NORTEL

GSM 18000 Indoor BTS Radio Test Report according to FCC Part 24 (FCC ID AB6BTS18000IND)

Document number:	PCS/BTS/DJD/015903
Document issue:	V01.01/EN
Document status:	Standard
Date:	20/06/2005

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Printed in France

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PUBLICATION HISTORY

20/06/2005	**A. CAILLE**
	Document creation.
	Issue V01.01 / EN
	Standard

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1. INTRODUCTION

1.1. OBJECT

This document presents the measurement results of tests performed on this report presents the test data in accordance with FCC Part 24 Subpart E for the Nortel Networks GSM 18000 Indoor BTS in PCS1900 band.

This report presents test data for GMSK modulation and 8PSK modulation (EDGE functionality)

1.2. SCOPE OF THIS DOCUMENT

This document applies to the Nortel Networks GSM 18000 Indoor BTS (FCC ID AB6BTS18000IND).

GSM 18000 Indoor BTS can integrate a maximum of 6Radio-Modules (RM).

1.3. AUDIENCE FOR THIS DOCUMENT

This document is to be used by any person needing a view on Nortel Networks GSM 18000 Indoor BTS.

2. RELATED DOCUMENTS

2.1. APPLICABLE DOCUMENTS

[A1]	47CFR Part 24	PERSONAL COMMUNICATIONS SERVICES January 2003
[A2]	47CFR Part 2	FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS October 2003

2.2. REFERENCE DOCUMENTS

[R1] RADIO TEST REPORT FOR FCC REGULATORY
IN EXTREME CONDITIONS OF GSM 18000 INDOOR BTS 1900MHZ
EXTERNAL LABORATORY GYL TECHNOLOGY – REPORT 15103-03-CC-2-A

3. TEST REPORT: GSM 18000 INDOOR BTS

3.1. INTRODUCTION

The following information is submitted for update of the type acceptance of a Broadband PCS Base Station for Northern Telecom, Inc., in accordance with FCC Part 24, Subpart E and Part 2, Subpart J of the FCC Rules and Regulations.

The measurement procedures were in accordance with the requirements of Part 2.

3.2. TX RF CHAIN CONFIGURATION UNDER TESTS

Tests are performed on Radio Module (RM) in first slot RM0.

Radio Module is equipped with three identical RF ways Tx0, Tx1, Tx2.
Each RF path includes a 30W Power amplifier.
The different RF way can be coupled with a coupling module placed before antenna connector.

Two types of coupling device are tested:

- DDM H2 on way Tx0, Tx1.
- **Tx Filter without H2 (TxF w/o H2)** on way Tx2.

Tx Filter (w/o H2) is the worst case for spurious level.
H2 combiner introduces additional 3dB losses

3.3. MEASUREMENT RESULTS

Measurement Results Summary:

FCC Measurement Specification	IC Limit Specification	Description	Result	Note
2.1046(a), 2.1033(c)(8) 24.232	6.2	RF Power Output	Complies	Results available on this document
2.1049		Occupied Bandwidth	Complies	
2.1051, 2.1057 24.238	6.3 6.4	Spurious Emissions at Antenna Terminals	Complies	
2.1055 24.235	7.0	Frequency Stability	Complies	[R1] External Laboratory Additional report

CONCLUSION :

GSM 18000 Indoor BTS (FCC ID AB6BTS18000IND) is compliant with FCC Part24 requirement.

The following power limitation are required to comply to Adjacent Band spurious which depend coupling configuration:

Coupling configuration	System Power limitation GMSK modulation	System Power limitation 8 PSK modulation
DDM Duplexer Tx Filter (without H2)	**Power Limitation : Pmax – 2 dB = 42 dBm**	**Power Limitation : Pmax – 2 dB = 42 dBm**
DDM H2 Tx Filter H2	Pmax = 41 dBm	Pmax = 41 dBm

3.4. NAME OF TEST: RF POWER OUTPUT

3.4.1 FCC REQUIREMENTS – FCC PART 24.232

Base stations are limited to 1640 watts peak equivalent isotropically radiated power (e.i.r.p.) with an antenna height up to 300 meters HAAT. See 24.53 for HAAT calculation method. Base station antenna heights may exceed 300 meters with a corresponding reduction in power. In no case may the peak output power of a base station transmitter exceed 100 watts.

3.4.2 TEST RESULTS

The Table shows the test results of RF Output Power for **GMSK modulation** with several coupling configurations:

Radio Channel	Frequency (MHz)	Tx0 DDM H2 Power (dBm)	Tx1 DDM H2 Power (dBm)	Tx2 TXF w/o H2 Power (dBm)	PA Output Power (dBm)	Limit (dBm)
512	1930,2	40.7	40.9	44.4	GMSK (30W) 44.8 dBm +/- 0.5 dB	50
661	1960	41	41	44.6		
810	1989,8	41	41.1	44.5		

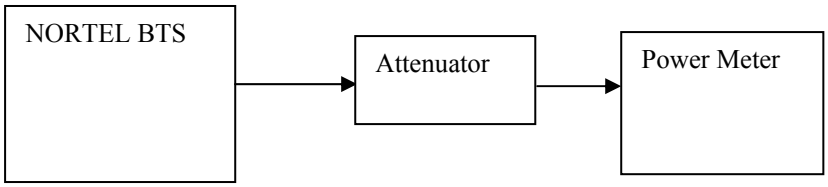
The Table shows the test results of RF Output Power for **8PSK modulation** with several coupling configurations:

Radio Channel	Frequency (MHz)	Tx0 DDM H2 Power (dBm)	Tx1 DDM H2 Power (dBm)	Tx2 TXF w/o H2 Power (dBm)	PA Output Power (dBm)	Limit (dBm)
512	1930,2	40.2	40.2	44	8PSK (30W) 44.8 dBm +/- 0.5 dB	50
661	1960	40.2	40.5	44		
810	1989,8	40.4	40.5	43.9		

3.4.3 TEST PROCEDURE

The equipment was configured as shown in schematic 1.

Schematic : Test configuration for RF Output Power



The BTS was configured to transmit at maximum power (static level 0) :

- for GMSK modulation, in mode GMSK no synchro,
- for 8PSK modulation, in mode logical PDCH, Type GPRS, coding MCS5.

Measurements were made at frequencies which are the bottom, middle and top of each of the licensed blocks.

The output power was measured using the power meter which has the following settings :

Mode:	Average
Reference Level Offset:	Corrected to account for cable(s) and attenuator losses

3.5. NAME OF TEST: OCCUPIED BANDWIDTH

3.5.1 FCC REQUIREMENTS

The occupied 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.

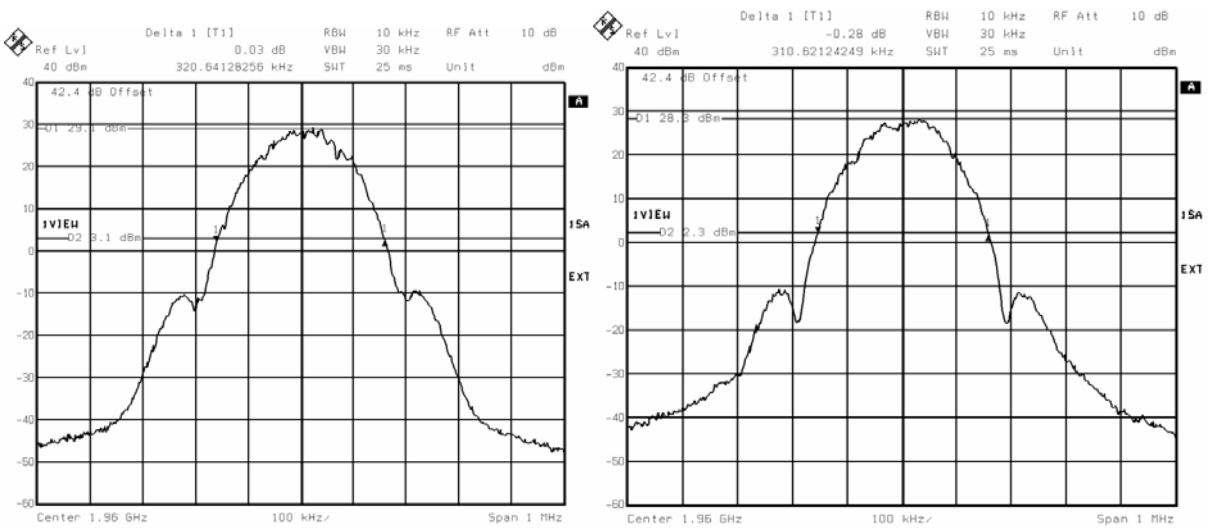
3.5.2 TEST RESULTS WITH DDM H2 CONFIGURATION

The maximum occupied bandwidth on Tx0 was found to be:

320.6 kHz, measured on channel 661, f=1960 MHz in GMSK modulation,
310.6 kHz, measured on channel 661, f=1960 MHz in 8PSK modulation.

Figure : Sample plot for occupied bandwidth for Tx0.

in GMSK modulation **8PSK modulation**

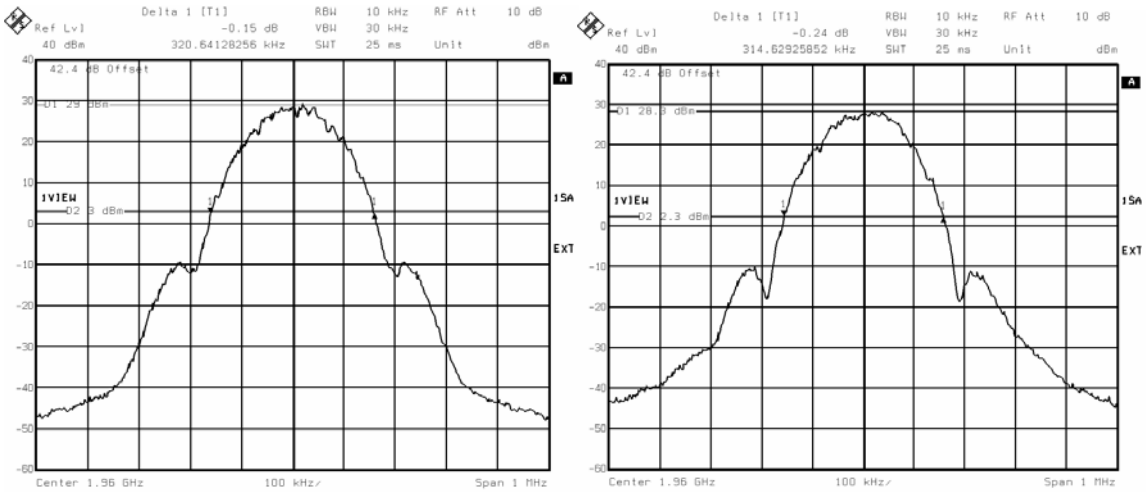


The maximum occupied bandwidth on Tx1 was found to be:

320.6 kHz, measured on channel 661, f=1960 MHz in GMSK modulation,
314.6 kHz, measured on channel 661, f=1960 MHz in 8PSK modulation.

Figure: Sample plot for occupied bandwidth in Tx1

in GMSK modulation **8PSK modulation**

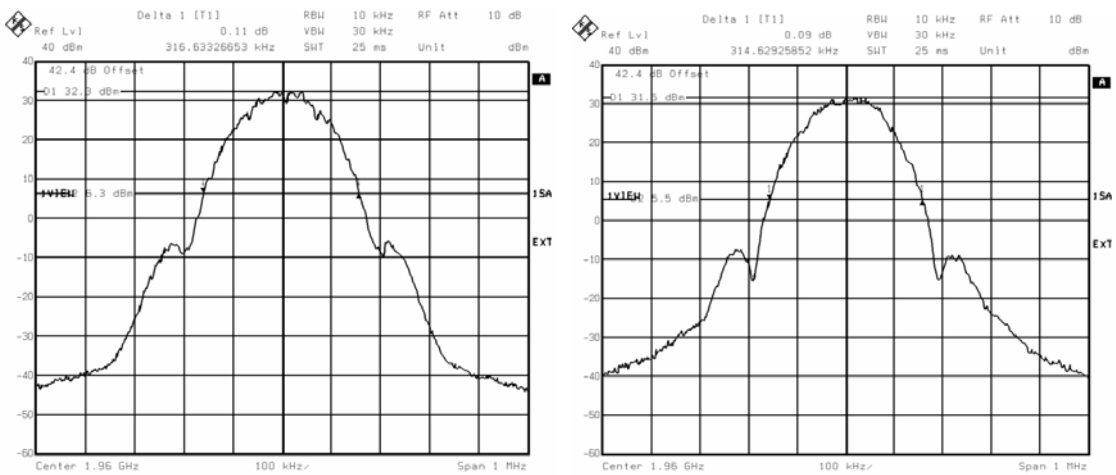


3.5.3 TEST RESULTS WITH TX FILTER (W/O H2) CONFIGURATION

The maximum occupied bandwidth on Tx2 was found to be:
316.6 kHz, measured on channel 661, f=1960 MHz in GMSK modulation,
314.6 kHz, measured on channel 661, f=1960 MHz in 8PSK modulation.

Figure : Sample plot for occupied bandwidth in Tx2

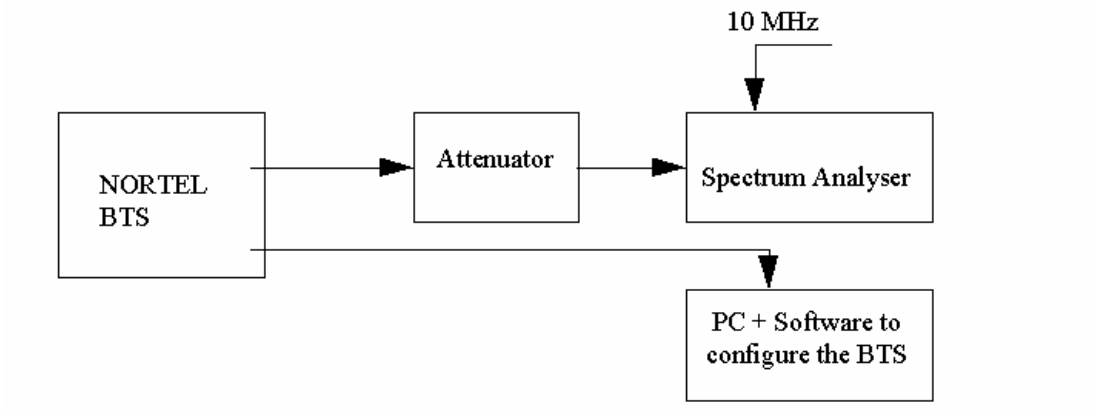
GMSK modulation **8PSK modulation**



3.5.4 TEST PROCEDURE

The equipment was configured as shown in schematic 2.

Schematic : Test configuration for Occupied bandwidth



The BTS was configured to transmit at maximum power (static level 0):

- for GMSK modulation, in mode GMSK no synchro,
- for 8PSK modulation, in mode logical PDCH, Type GPRS, coding MCS5.

The occupied bandwidth was measured by determining the bandwidth out of which all emissions are attenuated at least 26 dB below the transmitter power.

The spectrum analyzer had the following settings:

Detector:	Sample
Trace:	Average
Resolution bandwidth:	10 kHz
Video bandwidth:	30 kHz
Span:	1 MHz
Reference Level Offset:	Corrected to account for cable(s) and attenuator losses
Level range:	100 dB
Sweep time:	25 ms

3.6. NAME OF TEST: SPURIOUS EMISSIONS AT ANTENNA TERMINALS

3.6.1 FCC REQUIREMENTS LIMITS – FCC PART 24.238

(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.

(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.

3.6.2 TEST RESULTS WITH H2D CONFIGURATION

The reference level for spurious emissions at the antenna terminals is taken from the measured output power (41 dBm = 12.6 Watts).

Therefore the spurious emissions must be attenuated by at least 43 + 10*Log (12,6) = 54 dB

The measured output power was 41 dBm therefore the limit is 41 – 54 = -13 dBm.

Spurious measurement is performed with the DDM H2 configuration.

The Nominal power at antenna connector: PD max =41 dBm.

Tx 0 – Spurious emissions with DDM H2 for GMSK modulation

Channel	Power emission level	Spurious emissions level (dBm)	Limit (dB)	Margin (dB)
512	Pmax	-16.51	-13	3.51
810	Pmax	-15.19	-13	2.19

Tx 0 – Spurious emissions with the DDM H2 for 8PSK modulation

Channel	Power emission level	Spurious emissions level (dBm)	Limit (dB)	Margin (dB)
512	Pmax	-14.86	-13	1.86
810	Pmax	-16.46	-13	3.46

Tx 1 – Spurious emissions with the DDM H2 for GMSK modulation

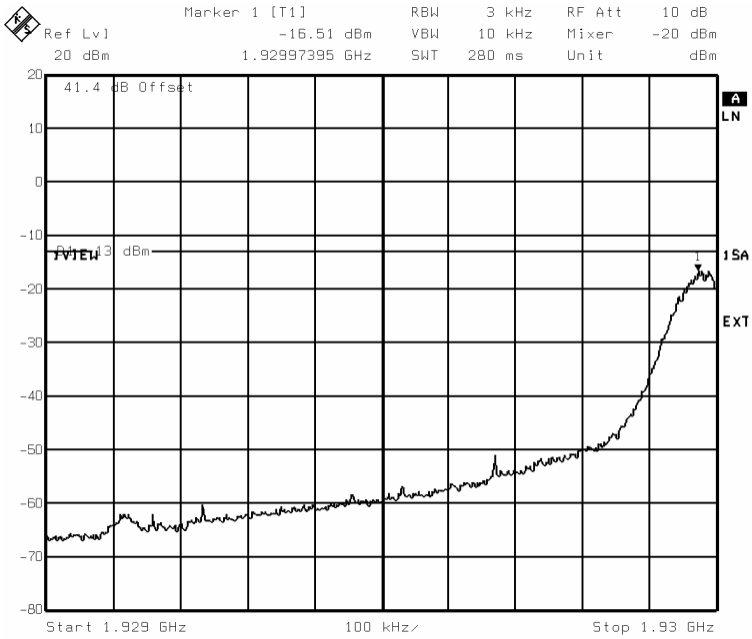
Channel	Power emission level	Spurious emissions level (dBm)	Limit (dB)	Margin (dB)
512	Pmax	-16.22	-13	3.22
810	Pmax	-15.61	-13	2.61

Tx 1 – Spurious emissions with theDDM H2 for 8PSK modulation

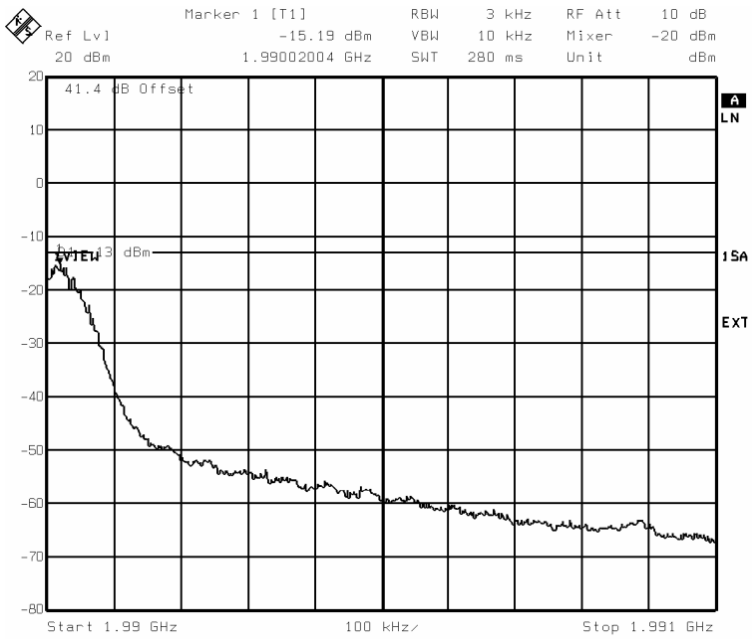
Channel	Power emission level	Spurious emissions level (dBm)	Limit (dB)	Margin (dB)
512	Pmax	-16.52	-13	3.52
810	Pmax	-17.42	-13	4.42

- **Tx 0 Spurious emissions with DDM H2 configuration .**

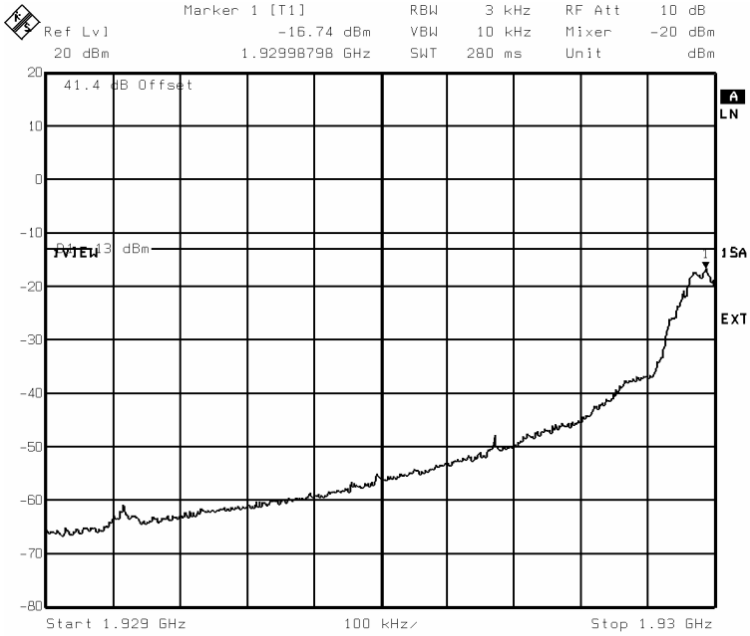
-1 MHz adjacent band (Channel 512, Pmax),
GMSK modulation



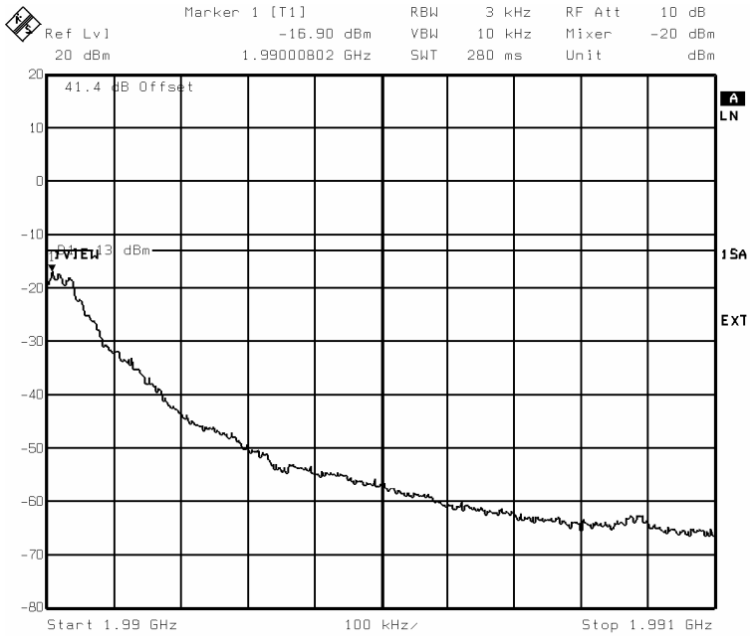
+1 MHz adjacent band (Channel 810, Pmax),
GMSK modulation



-1 MHz adjacent band (Channel 512, Pmax),
8PSK modulation

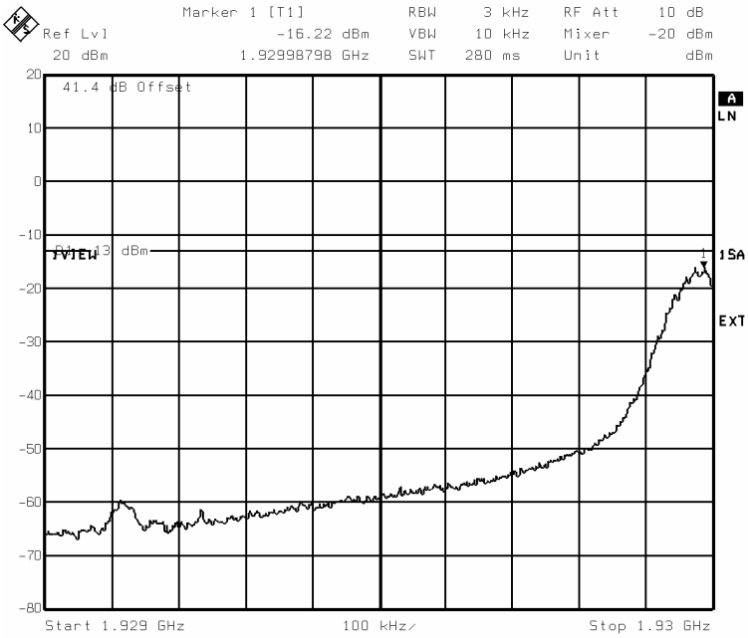


+1 MHz adjacent band (Channel 810, Pmax),
8PSK modulation

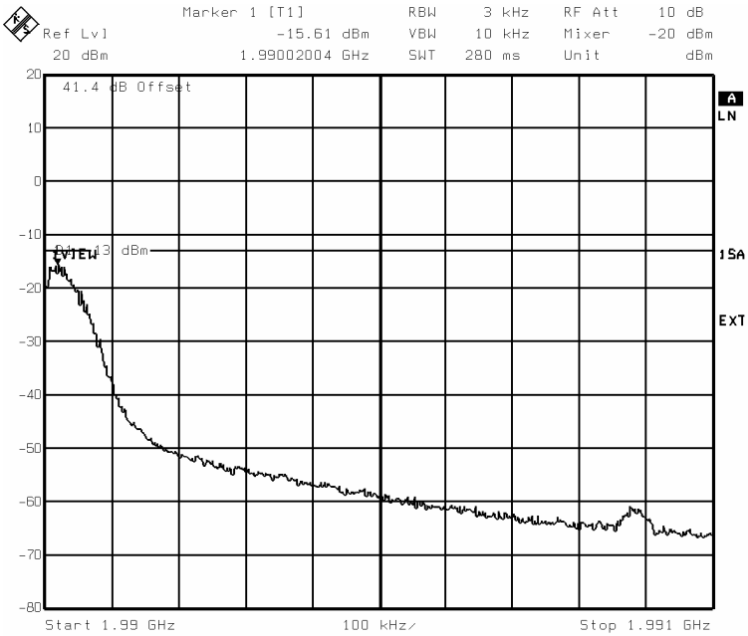


- **Tx 1 – Spurious emissions with DDM H2 configuration**

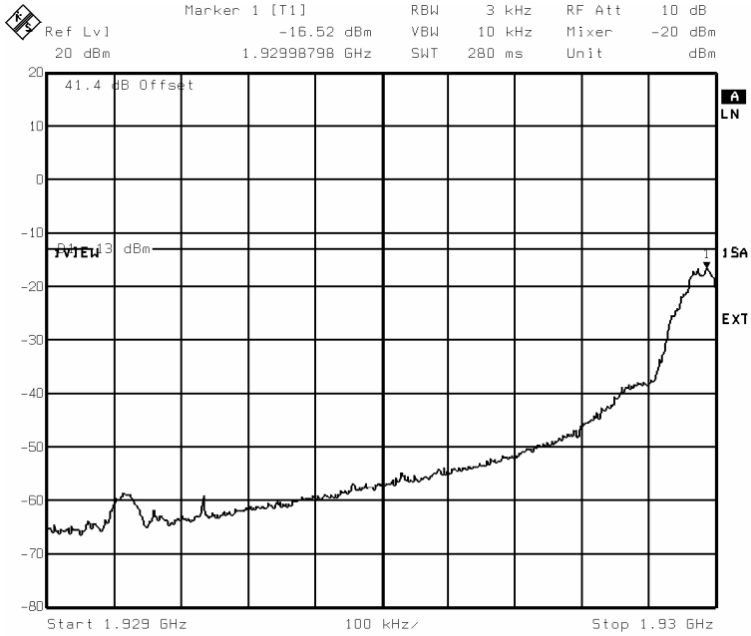
-1 MHz adjacent band (Channel 512, Pmax),
GMSK modulation



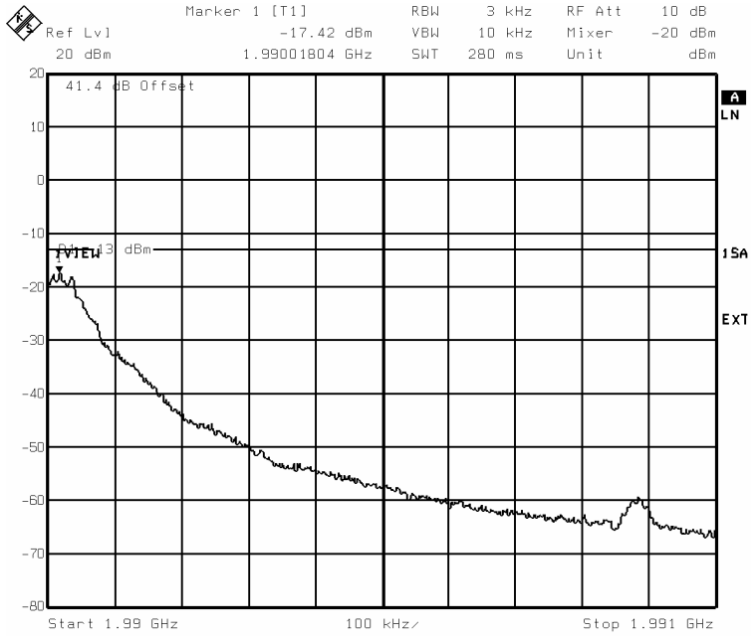
+1 MHz adjacent band (Channel 810, Pmax),
GMSK modulation



-1 MHz adjacent band (Channel 512, Pmax),
8PSK modulation



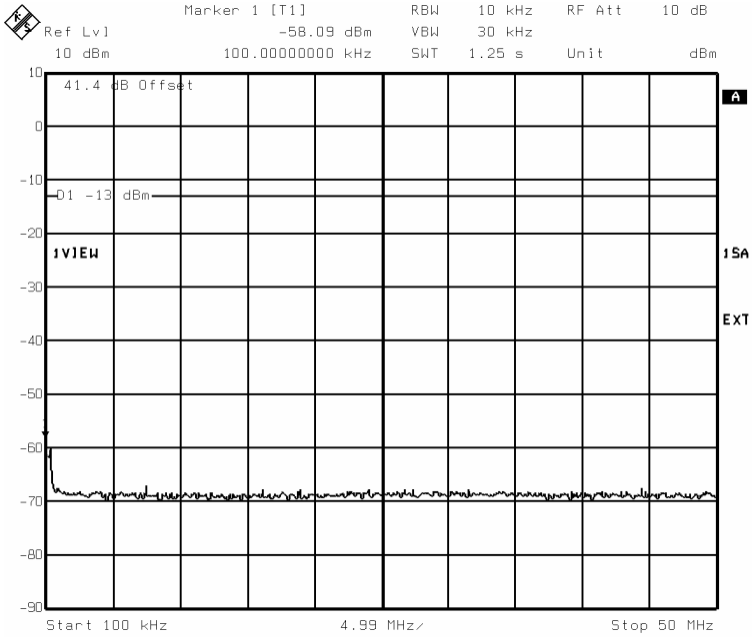
+1 MHz adjacent band (Channel 810, Pmax),
8PSK modulation



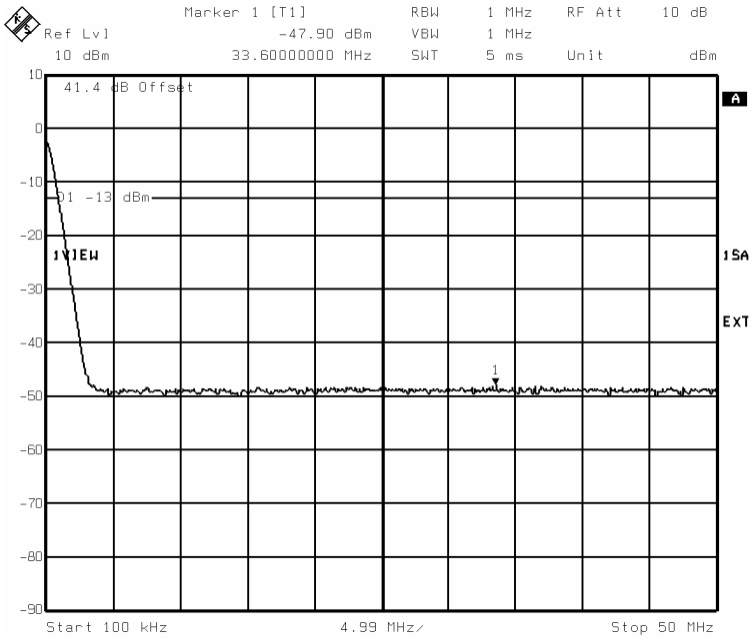
Out-of-block emissions (Channel 810, Pmax),

Tx0 - DDM H2 configuration , 8PSK modulation

100 kHz – 50 MHz



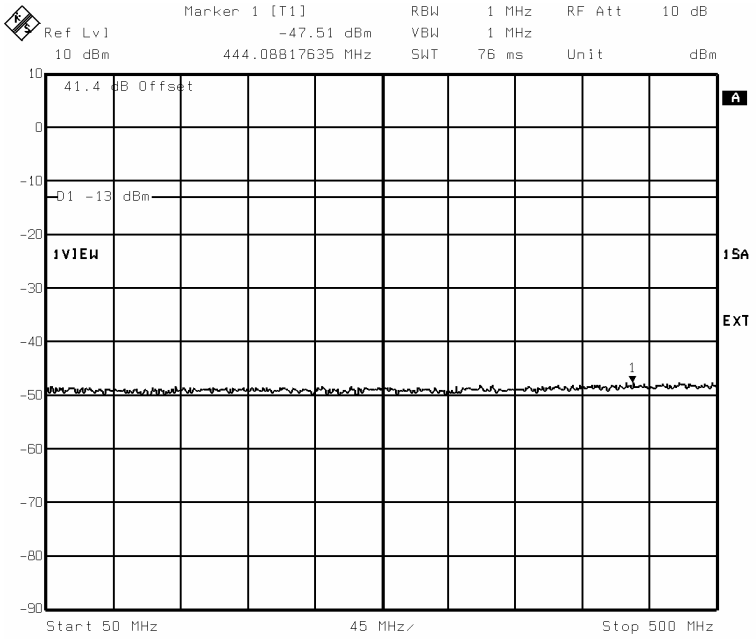
RBW=10 kHz



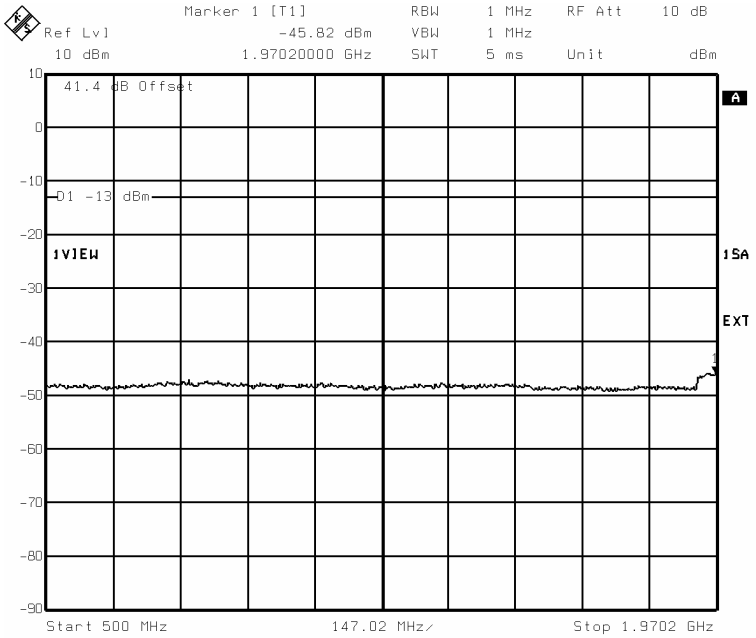
RBW=1 MHz (*)

(*) *Note: spectrum line at 100 kHz is internal DC spectrum line of analyzer*

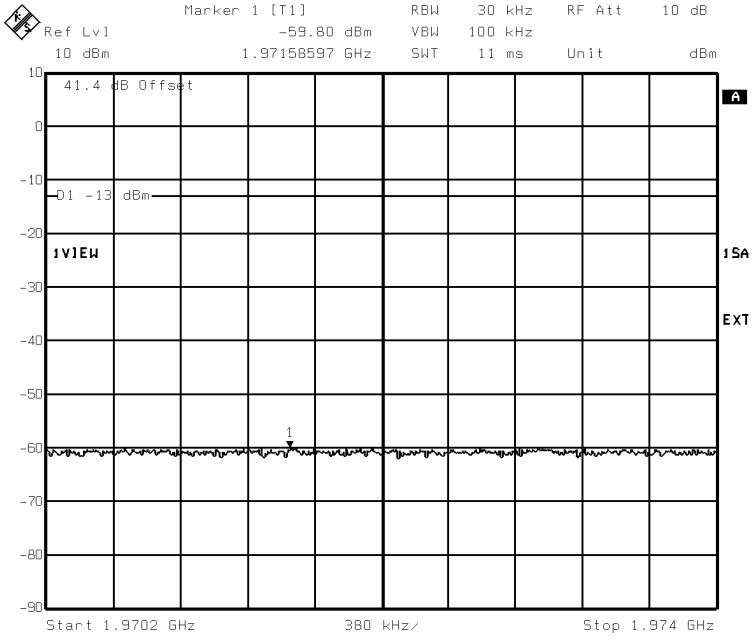
50 MHz – 500 MHz



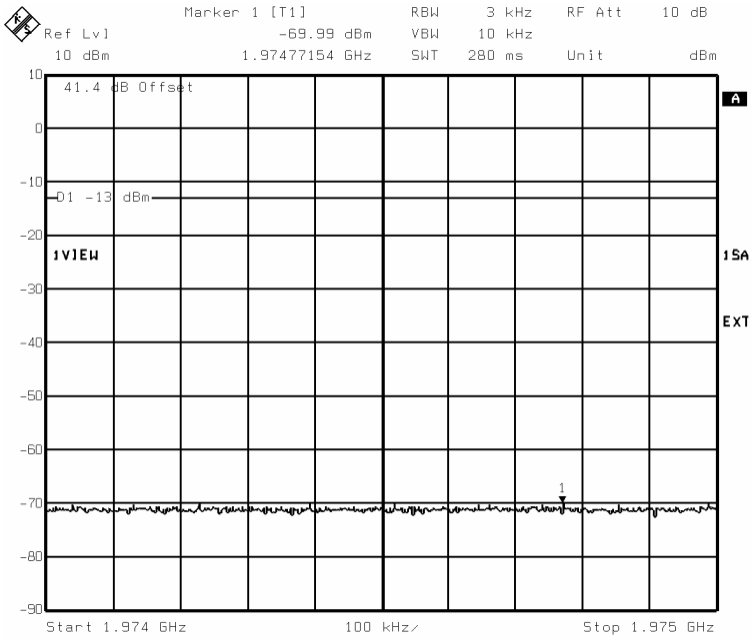
500 MHz – 1970.2 MHz



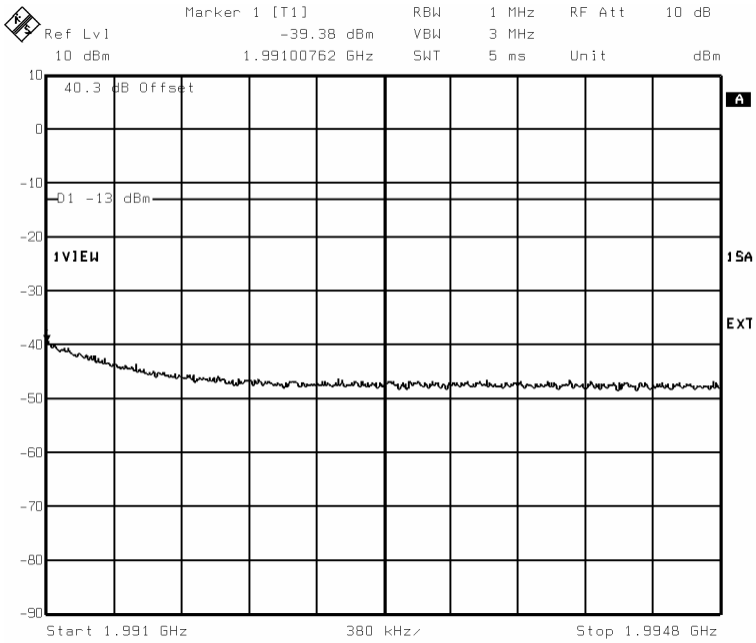
1970.2 – 1974 MHz



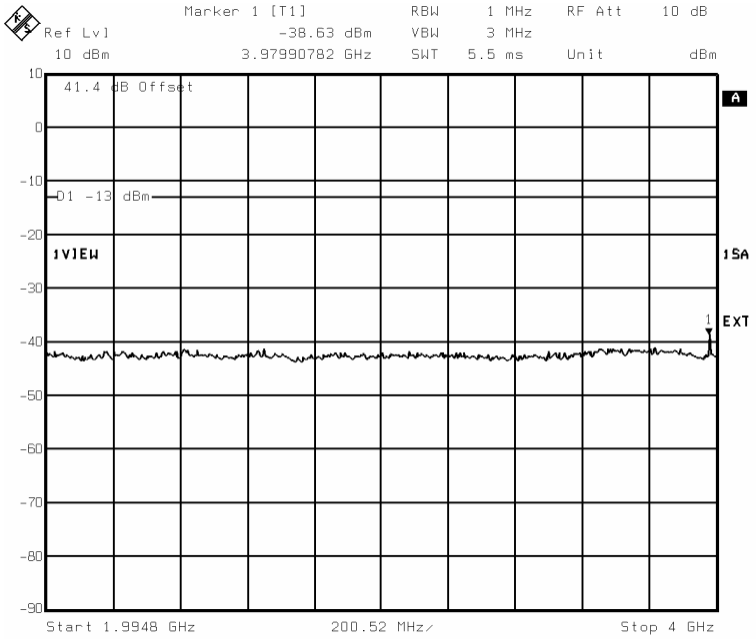
1974 – 1975 MHz



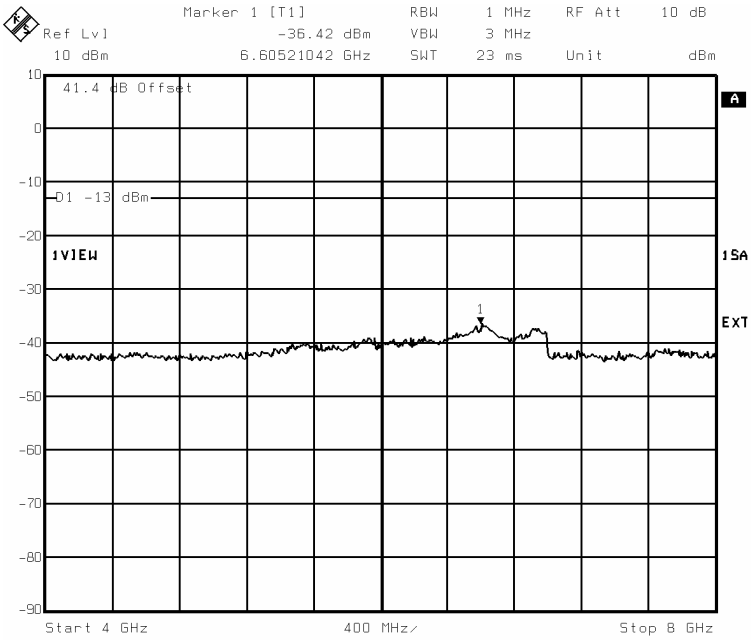
1991 – 1994.8 MHz



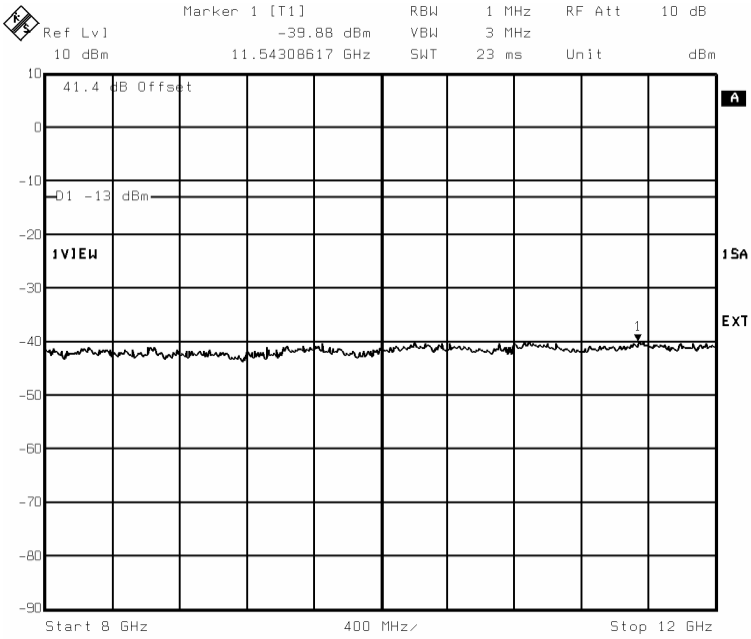
1994.8 MHz – 4 GHz



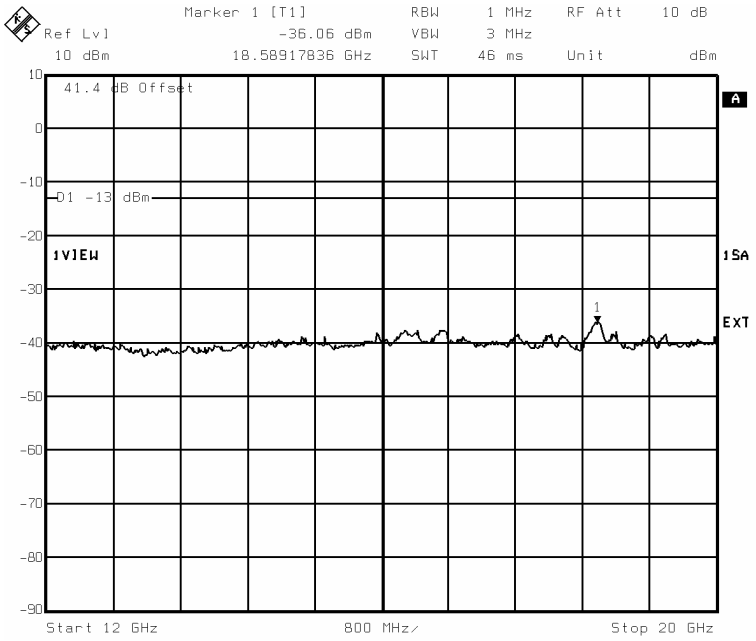
4 – 8 GHz



8 – 12 GHz



12 – 20 GHz



Test results for Tx0 - DDM H2 configuration , 8PSK modulation

Frequency band	Level max. (dBm)	Spec. (dBm)	Margin (dB)
100 kHz – 50 MHz	-47.9	-13	34.9
50 – 500 MHz	-47.5	-13	34.5
500 – 1970.2MHz	-45.8	-13	32.8
1970.2 – 1974 MHz	-59.8	-13	46.8
1974 – 1975 MHz	-70	-13	57
1991 – 1994.8 MHz	-39.4	-13	26.4
1994.8 MHz – 4 GHz	-38.6	-13	25.6
4 – 8 GHz	-36.4	-13	23.4
8 – 12 GHz	-39.9	-13	26.9
12 – 20 GHz	-36.1	-13	23.1

3.6.3 TEST RESULTS WITH TX FILTER (W/O H2) CONFIGURATION

The reference level for spurious emissions at the antenna terminals is taken from the measured output power (44.8 dBm = 30 Watts).

Therefore the spurious emissions must be attenuated by at least 43 + 10*Log(30) =57.8dB

The measured output power was 44.8 dBm therefore the limit is 44.8 – 57.8 = -13 dBm.

Spurious measurement is performed with the worst configuration with Duplexer coupling
The Nominal power at antenna connector: PD max =44.8 dBm.

The test compliance with DDM duplexer / TXF without H2 involves the compliance with DDM/ TxF H2 (two input coupler with 3dB loss coupling associated with TxF/duplexer).

Tx 2 – Spurious emissions with the TxF w/o H2 for GMSK modulation

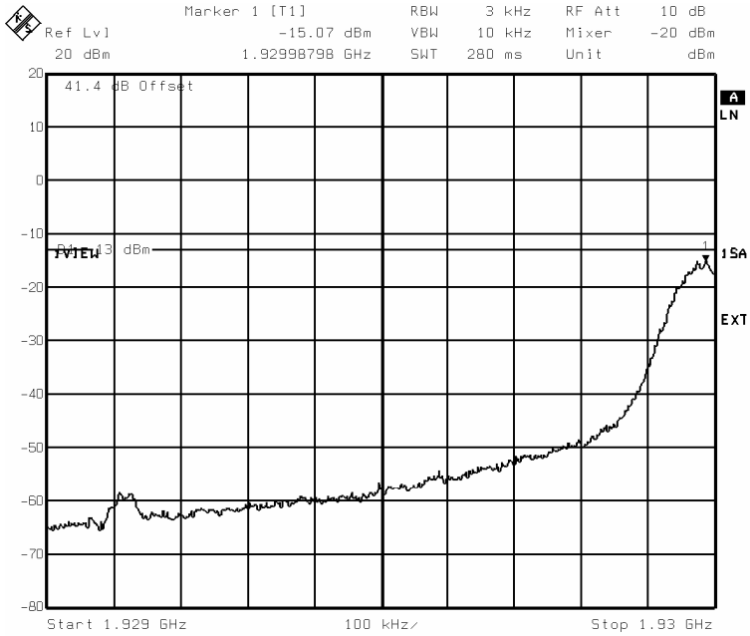
Channel	Power emission level	Spurious emissions level (dBm)	Limit (dB)	Margin (dB)
512	Pmax-2	-15.07	-13	2.07
810	Pmax-2	-14.19	-13	1.19

Tx 2 – Spurious emissions with the TxF w/o H2 for 8PSK modulation

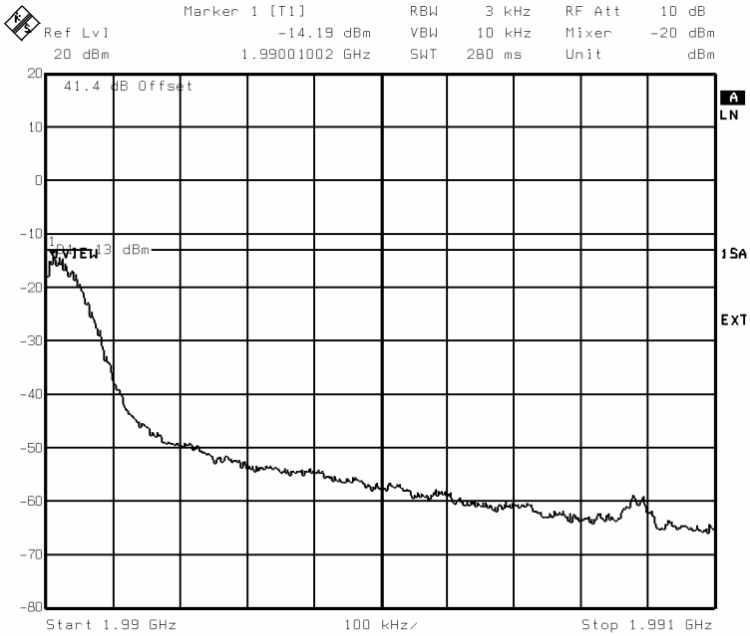
Channel	Power emission level	Spurious emissions level (dBm)	Limit (dB)	Margin (dB)
512	Pmax-2	-14.86	-13	1.86
810	Pmax-2	-16.46	-13	3.46

- **Tx 2 – Spurious emissions with the TXF w/o configuration**

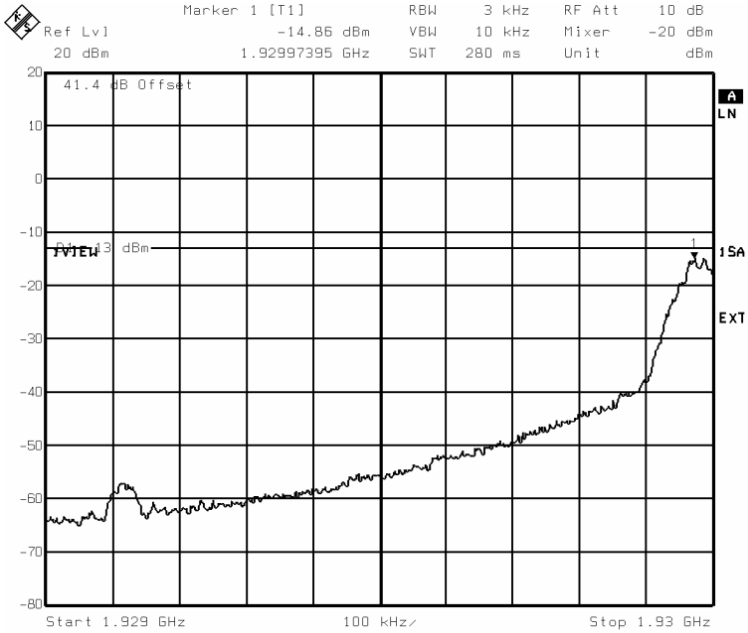
-1 MHz adjacent band (Channel 512, Pmax-2dB),
GMSK modulation



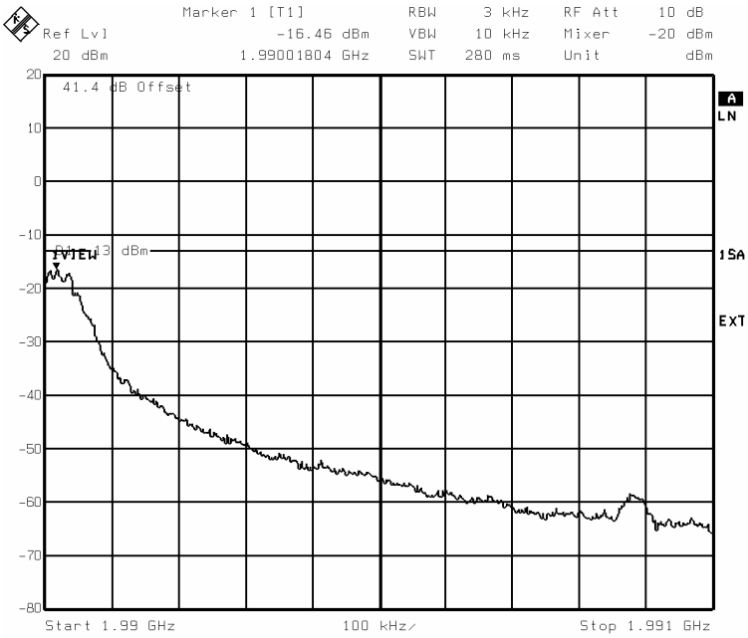
+1 MHz adjacent band (Channel 810, Pmax-2dB),
GMSK modulation



-1 MHz adjacent band (Channel 512, Pmax-2dB),
8PSK modulation



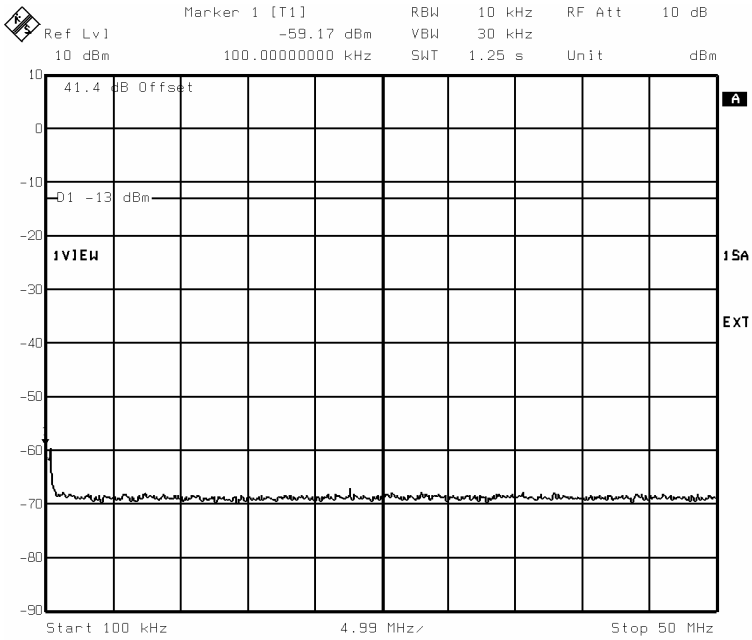
+1 MHz adjacent band (Channel 810, Pmax-2dB),
8PSK modulation



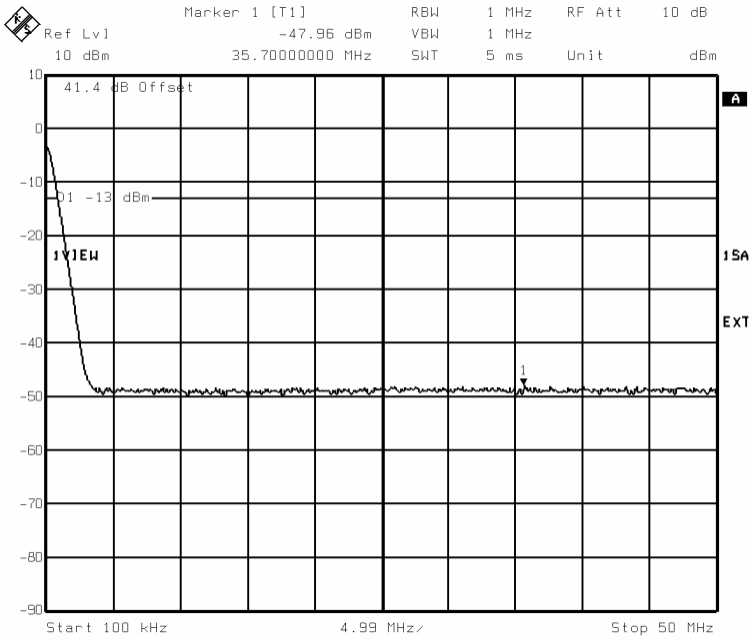
Out-of-block emissions (Channel 810, Pmax),

Tx2 TxF w/o, GMSK modulation

100 kHz – 50 MHz



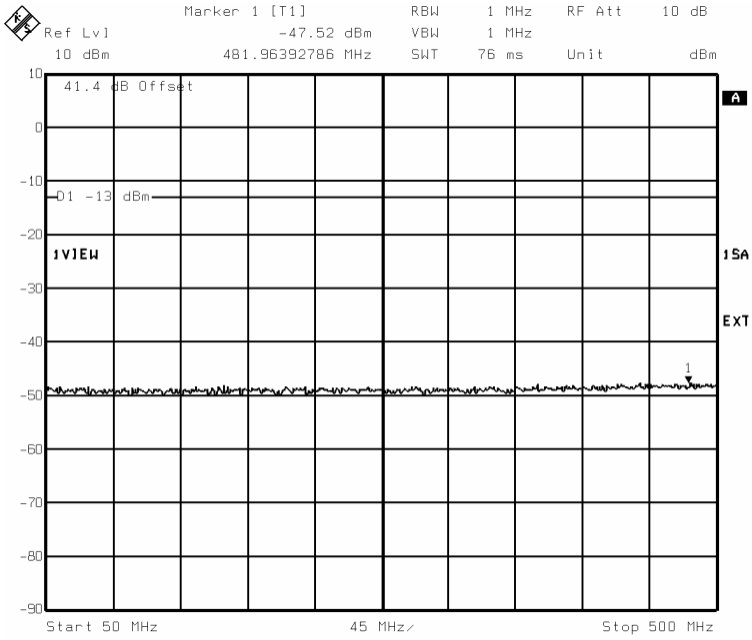
RBW=10 kHz



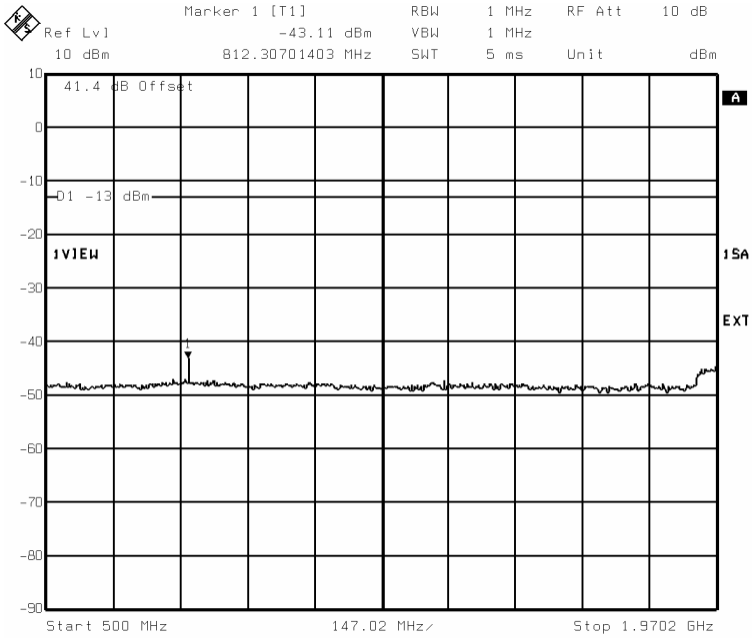
RBW=1 MHz (*)

(*) *Note: spectrum line at 100 kHz is internal DC spectrum line of analyser*

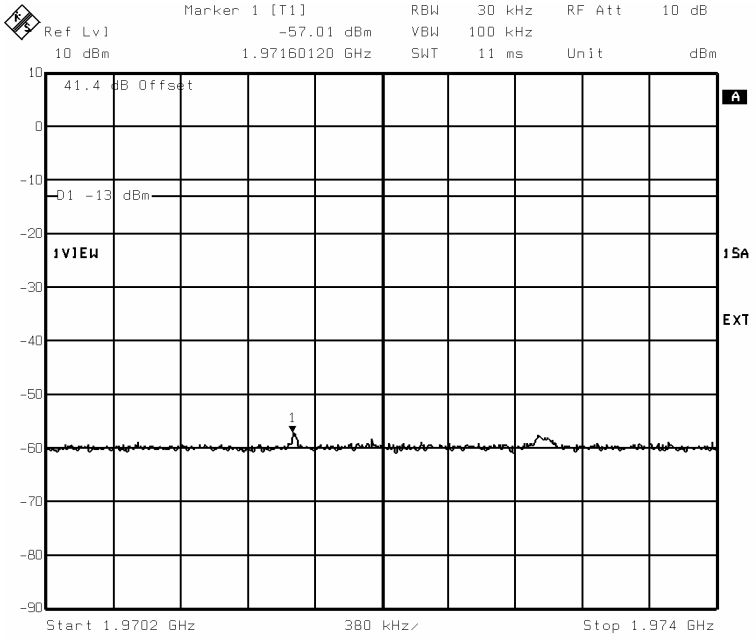
50 MHz – 500 MHz



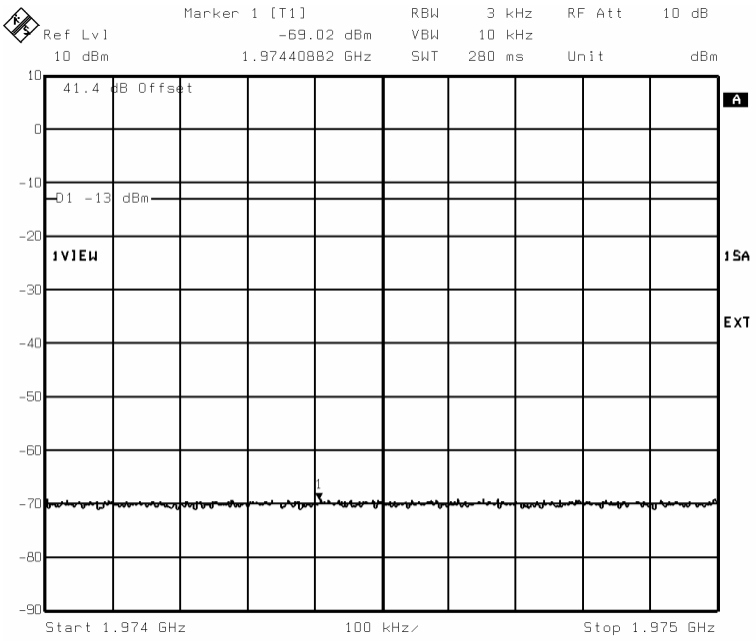
500 MHz – 1970.2 MHz



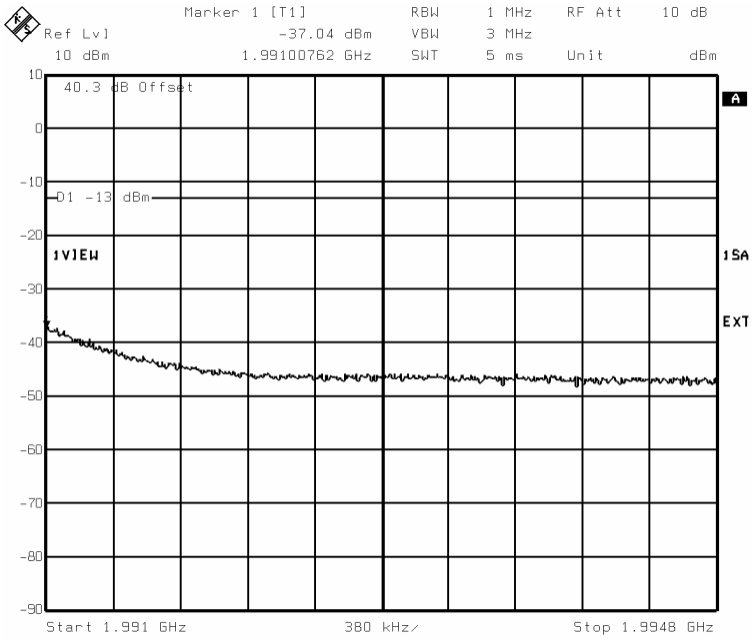
1970.2 – 1974 MHz



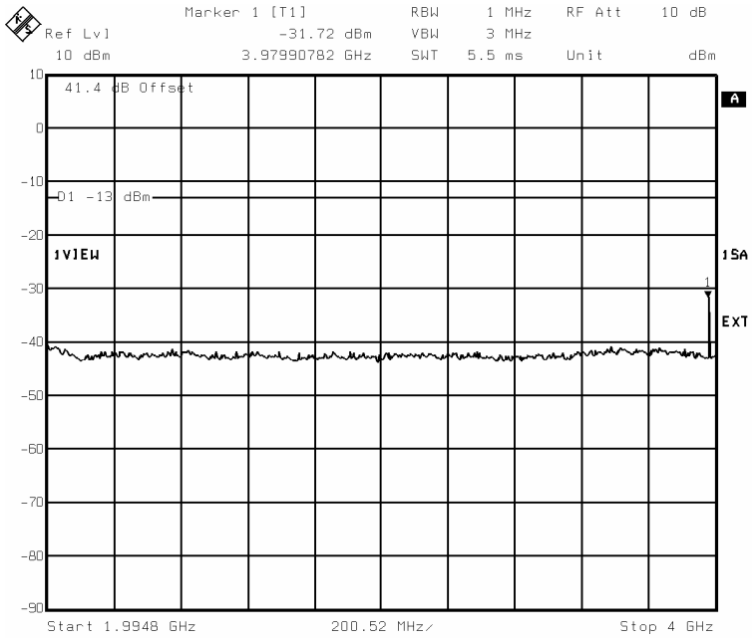
1974 – 1975 MHz



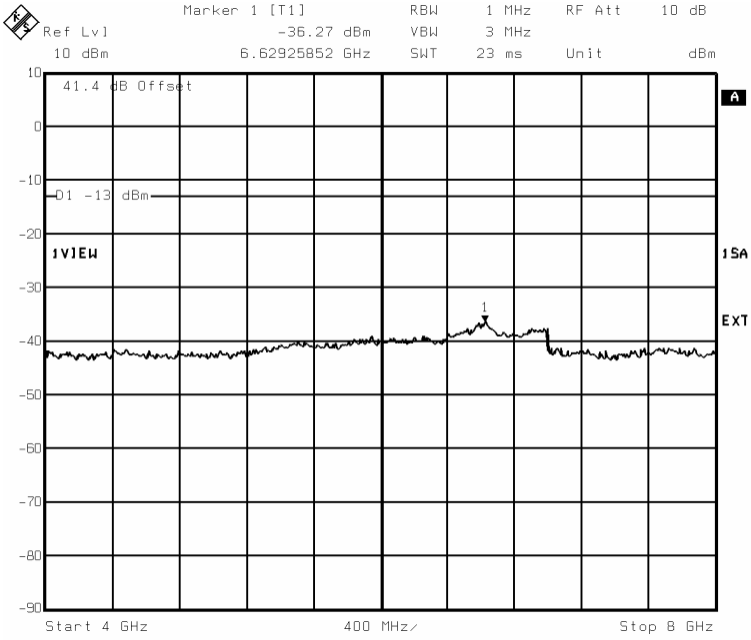
1991 – 1994.8 MHz



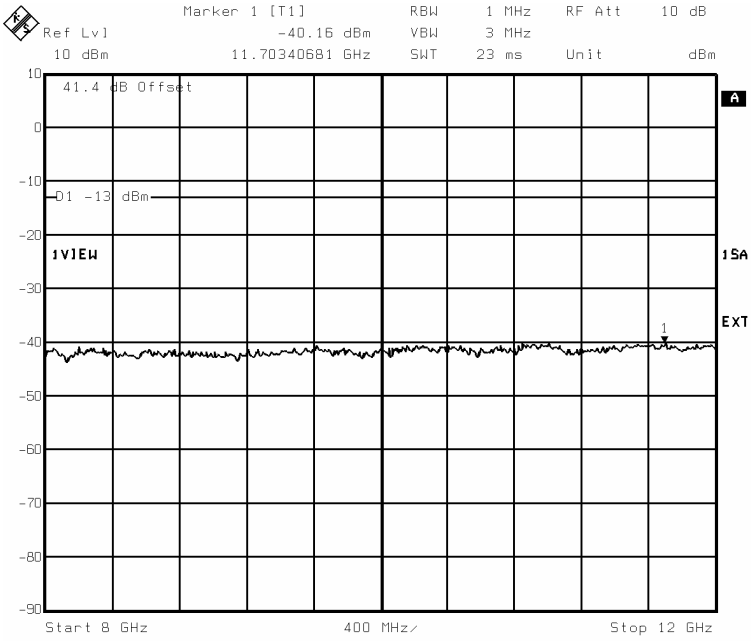
1994.8 MHz – 4 GHz



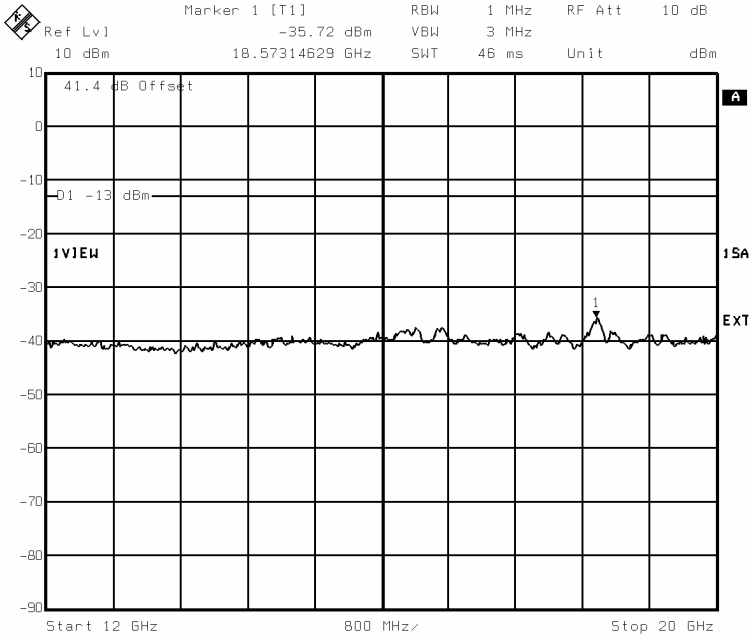
4 – 8 GHz



8 – 12 GHz



12 – 20 GHz



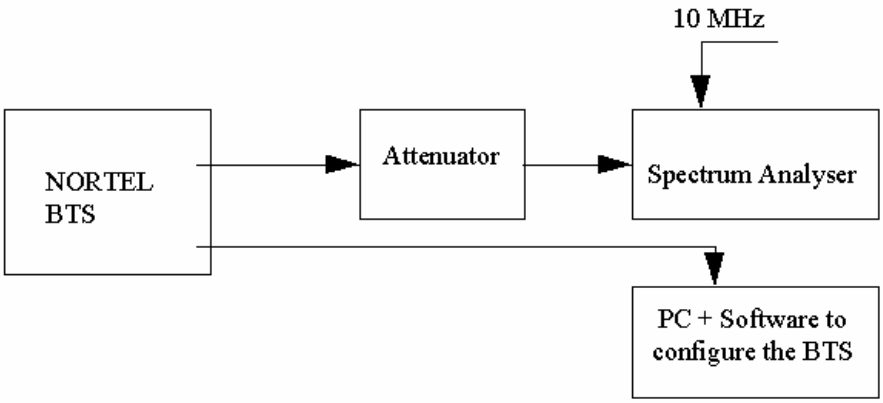
Test results for Tx2 TxF w/0 , GMSK modulation

Frequency band	Level max. (dBm)	Spec. (dBm)	Margin (dB)
100 kHz – 50 MHz	-45	-13	32
50 – 500 MHz	-47.5	-13	34.5
500 – 1970.2MHz	-43.1	-13	30.1
1970.2 – 1974 MHz	-57	-13	44
1974 – 1975 MHz	-69	-13	56
1991 – 1994.8 MHz	-37	-13	24
1994.8 MHz – 4 GHz	-31.7	-13	18.7
4 – 8 GHz	-36.3	-13	23.3
8 – 12 GHz	-40.2	-13	27.2
12 – 20 GHz	-35.7	-13	22.7

3.6.4 TEST PROCEDURE

The equipment was configured as shown in schematic 3.

Schematic : **Test configuration for spurious emissions at antenna terminals**



For adjacent channels emissions, the BTS nominal carrier frequency was adjusted to each block edge channel.

Channels 512 and 810 are those channels which are at the lower and upper edges of the PCS band respectively.

The BTS was configured to transmit at maximum power (static level 0) or a reduced power:

- for GMSK modulation, in mode GMSK no synchro
- for 8PSK modulation, in mode logical PDCH, Type GPRS, coding MCS5 .

For these measurements, the resolution bandwidth of the spectrum analyzer was set to at least 1% of the emission bandwidth. In this case the emission bandwidth measured was closed to 300 kHz. Therefore, the resolution bandwidth was set to 3 kHz.

The spectrum analyzer had the following settings for adjacent band:

Resolution bandwidth:	3 kHz
Video bandwidth:	10 kHz
Span:	1 MHz
Reference Level Offset:	Corrected to account for cable(s), filter and attenuator losses
Level range:	100 dB
Sweep time:	Coupled
Detector :	Sample
Trace :	Average
Sweep count :	200

For all other measurements the BTS carrier frequency was adjusted to Channel 810.

The spectrum analyzer had the following settings for out of block emissions.

Resolution bandwidth:	1 MHz
Video bandwidth:	1 MHz

The emissions were investigated up to the tenth harmonic of the fundamental emission (20 GHz).

The measured level of the emissions was recorded and compared to the -13 dBm limit.

4. ABBREVIATIONS AND DEFINITIONS

4.1. ABBREVIATIONS

RM	Radio Module
BCF	Base Common Function
BTS	Base Transceiving Station
GSM	Global System for Mobile Communications
GPRS	General Packet Radio Service
EDGE	Enhanced Data for GSM Evolution
PDTCH	Packet Data Logical Channel
PA	Power Amplifier
e-SCPA	EDGE Single Carrier PA
HePA	Edge High Power Amplifier
LNA	Low Noise Amplifier
OMC	Operation and Maintenance Center
TCU	Trans-Coding Unit
MSC	Mobile Switching Center
RF	Radio Frequency
Tx	Transmitter

4.2. DEFINITIONS

- PCS1900 Frequency Band and Channels

PCS 1900	C512	C661	C810
F Tx (MHz)	1930.2	1960	1989.8
F Rx (MHz)	1850.2	1880	1909.8

For 512 < n <810

$F_{Rx}(n) = 1850.2 + 0.2*(n-512)$

$F_{Tx}(n) = F_{Rx}(n) + 80$

IF frequencies on Radio Board: For Tx path 299 MHz
For Rx path 211 MHz

Clock frequency on the Radio Board 13MHz created from 4.096MHz coming from the Digital board.

5. MEASUREMENT EQUIPMENT LIST

List of all of the measurement equipment used in this report.

Equipment description	Manufacturer	Model	Serial No.
Spectrum Analyser	Rohde & Schwarz	FSEA	520564
Spectrum Analyser	Rohde & Schwarz	FSEM	517751
Power Meter	Giga-tronics	8542C	515956
Signal Generator	Hewlett Packard	8657B	502223

6. EQUIPMENT LIST UNDER TEST

Software Compatibility :
BTS load : Modules software version : Load RM V15a1e03 Load ICM V15a125 (CDI103589) Load ABM V15a125 (CDI103589)
PI software tools: TIL COAM version: v03b108 WIN TMI version: v03d302 WINSPU version: v04b201

HARDWARE EQUIPEMENT UNDER TEST		
Description	**Hardware code**	**Comment**
Interconnect board		
Logical board		
IFM 0 - IFM 1	NTN025AA D1	
ICM 0 - ICM 1	NTN023AA D1	
ABM 0 – ABM 1	NTN029AA D2	
Radio modules PCS1900		
DDM	NTN063AA 01	
TXF	NTN064AA	
RM 0	NTN050PM D1	

RM0 NTN050PM D1 - serial CDN200428036
- LRM : D1 mir 02 + derog 04 03 046 + derog 04 03 015 + derog 04 03 003
- TX1900 : D1 + derog 04 04 029 + derog 04 04 008 + DER 04 06 043
- RX1900 : D2
- BPM1900 : D2 + derog 04 06 026
- RMPSU : P5 + derog 04 06 040

Power limitation to comply to Adjacent Band spurious at antenna connector

Coupling configuration	System Power limitation GMSK modulation	System Power limitation 8 PSK modulation
DDM Duplexer Tx Filter **(without H2)**	**Power Limitation :** **Pmax – 2 dB** = 42 dBm	**Power Limitation :** **Pmax – 2 dB** = 42 dBm
DDM H2 Tx Filter H2	**Pmax** = 41 dBm	Pmax = 41 dBm

END OF DOCUMENT