



Test Report Serial Number: **45461346-R1.0**

Test Report Date: **4 April 2016**

EMC Test Report

Applicant:



Tekmar Control Systems Ltd.
5100 Silver Star Road
Vernon, British Columbia, V1B 3K4
Canada

FCC ID:

2AHQR-10850A

IC Registration Number

21247-10850A

Product Model Number / HVIN

10850A

Product Name / PMN

Wireless Outdoor Sensor Transmitter

In Accordance With:

FCC 47 CFR Part 15 Subpart C

Digital Transmission Systems (DTS)

RSS-GEN, RSS-247 Issue 1

Digital Transmission Systems (DTS)

Approved By:

Ben Hewson, President

Celltech Labs Inc.
21-364 Lougheed Rd.
Kelowna, BC, V1X 7R8
Canada



Test Lab Certificate: 2470.01



**Industry
Canada**

IC Registration 3874A-1



FCC Registration: 714830

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1.0 REVISION LOG



Tested By:	Art Voss		
Prepared By:	Art Voss		
Reviewed By:	Art Voss		
Issue Number	Description	By	Issue Date
1.0	Initial Release	Art Voss	4 April 2016

2.0 TEST RESULT SUMMARY

TEST SUMMARY					
Referenced Standard(s):		FCC CFR Title 47 Parts 2, 15(B), 15.247, RSS-GEN, RSS-247			
Appendix	Description of Test	Procedure Reference	Limit Reference	Test Date	Result
A	Occupied Bandwidth	ANSI C63.10 - 2013 KDB 558074D01v03r04	§15.247(a)(2) RSS-247 5.2(1)	30 March 2016	Pass
B	Peak Output Power (Conducted)	ANSI C63.10 - 2013 KDB 558074D01v03r04	§15.247(b) RSS-247 5.4(4)	30 March 2016	Pass
C	Power Spectral Density	ANSI C63.10 - 2013 KDB 558074D01v03r04	§15.247(e) RSS-247 5.2(2)	30 March 2016	Pass
D	Conducted Spurious Emissions Non-Restricted Frequency Bands	ANSI C63.10 - 2013 KDB 558074D01v03r04	§15.247(d) RSS-247 5.5	30 March 2016	Pass
E	Emissions at Band Edges	ANSI C63.10 - 2013 KDB 558074D01v03r04	§15.247(d) RSS-247 5.5	30 March 2016	Pass
G	Radiated Spurious Emissions	ANSI C63.10 - 2013 KDB 558074D01v03r04	§15.247(d), .209 RSS-247 5.5	1 April 2016	Pass

3.0 PASS/FAIL CRITERIA

Unless otherwise noted in the Appendices, the pass/fail criteria are the limits 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(s) tested.

<p>I attest that the data reported herein is true and accurate within the tolerance of the Measurement Instrument Uncertainty; that all tests and measurements were performed in accordance with accepted practices or procedures; and that all tests and measurements were performed by me or by trained personnel under my direct supervision. The results of this investigation are based solely on the test sample(s) provided by the client which were not adjusted, modified or altered in any manner whatsoever, except as required to carry out specific tests or measurements. This test report has been completed in accordance with ISO/IEC 17025.</p>	<div style="text-align: center;">  <hr/> Art Voss, P.Eng. Technical Manager Celltech Labs Inc. <hr/> 4 April 2016 Date </div> <div style="text-align: right;">  </div>
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4.0 SCOPE

Scope

This report presents the measurement and test results obtained during electromagnetic emissions evaluation of the:

Tekmar 10850A Configuration 0A Wireless Outdoor Sensor Transmitter

The measurement results were applied against the applicable FCC and Industry Canada requirements and limits outlined in the technical rules and regulations set forth in the Federal Communication's Commission Code of Federal Regulations and Industry Canada Radio Standards Specification cited in the Normative References below.

5.0 REFERENCES

Normative References

ANSI / ISO 17025:2005	General Requirements for competence of testing and calibration laboratories
IEEE/ANSI C63.4:2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
IEEE/ANSI C63.10:2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
CFR Title 47 Part 15C	Code of Federal Regulations Title 47: Telecommunication Part 15: Radio Frequency Devices Subpart C: Intentional Radiators
CFR Title 47 Part 15B	Code of Federal Regulations Title 47: Telecommunication Part 15: Radio Frequency Devices Subpart B: Unintentional Radiators
Industry Canada Spectrum Management & Telecommunications Policy	
RSS-Gen Issue 3:	General Requirements and Information for the Certification of Radiocommunication Equipment
RSS-2247 Issue 1:	Digital Transmission Systems (DTS), Frequency Hopping Systems (FHS) and License-Exempt Local Area Network (LE-LAN) Devices

6.0 FACILITIES AND ACCREDITATIONS

Facility and Accreditation

The facilities used to evaluate this device 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 under Test Firm Registration Number 714830 and Industry Canada under Test Site File Number IC 3874A-1.

7.0 GENERAL INFORMATION

Client Information

Applicant Name	Tekmar Control Systems Ltd.
Applicant Address	5100 Silver Start Road
	Vernon, British Columbia, V1B 3K4
	Canada

DUT Information

Device Identifier(s):	FCC ID: 2AHQR-10850A IC: 21247-10850A
Device Type:	Digital Transmission System (DTS)
Type of Equipment:	Temperature Sensor/Transmitter
Device Model(s) / HVIN:	10850A [Configuration 0A]
Device Marketing Name / PMN:	Wireless Outdoor Sensor Transmitter
Firmware Version ID Number / FVIN:	n/a
Host Marketing Name / HMN:	n/a
Test Sample Serial No.:	T/A Sample - Identical Prototype
Transmit Frequency Range:	915MHz
Number of Channels:	1
Manuf. Max. Rated Output Power:	25dBm (0.33W) Max
Manuf. Max. Rated BW/Data Rate:	n/a
Antenna Gain:	Internal Folded F PCB, -3dBi Max
Modulation:	LoRa: Chirp Spread Spectrum Modulation (CSS)
Mode:	Periodic Burst
Maximum Duty Cycle:	<<1.0% Max, 83ms Maximum Duration Every 10 Minutes
Emission Designator:	764KF1D
DUT Power Source:	Non-Rechargeable Lithium
Deviation(s) from standard/procedure:	None
Modification of DUT:	None

APPENDIX A - Occupied Bandwidth

Test Conditions

Normative Reference	FCC 47 CFR §15.247(a)(2), RSS-247 5.2(1), KDB 558074 (8.1)
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Limits

47 CFR §15.247 RSS-247	The minimum 6dB Bandwidth shall be greater than 500kHz
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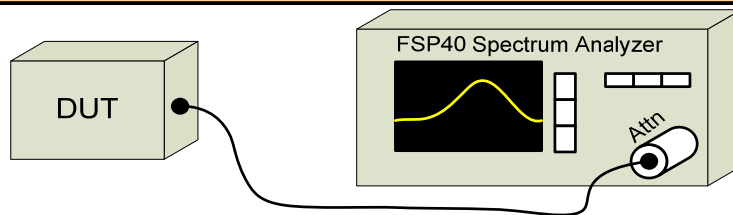
Environmental Conditions (Typical)

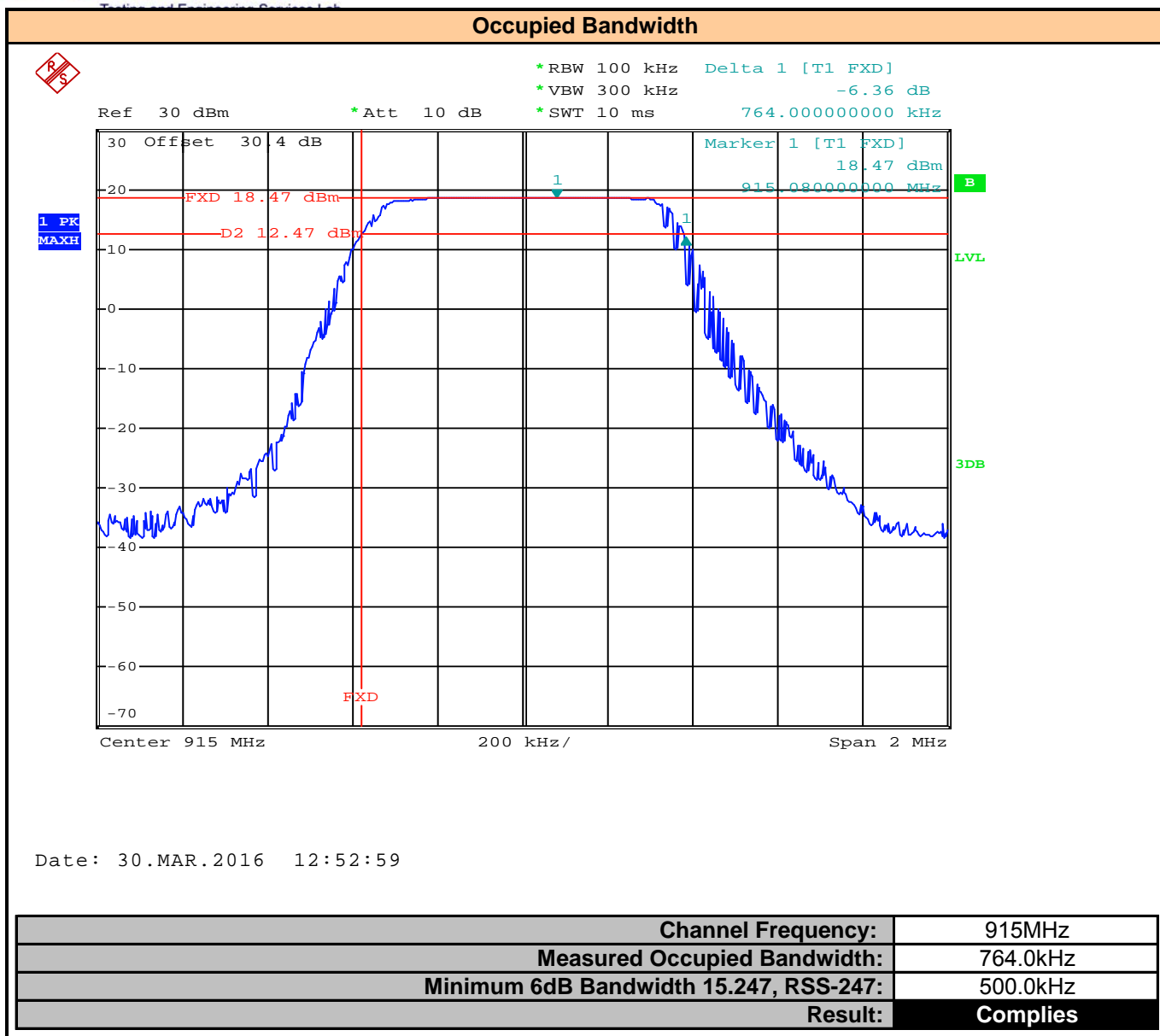
Temperature	25°C
Humidity	<60%
Barometric Pressure	101 +/- 3kPa

Equipment List

Asset Number	Manufacturer	Model Number	Description	Last Calibrated	Calibration Interval	Calibration Due
00241	R&S	FSU40	Spectrum Analyzer	23 Apr 2015	Biennial	23 Apr 2017

Set-Up Drawing





APPENDIX B - Peak Output Power (Conducted)

Test Conditions

Normative Reference	FCC 47 CFR §15.247(b), RSS-247 5.4(2), KDB 558074 (9.1.1)
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Limits

47 CFR §15.247 RSS-247	For systems employing DTS in the band 902-928MHz, the maximum peak conducted output power shall not exceed 1W.
---------------------------	----------------------------------------------------------------------------------------------------------------

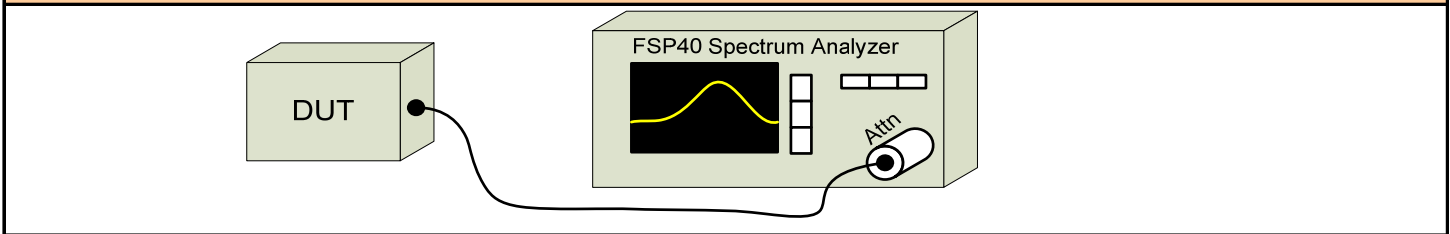
Environmental Conditions (Typical)

Temperature	25°C
Humidity	<60%
Barometric Pressure	101 +/- 3kPa

Equipment List

Asset Number	Manufacturer	Model Number	Description	Last Calibrated	Calibration Interval	Calibration Due
00241	R&S	FSU40	Spectrum Analyzer	23 Apr 2015	Biennial	23 Apr 2017

Set-Up Drawing



Measured Peak Conducted Output Power

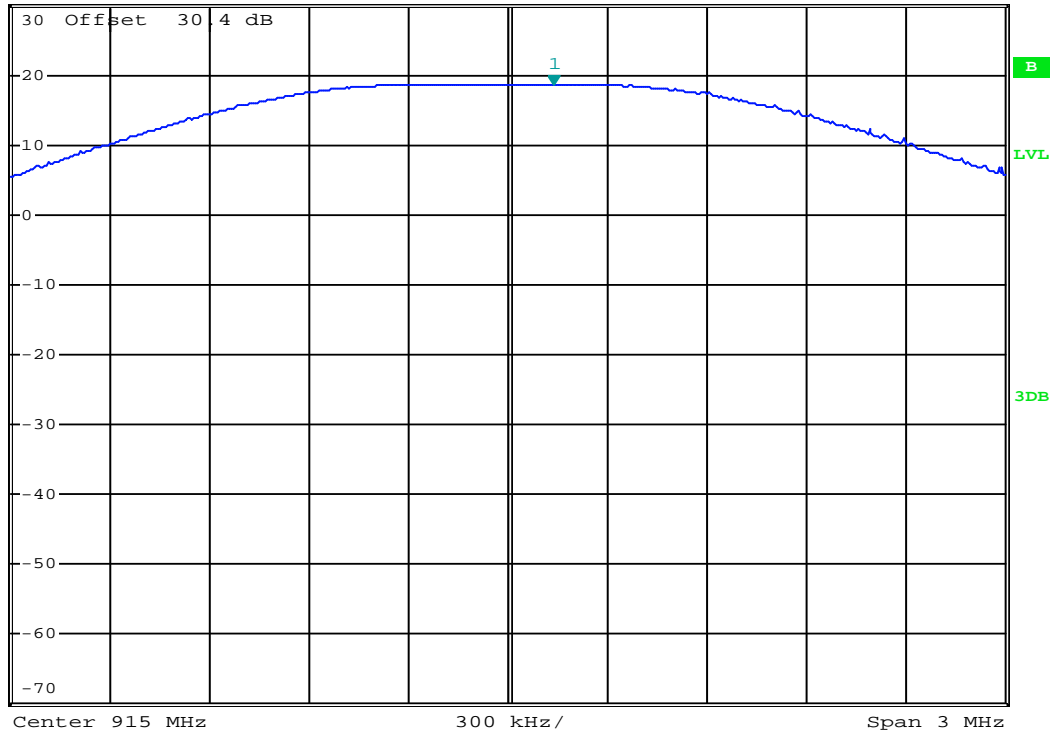


*RBW 1 MHz Marker 1 [T1]
 *VBW 3 MHz 18.57 dBm
 *SWT 10 ms 915.13600000 MHz

Ref 30 dBm

*Att 10 dB

1 PK
MAXH



Date: 30.MAR.2016 13:00:41

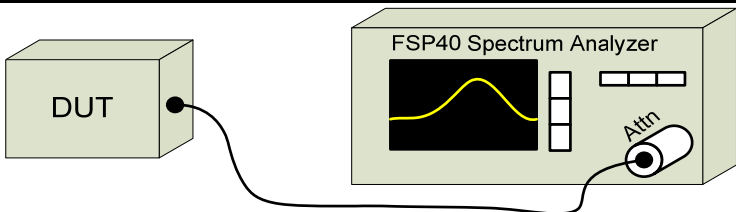
Center Frequency: **915MHz**

Measured Peak Conducted Power: **72mW**

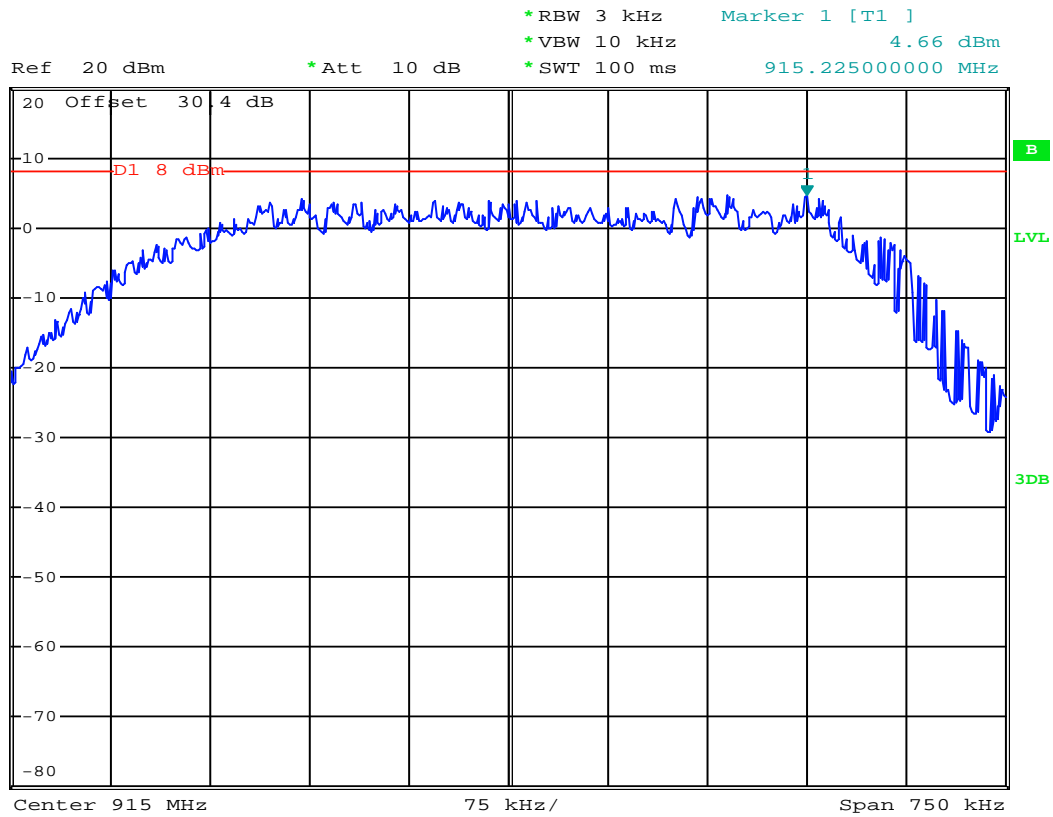
Limit 47CFR 15.247, RSS-247: **1.0W (30dBm)**

Result: **Complies**

APPENDIX C - Peak Power Spectral Density (Conducted)

Test Conditions						
Normative Reference		FCC 47 CFR §15.247(e), RSS-247 5.2(2), KDB 558074 (10.2)				
Limits						
47 CFR §15.247 RSS-247		For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.				
Environmental Conditions (Typical)						
Temperature		25°C				
Humidity		<60%				
Barometric Pressure		101 +/- 3kPa				
Equipment List						
Asset Number	Manufacturer	Model Number	Description	Last Calibrated	Calibration Interval	Calibration Due
00241	R&S	FSU40	Spectrum Analyzer	23 Apr 2015	Biennial	23 Apr 2017
Set-Up Drawing						
						

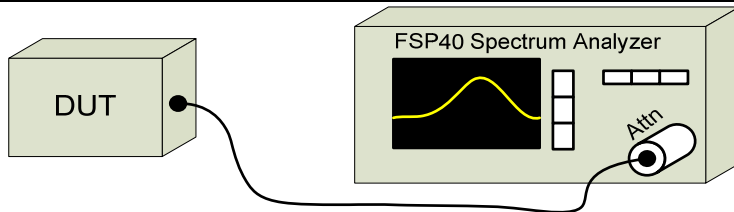
Measured Peak Power Spectral Density



Date: 30.MAR.2016 14:18:06

Center Frequency:	915MHz
Measured Peak Power Spectral Density:	4.66dBm
Limit 47CFR 15.247, RSS-247:	8.0dBm
Result:	Complies

APPENDIX D - Spurious Emissions (Conducted)

Test Conditions						
Normative Reference		FCC 47 CFR §15.247(d), RSS-247 5.5, KDB 558074 (11.1)				
Limits						
47 CFR §15.247		In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.				
RSS-247						
Environmental Conditions (Typical)						
Temperature		25°C				
Humidity		<60%				
Barometric Pressure		101 +/- 3kPa				
Equipment List						
Asset Number	Manufacturer	Model Number	Description	Last Calibrated	Calibration Interval	Calibration Due
00241	R&S	FSU40	Spectrum Analyzer	23 Apr 2015	Biennial	23 Apr 2017
Set-Up Drawing						
						

Measured Conducted Spurious Emissions (Reference Measurement)

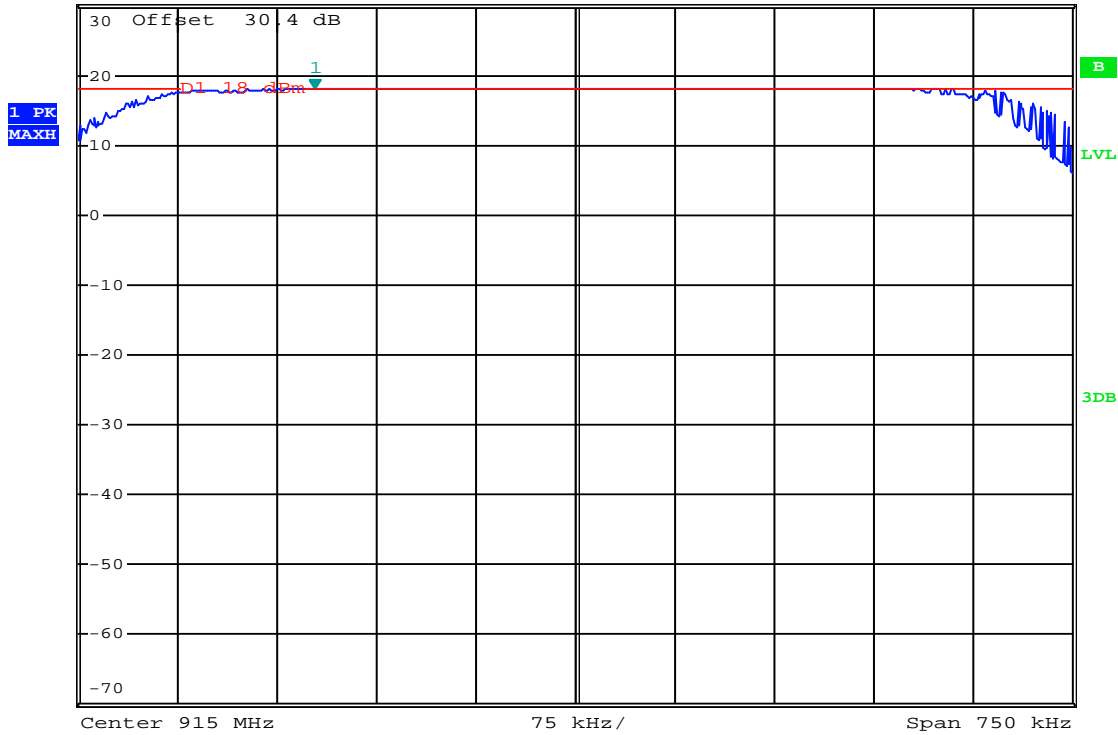


*RBW 100 kHz Marker 1 [T1]
*VBW 300 kHz 18.01 dBm
*SWT 100 ms 914.803500000 MHz

Ref 30 dBm

*Att 10 dB

914.803500000 MHz



Date: 30.MAR.2016 14:45:27

Center Frequency: 915MHz

Reference Measurement: 18dBm

Measured Conducted Spurious Emissions 30MHz - 1.0GHz

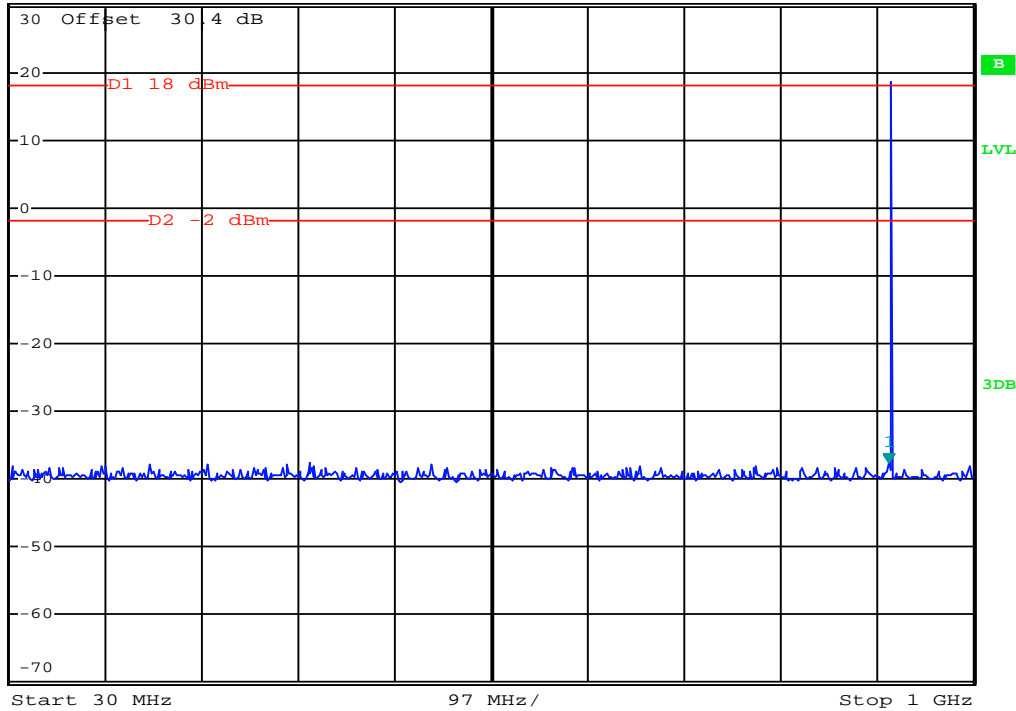


*RBW 100 kHz Marker 1 [T1]
*VBW 300 kHz -37.67 dBm
*SWT 100 ms 914.803500000 MHz

Ref 30 dBm

*Att 10 dB

1 PK
MAXH



Date: 30.MAR.2016 14:47:14

Plot for Reference Only - No Spurious Emissions Detected - Emission Shown is the Fundamental

Frequency Range:	30 - 1000MHz
Reference Measuremnt:	18dBm
Limit 47CFR 15.247, RSS-247:	-2dBm
Result:	Complies

Measured Conducted Spurious Emissions 1 - 10 GHz

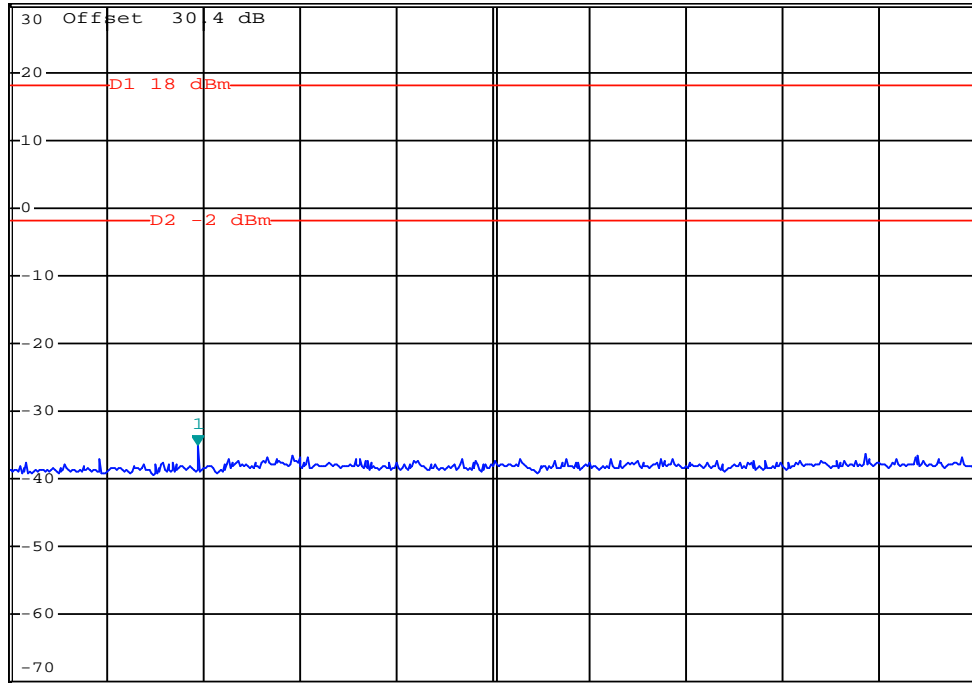


*RBW 100 kHz Marker 1 [T1]
*VBW 300 kHz -34.92 dBm
*SWT 1 s 2.746000000 GHz

Ref 30 dBm

*Att 10 dB

1 PK
MAXH



Start 1 GHz

900 MHz/

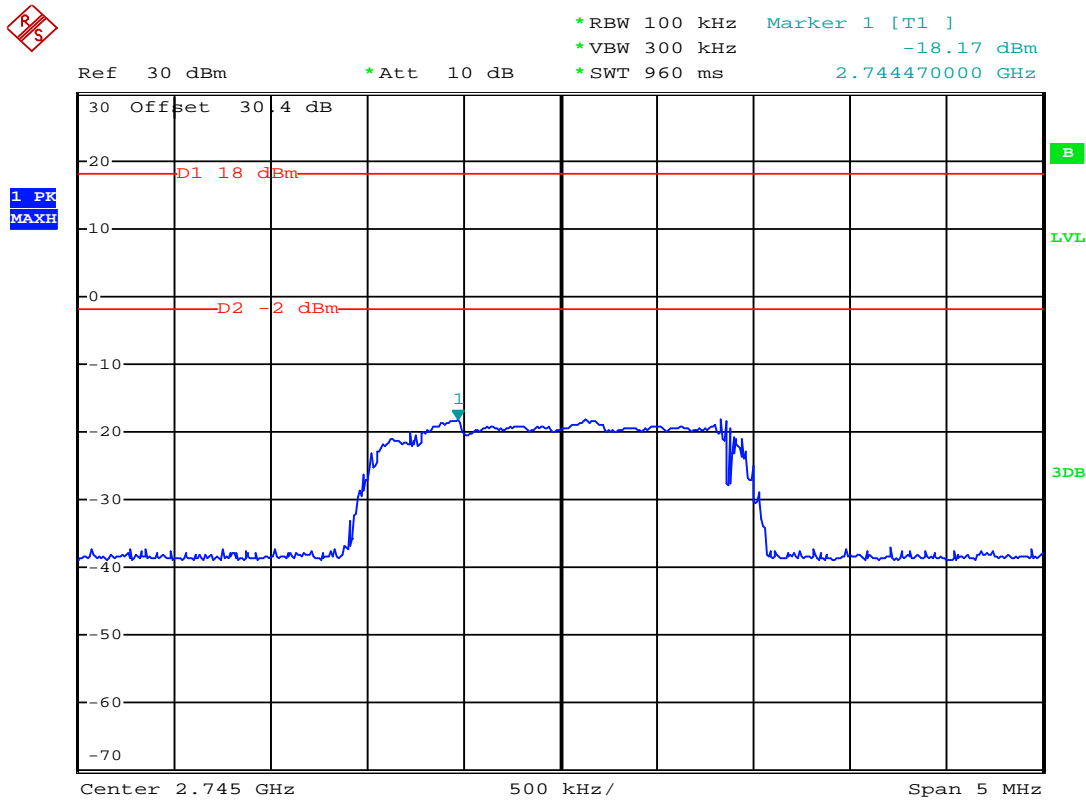
Stop 10 GHz

Date: 30.MAR.2016 14:57:08

Plot for Reference Only - Emission Searched to 10th Harmonic

Frequency Range:	1 - 10GHz
Reference Measuremnt:	18dBm
Limit 47CFR 15.247, RSS-247:	-2dBm
Result:	Complies

Measured Conducted Spurious Emissions 3rd Harmonic



Date: 30.MAR.2016 15:26:03

Evaluation of 3rd Harmonic - No Other Emissions within 20dB of Limit Detected

Center Frequency:	2.745GHz
Reference Measuremnt:	18dBm
Emission Measurement:	-18.2dBm
Limit 47CFR 15.247, RSS-247:	-2dBm
Margin:	16.2dBm
Result:	Complies

APPENDIX E - Band Edge Emissions (Conducted)

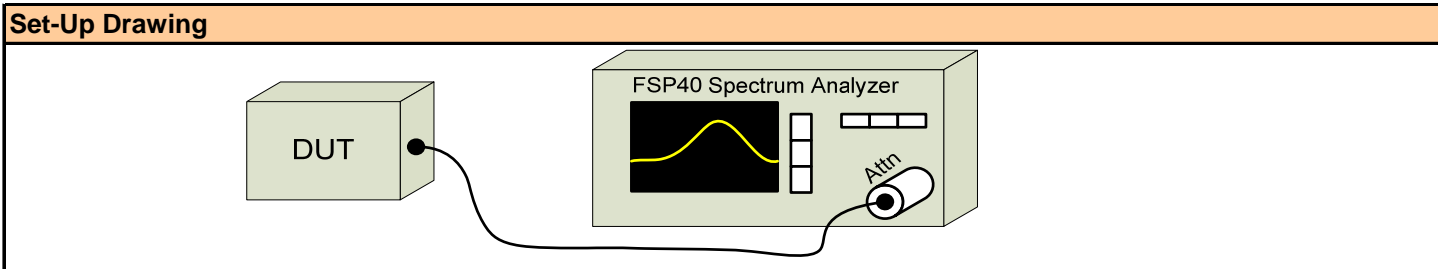
Test Conditions

Normative Reference	FCC 47 CFR §15.247(d), RSS-247 5.5, KDB 558074 (11.1)
----------------------------	-------------------------------------------------------

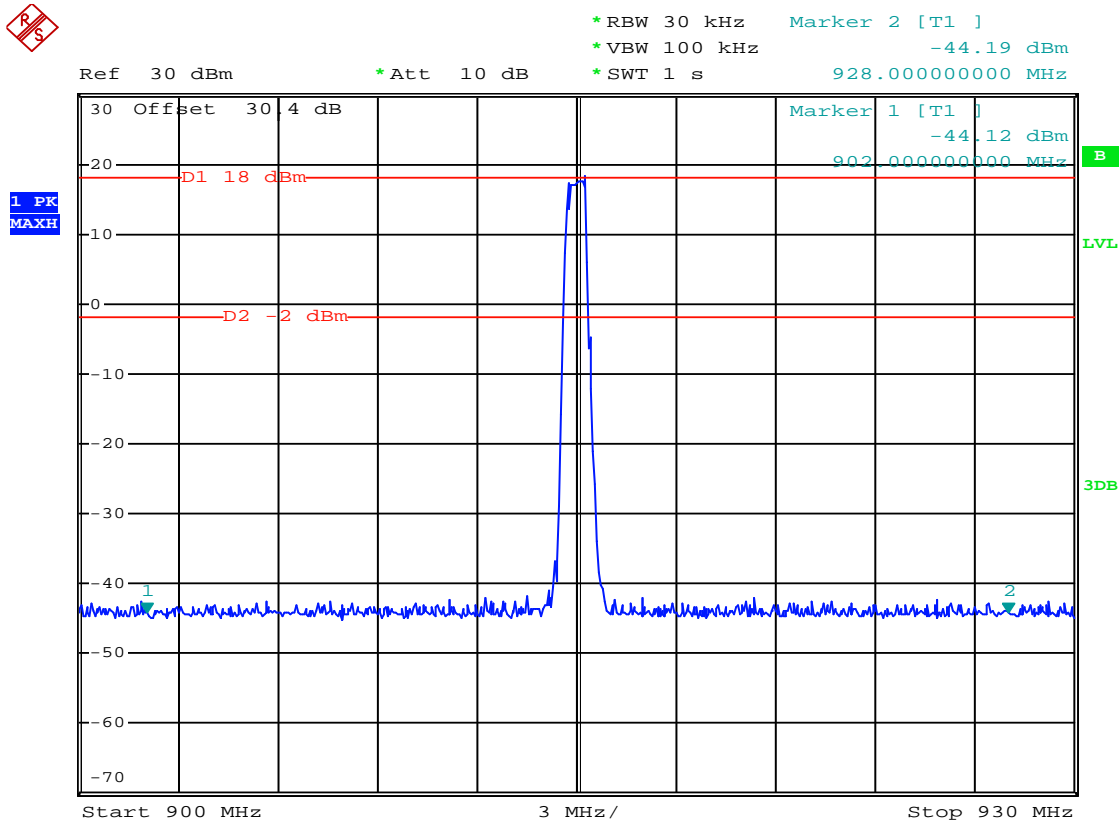
Limits	
47 CFR §15.247	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.
RSS-247	

Environmental Conditions (Typical)	
Temperature	25°C
Humidity	<60%
Barometric Pressure	101 +/- 3kPa

Equipment List						
Asset Number	Manufacturer	Model Number	Description	Last Calibrated	Calibration Interval	Calibration Due
00241	R&S	FSU40	Spectrum Analyzer	23 Apr 2015	Biennial	23 Apr 2017



Measured Conducted Emissions at Band Edge



Date: 30.MAR.2016 16:04:50

**This Device Transmits at 915MHz ONLY. No Emissions within 20dB of Reference Measured
 Marker 1 - 902MHz, Marker 2 - 928MHz**

Frequency Range:	900-930MHz
Reference Measurement:	18dBm
Limit 47CFR 15.247, RSS-247:	-2dBm
Result:	Complies

APPENDIX F - Duty Cycle Correction

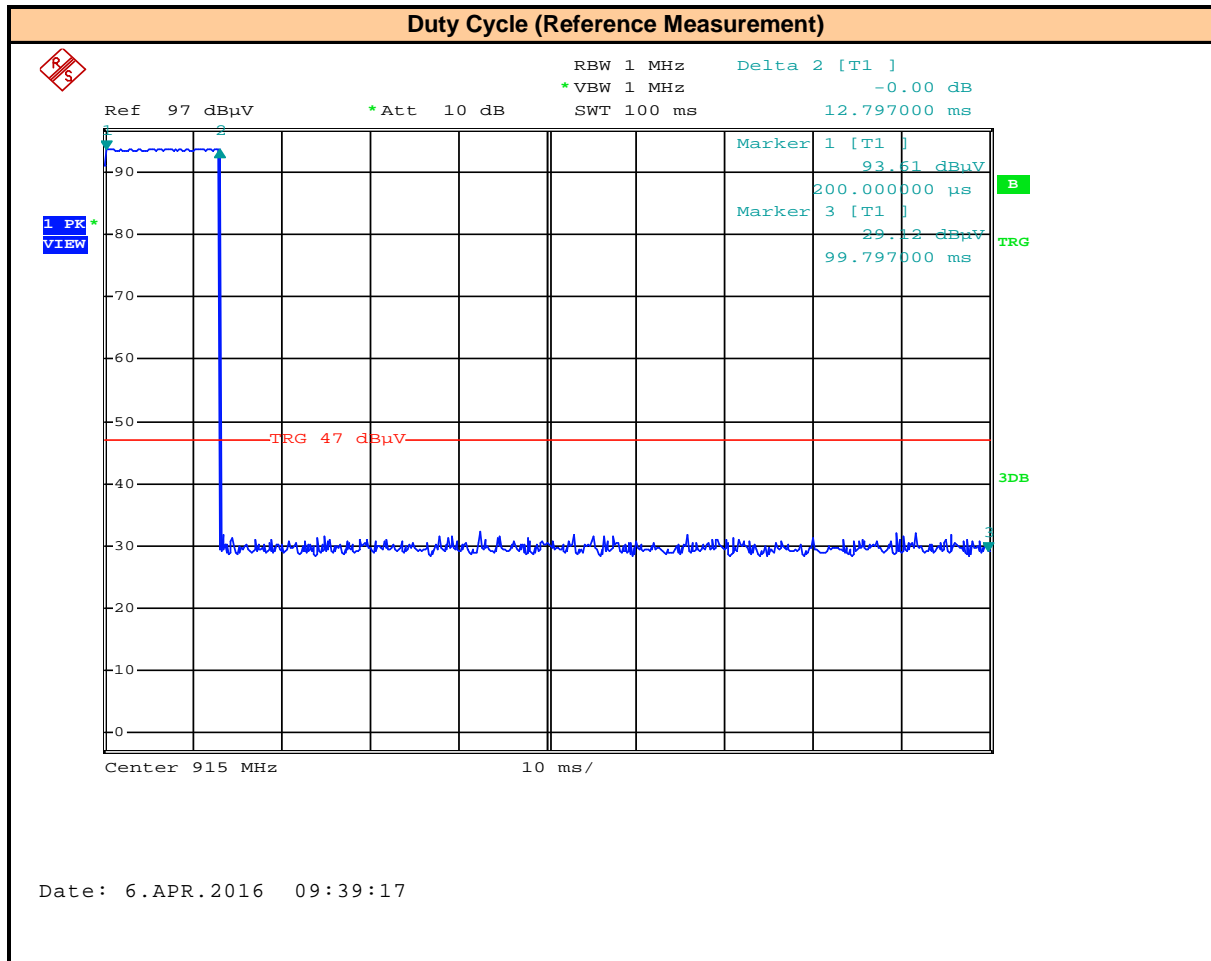
Test Conditions	
Normative Reference	ANSI C63.10 (7.5)
ANSI C63.10	Unless otherwise specified, when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 s (100 ms).

$$\delta(\text{dB}) = 20\log(\approx)$$

Where

δ = Duty Cycle Correction Factor [DC_F](dB)

Δ = Duty Cycle Over 100ms



$$\text{DC}_F = 20\log(12.8/100) = -17.8\text{dB}$$

Note: Normal transmit duty cycle is 1 transmission every 15 minutes

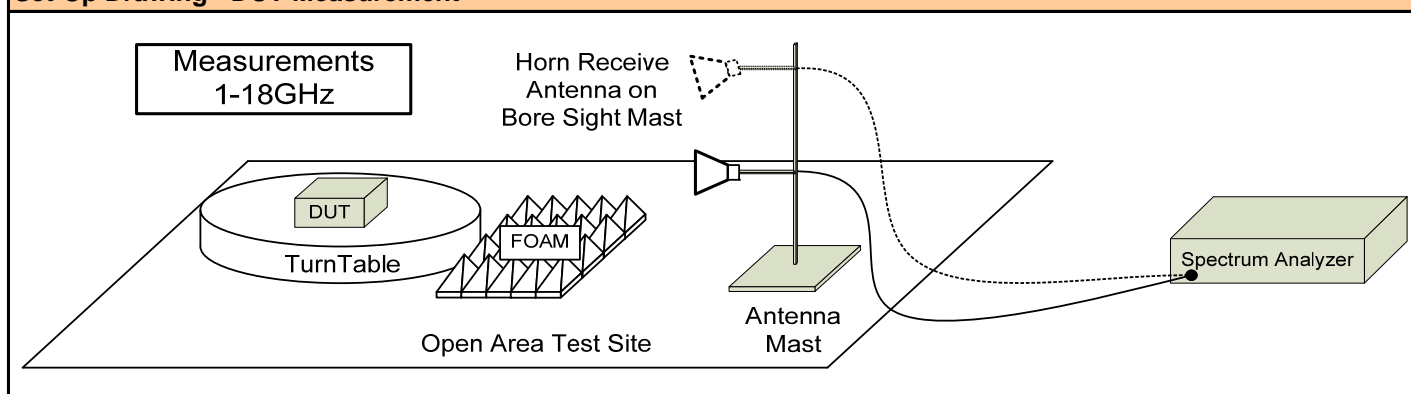
APPENDIX G - Radiated Spurious Emissions

Test Conditions						
Normative Reference	FCC 47 CFR §15.247(d), §15.209(a), RSS-247 5.5, RSS-GEN					
Procedure Reference	ANSI C63.10, ANSI C63.4, KDB 558074					
Limits						
FCC §15.209 RSS-247	Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength level 500uV/m @ 3m					
Environmental Conditions (Typical)						
Temperature	25°C					
Humidity	<60%					
Barometric Pressure	101 +/- 3kPa					
Equipment List						
Asset Number	Manufacturer	Model Number	Description	Last Calibrated	Calibration Interval	Calibration Due
00072	EMCO	2075	Mini-mast	n/a	n/a	n/a
00073	EMCO	2080	Turn Table	n/a	n/a	n/a
00071	EMCO	2090	Multi-Device Controller	n/a	n/a	n/a
00241	R&S	FSU40	Spectrum Analyzer	23 Apr 2015	Biennial	23 Apr 2017
00275	Coaxis	LMR400	25m Cable	COU	n/a	COU
00276	Coaxis	LMR400	4m Cable	COU	n/a	COU
00034	ETS	3115	Double Ridged Guide Horn	2-Dec-15	Triennial	2-Dec-18

CNR: Calibration Not Required

COU: Calibrate On Use

Set-Up Drawing - DUT Measurement



Notes:

The spectrum was searched from the lowest frequency generated in the device to the 10th harmonic of the fundamental.

All detected emissions have been reported.

The DUT was searched on all axis for worst case performance.

Worst case emissions are reported.

Radiated Spurious Emissions (Peak)



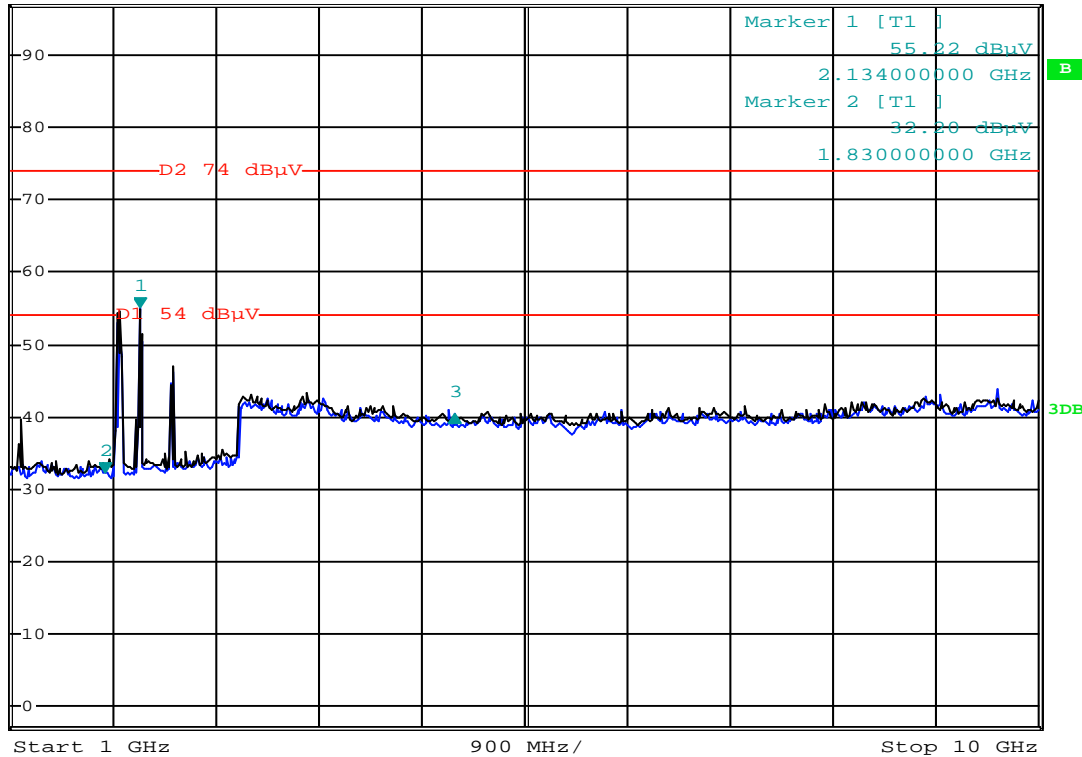
*RBW 1 MHz Delta 3 [T1]
*VBW 1 MHz -14.86 dB
*SWT 200 ms 2.745000000 GHz

Ref 97 dBμV

*Att 10 dB

1 PK
VIEW

2 PK
MAXH



Date: 1.APR.2016 14:46:41

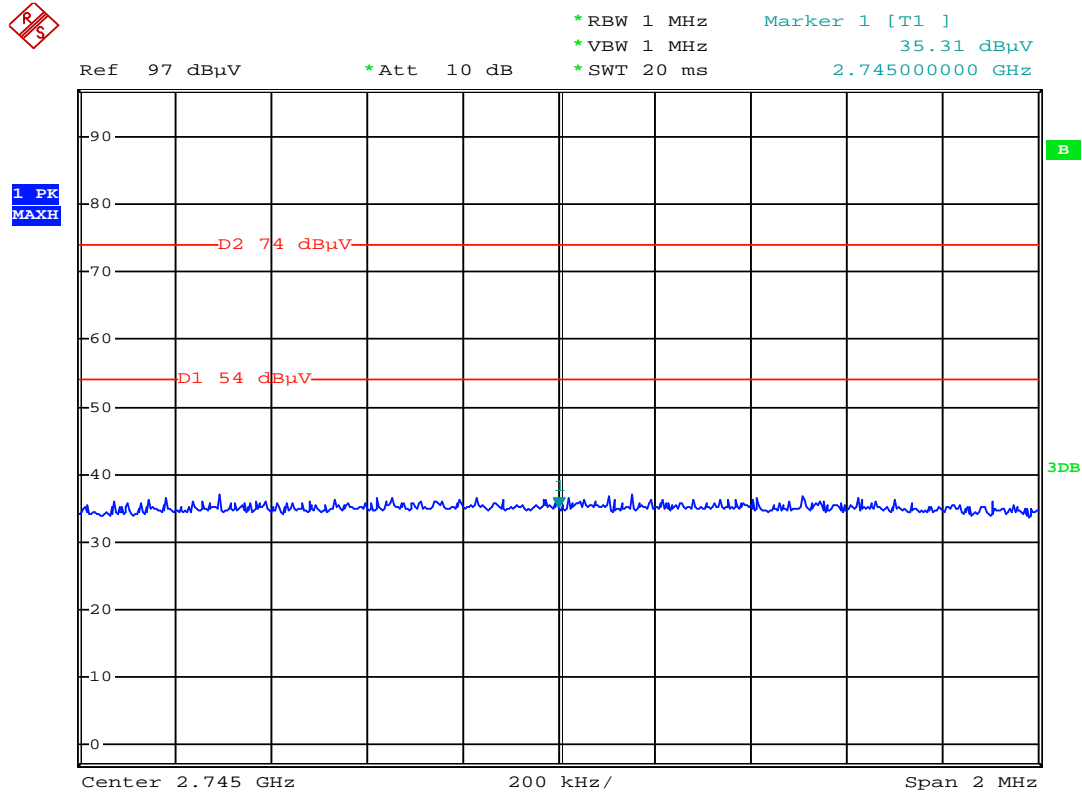
Plot for Reference Only - Emissions Indicated are Ambient

Frequency Range: 1-10GHz

Notes

Worst-case emissions shown
The device was searched to the 10th harmonic of the fundamental (9.15GHz)
Data presented may use a peak detector and compared to quasi-peak limit
All detected emissions have been reported

Radiated Spurious Emissions 3rd Harmonic (Peak)



Date: 1.APR.2016 15:03:30

Frequency (MHz)	Antenna Polarization	Measured Emission @ 3m [E _M] (dBμV)	Antenna Factor [AF] (dB)	Cable Loss [L _C] (dB)	Duty Cycle Correction [DC _F] (dB)	Emission Level @ 3m [E _C] (dBμV/m)	Peak Limit @ 3m [E _L] (dBμV/m)	Margin (dB)
1830	V*	32.2	26.8	4.0	-17.8	45.2	74.0	28.9
1830	H*	32.9	26.8	4.0	-17.8	45.9	74.0	28.2
2745	V	35.3	28.9	5.0	-17.8	51.4	74.0	22.6
2745	H	33.9	28.9	5.0	-17.8	50.0	74.0	24.0
Result:							Complies	

*No emissions found, noise floor measurement

Correction Calculation

$$E_C = E_M + AF + L_C + DC_F$$

$$\text{Margin} = E_L - E_C$$

Data presented may use a peak detector and compared to quasi-peak limit

All detected emissions have been reported

APPENDIX H - Measurement Uncertainty

CISPR 16-4 Measurement Uncertainty (U_{LAB})

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence interval using a coverage factor of $k=2$

30MHz - 200MHz

$$U_{LAB} = 5.14\text{dB} \quad U_{CISPR} = 6.3\text{dB}$$

200MHz - 1000MHz

$$U_{LAB} = 5.90\text{dB} \quad U_{CISPR} = 6.3\text{dB}$$

1GHz - 6GHz

$$U_{LAB} = 4.80\text{dB} \quad U_{CISPR} = 5.2\text{dB}$$

6GHz - 18GHz

$$U_{LAB} = 5.1\text{dB} \quad U_{CISPR} = 5.5\text{dB}$$

If the calculated uncertainty U_{lab} is **less** than U_{CISPR} then:

- | | |
|---|-----------------------------------------------------------------------------------------------------------|
| 1 | Compliance is deemed to occur if NO measured disturbance exceeds the disturbance limit |
| 2 | Non-Compliance is deemed to occur if ANY measured disturbance EXCEEDS the disturbance limit |

If the calculated uncertainty U_{lab} is **greater** than U_{CISPR} then:

- | | |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------|
| 3 | Compliance is deemed to occur if NO measured disturbance, increased by ($U_{lab} - U_{CISPR}$), exceeds the disturbance limit |
| 4 | Non-Compliance is deemed to occur if ANY measured disturbance, increased by ($U_{lab} - U_{CISPR}$), EXCEEDS the disturbance limit |

END OF DOCUMENT