www.nemko.com

Report Reference ID:	209925-6_TRFWL

Test specification:	Title 47 – Telecommunication Chapter I – Federal Communications Commission Subchapter B – Common carrier services **Part 24 – Personal communications services** **Subpart D – Narrowband PCS**

Applicant:	TEKO Telecom S.p.A. Via Meucci, 24/a I-40024 Castel S. Pietro Terme (BO) (Italy)
Apparatus:	Digital Donor Front-End
FCC ID:	XM2-DFE
Model:	TDFE-9S

Testing laboratory:	**Nemko Italy S.p.A.** Via Carroccio, 4 I-20046 Biassono (Italy)

	Name and title	**Date**
Tested by:	G. Curioni, Wireless/EMC Specialist	2012/06/21
Reviewed by:	P. Barbieri, Wireless/EMC Specialist	2012/06/21

Table of contents

Section 1: Report summary

1.1 Test specification

Specifications	**Part 24 – Personal communications services** **Subpart D – Narrowband PCS**

1.2 Statement of compliance

Compliance	In the configuration tested the EUT was found compliant Yes ☒ No ☐ This report contains an assessment of apparatus against specifications based upon tests carried out on samples submitted at Nemko Canada Inc. These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 24, subpart D. Radiated tests were conducted in accordance with ANSI C63.4-2003.

1.3 Exclusions

Exclusions	None

1.4 Registration number

Test site FCC ID number	481407 (10 m Semi anechoic chamber)

1.5 Test report revision history

Revision #	Details of changes made to test report
TRF	Original report issued
R1TRF	---

1.6 Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Nemko Canada Inc. authorizes the applicant to reproduce this report provided it is reproduced in its entirety and for use by the company's employees only.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.

Nemko Canada Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Section 2: Summary of test results

2.1 FCC Part 24 Subpart D, test results

Part	Test description	Verdict
§24.131	Authorized bandwidth	N
§24.132	Output power	Pass
§24.133	Emissions limits	Pass
§24.135	Frequency stability	Pass
§2.1049	Occupied bandwidth	Pass
§2.1047	Modulation characteristics	Pass
§2-11-04/EAB/RF	Filter Frequency Response	Pass

Notes:

Section 3: Equipment under test (EUT) and application details

3.1 Applicant details		
Applicant complete business name	Name:	Teko Telecom S.p.A.
	Federal Registration Number (FRN):	0018963462
	Grantee code	XM2
Mailing address	Address: City: Province/State: Post code: Country:	Via Meucci, 24/a Castel S. Pietro Terme Bologna 40024 Italy

3.2 Modular equipment	
a) Single modular approval	Single modular approval Yes ☐ No ☒
b) Limited single modular approval	Limited single modular approval Yes ☐ No ☒

3.3 Product details		
FCC ID	Grantee code:	XM2
	Product code:	-DFE
Equipment class	PCB	
Description of product as it is marketed	Digital Donor Front-End	
	Model name/number:	TDFE-9S
	Serial number:	120857001

3.4 Application purpose	
Type of application	☒ Original certification ☐ Change in identification of presently authorized equipment Original FCC ID: Grant date: ☐ Class II permissive change or modification of presently authorized equipment

3.5 Composite/related equipment	
a) Composite equipment	The EUT is a composite device subject to an additional equipment authorization Yes ☐ No ☒
b) Related equipment	The EUT is part of a system that operates with, or is marketed with, another device that requires an equipment authorization Yes ☒ No ☐
c) Related FCC ID	If either of the above is “yes”: ☐ has been granted under the FCC ID(s) listed below: ☐ is in the process of being filled under the FCC ID(s) listed below: ☐ is pending with the FCC ID(s) listed below: ☐ has a mix of pending and granted statues under the FCC ID(s) listed below: i FCC ID: ii FCC ID:

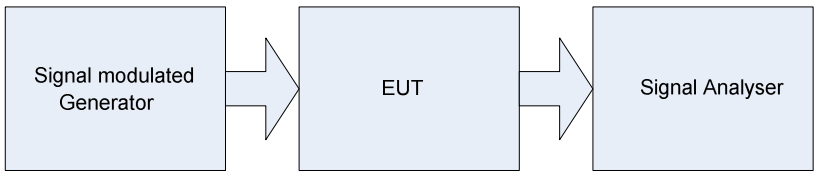
3.6 Sample information

Receipt date:	2012-06-11
Nemko sample ID number:	-----

3.7 EUT technical specifications

Operating band:	Down Link: 940–941 MHz, Up Link: 901-902 MHz
Operating frequency:	Wideband
Modulation type:	iDEN (QAM)
Occupied bandwidth:	25 kHz
Channel spacing:	standard
Emission designator:	D7W
RF Output	Down Link: 10dBm (0,010W) Up Link: 26dBm (0,400W)
Gain	Down Link: 63dB Up Link: 64dB
Antenna type:	External Antenna is not provided, equipment that has an external 50 Ω RF connector
Power source:	28-30 Vdc stand alone 100-240 Vac in subrack with external Ac/Dc power supply

3.8 EUT setup diagram



Section 4: Engineering considerations

4.1 Modifications incorporated in the EUT

Modifications	Modifications performed to the EUT during this assessment None ☒ Yes ☐, performed by Client ☐ or Nemko ☐ Details:

4.2 Deviations from laboratory tests procedures

Deviations	Deviations from laboratory test procedures None ☒ Yes ☐ - details are listed below:

4.3 Technical judgment

Judgment	None

Section 5: Test conditions

5.1 Power source and ambient temperatures

Normal temperature, humidity and air pressure test conditions	Temperature: 15–30 ℃ Relative humidity: 20–75 % Air pressure: 860–1060 hPa When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.
Power supply range:	The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

Section 6: Measurement uncertainty

Nemko S.p.A. measurement uncertainty has been calculated using the standard CISPR 16-4-2 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modeling – Uncertainty in EMC measurements“. All calculations have been performed to provide a confidence level of 95 % and can be found in Nemko S.p.A. document WML1002.

Section 7: Test equipment

Identification number	*Description*	*Manufacturer model*	*s/n*	*Cal. Due*
1a	Vector Signal Generator	Agilent N5182A MXG	MY48180714	May 2013
1b	Vector Signal Generator	Agilent E4438C ESG	MY45094485	Ago 2013
2	Spectrum Analyzer	Agilent E4440A	US40420470	Jul 2012
3	Network Analyzer	Agilent E5071B	MY42301133	Jan 2013
4	Climatic chamber	Angelantoni Hygros 600	7237	Nov 2014

Client's property

Identification number	*Equipment*	*Manufacturer*	*Model*	*Serial N°*	*Cal. due*
1	Trilog Broadband Antenna	Schwarzbeck	VULB 9163	VULB 9163-286	04/2013
2	Bilog antenna	Schwarzbeck	STLP 9148-123	123	09/2012
3	Double ridge waveguide horn	Spin	DRH40	061106A40	09/2013
4	Broadband preamplifier	Schwarzbeck	BBV 9718	9718-137	05/2013
5	Broadband preamplifier	Miteq	JS44	1648665	05/2013
6	Spectrum Analyzer 9kHz-40GHz	R&S	FSEK	848255/005	09/2012
7	Controller	EMCO	2090	9511-1099	NSC
8	Antenna Tower	EMCO	2071-2	9601-1940	NSC
9	Turning table Controller	EMCO	1061-1.521	9012-1508	NSC
10	Semi-anechoic chamber	Nemko	3m semi-anechoic chamber	70	04/2013
11	Control room	Siemens	3m control room	3	NSC

Property of Nemko Italy

Section 8: Testing data

8.1 Clause 24.131 Authorized bandwidth

The authorized bandwidth of narrowband PCS channels will be 10 kHz for 12.5 kHz channels and 45 kHz for 50 kHz channels. For aggregated adjacent channels, a maximum authorized bandwidth of 5 kHz less than the total aggregated channel width is permitted.

Special notes

The measurements were performed using RBW of 1 % of emission bandwidth.

Test data

Frequency (MHz)	Channel bandwidth (kHz)	Limit (kHz)	Margin (Hz)
		12.5/50	
		12.5/50	
		12.5/50	

NOT APPLICABLE

8.2 Clause 24.132 Output power

(a) Stations transmitting in the 901–902 MHz band are limited to 7 W (38.45 dBm) e.r.p.

(b) Mobile stations transmitting in the 930–931 MHz and 940–941 MHz bands are limited to 7 W (38.45 dBm) e.r.p.

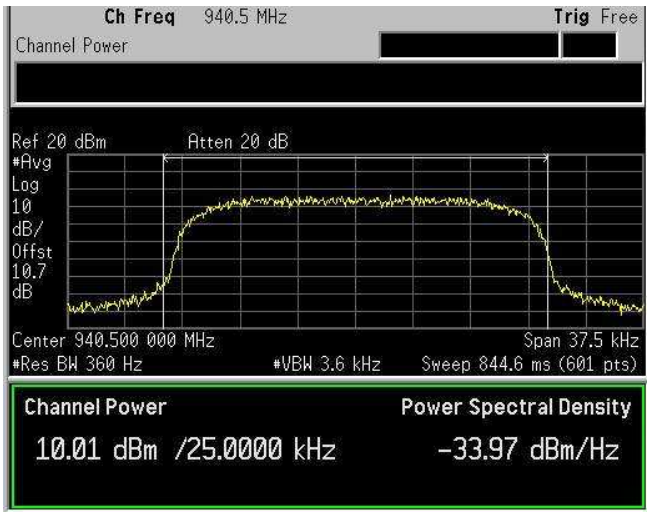
(c) Base stations transmitting in the 930–931 MHz and 940–941 MHz bands are limited to 3500 W (65.44 dBm) e.r.p. per authorized channel and are unlimited in antenna height except as provided in paragraph (d) of this section.

Special notes

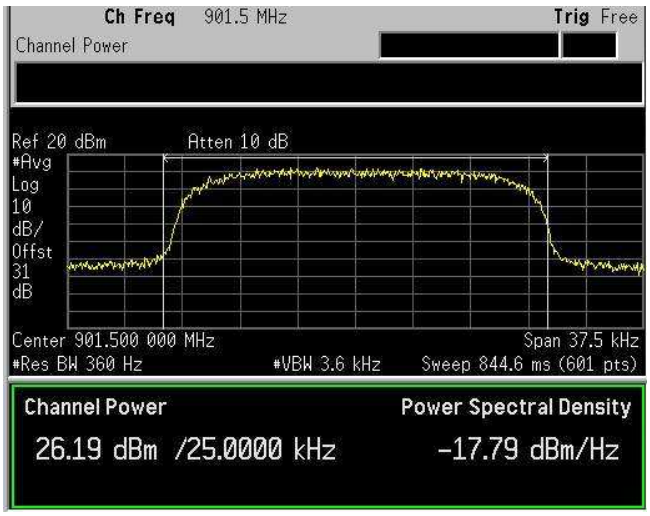
The measurements were performed with spectrum analyzer with RMS detector.

Test data			
Direction	Modulation	Frequency (MHz)	RF output power (dBm)
Down-link	iDEN (QAM)	940,5	10.01
Up-link	iDEN (QAM)	901,5	26.19

Mod. iDEN (QAM)



Down-link



Up-link

8.3 Clause 24.133 Emissions limits

(a) The power of any emission shall be attenuated below the transmitter power (P), as measured in accordance with §24.132(f), in accordance with the following schedule:

(1) For transmitters authorized a bandwidth greater than 10 kHz:

(i) On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (f_d in kHz) of up to and including 40 kHz: at least 116 Log10((f_d +10)/6.1) decibels or 50 plus 10 Log10(P) decibels or 70 decibels, whichever is the lesser attenuation;

(ii) On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 40 kHz: at least 43+10 Log10(P) decibels or 80 decibels, whichever is the lesser attenuation.

(2) For transmitters authorized a bandwidth of 10 kHz:

(i) On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (f_d in kHz) of up to and including 20 kHz: at least 116 × Log10((f_d +5)/3.05) decibels or 50+10×Log10(P) decibels or 70 decibels, whichever is the lesser attenuation;

(ii) On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 20 kHz: at least 43+10 Log10(P) decibels or 80 decibels, whichever is the lesser attenuation.

(b) 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.

(c) 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.

(d) The following minimum spectrum analyzer resolution bandwidth settings will be used: 300 Hz when showing compliance with paragraphs (a)(1)(i) and (a)(2)(i) of this section; and 30 kHz when showing compliance with paragraphs (a)(1)(ii) and (a)(2)(ii) of this section.

§24.132(f): All power levels specified in this section are expressed in terms of the maximum power, averaged over a 100 millisecond interval, when measured with instrumentation calibrated in terms of an rms-equivalent voltage with a resolution bandwidth equal to or greater than the authorized bandwidth.

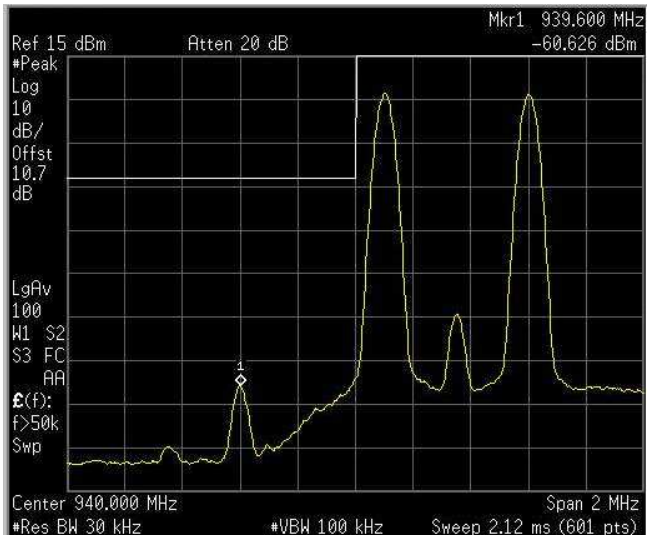
Special notes

- The spectrum was searched from 30 MHz to the 10th harmonic.
- All measurements were performed using a RMS detector.
- RBW within 30–1000 MHz was 100 kHz and 1 MHz above 1 GHz. VBW was wider than RBW.

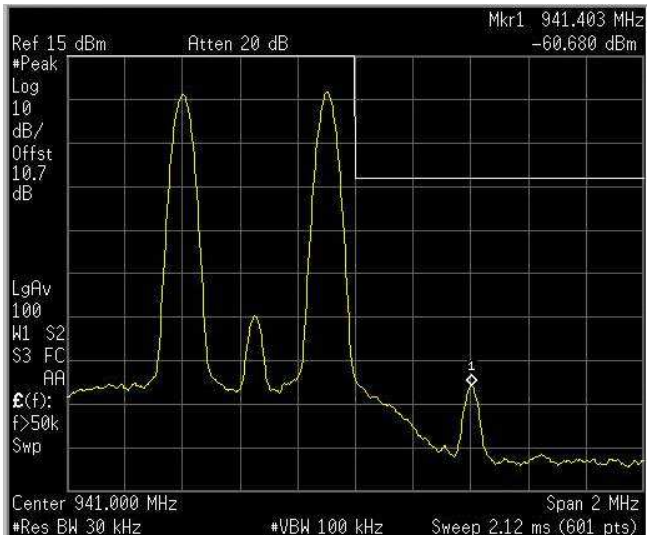
Test data			
Insert plots here			
Spurious emissions measurement results:			
Frequency (MHz)	Spurious emission (dBm)	Limit (dBm)	Margin (dB)
Low channel			
First channel Down-link	Negligible	-13	
First channel Up-link	Negligible	-13	
Mid channel			
940.5 MHz Down-link	Negligible	-13	
901.5 MHz Down-link	Negligible	-13	
High channel			
Last channel Down-link	Negligible	-13	
Last channel Up-link	Negligible	-13	

See Plots below

Mod. iDEN (QAM) (Down-link)

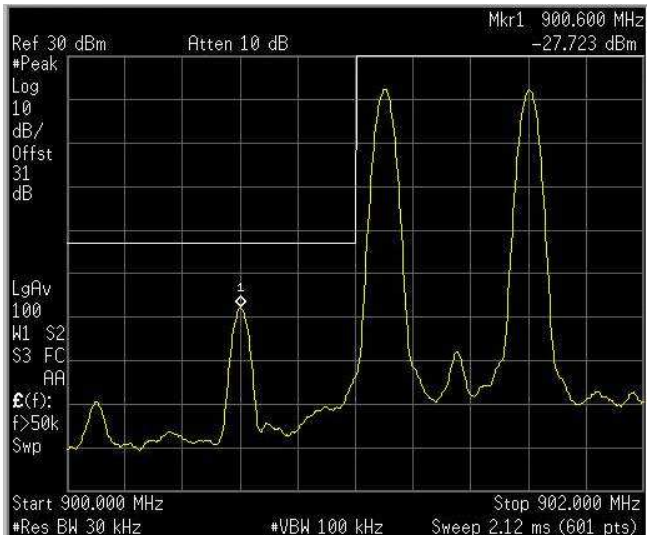


Low Band Edge

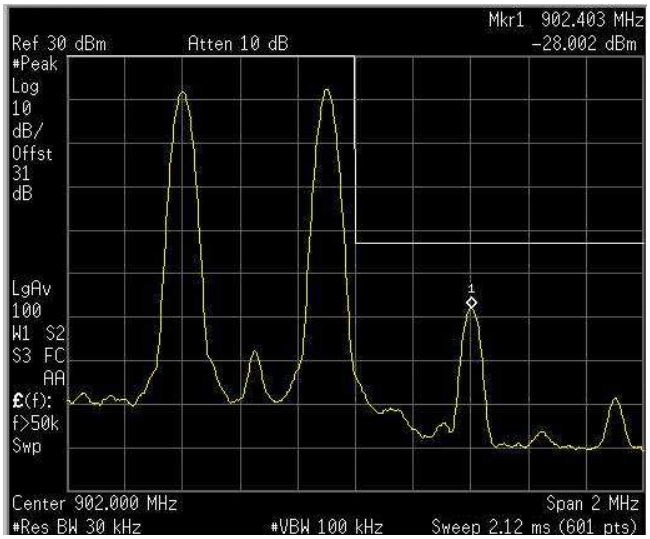


High Band Edge

Mod. iDEN (QAM) (Up-link)

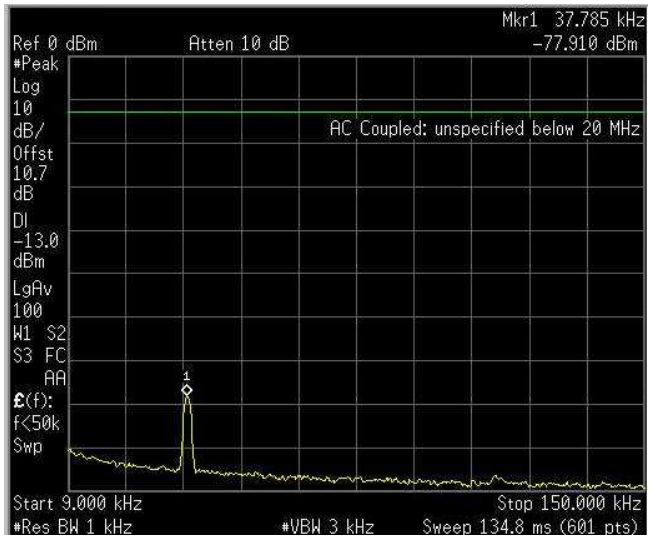


Low Band Edge

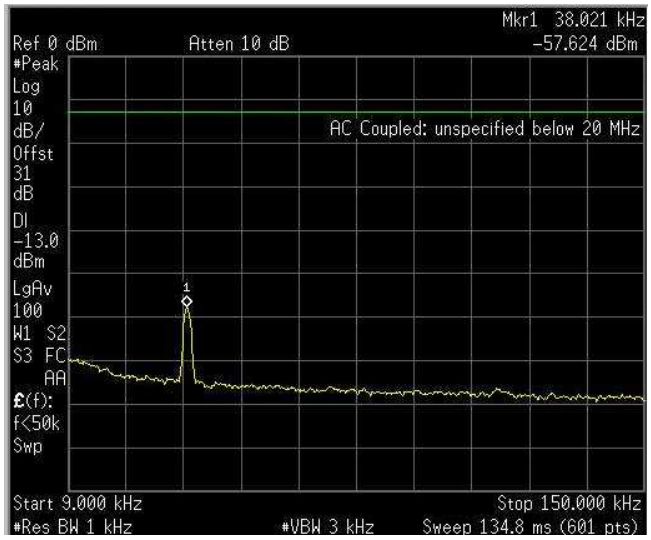


High Band Edge

Mod. iDEN (QAM) (9kHz-150kHz)

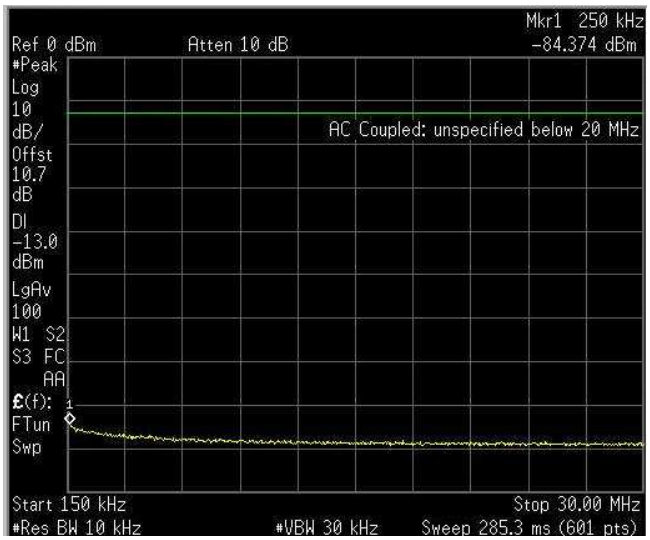


Downlink

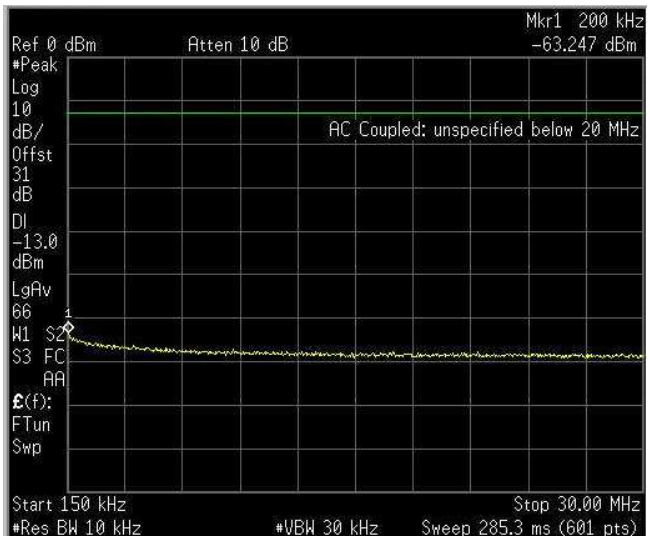


Uplink

Mod. iDEN (QAM) (150kHz-30MHz)

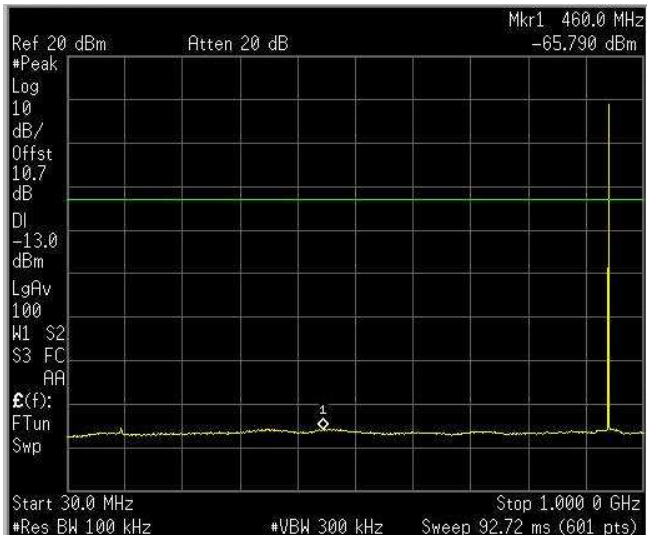


Downlink

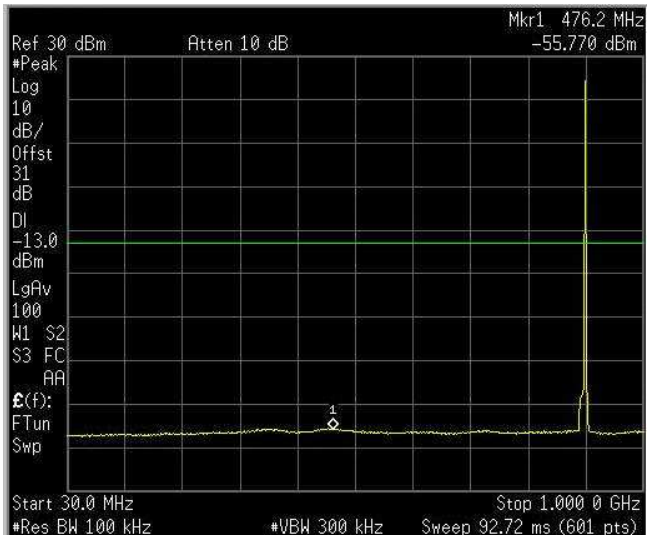


Uplink

Mod. iDEN (QAM) (30MHz-1GHz)

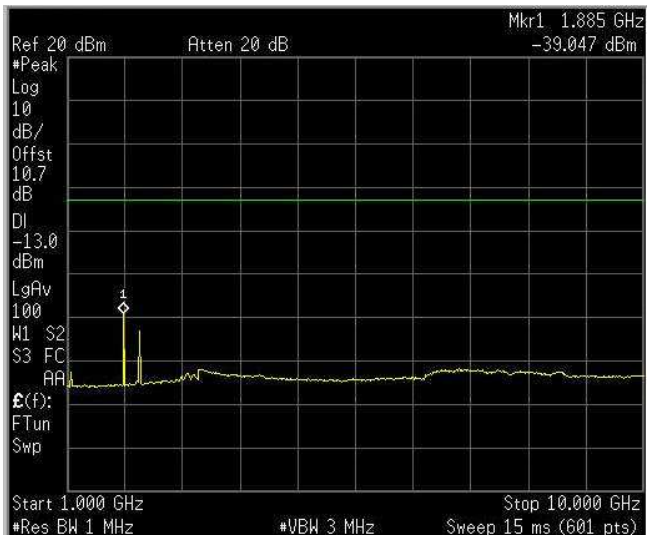


Downlink

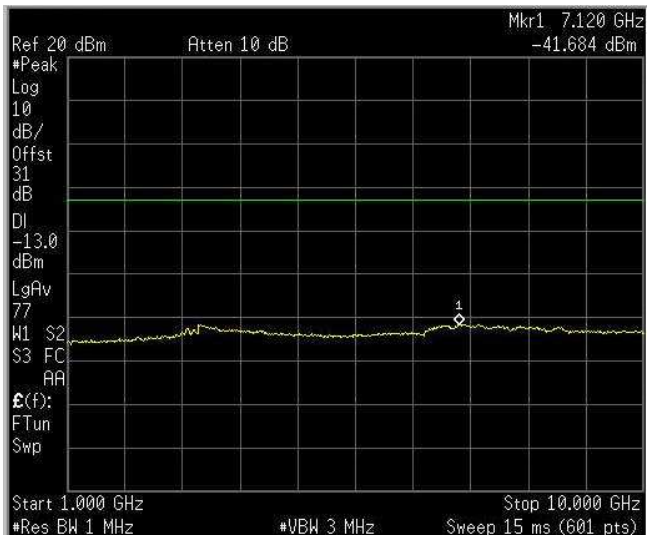


Uplink

Mod. iDEN (QAM) (1GHz -10GHz)



Downlink



Uplink

Field Strength of Spurious Radiation

The D.U.T. was positioned according to the radiated emissions set-up

The D.U.T. antenna connector was terminated by a 50 Ω shielded dummy load.

The spectrum was searched from 30 MHz to 1 GHz (RBW 100 kHz) & 1 GHz (RBW 1 MHz)to the tenth harmonic of the carrier.

There were no emissions detected above the noise floor which was at least 20 dB below the specification limit.

8.4 Clause 24.135 Frequency stability

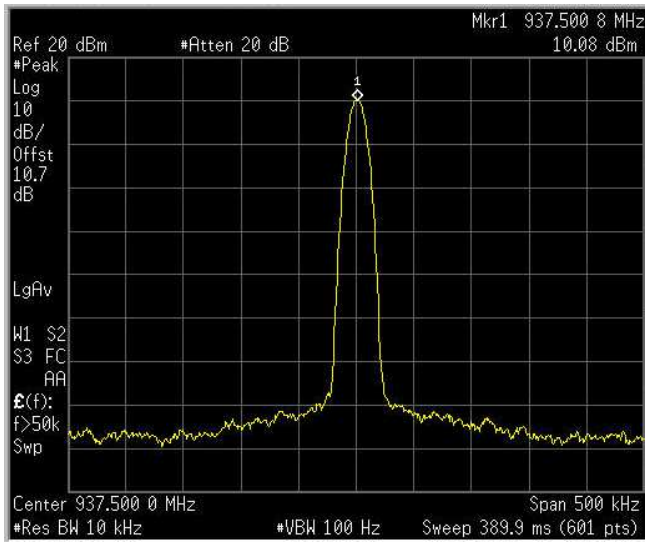
(a) The frequency stability of the transmitter shall be maintained within ±0.0001 percent (±1 ppm) of the center frequency over a temperature variation of −30 ℃ to +50 ℃ at normal supply voltage, and over a variation in the primary supply voltage of 85 percent to 115 percent of the rated supply voltage at a temperature of 20 ℃.

(b) For battery-operated equipment, the equipment tests shall be performed using a new battery without any further requirement to vary supply voltage.

(c) It is acceptable for a transmitter to meet this frequency stability requirement over a narrower temperature range provided the transmitter ceases to function before it exceeds these frequency stability limits.

Special notes

Test data, continued

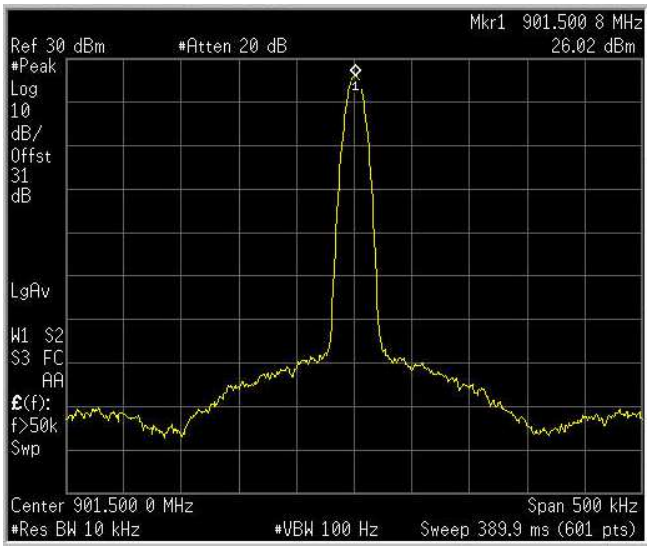


Down-link

Conditions	Frequency (Hz)	Offset (ppm)
+50 °C, Nominal power	940 500 800	0
+40 °C, Nominal power	940 500 800	0
+30 °C, Nominal power	940 500 800	0
+20 °C, +15 % power	940 500 800	0
+20 °C, Nominal power	940 500 800	Reference
+20 °C, -15 % power	940 500 800	0
+10 °C, Nominal power	940 500 800	0
0 °C, Nominal power	940 500 800	0
−10 °C, Nominal power	940 500 800	0
−20 °C, Nominal power	EUT doesn't work	
−30 °C, Nominal power	EUT doesn't work	

- Note: Offset calculation: $\frac{F_{Measured} - F_{reference}}{F_{reference}} \times 1 \cdot 10^{6}$
- Maximum frequency drift is 0 kHz

Test data, continued



Up-link

Conditions	Frequency (Hz)	Offset (ppm)
+50 °C, Nominal power	901 500 800	0
+40 °C, Nominal power	901 500 800	0
+30 °C, Nominal power	901 500 800	0
+20 °C, +15 % power	901 500 800	0
+20 °C, Nominal power	901 500 800	Reference
+20 °C, -15 % power	901 500 800	0
+10 °C, Nominal power	901 500 800	0
0 °C, Nominal power	901 500 800	0
−10 °C, Nominal power	901 500 800	0
−20 °C, Nominal power	EUT doesn't work	
−30 °C, Nominal power	EUT doesn't work	

- Note: Offset calculation: $\frac{F_{Measured} - F_{reference}}{F_{reference}} \times 1 \cdot 10^{6}$
- Maximum frequency drift is 0 kHz

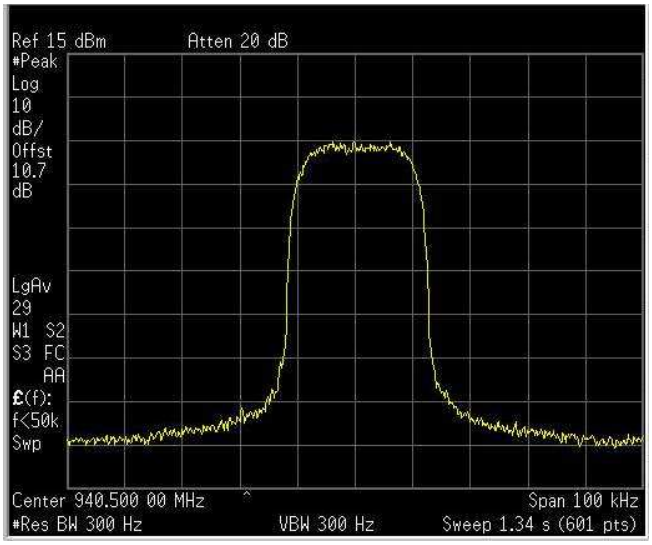
8.5 Clause 2.1049 Occupied bandwidth

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.

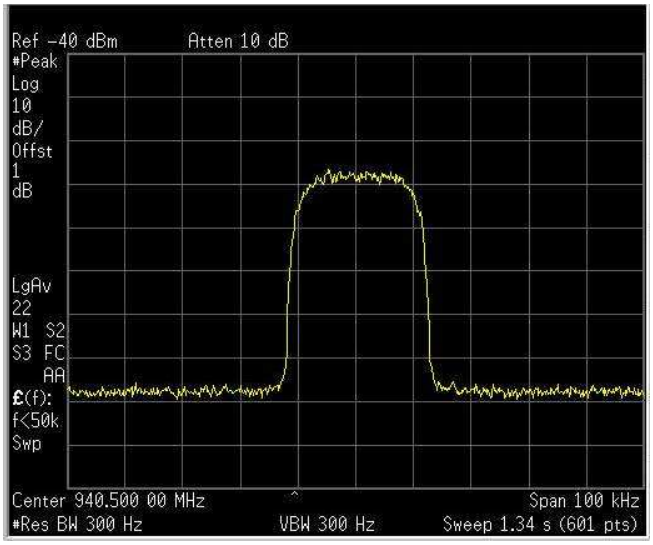
Special notes

- 26 dBc points provided in terms of attenuation below unmodulated carrier.
- RBW was set to 1 % of emissions bandwidth.

Mod. iDEN (QAM) (Down-link)

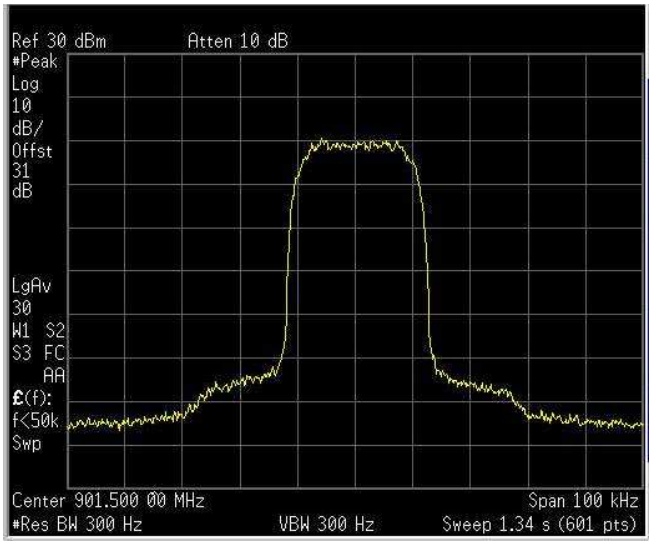


Output

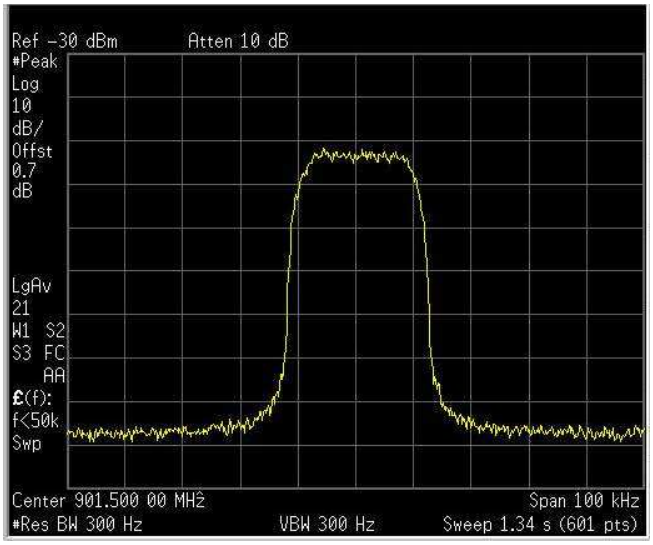


Input

Mod. iDEN (QAM) (Up-link)



Output



Input

Clause 90.207 Modulation characteristics

Unless specified elsewhere in this part, stations will be authorized emissions as provided for in paragraphs (b) through (n) of this section.

§ 2.1047 Measurements required: Modulation characteristics.

(a) Voice modulated communication equipment. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.

(b) Equipment which employs modulation limiting. A curve or family of curves showing the percentage of modulation versus the modulation input voltage shall be supplied. The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.

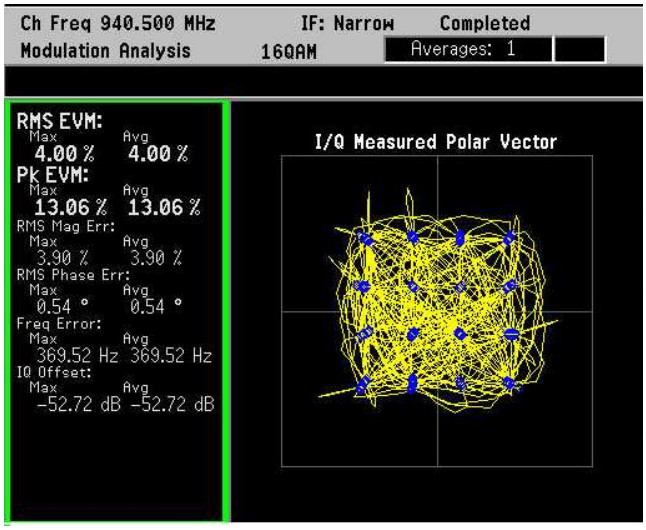
(c) Single sideband and independent sideband radiotelephone transmitters which employ a device or circuit to limit peak envelope power. A curve showing the peak envelope power output versus the modulation input voltage shall be supplied. The modulating signals shall be the same in frequency as specified in paragraph (c) of §2.1049 for the occupied bandwidth tests.

(d) Other types of equipment. A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

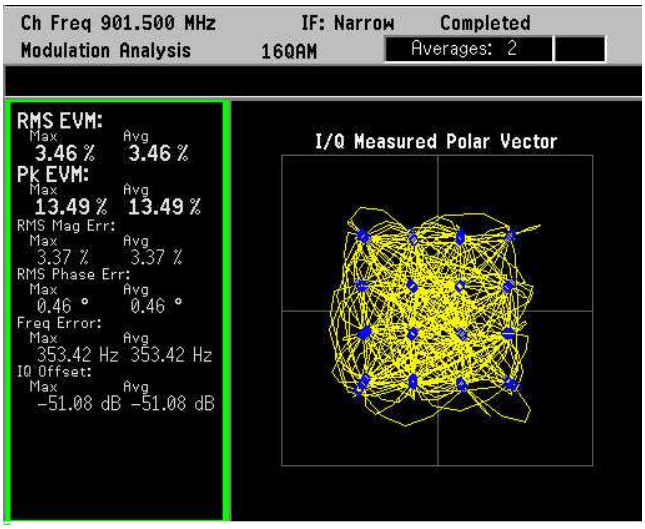
Test date: 2012-06-11

Test results: Pass

Mod. iDEN (QAM)

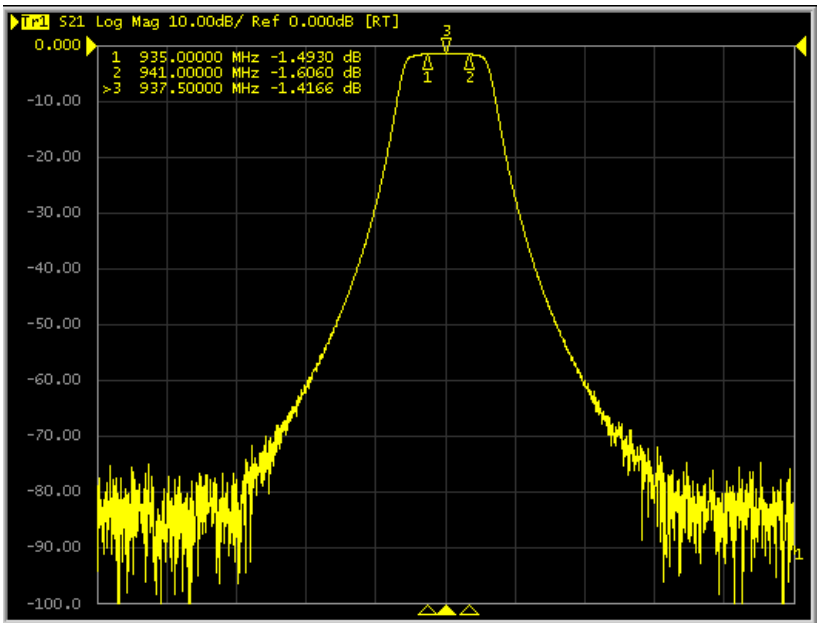


Down-link

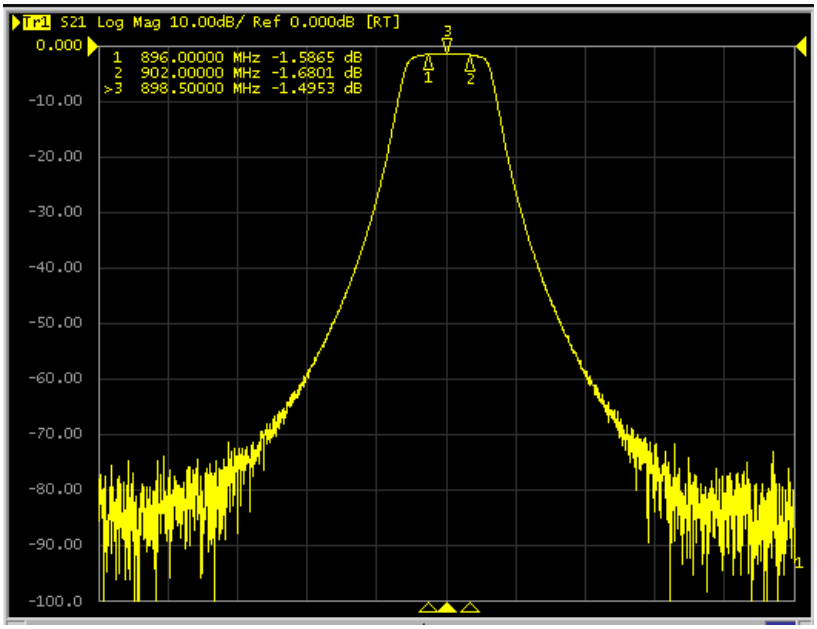


Up-link

Section 9: Filter Frequency Response



Down-link

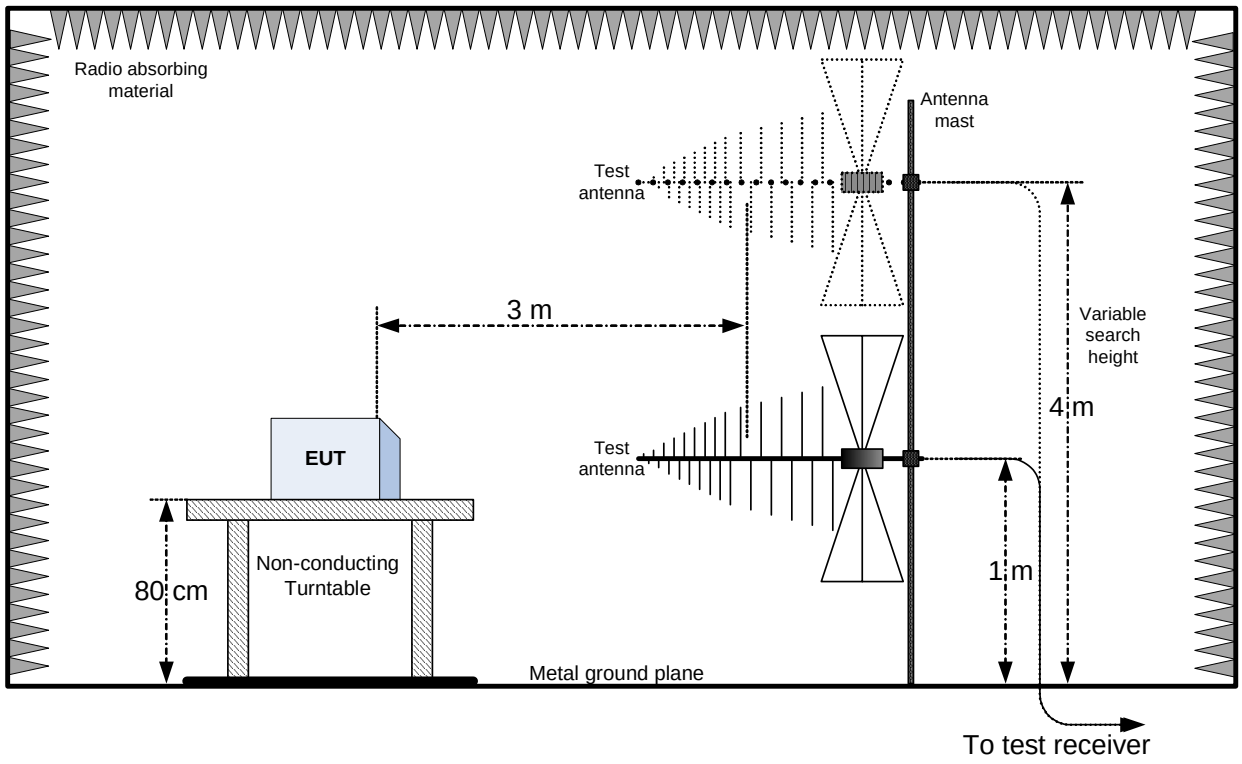


Up-link

REMARKS: Booster TDFE-9S works simultaneously on both SMR900 band and PCS Narrow band being adjacent channel (down-link band 935-940 + 940-941MHz and adjacent Up link band 896-901 + 901-902 MHz).

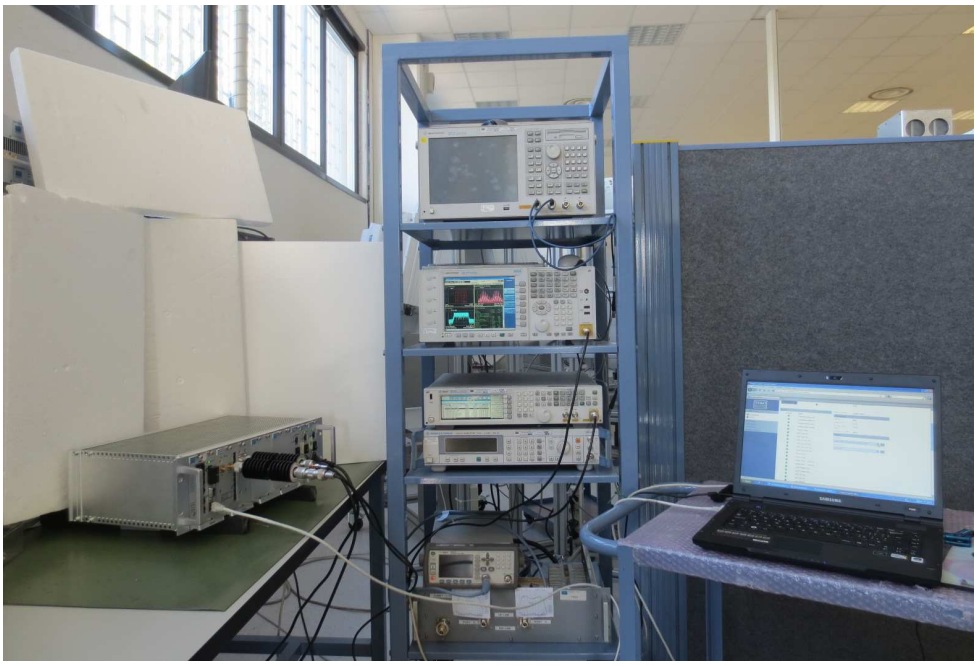
Section 10: Block diagrams of test set-ups

Radiated emissions set-up



Section 11: EUT photos

Photo Set up



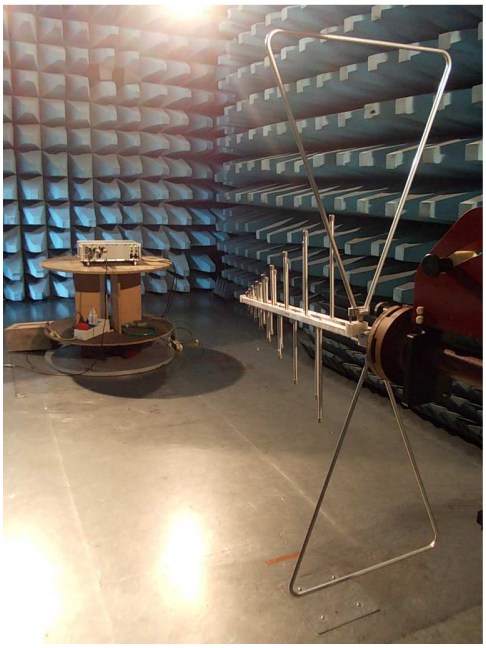


Photo EUT


TSPV-R
TDFE-7SL
TPSUAC


Nemko