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Anechoic chamber registration No.: 3463 (IC)

TCB ID: DE0001



Accredited by the
German Accreditation Council
DAR-Registration Number

TTI-P-G 081/94-D0



Independent ETSI
compliance test house



Test report No.: **2-3493-01-03/03**

Applicant : ENRAF B.V.

Type : Model 970 SmartRadar ATi

FCC ID : LOM970SR

Test standard : FCC Part 15

IC RSS 210 Issue 5

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1 **General information**

1.1 **Notes**

The test results of this test report relate exclusively to the test item specified in 1.5. CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalisations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item .

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Tester :

Date	Name	Signature
31.08.04	Detlev Gillmann	

Technical responsibility for area of testing:

Date	Name	Signature
31.08.04	Manfred Paschwitz	

1.2 Testing laboratory

CETECOM ICT Services GmbH	CETECOM ICT Services GmbH
Untertürkheimerstraße 6–10	P.O. Box 10 04 45
D-66117 Saarbrücken	D-66004 Saarbrücken
Germany	Germany

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Fax : + 49 (0) 681 598–9075
e-mail : info@ict.cetecom.de
Internet : <http://www.cetecom.de>

Accredited testing laboratory

Accredited by : Regulierungsbehörde für Telekommunikation und Post (RegTP)
Listed by : Federal Communications Commission (FCC)
Industry Canada (IC)

Authority	Identification/Registration No.
RegTP	TTI-P-G 081/94-D0
FCC	90462
IC	3463

Testing location, if different from CETECOM ICT Services GmbH: (Not applicable)

1.3 Details of applicant

Name : ENRAF B.V.
Street : Delftechpark 39
Town : NL-2628 XJ Delft
Country : Netherlands
Telephone : +31 15 2701 187
Fax : +31 15 2701 197
e-mail : wvelling@enraf.nl

Contact person

Name : Mr. Willem Velling
Telephone : +31 15 2701 187
Fax : +31 15 2701 197

1.4 Application details

Date of application : 31.08.2004
Date of receipt of EUT : 31.08.2004
Date of test : 31.08.2004

1.5 Equipment under test (EUT)

Description of EUT : Microwave field disturbance sensor mounted inside metal tanks
System designation : Level measurement equipment
Type designation : Model 970 SmartRadar ATi
Manufacturer : ENRAF B.V.
Delftechpark 39
NL-2628 XJ Delft
Netherlands

1.6 Technical data

Frequency range : 9.500 000 GHz 10.600 000 GHz
Operational frequency : 9.526 170 GHz 10.568 330 GHz
Type of modulation : 1G10F1N (FMCW)
Antenna (measurement) : Fixed flat plate antenna as an integral part of the equipment flange
Normal AC power supply : 115.0 V
Extreme AC power supply : 85.0 to 264.0 V
Variant
Normal DC power supply : 40.0 V
Extreme DC power supply : 18.0 to 72.0 V

1.6.1 Operation conditions

Operation: : As soon as the equipment is powered up, TX and RX start operation
Purpose of operation : Distance measurement inside metal tanks

1.6.2 Test item

ENRAF Model 970 SmartRadar ATi P/N Proto 2 S/N 000

The ENRAF Model 970 SmartRadar ATi can be equipped with DC power supply. AC or DC power supply have no effects on the tested RF parameters.

Electronic Boards

The unit is equipped with
Print ICU
Print ICU-RS232/485 (option)
ICU-GPS 85-264 or
ICU-GPS 85-264 or
ICU-GPS 18-72
Print RFB3-DAB
ICU HPI Hart1/Hart2/Spot (options)
Print ICU-HPO (option)

Antenna Types

Free Space
F06, F08, T06, W06, D02
(see antenna literature section)
Stilling Well
S06, S08, S10 and S12
(see antenna literature section)
High Pressure
H02 and H04
(see antenna literature section)

1.7 Test standards

Code of Federal Regulations (CFR 47) Federal Communications Commission (FCC)

FCC Part 15 Low power communication device transmitter (08/2003)

Section 15.209 RSS 210 Table 3
Radiation emission limits, general requirements

Section 15.205 RSS 210 Table 2
Restricted bands of operation.

Section 15.207 RSS 210 Item 6.6
Conducted limits

Canada Standard

IC RSS 210 Issue 5 Item 6.2.2 (V1)

ATTESTATION:

DECLARATION OF COMPLIANCE: I declare that the testing was performed or supervised by me; that the test measurements were made in accordance with the above-mentioned Industry Canada standard(s); and that the equipment identified in this application has been subjected to all the applicable test conditions specified in the Industry Canada standards and all of the requirements of the standard have been met.

Laboratory Manager :

03.09.2004 RSC 8434 M. Paschwitz



Date	Section	Name	Signature
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2 Technical test

2.1 Summary of test results

- No deviations from the technical specification (s) were ascertained in the course of the performed tests.
- The deviations as specified in 2.5 were ascertained in the course of the performed tests.

This test report :

- describes the first test
- describes an additional test
- is a verification of documents
- is only valid with the test report no.

2.2 Test environment

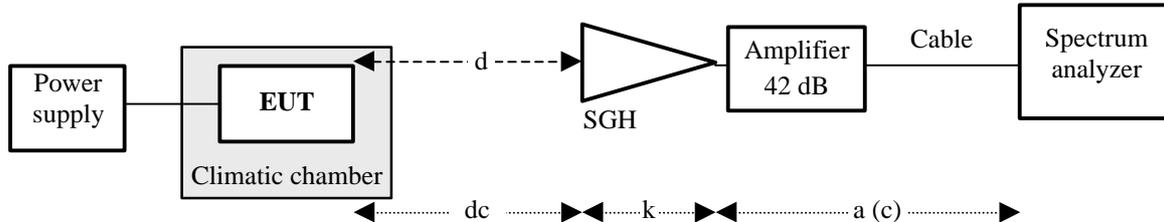
The environmental conditions are documented especially for each test.

2.3 Measurement and test set-up

The measurement and test set-up is defined in the technical specification .

2.4 Test equipment utilized and test set-up

2.4.1 Field strength and spurious radiation in the frequency range 4 GHz to 33 GHz with broadband amplifier



Frequency range [GHz]	Distance d [m]	Standard gain Horn ant. (SGH)	Antenna factor k [dB 1/m]	Amplifier gain g [dB]	Cable loss a [dB]
3.8 ... 6.0	3.0	narda 643	27.31	-42.0	1.5
5.3 ... 8.2	3.0	narda 642	30.06	-42.2	1.8
8.2 ... 12.4	3.0	narda 640	33.70	-42.0	2.0
12.4 ... 18.0	3.0	narda 639	33.97	-42.0	2.5
18 ... 26	1.0	narda 638	40.22	-42.0	3.0
26 ... 40	1.0	narda V637	44.00	-42.0	3.5

Calculation : Field strength = Analyser reading + Cable loss + Antenna factor + Ampl. gain

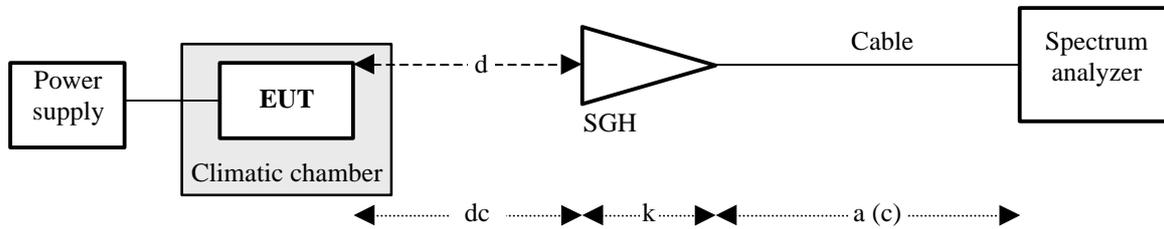
$$e = u + a + k + g$$

Test equipment	Manufacturer	Type	CETECOM reference
Spectrum Analyser	HP	HP 8565E	300001665
SGH 3.8 ... 6.0 GHz	narda	643	300002447
SGH 5.3 ... 8.2 GHz	narda	642	300000767
SGH 8.2 ... 12.4 GHz	narda	640	300002213
SGH 12.4 ... 18.0 GHz	narda	639	300000786
SGH 18 ... 27 GHz	narda	638	300002442
SGH 27 ... 40 GHz	narda	V637	300000510
SGH 27 ... 40 GHz	Thomson	COR 27_40	300000797a
Amplifier 0.5 ... 35 GHz	MITEC	U42	300003143
Power supply DC	HP	6032A	300002115
Power supply AC	Grundig	RT 5 A	300001263
RF-cable	HP	5061-5359	300002033
Power Supply	HP	6038A	300001174

Measurement uncertainty

Test parameter	Measurement uncertainty
Power supply	±0.1 V
Temperature	±0.2 °C
Frequency	±0.01 ppm
Field strength	±1.4 dB

2.4.2 Field strength and spurious radiation in the frequency range 4 GHz to 40 GHz



Frequency range [GHz]	Distance d [m]	Standard gain Horn ant. (SGH)	Antenna factor k [dB 1/m]	Distance corr. dc (3m/Xm) [dB]	Cable loss a [dB]
3.8 ... 6.0	1.0	narda 643	27.31	-9.54	1.5
5.3 ... 8.2	0.5	narda 642	30.06	-15.56	1.8
8.2 ... 12.4	0.5	narda 640	33.70	-15.56	2.0
12.4 ... 18.0	3.0	narda 639	33.97	n.a.	2.5
18.0 ... 27.0	3.0	narda 638	40.22	n.a.	3.0
24.125	3.0	narda 638	33.97	n.a.	2.9
27.0 ... 40.0	3.0	narda V637	44.00	n.a.	3.5

Calculation : Field strength = Analyser reading + Cable loss + Antenna factor + distance corr.

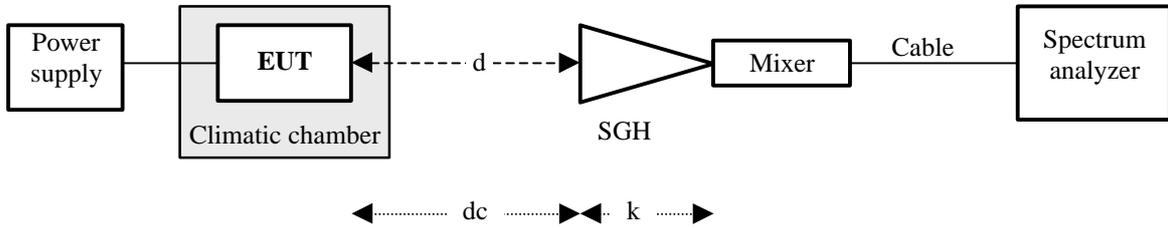
$$e = u + a + k + dc$$

Test equipment	Manufacturer	Type	CETECOM reference
Spectrum Analyser	HP	HP 8565E	300001665
SGH 3.8 ... 6.0 GHz	narda	643	300002447
SGH 5.3 ... 8.2 GHz	narda	642	300000767
SGH 8.2 ... 12.4 GHz	narda	640	300002213
SGH 12.4 ... 18.0 GHz	narda	639	300000786
SGH 18 ... 27 GHz	narda	638	300002442
SGH 27 ... 40 GHz	narda	V637	300000510
SGH 27 ... 40 GHz	Thomson	COR 27_40	300000797a
Power supply DC	HP	6032A	300002115
Power supply AC	Grundig	RT 5 A	300001263
RF-cable	HP	5061-5359	300002033
Power Supply	HP	6038A	300001174

Measurement uncertainty

Test parameter	Measurement uncertainty
Power supply	±0.1 V
Temperature	±0.2 °C
Frequency	±0.01 ppm
Field strength	±1.4 dB

2.4.3 Field strength and spurious radiation in the frequency range 33 GHz to 110 GHz



Frequency range [GHz]	Distance d [m]	Distance correction dc (3 m/Xm) [dB]	Antenna factor k [dB 1/m]
33.0 50.0	0.25	-21.58	39.10
50.0 75.0	0.25	-21.58	40.67
75.0 ... 110.0	0.125	-27.60	45.07

Calculation :
$$e = u + a + k + dc$$

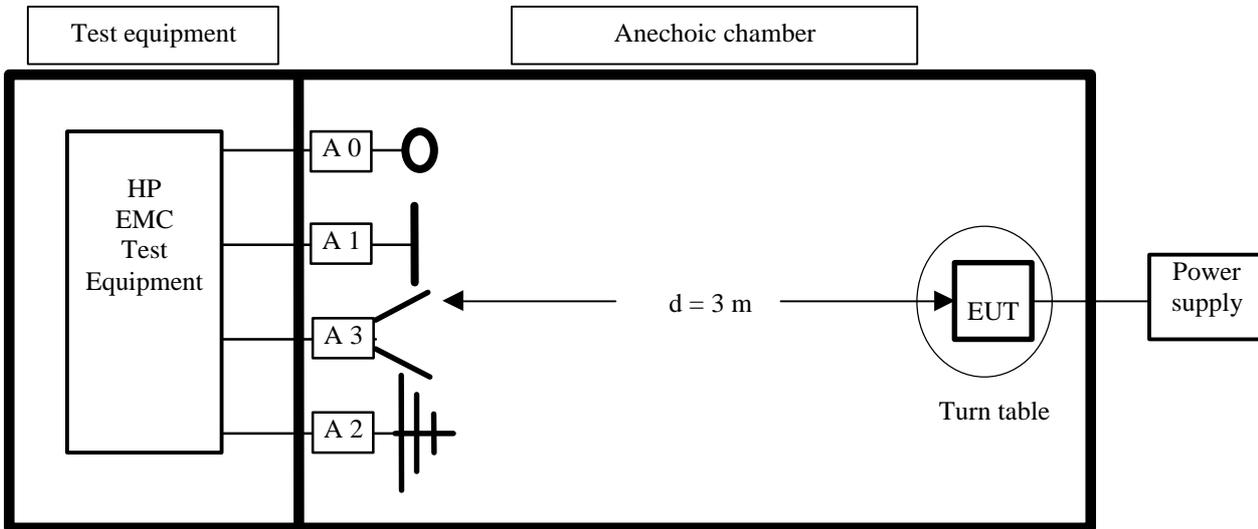
Test equipment	Manufacturer	Type	CETECOM reference
Spectrum Analyser	HP	HP 8565E	300001665
Power supply	HP	6032A	300002115
SGH 33 ... 50 GHz	Thomson	COR 33_50	300000812
Mixer 33 ... 50 GHz	HP	11970Q	300000781j
SGH 50 ... 75 GHz	Thomson	COR 50_75	300000789k
Mixer 50 ... 75 GHz	HP	11970V	300000871o
SGH 75 ... 110 GHz	Thomson	COR 75_110	300000789m
Mixer 75 ... 110 GHz	HP	11970W	300000871v
Power Supply	HP	6038A	300001174

Measurement uncertainty

Test parameter	Measurement uncertainty
Power supply	±0.1 VDC
Temperature	±0.2 °C
Frequency	±0.01 ppm
Field strength <50 GHz	±1.0 dB
Field strength >50 GHz	±3.0 dB

2.4.4 Field strength and spurious radiation in the frequency range 9 kHz to 4 GHz

Set-up for radiated measurements



Test equipment	Manufacturer	Type	Serial No.
Spectrum analyser	HP	HP 85660B	2478A05306
Analyser display	HP	HP 85662A	2816A16541
Quasi peak adapter	HP	HP 85650A	2811A01131
RF-preselector	HP	HP 85685A	2833A00768
Loop Antenna A 0	R&S	HFH 2-Z2	881 058/42
Biconical antenna A 1	Emco	3104	3758
Log.-per.-antenna A 2	Emco	3146	2304
Double ridge horn ant. A 3	Emco	3115	3007
Relay switch	R&S	RSU	375 339/002
High pass filter	FSY Microwave	HM 985955	001
Amplifier	Tron-Tech	P42-GA29	B2302
Power supply	HP	HP 6038A	2848A07027
RF-cable	HP	5061-5359	P36303

Measurement uncertainties

Performance	Measurement uncertainty
Input power (DC)	±0.1 V
Temperature	±0.2 °C
Frequency	±0.01 ppm
Field strength	±1.4 dB

2.5 Test results

2.5.1 Test results overview

This test was performed :

in addition to the test report no.

Verification of EUT :

EUT is in accordance with the technical description

EUT is not in accordance with the technical description

The equipment is compliant to FCC requirement

2.5.2 Remarks on methods of measurements

The EUT inclusive fixed flat plate antenna is positioned on top of a portable metal tank. This model tank simulates the operation within a normal size metal tank with a wall thickness of at least 3.5 mm. The Radar level gauge plus metal tank is fixed on a non-conductive support and can be rotated and tilted in all angles. A variable AC power supply drives the level gauge. The operation of the system is controlled by a service PC that is connected to the system by means of a twisted pair signal wire.

The equipment have 11 different antennas. The antenna F06 is the antenna with the highest gain. All radiated results was measured with the antenna F06.

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 9 kHz to 75 GHz in a semi - anechoic chamber. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are conform with specifications ANSI C63.2-1987 clause 15 and ANSI C63.4-2001 clause 4.1.5. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test set-ups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received.

The wanted and unwanted emissions are received by spectrum analysers where the detector modes and resolution bandwidths (RBW) over various frequency ranges are set according to requirement ANSI C63-4-2001 clause 4.2.

1. Measurements of at fundamental and spurious frequencies

Spurious frequencies are produced by transmitter and receiver when the EUT is active. According to FCC requirements 15.209, spurious emissions have to be investigated as maximum field strength values in the frequency range from 9 kHz to 960 MHz. Where possible, the measurement distance shall be 3 m.

In the low frequency range (9 kHz to 30 MHz), the receiving antenna is an active loop antenna which is positioned at 3 m distance in a shielded, anechoic chamber (see page 11). In case of required measuring distances > 3 m, a distance correction factor is used to calculate the received field strength.

In the frequency range 960 MHz to 75 GHz, spurious measurements are performed in a shielded fully anechoic chamber with rectangular SGH's. The measurement distances are indicated underneath each plot, and a calculation for EIRP is added, where all relevant factors like cable losses, antenna factors, etc are taken into account.

As a first step the sensor (FMCW Radar) is operating without a metal tank in order to measure the occupied bandwidth and the EIRP of the fundamental frequency and possible harmonic emissions. As a next step the EUT is positioned on top of a portable metal tank which simulates the operation under real life conditions. This test set-up allows to measure all RF leaking emissions from the EUT plus metal tank.

2. Measurements of conducted spurious frequencies onto the public AC power supply network

The measurements are performed in the frequency range 150 kHz to 30 MHz via a 50 μ H/50 Ohms LISN. The test receiver is a Rohde & Schwarz EMI selective voltmeter ESH 3 operated controlled and displayed with a specially designed PC software.

2.5.3 Test results in details

Equipment under test (EUT) : **ENRAF 970 SmartRadar ATi**

Ambient temperature : 23 °C

Relative humidity : 55 %

TRANSMITTER PARAMETERS

SECTION 15.209

FUNDAMENTAL FREQUENCY

SECTION 15.209

Operation : Function Test
 TX on; RX on. EUT operating without a metal tank
 Antenna assembly: Fixed integral antenna

Test condition t = 23.0 ° C AC Power supply		Measurement without the metal tank		
EUT operating: TX on and RX on	Start Frequency f [GHz]	middle Frequency f [GHz]	Stop Frequency f [GHz]	See plot no.
U AC = 115.0 V	9.526 170			1 / 2
U AC = 115.0 V			10.568 330	3 / 4
U AC = 115.0 V	9.500 000	sweep	10.600 000	5 / 6

LIMITS:

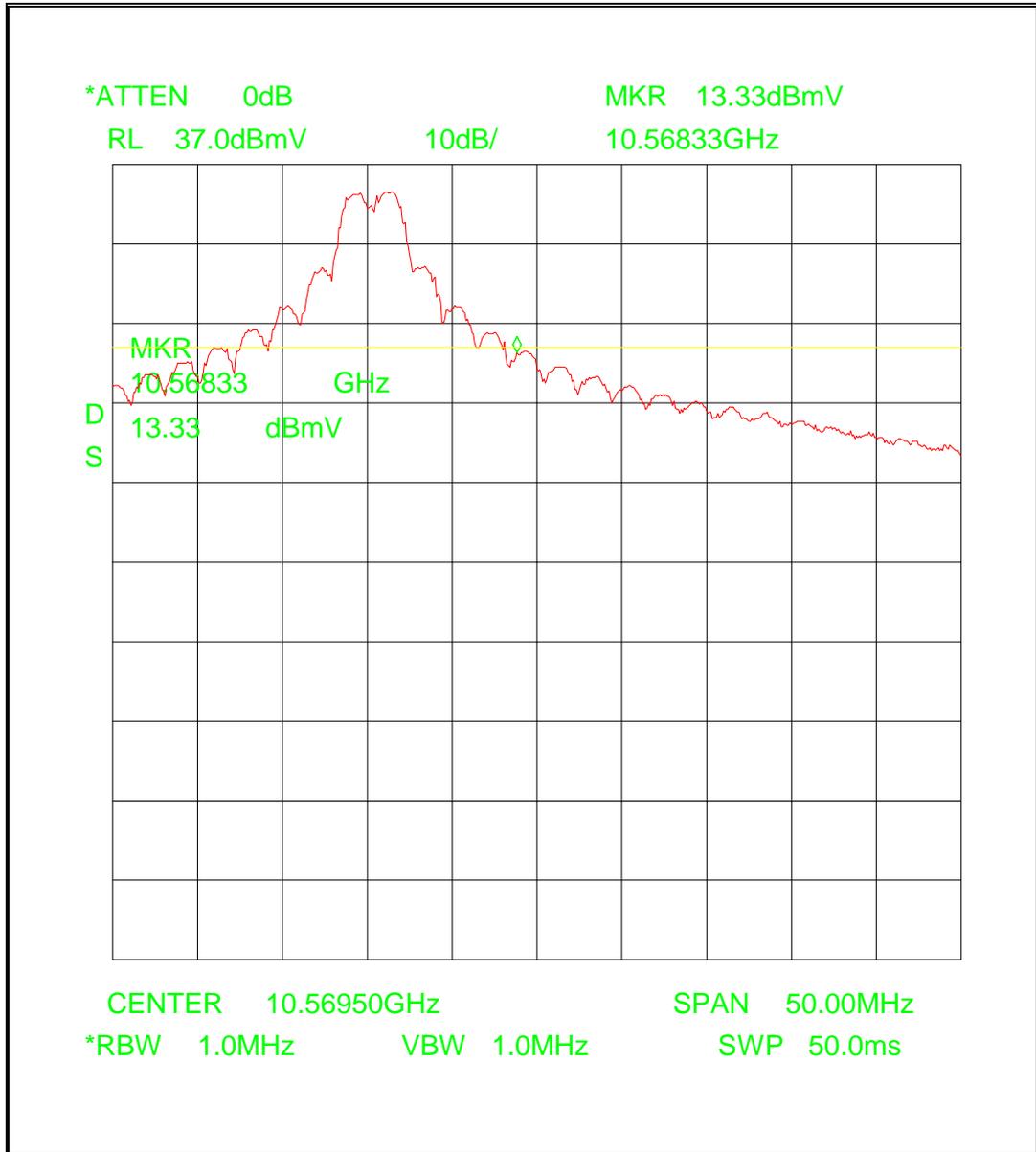
SECTION 15.205 / 15.209

Frequency range (MHz)	Measurement distance [m]	Field strength E [µV/m]	Field strength e [dBµV/m] @ 3 m
0.009 – 0.490	300	2400/F(kHz)	88.5 ... 53.8
0.490 – 1.705	30	24000/F(kHz)	53.8 ... 43.0
1.705 – 30.0	30	30	49.5
30.0 – 88.0	3	100	40.0
88.0 – 216.0	3	150	43.5
216.0 – 960.0	3	200	46.0
> 960.0	3	500	54.0

REFERENCE OF TEST EQUIPMENT USED : see test set-up on pages 8

Verdict : Function are kept
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Plot 4



Measurement distance d = 3.0 m

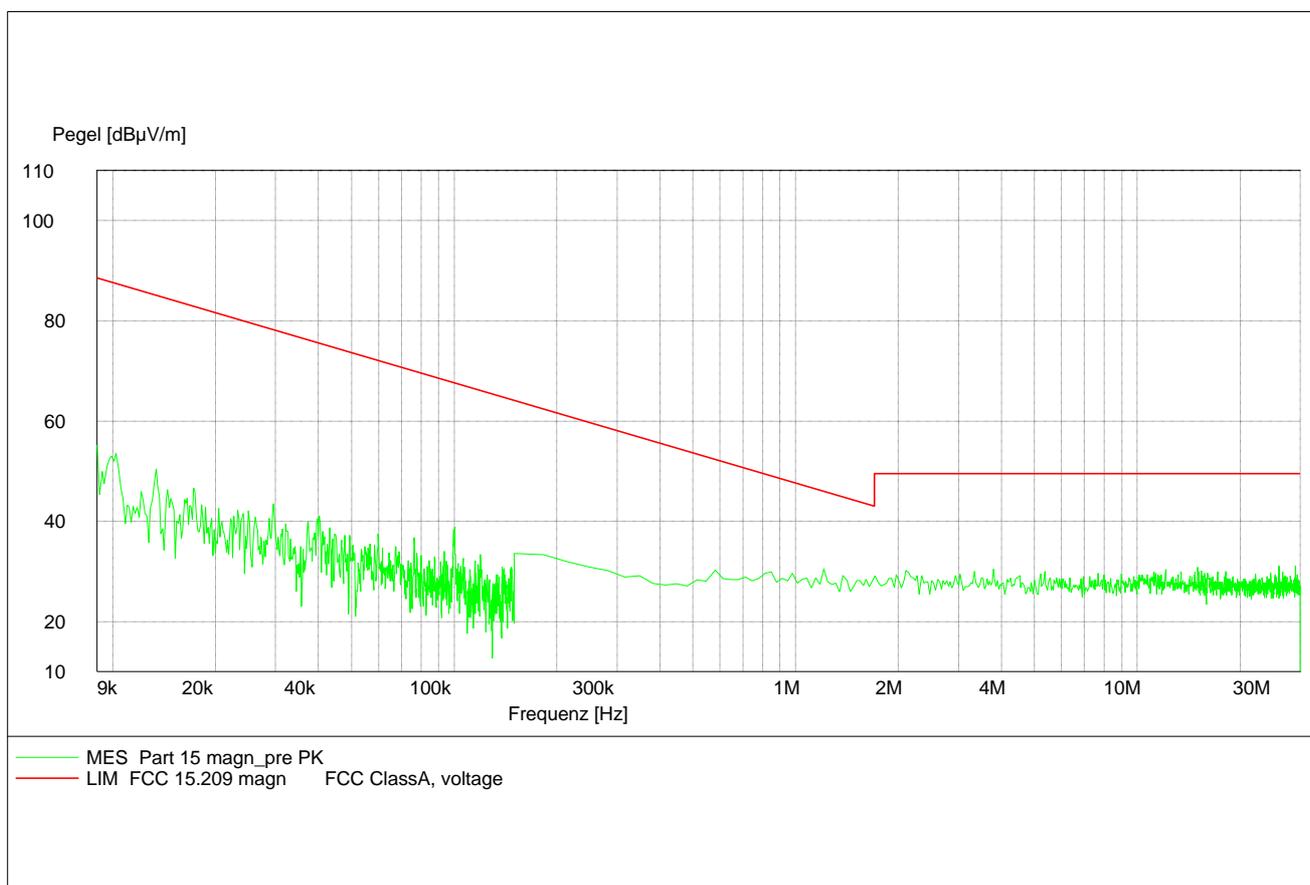
Operation : Function Test

TX on; RX on. EUT operating outside a metal tank

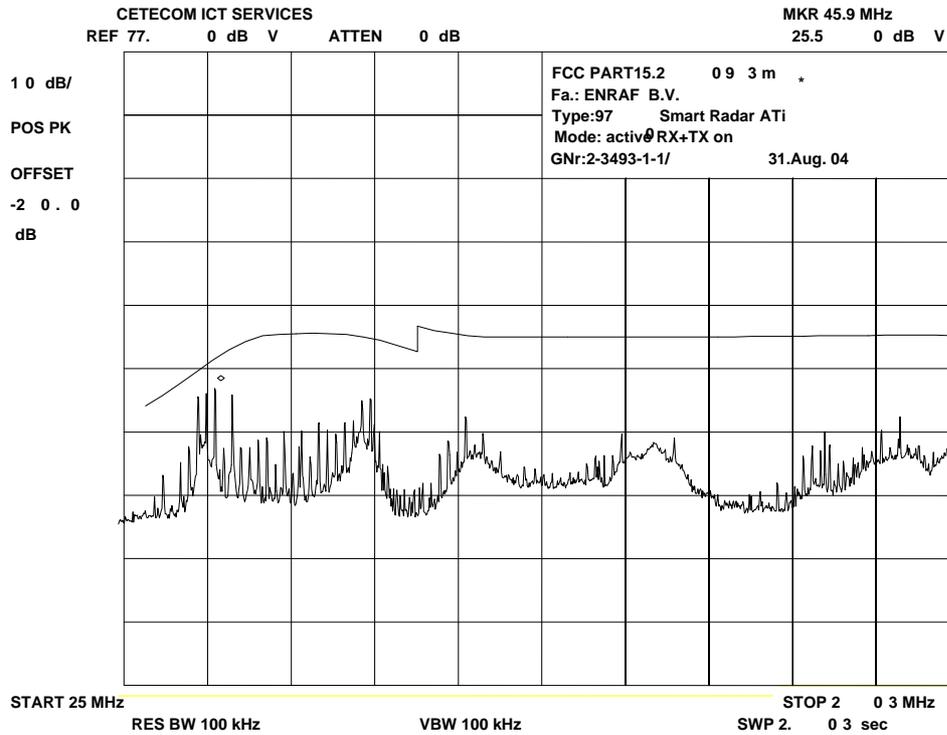
Note : The system attenuation is used as an offset in the spectrum analyzer in order to display the actual spurious.

Plot 7

EUT: Field disturbance sensor 970
Manufacturer: ENRAF B.V.
RX-Antenna: R & S HFH Z2
Operating conditions: TX on and RX on
AC Power supply: U = 115.0 V
Test specification: FCC 15.209



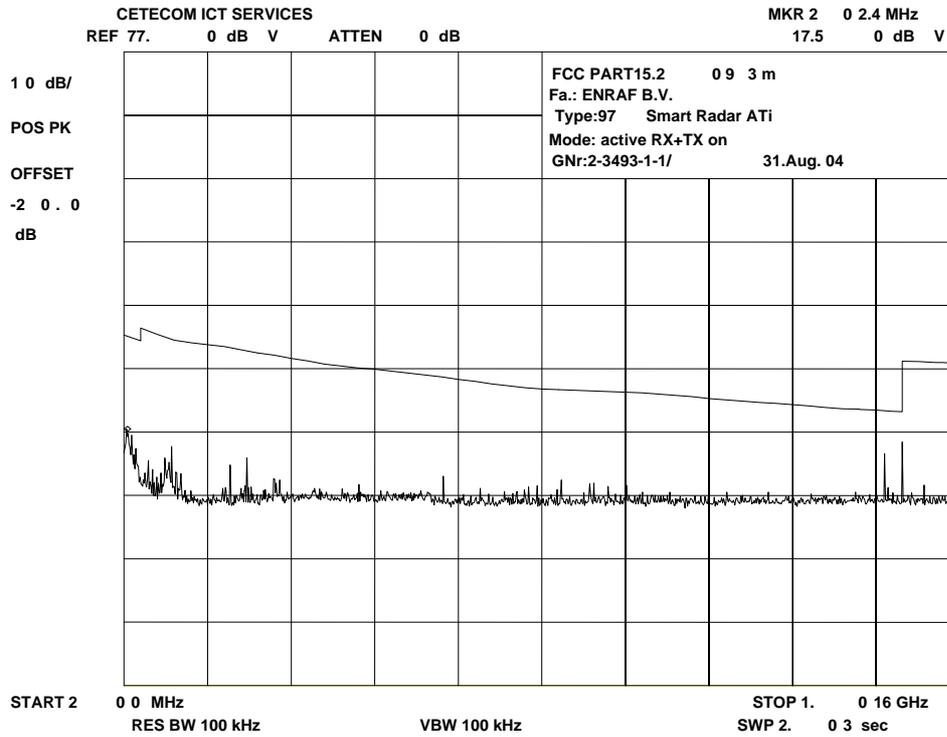
Plot 8



Remark: The spectrum analyser plot shows a snap shot of spurious emissions produced by the EUT. Maximum emission levels are investigated separately by scanning over antenna height (Ant. hgt) and azimuth of the turn table (Azm. TT) and employing different detector modes.

RX-Antenna vertical and horizontal (max hold function). Measurement distance = 3.0 m

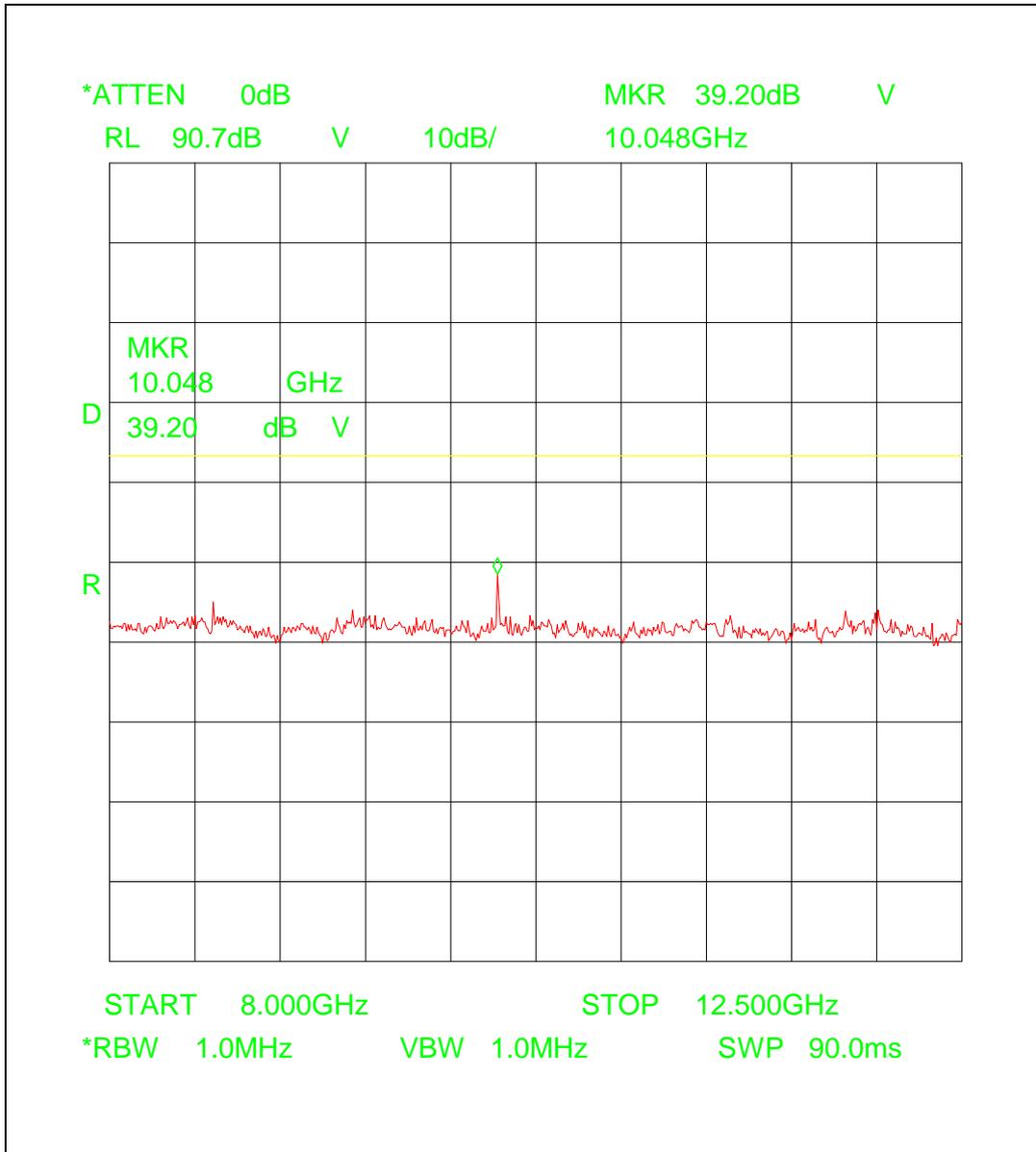
Plot 9



Remark: The spectrum analyser plot shows a snap shot of spurious emissions produced by the EUT. Maximum emission levels are investigated separately by scanning over antenna height (Ant. hgt) and azimuth of the turn table (Azm. TT) and employing different detector modes.

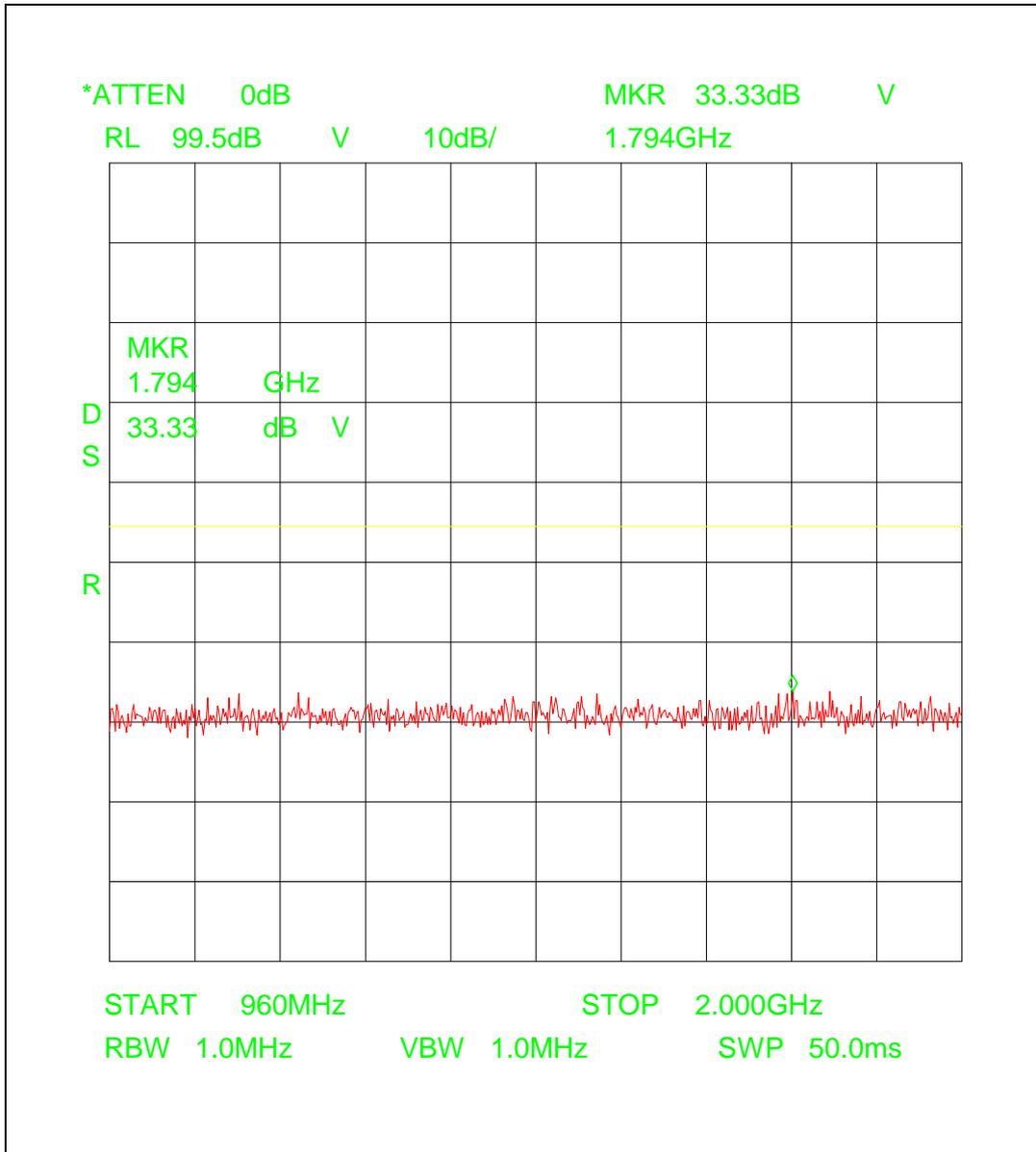
RX-Antenna vertical and horizontal (max hold function). Measurement distance = 3.0 m

Plot 22



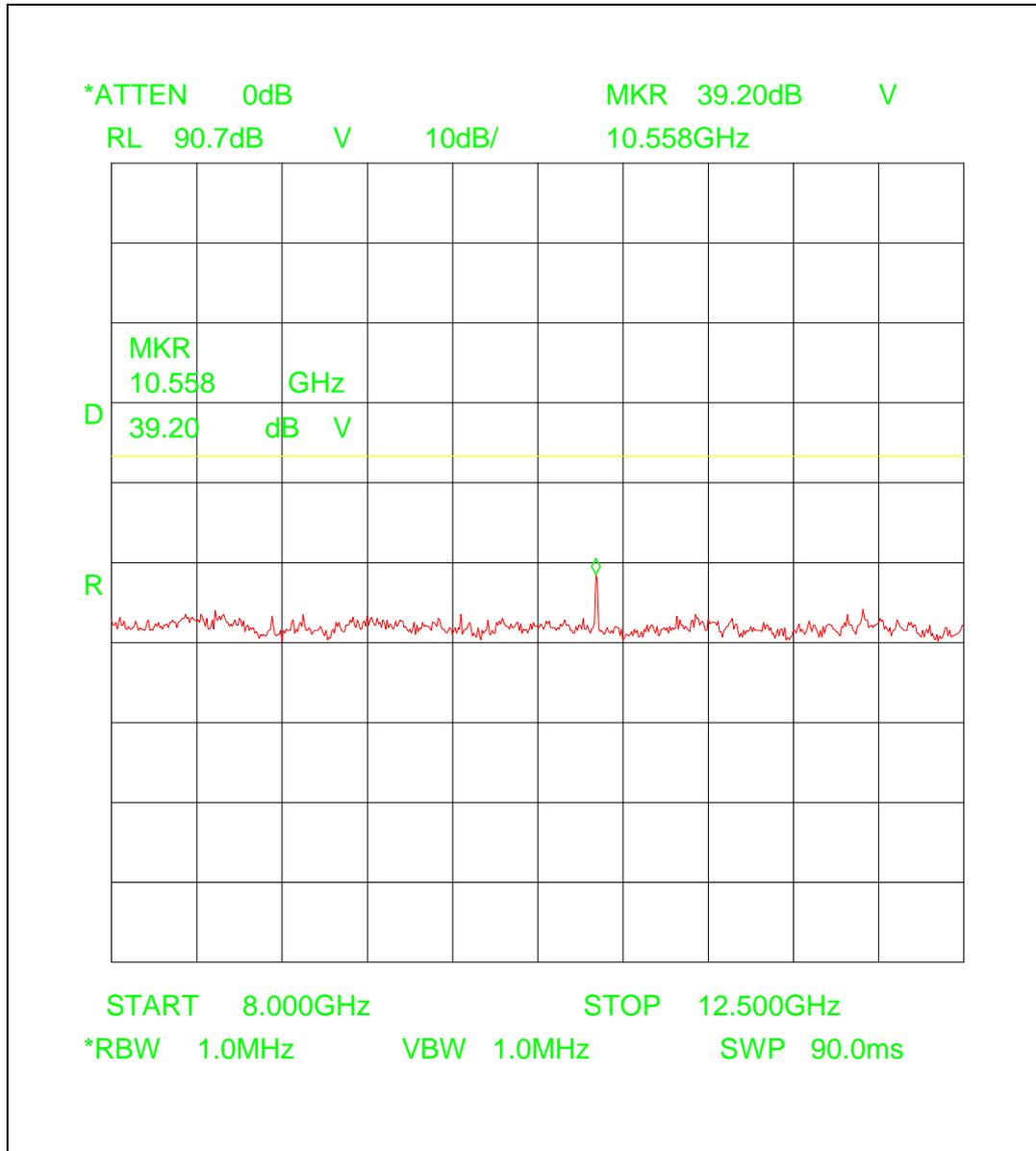
Measurement distance d = 3.0 m
 Function: middle frequency step 10.050 GHz
 Operation : Reality Test
 TX on; RX on. EUT operating inside a metal tank
 Note : The system attenuation is used as an offset in the
 spectrum analyzer in order to display the actual spurious.

Plot 30



Measurement distance d = 3.0 m
 Function: high frequency step 10.562 GHz
 Operation : Reality Test
 TX on; RX on. EUT operating inside a metal tank
 Note : The system attenuation is used as an offset in the
 spectrum analyzer in order to display the actual spurious.

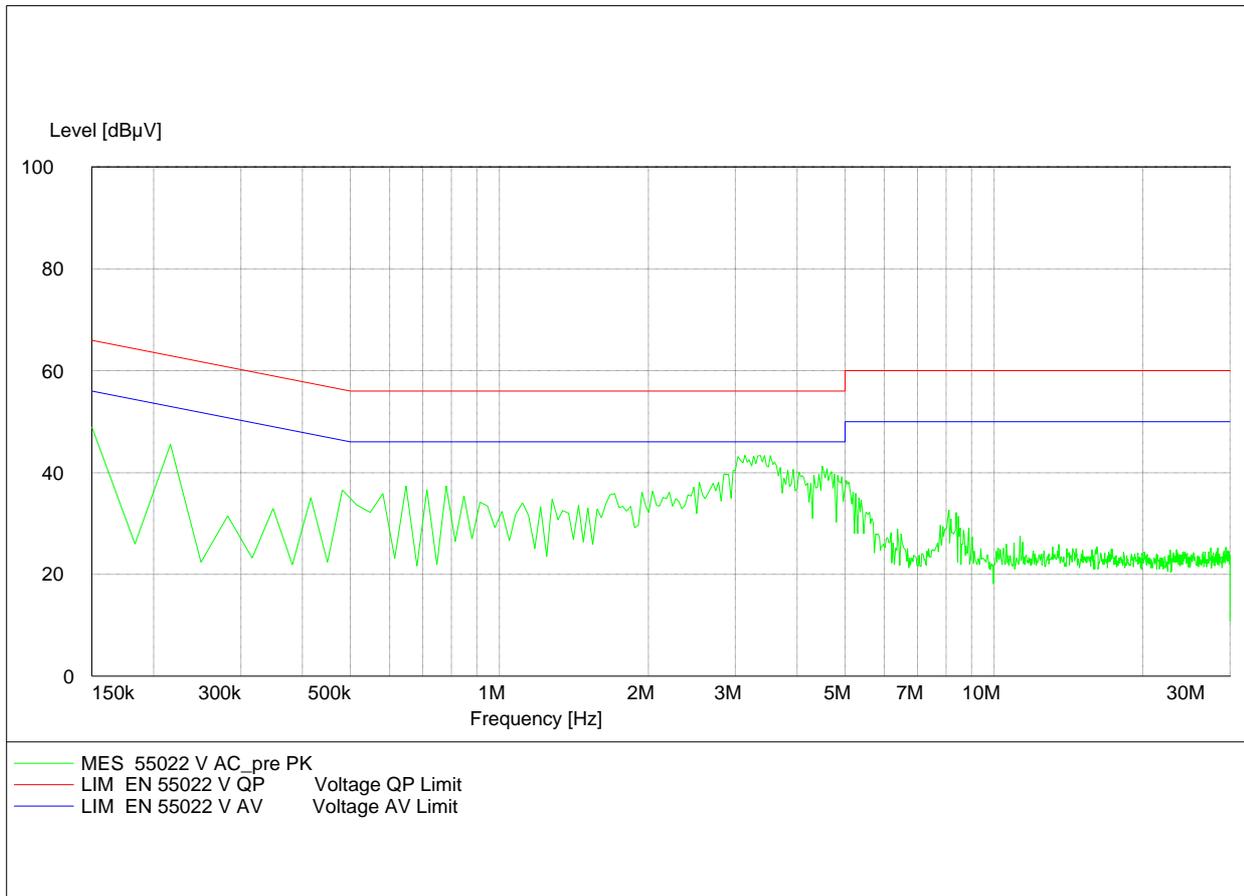
Plot 32



Measurement distance d = 3.0 m
 Function: high frequency step 10.562 GHz
 Operation : Reality Test
 TX on; RX on. EUT operating inside a metal tank
 Note : The system attenuation is used as an offset in the
 spectrum analyzer in order to display the actual spurious.

Plot 50

EUT Model 970 SmartRadar ATi
Manufacturer ENRAF B.V.
Operating Condition: RX and TX ON
Test Specification: CISPR 22
Comment: pass



The measurement were performed in TX and RX mode, L1 and N floating and grounded , max values was hold.

4 Photographs



Spurious tests with metal tank



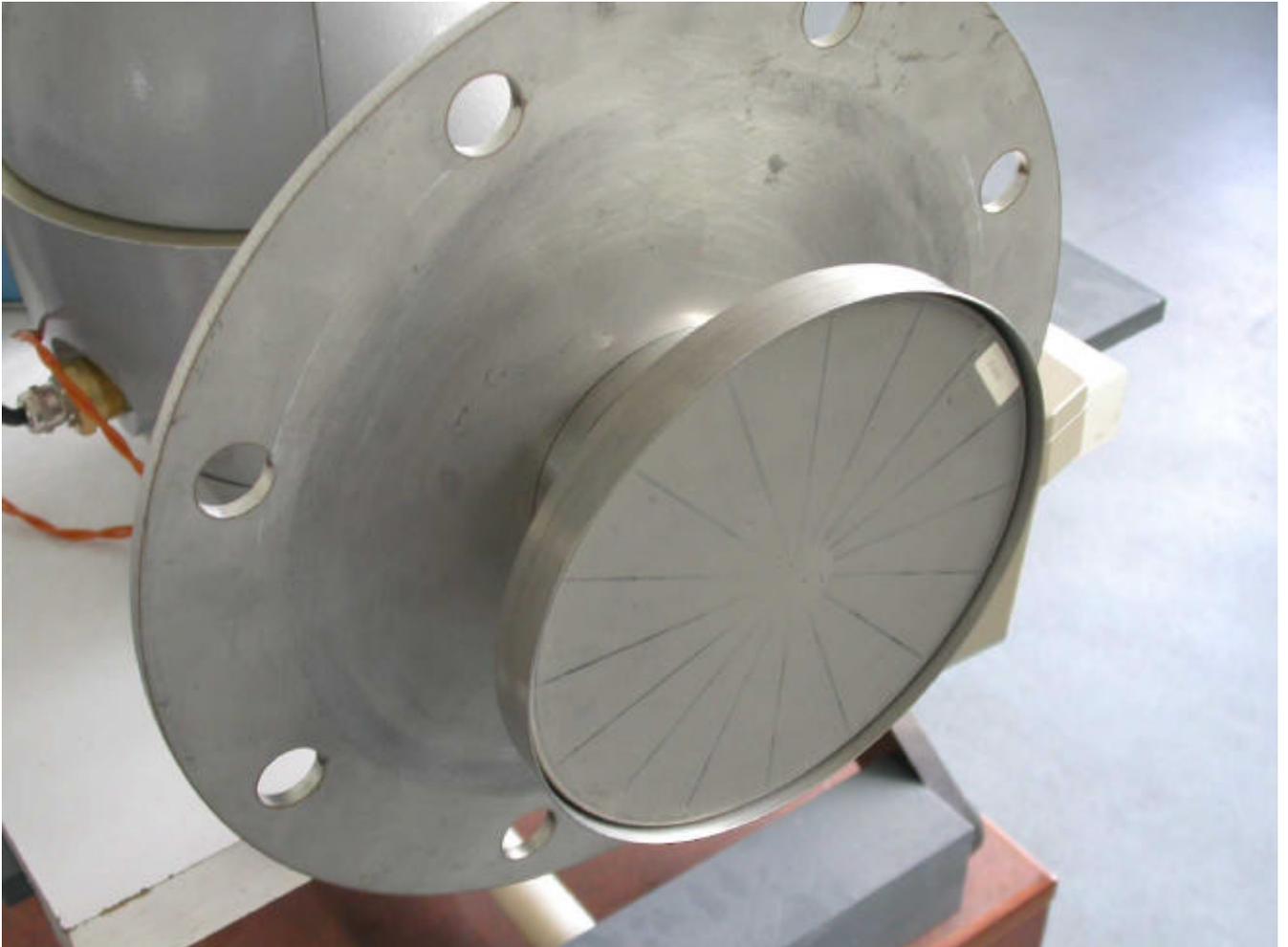
Spurious tests with metal tank



Spurious tests with metal tank



Measurement of spurious frequencies



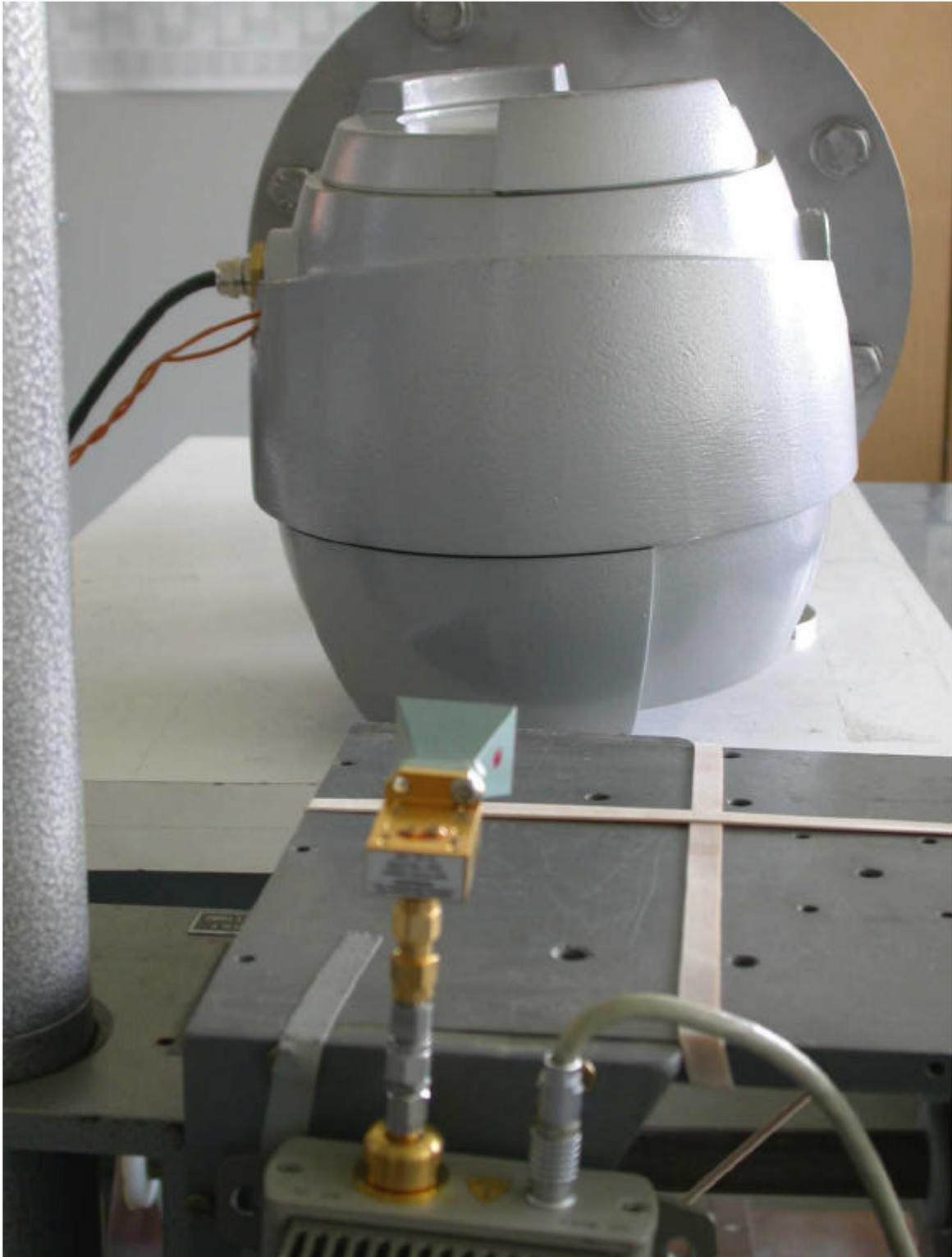
Antenna



Flat plate antenna with tank flange



Measurement of spurious frequencies



Measurement of spurious frequencies



Terminal