Compliance Test Report		FCC PART 90
Test Lab Information	**Name**	**CELLTECH LABS INC.**
	Address	21-364 Lougheed Road, Kelowna, British Columbia V1X 7R8 Canada
Test Site Registration No.(s)	**FCC**	Accredited Site (ISO 17025:2005 - A2LA Test Lab Certificate No. 2470.01)
	IC	3874A-1
Applicant Information	**Name**	**4RF Limited.**
	Address	26 Glover St. Wellington 6032 New Zealand
Standard(s) & Procedure(s)	**FCC**	47 CFR Part 2; Part 90
	ANSI	TIA/EIA-603-C-2004, C63.4-2003
Device Classification(s)	**FCC**	Private Land Mobile Radio Services (TNB)
Application Type(s)	**FCC/IC**	New Certification
Device Identifier(s)	**FCC ID:**	**UIPSQ450M140**
Device Under Test (DUT)	Aprisa SR+ 12.5 / 25 KHz Channels, Point-to-Multipoint Transmitter, Scada applications. Model # SQ450M140	

This wireless device has demonstrated compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in FCC 47 CFR Rule Parts 2 and Part 90; Industry Canada RSS-119 Issue 11 and RSS-Gen Issue 3; ANSI TIA/EIA-603-C-2004 and ANSI C63.4-2003.

I attest to the accuracy of data. All measurements were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

The results and statements contained in this report pertain only to the device(s) evaluated. This test report shall not be reproduced partially, or in full, without the prior written approval of Celltech Labs Inc.

Test Report Approved By		**Glen Westwell**	**Lab Manager**	**Celltech Labs Inc.**

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GENERAL REMARKS

This report shall not be reproduced partially or in full without the prior written approval of Celltech Labs Inc. The results and statements contained in this report pertain only to the device(s) evaluated.

SUMMARY

The device under test (DUT) fulfills the general approval requirements as identified in this test report.

REVISION LOG

Revision	Description	Implemented By	Implementation Date
1.0	1st Release	Glen Westwell	1/24/2016
2.0	Emission Designator change	Art Voss	10/3/2016

Test Report Prepared By	Date	QA Review By	Date
Glen Westwell	1/24/2014	Art Voss	1/24/2016
Art Voss	10/3/2016	Ben Hewson	10/3/2016

SCOPE

This report outlines the results collected during RF radiated and conducted measurements of the 4RF Aprisa SR+ SQ450M150 point-to-multipoint radio. The measurement results were applied against the applicable requirements and limits outlined in the technical rules and regulations set forth in the Federal Communication's Commission Code of Federal Regulations Title 47 Part 2 and Part 90; and Industry Canada Radio Standards Specification RSS-119 and RSS-Gen.

1.0 REFERENCES

1.1 Normative References

ANSI/ISO 17025:2005	General Requirements for competence of testing and calibration laboratories
IEEE/ANSI C63.4:2003	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI/TIA/EIA-603-C:2004	Land Mobile FM or PM Communication Equipment Measurement and Performance Standards
CFR Title 47 Part 2	Code of Federal Regulations Title 47: Telecommunication Part 2: Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
CFR Title 47 Part 90	Code of Federal Regulations Title 47: Telecommunication Part 90: Private Land Mobile Radio Services
IC Spectrum Management & Telecommunications Policy	Radio Standards Specification RSS-119 – Land Mobile Fixed Services; 27.41-960 MHz RSS-Gen - General Requirements and Information for the Certification of Radiocommunication Equipment

2.0 PASS/FAIL CRITERIA

Unless otherwise noted in the Appendices, the pass/fail criteria are the limit set forth in the reference standards. The DUT is considered to have passed the requirements if the data collected during the described measurement procedure is no greater than the specified limits as defined. The pass/fail statements made in this report only apply to the unit tested.

3.0 FACILITIES AND ACCREDITATIONS

The facilities used in collecting the test results outlined in this report are located at 21-364 Lougheed Road, Kelowna, British Columbia, Canada V1X 7R8. The radiated emissions site conforms to the requirements set forth in ANSI C63.4 and is filed and listed with the FCC as an accredited test facility and Industry Canada under File Number IC 3874A-1.

4.0 GENERAL INFORMATION

DUT Description & Specifications

Device Description	Aprisa SR+,SQ450M150, 12.5 / 25 kHz channels, kHz Point-to-Multipoint Digital Radio	
Test Sample Serial No.	T/A Sample - Identical Prototype	
Device Identifier(s)	**FCC ID:**	UIPSQ450M140
Model Number(s)	SQ450M140	
FCC Frequency Band:	421-512 MHz	
Transmit Frequency Range DUT:	450 – 512 MHz (12.5 / 25 KHz Channels)	
Rated TX Power and Modulation	QPSK: +37.0 dBm 16QAM: +35.0 dBm 64QAM: +34.0 dBm	
Spectral Efficiency	Min. = 19,200 bits per second / 25 KHz or 4800 bits per second / 6.25 kHz	
Antenna	Maximum antenna gain = 15dBi.	
Emission Designator	25.0 KHz CH. = 20K0G1D (99% = 18.3 kHz, ABW = 20 kHz) QPSK 25.0 KHz CH. = 20K0D1D (99% = 18.3 kHz, ABW = 20 kHz) QAM 12.5 KHz Ch. = 11K3G1D (99% = 10.1 kHz, ABW = 11.25 kHz) QPSK 12.5 KHz Ch. = 11K3D1D (99% = 10.1 kHz, ABW = 11.25 kHz) QAM	
DUT Power Source	10-30 Vdc	
Type of Equipment	Fixed. Licensed Non-Broadcast Station Transmitter (TNB)	
Deviation(s) from standard/procedure	None	
Modification of DUT	None	
Test Exercise	The DUT was placed in continuous transmit mode and CW mode.	
Applicable Standards	FCC Part 90.	

DUT Function & Test Statements

Spectrum Efficient Technologies Part 90.203(j)(5).
This device complies with the spectrum efficiency requirement of this rule part.
A manufacturer's attestation exhibit has been submitted with this filing.

This device has no voice frequency capability. It uses digital modulation only. Therefore no voice frequency test requirements have been reported.

Section	Description of Test	Procedure Reference	Limit Reference	Result
5	RF Output Power	ANSI/TIA/EIA-603-C	§2.1046, §90.205	Pass
6	Spurious Emissions at the antenna terminals (Conducted)	ANSI/TIA/EIA-603-C	§2.1051, 90.210	Pass
7	Occupied Bandwidth and Emission Mask	ANSI/TIA/EIA-603-C	§2.1049, §90.210	Pass
8	Radiated Spurious Emissions	ANSI C63.4-2003	§2.1053, §90.210	Pass
10	Frequency Stability	ANSI/TIA/EIA-603-C	§2.1055, §90.213	Pass
Section	**Description of Test**	**Procedure Reference**	**Limit Reference**	**Result**
5	Transmitter Output Power	RSS-Gen 4.8	RSS-119, 5.4	Pass
6	Spurious Emissions at the antenna terminals (Conducted)	RSS-Gen 4.9	RSS-119, 5.8	Pass
7	Occupied Bandwidth and Emission Mask	RSS-Gen 4.6.1	RSS-119, 5.5	Pass
8	Radiated Spurious Emissions	ANSI C63.4-2003	RSS-119, 5.8	Pass
10	Frequency Stability	RSS-Gen 4.7	RSS-119, 5.3	Pass

5.0 RF OUTPUT POWER MEASUREMENT

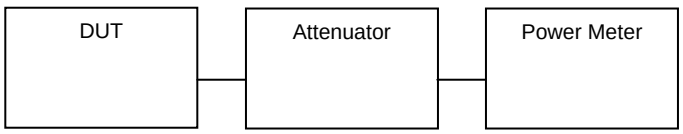
References	
Normative Reference Standard	FCC CFR 47 §2.1046, §90.205; IC RSS-119, 5.4
Procedure Reference	The RF output power measurements were performed in accordance with ANSI TIA/EIA Standard 603.

Limits	
FCC CFR 47 §90.279	ERP relative to Effective Antenna Height (EAH), 90.279.
RSS-119, 5.4	The output power shall be within ±1.0 dB of the manufacturers rated power.

Environmental conditions	
Temperature	25 +/- 5 ºC
Humidity	40 +/- 10 %
Barometric Pressure	101 +/- 3 kPa

ASSET NUMBER	MANUFACTURER	MODEL	DESCRIPTION	CAL DUE
00007	Gigatronics	8652A	Power Meter	03-May-14
00237	Gigatronics	80334A	Power Sensor	03-May-14

Setup drawing



Test results: Complies

Measured Frequency (MHz)	Conducted Output Power (dBm) 12.5 KHz Ch.	Conducted Output Power (dBm) 25 KHz Ch.	Rated Output Power (dBm)
QPSK	37.4	36.7	37.0
16QAM	35.6	35.6	35.0
64QAM	34.7	34.0	34.0

Sign-off

I attest to the accuracy of the data. All measurements reported herein were performed by me and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements.

Glen Westwell
Lab Manager
Celltech Labs Inc.

10/3/2016
Date

6.0 SPURIOUS EMISSIONS AT THE ANTENNA TERMINAL

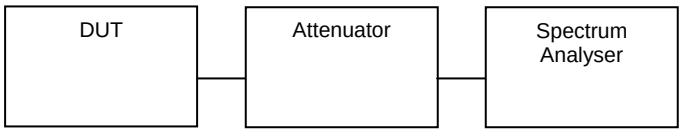
References	
Normative Reference Standard	FCC CFR 47 §2.1051, §90.210; IC RSS-119, 5.8
Procedure Reference	The spurious emissions measurements at the antenna terminal were performed in accordance with ANSI TIA/EIA Standard 603. The emission search was performed across all required ranges. The worst case performance has been presented.

Limits	
FCC CFR 47 §90.210	25.0 KHz Ch.= 43 + 10 Log (Po) dB.
	12.5 KHz CH. = 50 + 10 Log (Po) dB.

Environmental conditions	
Temperature	25 +/- 5 ºC
Humidity	40 +/- 10 %
Barometric Pressure	101 +/- 3 kPa

ASSET NUMBER	MANUFACTURER	MODEL	DESCRIPTION	CAL DUE
00051	HP	8566B	Spectrum Analyzer RF Section	10-May-2014
00047	HP	85685A	RF Preselector	10-May-2014
00241	R&S	FSU 40	Spectrum Analyzer	09-Apr-2015

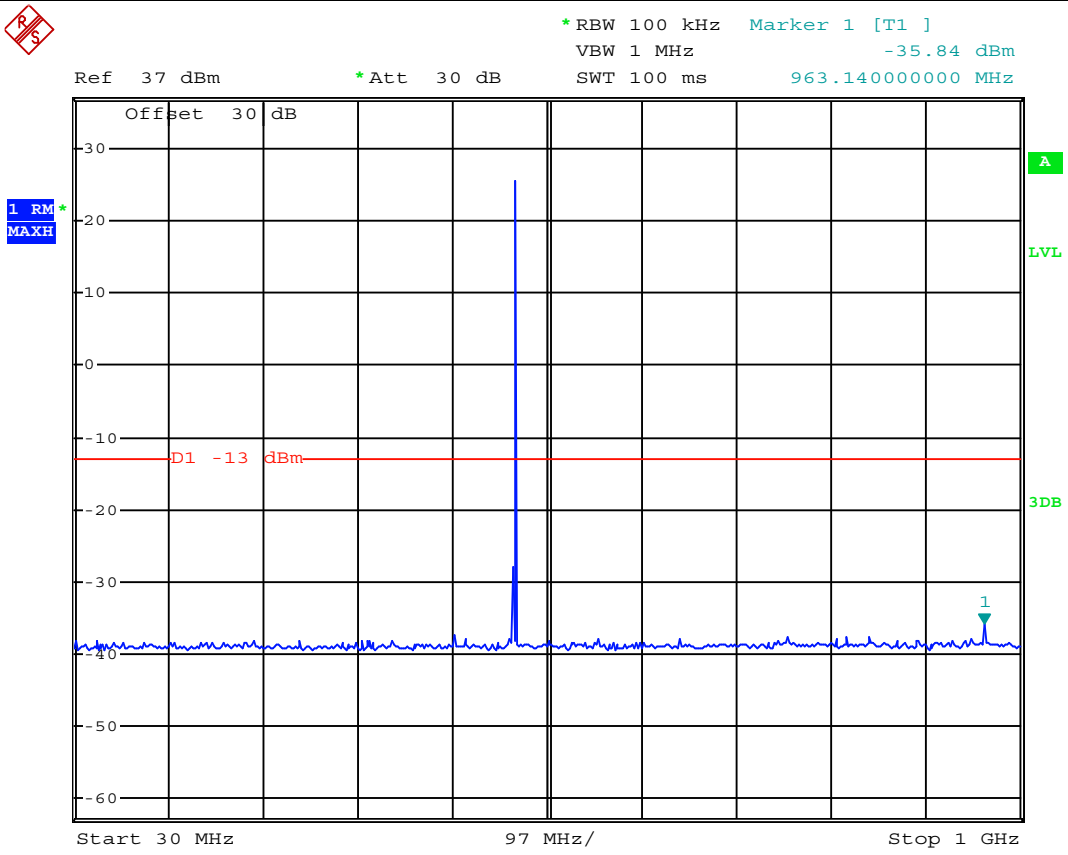
Setup drawing



Detected Emissions 12.5 KHz Ch.

Emission Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
962.0	-24.2	-20	-4.2

Test results: 12.5 KHz Channel



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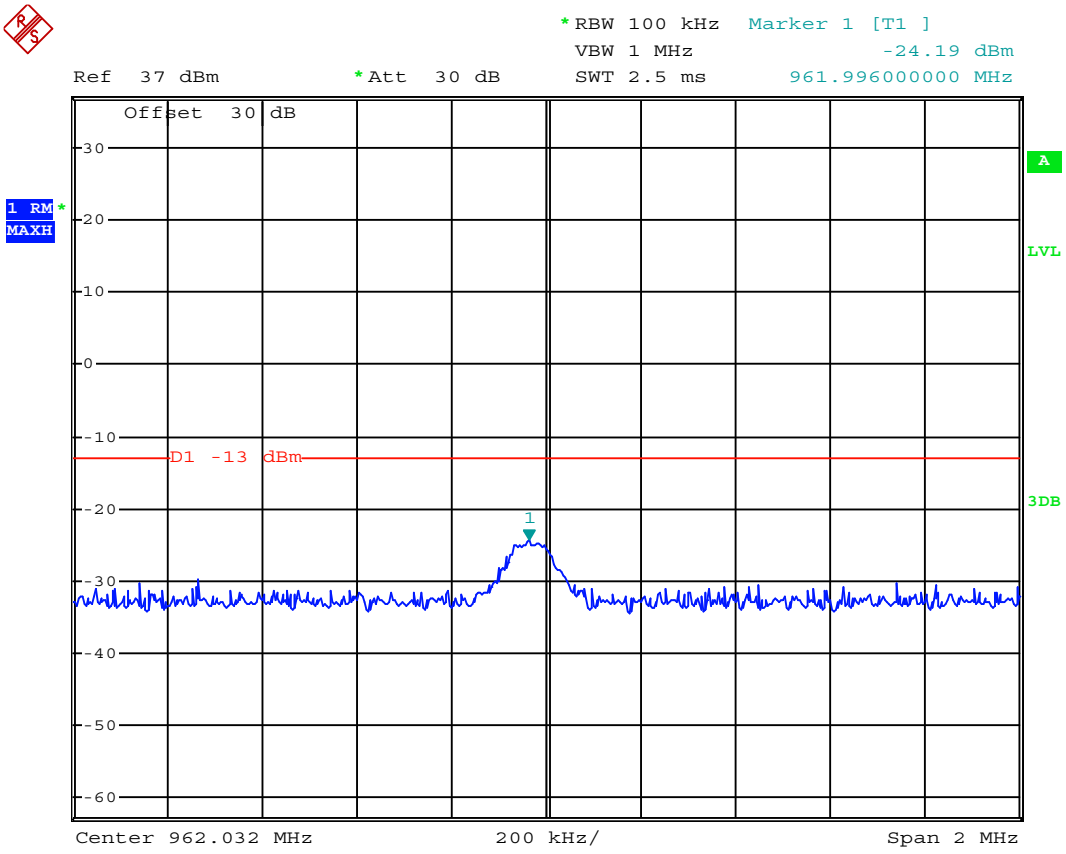

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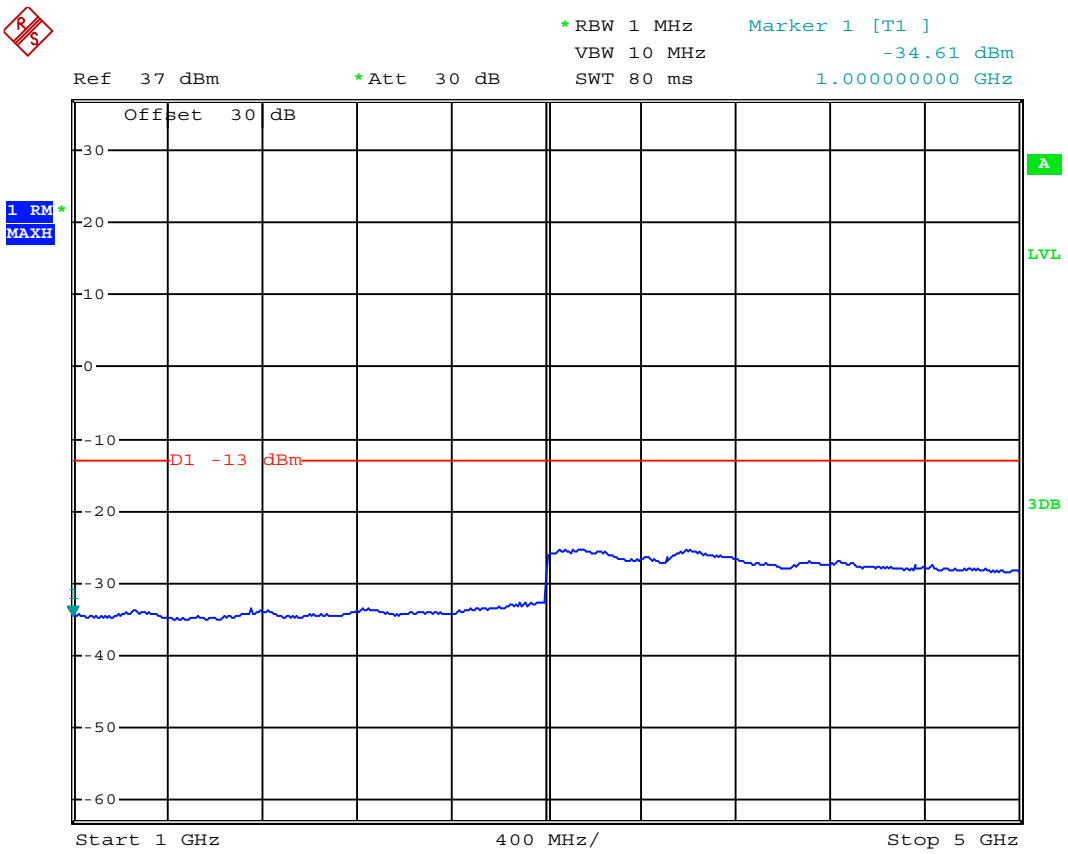
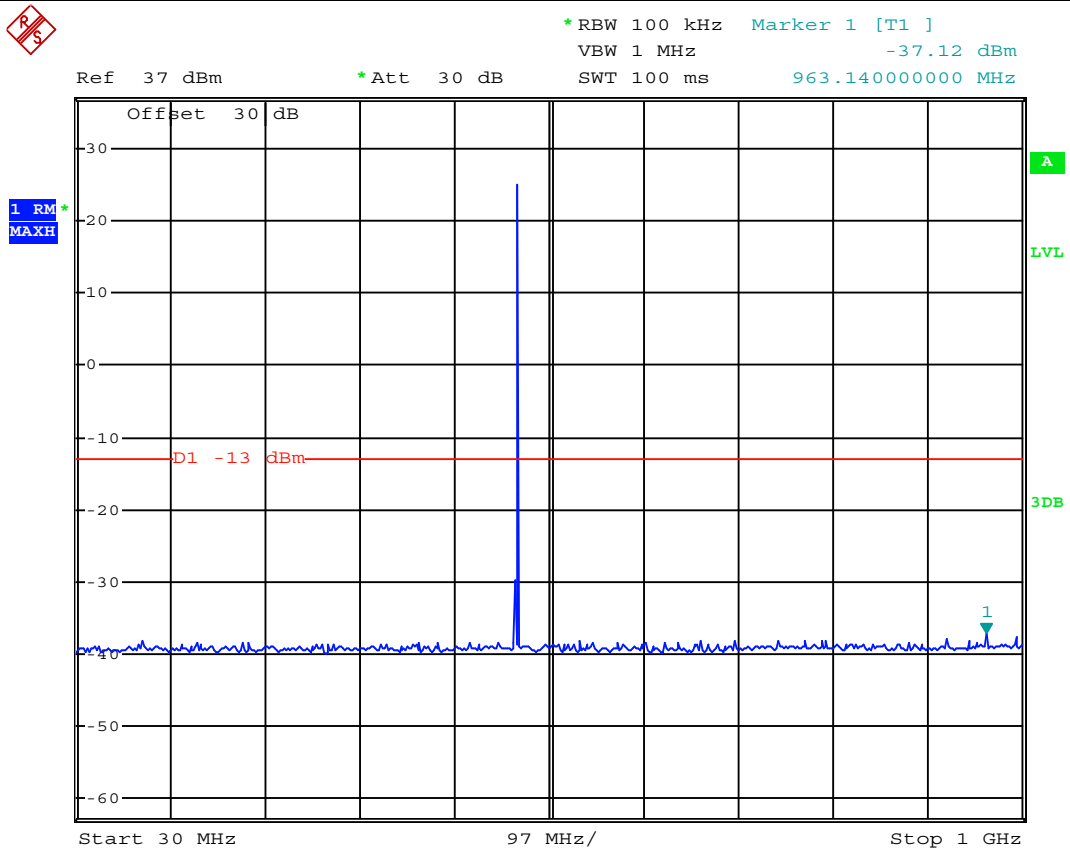


Date: 14.JAN.2014 19:06:34

Detected Emissions 25 KHz Ch.

Emission Frequency	Level	Limit	Margin
[MHz]	[dBm]	[dBm]	[dB]
962.0	-25.6	-13	-12.6

Test results: 25.0 KHz Channel



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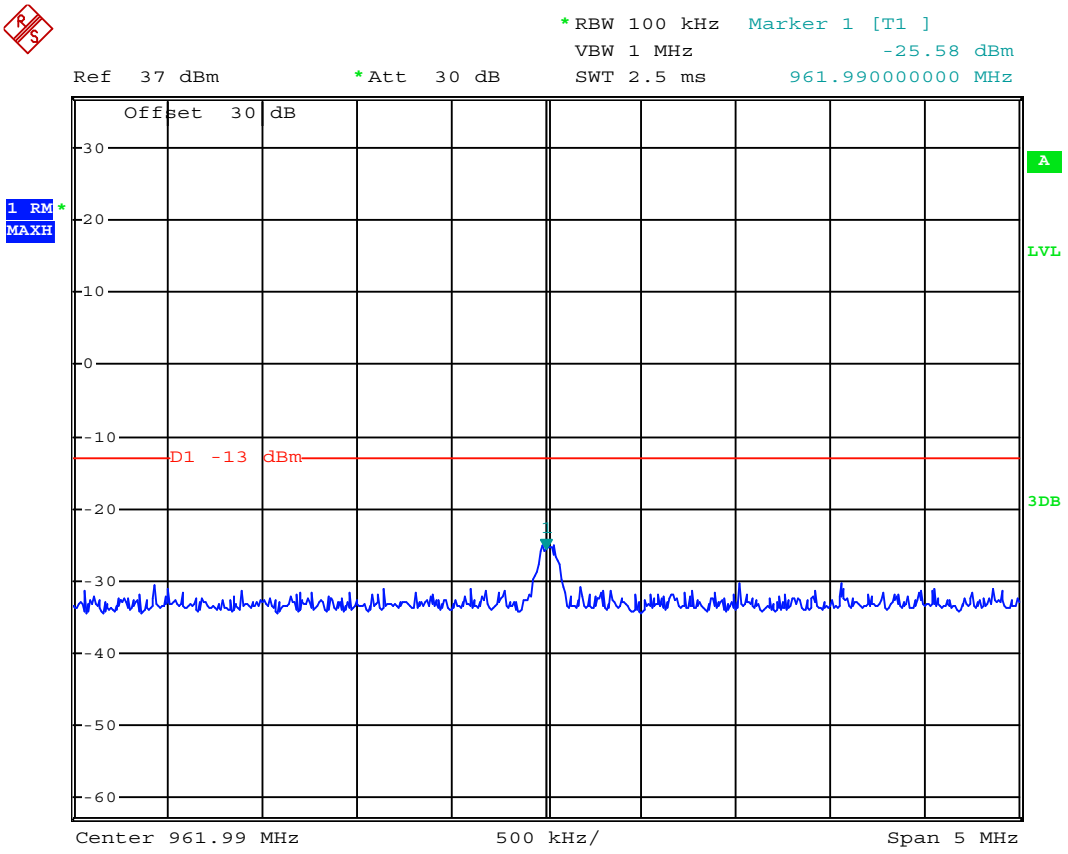

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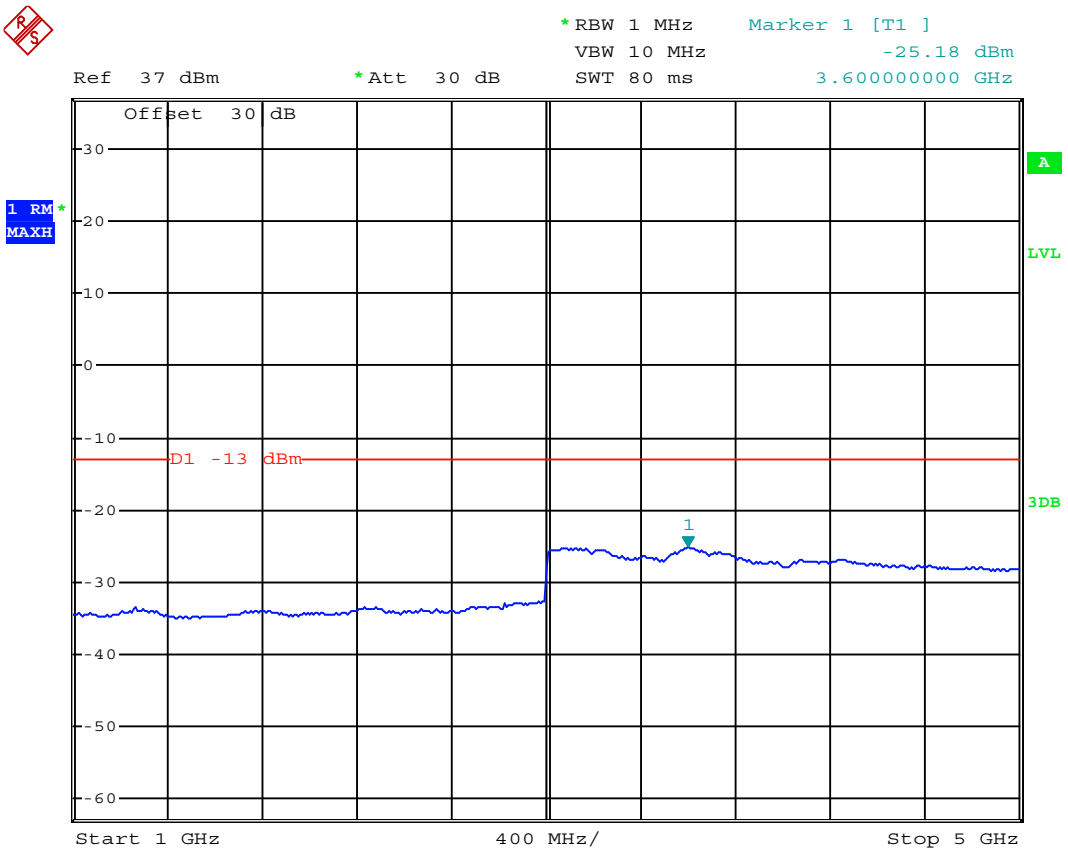


Date: 14.JAN.2014 19:09:46

Sign-off

I attest to the accuracy of the data. All measurements reported herein were performed by me and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements.

Glen Westwell.
Lab Manager
Celltech Labs Inc.

10/3/2016
Date

7.0 OCCUPIED BANDWIDTH AND EMISSION MASK

References	
Normative Reference Standard	FCC CFR 47 §2.1049, §90.210 RSS-119, 5.8
Procedure Reference / Description	Occupied bandwidth was performed by connecting the output of the DUT to the input of a spectrum analyzer.

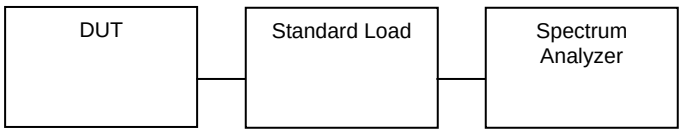
Limits	
§90.210	Mask B /25 KHz CH. Mask D /12.5 KHz CH.

Environmental conditions	
Temperature	25 +/- 5 ºC
Humidity	40 +/- 10 %
Barometric Pressure	101 +/- 3 kPa

Equipment list

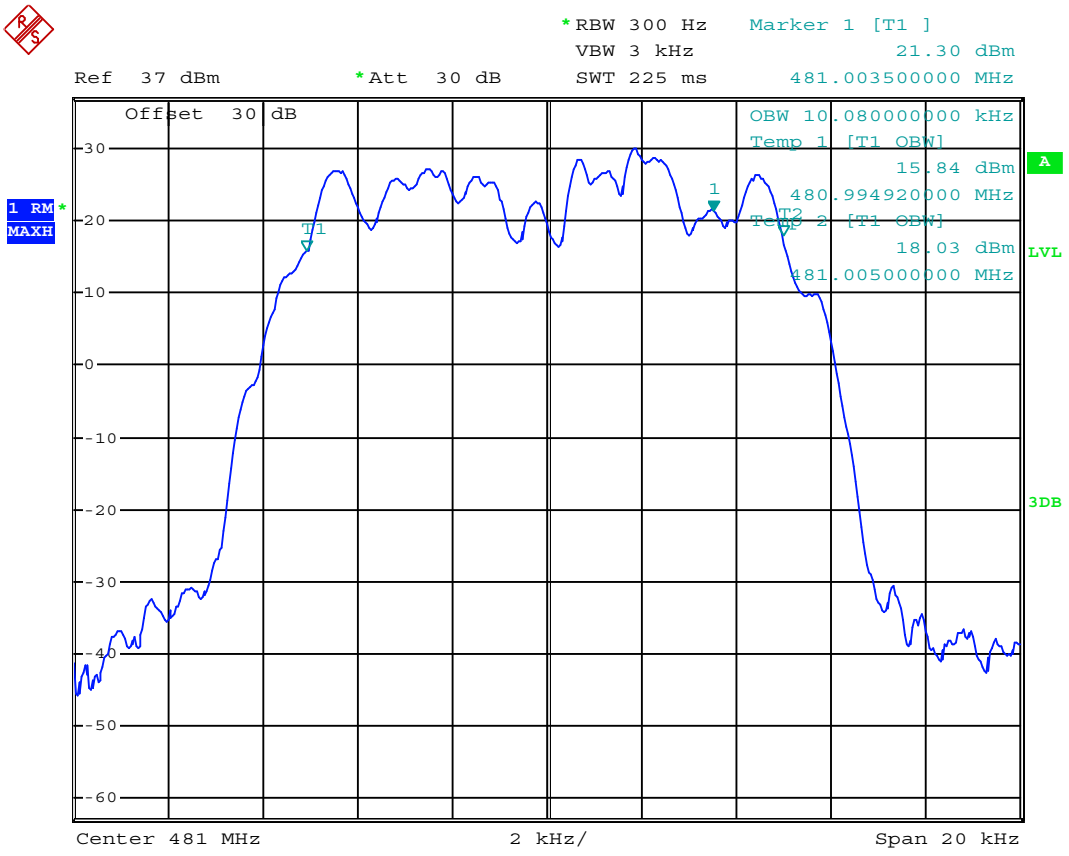
ASSET NUMBER	MANUFACTURER	MODEL	DESCRIPTION	CAL DUE
00241	R&S	FSU 40	Spectrum Analyzer	09-Apr-2015

Setup drawing



7.1 Test results - OBW, 12.5 KHz CH.

QPSK
99% Occupied Bandwidth = 10.1 kHz



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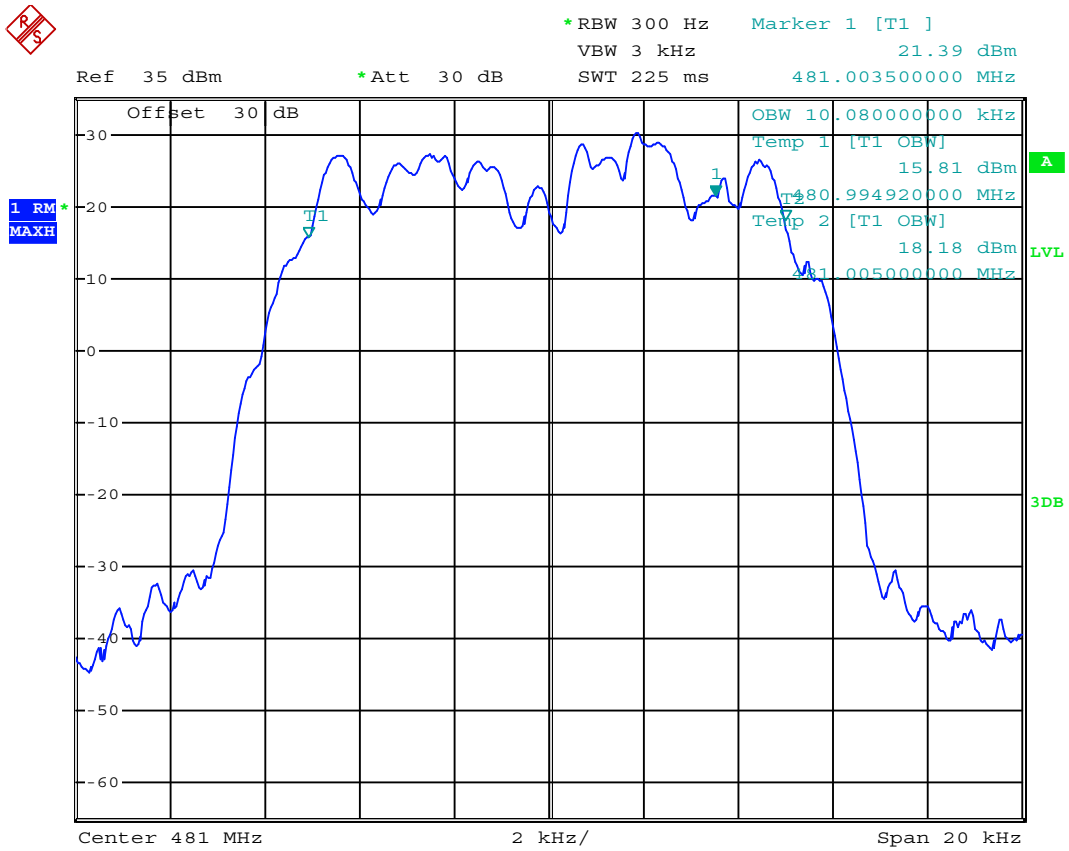
Test results Cont.

16QAM
99% Occupied Bandwidth = 10.1 KHz



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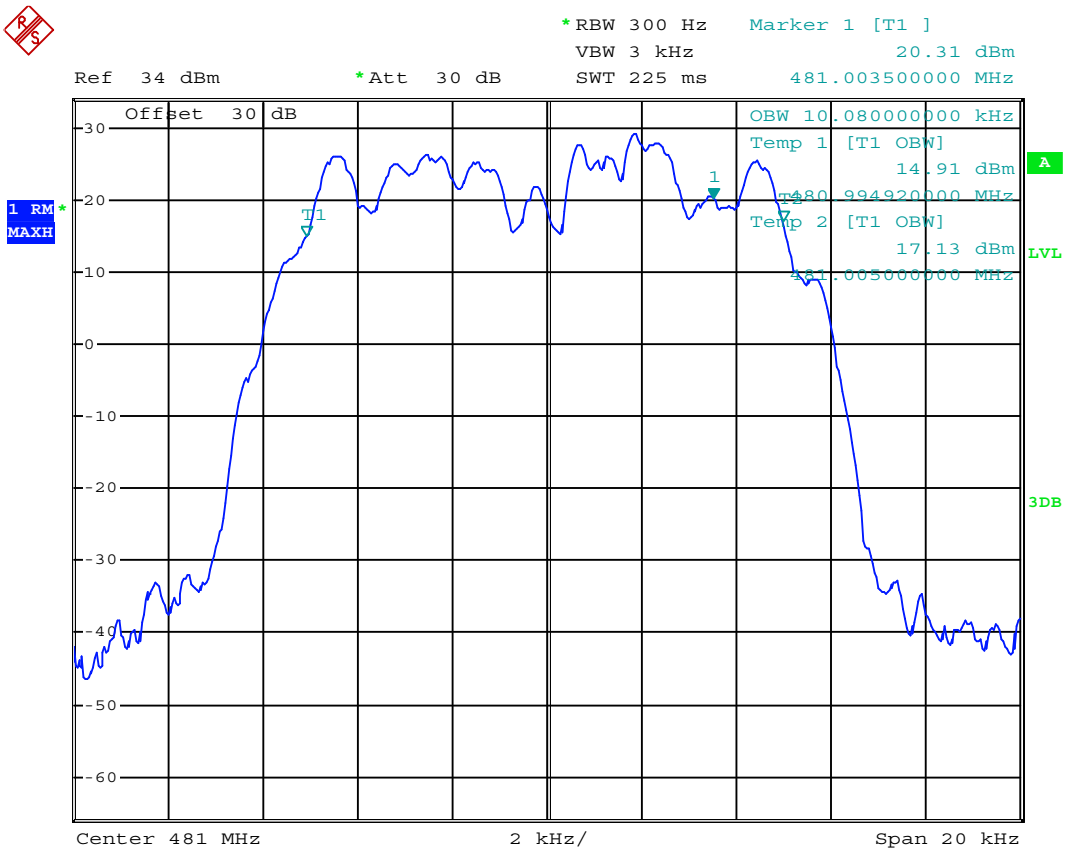
Test results Cont.

64QAM
99% Occupied Bandwidth = 10.1 KHz



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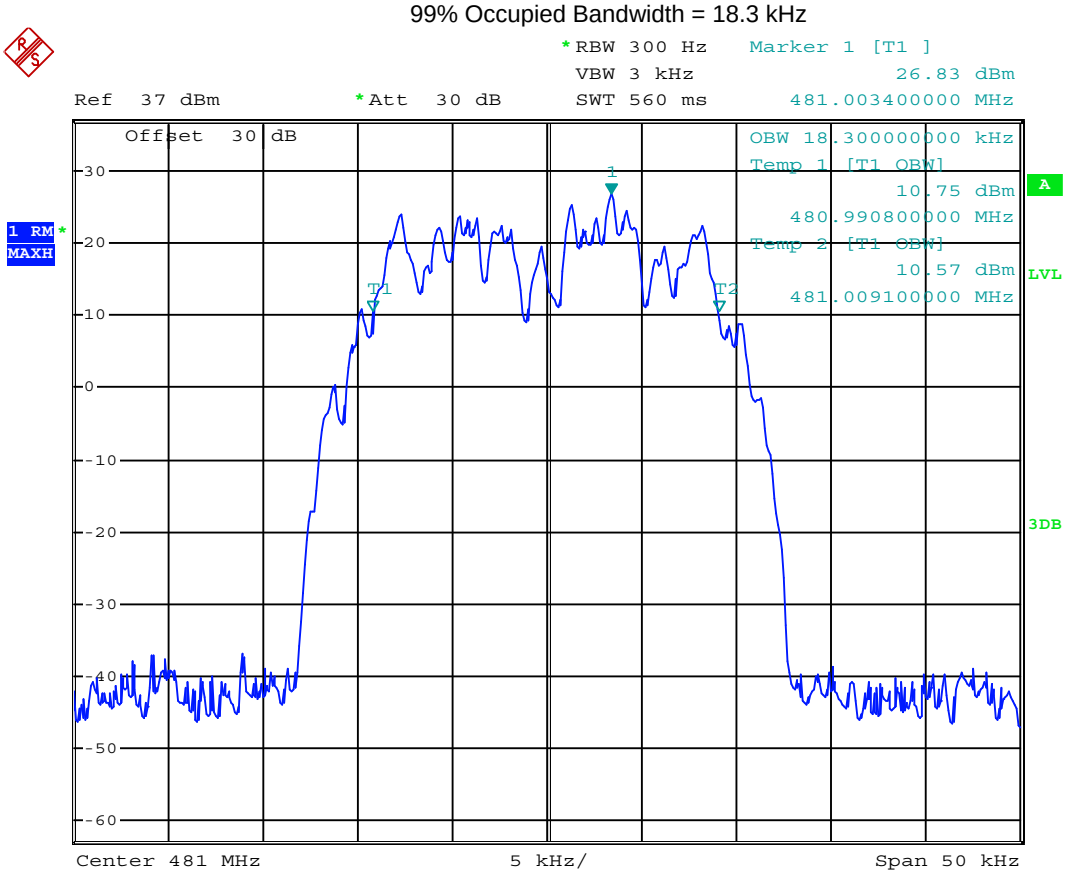
7.2 Test results - OBW, 25 KHz Ch.

QPSK
99% Occupied Bandwidth = 18.3 kHz



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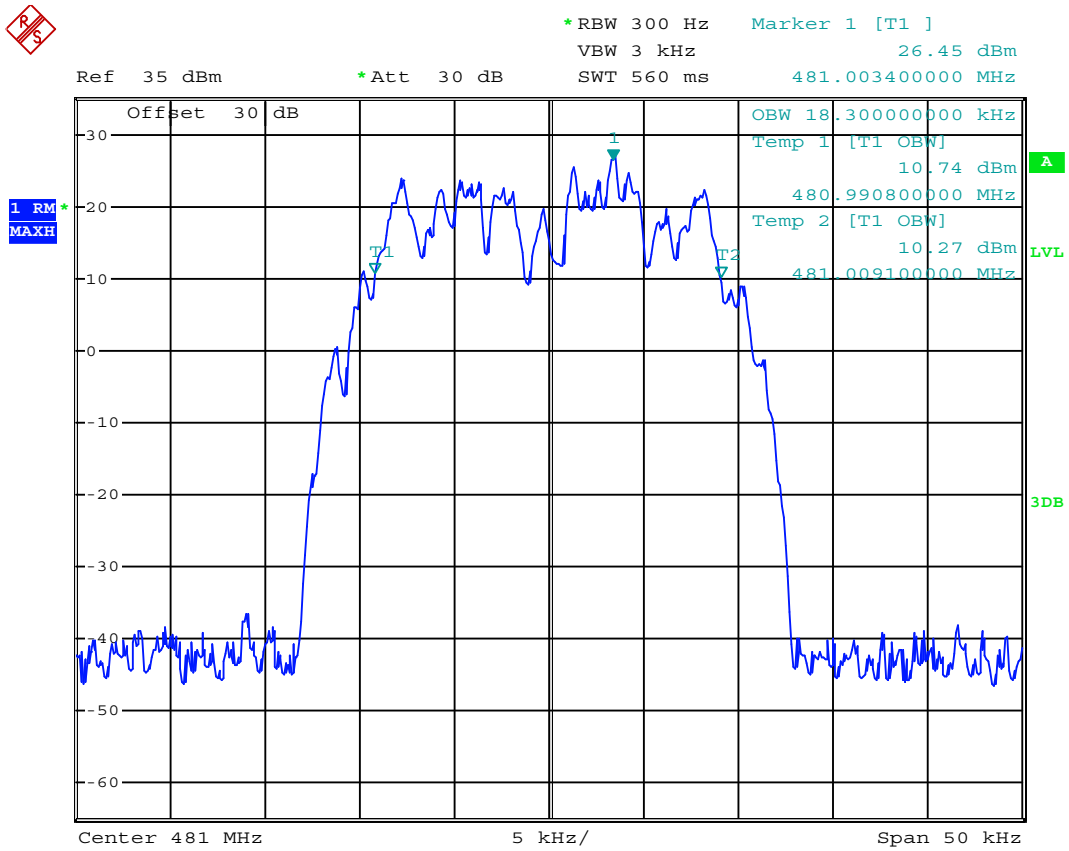
Test results Cont.

16QAM
99% Occupied Bandwidth = 18.3 KHz



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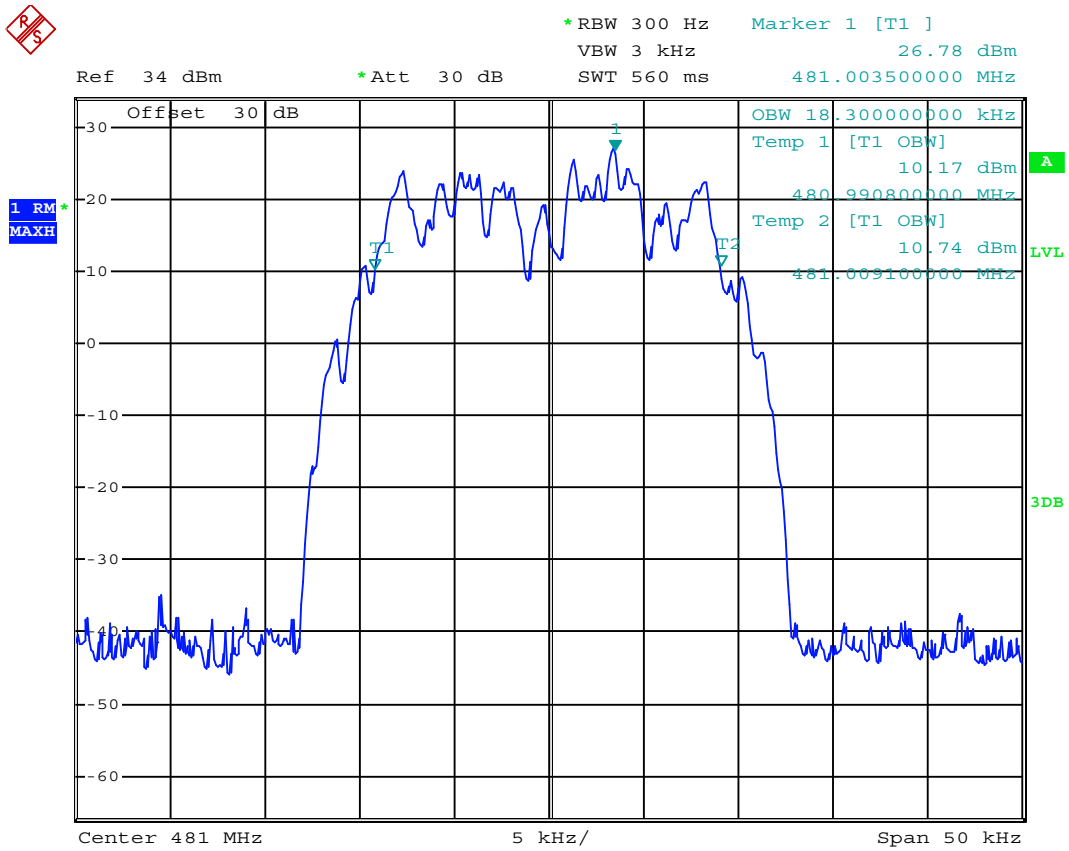
Test results Cont.

64QAM
99% Occupied Bandwidth = 18.3 KHz



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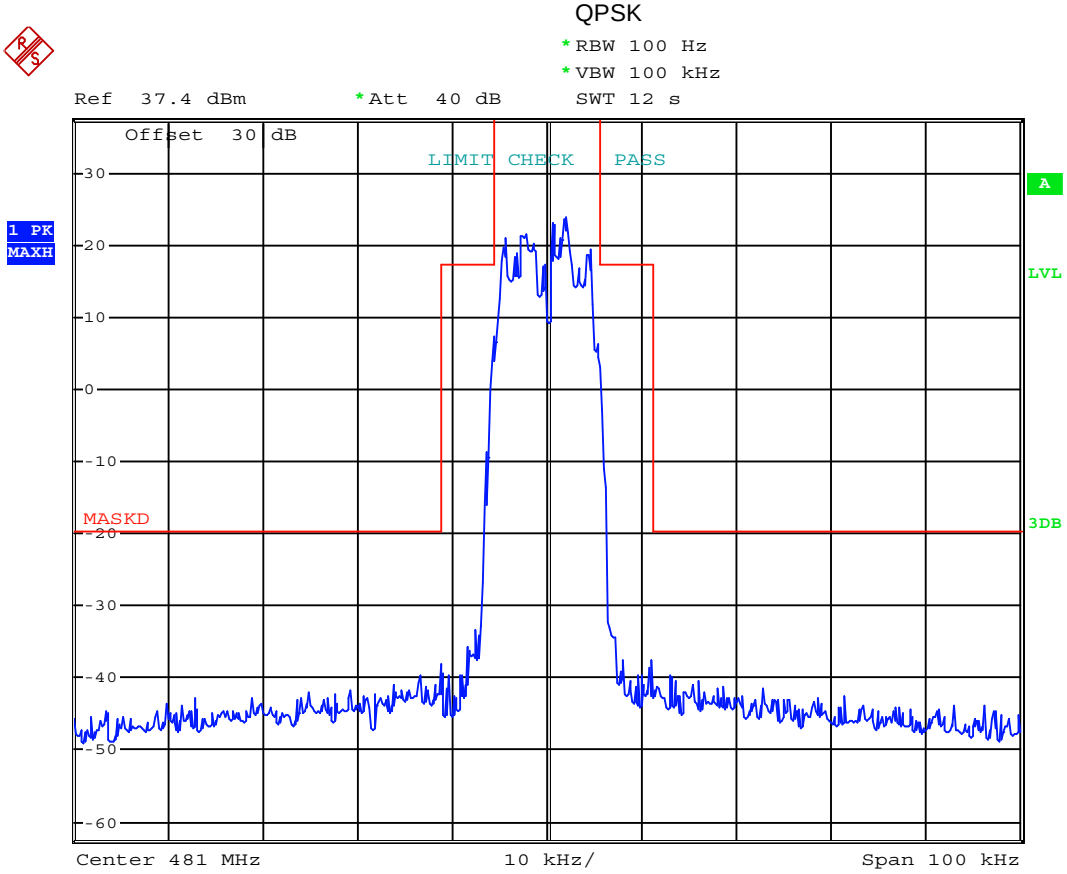
7.3 Test results – Spectrum Mask D: 12.5 KHz Ch.

Emission Mask 12.5 KHz Channel
QPSK



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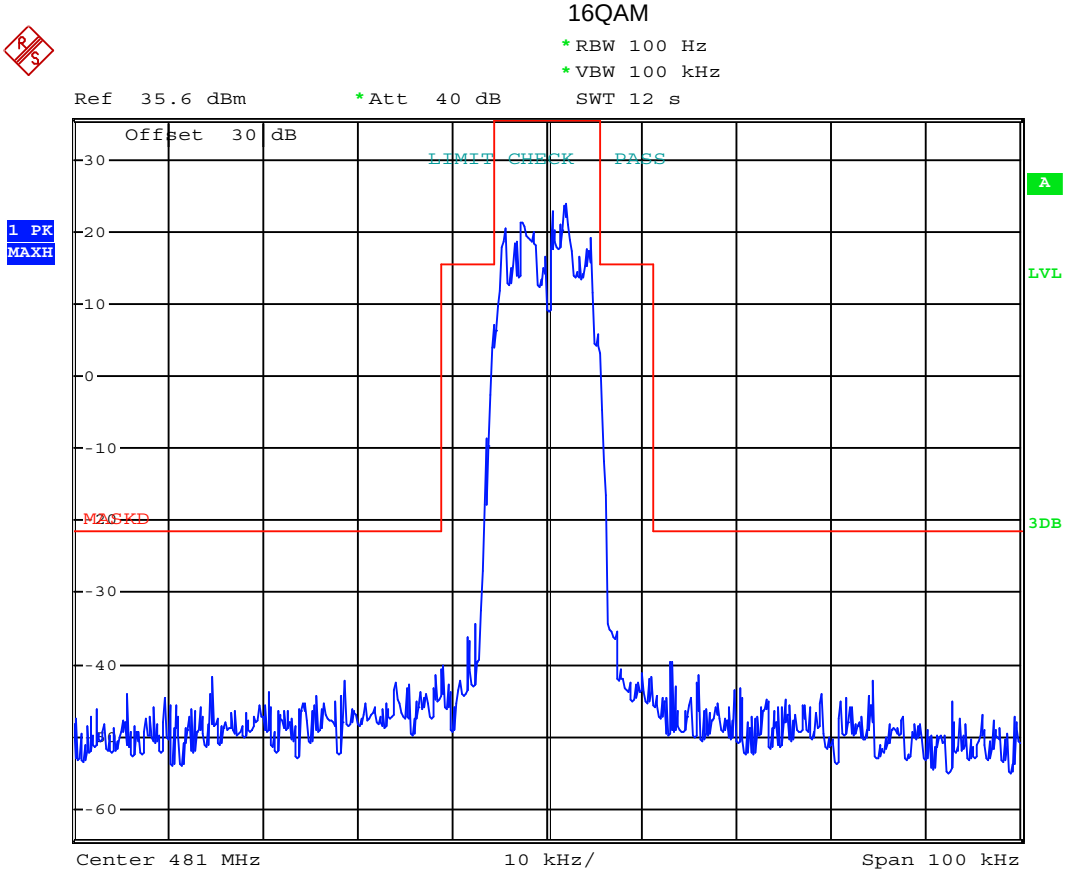
Emission Mask 12.5 KHz Channel
16QAM



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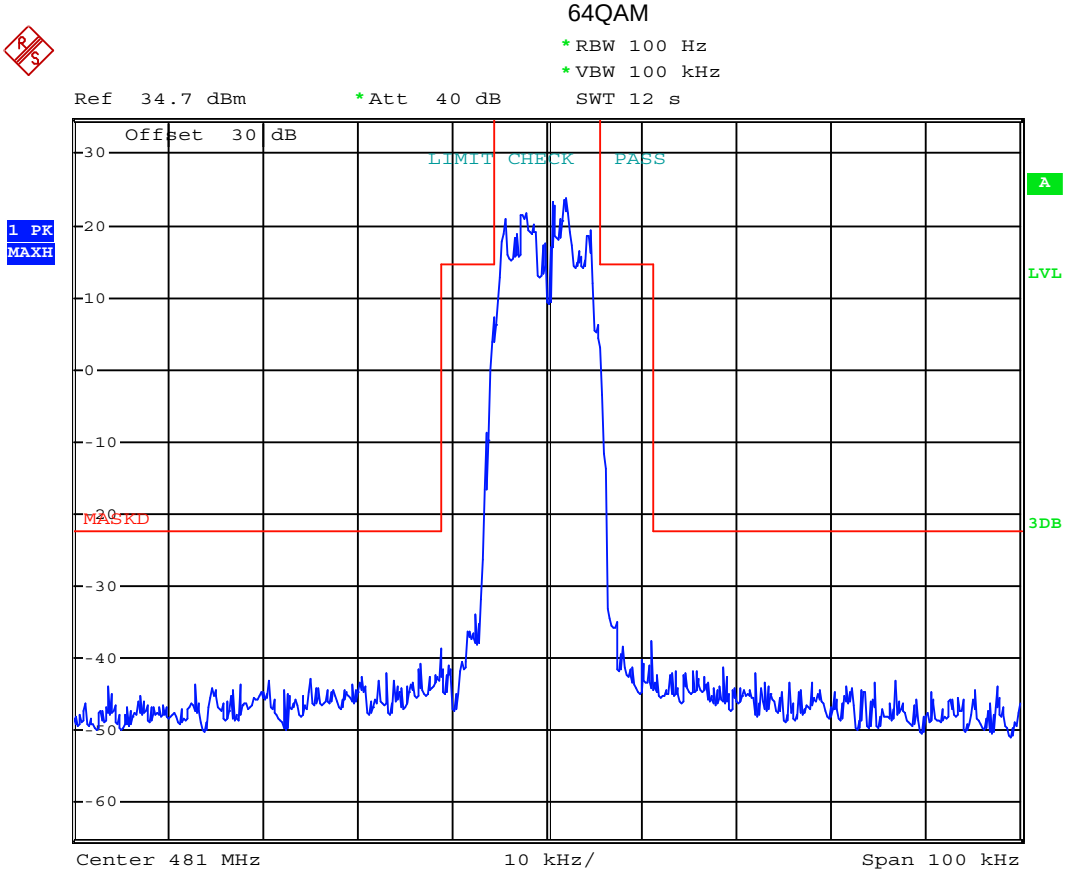
Emission Mask 12.5 KHz Channel
64QAM



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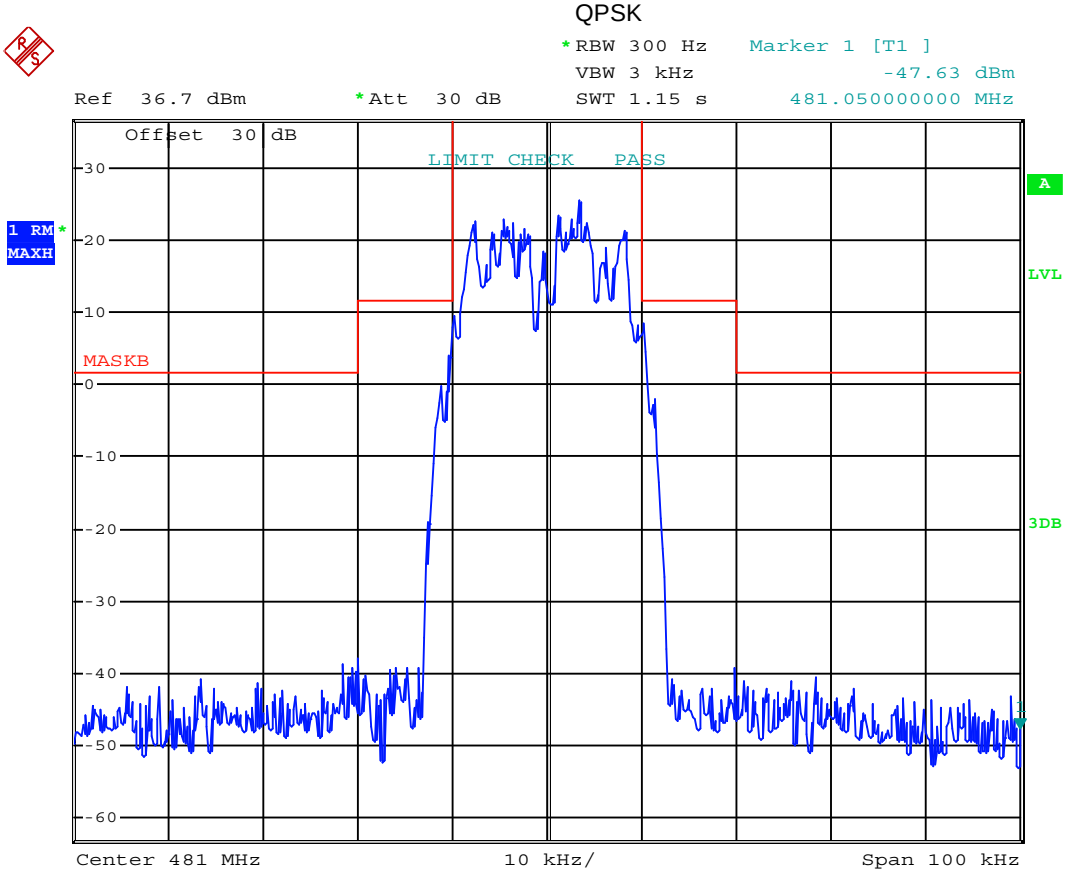
7.4 Test results – Spectrum Mask B: 25 KHz CH.

Emission Mask 25 KHz Channel
QPSK



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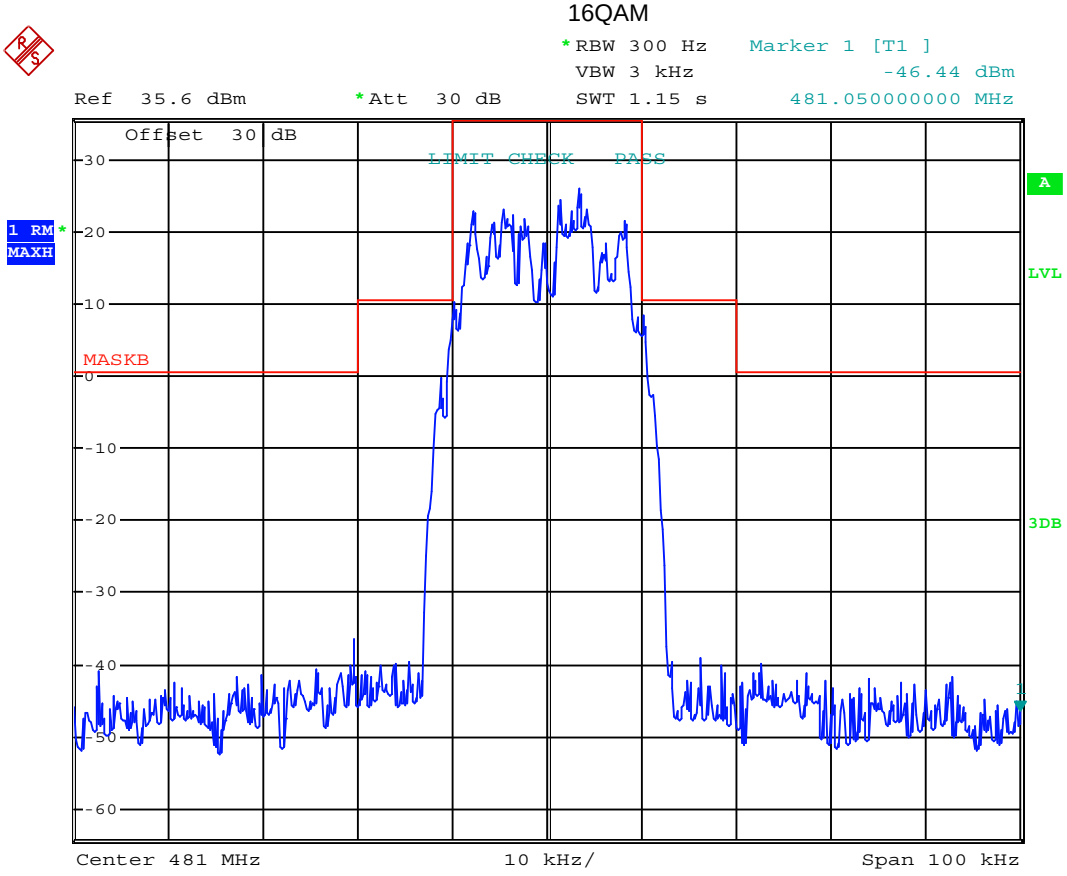
Emission Mask 25 KHz Channel
16QAM



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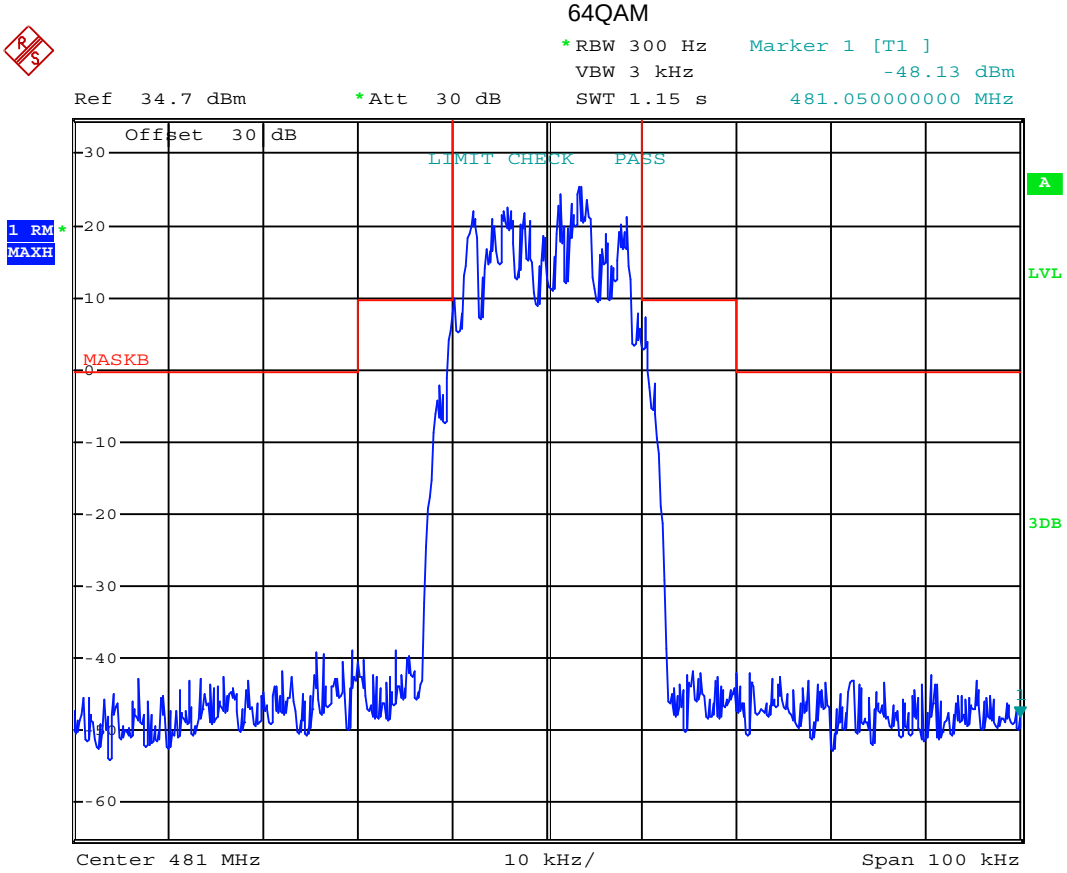
Emission Mask 25 KHz Channel
64QAM



Date: 14.JAN.2014 19:20:43

Sign-off

I attest to the accuracy of the data. All measurements reported herein were performed by me and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements.

Glen Westwell.
Lab Manager
Celltech Labs Inc.

10/3/2016
Date

8.0 RADIATED SPURIOUS EMISSIONS – TX (SIGNAL SUBSTITUTION)

References	
Normative Reference Standard	FCC CFR 47 §2.1053; 90.210;IC RSS-119, RSS-GEN
Measurement Reporting	• The transmitter spurious emissions were measured in accordance with ANSI/TIA-603-C. • The spectrum was searched from the lowest frequency generated in the DUT up to the 10th harmonic of the fundamental frequency. • The DUT was characterized on 3 orthogonal axis. • Detected emissions are reported.

Limits	
§90.210, RSS-119,	Emissions must be at least 50 + 10 $\log_{10}$ (P) dB below the mean power output of the transmitter.

Environmental conditions	
Temperature	25 +/- 5 ºC
Humidity	40 +/- 10 %
Barometric Pressure	101 +/- 3 kPa

Equipment list

ASSET NUMBER	MANUFACTURER	MODEL	DESCRIPTION	CAL DUE
00072	EMCO	2075	Mini-mast	n/a
00073	EMCO	2080	Turn Table	n/a
00071	EMCO	2090	Multi-Device Controller	n/a
00241	R&S	FSU 40	Spectrum Analyzer	09-Apr-15
00050	Chase	CBL-6111A	Bilog Antenna	07-May-14
00055	EMCO	3121C	Dipole Antenna	07-Mat-14
00034	EMCO	3115	Horn Ant.	06-Dec-14
00035	EMCO	3115	Horn Ant.	06-Dec-14
00239	Miteq	JS4-00102600	LNA	COU
00006	R & S	SMR 20	Signal Generator (10MHz-40GHz)	1-May-14
00007	Gigatronics	8652A	Power Meter	03-May-14
00237	Gigatronics	80334A	Power Sensor	03-May-14

Note: COU = cal on use.

Measurement equipment setup

MEASUREMENT EQUIPMENT CONNECTIONS

For the field strength measurements, the measurement equipment was connected as shown below. For the final substitutions, the DUT was replaced with the appropriate antenna and fed from a CW signal source sufficient to replicate the received field strength of the emission being investigated. Worst case performance is presented.

Frequency Range	RX Antenna	TX Antenna
30 MHz - 1GHz	Bilog	Dipole
1 GHz - 18 GHz	ETS 3115 Horn	ETS 3115 Horn

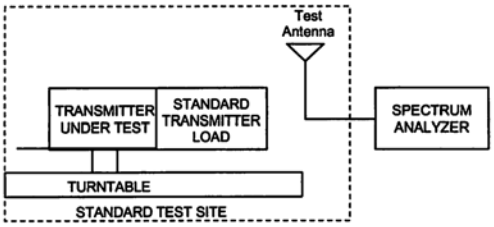
MEASUREMENT EQUIPMENT SETTINGS

Measurement Settings.

RBW	VBW	Detector
MHz	MHz	
100 kHz < 1GHz 1 MHz >1 GHz	300 kHz < 1 GHz 3 MHz> 1 GHz	Peak

Setup drawing(s)

A.



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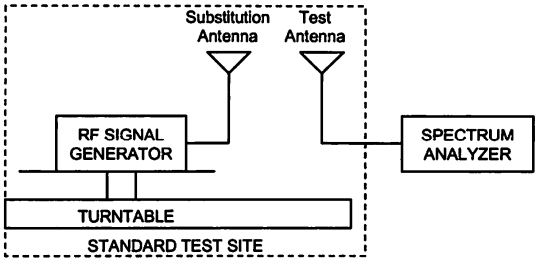


Radiated Emissions: Signal Substitution (Fig. A&B)

TX: 481.0 MHz	Ant. Polarity	Emission Level	Substitution Level	Antenna Gain (+)	Cable loss (+)	Amp Gain (-)	Corrected Pwr Level	Limit	Margin
(GHz)		(dBuV)	(dB)	(+dBi)	(dB)	(dB)	(dBm)	(dBm)	(dB)
1.3	V	45.2	-55.2	6.92	4.2	30.2	-36.12	-20.0	-16.2
1.4	V	35.2	-64.4	7.8	4.4	30.2	-46.4	-20.0	-26.4
1.45	V	35.2	-64.0	8.0	4.5	30.2	-46.3	-20.0	-26.3
1.5	V	39.6	-54.3	8.3	5.0	30.4	-37.0	-20.0	-17.0
1.8	H	37.1	-60.2	8.6	5.0	30.6	-43.2	-20.0	-23.2
1.924	V	28.7	-62.2	8.6	5.2	29.4	-46.6	-20.0	-26.6

Test results:

Complies.

- All detected emissions are reported.
- The worst case emission is 1.3 GHz at -36.12 dBm.
- The spectrum was searched from the lowest frequency generated in the DUT up to the 10th harmonic of the fundamental frequency.
- The DUT was characterized on 3 orthogonal axis.

Sign-off

I attest to the accuracy of the data. All measurements reported herein were performed by me and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements.

Glen Westwell
Lab Manager
Celltech Labs Inc.

10/3/2016
Date

9.0 FREQUENCY STABILITY

References	
Normative Reference Standard	FCC CFR 47 §2.1055, §90.213; IC RSS-119
Procedure Reference / Description	§2.1055(a)(2) The frequency stability shall be measured with variation of ambient temperature as follows: (1) From -40° to +70° centigrade.

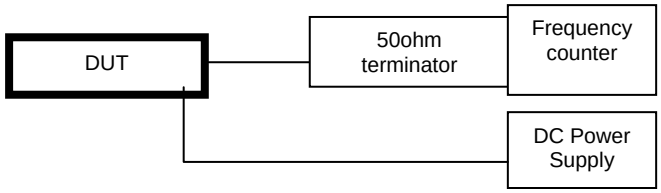
Limits	
§90.213 & RSS-119	90.213 - 421-512 MHz, 2.5ppm / 25 KHz CH.
	90.213 - 421-512 MHz, 1.5ppm / 12.5 KHz CH.

Environmental conditions	
Temperature	25 +/- 5 ºC
Humidity	40 +/- 10 %
Barometric Pressure	101 +/- 3 kPa

Equipment list

ASSET NUMBER	MANUFACTURER	MODEL	DESCRIPTION	CAL DUE
na	ESPEC	ECT-2	Heater/Refrigerator	na
0003	HP	53181A	Frequency Counter	02-May-14
na	HP	E3611A	DC Power Supply	na
00234	VWR	na	Temperature Humidity Monitor	20-July-14

Setup drawing



Test results: Complies

Temperature (degrees C)	Assigned Frequency (MHz)	Measured Frequency (MHz)	Deviation (Hz)	Frequency tolerance (ppm)
-40	481 000 000	480 999 558	442	-0.92
-30	481 000 000	480 999 594	406	-0.84
-20	481 000 000	480 999 614	386	-0.80
-10	481 000 000	480 999 647	353	-0.73
0	481 000 000	480 999 858	142	-0.30
10	481 000 000	480 999 845	155	-0.32
20 -end point	481 000 000	480 999 902	98	-0.20
20	481 000 000	480 999 899	101	-0.21
20 +end point	481 000 000	480 999 899	101	-0.21
30	481 000 000	480 999 881	119	-0.25
40	481 000 000	480 999 774	226	-0.47
50	481 000 000	480 999 768	232	-0.48
60	481 000 000	480 999 722	278	-0.58
70	481 000 000	480 999 655	345	-0.72

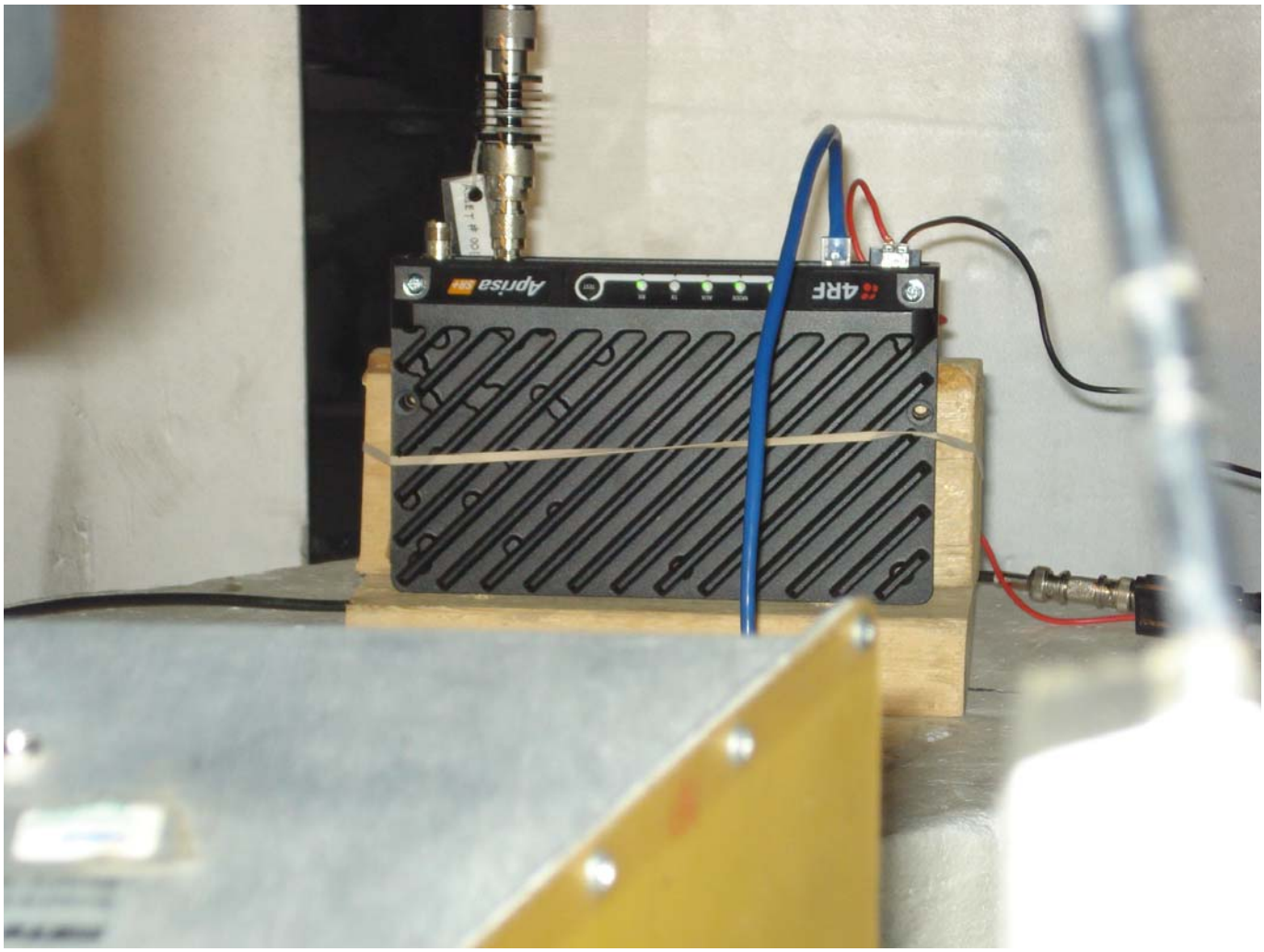
Sign-off

I attest to the accuracy of the data. All measurements reported herein were performed by me and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements.

Glen Westwell
Lab Manager
Celltech Labs Inc.

10/3/2016
Date

10.0 TEST SET-UP PHOTO'S



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