SEIBERSDORF LABORATORIES

FREQUENTLY ASKED SOLUTIONS

RefRad X - Field Source and Comb Generator

FibreLink X

LISN Coupler

MANUAL

RefRad X - Reference Radiator Model X

SEIBERSDORF LABORATORIES

MANUAL
RefRad X

RefRad X – Field Source and Comb Generator
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1. INTRODUCTION

The Reference Radiator Model X (RefRad X) was developed by Seibersdorf Laboratories (former ARC) for checking the quality of radiated and conducted EMC tests. This battery-operated comb generator will radiate a precisely defined field strength for checking radiofrequency measurement systems in a frequency range of 10 kHz to 3 GHz and beyond.

The first Reference Radiator was given the name "RefRad" in 1990. Both the RefRad and the method for comparison measurement are protected by patent.

In 2003, the engineers developed a test device for checking the functionality of field strength measurement systems that could be used in the area of personal safety: the RefRad 3000, an improved comb generator with an increased frequency range. This device served EMC test laboratories for quality assurance in interference field strength measurements on electronic devices: A rapid "System Check" implemented by measuring the field strength of the RefRad and comparing it with the known setpoint. Defective components in the measuring system can therefore be detected before the testing activity commenced.

In 2007, the research team improved the RefRad, developing a comb generator with new functions. The electronics of the innovative RefRad X are integrated in one of the conical antenna elements, thus guaranteeing good symmetry in radiation. The synchronisation of the comb generator clock frequency with that of the measurement receiver enables a very small measuring bandwidth and therefore improves the signal-to-noise ratio by up to 30 dB. In addition to the already existing antenna couplers, additional couplers were developed for checking the line impedance stabilization network for conducted emission measurements.

This manual describes in detail the application of the RefRad X and its accessories for system check, site validation and shielding measurements.

Technical specifications of the system and radiation patterns are presented.

2. APPLICATIONS

Seibersdorf Laboratories offer three measurement sets containing the RefRad X and components tailored for different applications (see Chapter 3):

- RefRad X Set
- Field Source Set
- Field Source Set, Sync Mode

Application	Description
System Check with Radiated Field	**Procedure:** the well-defined field generated by the **RefRad X Field Source** is measured with the EMC/EMF measurement system. This measurement is done once with a well-checked setup as reference and it is repeated before each measurement campaign. A comparison between the reference and the actual system check ensures the quality of the results. **Advantages:** • convenient detection of defects in the receiving system • suitable for all antennas • suitable for GTEM and other micro cells **Considerations:** • influenced by the test environment (EMF) • influenced by the EUT (EMC) • coupling to the receive cable hinders fault detection • positioning can be critical
System Check with Antenna Coupler	**Procedure:** the well-defined field generated by the antenna coupler connected to the **RefRad X Comb Generator** is measured with the EMC/EMF measurement system. Same procedure as System Check with Radiated Field. **Advantages:** • not influenced by the test environment (EMF) • not influenced by the EUT (EMC) • reliable detection of defects in the receiving system • easy and precise positioning for high repeatability **Considerations:** • individual coupler required for each antenna
System Check with LISN Coupler	**Procedure:** check of conducted emission test setup using the **RefRad X Comb Generator** and the LISN coupler. Same procedure as System Check with Radiated Field. **Advantages:** • reliable detection of defects in the measurement system • easy and precise operation **Considerations:** • individual coupler required for each LISN type

Application	Description
Coaxial System Check	**Procedure:** check of coaxial section of conducted or radiated emission test setup using the **RefRad X Comb Generator** and the protective attenuator. Same procedure as System Check with Radiated Field. **Advantages:** • reliable identification of the fault source • easy and precise operation
Normalized Site Attenuation Measurement, Semi Anechoic Chamber	**Procedure:** the **RefRad X Comb Generator** is used as a signal generator in the normalized site attenuation measurement [1,2]. **Advantages:** • high measurement speed with modern EMI receiver • high output power guarantees a good signal-to-noise ratio • the FibreLink X can be used to increase the dynamic range by up to 30 dB • battery powered operation avoids metallic cables in the test volume **Software:** CalStan 10.0, NSA SAC module recommended
Normalized Site Attenuation Measurement, Fully Anechoic Room	**Procedure:** the **RefRad X Field Source** is used as a signal generator and transmit antenna in the normalized site attenuation measurement [1] **Advantages:** • ideal radiation characteristic, no metallic feed cable • high measurement speed with modern EMI receiver • high output power guarantees a good signal-to-noise ratio • the FibreLink X can be used to increase the dynamic range by up to 30 dB **Software:** CalStan 10.0, NSA FAR module recommended
Cable Loss Measurement	**Procedure:** the **RefRad X Comb Generator** with the protective attenuator is used as signal generator. **Advantages:** • convenient measurement of installed cables • high measurement speed with modern EMI receiver **Considerations:** • overload of receiver possible when no attenuator is used **Software:** CalStan 10.0, cable loss module recommended

Application	Description
Field Strength Transfer	**Procedure:** the **RefRad X Field Source** is used as signal generator and transmit antenna to compare the site attenuation of different test site types. The field strength generated is measured on the calibration site (e.g. Open Area Test Site) and then in the GTEM cell. The difference is the calibration factor of the cell. **Advantages:** • calibration of TEM and GTEM cells • no metallic feed cable – no field disturbance • high measurement speed with modern EMI receiver • high output power guarantees a good signal-to-noise ratio • the FibreLink X can be used to increase the dynamic range by up to 30 dB **Considerations:** • overload of receiver possible when no attenuator is used
Shielding Attenuation Measurement	**Procedure:** the **RefRad X Field Source**, **Sync Mode** is used as signal generator and transmit antenna to investigate the shielding attenuation of enclosures. **Advantages:** • optical fibre does not degrade shielding performance • high output power guarantees a good signal-to-noise ratio

3. CONTENT OF SETS

Table 1 shows the three measurement sets and their components.

		RefRad X Set[1]	Field Source Set [2]	Field Source Set, Sync Mode [3]
RefRad X Comb Generator		✓	✓	✓
Charger		✓	✓	✓
Protective Attenuator		✓	✓	✓
Conical Antenna Element			✓	✓
H-Holder			✓	✓
Transport Case			✓	✓
FibreLink X				✓
Optical Fibre Cable and Connector				✓

Table 1: Contents of different RefRad X sets

[1] Set RR 4 in price list
[2] Set RR 5 in price list
[3] Set RR 6 in price list

3.1. Accessories

Table 2 shows the accessories available for the RefRad X and their suitability for the different sets offered.

		RefRad X Set	Field Source Set	Field Source Set, Sync Mode
LISN Coupler		●	●	●
Antenna Coupler		●	●	●
Optical Fibre Cable 30m				●
Software CalStan 10.0		●	●	●

Table 2: Accessories for RefRad X sets

3.2. RefRad X Set (RO 10)

Figure 1: Contents of the RefRad X Set

3.3. Field Source Set (RR 5)

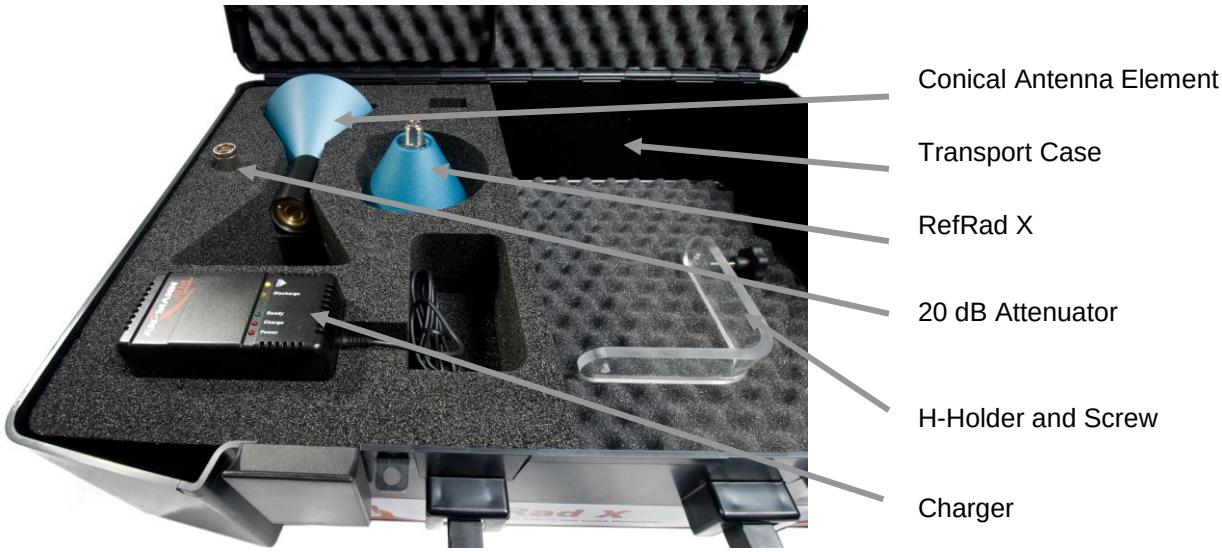

Figure 2: Contents of the Field Source Set

3.4. Field Source Set, Sync Mode (RR 6)

Figure 3: Contents of the Field Source Set, Sync Mode

4. DESCRIPTION OF THE REFRAD X SYSTEM COMPONENTS AND ACCESSORIES

For electromagnetic compatibility (EMC) and electromagnetic field (EMF) testing it is important to validate the radiated and conducted measurements on a regular basis for quality assurance reasons. The modular concept, the selectable line spacing and the ultra-wide frequency range make the RefRad X to a one box solution for much more flexibility in EMC and EMF testing.

RefRad X can be used as a classical comb generator for all kinds of coaxial measurements and measurements with an antenna or LISN coupler (see Chapter 2). With the conical antenna element attached, it transforms into a field source (patented) - an antenna with built-in comb generator (see **Figure 4**)

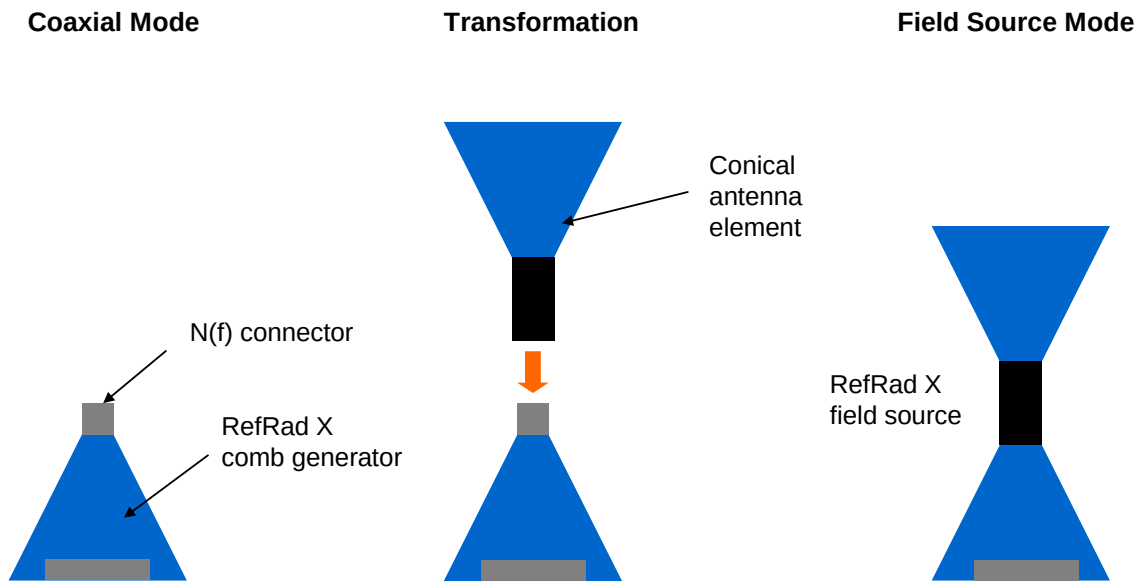

Figure 4: Schematic of the RefRad X comb generator (left) for coaxial measurements via the N-connector and the transformation (centre) to the RefRad X field source (right) using the conical antenna element

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The FibreLink X increases the measurement dynamic (e.g. for shielding efficiency tests) by synchronizing the comb generator with the receiver. See **Figure 5** for a schematic of the test setup.

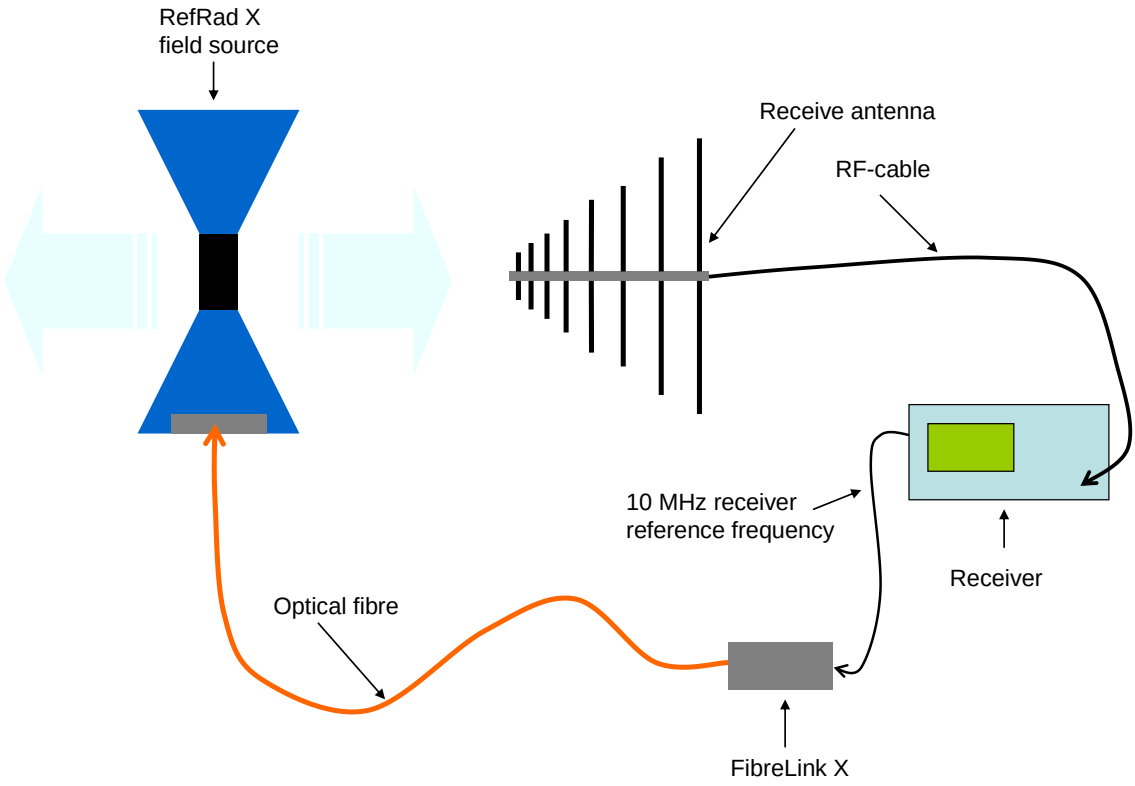


Figure 5: Schematic of the RefRad X operated in field source mode with FibreLink X for Sync Mode measurements

4.1. RefRad X Comb Generator

Figure 6: RefRad X

4.1.1. Description

The comb generator RefRad X (see **Figure 6**) produces pulses with a repetition rate of 100 µs, 1 µs or 200 ns in time domain. These pulses represent a comb spectrum with a line spacing of 10 kHz, 1 MHz or 5 MHz in frequency domain. All frequency lines are present at the same time (see **Figure 7**) therefore no remote control between the comb generator and the receiver is required.

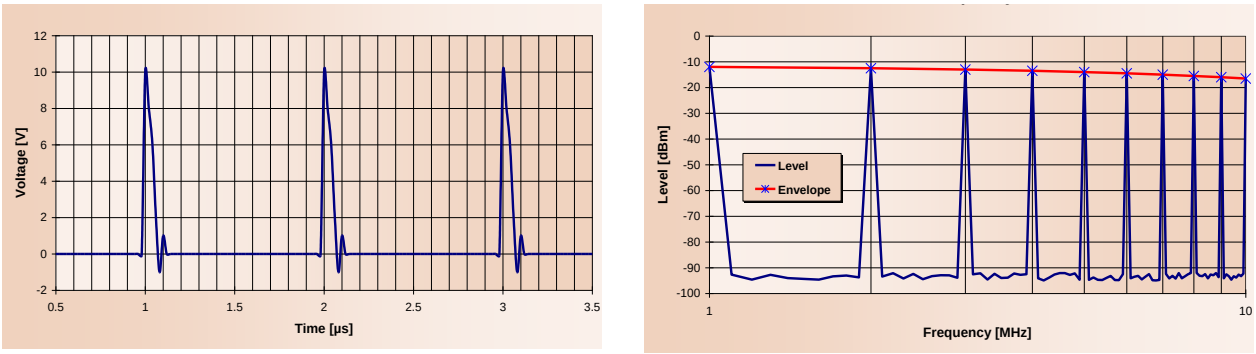


Figure 7: The RefRad X comb generator pulses in time domain (left) and in frequency domain (right), 1 MHz spectrum

Like all comb generators, RefRad X uses a built-in crystal oscillator with limited accuracy. The settings on the measurement instrument (e.g. receiver) have to be made with consideration of this effect by using a proper resolution bandwidth which is larger than the frequency error (e.g. 100 kHz) and as low as possible for getting a good signal-to-noise ratio.

To improve the frequency accuracy, RefRad X is equipped with a synchronisation circuit used to connect an external 10 MHz reference signal via optical fibre: FibreLink X. By synchronizing the RefRad X with the test receiver measurements with the lowest resolution bandwidth, the dynamic range is increased by up to 30 dB. A resistive 50 Ω matching network is provided between the pulse generator and the output for matching purposes.

The RefRad X comb generator is not designed to be operated using the battery charger as a power source.

4.1.2. Technical Specifications

Technical Specifications	
Frequency range	10 kHz – 3 GHz
Frequency spacing	10 kHz, 1 MHz, 5 MHz
Frequency stability (internal)	25 ppm -45°C - +80°C (25 Hz at 1 MHz, 75 kHz at 3 GHz)
Amplitude per line (coaxial)	See **Figure 8**
Amplitude stability	± 0.2 dB, battery voltage cycle ± 0.5 dB, temperature range 0°C - 40°C
Batteries	internal, NiMH (factory serviceable only)
Battery operation time	12 hours (10 kHz), 8 hours (1 MHz), 6 hours (5 MHz)
Low battery warning	Yellow LED - recharge recommended Red LED - recharge
RF-output connector	N-female
Optical input connector	ST-female
Tripod thread	1/4"
Climatic operation conditions	Temperature: 10 – 40 °C Humidity: 30 – 80% avoid humidity and rain
Dimension of RefRad X	134 mm ∅ x 110 mm
Weight of RefRad X	0.955 kg

Table 3: Technical specifications of RefRad X Comb Generator

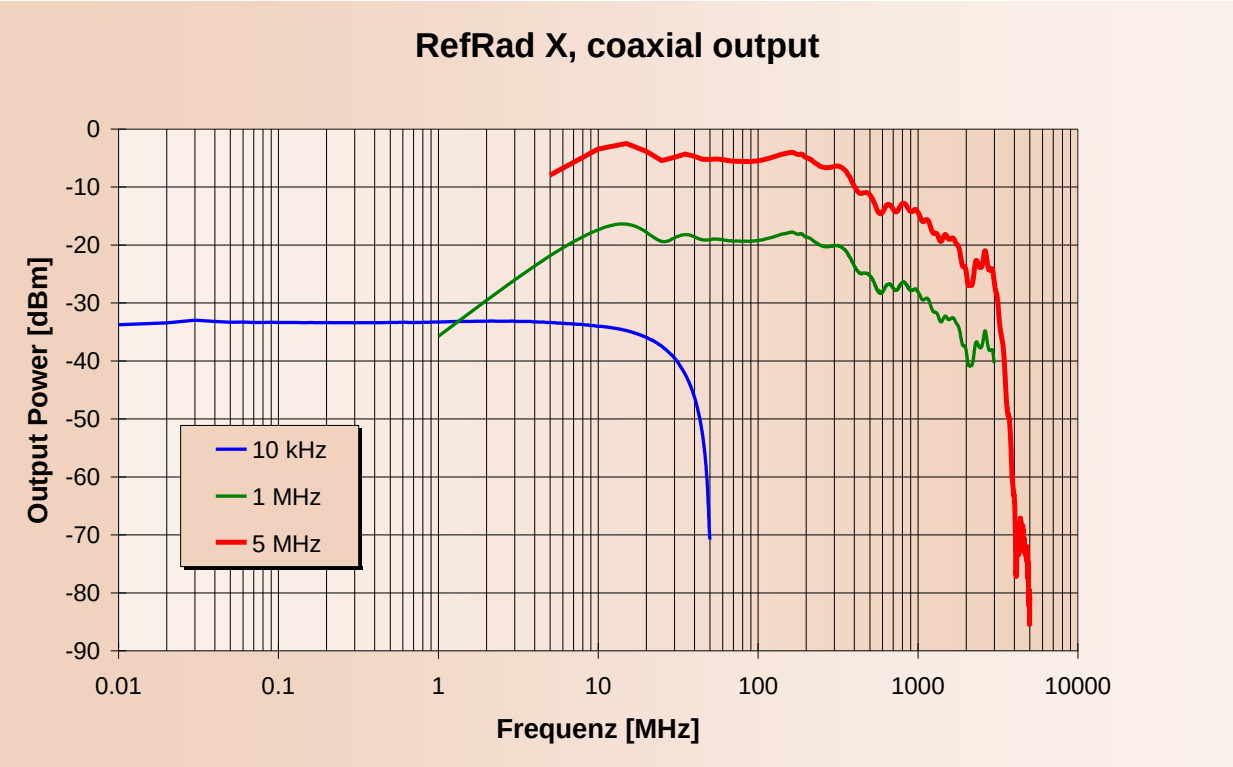


Figure 8: Typical coaxial output for all three line spacings

4.2. Conical Antenna Element

Figure 9: Conical Antenna Element

4.2.1. Description

To operate the RefRad X in field source mode, the conical antenna element (**Figure 9**) must be connected to the coaxial RF-output of the comb generator (see **Figure 10**).

Figure 10: RefRad X in field source mode, mounted on the H-Holder in horizontal polarisation

4.2.2. Technical Specifications

Technical Specifications	
Frequency range	30 MHz – 1 GHz
Field strength	See **Figure 11** to **Figure 12**
Radiation pattern	See **Figure 13**
Dimension of RefRad X with conical antenna element	134 mm ∅ x 255 mm
Weight of RefRad X with conical antenna element	1.405 kg

Table 4: Technical specifications of the conical antenna element

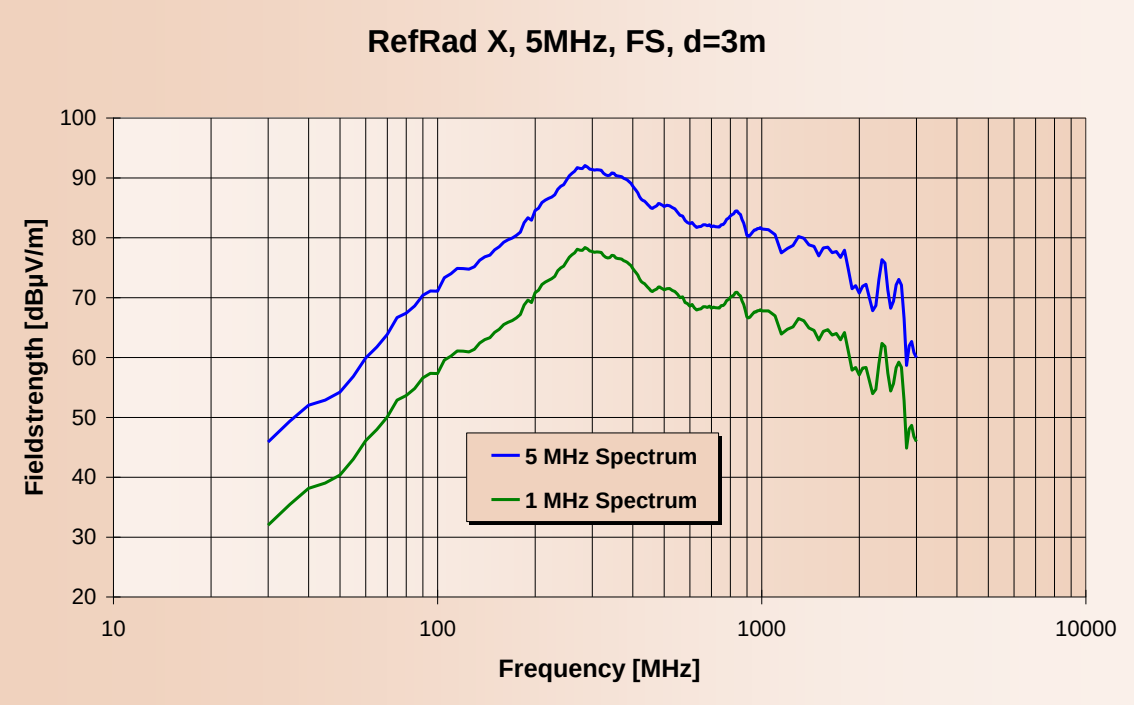


Figure 11: Typical field strength measured in free space
1 and 5 MHz line spacing in 3 m distance

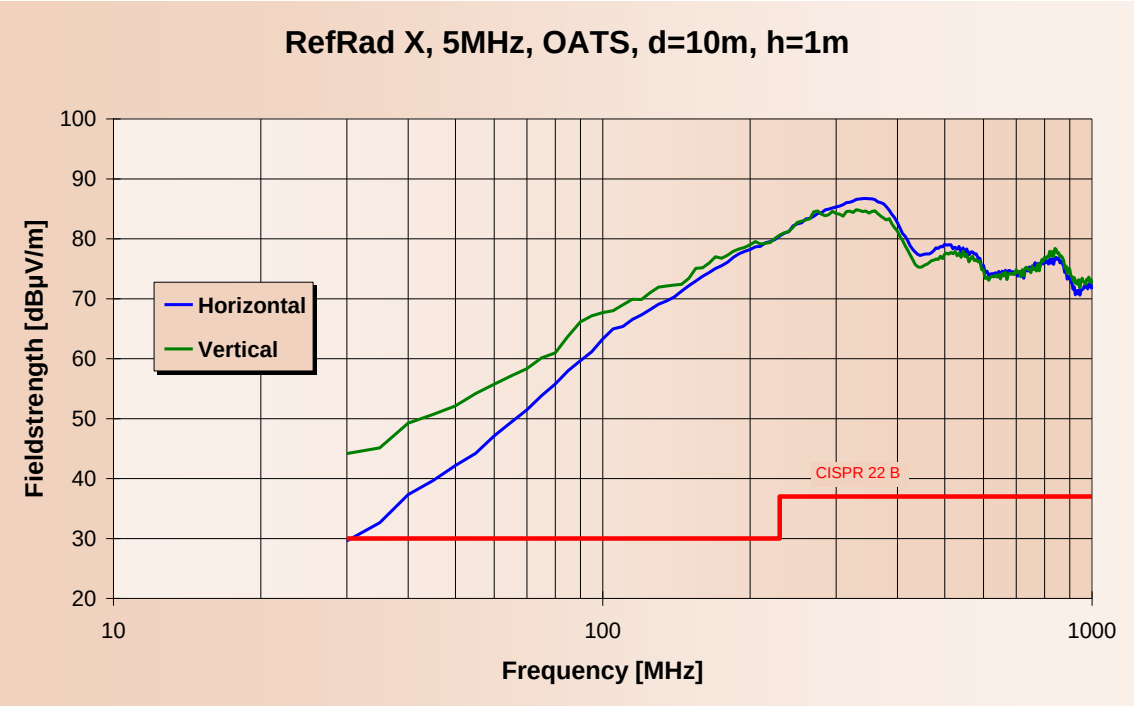


Figure 12: Typical field strength measured above groundplane
5 MHz line spacing in 10 m distance, horizontal land vertical polarization

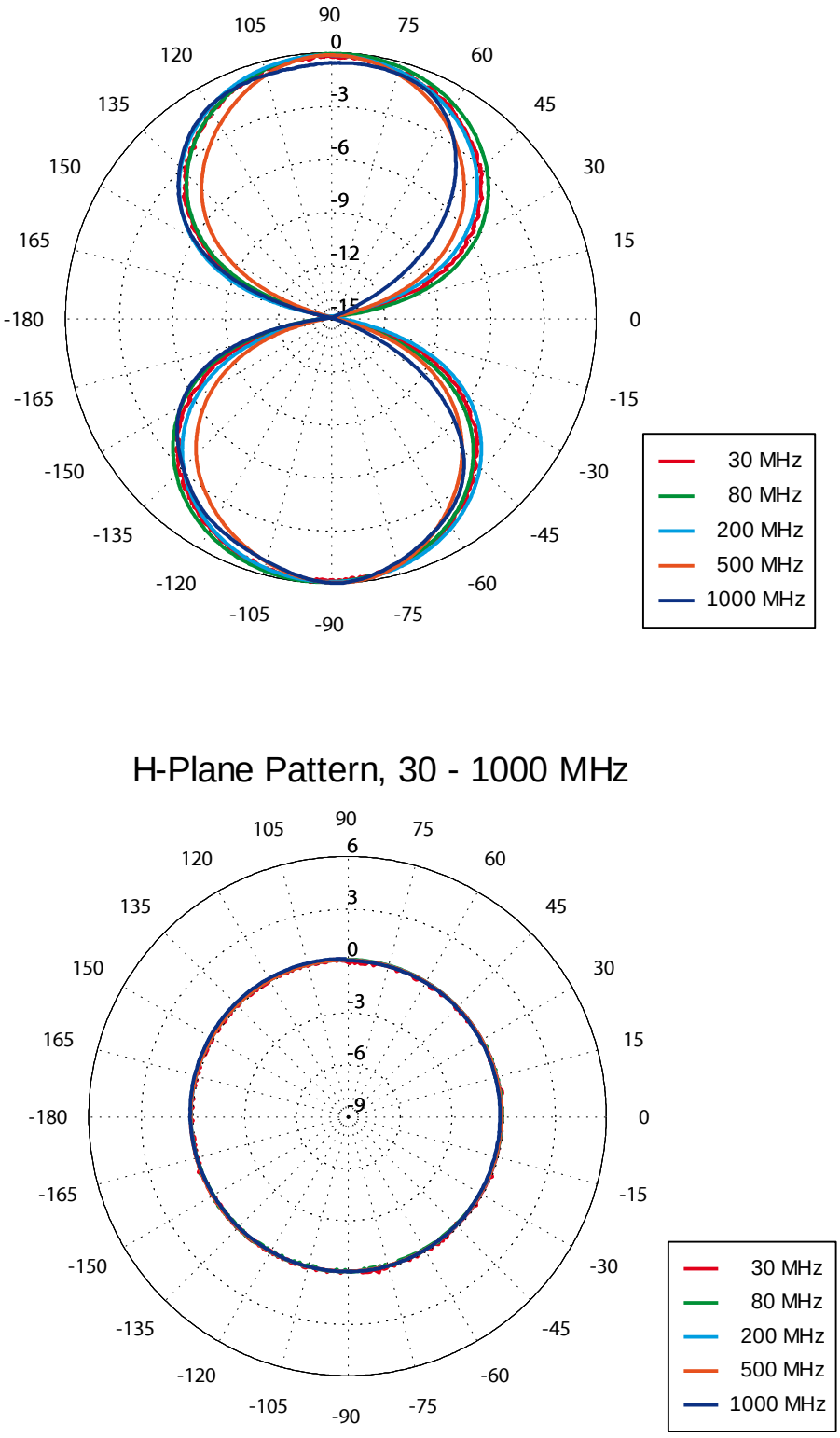


Figure 13: Typical radiation pattern in E- and H- plane

4.3. FibreLink X

Figure 14: FibreLink X:
Left: on / off switch with status LEDs for operation and optical output
Right: BNC connector for reference frequency input and charge connector

4.3.1. Description

The FibreLink X is used for synchronisation of the RefRad X with an external 10 MHz reference frequency signal via optical fibre. Due to the external synchronisation, a much smaller resolution bandwidth can be adjusted and therefore a much higher dynamic range is achievable. The outcome is better performance in measuring signals near the noise level.

The 10 MHz reference frequency signal of the test receiver (or spectrum analyzer) is connected via coaxial cable (BNC connector) to the FibreLink X. With the optical fibre the reference signal is sent to the RefRad X. The green “Sync.-LED” indicates the proper synchronisation. The delivered connector allows the coupling of two cables through the filter panels.

The FibreLink can be operated connected to the charger.

4.3.2. Technical Specifications

Technical Specifications	
Input connector	BNC-female
Optical output connector	ST-female
Input signal	sinusoidal, > 1 Vpp @ 50Ω, 10 MHz rectangular, > 500 mVpp @ 50Ω, 10 MHz
Optical fibre length	max. 50m and 2 optical connectors
Batteries	internal, NiMH (9V)
Battery operation time	5 hours
Low battery warning	Yellow LED - recharge recommended Red LED - recharge
Dimensions	120 x 40 x 25 mm
Weight	0.15 kg

Table 5: Technical specifications of the FibreLink X

4.4. Optic Fibres and Connector

Figure 15: Optic Fibre and Connector

4.4.1. Description

Two optical fibres can be coupled with the delivered connector. This connector can be used for assembly in a filter panel (e.g. of an anechoic room).

4.4.2. Technical Specifications

Technical Specifications	
Fibre type	200/230µ
Connectors	ST-male
Length	5 m, 10 m, 30 m

Table 6: Technical specifications of the optical fibre

4.5. H-Holder

Figure 16: H-Holder

4.5.1. Description

The H-Holder (see **Figure 16**) is used for mounting the RefRad X in horizontal orientation onto a tripod or stand. **Figure 17** shows the proper mounting.

Note that one hole has a thread (to be mounted on the stand) and the other hole has no thread (use the enclosed screw to fix onto the RefRad X).

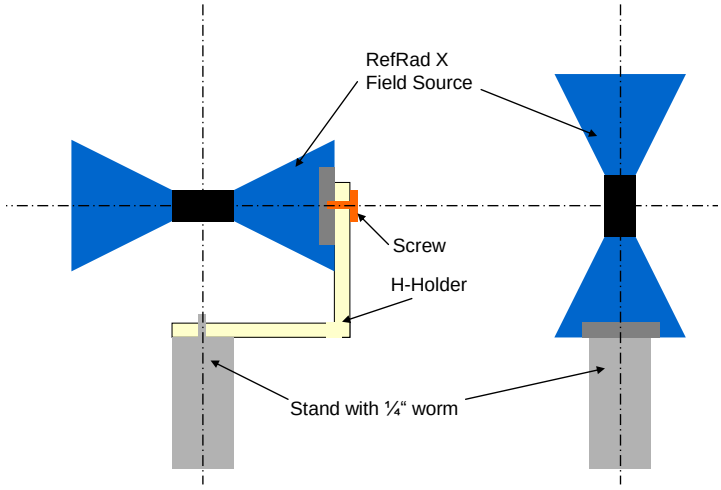


Figure 17: Mounting the RefRad X in horizontal polarization (left) and vertical polarization (right)

4.5.2. Technical Specifications

Technical Specifications	
Material	Plexiglass®
Dimensions	144.5 x 144.5 x 36 mm
Weight	0.13 kg
Max load	2.5 kg
Screw	¼” x 15 mm

Table 7: Technical specifications of the H-holder

4.6. Charger

Figure 18: Charger

4.6.1. Description

The built-in batteries of the RefRad X and the FibreLink X are charged with the enclosed Ansmann ACS 110 Traveller charger. Due to the switch mode power supply and an exchangeable primary plug set, worldwide use is possible. When charging is completed the charger automatically switches over to trickle charge. Please follow the instructions of the enclosed original manual of the charger.

4.6.2. Technical Specifications

Technical Specifications	
Input voltage	110...240 VAC @ 50...60 Hz
Connection on the primary side	Euro, US, J, Australia primary adapters
Connection on the secondary side	coaxial plug, positive inner
Output	1.45 – 14.5 V DC, max 800 mA, 9.6 VA
Dimensions	118 x 62 x 48 mm
Weight	280 g

Table 8: Technical specifications of the charger

4.7. Protective Attenuator

Figure 19: Protective Attenuator

4.7.1. Description

An attenuator is delivered together with the RefRad X for conducted measurements to protect the measurement instruments (receiver or spectrum analyzer) from overload and damage. The attenuator has to be connected between the output of the RefRad X and the input of the measurement instrument.

4.7.2. Technical Specifications

Technical Specifications	
Nominal attenuation	20 dB
Frequency range	DC – 12 GHz
Max. power	2 W
Connector type	N-Type

Table 9: Technical specifications of the Protective Attenuator

4.8. Transport Case

Figure 20: Transport Case

4.8.1. Description

A transport case is available for safe storage and transportation of the RefRad X and all its available accessories.

4.8.2. Technical Specifications

Technical Specifications	
Dimensions of transport case	65 x 47 x 22 cm
Weight of empty case	4.805 kg
Weight of complete sets	Field Source Set: 6.8 kg Field Source Set, Sync Mode: 7.5 kg

Table 10: Technical specifications of the Transport Case

4.9. LISN Coupler

Figure 21: 3 LISN Coupler: AC230V (Europe), AC400V(16A) and 32A plug, DC BNC

4.9.1. Description

The LISN coupler is used for a check of conducted emission test setup using the RefRad X comb generator (10 kHz spectrum). The LISN coupler feeds the RF-signal from the RefRad X into the LISN in a well-defined way (see **Figure 22**). Individual couplers for each LISN type are available (DC LISN coupler, 2-phase LISN coupler and 3-phase LISN coupler).

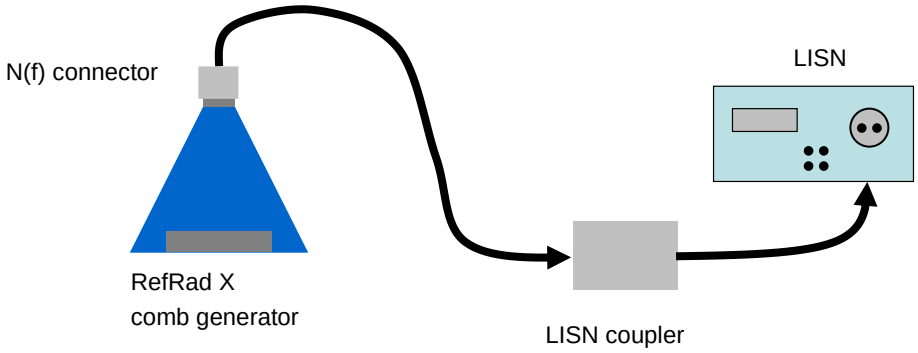


Figure 22: Schematic of the RefRad X connected via a LISN coupler to a LISN.

4.9.2. Technical Specifications

Technical Specifications	
Available types	230V, European plug 400V, Multiphase plug DC, BNC plug
RF connector	BNC-female
Length of cable	10 cm (230V) 20 cm (400V)
Dimensions	100 x 40 x 25 mm (DC) 120 x 105 x 34 mm (230V, 400V)
Weight	~ 0.3 kg

Table 11: Technical specifications of the LISN Coupler

WARNING !

LISN Coupler works with high electrical voltage, therefore **NEVER** use a damaged Coupler. For your personal protection you have to check the electrical safety in regular intervals in accordance with relevant applicable regulations.

You Coupler is supplied with power from the LISN, which is used on a residual-current circuit-breaker free electrical circuit, so check protective earth before mains connection.

4.10. Antenna Coupler

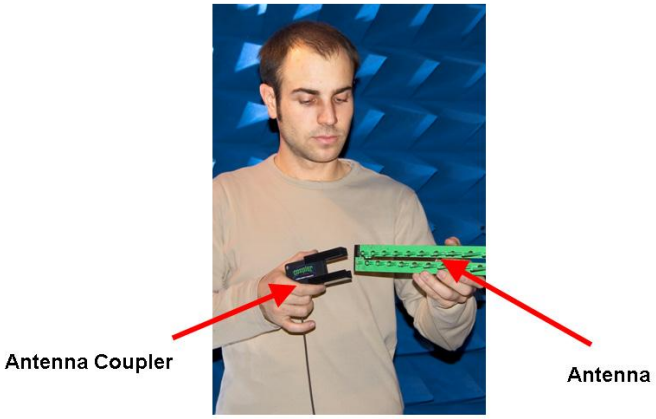


Figure 23: Antenna Coupler is mounted on a BiLog antenna

4.10.1. Description

The Antenna Coupler consists of a very small balanced dipole antenna completely protected in a plastic covering which is mounted directly on the EMF/EMC receive antenna. The critical positioning is done via the shape of the covering with accuracy better than a few tenth of a millimetre. Individual couplers for various antenna types are available.

4.10.2. Technical Specifications

Technical Specifications	
Coupling element	Balanced Dipole
Connection cable	1.5 m coaxial cable with N-Type male connector
CU 8250 Type	
Suitable for	PCD 8250, PCD 3100 from Seibersdorf Laboratories
Frequency range	30 MHz – 3 GHz
CU 6112 Type	
Suitable for	BiLog CBL 6112A from Schaffner Chase
Frequency range	30 MHz – 2 GHz

Table 12: Technical specifications of the Antenna Coupler

4.11. Software CalStan 10.0

4.11.1. Description

CalStan 10.0 is a software tool for automation of radio frequency (RF) calibrations and measurements. The software controls the instruments via GPIB bus, reads the measurement values and computes the results. The purpose of the software is to perform calibrations and validations of equipment, such as antennas, cables, test sites and test setups. Every measurement type is implemented as a plug-in to the base application.

Check at www.seibersdorf-rf.com/calstan for the latest version, the CalStan manual and the list of supported instruments.

4.11.2. Technical Specifications

Technical Specifications	
CalStan modules	Core application (always necessary) Site VSWR Measurement NSA Measurement in semi anechoic chambers NSA Measurement in fully anechoic rooms Cable Loss Experimental Measurement
Supported applications	Normalized site attenuation Chamber factor Cable loss Field strength transfer
Operating systems	Windows XP Windows Vista
Minimum computer requirements	1500 MHz CPU 256 MB RAM 50 MB HDD
Additional hardware	National Instruments GPIB card
Installed software	.NET framework version 3.5 (or higher) National Instruments Runtime

Table 13: Technical specifications of the software CalStan10.0

5. OPERATION AND APPLICATION

A properly charged RefRad X comb generator is required for all measurements. The colour of the operation LED is green when the battery voltage is OK and red when the voltage is low. Do not use the comb generator when the operation LED is red. In this case re-charge the comb generator immediately. The Yellow LED indicates that the RefRad X should be recharged soon.

It is recommended that the measurement in the frequency domain is done with the same frequency of the selected spectrum (or with multiples of the selected spectrum) so that only the relevant signal information (power level, voltage, field strength) is shown as the upper envelope curve (see **Figure 24)**. Comparing the noise signal in between the frequency lines is irrelevant.

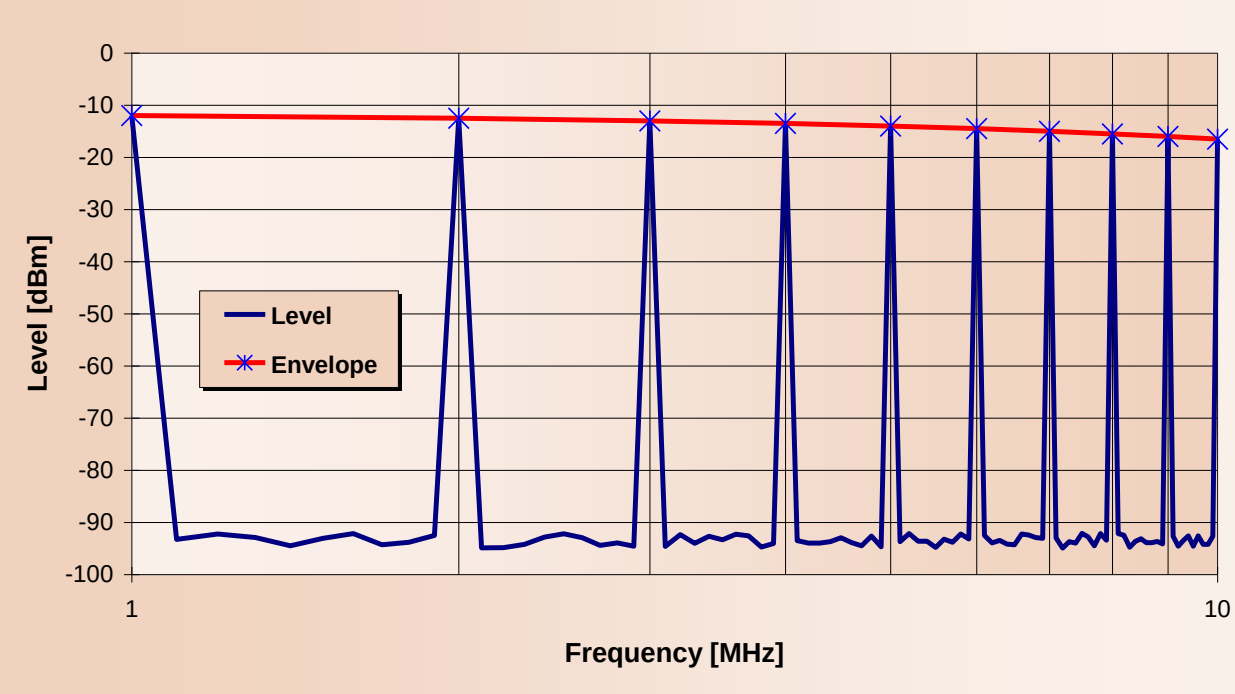


Figure 24: Measurement example of the 1 MHz spectrum
the receiver should take the level reading in 1MHz (or multiple) steps

The bandwidth of the generated spectral lines is very small so that the resolution bandwidth (RBW) of the receiver has no influence on the measured amplitude as long as it covers one and ONLY one line: due to the limited frequency accuracy of the built-in crystal oscillator - a 10 MHz, 25 ppm crystals 300th harmonics at 3 GHz has 75 kHz frequency accuracy - the RBW must be set large enough to cover one line and it must be set to less than 50% of the line spacing to cover only one line. Typical measurement bandwidths are 100 kHz for the 1 MHz and 5 MHz spectrum. For measurement bandwidth as low as 10 Hz a synchronisation via FibreLink X is required.

The FibreLink X is for synchronisation of the RefRad X with an external 10 MHz reference frequency signal via optical fibre. Due to the external synchronisation a much smaller resolution bandwidth can be adjusted and therefore a much higher dynamic range is achievable. A better performance for measuring signals near the noise level is the outcome. The green “Sync.-LED” indicates the proper synchronisation. If the “Sync.-LED” will not illuminate please check that the optical repeater is switched on, the batteries are fully charged, the 10 MHz reference frequency signal of the receiver is present (may need to be switched on) and that all connectors and cables are working.

Once the battery power decreases the LED indication is the same as for the RefRad X.

ATTENTION !

For coaxial measurements make sure to use the protective attenuator as the peak output voltage of the comb generator may exceed the allowed receivers input voltage and the broadband comb spectrum may overload the mixer.

When operating the RefRad X in Field Source mode special care must be taken not to disturb the environment (e.g. by operating it in anechoic chambers, GTEM cells and not in the unshielded laboratory).

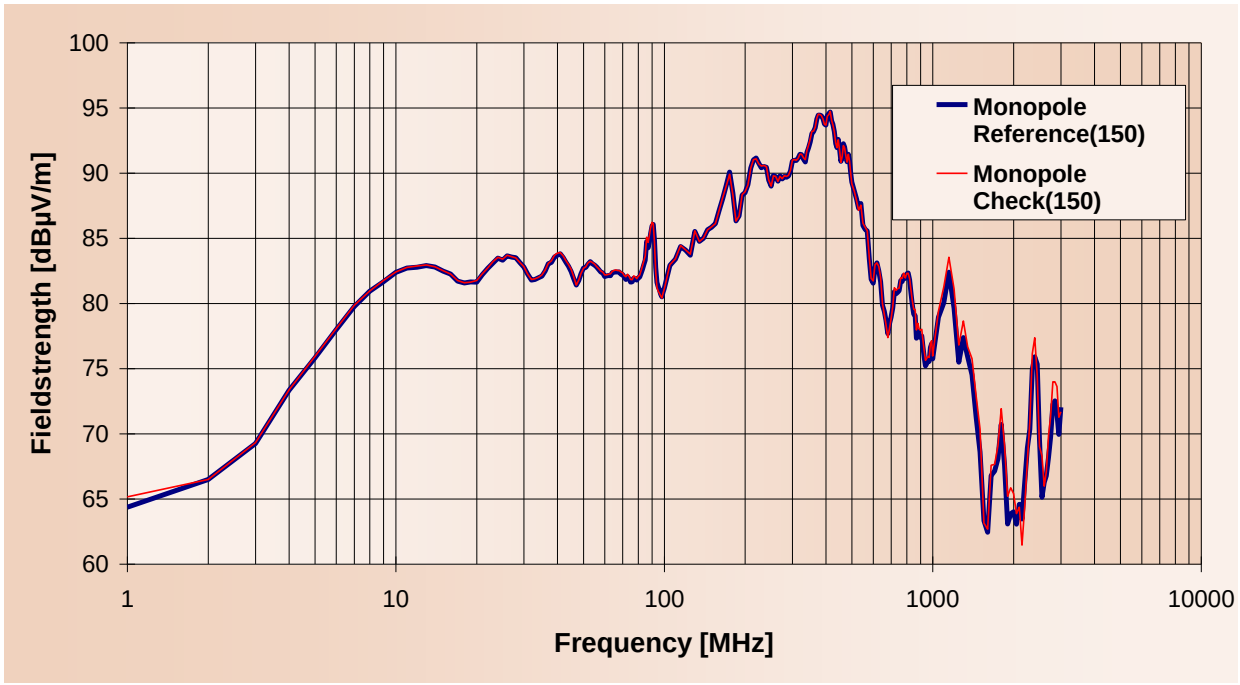
5.1. System Check with Radiated Field

The system check with the radiated field is easy and convenient but not always reliable. Due to the distance of several wavelengths between EMF measurement antenna and the field source, reflections from surrounding objects influence the result. The positioning of the source is a critical parameter. For EMC measurements a high quality functional check is possible if the test site is empty and the positioning is done very precisely. Otherwise just a signal/no signal decision should be made.

Some defects of the measurement system (e.g. broken connection between antenna element and balun) cause such a strong imbalance in the antenna system that the receive cable acts as part of the antenna. In this case the measured field strength can be higher in some frequency ranges. Therefore it is not possible to guarantee reliable identification of broken equipment using this method.

In **Figure 25** the results of two system checks with the field source in a distance of 15 cm from the receive antenna are shown. The upper graph shows the reference trace and the result of a check where the system worked well. A good match of the traces is only possible when the positioning is done extremely carefully. The lower graph shows the result of a system check when there was a problem. The receiving antenna was damaged by an intentionally broken soldering of an internal connection to the conical element. It is apparent that the received signal is different (sometimes lower, sometimes higher) than the reference signal. Therefore detection of a failure can be difficult if a limited frequency range is only investigated (e.g. GSM 900).

a)



b)

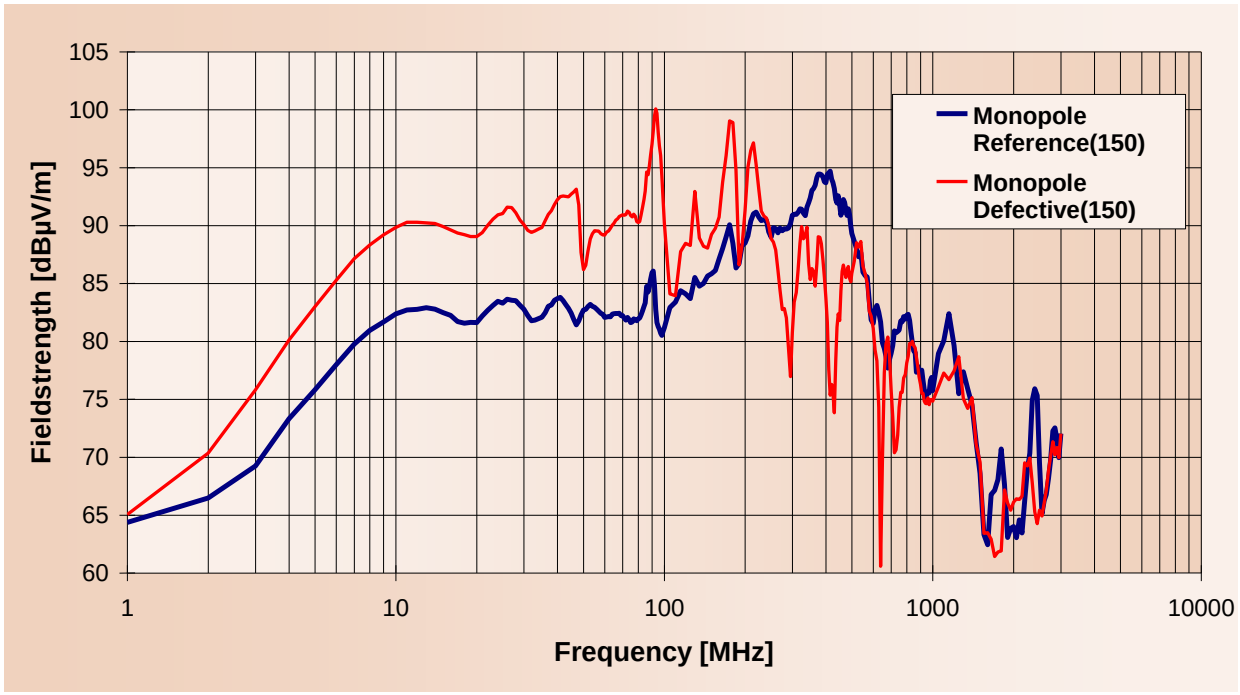


Figure 25: Functional check with the field source positioned 150 mm in front of the PCD 8250 antenna, showing (a) a well working and (b) a defective system

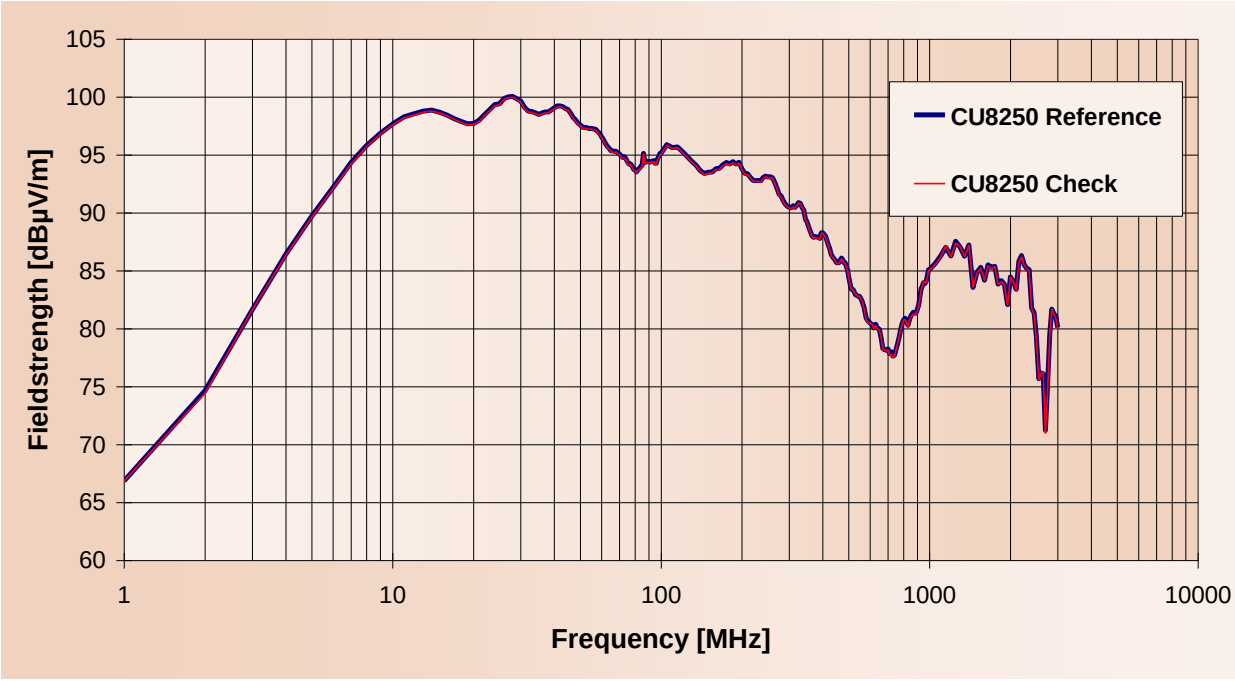
5.2. System Check with Antenna Coupler

To overcome the disadvantages of the system check with the radiated field a dedicated antenna coupler can be used. It consists of a very small balanced dipole antenna completely protected in a plastic covering which is mounted directly on the EMF/EMC receive antenna. The critical positioning is done via the shape of the covering with accuracy better than a few tenth of a millimetre. Due to the close proximity of transmit and receive antenna the system becomes insensitive to the environment which is a further advantage of the antenna coupler. The system check can be done very precisely even with the EUT set up in the EMC test chamber.

In **Figure 26** the results of two EMF system checks with the antenna coupler are shown. The upper graph shows the reference trace and the result of a check where the system worked well. The precise positioning of the antenna coupler and its close proximity are the main reasons for the perfect match of the traces - beside a good working EMF measurement system of course. The lower graph shows the result of a system check when a problem occurs. The receive antenna was damaged by breaking the soldering of an internal connection to the conical element. It is obvious that the received signal is lower over the whole frequency range and therefore an easy and safe detection of a failure is possible.

In **Figure 27** the results of several EMC system checks with the antenna coupler show the difference between reference and check-measurement. The upper graph shows the result of a check where the system also worked well with EUT present in 1 m distance from the antenna. In the lower graph the result of a system check with several typical antenna problems is shown. It is apparent that the received signal has changed by more than 3 dB because of the problems.

a)



b)

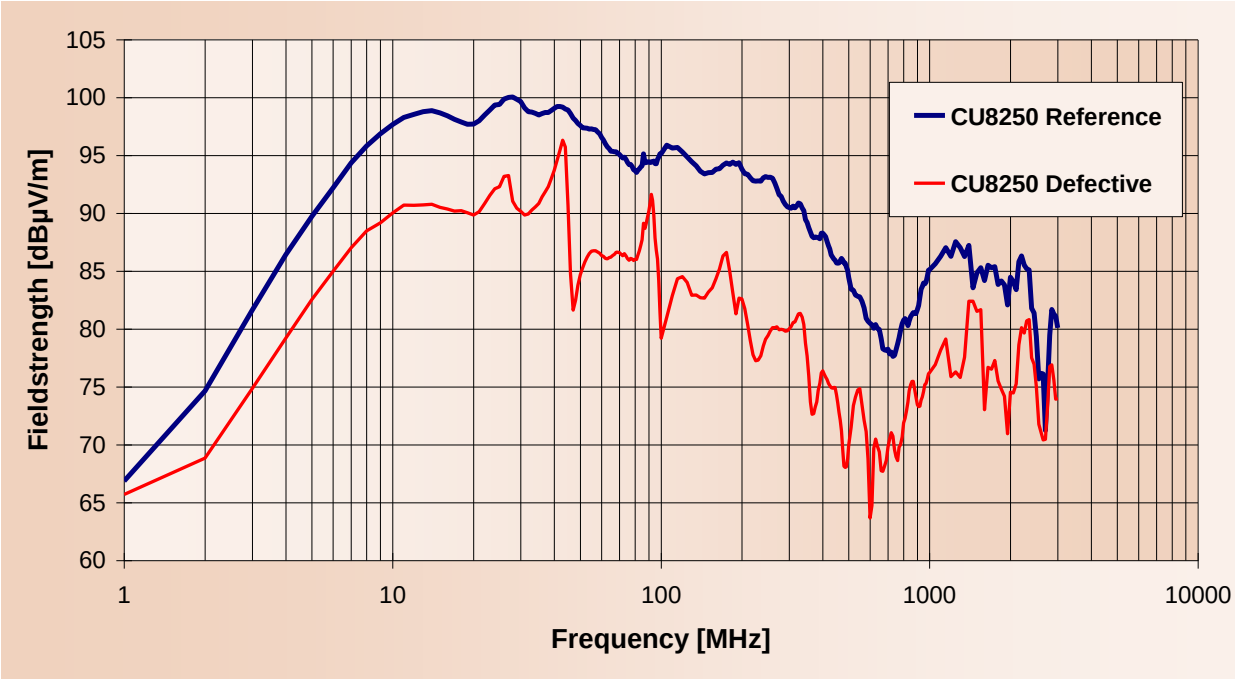
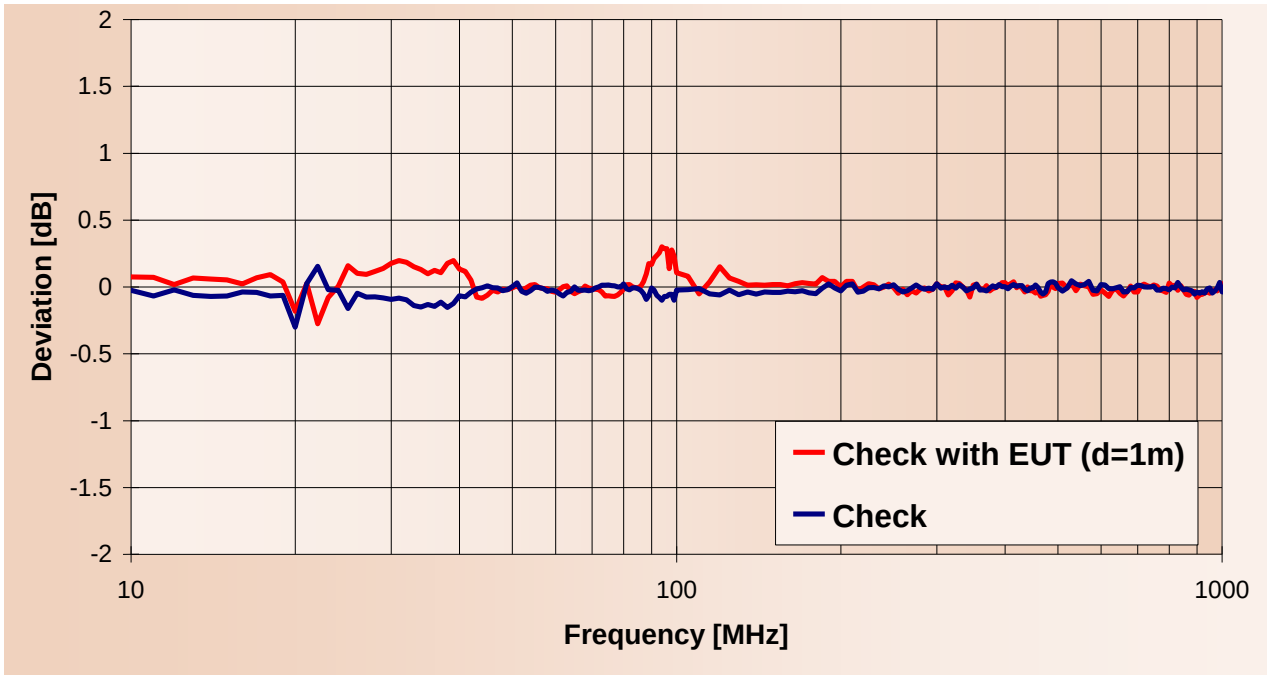


Figure 26: System check using the CU8250 antenna coupler on the PCD 8250 antenna showing (a) a well working and (b) a defective system

a)



b)

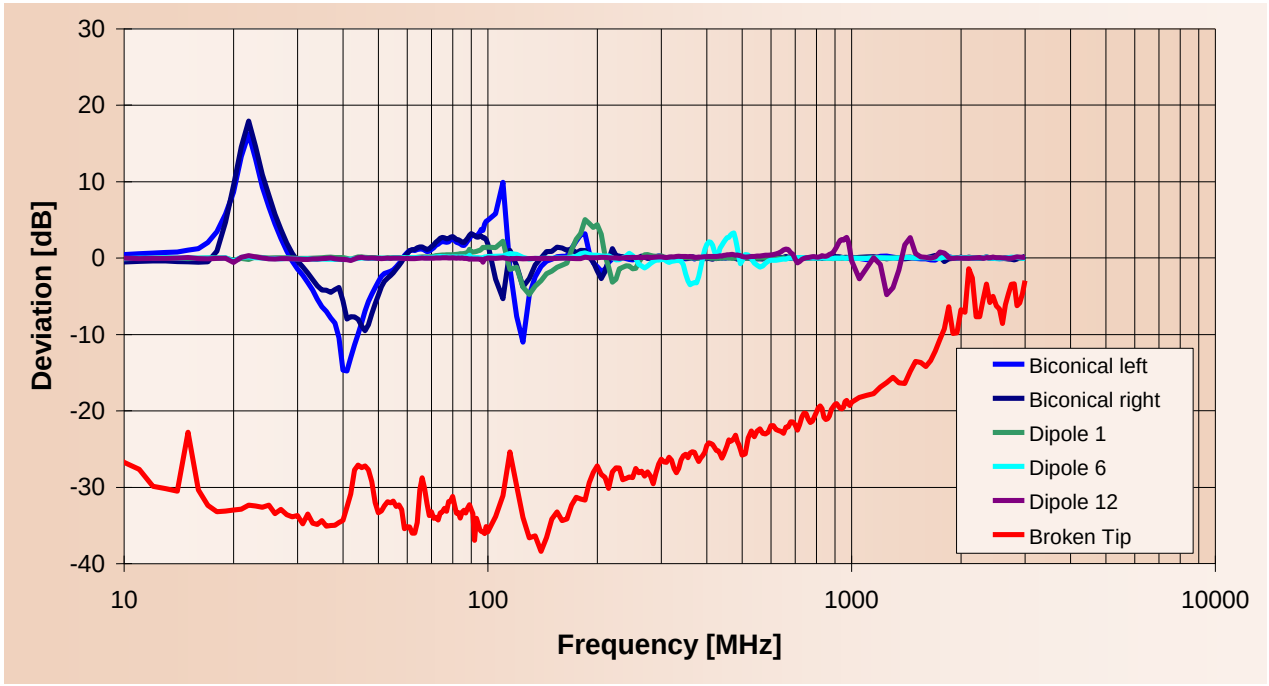


Figure 27: Results of a system check (difference between reference and check measurement) using the CU6112 antenna coupler on the bilog antenna CBL6112A, showing (a) a well working and (b) a defective system

5.3. Coaxial System Check

The coaxial system check is used to distinguish the source of error. To perform this check a prior reference measurement is required. This should be done by connecting the RefRad X comb generator via the protective attenuator to the receive cable.

If the system check with the antenna coupler shows a deviation above the quality threshold the coaxial system check helps to identify the source of the problem. In case of a similar deviation the antenna is not responsible for the problem. The problem could be caused by the cable, the receiver or the comb generator. If the result of the coaxial check is within the specifications it is very likely that the antenna is the source of the deviations.

In **Figure 28** the results of a coaxial system check are shown. For the system check measurement a damaged coaxial adapter was used. The received signal at 1600 MHz is lower, an indication for failure. These kinds of failures can be very narrowband and therefore it is recommended to use a fine frequency resolution (e.g. 1 MHz) for the test.

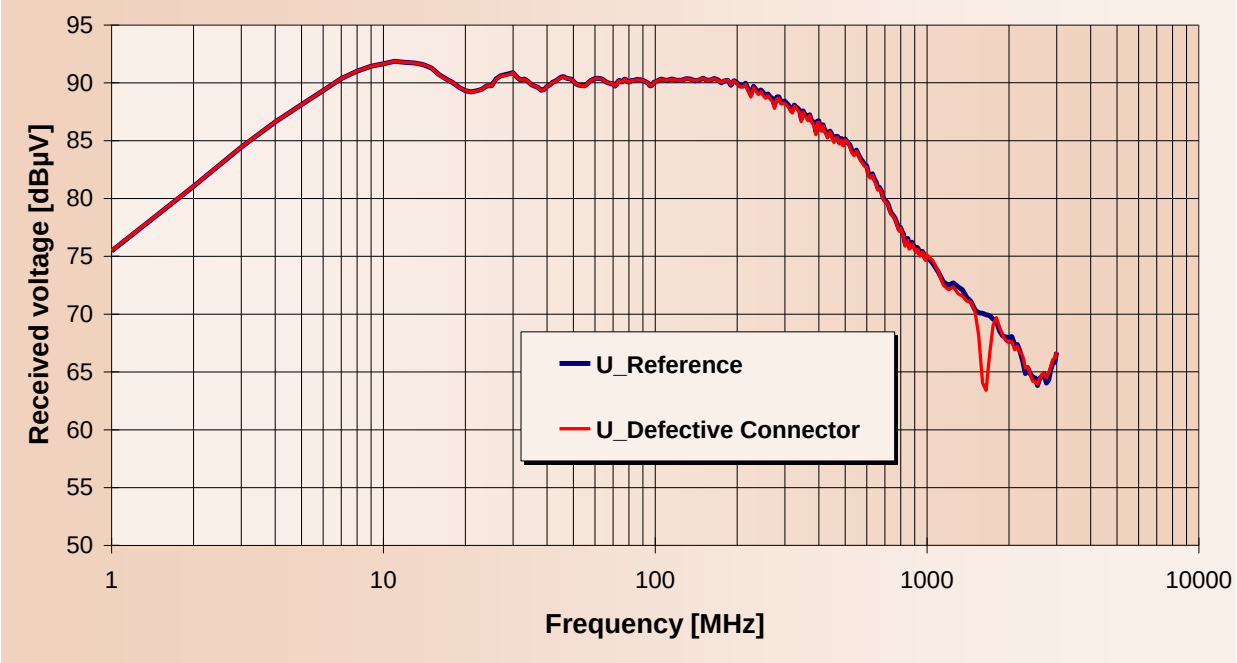


Figure 28: Coaxial System check showing a defective connector

6. ADDITIONAL EQUIPMENT

6.1. FibreSync X

Figure 29: FibreSync X
Left: on / off switch with status LEDs for operation and optical input
Right: BNC connector for reference frequency input and charge connector

6.1.1. Description

The FibreSync X can be used in combination with the FibreLink X (part of RefRadX Field Source Set, Sync Mode) for fibre optical transmission of a 10 MHz reference frequency signal to an optical signal transferred via an optical fibre. Using the FibreLink X as transmitter, converting the 10 MHz reference frequency signal from an e.g. test receiver, the FibreSync X acts as the receiving counterpart converting back the received optical signal to electrical.

The 10 MHz reference frequency signal of the test receiver (or spectrum analyzer) is connected via coaxial cable (BNC connector) to the FibreLink X. With the optical fibre the reference frequency signal is sent to the FibreSync X with the e.g. signal generator connected via coaxial cable (BNC connector). The green “Sync.-LED” indicates the proper synchronisation.

The FibreLink & Sync can be operated via internal NiMH batteries (~ 5h) or connected to the charger (same as for RefRadX and FibreLink; optional). A schematic of a principal set up is shown in **Figure 30**.

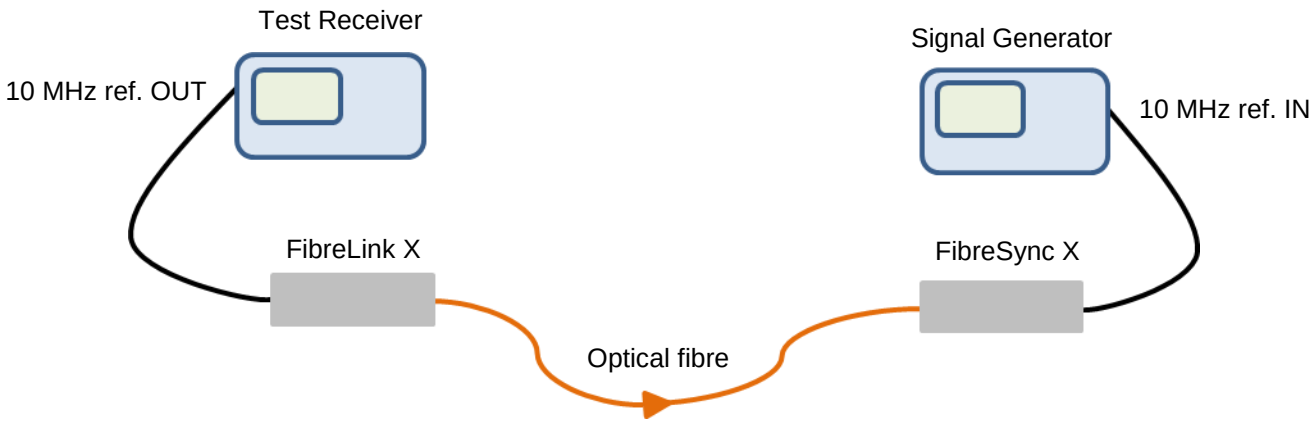


Figure 30: Schematic of the FibreLink X and FibreSync X connected to a test receiver and a signal generator.

6.1.2. Technical Specifications

Technical Specifications	
Output connector	BNC-female
Optical input connector	ST-female (SMA-female – optional)
Output signal	rectangular, ~1.4 Vpp @ 50Ω, 10 MHz
Optical fibre length	max. 50m and 2 optical connectors
Batteries	internal, NiMH (9V)
Battery operation time	5 hours
Low battery warning	Yellow LED - recharge recommended Red LED - recharge
Synchronisation	Green LED
Dimensions	120 x 40 x 25 mm
Weight	0.15 kg

Table 14: Technical specifications of the FibreSync X

7. LITERATURE AND INFORMATION

[1] CISPR 16-1-4 Consol. Ed. 2.1-2008 & am2 Ed.2.0: “Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-4: Radio disturbance and immunity measuring apparatus – Ancillary equipment - Radiated disturbances”, 2008-01

[2] ANSI C63.4-2003: “American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz”, 2004-01

[3] CalStan 10.0 Manual, www.seibersdorf-rf.com/calstan

[4] W. Müllner, A. Kriz, H. Haider, G. Kolb: „Conducted and Radiated Comb Generator Measurement Techniques”, 7-th International Symposium on Electromagnetic Compatibility and Electromagnetic Ecology, June 26-29, Saint-Petersburg

[5] Alexander Kriz, Wolfgang Müllner: „Validierung von EMV Emissionsmessplätzen im Frequenzbereich 1 GHz bis 18 GHz nach dem Site VSWR Verfahren“, e&i, ÖVE Verbandszeitschrift, Heft 1-2.2006

8. FIGURES

9. TABLES

ANNEX I. WARRANTY

Seibersdorf Labor GmbH, hereinafter referred to as the Seller, warrants that standard Seibersdorf Laboratories products are free from defect in materials and workmanship for a period of two (2) years from the date of shipment.

Standard Seibersdorf Laboratories products include the following:

- Antennas
- Cables
- Reference Radiators
- Software
- Antenna stands and positioners

If the Buyer notifies the Seller of a defect within the warranty period, the Seller will, at the Seller's option, either repair and/or replace products which prove to be defective during the warranty period.
There will be no charge for warranty services performed at the location the Seller designates. The Buyer must, however, prepay inbound shipping costs and any duties or taxes. The Seller will pay outbound shipping cost for a carrier of the Seller's choice, exclusive of any duties or taxes.

This warranty does not apply to:

- Normal wear and tear of materials
- Consumable items such as fuses, batteries, etc.
- Products that have been improperly installed, maintained or used
- Products which have been operated outside the specifications
- Products which have been modified without authorization
- Calibration of products, unless necessitated by defects

THIS WARRANTY IS EXCLUSIVE. NO OTHER WARRANTY, WRITTEN OR ORAL, IS EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE REMEDIES PROVIDED BY THIS WARRANTY ARE THE BUYER'S SOLE AND EXCLUSIVE REMEDIES. IN NO EVENT IS THE SELLER LIABLE FOR ANY DAMAGES WHATSOEVER, INCLUDING BUT NOT LIMITED TO, DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

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