

# Test Report

<b>Product</b>	Bluetooth Low Energy Transceiver		
<b>Name and address of the applicant</b>	LEGO System A/S Aastvej 1, 7190 Billund, Denmark		
<b>Name and address of the manufacturer</b>	LEGO System A/S Aastvej 1, 7190 Billund, Denmark		
<b>Model</b>	LEAF No.3		
<b>Rating</b>	3.0Vdc		
<b>Trademark</b>	LEGO		
<b>Serial number</b>	See page 3		
<b>Additional information</b>	This tested device can be operated with BLE		
<b>Tested according to</b>	<b>FCC Part 15.247</b> Frequency Hopping Transmitters / Digital Transmission Systems <b>Industry Canada RSS-247, Issue 2</b> Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices		
<b>Order number</b>	450233		
<b>Tested in period</b>	2021-12-06 – 2021-12-08		
<b>Issue date</b>	2022-01-05		
<b>Name and address of the testing laboratory</b>	Nemko Scandinavia AS Instituttveien 6, 2007 Kjeller, Norway	CAB Number: FCC: NO0001 ISED: NO0470	 
An accredited technical test executed under the Norwegian accreditation scheme			
 Prepared by [G.Suhanthakumar]		 Approved by [Roy Uggerud]	
This report shall not be reproduced except in full without the written approval of Nemko. Opinions and interpretations expressed within this report are not part of the current accreditation. This report was originally distributed electronically with digital signatures. For more information contact Nemko.			

## Nemko Group

Nemko Scandinavia AS, Instituttveien 6, P.O. Box 96 Kjeller, 2027 Kjeller, Norway  
 TEL +47 22 96 03 30 EMAIL info@nemko.com

## CONTENTS

<b>1</b>	<b>INFORMATION .....</b>	<b>3</b>
1.1	Test Item .....	3
1.2	Normal test condition .....	4
1.3	Test Engineer(s) .....	4
1.4	Antenna Requirement .....	4
1.5	EUT Operating Modes .....	4
1.6	Comments .....	4
<b>2</b>	<b>TEST REPORT SUMMARY .....</b>	<b>5</b>
2.1	General .....	5
2.2	Test Summary .....	6
<b>3</b>	<b>TEST RESULTS .....</b>	<b>7</b>
3.1	Occupied Bandwidth (99% BW) .....	7
3.2	DTS Bandwidth .....	9
3.3	Peak Power Output .....	11
3.4	Conducted Emissions at Antenna Connector .....	13
3.5	Restricted Bands of operation .....	15
3.6	Radiated Emissions, Band Edge .....	16
3.8	Radiated Emission, 30 – 1000 MHz .....	19
3.9	Radiated Emissions, 1-26 GHz .....	20
3.10	Power Spectral Density (PSD) .....	24
<b>4</b>	<b>Measurement Uncertainty .....</b>	<b>26</b>
<b>5</b>	<b>LIST OF TEST EQUIPMENT .....</b>	<b>27</b>
<b>6</b>	<b>BLOCK DIAGRAM .....</b>	<b>28</b>
6.1	Power Line Conducted Emission .....	28
6.2	Test Site Radiated Emission .....	28

# 1 INFORMATION

## 1.1 Test Item

Name	LEGO
Model/version	NPI80731
FCC ID	3072A-80731
ISED ID	LEAF No.3
Serial number	Radiated sample : "805" Conducted sample: "EP1-754"
Hardware identity and/or version	10080717E
Software identity and/or version	5.0.00.0250
Frequency Range	2402–2480 MHz
Number of Channels	40
Measured OBW (99%)	2.13 MHz
Emission clasification	FID
Transmitter spurious, dB $\mu$ V/m@3m	4.804GHz - PK 55.55 - AV 52.35
Operating Modes	TX/RX
Type of Modulation	GFSK
Conducted Output Power	0.46 mW (Peak)
Antenna Connector	None, integral antenna type: PCB
Number of Antennas	1
Diversity or Smart Antennas	No
Power Supply	3.0Vdc (2x 1.5Vdc AAA batteries)
Desktop Charger	N/A

### Description of Test Item

The device tested is a construction toy which communicate via BLE with remote device such as iOS, Android or similar.

## 1.2 Normal test condition

Temperature:	20 - 24 °C
Relative humidity:	20 - 50 %
Normal test voltage:	3.0V DC

The values are the limit registered during the test period.

## 1.3 Test Engineer(s)

G.Suhanthakumar

## 1.4 Antenna Requirement

Does the EUT have detachable antenna(s)?	<input type="checkbox"/> YES	<input checked="" type="checkbox"/> NO
If detachable, is the antenna connector(s) non-standard?	<input type="checkbox"/> YES	<input type="checkbox"/> NO
The tested equipment has only integral antennas. Conducted tests were performed with a temporary antenna connector.		

Requirement: FCC 15.203, 15.204

## 1.5 EUT Operating Modes

Description of operating modes	Continuous TX with GFSK modulation
Additional information	The following settings were used for all tests: Power Setting: 0 dBm Data rate: 1Mbit/s

## 1.6 Comments

All measurements were done with the EUT powered by a fully charged battery.

All ports were populated during spurious emission measurements.

## 2 TEST REPORT SUMMARY

### 2.1 General

All measurements are traceable to national standards.

The tests were conducted for demonstrating compliance with FCC CFR 47 Part 15, paragraph 15.247 and Industry Canada RSS-247 Issue 2 and RSS-GEN Issue 5.

Tests were performed in accordance with ANSI C63.4-2014 and and ANSI C63.10-2013.

Radiated tests were made in a semi-anechoic chamber at measuring distances of 1m, 3m and 10m.

A description of the test facility is on file with FCC and ISED.

- |   |   |
|---|---|
| <input checked="" type="checkbox"/> New Submission  | <input type="checkbox"/> Production Unit                |
| <input type="checkbox"/> Class II Permissive Change | <input checked="" type="checkbox"/> Pre-production Unit |
| <b>DTS</b> Equipment Code                           | <input type="checkbox"/> Family Listing                 |



#### **THIS TEST REPORT APPLIES ONLY TO THE ITEM(S) AND CONFIGURATIONS TESTED.**

Deviations from, additions to, or exclusions from the test specifications are described in "Summary of Test Data".

Nemko Group authorizes the above named entity to reproduce this report provided it is reproduced in its entirety and for use by the entity's employees only. Any reproduction of parts of this report requires approval in writing from Nemko Group.

Any use that 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 Group accepts no responsibility for damages suffered by any third party caused by decisions made or actions based on this report.

## 2.2 Test Summary

Name of test	FCC Part 15 reference	RSS-247 Issue 2, RSS-GEN Issue 5 reference	ANSI C63.10-2013 Reference	Result
Supply Voltage Variations	15.31(e)	6.11 (RSS-GEN)	5.13	N/A <sup>1</sup>
Antenna Requirement	15.203	6.8 (RSS-GEN)	5.8	Complies <sup>2</sup>
Power Line Conducted Emission	15.107(a) 15.207(a)	7.2 / 8.8 (RSS-GEN)	6.2	N/A <sup>1</sup>
Occupied Bandwidth (99% BW)	N/A	6.7 (RSS-GEN)	6.9.3	-
DTS Bandwidth	15.247(a)(2)	5.2 (1) (RSS-247)	11.8 Option 1	Complies
Peak Power Output	15.247(b)	5.4 (RSS-247)	11.9.1.1	Complies
Power Spectral Density	15.247(d)	5.2 (2) (RSS-247)	11.10.2 PKPSD (DTS)	Complies
Spurious Emissions (Antenna Conducted)	15.247(c)	5.5 (RSS-247)	6.7 11.11 (DTS) 7.8.6 (FHSS) 7.8.8 (FHSS)	Complies
Spurious Emissions (Radiated)	15.247(c) 15.109(a) 15.209(a)	5.5 (RSS-247) 7.3 (RSS-GEN) 8.9 (RSS-GEN)	6.3, 6.5, 6.6, 6.10 11.12, 11.13 (DTS)	Complies

<sup>1</sup> The tested equipment only operates with battery

<sup>2</sup> Integral antenna.

-Only for information

## Revision history

Revision	Date	Comment	Sign
00	2022-01-05	First edition	gns

### 3 TEST RESULTS

#### 3.1 Occupied Bandwidth (99% BW)

FCC Part 15.247 (a)(1)(iii)

ISED Canada RSS-247 Issue 2, Clause 5.1

ISED Canada RSS-GEN Issue 5, Clause 6.7

Measurement procedure: ANSI C63.10-2013 Clause 6.9.3 / 7.8.3

Test Results: Complies

##### Measurement Data:

Carrier Frequency and Data Rate	Occupied Bandwidth (99% BW)
2402 MHz/1Mbit/s	2.09 MHz
2440 MHz/1Mbit/s	2.13 MHz
2480 MHz/1Mbit/s	2.12 MHz

Occupied Bandwidth is the same for all channels

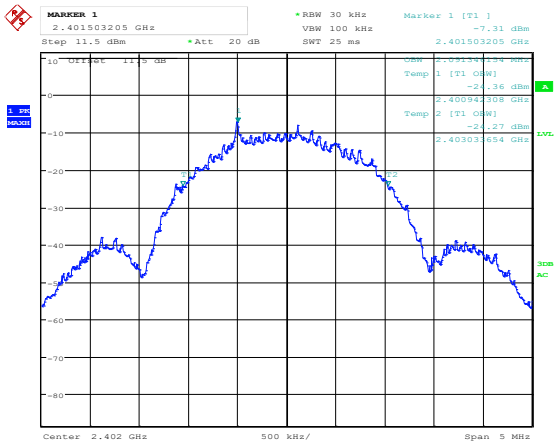
See attached plots.

##### Requirements:

Frequency hopping systems in the 2400 - 2483.5 MHz band shall use at least 15 non-overlapping channels. No requirements for bandwidth for this frequency band.

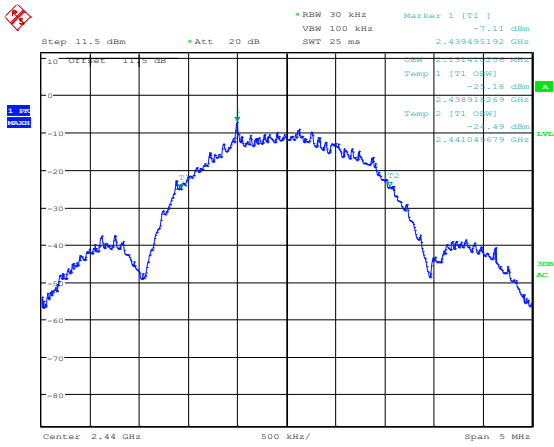
No requirements for Digital Transmission Systems.

No requirement for 99% BW, reported for information only.



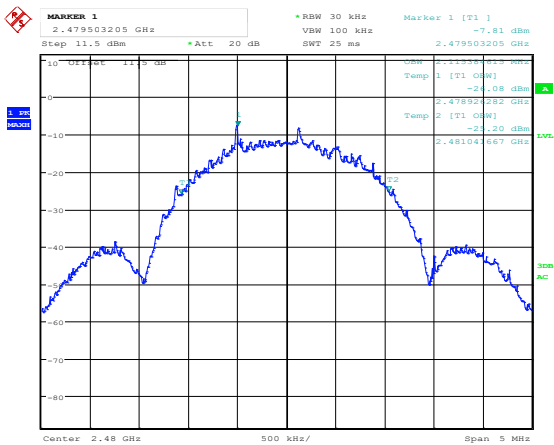
Date: 4.JAN.2003 07:15:13

**99% Occupied BW, GFSK,ch2402MHz**



Date: 4.JAN.2003 07:32:52

**99% Occupied BW, GFSK,ch2440MHz**



Date: 4.JAN.2003 07:34:47

**99% Occupied BW, GFSK,ch2480MHz**



### 3.2 DTS Bandwidth

FCC Part 15.247 (a)(2)

ISED Canada RSS-247 Issue 2, Clause 5.2 (a)

Measurement procedure: ANSI C63.10-2013 Clause 11.8

Test Results: Complies

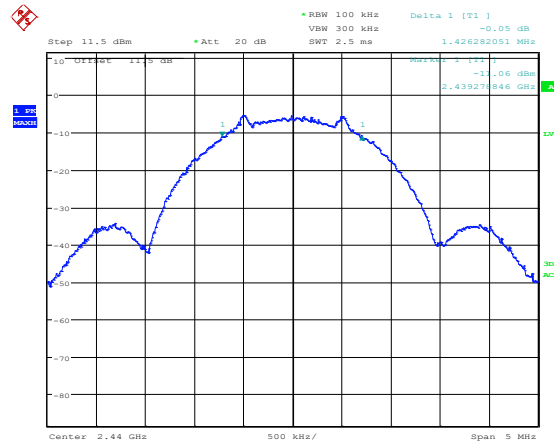
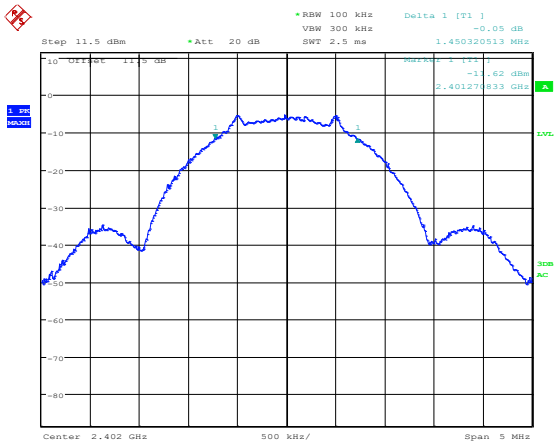
**Measurement Data:**

Operating Mode	DTS Bandwidth (6dB BW)		
	2402 MHz	2440 MHz	2480 MHz
GFSK, 1Mb/s	1.45 MHz	1.42 MHz	1.34 MHz

**Requirements:**

For Digital Transmission Systems in the 2400-2483.5 MHz band the minimum 6 dB bandwidth shall be at least 500 KHz.

No requirements for Frequency Hopping Systems.

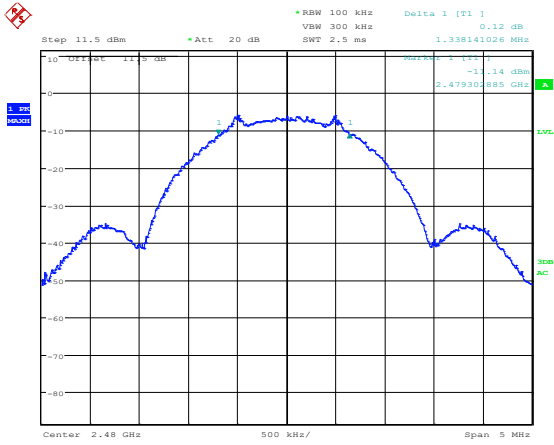


Date: 4.JAN.2003 07:16:23

Date: 4.JAN.2003 07:32:17

**DTS BW, 2402 MHz, 1Mb**

**DTS BW, 2440 MHz, 1Mb**



Date: 4.JAN.2003 07:35:44

**DTS BW, 2480 MHz, 1Mb**

### 3.3 Peak Power Output

FCC Part 15.247 (b)

ISED Canada RSS-247 Issue 2, Clause 5.4

Measurement procedure: ANSI C63.10-2013 Clause 11.9.1.2

Test Results: Complies

#### Measurement Data:

Carrier Frequency (MHz)	Modulation Type	Conducted Power (dBm)	Conducted Power (mW)	Field Strength (dB $\mu$ V/m)	EIRP (mW)	Antenna gain (dBi)
2402	GFSK	-3.41	0.46	94.43	0.83	2.6
2440	GFSK	-3.58	0.44	94.84	0.91	3.2
2480	GFSK	-3.97	0.40	94.08	0.77	2.8

The maximum radiated field strength is obtained in XZ plane and horizontal polarization.

Output Power reported is Maximum Peak Power.

Radiated Power was calculated from measured Field Strength using the method described in FCC KDB 412172 D01.

Antenna Gain is less than 6 dBi.

See attached plots.

#### Requirements:

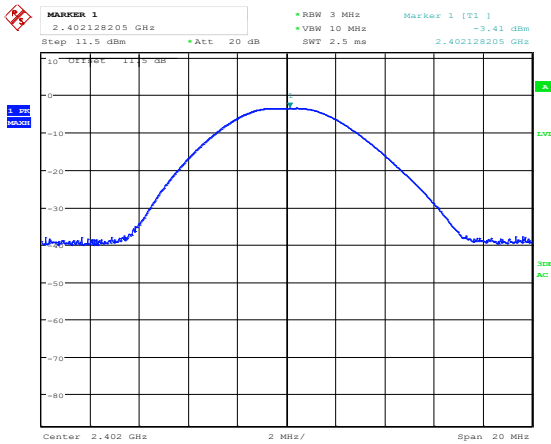
The maximum peak output power shall not exceed the following limits:

For frequency hopping systems employing at least 75 hopping channels: 1 Watt

For all other frequency hopping systems in the 2400 - 2483.5 MHz band: 0.125 Watts

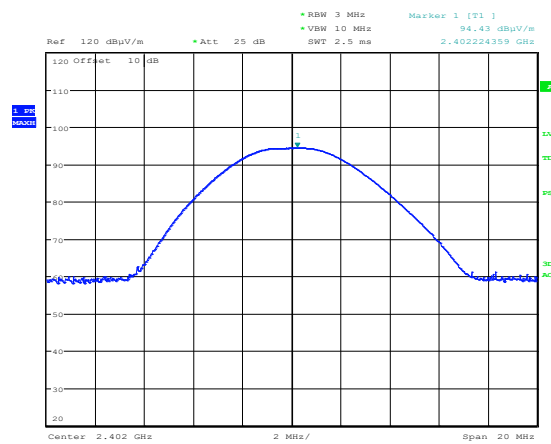
For Digital Transmission Systems in the 2400 - 2483.5 MHz band: 1 Watt

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced below the stated value above by the amount in dB that the directional gain of the antenna exceeds 6 dBi.



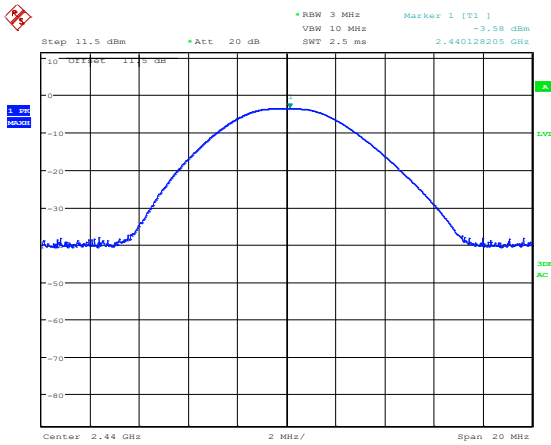
Date: 4.JAN.2003 07:11:49

Peak Power, 2402 MHz, GFSK



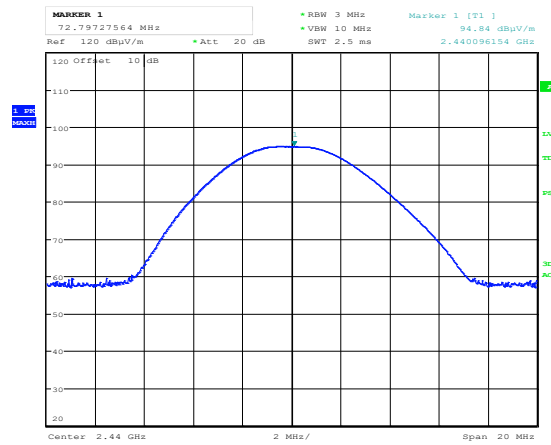
Date: 4.JAN.2003 01:39:12

Maximum Field Strength, 2402 MHz, GFSK



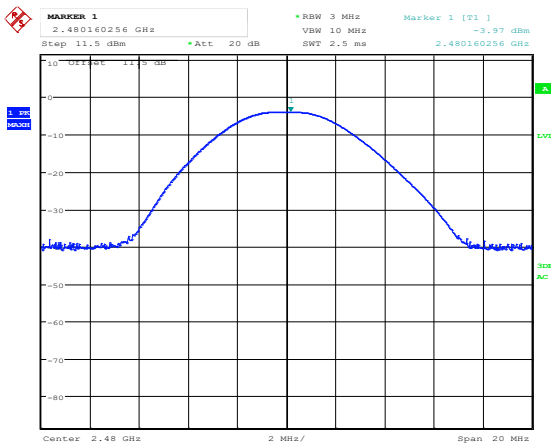
Date: 4.JAN.2003 07:31:28

Peak Power, 2444 MHz, GFSK



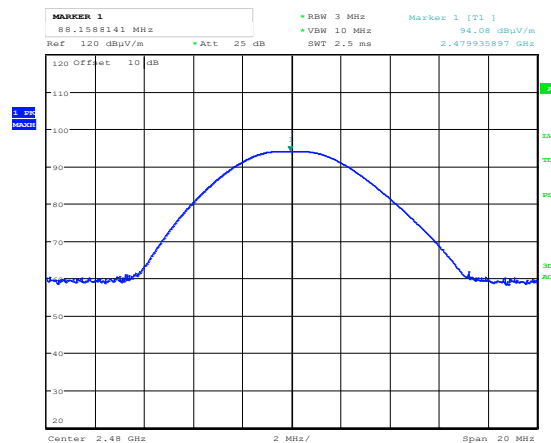
Date: 4.JAN.2003 02:08:48

Maximum Field Strength, 2444 MHz, GFSK



Date: 4.JAN.2003 07:36:02

Peak Power, 2480 MHz, GFSK



Date: 4.JAN.2003 02:27:21

Maximum Field Strength, 2480 MHz, GFSK

### 3.4 Conducted Emissions at Antenna Connector

FCC Part 15.247 (d)

ISED Canada RSS-247 Issue 2, Clause 5.5

Measurement procedure: ANSI C63.10-2013 Clause 11.11

Test Results: Complies

**Measurement Data:**

Carrier Frequency	Highest Value (dBc)	Margin (dB)	Verdict
2402 MHz	35.48	> 20	Pass
2440 MHz	35.26	> 20	Pass
2480 MHz	35.61	> 20	Pass

Measured with Peak Detector

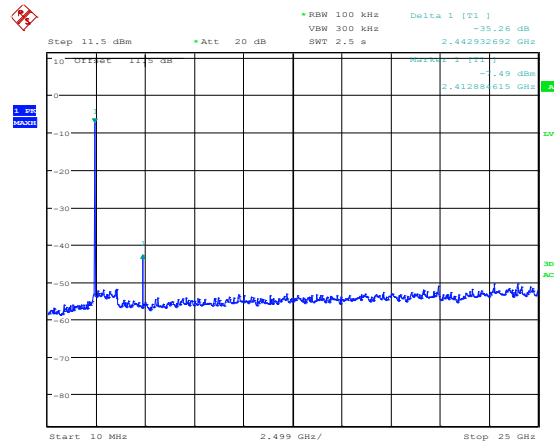
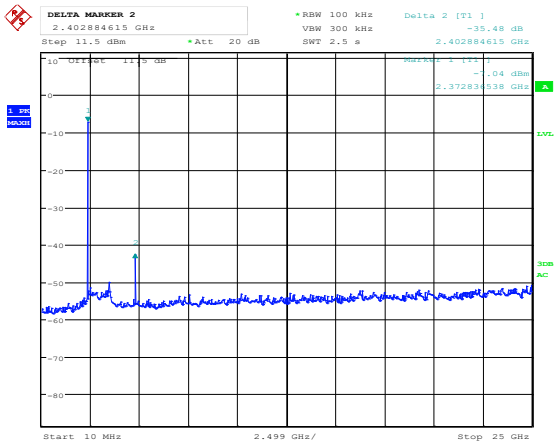
RF conducted power to 25 GHz: see attached plots.

**Limit**

Peak measurement	RMS averaging
20 dBc or more in 100 kHz bandwidth	30 dBc or more in 100 kHz bandwidth

Detector type shall be the same as used for measuring Output Power.

Attenuation below the general limits specified in part 15.209(a) is not required.

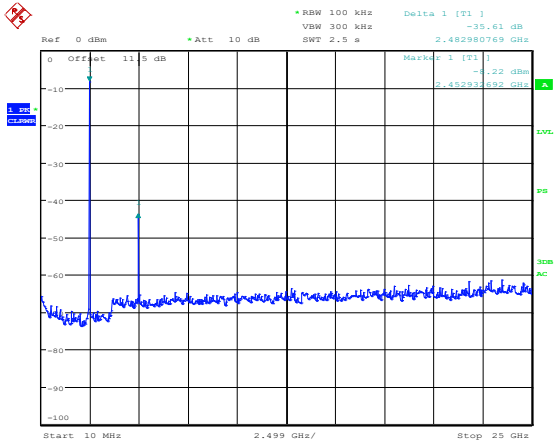


Date: 4.JAN.2003 07:17:09

Date: 4.JAN.2003 07:30:58

**Conducted Emissions 10-25000MHz, 2402 MHz, GFSK**

**Conducted Emissions 10 - 25000 MHz, 2440 MHz, GFSK**



Date: 5.JAN.2003 23:18:31

**Conducted Emissions 10-25000 MHz, 2480 MHz, GFSK**

### 3.5 Restricted Bands of operation

Restricted Bands of operation for FCC and ISED are defined in FCC Part 15.205 and ISED RSS-GEN, Issue 5 clause 8.10.

Generally, no fundamentals are allowed in the restricted bands and all emissions must comply with the limits in FCC 15.209 or RSS-GEN, Issue 5, clause 8.9.

FCC (MHz)	ISED Canada (MHz)	FCC (GHz)	ISED Canada (GHz)
0.090-0.110		<b>0.96-1.24</b> <b>1.3-1.427</b>	<b>0.96-1.427</b>
0.495-0.505		1.435-1.6265	
2.1735-2.1905		1.6455-1.6465	
	<b>3.020-3.026</b>	1.660-1.710	
4.125-4.128		1.7188-1.7222	
4.17725-4.17775		2.2-2.3	
4.20725-4.20775		2.31-2.39	
	<b>5.677-5.683</b>	2.4835-2.5	
6.215-6.218		<b>2.69-2.9</b>	<b>2.655-2.9</b>
6.26775-6.26825		3.26-3.267	
6.31175-6.31225		3.332-3.339	
8.291-8.294		3.3458-3.358	
8.362-8.366		<b>3.6-4.4</b>	<b>3.5-4.4</b>
8.37625-8.38675		4.5-5.15	
8.41425-8.41475		5.35-5.46	
12.29-12.293		7.25-7.75	
12.51975-12.52025		8.025-8.5	
12.57675-12.57725		9.0-9.2	
13.36-13.41		9.3-9.5	
16.42-16.423		10.6-12.7	
16.69475-16.69525		13.25-13.4	
16.80425-16.80475		14.47-14.5	
25.5-25.67		15.35-16.2	
37.5-38.25		17.7-21.4	
73-74.6		22.01-23.12	
74.8-75.2		23.6-24.0	
<b>108-121.94</b> <b>123-138</b>	<b>108-138</b>	31.2-31.8	
149.9-150.05		36.43-36.5	
156.52475-156.52525		Above 38.6	
156.7-156.9			
162.0125-167.17			
167.72-173.2			
240-285			
322-335.4			
399.9-410			
608-614			

Frequencies in **Bold** text are specific for FCC or ISED, all other frequencies are common.

### 3.6 Radiated Emissions, Band Edge

FCC Part 15.209 (a)

ISED Canada RSS-GEN Issue 5, Clause 7.3 / 8.9

Measurement procedure: ANSI C63.10-2013 Clause 11.12

Test Results: Complies

#### Measurement Data:

100% duty cycle

Carrier Frequency and Data Rate	Band Edge Frequency	Measured Field Strength (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
		Peak Detector	Average Detector	Peak Det	Average Det	Peak Det	Average Det
2402 MHz GFSK	2390 MHz	54.37	41.81	74	54	19.63	12.19
2480 MHz GFSK	2483.5 MHz	59.70	52.13			14.30	1.87

0 byte payload:

Carrier Frequency and Data Rate	Band Edge Frequency	Measured Field Strength (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
		Peak Detector	Average Detector	Peak Det	Average Det	Peak Det	Average Det
2402 MHz GFSK	2390 MHz	55.47	39.55	74	54	18.53	14.45
2480 MHz GFSK	2483.5 MHz	55.99	40.07			18.01	13.93

Average Detector values are measured with peak Detector and corrected for Duty Cycle.

37 byte payload:

Carrier Frequency and Data Rate	Band Edge Frequency	Measured Field Strength (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
		Peak Detector	Average Detector	Peak Det	Average Det	Peak Det	Average Det
2402 MHz GFSK	2390 MHz	53.91	/	74	54	20.09	/
2480 MHz GFSK	2483.5 MHz	56.25	52.29			17.75	1.71

Average Detector values are measured with peak Detector and corrected for Duty Cycle.

See attached plots.

#### Duty Cycle Correction Factor Calculation:

0 byte pay load: 15.92%

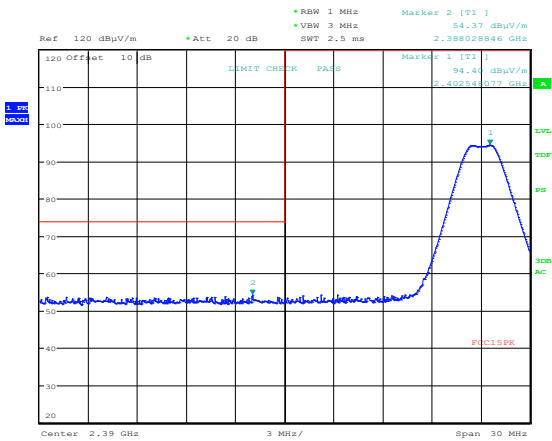
Duty Cycle Correction factor =  $-20 \times \log(0.1/0.631) = -15.92$  dB

37 byte pay load: 63.42%

Duty Cycle Correction factor =  $-20 \times \log(0.399/0.630) = -3.96$  dB

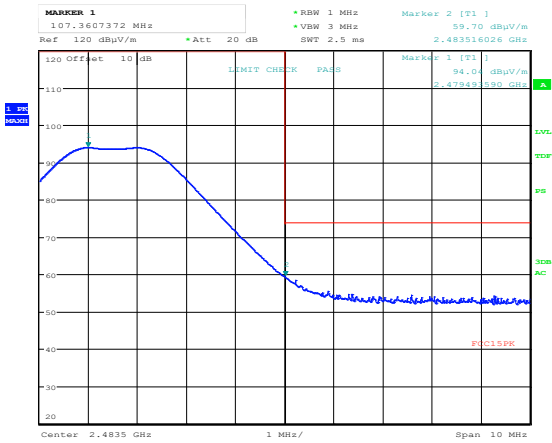
**Maximum Duty Cycle Correction Factor according to Para 15.35 (b): 20 dB**





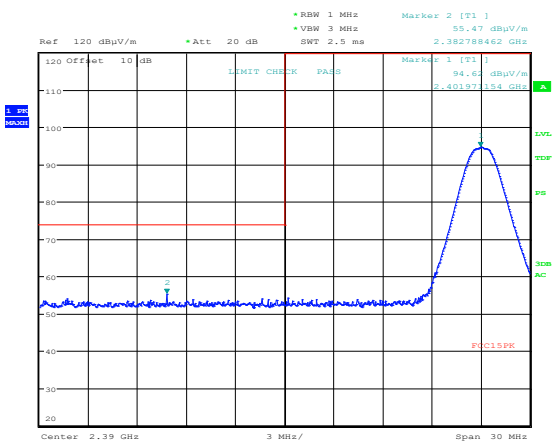
Date: 4.JAN.2003 01:40:27

Lower Band Edge 2402 MHz, GFSK, Peak, 100% DC



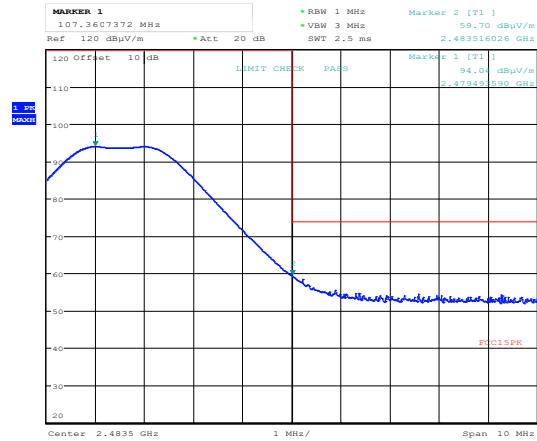
Date: 4.JAN.2003 02:28:38

Lower Band Edge 2402 MHz, GFSK, AV, 100% DC



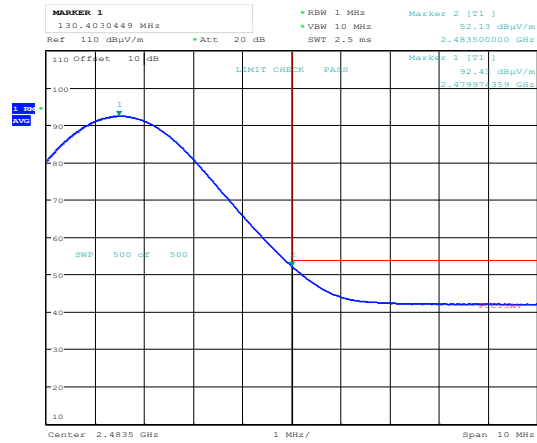
Date: 4.JAN.2003 01:45:19

Lower Band Edge 2402 MHz, GFSK, Peak, 0 byte payload



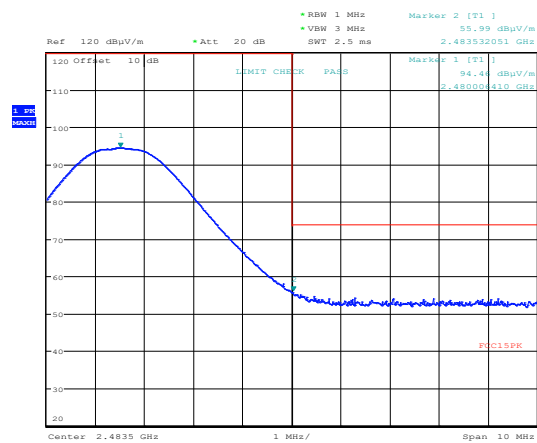
Date: 4.JAN.2003 02:28:38

Upper Band Edge 2480 MHz, GFSK, Peak, 100% DC



Date: 4.JAN.2003 02:29:15

Upper Band Edge 2480 MHz, GFSK, AV, 100% DC



Date: 4.JAN.2003 02:34:43

Upper Band Edge 2480 MHz, GFSK, Peak, 0 byte payload



### 3.8 Radiated Emission, 30 – 1000 MHz.

FCC Part 15.209 (a)

ISED Canada RSS-GEN Issue 5, Clause 7.3/8.9

Measurement procedure: ANSI C63.10-2013 Clause 11.12

Test Results: Complies

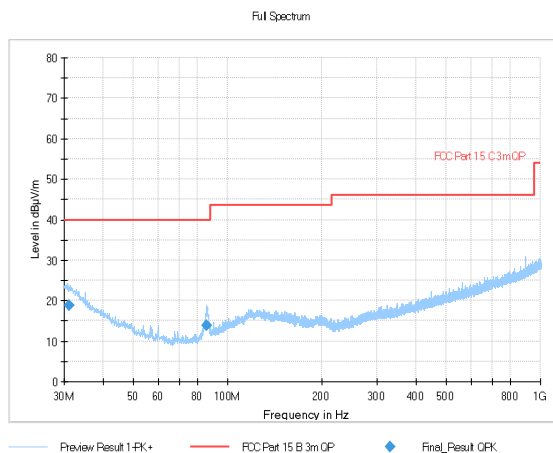
#### Measurement Data:

Detector: Peak (found frequencies were measured with Quasi-Peak Detector)

Measuring distance 3 m

Tested in active mode.

Frequency (MHz)	QuasiPeak (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
31.014850	18.73	40.00	21.27	1000.0	120.000	360.0	H	45.0
85.721350	13.98	40.00	26.02	1000.0	120.000	114.0	V	88.0



Radiated Emissions 30 - 1000 MHz, GFSK

#### Requirements/Limit

FCC	Part 15.209 @ frequencies defined in §15.205	
ISED	RSS-GEN Issue 5, Clause 8.9 @ frequencies defined in clause 8.10	
Frequency	Radiated emission limit @3 meters	
30 – 88 MHz	100 $\mu$ V/m	40.0 dB $\mu$ V/m
88 – 216 MHz	150 $\mu$ V/m	43.5 dB $\mu$ V/m
216 – 960 MHz	200 $\mu$ V/m	46.0 dB $\mu$ V/m
960 – 1000 MHz	500 $\mu$ V/m	54.0 dB $\mu$ V/m
	Limits above are with Quasi Peak Detector	

### 3.9 Radiated Emissions, 1-26 GHz

FCC Part 15.209 (a)

ISED Canada RSS-GEN Issue 5, Clause 7.3/8.9

Measurement procedure: ANSI C63.10-2013 Clause 11.12

Test Results: Complies

Measurement Data:

Measuring distance: 3m (1 – 18 GHz)

A pre-scan was performed above 18 GHz and no spurious emissions were detected.

Peak Detector, RBW=1 MHz

Carrier freq. (MHz)	Measured Frequency (GHz)	Modulation	Measured Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2402	4.804	GFSK	55.55	74	18.45
2440	4.880	GFSK	52.91	74	21.09
2480	4.960	GFSK	50.36	74	23.64
2402	/	GFSK	/	74	/
2440	/	GFSK	/	74	/
2480	7.319	GFSK	53.01	74	20.99

Average Detector, RBW=1 MHz

Carrier freq. (MHz)	Measured Frequency (GHz)	Modulation	Measured Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2402	4.804	GFSK	52.35	54	1.65
2440	4.880	GFSK	48.12	54	5.88
2480	4.960	GFSK	43.80	54	10.20
2402	/	GFSK	/	54	/
2440	/	GFSK	/	54	/
2480	7.319	GFSK	48.54	54	5.46

Average Detector values are measured with average detector (100%)

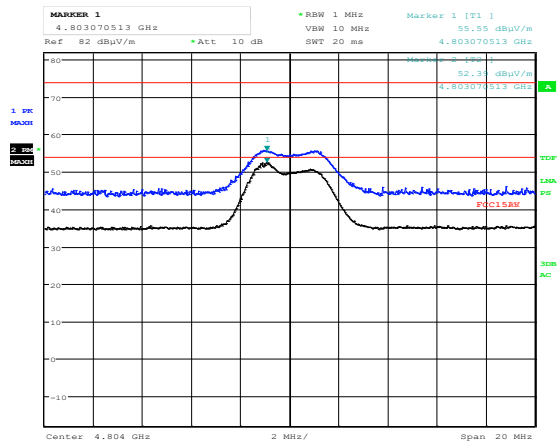
A Band Reject Filter was used for measurements from 1 GHz to 18 GHz

Antenna factor, amplifier gain and cable loss are included in spectrum analyzer "Transducer factor"

See plots

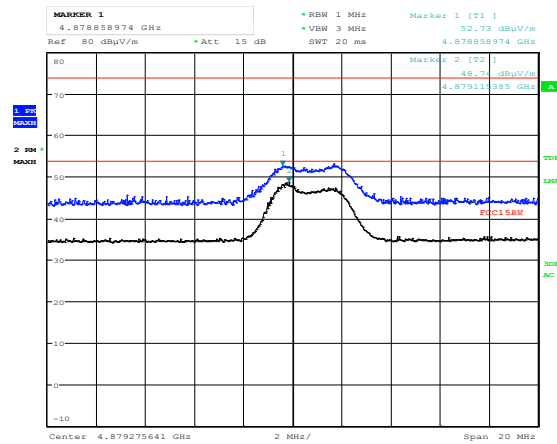
Requirements/Limit

FCC	Part 15.209 @ frequencies defined in §15.205	
ISED	RSS-GEN Issue 5, clause 8.9 @ frequencies defined in clause 8.10	
	Radiated emission limit @3 meters	
Frequency	Average Detector	Peak Detector
1 – 26 GHz	54.0 dBµV/m	74.0 dBµV/m



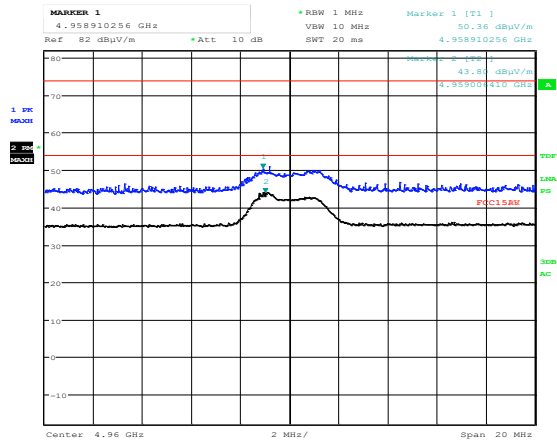
Date: 4.JAN.2003 04:23:15

2<sup>nd</sup> harmonic, ch2402MHz,HP, PK and AV



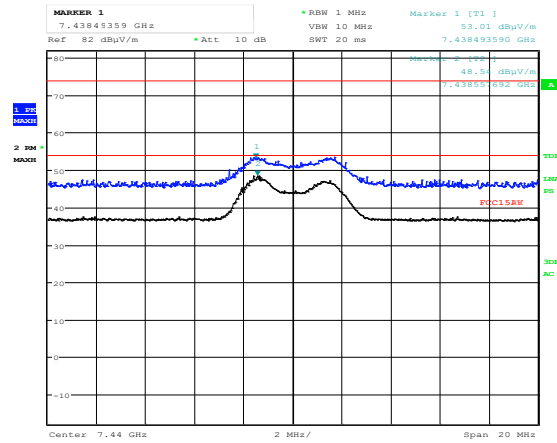
Date: 4.JAN.2003 03:59:42

2<sup>nd</sup> harmonic, ch2440MHz,HP, PK and AV



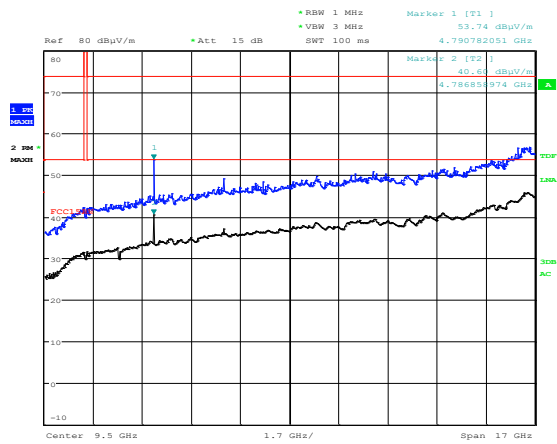
Date: 4.JAN.2003 04:17:41

2<sup>nd</sup> harmonic, ch2480MHz,HP, PK and AV



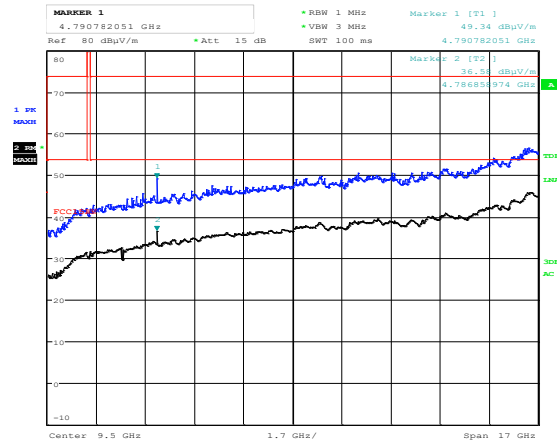
Date: 4.JAN.2003 04:20:59

3<sup>rd</sup> harmonic, ch2480MHz,HP, PK and AV



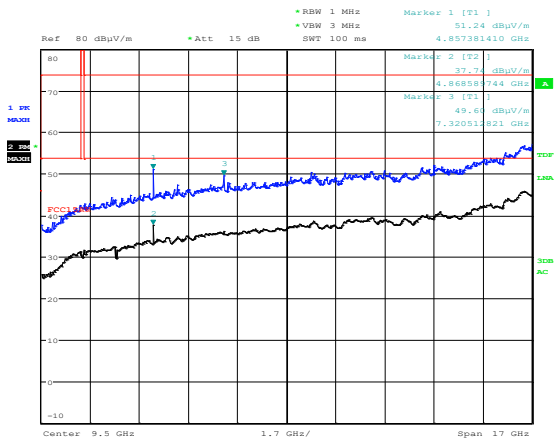
Date: 4.JAN.2003 03:07:29

Radiated Emissions 1 - 18 GHz, 2402 MHz, GFSK, HP



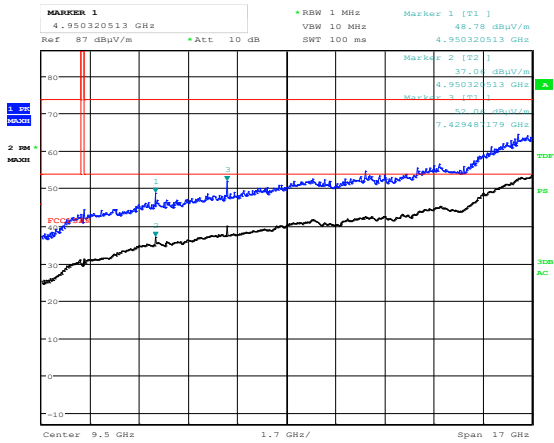
Date: 4.JAN.2003 03:05:46

Radiated Emissions 1 - 18 GHz, 2402 MHz, GFSK, SP



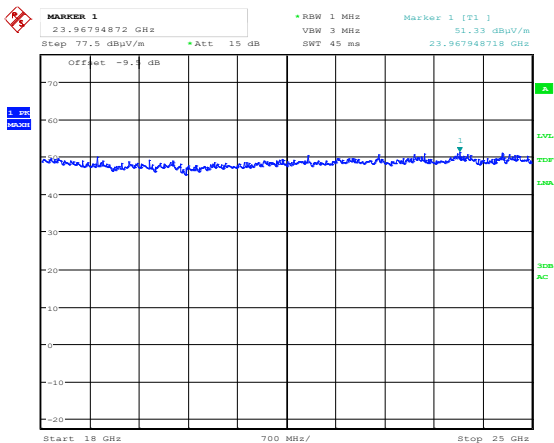
Date: 4.JAN.2003 03:53:27

**Radiated Emissions 1 - 18 GHz, 2440 MHz, GFSK, HP**



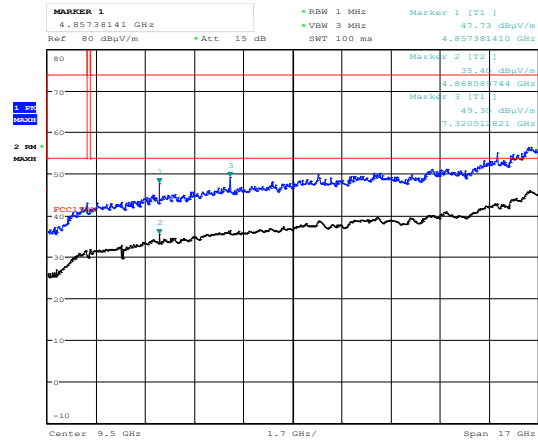
Date: 4.JAN.2003 04:13:42

**Radiated Emissions 1 - 18 GHz, 2480 MHz, GFSK, HP**



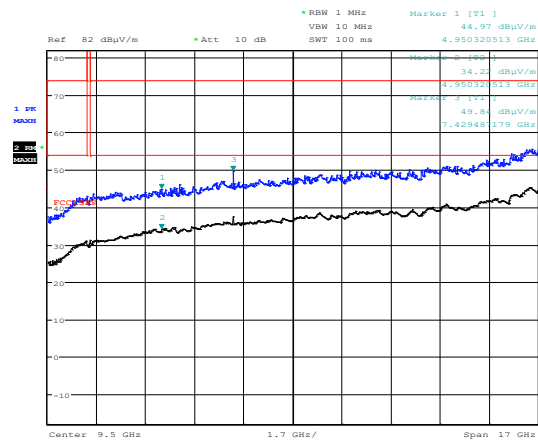
Date: 4.JAN.2003 07:03:59

**Radiated Emissions 18 - 25 GHz, 2402 MHz, GFSK, HP, pk scan @1m**



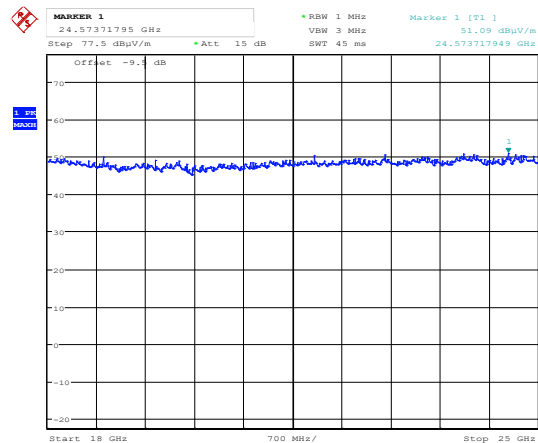
Date: 4.JAN.2003 03:54:48

**Radiated Emissions 1 - 18 GHz, 2440 MHz, GFSK, VP**



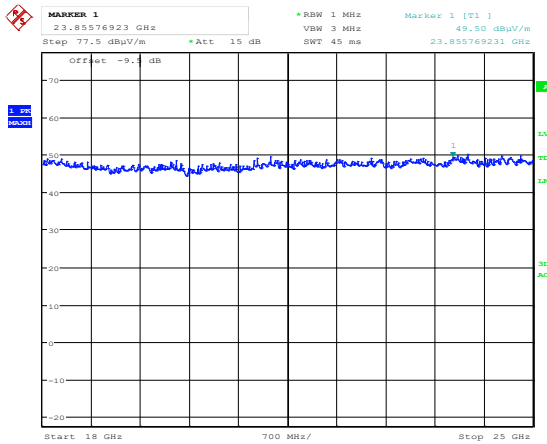
Date: 4.JAN.2003 04:15:19

**Radiated Emissions 1 - 18 GHz, 2480 MHz, GFSK, VP**



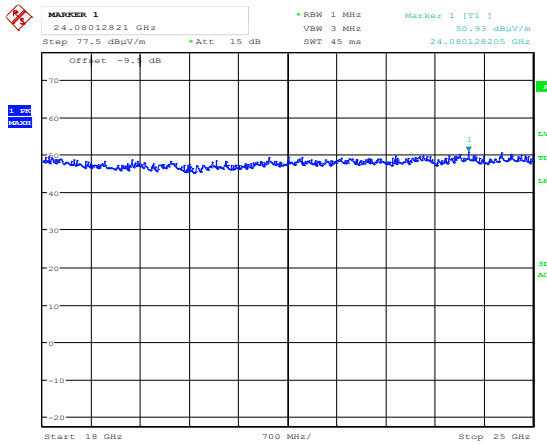
Date: 4.JAN.2003 07:03:33

**Radiated Emissions 18 - 25 GHz, 2402 MHz, GFSK, VP, pk scan @1m**



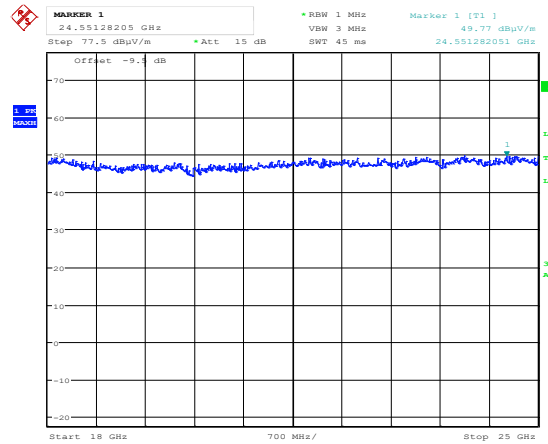
Date: 4.JAN.2003 07:04:42

**Radiated Emissions 18 - 25 GHz, 2440 MHz, GFSK, HP,pk scan @1m**



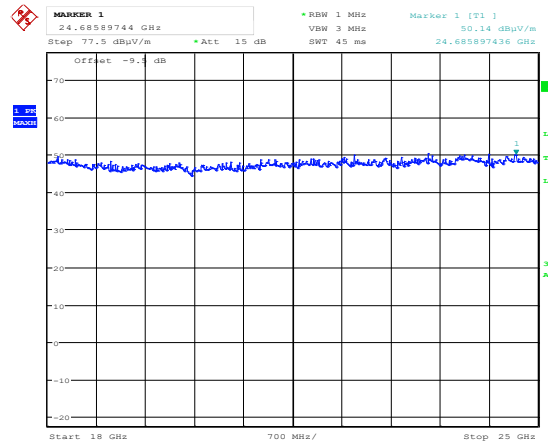
Date: 4.JAN.2003 07:05:33

**Radiated Emissions 18 - 25 GHz, 2480 MHz, GFSK, HP,pk scan @1m**



Date: 4.JAN.2003 07:05:04

**Radiated Emissions 18 - 25 GHz, 2440 MHz, GFSK, VP, pk scan @1m**



Date: 4.JAN.2003 07:05:52

**Radiated Emissions 18 - 25 GHz, 2480 MHz, GFSK, VP,pk scan @1m**

### 3.10 Power Spectral Density (PSD)

FCC part 15.247(d)

ISED Canada RSS-247 Issue 2, Clause 5.2 (2)

Measurement procedure: ANSI C63.10-2013 Clause 11.10

Test Results: Complies

#### Measurement Data:

The measurement procedure PKPSD described in ANSI C63.10-2013 was used.

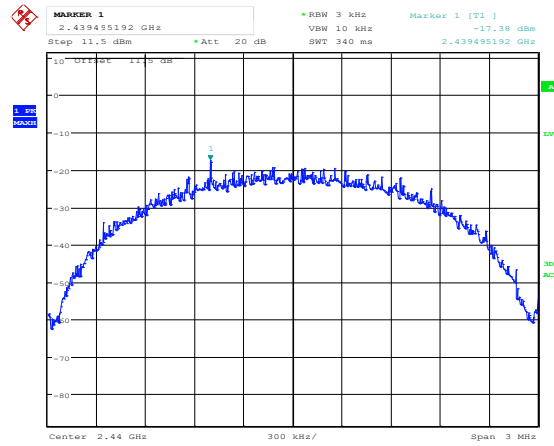
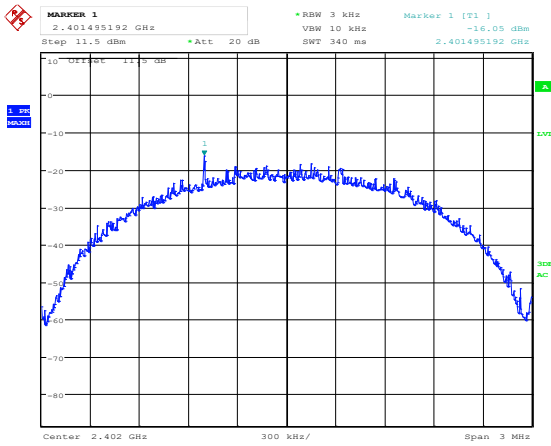
Modulation Type	Measured Power Spectral Density (dBm/3kHz)		
	2402 MHz	2440 MHz	2480 MHz
GFSK	-16.05	-17.38	-17.86

#### Requirements:

The Power Spectral Density of a Digital Transmission System shall be no greater than +8 dBm in any 3 kHz band

No requirements for Frequency Hopping Systems.



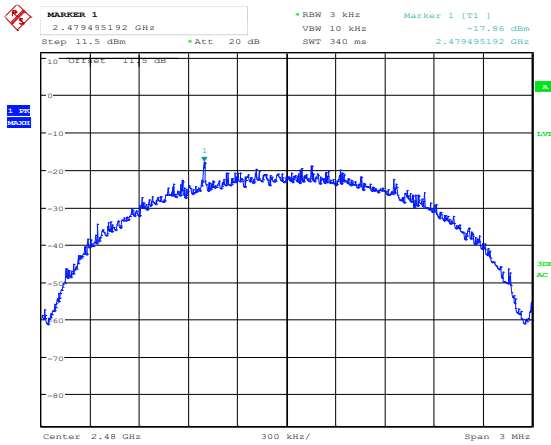


Date: 4.JAN.2003 07:14:26

Date: 4.JAN.2003 07:33:32

**PSD, 2402 MHz, GFSK**

**PSD, 2440 MHz, GFSK**



Date: 4.JAN.2003 07:34:21

**PSD, 2480 MHz, GFSK**

## 4 Measurement Uncertainty

Measurement Uncertainty Values		
Test Item		Uncertainty
Output Power		±0.5 dB
Power Spectral Density		±0.5 dB
Out of Band Emissions, Conducted	< 3.6 GHz	±0.6 dB
	> 3.6 GHz	±0.9 dB
Spurious Emissions, Radiated	< 1 GHz	±2.5 dB
	> 1 GHz	±2.2 dB
Emission Bandwidth		±4 %
Power Line Conducted Emissions		+2.9 / -4.1 dB
Spectrum Mask Measurements	Frequency	±5 %
	Amplitude	±1.0 dB
Frequency Error		±0.6 ppm
Temperature Uncertainty		±1 °C

All uncertainty values are expanded standard uncertainty to give a confidence level of 95%, based on coverage factor k=2

## 5 LIST OF TEST EQUIPMENT

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the Test Laboratory.

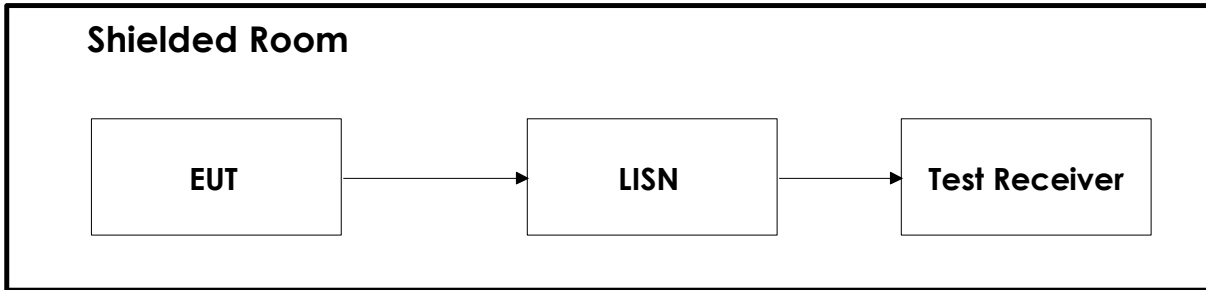
No.	Model number	Description	Manufacturer	Ref. no.	Cal. date	Cal. Due
1.	FSU26	Spectrum Analyzer	Rohde & Schwarz	LR 1504	2020-01	2022-01
2.	6810.17B	Attenuator	Suhner	LR 1668	COU	
3.	NO324415	Band Reject Filter	Microwave Circuits	LR 1760	COU	
4.	JB3	Biconical-Log Hybrid	Sunol Sciences	N-4525	2020-03	2023-03
5.	316	Preamplifier	Sonoma Inst.	LR 1686	2021-08	2022-08
6.	3117-PA	Horn Antenna +PreAmp	EMCO	LR 1717	2017-08	2022-08
7.	8449A	Pre-amplifier	Hewlett Packard	LR 1322	2021-08	2022-08
8.	638	Antenna Horn	Narda	LR 1480	N/A	
9.	4768-10	Attenuator	Narda	LR 1670	COU	
10	Model 87V	Multimeter	Fluke	LR 1599	2021.01	2023.01
11	ST18/SMA/N/36	RF Cable	Suhner	LR 1627	COU	

The software listed below has been used for one or more tests.

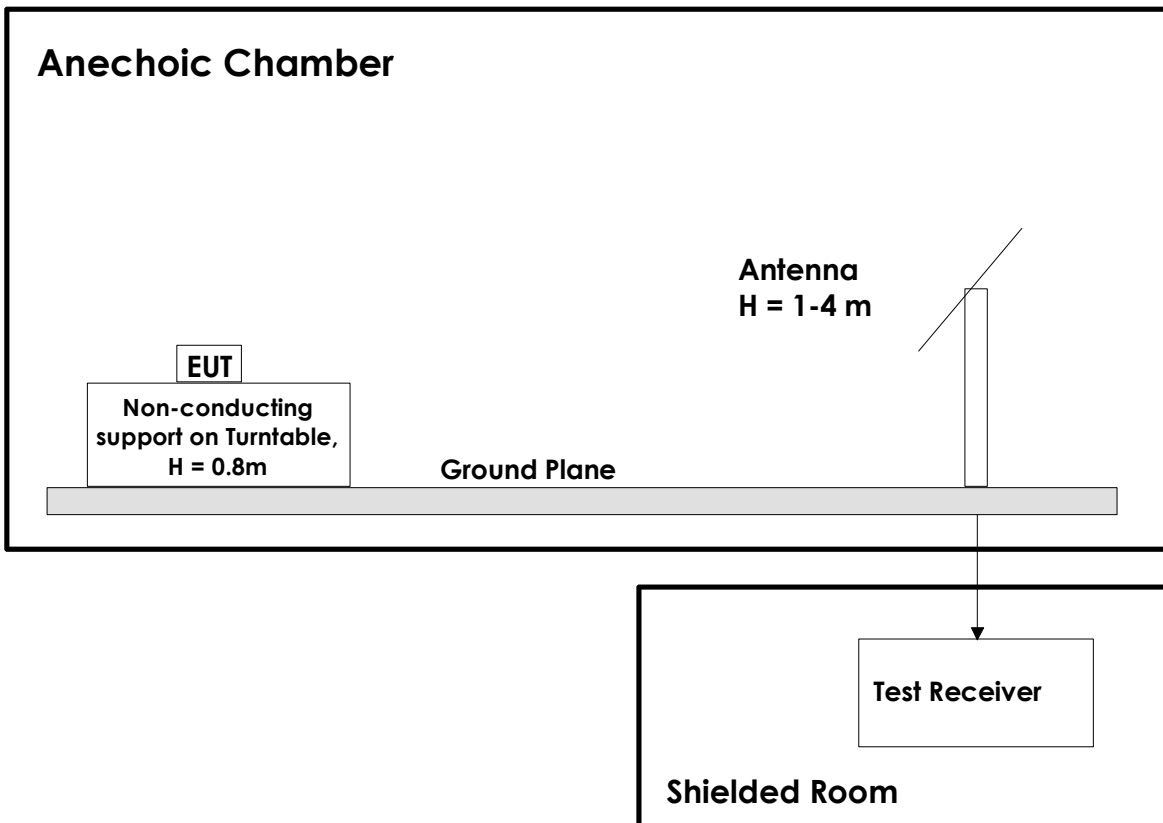
No.	Manufacturer	Name	Version	Comment
1	Rohde & Schwarz	EMC32	10.30.10	Power Line Conducted test software
2	Rohde & Schwarz	EMC32	10.30.10	Radiated Emission test software
3	Nemko AS	RSPlot	1.0.8.0	Screen capture from R&S Spectrum Analyzers

## 6 BLOCK DIAGRAM

### 6.1 Power Line Conducted Emission



### 6.2 Test Site Radiated Emission



This test setup is used for all radiated emissions tests. For frequencies below 30 MHz the measuring distance is 10m, for all other frequencies it is 3m or 1m. Emissions above 1 GHz are measured with a Spectrum Analyzer and Horn Antenna. For measurements above 18 GHz the test receiver is moved inside the anechoic chamber and located next to the antenna to minimize the cable loss. All measurements at 1GHz and above were performed with turntable height 1.5m and with the ground plane covered by absorbers. A pre-amplifier is used for all measurements above 30 MHz, and High-Pass or Band-Pass filter is used for all harmonics.