

TEST REPORT

Reference No..... : WTX20X11081880W-3
FCC ID : 2AW4Z-DUPLEXDS12
Applicant : Spirit System
Address..... : K Olsine 28, 73514 Orlova – Lutyne, Czech Republic
Product Name : DUPLEX DS-12
Test Model. : DUPLEX DS-12
Standards : FCC Part 15.247
Date of Receipt sample : Nov.15, 2020
Date of Test..... : Nov.15, 2020 to Nov.26, 2020
Date of Issue : Nov.26, 2020
Test Result..... : **Pass**

Remarks:

The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

Prepared By:

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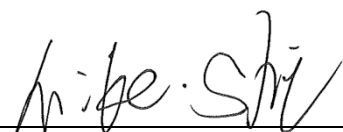
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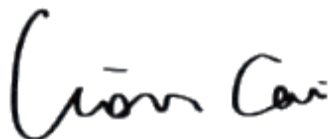
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Report version

Version No.	Date of issue	Description
Rev.00	Nov.26, 2020	Original
/	/	/

1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant: Spirit System
 Address of applicant: K Olsine 28, 73514 Orlova – Lutyne, Czech Republic

Manufacturer: Spirit System
 Address of manufacturer: K Olsine 28, 73514 Orlova – Lutyne, Czech Republic

General Description of EUT	
Product Name:	DUPLEX DS-12
Trade Name:	/
Model No.:	DUPLEX DS-12
Adding Model(s):	/
Rated Voltage:	Charging Port: DC12V Battery: DC3.6V
Battery Capacity:	6.2Ah
Power Adapter:	MODEL:SYS1531-2412-W2 INPUT:100-240V~,1.0A MAX, 50-60Hz OUTPUT:DC12V,2A
<i>Note: The test data is gathered from a production sample, provided by the manufacturer.</i>	

Technical Characteristics of EUT	
Frequency Range:	902.5-927.3MHz
RF Output Power:	1.77dBm (Conducted)
Modulation:	L1 F7: Chirp Spread Spectrum (CSS) L2 SF6: LoRa
Quantity of Channels:	32
Channel Separation:	800kHz
Type of Antenna:	Helical Antenna
Antenna Gain:	2.1dBi

1.2 Test Standards

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

558074 D01 15.247 Meas Guidance v05r02: Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating under section 15.247 of the Fcc rules.

ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product, which result in lowering the emission, should be checked to ensure compliance has been maintained.

1.3 Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, The equipment under test (EUT) was configured to measure its highest possible emission level. The test modes were adapted accordingly in reference to the Operating Instructions.

1.4 Test Facility

Address of the test laboratory

Laboratory: Waltek Testing Group (Shenzhen) Co., Ltd.

Address: 1/F., Room 101, Building 1, Hongwei Industrial Park, Liuxian 2nd Road, Block 70 Bao'an District, Shenzhen, Guangdong, China

FCC – Registration No.: 125990

Waltek Testing Group (Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. The Designation Number is CN5010, and Test Firm Registration Number is 125990.

Industry Canada (IC) Registration No.: 11464A

The 3m Semi-anechoic chamber of Waltek Testing Group (Shenzhen) Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 11464A.

1.5 EUT Setup and Test Mode

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. All testing shall be performed under maximum output power condition, and to measure its highest possible emissions level, more detailed description as follows:

Test Mode List		
Test Mode	Description	Remark
TM1	Low Channel	902.5MHz
TM2	Middle Channel	914.5MHz
TM3	High Channel	927.3MHz
TM4	Hopping	902.5-927.3MHz

Test Conditions	
Temperature:	22~25 °C
Relative Humidity:	50~55 %.
ATM Pressure:	1019 mbar

EUT Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
DC Cable	1.8	Unshielded	With Ferrite

Special Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
/	/	/	/

1.6 Measurement Uncertainty

Measurement uncertainty		
Parameter	Conditions	Uncertainty
RF Output Power	Conducted	$\pm 0.42\text{dB}$
Occupied Bandwidth	Conducted	$\pm 1.5\%$
Conducted Spurious Emission	Conducted	$\pm 2.17\text{dB}$
Conducted Emissions	Conducted	9-150kHz $\pm 3.74\text{dB}$
		0.15-30MHz $\pm 3.34\text{dB}$
Transmitter Spurious Emissions	Radiated	30-200MHz $\pm 4.52\text{dB}$
		0.2-1GHz $\pm 5.56\text{dB}$
		1-6GHz $\pm 3.84\text{dB}$
		6-26GHz $\pm 3.92\text{dB}$

1.7 Test Equipment List and Details

No.	Description	Manufacturer	Model	Serial No.	Cal Date	Due Date
SEMT-1072	Spectrum Analyzer	Agilent	E4407B	MY41440400	2020-04-28	2021-04-27
SEMT-1031	Spectrum Analyzer	Rohde & Schwarz	FSP30	836079/035	2020-04-28	2021-04-27
SEMT-1007	EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2020-04-28	2021-04-27
SEMT-1008	Amplifier	Agilent	8447F	3113A06717	2020-04-28	2021-04-27
SEMT-1043	Amplifier	C&D	PAP-1G18	2002	2020-04-28	2021-04-27
SEMT-1011	Broadband Antenna	Schwarz beck	VULB9163	9163-333	2019-05-05	2021-05-04
SEMT-1042	Horn Antenna	ETS	3117	00086197	2019-05-05	2021-05-04
SEMT-1121	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170582	2019-05-05	2021-05-04
SEMT-1069	Loop Antenna	Schwarz beck	FMZB 1516	9773	2019-05-05	2021-05-04
SEMT-1001	EMI Test Receiver	Rohde & Schwarz	ESPI	101611	2020-04-28	2021-04-27
SEMT-1003	L.I.S.N	Schwarz beck	NSLK8126	8126-224	2020-04-28	2021-04-27
SEMT-1002	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100911	2020-04-28	2021-04-27
SEMT-1168	Pre-amplifier	Direction Systems Inc.	PAP-0126	14141-12838	2020-04-28	2021-04-27
SEMT-1169	Pre-amplifier	Direction Systems Inc.	PAP-2640	14145-14153	2020-04-28	2021-04-27
SEMT-1163	Spectrum Analyzer	Rohde & Schwarz	FSP40	100612	2020-04-28	2021-04-27
SEMT-1170	DRG Horn Antenna	A.H. SYSTEMS	SAS-574	571	2019-05-05	2021-05-04
SEMT-1166	Power Limiter	Agilent	N9356B	MY45450376	2020-04-28	2021-04-27
SEMT-1048	RF Limiter	ATTEN	AT-BSF-2400~2500	/	2020-04-28	2021-04-27
SEMT-1076	RF Switcher	Top Precision	RCS03-A2	/	2020-04-28	2021-04-27
SEMT-C001	Cable	Zheng DI	LL142-07-07-10M(A)	/	2020-03-17	2021-03-16
SEMT-C002	Cable	Zheng DI	ZT40-2.92J-2.92J-6M	/	2020-03-17	2021-03-16
SEMT-C003	Cable	Zheng DI	ZT40-2.92J-2.92J-2.5M	/	2020-03-17	2021-03-16
SEMT-C004	Cable	Zheng DI	2M0RFC	/	2020-03-17	2021-03-16
SEMT-C005	Cable	Zheng DI	1M0RFC	/	2020-03-17	2021-03-16
SEMT-C006	Cable	Zheng DI	1M0RFC	/	2020-03-17	2021-03-16

Software List			
Description	Manufacturer	Model	Version
EMI Test Software (Radiated Emission)*	Farad	EZ-EMC	RA-03A1
EMI Test Software (Conducted Emission)*	Farad	EZ-EMC	RA-03A1

*Remark: indicates software version used in the compliance certification testing

2. SUMMARY OF TEST RESULTS

FCC Rules	Description of Test Item	Result
§15.203; §15.247(b)(4)(i)	Antenna Requirement	Compliant
§15.205	Restricted Band of Operation	Compliant
§15.207(a)	Conducted Emission	Compliant
§15.209(a)	Radiated Spurious Emissions	Compliant
§15.247(a)(1)(iii)	Quantity of Hopping Channel	Compliant
§15.247(a)(1)	Channel Separation	Compliant
§15.247(a)(1)(iii)	Time of Occupancy (Dwell time)	Compliant
§15.247(a)	20dB Bandwidth	Compliant
§15.247(b)(1)	RF Power Output	Compliant
§15.247(d)	Band Edge (Out of Band Emissions)	Compliant
§15.247(a)(1)	Frequency Hopping Sequence	Compliant
§15.247(g), (h)	Frequency Hopping System	Compliant

N/A: Not applicable

3 Antenna Requirement

3.1 Standard Applicable

According to FCC Part 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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

3.2 Evaluation Information

This product has a Helical antenna, fulfill the requirement of this section.

4. Frequency Hopping System Requirements

4.1 Standard Applicable

According to FCC Part 15.247(a)(1), the system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

(h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

4.2 Frequency Hopping System

This transmitter device is frequency hopping device, and complies with FCC part 15.247 rule.

This device uses transmitter radio which operates in 902.5-927.3 MHz band. It uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 18 bands (4 MHz each; centred from 902.5 to 927.3MHz) in the range 902.5-927.3MHz.

This device was tested with a system receiver to check that the device maintained hopping synchronization, and the device complied with these requirements for 558074 D01 15.247 Meas Guidance v05r02 and FCC Part 15.247 rule.

4.3 EUT Pseudorandom Frequency Hopping Sequence

Pseudorandom Frequency Hopping Sequence Table as below:

Channel: 4, 10, 14, 15, 16, 14, 11, 15, 6, 8, 4, 1, 3, 13, 14, 17, 6, 14, 7, 18, 11, 6, 13, 12, 2, 11, 5, 3, 17, 11, 12, 18, 13, 7, 5, 2, 7, 6, 13, 14, 8, 10, 14, 15, 17, 4, 1, 11, 10, 11, 18, 6, 17, 11, 1, 4, 18, 5, 11, 12, 16, 15, 2, 17, 13, 9, 10, 15, 5, 1, 18, 12, 1, 6 etc.

The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

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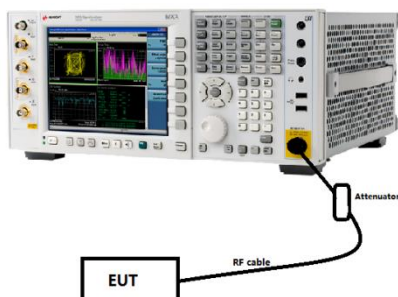
<http://www.semtest.com.cn>

5. Quantity of Hopping Channels and Channel Separation

5.1 Standard Applicable

According to FCC 15.247(a)(1), frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, and frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

5.2 Test Setup Block Diagram



5.3 Test Procedure

According to KDB 558074 D01 v05r02 Subclause 9 and ANSI C63.10-2013 section 7.8.3, the number of hopping frequencies test method as follows.

- a) Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
- b) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
- c) $VBW \geq RBW$.
- d) Sweep: Auto.
- e) Detector function: Peak.
- f) Trace: Max hold.
- g) Allow the trace to stabilize.

According to KDB 558074 D01 v05r02 Subclause 9 and ANSI C63.10-2013 section 7.8.2, the EUT shall have its hopping function enabled, the Carrier frequency separation test method as follows:

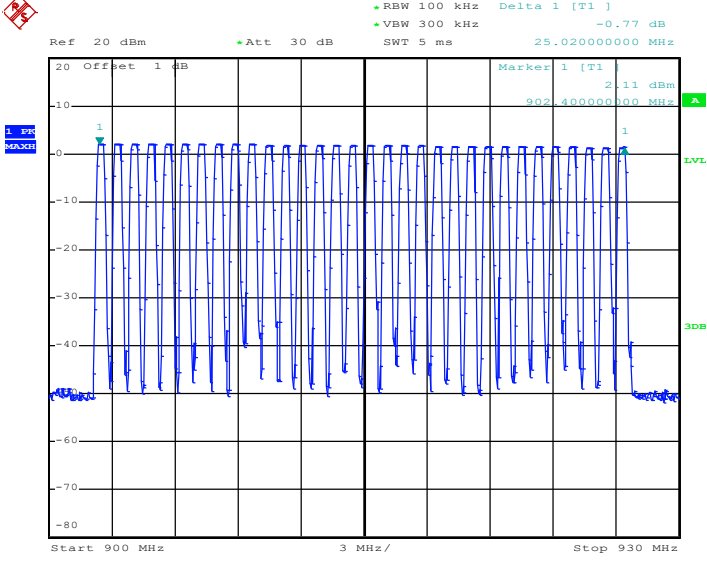
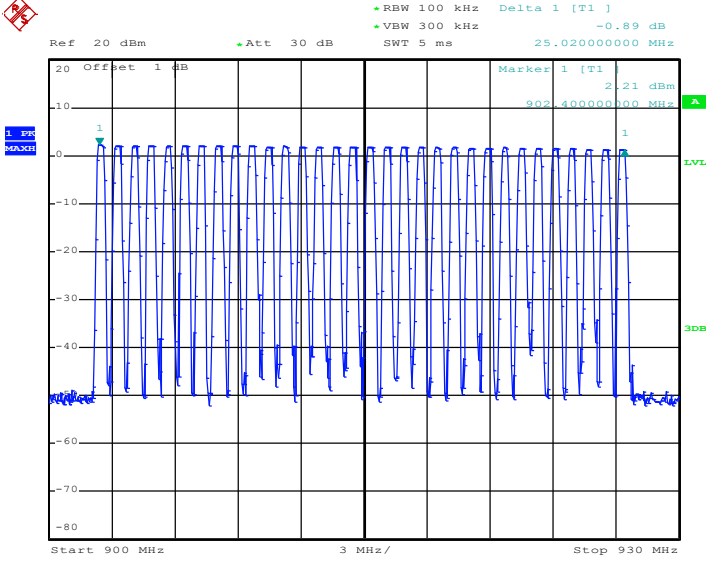
- a) Span: Wide enough to capture the peaks of two adjacent channels.
- b) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
- c) Video (or average) bandwidth (VBW) \geq RBW.
- d) Sweep: Auto.
- e) Detector function: Peak.

f) Trace: Max hold.

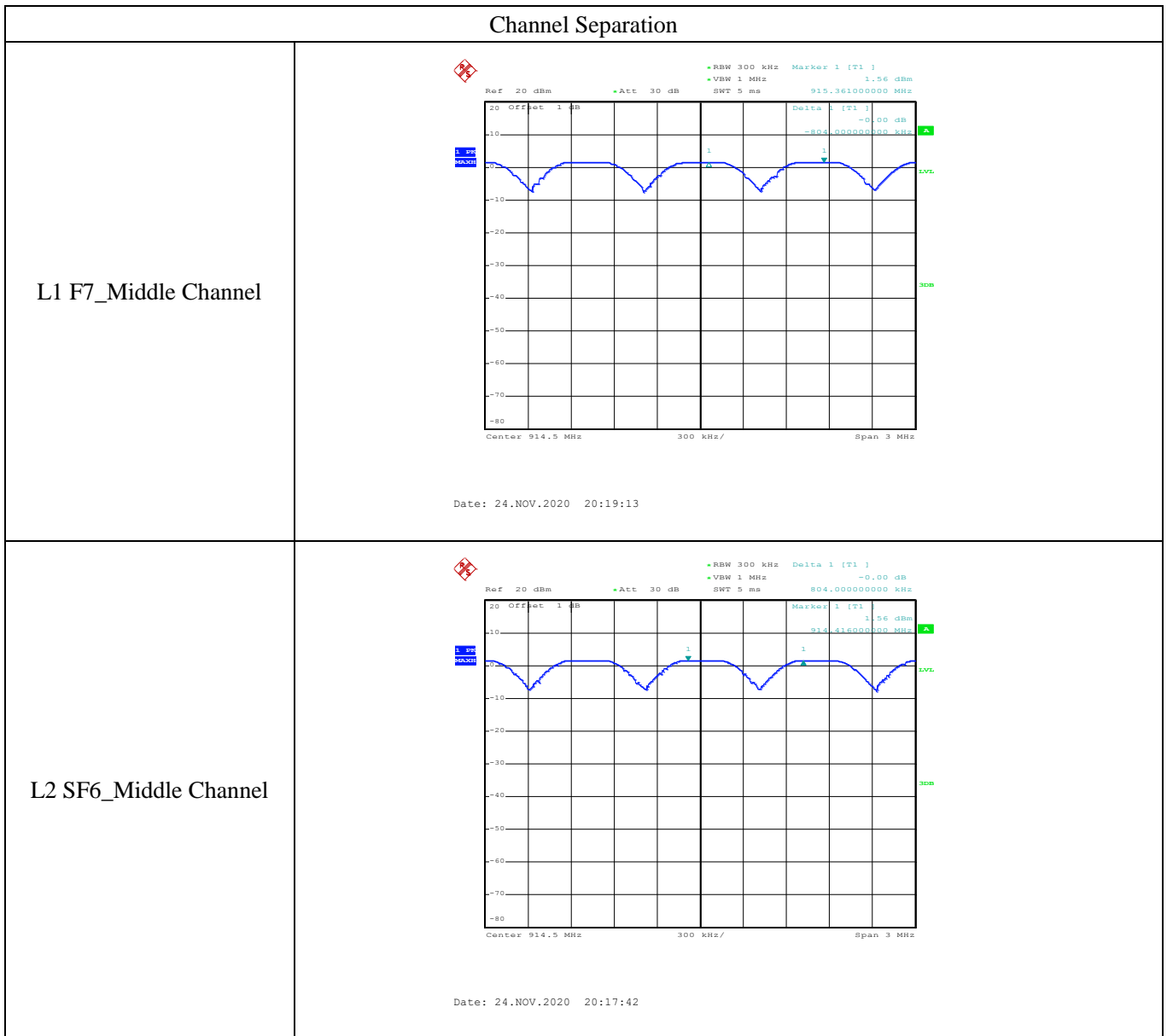
g) Allow the trace to stabilize.

Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

5.4 Summary of Test Results/Plots

<p>L1 F7_Hopping Channel</p>	 <p>Date: 24.NOV.2020 20:27:17</p>
<p>L2 SF6_Hopping Channel</p>	 <p>Date: 24.NOV.2020 20:28:06</p>

Radio Modulation	Channel	Carrier Frequencies Separation (kHz)	Result
L1 F7	Middle	804.0	Pass
L2 SF6	Middle	804.0	Pass

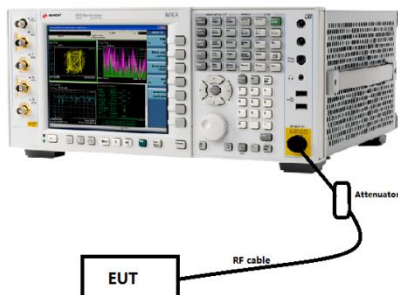


6. Dwell Time of Hopping Channel

6.1 Standard Applicable

According to 15.247(a)(1)(iii), frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

6.2 Test Setup Block Diagram



6.3 Test Procedure

According to KDB 558074 D01 v05r02 Subclause 9 and ANSI C63.10-2013 section 7.8.4, the dwell time of a hopping channel test method as follows.

- a) Span: Zero span, centered on a hopping channel.
- b) RBW shall be \leq channel spacing and where possible RBW should be set $\gg 1/T$, where T is the expected dwell time per channel.
- c) Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
- d) Detector function: Peak.
- e) Trace: Max hold.

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

$$(\text{Number of hops in the period specified in the requirements}) = (\text{number of hops on spectrum analyzer}) \times (\text{period specified in the requirements} / \text{analyzer sweep time})$$

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The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified in the requirements. If the number of hops in a specific time varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation. The measured transmit time and time between hops shall be consistent with the values described in the operational description for the EUT.

6.4 Summary of Test Results/Plots

Dwell time = time slot length * (Hopping rate / Number of hopping channels) * Period

L1 F7:

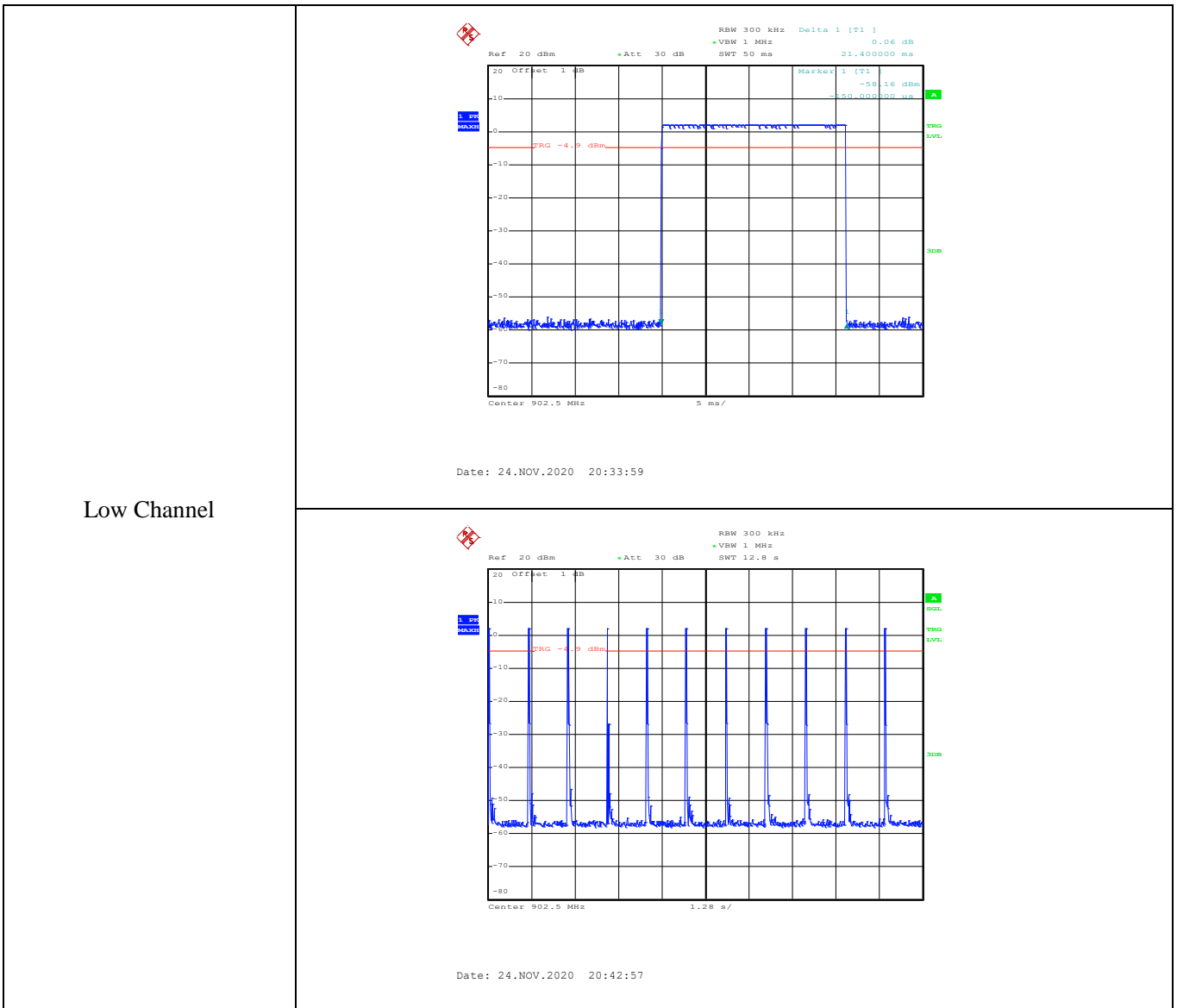
Test Channel	Test period (s)	Number of Bursts per Hopping Period	Burst Duration (ms)	Dwell time (ms)	Limit (ms)
Low	12.8	11	21.4	235.4	400
Middle	12.8	11	21.4	235.4	400
High	12.8	11	21.4	235.4	400

L2 SF6:

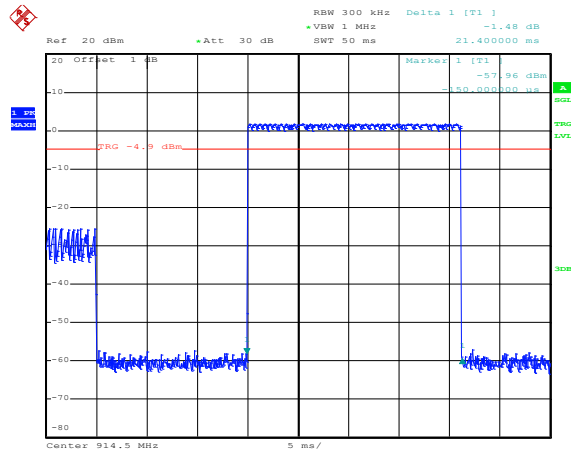
Test Channel	Test period (s)	Number of Bursts per Hopping Period	Burst Duration (ms)	Dwell time (ms)	Limit (ms)
Low	12.8	23	10.8	248.4	400
Middle	12.8	23	10.8	248.4	400
High	12.8	23	10.8	248.4	400

Please refer to the test plots as below:

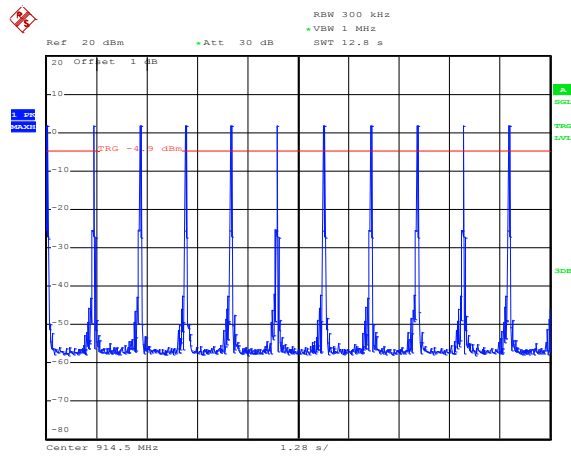
L1 F7:



Middle Channel

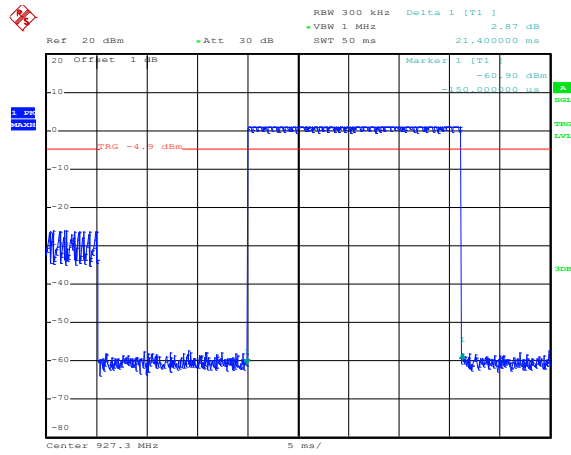


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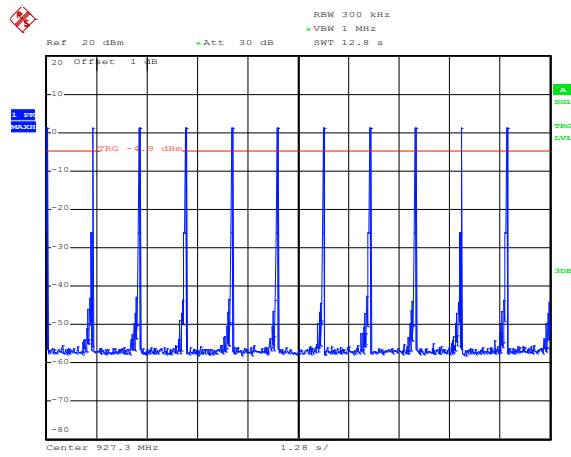


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High Channel

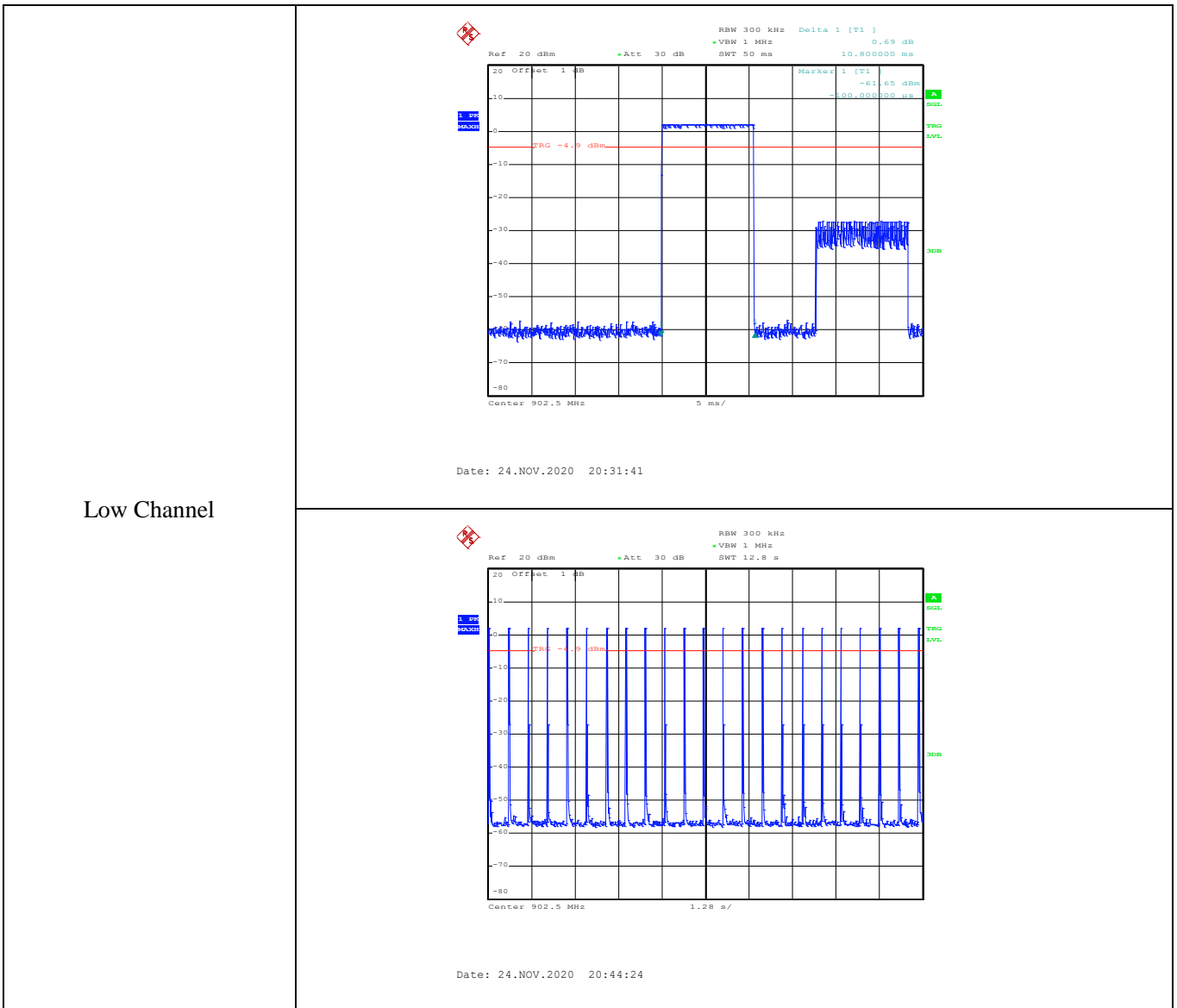


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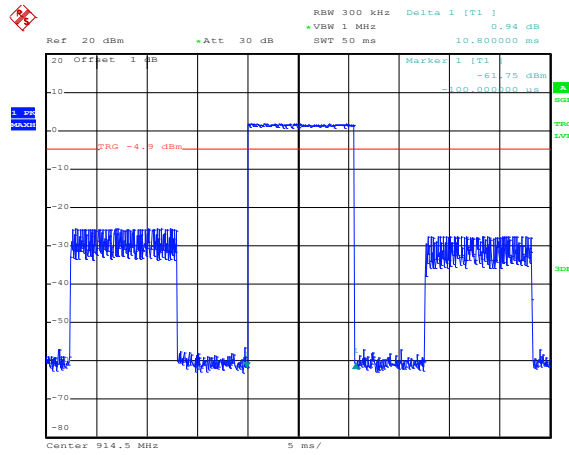


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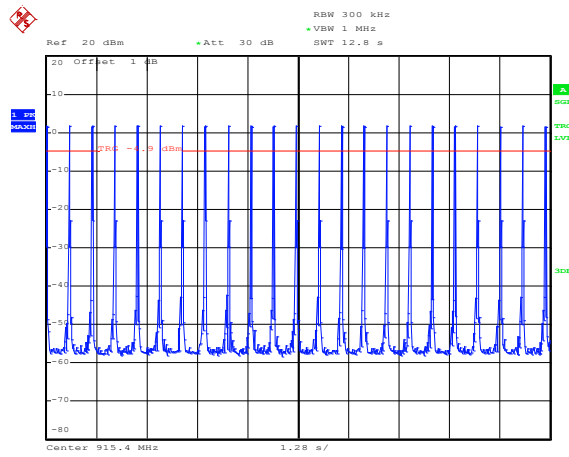
L2 SF6:



Middle Channel

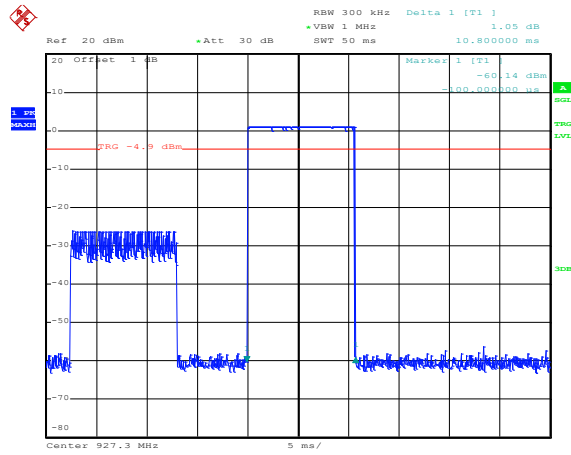


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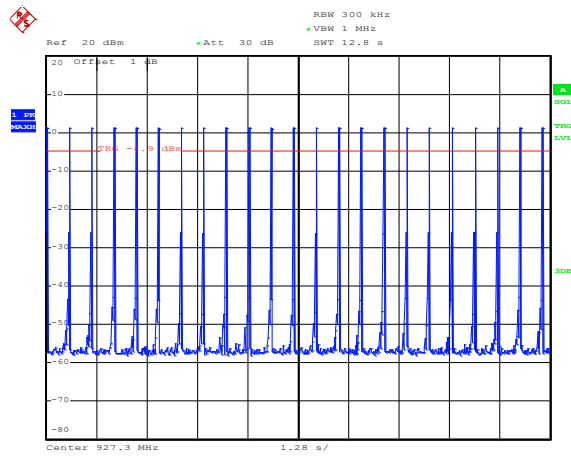


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High Channel



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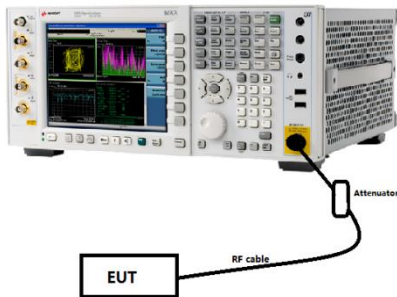
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7. 20dB Bandwidth

7.1 Standard Applicable

According to 15.247(a) and 15.215(c), 20dB bandwidth is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

7.2 Test Setup Block Diagram



7.3 Test Procedure

According to KDB 558074 D01 v05r02 Subclause 9 and ANSI C63.10-2013 section 6.9.2, the 20dB bandwidth test method as follows.

- a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the EMI receiver or spectrum analyzer shall be between two times and five times the OBW.
- b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW, unless otherwise specified by the applicable requirement.
- c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than $[10 \log (\text{OBW}/\text{RBW})]$ below the reference level.
- d) Steps a) through c) might require iteration to adjust within the specified tolerances.
- e) The dynamic range of the instrument at the selected RBW shall be more than 10 dB below the target “-xx dB down” requirement; that is, if the requirement calls for measuring the -20 dB OBW, the instrument noise floor at the selected RBW shall be at least 30 dB below the reference value.
- f) Set detection mode to peak and trace mode to max hold.
- g) Determine the reference value: Set the EUT to transmit an unmodulated carrier or modulated signal, as applicable. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).
- h) Determine the “-xx dB down amplitude” using $[(\text{reference value}) - \text{xx}]$. Alternatively, this calculation may be made by using the marker-delta function of the instrument.
- i) If the reference value is determined by an unmodulated carrier, then turn the EUT modulation ON, and either clear the existing trace or start a new trace on the spectrum analyzer and allow the new trace to stabilize. Otherwise, the trace from step g) shall be used for step j).

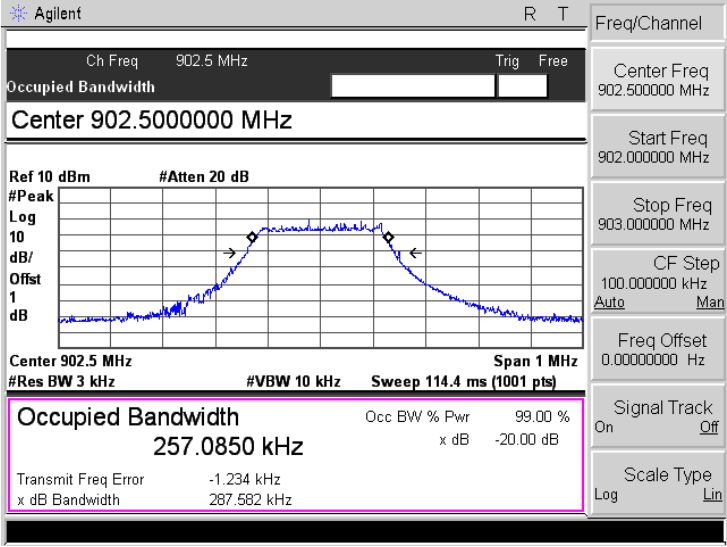
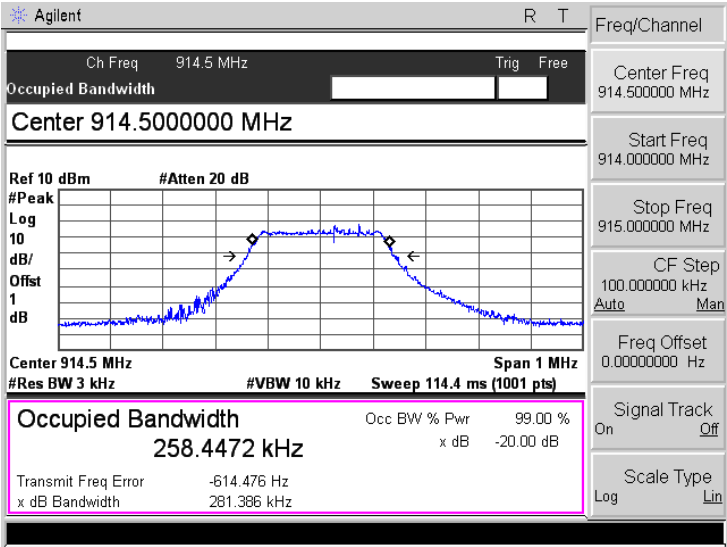
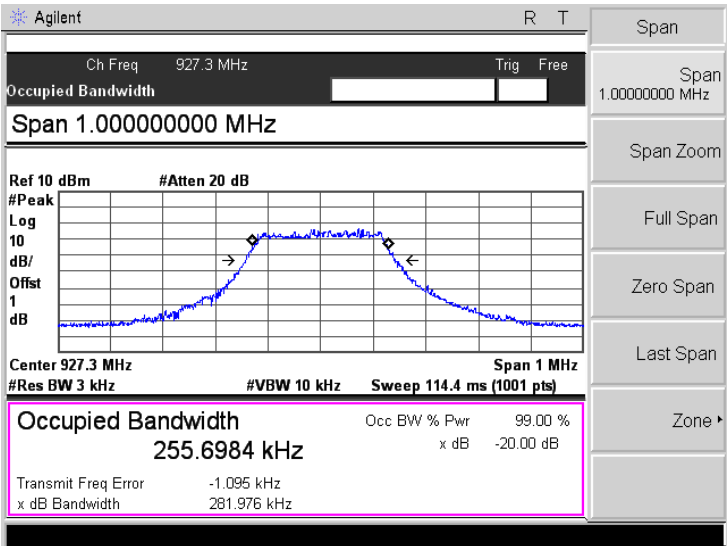
j) Place two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the “-xx dB down amplitude” determined in step h). If a marker is below this “-xx dB down amplitude” value, then it shall be as close as possible to this value. The occupied bandwidth is the frequency difference between the two markers. Alternatively, set a marker at the lowest frequency of the envelope of the spectral display, such that the marker is at or slightly below the “-xx dB down amplitude” determined in step h). Reset the marker-delta function and move the marker to the other side of the emission until the delta marker amplitude is at the same level as the reference marker amplitude. The marker-delta frequency reading at this point is the specified emission bandwidth.

k) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

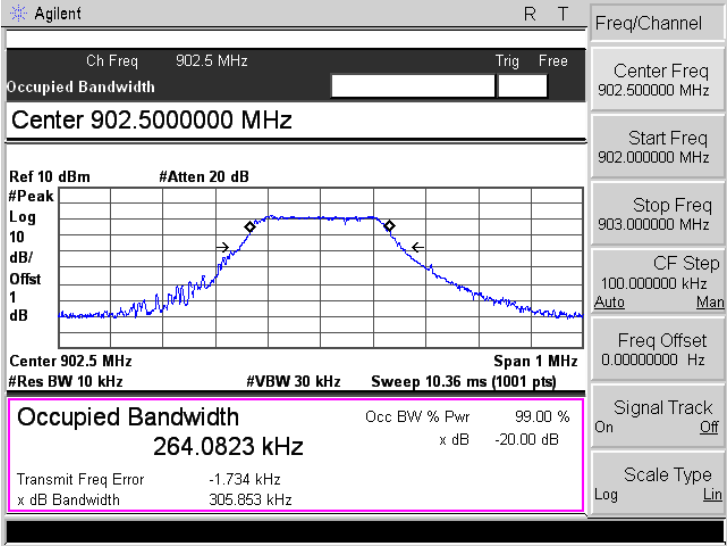
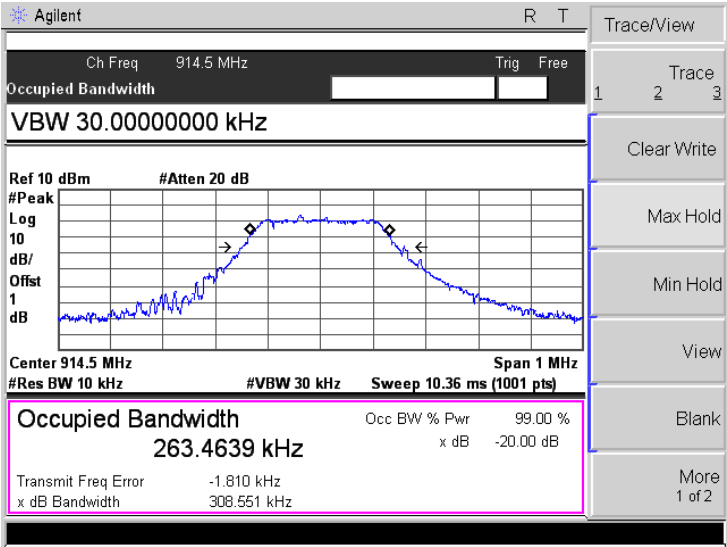
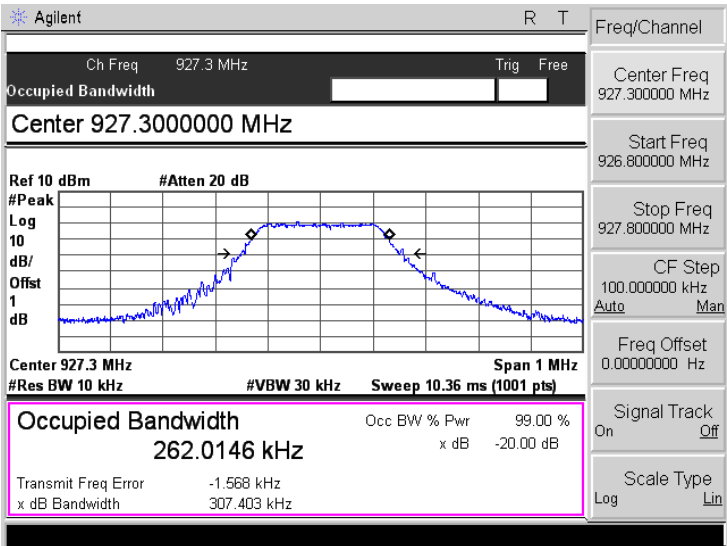
7.4 Summary of Test Results/Plots

Radio Modulation	Test Channel	20dB Bandwidth (kHz)	Result
L1 F7	Low	287.582	Pass
	Middle	281.386	Pass
	High	281.976	Pass
L2 SF6	Low	305.853	Pass
	Middle	308.551	Pass
	High	307.403	Pass

L1 F7:

<p>Low Channel</p>	 <p>Agilent R T</p> <p>Ch Freq 902.5 MHz Trig Free</p> <p>Occupied Bandwidth</p> <p>Center 902.500000 MHz</p> <p>Ref 10 dBm #Atten 20 dB</p> <p>#Peak Log 10 dB/ Offst 1 dB</p> <p>Center 902.5 MHz Span 1 MHz</p> <p>#Res BW 3 kHz #VBW 10 kHz Sweep 114.4 ms (1001 pts)</p> <p>Occupied Bandwidth 257.0850 kHz</p> <p>Occ BW % Pwr 99.00 % x dB -20.00 dB</p> <p>Transmit Freq Error -1.234 kHz x dB Bandwidth 287.582 kHz</p> <p>Freq/Channel</p> <p>Center Freq 902.500000 MHz</p> <p>Start Freq 902.000000 MHz</p> <p>Stop Freq 903.000000 MHz</p> <p>CF Step 100.000000 kHz Auto Man</p> <p>Freq Offset 0.000000 Hz</p> <p>Signal Track On Off</p> <p>Scale Type Log Lin</p>
<p>Middle Channel</p>	 <p>Agilent R T</p> <p>Ch Freq 914.5 MHz Trig Free</p> <p>Occupied Bandwidth</p> <p>Center 914.500000 MHz</p> <p>Ref 10 dBm #Atten 20 dB</p> <p>#Peak Log 10 dB/ Offst 1 dB</p> <p>Center 914.5 MHz Span 1 MHz</p> <p>#Res BW 3 kHz #VBW 10 kHz Sweep 114.4 ms (1001 pts)</p> <p>Occupied Bandwidth 258.4472 kHz</p> <p>Occ BW % Pwr 99.00 % x dB -20.00 dB</p> <p>Transmit Freq Error -614.476 Hz x dB Bandwidth 281.386 kHz</p> <p>Freq/Channel</p> <p>Center Freq 914.500000 MHz</p> <p>Start Freq 914.000000 MHz</p> <p>Stop Freq 915.000000 MHz</p> <p>CF Step 100.000000 kHz Auto Man</p> <p>Freq Offset 0.000000 Hz</p> <p>Signal Track On Off</p> <p>Scale Type Log Lin</p>
<p>High Channel</p>	 <p>Agilent R T</p> <p>Ch Freq 927.3 MHz Trig Free</p> <p>Occupied Bandwidth</p> <p>Span 1.00000000 MHz</p> <p>Ref 10 dBm #Atten 20 dB</p> <p>#Peak Log 10 dB/ Offst 1 dB</p> <p>Center 927.3 MHz Span 1 MHz</p> <p>#Res BW 3 kHz #VBW 10 kHz Sweep 114.4 ms (1001 pts)</p> <p>Occupied Bandwidth 255.6984 kHz</p> <p>Occ BW % Pwr 99.00 % x dB -20.00 dB</p> <p>Transmit Freq Error -1.095 kHz x dB Bandwidth 281.976 kHz</p> <p>Span</p> <p>Span 1.00000000 MHz</p> <p>Span Zoom</p> <p>Full Span</p> <p>Zero Span</p> <p>Last Span</p> <p>Zone ▶</p>

L2 SF6:

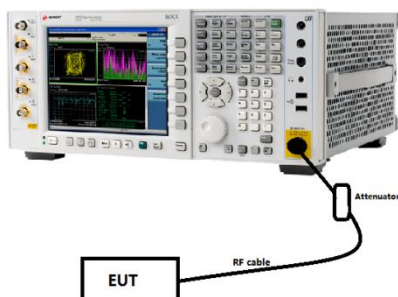
<p>Low Channel</p>	 <p>Agilent R T</p> <p>Ch Freq 902.5 MHz Trig Free</p> <p>Occupied Bandwidth</p> <p>Center 902.500000 MHz</p> <p>Ref 10 dBm #Atten 20 dB</p> <p>#Peak Log 10 dB/ Offst 1 dB</p> <p>Center 902.5 MHz Span 1 MHz</p> <p>#Res BW 10 kHz #VBW 30 kHz Sweep 10.36 ms (1001 pts)</p> <table border="1"> <tr> <td>Occupied Bandwidth</td> <td>Occ BW % Pwr</td> <td>99.00 %</td> </tr> <tr> <td>264.0823 kHz</td> <td>x dB</td> <td>-20.00 dB</td> </tr> <tr> <td>Transmit Freq Error</td> <td colspan="2">-1.734 kHz</td> </tr> <tr> <td>x dB Bandwidth</td> <td colspan="2">305.853 kHz</td> </tr> </table> <p>Freq/Channel</p> <p>Center Freq 902.500000 MHz</p> <p>Start Freq 902.000000 MHz</p> <p>Stop Freq 903.000000 MHz</p> <p>CF Step 100.000000 kHz Auto Man</p> <p>Freq Offset 0.0000000 Hz</p> <p>Signal Track On Off</p> <p>Scale Type Log Lin</p>	Occupied Bandwidth	Occ BW % Pwr	99.00 %	264.0823 kHz	x dB	-20.00 dB	Transmit Freq Error	-1.734 kHz		x dB Bandwidth	305.853 kHz	
Occupied Bandwidth	Occ BW % Pwr	99.00 %											
264.0823 kHz	x dB	-20.00 dB											
Transmit Freq Error	-1.734 kHz												
x dB Bandwidth	305.853 kHz												
<p>Middle Channel</p>	 <p>Agilent R T</p> <p>Ch Freq 914.5 MHz Trig Free</p> <p>Occupied Bandwidth</p> <p>VBW 30.00000000 kHz</p> <p>Ref 10 dBm #Atten 20 dB</p> <p>#Peak Log 10 dB/ Offst 1 dB</p> <p>Center 914.5 MHz Span 1 MHz</p> <p>#Res BW 10 kHz #VBW 30 kHz Sweep 10.36 ms (1001 pts)</p> <table border="1"> <tr> <td>Occupied Bandwidth</td> <td>Occ BW % Pwr</td> <td>99.00 %</td> </tr> <tr> <td>263.4639 kHz</td> <td>x dB</td> <td>-20.00 dB</td> </tr> <tr> <td>Transmit Freq Error</td> <td colspan="2">-1.810 kHz</td> </tr> <tr> <td>x dB Bandwidth</td> <td colspan="2">308.551 kHz</td> </tr> </table> <p>Trace/View</p> <p>1 2 3</p> <p>Clear Write</p> <p>Max Hold</p> <p>Min Hold</p> <p>View</p> <p>Blank</p> <p>More 1 of 2</p>	Occupied Bandwidth	Occ BW % Pwr	99.00 %	263.4639 kHz	x dB	-20.00 dB	Transmit Freq Error	-1.810 kHz		x dB Bandwidth	308.551 kHz	
Occupied Bandwidth	Occ BW % Pwr	99.00 %											
263.4639 kHz	x dB	-20.00 dB											
Transmit Freq Error	-1.810 kHz												
x dB Bandwidth	308.551 kHz												
<p>High Channel</p>	 <p>Agilent R T</p> <p>Ch Freq 927.3 MHz Trig Free</p> <p>Occupied Bandwidth</p> <p>Center 927.300000 MHz</p> <p>Ref 10 dBm #Atten 20 dB</p> <p>#Peak Log 10 dB/ Offst 1 dB</p> <p>Center 927.3 MHz Span 1 MHz</p> <p>#Res BW 10 kHz #VBW 30 kHz Sweep 10.36 ms (1001 pts)</p> <table border="1"> <tr> <td>Occupied Bandwidth</td> <td>Occ BW % Pwr</td> <td>99.00 %</td> </tr> <tr> <td>262.0146 kHz</td> <td>x dB</td> <td>-20.00 dB</td> </tr> <tr> <td>Transmit Freq Error</td> <td colspan="2">-1.568 kHz</td> </tr> <tr> <td>x dB Bandwidth</td> <td colspan="2">307.403 kHz</td> </tr> </table> <p>Freq/Channel</p> <p>Center Freq 927.300000 MHz</p> <p>Start Freq 926.800000 MHz</p> <p>Stop Freq 927.800000 MHz</p> <p>CF Step 100.000000 kHz Auto Man</p> <p>Freq Offset 0.0000000 Hz</p> <p>Signal Track On Off</p> <p>Scale Type Log Lin</p>	Occupied Bandwidth	Occ BW % Pwr	99.00 %	262.0146 kHz	x dB	-20.00 dB	Transmit Freq Error	-1.568 kHz		x dB Bandwidth	307.403 kHz	
Occupied Bandwidth	Occ BW % Pwr	99.00 %											
262.0146 kHz	x dB	-20.00 dB											
Transmit Freq Error	-1.568 kHz												
x dB Bandwidth	307.403 kHz												

8. RF Output Power

8.1 Standard Applicable

According to 15.247(b)(1), for frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

8.2 Test Setup Block Diagram



8.3 Test Procedure

According to KDB 558074 D01 v05r02 Subclause 9 and ANSI C63.10-2013 section 7.8.5, the output power test method as follows.

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

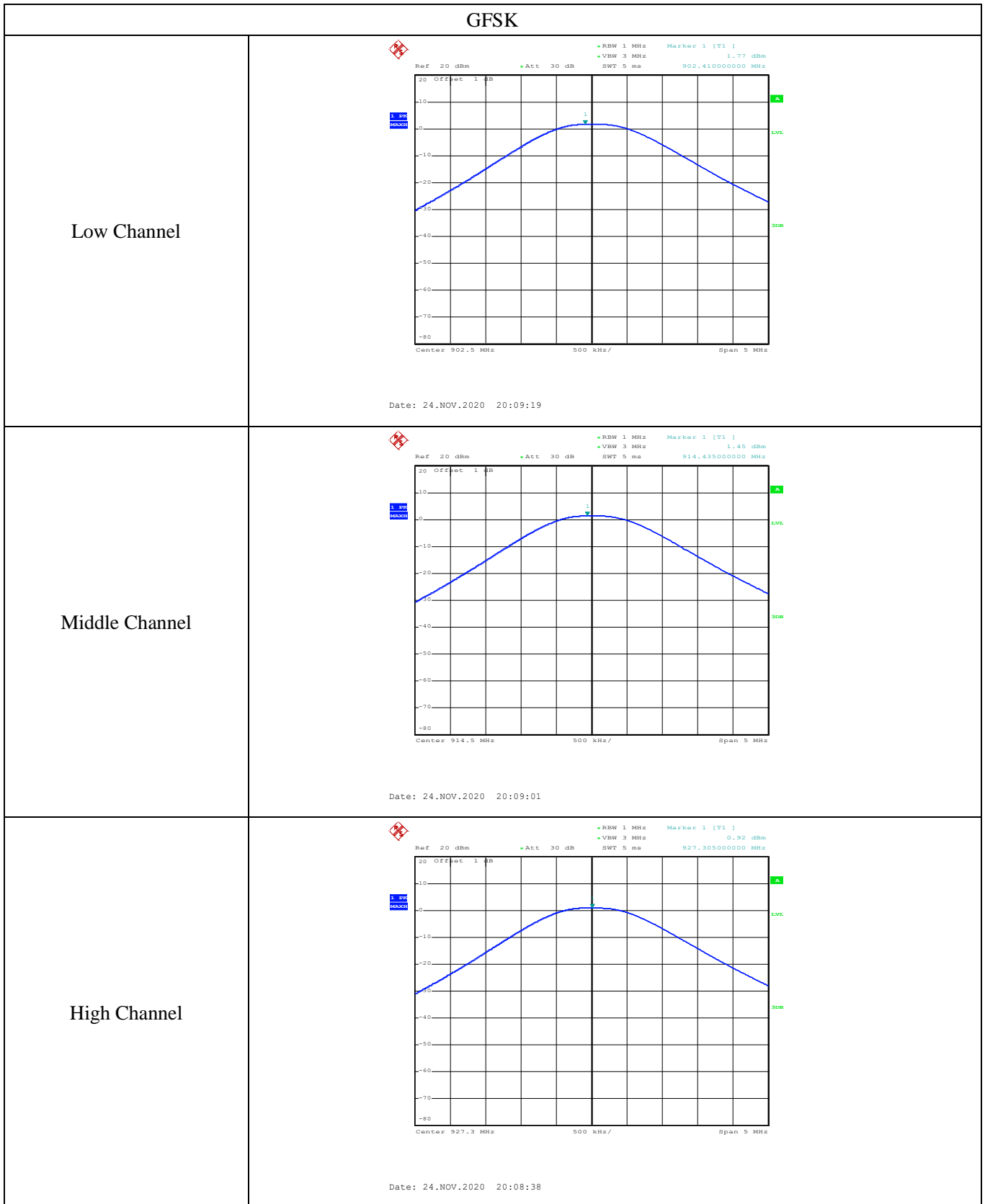
This is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation. The hopping shall be disabled for this test:

- a) Use the following spectrum analyzer settings:
 - 1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
 - 2) RBW > 20 dB bandwidth of the emission being measured.
 - 3) VBW \geq RBW.
 - 4) Sweep: Auto.
 - 5) Detector function: Peak.
 - 6) Trace: Max hold.
- b) Allow trace to stabilize.
- c) Use the marker-to-peak function to set the marker to the peak of the emission.
- d) The indicated level is the peak output power, after any corrections for external attenuators and cables.
- e) A plot of the test results and setup description shall be included in the test report.

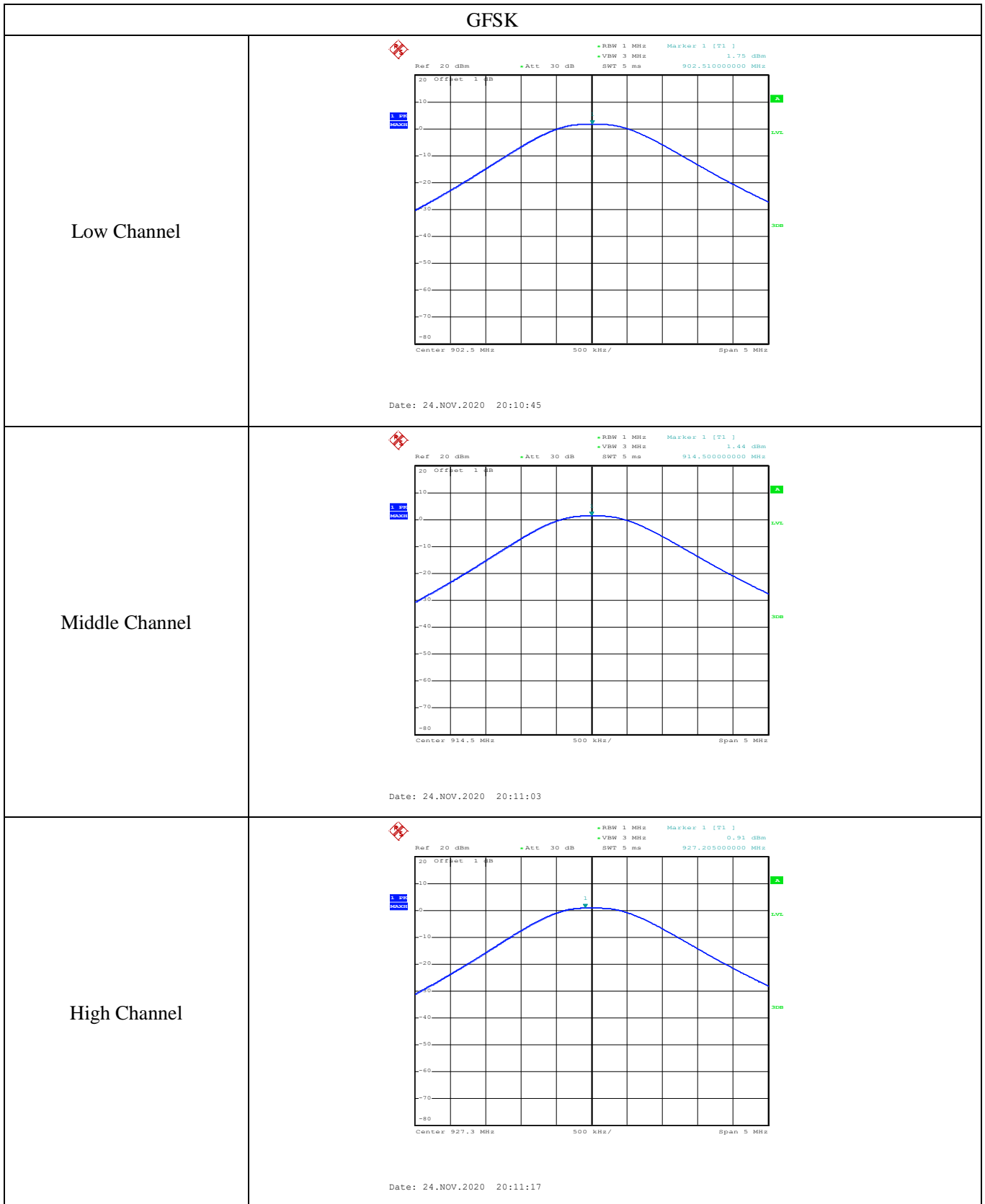
8.4 Summary of Test Results/Plots

Radio Modulation	Test Channel	Measured Value dBm	Output Power mW	Limit mW
L1 F7	Low	1.77	1.50	1000
	Middle	1.45	1.40	1000
	High	0.92	1.24	1000
L2 SF6	Low	1.75	1.50	1000
	Middle	1.44	1.39	1000
	High	0.91	1.23	1000

L1 F7:



L2 SF6:



9. Field Strength of Spurious Emissions

9.1 Standard Applicable

According to §15.247(d), 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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

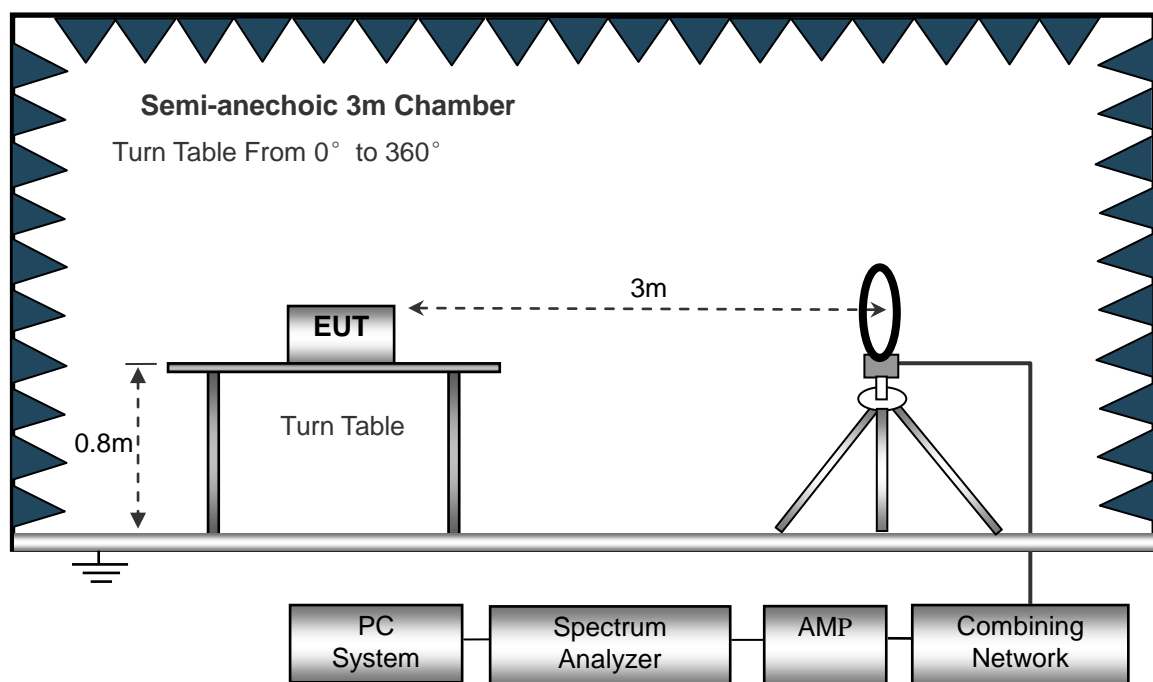
9.2 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.205 15.247(a) and FCC Part 15.209 Limit.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

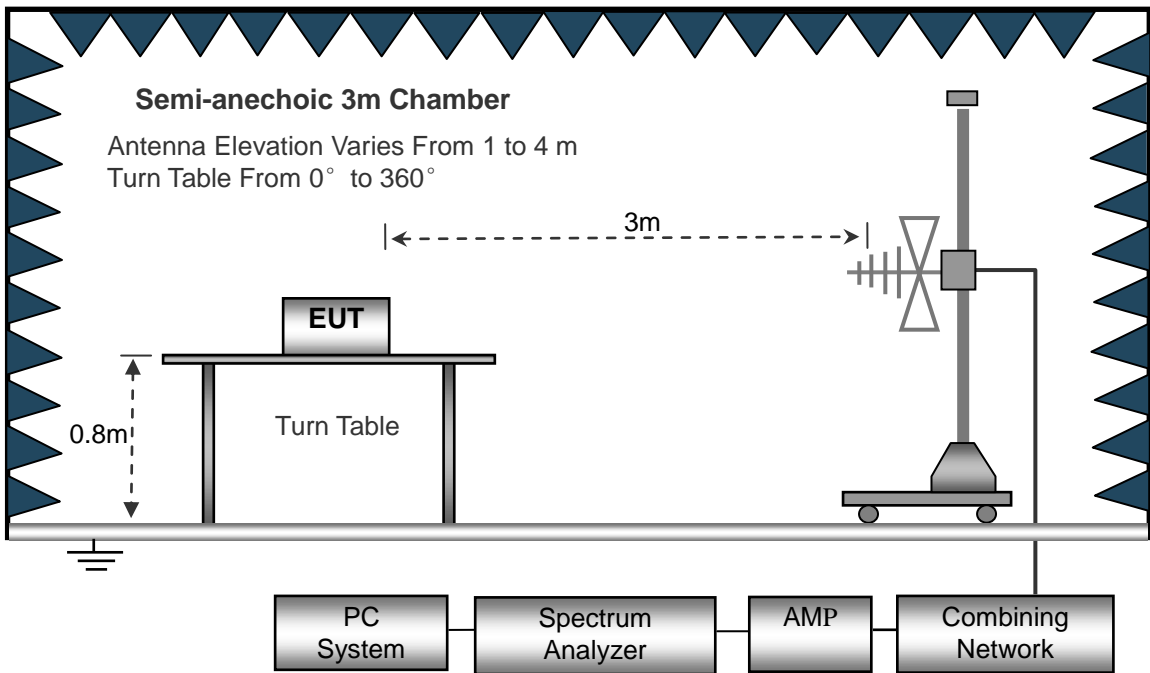
The test setup for emission measurement below 30MHz..



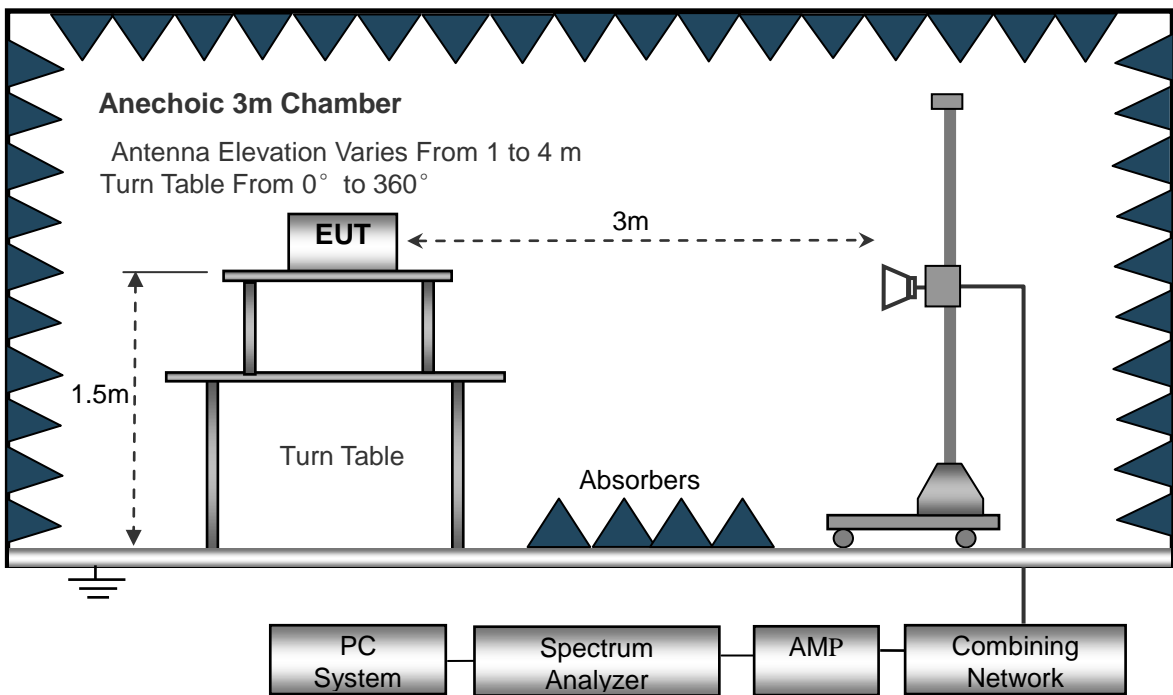
The test setup for emission measurement from 30 MHz to 1 GHz..

Waltek Testing Group (Shenzhen) Co., Ltd.

<http://www.semtest.com.cn>



The test setup for emission measurement above 1 GHz..



Frequency :9kHz-30MHz
 RBW=10KHz,
 VBW =30KHz
 Sweep time= Auto
 Trace = max hold
 Detector function = peak

Frequency :30MHz-1GHz
 RBW=120KHz,
 VBW=300KHz
 Sweep time= Auto
 Trace = max hold
 Detector function = peak, QP

Frequency :Above 1GHz
 RBW=1MHz,
 VBW=3MHz(Peak), 10Hz(AV)
 Sweep time= Auto
 Trace = max hold
 Detector function = peak, AV

9.3 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and the Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

$$\begin{aligned}\text{Corr. Ampl.} &= \text{Indicated Reading} + \text{Correct} \\ \text{Correct} &= \text{Ant. Factor} + \text{Cable Loss} - \text{Ampl. Gain}\end{aligned}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -6dB μ V means the emission is 6dB μ V below the maximum limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{FCC Part 15 Limit}$$

9.4 Summary of Test Results/Plots

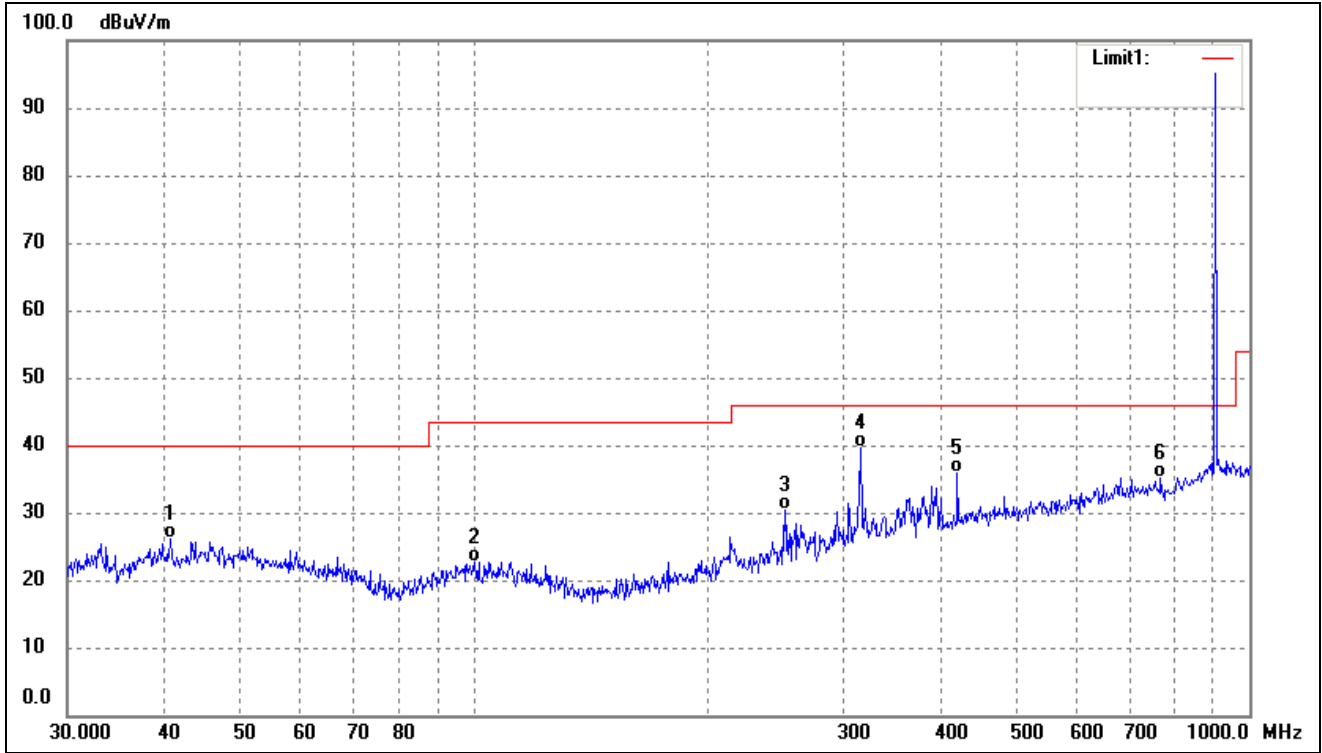
Note: this EUT was tested in 3 orthogonal positions and the worst case position data was reported.

All test modes (different data rate and different modulation) are performed, but only the worst case (GFSK) is recorded in this report.

➤ Spurious Emissions Below 1GHz

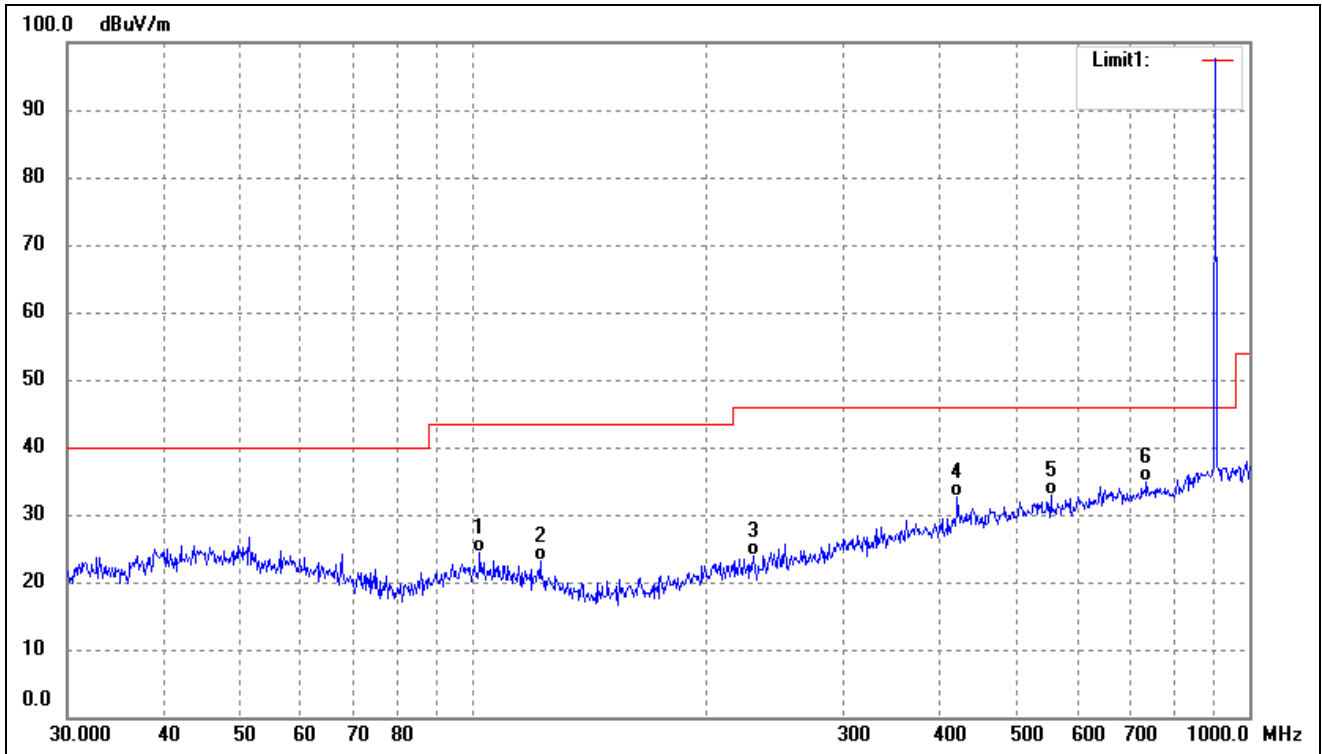
➤ L1 F7

Test Channel	Low Channel	Polarity:	Horizontal
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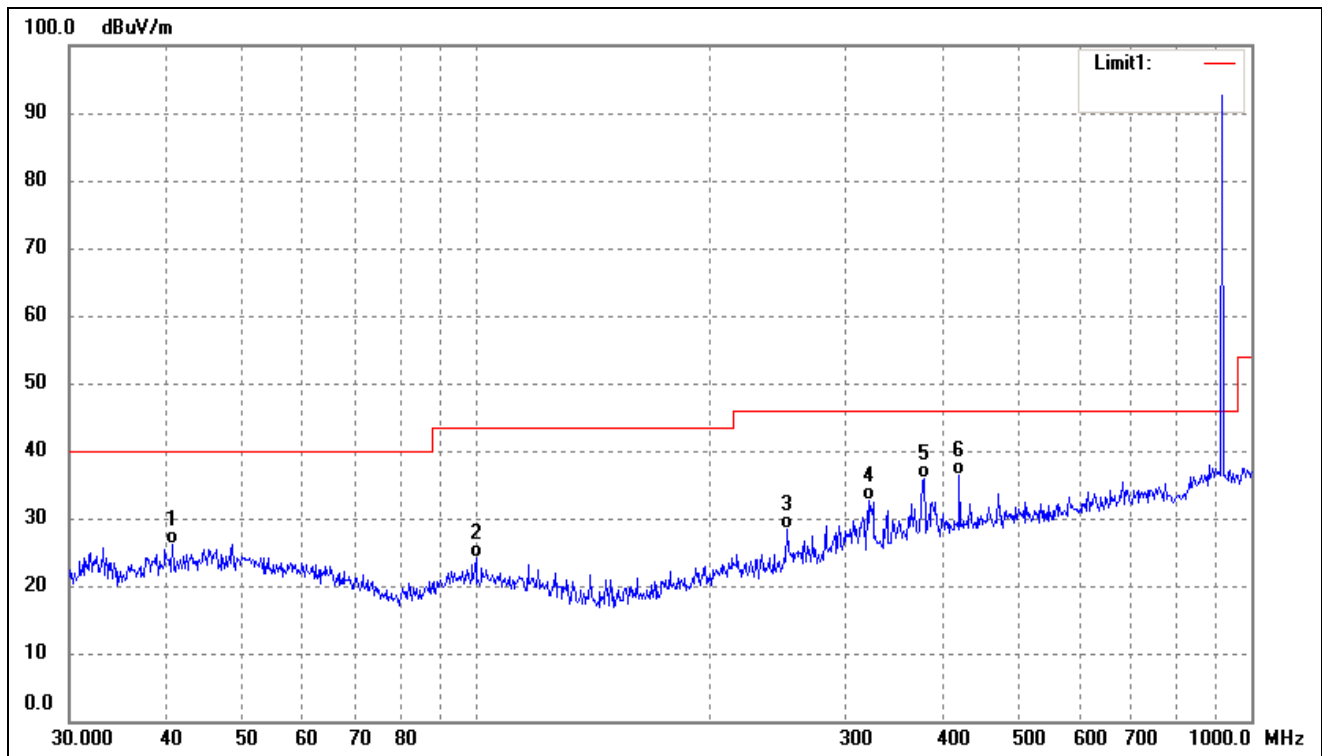
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	40.7016	38.15	-11.96	26.19	40.00	-13.81	-	-	QP
2	100.5806	36.05	-13.33	22.72	43.50	-20.78	-	-	QP
3	252.0627	41.22	-10.91	30.31	46.00	-15.69	-	-	QP
4	315.4808	48.49	-8.95	39.54	46.00	-6.46	-	-	QP
5	420.5803	41.88	-5.99	35.89	46.00	-10.11	-	-	QP
6	768.7482	36.28	-1.14	35.14	46.00	-10.86	-	-	QP

Test Channel	Low Channel	Polarity:	Vertical
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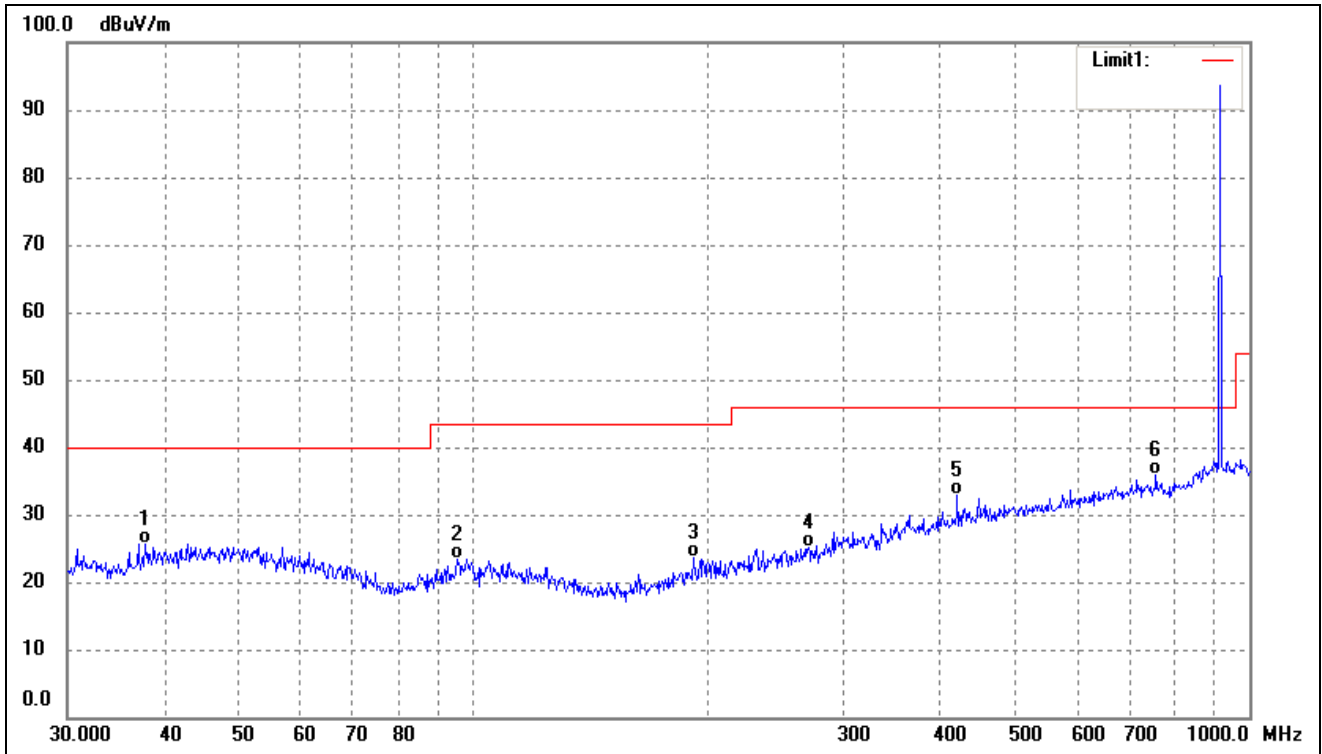
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	102.0014	37.82	-13.32	24.50	43.50	-19.00	-	-	QP
2	121.9755	37.87	-14.83	23.04	43.50	-20.46	-	-	QP
3	229.2931	35.89	-11.93	23.96	46.00	-22.04	-	-	QP
4	420.5803	38.53	-5.99	32.54	46.00	-13.46	-	-	QP
5	554.8254	36.32	-3.56	32.76	46.00	-13.24	-	-	QP
6	737.0714	35.97	-1.13	34.84	46.00	-11.16	-	-	QP

Test Channel	Middle Channel	Polarity:	Horizontal
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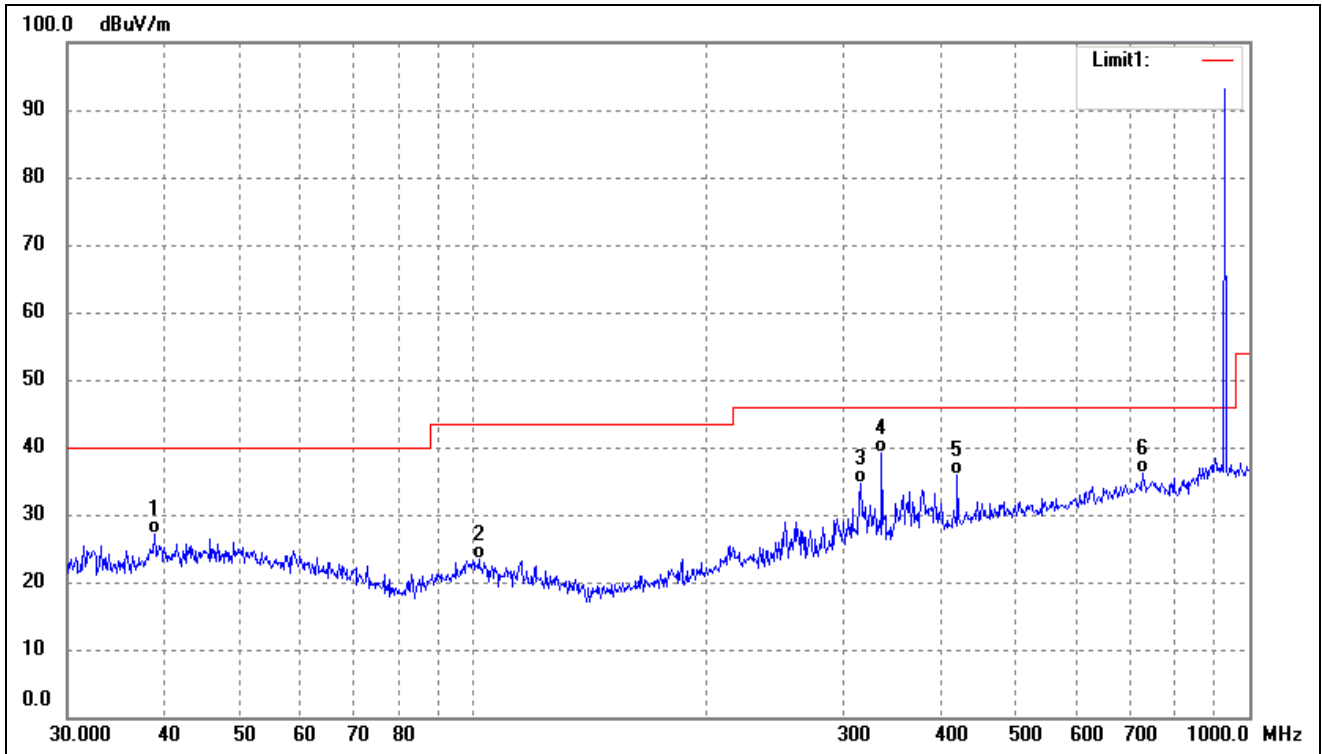
No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	40.7016	38.07	-11.96	26.11	40.00	-13.89	-	-	QP
2	100.2286	37.43	-13.32	24.11	43.50	-19.39	-	-	QP
3	252.0627	39.21	-10.91	28.30	46.00	-17.70	-	-	QP
4	322.1886	41.59	-8.96	32.63	46.00	-13.37	-	-	QP
5	378.5843	43.09	-7.09	36.00	46.00	-10.00	-	-	QP
6	420.5803	42.47	-5.99	36.48	46.00	-9.52	-	-	QP

Test Channel	Middle Channel	Polarity:	Vertical
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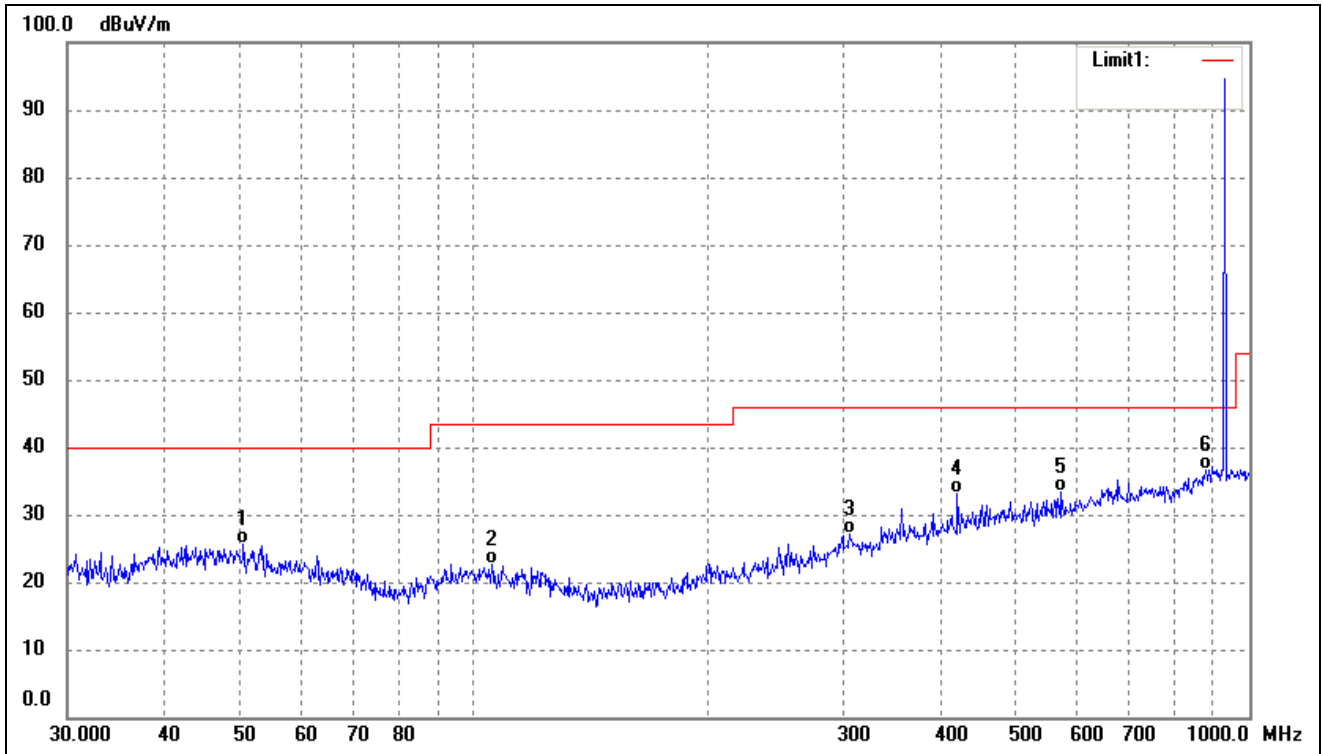
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	37.8121	38.37	-12.81	25.56	40.00	-14.44	-	-	QP
2	95.4270	37.47	-14.08	23.39	43.50	-20.11	-	-	QP
3	192.4186	36.58	-12.94	23.64	43.50	-19.86	-	-	QP
4	270.3748	36.02	-10.78	25.24	46.00	-20.76	-	-	QP
5	420.5803	38.94	-5.99	32.95	46.00	-13.05	-	-	QP
6	758.0408	37.11	-1.24	35.87	46.00	-10.13	-	-	QP

Test Channel	High Channel	Polarity:	Horizontal
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No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	38.8879	39.63	-12.40	27.23	40.00	-12.77	-	-	QP
2	101.6443	36.62	-13.32	23.30	43.50	-20.20	-	-	QP
3	315.4808	43.53	-8.95	34.58	46.00	-11.42	-	-	QP
4	336.0352	47.33	-8.28	39.05	46.00	-6.95	-	-	QP
5	420.5803	41.98	-5.99	35.99	46.00	-10.01	-	-	QP
6	729.3583	37.19	-1.03	36.16	46.00	-9.84	-	-	QP

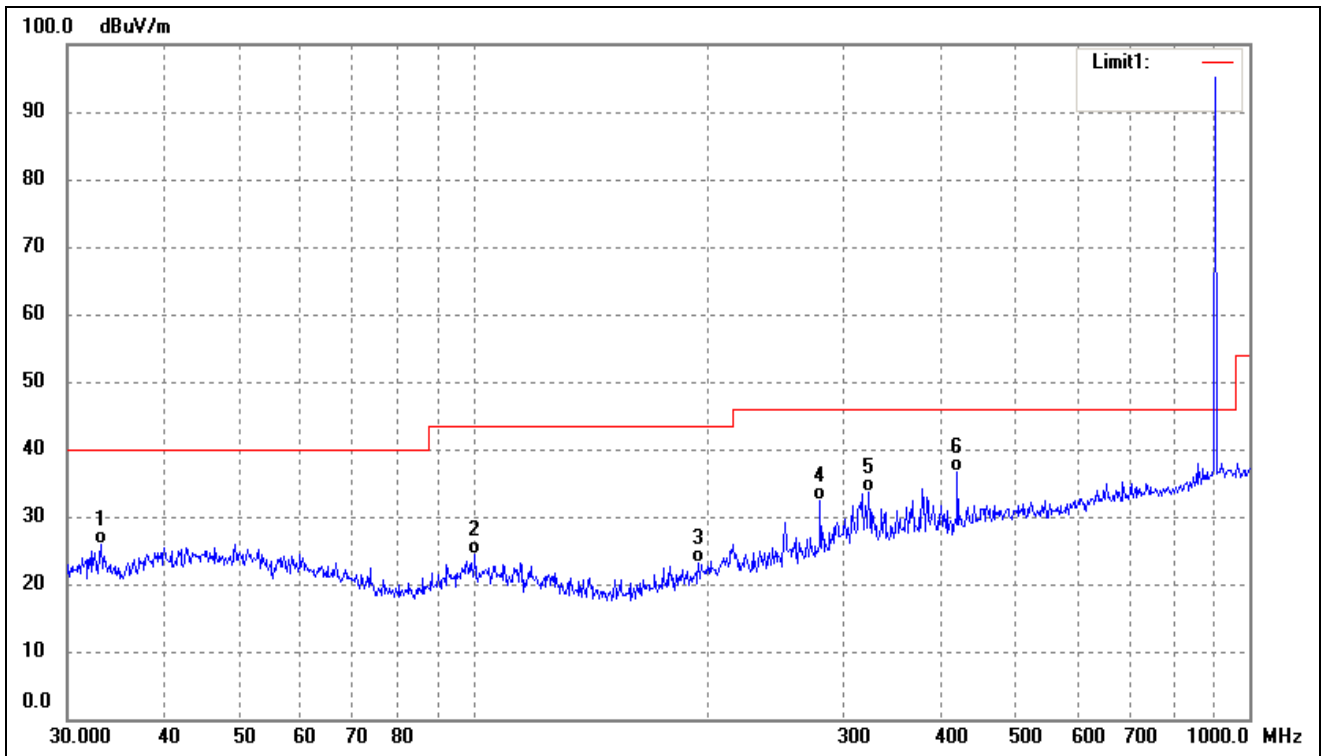
Test Channel	High Channel	Polarity:	Vertical
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No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	50.5860	37.35	-11.69	25.66	40.00	-14.34	-	-	QP
2	105.6415	35.90	-13.31	22.59	43.50	-20.91	-	-	QP
3	305.6800	36.06	-8.93	27.13	46.00	-18.87	-	-	QP
4	420.5803	39.15	-5.99	33.16	46.00	-12.84	-	-	QP
5	572.6144	36.10	-2.67	33.43	46.00	-12.57	-	-	QP
6	878.3214	36.02	0.67	36.69	46.00	-9.31	-	-	QP

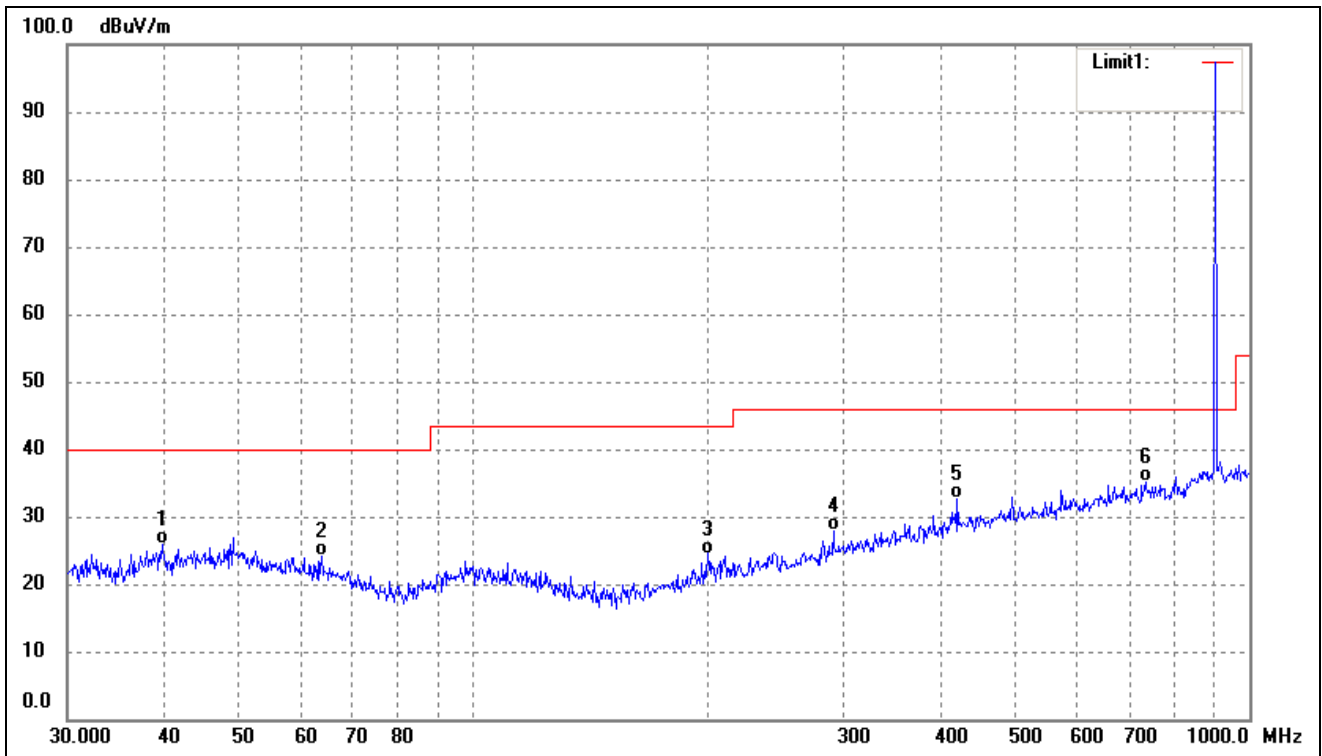
➤ L2 SF6

Test Channel	Low Channel	Polarity:	Horizontal
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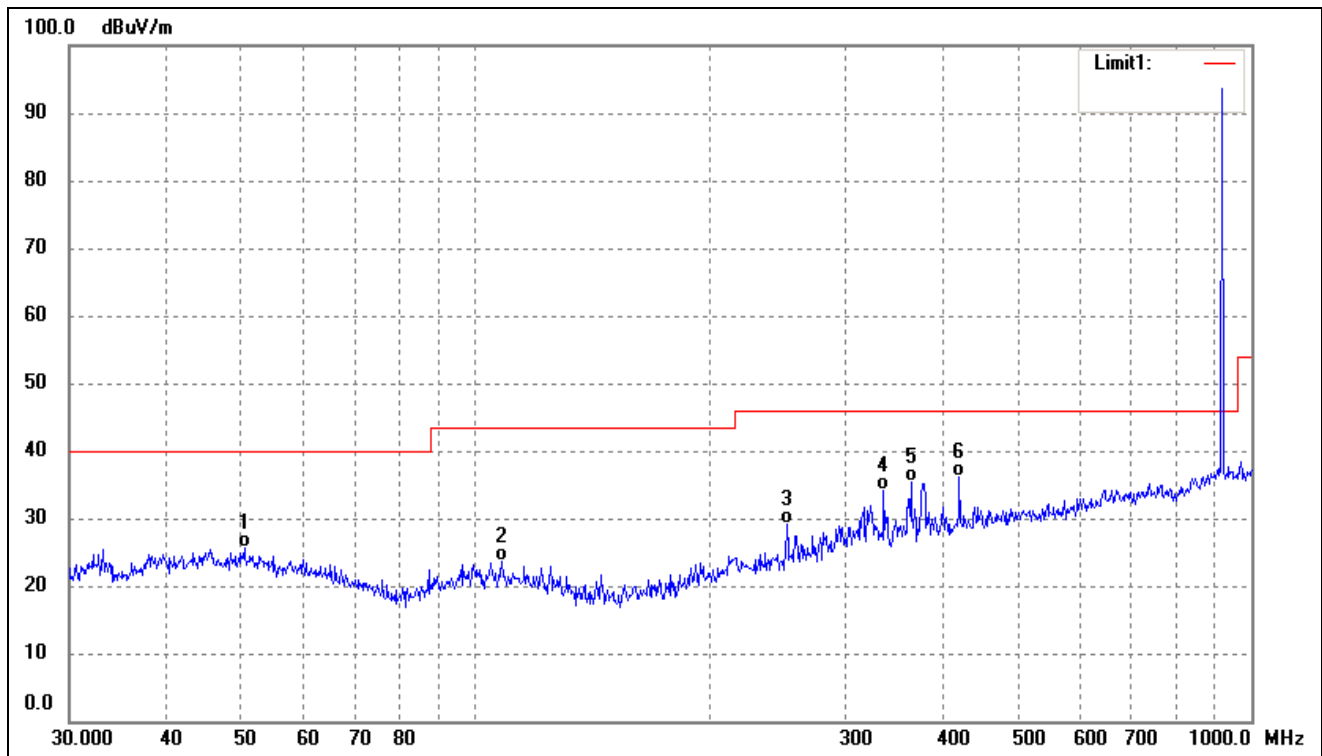
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	33.2112	39.92	-13.97	25.95	40.00	-14.05	-	-	QP
2	100.5806	37.79	-13.33	24.46	43.50	-19.04	-	-	QP
3	195.1365	35.83	-12.75	23.08	43.50	-20.42	-	-	QP
4	280.0238	42.86	-10.39	32.47	46.00	-13.53	-	-	QP
5	323.3204	42.63	-8.96	33.67	46.00	-12.33	-	-	QP
6	420.5803	42.73	-5.99	36.74	46.00	-9.26	-	-	QP

Test Channel	Low Channel	Polarity:	Vertical
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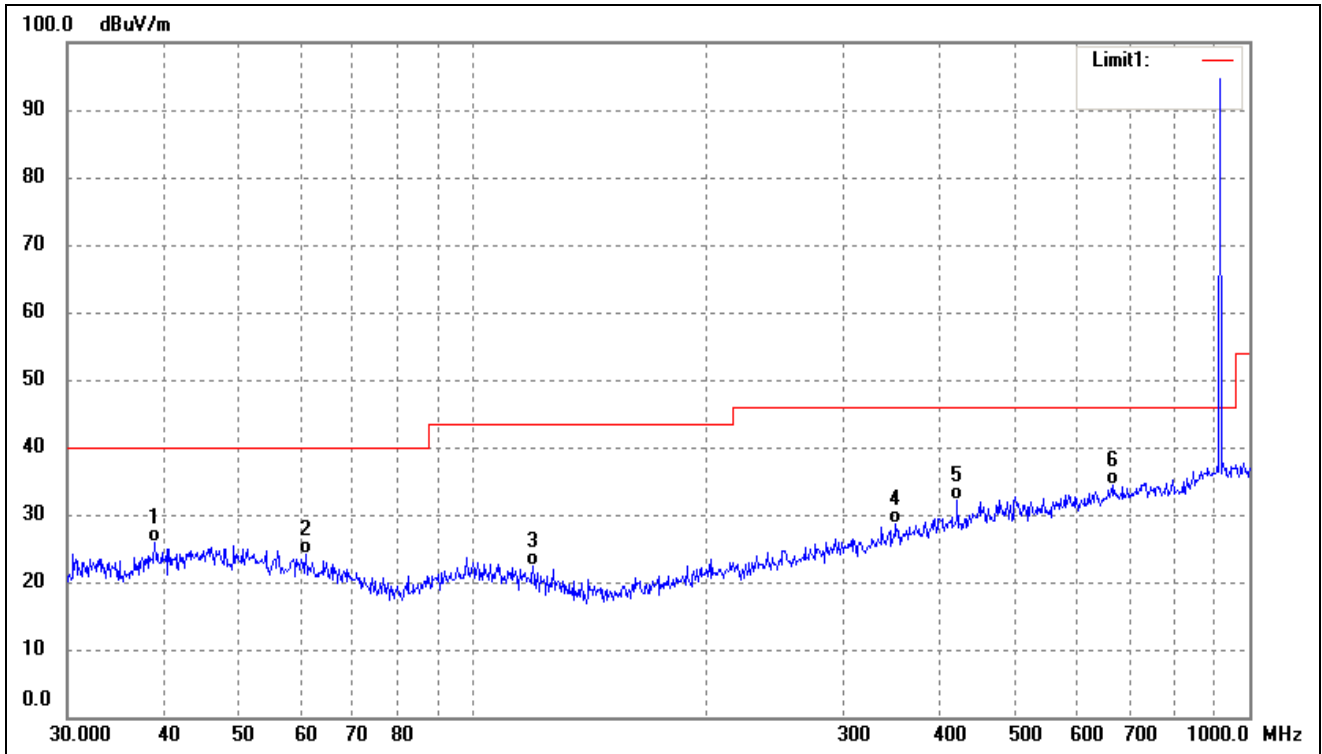
No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	39.7147	37.93	-12.09	25.84	40.00	-14.16	-	-	QP
2	63.7588	37.85	-13.69	24.16	40.00	-15.84	-	-	QP
3	200.6881	36.92	-12.42	24.50	43.50	-19.00	-	-	QP
4	291.0360	37.57	-9.58	27.99	46.00	-18.01	-	-	QP
5	420.5803	38.60	-5.99	32.61	46.00	-13.39	-	-	QP
6	734.4913	36.11	-1.10	35.01	46.00	-10.99	-	-	QP

Test Channel	Middle Channel	Polarity:	Horizontal
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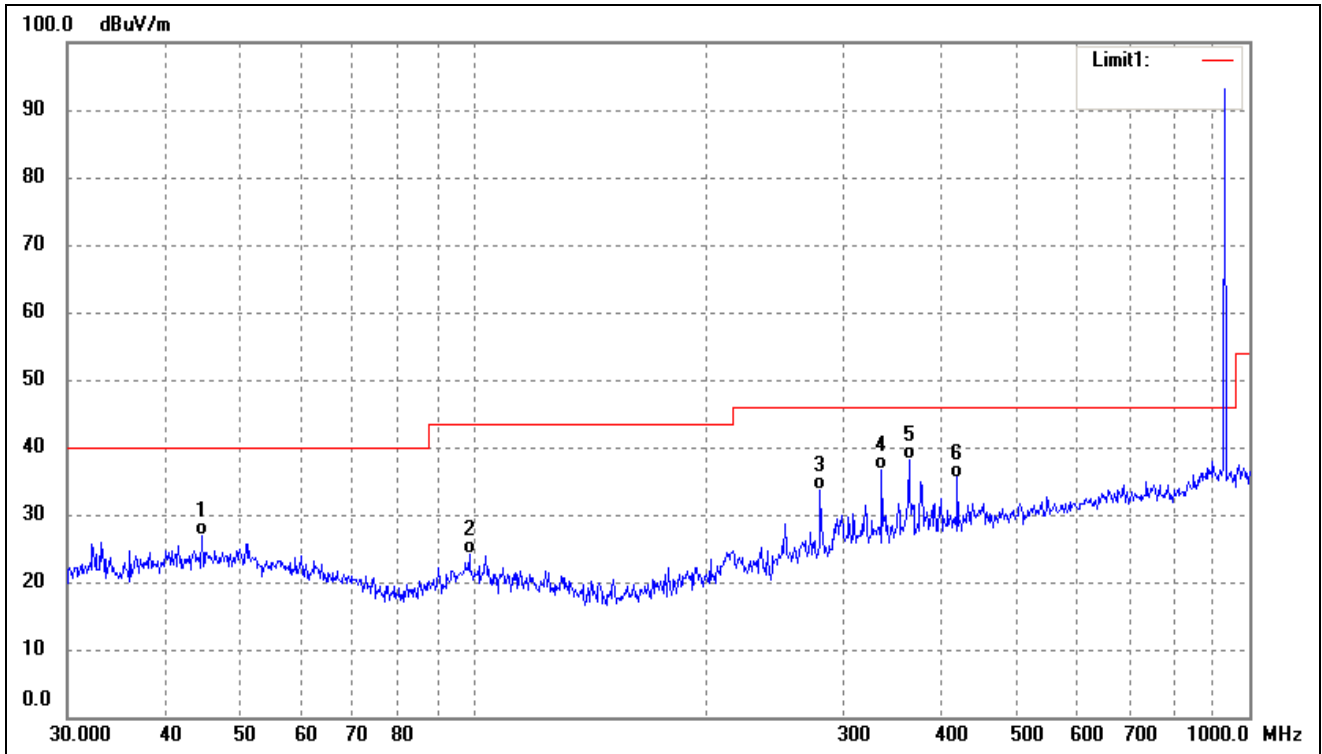
No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	50.4089	37.25	-11.65	25.60	40.00	-14.40	-	-	QP
2	108.2667	36.82	-13.31	23.51	43.50	-19.99	-	-	QP
3	252.0627	40.07	-10.91	29.16	46.00	-16.84	-	-	QP
4	336.0352	42.33	-8.28	34.05	46.00	-11.95	-	-	QP
5	364.2595	42.73	-7.29	35.44	46.00	-10.56	-	-	QP
6	420.5803	42.21	-5.99	36.22	46.00	-9.78	-	-	QP

Test Channel	Middle Channel	Polarity:	Vertical
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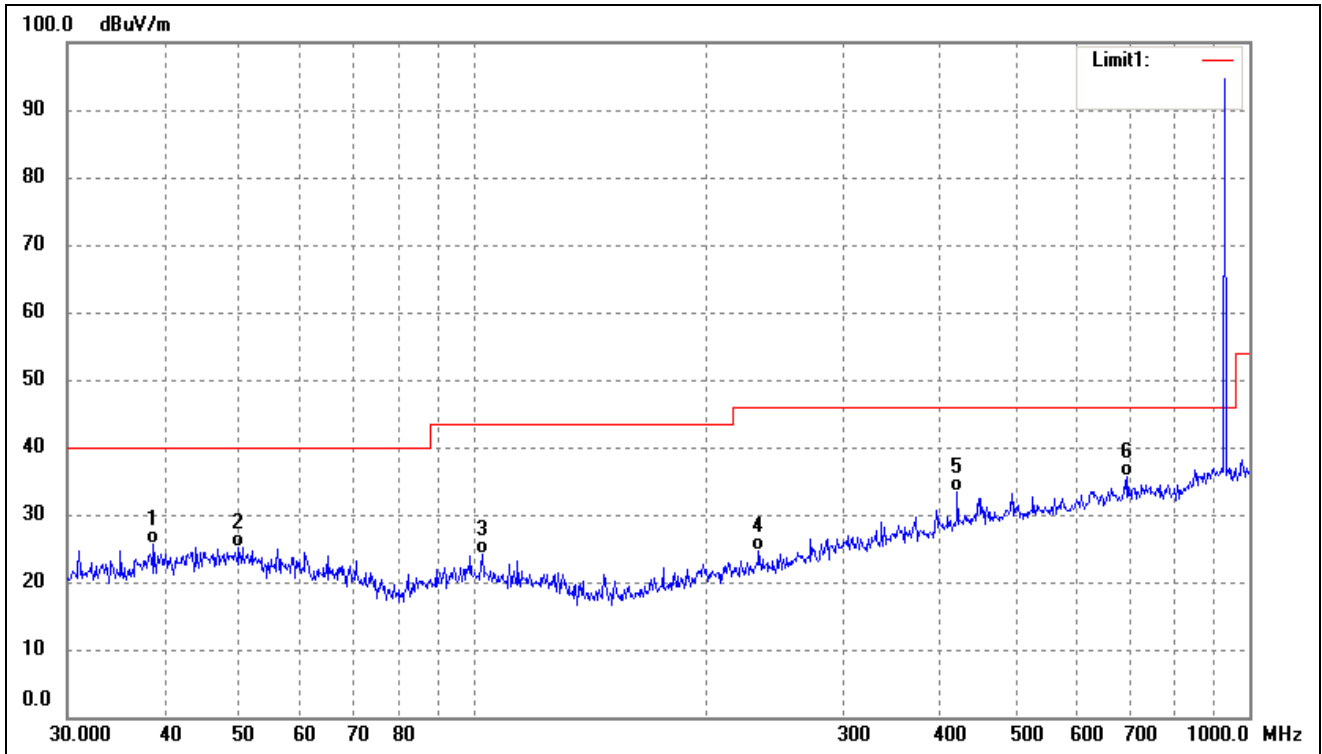
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	38.8879	38.36	-12.40	25.96	40.00	-14.04	-	-	QP
2	60.9176	37.30	-13.15	24.15	40.00	-15.85	-	-	QP
3	119.4361	36.63	-14.24	22.39	43.50	-21.11	-	-	QP
4	350.4768	36.13	-7.43	28.70	46.00	-17.30	-	-	QP
5	420.5803	38.04	-5.99	32.05	46.00	-13.95	-	-	QP
6	668.1423	36.32	-2.01	34.31	46.00	-11.69	-	-	QP

Test Channel	High Channel	Polarity:	Horizontal
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No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	44.7434	38.73	-11.81	26.92	40.00	-13.08	-	-	QP
2	98.8326	37.64	-13.52	24.12	43.50	-19.38	-	-	QP
3	280.0238	44.08	-10.39	33.69	46.00	-12.31	-	-	QP
4	336.0352	44.80	-8.28	36.52	46.00	-9.48	-	-	QP
5	364.2595	45.45	-7.29	38.16	46.00	-7.84	-	-	QP
6	420.5803	41.49	-5.99	35.50	46.00	-10.50	-	-	QP

Test Channel	High Channel	Polarity:	Vertical
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No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	38.7518	38.14	-12.45	25.69	40.00	-14.31	-	-	QP
2	49.8814	36.78	-11.54	25.24	40.00	-14.76	-	-	QP
3	102.7192	37.42	-13.32	24.10	43.50	-19.40	-	-	QP
4	233.3487	36.32	-11.73	24.59	46.00	-21.41	-	-	QP
5	420.5803	39.40	-5.99	33.41	46.00	-12.59	-	-	QP
6	696.8567	37.41	-1.86	35.55	46.00	-10.45	-	-	QP

Remark: ‘-’Means’ the test Degree and Height are not recorded by the test software and only show the worst case in the test report.

➤ Spurious Emissions Above 1GHz

L1 F7:

Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-902.5MHz							
1805.00	57.71	-9.40	48.31	74	-25.69	H	PK
1805.00	44.85	-9.40	35.45	54	-18.55	H	AV
1805.00	57.26	-9.40	47.86	74	-26.14	V	PK
1805.00	46.51	-9.40	37.11	54	-16.89	V	AV
Middle Channel-914.5MHz							
1829.00	55.95	-9.30	46.65	74	-27.35	H	PK
1829.00	45.11	-9.30	35.81	54	-18.19	H	AV
1829.00	54.89	-9.30	45.59	74	-28.41	V	PK
1829.00	43.31	-9.30	34.01	54	-19.99	V	AV
High Channel-927.3MHz							
1854.60	56.30	-9.18	47.12	74	-26.88	H	PK
1854.60	44.41	-9.18	35.23	54	-18.77	H	AV
1854.60	58.98	-9.18	49.80	74	-24.20	V	PK
1854.60	51.02	-9.18	41.84	54	-12.16	V	AV

L2 SF6:

Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-902.5MHz							
1805.00	57.07	-9.40	47.67	74	-26.33	H	PK
1805.00	45.82	-9.40	36.42	54	-17.58	H	AV
1805.00	55.89	-9.40	46.49	74	-27.51	V	PK
1805.00	47.65	-9.40	38.25	54	-15.75	V	AV
Middle Channel-914.5MHz							
1829.00	55.56	-9.30	46.26	74	-27.74	H	PK
1829.00	45.35	-9.30	36.05	54	-17.95	H	AV
1829.00	55.61	-9.30	46.31	74	-27.69	V	PK
1829.00	41.89	-9.30	32.59	54	-21.41	V	AV
High Channel-927.3MHz							
1854.60	56.52	-9.18	47.34	74	-26.66	H	PK
1854.60	45.04	-9.18	35.86	54	-18.14	H	AV
1854.60	59.64	-9.18	50.46	74	-23.54	V	PK
1854.60	50.29	-9.18	41.11	54	-12.89	V	AV

Note: Testing is carried out with frequency rang 9kHz to the tenth harmonics, other than listed in the table above are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

10. Out of Band Emissions

10.1 Standard Applicable

According to §15.247 (d), 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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

10.2 Test Procedure

According to ANSI C63.10-2013 section 7.8.6, the Band-edge measurements for RF conducted emissions test method as follows.

- a) Connect the EMI receiver or spectrum analyzer to the EUT using an appropriate RF cable connected to the EUT output. Configure the spectrum analyzer settings as described in step e) (be sure to enter all losses between the unlicensed wireless device output and the spectrum analyzer).
 - b) Set the EUT to the lowest frequency channel (for the hopping on test, the hopping sequence shall include the lowest frequency channel).
 - c) Set the EUT to operate at maximum output power and 100% duty cycle, or equivalent “normal mode of operation” as specified in 6.10.3.
 - d) If using the radiated method, then use the applicable procedure(s) of 6.4, 6.5, or 6.6, and orient the EUT and measurement antenna positions to produce the highest emission level.
 - e) Perform the test as follows:
 - 1) Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products that fall outside of the authorized band of operation.
 - 2) Reference level: As required to keep the signal from exceeding the maximum instrument input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than $[10 \log (OBW/RBW)]$ below the reference level. Specific guidance is given in 4.1.5.2.
 - 3) Attenuation: Auto (at least 10 dB preferred).
 - 4) Sweep time: Coupled.
 - 5) Resolution bandwidth: 100 kHz.
 - 6) Video bandwidth: 300 kHz.
 - 7) Detector: Peak.
 - 8) Trace: Max hold.
 - f) Allow the trace to stabilize. For the test with the hopping function turned ON, this can take several minutes to achieve a reasonable probability of intercepting any emissions due to oscillator overshoot.
 - g) Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if
- Waltek Testing Group (Shenzhen) Co., Ltd.
<http://www.semtest.com.cn>

this level is greater than that at the band edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.

h) Repeat step c) through step e) for every applicable modulation.

i) Set the EUT to the highest frequency channel (for the hopping on test, the hopping sequence shall include the highest frequency channel) and repeat step c) through step d).

j) The band-edge measurement shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

Restricted-band band-edge test method please refers to ANSI C63.10-2013 section 6.10.5. The emission must comply with the 15.209 limit for fall in the restricted bands listed in section 15.205. Note that the method of measurement KDB publication number: 913591 may be used for the radiated band-edge measurements.

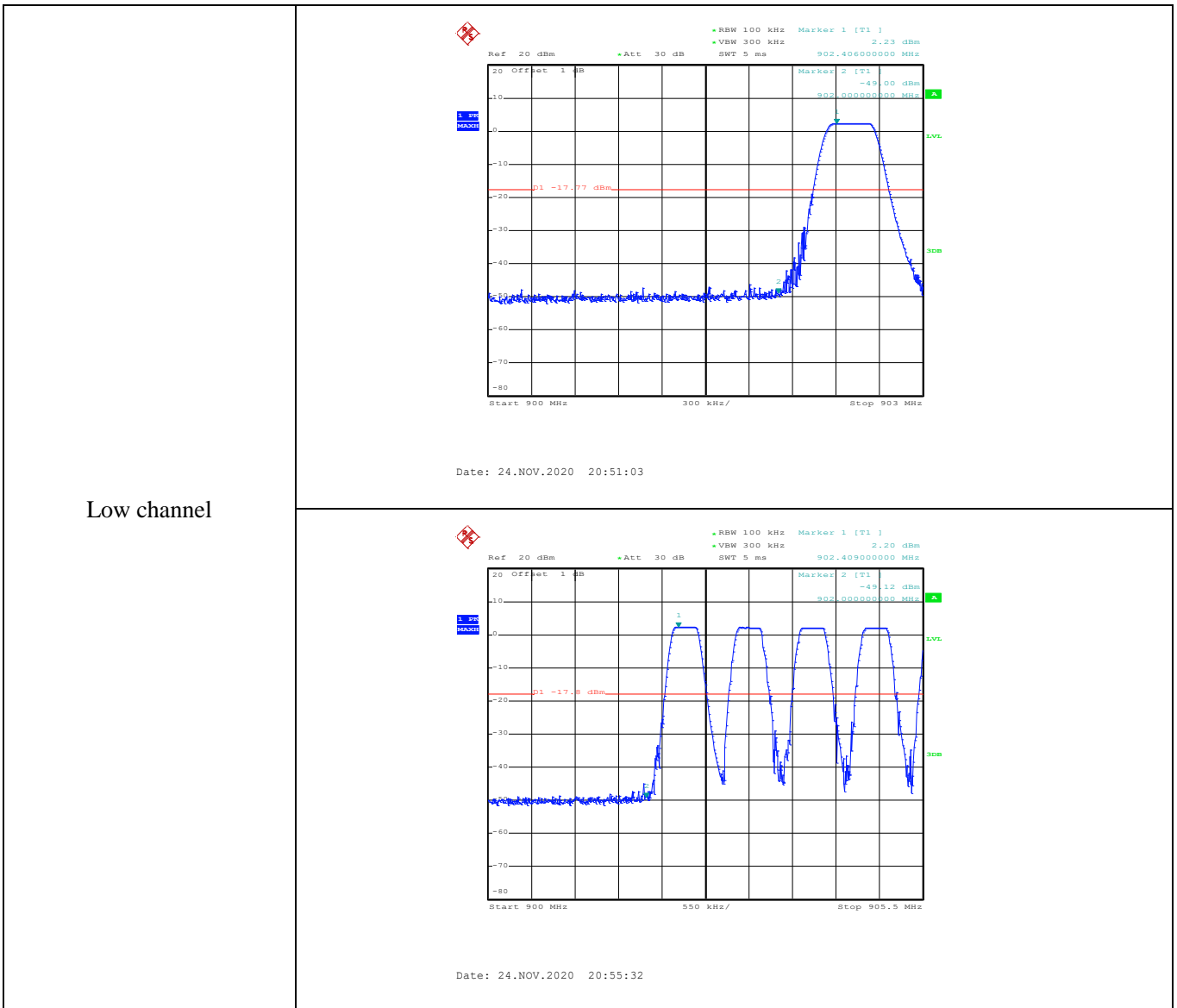
According to ANSI C63.10-2013 section 7.8.8, Conducted spurious emissions shall be measured for the transmit frequency, per 5.5 and 5.6, and at the maximum transmit powers.

Connect the primary antenna port through an attenuator to the spectrum analyzer input; in the results, account for all losses between the unlicensed wireless device output and the spectrum analyzer. The instrument shall span 30 MHz to 10 times the operating frequency in GHz, with a resolution bandwidth of 100 kHz, video bandwidth of 300 kHz, and a coupled sweep time with a peak detector. The band 30 MHz to the highest frequency may be split into smaller spans, as long as the entire spectrum is covered.

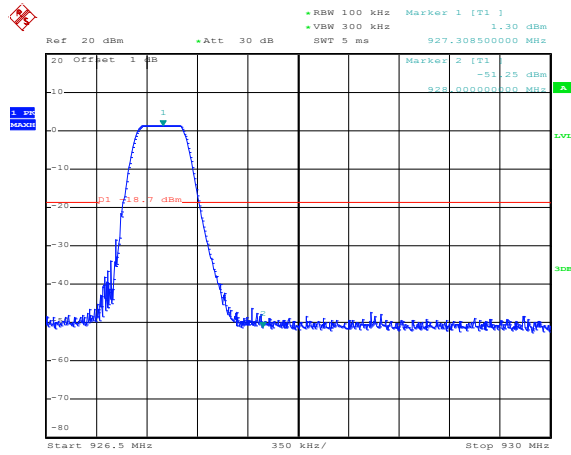
10.3 Summary of Test Results/Plots

Note: All test modes (different data rate and different modulation) are performed, but only the worst case (GFSK) is recorded in this report.

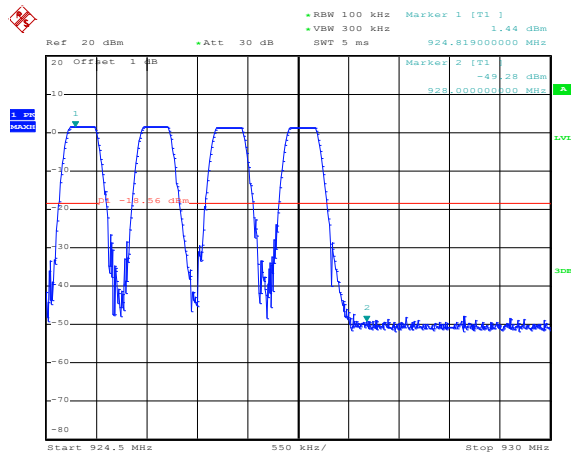
➤ L1F7



High channel

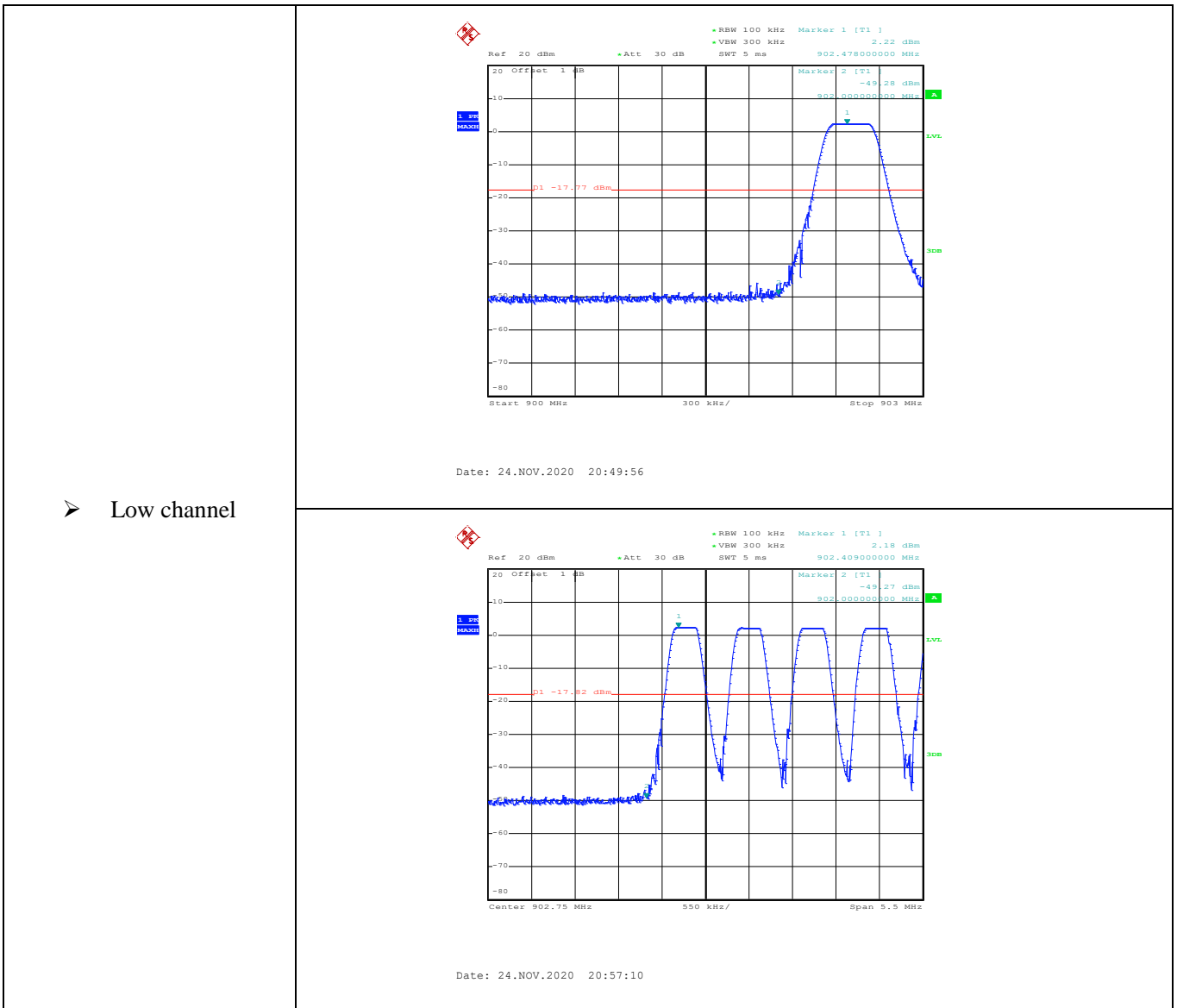


Date: 24.NOV.2020 21:02:47



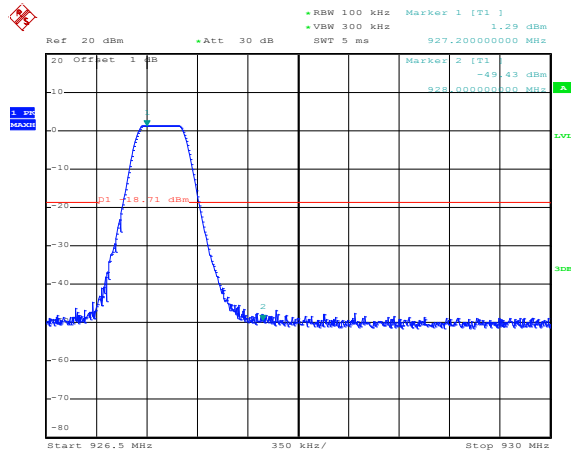
Date: 24.NOV.2020 20:59:37

➤ L2 SF6

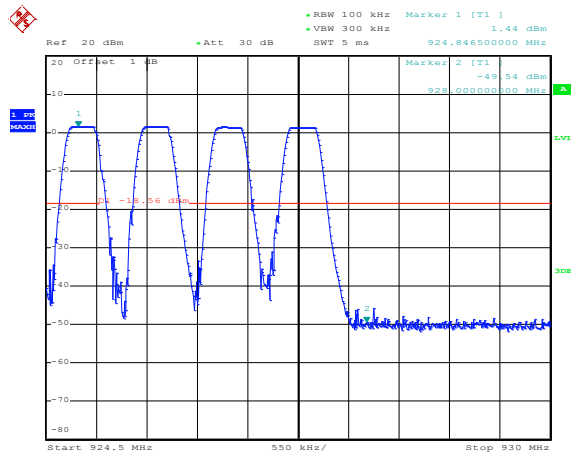


➤ Low channel

High channel



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11. Conducted Emissions

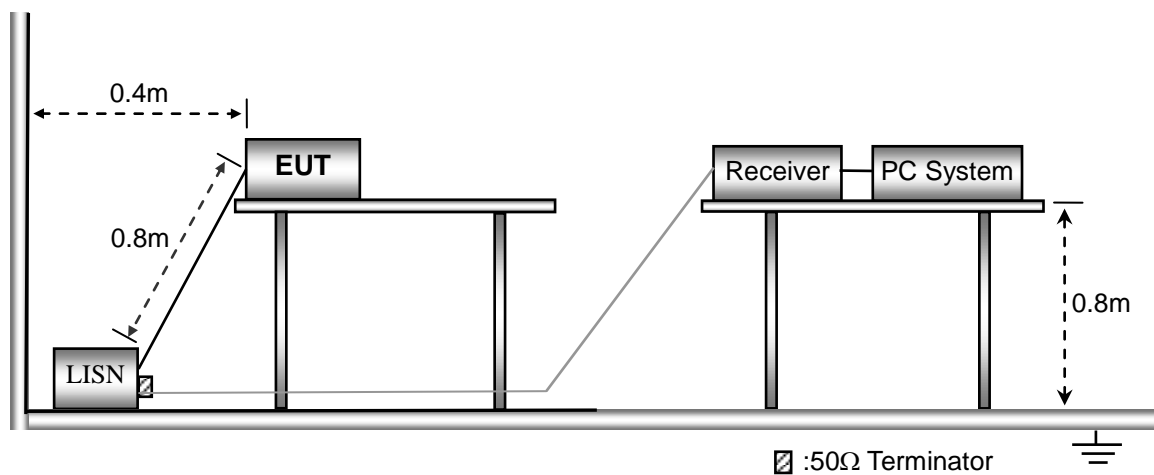
11.1 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 Limit.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

11.2 Basic Test Setup Block Diagram



11.3 Test Receiver Setup

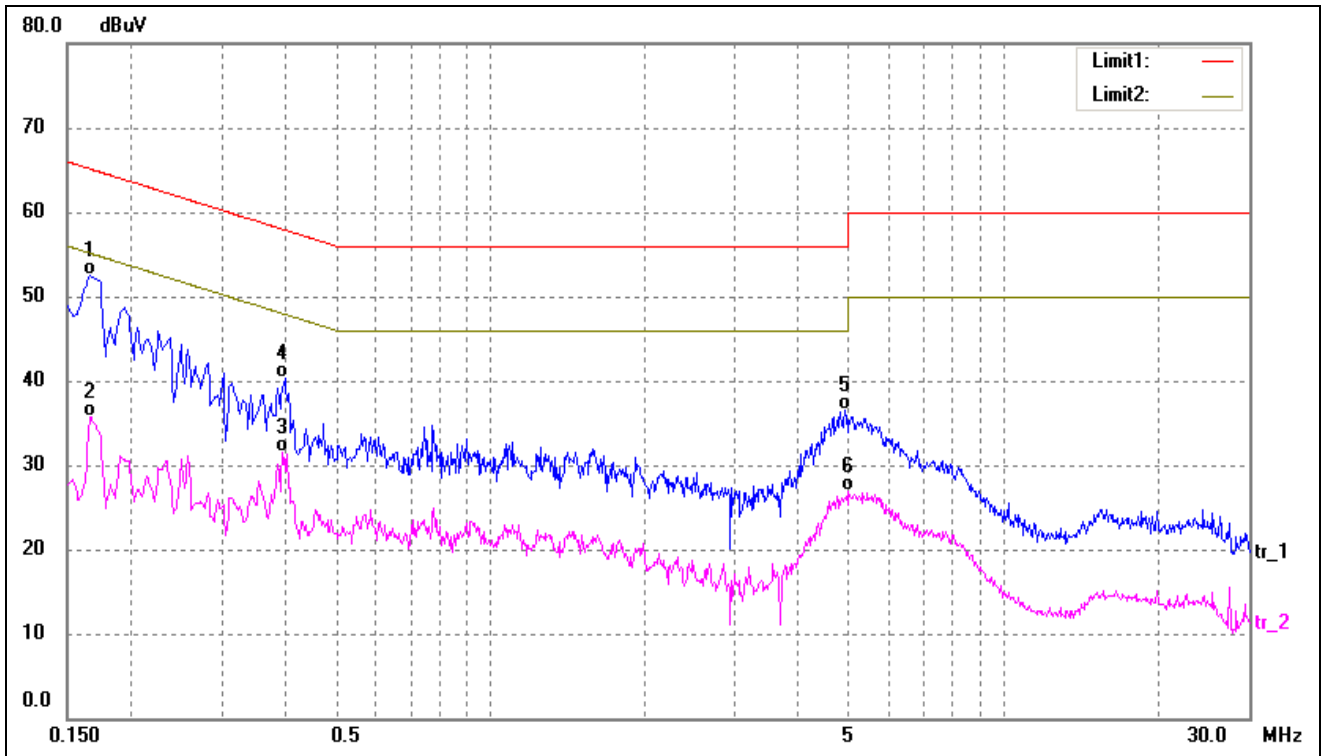
During the conducted emission test, the test receiver was set with the following configurations:

Start Frequency	150 kHz
Stop Frequency	30 MHz
Sweep Speed	Auto
IF Bandwidth.....	10 kHz
Quasi-Peak Adapter Bandwidth	9 kHz
Quasi-Peak Adapter Mode	Normal

11.4 Summary of Test Results/Plots

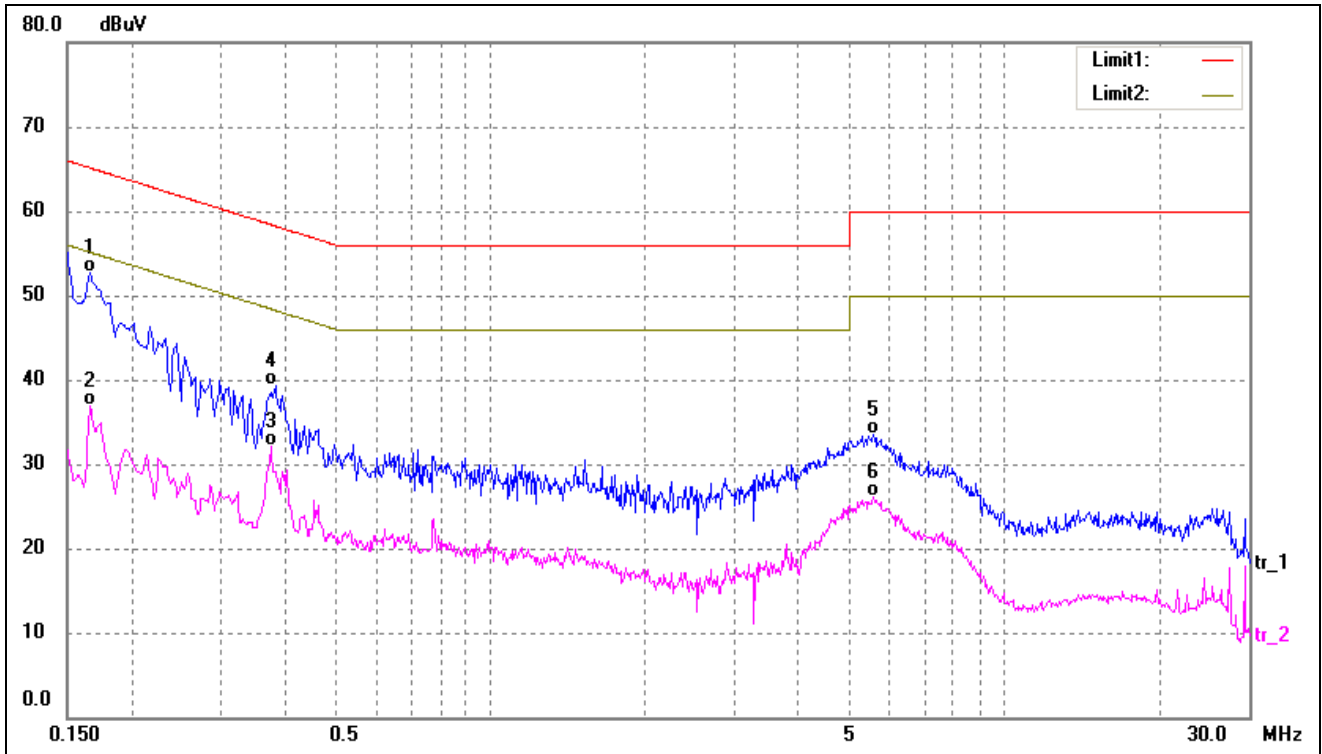
➤ L1 F7

Test Mode	Communication	AC120V 60Hz	Polarity:	Neutral
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No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1*	0.1660	42.18	10.26	52.44	65.16	-12.72	QP
2	0.1660	25.54	10.26	35.80	55.16	-19.36	AVG
3	0.3940	21.25	10.23	31.48	47.98	-16.50	AVG
4	0.3980	30.15	10.23	40.38	57.90	-17.52	QP
5	4.9220	26.32	10.22	36.54	56.00	-19.46	QP
6	4.9860	16.60	10.22	26.82	46.00	-19.18	AVG

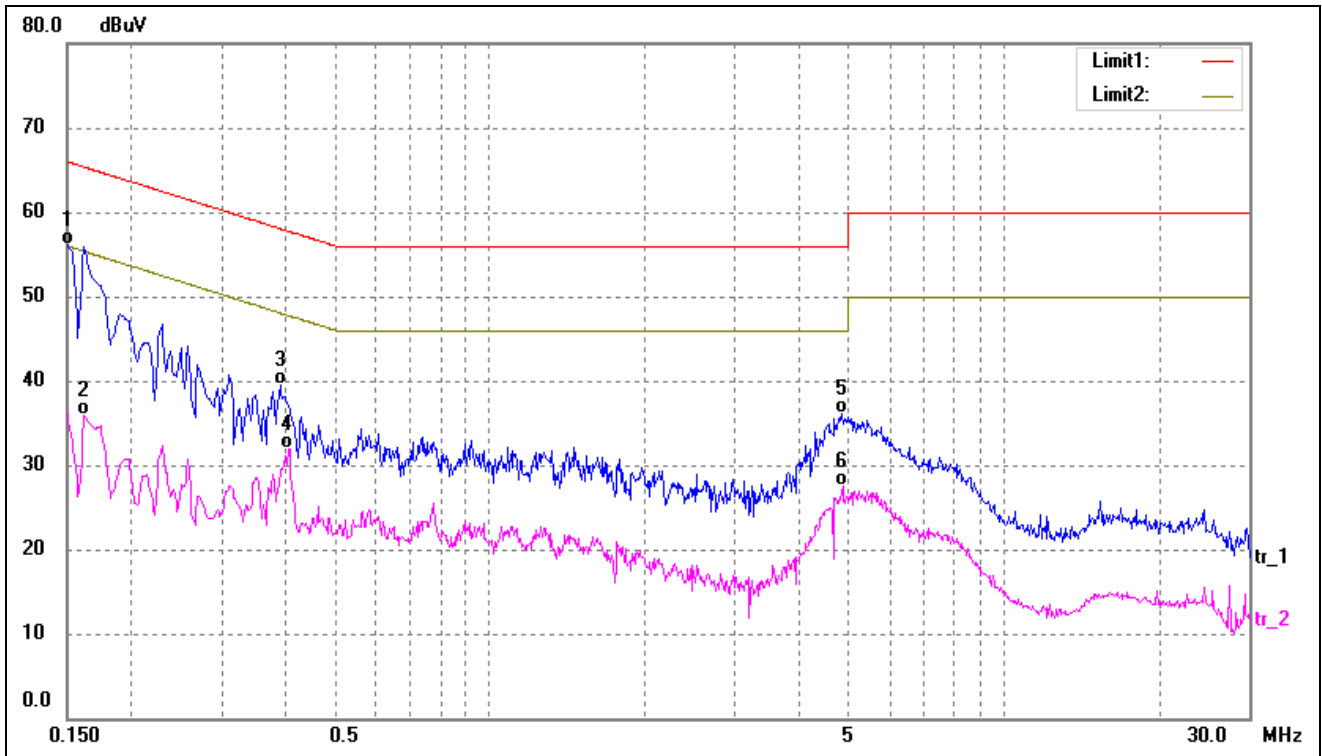
Test Mode	Communication	AC120V 60Hz	Polarity:	Line
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No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1*	0.1660	42.37	10.26	52.63	65.16	-12.53	QP
2	0.1660	26.56	10.26	36.82	55.16	-18.34	AVG
3	0.3740	21.89	10.24	32.13	48.41	-16.28	AVG
4	0.3820	29.00	10.23	39.23	58.24	-19.01	QP
5	5.5780	23.24	10.23	33.47	60.00	-26.53	QP
6	5.5780	15.96	10.23	26.19	50.00	-23.81	AVG

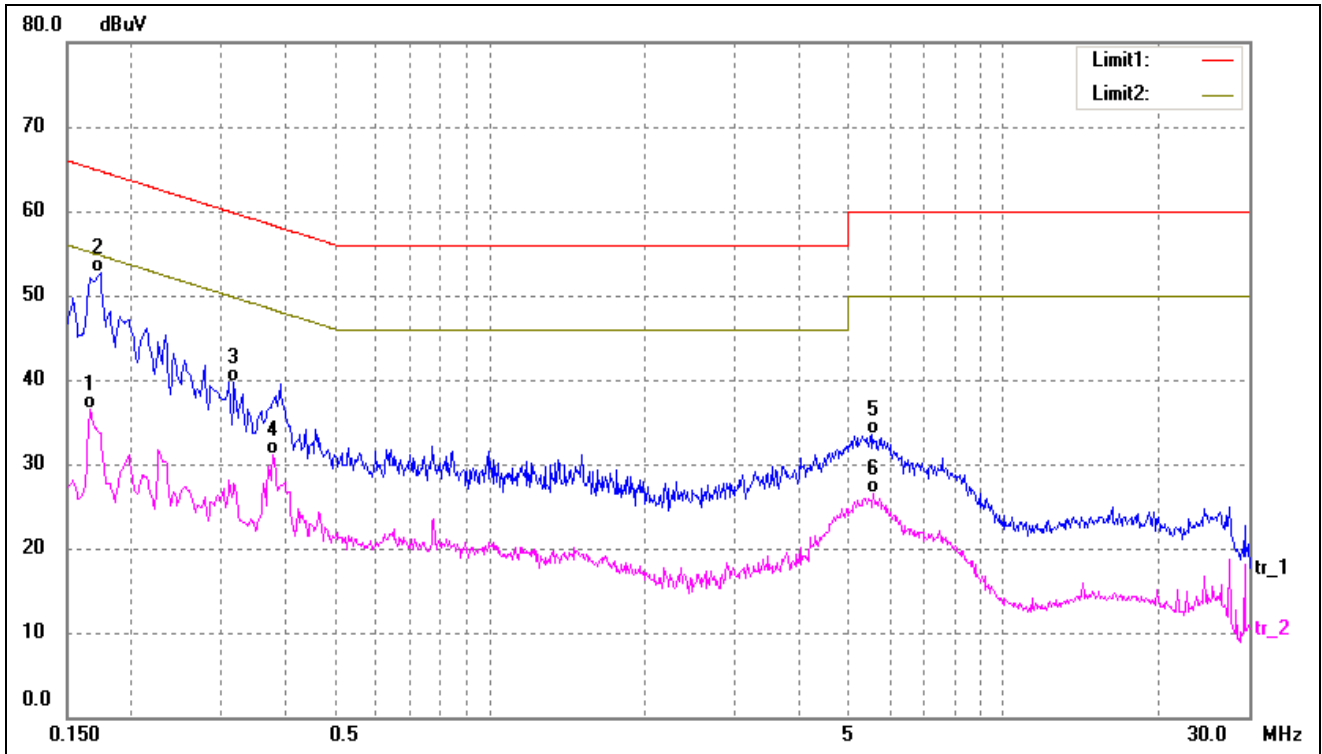
➤ L2 SF6

Test Mode	Communication	AC120V 60Hz	Polarity:	Neutral
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No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1*	0.1500	45.84	10.25	56.09	66.00	-9.91	QP
2	0.1620	25.55	10.26	35.81	55.36	-19.55	AVG
3	0.3900	29.17	10.24	39.41	58.06	-18.65	QP
4	0.4060	21.69	10.23	31.92	47.73	-15.81	AVG
5	4.8460	25.93	10.23	36.16	56.00	-19.84	QP
6	4.8580	17.27	10.23	27.50	46.00	-18.50	AVG

Test Mode	Communication	AC120V 60Hz	Polarity:	Line
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No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.1660	26.17	10.26	36.43	55.16	-18.73	AVG
2*	0.1740	42.41	10.25	52.66	64.77	-12.11	QP
3	0.3180	29.40	10.25	39.65	59.76	-20.11	QP
4	0.3780	20.90	10.24	31.14	48.32	-17.18	AVG
5	5.5260	23.23	10.23	33.46	60.00	-26.54	QP
6	5.5700	16.21	10.23	26.44	50.00	-23.56	AVG

APPENDIX PHOTOGRAPHS

Please refer to “ANNEX”

******* END OF REPORT *******