EMC Measurement/Technical Report

on

Dual Band Integrated Modem E-GSM900/PCS1900

WMOi3

with

Integrated Modem WMOi3

Report Reference: 3_wavecom_FCC_01b

7 Layers AG
Borsigstr. 11
40880 Ratingen
Germany

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0 Summary

0.1 Technical Report Summary

Type of Authorization

Certification for a broadband PCS device

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 0 to 19 and Parts 20 to 69 (10-1-98 Edition). The following subparts are applicable to the results in this test report.

Part 2

Subpart J - Equipment Authorization Procedures, Certification

§ 2.1046 Measurement required: RF power output

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Part 24

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Summary Test Results:

The EUT complied with all the applicable FCC rules as listed above.

0.2 Measurement Summary

RF Power Output

The measurement was performed according to FCC §2.1046 10-01-1998

OP-Mode	Setup	Port	Final Result
op-mode 1	setup 1	antenna port	passed
op-mode 2	setup 1	antenna port	passed
op-mode 3	setup 1	antenna port	passed

Frequency stability

The measurement was performed according to FCC §2.1055 10-01-1998

OP-Mode	Setup	Port	Final Result
op-mode 4	setup 2	antenna port	passed

Spurious emissions at antenna terminals

The measurement was performed according to FCC §2.1051 10-01-1998

OP-Mode	Setup	Port	Final Result
op-mode 1	setup 1	antenna port	passed
op-mode 3	setup 1	antenna port	passed

Field strength of spurious radiation

The measurement was performed according to FCC §2.1053 10-01-1998

OP-Mode	Setup	Port	Final Result
op-mode 1	setup 3	enclosure	passed
op-mode 3	setup 3	enclosure	passed

Occupied Bandwidth

The measurement was performed according to FCC §2.1049 10-01-1998

OP-Mode	Setup	Port	Final Result
op-mode 1	setup 1	antenna port	passed
op-mode 2	setup 1	antenna port	passed
op-mode 3	setup 1	antenna port	passed

Modulation Characteristics

The measurement was performed according to FCC §2.1047 10-01-1998

OP-Mode	Setup	Port	Final Result
op-mode 4	setup 2	antenna port	passed

Responsible for Accreditation Scope: _____

Responsible for Test Report: _____

1. Administrative Data

1.1 Testing Laborator

Company Name:	7 Layers AG
Address:	Borsigstr. 11 40880 Ratingen Germany

This facility has been fully described in a report submitted to the FCC and accepted in a letter dated February 07, 2000 under the registration number 96716 .

The test facility is also accredited by the following accreditation organisation:

- Deutscher Akkreditierungs Rat DAR-Registration no. TTI-P-G 178/99-10
- Regulierungsbehörde für Telekommunikation und Post (Reg TP)

Responsible for Accreditation Scope: Dipl.-Ing Bernhard Retka
Dipl.-Ing Arndt Stöcker

1.2 Project Data

Project Leader:	Marco Kullik
Receipt of EUT:	2000-08-25
Date of Test(s):	2000-08-31 / 2000-09-04 / 2000-09-
Date of Report:	2000-09-08
No. of Pages in Annex:	45

1.3 Applicant Data

Company Name:	WAVECOM S.A.
Address:	39, rue du Gouverneur Général E 92442 Issy-les-Moulineaux Cede France
Contact Person:	Mr. Hatim Limati

1.4 Manufacturer Data

Company Name:	see applicant
Address:	
Contact Person:	

2. Testobject Data

2.1 General EUT Descriptio

Equipment under Test:	Dual Band Integrated Modem E-GSM900/PCS190
Type Designation:	WMOi3
Kind of Device: (optional)	
Voltage Type:	DC
Voltage level:	5.0

General product description:

The Equipment Under Test (EUT) is an integrated modem called WMOi3. The product includes a E-GSM900/PCS1900 dual band module. In the PCS1900 mode the WMOi3 operates in blocks A through F from 1850,2 MHz (lowest channel = 512) to 1909,8 MHz (highest channel = 810). Beside the antenna connector and the integrated SIM reader there is an interface connector available which provides among others a DC and a RS232 Port. For more information see WAVECOM users manual and WAVECOM WM2C-G900/G1900 EGSM/PCS DUAL BAND Module Specifications.

The EUT provides the following ports:

Ports
RS232 port
DC port
antenna port
enclosure

The main components of EUT are listed and described in Chapter 2.2

2.2 EUT Main components:
Type, S/N, Short Descriptions etc. used in this Test Report

Short Description	Equipment under Test	Type Designation	Serial No.	HW Status	SW Status	Date of Receipt
EUT A	Integrated Modem	WMOi3	without serial number	3.0	402M11B	2000-08-25

NOTE: The short description is used to simplify the identification of the EUT in this test report

2.3 Ancillary Equipment

For the purposes of this test report, ancillary equipment is defined as equipment which is used in conjunction with the EUT to provide additional operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it.

Short Description	Equipment under Test	Type Designation	HW Status	SW Status	Serial No.	FCC Id

2.4 EUT Setups

This chapter describes the combination of EUT's and ancillary equipment used for testing.

Setup No.	Combination of EUTs	Description
setup 1	EUT A	Setup for conducted measurements under nominal condition (see chapter "Drawings"). The EUT was set in auto answer mode, so no ancillary equipment was necessary.
setup 2	EUT A	Setup for conducted measurements under extreme condition (see chapter "Drawings"). The EUT was set in auto answer mode, so no ancillary equipment was necessary.
setup 3	EUT A	Setup for radiated measurements under nominal conditions (see chapter "Drawings"). The EUT was set in auto answer mode, so no ancillary equipment was necessary.

2.5 Operating Modes

This chapter describes the operating modes of the EUT's used for testing in this test report.

Op. Mode	Description of Operating Modes	Remarks
op-mode 1	Call established on Traffic Channel (TCH) 512, Carrier Frequency 1850,2 MHz	512 is the lowest channel
op-mode 2	Call established on Traffic Channel (TCH) 649, Carrier Frequency 1877,6 MHz	649 is a mid channel of the full PCS band (blocks A to F)
op-mode 3	Call established on Traffic Channel (TCH) 810, Carrier Frequency 1909,8 MHz	810 is the highest channel
op-mode 4	Call established on Traffic Channel (TCH) 611, Carrier Frequency 1870 MHz	1870 MHz = lowest frequency of block B (see FCC §24.229)

3. Measurement Results

3.1 RF Power Output

Standard FCC Part 24, Subpart E 10-01-98

The test was performed according to: FCC §2.1046 10-01-1998

3.1.1 Test Description

1) The mobile station was coupled to the R&S ESI Spectrum Analyser and the R&S CMD55 Digital Communication Tester through a Power Divider and an Attenuator (20 dB) at the Spectrum Analyser input. Refer to chapter "Setup Drawings".

2) The total insertion losses for RF Path 1 and RF Path 2 were measured. The values were used to correct the readings from the R&S ESI Spectrum Analyser and the R&S CMD55 Digital Communication Tester.

3) A speech call was established on a Traffic Channel (TCH) between the mobile station and the base station simulator (R&S CMD55 Digital Communication Tester).
Important Settings:
- Discontinuous Transmission: OFF
- Modulation Signal: PSR16-1 (Pseudo Random Sequenz)
- Output Power: Varied during measurements
- Channel (Frequency): Varied during measurements

4) The transmitted power of the mobile station was recorded for all possible power control level by using an internal measurement function of the CMD55.

5) During this test the Spectrum Analyser was only used to check if the results are comprehensible.

3.1.2 Test Requirements / Limits

§2.1046 Measurements Required: RF Power Output

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § 2.1033(c)(8). The electrical characteristics of the output terminals when this test is made shall be stated.

§24.232 Power and antenna height limits

(b) Mobile/portable stations are limited to 2 watts e.i.r.p peak power and the equipment must employ means to limit the power to the minimum necessary for succesful communications.

(c) Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage. The measurement results shall be properly adjusted for any

instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

3. 1 .3 Test Protocol

Temperature: 23,8 °C
Air Pressure: 1020 hPa
Humidity: 40 %

Op. Mode	Setup	Port
op-mode 1	setup 1	antenna port

Power Control Level	Output power Nominal (dBm)	Output power Measured (dBm)	Difference dB
0	30	29	-1,00
1	28	28,1	0,10
2	26	26	0,00
3	24	24	0,00
4	22	21,9	-0,10
5	20	19,9	-0,10
6	18	17,9	-0,10
7	16	15,7	-0,30
8	14	13,8	-0,20
9	12	11,4	-0,60
10	10	10,8	0,80
11	8	8,5	0,50
12	6	7	1,00
13	4	4,7	0,70
14	2	2,8	0,80
15	0	0,7	0,70

Remark: none

Temperature: 23,8 °C
Air Pressure: 1020 hPa
Humidity: 40 %

Op. Mode	Setup	Port
op-mode 2	setup 1	antenna port

Power Control Level	Output power Nominal (dBm)	Output power Measured (dBm)	Difference dB
0	30	29,3	-0,70
1	28	28,4	0,40
2	26	26,3	0,30
3	24	24,2	0,20
4	22	22,1	0,10
5	20	20	0,00
6	18	17,9	-0,10
7	16	15,7	-0,30
8	14	13,7	-0,30
9	12	11,4	-0,60
10	10	10,2	0,20
11	8	7,8	-0,20
12	6	6,1	0,10
13	4	3,8	-0,20
14	2	1,7	-0,30
15	0	-0,8	-0,80

Remark: none

Temperature: 23,8 °C
Air Pressure: 1020 hPa
Humidity: 40 %

Op. Mode	Setup	Port
op-mode 3	setup 1	antenna port

Power Control Level	Output power Nominal (dBm)	Output power Measured (dBm)	Difference dB
0	30	27,7	-2,30
1	28	26,8	-1,20
2	26	24,7	-1,30
3	24	22,6	-1,40
4	22	20,3	-1,70
5	20	18,2	-1,80
6	18	16,2	-1,80
7	16	13,7	-2,30
8	14	11,6	-2,40
9	12	10,1	-1,90
10	10	8,2	-1,80
11	8	5,7	-2,30
12	6	4	-2,00
13	4	1,6	-2,40
14	2	-0,8	-2,80
15	0	-3,7	-3,70

Remark: none

4.1.3 Test result: RF Power Output

FCC Part 24, Subpart E	Op. Mode	Setup	Port	Result
	op-mode 1	setup 1	antenna port	**passed**
	op-mode 2	setup 1	antenna port	**passed**
	op-mode 3	setup 1	antenna port	**passed**

3.2 Frequency stability

Standard FCC Part 24, Subpart E 10-01-98

The test was performed according to: FCC §2.1055 10-01-1998

3.2.1 Test Description

1) The PCS1900 mobile station was placed inside the climatic chamber.

2) The mobile station was coupled to the R&S CMD55 Digital Communication Tester.
Refer to chapter "Setup Drawings".

3) The climatic chamber was cycled down/up to a certain temperature, starting with –30°C.

4) After the temparature was stabilized (at least one hour) the mobile station was switched on and a speech call was established on a Traffic Channel (TCH) between the mobile station and the base station simulator (R&S CMD55 Digital Communication Tester).
Important Settings:
- Discontinuous Transmission: OFF
- Modulation Signal: PSR16-1 (Pseudo Random Sequenz)
- Output Power: Maximum
- Channel : 661 [1870 MHz = lowest frequency of block B (see FCC §24.229)]

5) The frequency error of the mobile station were recorded by using an internal measurement function of the CMD55 immediately after the call was established, five minutes after the call was established and ten minutes after the call was established.

6) This measurement procedure was performed for all combinations of voltage (low, nominal, high) and temperature (from –30°C to +50°C in increments of 10°C).

3.2.2 Test Requirements / Limits

§2.1055 Measurements required: Frequency stability

(a) The frequency stability shall be measured with variation of ambient temperature as follows:

(1) From -30° to +50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.

(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter

containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

(d) The frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

§24.235 Frequency stability

The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

3. 2 .3 Test Protocol

Temperature: 25 °C
Air Pressure: 1020 hPa
Humidity: 41%

Op. Mode	Setup	Port
op-mode 4	setup 2	antenna port

		Minimum Voltage / V		Normal Voltage / V		Maximum Voltage /V	
		4.75		5.0		5.25	
Temperature °C	Duration min	Freq. error Average (Hz)	Freq. error Max. (Hz)	Freq. error Average (Hz)	Freq. error Max. (Hz)	Freq. error Average (Hz)	Freq. error Max. (Hz)
-30	0	121	168	70	107	61	97
-30	5	55	113	49	89	47	78
-30	10	43	82	58	76	47	72
-20	0	75	120	44	79	43	74
-20	5	42	56	29	46	15	33
-20	10	37	53	39	76	49	63
-10	0	43	81	46	72	35	53
-10	5	48	66	56	72	46	62
-10	10	29	47	51	71	44	66
0	0	28	69	33	60	32	66
0	5	22	71	17	70	33	56
0	10	11	33	36	70	33	52
10	0	18	60	19	53	25	57
10	5	23	62	27	54	34	63
10	10	14	65	44	61	17	36
20	0	8	47	17	57	22	49
20	5	24	54	26	50	31	56
20	10	8	28	22	41	5	25
30	0	8	53	14	50	20	44
30	5	16	49	20	57	26	51
30	10	10	34	37	52	37	54
40	0	23	53	12	49	9	40
40	5	9	26	38	55	27	48
40	10	10	27	6	28	27	41
50	0	34	56	41	65	28	68
50	5	29	51	34	52	27	68
50	10	9	28	19	43	48	66

Remark: Minimum and maximum voltage were selected according to the product specification.

4. 2 .3 Test result: Frequency stability

FCC Part 24, Subpart E	Op. Mode	Setup	Port	Result
	op-mode 4	setup 2	antenna port	**passed**

3.3 Spurious emissions at antenna terminals

Standard FCC Part 24, Subpart E 10-01-98

The test was performed according to: FCC §2.1051 10-01-1998

3.3.1 Test Description

1) The mobile station was coupled to the R&S ESI Spectrum Analyser and the R&S CMD55 Digital Communication Tester through a Power Divider and an Attenuator (20 dB) at the Spectrum Analyser input. Refer to chapter "Setup Drawings".

2) The total insertion losses for RF Path 1 and RF Path 2 were measured. The values were used to correct the readings from the R&S ESI Spectrum Analyser and the R&S CMD55 Digital Communication Tester.

3) A speech call was established on a Traffic Channel (TCH) between the mobile station and the base station simulator (R&S CMD55 Digital Communication Tester).
Important Settings:
- Discontinuous Transmission: OFF
- Modulation Signal: PSR16-1 (Pseudo Random Sequenz)
- Output Power: Maximum
- Channel : Varied during measurements
(lowest channel: 512 and highest channel: 810)

4) Important Analyser Settings
- [Resolution Bandwidth / Video Bandwidth]:
a) [3 kHz / 10 kHz] in the Span of 1 MHz directly below and above the PCS-Band,
b) [10 kHz / 30 kHz] in case the curve of the analyser IF-Filter leads to an exceeding of the limit, in this case a worst case correction factor of 20 dB (1 MHz -> 10 kHz) was used
c) [1 MHz / 3 MHz] otherwise
- Sweep Time: Calculated by using a formula given in the Product Standard "PCS 11.10-1 edition 4" for spurious emissions measurements (depending on the transmitting signal, the span and the resolution bandwidth)

5) The spurious emissions (peak) were measured in the frequency range from 9 kHz to 20 GHz (up to the 10th harmonic) during the call is established on the lowest channel (512) and on the highest channel (810).

3.3.2 Test Requirements / Limits

§ 2.1051 Spurious emissions at antenna terminals

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in Sec. 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

§ 2.1057 Frequency spectrum to be investigated.

(a) In all of the measurements set forth in Secs. 2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the frequency shown below:
(1) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
(b) Particular attention should be paid to harmonics and subharmonics of the carrier frequency as well as to those frequencies removed from the carrier by multiples of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.
(c) The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.
(d) Unless otherwise specified, measurements above 40 GHz shall be performed using a minimum resolution bandwidth of 1 MHz.

§ 24.238 Emission Limits

(a) On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB.
Remark of the test laboratory: This is calculated to be -13 dBm.

(b) Compliance with these provisions is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

(c) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the licensee's frequency block edges, both upper and lower, as the design permits.

(d) The measurements of emission power can be expressed in peak or average values, provided they are expressed in the same parameters as the transmitter power.

(e) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.

3. 3 .3 Test Protocol

Temperature: 29 °C
Air Pressure: 1020 hPa
Humidity: 39 %

Op. Mode	Setup	Port
op-mode 1	setup 1	antenna port

Frequency MHz	Bandwidth kHz	Measured Level dBm	Limit dBm
1850,00	3,00	-13,83	-13,00
1910,00	1000,00	-33,41	-13,00
3670,70	1000,00	-41,67	-13,00
5542,80	1000,00	-26,87	-13,00
9252,50	1000,00	-39,89	-13,00

Remark: none

Temperature: 29 °C
Air Pressure: 1020 hPa
Humidity: 39 %

Op. Mode	Setup	Port
op-mode 3	setup 1	antenna port

Frequency MHz	Bandwidth kHz	Measured Level dBm	Limit dBm
322,98	1000,00	-39,90	-13,00
1587,48	1000,00	-36,89	-13,00
1910,02	3,00	-14,58	-13,00
1910,78	3,00	-42,70	-13,00
1927,82	1000,00	-33,07	-13,00
1960,64	1000,00	-35,33	-13,00
3809,42	1000,00	-43,61	-13,00
5716,23	1000,00	-32,29	-13,00
7623,04	1000,00	-42,29	-13,00
9529,86	1000,00	-42,70	-13,00

Remark: none

4.3.3 Test result: Spurious emissions at antenna terminals

FCC Part 24, Subpart E	Op. Mode	Setup	Port	Result
	op-mode 1	setup 1	antenna port	**passed**
	op-mode 3	setup 1	antenna port	**passed**

3.4 Field strength of spurious radiation

Standard FCC Part 24, Subpart E 10-01-98

The test was performed according to: FCC §2.1053 10-01-1998

3.4.1 Test Description

1) The mobile station was placed inside a anechoic chamber. Refer to chapter "Setup Drawings". The mobile station was coupled to the R&S CMD55 Digital Communication Tester which was located outside the chamber via coaxial cable.

2) A speech call was established on a Traffic Channel (TCH) between the mobile station and the base station simulator (R&S CMD55 Digital Communication Tester).
Important Settings:
- Discontinuous Transmission: OFF
- Modulation Signal: PSR16-1 (Pseudo Random Sequenz)
- Output Power: Maximum
- Channel : Varied during measurements
(lowest channel: 512 and highest channel: 810)

3) A pre-calibration procedure is used so that the readings from the spectrum analyser are corrected and represent directly the equivalent radiated power (related to a lamda/2 dipole).

4) All spurious radiation measuements were made with spectrum analyser and the appropriate calibrated antennas for the frequency range of 30 MHz to 20 GHz (up to the 10th harmonic of the transmit frequency).

5) Important Analyser Settings
- [Resolution Bandwidth / Video Bandwidth]:
a) [3 kHz / 10 kHz] in the Span of 1 MHz directly below and above the PCS-Band,
b) [10 kHz / 30 kHz] in case the curve of the analyser IF-Filter leads to an exceeding of the limit, in this case a worst case correction factor of 20 dB (1 MHz -> 10 kHz) was used
c) [1 MHz / 3 MHz] otherwise
- Sweep Time: Calculated by using a formula given in the Product Standard "PCS 11.10-1 edition 4" for spurious emissions measurements (depending on the transmitting signal, the span and the resolution bandwidth)

6) The spurious emissions (peak) were measured in both vertical and horizontal antenna polarisation during the call is established on the lowest channel (512) and on the highest channel (810).

3.4.2 Test Requirements / Limits

§ 2.1053 Measurements required: Field strength of spurious radiation.

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the

magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of Sec. 2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.
(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:
(2) All equipment operating on frequencies higher than 25 MHz.

§ 2.1057 Frequency spectrum to be investigated.

(a) In all of the measurements set forth in Secs. 2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the frequency shown below:
(1) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
(b) Particular attention should be paid to harmonics and subharmonics of the carrier frequency as well as to those frequencies removed from the carrier by multiples of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.
(c) The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.
(d) Unless otherwise specified, measurements above 40 GHz shall be performed using a minimum resolution bandwidth of 1 MHz.

§ 24.238 Emission limits

(a) On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB.

This is calculated to be -13 dBm (effective radiated power) which corresponds to 84.6 dBµV/m (field strength) in a distance of 3 m.

3. 4 .3 Test Protocol

Temperature: 27 °C
Air Pressure: 1016 hPa
Humidity: 41 %

Op. Mode	Setup	Port
op-mode 1	setup 3	enclosure

Frequency MHz	Antenna Polarisation vertical / horizontal	Bandwidth kHz	Measured Level dBm	Limit dBm
3681,00	vertical	1000,00	-41,00	-13,00
3681,00	horizontal	1000,00	-39,68	-13,00
5551,00	vertical	1000,00	-14,68	-13,00
5551,00	horizontal	1000,00	-29,54	-13,00
9261,00	vertical	1000,00	-35,87	-13,00
9261,00	horizontal	1000,00	-38,48	-13,00
11101,00	vertical	1000,00	-39,75	-13,00
12971,00	vertical	1000,00	-35,09	-13,00
12971,00	horizontal	1000,00	-35,90	-13,00

Remark: none

Temperature: 27 °C
Air Pressure: 1016 hPa
Humidity: 41 %

Op. Mode	Setup	Port
op-mode 3	setup 3	enclosure

Frequency MHz	Antenna Polarisation vertical / horizontal	Bandwidth kHz	Measured Level dBm	Limit dBm
3803,00	horizontal	1000,00	-38,95	-13,00
3804,00	vertical	1000,00	-42,01	-13,00
5735,00	vertical	1000,00	-22,22	-13,00
5735,00	horizontal	1000,00	-37,70	-13,00
7636,00	vertical	1000,00	-40,25	-13,00
7636,00	horizontal	1000,00	-40,58	-13,00
9537,00	vertical	1000,00	-37,39	-13,00
9537,00	horizontal	1000,00	-39,37	-13,00
11469,00	vertical	1000,00	-37,32	-13,00
13370,00	vertical	1000,00	-35,18	-13,00
13370,00	horizontal	1000,00	-39,23	-13,00

Remark: none

4.4.3 Test result: Field strength of spurious radiation

FCC Part 24, Subpart E	Op. Mode	Setup	Port	Result
	op-mode 1	setup 3	enclosure	**passed**
	op-mode 3	setup 3	enclosure	**passed**

3.5 Occupied Bandwidth

Standard FCC Part 24, Subpart E 10-01-98

The test was performed according to: FCC §2.1049 10-01-1998

3.5.1 Test Description

1) The mobile station was coupled to the R&S ESI Spectrum Analyser and the R&S CMD55 Digital Communication Tester through a Power Divider and an Attenuator (20 dB) at the Spectrum Analyser input. Refer to chapter "Setup Drawings".

2) The total insertion losses for RF Path 1 and RF Path 2 were measured. The values were used to correct the readings from the R&S ESI Spectrum Analyser and the R&S CMD55 Digital Communication Tester.

3) A speech call was established on a Traffic Channel (TCH) between the mobile station and the base station simulator (R&S CMD55 Digital Communication Tester).
Important Settings:
- Discontinuous Transmission: OFF
- Modulation Signal: PSR16-1 (Pseudo Random Sequenz)
- Output Power: Maximum
- Channel : Varied during measurements
(lowest channel: 512, mid channel: 649 and highest channel: 810)

4) Important Analyser Settings:
- Resolution Bandwidth: 3 kHz (1% of the manufacturers stated occupied bandwidth)
- Video Bandwidth: 10 kHz (three times the Resolution Bandwidth)
- Sweep Span: 1 MHz (at least 250% of the emission bandwidth)

5) The maximum spectral level of the modulated signal was recorded as the reference.

6) The two furthest frequencies above and below the frequency of the maximum reference level where the spectrum is –26 dB down have to be found. The difference between these upper and lower frequencies is the 20 dB emission bandwidth.

3.5.2 Test Requirements / Limits

§ 2.1049 Measurements required: Occupied bandwidth

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions (as applicable):

(h) Transmitters employing digital modulation techniques - when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally,

the occupied bandwidth shall be shown for operation with any devices used for modifying the spectrum when such devices are optional at the discretion of the user.

(i) Transmitters designed for other types of modulation -

3. 5 .3 Test Protocol

Temperature: 29 °C
Air Pressure: 1020 hPa
Humidity: 39 %

Op. Mode	Setup	Port
op-mode 1	setup 1	antenna port

Bandwidth kHz	Remarks
316,6332	Sum of value delta marker 1(176,35270541 MHz) and delta marker 2 (140,28056112 MH

Remark: none

Temperature: 29 °C
Air Pressure: 1020 hPa
Humidity: 39 %

Op. Mode	Setup	Port
op-mode 2	setup 1	antenna port

Bandwidth kHz	Remarks
304,6092	Sum of value delta marker 1 (176,35270541 MHz) and delta marker 2 (128,25651303 MH

Remark: none

Temperature: 29 °C
Air Pressure: 1020 hPa
Humidity: 39 %

Op. Mode	Setup	Port
op-mode 3	setup 1	antenna port

Bandwidth kHz	Remarks
318,6373	Sum of value delta marker 1 (175,35570140 MHz) and delta marker 2 (143,28157315 MH

Remark: none

4. 5 .3 Test result: Occupied Bandwidth

FCC Part 24, Subpart E	Op. Mode	Setup	Port	Result
	op-mode 1	setup 1	antenna port	**passed**
	op-mode 2	setup 1	antenna port	**passed**
	op-mode 3	setup 1	antenna port	**passed**

3.6 Modulation Characteristics

Standard FCC Part 24, Subpart E 10-01-98

The test was performed according to: FCC §2.1047 10-01-1998

3.6.1 Test Description

See Test Description of "Frequency Stability" but instead of the frequency error the phase error of the mobile station was recorded by using an internal measurement function of the CMD55.

3.6.2 Test Requirements / Limits

The PCS mobile station uses GMSK modulation; therefore the test "Modulation Characteristics" does not apply.

To prove the modulation characteristics and accuracy in addition to the frequency error we have measured the phase error of the mobile station under extreme conditions.
The phase error is a measure for accuracy of the implemented modulation technology. The requirements for the phase error are specified in PCS 11.10 section 13 transmitter characteristics. If the phase error is below the specified limit of 20 degrees peak error and 5 degrees average error the EUT meets the specifications for PCS 1900 cellular phones.

3.6.3 Test Protocol

Temperature: 25 °C
Air Pressure: 1020 hPa
Humidity: 41 %

Op. Mode	Setup	Port
op-mode 4	setup 2	antenna port

		Minimum Voltage / V				Normal Voltage / V				Maximum Voltage /V			
		4.75				5.0				5.25			
Temperature °C	TX Duration min	Phase error (Peak) deg.		Phase error (RMS) deg.		Phase error (Peak) deg.		Phase error (RMS) deg.		Phase error (Peak) deg.		Phase error (RMS) deg.	
		AV	Max	AV	Max	AV	Max	AV	Max	AV	Max	AV	Max
-30	5	7,2	-10,9	2,4	3,5	7,1	12,3	2,3	3,7	7,1	-10,9	2,3	3,3
-30	10	7,2	-10,6	2,4	3,2	7	-10,8	2,4	3,4	6,9	-13,2	2,3	3,9
-20	0	7	-10,8	2,3	3,4	7,1	-12	2,4	3,6	7,3	-10,9	2,3	3,6
-20	5	7	-11,6	2,3	3,4	7	-11,5	2,3	3,3	6,8	-10,1	2,2	3,1
-20	10	6,8	-10,1	2,3	3,2	7	-10,6	2,3	3,3	6,9	-11,8	2,3	3,2
-10	0	7,2	-11,1	2,3	3,6	7	-12,1	2,3	3,4	6,9	-10,7	2,3	3,2
-10	5	6,8	-10,1	2,2	3,4	6,8	-11,8	2,3	3,4	7,1	-11,7	2,3	3,6
-10	10	7	-11,1	2,3	3,3	7	10,9	2,3	3,1	6,9	-10,3	2,3	3,3
0	0	7,3	9,9	2,4	3,3	7,1	-11,1	2,3	3,2	7,1	-10,6	2,3	3,3
0	5	7,1	-11,5	2,3	3,7	7	-10,5	2,3	3,7	6,9	-10,3	2,3	3
0	10	6,7	-10,3	2,2	3,4	6,9	10	2,3	3,3	6,8	-10,1	2,3	3,2
10	0	7	-10	2,2	3,3	6,9	-10,9	2,3	3,4	6,7	10,3	2,2	3,3
10	5	6,8	-9,9	2,2	3,4	7	-11,6	2,3	3,3	6,9	-10,8	2,3	3,5
10	10	6,9	-10,7	2,3	3,6	7	-10,7	2,3	3,4	6,9	11,1	2,3	3,3
20	0	6,8	-11,7	2,2	3,2	6,9	-9,6	2,3	3,2	6,8	-11,5	2,3	3,2
20	5	6,9	10,7	2,3	3,2	7	-11,7	2,3	3,3	7,1	-10,2	2,4	3,5
20	10	6,7	-11,2	2,2	3,4	6,8	9,5	2,3	3,1	7	11,7	2,3	3,5
30	0	6,8	-10,2	2,3	3,1	7,2	-10,7	2,3	3,4	7,2	10,2	2,3	3,5
30	5	6,8	-10,8	2,2	3,2	6,9	10,6	2,3	3,1	6,8	10,3	2,3	3,5
30	10	7	-10,4	2,3	3,3	7	-9,7	2,3	3,6	6,9	-10,8	2,3	3,2
40	0	6,9	10,4	2,9	3,1	7	9,8	2,3	3,2	6,8	-10,5	2,2	3,2
40	5	7	-11,2	2,3	3,5	7	-10,8	2,3	3,8	6,9	-10,1	2,3	3,4
40	10	6,9	-12,4	2,4	3,4	7,1	-10,5	2,3	3,3	6,8	-11,6	2,3	3,3
41	0	7,3	-10,6	2,4	3,4	7,3	-11,8	2,4	3,7	7,1	-10,9	2,4	3,3
50	0	7	11,3	2,3	3,7	7,5	11,3	2,4	3,7	7,1	-11,2	2,3	3,4
50	5	7	-11,1	2,3	3,4	7,3	-10,6	2,4	3,5	7,1	-11,6	2,4	3,7
50	10	7,5	-10,6	2,5	3,5	7,1	-10,4	2,4	3,3	7,1	-11,1	2,4	3,5

Remark: Minimum and maximum voltage were selected according to the product specification.

4.6.3 Test result: Modulation Characteristics

	FCC Part 24, Subpart E	Op. Mode	Setup	Port	Result
		op-mode 4	setup 2	antenna port	**passed**

4. Test Equipment

EUT Digital Signaling System

Equipment	Type	Serial No.	Manufacturer	Cal due
Digital Radio Communication Tester	CMD 55	831050/020	Rohde & Schwarz	17.06.01

EMI Test System

Equipment	Type	Serial No.	Manufacturer	Cal due
EMI Analyzer	ESI 26	830482/004	Rohde & Schwarz	29.06.01
Signal Generator	SMR 20	846834/008	Rohde & Schwarz	26.07.02
Comparison Noise Emitter	CNE III	99/016	York	04.05.01

EMI Radiated Auxiliary Equipment

Equipment	Type	Serial No.	Manufacturer	Cal due
High Pass Filter	4HC1600/12750-1.	9942011	Trilithic	02.11.00
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz	16.06.01
Cable "ESI to Horn Antenna"	RTK 081	W18.04+3599/001	Rosenberger	09.12.00
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz	18.05.01
Double-ridged horn	HF 906	357357/001	Rohde & Schwarz	18.05.01
Broadband Amplifier 45MHz-27GHz	JS4-00102600-42-5	619368	Miteq	
Log.-per. Antenna	HL 562 Ultralog	830547/003	Rohde & Schwarz	04.10.01
High Pass Filter	5HC2700/12750-1.	9942012	Trilithic	02.11.00
Pyramidal Horn Antenna 26,5 GHz	Model 3160-09	9910-1184	EMCO	22.08.01
Cable "ESI to EMI Antenna"	RTK081+Aircell7	W18.01+W38.01a	Huber+Suhner	09.12.00
Biconical dipole	VUBA 9117	9117108	Schwarzbeck	03.06.01

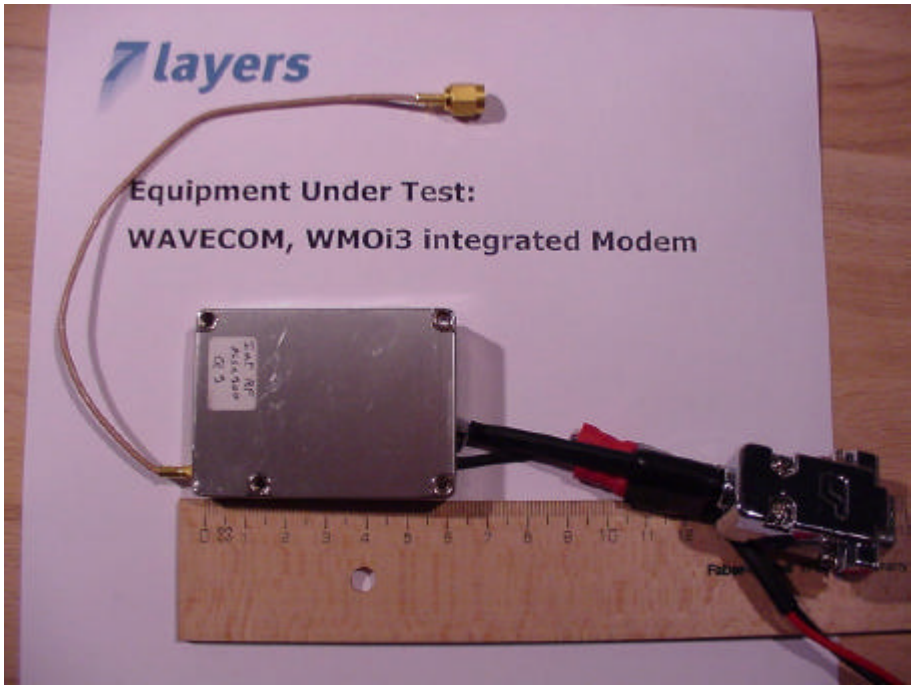
EMI Conducted Auxiliary Equipment

Equipment	Type	Serial No.	Manufacturer	Cal due
Two-Line V-Network	ESH 3-Z5	829996/002	Rohde & Schwarz	22.06.01
Cable "LISN to ESI"	RG214	W18.03+W48.03	Huber+Suhner	14.09.00
Two-Line V-Network	ESH 3-Z5	828304/029	Rohde & Schwarz	22.06.01

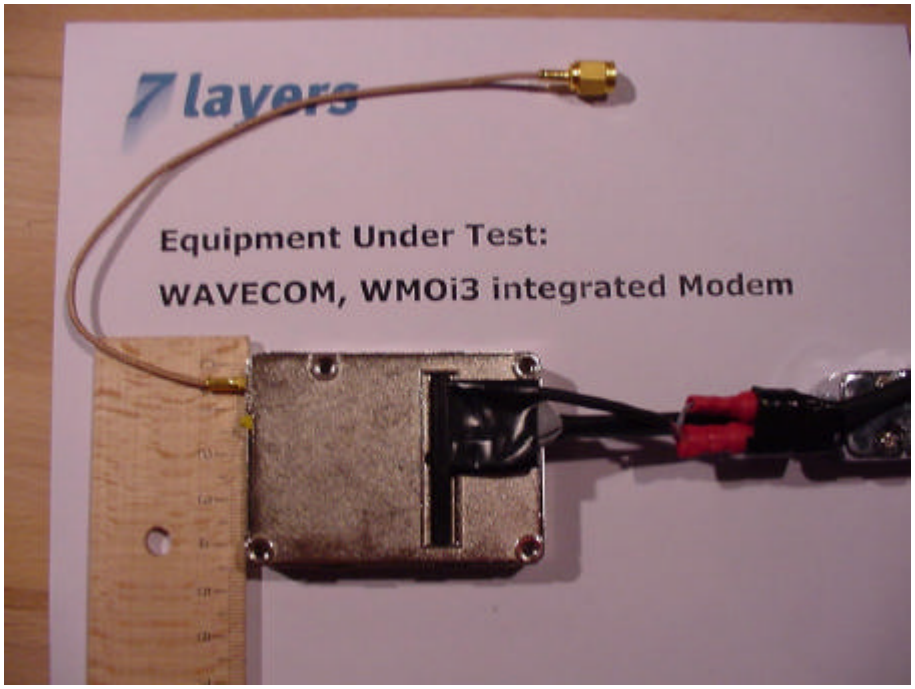
Auxiliary Test Equipment

Equipment	Type	Serial No.	Manufacturer	Cal due
Digital Multimeter 02	Voltcraft M-3860M	IJ095955	Conrad	03.06.01
Digital Multimeter 01	Voltcraft M-3860M	IJ096055	Conrad	03.06.01
Digital Oscilloscope	TDS 784C	B021311	Tektronix	26.05.01
Fibre optic link Transceiver	FO RS232 Link	182-018	Pontis	
Notch Filter ultra stable	WRCA800/960-6EE	24	Wainwright	03.02.03
Broadband Resist. Power Divider SMA	1515 / 93459	LN673	Weinschel	
Broadband Resist. Power Divider N	1506A / 93459	LM390	Weinschel	
Signal Generator	SMIQ 03B	832492/061	Rohde & Schwarz	09.11.00
I/Q Modulation Generator	AMIQ-B1	832085/018	Rohde & Schwarz	27.10.00
Temperature Chamber	VT 4002	58566002150010	Vötsch	
Temperature Chamber	S-1.2C-B	393/25-1389-27RF	Thermotron	23.05.03
Fibre optic link Satellite	FO RS232 Link	181-018	Pontis	

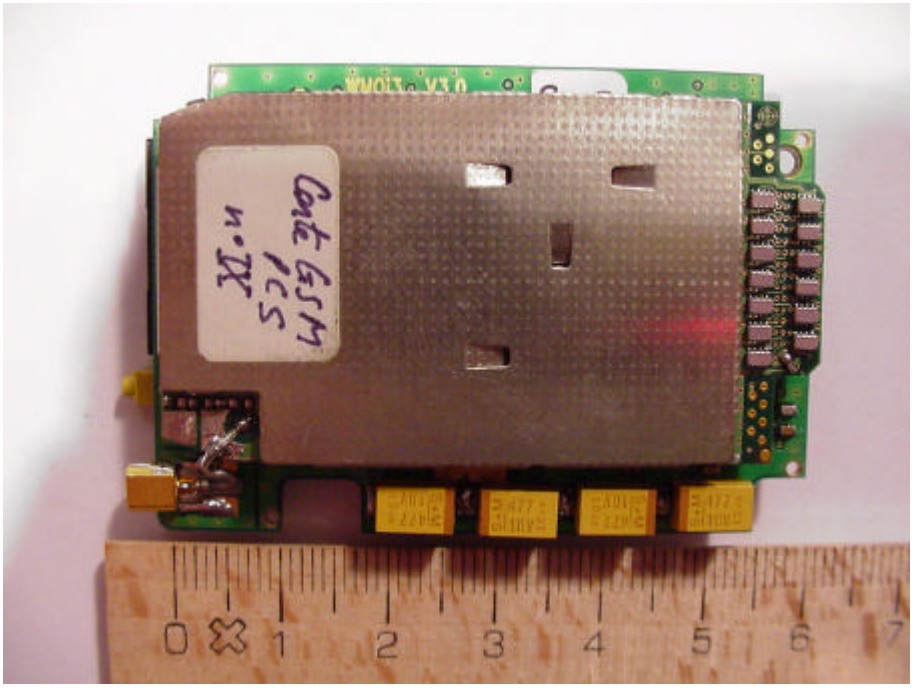
5. Foto Report



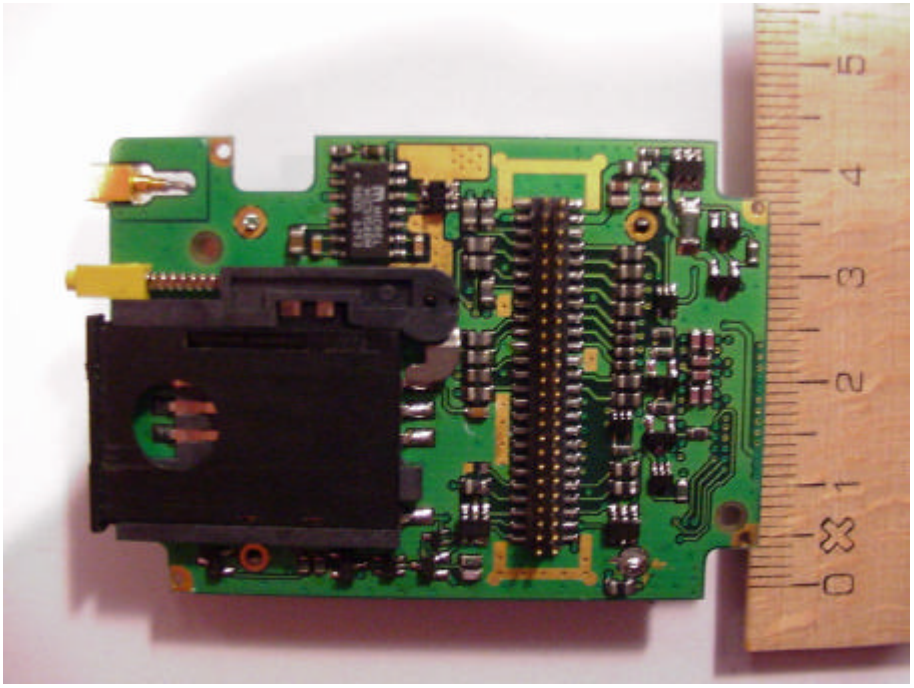
Picture 1 : Integrated Modem WMOi3 (top view)



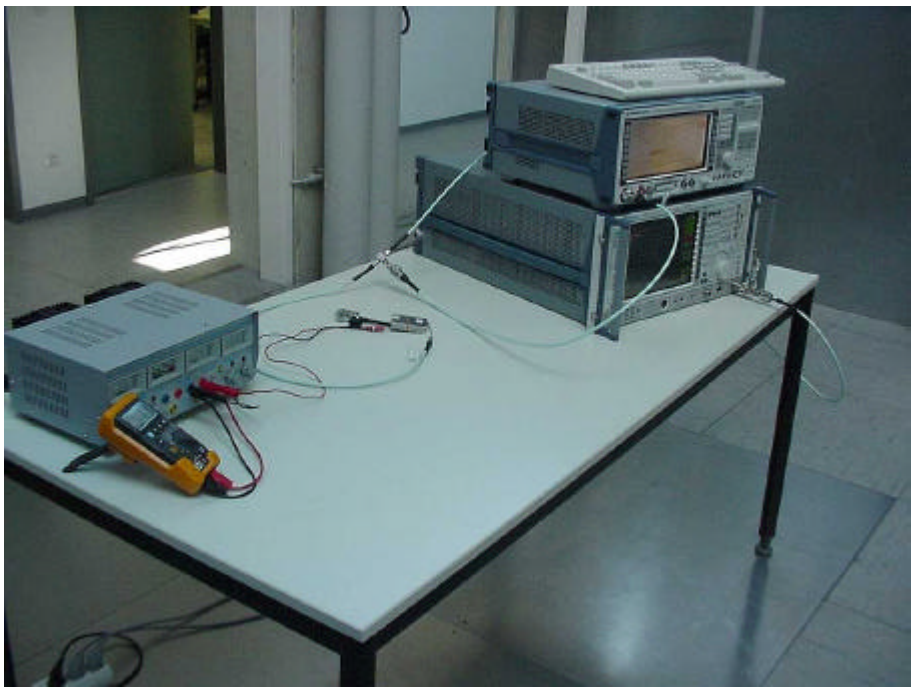
Picture 2 : Integrated Modem WMOi3 (bottom view)



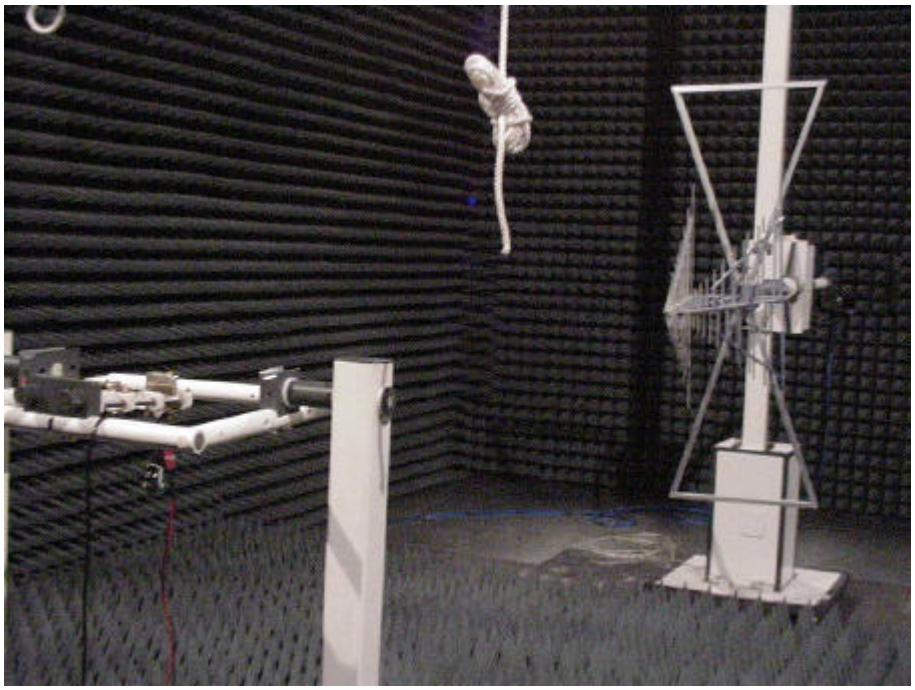
Picture 3 : Integrated Modem WMOi3, enclosure removed (PCB top view)



Picture 4 : Integrated Modem WMOi3, enclosure removed (PCB bottom view

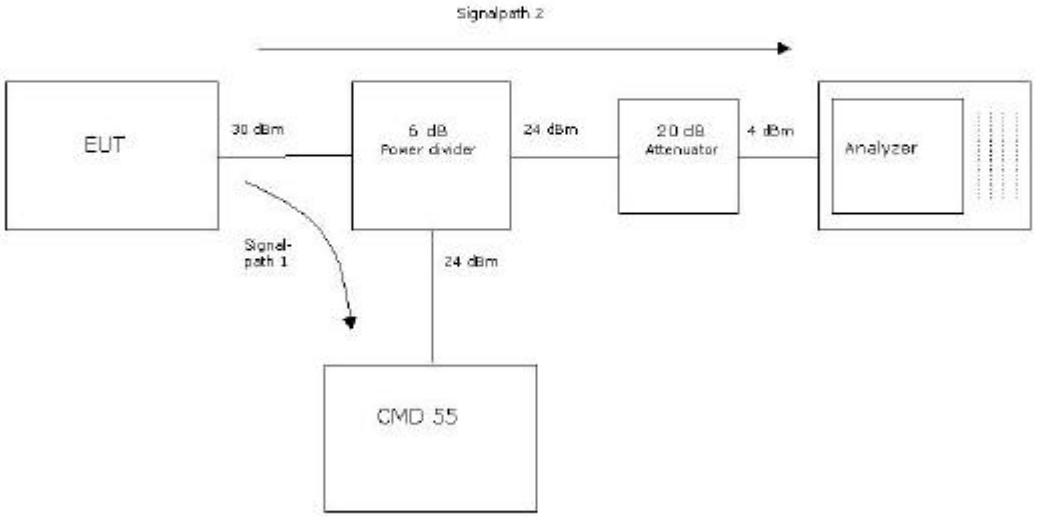


Picture 5 : Test set-up 1 for conducted measurements under nominal conditions

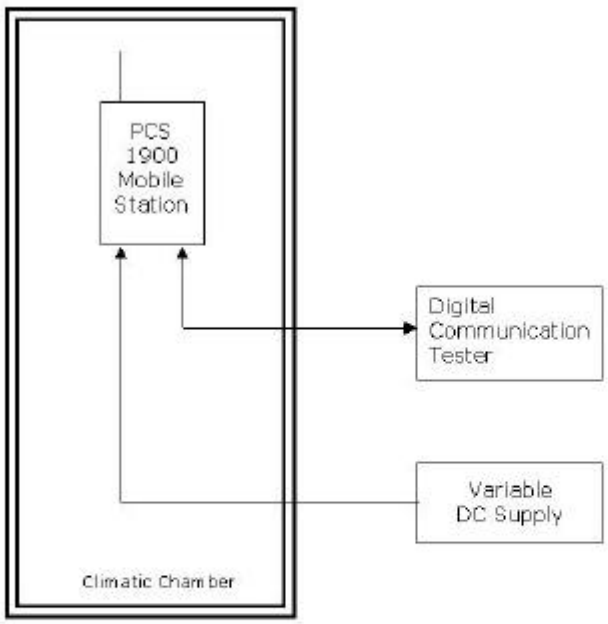


Picture 6 : Test set-up 3 for radiated measurements under nominal conditions

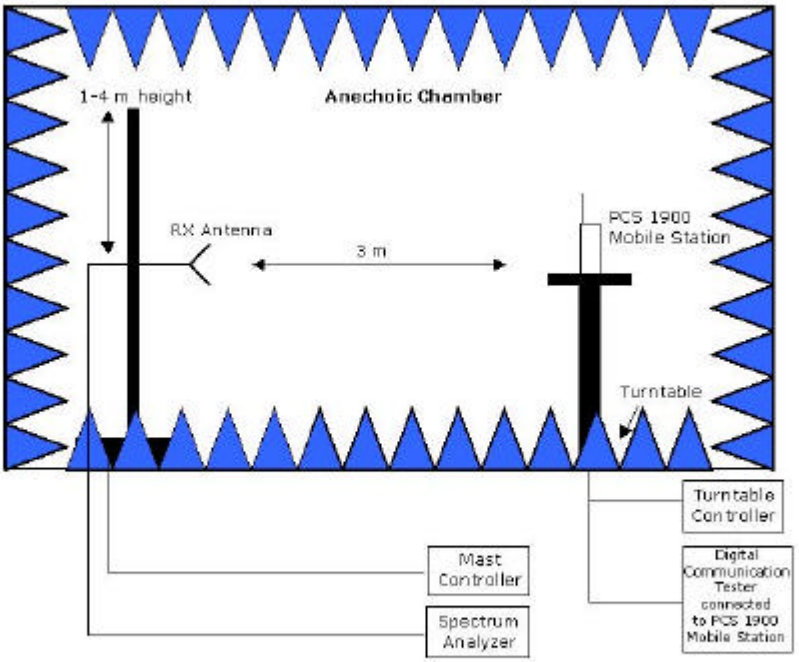
6. Setup Drawings



Drawin 1 : Setup 1 for conducted measurements under nominal conditions



Drawin 2 : Setup 2 for conducted measurements under extreme conditions



Drawin 3 : Setup 3 for radiated measurements under nominal conditions

7. Annex

Measurement plots