



Timco Engineering, Inc., an IIA Company
 849 NW State Road 45, Newberry, Florida 32669
 (352) 472-5500 / testing@timcoengr.com

Timco Test Report # TR_3827-20_FCC_DTS_2

Revision: 2

Issue Date: October 29, 2020

Final Test Date: October 21, 2020



Test Report- FCC PART 15.247 / DTS
Prepared For: TANDD CORPORATION

Approved for Release By:

Signature: Bruno Clavier

Name & Title: Bruno Clavier, General Manager

Date of Signature

(YYYY-MM-DD): 2020-10-29

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1 Applicant Information

Applicant: TANDD Corporation
Address: 817-1-Shimadachi
Matsumoto City, Nagano, Japan 390-0852

Contact: Akemo Oana
Telephone: 81-263-40-0131
Email address: oana@tandd.co.jp

1.1 Test Result Summary

The following test procedure and guidance were used for measuring Digital Transmission System (DTS); FCC KDB 558074 D01 DTS Measurement Guidance and ANSI C63.10-2013. Full test results are available in this report.

No additions to the test methods were needed. There were no deviations, or exclusions from the test methods. No test results are from external providers or from the customer. The test results relate only to the items tested. Timco does not offer opinions and interpretations, only a pass/fail statement.



The Following is for Test item FCC ID: SRD10100

FCC Clauses	Description of the requirements	Result (Pass, Fail or N/A)
Applicable Clauses from Part 2 or KDB		
KDB 558074 D01	Duty Cycle	
KDB 558074 D01	99 % Bandwidth	for reporting only
KDB 558074 D01	Band-edge measurements	Pass
Applicable Clauses from Part 15.247		
15.247 (a) (1)	FHSS (i,ii,iii)	N/A
15.247 (a) (2)	6dB Bandwidth	Pass
15.247 (b) (1)	FHSS conducted output power for 2.400-2483.5 MHz	N/A
15.247 (b) (2)	FHSS conducted output power for 902-928 MHz	N/A
15.247 (b) (3)	DTS conducted output power	Pass
15.247 (b) (4)	Conducted output power >6dBi	Pass
15.247 (c) (1)	Ant Gain >6dBi Fixed PtP	
15.247 (c) (2)	Ant Gain >6dBi MIMO	
15.247 (d) / 15.215 (b)	Spurious Emissions (Out of Band) Emissions in nonrestricted frequency bands	Pass
15.247 (e)	Power Spectral Density (PSD)	Pass
15.247 (f)	Hybrid System requirements	
15.247 (g)	FHSS System requirements	N/A
15.247 (h)	FHSS spectrum sensing	N/A
Applicable Clauses from Part 2 and Part 15 Subpart C		
15.203	Antenna requirements	
15.205	Restricted bands of operation	
15.207	AC Power Conducted Emissions	N/A
15.209	Radiated Emissions	
15.211	Tunnel Radio Systems	N/A
15.212 (a)	Single Modular Transmitter	
15.212 (b)	Limited Modular Transmitter	
15.213	Cable Locating Equipment	N/A



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2 Location of Testing

Test Laboratory

Timco Engineering Inc. is a subsidiary of Industrial Inspection & Analysis, Inc. (“IIA”).
Testing was performed at Timco’s permanent laboratory located at 849 NW State Road 45,
Newberry, Florida 32669

FCC test firm # 578780
FCC Designation # US1070
FCC site registration is under A2LA certificate # 0955.01
ISED Canada test site registration # 2056A
EU Notified Body # 1177
For all designations see A2LA scope # 0955.01

2.1 Testing was performed, reviewed by:

Dates of Testing: OCT 21, 2020

Signature: _____

Sr. EMC Engineer
EMC-003838-NE



Name & Title: Tim Royer, EMC Engineer

Date of Signature

(YYYY-MM-DD): 2020-10-29

3 Test Sample(s) (EUT/DUT)

The test sample was received: October 21, 2020

3.1 Description of the EUT

A description as well as unambiguous identification of the EUT(s) tested. Where more than one sample is required for technical reasons (such as the use of connected units for the purpose of conducted output power testing where the product units will have integral antennas), each specific test shall identify which unit was tested.

Identification

FCC ID:	SRD10100
Brief Description	Data Logger Base Unit
Type of Modular	NA
Model(s) #	RTR500BW, RTR500BC
Trade name	TANDD
Firmware version	NA
Software version	NA
Serial Number	NA

Technical Characteristics

Technology	BLE
Frequency Range	902-928
RF O/P Power (Max.)	7.2 dBm, 0.005248 Watts
Modulation	FSK
Bandwidth & Emission Class	552.55 kHz
Number of Channels	21
Duty Cycle	10%
Antenna Type	External
Antenna Gain (for each ant.)	2.15 dBi
Antenna Connector	N/A
Voltage Rating (AC or Batt.)	Batt

Antenna Characteristics

Frequency Range	Mode / BW	Ant Gain 1	Ant Gain 2
902-928		2.15 dBi	



3.2 Configuration of EUT

Test Modes

Band	Mode	BW (nominal)	Modulation	Number of Ant.
902-928	1		FSK	1

DTS	Test Frequencies	Number of Ant.
	902.94, 915.6, 927.13 MHz	1

Operating conditions during Testing:

No modifications of the device under test (including firmware, specific software settings, and input/output signal levels to the EUT).

Peripherals used during Testing:

No peripherals used.

3.3 Test Setup of EUT

Equipment, antenna, and cable arrangement. The setup of the equipment and cable or wire placement on the test site that produces the highest radiated and the highest ac power-line conducted emissions shall be shown clearly and described. Information on the orientation of portable equipment during testing shall be included. Drawings or photographs may be used for this purpose.

Test Setups are included in the test report.

4 Test methods & Applicable Regulatory Limits

Test methods/Standards/Guidance:

Test procedures and guidance for measuring Digital Transmission System (DTS) are provided in the FCC KDB 558074 D01 DTS Measurement Guidance and in Clause 11 of ANSI C63.10-2013.

- 1) ANSI C63.10-2013;
- 2) FCC KDB 558074 D01

Limits and Regulatory Limits:

- 1) FCC CFR 47 Part 15.247

5 Measurement Uncertainty

Parameter	Uncertainty (dB)
Conducted Emissions	1.42
Radiated Emissions (30 – 200 MHz)	5.49
Radiated Emissions (200 – 1000 MHz)	5.79
Radiated Emissions (1 GHz – 18 GHz)	4.37
The uncertainties provided in this table represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of K=2.	

6 Environmental Conditions

Temperature & Humidity

Measurements performed at the test site did not exceed the following:

TEMPERATURE	23 C +/- 5%
HUMIDITY	55% +/- 5%
BARAMETRIC PRESSURE	30.05 inHg

Note: Specific environmental conditions that are applicable to a specific test are available in the test result section.

7 List of Test Equipment and Test Facility

The test equipment used identified by type, manufacturer, serial number, or other identification and the date on which the next calibration or service check is due.



Description of the firmware or software used to operate EUT for testing purposes.

A complete list of all test equipment used shall be included with the test report. The manufacturer's model and serial numbers, and date of last calibration, and calibration interval shall be included. Measurement cable loss, measuring instrument bandwidth and detector function, video bandwidth, if appropriate, and antenna factors shall also be included where applicable.

List of Test Equipment

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Antenna: Active Loop	ETS-Lindgren	6502	62529	12/11/2017	12/11/2020
Antenna: Biconical 1057	Eaton	94455-1	1057	12/13/2017	12/13/2020
Antenna: Log-Periodic 1122	Electro-Metrics	LPA-25	1122	10/26/2017	10/26/2020
CHAMBER	Panashield	3M	N/A	3/15/2019	3/15/2021
EMI Test Receiver R & S ESU 40 Chamber	Rohde & Schwarz	ESU 40	100320	08/28/18	08/28/2021
Software: Field Strength Program	Timco	N/A	Version 4.10.7.0	N/A	N/A
Antenna: Double-Ridged Horn/ETS Horn 2	ETS-Lindgren	3117	41534	9/1/2017	9/1/2020
Bore-sight Antenna Positioning Tower	Sunol Sciences	TLT2	N/A	N/A	N/A
Coaxial Cable #103 - KMKM-0180-01 Aqua	Micro-Coax	UFB142A-0-0720-200200	225363-002 (#103)	4/12/2019	4/12/2021
Coaxial Cable - Chamber 3 cable set (Primary)	Micro-Coax	Chamber 3 cable set (Primary)	KMKM-0244-01 KMKM-0670-00 KFKF-0198-01	4/12/2019	4/12/2021
Band Reject Filter 2.4 GHz	Micro-Tronics	BRM50702-02	0	4/12/2019	4/12/2021
Pre-amp	RF-LAMBDA	RLNA00M45GA	N/A	2/27/2019	2/27/2021
Antenna: Double-Ridged Horn 18-40 GHz	EMCO	3116	9011-2145	12/8/2017	12/8/2020
Attenuator SMA 30dB 5W DC-18G	Pasternack	PE7013-30	#23	11/19/2017	11/19/2020
Test Software	Rohde & Schwarz	RSCCommander	18e	17-Jun-2019	N/A



8 Test Results

The results of the test are usually indicated in the form of tables, spectrum analyzer plots, charts, sample calculations, as appropriate for each test procedure.

A description and/or a block diagram of the test setup is usually provided.

The measurement results, along with the appropriate limits for comparison, may be presented in tabular or graphical form. In addition, any variation in the measurement environment may be reported if applicable (e.g., a significant change of temperature that could affect the cable loss and amplifier response).

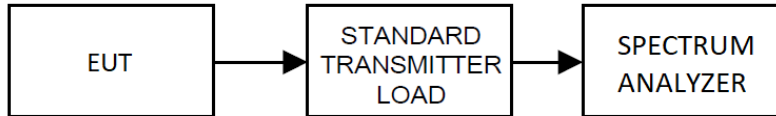
Units of measurement

Unless noted otherwise in the referenced standard, the measurements of **ac power-line conducted emissions and conducted power output** will be reported in units of dB μ V. Unless noted otherwise in the referenced standard, the measurements of **radiated emissions** will be reported in units of decibels, referenced to one microvolt per meter (dB μ V/m) for electric fields, or to one ampere per meter (dBA/m) for magnetic fields, at the distance specified in the appropriate standards or requirements. The measurements of antenna-conducted power for receivers may be reported in units of dB μ V if the impedance of the measuring instrument is also reported. Otherwise, antenna-conducted power will be reported in units of decibels referenced to one milliwatt (dBm). All formulas for data conversions and conversion factors, if used, will be included in this measurement report.

8.1 99% Occupied Bandwidth

Requirement from FCC KDB 558074 D01 and test procedure from ANSI C63.10-2013 section 6.9.3

Setup



99% BW Test Results

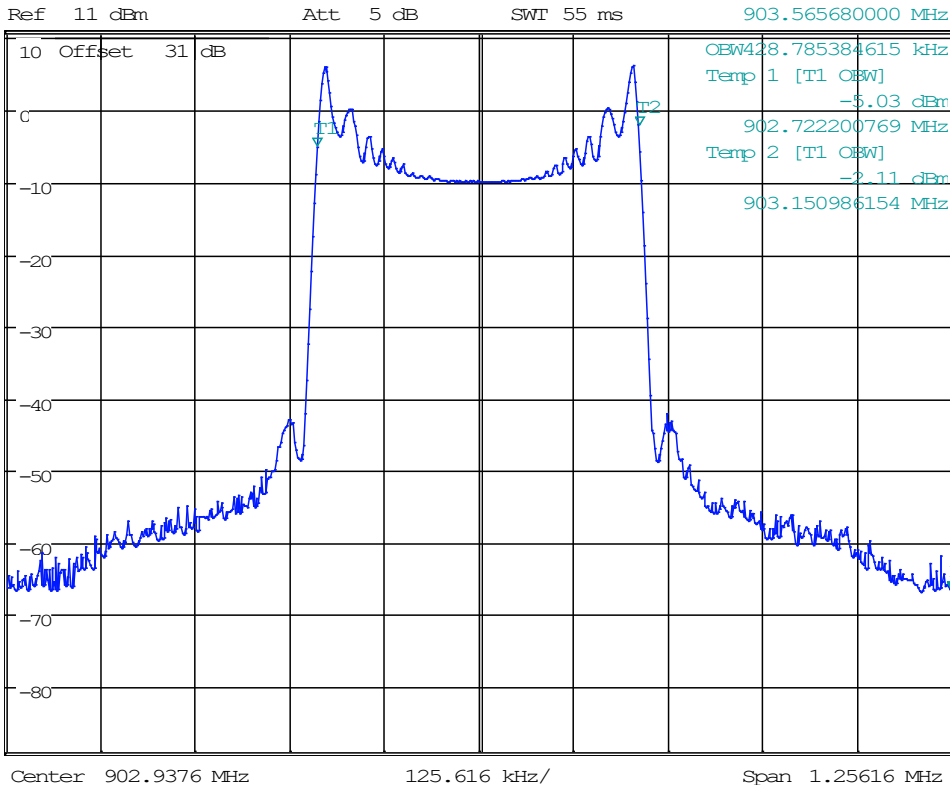
Tuned Frequency (MHz)	99% BW (kHz)
902.94	428.78
915.6	427.32
927.13	426.77

99% Occupied Bandwidth Test Data / Spectrum Plots

99% BW
902.9376 MHz



* REW 10 kHz Marker 1 [T1]
 * VBW 30 kHz -66.57 dBm
 SWI 55 ms 903.565680000 MHz



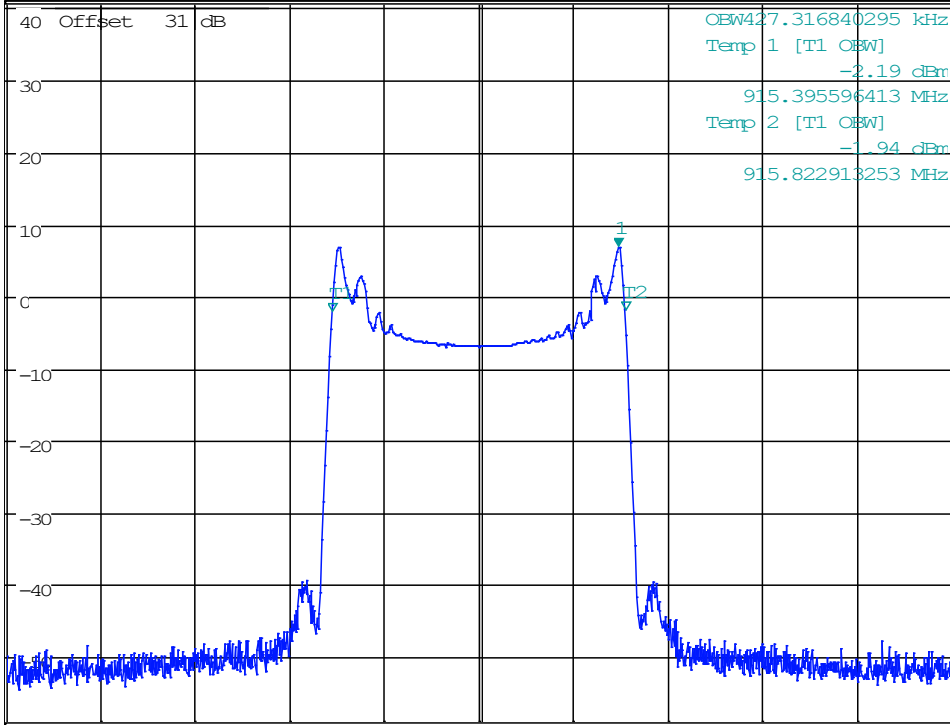
Date: 21.OCT.2020 12:52:09

99% BW
915.6 MHz



*REW 10 kHz Marker 1 [T1]
 *VBW 30 kHz 6.87 dBm
 SWI 60 ms 915.813938909 MHz

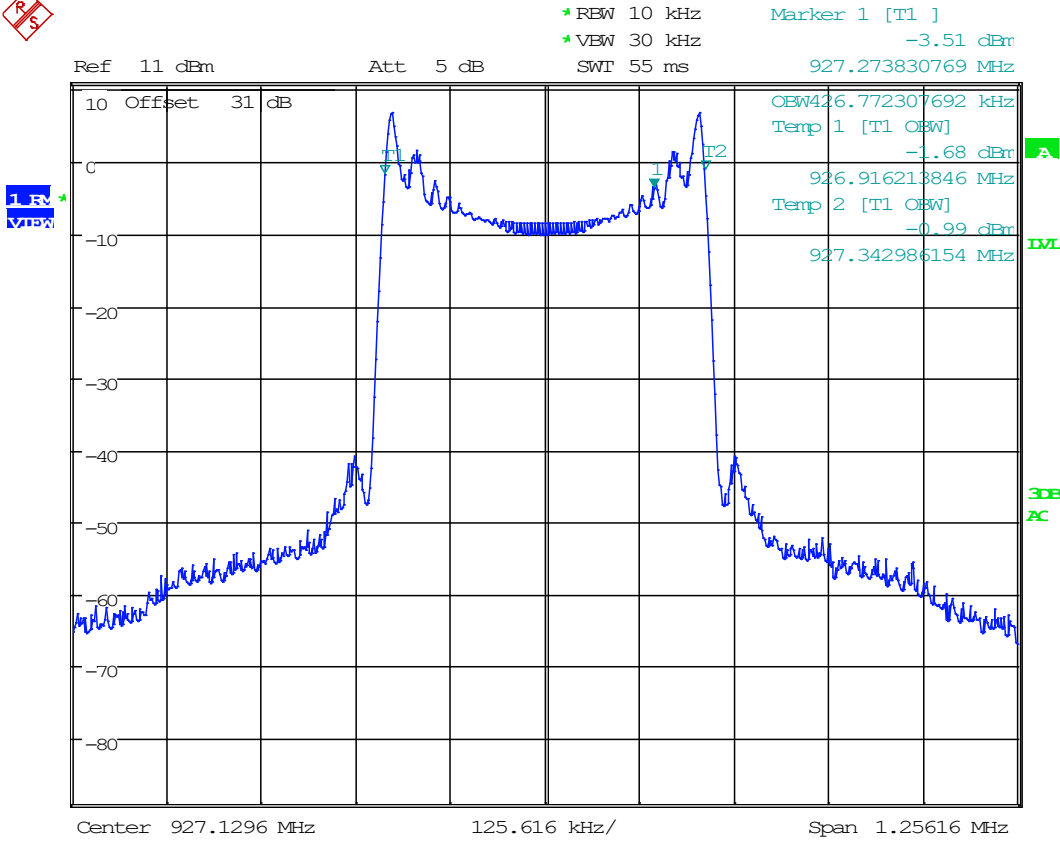
Ref 41 dBm *Att 10 dB



Center 915.6096 MHz 137.9287636 kHz/ Span 1.379287636 MHz

Date: 21.OCT.2020 12:43:22

99% BW
LoRa at 927.13 MHz

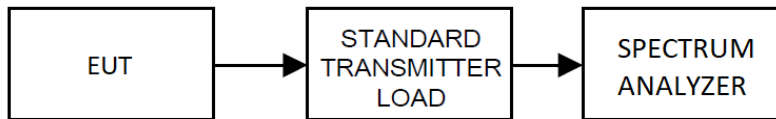


Date: 21.OCT.2020 12:51:29

8.2 6dB Bandwidth (DTS BW)

Limits from FCC Part 15.247 (a) (2) and test procedure from ANSI C63.10-2013 section 11.8

Setup



6dB BW Results

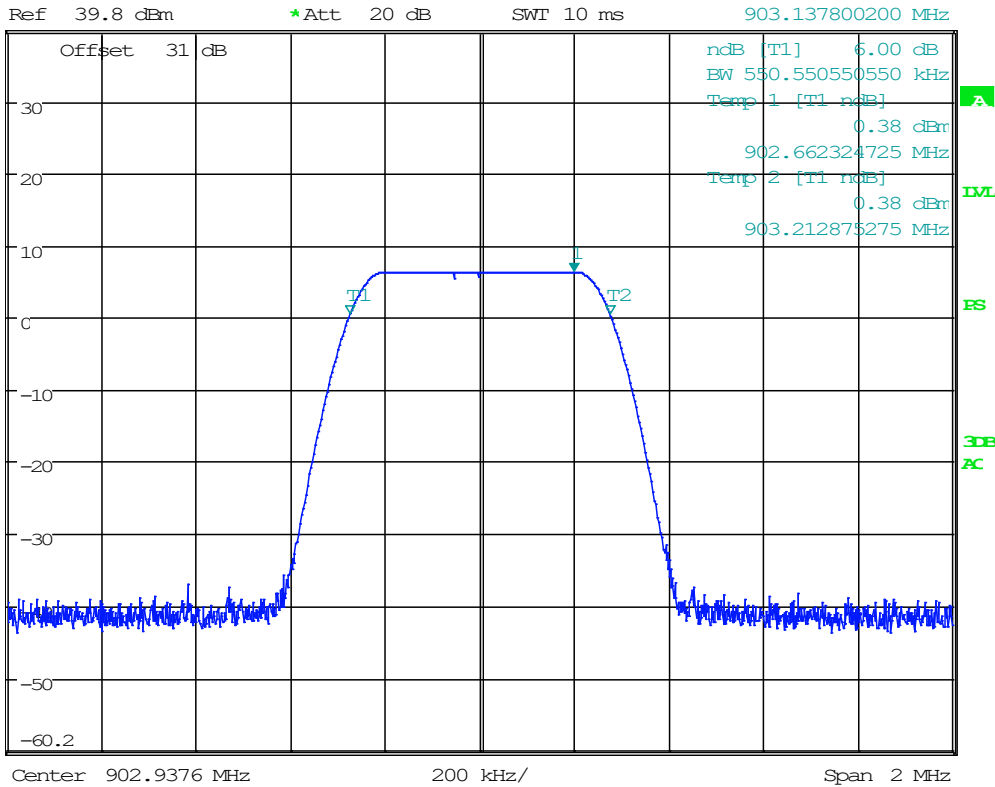
Tuned Frequency (MHz)	6dB Bandwidth (DTS BW) (kHz)
902.94	550.55
915.6	550.55
927.13	550.55

6dB BW Test Data / Spectrum Plots

6dB Bandwidth (DTS BW) 902.94 MHz



*RBW 100 kHz Marker 1 [T1]
 VBW 300 kHz 6.35 dBm
 SWI 10 ms 903.137800200 MHz



Date: 21.OCT.2020 12:52:59

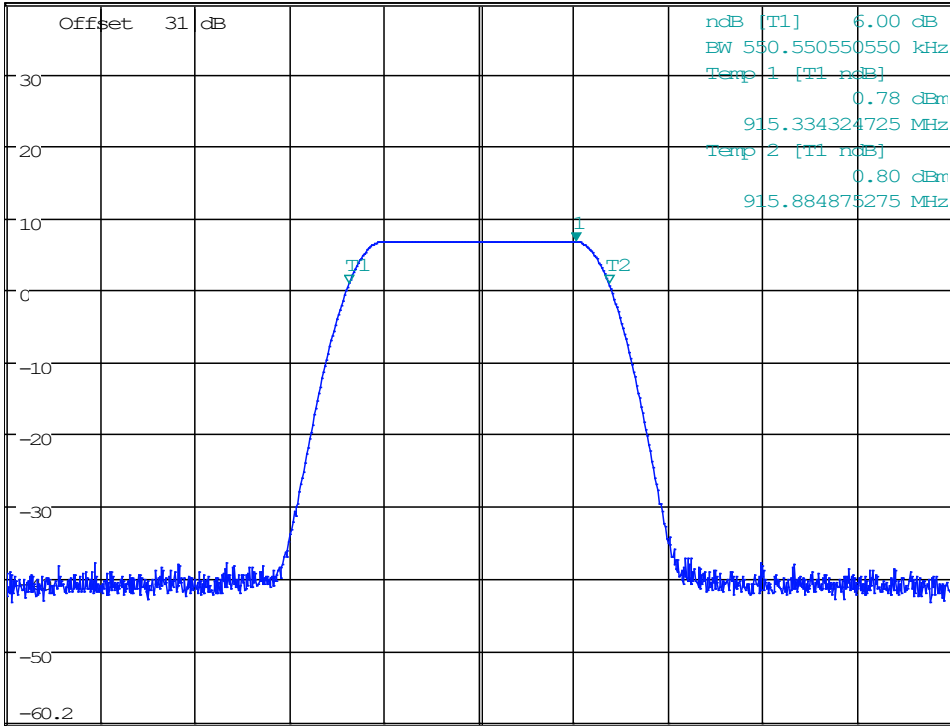
6dB Bandwidth (DTS BW)
915.6 MHz



*REW 100 kHz Marker 1 [T1]
 VEW 300 kHz 6.75 dBm
 SWF 10 ms 915.813804204 MHz

Ref 39.8 dBm *Att 20 dB

1.0k
 V/div



Center 915.6096 MHz 200 kHz/ Span 2 MHz

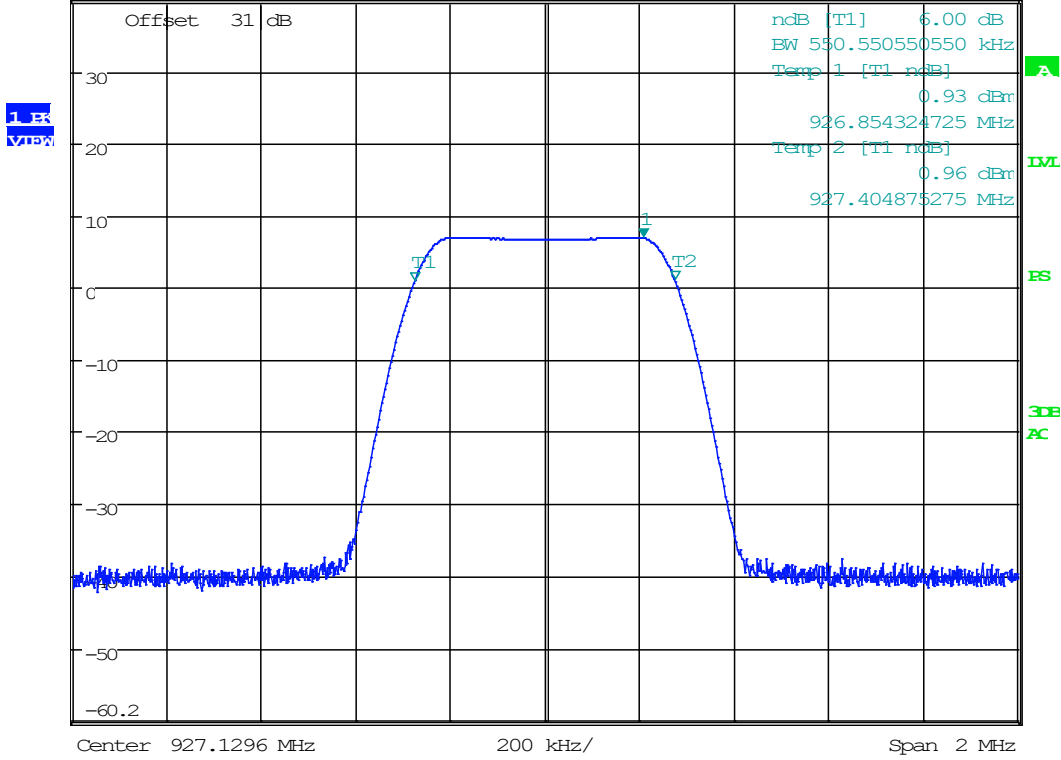
Date: 21.OCT.2020 12:53:31

6dB Bandwidth (DTS BW)
927.13 MHz



*REW 100 kHz Marker 1 [T1]
 VEW 300 kHz 6.88 dBm
 SWI 10 ms 927.336807207 MHz

Ref 39.8 dBm *Att 20 dB

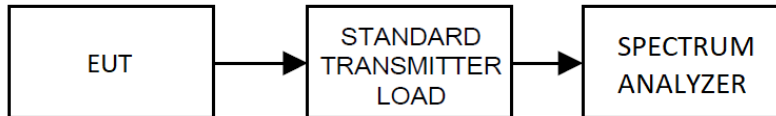


Date: 21.OCT.2020 12:55:01

8.3 DTS conducted output power

Limits from FCC Part 15.247 (b) (3) and test procedure from ANSI C63.10-2013 section 11.9

Setup



Conducted Output Power Test Results

Tuned Frequency (MHz)	Power Output (dBm)
902.94	6.65
915.6	7.04
927.13	7.18

- **MAXIMUM Conducted Output Power = 7.18 dBm**

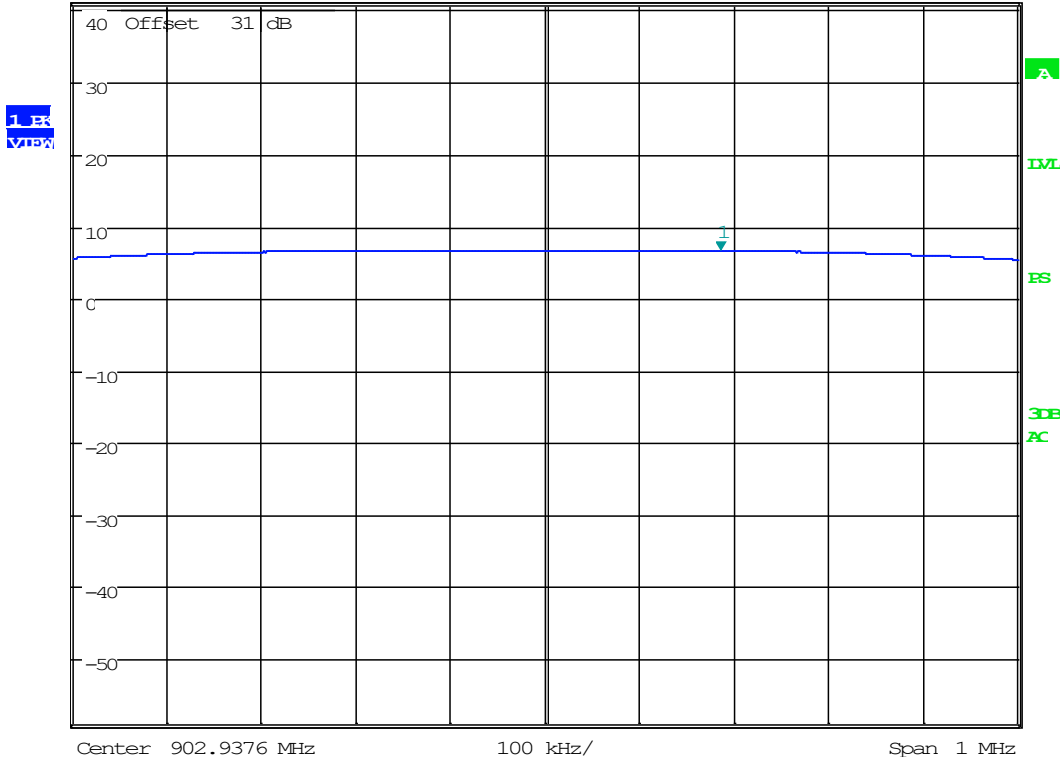
Conducted Output Power Test Data / Spectrum Plots

Conducted Output Power 902.94 MHz



*RBW 1 MHz Marker 1 [T1]
 VEW 3 MHz 6.65 dBm
 SWI 10 ms 903.124286687 MHz

Ref 41 dBm *Att 10 dB



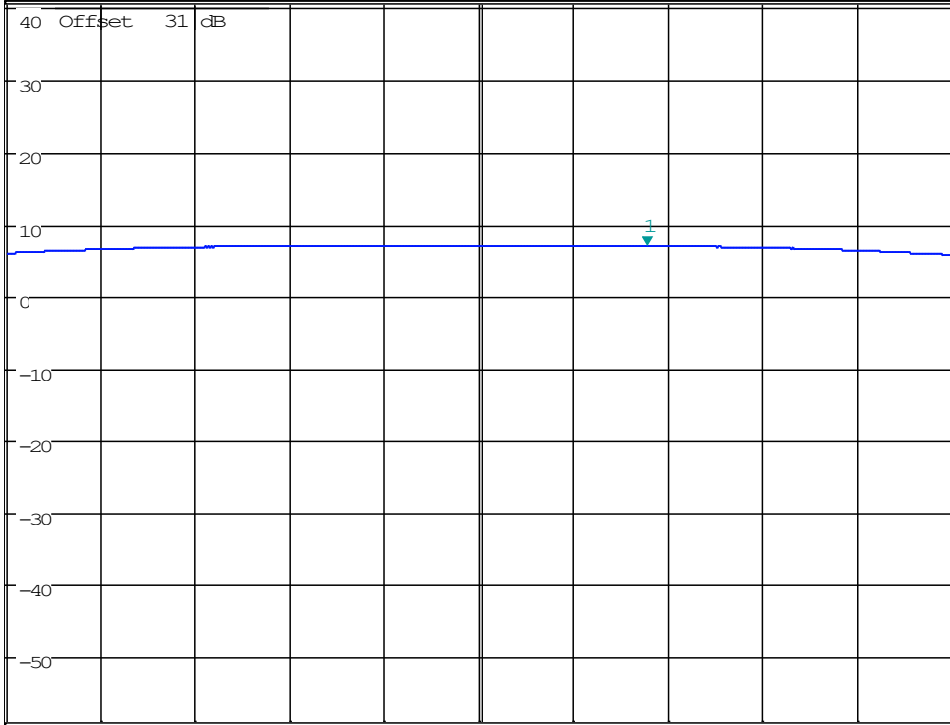
Date: 21.OCT.2020 12:41:30

Conducted Output Power 915.6 MHz



*REW 1 MHz Marker 1 [T1]
 VEW 3 MHz 7.04 dBm
 SWI 10 ms 915.788278679 MHz

Ref 41 dBm *Att 10 dB



Center 915.6096 MHz 100 kHz/ Span 1 MHz

Date: 21.OCT.2020 12:41:51



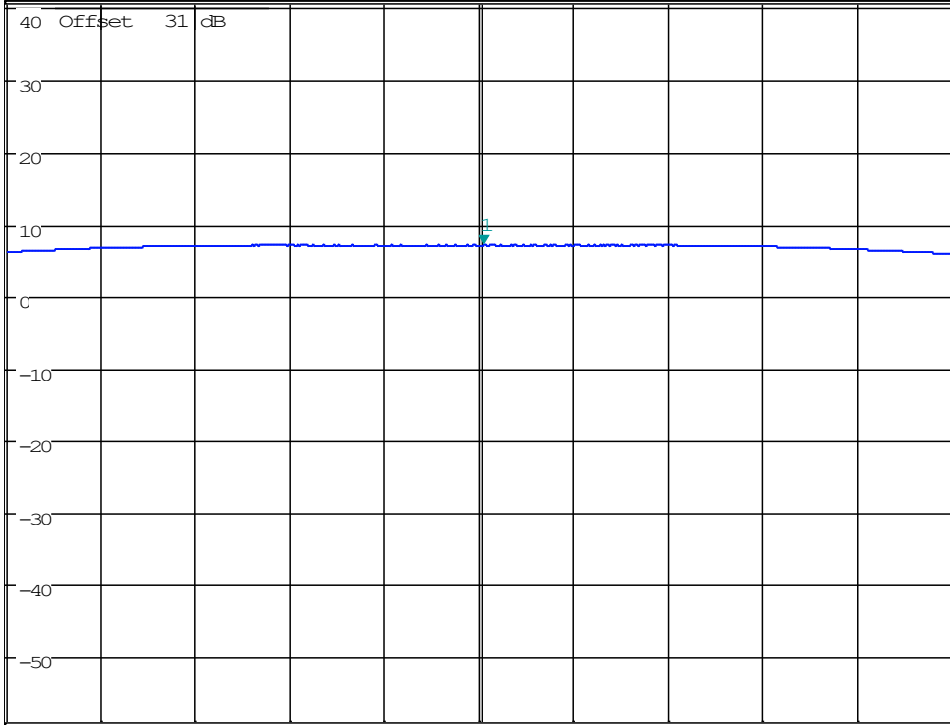
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Conducted Output Power 927.13 MHz



*REW 1 MHz Marker 1 [T1]
VEW 3 MHz 7.18 dBm
SWI 10 ms 927.134605005 MHz

Ref 41 dBm *Att 10 dB



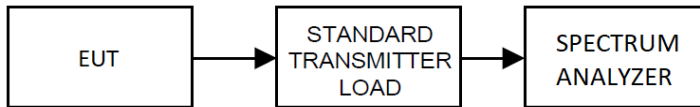
Center 927.1296 MHz 100 kHz/ Span 1 MHz

Date: 21.OCT.2020 12:40:57

8.4 Power Spectral Density (PSD)

Limits from FCC Part 15.247 (e) and test procedure from ANSI C63.10-2013 section 11.10

Setup



PSD Test Results

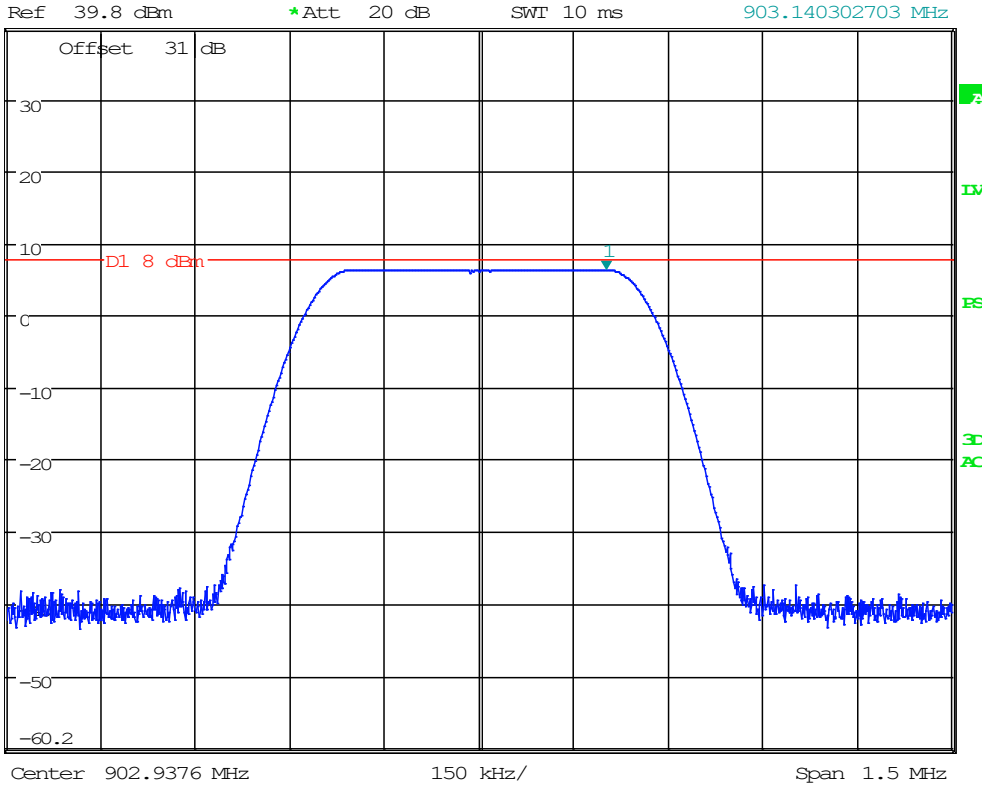
Tuned Frequency (MHz)	PSD Level (dBm)
902.94	6.32
915.6	6.73
927.13	6.86

Power Spectral Density (PSD) Test Data / Spectrum Plots

PSD 902.94 MHz



*REW 100 kHz Marker 1 [T1]
VEW 300 kHz 6.32 dBm
SWI 10 ms 903.140302703 MHz



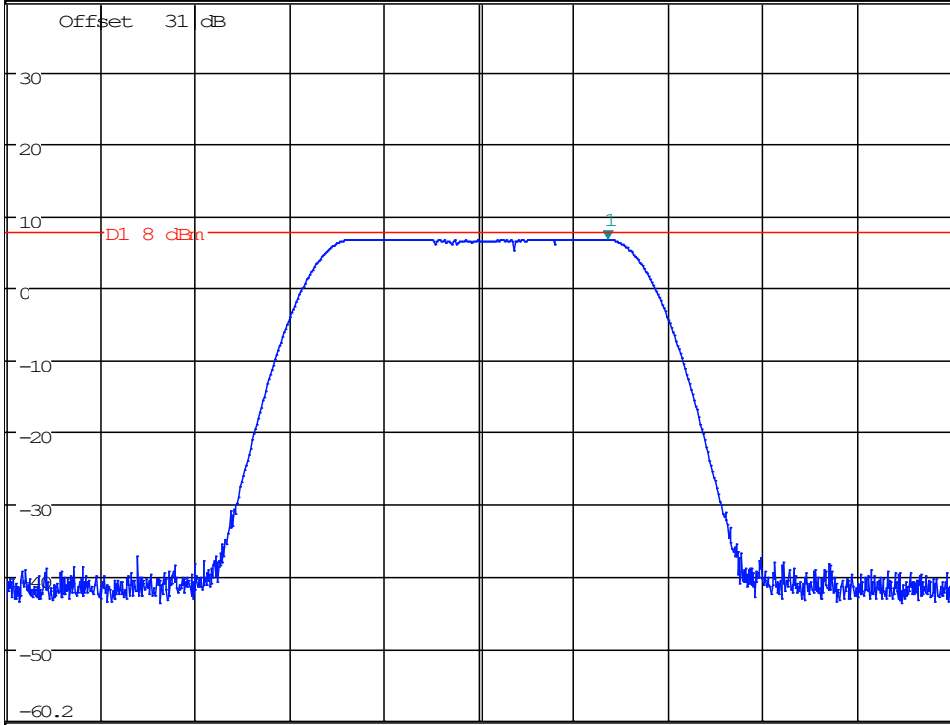
Date: 21.OCT.2020 12:57:21

PSD
915.6 MHz



*RBW 100 kHz Marker 1 [T1]
 *Att 20 dB 6.73 dBm
 VEW 300 kHz
 SWI 10 ms 915.814554955 MHz

Ref 39.8 dBm Offset 31 dB



Center 915.6096 MHz 150 kHz/ Span 1.5 MHz

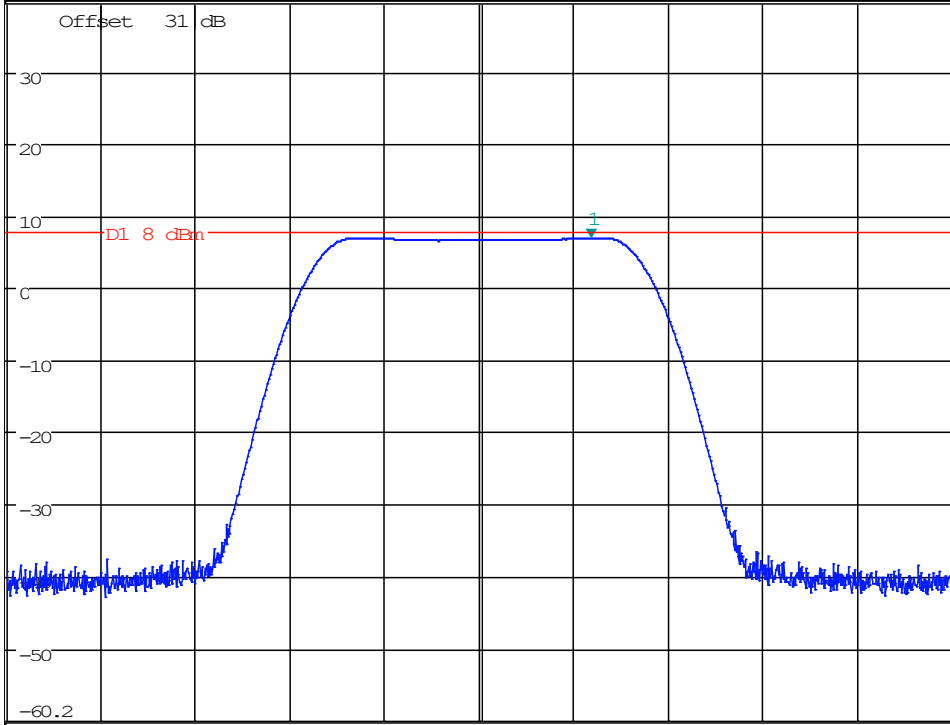
Date: 21.OCT.2020 12:57:01

PSD
927.13 MHz



*RBW 100 kHz Marker 1 [T1]
 *Att 20 dB 6.86 dBm
 VEW 300 kHz
 SWI 10 ms 927.307527928 MHz

Ref 39.8 dBm Offset 31 dB



Center 927.1296 MHz 150 kHz/ Span 1.5 MHz

Date: 21.OCT.2020 12:56:41

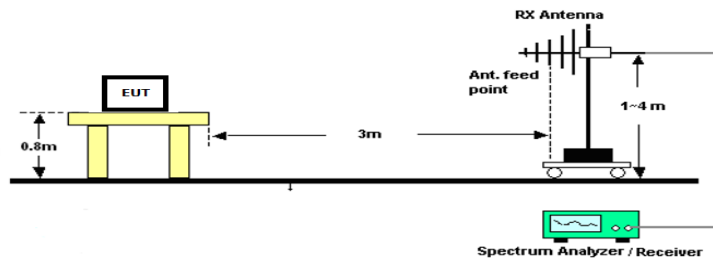
8.5 Spurious Emissions (Out of Band)

Emissions in nonrestricted frequency bands

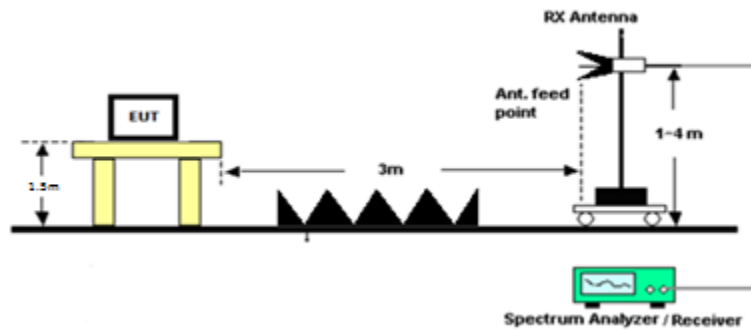
Limits from FCC Part 15.247 (d) and 15.215 (b) and test procedure from ANSI C63.10-2013 section 11.11

Setup

Emissions 30 – 1000 MHz



Emissions above 1 GHz

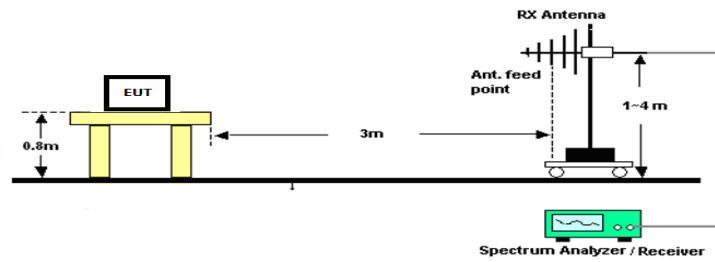


8.6 Restricted Bands of Operation

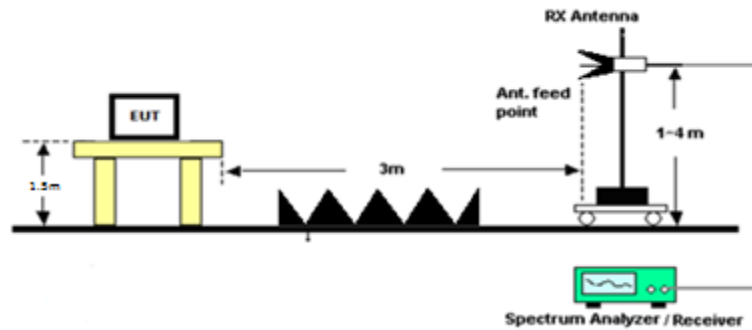
Limits from FCC Part 15.209

Setup

Emissions 30 – 1000 MHz



Emissions above 1 GHz





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Tuned Frequency (MHz)	Emission Frequency (MHz)	15.205 Restricted Band	15.205, 15.35, 15.247(d) Detector	Meter Reading (dBµV)	Antenna Polarity	Coax Loss (dB)	Duty Cycle Correction (dB)	Antenna Correction Factor (dB/m)	Distance (m)	Field Strength (dBµV/m)	Limit	Margin (dB)
927.13	2781.39	X	PK	10.39	H	6.15	0.00	32.46	3.00	49.00	73.98	24.98
927.13	2781.39	X	PK	11.56	V	6.15	0.00	32.46	3.00	50.17	73.98	23.81
927.13	2781.39	X	AVG		H	6.15	0.00	32.46	3.00	38.61	53.98	15.37
927.13	2781.39	X	AVG		V	6.15	0.00	32.46	3.00	38.61	53.98	15.37
927.13	3708.52	X	PK	9.22	H	6.57	0.00	33.18	3.00	48.97	73.98	25.01
927.13	3708.52	X	PK	11.14	V	6.57	0.00	33.18	3.00	50.89	73.98	23.09
927.13	3708.52	X	AVG		H	6.57	0.00	33.18	3.00	39.75	53.98	14.23
927.13	3708.52	X	AVG		V	6.57	0.00	33.18	3.00	39.75	53.98	14.23
927.13	4635.65	X	PK	8.23	H	7.52	0.00	33.95	3.00	49.69	73.98	24.29
927.13	4635.65	X	PK	8.78	V	7.52	0.00	33.95	3.00	50.24	73.98	23.74
927.13	4635.65	X	AVG		H	7.52	0.00	33.95	3.00	41.46	53.98	12.52
927.13	4635.65	X	AVG		V	7.52	0.00	33.95	3.00	41.46	53.98	12.52
927.13	7417.04	X	PK	2.08	H	9.52	0.00	36.04	3.00	47.64	73.98	26.34
927.13	7417.04	X	PK	1.60	V	9.52	0.00	36.04	3.00	47.16	73.98	26.82
927.13	7417.04	X	AVG		H	9.52	0.00	36.04	3.00	45.56	53.98	8.42
927.13	7417.04	X	AVG		V	9.52	0.00	36.04	3.00	45.56	53.98	8.42
927.13	8344.17	X	PK	-0.67	H	10.15	0.00	35.90	3.00	45.38	73.98	28.60
927.13	8344.17	X	PK	0.08	V	10.15	0.00	35.90	3.00	46.13	73.98	27.85
927.13	8344.17	X	AVG		H	10.15	0.00	35.90	3.00	46.05	53.98	7.93
927.13	8344.17	X	AVG		V	10.15	0.00	35.90	3.00	46.05	53.98	7.93



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8.7 Band-edge measurements

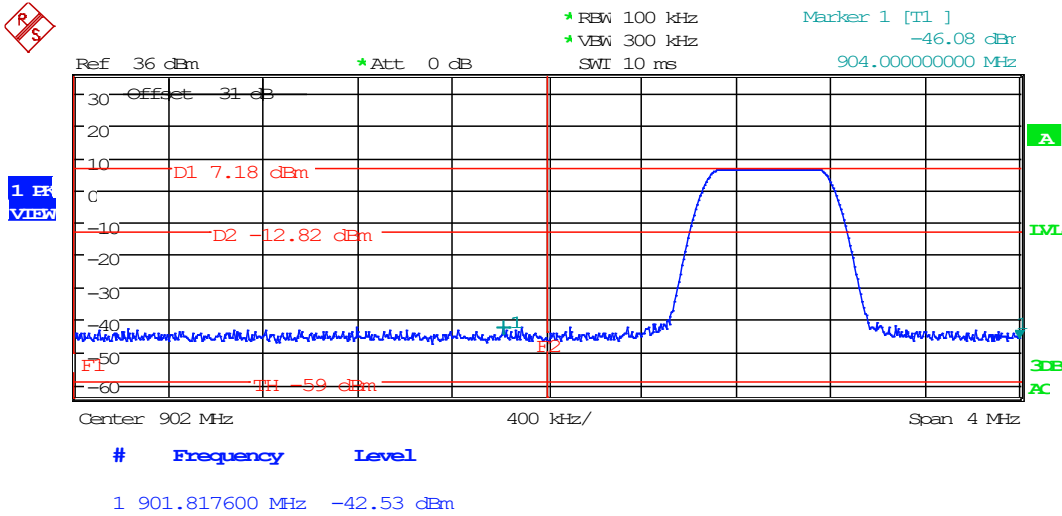
Requirement from FCC KDB 558074 D01 and test procedure from ANSI C63.10-2013 section 11.13

General

Emissions within a restricted band and within 2 MHz of an authorized band edge may be measured using either the marker-delta method or the integration method, which is described in 11.13.3, provided that the DTS bandwidth (or EBW) edge falls within 2 MHz of the band edge. Otherwise, all unwanted emissions measurements shall be performed using the standard methods.

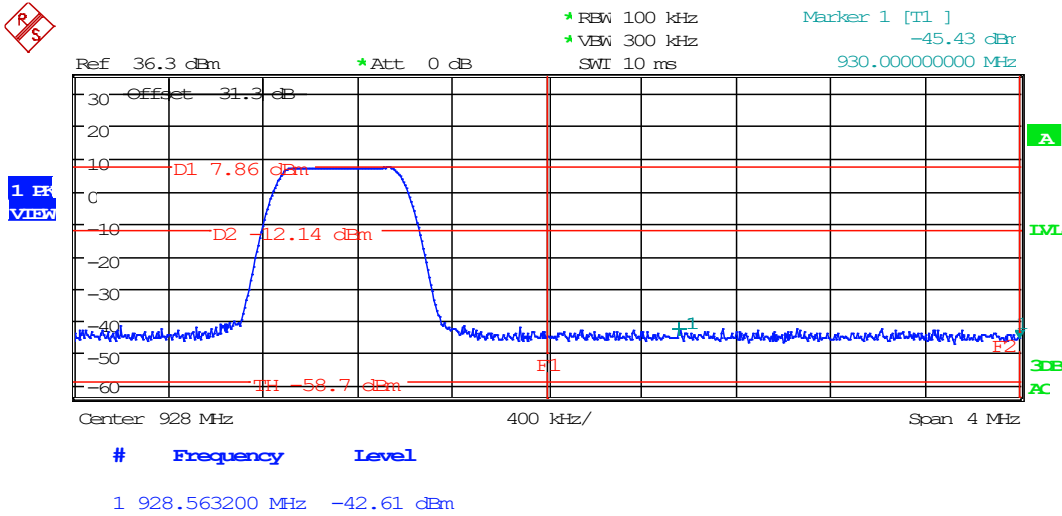
Band-edge Test Data / Spectrum Plots

Lower Band-edge spectrum plot



Date: 21.OCT.2020 13:03:59

Upper Band-edge spectrum plot



Date: 21.OCT.2020 13:04:55



9 ANNEX-A - Photographs of the EUT

Photographs of the EUT and any manufacturer supplied accessories to be used with the EUT Are in a separate supplementary ANNEX-A document.

10 ANNEX-B – Test Setup Photographs

Test setup photographs are located in a separate supplementary ANNEX-B document.

11 History of Test Report Changes

Test Report #	Revision #	Description	Date of Issue
TR_3846-20_FCC_DTS_1	1	Initial release	OCTOBER 29, 2020
	2	Revised 28, 30 & 31	November 17, 2020



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END of Test Report
