Nemko TEST REPORT

Date:	**ESPOO 29.02.2008**	Page:	**1 (39)**
		Appendices	–

Number: **102639**
No. 1 / 1

Date of handing in: 27.02.2008

Measured by:

Timo Hietala, Test Engineer

Reviewed by:

Timo Leismala, Test Manager

SORT OF EQUIPMENT:	**WiMAX Base Station RF module**
MARKETING NAME:	***Nokia Siemens Networks Flexi WiMAX BTS RF module 2.5GHz***
TYPE:	***FYRF***
MANUFACTURER:	***Nokia Siemens Networks Oy***
FCC ID:	**VBNFYRF-01**
CLIENT:	**Nokia Siemens Networks Oy**
ADDRESS:	**P.O.Box 319, FI-90651 OULU, FINLAND**
TELEPHONE:	**+358 7180 08000**
TEST LABORATORY:	**NSN Oulu**
FCC REG. NO.	**411251**
REFERENCE:	**FCC Part 27, SUBPART M**

SUMMARY:

In regard to the performed tests the equipment under test fulfils the requirements defined in the test specifications, see page 4 for details

Contents

1. EUT and Accessory Information

1.1 EUT description

The EUT is a WiMAX Base station RF module 2.5 GHz with 2 power amplifier.

1.2 EUT and accessories

Manufacturer:	Nokia Siemens Networks Oy
Model:	FYRF, s/n: K7080800004
Other Units:	System module, FYSB, s/n: L9080100305
General:	All measurements are traceable to national standards.

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 27, Subpart M.

☒	New Submission	☒	Production Unit
☐	Class II Permissive Change	☐	Pre-Production Unit

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE. **NONE**

This report applies only to the items tested.

Summary of Test Data

NAME OF TEST	SECTION IN CFR 47	SPEC.	RESULT
RF Power Output	27.50 (h), 2.1046	33 dBW+ 10log(X/Y) dBW	**Complies**
99% Occupied Bandwidth	2.1049, (i)	Unspecified	**Complies**
Spurious Emissions at Antenna Terminals	27.53(l)(2)(6), 2.1051	- 13 dBm	**Complies**
Field Strength of Spurious Emissions	27.53(l)(2), 2.1053	- 13 dBm E.I.R.P	**Complies**
Frequency stability	27.54, 2.1055	± 0.05 ppm[1)]	**Complies**

Note [1)] Limit is the manufacturer's specification

Measurement uncertainty is expressed to a confidence level of 95%.

2. General Equipment Specification

Supply Voltage Input:	48 Vdc
Frequency Bands: TX:	☒ 2583 – 2690 MHz Lowest tunable freq. 2588.000 MHz Middle freq. 2636.000 MHz Highest tunable freq. 2685.000 MHz
Frequency Bands: RX:	☒ 2583 – 2690 MHz
Emission Designator:	**WiMAX (10M0W7D)**
Maximum No. of Carriers:	1
Output Impedance:	50 ohms.
RF Power Output:	43 dBm (20 W) conducted
Duty Cycle:	1:1 to 3:1
Duplex Mode:	Time Division Duplex (TDD)
Channel Bandwidth:	10 MHz
Modulation:	QPSK 16QAM 64QAM

System Description

Nokia Flexi WiMAX Base Station is based on WiMAX TDD (Time Division Duplex) system and is designed according to IEEE 802.16e-2005 radio access technology. This is a licensed base transceiver station and is designed for use with antennas that are fixed mounted on outdoor permanent structures.

Test setup
Nokia BTS Site Manager is used for the BTS's configuration. The AHTI is used for sending test model and PER measure messages.
Nokia BTS Site Manager has the following features:
- BTS set-up management (e.g. parameter settings, software downloading).
- BTS status monitoring.

The AHTI has the following features:
- BTS Testing.

All RF tests were performed in normal temperature by repeating the Frequency Stability in environmental chamber.
Frequency Stability was performed also over a variation in the primary supply voltage 85 percent to 115 percent of the rated supply voltage at a temperature of 20° Celsius.
The test configurations were as close to normal intended use as possible. Cable connections were accordance with the instruction of the manufacturer.
Grounding of the equipment was performed in accordance with the guideline of the manufacturer.
All measurements were performed on the base station downlink signal, when having the base station transmitter active at maximum power level. For all tests test model 67075 was used.

Test model 67075
The WiMAX system protocol utilizes three modulations with various code rates.
Test model 67075 includes modulation types; QPSK, 16-QAM and 64-QAM. The code rate doesn't change the transmitted RF signal, therefore it's not necessary to measure all possible variations.
In Test model 67075 the modulation mode is switched continuously at maximum speed permitted by the system and all the supported modulation schemes are used. Test model 67075 duty cycle was 60%.
Test model 67075 has been specified worst case frame structure and the information presented in this test report is believed to represent a worst case scenario.

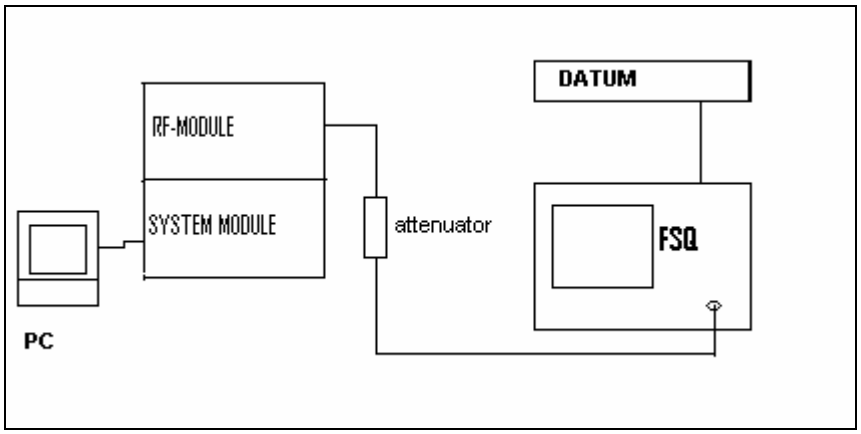


Figure TX test setup

The BTS under test (System Module + RF Module) was DC powered and configuration of 1 carrier which rated output power is 20W, 1*1 20W.
The BTS System Module contains the Transport functional block (Transport Sub-module), the Control & Clock functional block and the BB functional block, whereas the RF Module contains the RF functional block.
For transmitter measurements, Signal Analyzer Rohde & Schwarz FSQ 26 with K93 WiMAX-option was used.

3. RF Power Output

NAME OF TEST: RF Power Output	PARA.NO.: 27.50 (h) & 2.1046
TESTED BY: Timo Hietala	DATE: 27/02/2008

Test Results: Complies.

Measurement Data: Refer to attached plot.

Modulation Type	Frequency (MHz)	Measured Output Power (dBm)	Power (W)
Test model 67075	2588	**43.27**	**21.23**
Test model 67075	2636	**43.34**	**21.58**
Test model 67075	2685	**43.20**	**20.89**

Note: Test model 67075 includes modulation types; QPSK, 16-QAM and 64-QAM, duty cycle 60%

Equipment used: 11, 12, 17, 18

Measurement Uncertainty: ± 0.7 dB.

Temperature: 23 °C.

Relative Humidity: 10 %.

Test Data – RF Power Output

Nemko Oy, Finland

Data Plot

RF POWER OUTPUT

Page 1 of 7 — Complete x

Job No.:	102639	Date:	27/02/2008	Preliminary:	
Specification:	PT27	Temperature (°C):	23		
Tested By:	Timo Hietala	Relative Humidity (%):	10		
E.U.T.:	WiMAX TRANSMITTER				
Configuration:	TX FULL POWER BOTTOM CHANNEL				
Sample Number:	1				
Location:	NET/IMN Oulu	RBW:	Refer to plots	Measurement	
Detector type:	Rms	VBW:	Refer to plots	Distance:	N/A m

Test Equipment Used

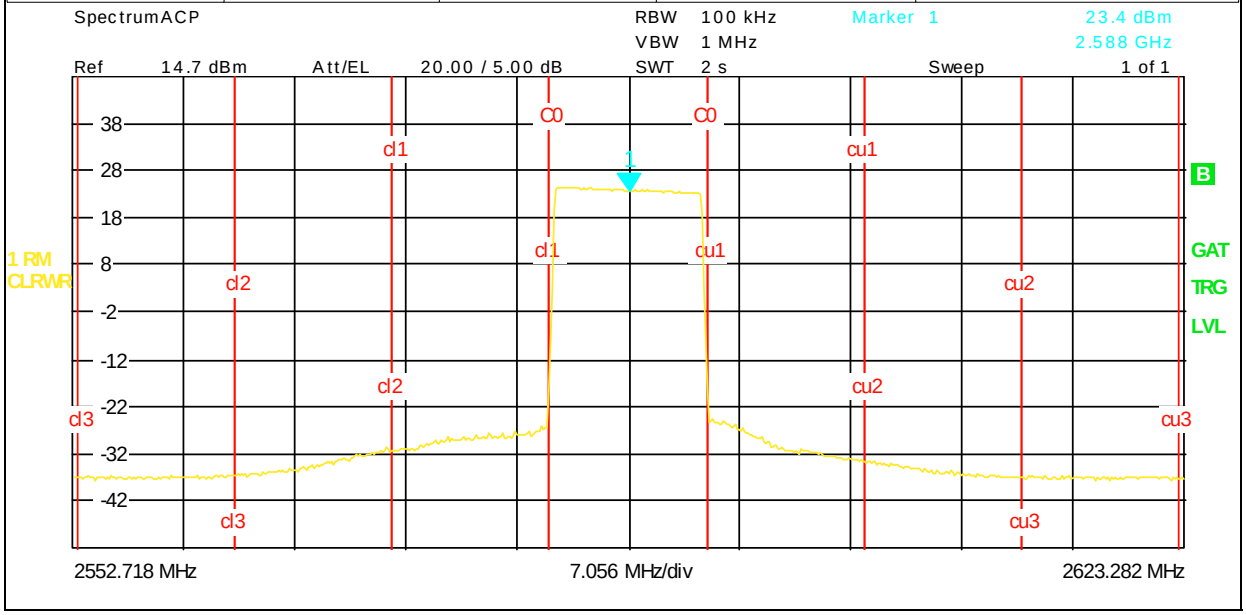
Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	
Filter:		Cable #2:	
Receiver:	1	Cable #3:	
Attenuator #1:	17	Cable #4:	
Attenuator #2:		Mixer:	
Additional equipment used:			
Measurement Uncertainty:	± 0.7 dB		

IEEE 802.16e-2005 OFDMA

Frequency: 2.588 GHz	Signal Level Setting: 13.2 dBm	Ref. Level / Att: 14.7 dBm / 32.8 dB
N_{FFT}: 1024	Sweep Mode: Continuous	Trigger Mode / Offset: Power/0 S
Zone / Seg: DL-PUSC, ID=A, Seg=0	Modulation: ALL	Zone Offset / Length: 1/28 Symbols

Adjacent Channel Power Relative

Channel	Bandwidth	Spacing	Lower	Upper
TX	10 MHz	...	43.15 dBm	
Adjacent	10 MHz	10 MHz	-52.11 dB	-52.32 dB
Alternate1	10 MHz	20 MHz	-57.41 dB	-58.99 dB
Alternate2	10 MHz	30 MHz	-60.40 dB	-60.48 dB
Alternate3	...	...	...	...
Alternate4	...	...	...	...



Notes:

Test Data – RF Power Output

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Data Plot

RF POWER OUTPUT

Page 2 of 7 | Complete x

Job No.:	102639	Date:	27/02/2008	Preliminary:	
Specification:	PT27	Temperature (°C):	23		
Tested By:	Timo Hietala	Relative Humidity (%):	10		
E.U.T.:	WiMAX TRANSMITTER				
Configuration:	TX FULL POWER CENTER CHANNEL				
Sample Number:	1				
Location:	NET/IMN Oulu	RBW:	Refer to plots	Measurement	
Detector type:	Rms	VBW:	Refer to plots	Distance:	N/A m

Test Equipment Used

Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	
Filter:		Cable #2:	
Receiver:	1	Cable #3:	
Attenuator #1:	17	Cable #4:	
Attenuator #2:		Mixer:	

Additional equipment used:

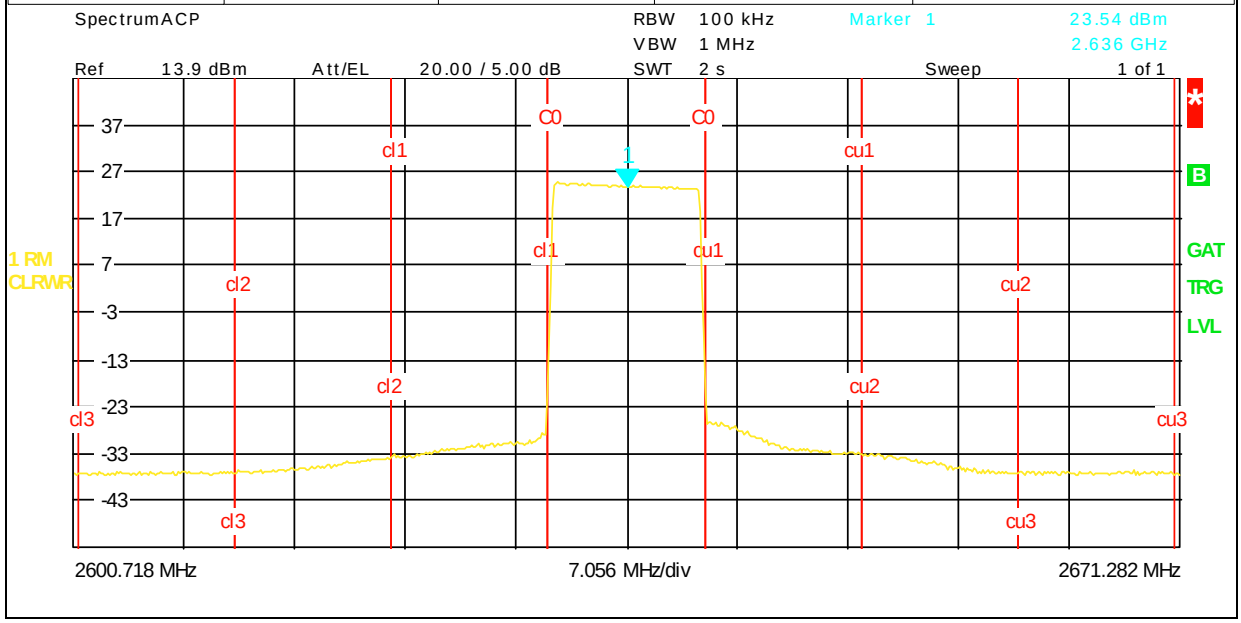
Measurement Uncertainty: ± 0.7 dB

IEEE 802.16e-2005 OFDMA

Frequency: 2.636 GHz	Signal Level Setting: 13.6 dBm	Ref. Level / Att: 13.9 dBm / 32.8 dB
N_{FFT}: 1024	Sweep Mode: Continuous	Trigger Mode / Offset: Power/0 S
Zone / Seg: DL-PUSC, ID=A, Seg=0	Modulation: ALL	Zone Offset / Length: 1/28 Symbols

Adjacent Channel Power Relative

Channel	Bandwidth	Spacing	Lower	Upper
TX	10 MHz	...	43.26 dBm	
Adjacent	10 MHz	10 MHz	-55.00 dB	-53.37 dB
Alternate1	10 MHz	20 MHz	-59.23 dB	-58.69 dB
Alternate2	10 MHz	30 MHz	-60.75 dB	-60.66 dB
Alternate3	...	...	...	...
Alternate4	...	...	...	...



Notes:

Test Data – RF Power Output

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Data Plot

RF POWER OUTPUT

Page 3 of 7 | Complete x | Preliminary:

Job No.:	102639	Date:	27/02/2008		
Specification:	PT27	Temperature (°C):	23		
Tested By:	Timo Hietala	Relative Humidity (%):	10		
E.U.T.:	WiMAX TRANSMITTER				
Configuration:	TX FULL POWER HIGHEST CHANNEL				
Sample Number:	1				
Location:	NET/IMN Oulu	RBW:	Refer to plots	Measurement	
Detector type:	Rms	VBW:	Refer to plots	Distance:	N/A m

Test Equipment Used

Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	
Filter:		Cable #2:	
Receiver:	1	Cable #3:	
Attenuator #1:	17	Cable #4:	
Attenuator #2:		Mixer:	

Additional equipment used:

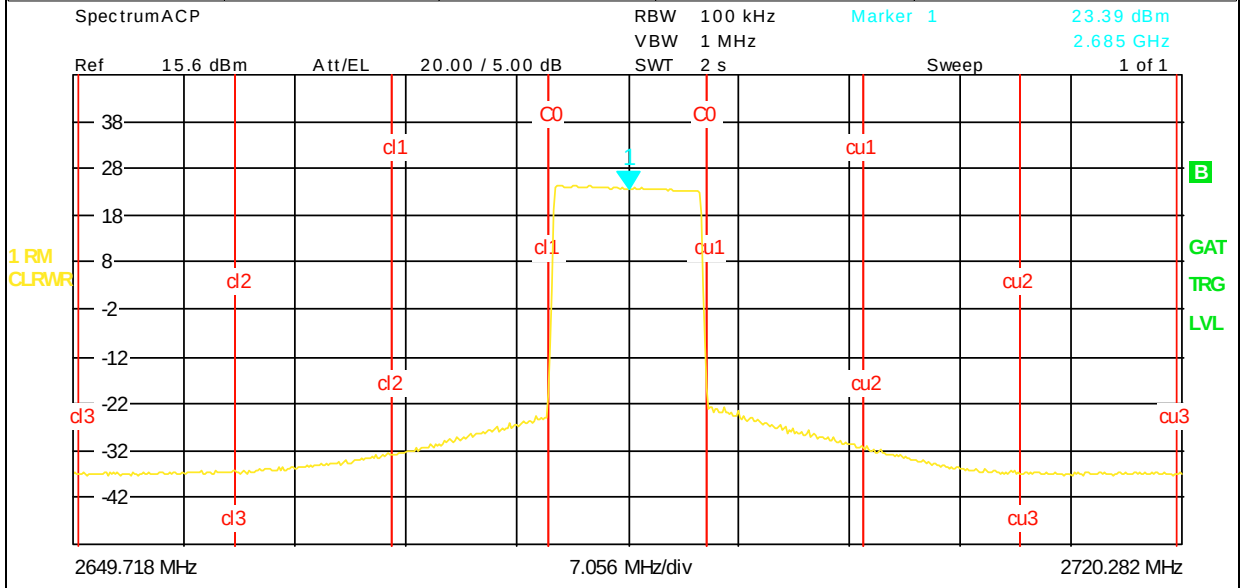
Measurement Uncertainty: ± 0.7 dB

IEEE 802.16e-2005 OFDMA

Frequency: 2.685 GHz	Signal Level Setting: 14.1 dBm	Ref. Level / Att: 15.6 dBm / 32.8 dB
N_{FFT}: 1024	Sweep Mode: Continuous	Trigger Mode / Offset: Power/0 S
Zone / Seg: DL-PUSC, ID=A, Seg=0	Modulation: ALL	Zone Offset / Length: 1/28 Symbols

Adjacent Channel Power Relative

Channel	Bandwidth	Spacing	Lower	Upper
TX	10 MHz	...	43.08 dBm	
Adjacent	10 MHz	10 MHz	-51.57 dB	-49.77 dB
Alternate1	10 MHz	20 MHz	-58.29 dB	-57.84 dB
Alternate2	10 MHz	30 MHz	-60.16 dB	-60.23 dB
Alternate3	...	...	...	...
Alternate4	...	...	...	...



Notes:

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Data Plot

RF POWER OUTPUT

Page 4 of 7

Complete x

Job No.: 102639 Date: 27/02/2008 Preliminary:

Specification: PT27 Temperature (°C): 23

Tested By: Timo Hietala Relative Humidity (%): 10

E.U.T.: WiMAX TRANSMITTER

Configuration: TX FULL POWER HIGHEST CHANNEL

Sample Number: 1

Location: NET/IMN Oulu RBW: Refer to plots Measurement

Detector type: Rms VBW: Refer to plots Distance: N/A m

Test Equipment Used

Antenna: Directional Coupler:

Pre-Amp: Cable #1:

Filter: Cable #2:

Receiver: 1 Cable #3:

Attenuator #1: 17 Cable #4:

Attenuator #2: Mixer:

Additional equipment used:

Measurement Uncertainty: ± 0.7 dB

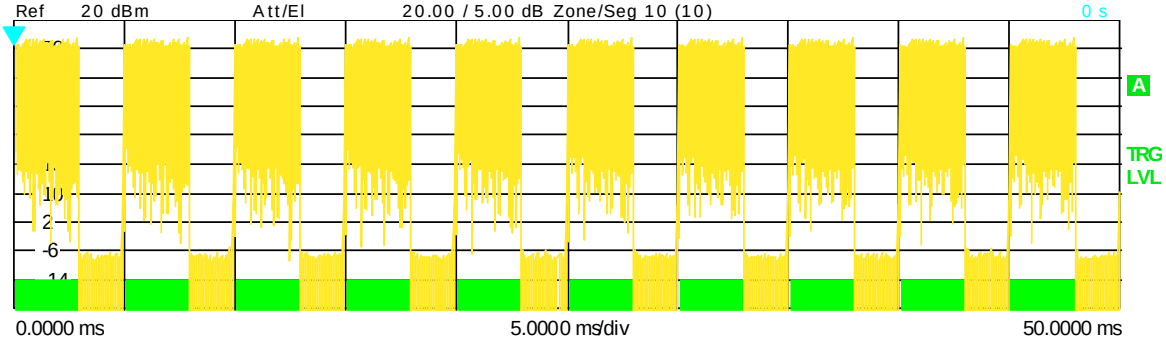
IEEE 802.16e-2005 OFDMA

Frequency: 2.588 GHz	Signal Level Setting: 10 dBm	Ref. Level / Att: 20 dBm / 34.2 dB
N_{FFT}: 1024	Sweep Mode: Continuous	Trigger Mode / Offset: Power / 0 S
Zone / Seg: DL-PUSC, ID=A, Seg=0	Modulation: ALL	Zone Offset / Length: 1/28 Symbols

Capture Memory No of Samples 560001 Time to Capture Buffer Start 7.85714 µs

Capture Time 50 ms Gate Off Marker 1 50.99 dBm

Ref 20 dBm Att/El 20.00 / 5.00 dB Zone/Seg 10 (10) 0 s



0.0000 ms 5.0000 ms/div 50.0000 ms

Burst Summary

Zone/Segment ID = A

Frame	Burst ID	Type	Modulation	No.of Slots	Power[dBm]	EVM[dB]
1	0	FCH	QPSK	4	43.07	-43.96
1	1	MAP	QPSK	56	43.28	-44.99
1	2	Data	QPSK	60	43.31	-41.25
1	3	Data	16QAM	36	43.28	-42.42
1	4	Data	16QAM	42	43.50	-42.83
1	5	Data	QPSK	168	43.37	-42.57
1	6	Data	64QAM	54	43.02	-42.54
Overall				420	43.26	-42.80
2	0	FCH	QPSK	4	43.06	-44.35
2	1	MAP	QPSK	56	43.28	-44.27
2	2	Data	QPSK	60	43.31	-41.61

Running ...

Notes:

Nemko Oy, Finland

Data Plot

RF POWER OUTPUT

Page 5 of 7 | Complete x | Preliminary:

Job No.:	102639	Date:	27/02/2008
Specification:	PT27	Temperature (°C):	23
Tested By:	Timo Hietala	Relative Humidity (%):	10
E.U.T.:	WiMAX TRANSMITTER		
Configuration:	TX FULL POWER CENTER CHANNEL		
Sample Number:	1		
Location:	NET/IMN Oulu	RBW:	Refer to plots
Detector type:	Rms	VBW:	Refer to plots

Measurement Distance: N/A m

Test Equipment Used

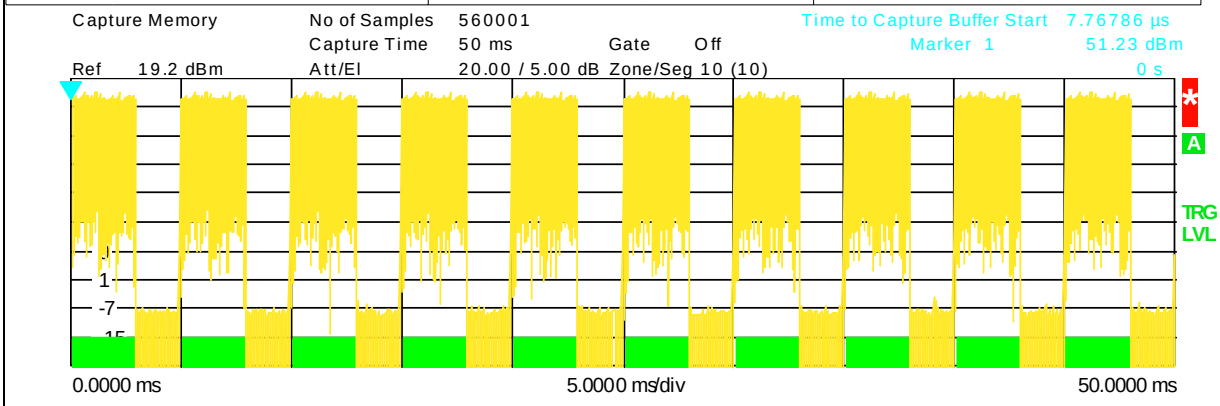
Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	
Filter:		Cable #2:	
Receiver:	1	Cable #3:	
Attenuator #1:	17	Cable #4:	
Attenuator #2:		Mixer:	

Additional equipment used:

Measurement Uncertainty: ± 0.7 dB

IEEE 802.16e-2005 OFDMA

Frequency: 2.636 GHz	Signal Level Setting: 9.2 dBm	Ref. Level / Att: 19.2 dBm / 34.2 dB
N_{FFT}: 1024	Sweep Mode: Continuous	Trigger Mode / Offset: Power / 0 S
Zone / Seg: DL-PUSC, ID=A, Seg=0	Modulation: ALL	Zone Offset / Length: 1/28 Symbols



Burst Summary

Zone/Segment ID = A

Frame	Burst ID	Type	Modulation	No.of Slots	Power[dBm]	EVM[dB]
1	0	FCH	QPSK	4	43.26	-43.27
1	1	MAP	QPSK	56	43.45	-44.08
1	2	Data	QPSK	60	43.49	-44.09
1	3	Data	16QAM	36	43.48	-44.43
1	4	Data	16QAM	42	43.68	-44.23
1	5	Data	QPSK	168	43.55	-44.66
1	6	Data	64QAM	54	43.22	-44.66
Overall				420	43.45	-44.18
2	0	FCH	QPSK	4	43.25	-44.81
2	1	MAP	QPSK	56	43.45	-45.36
2	2	Data	QPSK	60	43.49	-42.92

Running ...

Notes:

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Data Plot

RF POWER OUTPUT

Page 6 of 7 | Complete x | Preliminary:

Job No.:	102639	Date:	27/02/2008		
Specification:	PT27	Temperature (°C):	23		
Tested By:	Timo Hietala	Relative Humidity (%):	10		
E.U.T.:	WiMAX TRANSMITTER				
Configuration:	TX FULL POWER HIGHEST CHANNEL				
Sample Number:	1				
Location:	NET/IMN Oulu	RBW:	Refer to plots	Measurement	
Detector type:	Rms	VBW:	Refer to plots	Distance:	N/A m

Test Equipment Used

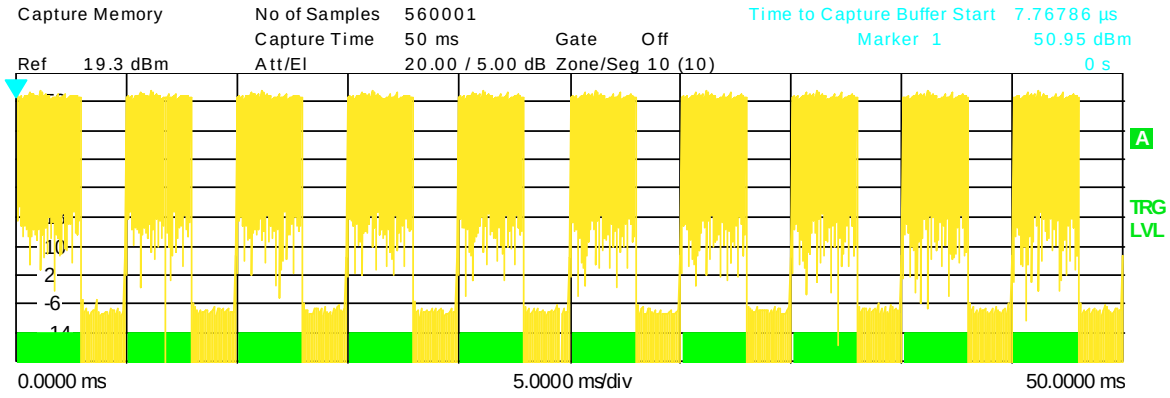
Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	
Filter:		Cable #2:	
Receiver:	1	Cable #3:	
Attenuator #1:	17	Cable #4:	
Attenuator #2:		Mixer:	

Additional equipment used:

Measurement Uncertainty: ± 0.7 dB

IEEE 802.16e-2005 OFDMA

Frequency: 2.685 GHz	Signal Level Setting: 9.3 dBm	Ref. Level / Att: 19.3 dBm / 34.2 dB
N_{FFT}: 1024	Sweep Mode: Continuous	Trigger Mode / Offset: Power / 0 S
Zone / Seg: DL-PUSC, ID=A, Seg=0	Modulation: ALL	Zone Offset / Length: 1/28 Symbols



Burst Summary

Zone/Segment ID = A

Frame	Burst ID	Type	Modulation	No.of Slots	Power[dBm]	EVM[dB]
1	0	FCH	QPSK	4	43.24	-43.87
1	1	MAP	QPSK	56	43.44	-43.29
1	2	Data	QPSK	60	43.50	-41.33
1	3	Data	16QAM	36	43.49	-42.65
1	4	Data	16QAM	42	43.68	-41.87
1	5	Data	QPSK	168	43.54	-42.86
1	6	Data	64QAM	54	43.24	-42.49
Overall				420	43.45	-42.55
2	0	FCH	QPSK	4	43.25	-44.82
2	1	MAP	QPSK	56	43.44	-45.12
2	2	Data	QPSK	60	43.49	-41.24

Running ...

Notes:

Nemko Oy, Finland

RF POWER OUTPUT duty cycle

Data Plot

Page 7 of 7 — Complete x

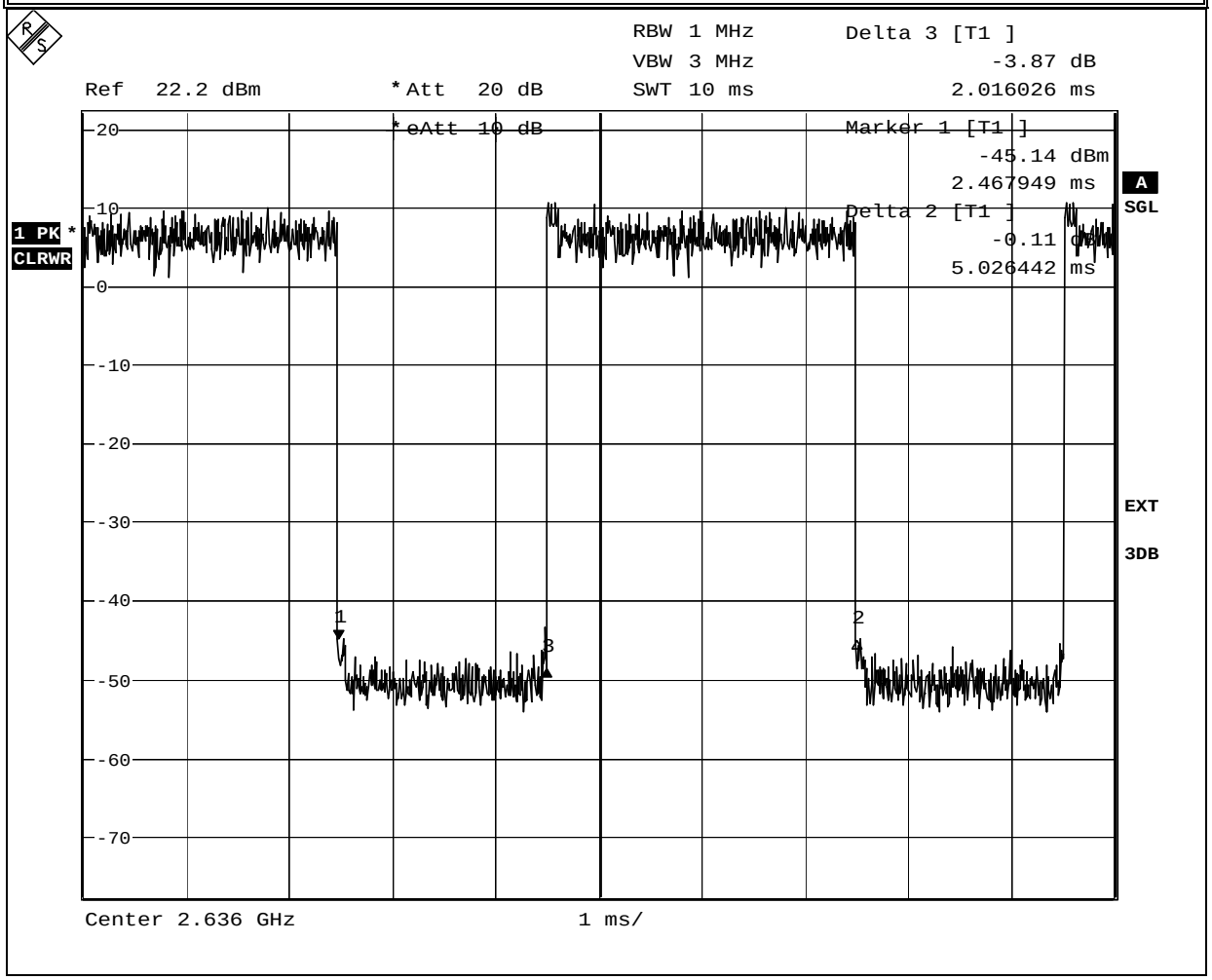
Job No.:	102639	Date:	27/02/2008	Preliminary:	
Specification:	PT27	Temperature (°C):	23		
Tested By:	Timo Hietala	Relative Humidity (%):	10		
E.U.T.:	WiMAX TRANSMITTER				
Configuration:	TX FULL POWER CENTER CHANNEL				
Sample Number:	1				
Location:	NET/IMN Oulu	RBW:	Refer to plots	Measurement	
Detector type:	Peak	VBW:	Refer to plots	Distance:	N/A m

Test Equipment Used

Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	
Filter:		Cable #2:	
Receiver:	1	Cable #3:	
Attenuator #1:	17	Cable #4:	
Attenuator #2:		Mixer:	

Additional equipment used:

Measurement Uncertainty: ± 0.7 dB



Notes: Tx duty cycle 60% ON 40%OFF

4. 99% Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA.NO.: 2.1049, (i)
TESTED BY: Timo Hietala	DATE: 27/02/2008

Test Results: Complies.

Test Data: See attached plot(s).

Modulation Type	Frequency (MHz)	Measured 99% Occupied Bandwidth (MHz)
Test model 67075	2636.0	**9.143**

Note: Test model 67075 includes modulation types; QPSK, 16-QAM and 64-QAM, duty cycle 60%

Equipment used: 1, 17

Measurement Uncertainty: ± 0.7 dB.

Temperature: 23 °C.

Relative Humidity: 10 %.

Test Data – 99% Occupied Bandwidth

Nemko Oy, Finland

Data Plot — 99% Occupied Bandwidth

Page 1 of 1 | Complete x | Preliminary:

Job No.:	102639	Date:	01/06/2006
Specification:	PT27	Temperature (°C):	23
Tested By:	Timo Hietala	Relative Humidity (%):	10
E.U.T.:	WiMAX TRANSMITTER		
Configuration:	TX FULL POWER CENTER CHANNEL		
Sample Number:	1		
Location:	NET/IMN Oulu	RBW:	Refer to plots
Detector type:	Rms	VBW:	Refer to plots

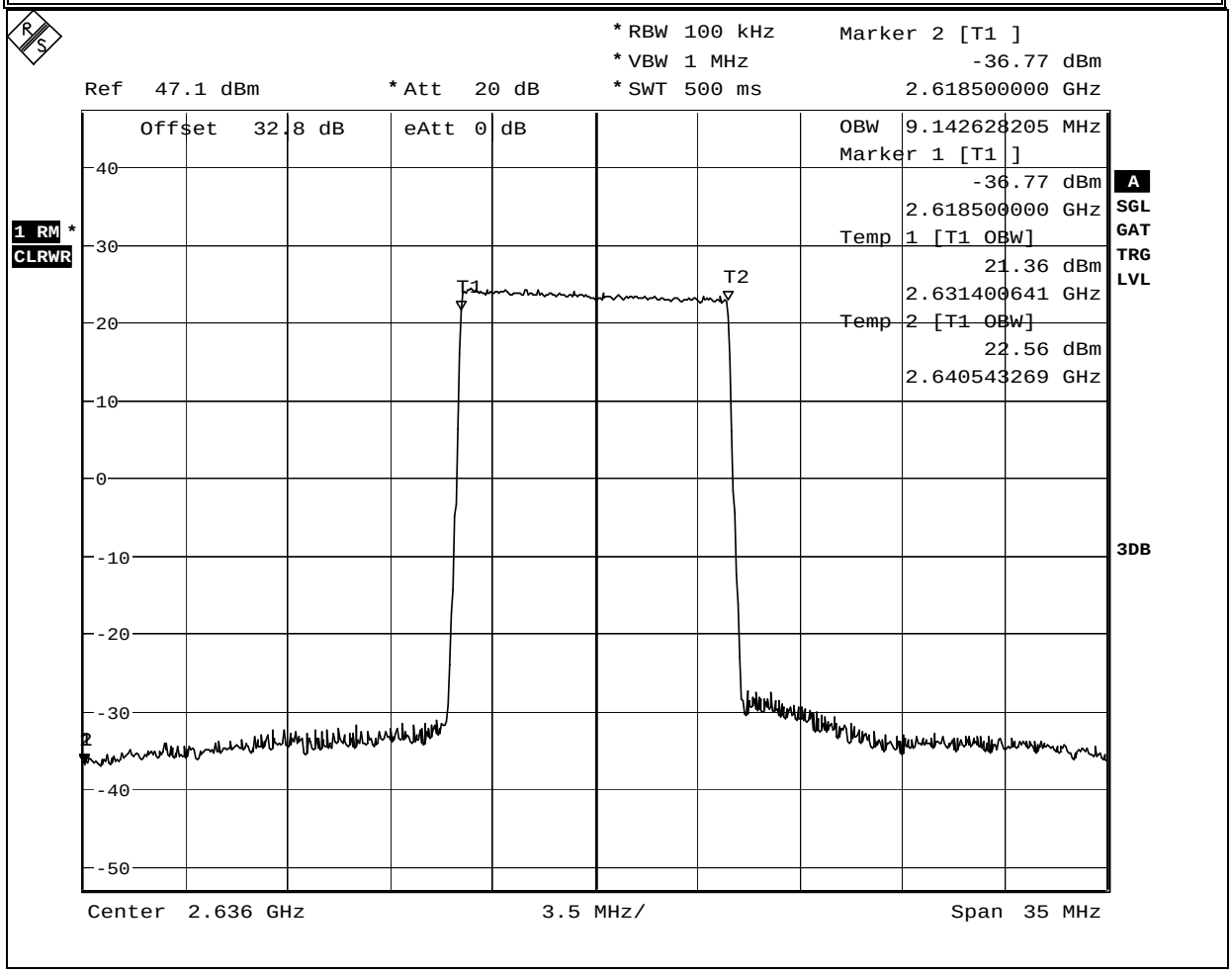
Measurement Distance: N/A m

Test Equipment Used

Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	
Filter:		Cable #2:	
Receiver:	1	Cable #3:	
Attenuator #1:	17	Cable #4:	
Attenuator #2:		Mixer:	

Additional equipment used:

Measurement Uncertainty: ± 0.7 dB



Notes:

5. Spurious Emissions at Antenna Terminals

NAME OF TEST: Spurious Emissions @ Antenna Terminals	PARA.NO.: 27.53(l), 2.1051
TESTED BY: Timo Hietala	DATE: 27/02/2008

Test Results: Complies.

Test Data: See attached plots.

Frequency (MHz)	Modulation	Spurious Emission (dBm) rms det.
321.109	**Test model 67075**	**-23.11**
7909.615	**Test model 67075**	**-49.10**
All other	**Test model 67075**	**More than 20 dB below limit -13 dBm**

Lower Band Edge

Frequency (MHz)	Modulation	Peak Emission Level (dBm) rms det.
2583.000	**Test model 67075**	**-25.28**

Upper Band Edge

Frequency (MHz)	Modulation	Peak Emission Level (dBm) rms det.
2690.000	**Test model 67075**	**-24.93**

Equipment used: 1, 2, 3, 4, 7, 8, 9, 12, 13, 14

Measurement Uncertainty: ± 0.7 dB.

Temperature: 23 °C.

Relative Humidity: 10 %.

Note: Test model 67075 includes modulation types; QPSK, 16-QAM and 64-QAM, duty cycle 60%

The spectrum was searched from 9 kHz to the 10th harmonic of the carrier.

Test Data – Spurious Emissions

Nemko Oy, Finland

Data Plot — Spurious Emissions at Antenna Terminals

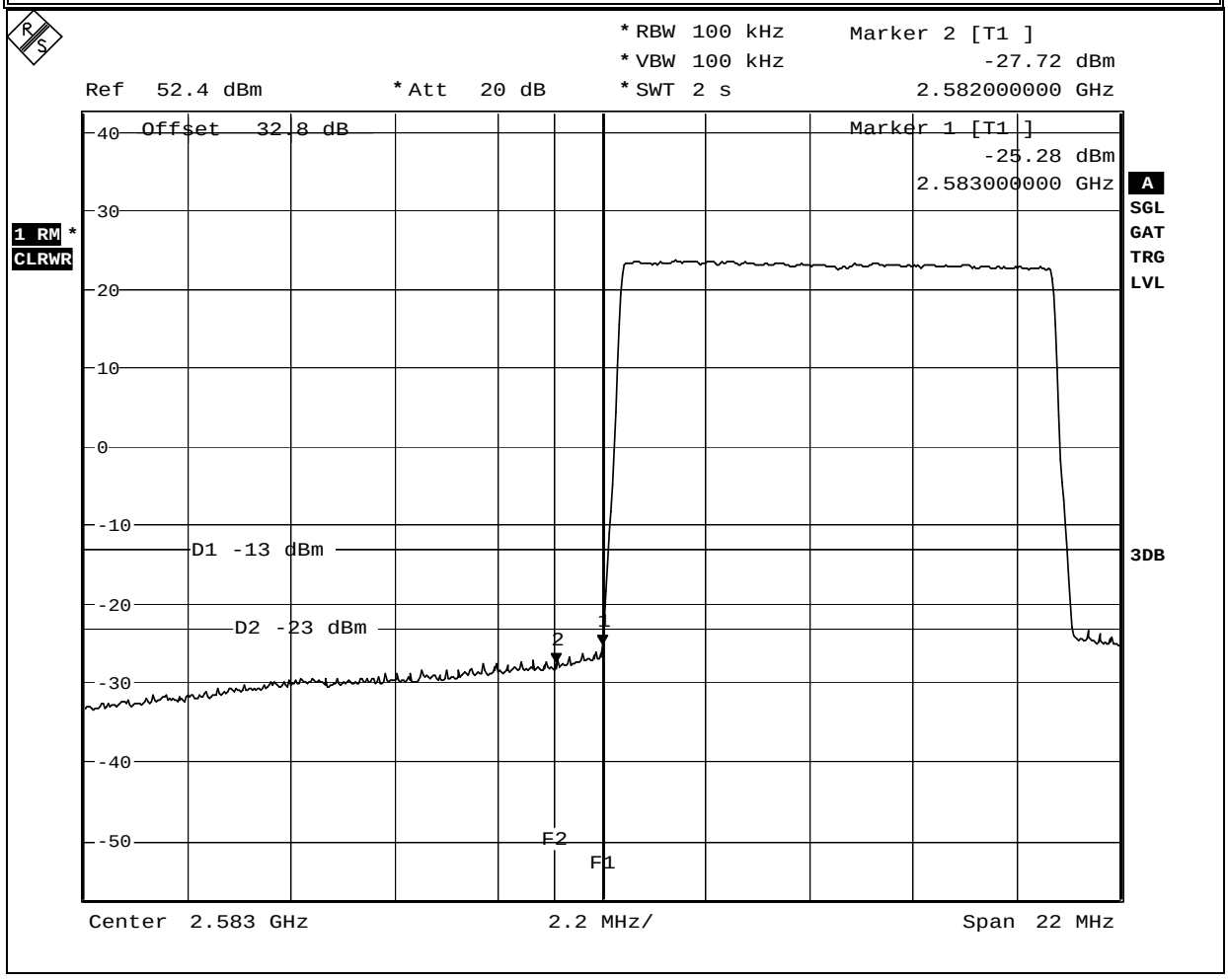
Page 1 of 8				Complete	x
Job No.:	102639	Date:	27/02/2008	Preliminary:	
Specification:	PT27	Temperature (°C):	23		
Tested By:	Timo Hietala	Relative Humidity (%):	10		
E.U.T.:	WIMAX TRANSMITTER				
Configuration:	TX FULL POWER LOWEST CHANNEL				
Sample Number:	1				
Location:	NET/IMN Oulu	RBW:	Refer to plots	Measurement	
Detector type:	Rms	VBW:	Refer to plots	Distance:	N/A m

Test Equipment Used

Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	
Filter:		Cable #2:	
Receiver:	1	Cable #3:	
Attenuator #1:	17	Cable #4:	
Attenuator #2:		Mixer:	

Additional equipment used:

Measurement Uncertainty: ± 0.7 dB



Notes: Tx 2588 MHz, LOWER BANDEDGE. RBW of 100kHz was used 1-11MHz from band edge and the limit was adjusted from -13dBm to -23dBm for compensate the reduced bandwidth.

Test Data – Spurious Emissions

Nemko Oy, Finland

Data Plot — Spurious Emissions at Antenna Terminals

Page 2 of 8 | Complete x | Preliminary:

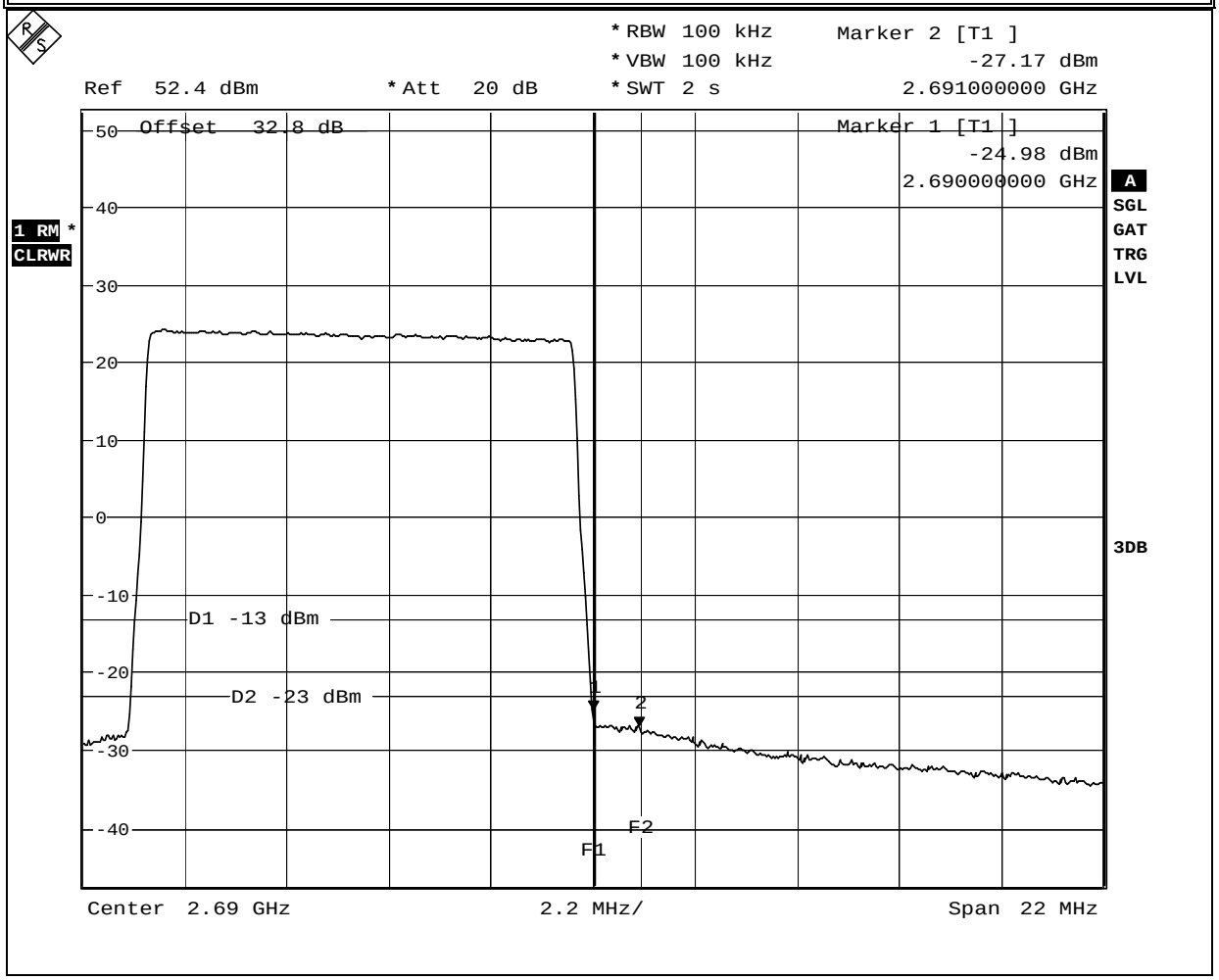
Job No.:	102639	Date:	27/02/2008		
Specification:	PT27	Temperature (°C):	23		
Tested By:	Timo Hietala	Relative Humidity (%):	10		
E.U.T.:	WIMAX TRANSMITTER				
Configuration:	TX FULL POWER HIGHEST CHANNEL				
Sample Number:	1				
Location:	NET/IMN Oulu	RBW:	Refer to plots	Measurement	
Detector type:	RMS	VBW:	Refer to plots	Distance:	N/A m

Test Equipment Used

Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	
Filter:		Cable #2:	
Receiver:	1	Cable #3:	
Attenuator #1:	17	Cable #4:	
Attenuator #2:		Mixer:	

Additional equipment used:

Measurement Uncertainty: ± 0.7 dB



Notes: Tx 2685 MHz, UPPER BANDEDGE . RBW of 100kHz was used 1-11MHz from band edge and the limit was adjusted from -13dBm to -23dBm for compensate the reduced bandwidth.

Test Data – Spurious Emissions

Nemko Oy, Finland

Data Plot — Spurious Emissions at Antenna Terminals

Page 3 of 8 | Complete x | Preliminary:

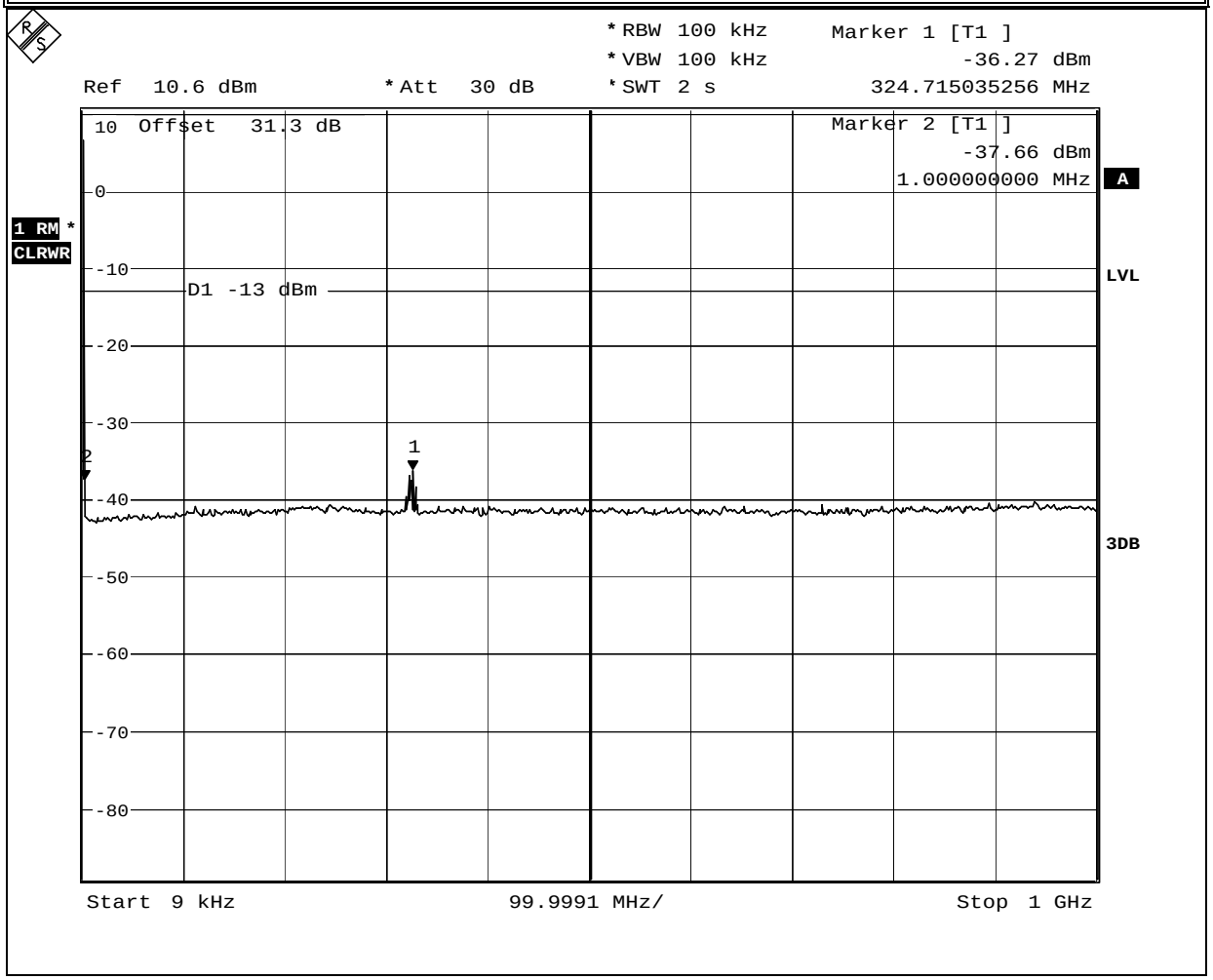
Job No.:	102639	Date:	27/02/2008		
Specification:	PT27	Temperature (°C):	23		
Tested By:	Timo Hietala	Relative Humidity (%):	10		
E.U.T.:	WIMAX TRANSMITTER				
Configuration:	TX FULL POWER MIDDLE CHANNEL				
Sample Number:	1				
Location:	NET/IMN Oulu	RBW:	Refer to plots	Measurement	
Detector type:	RMS	VBW:	Refer to plots	Distance:	N/A m

Test Equipment Used

Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	
Filter:		Cable #2:	
Receiver:	1	Cable #3:	
Attenuator #1:	17	Cable #4:	
Attenuator #2:		Mixer:	

Additional equipment used:

Measurement Uncertainty: ± 0.7 dB



Notes: Tx 2636 MHz

Test Data – Spurious Emissions

Nemko Oy, Finland

Data Plot — Spurious Emissions at Antenna Terminals

Page 4 of 8 — Complete x

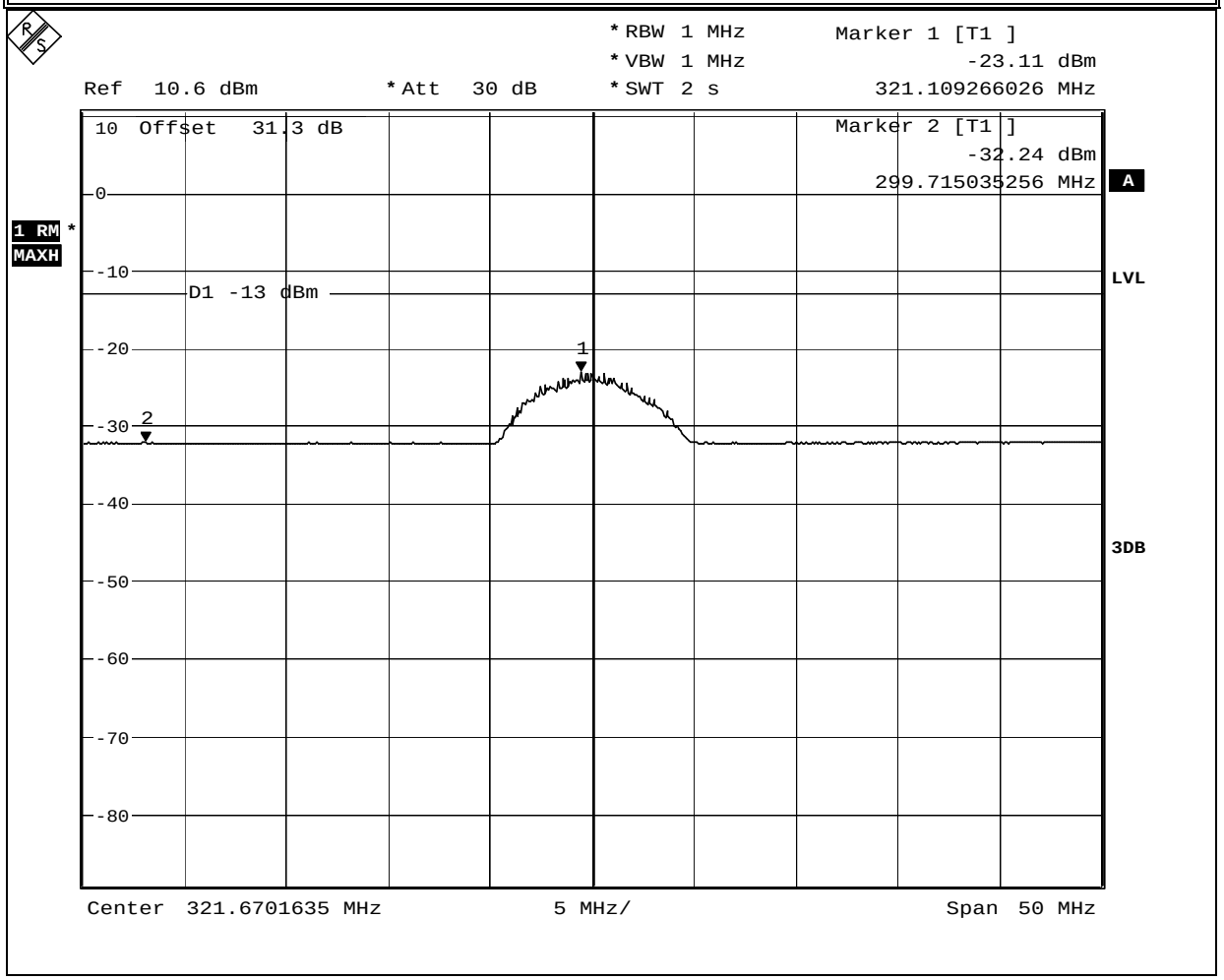
Job No.:	102639	Date:	27/02/2008	Preliminary:	
Specification:	PT27	Temperature (°C):	23		
Tested By:	Timo Hietala	Relative Humidity (%):	10		
E.U.T.:	WIMAX TRANSMITTER				
Configuration:	TX FULL POWER MIDDLE CHANNEL				
Sample Number:	1				
Location:	NET/IMN Oulu	RBW:	Refer to plots	Measurement	
Detector type:	RMS	VBW:	Refer to plots	Distance:	N/A m

Test Equipment Used

Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	
Filter:		Cable #2:	
Receiver:	1	Cable #3:	
Attenuator #1:	17	Cable #4:	
Attenuator #2:		Mixer:	

Additional equipment used:

Measurement Uncertainty: ± 0.7 dB



Notes: Tx 2636 MHz

Test Data – Spurious Emissions

Nemko Oy, Finland

Data Plot — Spurious Emissions at Antenna Terminals

Page 5 of 8 | Complete x | Preliminary:

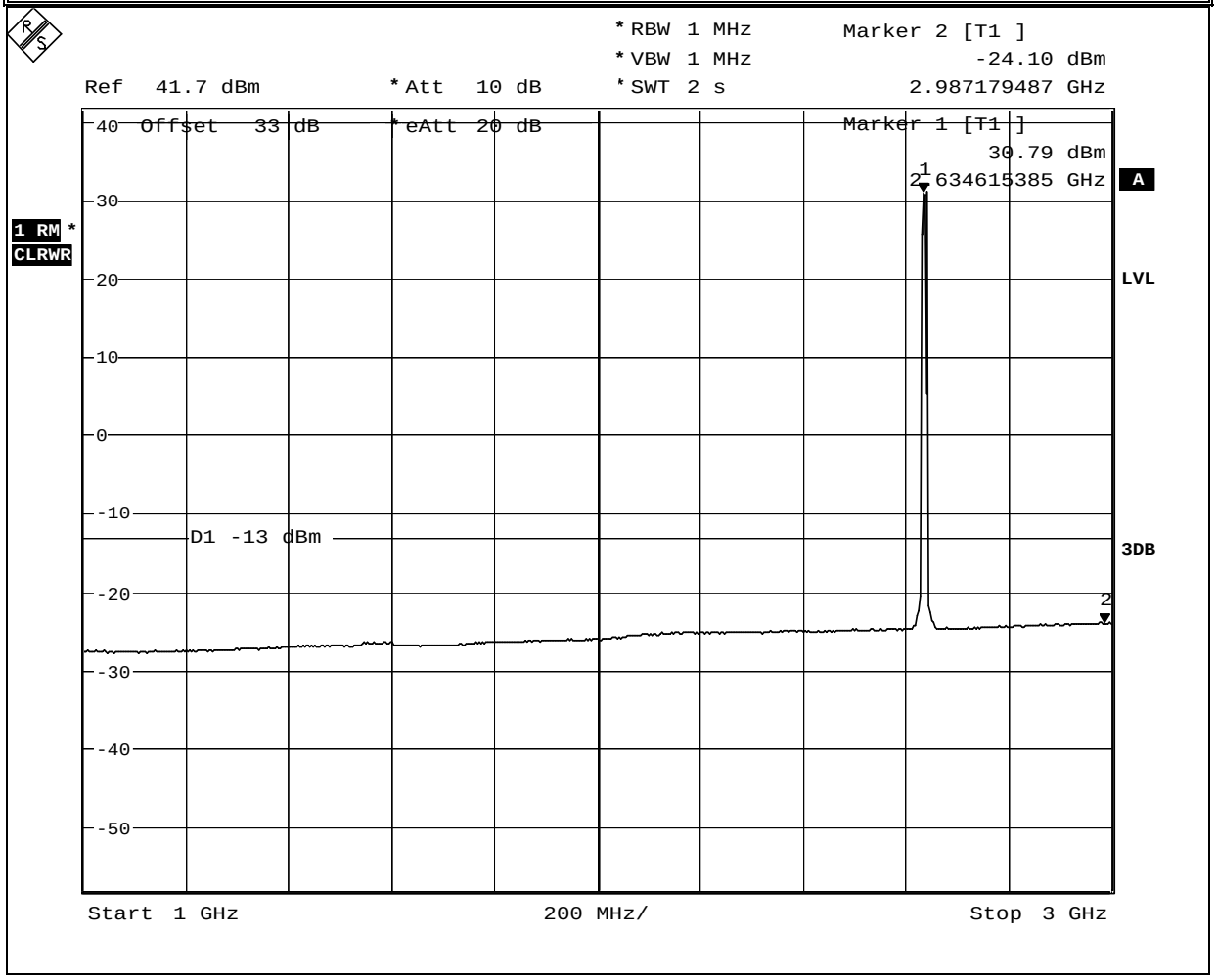
Job No.:	102639	Date:	27/02/2008		
Specification:	PT27	Temperature (°C):	23		
Tested By:	Timo Hietala	Relative Humidity (%):	10		
E.U.T.:	WIMAX TRANSMITTER				
Configuration:	TX FULL POWER MIDDLE CHANNEL				
Sample Number:	1				
Location:	NET/IMN Oulu	RBW:	Refer to plots	Measurement	
Detector type:	RMS	VBW:	Refer to plots	Distance:	N/A m

Test Equipment Used

Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	
Filter:	-	Cable #2:	
Receiver:	1	Cable #3:	
Attenuator #1:	17	Cable #4:	
Attenuator #2:		Mixer:	

Additional equipment used:

Measurement Uncertainty: ± 0.7 dB



Notes: Tx 2636 MHz

Test Data – Spurious Emissions

Nemko Oy, Finland

Data Plot — Spurious Emissions at Antenna Terminals

Page 6 of 8 | Complete x | Preliminary:

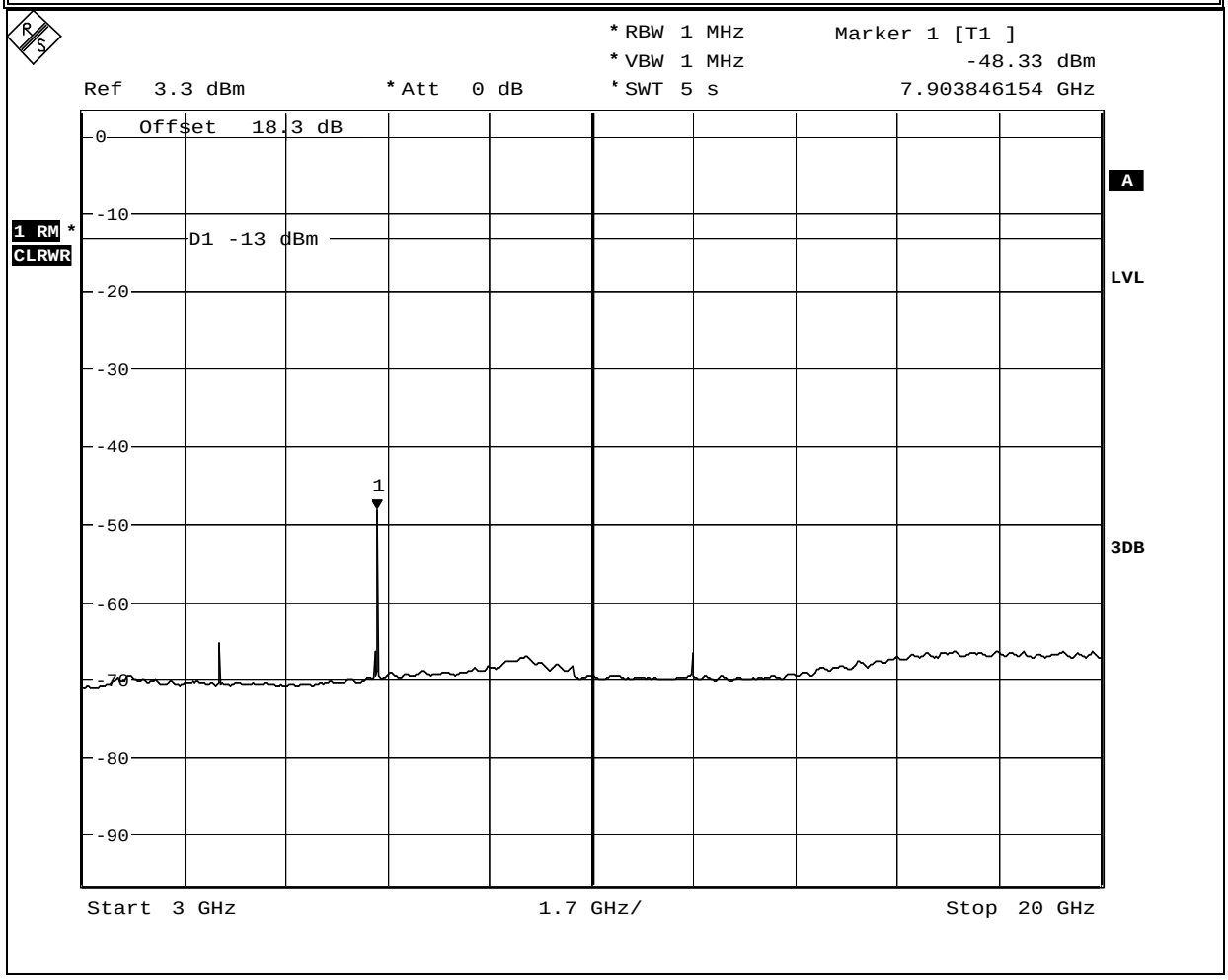
Job No.:	102639	Date:	27/02/2008		
Specification:	PT27	Temperature (°C):	23		
Tested By:	Timo Hietala	Relative Humidity (%):	10		
E.U.T.:	WIMAX TRANSMITTER				
Configuration:	TX FULL POWER MIDDLE CHANNEL				
Sample Number:	1				
Location:	NET/IMN Oulu	RBW:	Refer to plots	Measurement	
Detector type:	RMS	VBW:	Refer to plots	Distance:	N/A m

Test Equipment Used

Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	
Filter:	13	Cable #2:	
Receiver:	1	Cable #3:	
Attenuator #1:	15	Cable #4:	
Attenuator #2:		Mixer:	

Additional equipment used:

Measurement Uncertainty: ± 0.7 dB



Notes: Tx 2636 MHz

Test Data – Spurious Emissions

Nemko Oy, Finland

Data Plot — Spurious Emissions at Antenna Terminals

Page 7 of 8 — Complete x

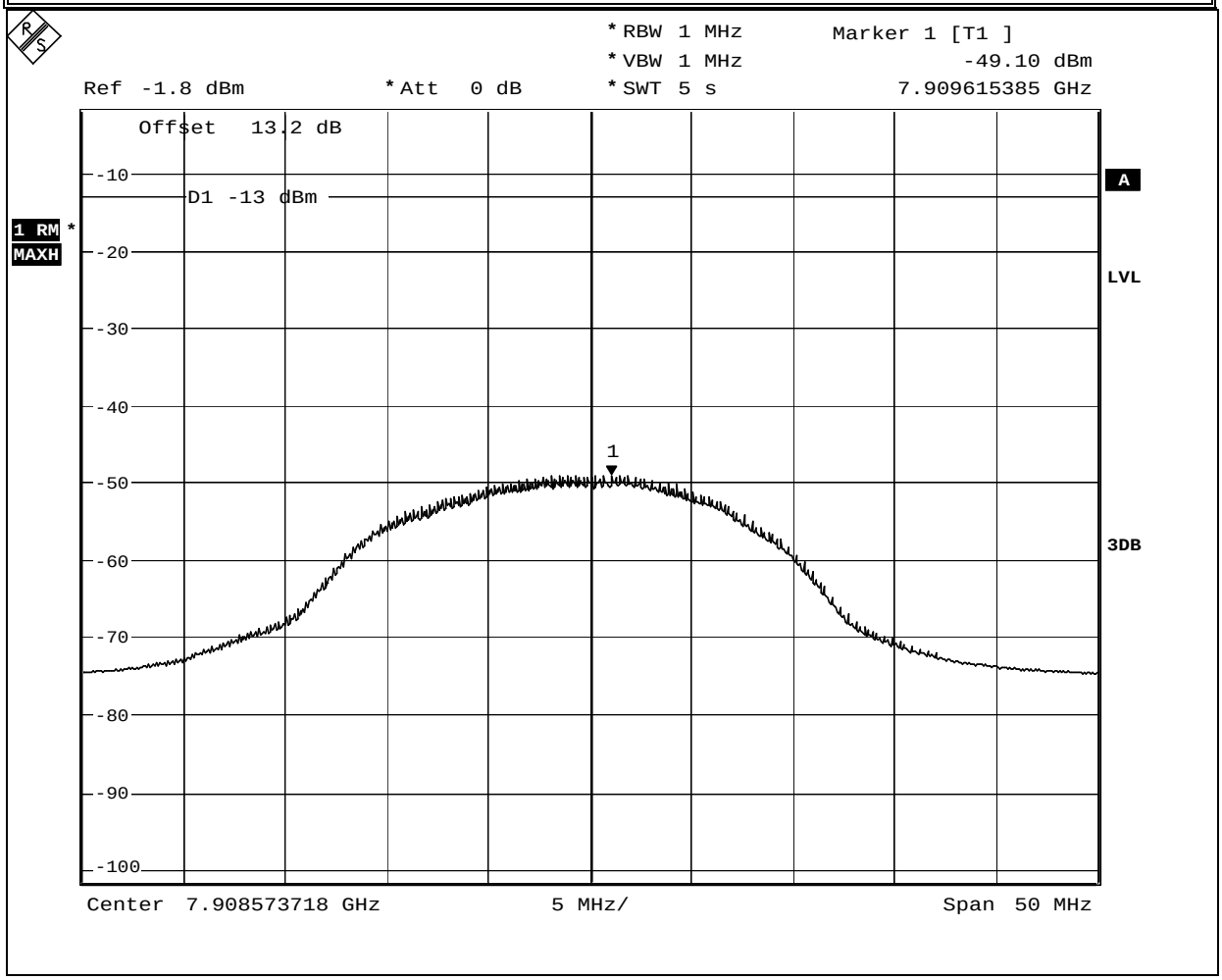
Job No.:	102639	Date:	27/02/2008	Preliminary:	
Specification:	PT27	Temperature (°C):	23		
Tested By:	Timo Hietala	Relative Humidity (%):	10		
E.U.T.:	WIMAX TRANSMITTER				
Configuration:	TX FULL POWER MIDDLE CHANNEL				
Sample Number:	1				
Location:	NET/IMN Oulu	RBW:	Refer to plots	Measurement	
Detector type:	RMS	VBW:	Refer to plots	Distance:	N/A m

Test Equipment Used

Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	
Filter:	13	Cable #2:	
Receiver:	1	Cable #3:	
Attenuator #1:	15	Cable #4:	
Attenuator #2:		Mixer:	

Additional equipment used:

Measurement Uncertainty: ± 0.7 dB



Notes: Tx 2636 MHz

Test Data – Spurious Emissions

Nemko Oy, Finland

Data Plot — Spurious Emissions at Antenna Terminals

Page 8 of 8 — Complete x

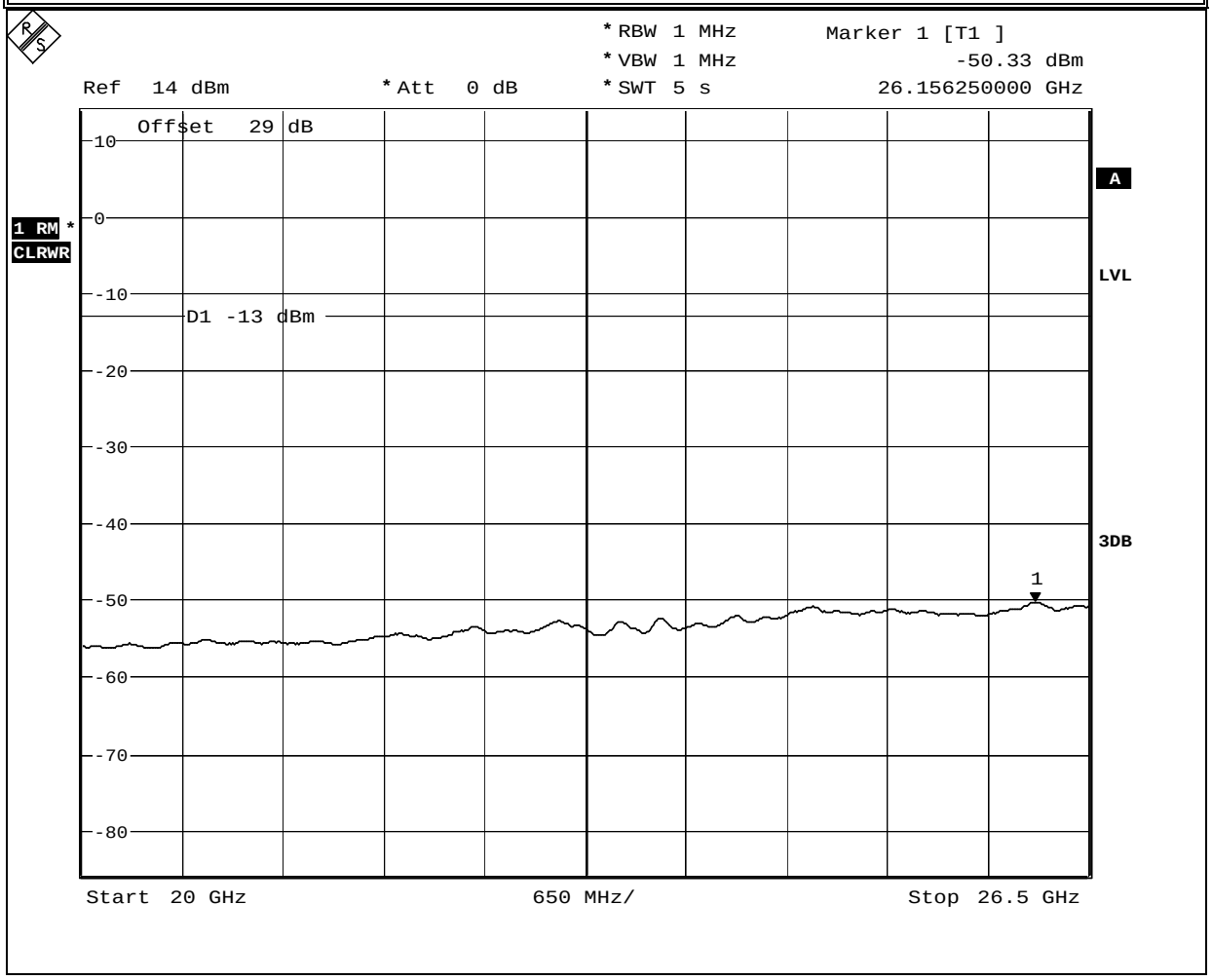
Job No.:	102639	Date:	27/02/2008	Preliminary:	
Specification:	PT27	Temperature (°C):	23		
Tested By:	Timo Hietala	Relative Humidity (%):	10		
E.U.T.:	WIMAX TRANSMITTER				
Configuration:	TX FULL POWER MIDDLE CHANNEL				
Sample Number:	1				
Location:	NET/IMN Oulu	RBW:	Refer to plots	Measurement	
Detector type:	RMS	VBW:	Refer to plots	Distance:	N/A m

Test Equipment Used

Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	
Filter:	14	Cable #2:	
Receiver:	1	Cable #3:	
Attenuator #1:	16	Cable #4:	
Attenuator #2:		Mixer:	

Additional equipment used:

Measurement Uncertainty: ± 0.7 dB



Notes: Tx 2636 MHz

6. Field Strength of Spurious

NAME OF TEST: Field Strength of Spurious Emissions	PARA.NO.: 27.53(l), 2.1053
TESTED BY: Timo Hietala	DATE: 28/02/2008

Test Results: Complies.

Test Data: See attached table.

Frequency (MHz)	Spurious Emission EIRP (dBm) ave
All	More than 20 dB below limit -13 dBm

Equipment used: 19, 20, 21, 22, 24, 29, 30, 31, 32

Measurement Uncertainty: ± 5.2 dB.

Temperature: 23 °C.

Relative Humidity: 10 %.

Note: Test model 67075 includes modulation types; QPSK, 16-QAM and 64-QAM, duty cycle 60%

The spectrum was searched from 30 MHz to the 10th harmonic of the carrier.

Test Data – Radiated Emissions

Nemko Oy, Finland

Data Plot — Radiated Emissions Substitution Method

Page 1 of 4 — Complete x

Job No.:	102639	Date:	28/02/2008	Preliminary:	
Specification:	PT27	Temperature (°C):	23		
Tested By:	Timo Hietala	Relative Humidity (%):	10		
E.U.T.:	WIMAX TRANSMITTER				
Configuration:	TX FULL POWER MIDDLE CHANNEL				
Sample Number:	1				
Location:	NET/IMN Oulu	RBW:	1 MHz	Measurement	
Detector type:	Ave	VBW:	1 MHz	Distance:	3 m

Test Equipment Used

Antenna:	21, 22, 24	Directional Coupler:	
Pre-Amp:	29, 30	Cable #1:	
Filter:		Cable #2:	
Receiver:	19	Cable #3:	
Attenuator #1:	-	Cable #4:	
Attenuator #2:		Mixer:	
Additional equipment used:	31, 32		
Measurement Uncertainty:	± 5.2 dB		

Frequency (MHz)	Meter Reading (dBm)	Correction Factor (dB)	Gen. Level (dBm)	Substitution Antenna Gain (dBi)	EIRP (dBm)	EIRP (µW)	Polarity	Comments

Notes: Pre measurement in stack installation Tx 2636 MHz, transmitters full power terminated 50Ω

Test Data – Radiated Emissions 30 MHz - 26.5 GHz

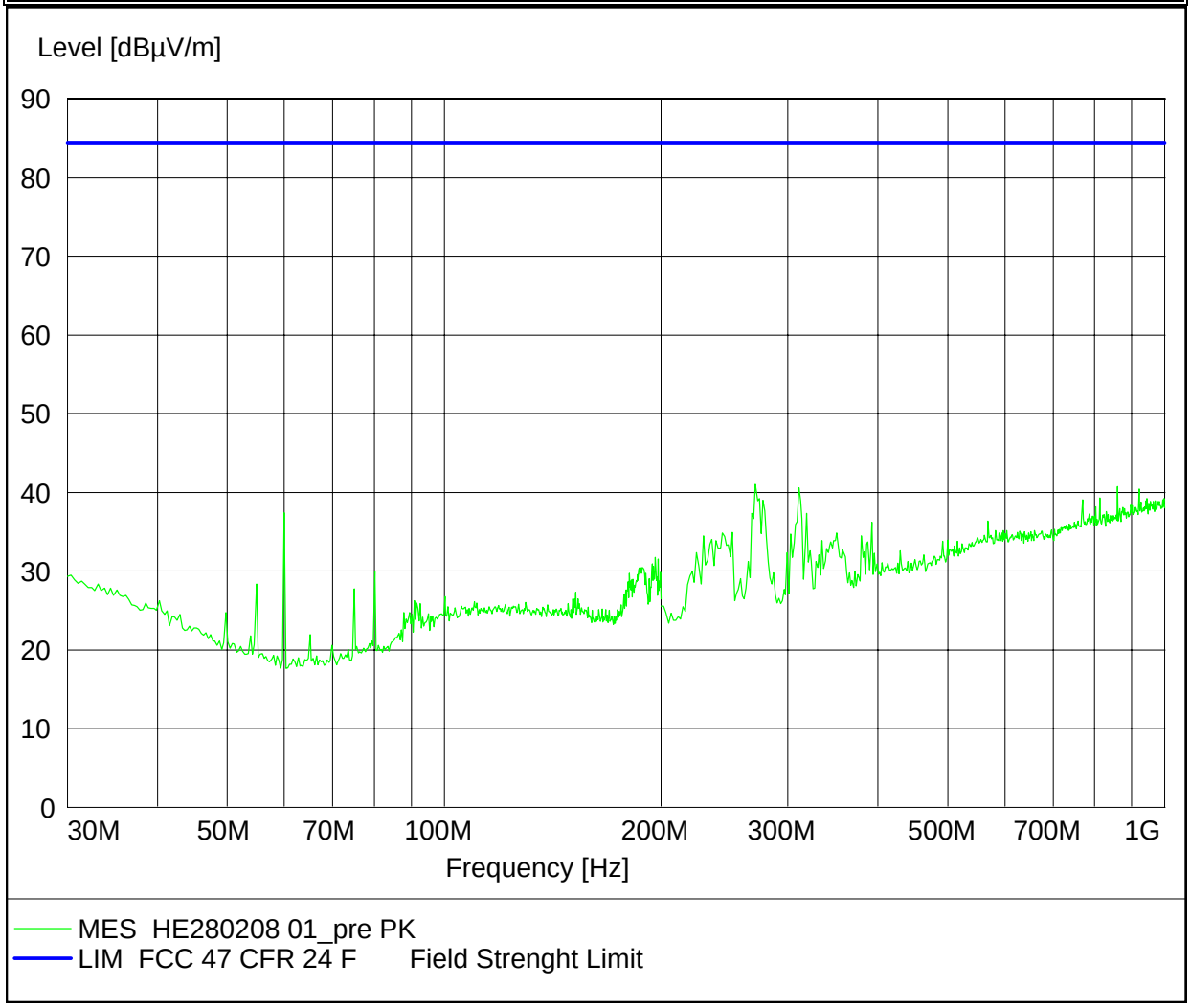
Nemko Oy, Finland

Data Plot — Radiated Emissions Substitution Method

Page 2 of 4				Complete	x
Job No.:	102639	Date:	28/02/2008	Preliminary:	
Specification:	PT27	Temperature (°C):	23		
Tested By:	Timo Hietala	Relative Humidity (%):	10		
E.U.T.:	WIMAX TRANSMITTER				
Configuration:	TX FULL POWER MIDDLE CHANNEL				
Sample Number:	1				
Location:	NET/IMN Oulu	RBW:	120 kHz	Measurement	
Detector type:	Peak	VBW:		Distance:	3 m

Test Equipment Used

Antenna:	22	Directional Coupler:	
Pre-Amp:	29	Cable #1:	
Filter:		Cable #2:	
Receiver:	20	Cable #3:	
Attenuator #1:	-	Cable #4:	
Attenuator #2:		Mixer:	
Additional equipment used:	31, 32		
Measurement Uncertainty:	± 5.2 dB		



Notes: Limit line (84.4 dBuV/m) is converted from substitution limit (–13 dBm) to unit dBuV/m in 3 meter measurement distance

Nemko Oy, Finland

Data Plot — Radiated Emissions Substitution Method

Page 3 of 4 — Complete x

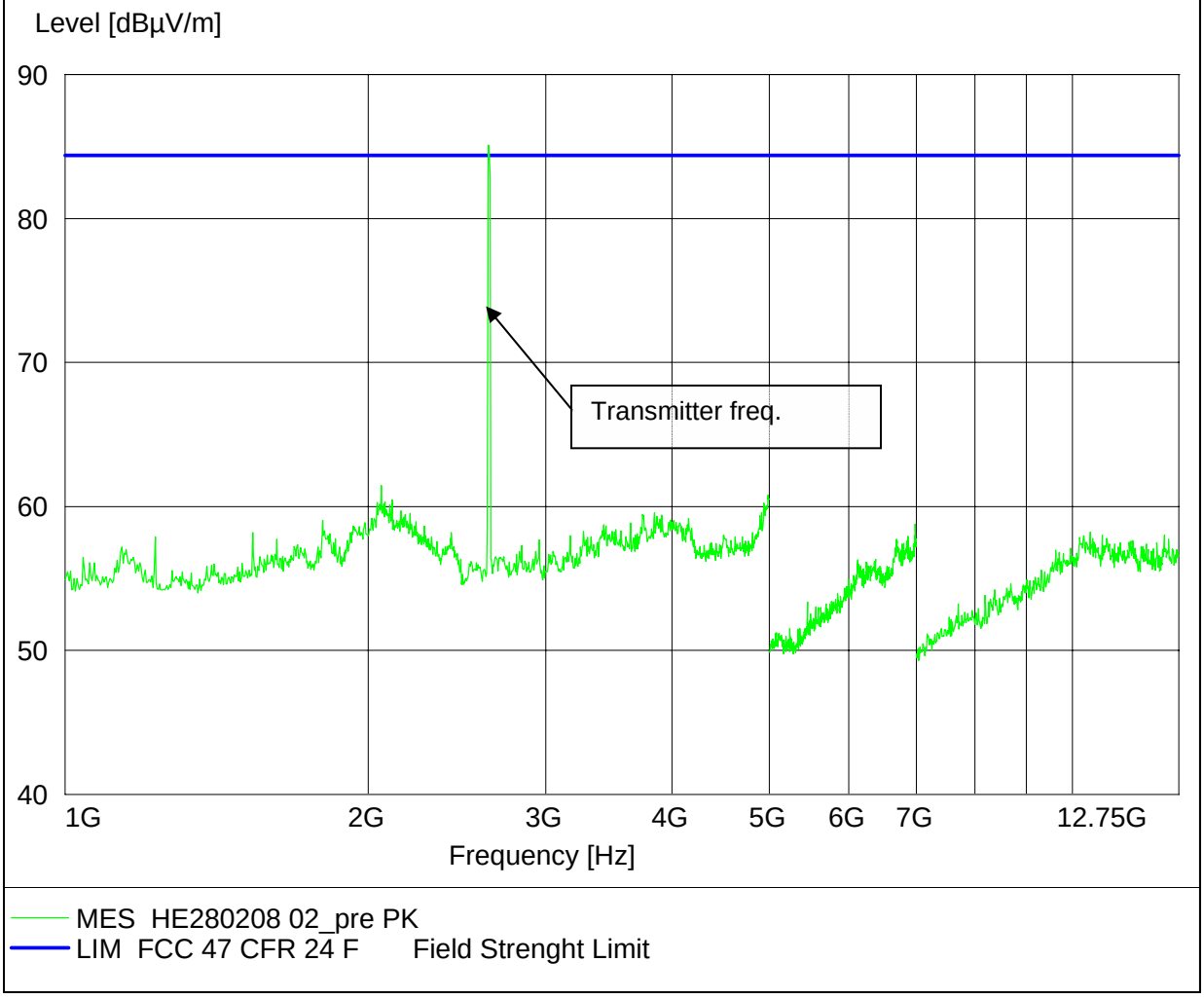
Job No.:	102639	Date:	28/02/2008	Preliminary:	
Specification:	PT27	Temperature (°C):	23		
Tested By:	Timo Hietala	Relative Humidity (%):	10		
E.U.T.:	WIMAX TRANSMITTER				
Configuration:	TX FULL POWER MIDDLE CHANNEL				
Sample Number:	1				
Location:	NET/IMN Oulu	RBW:	1 MHz	Measurement	
Detector type:	Peak	VBW:	1 MHz	Distance:	3 m

Test Equipment Used

Antenna:	24	Directional Coupler:	
Pre-Amp:	29	Cable #1:	
Filter:		Cable #2:	
Receiver:	20	Cable #3:	
Attenuator #1:	-	Cable #4:	
Attenuator #2:		Mixer:	

Additional equipment used: 31, 32

Measurement Uncertainty: ± 5.2 dB



Notes: Tx 2636 MHz

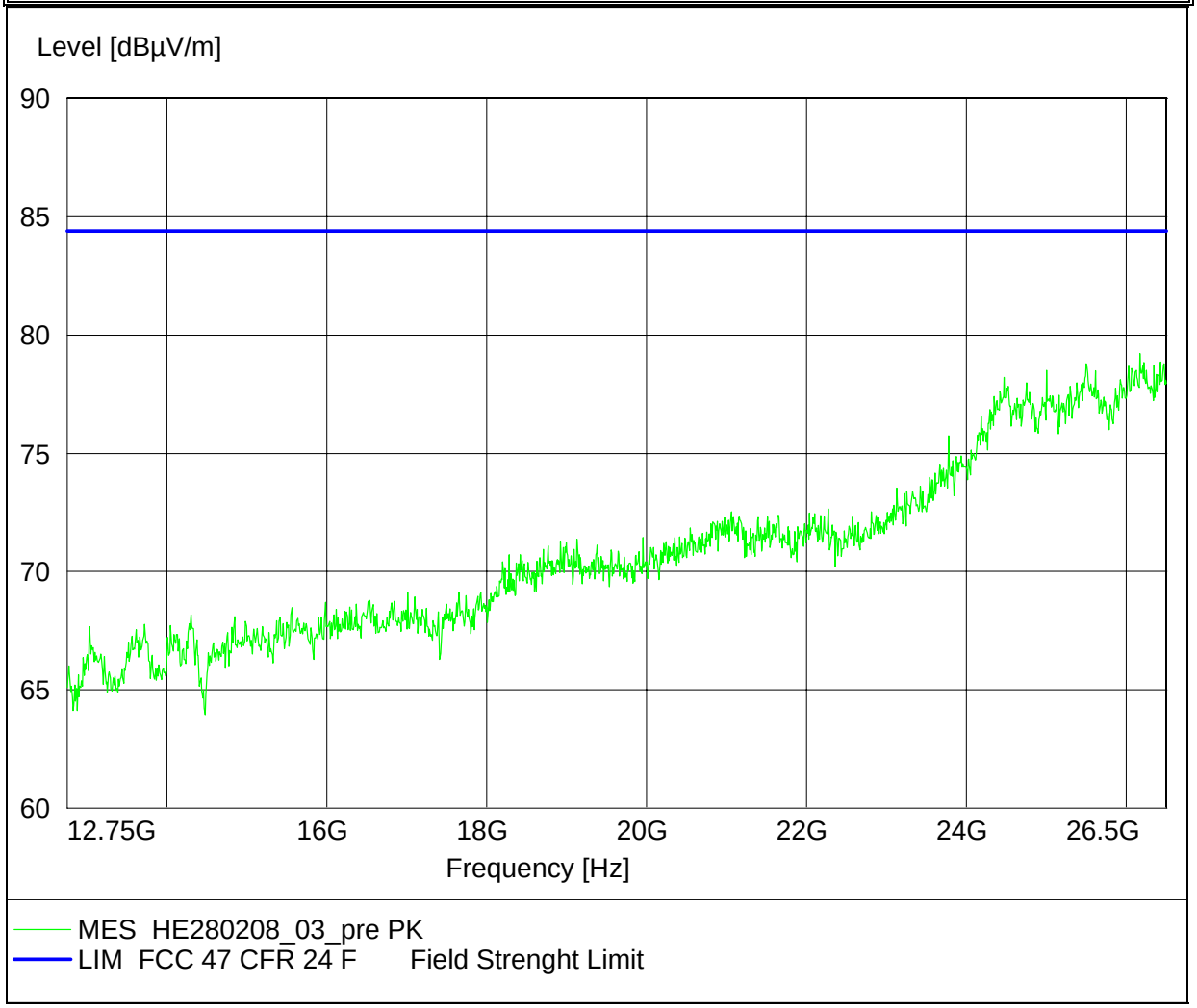
Nemko Oy, Finland

Data Plot — Radiated Emissions Substitution Method

Page 4 of 4				Complete	x
Job No.:	102639	Date:	28/02/2008	Preliminary:	
Specification:	PT27	Temperature (°C):	23		
Tested By:	Timo Hietala	Relative Humidity (%):	10		
E.U.T.:	WIMAX TRANSMITTER				
Configuration:	TX FULL POWER MIDDLE CHANNEL				
Sample Number:	1				
Location:	NET/IMN Oulu	RBW:	1 MHz	Measurement	
Detector type:	Peak	VBW:	1 MHz	Distance:	3 m

Test Equipment Used

Antenna:	21	Directional Coupler:	
Pre-Amp:	30	Cable #1:	
Filter:		Cable #2:	
Receiver:	20	Cable #3:	
Attenuator #1:	-	Cable #4:	
Attenuator #2:		Mixer:	
Additional equipment used:	31, 32		
Measurement Uncertainty:	± 5.2 dB		



Notes: Tx 2636 MHz

7. Frequency stability

NAME OF TEST: Frequency stability	PARA.NO.: 27.54, & 2.1055
TESTED BY: Timo Hietala	DATE: 28/02/2008

Test Results: Complies.

Standard Test Frequency: 2636.000 MHz.

Standard Test Voltage: 48 V DC.

Equipment used: 1, 5, 6, 7, 8, 17

EUT: WiMAX TRANSMITTER.

Configuration: TX FULL POWER MIDDLE CHANNEL.

Measurement Data: **Frequency stability with voltage variation.**

Voltage (V DC)	Temp (°C)	Rated (Hz/ppm)	Deviation (Hz)	Deviation (ppm)
48.0	20	132 / 0.05	**27.2**	**0.0103**
55.2	20	132 / 0.05	**33.1**	**0.0126**
40.8	20	132 / 0.05	**26.8**	**0.0102**

Measurement Uncertainty: ± 0.001 ppm (± 2.0 Hz).

Relative Humidity: 10 %.

Note: Test model 67075 includes modulation types; QPSK, 16-QAM and 64-QAM, duty cycle 60%

NAME OF TEST: Frequency stability	PARA.NO.: 27.54, & 2.1055
TESTED BY: Timo Hietala	DATE: 28/02/2008

Test Results: Complies.

Standard Test Frequency: 2636.000 MHz.

Standard Test Voltage: 48 V DC.

Equipment used: 1, 5, 6, 7, 8, 17

EUT: WiMAX TRANSMITTER.

Configuration: TX FULL POWER MIDDLE CHANNEL.

Measurement Data: **Frequency stability with temperature variation.**

Voltage (V DC)	Temp (°C)	Rated (Hz/ppm)	Deviation (Hz)	Deviation (ppm)
48.0	50	132 / 0.05	**-34.7**	**-0.0132**
48.0	40	132 / 0.05	**-19.8**	**-0.0075**
48.0	30	132 / 0.05	**16.3**	**0.0062**
48.0	10	132 / 0.05	**32.5**	**0.0123**
48.0	0	132 / 0.05	**28.8**	**0.0109**
48.0	-10	132 / 0.05	**21.9**	**0.0083**
48.0	-20	132 / 0.05	**-17.0**	**-0.0064**
48.0	-30	132 / 0.05	**-33.7**	**-0.0128**

Measurement Uncertainty: ± 0.001 ppm (± 2.0 Hz).

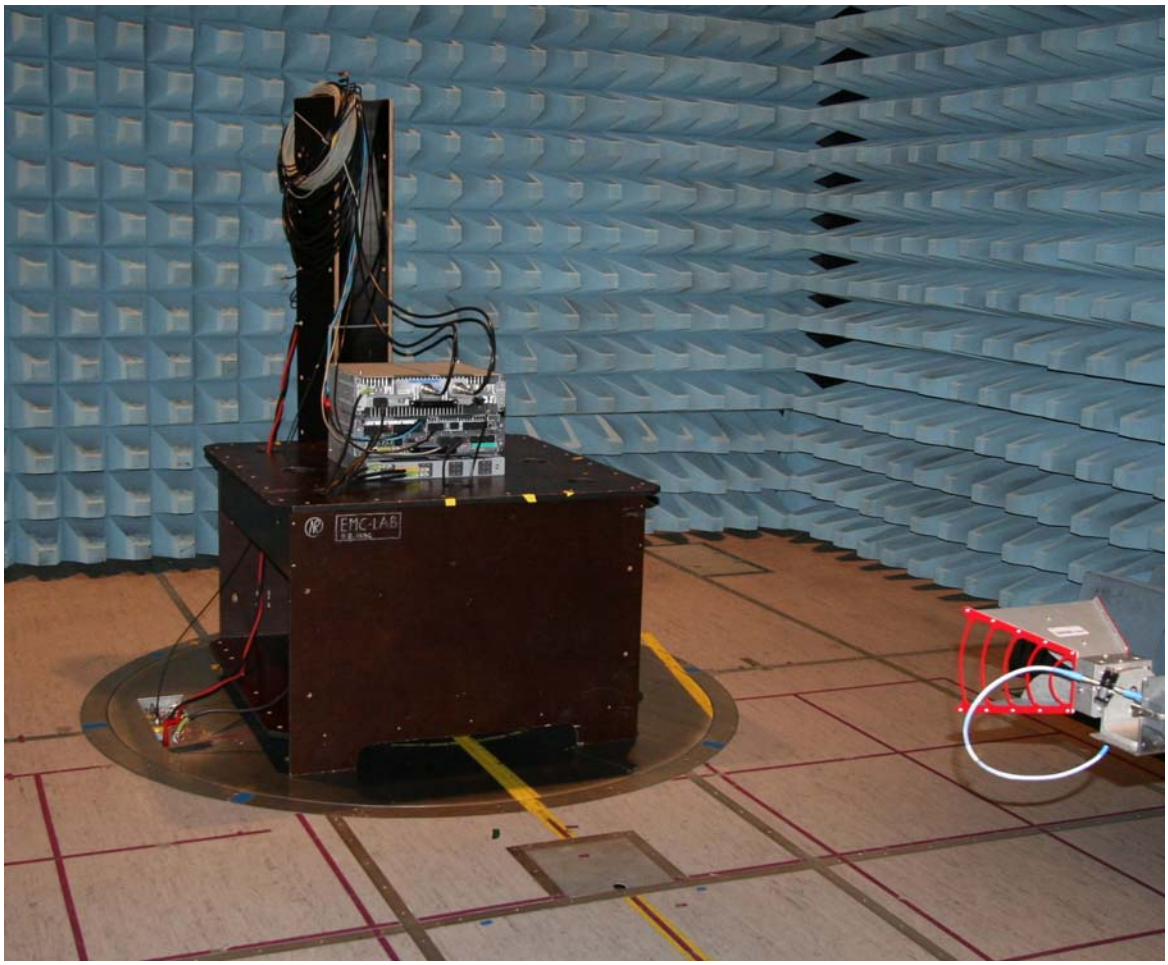
Note: Test model 67075 includes modulation types; QPSK, 16-QAM and 64-QAM, duty cycle 60%

8. List of test equipment

Each active test equipment is calibrated annually.

Nr.	Equipment	Name of equipment	Serial number
1	Signal analyzer	Rohde & Schwarz:FSQ26/K93	100364
2	Network analyzer	Hewlett-Packard:HP8753E	US38431868
3	Network analyzer	Hewlett-Packard:HP8720ES	US39172107
4	Calibration kit	Hewlett-Packard:HP85032B	2919A04843
5	Environmental chamber	Weiss technick DU 22/500/80	221/19600
6	Frequency standard	Datum 8040	23006282
7	DC power	Sörensen	9950C0085
8	Temperature/humidity meter	VAISALA HMI 31	P3730008
9	Vector Network analyzer	Rohde & Schwarz:ZVA40	100102
10	Calibration kit	Rohde & Schwarz:ZV-Z34	100026
11	Power meter	Rohde & Schwarz:NRVD	832025/034
12	Power sensor	Rohde & Schwarz:NRVZ	839913/010
13	High Pass filter	Reactel 9HSX-3/20-S11	0531
14	High Pass filter	BSC MCN-S8282/02	1182501
15	Attenuator	Weinschel 66-10-34	BK1136
16	Attenuator	Aeroflex/Weinschel 68-20-11	401
17	Attenuator	Narda FSCM 99899	08275
18	Attenuator	Narda 752-30	FSCM99899
19	Semianechoic chamber	Siemens Matsushita 9m × 5m × 6m (room 0039)	Product No S&M B83317- C6019-T232
20	EMI Test Receiver	R&S ESIB 26	100335
21	LogPer Antenna	R&S HL025	349048/002 (1-26 GHz)
22	Bilog Antenna	Chase CBL6112B	2694
23	Horn Antenna	Emco 3115	6346
24	Horn Antenna	Emco 3115	000075697
25	Biconical Antenna	R&S HK116	836891/009
26	Dipole VHF	Mess-Elektronik VHA9103	
27	Dipole UHF	Mess-Elektronik UHA9105	
28	Signal Generator	R&S SMR 20	1715
29	Amplifier	Miteq AFSX4	791117
30	Amplifier	HP 83017A	3123A00444
31	Antenna Mast	Deisel HD240	2401323194
32	Mast Controller	Deisel HD100	1001331

9. Photographs of Test Setup



Photograph 1: Radiated spurious emissions test

10. ANNEX A, TEST DETAILS

NAME OF TEST: RF Power Output	PARA. NO.: 2.1046

Minimum Standard: Para. No. 27.50 (h).(1) Main, booster and base stations. (i) The maximum EIRP of a main, booster or base station shall not exceed 33 dBW + 10log(X/Y) dBW, where X is the actual channel width in MHz and Y is either 6 MHz if prior to transition or the station is in the MBS following transition or 5.5 MHz if the station is in the LBS and UBS following transition, except as provided in paragraph (h)(1)(ii) of this section.
Sample calculation: 33dBW+ 10log(10 MHz / 5.5 MHz) dBW =34.26 dBW = ~2667 W.

Method Of Measurement:

CDMA Per ANSI/J-STD-014
TDMA Per ANSI/J-STD-010

Antenna terminal:
The power at antenna terminal is measured by using the R&S NRVD broad-band power meter and power sensor NRV-Z1. At Test model 67075 pulse mode duty cycle 60% was used.

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 2.1049

Minimum Standard: Para. No. 2.1049. The 99% occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5% of the emitted power.

Method Of Measurement:

The 99% occupied bandwidth of the carrier emission is measured using a signal analyzer with Resolution Bandwidth set to 1% of the necessary bandwidth of the transmitted carrier. R&S FSQ 26 signal analyzer with WiMAX K93 option was used.

NAME OF TEST: Spurious Emission at Antenna Terminals	PARA. NO.: 2.1051

Minimum Standard: Para. No. 27.53(l). For BRS and EBS stations, the power of any emissions outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) measured in watts.
(l)(2) For fixed and temporary fixed digital stations, the attenuation shall be not less than 43 + 10 log (P) dB

Method Of Measurement:

Spectrum analyzer settings:
RBW: 1 MHz
VBW: 1 MHz
Within 1 MHz of the upper and lower edges of the assigned band of operation the resolution bandwidth is lowered to 1 % of the 26 dB occupied bandwidth of the transmitted carrier. A pre–measurement was performed with the max peak detector and spurious emissions closer than 20 dB to the limit was measured with rms detector.

NAME OF TEST: Field Strength of Spurious Radiation	PARA. NO.: 2.1053

Minimum Standard: Para. No. 27.53(l). For BRS and EBS stations, the power of any emissions outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) measured in watts.
(l)(2) For fixed and temporary fixed digital stations, the attenuation shall be not less than 43 + 10 log (P) dB

Test Method:
TIA/EIA-603-C-2004, Section 2.2.12

The test was performed in a semi-anechoic shielded room. The EUT was placed on a non-conductive 0.8 m high table standing on the turntable. During the test in the frequency range 30-26500 MHz the distance from the EUT to the measuring antenna was 3 m. In order to find the maximum levels of the disturbance radiation the angle of the turntable, the height of the measuring antenna were varied during the tests. The test was performed with the measuring antenna being both in horizontal and vertical polarizations.

Vertical and horizontal polarizations in the frequency range 30 – 26500 MHz was first measured by using the peak detector. During the peak detector scan the turntable was rotated from 0° to 360° with 30° step with the antenna heights 1.0 m and 2.5 m.

The limit of -13 dBm has been calculated to correspond 84.4 dB(µV/m).
Spurious emissions closer than 20 dB to the limit were measured with average detector.

The antenna substitution method was used to determine the equivalent radiated power at spurious frequencies. The EUT was replaced with a reference substitution antenna with a known gain referenced to an isotropic radiator $G_{Antenna[dBi]}$. This antenna was fed with a signal at the spurious frequency $P_{Gen[dBm]}$. The level of the signal was adjusted to repeat the previously measured level. The resulting EIRP is the signal level fed to the reference antenna corrected for gain referenced to an isotropic.
The formula below was used to calculate the EIRP of the EUT.

$$P_{EIRP[dbm]} = P_{Gen[dBm]} - L_{Cable[dB]} + G_{Antenna[dBi]}$$

NAME OF TEST: Frequency Stability	PARA. NO.: 2.1055

Minimum Standard: Para. No. 27.54. The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

Method Of Measurement:

Frequency Stability With Voltage Variation

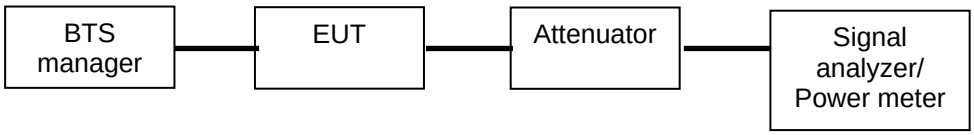
The E.U.T. is placed in an environmental chamber and allowed to stabilize at +20 degrees Celsius for at least 15 minutes. With the voltage input to the E.U.T. set to 85% S.T.V., the frequency error is measure. This procedure is repeated at 100% S.T.V. and 115% S.T.V.

Frequency Stability With Temperature Variation

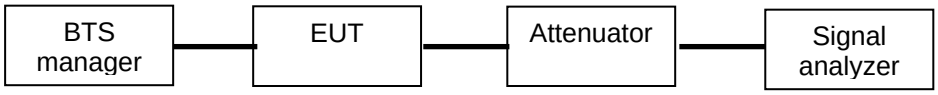
The input voltage to the E.U.T. is set to S.T.V. and the temperature of the environmental chamber is varied in 10 degree steps from -30 degrees C to +50 degrees C. The E.U.T. is allowed to stabilize at each temperature and the frequency error is measured.

11. ANNEX B, TEST DIAGRAMS

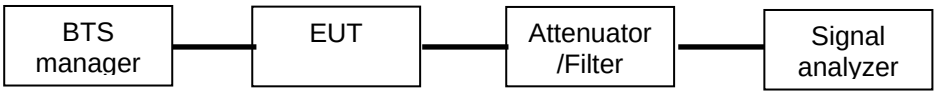
RF Power Output PARA. NO.: 2.1046



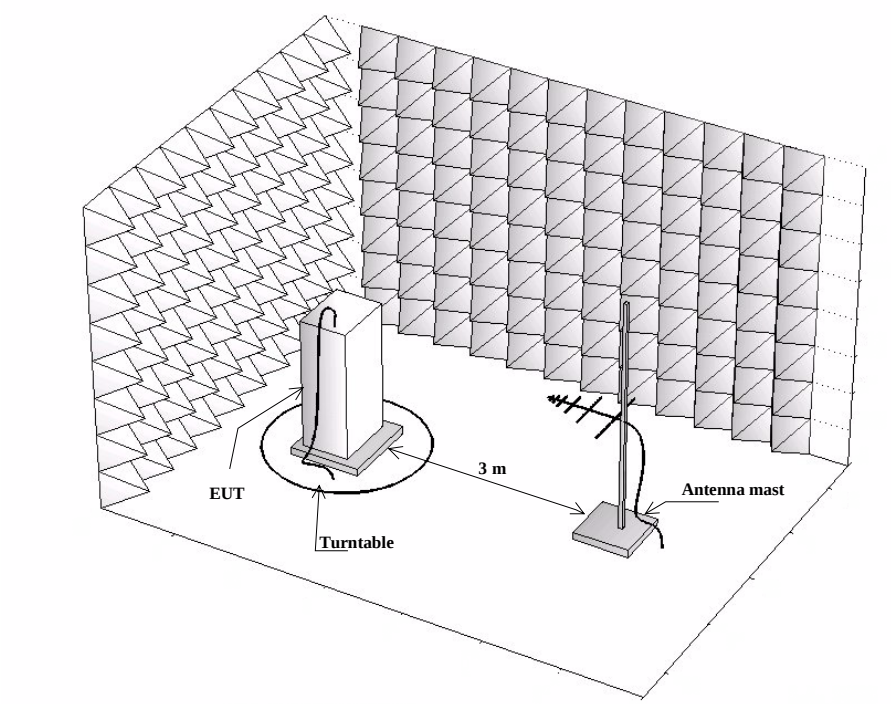
Occupied Bandwidth PARA. NO.: 2.1049



Spurious Emission at Antenna Terminals PARA. NO.: 2.1051

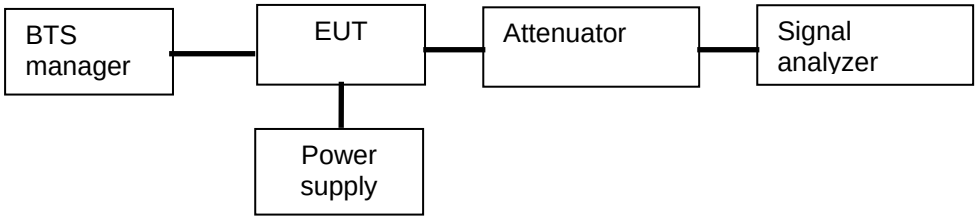


Field Strength of Spurious Radiation PARA. NO.: 2.1053



Frequency Stability PARA. NO.: 2.1055

Frequency Stability With Voltage Variation



Frequency Stability With Temperature Variation