER8000

2.17 PMM LISNs
Three Phase
Remote Cable
configuration
for PMM ER8000
(L3-25 excluded)

The following figure shows the LISN remote cable pin configuration. The cable can be requested to Narda or arranged locally.

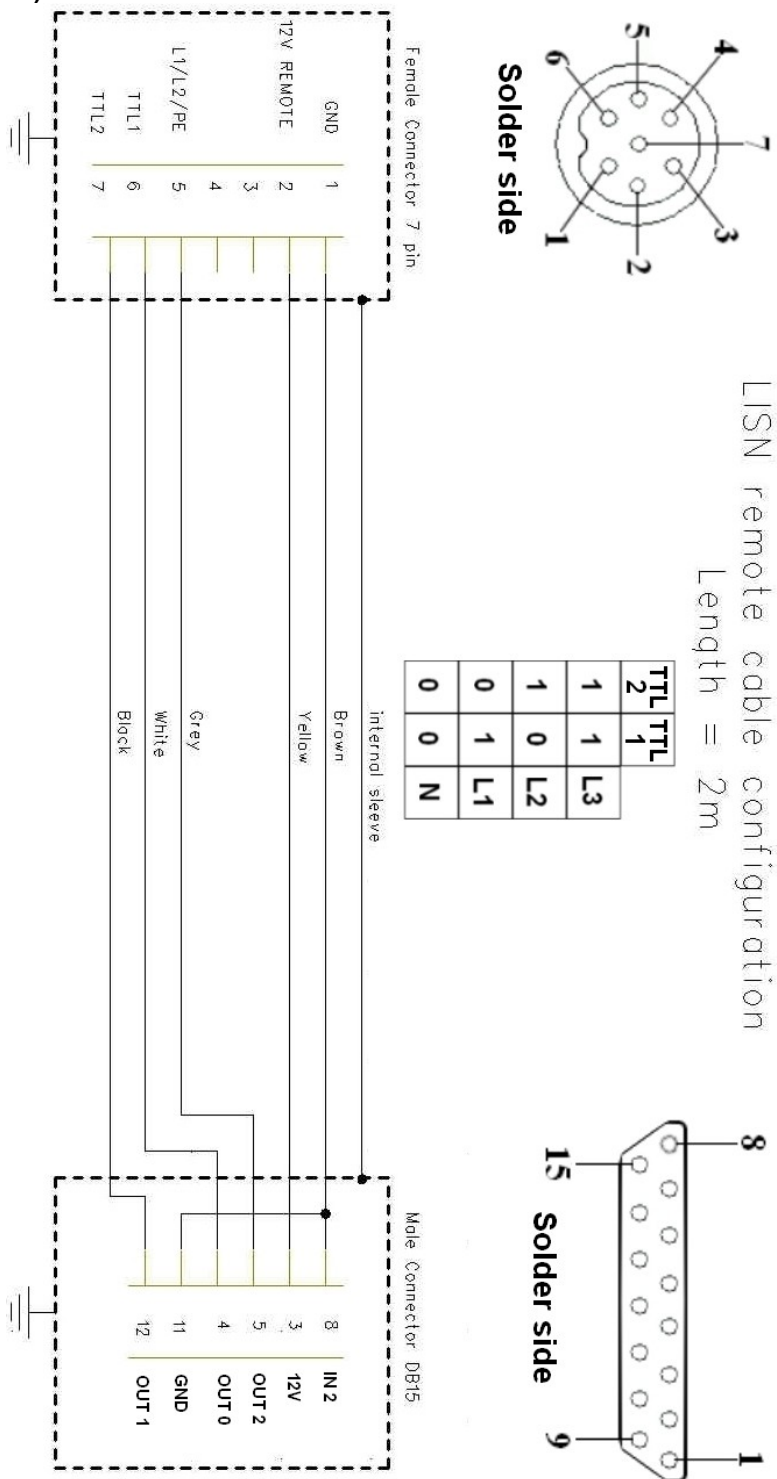


Fig. 2-2 PMM LISN three phase remote cable configuration for PMM ER8000

2.18 PMM L3-25 Remote Cable configuration for PMM ER8000



The following figure shows the LISN remote cable pin configuration. The cable can be requested to Narda or arranged locally.

The PMM L3-25 is no longer supported. Please, check the manufacturing status of the Narda products from the website at <http://www.narda-sts.it> or contact your Narda – PMM local Dealer

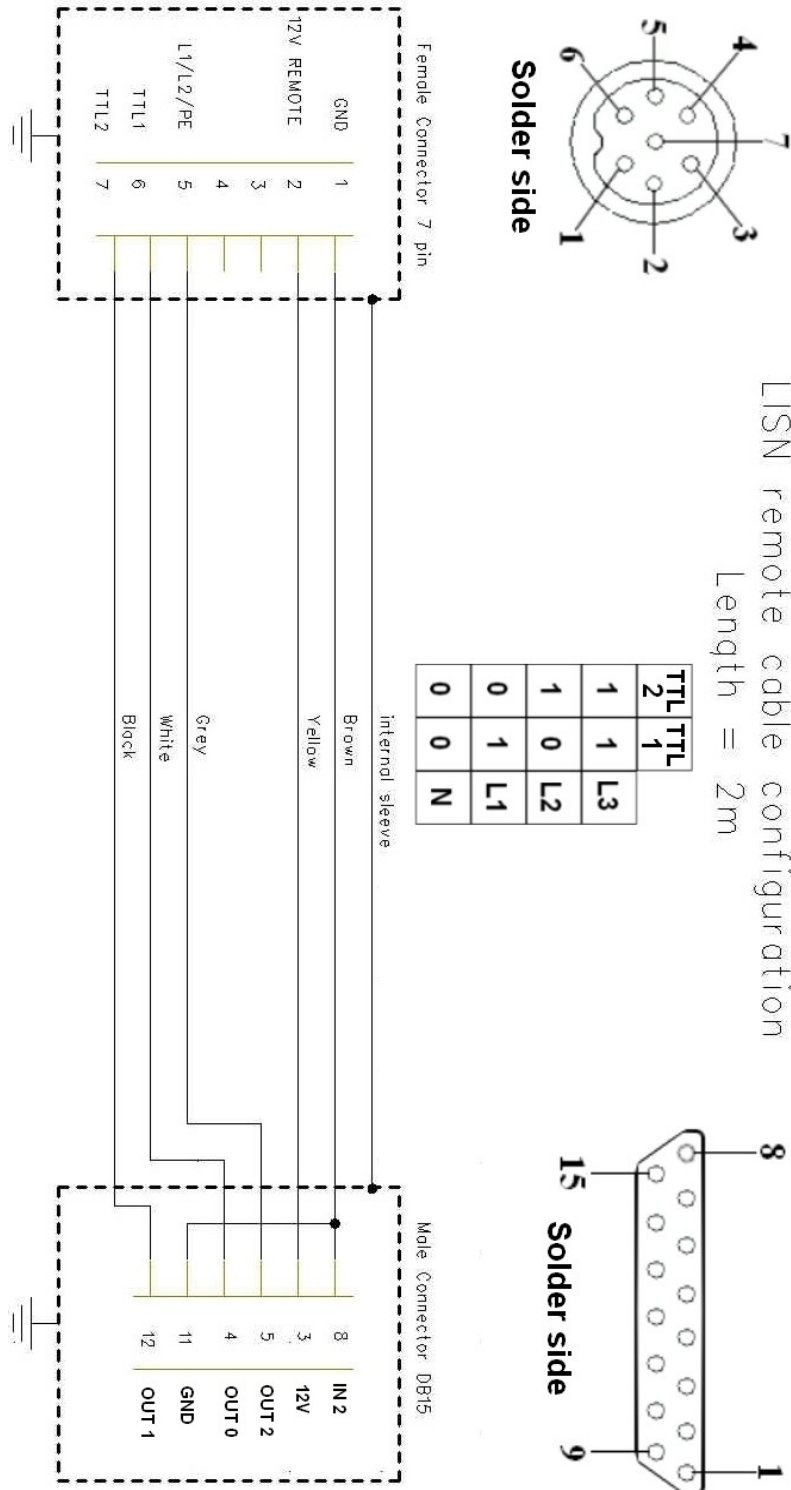


Fig. 2-3 PMM L3-25 remote cable configuration for PMM ER8000

2.19 Schwarzbeck Model HXYZ 9170 Triple Loop Antenna Remote Cable configuration for PMM 7010

The following figure shows the HXYZ 9170 Triple Loop Antenna remote cable pin configuration. This cable can be requested to Narda or arranged locally.

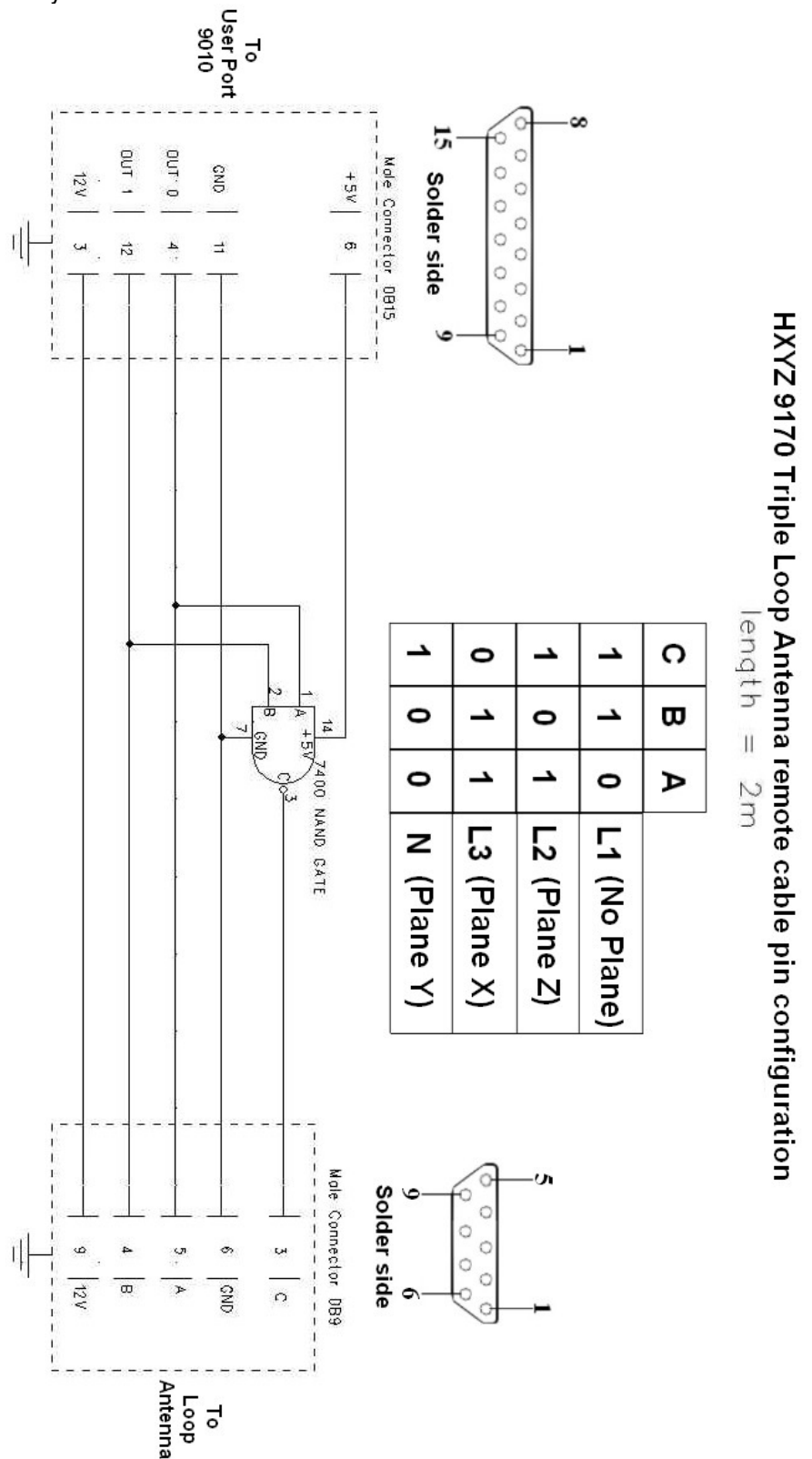


Fig. 2-4 HXYZ 9170 remote cable configuration for PMM ER8000



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3 – Operating Instructions

3.1 Introduction

The PMM ER8000 EMI Receiver needs to be driven by a PC through an USB connection.

The system is provided with a specifically developed software called PMM Emission Suite, which installer utility is stored on the Software Media shipped together with the instrument.

Please refer to the PMM Emission Suite Manual for any information and instruction concerning the operation of the software.

3.2 Operating Modes

Under the control of the PMM Emission Suite PC Software it is possible to use the receiver in different modes of operation.

3.2.1 SWEEP MODE

The **Sweep Mode** is the most common way to perform measurements in the EMI environment.

The Sweep mode is used to operate the PMM ER8000 as a powerful scanning EMI receiver. To enter in this mode it's enough to depress the Sweep soft key on the main screen, and immediately the scan setup window pops up and allows the operator to set the parameters for the scan. All the automatic settings (RBW, frequency step, etc.) refer to the CISPR standard.

In Sweep mode the Peak, QPeak, C-Rms, RMS, C-Avg, Avg detectors are available.

All the relevant information are reported on the screen running the PMM Emission Suite. Please refer to the software User's Manual for further information.

In this way the User can see which detector is in use and the relevant hold time; if the function "Smart Detector" is activated and which one and if a Minimum attenuation is set.

On the right it is possible to choose the Reference level. During the scan, in the center above the graph the actual frequency measured is displayed and continuously updated.

Below the graph the start and the stop frequency, and loaded limits, if any.

When the sweep has been executed, on the bottom of the screen the most important sweep parameters are repeated.

3.2.2 ANALYZER MODE

The purpose of this operating mode is to make an easy and fast debugging tool available to the User.

To enter the **ANALYZER Mode** it's enough to depress the Analyzer soft key on the main screen.

In this mode the receiver works as a powerful Spectrum Analyzer and the display shows the "spectrum analysis" in the frequency domain.

The analysis is done at the selected span frequency.

Using the marker facility the User can accomplish a very accurate measurement of the signals either in frequency as well as in level.

On the screen of the Analyzer Mode all the relevant information are reported.

So that the User can see which detector is in use and the relevant hold time; if the input attenuation is Automatic or Manual and the set attenuation and the Minimum attenuation.

Near the graph there is the Reference level, the Resolution bandwidth and the span value.

Below the graph the start, center and stop frequency.

A proper box is dedicated to the marker indication, with actual frequency and level of the marker.

3.2.3 MANUAL MODE

The **MANUAL mode** is a very useful feature to manually control the receiver and to deeply investigate electrical signals modifying the parameters of receiver exactly as per the needs of the Test Engineer.

In this operating mode, the instrument continuously display the signal level at a desired fixed frequency (not sweeping).

It is possible, for example, to observe the signals exceeding the limits frequency by frequency; evaluating their levels measured simultaneously with 4 different detectors (Peak, QuasiPeak, Average and RMS); listening to them after a demodulation, etc.

To enter in **Manual Mode** press the key in the main menu, and immediately the first Manual window opens.

In manual mode the levels corresponding to the detectors in use are displayed both in analogue and in digital format, and exactly as for the other operating modes, all the relevant information are reported on the screen.

The User can see the resolution bandwidth, the longest hold time associated to the detectors in use; if the input attenuation is Automatic or Manual and the set attenuation and the Minimum attenuation.

Also the Demodulator can be switched on and set to AM or FM, and the audio volume regulated as wished and represented by a simple bar.

Then there are three or fours vertical bars representing the detectors and indicating in analogue and digital (the figures below each bar) the level measured; on top of the bars the relevant detector, the unit in use and the tuned frequency. The analogue scale of the analogue bars is set automatically by the software in accordance with the Reference Level set.



In case an **OVERLOAD** indication occurs it is necessary to add an external attenuator to carry on the measurement without overpassing the declared limit for continuous power or spectral density.

Using 0 dB attenuation PMM ER8000 has no input protection.

This is a potentially dangerous condition for the input stage of the receiver.

NOTICE

Use 0 dB attenuation only if you are very sure that your input signal is less than 0,5 Vpp (or 106 dBμV).

Before to apply an unknown signal to PMM ER8000 receiver, use an oscilloscope or a wide band RF voltmeter to measure it. In any case set Min. ATT at 10 dB and select the maximum available attenuation.

If needed, add an external coaxial attenuator on the input signal line.



3.3 Detectors

PMM ER8000 has been designed to allow the use of many kinds of detectors. CISPR Standard has introduced the application of two detectors that are derived from the Root Mean Squared and from the Average ones.

3.3.1 RMS-AVG Definition



The RMS-Average detector is a special function, defined by the CISPR standard, implemented in the PMM ER8000 receiver.

RMS-Average detector is manufactured under license of Rohde & Schwarz GmbH & Co. KG.

The RMS-Average detector, according to the CISPR 16-1-1 standard, supplies a reading of the input signal that is weighted, for repeated pulses, such that for a constant indication, the relationship between amplitude and repetition frequency is in accordance with the following rule:

The Amplitude is proportional to (repetition frequency)^{-1/2}

The value is the maximum level during the measurement time (Hold Time) and the averaging is carried out with a lowpass filter of the 2nd order to simulate a mechanical instrument.

The calibration is in reference to the RMS value of an unmodulated sine wave signal.

3.3.2 C-AVG Definition

CISPR 16-1-1 defines the Average detector as designed to indicate the weighted average value of the maximum value of the envelope of the signal passed through the pre-detector stages:

up to 1000 MHz, is defined as the response of the measuring receiver to pulses of repetition rate n Hz and impulse area of $1,4/n$ mVs emf at 50Ω source impedance that shall be equal to the response to an unmodulated sine-wave signal at the tuned frequency having an emf with rms value of 66 dBμV.

The value of n shall be 500 for Band B, and 5000 for Bands C and D.

The average detector is useful to measure narrowband signals to overcome problems associated with either modulation content or the presence of broadband noise.

When the Average is measured according to CISPR 16-1-1, the maximum value of the linear mean envelope during the measurement interval is shown. The detector is used, for example, to measure pulsed sinusoidal signals with a low pulse repetition rate. It is calibrated with the rms value of an unmodulated sine wave signal. Averaging is carried out with lowpass filters of the 2nd order (simulating a mechanical instrument).

3.3.3 Smart Detector

The **Smart Detector** is a special function implemented in the PMM ER8000 receiver with the purpose of reducing the test time and increasing the productivity of the lab.

This function works only in the C, D and E bands when at least one limit is loaded, therefore remember to enable a limit to run the Smart detector function.

Selecting one out of the five **Smart detectors** the receiver will execute the scan using at first the Peak detector and, if a peak value is found over the selected limit minus a **Margin** set with the specific button, the reading is re-measured and displayed with the chosen (C-Avg, AVG, C-Rms, RMS or QPeak) detector.

Obviously this way of operation results in a much faster scan sweep and moreover it immediately draws the attention of the test Engineer to the most critical points. The limit associated to the Margin is displayed as a bold colored line and is automatically selected by the receiver depending which Smart detector is chosen; for example, if a Smart QP is selected, the associated QP limit line will be displayed as a bold colored line.

To deselect the Smart Detector function simply select a single detector.



The weighting time must be properly set in the Hold Time window to allow the Smart detectors functions to operate as intended.

The Hold Time is the measurement time the receiver takes to value the input signal and form result weighted by the selected detector.

When using the **C-Avg** (CISPR-Average) or the **C-RMS** (CISPR-RMS) detector, since for definition they are characterized by a long time constant, the minimum measurement time should be set long enough to allow a correct measurement.

For this reason, **when unknown signal are to be measured, the Hold Time should be at least 1000ms** to correctly weight signals pulsed at a rate of 5 Hz or faster, and longer for lower repetition rates.



With the Peak, RMS and AVG detectors the smallest settable measurement time depends on the RBW.

If several detectors are used contemporarily the Hold Time should be set to meet the requirement of the slowest one, so that the results of the measurement are correct for all them.

When a frequency change or an attenuation variation occurs, PMM ER8000 waits automatically the time needed to the internal circuits to overcome the transient before the measurement time starts again.

3.4 RBW Filters

The **Resolution Bandwidth** box is used to select the bandwidth of the measuring filter.

The drop-down menu allows the User to select from the list, the filter desired. These filters are mathematically modeled using digital techniques and, concerning the 200 Hz, 9 kHz and 120 kHz, they are compliant to the CISPR 16-1-1 standard.

Other additional -6dB bandwidth filters are also available: please refer to the instrument specifications paragraph for the complete list.

3.4.1 MIL Filters

The 100 Hz, 1 kHz, 10 kHz and 100 kHz provided filters are MIL-STD-461E (they are not optional but always available).



When a non-CISPR filter is selected, the Quasi Peak, C-RMS and C-AVG detectors are disabled.



3.5 Hold Time

The Hold Time (expressed in milliseconds) represents the time the receiver uses to “take a snapshot” of the incoming signal and to measure it with the chosen detector. When selecting a detector, the default hold time value is automatically loaded, but in some cases this time is not appropriate, e.g. when the interference signals have a low repetition rate or when the standard impose a proper measurement time.

In case of low repetition pulsed disturbances, a too short hold time may cause the automatic input attenuator to change its setting everytime the pulsed incoming disturbance appears or disappears.

On the other hand, if the Hold Time is too long, the length of the measurement increases without having any useful effect.

In this situation, the Hold Time value should be manually set to find a correct compromise between test precision and duration. That is to say choosing a Hold Time long enough for the lower repetition rate of the supposed disturbance and to keep the measurement length within a practical duration.

To set the Hold Time to the lowest possible value (this value dynamically depends from the measurement conditions), enter the figure 0; if a value lower than the allowed is entered, the lowest possible value is automatically selected.

The max. Hold Time that can be set is 120 sec (120.000 ms).

NOTICE

Be sure not to overload PMM ER8000: the input signal should not exceed the maximum level indicated in the main specifications in chapter 1.



NOTE

The measuring time must be properly set in the Hold Time window to allow the desired detectors to operate as intended.



4 – Applications

4.1 Measuring the EMI Voltage

ElectroMagnetic Interference (EMI) voltage measurements on power supply lines or on signal lines are carried out by means of "Coupling Networks" (e.g. LISNs) or other transducers (e.g. voltage probes). The frequency range is dictated by the applicable standard, however it is generally limited from 9 kHz to 30 MHz in commercial applications, while for measurements on other equipment/accessories - e.g. military, automotive, information technology and communication equipment (ITE), ISDN devices, etc. - the frequency range extends up to 200 MHz, depending the relevant standards. Nevertheless, the most common tests in the frequency range covered by PMM ER8000 are certainly the conducted measurements, done with the help of a LISN, and the radiated ones, for which various types of antennas can be used.

4.1.1 Measuring Principle with a LISN

In the case of a system with two floating conductors, the EMI voltages of the two conductors relative to each other and with reference to the ground form a vector system where three kind of RFI voltages are present (sometime EMI is also referred as RFI: Radio Frequency Interference). They are:

- Symmetrical (or differential mode) voltages. These RFI components are measured between the two conductors. They behave like the wanted signal on the forward and return lines.
- Asymmetrical (or common mode) voltages. These EMI components are measured between the electrical midpoint of the two conductor voltages and reference ground. Usually these are the components most likely to cause interference effects.
- Unsymmetrical voltages. These RFI components are measured from each line conductor and the reference ground. They consist of symmetrical and asymmetrical components. The measurement of these RFI voltages is the easiest to do and the most commonly performed.

Indeed, for practical reasons, Standards mostly specify the measurements of unsymmetrical voltages instead of the theoretically more meaningful common mode EMI, but the standard doesn't necessarily reflect the real life exactly as it is: it shall be a common practice reference aiming to create a database of fully comparable results.

See figure 4-1 for a graphic explanations of these differences between the EMI voltages.

Some Regulations require both measurement of symmetrical and asymmetrical RFI voltages, also defining separate and different limits for them.

4.1.2 Coupling Networks

Coupling Networks are electrical interfaces which allow to "transfer" the quantity to be measured (e.g. EMI voltages or currents) from the lines under test to the receiver.

Some types of Coupling Networks are: AMN (Artificial Mains Network), also known as "LISN" (Line Impedance Stabilization Network), Current Probe and Voltage Probe. Again, Fig. 4-1 also shows the AMN principle.

The PMM ER8000 is already equipped with a built-in LISN.

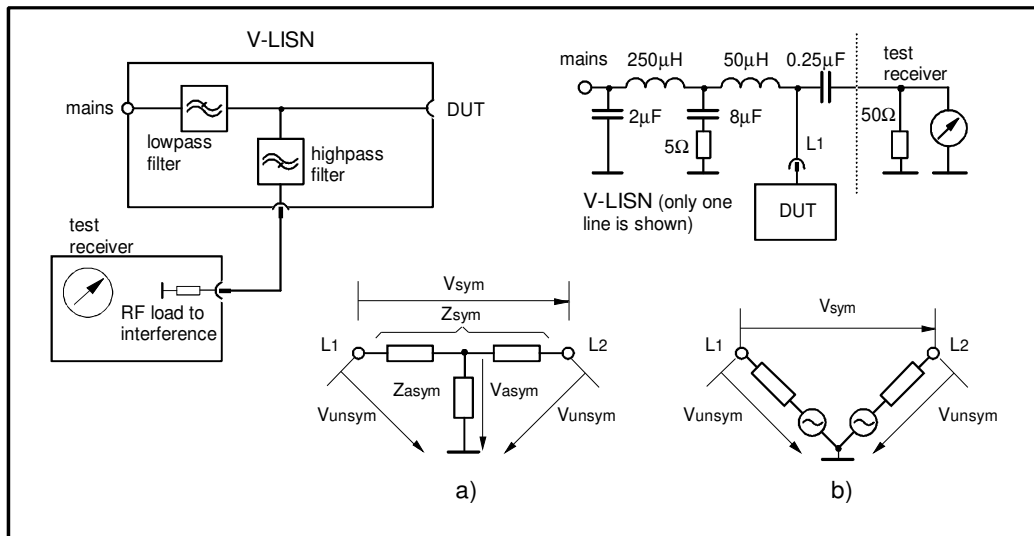


Fig. 4-1 AMN Principle: a) Δ -type or T-type LISN ; b) V-type LISN

4.1.2.1 AMN

AMNs are usually classified depending their configuration: V-type Networks, Δ -type Networks, T-type Networks.

- The V-type Network is used for measuring the unsymmetrical RFI voltage on AC and DC supply line. Standard impedances specified by CISPR and other international standards are $50\Omega // 50\mu H + 5\Omega$ and $50\Omega // 5\mu H + 1\Omega$.
- The Δ -type Network is used for measuring the symmetrical RFI voltage on balanced telecommunication lines. It is generally designed to permit switchover between symmetrical and asymmetrical RFI measurements. Its use is limited; Standards usually specify the T-type Network instead. The most common impedance for Δ -type Network is 150Ω .
- The T-type Network is used for measuring the asymmetrical RFI voltage on balanced (electrically symmetrical) audio frequency, control and data lines. Standard impedance is 150Ω as well.

An Artificial Mains Network shall be designed in order to:

1. terminate each line (power, signal, etc.) of the EUT (Equipment Under Test) with a standardized impedance;
2. permit the feeding of the EUT with the proper supply voltage and current or with the signal and data required for operations;
3. isolate the side of the test circuit where EMI voltages are measured against interference coming from mains network or from the auxiliary equipment supplying the EUT with the required data;
4. provide a suitable test point – to be connected to the test receiver - to pick up the RFI voltages from the conductor under test;
5. ensure that the impedance of the source (power, signal) is not varied in a significant way, otherwise EUT response to the interference may change.



4.1.2.2 Current Probe

Current Probes may be Clamp-on Probes or Fixed-ring Probes.

Current Probes are used to measure differential or common mode RFI currents. In some cases it may be important to make a distinction between the two kinds of current flowing in a system.

RFI current measurements with Current Probes may be required, for example, when measuring EMI from shielded lines or from complex wiring systems, when finding interference sources among other sources in a system, when performing compliance to some Standards, etc.

4.1.2.3 Voltage Probe

Voltage Probes include Active Probes and Passive Probes.

Active Probe has a very high input impedance $Z_{in} > 100\text{ K}\Omega // < 10\text{ pF}$.

Passive Probe has a standard impedance $Z_{in} = 1,5\text{ K}\Omega // < 10\text{ pF}$.

Voltage Probe is used for measuring the unsymmetrical RFI voltage when it is not possible to carry out measurement by interconnecting an Artificial V-type Network. Such situation may occur, for example, when measuring on lines on which only small loads are permissible (control and signal lines), when measuring on a EUT (Equipment Under Test) which would not operate correctly using V-type LISN or a DUT (Device Under Test) requiring very high power supply current for which no V-type LISN is available.

For diagnostic or design purposes on high impedance circuits, Voltage Probe may be used to determine, for example, noisy components or conductors that cause interference on CMOS PC boards.

Some Regulations give statements when Voltage Probe are to be used and specify relevant setup and RFI voltage limits.

4.1.3 Test Setup

A general test layout for a simple table top EUT is according to figure 4-2. Some product/family product standards may prescribe different requirements.

The EUT shall be placed 0,4m from a ground reference plane of at least 2m x 2m in size, either horizontal or vertical. If the measurements are made in a shielded room, the EUT shall be placed 0,4m from either one of the walls of the room or the conducting floor.

All other earthed conducting surfaces shall be at least 0,8m apart from the EUT.

As the ER8000 carries the internal LISN, it shall be placed 0,8m from the EUT and bonded to the ground reference plane by the ER8000/GND Ground connection, optional accessory.

Floor-standing EUTs are subject to the same provisions as above with the exception that they shall be placed on a floor, the points of contact being consistent with normal use. In this case the ground reference plane and shall extend at least 50 cm beyond the boundaries of the EUT and have minimum dimensions of 2m by 2m. The floor standing EUT shall be isolated by the ground reference floor and kept at a maximum distance of 0,15m.

The power cable should be 1m long; longer cable should be centrally bundled for at least 0,4m.

EUTs without a PE (Protective Earth) conductor and handheld DUTs shall be measured in conjunction with an auxiliary screen or an "Artificial Hand", as duly specified in the relevant standards.

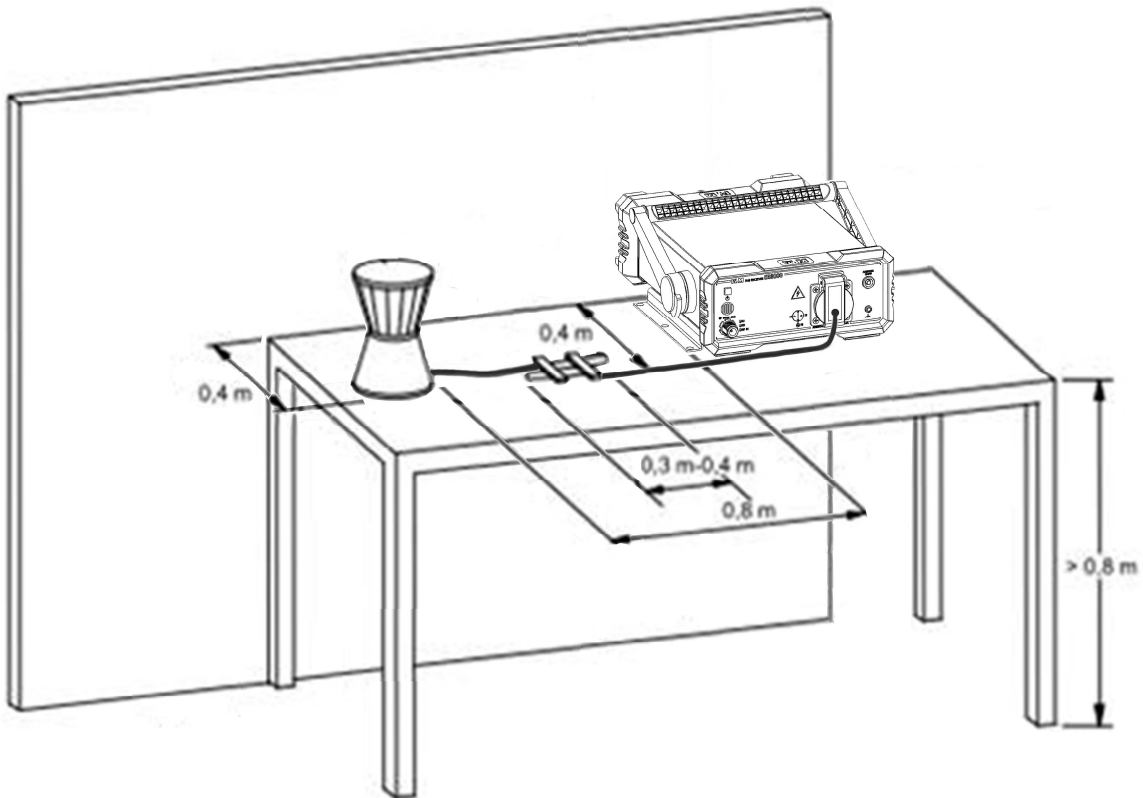


Fig. 4-2 ER8000 internal LISN

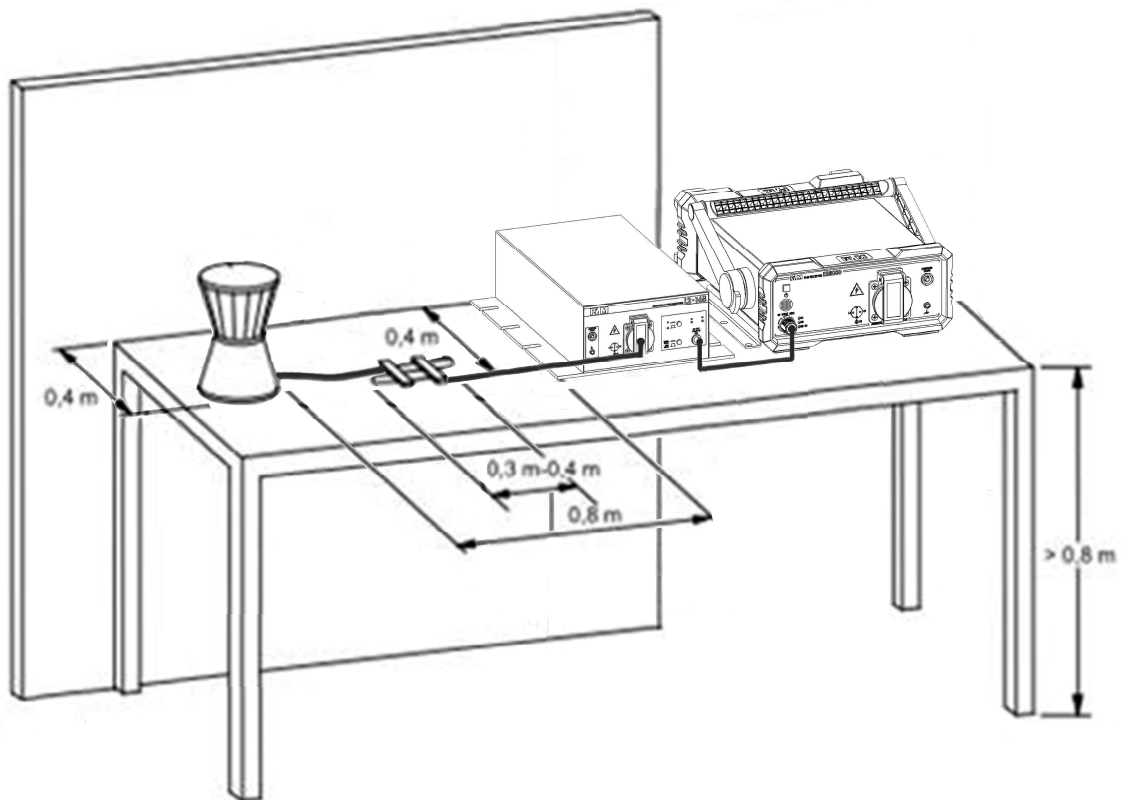


Fig. 4-3 ER8000 with external L2-16B LISN



4.1.4 Guidance on a preliminary Measuring Procedure

A step-by-step example of a conducted test is the following:

1. Connect the EUT to the front panel socket and the mains network to the rear plug trough a proper isolation transformer. Leave the EUT switched off;
2. Switch ON the PMM ER8000 and wait for it to be ready;
3. Run the PMM Emission Suite software;
4. Enter the Sweep Mode by clicking the related tab;
5. Set the Display Dynamics to 120 dB;
6. Choose a Reference Level between 100 and 125 dB μ V;
7. Click right key onto the Scan Table and choose the B band;
8. The Minimum Attenuation should be 10 dB;
9. Set the Pulse Limiter in the Front End box on the right of the screen, to protect the input against voltage spikes;
10. The Detector should be Peak;
11. Select the desired phase/line of the LISN in the Ancillary column of the Scan Table after having chosen L2 ER in the Ancillary box on the right of the screen;
12. With the EUT switched OFF, click the Execute soft button and wait until the first scan has been finished;
13. Carry out an overview of the whole spectrum and check the by executing a pre-measurement with peak detector that the ambient RF disturbances are at least 20 dB below the desired emission levels;
14. If the ambient noises are low enough continue to the next step, otherwise take all the necessary steps to reduce the ambient disturbances (e.g. go to a shielded room, etc.);
15. Switch ON the EUT and then **Redo Sweep** again and wait until the scan has been finished;
16. Adjust the Dynamic Range and the Reference Level for the most convenient visualization;
17. If the results are satisfactory select the cursor **Marker** (or the **Multi Marker**) and find the Highest **Peak(s)** and then either click **Analyzer** or **Manual** to enter respectively in Spectrum Mode or in Manual Mode and deeply investigate the highest signals;
18. If the results of the scan need to be compared to a defined level, select a **Limit**, if appropriate, and then measure again.

4.1.5 Remarks and Hints for Measuring

To avoid errors caused by ambient interference, measurements should be carried out inside a properly certified anechoic chamber or open site (OATS). Different sites, like basements or other shielded rooms with low ambient interferences, are often sufficient for a precertification evaluation and for debug purposes.



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5 – Updating firmware

5.1 Introduction

The PMM ER8000 features a simple and user-friendly method for updating its internal firmware through a Personal Computer (PC). This section provides all the information required for easy updating.



The following procedure works both for the ER8000/00 and ER8000/01 options.

5.2 System requirements

The minimum requirements to allow the software to operate properly are the following:

- CPU Processor Pentium III
- 256 MB of RAM
- at least 100 MB of free space on hard disk
- 1 free RS232 or USB Port
- Minimum resolution display 1024x768
- Windows Operating System™ Win7, Win8.1, Win10

Use a RS232 or USB port for updating ER8000 internal firmware. Instead, the ER8000 needs to be driven by a PC through an USB connection as reported on §3.1 and §7.1 .

5.3 Preparing the Hardware

Turn off the PMM ER8000 and connect the serial cable supplied with the apparatus, to the RS232 or USB socket situated on the back panel of PMM ER8000 on one side and to a free port (again RS232 or USB) on the PC side.

The first free port will be automatically detected by the Firmware Update Program during installation. In case of troubles please check port assignments on the PC through the Control Panel utility.

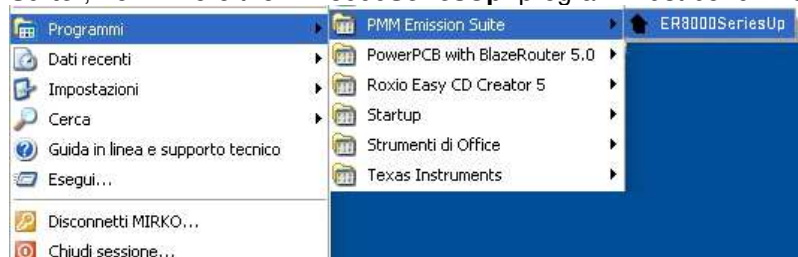
5.4 Software Installation

The Update Firmware executable program is provided together with the ER8000 Software Utility stored on Software Media and included in PMM ER8000 Receiver package; anyway it's always possible to check for newer releases and download them from official NARDA Italy Web Site Support page www.narda-sts.it.



The User must have administrator privileges to install the ER8000SeriesUp software in Windows; right click on the program .exe file and click on “Run as administrator” to temporarily run the program or application as an administrator until close it (Windows also allows to mark an application so that it always runs with administrator rights).

Once the **ER8000SeriesUp Setup** has been installed in the PC, another item is created in the Programs list at Start Menu, which is **“PMM Emission Suite”**, from where the **“ER8000SeriesUp”** program must be run from.



Click on “**ER8000SeriesUp**” (**ER8000SeriesUp.exe**) once for running the update program, so getting the following window:



Two firmware components can be updated by this application: Firmware, which is the receiver internal program, and FPGA, to update the internal programmable logic.

The **ER8000FW.Idr** file required for Firmware updating and the **mainER8000.bin** file for FPGA are automatically stored in the same directory of the **ER8000SeriesUp.exe**, otherwise just copy them there before performing the upgrade.

Be sure the power to the PMM ER8000 is stable and reliable before performing the FW Upgrade, otherwise the upgrade progress could not terminate properly.

NOTICE

Anyway, even in case of failure, the internal BIOS will never be corrupted and you'll just need to repeat the procedure once more (this is a unique feature!).

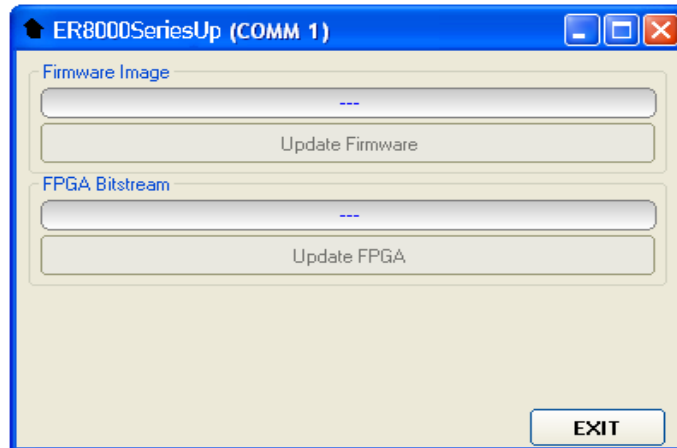
Should FW Upgrade procedure stop before reaching the 100% completion that will have not to be considered a trouble but simply an intermediate step: in this case please switch OFF and ON the receiver and repeat the FW Upgrade procedure once more until the end. Always cycle power OFF and ON again after every FW Upgrade.

Choose the COM port from the pulldown menu.



Press **RS232** button or **Enter** key to set the com port.

The program will display the following window:



5.5 To transfer data

To start the process simply switch PMM ER8000 on, select **Update Firmware** or **Update FPGA** button, and wait until the automatic transfer is completed.



During the firmware storing procedure, a blue bar will progress from left to right in the window of the PC, showing percentage of downloading time by time until 100%.



In the meanwhile on the ER8000 front panel the DATA RX and TX led will blink to indicate a serial communication is going on.

When FW download finishes, following message appears to show that everything was properly completed:



The length of the file can change with the version.

In case of failure, an error message is showed instead.

After Firmware Update is successfully completed, switch OFF and then ON again the PMM ER8000, looking at screen, and then perform Auto-calibration.

It is now possible to disconnect the cable connected to the PC, with the PMM ER8000 receiver either switched On or Off.



To obtain up-to-date Firmware or PC Utility for PMM ER8000, the user can contact his NARDA distributor or download it directly from Support area of EMC Product Range on the following Web Site: www.narda-sts.it.



6 – PMM 9010-RMA Rack Mount Adapter for Rack 19” (Option)



6.1 Introduction

A **19-inch rack** is a standardized frame or enclosure for mounting multiple equipment modules. Equipment designed to be placed in a rack is typically described as **rack-mount** or simply **chassis**; the height of the electronic modules is standardized as multiples of 1.75 inches (44.5 mm) or one rack unit or "U". Each module has a front panel that is 19 inches (482.6 mm) wide, including edges that protrude on each side which allow the module to be fastened to the rack frame with screws.

6.2 Instrument Items

PMM 9010-RMA Rack Mount Adapter includes the following items:

- Rack Mount kit (screws, plastic round washers and cage nuts).
- Return for Repair Form.

6.3 PMM 9010-RMA
 Main Specifications

Table 6-1 lists the PMM 9010-RMA specifications.

TABLE 6-1 Technical Specifications	
Environment temperature	-5° to 45°C
Rack unit	3U
Dimensions	483 x 410 x 132,5 mm (WxDxH)
Weight	5,5 Kg (without instruments)

6.4 PMM 9010-RMA Front view



Fig. 6-1 Front view

- Legend::

 - 1 – Holes Flanges used to fix the Rack Mount to the Rack
 - 2 – Handles used to carry the Rack Mount
 - 3 – PMM ER8000 window
 - 4 – Milled knob used to fix the frontal panel to the Rack
 - 5 – Cover for future implementation

6.5 PMM 9010-RMA Inside view

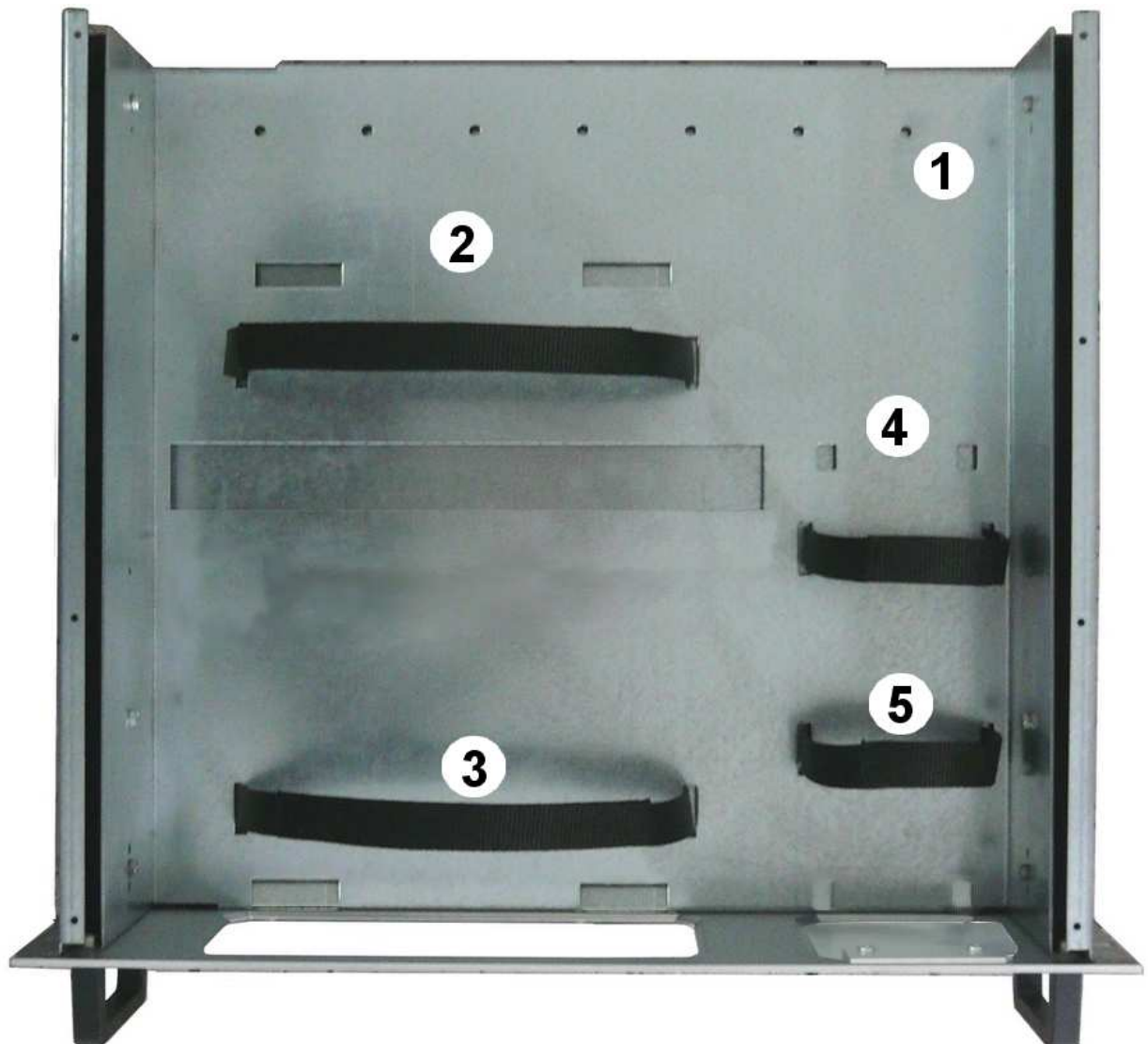


Fig. 6-2 Inside view

Legend::

- **1** – Round holes of service
- **2** – Rectangular holes used to put ER8000 Instrument;
- **3** – ER8000 straps;
- **4** – Rectangular holes for future implementation;
- **5** – Straps for future implementation.

**6.6 Rack Requirements** The rack must be of the following type:

- Standard 19 inch (483 mm) with mounting rails that conform to English universal hole spacing per section 1 of ANSI/EIA-310-D-1992.
- The minimum vertical rack space per chassis must be 3U (rack units), equal to 3 inches (132,5 mm).

6.7 Required Equipment Before you begin the installation, ensure that you have the following items:

- Crosshead screwdriver (not provided)
- Flat-blade screwdriver or rack-insertion tool (not provided)
- Tape measure and level (not provided)
- Rack Mount kit (provided)

6.8 Moving chassis When lifting the chassis, be aware of its weight, and follow these guidelines:

- Disconnect all power and external cables before lifting the chassis.
- Remove all instruments from the chassis before lifting.

NOTICE

- **Make sure that the milled knob well locking.**
- Using the two handles, lift the PMM 9010-RMA slowly keeping your back straight. Lift with your legs, not with your back. Bend at the knees, not at the waist.



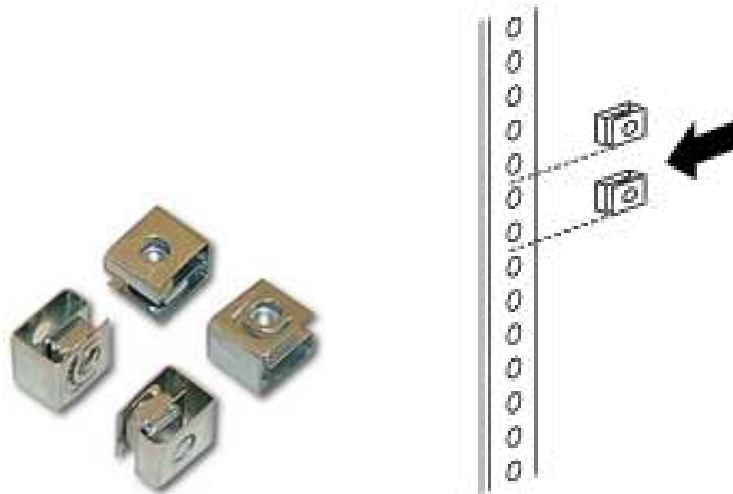
6.9 Installation guidelines

When installing the chassis, follow these guidelines:

- Plan your site configuration and prepare the site before installing the chassis.
- Ensure that there is adequate space around the rack to allow for servicing the chassis and for airflow.
- If the rack has wheels, ensure that the brakes are engaged or that the rack is otherwise stabilized

NOTICE

- For a round hole (tapped) rack, use clip nuts with M6 x 16 screw (not provided).



NOTICE

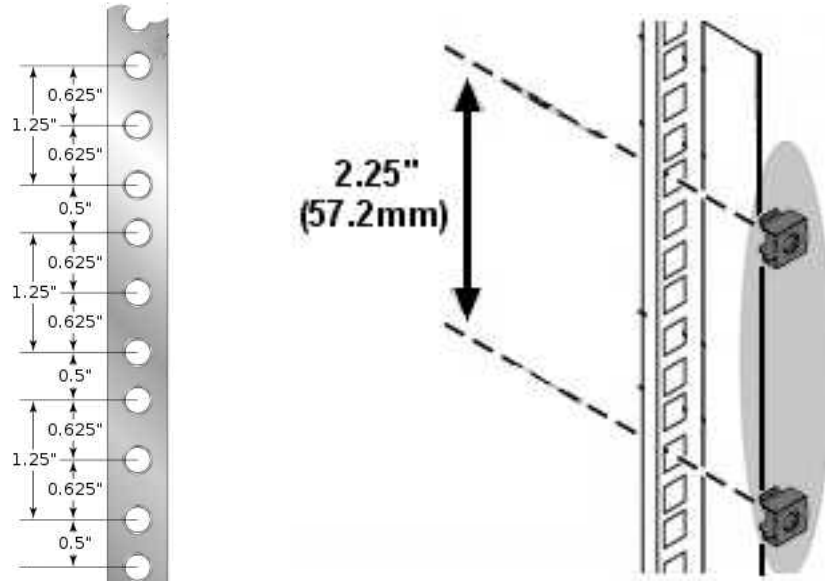
- For a square hole (untapped) rack (shown below), use M6 x 16 screws, plastic round washers head screws and M6 cage nut (provided).



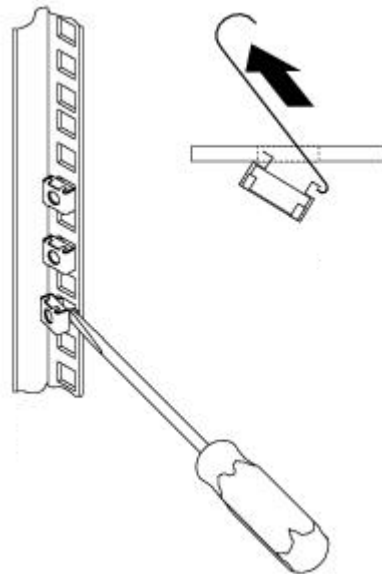
6.10 Installing the PMM 9010-RMA

This section describes how to install the PMM 9010-RMA Rack Mount Adapter:

- Insert the cage nuts behind the vertical rails with respect to the Rack Unit Boundary and the distance show below:



- You can use a rack-insertion tool or a flat-blade screwdriver to install the cage nuts.



- Insert the chassis into the rack.
- Slide the chassis into the rack until the front flange is flat against the cage nuts.
- Using the four screws and black plastic washers, fix the chassis by its flanges to the rack.



6.11 Use of the PMM 9010-RMA with PMM ER8000

The following procedure is indifferently referred to the ER8000/00 or ER8000/01.

This section provides the information needed to install your ER8000 Instrument on the PMM 9010-RMA Rack Mount Adapter.

- Remove the frontal panel from the Rack unscrewing the milled knob without loosening it completely.
- Using the handles, open the PMM 9010-RMA slowly.
- Place the instrument by the rectangular holes and drag the instrument in contact with the frontal panel.
- To ensure the necessary stability, the instrument must be fastened to the unit using the straps.
- Connect the cables on the rear panel (see "Installation" chapter for further information)
- To fix the rear cables to the Rack Mount insert plastic straps by of the round holes.
- Using the handles, close the PMM 9010-RMA slowly.



Fig. 6-3 PMM 9010-RMA with ER8000 Instrument



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7 – Remote control

7.1 Introduction

PMM ER8000 has been designed to allow remote control operations through its USB (Rear) port.
A RS232 serial port is also provided for service activities.

7.2 Communication

Half duplex communication is implemented. The RS232 port has a DB-9 female connector and the USB 2.0 has a USB-B connector.
A built-in automatic tool identify the type of communication used.
The communication is at 115200 bit/sec with 8 bit words, one start bit, one stop bit and no parity
(**115200 N 8 1**).

7.3 Protocol

Be aware that only the PC can send the commands. PMM ER8000 will answer when is inquired only.
The communication uses strings with variable byte width. The characters used inside the strings are in ASCII format (00 - 127) at 7 bits. The most significant bits are ignored in reception and set to 0 during transmission.
Every string starts with the special character “#” and stops with “*”.

7.4 Format

Commands are made of ASCII string delimited character “#” (0x23) and the character “*” (0x2A)
Replies are terminated with <CR><LF> (\r\n)



The following examples are referred, some to the PMM ER8000/00 and some to the ER8000/01.

7.5 List of commands

Query COMMANDS

Syntax	Function
?3PR*	Tells whether the apparatus is a PMM ER8000 and in which mode
?AAT*	Requests the Attenuator status for Analyzer mode.
?ACE*	Requests the Center frequency for analyzer mode
?ADT*	Requests the detector used for Analyzer mode
?AHT*	Requests the Hold Time for Analyzer mode.
?AOP*	Requests the Stop frequency for analyzer mode
?ART*	Requests the Start frequency for analyzer mode
?ASP*	Requests the Span frequency for analyzer mode
?CFA*	Sends back the ID of the conversion factor
?CRA*	Tells whether RMS-AVG detector is available
?DET*	Reports the five detector for manual mode
?DMD*	Requests the status of demodulator.
?DMV*	Requests the volume of demodulator.
?FPGA	Sends back a string containing information about version of FPGA.
?IDN*	Requests model, release and date of firmware
?LSN	Sends back a string showing which Band B input is selected
?MAF*	Requests the tuning frequency for manual mode
?MAT*	Requests the Attenuator status for Manual mode
?MHT*	Requests the Hold Time for manual mode
?RBW	Sends back a string expressing the selected RBW
?S/N*	Requests Serial Number internally stored by manufacturer
?TAT*	Requests the MinAtt value
?TMP	Sends back a string showing the temperature expressed in Celsius (°C)
?UHT*	Requests the actual Hold Time currently or lastly used
?UPP*	Requests the status of input PINs of the User Port



Setting COMMANDs

Syntax	Function
ASBK	Aborts a sweep currently in progress
ASPA	Suspends a sweep currently in progress
ASRE	Resumes a sweep previously paused
S3PRC	Sets the input for bands A, B
S3PRR	Sets the input for bands C, D and E
SAAT a	Sets Attenuator for Analyzer Mode
SADT b	Sets the Detector for Analyzer Mode.
SAFF start,stop	Sets both Start and Stop frequency for Analyzer mode.
SAGO	Sets the ER8000 in Analyzer mode
SAHT h	Sets Hold Time for Analyzer mode.
SAOP f	Sets the Stop frequency for Analyzer mode
SART f	Sets the Start frequency for Analyzer mode
SCFA n	Activates the conversion factor stored in the ER8000
SCFE n, name	Saves the conversion factor (made by SCFW).
SCFW n, freq; lev	Creates a conversion factor frequency by frequency.
SDMD a	Switches the Demodulator On or OFF
SDMV v	Sets the volume of Demodulator
SLDW n, freq; levq, leva	Sets the custom double value limit frequency by frequency
SLIE name	Name the custom limit and making it active or deactivating it.
SLIM n	Sets the Margin to be used with Smart Detector function
SLIW n, freq; lev	Sets the custom limit frequency by frequency
SLSN n	Sets the input for Band B
SMAF f	Sets the tuning frequency for manual mode
SMAN	Sets the ER8000 in manual mode
SMANP	Sets the ER8000 in manual mode and sets the default value
SMAT a	Sets Attenuator for Manual Mode.
SMHT h	Sets Hold Time for manual mode
SRBW b	Sets RBW
SSFD	Sets parameters and triggers a sweep
SSFW n, freq	Creates a Frequency-Scan-Tab frequency by frequency
SSTP	Stops abruptly a running sweep in Analyzer mode
STAT b	Sets MinAtt
SUPP n	Outputs on the User Port bit by bit the argument n



- 7.6 PMM ER8000 COMMANDS** Following are Commands to control and set various operating modes of PMM ER8000, that can be distinguished in two main groups:
- Query Commands
 - Setting Commands

7.6.1 Query COMMANDS

Description

?3PR	This query command #?3PR * sends back a string expressing whether the apparatus is a PMM ER8000 and in which mode. The reply is either: • 3PR =CON (The PMM ER8000 is ready for conducted frequency range) • 3PR =RAD (The PMM ER8000 is ready for radiated frequency range) • 3PR=NUL (The PMM ER8000 is not ready)
?AAT	This query command #?AAT * sends back a string expressing the Attenuator status for Analyzer mode. The reply is made of 2 fields: • AAT =AUTO (ER8000 automatically selects the most suitable attenuator to get best dynamic range) or AAT =MAN (operator selects manually the attenuator) • Value (in dB) of current attenuator Example of reply: AAT =AUTO; 20 which means that the Attenuator is now switched to 20dB automatically by ER8000
?ACE	This query command #?ACE* sends back a string expressing the Center frequency, in exponential notation, for analyzer mode. Unit is fixed MHz. Example of reply: ACE = 1.500000e+07 which means that the Center frequency in Analyzer mode is 15MHz
?ADT	This query command #?ADT * sends back a string expressing the detector used for Analyzer mode. The reply can be: • ADT =Peak • ADT =Avg • ADT =Rms
?AHT	This query command #?AHT* sends back a string expressing the HOLD TIME for Analyzer mode. Unit is fixed ms. Example of reply: AHT= 1000 ms which means that the hold time in Analyzer mode is 1000ms (or 1s)
?AOP	This query command #?AOP* sends back a string expressing the Stop frequency, in exponential notation, for analyzer mode. Unit is fixed MHz. Example of reply: AOP = 3.000000e+07 which means that the Stop frequency in Analyzer mode is 30MHz
?ART	This query command #?ART* sends back a string expressing the Start frequency, in exponential notation, for analyzer mode. Unit is fixed MHz. Example of reply: ART = 1.500000e+07 which means that the start frequency in Analyzer mode is 15MHz
?ASP	This query command #?ASP* sends back a string expressing the Spanfrequency, in exponential notation, for analyzer mode. Unit is fixed MHz. Example of reply: ASP = 3.000000e+07 which means that the Span frequency in Analyzer mode is 30MHz



?CFA	This query command #?CFA* sends back a string in the format CFA=n,(LABEL) where n is the ID of the conversion factor as shown in ER8000 menu and LABEL is its temporary name as it was last labelled. If No conversion factor is active the reply is: CFA= NONE Example of reply: CFA=1,(PROBE) means that conversion factor 1 is active and it was last named as PROBE
?CRA	This query command #?CRA* sends back a string telling whether RMS-AVG detector is available. Reply is: • CRA=N/A if RMS-AVG detector is NOT available • CRA=OK if RMS-AVG detector is available
?DET	This query command #?DET* sends back a string reporting the six detector for manual mode. Unit is fixed dBμV. Each value is separated by a semicolon. The order is Peak; Qpeak; RMS;AVG;C-RMS:C-AVG In case Qpeak is not available (RBW other than 9kHz [only for Band B] ,120kHz) Qpeak field is replaced by the string "----". In case C-RMS or C-AVG is not available (RBW other than 9kHz,120kHz) respective field is replaced by the string "----". An additional string "OVER;" is appended at the end whenever an over range condition occurred Example of reply: DET=23.22;17.09;16.23;11.36,16.01,15.50; (which means Peak=23.22; Qpeak=17.09; RMS=16.23;AVG=11.36;C-RMS=16.01;C-Avg=15.50 Example of reply (No Cspr filter selected, over range shown): DET=17.20;-----;11.98;9.57;-----;-----;OVER;
?DMD	This query command #?DMD * sends back a string expressing the status of demodulator. The reply is either: • DMD=Off (The Demodulator is OFF) • DMD =AM (The Demodulator is On and demodulating AM) • DMD =FM (The Demodulator is On and demodulating FM)
?DMV	This query command #?DMV * sends back a string expressing the volume of demodulator. The reply is made of the string "DMV=" followed by the magnitude of volume ranging from 0 to 100 • DMV=50 (The Demodulator Volume is 50)
?FPGA	This query command #?FPGA* sends back a string containing information about version of FPGA. Note that two <LF> are appended to the string before the terminator Example of reply: FPGA=0x14<LF><LF>
?IDN	This query command #?IDN* sends back a string containing information about model, release and date of firmware. Note that two <LF> are appended to the string before the terminator Example of reply: IDN=ER8000/03-FW - 1.09 11/06/14<LF><LF>



?LSN	This query command #?LSN* sends back a string showing which Band B input is selected in the format: LSN=<i>n</i> Where <i>n</i> can be: • 0 → Input on N connector • 1 → Input on ER8000 internal LISN L1 • 2 → Input on ER8000 internal LISN L2 Example of reply: LSN=0
?MAF	This query command #?MAF* sends back a string expressing the tuning frequency, in exponential notation, for manual mode. Unit is fixed MHz. Example of reply: MAF= 1.500000e+07 which means that the tuned frequency in manual mode is 15MHz
?MAT	This query command #?MAT * sends back a string expressing the Attenuator status for Manual mode. The reply is made of 2 fields: • MAT=AUTO (ER8000 automatically selects the most suitable attenuator to get best dynamic range) or MAT=MAN (the operator selects manually the attenuator) • Value (in dB) of current attenuator Example of reply: MAT=AUTO; 20 which means that the Attenuator is now switched to 20dB automatically by ER8000
?MHT	This query command #?MHT* sends back a string expressing the HOLD TIME for manual mode. Unit is fixed ms. Example of reply: MHT= 1000 ms which means that the hold time in manual mode is 1000ms (or 1s)
?RBW	This query command #?RBW * sends back a string expressing the selected RBW. The reply is made of 3 fields: 1. RBW=AUTO (ER8000 automatically selects the suitable RBW according the tuned frequency) or RBW=MAN (Operator selects manually the RBW) 2. Id identify the RBW as follows: ○ 1 →300kHz ○ 2 →100kHz ○ 3 →30kHz ○ 4 →10kHz ○ 5 →3kHz ○ 6 →9kHz (Cispr 16-1) ○ 7 →200Hz (Cispr 16-1) ○ 8 →1kHz ○ Only for C, D band or > 30 MHz ▪ 10 →120kHz (Cispr 16-1) (Opt. 01) ▪ 9 →1MHz (Opt. 01) 3. RBW NickName (a mnemonic name) Example of reply: RBW=AUTO 6 (9k_CISPR) which means that selection is automatically made by ER8000, the RBW id is 6 (9kHz (Cispr 16-1)). (9k_CISPR) is the nickname to quickly identify it
?S/N	This query command #?S/N* sends back a string containing serial number internally stored by manufacturer. Example of reply: S/N=000WE50327



?TAT	This query command #?TAT * sends back a string expressing MinAtt value. The reply is a string representing the minimum reachable value of attenuator in dB Example of reply: TAT=10 which means that MinAtt is 10dB
?TMP	This query command #?TMP* sends back a string showing the temperature expressed in Celsius (°C) . Example of reply: TMP= 40.50
?UHT	This query command #?UHT* sends back a string expressing the actual hold time currently or lastly used Example of reply: UHT=1.9ms
?UPP	This query command #?UPP* sends back a string expressing the status of input PIN of the User Port. Example of reply: UPP= 1 means that user port pin is high level

7.6.2 SETTING

Commands

Behaviour

ASBK	This command aborts a sweep currently in progress previously started by command SSFD. The reply is either: • SBK=OK which means the sweep has been stopped and all setting commands are available again. • SBK=SERR which informs that the sweep was not in need to be stopped
ASPA	This command suspends a sweep currently in progress previously started by command SSFD. There is no reply unless a sweep is not in progress in which case the reply is: • SPA=SERR which informs that the sweep was not in need to be paused
ASRE	This command resumes a sweep previously paused by command ASPA. There is no reply unless a sweep is not in progress in which case the reply is: • SRE=SERR which informs that the sweep was not in need to be resumed
S3PRC	This setting command #S3PRC * sets the input for bands A, B. The reply is: • 3PR=OK (The input has been set for bands A, B) • 3PR =BERR (The command has been ignored for the following: • The instrument is not idling and therefore cannot switch to a different mode. In such an event, stop the current process (Manual, Analyzer or Sweep) and put it back to Idle. • 3PR =SERR (The command contains a syntax error)
S3PRR	This setting command #S3PRR * sets the input for bands C, D and E. The reply is: • 3PR=OK (The input has been set for bands C, D and E) • 3PR =BERR (The command has been ignored for the following: • The instrument is not idling and therefore cannot switch to a different mode. In such an event, stop the current process (Manual, Analyzer or Sweep) and put it back to Idle. • 3PR =SERR (The command contains a syntax error)
SAAT a	This setting command sets Attenuator, for Analyzer Mode, to the value indicated by (a) which can be 0 to 45. Automatic Attenuator feature is disabled. If (a) is a negative figure then the Automatic Attenuator feature is turned on. The reply is AAT=OK which acknowledges the command has been granted or AAT =SERR if the command has been ignored. Example: # AAT 15* (set attenuator to 15dB and disable Automatic Attenuator feature) Example: # AAT -1* (Enable Automatic Attenuator feature)



SADT b	This setting command sets the detector for Analyzer Mode. The argument (b) should be a index representing the detector as follows: ○ 1 →Peak ○ 2 →Avg ○ 3 →Rms The reply is SADT =OK which acknowledges the command has been granted or SADT =SERR if the command has been ignored. Example: # SADT 1* sets the detector to Peak for Analyzer Mode
SAFF start,stop	This setting command sets both Start and Stop frequency for Analyzer mode. The strings (Start and Stop) can be in exponential form and should be expressed in Hz. The reply is AFF=OK which acknowledges the command has been granted or AFF =SERR if the command has been ignored. Example: #SAFF 150e3,30e6* Sets the Start frequency to 150kHz and Stop frequency to 30MHz for Analyzer mode
SAGO	This setting command puts the ER8000 in Analyzer mode. The reply is always SAGO=OK, which acknowledges the command has been granted, followed by an array, variable in size, representing the reply. Please refer to “Analyzer Reply” section for details of the response. The ER8000 goes to Analyzer mode. The ER8000 goes to Analyzer mode. Example: #SAGO*
SAHT h	This setting command sets hold time for Analyzer mode. The string (h) should be expressed in ms. The reply is AHT=OK which acknowledges the command has been granted or AHT =SERR if the command has been ignored. Example: #S AHT 1500* Sets the hold time, for Analyzer mode, to 1500 ms (or 1.5s)
SAOP f	This setting command sets the Stop frequency for Analyzer mode. The string (f) can be in exponential form and should be expressed in Hz. The reply is AOP=OK which acknowledges the command has been granted or AOP =SERR if the command has been ignored. Example: #SAOP 10e6* Sets the Stop frequency, for Analyzer mode, to 10MHz
SART f	This setting command sets the Start frequency for Analyzer mode. The string (f) can be in exponential form and should be expressed in Hz. The reply is ART=OK which acknowledges the command has been granted or ART =SERR if the command has been ignored. Example: #SART 150e3* Sets the Start frequency, for Analyzer mode, to 150kHz
SCFA	This setting command deactivates the conversion factor (if any). The reply is: CFA=OK (OFF)



SCFE n, name	This setting command is used for saving the conversion factor (made by SCFW). The command is made of the string: • FCE (the command itself), • n is the index and should be 0 (other index are ignored because into memory can be saved one index only). • name which is a string representing the name of it This command is intended for creating a conversion factor into PMMER8000. For further information see command SCFW.. When the command is received the conversion factor is checked and, if data (frequency and level) are coherent, the command is granted by replying SCFW =OK otherwise the replay is SCFW =SERR Example: #SCFE 0,Probe* checks the data previously loaded by SCFW commands, names it as "Probe" and activates it.
SCFW n,freq;lev	This setting command is used for creating a conversion factor frequency by frequency. It consists of three fields as follows: • n is the index of frequency being written and it should range from 0 to 499 • freq is the frequency, expressed in Hz (exponential notation allowed), being written • lev is the conversion factor and is expressed in dB The procedure to creating a conversion factor on PMMER8000 is the following: • Send as many commands as the frequency points of limit are in upwards order. • Terminate (and make it active) by sending the command SCFE Here is an example how to make a custom correction factor on PMMER8000: • #SCFW 0, 150e3; -1 * Send the first line 150kHz -1 dB • # SCFW 1, 500e3; 0 * Send the second line 500kHz 0 dB • # SCFW 2, 5e6; 1.2 * Send the third line 5MHz +1.2 dB • # SCFW 3, 50e6; 1.1 * Send the fourth line 50MHz +1.1 dB • # SCFW 4, 300e6; 1 * Send the fifth line 300MHz +1 dB • #SCFE 0,Probe* Save it permanently as #0 into ER8000 and name it as "PROBE" Note that all the higher indexes in the conversion factor are cleared. Therefore, a conversion factor must be made upwards otherwise all points, having a higher index previously written, are cleared. It is responsibility of the user to make sure the data sent are correct and coherent. The reply is SCFW =OK which acknowledges the command has been granted or LCFW =SERR if the command has been ignored.
SDMD	This setting command switches the Demodulator; according the parameter (a) which can be AM, FM or OFF. The reply is DMD =OK which acknowledges the command has been granted or DMD =SERR if the command has been ignored. Example: # DMD FM* Example: # DMD OFF*



SDMV v	This setting command sets the volume of demodulator. The string (v) should be in the range of 0 to 100. The reply is DMV =OK which acknowledges the command has been granted or DMV =SERR if the command has been ignored. Example: #SDMV 50* Sets the volume of demodulator to half of the audio power.
SLDW n,freq; levq,leva	This setting command is used for setting the custom double value limit frequency by frequency. It consists of four fields as follows: • n Is the index of frequency being written and it should range from 0 to 15 • freq Is the frequency, expressed in Hz (exponential notation allowed), being written • levq Is the level of the limit which refers to QPeak and is expressed in dBμV • leva Is the level of the limit which refers to the alternate detector and is expressed in dBμV The purpose of this command is to have a double value limit that can be used along with smart detector function when sweeping by the command SSFD: The procedure to set a custom double value limit on PMMER8000 is the following: • Send as many commands as the frequency points of limit are in upwards order. • Terminate (and make it active) by sending the command SLIE Here is an example how to make a custom limit on PMMER8000: • #SLDW 0, 150e3; 66,56 * Send the first line 150kHz 66 dBμV (QP) • #SLDW 1, 500e3; 56,46 * Send the second line 500kHz 56 dBμV (other det.) • #SLDW 2, 5e6; 56,46 * Send the third line 5MHz 56 dBμV • #SLDW 3, 5e6; 60,50 * Send the fourth line 5MHz 60 dBμV • #SLDW 4, 30e6; 60,50 * Send the fifth line 30MHz 60 dBμV • #SLIE Custom Double * Send the name and make the limit active Note that all the higher indexes in the limit are cleared. Therefore, a limit must be made in upwards order otherwise all points, having a higher index previously written, are cleared. It is responsibility of the user to make sure the data sent are correct and coherent. The reply is SLDW =OK which acknowledges the command has been granted or LDW =SERR if the command has been ignored.
SLIE name	This setting command is used for naming the custom limit and making it active or deactivating it. The command is made of the string LIE (the command itself) and a string which represents the name of the limit it will be shown. It is suggested a name of maximum 10 characters. Sending a LIE with no argument (Limit name) deactivates all limit active, if any. This command is intended for making a custom limit into PMM ER8000. For further information see command SLIW. When the command is received the limit is checked and, if data (frequency and level) are coherent, the command is granted by replying SLIW =OK otherwise the replay is SLIW =SERR Example: # SLIE Custom Limit* checks the data previously loaded by SLIW commands, names the limit as "Custom Limit" and activates it Example: # SLIE * deactivates any limits



SLIM n	This setting command sets the Margin to be used with Smart Detector function. The argument (n) in the range of -20 to 20. The reply is LIM =OK which acknowledges the command has been granted or LIM =SERR if the command has been ignored. Example: #SLIM 2* Sets the threshold of smart detector to 2 dB below the limit.
SLIW n,freq;lev	This setting command is used for setting the custom limit frequency by frequency. It consists of three fields as follows: n Is the index of frequency being written and it should range from 0 to 15 freq Is the frequency, expressed in Hz (exponential notation allowed), being written lev Is the level of the limit and is expressed in dBμV The procedure to set a custom limit on PMMER8000 is the following: - Send as many commands as the frequency points of limit are in upwards order. - Terminate (and make it active) by sending the command SLIE Here is an example how to make a custom limit on PMMER8000: #SLIW 0, 150e3; 66 * Send the first line 150kHz 66 dBμV #SLIW 1, 500e3; 56 * Send the second line 500kHz 56 dBμV #SLIW 2, 5e6; 56 * Send the third line 5MHz 56 dBμV #SLIW 3, 5e6; 60 * Send the fourth line 5MHz 60 dBμV #SLIW 4, 30e6; 60 * Send the fifth line 30MHz 60 dBμV #SLIE Custom CISPR 14-1 * Send the name and make the limit active Note that all the higher indexes in the limit are cleared. Therefore, a limit must be made in upwards order otherwise all points, having a higher index previously written, are cleared. It is responsibility of the user to make sure the data sent are correct and coherent. The reply is SLIW =OK which acknowledges the command has been granted or LIW =SERR if the command has been ignored.
SLSN n	This setting command #SLSN n* sets the input for Band B according to the argument 'n' as follows: 0 → Input on N connector 1 → Input on ER8000 internal LISN L1 2 → Input on ER8000 internal LISN L2 'n' higher than '2' is ignored and SERR message sent back The reply is LSN =OK which acknowledges the command has been granted or LSN =SERR if the command has been ignored. Example: #SLSN 0* switches the input from 'N' connector Example: #SLSN 2* switches the input from ER8000 built-in LISN Line-2
SMAF f	This setting command sets the tuning frequency for manual mode. The string (f) can be in exponential form and should be expressed in Hz. The reply is MAF=OK which acknowledges the command has been granted or MAF=SERR if the command has been ignored. When the command is granted the ER8000 goes to manual mode automatically Example: #SMAF150e3* Sets the manual frequency to 150kHz



SMAN	This setting command puts the ER8000 in manual mode. The reply is always MAN=OK which acknowledges the command has been granted. The ER8000 goes to manual mode. Example: #SMAN *
SMANP	This setting command puts the ER8000 in manual mode and sets the default value to the following settings: • RBW Automatic • Attenuator Automatic • MinAtt=10 dB • Preselector On • Preamplifier OFF • Hold Time =1000ms • Pulse Limiter = OFF The reply is always MANP=OK which acknowledges the command has been granted. The ER8000 goes to manual mode. Example: #SMANP*
SMAT a	This setting command sets Attenuator, for Manual Mode, to the value indicated by (a) which can be 0 to 45. Automatic Attenuator feature is disabled. If (a) is a negative figure then the Automatic Attenuator feature is turned on. The reply is MAT=OK which acknowledges the command has been granted or MAT =SERR if the command has been ignored. When the command is granted the ER8000 goes to manual mode automatically. Example: #SMAT 15* (set attenuator to 15dB and disable Automatic Attenuator feature) Example: #SMAT -1* (Enable Automatic Attenuator feature)
SMHT h	This setting command sets hold time for manual mode. The string (h) should be expressed in ms. The reply is MHT=OK which acknowledges the command has been granted or MHT =SERR if the command has been ignored. When the command is granted the ER8000 goes to manual mode automatically. Example: #SMHT 1500* Sets the hold time, for manual mode, to 1500 ms (or 1.5s)
SRBW b	This setting command sets RBW. The argument (b) should be a string representing the RBW as follows: ○ 0 →RBW is Automatic so that the ER8000 automatically selects the suitable RBW according to the tuned frequency ○ 1 →300kHz ○ 2 →100kHz ○ 3 →30kHz ○ 4 →10kHz ○ 5 →3kHz ○ 6 →9kHz (Cispr 16-1) ○ 7 →200Hz (Cispr 16-1) ○ 8 →1kHz ○ Only for C, D band o > 30 MHz ▪ 10 →120kHz (Cispr 16-1) (Opt. 01) ▪ 9 →1MHz (Opt. 01) The reply is RBW =OK which acknowledges the command has been granted or RBW =SERR if the command has been ignored. Example: #SRBW 3* sets the RBW to 30kHz and disables Auto RBW mode Example: #SRBW 0* turn the RBW mode in Automatic

**SSFD**

FreqStart;
FreqStop;
FreqStep;
Detector;
HoldTime; Rbw;
MinAtt; Preamp;
Preselector;
ScanHoldT

This setting command sets parameters and triggers a sweep.

Arguments are as follows:

- **FreqStart** = Sweep Start Frequency expressed in Hz
- **FreqStop** = Sweep Stop Frequency expressed in Hz
- **FreqStep** = Sweep Step Frequency expressed in Hz
 - If **FreqStep** > 0 then a standard sweep, tuned step by step, is made
 - If **FreqStep** < 0 (typical = -1) then the step will be set to AUTO
 - If **FreqStep** = 0 then the sweep will be made by tuning the frequencies listed in Frequency-Scan-Tab (which it must have been written previously by command **SSFW**). The frequencies not included from **FreqStart** and **FreqStop** are ignored.
- **Detector**. In **non –smart mode**, any combination of the following detectors can be used and combined. All the detectors set will be measured and sent out. However, in **Smart Mode** only one detector at time, in addition to PEAK which is always present, can be set.
 - **Non Smart Mode** (All detectors can be indicated at once). Order is not important.
 - P → Peak
 - Q → Q Peak
 - N → C-Rms
 - A → Avg
 - R → Rms
 - C → C-Avg
 - **Smart Mode** (No more than 2 detectors can be indicated at once)
 - S → Smart Mode (this must be the first in the string)
 - Q → Q Peak
 - N → C-Rms
 - A → Avg
 - R → Rms
 - C → C-Avg
- **HoldTime** = Hold Time for each step and it is expressed in ms. Note that in case of Smart Mode HoldTime is used only when the disturbance is measured again by the alternative detector as minimum time, depending on the RBW set, is used for the fast scan.
- **RBW**. This is the index of RBW to be used for the scan. Neither automatic selection, nor automatic switch is performed. The user must issue a suitable RBW index. Index are as follows:
 - 1 → 300kHz
 - 2 → 100kHz
 - 3 → 30kHz
 - 4 → 10kHz
 - 5 → 3kHz
 - 6 → 9kHz (Cispr 16-1)
 - 7 → 200Hz (Cispr 16-1)
 - 8 → 1kHz
 - Only for C, D bands o > 30 MHz
 - 10 → 120kHz (Cispr 16-1) (Opt. 01)
 - 9 → 1MHz (Opt. 01)
- **MinAtt** = Minimum attenuation allowed during sweeping. This parameter ranges from 0 (no limitation) to the maximum available attenuation. This parameter is normally used to avoid switching up the sensitivity in order to either protect the input from high spikes or to prevent switching down the attenuation when, for instance, the limit is so high that it would be only waste of time.

Note: In Sweep mode the Attenuator is always forced to AUTO



(Continued)

SSFD FreqStart;
FreqStop;
FreqStep;
Detector;
HoldTime; Rbw;
MinAtt; Preamp;
Preselector;
ScanHoldT

- **Preamp.** This Parameter switches the Preamplifier On or Off according to its content as follows.
 - **On.** It turns ON the preamplifier.
 - **Off.** It turns Off the preamplifier.
- **Preselector.** This Parameter switches the Preselector On or Off according to its content as follows.
 - **On.** It turns ON the Preselector.
 - **Off.** It turns Off the Preselector.
- **ScanHoldT** = Hold Time used in Smart Mode when tuning for Peak for each step and it is expressed in ms. Note that this is used only in case of Smart Mode and not in standard sweep. This parameters is not compulsory and can be omitted if not required. I case it is not present, minimum time is taken.

This command triggers a free sweep (no automatic items are selected) based on the provided parameters. After this command has been received, all parameters issued in the command itself are checked out and, if coherent, a sweep starts otherwise the related error is notified and the sweep is not triggered.

Moreover, using the Frequency-Scan-Tab, the user has the capability of tuning only those frequencies which are suspected skipping thus the remainder. Hence, saving a lot of time.

After the command has been received, the ER8000 replies by sending a string which reflects the status of parameter check as follows:

- **SFD=OK<RC><LF>** No error in parameters and sweep started.
- **SFD=ERR 1<RC><LF>** An Error was found in **start** or **stop** frequencies. Errors can be one of the following:
 - Start Frequency lower than minimum allowed frequency
 - Stop Frequency higher than maximum allowed frequency
 - Start Frequency higher than Stop Frequency
- **SFD=ERR 2<RC><LF>** An Error was found in **step** frequency. Step is either
 - Too small.
 - Is equal to zero (use of Frequency-Scan-Tab) but there are less than two frequencies in the table
- **SFD=ERR 3<RC><LF>** An Error was found in **detector**. Errors can be one of the following:
 - Invalid Detector or no detector found. Detectors must be indicated by 'P', 'Q', 'R', 'A', 'N' and 'S' only
 - Smart Mode selected but no active limit
 - Smart Mode selected but no alternative detector
 - Smart Mode selected but more than two alternative detector indicated
- **SFD=ERR 4<RC><LF>** An Error was found in **HoldTime** value. **HoldTime** is either too big (>30s) or negative.
- **SFD=ERR 5<RC><LF>** An Error was found in **RBW**. Errors can be one of the following:
 - Unsuitable RBW for the active unit (for instance 200 Hz RBW while operating in bands C, D and E)
 - Unsuitable RBW for the detector previously selected (for instance 100 kHz RBW and QuasiPeak selected).
- **SFD=ERR 6<RC><LF>** An Error was found in **MinAtt** value. Errors can be one of the following:
 - **MinAtt** value is negative
 - **MinAtt** value is higher than maximum available attenuation
 - **MinAtt** value is not in step of 5
- **SFD=ERR 7<RC><LF>** An Error was found in **Preamp** string. **Preamp** string can be either **ON** or **OFF** only. String is not case sensitive.
- **SFD=ERR 8<RC><LF>** An Error was found in **Preselector** string. **Preselector** string can be either **ON** or **OFF** only. String is not case sensitive.



(Continued) SSFD FreqStart; FreqStop; FreqStep; Detector; HoldTime; Rbw; MinAtt; Preamp; Preselector; ScanHoldT	Once the sweep is started, the ER8000 sends the value of each detector chosen in the command. Each detector is made of a Little Endian 16 bit integer which represents the value of that particularly tuned frequency. The value is expressed in hundredth of dBm. Therefore, for each step, there will be a packet of n detectors (n *2 bytes). The order of detectors is fixed and is not related to the order issued in the command. For instance, PAQ is equivalent to QAP as well as RA is same as AR. The order of detector is as follows (from the first to the last): 1. Peak (which is always present) 2. QPeak (QuasiPeak) 3. RMS 4. AVG (Average) 5. C-RMS 6. C-AVG Special meaning has the value NOLEVEL, -32700 (Hex 8044), which informs that the detector has not been measured. This happens, for example, in Smart mode where the alternative detector is taken only for those frequencies the Peak was above the margin. After having terminated all steps and sent all data, the string SFD_END<RC><LF> is then sent informing the user there are no more data left. Any started sweep can be stopped by sending the command ASBK which abruptly terminates it. In case the sweep was prematurely terminated by the command ASBK, the end of sweep (which will not contain all expected data) is SBK=OK<RC><LF> Here is an example of the command: #SSFD 1e6;10e6;10e3;PAR;0;6;10;OFF;ON* Which triggers a sweep from 1 MHz to 10 MHz using a step of 10 kHz. Detectors are Peak, AVG and RMS. The hold time will be the minimum suitable (automatically adjusted by the unit). RBW is 9kHz. MinAtt is 10 dB which means that the attenuator will not switch below 10 dB attenuation. Preamplifier is OFF while the Preselector is turned on. Here, for each step there will be a packet of 3 detectors per step (Peak, AVG and RMS in this order) counting thus 6 bytes (3 * 2) per step. Here is another example: #SSFD 9e3;150e3;50;SPQ;1000;7;10;OFF;ON;100* Which triggers a sweep from 9kHz to 150kHz using a step of 50 Hz. Detector is Smart QuasiPeak using a hold time of 1s in re-measuring those frequencies which value was over the limit scanned using 100ms holdtime . RBW is 200Hz. MinAtt is 10 dB which means that the attenuator will not switch below 10 dB attenuation. Preamplifier is OFF while the Preselector is turned on. In this case, as all the needed conditions are matched, FFT is used to perform the Peak scan. Here, for each step there will be a packet of 2 detectors per step (Peak and QuasiPeak in this order) counting thus 4 bytes (2 * 2) per step. Of course, most of QuasiPeak value will be populated by NOLEVEL as QuasiPeak will be measured only for few frequencies (the ones which value is above the margin).
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SSFW n,freq	This setting command is used for creating a Frequency-Scan-Tab frequency by frequency. It is made of two fields as follows: n Is the index of frequency being written and it should range from 0 to 99 freq Is the frequency, expressed in Hz (exponential notation allowed), being written The procedure to make and use a Frequency-Scan-Tab on PMM ER8000 is the following: - Send as many commands SSFW as frequency points of table are in upwards order. - Send the command SSFD with step size set to zero Here is an example how to make a Frequency-Scan-Tab on PMMER8000: #SSFW 0, 150e3 * Set the first freq to 150kHz # SSFW 1, 500e3 * Set the second freq to 500kHz # SSFW 2, 5e6* Set the third freq to 5MHz # SSFW 3, 6e6* Set the fourth freq to 6MHz # SSFW 4, 30e6 * Set the fifth freq to 30MHz Note that all the higher indexes in the Frequency-Scan-Tab are cleared. Therefore, a Frequency-Scan-Table must be made in upwards order. All points, having a higher index previously written, are cleared. Note that only the present frequencies will be tuned and measured as all remaining will be completely neglected. Hence, it is responsibility of the user to make sure the data sent are correct and coherent. The reply is SSFW =OK which acknowledges the command has been granted or SSFW =SERR if the command has been ignored.
SSTP	This setting command stops abruptly a running sweep in Analyzer mode. The reply is always STP=OK, which acknowledges the command has been granted
STAT b	This setting command sets MinAtt to the value indicated by (b) which range from 0dB to the maximum available attenuation and must be in step of 5dB. The reply is TAT=OK which acknowledges the command has been granted or TAT=SERR if the command has been ignored. Example: #STAT 10* Note: In Sweep mode the Attenuator is always forced to AUTO
SUPP n	This setting command #SUPP n* outputs on the User Port bit by bit the argument n . Each Pin has its own contribution according to its index as follows: OUT0= 2⁰ OUT1= 2¹ OUT2= 2² Thus, the argument sent is the sum of each weighted contribution The reply is UPP=OK which acknowledges the command has been granted or UPP=SERR if the command has been ignored (IE argument >31). Example: SUPP 5 will set: - user port pins OUT0 and OUT2 to high level - user port pins OUT1 to low level



7.6.3 Analyzer Reply

The PMM ER8000 replies to the command "**SAGO**" sending back an array of bytes which contains all the information needed to draw a sweep. Typically, the user should first send the PMM ER8000 all the setting commands to insure the receiver is correctly set on the wanted parameters and then read the reply.

Just as an example, the user could send the following commands:

7.6.3.1 Reply example

#SAAT -1*	Set Attenuator Automatic mode
#SAPA Off*	Switch Preamplifier OFF
#SPLM a*	Switch Pulse Limiter OFF
#SAFF 150e3,30e6*	Sets the Start frequency to 150kHz and Stop frequency to 30MHz
#SAHT 2*	Sets the hold time to 2 ms
#SADT 2*	Sets the detector to AVG
.....	More Command
.....	More Command
#SAGO *	Start Sweep in Analyzer Mode



NOTE

The PMMER8000 replies by sending a 48 bytes header followed by a variable size array of integer (the size depends on frequency settings) as follows:

HEADER		
ID Byte	Value	Meaning
1	A	The first 8 Bytes are just a fixed header and acknowledge the command
2	G	
3	O	
4	=	
5	O	
6	K	
7	0x13 (CR)	
8	0x10 (LF)	
9	Start Frequency	Little Endian 32 bit Float figure representing the start frequency of sweep
10		
11		
12		
13	Stop Frequency	Little Endian 32 bit Float figure representing the Stop frequency of sweep
14		
15		
16		
17	Step Frequency	Little Endian 32 bit Float figure representing the step frequency of sweep
18		
19		
20		
21	Reserved	...
...	...	
26		
27	Attenuator	
28		
29	Reserved	...
...		
48		



***** End of Header ***** (continued)		
From here all figures represent the level referred to the tuned frequency And are expressed in hundredth of dBm		
49	Level Fstart	Little Endian 16 bit integer representing the level referred to start frequency.
50		
51	Level Fstart +Fstep	Little Endian 16 bit integer representing the level referred to start frequency plus step frequency
52		
51	Level Fstart +2*Fstep	Little Endian 16 bit integer representing the level referred to start frequency plus 2 * step frequency
52		
....		
....		
nn	Level Fstop	Little Endian 16 bit integer representing the level referred to Stop frequency
nn+1		

**NOTE**

The number of levels replied is calculated by the formula $1+(Fstop-Fstart)/Fstep$. However, because of the different approximation in managing floating point figures, please note that the number of received levels may slightly differ specially with big difference in (Fstop-Fstart).

It is always possible to terminate a sweep before its natural end by sending the command SSTP.



7.7 Sweep Mode commands sequence example This is the sequence used by the PMM Emission Suite when a scantable is run, in the “conducted” range (Band B from 0.15 to 30 MHz).

Example		
Command sent	Reply received	Description
#?IDN*		Queries information about model, release and date of the firmware
	IDN=ER8000/00-FW - 1.00 11/06/20	It is a ER8000/00 with its FW
		It is used to check congruencies, frequency limits, and all the related characteristics
#?S/N*		Queries the serial number
	S/N=000WE20304	Serial number
#?CRA*		Queries if RMS-AVG optional detector is active
	CRA=OK	RMS-AVG active
#SCFA -1*		Correction factors, if present, deactivated
	CFA=OK (OFF)	Important. Could be previously stored and activated.
#S3PRC*		Sets the unit in the bands A and B for conducted
	3PR=OK	ack
#SSFD 150000;30000000;5000;P;2;6;10;OFF;OFF;0*		Sweep
	Binary data reply	Measurements data
#?UHT*		Queries the hold time
	UHT=2.5ms	Applied hold time

8 - Click Mode Operating Instructions (PMM CA0010 Option)

8.1 Introduction

The **CLICK mode** allows the User to make in a fast, easy and fully automatic way a difficult test like the Discontinuous Disturbances measurement, as defined by current CISPR standards.



8.2 Click Mode Option

To enable the Click mode you need the optional PMM CA0010 Click Analyzer.



For further information about Click Analysis and Generation software installation and use, please refer to the “PMM CA0010 User’s Manual”.



When the Click option has been successfully installed, the PMM Click Analysis software can be run to take measurements.

8.3 Enter the Click Mode

To enter **Click Mode**, run the PMM CA0010 Click Analysis software and follow the instructions contained in the CA0010 User’s Manual.

The main window will be the **IDLE** function, which allows a preliminary, free running evaluation, at the selected frequency and level.

To increase test productivity the PMM ER8000 has some very unique features: it allows skipping as many as 2 steps, as it may predict how many clicks would overcome the Lq limit and may also advice the User if the next step would fail.



PMM ER8000 works as a simultaneous 4 channels click meter.



8.4 Introduction to the discontinuous disturbance (click) measurement

Mechanical or electronic switching procedures - e.g. those due to thermostats or program controls – may unintentionally generate broadband discontinuous disturbances with a repetition rate lower than 1 Hz.

Indeed, CISPR 16-2-1 and CISPR 14-1 define a discontinuous disturbance, also called “click”, as a disturbance the amplitude of which exceeds the quasi-peak limit of continuous disturbance, the duration of which is not longer than 200 ms and which is separated from a subsequent disturbance by at least 200 ms. The durations are determined from the signal which exceeds the IF reference level of the measuring receiver.

A click may also contain a number of impulses; in which case the relevant time is that from the beginning of the first to the end of the last impulse.

The test procedures and the test setup for click measurement are indicated in CISPR 16-2-1 and in CISPR 14-1 standards.

It basically consists in the measurement of the number of clicks exceeding a certain level determined as function of the click number and duration.

The PMM ER8000 has a better than 500µs time resolution, as requested by the standard.

Moreover, several “exceptions” shall be dealt with by the click analyzer in order to make the test as per the standard.

To better understand the click measurement process – automatically made by PMM ER8000 - it could be useful also to know few more definitions:

- *switching operation*: one opening or closing of a switch or contact;
- *minimum observation time T*: the minimum time necessary when counting clicks (or switching operations) to provide firm evidence for the statistical interpretation of the number of click (or switching operations) per time unit;
- *click rate N*: number of clicks or switching operations within one minute (this figure is being used to determine the click limit);
- *Click limit L_q*: the relevant limit L for continuous disturbance for the measurement with the quasi-peak detector, increased by a certain value (offset) determined from the click rate N. The click limit applies to the disturbance assessed according to the upper quartile method;
- *Upper quartile method*: a quarter of the number of the clicks registered during the observation time T is allowed to exceed the click limit L_q. In the case of switching operations a quarter of the number of switching operations registered during the observation time T is allowed to produce clicks exceeding the click limit L_q.
- *short click 1*: a disturbance not longer than 10 ms;
- *short click 2 (E3)*: a disturbance between 10 ms and 20 ms;
- *click*: a disturbance longer than 10 ms and not longer than 200 ms;
- *other than click*: a discontinuous disturbance longer than 200 ms.

With reference to the mentioned standards, a schematic process flow of the measurement is the following:

- ❏ Determination of the click rate *N*
- ❏ Pass/fail decision if instantaneous switching and if $N \geq 30$
- ❏ Check conformity to definitions
- ❏ Apply Exceptions (whenever applicable)
- ❏ Calculate Limit Quartile
- ❏ Measurement using Upper Quartile Method
- ❏ Pass/fail using Upper Quartile criterion
- ❏ Repeat for next frequency

As PMM ER8000 manages all these steps in a completely automatic way, a detailed step by step description is here given before to describe each command and function.

8.4.1 Determination of the click rate

The first step of the measuring process is to determine the click rate N in the minimum observation time. This is done measuring the time needed to count up to 40 clicks or 40 switching operations; the maximum time allowed is anyway 2 hours (120 minutes), unless the cycle is determined by a program, which needs additional time to be terminated.

Therefore, if the equipment has a cycle and in this cycle less than 40 clicks appear, then the cycle shall be repeated until 40 clicks are counted or until the observation time is 2 hours.

If the equipment has a cycle and in this cycle more than 40 clicks appear, the observation time is anyway determined by the cycle.

When the minimum observation time has been defined, it is possible to calculate the click rate N using the simple relationship:

$$N = \frac{n_1}{T}$$

where n_1 is the number of clicks measured and T is the minimum observation time.

However, in certain conditions – see CISPR 14-1 for further reference – the click rate N must be calculated using a different approach:

$$N = \frac{n_2 \cdot f}{T}$$

where n_2 is the number of switching operations and f is a factor dictated in the standard. Such a factor can be taken into account for automatic calculations if its value is properly set in the main setup page.

The click rate shall be determined at two frequencies: 150 kHz (Step 1) and 500 kHz (Step 3).

8.4.2 Preliminary Conformity and Exceptions

Once the number of clicks – or switching operations – has been determined, then some preliminary controls can be made to verify if the rate is greater than 30 (fail conditions); if the measured clicks are conforming to the definition of the standard; if there are exceptions applicable.

Thanks to its digital architecture, PMM ER8000 can easily record and store all the relevant parameters, keeping trace of all the events occurring during the test and allowing the User to post-process all these data; PMM ER8000 will also notify immediately the test results to the User.

8.4.2.1 Old and New exceptions

The “Click” test also requires verifying if exceptions E1 to E4 are applicable. While E1 and E2 are “old” exceptions, easy to deal with, the new E3 and, in particular, E4 are calling for a new hardware structure: an old click analyzer is no longer compliant.

E3 is an additional counter, does not require additional memory and implies only minor changes in the test flow, thus can be implemented in a relatively easy way.

E4 is very demanding in terms of hardware requirements: a memory for storing each disturbance duration and interval is required in order to post-elaborate them, and it is mandatory to provide all the data in the test report. Moreover, as the application of E4 is conditional to the final click rate N - which in turn may prevent using E4 – the test flow significantly changes.

Only new analysers specifically designed – like the PMM ER8000 - can successfully meet the requirements of the standard and be compliant with the new Click test criteria.



8.4.3 Calculate Limit Quartile

When the click rate N is determined it is possible to calculate the click limit L_q by increasing the relevant limit (quasi-peak) L for continuous disturbances with:

- ⌚ 44 dB for $N < 0,2$, or
- ⌚ $20 \log (30/N)$ dB for $0,2 < N < 30$

Therefore

$$L_q = L + 20 \cdot \log \frac{30}{N}$$

8.4.4 Measurement vs. L_q limit

Now the test can be done at the 4 fixed frequencies dictated by the standard: 150 kHz, 500 kHz, 1.4 MHz, 30 MHz, and the results compared with the limit L_q .

If less than 25% of the clicks measured exceeds the limit L_q , then the test is positive, otherwise it fails.

The PMM ER8000 can now produce an extensive report with all the relevant data.

8.5 Start

As soon as the Setup has been done, it is possible to start the test.

First of all the analyzer will determine the click rate N, and – if all the conditions apply – after that the analyzer will immediately continue measuring the number of clicks exceeding the upper quartile limit L_q .

Simply select **Start**: the PMM ER8000 will automatically take care of all the necessary steps, reporting at the end of the test all the relevant results.

During the test, the evolution of the measurements can be continuously controlled in the Data and Details windows, where all the info are duly provided.

At any time, it is possible to **Stop** the measure or to **Pause** it.

The PMM ER8000 does the determination of the click rate at the two frequencies of 150 kHz and 500 kHz or at all the four frequencies, depending on the Operator's choice.



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8.5.1 RUN 2

After the Run 1 is completed, the **Run 2** begins automatically, carrying out the measurements vs Lq limit, or, in other words, performing the heart of the test itself.

Among the parameters, on the display it is reported the max clicks number allowed (25% of the clicks measured during Step 1).



In certain conditions, the analyzer may judge the input attenuation is not adequate (for example, when the limit is recalculated following up the Lq value): in that case, a message appears, requiring additional attenuation.

In most cases, it is enough to touch **OK** to adjust the input attenuation to the optimum value and continue the test.



The total amount of available internal attenuation is 45 dB but the CA0010 is also equipped with supplementary attenuators so that a very high dynamic range can be accomplished.

NOTICE

Please remember that the maximum input signal allowed is 7 V (137 dB μ V), and that a click test may result in a potentially dangerous condition for the input stage of the receiver.

Before to apply an unknown signal to PMM ER8000 receiver, use an oscilloscope or a wide band RF voltmeter to measure it.

If needed, set a proper threshold and consequently input attenuator.

8.5.2 Stop and Pause

If Stop has been selected during a measurement, the test can then be aborted or it is possible to go immediately to the next step.

If Paused, the test can be resumed at any convenient time.



8.6 Report

After a Click test the PMM ER8000 reports all the relevant data.
Due to the complexity of the test and to the various conditions that may happen during the measurement, several reports may be issued.

8.6.1 Fail during determination of the click rate N

In case a test failed condition is recorded during the determination of the click rate N during the first Run, the report will show the situation. In this case there is no need to go on testing that specific frequency/frequencies.

8.6.2 Report after a successful test with less than 5 instantaneous switching at one frequency

If the determination of the click rate N shows that at a given frequency there are less than 5 instantaneous switching operations, there is no need of any further test at that frequency or frequencies (the investigation frequencies are 150 kHz for the interval from 150 to 500 kHz, and 500 kHz for the interval from 500 kHz to 30 MHz).

8.7 Setup

Due to the complexity of the discontinuous disturbance test, this panel is rather complex, as many parameters shall be defined.
However, the PMM ER8000 has been designed to be extremely user-friendly and to take care in a fully automatic way of all the necessary steps of the test.

**NOTE**

Due to the fact that the Standard fixes the frequencies at which the test shall be done, these frequencies have been uniquely assigned by factory and the User cannot modify them; nevertheless it is possible to select an arbitrary Frequency Value for "Idle Mode" instead, useful for debugging purposes.

From the main Click Analysis window, select START and the main Setup panel will be displayed.
The User can navigate through the different parameters to set the desired values.

8.7.1 External attenuator

In case an external attenuator is used to protect the input of the analyzer, the value of this attenuator can be entered, in order to have the PMM ER8000 taking into account the value in all calculations of measured levels. The way to enter the value of the attenuator is shown in the CA0010 User's Manual.

8.7.2 Limit

Three most used limits are built-in into the analyzer: CISPR 14, CISPR22 and CISPR11.

Either one can be selected simply by the drop down menu.

The limit will be loaded and all the calculations will be done with reference to the selected limit:

The Reference Standard for Click tests is always EN 55014-1 (or equivalent CISPR 14-1), which defines 4 different Limit Curves for Q-Peak according to Table 1, with following cross-correlation as for names assigned on ER8000 :

014-1 --> Limit in Column 2
014-2 --> Limit in Column 6
014-3 --> Limit in Column 8
014-4 --> Limit in Column 10

**NOTE**

Limit in Column 4 of Tab.1 is not used for Click test, as referred to Load and Auxiliary terminals.

8.7.3 Determination of N As required by the standard, N may be determined either by counting the clicks, or by counting the switching operations.

Select **Clicks** if N has to be calculated on the number of clicks, or select **Sw.Op. current** to determine N on the number of switching operations, going up and down the list of the available options in terms of switched current: 10mA; 20 mA; 50 mA; 100mA; 200mA; 500mA; 1A; 2A and 5A. The current threshold value must be chosen in relation to the DUT declared consumption.



The internal LISN is able to autonomously measure the mains current drawn by the Device Under Test, when you need to count the switching operations.

8.7.4 Factor f The applicable standard may require a certain factor f to be used to calculate the click rate N. For example, table A2 of the CISPR14 gives the factor f for several products.

This factor depends on the nature of the EUT and shall be entered by the User in the normal way.

8.7.5 Stop on Fail The Click test may be rather long, as the observation time and EUT cycle can take as long as 120 minutes.

In order to save time and increase productivity, the PMM ER8000 can stop the test as soon as a fail condition is achieved.

Two options are therefore available: stop immediately as the fail condition occurs (Right away) or anyway at the End of Step.

Please select the desired option.

8.7.6 Line When using a PMM LISN, it's possible to select the Line on which to perform the test through the Setup Menu, just selecting the model and the specific desired line.

In case a 3rd party LISN would be used, just leave "NONE" in the menu.

8.8 Click option The click option includes all the items described in the PMM CA0010 User's Manual, briefly listed here:

- CA0010 Click Analyzer from 150 kHz up to 30 MHz
- AC/DC Converter with plug adapters;
- Flexible black cover/accessories holding;
- LISN Mains Cable
- BNC-BNC coaxial cable 0,25 m length;
- DB9 male to DB9 male cable 0,25 m length for ER8000 connection;
- USB cable, 2m;
- Operating manual;
- Click Analysis and Click generation software
- Certificate of Compliance;
- Return for Repair Form.

For quick reference look at the following picture.

8.9 Test Set up

As required by the relevant standards, the discontinuous measurement (Click) test set up shall be the same adopted for continuous disturbances, therefore, usually, a LISN is used to sample the RF signal to be measured. In case the internal LISN is to be used, it is the one contained in the PMM CA0010 Click Analyzer.

Please follow all the instructions illustrated in the CA0010 User's Manual to assemble the correct setup for your test.



WARNING

This is a Safety Class I apparatus and it is also equipped with a couple of protective/functional earth terminals, both on the rear and front panels. A good safety/functional ground connection should be provided before to operate the analyzer.

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☒ Accessori ritornati con l'apparecchiatura:	☐ Nessuno	☐ Cavo(i)	☐ Cavo di alimentazione	☐ Altro:
☒ <i>Accessories returned with unit:</i>	☐ <i>None</i>	☐ <i>Cable(s)</i>	☐ <i>Power cable</i>	☐ <i>Other:</i>

☒ **Sintomi o problemi osservati:** ☒ *Observed symptoms / problems:*

☒ Guasto:	☐ Fisso	☐ Intermittente	Sensibile a:	☐ Freddo	☐ Caldo	☐ Vibrazioni	☐ Altro
☒ <i>Failure:</i>	☐ <i>Continuous</i>	☐ <i>Intermittent</i>	<i>Sensitive to:</i>	☐ <i>Cold</i>	☐ <i>Heat</i>	☐ <i>Vibration</i>	☐ <i>Other</i>

Descrizione del guasto/condizioni di funzionamento:*Failure symptoms/special control settings description:***Se l'unità è parte di un sistema descriverne la configurazione:***If unit is part of system please list other interconnected equipment and system set up:*

[illegible]