

Prüfbericht-Nr.: <i>Test Report No.:</i>	JP21PGQD 002	Auftrags-Nr.: <i>Order No.:</i>	150232700	Seite 1 von 90 <i>Page 1 of 90</i>
Kunden-Referenz-Nr.: <i>Client Reference No.:</i>	N/A	Auftragsdatum: <i>Order Date:</i>	2020-12-25	
Auftraggeber: <i>Client:</i>	Mitsubishi Electric Corporation Sanda Works 2-3-33, Miwa, Sanda-city, Hyogo, 669-1513, Japan			
Prüfgegenstand: <i>Test Item:</i>	Display Audio			
Bezeichnung / Typ-Nr.: <i>Identification / Type No.:</i>	NR-000	Serien-Nr.: <i>Serial No.:</i>	Refer to section 4.3	
Auftrags-Inhalt: <i>Order Content:</i>	Radio Testing			
Prüfgrundlage: <i>Test Specification:</i>	FCC 47 CFR Part 15, Subpart C, Section 15.247 ANSI C63.10-2013			
Wareneingangsdatum: <i>Date of Receipt:</i>	2021-01-07, 2021-01-20			
Prüfmuster-Nr.: <i>Test Sample No.:</i>	A00292387, A002991001, A002990060			
Prüfzeitraum: <i>Testing Period:</i>	2021-01-12 - 2021-01-27			
Ort der Prüfung: <i>Place of Testing:</i>	Yokohama EMC Laboratory			
Prüflaboratorium: <i>Testing Laboratory:</i>	TÜV Rheinland Japan Ltd.			
Prüfergebnis*: <i>Test Result*:</i>	Pass			
Überprüft von: <i>Reviewed by:</i>		Genehmigt von: <i>Authorized by:</i>		
Datum: 2021-02-26 <i>Date:</i>	_____	Datum: 2021-02-26 <i>Date:</i>	_____	
Stellung / Position:	Inspector	Stellung / Position:	Reviewer	
Sonstiges / Other:				
Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the Test Item at Delivery:</i>	Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>			
* Legende: P(ass) = entspricht o.g. Prüfgrundlage(n) * Legend: P(ass) = passed a.m. test specification(s)	F(ail) = entspricht nicht o.g. Prüfgrundlage(n) F(ail) = failed a.m. test specification(s)	N/A = nicht anwendbar N/A = not applicable	N/T = nicht getestet N/T = not tested	
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. <i>This test report relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.</i>				

REVISIONS

Report No.	Issue date	Changes / Remarks
JP21PGQD 001	2021-02-26	Original document for WLAN 2.4GHz
JP21PGQD 002	2021-02-26	Original document for Bluetooth

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1. General Remarks

1.1 Test Specifications

Table 1: Test Summary

Test	Specifications	Result
Radio: FCC 47 CFR Part 15, Subpart C, Section 15.247 ANSI C63.10-2013		
Conducted Output Power	FCC 15.247(b)(1)	Pass
Conducted Spurious Emissions	FCC 15.247(d)	Pass
20dB Bandwidth	FCC 15.215(c), 15.247(a)(1)	Pass
99% Bandwidth	For reference	Performed
Carrier Frequency Separation	FCC §15.247(a)(1)	Pass
Number of Hopping Frequencies	FCC §15.247(a)(1)(iii)	Pass
Average Time of Occupancy	FCC §15.247(a)(1)(iii)	Pass
Radiated Spurious Emissions of Transmitter	FCC 15.205, FCC 15.209, FCC 15.247(d)	Pass
Conducted Emission on AC Power Ports	FCC 15.207 Not applicable since the EUT is not the device that is designed to be connected to the public utility (AC) power line.	N/A

1.2 Test Report Purpose

The purpose of this test report is to show compliance of the EUT (Equipment Under Test) with the requirements of the FCC rules listed in section 1.1.

This test report is intended for C2PC application due to modifications on the certified radio transmitter in accordance with the KDB Publication No. 178919 D01 v06.

This test report covers Bluetooth part of the product, who has multiple wireless connectivity: Bluetooth, WLAN (2.4GHz and 5GHz)

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1.3 Complementary Materials

There is no attachment to this test report.

2. Test Sites

2.1 Test Facilities

TÜV Rheinland Japan Ltd. – Global Technology Assessment Center
4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan

The used test equipment is in accordance with CISPR 16 for measurement of radio interference.

The test facility is recognized by the Federal Communications Commission (FCC) as Accredited Testing Laboratory under designation number JP0017.

The test facility is accredited by VLAC (member of ILAC) under number VLAC-017 according to ISO/IEC 17025:2017.

2.2 List of Test and Measurement Instruments

Table 2: List of Test and Measurement Equipment

Kind of Equipment	Manufacturer	Model Name	Serial Number	Equip. ID	Cal. Interval	Cal. Date	Next Cal.
For Antenna Port Conducted Emission							
EMI Receiver	Rohde & Schwarz	ESW 26	101316	RF-0812	1 year	2020-04-22	2021-04-22
3dB Attenuator	Huber + Suhner	6603_SMA-50-1/199_NE	-	RF-0761	1 year	2020-03-16	2021-03-16
For Radiated Emission (RE)							
Radiated Emission Measurement Soft-ware (above 30MHz)	Toyo Corporation	EP7/RE	VER. 8.0.90	RF-0026	1 year	2020-02-25	2021-02-25
EMI Receiver	Rohde & Schwarz	ESU 40	100029	RF-0021	1 year	2020-08-17	2021-08-17
RF Selector (10m Chamber)	Toyo Corporation	NS4900	0703-182	RF-0029	1 year	2020-02-25	2021-02-25
Loop Antenna with Amplifier, 9kHz-30MHz	Rohde & Schwarz	HFH2-Z2	100139	RF-0048	1 year	2020-04-24	2021-04-24
Trilog Antenna No. 2, 30-1000MHz	Schwarzbeck	VULB 9168	9168-475	RF-0462	1 year	2020-04-28	2021-04-28
5dB Attenuator	Pasternack	PE7047-5	-	RF-0731	1 year	2020-04-28	2021-04-28
Horn Antenna, 1-8GHz	Schwarzbeck	BBHA 9120 D	1059	RF-0553	1 year	2020-04-18	2021-04-18
Microwave Preamplifier, 1-8GHz	Toyo Corporation	TPA0108-40	0634	RF-0052	1 year	2021-01-06	2022-01-06
Horn Antenna with Preamp, 8-18GHz (RX)	Toyo Corporation	HAP06-18W	00000025	RF-0065	1 year	2020-04-18	2021-04-18
2.4GHz Band Reject Filter	Creowave	CW-BSF-2400-2483.5	746001	RF-0591	1 year	2021-01-06	2022-01-06
High Pass Filter, 8-18GHz	Micro-Tronics	HPM50107	006	RF-0334	1 year	2020-04-18	2021-04-18
Horn Antenna with Preamp, 18-26.5GHz (RX)	Toyo Corporation	HAP18-26N	00000010	RF-0070	1 year	2020-04-18	2021-04-18
Constant Voltage Constant Frequency Stabilizers and Power Accessories							
CVCF (10m Chamber)	NF Corporation	ES2000U	9067307	RF-0212	1 year	2020-03-13	2021-03-13
CVCF Booster (10m Chamber)	NF Corporation	ES2000B	9074408	RF-0213	1 year	2020-03-13	2021-03-13
True RMS Multimeter	Fluke	87V	97680445	RF-0281	1 year	2020-12-15	2021-12-15
True RMS Multimeter	Fluke	87V	16110176	RF-0414	1 year	2020-06-18	2021-06-18
DC Power Supply	Kikusui	PWR800L	NA003235	PV-0039	1 year	2020-10-07	2021-10-07

Conformance of the used measurement and test equipment with the requirements of ISO/IEC 17025 has been confirmed before testing.

2.3 Measurement Uncertainty

Table 3: Emission Measurement Uncertainty

Measurement Type	Frequency	Uncertainty
AC Power Line Conducted Emission	150kHz - 30MHz	±2.0dB
Antenna Port Conducted Emission	20Hz - 40GHz	±1.5dB
Radiated Emission	150kHz - 30MHz	±4.7dB
	30MHz - 1GHz	±4.8dB
	> 1GHz	±3.8dB

Note:

The measurement instrumentation uncertainty (MIU) was determined according to CISPR 16-4-2 and ETSI TR 100-028. All MIU values mentioned in the above table are smaller than the uncertainty budgets specified by CISPR 16-4-2 and ETSI TR 100-028, therefore compliance for all emission measurements is deemed to occur if no measured disturbance level exceeds the disturbance limit.

3. General Product Information

3.1 Product Function and Intended Use

The **EUT** (Equipment Under Test) is a display audio installed in vehicles with wireless connectivity of Bluetooth, WLAN (2.4GHz) and GNSS.

3.2 Ratings and System Details

Radio standard:	Bluetooth Ver.3.0 DH5, 2DH5, 3DH5
Frequency range:	2402 – 2480MHz
Antenna gain:	+0.29dBi
Antenna type:	Pattern antenna (Inverted F)
Antenna mounting type:	Internal
Modulation type:	DH5 (FHSS): GFSK 2DH5 (OFDM): $\pi/4$ -DQPSK 3DH5: (OFDM): 8DPSK
Signal spreading:	FHSS (coupled with modulation type above)
Transmit speed:	DH5: 1 Mbps, 2DH5: 2 Mbps, 3DH5: 3 Mbps
Number of channels:	79
Channel spacing:	1MHz (2MHz for Inquiry)
Rated temperature:	-30 to +70°C
Rated voltage:	DC 12V
Rated input Current:	1.4A
Protection class:	III
Test voltage:	DC 13.2V for radio testing

3.3 Noise Generating and Noise Suppressing Parts

The highest frequency generated or used by the EUT is 900MHz as digital interface portion, 2480MHz as radio portion.

3.4 Submitted Documents and Information

Following documents have been submitted by the client:

Block Diagram, BOM, Label and location.

Following information provided in this test report has been submitted by the client:

- client name and address;
- EUT identification, ratings, system details, and description of product function and intended use;
- information related to noise generating and noise suppressing parts (if any).

4. Test Setup and Operation Modes

4.1 Test Methodology

The test methodology used is based on the requirements of 47 CFR Part 15, Sections 15.31, 15.33, 15.35, 15.205, 15.207, 15.209, 15.247.

The test methods, which have been used, are based on ANSI C63.10.

For details, see under each test item.

4.2 Operation Modes

Testing was performed at the lowest operating frequency (2402MHz), at the operating frequency in the middle of the specified frequency band (2441MHz) and at the highest operating frequency (2480MHz).

The basic operation modes used for testing are:

- A. EUT transmits (TX mode), with full power, at lowest channel (2402MHz), a continuous modulated signal streaming.
- B. EUT transmits (TX mode), with full power, at middle channel (2441MHz), a continuous modulated signal streaming.
- C. EUT transmits (TX mode), with full power, at highest channel (2480MHz), a continuous modulated signal streaming.
- H. EUT transmits (TX mode), with full power, a continuous modulated signal streaming while hopping on all channels.
- I. Inquiry

Configurations:

- BDR 1 Mbps (DH1, DH3, DH5)
- EDR 2 Mbps (2DH1, 2DH3, 2DH5)
- EDR 3 Mbps (3DH1, 3DH3, 3DH5)

Note: The worst condition was determined based on the test result of Maximum Peak Output Power (Mid Channel)

Note: Since 2DH and 3DH have the same modulation method and no differences in transmitting specification, test was performed on the representative mode that had the highest peak output power.

4.3 Physical Configuration for Testing

The test system was configured in a typical fashion (as a customer would normally use it).

The justification and manipulation of cables and equipment in order to simulate a worst-case behavior of the test setup has been carried out as prescribed in ANSI C63.10.

Figure 1: Block Diagram (Internal Amplifier model, Conducted Radio Testing)

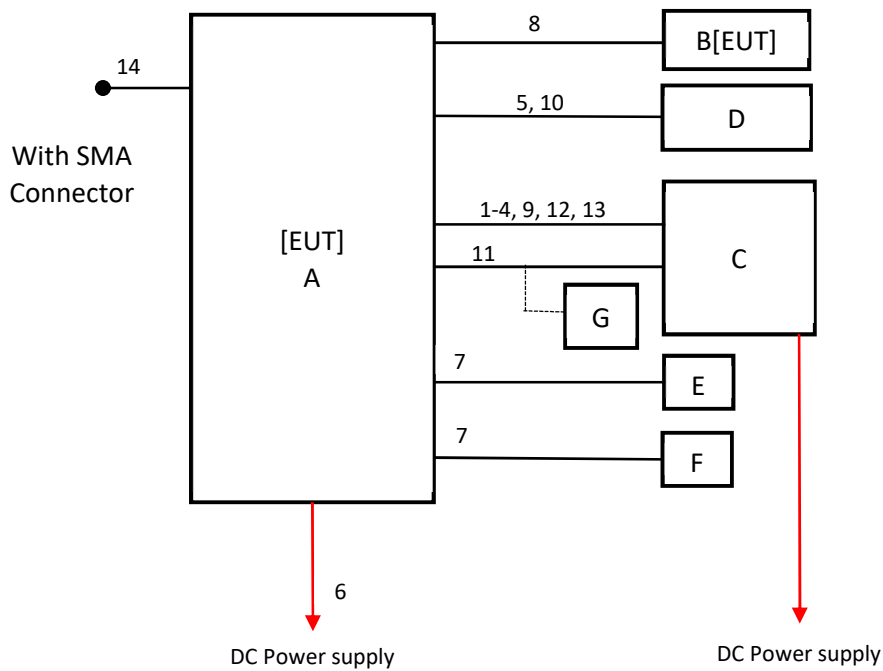


Figure 2: Block Diagram (Internal Amplifier model, Radiated Radio Testing)

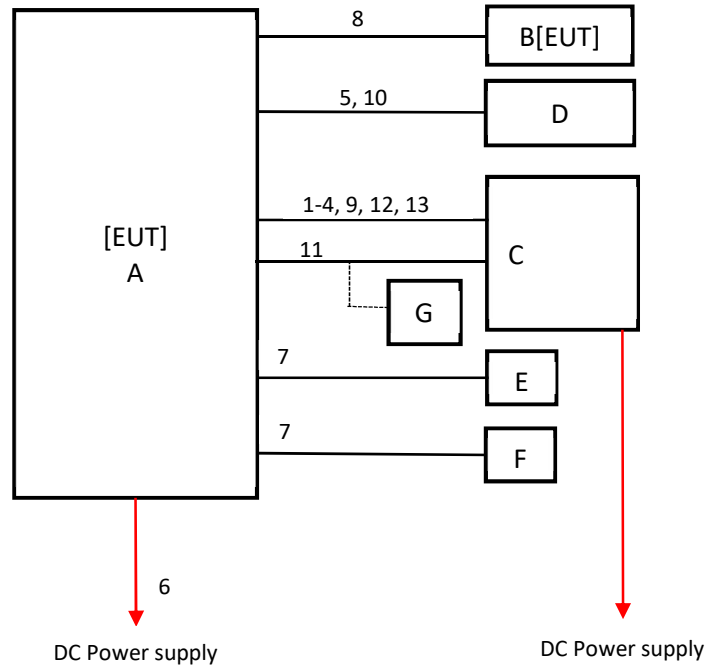


Table 4: The System consists of the Following Units

No.	Item	Model No.	Serial Number	Manufacturer	Remarks
A	UNIT ASSY, AUDIO	NR-000	<i>See Note below</i>	Mitsubishi Electric Corporation Sanda Works	EUT
B	GPS Antenna	-/-	Unspecified	Mitsubishi Electric Corporation Sanda Works	EUT
C	Dummy load	-/-	Unspecified	Mitsubishi Electric Corporation Sanda Works	-/-
D	Display	39710-TBAA-A11	506VIBB000701	LG	-/-
E, F	Speaker	TP1371	Unspecified	Tiaoping	-/-
G	HD Video Capture	GV-HDREC	Unspecified	I-O DATA DEVICE, INC	-/-

Note:

For more details, refer to section: Photographs of the Test Set-Up.

The samples of the model NR-000 with the following S/N were available;

- No. 90ZPU003 for conducted radio measurements;
- No. 90ZPU004 for radiated radio measurements.

Table 5: Interfaces present on the EUT

No.	Name	Length(m)	Shield		Remarks
			Cable	Connector	
1	Signal cable	2m	Shielded	Shielded	-
2	Signal cable	2m	Shielded/Unshielded	Unshielded	-
3	Signal cable	2m	Shielded/Unshielded	Unshielded	-
4	Signal cable	2m	Shielded/Unshielded	Unshielded	-
5	Display cable	1m	Shielded	Shielded	-
6	DC cable	1m	Unshielded	Unshielded	-
7	Signal cable	1m	Unshielded	Unshielded	-
8	GPS cable	3m	Shielded	Shielded	-
9	Signal cable	2m	Shielded	Shielded	-
10	Display cable	2m	Unshielded	Unshielded	-
11	Signal cable	2m	Shielded	Shielded	-
12	Signal cable	2m	Shielded	Shielded	-
13	Signal cable	2m	Shielded	Shielded	-
14	Coaxial cable	0.18m	Shielded	Shielded	For conducted testing purpose only

For more details, refer to section: Photographs of the Test Setup.

4.4 Test Software

The EUT was provided by the manufacturer with suitable software to allow operation in all the required modes.

Software used for testing: TBAW #12.9a by Mitsubishi Electric Corporation Sanda Works.

This firmware was running on the EUT. It was used to enable the operation modes (mode A to C, N, I) listed in section 4.2 as appropriate.

4.5 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

1. Product: Dummy Load
Manufacturer: Mitsubishi Electric Corporation Sanda Works
Rated Voltage: DC 12V
Serial Number: Unspecified
2. Product: Display
Manufacturer: LG
Model: 39710-TBAA-A11
Rated Voltage: DC 13.2V
Serial Number: 506VIBB000701
3. Product: Speaker × 2
Manufacturer: Tiaoping
Model: TP1371
Serial Number: Unspecified
4. Product: HD Video Caputure
Manufacturer: I-O DATA DEVICE, INC
Model: GV-HDREC
Rated Voltage: DC 5V
Input Current: 840mA
Protection Class: III
Serial Number: K4W10527455T

4.6 Countermeasures to achieve Compliance

No additional measures were employed to achieve compliance.

5. Test Results RADIO

5.1 Technical Requirements

5.1.1 Supply Voltage Requirements

RESULT:

PASS

Requirements:

FCC 15.31(e)

For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

Verdict:

The EUT has an internal voltage regulator to supply the RF circuit. Hence it complies with the supply voltage requirements.

5.1.2 Antenna Requirements

RESULT:

PASS

Requirements:

FCC 15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Verdict:

The EUT has an internal antenna which is not user accessible. Hence it complies with the antenna requirements.

5.1.3 Restricted Bands of Operation

RESULT:

PASS

Requirements:

FCC 15.205

Only spurious emissions are permitted in any of the restricted frequency bands, unless otherwise specified.

Verdict:

The EUT operation frequency range is 2400-2483.5MHz. Therefore only spurious emissions may be found in the restricted bands of operation and the EUT complies with the restricted frequency band requirement.

5.2 Conducted Measurements at Antenna Port

5.2.1 Maximum Peak Output Power

RESULT:

PASS

Date of testing: 2021-01-24

Ambient temperature: 22°C

Relative humidity: 31%

Atmospheric pressure: 1019hPa

Requirements:

FCC 15.247(b)(1)

For frequency hopping systems operating in the 2400-2483.5MHz band employing at least 75 non-overlapping hopping channels, the maximum peak conducted output power shall be 1W (30dBm). For other hopping systems operating in the 2400-2483.5MHz band, the maximum peak conducted output power shall be 0.125W (21dBm).

Test procedure:

ANSI C63.10 §7.8.5.

The maximum peak output power (conducted) was measured at the antenna connector with a power meter. The final result takes into account the loss generated by all the involved cables.

The measurement was performed at all the available modulations (data rates) in order to identify the one producing the highest output power for each of radios. The results given here below show that the worst case output power is found at the data rate of DH5 for the radio DH and of 2DH5 for the radio 2DH and of 3DH5 for the radio 3DH. Therefore, all the other measurements for the evaluation of the radio properties of the EUT have been performed using this data rates.

Maximum Average Output Power was not performed since the Maximum Peak Output Power is lower than the SAR Test Exclusion Threshold at 5mm distance according to KDB 447498 D01.

Table 6: Maximum Peak Output Power, DH5

Freq. [MHz]	Peak Output Power [dBm]	Limit [dBm]	Margin [dB]
2402	-1.04	21	22.04
2441	-0.89	21	21.89
2480	-1.06	21	22.06

Table 7: Maximum Peak Output Power, Mode B (2441MHz), all Data Rates

Data Rate	Peak Output Power [dBm]	Remark
DH1	-0.74	
DH3	-0.89	
DH5	-0.89	Worst

Table 8: Maximum Peak Output Power, 2DH5

Freq. [MHz]	Peak Output Power [dBm]	Limit [dBm]	Margin [dB]
2402	1.32	21	19.68
2441	1.52	21	19.48
2480	1.22	21	19.78

Table 9: Maximum Peak Output Power, Mode B (2441MHz), all Data Rates

Data Rate	Peak Output Power [dBm]	Remark
2DH1	1.52	
2DH3	1.49	
2DH5	1.52	Worst

Table 10: Maximum Peak Output Power, 3DH5

Freq. [MHz]	Peak Output Power [dBm]	Limit [dBm]	Margin [dB]
2402	1.96	21	19.04
2441	2.11	21	18.89
2480	1.87	21	19.13

Table 11: Maximum Peak Output Power, Mode B (2441MHz), all Data Rates

Data Rate	Peak Output Power [dBm]	Remark
3DH1	2.06	
3DH3	2.09	
3DH5	2.11	Worst

Table 12: Maximum Peak Output Power, Inquiry

Freq. [MHz]	Peak Output Power [dBm]	Limit [dBm]	Margin [dB]
2441	-1.08	21	22.08

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5.2.2 20dB Bandwidth

RESULT:

PASS

Date of testing: 2021-01-24

Ambient temperature: 22°C

Relative humidity: 31%

Atmospheric pressure: 1019hPa

Requirements:

FCC 15.215(c) and 15.247(a)(1)

For frequency hopping systems operating in the 2400-2483.5MHz band, no bandwidth limit is specified, but data shall be taken for reference.

The 20dB bandwidth shall be contained within the frequency band designated in the rule section under which the equipment is operated.

Test procedure:

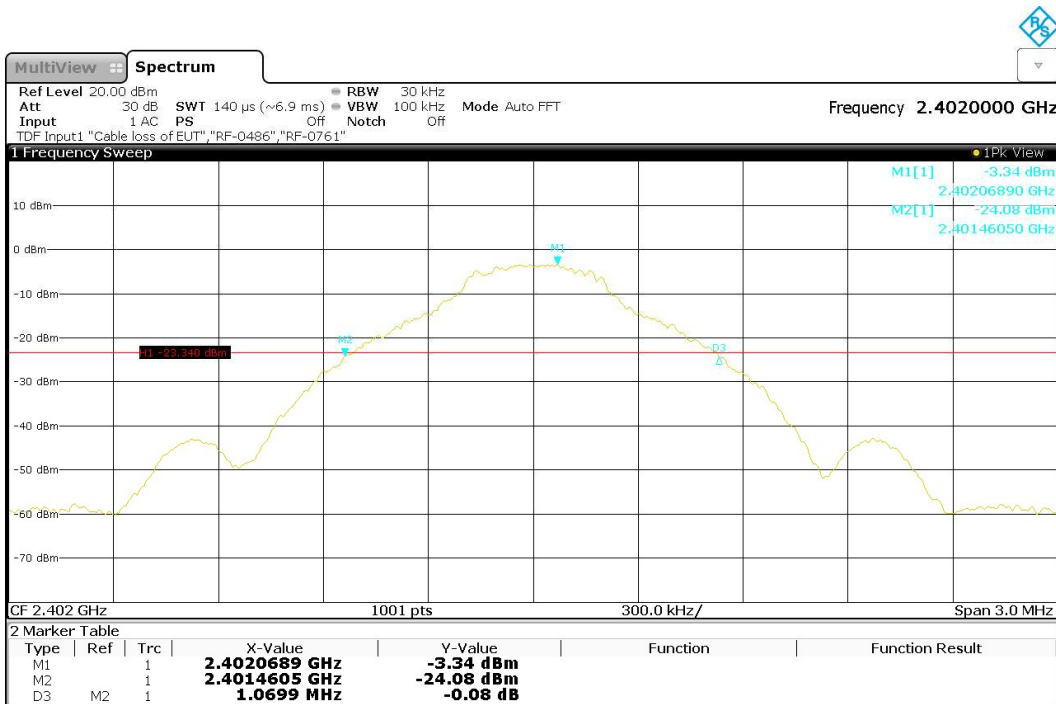
ANSI C63.10 §7.8.7.

The 20dB bandwidth was measured at the antenna port with a spectrum analyzer using a peak detector with the following settings: RBW = 30kHz, VBW = 100kHz. Markers were placed at the lowest and highest intersections of the trace with a 20dBc line to obtain the value of the emission bandwidth.

Table 13: 20dB Bandwidth, DH5

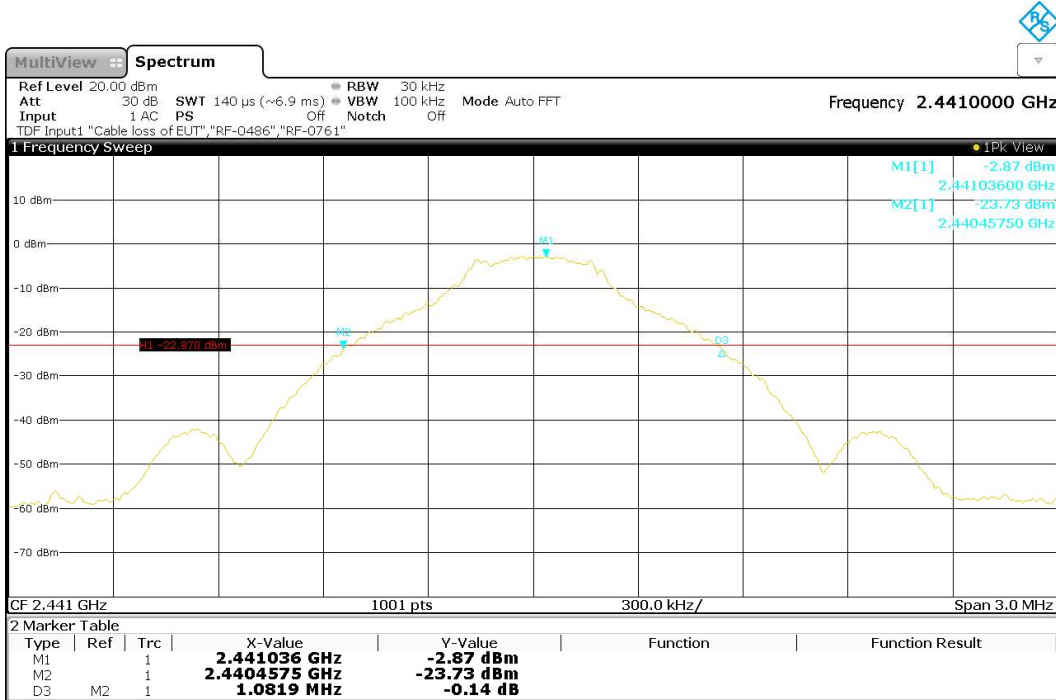
Operating Frequency [MHz]	20dB Bandwidth [MHz]
2402	1.070
2441	1.082
2480	1.076

Figure 3: 20dB Bandwidth, DH5, Mode A (2402MHz)



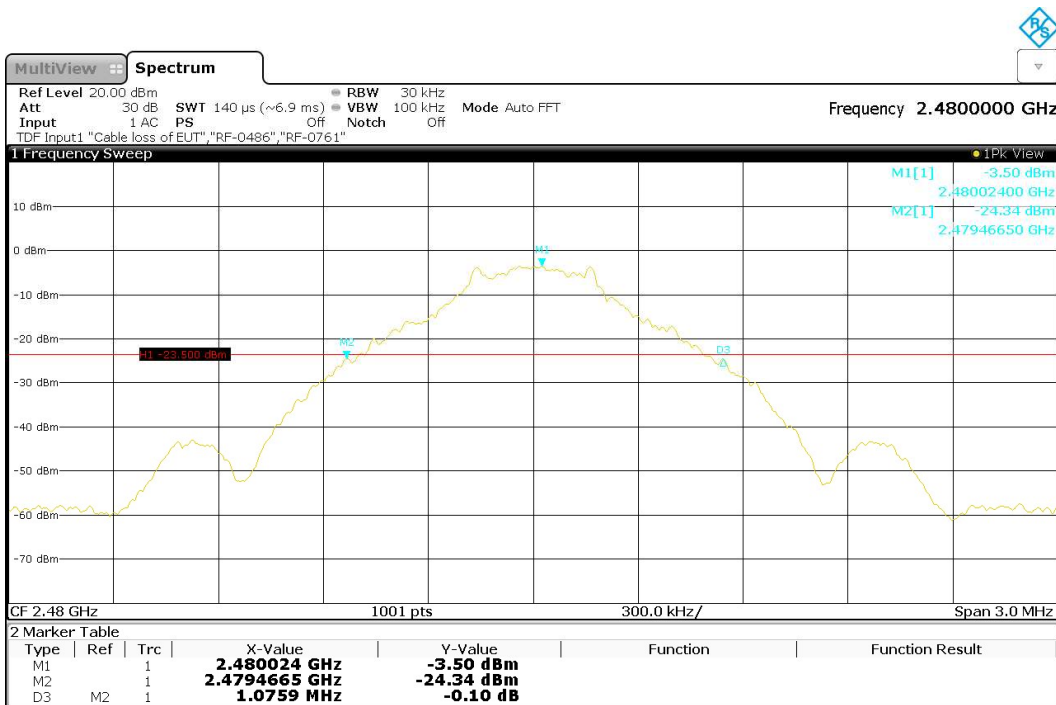
11:52:45 24.01.2021

Figure 4: 20dB Bandwidth, DH5, Mode B (2441MHz)



11:41:17 24.01.2021

Figure 5: 20dB Bandwidth, DH5, Mode C (2480MHz)

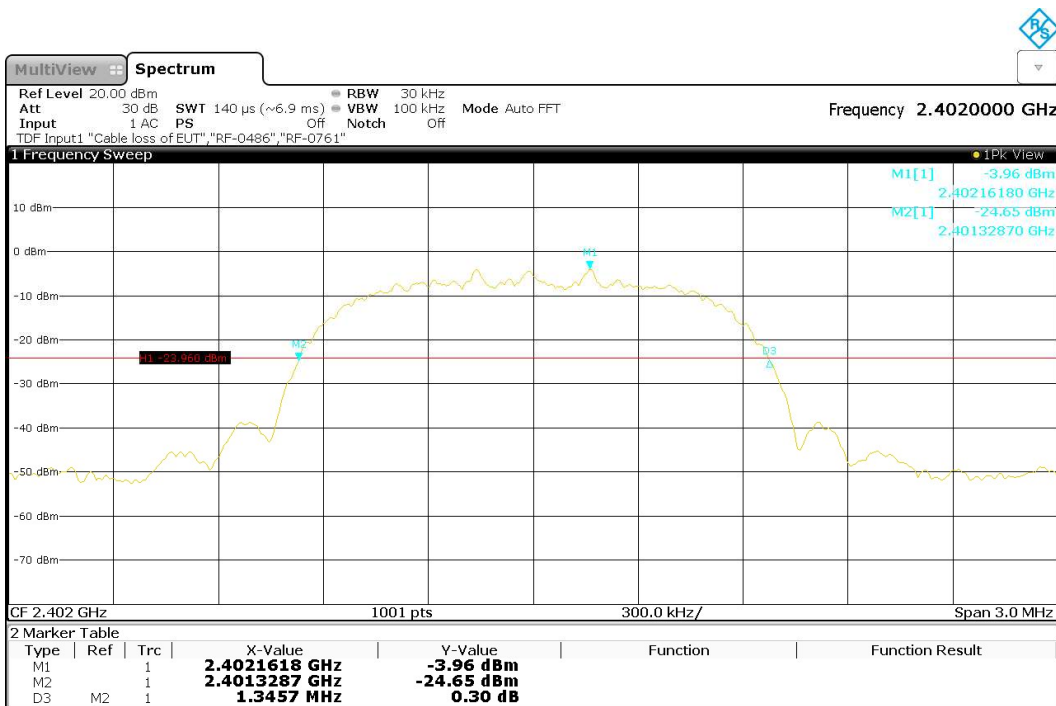


12:00:27 24.01.2021

Table 14: 20dB Bandwidth, 3DH5

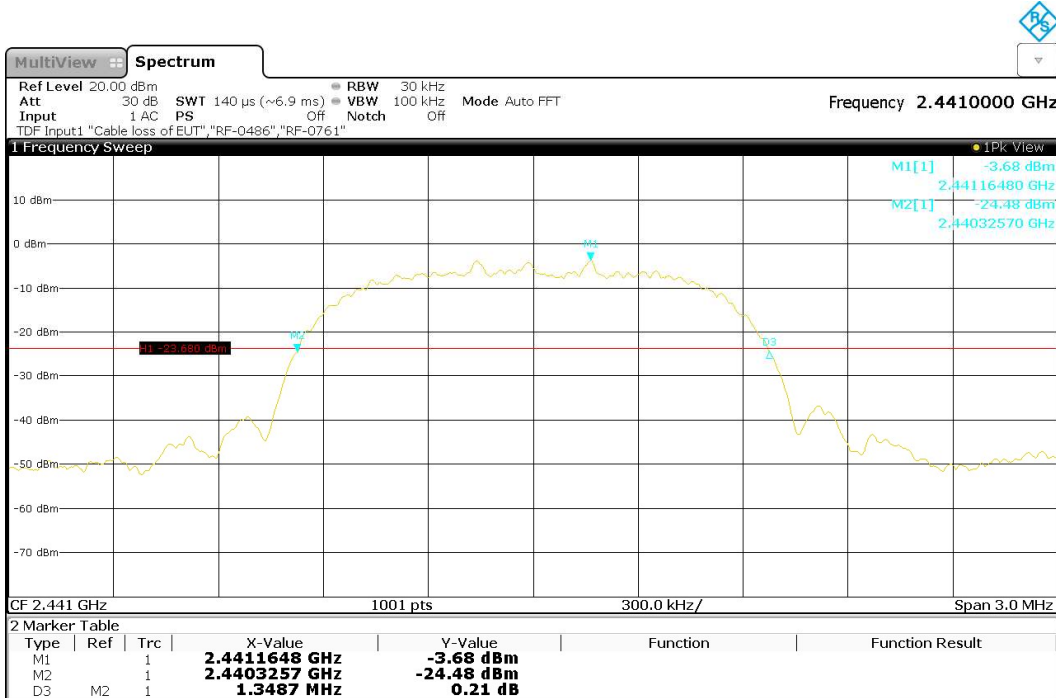
Operating Frequency [MHz]	20dB Bandwidth [MHz]
2402	1.346
2441	1.349
2480	1.358

Figure 6: 20dB Bandwidth, 3DH5, Mode A (2402MHz)



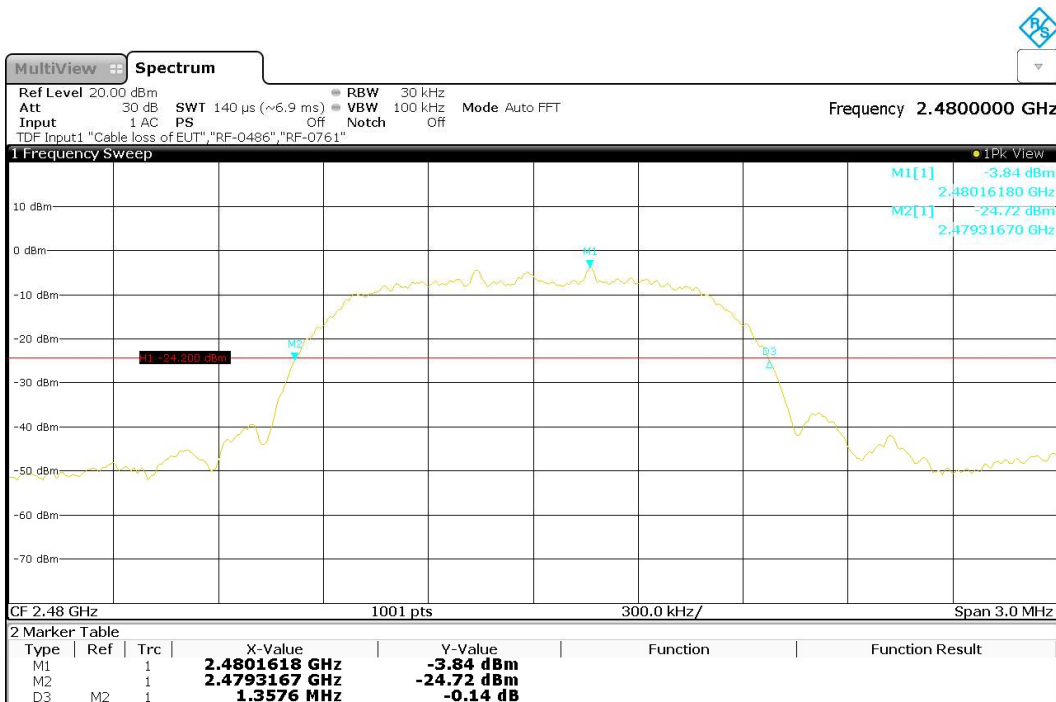
11:57:36 24.01.2021

Figure 7: 20dB Bandwidth, 3DH5, Mode B (2441MHz)



11:48:28 24.01.2021

Figure 8: 20dB Bandwidth, 3DH5, Mode C (2480MHz)

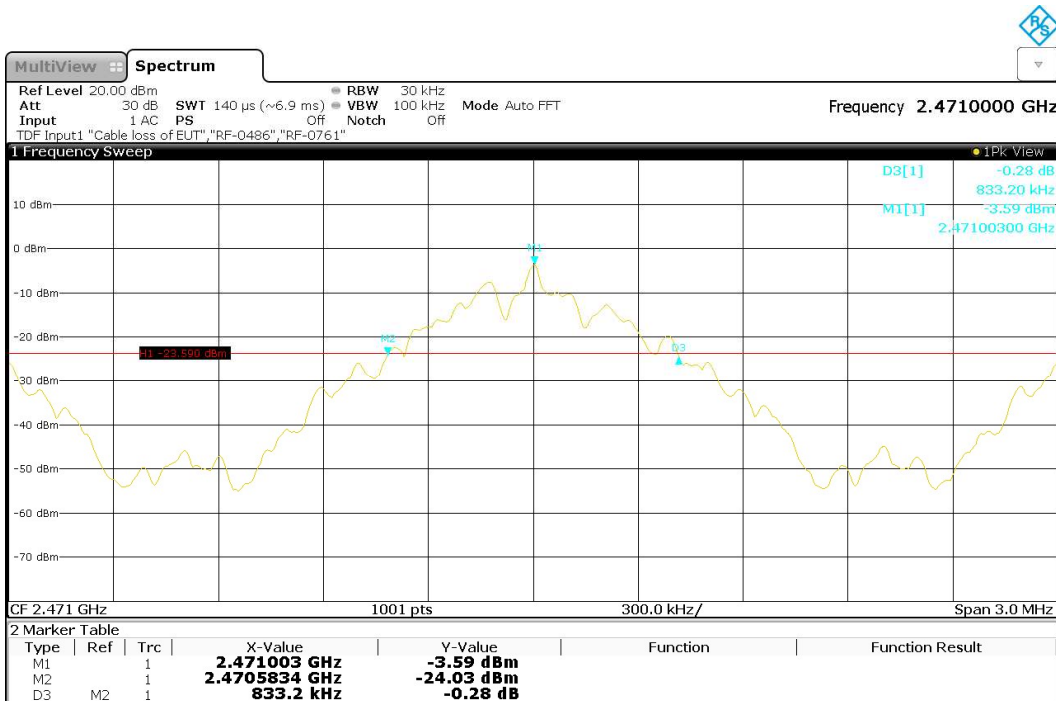


12:05:06 24.01.2021

Table 15: 20dB Bandwidth, Inquiry

Operating Frequency [MHz]	20dB Bandwidth [MHz]
2471	0.833

Figure 9: 20dB Bandwidth, Inquiry



12:51:08 24.01.2021

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5.2.3 99% Bandwidth

RESULT:

PERFORMED

Date of testing: 2021-01-24

Ambient temperature: 22°C

Relative humidity: 31%

Atmospheric pressure: 1019hPa

Test procedure:

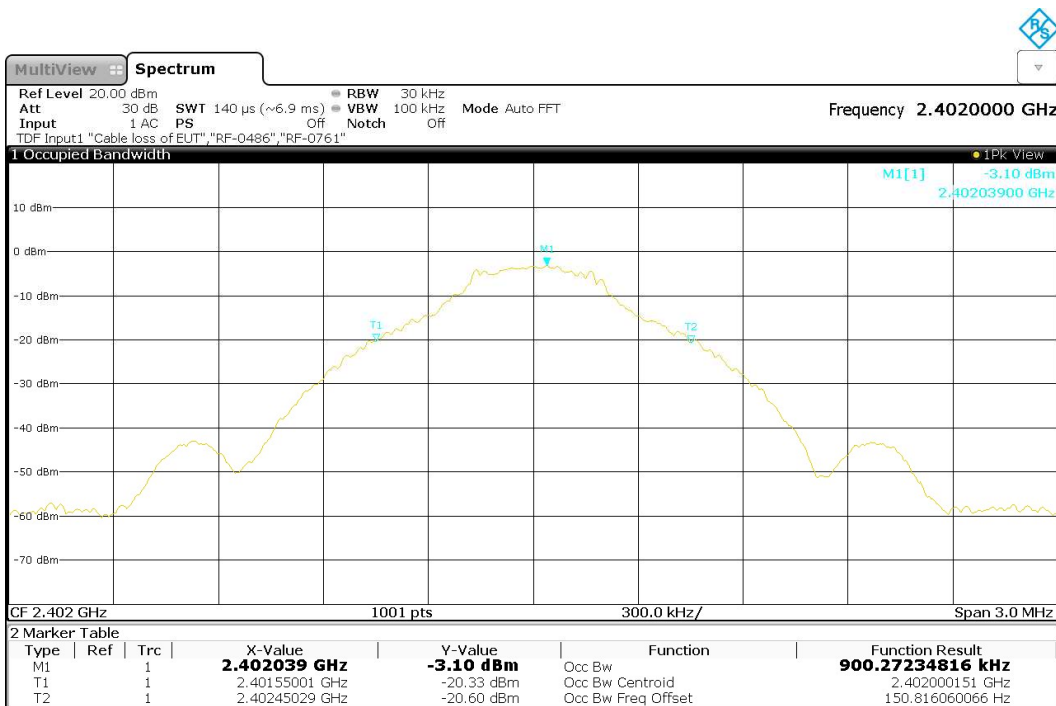
ANSI C63.10 §6.9.3

The 99% bandwidth was measured at the antenna port with a spectrum analyzer using a peak detector. The value of the emission bandwidth was obtained by using the OBW function of the analyzer with a 99% coverage setting.

Table 16: 99% Bandwidth, DH5

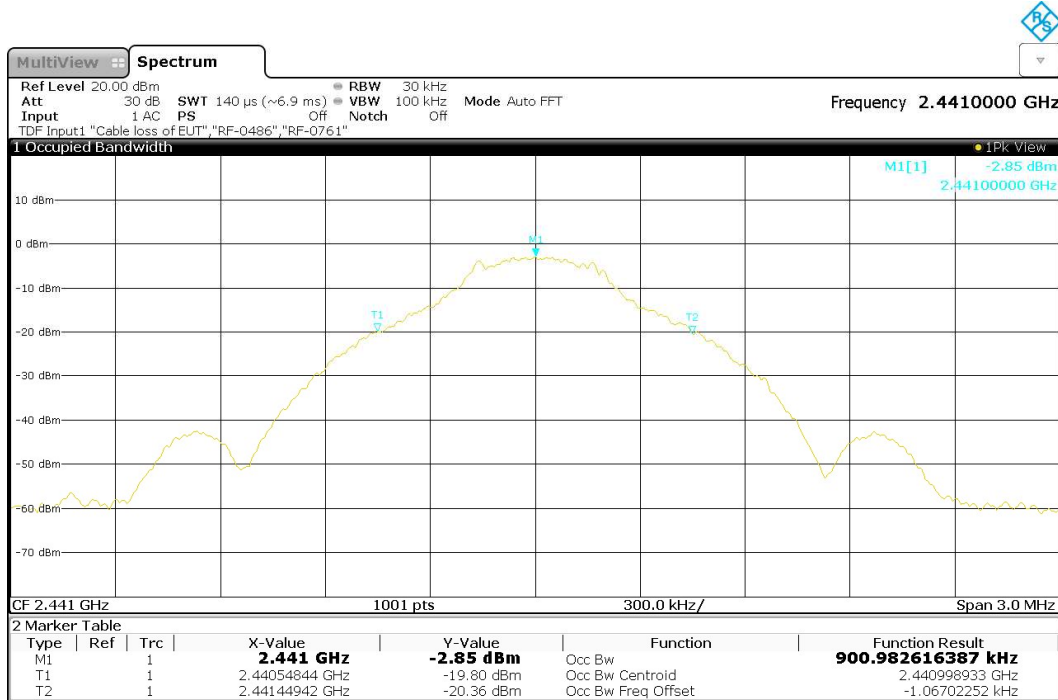
Operating Frequency [MHz]	99% Bandwidth [MHz]
2402	0.900
2441	0.901
2480	0.893

Figure 10: 99% Bandwidth, DH5, Mode A (2402MHz)



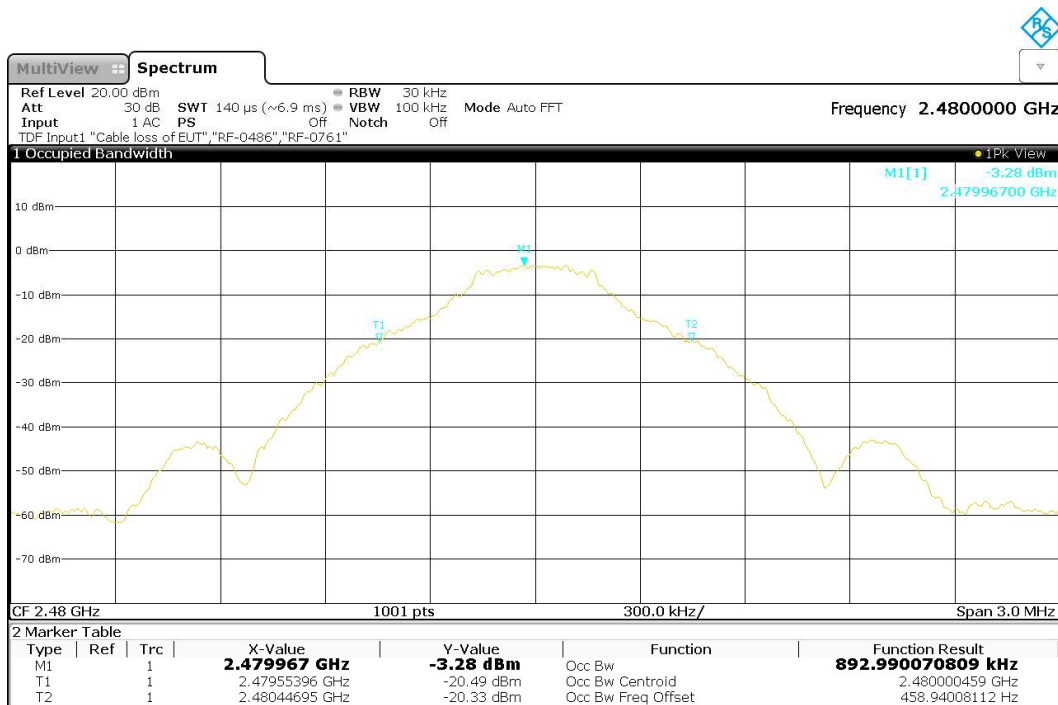
14:05:42 24.01.2021

Figure 11: 99% Bandwidth, DH5, Mode B (2441MHz)



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Figure 12: 99% Bandwidth, DH5, Mode C (2480MHz)

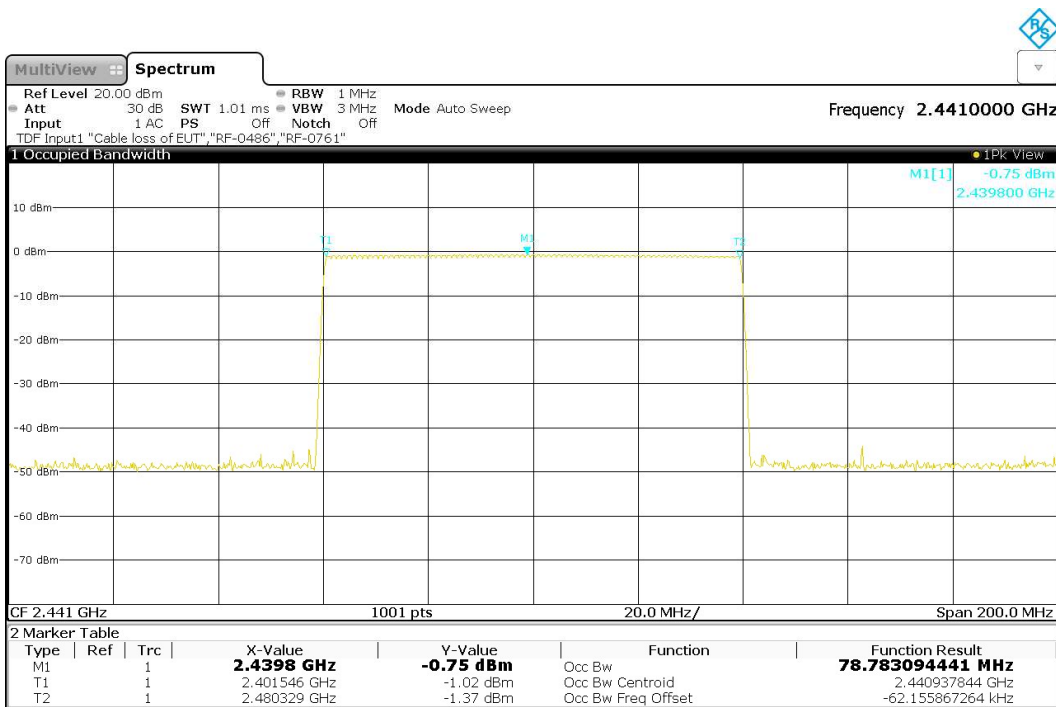


14:12:07 24.01.2021

Table 17: 99% Bandwidth, DH5, Mode H

Operating Frequency [MHz]	99% Bandwidth [MHz]
Hopping	78.783

Figure 13: 99% Bandwidth, DH5, Mode H



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Table 18: 99% Bandwidth, 3DH5

Operating Frequency [MHz]	99% Bandwidth [MHz]
2402	1.198
2441	1.199
2480	1.199

Figure 14: 99% Bandwidth, 3DH5, Mode A (2402MHz)



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Figure 15: 99% Bandwidth, 3DH5, Mode B (2441MHz)



14:16:15 24.01.2021

Figure 16: 99% Bandwidth, 3DH5, Mode C (2480MHz)

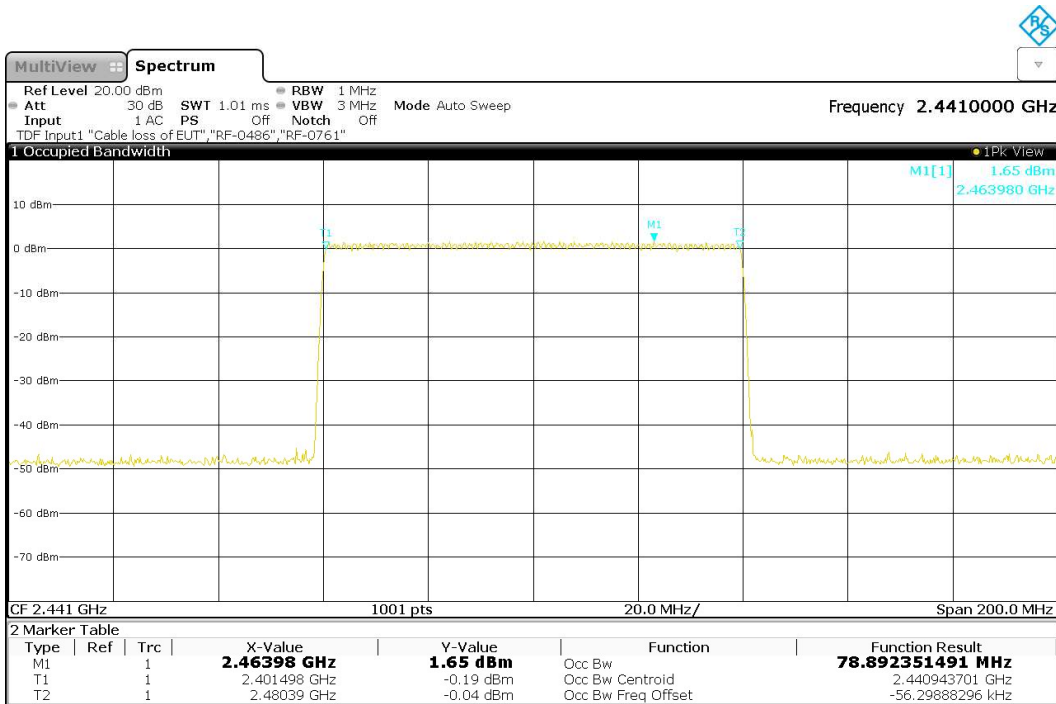


14:14:44 24.01.2021

Table 19: 99% Bandwidth, 3DH5, Mode H

Operating Frequency [MHz]	99% Bandwidth [MHz]
Hopping	78.892

Figure 17: 99% Bandwidth, 3DH5, Mode H



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Table 20: 99% Bandwidth, Inquiry

Operating Frequency [MHz]	99% Bandwidth [MHz]
Hopping	78.552

Figure 18: 99% Bandwidth, Inquiry



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5.2.4 Carrier Frequency Separation

RESULT:

PASS

Date of testing: 2021-01-24, 2021-01-27

Ambient temperature: 22, 23°C

Relative humidity: 31, 40%

Atmospheric pressure: 1019, 1021hPa

Requirements:

FCC 15.247(a)(1)

Frequency hopping systems operating in the 2400-2483.5MHz band shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater. In case of an output power less than 125mW, the frequency hopping system may have channels separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater.

Test procedure:

ANSI C63.10 §7.8.2.

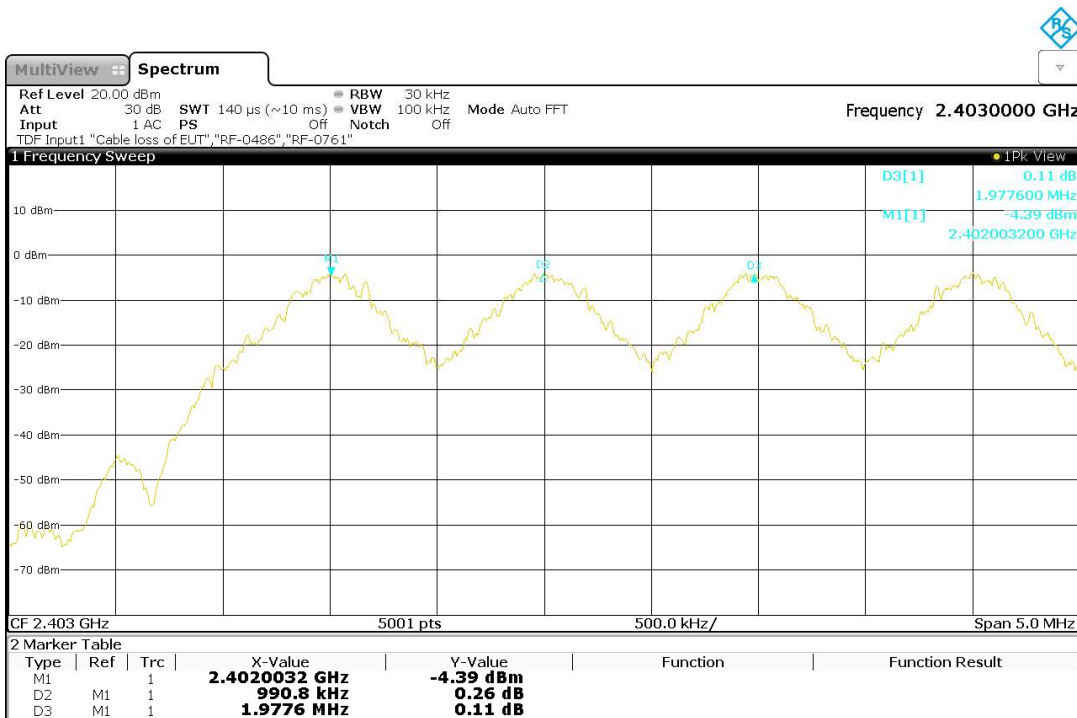
A spectrum analyzer was connected to the antenna port of the EUT. The analyzer resolution bandwidth was set to 300kHz and the video bandwidth to 1MHz. The Delta Marker function was used to determine the separation between the peaks of two adjacent channels.

Table 21: Carrier Frequency Separation, DH5

Freq. [MHz]	Channel Separation [MHz]	20dB Bandwidth [MHz]	Limit [MHz]
2402	0.991	1.070	0.713
2441	0.996	1.082	0.721
2480	1.004	1.076	0.717

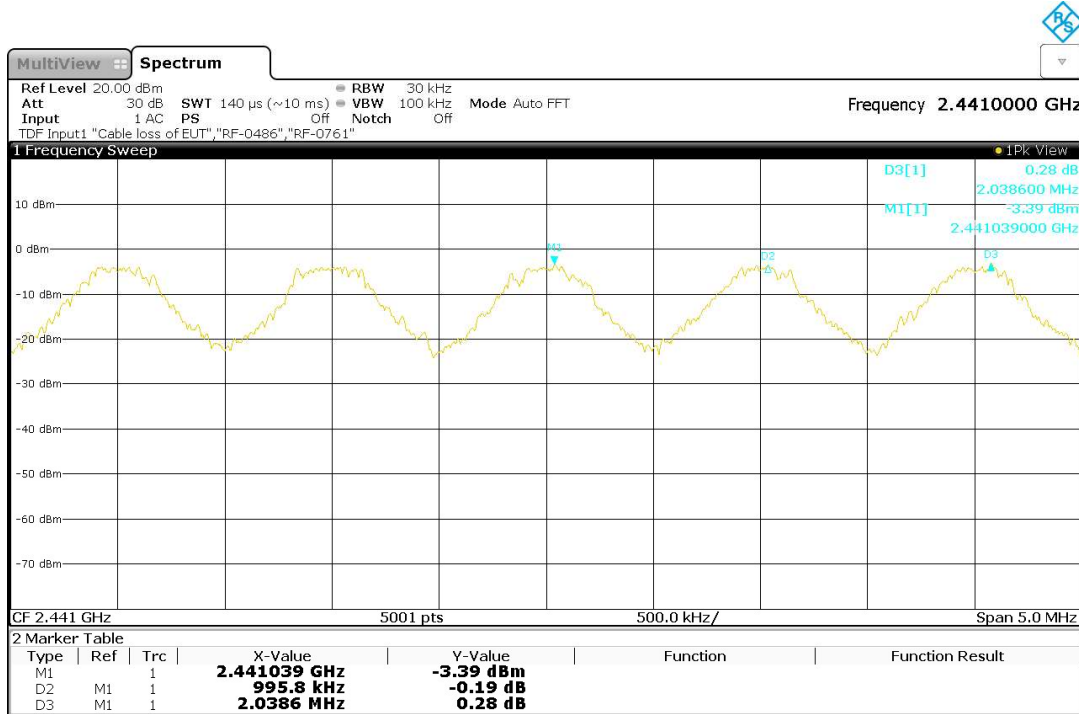
Notes: Limit = 20dB bandwidth * 2/3 since it is greater than 125kHz and the output power is less than 125mW.

Figure 19: Carrier Frequency Separation, DH5, Mode A (2402MHz)



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Figure 20: Carrier Frequency Separation, DH5, Mode B (2441MHz)



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Figure 21: Carrier Frequency Separation, DH5, Mode C (2480MHz)



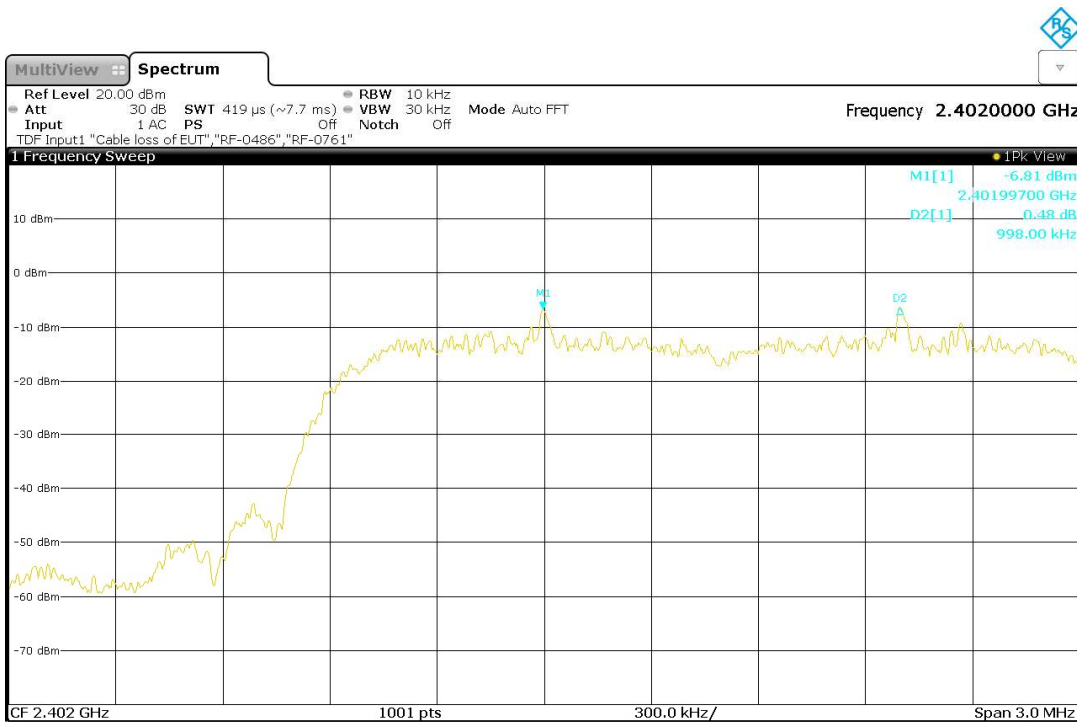
18:08:03 24.01.2021

Table 22: Carrier Frequency Separation, 3DH5

Freq. [MHz]	Channel Separation [MHz]	20dB Bandwidth [MHz]	Limit [MHz]
2402	0.998	1.346	0.897
2441	1.004	1.349	0.899
2480	0.998	1.358	0.905

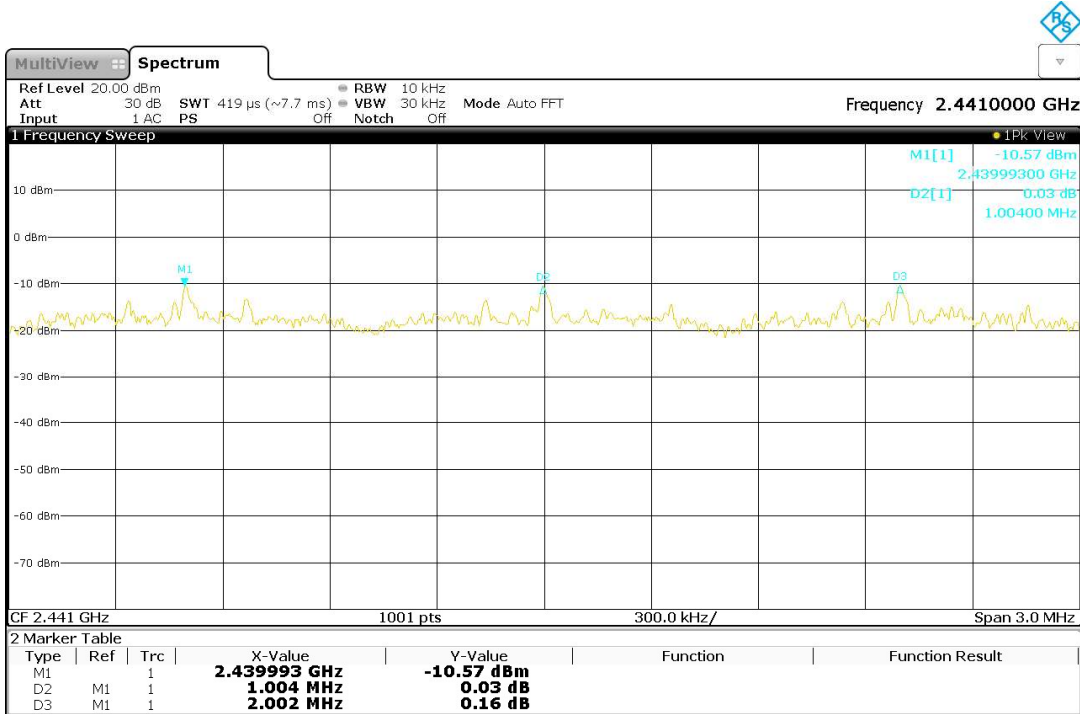
Notes: Limit = 20dB bandwidth * 2/3 since it is greater than 125kHz and the output power is less than 125mW.

Figure 22: Carrier Frequency Separation, 3DH5, Mode A (2402MHz)



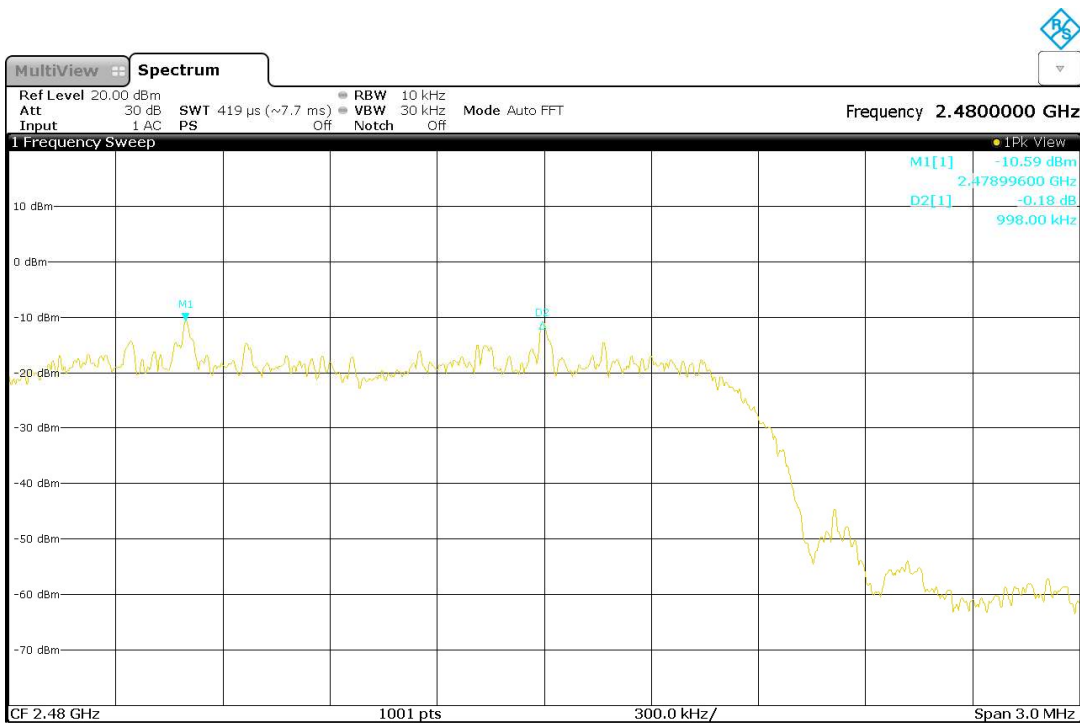
10:20:46 27.01.2021

Figure 23: Carrier Frequency Separation, 3DH5, Mode B (2441MHz)



10:31:22 27.01.2021

Figure 24: Carrier Frequency Separation, 3DH5, Mode C (2480MHz)



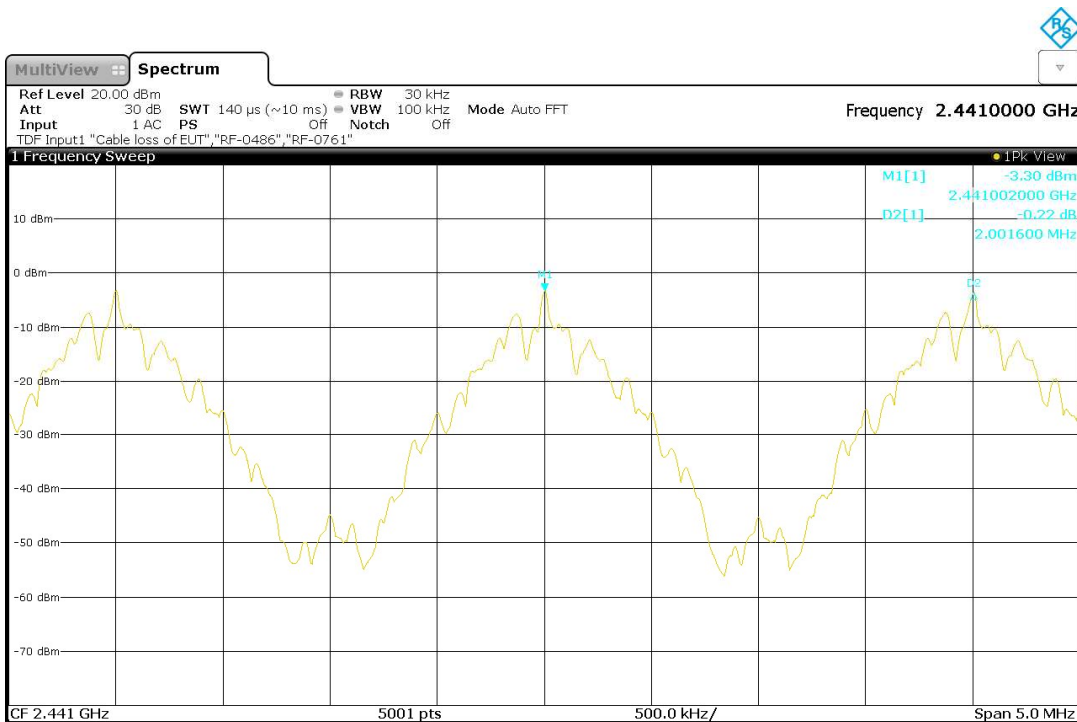
10:33:18 27.01.2021

Table 23: Carrier Frequency Separation, Inquiry

Freq. [MHz]	Channel Separation [MHz]	20dB Bandwidth [MHz]	Limit [MHz]
Hopping	2.002	0.833	0.555

Notes: Limit = 20dB bandwidth * 2/3 since it is greater than 125kHz and the output power is less than 125mW.

Figure 25: Carrier Frequency Separation, Inquiry



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5.2.5 Number of Hopping Frequencies

RESULT:

PASS

Date of testing: 2021-01-24

Ambient temperature: 22°C

Relative humidity: 31%

Atmospheric pressure: 1019hPa

Requirements:

FCC 15.247(a)(1)(iii)

Frequency hopping systems operating in the 2400-2483.5MHz band shall use at least 15 channels.

Test procedure:

ANSI C63.10 §7.8.3.

A spectrum analyzer was connected to the antenna port of the EUT. The analyzer resolution bandwidth and video bandwidth were set to 100kHz. The spectrum was broken in two plots having each a 50MHz span to show all the hopping frequencies.

Table 24: Number of Hopping Frequencies, DH5

Number of Hopping Frequencies	Limit
79	15

Figure 26: Hopping Frequencies, DH5, Mode H

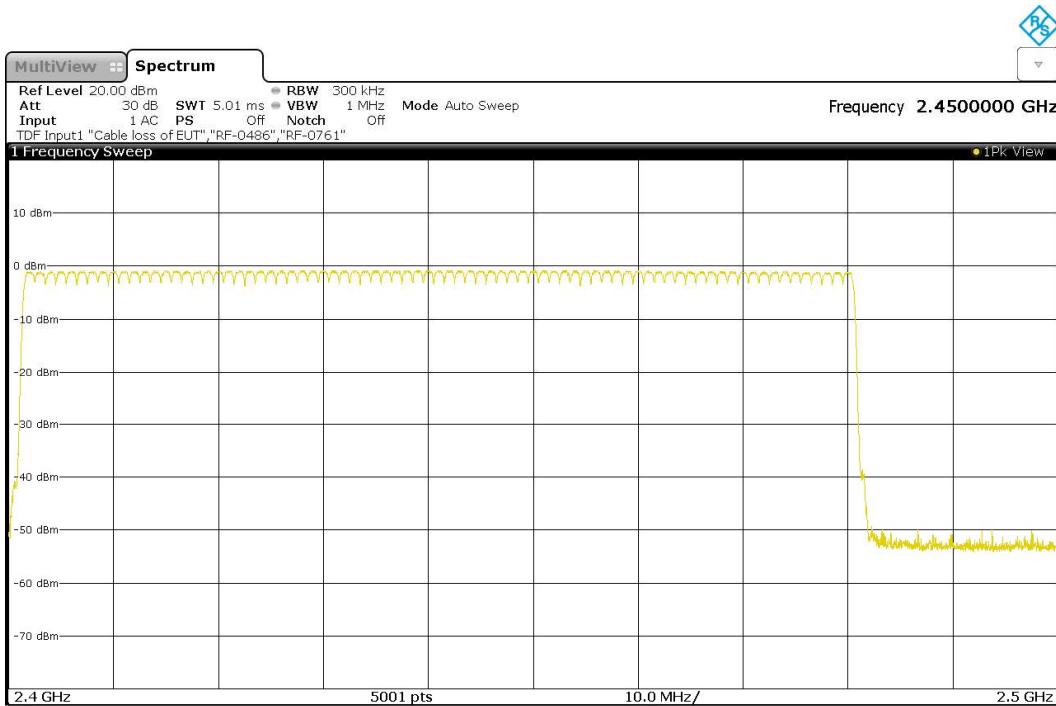


17:37:01 24.01.2021

Table 25: Number of Hopping Frequencies, 3DH5

Number of Hopping Frequencies	Limit
79	15

Figure 27: Hopping Frequencies, 3DH5, Mode H



17:42:17 24.01.2021