ETSI EN 300 220-1 V3.1.1
ETSI EN 300 220-2 V3.1.1

TEST REPORT

FOR

868-870 MHZ TRANSCEIVER

MODEL NUMBER: A110LR09A and A110LR09C*

REPORT NUMBER: 11773240-E2V1

ISSUE DATE: AUGUST 23, 2017

Prepared for
ANAREN, INC.
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* Model Differences are explained in the body of this report

NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	08/23/17	Initial Issue	--

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TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS 6

2. TEST METHODOLOGY 7

3. FACILITIES AND ACCREDITATION 7

4. CALIBRATION AND UNCERTAINTY 7

4.4. MEASURING INSTRUMENT CALIBRATION 7

4.5. MEASUREMENT UNCERTAINTY 8

5. EQUIPMENT UNDER TEST 9

5.1. DESCRIPTION OF EUT 9

5.2. DESCRIPTION OF MODELS DIFFERENCES 9

5.3. MAXIMUM OUTPUT ERP 9

5.4. DESCRIPTION OF AVAILABLE ANTENNAS 9

5.5. SOFTWARE AND FIRMWARE 9

5.6. WORST-CASE CONFIGURATIONS AND MODES OF OPERATION 10

5.7. DESCRIPTION OF TEST SETUP 13

6. TEST AND MEASUREMENT EQUIPMENT 15

7. TEST RESULTS 16

7.1. NORMAL AND EXTREME CONDITIONS 16

7.2. GFSK MODULATION IN M BAND 17

7.2.1. OPERATING FREQUENCY 17
7.2.2. TX EFFECTIVE RADIATED POWER 19
7.2.3. TX OCCUPIED BANDWIDTH 20
7.2.4. TX OUT OF BAND EMISSIONS 47
7.2.5. TX UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN 115
7.2.6. TX TRANSIENT POWER 128

7.3. GFSK MODULATION IN N BAND 137

7.3.1. OPERATING FREQUENCY 137
7.3.2. TX EFFECTIVE RADIATED POWER 139
7.3.3. TX OCCUPIED BANDWIDTH 140
7.3.4. TX OUT OF BAND EMISSIONS 167
7.3.5. TX UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN 213
7.3.6. TX TRANSIENT POWER 226

7.4. GFSK MODULATION IN P BAND 235

7.4.1. OPERATING FREQUENCY 235
7.4.2. TX EFFECTIVE RADIATED POWER 237
7.4.3. TX OCCUPIED BANDWIDTH 238
7.4.4. TX OUT OF BAND EMISSIONS 250
7.4.5. TX UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN 263

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7.4.6. TX TRANSIENT POWER....271

7.5. GFSK MODULATION IN Q BAND....276
7.5.1. OPERATING FREQUENCY....276
7.5.2. TX EFFECTIVE RADIATED POWER....278

7.6. GFSK MODULATION IN R BAND....279
7.6.1. OPERATING FREQUENCY....279
7.6.2. TX EFFECTIVE RADIATED POWER....281
7.6.3. TX OCCUPIED BANDWIDTH....282
7.6.4. TX OUT OF BAND EMISSIONS....307
7.6.5. TX UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN....342
7.6.6. TX TRANSIENT POWER....350

7.7. GFSK MODULATION IN X BAND....355
7.7.1. OPERATING FREQUENCY....355
7.7.2. TX EFFECTIVE RADIATED POWER....357
7.7.3. TX OCCUPIED BANDWIDTH....358
7.7.4. MAXIMUM E.R.P SPECTRAL DENSITY....365
7.7.5. TX OUT OF BAND EMISSIONS....367
7.7.6. TX UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN....381
7.7.7. TX TRANSIENT POWER....394

7.8. 2-FSK MODULATION IN M BAND....403
7.8.1. OPERATING FREQUENCY....403
7.8.2. TX EFFECTIVE RADIATED POWER....405
7.8.3. TX OCCUPIED BANDWIDTH....406
7.8.4. TX OUT OF BAND EMISSIONS....423
7.8.5. TX UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN....469
7.8.6. TX TRANSIENT POWER....482

7.9. 2-FSK MODULATION IN N BAND....491
7.9.1. OPERATING FREQUENCY....491
7.9.2. TX EFFECTIVE RADIATED POWER....493
7.9.3. TX OCCUPIED BANDWIDTH....494
7.9.4. TX OUT OF BAND EMISSIONS....511
7.9.5. TX UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN....557
7.9.6. TX TRANSIENT POWER....570

7.10. 2-FSK MODULATION IN P BAND....579
7.10.1. OPERATING FREQUENCY....579
7.10.2. TX EFFECTIVE RADIATED POWER....581
7.10.3. TX OCCUPIED BANDWIDTH....582
7.10.4. TX OUT OF BAND EMISSIONS....589
7.10.5. TX UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN....602
7.10.6. TX TRANSIENT POWER....610

7.11. 2-FSK MODULATION IN Q BAND....615
7.11.1. OPERATING FREQUENCY....615
7.11.2. TX EFFECTIVE RADIATED POWER....617

7.12. 2-FSK MODULATION IN R BAND....618
7.12.1. OPERATING FREQUENCY....618
7.12.2. TX EFFECTIVE RADIATED POWER....620
7.12.3. TX OCCUPIED BANDWIDTH....621
7.12.4. TX OUT OF BAND EMISSIONS....633

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7.12.5. TX UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN 657
7.12.6. TX TRANSIENT POWER 670

7.13. 4-FSK MODULATION IN X BAND.....679
7.13.1. OPERATING FREQUENCY 679
7.13.2. TX EFFECTIVE RADIATED POWER.....681
7.13.3. TX OCCUPIED BANDWIDTH 683
7.13.4. MAXIMUM E.R.P SPECTRAL DENSITY.....695
7.13.5. TX OUT OF BAND EMISSIONS.....698
7.13.6. TX UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN 724
7.13.7. TX TRANSIENT POWER 737

7.14. RX UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN.....746

8. SETUP PHOTOS.....765

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: ANAREN, INC.
6635 KIRKVILLE ROAD
EAST SYRACUSE, NY 13057. U.S.A

EUT DESCRIPTION: 868-870 MHZ TRANSCEIVER

MODEL: A110LR09A (Radiated Sample) and A110LR09C (Conducted Sample)

SERIAL NUMBER: 0007-41-1105

DATE TESTED: July 31 to August 15, 2017

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
ETSI EN 300 220-1 V3.1.1	Pass
ETSI EN 300 220-2 V3.1.1	Pass

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

Approved & Released For
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2. TEST METHODOLOGY

All tests were performed in accordance with the procedures documented in ETSI EN 300 220-1 V3.1.1 as referenced by ETSI EN 300 220-2 V3.1.1.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street
☒ Chamber A	☐ Chamber D
☐ Chamber B	☐ Chamber E
☒ Chamber C	☐ Chamber F
	☐ Chamber G
	☐ Chamber H

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://ts.nist.gov/standards/scopes/2000650.htm.

4. CALIBRATION AND UNCERTAINTY

4.4. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

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4.5. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Radio Frequency	±0.18 ppm
RF power, conducted	±0.47 dB
Conducted spurious emission of transmitter, valid up to 6 GHz	±2.94 dB
Conducted emission of receivers	±2.94 dB
Radiated emission of transmitter, valid up to 6 GHz	±5.36 dB
Radiated emission of receiver, valid up to 6 GHz	±5.36 dB
RF level uncertainty for a given BER	±0.4 dB
Occupied BandWidth	±0.39 %
Temperature	±0.9 °C
Humidity	±4.5 %

Uncertainty figures are valid to a confidence level of 95%.

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5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is an 868-870 MHz Transceiver.

5.2. DESCRIPTION OF MODELS DIFFERENCES

A110LR09C is a conducted sample that has an antenna port, to which an external monopole antenna can be connected.
A110LR09A is a radiated sample with PCB antenna built on the board; all other hardware design is identical.

5.3. MAXIMUM OUTPUT ERP

The highest EIRP under normal and extreme environmental conditions is as follows:

Frequency Band	Mode	Output ERP (dBm)	Output ERP (mW)
M	GFSK	12.33	17.1
M	2-FSK	12.36	17.2
N	GFSK	12.34	17.1
N	2-FSK	12.36	17.2
P	GFSK	12.34	17.1
P	2-FSK	12.35	17.2
Q	GFSK	6.72	4.7
Q	2-FSK	6.69	4.7
R	GFSK	12.37	17.3
R	2-FSK	12.35	17.2
X	GFSK	9.69	9.3
X	4-FSK	12.08	16.1

5.4. DESCRIPTION OF AVAILABLE ANTENNAS

The conducted product A110LR09C utilizes an external monopole antenna with a maximum peak gain of 2 dBi (with cable loss of 1 dB).
The radiated product A110LR09A utilizes PCB antenna with a maximum peak gain of 0 dBi.

5.5. SOFTWARE AND FIRMWARE

The software used in the EUT during testing was AIR FCC Test Vers. 4.3.0.0
The firmware installed in the EUT during testing was version 01.00

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5.6. WORST-CASE CONFIGURATIONS AND MODES OF OPERATION

Radiated sample was investigated in three orthogonal orientations X,Y,Z and Z orientation was found to be the worst-case orientation; therefore, final radiated testing on the radiated sample was performed with the EUT laid out in the Z orientation.

Based on an input from the client, the operating band Q can be covered by the operational band R for Occupied Bandwidth, Out Of Band Emissions, Unwanted Emissions In The Spurious Domain and Transient Power since the ERP limit of the operational band Q has the lower ERP limit than the operational band R.

The operational band P covers the operational band O as the output power and duty cycle for the operational band P is higher than those of the operational band O.

The test results of the operational band M and band R cover the operational band X for the modulation codes: M4, M5, M6, M7, M11, M12, M13, ML1.

ERP was performed using CW signal.

Worst Modulation Codes were selected based on Occupied Bandwidth results.

Except for ERP measurement, the duty cycle values that were used for the testing were set to the limits based on annex B and annex C of EN 300 220-2. End user of the device shall comply with duty cycle restrictions based on annex B and annex C of EN 300 220-2. For ERP CW signal with 100% duty cycle was used.

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THE WORST CASE OF ERP AND OUT OF BAND EMISSIONS

TEST ITEM	OPERATING BAND	MODULATION	WORST MODULATION CODE	CHANNELS
ERP	M	CW	N/A	CH2 and CH8
		CW	N/A	CH3 and CH7
	N	CW	N/A	CH17 and CH20
		CW	N/A	CH17 and CH19
	P	CW	N/A	CH30
		CW	N/A	CH30
	Q	CW	N/A	CH36
		CW	N/A	CH36 and CH37
	R	CW	N/A	CH36
		CW	N/A	CH36 and CH37
	X	CW	N/A	CH5 and CH34
		CW	N/A	CH4 and CH35
		CW	N/A	CH12 and CH26
OUT OF BAND EMISSIONS	M	GFSK	M6	CH1 and CH9
			M7	CH2 and CH9
			ML1	CH2 and CH8
		2-FSK	M4	CH2 and CH9
			M5	CH3 and CH7
	N	GFSK	M7	CH16 and CH21
			ML1	CH17 and CH20
		2-FSK	M4	CH16 and CH21
			M5	CH17 and CH19
	P	GFSK	M7	CH30
		2-FSK	M4	CH30
	R	GFSK	M7	CH36 and CH37
			ML1	CH36
		2-FSK	M4	CH36 and CH37
	X	GFSK	ML2	CH4 and CH35
		4-FSK	M14	CH12 and CH26

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THE WORST CASE OF UNWANTED EMISSION AND TRANSIENT POWER

TEST ITEM	OPERATING BAND	MODULATION	WORST MODULATION CODE	CHANNELS
TX UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN AND TRANSIENT POWER	M	GFSK	ML1	CH2 and CH8
		2-FSK	M5	CH3 and CH7
	N	GFSK	ML1	CH17 and CH20
		2-FSK	M5	CH17 and CH19
	P	GFSK	M7	CH30
		2-FSK	M4	CH30
	R	GFSK	ML1	CH36
		2-FSK	M4	CH36 and CH37
	X	GFSK	ML2	CH4 and CH35
		4-FSK	M14	CH12 and CH26
RX UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN	M	2-FSK	M5	CH3 and CH7
	N	2-FSK	M5	CH17 and CH19
	P	2-FSK	M4	CH30
	R	GFSK	ML1	CH36
	X	4-FSK	M14	CH12 and CH26

CC110L - ETSI CONFIGURATIONS			
Modulation	**Data rate [kbps]**	**Code**	**Deviation (kHz)**
2-FSK	1.2	M4	26.4
2-FSK	10	M5	36
GFSK	10	M6	13
GFSK	38	M7	18
2-FSK	0.6	M11	16.5
GFSK	4.8	M12	13.2
GFSK	19.2	M13	13.2
4-FSK	600	M14	237/263(Tx/Rx)
GFSK*	50	ML1	25
GFSK*	100	ML2	50
4-FSK*	200	ML3	50

(*) : 802.15.4g compatible configuration

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5.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST			
Description	**Manufacturer**	**Model**	**Serial Number**
Laptop PC	DELL	PP18L	2921940145
AC Adapter	DELL	LA65NS0-00	0D5263-71615-82P-217E
DC Power Supply	ABM	8185D	D021364
Extend Card	Anaren	Mono Pole	N/A

I/O CABLES

I/O CABLE LIST						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length**	**Remarks**
1	AC	1	AC	Unshielded	1.0m	N/A
2	DC	1	DC	Unshielded	1.8m	N/A
3	USB	1	USB	Shielded	1.0m	N/A

TEST SETUP

The EUT was connected to a host Laptop via USB cable. Test software exercised the EUT.

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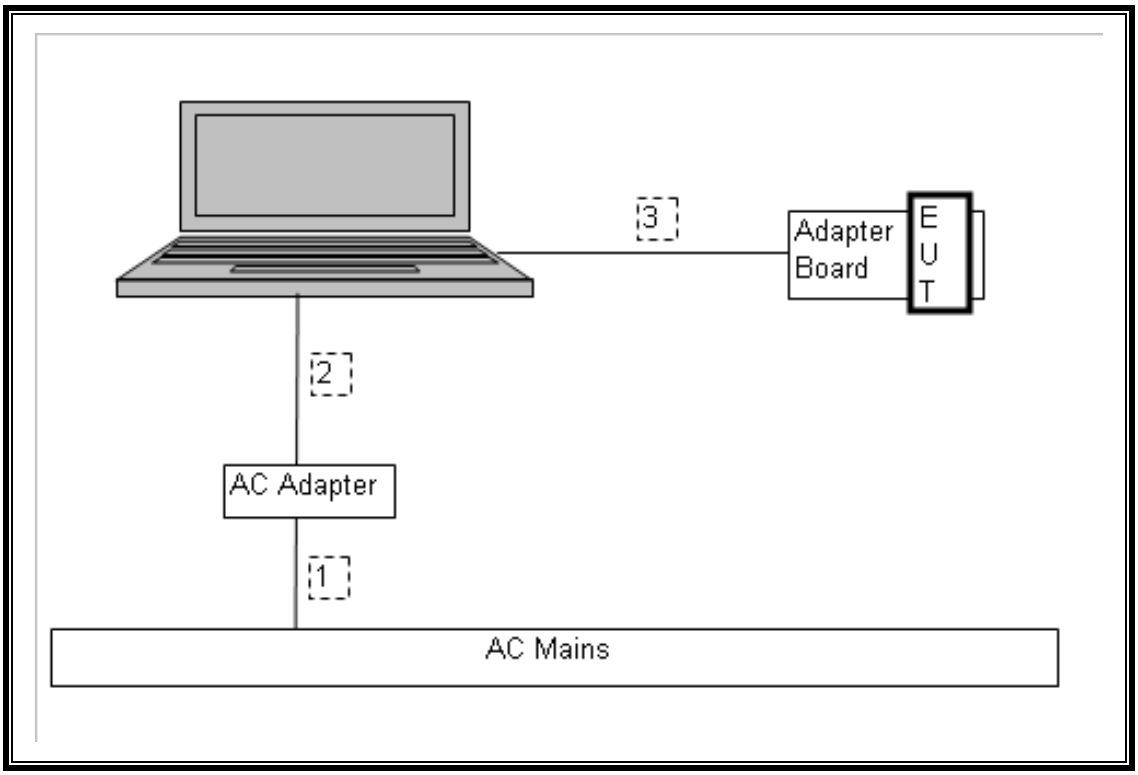
SETUP DIAGRAM



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6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment List					
Description	**Manufacturer**	**Model**	**T No.**	**Cal Date**	**Cal Due**
Temperature/Humidity Chamber	Thermotron	SE-600-10-10	80	02/21/17	08/21/17
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent	N9030A	1450	01/10/17	01/10/18
Spectrum Analyzer, PSA, 3Hz to 44GHz	Agilent	E4446A	907	01/23/17	01/23/18
Spectrum Analyzer, PSA, 3Hz to 44GHz	Agilent	E4446A	905	01/11/17	01/11/18
Amplifier, 1 - 26.5GHz	Miteq	AFS42	1165	08/01/17	08/01/18
Amplifier, 1 - 26.5GHz	Miteq	AFS42	931	08/26/16	08/26/17
Antenna, Broadband Hybrid 30MHz - 2GHz	Sunol Sciences	JB1	130	09/01/16	09/01/17
Antenna, Broadband Hybrid 30MHz - 2GHz	Sunol Sciences	JB1	408	11/10/16	11/10/17
Antenna, Horn 1-18GHz	ETS Lindgren	3117	711	02/22/17	02/22/18
Antenna, Horn 1-18GHz	ETS Lindgren	3117	712	01/30/17	01/30/18
Amplifier, 10kHz to 1GHz, 32dB	Keysight	8447D	10	02/01/17	02/01/18
Amplifier, 10kHz to 1GHz, 32dB	Keysight	8447D	15	08/26/16	08/26/17

Test Software List			
Description	**Manufacturer**	**Model**	**Version**
Antenna Port Software	UL	UL RF	Ver 6.2, March 10, 2017
Radiated Software	UL	UL EMC	Ver 9.5 Apr 26, 2016

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7. TEST RESULTS

7.1. NORMAL AND EXTREME CONDITIONS

LIMITS

None; for reporting purposes only.

RESULTS

Normal conditions are +25 deg C, +2.7 VDC.
The low temperature condition is -40 deg C.
The high temperature condition is +85 deg C.
The low voltage condition is +1.8 VDC.
The high voltage condition is +3.6 VDC.

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7.2. GFSK MODULATION IN M BAND

7.2.1. OPERATING FREQUENCY

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.2.1.2

The manufacturer may declare either one or more operating frequencies and operating channels.
Operating channel(s) shall be entirely within operational frequency bands allowed by annexes B, C or any NRI.

22 ETSI EN 300 220-2 V3.1.1 (2017-02)

Operational Frequency Band		Maximum effective radiated power, e.r.p.	Channel access and occupation rules (e.g. Duty cycle or LBT + AFA)	Maximum occupied bandwidth	Other usage restrictions	Band number from EC Decision 2013/752/EU [i.3]	Class 1 sub-class number according Commission Decision 2000/299/EU [i.7]
M	868,000 MHz to 868,600 MHz	25 mW e.r.p.	≤ 1 % duty cycle or polite spectrum access	The whole band except for audio & video applications limited to 300 kHz		48	28
N	868,700 MHz to 869,200 MHz	25 mW e.r.p.	≤ 0,1% duty cycle or polite spectrum access	The whole sub-band except for audio & video applications limited to 300 kHz		50	29
O	869,400 MHz to 869,650 MHz	25 mW e.r.p.	≤ 0.1% duty cycle or polite spectrum access	The whole band	.	54a	130
P	869,400 MHz to 869,650 MHz	500 mW e.r.p.	≤ 10 % duty cycle or polite spectrum access	The whole band		54b	30
Q	869,700 MHz to 870,000 MHz	5 mW e.r.p.	No requirement	The whole band	Audio and video applications are excluded.	56a	31
R	869,700 MHz to 870,000 MHz	25 mW e.r.p.	≤ 1% duty cycle or polite spectrum access	The whole band	Analogue audio applications are excluded. Analogue video applications are excluded.	56b	69

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.1.2

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RESULTS

Parameter	Values as declared by the manufacturer
M6, GFSK	
Operational Frequency band or bands	868 - 868.6
Nominal Operating Frequencies (MHz)	868.036076 - 868.451123
Operating Channel width(s) - OCW	40 kHz
M7, GFSK	
Operational Frequency band or bands	868 - 868.6
Nominal Operating Frequencies (MHz)	868.103806 - 868.467178
Operating Channel width(s) - OCW	80 kHz
M12, GFSK	
Operational Frequency band or bands	868 - 868.6
Nominal Operating Frequencies (MHz)	868.103806 - 868.467178
Operating Channel width(s) - OCW	30 kHz
M13, GFSK	
Operational Frequency band or bands	868 - 868.6
Nominal Operating Frequencies (MHz)	868.103806 - 868.467178
Operating Channel width(s) - OCW	40 kHz
ML1, GFSK	
Operational Frequency band or bands	868 - 868.6
Nominal Operating Frequencies (MHz)	868.103806 - 868.415268
Operating Channel width(s) - OCW	100 kHz

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7.2.2. TX EFFECTIVE RADIATED POWER

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.3.1.2

The effective radiated power shall not be greater than the value allowed in annexes B or C for the chosen operational frequency band(s).

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.2.2.1.2

RESULTS

Date: 08/11/17
Project No: 11773240
Tester: 50818_JQ

CHANNELS FOR MODULATION CODE: ML1

EUT Antenna Gain (dBi) =	2.00

Condition	Output Power (dBm)	EIRP (dBm)	ERP (dBm)	Limit (dBm)	Margin (dB)
Low Channel, CH2					
Normal	11.78	13.78	11.63	13.98	-2.35
Extreme T low, V low	12.48	14.48	12.33	13.98	-1.66
Extreme T low, V high	12.48	14.48	12.33	13.98	-1.66
Extreme T high, V low	11.21	13.21	11.06	13.98	-2.92
Extreme T high, V high	11.20	13.20	11.05	13.98	-2.93
High Channel, CH8					
Normal	11.77	13.77	11.62	13.98	-2.37
Extreme T low, V low	12.48	14.48	12.33	13.98	-1.65
Extreme T low, V high	12.48	14.48	12.33	13.98	-1.65
Extreme T high, V low	11.21	13.21	11.06	13.98	-2.92
Extreme T high, V high	11.20	13.20	11.05	13.98	-2.93

Note: Cable loss correction factor is included in the Power Meter Reading

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7.2.3. TX OCCUPIED BANDWIDTH

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.3.4.2

The occupied bandwidth of the EUT according to ETSI EN 300 220-1 [1], clause 5.6.2 shall comply with the limits in annex B or C.

Reference Limit:

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.6.2

The Operating Channel shall be declared and shall reside entirely within the Operational Frequency Band. The Maximum Occupied Bandwidth at 99 % shall reside entirely within the Operating Channel defined by F_{low} and F_{high}.

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.6.3.3 (Conducted Measurement)

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RESULTS

BAND M

Condition	Low CH (MHz)	High CH (MHz)	Low CH OBW (kHz)	High CH OBW (kHz)	F_{Low} (MHz)	F_{Low} Limit (MHz)	F_{High} (MHz)	F_{High} Limit (MHz)
M6, GFSK								
Normal	868.0519	868.4667	31.639	32.190	868.04	> 868	868.48	< 868.6
T low, V low	868.0519	868.4667	31.435	31.777	868.04	> 868	868.48	< 868.6
T low, V high	868.0519	868.4667	32.263	32.003	868.04	> 868	868.48	< 868.6
T high, V low	868.0519	868.4667	32.087	31.619	868.04	> 868	868.48	< 868.6
T high, V high	868.0519	868.4667	31.673	31.750	868.04	> 868	868.48	< 868.6
M7, GFSK								
Normal	868.1038	868.4672	65.939	66.098	868.07	> 868	868.50	< 868.6
T low, V low	868.1038	868.4672	65.973	65.660	868.07	> 868	868.50	< 868.6
T low, V high	868.1038	868.4672	64.742	64.637	868.07	> 868	868.50	< 868.6
T high, V low	868.1038	868.4672	64.709	65.579	868.07	> 868	868.50	< 868.6
T high, V high	868.1038	868.4672	65.612	65.949	868.07	> 868	868.50	< 868.6
M12, GFSK								
Normal	868.1038	868.4672	29.557	29.511	868.09	> 868	868.48	< 868.6
T low, V low	868.1038	868.4672	29.874	29.535	868.09	> 868	868.48	< 868.6
T low, V high	868.1038	868.4672	29.665	29.610	868.09	> 868	868.48	< 868.6
T high, V low	868.1038	868.4672	29.650	29.567	868.09	> 868	868.48	< 868.6
T high, V high	868.1038	868.4672	29.593	29.731	868.09	> 868	868.48	< 868.6
M13, GFSK								
Normal	868.1038	868.4672	38.921	38.503	868.08	> 868	868.49	< 868.6
T low, V low	868.1038	868.4672	38.525	38.282	868.08	> 868	868.49	< 868.6
T low, V high	868.1038	868.4672	38.524	38.571	868.08	> 868	868.49	< 868.6
T high, V low	868.1038	868.4672	38.710	38.827	868.08	> 868	868.49	< 868.6
T high, V high	868.1038	868.4672	38.595	38.002	868.08	> 868	868.49	< 868.6
ML1, GFSK								
Normal	868.1038	868.4153	89.915	88.942	868.06	> 868	868.46	< 868.6
T low, V low	868.1038	868.4153	89.045	89.322	868.06	> 868	868.46	< 868.6
T low, V high	868.1038	868.4153	91.296	93.784	868.06	> 868	868.46	< 868.6
T high, V low	868.1038	868.4153	88.169	89.172	868.06	> 868	868.46	< 868.6
T high, V high	868.1038	868.4153	89.906	88.665	868.06	> 868	868.46	< 868.6

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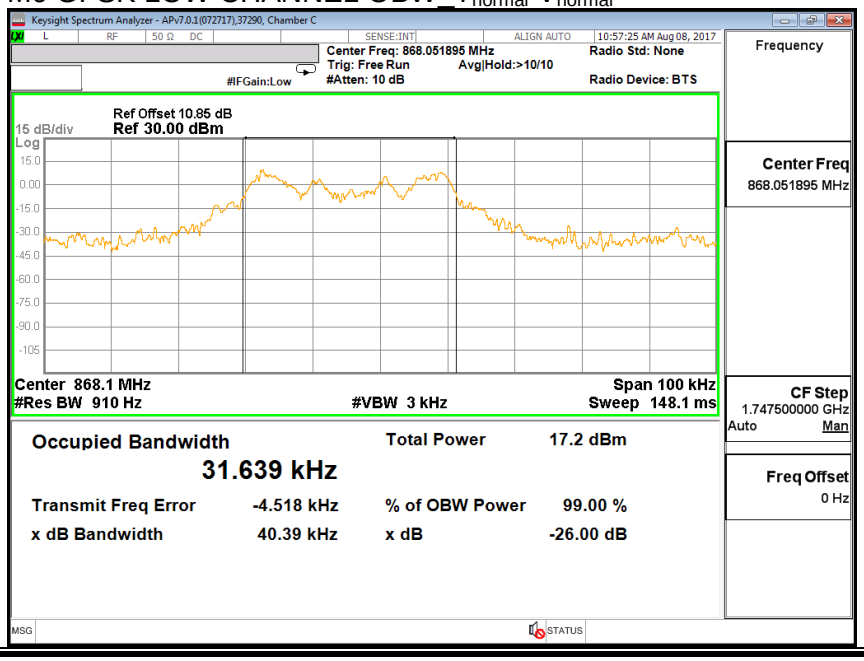
M6 GFSK LOW CHANNEL OBW_T_{normal} V_{normal}



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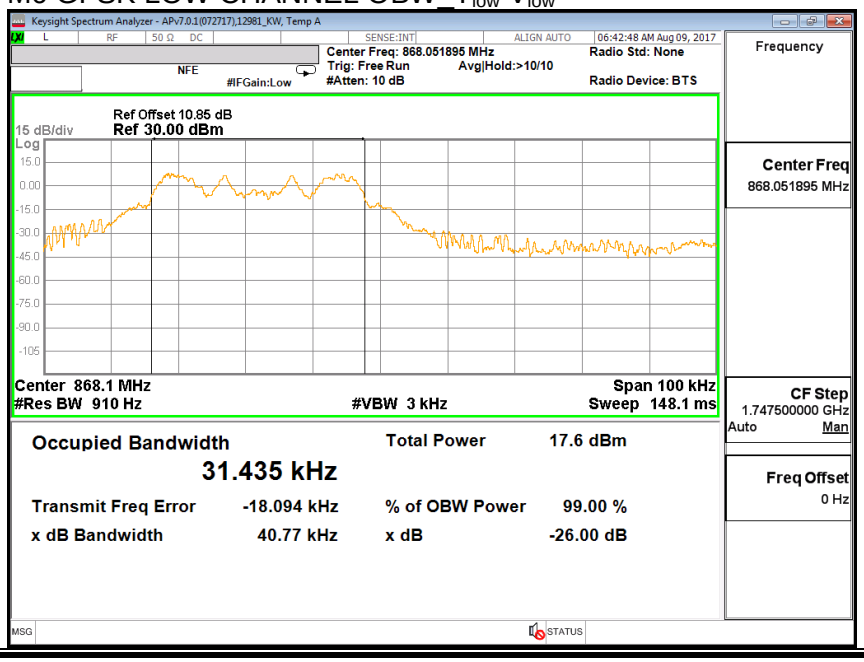

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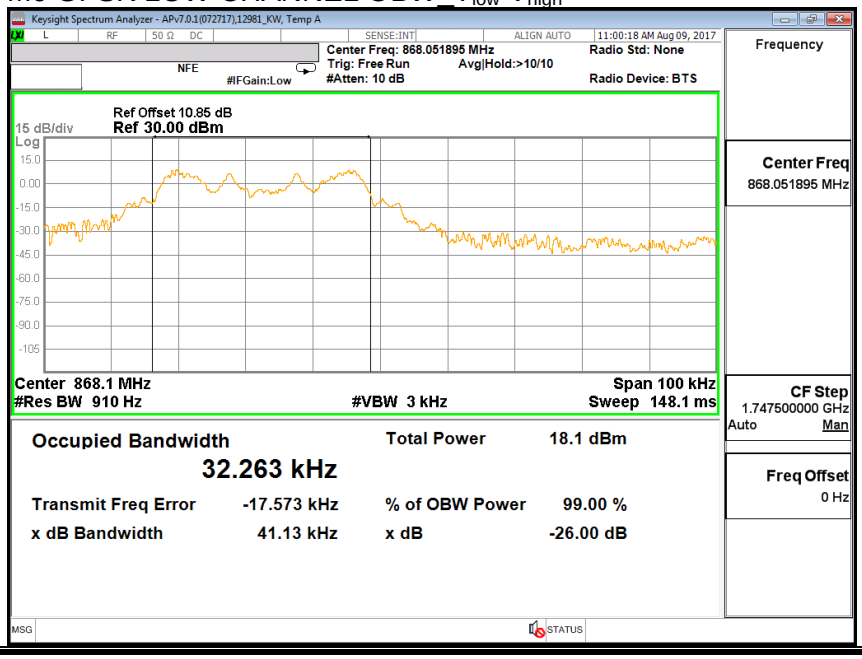
M6 GFSK LOW CHANNEL OBW_T_{low} V_{high}



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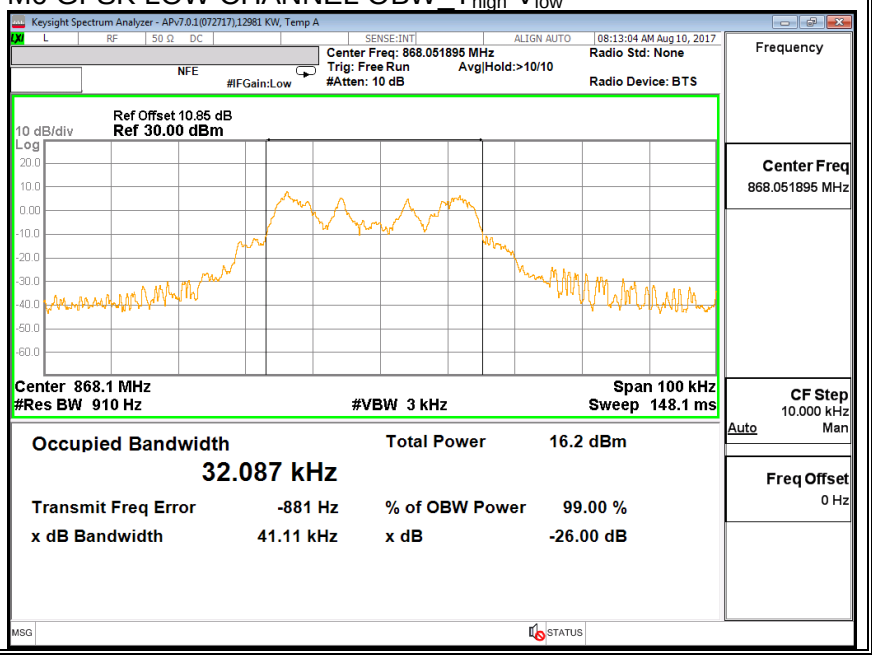

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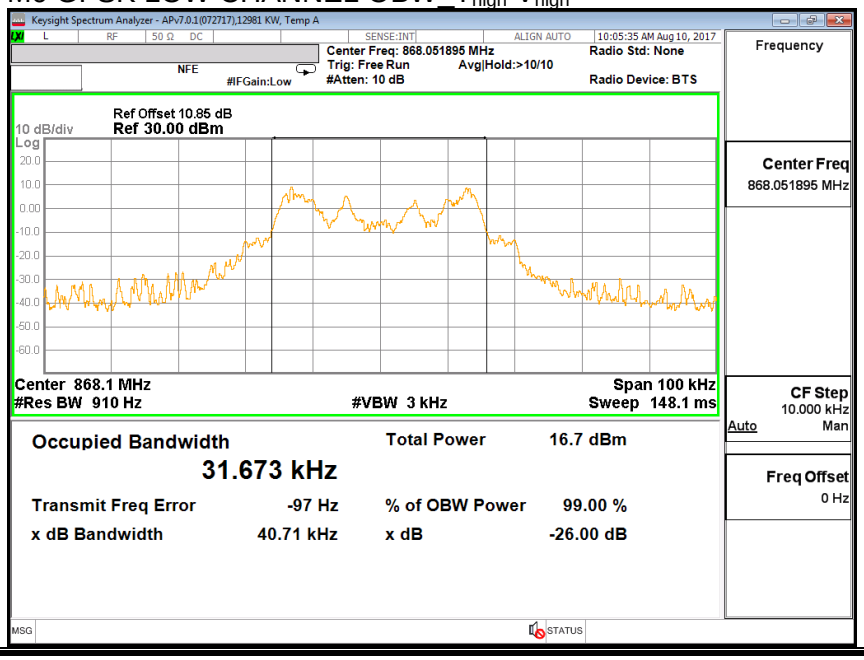
M6 GFSK LOW CHANNEL OBW_T_{high} V_{high}



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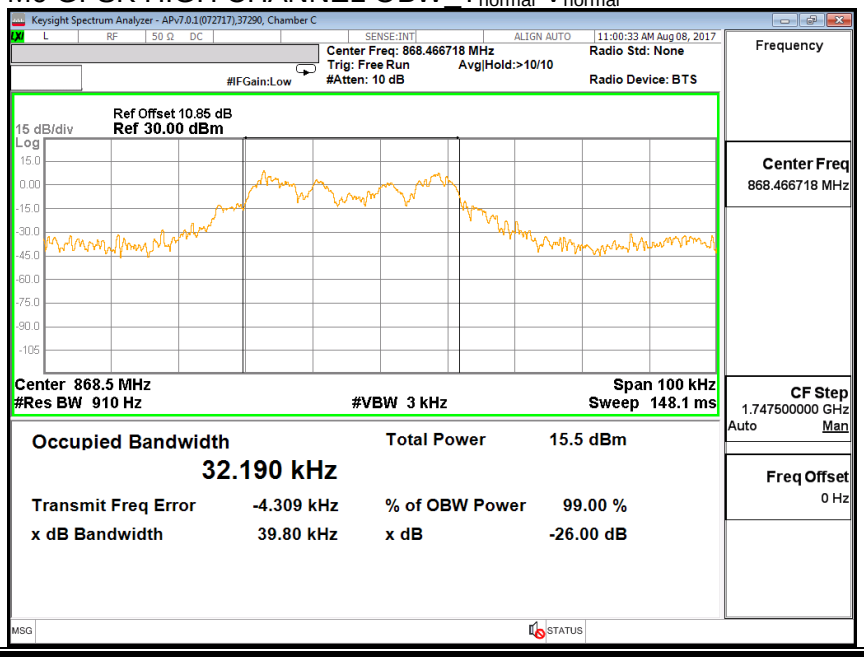

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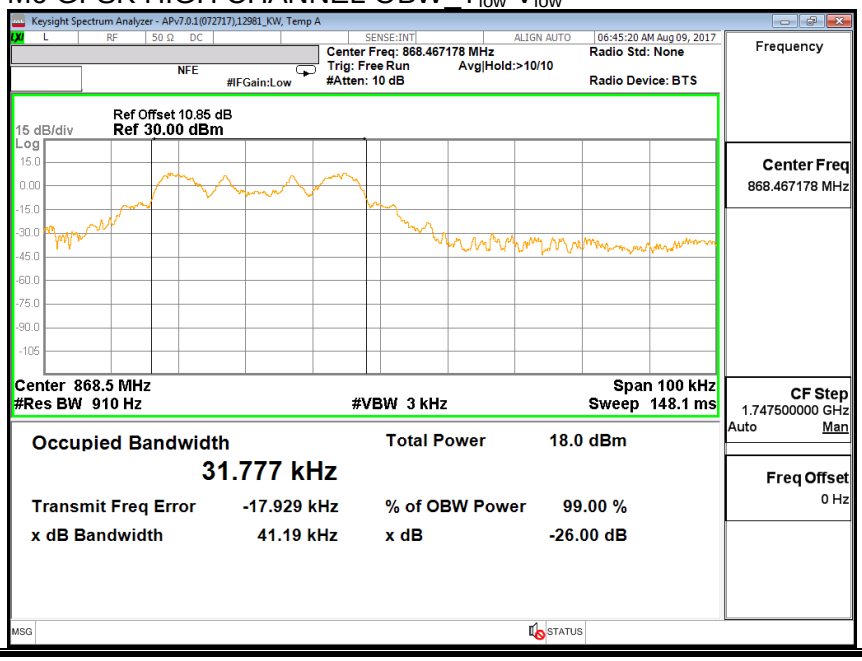
M6 GFSK HIGH CHANNEL OBW_T_{low} V_{low}



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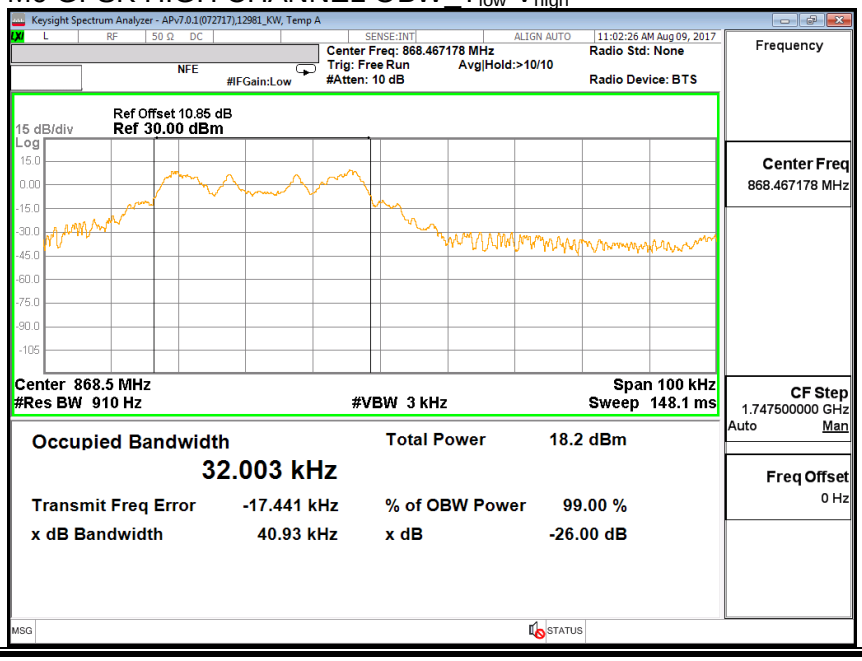

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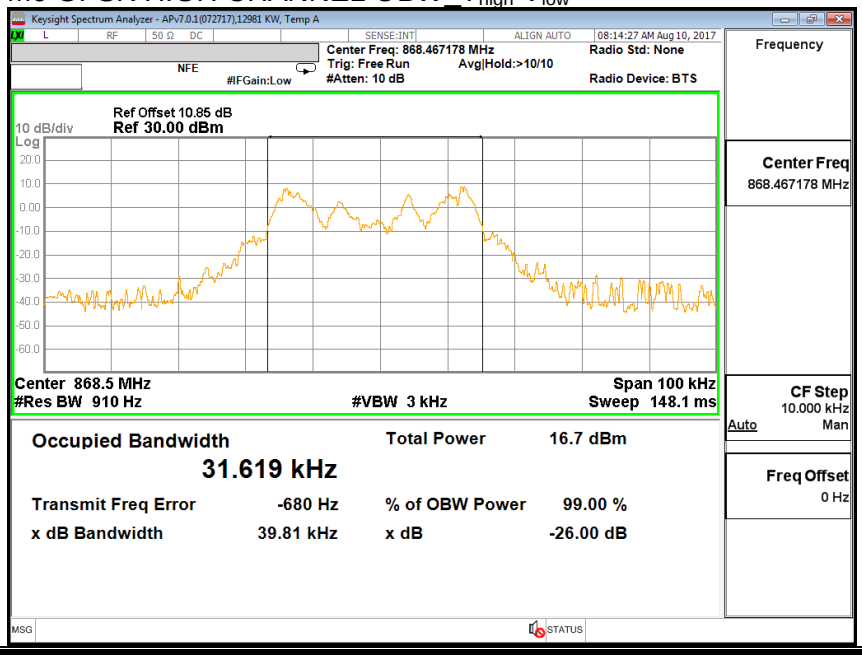
M6 GFSK HIGH CHANNEL OBW_T_{high} V_{low}



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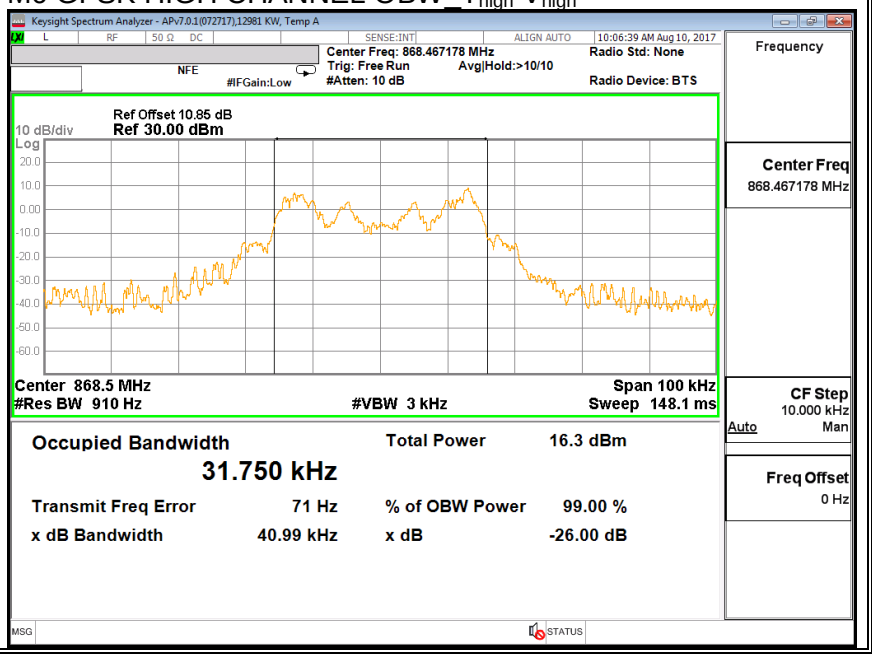

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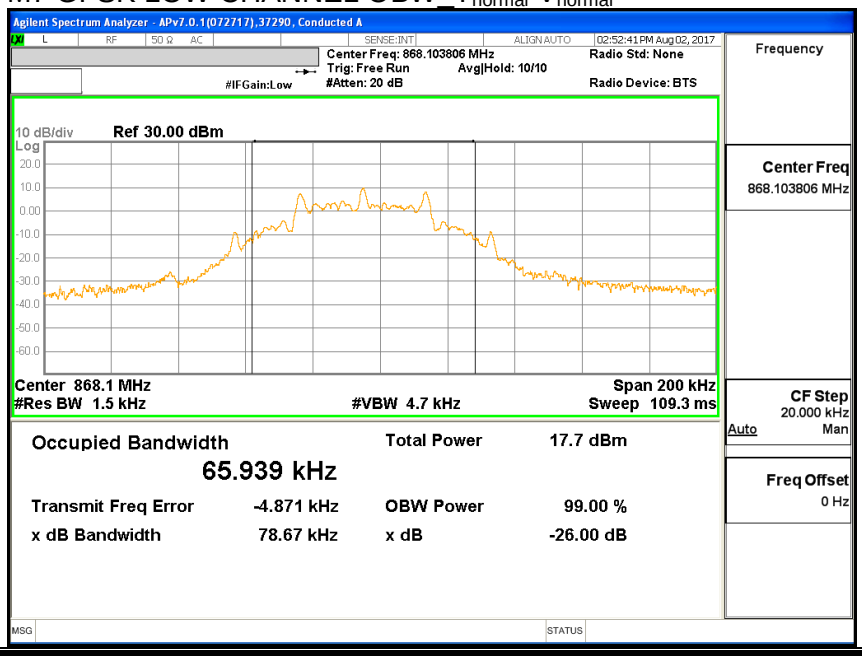
M7 GFSK LOW CHANNEL OBW_T_{normal} V_{normal}



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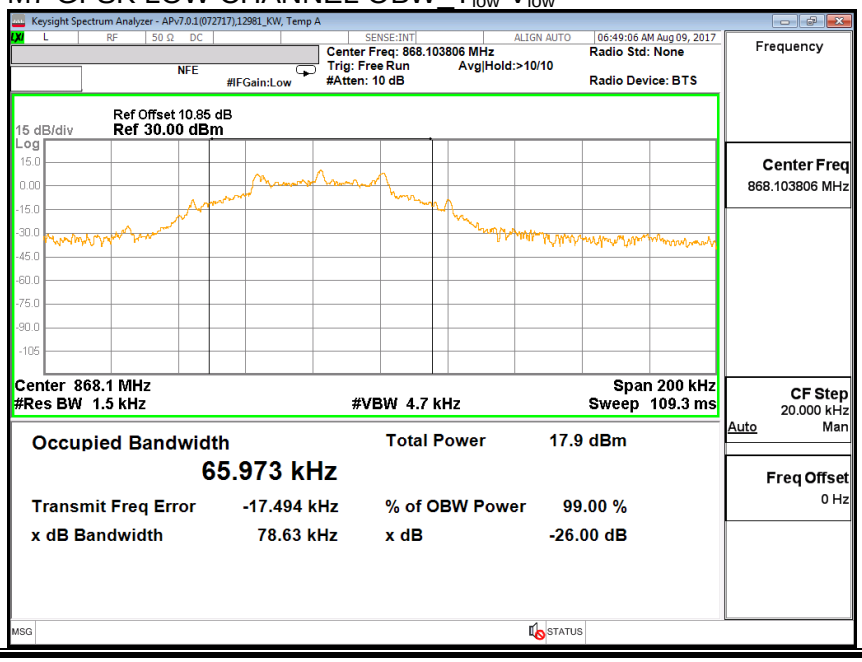

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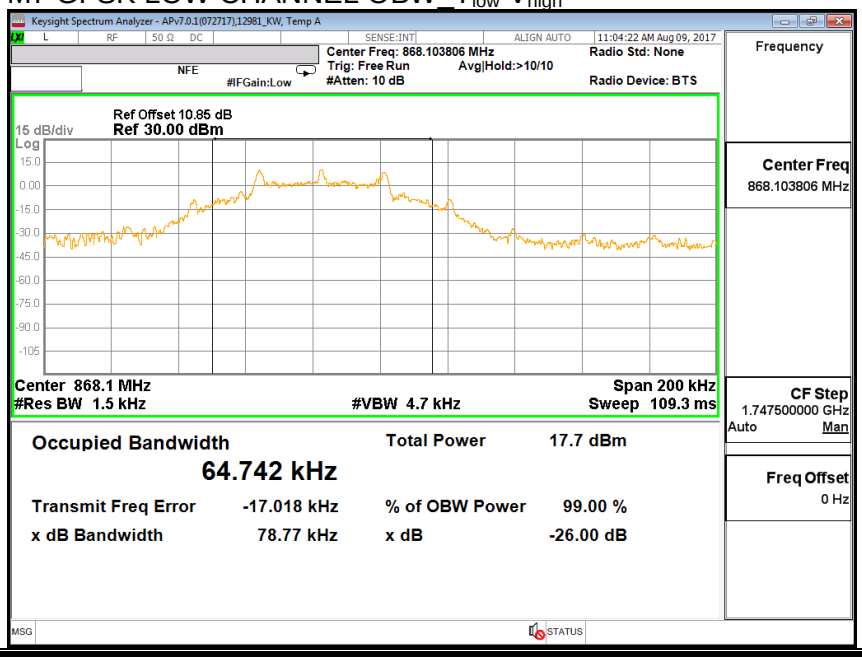
M7 GFSK LOW CHANNEL OBW_T_{low} V_{high}



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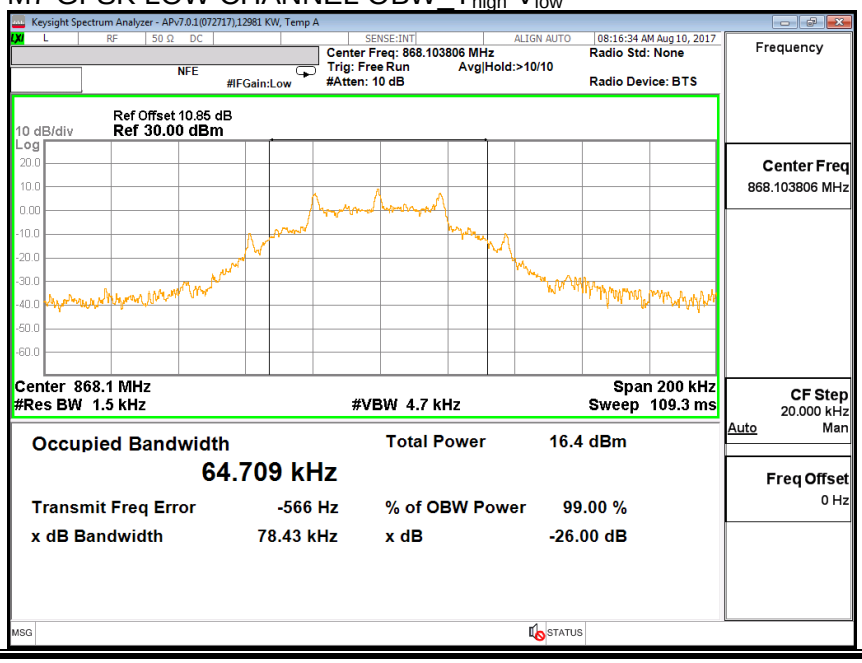

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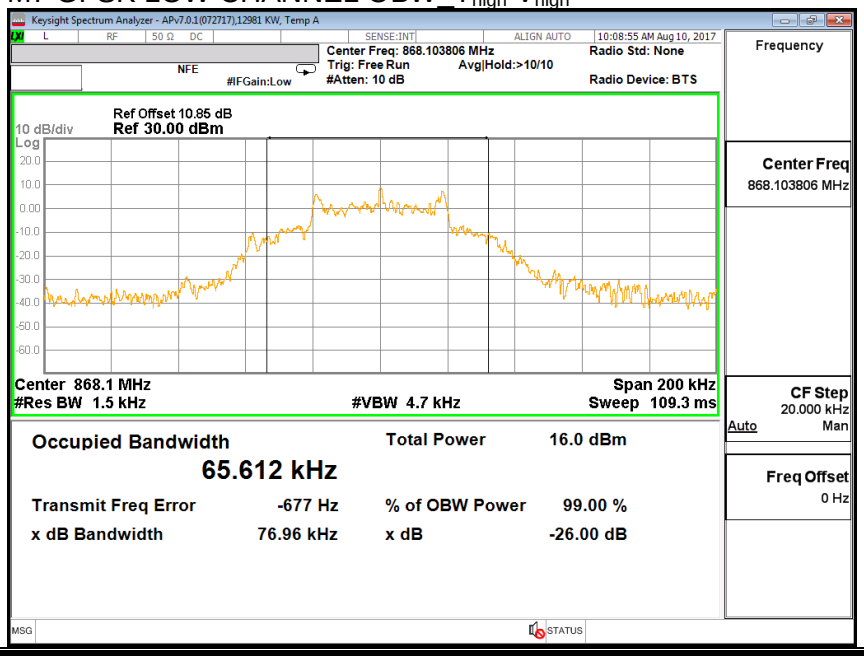
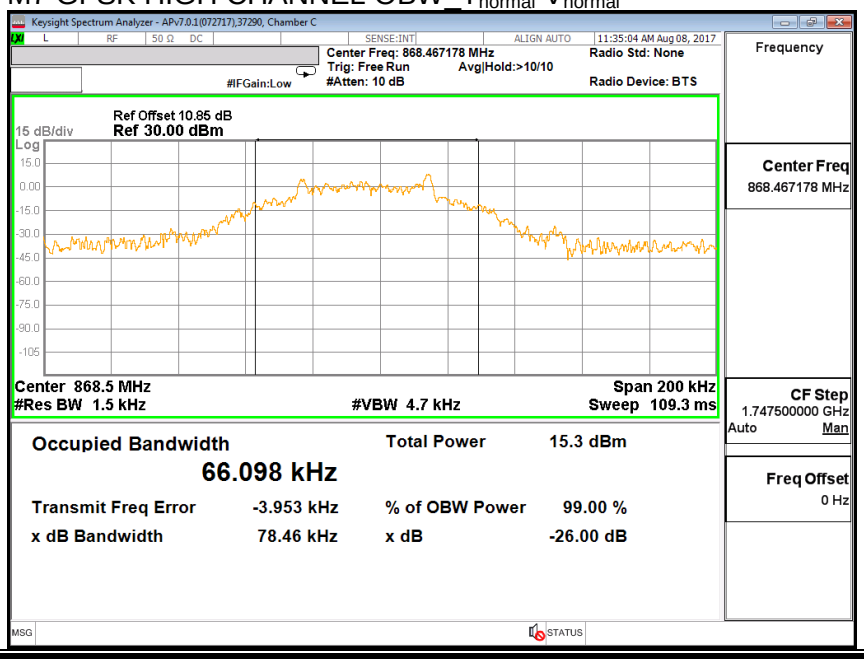
M7 GFSK LOW CHANNEL OBW_T_{high} V_{high}



M7 GFSK HIGH CHANNEL OBW_T_{normal} V_{normal}



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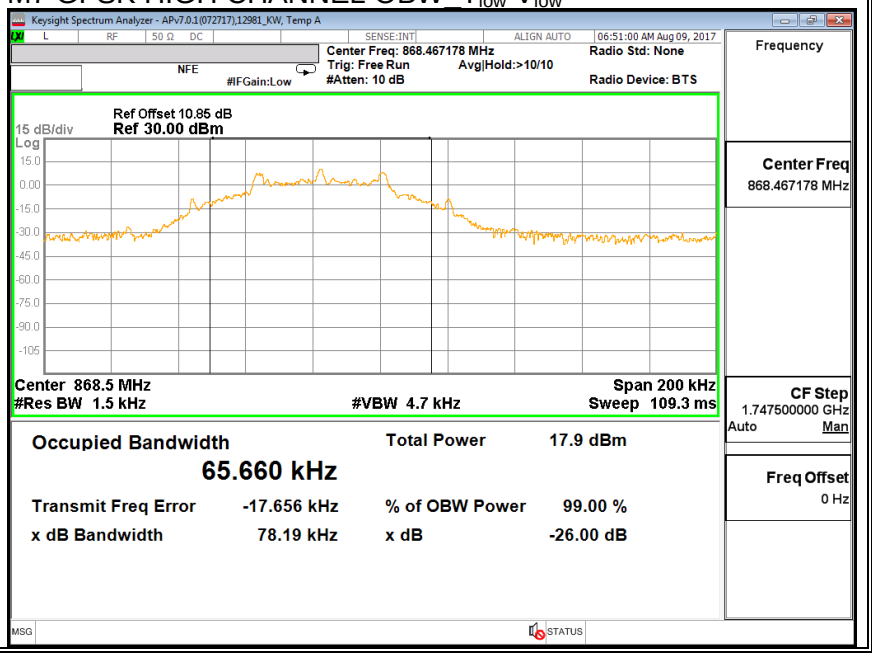
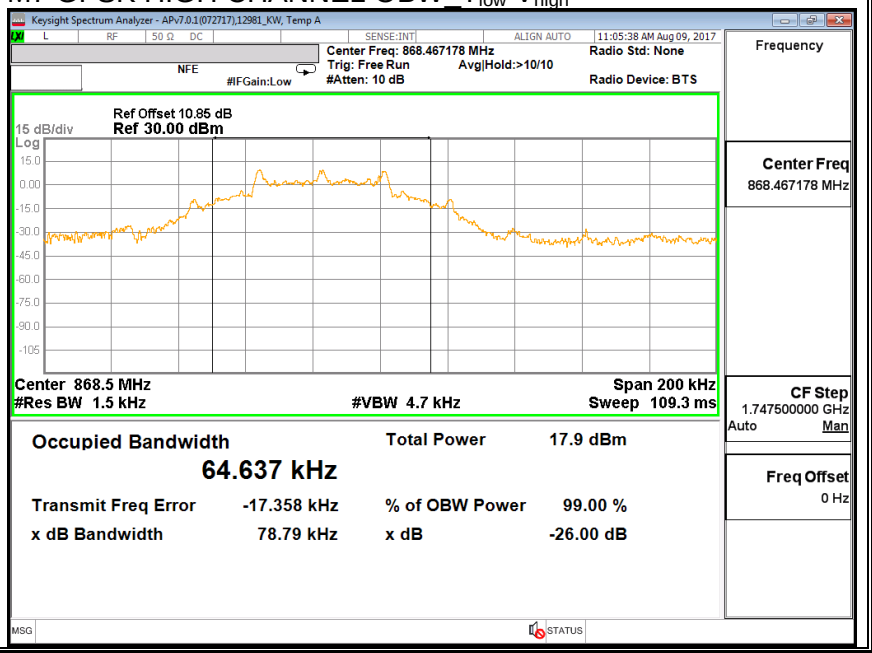
M7 GFSK HIGH CHANNEL OBW_T_{low} V_{low}



M7 GFSK HIGH CHANNEL OBW_T_{low} V_{high}



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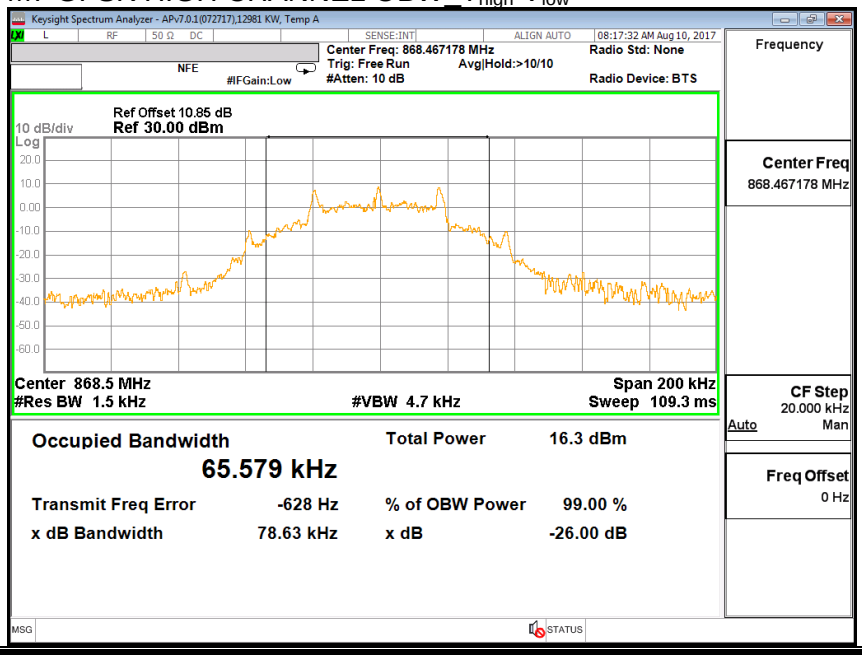
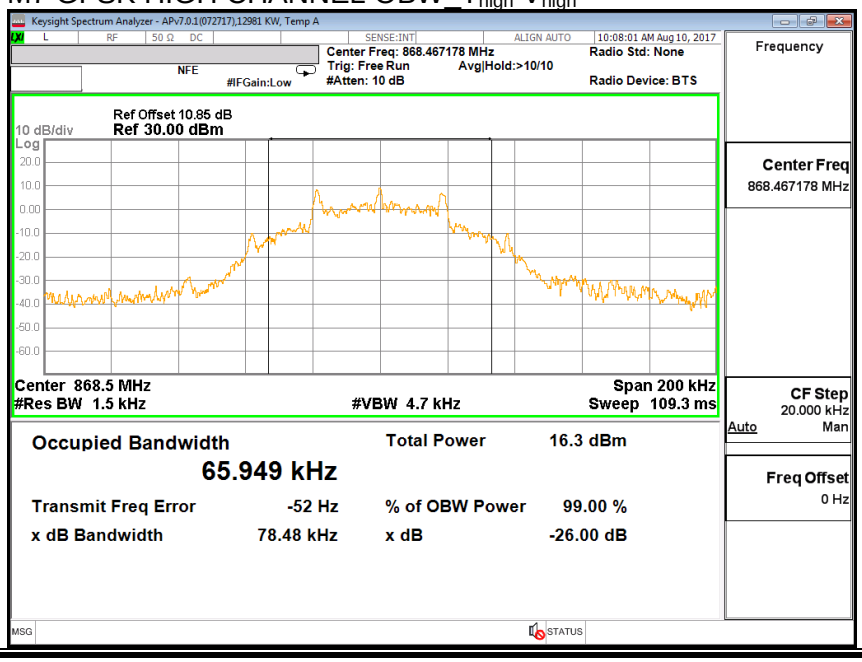
M7 GFSK HIGH CHANNEL OBW_T_{high} V_{low}



M7 GFSK HIGH CHANNEL OBW_T_{high} V_{high}



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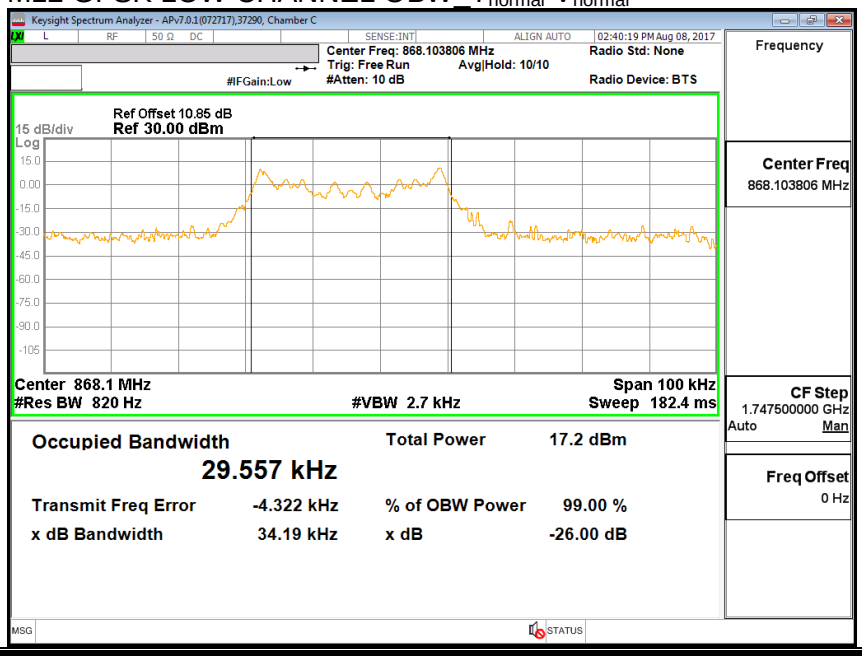
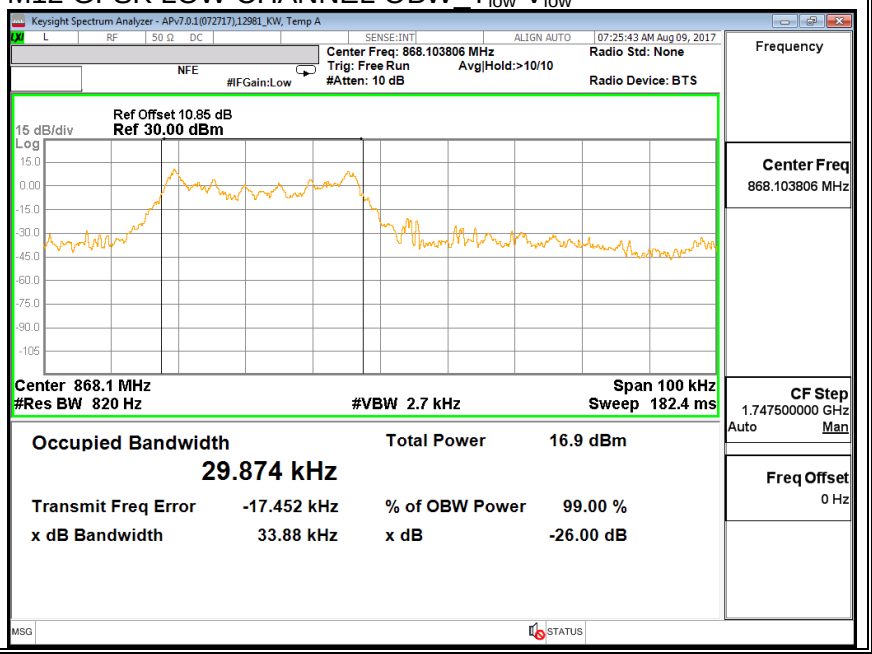
M12 GFSK LOW CHANNEL OBW_T_{normal} V_{normal}



M12 GFSK LOW CHANNEL OBW_T_{low} V_{low}



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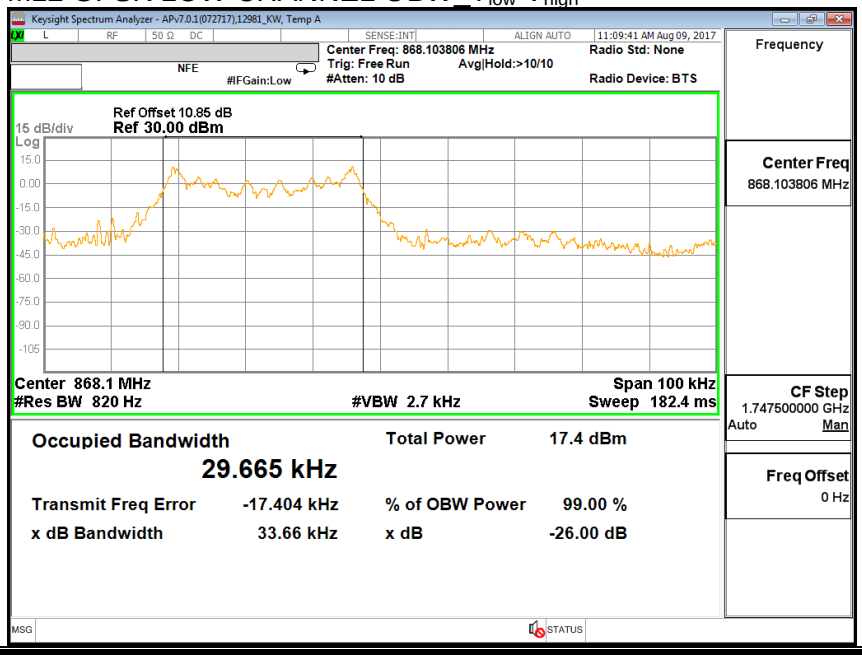
M12 GFSK LOW CHANNEL OBW_T_{low} V_{high}



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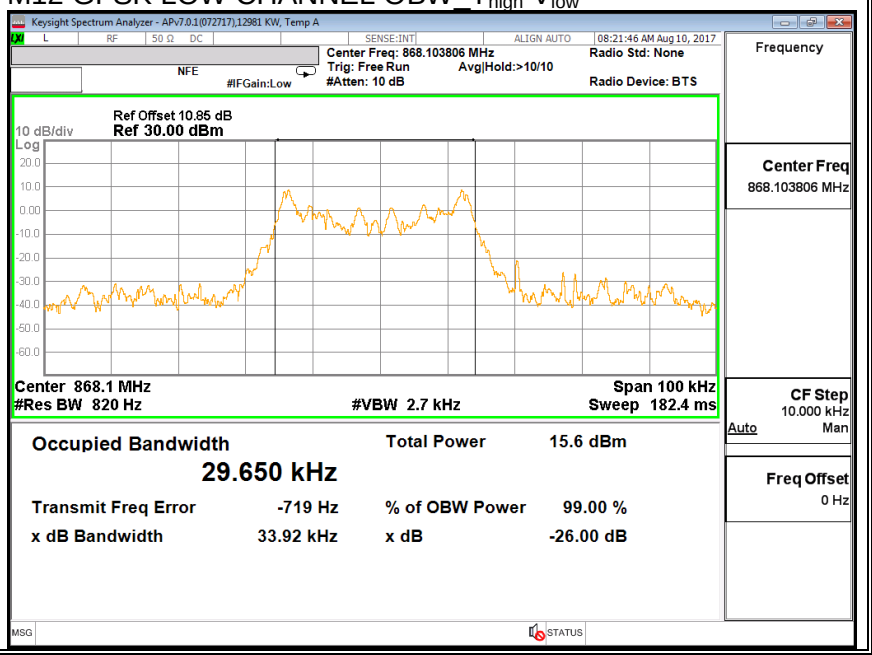

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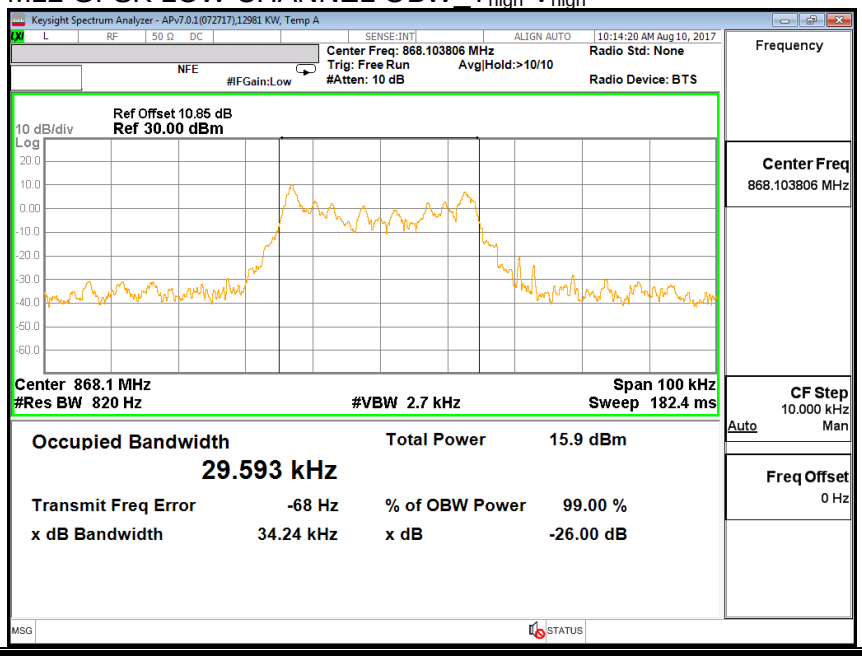
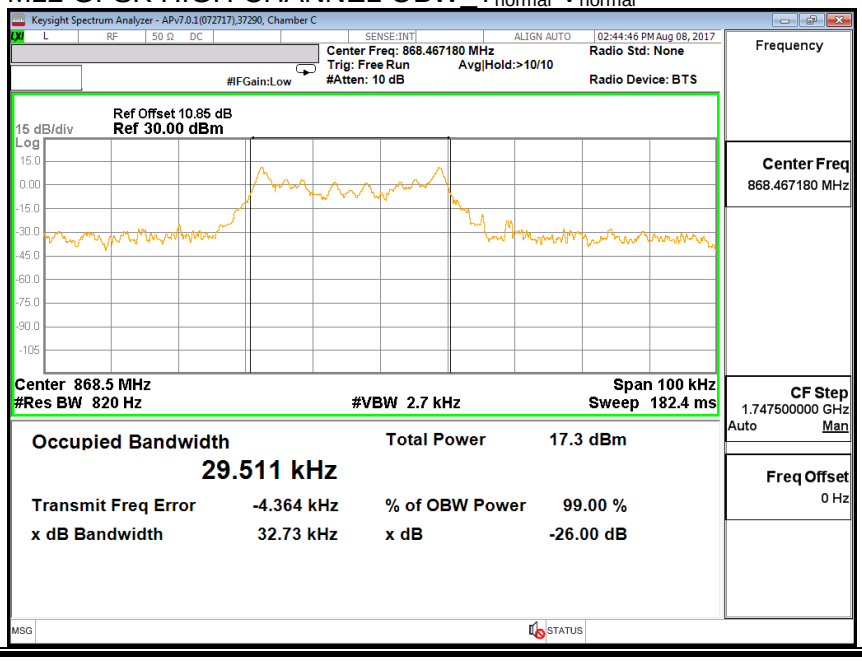
M12 GFSK LOW CHANNEL OBW_T_{high} V_{high}



M12 GFSK HIGH CHANNEL OBW_T_{normal} V_{normal}



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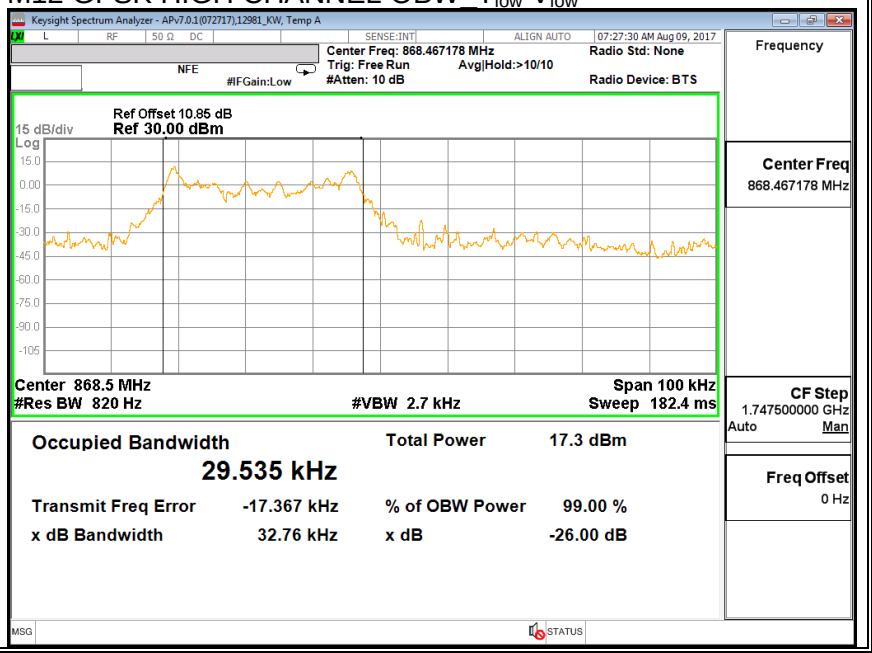
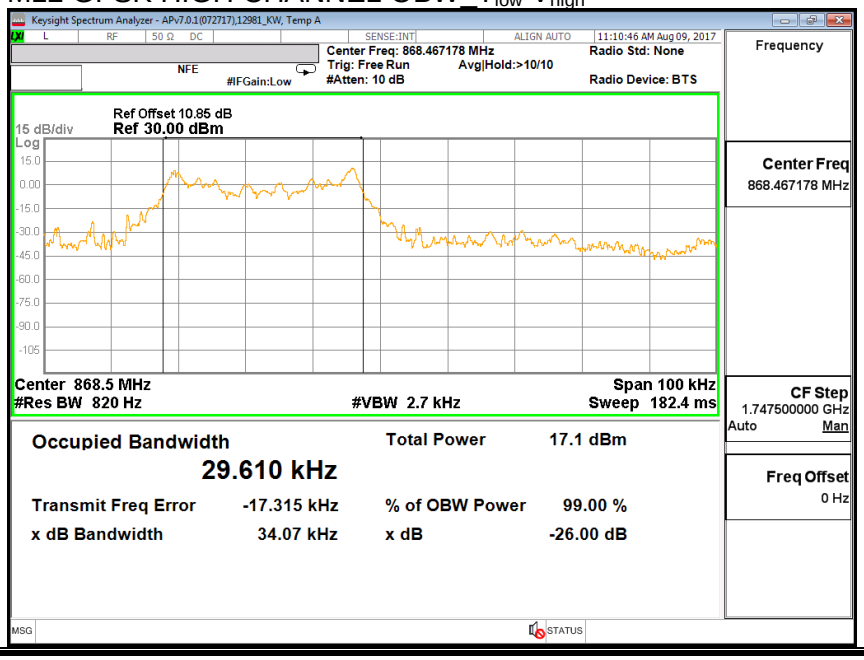
M12 GFSK HIGH CHANNEL OBW_T_{low} V_{low}



M12 GFSK HIGH CHANNEL OBW_T_{low} V_{high}



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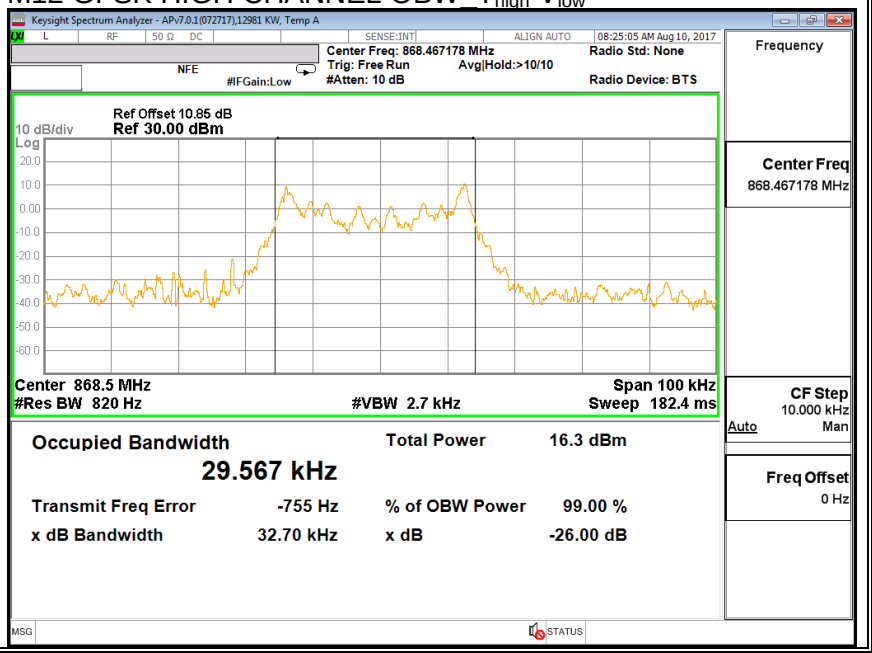
M12 GFSK HIGH CHANNEL OBW_T_{high} V_{low}



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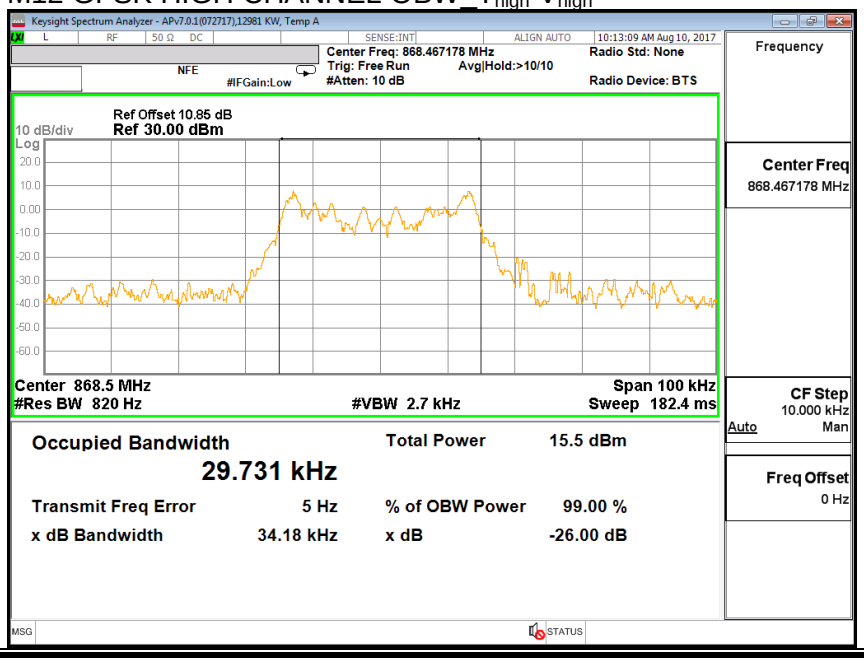

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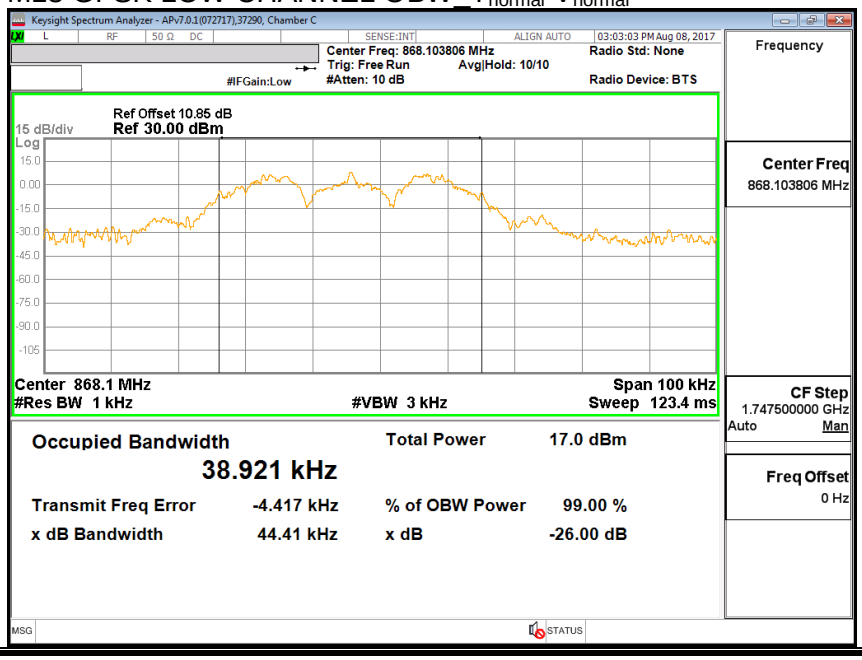
M13 GFSK LOW CHANNEL OBW_T_{normal} V_{normal}



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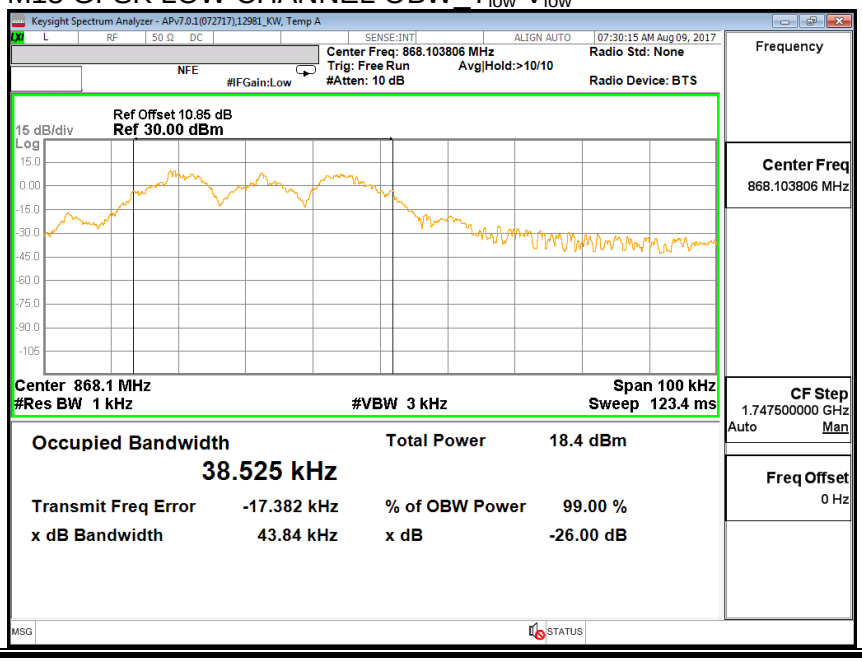

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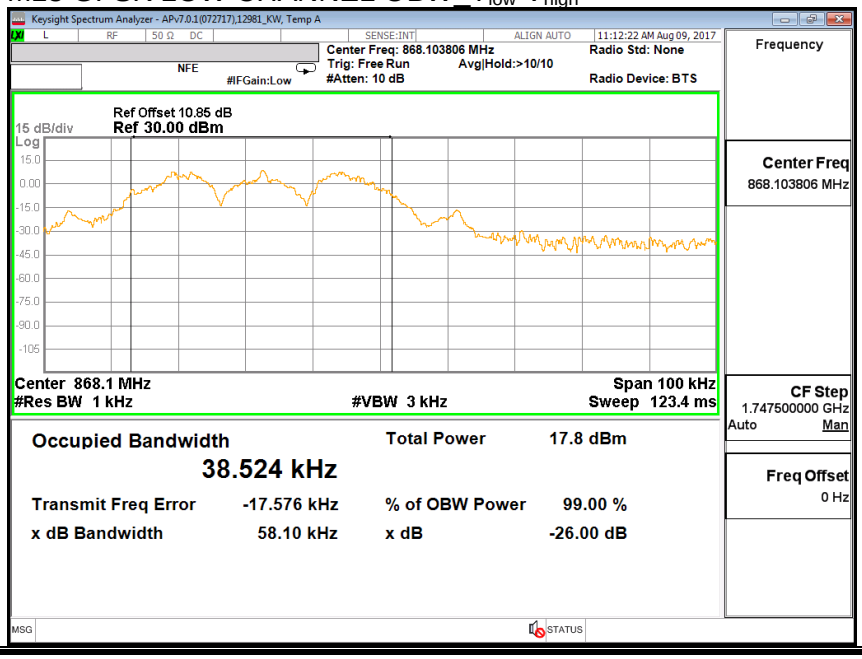
M13 GFSK LOW CHANNEL OBW_T_{low} V_{high}



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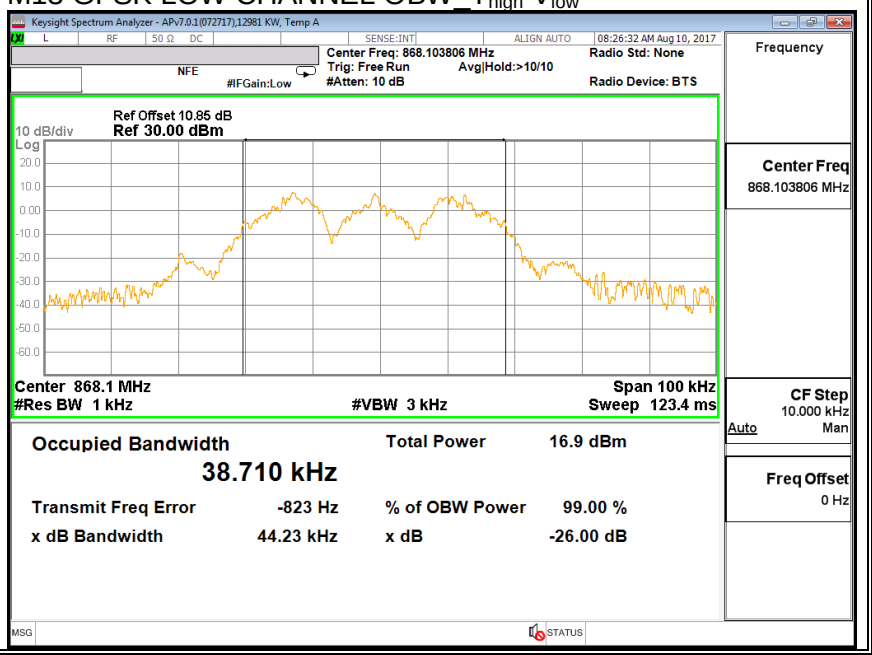

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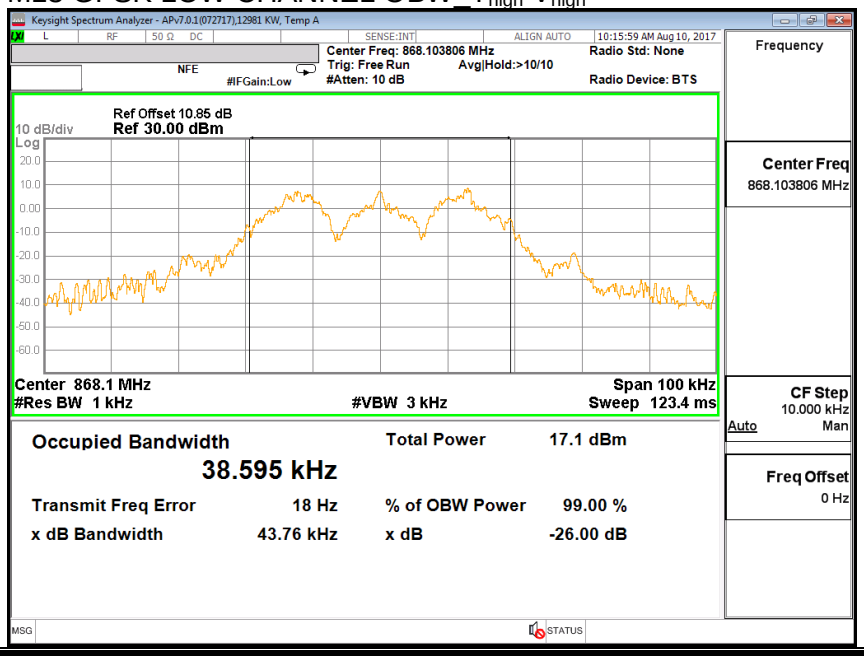
M13 GFSK LOW CHANNEL OBW_T_{high} V_{high}



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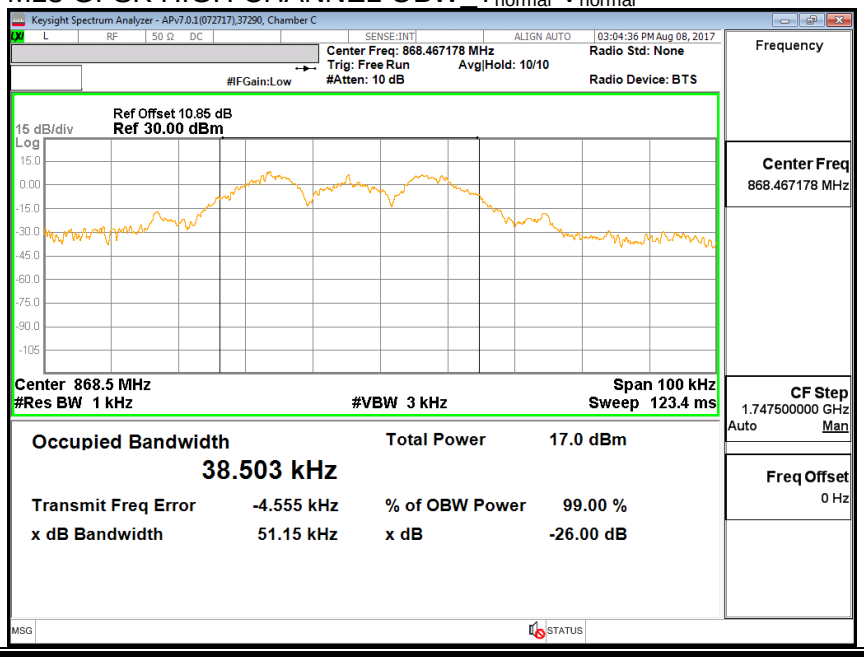

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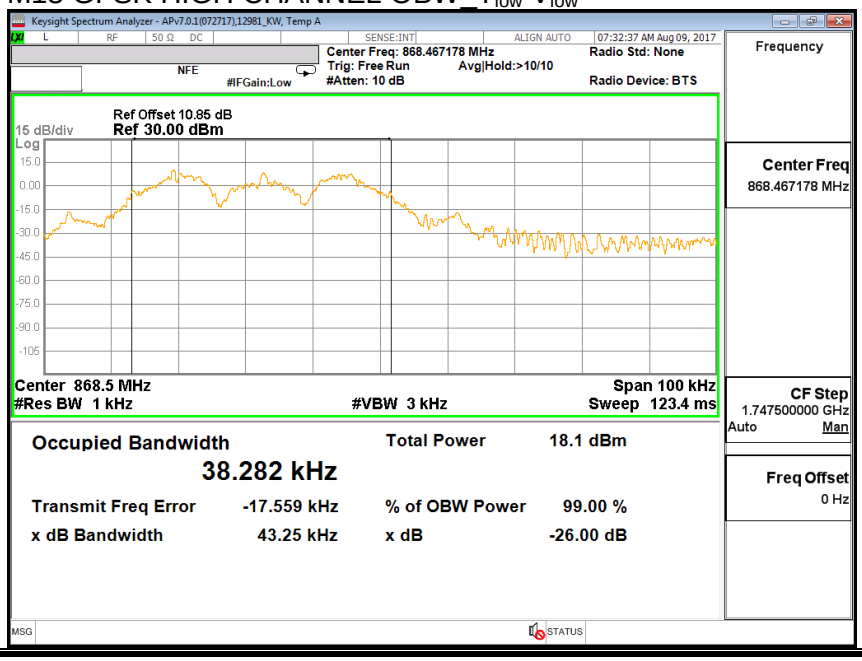
M13 GFSK HIGH CHANNEL OBW_T_{low} V_{low}



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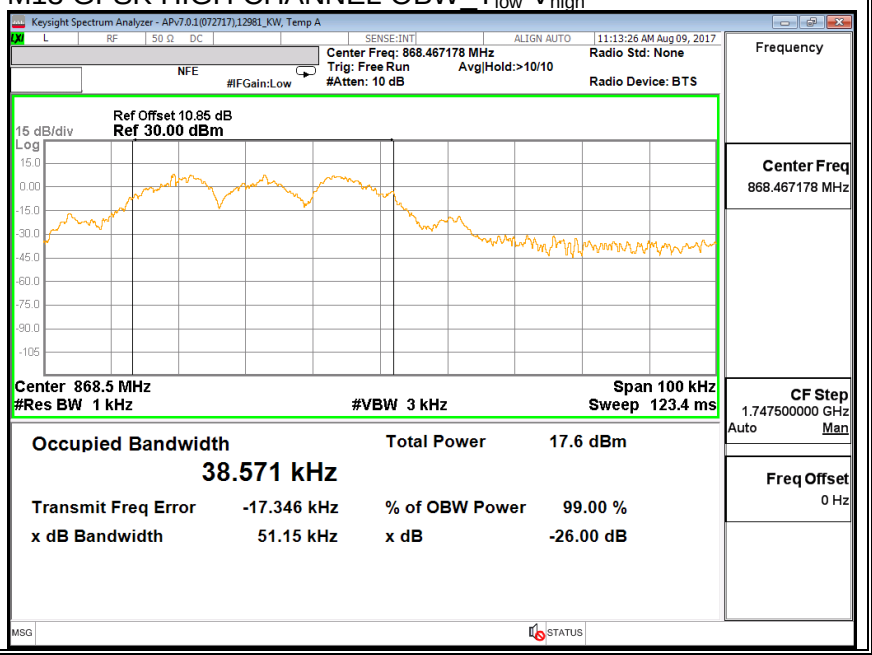

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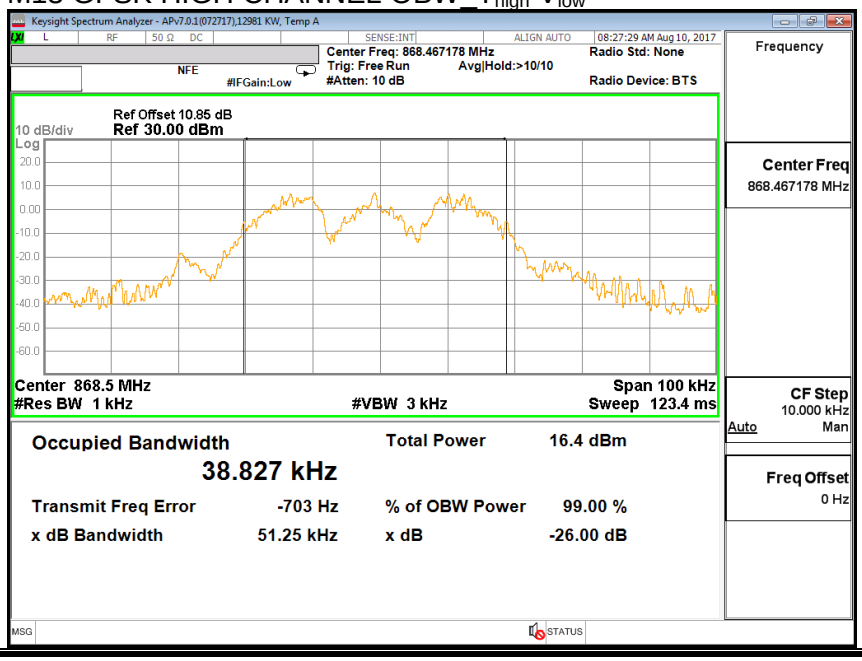
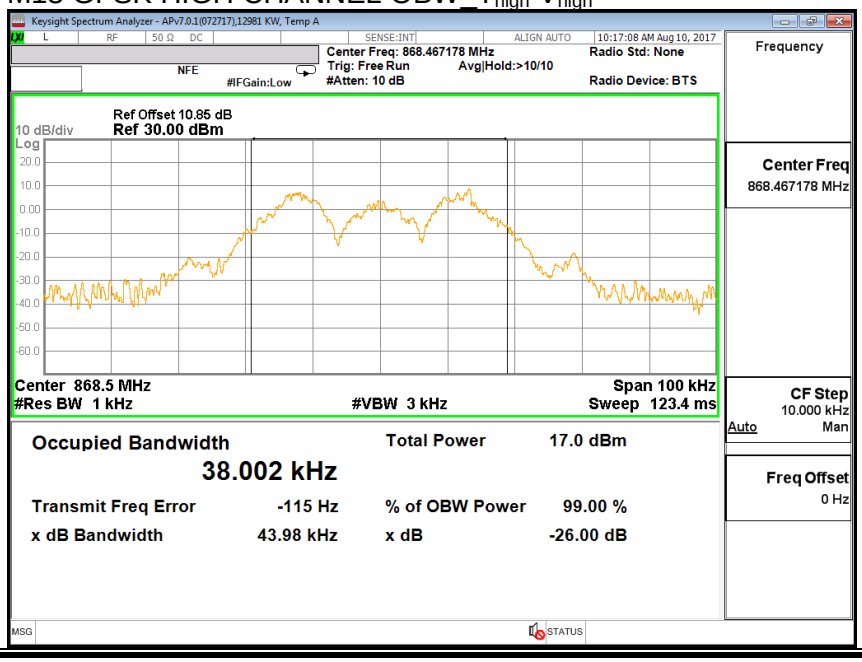
M13 GFSK HIGH CHANNEL OBW_T_{high} V_{low}



M13 GFSK HIGH CHANNEL OBW_T_{high} V_{high}



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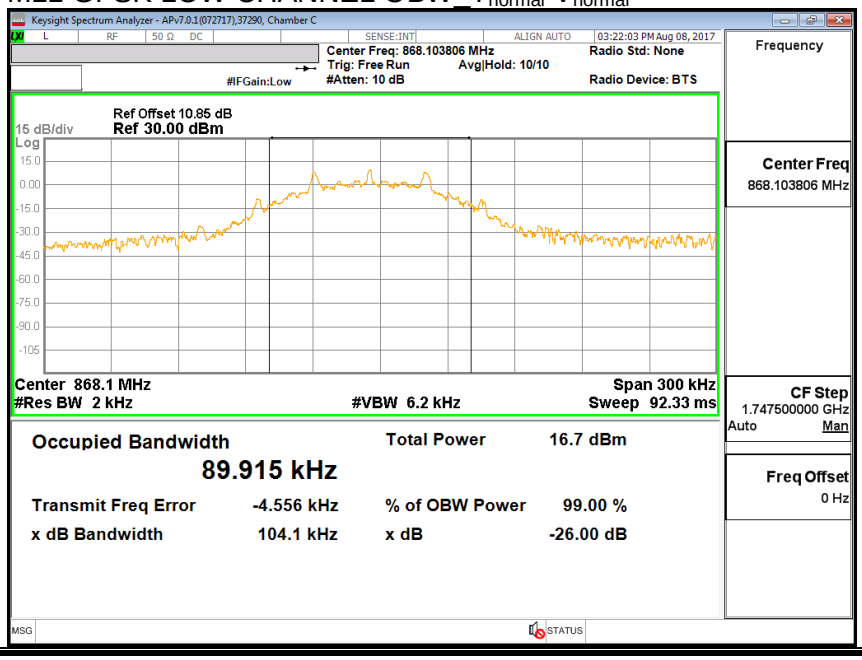
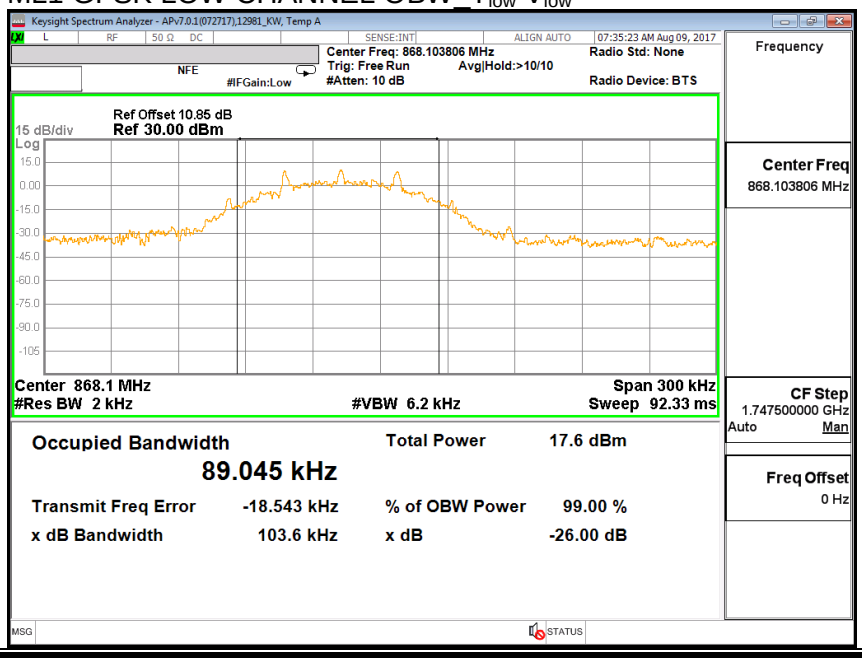
ML1 GFSK LOW CHANNEL OBW_T_{normal} V_{normal}



ML1 GFSK LOW CHANNEL OBW_T_{low} V_{low}



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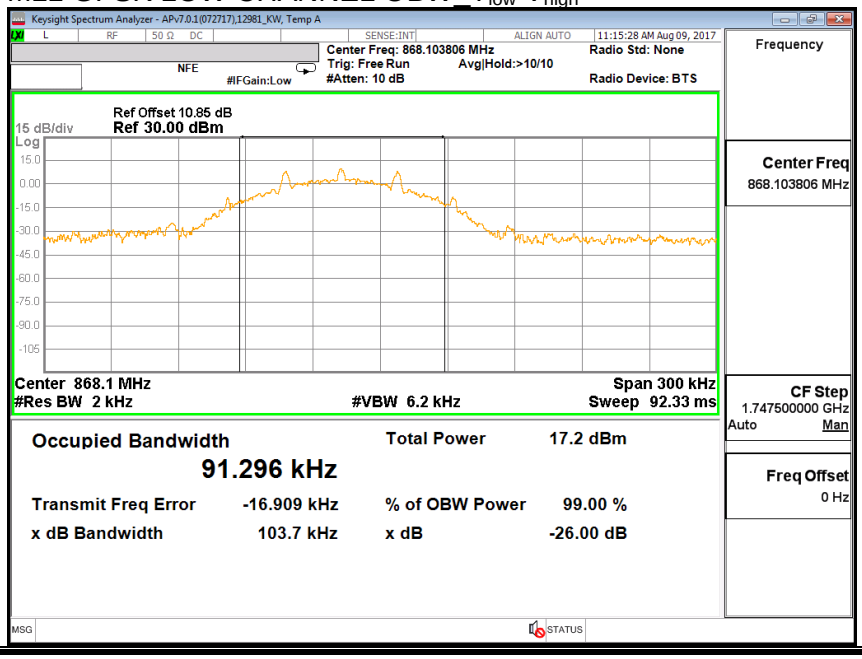
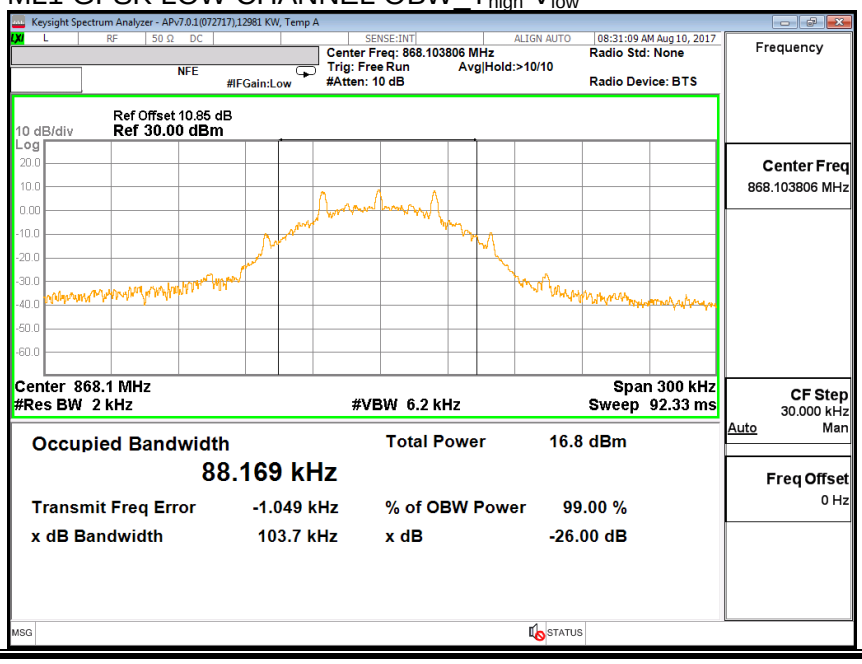
ML1 GFSK LOW CHANNEL OBW_T_{low} V_{high}



ML1 GFSK LOW CHANNEL OBW_T_{high} V_{low}



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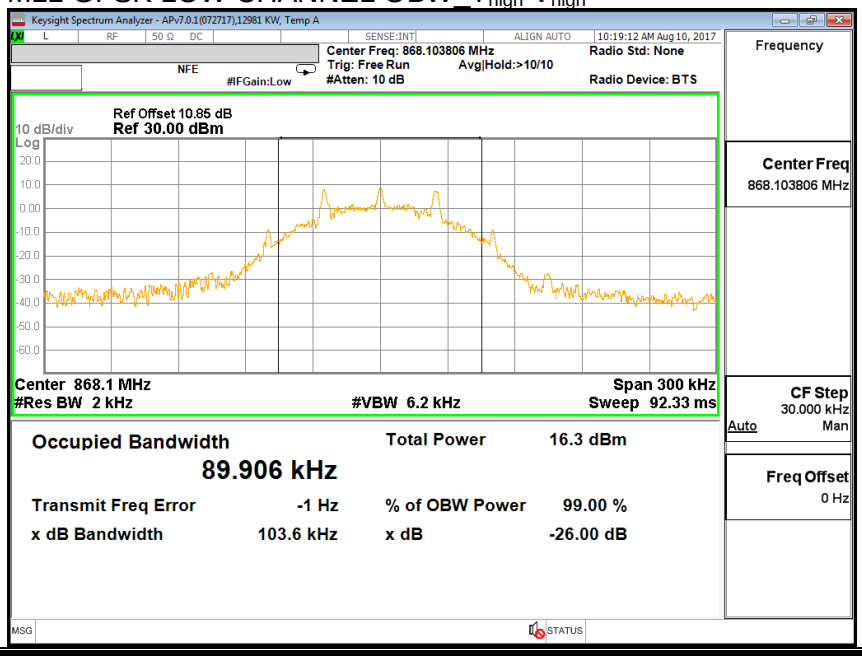
ML1 GFSK LOW CHANNEL OBW_T_{high} V_{high}



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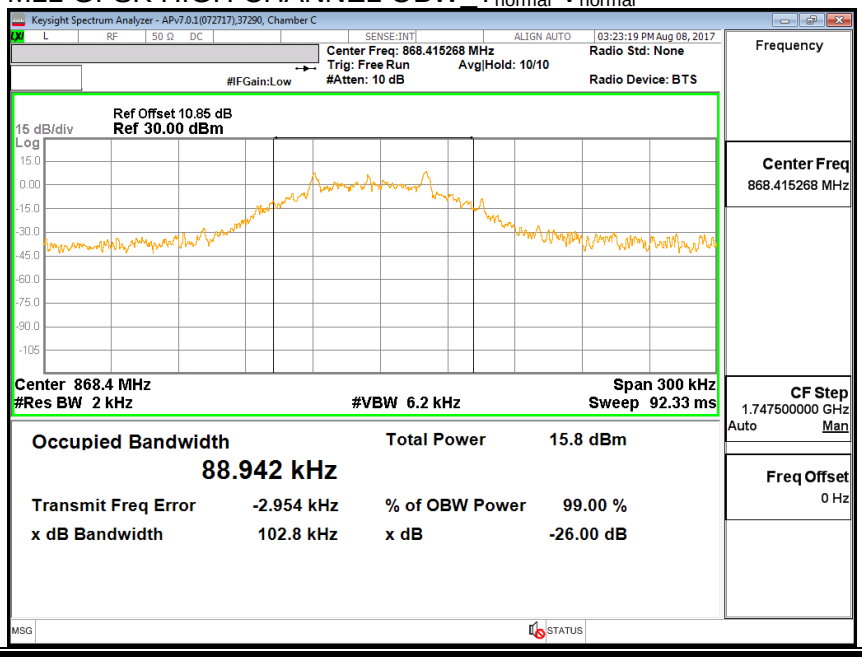

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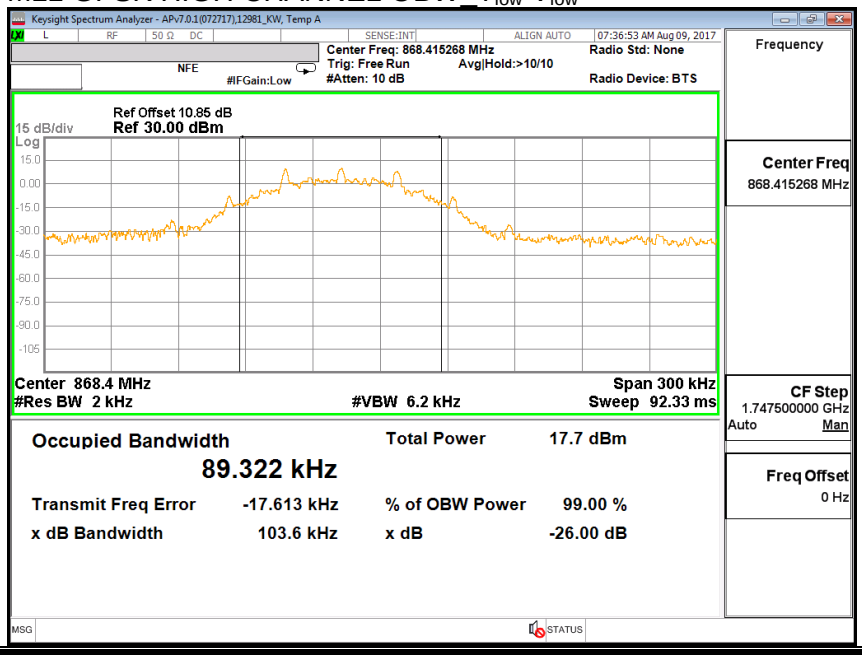
ML1 GFSK HIGH CHANNEL OBW_T_{low} V_{low}



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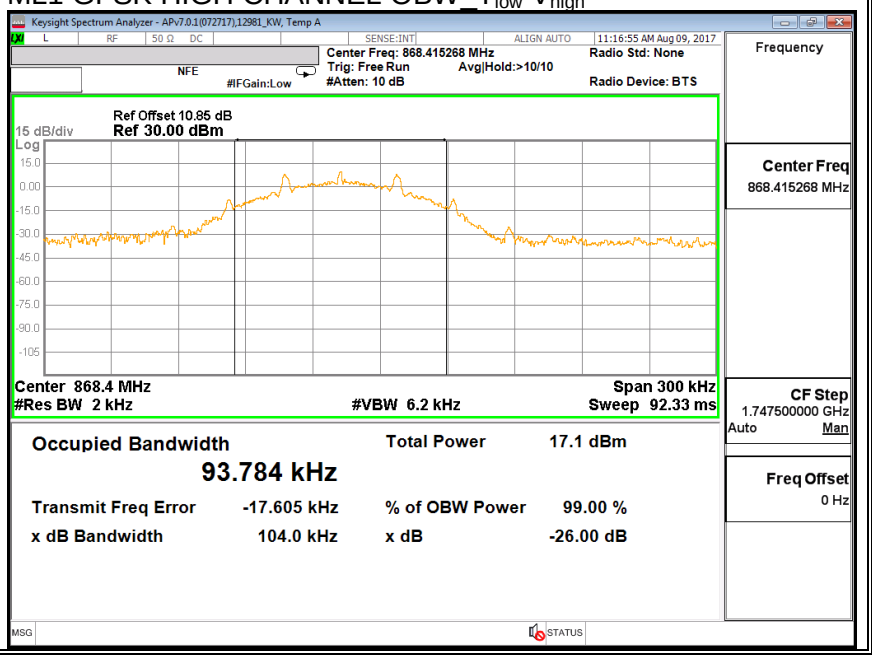

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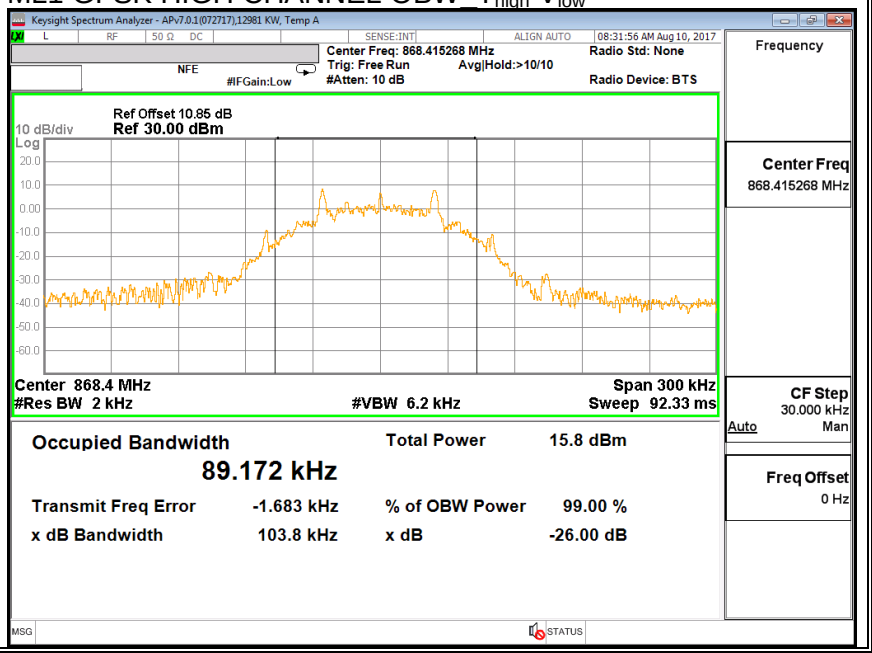

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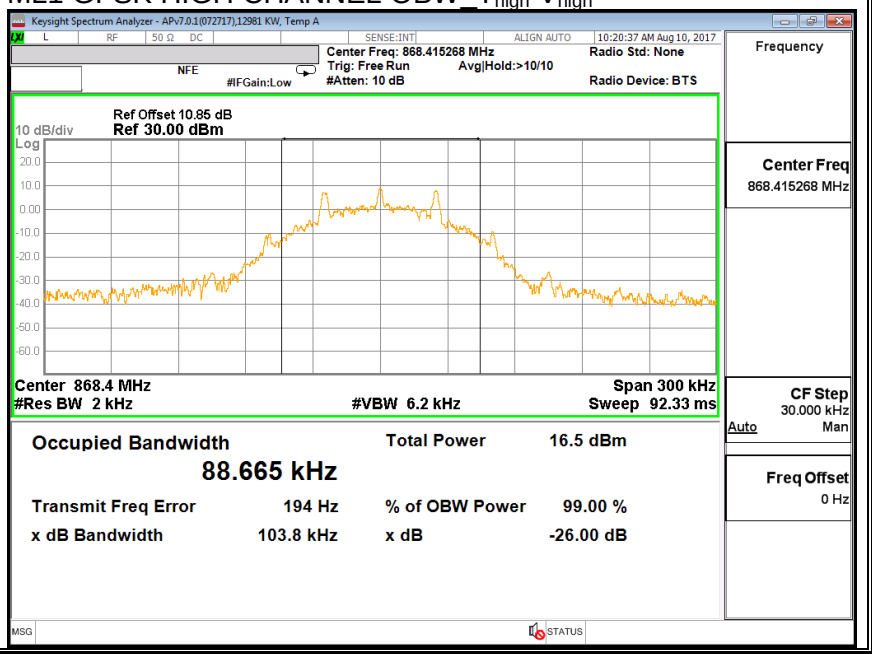

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7.2.4. TX OUT OF BAND EMISSIONS

REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.1

Two OOB domains are defined; one for OC (see Figure 5) and one for Operational Frequency band (see Figure 6). The spectrum masks for these two OOB domains may overlap.

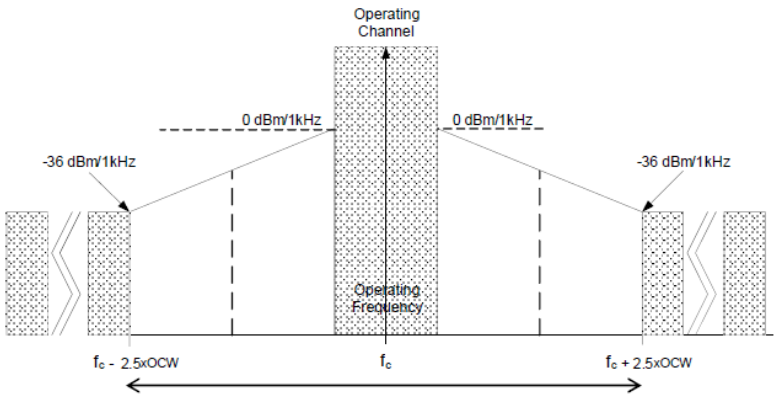

Figure 5: Out Of Band Domain for Operating Channel with reference BW

Unwanted emissions in the Out Of Band domain are those falling in the frequency range immediately below the lower, and above the upper, frequency of the Operating Channel. The OOB domain includes both frequencies outside the Operating Channel within the Operational Frequency Band and frequencies outside the Operational Frequency Band.
The relevant Out Of Band domain is shown in Figure 5 and applies within the Operational Frequency Band.

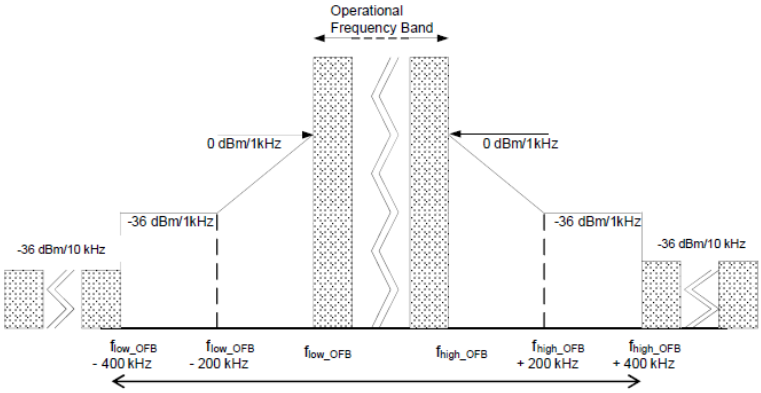

Figure 6: Out Of Band Domain for Operational Frequency Band with reference BW

Specific limits apply at frequencies immediately above and below the Operational Frequency Band as shown in Figure 6.
NOTE: f_{low}_OFB is the lower edge of the Operational Frequency Band. f_{high}_OFB is the upper edge of the Operational Frequency Band.

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REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.2

The EUT emissions level in OOB domains for the Operating Channel and the Operational Frequency Band shall be less or equal to Table 15 spectrum mask.

Table 15: Emission limits in the Out Of Band domains

Domain	Frequency Range	RBW_{REF}	Max power limit
OOB limits applicable to Operational Frequency Band (See Figure 6)	$f \le f_{low_OFB}$ - 400 kHz	10 kHz	-36 dBm
	F_{low_OFB} - 400 kHz ≤ f ≤ f_{low_OFB} - 200 kHz	1 kHz	-36 dBm
	f_{low} - 200 kHz ≤ f < f_{low_OFB}	1 kHz	See Figure 6
	$f = f_{low_OFB}$	1 kHz	0 dBm
	$f = f_{high_OFB}$	1 kHz	0 dBm
	F_{high_OFB} < f ≤ f_{high_OFB} + 200 kHz	1 kHz	See Figure 6
	F_{high_OFB} + 200 kHz ≤ f ≤ f_{high_OFB} + 400 kHz	1 kHz	-36 dBm
	F_{high_OFB} + 400 kHz ≤ f	10 kHz	-36 dBm
OOB limits applicable to Operating Channel (See Figure 5)	$f = f_c$- 2.5 x OCW	1 kHz	-36 dBm
	f_c - 2,5 x OCW ≤ f ≤ f_c - 0,5 x OCW	1 kHz	See Figure 5
	$f = f_c$ - 0,5 x OCW	1 kHz	0 dBm
	$f = f_c$ + 0,5 x OCW	1 kHz	0 dBm
	f_c + 0,5 x OCW ≤ f ≤ f_c + 2,5 x OCW	1 kHz	See Figure 5
	$f = f_c$+ 2,5 x OCW	1 kHz	-36 dBm

NOTE: f is the measurement frequency.
f_c is the Operating Frequency.
F_{low_OFB} is the lower edge of the Operational Frequency Band.
F_{high_OFB} is the upper edge of the Operational Frequency Band.
OCW is the operating channel bandwidth.

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.3.3 (Conducted Measurement)

RESULTS

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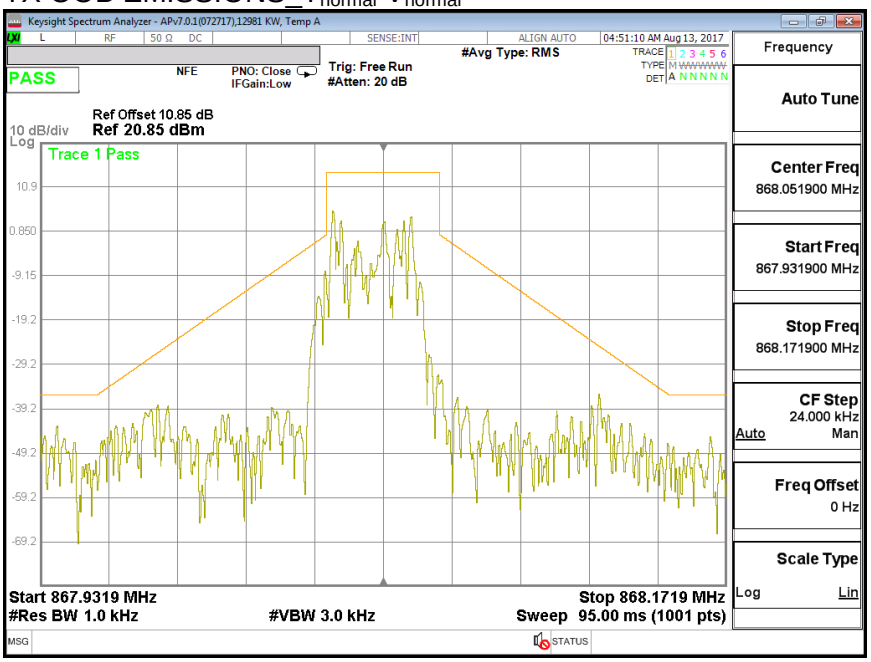
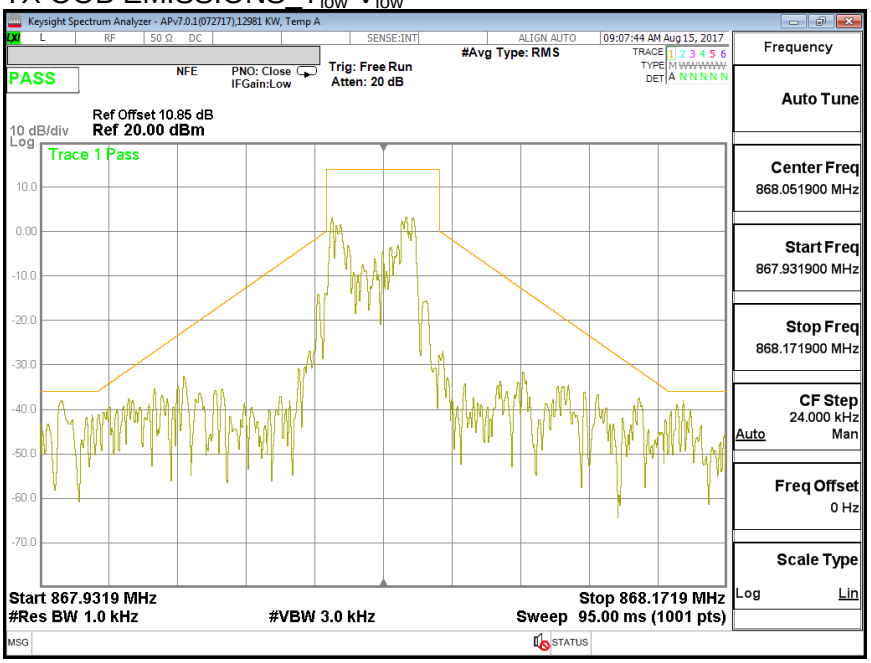
TX OUT OF BAND EMISSIONS (APPLICABLE TO OPERATING CHANNEL)

M6 LOW CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal}



TX OOB EMISSIONS_T_{low} V_{low}



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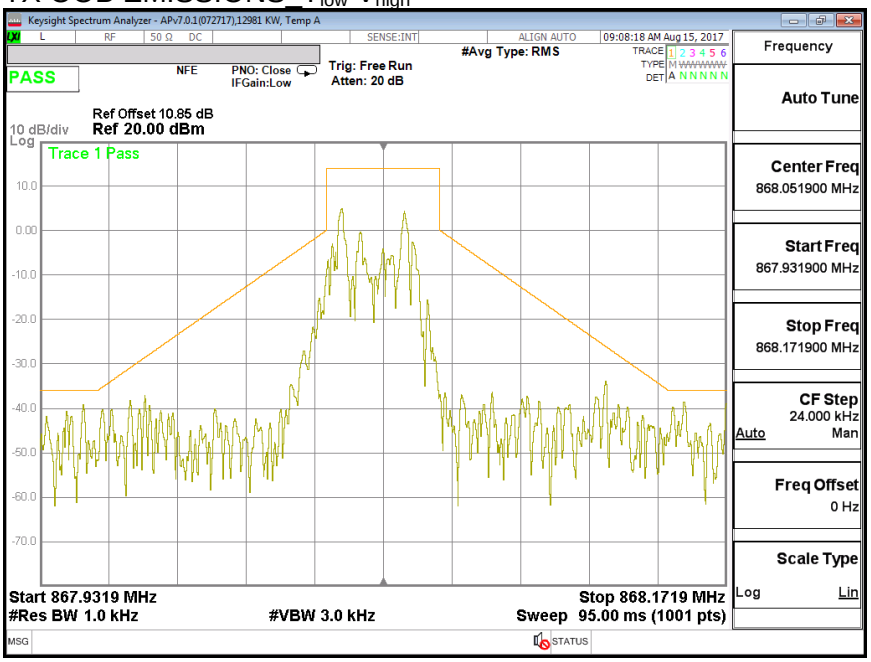
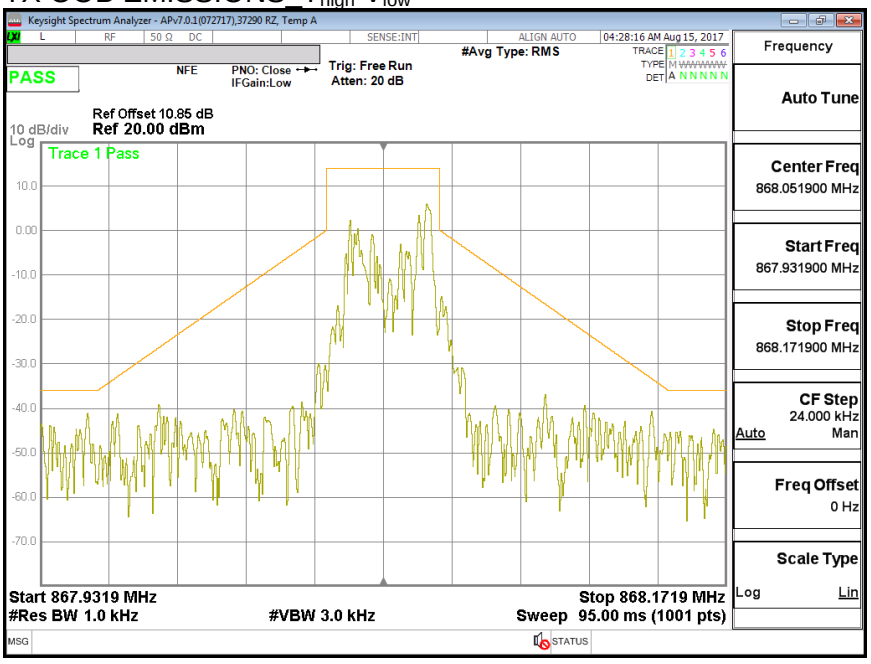
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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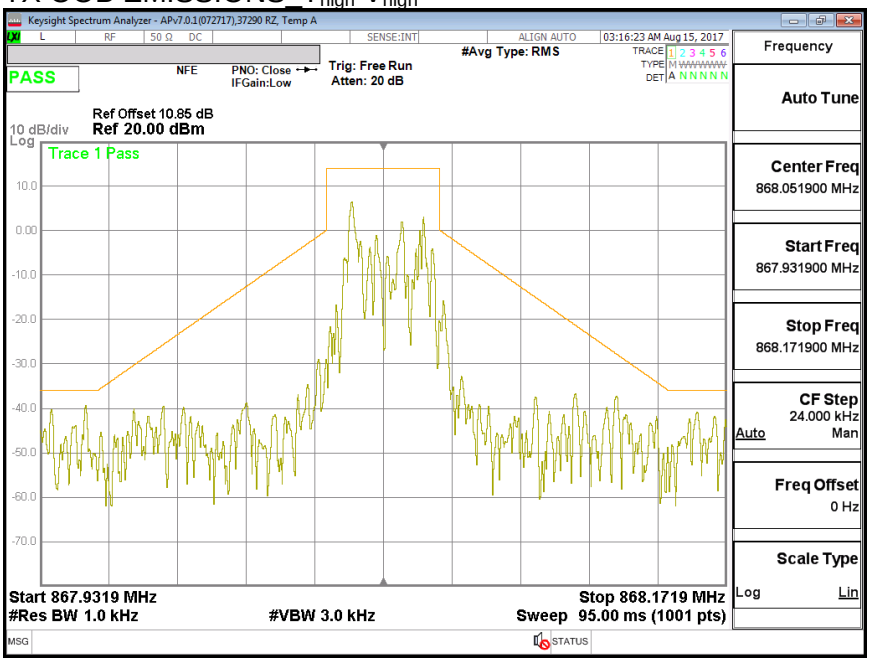
TX OOB EMISSIONS_T_{high} V_{high}



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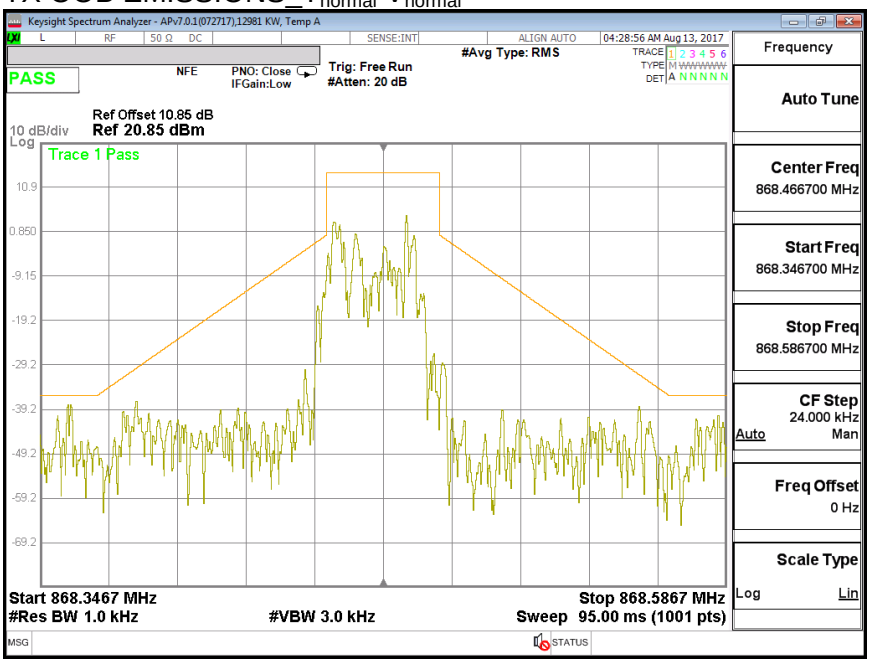
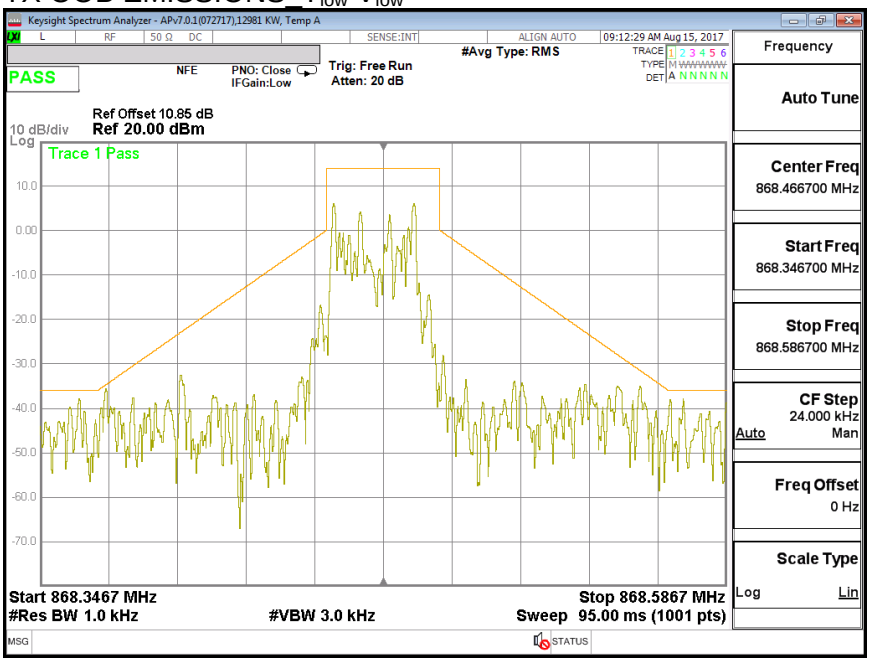
M6 HIGH CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal}



TX OOB EMISSIONS_T_{low} V_{low}



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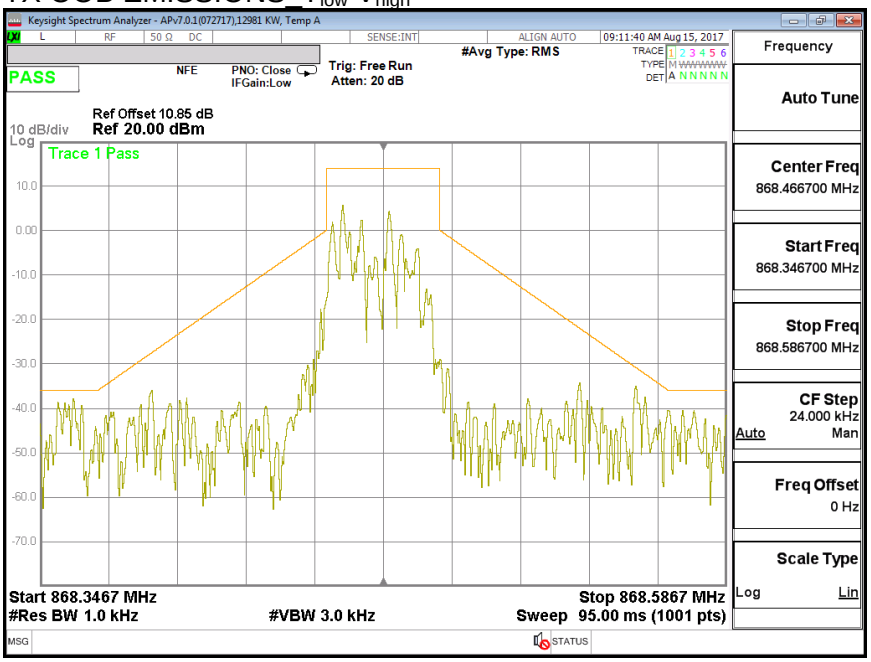
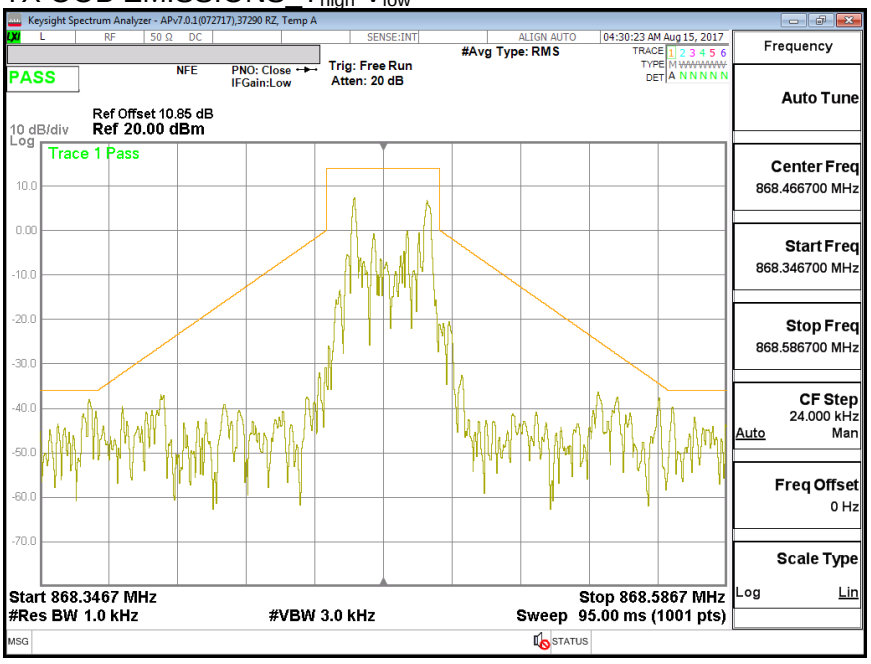
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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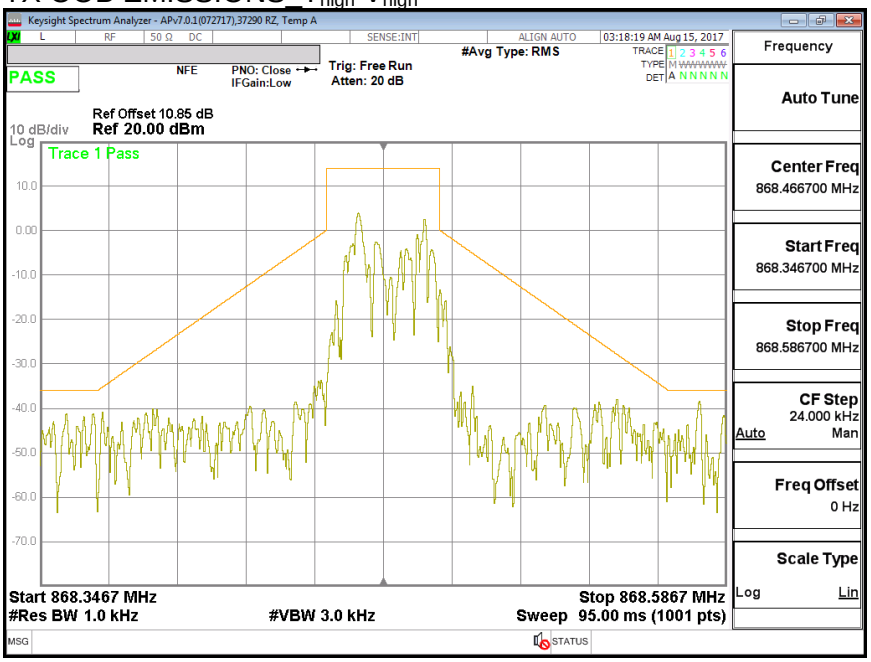
TX OOB EMISSIONS_T_{high} V_{high}



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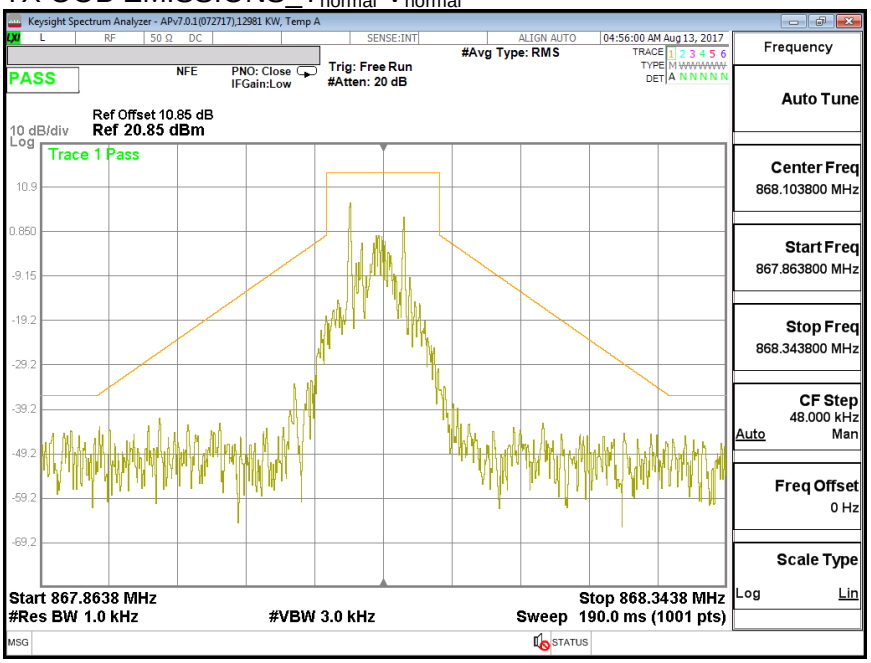
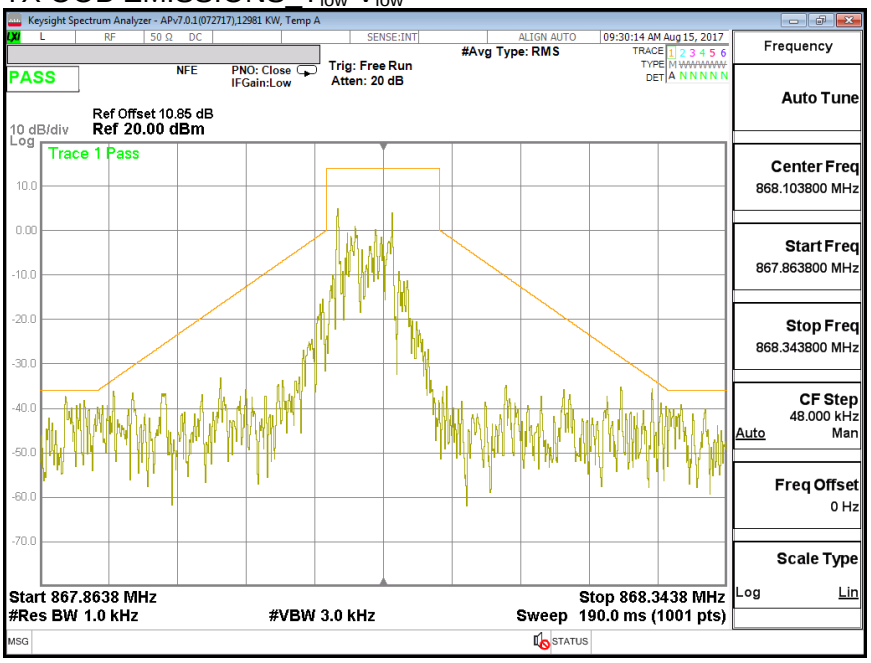
M7 LOW CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$



TX OOB EMISSIONS_T$_{low}$ V$_{low}$



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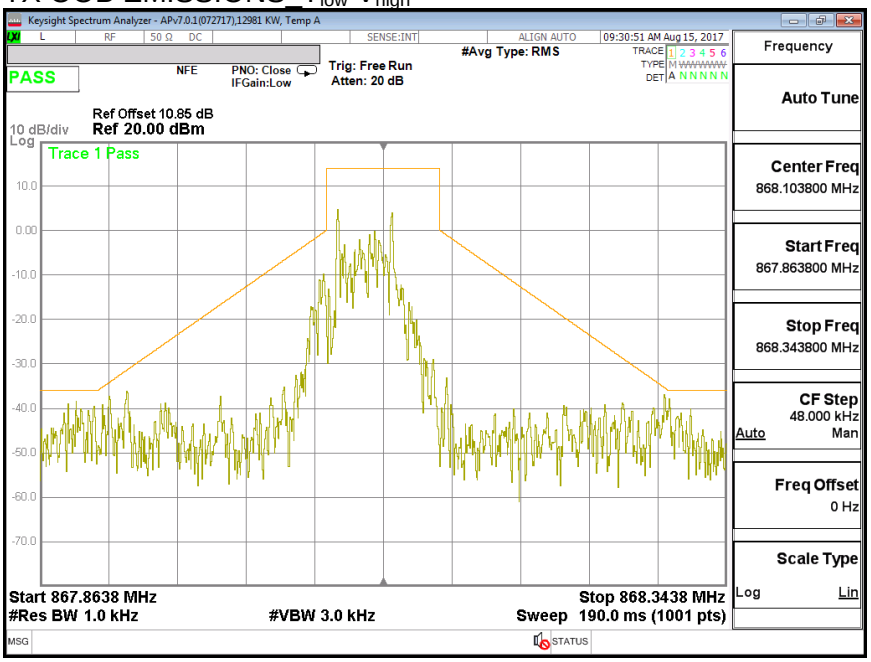
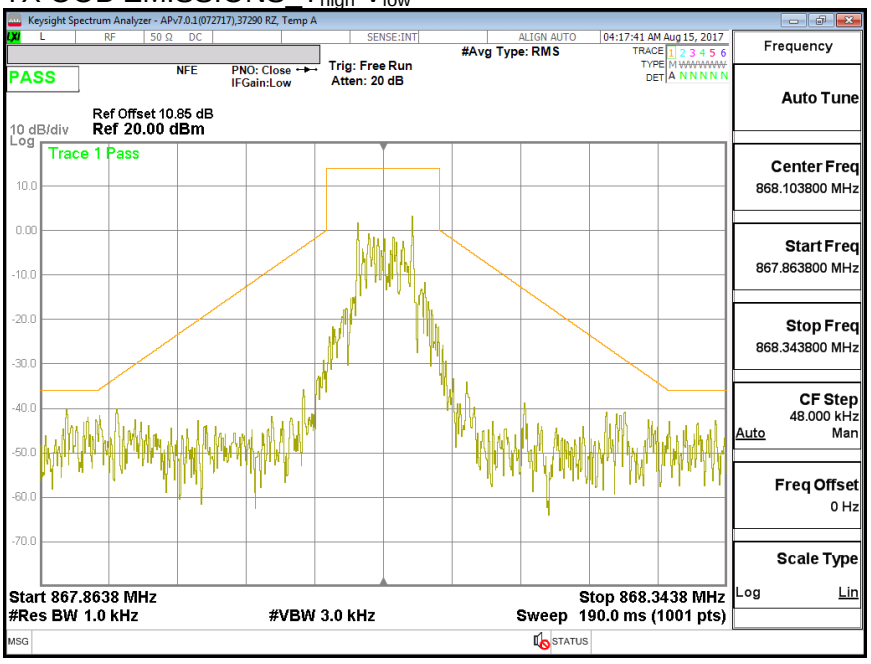
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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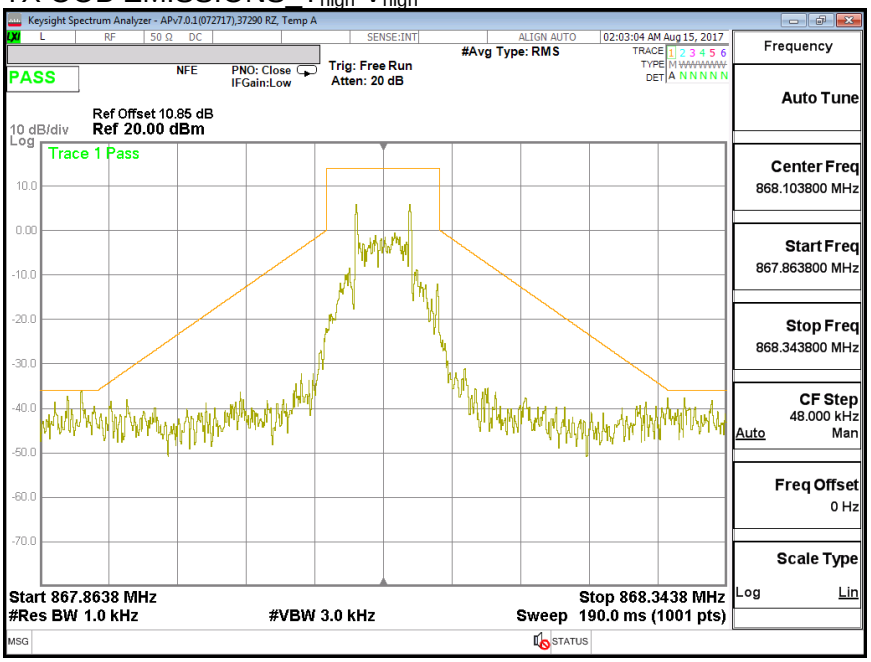
TX OOB EMISSIONS_T_{high} V_{high}



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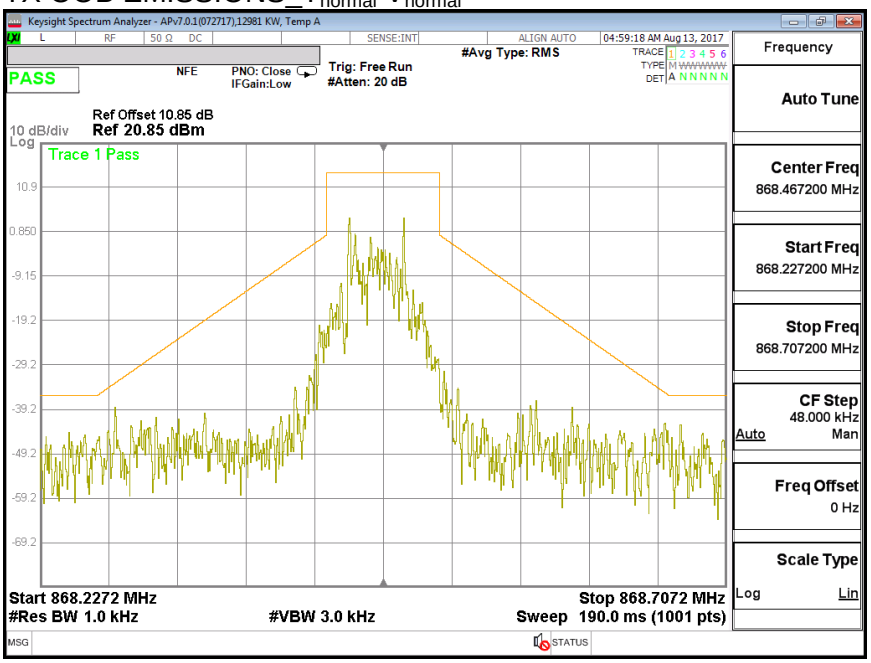
M7 HIGH CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$



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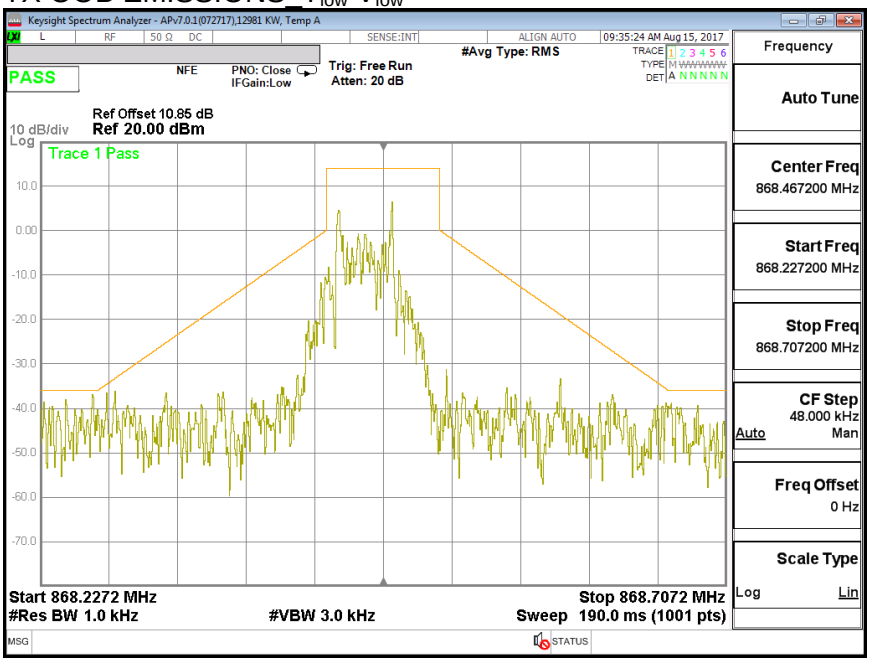

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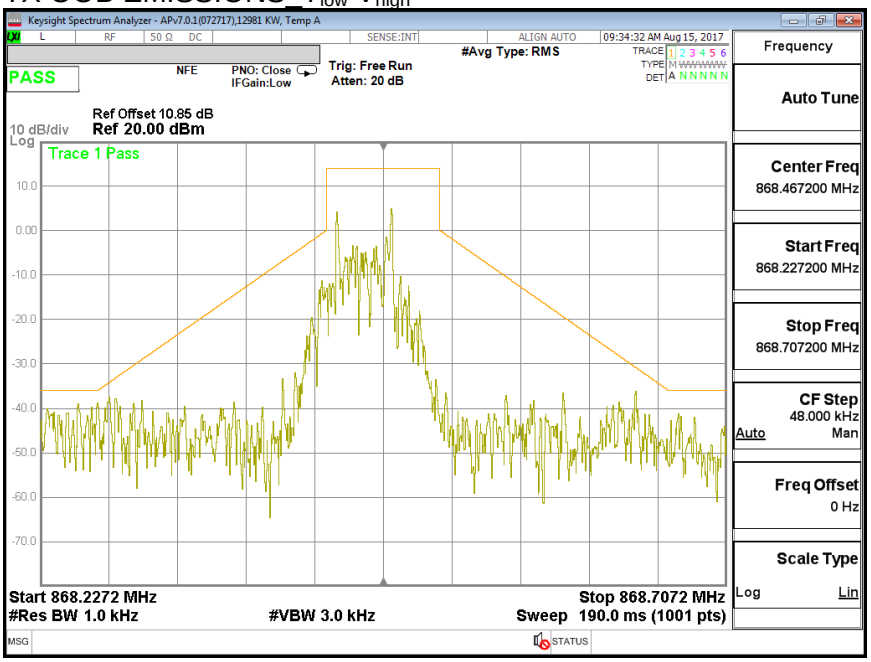
TX OOB EMISSIONS_T_{low} V_{high}



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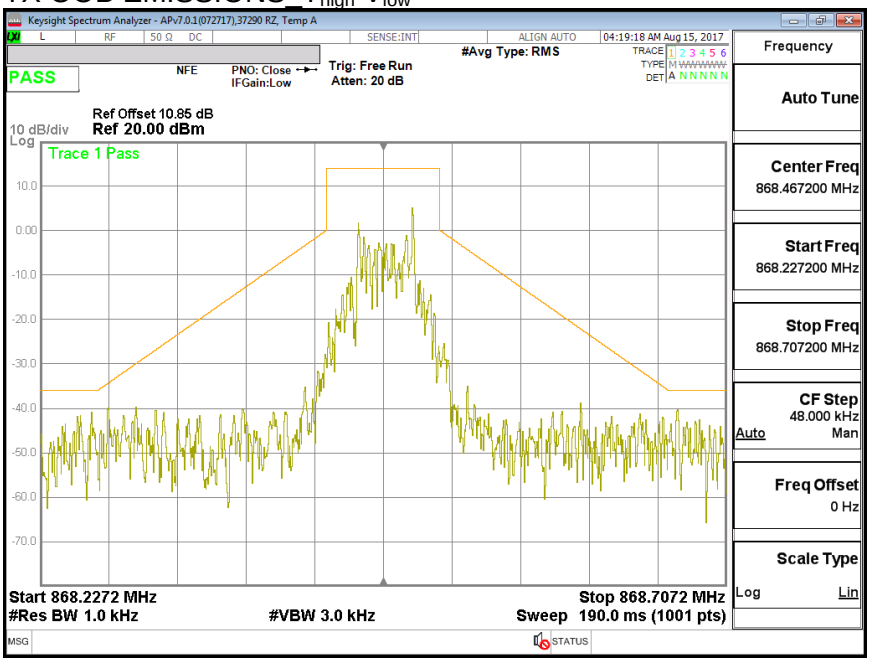

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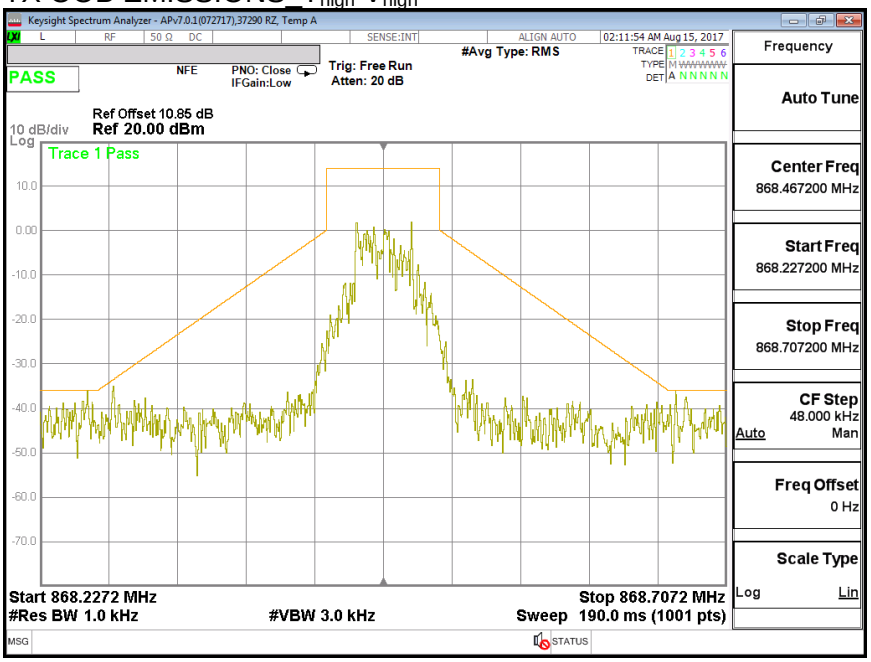
TX OOB EMISSIONS_T_{high} V_{high}



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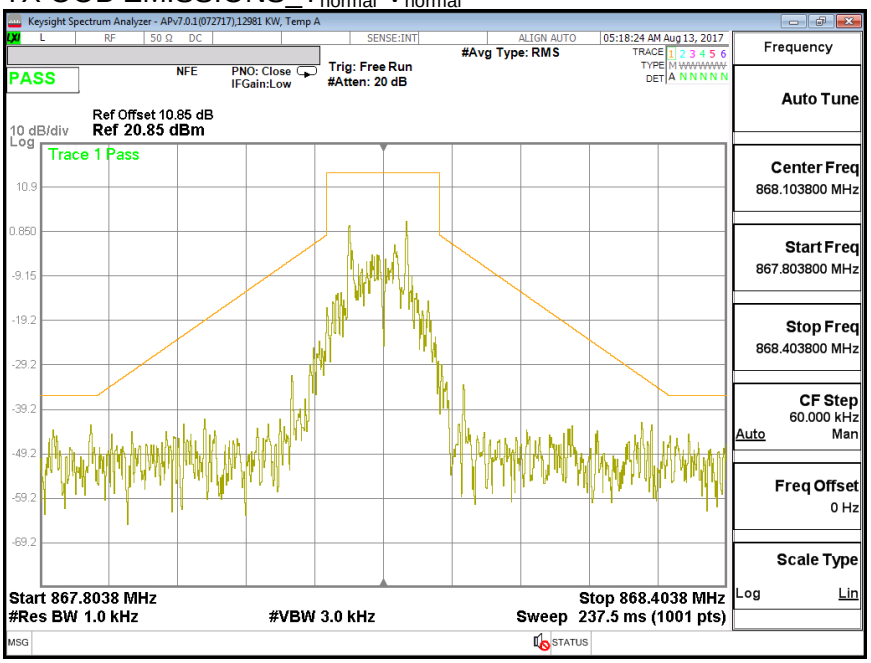
ML1 LOW CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$



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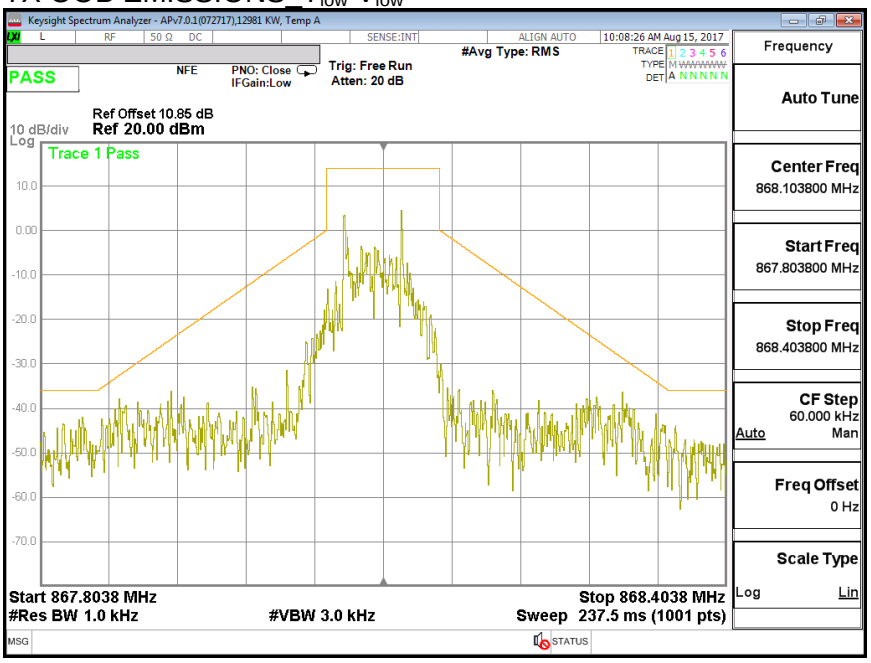

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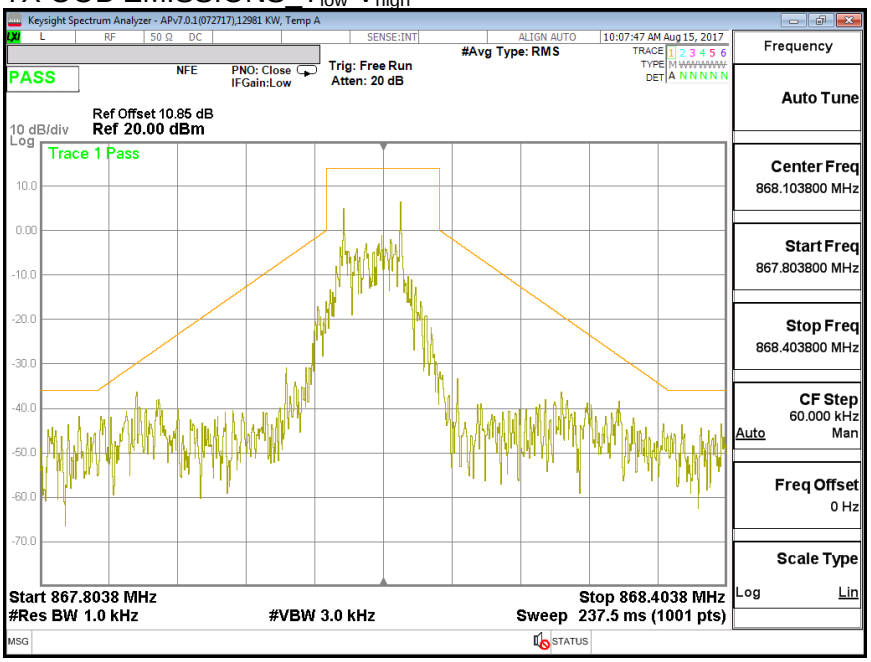
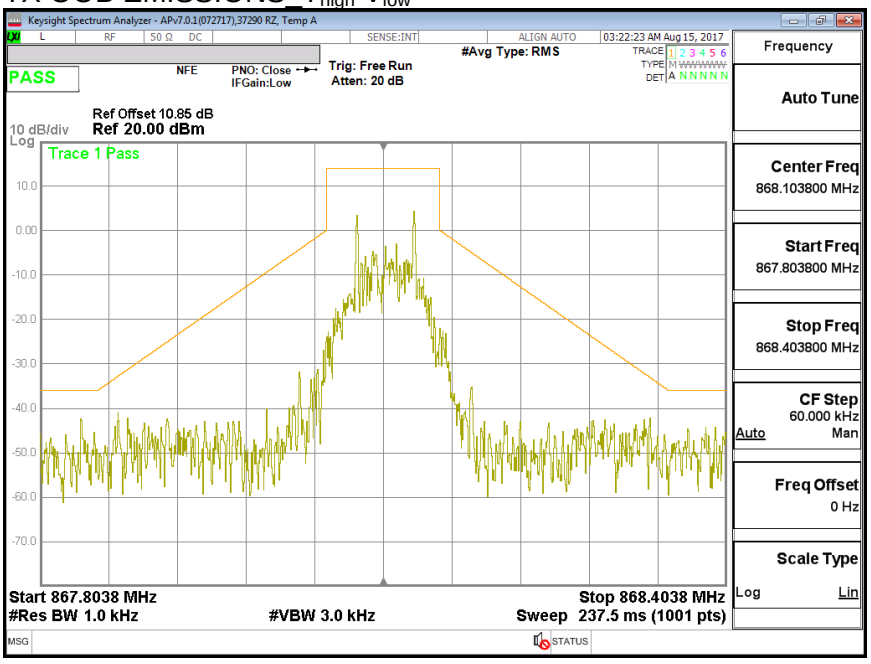
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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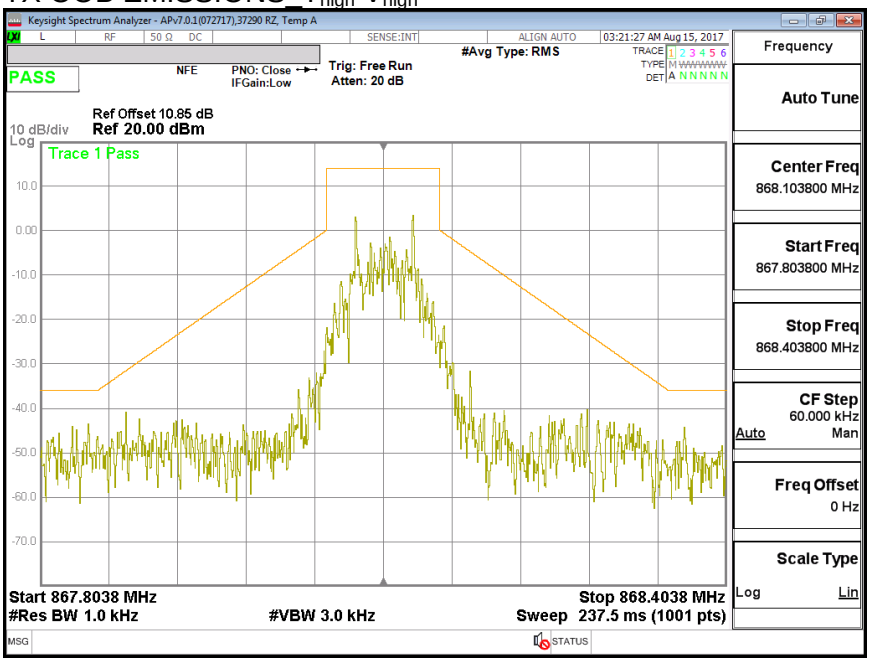
TX OOB EMISSIONS_T_{high} V_{high}



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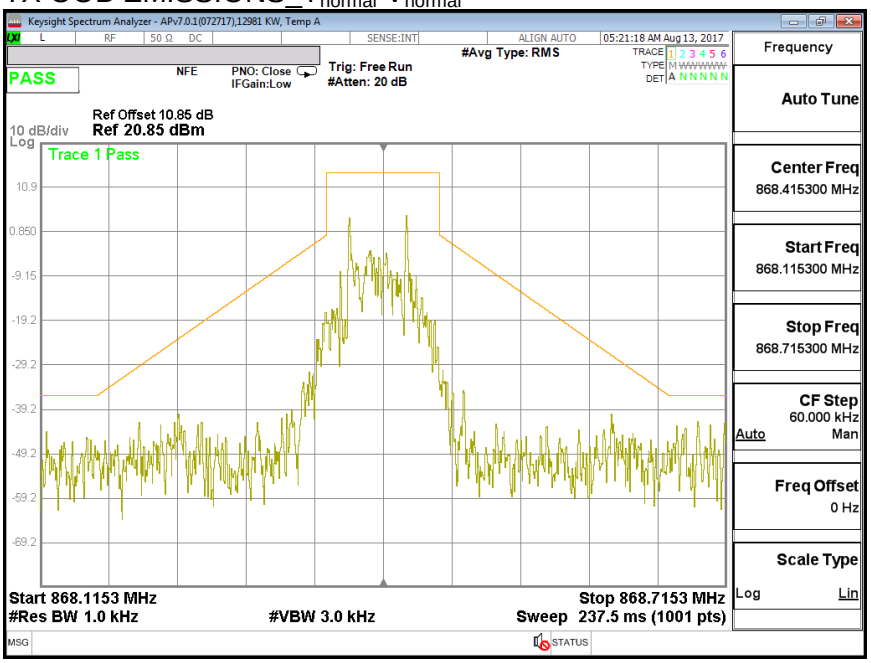
ML1 HIGH CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal}



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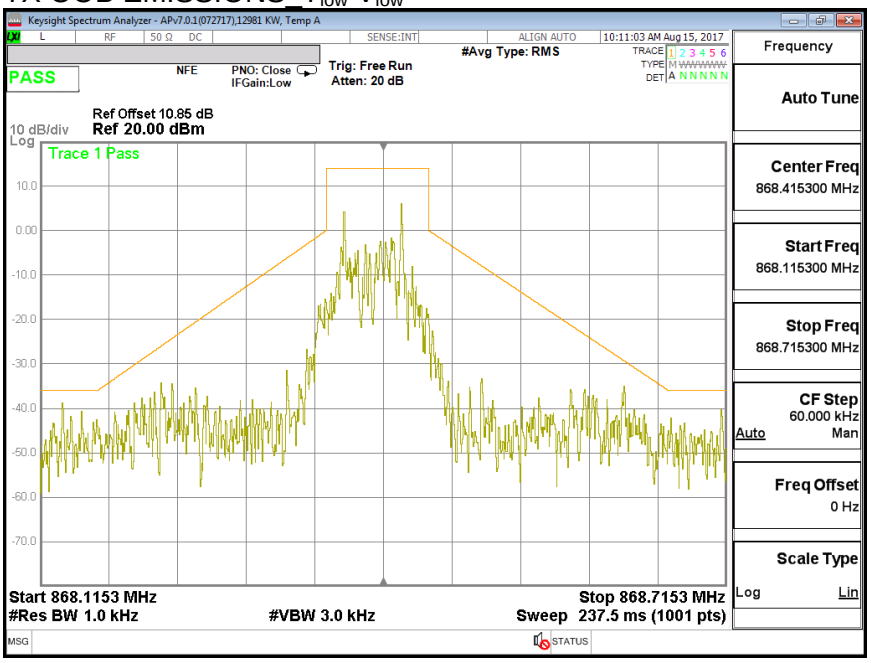

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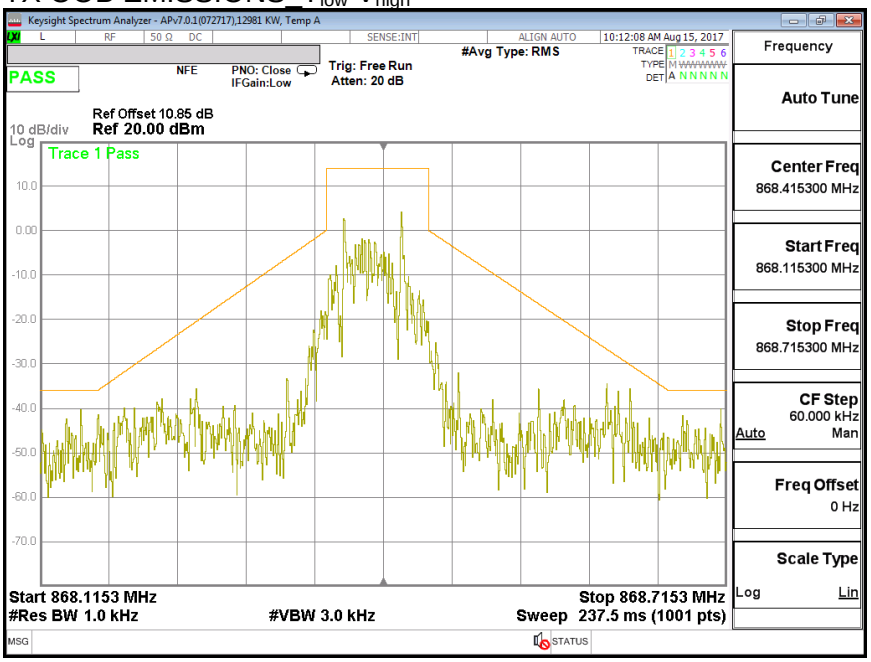
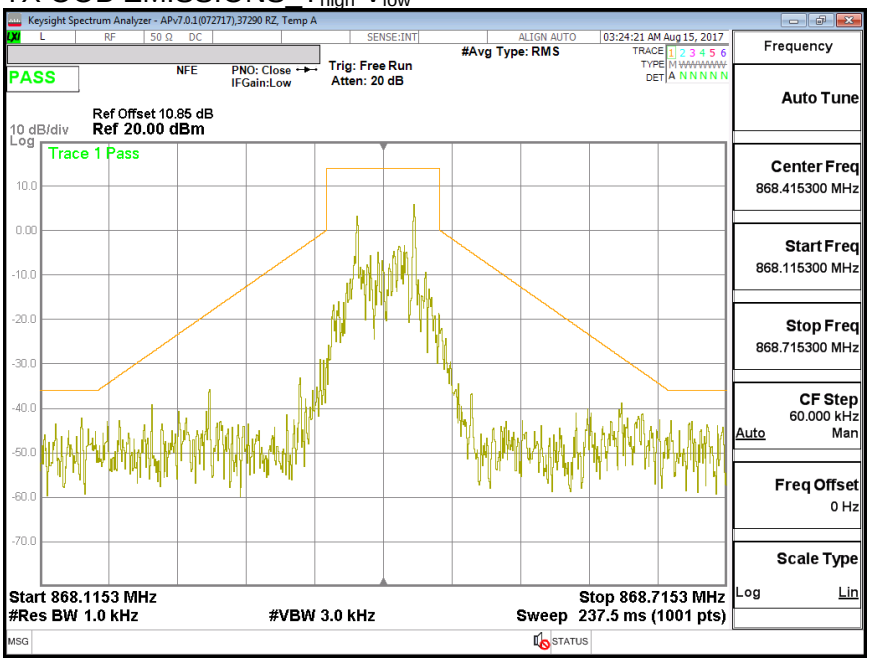
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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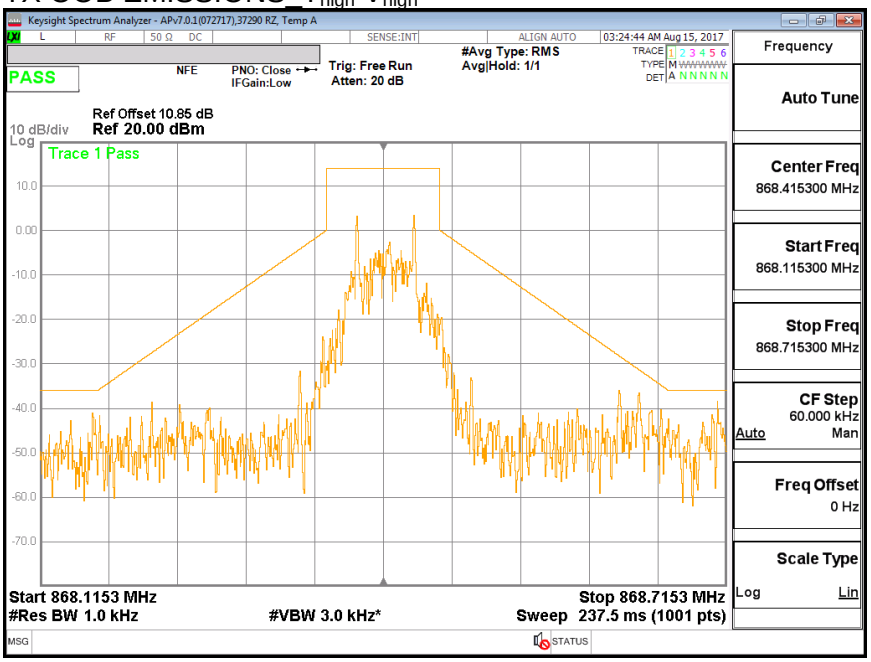
TX OOB EMISSIONS_T_{high} V_{high}



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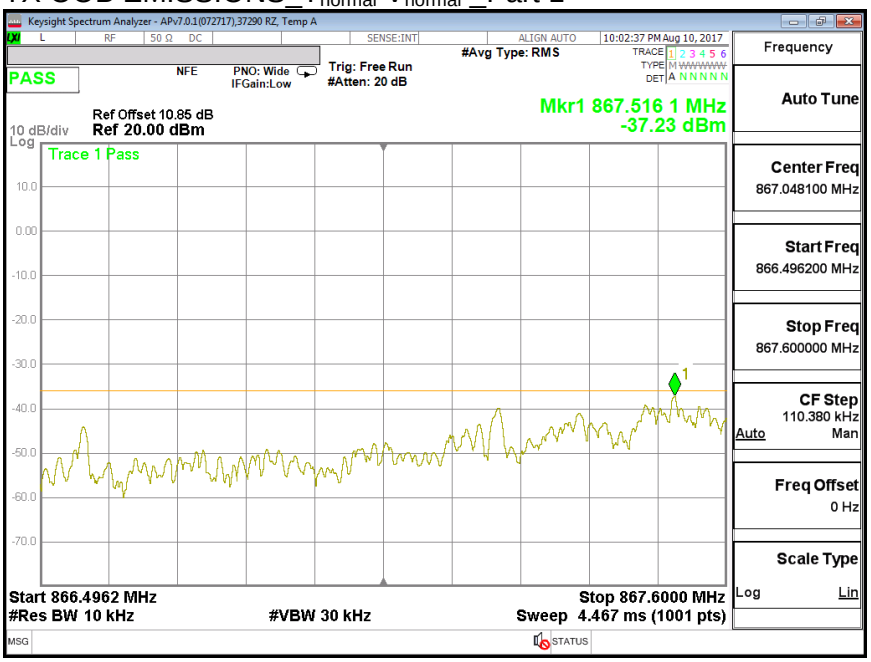
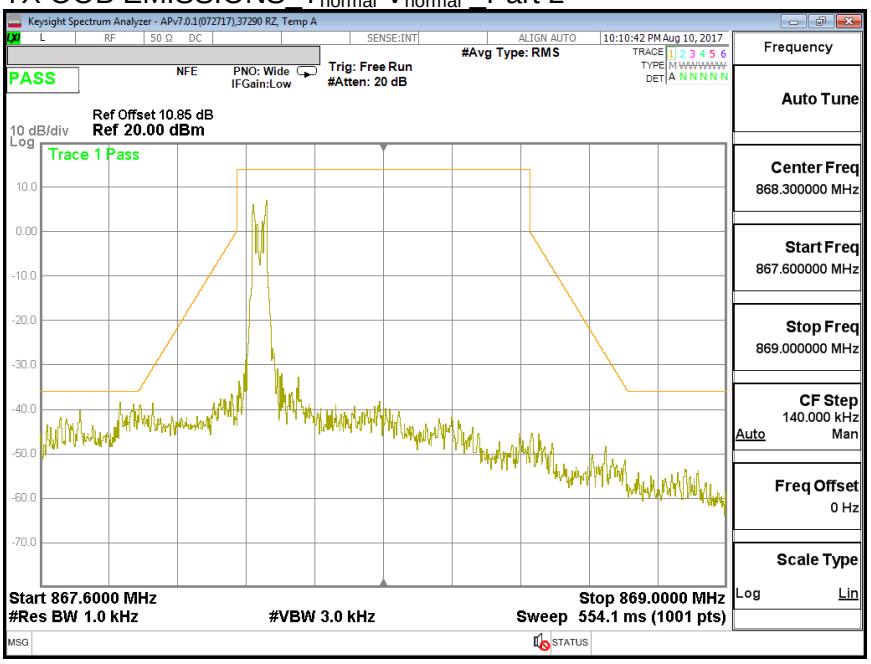
TX OUT OF BAND EMISSIONS (APPLICABLE TO OPERATIONAL FREQUENCY BANDS)

M6 LOW CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal} _Part 1



TX OOB EMISSIONS_T_{normal} V_{normal} _Part 2



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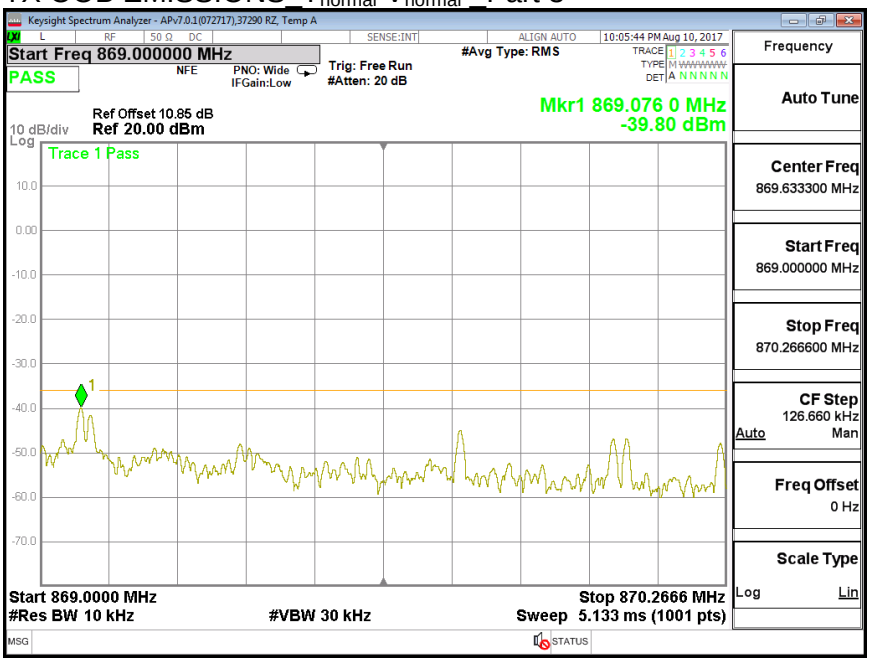
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3



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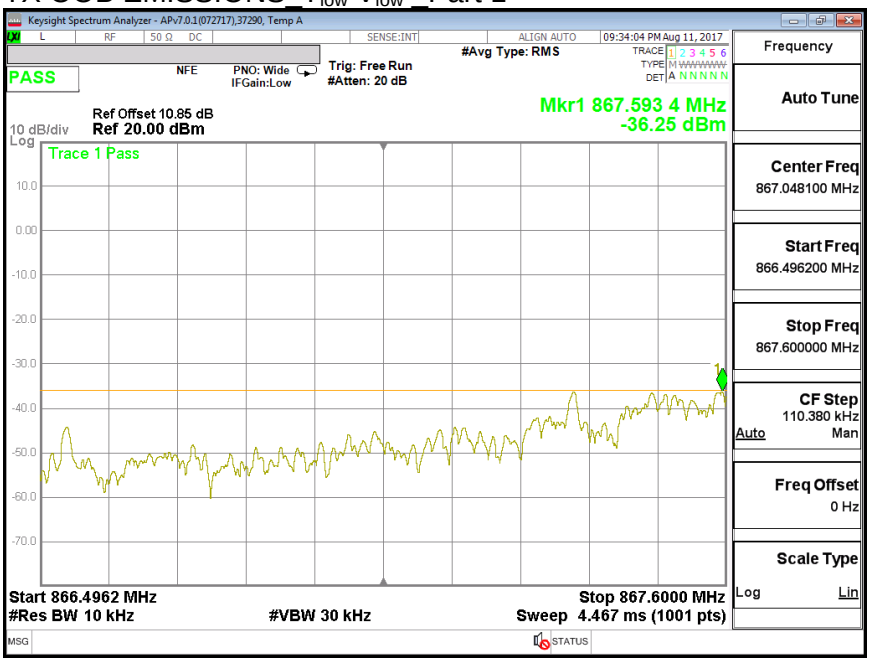

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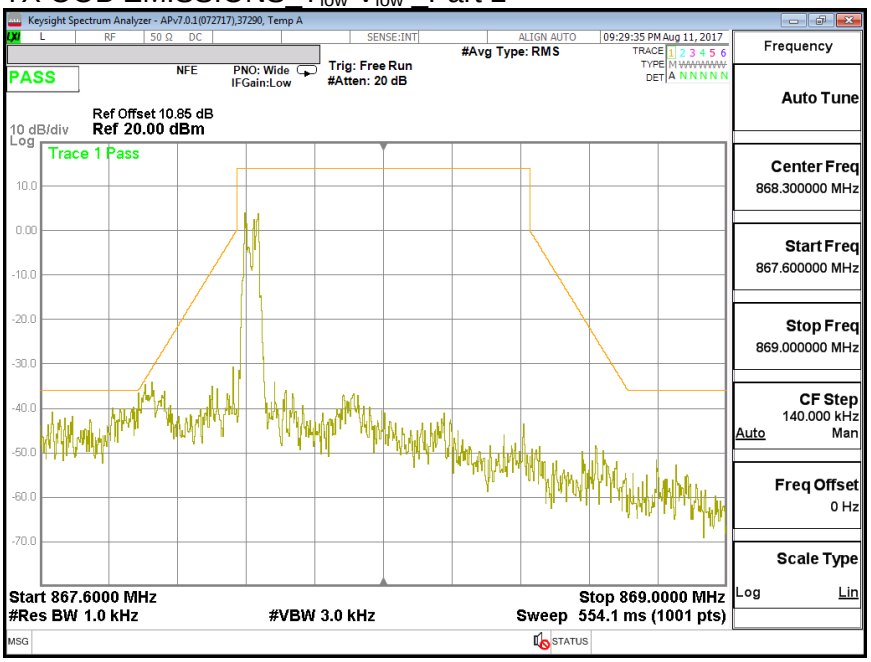
TX OOB EMISSIONS_T_{low} V_{low} _Part 2



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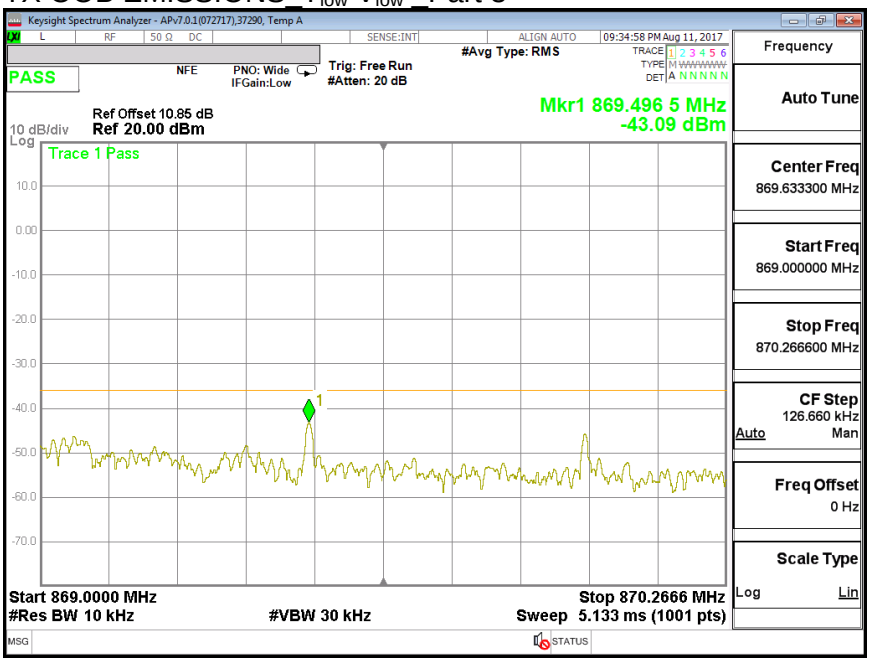

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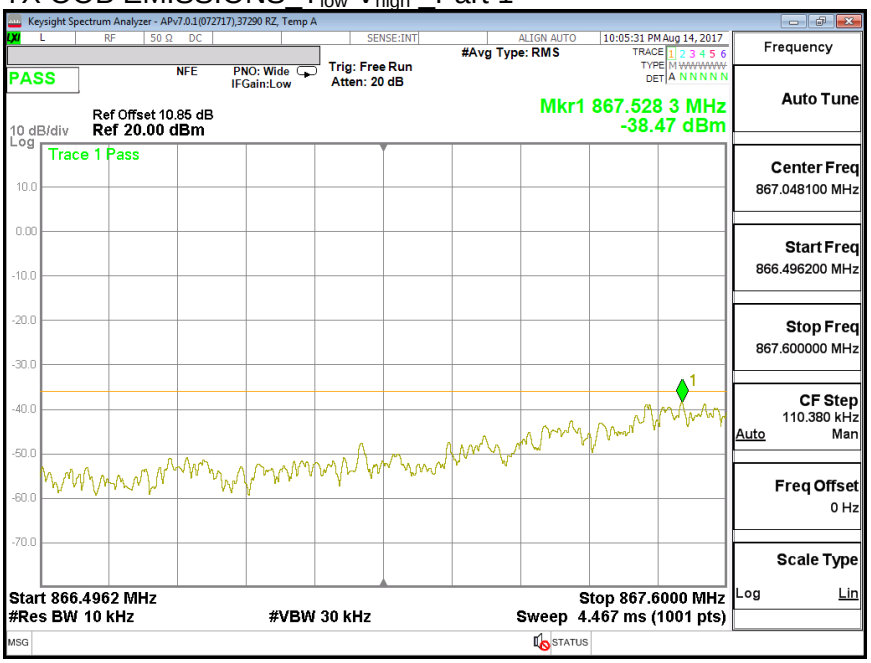
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



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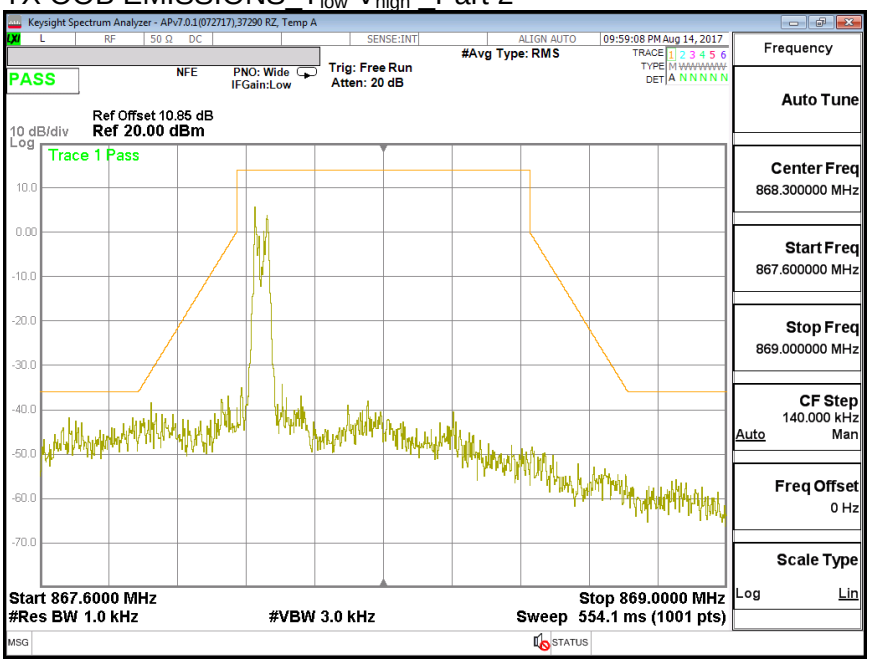

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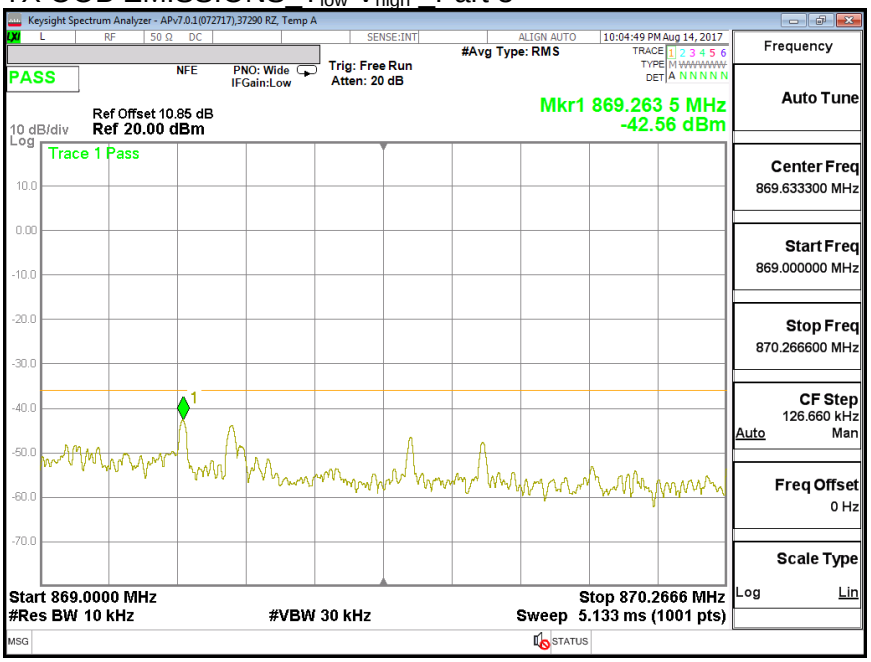
TX OOB EMISSIONS_T_{low} V_{high} _Part 3



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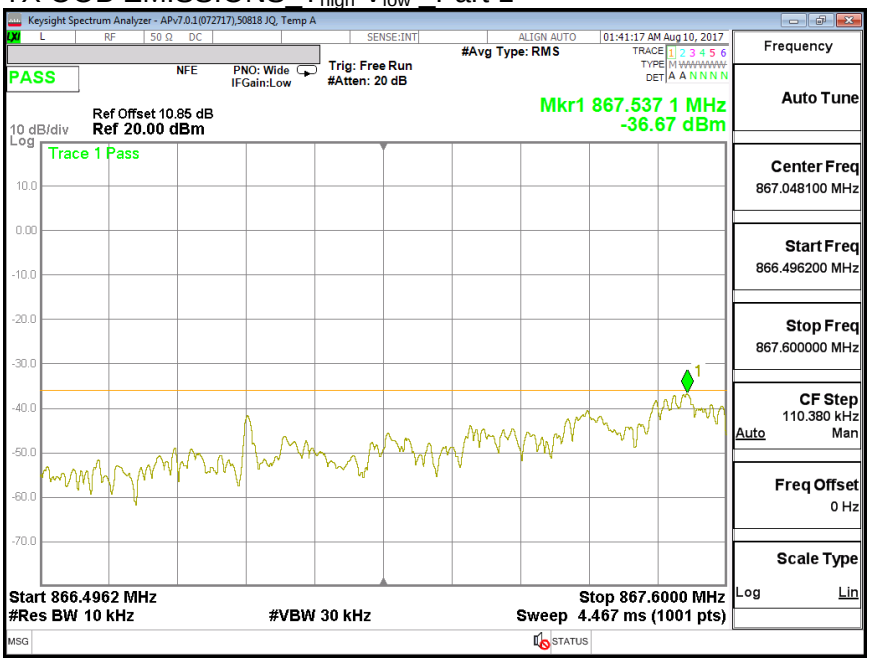

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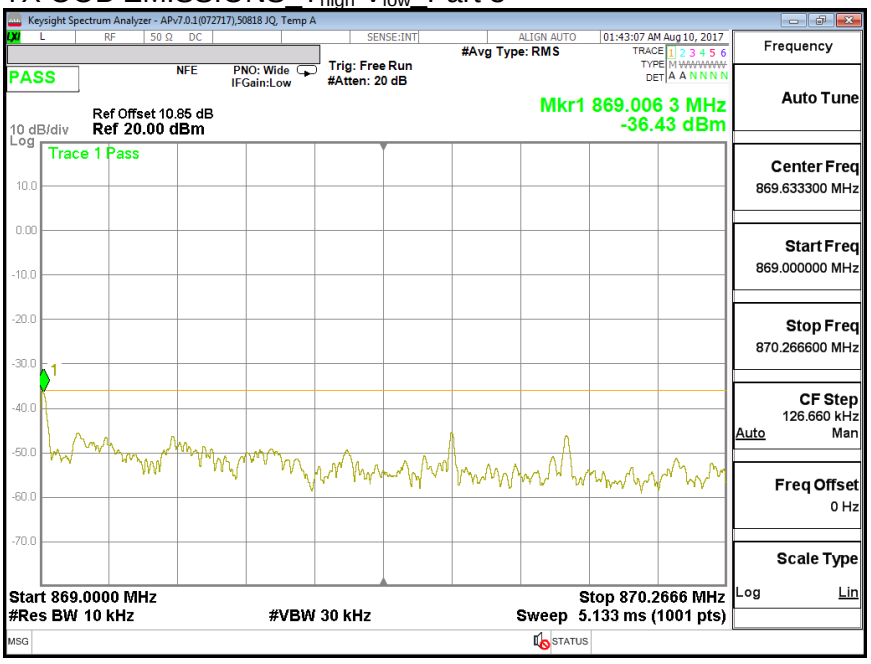
TX OOB EMISSIONS_T_{high} V_{low} _Part 2

TX OOB EMISSIONS_T_{high} V_{low}_Part 3



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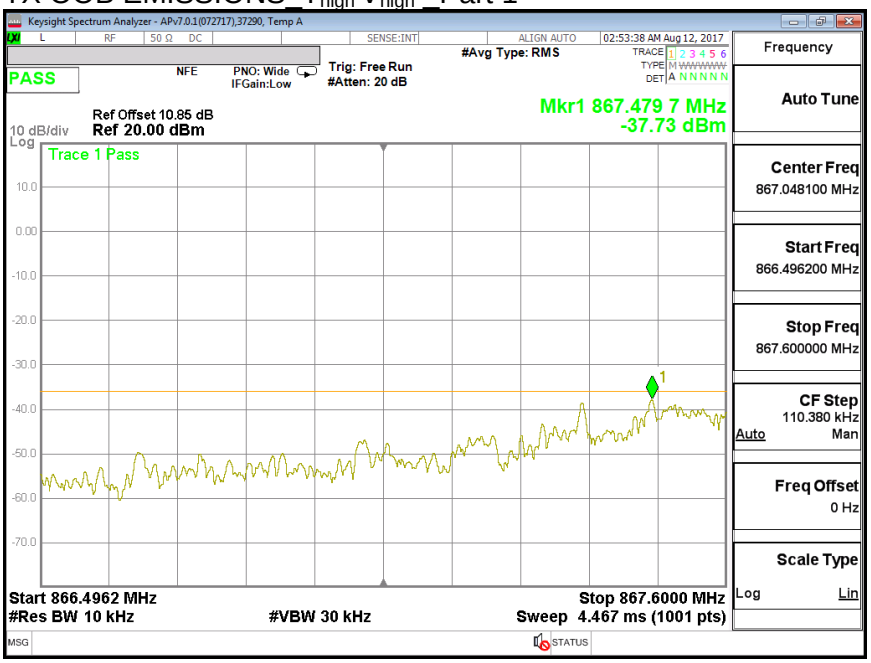
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



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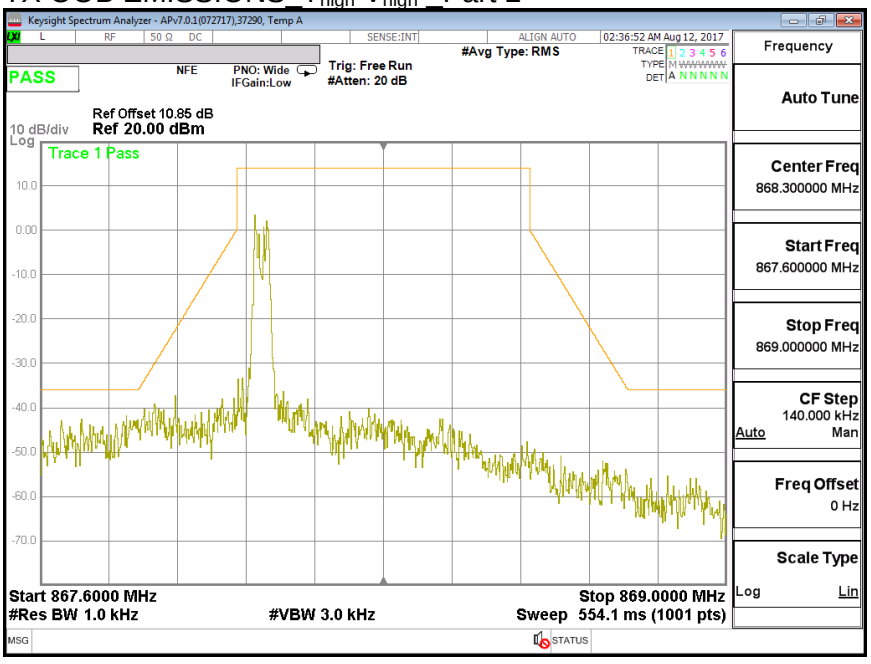

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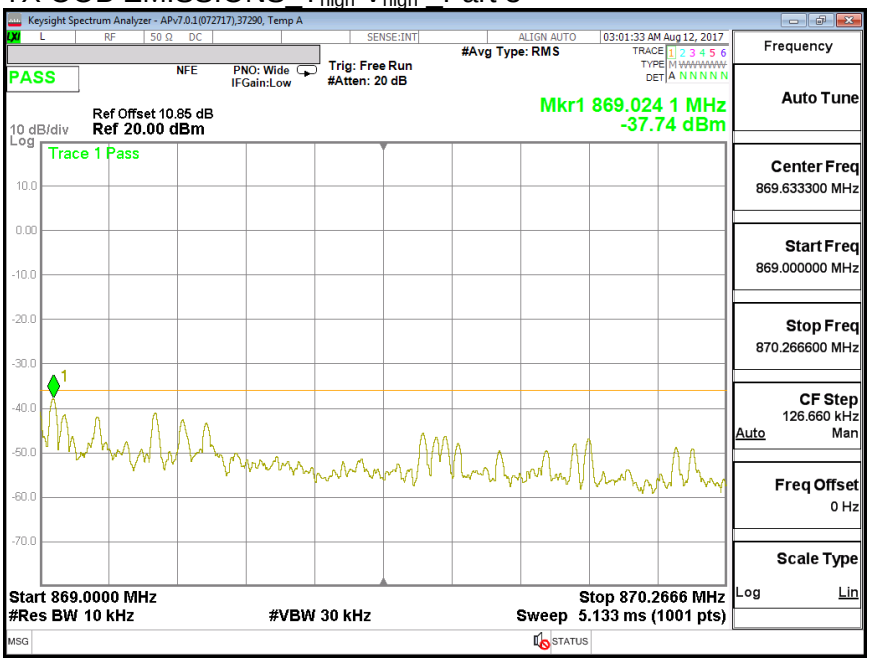
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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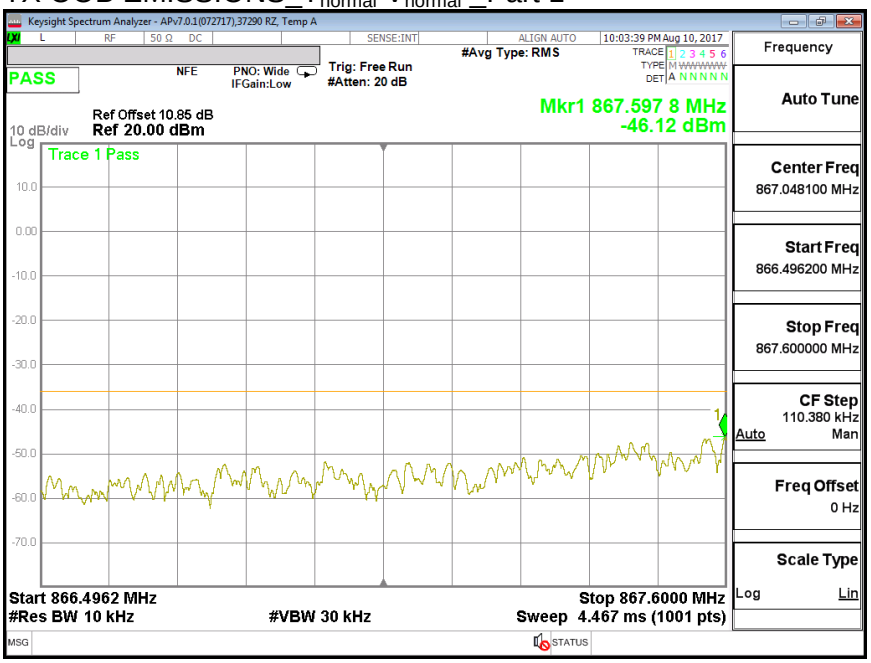
M6 HIGH CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 1



TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 2

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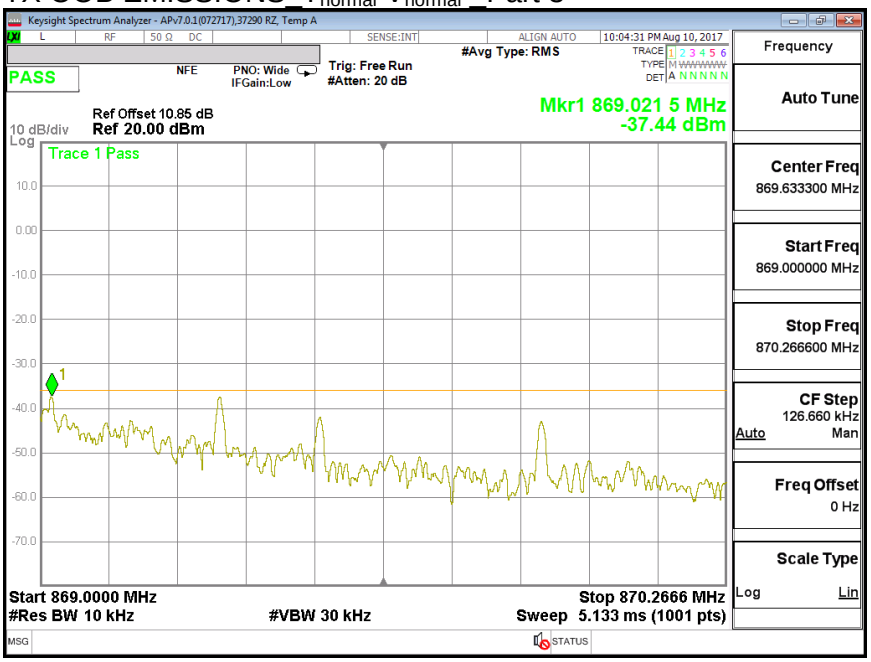
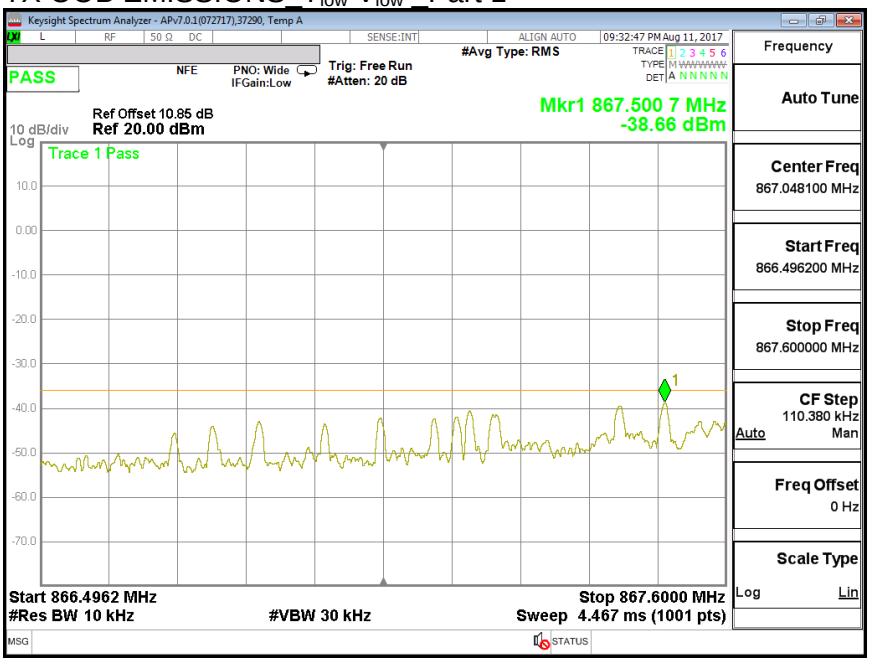
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3



TX OOB EMISSIONS_T_{low} V_{low} _Part 1



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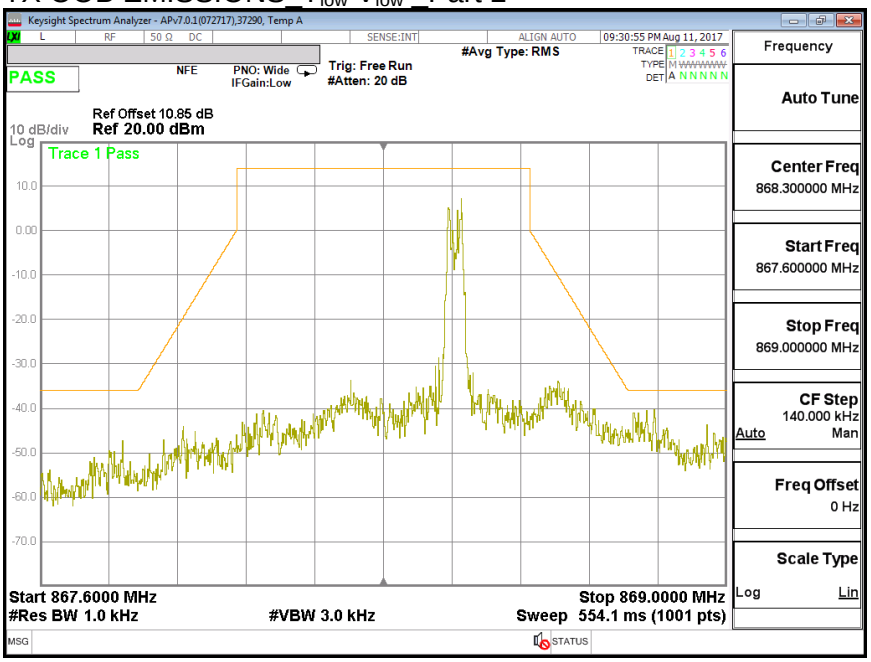
TX OOB EMISSIONS_T_{low} V_{low} _Part 2



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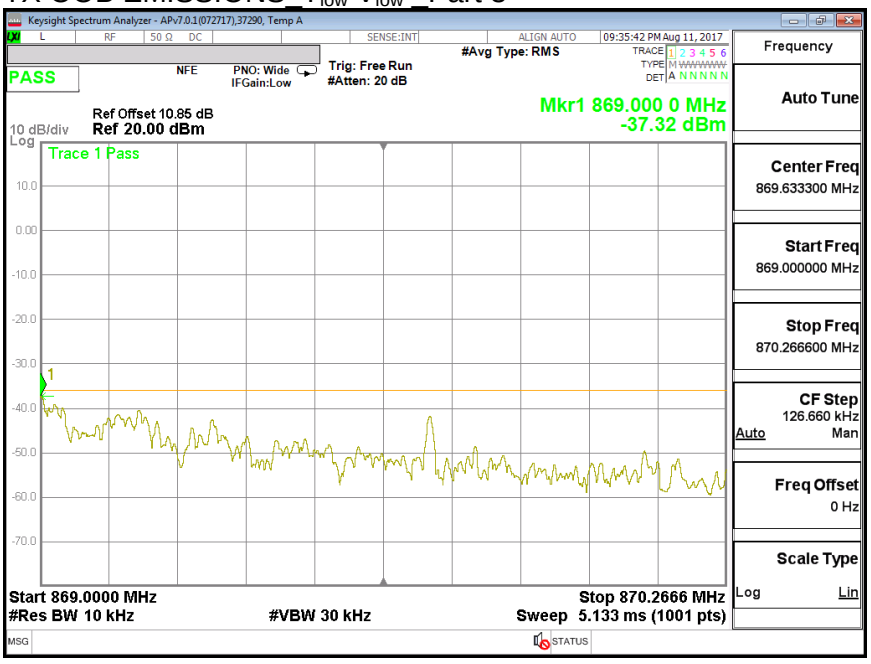

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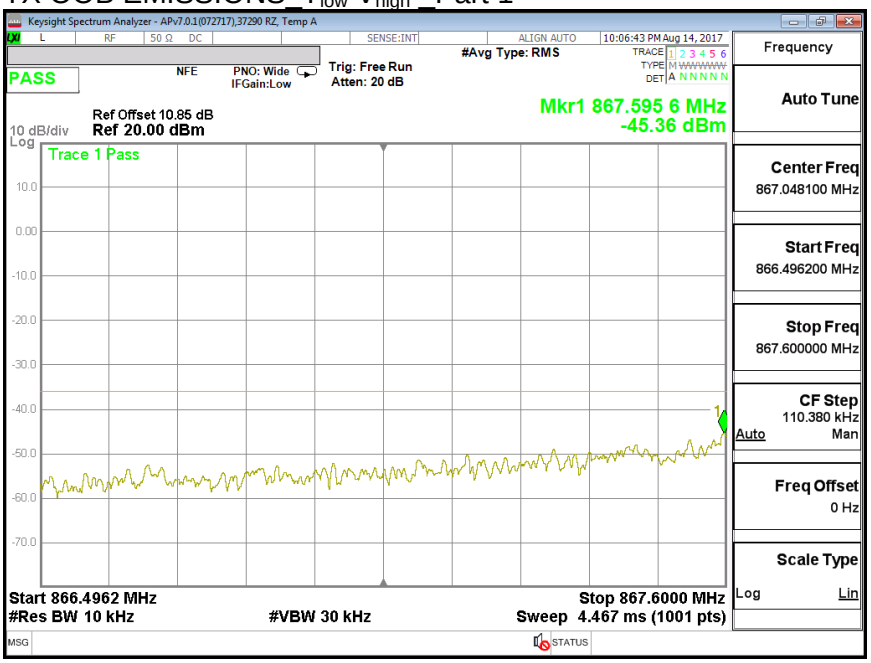
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



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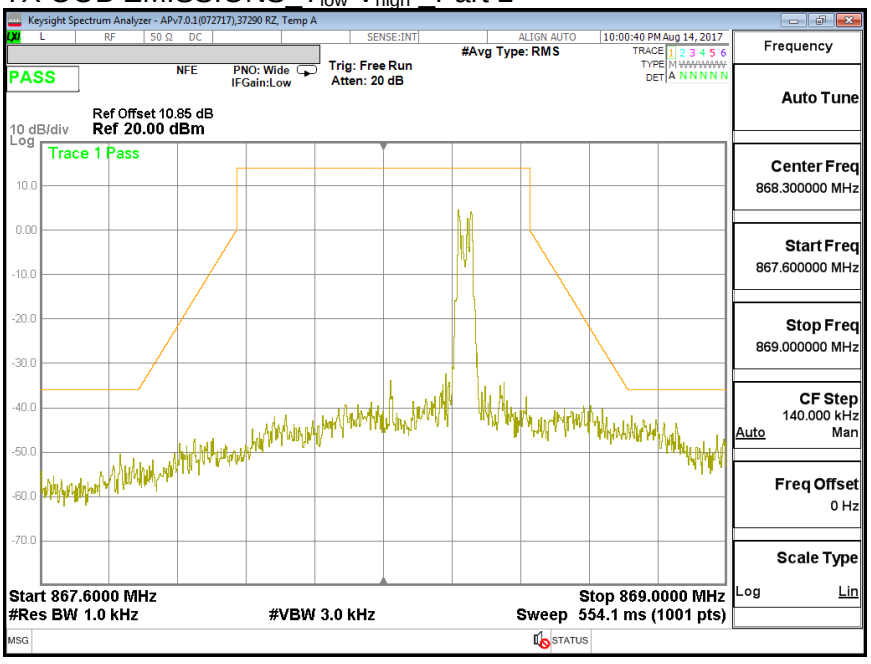

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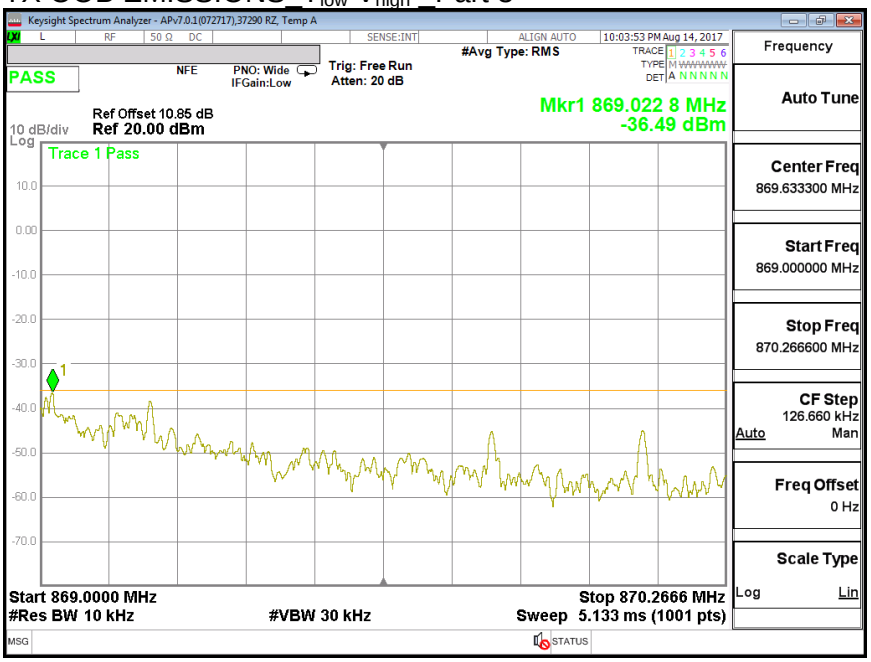
TX OOB EMISSIONS_T_{low} V_{high} _Part 3



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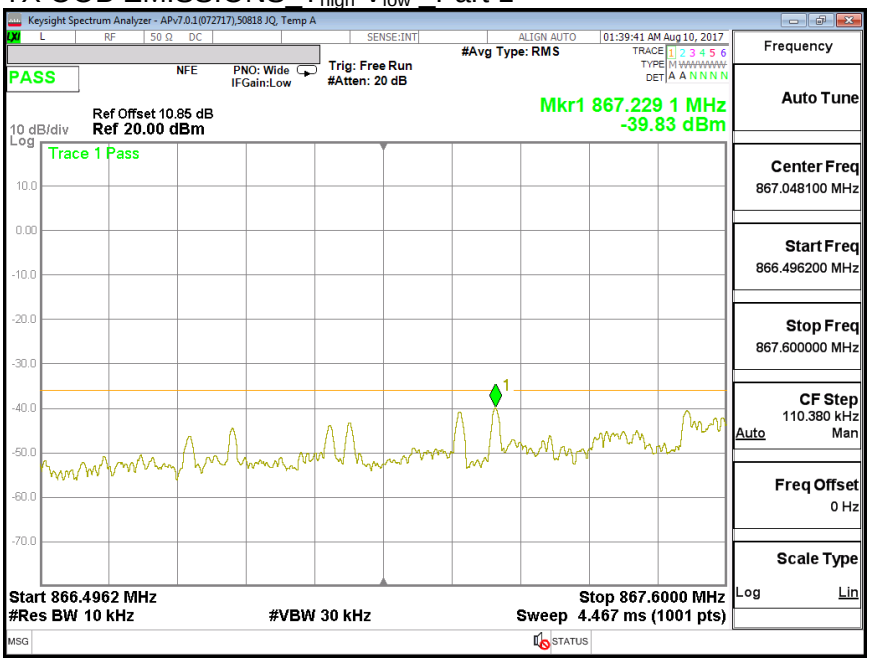

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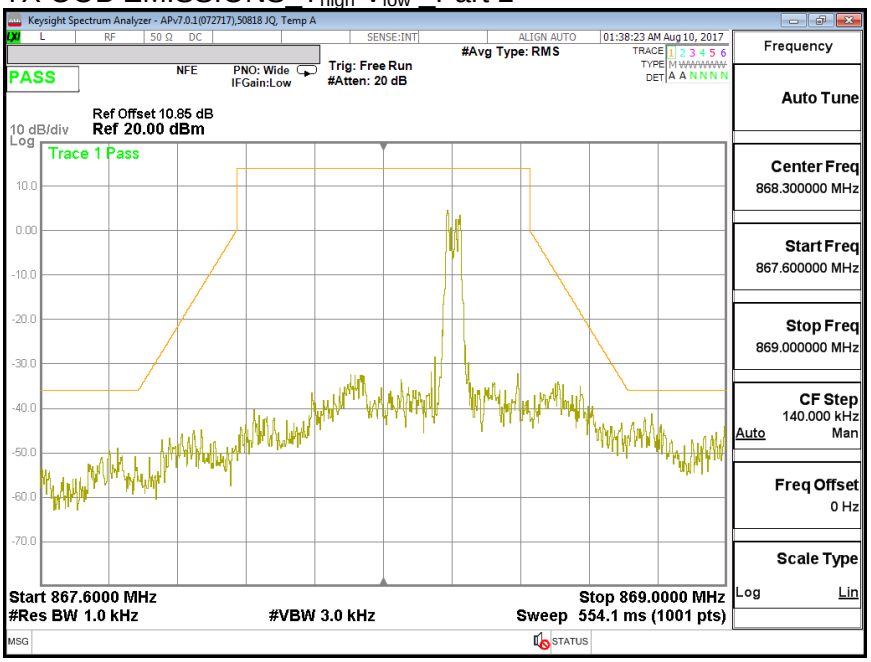
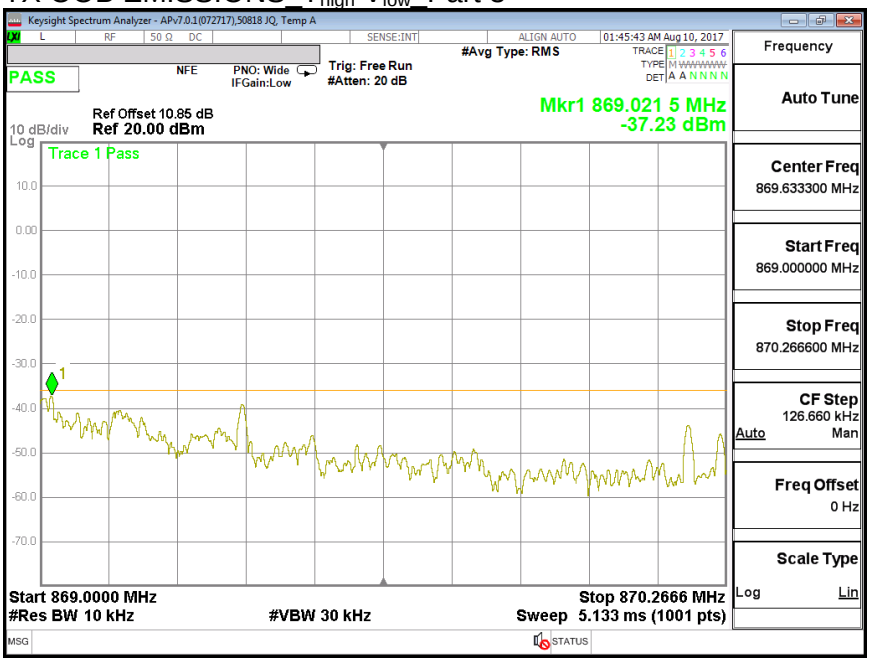


TX OOB EMISSIONS_T_{high} V_{low}_Part 3



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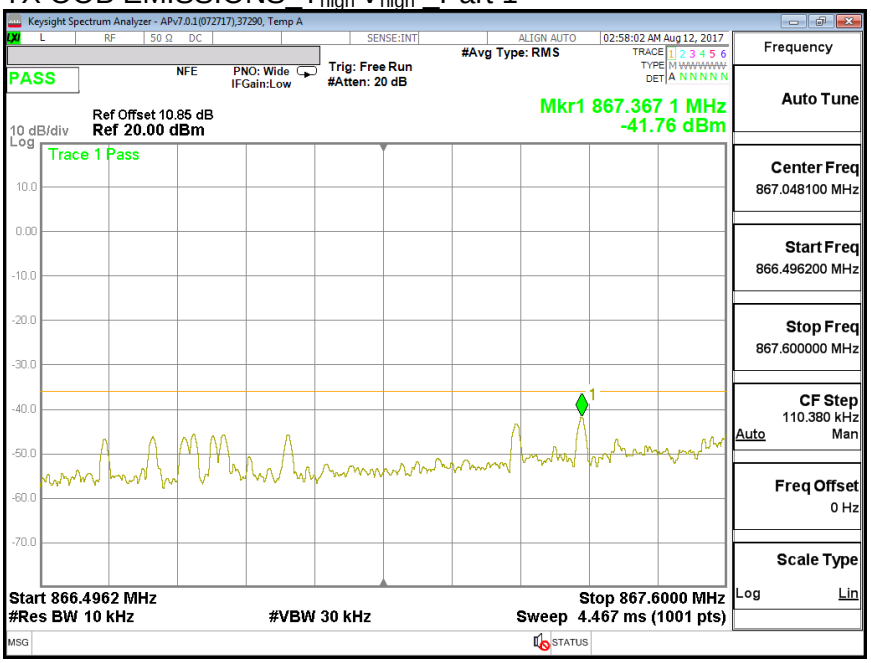
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



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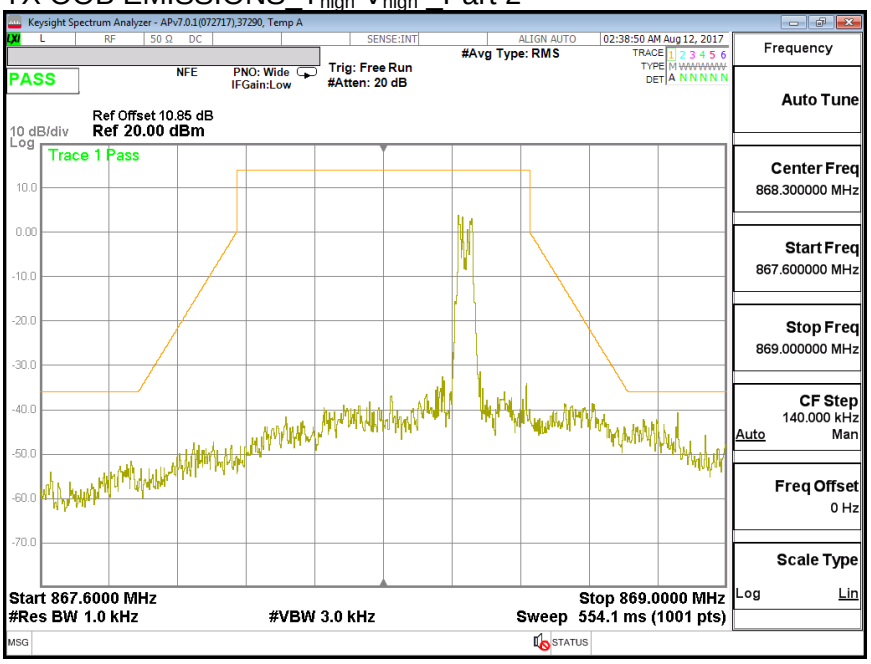

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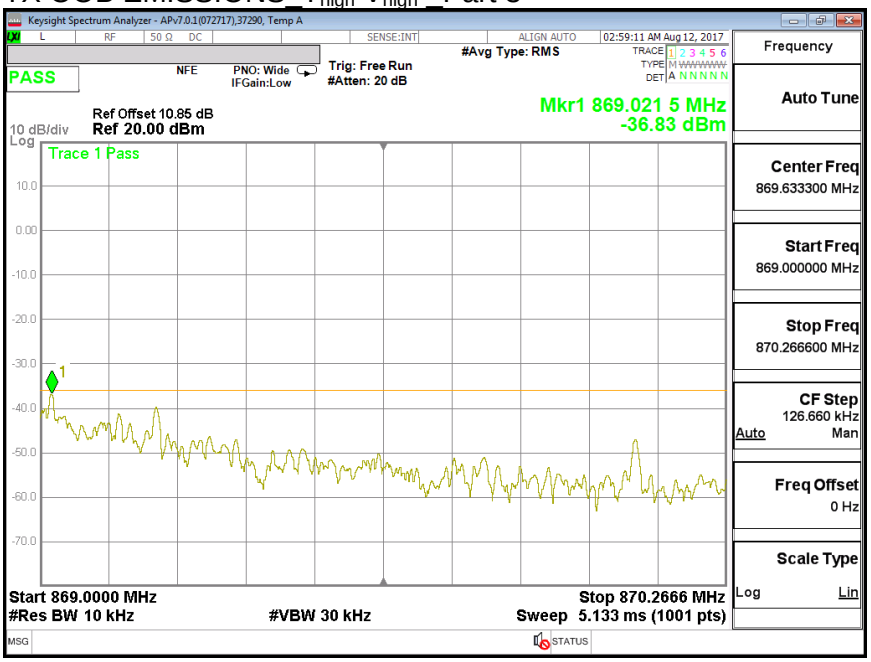
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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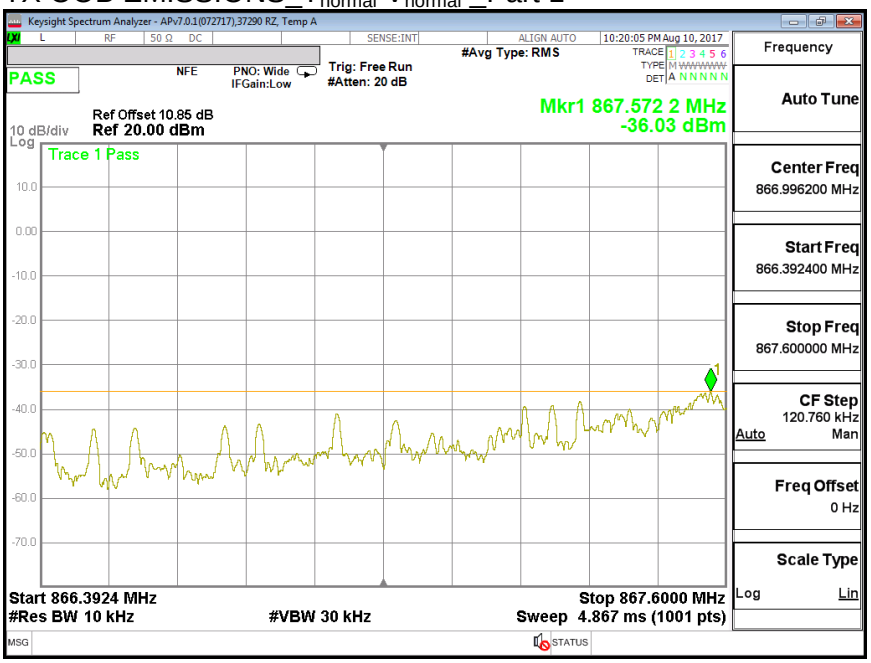
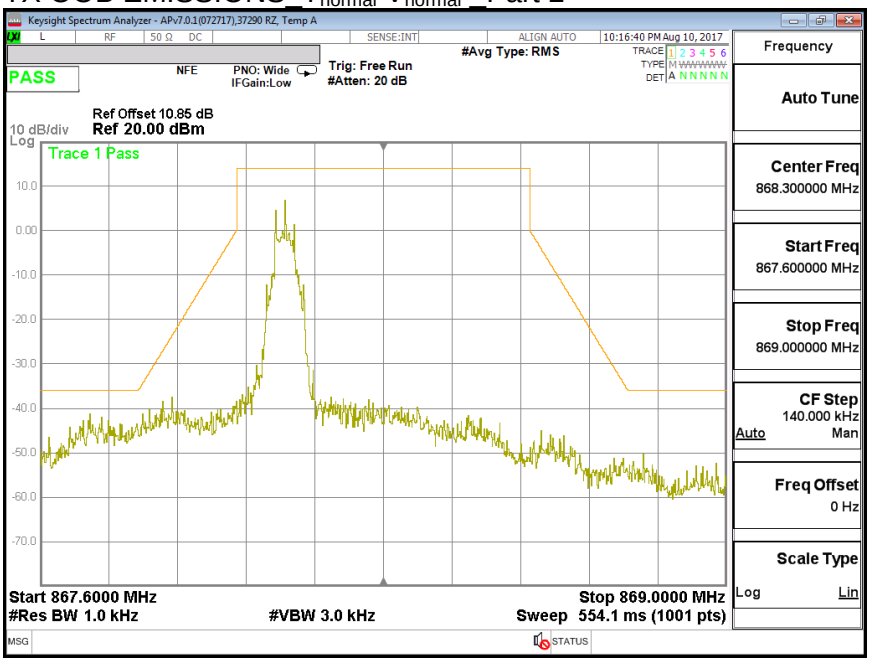
M7 LOW CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 1



TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 2



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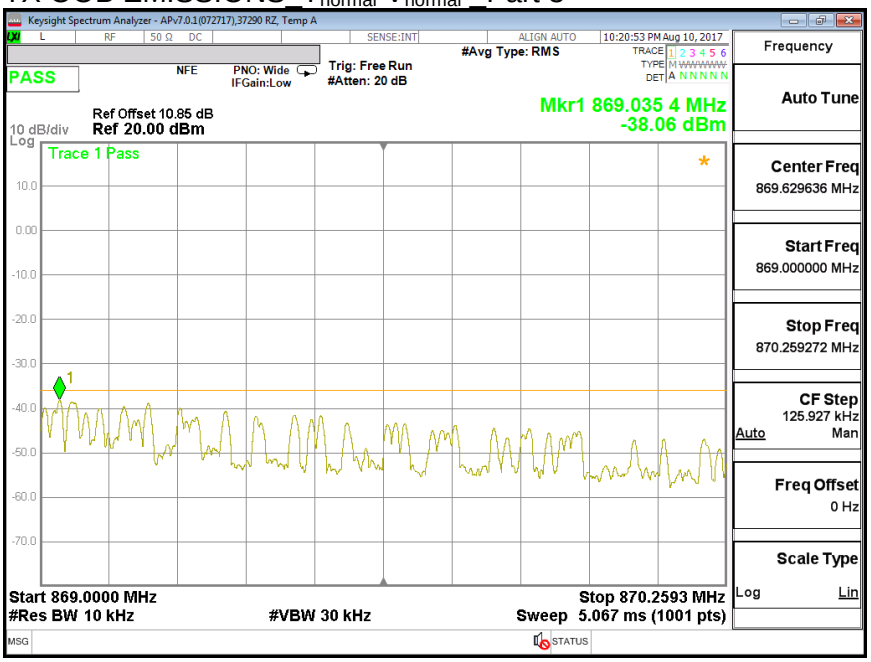
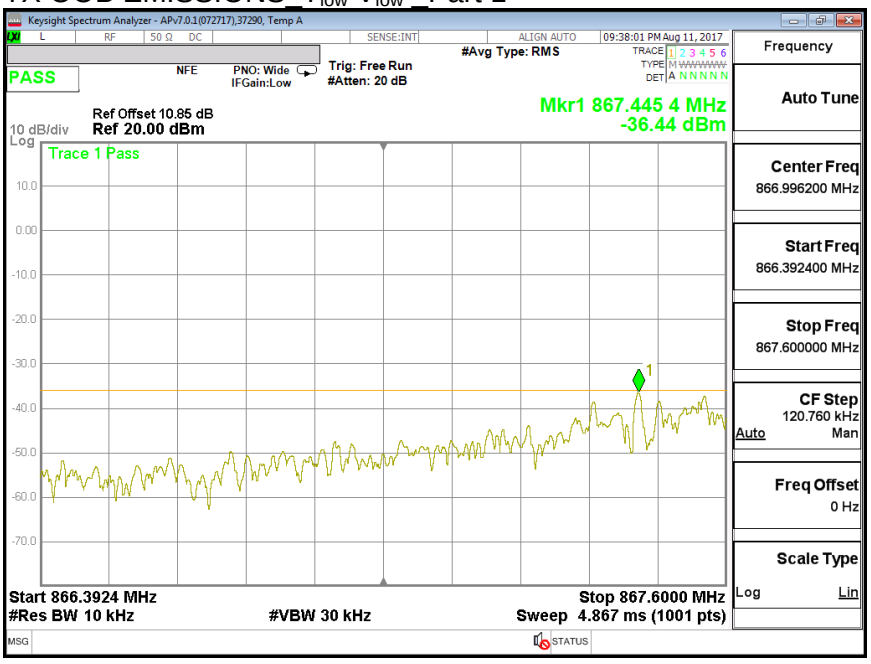
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3



TX OOB EMISSIONS_T_{low} V_{low} _Part 1



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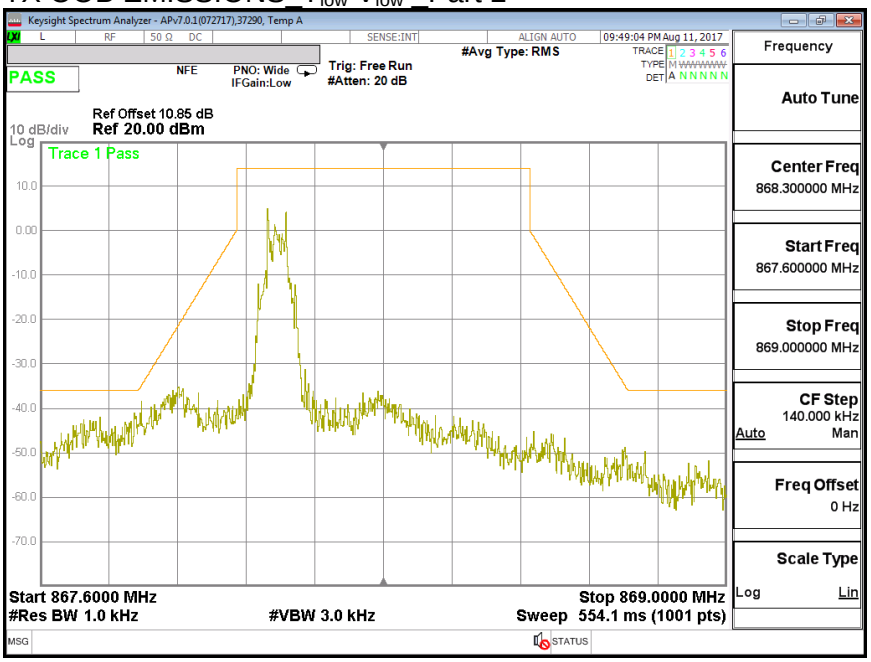

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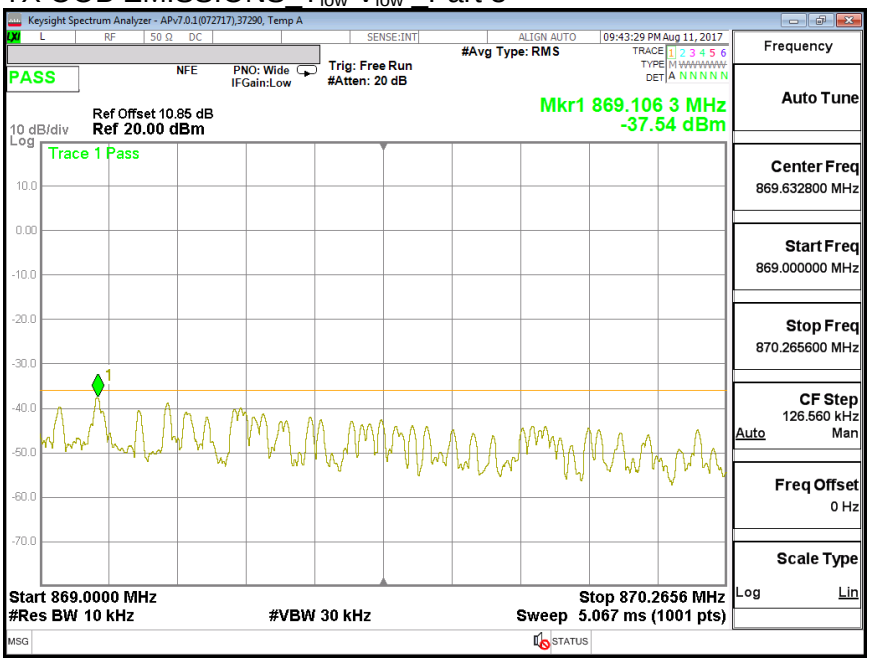

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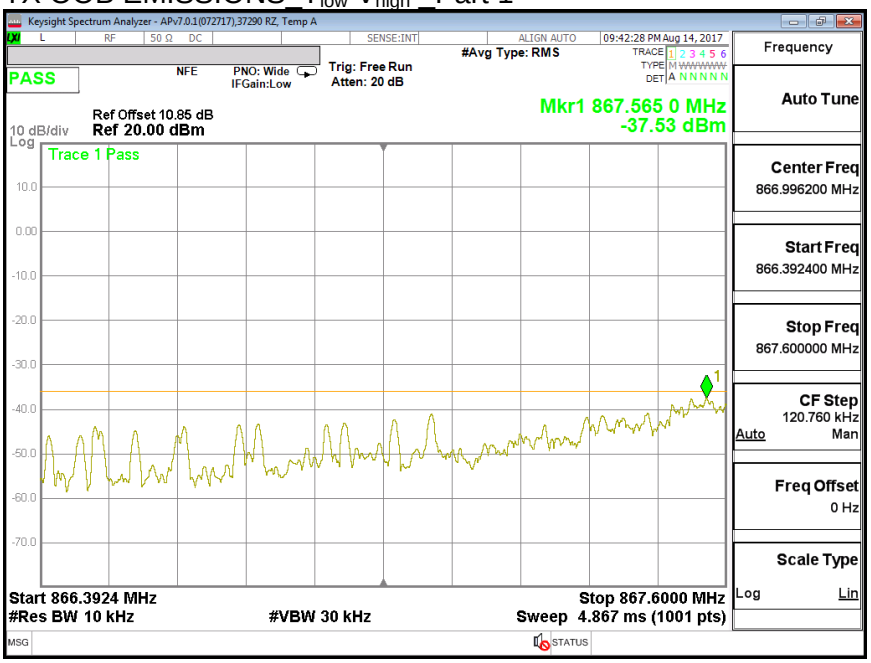
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



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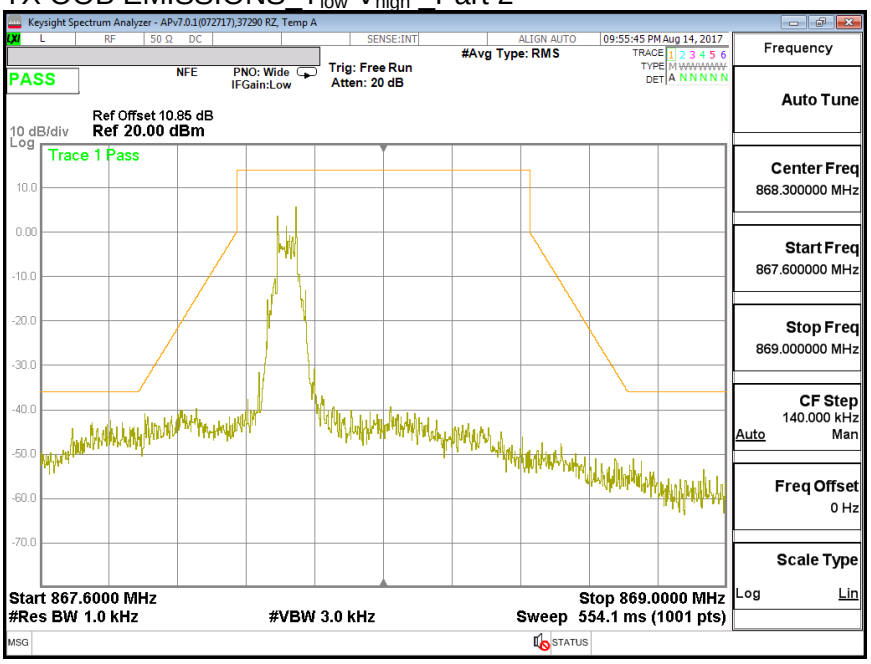

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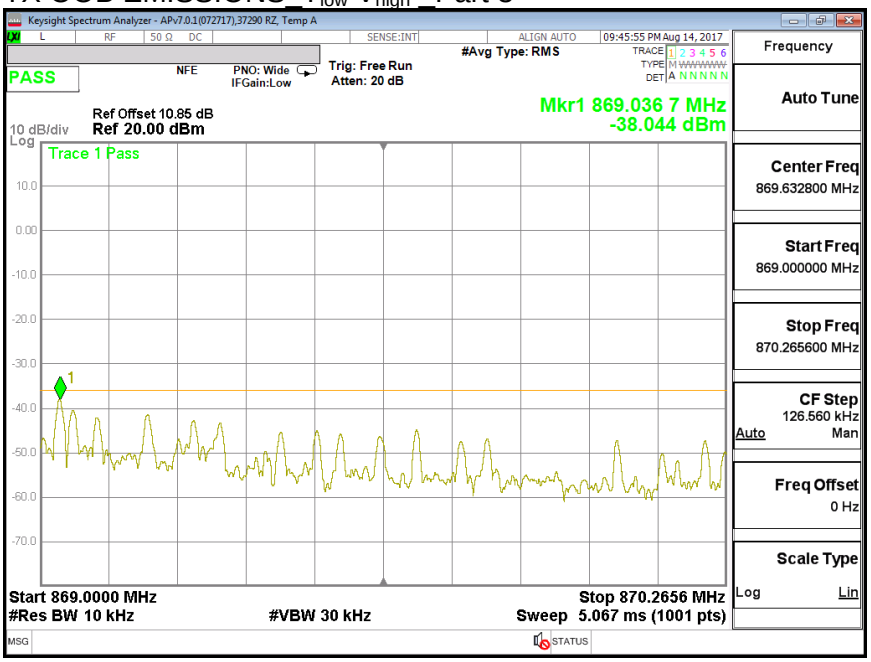
TX OOB EMISSIONS_T_{low} V_{high} _Part 3



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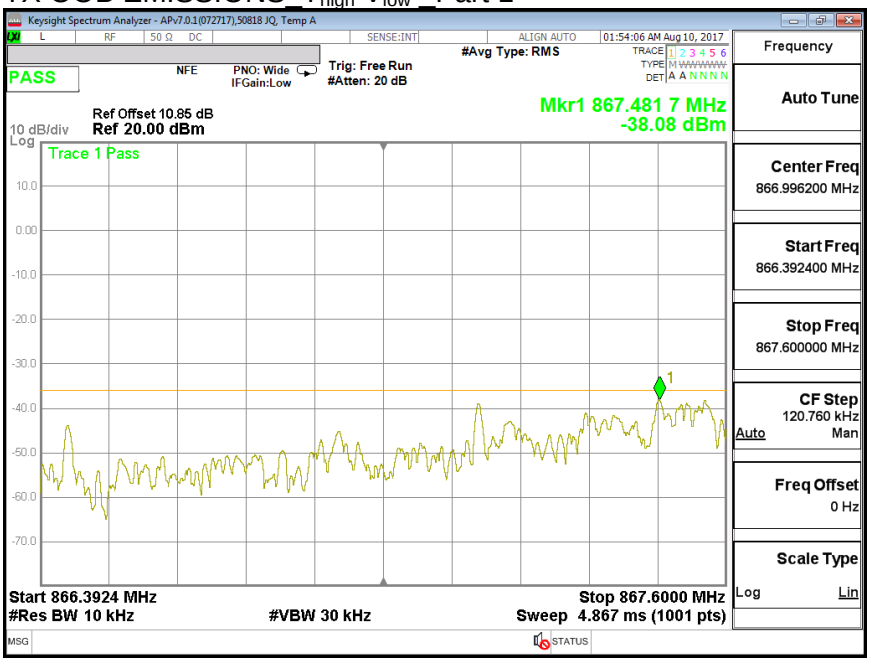

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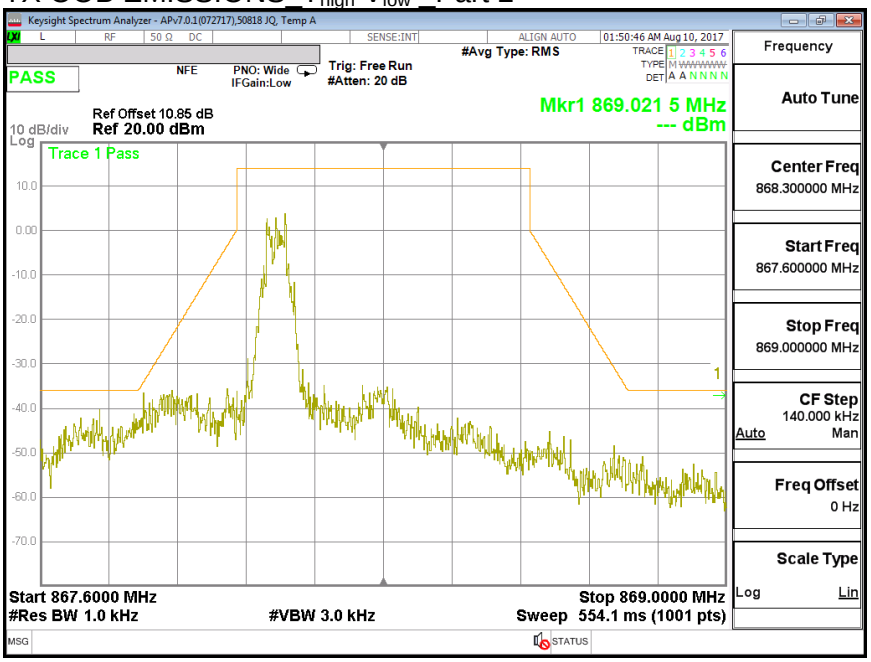
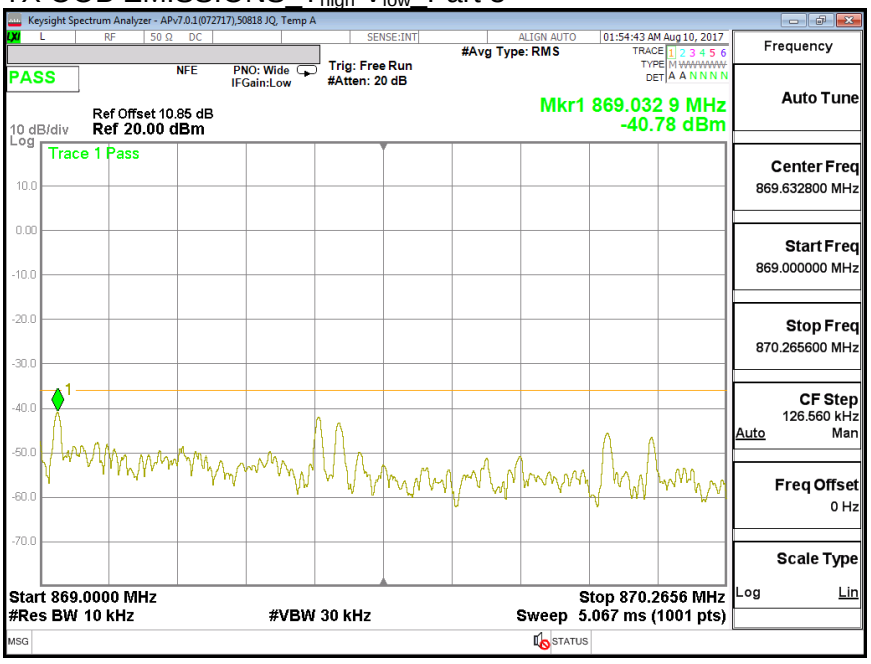


TX OOB EMISSIONS_T_{high} V_{low}_Part 3



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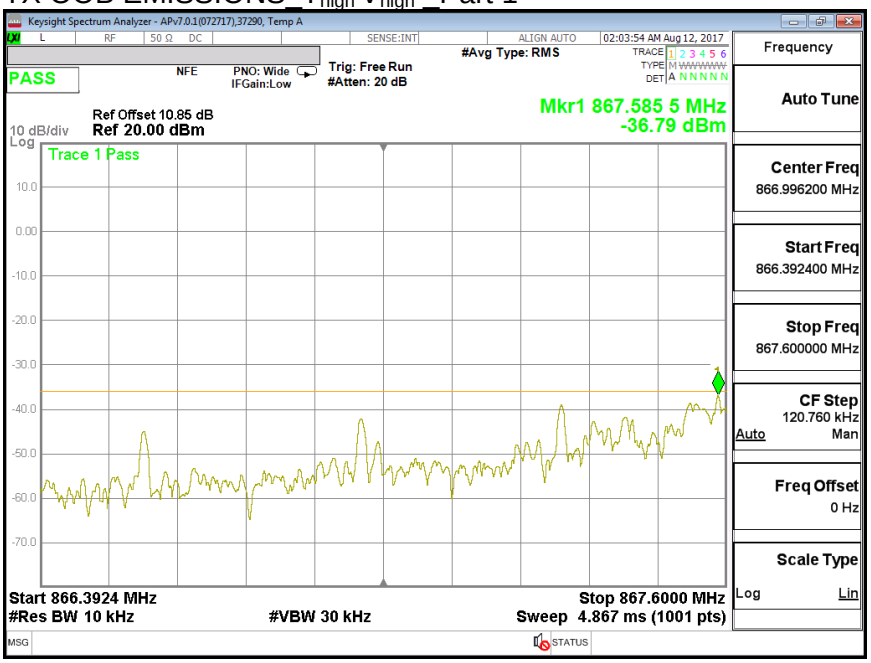
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



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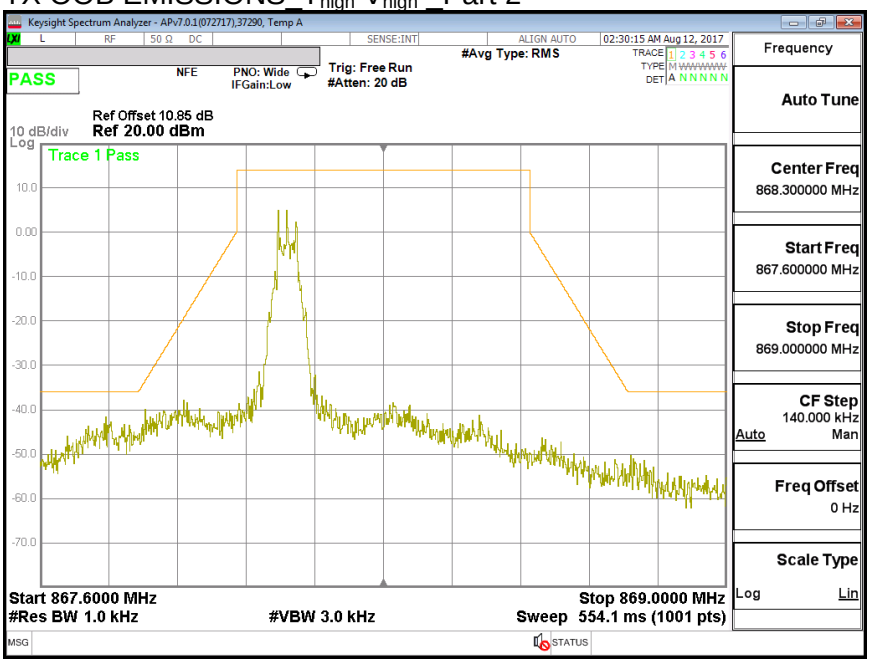

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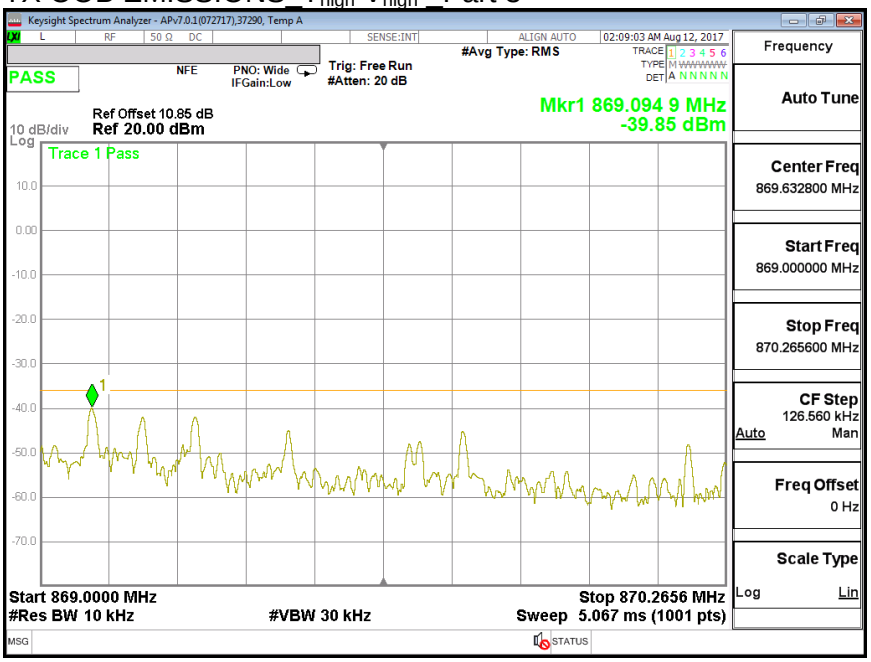
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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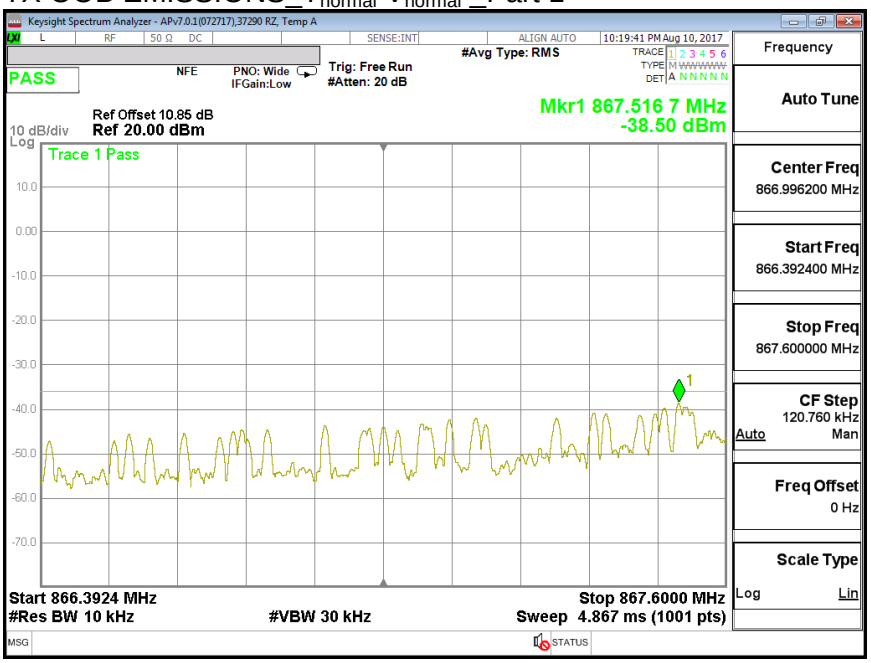
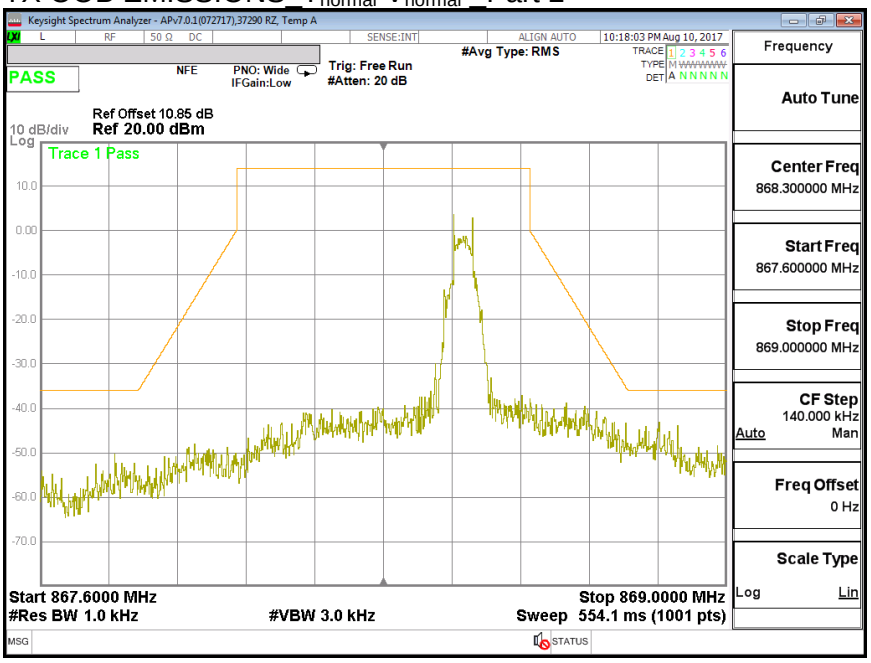
M7 HIGH CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 1



TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 2



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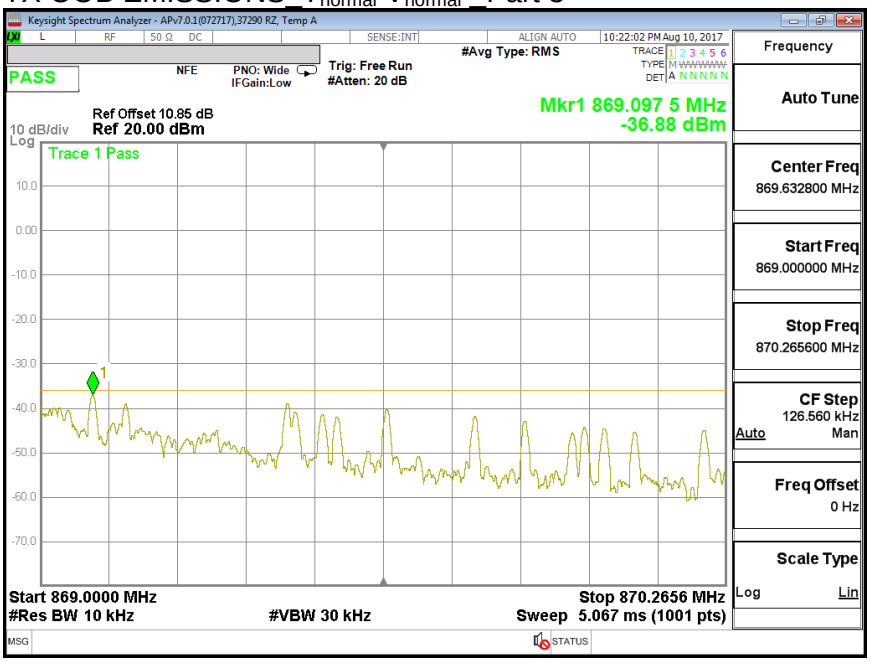
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3



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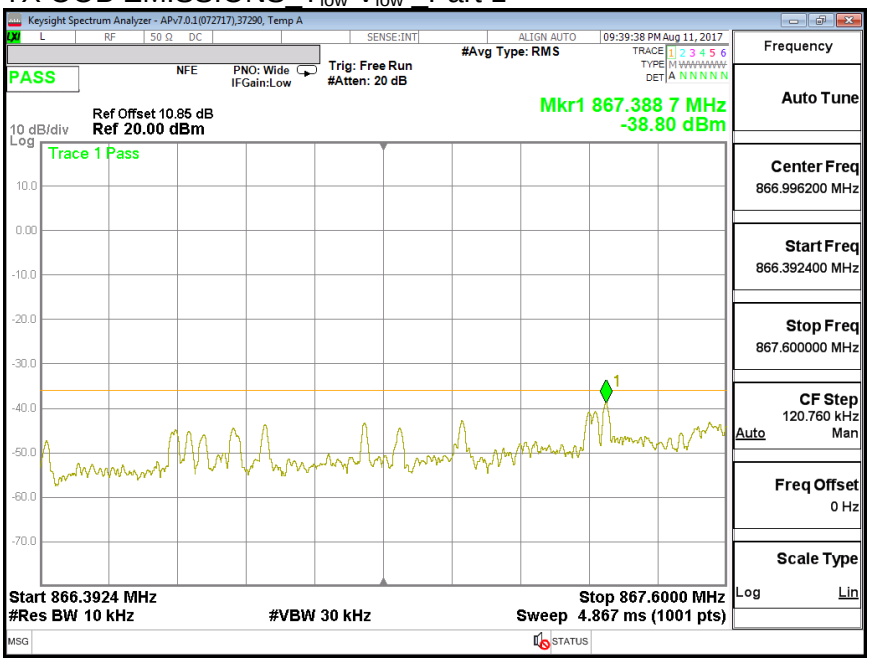

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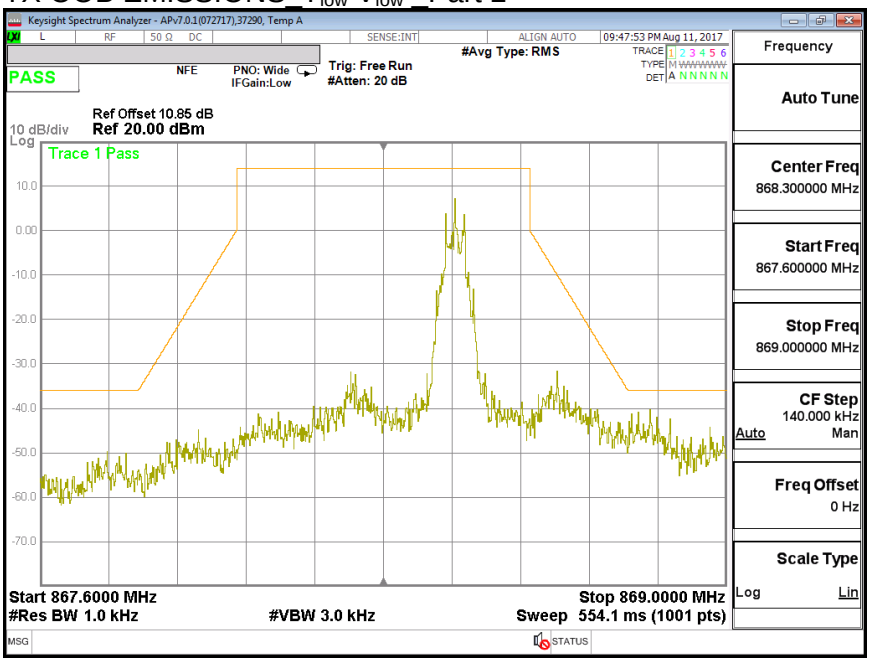
TX OOB EMISSIONS_T_{low} V_{low} _Part 2



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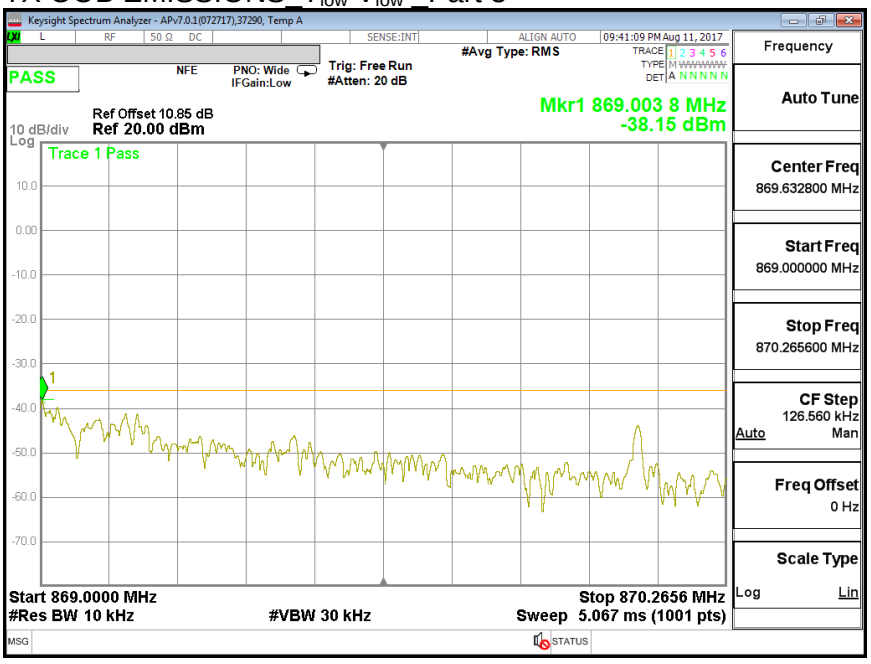

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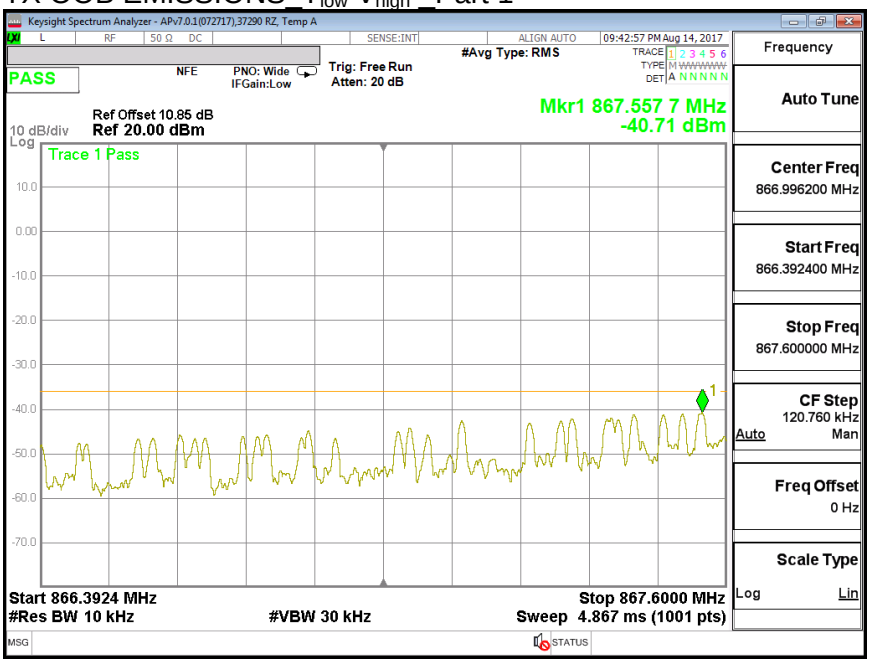
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



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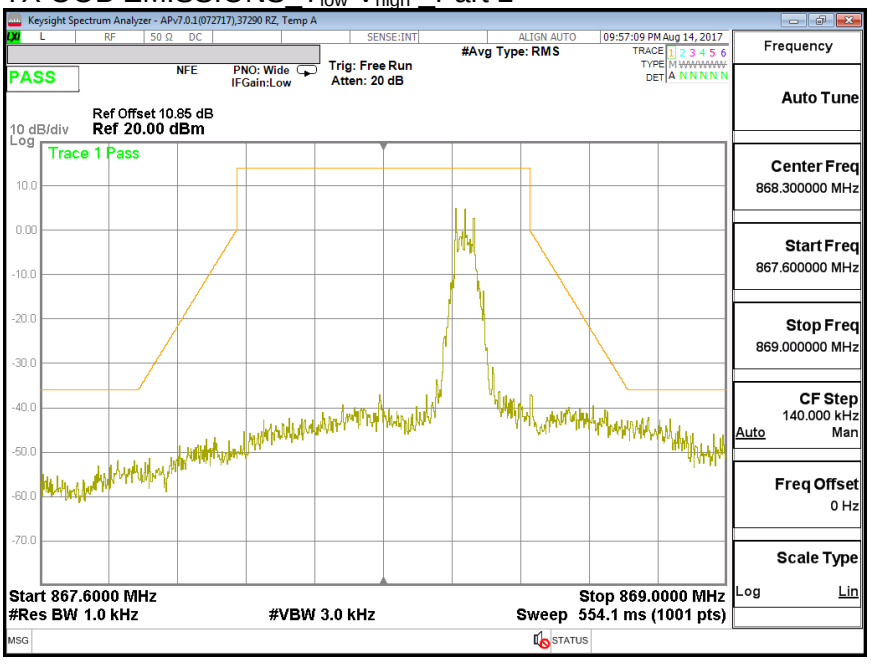

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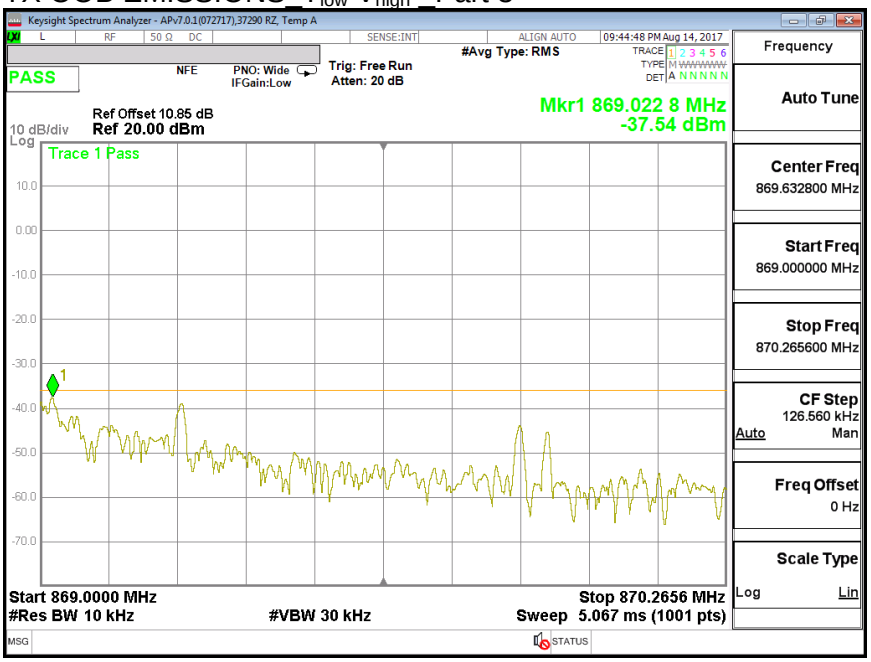
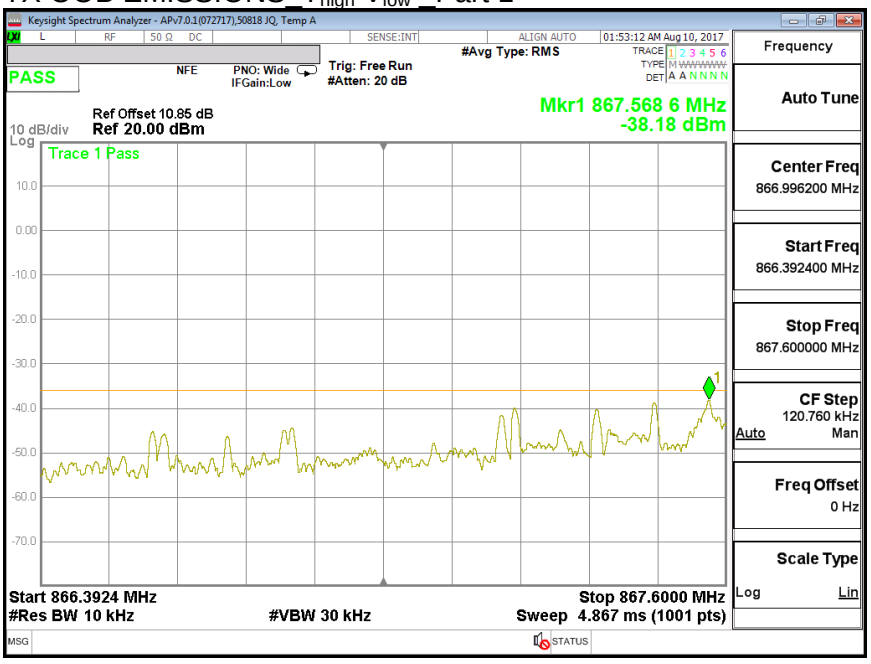
TX OOB EMISSIONS_T_{low} V_{high} _Part 3



TX OOB EMISSIONS_T_{high} V_{low} _Part 1



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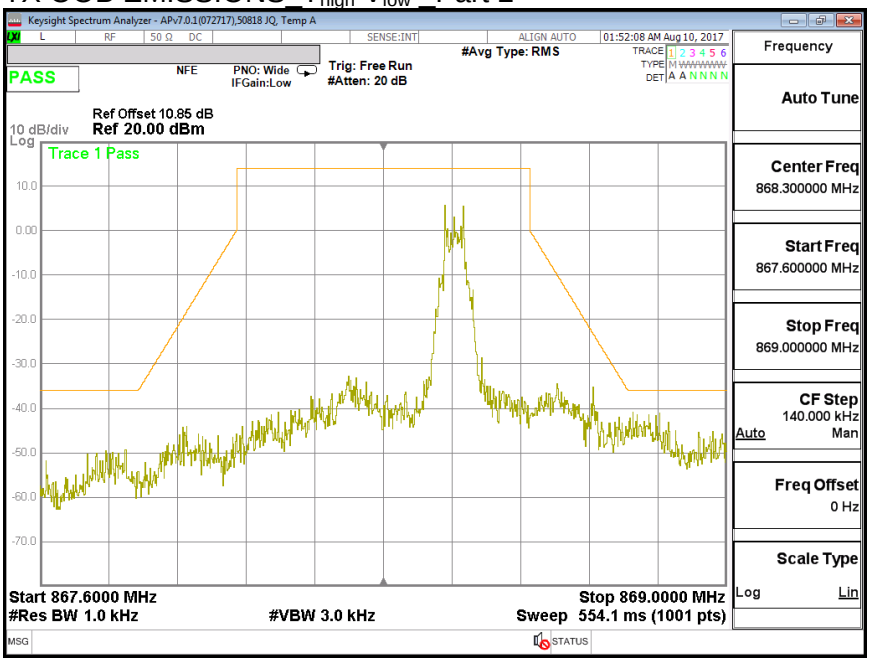
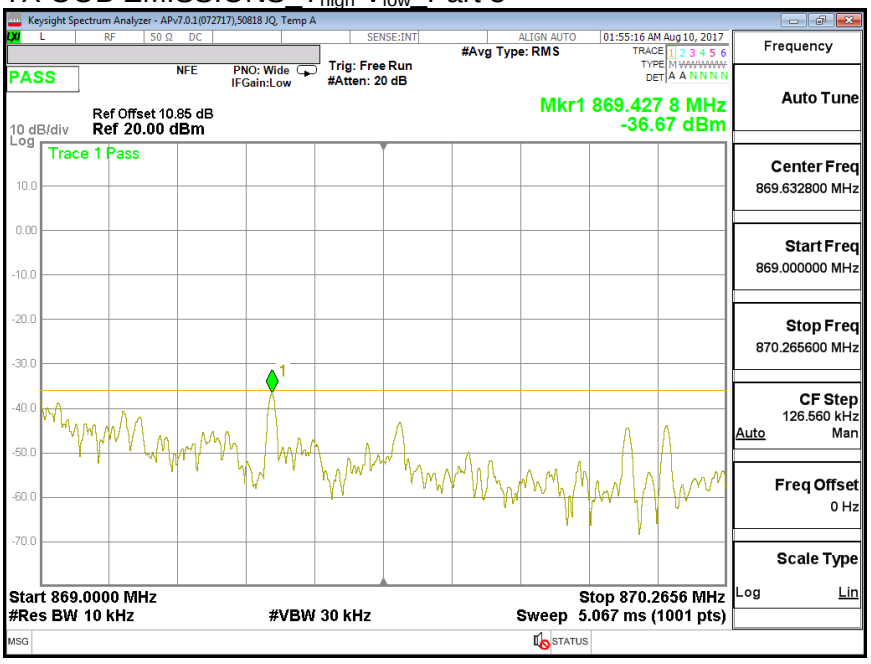
TX OOB EMISSIONS_T_{high} V_{low} _Part 2



TX OOB EMISSIONS_T_{high} V_{low}_Part 3



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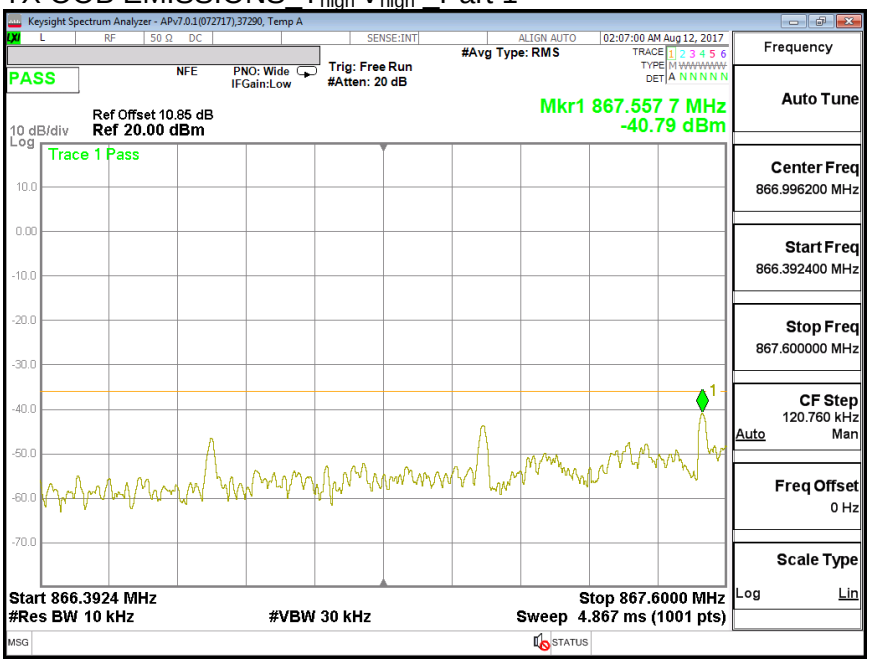
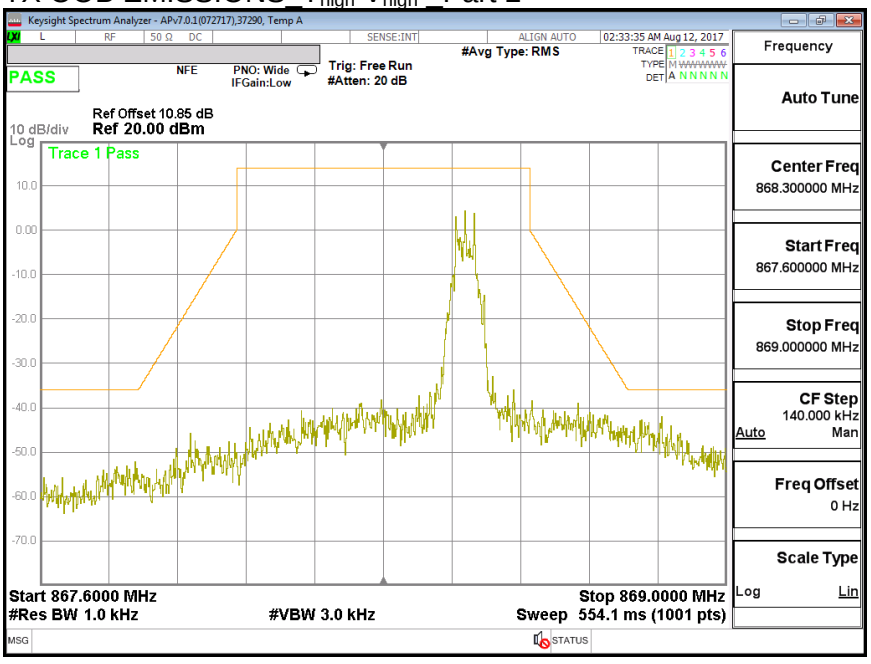
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



TX OOB EMISSIONS_T_{high} V_{high} _Part 2



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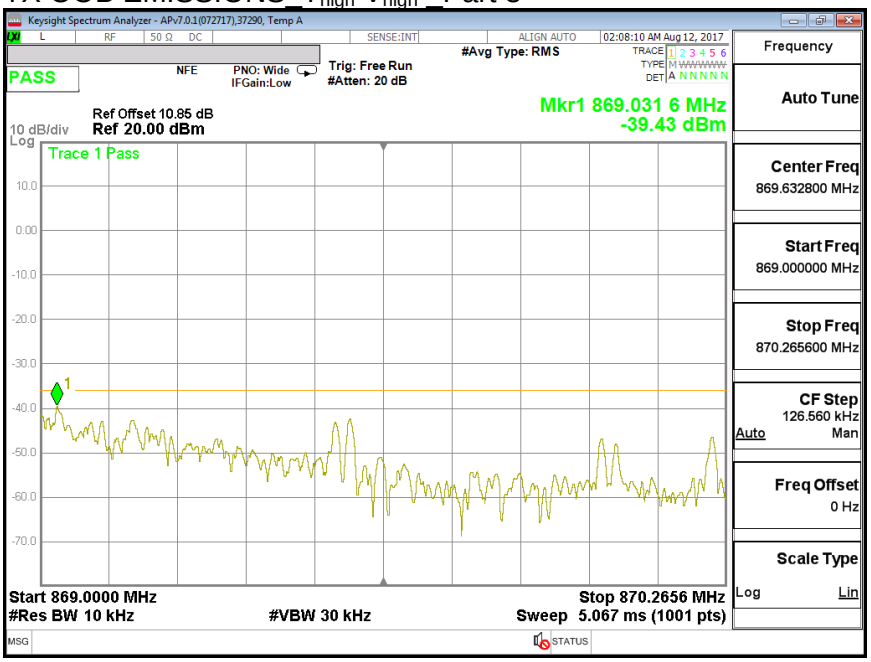
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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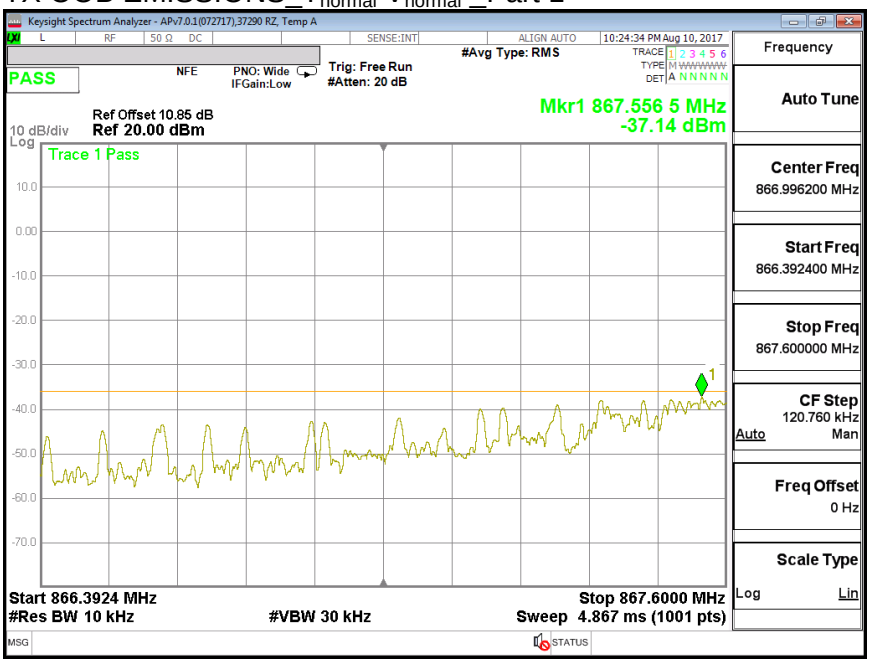
ML1 LOW CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 1



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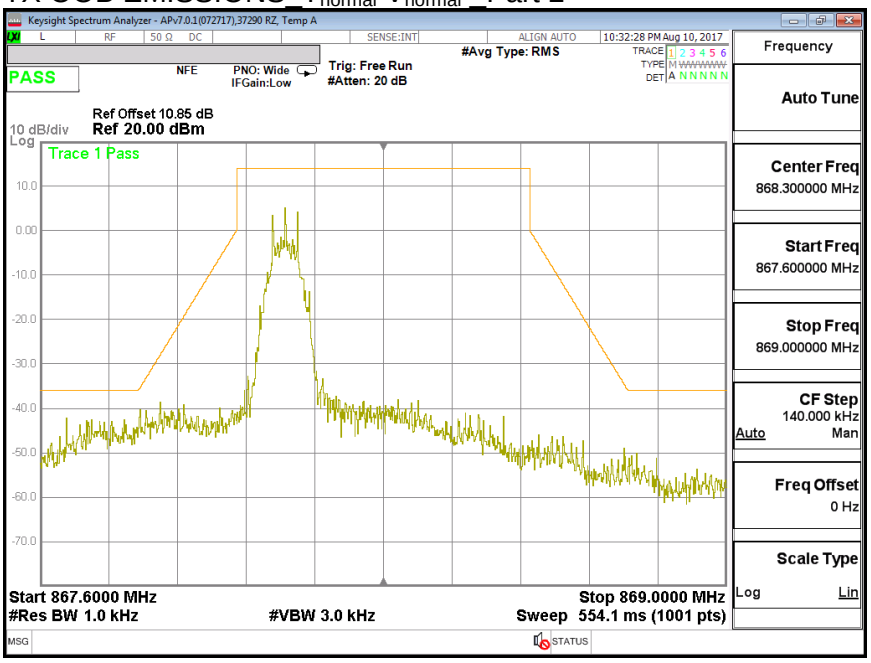

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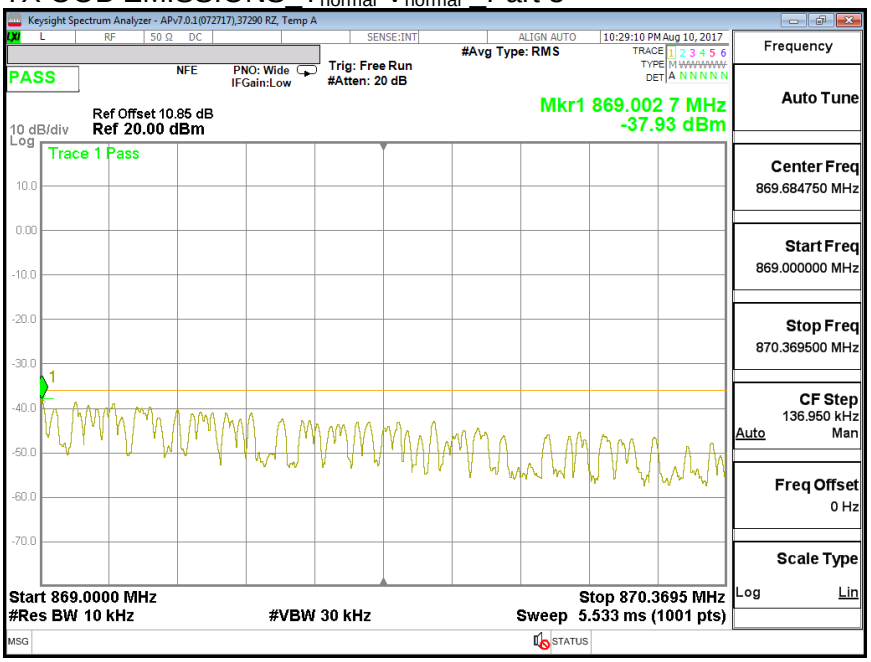
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3



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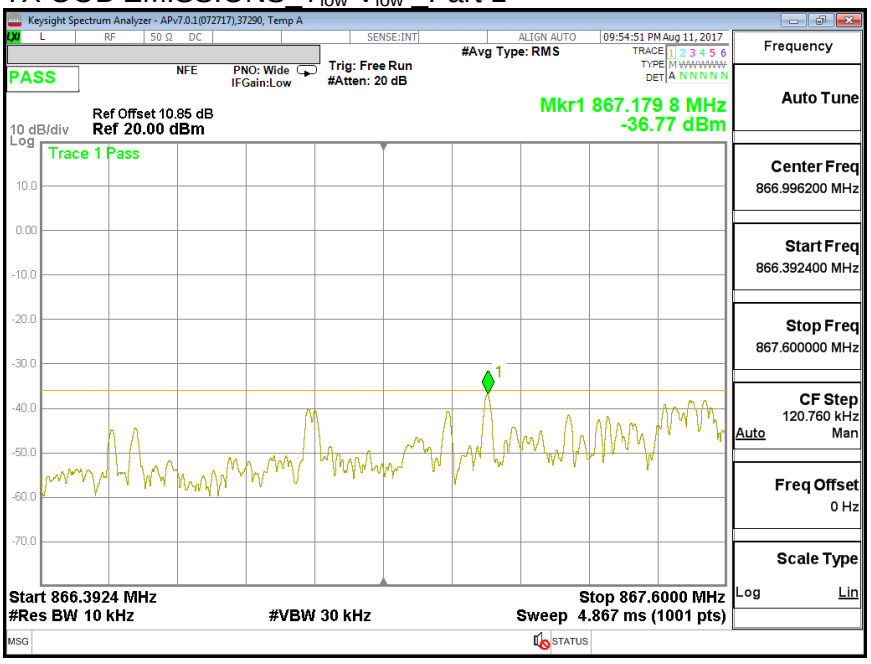

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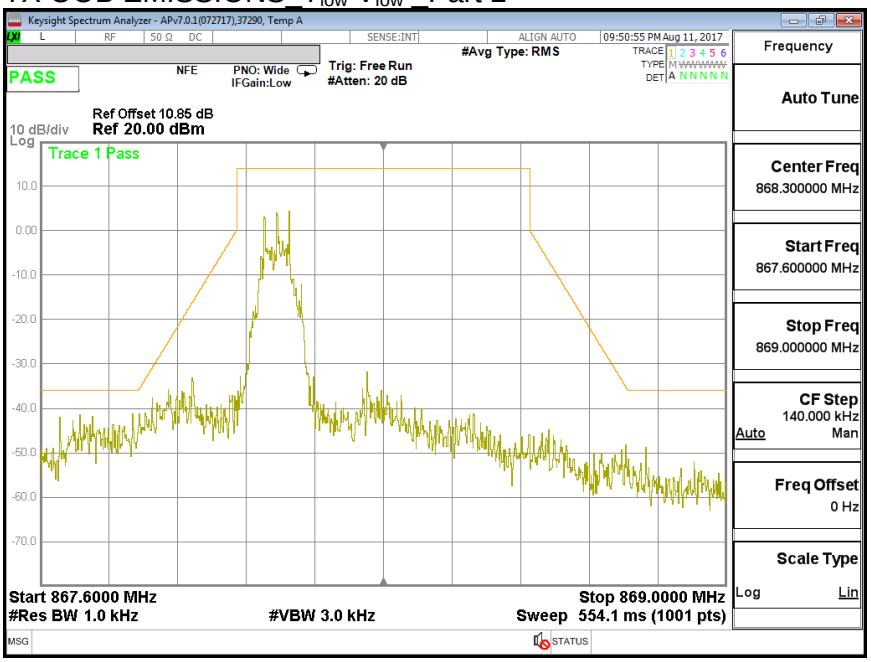
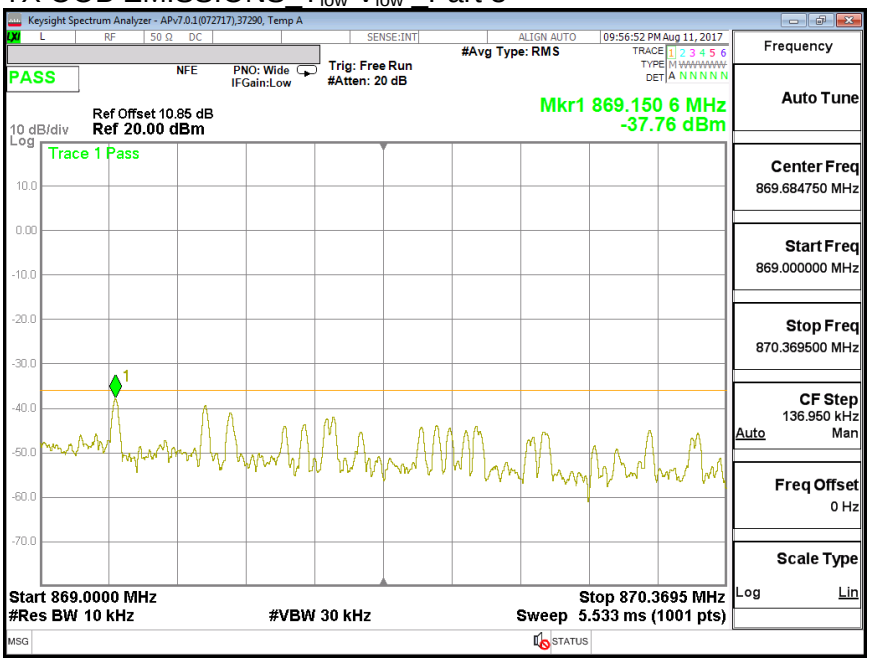


TX OOB EMISSIONS_T_{low} V_{low} _Part 3



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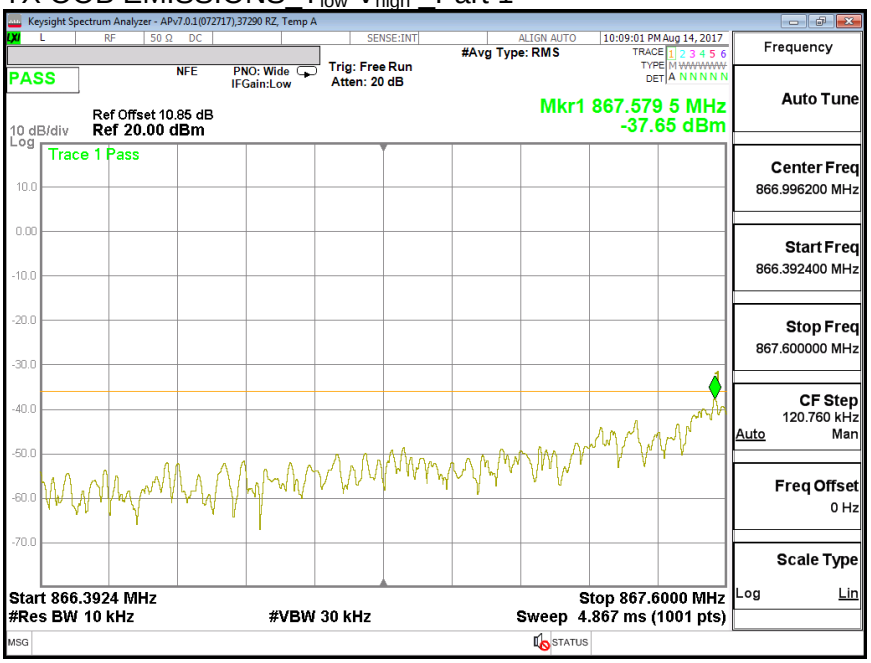
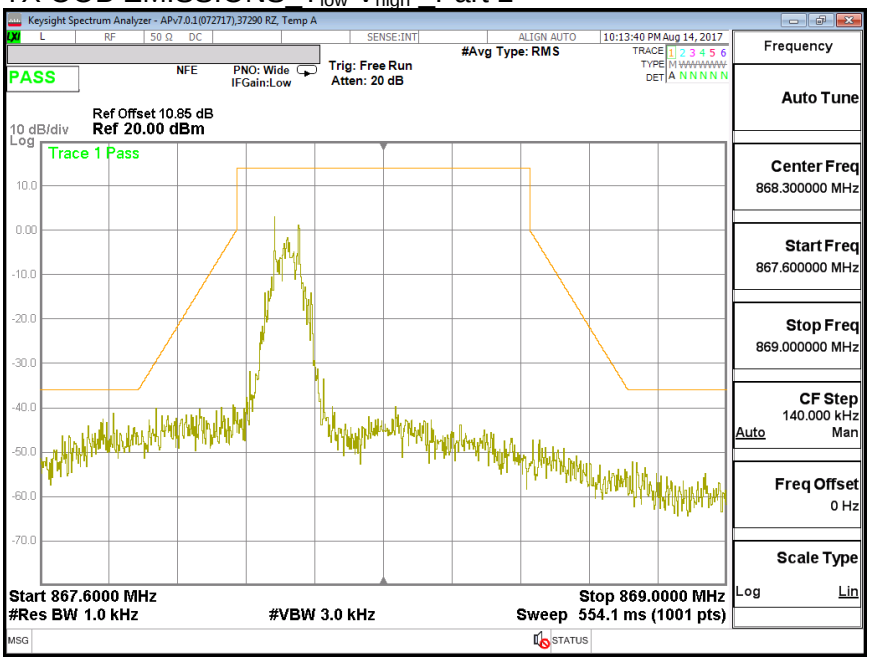
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



TX OOB EMISSIONS_T_{low} V_{high} _Part 2



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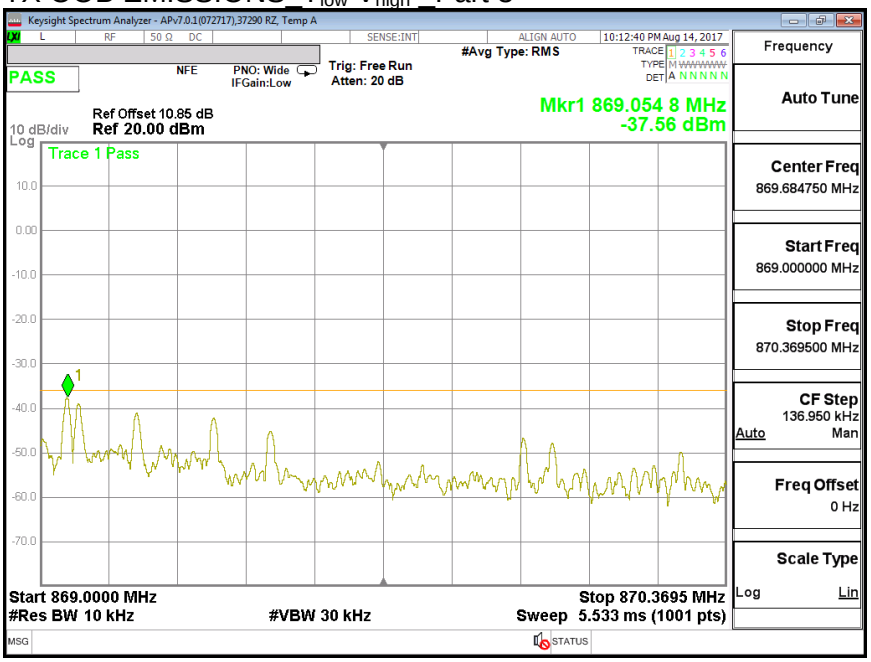
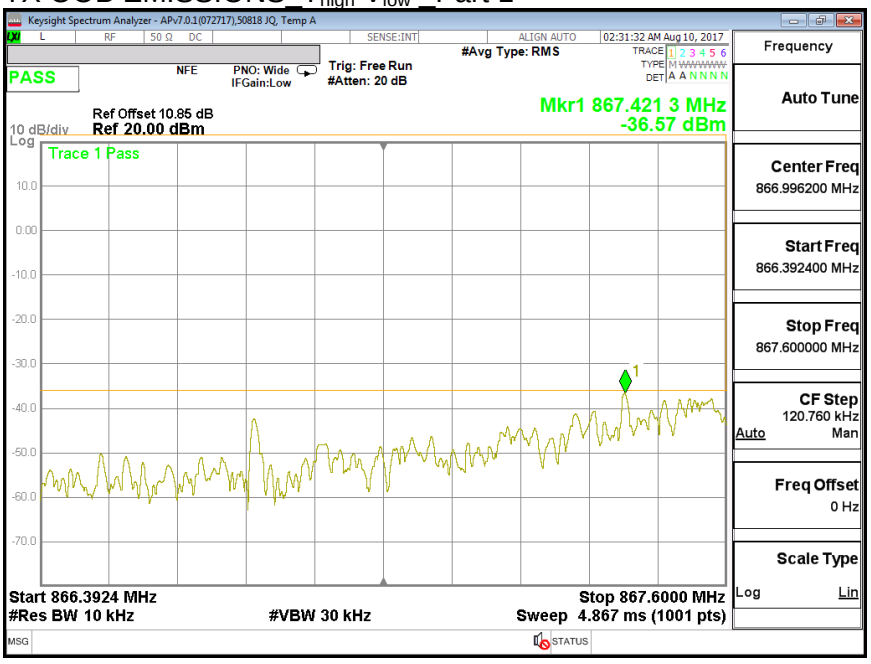
TX OOB EMISSIONS_T_{low} V_{high} _Part 3



TX OOB EMISSIONS_T_{high} V_{low} _Part 1



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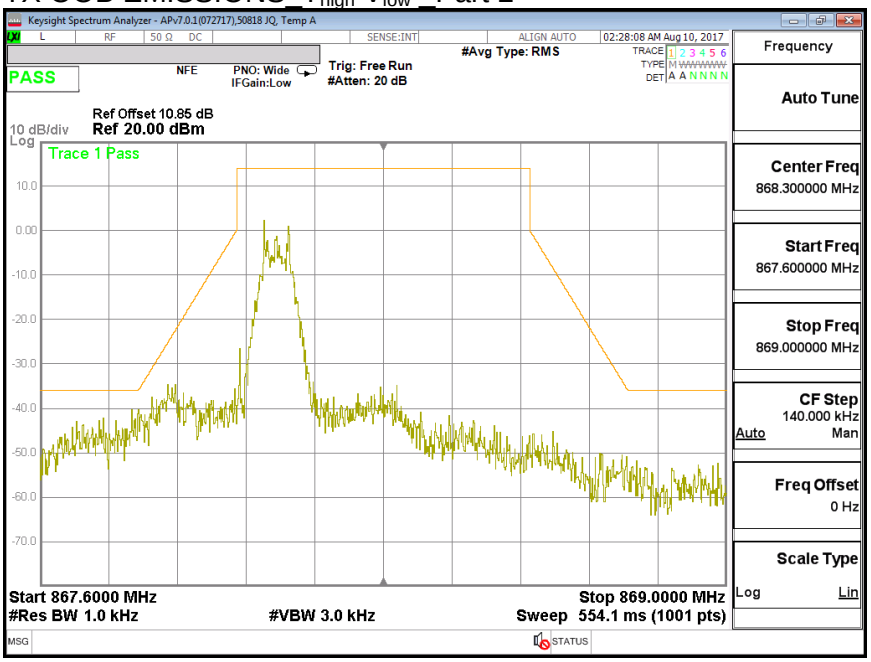
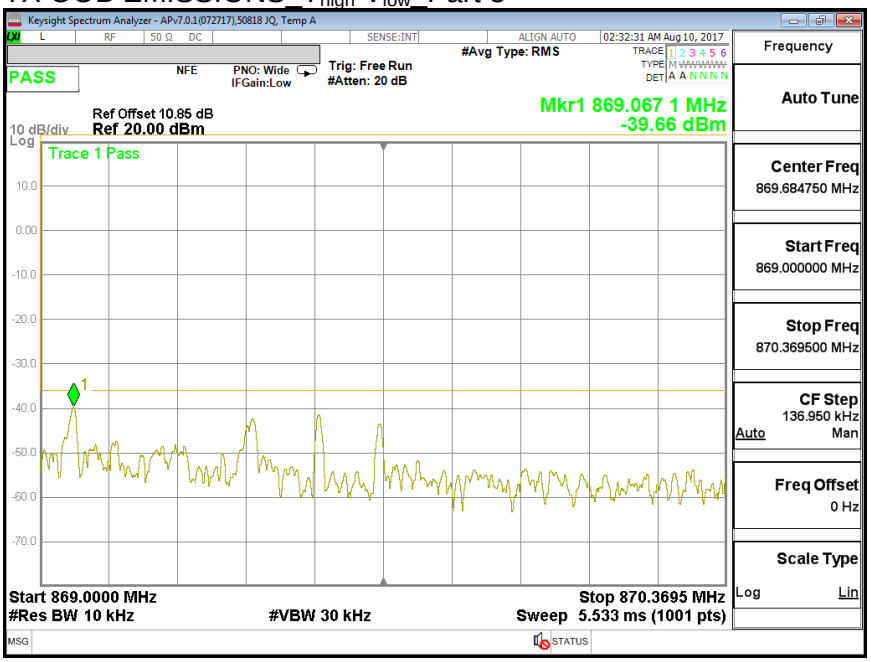
TX OOB EMISSIONS_T_{high} V_{low} _Part 2



TX OOB EMISSIONS_T_{high} V_{low}_Part 3



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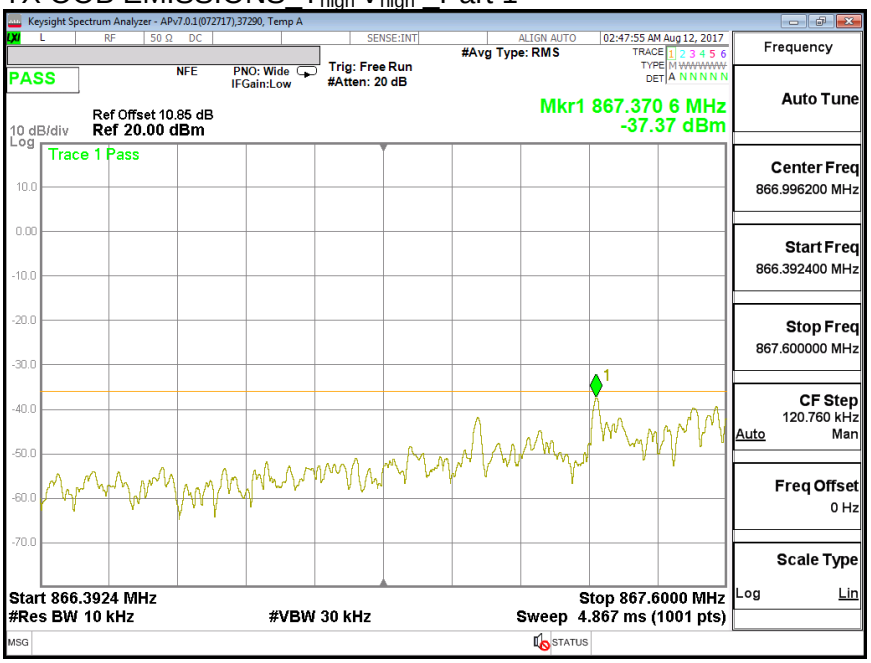
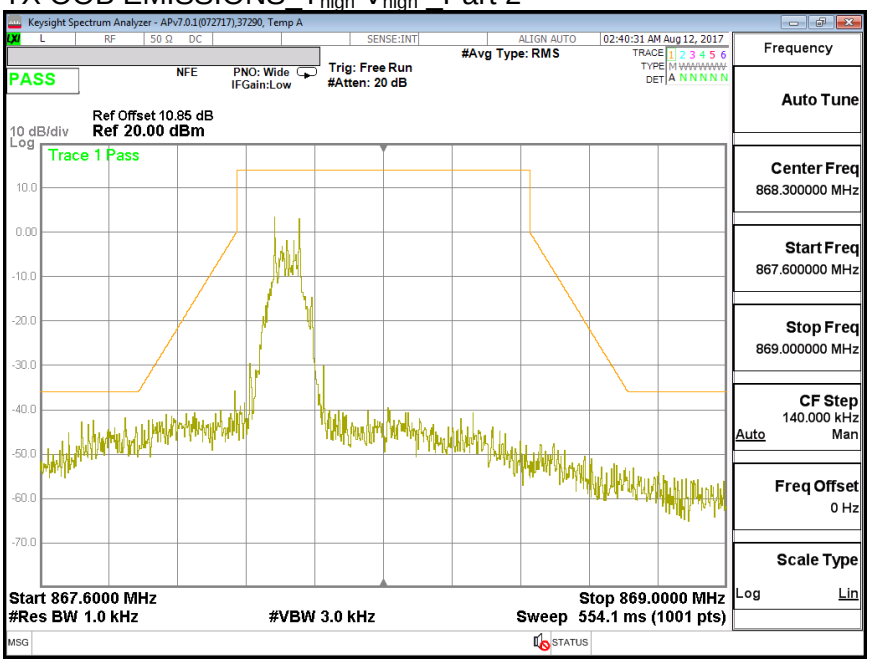
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



TX OOB EMISSIONS_T_{high} V_{high} _Part 2



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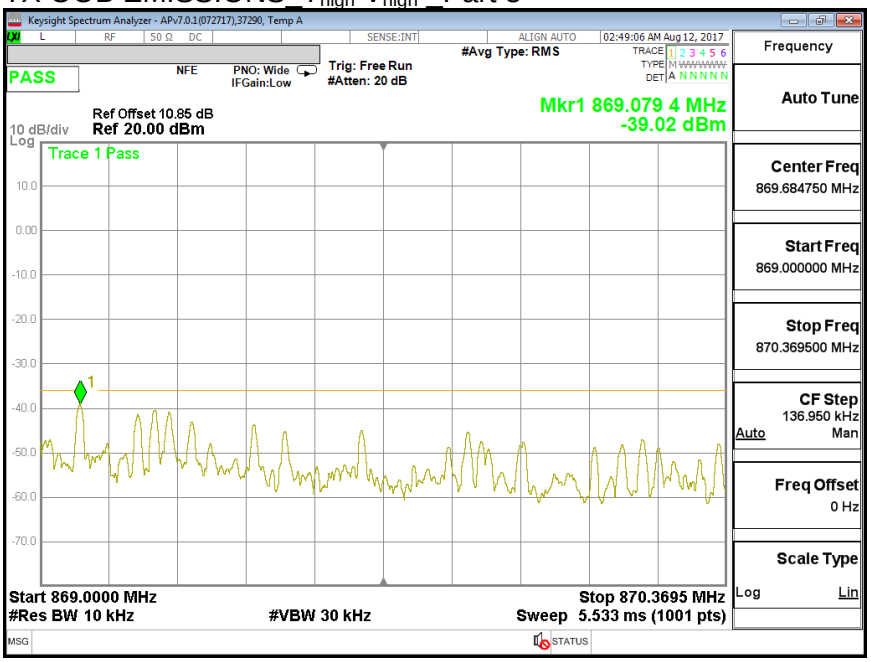
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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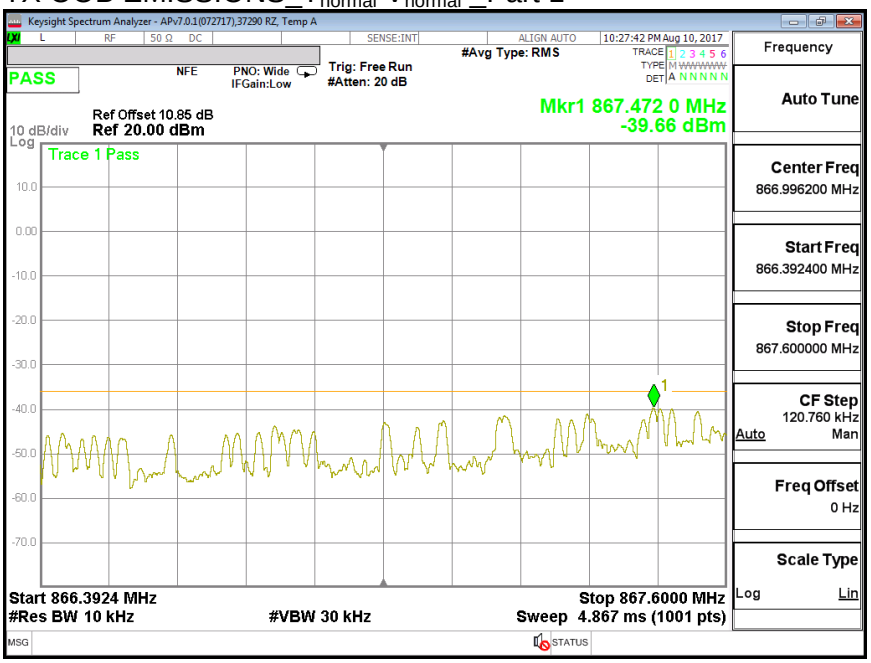
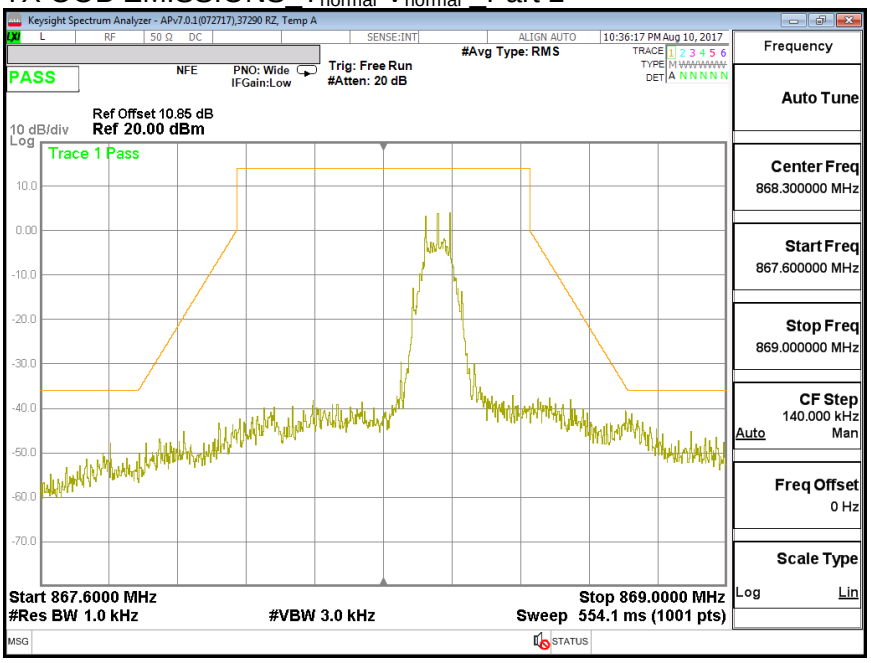
ML1 HIGH CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 1



TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 2



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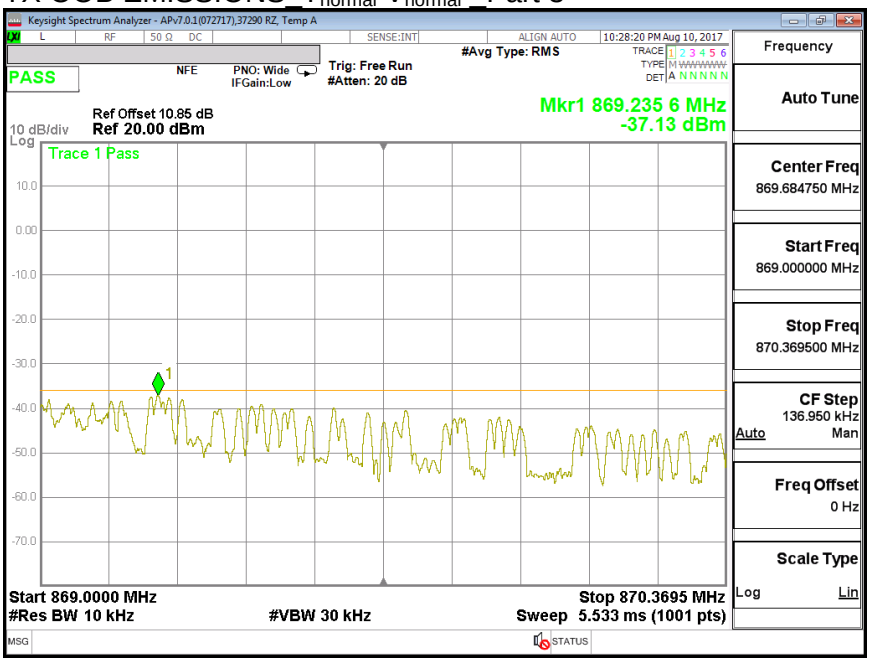
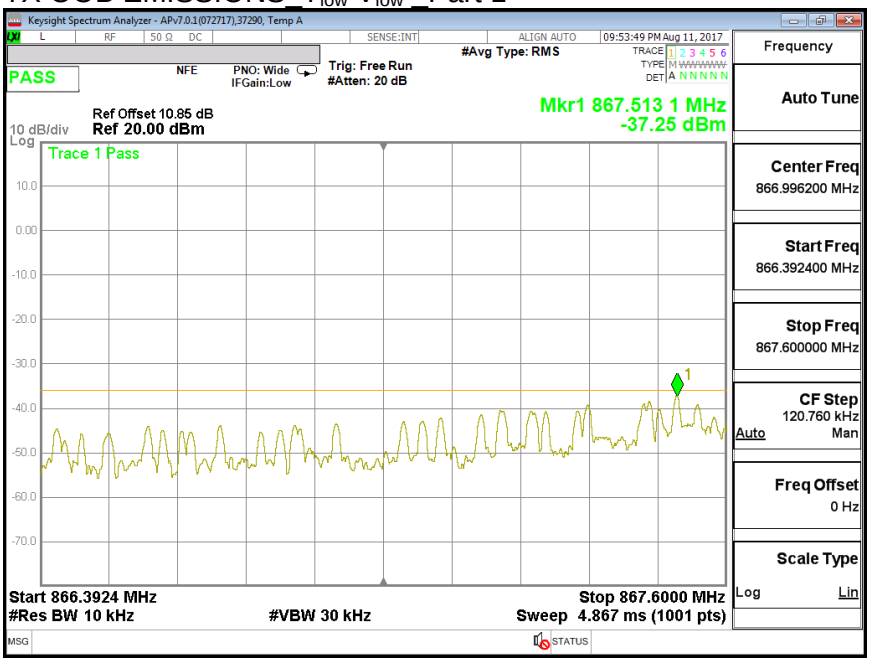
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3



TX OOB EMISSIONS_T_{low} V_{low} _Part 1



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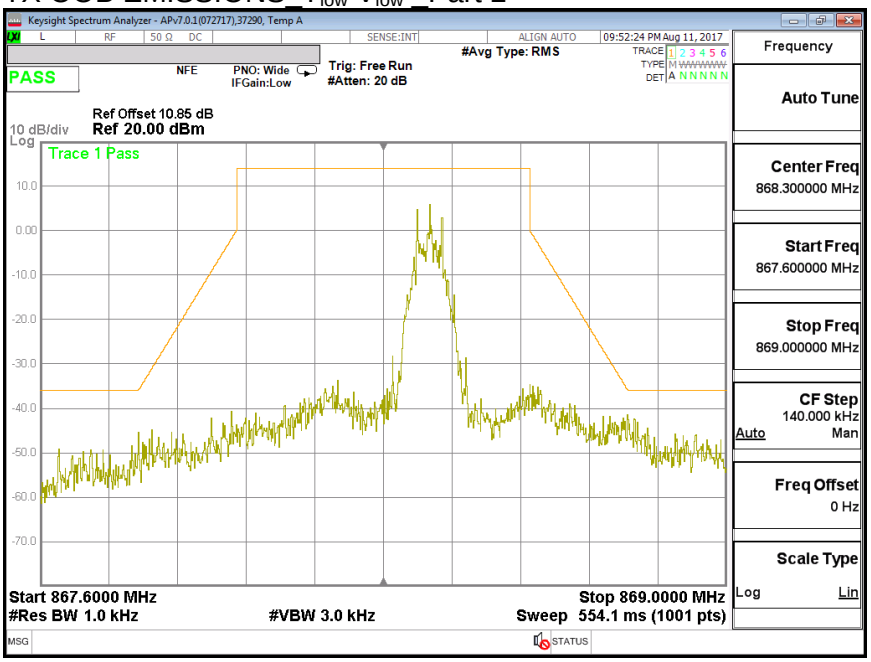

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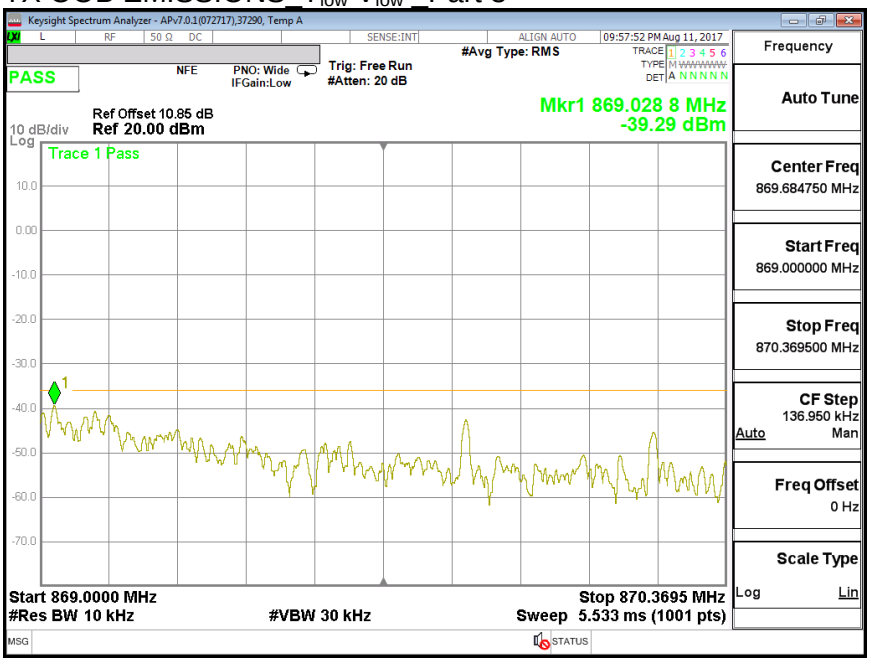

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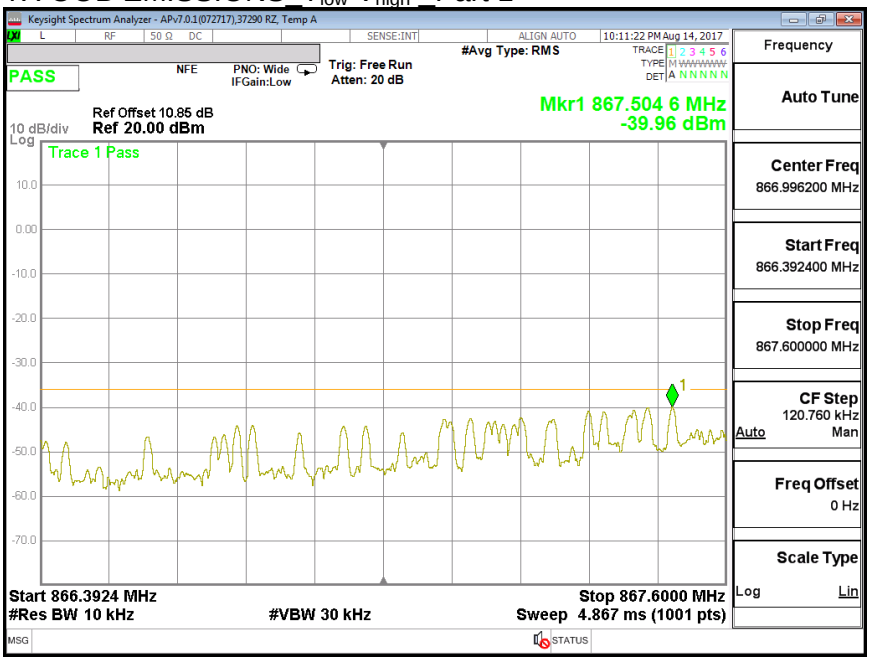
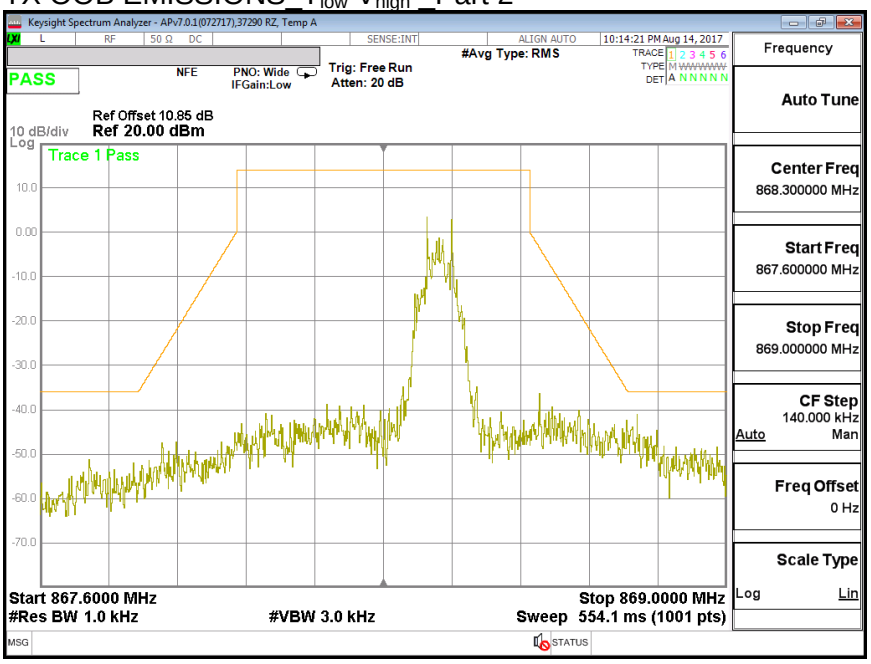
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



TX OOB EMISSIONS_T_{low} V_{high} _Part 2



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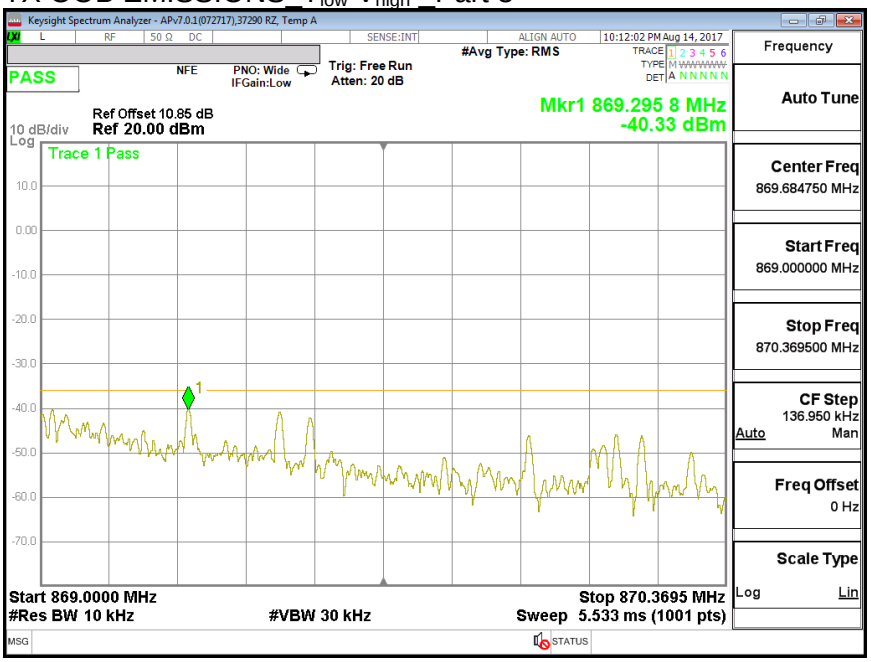
TX OOB EMISSIONS_T_{low} V_{high} _Part 3



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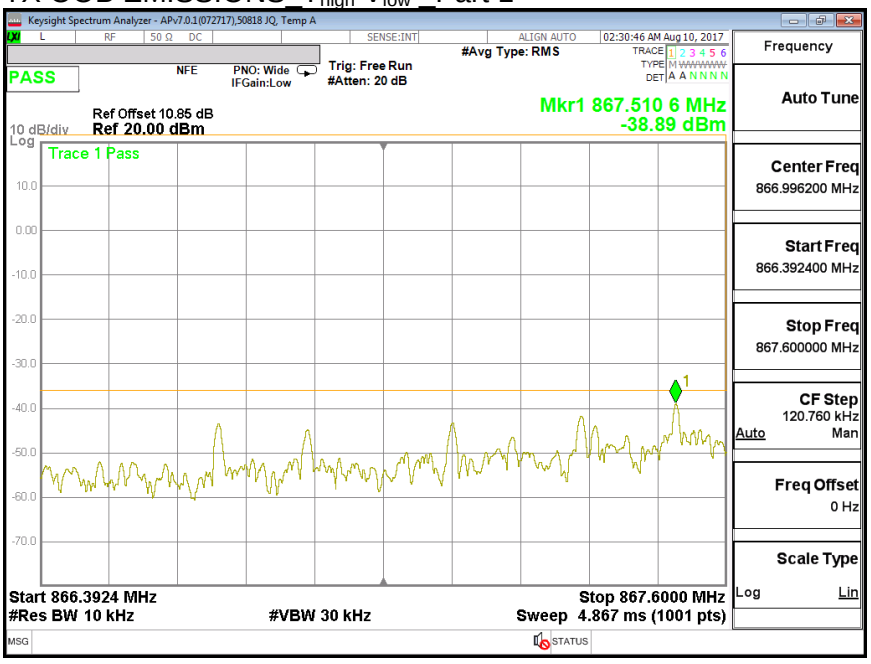

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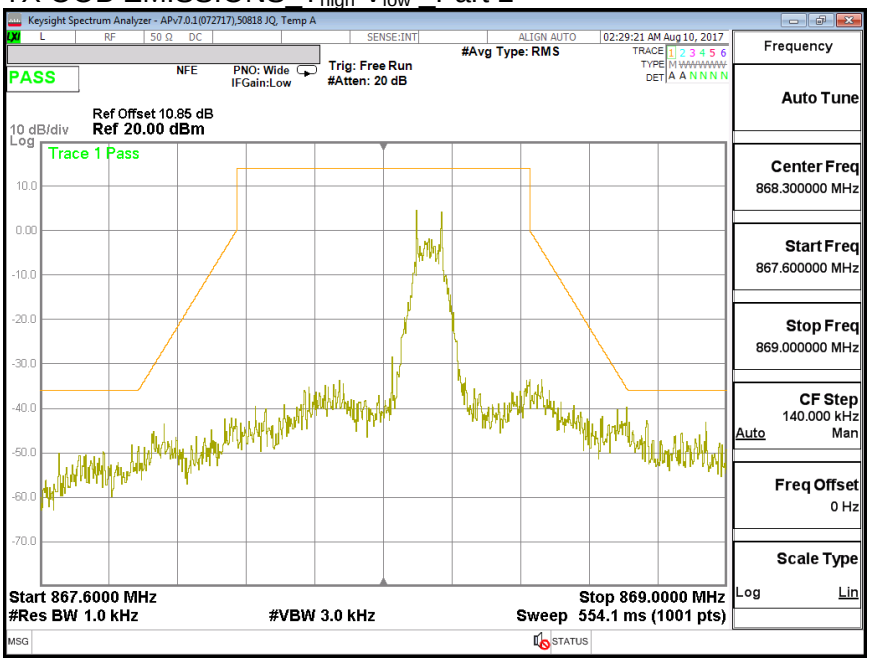
TX OOB EMISSIONS_T_{high} V_{low} _Part 2



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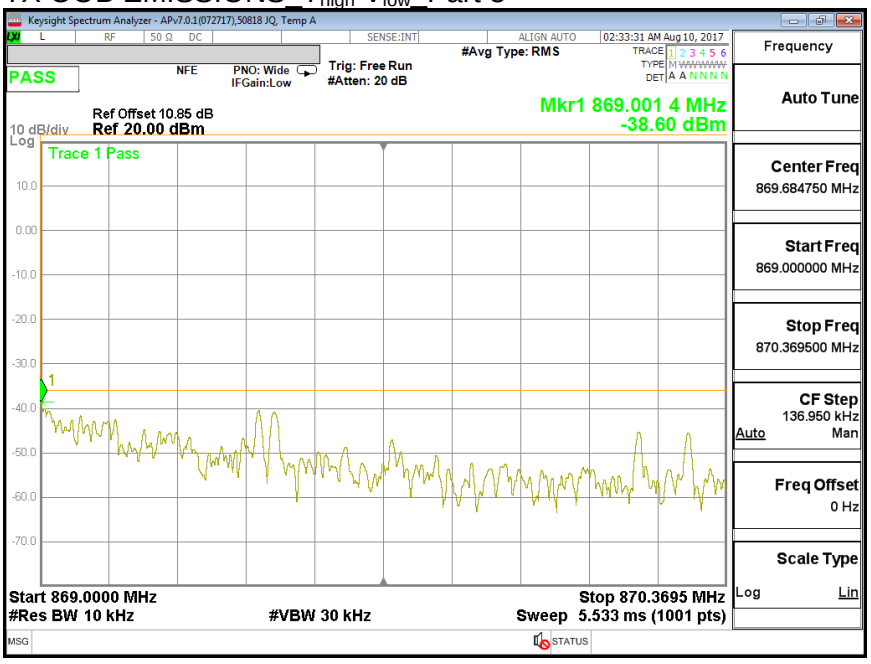

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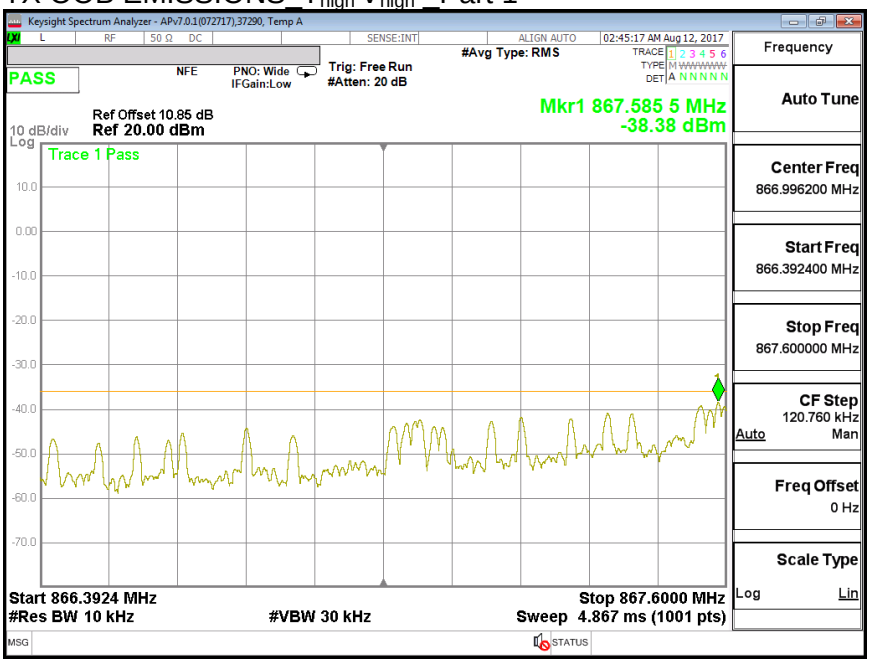
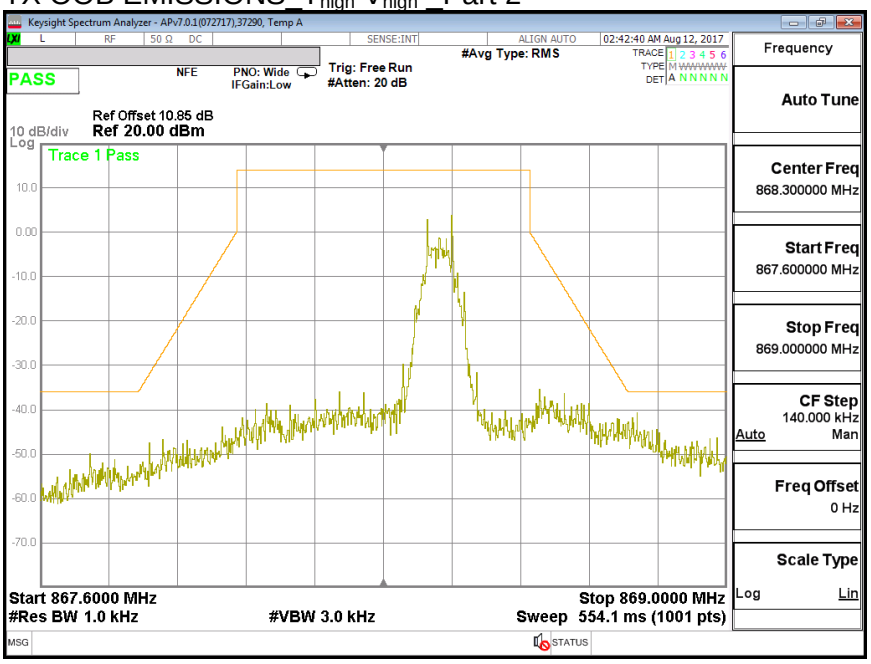
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



TX OOB EMISSIONS_T_{high} V_{high} _Part 2



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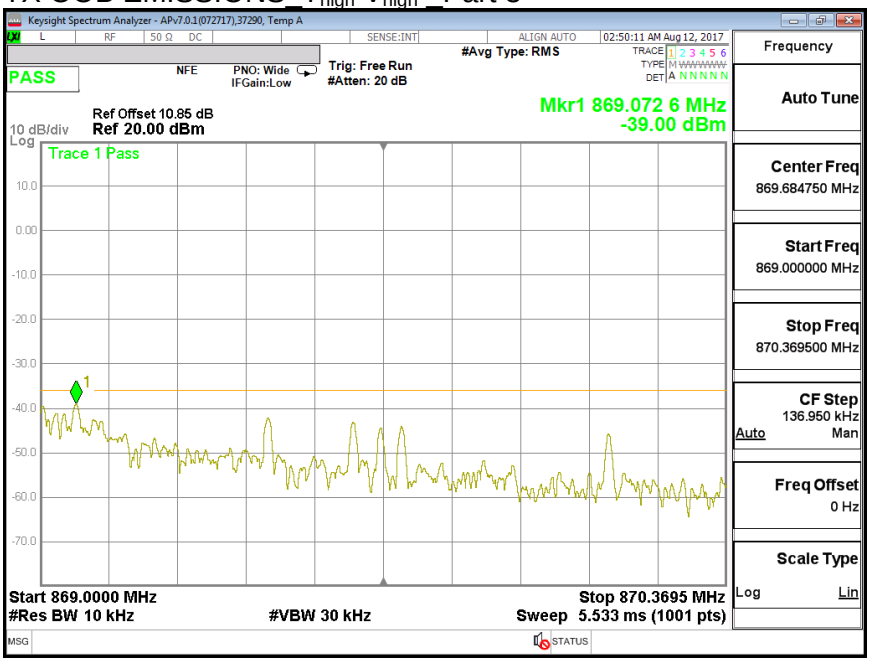
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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7.2.5. TX UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.2.2.2
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.1.1
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.2

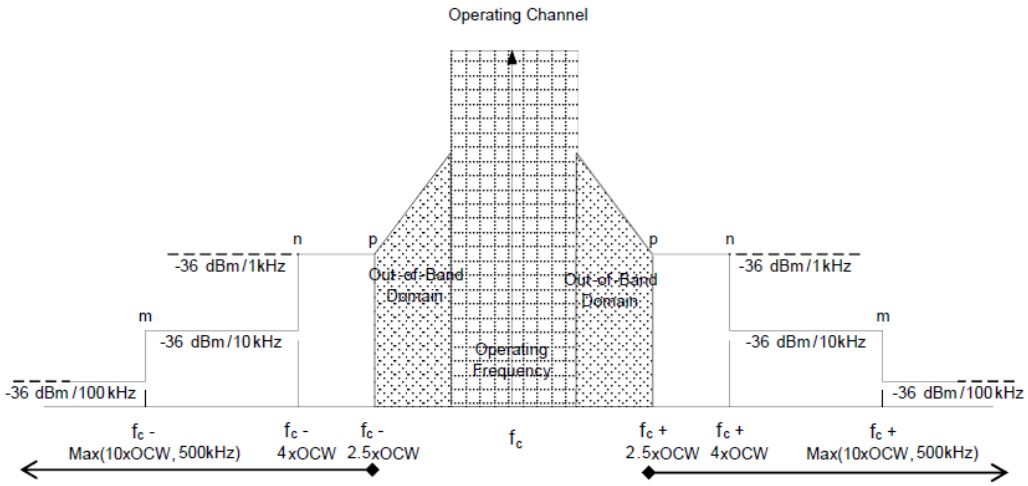

Figure 7: Spectrum Mask for Unwanted Emissions in the Spurious Domain with reference BW

Reference Limit:

The power of any unwanted emission in the spurious domain shall not exceed the values given in Table 19.

Table 19: Spurious domain emission limits

Frequency / State	47 MHz to 74 MHz 87,5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 790 MHz	Other frequencies below 1 000 MHz	Frequencies above 1 000 MHz
TX mode	-54 dBm	-36 dBm	-30 dBm
RX and all other modes	-57 dBm	-57 dBm	-47 dBm

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.3.3.1 (Conducted Measurement)
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.3.3.2 (Radiated Measurement)

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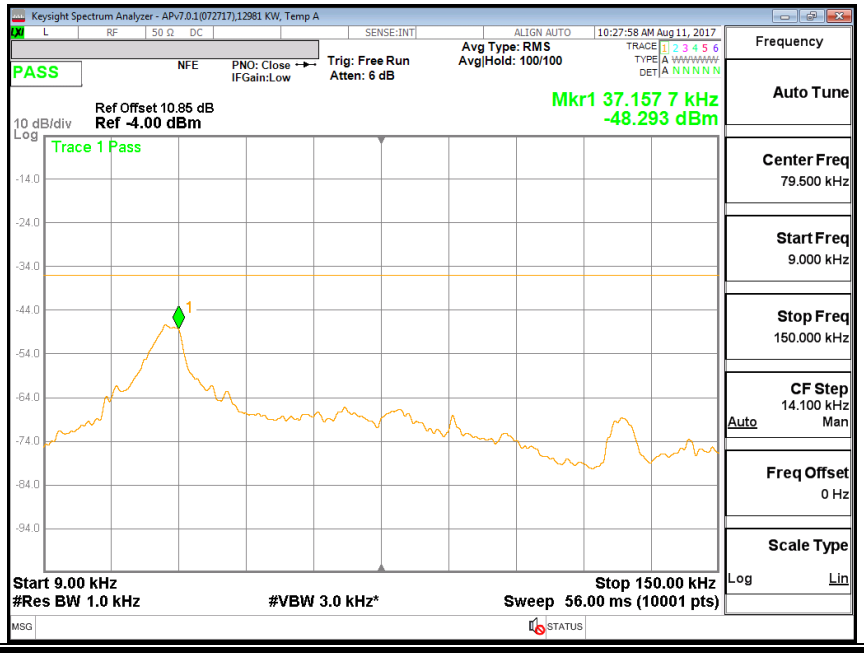
RESULTS

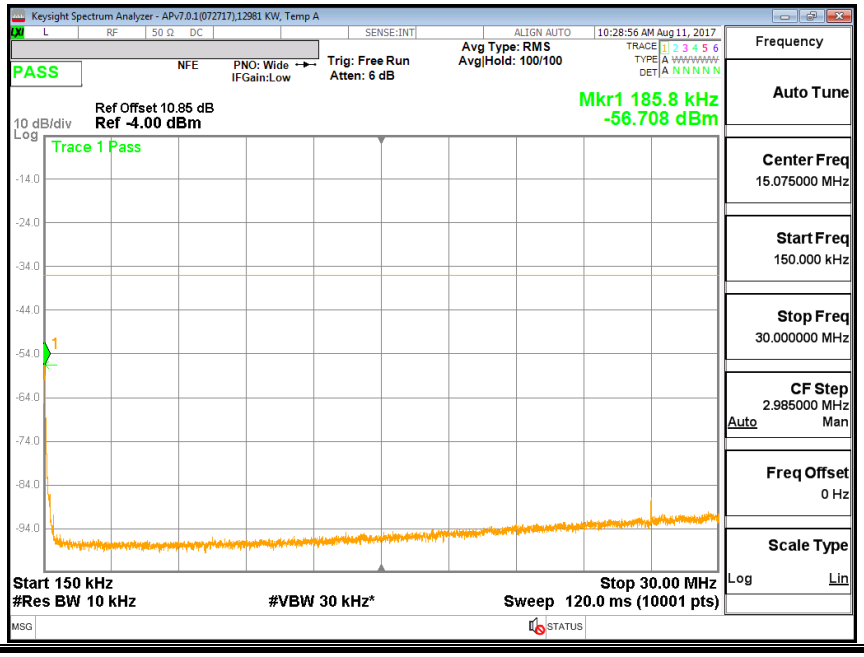
CONDUCTED SPURIOUS EMISSIONS

THE WORST CASE OF GFSK LOW CHANNEL

9kHz to 150kHz



150kHz to 30MHz



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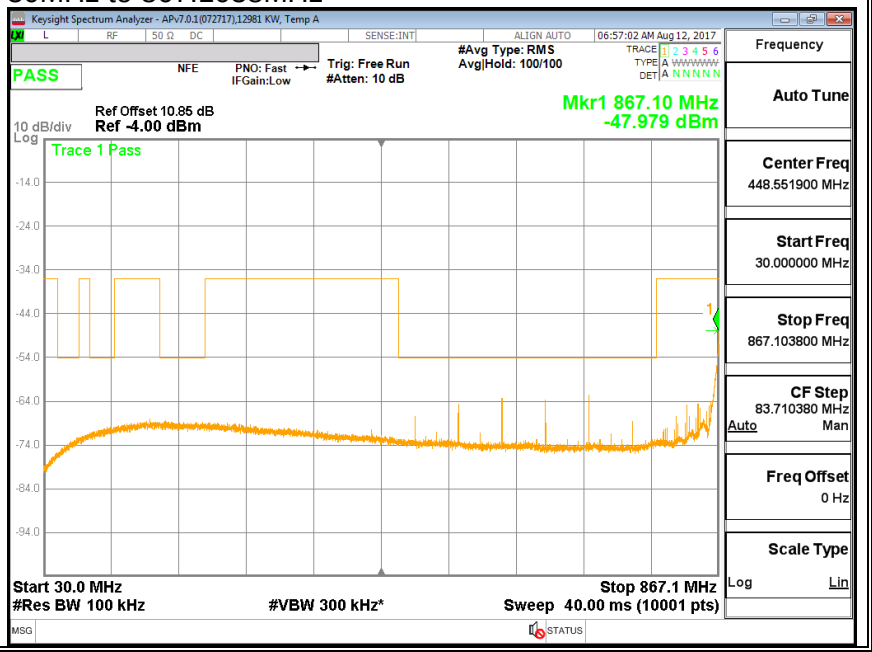
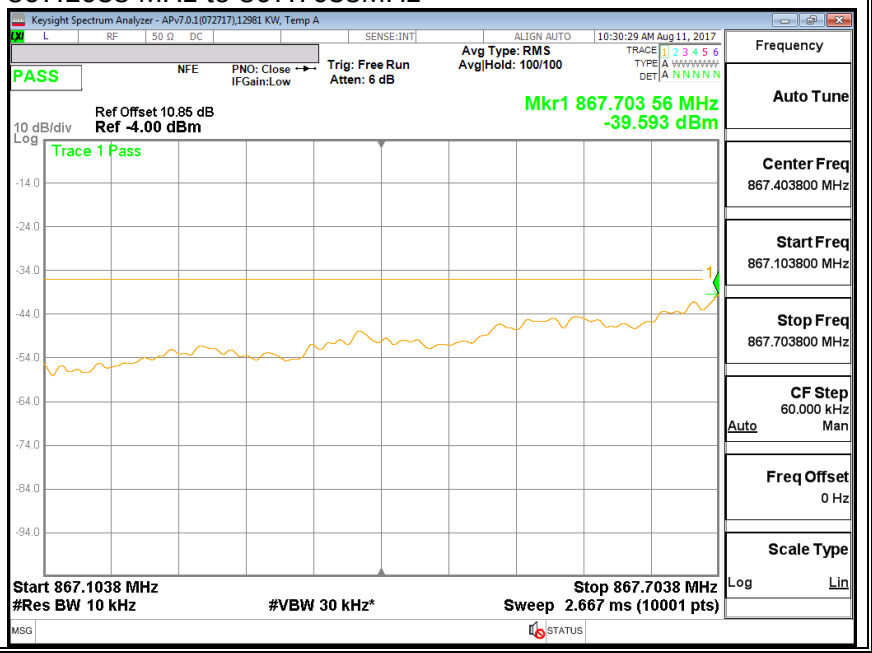
30MHz to 867.1038MHz



867.1038 MHz to 867.7038MHz



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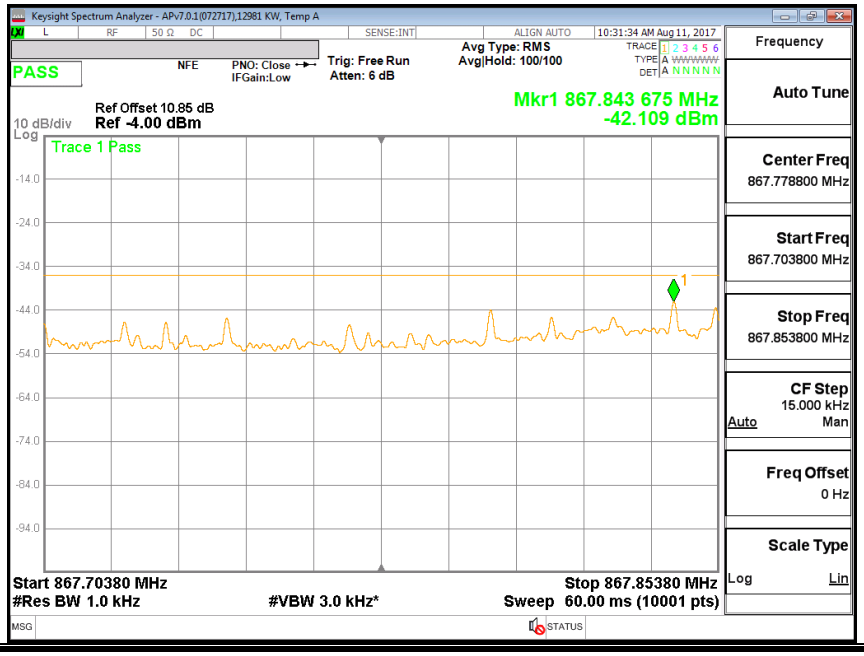
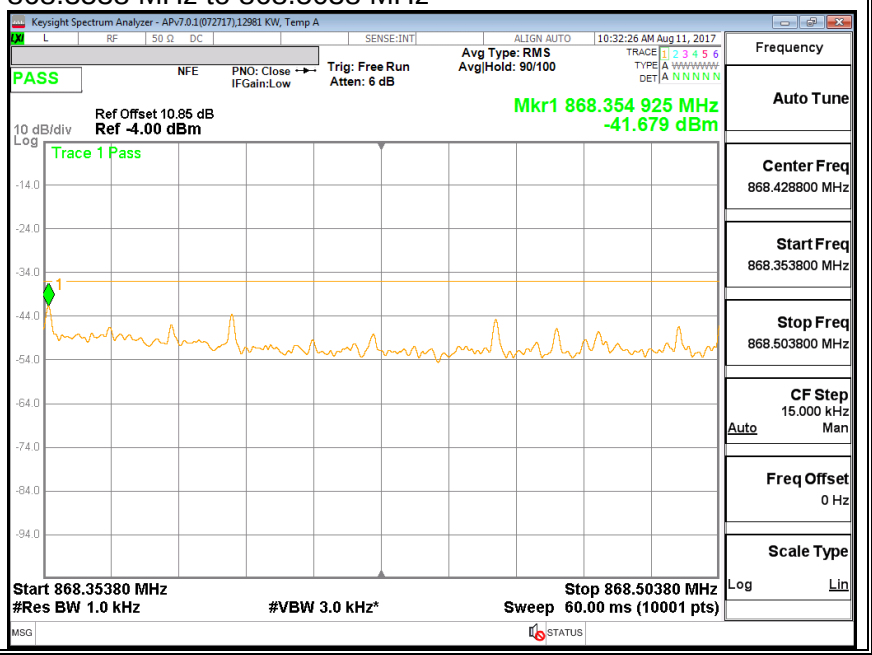
867.7038 MHz to 867.8538 MHz



868.3538 MHz to 868.5038 MHz



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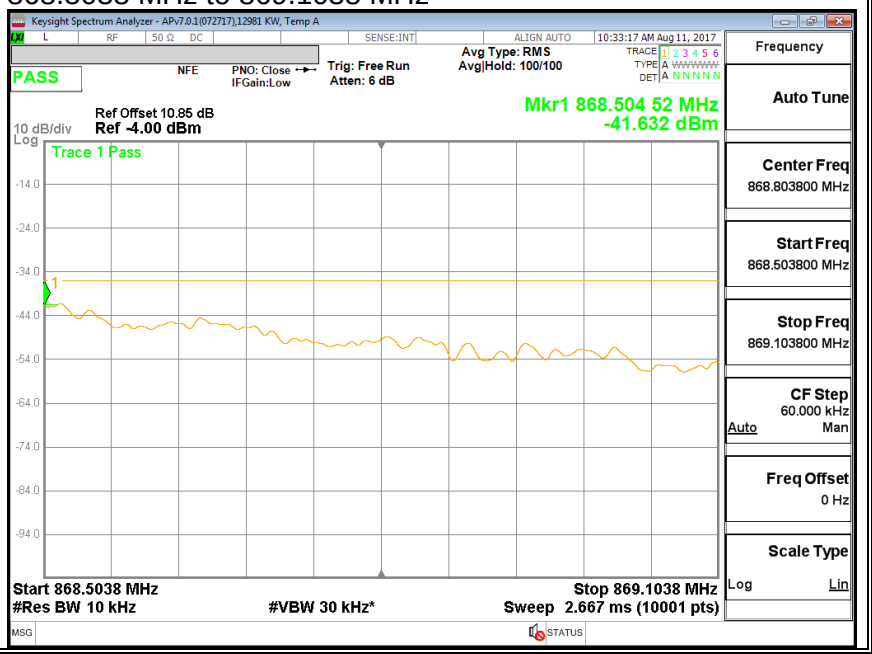
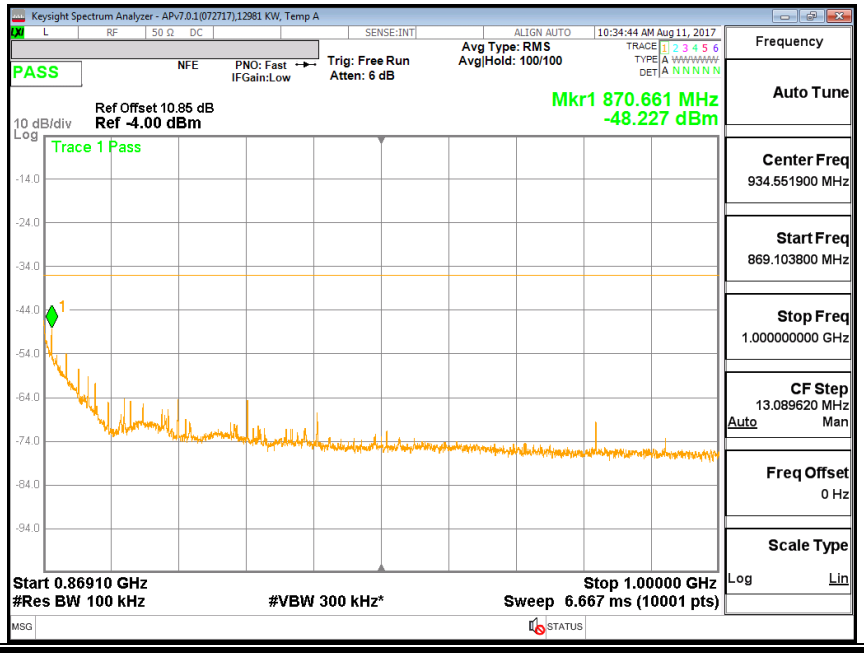
868.5038 MHz to 869.1038 MHz



869.1038 MHz to 1 GHz



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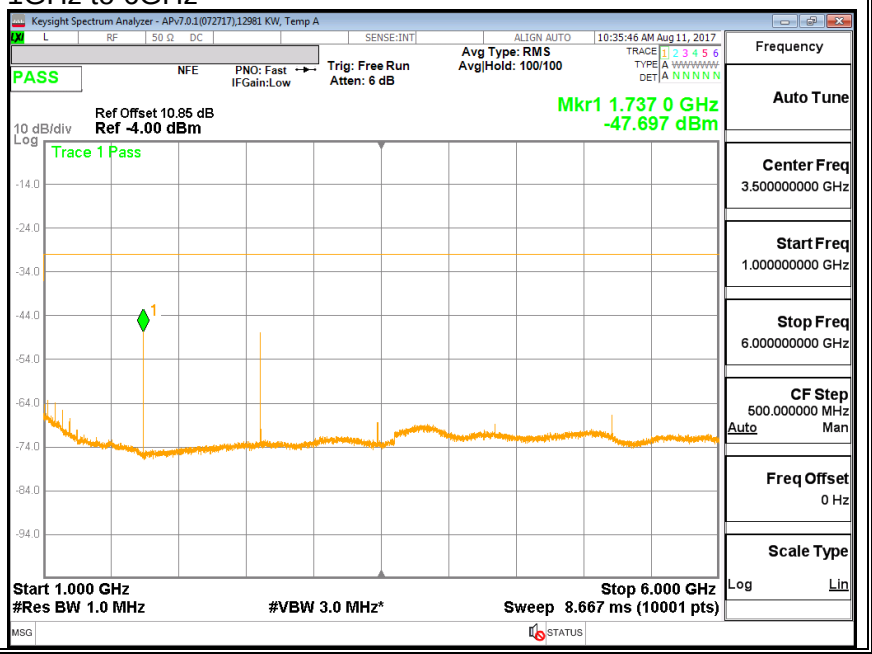
1GHz to 6GHz



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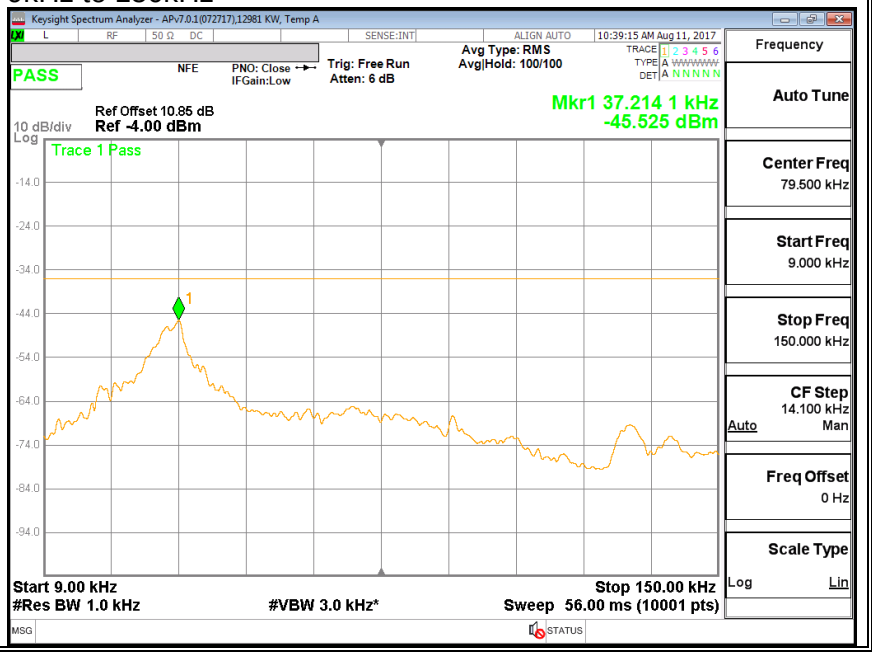
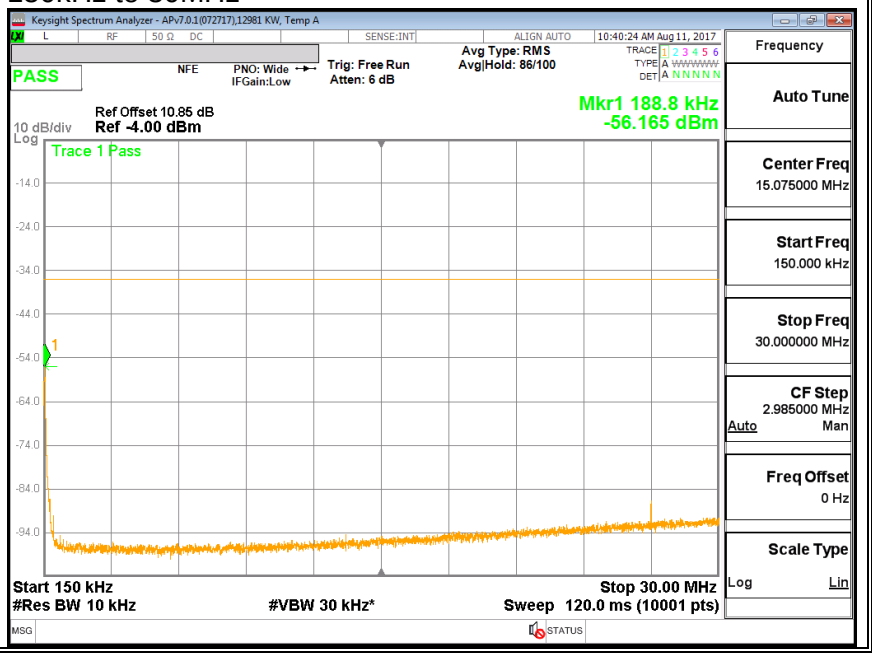
THE WORST CASE OF GFSK HIGH CHANNEL

9kHz to 150kHz



150kHz to 30MHz



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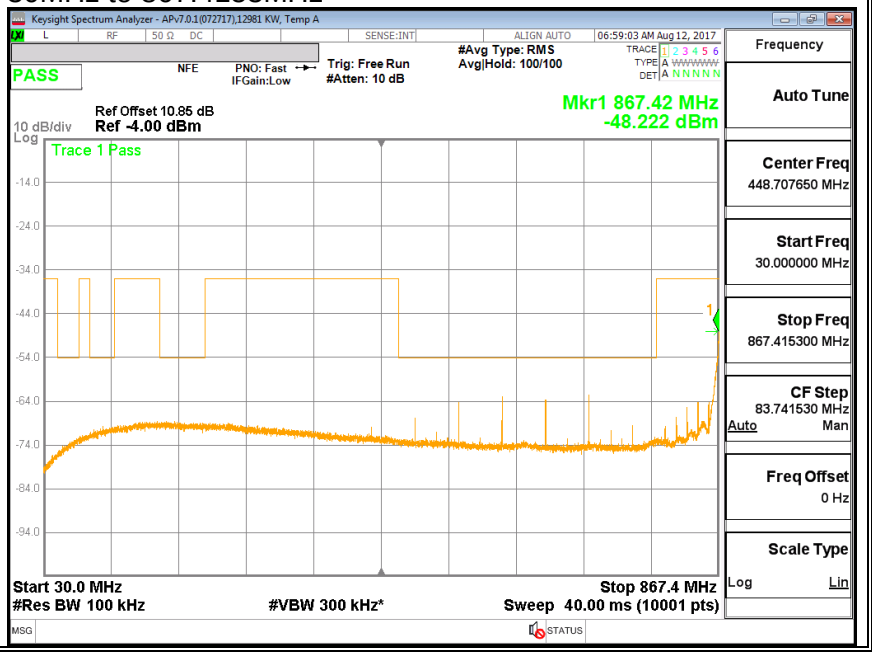
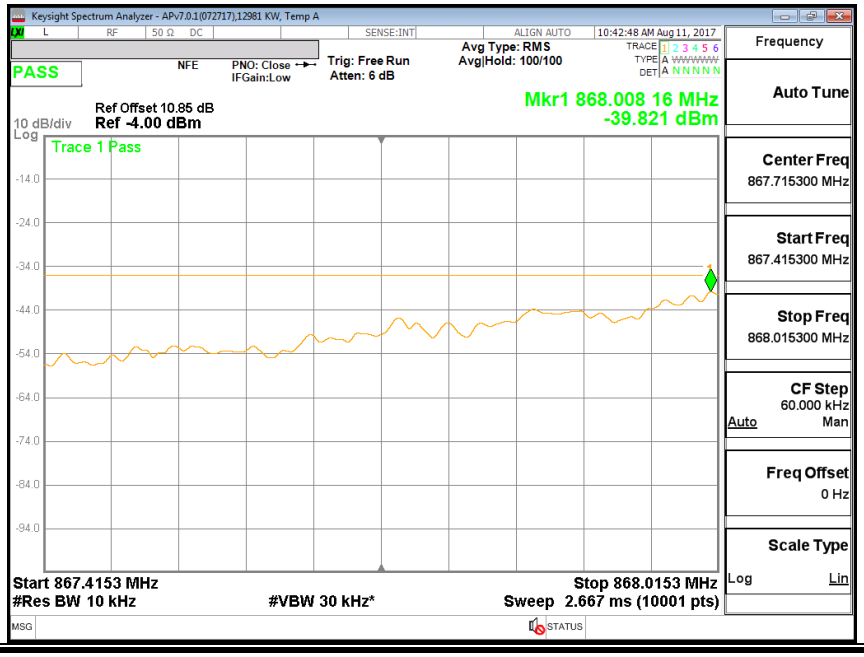
30MHz to 867.4153MHz



867.4153 MHz to 868.0153 MHz



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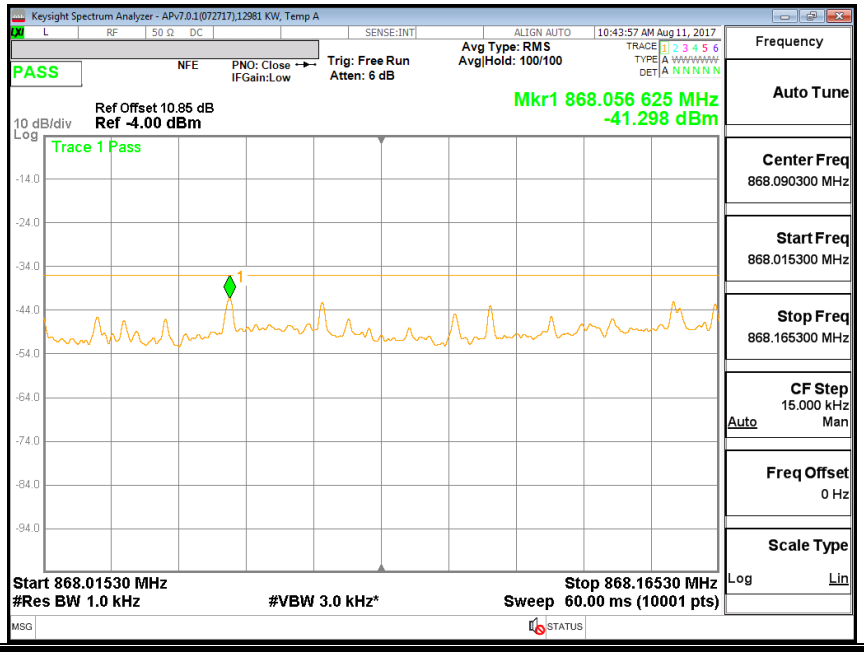
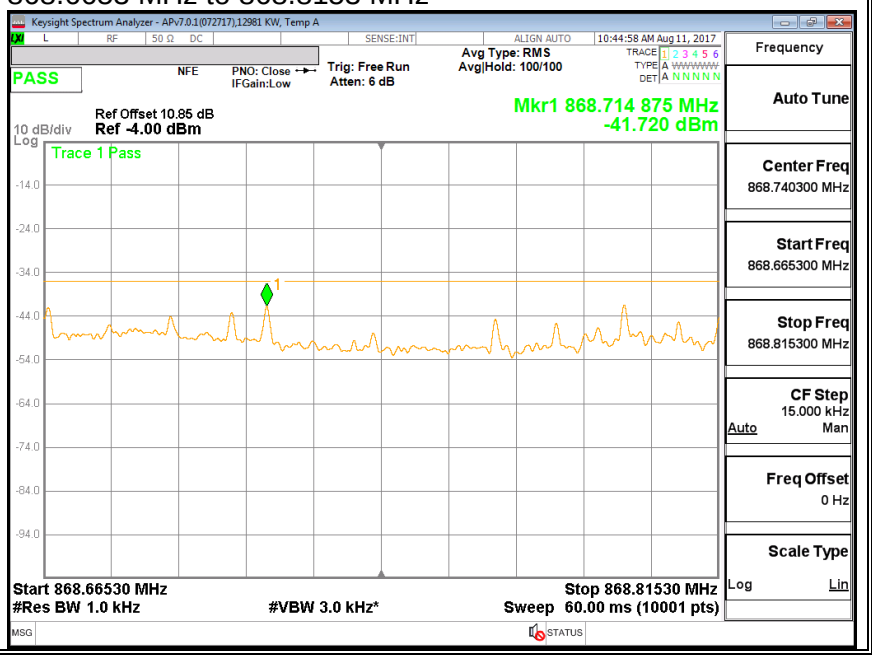
868.0153 MHz to 868.1653 MHz



868.6653 MHz to 868.8153 MHz



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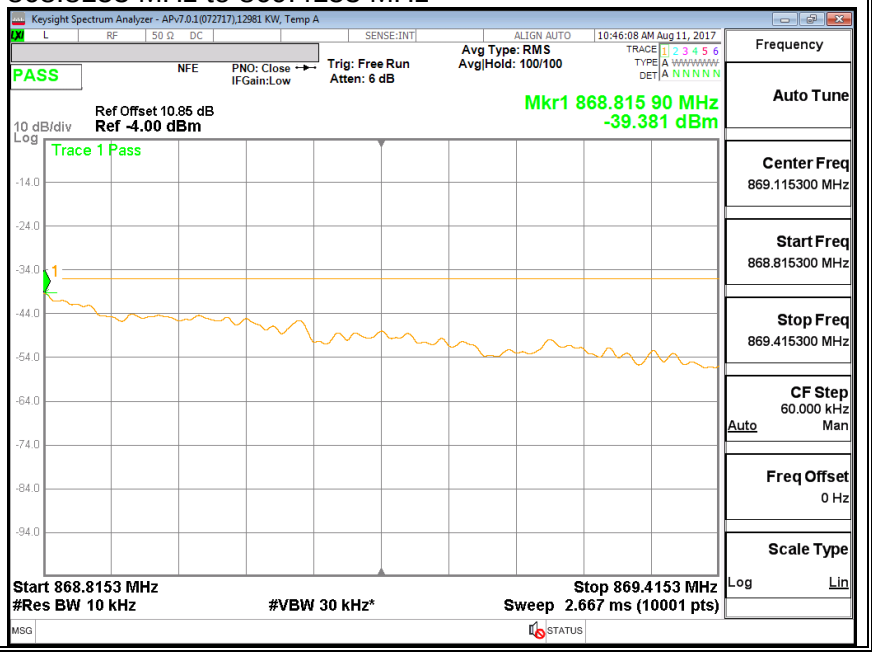
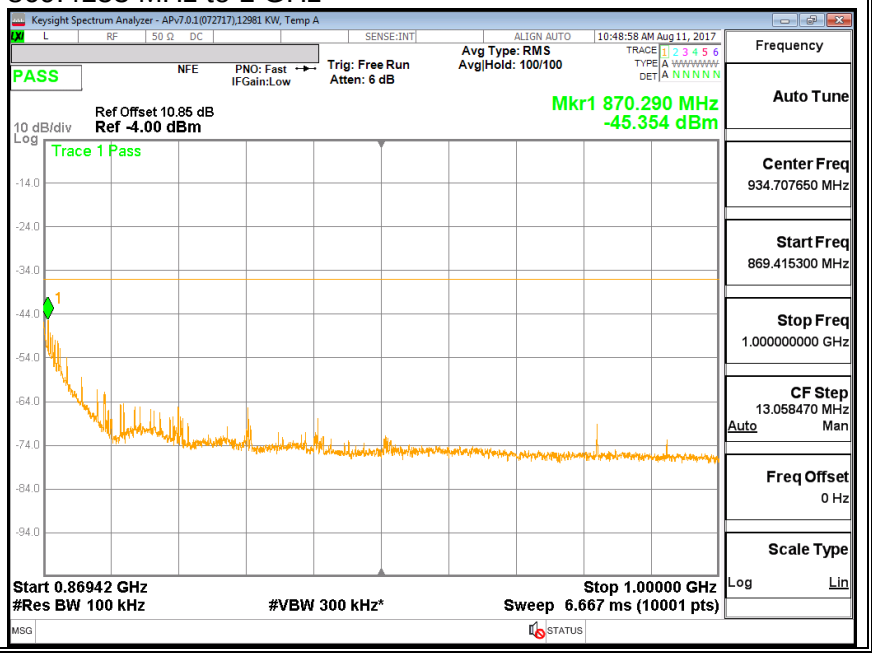
868.8153 MHz to 869.4153 MHz



869.4153 MHz to 1 GHz



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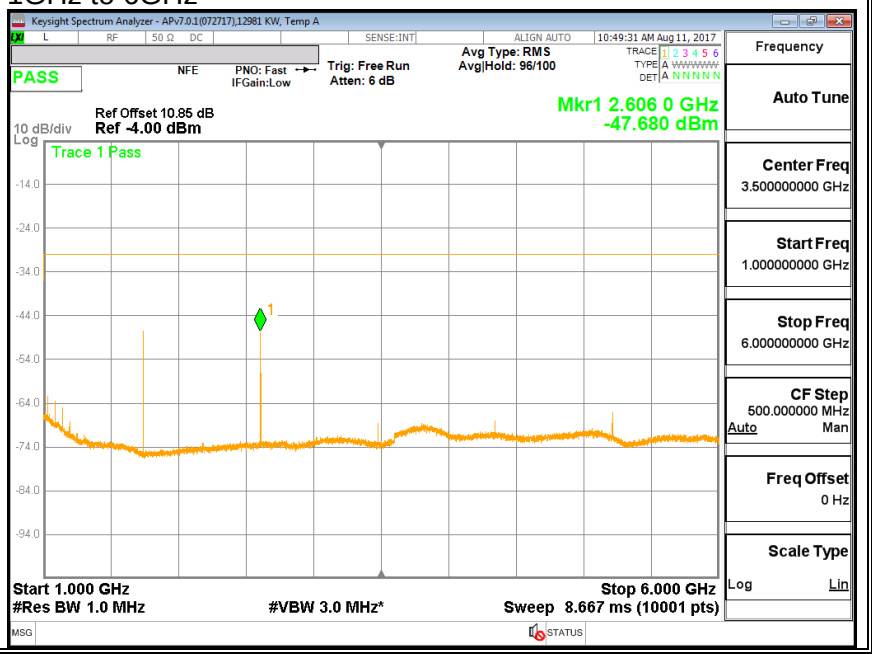
1GHz to 6GHz



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RADIATED SPURIOUS EMISSIONS

3m Radiated Emissions Chamber
30 - 1000MHz Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/13/2017
Test Engineer: 50818
Configuration: EUT with 50Ohm load and a support laptop
Mode: TX Below 1GHz GFSK M band worst case

Chamber	Pre-amplifer	Attenuator	Limit
3m Chamber B	3m-B T10		ETSI 300 220 Tx

Frequency (MHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Attenuator (dB)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel										
489.11	-71.1	H	3.0	26.0	29.1		-74.2	-54.0	-20.2	
699.33	-70.4	H	3.0	29.0	28.6		-70.1	-54.0	-16.1	
800.14	-71.3	H	3.0	30.2	28.4		-69.5	-54.0	-15.5	
432.22	-71.2	V	3.0	26.6	28.8		-73.4	-36.0	-37.4	
777.32	-71.6	V	3.0	32.2	28.5		-68.0	-54.0	-14.0	
796.51	-72.6	V	3.0	32.4	28.4		-68.5	-54.0	-14.5	
High Channel										
433.16	-70.3	H	3.0	25.0	28.8		-74.1	-36.0	-38.1	
658.39	-72.1	H	3.0	28.7	28.9		-72.3	-54.0	-18.3	
798.19	-72.0	H	3.0	30.1	28.4		-70.3	-54.0	-16.3	
432.22	-70.1	V	3.0	26.6	28.8		-72.3	-36.0	-36.3	
767.25	-71.3	V	3.0	31.9	28.4		-67.8	-54.0	-13.8	
821.38	-71.4	V	3.0	33.1	28.2		-66.5	-54.0	-12.5	

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3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/13/2017
Test Engineer: 50818
Configuration: EUT with 50Ohm load and a support laptop
Mode: TX Above 1GHz M band GFSK worst case

Chamber	Pre-amplifer	Filter	Limit
3m Chamber B	3m Chamber B	Filter	ETSI 300 220 Tx

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss @ SG End (dBm)	Preamp (dB)	Attenuator (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel										
1.610	-60.53	H	3.0	-15.7	38.7	1.0	-53.3	-30.0	-23.3	
2.395	-58.44	H	3.0	-9.0	38.7	1.0	-46.6	-30.0	-16.6	
5.211	-57.98	H	3.0	-3.3	38.7	1.0	-41.0	-30.0	-11.0	
1.196	-55.66	V	3.0	-13.5	38.5	1.0	-51.0	-30.0	-21.0	
1.609	-59.07	V	3.0	-14.2	38.7	1.0	-51.9	-30.0	-21.9	
2.001	-61.56	V	3.0	-13.1	38.0	1.0	-50.0	-30.0	-20.0	
High Channel										
1.611	-58.43	H	3.0	-13.6	38.7	1.0	-51.2	-30.0	-21.2	
2.401	-60.92	H	3.0	-11.4	38.7	1.0	-49.1	-30.0	-19.1	
5.211	-57.33	H	3.0	-2.6	38.7	1.0	-40.4	-30.0	-10.4	
1.198	-57.99	V	3.0	-15.8	38.5	1.0	-53.3	-30.0	-23.3	
1.610	-60.33	V	3.0	-15.5	38.7	1.0	-53.1	-30.0	-23.1	
1.998	-60.89	V	3.0	-12.4	38.0	1.0	-49.4	-30.0	-19.4	

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7.2.6. TX TRANSIENT POWER

REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.10.2

The TX TRANSIENT POWER shall not exceed the values given in Table 23.

Table 23: Transmitter Transient Power limits

Absolute offset from centre frequency	RBW_{REF}	Peak power limit applicable at measurement points
≤ 400 kHz	1 kHz	0 dBm
> 400 kHz	1 kHz	-27 dBm

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.10.3.2

RESULTS

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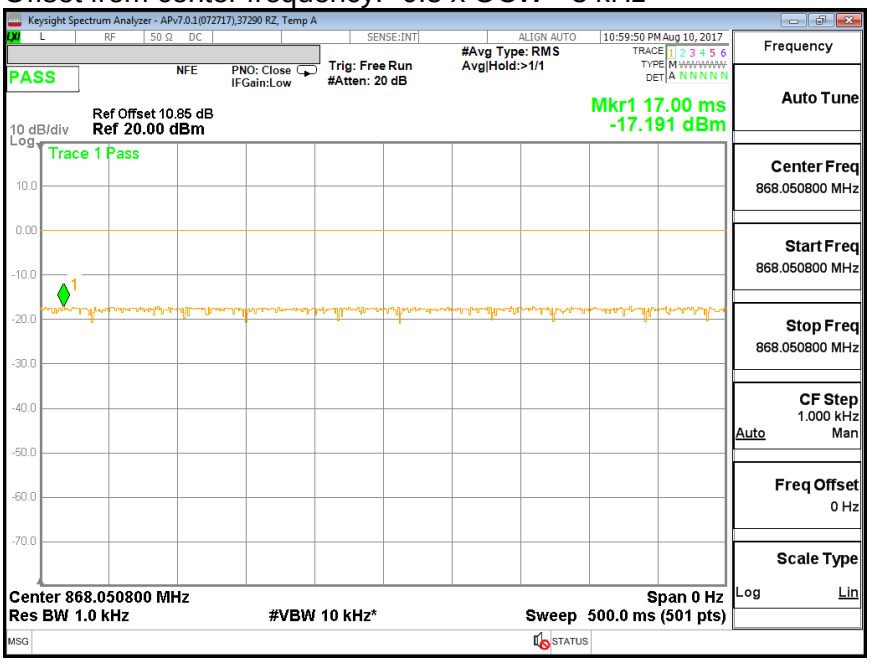
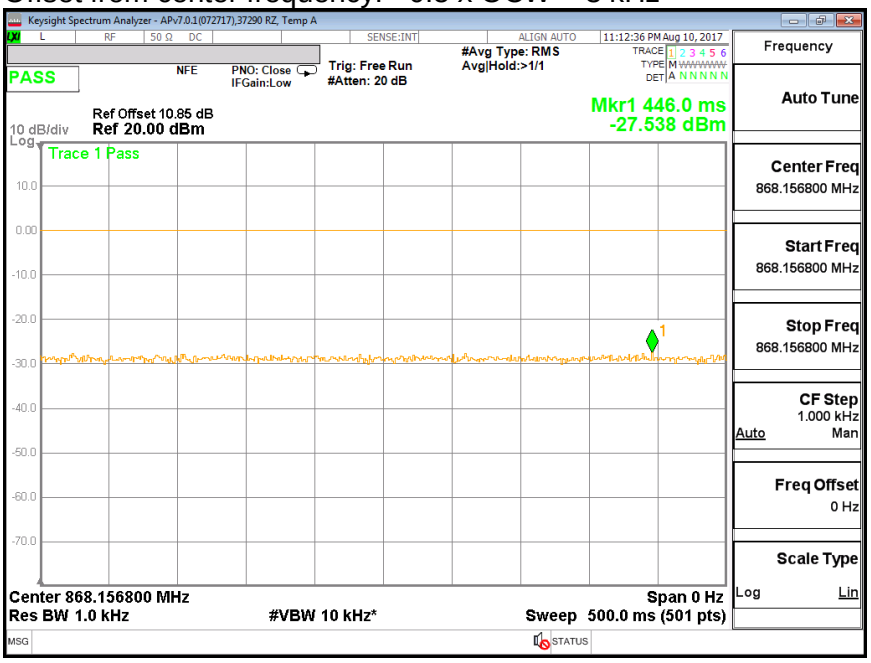
THE WORST CASE OF GFSK LOW CHANNEL

TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 3 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 3 kHz



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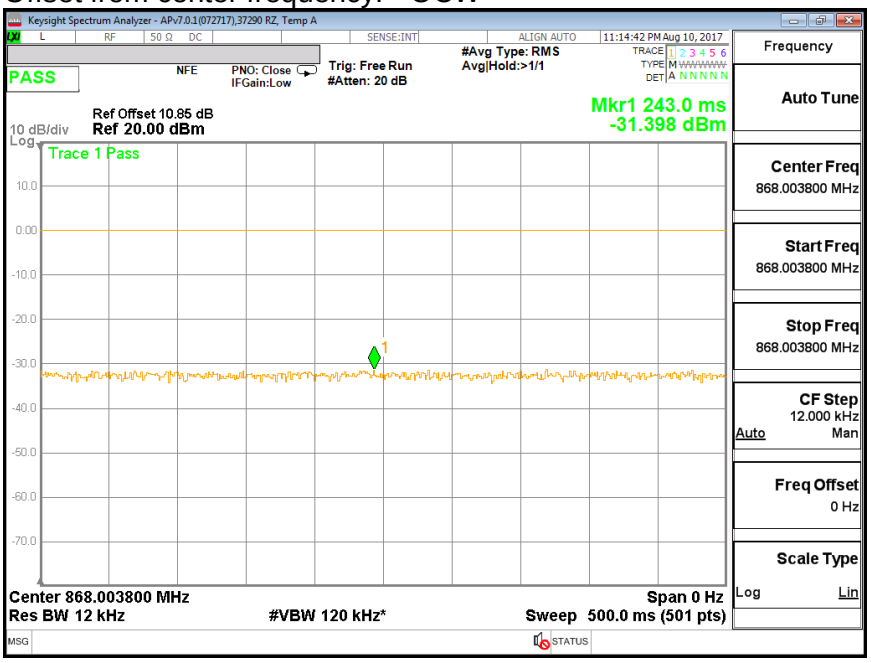
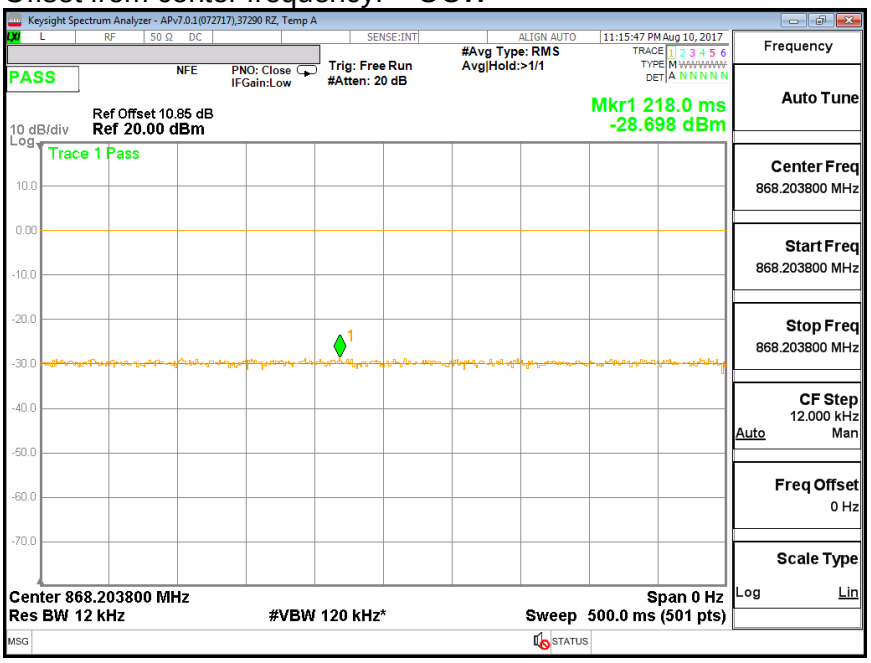
TX TRANSIENT
Offset from center frequency: - OCW



TX TRANSIENT
Offset from center frequency: + OCW



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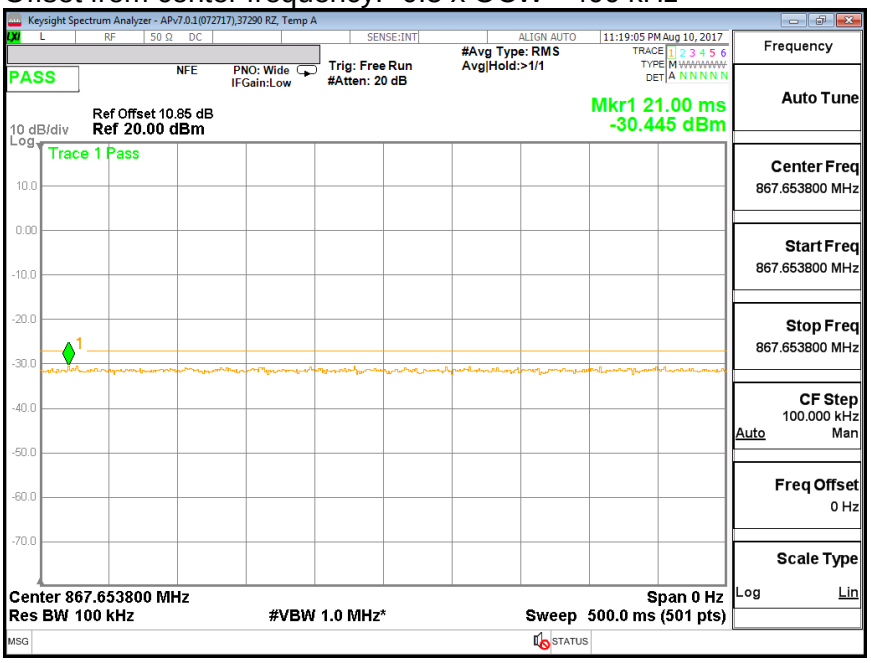
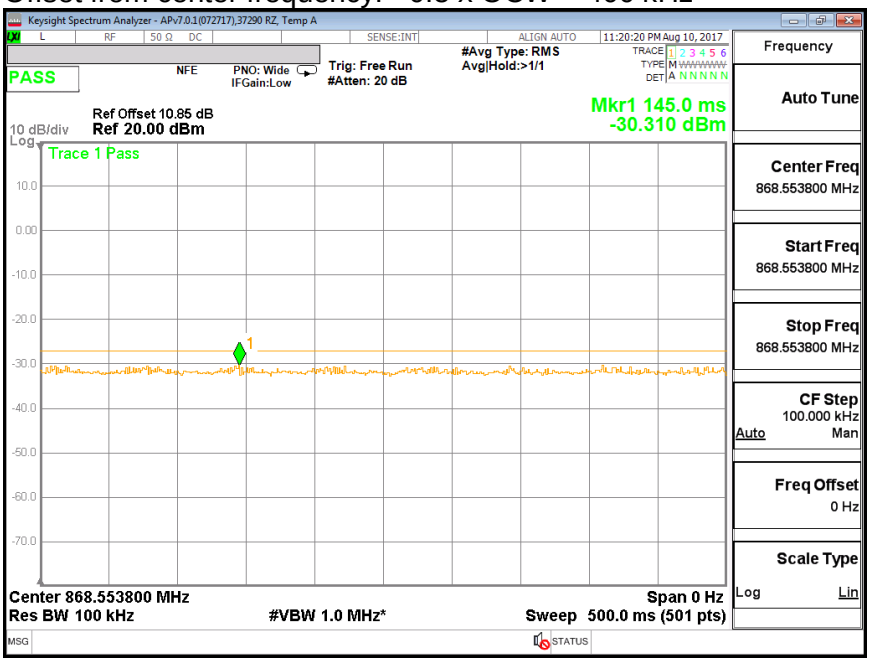
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 400 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 400 kHz



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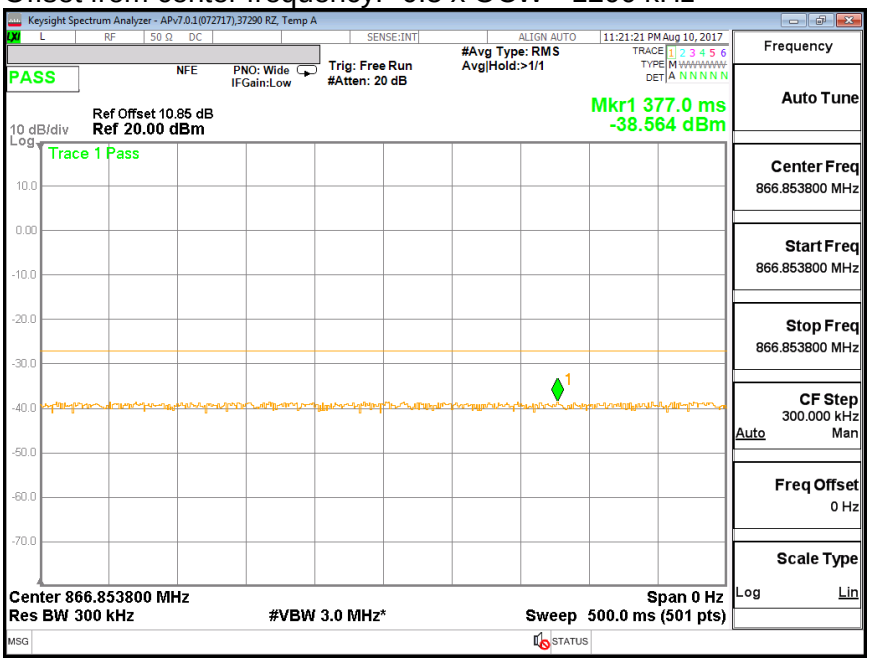
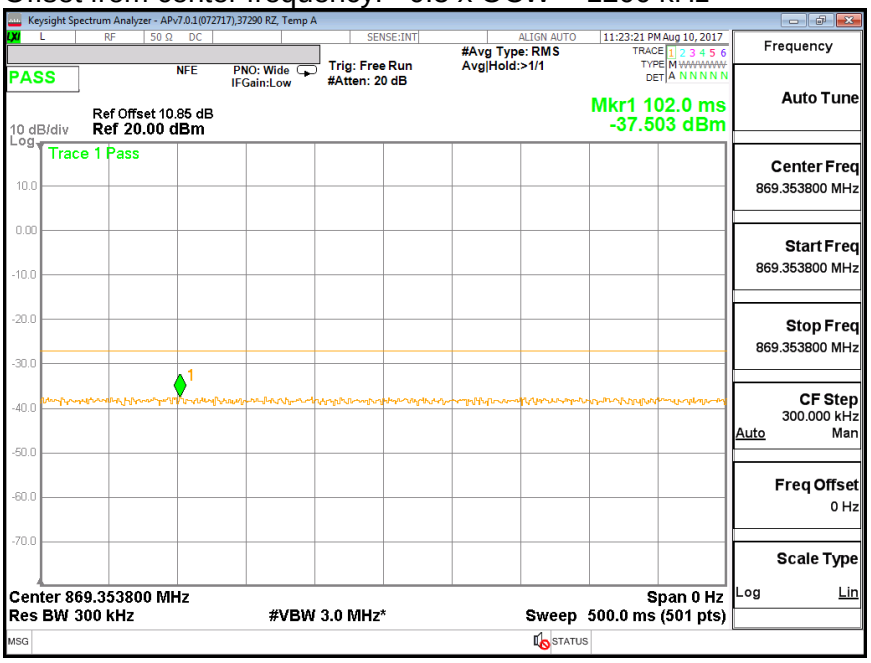
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 1200 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 1200 kHz



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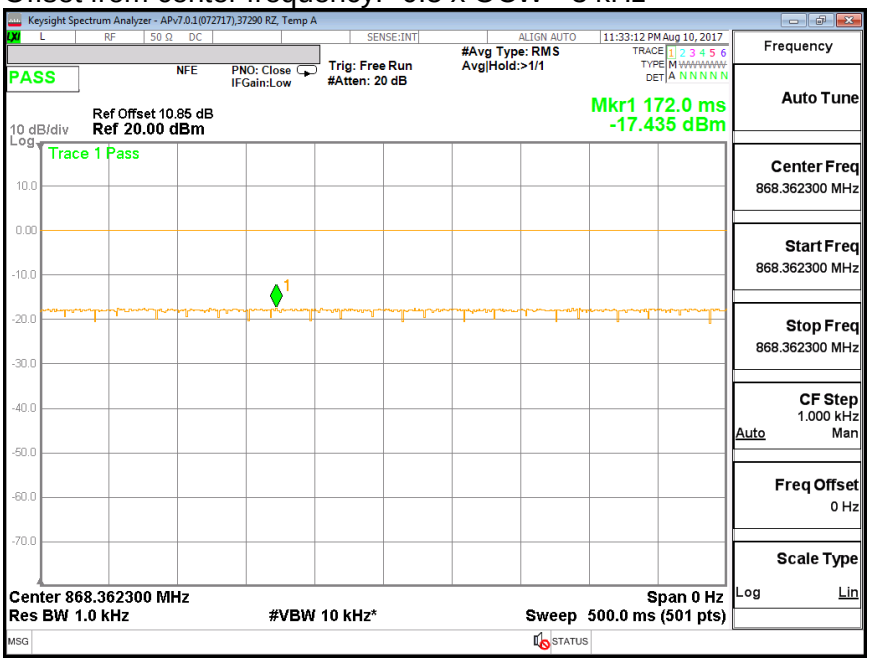
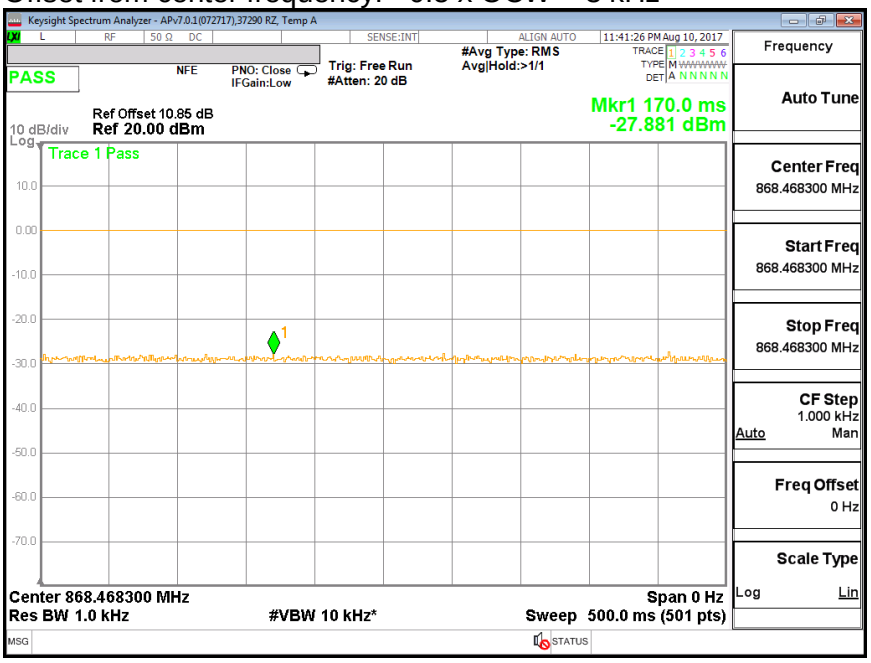
THE WORST CASE OF GFSK HIGH CHANNEL

TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 3 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 3 kHz



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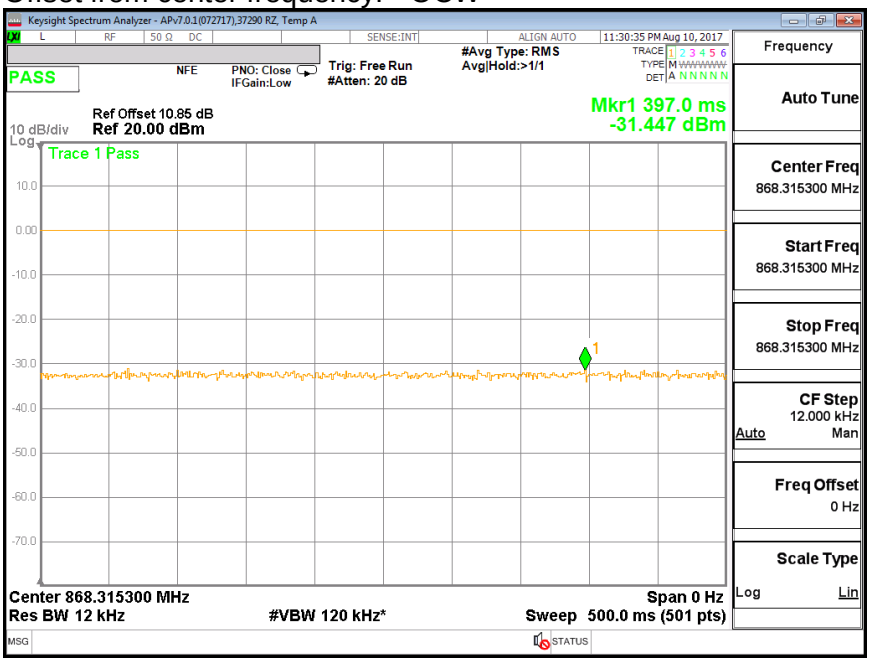
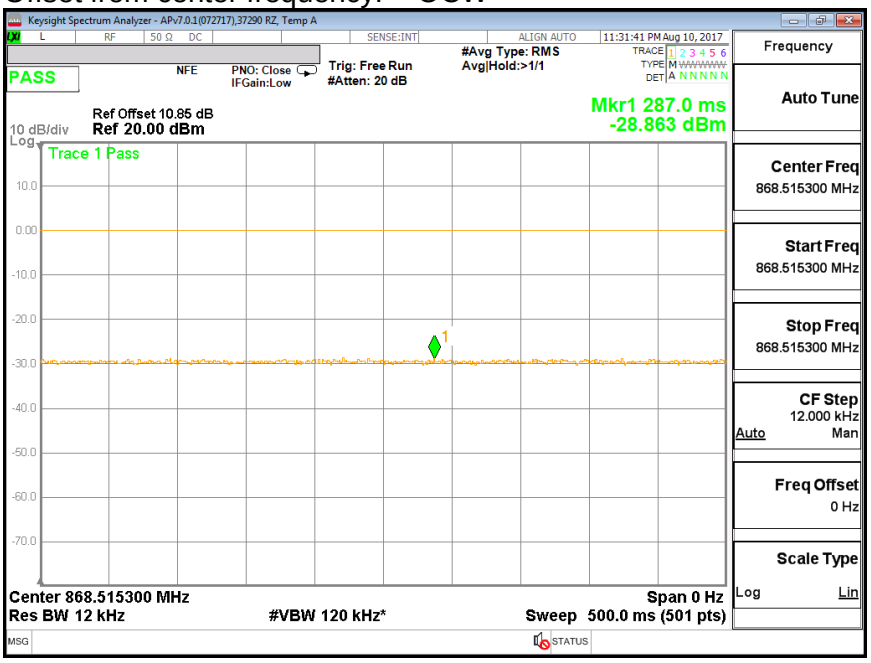
TX TRANSIENT
Offset from center frequency: - OCW



TX TRANSIENT
Offset from center frequency: + OCW



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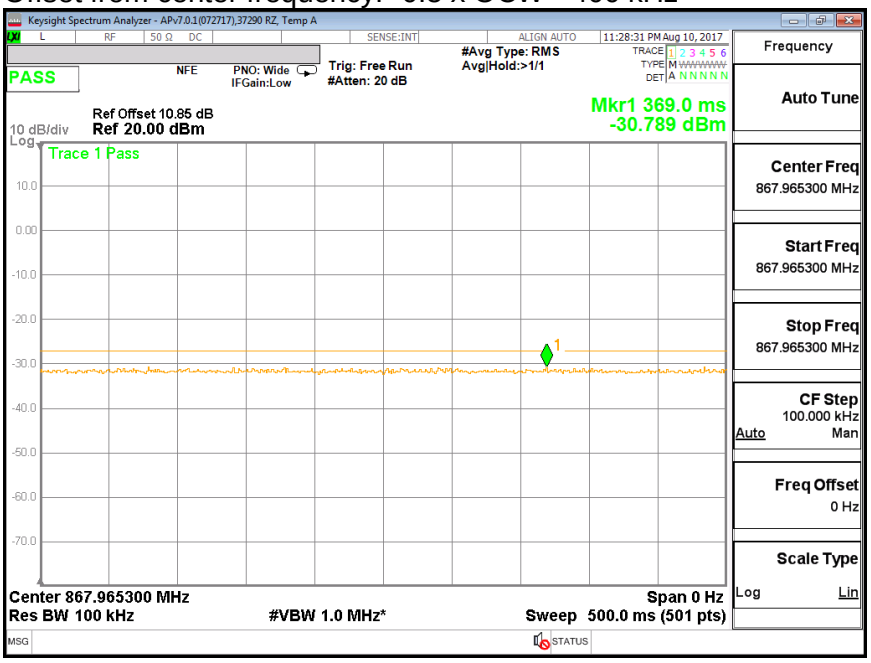
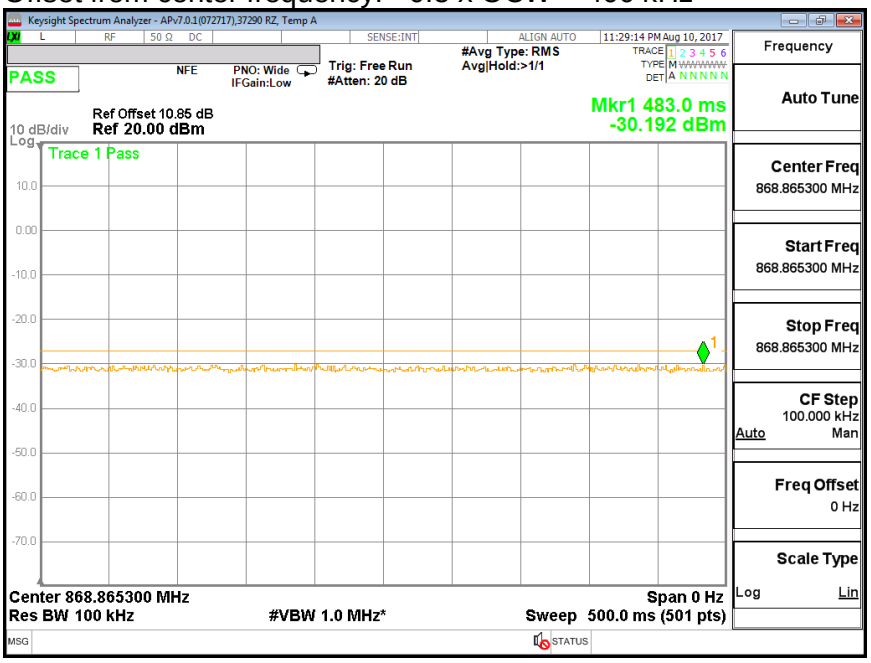
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 400 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 400 kHz



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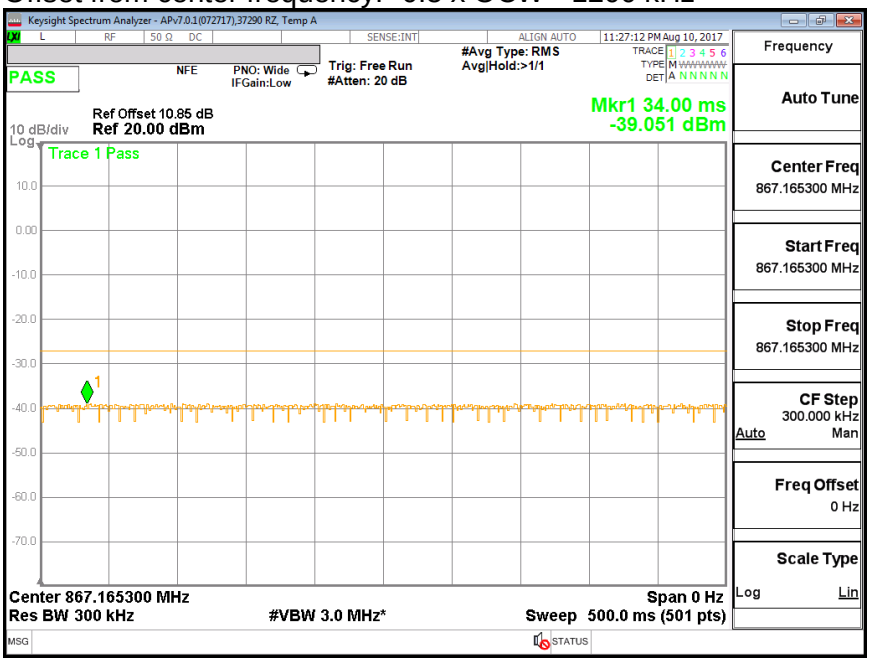
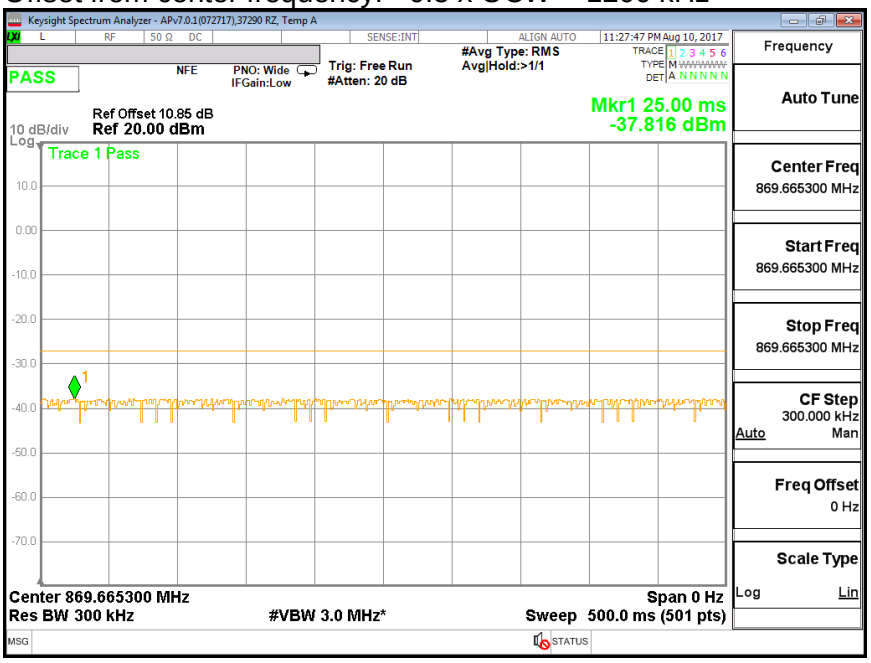
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 1200 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 1200 kHz



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7.3. GFSK MODULATION IN N BAND

7.3.1. OPERATING FREQUENCY

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.2.1.2

The manufacturer may declare either one or more operating frequencies and operating channels.
Operating channel(s) shall be entirely within operational frequency bands allowed by annexes B, C or any NRI.

22 ETSI EN 300 220-2 V3.1.1 (2017-02)

Operational Frequency Band		Maximum effective radiated power, e.r.p.	Channel access and occupation rules (e.g. Duty cycle or LBT + AFA)	Maximum occupied bandwidth	Other usage restrictions	Band number from EC Decision 2013/752/EU [i.3]	Class 1 sub-class number according Commission Decision 2000/299/EU [i.7]
M	868,000 MHz to 868,600 MHz	25 mW e.r.p.	≤ 1 % duty cycle or polite spectrum access	The whole band except for audio & video applications limited to 300 kHz		48	28
N	868,700 MHz to 869,200 MHz	25 mW e.r.p.	≤ 0,1% duty cycle or polite spectrum access	The whole sub-band except for audio & video applications limited to 300 kHz		50	29
O	869,400 MHz to 869,650 MHz	25 mW e.r.p.	≤ 0.1% duty cycle or polite spectrum access	The whole band	.	54a	130
P	869,400 MHz to 869,650 MHz	500 mW e.r.p.	≤ 10 % duty cycle or polite spectrum access	The whole band		54b	30
Q	869,700 MHz to 870,000 MHz	5 mW e.r.p.	No requirement	The whole band	Audio and video applications are excluded.	56a	31
R	869,700 MHz to 870,000 MHz	25 mW e.r.p.	≤ 1% duty cycle or polite spectrum access	The whole band	Analogue audio applications are excluded. Analogue video applications are excluded.	56b	69

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.1.2

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RESULTS

Parameter	Values as declared by the manufacturer
M6, GFSK	
Operational Frequency band or bands	868.7 - 869.2
Nominal Operating Frequencies (MHz)	868.830551 - 869.090103
Operating Channel width(s) - OCW	40 kHz
M7, GFSK	
Operational Frequency band or bands	868.7 - 869.2
Nominal Operating Frequencies (MHz)	868.830551 - 869.090103
Operating Channel width(s) - OCW	80 kHz
M12, GFSK	
Operational Frequency band or bands	868.7 - 869.2
Nominal Operating Frequencies (MHz)	868.830551 - 869.090103
Operating Channel width(s) - OCW	30 kHz
M13, GFSK	
Operational Frequency band or bands	868.7 - 869.2
Nominal Operating Frequencies (MHz)	868.830551 - 869.090103
Operating Channel width(s) - OCW	40 kHz
ML1, GFSK	
Operational Frequency band or bands	868.7 - 869.2
Nominal Operating Frequencies (MHz)	868.882462 - 869.038193
Operating Channel width(s) - OCW	100 kHz

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7.3.2. TX EFFECTIVE RADIATED POWER

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.3.1.2

The effective radiated power shall not be greater than the value allowed in annexes B or C for the chosen operational frequency band(s).

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.2.2.1.2

RESULTS

Date: 08/11/17
Project No: 11773240
Tester: 50818_JQ

CHANNELS FOR MODULATION CODE: ML1

EUT Antenna Gain (dBi) =	2.00

Condition	Output Power (dBm)	EIRP (dBm)	ERP (dBm)	Limit (dBm)	Margin (dB)
Low Channel, CH17					
Normal	11.76	13.76	11.61	13.98	-2.37
Extreme T low, V low	12.48	14.48	12.33	13.98	-1.65
Extreme T low, V high	12.48	14.48	12.33	13.98	-1.65
Extreme T high, V low	11.19	13.19	11.04	13.98	-2.94
Extreme T high, V high	11.21	13.21	11.06	13.98	-2.92
High Channel, CH20					
Normal	11.75	13.75	11.60	13.98	-2.38
Extreme T low, V low	12.49	14.49	12.34	13.98	-1.64
Extreme T low, V high	12.49	14.49	12.34	13.98	-1.64
Extreme T high, V low	11.19	13.19	11.04	13.98	-2.94
Extreme T high, V high	11.20	13.20	11.05	13.98	-2.93

Note: Cable loss correction factor is included in the Power Meter Reading

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7.3.3. TX OCCUPIED BANDWIDTH

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.3.4.2

The occupied bandwidth of the EUT according to ETSI EN 300 220-1 [1], clause 5.6.2 shall comply with the limits in annex B or C.

Reference Limit:

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.6.2

The Operating Channel shall be declared and shall reside entirely within the Operational Frequency Band. The Maximum Occupied Bandwidth at 99 % shall reside entirely within the Operating Channel defined by F_{low} and F_{high}.

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.6.3.3 (Conducted Measurement)

UL VERIFICATION SERVICES INC. FORM NO: CCSUP4701I
47173 BENICIA STREET, FREMONT, CA 94538, USA TEL: (510) 771-1000 FAX: (510) 661-0888
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RESULTS

BAND N

Condition	Low CH (MHz)	High CH (MHz)	Low CH OBW (kHz)	High CH OBW (kHz)	F_{Low} (MHz)	F_{Low} Limit (MHz)	F_{High} (MHz)	F_{High} Limit (MHz)
M6, GFSK								
Normal	868.8306	869.0901	34.434	31.369	868.81	> 868.7	869.11	< 869.2
T low, V low	868.8306	869.0901	32.015	31.668	868.81	> 868.7	869.11	< 869.2
T low, V high	868.8306	869.0901	31.681	31.637	868.81	> 868.7	869.11	< 869.2
T high, V low	868.8306	869.0901	31.833	32.235	868.81	> 868.7	869.11	< 869.2
T high, V high	868.8306	869.0901	32.330	31.759	868.81	> 868.7	869.11	< 869.2
M7, GFSK								
Normal	868.8306	869.0901	62.360	65.521	868.80	> 868.7	869.12	< 869.2
T low, V low	868.8306	869.0901	64.292	63.756	868.80	> 868.7	869.12	< 869.2
T low, V high	868.8306	869.0901	65.777	65.495	868.80	> 868.7	869.12	< 869.2
T high, V low	868.8306	869.0901	64.901	64.460	868.80	> 868.7	869.12	< 869.2
T high, V high	868.8306	869.0901	65.036	66.439	868.80	> 868.7	869.12	< 869.2
M12, GFSK								
Normal	868.8306	869.0901	29.518	29.489	868.82	> 868.7	869.10	< 869.2
T low, V low	868.8306	869.0901	29.607	29.755	868.82	> 868.7	869.10	< 869.2
T low, V high	868.8306	869.0901	29.656	29.425	868.82	> 868.7	869.10	< 869.2
T high, V low	868.8306	869.0901	29.506	29.677	868.82	> 868.7	869.10	< 869.2
T high, V high	868.8306	869.0901	29.499	29.752	868.82	> 868.7	869.10	< 869.2
M13, GFSK								
Normal	868.8306	869.0901	38.658	38.853	868.81	> 868.7	869.11	< 869.2
T low, V low	868.8306	869.0901	38.896	38.912	868.81	> 868.7	869.11	< 869.2
T low, V high	868.8306	869.0901	38.814	38.949	868.81	> 868.7	869.11	< 869.2
T high, V low	868.8306	869.0901	38.083	38.614	868.81	> 868.7	869.11	< 869.2
T high, V high	868.8306	869.0901	38.954	38.669	868.81	> 868.7	869.11	< 869.2
ML1, GFSK								
Normal	868.8825	869.0382	91.020	88.656	868.84	> 868.7	869.08	< 869.2
T low, V low	868.8825	869.0382	91.738	90.900	868.84	> 868.7	869.08	< 869.2
T low, V high	868.8825	869.0382	88.796	89.212	868.84	> 868.7	869.08	< 869.2
T high, V low	868.8825	869.0382	91.499	91.201	868.84	> 868.7	869.08	< 869.2
T high, V high	868.8825	869.0382	91.097	92.492	868.84	> 868.7	869.08	< 869.2

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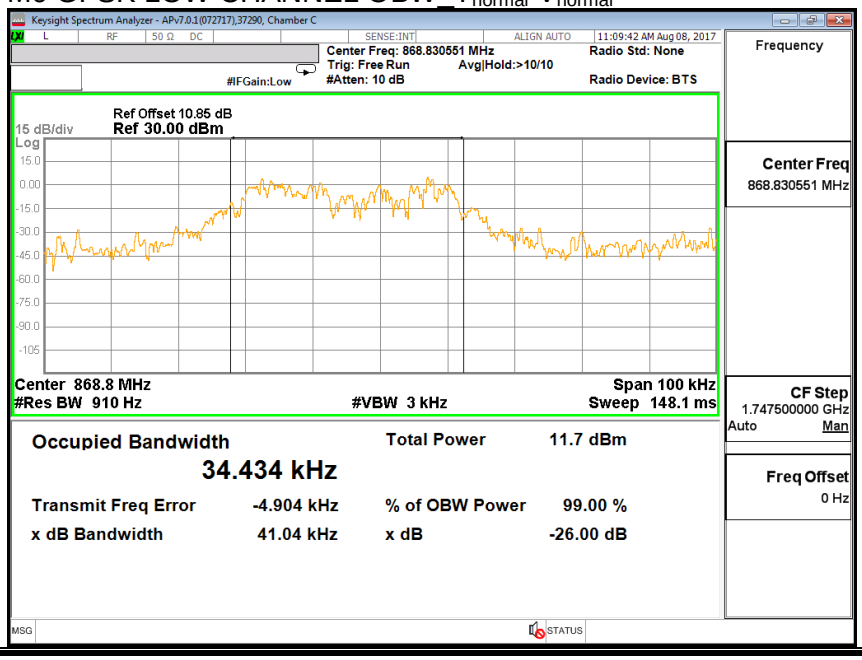
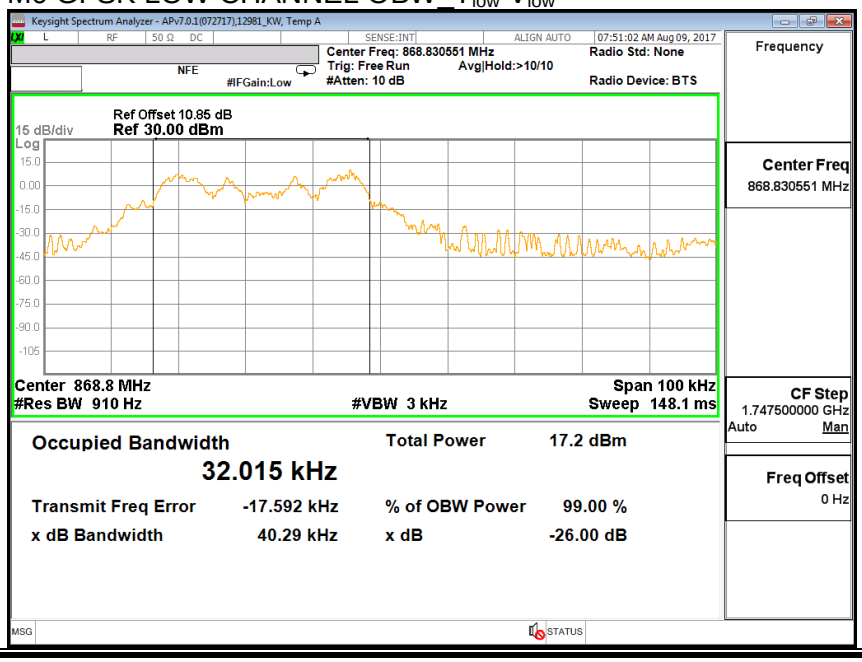
M6 GFSK LOW CHANNEL OBW_T_{normal} V_{normal}



M6 GFSK LOW CHANNEL OBW_T_{low} V_{low}



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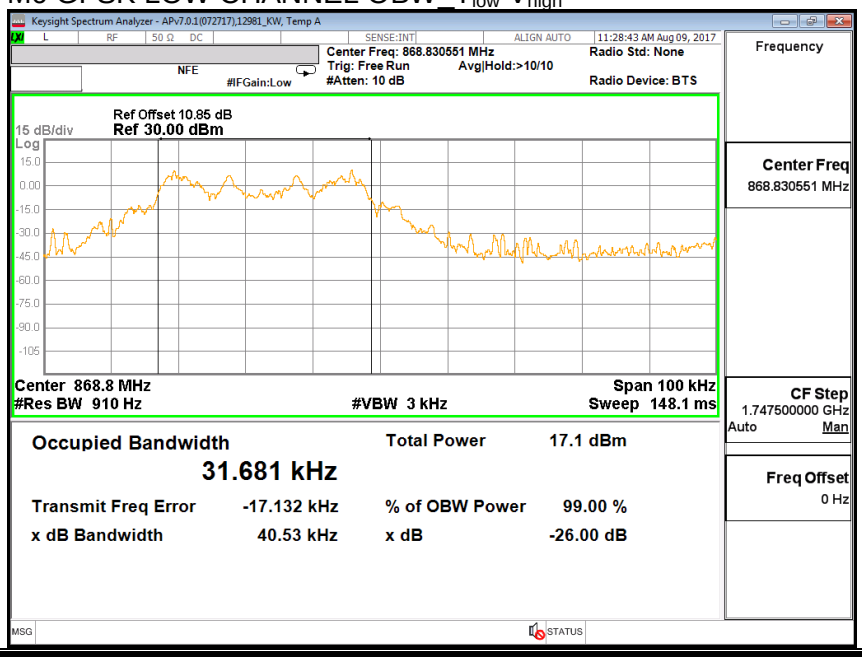
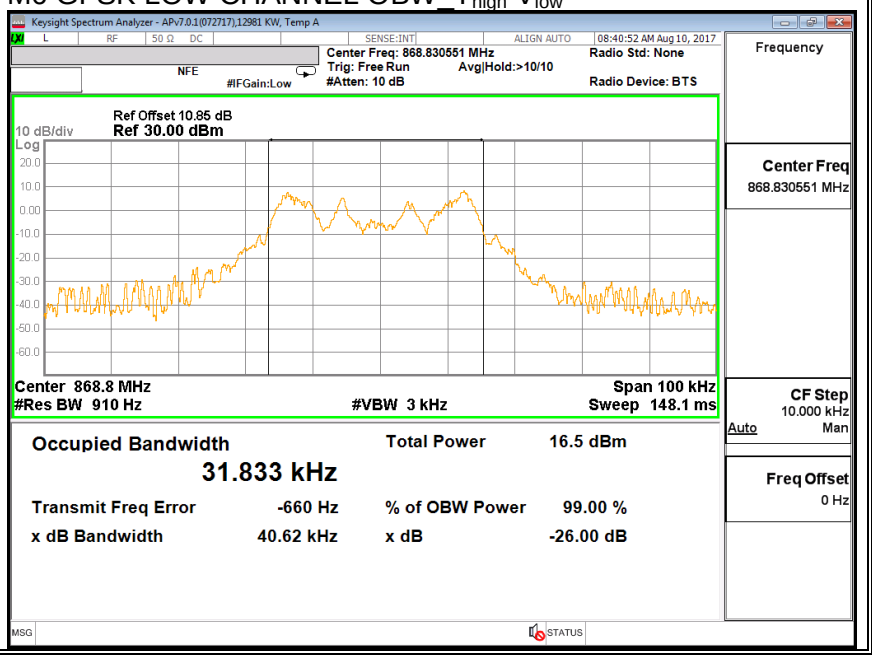
M6 GFSK LOW CHANNEL OBW_T_{low} V_{high}



M6 GFSK LOW CHANNEL OBW_T_{high} V_{low}



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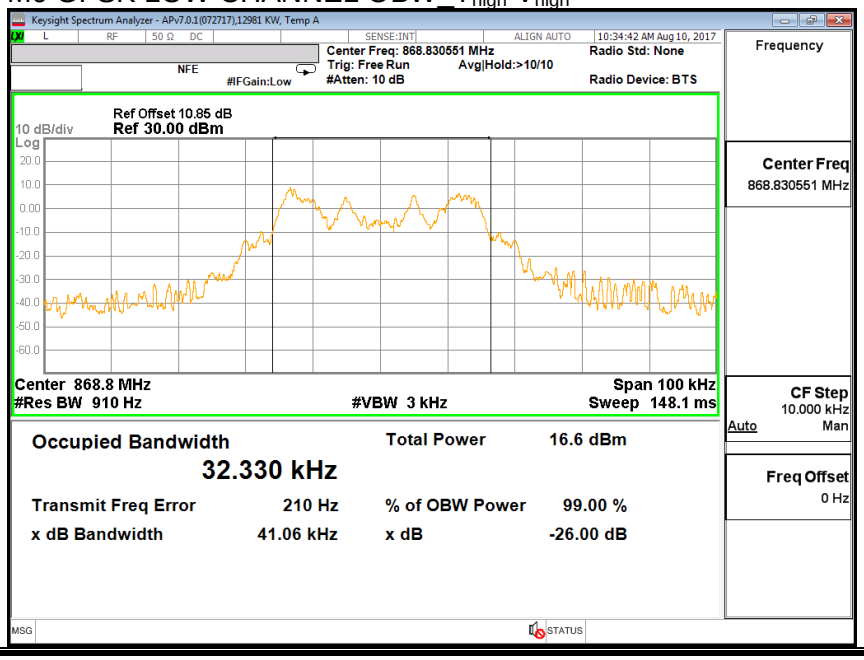
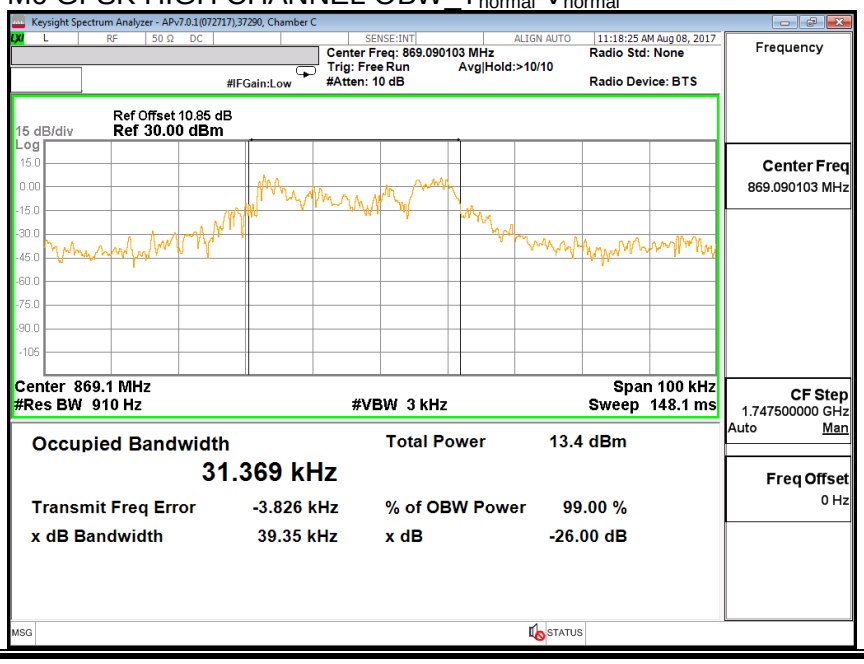
M6 GFSK LOW CHANNEL OBW_T_{high} V_{high}



M6 GFSK HIGH CHANNEL OBW_T_{normal} V_{normal}



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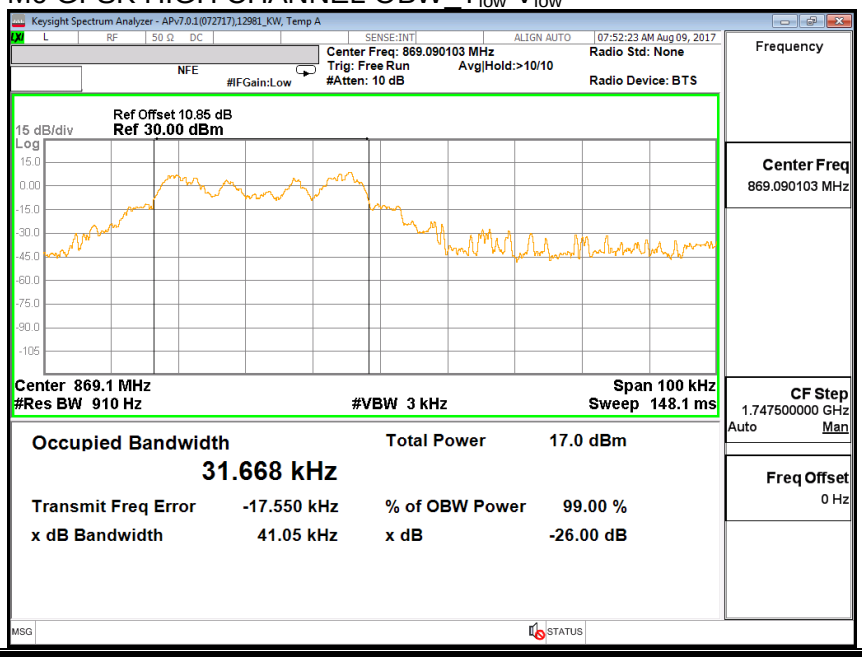
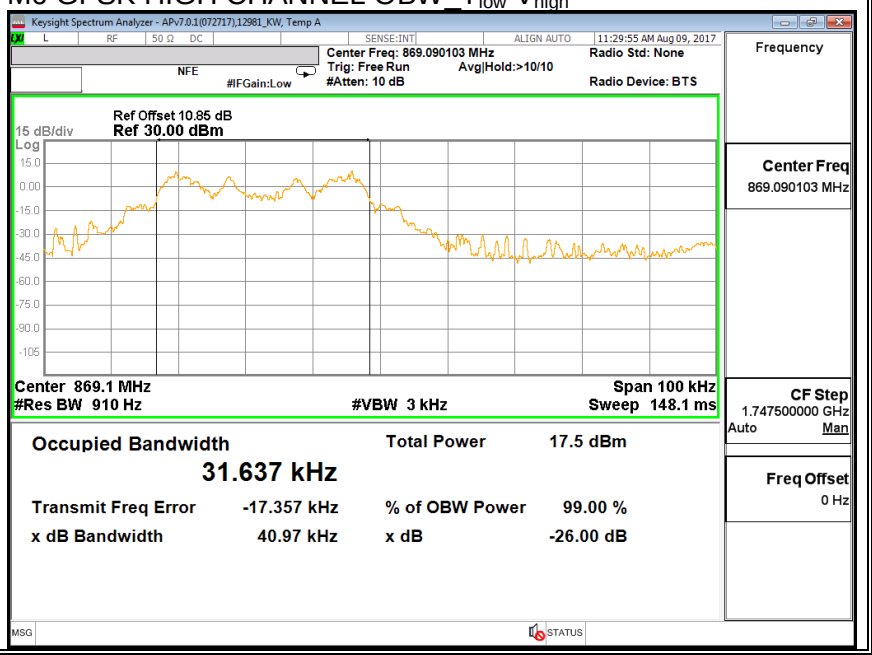
M6 GFSK HIGH CHANNEL OBW_T_{low} V_{low}



M6 GFSK HIGH CHANNEL OBW_T_{low} V_{high}



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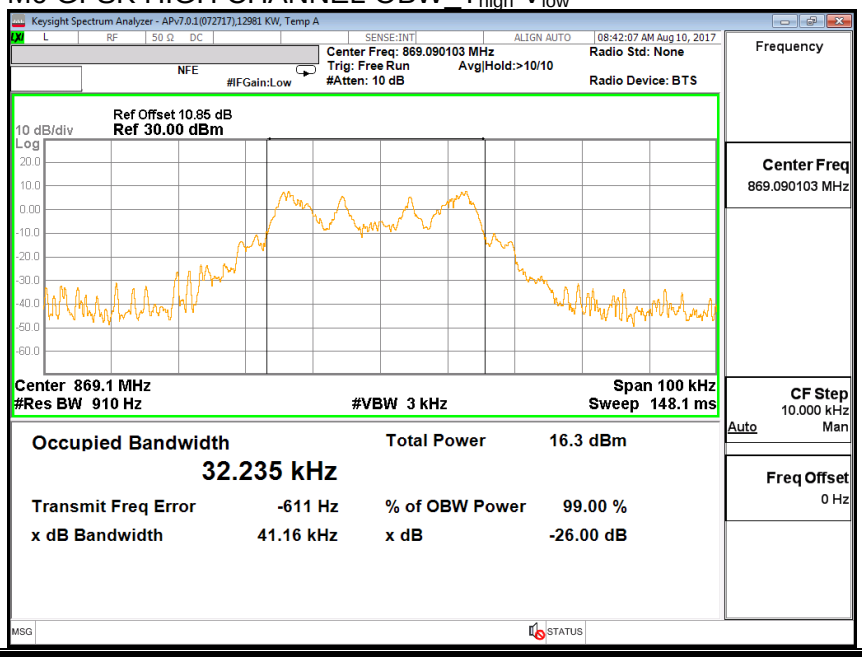
M6 GFSK HIGH CHANNEL OBW_T_{high} V_{low}



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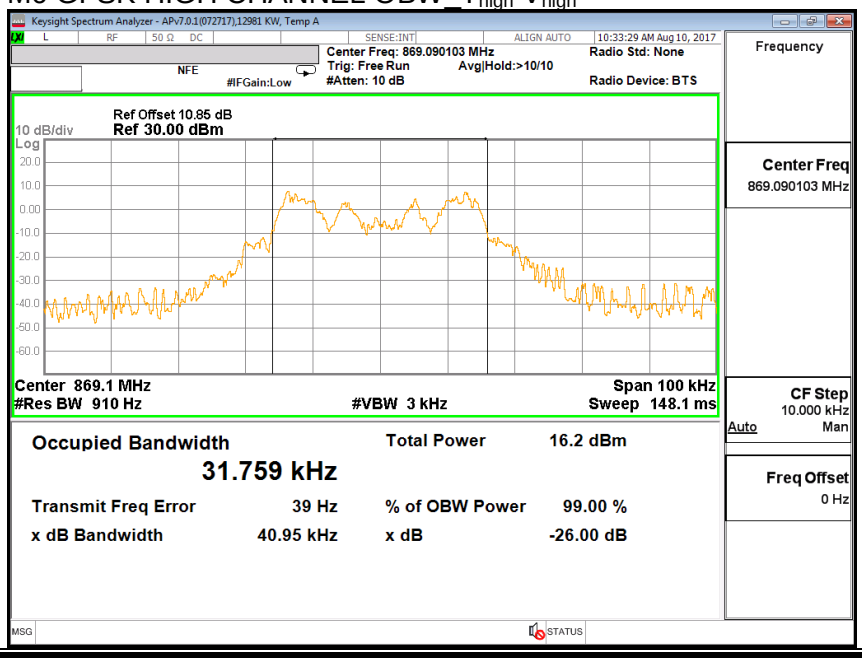

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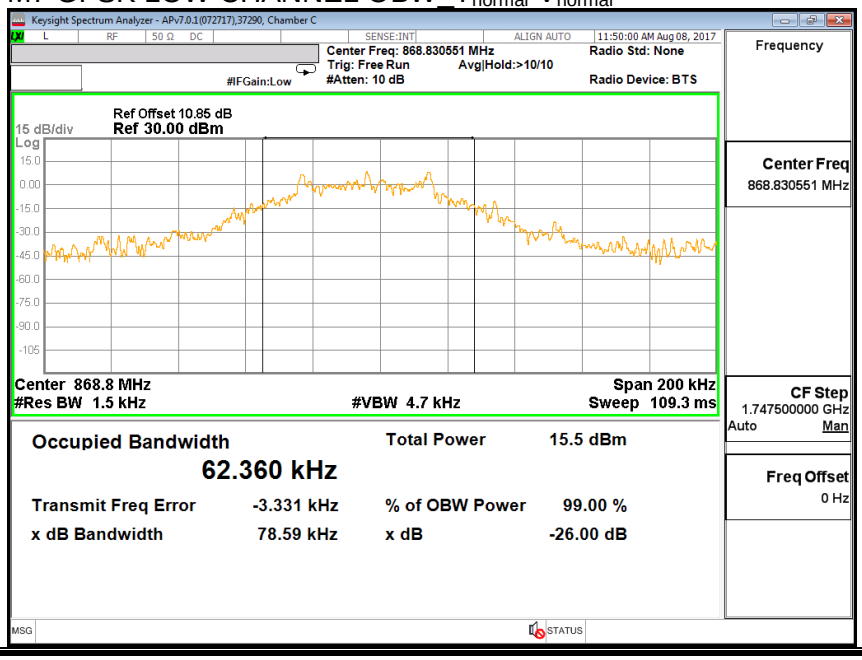
M7 GFSK LOW CHANNEL OBW_T_{normal} V_{normal}



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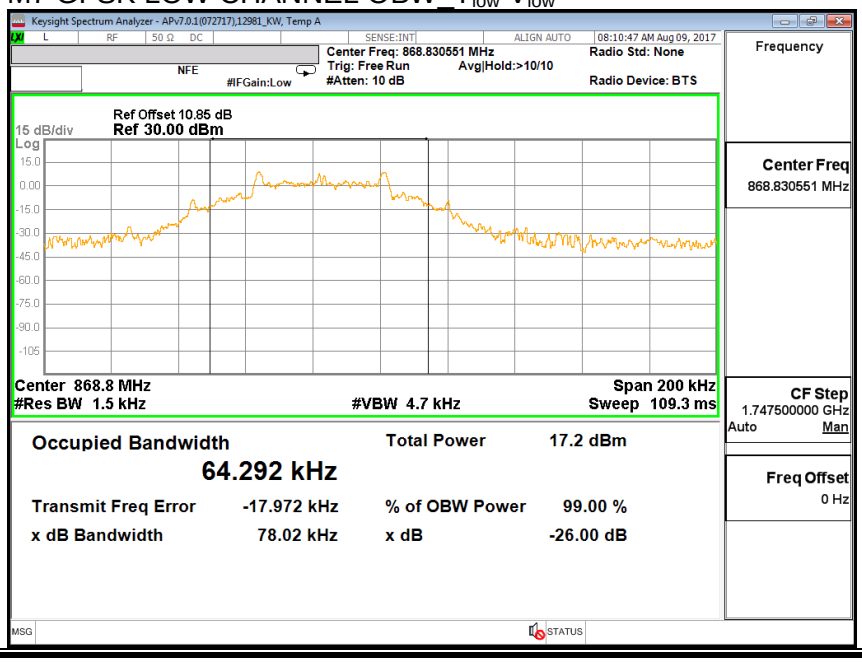

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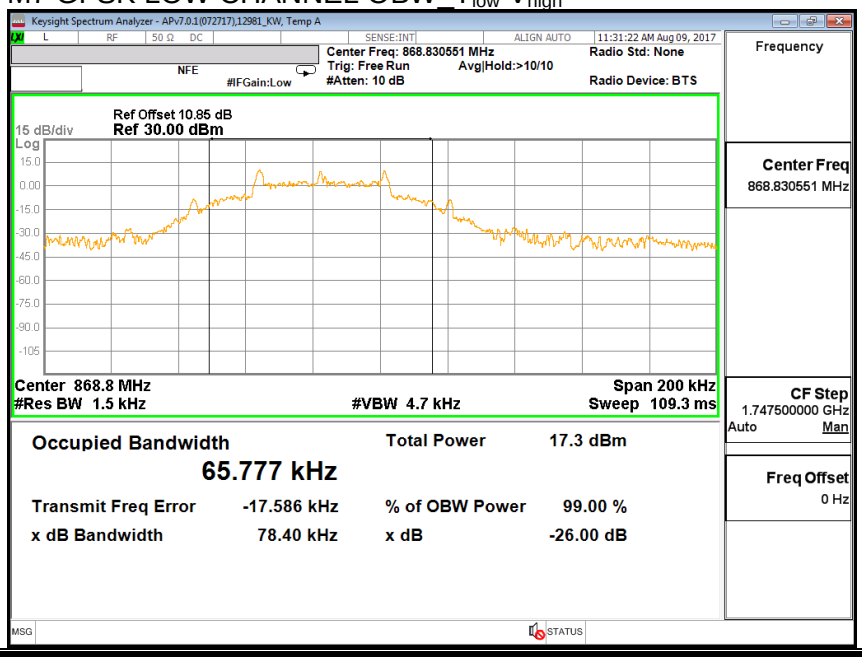
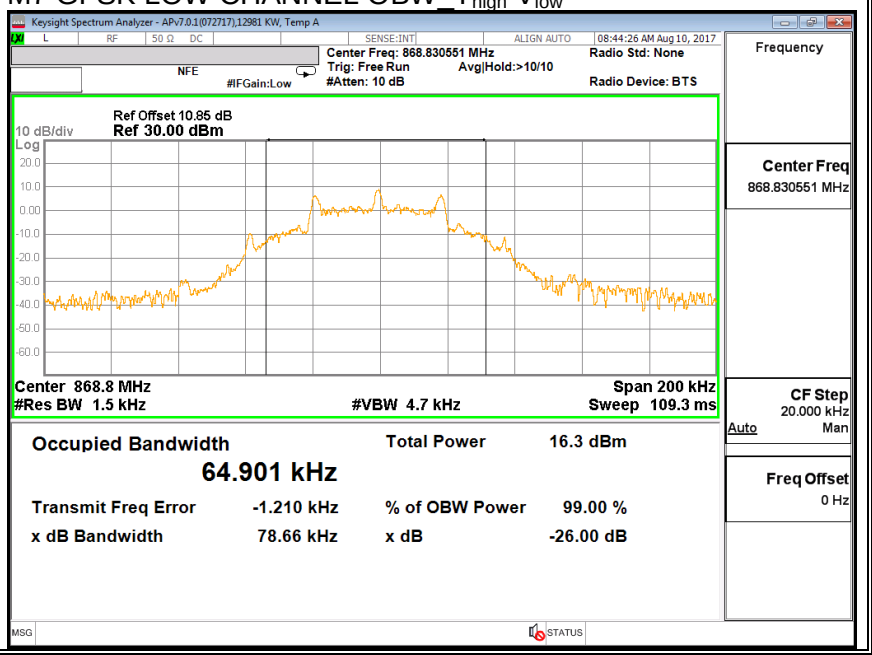
M7 GFSK LOW CHANNEL OBW_T_{low} V_{high}



M7 GFSK LOW CHANNEL OBW_T_{high} V_{low}



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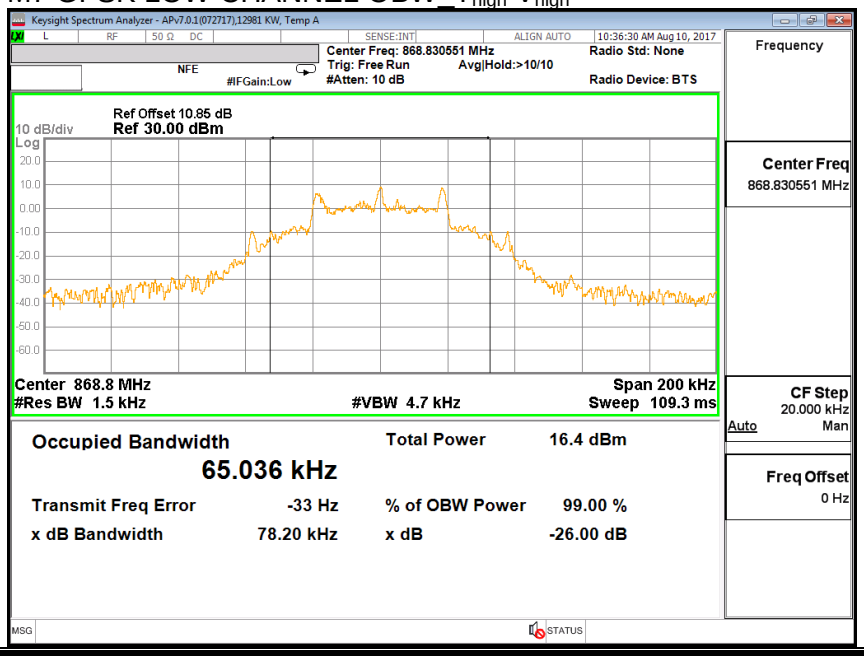
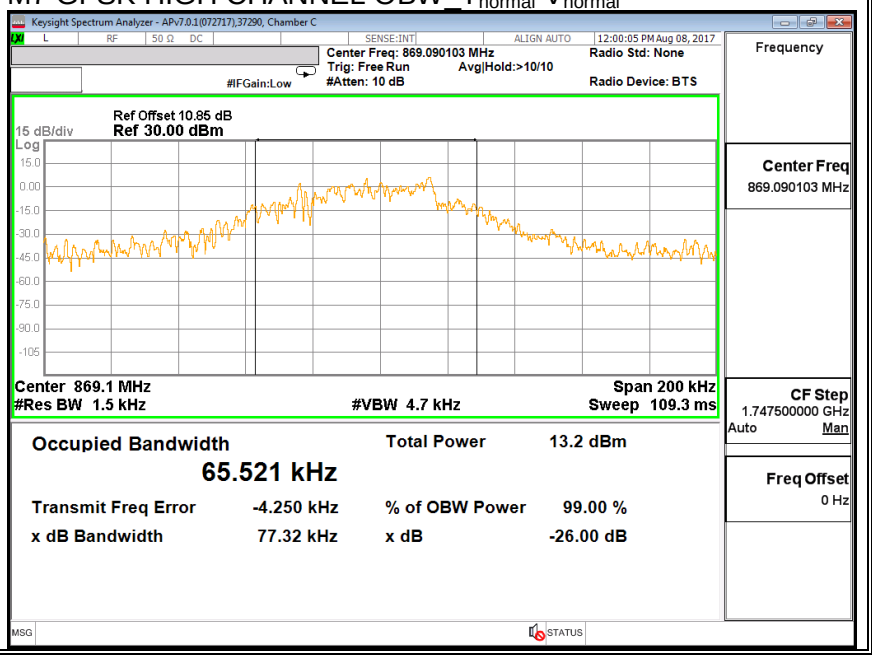
M7 GFSK LOW CHANNEL OBW_T_{high} V_{high}



M7 GFSK HIGH CHANNEL OBW_T_{normal} V_{normal}



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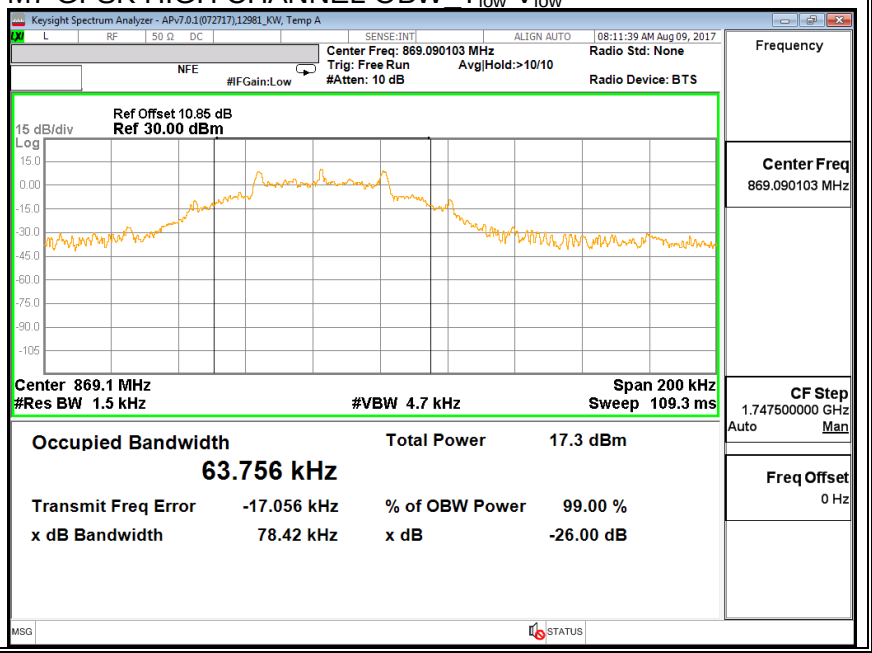
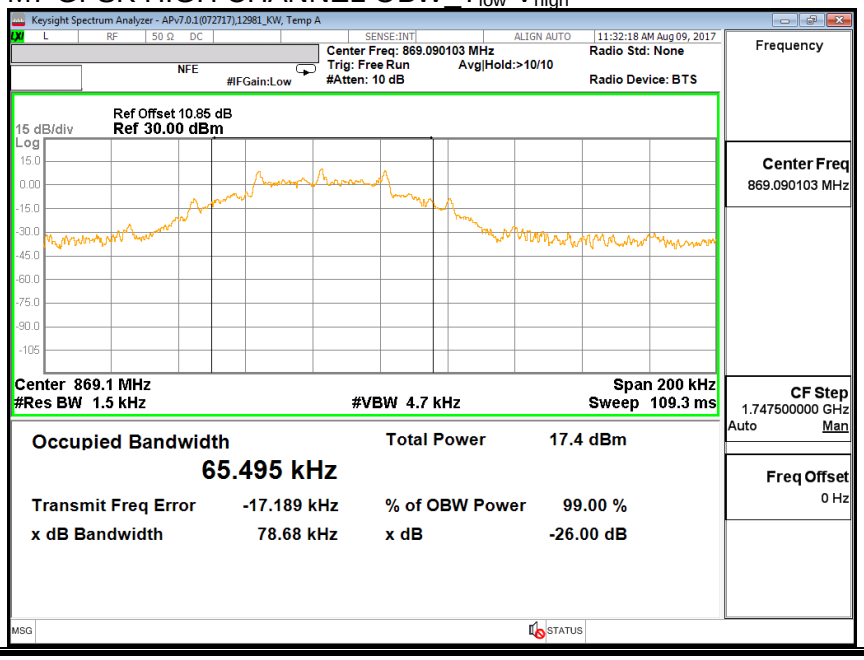
M7 GFSK HIGH CHANNEL OBW_T_{low} V_{low}



M7 GFSK HIGH CHANNEL OBW_T_{low} V_{high}



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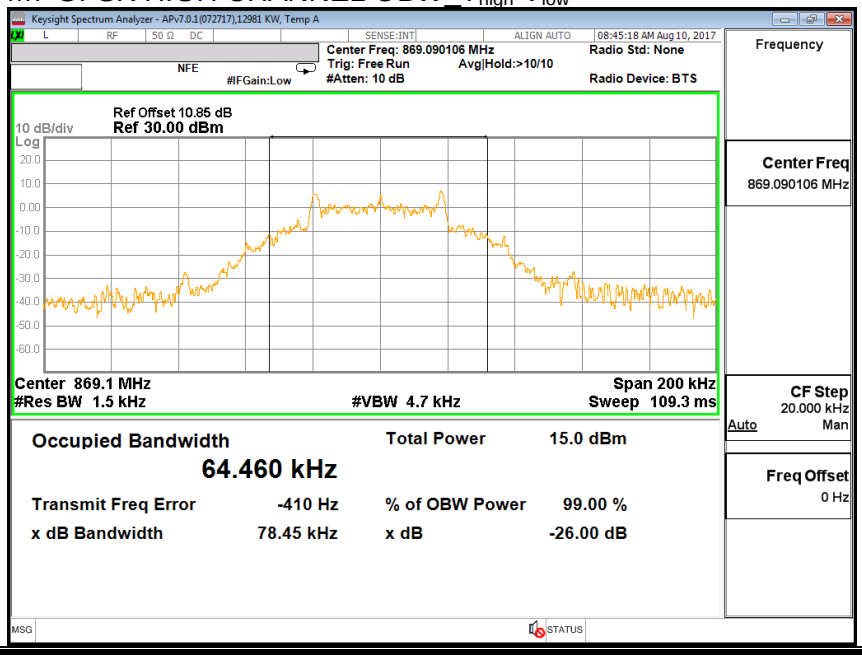
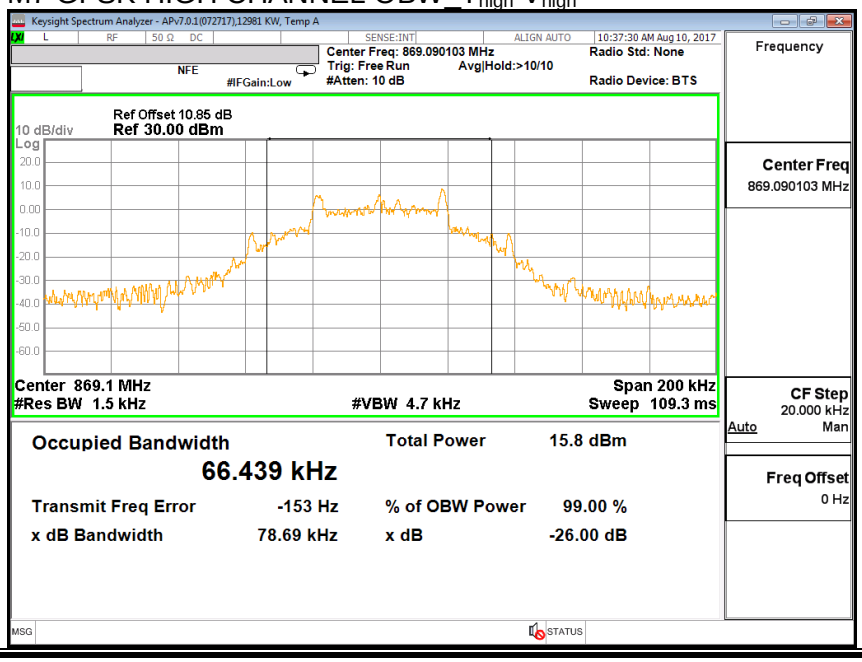
M7 GFSK HIGH CHANNEL OBW_T_{high} V_{low}



M7 GFSK HIGH CHANNEL OBW_T_{high} V_{high}



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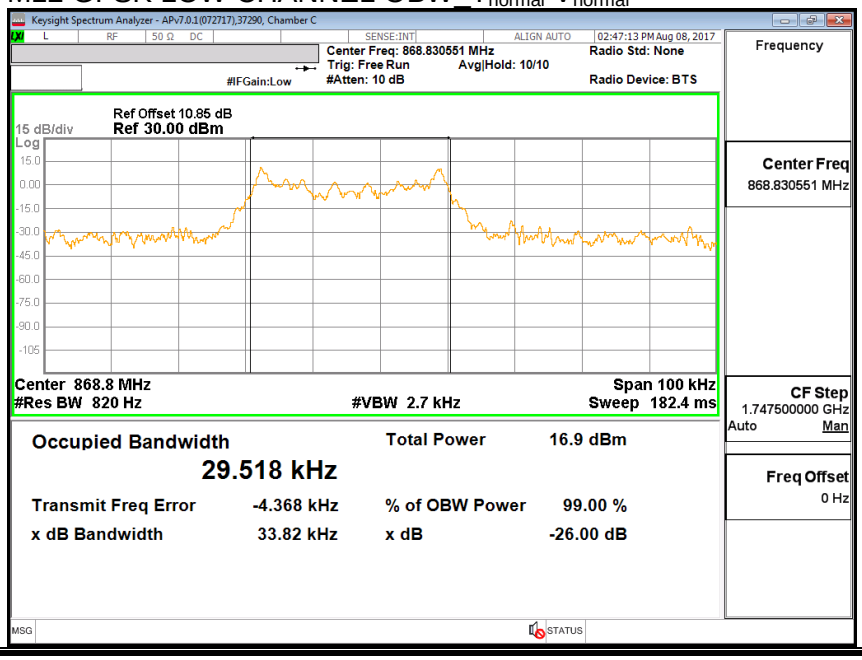
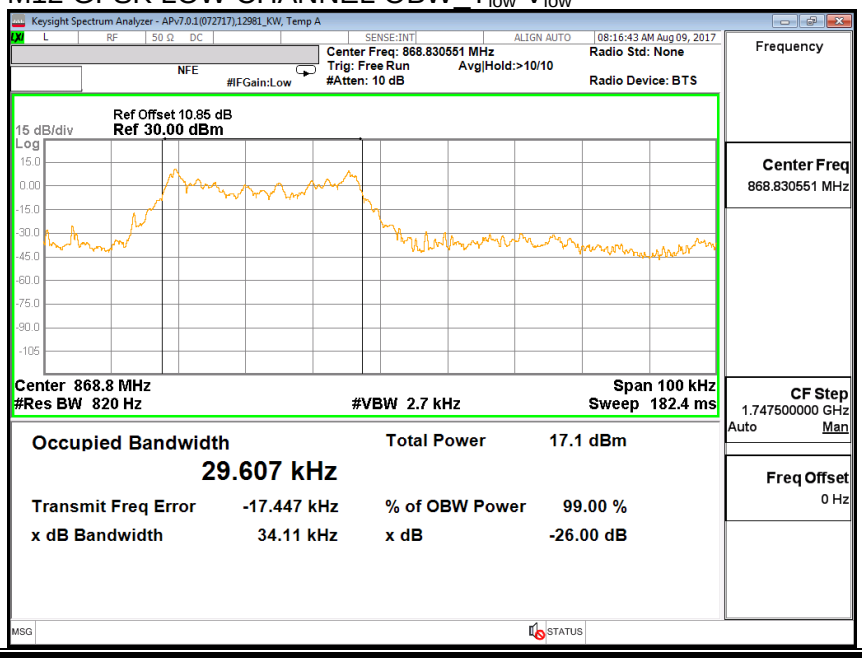
M12 GFSK LOW CHANNEL OBW_T_{normal} V_{normal}



M12 GFSK LOW CHANNEL OBW_T_{low} V_{low}



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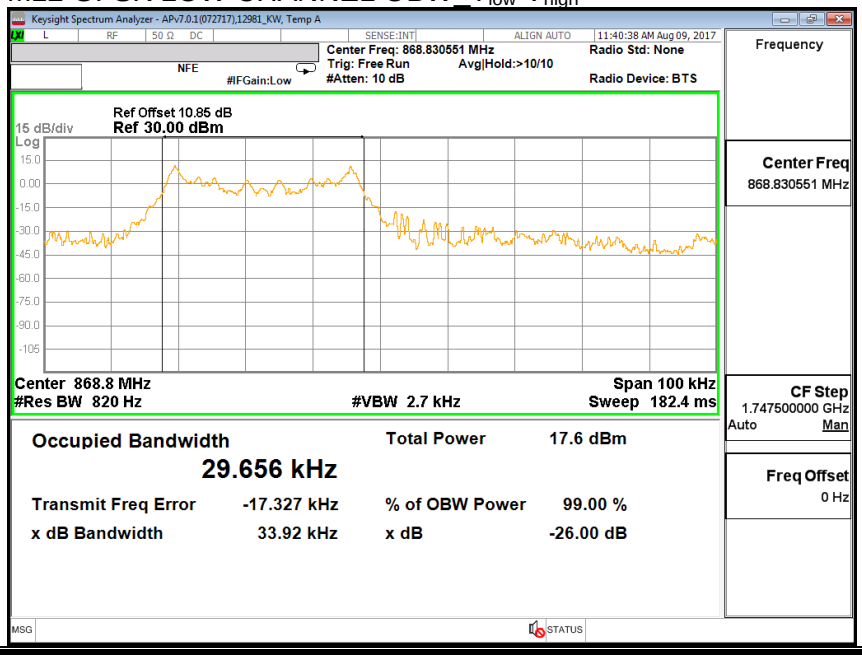
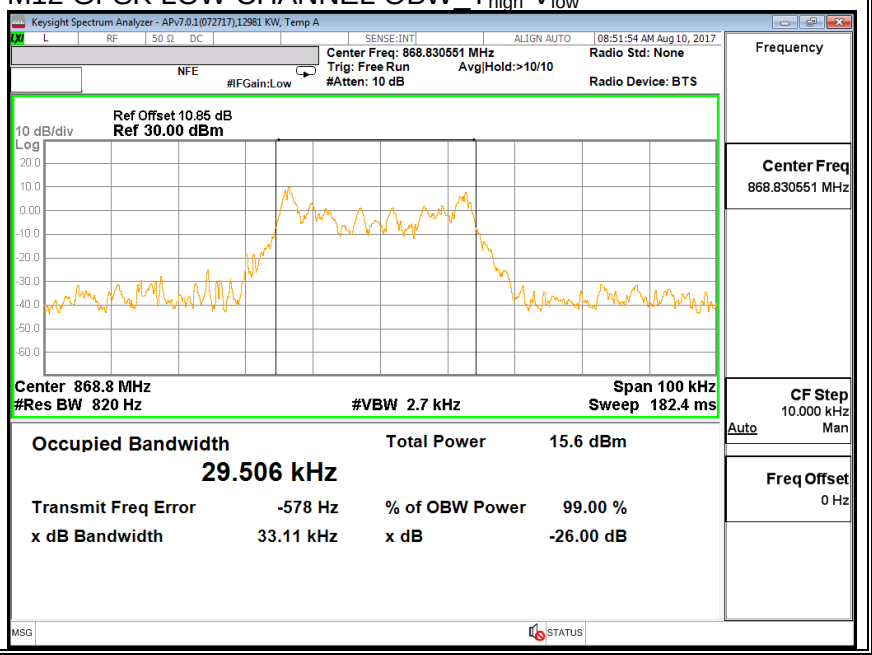
M12 GFSK LOW CHANNEL OBW_T_{low} V_{high}



M12 GFSK LOW CHANNEL OBW_T_{high} V_{low}



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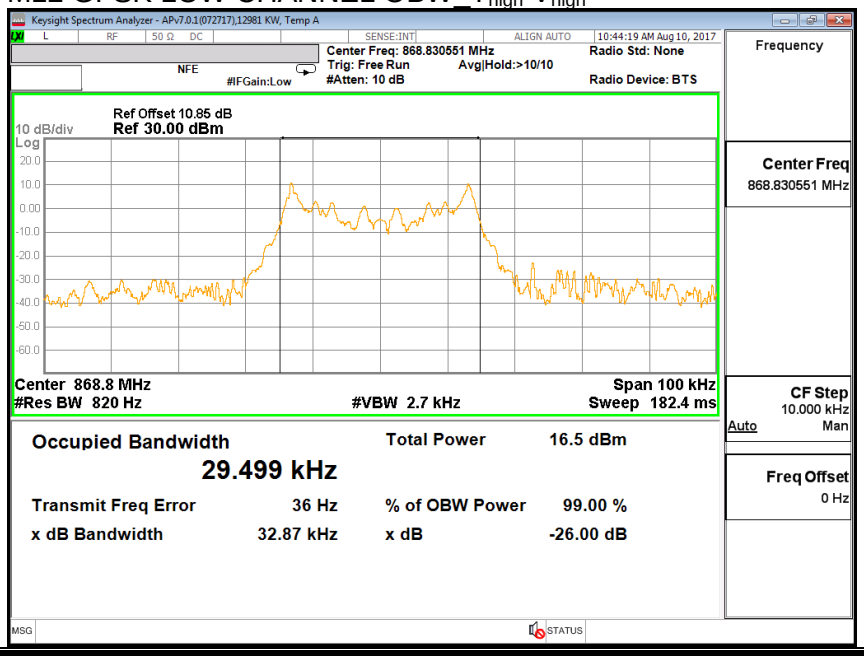
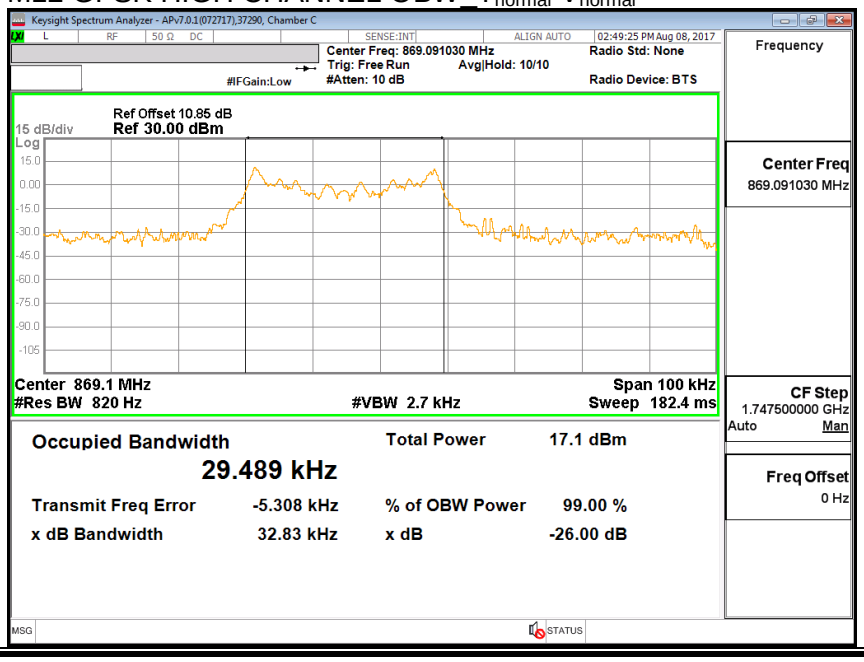
M12 GFSK LOW CHANNEL OBW_T_{high} V_{high}



M12 GFSK HIGH CHANNEL OBW_T_{normal} V_{normal}



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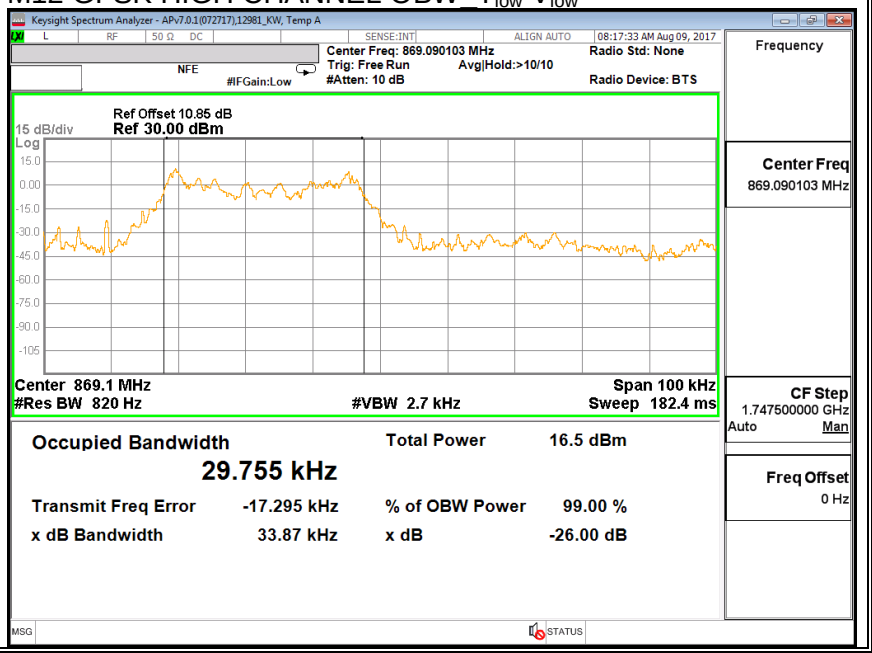
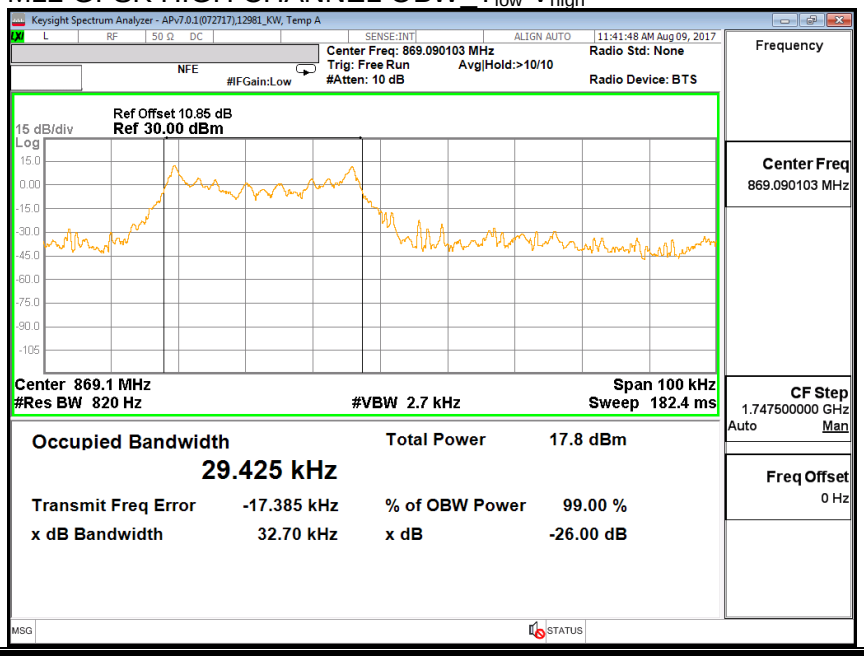
M12 GFSK HIGH CHANNEL OBW_T_{low} V_{low}



M12 GFSK HIGH CHANNEL OBW_T_{low} V_{high}



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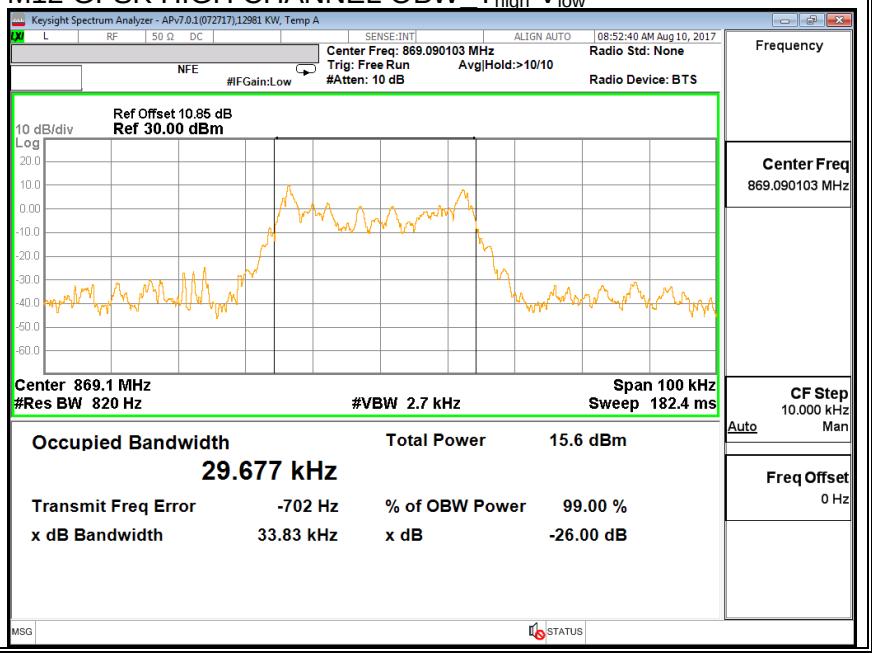
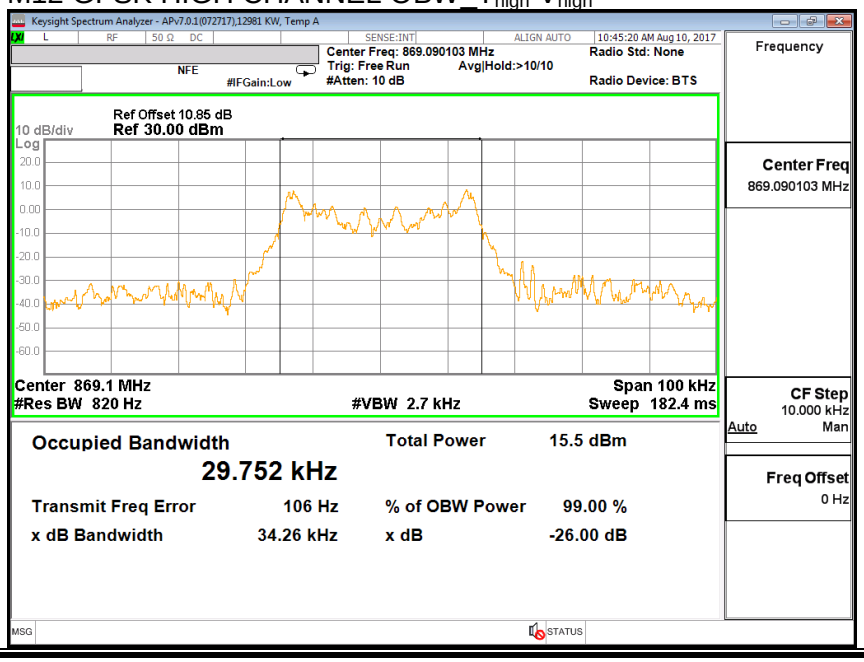
M12 GFSK HIGH CHANNEL OBW_T_{high} V_{low}



M12 GFSK HIGH CHANNEL OBW_T_{high} V_{high}



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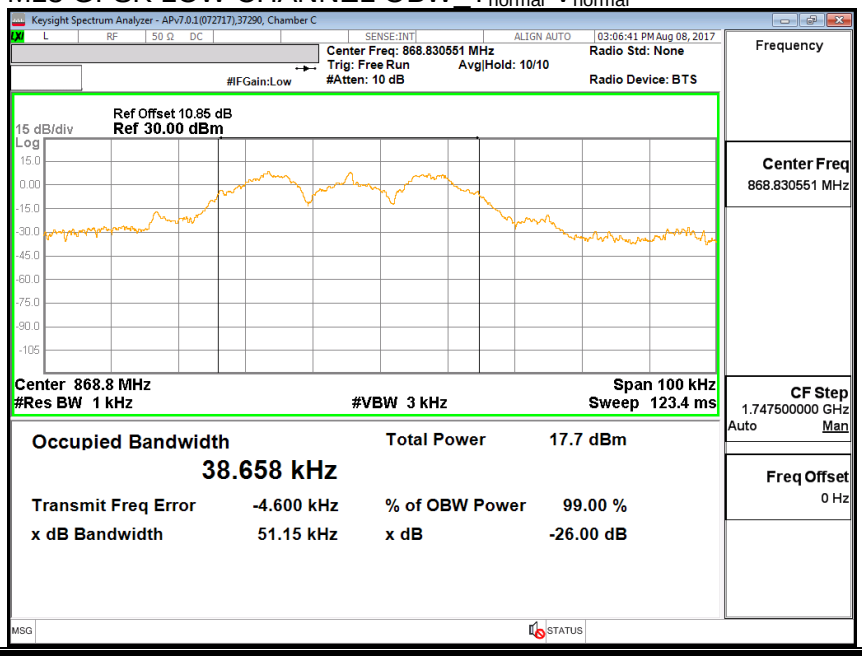
M13 GFSK LOW CHANNEL OBW_T_{normal} V_{normal}



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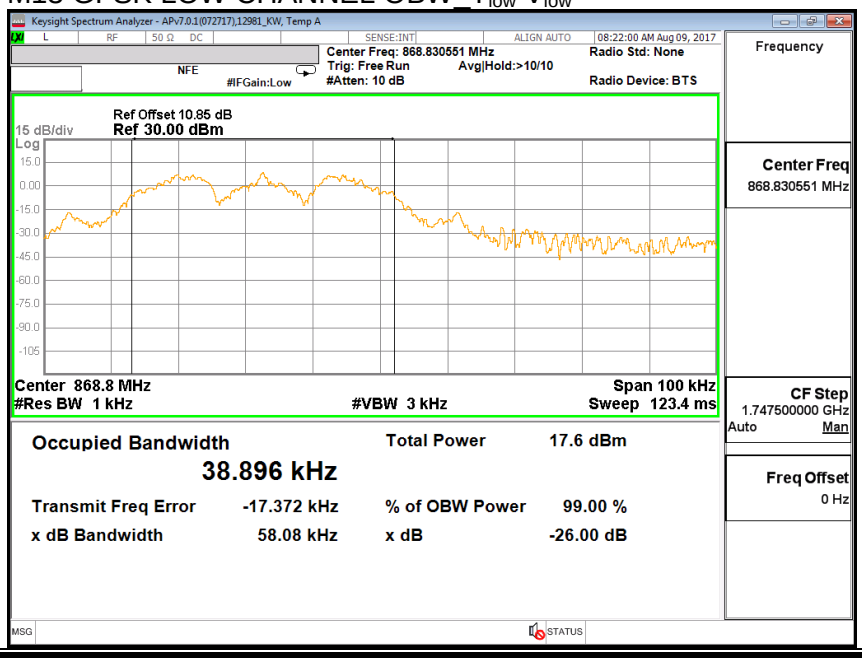

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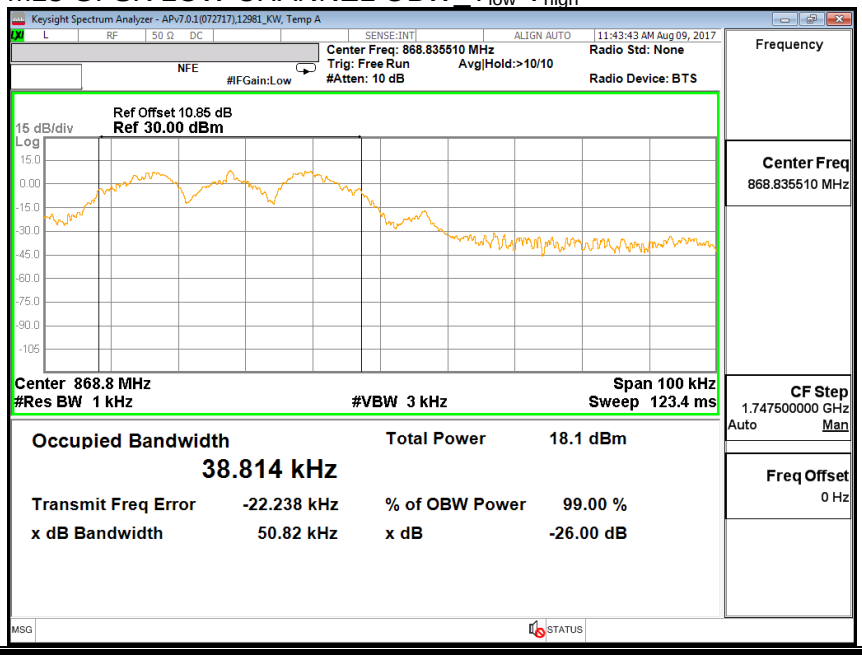
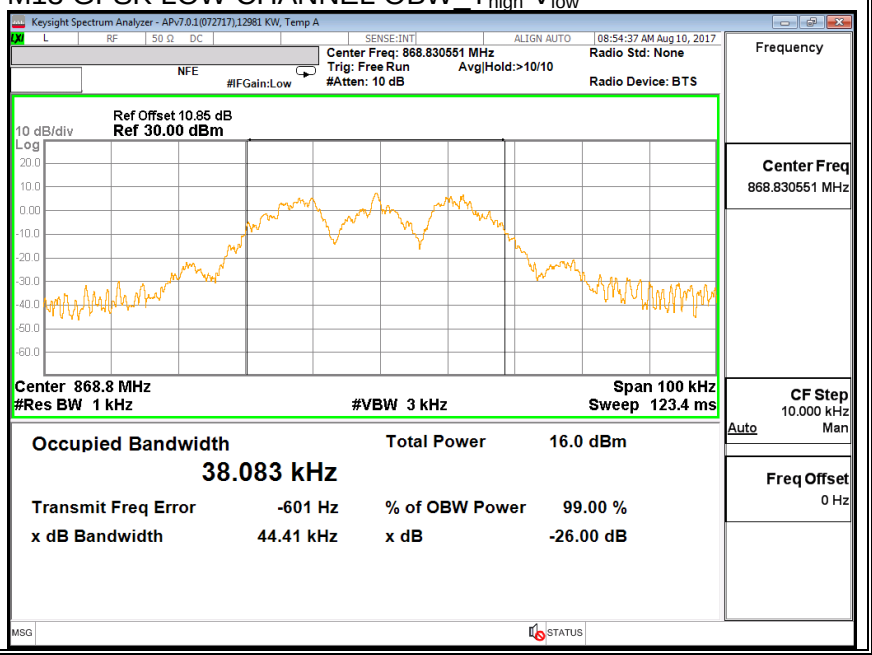
M13 GFSK LOW CHANNEL OBW_T_{low} V_{high}



M13 GFSK LOW CHANNEL OBW_T_{high} V_{low}



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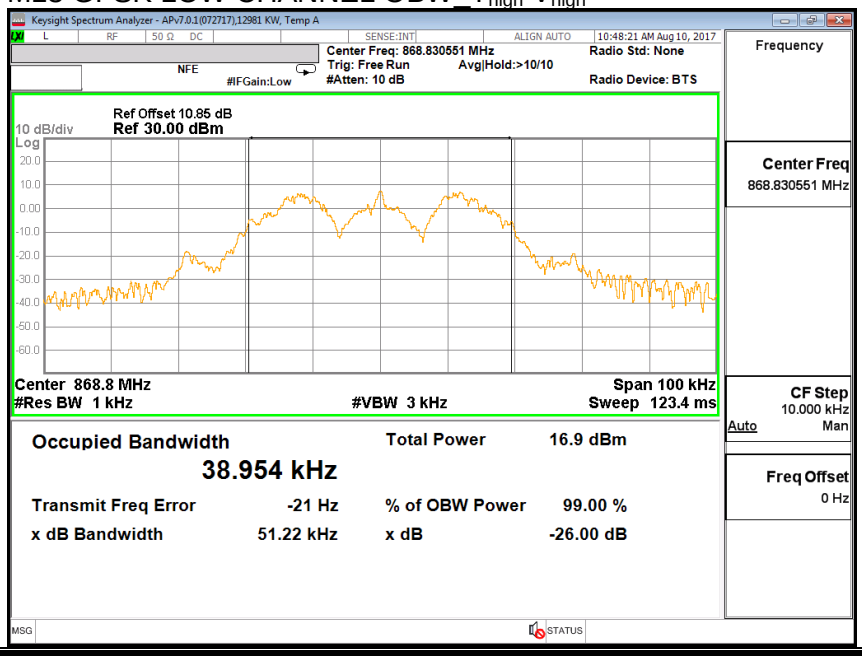
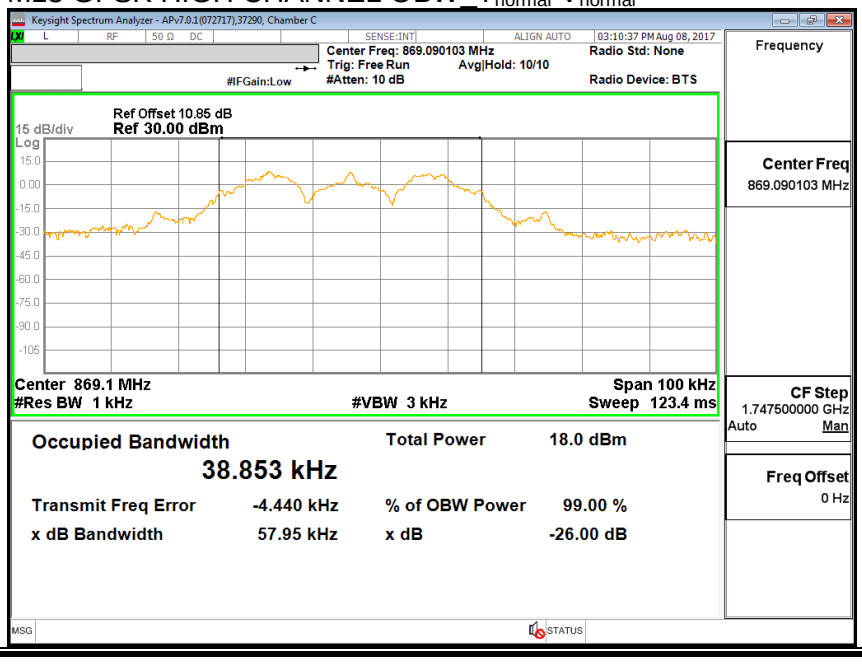
M13 GFSK LOW CHANNEL OBW_T_{high} V_{high}



M13 GFSK HIGH CHANNEL OBW_T_{normal} V_{normal}



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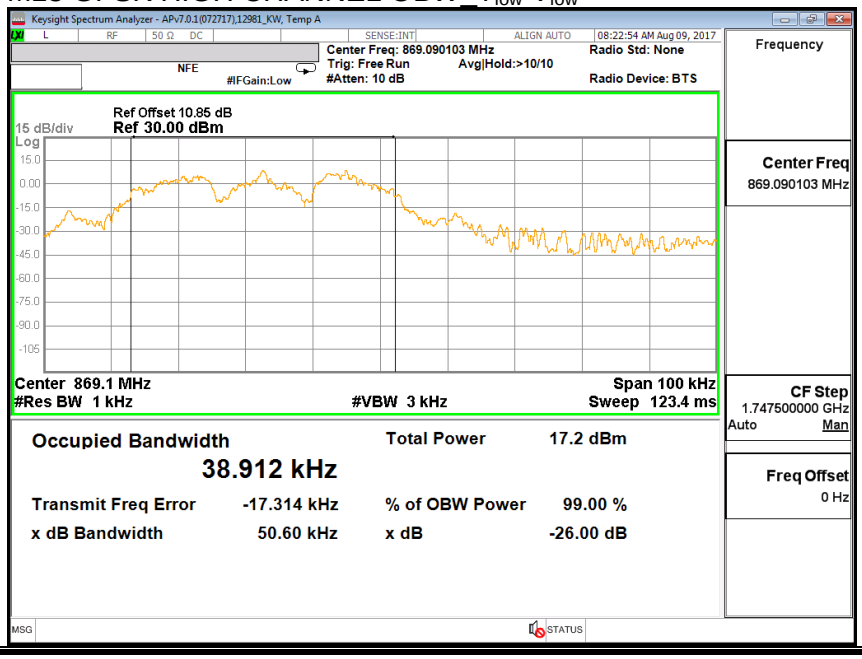
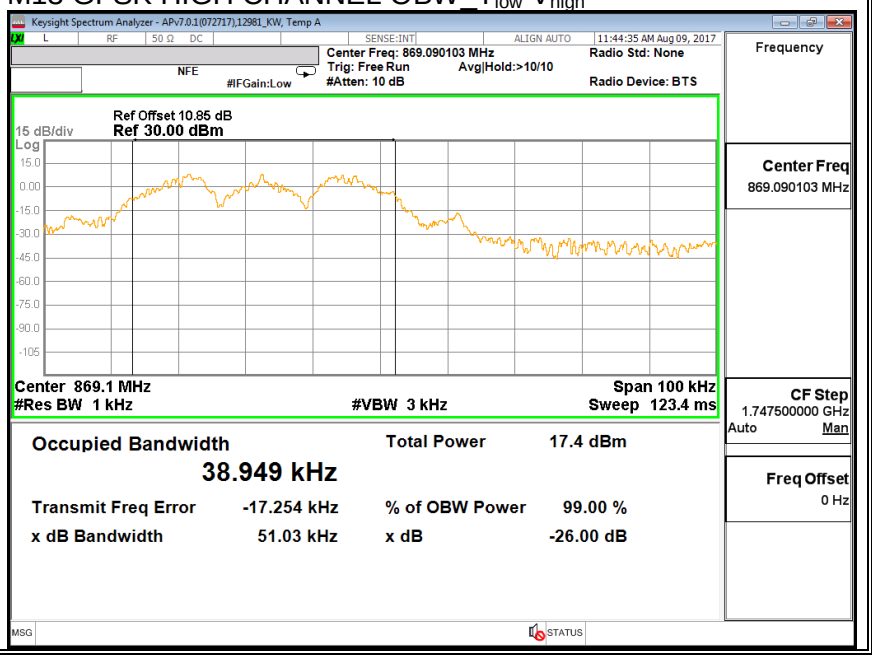
M13 GFSK HIGH CHANNEL OBW_T_{low} V_{low}



M13 GFSK HIGH CHANNEL OBW_T_{low} V_{high}



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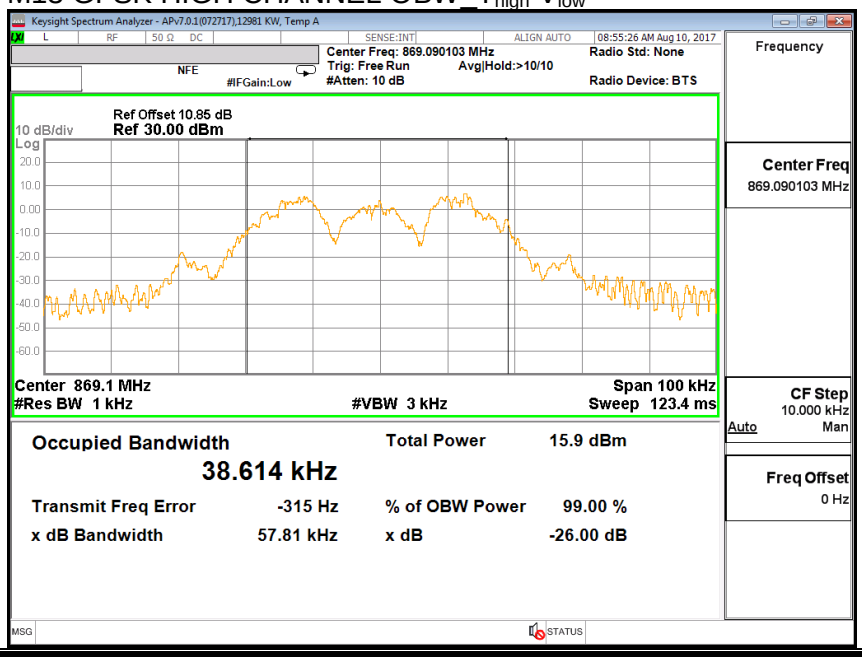
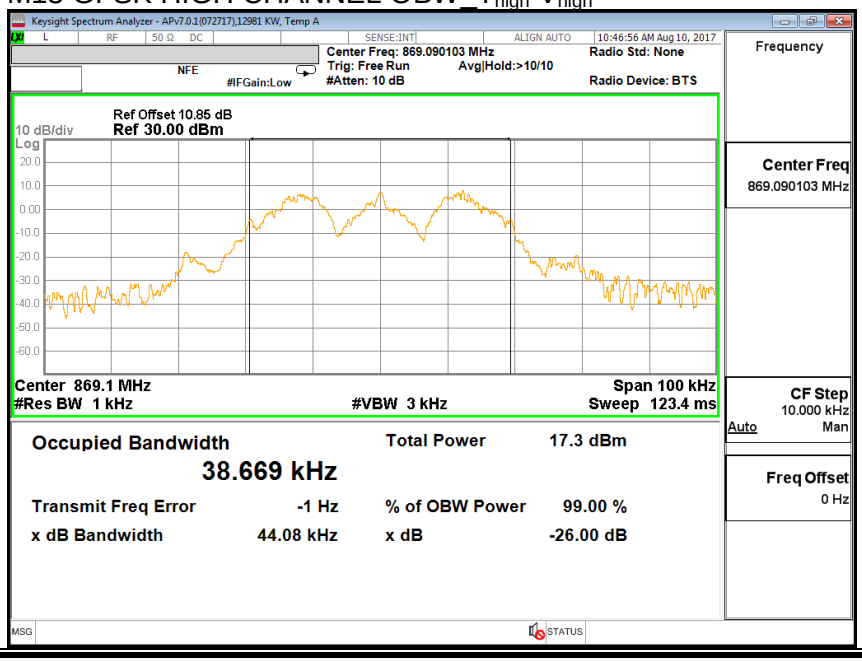
M13 GFSK HIGH CHANNEL OBW_T_{high} V_{low}



M13 GFSK HIGH CHANNEL OBW_T_{high} V_{high}



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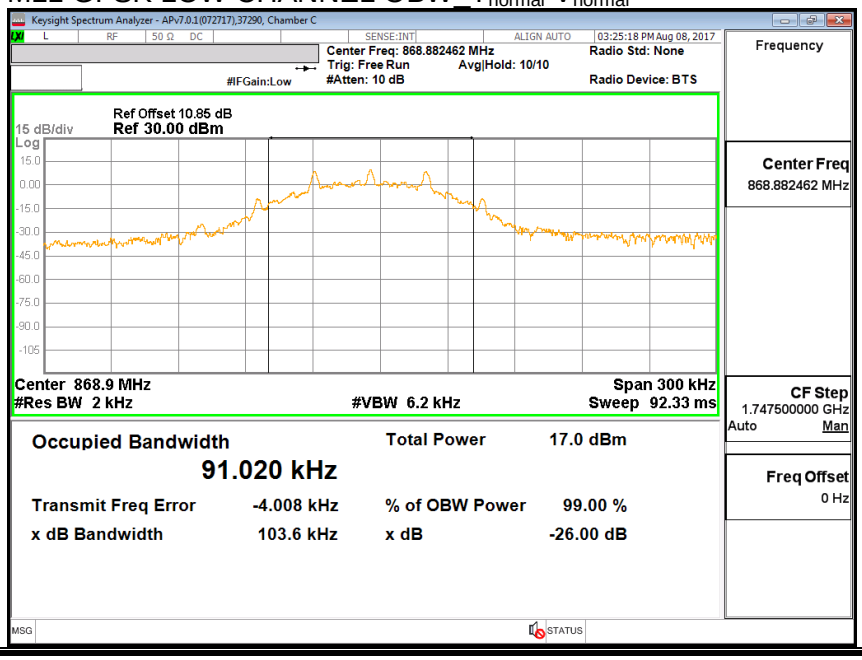
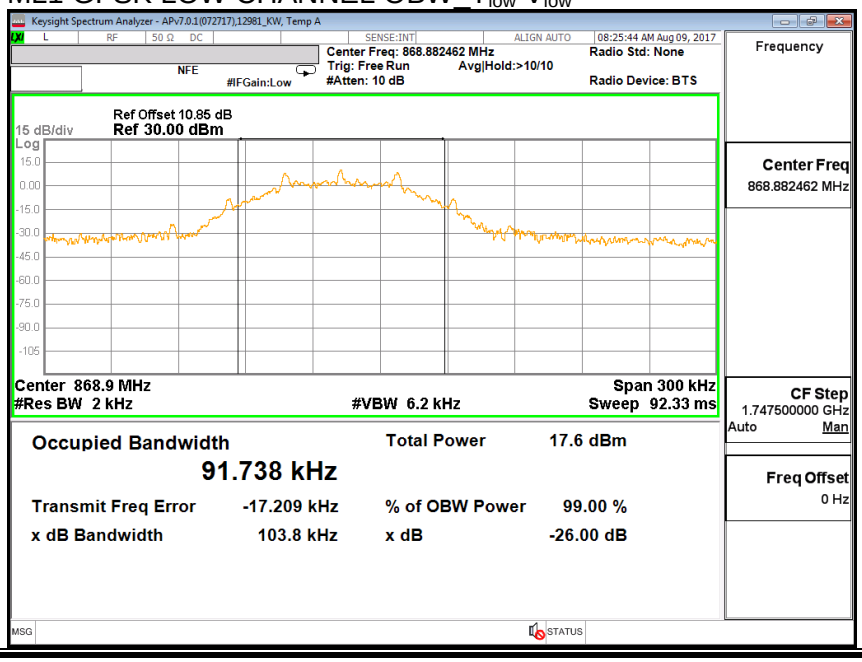
ML1 GFSK LOW CHANNEL OBW_T_{normal} V_{normal}



ML1 GFSK LOW CHANNEL OBW_T_{low} V_{low}



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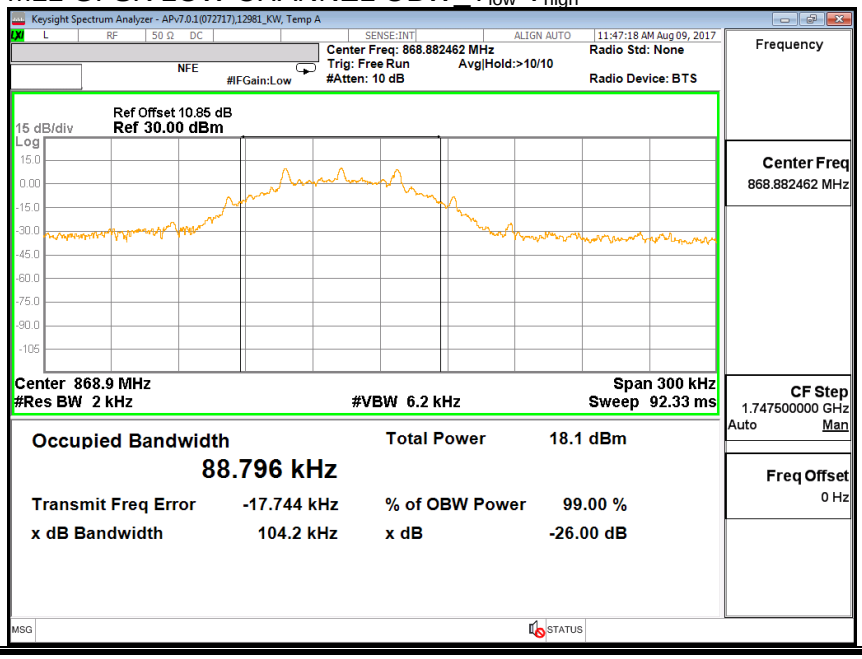
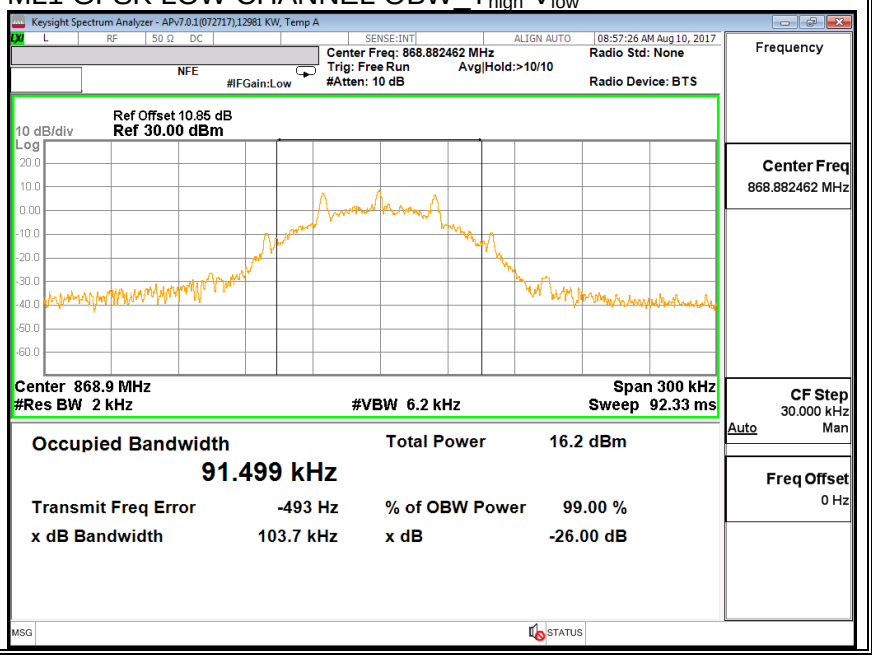
ML1 GFSK LOW CHANNEL OBW_T_{low} V_{high}



ML1 GFSK LOW CHANNEL OBW_T_{high} V_{low}



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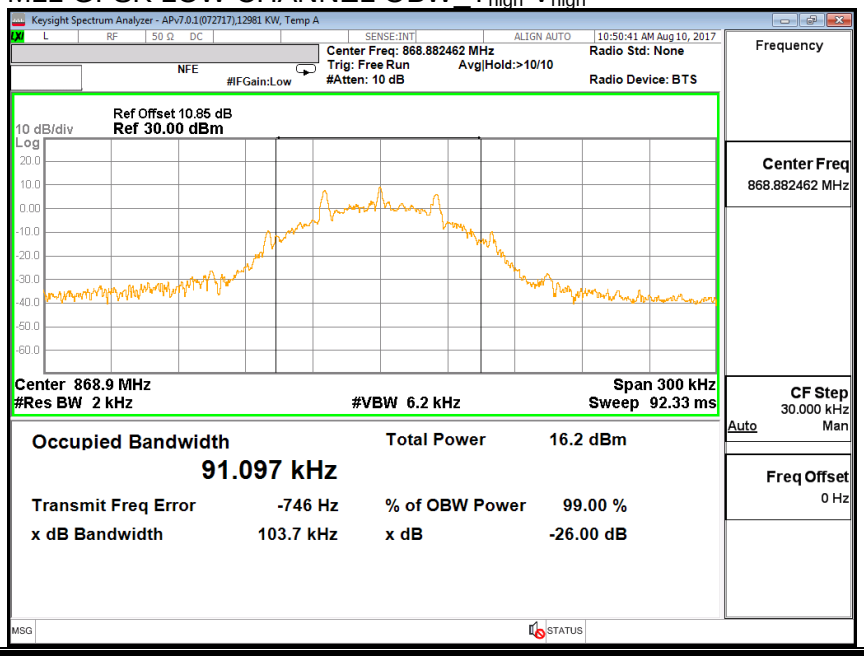
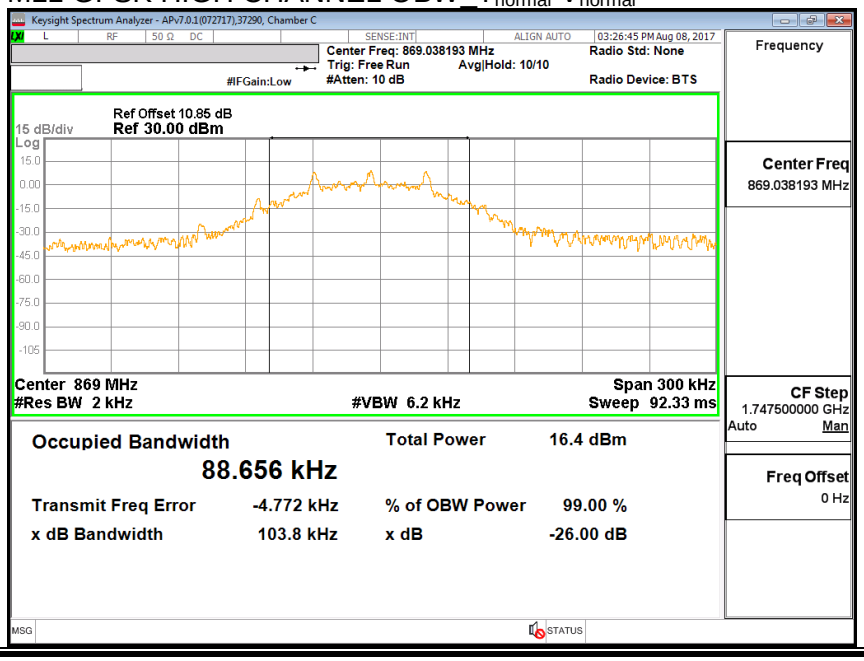
ML1 GFSK LOW CHANNEL OBW_T_{high} V_{high}



ML1 GFSK HIGH CHANNEL OBW_T_{normal} V_{normal}



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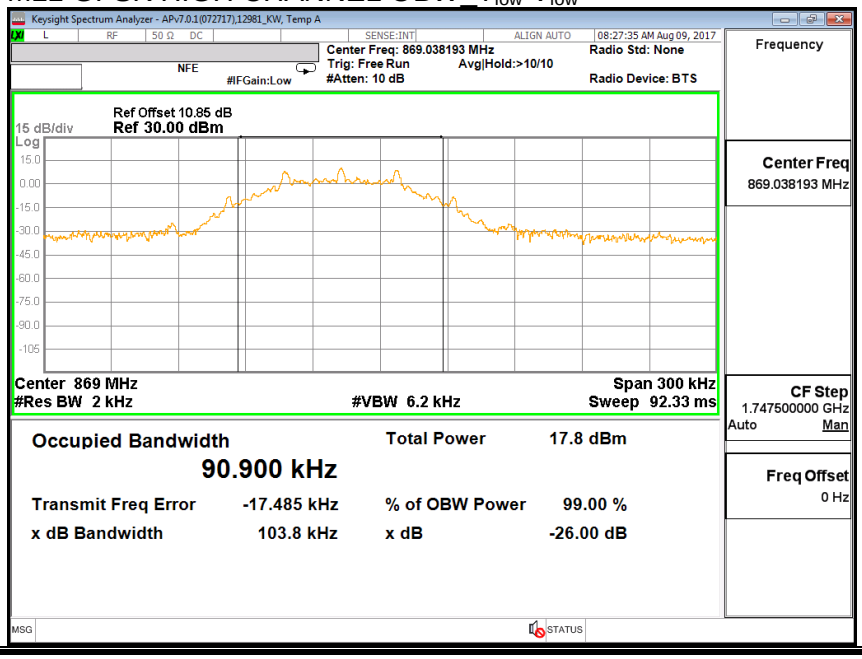
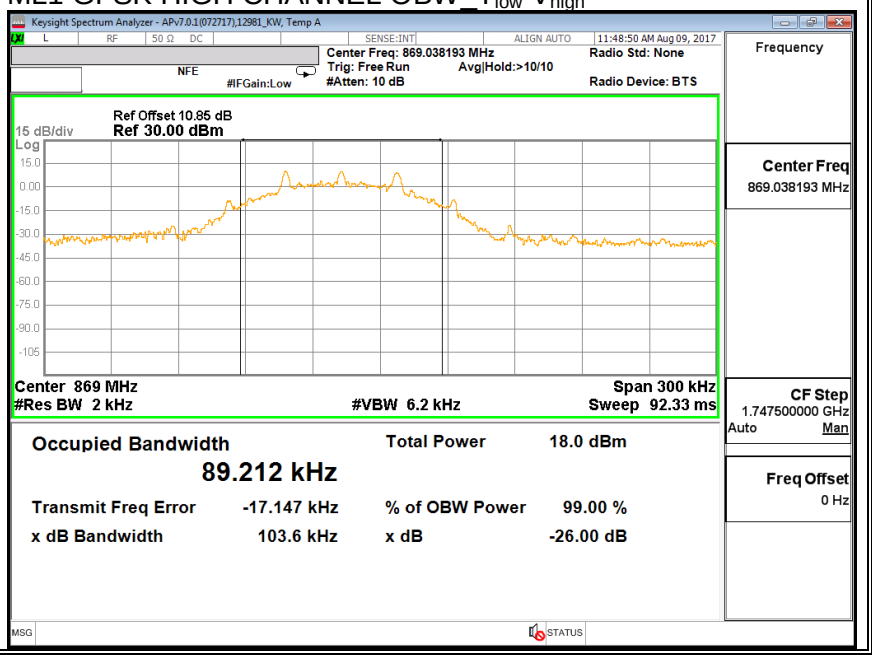
ML1 GFSK HIGH CHANNEL OBW_T_{low} V_{low}



ML1 GFSK HIGH CHANNEL OBW_T_{low} V_{high}



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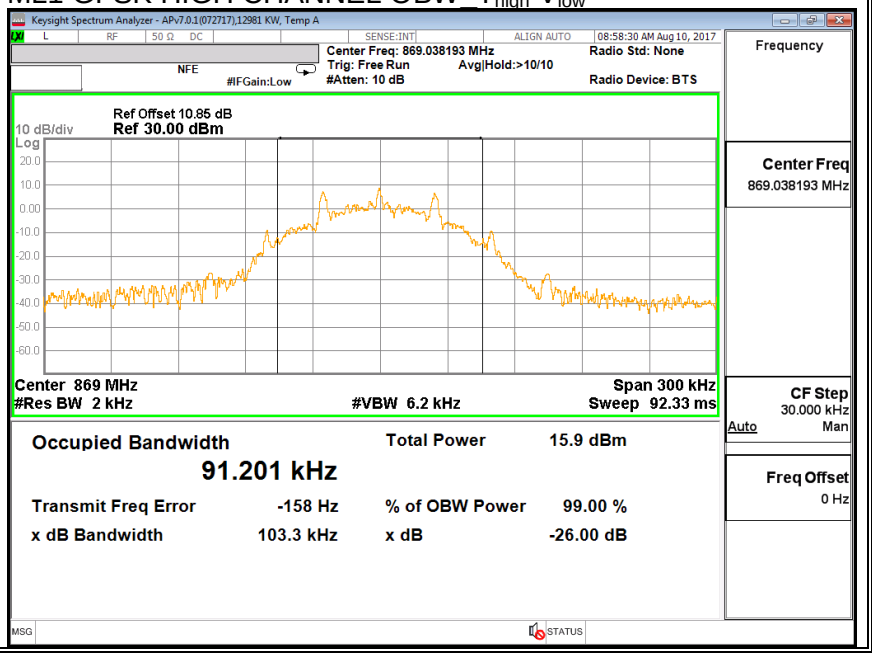
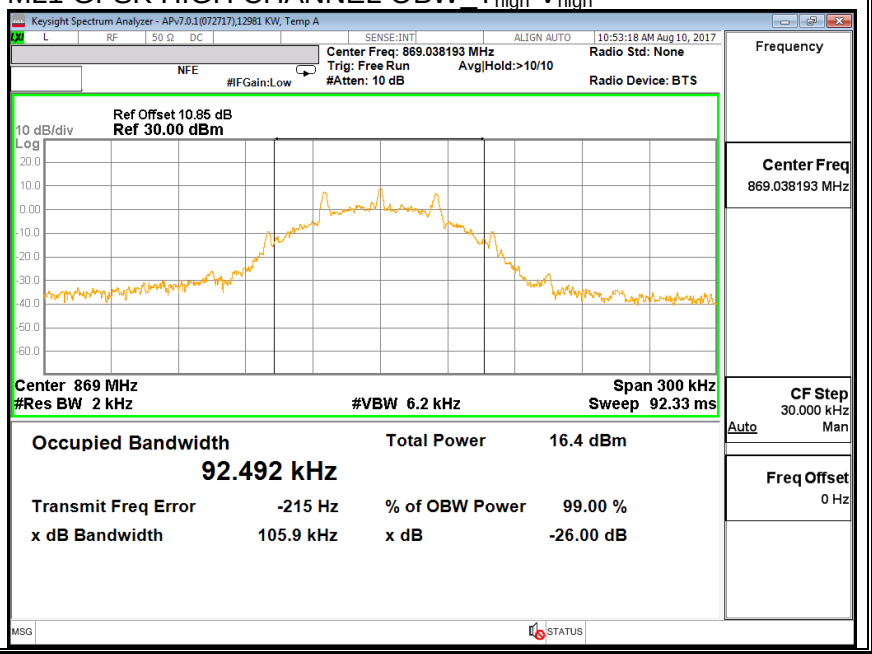
ML1 GFSK HIGH CHANNEL OBW_T_{high} V_{low}



ML1 GFSK HIGH CHANNEL OBW_T_{high} V_{high}



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7.3.4. TX OUT OF BAND EMISSIONS

REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.1

Two OOB domains are defined, one for OC (see Figure 5) and one for Operational Frequency band (see Figure 6). The spectrum masks for these two OOB domains may overlap.

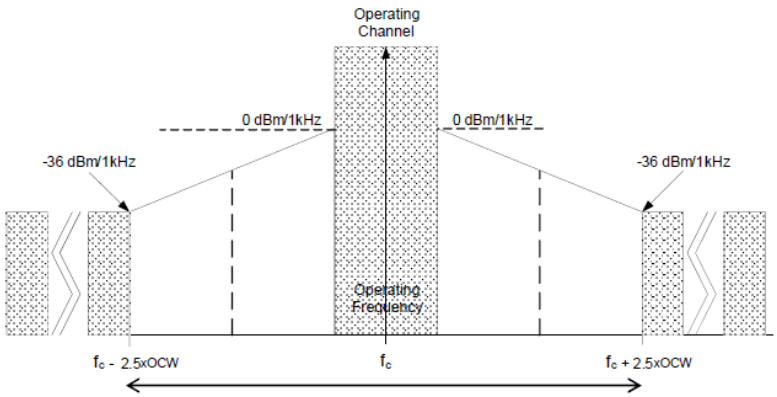

Figure 5: Out Of Band Domain for Operating Channel with reference BW

Unwanted emissions in the Out Of Band domain are those falling in the frequency range immediately below the lower, and above the upper, frequency of the Operating Channel. The OOB domain includes both frequencies outside the Operating Channel within the Operational Frequency Band and frequencies outside the Operational Frequency Band.
The relevant Out Of Band domain is shown in Figure 5 and applies within the Operational Frequency Band.

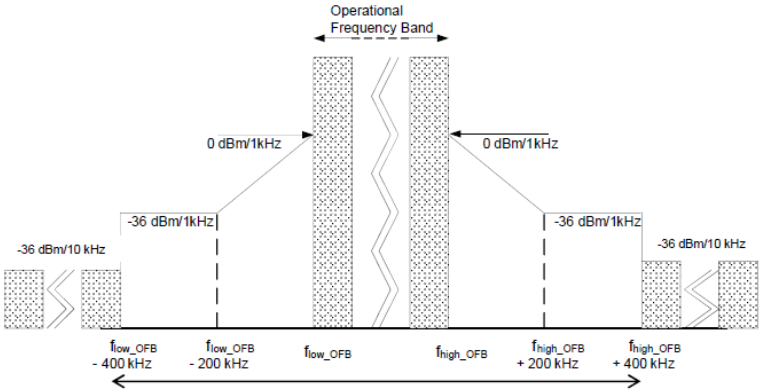

Figure 6: Out Of Band Domain for Operational Frequency Band with reference BW

Specific limits apply at frequencies immediately above and below the Operational Frequency Band as shown in Figure 6.
NOTE: f_{low}_OFB is the lower edge of the Operational Frequency Band. f_{high}_OFB is the upper edge of the Operational Frequency Band.

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REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.2

The EUT emissions level in OOB domains for the Operating Channel and the Operational Frequency Band shall be less or equal to Table 15 spectrum mask.

Table 15: Emission limits in the Out Of Band domains

Domain	Frequency Range	RBW_{REF}	Max power limit
OOB limits applicable to Operational Frequency Band (See Figure 6)	$f \le f_{low_OFB}$ - 400 kHz	10 kHz	-36 dBm
	F_{low_OFB} - 400 kHz ≤ f ≤ f_{low_OFB} - 200 kHz	1 kHz	-36 dBm
	f_{low} - 200 kHz ≤ f < f_{low_OFB}	1 kHz	See Figure 6
	$f = f_{low_OFB}$	1 kHz	0 dBm
	$f = f_{high_OFB}$	1 kHz	0 dBm
	F_{high_OFB} < f ≤ f_{high_OFB} + 200 kHz	1 kHz	See Figure 6
	F_{high_OFB} + 200 kHz ≤ f ≤ f_{high_OFB} + 400 kHz	1 kHz	-36 dBm
	F_{high_OFB} + 400 kHz ≤ f	10 kHz	-36 dBm
OOB limits applicable to Operating Channel (See Figure 5)	$f = f_c$- 2.5 x OCW	1 kHz	-36 dBm
	f_c - 2,5 x OCW ≤ f ≤ f_c - 0,5 x OCW	1 kHz	See Figure 5
	$f = f_c$ - 0,5 x OCW	1 kHz	0 dBm
	$f = f_c$ + 0,5 x OCW	1 kHz	0 dBm
	f_c + 0,5 x OCW ≤ f ≤ f_c + 2,5 x OCW	1 kHz	See Figure 5
	$f = f_c$+ 2,5 x OCW	1 kHz	-36 dBm

NOTE: f is the measurement frequency.
f_c is the Operating Frequency.
F_{low_OFB} is the lower edge of the Operational Frequency Band.
F_{high_OFB} is the upper edge of the Operational Frequency Band.
OCW is the operating channel bandwidth.

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.3.3 (Conducted Measurement)

RESULTS

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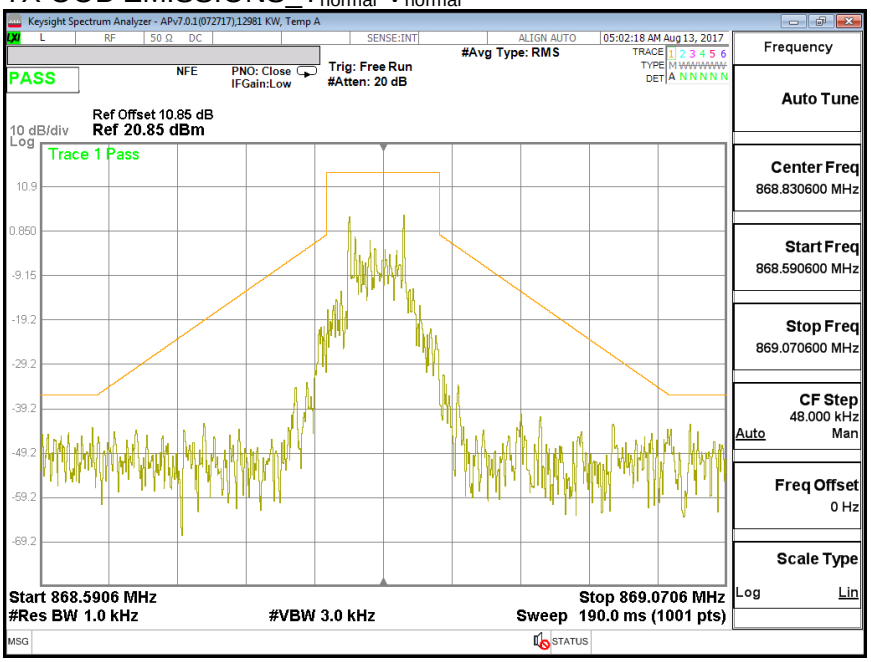
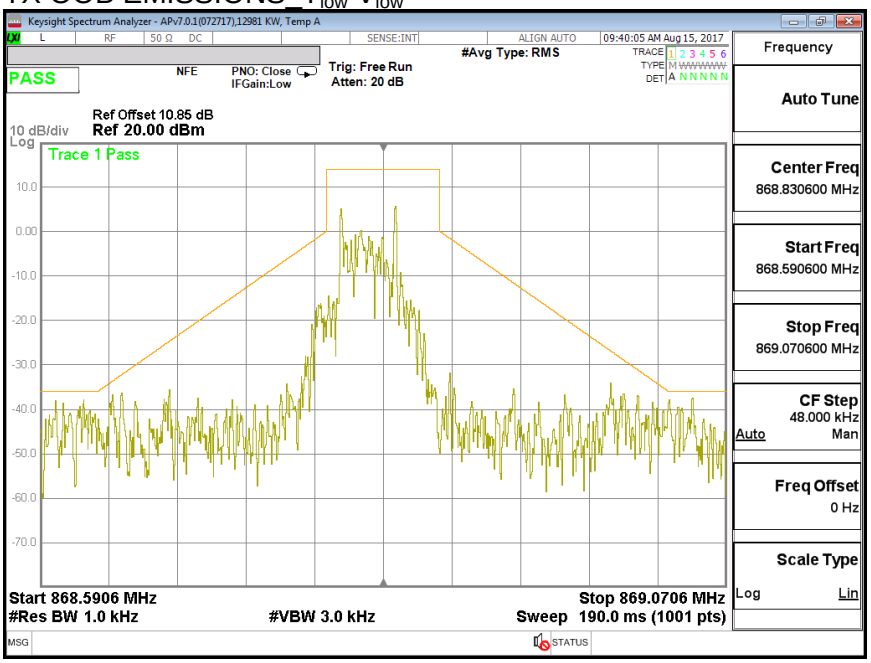
TX OUT OF BAND EMISSIONS (APPLICABLE TO OPERATING CHANNEL)

M7 LOW CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal}



TX OOB EMISSIONS_T_{low} V_{low}



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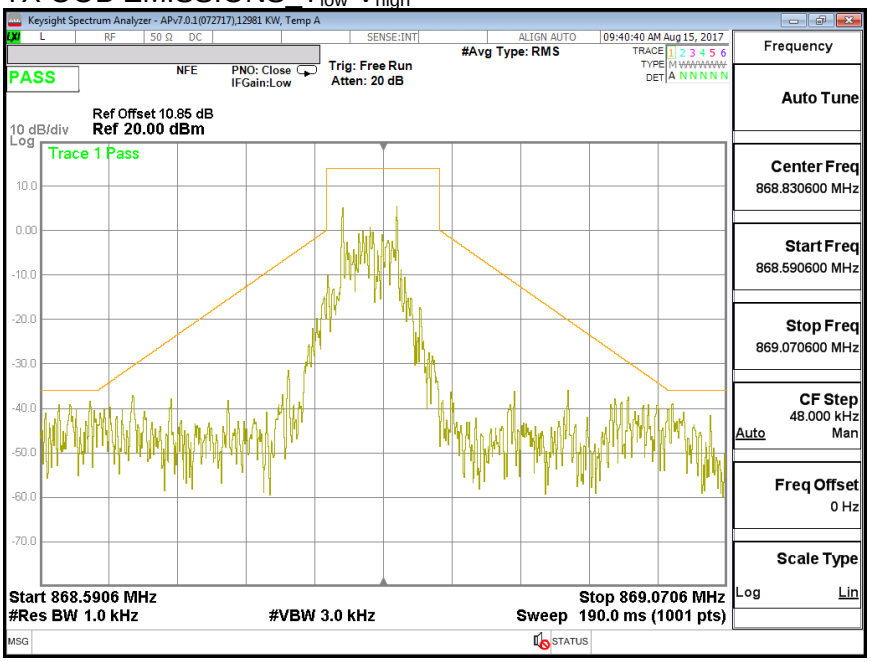
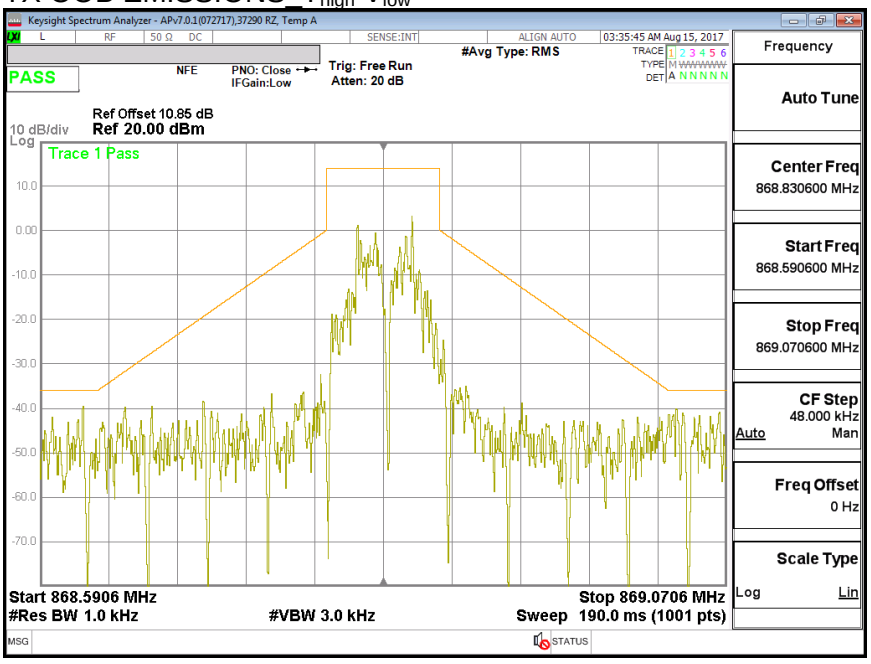
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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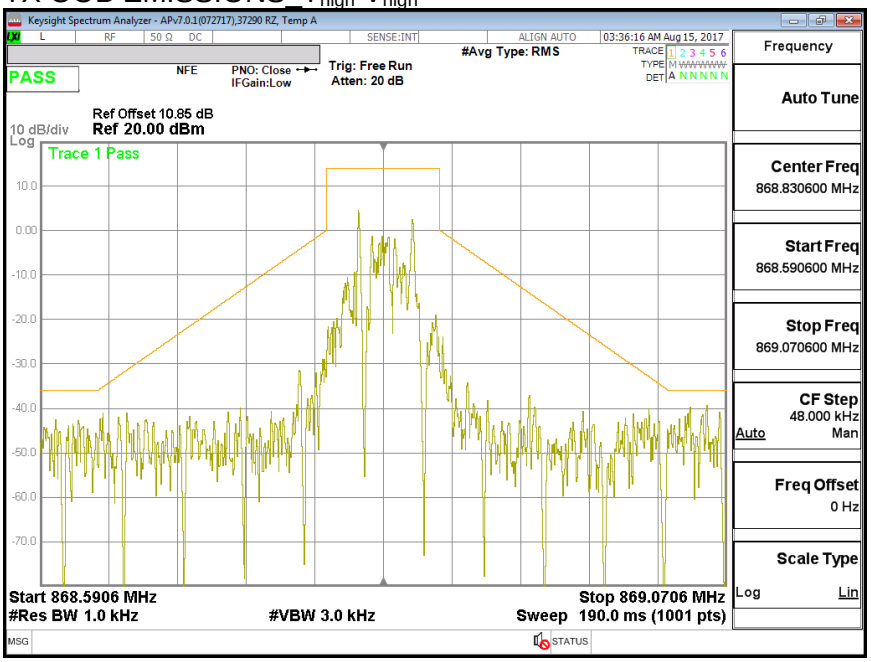
TX OOB EMISSIONS_T_{high} V_{high}



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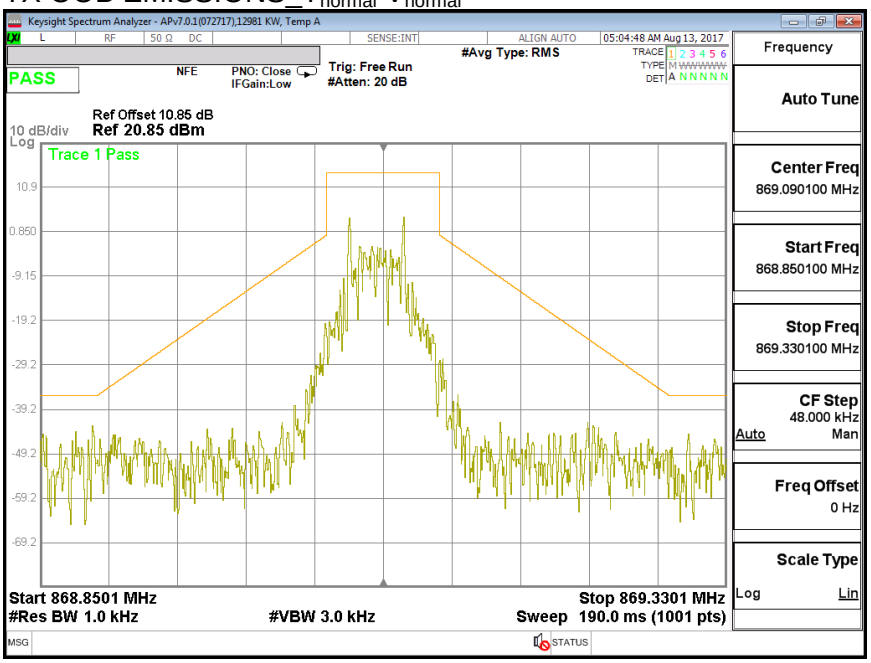
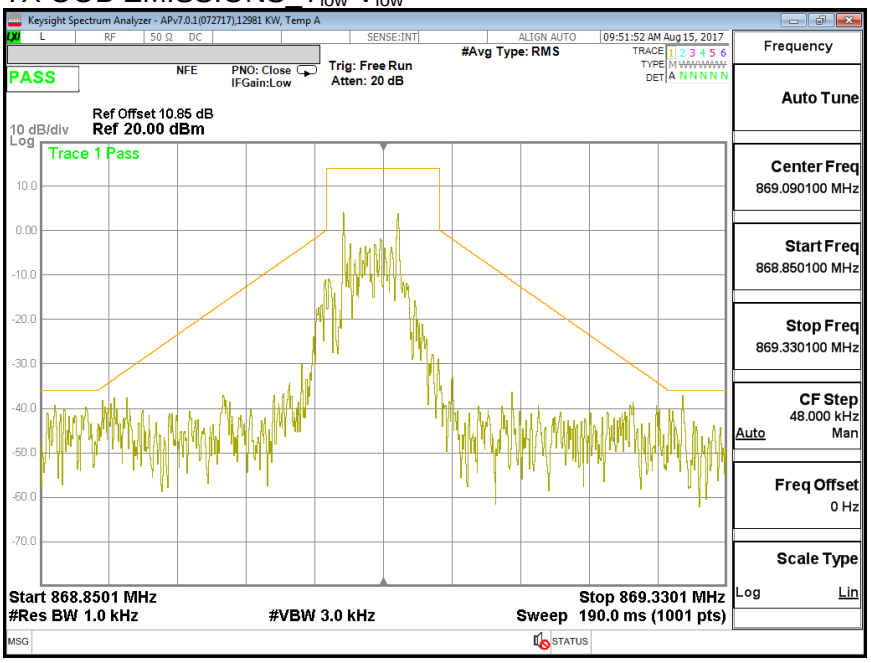
M7 HIGH CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal}



TX OOB EMISSIONS_T_{low} V_{low}



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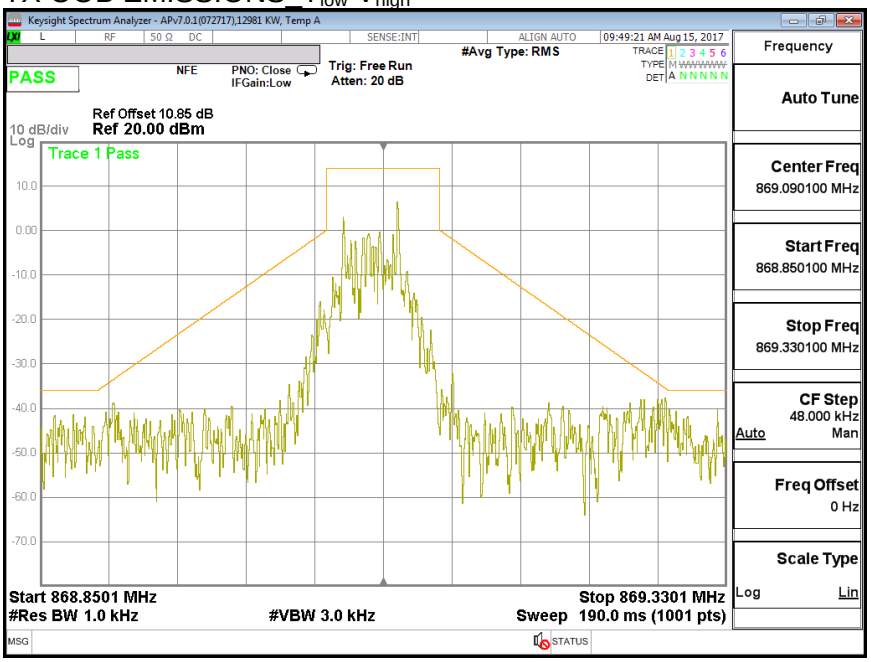
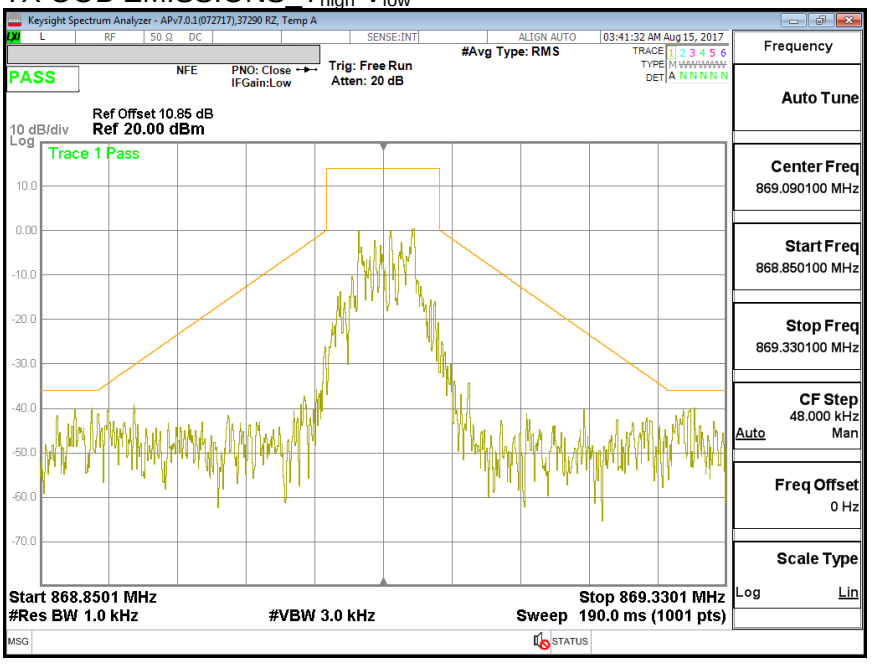
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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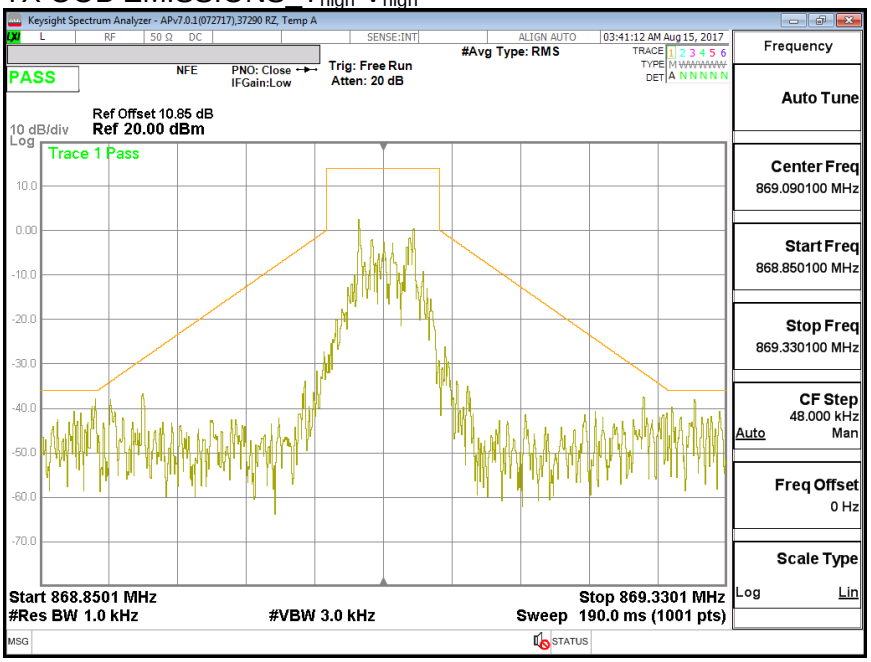
TX OOB EMISSIONS_T_{high} V_{high}



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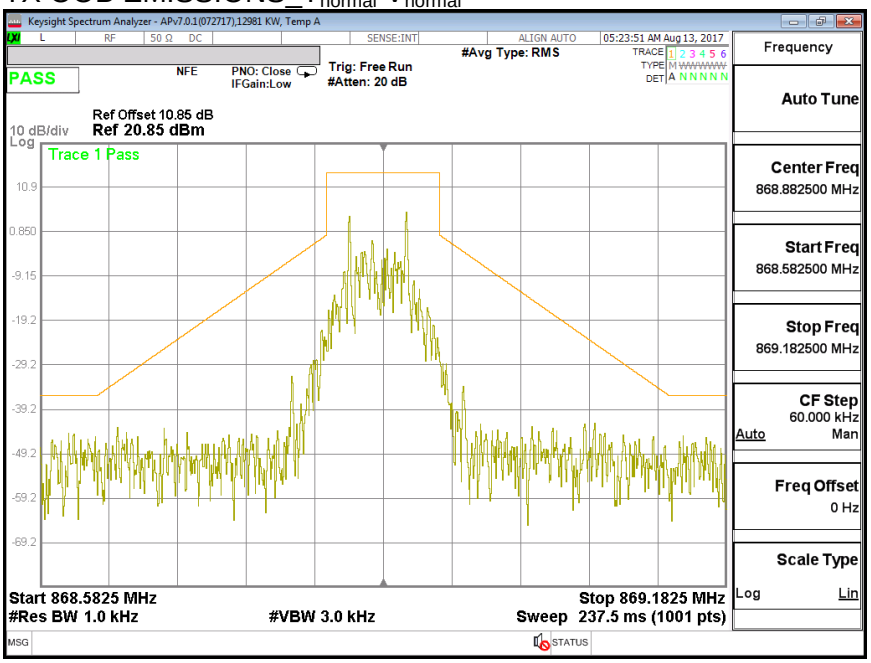
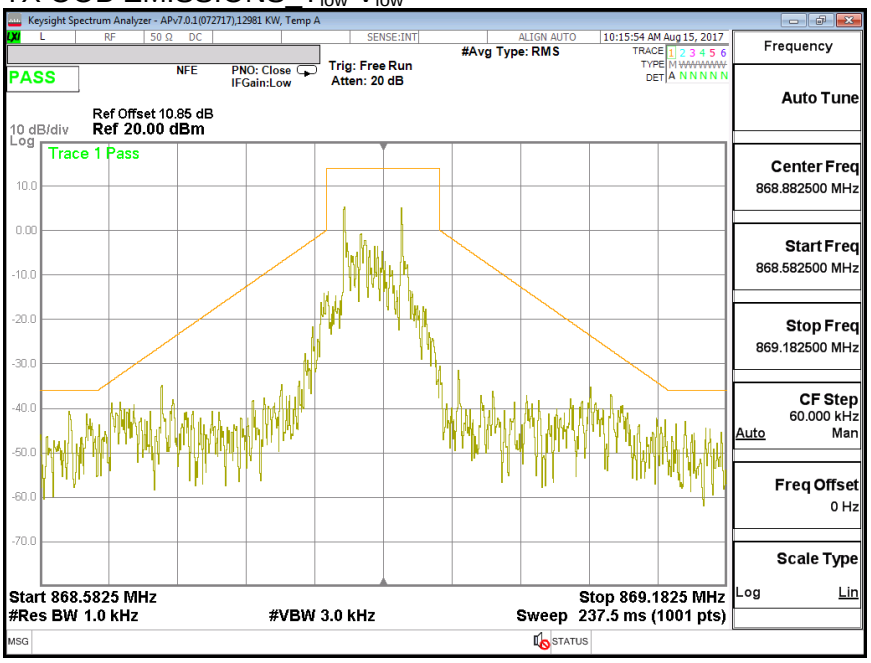
ML1 LOW CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$



TX OOB EMISSIONS_T$_{low}$ V$_{low}$



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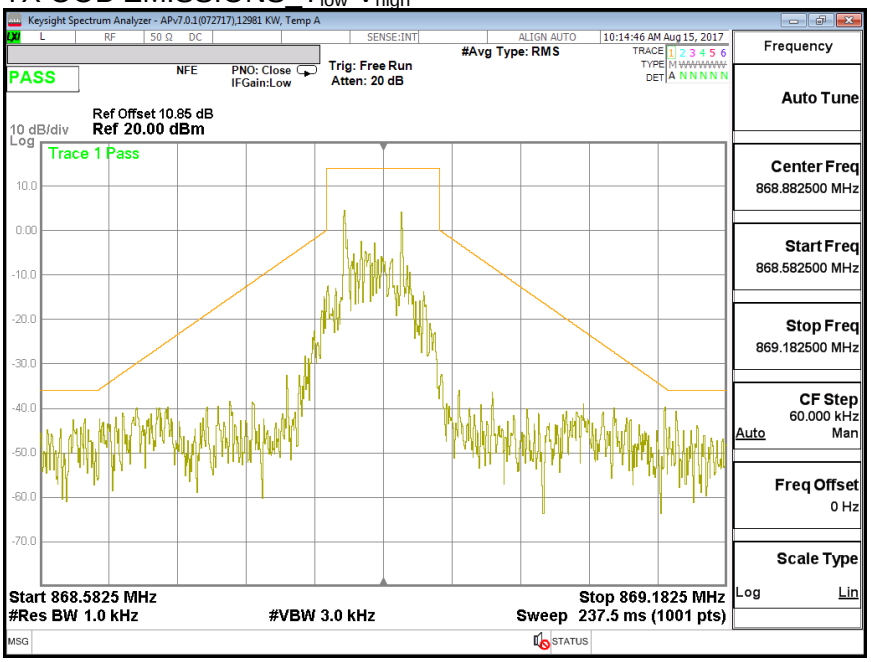
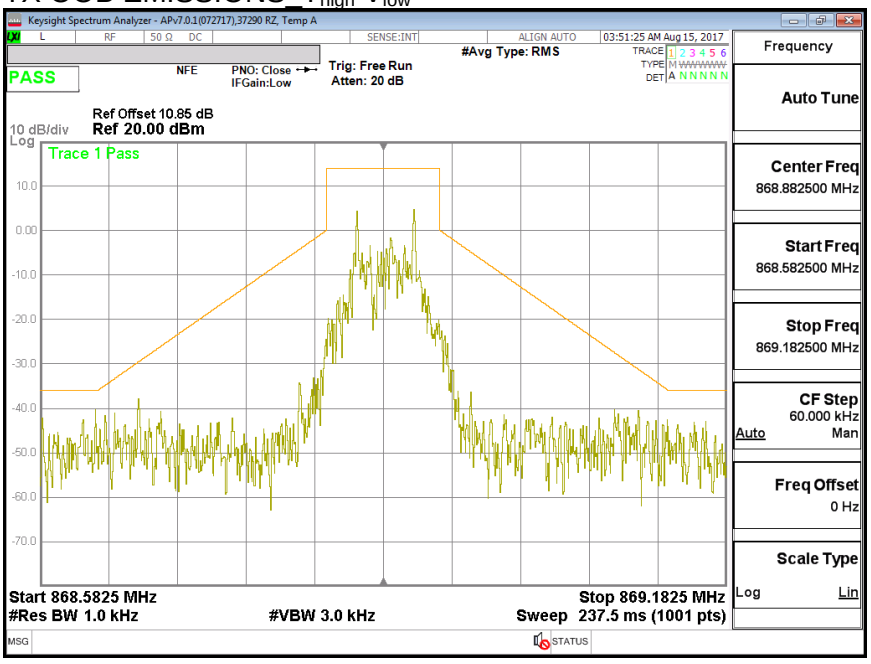
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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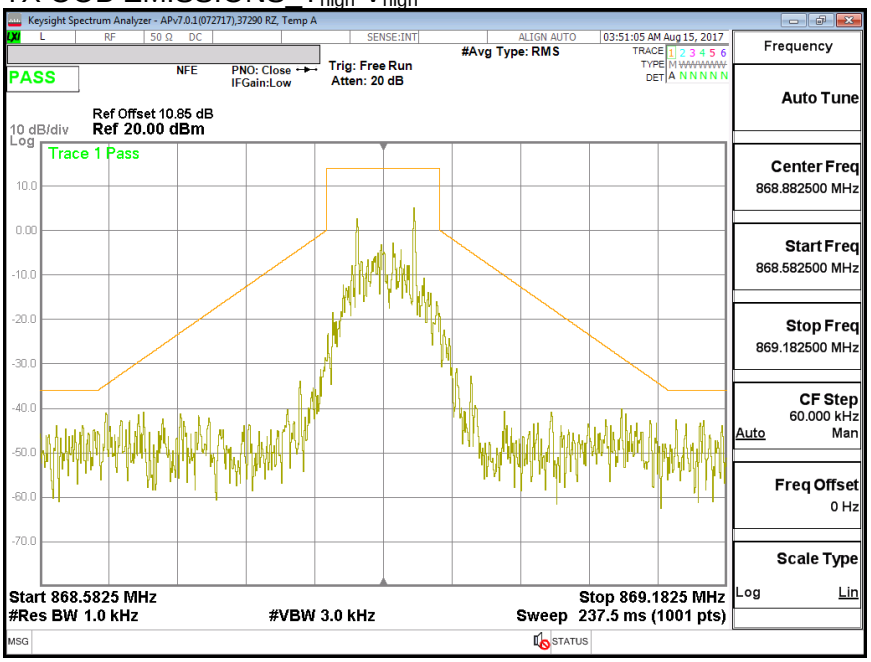
TX OOB EMISSIONS_T_{high} V_{high}



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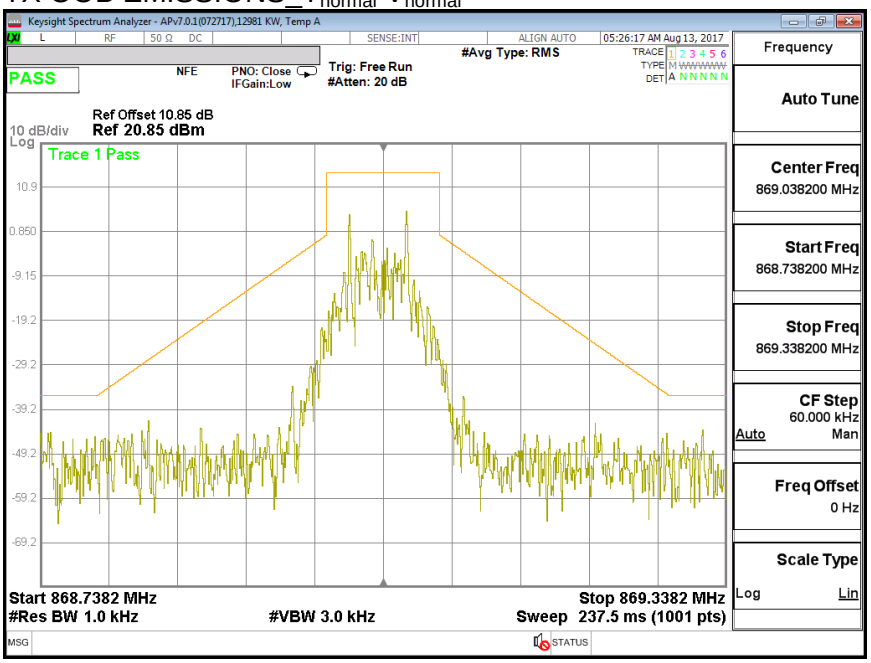
ML1 HIGH CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal}



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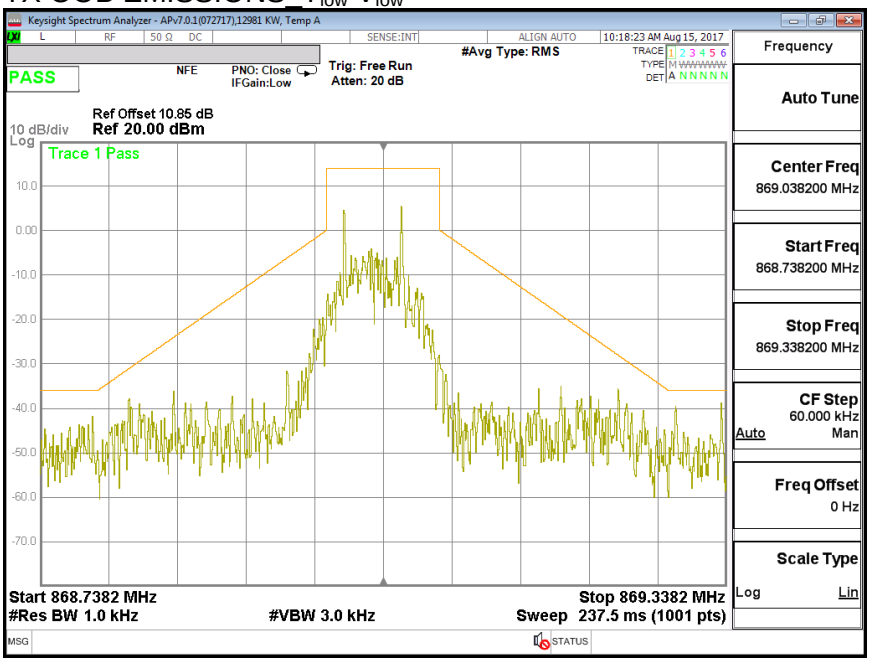

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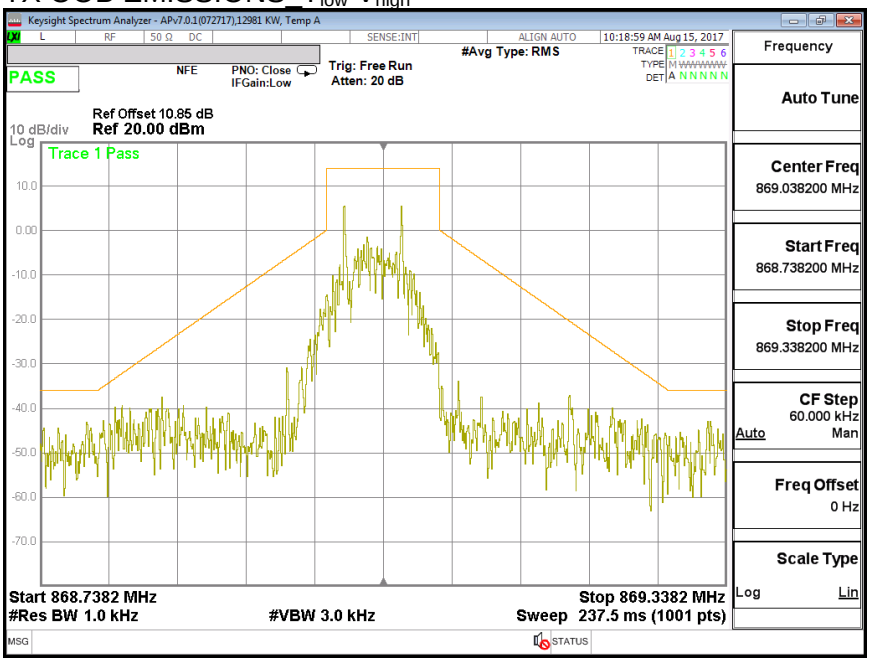
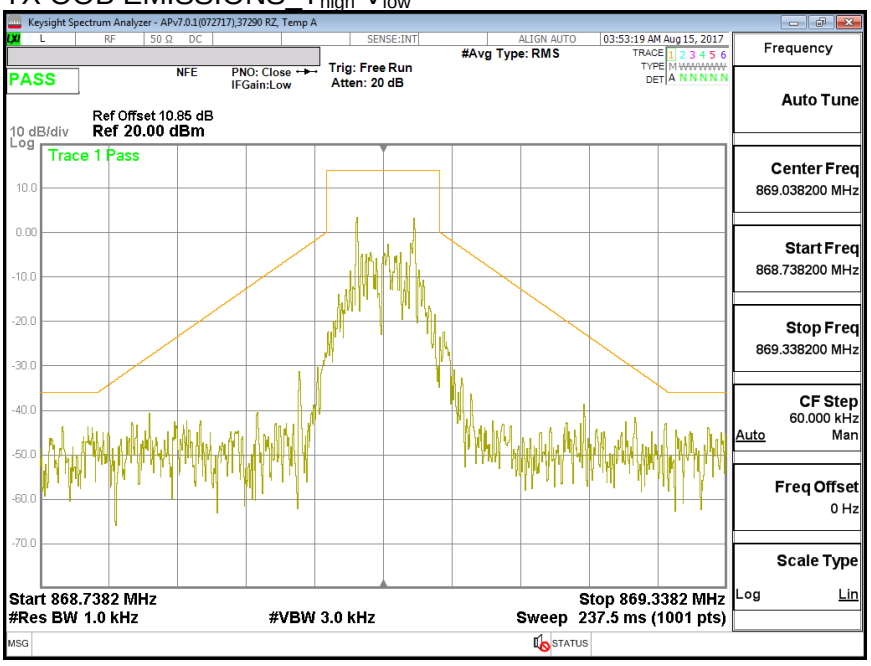
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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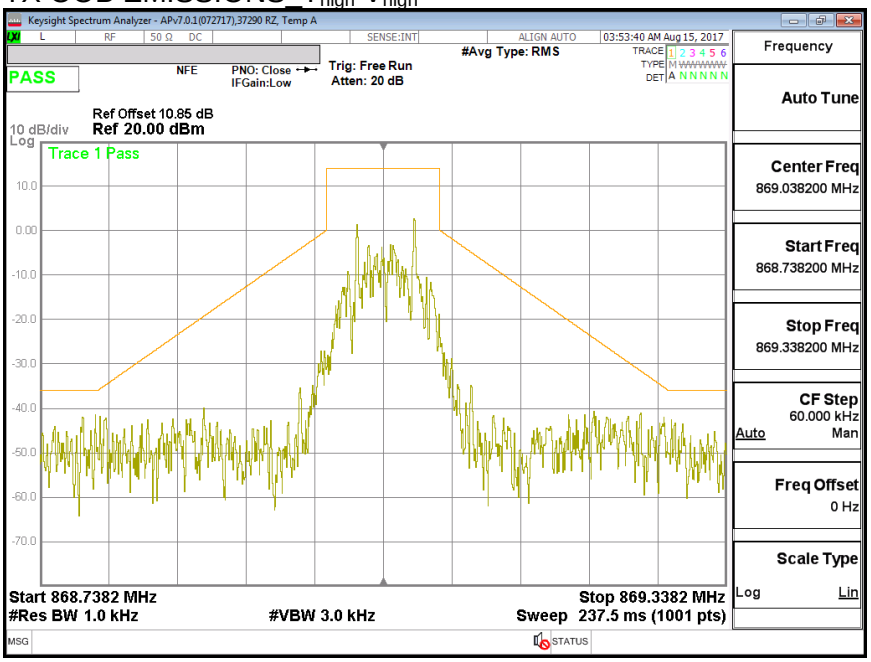
TX OOB EMISSIONS_T_{high} V_{high}



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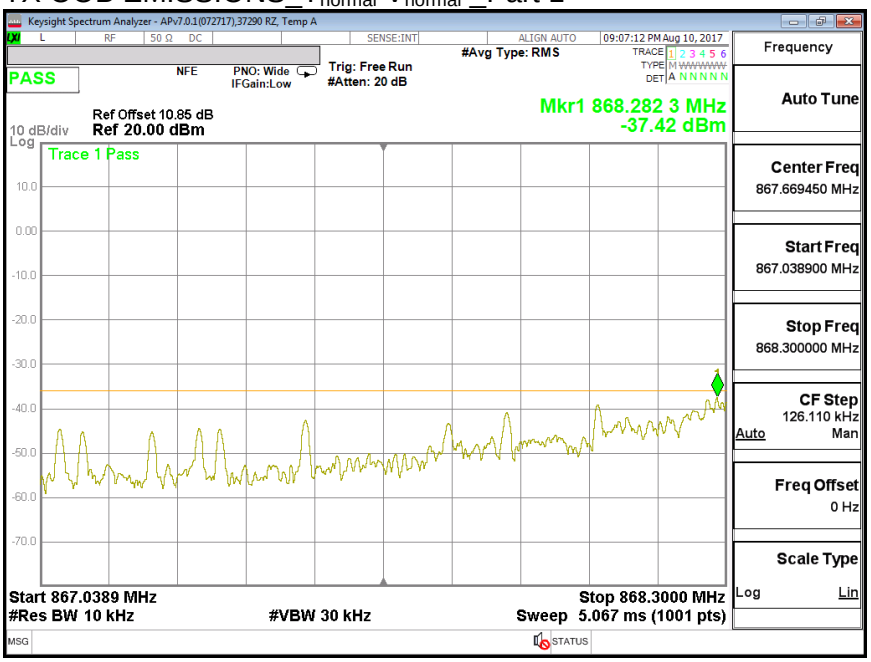
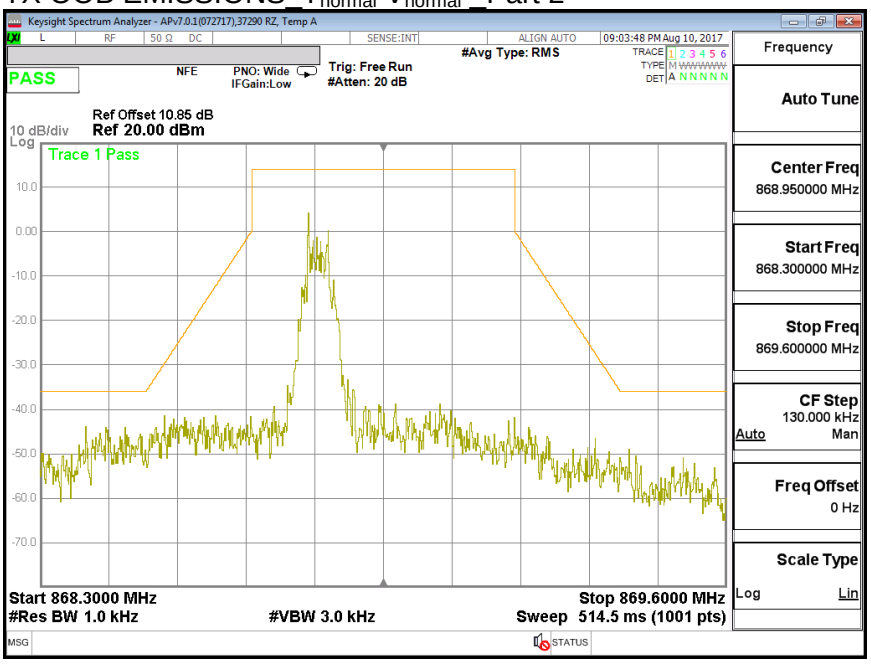
TX OUT OF BAND EMISSIONS (APPLICABLE TO OPERATIONAL FREQUENCY BANDS)

M7 LOW CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal} _Part 1



TX OOB EMISSIONS_T_{normal} V_{normal} _Part 2



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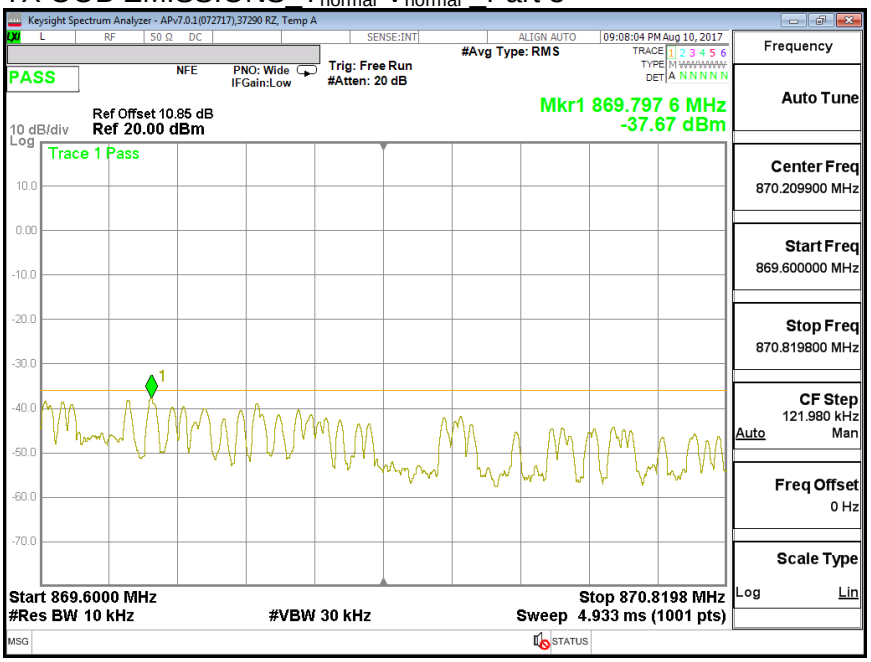
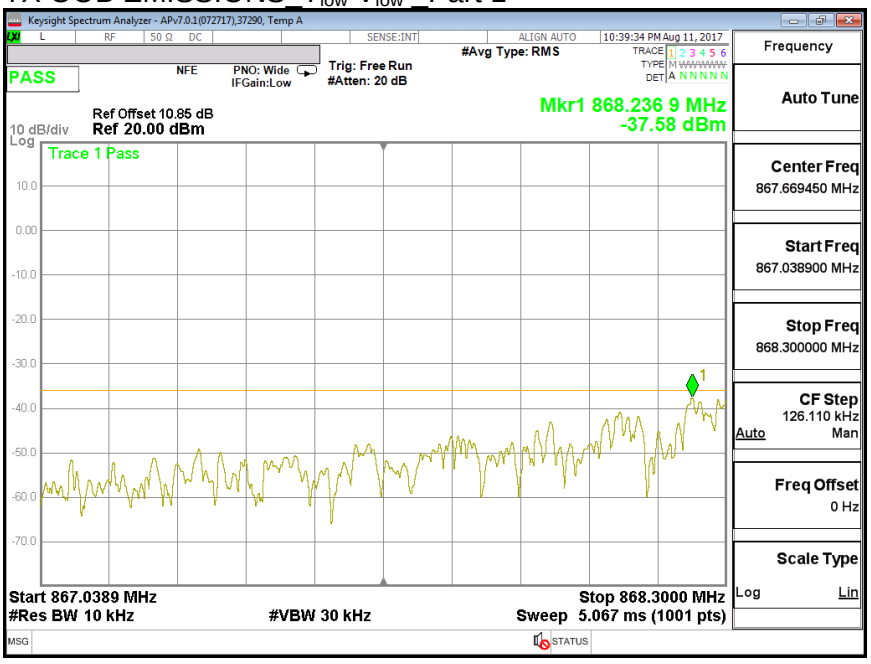
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3



TX OOB EMISSIONS_T_{low} V_{low} _Part 1



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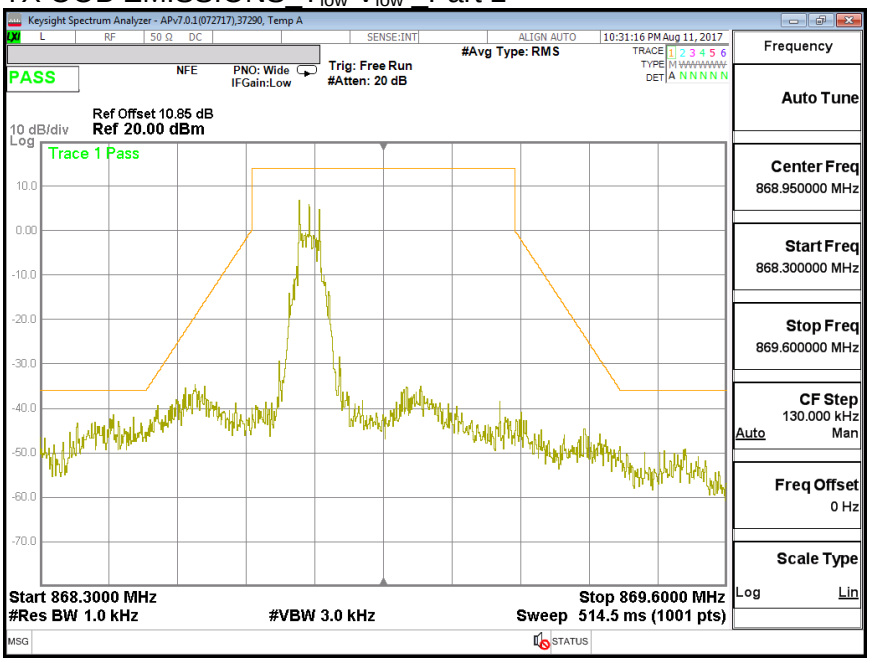

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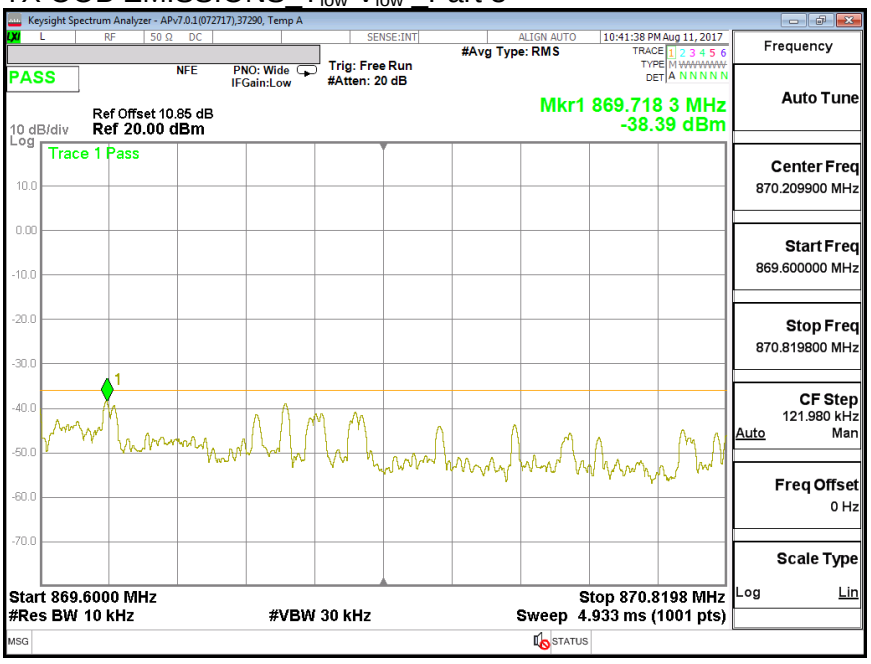

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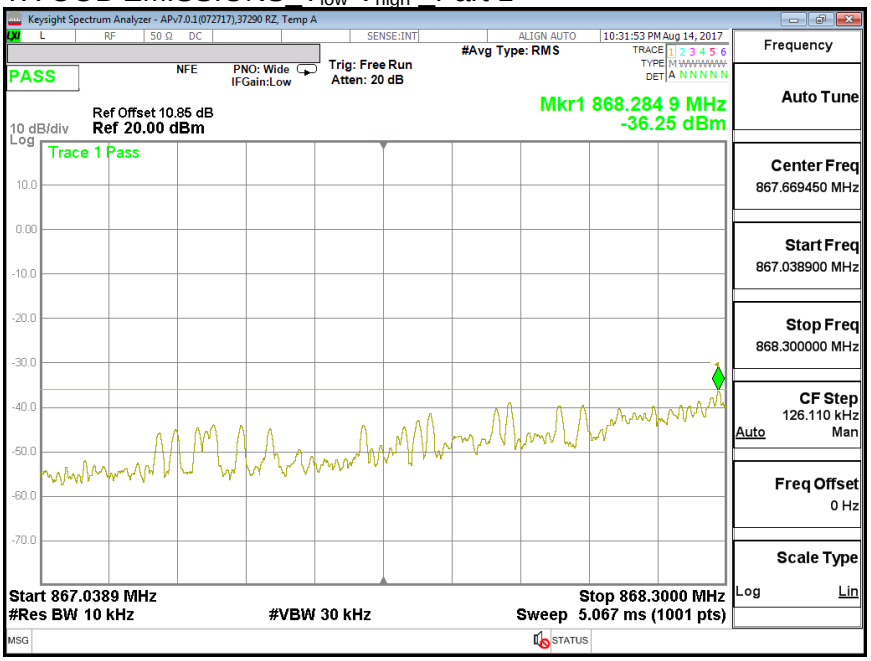
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



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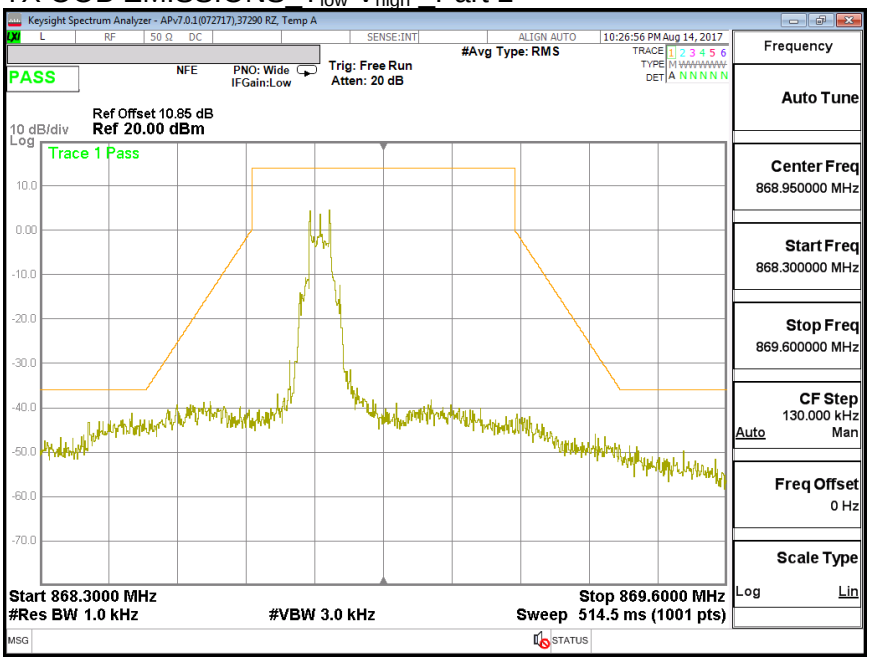

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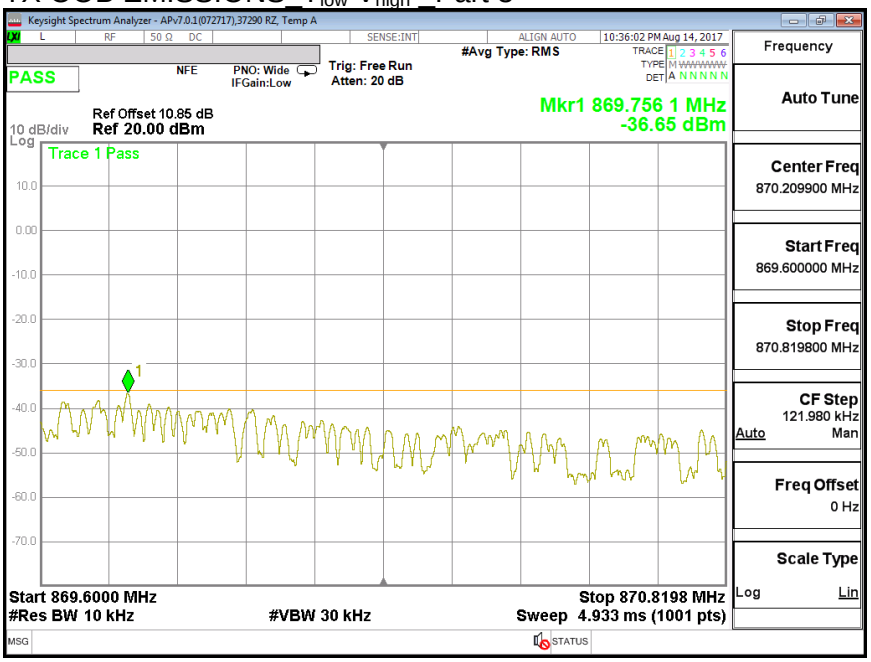
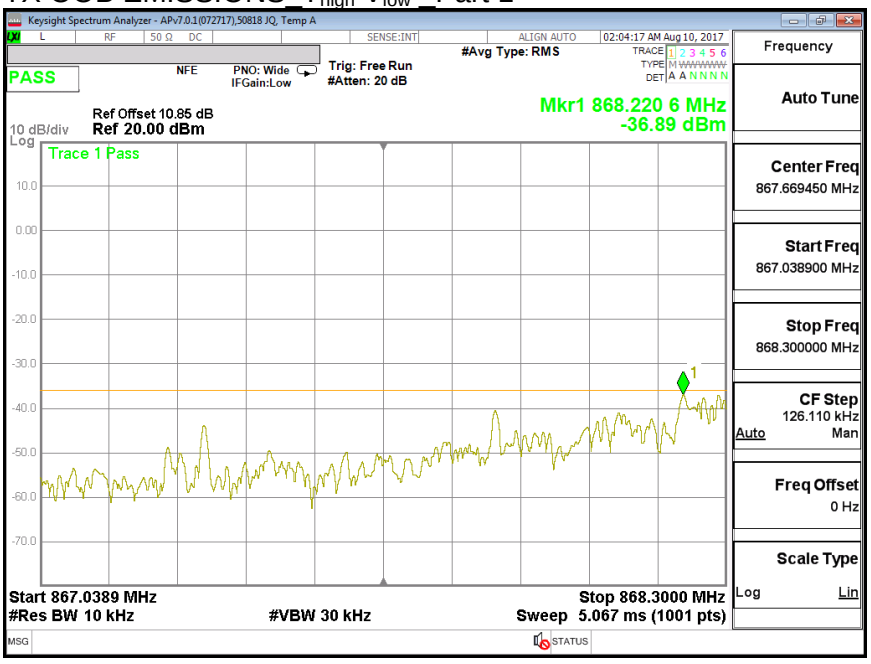


TX OOB EMISSIONS_T_{high} V_{low} _Part 1



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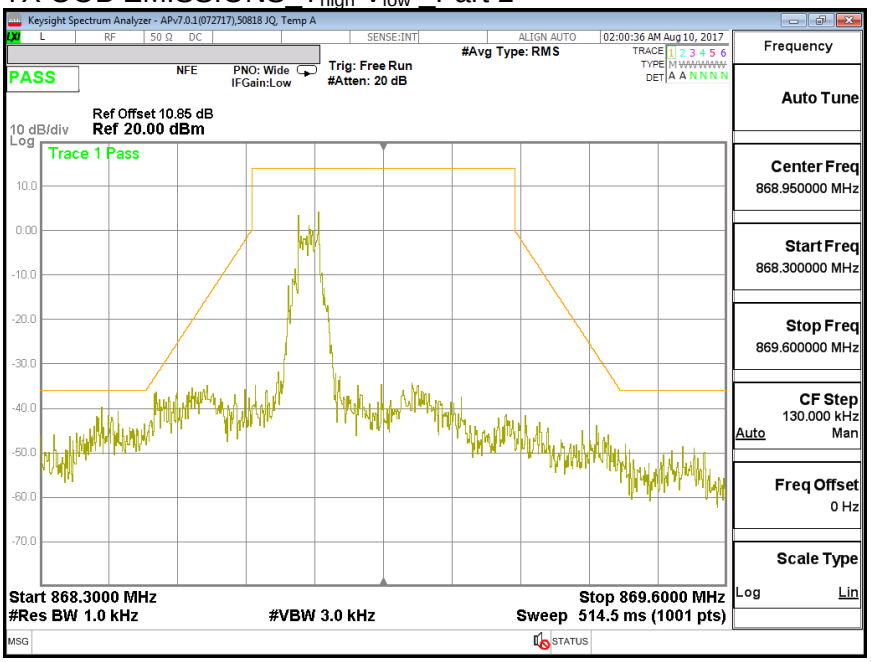
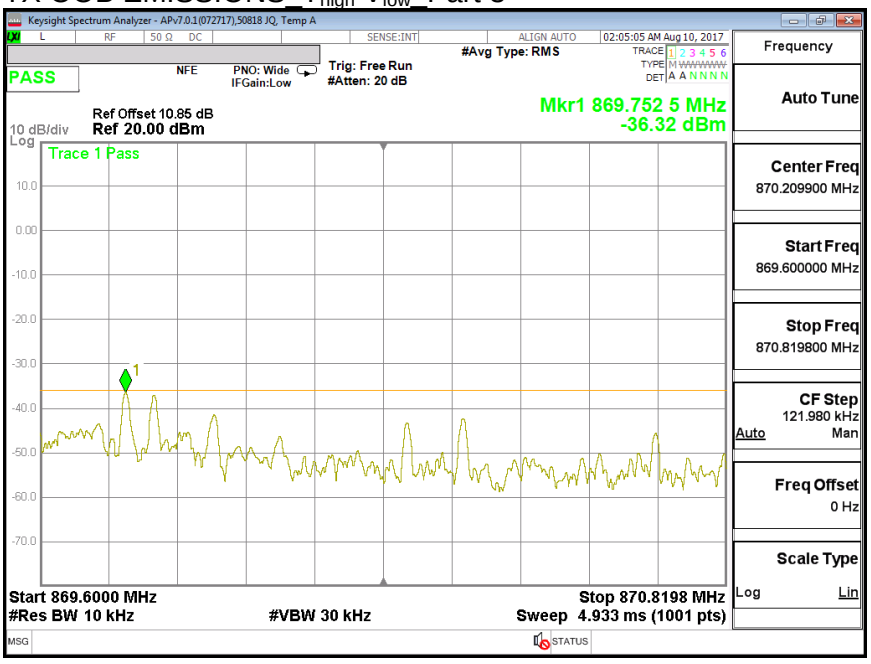
TX OOB EMISSIONS_T_{high} V_{low} _Part 2



TX OOB EMISSIONS_T_{high} V_{low}_Part 3



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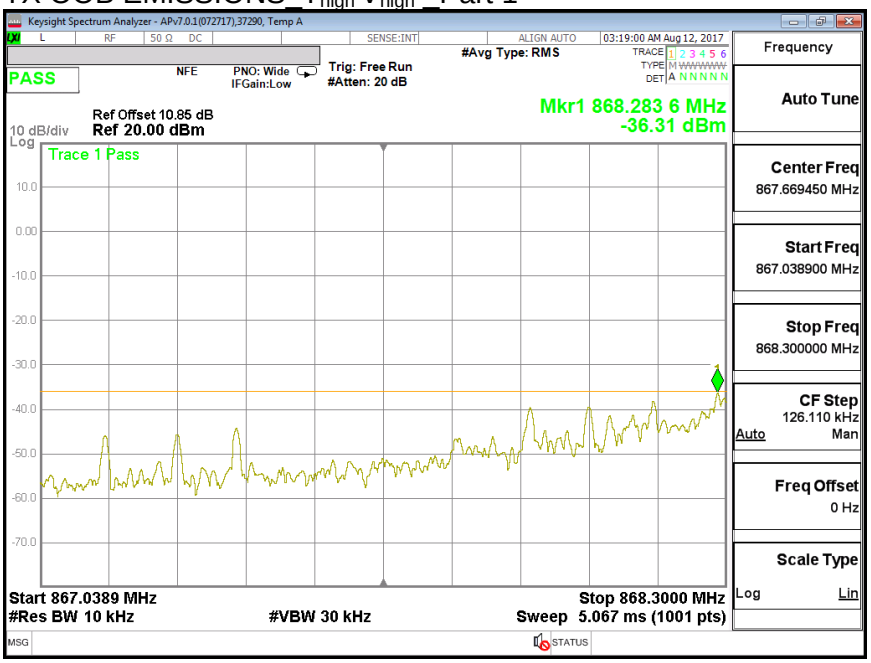
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



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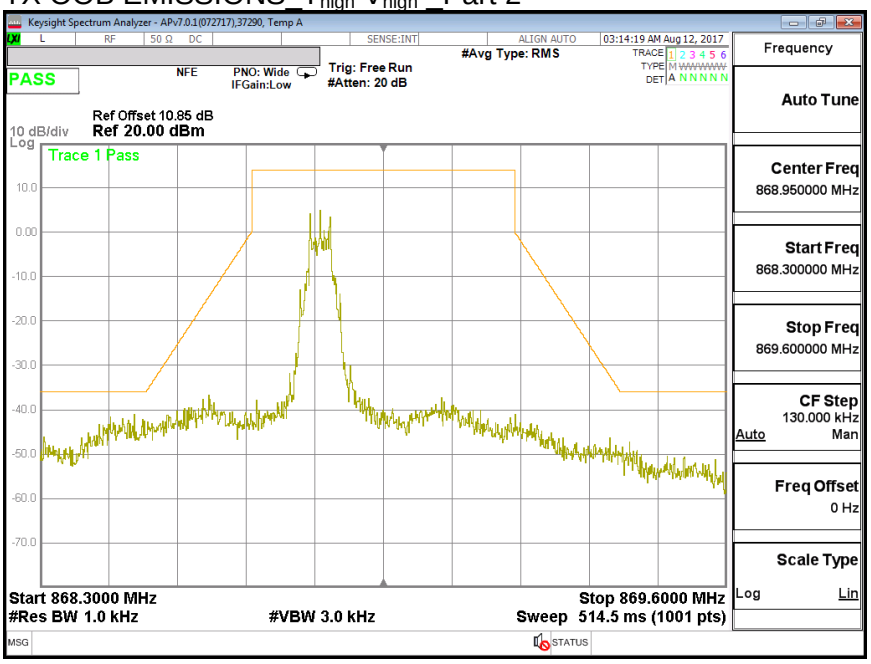

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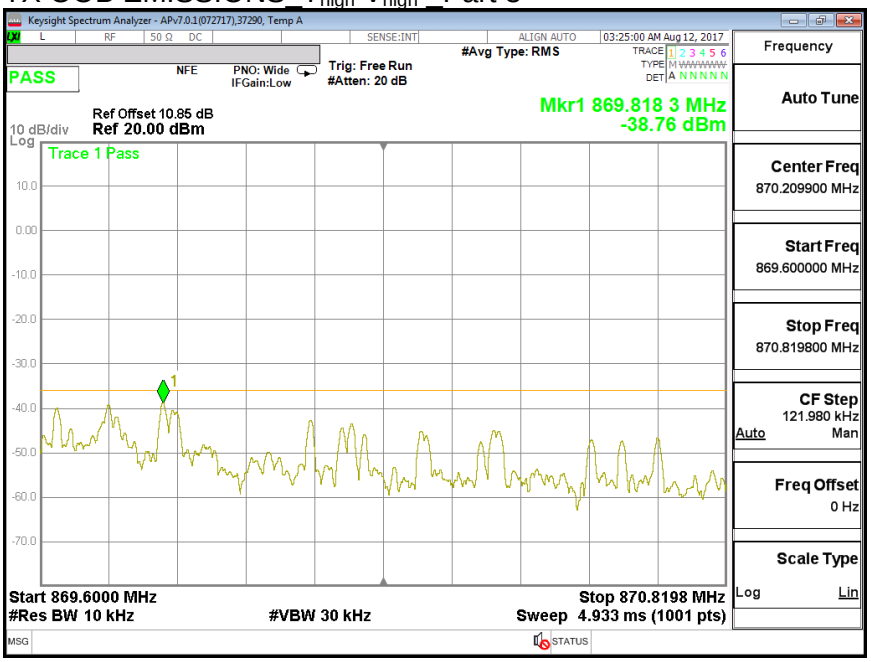
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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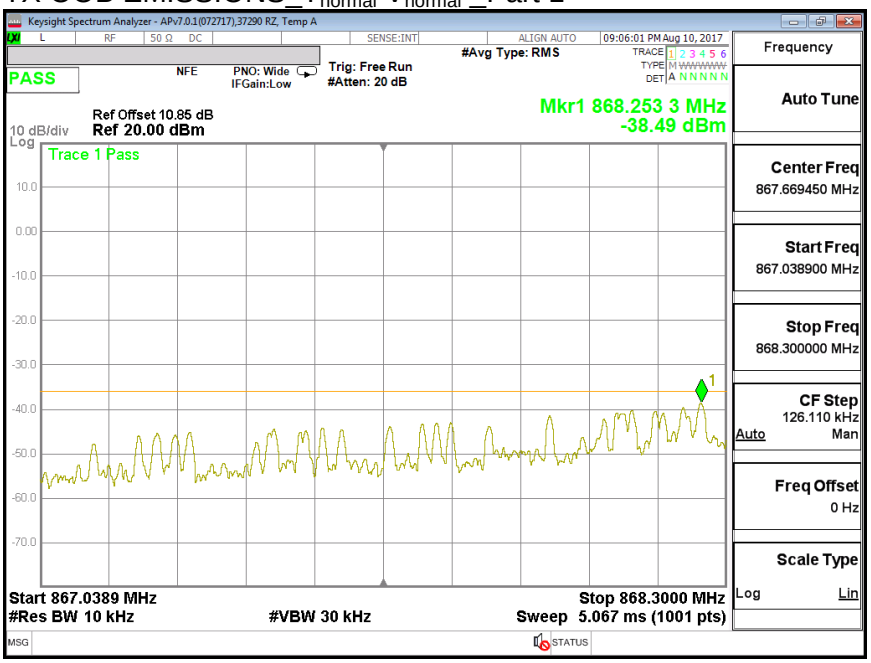
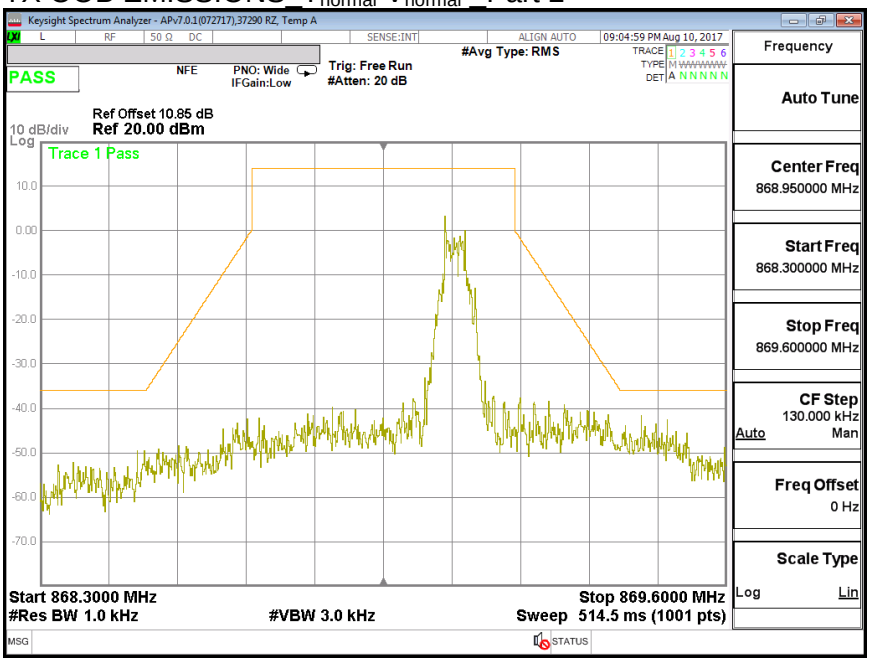
M7 HIGH CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 1



TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 2



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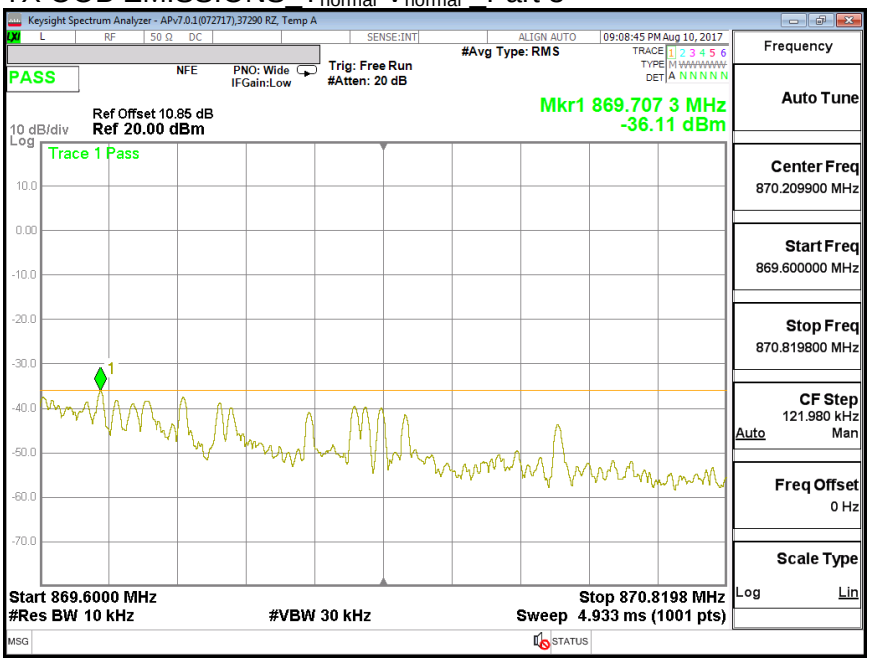
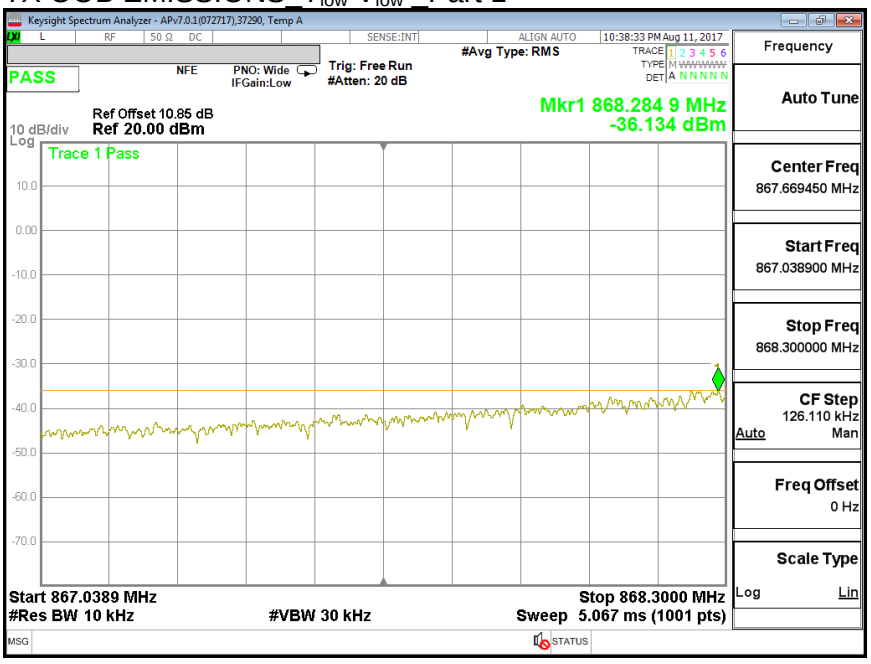
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3



TX OOB EMISSIONS_T_{low} V_{low} _Part 1



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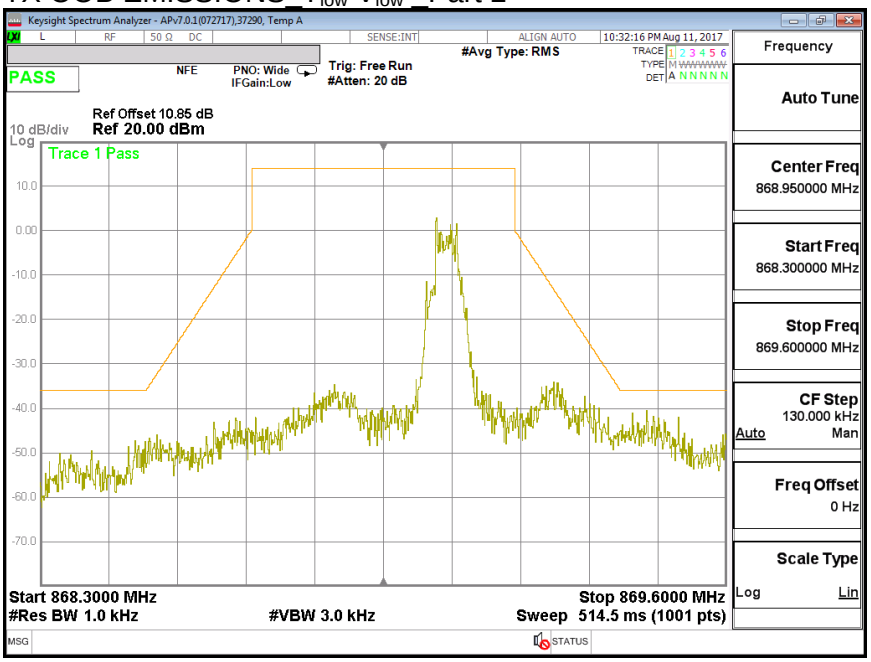
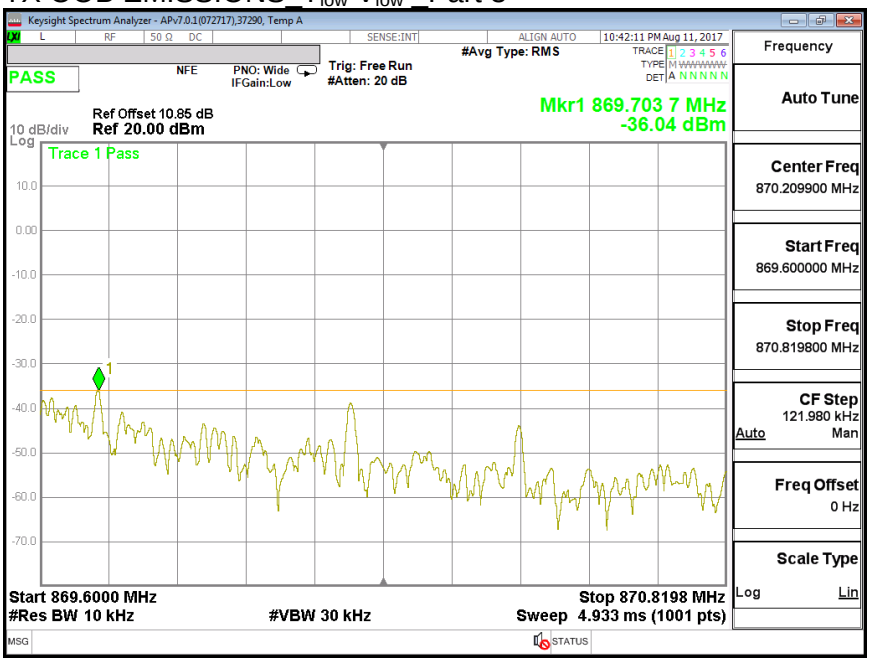
TX OOB EMISSIONS_T_{low} V_{low} _Part 2



TX OOB EMISSIONS_T_{low} V_{low} _Part 3



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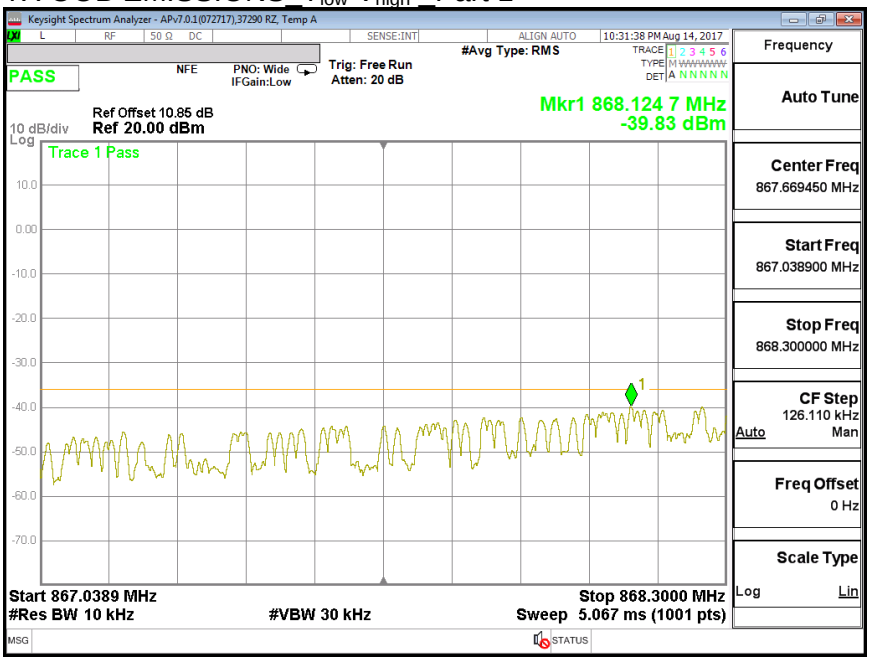
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



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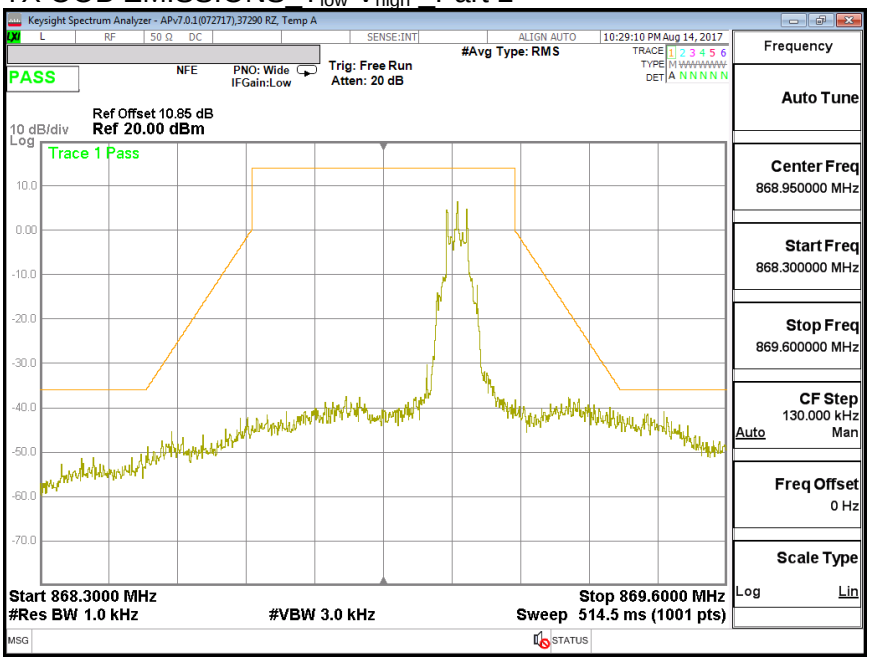

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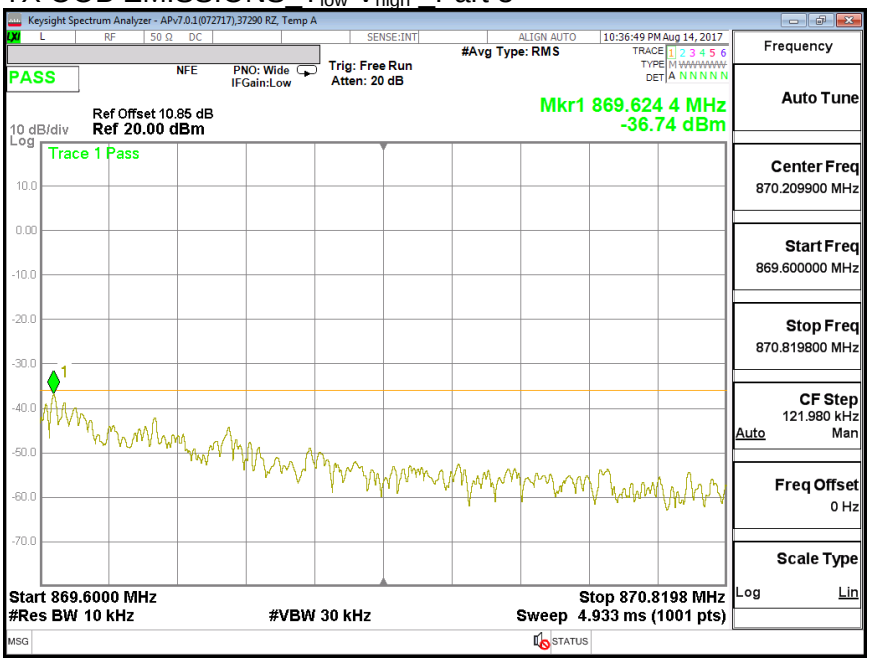
TX OOB EMISSIONS_T_{low} V_{high} _Part 3



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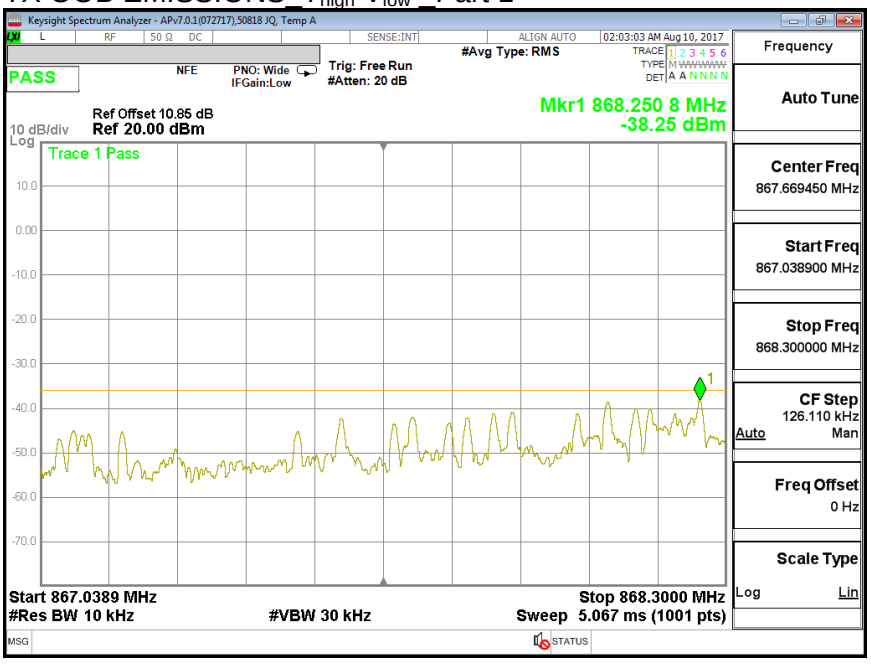

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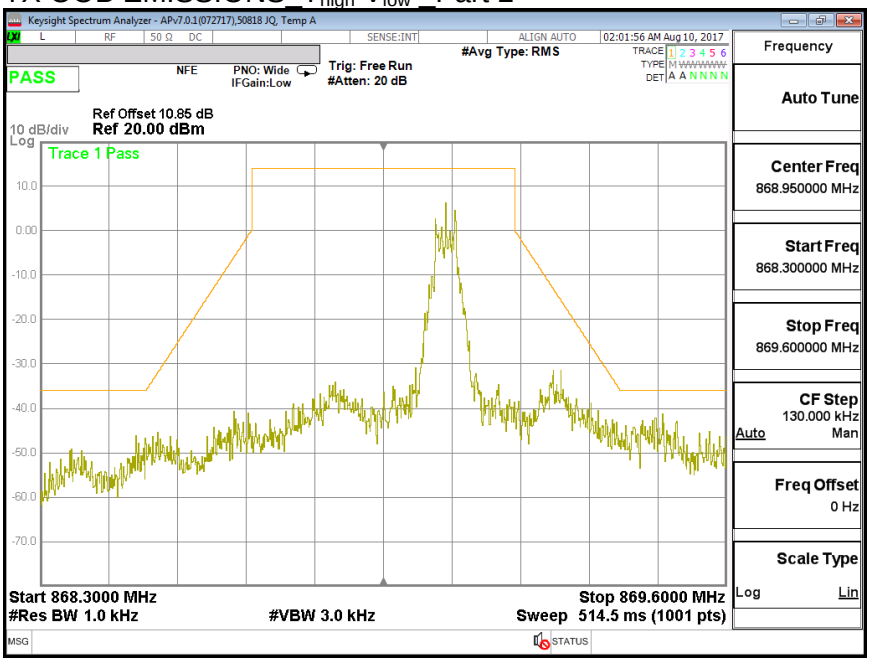

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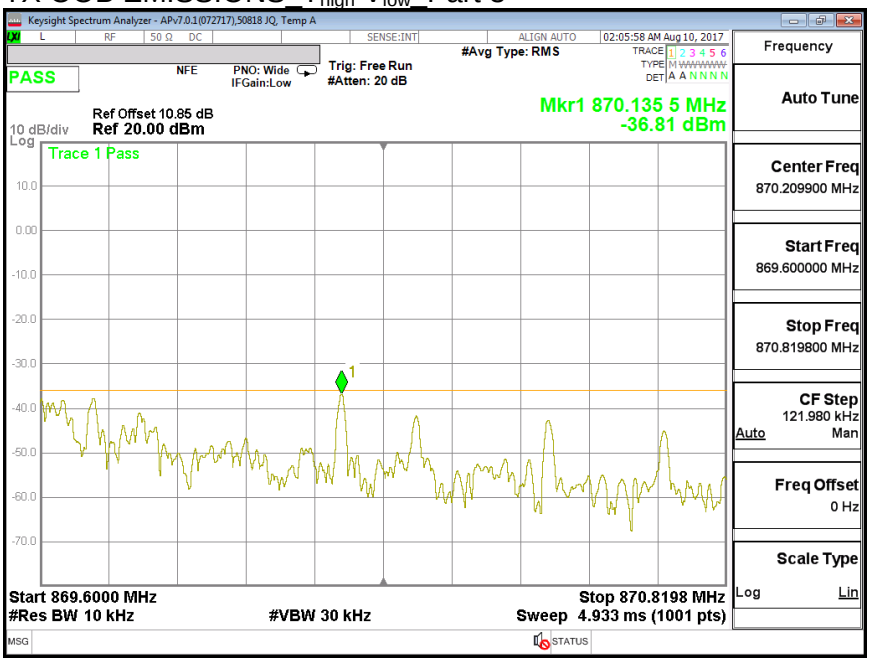

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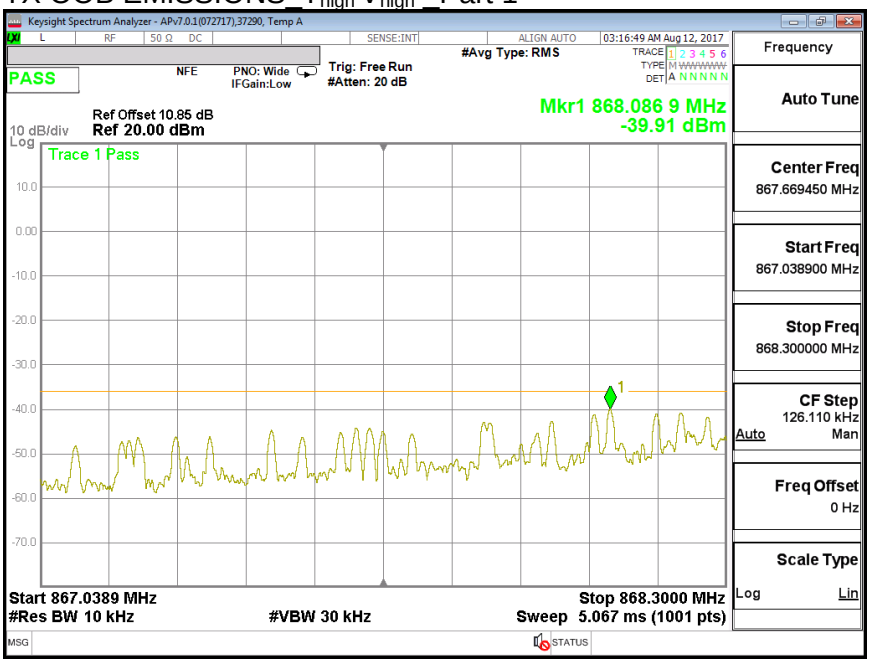
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



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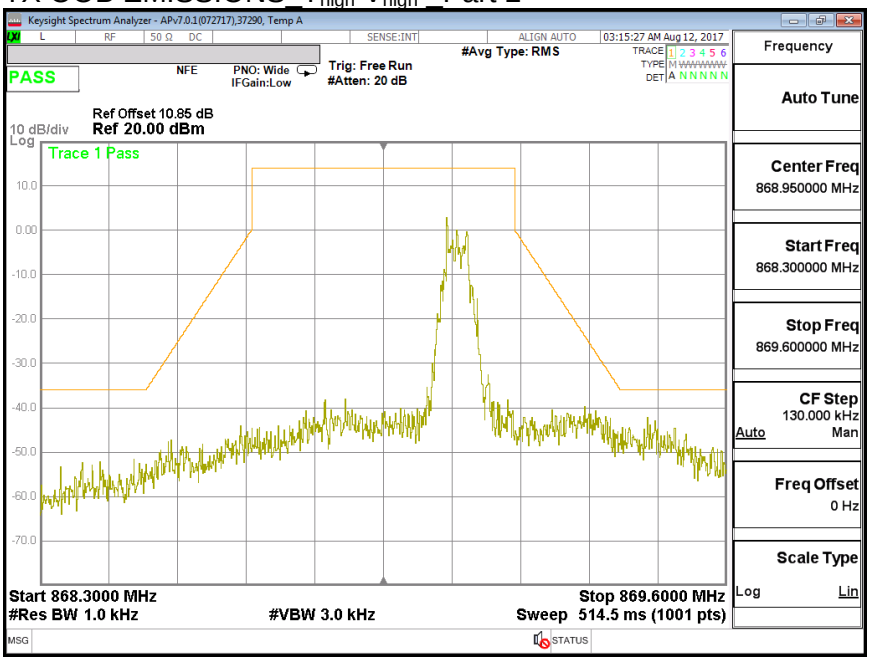

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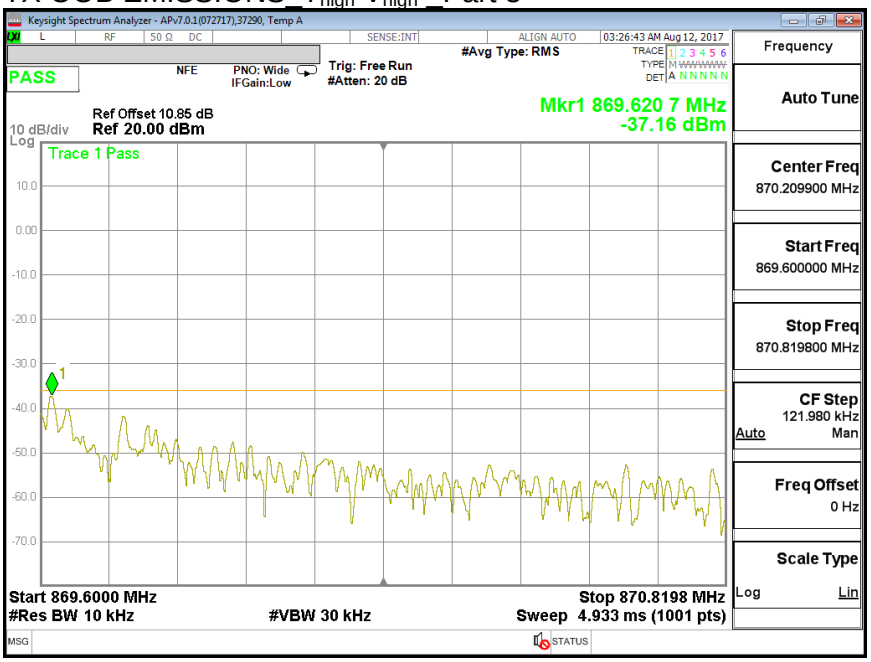
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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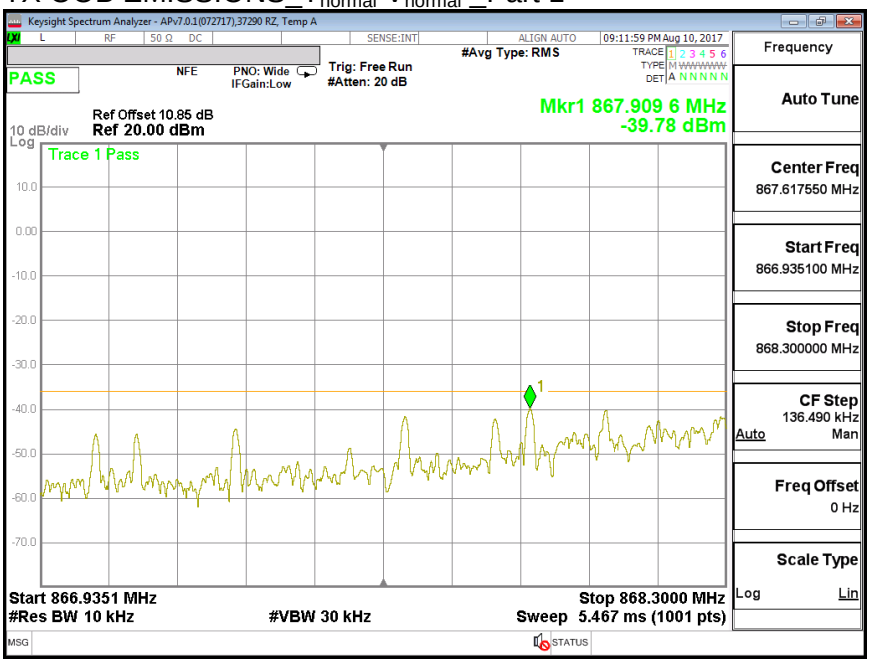
ML1 LOW CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 1



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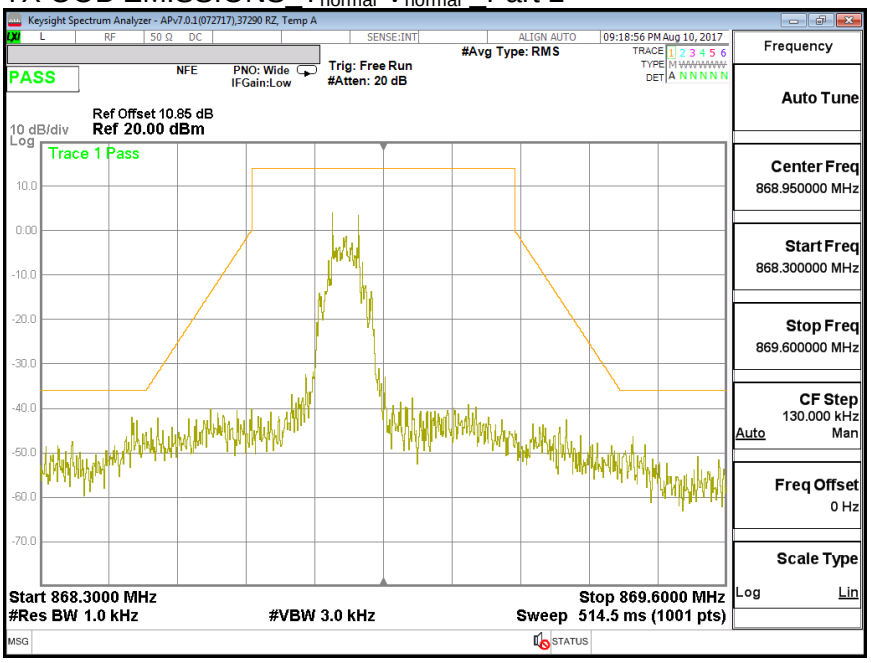

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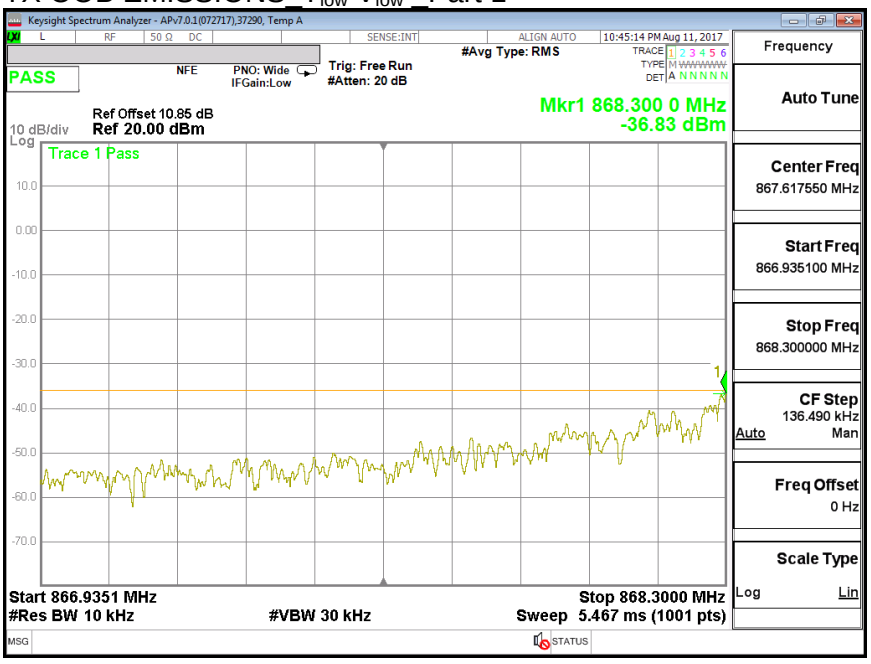
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3

TX OOB EMISSIONS_T_{low} V_{low} _Part 1



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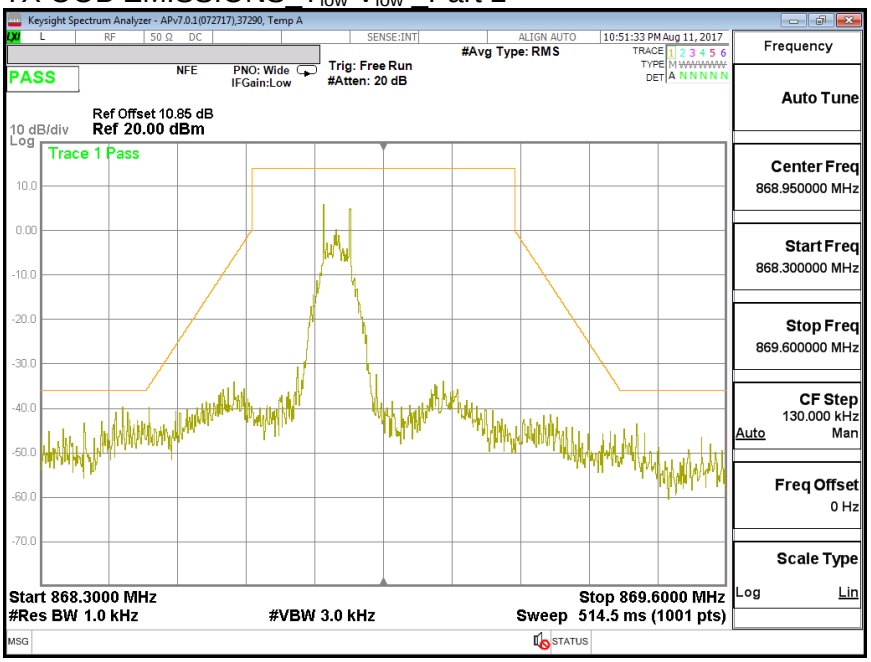

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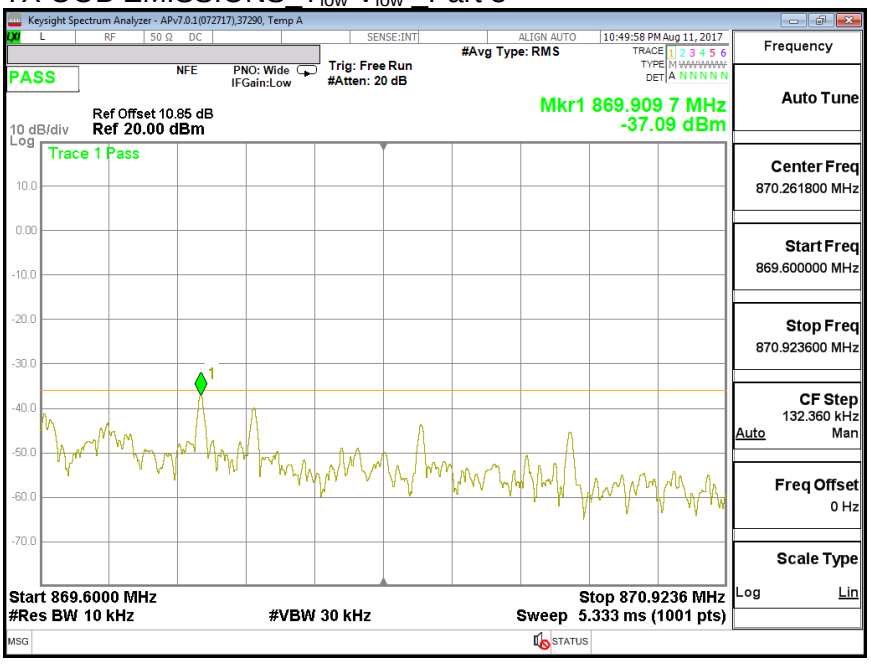

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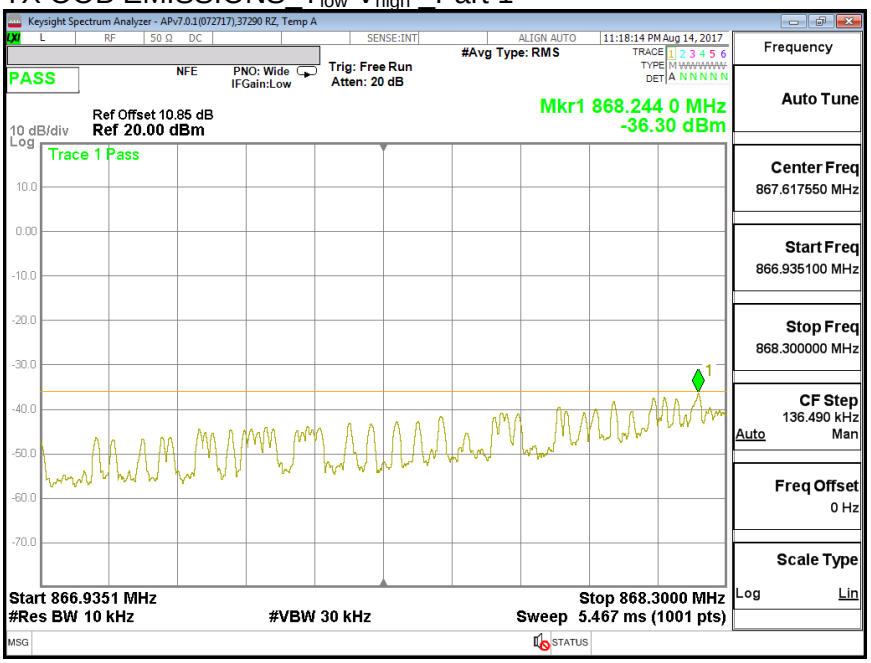
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



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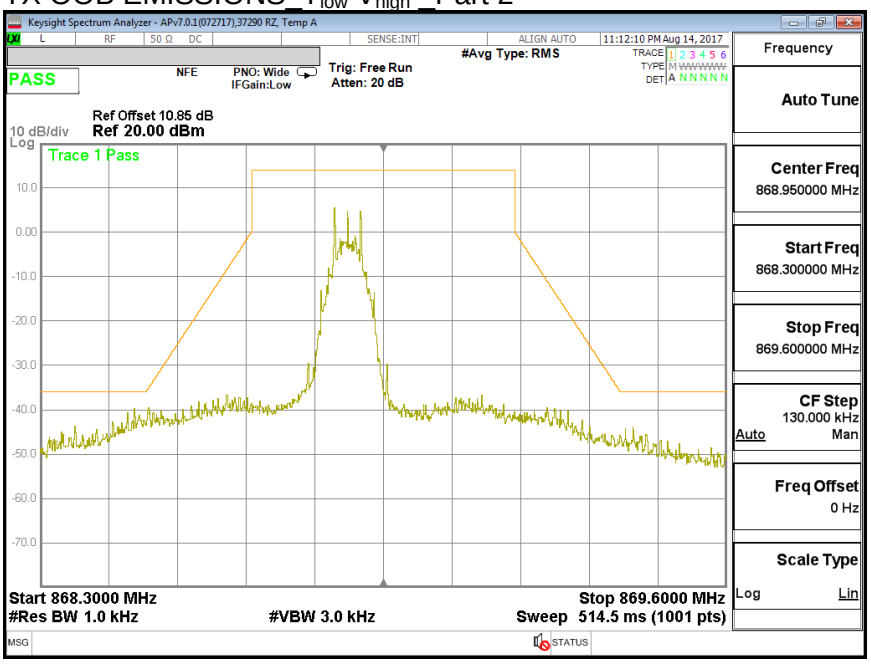

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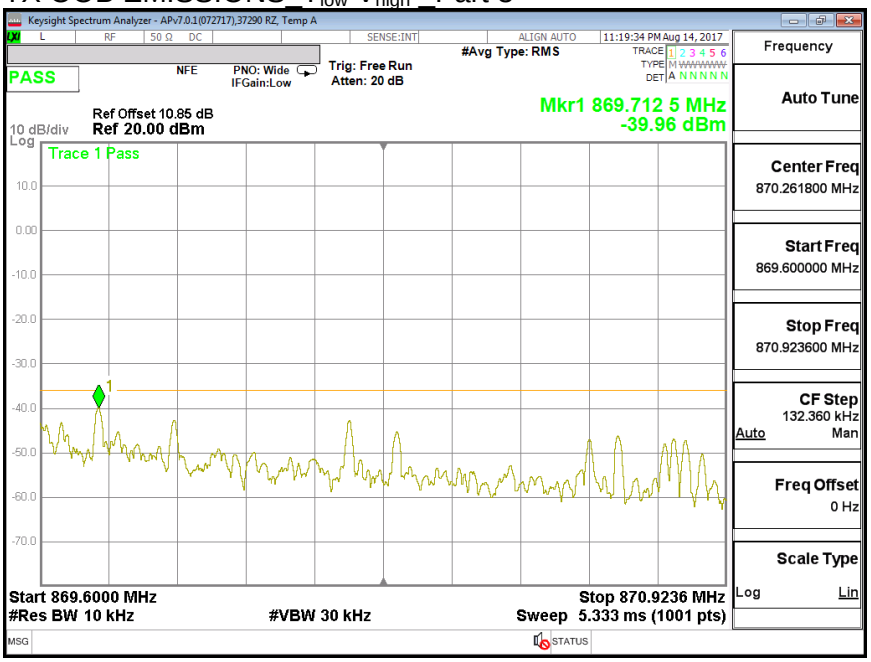
TX OOB EMISSIONS_T_{low} V_{high} _Part 3



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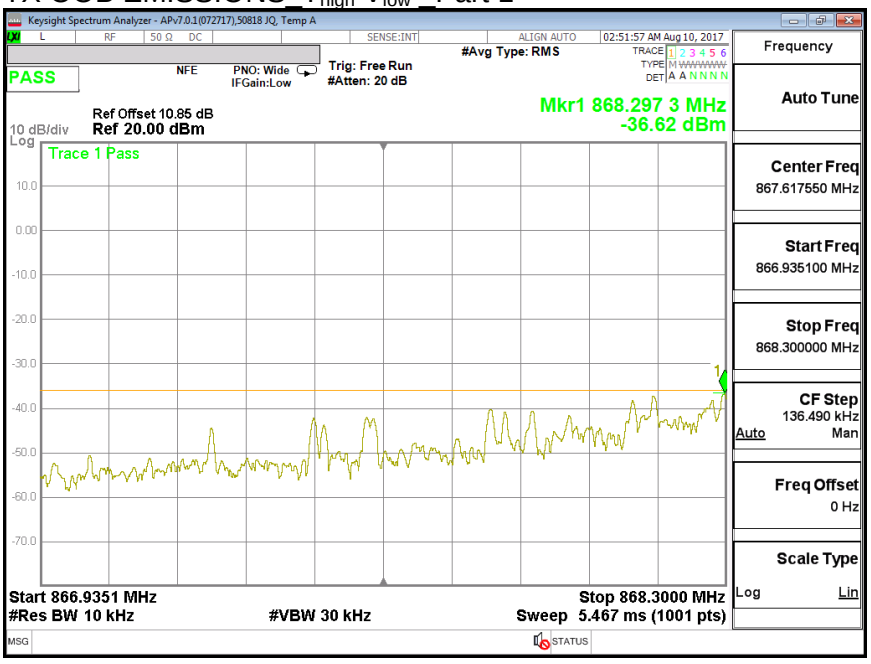

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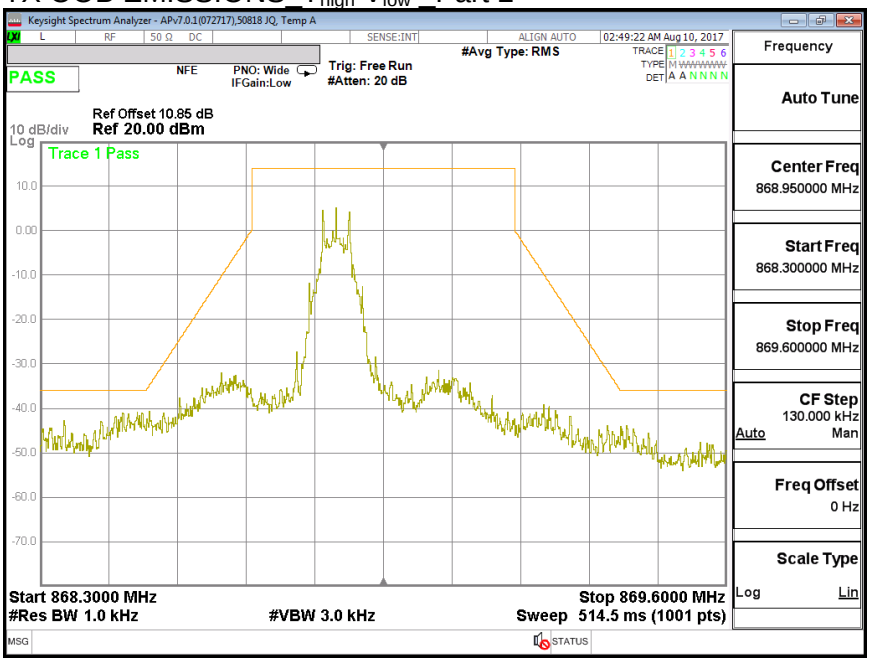
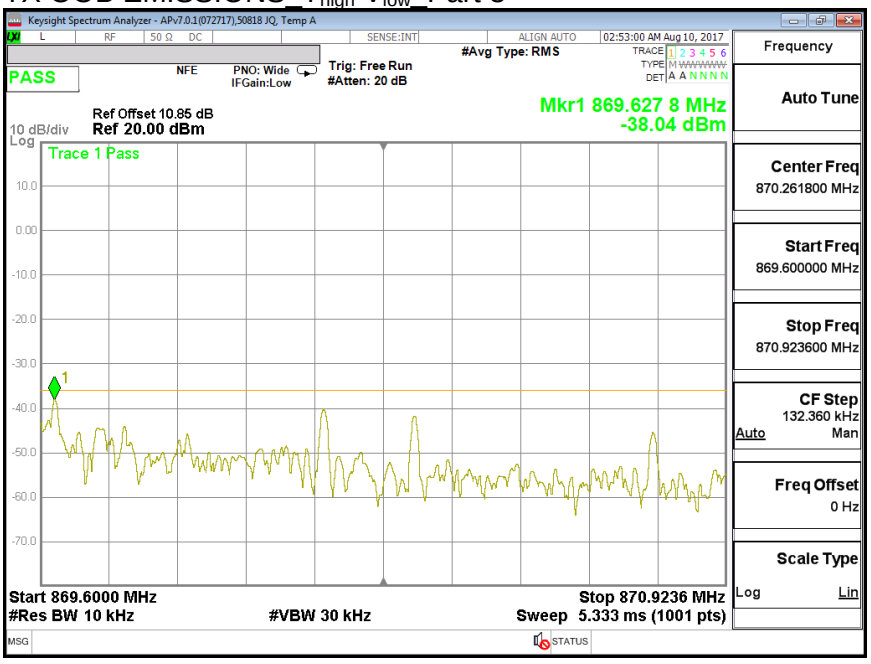


TX OOB EMISSIONS_T_{high} V_{low}_Part 3



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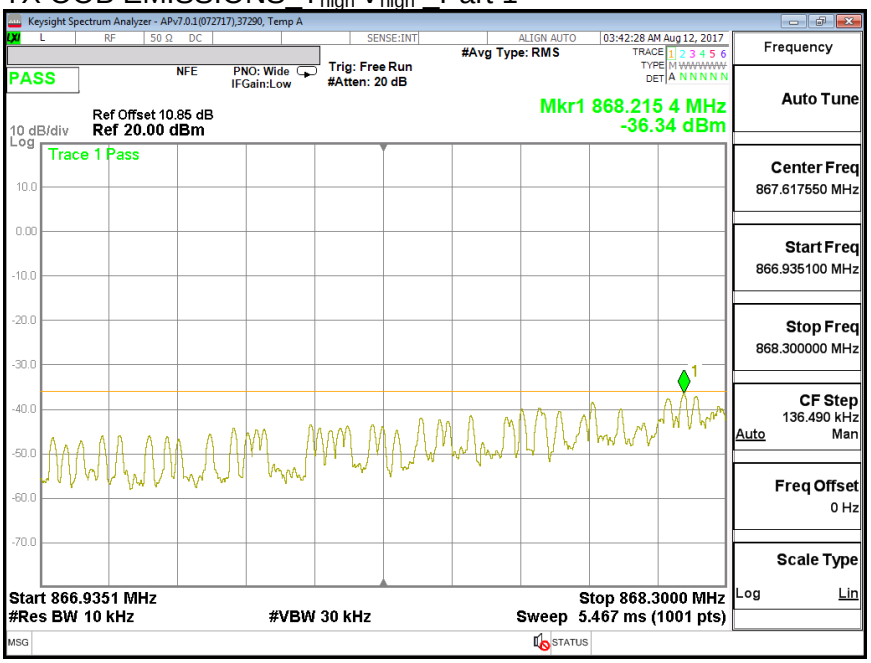
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



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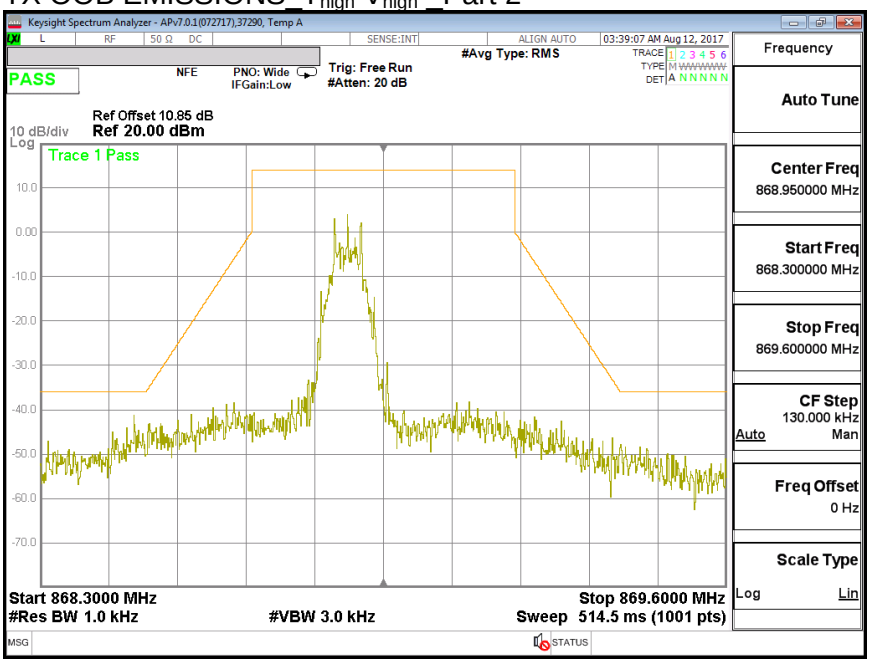

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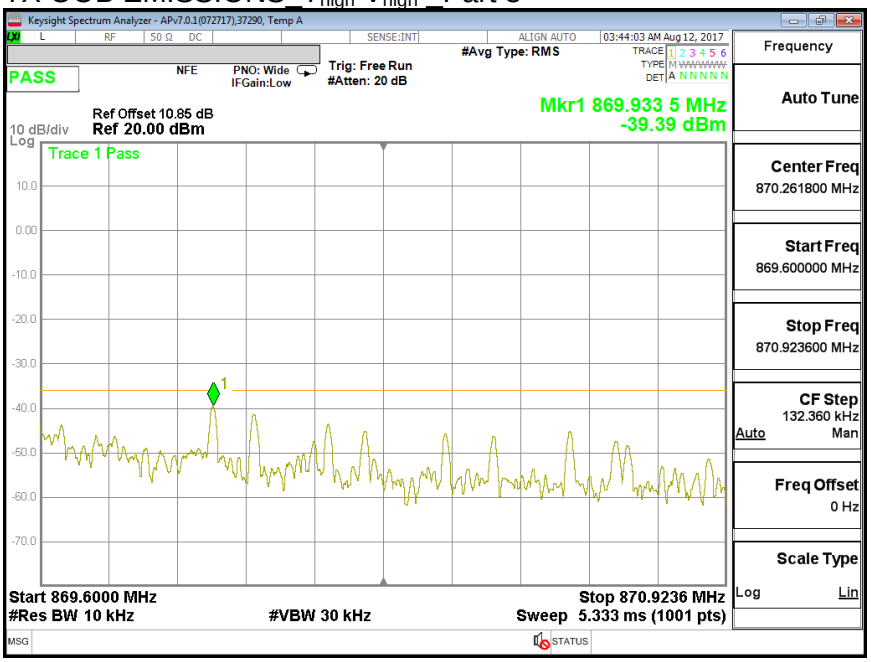
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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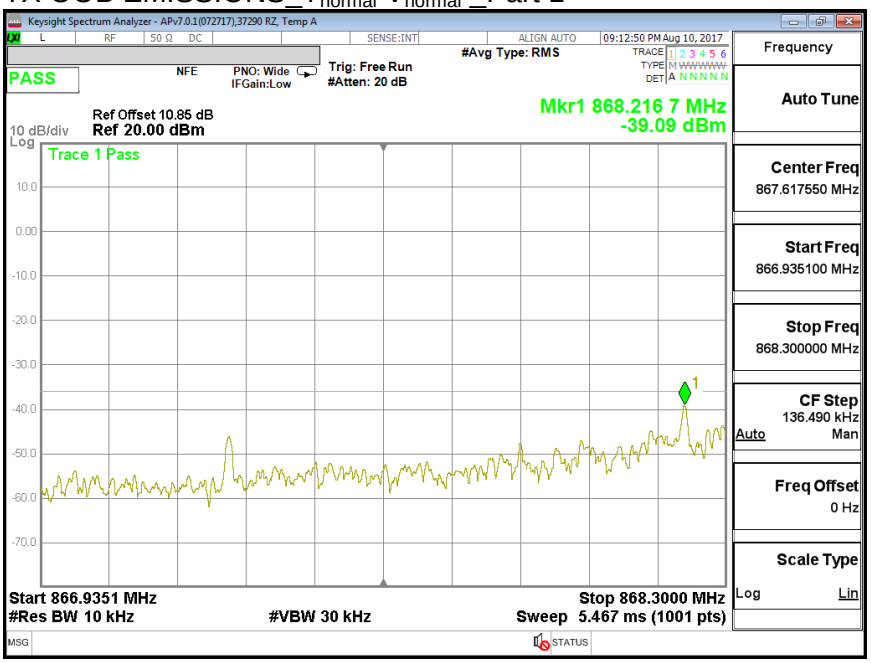
ML1 HIGH CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 1



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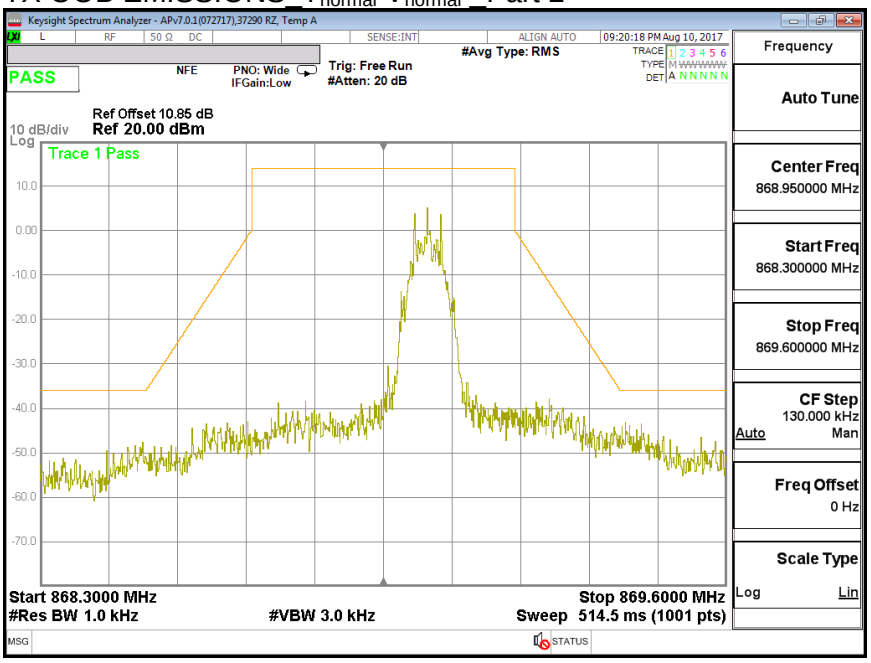

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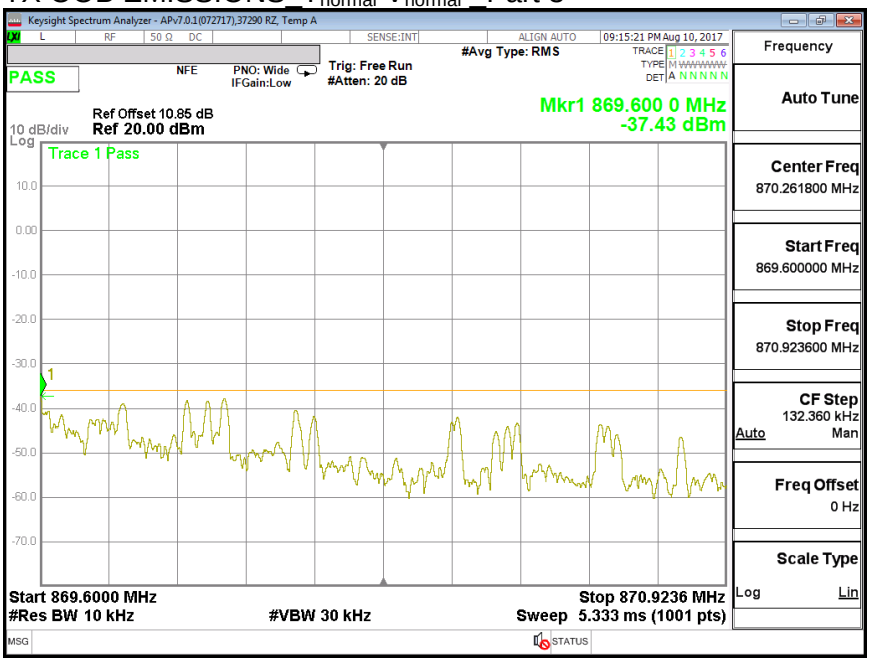
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3



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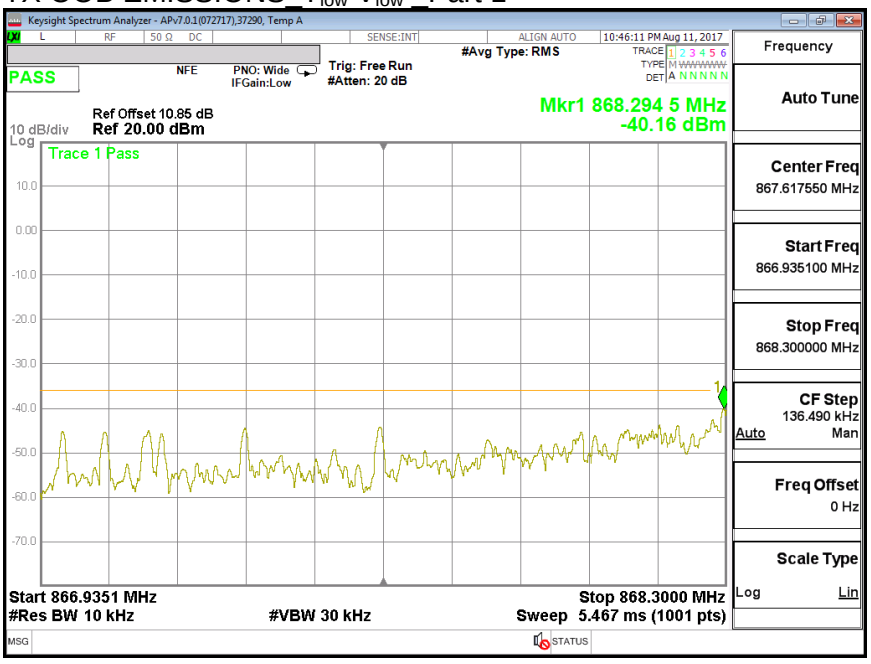

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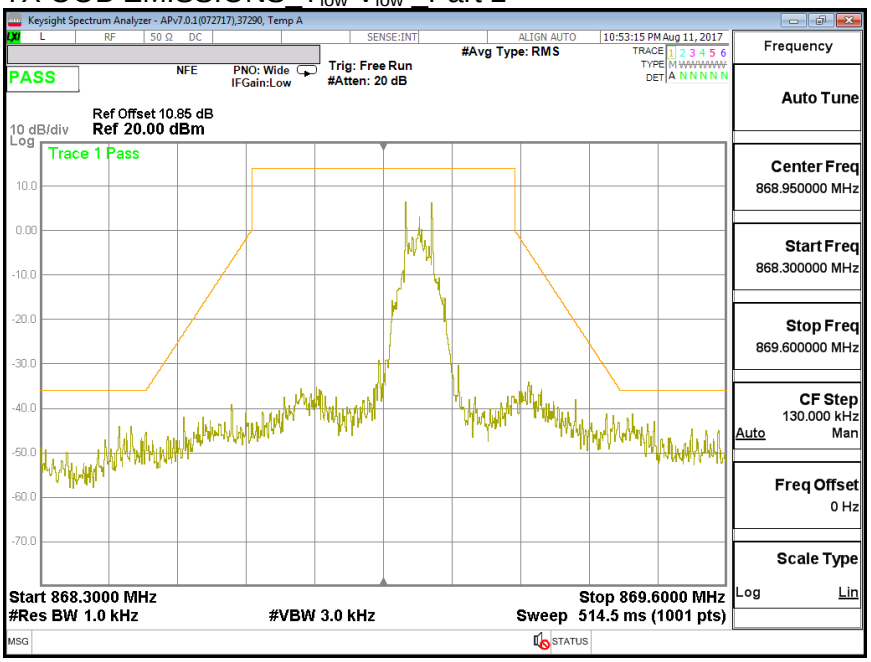

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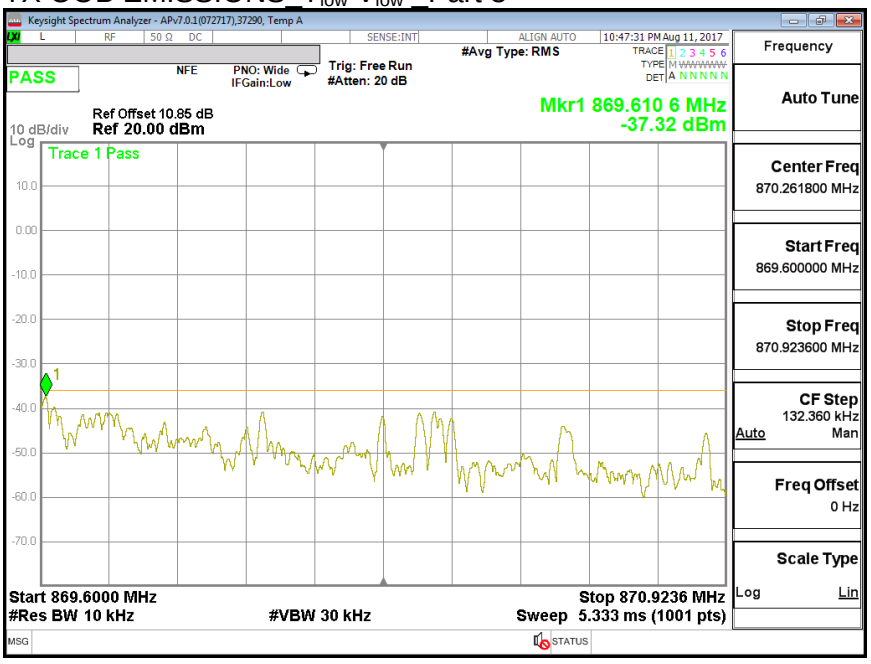

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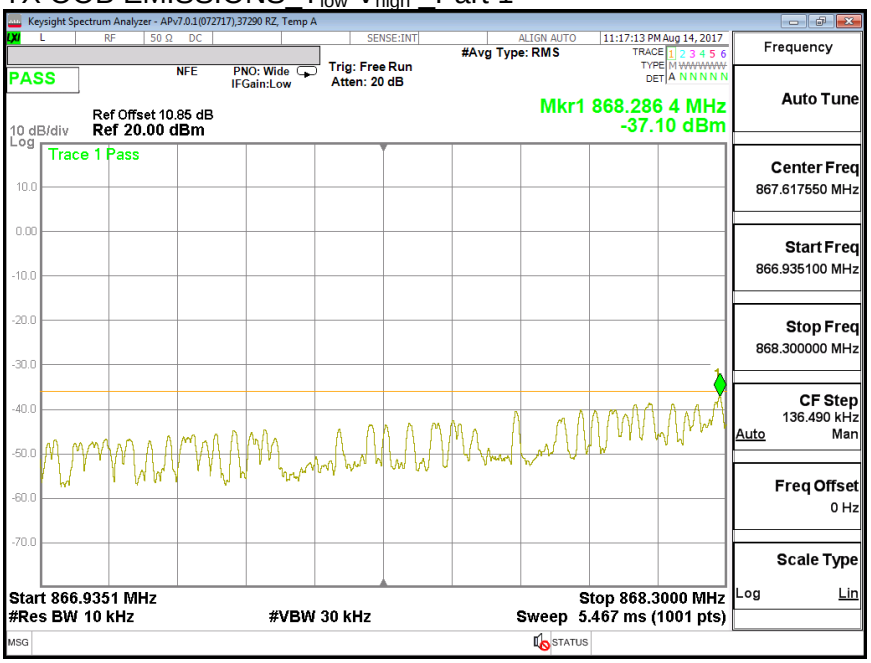
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



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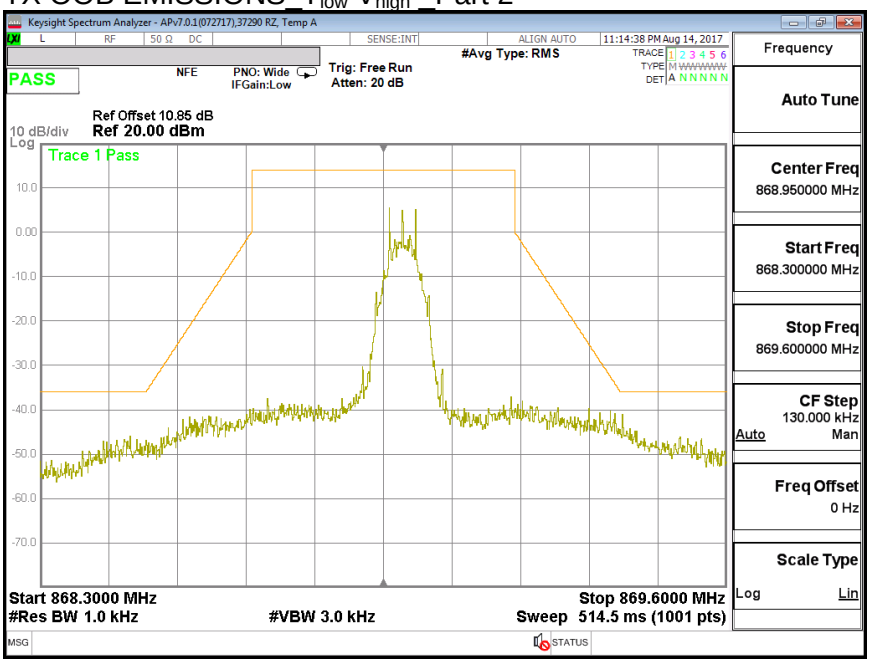

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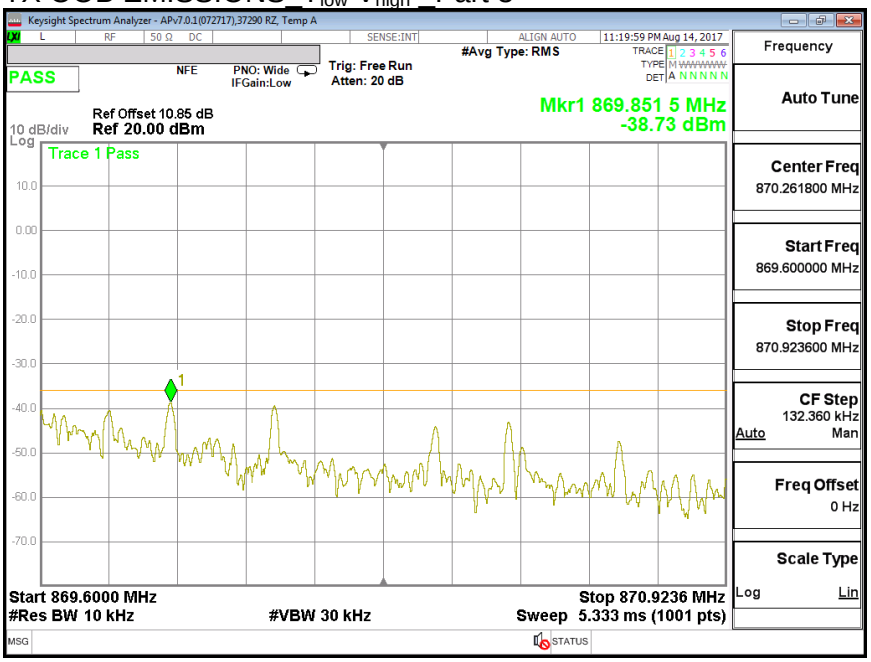
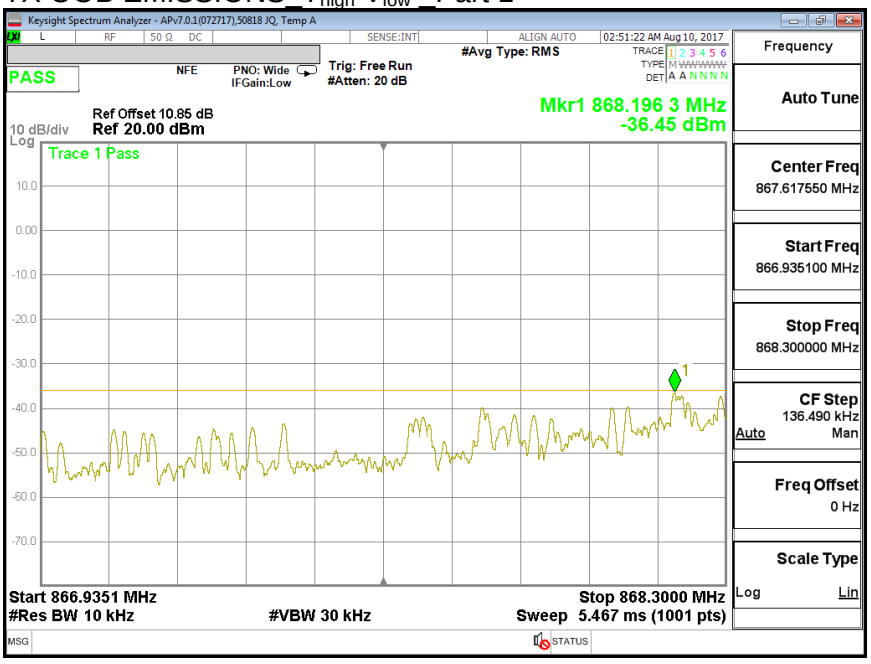
TX OOB EMISSIONS_T_{low} V_{high} _Part 3



TX OOB EMISSIONS_T_{high} V_{low} _Part 1



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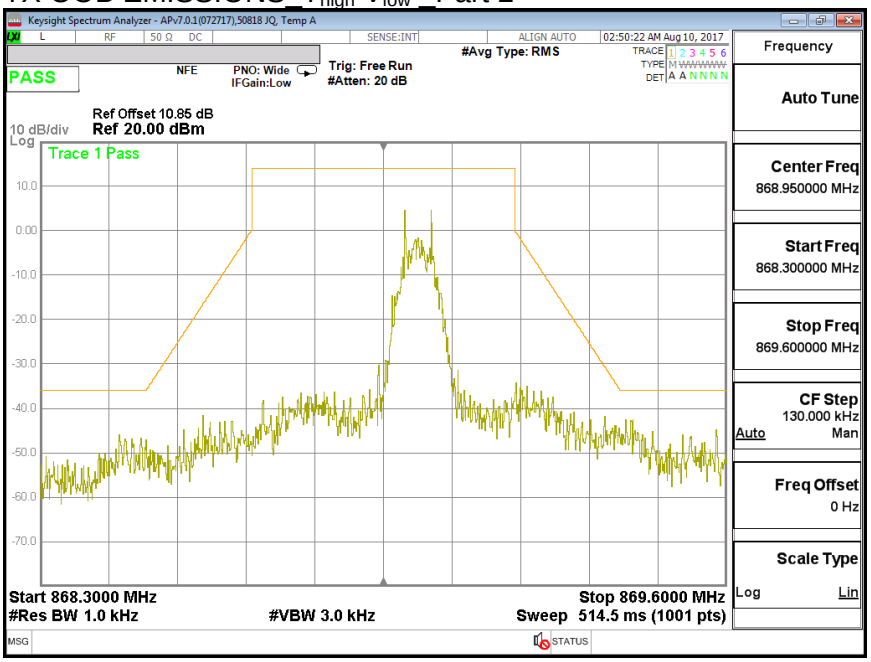

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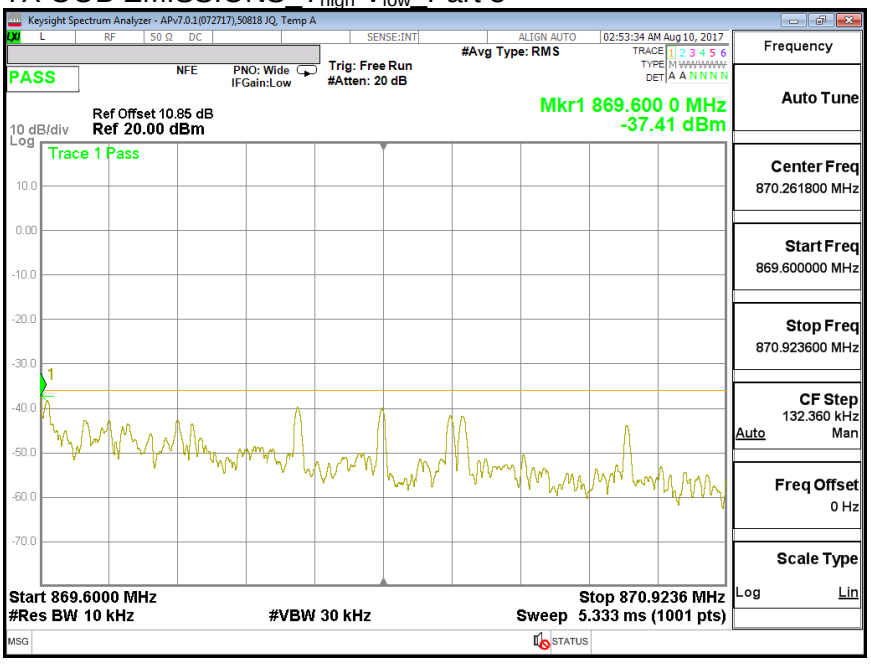

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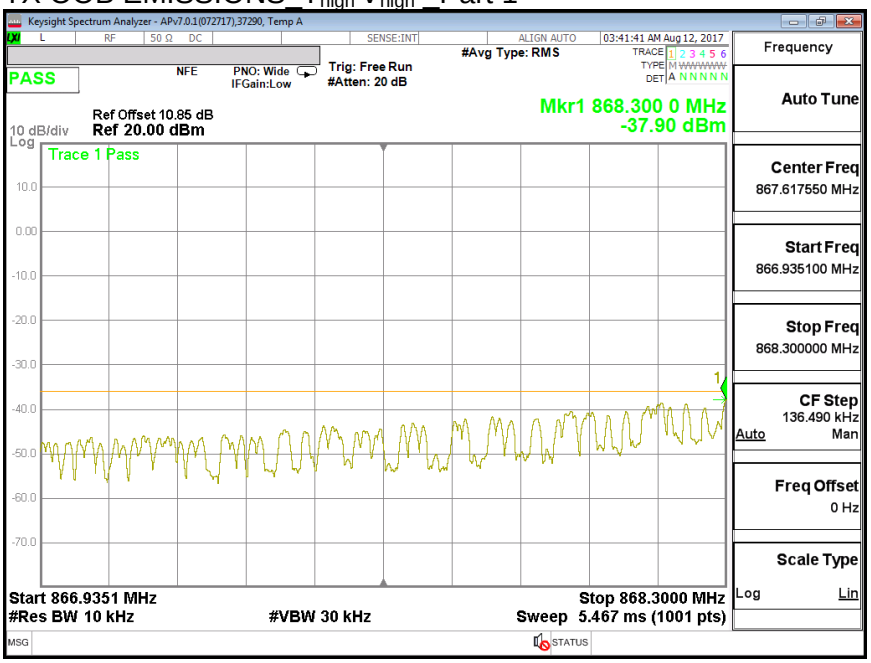
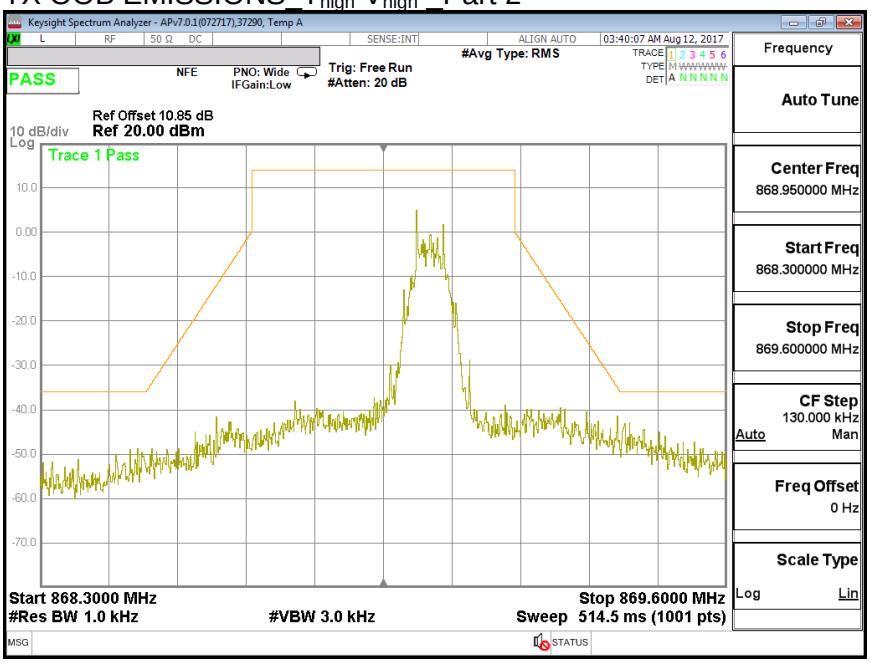
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



TX OOB EMISSIONS_T_{high} V_{high} _Part 2



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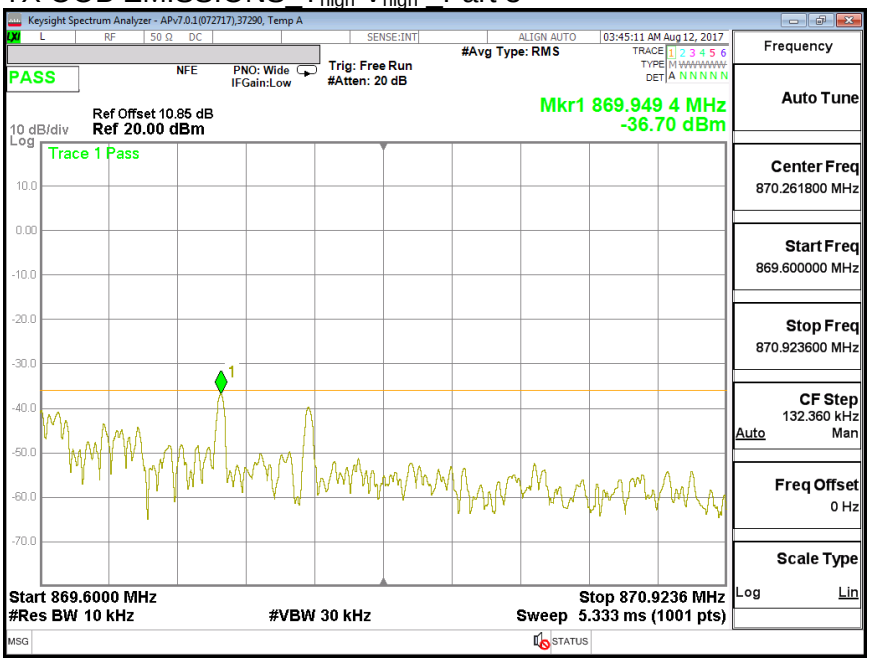
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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7.3.5. TX UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.2.2.2
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.1.1
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.2

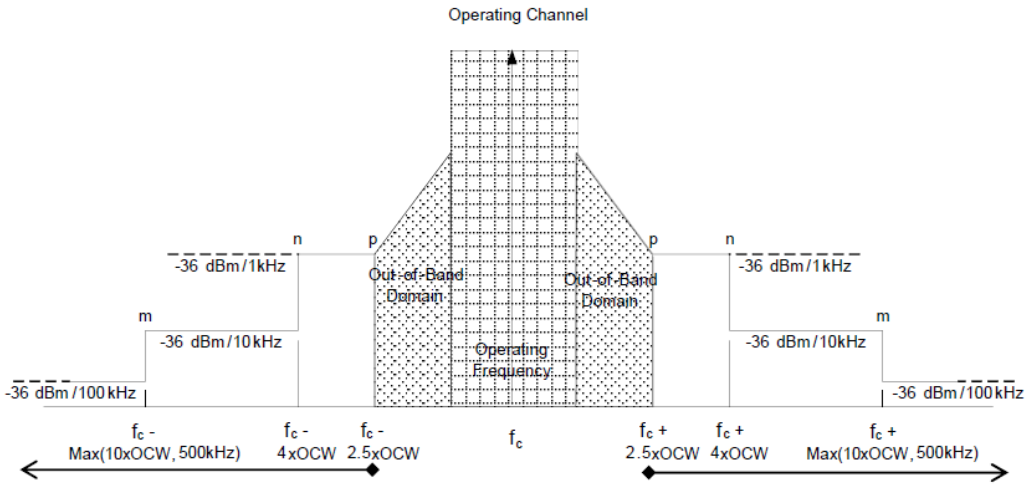

Figure 7: Spectrum Mask for Unwanted Emissions in the Spurious Domain with reference BW

Reference Limit:

The power of any unwanted emission in the spurious domain shall not exceed the values given in Table 19.

Table 19: Spurious domain emission limits

Frequency / State	47 MHz to 74 MHz 87,5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 790 MHz	Other frequencies below 1 000 MHz	Frequencies above 1 000 MHz
TX mode	-54 dBm	-36 dBm	-30 dBm
RX and all other modes	-57 dBm	-57 dBm	-47 dBm

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.3.3.1 (Conducted Measurement)
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.3.3.2 (Radiated Measurement)

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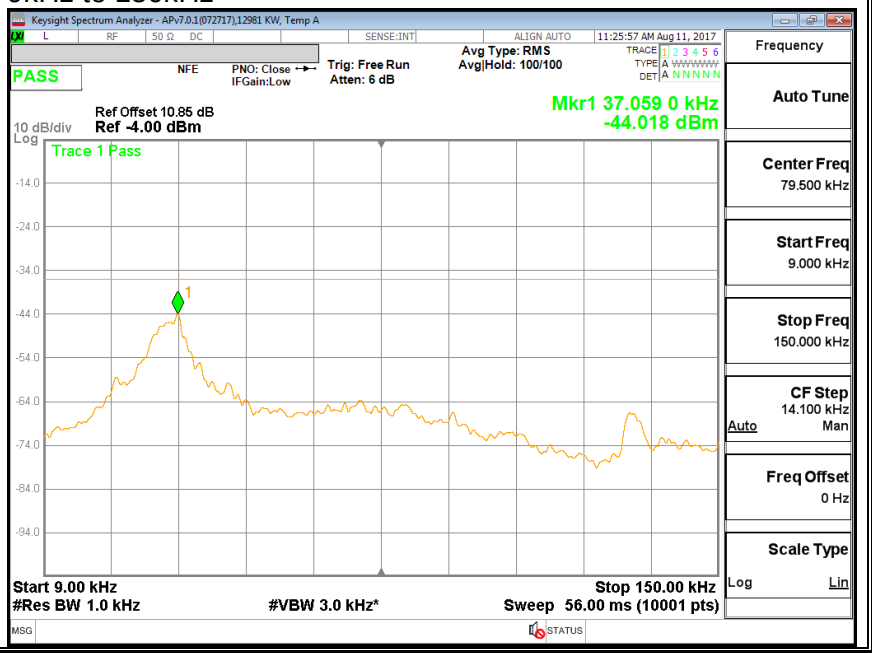
RESULTS

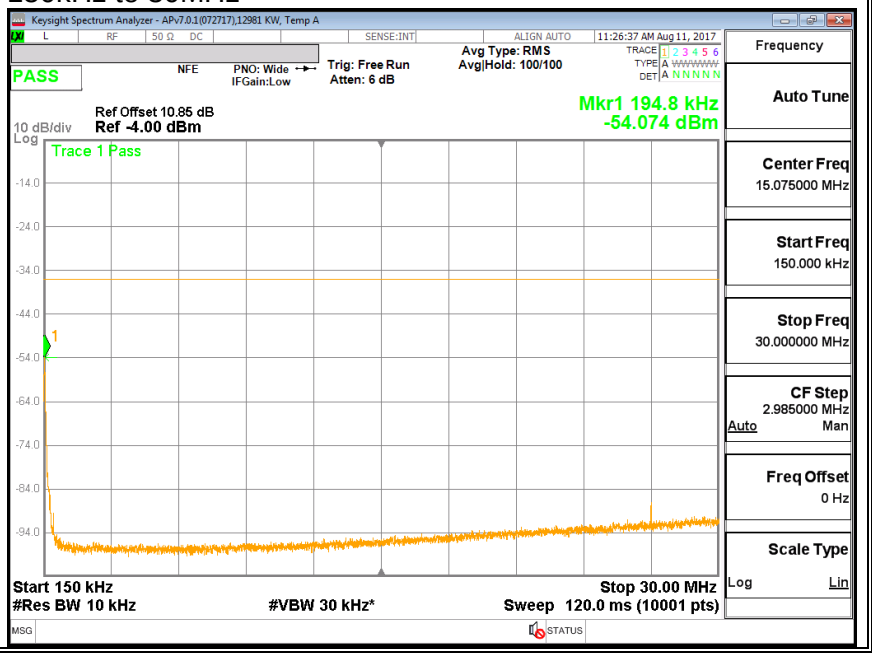
CONDUCTED SPURIOUS EMISSIONS

THE WORST CASE OF GFSK LOW CHANNEL

9kHz to 150kHz



150kHz to 30MHz



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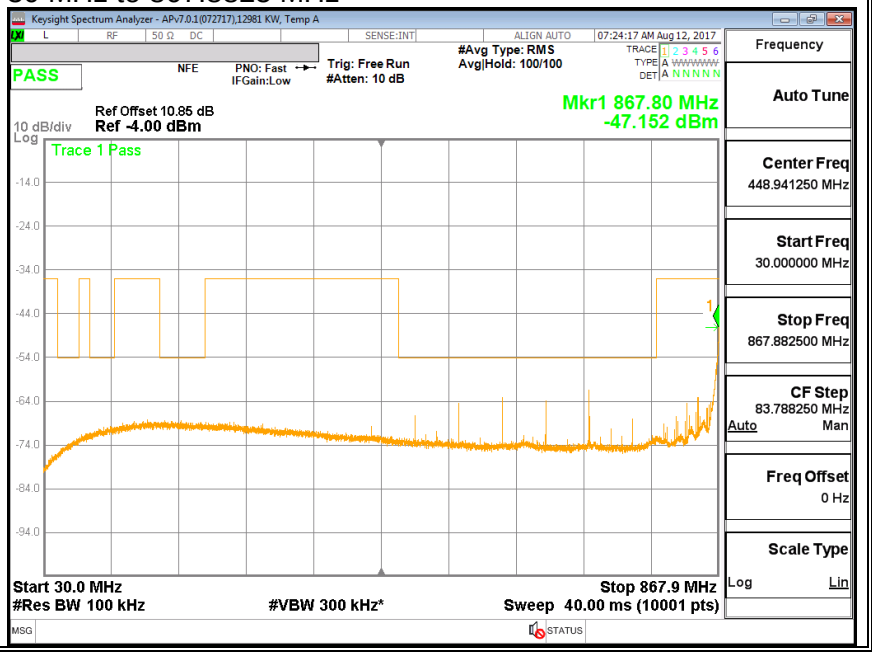
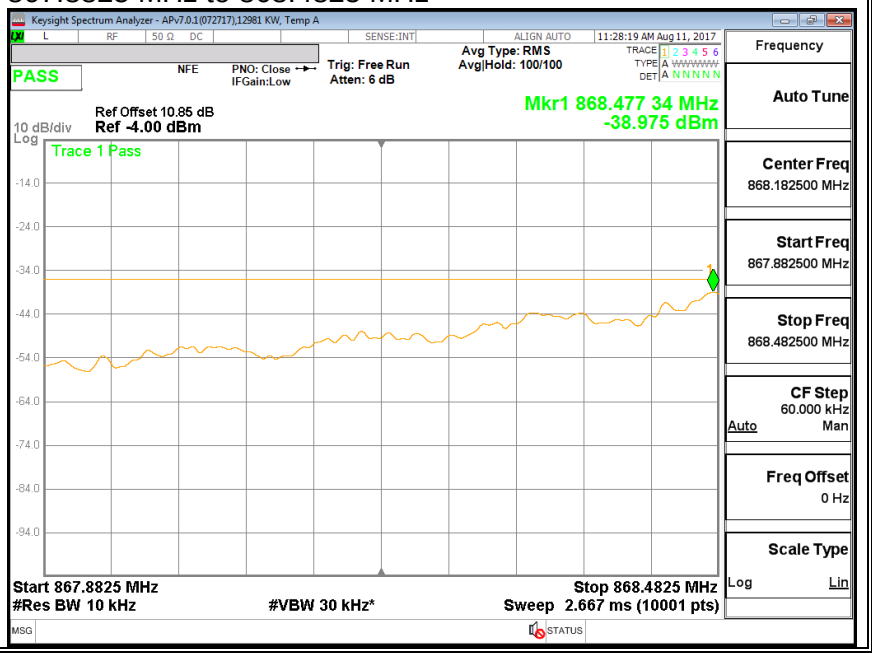
30 MHz to 867.8825 MHz



867.8825 MHz to 868.4825 MHz



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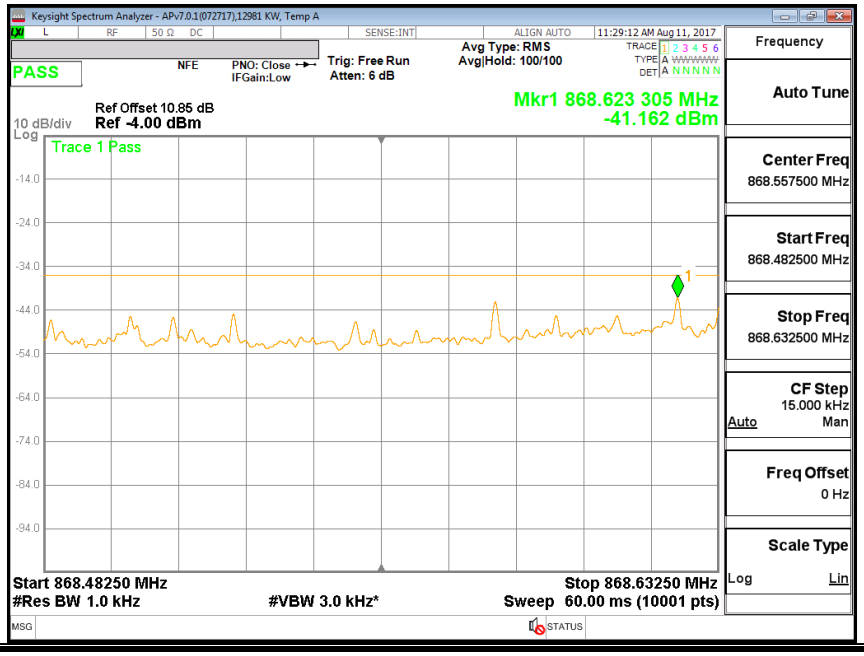
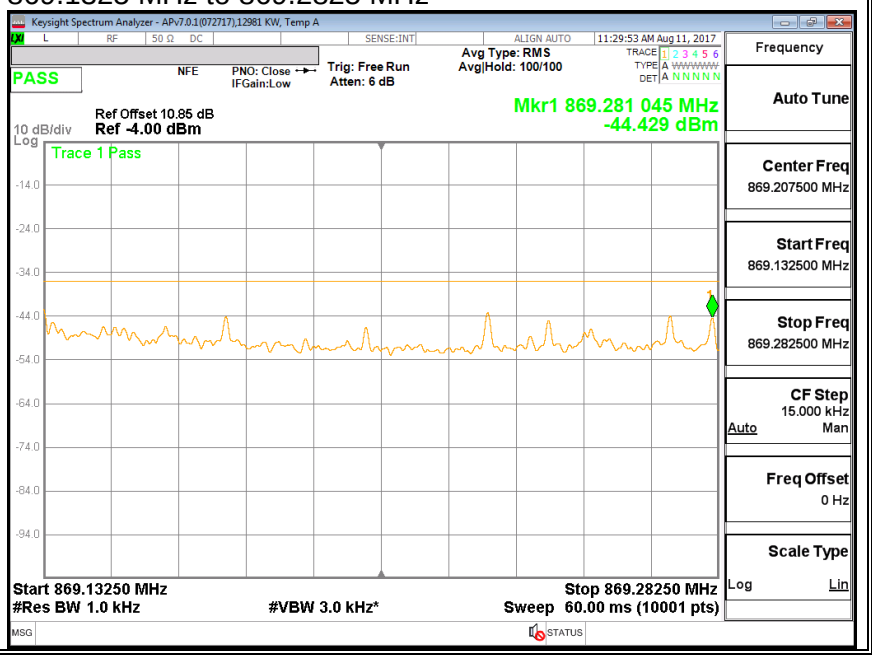
868.4825 MHz to 868.6325 MHz



869.1325 MHz to 869.2825 MHz



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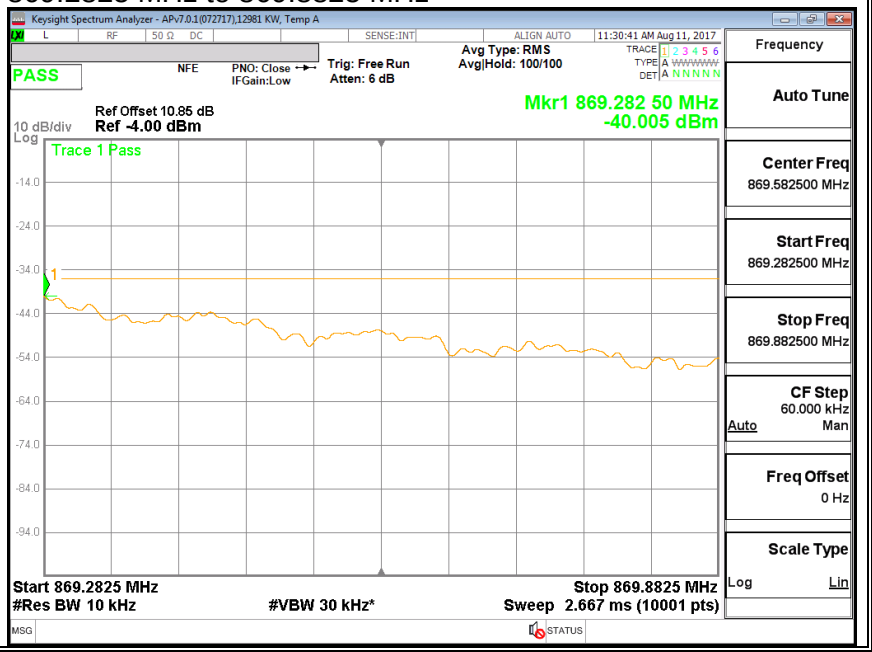
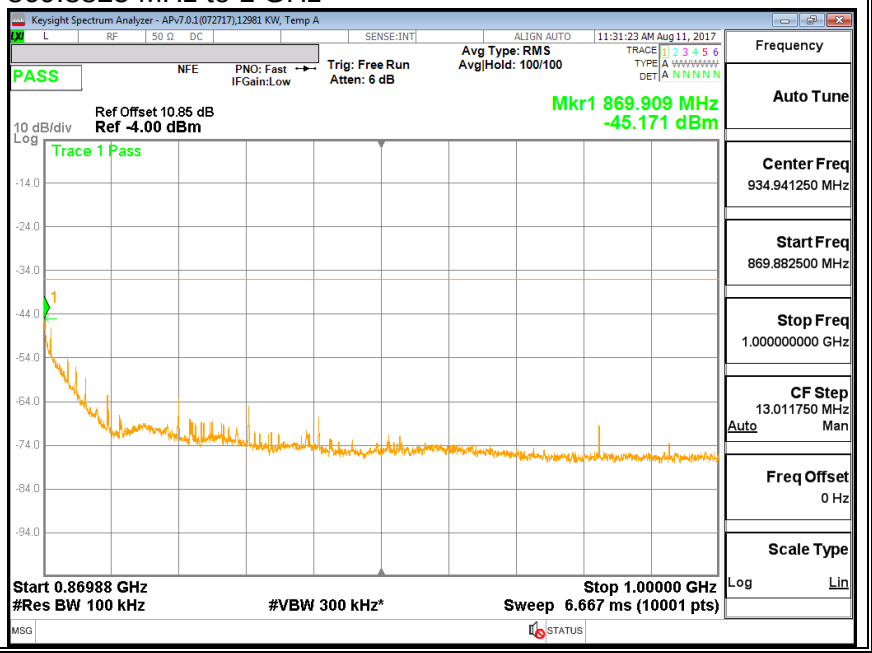
869.2825 MHz to 869.8825 MHz



869.8825 MHz to 1 GHz



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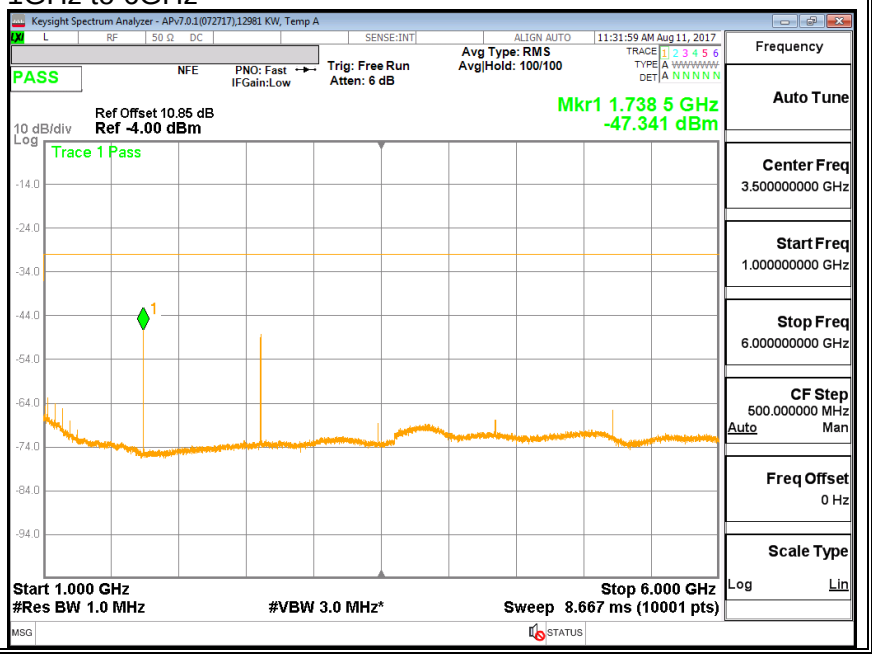
1GHz to 6GHz



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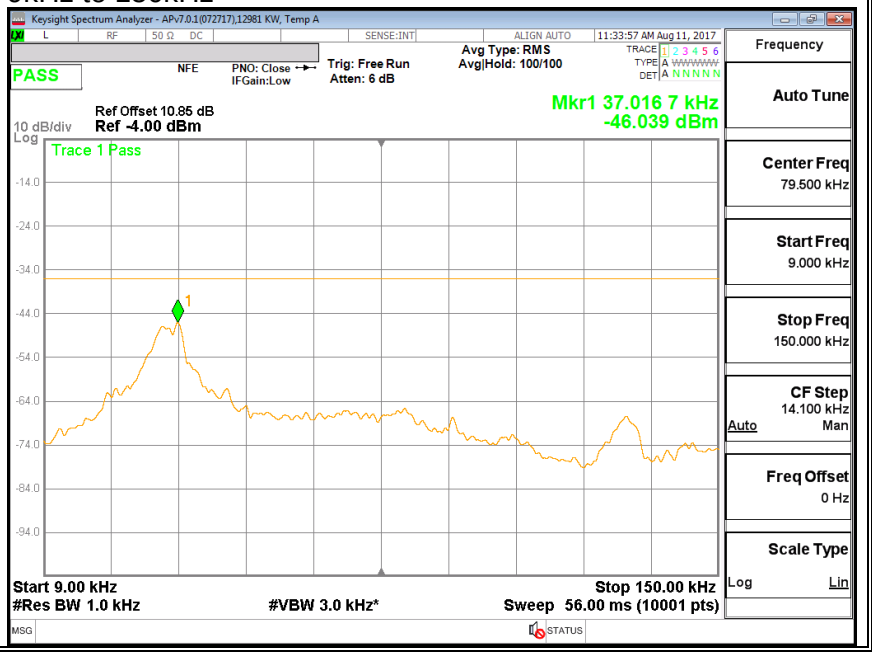
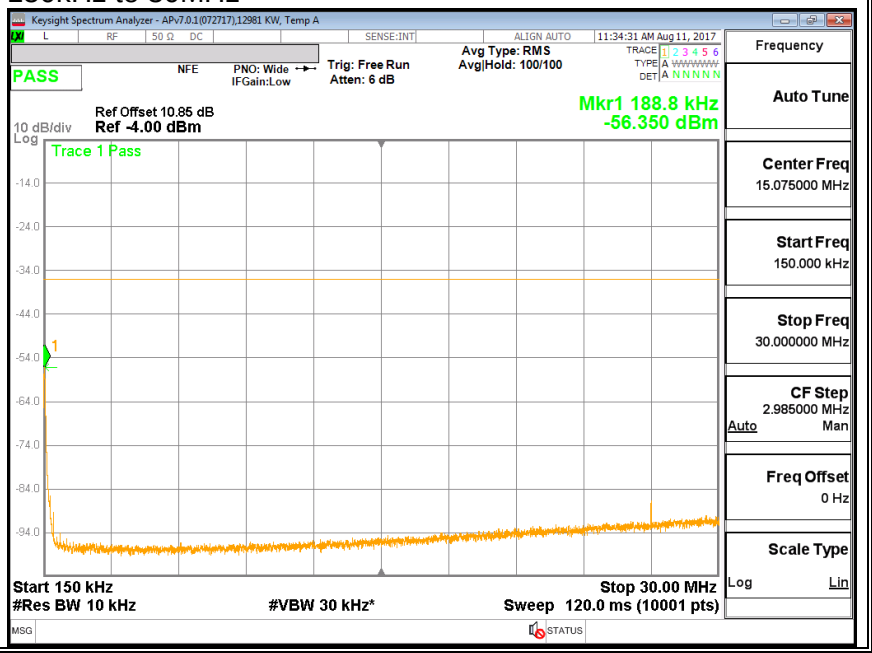
THE WORST CASE OF GFSK HIGH CHANNEL

9kHz to 150kHz



150kHz to 30MHz



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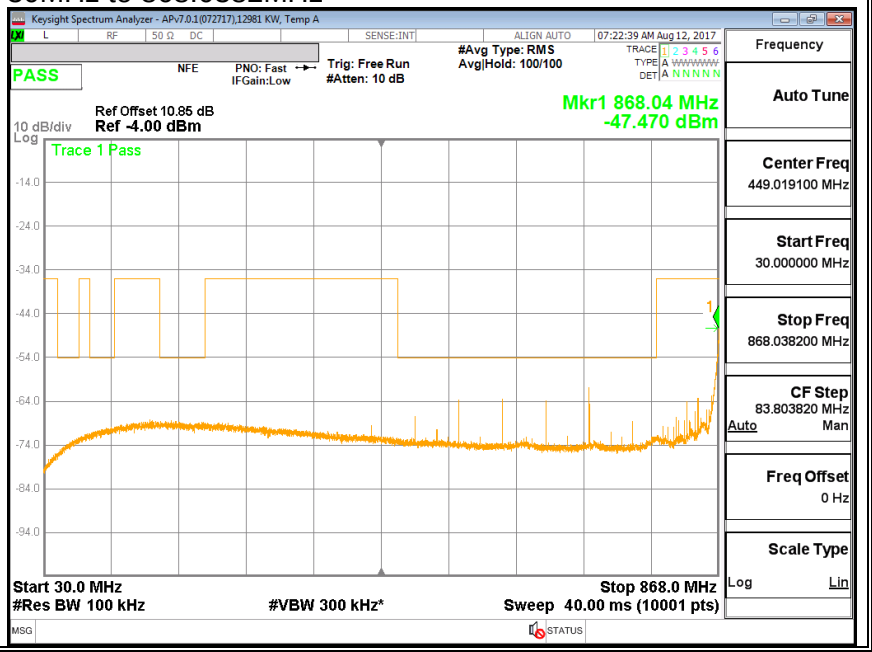
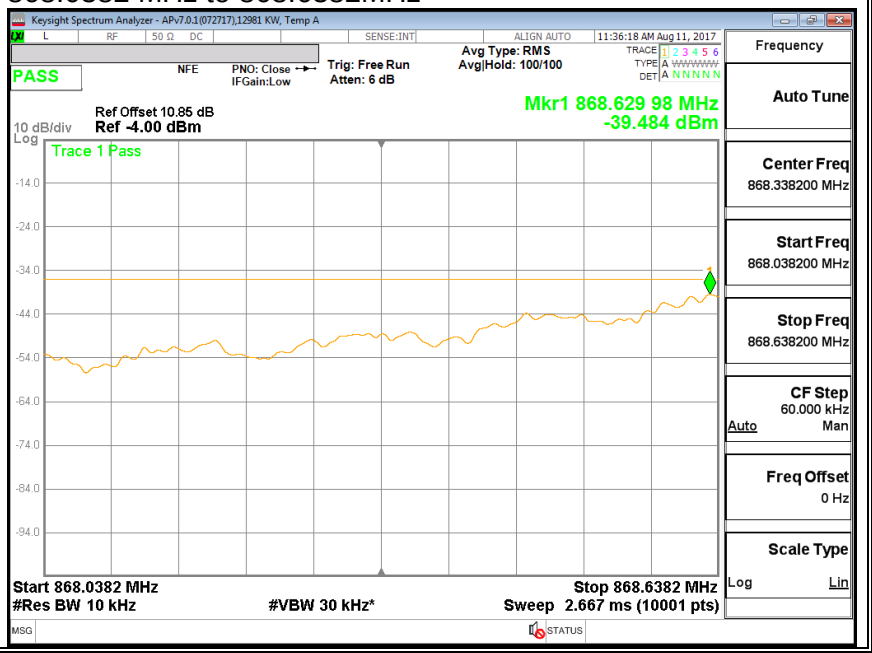
30MHz to 868.0382MHz



868.0382 MHz to 868.6382MHz



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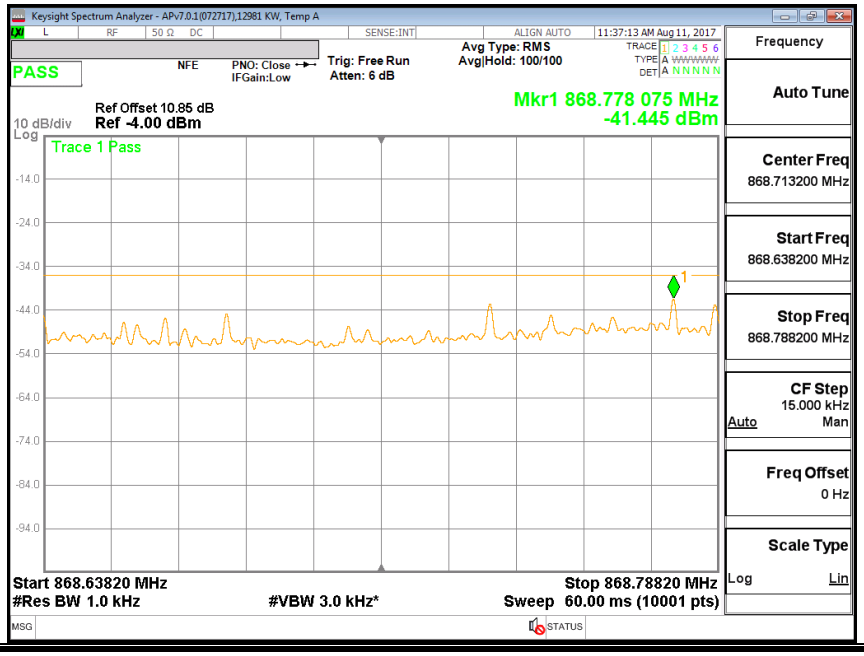
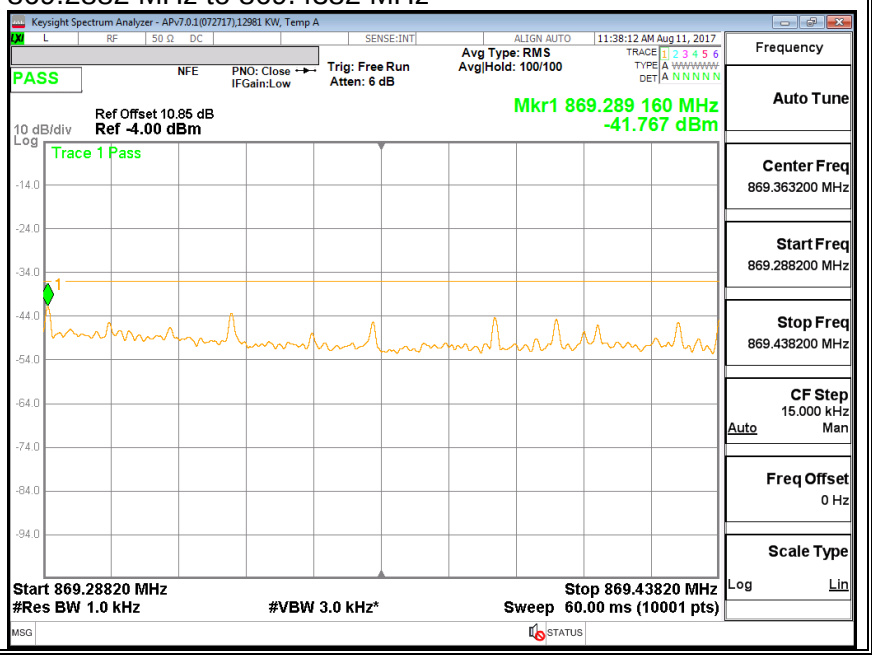
868.6382 MHz to 868.7882 MHz



869.2882 MHz to 869.4382 MHz



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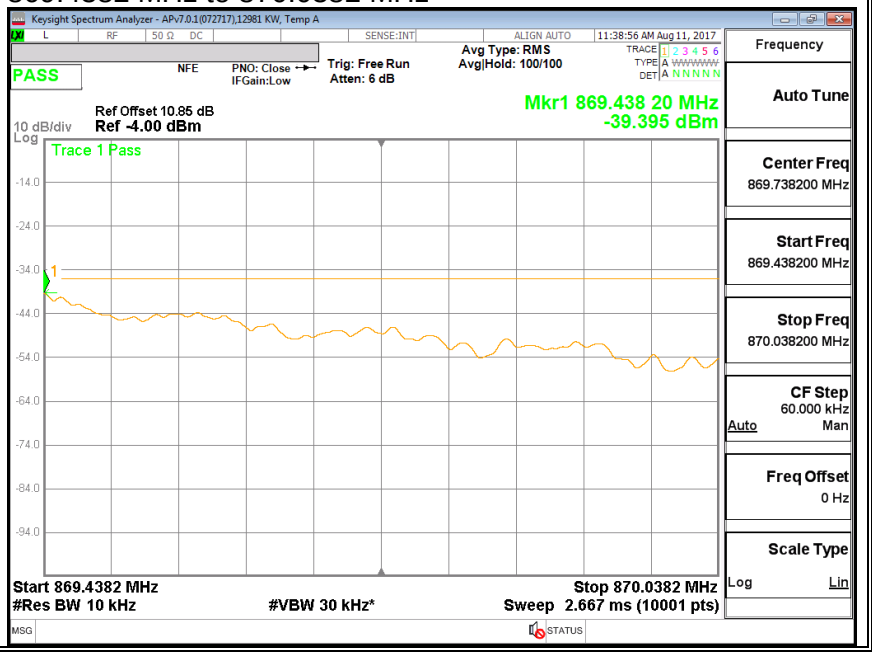
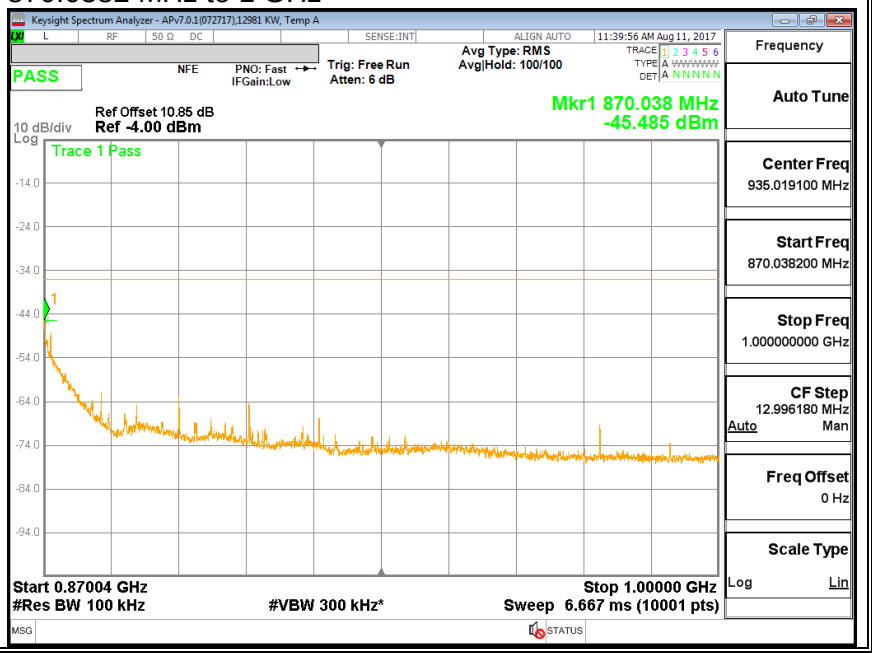
869.4382 MHz to 870.0382 MHz



870.0382 MHz to 1 GHz



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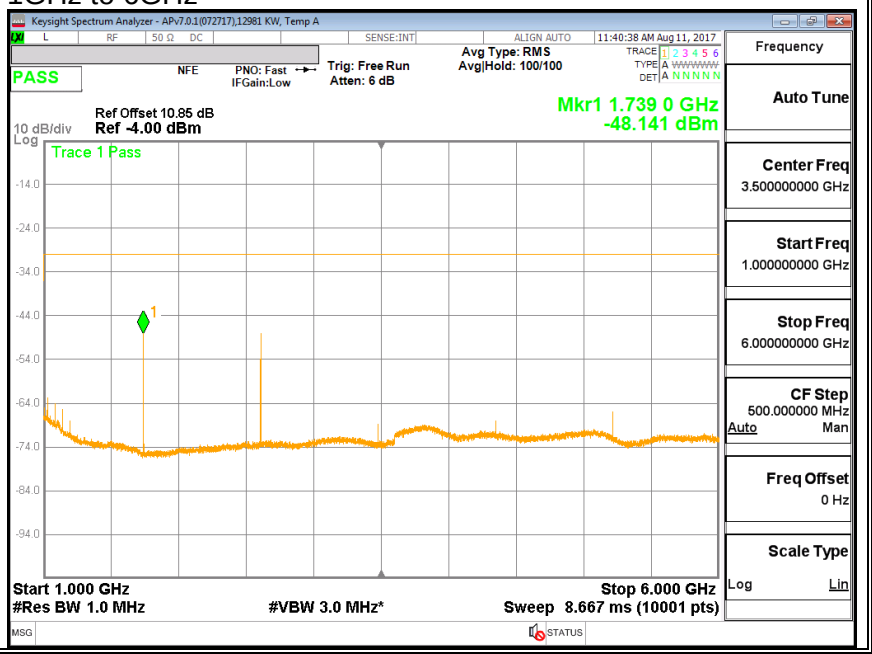
1GHz to 6GHz



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RADIATED SPURIOUS EMISSIONS

3m Radiated Emissions Chamber
30 - 1000MHz Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/13/2017
Test Engineer: 50818
Configuration: EUT with 50Ohm load and a support laptop
Mode: TX Below 1GHz GFSK N band worst case

Chamber	Pre-amplifer	Attenuator	Limit
3m Chamber B	3m-B T10		ETSI 300 220 Tx

Frequency (MHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Attenuator (dB)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel										
432.88	-71.3	H	3.0	25.0	28.8		-75.1	-36.0	-39.1	
699.54	-72.3	H	3.0	29.0	28.6		-72.0	-54.0	-18.0	
801.71	-70.2	H	3.0	30.2	28.4		-68.4	-54.0	-14.4	
433.01	-71.5	V	3.0	26.6	28.8		-73.7	-36.0	-37.7	
765.42	-70.8	V	3.0	31.9	28.4		-67.4	-54.0	-13.4	
801.69	-72.1	V	3.0	32.5	28.4		-67.9	-54.0	-13.9	
High Channel										
432.56	-70.4	H	3.0	25.0	28.8		-74.2	-36.0	-38.2	
659.89	-71.3	H	3.0	28.7	28.9		-71.5	-54.0	-17.5	
799.59	-71.6	H	3.0	30.1	28.4		-69.8	-54.0	-15.8	
432.21	-71.1	V	3.0	26.6	28.8		-73.3	-36.0	-37.3	
767.18	-72.3	V	3.0	31.9	28.4		-68.9	-54.0	-14.9	
820.49	-71.1	V	3.0	33.1	28.2		-66.2	-54.0	-12.2	

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3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/13/2017
Test Engineer: 50818
Configuration: EUT with 50Ohm load and a support laptop
Mode: TX Above 1GHz N band GFSK worst case

Chamber	Pre-amplifer	Filter	Limit
3m Chamber B	3m Chamber B	Filter	ETSI 300 220 Tx

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss @ SG End (dBm)	Preamp (dB)	Attenuator (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel										
1.611	-63.42	H	3.0	-18.6	38.7	1.0	-56.2	-30.0	-26.2	
2.400	-58.97	H	3.0	-9.5	38.7	1.0	-47.1	-30.0	-17.1	
5.209	-56.48	H	3.0	-1.8	38.7	1.0	-39.5	-30.0	-9.5	
1.196	-57.24	V	3.0	-15.0	38.5	1.0	-52.5	-30.0	-22.5	
1.610	-58.36	V	3.0	-13.5	38.7	1.0	-51.2	-30.0	-21.2	
1.991	-61.07	V	3.0	-12.7	38.0	1.0	-49.6	-30.0	-19.6	
High Channel										
1.611	-61.43	H	3.0	-16.6	38.7	1.0	-54.2	-30.0	-24.2	
2.393	-60.52	H	3.0	-11.1	38.6	1.0	-48.7	-30.0	-18.7	
5.208	-56.43	H	3.0	-1.7	38.7	1.0	-39.5	-30.0	-9.5	
1.199	-57.33	V	3.0	-15.1	38.5	1.0	-52.6	-30.0	-22.6	
1.611	-60.28	V	3.0	-15.4	38.7	1.0	-53.1	-30.0	-23.1	
1.994	-59.31	V	3.0	-10.9	38.0	1.0	-47.9	-30.0	-17.9	

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7.3.6. TX TRANSIENT POWER

REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.10.2

The TX TRANSIENT POWER shall not exceed the values given in Table 23.

Table 23: Transmitter Transient Power limits

Absolute offset from centre frequency	RBW_{REF}	Peak power limit applicable at measurement points
≤ 400 kHz	1 kHz	0 dBm
> 400 kHz	1 kHz	-27 dBm

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.10.3.2

RESULTS

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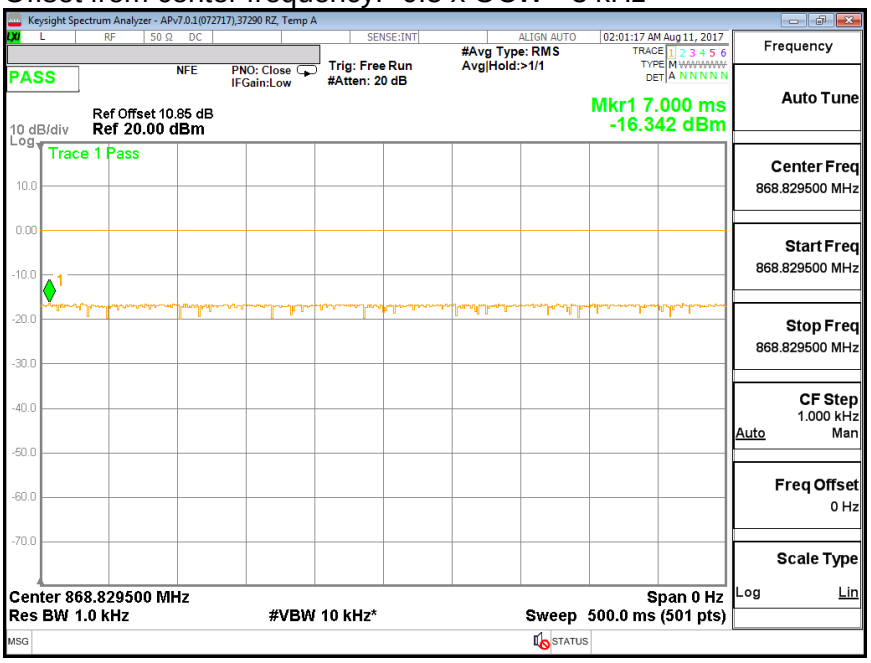
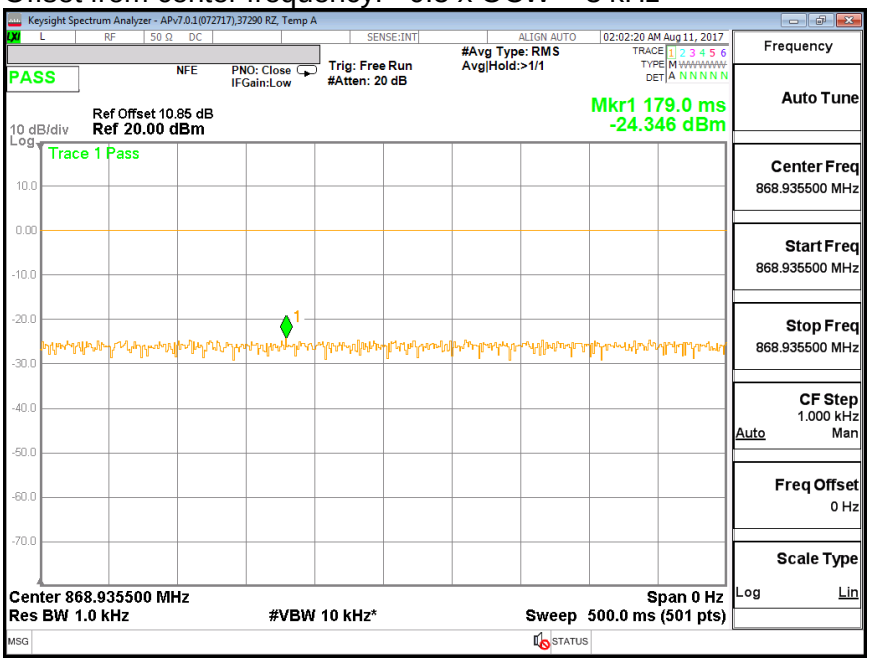
THE WORST CASE OF GFSK LOW CHANNEL

TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 3 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 3 kHz



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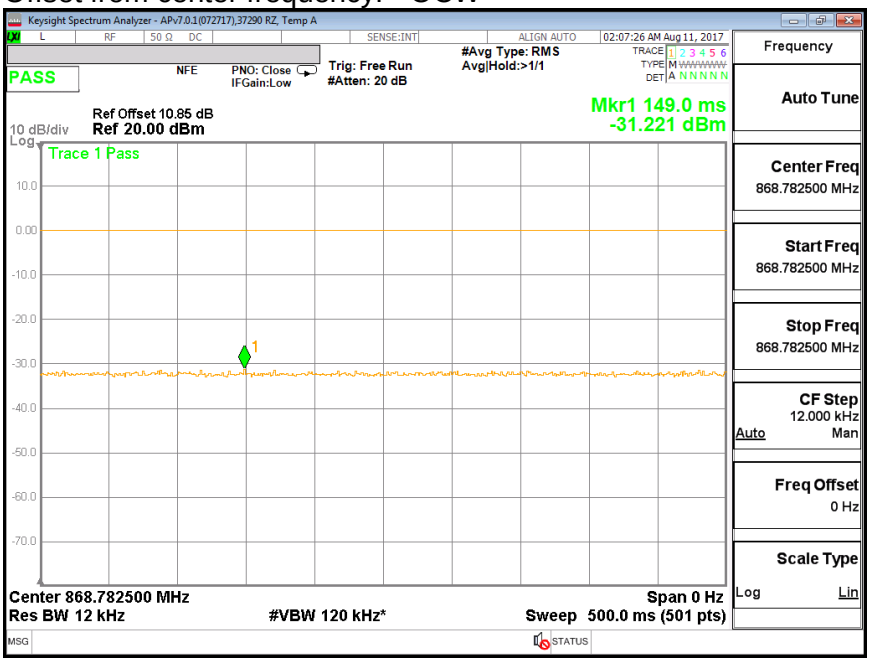
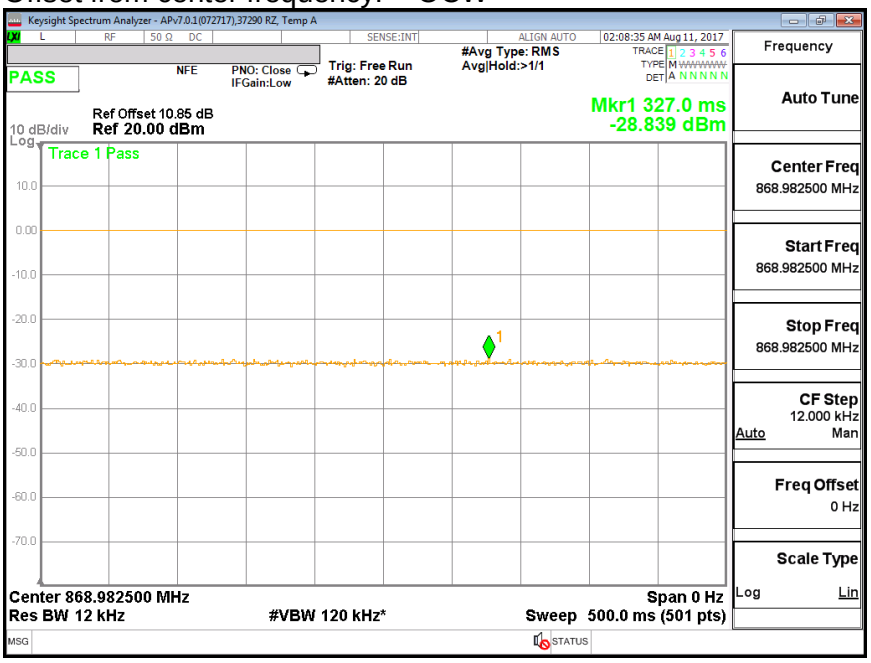
TX TRANSIENT
Offset from center frequency: - OCW



TX TRANSIENT
Offset from center frequency: + OCW



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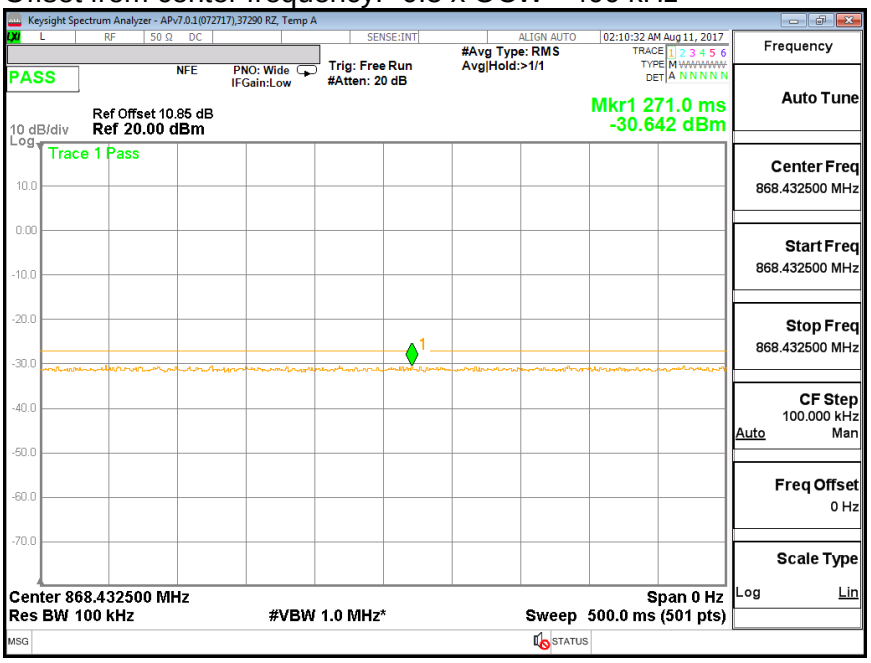
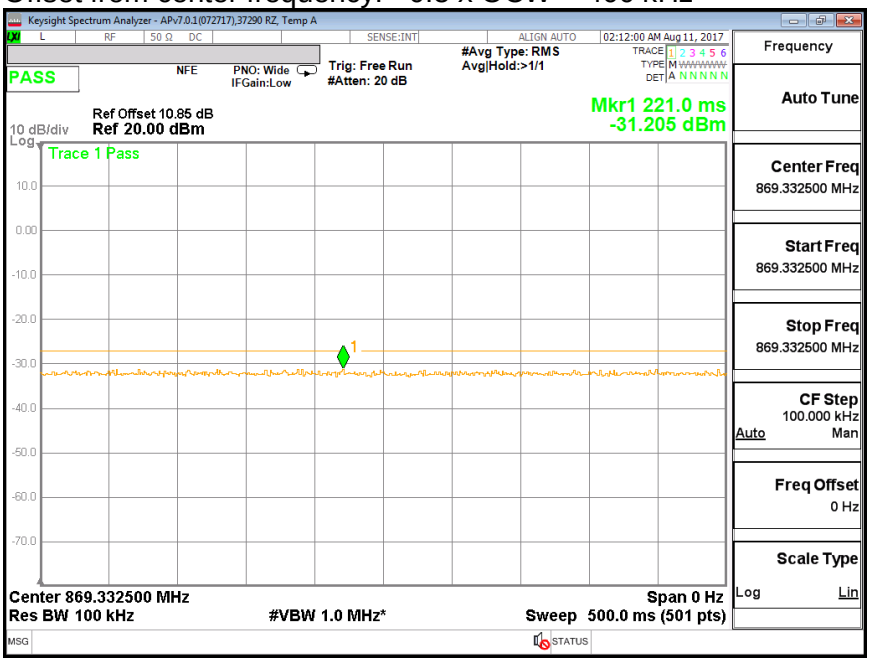
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 400 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 400 kHz



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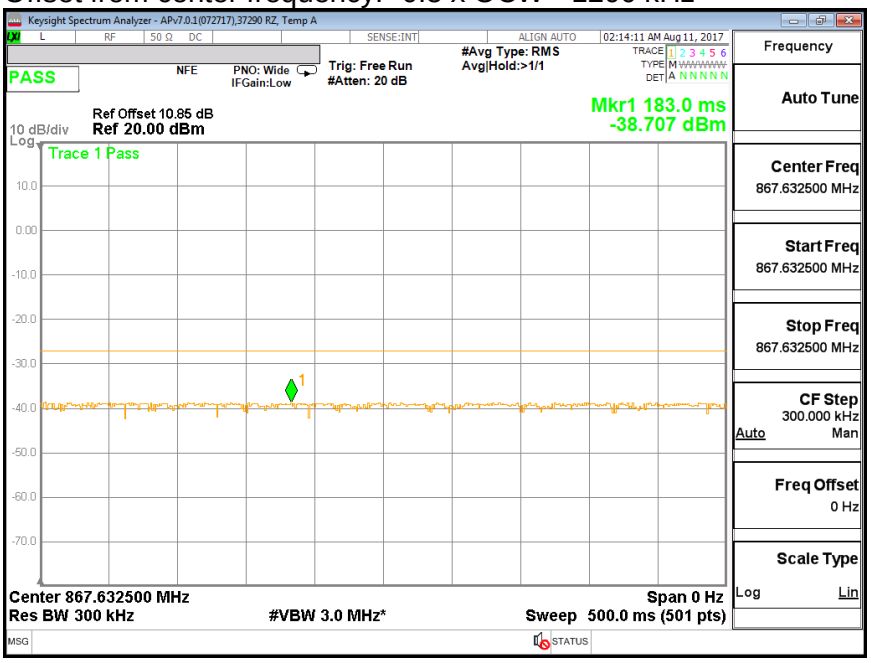
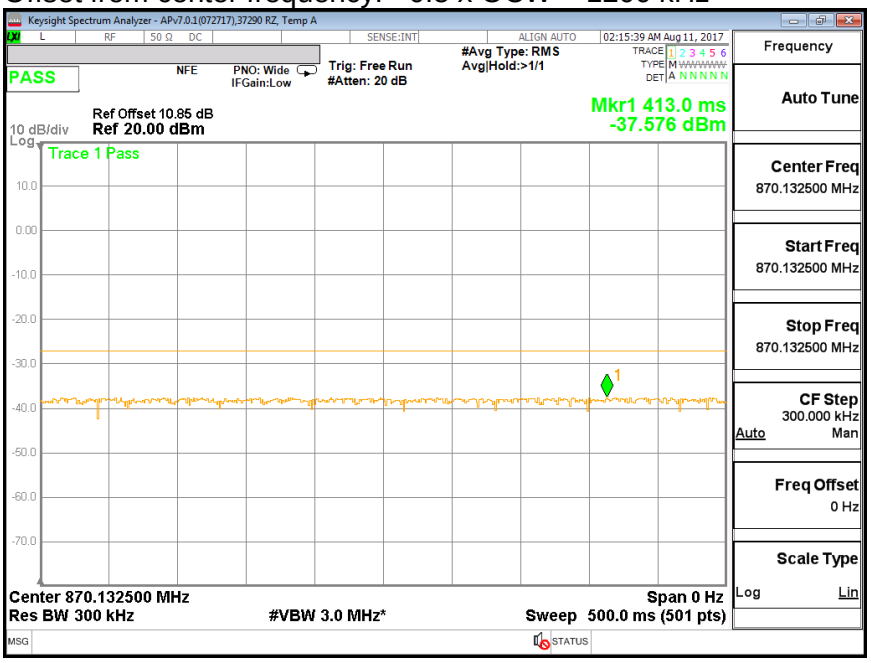
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 1200 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 1200 kHz



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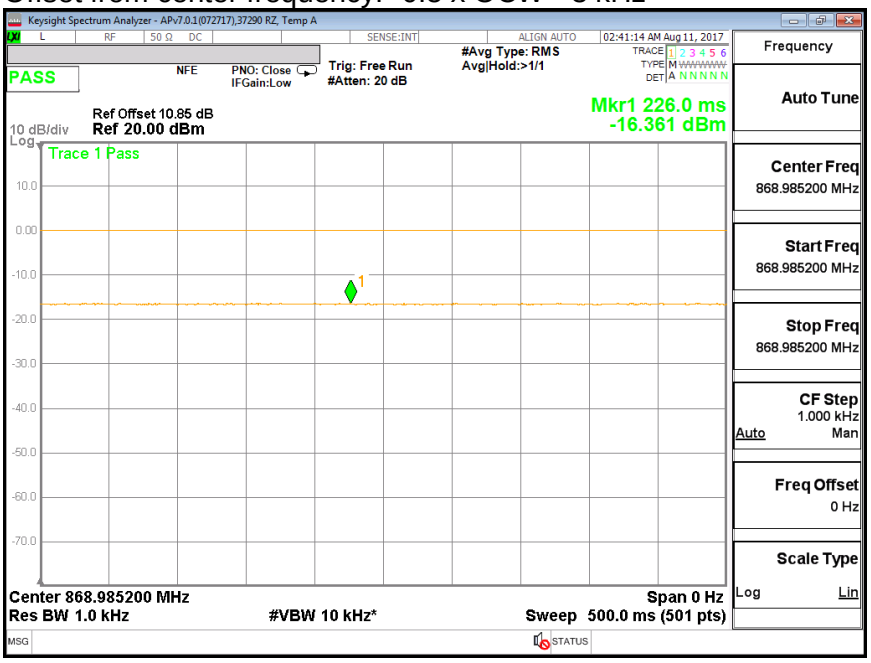
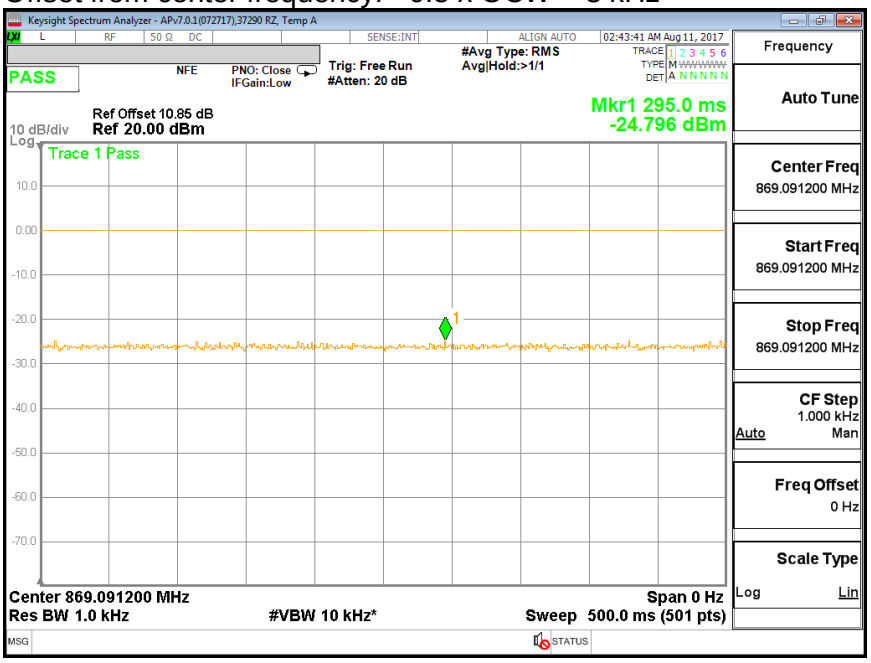
THE WORST CASE OF GFSK HIGH CHANNEL

TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 3 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 3 kHz



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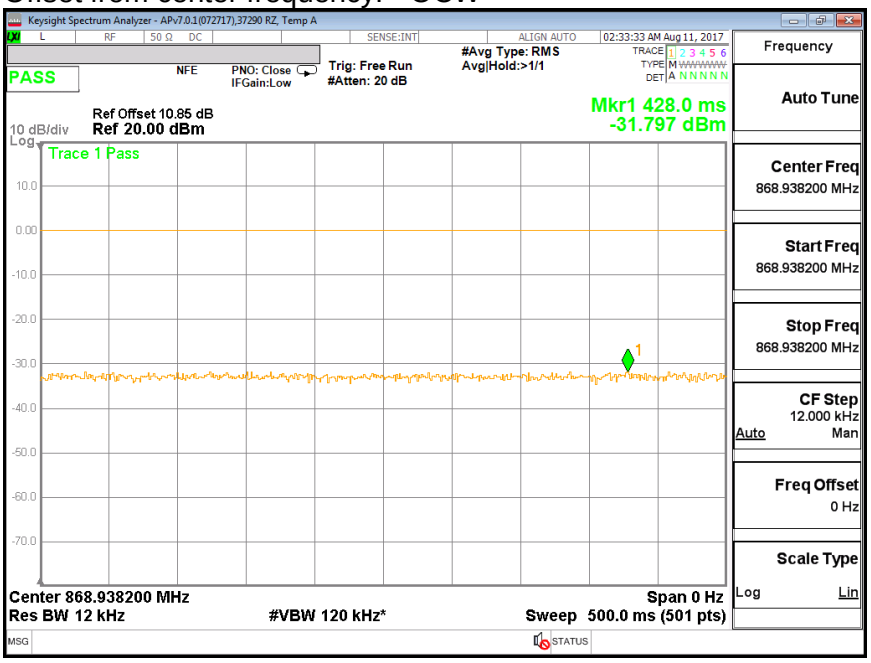
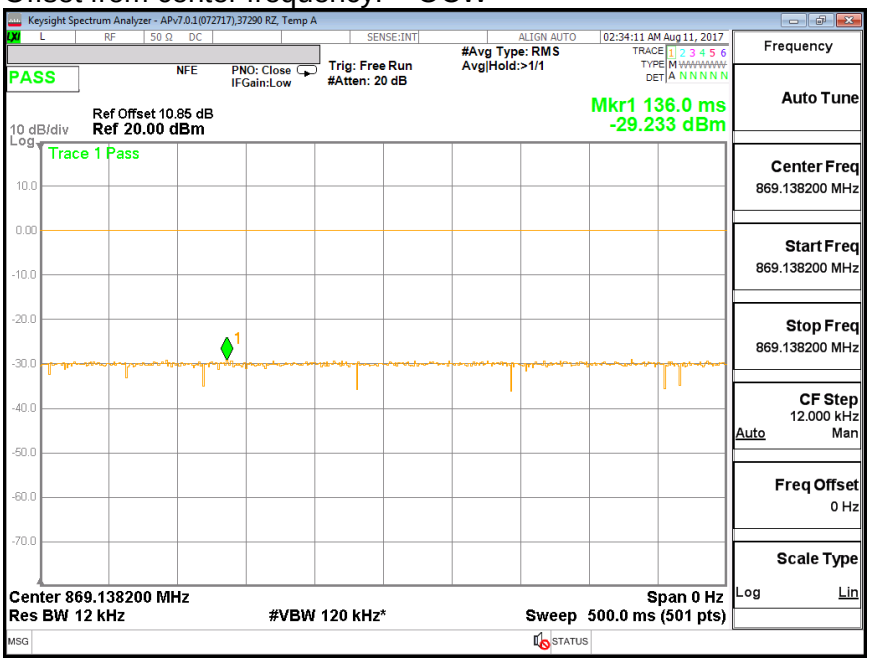
TX TRANSIENT
Offset from center frequency: - OCW



TX TRANSIENT
Offset from center frequency: + OCW



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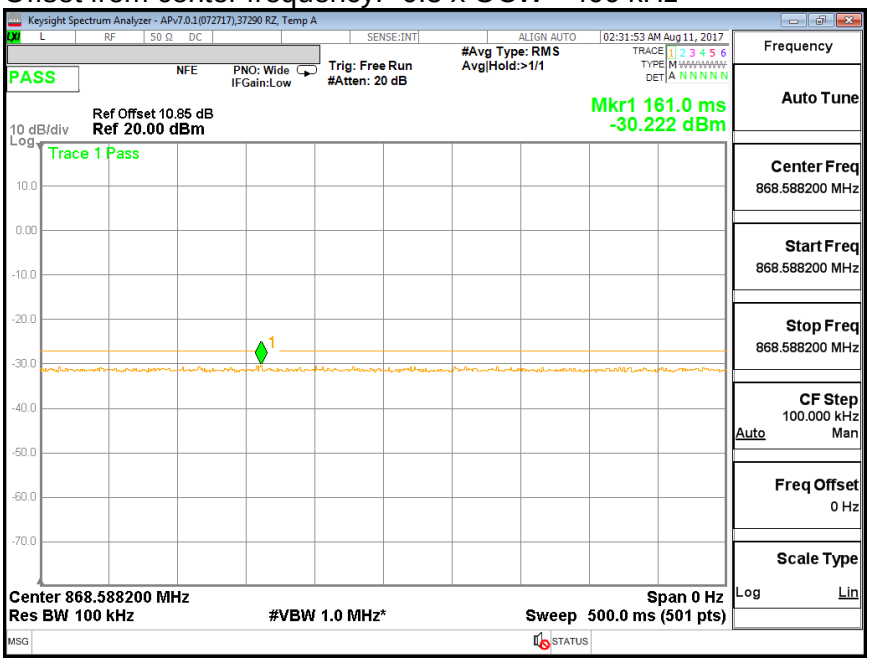
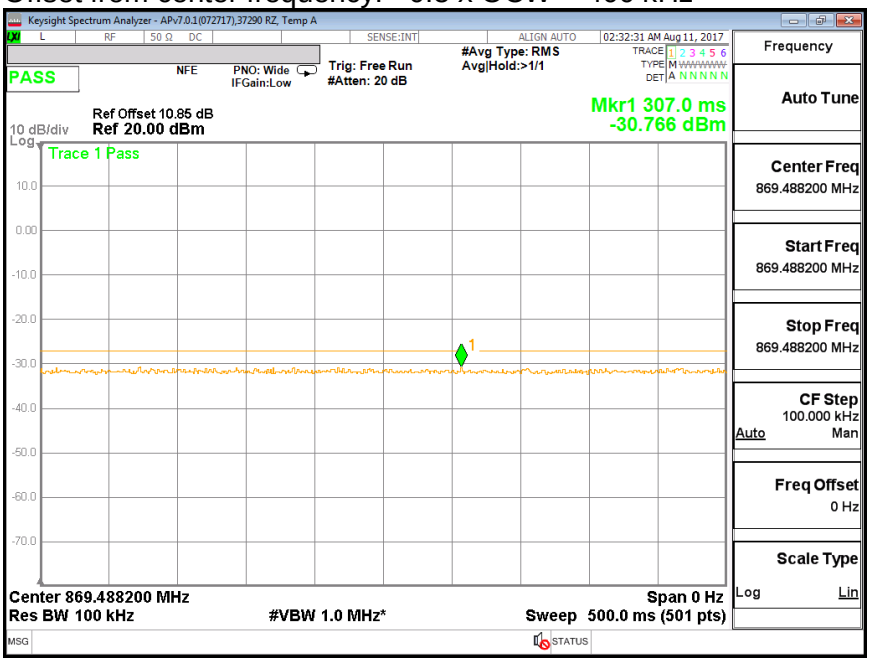
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 400 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 400 kHz



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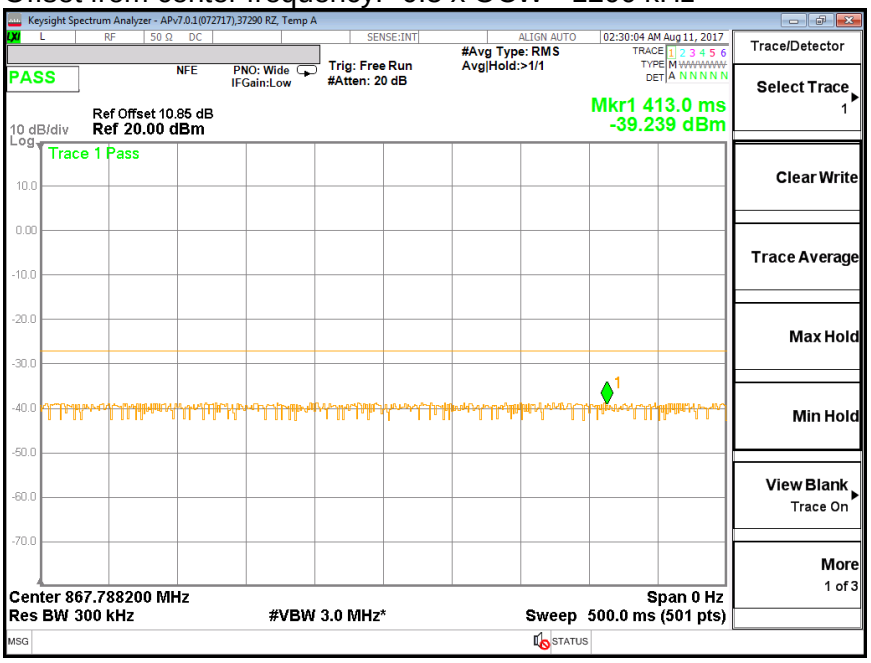
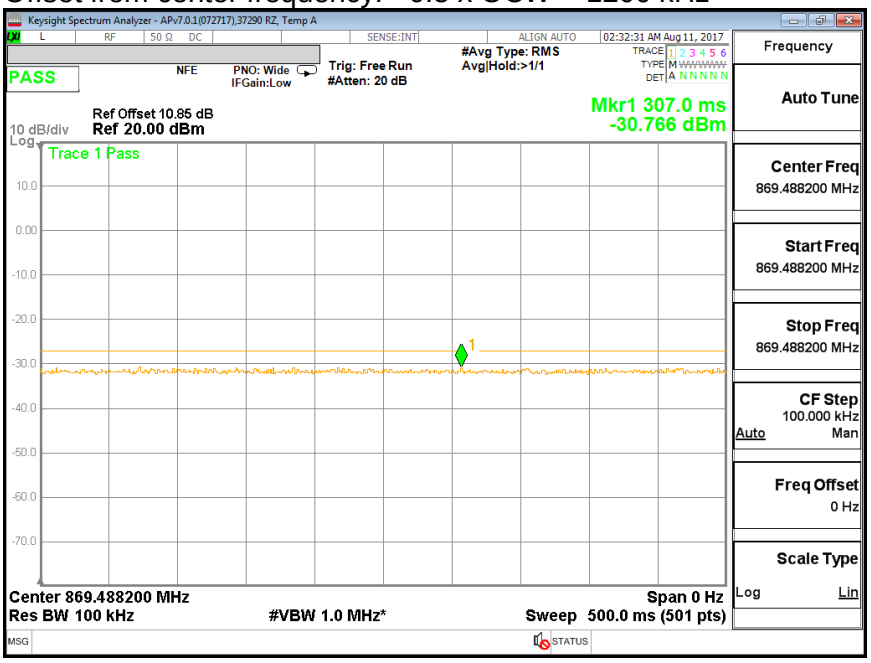
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 1200 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 1200 kHz



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7.4. GFSK MODULATION IN P BAND

7.4.1. OPERATING FREQUENCY

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.2.1.2

The manufacturer may declare either one or more operating frequencies and operating channels.
Operating channel(s) shall be entirely within operational frequency bands allowed by annexes B, C or any NRI.

22 ETSI EN 300 220-2 V3.1.1 (2017-02)

Operational Frequency Band		Maximum effective radiated power, e.r.p.	Channel access and occupation rules (e.g. Duty cycle or LBT + AFA)	Maximum occupied bandwidth	Other usage restrictions	Band number from EC Decision 2013/752/EU [i.3]	Class 1 sub-class number according Commission Decision 2000/299/EU [i.7]
M	868,000 MHz to 868,600 MHz	25 mW e.r.p.	≤ 1 % duty cycle or polite spectrum access	The whole band except for audio & video applications limited to 300 kHz		48	28
N	868,700 MHz to 869,200 MHz	25 mW e.r.p.	≤ 0,1% duty cycle or polite spectrum access	The whole sub-band except for audio & video applications limited to 300 kHz		50	29
O	869,400 MHz to 869,650 MHz	25 mW e.r.p.	≤ 0.1% duty cycle or polite spectrum access	The whole band	.	54a	130
P	869,400 MHz to 869,650 MHz	500 mW e.r.p.	≤ 10 % duty cycle or polite spectrum access	The whole band		54b	30
Q	869,700 MHz to 870,000 MHz	5 mW e.r.p.	No requirement	The whole band	Audio and video applications are excluded.	56a	31
R	869,700 MHz to 870,000 MHz	25 mW e.r.p.	≤ 1% duty cycle or polite spectrum access	The whole band	Analogue audio applications are excluded. Analogue video applications are excluded.	56b	69

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.1.2

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RESULTS

Parameter	Values as declared by the manufacturer
M6, GFSK	
Operational Frequency band or bands	869.4 - 869.65
Nominal Operating Frequencies (MHz)	869.557297
Operating Channel width(s) - OCW	40 kHz
M7, GFSK	
Operational Frequency band or bands	869.4 - 869.65
Nominal Operating Frequencies (MHz)	869.557297
Operating Channel width(s) - OCW	80 kHz
M12, GFSK	
Operational Frequency band or bands	869.4 - 869.65
Nominal Operating Frequencies (MHz)	869.557297
Operating Channel width(s) - OCW	30 kHz
M13, GFSK	
Operational Frequency band or bands	869.4 - 869.65
Nominal Operating Frequencies (MHz)	869.557297
Operating Channel width(s) - OCW	40 kHz

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7.4.2. TX EFFECTIVE RADIATED POWER

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.3.1.2

The effective radiated power shall not be greater than the value allowed in annexes B or C for the chosen operational frequency band(s).

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.2.2.1.2

RESULTS

Date: 08/11/17
Project No: 11773240
Tester: 50818_JQ

CHANNELS FOR MODULATION CODE: M7

EUT Antenna Gain (dBi) =	2.00

Condition	Output Power (dBm)	EIRP (dBm)	ERP (dBm)	Limit (dBm)	Margin (dB)
Operating Channel, CH30					
Normal	11.75	13.75	11.60	27	-15.40
Extreme T low, V low	12.49	14.49	12.34	27	-14.66
Extreme T low, V high	12.49	14.49	12.34	27	-14.66
Extreme T high, V low	11.19	13.19	11.04	27	-15.96
Extreme T high, V high	11.23	13.23	11.08	27	-15.92

Note: Cable loss correction factor is included in the Power Meter Reading

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7.4.3. TX OCCUPIED BANDWIDTH

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.3.4.2

The occupied bandwidth of the EUT according to ETSI EN 300 220-1 [1], clause 5.6.2 shall comply with the limits in annex B or C.

Reference Limit:

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.6.2

The Operating Channel shall be declared and shall reside entirely within the Operational Frequency Band. The Maximum Occupied Bandwidth at 99 % shall reside entirely within the Operating Channel defined by F_{low} and F_{high}.

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.6.3.3 (Conducted Measurement)

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RESULTS

BAND P

Condition	Low CH (MHz)	High CH (MHz)	Low CH OBW (kHz)	High CH OBW (kHz)	F_{Low} (MHz)	F_{Low} Limit (MHz)	F_{High} (MHz)	F_{High} Limit (MHz)
M6, GFSK								
Normal	869.5573	869.5573	32.019	32.019	869.54	> 869.4	869.57	< 869.65
T low, V low	869.5573	869.5573	31.904	31.904	869.54	> 869.4	869.57	< 869.65
T low, V high	869.5573	869.5573	32.272	32.272	869.54	> 869.4	869.57	< 869.65
T high, V low	869.5573	869.5573	31.886	31.886	869.54	> 869.4	869.57	< 869.65
T high, V high	869.5573	869.5573	31.959	31.959	869.54	> 869.4	869.57	< 869.65
M7, GFSK								
Normal	869.5573	869.5573	67.560	67.560	869.52	> 869.4	869.59	< 869.65
T low, V low	869.5573	869.5573	65.276	65.276	869.52	> 869.4	869.59	< 869.65
T low, V high	869.5573	869.5573	65.646	65.646	869.52	> 869.4	869.59	< 869.65
T high, V low	869.5573	869.5573	66.999	66.999	869.52	> 869.4	869.59	< 869.65
T high, V high	869.5573	869.5573	63.692	63.692	869.53	> 869.4	869.59	< 869.65
M12, GFSK								
Normal	869.5573	869.5573	29.675	29.675	869.54	> 869.4	869.57	< 869.65
T low, V low	869.5573	869.5573	29.650	29.650	869.54	> 869.4	869.57	< 869.65
T low, V high	869.5573	869.5573	29.715	29.715	869.54	> 869.4	869.57	< 869.65
T high, V low	869.5573	869.5573	29.651	29.651	869.54	> 869.4	869.57	< 869.65
T high, V high	869.5573	869.5573	29.775	29.775	869.54	> 869.4	869.57	< 869.65
M13, GFSK								
Normal	869.5573	869.5573	38.867	38.867	869.54	> 869.4	869.58	< 869.65
T low, V low	869.5573	869.5573	38.907	38.907	869.54	> 869.4	869.58	< 869.65
T low, V high	869.5573	869.5573	38.749	38.749	869.54	> 869.4	869.58	< 869.65
T high, V low	869.5573	869.5573	38.713	38.713	869.54	> 869.4	869.58	< 869.65
T high, V high	869.5573	869.5573	38.635	38.635	869.54	> 869.4	869.58	< 869.65

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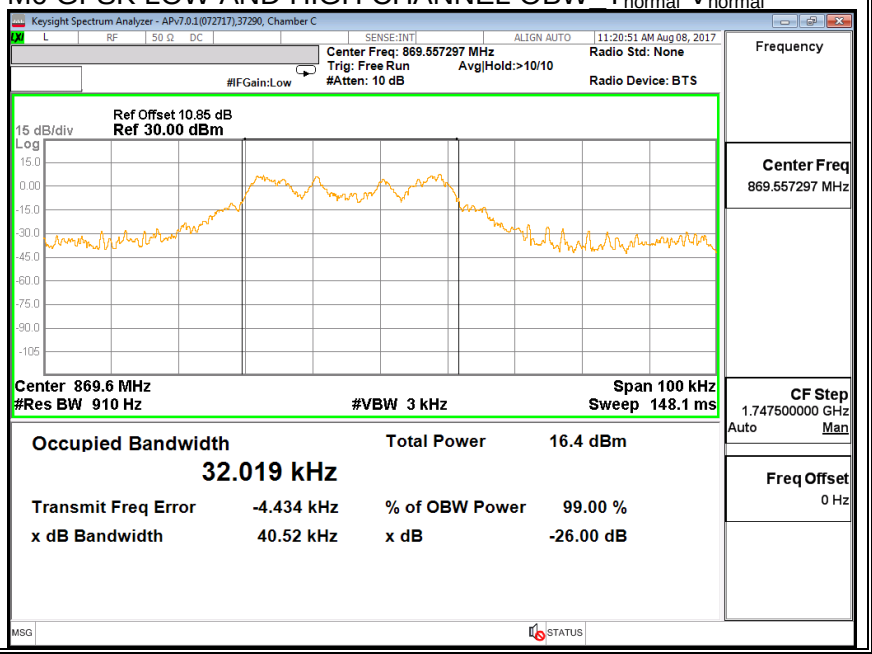
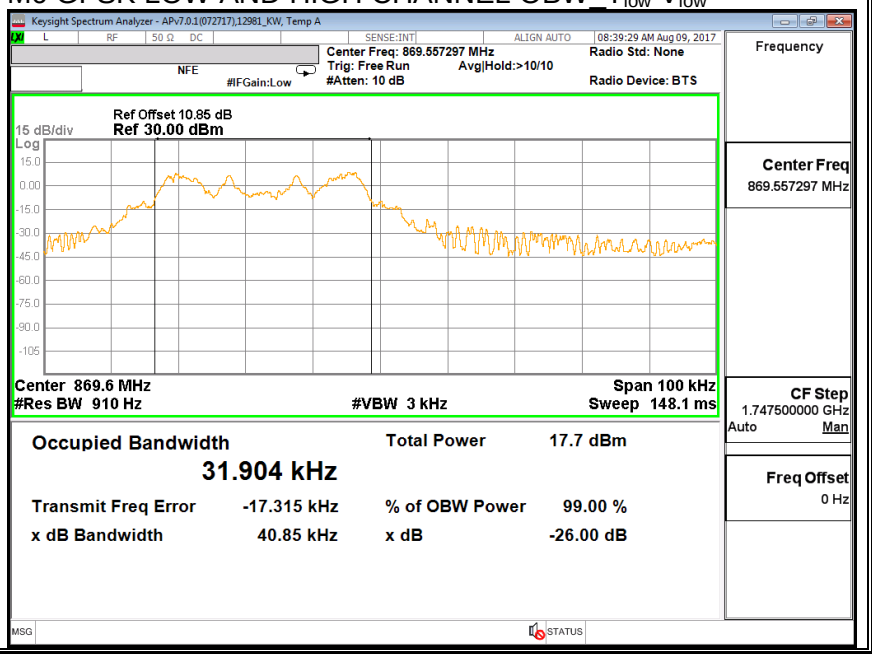
M6 GFSK LOW AND HIGH CHANNEL OBW_T_{normal} V_{normal}



M6 GFSK LOW AND HIGH CHANNEL OBW_T_{low} V_{low}



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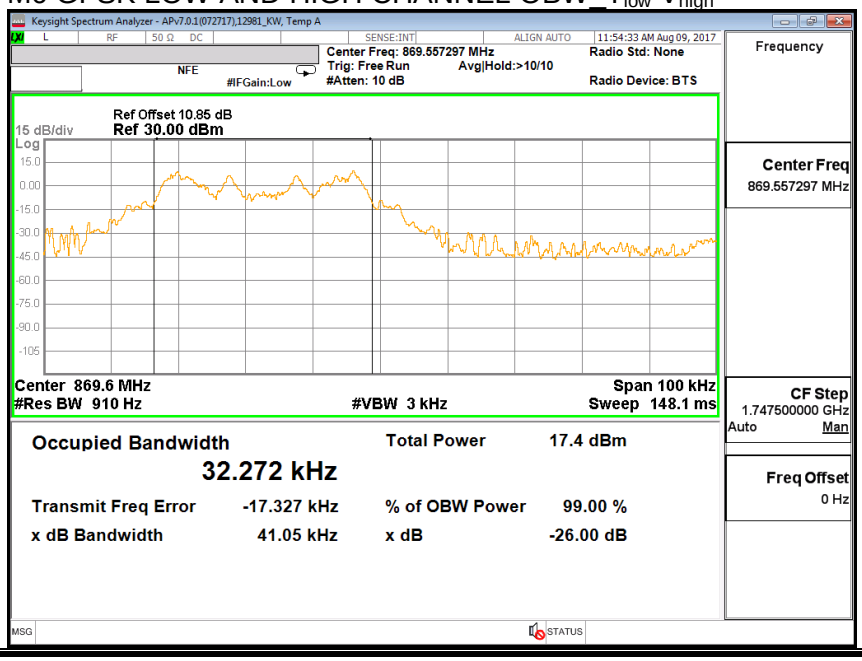
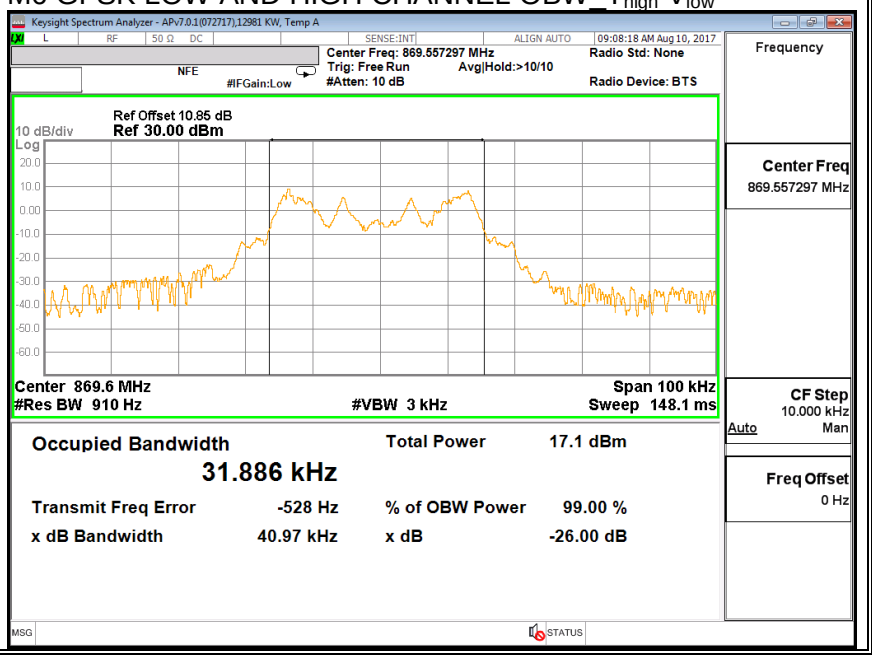
M6 GFSK LOW AND HIGH CHANNEL OBW_T_{low} V_{high}



M6 GFSK LOW AND HIGH CHANNEL OBW_T_{high} V_{low}



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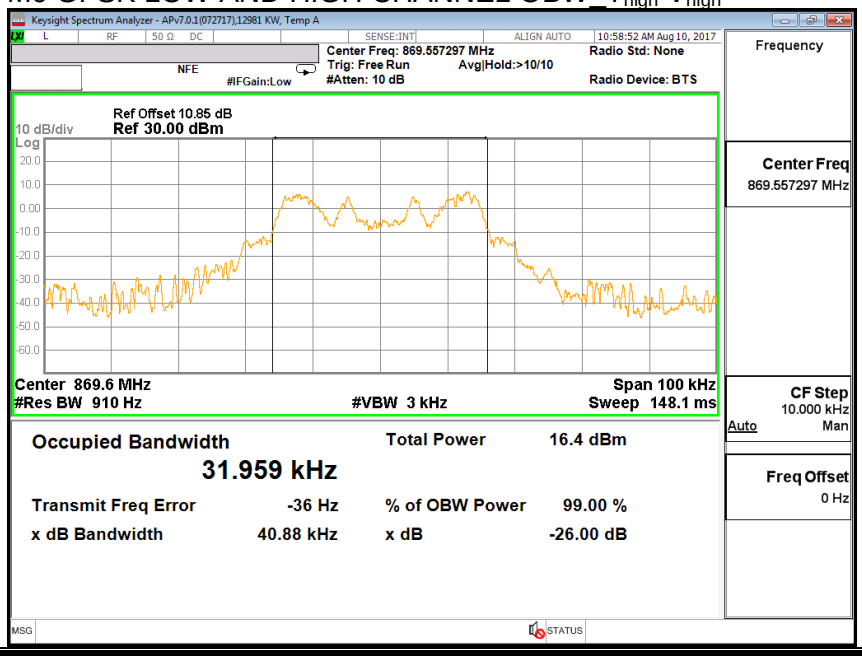
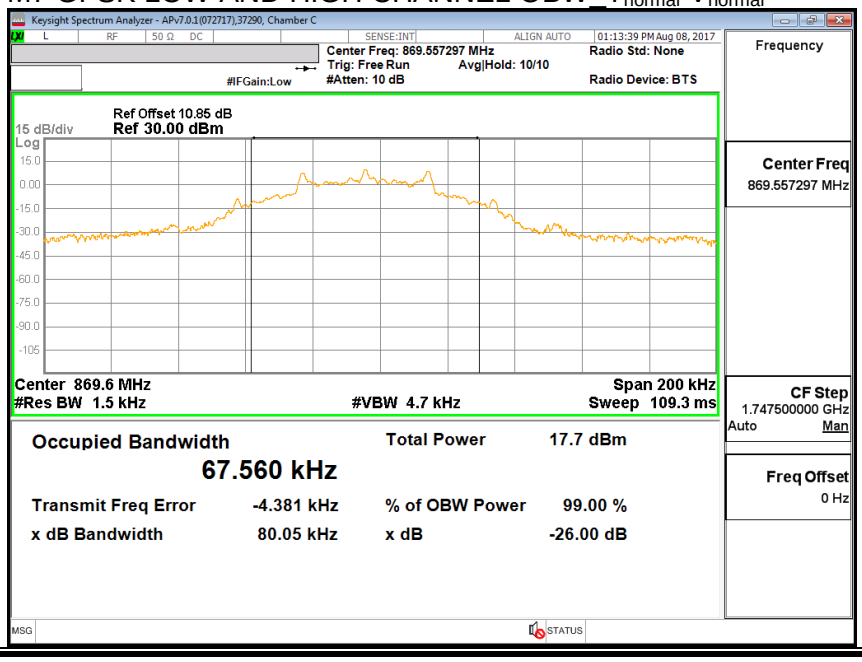
M6 GFSK LOW AND HIGH CHANNEL OBW_T_{high} V_{high}



M7 GFSK LOW AND HIGH CHANNEL OBW_T_{normal} V_{normal}



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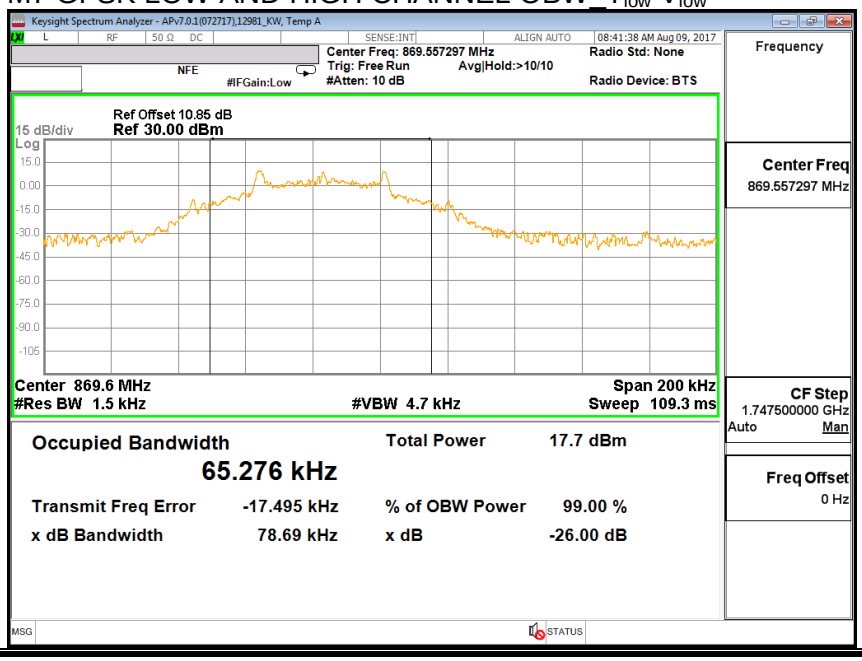
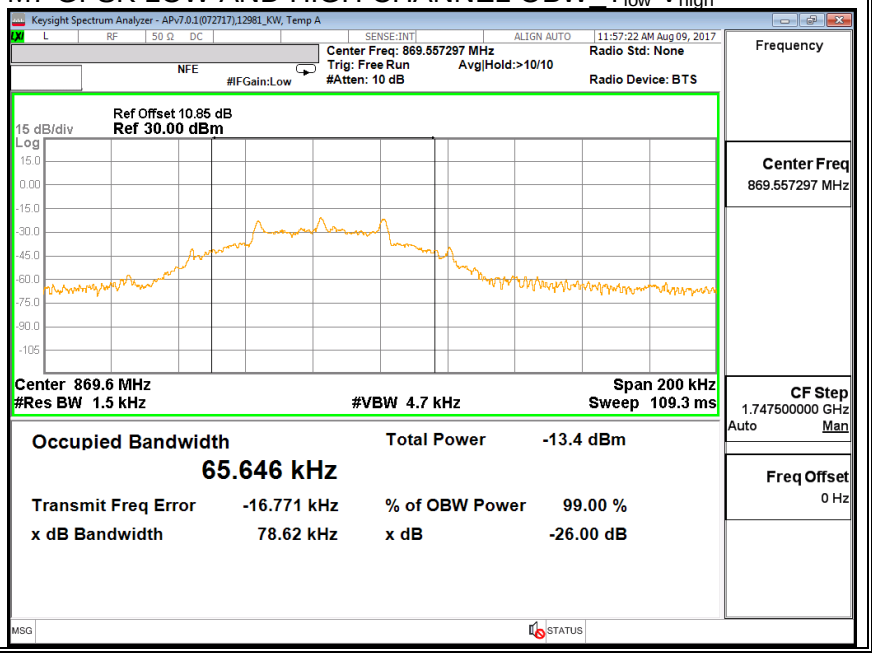
M7 GFSK LOW AND HIGH CHANNEL OBW_T_{low} V_{low}



M7 GFSK LOW AND HIGH CHANNEL OBW_T_{low} V_{high}



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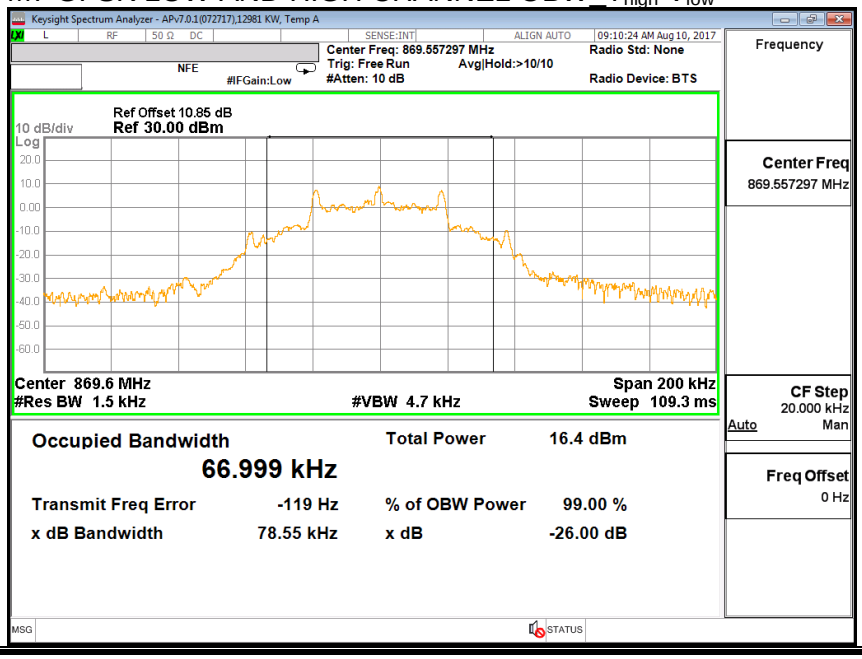
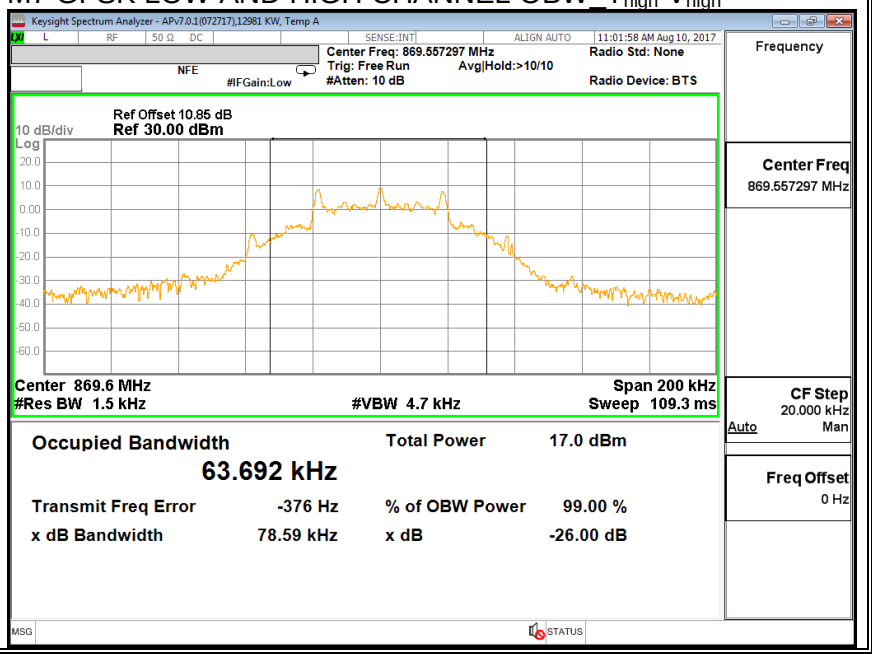
M7 GFSK LOW AND HIGH CHANNEL OBW_T_{high} V_{low}



M7 GFSK LOW AND HIGH CHANNEL OBW_T_{high} V_{high}



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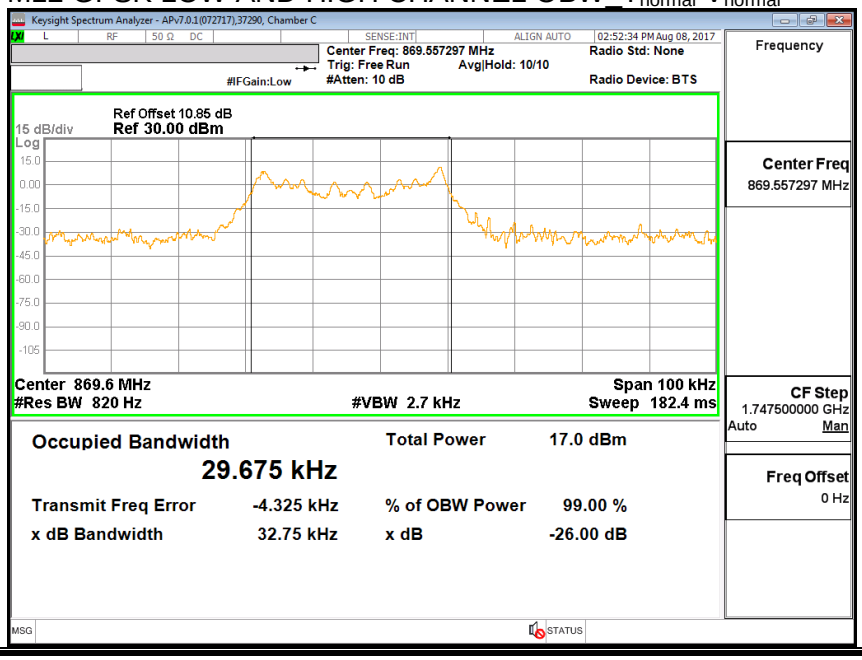
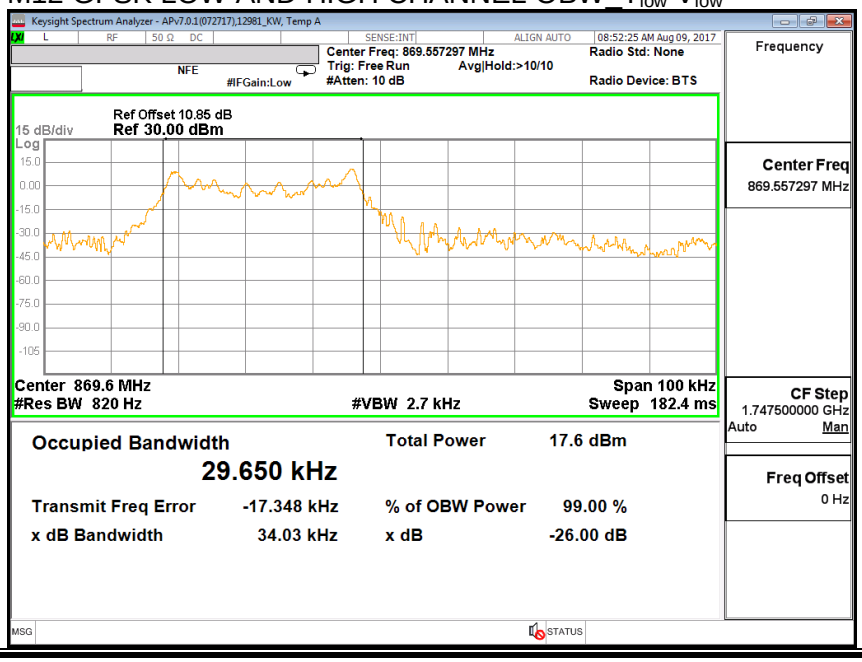
M12 GFSK LOW AND HIGH CHANNEL OBW_T_{normal} V_{normal}



M12 GFSK LOW AND HIGH CHANNEL OBW_T_{low} V_{low}



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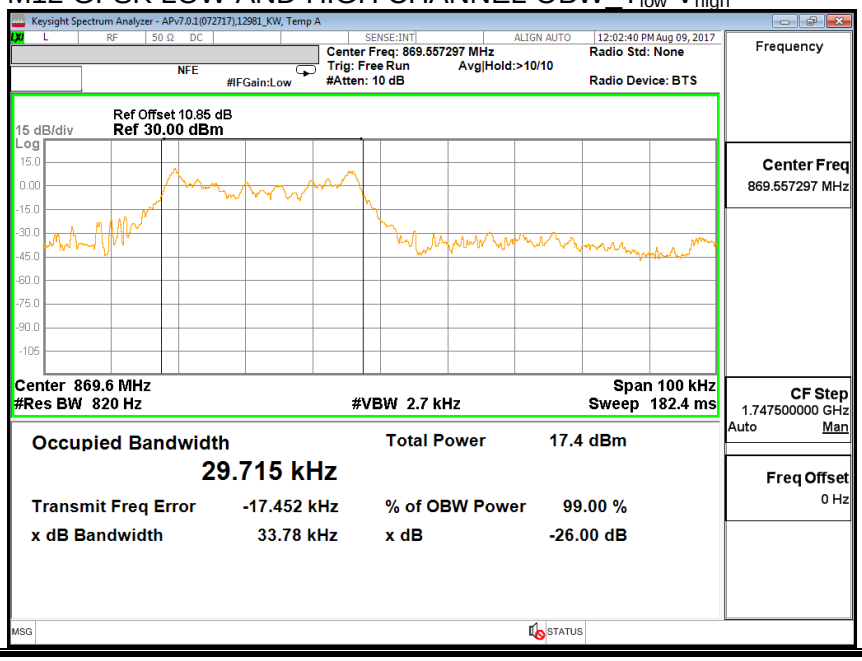
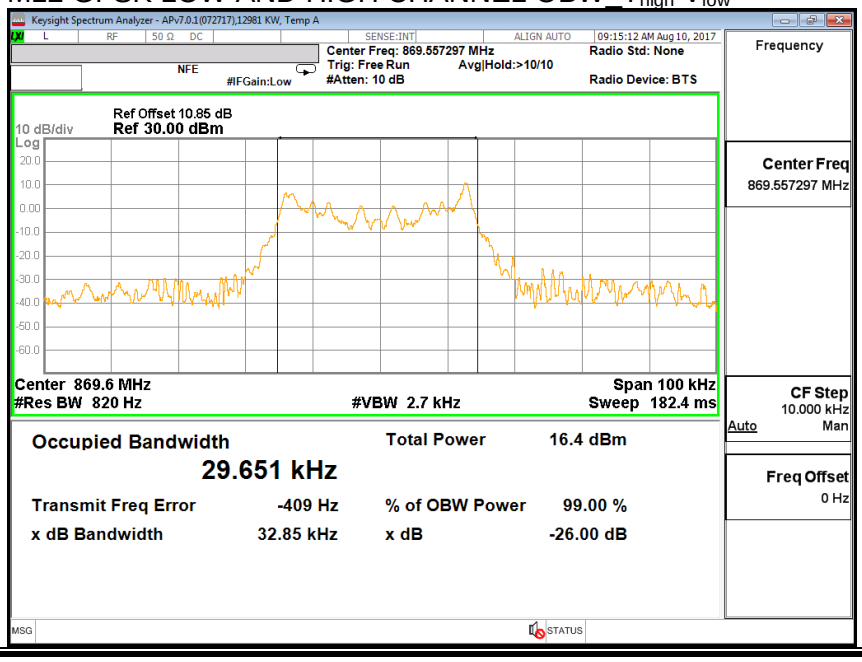
M12 GFSK LOW AND HIGH CHANNEL OBW_T_{low} V_{high}



M12 GFSK LOW AND HIGH CHANNEL OBW_T_{high} V_{low}



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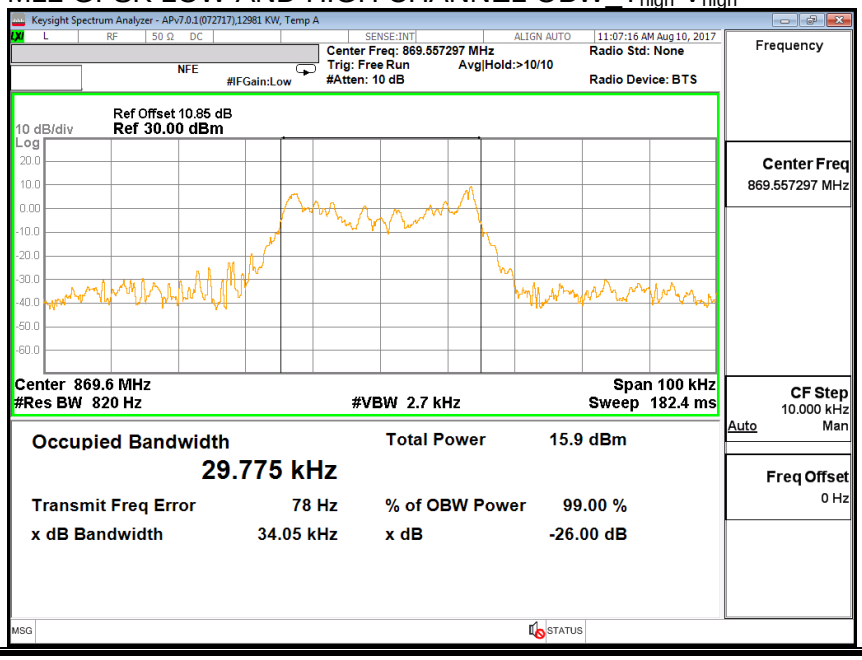
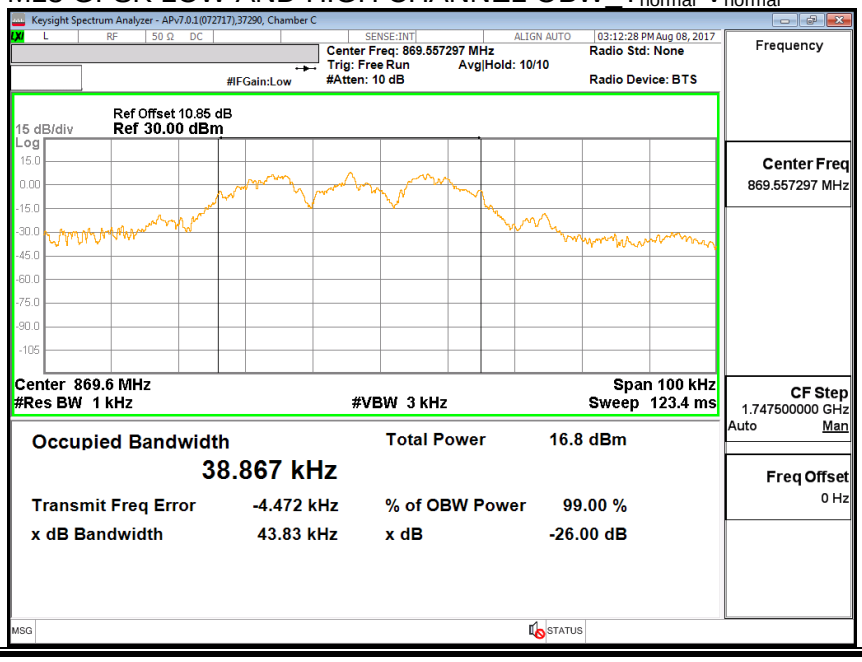
M12 GFSK LOW AND HIGH CHANNEL OBW_T_{high} V_{high}



M13 GFSK LOW AND HIGH CHANNEL OBW_T_{normal} V_{normal}



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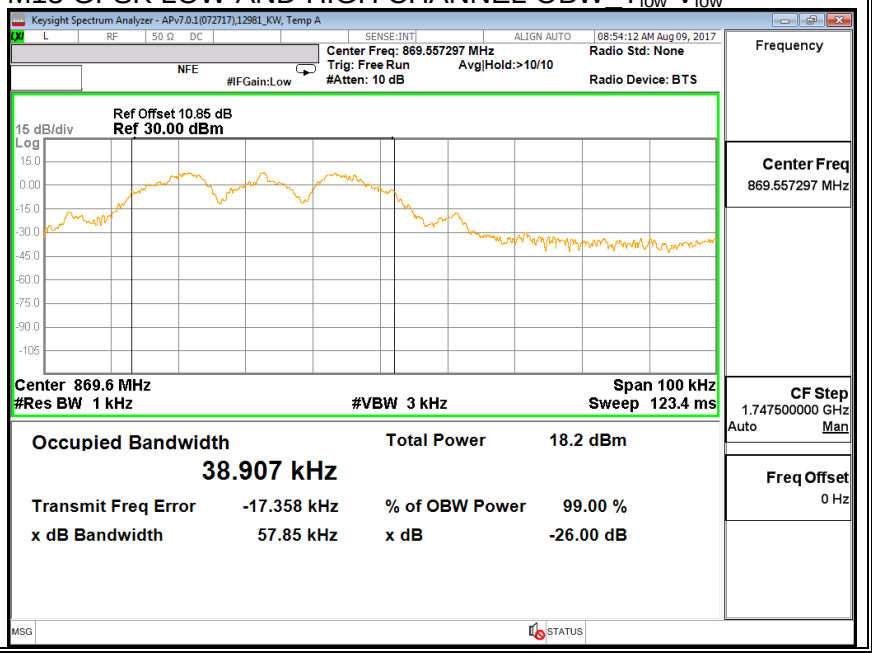
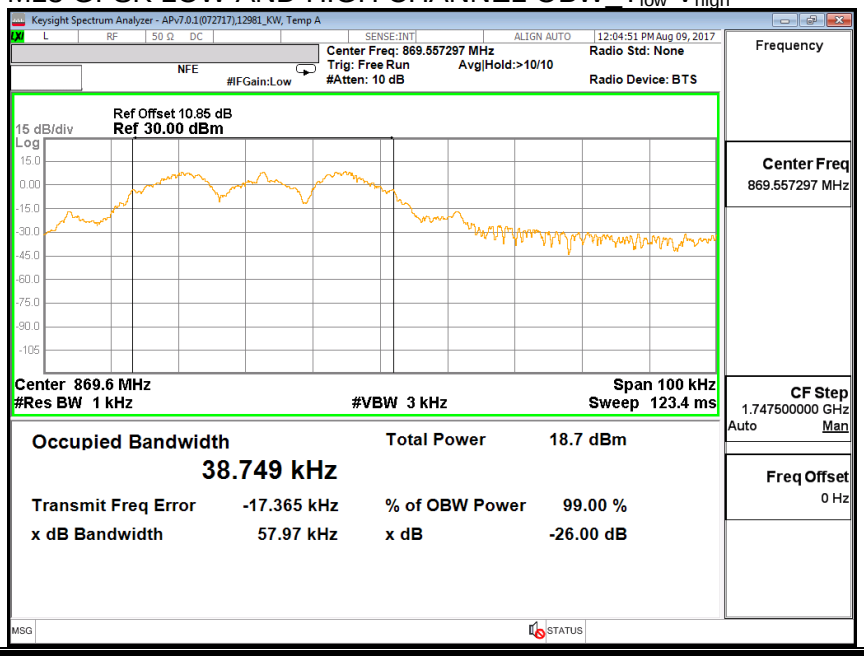
M13 GFSK LOW AND HIGH CHANNEL OBW_T_{low} V_{low}



M13 GFSK LOW AND HIGH CHANNEL OBW_T_{low} V_{high}



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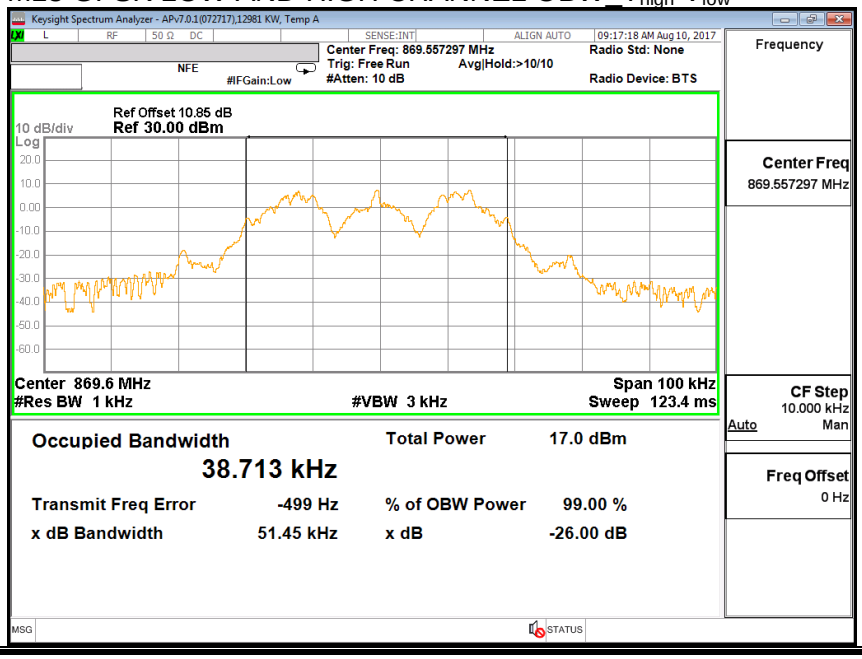
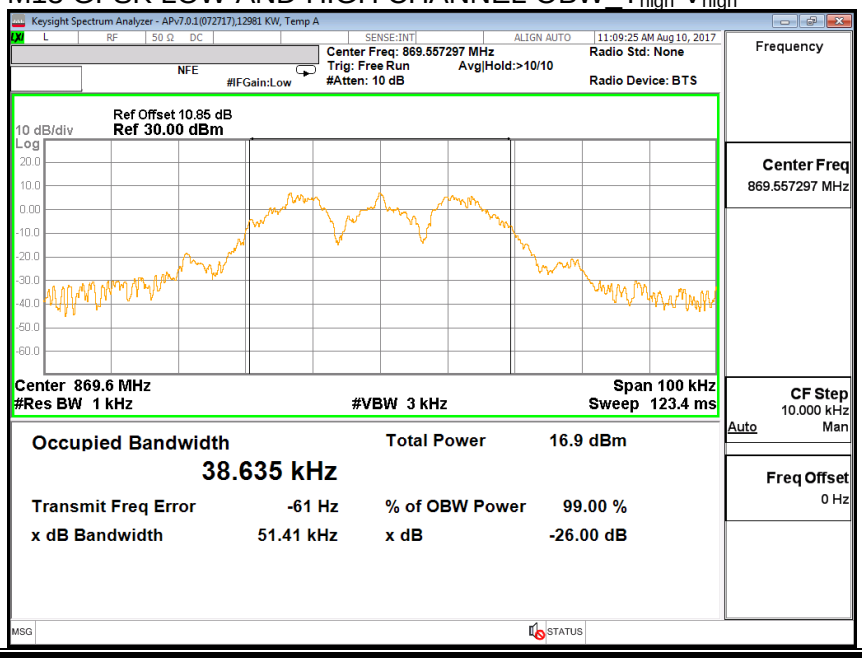
M13 GFSK LOW AND HIGH CHANNEL OBW_T_{high} V_{low}



M13 GFSK LOW AND HIGH CHANNEL OBW_T_{high} V_{high}



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7.4.4. TX OUT OF BAND EMISSIONS

REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.1

Two OOB domains are defined, one for OC (see Figure 5) and one for Operational Frequency band (see Figure 6). The spectrum masks for these two OOB domains may overlap.

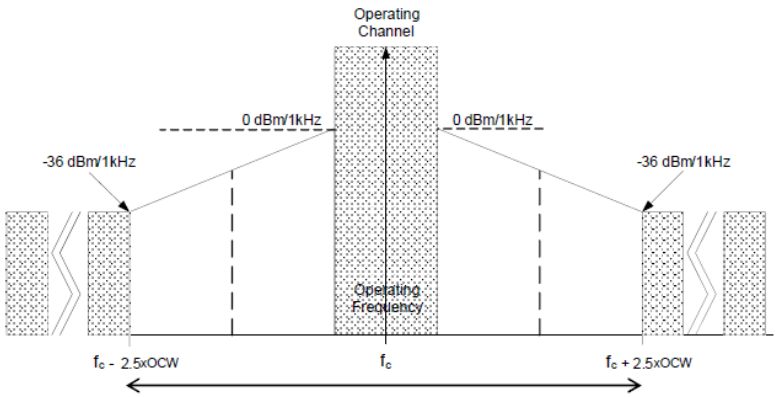

Figure 5: Out Of Band Domain for Operating Channel with reference BW

Unwanted emissions in the Out Of Band domain are those falling in the frequency range immediately below the lower, and above the upper, frequency of the Operating Channel. The OOB domain includes both frequencies outside the Operating Channel within the Operational Frequency Band and frequencies outside the Operational Frequency Band.
The relevant Out Of Band domain is shown in Figure 5 and applies within the Operational Frequency Band.

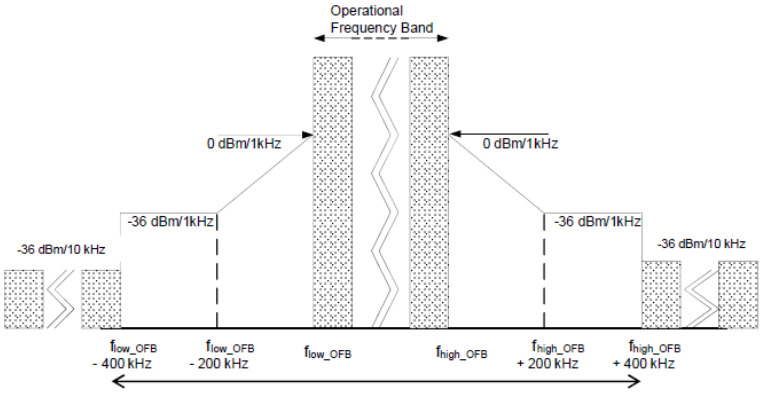

Figure 6: Out Of Band Domain for Operational Frequency Band with reference BW

Specific limits apply at frequencies immediately above and below the Operational Frequency Band as shown in Figure 6.
NOTE: f_{low}_OFB is the lower edge of the Operational Frequency Band. f_{high}_OFB is the upper edge of the Operational Frequency Band.

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REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.2

The EUT emissions level in OOB domains for the Operating Channel and the Operational Frequency Band shall be less or equal to Table 15 spectrum mask.

Table 15: Emission limits in the Out Of Band domains

Domain	Frequency Range	RBW_{REF}	Max power limit
OOB limits applicable to Operational Frequency Band (See Figure 6)	$f \le f_{low_OFB}$ - 400 kHz	10 kHz	-36 dBm
	F_{low_OFB} - 400 kHz ≤ f ≤ f_{low_OFB} - 200 kHz	1 kHz	-36 dBm
	f_{low} - 200 kHz ≤ f < f_{low_OFB}	1 kHz	See Figure 6
	$f = f_{low_OFB}$	1 kHz	0 dBm
	$f = f_{high_OFB}$	1 kHz	0 dBm
	F_{high_OFB} < f ≤ f_{high_OFB} + 200 kHz	1 kHz	See Figure 6
	F_{high_OFB} + 200 kHz ≤ f ≤ f_{high_OFB} + 400 kHz	1 kHz	-36 dBm
	F_{high_OFB} + 400 kHz ≤ f	10 kHz	-36 dBm
OOB limits applicable to Operating Channel (See Figure 5)	$f = f_c$- 2.5 x OCW	1 kHz	-36 dBm
	f_c - 2,5 x OCW ≤ f ≤ f_c - 0,5 x OCW	1 kHz	See Figure 5
	$f = f_c$ - 0,5 x OCW	1 kHz	0 dBm
	$f = f_c$ + 0,5 x OCW	1 kHz	0 dBm
	f_c + 0,5 x OCW ≤ f ≤ f_c + 2,5 x OCW	1 kHz	See Figure 5
	$f = f_c$+ 2,5 x OCW	1 kHz	-36 dBm

NOTE: f is the measurement frequency.
f_c is the Operating Frequency.
F_{low_OFB} is the lower edge of the Operational Frequency Band.
F_{high_OFB} is the upper edge of the Operational Frequency Band.
OCW is the operating channel bandwidth.

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.3.3 (Conducted Measurement)

RESULTS

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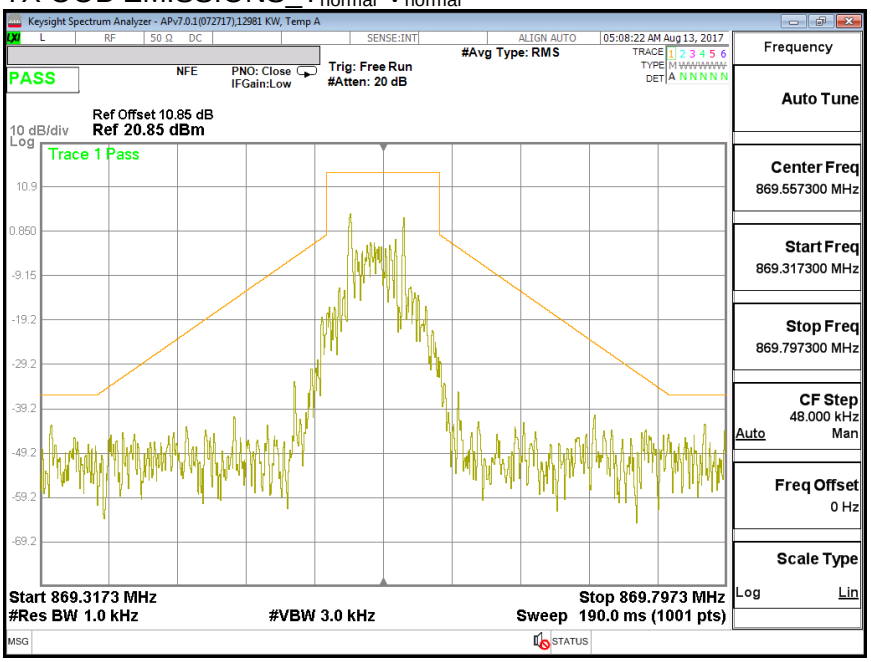
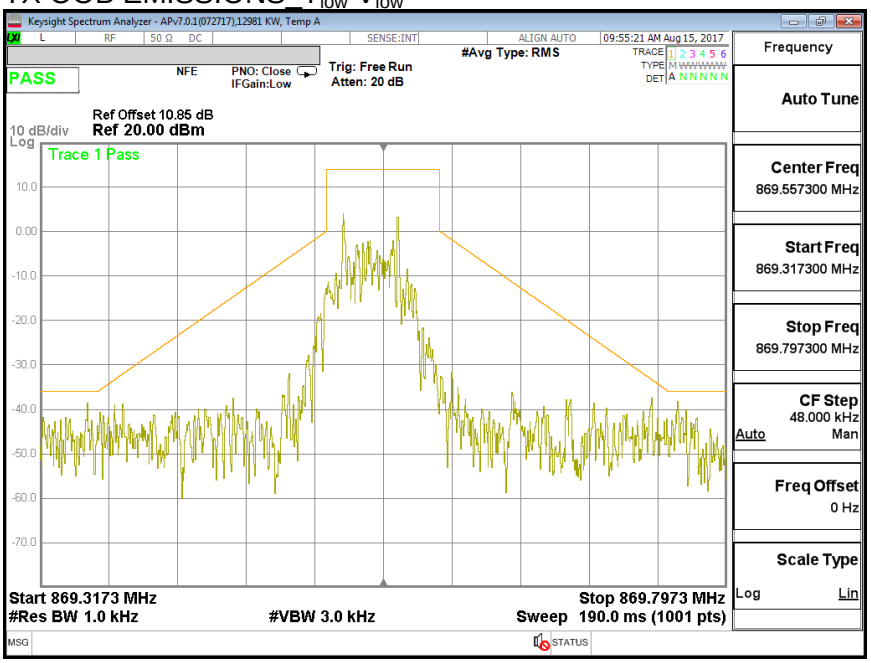
TX OUT OF BAND EMISSIONS (APPLICABLE TO OPERATING CHANNEL)

M7 OPERATING CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal}



TX OOB EMISSIONS_T_{low} V_{low}



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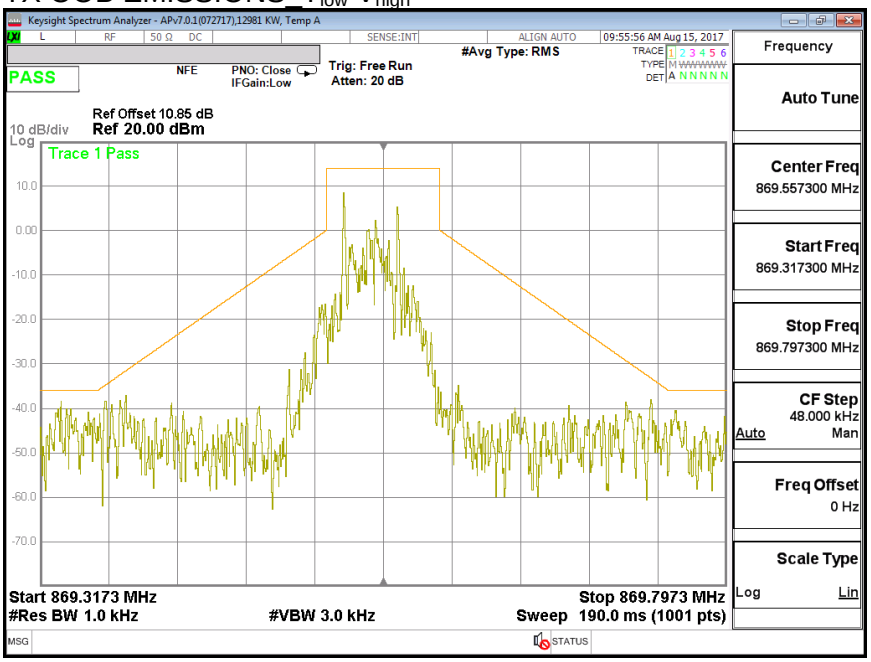
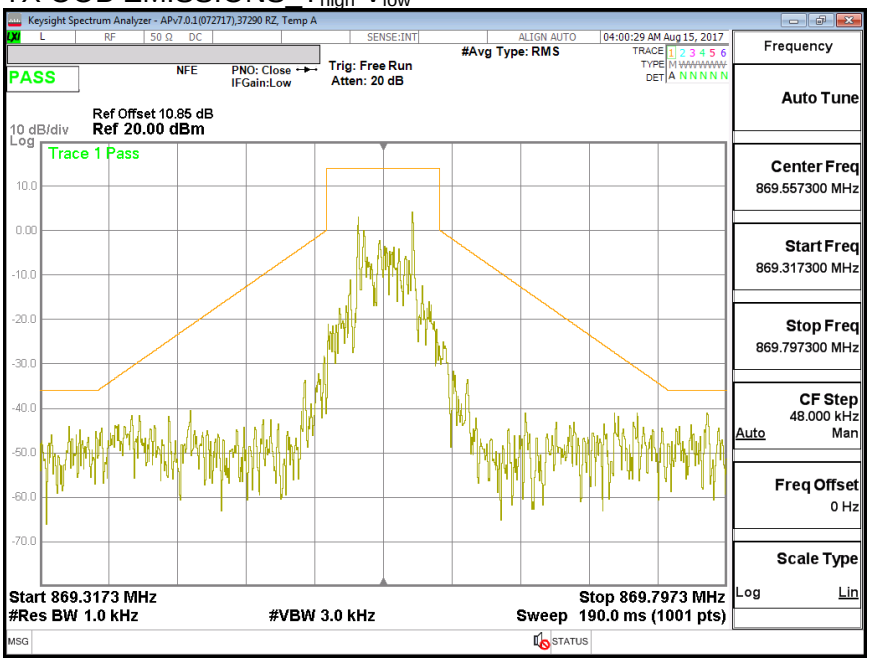
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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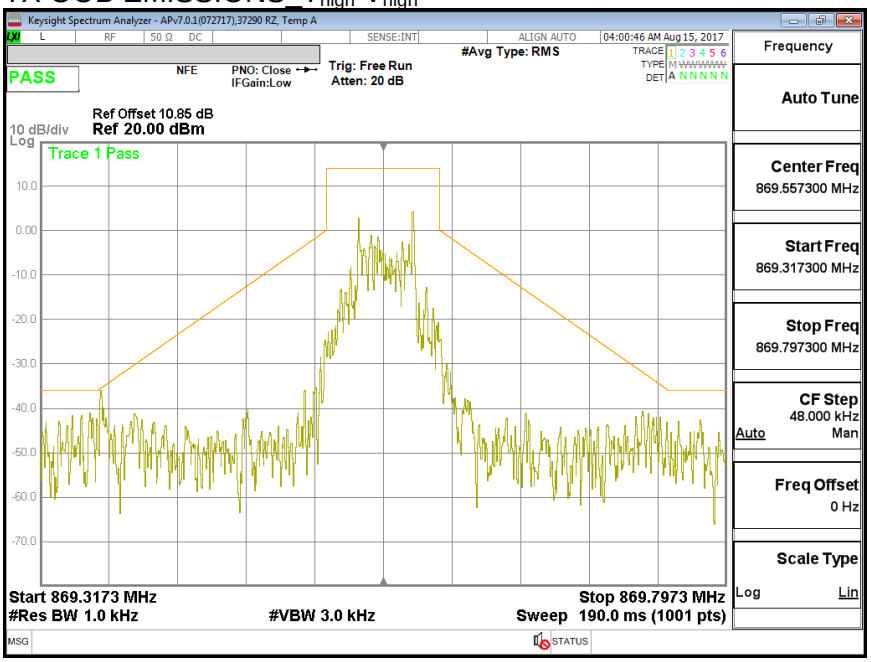
TX OOB EMISSIONS_T_{high} V_{high}



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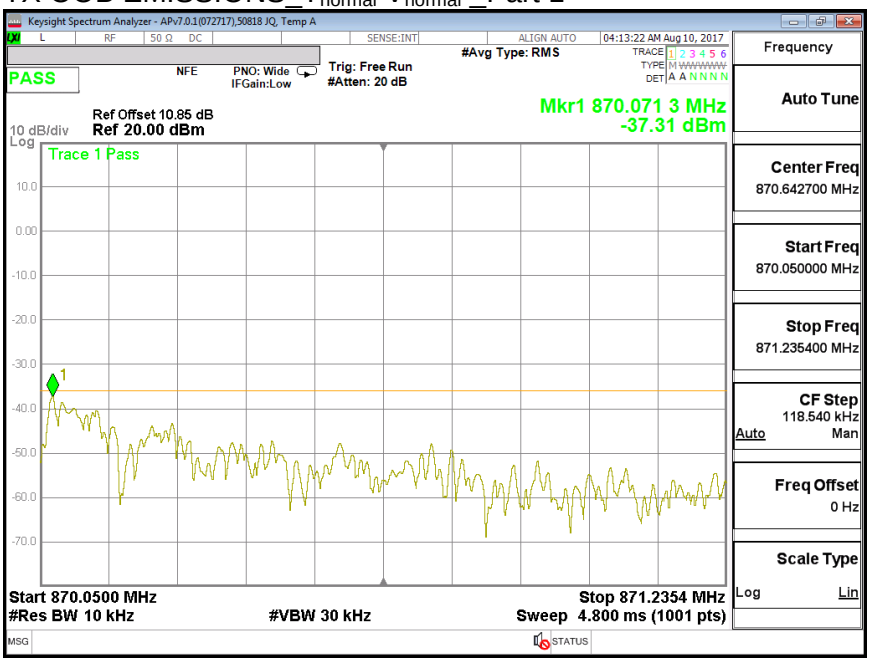
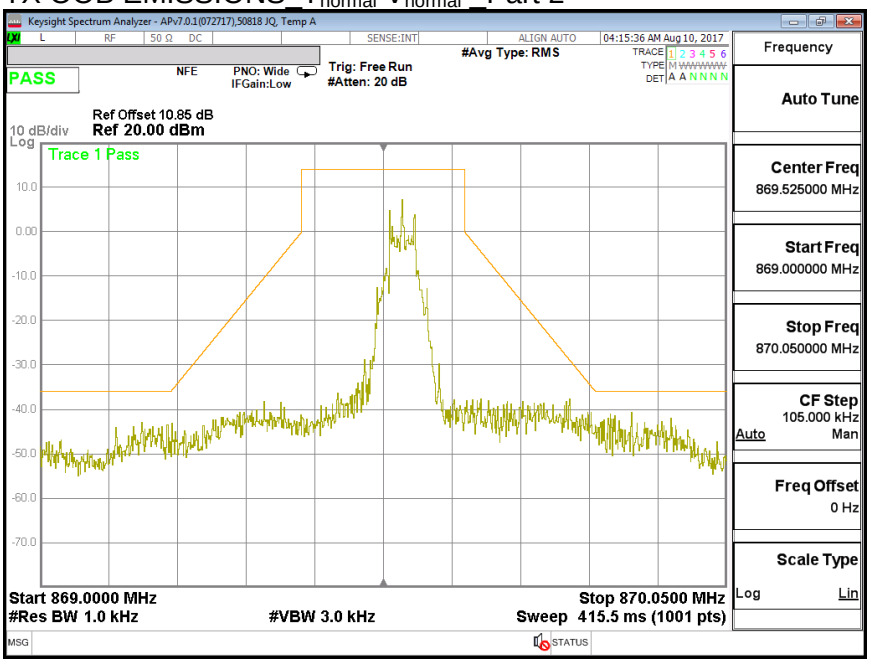
TX OUT OF BAND EMISSIONS (APPLICABLE TO OPERATIONAL FREQUENCY BANDS)

M7 OPERATING CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal} _Part 1



TX OOB EMISSIONS_T_{normal} V_{normal} _Part 2



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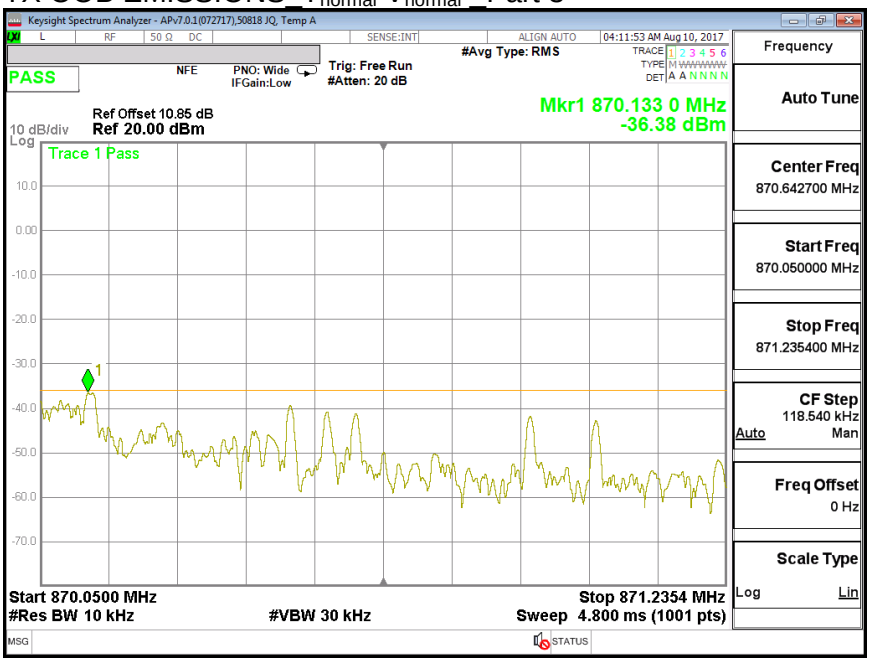
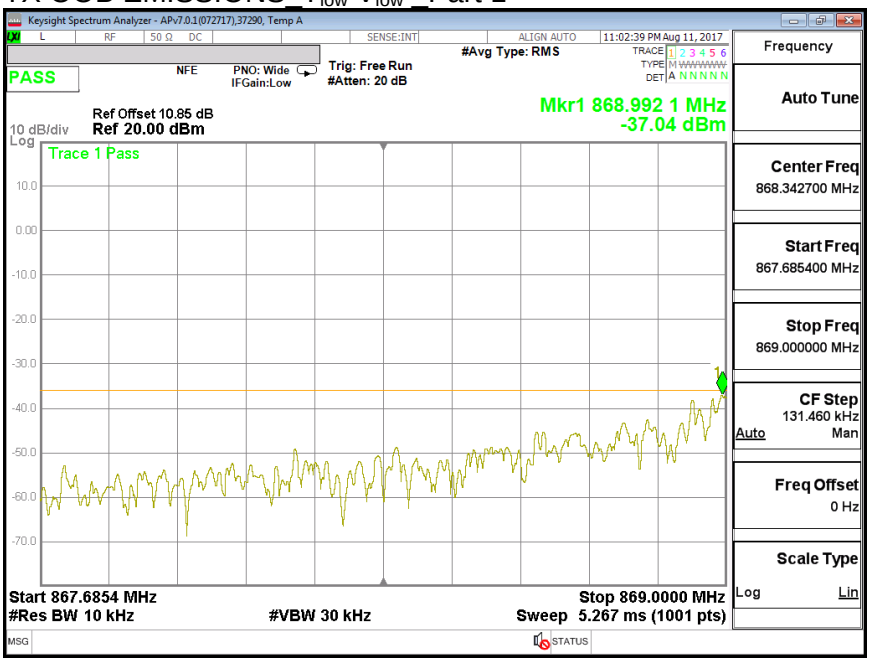
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3



TX OOB EMISSIONS_T_{low} V_{low} _Part 1



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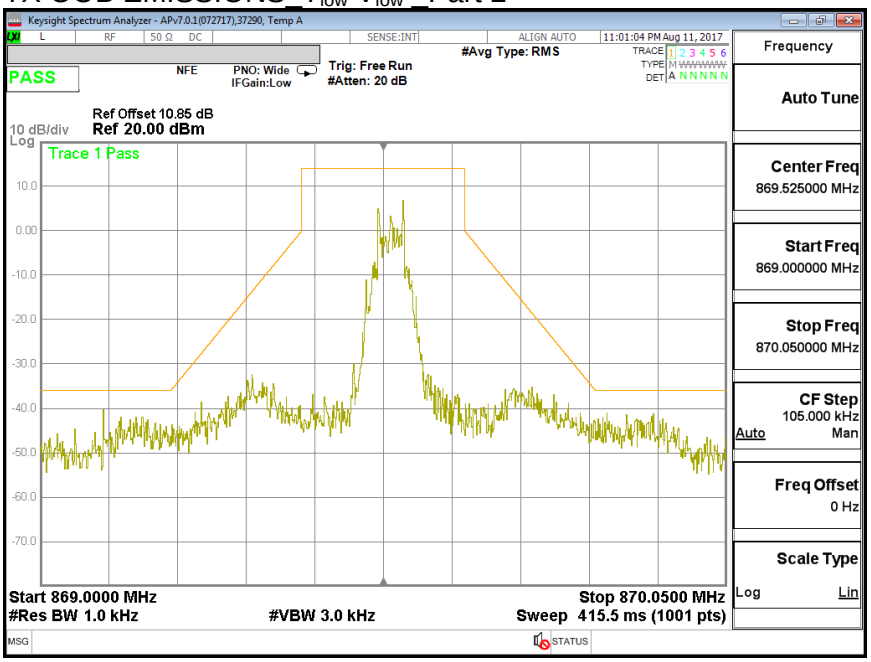
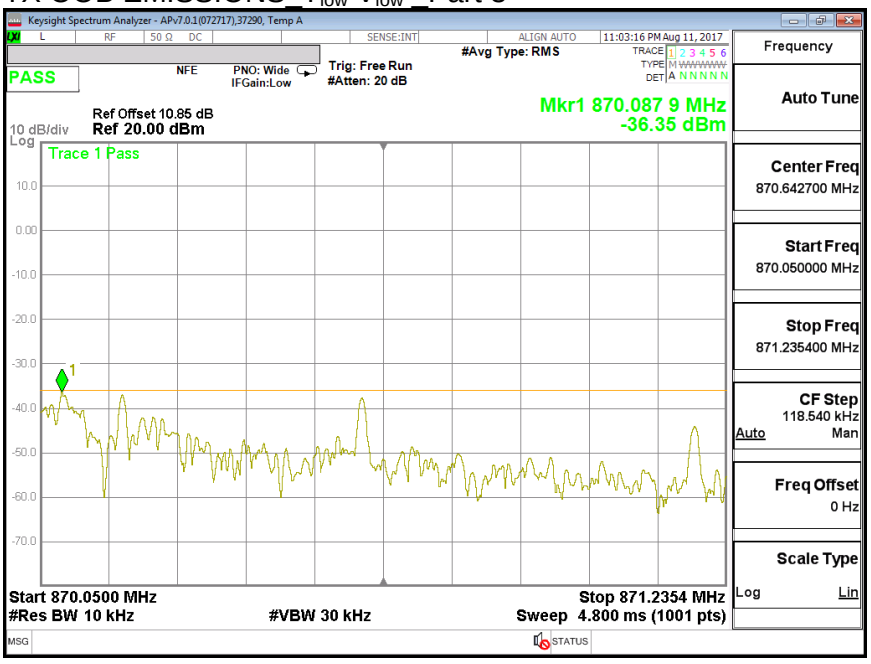
TX OOB EMISSIONS_T_{low} V_{low} _Part 2



TX OOB EMISSIONS_T_{low} V_{low} _Part 3



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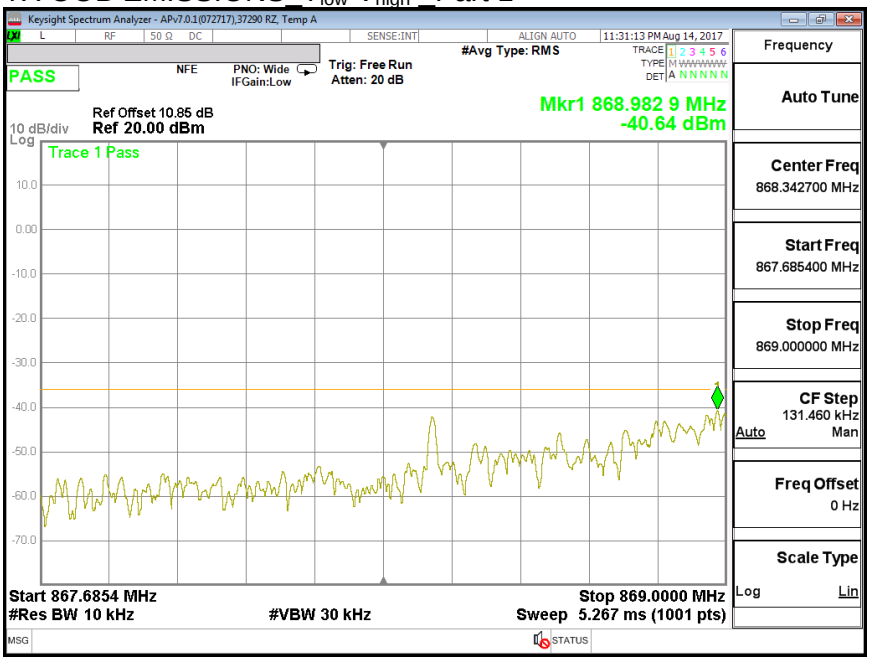
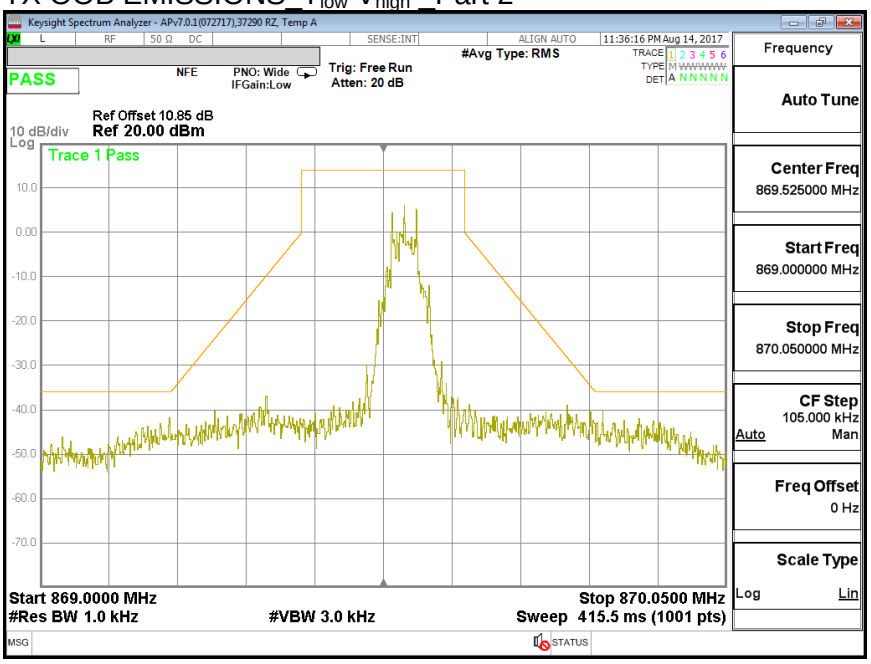
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



TX OOB EMISSIONS_T_{low} V_{high} _Part 2



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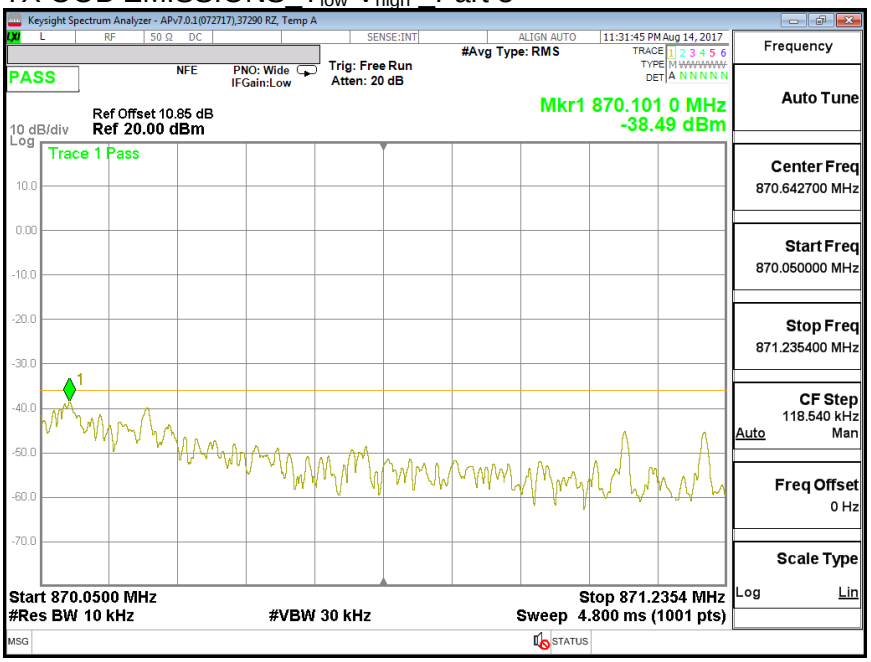
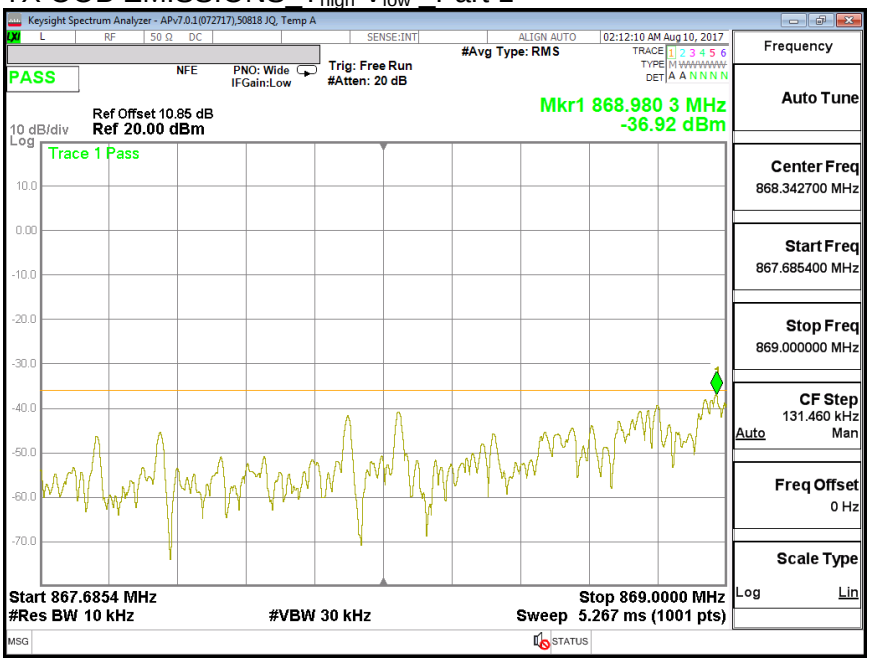
TX OOB EMISSIONS_T_{low} V_{high} _Part 3



TX OOB EMISSIONS_T_{high} V_{low} _Part 1



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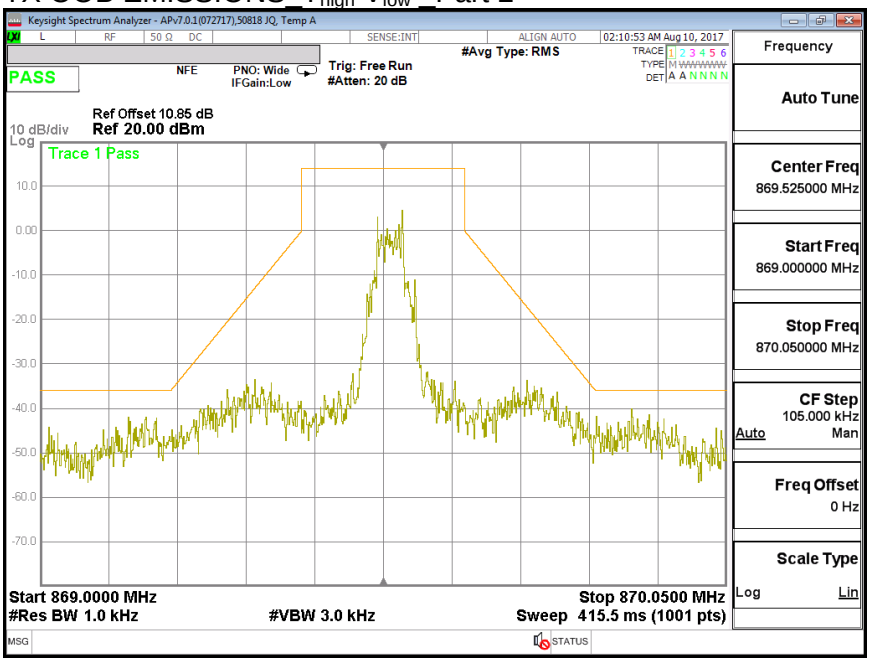
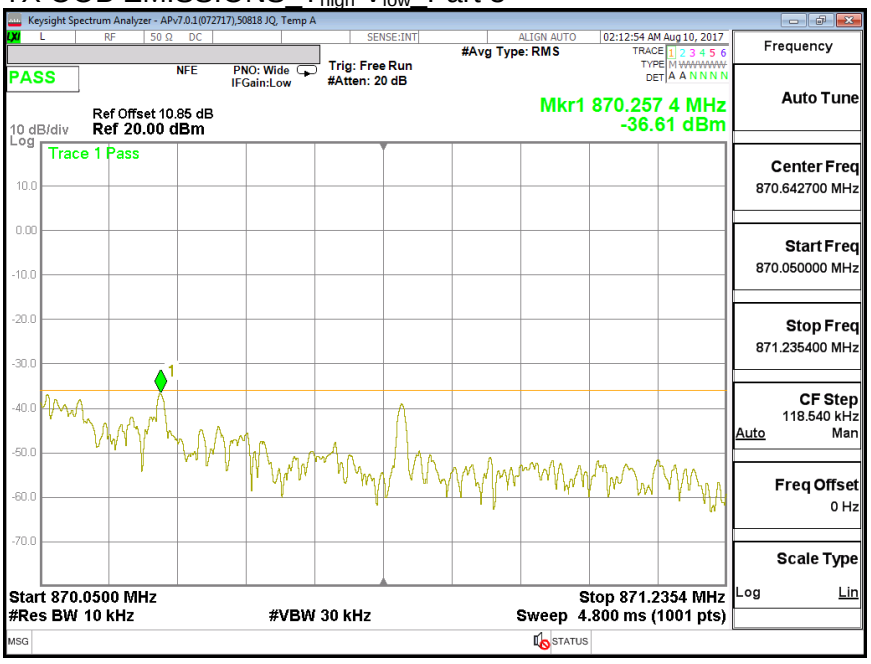
TX OOB EMISSIONS_T_{high} V_{low} _Part 2



TX OOB EMISSIONS_T_{high} V_{low}_Part 3



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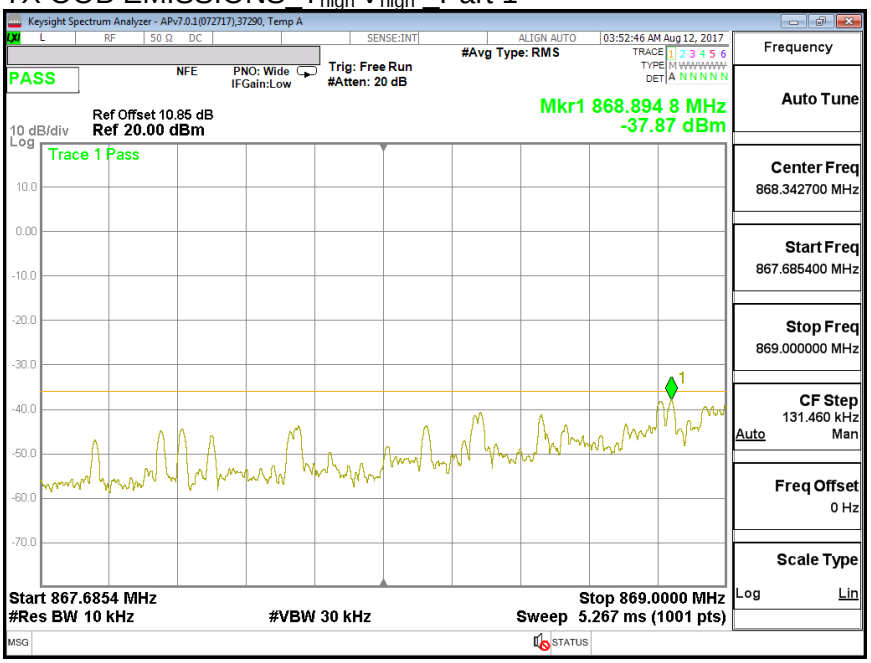
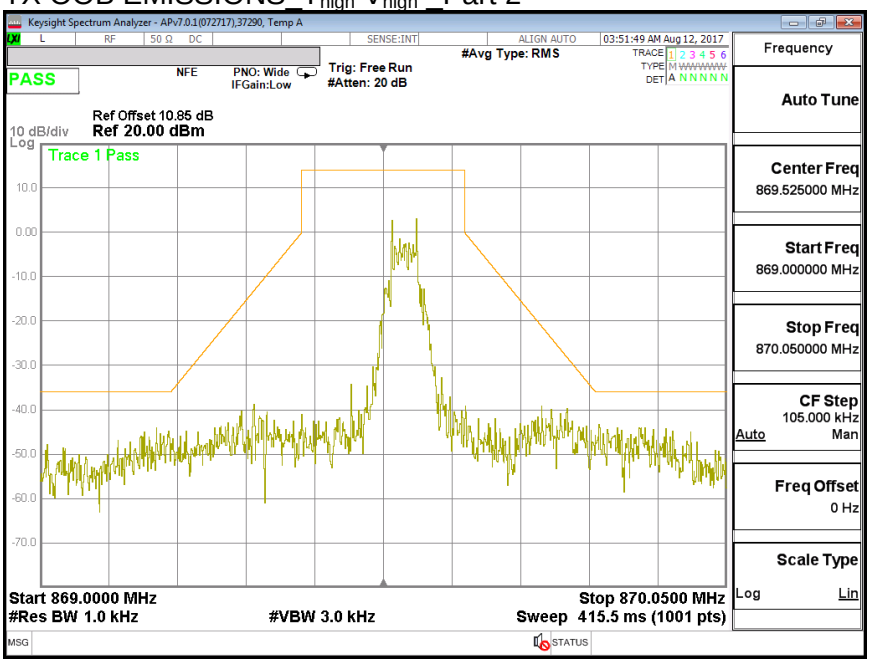
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



TX OOB EMISSIONS_T_{high} V_{high} _Part 2



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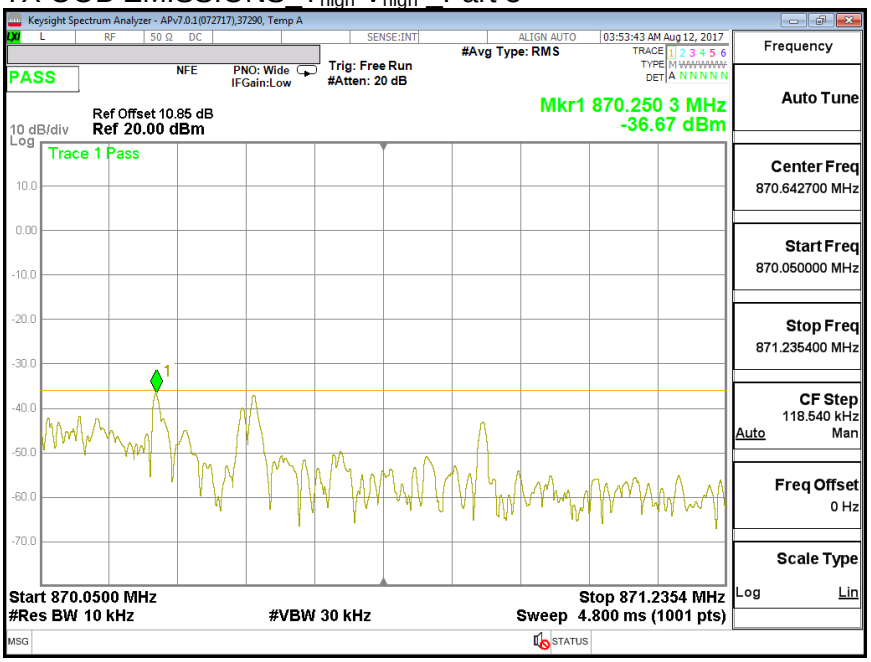
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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7.4.5. TX UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.2.2.2
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.1.1
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.2

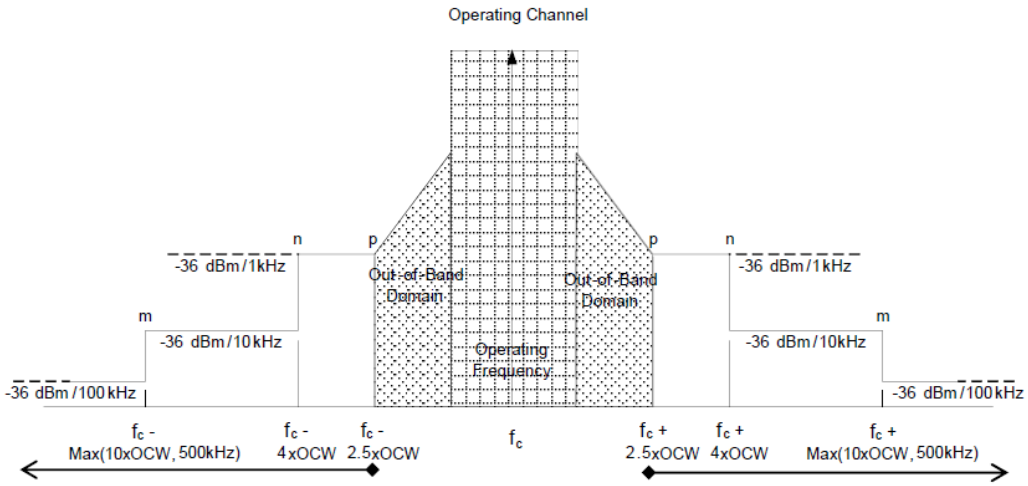

Figure 7: Spectrum Mask for Unwanted Emissions in the Spurious Domain with reference BW

Reference Limit:

The power of any unwanted emission in the spurious domain shall not exceed the values given in Table 19.

Table 19: Spurious domain emission limits

Frequency / State	47 MHz to 74 MHz 87,5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 790 MHz	Other frequencies below 1 000 MHz	Frequencies above 1 000 MHz
TX mode	-54 dBm	-36 dBm	-30 dBm
RX and all other modes	-57 dBm	-57 dBm	-47 dBm

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.3.3.1 (Conducted Measurement)
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.3.3.2 (Radiated Measurement)

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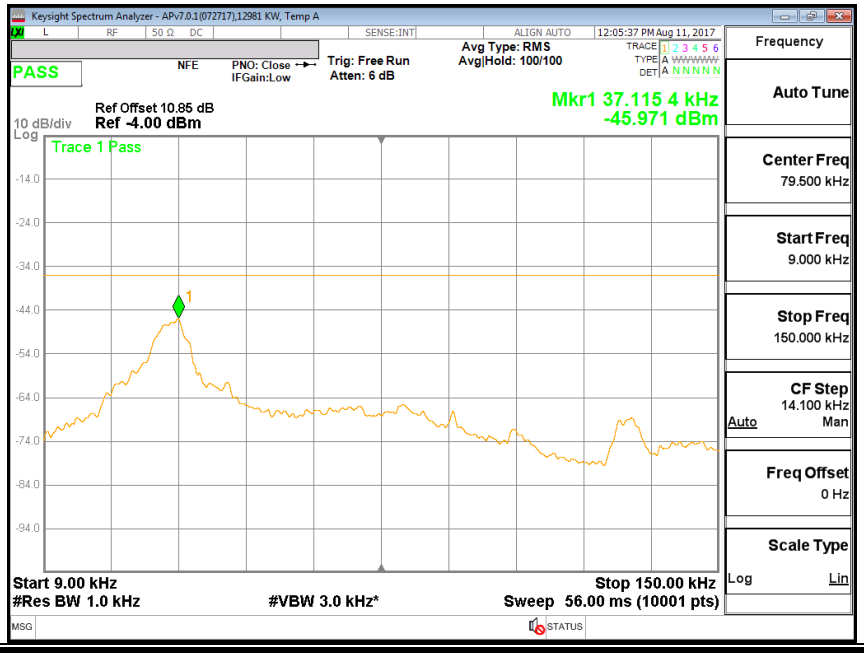
RESULTS

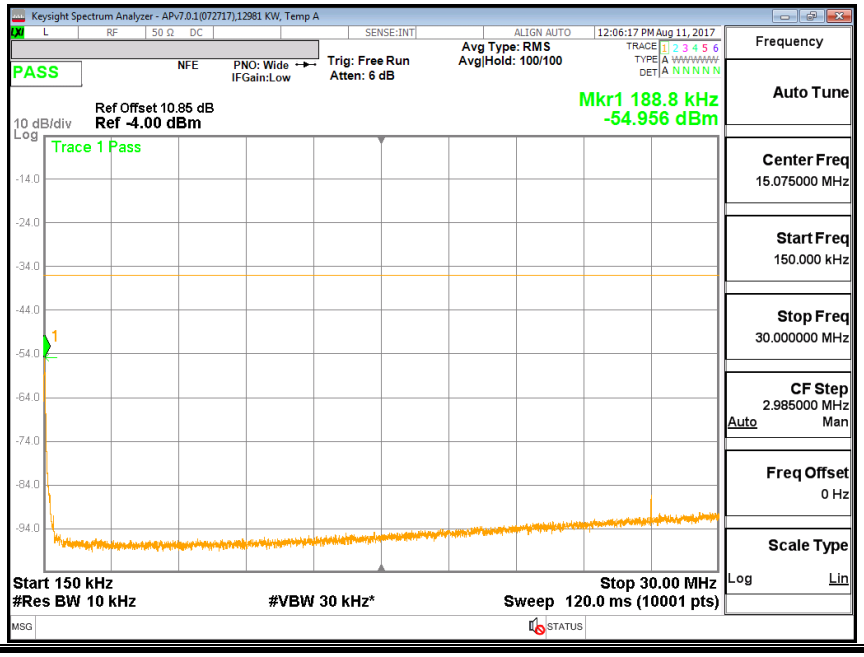
CONDUCTED SPURIOUS EMISSIONS

THE WORST CASE OF GFSK OPERATING CHANNEL

9kHz to 150kHz



150kHz to 30MHz



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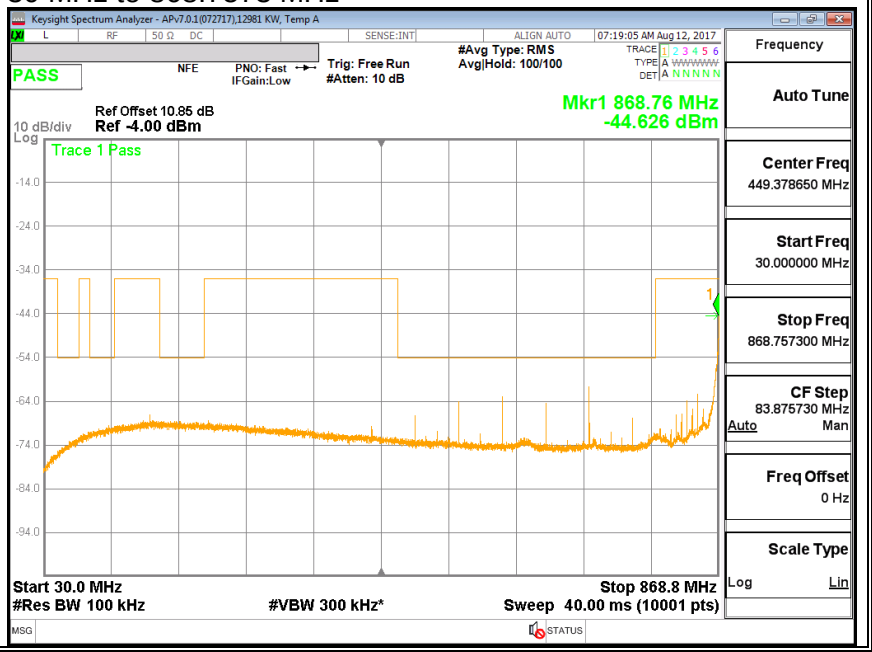
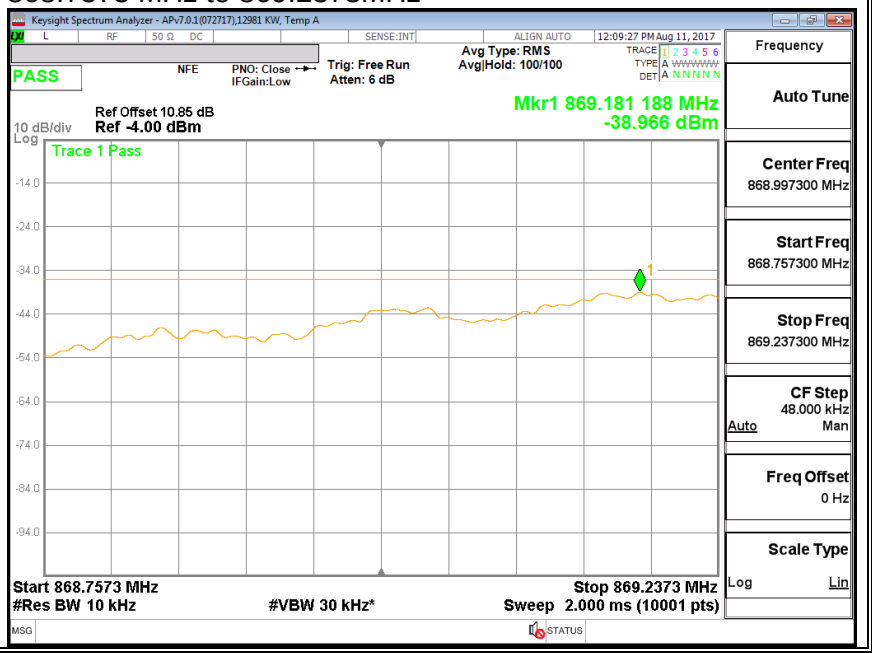
30 MHz to 868.7573 MHz



868.7573 MHz to 869.2373MHz



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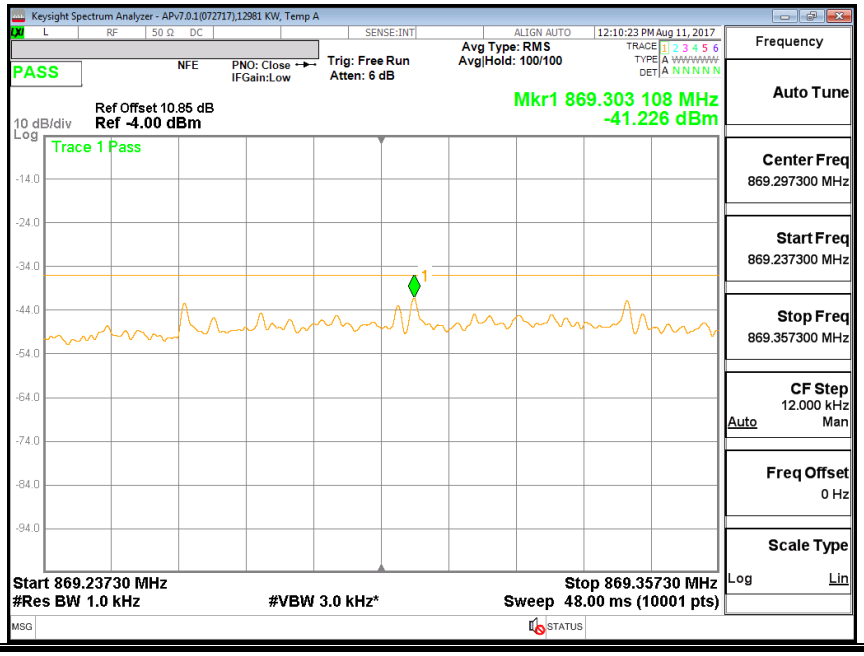
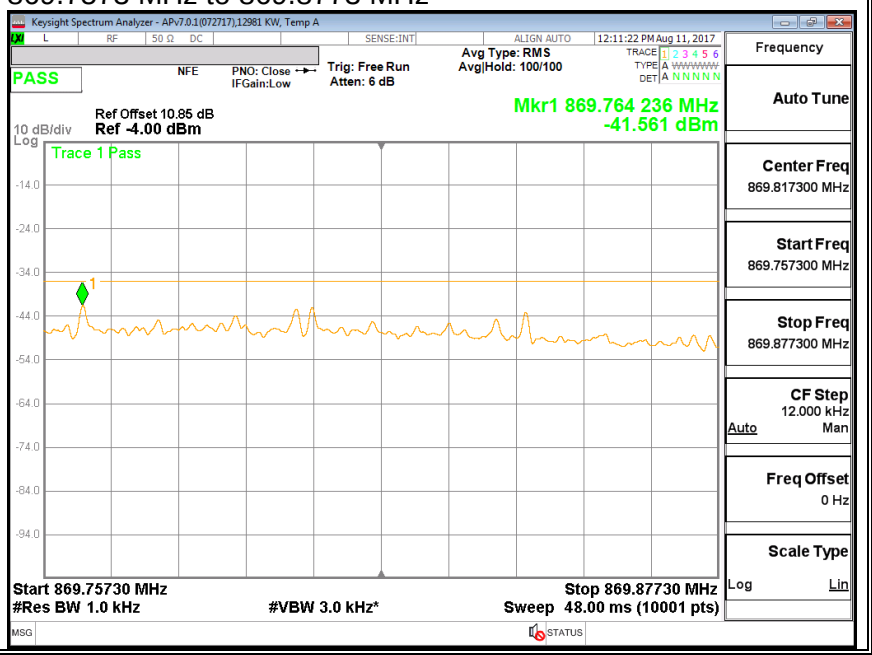
869.2373 MHz to 869.3573 MHz



869.7573 MHz to 869.8773 MHz



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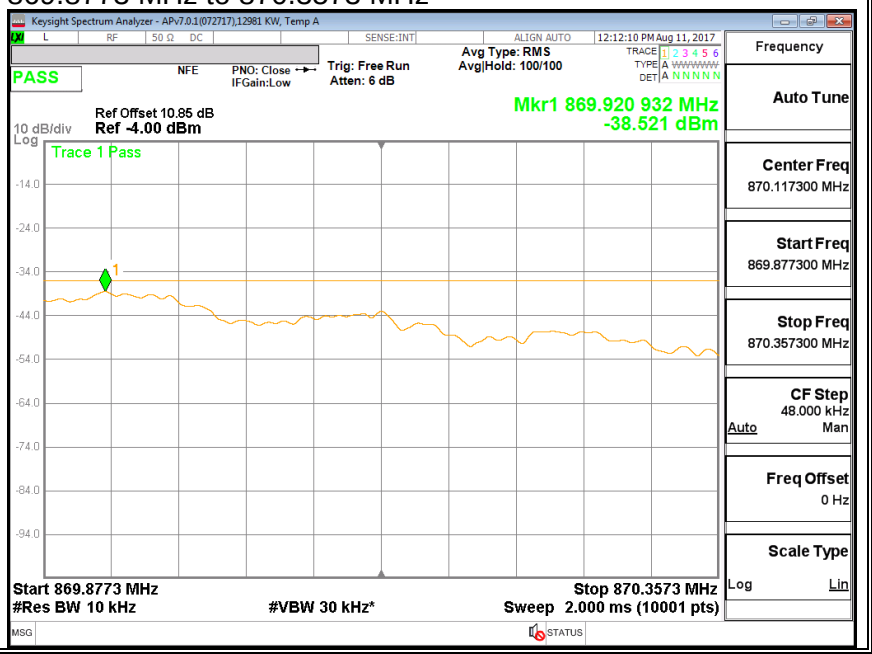
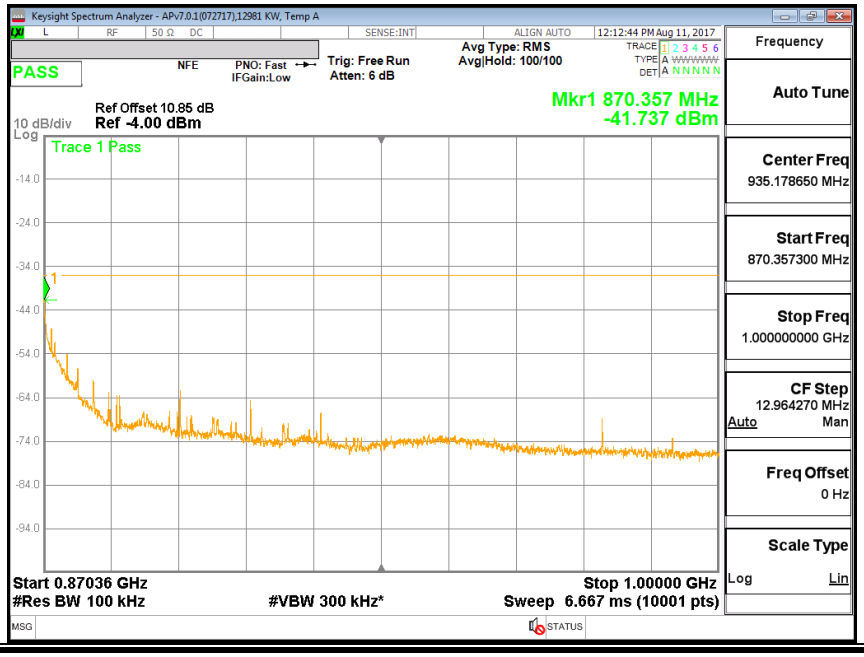
869.8773 MHz to 870.3573 MHz



870.3573 MHz to 1 GHz



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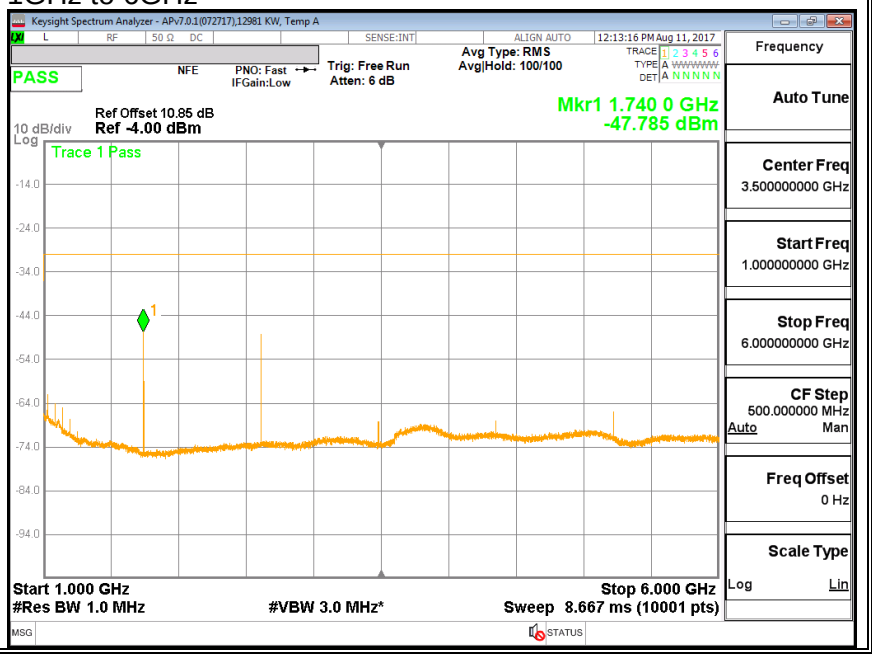
1GHz to 6GHz



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RADIATED SPURIOUS EMISSIONS

3m Radiated Emissions Chamber
30 - 1000MHz Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/13/2017
Test Engineer: 50818
Configuration: EUT with 50Ohm load and a support laptop
Mode: TX Below 1GHz GFSK P band worst case

Chamber	Pre-amplifer	Attenuator	Limit
3m Chamber B	3m-B T10		ETSI 300 220 Tx

Frequency (MHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Attenuator (dB)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Operating Channel 30										
432.15	-70.2	H	3.0	24.9	28.8		-74.0	-36.0	-38.0	
699.54	-71.0	H	3.0	29.0	28.6		-70.7	-54.0	-16.7	
800.97	-71.2	H	3.0	30.2	28.4		-69.4	-54.0	-15.4	
432.28	-72.4	V	3.0	26.6	28.8		-74.6	-36.0	-38.6	
767.57	-70.3	V	3.0	31.9	28.4		-66.8	-54.0	-12.8	
799.39	-71.5	V	3.0	32.5	28.4		-67.4	-54.0	-13.4	

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3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/13/2017
Test Engineer: 50818
Configuration: EUT with 50Ohm load and a support laptop
Mode: TX Above 1GHz P band GFSK worst case

Chamber	Pre-amplifer	Filter	Limit
3m Chamber B	3m Chamber B	Filter	ETSI 300 220 Tx

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss @ SG End (dBm)	Preamp (dB)	Attenuator (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Operating Channel 30										
1.731	-59.42	H	3.0	-13.5	38.5	1.0	-51.0	-30.0	-21.0	
2.396	-57.32	H	3.0	-7.8	38.7	1.0	-45.5	-30.0	-15.5	
5.211	-58.33	H	3.0	-3.6	38.7	1.0	-41.4	-30.0	-11.4	
1.123	-56.13	V	3.0	-14.3	38.4	1.0	-51.7	-30.0	-21.7	
1.742	-56.38	V	3.0	-10.3	38.4	1.0	-47.7	-30.0	-17.7	
2.001	-58.23	V	3.0	-9.7	38.0	1.0	-46.7	-30.0	-16.7	

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7.4.6. TX TRANSIENT POWER

REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.10.2

The TX TRANSIENT POWER shall not exceed the values given in Table 23.

Table 23: Transmitter Transient Power limits

Absolute offset from centre frequency	RBW_{REF}	Peak power limit applicable at measurement points
≤ 400 kHz	1 kHz	0 dBm
> 400 kHz	1 kHz	-27 dBm

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.10.3.2

RESULTS

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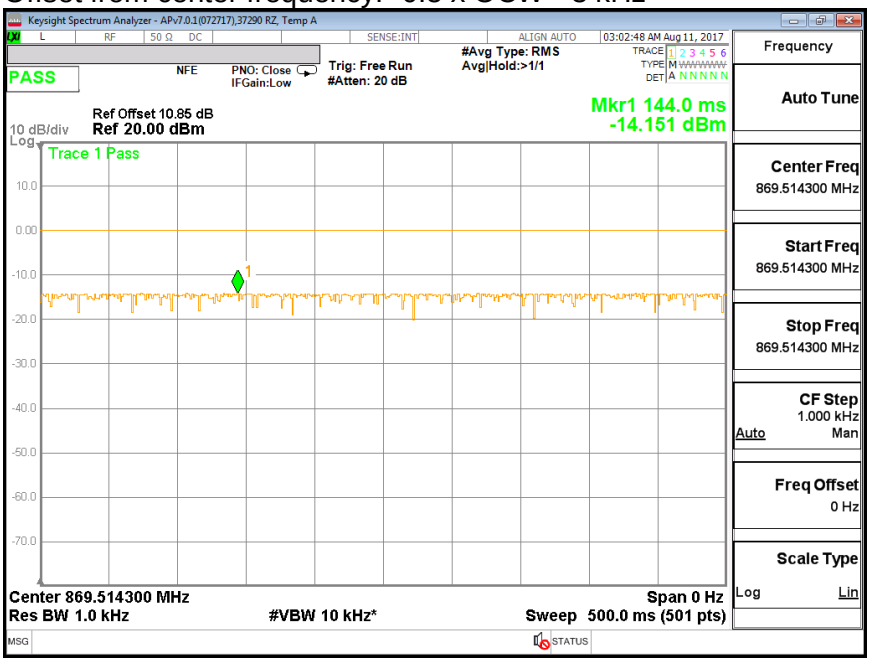
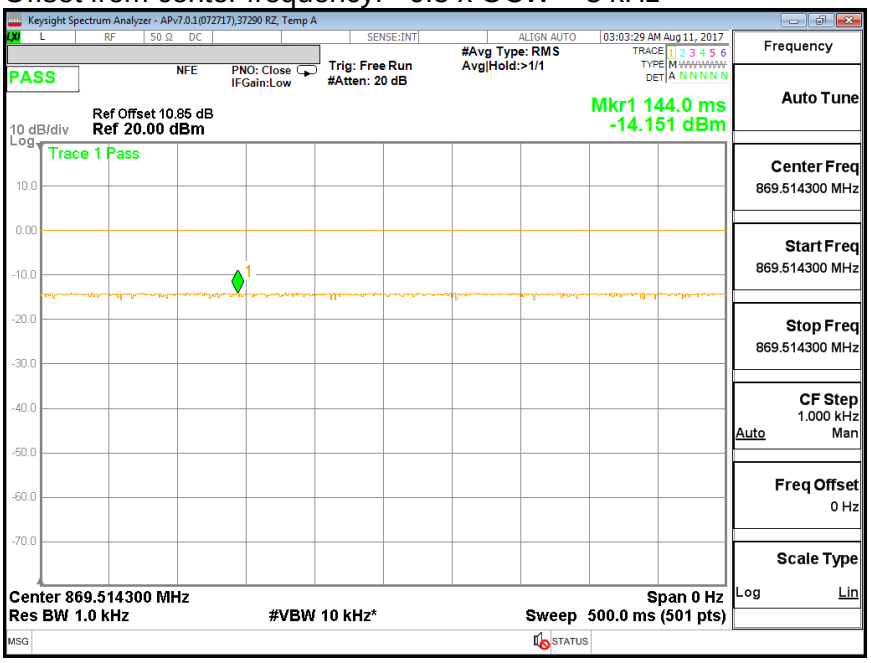
THE WORST CASE OF GFSK OPERATING CHANNEL

TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 3 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 3 kHz



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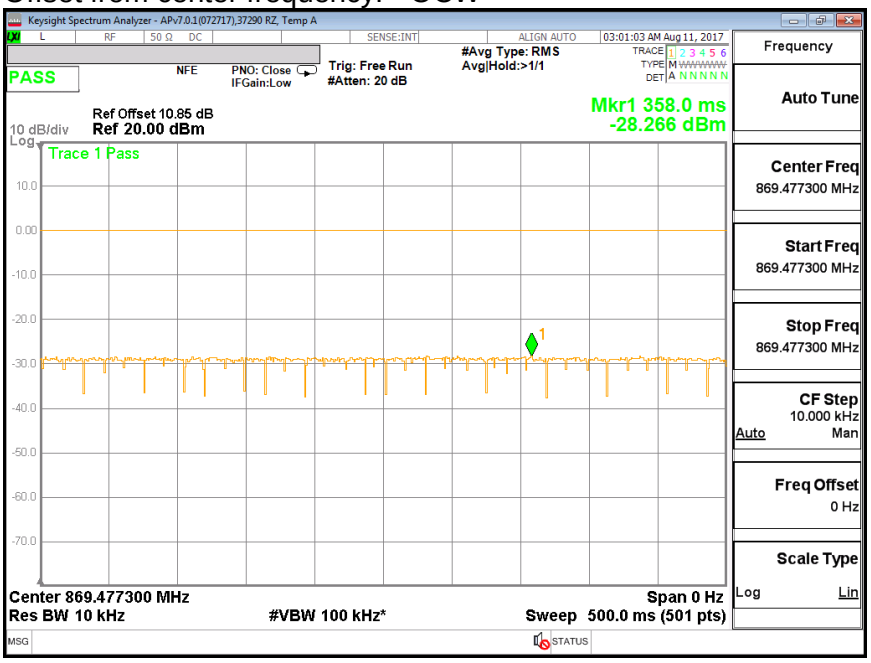
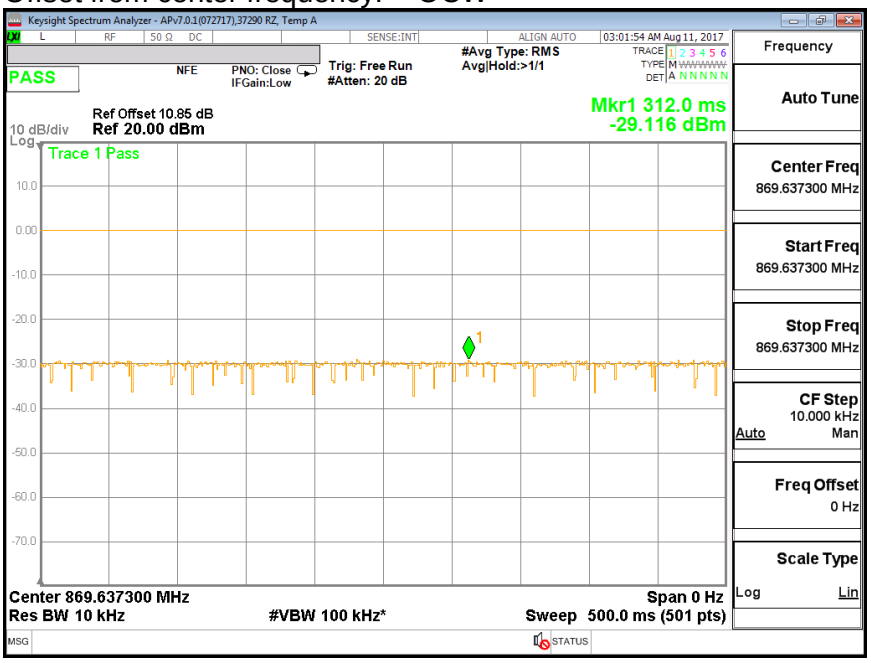
TX TRANSIENT
Offset from center frequency: - OCW



TX TRANSIENT
Offset from center frequency: + OCW



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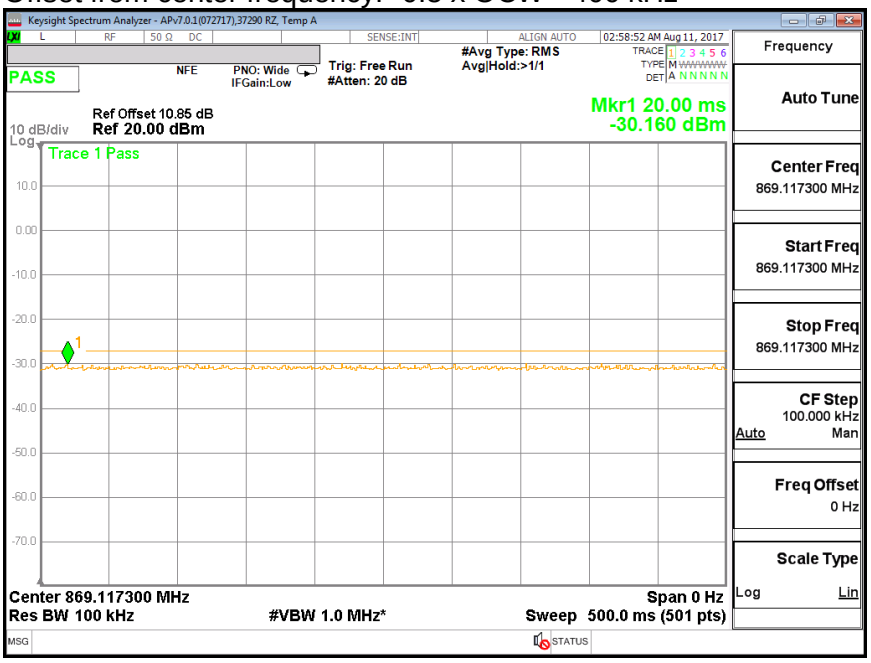
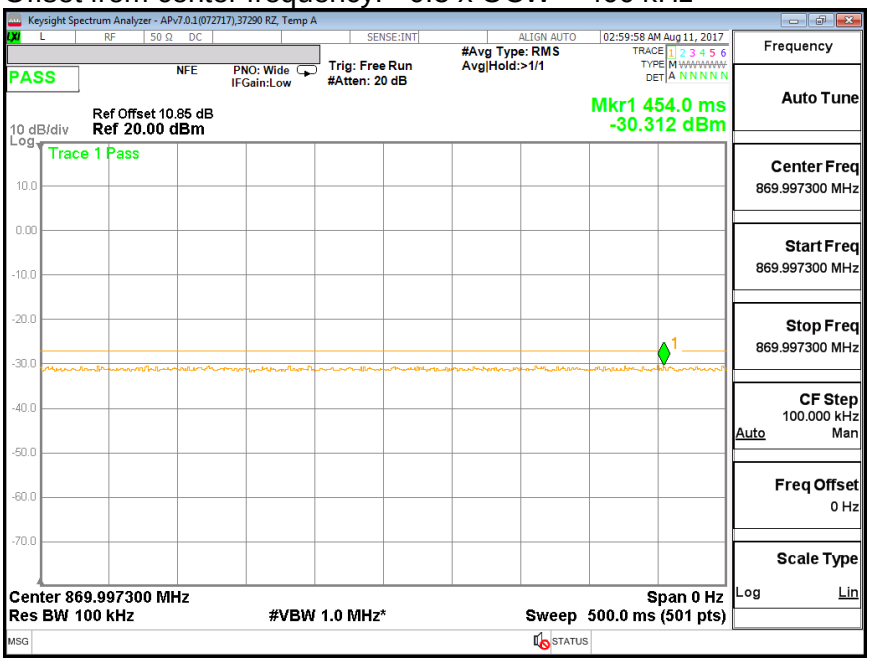
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 400 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 400 kHz



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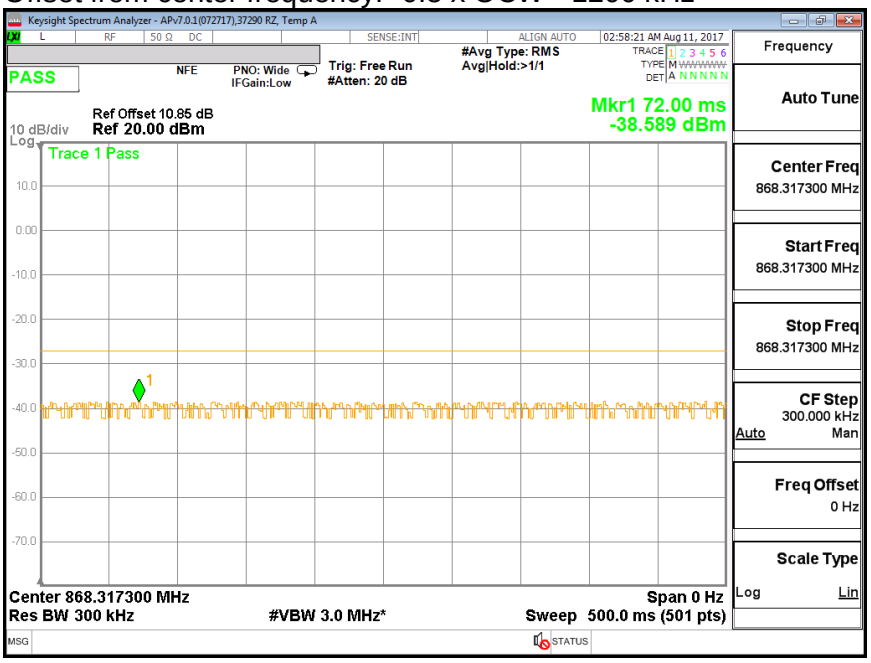
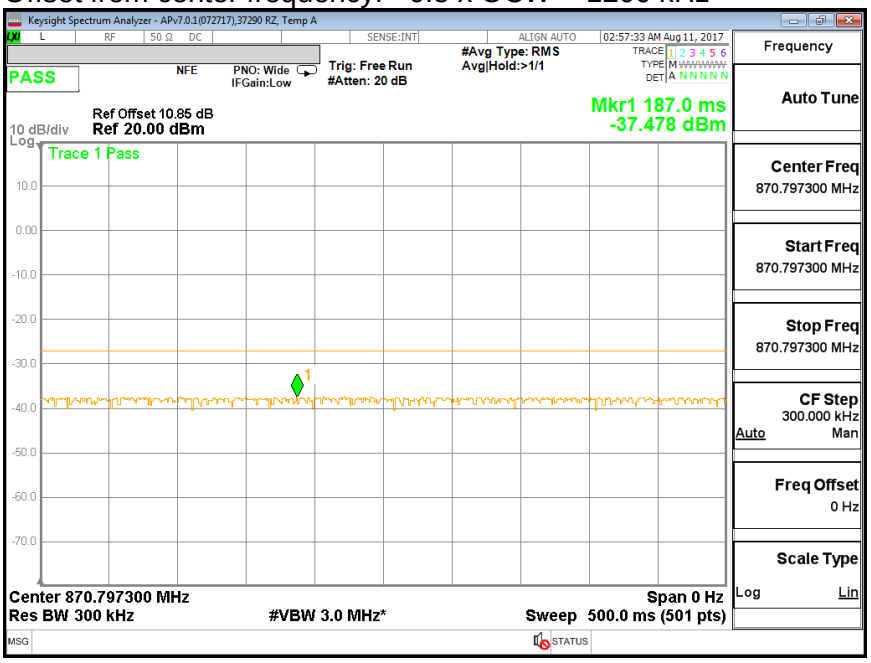
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 1200 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 1200 kHz



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7.5. GFSK MODULATION IN Q BAND

7.5.1. OPERATING FREQUENCY

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.2.1.2

The manufacturer may declare either one or more operating frequencies and operating channels.
Operating channel(s) shall be entirely within operational frequency bands allowed by annexes B, C or any NRI.

22 ETSI EN 300 220-2 V3.1.1 (2017-02)

Operational Frequency Band		Maximum effective radiated power, e.r.p.	Channel access and occupation rules (e.g. Duty cycle or LBT + AFA)	Maximum occupied bandwidth	Other usage restrictions	Band number from EC Decision 2013/752/EU [i.3]	Class 1 sub-class number according Commission Decision 2000/299/EU [i.7]
M	868,000 MHz to 868,600 MHz	25 mW e.r.p.	≤ 1 % duty cycle or polite spectrum access	The whole band except for audio & video applications limited to 300 kHz		48	28
N	868,700 MHz to 869,200 MHz	25 mW e.r.p.	≤ 0,1% duty cycle or polite spectrum access	The whole sub-band except for audio & video applications limited to 300 kHz		50	29
O	869,400 MHz to 869,650 MHz	25 mW e.r.p.	≤ 0.1% duty cycle or polite spectrum access	The whole band	.	54a	130
P	869,400 MHz to 869,650 MHz	500 mW e.r.p.	≤ 10 % duty cycle or polite spectrum access	The whole band		54b	30
Q	869,700 MHz to 870,000 MHz	5 mW e.r.p.	No requirement	The whole band	Audio and video applications are excluded.	56a	31
R	869,700 MHz to 870,000 MHz	25 mW e.r.p.	≤ 1% duty cycle or polite spectrum access	The whole band	Analogue audio applications are excluded. Analogue video applications are excluded.	56b	69

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.1.2

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RESULTS

Parameter	Values as declared by the manufacturer
M6, GFSK	
Operational Frequency band or bands	869.7 - 870
Nominal Operating Frequencies (MHz)	869.868759 - 869.920670
Operating Channel width(s) - OCW	40 kHz
M7, GFSK	
Operational Frequency band or bands	869.7 - 870
Nominal Operating Frequencies (MHz)	869.868759 - 869.920670
Operating Channel width(s) - OCW	80 kHz
M12, GFSK	
Operational Frequency band or bands	869.7 - 870
Nominal Operating Frequencies (MHz)	869.868759 - 869.920670
Operating Channel width(s) - OCW	30 kHz
M13, GFSK	
Operational Frequency band or bands	869.7 - 870
Nominal Operating Frequencies (MHz)	869.868759 - 869.920670
Operating Channel width(s) - OCW	40 kHz
ML1, GFSK	
Operational Frequency band or bands	869.7 - 870
Nominal Operating Frequencies (MHz)	869.868759
Operating Channel width(s) - OCW	100 kHz

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7.5.2. TX EFFECTIVE RADIATED POWER

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.3.1.2

The effective radiated power shall not be greater than the value allowed in annexes B or C for the chosen operational frequency band(s).

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.2.2.1.2

RESULTS

Date: 08/11/17
Project No: 11773240
Tester: 50818_JQ

CHANNELS FOR MODULATION CODE: ML1

EUT Antenna Gain (dBi) =	2.00

Condition	Output Power (dBm)	EIRP (dBm)	ERP (dBm)	Limit (dBm)	Margin (dB)
Operating Channel, CH36					
Normal	5.77	7.77	5.62	6.99	-1.37
Extreme T low, V low	6.86	8.86	6.71	6.99	-0.28
Extreme T low, V high	6.87	8.87	6.72	6.99	-0.27
Extreme T high, V low	5.05	7.05	4.90	6.99	-2.09
Extreme T high, V high	5.05	7.05	4.90	6.99	-2.09

Note: Cable loss correction factor is included in the Power Meter Reading

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7.6. GFSK MODULATION IN R BAND

7.6.1. OPERATING FREQUENCY

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.2.1.2

The manufacturer may declare either one or more operating frequencies and operating channels.
Operating channel(s) shall be entirely within operational frequency bands allowed by annexes B, C or any NRI.

22 ETSI EN 300 220-2 V3.1.1 (2017-02)

Operational Frequency Band		Maximum effective radiated power, e.r.p.	Channel access and occupation rules (e.g. Duty cycle or LBT + AFA)	Maximum occupied bandwidth	Other usage restrictions	Band number from EC Decision 2013/752/EU [i.3]	Class 1 sub-class number according Commission Decision 2000/299/EU [i.7]
M	868,000 MHz to 868,600 MHz	25 mW e.r.p.	≤ 1 % duty cycle or polite spectrum access	The whole band except for audio & video applications limited to 300 kHz		48	28
N	868,700 MHz to 869,200 MHz	25 mW e.r.p.	≤ 0,1% duty cycle or polite spectrum access	The whole sub-band except for audio & video applications limited to 300 kHz		50	29
O	869,400 MHz to 869,650 MHz	25 mW e.r.p.	≤ 0.1% duty cycle or polite spectrum access	The whole band	.	54a	130
P	869,400 MHz to 869,650 MHz	500 mW e.r.p.	≤ 10 % duty cycle or polite spectrum access	The whole band		54b	30
Q	869,700 MHz to 870,000 MHz	5 mW e.r.p.	No requirement	The whole band	Audio and video applications are excluded.	56a	31
R	869,700 MHz to 870,000 MHz	25 mW e.r.p.	≤ 1% duty cycle or polite spectrum access	The whole band	Analogue audio applications are excluded. Analogue video applications are excluded.	56b	69

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.1.2

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RESULTS

Parameter	Values as declared by the manufacturer
M6, GFSK	
Operational Frequency band or bands	869.7 - 870
Nominal Operating Frequencies (MHz)	869.868759 - 869.920670
Operating Channel width(s) - OCW	40 kHz
M7, GFSK	
Operational Frequency band or bands	869.7 - 870
Nominal Operating Frequencies (MHz)	869.868759 - 869.920670
Operating Channel width(s) - OCW	80 kHz
M12, GFSK	
Operational Frequency band or bands	869.7 - 870
Nominal Operating Frequencies (MHz)	869.868759 - 869.920670
Operating Channel width(s) - OCW	30 kHz
M13, GFSK	
Operational Frequency band or bands	869.7 - 870
Nominal Operating Frequencies (MHz)	869.868759 - 869.920670
Operating Channel width(s) - OCW	40 kHz
ML1, GFSK	
Operational Frequency band or bands	869.7 - 870
Nominal Operating Frequencies (MHz)	869.868759
Operating Channel width(s) - OCW	100 kHz

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7.6.2. TX EFFECTIVE RADIATED POWER

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.3.1.2

The effective radiated power shall not be greater than the value allowed in annexes B or C for the chosen operational frequency band(s).

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.2.2.1.2

RESULTS

Date: 08/11/17
Project No: 11773240
Tester: 50818_JQ

CHANNELS FOR MODULATION CODE: ML1

EUT Antenna Gain (dBi) =	2.00

Condition	Output Power (dBm)	EIRP (dBm)	ERP (dBm)	Limit (dBm)	Margin (dB)
Operating Channel, CH36					
Normal	11.75	13.75	11.60	13.98	-2.38
Extreme T low, V low	12.51	14.51	12.36	13.98	-1.62
Extreme T low, V high	12.52	14.52	12.37	13.98	-1.61
Extreme T high, V low	11.21	13.21	11.06	13.98	-2.92
Extreme T high, V high	11.23	13.23	11.08	13.98	-2.90

Note: Cable loss correction factor is included in the Power Meter Reading

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7.6.3. TX OCCUPIED BANDWIDTH

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.3.4.2

The occupied bandwidth of the EUT according to ETSI EN 300 220-1 [1], clause 5.6.2 shall comply with the limits in annex B or C.

Reference Limit:

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.6.2

The Operating Channel shall be declared and shall reside entirely within the Operational Frequency Band. The Maximum Occupied Bandwidth at 99 % shall reside entirely within the Operating Channel defined by F_{low} and F_{high}.

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.6.3.3 (Conducted Measurement)

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RESULTS

BAND R

Condition	Low CH (MHz)	High CH (MHz)	Low CH OBW (kHz)	High CH OBW (kHz)	F_{Low} (MHz)	F_{Low} Limit (MHz)	F_{High} (MHz)	F_{High} Limit (MHz)
M6, GFSK								
Normal	869.8688	869.9207	31.798	31.531	869.85	> 869.7	869.94	< 870
T low, V low	869.8688	869.9207	31.652	31.841	869.85	> 869.7	869.94	< 870
T low, V high	869.8688	869.9207	31.721	32.496	869.85	> 869.7	869.94	< 870
T high, V low	869.8688	869.9207	31.817	32.181	869.85	> 869.7	869.94	< 870
T high, V high	869.8688	869.9207	31.501	31.693	869.85	> 869.7	869.94	< 870
M7, GFSK								
Normal	869.8688	869.9207	68.248	64.122	869.84	> 869.7	869.95	< 870
T low, V low	869.8688	869.9207	67.617	64.433	869.84	> 869.7	869.95	< 870
T low, V high	869.8688	869.9207	64.366	65.756	869.84	> 869.7	869.95	< 870
T high, V low	869.8688	869.9207	66.724	62.365	869.84	> 869.7	869.95	< 870
T high, V high	869.8688	869.9207	65.928	65.910	869.84	> 869.7	869.95	< 870
M12, GFSK								
Normal	869.8688	869.9207	29.786	29.520	869.85	> 869.7	869.94	< 870
T low, V low	869.8688	869.9207	29.631	29.640	869.85	> 869.7	869.94	< 870
T low, V high	869.8688	869.9207	29.688	29.470	869.85	> 869.7	869.94	< 870
T high, V low	869.8688	869.9207	29.761	29.458	869.85	> 869.7	869.94	< 870
T high, V high	869.8688	869.9207	29.795	29.700	869.85	> 869.7	869.94	< 870
M13, GFSK								
Normal	869.8688	869.9207	38.870	38.720	869.85	> 869.7	869.94	< 870
T low, V low	869.8688	869.9207	39.043	39.024	869.85	> 869.7	869.94	< 870
T low, V high	869.8688	869.9207	38.755	38.795	869.85	> 869.7	869.94	< 870
T high, V low	869.8688	869.9207	38.753	39.143	869.85	> 869.7	869.94	< 870
T high, V high	869.8688	869.9207	38.896	38.760	869.85	> 869.7	869.94	< 870
ML1, GFSK								
Normal	869.8688	869.8688	87.125	87.125	869.83	> 869.7	869.91	< 870
T low, V low	869.8688	869.8688	89.150	89.150	869.82	> 869.7	869.91	< 870
T low, V high	869.8688	869.8688	93.113	93.113	869.82	> 869.7	869.92	< 870
T high, V low	869.8688	869.8688	89.204	89.204	869.82	> 869.7	869.91	< 870
T high, V high	869.8688	869.8688	91.948	91.948	869.82	> 869.7	869.91	< 870

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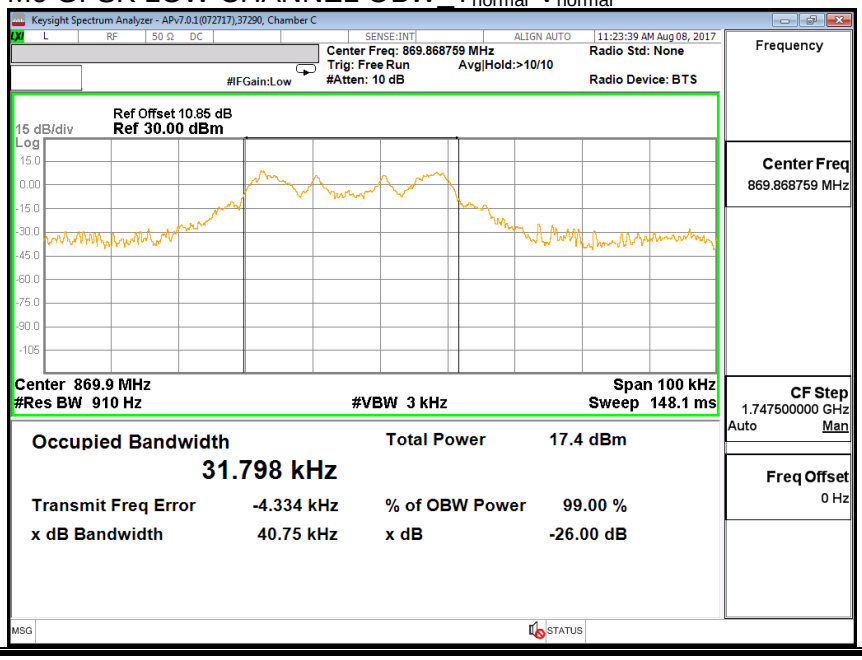
M6 GFSK LOW CHANNEL OBW_T_{normal} V_{normal}



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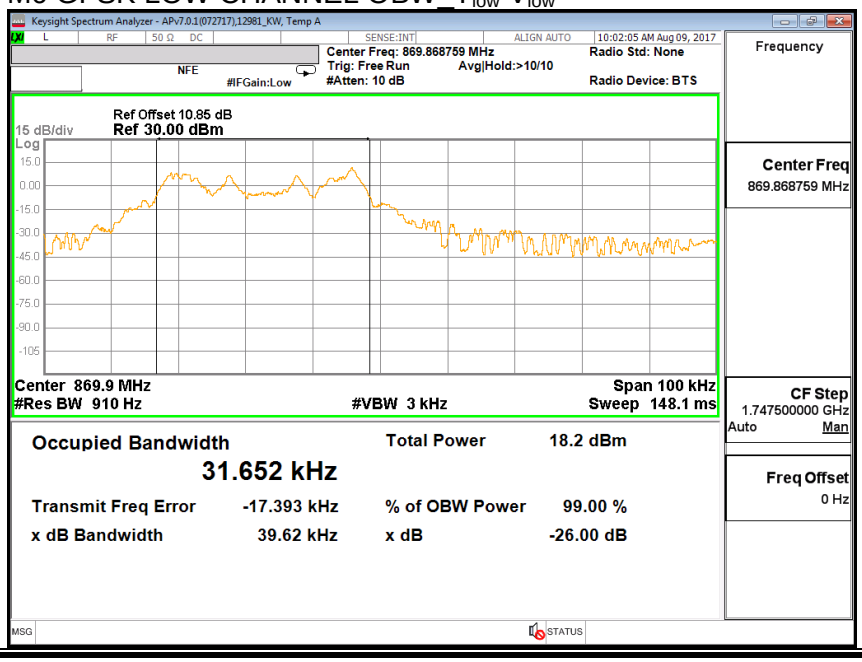

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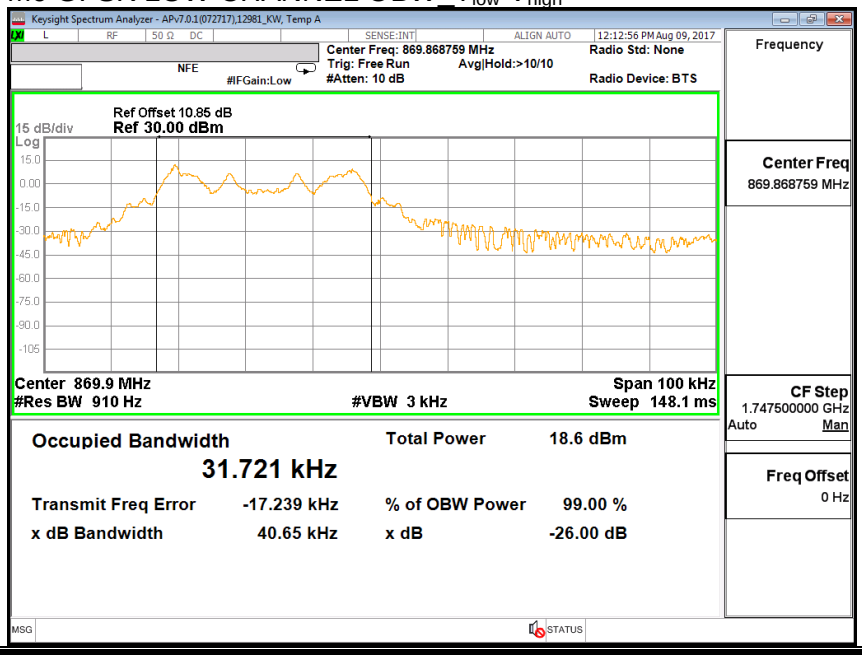
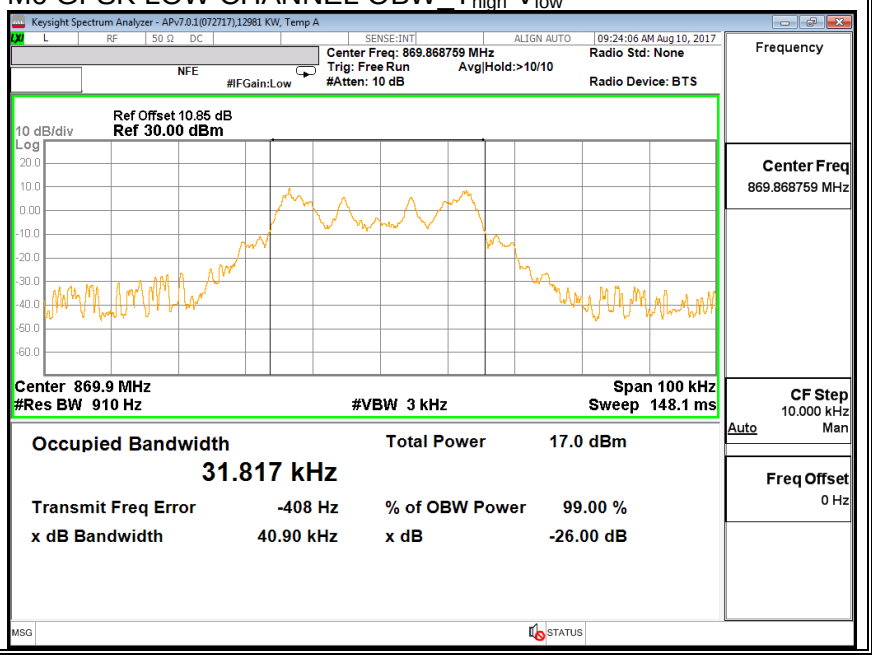
M6 GFSK LOW CHANNEL OBW_T_{low} V_{high}



M6 GFSK LOW CHANNEL OBW_T_{high} V_{low}



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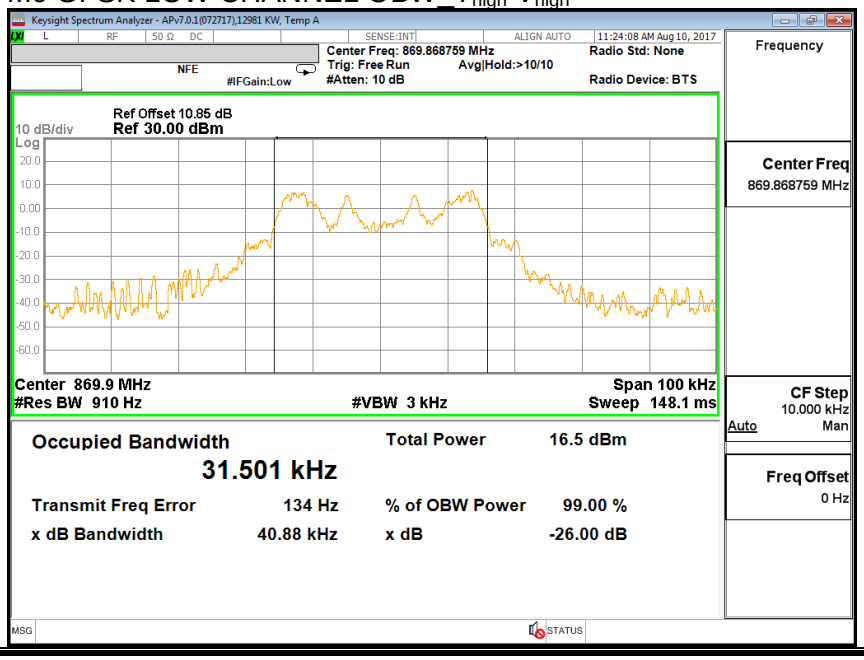
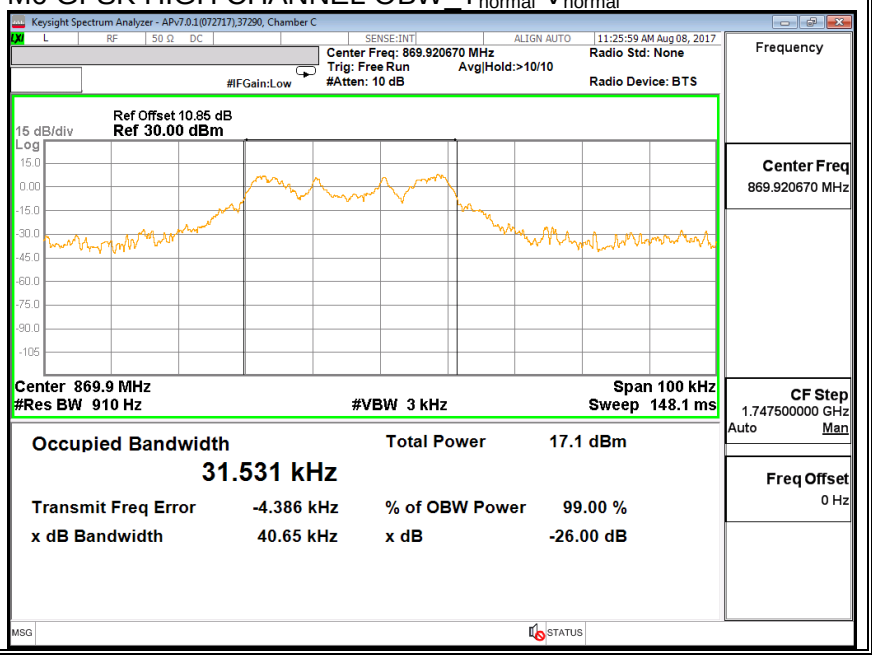
M6 GFSK LOW CHANNEL OBW_T_{high} V_{high}



M6 GFSK HIGH CHANNEL OBW_T_{normal} V_{normal}



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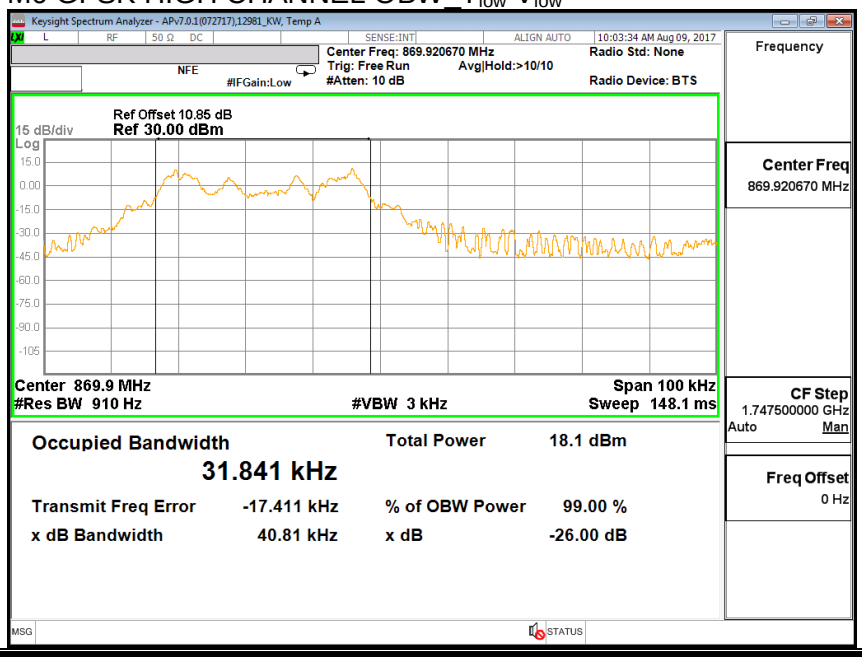
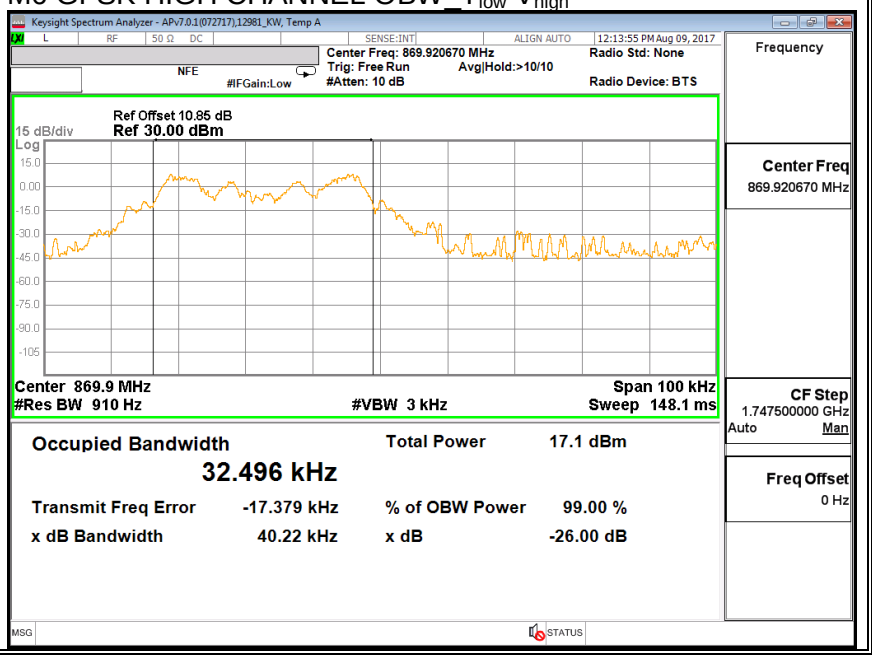
M6 GFSK HIGH CHANNEL OBW_T_{low} V_{low}



M6 GFSK HIGH CHANNEL OBW_T_{low} V_{high}



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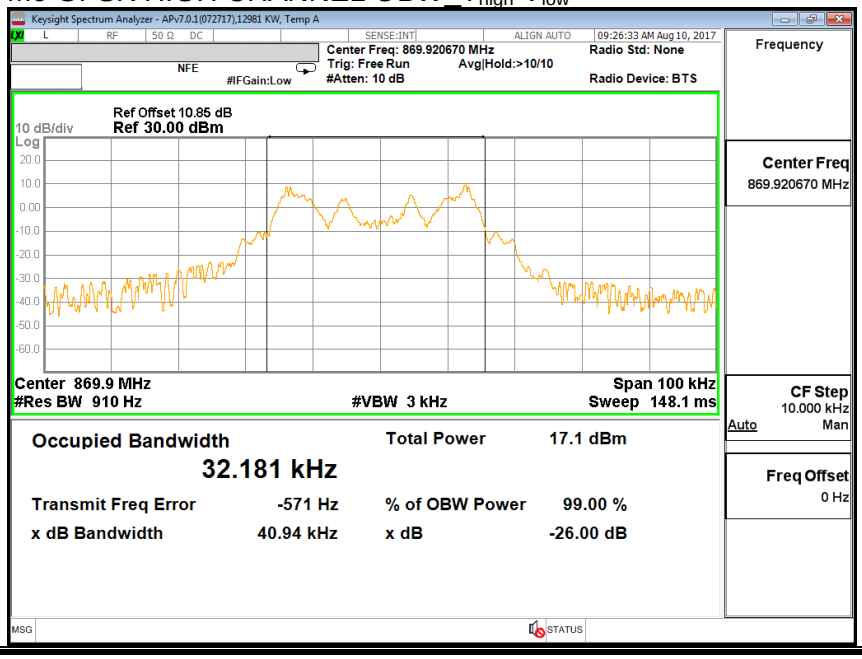
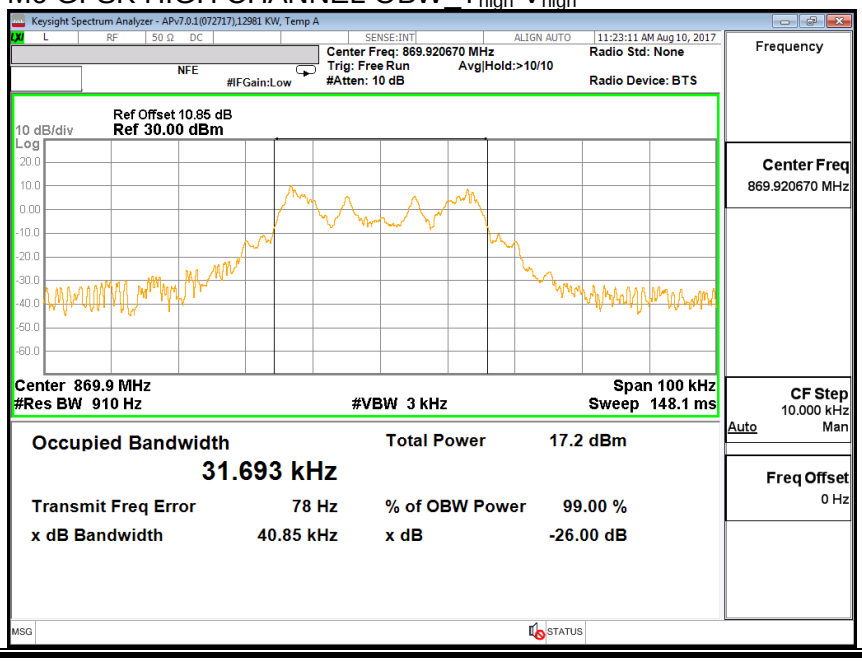
M6 GFSK HIGH CHANNEL OBW_T_{high} V_{low}



M6 GFSK HIGH CHANNEL OBW_T_{high} V_{high}



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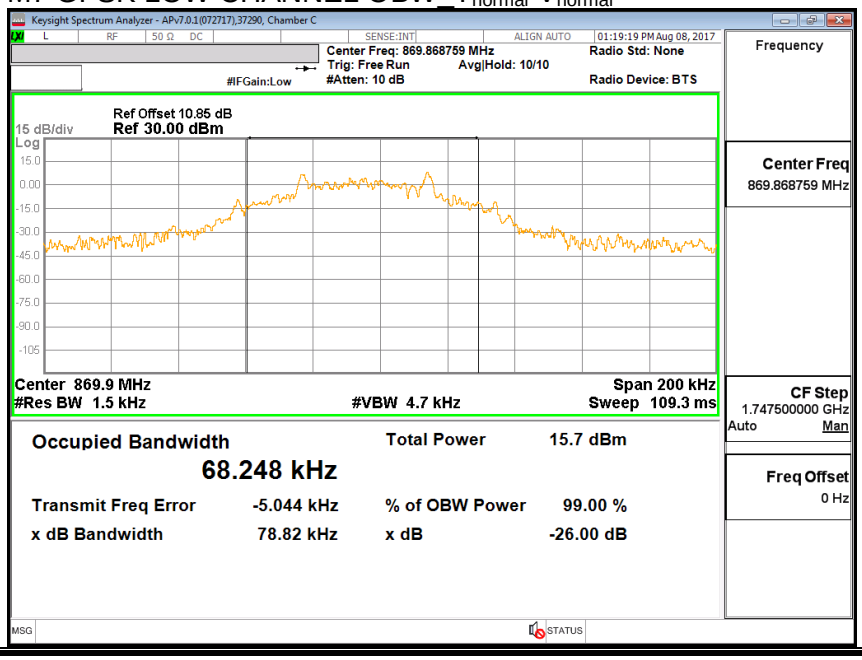
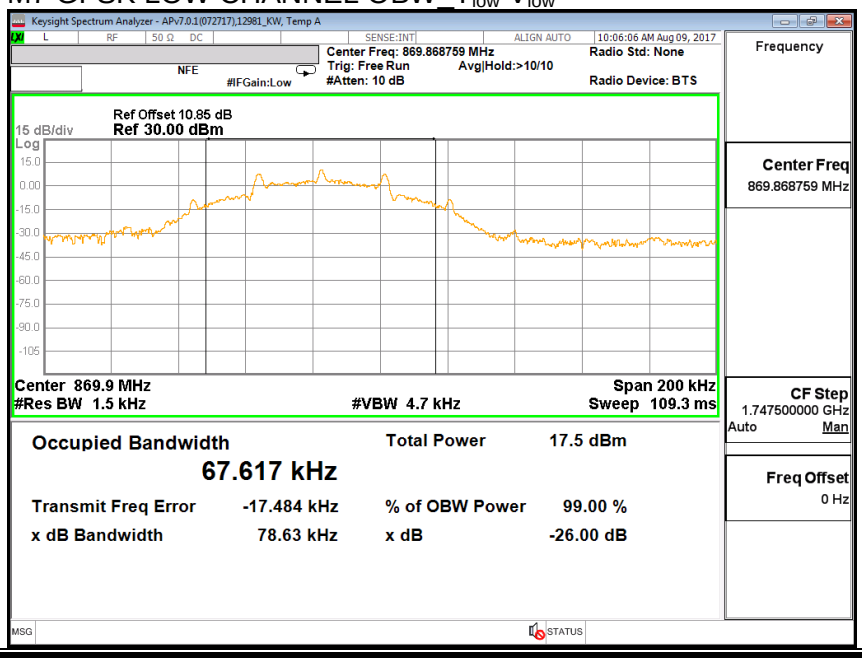
M7 GFSK LOW CHANNEL OBW_T_{normal} V_{normal}



M7 GFSK LOW CHANNEL OBW_T_{low} V_{low}



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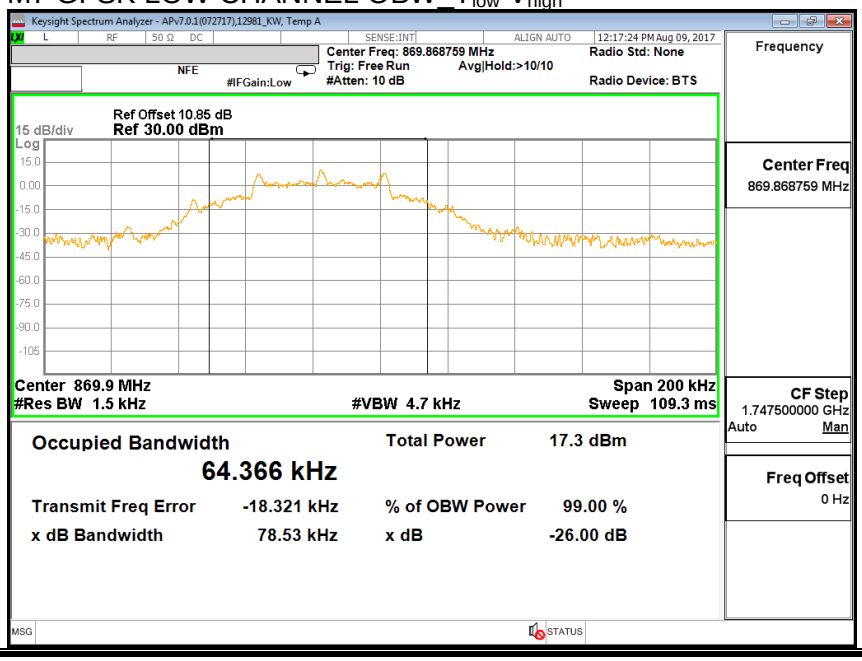
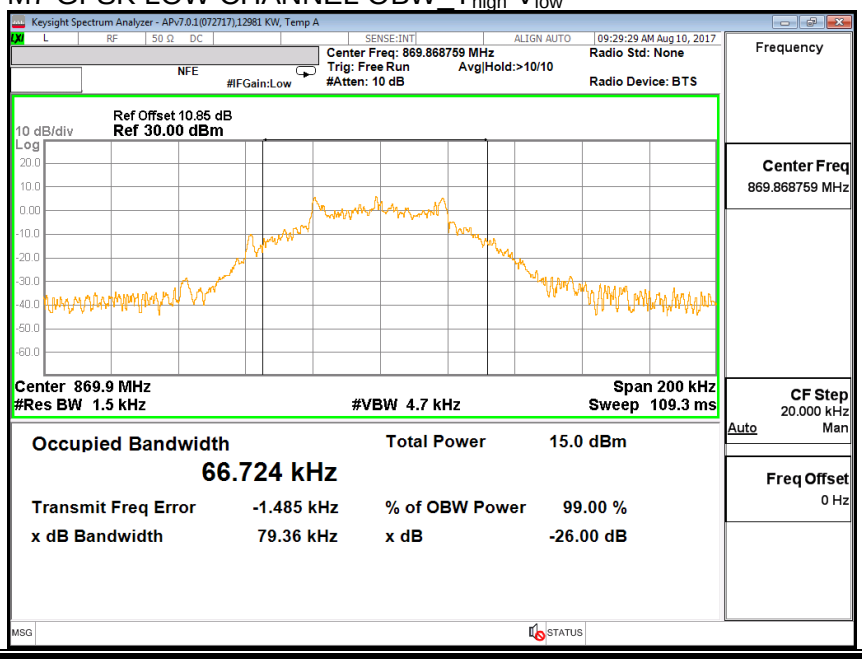
M7 GFSK LOW CHANNEL OBW_T_{low} V_{high}



M7 GFSK LOW CHANNEL OBW_T_{high} V_{low}



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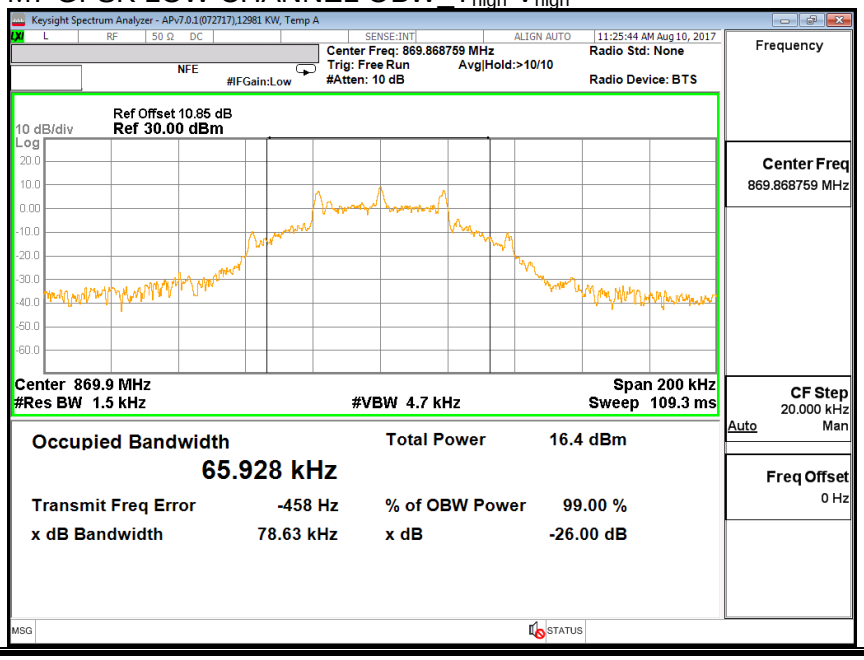
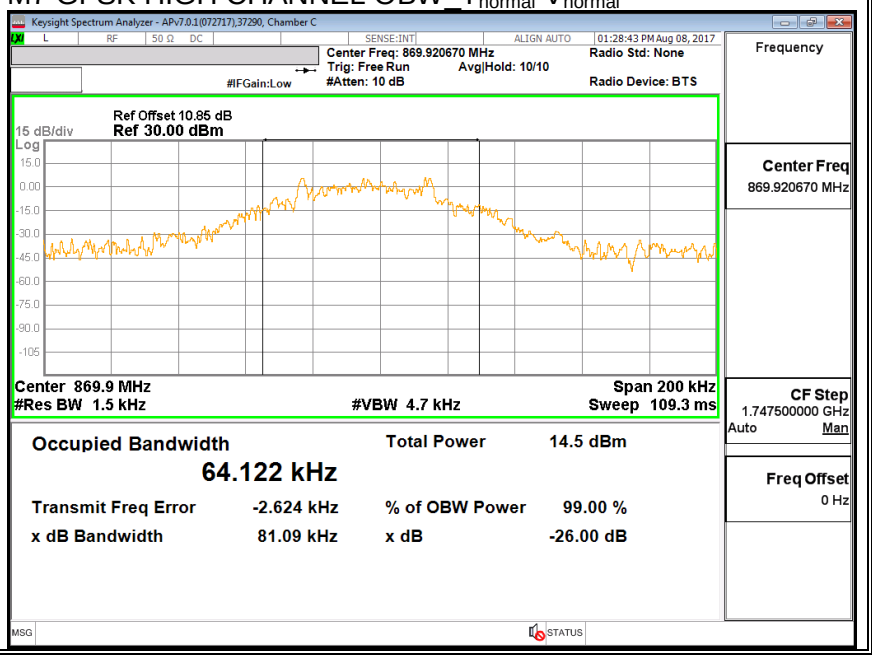
M7 GFSK LOW CHANNEL OBW_T_{high} V_{high}



M7 GFSK HIGH CHANNEL OBW_T_{normal} V_{normal}



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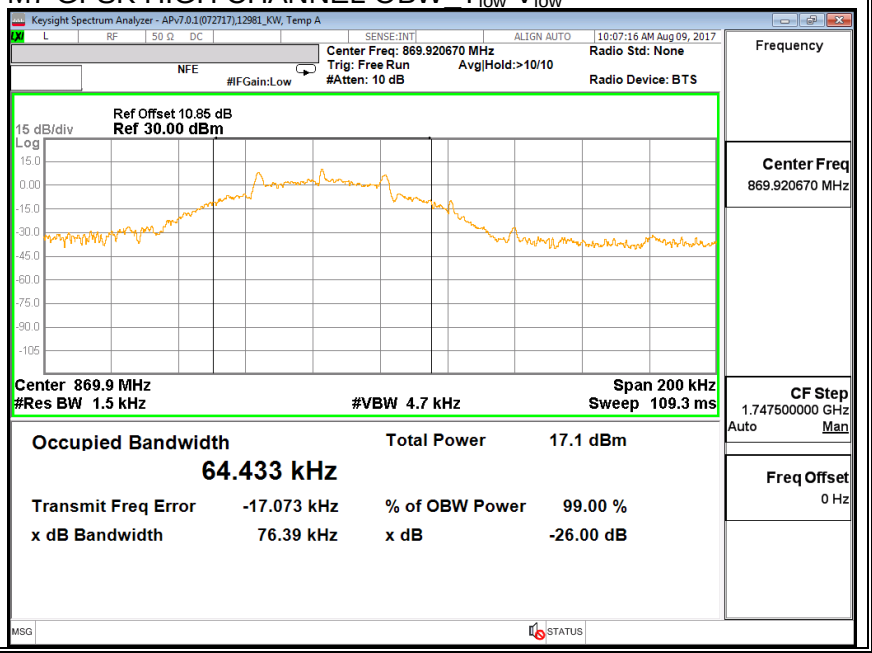
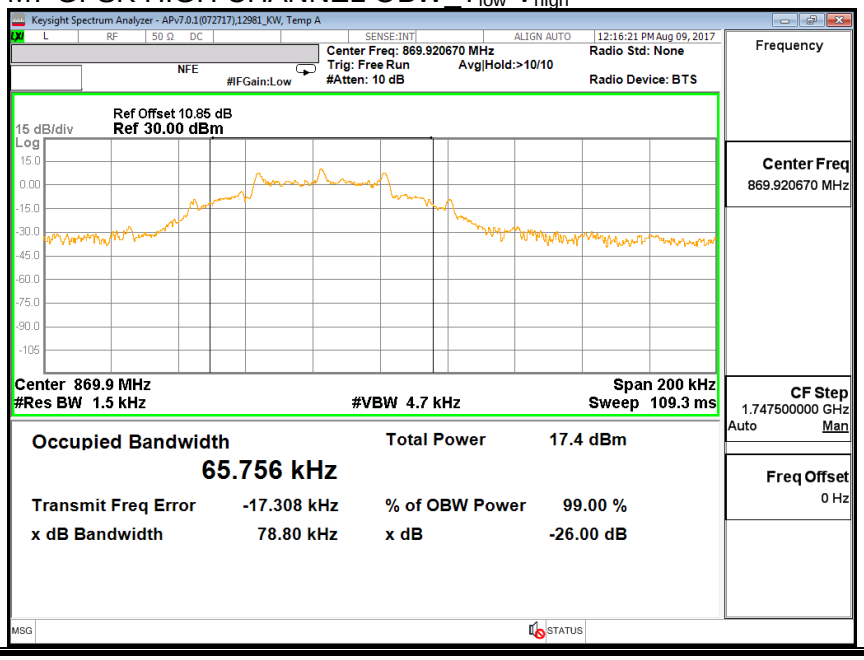
M7 GFSK HIGH CHANNEL OBW_T_{low} V_{low}



M7 GFSK HIGH CHANNEL OBW_T_{low} V_{high}



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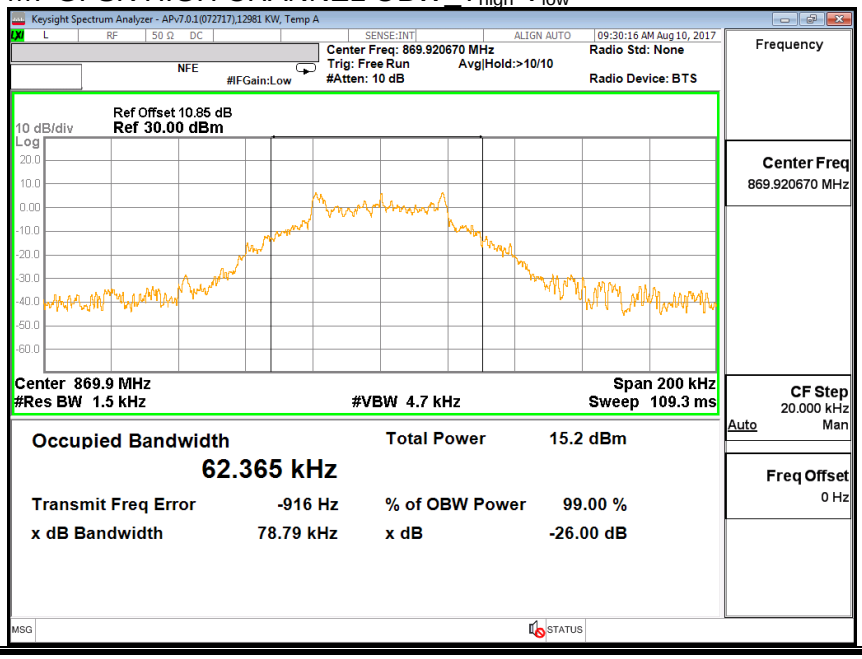
M7 GFSK HIGH CHANNEL OBW_T_{high} V_{low}



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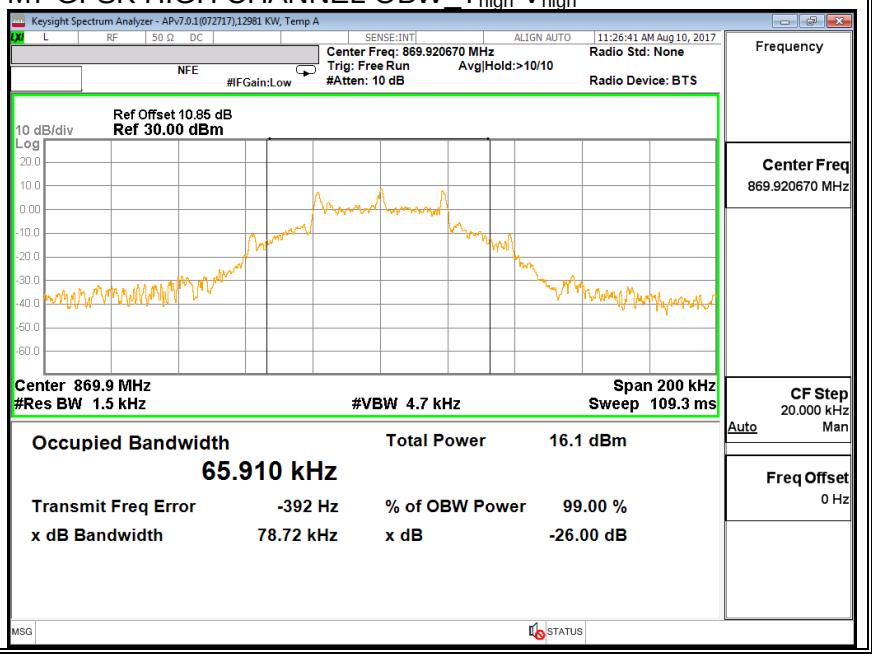

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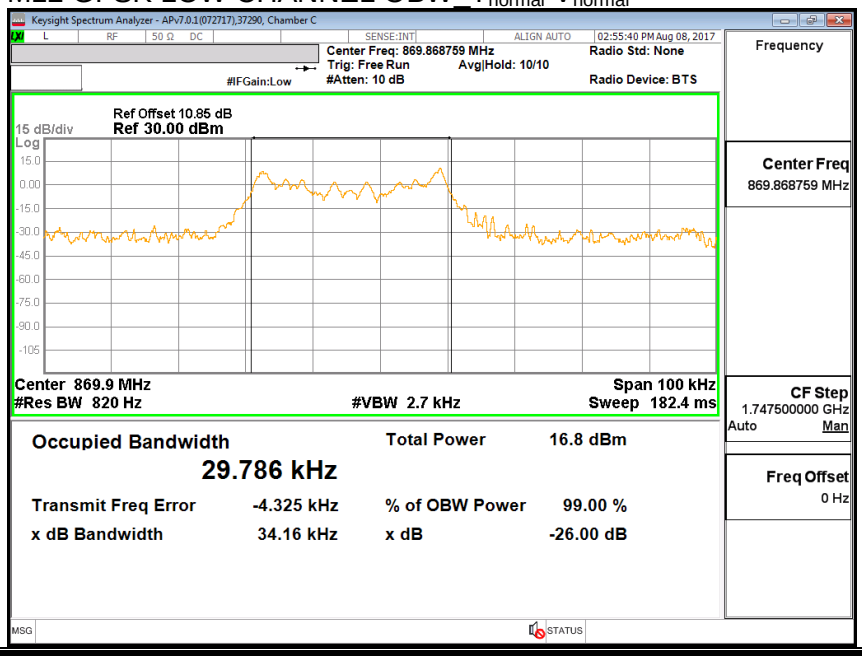
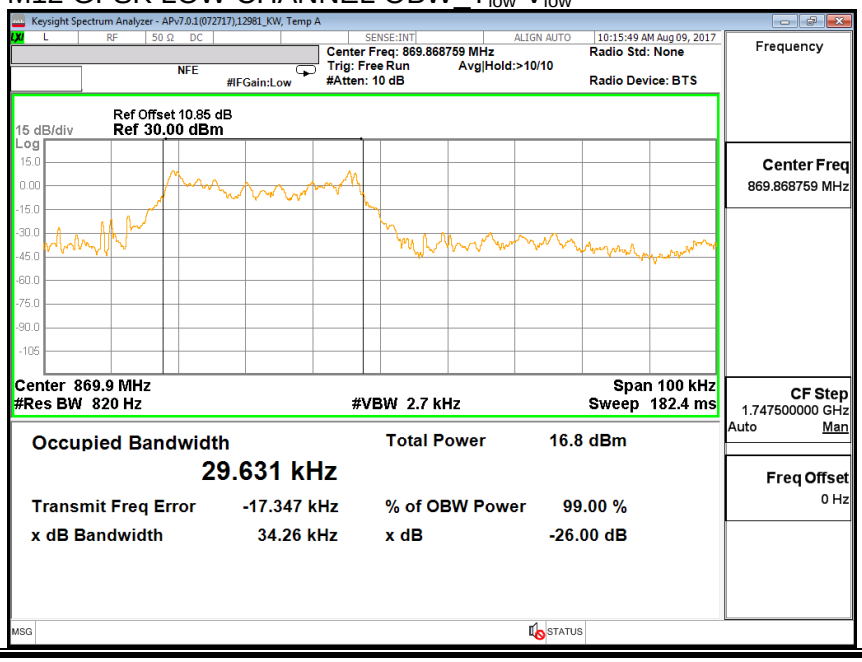
M12 GFSK LOW CHANNEL OBW_T_{normal} V_{normal}



M12 GFSK LOW CHANNEL OBW_T_{low} V_{low}



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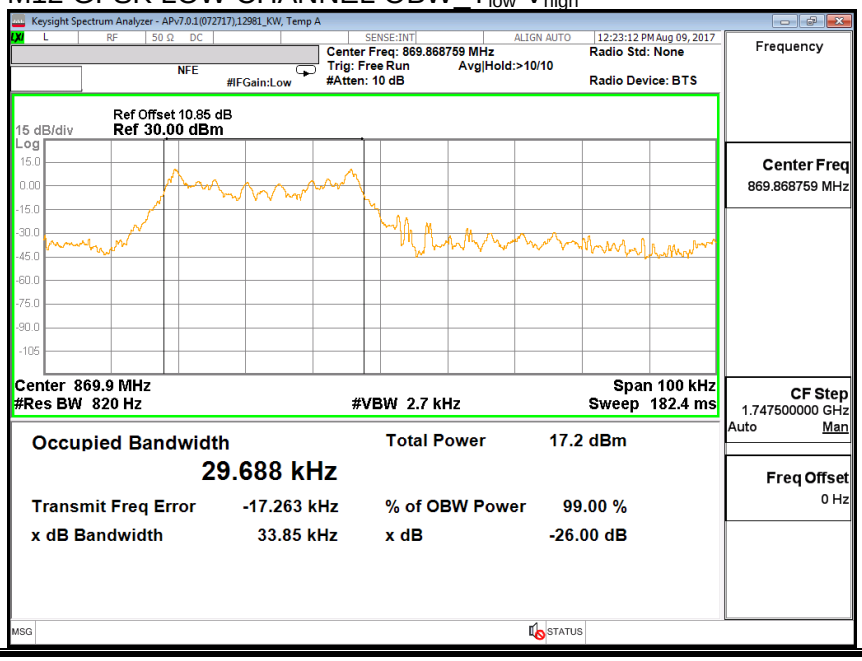
M12 GFSK LOW CHANNEL OBW_T_{low} V_{high}



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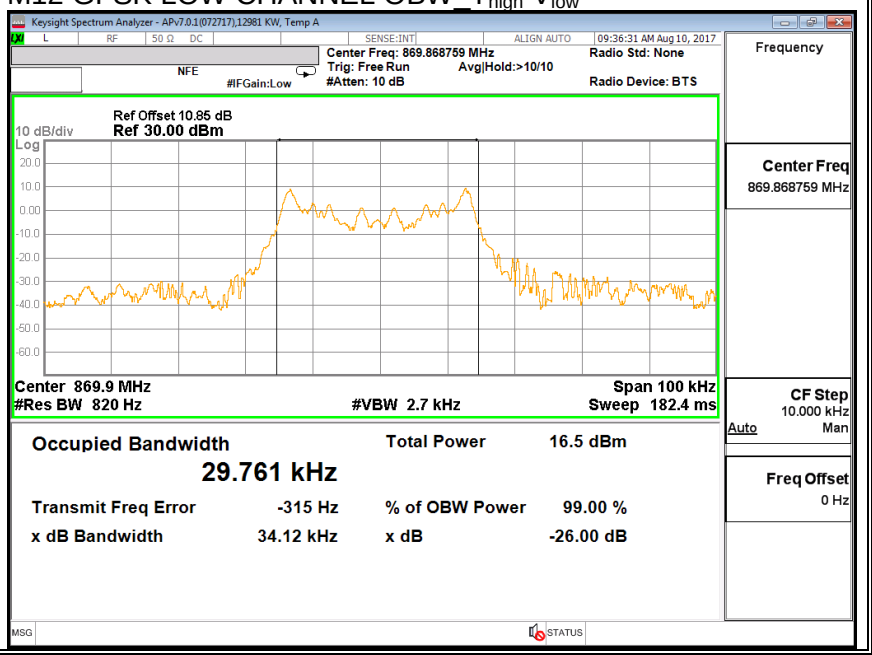

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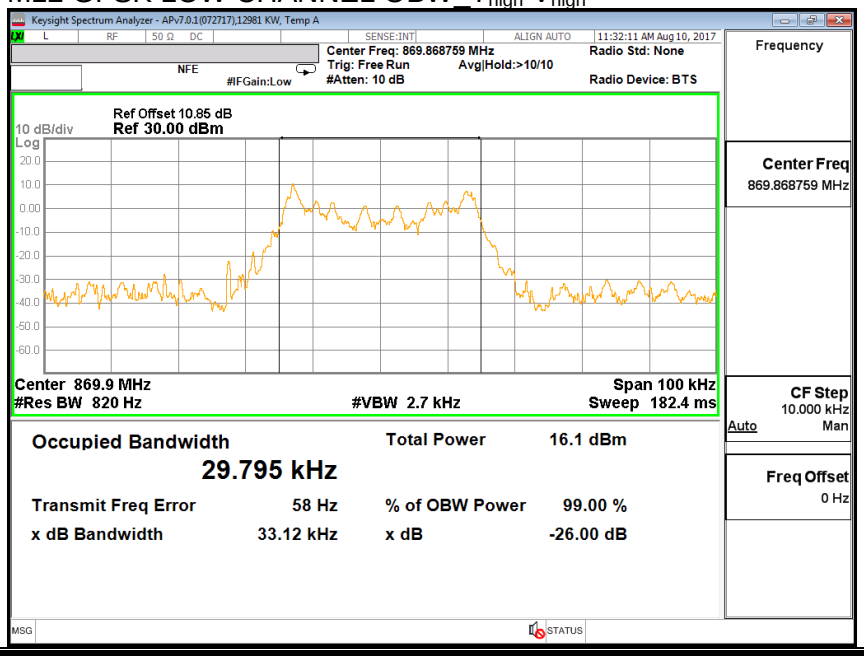
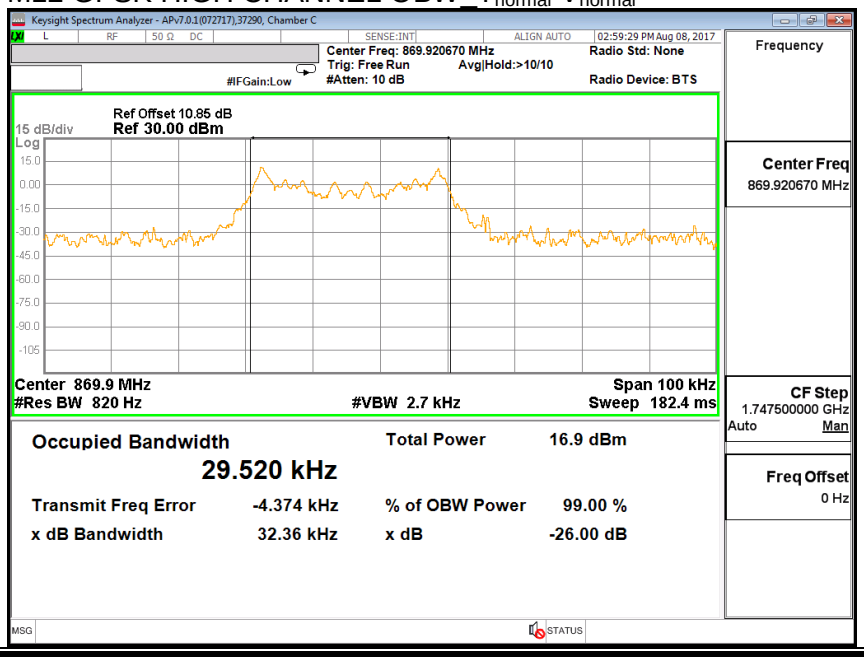
M12 GFSK LOW CHANNEL OBW_T_{high} V_{high}



M12 GFSK HIGH CHANNEL OBW_T_{normal} V_{normal}



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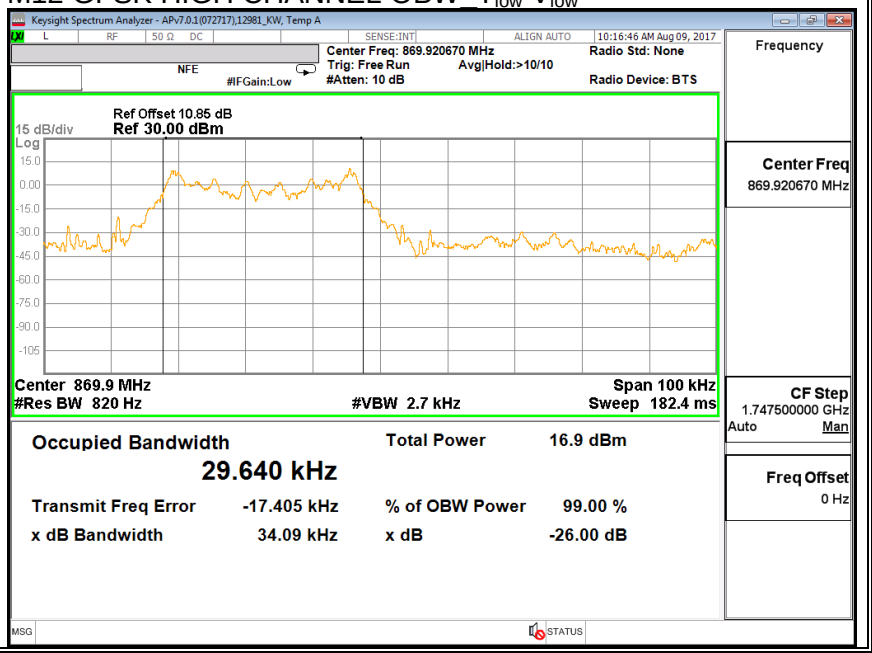
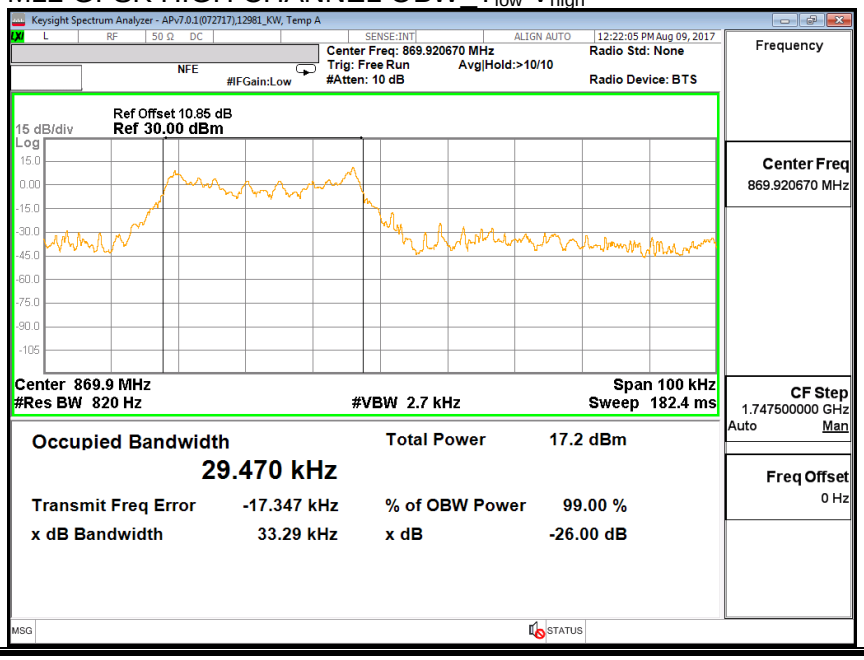
M12 GFSK HIGH CHANNEL OBW_T_{low} V_{low}



M12 GFSK HIGH CHANNEL OBW_T_{low} V_{high}



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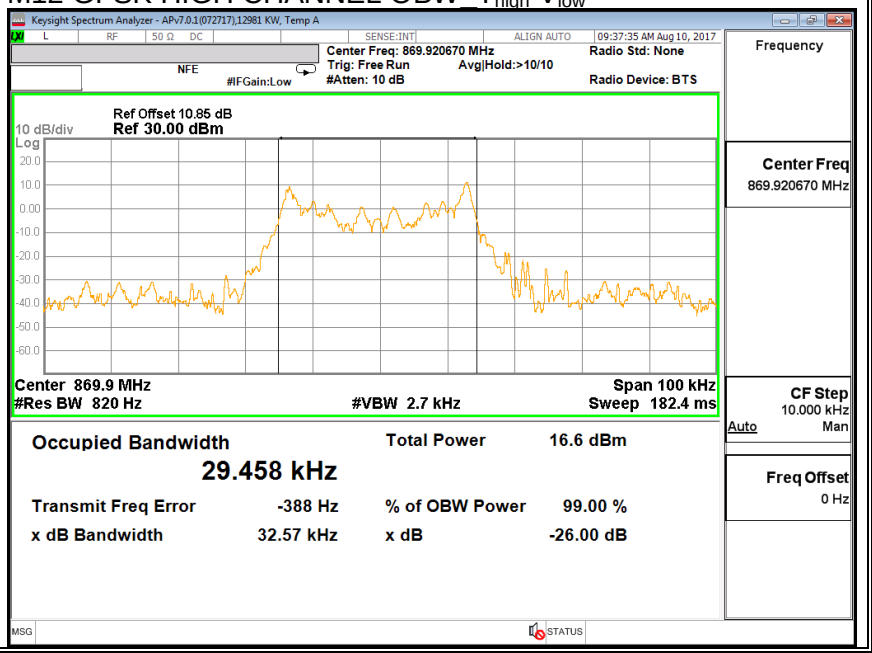
M12 GFSK HIGH CHANNEL OBW_T_{high} V_{low}



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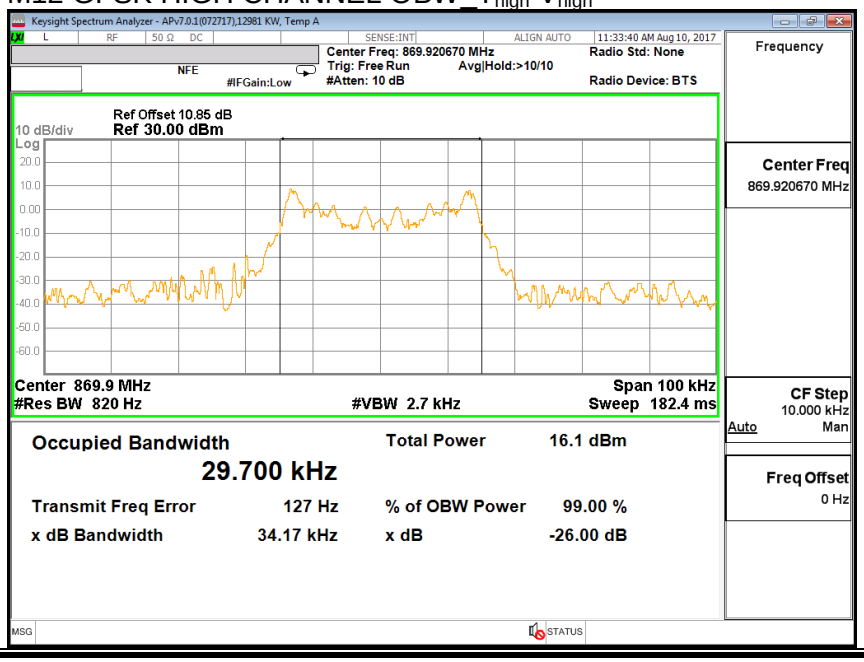

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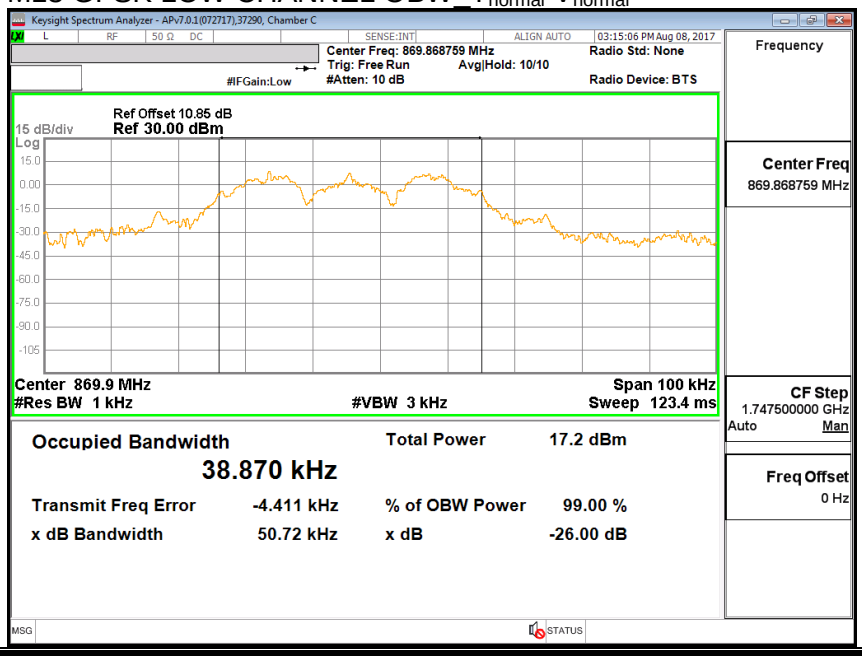
M13 GFSK LOW CHANNEL OBW_T_{normal} V_{normal}



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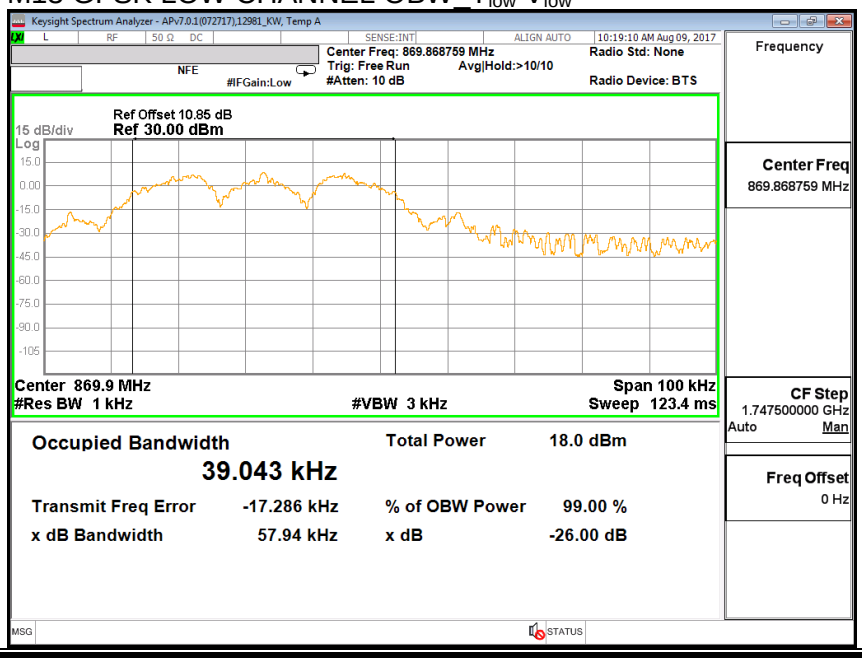

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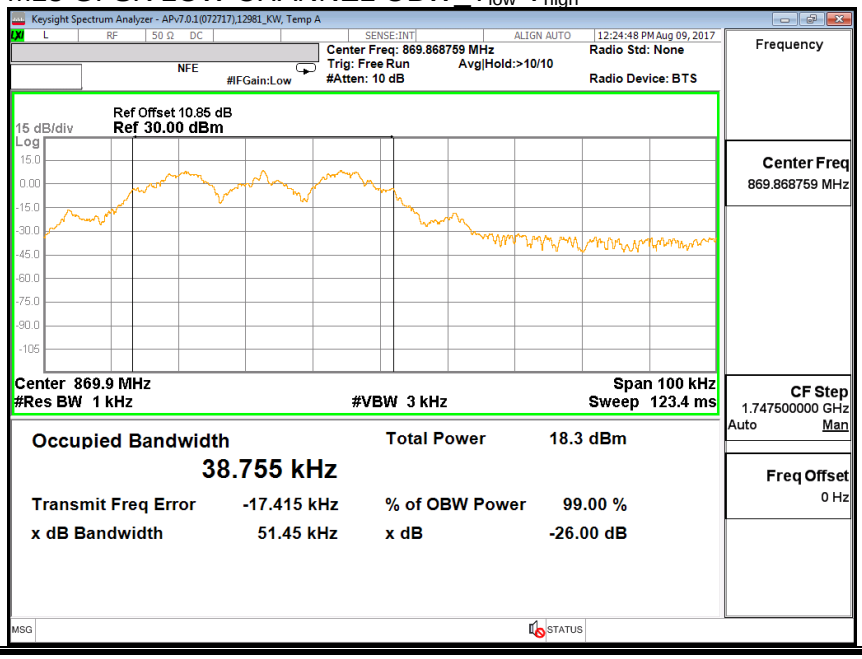
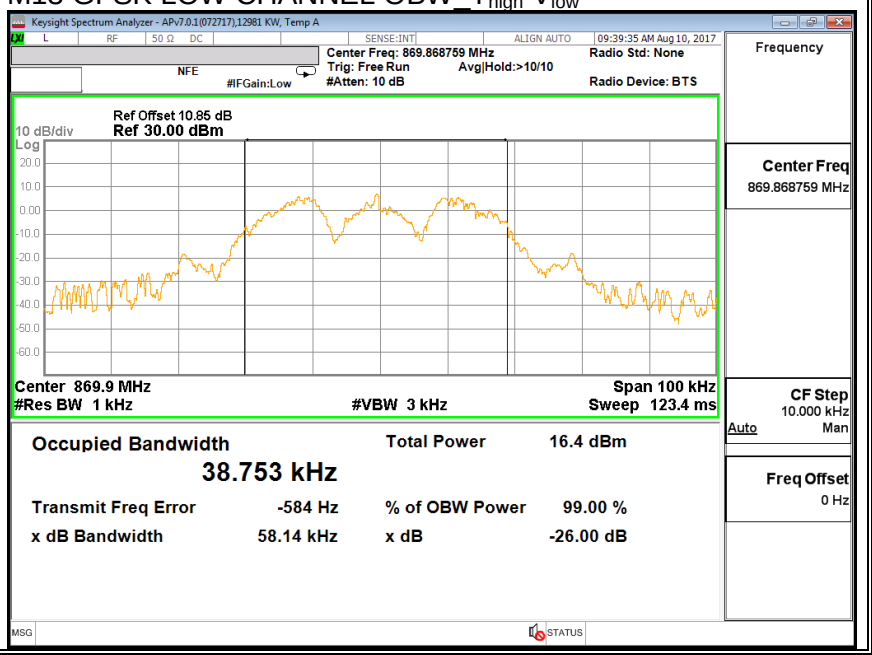
M13 GFSK LOW CHANNEL OBW_T_{low} V_{high}



M13 GFSK LOW CHANNEL OBW_T_{high} V_{low}



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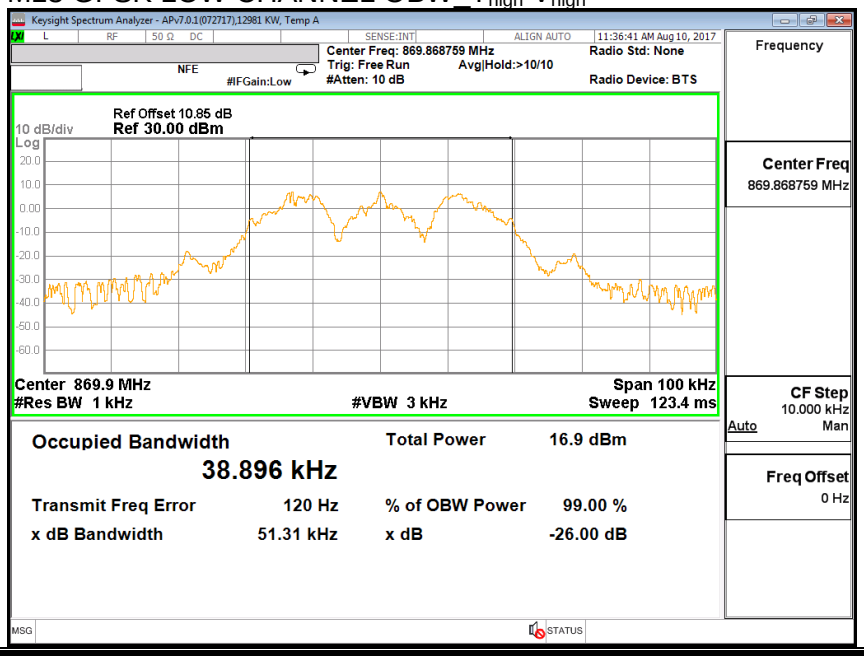
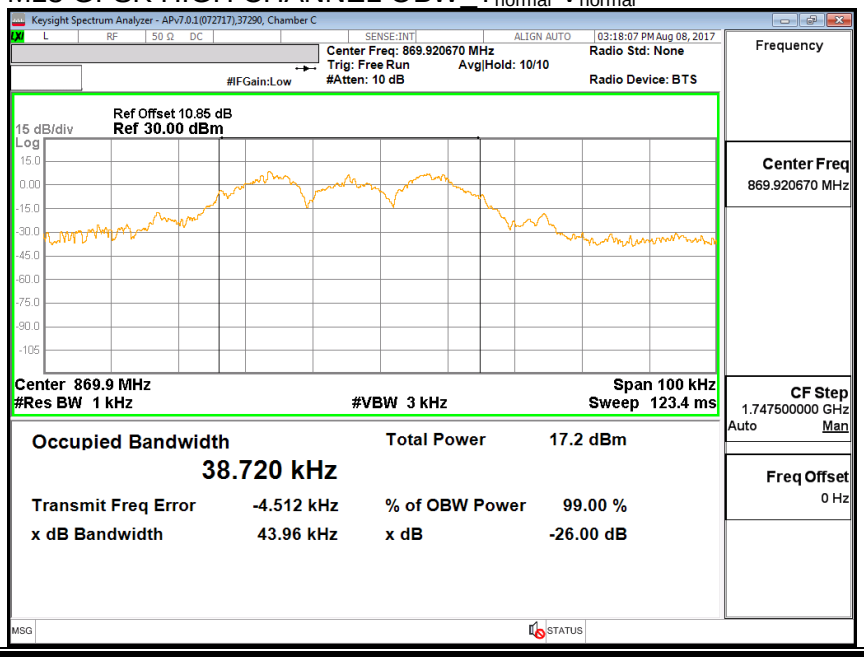
M13 GFSK LOW CHANNEL OBW_T_{high} V_{high}



M13 GFSK HIGH CHANNEL OBW_T_{normal} V_{normal}



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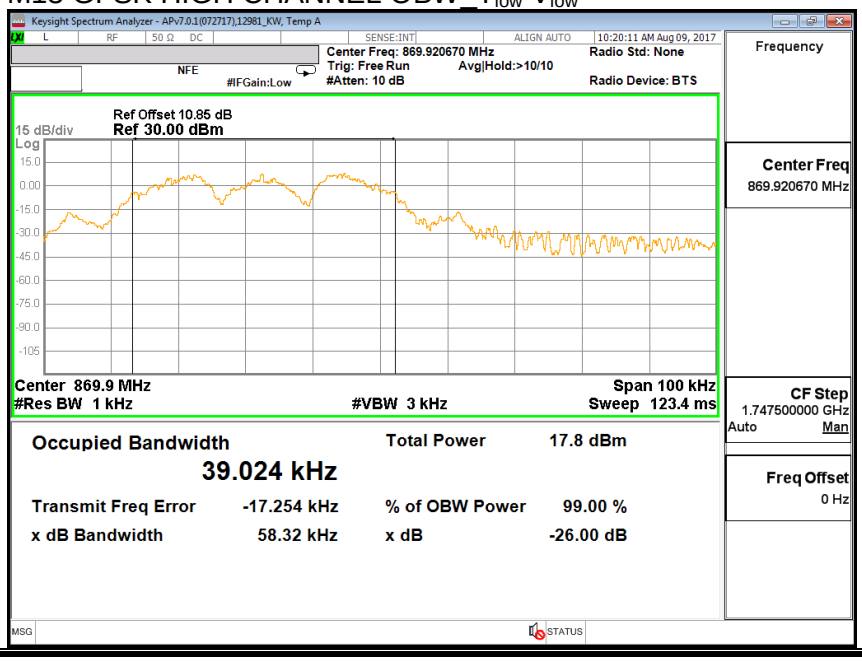
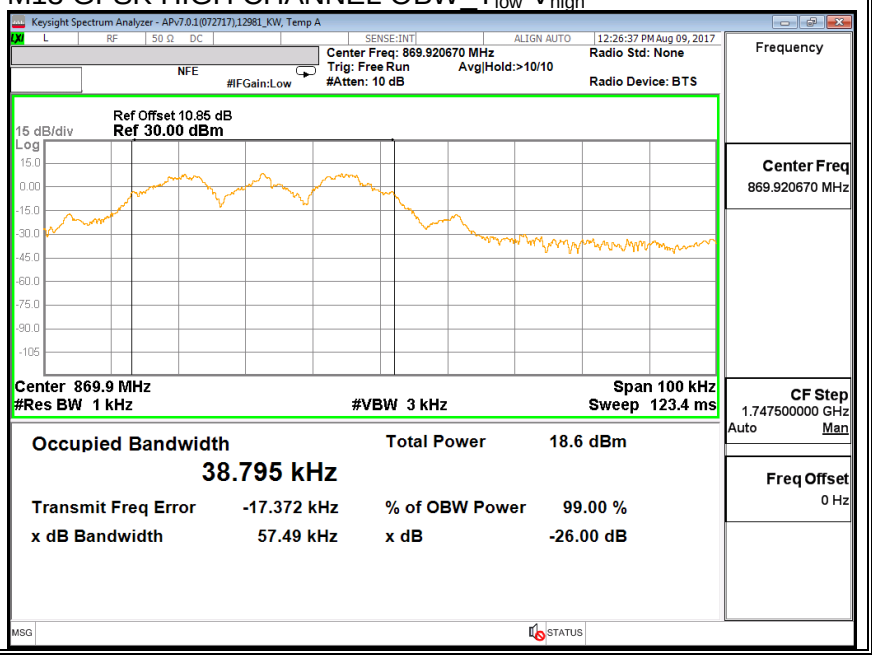
M13 GFSK HIGH CHANNEL OBW_T_{low} V_{low}



M13 GFSK HIGH CHANNEL OBW_T_{low} V_{high}



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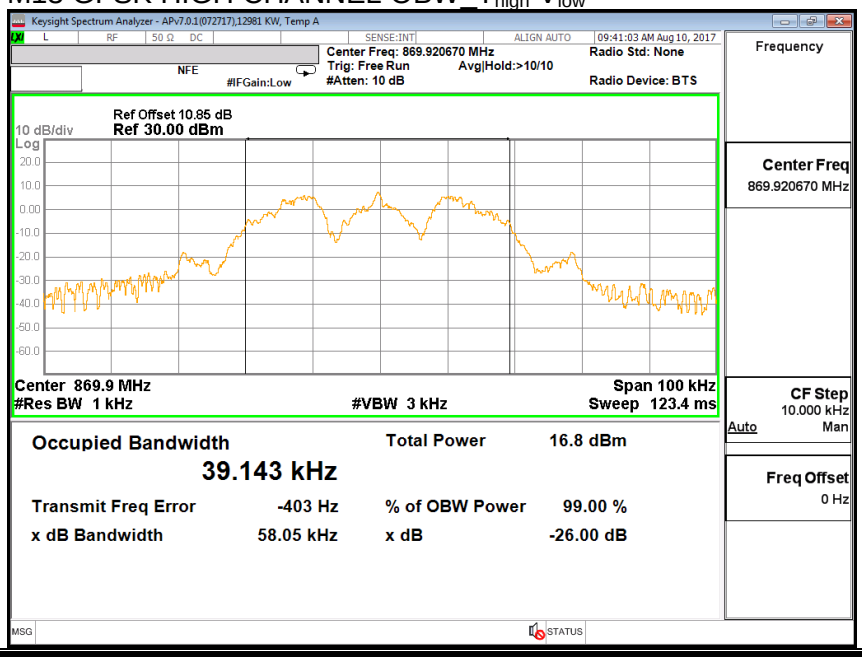
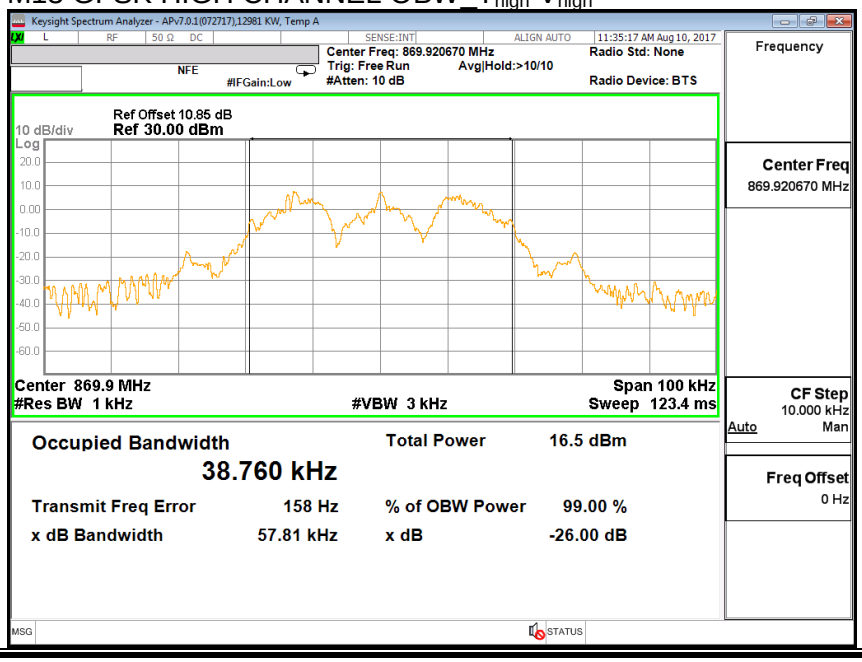
M13 GFSK HIGH CHANNEL OBW_T_{high} V_{low}



M13 GFSK HIGH CHANNEL OBW_T_{high} V_{high}



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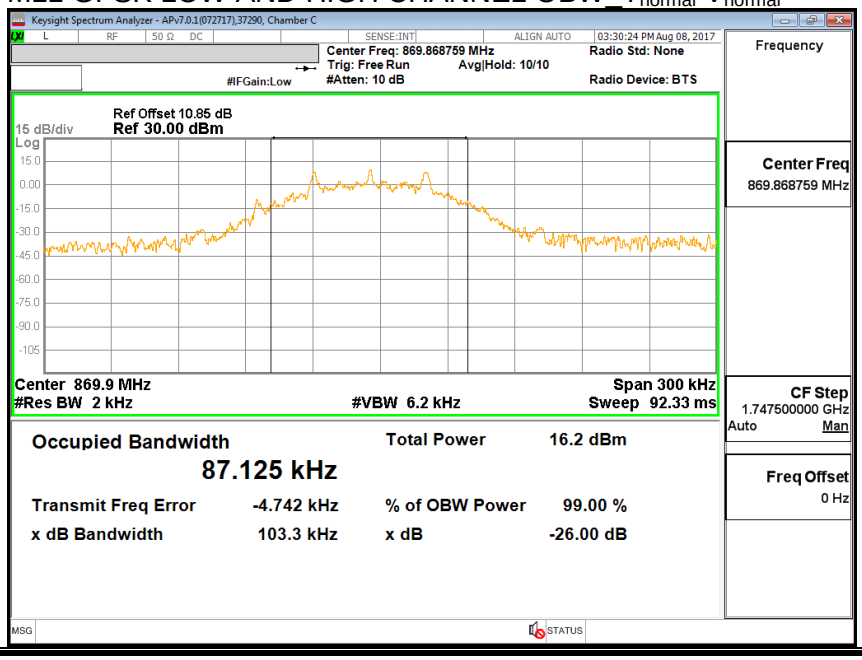
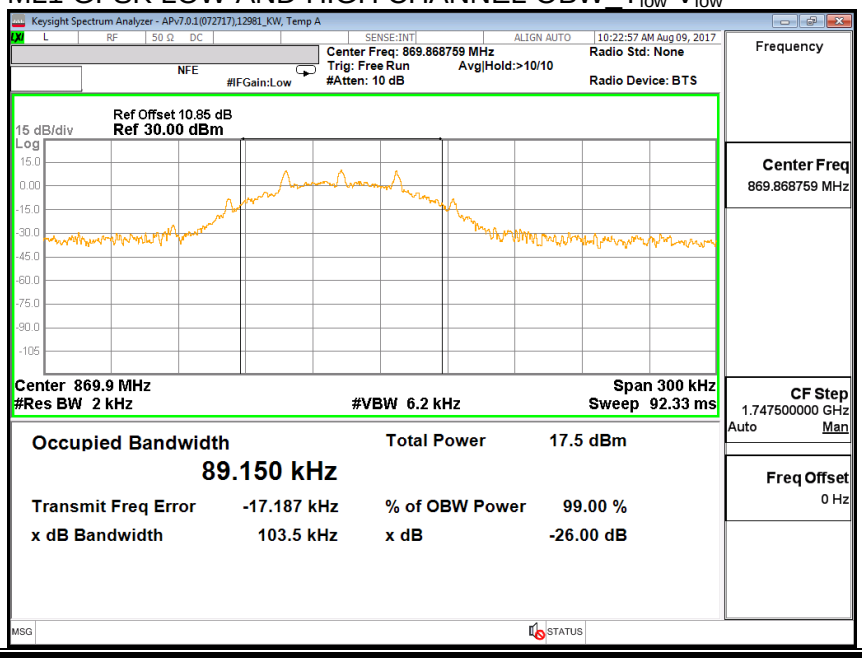
ML1 GFSK LOW AND HIGH CHANNEL OBW_T_{normal} V_{normal}



ML1 GFSK LOW AND HIGH CHANNEL OBW_T_{low} V_{low}



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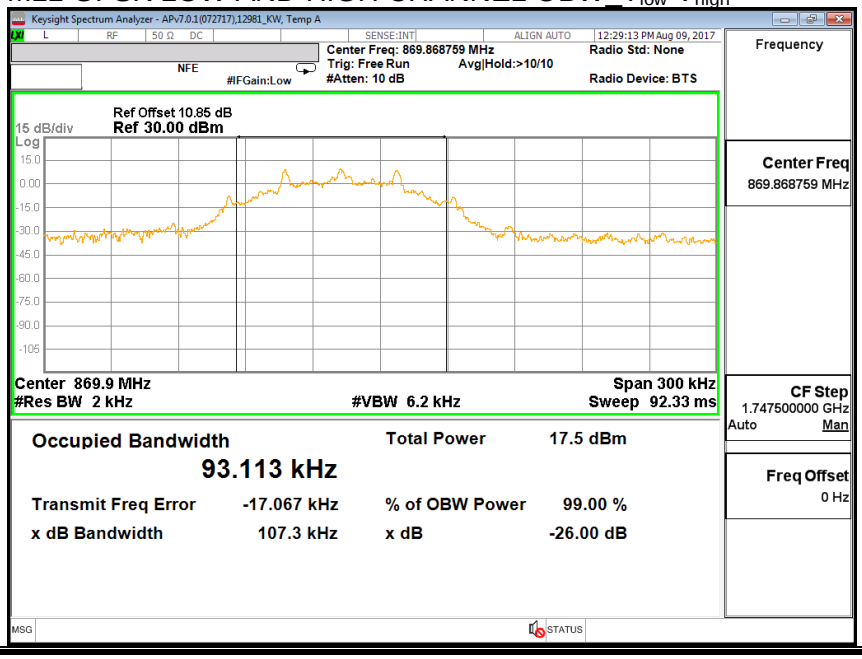
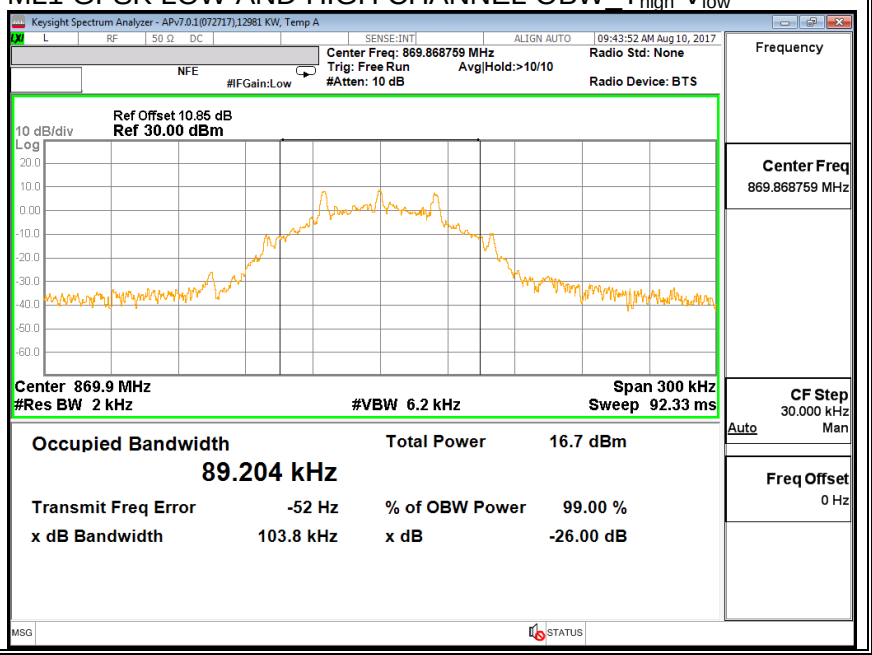
ML1 GFSK LOW AND HIGH CHANNEL OBW_T_{low} V_{high}



ML1 GFSK LOW AND HIGH CHANNEL OBW_T_{high} V_{low}



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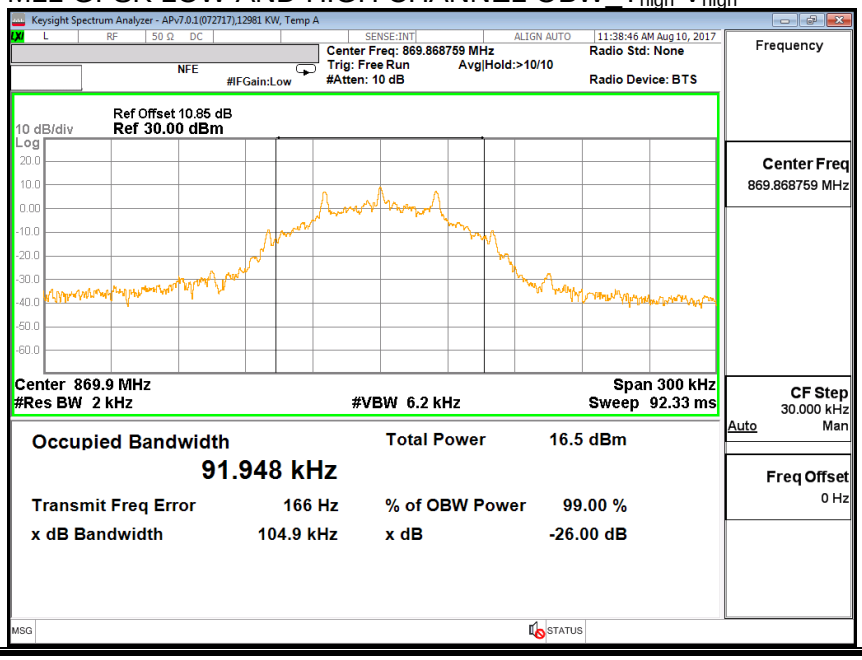
ML1 GFSK LOW AND HIGH CHANNEL OBW_T_{high} V_{high}



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7.6.4. TX OUT OF BAND EMISSIONS

REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.1

Two OOB domains are defined, one for OC (see Figure 5) and one for Operational Frequency band (see Figure 6). The spectrum masks for these two OOB domains may overlap.

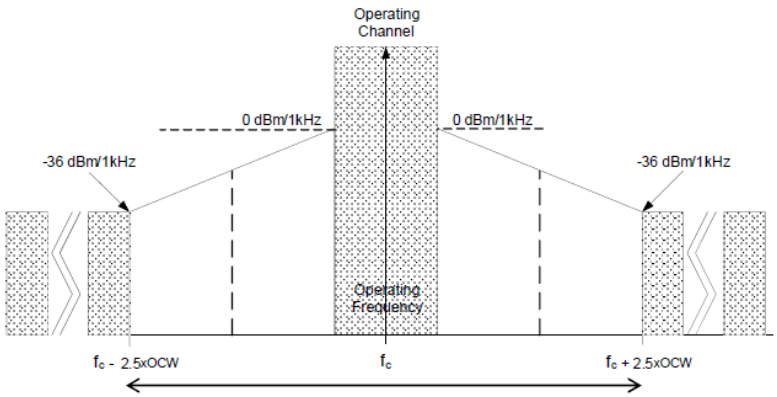

Figure 5: Out Of Band Domain for Operating Channel with reference BW

Unwanted emissions in the Out Of Band domain are those falling in the frequency range immediately below the lower, and above the upper, frequency of the Operating Channel. The OOB domain includes both frequencies outside the Operating Channel within the Operational Frequency Band and frequencies outside the Operational Frequency Band.
The relevant Out Of Band domain is shown in Figure 5 and applies within the Operational Frequency Band.

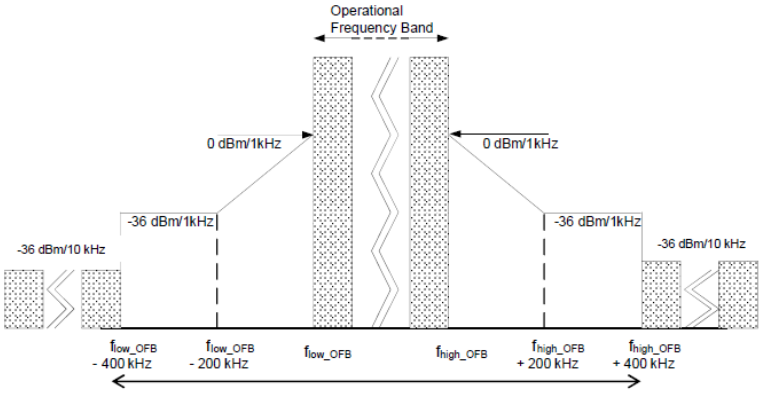

Figure 6: Out Of Band Domain for Operational Frequency Band with reference BW

Specific limits apply at frequencies immediately above and below the Operational Frequency Band as shown in Figure 6.
NOTE: f_{low}_OFB is the lower edge of the Operational Frequency Band. f_{high}_OFB is the upper edge of the Operational Frequency Band.

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REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.2

The EUT emissions level in OOB domains for the Operating Channel and the Operational Frequency Band shall be less or equal to Table 15 spectrum mask.

Table 15: Emission limits in the Out Of Band domains

Domain	Frequency Range	RBW_{REF}	Max power limit
OOB limits applicable to Operational Frequency Band (See Figure 6)	$f \le f_{low_OFB}$ - 400 kHz	10 kHz	-36 dBm
	F_{low_OFB} - 400 kHz ≤ f ≤ f_{low_OFB} - 200 kHz	1 kHz	-36 dBm
	f_{low} - 200 kHz ≤ f < f_{low_OFB}	1 kHz	See Figure 6
	$f = f_{low_OFB}$	1 kHz	0 dBm
	$f = f_{high_OFB}$	1 kHz	0 dBm
	F_{high_OFB} < f ≤ f_{high_OFB} + 200 kHz	1 kHz	See Figure 6
	F_{high_OFB} + 200 kHz ≤ f ≤ f_{high_OFB} + 400 kHz	1 kHz	-36 dBm
	F_{high_OFB} + 400 kHz ≤ f	10 kHz	-36 dBm
OOB limits applicable to Operating Channel (See Figure 5)	$f = f_c$- 2.5 x OCW	1 kHz	-36 dBm
	f_c - 2,5 x OCW ≤ f ≤ f_c - 0,5 x OCW	1 kHz	See Figure 5
	$f = f_c$ - 0,5 x OCW	1 kHz	0 dBm
	$f = f_c$ + 0,5 x OCW	1 kHz	0 dBm
	f_c + 0,5 x OCW ≤ f ≤ f_c + 2,5 x OCW	1 kHz	See Figure 5
	$f = f_c$+ 2,5 x OCW	1 kHz	-36 dBm

NOTE: f is the measurement frequency.
f_c is the Operating Frequency.
F_{low_OFB} is the lower edge of the Operational Frequency Band.
F_{high_OFB} is the upper edge of the Operational Frequency Band.
OCW is the operating channel bandwidth.

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.3.3 (Conducted Measurement)

RESULTS

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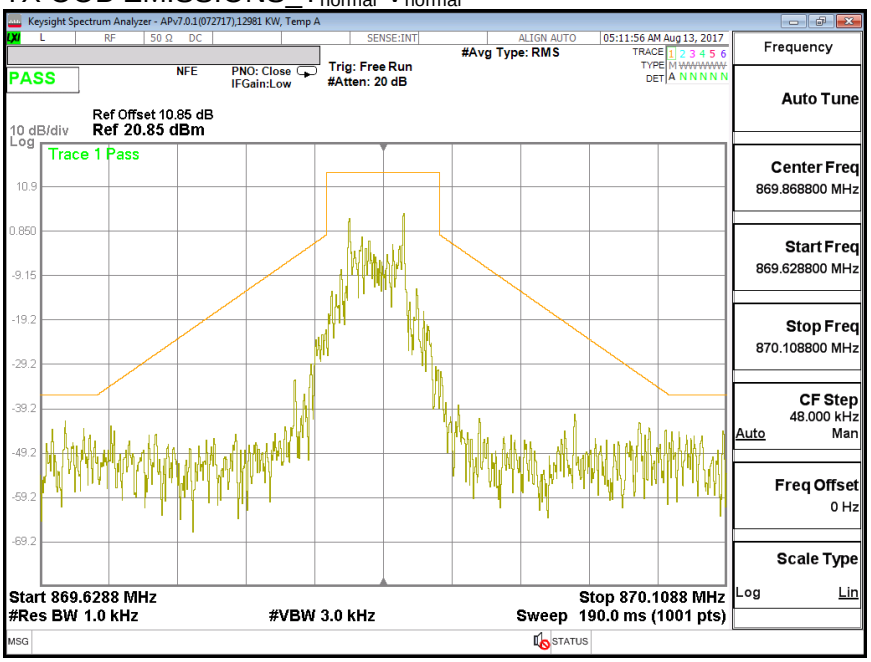
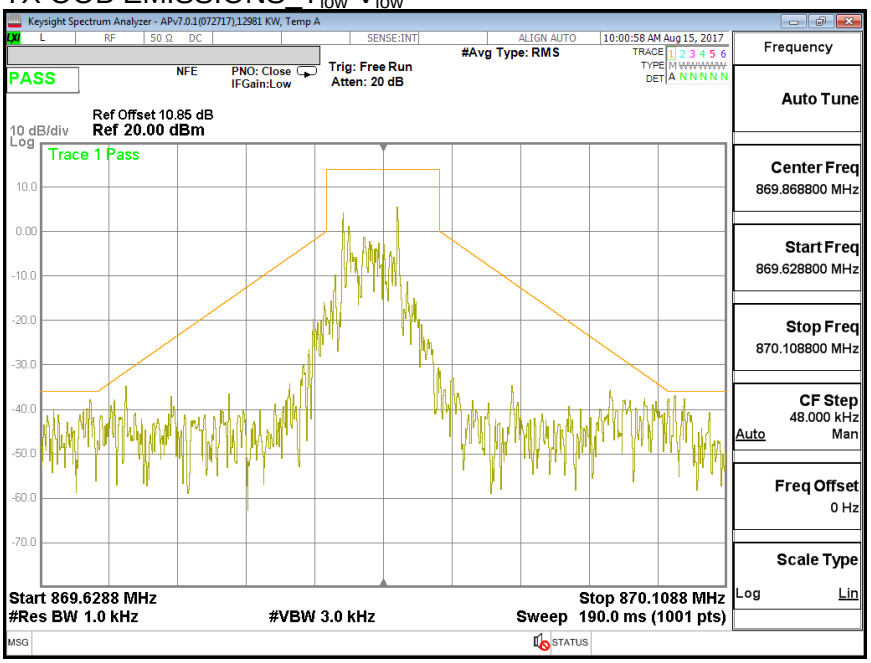
TX OUT OF BAND EMISSIONS (APPLICABLE TO OPERATING CHANNEL)

M7 LOW CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal}



TX OOB EMISSIONS_T_{low} V_{low}



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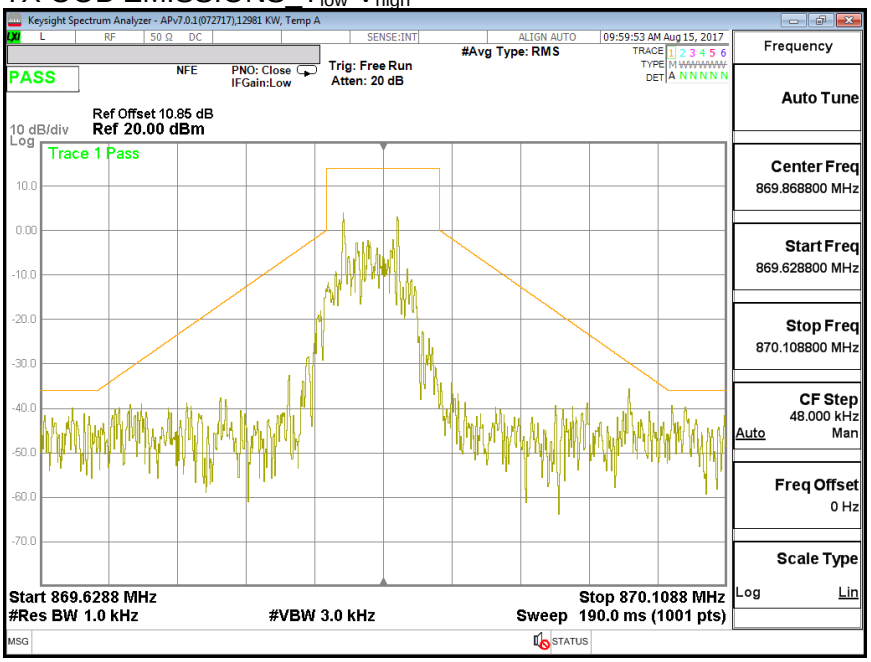
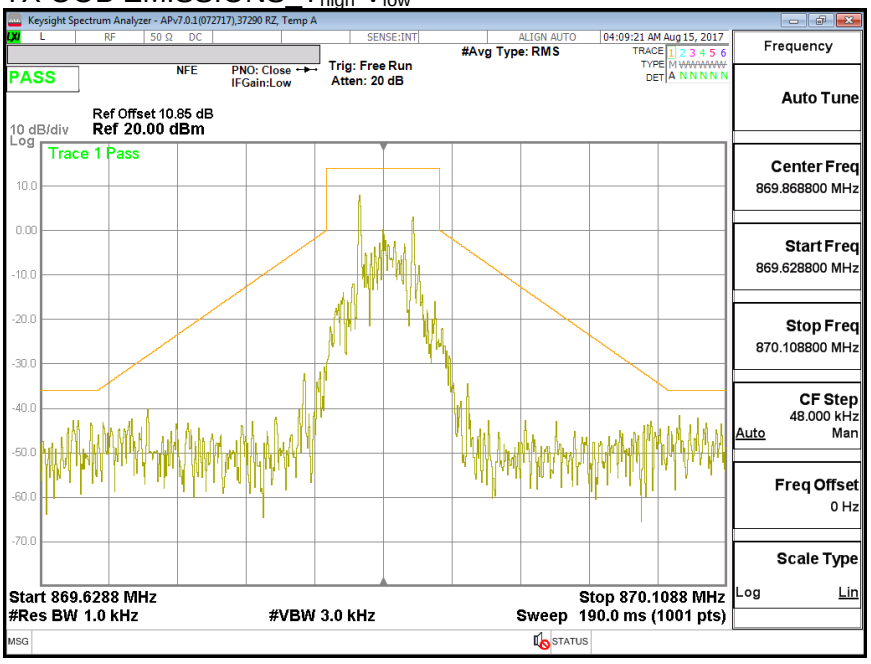
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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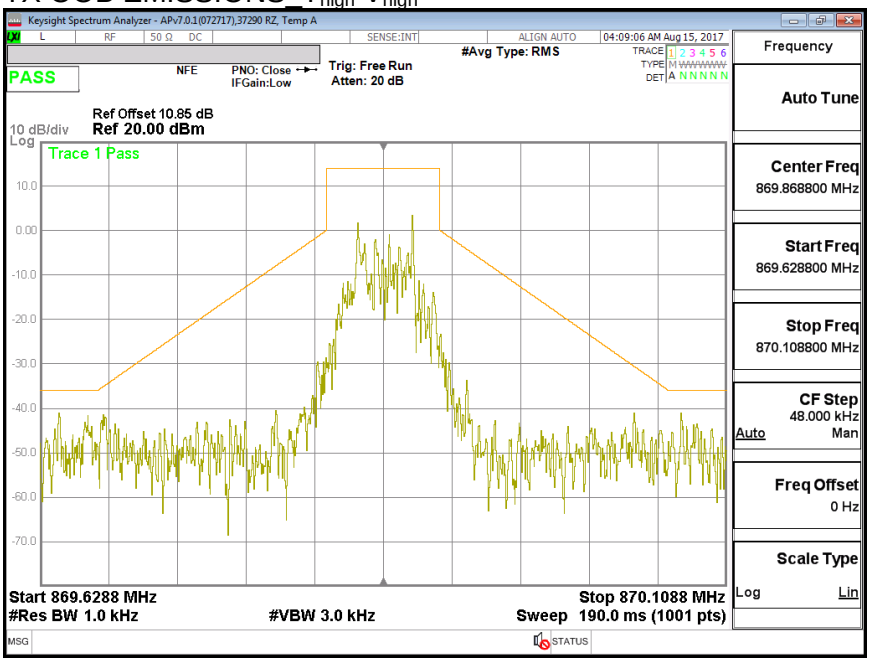
TX OOB EMISSIONS_T_{high} V_{high}



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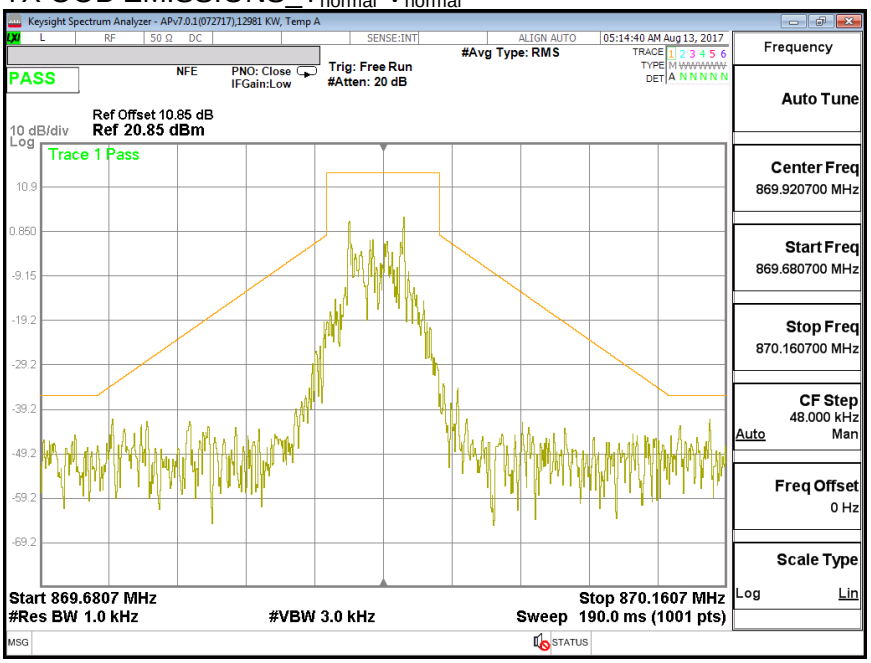
M7 HIGH CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$



TX OOB EMISSIONS_T$_{low}$ V$_{low}$

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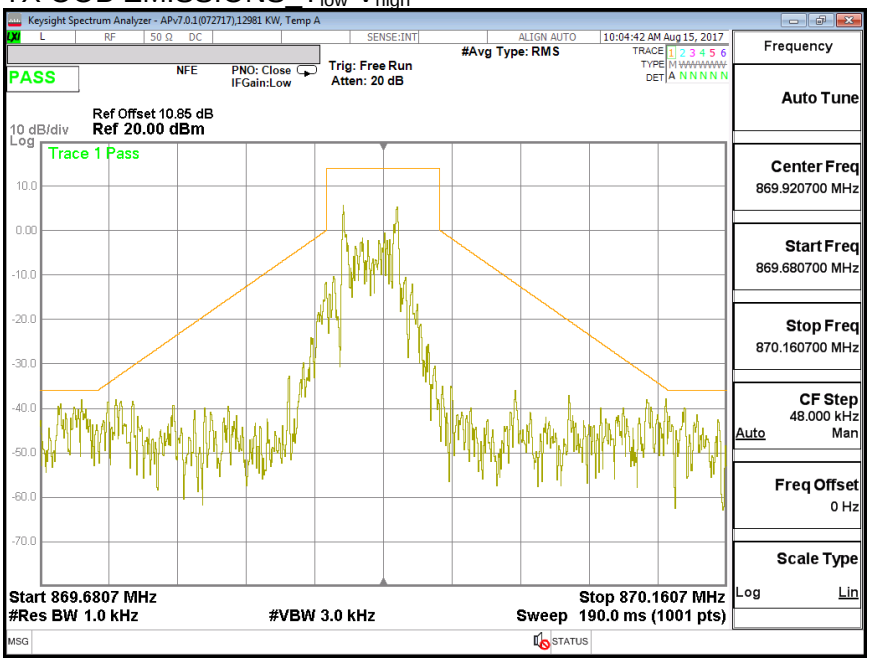
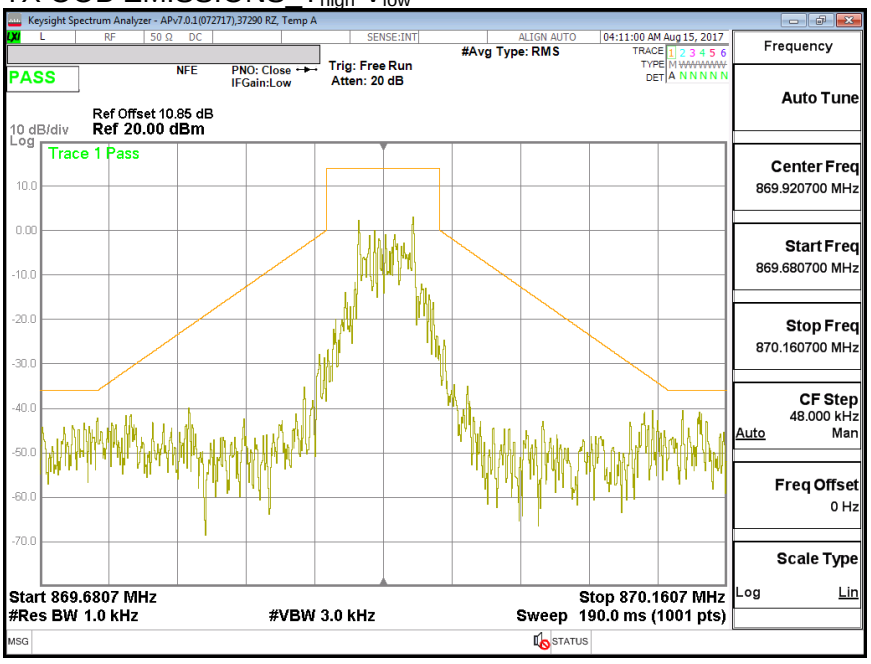
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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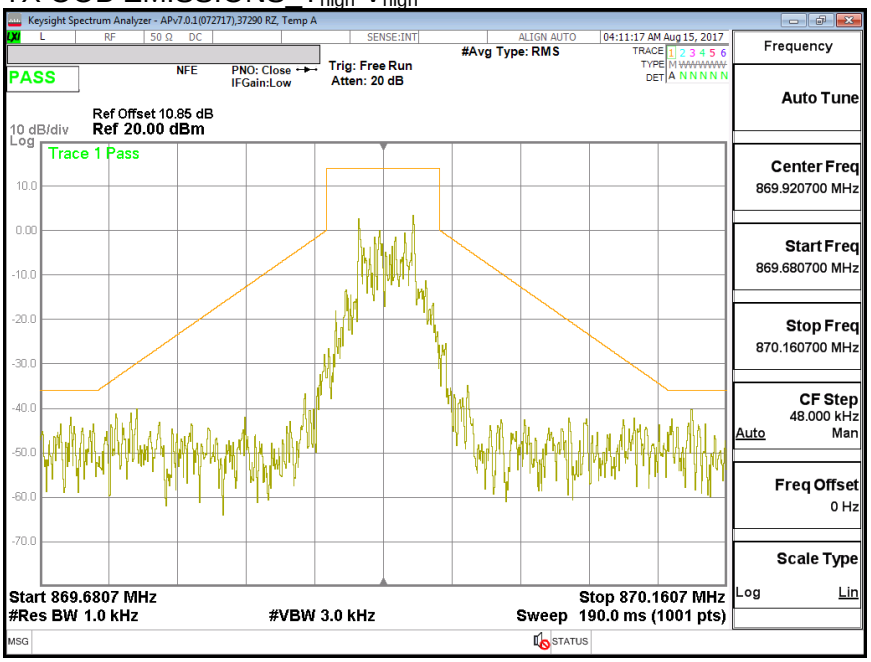
TX OOB EMISSIONS_T_{high} V_{high}



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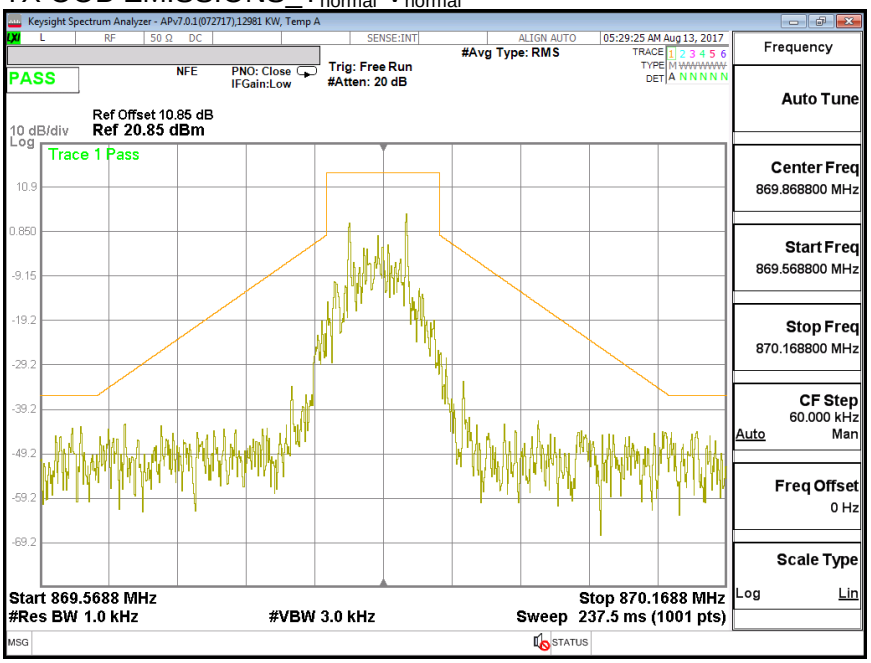
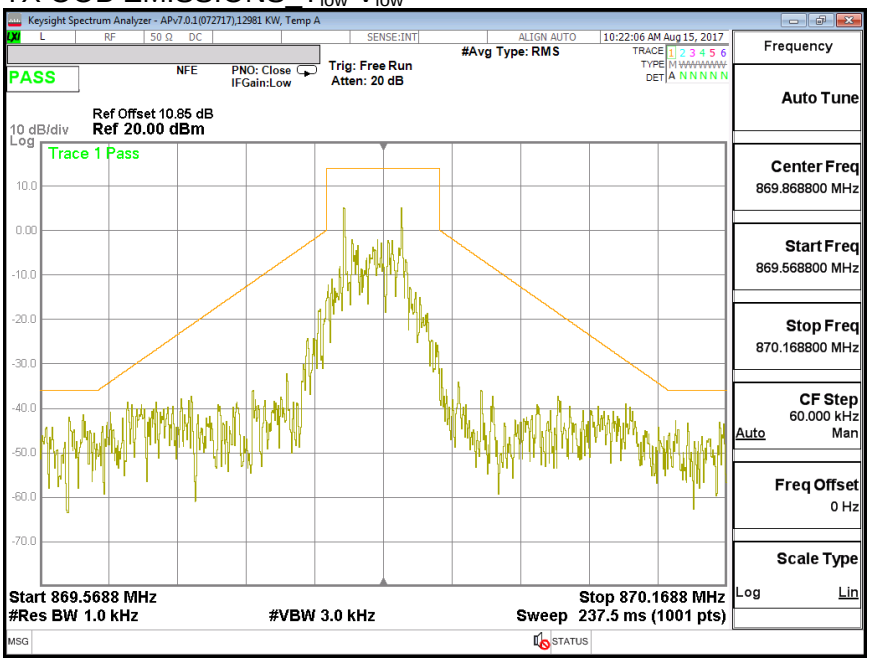
ML1 OPERATING CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$



TX OOB EMISSIONS_T$_{low}$ V$_{low}$



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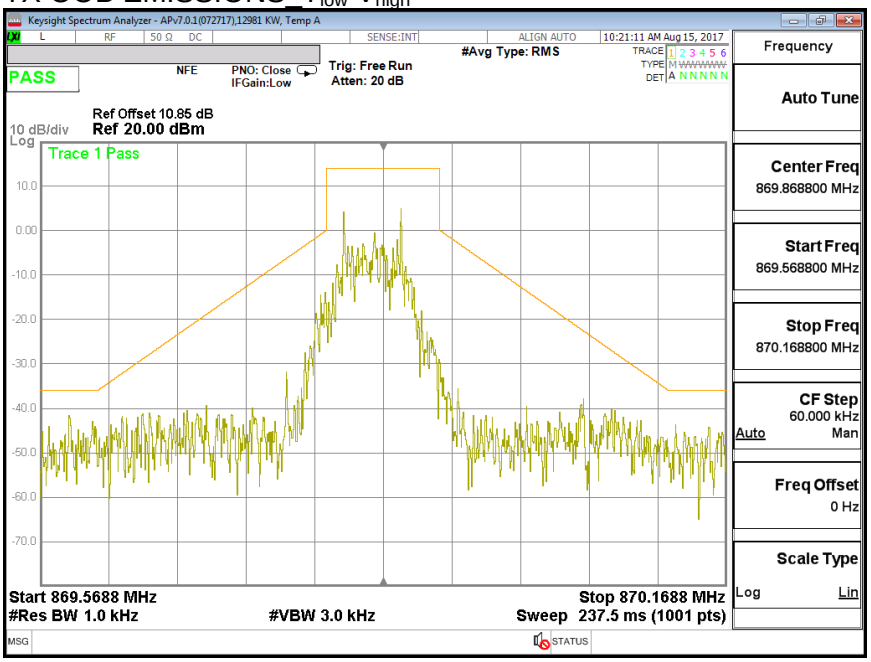
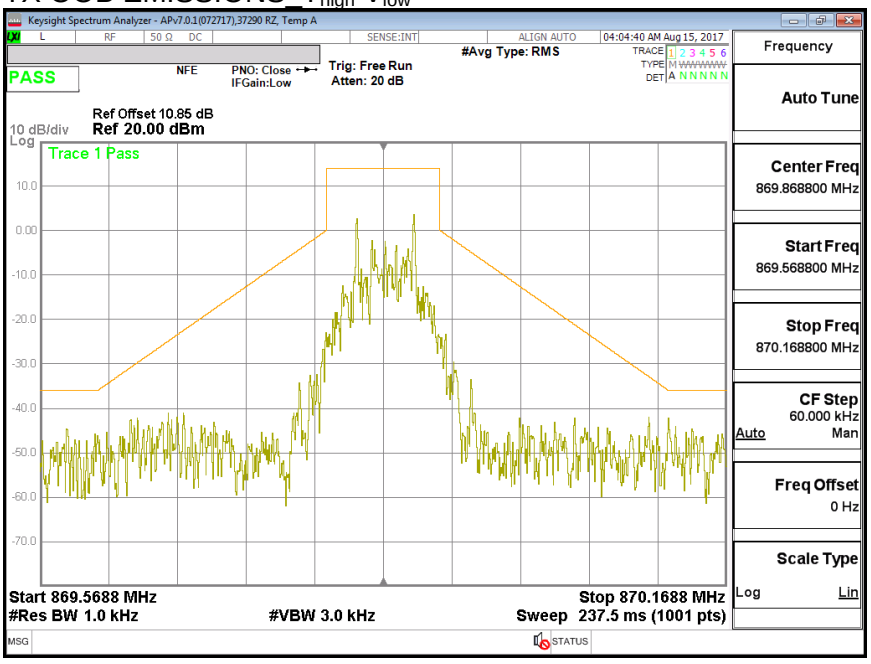
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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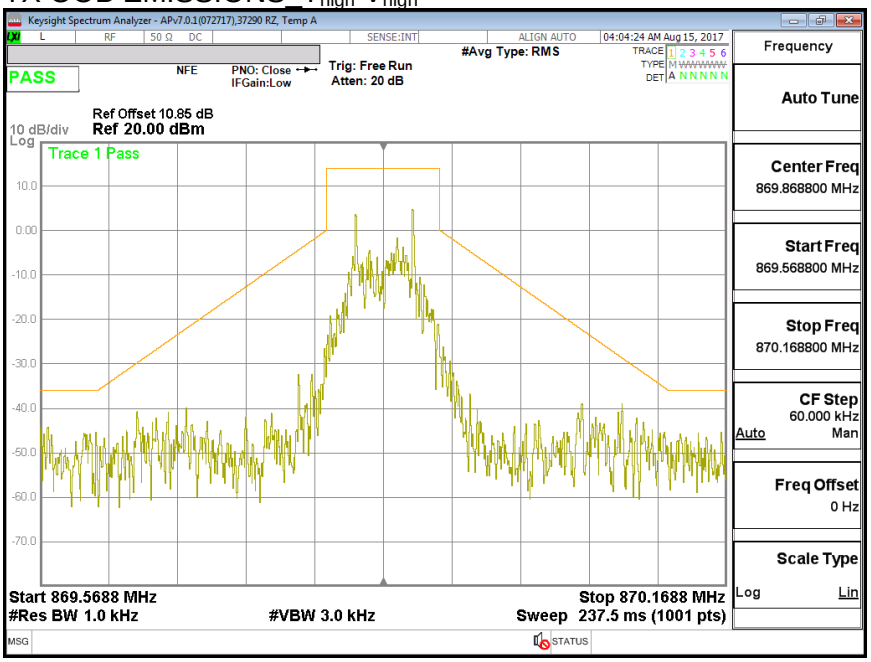
TX OOB EMISSIONS_T_{high} V_{high}



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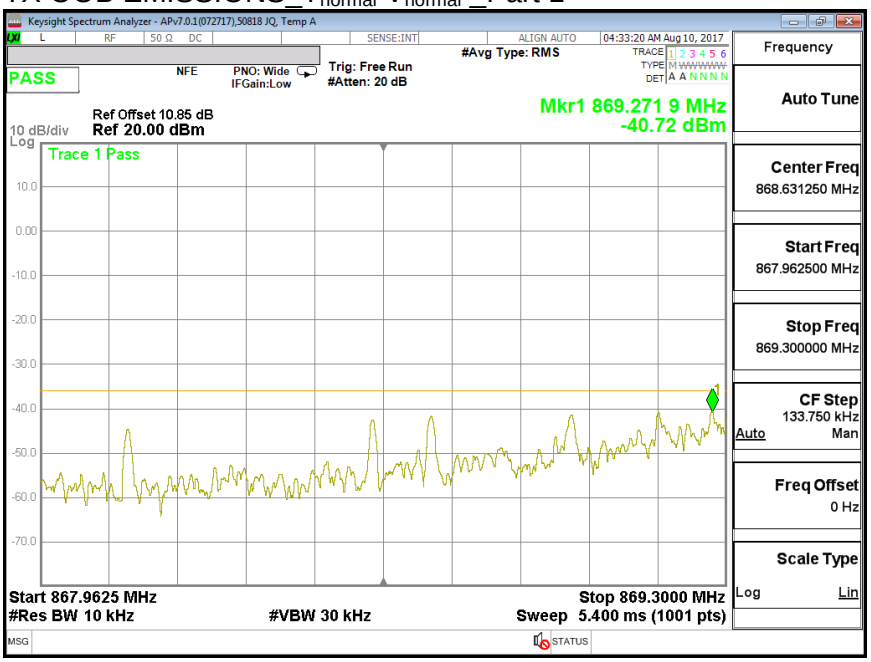
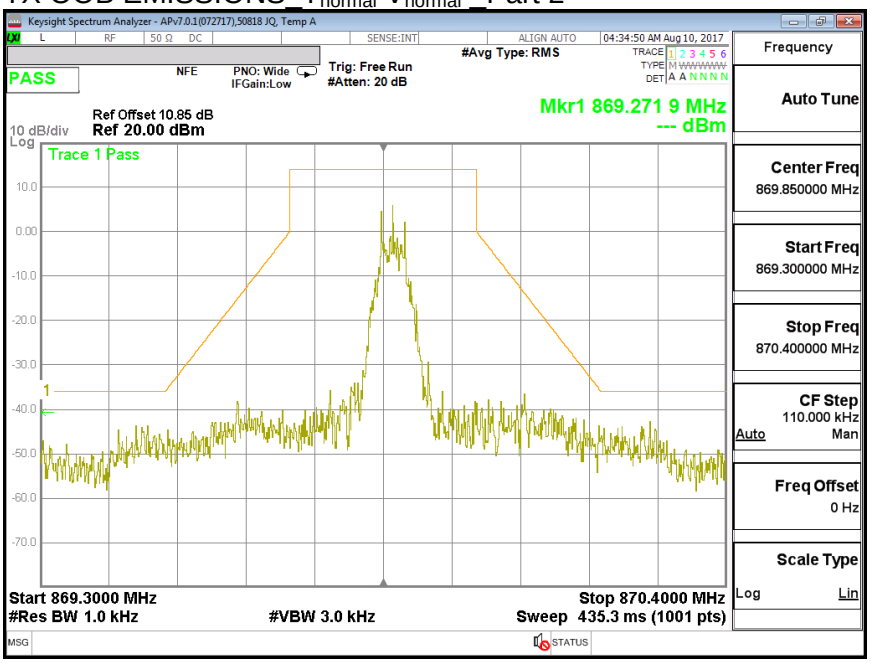
TX OUT OF BAND EMISSIONS (APPLICABLE TO OPERATIONAL FREQUENCY BANDS)

M7 LOW CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 1



TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 2



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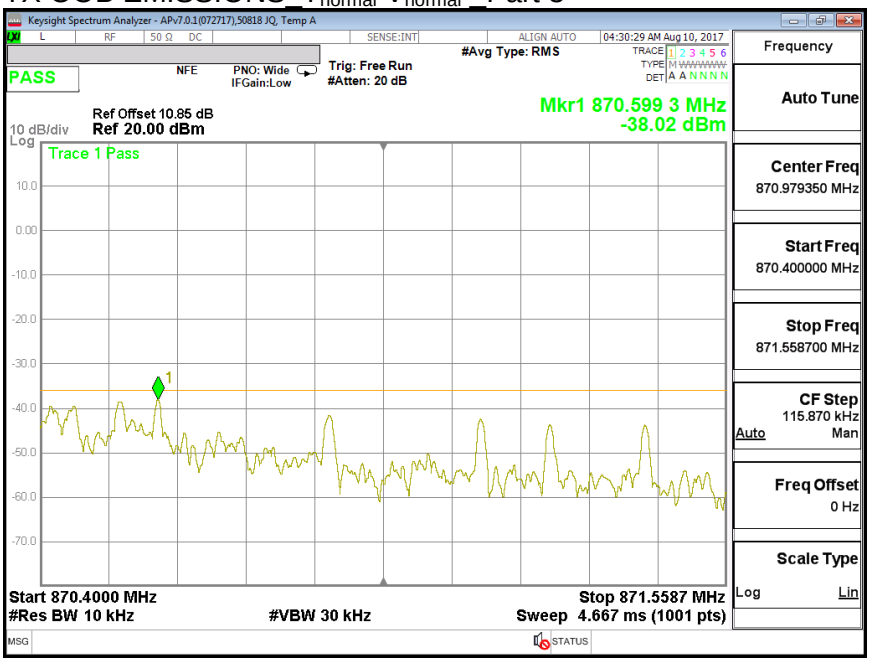
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3



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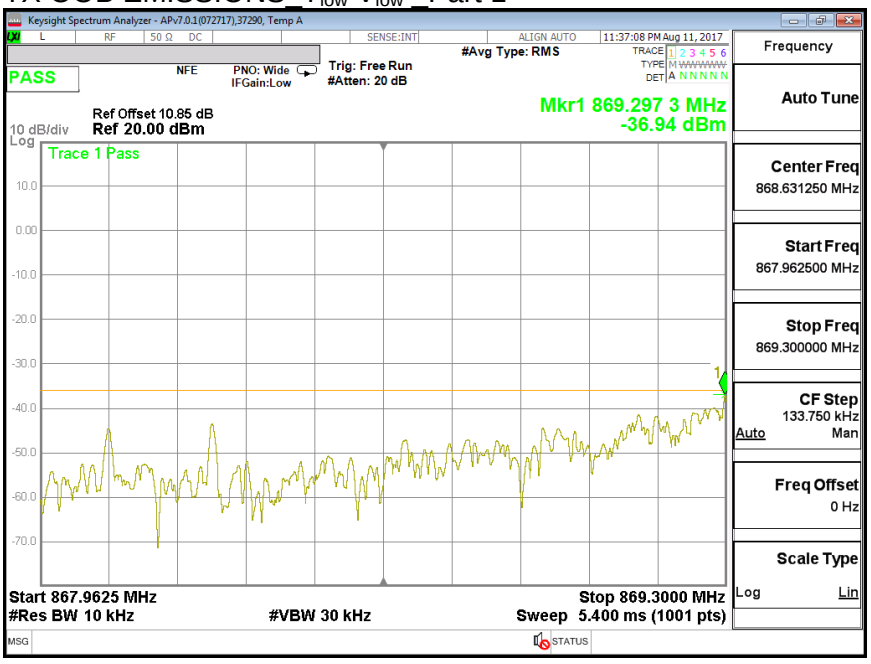

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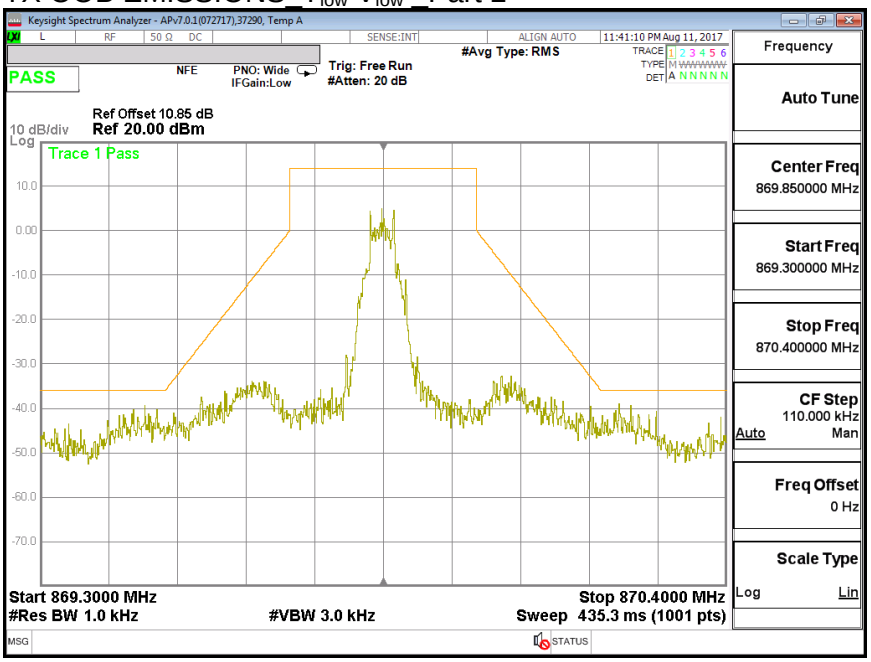

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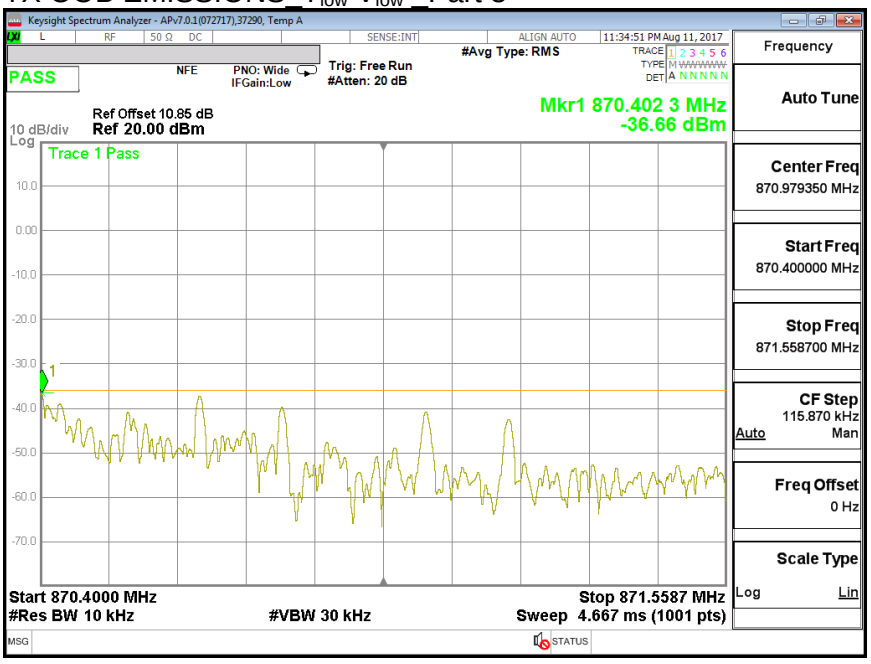

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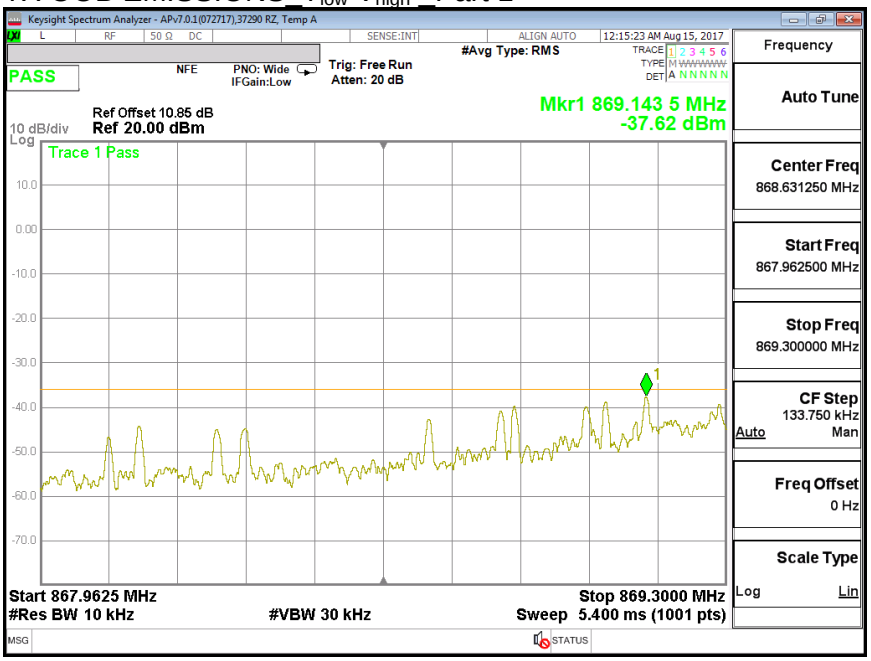
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



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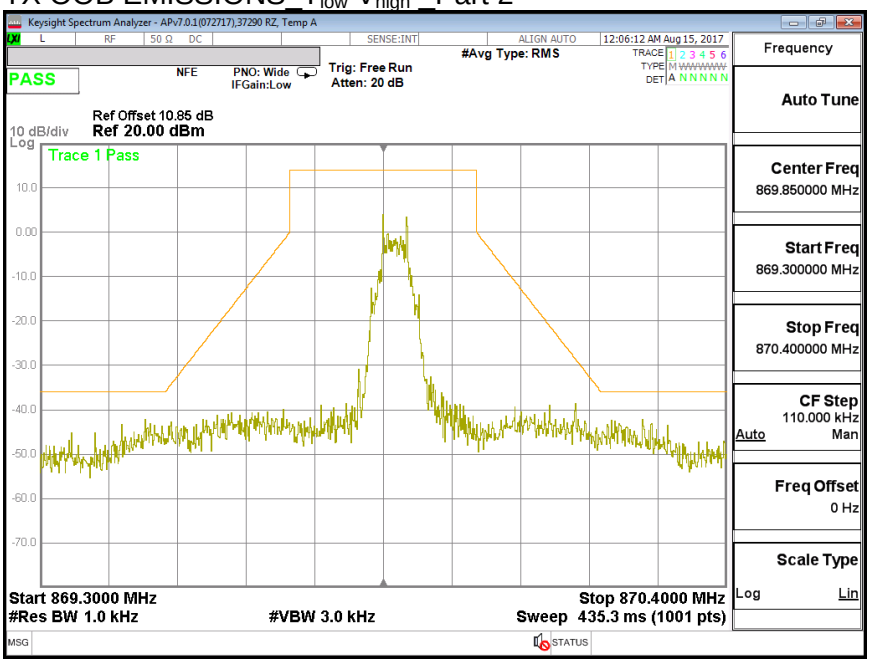

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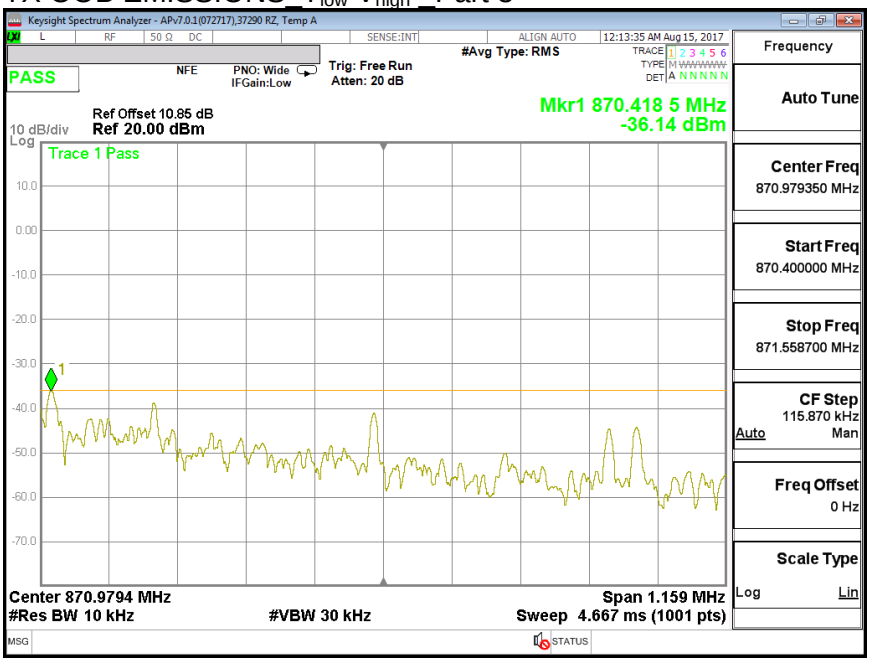
TX OOB EMISSIONS_T_{low} V_{high} _Part 3



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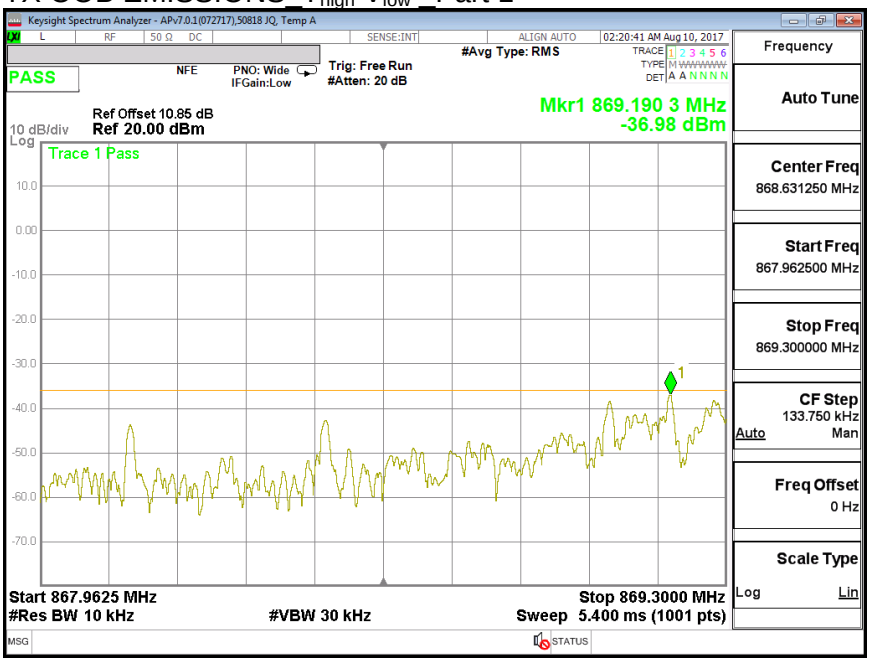

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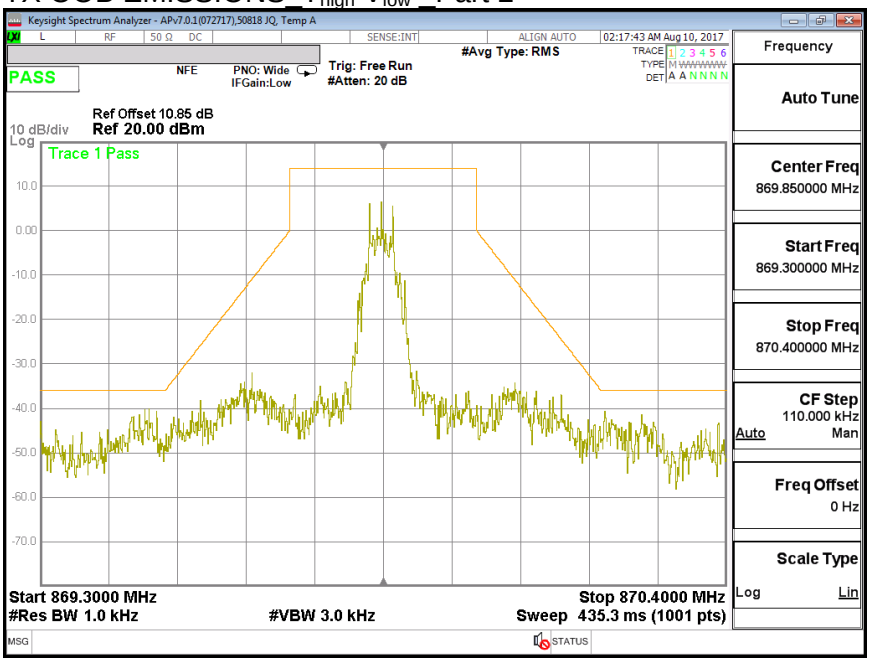
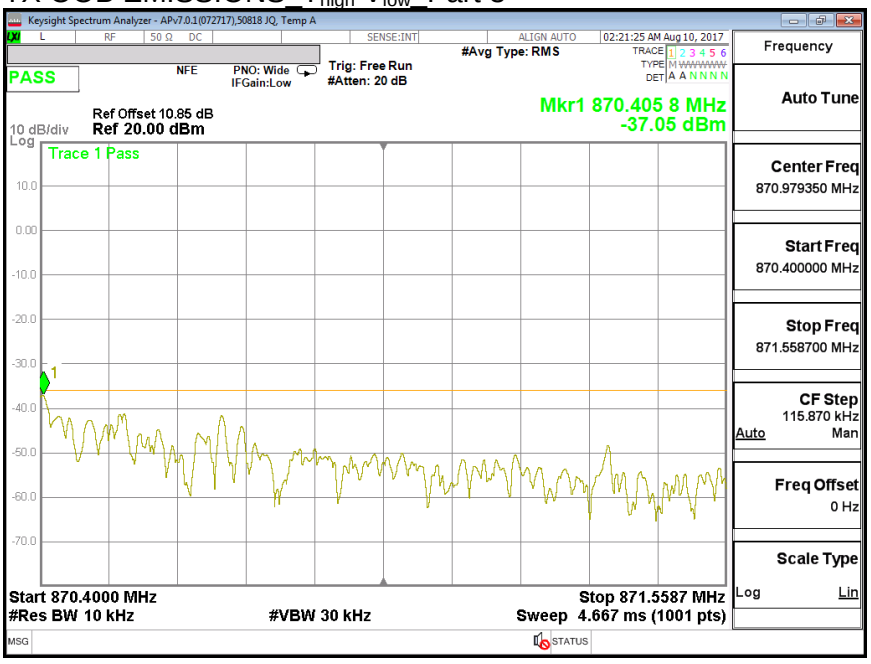
TX OOB EMISSIONS_T_{high} V_{low} _Part 2



TX OOB EMISSIONS_T_{high} V_{low}_Part 3



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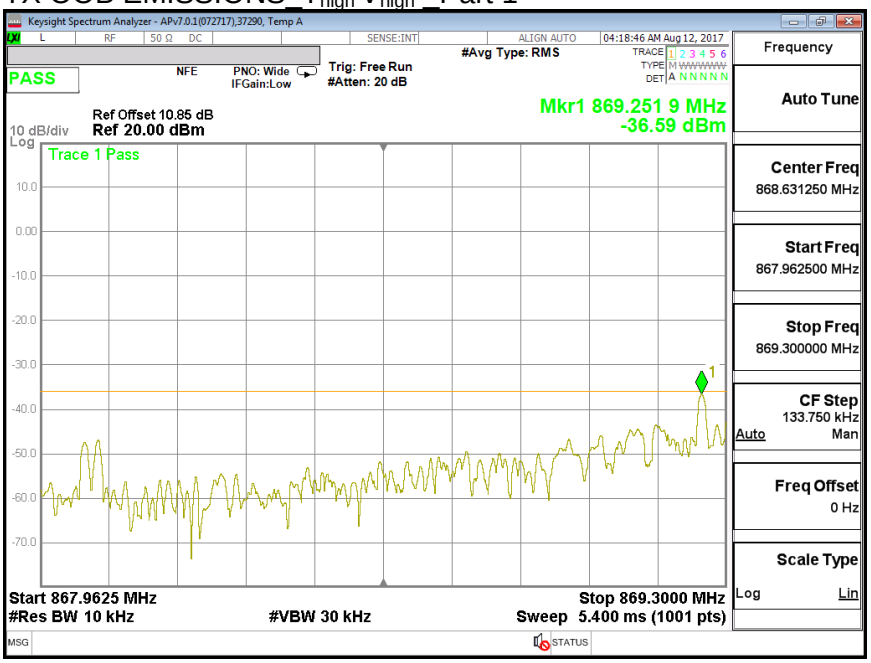
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



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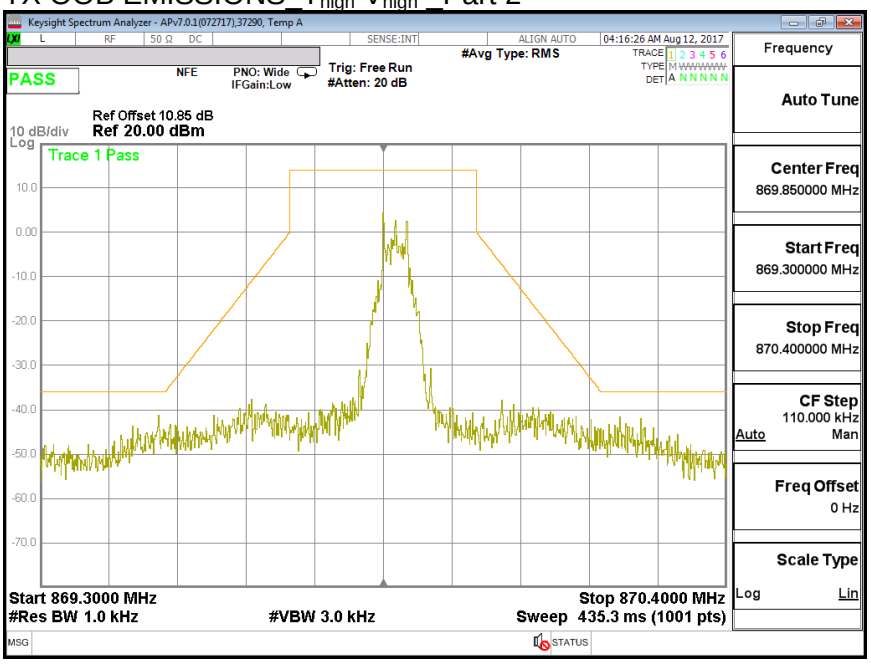

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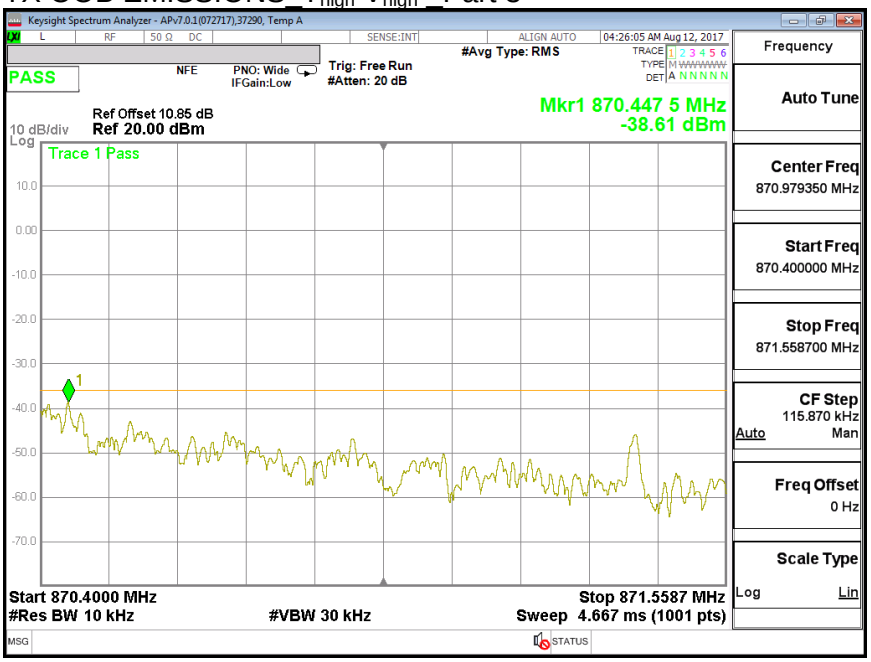
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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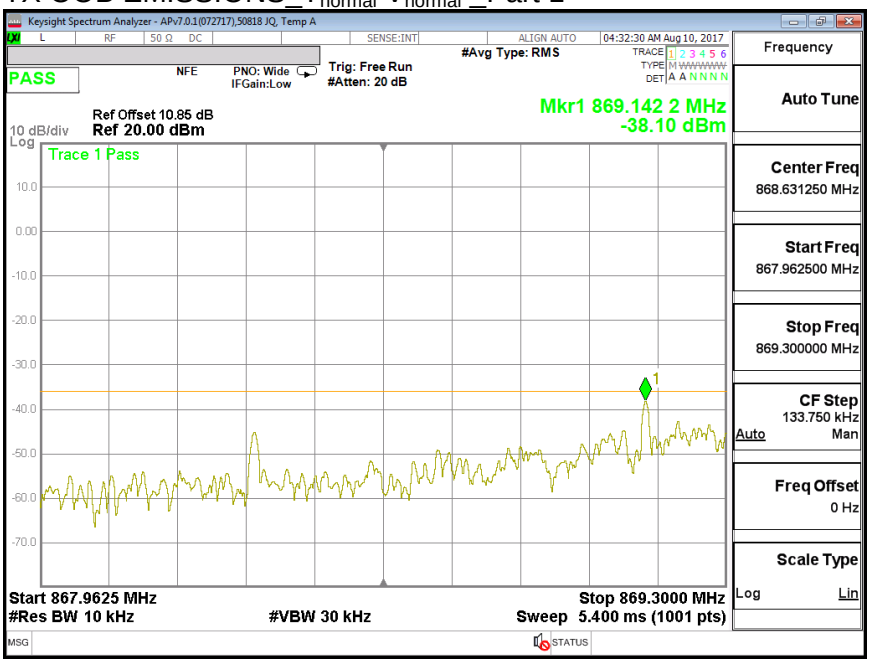
M7 HIGH CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 1



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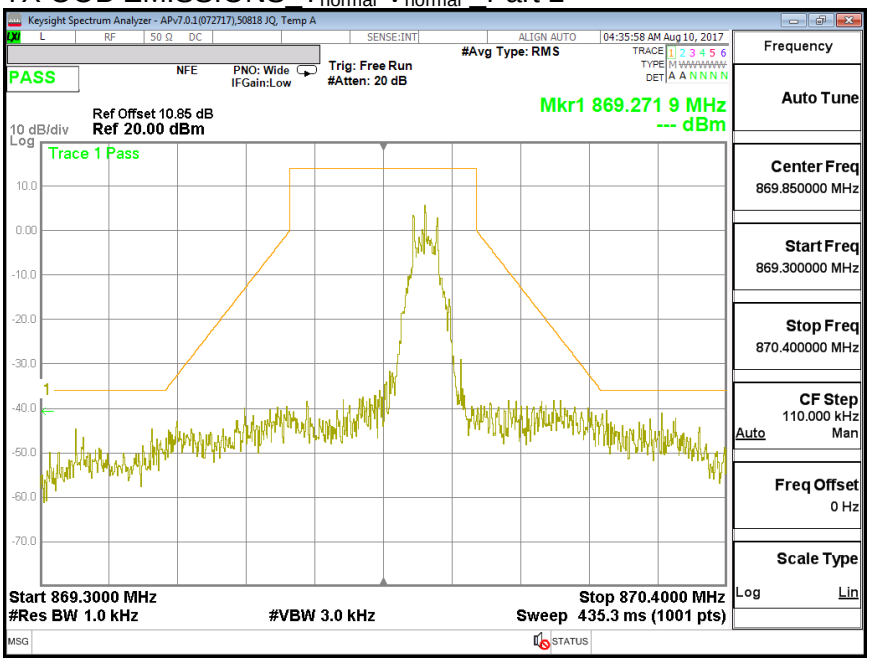

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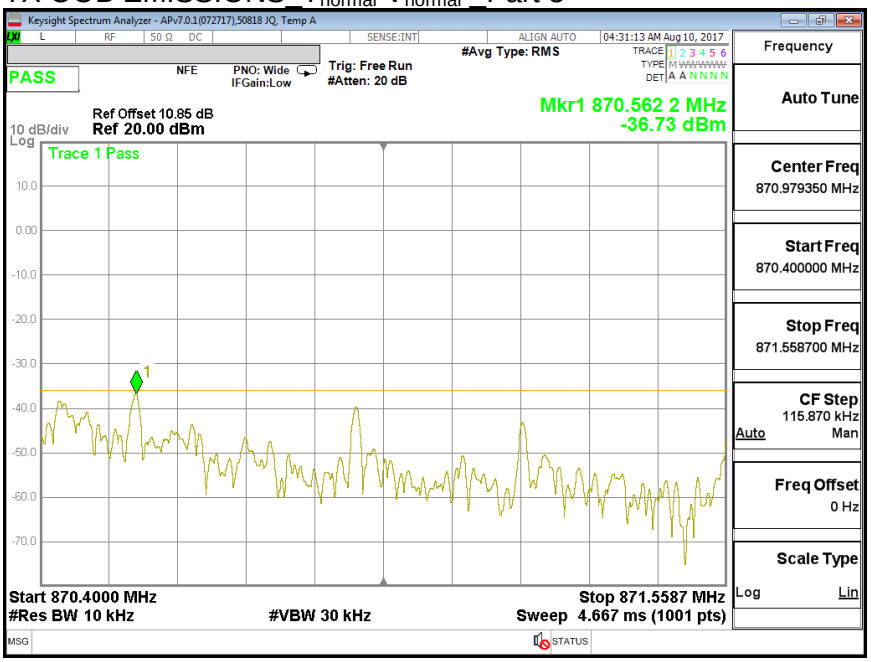
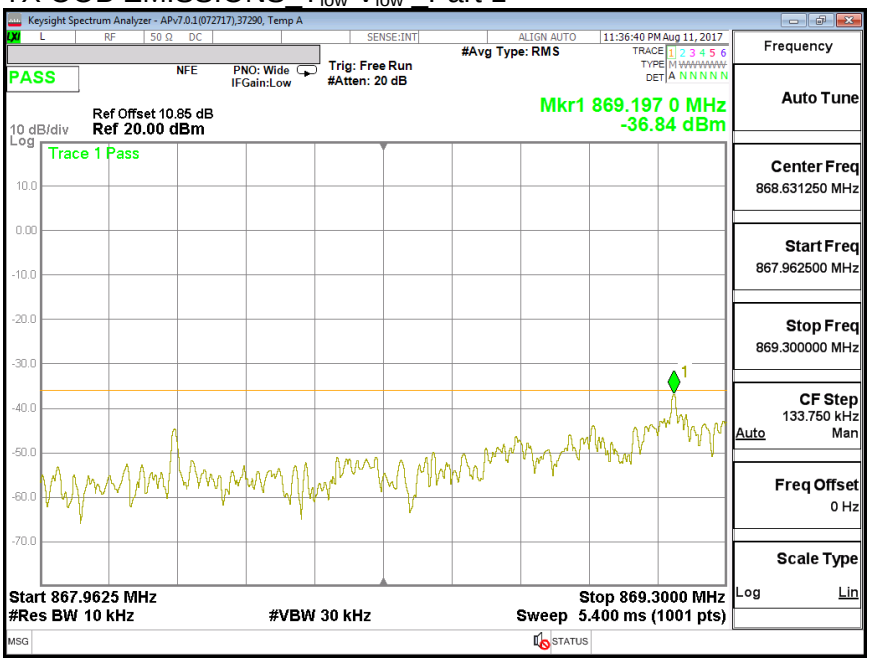
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3



TX OOB EMISSIONS_T_{low} V_{low} _Part 1



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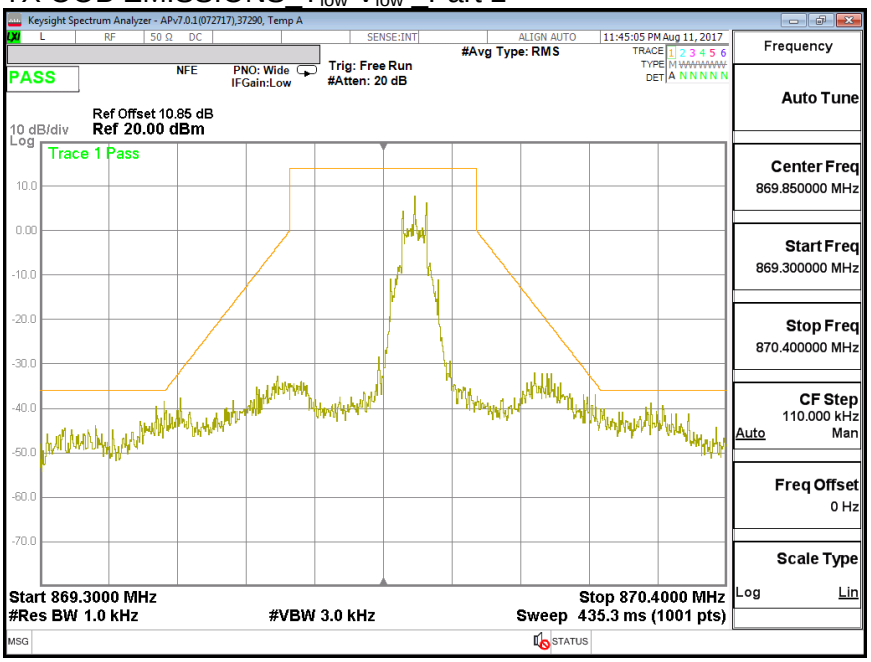

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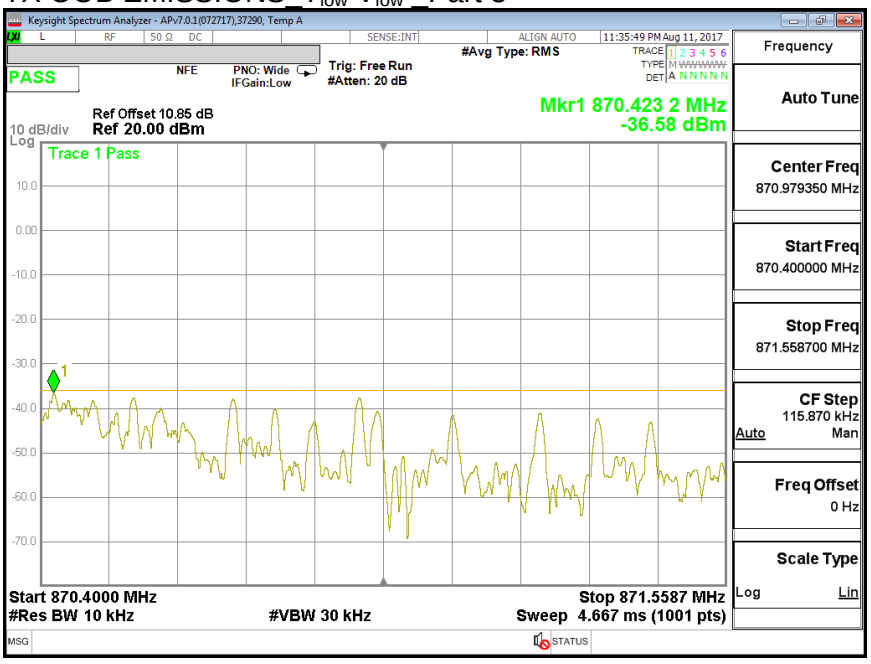

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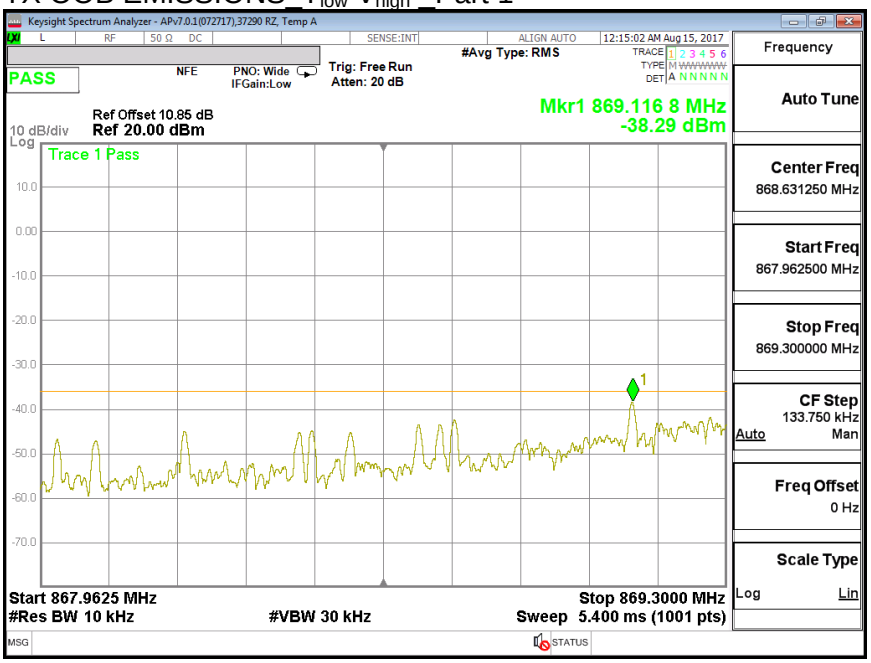
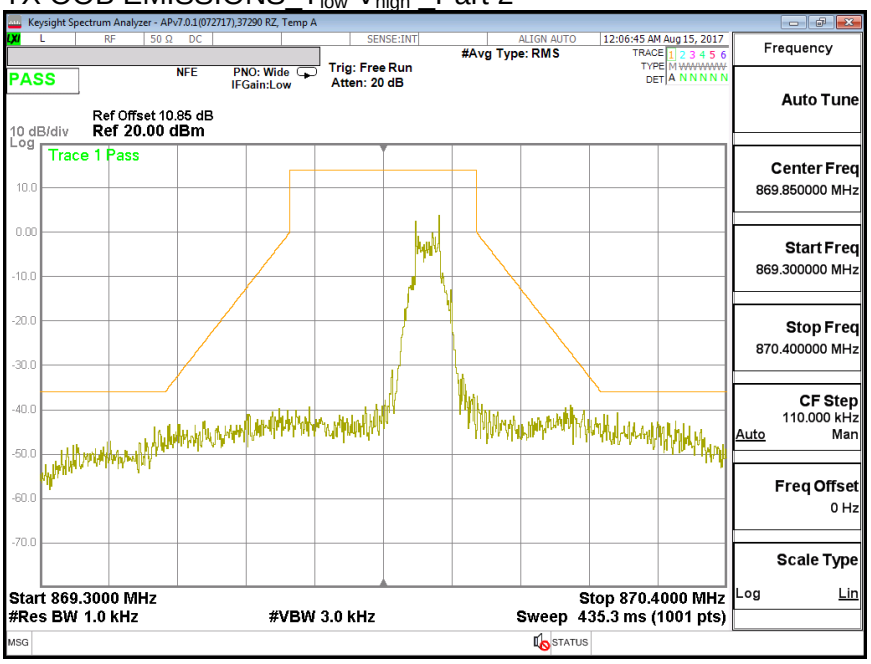
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



TX OOB EMISSIONS_T_{low} V_{high} _Part 2



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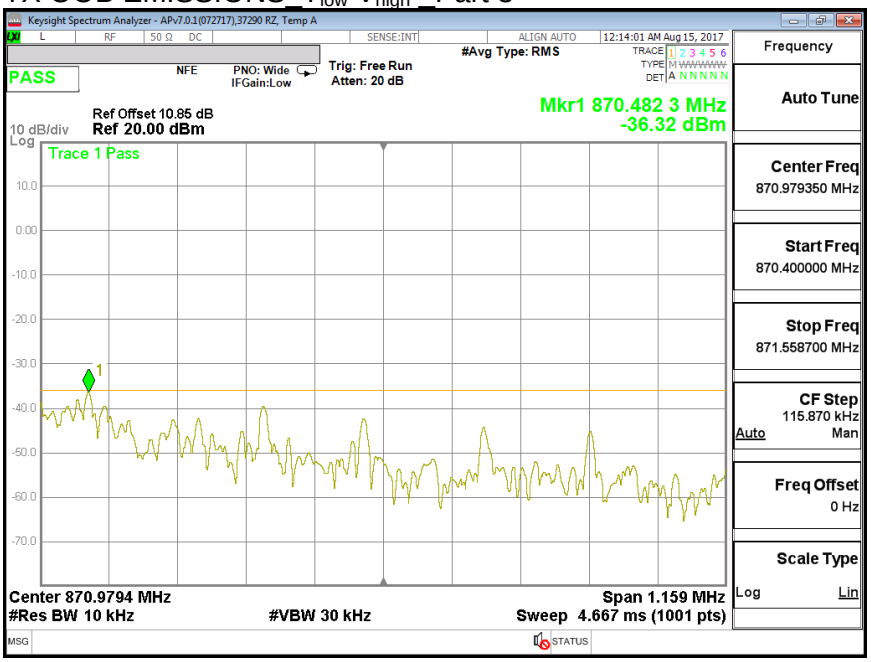
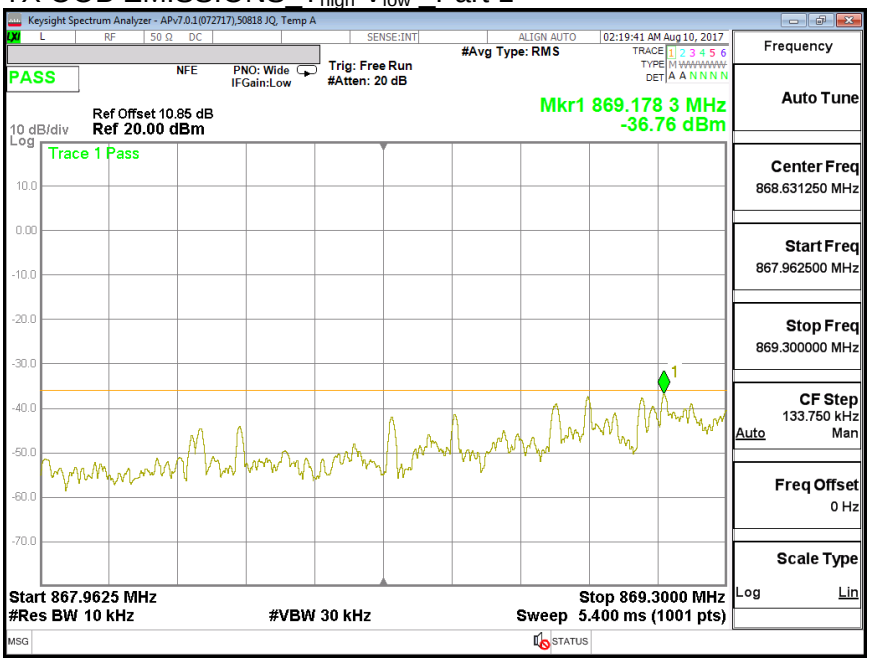
TX OOB EMISSIONS_T_{low} V_{high} _Part 3



TX OOB EMISSIONS_T_{high} V_{low} _Part 1



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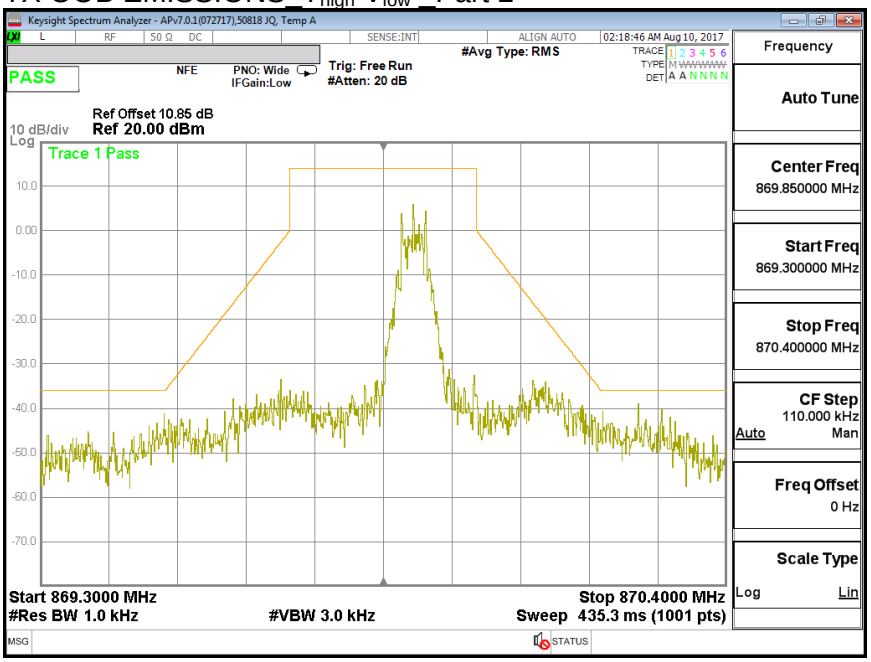
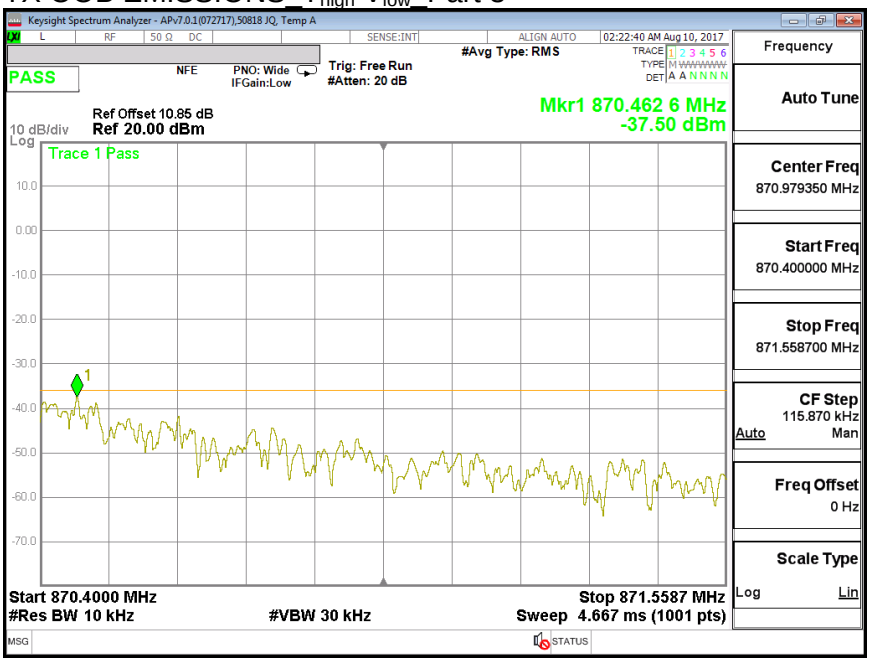
TX OOB EMISSIONS_T_{high} V_{low} _Part 2



TX OOB EMISSIONS_T_{high} V_{low}_Part 3



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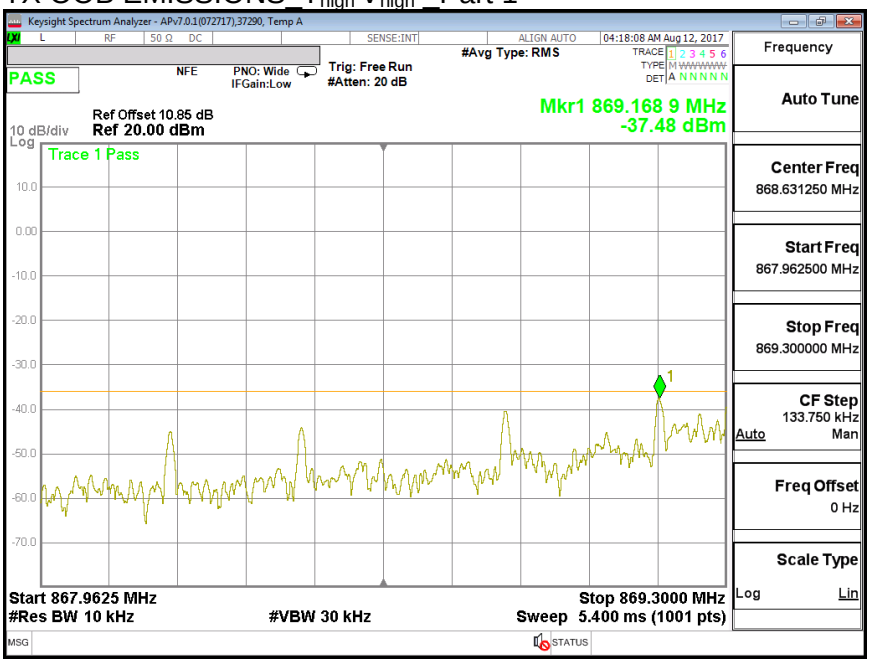
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



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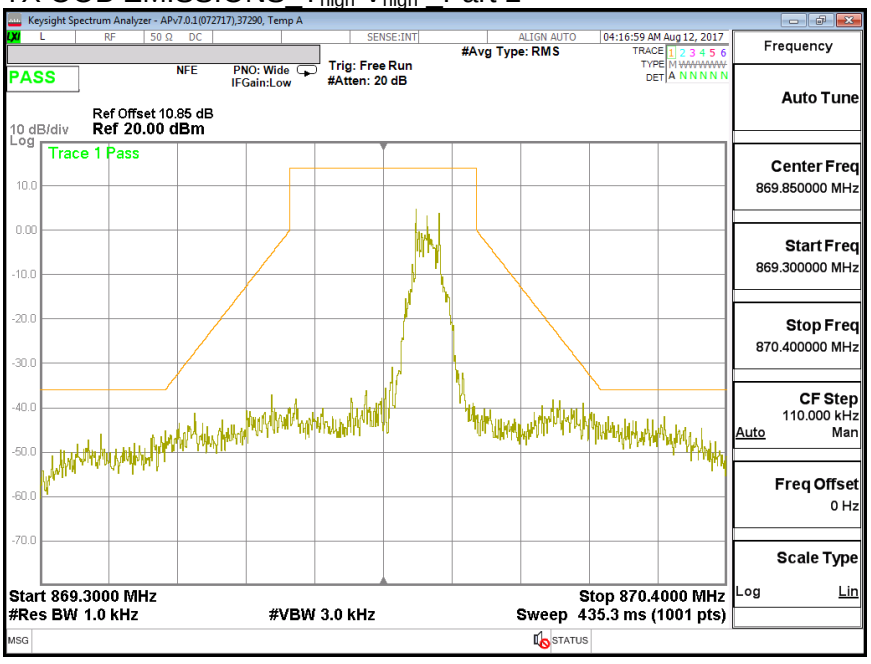

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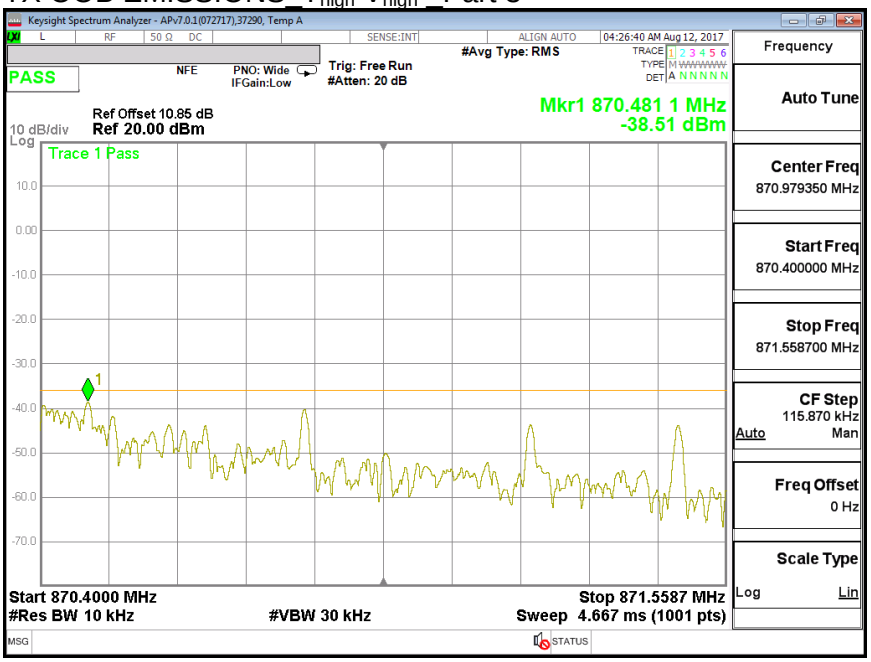
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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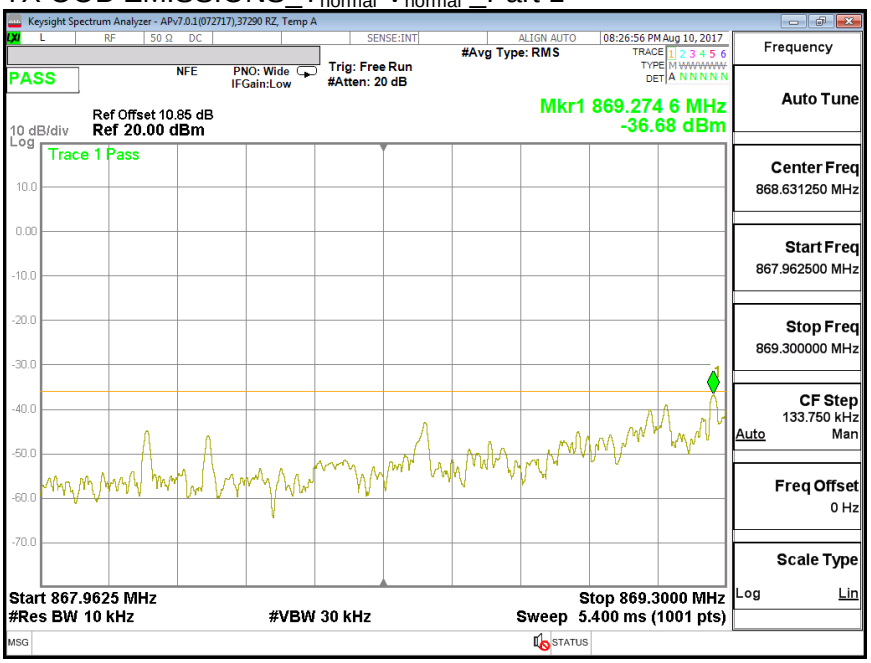
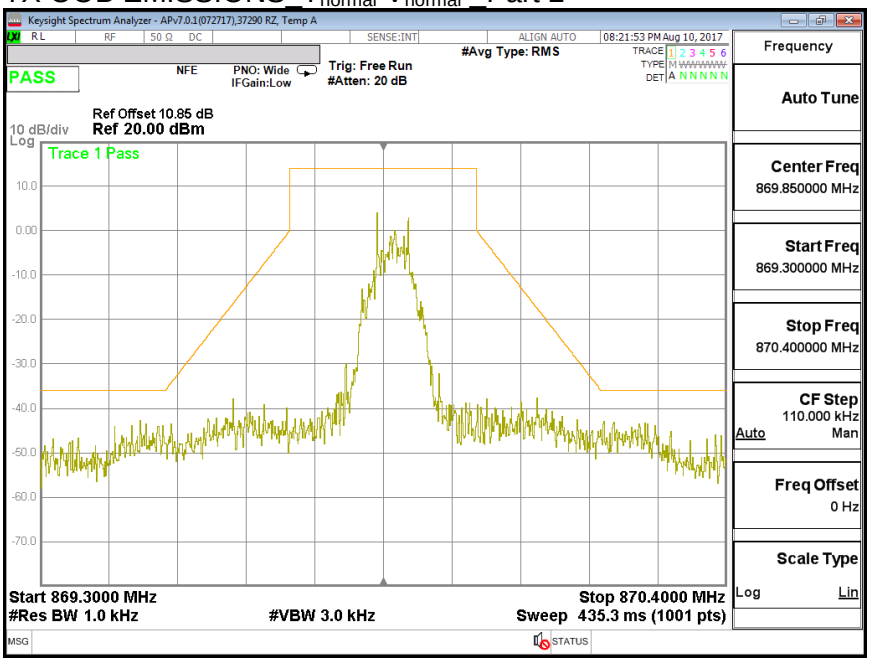
ML1 OPERATING CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 1



TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 2



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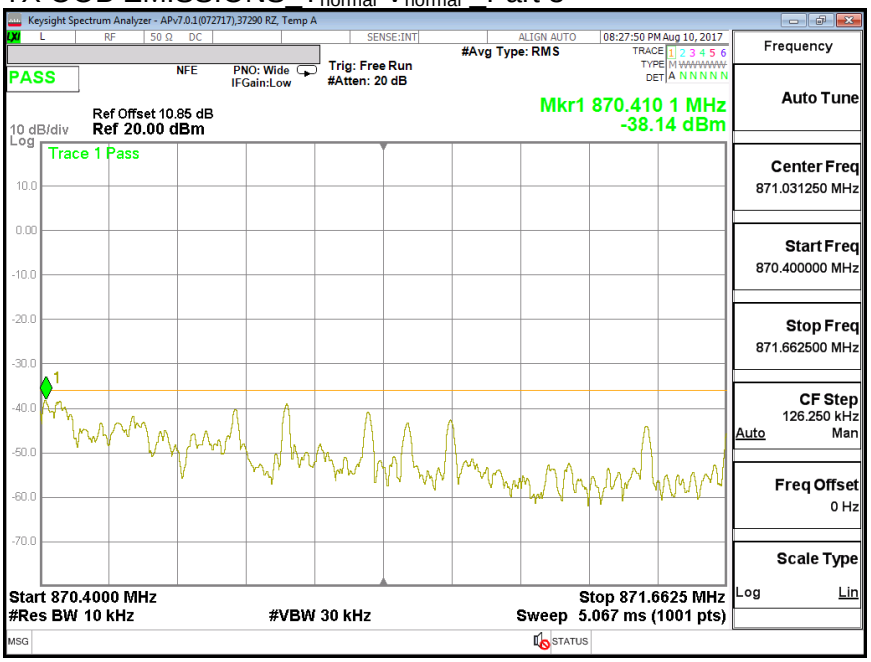
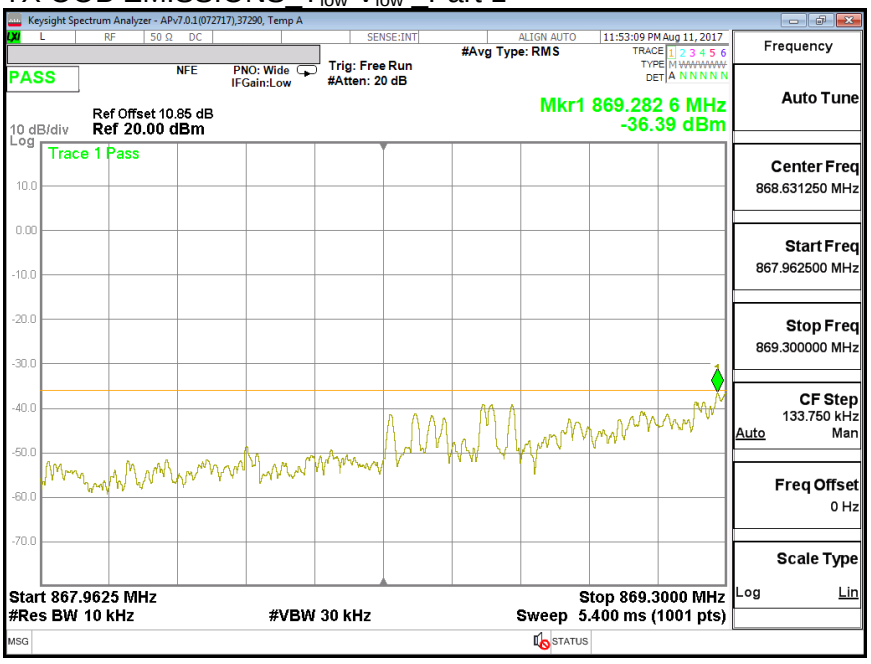
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3



TX OOB EMISSIONS_T_{low} V_{low} _Part 1



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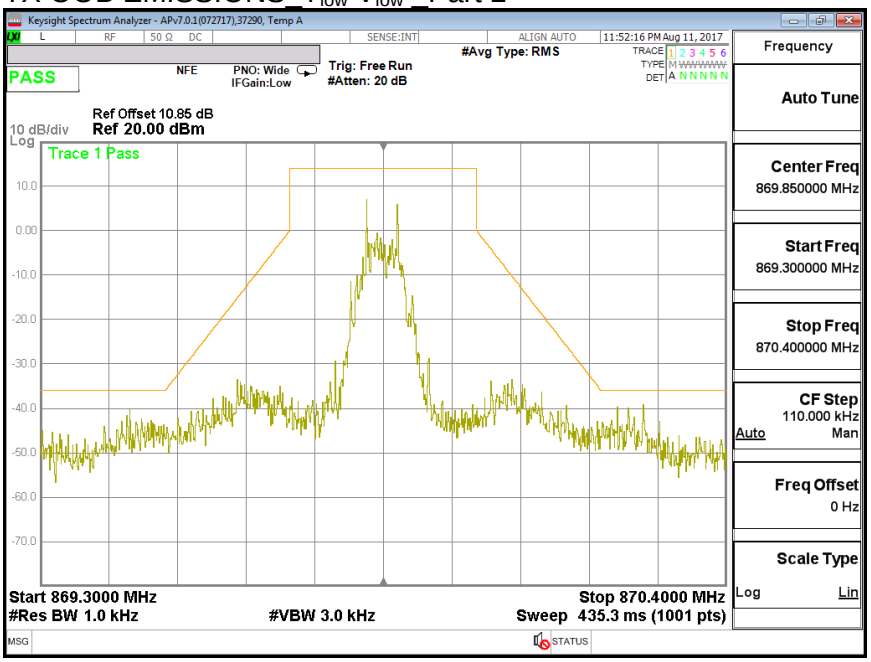
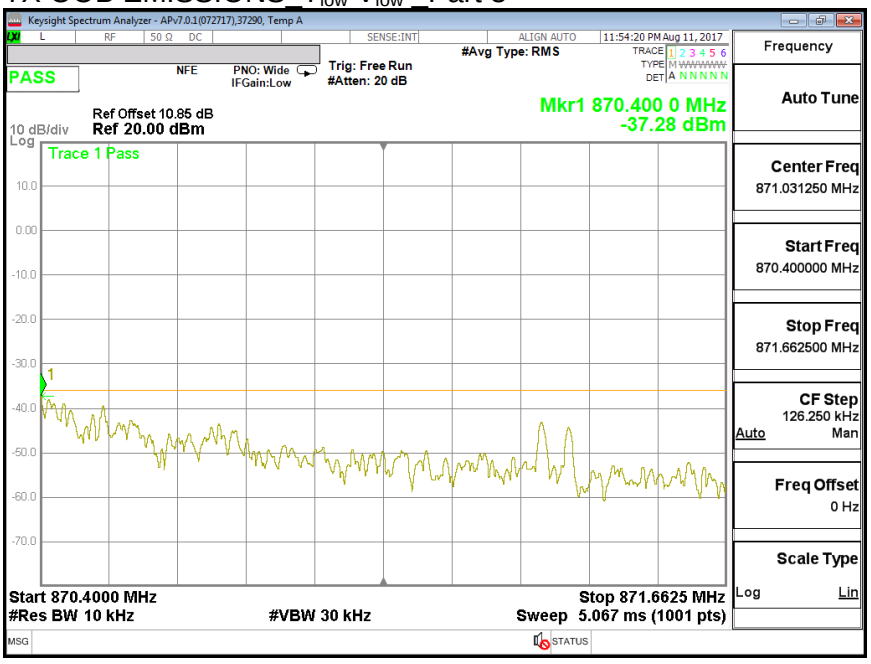
TX OOB EMISSIONS_T_{low} V_{low} _Part 2



TX OOB EMISSIONS_T_{low} V_{low} _Part 3



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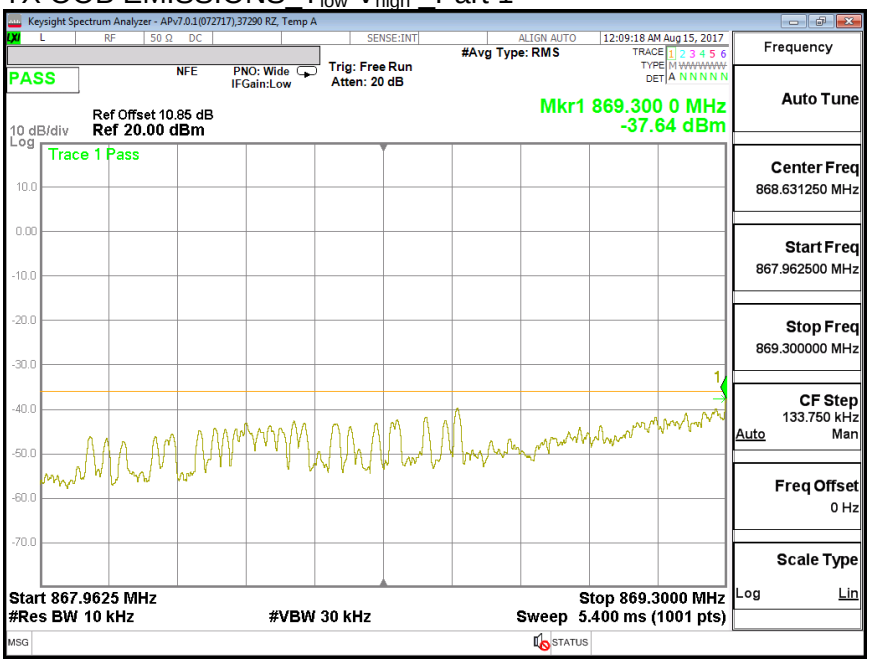
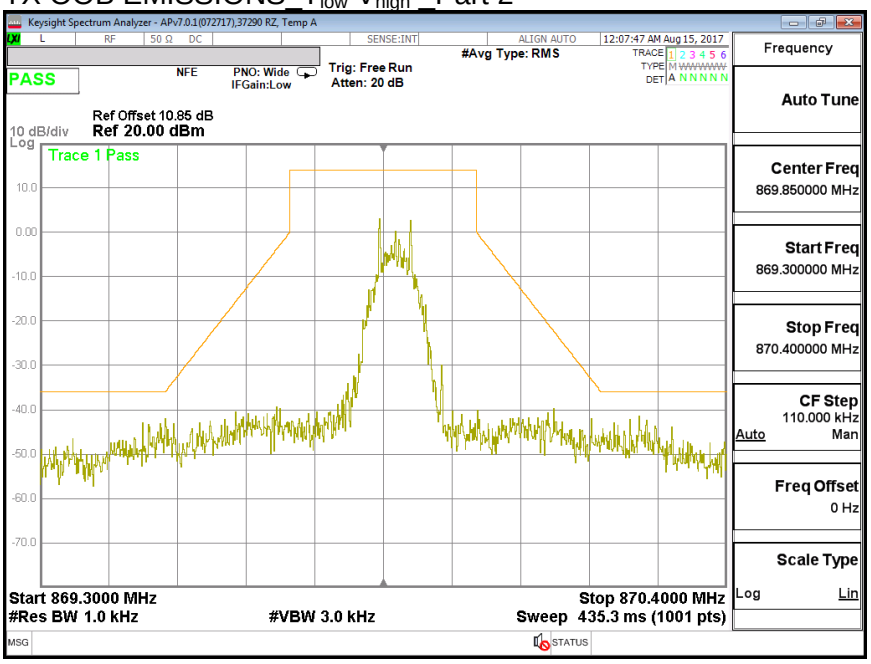
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



TX OOB EMISSIONS_T_{low} V_{high} _Part 2



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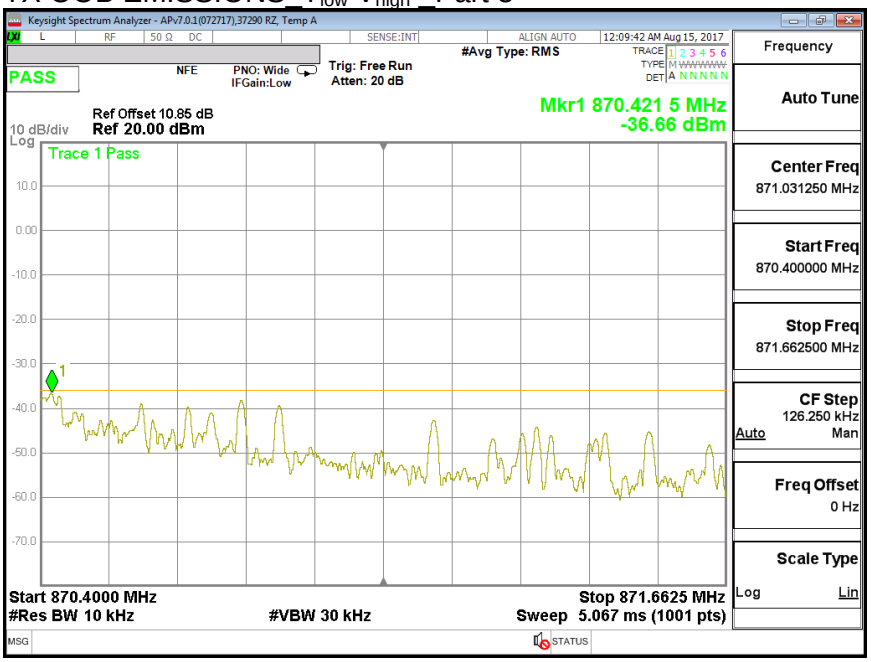
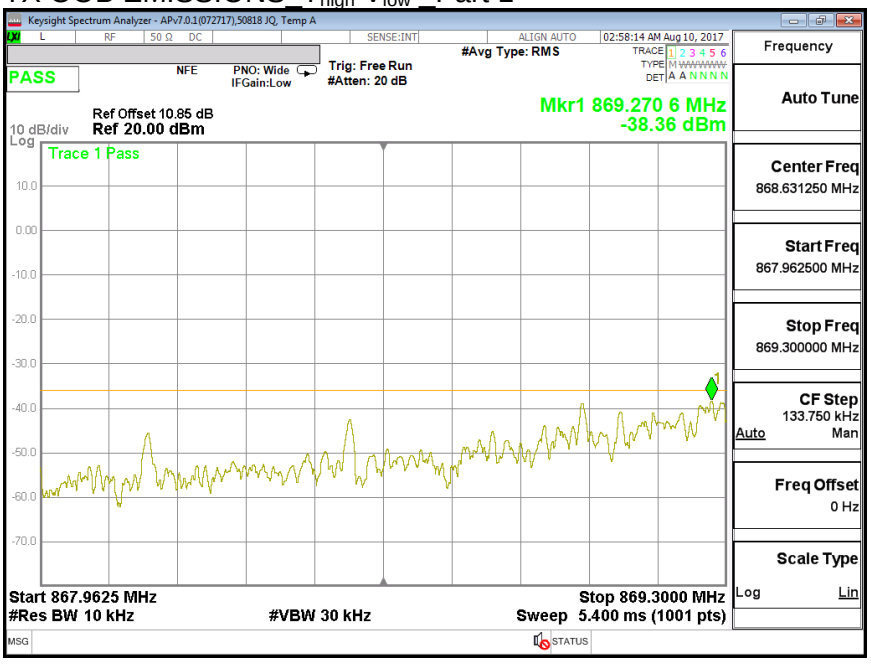
TX OOB EMISSIONS_T_{low} V_{high} _Part 3



TX OOB EMISSIONS_T_{high} V_{low} _Part 1



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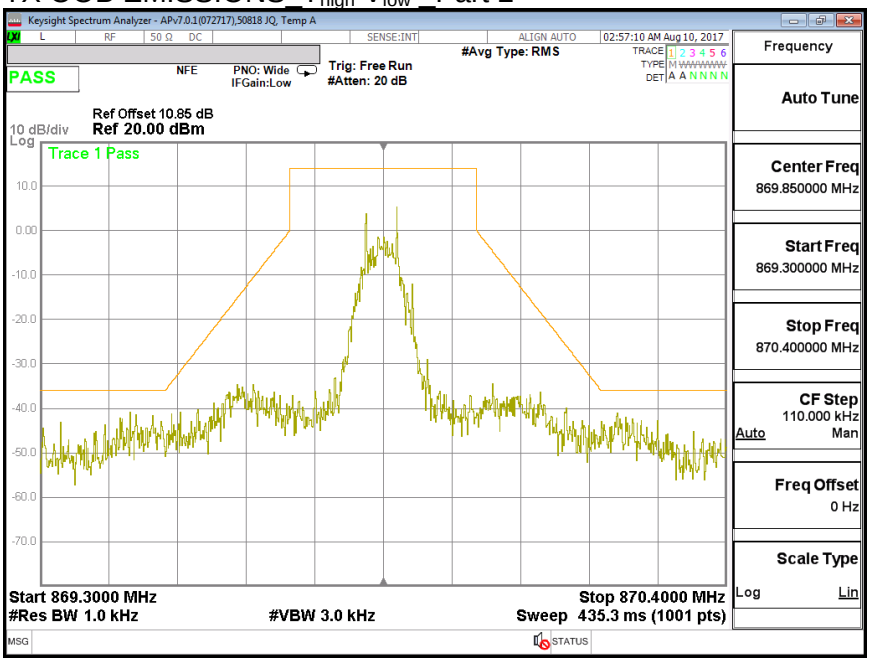
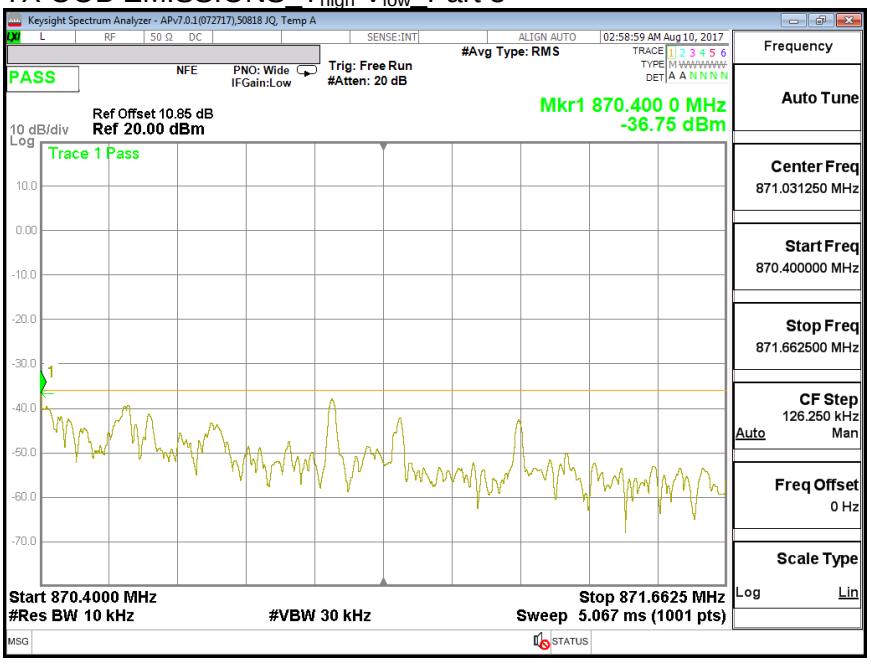
TX OOB EMISSIONS_T_{high} V_{low} _Part 2



TX OOB EMISSIONS_T_{high} V_{low}_Part 3



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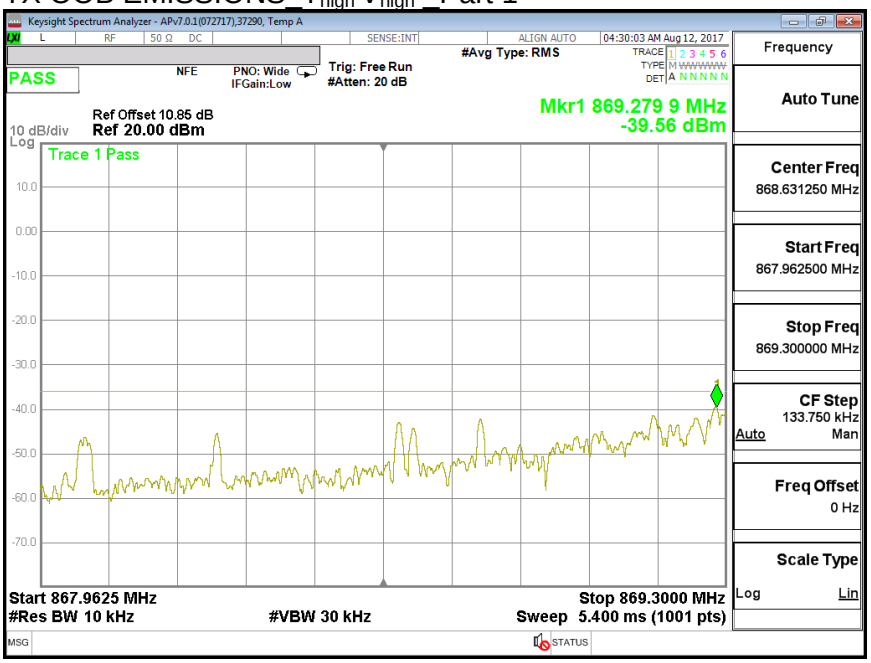
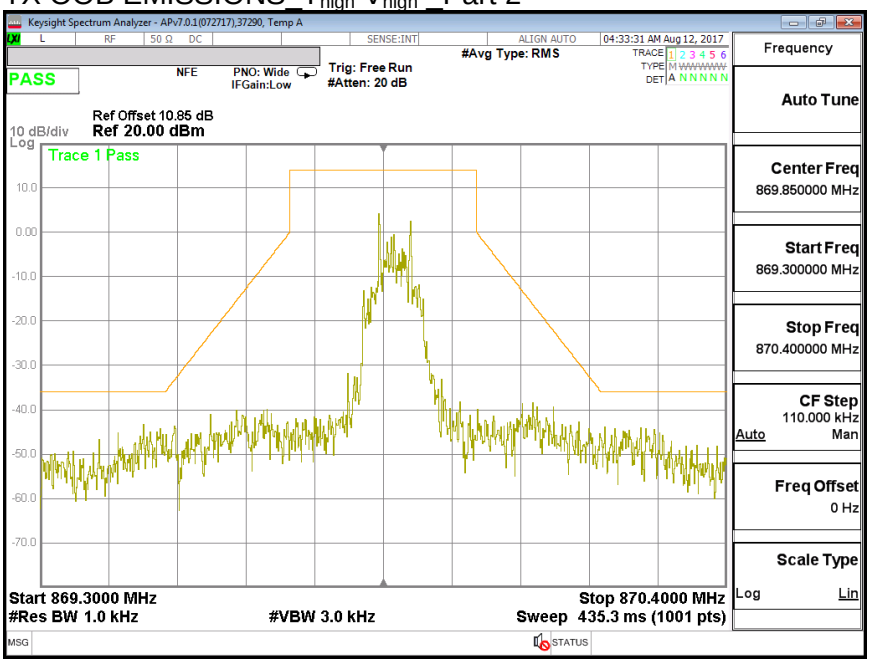
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



TX OOB EMISSIONS_T_{high} V_{high} _Part 2



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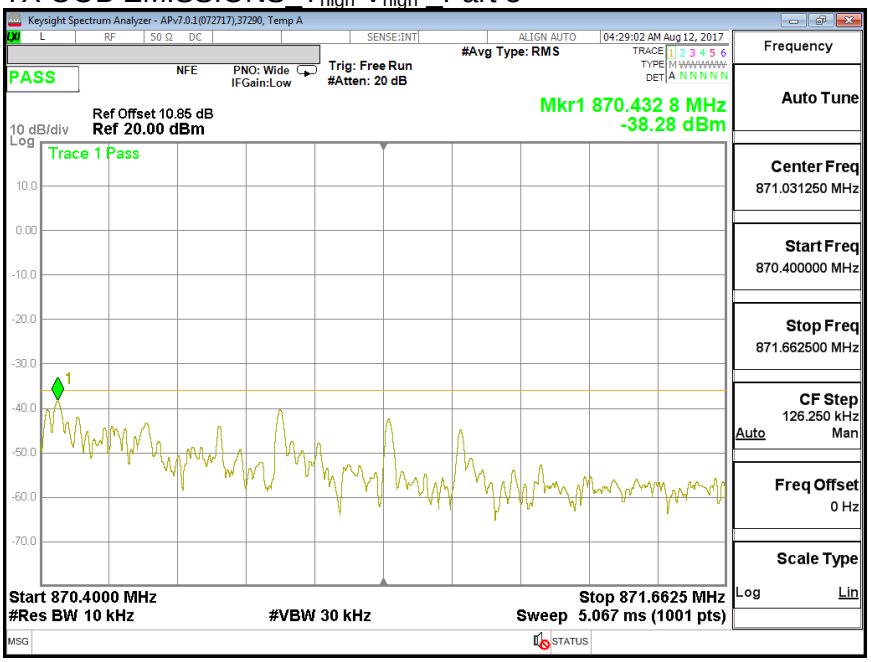
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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7.6.5. TX UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.2.2.2
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.1.1
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.2

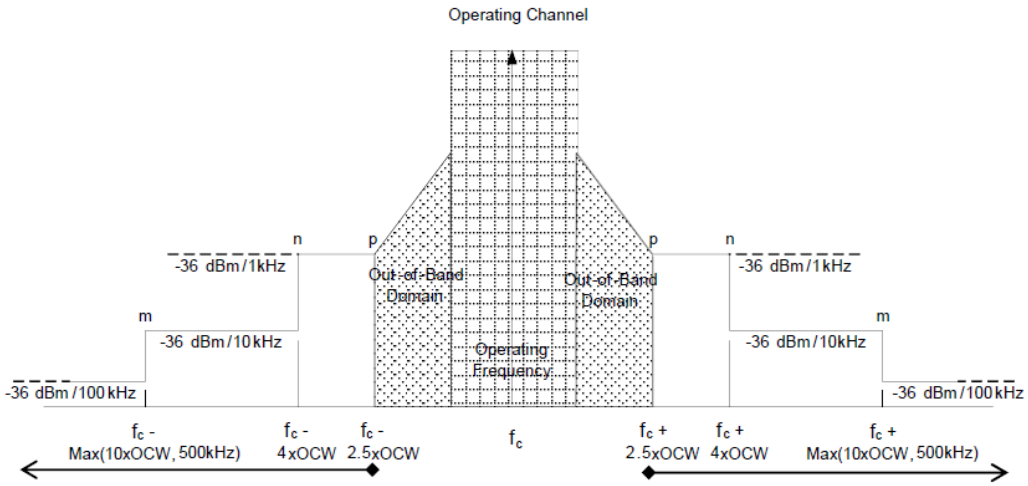

Figure 7: Spectrum Mask for Unwanted Emissions in the Spurious Domain with reference BW

Reference Limit:

The power of any unwanted emission in the spurious domain shall not exceed the values given in Table 19.

Table 19: Spurious domain emission limits

Frequency / State	47 MHz to 74 MHz 87,5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 790 MHz	Other frequencies below 1 000 MHz	Frequencies above 1 000 MHz
TX mode	-54 dBm	-36 dBm	-30 dBm
RX and all other modes	-57 dBm	-57 dBm	-47 dBm

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.3.3.1 (Conducted Measurement)
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.3.3.2 (Radiated Measurement)

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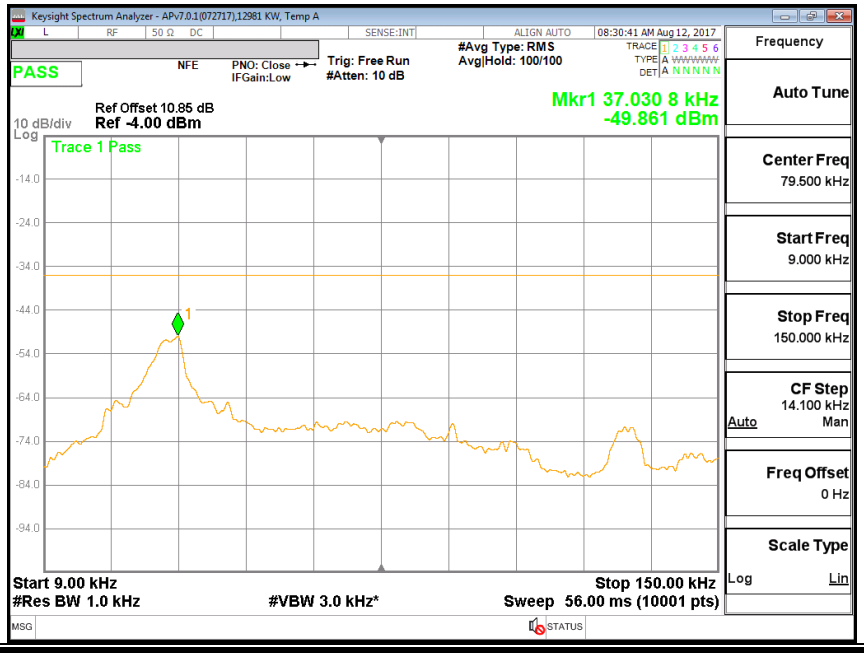
RESULTS

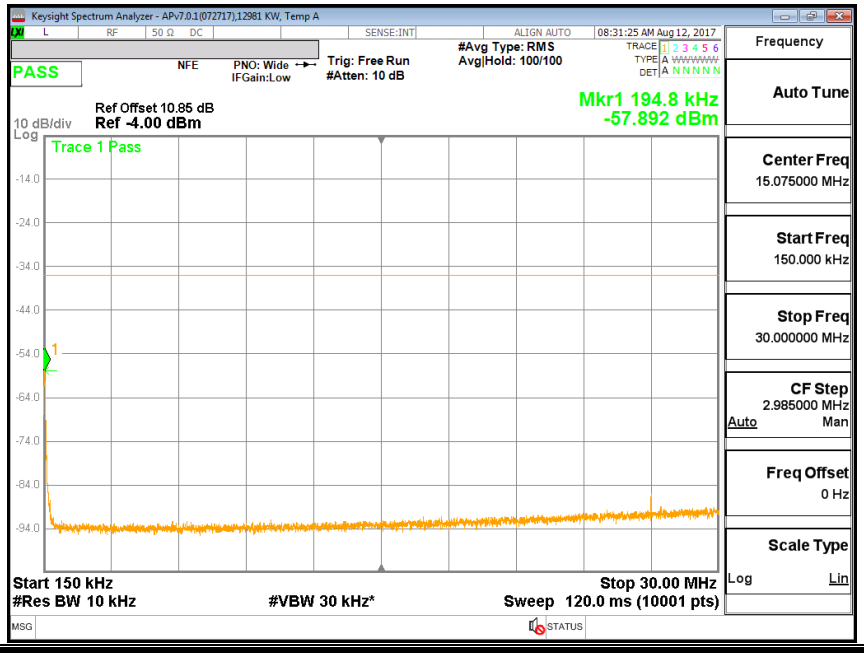
CONDUCTED SPURIOUS EMISSIONS

THE WORST CASE OF GFSK OPERATING CHANNEL

9kHz to 150kHz



150kHz to 30MHz



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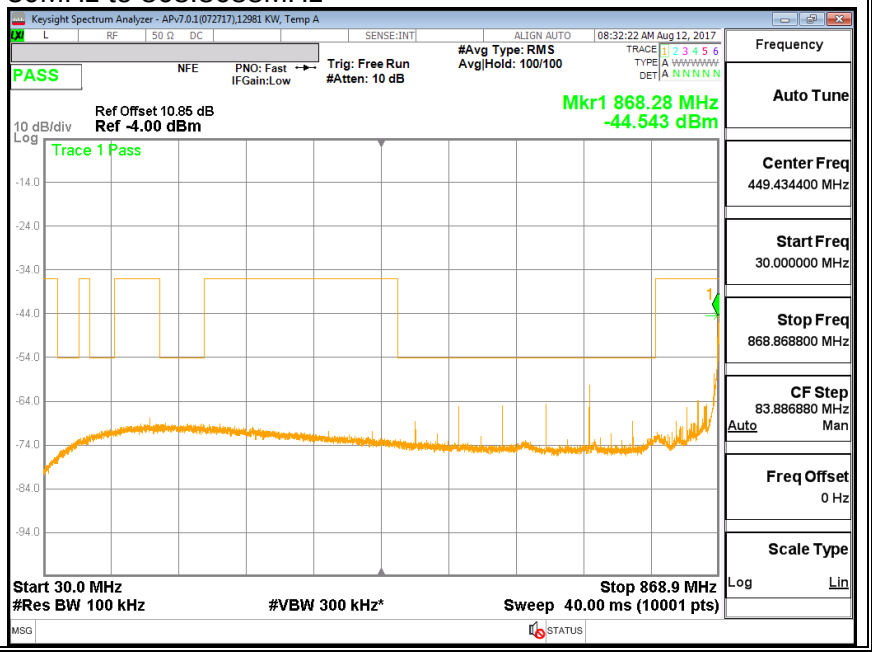
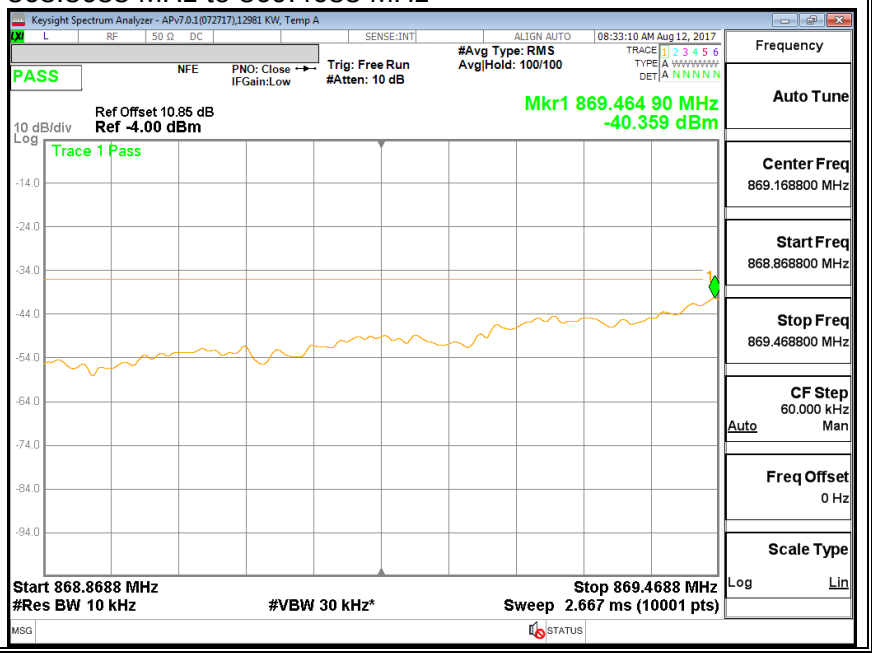
30MHz to 868.8688MHz



868.8688 MHz to 869.4688 MHz



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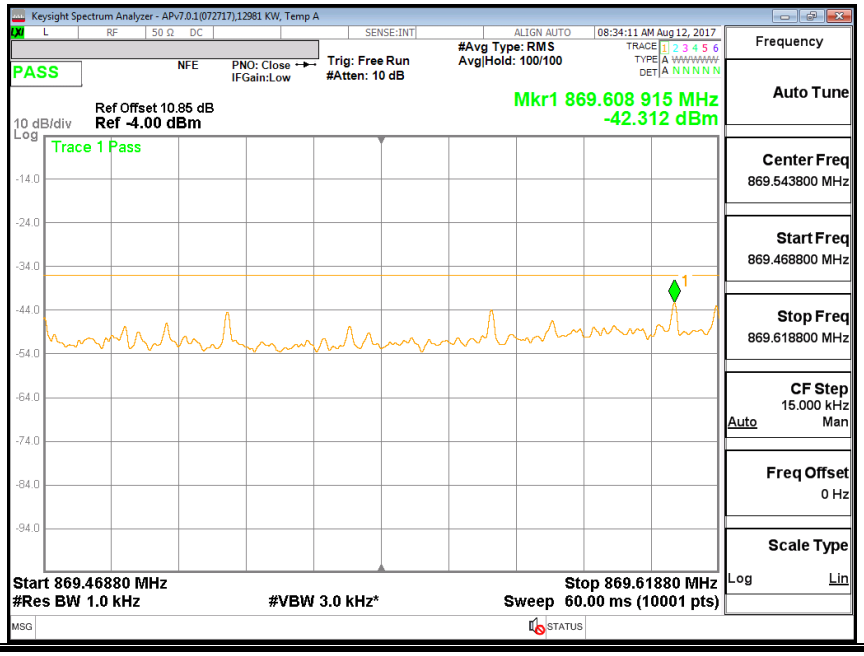
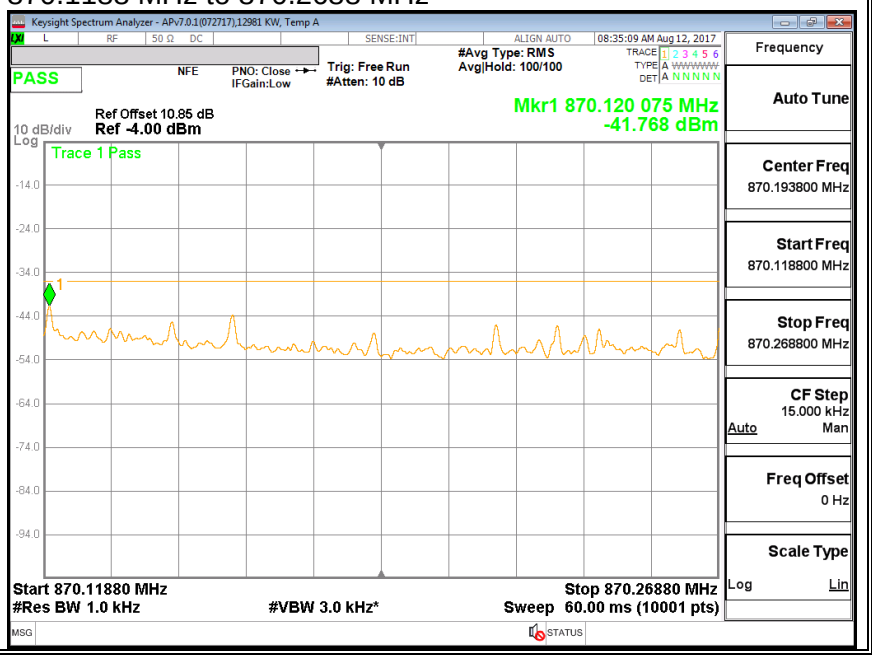
869.4688 MHz to 869.6188 MHz



870.1188 MHz to 870.2688 MHz



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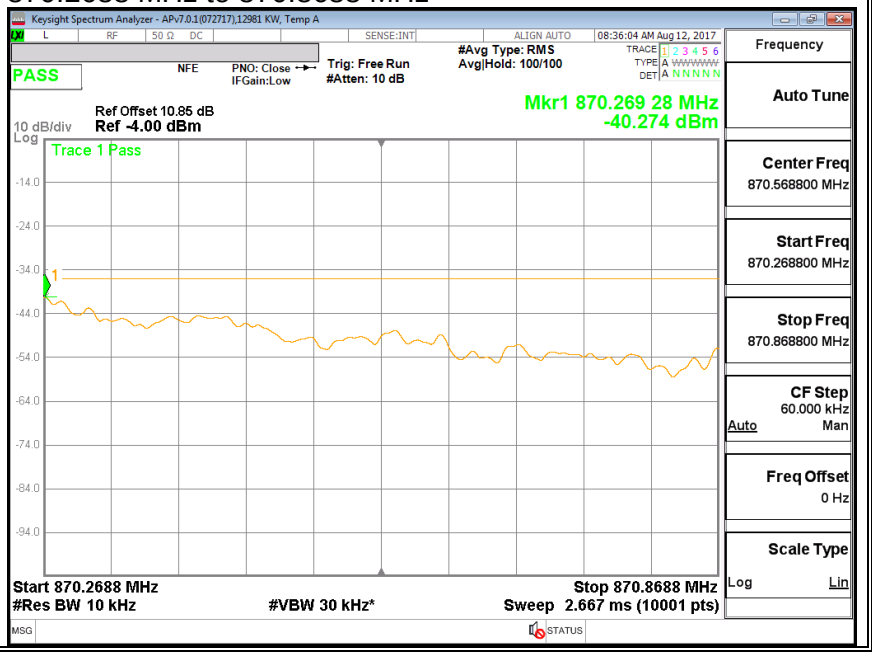
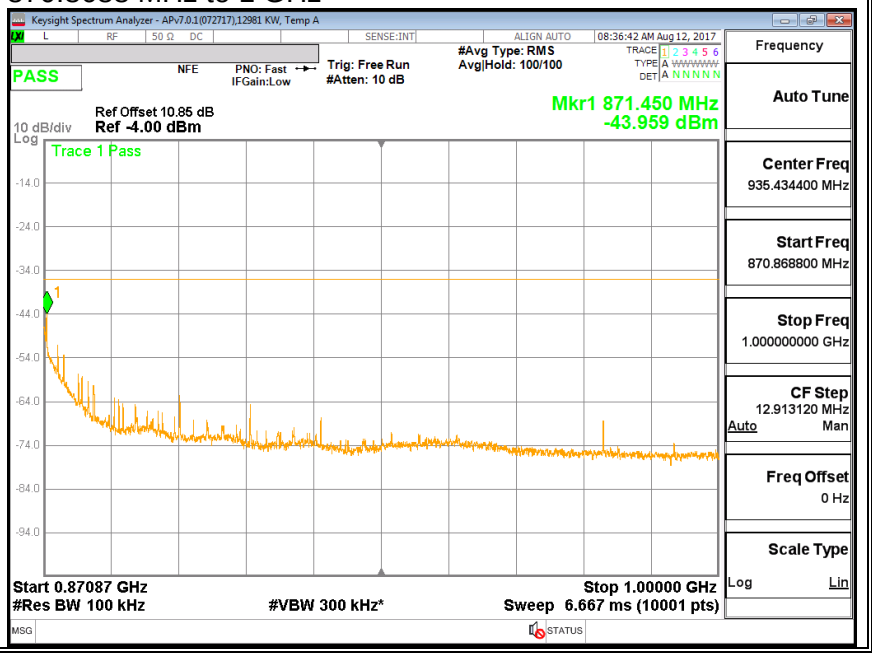
870.2688 MHz to 870.8688 MHz



870.8688 MHz to 1 GHz



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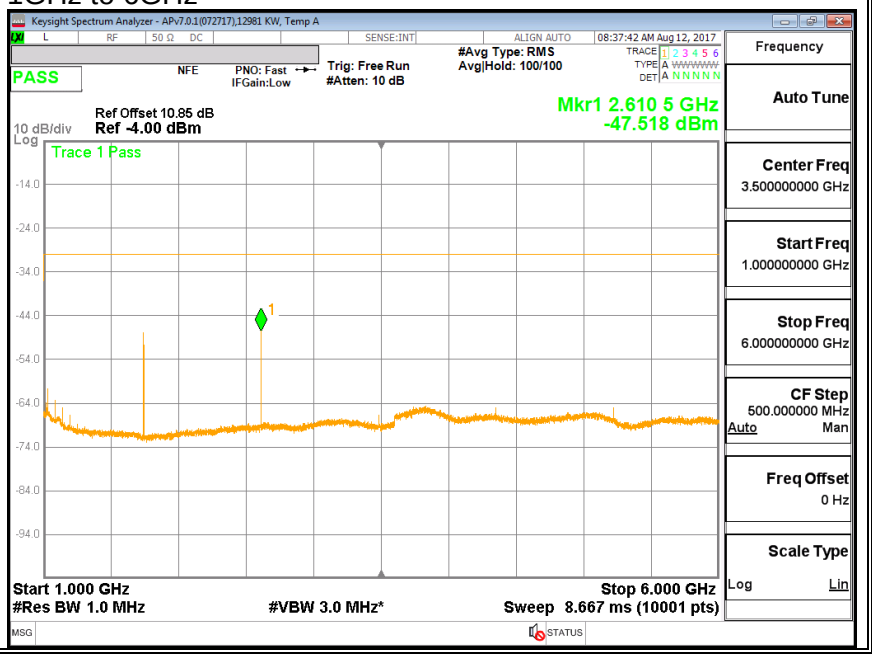
1GHz to 6GHz



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RADIATED SPURIOUS EMISSIONS

3m Radiated Emissions Chamber
30 - 1000MHz Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/13/2017
Test Engineer: 50818
Configuration: EUT with 50Ohm load and a support laptop
Mode: TX Below 1GHz GFSK R band worst case

Chamber	Pre-amplifer	Attenuator	Limit
3m Chamber B	3m-B T10		ETSI 300 220 Tx

Frequency (MHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Attenuator (dB)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Operating Channel 36										
432.13	-70.2	H	3.0	24.9	28.8		-74.0	-36.0	-38.0	
699.30	-71.3	H	3.0	29.0	28.6		-71.0	-54.0	-17.0	
800.52	-71.9	H	3.0	30.2	28.4		-70.1	-54.0	-16.1	
432.16	-70.6	V	3.0	26.6	28.8		-72.8	-36.0	-36.8	
768.93	-72.4	V	3.0	32.0	28.5		-68.9	-54.0	-14.9	
799.42	-72.0	V	3.0	32.5	28.4		-67.9	-54.0	-13.9	

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3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/13/2017
Test Engineer: 50818
Configuration: EUT with 50Ohm load and a support laptop
Mode: TX Above 1GHz R band GFSK worst case

Chamber	Pre-amplifer	Filter	Limit
3m Chamber B	3m Chamber B	Filter	ETSI 300 220 Tx

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss @ SG End (dBm)	Preamp (dB)	Attenuator (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Operating Channel 36										
1.757	-57.99	H	3.0	-11.9	38.4	1.0	-49.3	-30.0	-19.3	
2.399	-58.91	H	3.0	-9.4	38.7	1.0	-47.1	-30.0	-17.1	
5.213	-59.42	H	3.0	-4.7	38.7	1.0	-42.5	-30.0	-12.5	
1.211	-57.14	V	3.0	-14.8	38.5	1.0	-52.4	-30.0	-22.4	
1.741	-58.32	V	3.0	-12.2	38.4	1.0	-49.7	-30.0	-19.7	
2.101	-57.53	V	3.0	-8.8	38.2	1.0	-45.9	-30.0	-15.9	

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7.6.6. TX TRANSIENT POWER

REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.10.2

The TX TRANSIENT POWER shall not exceed the values given in Table 23.

Table 23: Transmitter Transient Power limits

Absolute offset from centre frequency	RBW_{REF}	Peak power limit applicable at measurement points
≤ 400 kHz	1 kHz	0 dBm
> 400 kHz	1 kHz	-27 dBm

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.10.3.2

RESULTS

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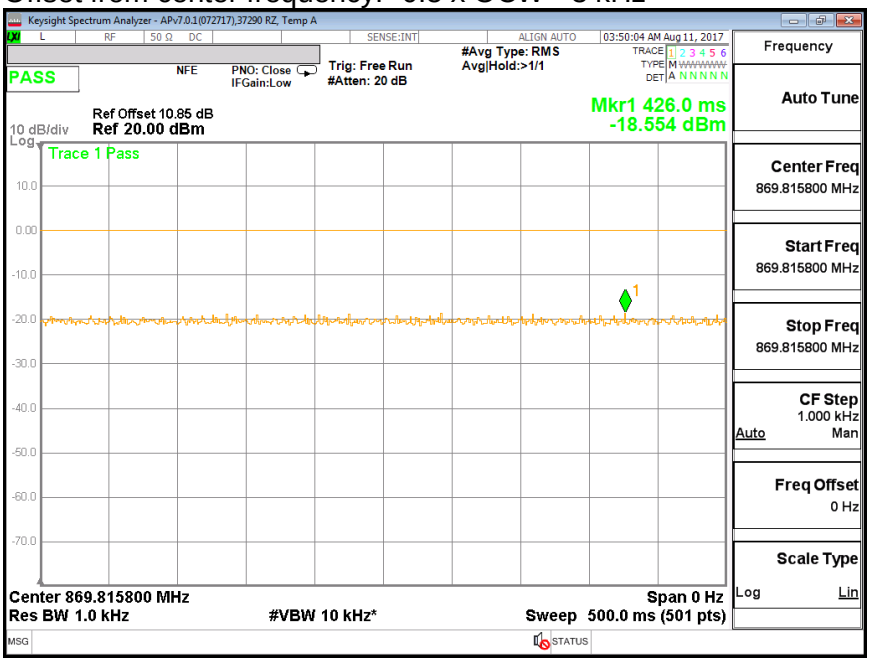
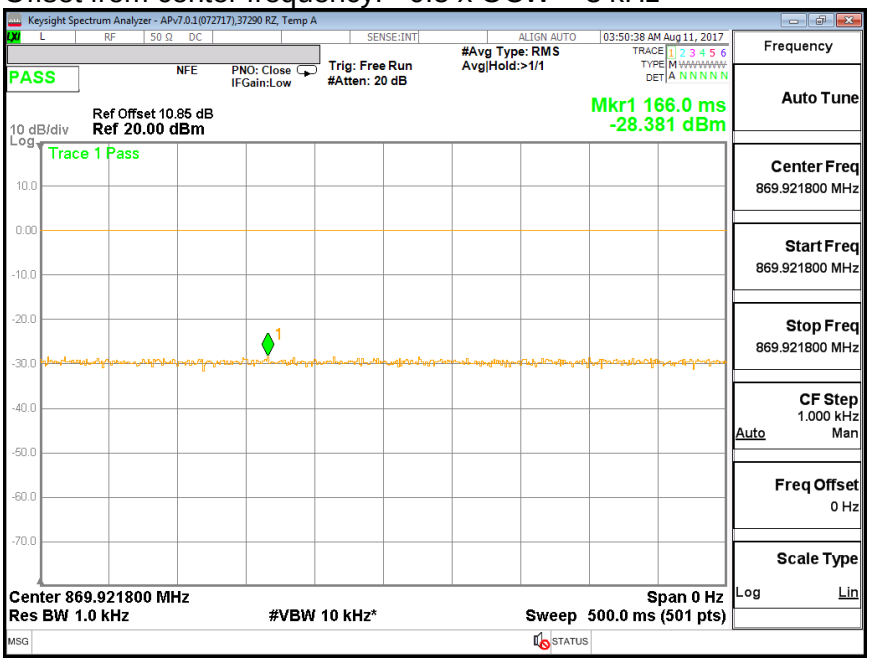
THE WORST CASE OF GFSK OPERATING CHANNEL

TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 3 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 3 kHz



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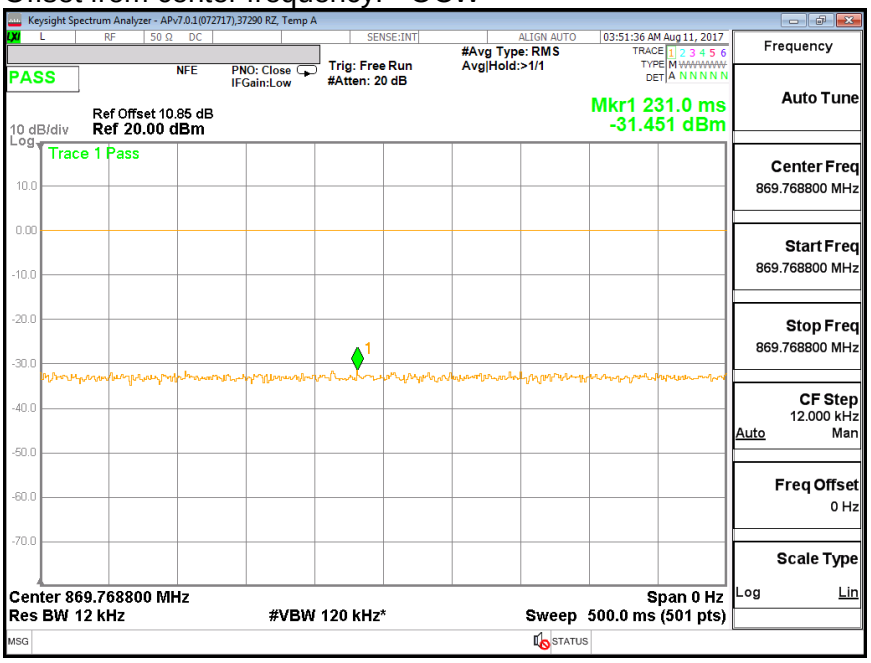
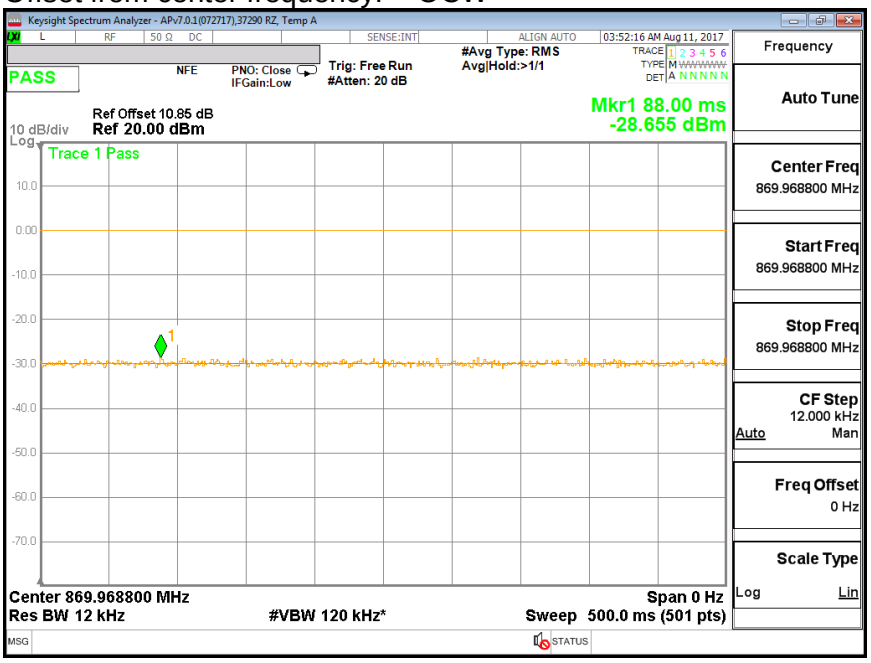
TX TRANSIENT
Offset from center frequency: - OCW



TX TRANSIENT
Offset from center frequency: + OCW



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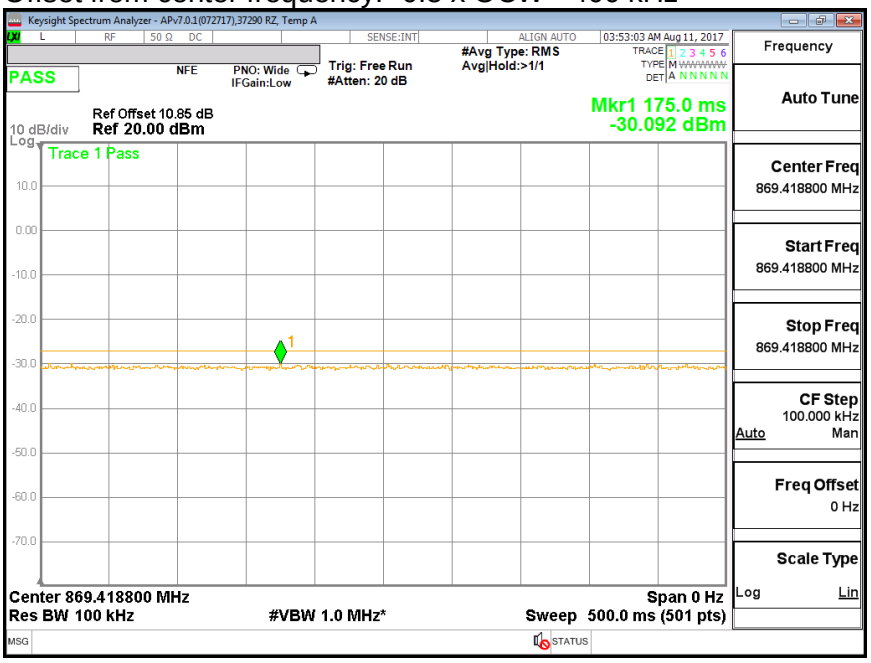
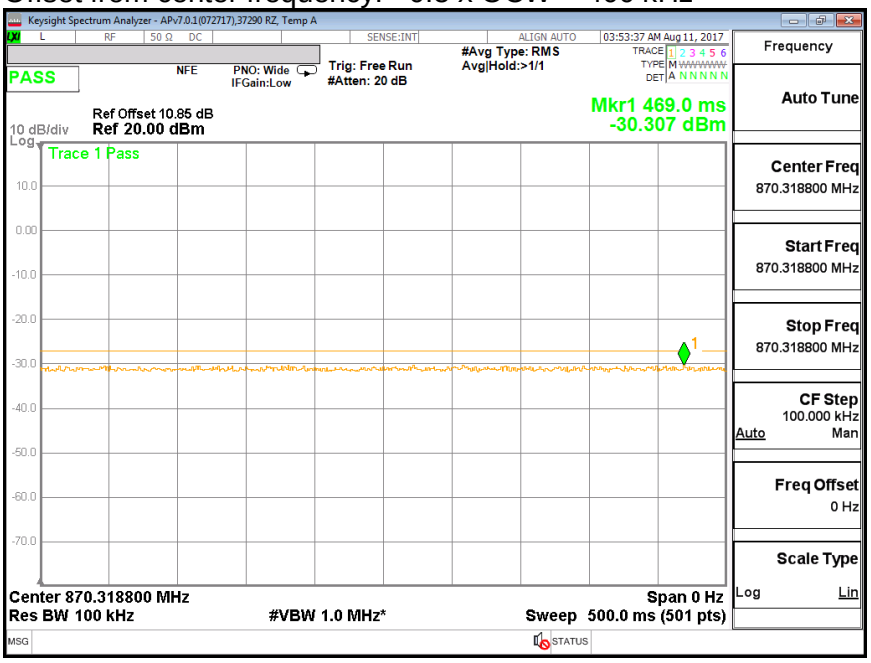
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 400 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 400 kHz



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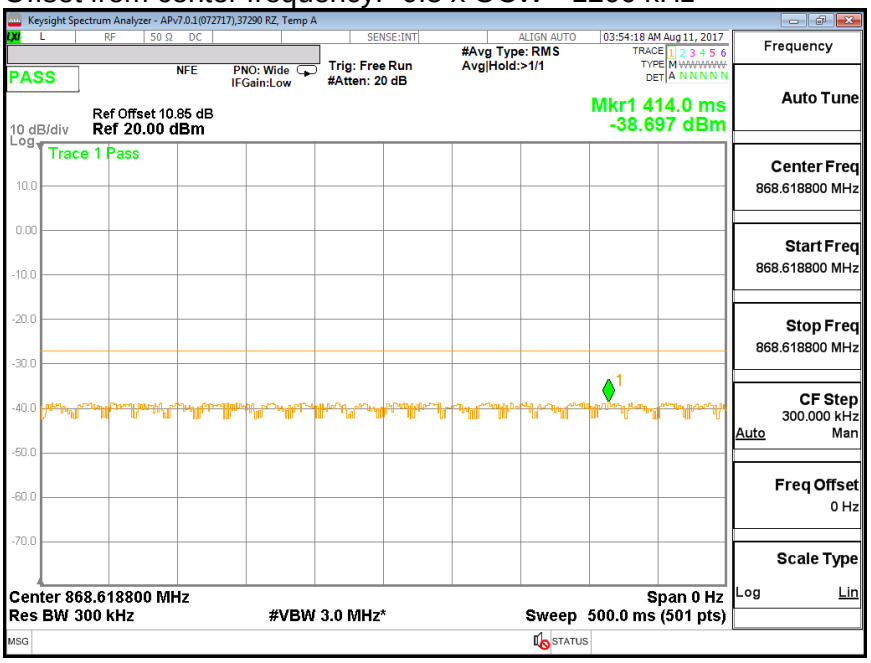
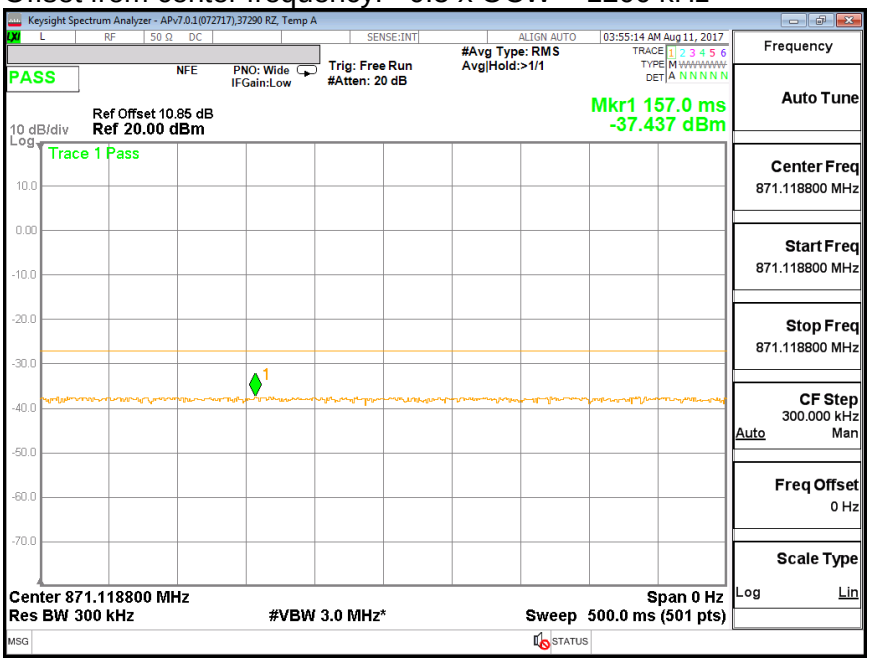
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 1200 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 1200 kHz



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7.7. GFSK MODULATION IN X BAND

7.7.1. OPERATING FREQUENCY

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.2.1.2

The manufacturer may declare either one or more operating frequencies and operating channels.
Operating channel(s) shall be entirely within operational frequency bands allowed by annexes B, C or any NRI.

Operational Frequency Band		Maximum Effective Radiated Power	Channel access and occupation rules	Additional/other spectrum access parameters	Maximum occupied bandwidth	Other usage restriction	Notes	CEPT/ERC/REC 70-03 [i.1] implementation status
X	863 MHz to 870 MHz	25 mW e.r.p.	≤ 0,1 % duty cycle or polite spectrum access	≤ 1 % Duty Cycle if the band is limited to 865 MHz to 868 MHz	100 kHz for 47 or more channels	FHSS	Sub-bands for alarms [868,6 MHz to 868,7 MHz], [869,250 - 869,4 MHz], [869,650 MHz to 869,700 MHz] are excluded.	90 %
		25 mW e.r.p. Power density: -4,5 dBm/100 kHz. The power density can be increased to +6,2 dBm/100 kHz if the band of operation is limited to 865 MHz to 868 MHz. The power density can be increased to -0,8 dBm/100 kHz, if the band of operation is limited 865 MHz to 870 MHz.	≤ 0,1 % duty cycle or polite spectrum access	Duty cycle may be increased to 1 % if the band is limited to 865 MHz to 868 MHz and power limited to 10 mW e.r.p.	The whole band except for audio & video limited to 300 kHz and voice limited to 25 kHz		DSSS and any techniques other than FHSS Sub-bands [868,6 MHz to 868,7 MHz], [869,250 MHz to 869,4 MHz], [869,650 MHz to 869,700 MHz] for alarms are excluded.	90 %
		25 mW e.r.p.	≤ 0,1 % duty cycle or polite spectrum access		300 kHz except for voice limited to 25 kHz		Sub-bands [868,6 MHz to 868,7 MHz], [869,250 - 869,4 MHz], [869,650 MHz to 869,700 MHz] for alarms are excluded.	90 %

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.1.2

UL VERIFICATION SERVICES INC. FORM NO: CCSUP4701I
47173 BENICIA STREET, FREMONT, CA 94538, USA TEL: (510) 771-1000 FAX: (510) 661-0888
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RESULTS

Parameter	Values as declared by the manufacturer
ML2, GFSK	
Operational Frequency band or bands	863 - 870
Nominal Operating Frequencies (MHz)	868.207626 - 869.816849
Operating Channel width(s) - OCW	200 kHz

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7.7.2. TX EFFECTIVE RADIATED POWER

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.3.1.2

The effective radiated power shall not be greater than the value allowed in annexes B or C for the chosen operational frequency band(s).

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.2.2.1.2

RESULTS

Date: 08/17/17
Project No: 11773240
Tester: 50818_JQ

CHANNELS FOR MODULATION CODE: ML2

EUT Antenna Gain (dBi) =	2.00

Condition	Output Power (dBm)	EIRP (dBm)	ERP (dBm)	Limit (dBm)	Margin (dB)
Low Channel, CH4					
Normal	9.14	11.14	8.99	13.98	-4.99
Extreme T low, V low	9.82	11.82	9.67	13.98	-4.31
Extreme T low, V high	9.83	11.83	9.68	13.98	-4.30
Extreme T high, V low	8.72	10.72	8.57	13.98	-5.41
Extreme T high, V high	8.71	10.71	8.56	13.98	-5.42
High Channel, CH35					
Normal	9.13	11.13	8.98	13.98	-5.00
Extreme T low, V low	9.84	11.84	9.69	13.98	-4.29
Extreme T low, V high	9.83	11.83	9.68	13.98	-4.30
Extreme T high, V low	8.71	10.71	8.56	13.98	-5.42
Extreme T high, V high	8.71	10.71	8.56	13.98	-5.42

Note: Cable loss correction factor is included in the Power Meter Reading

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7.7.3. TX OCCUPIED BANDWIDTH

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.3.4.2

The occupied bandwidth of the EUT according to ETSI EN 300 220-1 [1], clause 5.6.2 shall comply with the limits in annex B or C.

Reference Limit:

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.6.2

The Operating Channel shall be declared and shall reside entirely within the Operational Frequency Band. The Maximum Occupied Bandwidth at 99 % shall reside entirely within the Operating Channel defined by F_{low} and F_{high}.

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.6.3.3 (Conducted Measurement)

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RESULTS

BAND X

Condition	Low CH (MHz)	High CH (MHz)	Low CH OBW (kHz)	High CH OBW (kHz)	F_{Low} (MHz)	F_{Low} Limit (MHz)	F_{High} (MHz)	F_{High} Limit (MHz)
ML2, GFSK								
Normal	868.2076	869.8168	192.17	192.83	868.11	> 863	869.91	< 870
T low, V low	868.2076	869.8168	197.34	194.53	868.11	> 863	869.91	< 870
T low, V high	868.2076	869.8168	195.02	194.07	868.11	> 863	869.91	< 870
T high, V low	868.2076	869.8168	190.25	188.95	868.11	> 863	869.91	< 870
T high, V high	868.2076	869.8168	190.03	188.56	868.11	> 863	869.91	< 870

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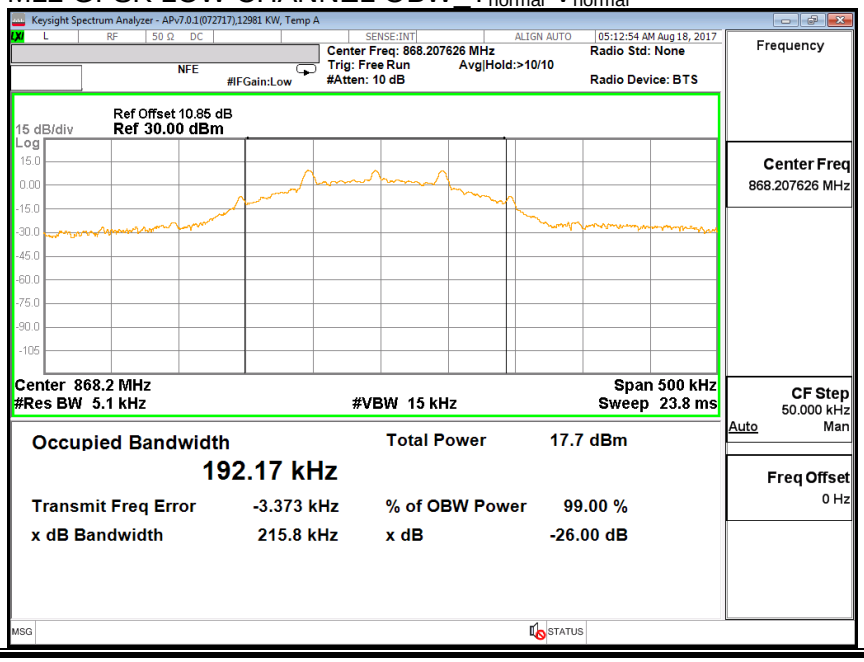
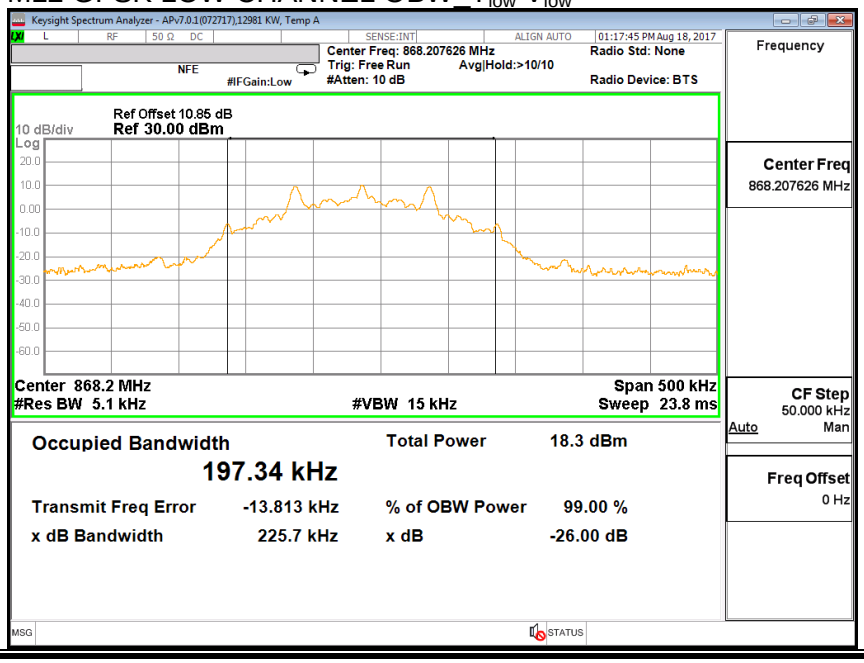
ML2 GFSK LOW CHANNEL OBW_T_{normal} V_{normal}



ML2 GFSK LOW CHANNEL OBW_T_{low} V_{low}



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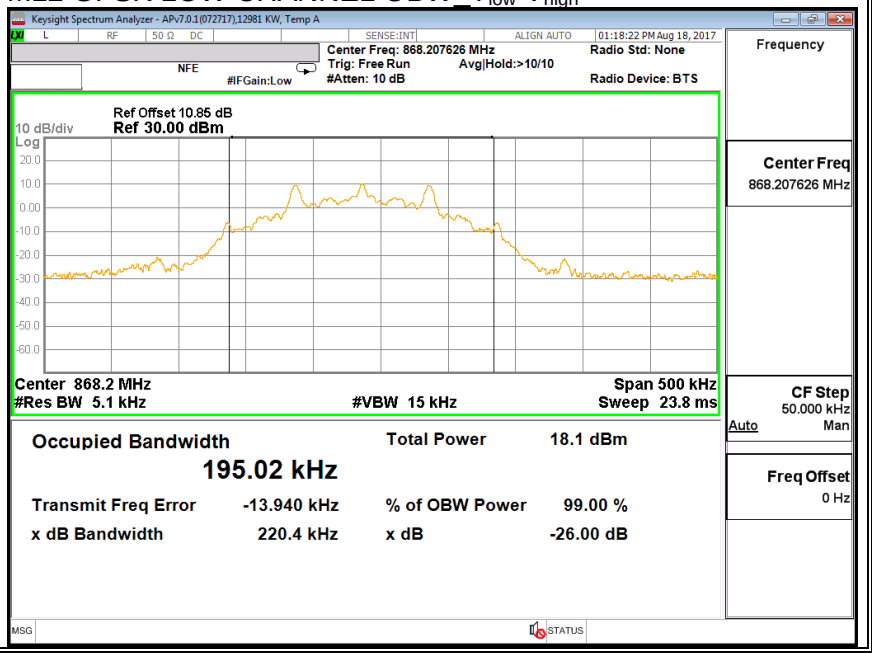
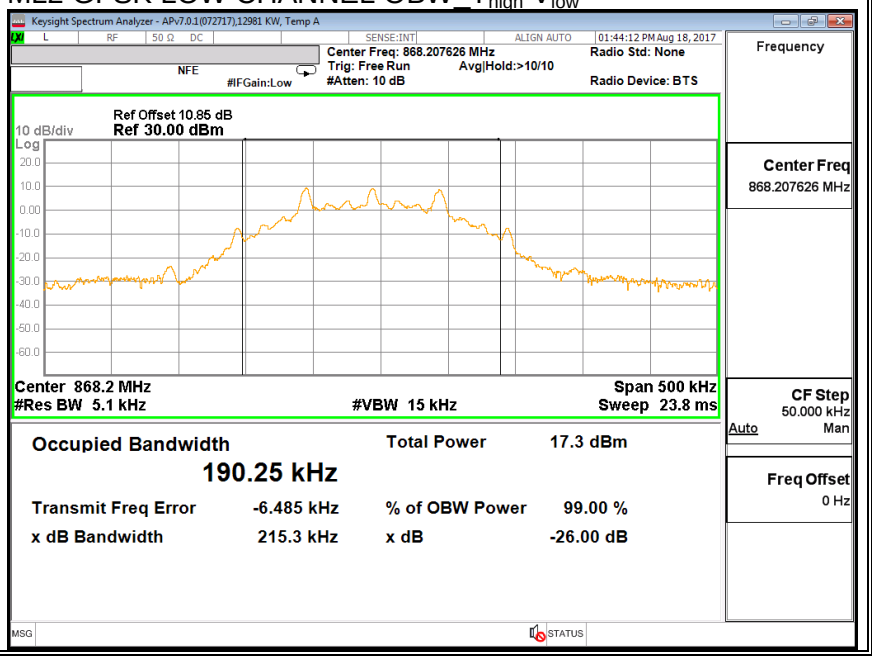
ML2 GFSK LOW CHANNEL OBW_T_{low} V_{high}



ML2 GFSK LOW CHANNEL OBW_T_{high} V_{low}



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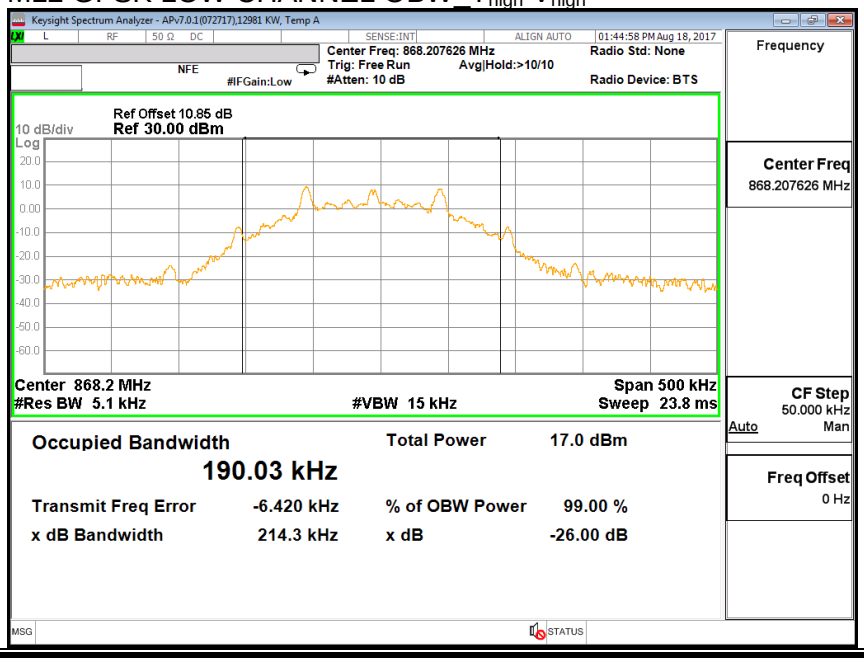
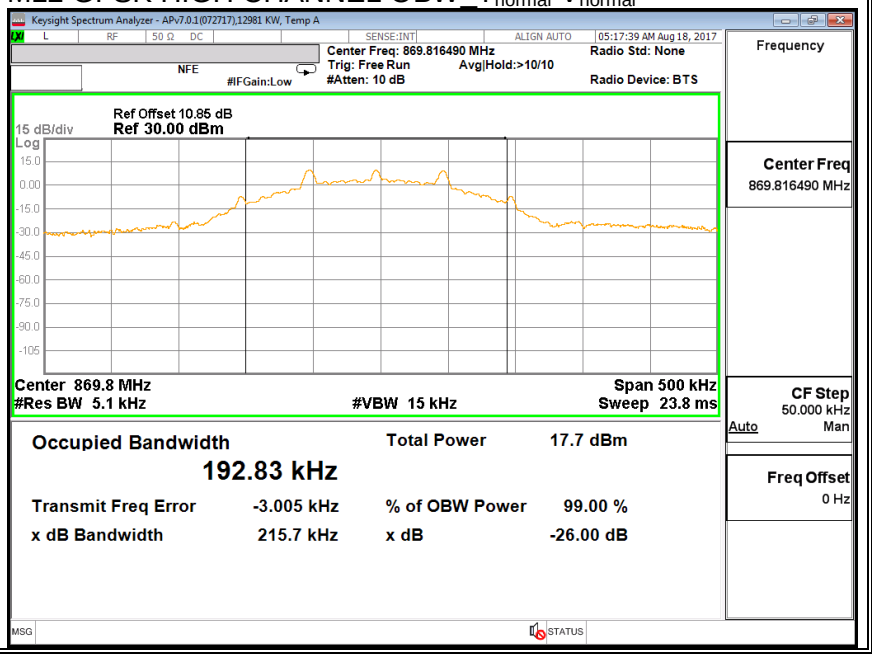
ML2 GFSK LOW CHANNEL OBW_T_{high} V_{high}



ML2 GFSK HIGH CHANNEL OBW_T_{normal} V_{normal}



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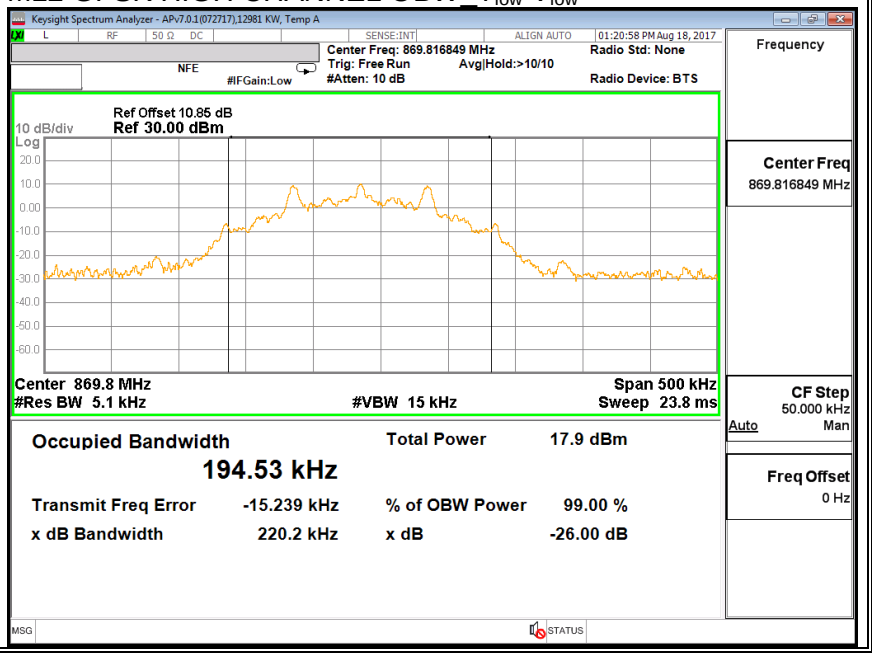
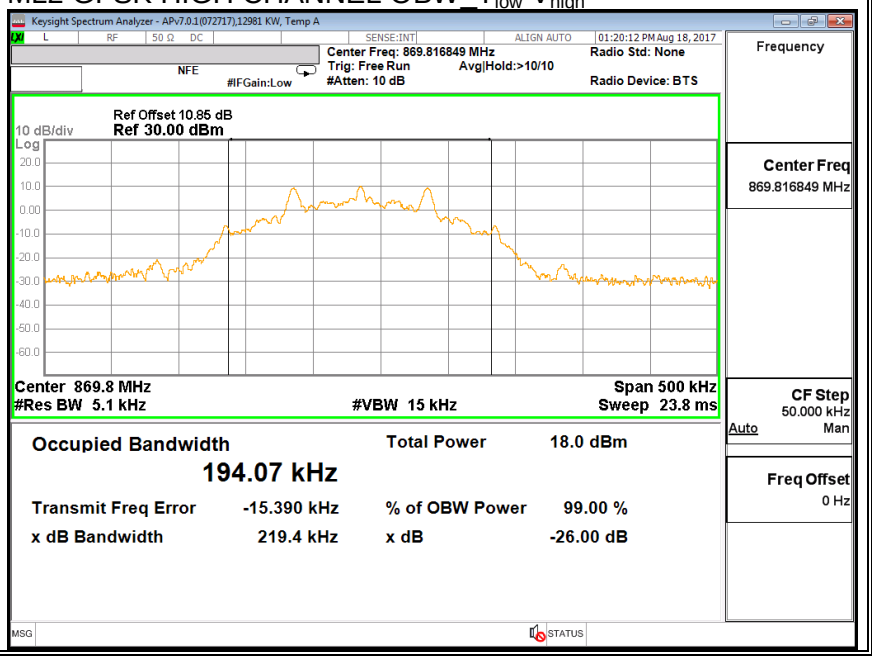
ML2 GFSK HIGH CHANNEL OBW_T_{low} V_{low}



ML2 GFSK HIGH CHANNEL OBW_T_{low} V_{high}



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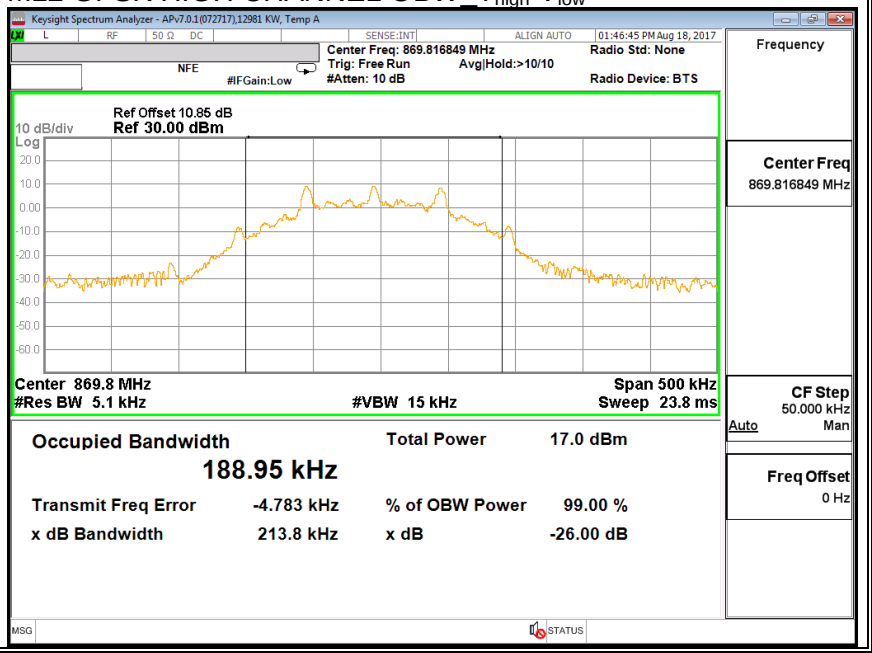
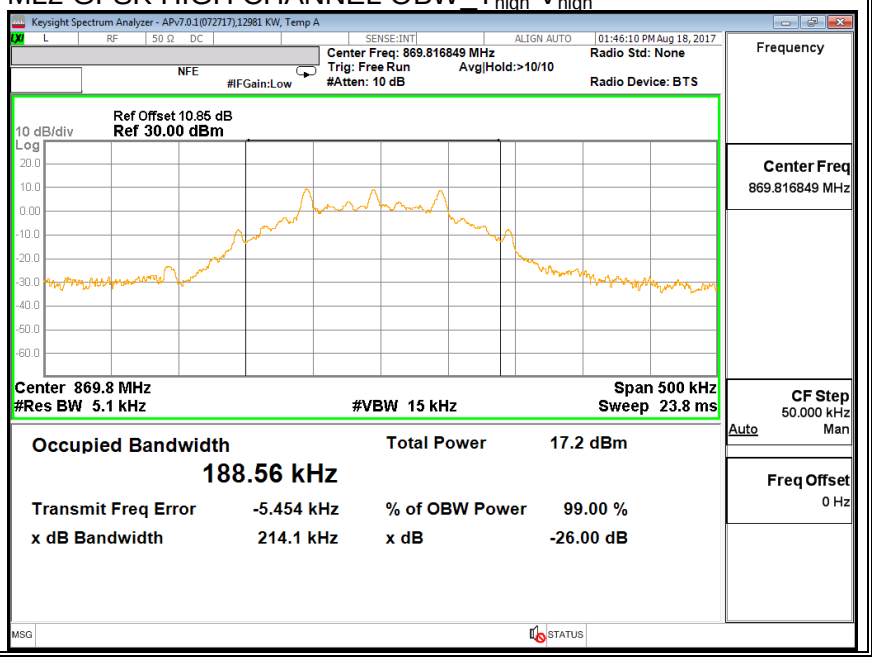
ML2 GFSK HIGH CHANNEL OBW_T_{high} V_{low}



ML2 GFSK HIGH CHANNEL OBW_T_{high} V_{high}



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7.7.4. MAXIMUM E.R.P SPECTRAL DENSITY

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.3.2.2

The Maximum e.r.p. spectral density shall not be greater than the value allowed in annexes B or C for the chosen operational frequency band(s).

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.3.2.1.2

RESULTS

BAND X

EUT Antenna Gain (dBi) =	2.00

Condition	SPECTRAL DENSITY (dBm/100kHz)	E.R.P SPECTRAL DENSITY (dBm/100kHz)	Limit (dBm/100kHz)	Margin (dB)
ML2, Low Channel, CH4				
Normal	-1.15	-1.30	-0.8	-0.50
ML2, High Channel, CH35				
Normal	-1.18	-1.33	-0.8	-0.53

Note: E.R.P Spectral Density = Spectral Density + EUT Antenna Gain – 2.15

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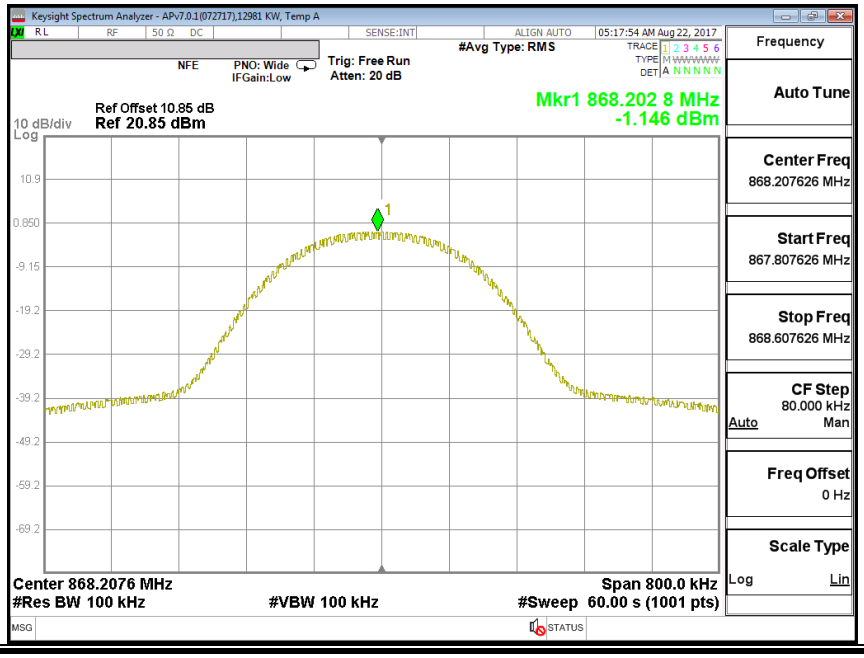
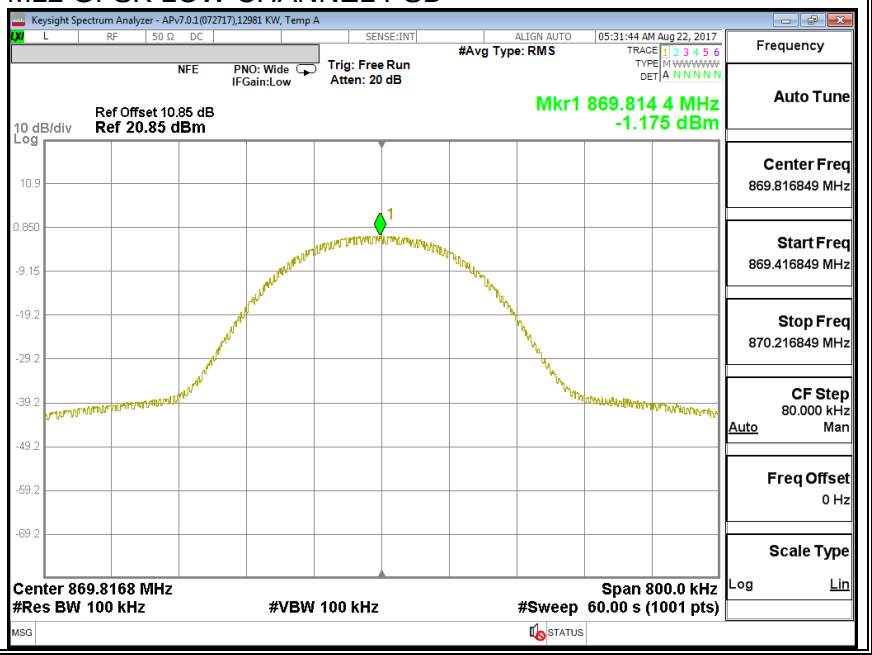
ML2 GFSK LOW CHANNEL PSD



ML2 GFSK LOW CHANNEL PSD



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7.7.5. TX OUT OF BAND EMISSIONS

REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.1

Two OOB domains are defined, one for OC (see Figure 5) and one for Operational Frequency band (see Figure 6). The spectrum masks for these two OOB domains may overlap.

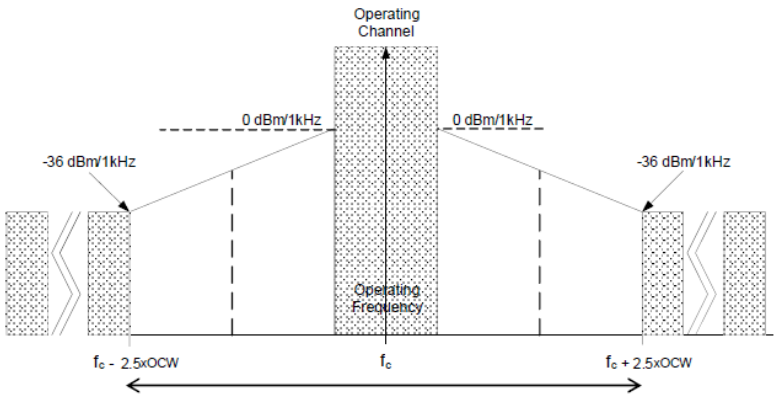

Figure 5: Out Of Band Domain for Operating Channel with reference BW

Unwanted emissions in the Out Of Band domain are those falling in the frequency range immediately below the lower, and above the upper, frequency of the Operating Channel. The OOB domain includes both frequencies outside the Operating Channel within the Operational Frequency Band and frequencies outside the Operational Frequency Band.
The relevant Out Of Band domain is shown in Figure 5 and applies within the Operational Frequency Band.

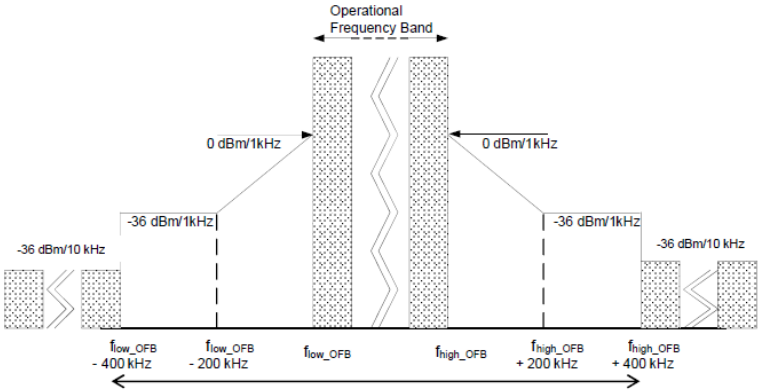

Figure 6: Out Of Band Domain for Operational Frequency Band with reference BW

Specific limits apply at frequencies immediately above and below the Operational Frequency Band as shown in Figure 6.
NOTE: f_{low}_OFB is the lower edge of the Operational Frequency Band. f_{high}_OFB is the upper edge of the Operational Frequency Band.

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REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.2

The EUT emissions level in OOB domains for the Operating Channel and the Operational Frequency Band shall be less or equal to Table 15 spectrum mask.

Table 15: Emission limits in the Out Of Band domains

Domain	Frequency Range	RBW_{REF}	Max power limit
OOB limits applicable to Operational Frequency Band (See Figure 6)	$f \le f_{low_OFB}$ - 400 kHz	10 kHz	-36 dBm
	F_{low_OFB} - 400 kHz ≤ f ≤ f_{low_OFB} - 200 kHz	1 kHz	-36 dBm
	f_{low} - 200 kHz ≤ f < f_{low_OFB}	1 kHz	See Figure 6
	$f = f_{low_OFB}$	1 kHz	0 dBm
	$f = f_{high_OFB}$	1 kHz	0 dBm
	F_{high_OFB} < f ≤ f_{high_OFB} + 200 kHz	1 kHz	See Figure 6
	F_{high_OFB} + 200 kHz ≤ f ≤ f_{high_OFB} + 400 kHz	1 kHz	-36 dBm
	F_{high_OFB} + 400 kHz ≤ f	10 kHz	-36 dBm
OOB limits applicable to Operating Channel (See Figure 5)	$f = f_c$- 2.5 x OCW	1 kHz	-36 dBm
	f_c - 2,5 x OCW ≤ f ≤ f_c - 0,5 x OCW	1 kHz	See Figure 5
	$f = f_c$ - 0,5 x OCW	1 kHz	0 dBm
	$f = f_c$ + 0,5 x OCW	1 kHz	0 dBm
	f_c + 0,5 x OCW ≤ f ≤ f_c + 2,5 x OCW	1 kHz	See Figure 5
	$f = f_c$+ 2,5 x OCW	1 kHz	-36 dBm

NOTE: f is the measurement frequency.
f_c is the Operating Frequency.
F_{low_OFB} is the lower edge of the Operational Frequency Band.
F_{high_OFB} is the upper edge of the Operational Frequency Band.
OCW is the operating channel bandwidth.

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.3.3 (Conducted Measurement)

RESULTS

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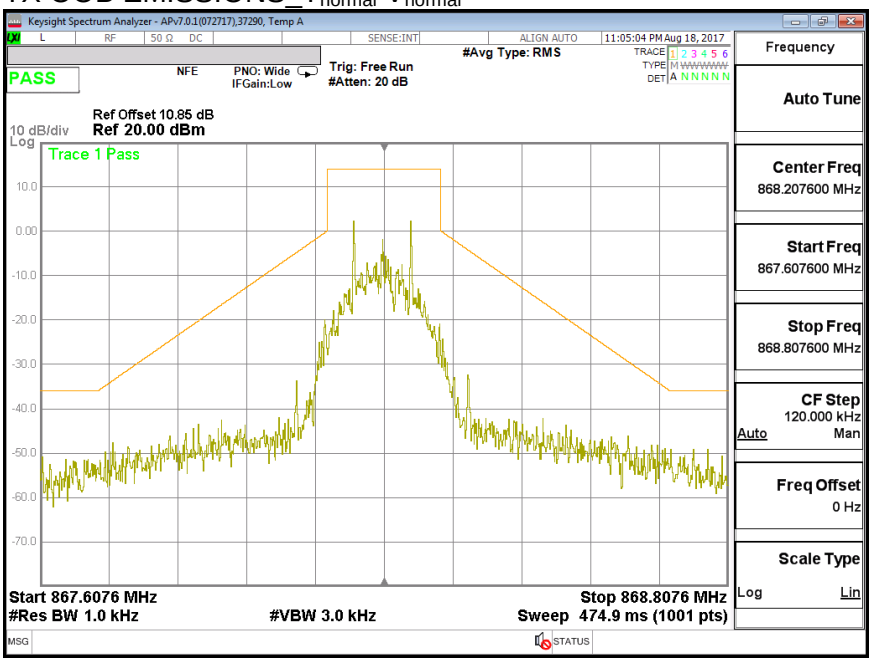
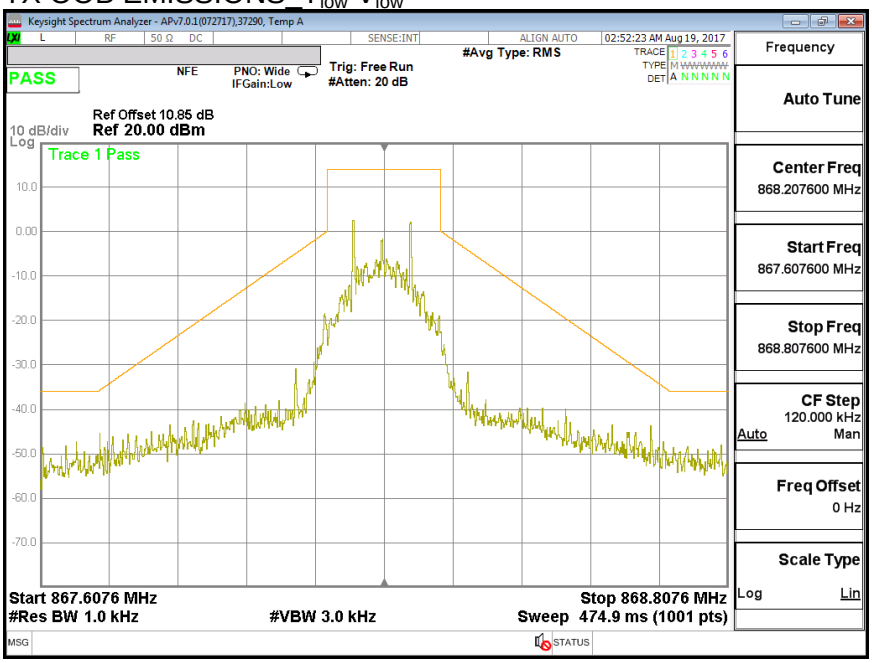
TX OUT OF BAND EMISSIONS (APPLICABLE TO OPERATING CHANNEL)

ML2 LOW CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal}



TX OOB EMISSIONS_T_{low} V_{low}



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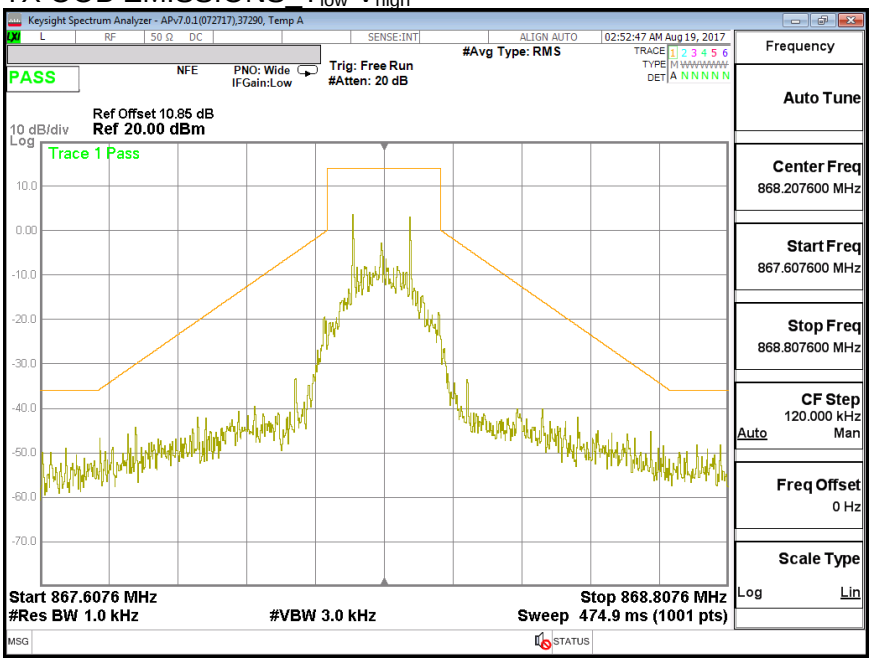
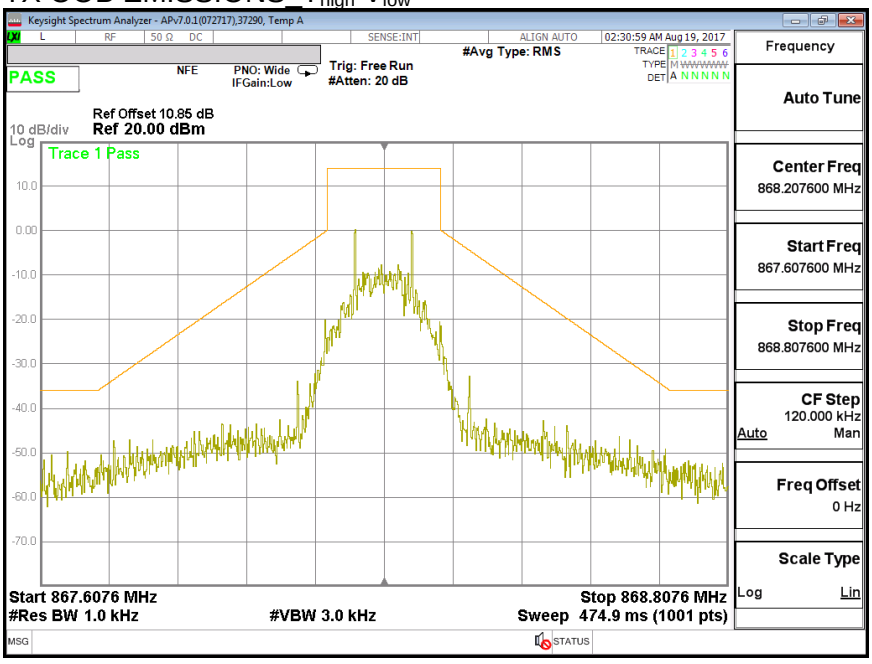
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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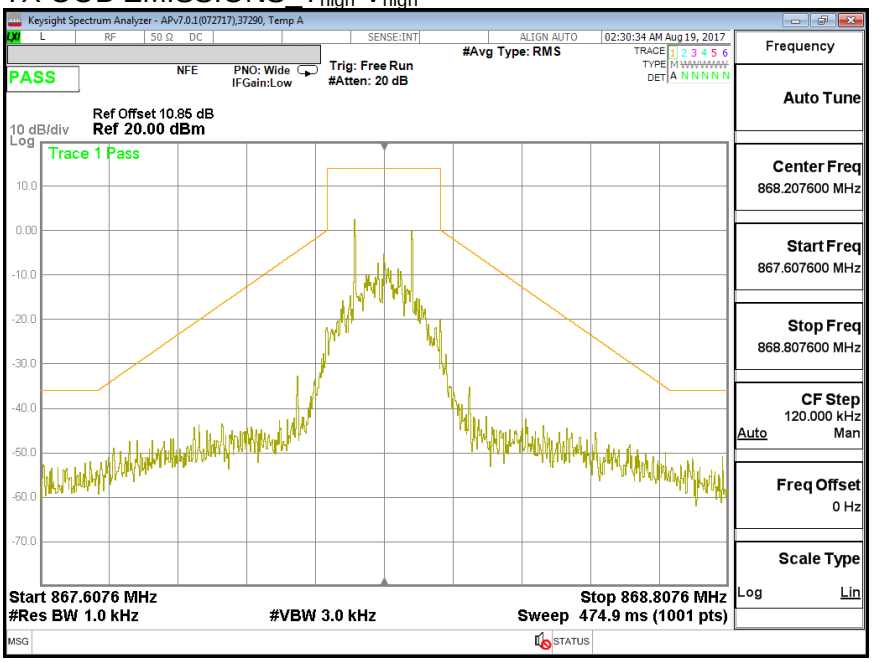
TX OOB EMISSIONS_T_{high} V_{high}



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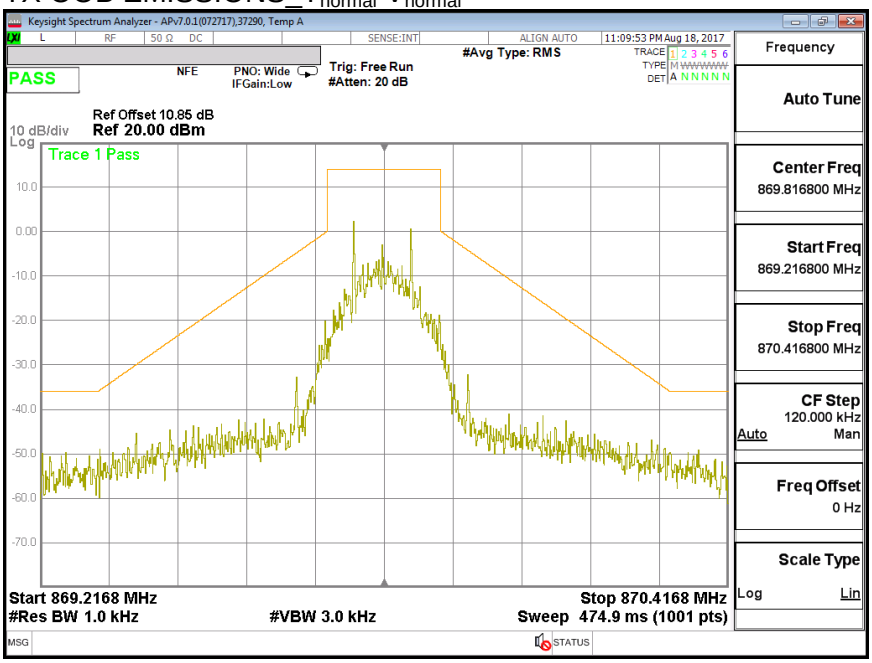
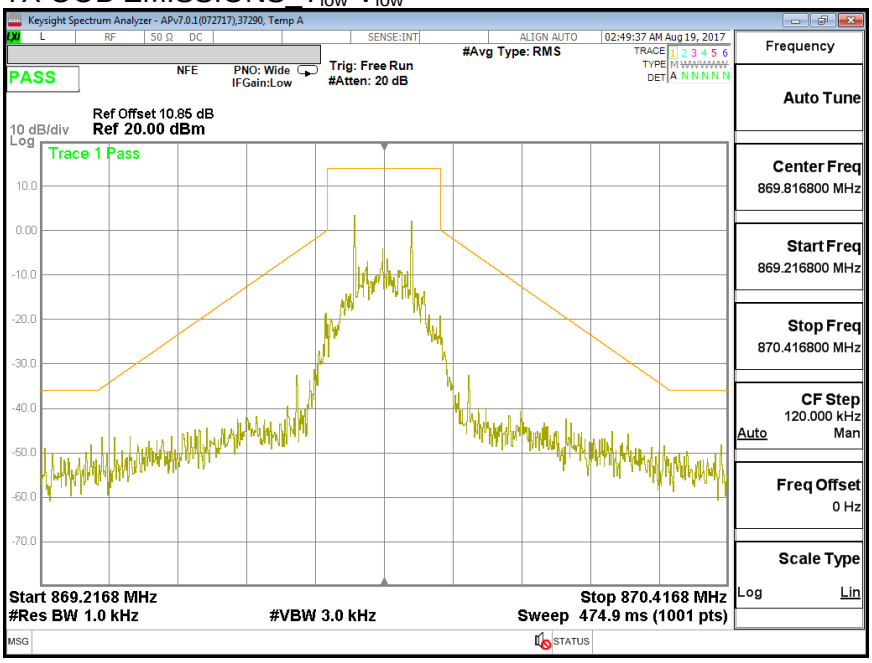
ML2 HIGH CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$



TX OOB EMISSIONS_T$_{low}$ V$_{low}$



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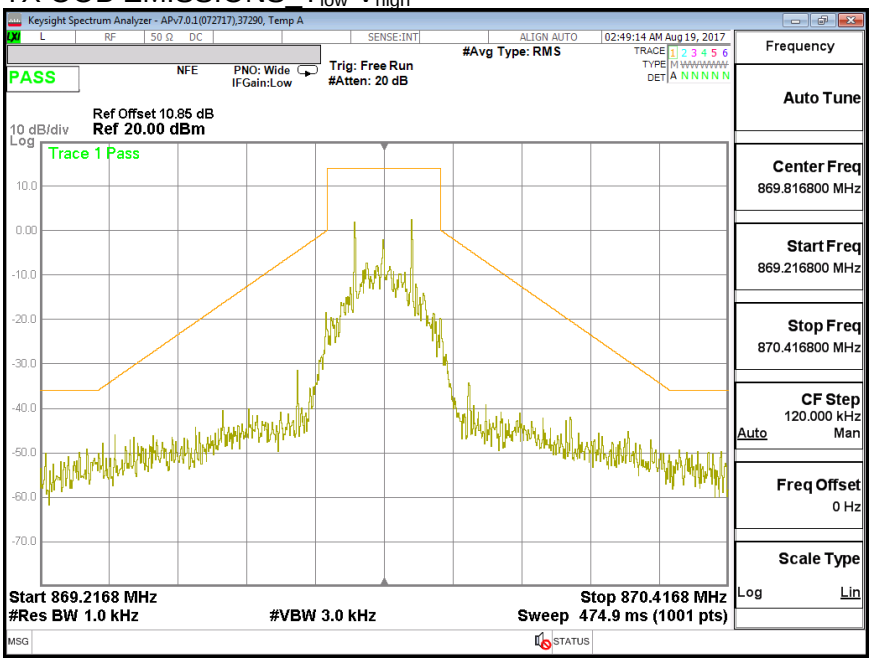
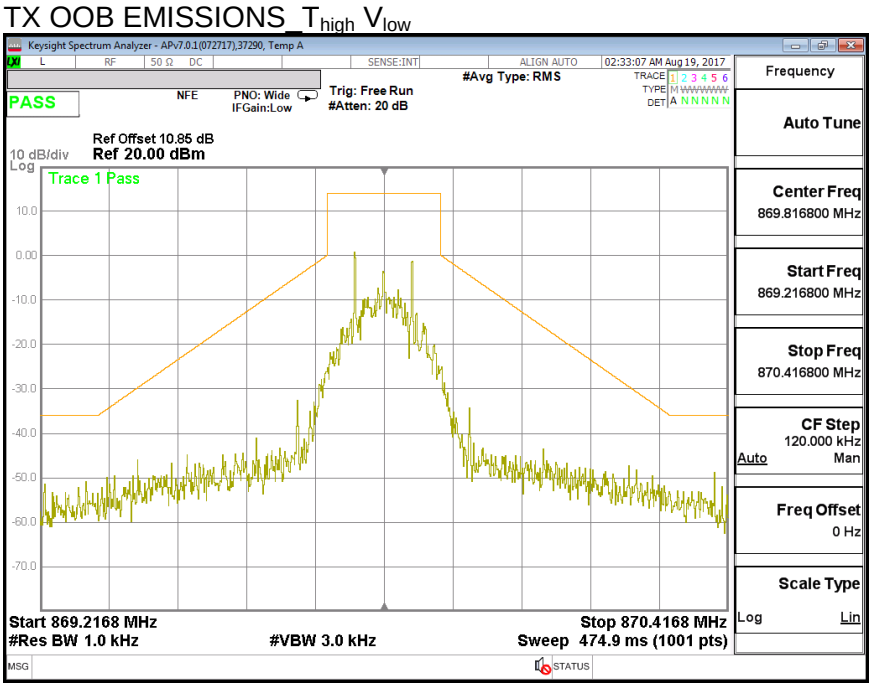
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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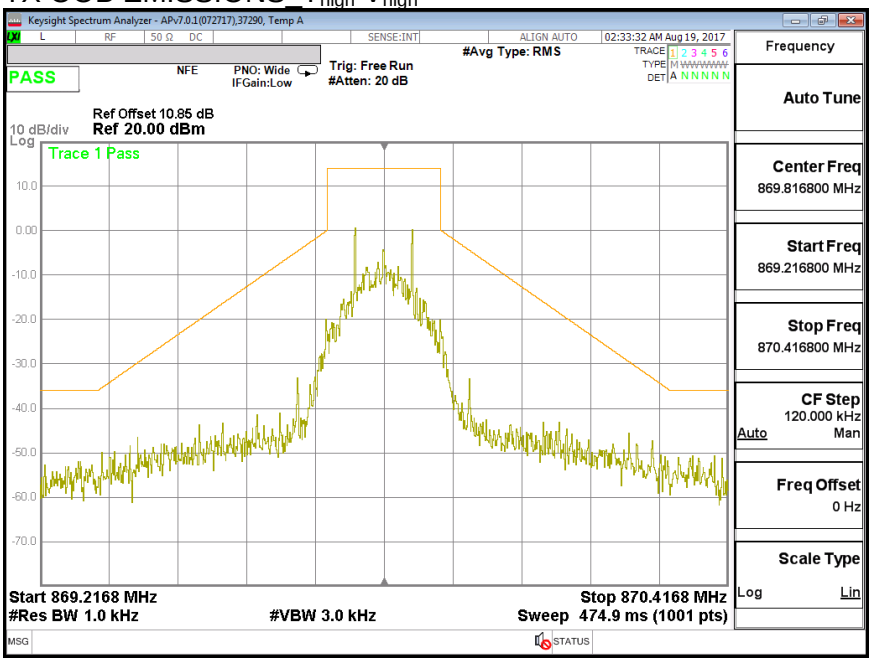
TX OOB EMISSIONS_T_{high} V_{high}



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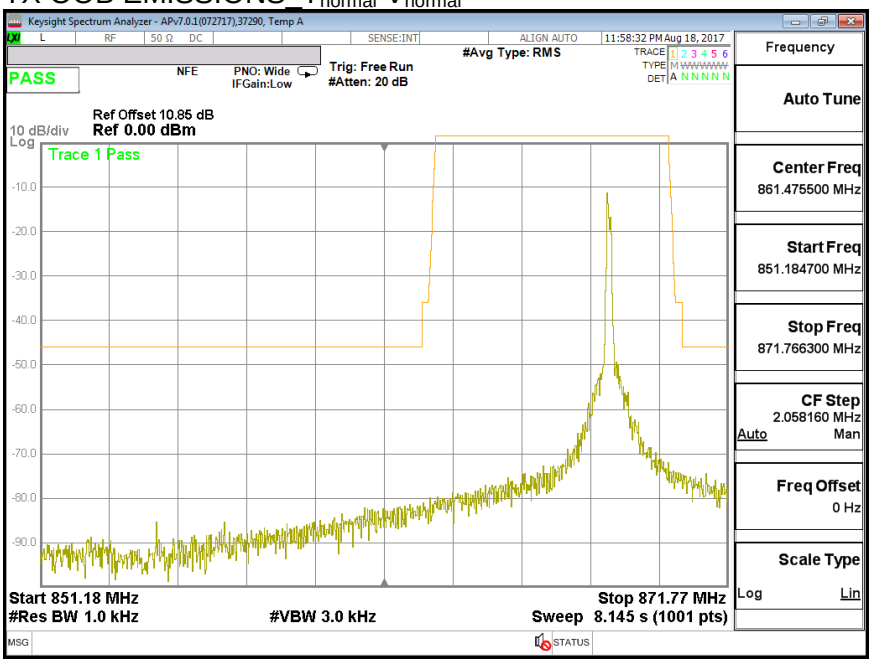
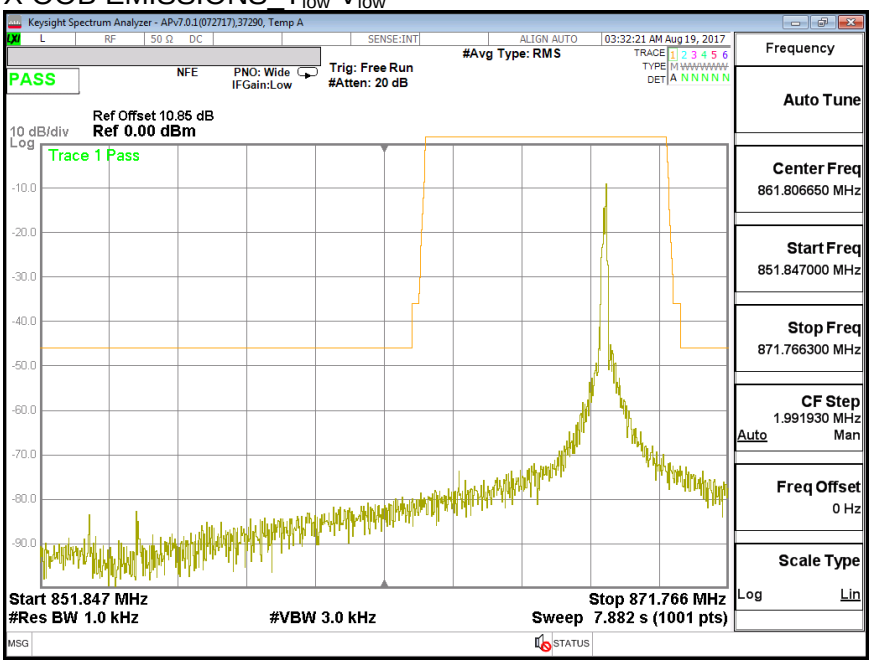
TX OUT OF BAND EMISSIONS (APPLICABLE TO OPERATIONAL FREQUENCY BANDS)

ML2 LOW CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal}



X OOB EMISSIONS_T_{low} V_{low}



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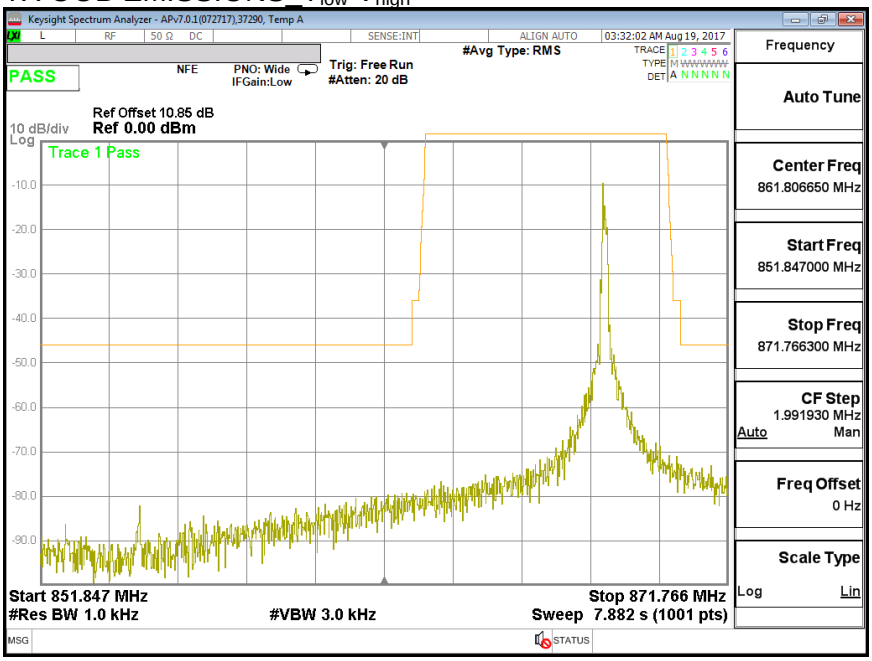
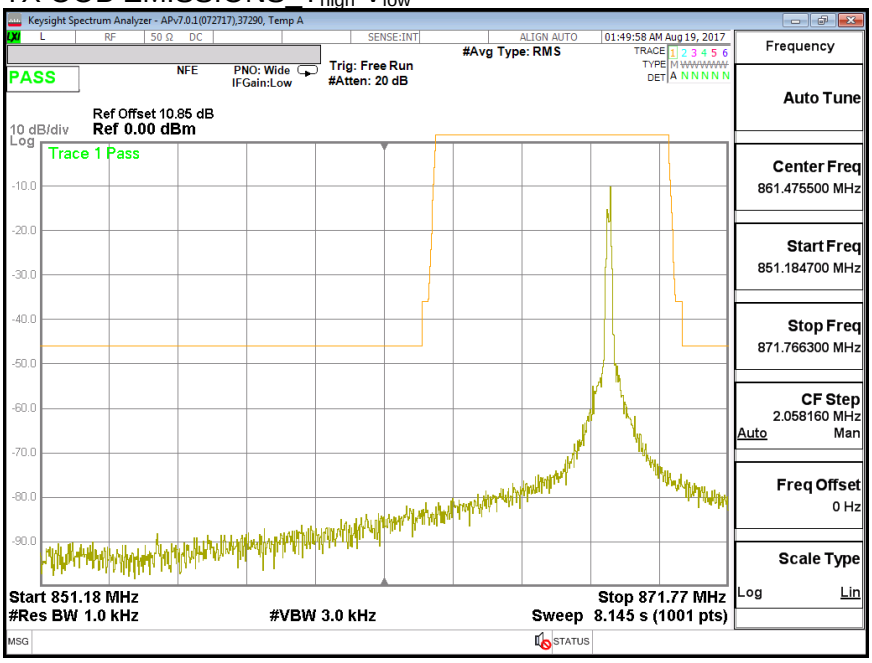
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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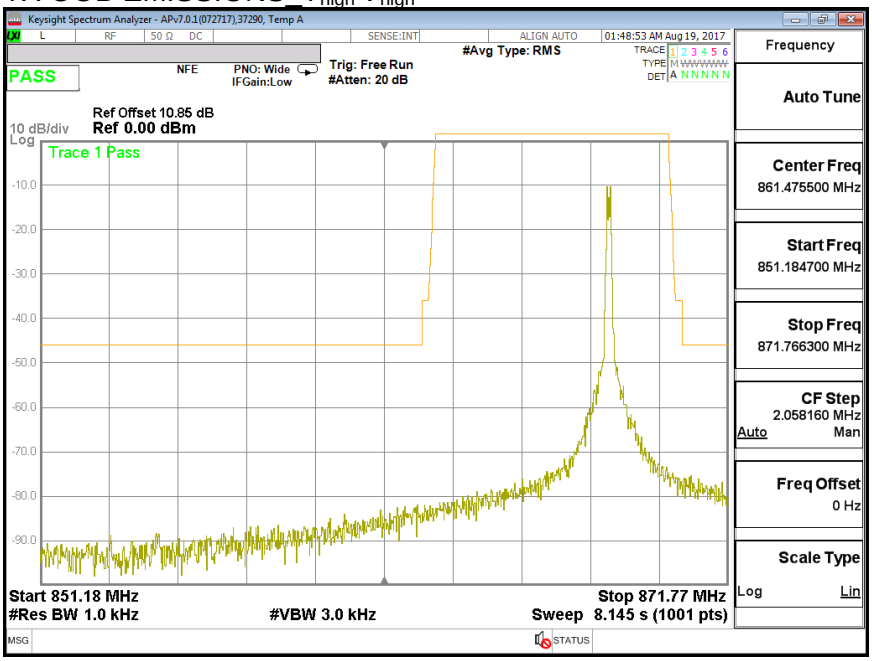
TX OOB EMISSIONS_T_{high} V_{high}



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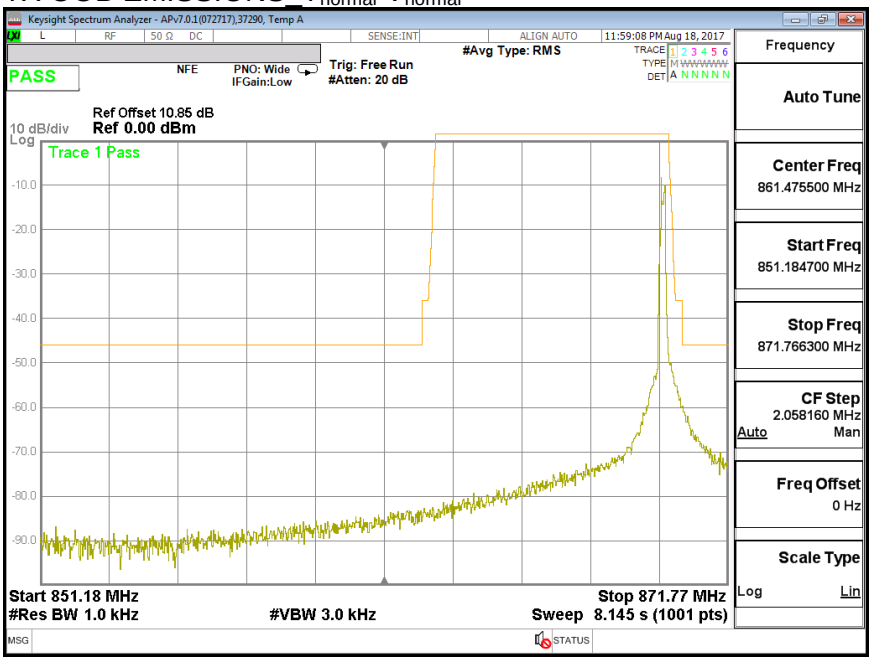
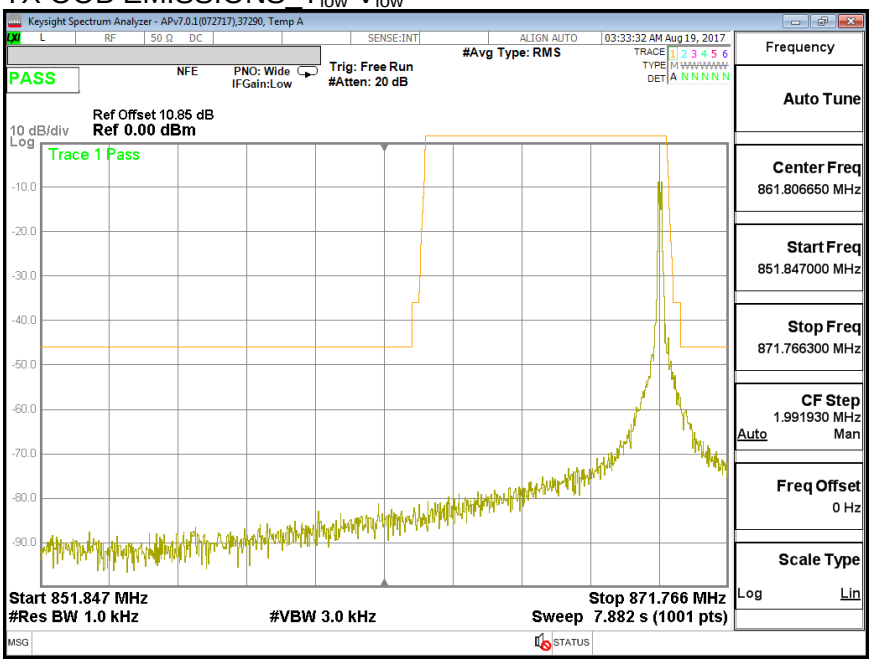
ML2 HIGH CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal}



TX OOB EMISSIONS_T_{low} V_{low}



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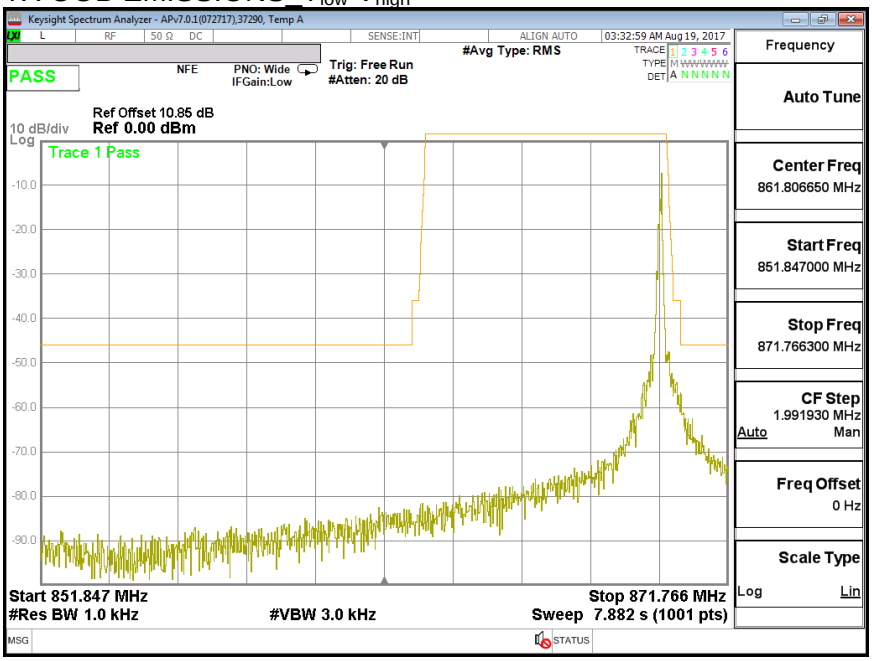
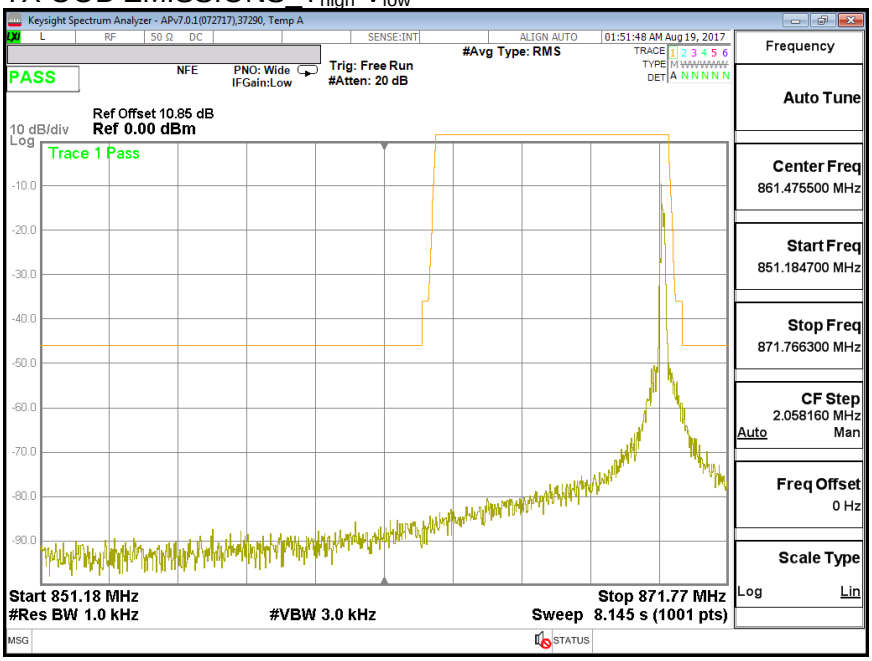
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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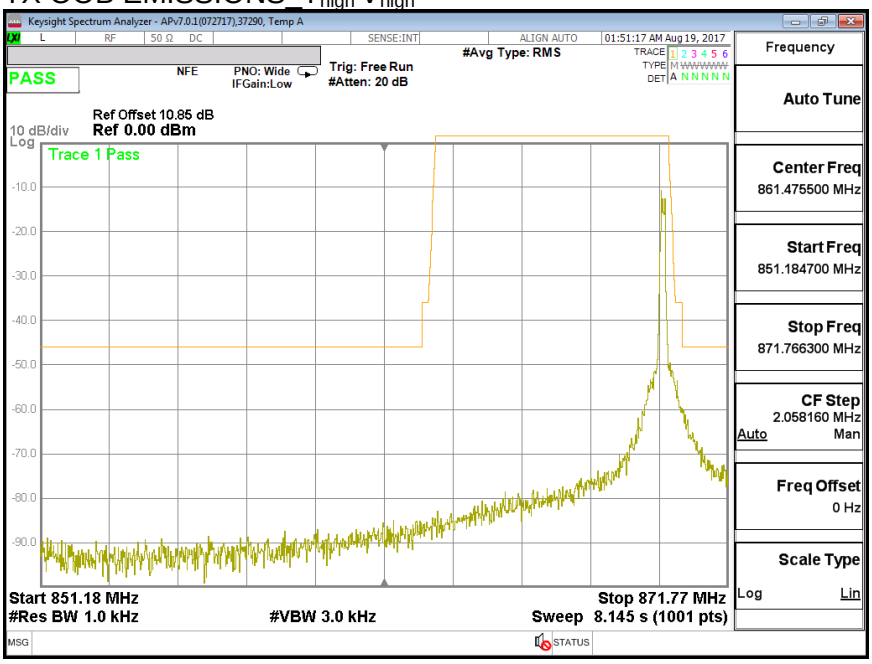
TX OOB EMISSIONS_T_{high} V_{high}



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7.7.6. TX UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.2.2.2
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.1.1
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.2

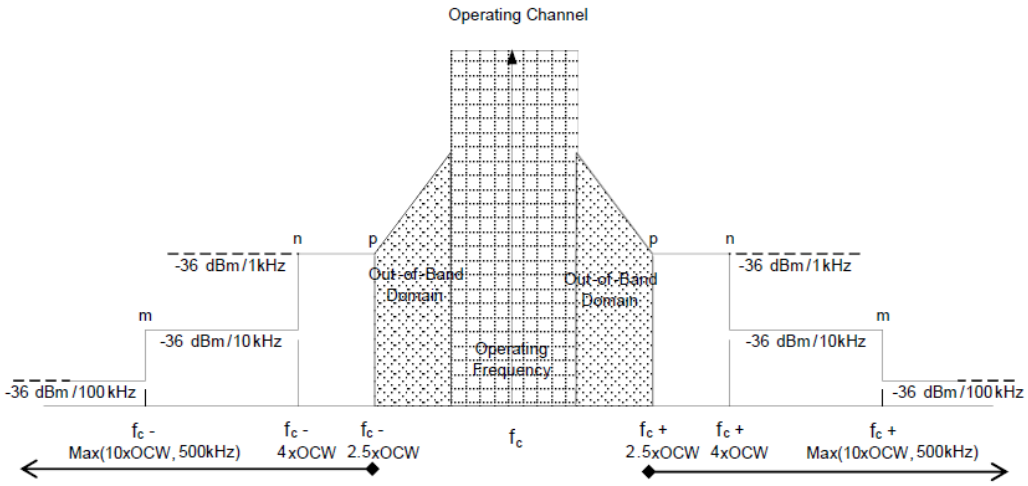

Figure 7: Spectrum Mask for Unwanted Emissions in the Spurious Domain with reference BW

Reference Limit:

The power of any unwanted emission in the spurious domain shall not exceed the values given in Table 19.

Table 19: Spurious domain emission limits

Frequency / State	47 MHz to 74 MHz 87,5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 790 MHz	Other frequencies below 1 000 MHz	Frequencies above 1 000 MHz
TX mode	-54 dBm	-36 dBm	-30 dBm
RX and all other modes	-57 dBm	-57 dBm	-47 dBm

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.3.3.1 (Conducted Measurement)
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.3.3.2 (Radiated Measurement)

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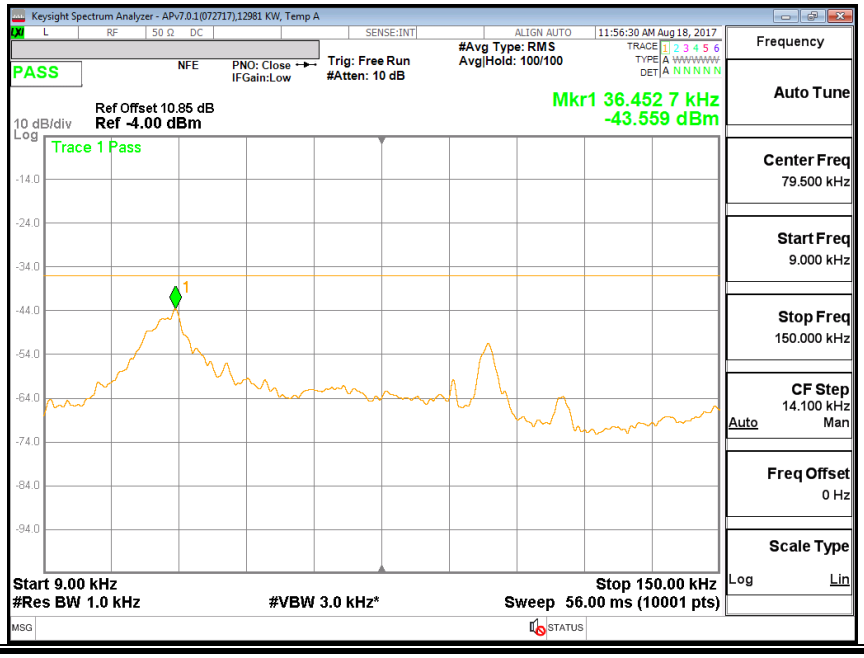
RESULTS

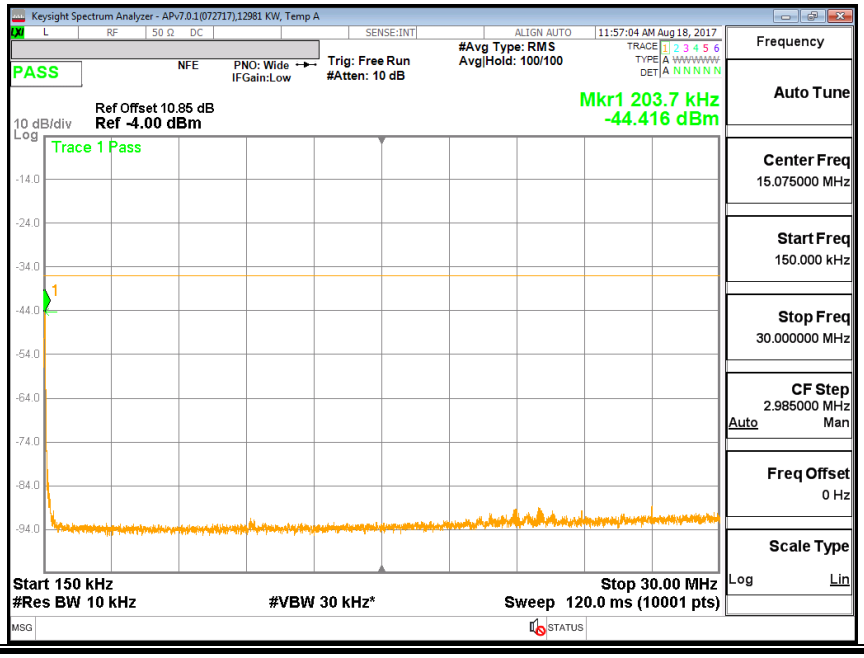
CONDUCTED SPURIOUS EMISSIONS

THE WORST CASE OF GFSK LOW CHANNEL

9kHz to 150kHz



150kHz to 30MHz



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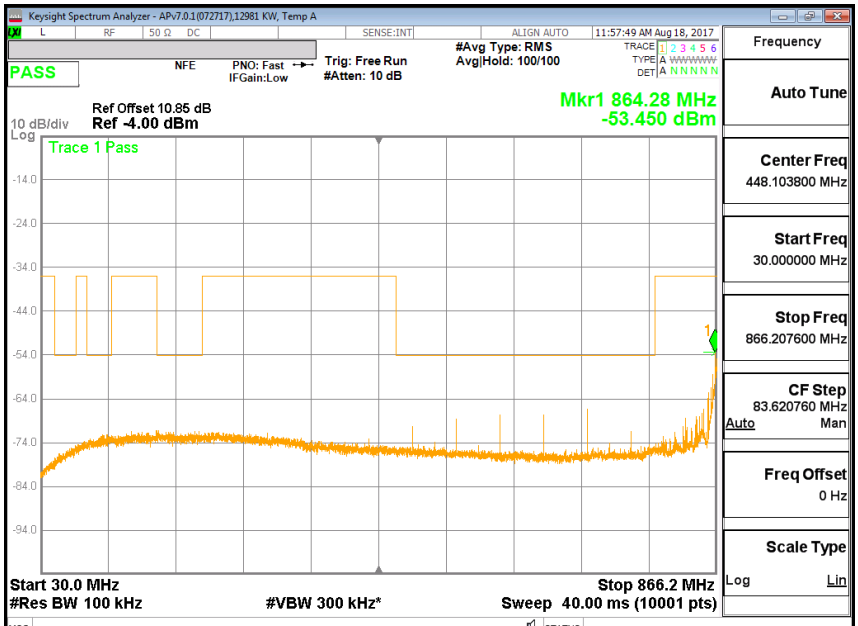
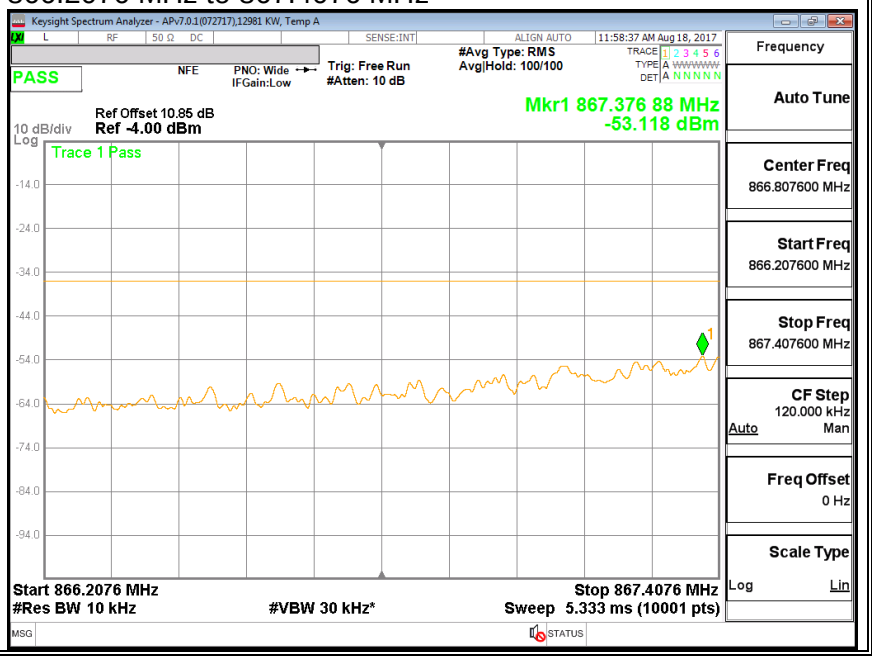
30MHz to 866.2076MHz



866.2076 MHz to 867.4076 MHz



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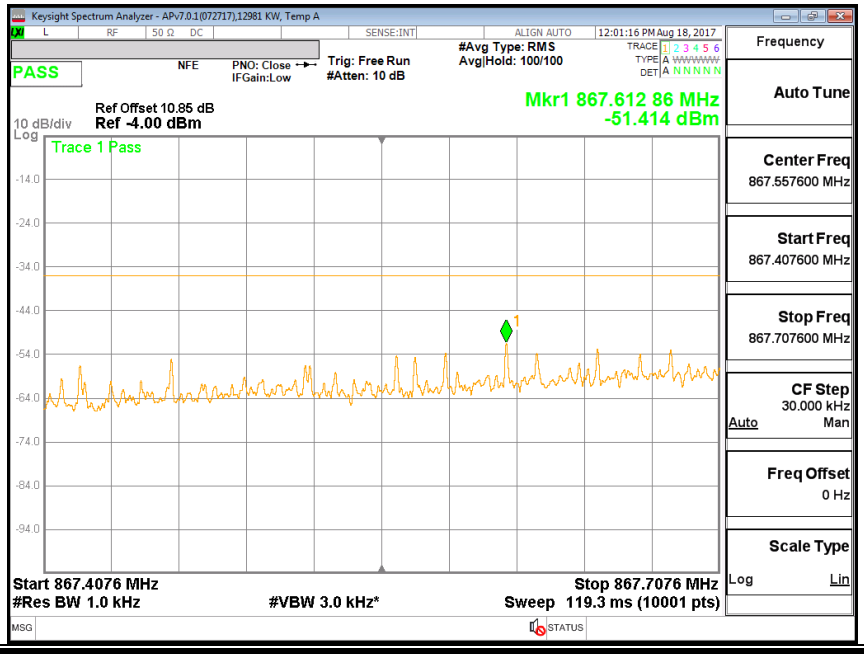
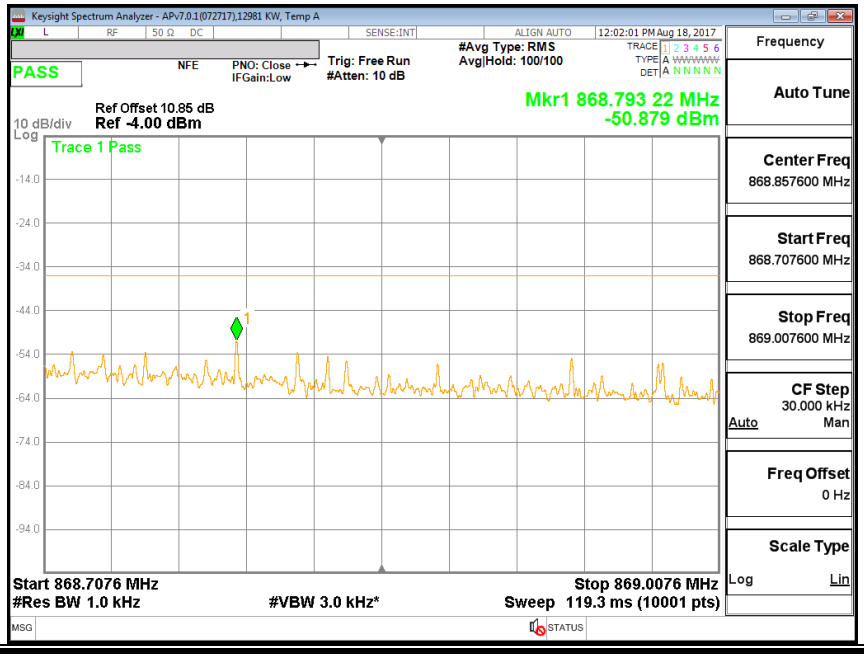
867.4076 MHz to 867.7076 MHz



868.7076 MHz to 869.0076 MHz



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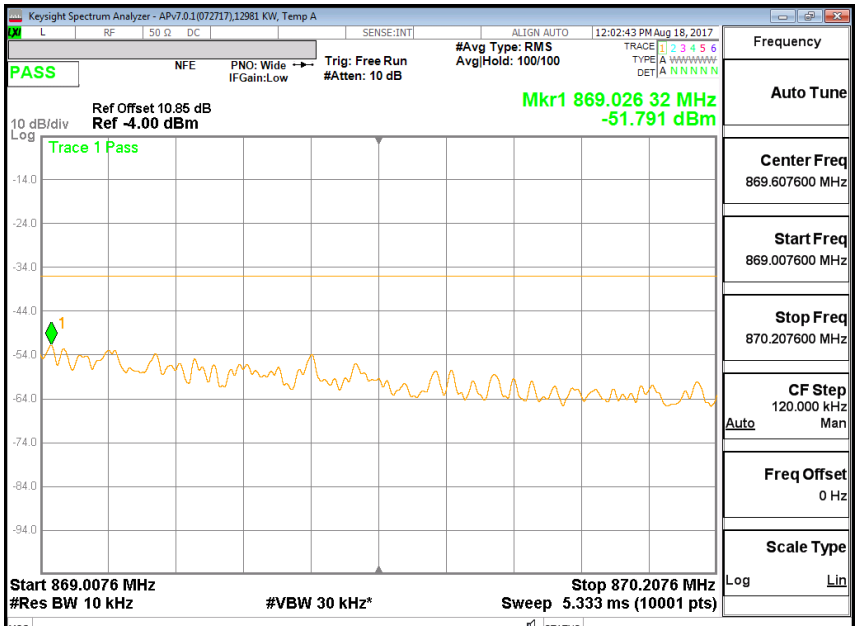
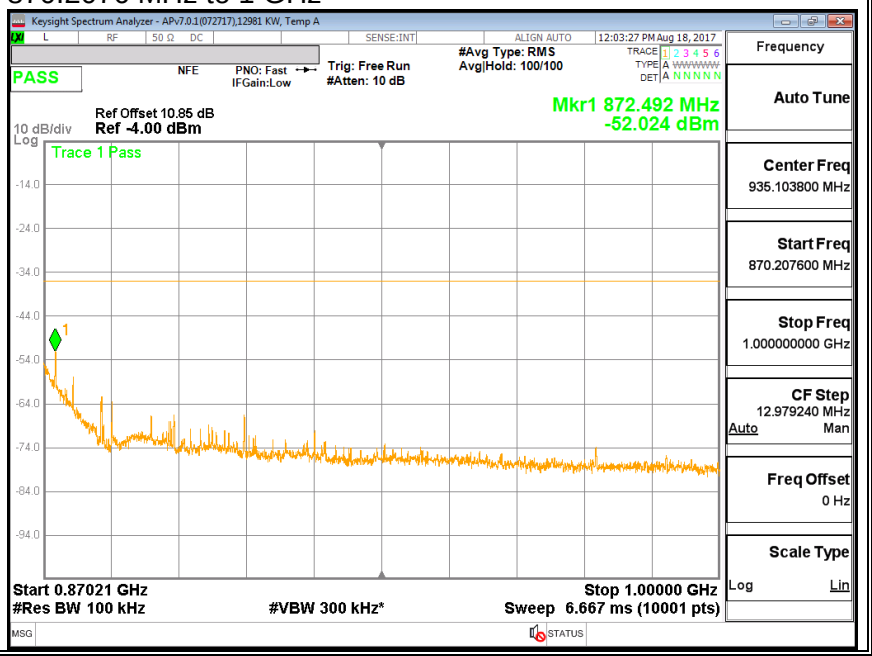
869.0076 MHz to 870.2076 MHz



870.2076 MHz to 1 GHz



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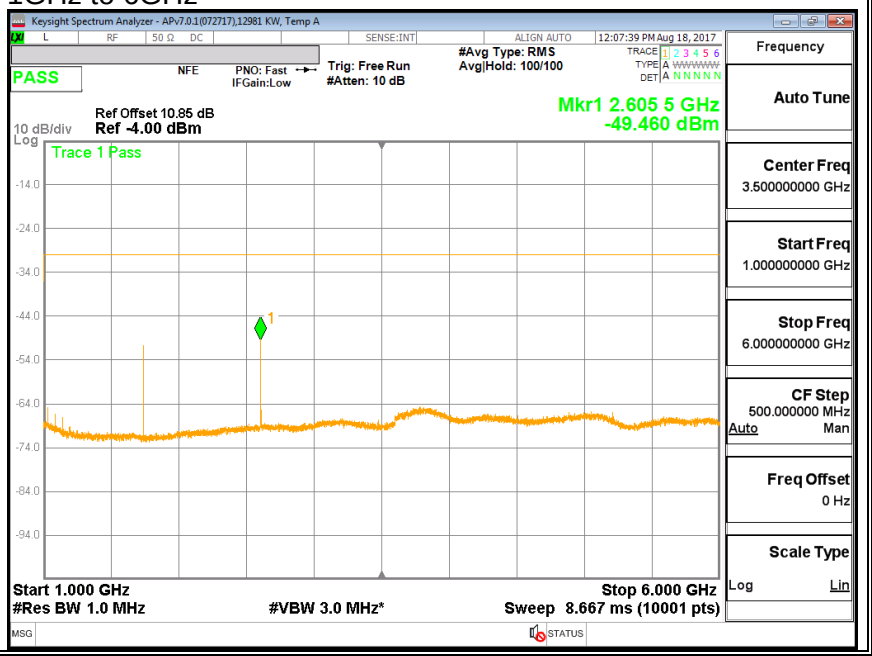
1GHz to 6GHz



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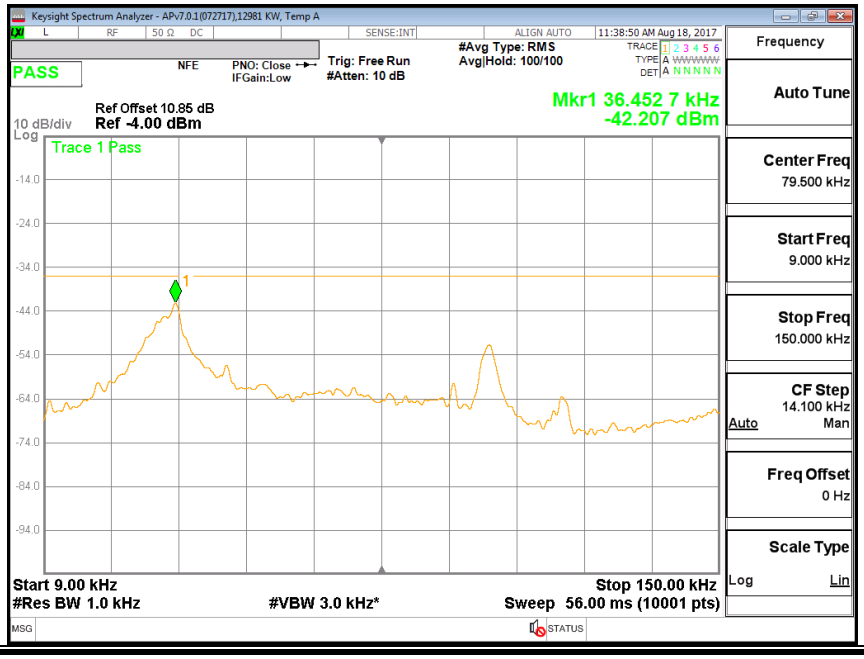
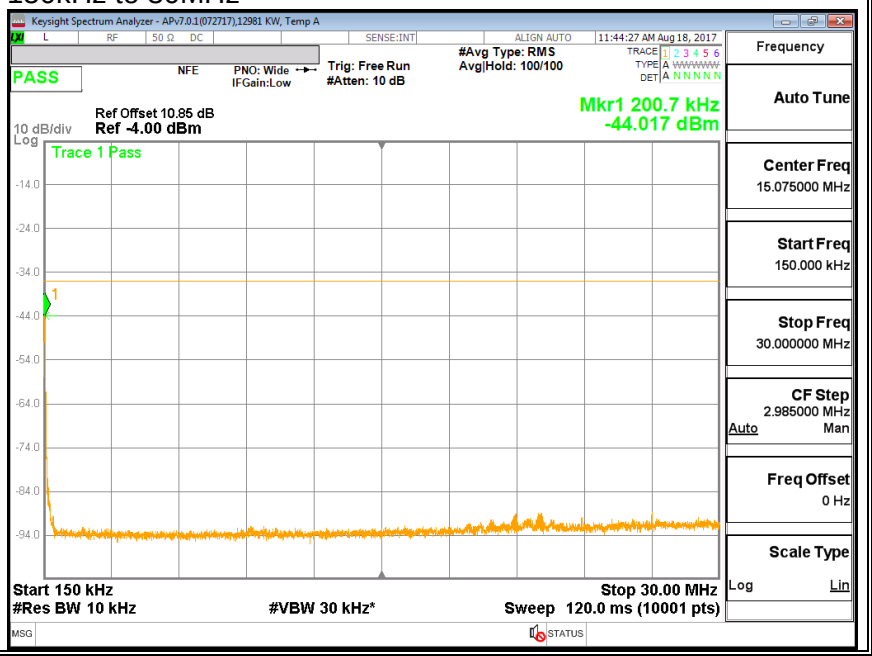
THE WORST CASE OF GFSK HIGH CHANNEL

9kHz to 150kHz



150kHz to 30MHz



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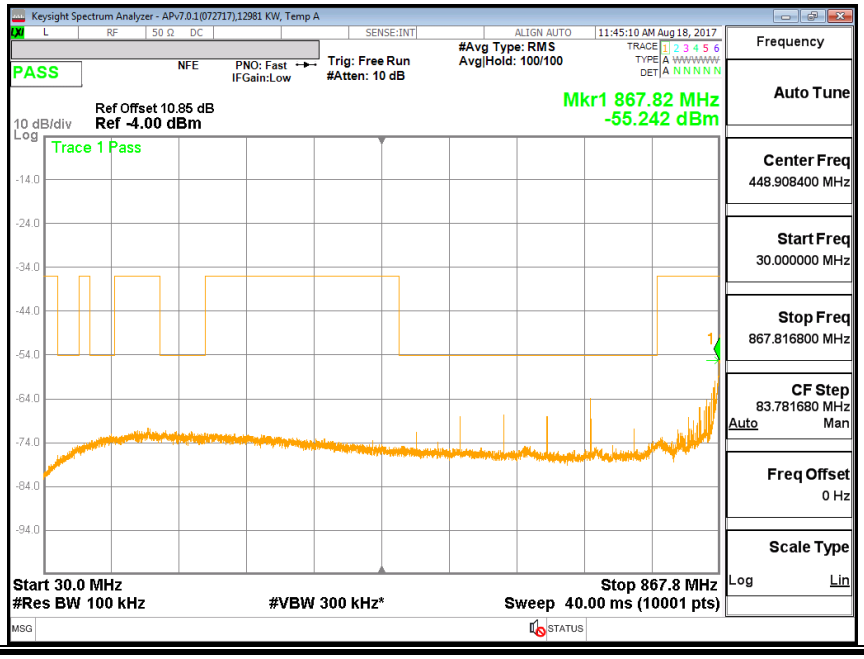
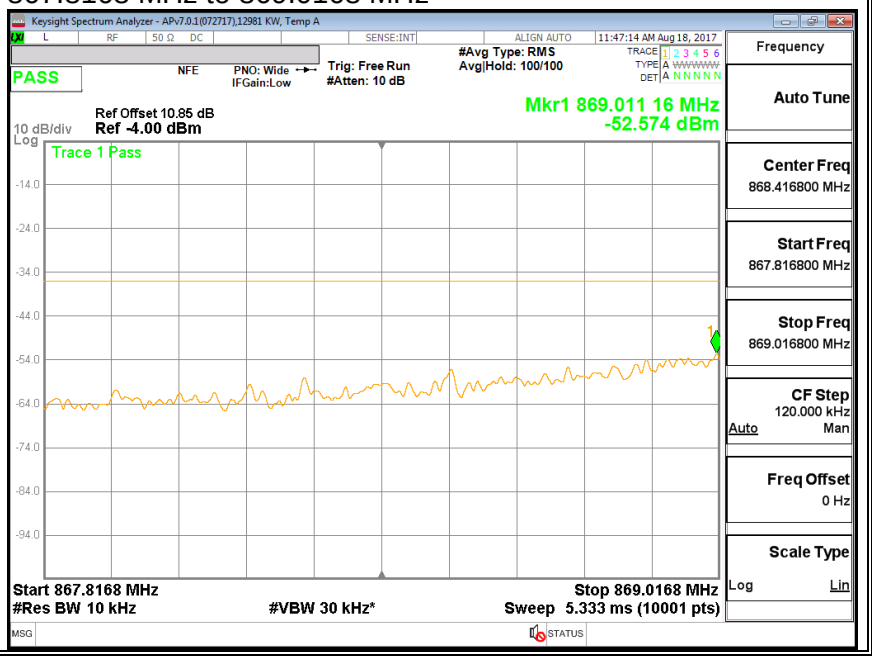
30MHz to 867.8168MHz



867.8168 MHz to 869.0168 MHz



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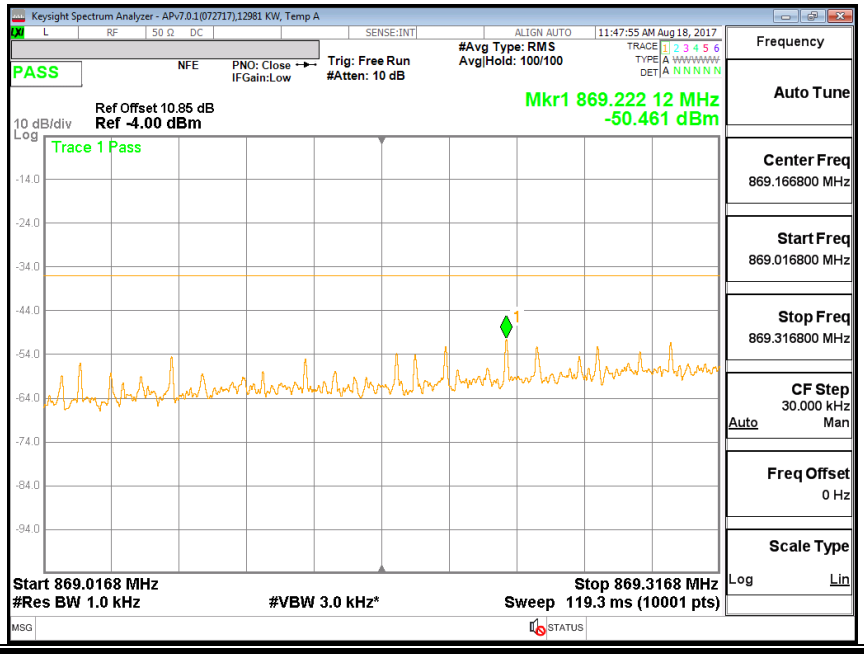
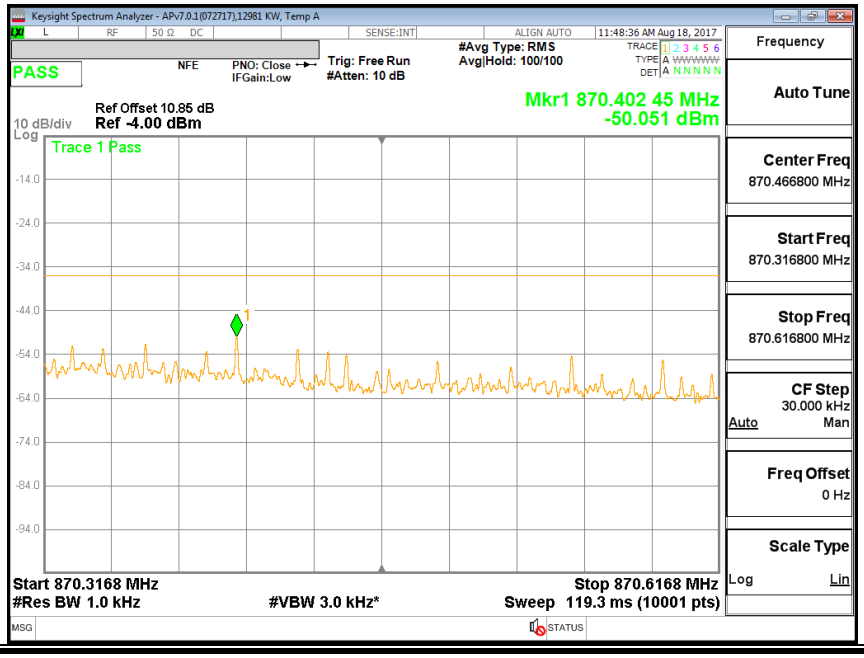
869.0168 MHz to 869.3168 MHz



870.3168 MHz to 870.6168 MHz



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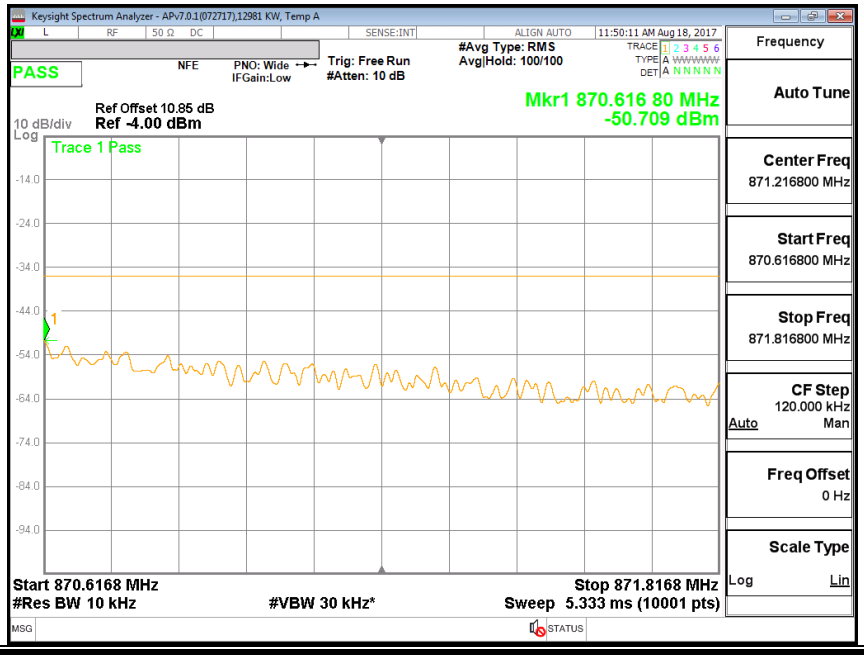
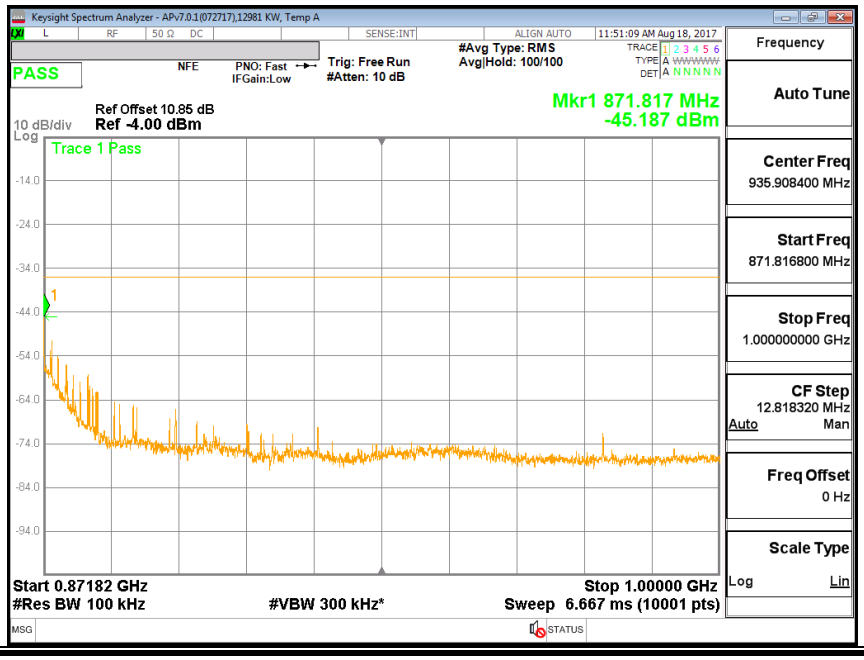
870.6168 MHz to 871.8168 MHz



871.8168 MHz to 1 GHz



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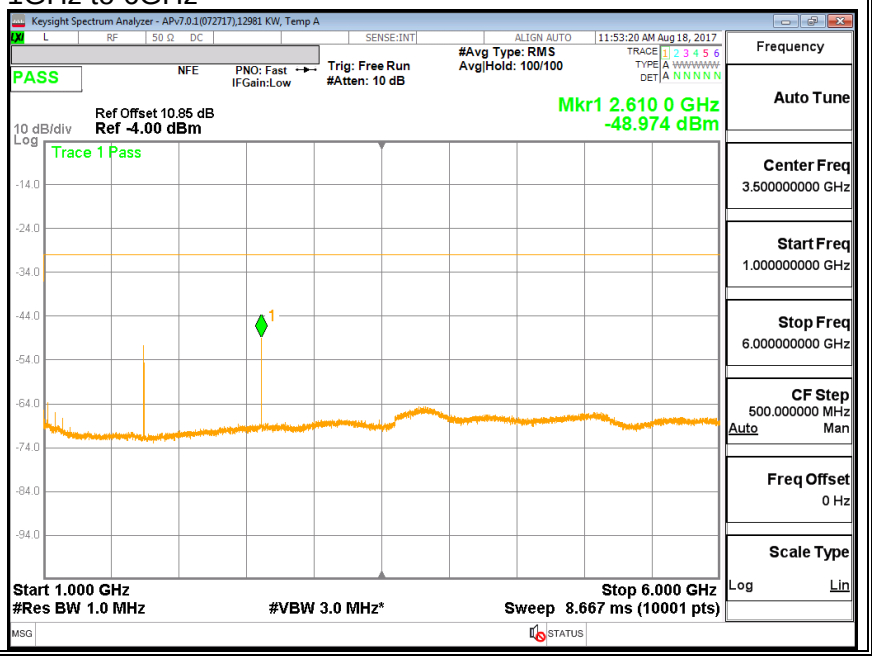
1GHz to 6GHz



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RADIATED SPURIOUS EMISSIONS

3m Radiated Emissions Chamber
30 - 1000MHz Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/21/2017
Test Engineer: 37290
Configuration: EUT with 50Ohm load and a support laptop
Mode: TX Below 1GHz GFSK X band worst case

Chamber	Pre-amplifer	Attenuator	Limit
3m Chamber B	3m-B T10		ETSI 300 220 Tx

Frequency (MHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Attenuator (dB)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel										
43.33	-54.4	H	3.0	21.0	29.0		-62.4	-36.0	-26.4	
215.94	-64.1	H	3.0	20.0	28.4		-72.6	-54.0	-18.6	
869.91	-57.3	H	3.0	30.4	28.0		-55.0	-36.0	-19.0	
44.98	-49.5	V	3.0	18.0	29.0		-60.4	-36.0	-24.4	
92.56	-59.2	V	3.0	20.0	28.8		-67.9	-54.0	-13.9	
869.80	-55.9	V	3.0	-3.9	28.0		-87.9	-36.0	-51.9	
High Channel										
42.65	-59.5	H	3.0	21.6	29.0		-66.9	-36.0	-30.9	
215.94	-60.1	H	3.0	20.0	28.4		-68.5	-54.0	-14.5	
869.81	-51.9	H	3.0	30.4	28.0		-49.5	-36.0	-13.5	
43.91	-52.5	V	3.0	18.5	29.0		-63.0	-36.0	-27.0	
210.79	-68.6	V	3.0	22.1	28.4		-74.9	-54.0	-20.9	
869.90	-56.2	V	3.0	-3.8	28.0		-88.0	-36.0	-52.0	

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3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/21/2017
Test Engineer: 37290
Configuration: EUT with 50Ohm load and a support laptop
Mode: TX Above 1GHz X band GFSK worst case

Chamber	Pre-amplifer	Filter	Limit
3m Chamber B	3m Chamber B	Filter	ETSI 300 220 Tx

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss @ SG End (dBm)	Preamp (dB)	Attenuator (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel										
1.599	-61.73	H	3.0	-17.0	38.7	1.0	-54.6	-30.0	-24.6	
2.391	-64.67	H	3.0	-15.2	38.6	1.0	-52.9	-30.0	-22.9	
4.146	-65.90	H	3.0	-13.3	38.4	1.0	-50.7	-30.0	-20.7	
1.197	-60.69	V	3.0	-18.5	38.5	1.0	-56.0	-30.0	-26.0	
3.749	-64.51	V	3.0	-12.3	38.4	1.0	-49.7	-30.0	-19.7	
5.209	-64.92	V	3.0	-10.3	38.7	1.0	-48.0	-30.0	-18.0	
High Channel										
1.740	-62.73	H	3.0	-16.8	38.4	1.0	-54.2	-30.0	-24.2	
3.460	-68.20	H	3.0	-16.7	38.5	1.0	-54.2	-30.0	-24.2	
4.678	-65.94	H	3.0	-12.3	38.6	1.0	-49.9	-30.0	-19.9	
1.739	-62.65	V	3.0	-16.6	38.4	1.0	-54.0	-30.0	-24.0	
3.747	-64.85	V	3.0	-12.6	38.4	1.0	-50.0	-30.0	-20.0	
5.218	-65.14	V	3.0	-10.5	38.7	1.0	-48.2	-30.0	-18.2	

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7.7.7. TX TRANSIENT POWER

REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.10.2

The TX TRANSIENT POWER shall not exceed the values given in Table 23.

Table 23: Transmitter Transient Power limits

Absolute offset from centre frequency	RBW_{REF}	Peak power limit applicable at measurement points
≤ 400 kHz	1 kHz	0 dBm
> 400 kHz	1 kHz	-27 dBm

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.10.3.2

RESULTS

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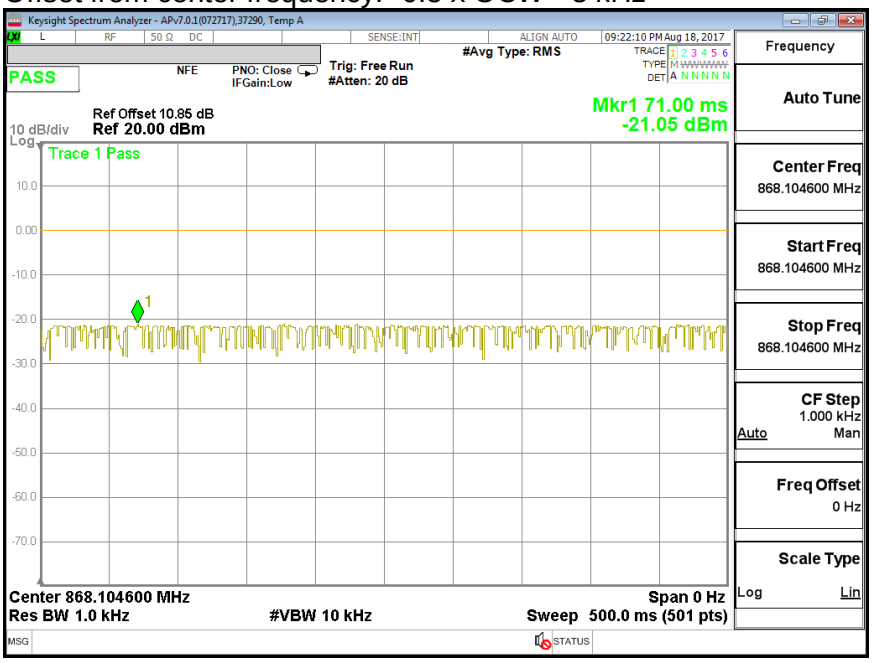
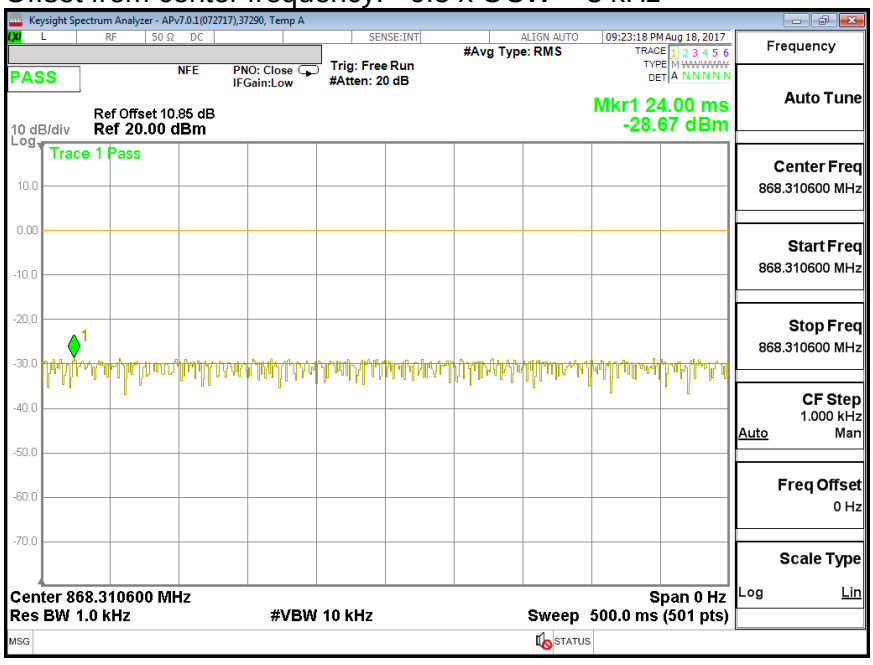
THE WORST CASE OF GFSK LOW CHANNEL

TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 3 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 3 kHz



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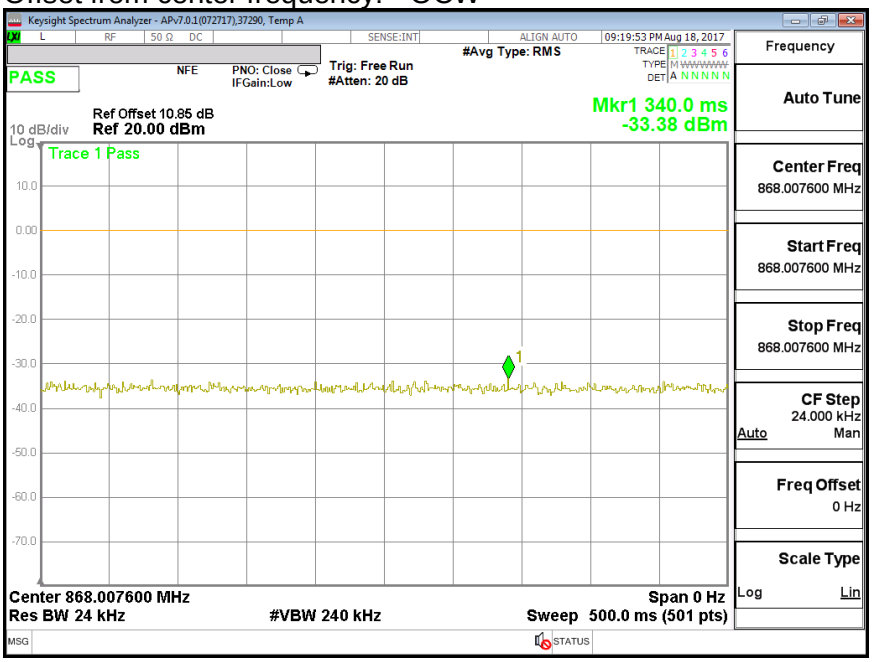
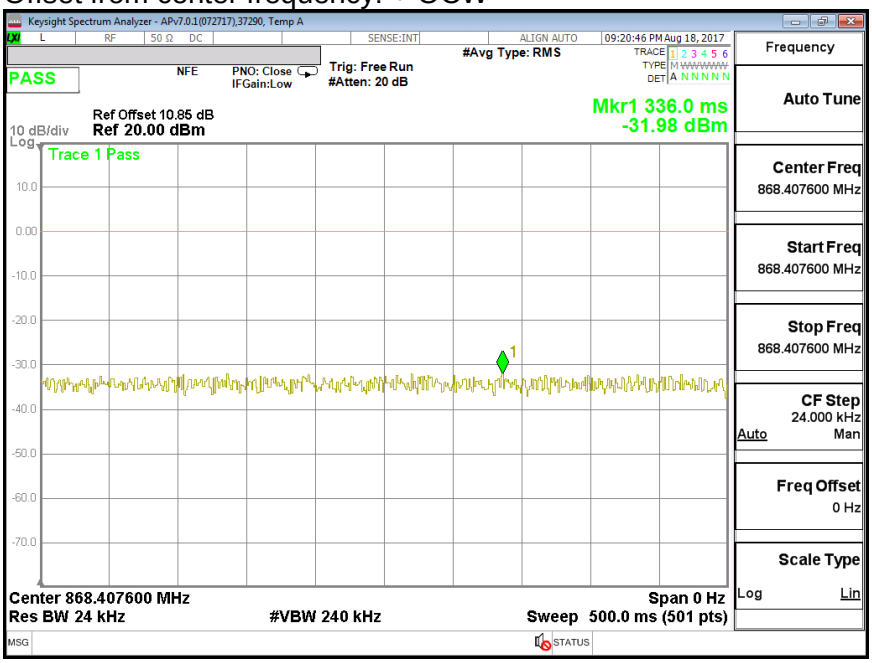
TX TRANSIENT
Offset from center frequency: - OCW



TX TRANSIENT
Offset from center frequency: + OCW



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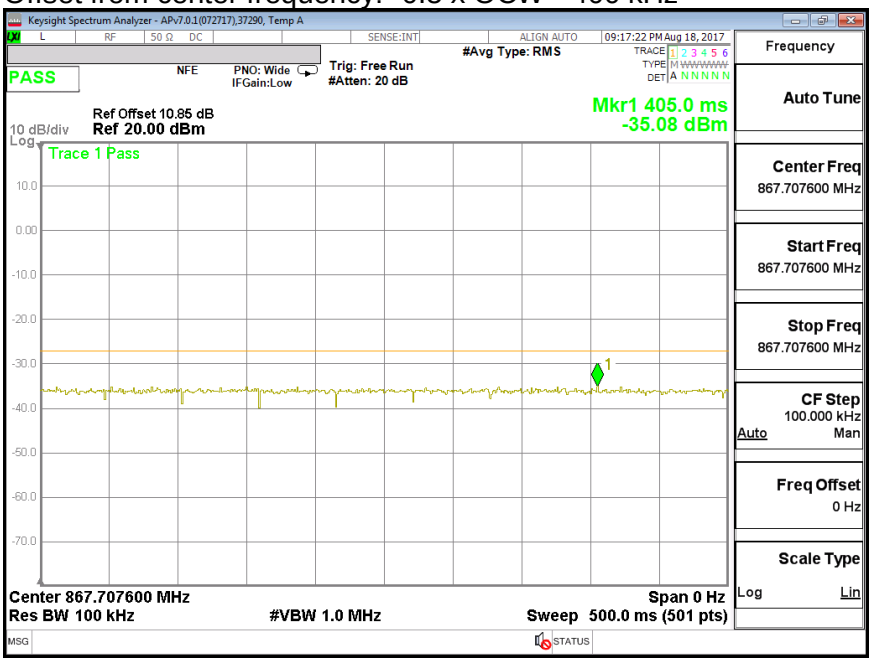
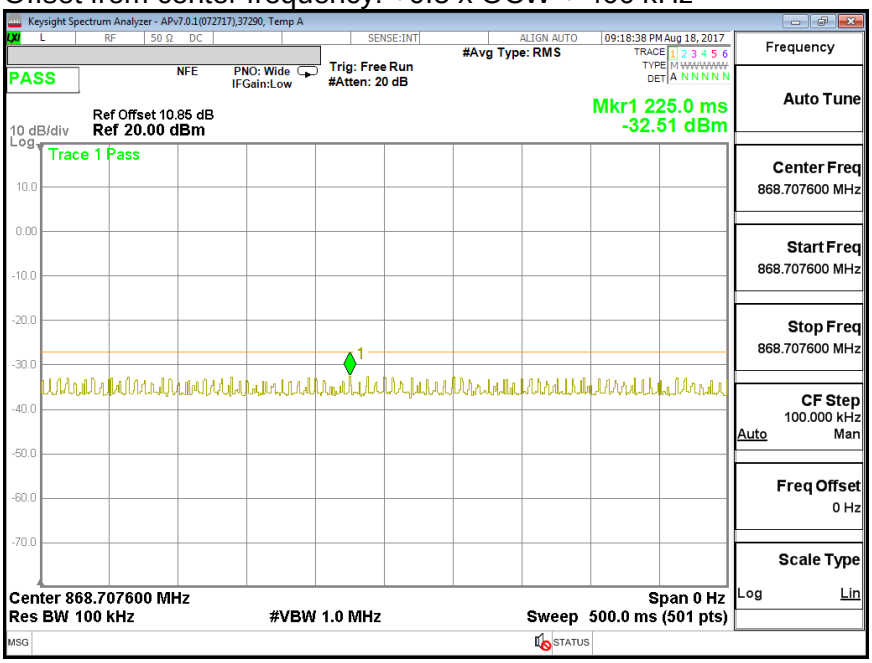
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 400 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 400 kHz



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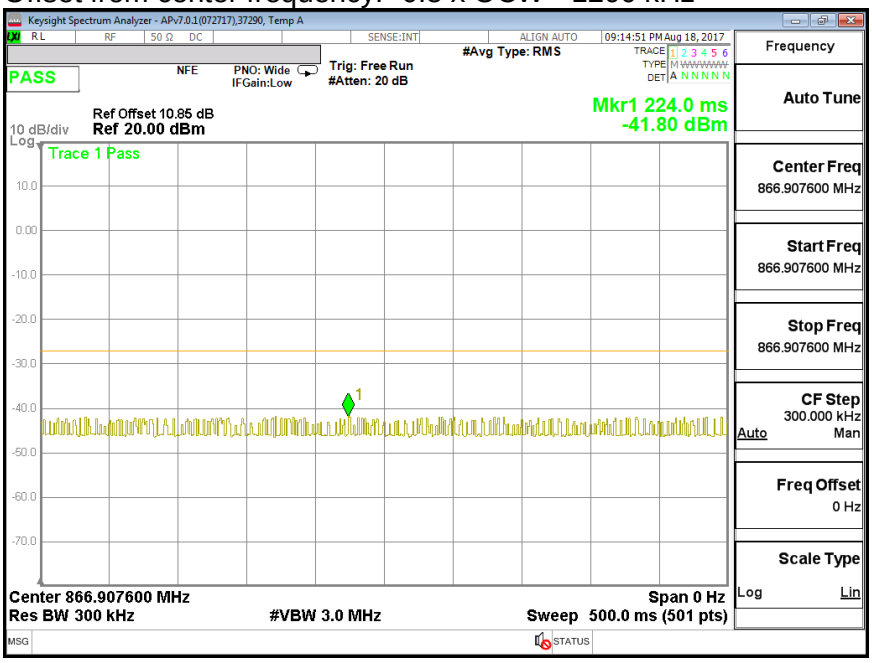
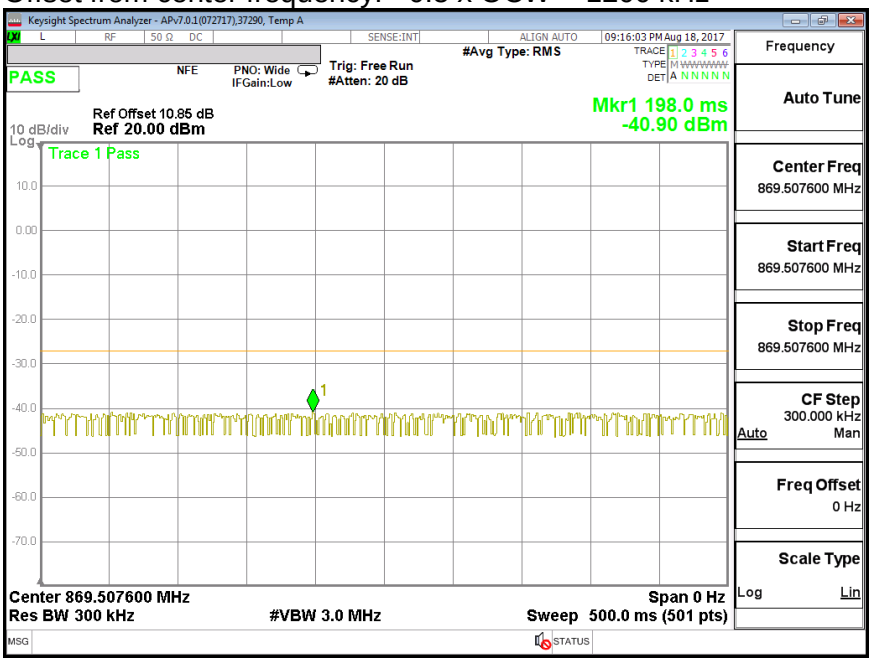
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 1200 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 1200 kHz



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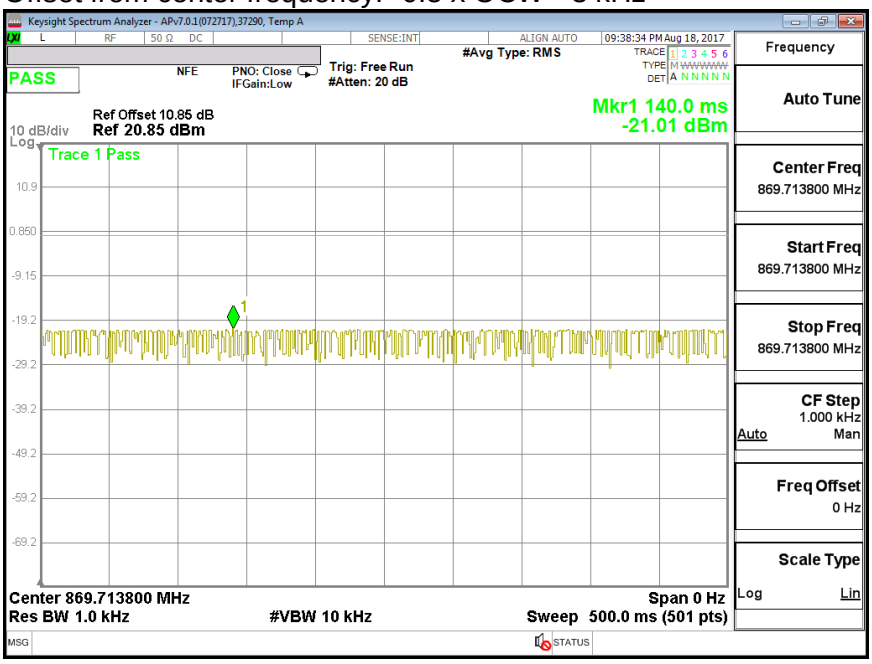
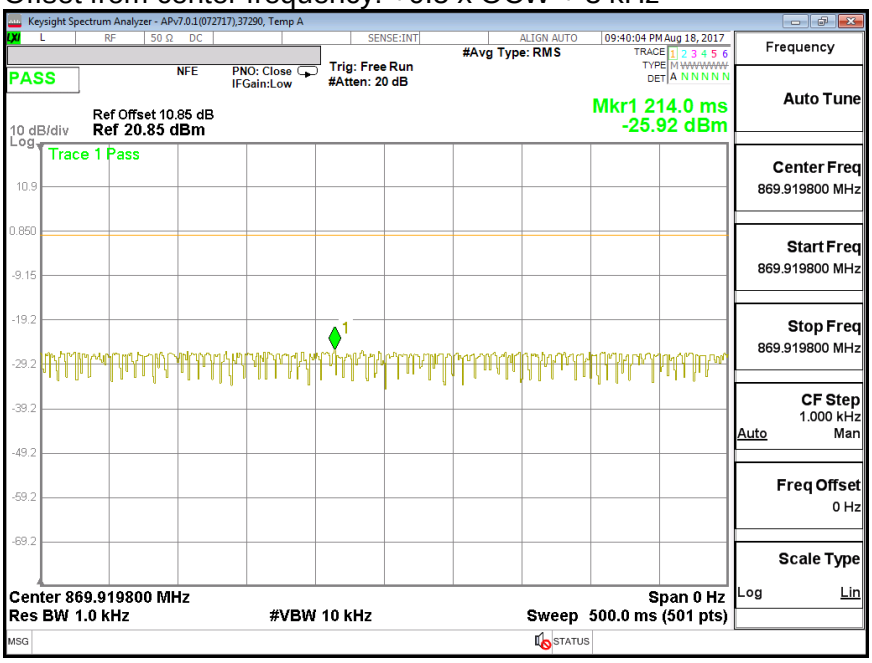
THE WORST CASE OF GFSK HIGH CHANNEL

TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 3 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 3 kHz



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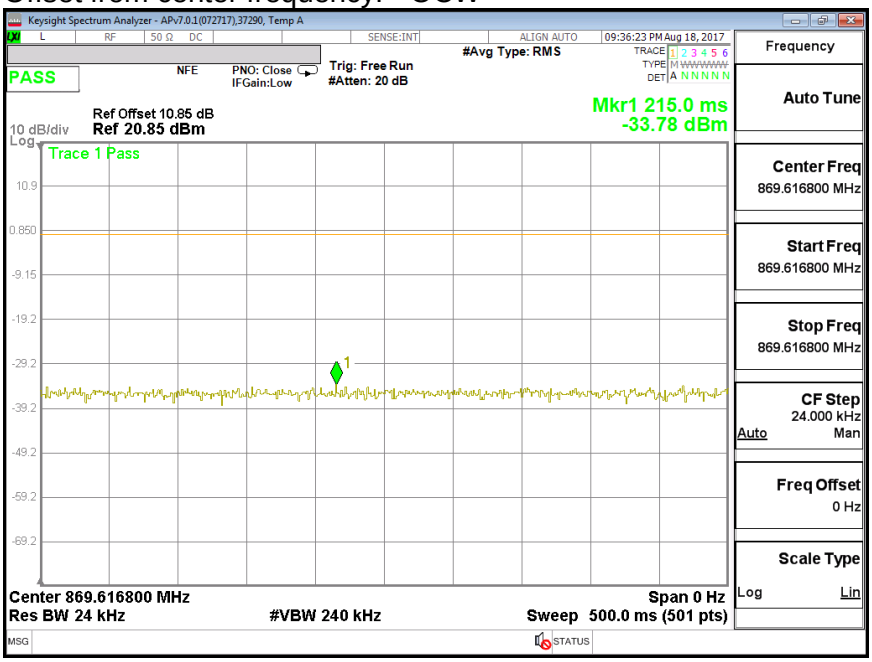
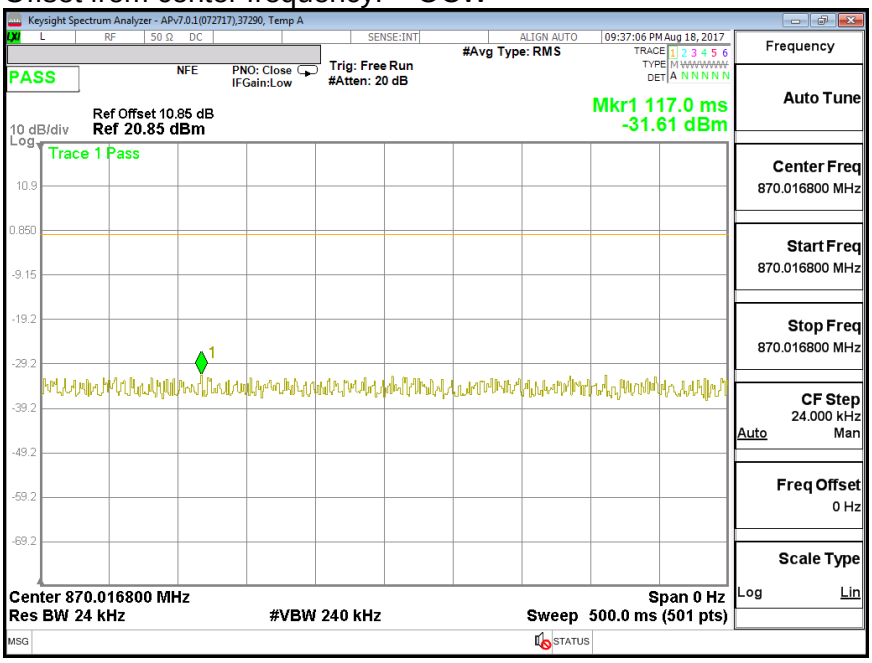
TX TRANSIENT
Offset from center frequency: - OCW



TX TRANSIENT
Offset from center frequency: + OCW



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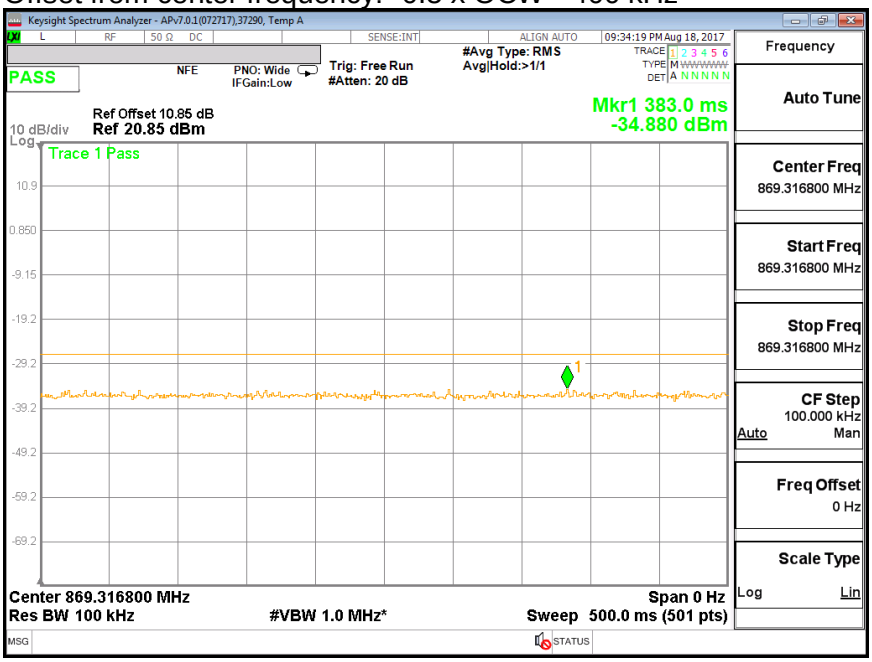
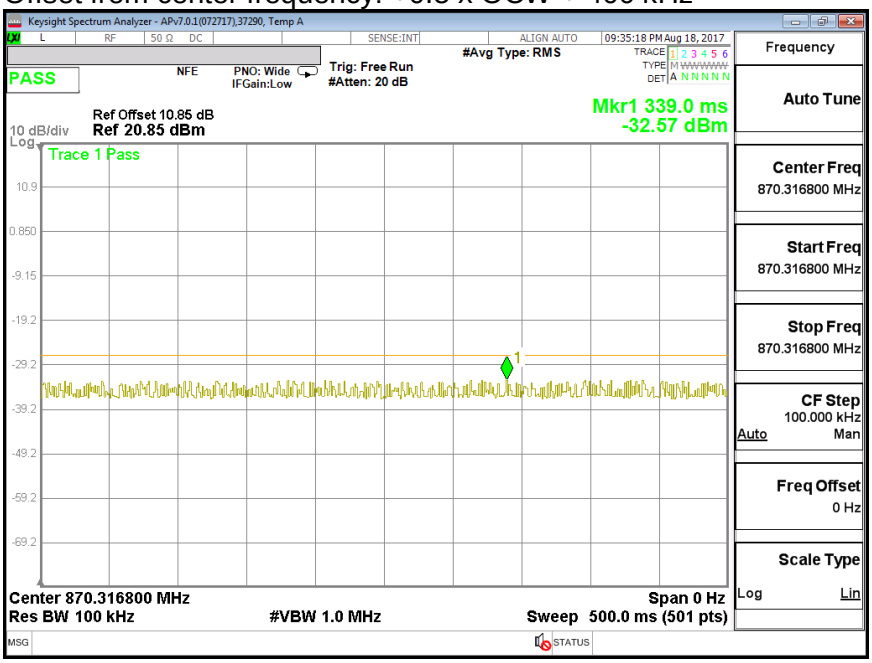
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 400 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 400 kHz



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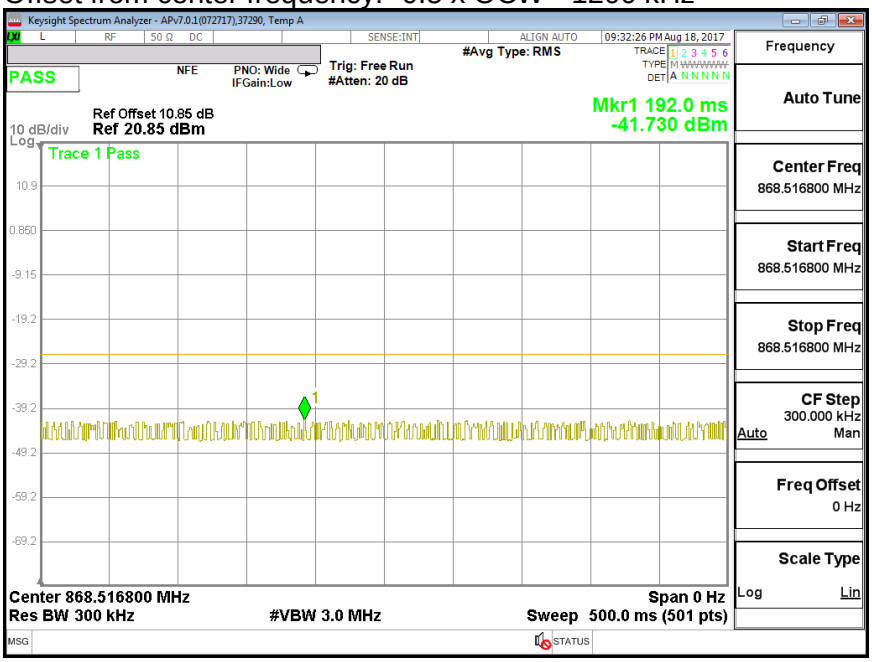
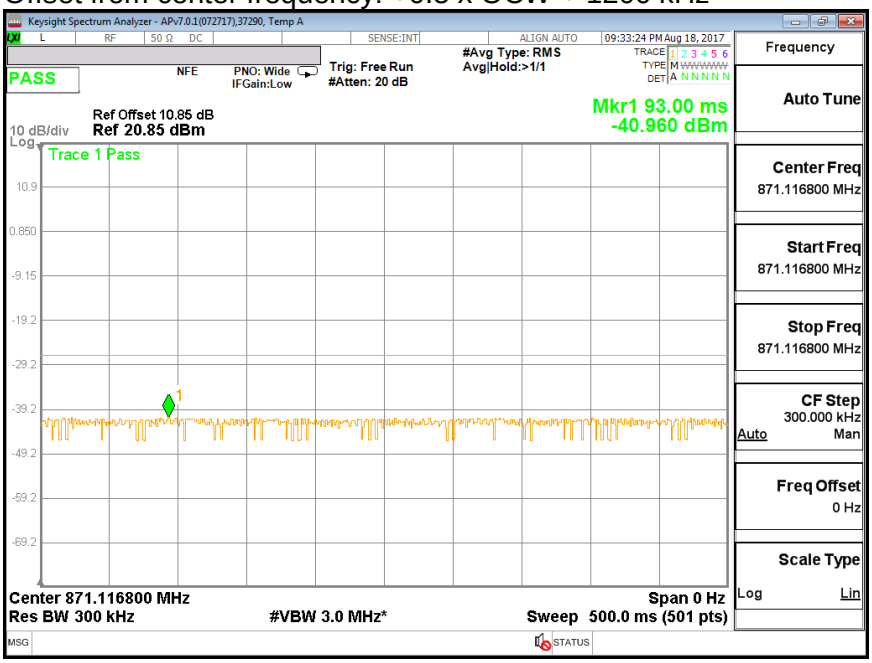
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 1200 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 1200 kHz



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7.8. 2-FSK MODULATION IN M BAND

7.8.1. OPERATING FREQUENCY

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.2.1.2

The manufacturer may declare either one or more operating frequencies and operating channels.
Operating channel(s) shall be entirely within operational frequency bands allowed by annexes B, C or any NRI.

22 ETSI EN 300 220-2 V3.1.1 (2017-02)

Operational Frequency Band		Maximum effective radiated power, e.r.p.	Channel access and occupation rules (e.g. Duty cycle or LBT + AFA)	Maximum occupied bandwidth	Other usage restrictions	Band number from EC Decision 2013/752/EU [i.3]	Class 1 sub-class number according Commission Decision 2000/299/EU [i.7]
M	868,000 MHz to 868,600 MHz	25 mW e.r.p.	≤ 1 % duty cycle or polite spectrum access	The whole band except for audio & video applications limited to 300 kHz		48	28
N	868,700 MHz to 869,200 MHz	25 mW e.r.p.	≤ 0,1% duty cycle or polite spectrum access	The whole sub-band except for audio & video applications limited to 300 kHz		50	29
O	869,400 MHz to 869,650 MHz	25 mW e.r.p.	≤ 0.1% duty cycle or polite spectrum access	The whole band	.	54a	130
P	869,400 MHz to 869,650 MHz	500 mW e.r.p.	≤ 10 % duty cycle or polite spectrum access	The whole band		54b	30
Q	869,700 MHz to 870,000 MHz	5 mW e.r.p.	No requirement	The whole band	Audio and video applications are excluded.	56a	31
R	869,700 MHz to 870,000 MHz	25 mW e.r.p.	≤ 1% duty cycle or polite spectrum access	The whole band	Analogue audio applications are excluded. Analogue video applications are excluded.	56b	69

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.1.2

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RESULTS

Parameter	Values as declared by the manufacturer
M4, 2-FSK	
Operational Frequency band or bands	868 - 868.6
Nominal Operating Frequencies (MHz)	868.103806 - 868.467178
Operating Channel width(s) - OCW	80 kHz
M5, 2-FSK	
Operational Frequency band or bands	868 - 868.6
Nominal Operating Frequencies (MHz)	868.155716 - 868.363358
Operating Channel width(s) - OCW	120 kHz
M11, 2-FSK	
Operational Frequency band or bands	868 - 868.6
Nominal Operating Frequencies (MHz)	868.103806 - 868.467178
Operating Channel width(s) - OCW	40 kHz

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7.8.2. TX EFFECTIVE RADIATED POWER

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.3.1.2

The effective radiated power shall not be greater than the value allowed in annexes B or C for the chosen operational frequency band(s).

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.2.2.1.2

RESULTS

Date: 08/11/17
Project No: 11773240
Tester: 50818_JQ

CHANNELS FOR MODULATION CODE: M5

EUT Antenna Gain (dBi) =	2.00

Condition	Output Power (dBm)	EIRP (dBm)	ERP (dBm)	Limit (dBm)	Margin (dB)
Low Channel, CH3					
Normal	11.76	13.76	11.61	13.98	-2.37
Extreme T low, V low	12.51	14.51	12.36	13.98	-1.62
Extreme T low, V high	12.47	14.47	12.32	13.98	-1.66
Extreme T high, V low	11.20	13.20	11.05	13.98	-2.93
Extreme T high, V high	11.19	13.19	11.04	13.98	-2.94
High Channel, CH7					
Normal	11.76	13.76	11.61	13.98	-2.37
Extreme T low, V low	12.49	14.49	12.34	13.98	-1.64
Extreme T low, V high	12.47	14.47	12.32	13.98	-1.66
Extreme T high, V low	11.20	13.20	11.05	13.98	-2.93
Extreme T high, V high	11.20	13.20	11.05	13.98	-2.93

Note: Cable loss correction factor is included in the Power Meter Reading

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7.8.3. TX OCCUPIED BANDWIDTH

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.3.4.2

The occupied bandwidth of the EUT according to ETSI EN 300 220-1 [1], clause 5.6.2 shall comply with the limits in annex B or C.

Reference Limit:

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.6.2

The Operating Channel shall be declared and shall reside entirely within the Operational Frequency Band. The Maximum Occupied Bandwidth at 99 % shall reside entirely within the Operating Channel defined by F_{low} and F_{high}.

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.6.3.3 (Conducted Measurement)

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RESULTS

BAND M

Condition	Low CH (MHz)	High CH (MHz)	Low CH OBW (kHz)	High CH OBW (kHz)	F_{Low} (MHz)	F_{Low} Limit (MHz)	F_{High} (MHz)	F_{High} Limit (MHz)
M4, 2-FSK								
Normal	868.1038	868.4672	64.141	63.938	868.07	> 868	868.50	< 868.6
T low, V low	868.1038	868.4672	64.310	64.706	868.07	> 868	868.50	< 868.6
T low, V high	868.1038	868.4672	64.755	64.694	868.07	> 868	868.50	< 868.6
T high, V low	868.1038	868.4672	64.188	64.698	868.07	> 868	868.50	< 868.6
T high, V high	868.1038	868.4672	64.568	64.651	868.07	> 868	868.50	< 868.6
M5, 2-FSK								
Normal	868.1557	868.3634	101.460	101.800	868.10	> 868	868.41	< 868.6
T low, V low	868.1557	868.3634	101.880	101.490	868.10	> 868	868.41	< 868.6
T low, V high	868.1557	868.3634	102.310	102.280	868.10	> 868	868.41	< 868.6
T high, V low	868.1557	868.3634	101.160	101.090	868.11	> 868	868.41	< 868.6
T high, V high	868.1557	868.3634	101.390	101.480	868.10	> 868	868.41	< 868.6
M11, 2-FSK								
Normal	868.1038	868.4672	38.619	39.056	868.08	> 868	868.49	< 868.6
T low, V low	868.1038	868.4672	37.357	37.665	868.08	> 868	868.49	< 868.6
T low, V high	868.1038	868.4672	37.662	37.694	868.08	> 868	868.49	< 868.6
T high, V low	868.1038	868.4672	37.829	38.668	868.08	> 868	868.49	< 868.6
T high, V high	868.1038	868.4672	38.389	38.493	868.08	> 868	868.49	< 868.6

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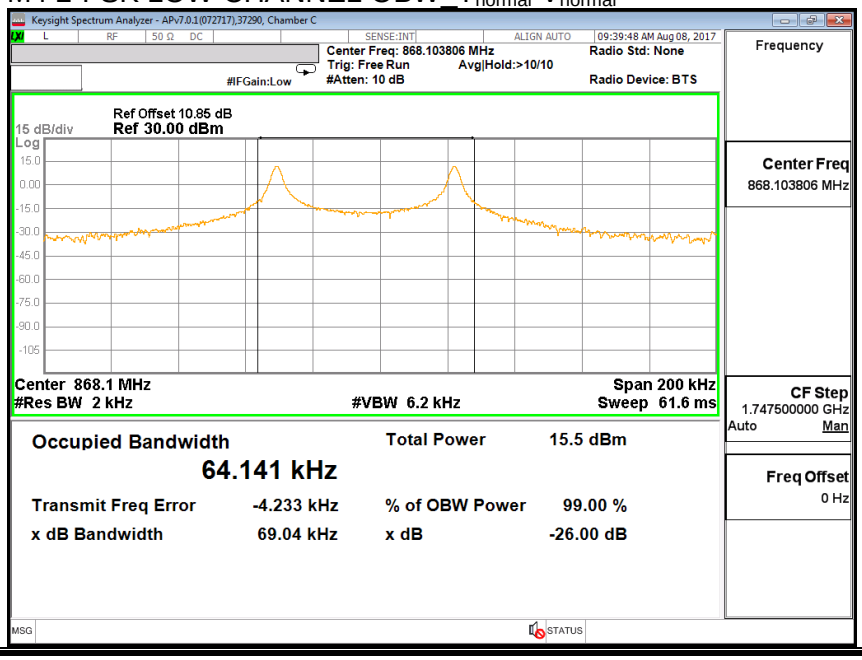
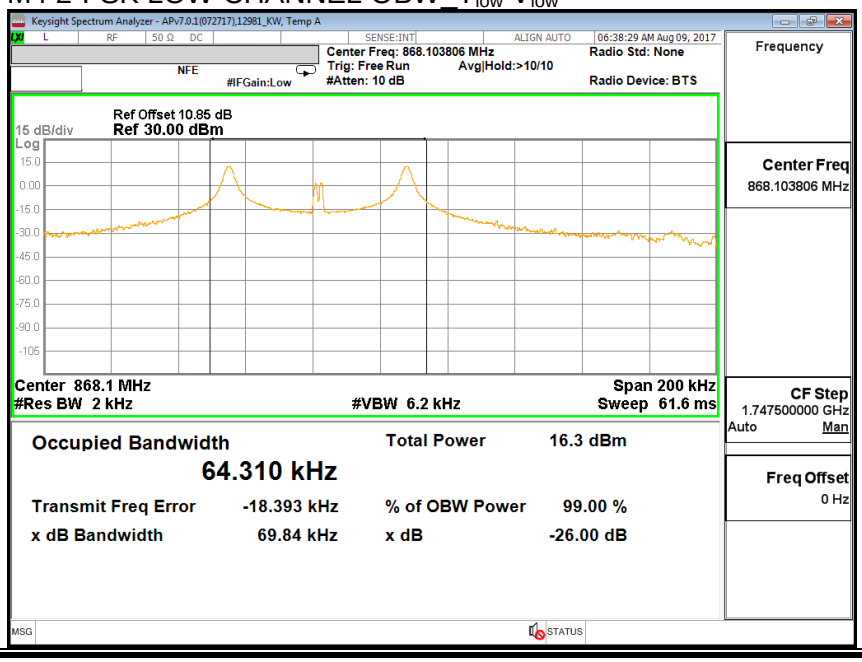
M4 2-FSK LOW CHANNEL OBW_T_{normal} V_{normal}



M4 2-FSK LOW CHANNEL OBW_T_{low} V_{low}



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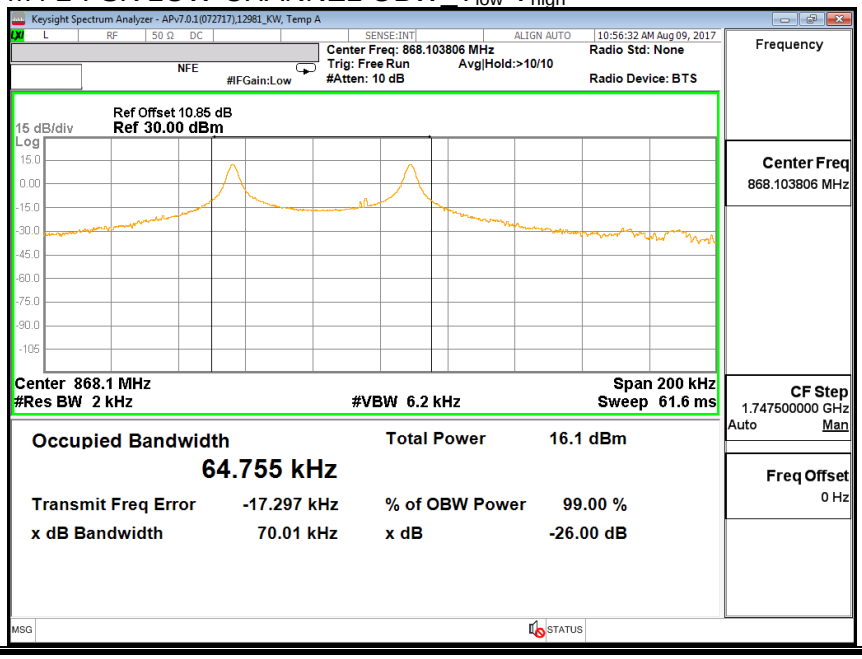
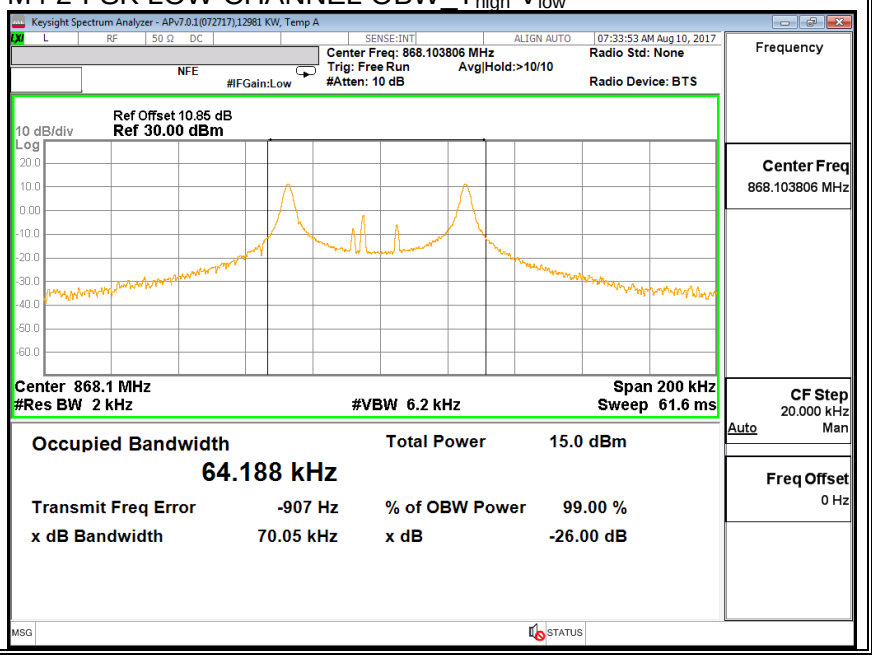
M4 2-FSK LOW CHANNEL OBW_T_{low} V_{high}



M4 2-FSK LOW CHANNEL OBW_T_{high} V_{low}



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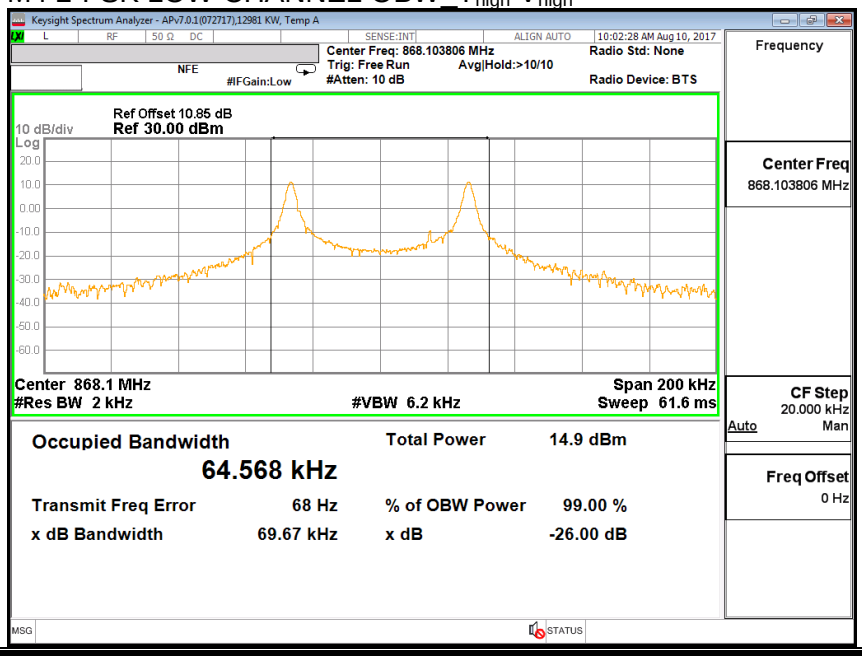
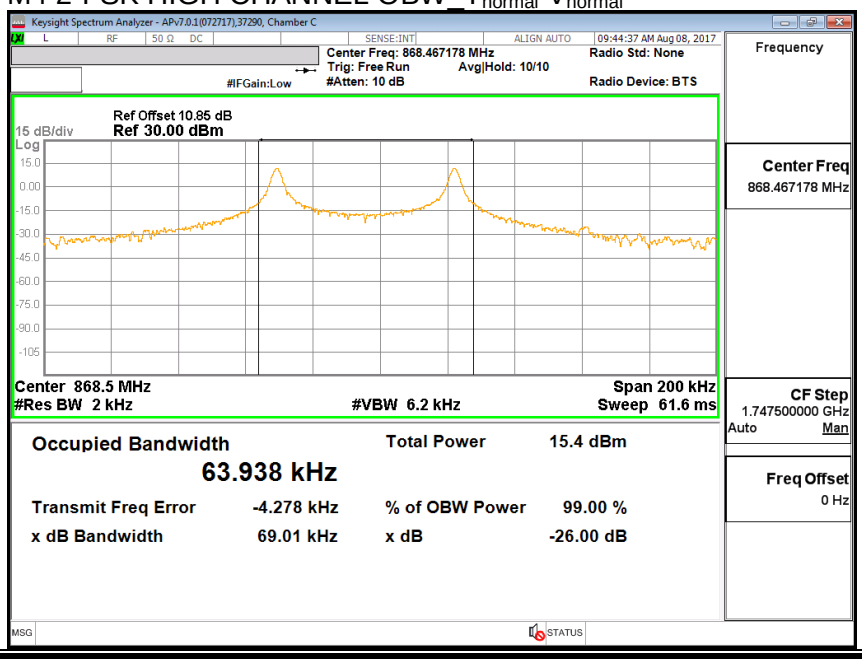
M4 2-FSK LOW CHANNEL OBW_T_{high} V_{high}



M4 2-FSK HIGH CHANNEL OBW_T_{normal} V_{normal}



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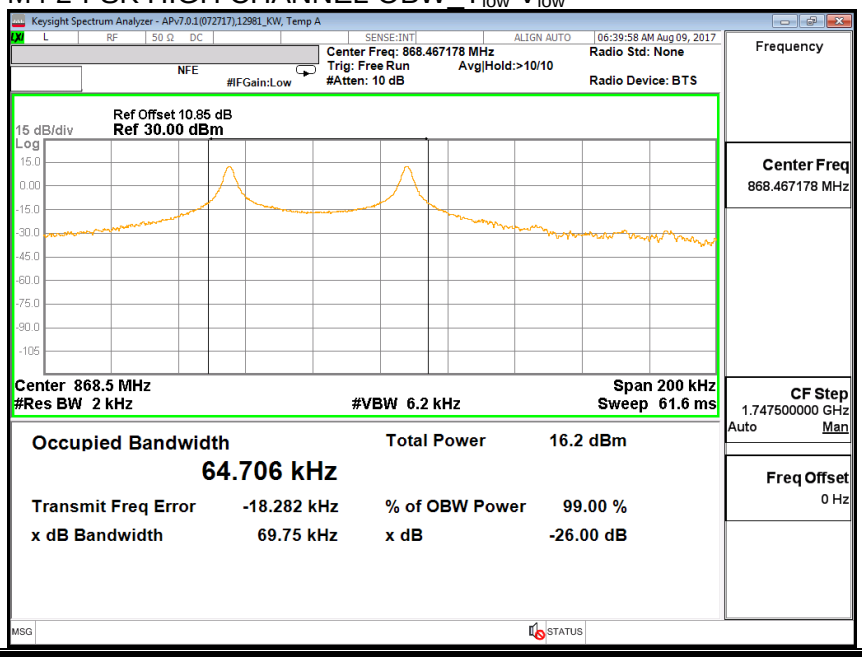
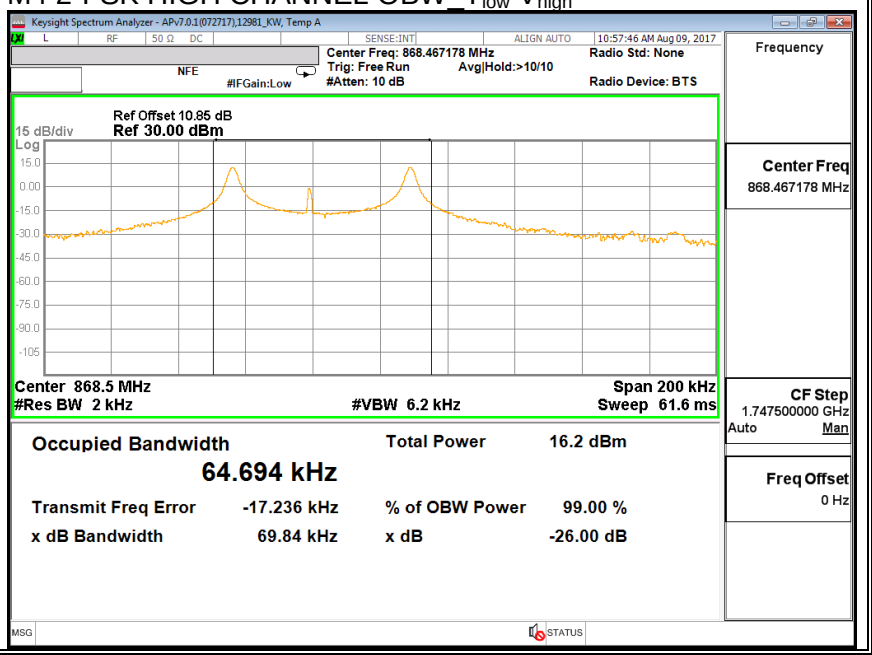
M4 2-FSK HIGH CHANNEL OBW_T_{low} V_{low}



M4 2-FSK HIGH CHANNEL OBW_T_{low} V_{high}



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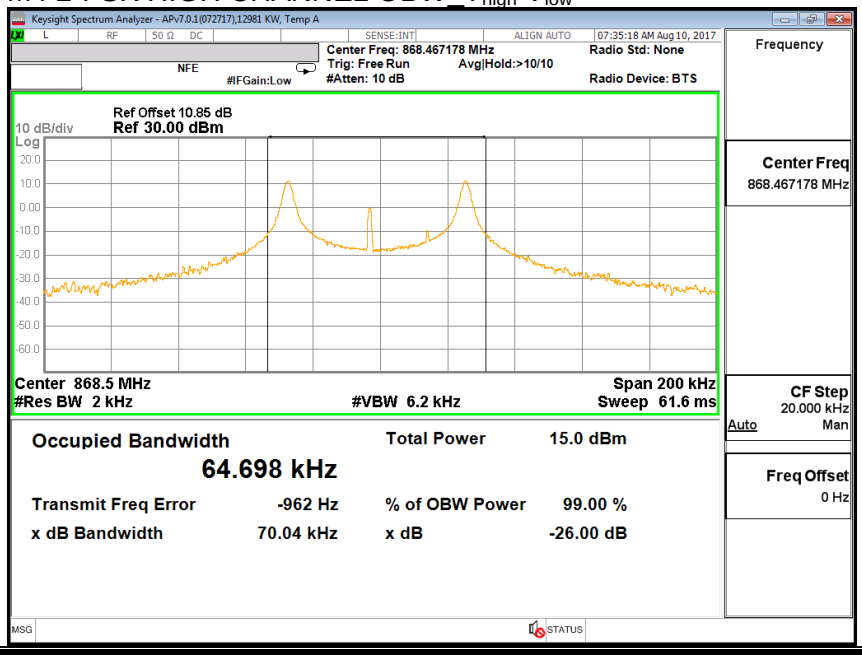
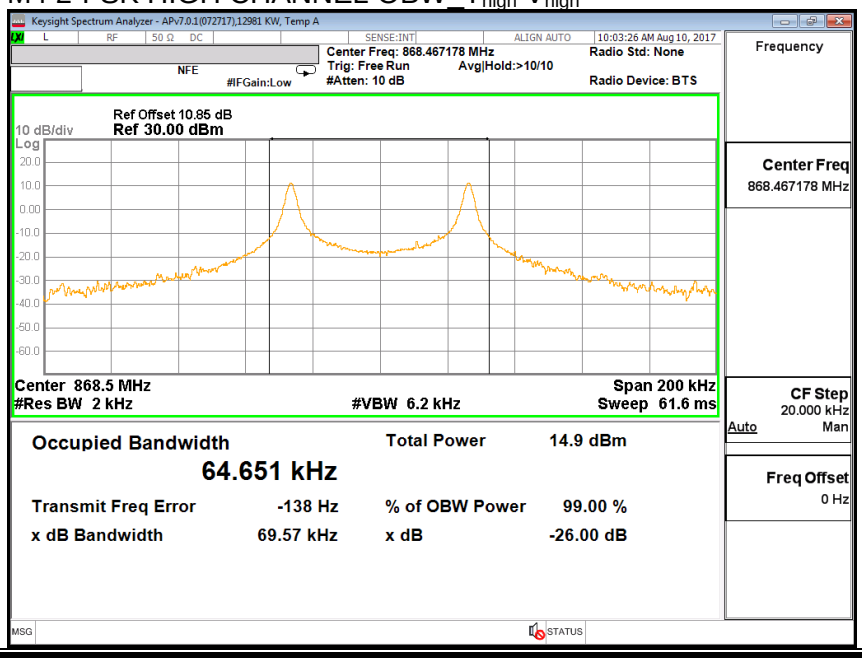
M4 2-FSK HIGH CHANNEL OBW_T_{high} V_{low}



M4 2-FSK HIGH CHANNEL OBW_T_{high} V_{high}



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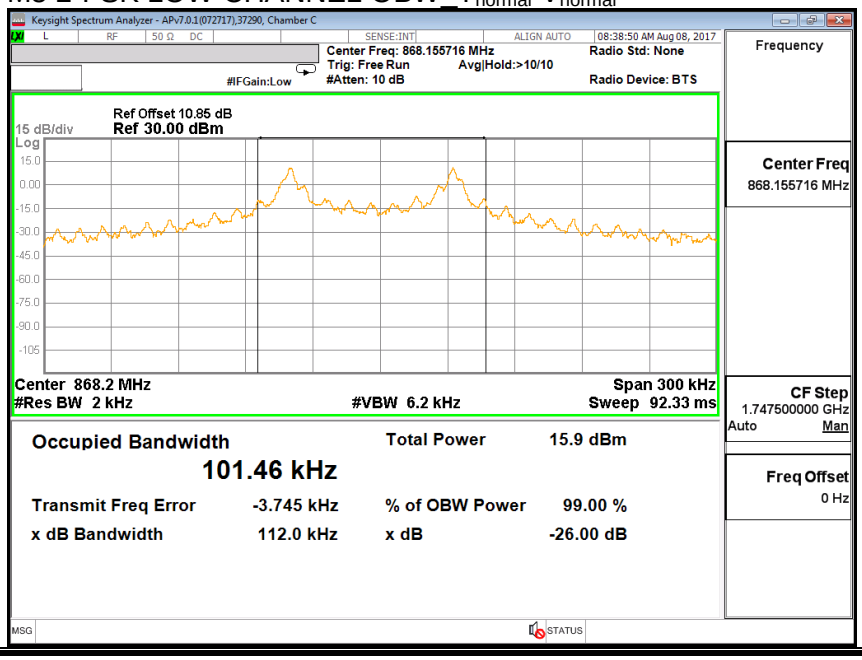
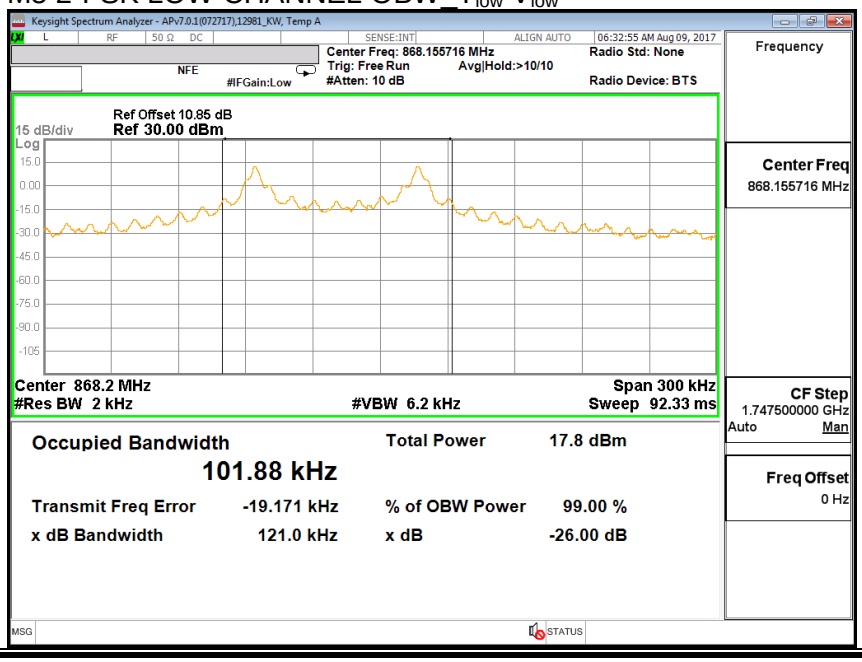
M5 2-FSK LOW CHANNEL OBW_T_{normal} V_{normal}



M5 2-FSK LOW CHANNEL OBW_T_{low} V_{low}



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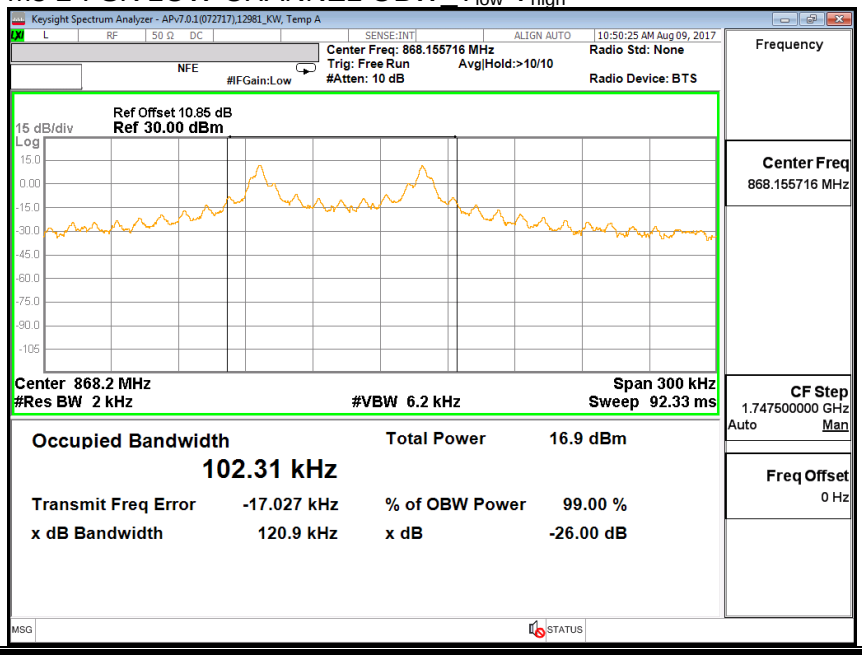
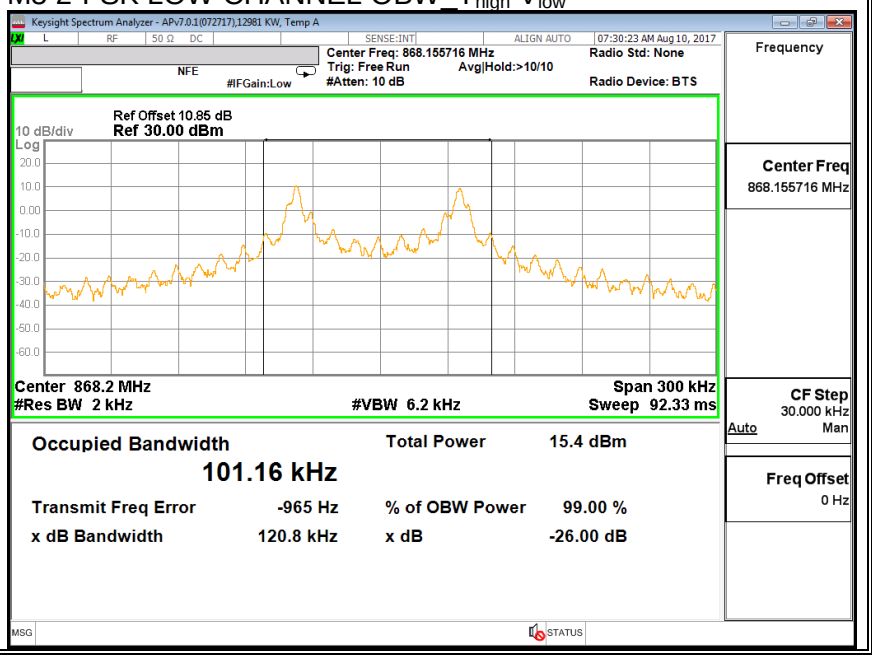
M5 2-FSK LOW CHANNEL OBW_T_{low} V_{high}



M5 2-FSK LOW CHANNEL OBW_T_{high} V_{low}



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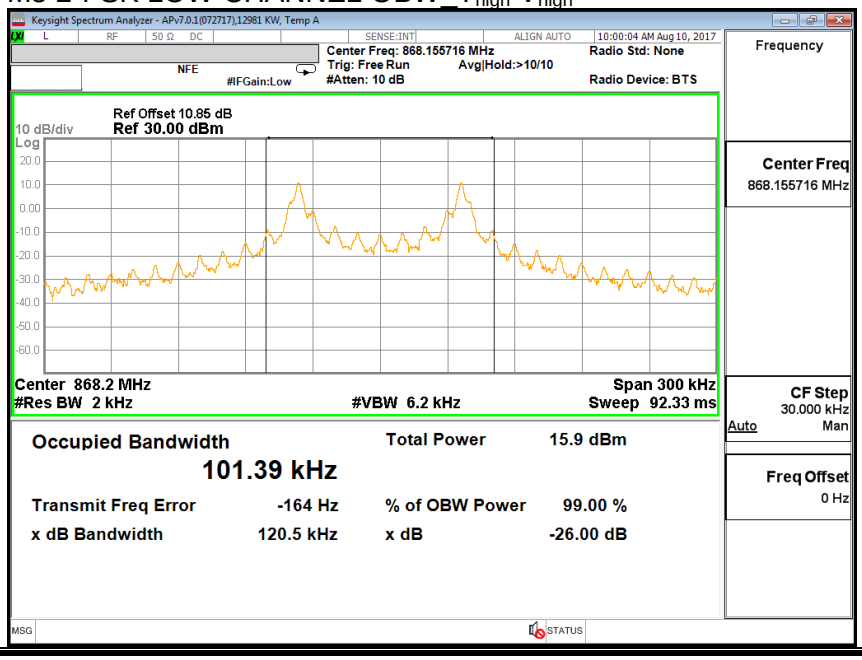
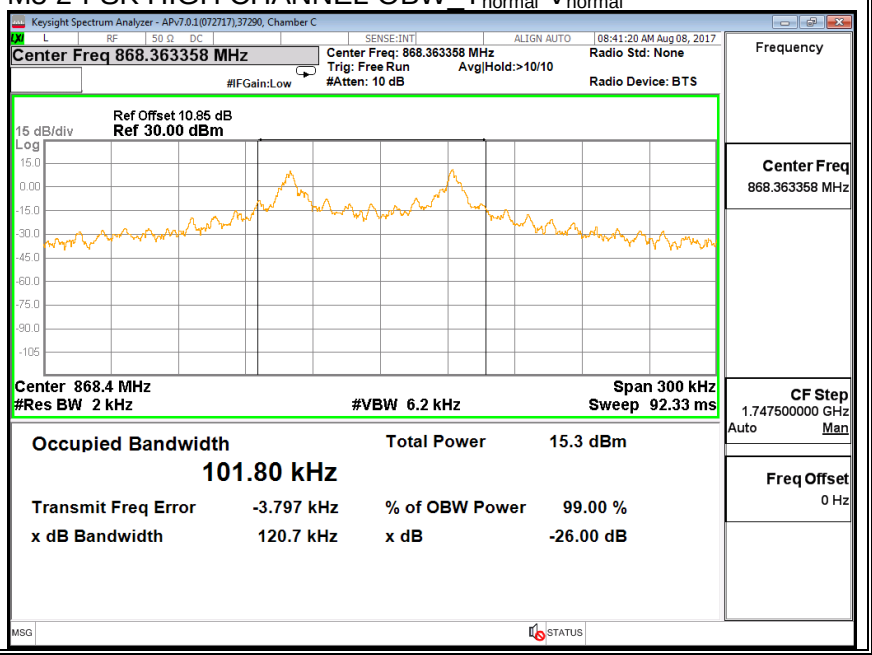
M5 2-FSK LOW CHANNEL OBW_T_{high} V_{high}



M5 2-FSK HIGH CHANNEL OBW_T_{normal} V_{normal}



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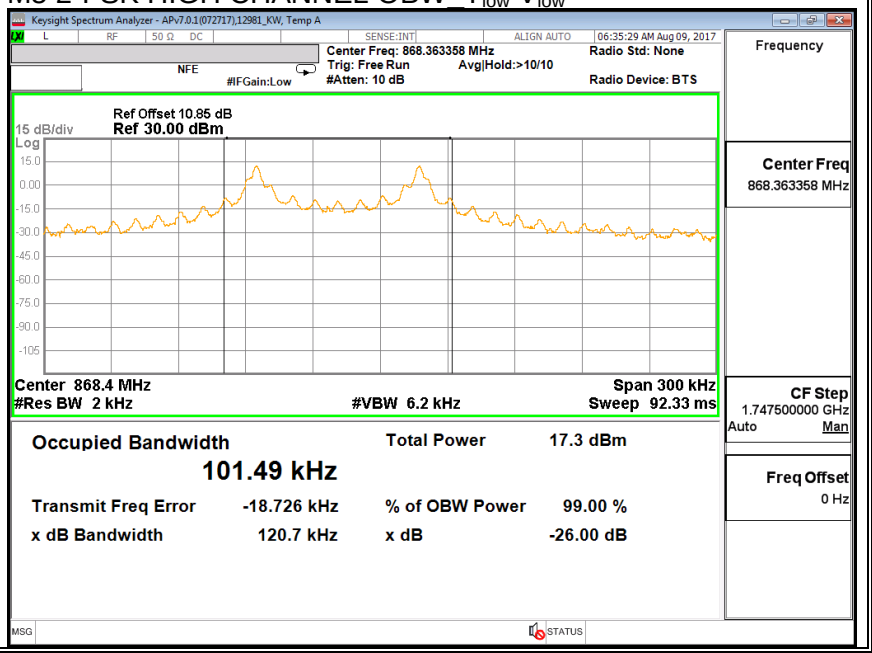
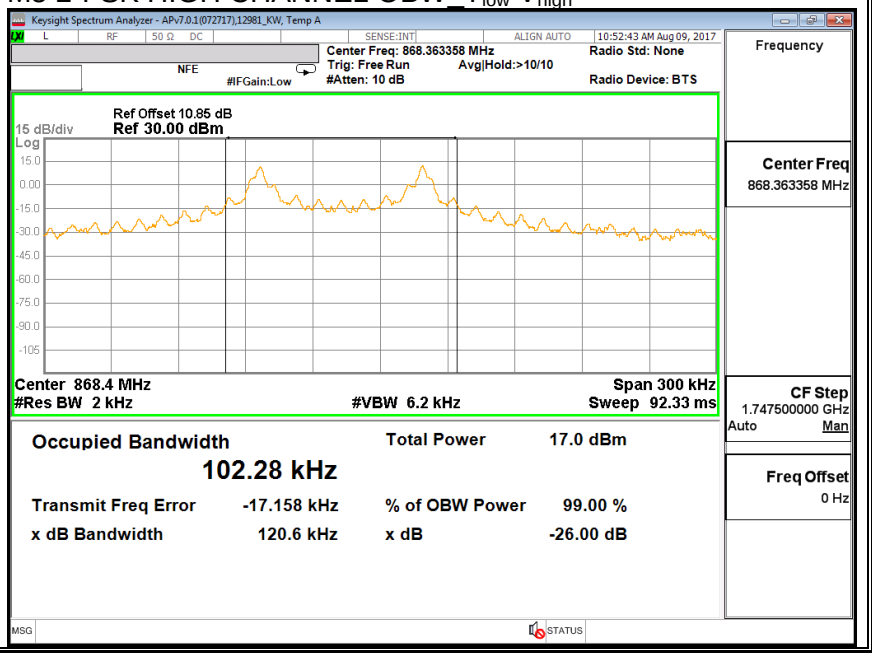
M5 2-FSK HIGH CHANNEL OBW_T_{low} V_{low}



M5 2-FSK HIGH CHANNEL OBW_T_{low} V_{high}



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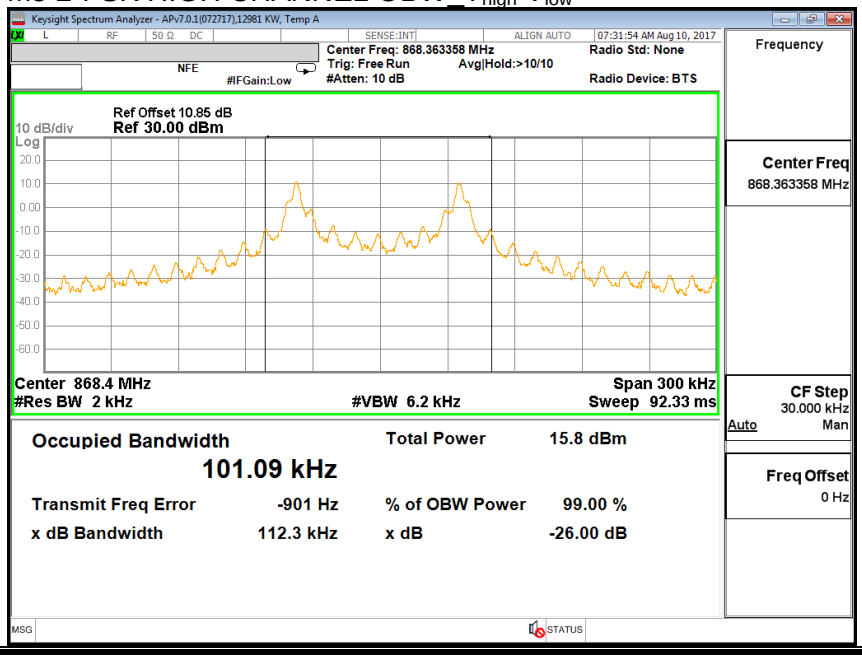
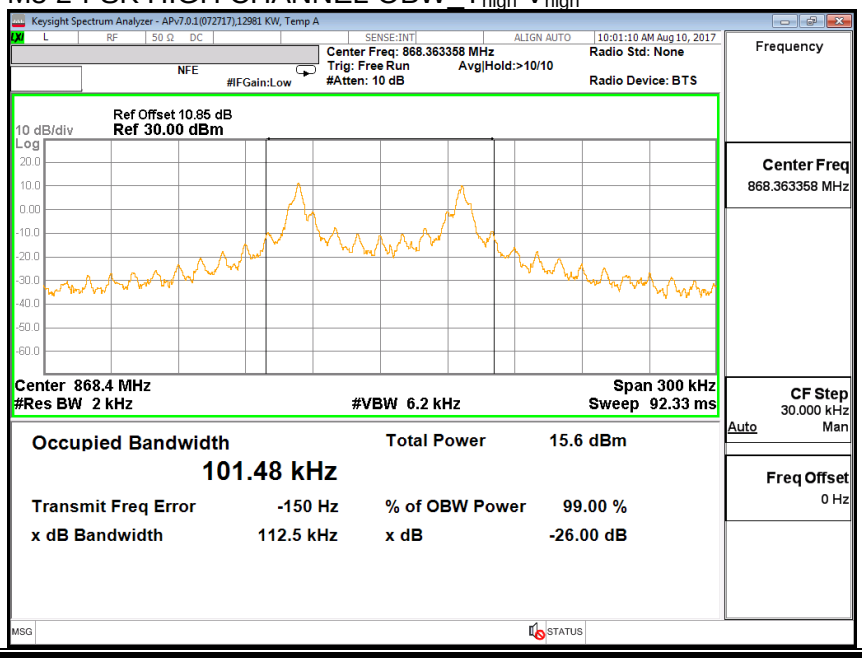
M5 2-FSK HIGH CHANNEL OBW_T_{high} V_{low}



M5 2-FSK HIGH CHANNEL OBW_T_{high} V_{high}



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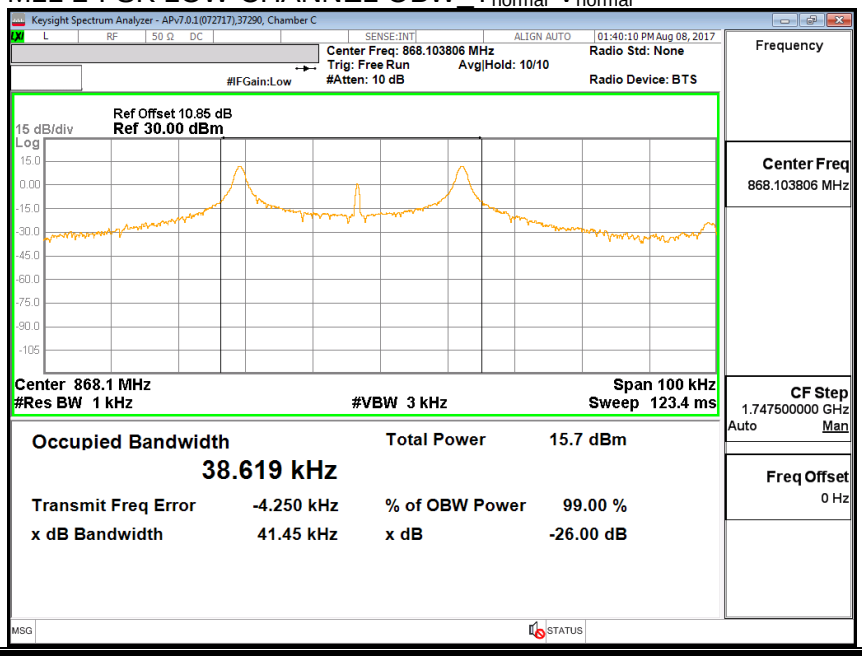
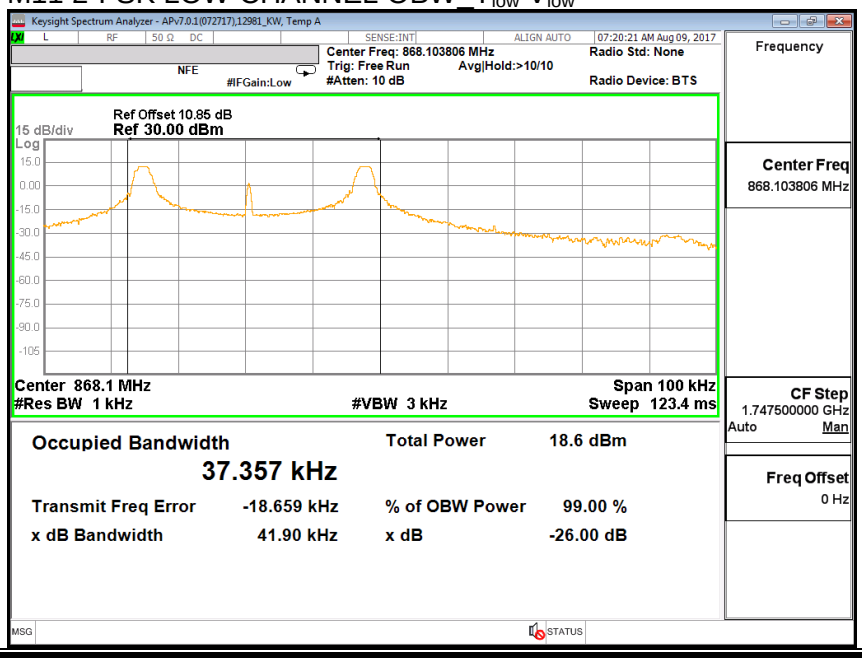
M11 2-FSK LOW CHANNEL OBW_T_{normal} V_{normal}



M11 2-FSK LOW CHANNEL OBW_T_{low} V_{low}



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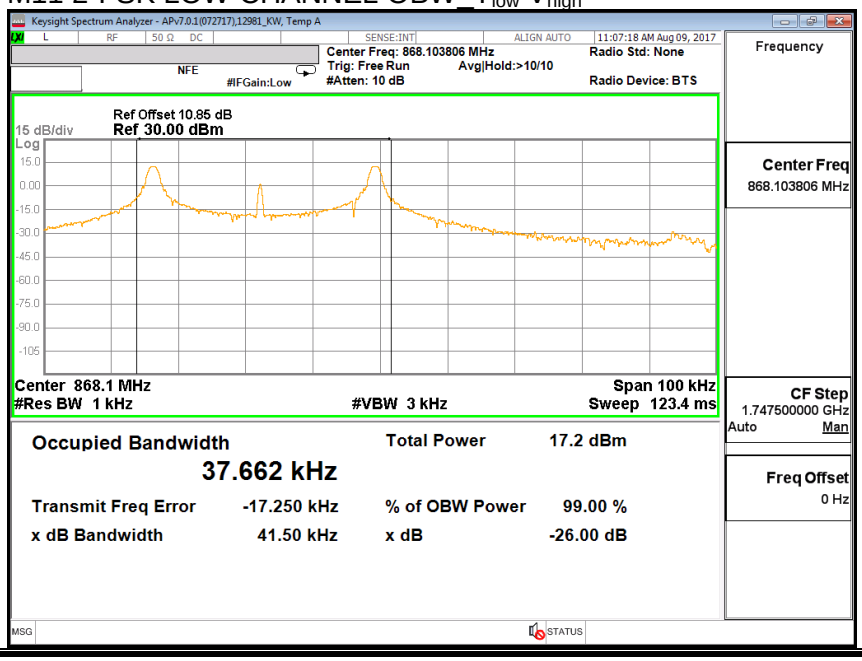
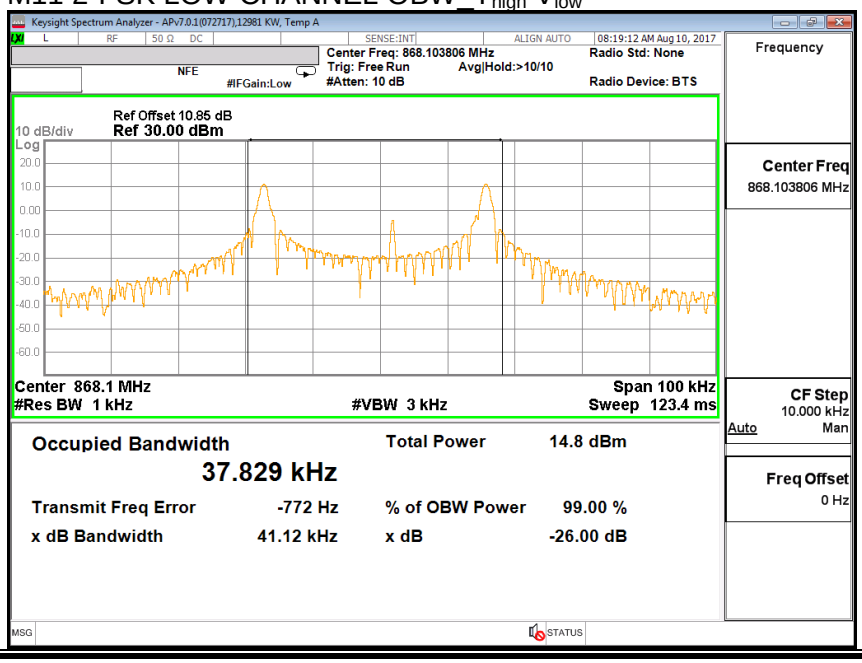
M11 2-FSK LOW CHANNEL OBW_T_{low} V_{high}



M11 2-FSK LOW CHANNEL OBW_T_{high} V_{low}



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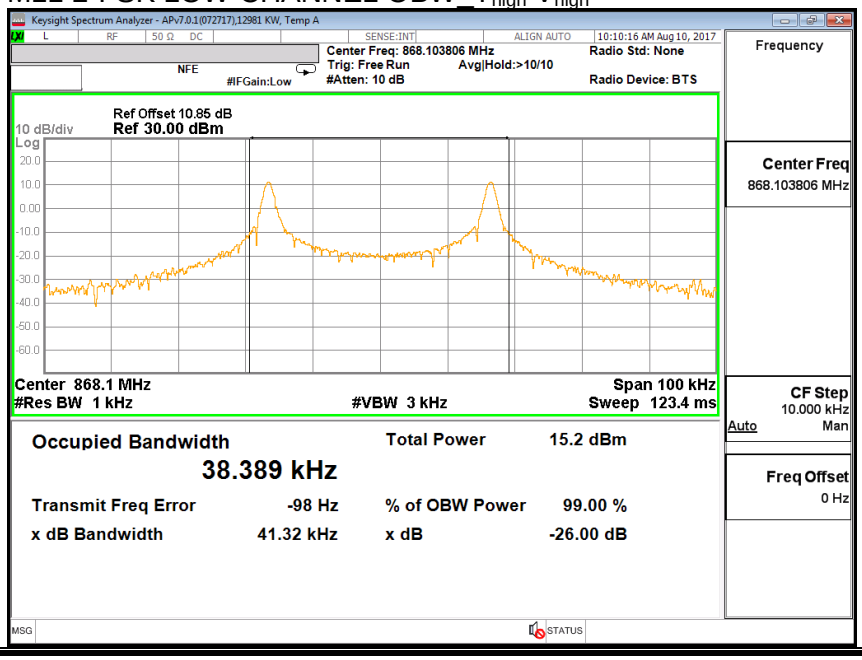
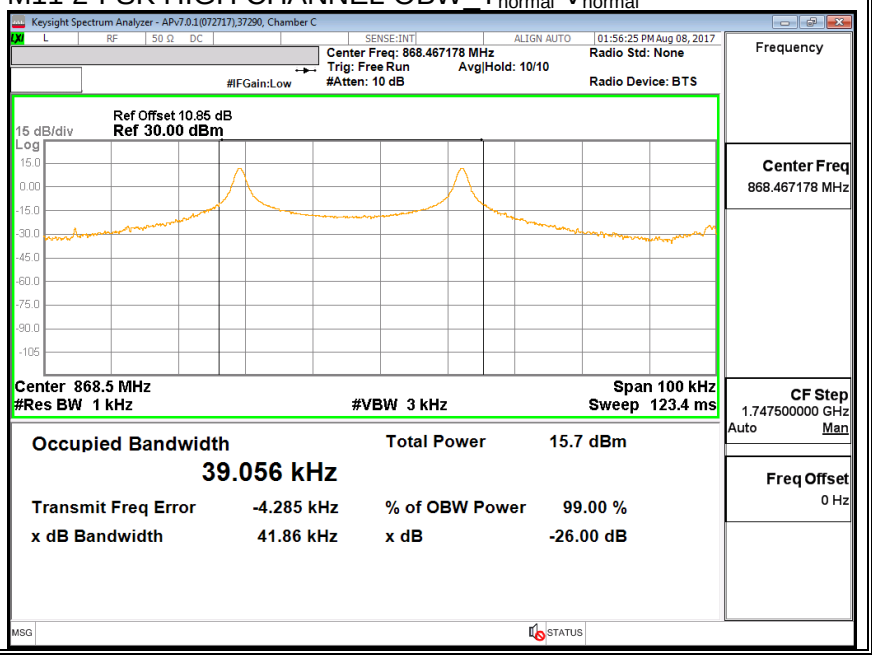
M11 2-FSK LOW CHANNEL OBW_T_{high} V_{high}



M11 2-FSK HIGH CHANNEL OBW_T_{normal} V_{normal}



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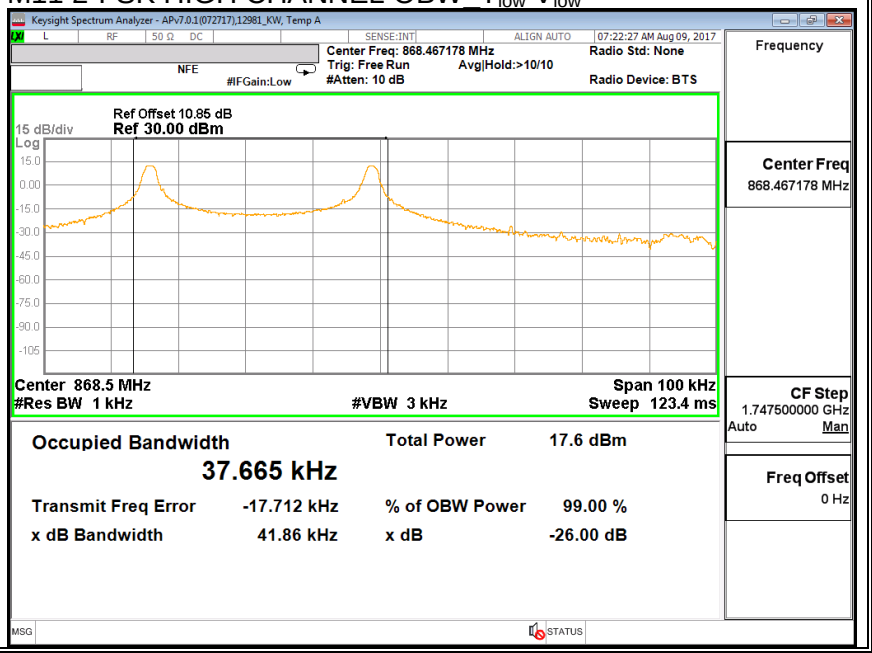
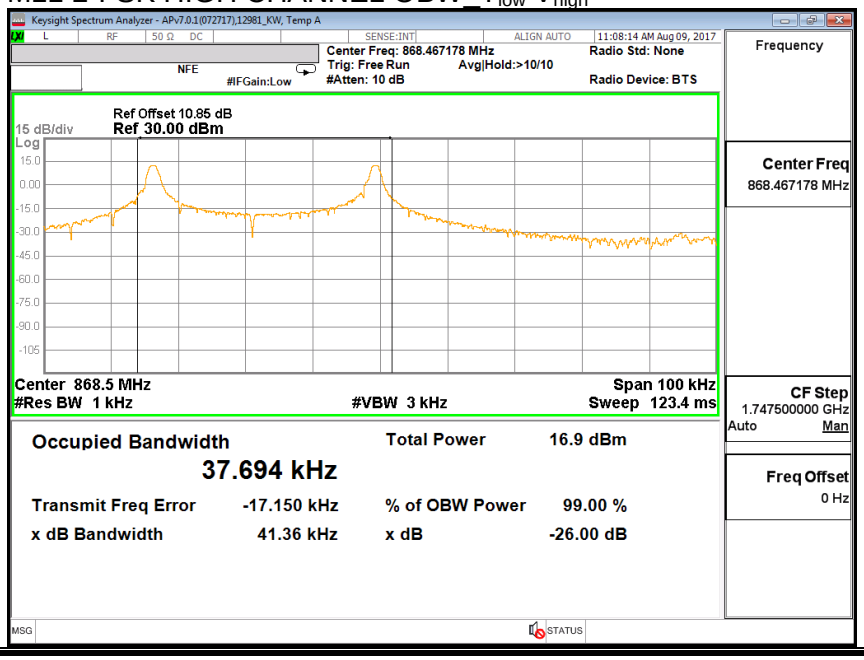
M11 2-FSK HIGH CHANNEL OBW_T_{low} V_{low}



M11 2-FSK HIGH CHANNEL OBW_T_{low} V_{high}



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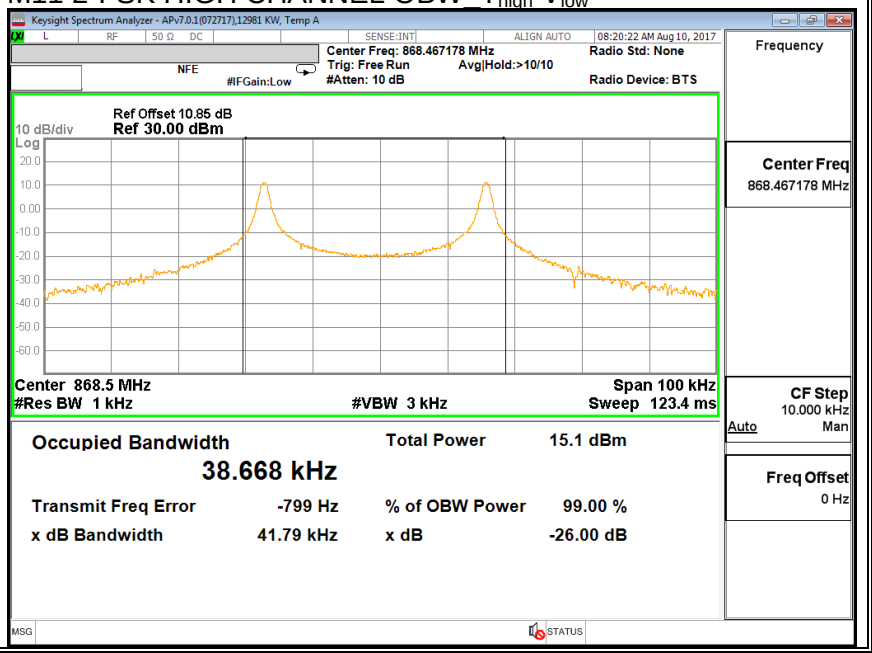
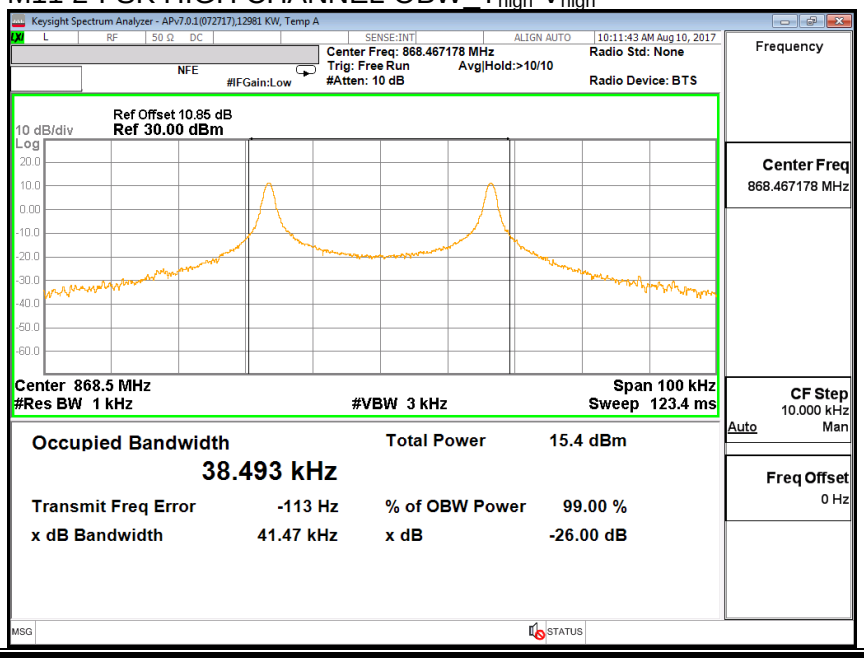
M11 2-FSK HIGH CHANNEL OBW_T_{high} V_{low}



M11 2-FSK HIGH CHANNEL OBW_T_{high} V_{high}



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7.8.4. TX OUT OF BAND EMISSIONS

REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.1

Two OOB domains are defined, one for OC (see Figure 5) and one for Operational Frequency band (see Figure 6). The spectrum masks for these two OOB domains may overlap.

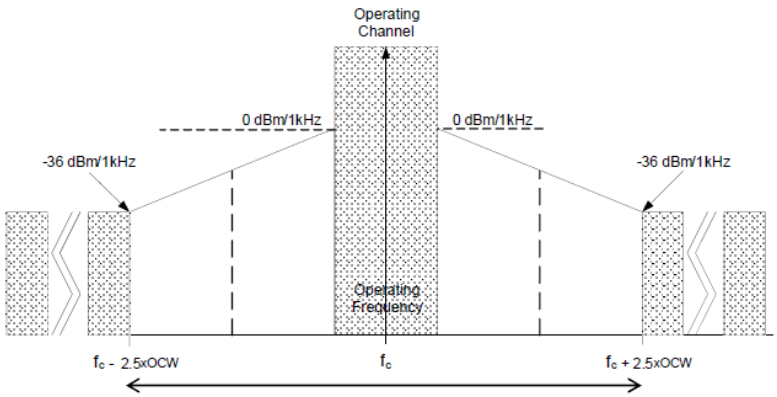

Figure 5: Out Of Band Domain for Operating Channel with reference BW

Unwanted emissions in the Out Of Band domain are those falling in the frequency range immediately below the lower, and above the upper, frequency of the Operating Channel. The OOB domain includes both frequencies outside the Operating Channel within the Operational Frequency Band and frequencies outside the Operational Frequency Band.
The relevant Out Of Band domain is shown in Figure 5 and applies within the Operational Frequency Band.

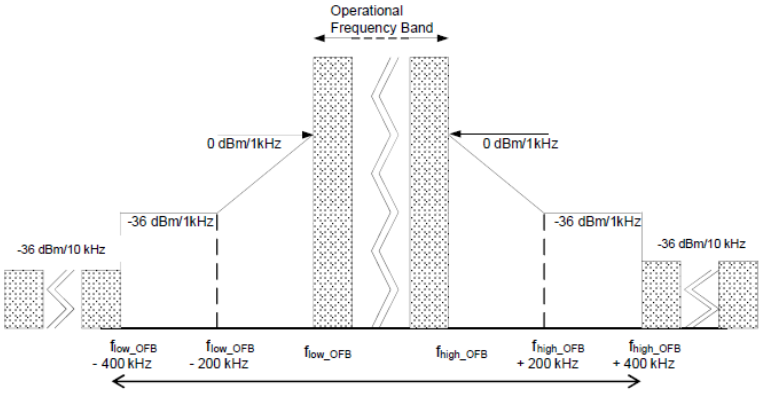

Figure 6: Out Of Band Domain for Operational Frequency Band with reference BW

Specific limits apply at frequencies immediately above and below the Operational Frequency Band as shown in Figure 6.
NOTE: f_{low}_OFB is the lower edge of the Operational Frequency Band. f_{high}_OFB is the upper edge of the Operational Frequency Band.

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REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.2

The EUT emissions level in OOB domains for the Operating Channel and the Operational Frequency Band shall be less or equal to Table 15 spectrum mask.

Table 15: Emission limits in the Out Of Band domains

Domain	Frequency Range	RBW_{REF}	Max power limit
OOB limits applicable to Operational Frequency Band (See Figure 6)	$f \le f_{low_OFB}$ - 400 kHz	10 kHz	-36 dBm
	F_{low_OFB} - 400 kHz ≤ f ≤ f_{low_OFB} - 200 kHz	1 kHz	-36 dBm
	f_{low} - 200 kHz ≤ f < f_{low_OFB}	1 kHz	See Figure 6
	$f = f_{low_OFB}$	1 kHz	0 dBm
	$f = f_{high_OFB}$	1 kHz	0 dBm
	F_{high_OFB} < f ≤ f_{high_OFB} + 200 kHz	1 kHz	See Figure 6
	F_{high_OFB} + 200 kHz ≤ f ≤ f_{high_OFB} + 400 kHz	1 kHz	-36 dBm
	F_{high_OFB} + 400 kHz ≤ f	10 kHz	-36 dBm
OOB limits applicable to Operating Channel (See Figure 5)	$f = f_c$- 2.5 x OCW	1 kHz	-36 dBm
	f_c - 2,5 x OCW ≤ f ≤ f_c - 0,5 x OCW	1 kHz	See Figure 5
	$f = f_c$ - 0,5 x OCW	1 kHz	0 dBm
	$f = f_c$ + 0,5 x OCW	1 kHz	0 dBm
	f_c + 0,5 x OCW ≤ f ≤ f_c + 2,5 x OCW	1 kHz	See Figure 5
	$f = f_c$+ 2,5 x OCW	1 kHz	-36 dBm

NOTE: f is the measurement frequency.
f_c is the Operating Frequency.
F_{low_OFB} is the lower edge of the Operational Frequency Band.
F_{high_OFB} is the upper edge of the Operational Frequency Band.
OCW is the operating channel bandwidth.

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.3.3 (Conducted Measurement)

RESULTS

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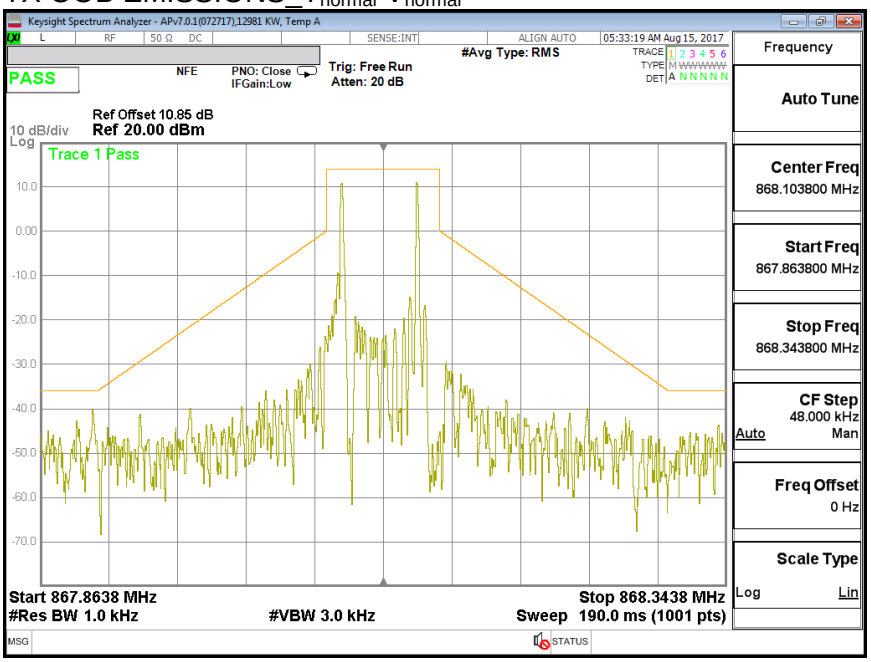
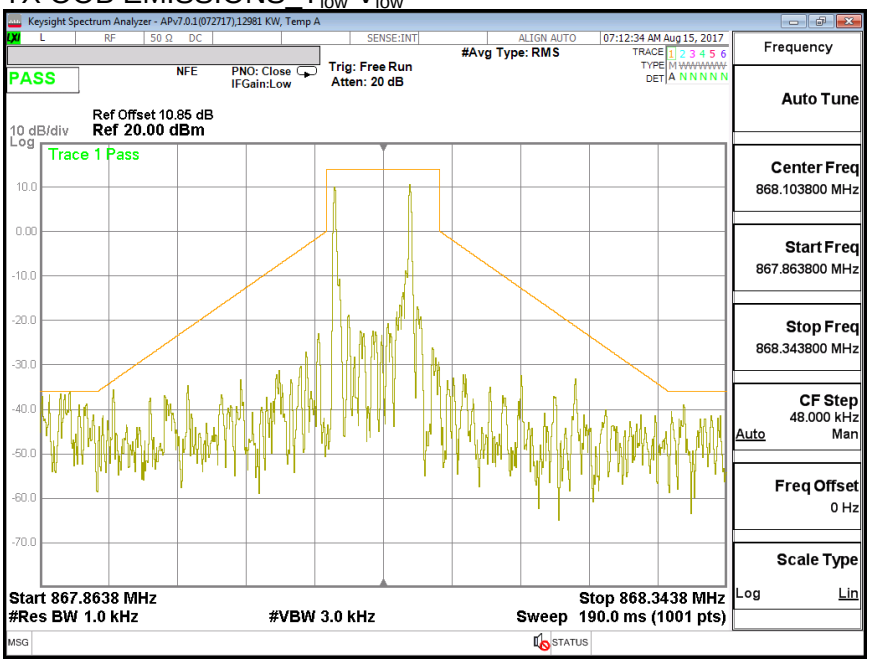
TX OUT OF BAND EMISSIONS (APPLICABLE TO OPERATING CHANNEL)

M4 LOW CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal}



TX OOB EMISSIONS_T_{low} V_{low}



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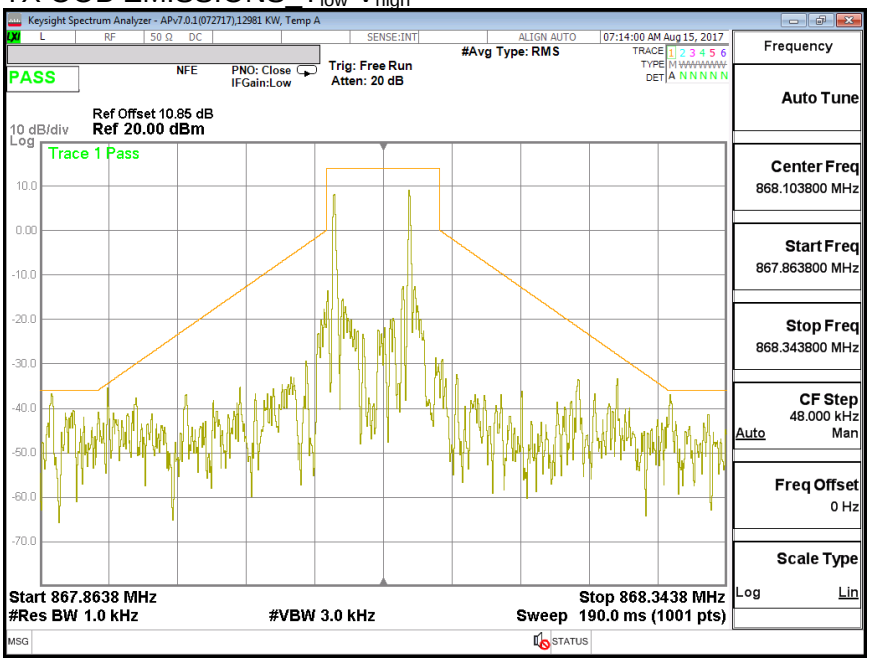
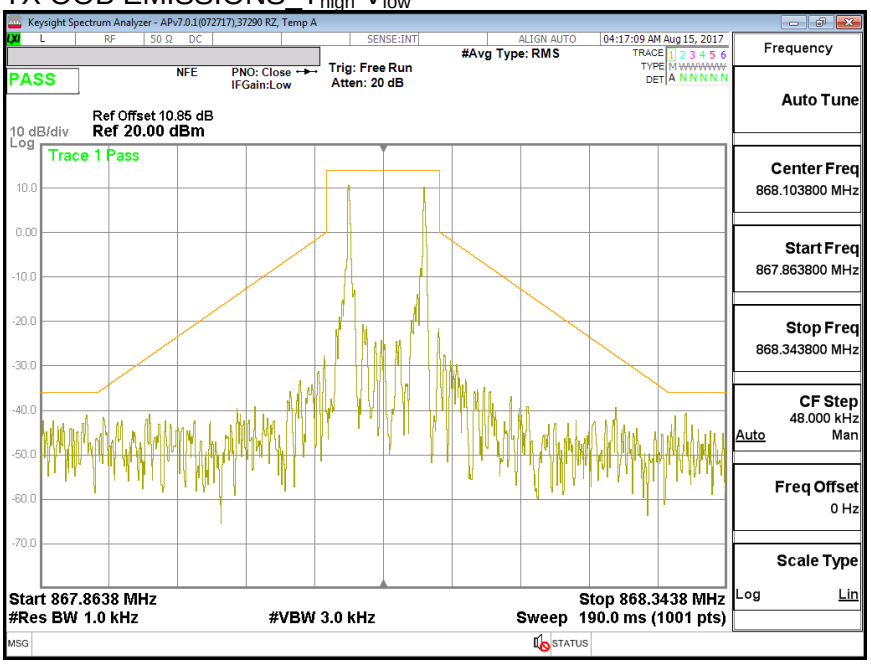
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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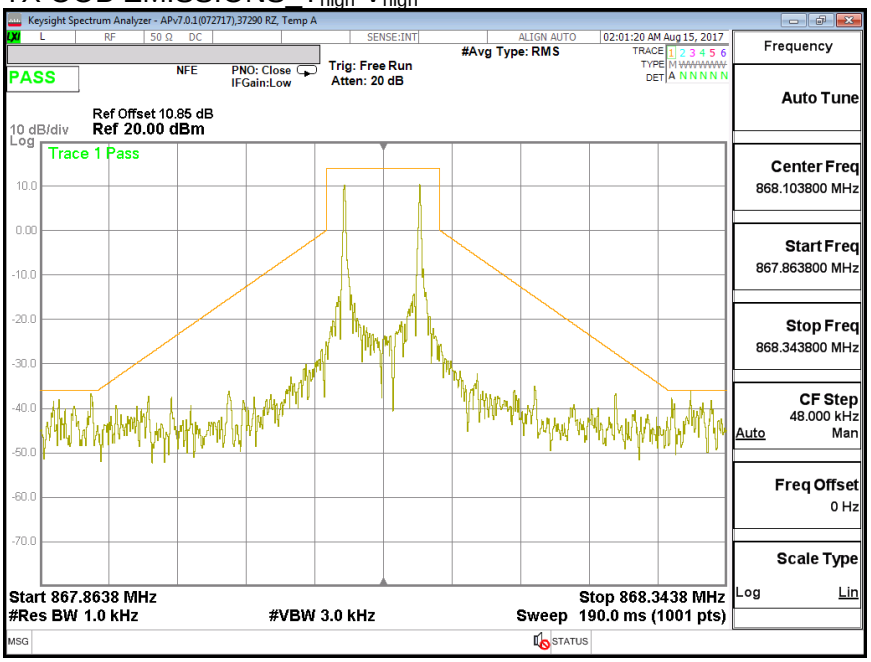
TX OOB EMISSIONS_T_{high} V_{high}



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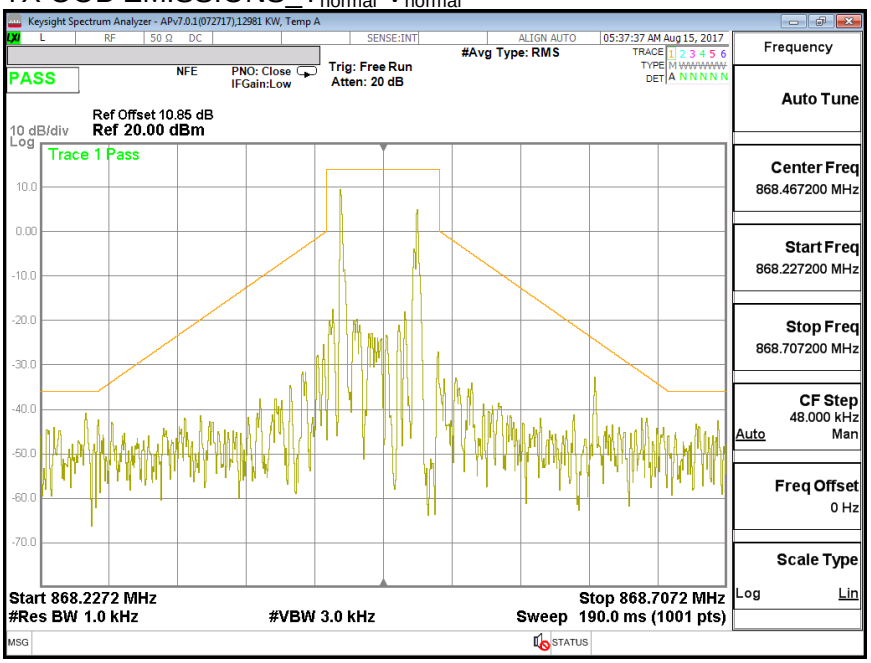
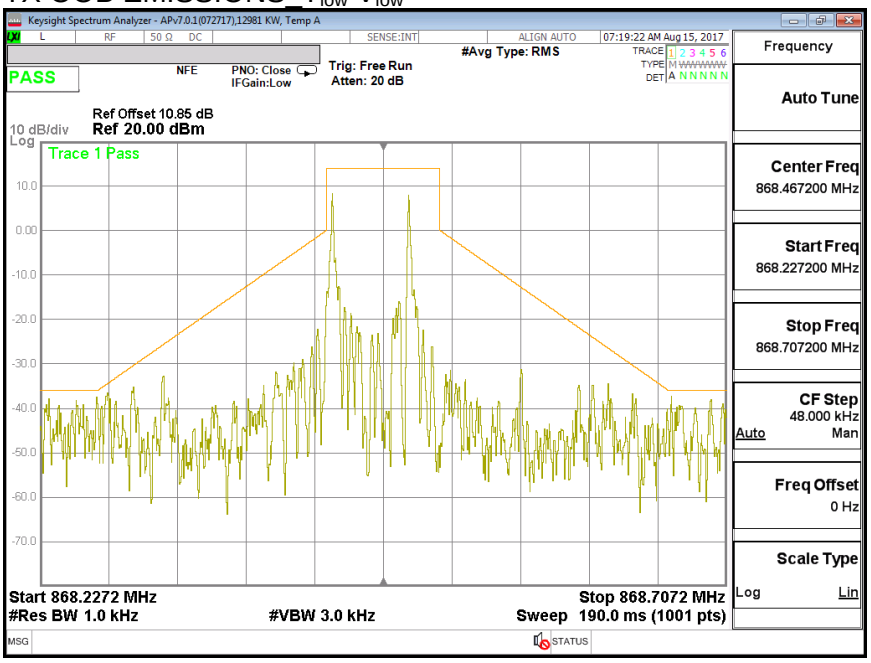
M4 HIGH CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal}



TX OOB EMISSIONS_T_{low} V_{low}



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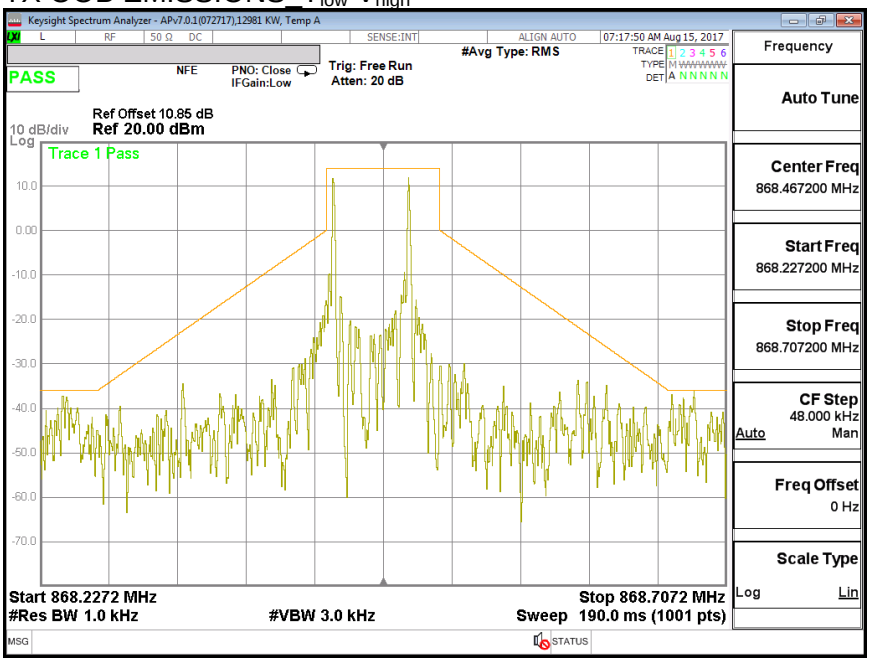
TX OOB EMISSIONS_T_{low} V_{high}



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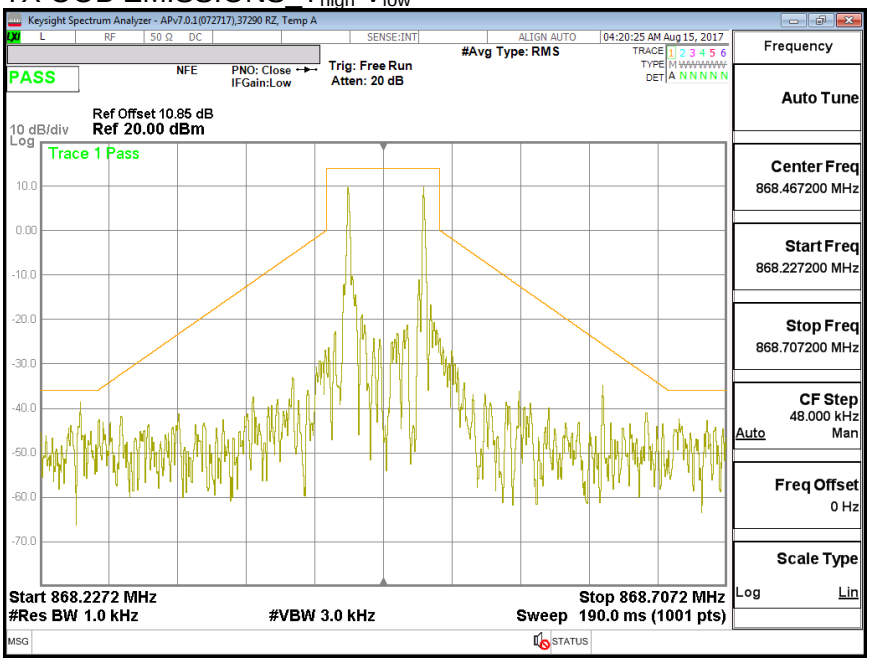

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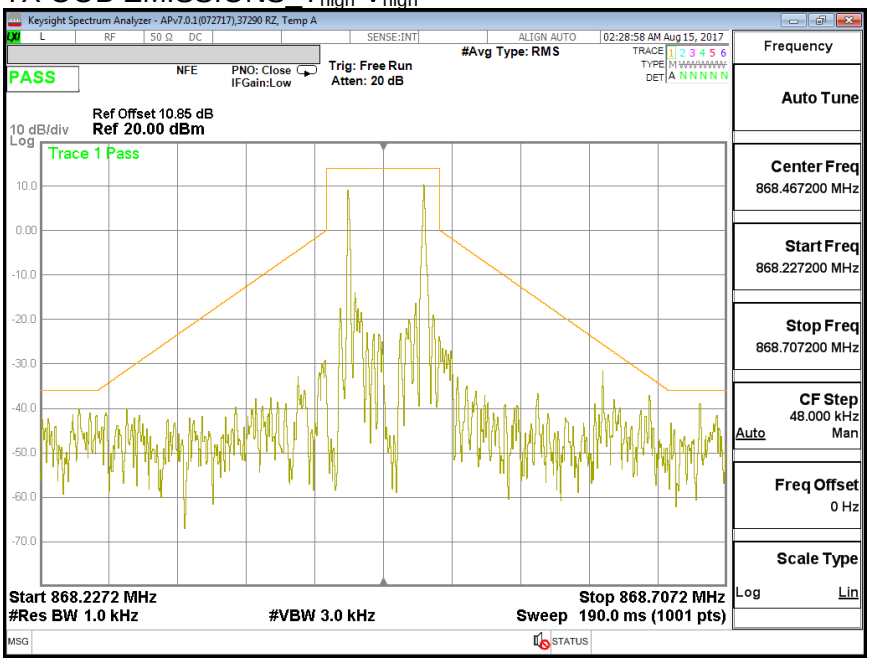
TX OOB EMISSIONS_T_{high} V_{high}



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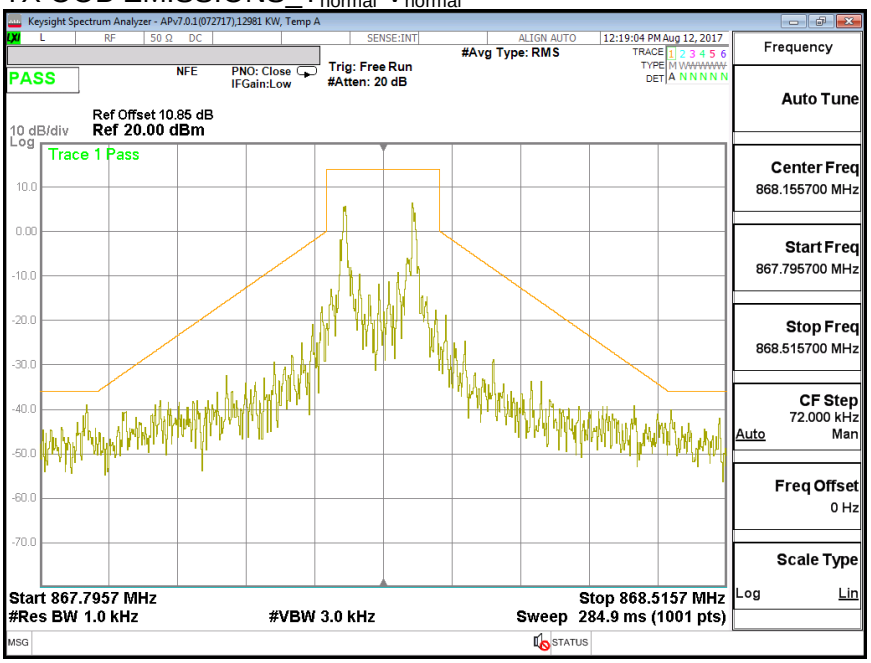
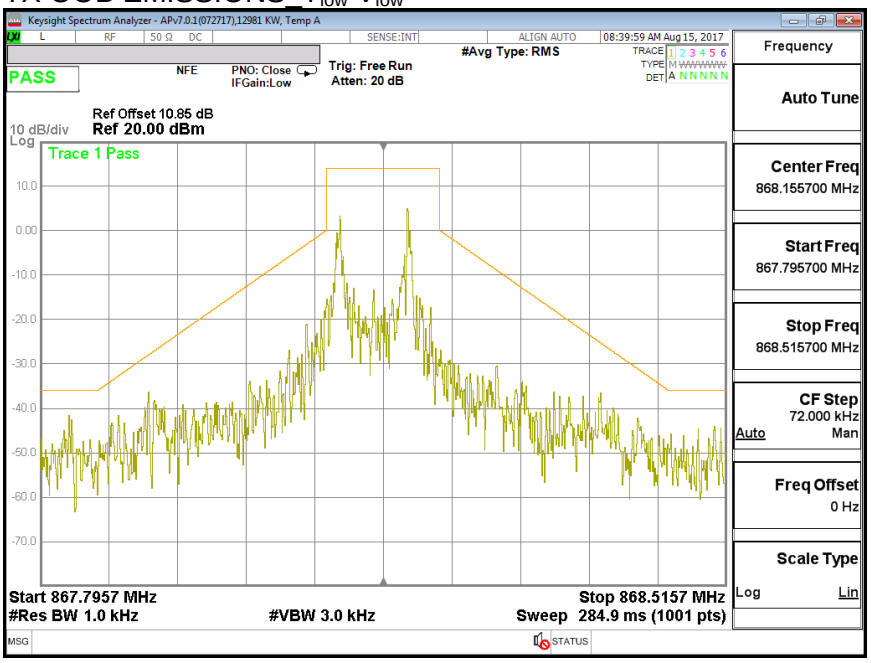
M5 LOW CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$



TX OOB EMISSIONS_T$_{low}$ V$_{low}$



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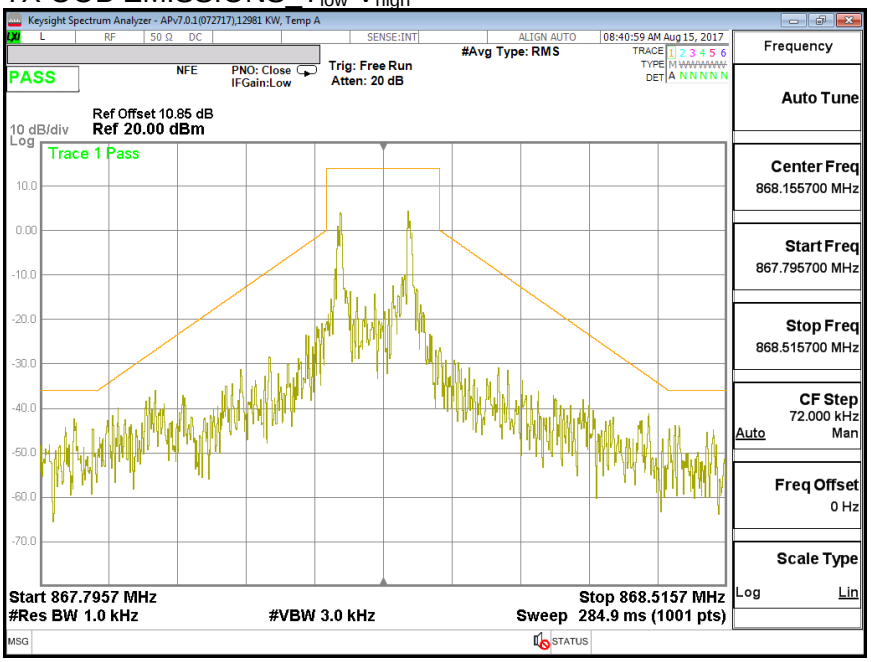
TX OOB EMISSIONS_T_{low} V_{high}



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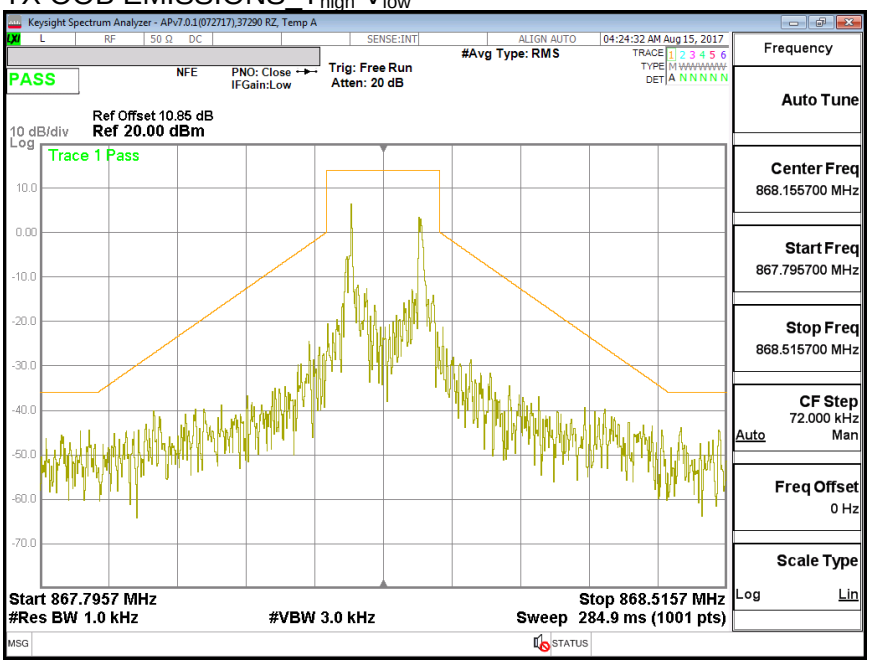

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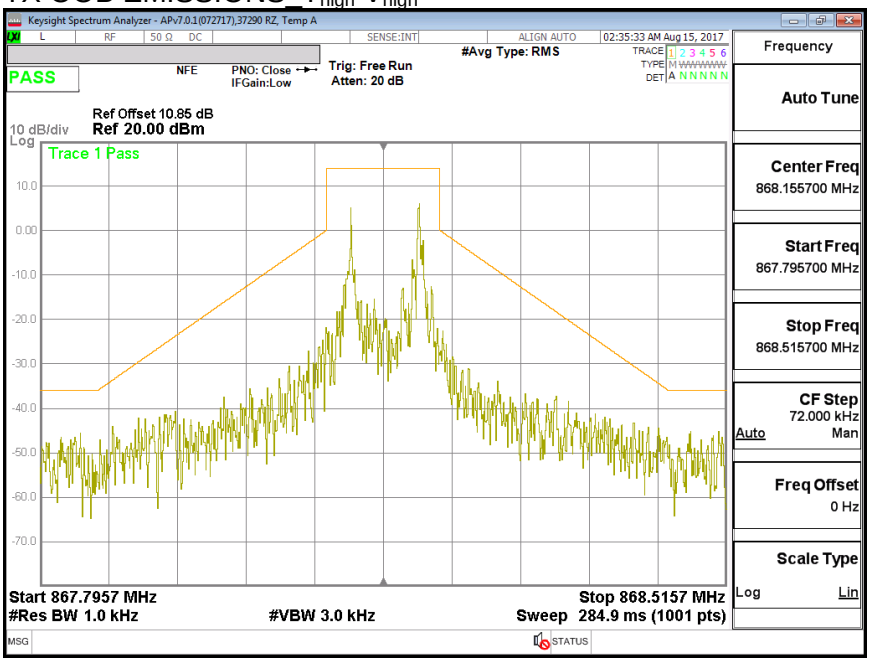
TX OOB EMISSIONS_T_{high} V_{high}



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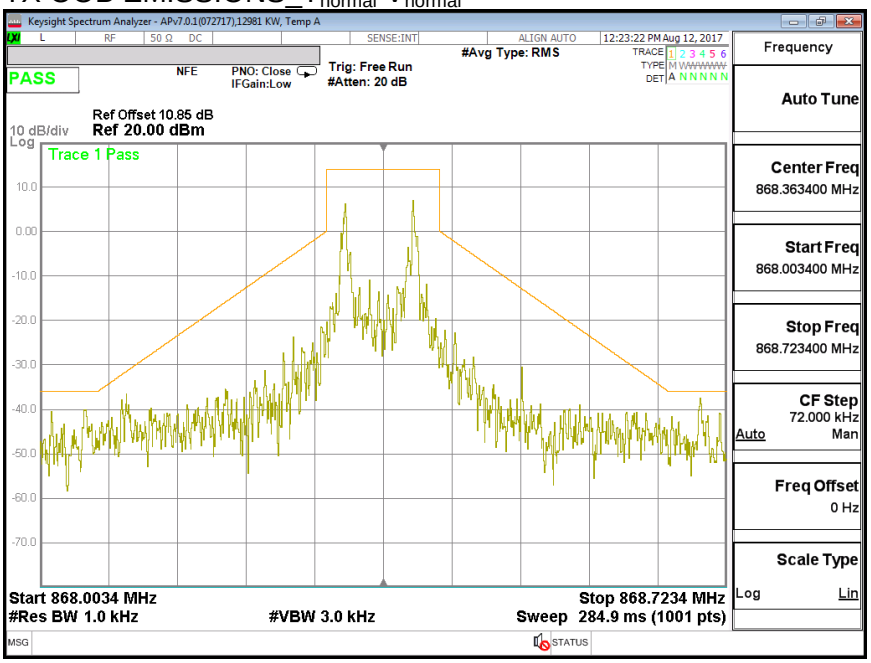
M5 HIGH CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$



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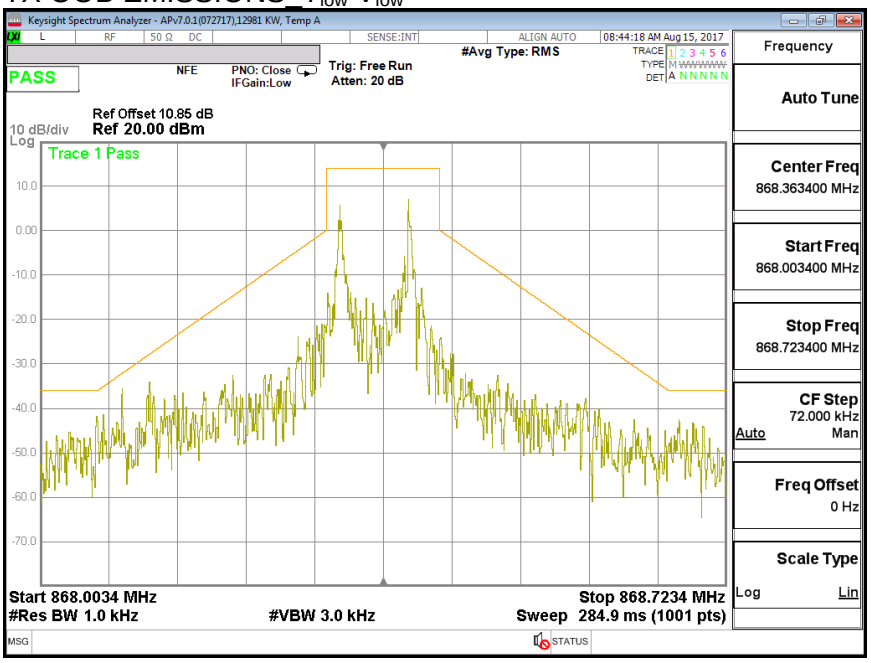

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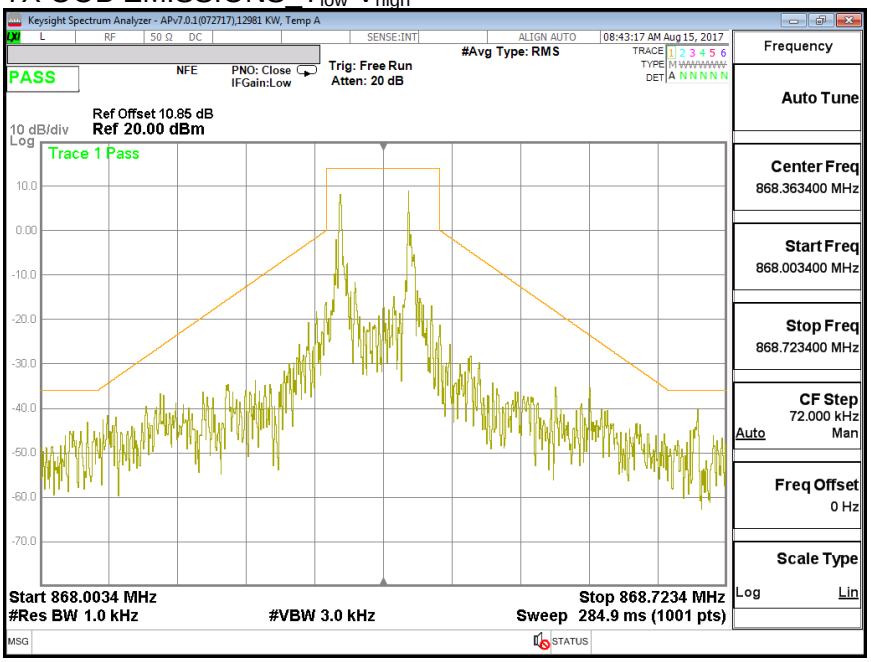
TX OOB EMISSIONS_T_{low} V_{high}



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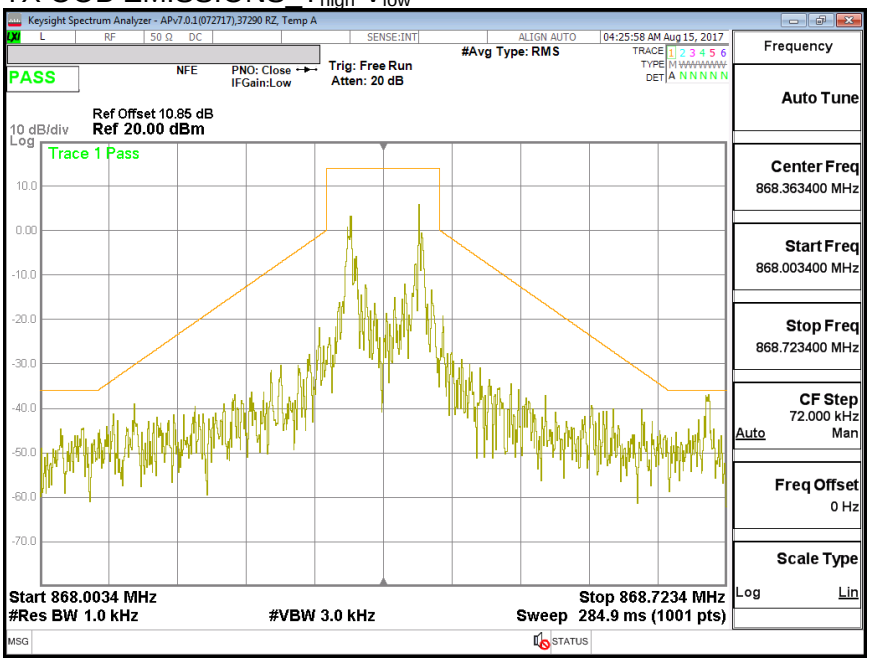

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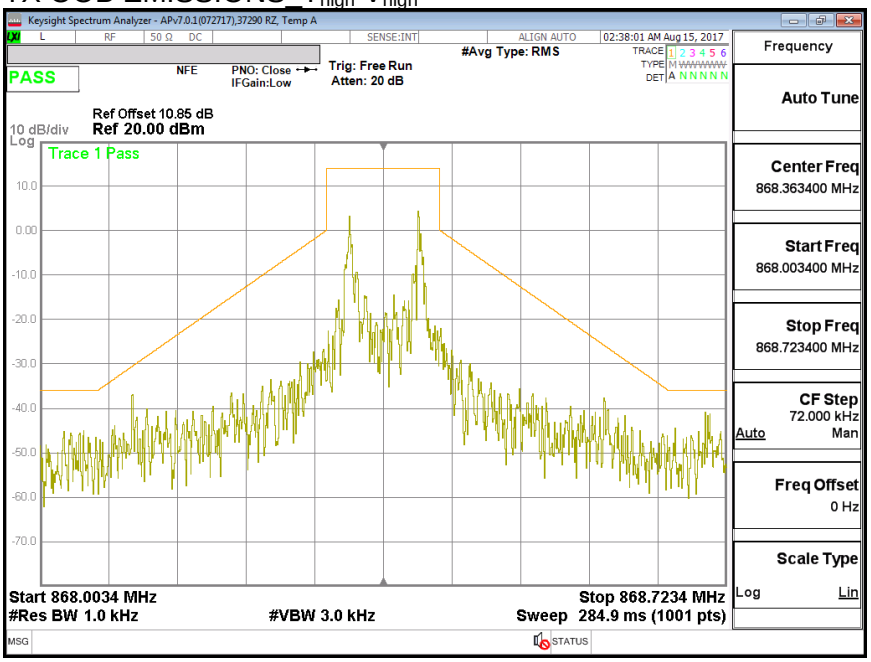
TX OOB EMISSIONS_T_{high} V_{high}



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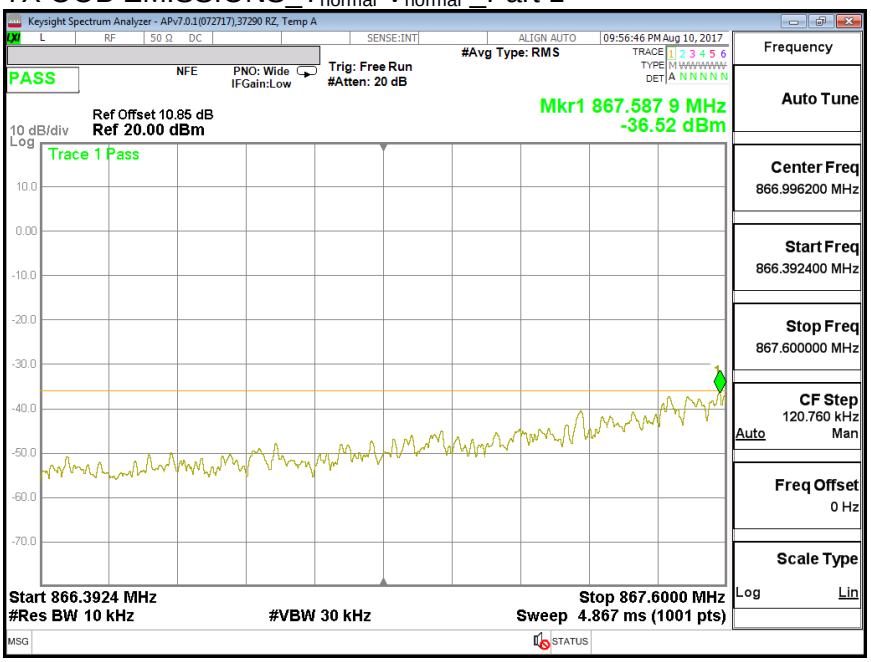
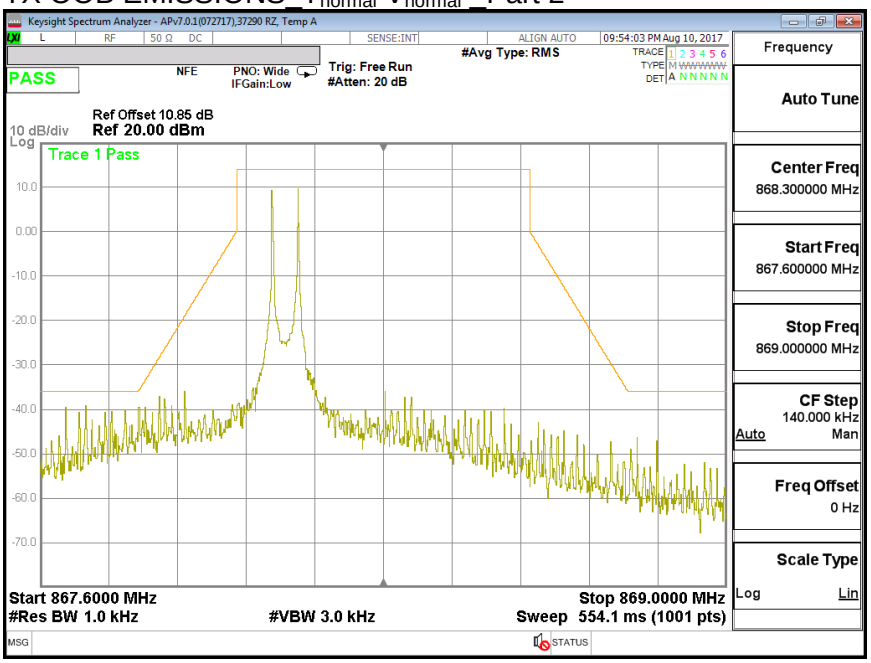
TX OUT OF BAND EMISSIONS (APPLICABLE TO OPERATIONAL FREQUENCY BANDS)

M4 LOW CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal} _Part 1



TX OOB EMISSIONS_T_{normal} V_{normal} _Part 2



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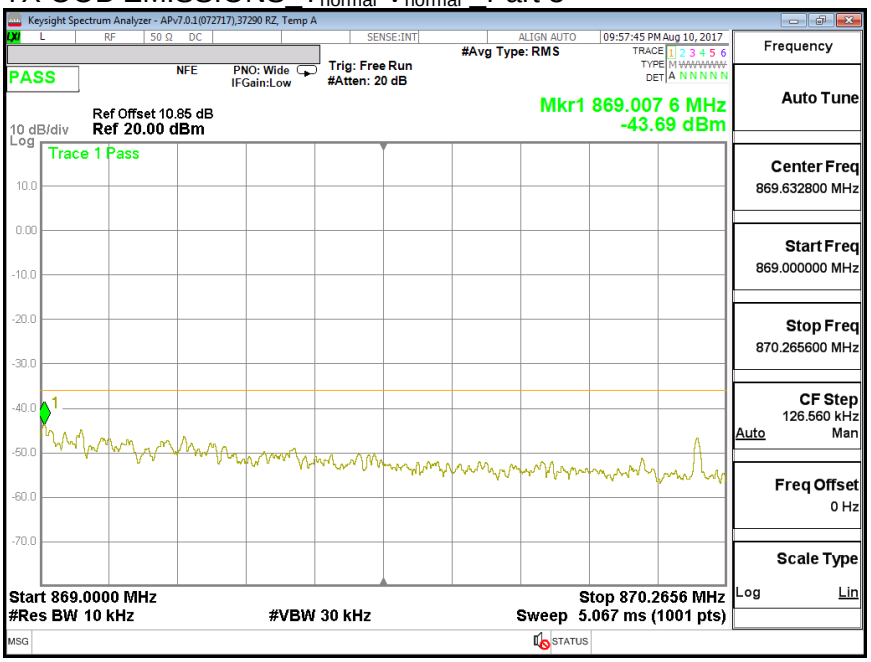
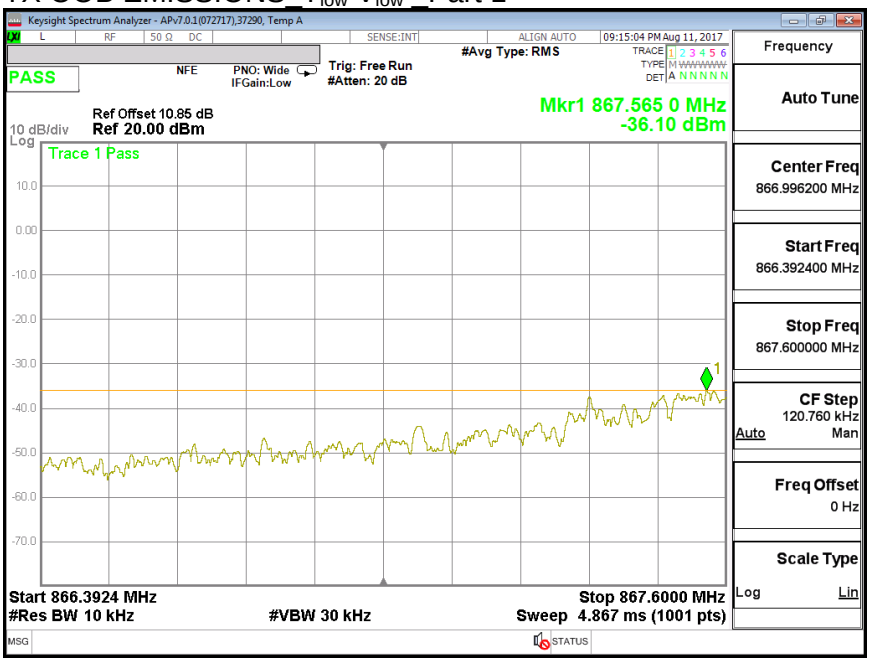
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3



TX OOB EMISSIONS_T_{low} V_{low} _Part 1



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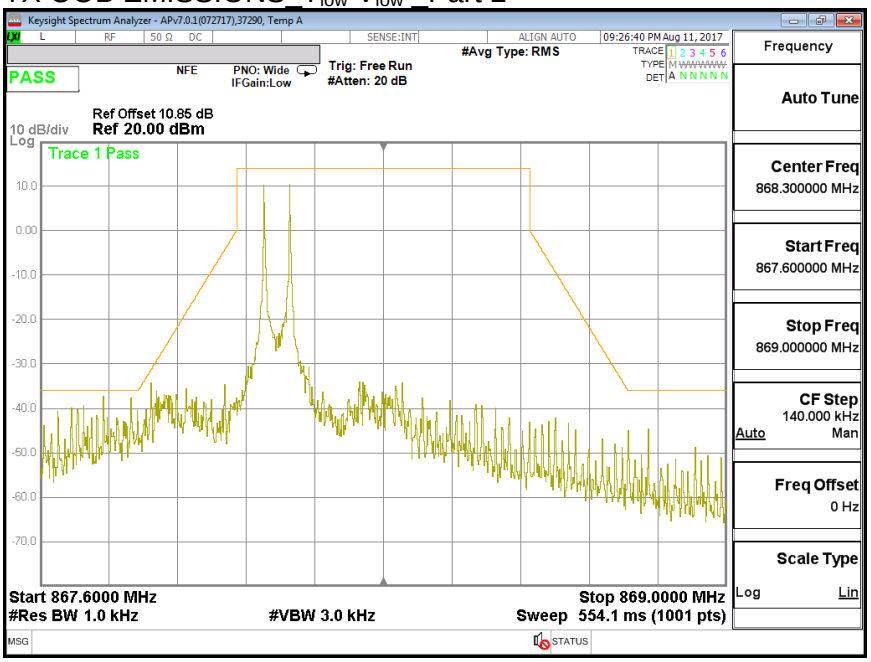
TX OOB EMISSIONS_T_{low} V_{low} _Part 2



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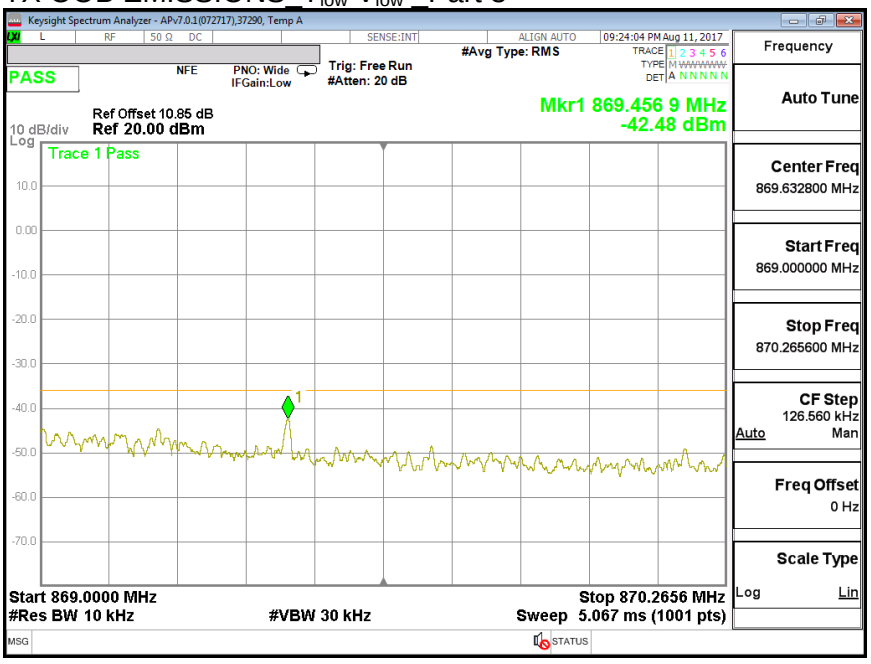

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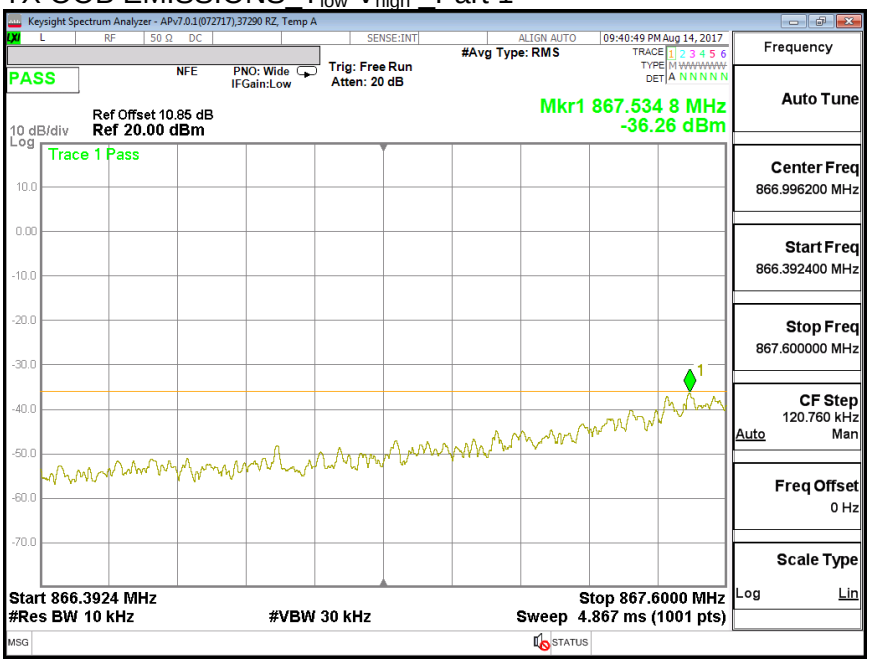
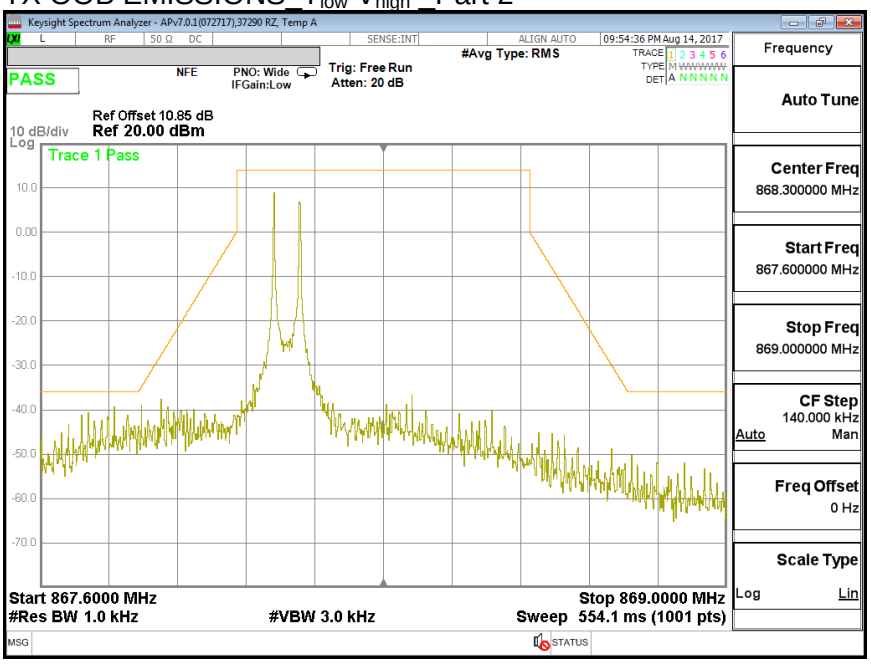
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



TX OOB EMISSIONS_T_{low} V_{high} _Part 2



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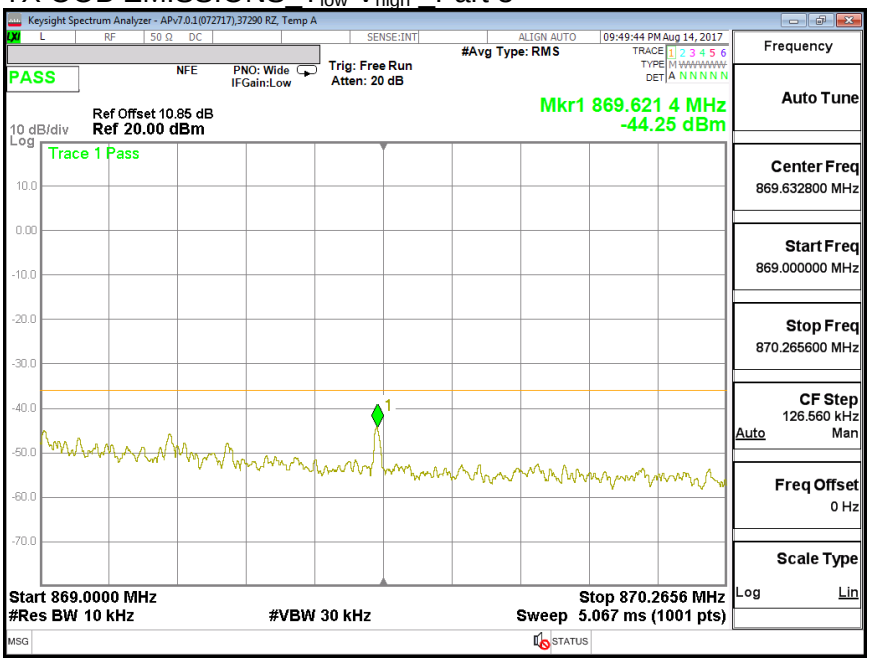
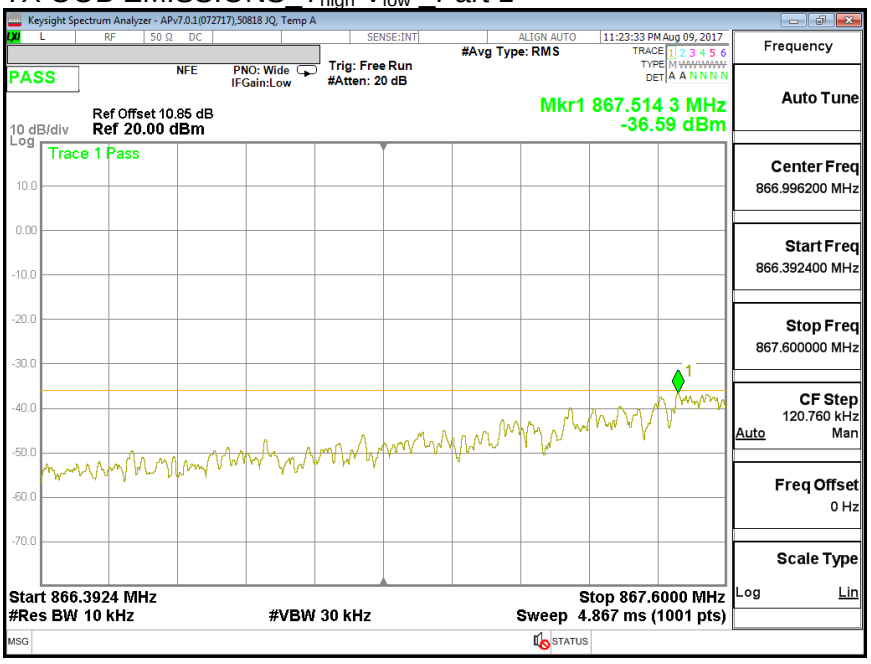
TX OOB EMISSIONS_T_{low} V_{high} _Part 3



TX OOB EMISSIONS_T_{high} V_{low} _Part 1



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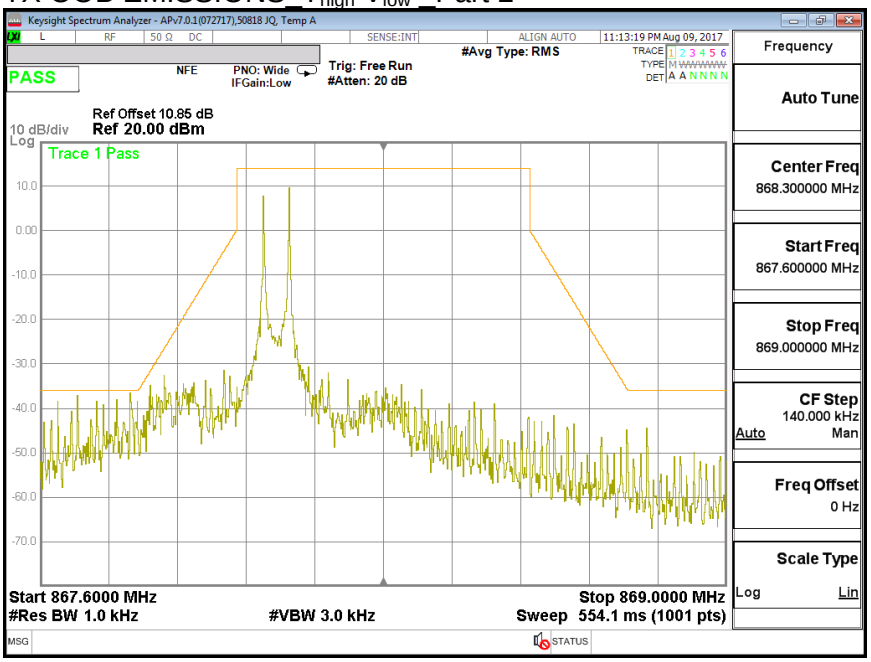
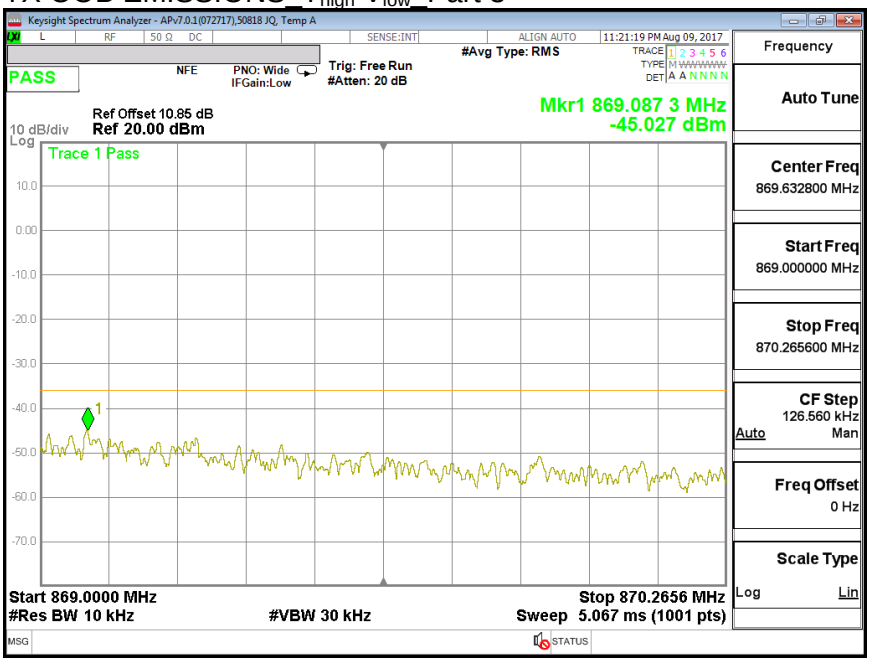
TX OOB EMISSIONS_T_{high} V_{low} _Part 2



TX OOB EMISSIONS_T_{high} V_{low}_Part 3



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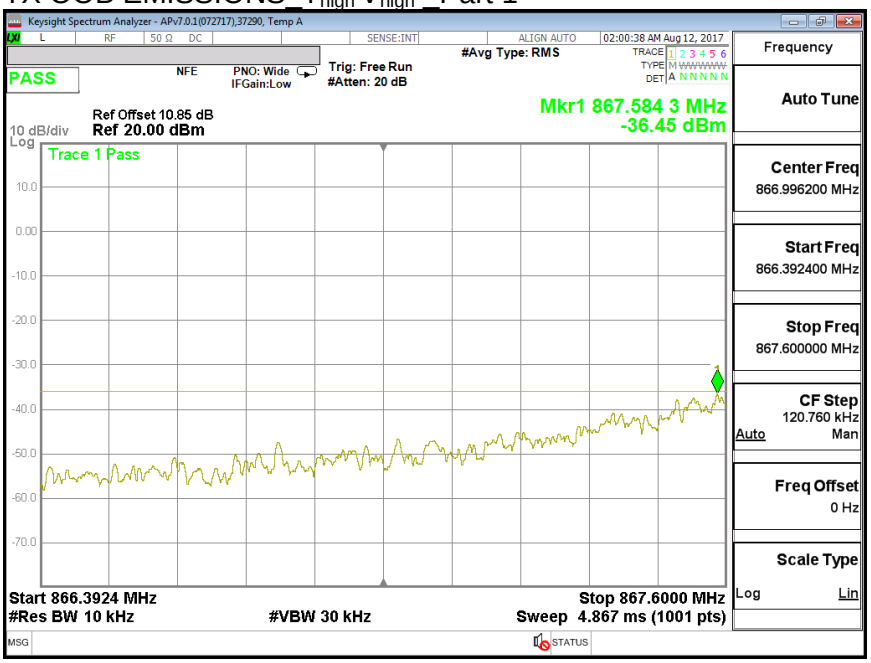
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



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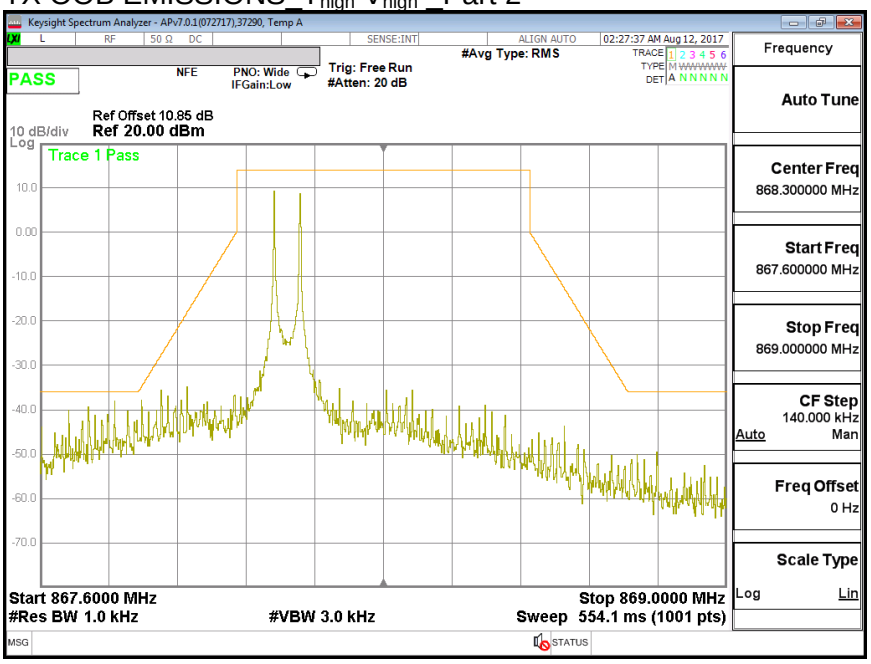

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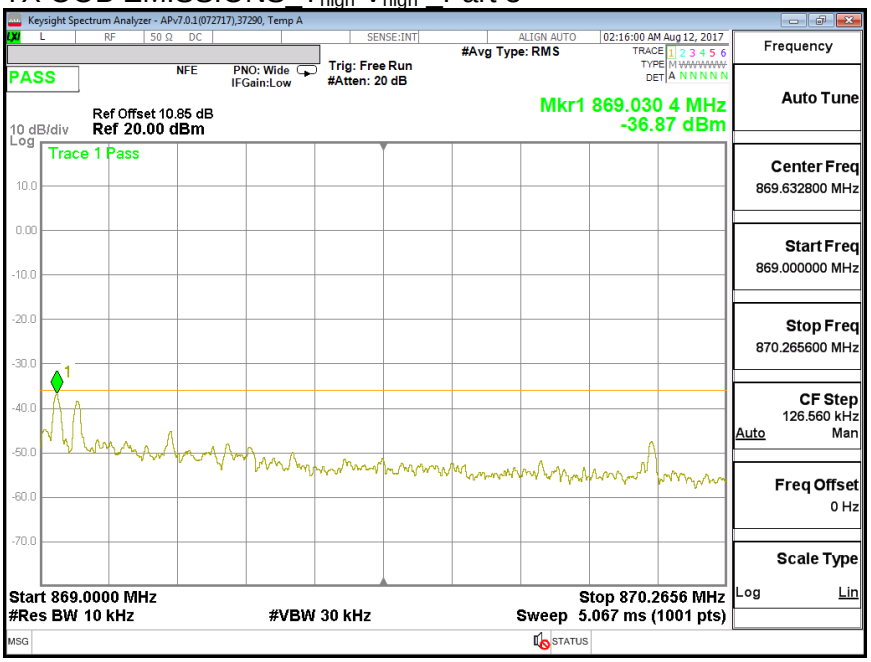
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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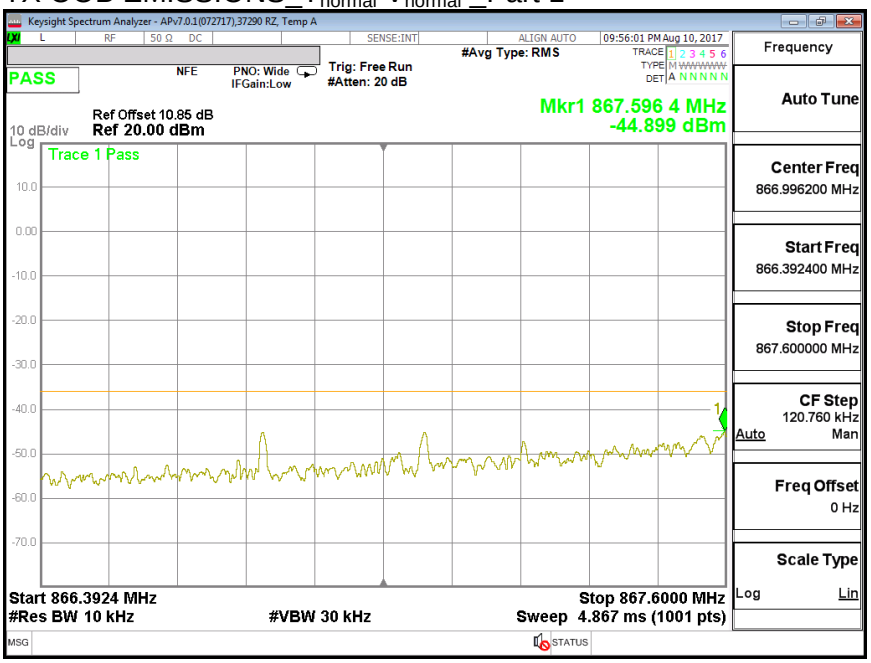
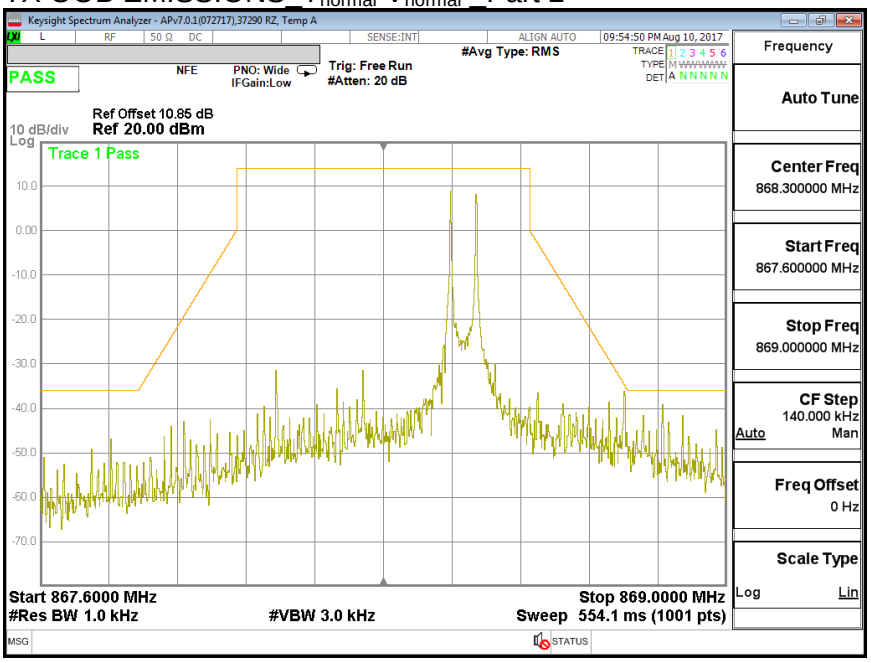
M4 HIGH CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 1



TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 2



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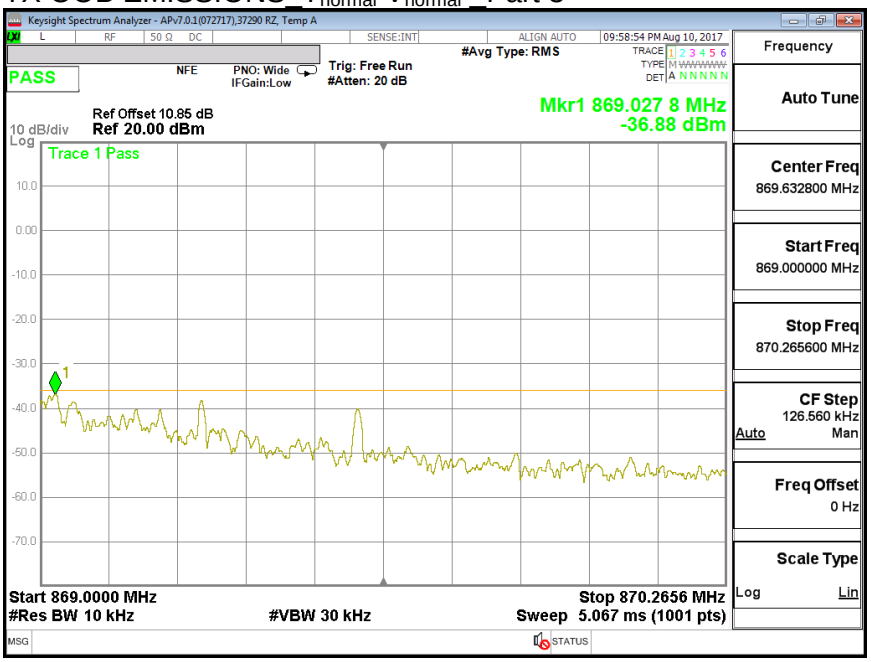
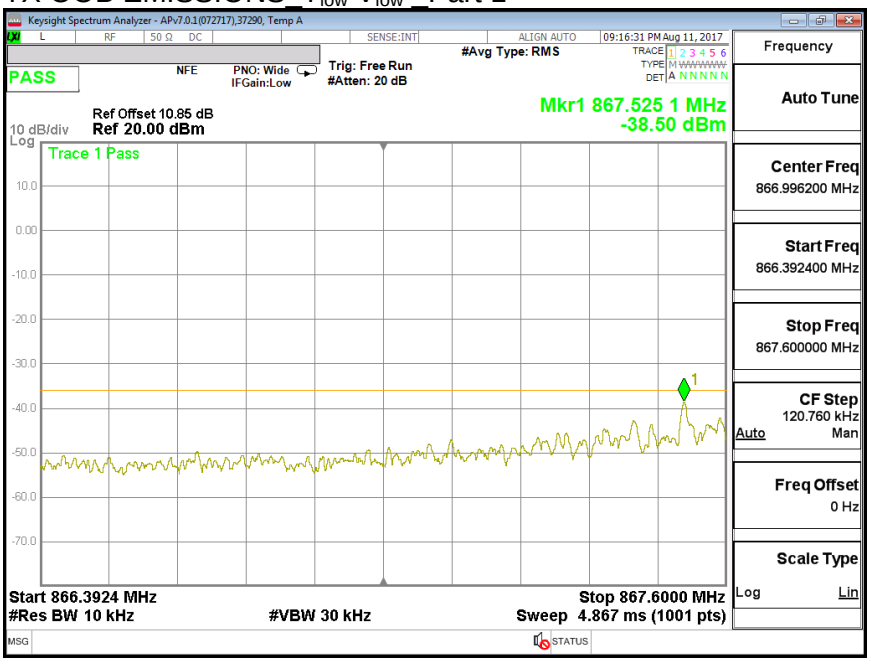
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3



TX OOB EMISSIONS_T_{low} V_{low} _Part 1



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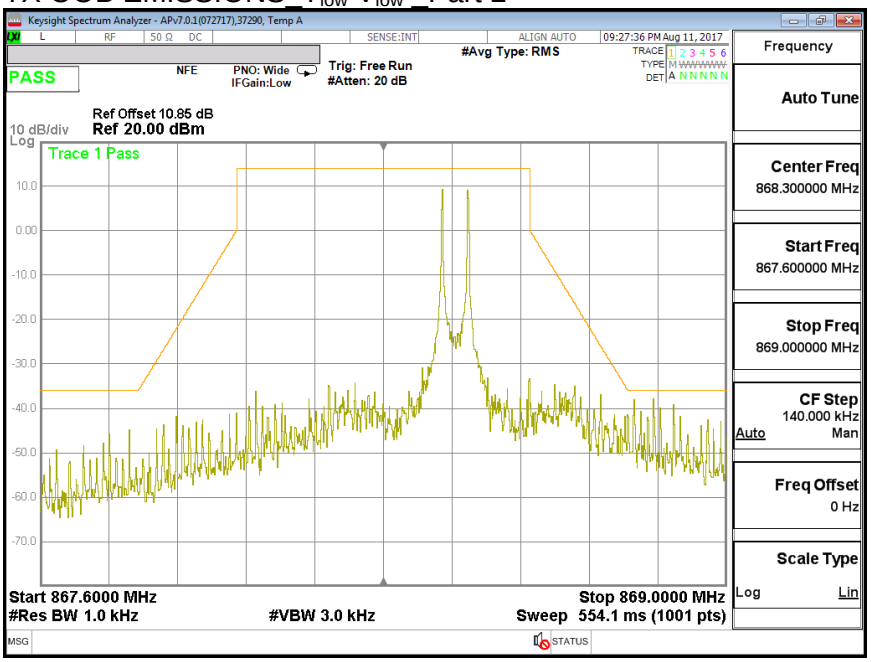
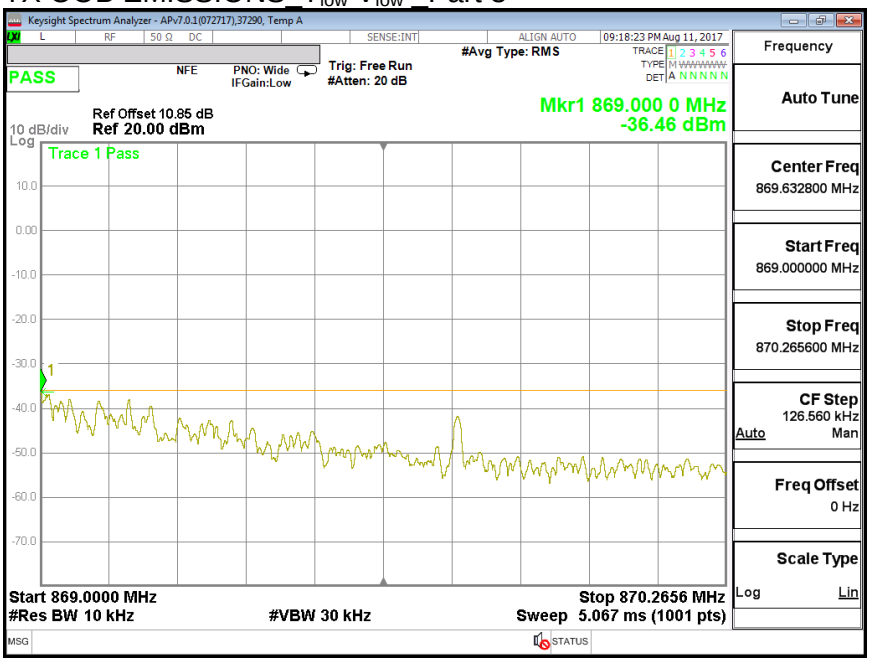
TX OOB EMISSIONS_T_{low} V_{low} _Part 2



TX OOB EMISSIONS_T_{low} V_{low} _Part 3



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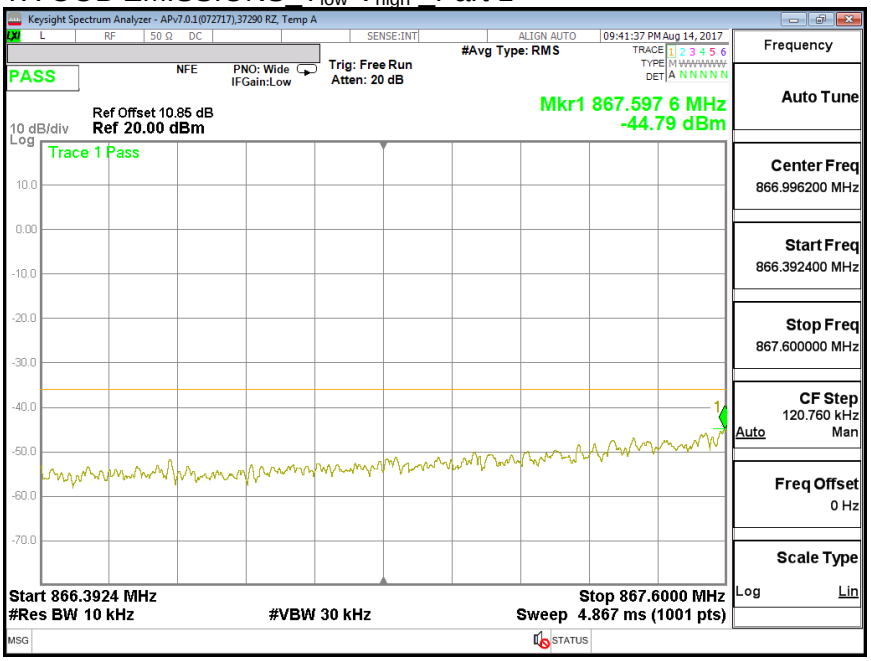
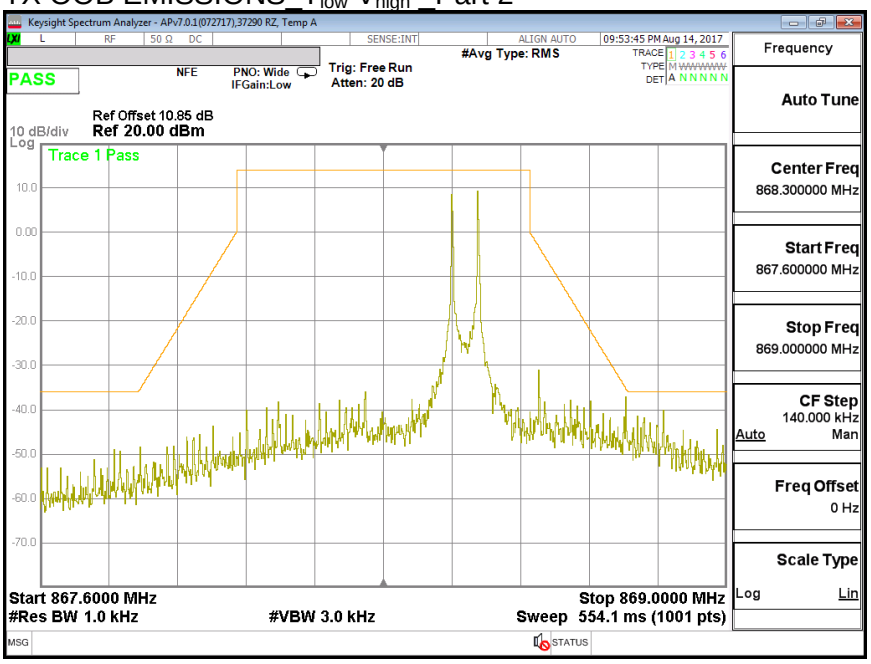
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



TX OOB EMISSIONS_T_{low} V_{high} _Part 2



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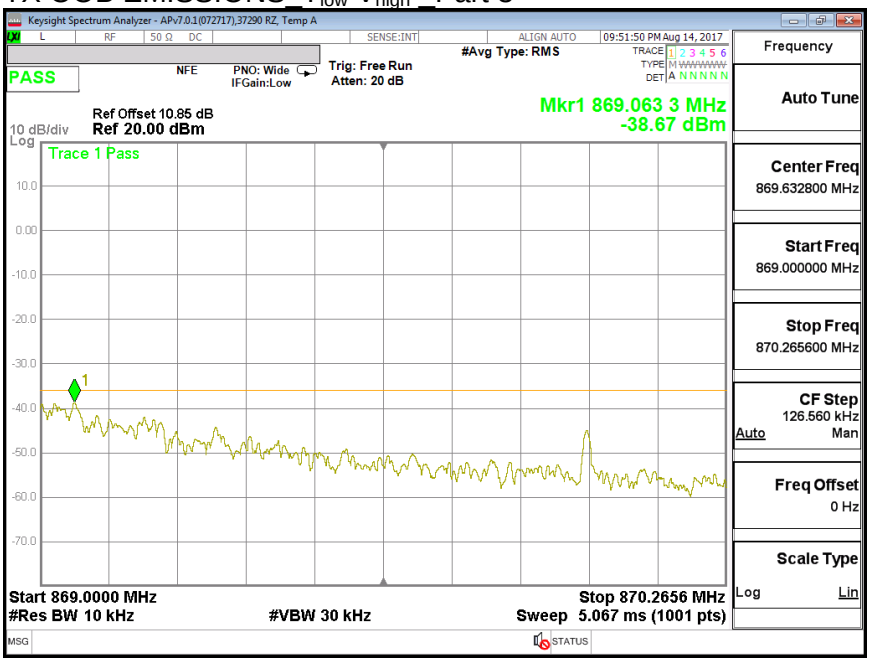
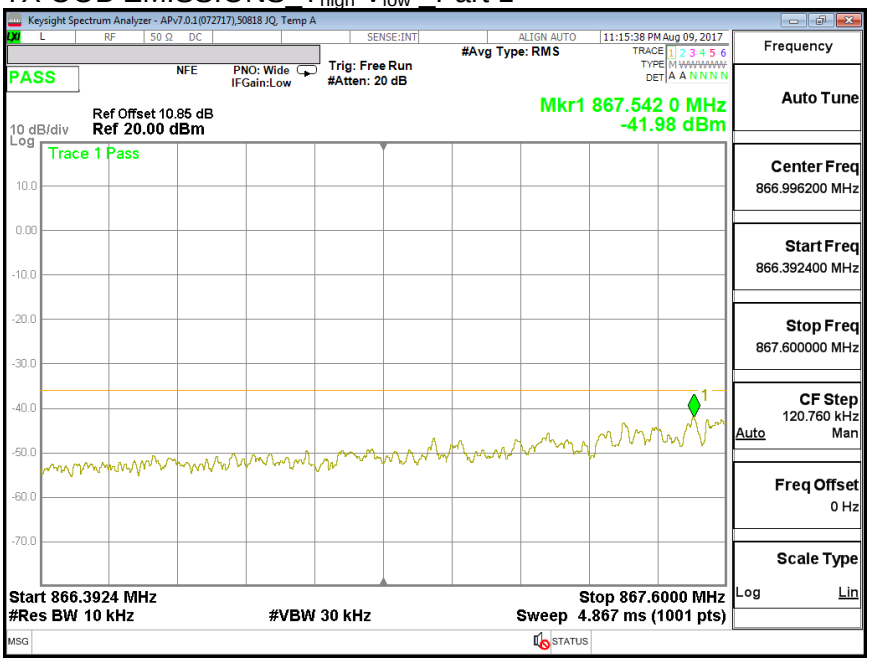
TX OOB EMISSIONS_T_{low} V_{high} _Part 3



TX OOB EMISSIONS_T_{high} V_{low} _Part 1



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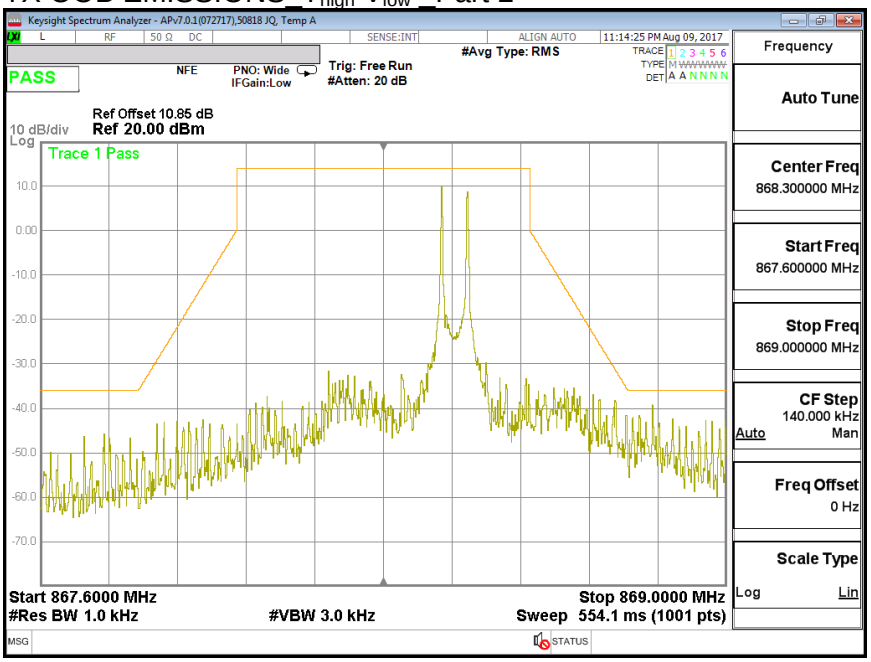
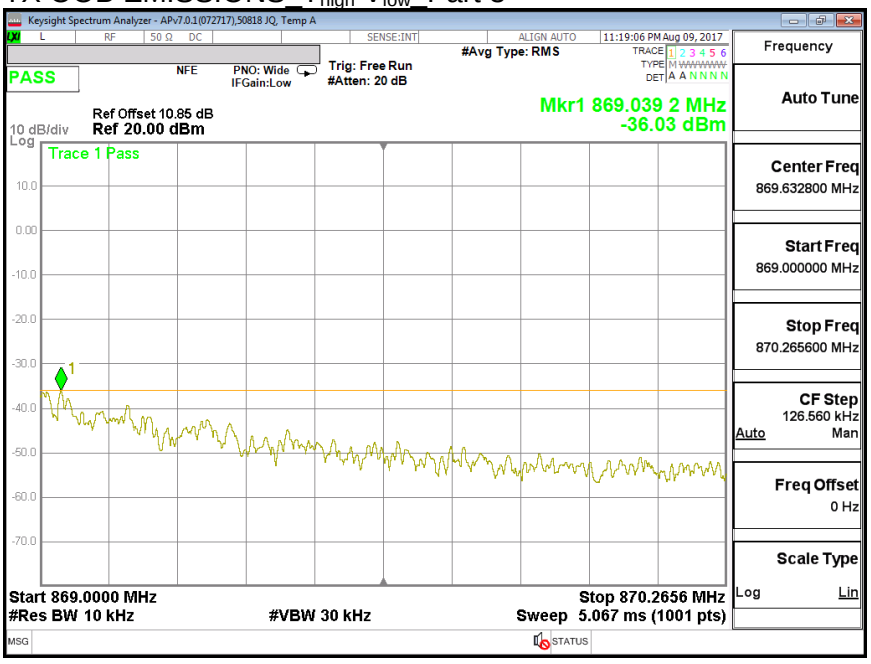
TX OOB EMISSIONS_T_{high} V_{low} _Part 2



TX OOB EMISSIONS_T_{high} V_{low}_Part 3



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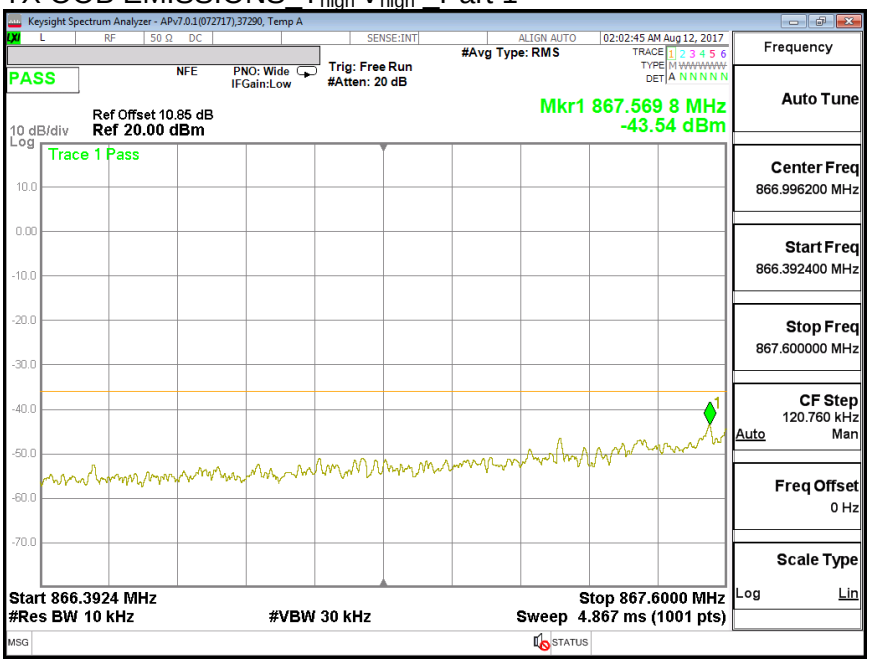
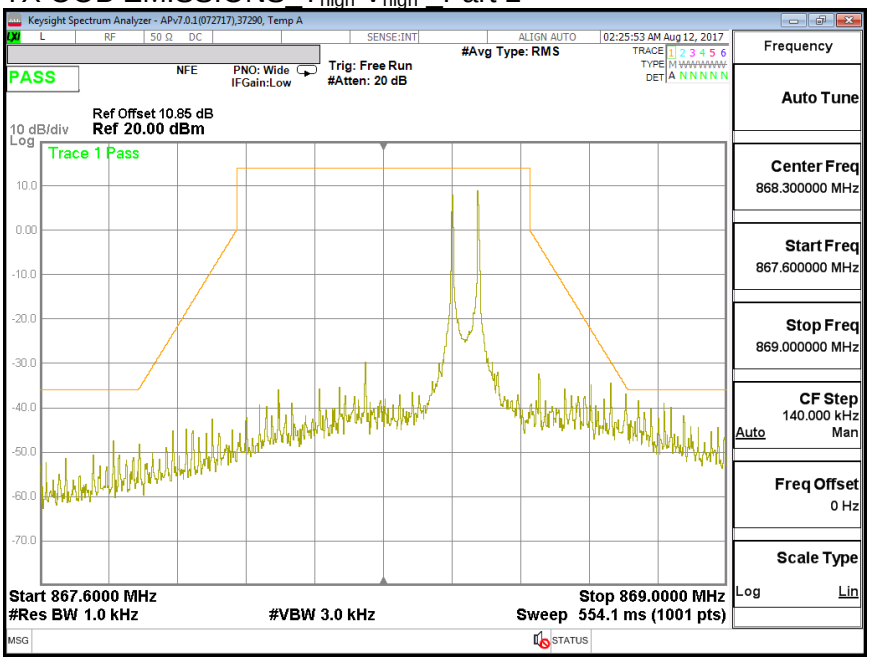
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



TX OOB EMISSIONS_T_{high} V_{high} _Part 2



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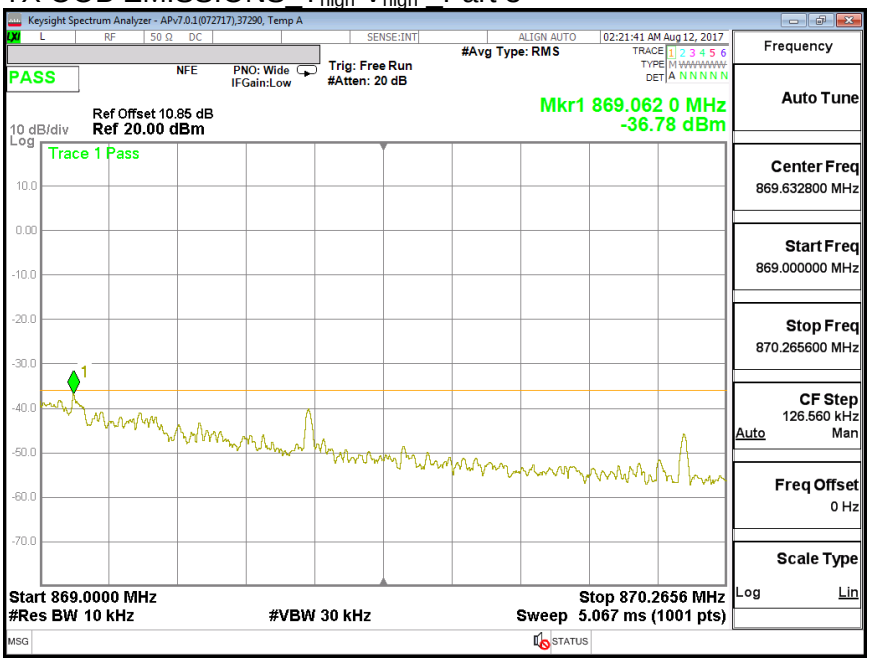
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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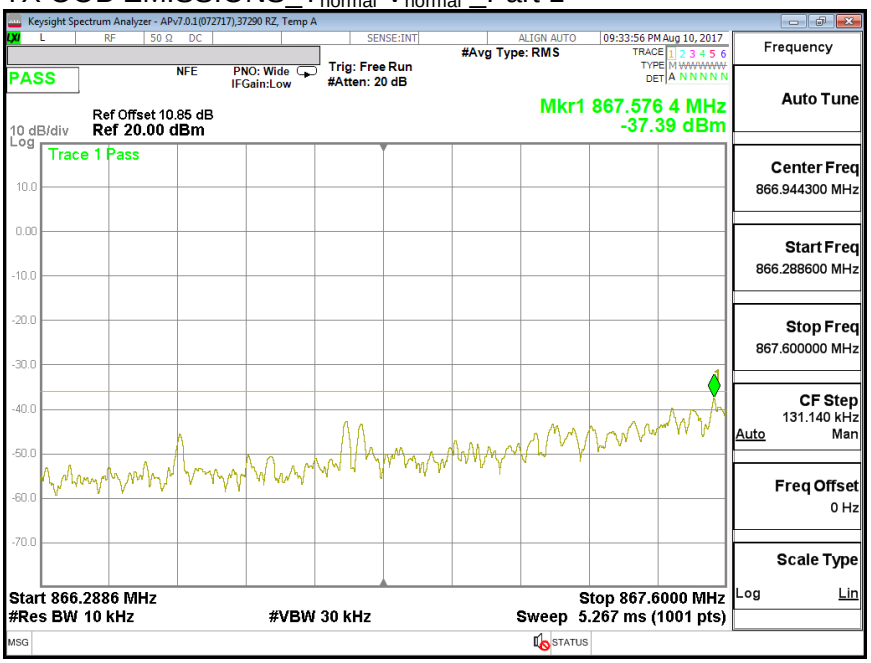
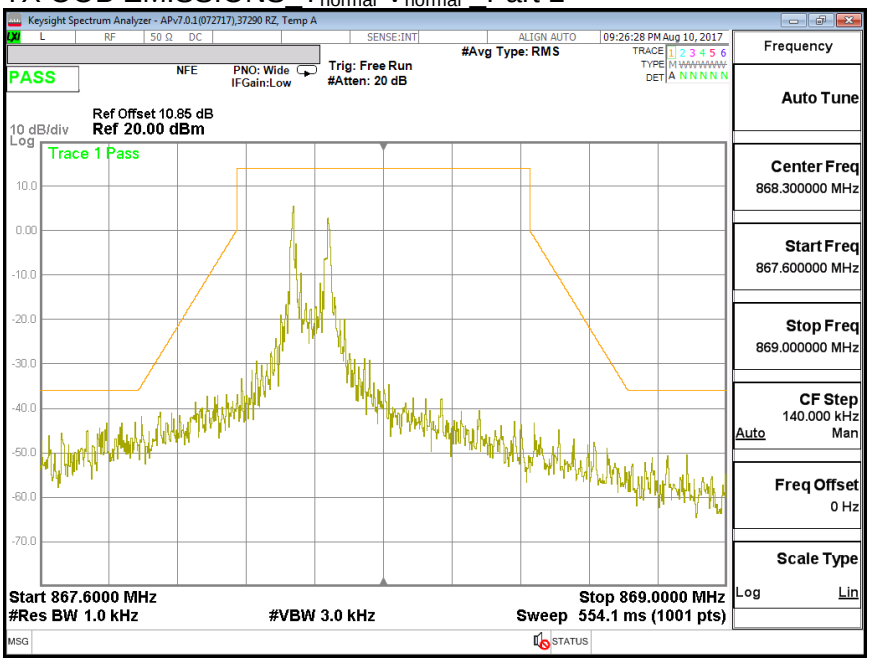
M5 LOW CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 1



TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 2



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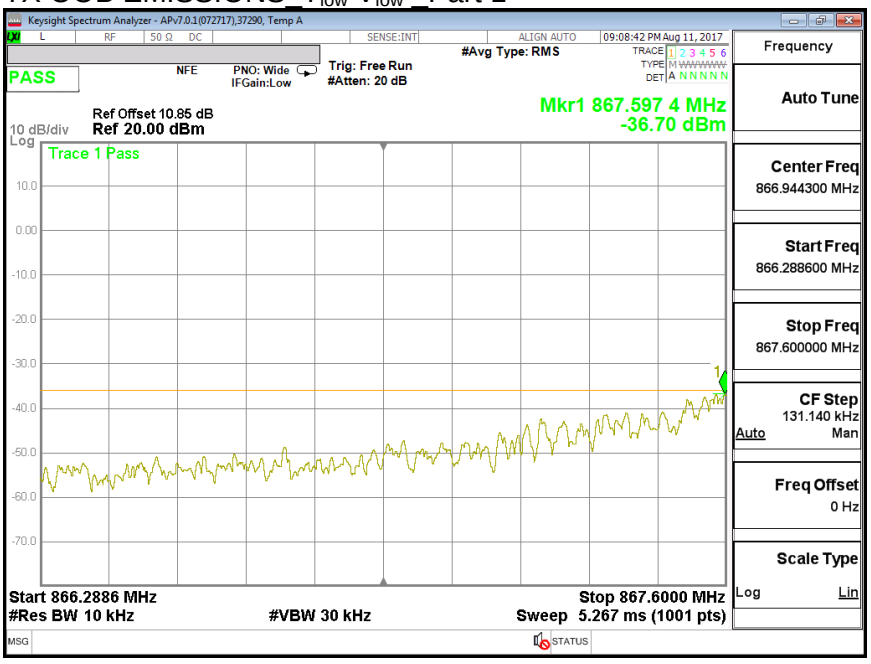
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3

TX OOB EMISSIONS_T_{low} V_{low} _Part 1



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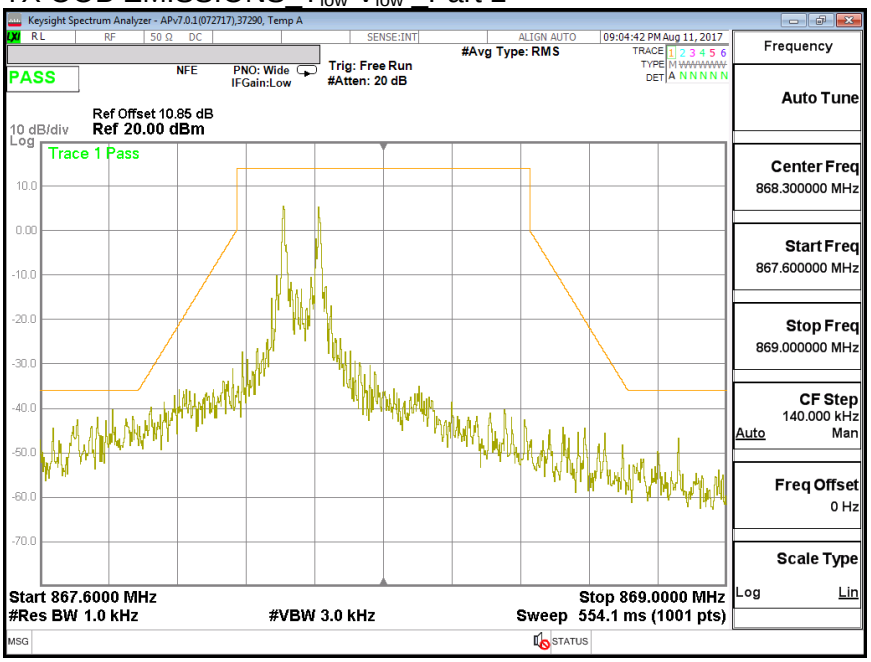
TX OOB EMISSIONS_T_{low} V_{low} _Part 2



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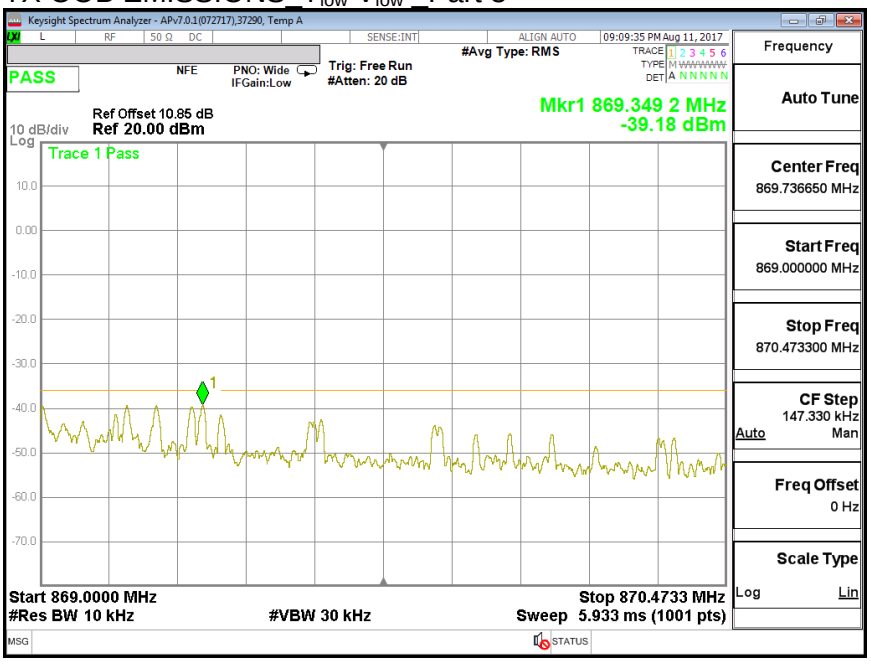

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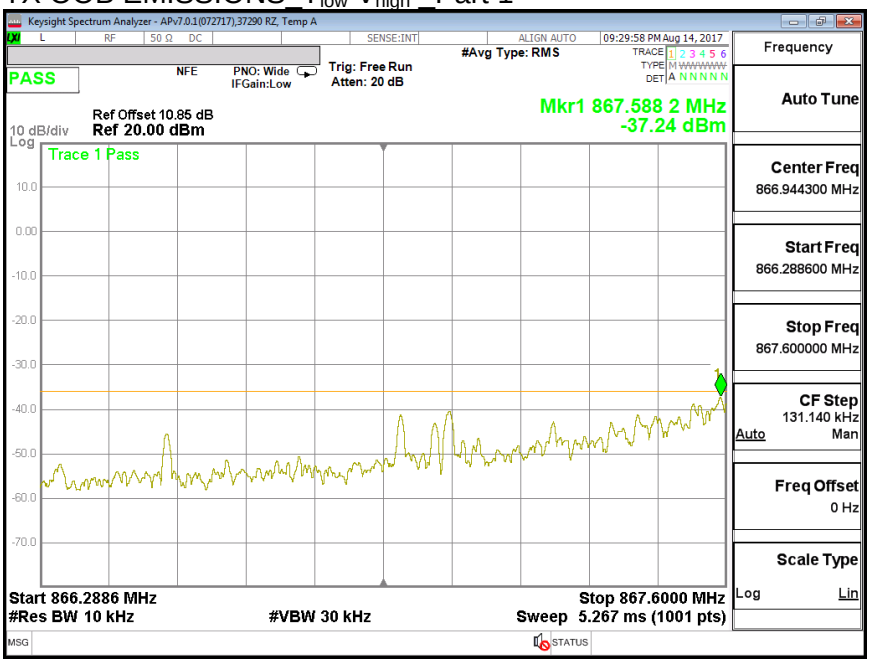
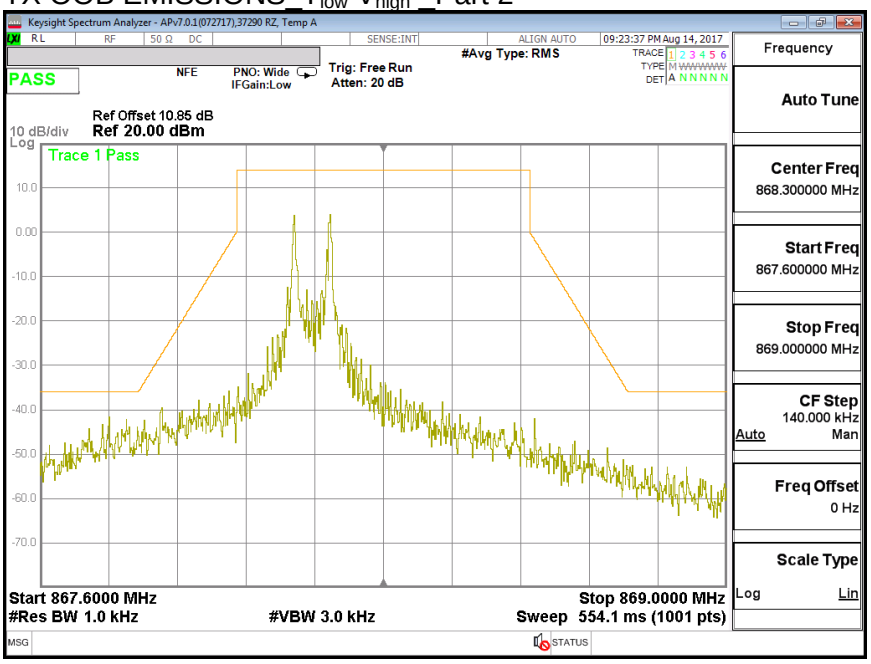
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



TX OOB EMISSIONS_T_{low} V_{high} _Part 2



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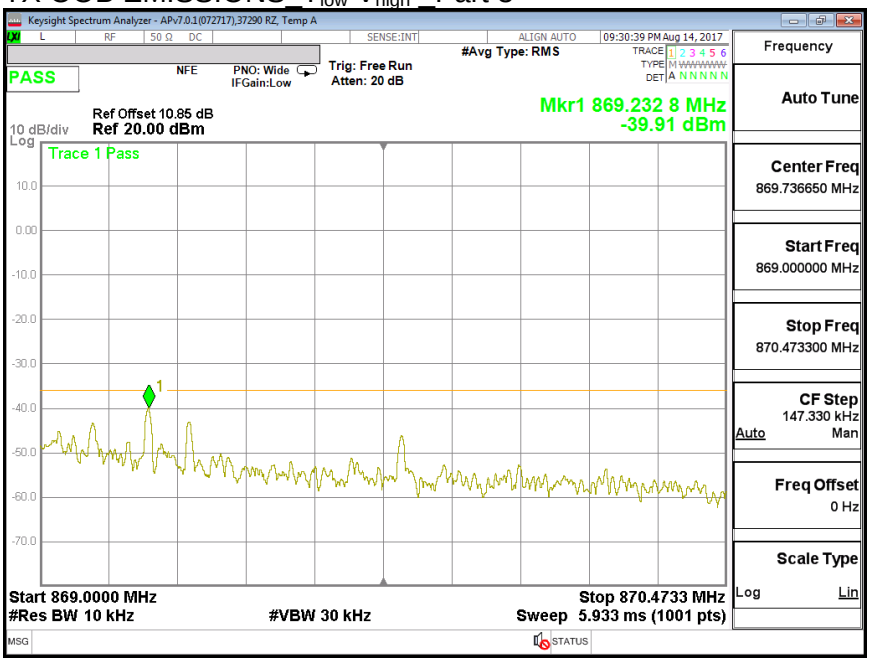
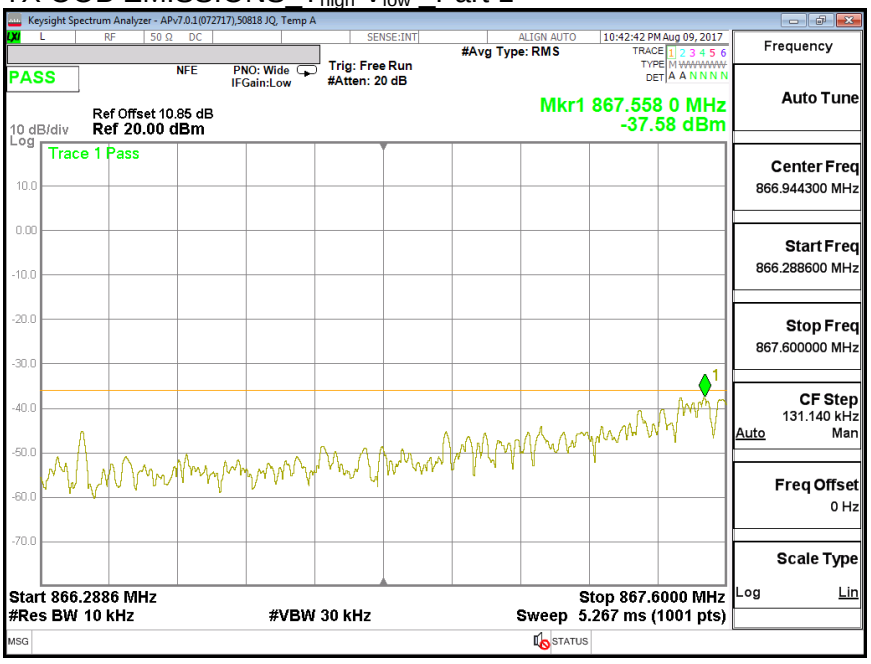
TX OOB EMISSIONS_T_{low} V_{high} _Part 3



TX OOB EMISSIONS_T_{high} V_{low} _Part 1



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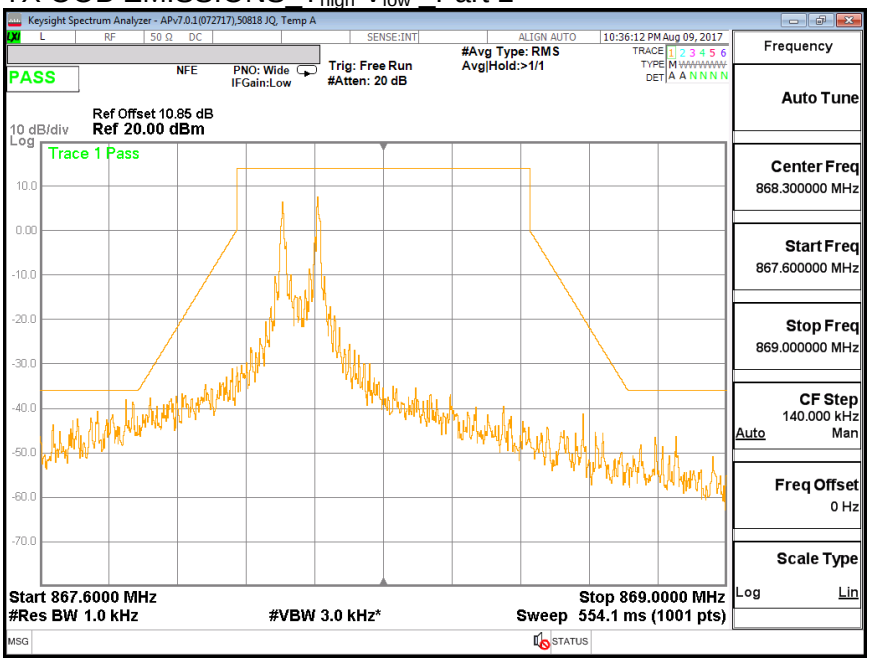
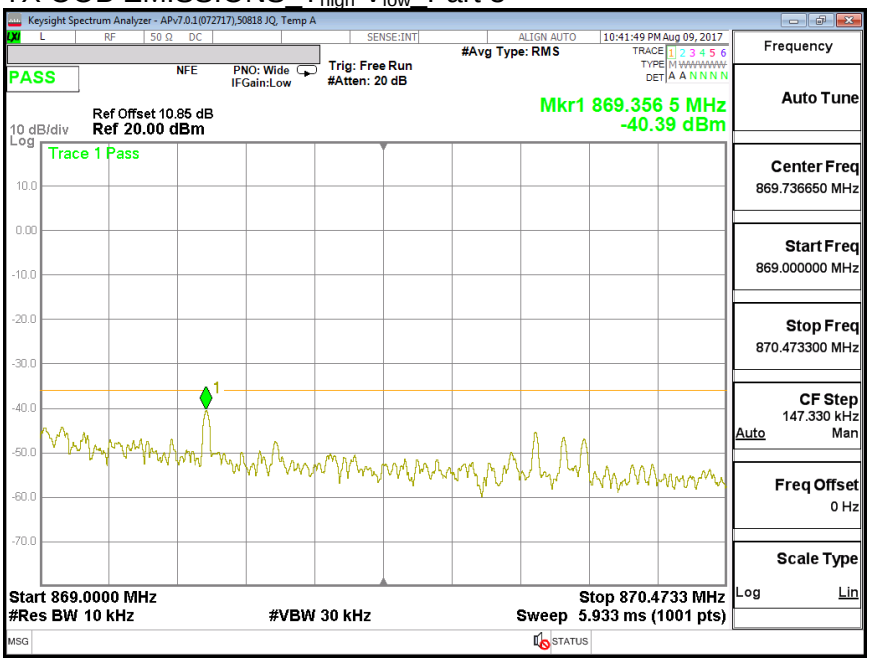


TX OOB EMISSIONS_T_{high} V_{low}_Part 3



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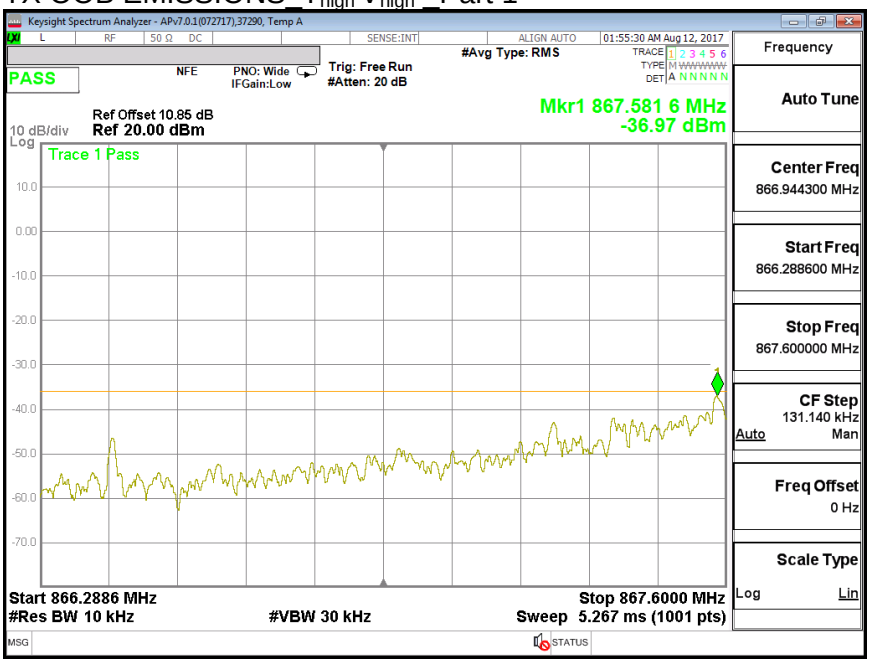
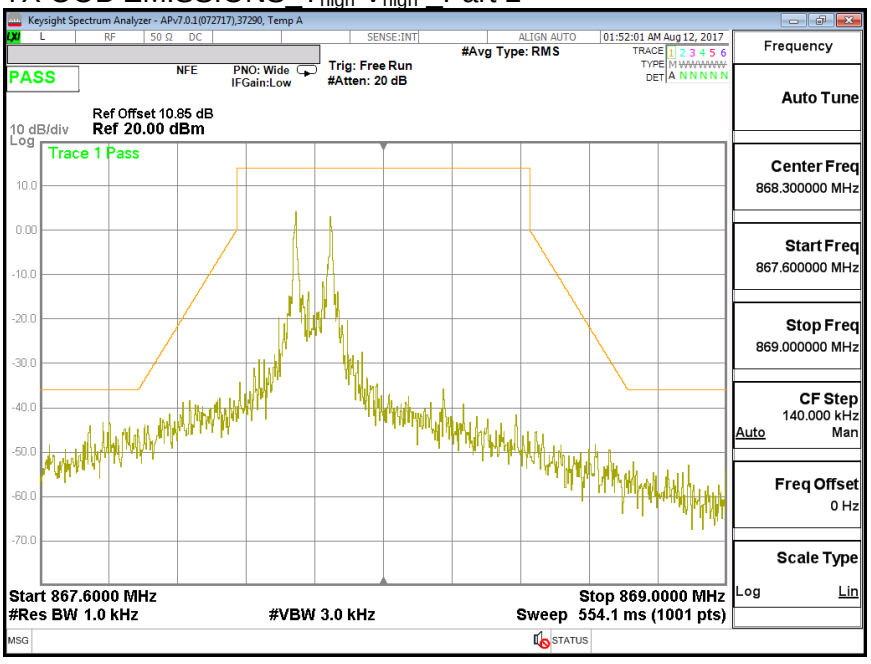
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



TX OOB EMISSIONS_T_{high} V_{high} _Part 2



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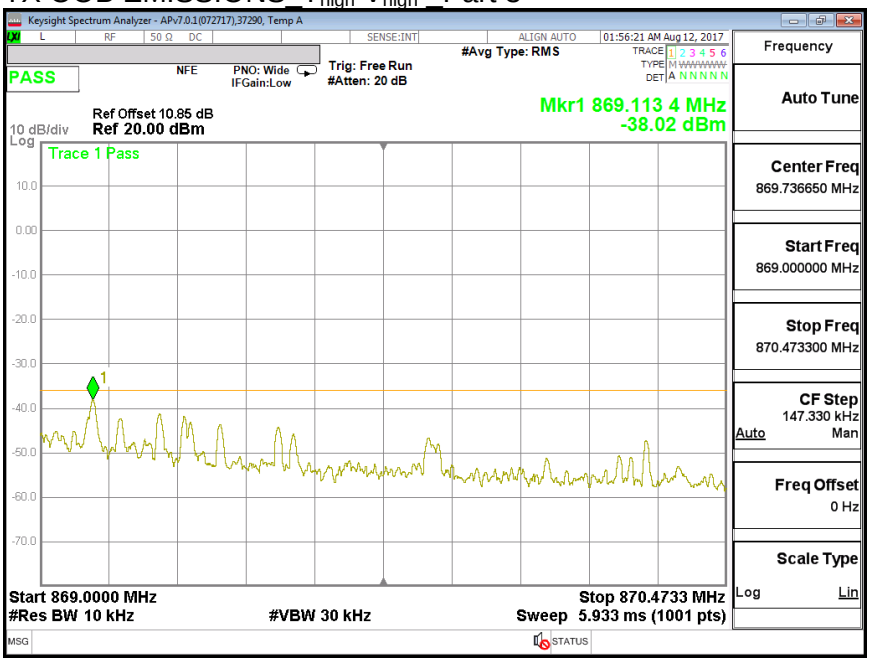
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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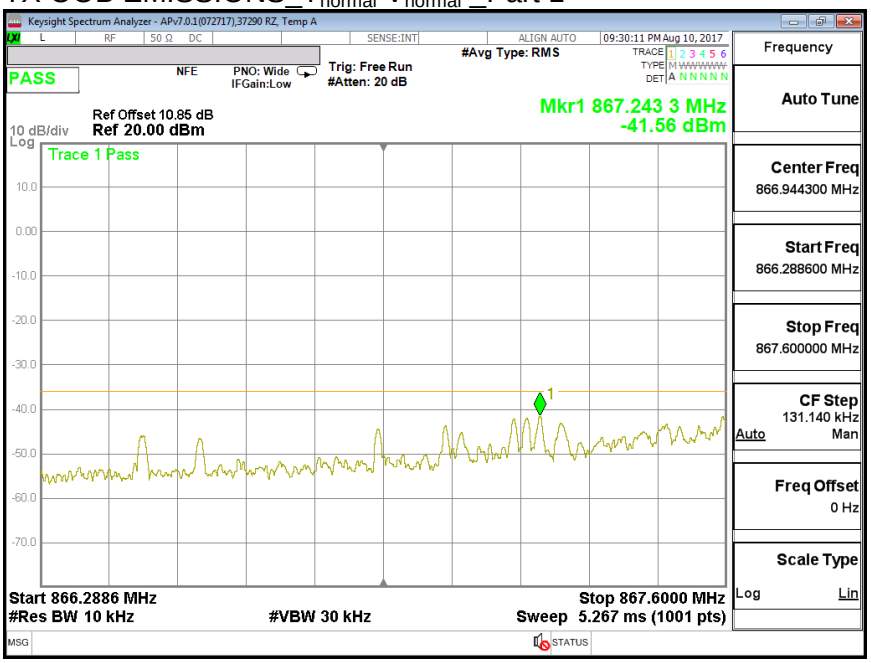
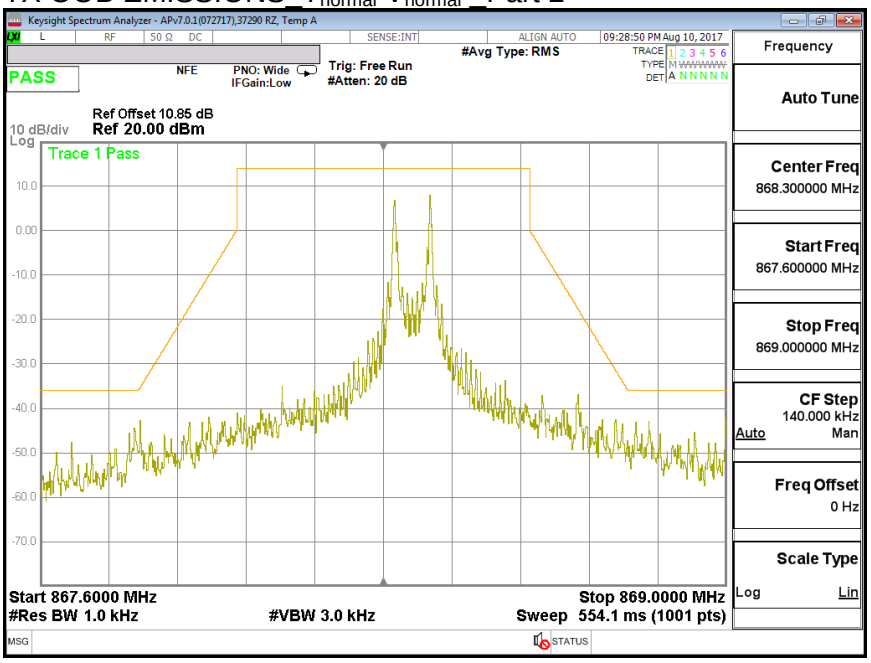
M5 HIGH CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 1



TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 2



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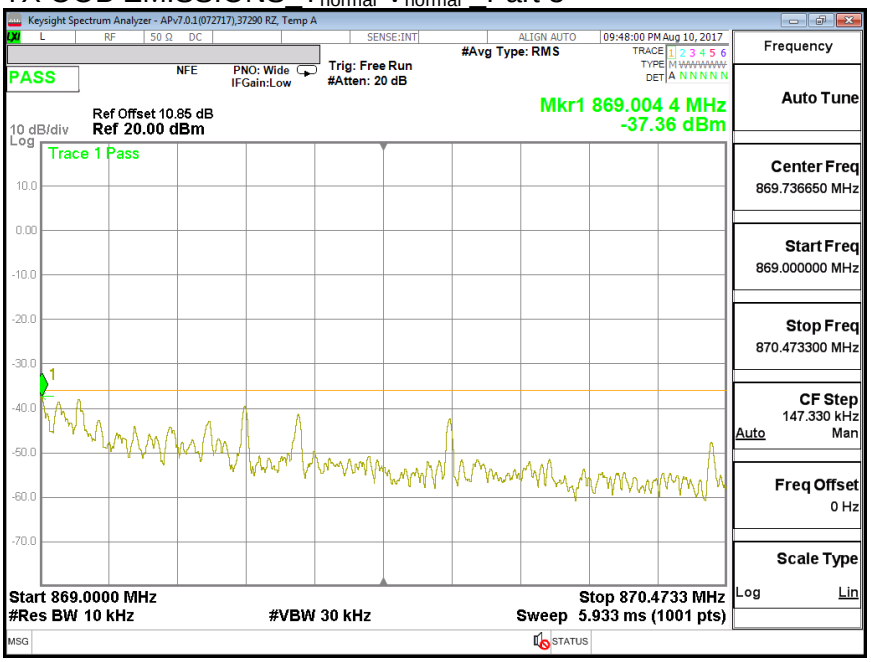
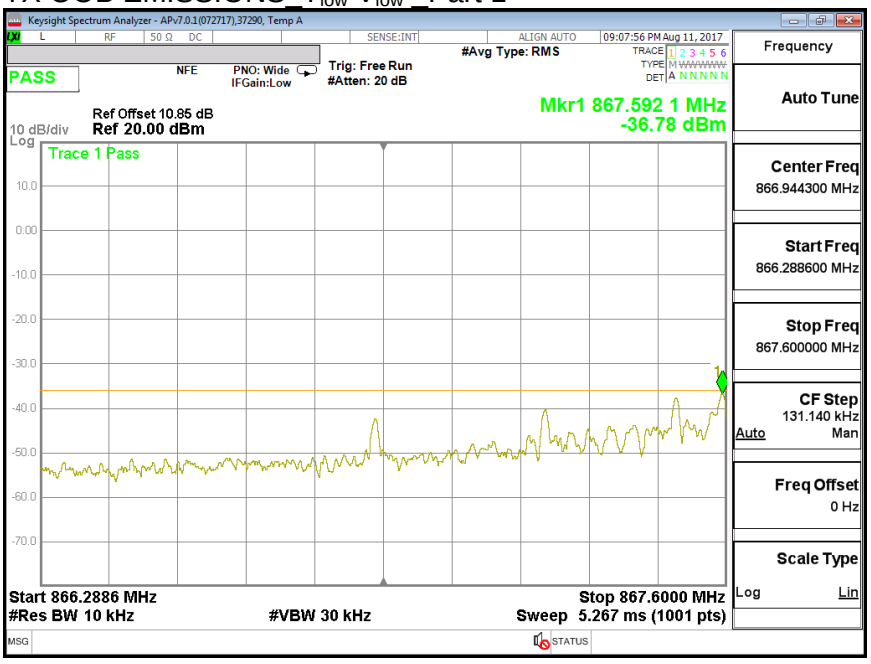
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3



TX OOB EMISSIONS_T_{low} V_{low} _Part 1



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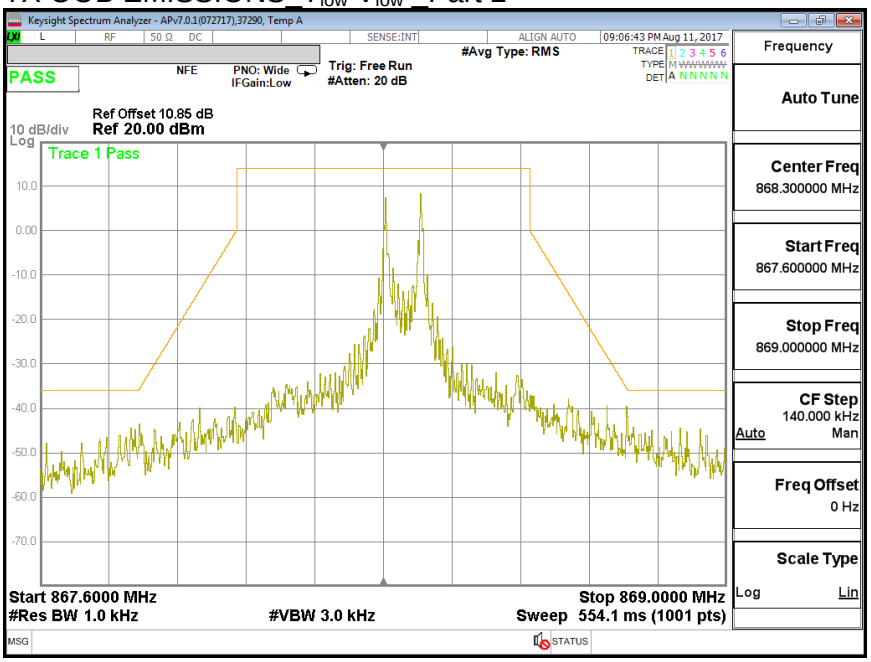
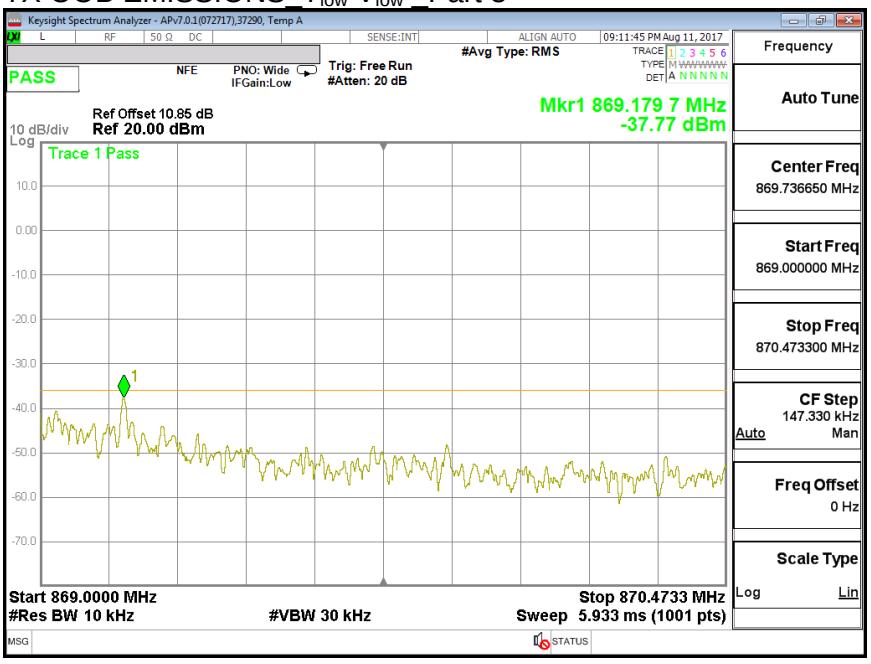
TX OOB EMISSIONS_T_{low} V_{low} _Part 2



TX OOB EMISSIONS_T_{low} V_{low} _Part 3



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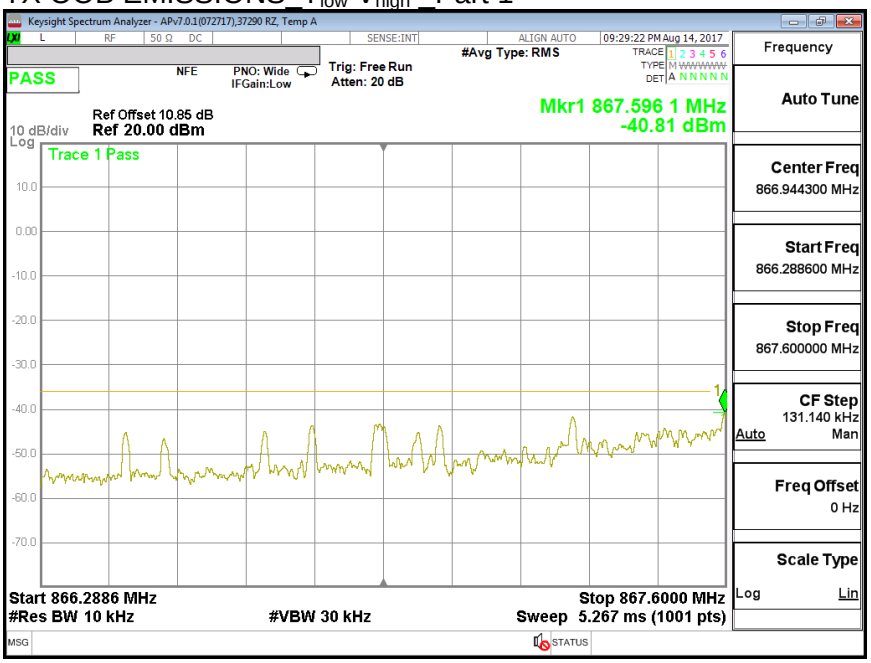
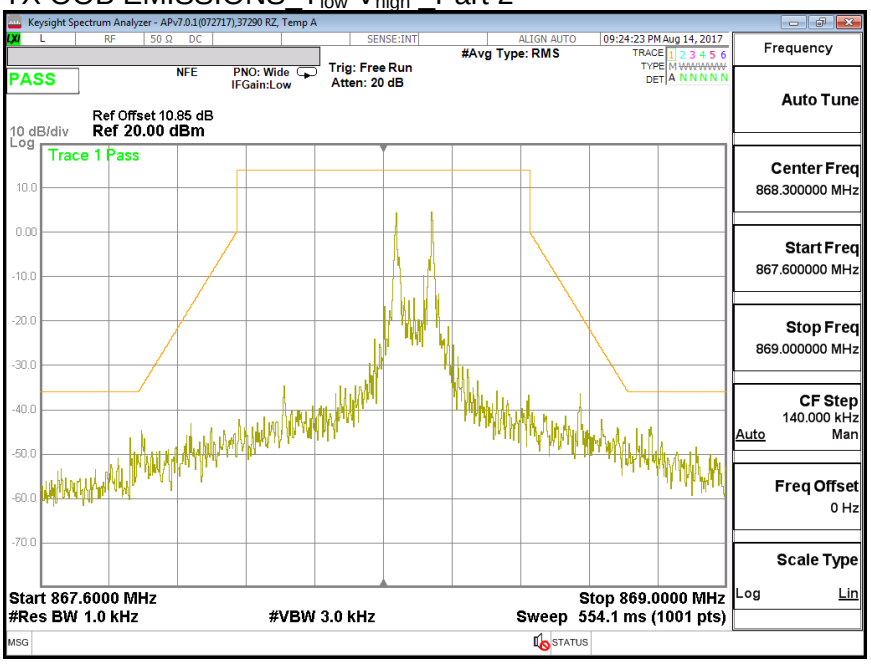
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



TX OOB EMISSIONS_T_{low} V_{high} _Part 2



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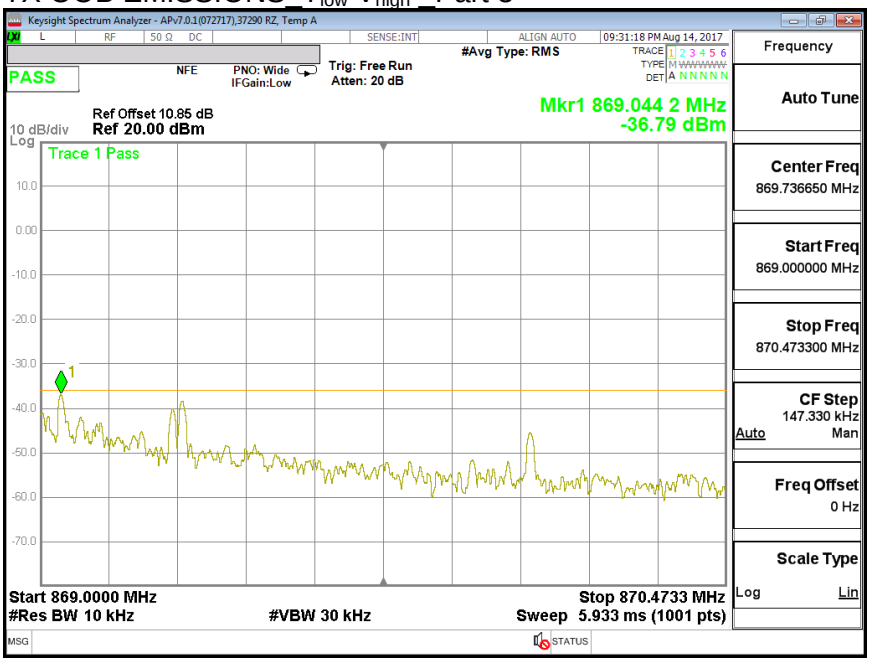
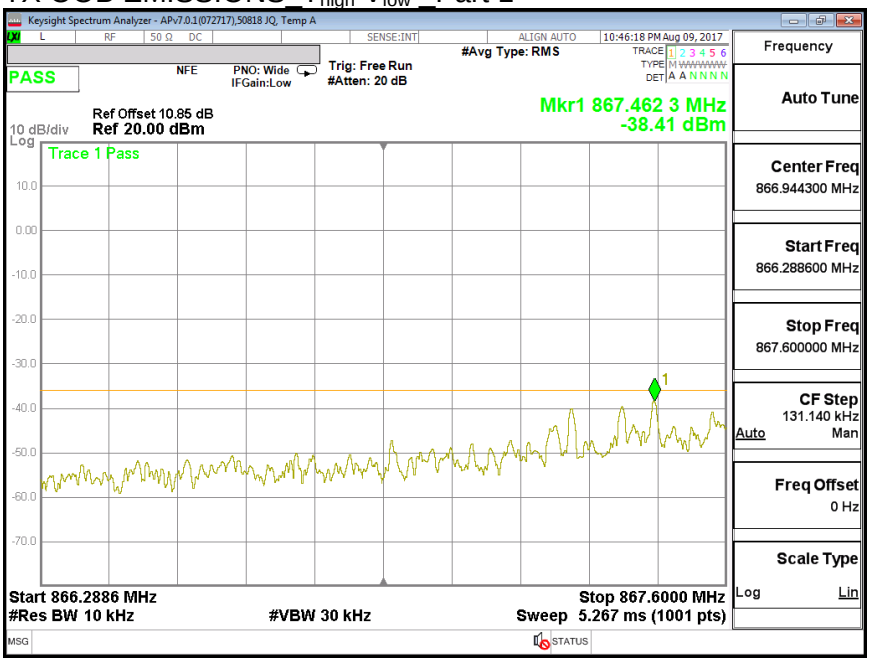
TX OOB EMISSIONS_T_{low} V_{high} _Part 3



TX OOB EMISSIONS_T_{high} V_{low} _Part 1



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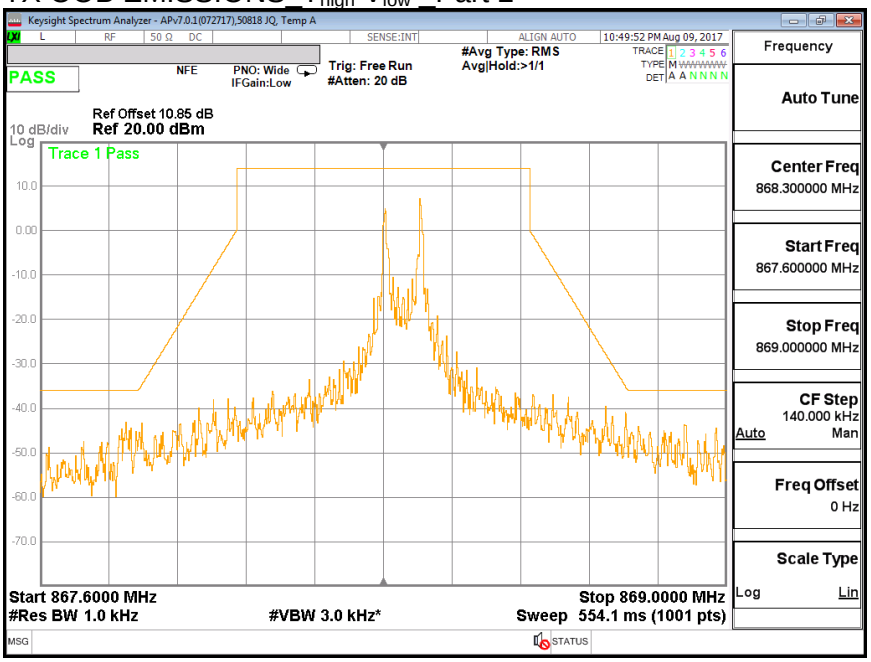
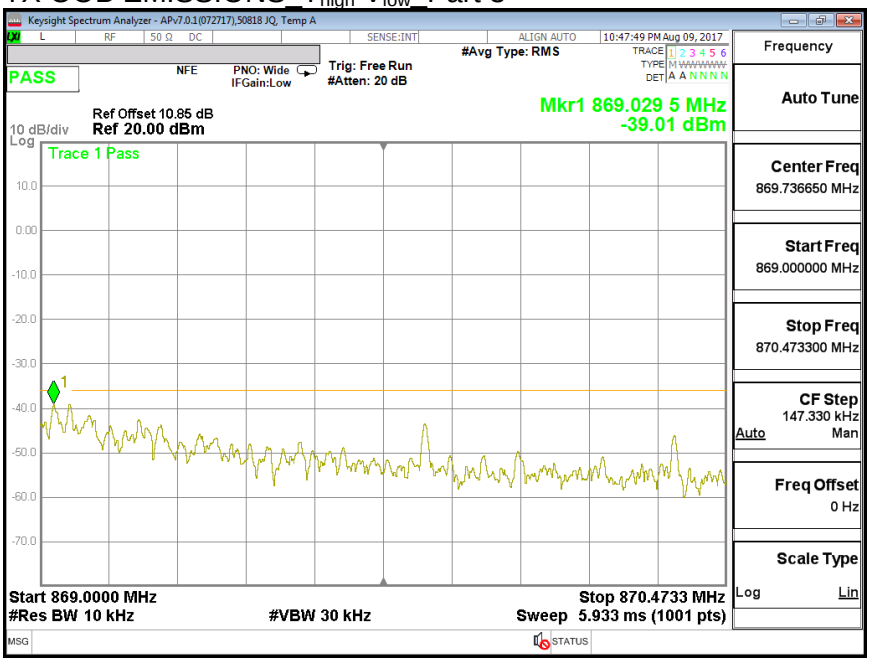
TX OOB EMISSIONS_T_{high} V_{low} _Part 2



TX OOB EMISSIONS_T_{high} V_{low}_Part 3



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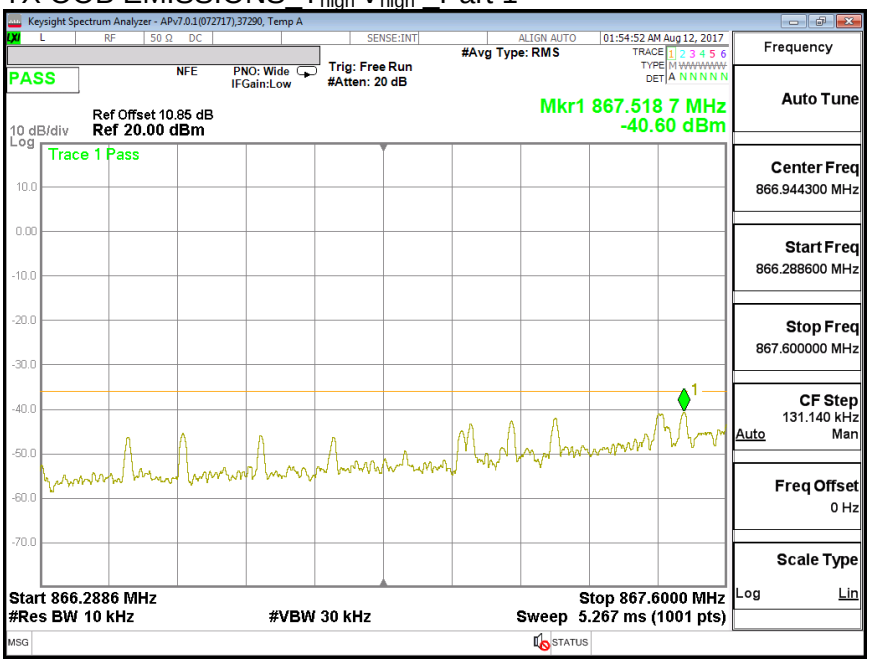
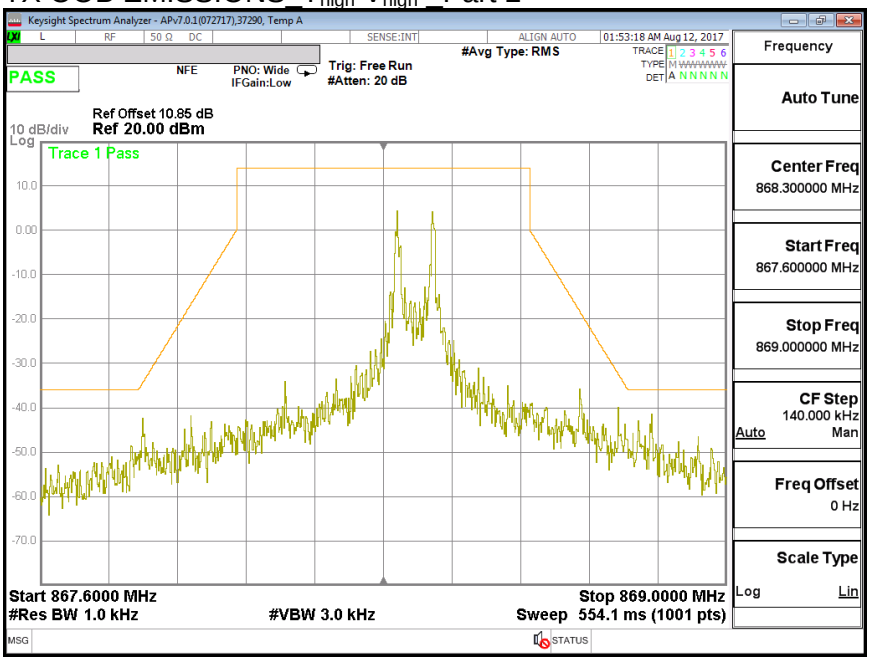
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



TX OOB EMISSIONS_T_{high} V_{high} _Part 2



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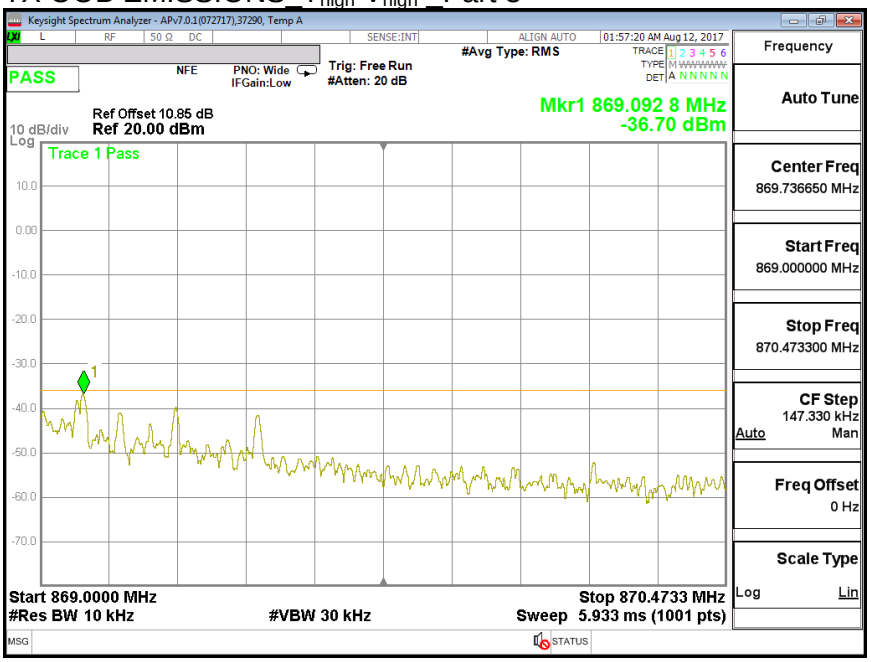
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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7.8.5. TX UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.2.2.2
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.1.1
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.2

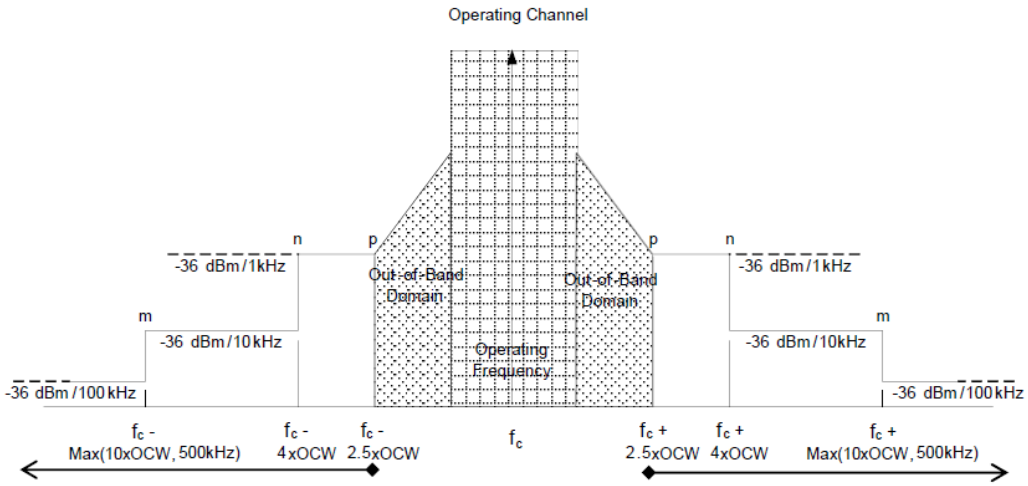

Figure 7: Spectrum Mask for Unwanted Emissions in the Spurious Domain with reference BW

Reference Limit:

The power of any unwanted emission in the spurious domain shall not exceed the values given in Table 19.

Table 19: Spurious domain emission limits

Frequency / State	47 MHz to 74 MHz 87,5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 790 MHz	Other frequencies below 1 000 MHz	Frequencies above 1 000 MHz
TX mode	-54 dBm	-36 dBm	-30 dBm
RX and all other modes	-57 dBm	-57 dBm	-47 dBm

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.3.3.1 (Conducted Measurement)
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.3.3.2 (Radiated Measurement)

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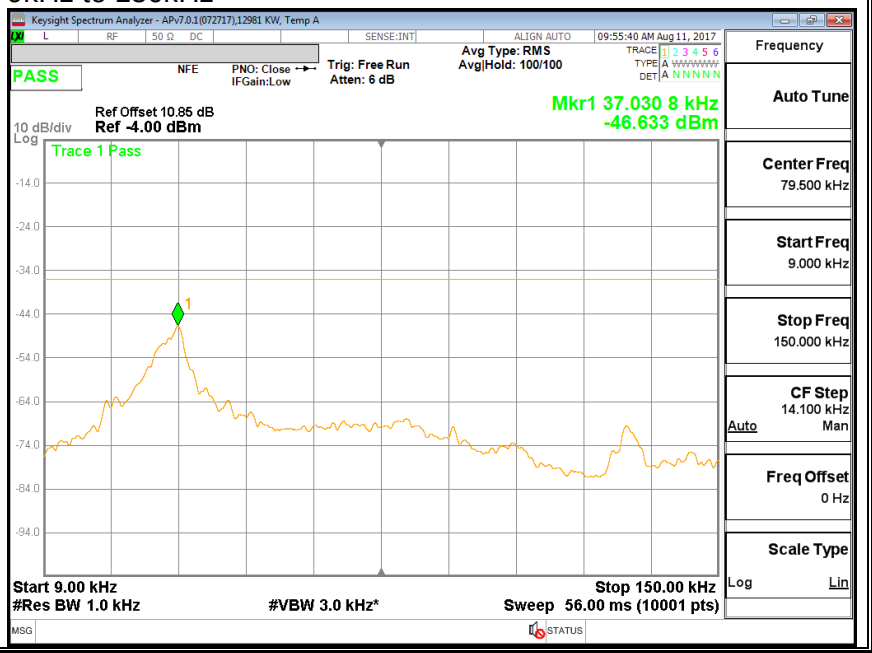
RESULTS

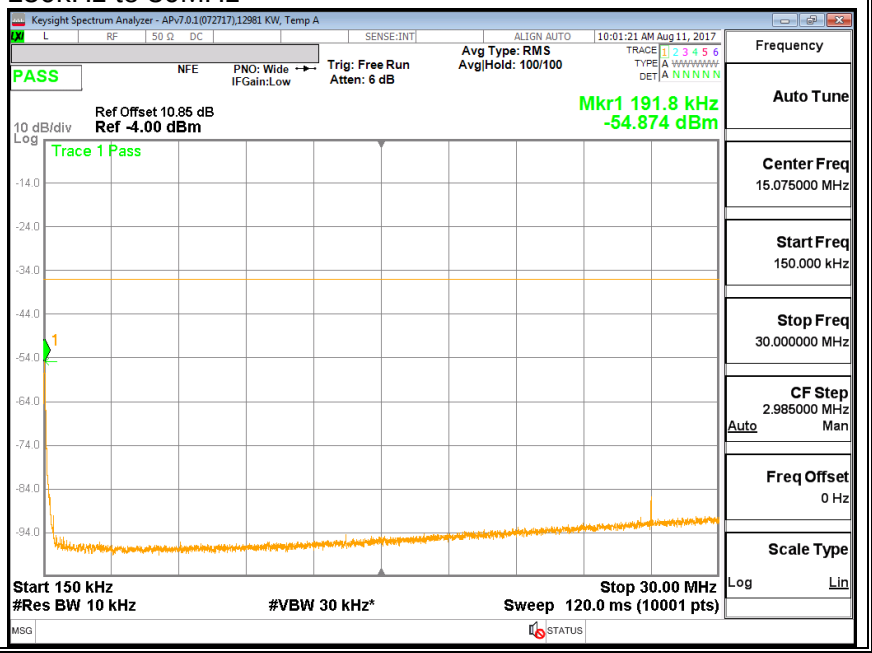
CONDUCTED SPURIOUS EMISSIONS

THE WORST CASE OF 2-FSK LOW CHANNEL

9kHz to 150kHz



150kHz to 30MHz



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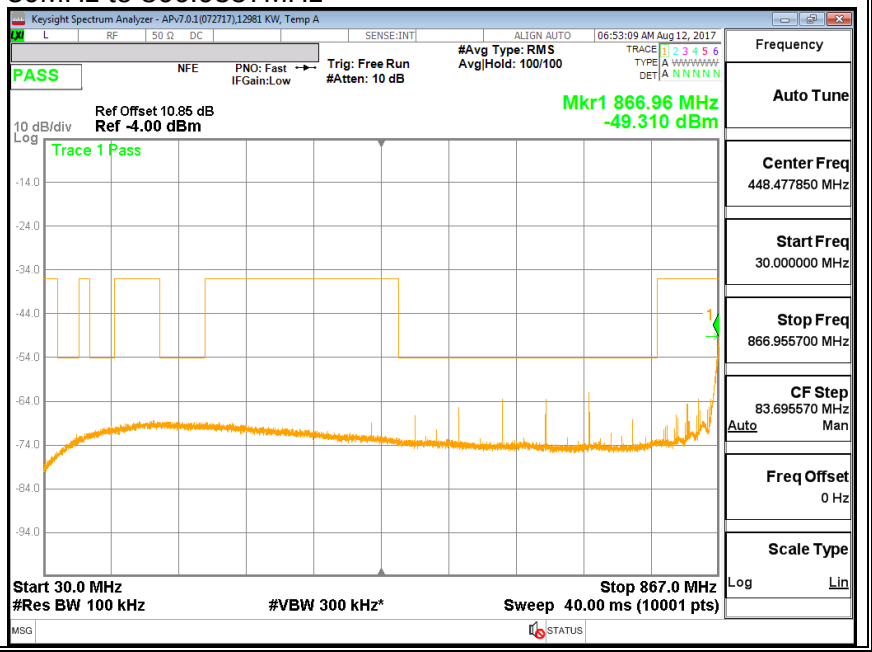
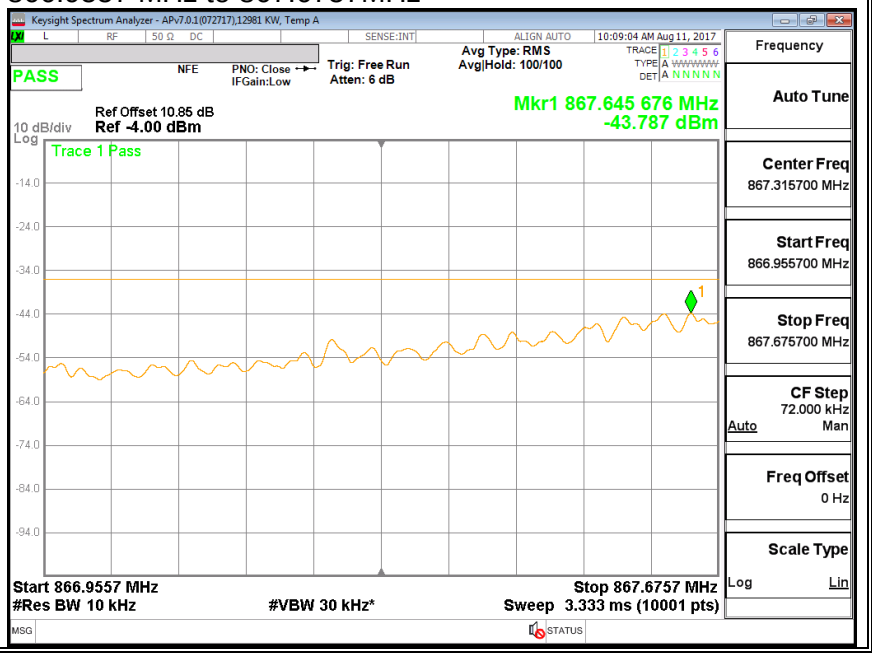
30MHz to 866.9557MHz



866.9557 MHz to 867.6757MHz



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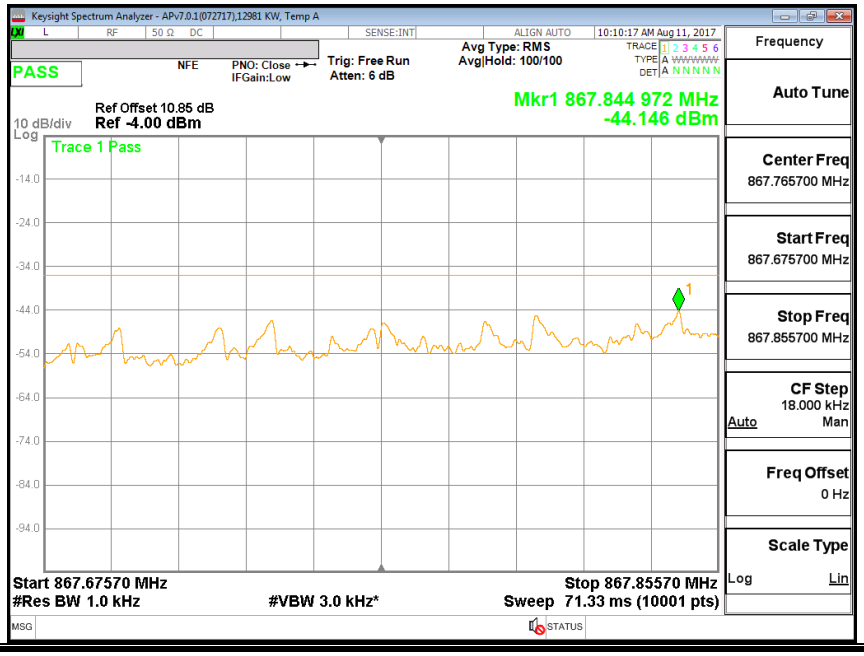
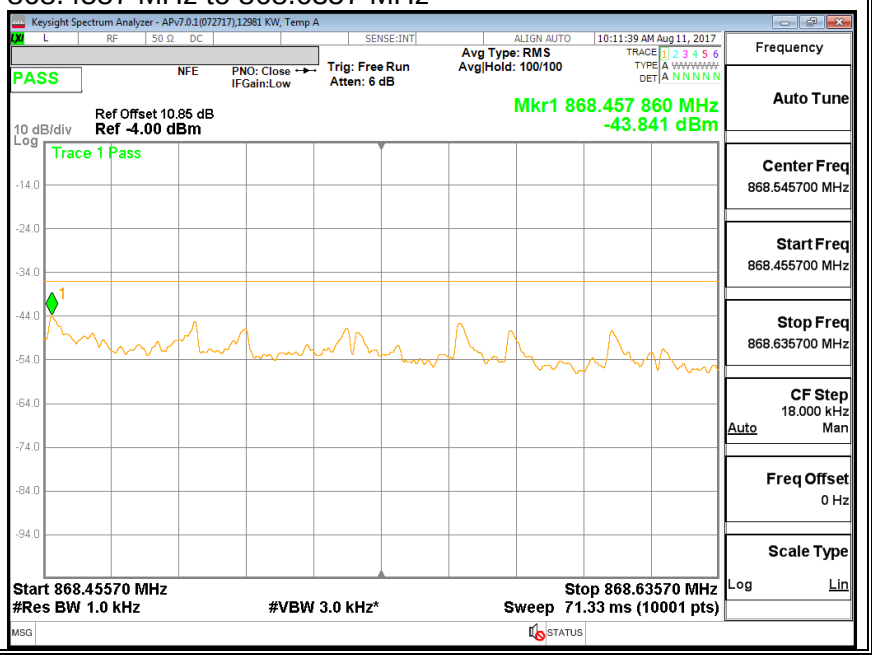
867.6757 MHz to 867.8557 MHz



868.4557 MHz to 868.6357 MHz



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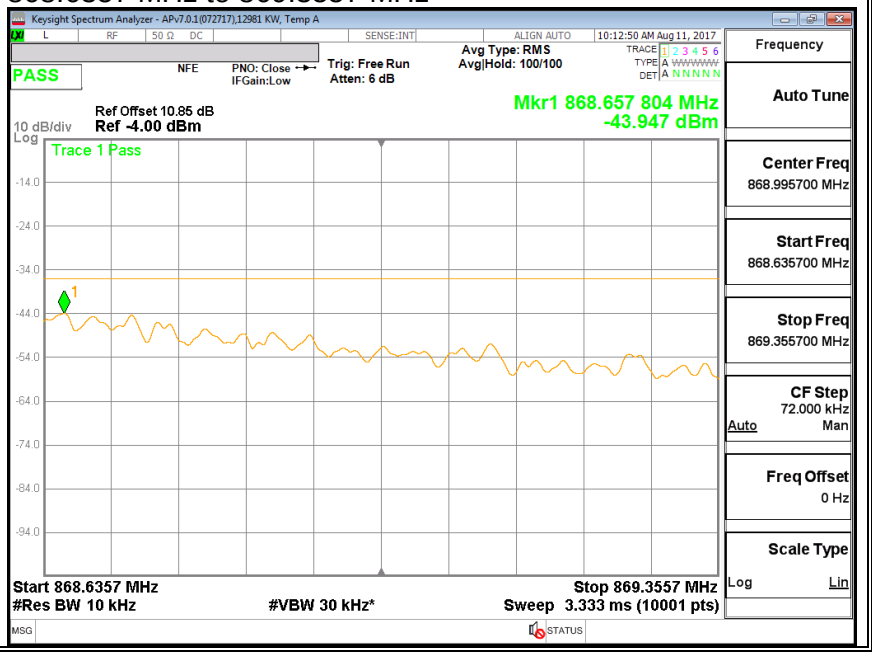
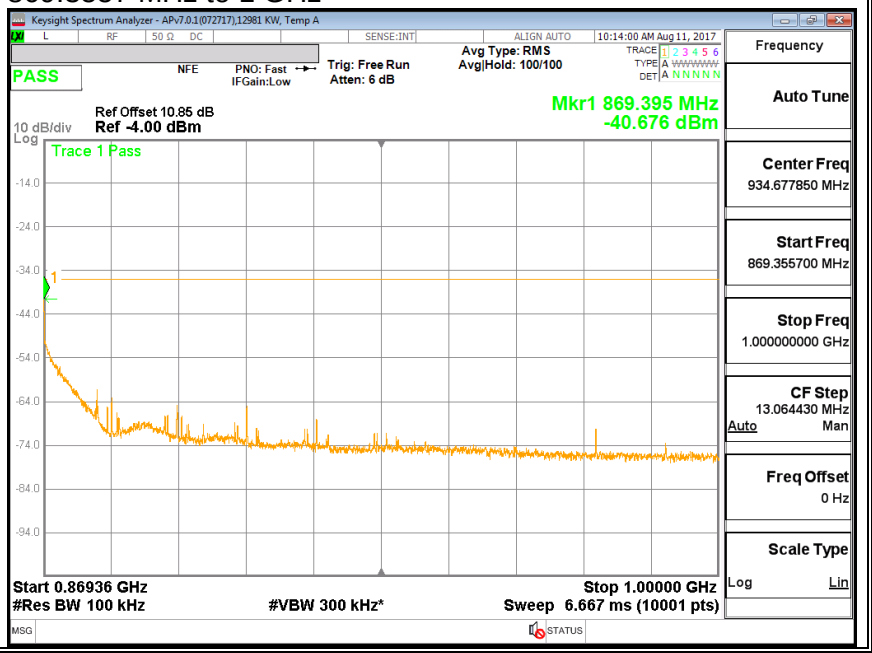
868.6357 MHz to 869.3557 MHz



869.3557 MHz to 1 GHz



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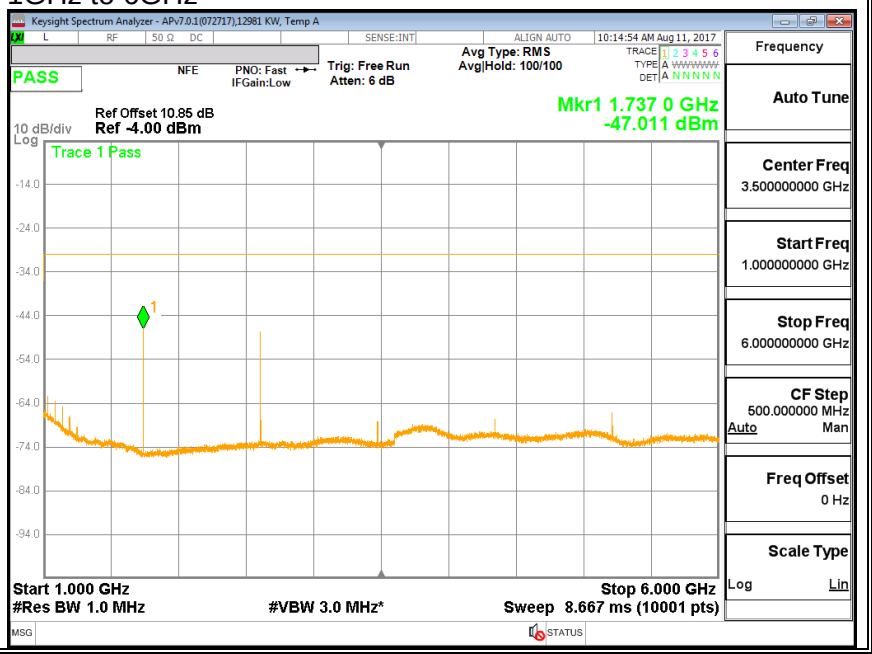
1GHz to 6GHz



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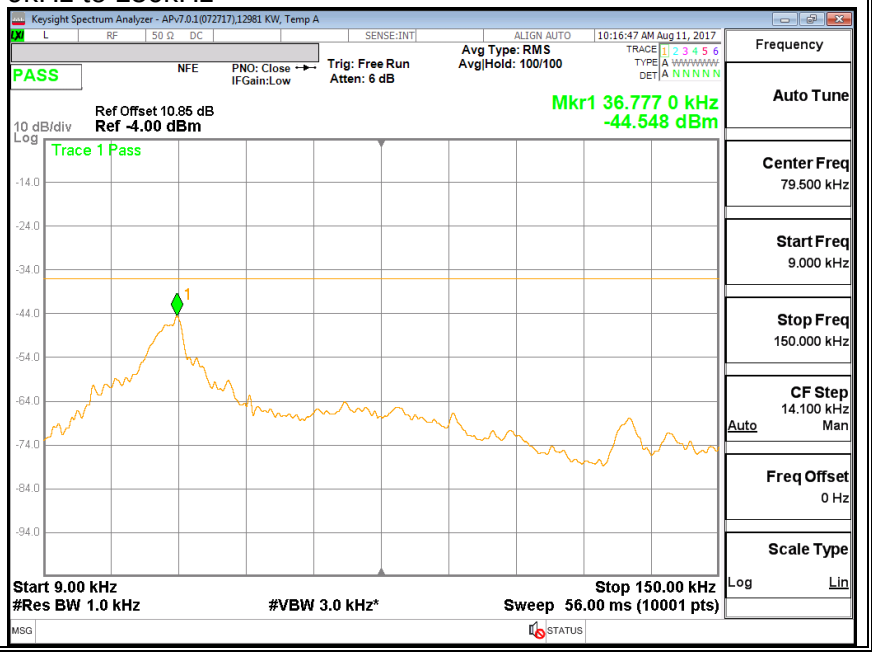
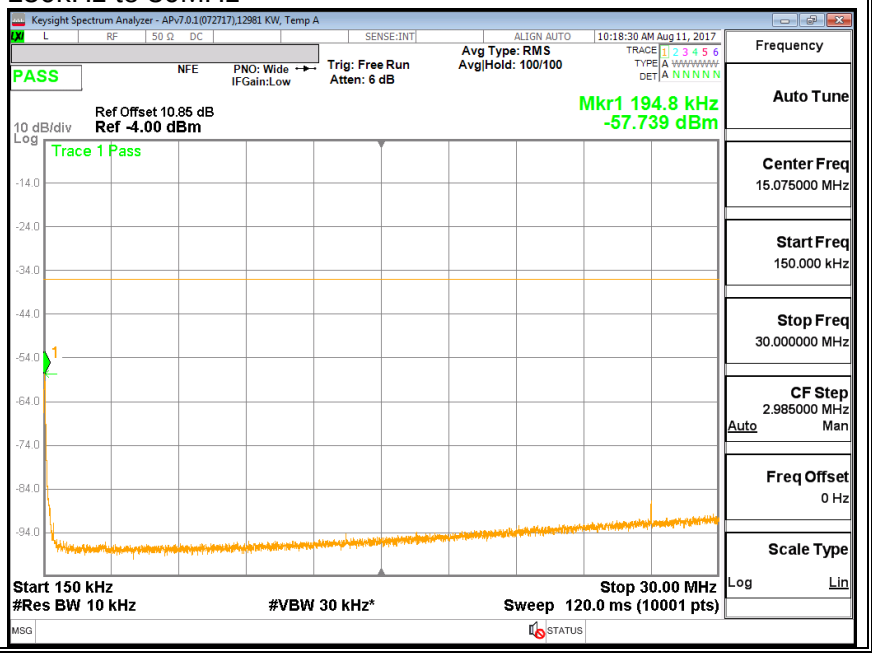
THE WORST CASE OF 2-FSK HIGH CHANNEL

9kHz to 150kHz



150kHz to 30MHz



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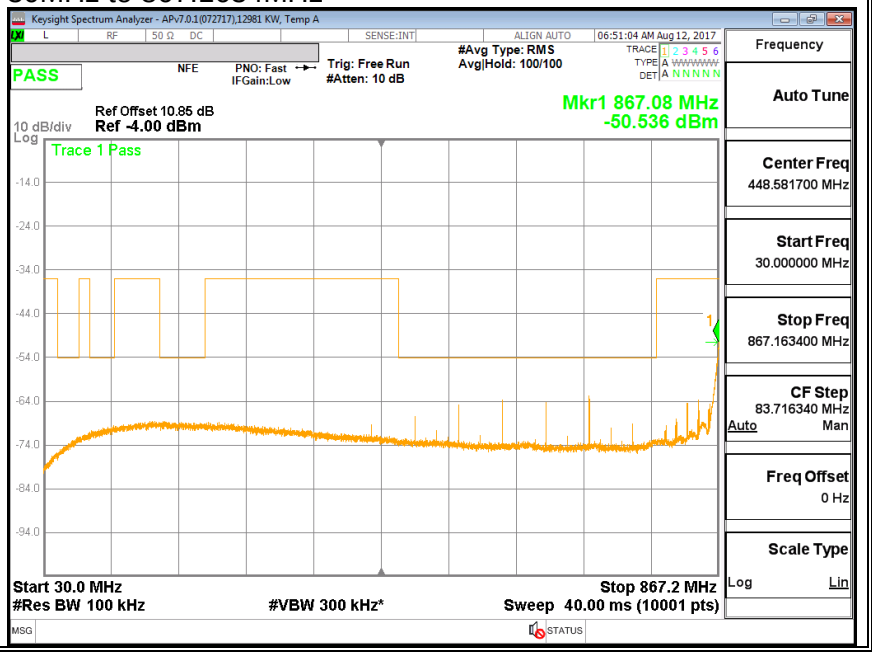
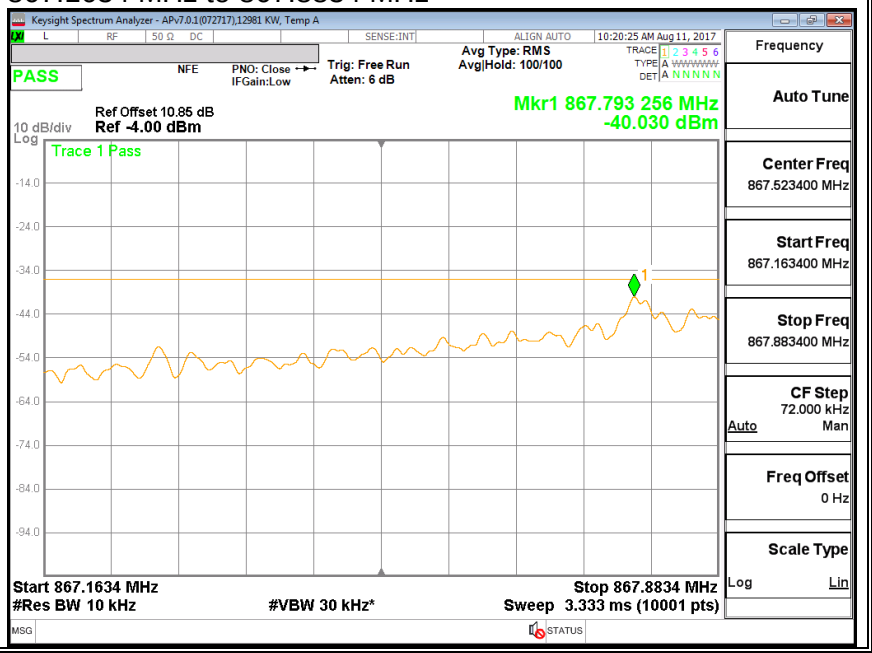
30MHz to 867.1634MHz



867.1634 MHz to 867.8834 MHz



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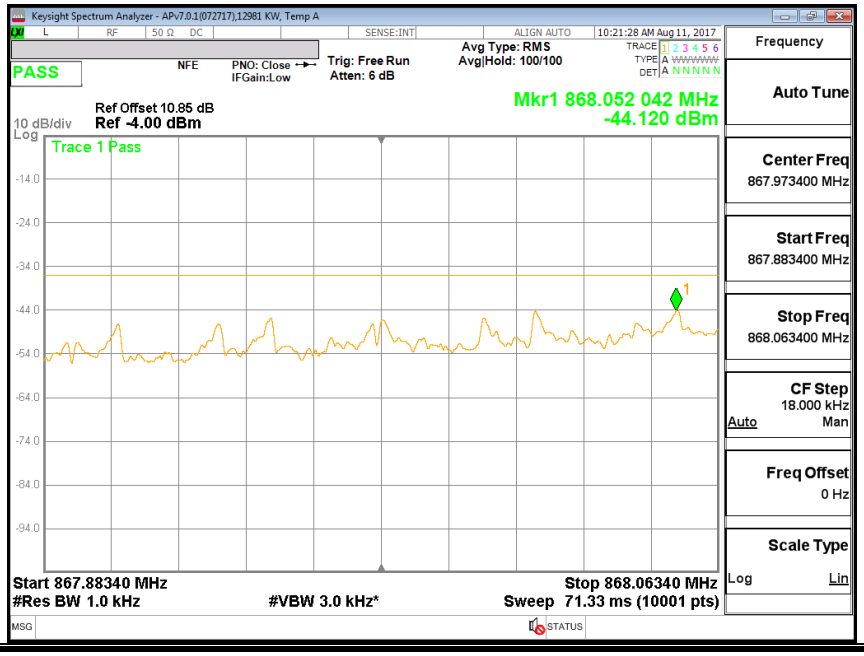
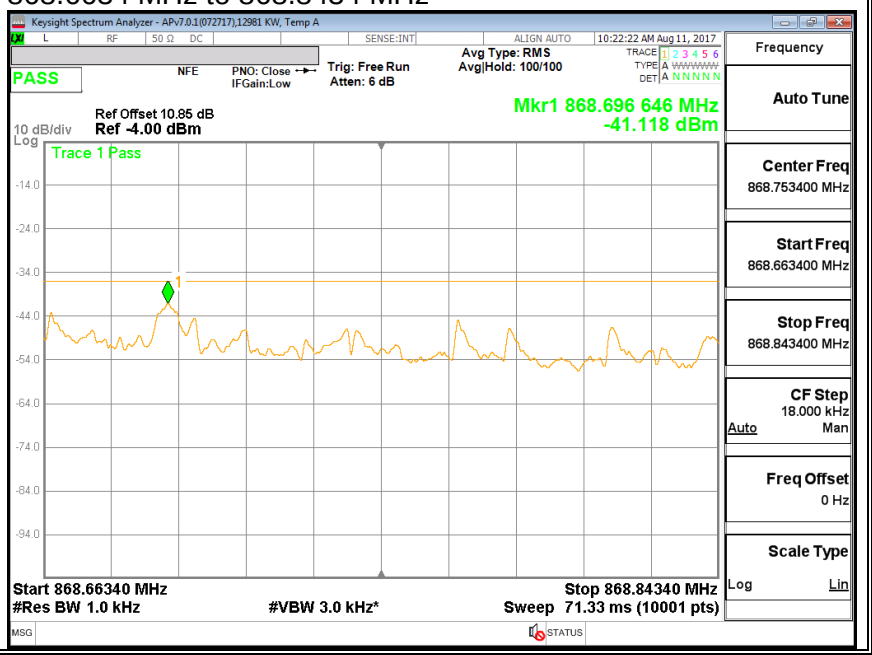
867.8834 MHz to 868.0634 MHz



868.6634 MHz to 868.8434 MHz



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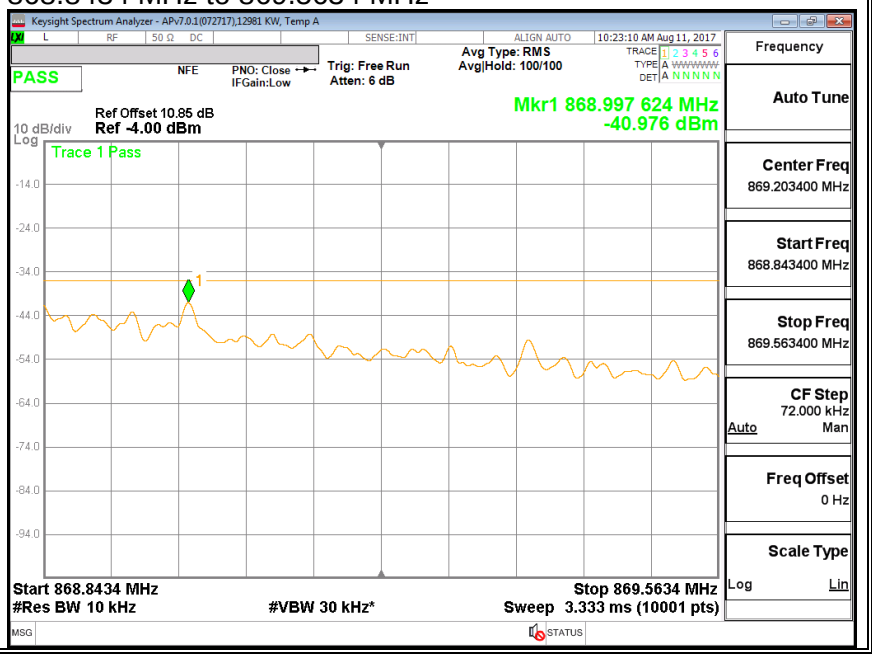
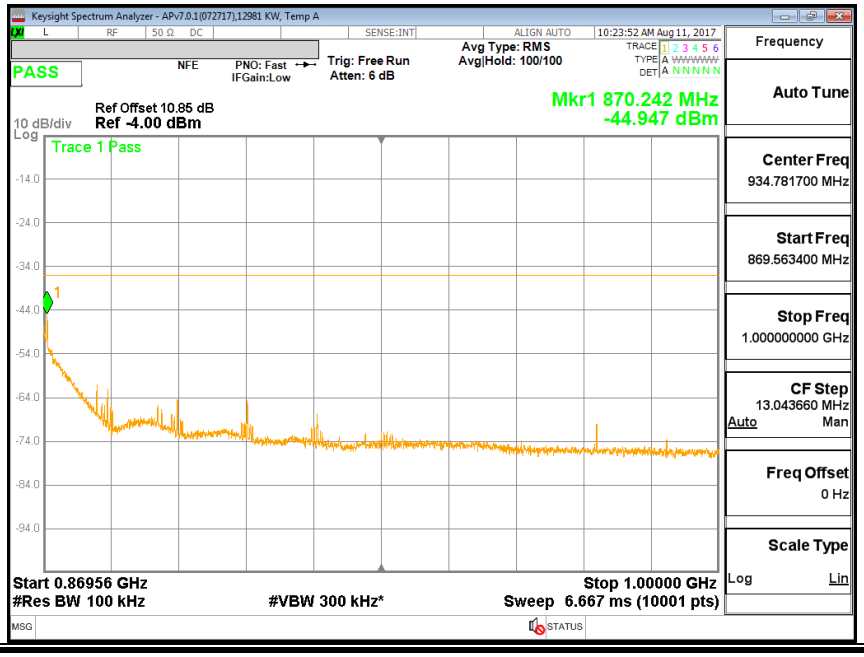
868.8434 MHz to 869.5634 MHz



869.5634 MHz to 1 GHz



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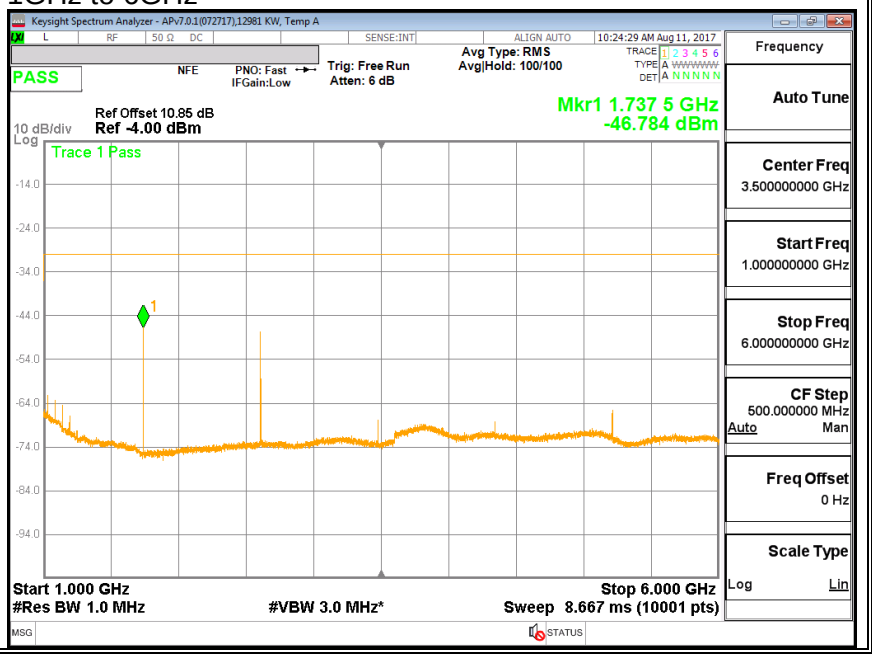
1GHz to 6GHz



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RADIATED SPURIOUS EMISSIONS

3m Radiated Emissions Chamber
30 - 1000MHz Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/13/2017
Test Engineer: 50818
Configuration: EUT with 50Ohm load and a support laptop
Mode: TX Below 1GHz 2FSK M band worst case

Chamber	Pre-amplifer	Attenuator	Limit
3m Chamber B	3m-B T10		ETSI 300 220 Tx

Frequency (MHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Attenuator (dB)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel										
432.11	-72.2	H	3.0	24.9	28.8		-76.0	-36.0	-40.0	
699.33	-70.3	H	3.0	29.0	28.6		-69.9	-54.0	-15.9	
801.63	-70.1	H	3.0	30.2	28.4		-68.3	-54.0	-14.3	
432.22	-70.3	V	3.0	26.6	28.8		-72.5	-36.0	-36.5	
767.01	-72.4	V	3.0	31.9	28.4		-68.9	-54.0	-14.9	
796.49	-72.8	V	3.0	32.4	28.4		-68.7	-54.0	-14.7	
High Channel										
432.16	-71.2	H	3.0	24.9	28.8		-75.0	-36.0	-39.0	
658.27	-73.9	H	3.0	28.7	28.9		-74.1	-54.0	-20.1	
798.19	-72.4	H	3.0	30.1	28.4		-70.7	-54.0	-16.7	
432.21	-70.8	V	3.0	26.6	28.8		-73.0	-36.0	-37.0	
767.25	-70.6	V	3.0	31.9	28.4		-67.1	-54.0	-13.1	
820.60	-72.4	V	3.0	33.1	28.2		-67.5	-54.0	-13.5	

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3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/13/2017
Test Engineer: 50818
Configuration: EUT with 50Ohm load and a support laptop
Mode: TX Above 1GHz M band 2FSK worst case

Chamber	Pre-amplifer	Filter	Limit
3m Chamber B	3m Chamber B	Filter	ETSI 300 220 Tx

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss @ SG End (dBm)	Preamp (dB)	Attenuator (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel										
1.610	-60.27	H	3.0	-15.4	38.7	1.0	-53.1	-30.0	-23.1	
2.394	-59.49	H	3.0	-10.0	38.6	1.0	-47.7	-30.0	-17.7	
5.209	-58.68	H	3.0	-4.0	38.7	1.0	-41.8	-30.0	-11.8	
1.195	-55.63	V	3.0	-13.4	38.5	1.0	-50.9	-30.0	-20.9	
1.609	-58.96	V	3.0	-14.1	38.7	1.0	-51.8	-30.0	-21.8	
1.995	-61.39	V	3.0	-12.9	38.0	1.0	-49.9	-30.0	-19.9	
High Channel										
1.611	-56.63	H	3.0	-11.8	38.7	1.0	-49.4	-30.0	-19.4	
2.392	-60.30	H	3.0	-10.8	38.6	1.0	-48.5	-30.0	-18.5	
5.210	-58.77	H	3.0	-4.1	38.7	1.0	-41.8	-30.0	-11.8	
1.197	-58.00	V	3.0	-15.8	38.5	1.0	-53.3	-30.0	-23.3	
1.610	-61.55	V	3.0	-16.7	38.7	1.0	-54.4	-30.0	-24.4	
1.996	-61.78	V	3.0	-13.3	38.0	1.0	-50.3	-30.0	-20.3	

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7.8.6. TX TRANSIENT POWER

REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.10.2

The TX TRANSIENT POWER shall not exceed the values given in Table 23.

Table 23: Transmitter Transient Power limits

Absolute offset from centre frequency	RBW_{REF}	Peak power limit applicable at measurement points
≤ 400 kHz	1 kHz	0 dBm
> 400 kHz	1 kHz	-27 dBm

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.10.3.2

RESULTS

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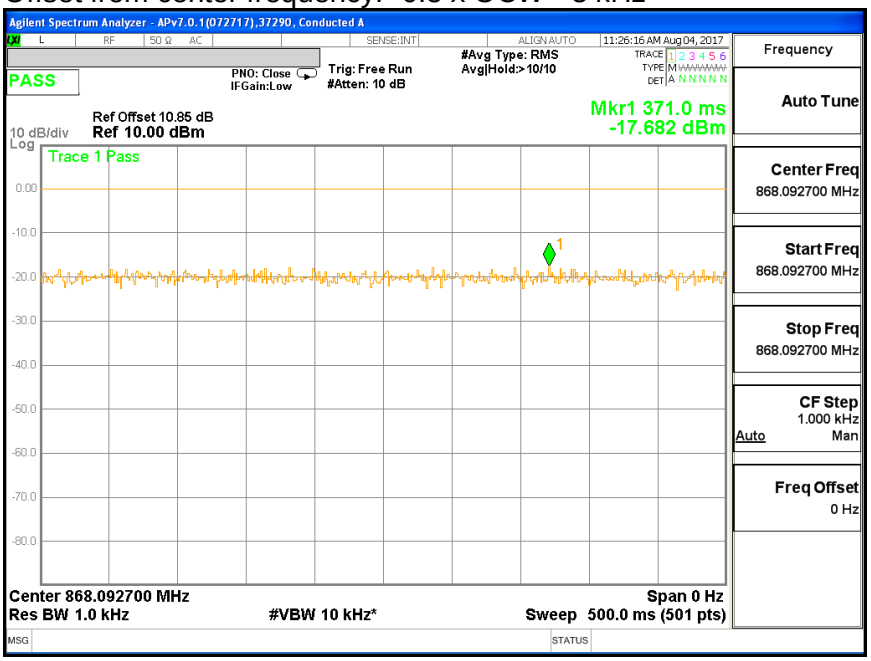
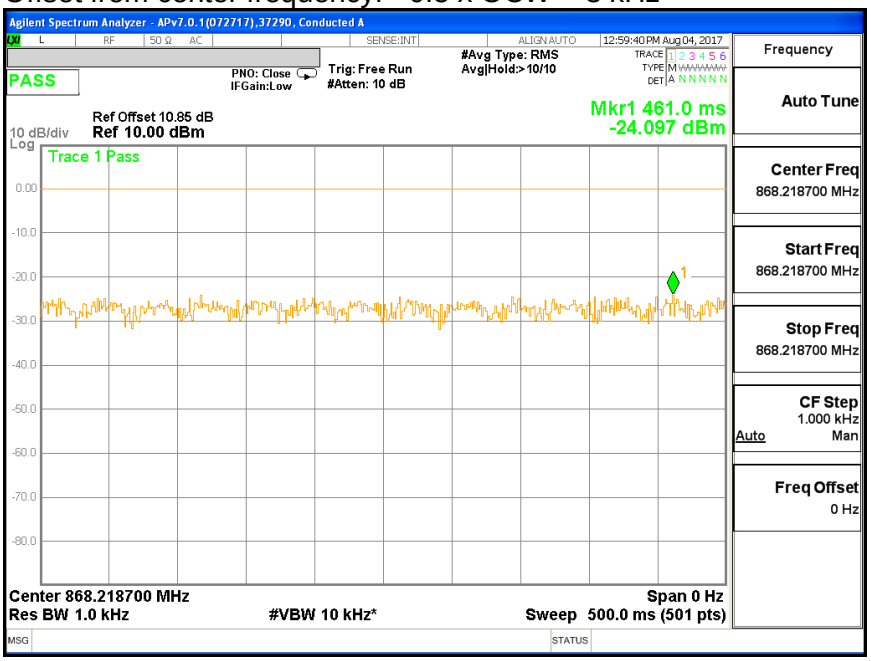
THE WORST CASE OF 2-FSK LOW CHANNEL

TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 3 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 3 kHz



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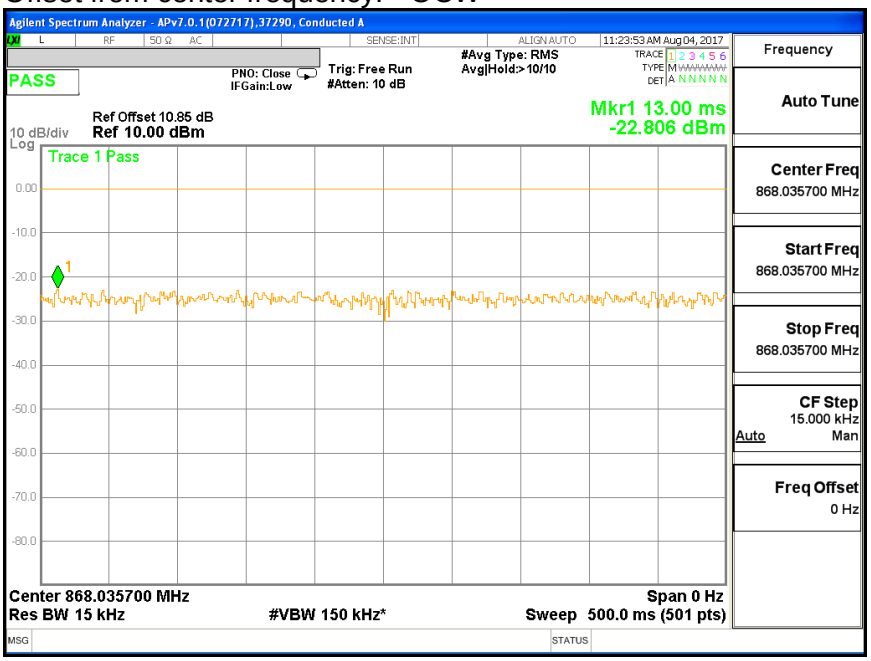
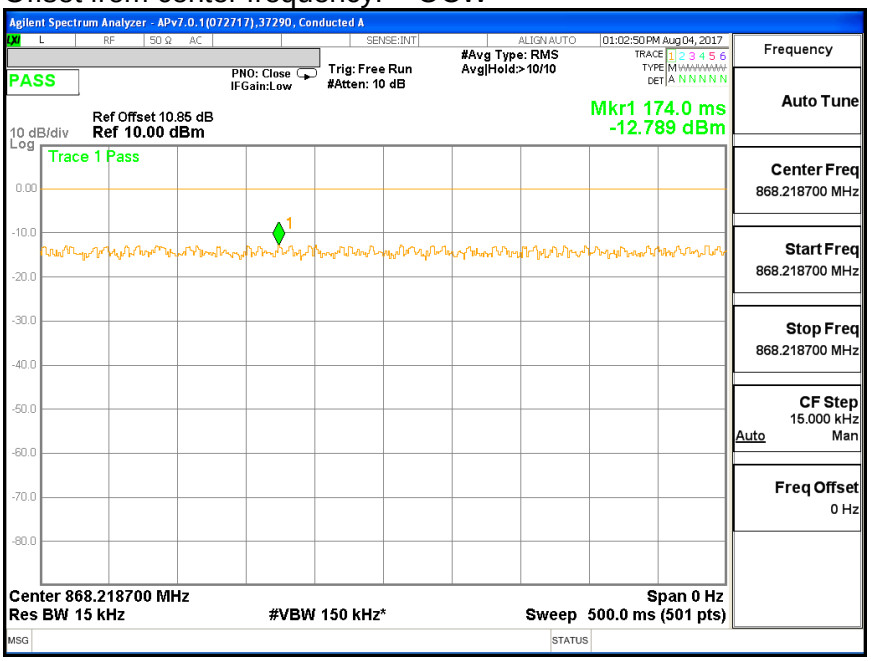
TX TRANSIENT
Offset from center frequency: - OCW



TX TRANSIENT
Offset from center frequency: + OCW



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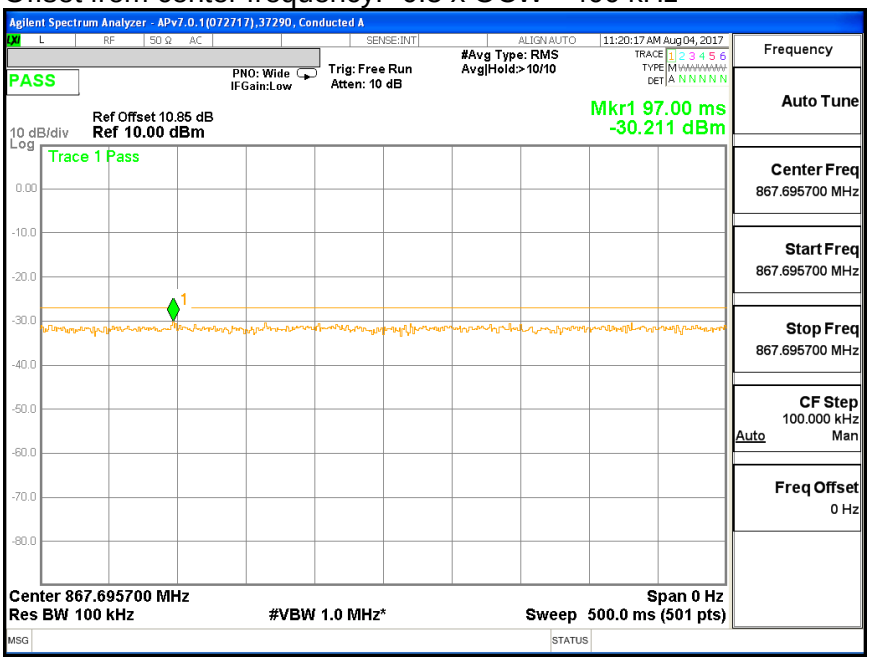
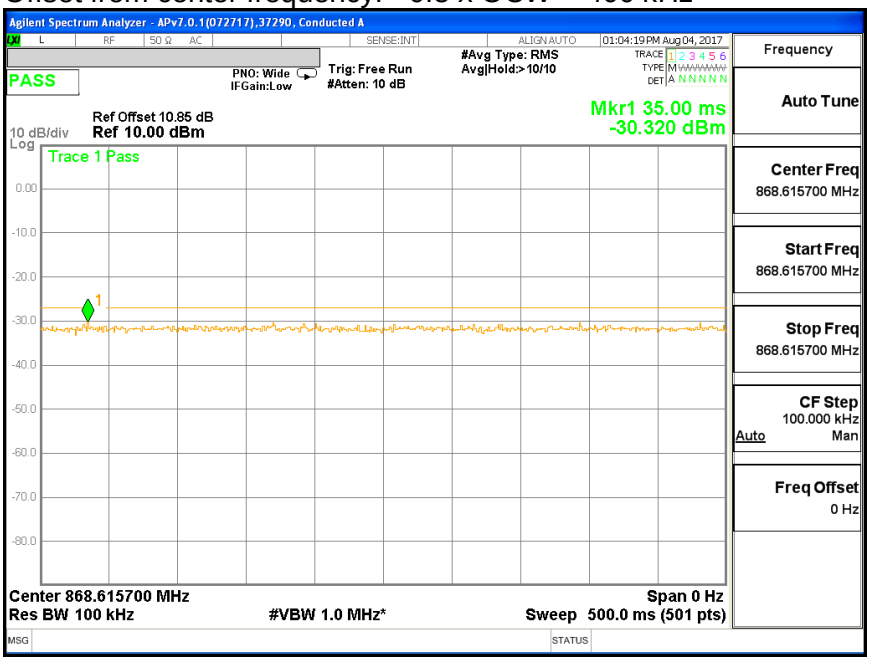
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 400 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 400 kHz



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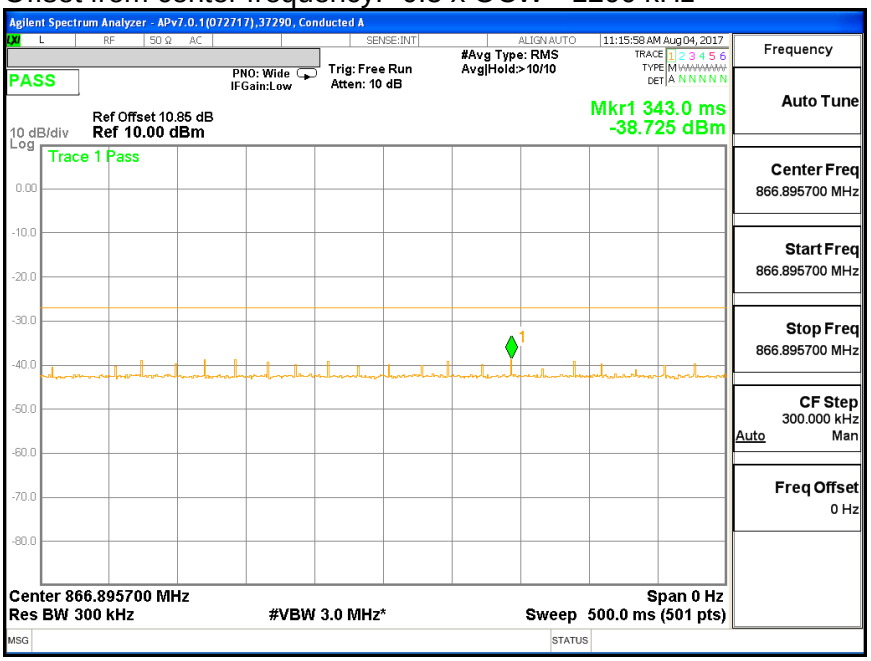
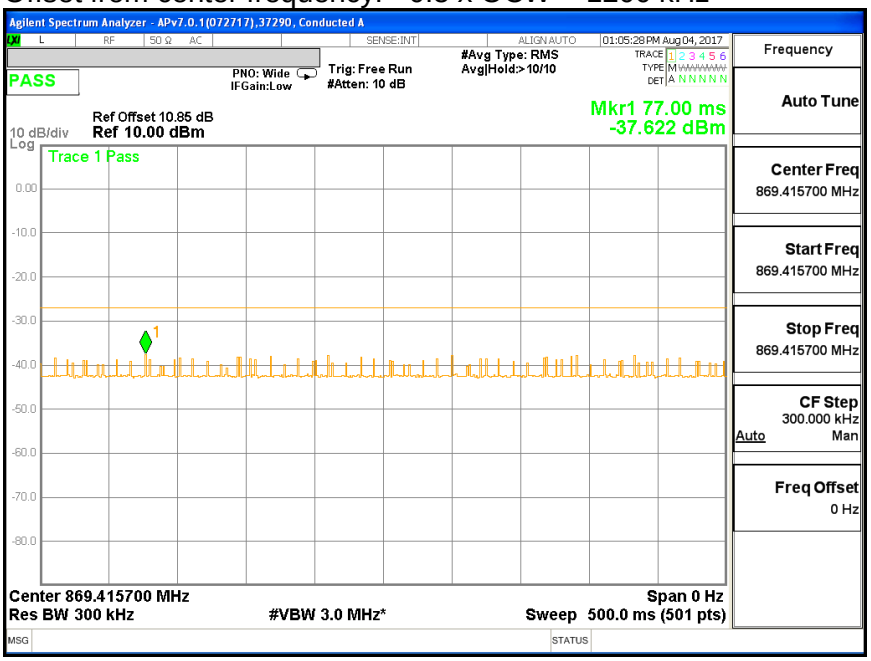
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 1200 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 1200 kHz



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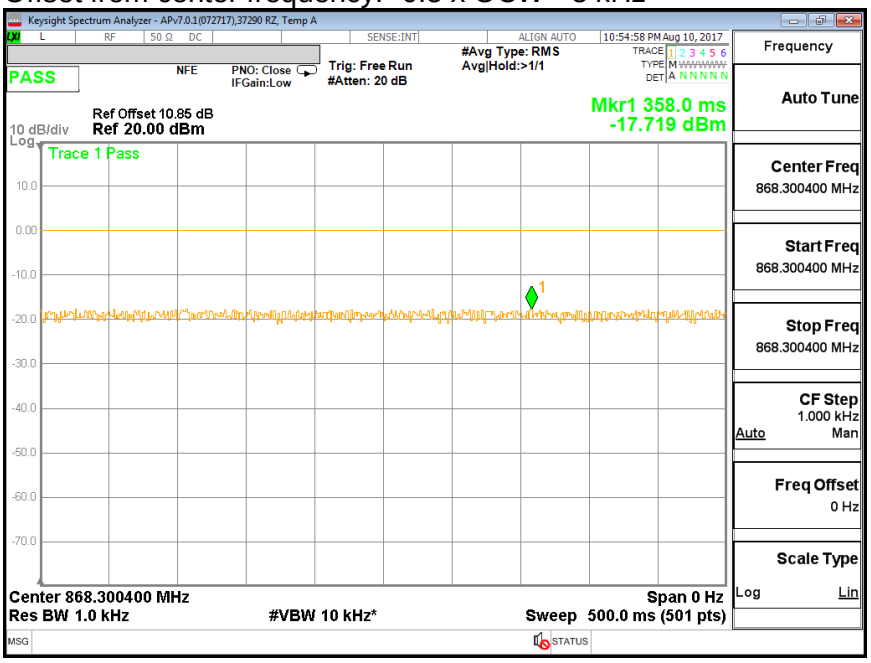
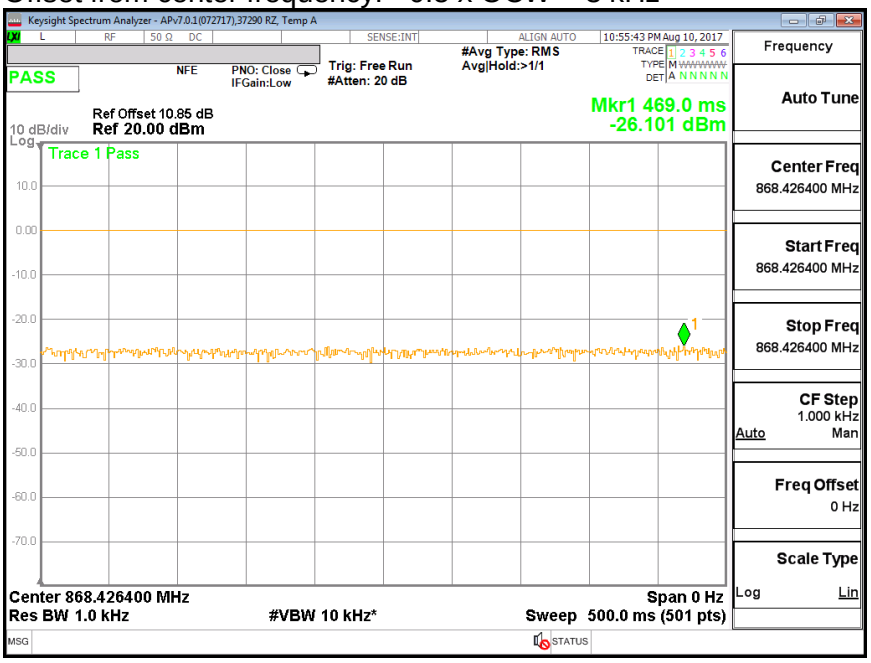
THE WORST CASE OF 2-FSK HIGH CHANNEL

TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 3 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 3 kHz



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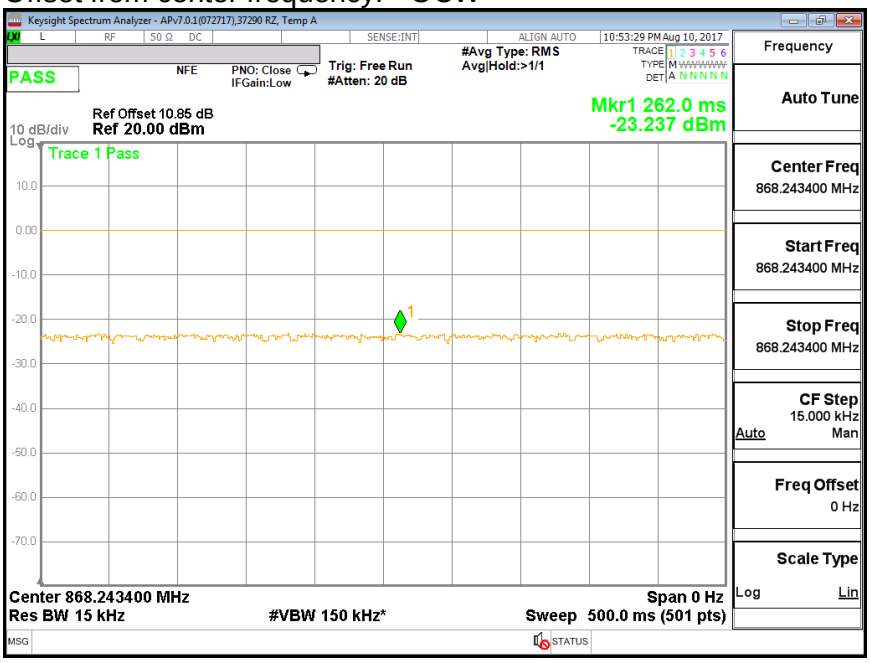
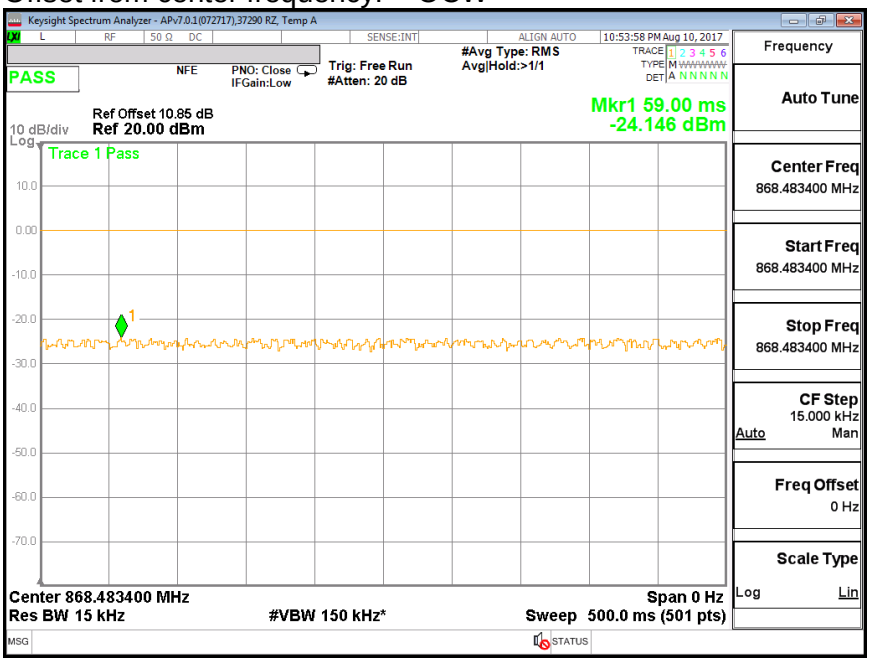
TX TRANSIENT
Offset from center frequency: - OCW



TX TRANSIENT
Offset from center frequency: + OCW



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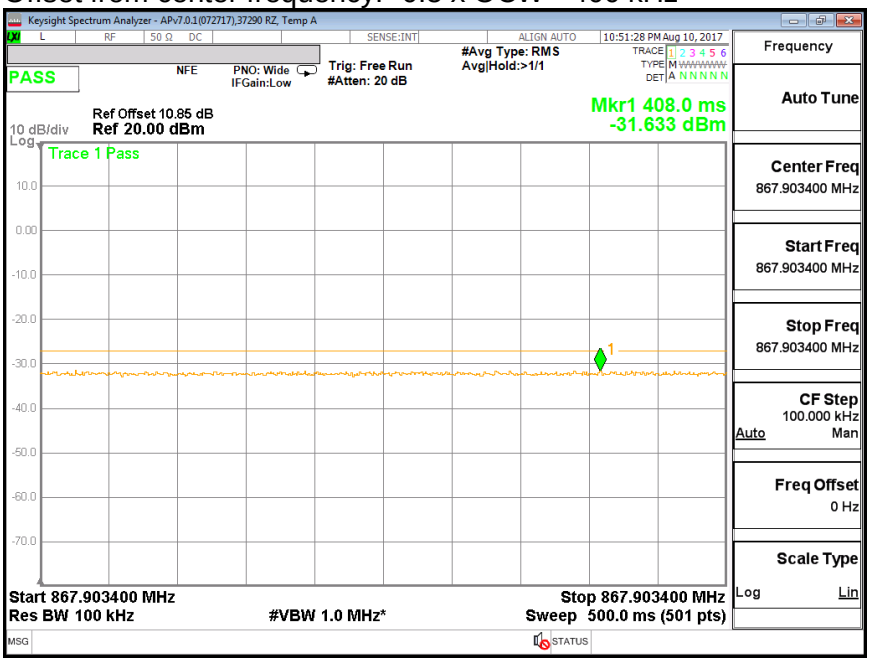
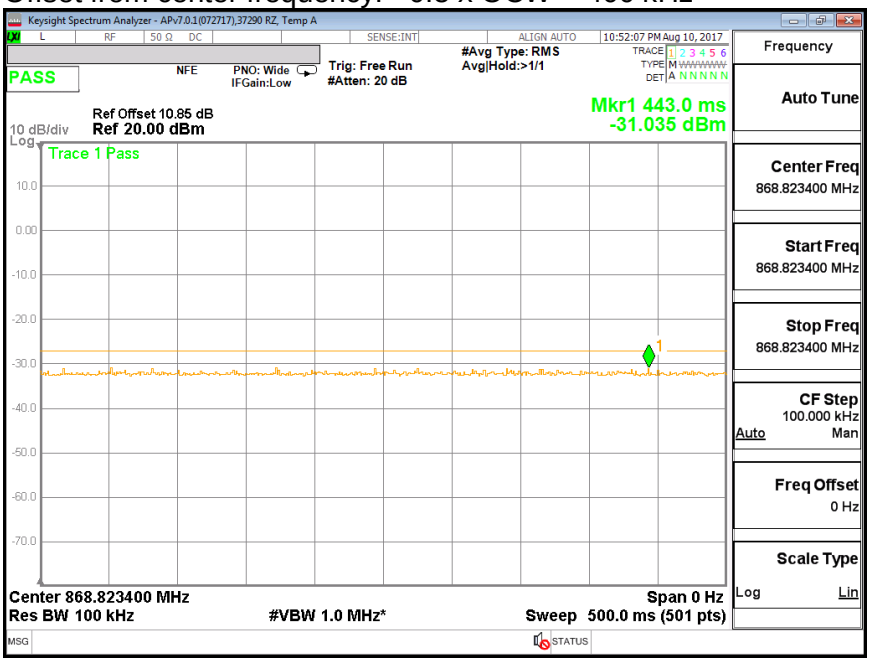
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 400 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 400 kHz



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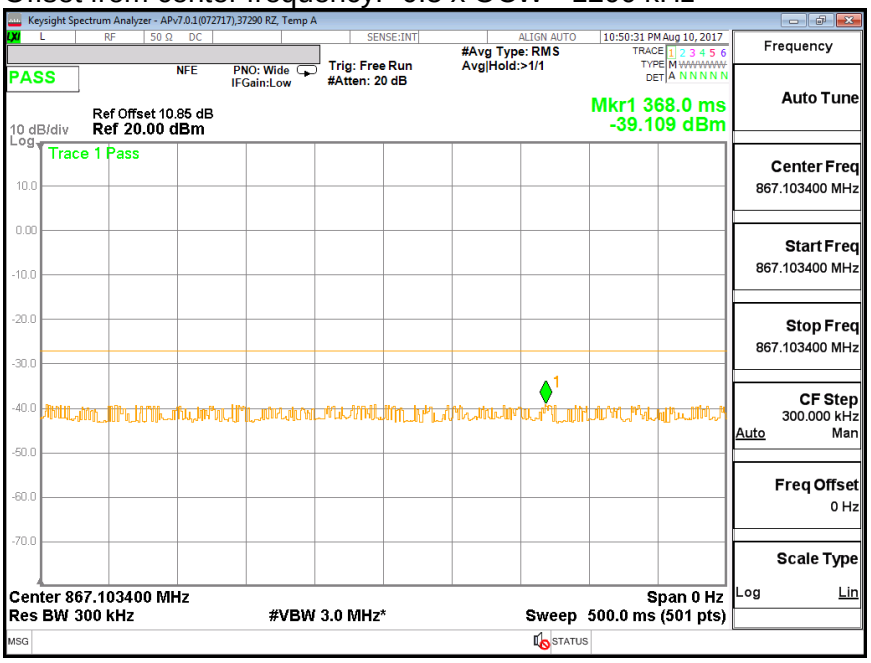
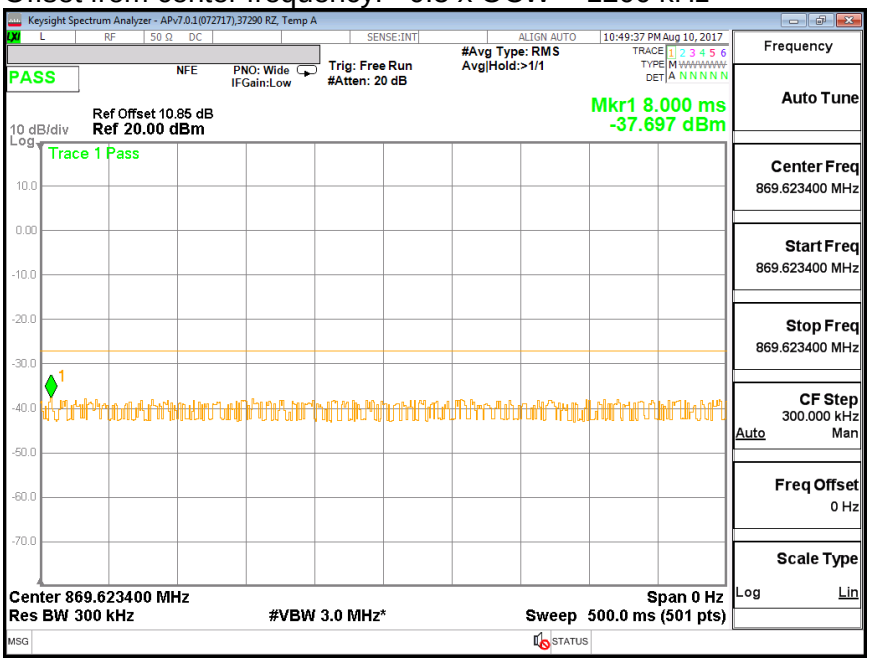
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 1200 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 1200 kHz



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7.9. 2-FSK MODULATION IN N BAND

7.9.1. OPERATING FREQUENCY

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.2.1.2

The manufacturer may declare either one or more operating frequencies and operating channels.
Operating channel(s) shall be entirely within operational frequency bands allowed by annexes B, C or any NRI.

22 ETSI EN 300 220-2 V3.1.1 (2017-02)

Operational Frequency Band		Maximum effective radiated power, e.r.p.	Channel access and occupation rules (e.g. Duty cycle or LBT + AFA)	Maximum occupied bandwidth	Other usage restrictions	Band number from EC Decision 2013/752/EU [i.3]	Class 1 sub-class number according Commission Decision 2000/299/EU [i.7]
M	868,000 MHz to 868,600 MHz	25 mW e.r.p.	≤ 1 % duty cycle or polite spectrum access	The whole band except for audio & video applications limited to 300 kHz		48	28
N	868,700 MHz to 869,200 MHz	25 mW e.r.p.	≤ 0,1% duty cycle or polite spectrum access	The whole sub-band except for audio & video applications limited to 300 kHz		50	29
O	869,400 MHz to 869,650 MHz	25 mW e.r.p.	≤ 0.1% duty cycle or polite spectrum access	The whole band	.	54a	130
P	869,400 MHz to 869,650 MHz	500 mW e.r.p.	≤ 10 % duty cycle or polite spectrum access	The whole band		54b	30
Q	869,700 MHz to 870,000 MHz	5 mW e.r.p.	No requirement	The whole band	Audio and video applications are excluded.	56a	31
R	869,700 MHz to 870,000 MHz	25 mW e.r.p.	≤ 1% duty cycle or polite spectrum access	The whole band	Analogue audio applications are excluded. Analogue video applications are excluded.	56b	69

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.1.2

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RESULTS

Parameter	Values as declared by the manufacturer
M4, 2-FSK	
Operational Frequency band or bands	868.7 - 869.2
Nominal Operating Frequencies (MHz)	868.103806 - 868.467178
Operating Channel width(s) - OCW	80 kHz
M5, 2-FSK	
Operational Frequency band or bands	868.7 - 869.2
Nominal Operating Frequencies (MHz)	868.155716 - 868.363358
Operating Channel width(s) - OCW	120 kHz
M11, 2-FSK	
Operational Frequency band or bands	868.7 - 869.2
Nominal Operating Frequencies (MHz)	868.103806 - 868.467178
Operating Channel width(s) - OCW	40 kHz

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7.9.2. TX EFFECTIVE RADIATED POWER

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.3.1.2

The effective radiated power shall not be greater than the value allowed in annexes B or C for the chosen operational frequency band(s).

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.2.2.1.2

RESULTS

Date: 08/11/17
Project No: 11773240
Tester: 50818_JQ

CHANNELS FOR MODULATION CODE: M5

EUT Antenna Gain (dBi) =	2.00

Condition	Output Power (dBm)	EIRP (dBm)	ERP (dBm)	Limit (dBm)	Margin (dB)
Low Channel, CH17					
Normal	11.76	13.76	11.61	13.98	-2.37
Extreme T low, V low	12.51	14.51	12.36	13.98	-1.62
Extreme T low, V high	12.47	14.47	12.32	13.98	-1.66
Extreme T high, V low	11.20	13.20	11.05	13.98	-2.93
Extreme T high, V high	11.19	13.19	11.04	13.98	-2.94
High Channel, CH19					
Normal	11.76	13.76	11.61	13.98	-2.37
Extreme T low, V low	12.49	14.49	12.34	13.98	-1.64
Extreme T low, V high	12.48	14.48	12.33	13.98	-1.65
Extreme T high, V low	11.20	13.20	11.05	13.98	-2.93
Extreme T high, V high	11.18	13.18	11.03	13.98	-2.95

Note: Cable loss correction factor is included in the Power Meter Reading

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7.9.3. TX OCCUPIED BANDWIDTH

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.3.4.2

The occupied bandwidth of the EUT according to ETSI EN 300 220-1 [1], clause 5.6.2 shall comply with the limits in annex B or C.

Reference Limit:

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.6.2

The Operating Channel shall be declared and shall reside entirely within the Operational Frequency Band. The Maximum Occupied Bandwidth at 99 % shall reside entirely within the Operating Channel defined by F_{low} and F_{high}.

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.6.3.3 (Conducted Measurement)

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RESULTS

BAND N

Condition	Low CH (MHz)	High CH (MHz)	Low CH OBW (kHz)	High CH OBW (kHz)	F_{Low} (MHz)	F_{Low} Limit (MHz)	F_{High} (MHz)	F_{High} Limit (MHz)
M4, 2-FSK								
Normal	868.8306	869.0901	63.183	63.440	868.80	> 868.7	869.12	< 869.2
T low, V low	868.8306	869.0901	64.671	64.699	868.80	> 868.7	869.12	< 869.2
T low, V high	868.8306	869.0901	64.666	64.270	868.80	> 868.7	869.12	< 869.2
T high, V low	868.8306	869.0901	64.458	63.470	868.80	> 868.7	869.12	< 869.2
T high, V high	868.8306	869.0901	64.398	64.623	868.80	> 868.7	869.12	< 869.2
M5, 2-FSK								
Normal	868.8825	868.9863	100.540	101.950	868.83	> 868.7	869.04	< 869.2
T low, V low	868.8825	868.9863	101.100	101.410	868.83	> 868.7	869.04	< 869.2
T low, V high	868.8825	868.9863	101.730	101.510	868.83	> 868.7	869.04	< 869.2
T high, V low	868.8825	868.9863	101.300	101.850	868.83	> 868.7	869.04	< 869.2
T high, V high	868.8825	868.9863	101.540	100.900	868.83	> 868.7	869.04	< 869.2
M11, 2-FSK								
Normal	868.8306	869.0901	38.338	38.151	868.81	> 868.7	869.11	< 869.2
T low, V low	868.8306	869.0901	37.963	37.799	868.81	> 868.7	869.11	< 869.2
T low, V high	868.8306	869.0901	37.909	38.804	868.81	> 868.7	869.11	< 869.2
T high, V low	868.8306	869.0901	38.042	38.475	868.81	> 868.7	869.11	< 869.2
T high, V high	868.8306	869.0901	38.542	38.413	868.81	> 868.7	869.11	< 869.2

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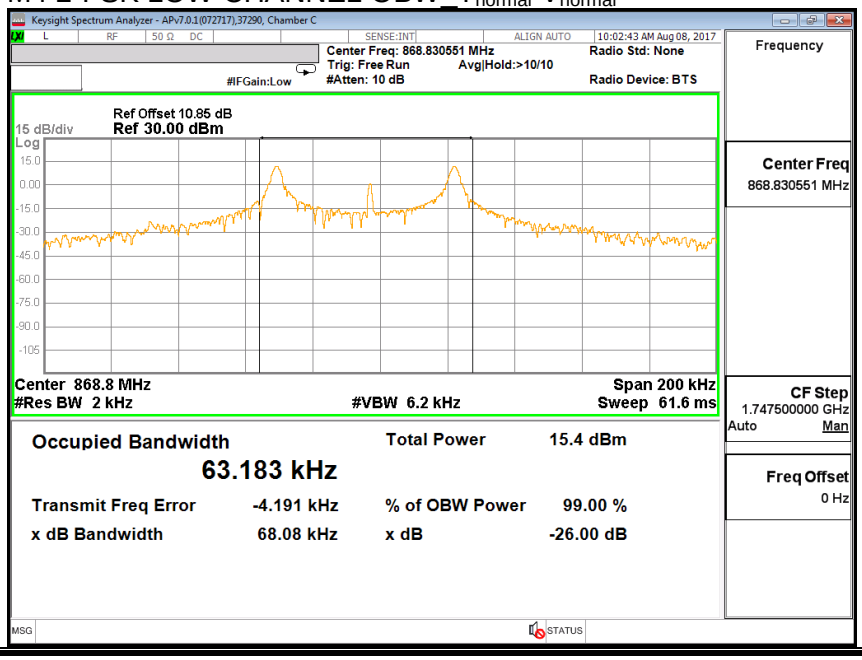
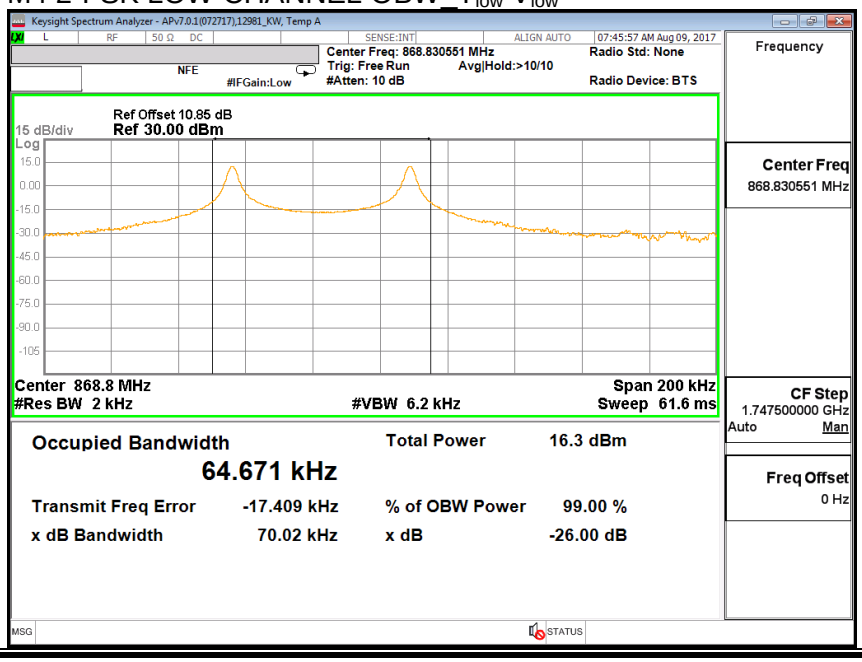
M4 2-FSK LOW CHANNEL OBW_T_{normal} V_{normal}



M4 2-FSK LOW CHANNEL OBW_T_{low} V_{low}



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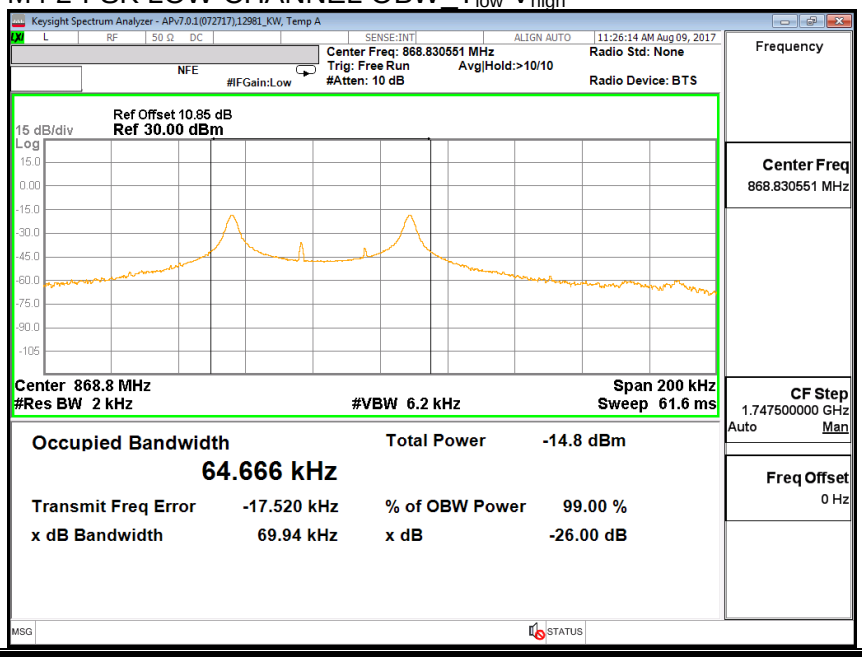
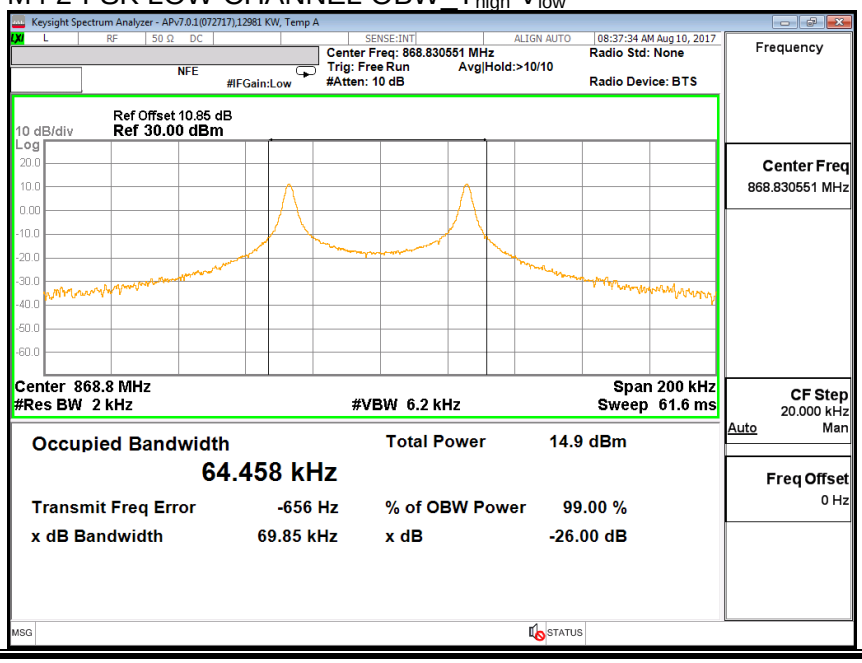
M4 2-FSK LOW CHANNEL OBW_T_{low} V_{high}



M4 2-FSK LOW CHANNEL OBW_T_{high} V_{low}



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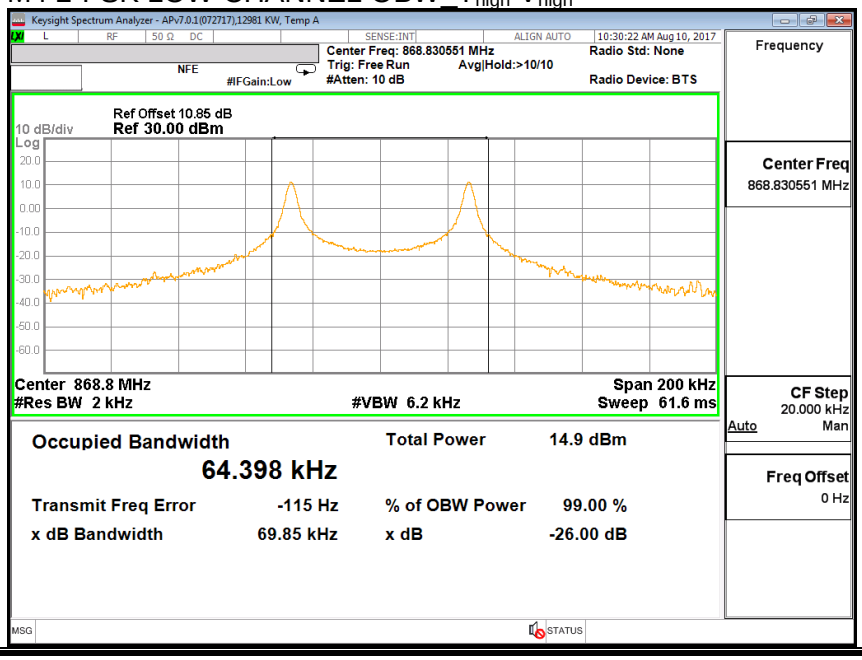
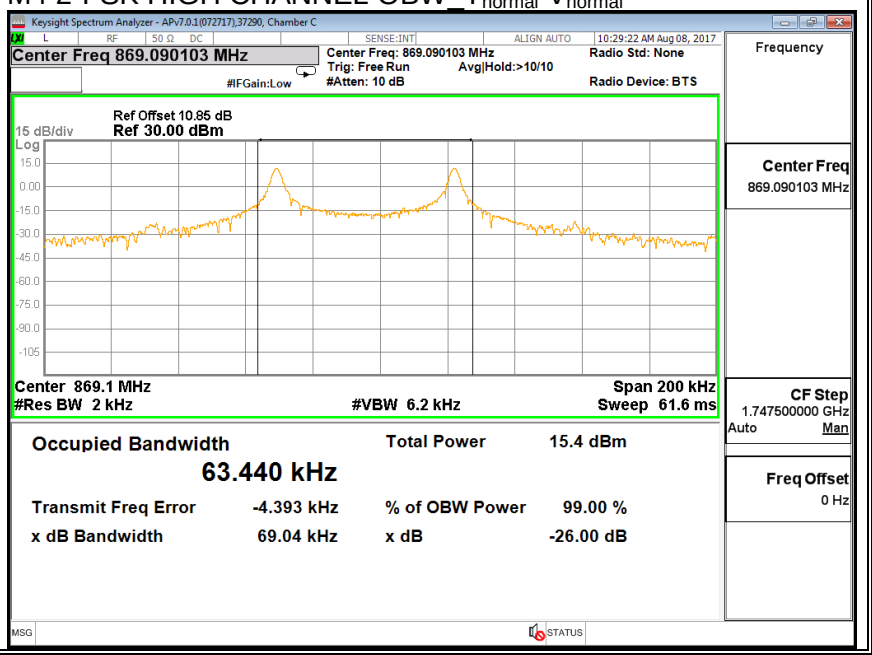
M4 2-FSK LOW CHANNEL OBW_T_{high} V_{high}



M4 2-FSK HIGH CHANNEL OBW_T_{normal} V_{normal}



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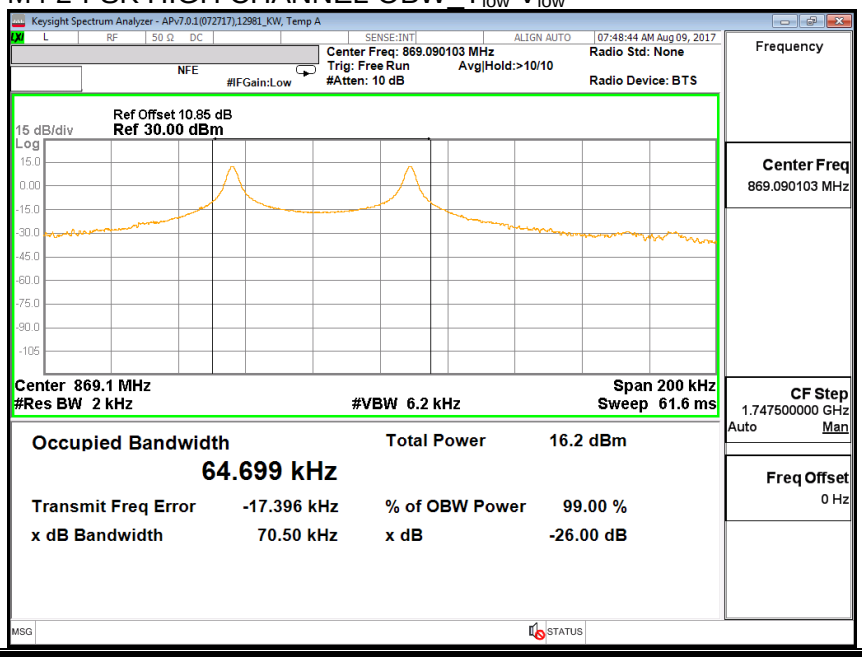
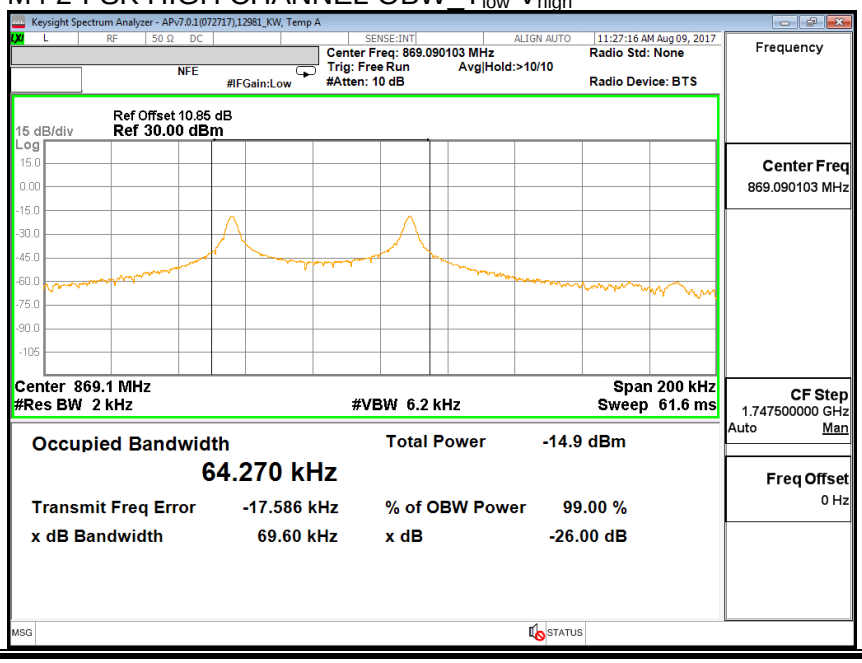
M4 2-FSK HIGH CHANNEL OBW_T_{low} V_{low}



M4 2-FSK HIGH CHANNEL OBW_T_{low} V_{high}



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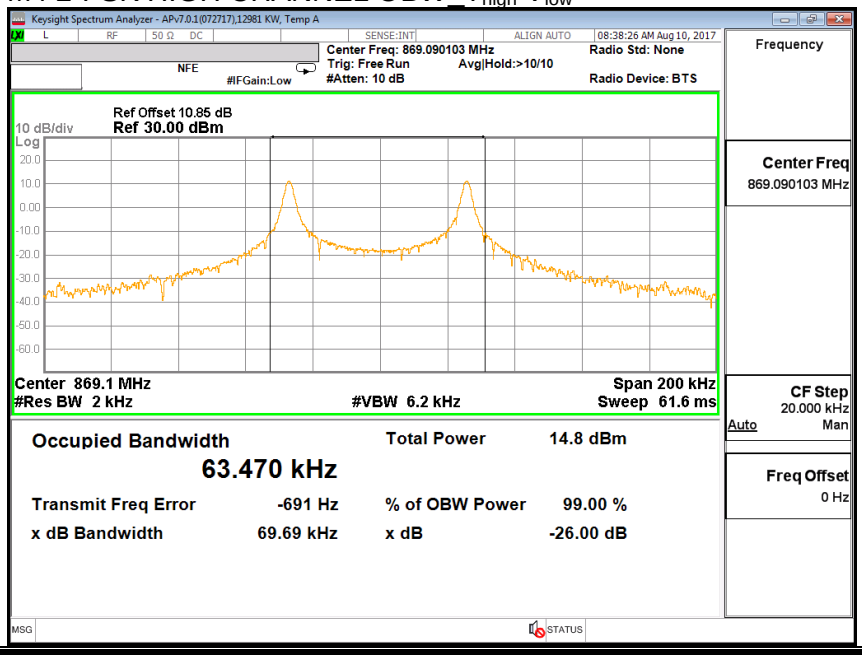
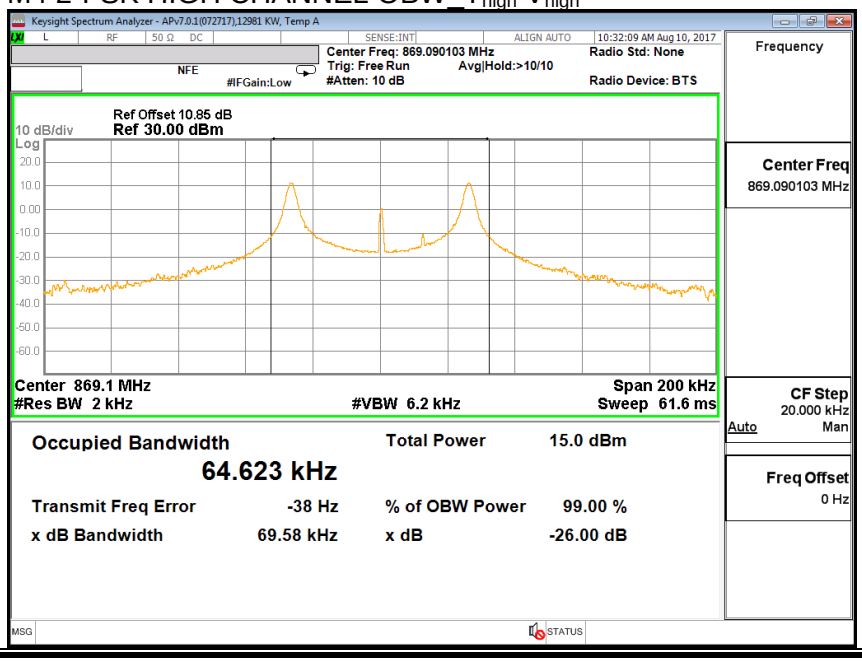
M4 2-FSK HIGH CHANNEL OBW_T_{high} V_{low}



M4 2-FSK HIGH CHANNEL OBW_T_{high} V_{high}



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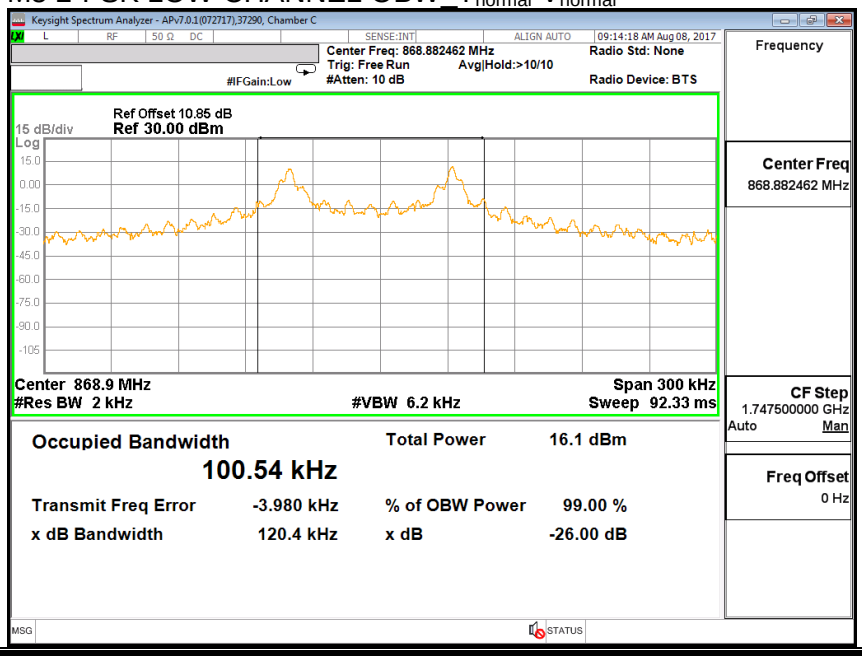
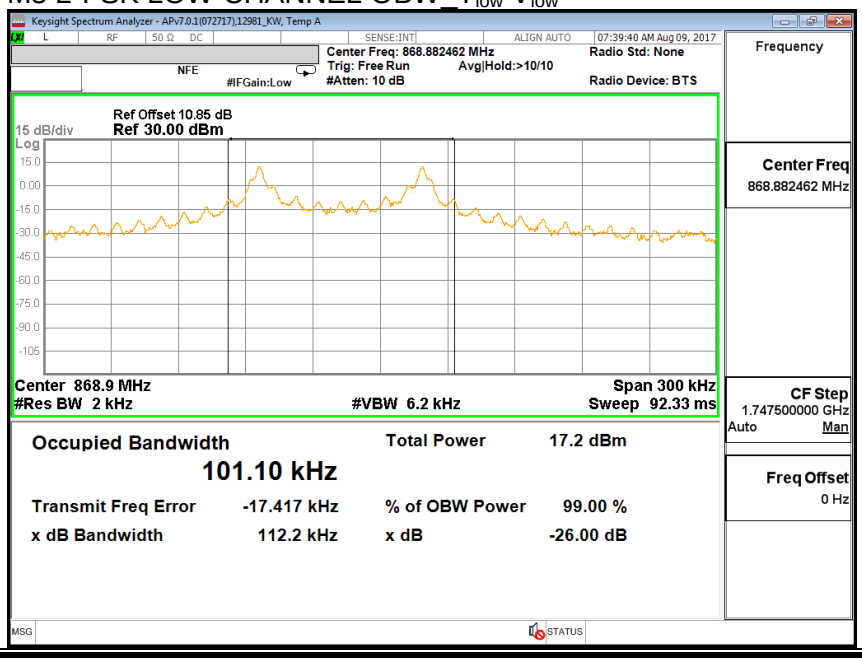
M5 2-FSK LOW CHANNEL OBW_T_{normal} V_{normal}



M5 2-FSK LOW CHANNEL OBW_T_{low} V_{low}



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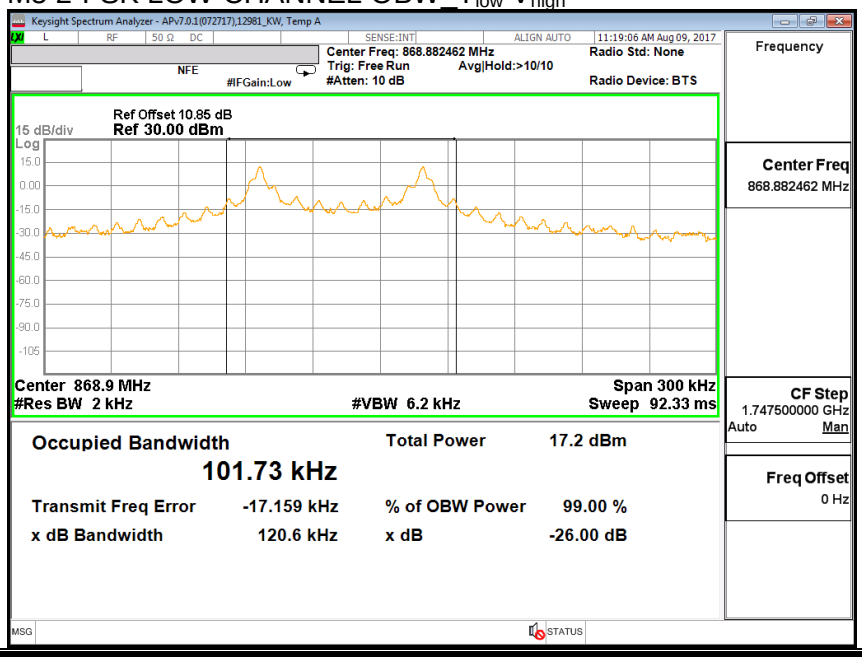
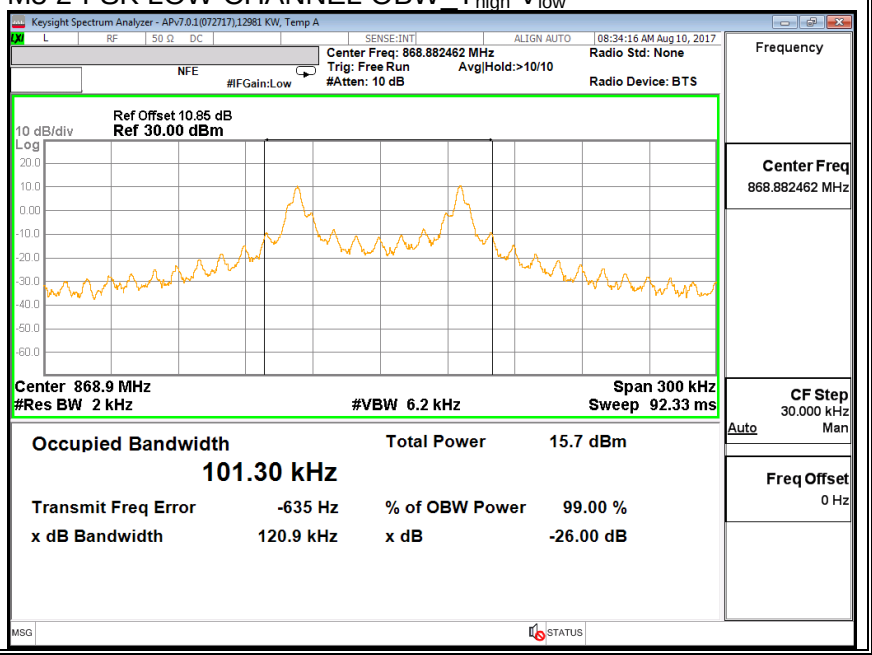
M5 2-FSK LOW CHANNEL OBW_T_{low} V_{high}



M5 2-FSK LOW CHANNEL OBW_T_{high} V_{low}



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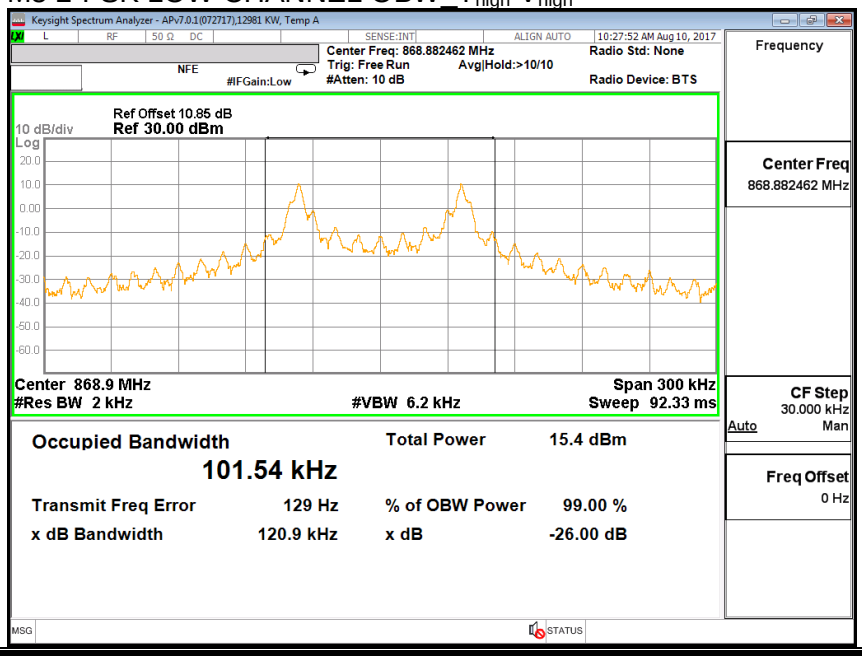
M5 2-FSK LOW CHANNEL OBW_T_{high} V_{high}



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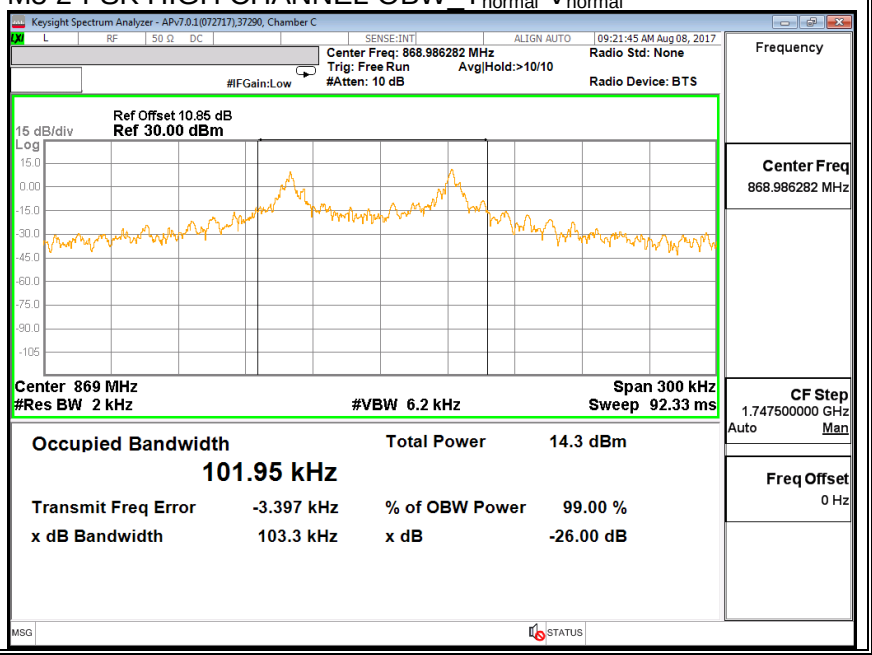

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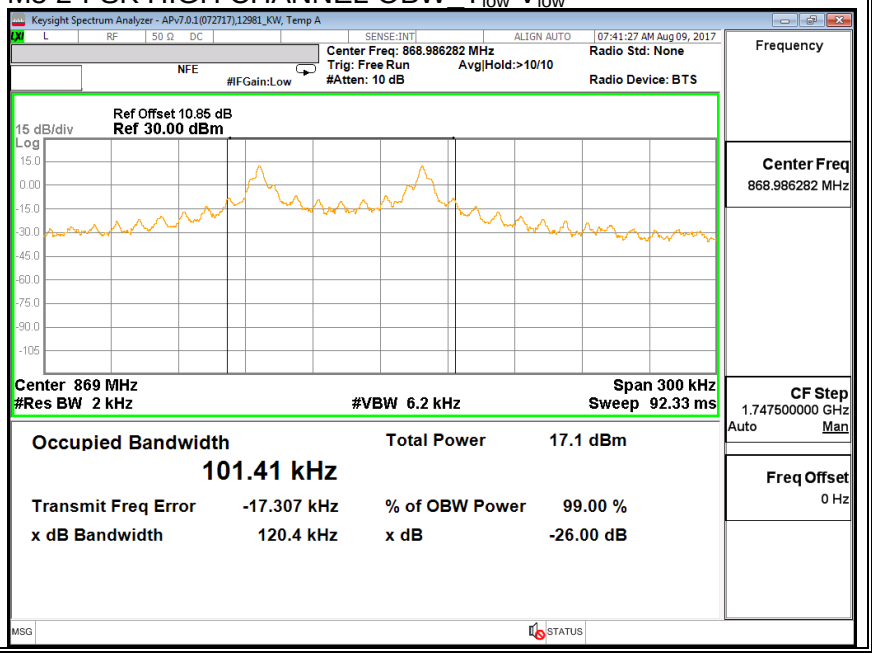
M5 2-FSK HIGH CHANNEL OBW_T_{low} V_{low}



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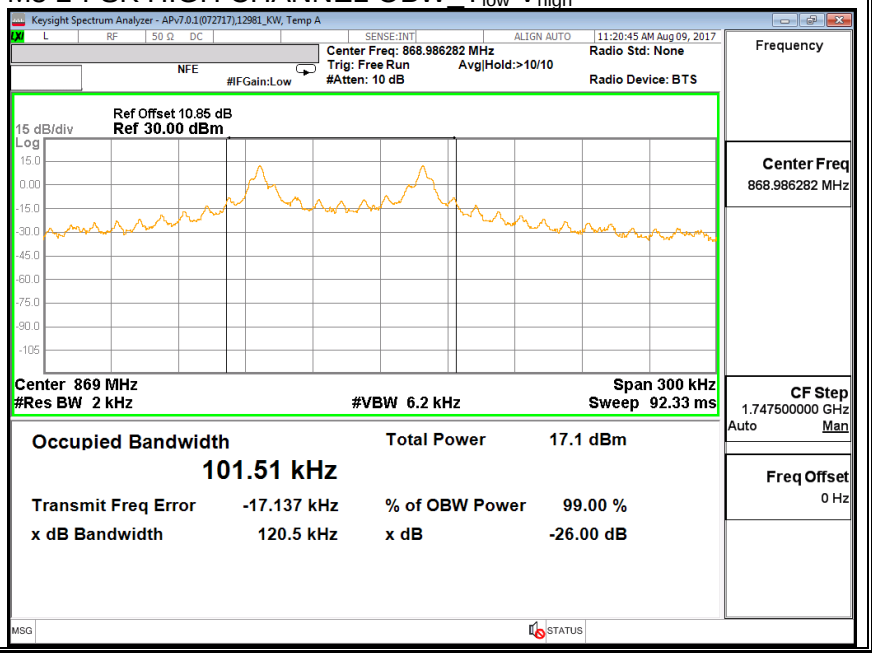

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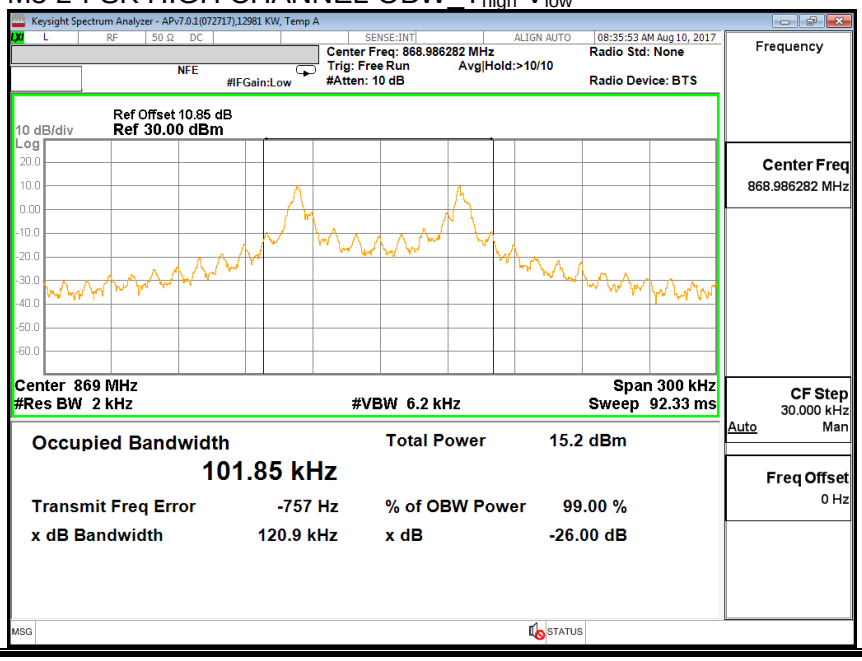
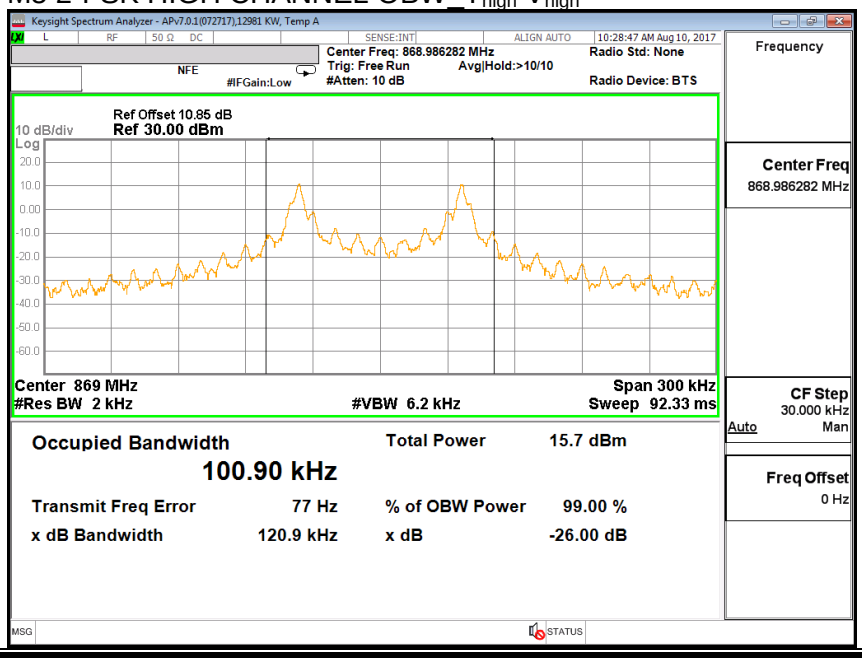
M5 2-FSK HIGH CHANNEL OBW_T_{high} V_{low}



M5 2-FSK HIGH CHANNEL OBW_T_{high} V_{high}



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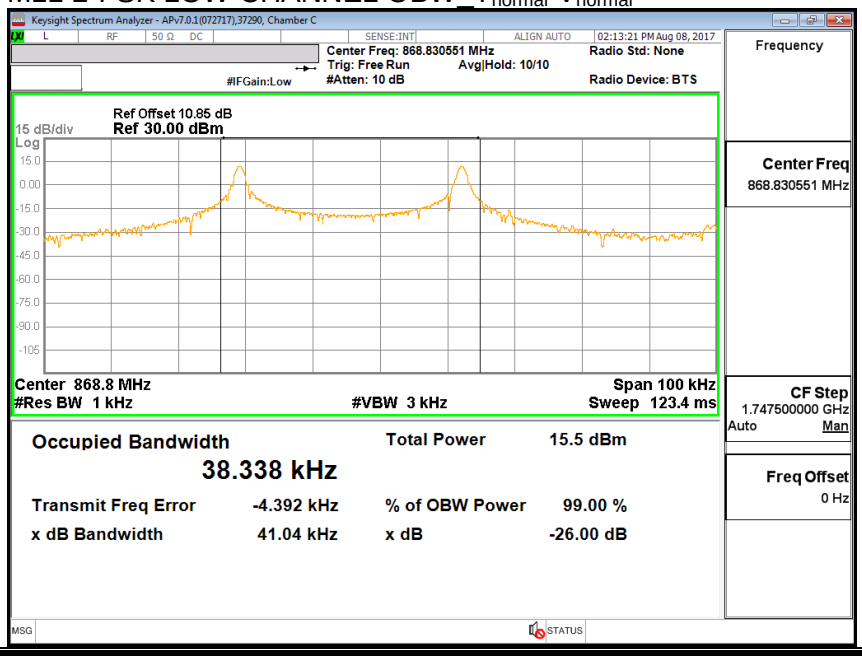
M11 2-FSK LOW CHANNEL OBW_T_{normal} V_{normal}



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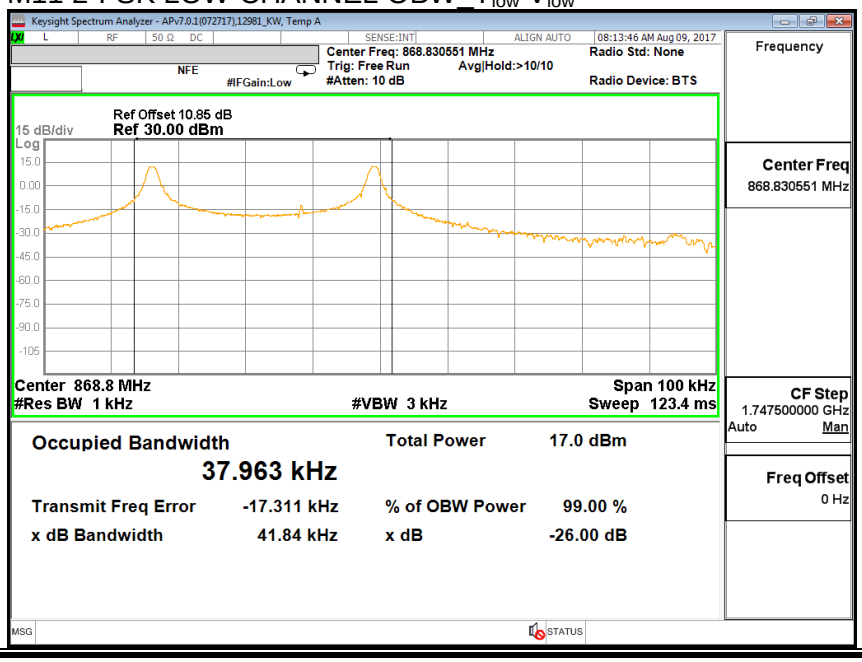

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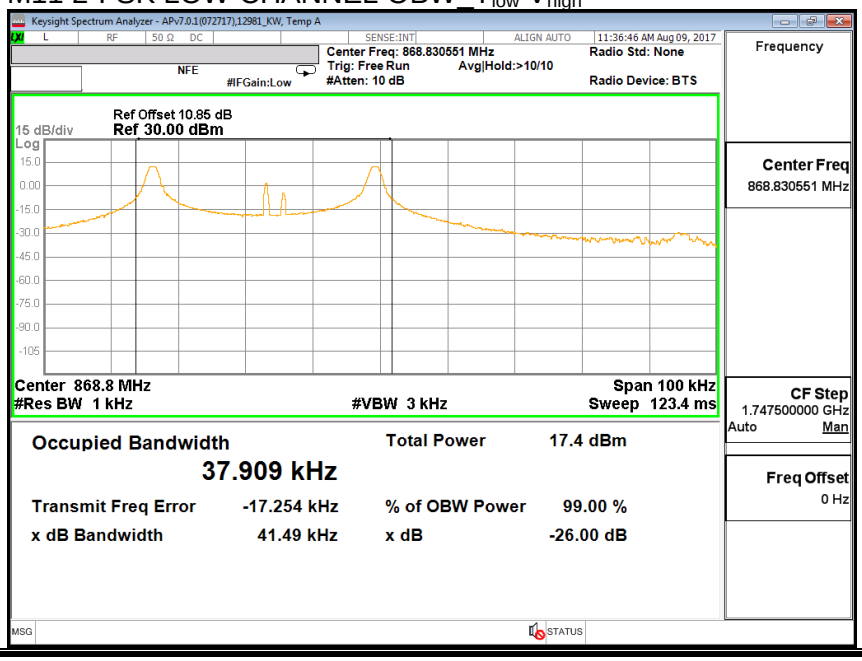
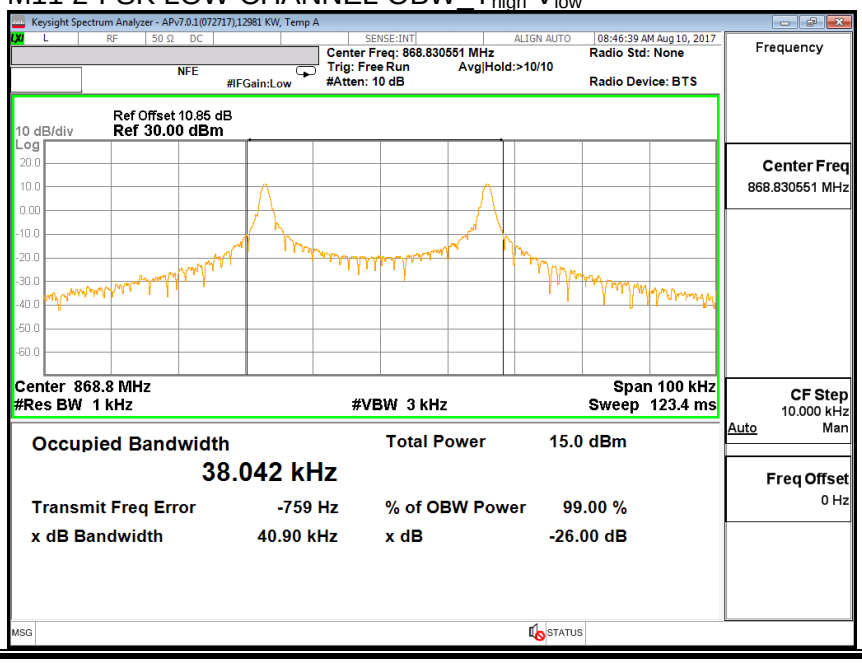
M11 2-FSK LOW CHANNEL OBW_T_{low} V_{high}



M11 2-FSK LOW CHANNEL OBW_T_{high} V_{low}



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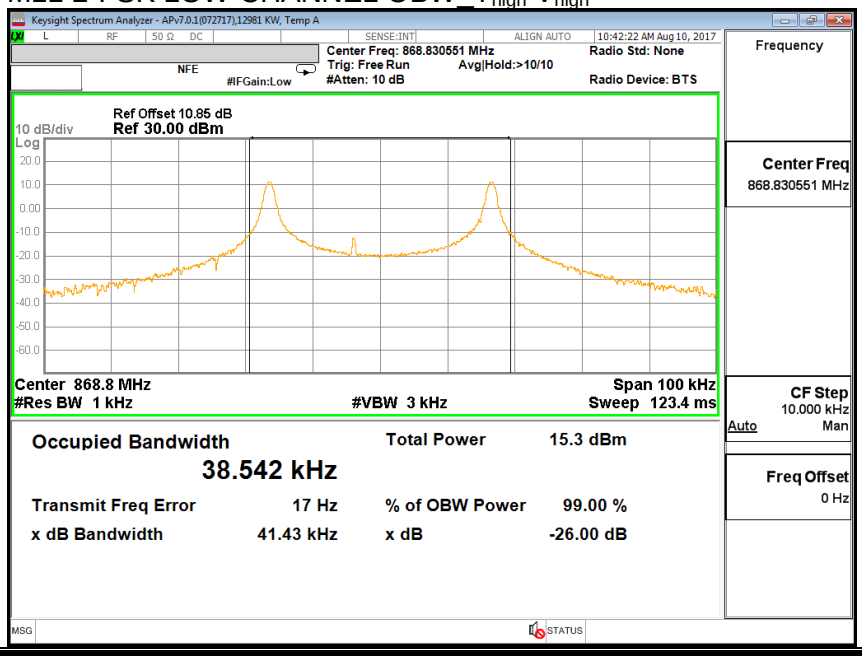
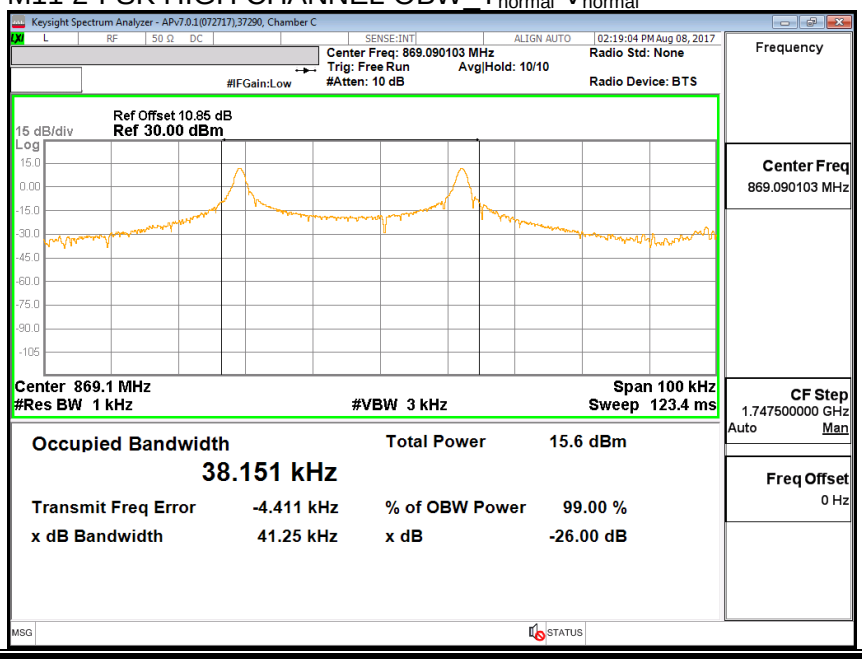
M11 2-FSK LOW CHANNEL OBW_T_{high} V_{high}



M11 2-FSK HIGH CHANNEL OBW_T_{normal} V_{normal}



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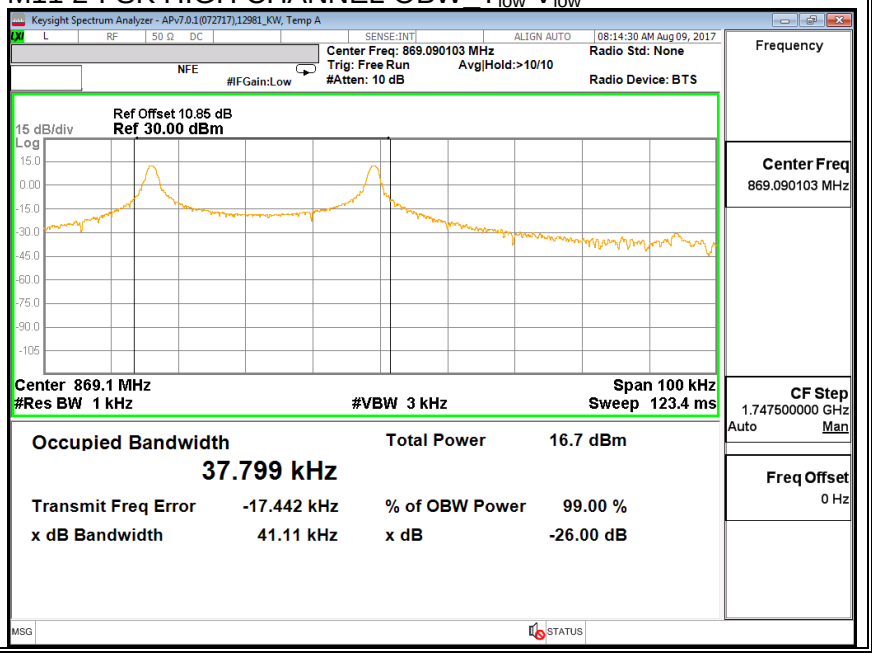
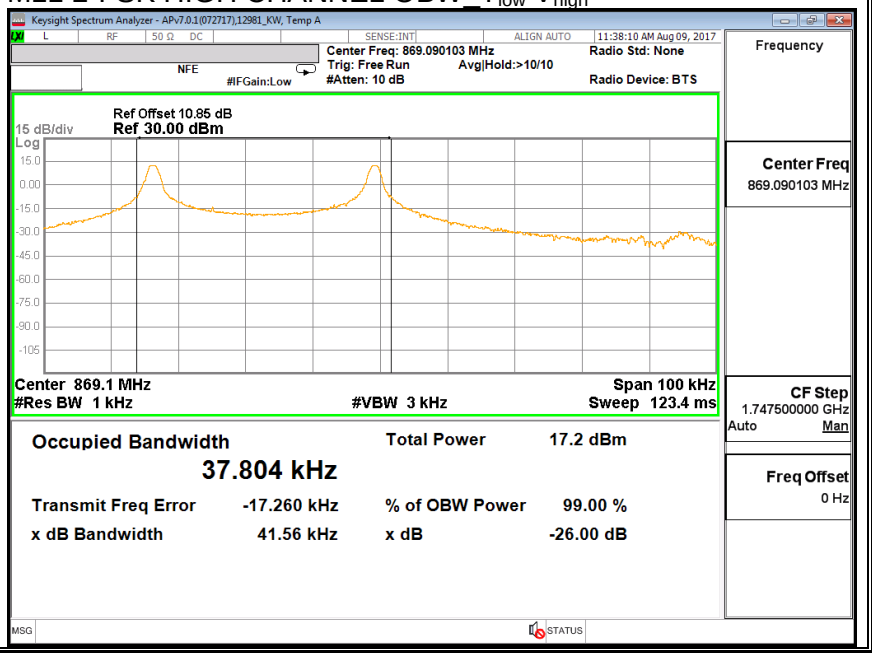
M11 2-FSK HIGH CHANNEL OBW_T_{low} V_{low}



M11 2-FSK HIGH CHANNEL OBW_T_{low} V_{high}



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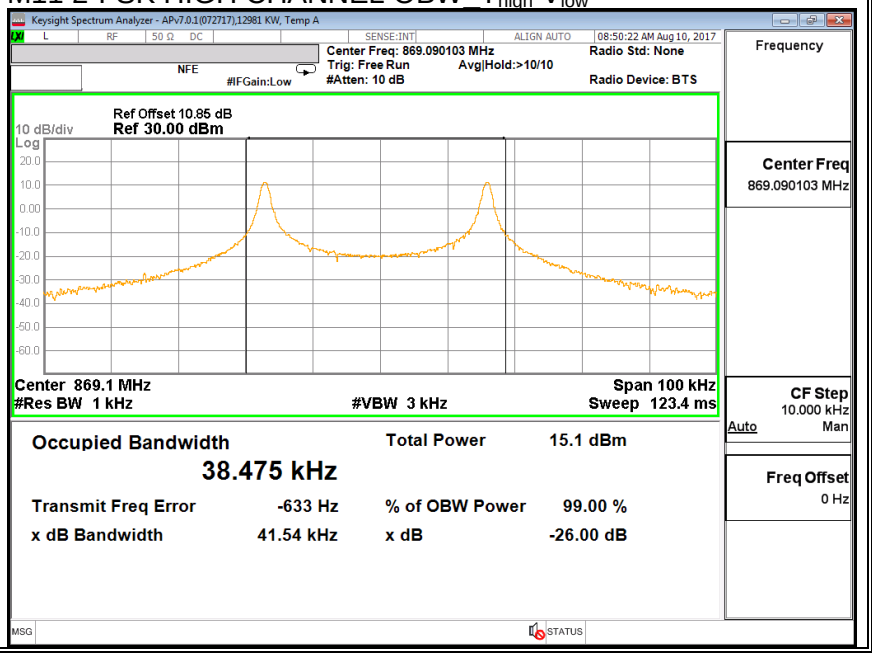
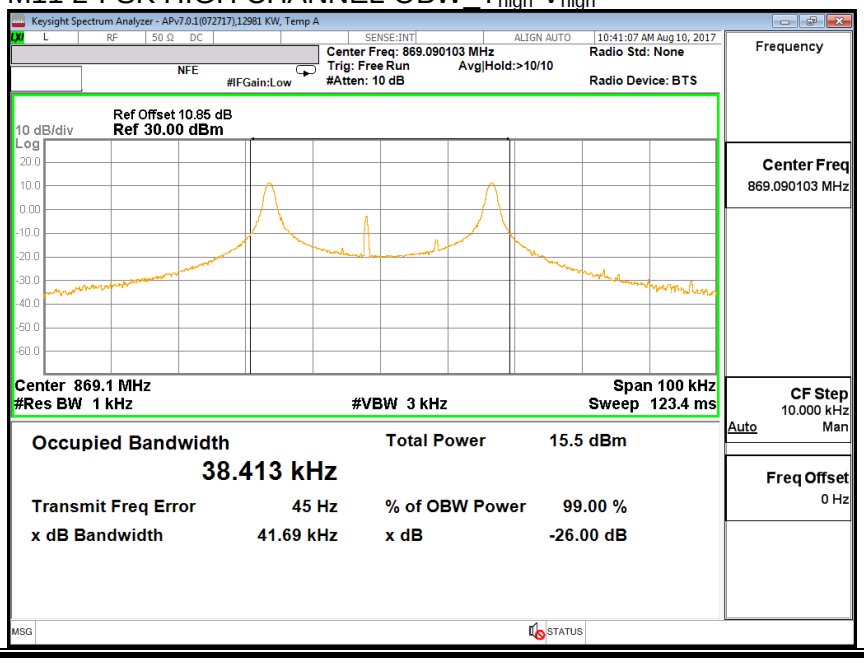
M11 2-FSK HIGH CHANNEL OBW_T_{high} V_{low}



M11 2-FSK HIGH CHANNEL OBW_T_{high} V_{high}



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7.9.4. TX OUT OF BAND EMISSIONS

REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.1

Two OOB domains are defined, one for OC (see Figure 5) and one for Operational Frequency band (see Figure 6). The spectrum masks for these two OOB domains may overlap.

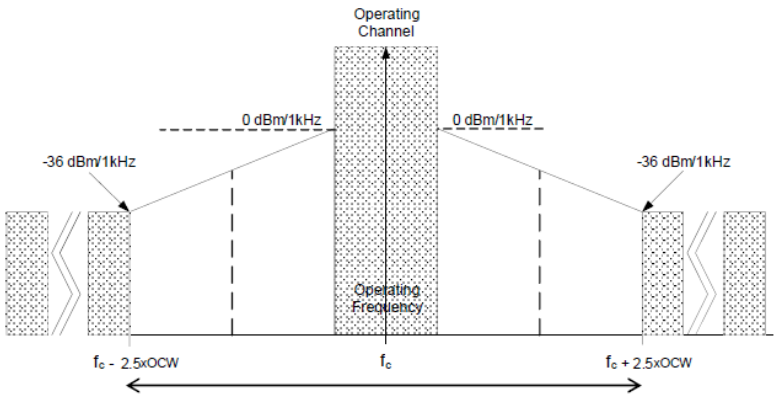

Figure 5: Out Of Band Domain for Operating Channel with reference BW

Unwanted emissions in the Out Of Band domain are those falling in the frequency range immediately below the lower, and above the upper, frequency of the Operating Channel. The OOB domain includes both frequencies outside the Operating Channel within the Operational Frequency Band and frequencies outside the Operational Frequency Band.
The relevant Out Of Band domain is shown in Figure 5 and applies within the Operational Frequency Band.

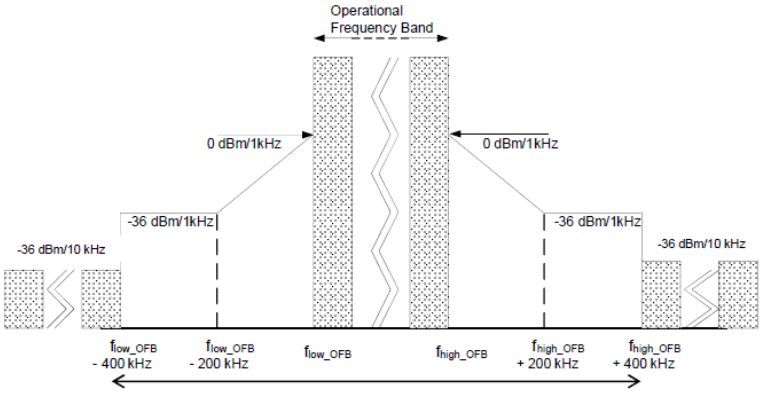

Figure 6: Out Of Band Domain for Operational Frequency Band with reference BW

Specific limits apply at frequencies immediately above and below the Operational Frequency Band as shown in Figure 6.
NOTE: f_{low}_OFB is the lower edge of the Operational Frequency Band. f_{high}_OFB is the upper edge of the Operational Frequency Band.

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REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.2

The EUT emissions level in OOB domains for the Operating Channel and the Operational Frequency Band shall be less or equal to Table 15 spectrum mask.

Table 15: Emission limits in the Out Of Band domains

Domain	Frequency Range	RBW_{REF}	Max power limit
OOB limits applicable to Operational Frequency Band (See Figure 6)	$f \le f_{low_OFB}$ - 400 kHz	10 kHz	-36 dBm
	F_{low_OFB} - 400 kHz ≤ f ≤ f_{low_OFB} - 200 kHz	1 kHz	-36 dBm
	f_{low} - 200 kHz ≤ f < f_{low_OFB}	1 kHz	See Figure 6
	$f = f_{low_OFB}$	1 kHz	0 dBm
	$f = f_{high_OFB}$	1 kHz	0 dBm
	F_{high_OFB} < f ≤ f_{high_OFB} + 200 kHz	1 kHz	See Figure 6
	F_{high_OFB} + 200 kHz ≤ f ≤ f_{high_OFB} + 400 kHz	1 kHz	-36 dBm
	F_{high_OFB} + 400 kHz ≤ f	10 kHz	-36 dBm
OOB limits applicable to Operating Channel (See Figure 5)	$f = f_c$- 2.5 x OCW	1 kHz	-36 dBm
	f_c - 2,5 x OCW ≤ f ≤ f_c - 0,5 x OCW	1 kHz	See Figure 5
	$f = f_c$ - 0,5 x OCW	1 kHz	0 dBm
	$f = f_c$ + 0,5 x OCW	1 kHz	0 dBm
	f_c + 0,5 x OCW ≤ f ≤ f_c + 2,5 x OCW	1 kHz	See Figure 5
	$f = f_c$+ 2,5 x OCW	1 kHz	-36 dBm
NOTE: f is the measurement frequency. f_c is the Operating Frequency. F_{low_OFB} is the lower edge of the Operational Frequency Band. F_{high_OFB} is the upper edge of the Operational Frequency Band. OCW is the operating channel bandwidth.			

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.3.3 (Conducted Measurement)

RESULTS

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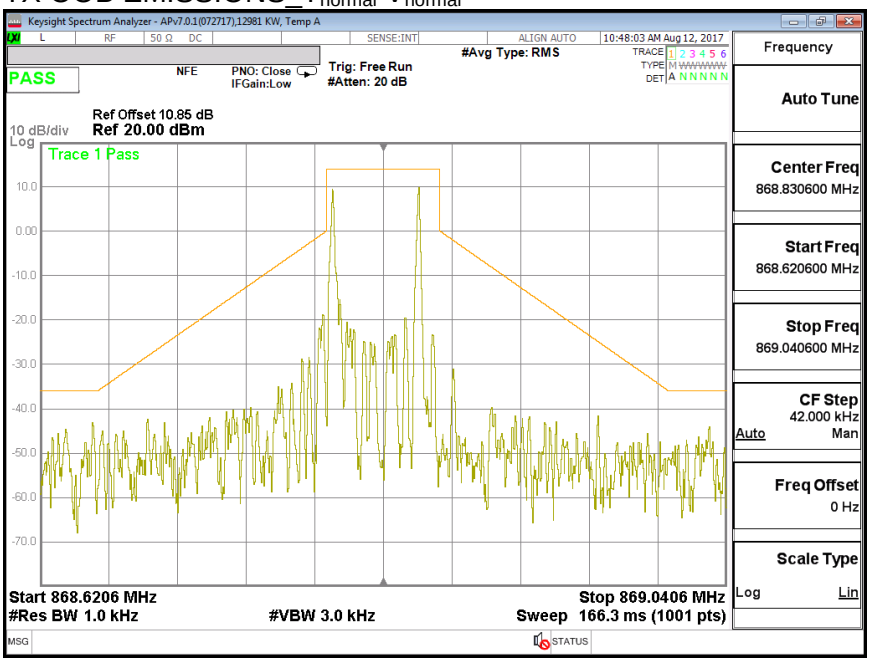
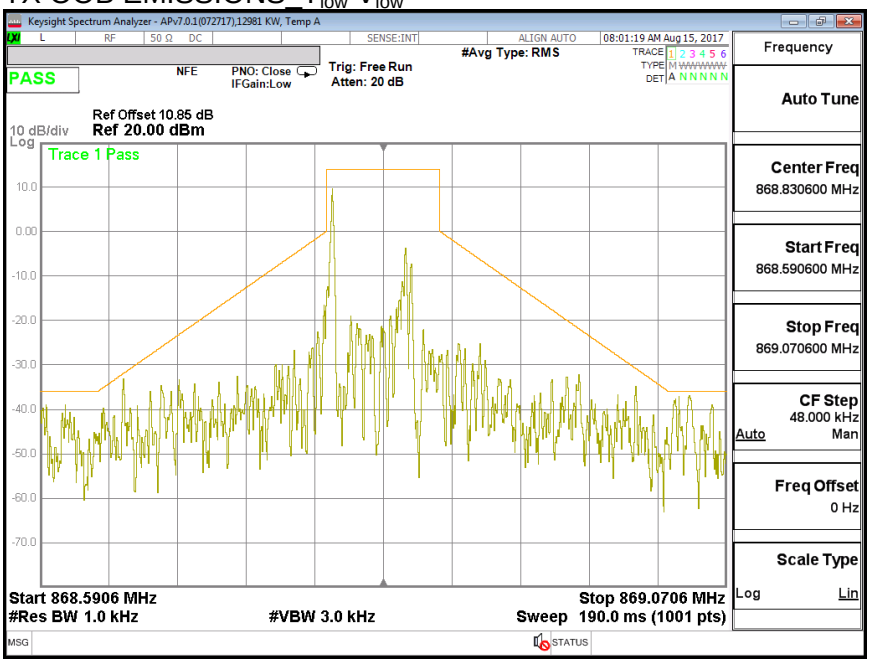
TX OUT OF BAND EMISSIONS (APPLICABLE TO OPERATING CHANNEL)

M4 LOW CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal}



TX OOB EMISSIONS_T_{low} V_{low}



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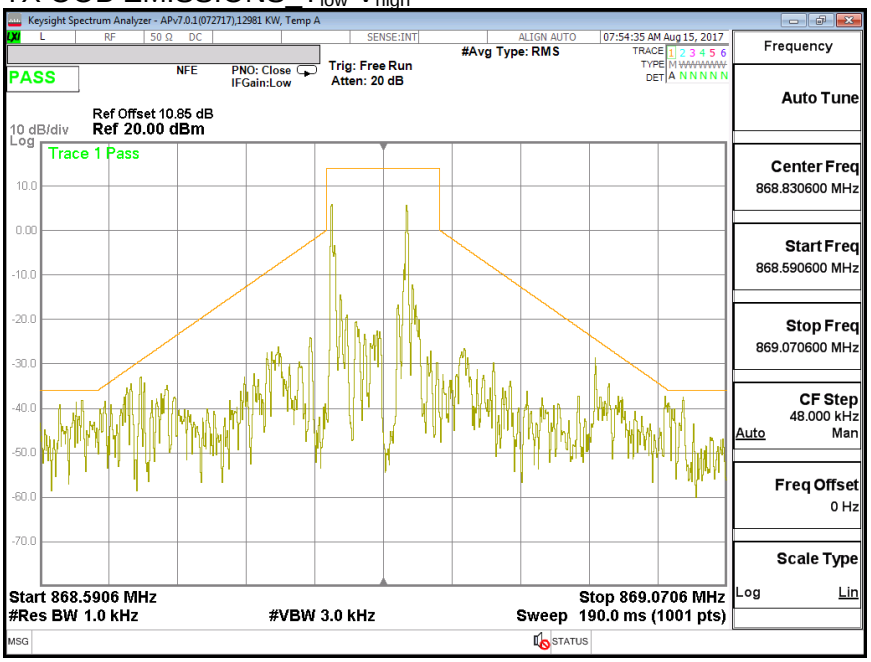
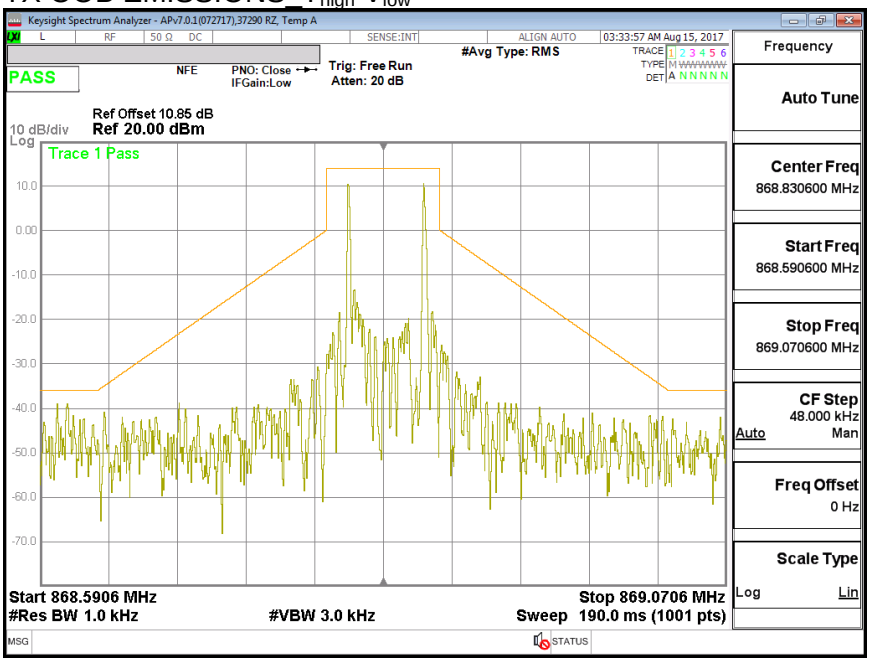
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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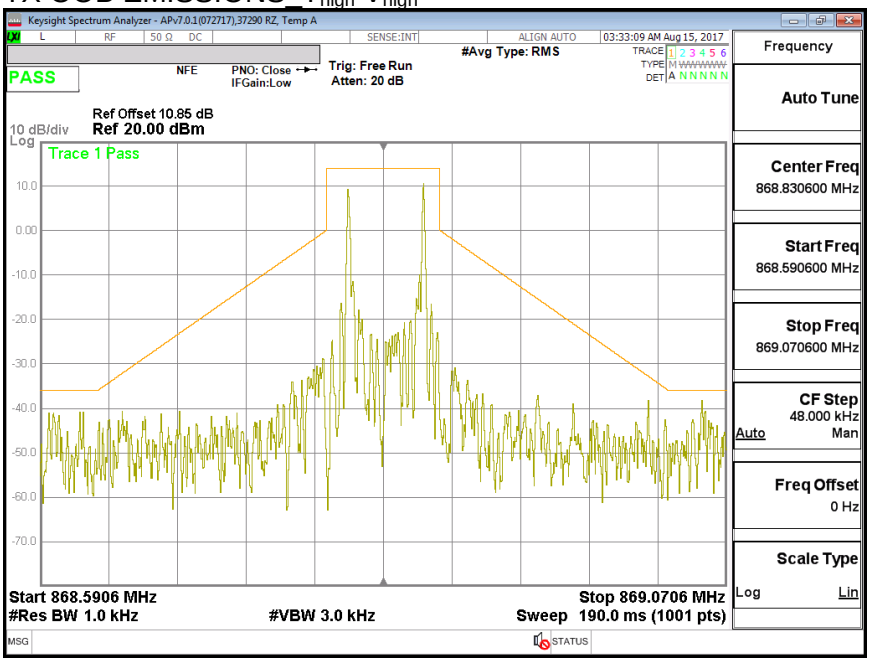
TX OOB EMISSIONS_T_{high} V_{high}



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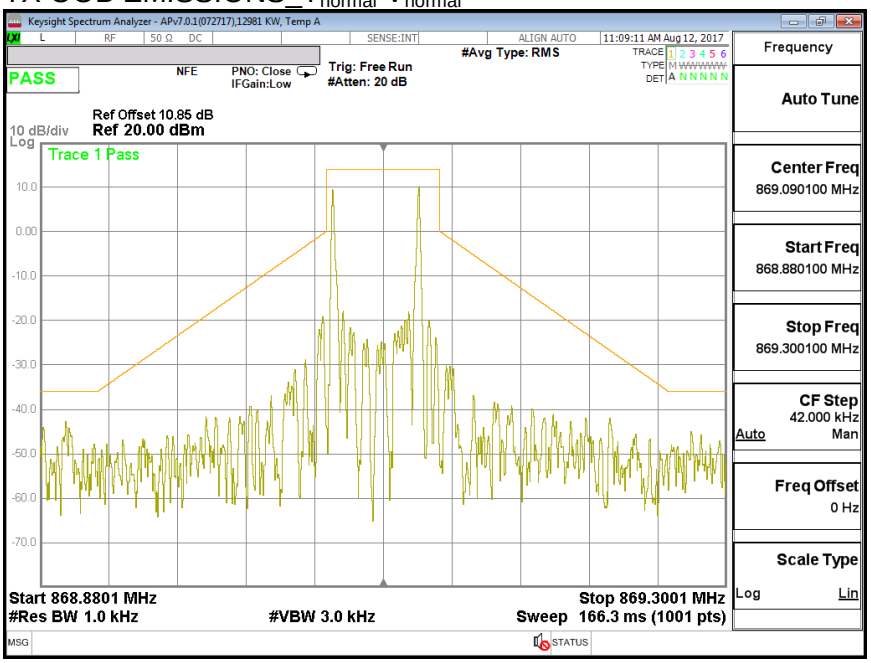
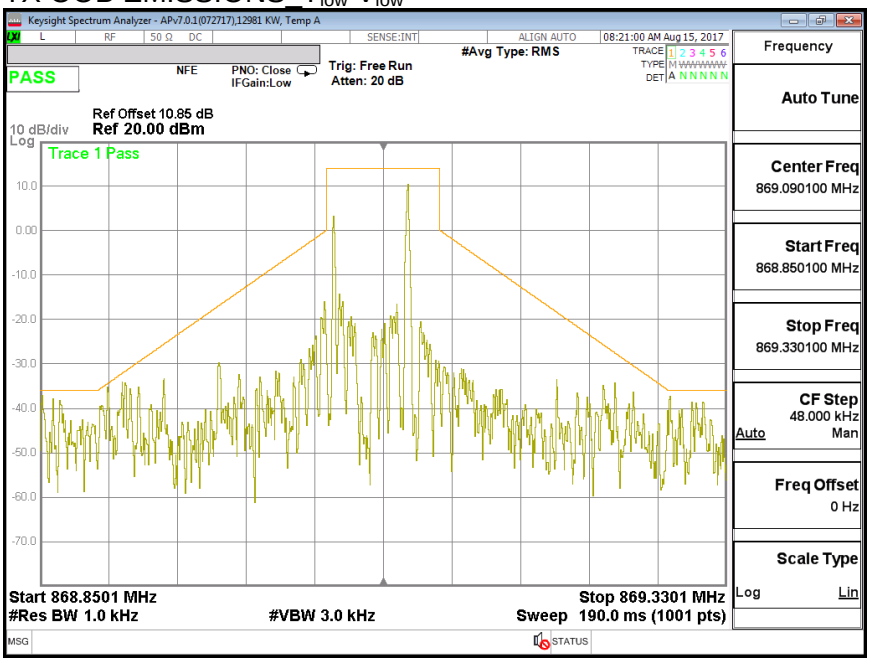
M4 HIGH CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$



TX OOB EMISSIONS_T$_{low}$ V$_{low}$



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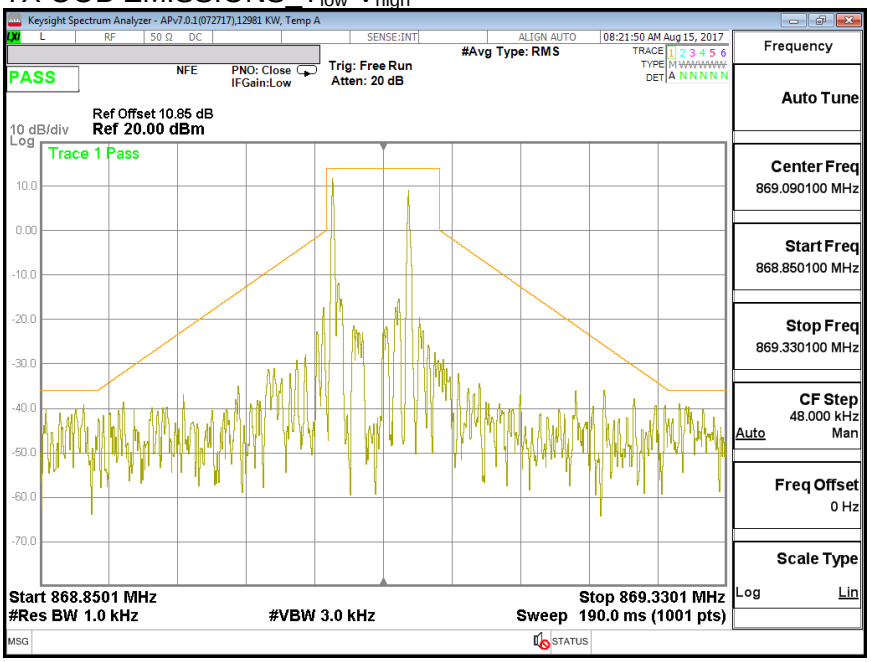
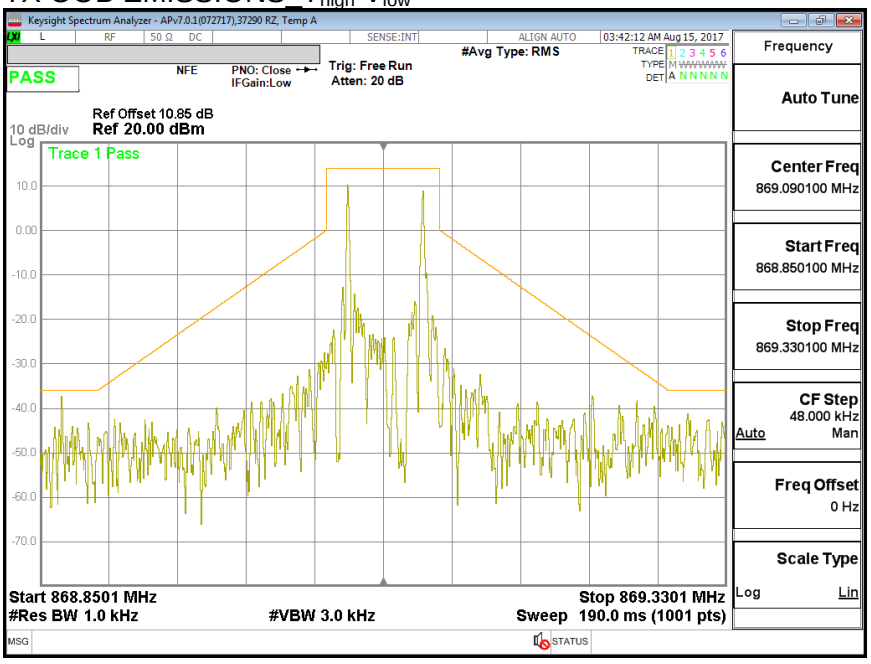
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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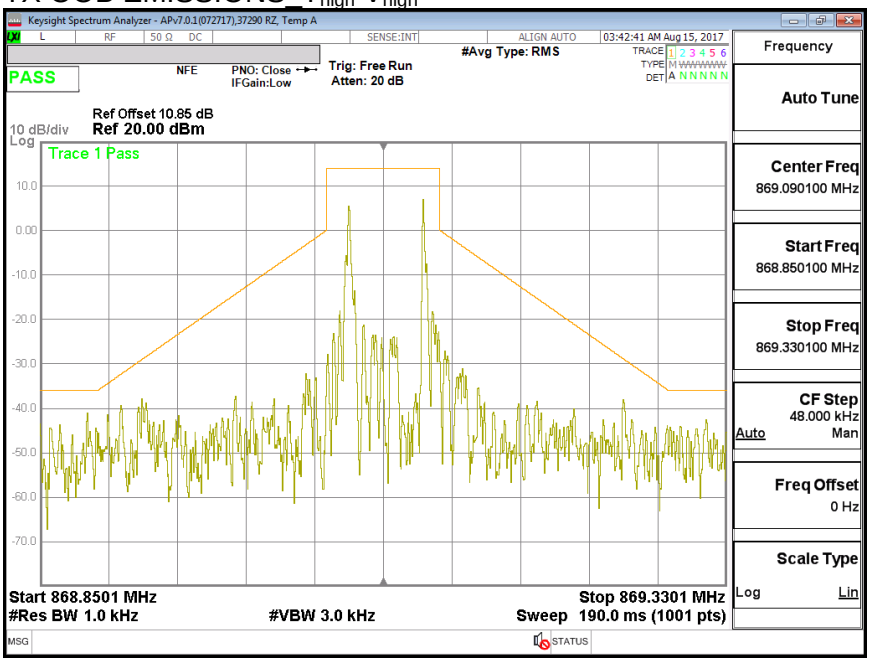
TX OOB EMISSIONS_T_{high} V_{high}



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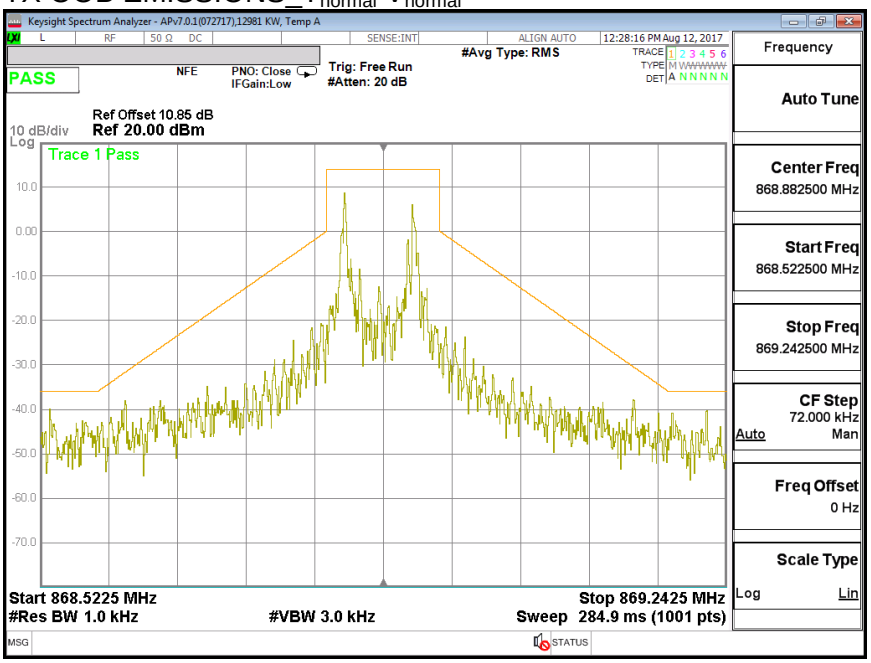
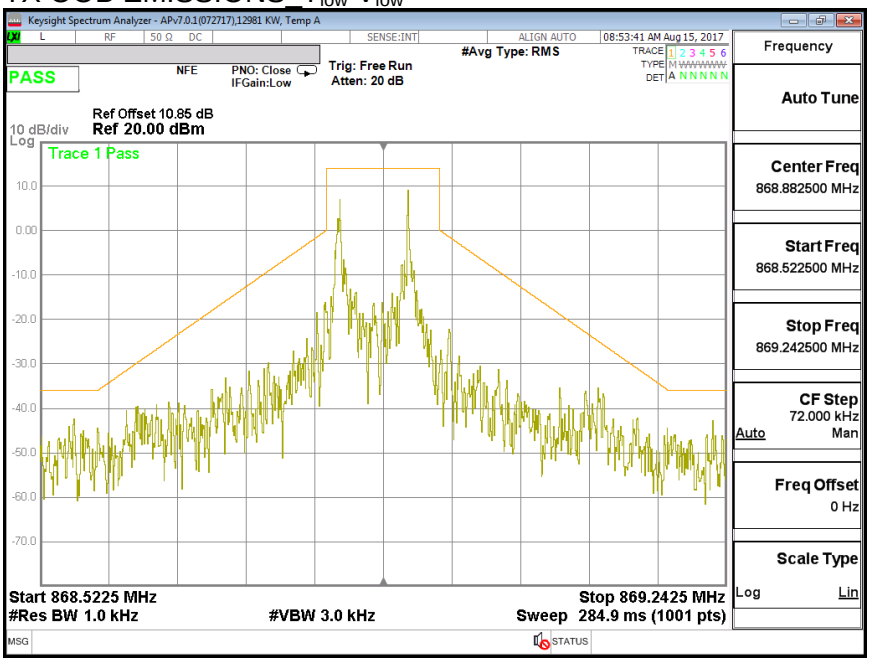
M5 LOW CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$



TX OOB EMISSIONS_T$_{low}$ V$_{low}$



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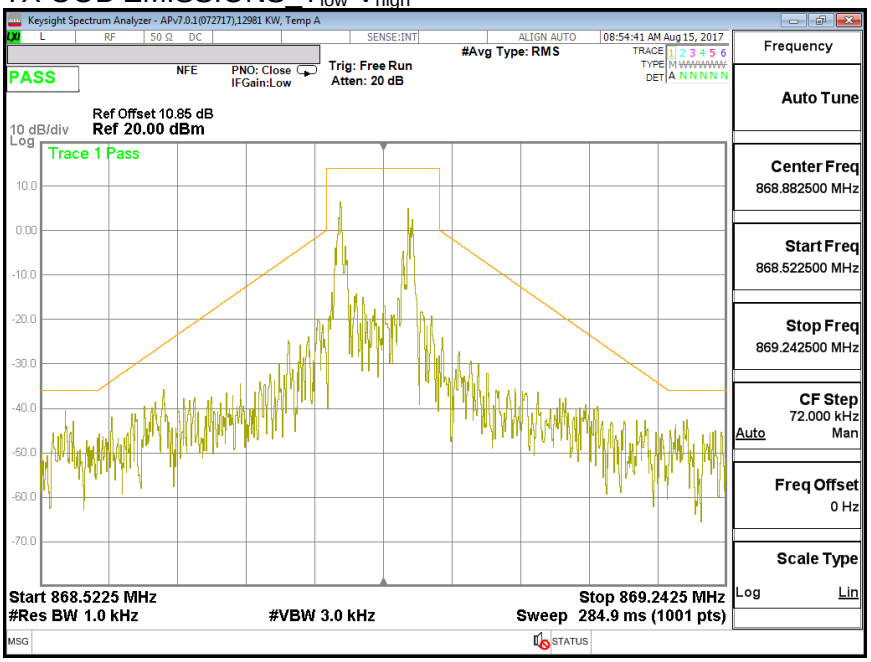
TX OOB EMISSIONS_T_{low} V_{high}



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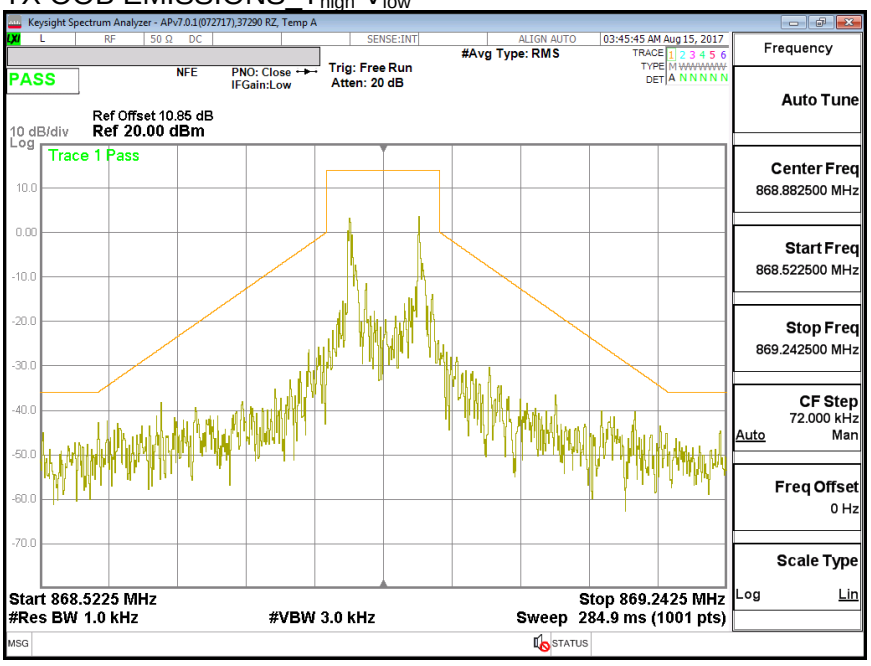

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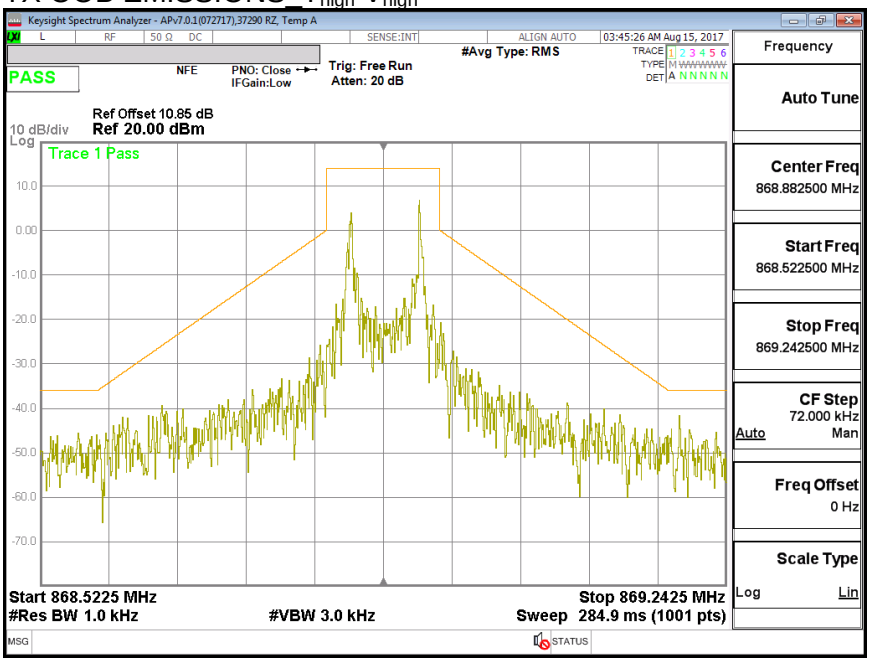
TX OOB EMISSIONS_T_{high} V_{high}



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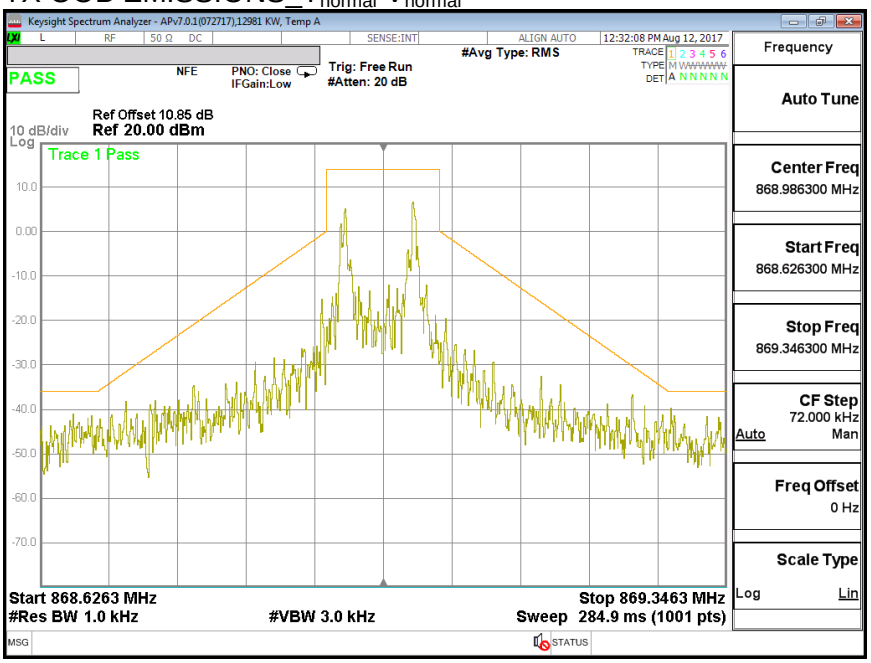
M5 HIGH CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$



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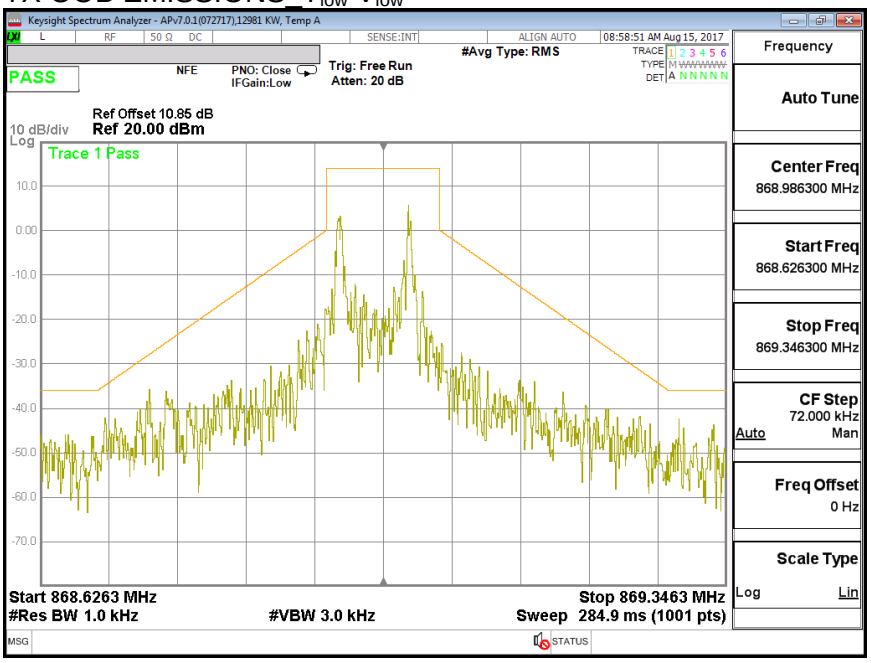

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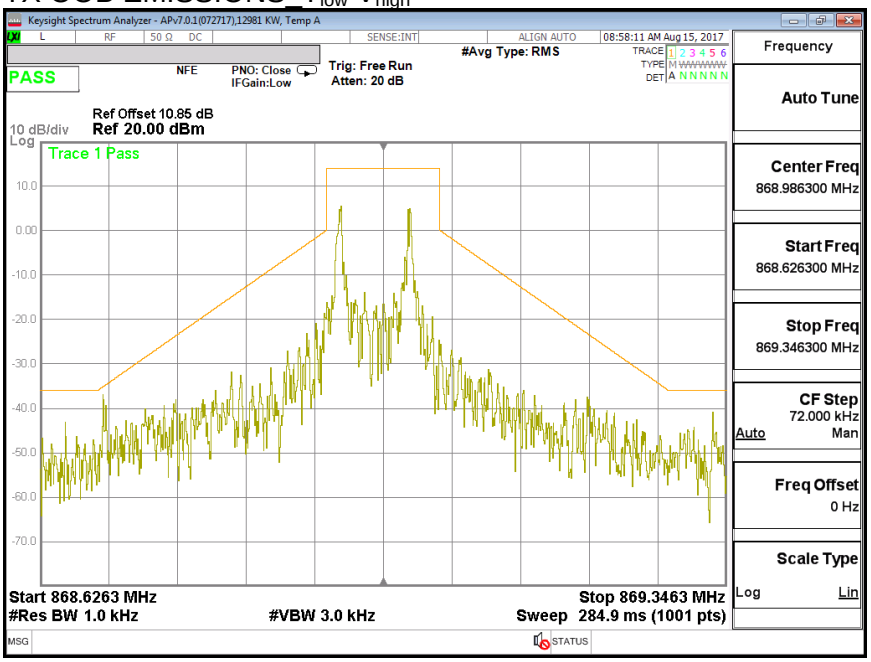
TX OOB EMISSIONS_T_{low} V_{high}



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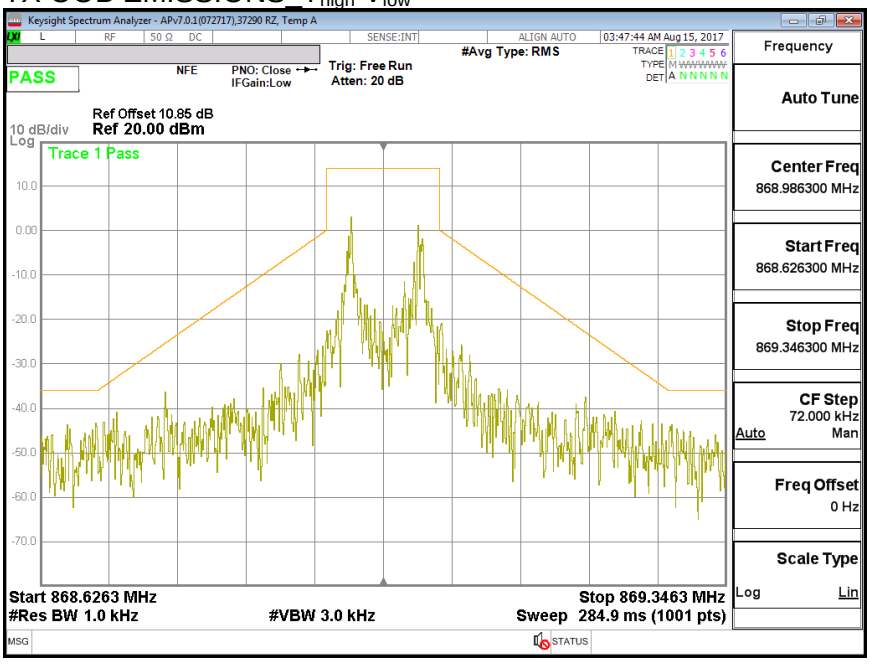

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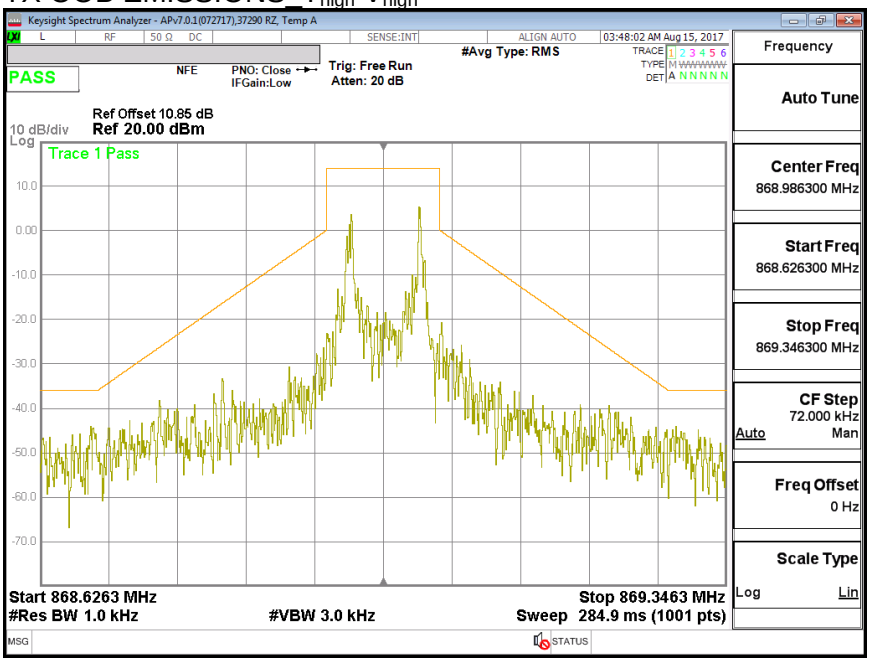
TX OOB EMISSIONS_T_{high} V_{high}



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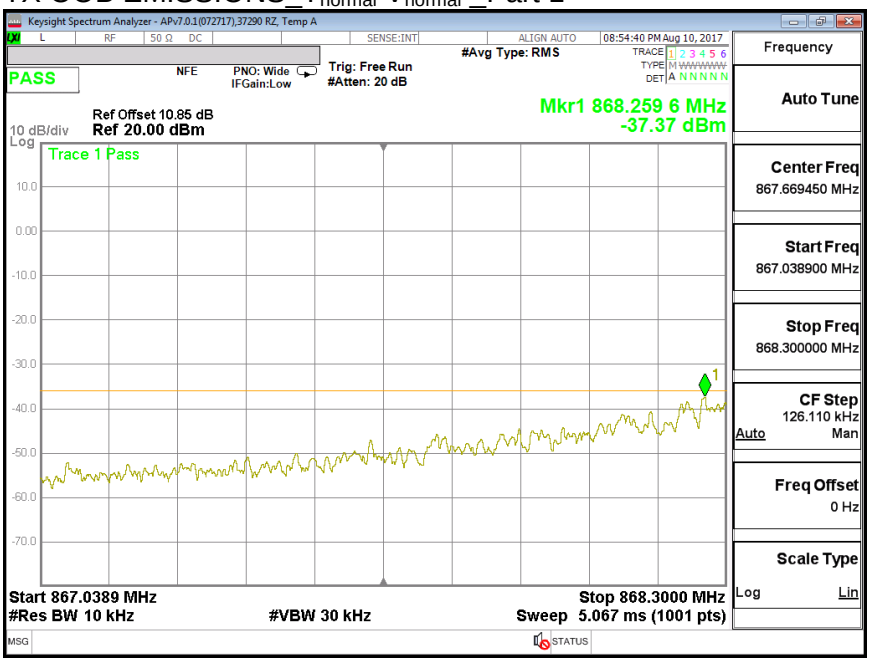
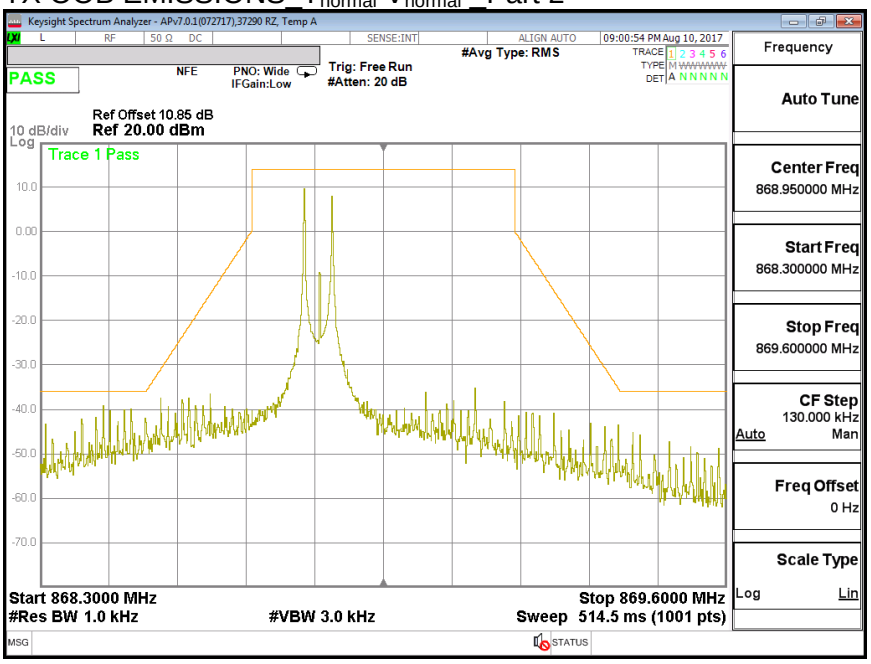
TX OUT OF BAND EMISSIONS (APPLICABLE TO OPERATIONAL FREQUENCY BANDS)

M4 LOW CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal} _Part 1



TX OOB EMISSIONS_T_{normal} V_{normal} _Part 2



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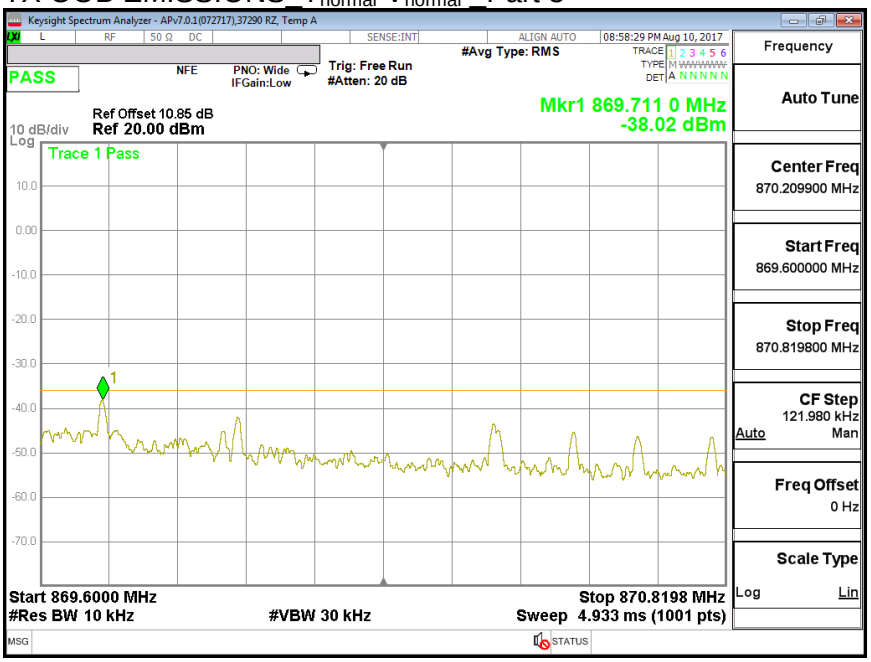
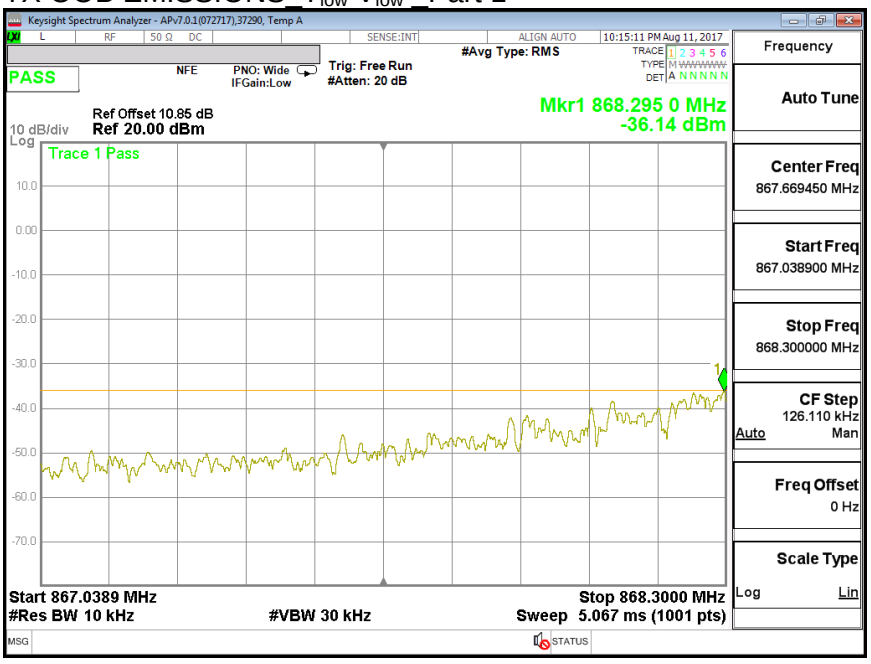
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3



TX OOB EMISSIONS_T_{low} V_{low} _Part 1



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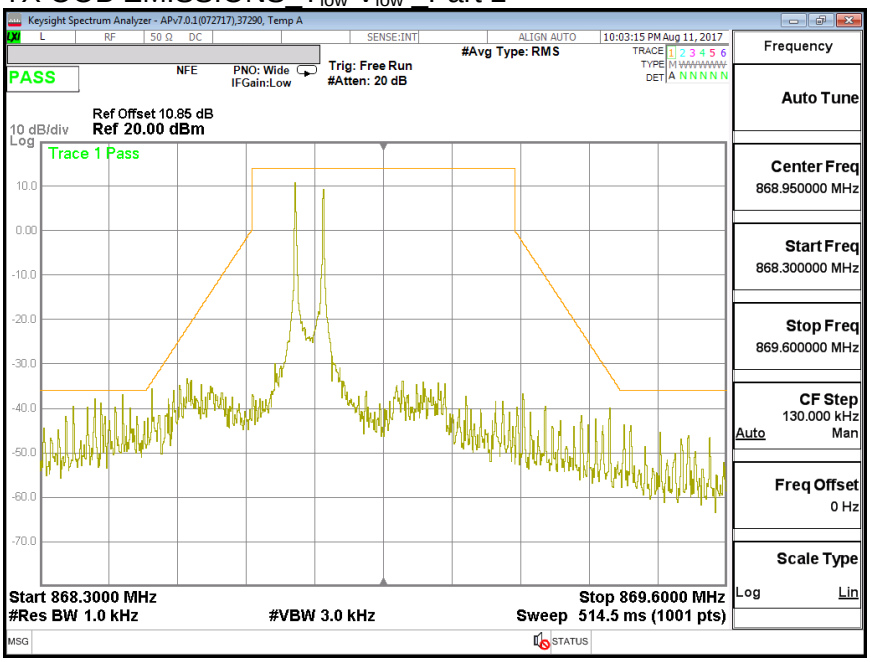

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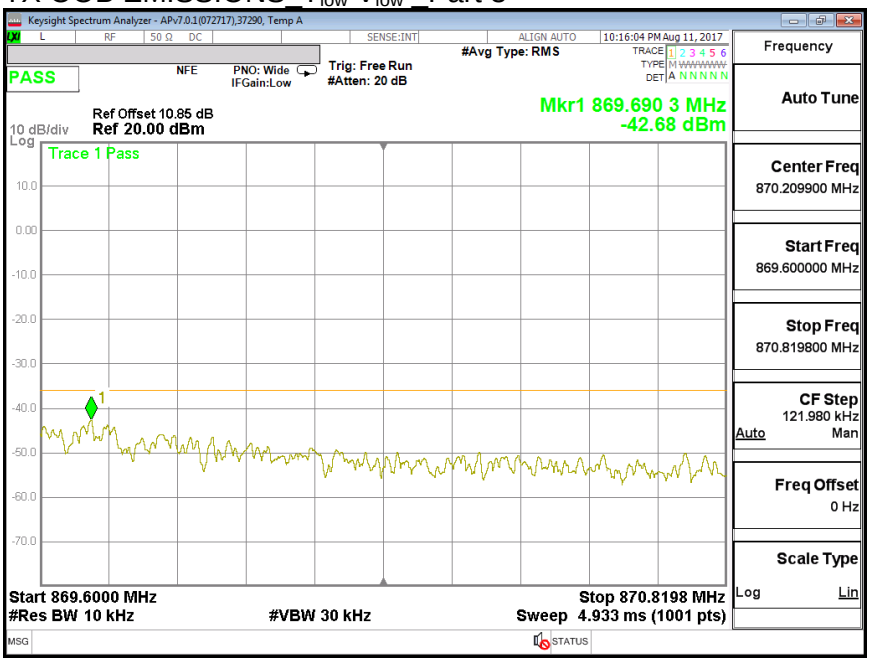

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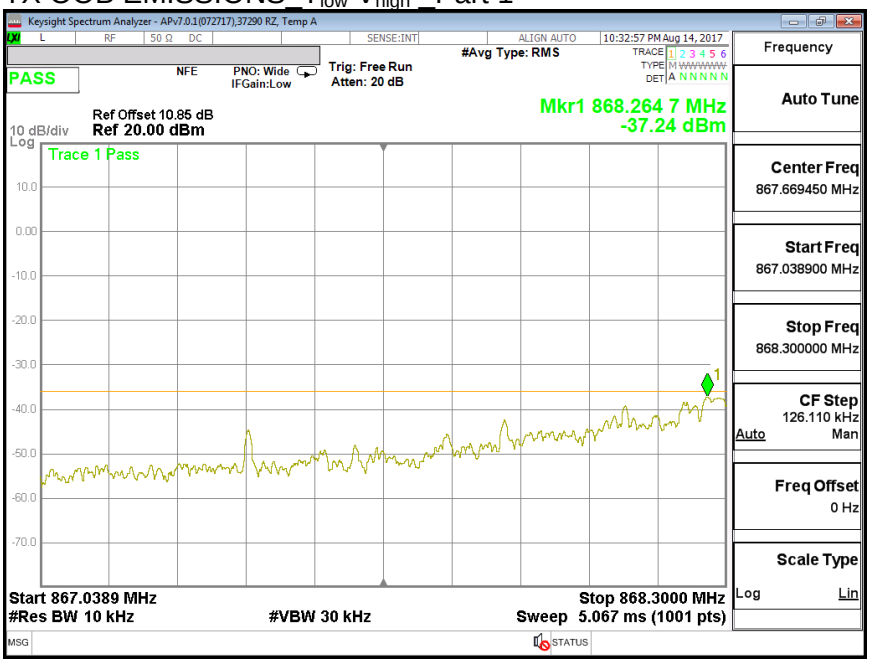
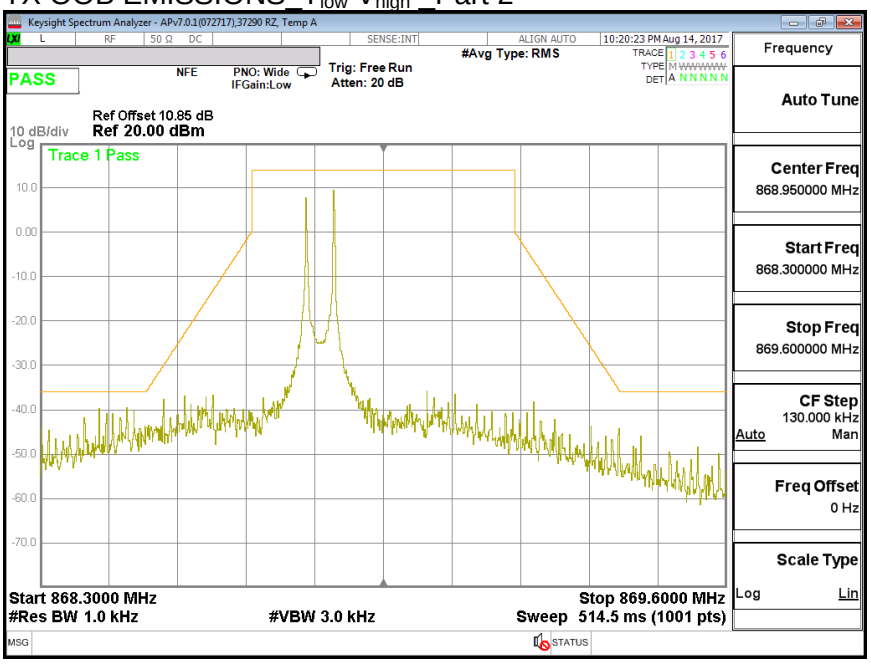
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



TX OOB EMISSIONS_T_{low} V_{high} _Part 2



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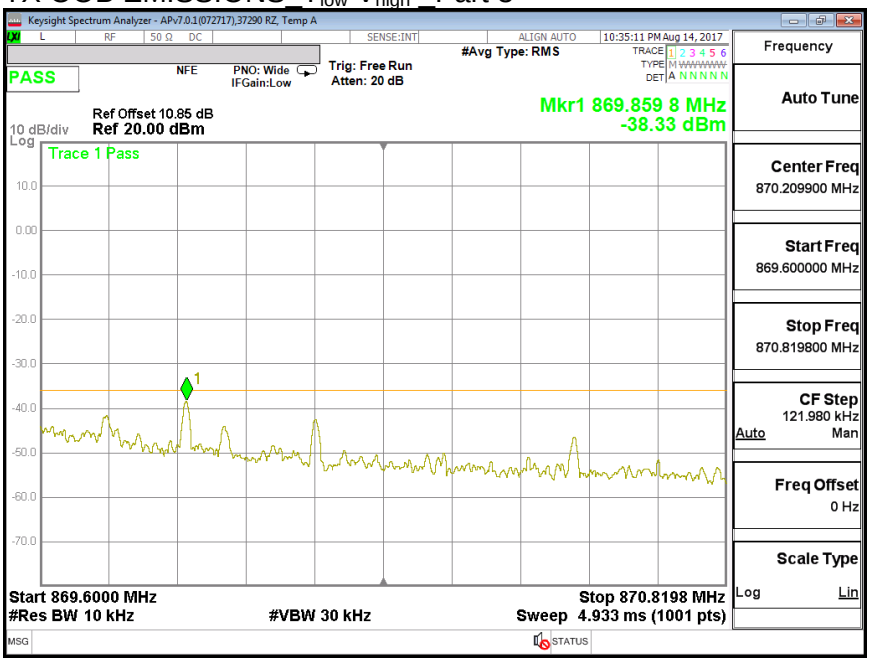
TX OOB EMISSIONS_T_{low} V_{high} _Part 3



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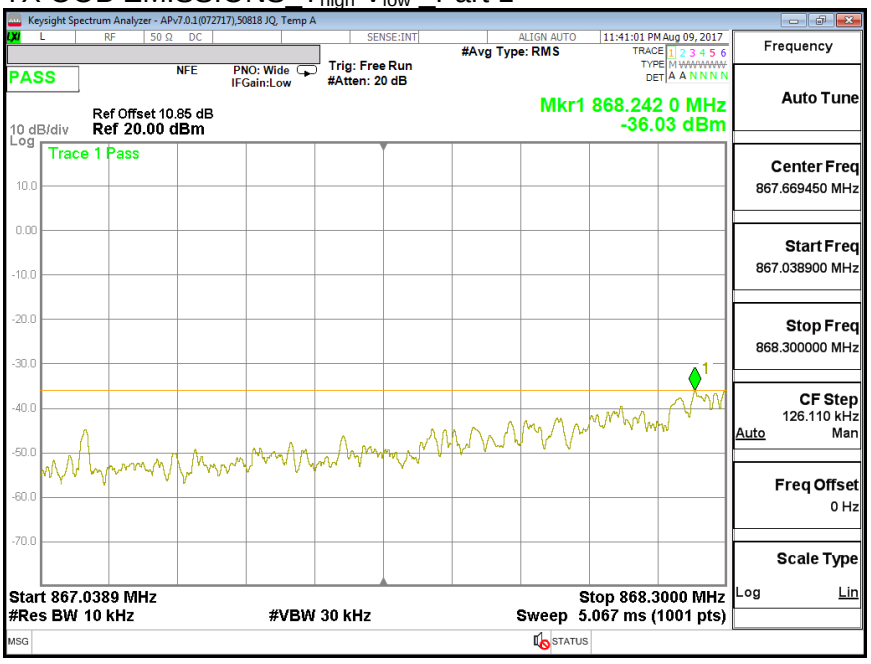

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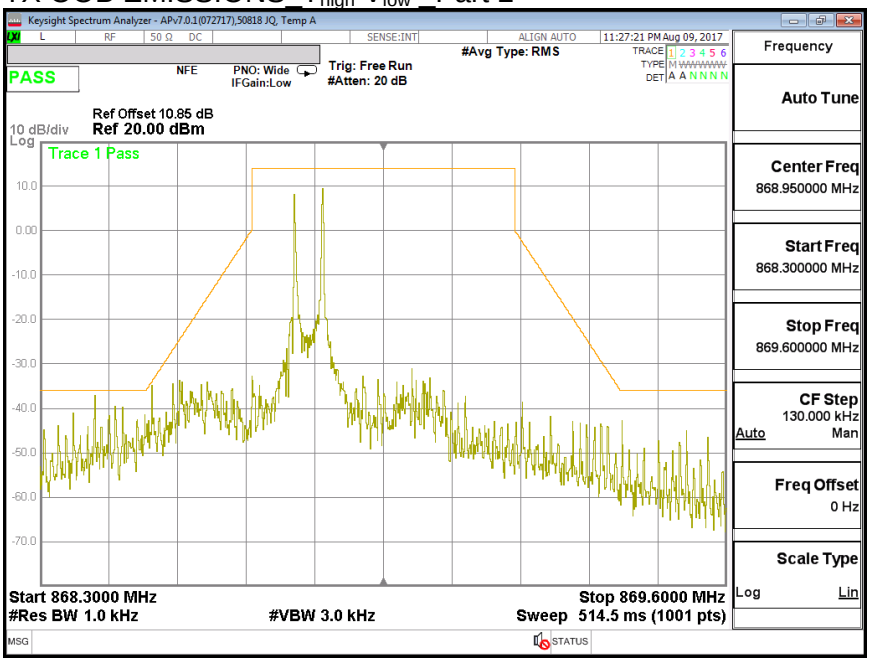
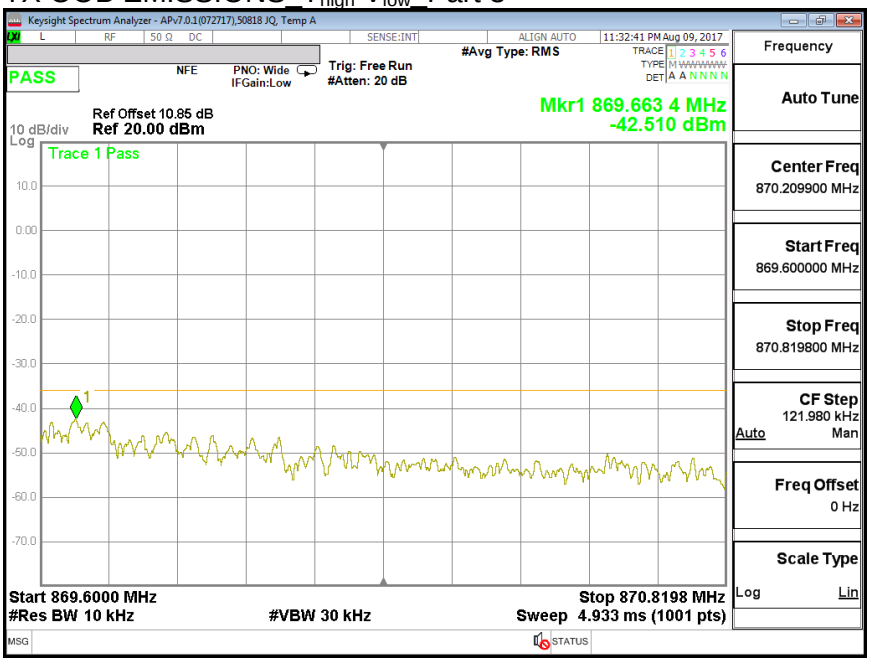
TX OOB EMISSIONS_T_{high} V_{low} _Part 2



TX OOB EMISSIONS_T_{high} V_{low}_Part 3



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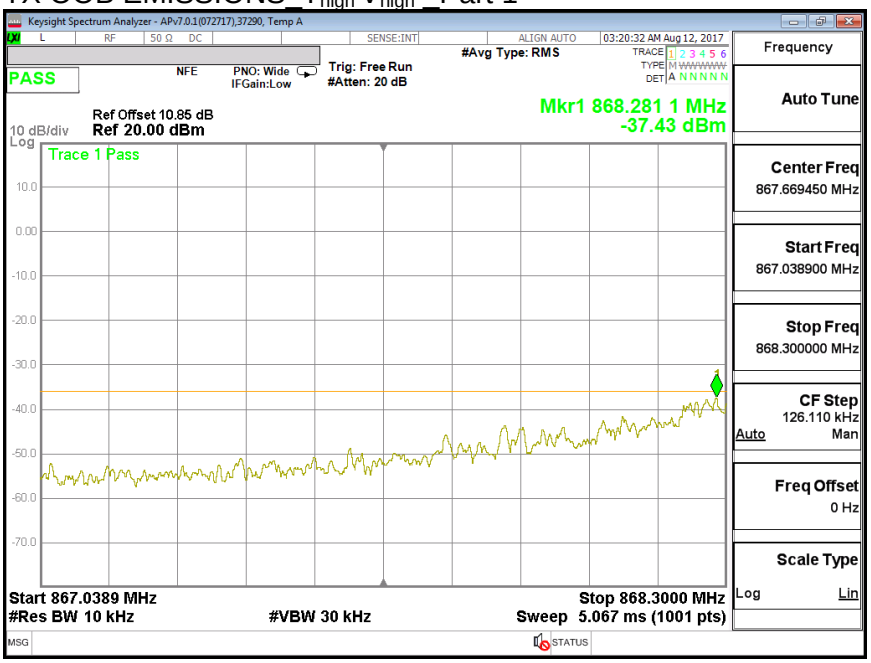
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



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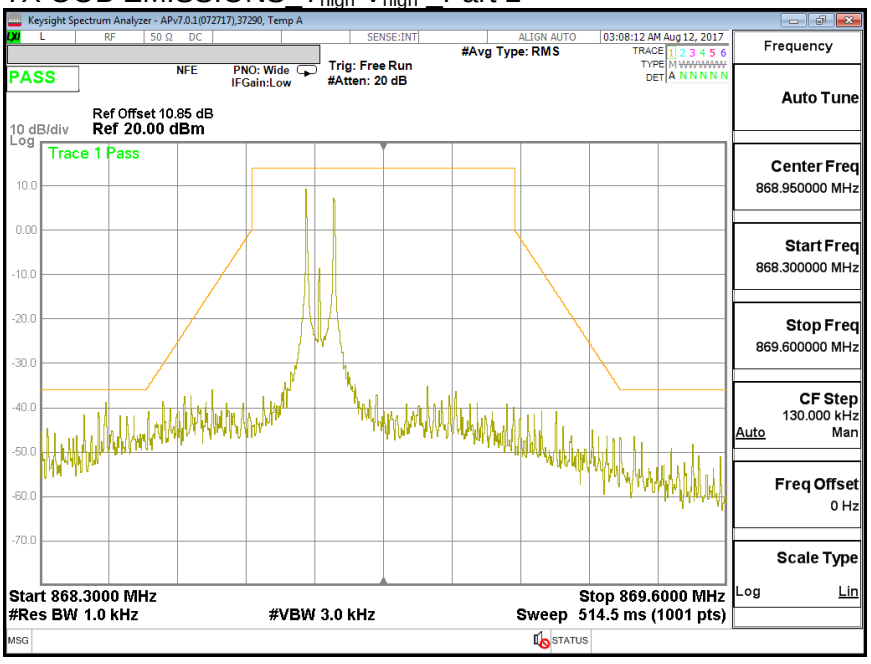

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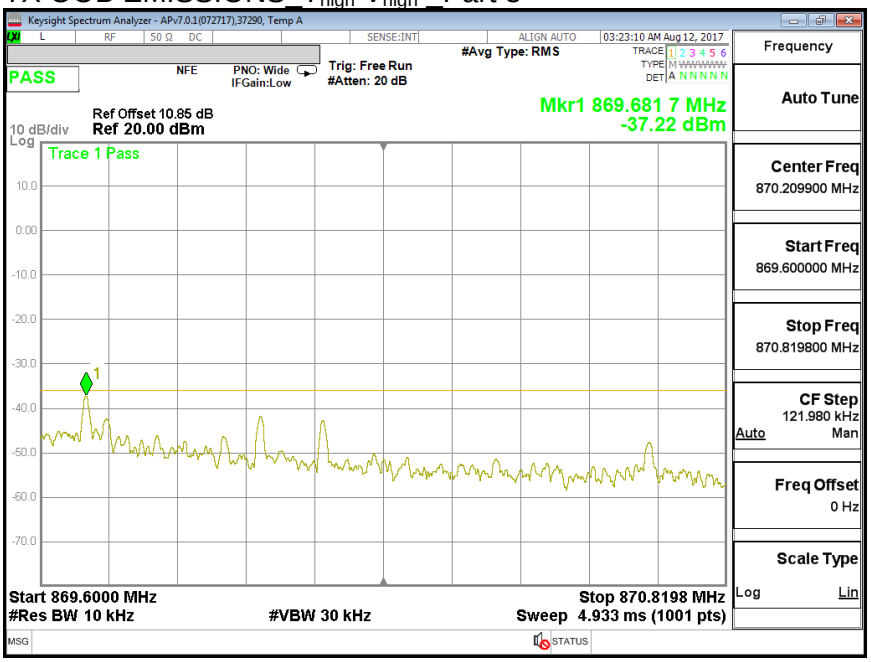
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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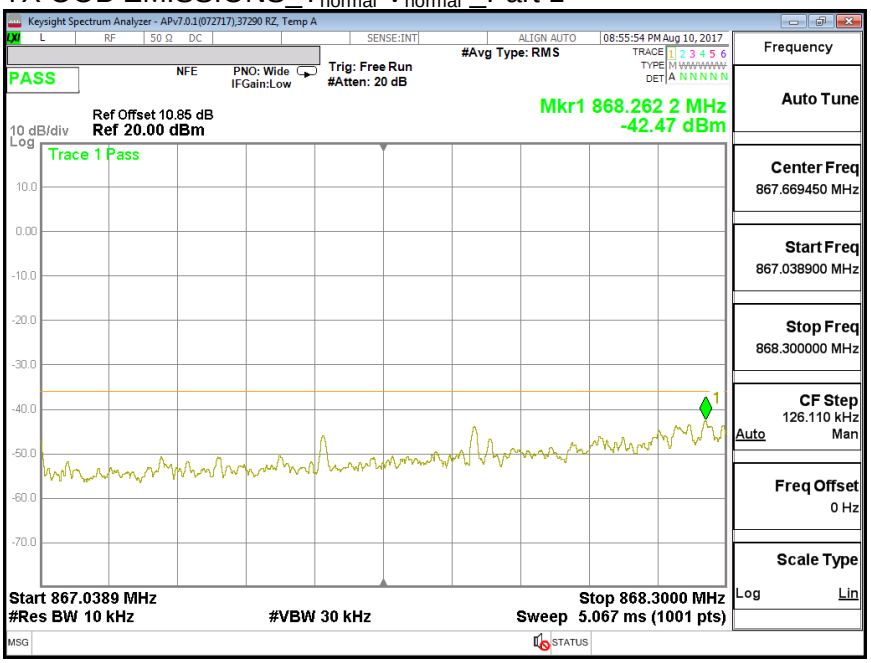
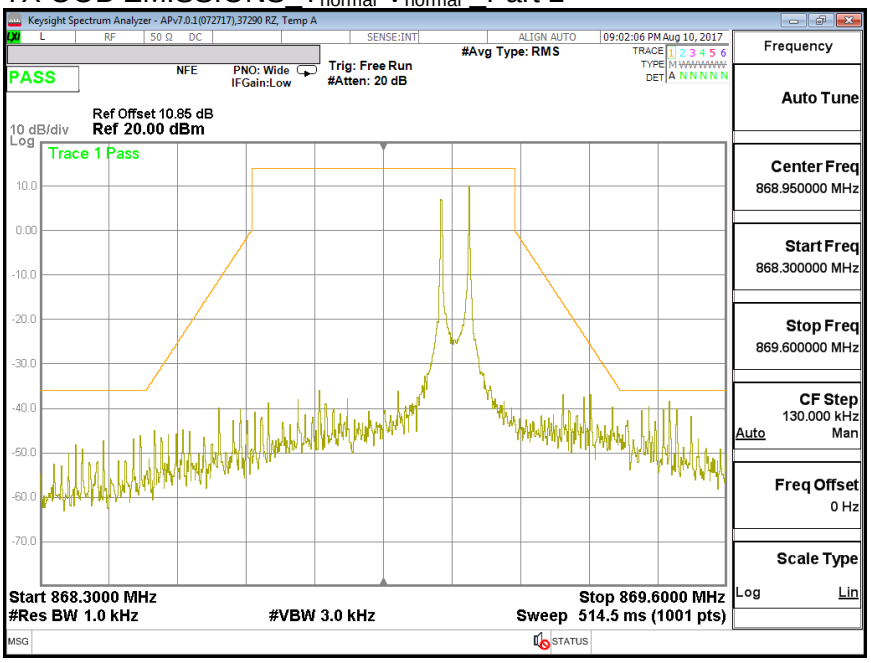
M4 HIGH CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 1



TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 2



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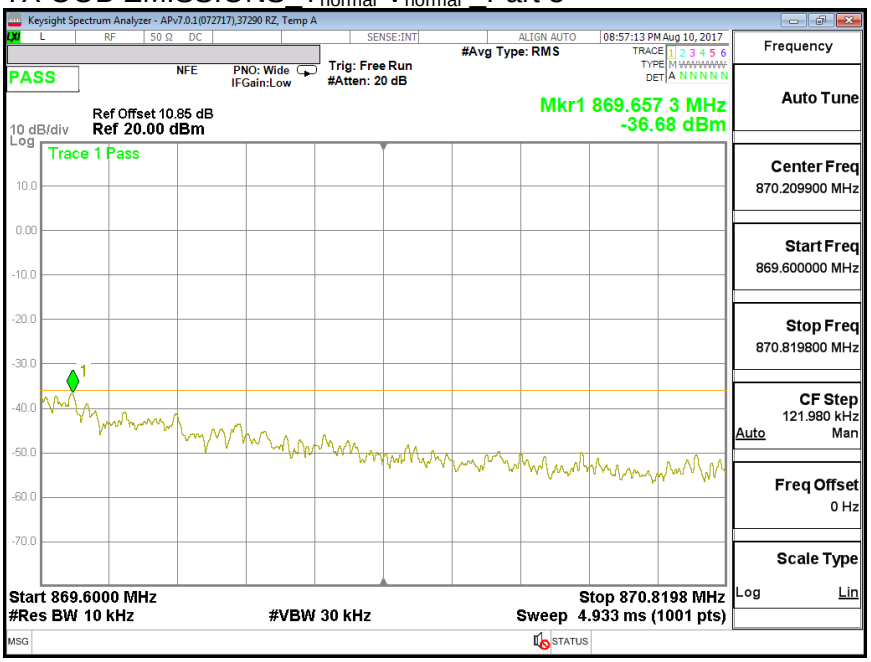
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3



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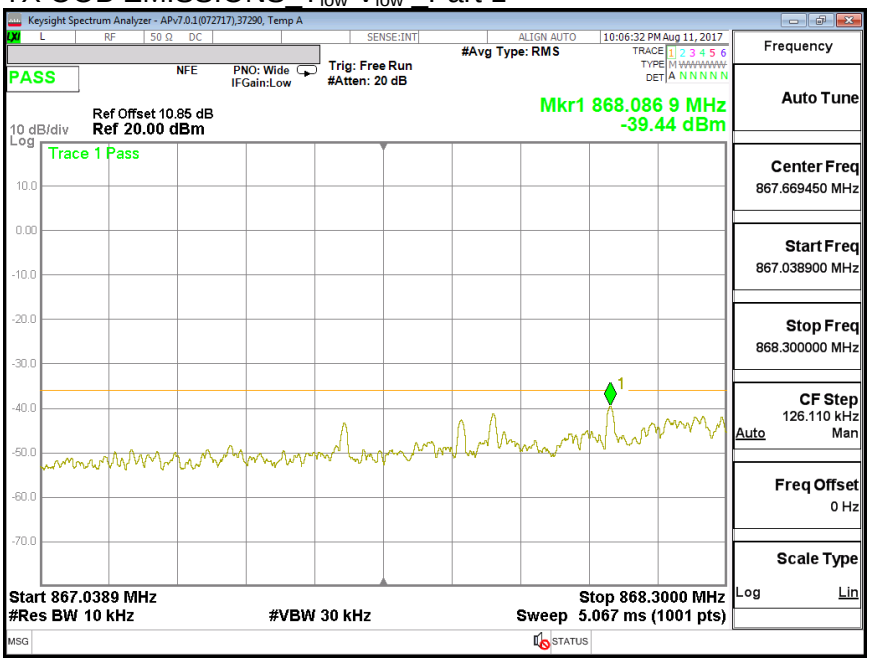

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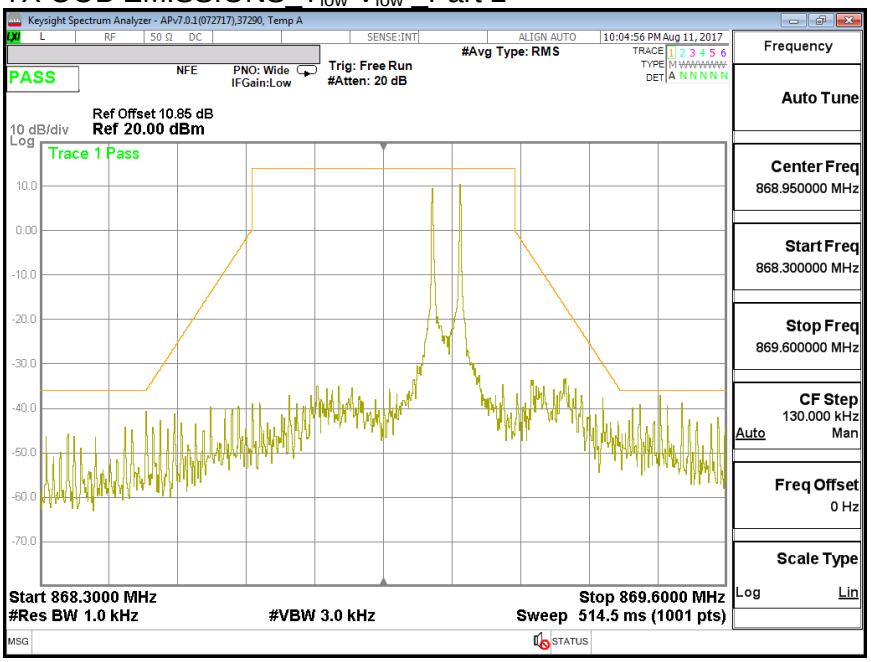

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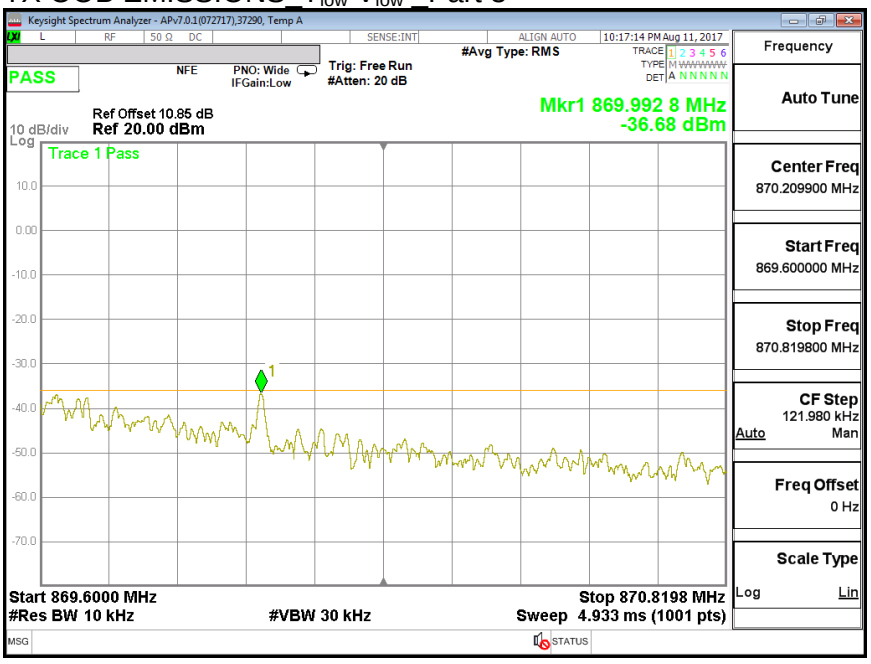

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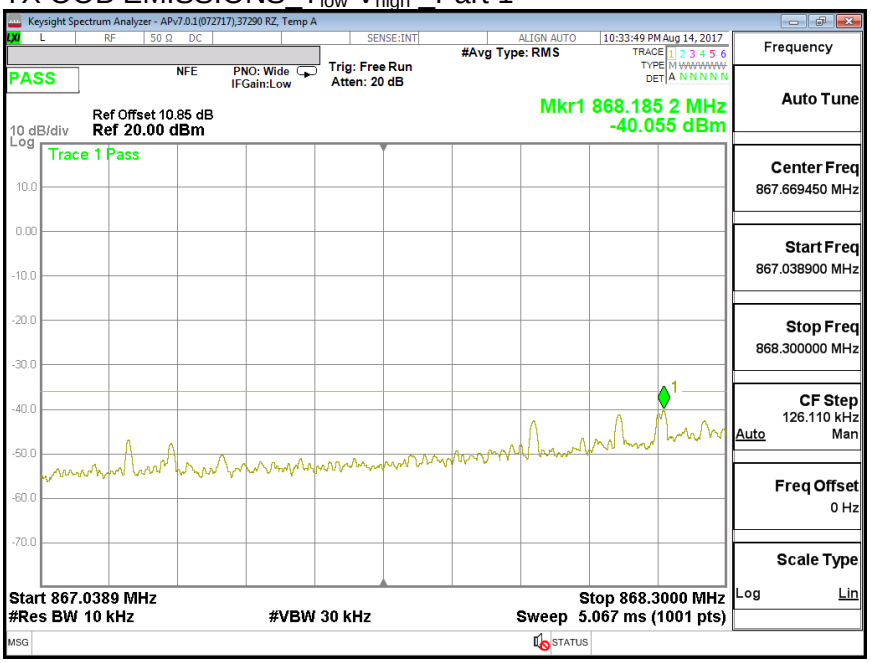
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



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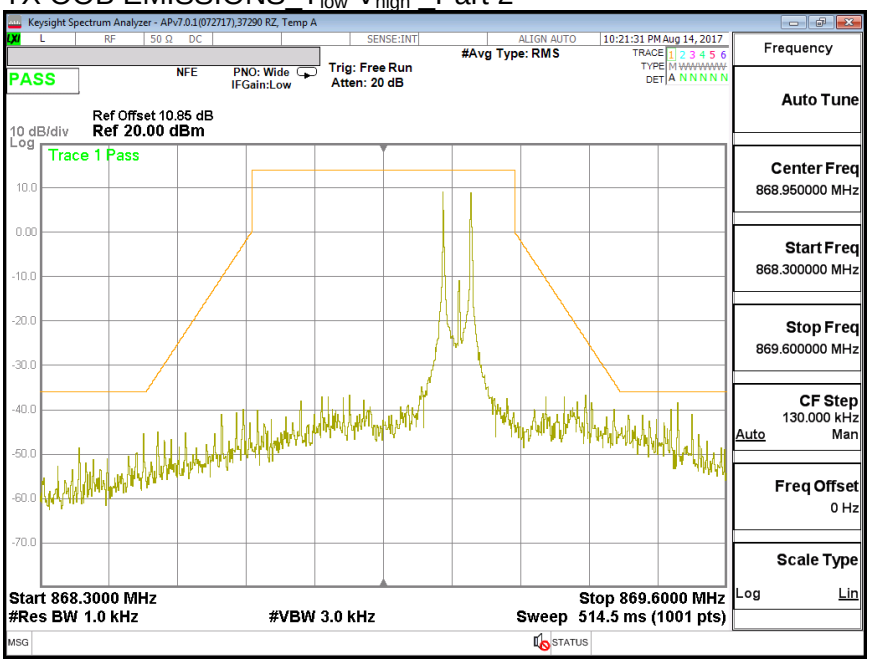

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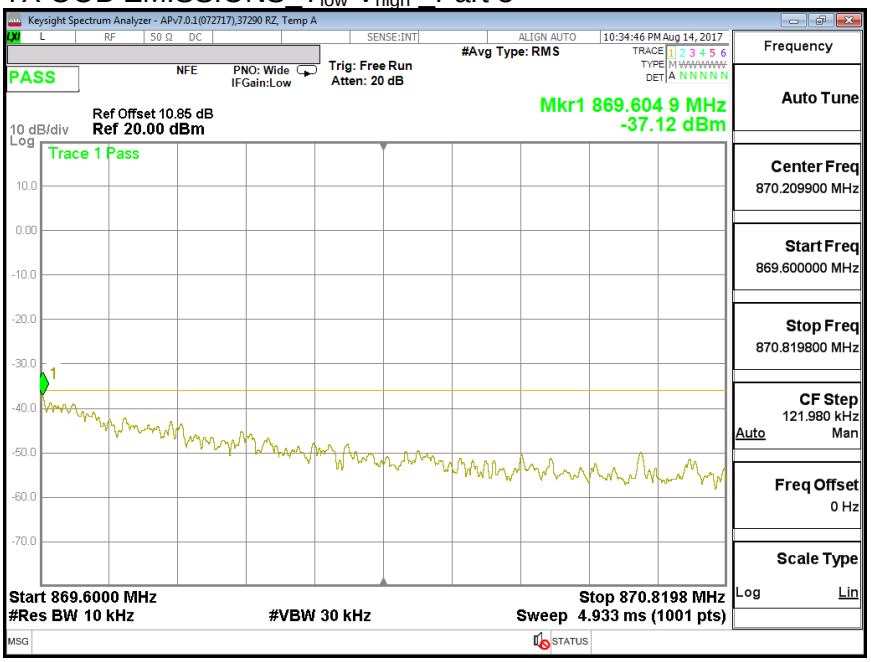
TX OOB EMISSIONS_T_{low} V_{high} _Part 3



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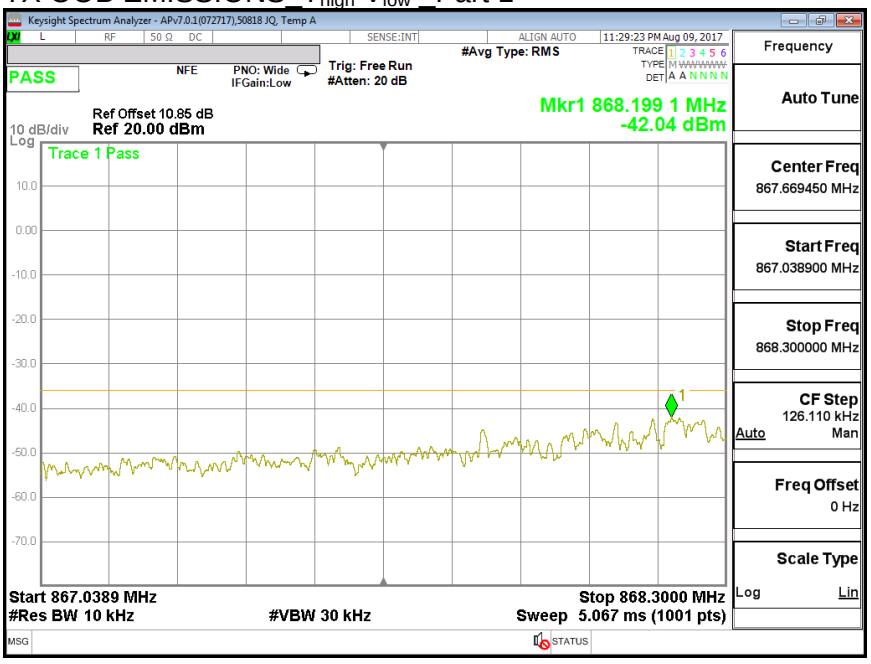

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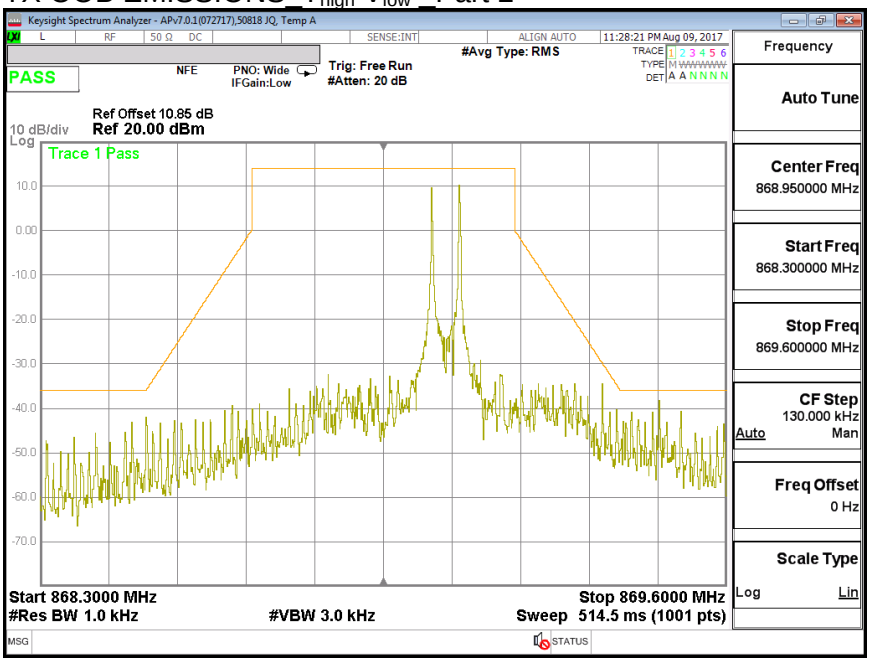
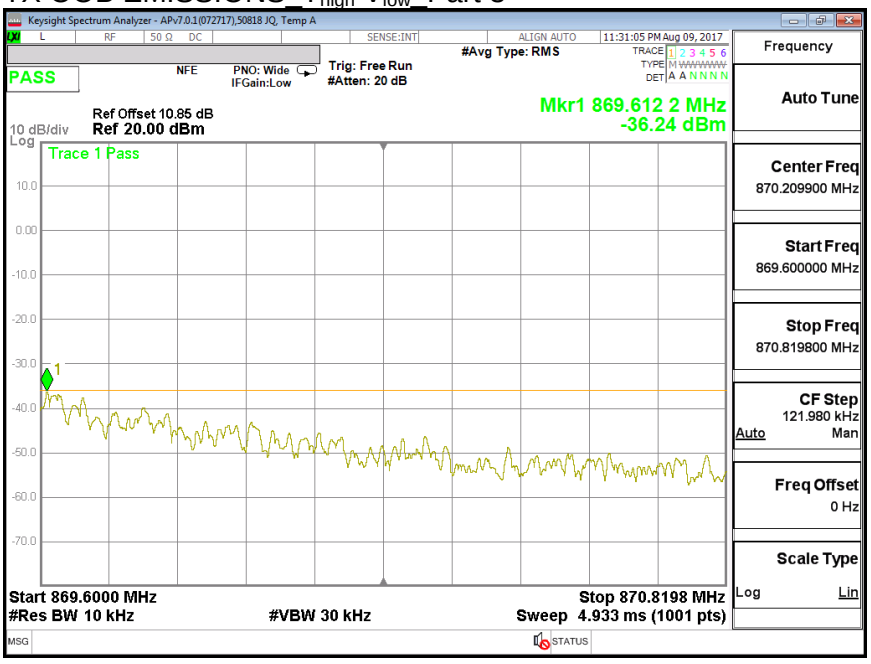


TX OOB EMISSIONS_T_{high} V_{low}_Part 3



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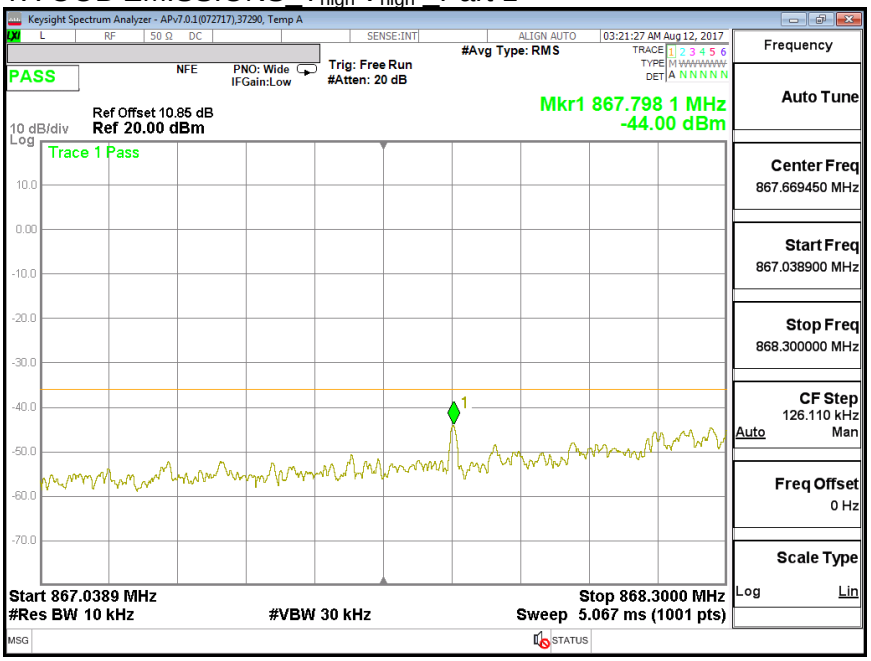
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



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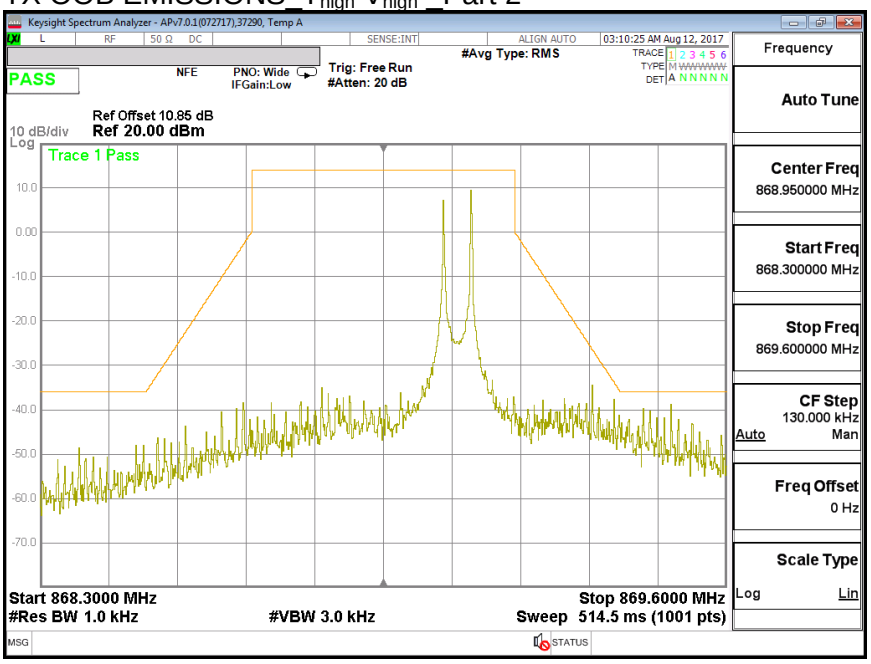

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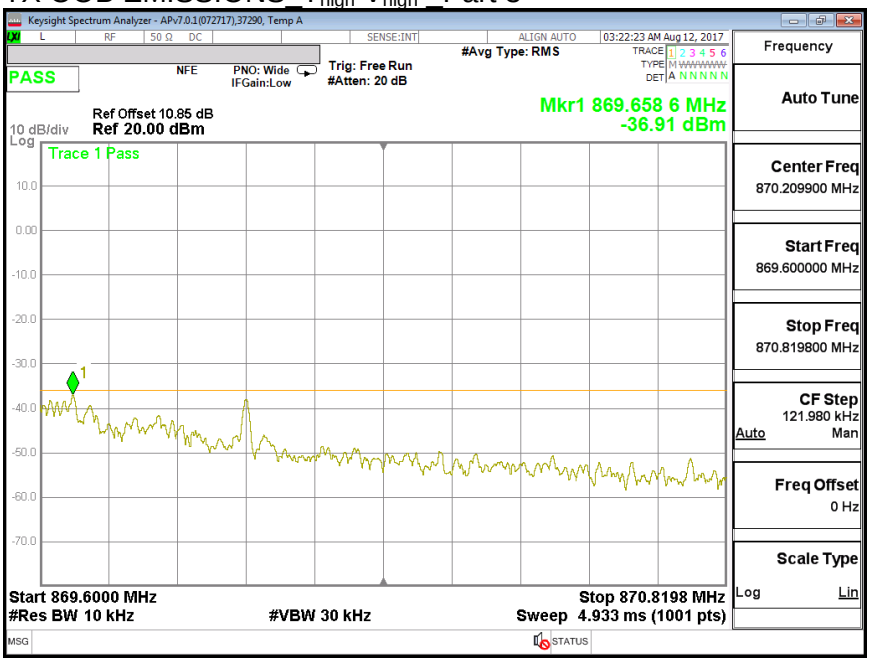
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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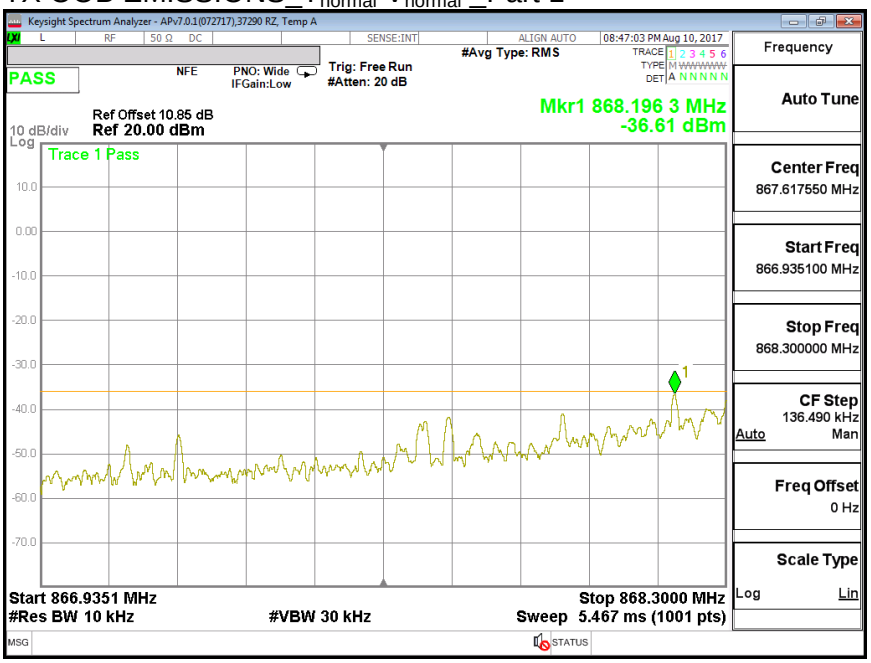
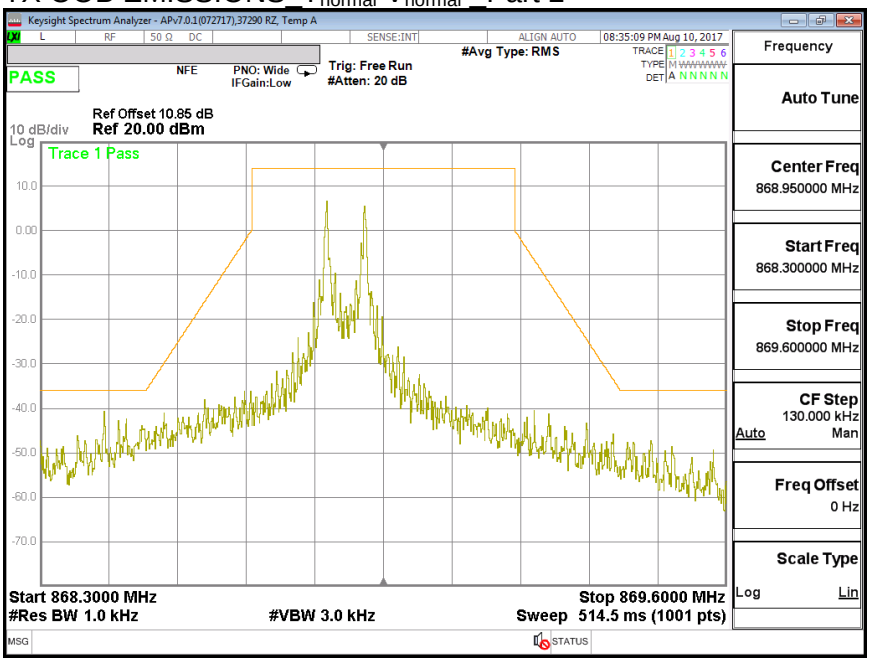
M5 LOW CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 1



TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 2



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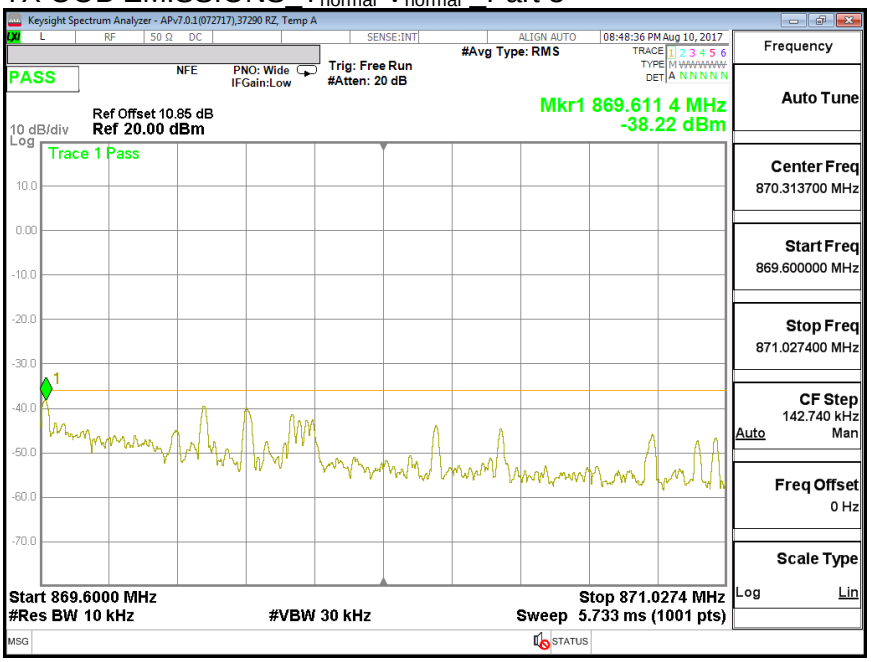
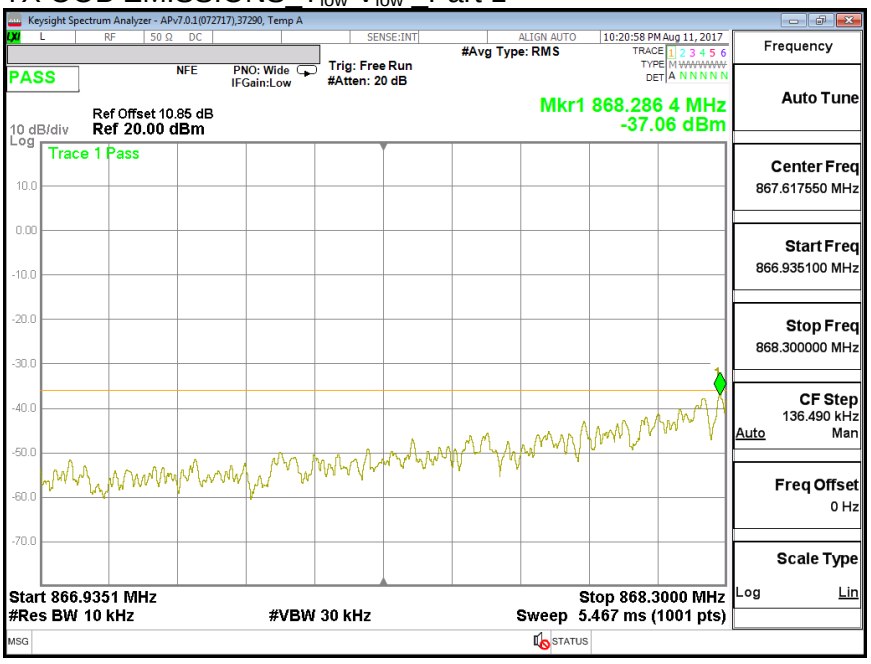
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3



TX OOB EMISSIONS_T_{low} V_{low} _Part 1



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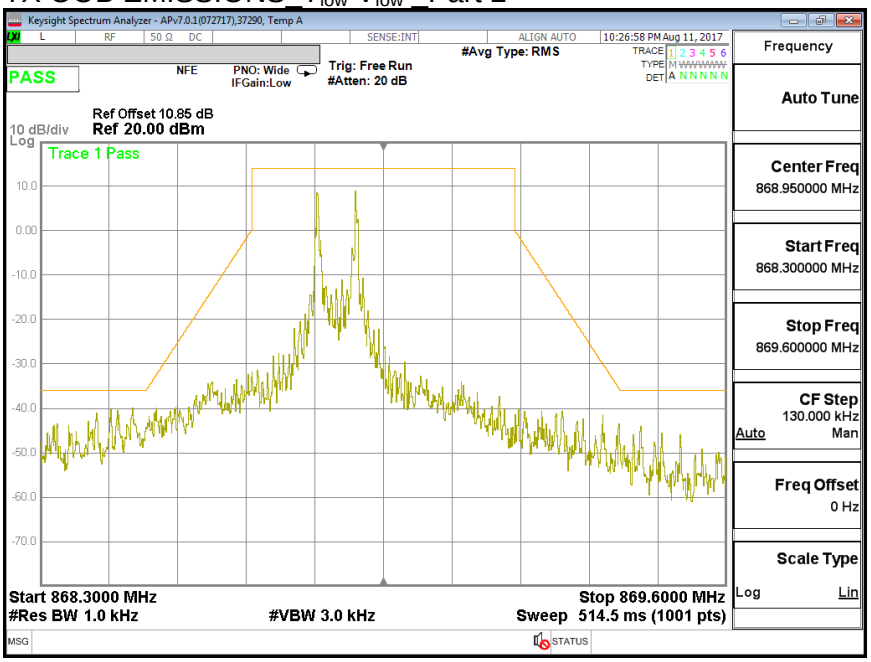
TX OOB EMISSIONS_T_{low} V_{low} _Part 2



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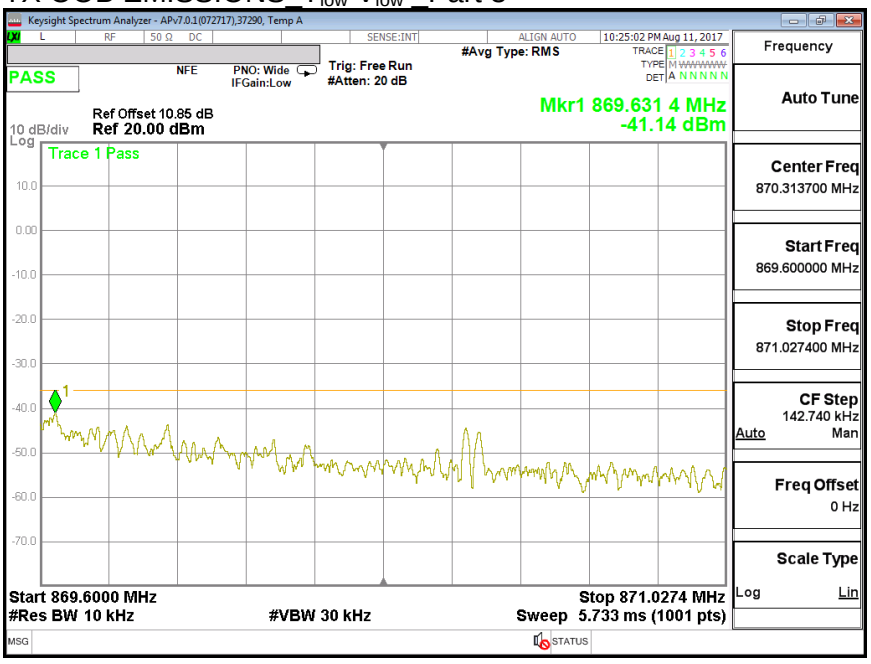

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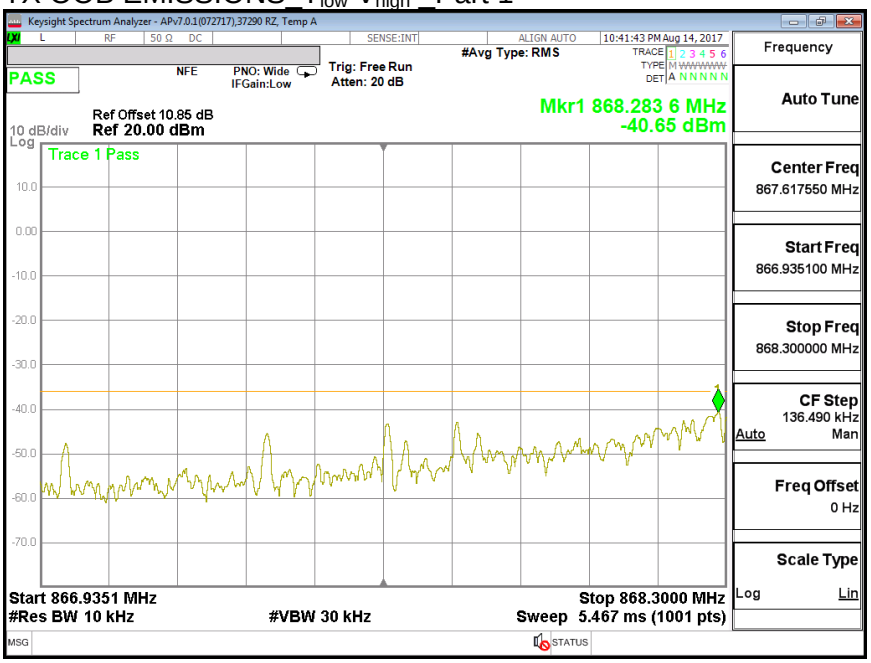
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



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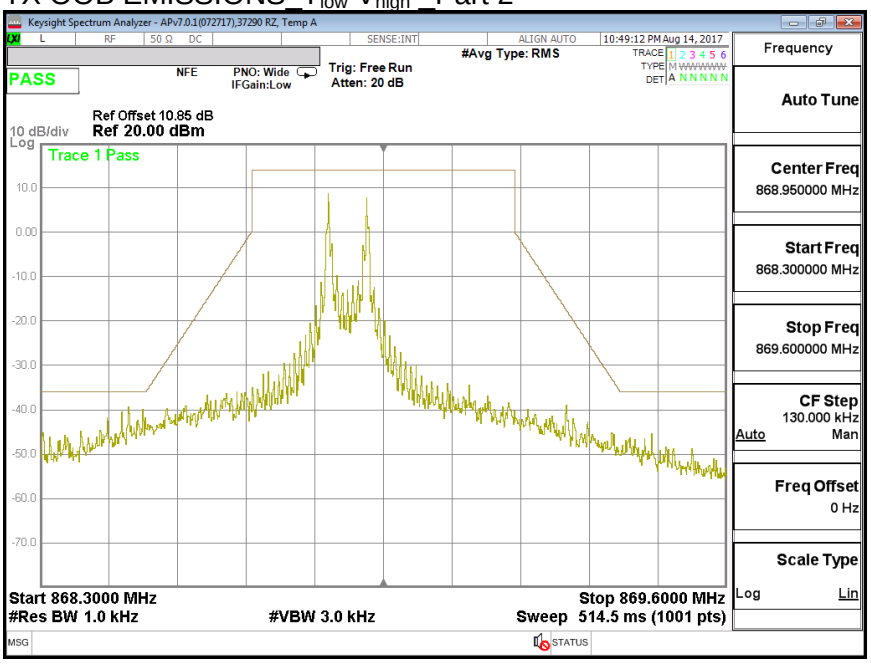

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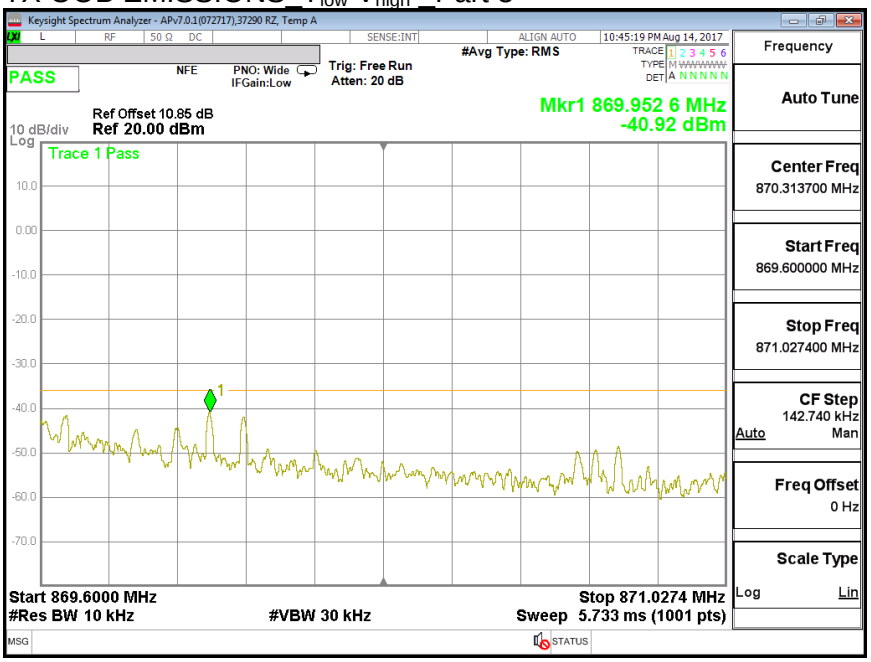
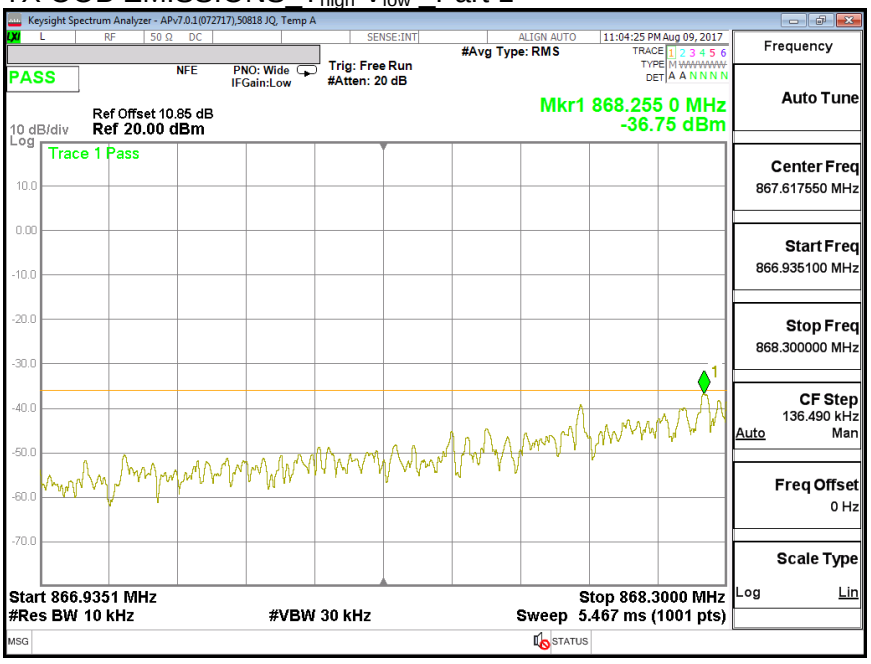
TX OOB EMISSIONS_T_{low} V_{high} _Part 3



TX OOB EMISSIONS_T_{high} V_{low} _Part 1



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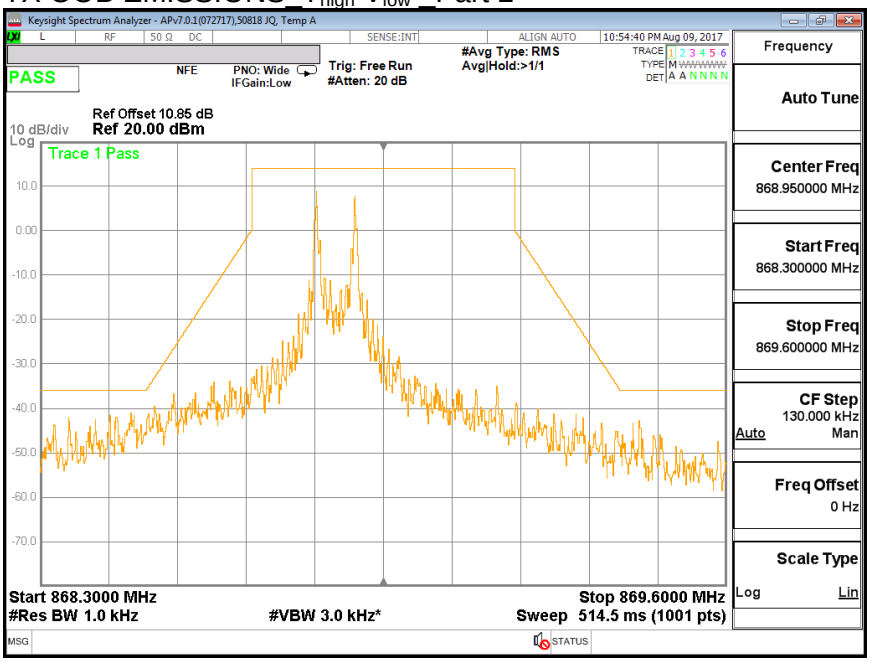
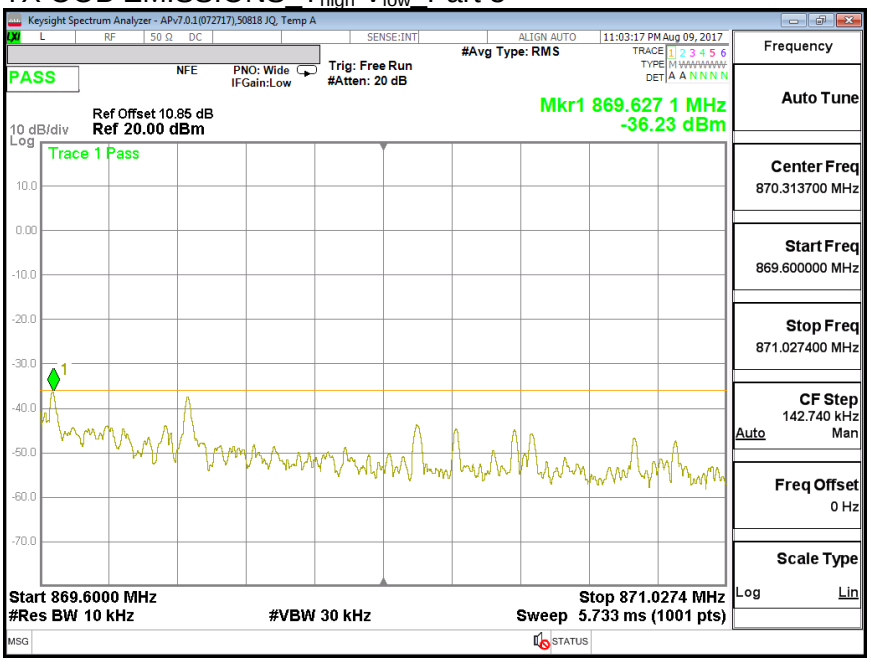
TX OOB EMISSIONS_T_{high} V_{low} _Part 2



TX OOB EMISSIONS_T_{high} V_{low}_Part 3



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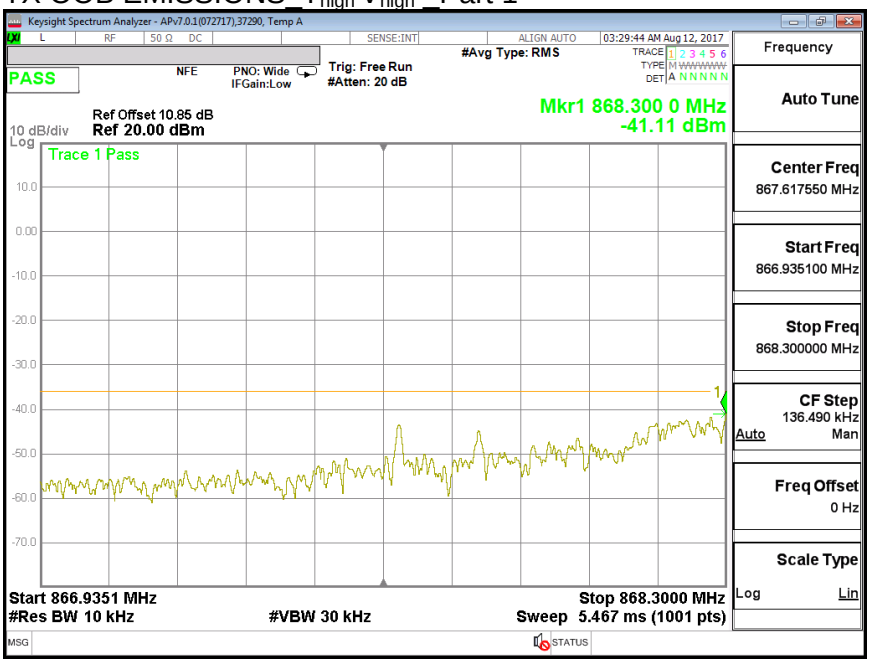
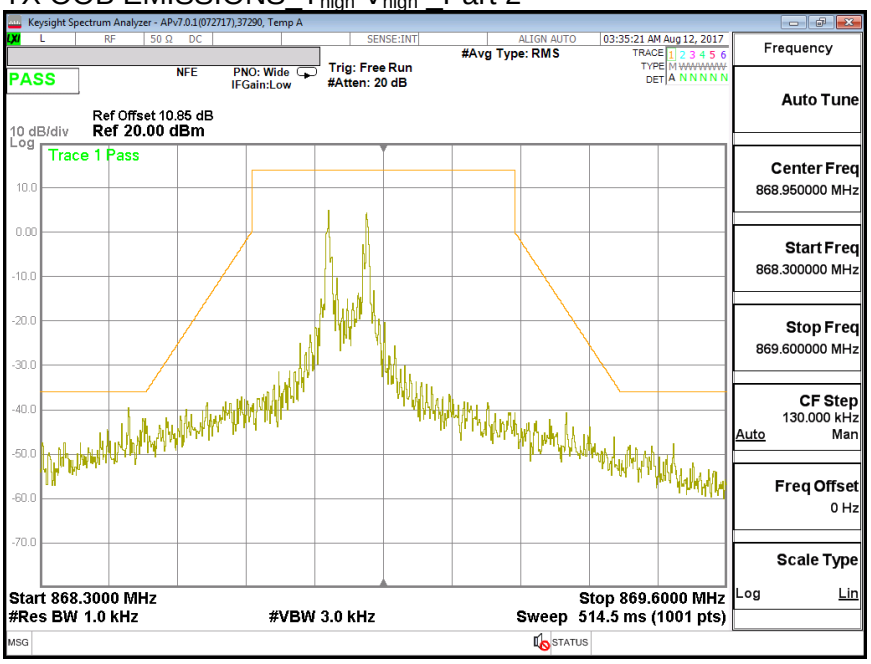
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



TX OOB EMISSIONS_T_{high} V_{high} _Part 2



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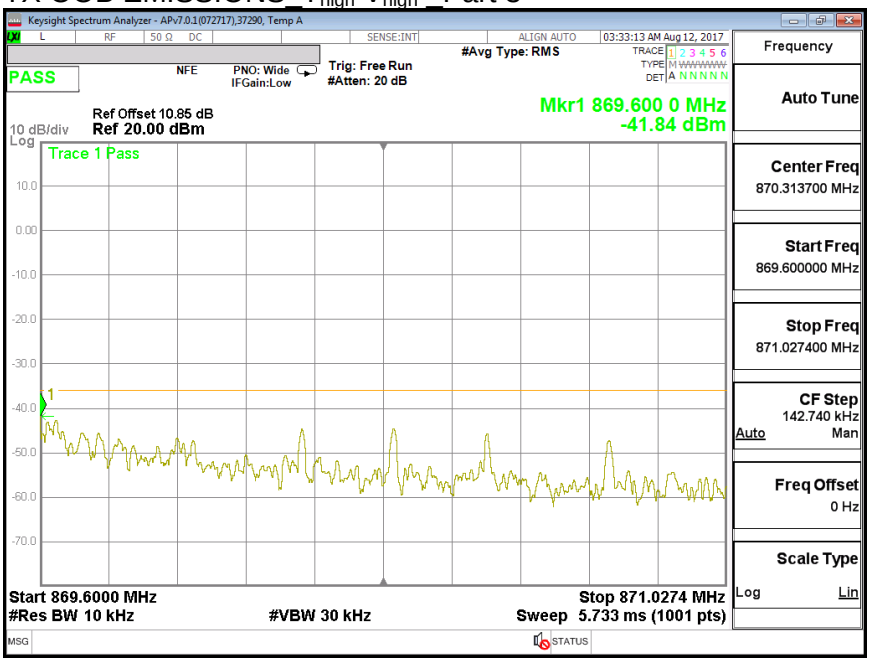
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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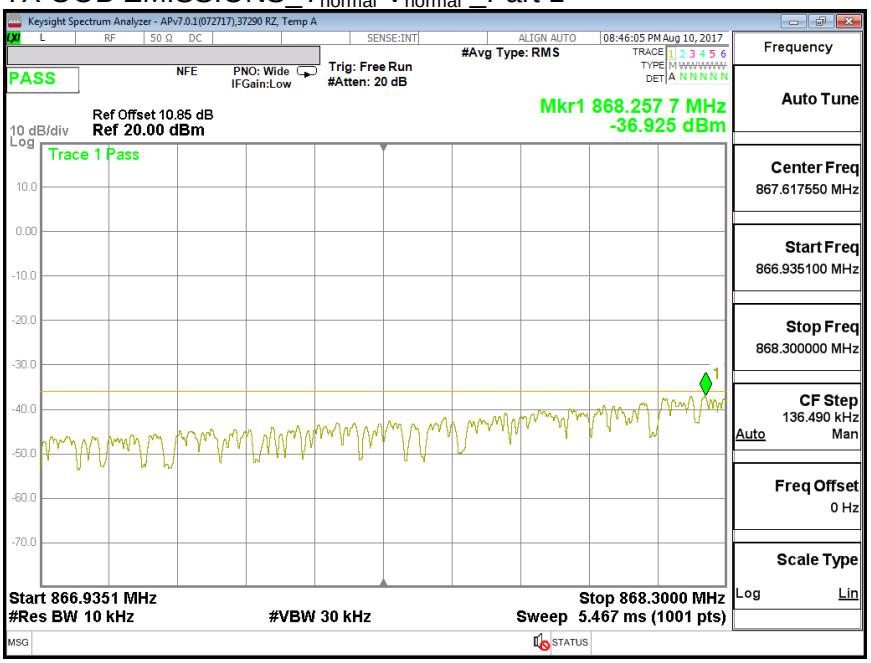
M5 HIGH CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 1



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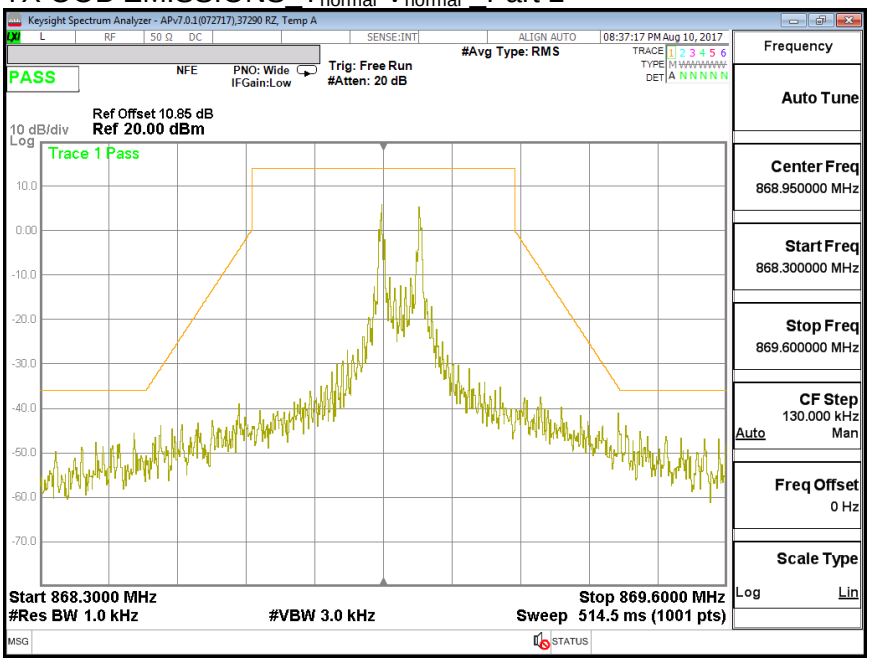

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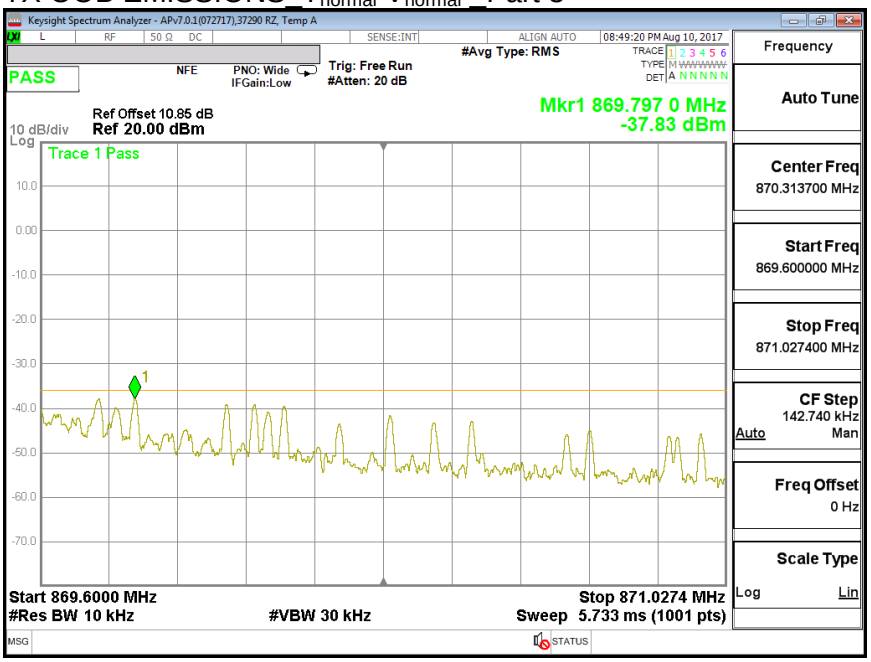
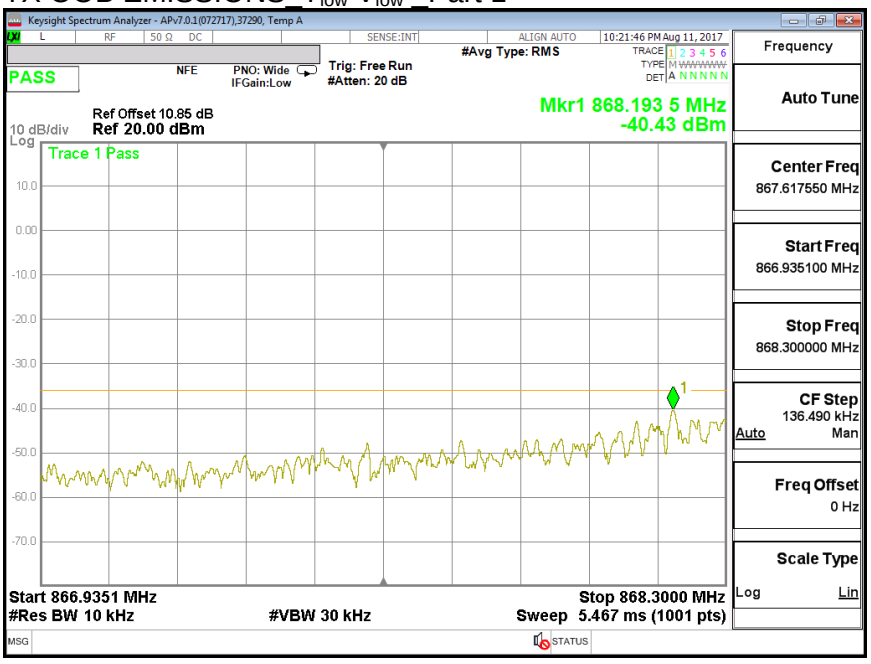
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3



TX OOB EMISSIONS_T_{low} V_{low} _Part 1



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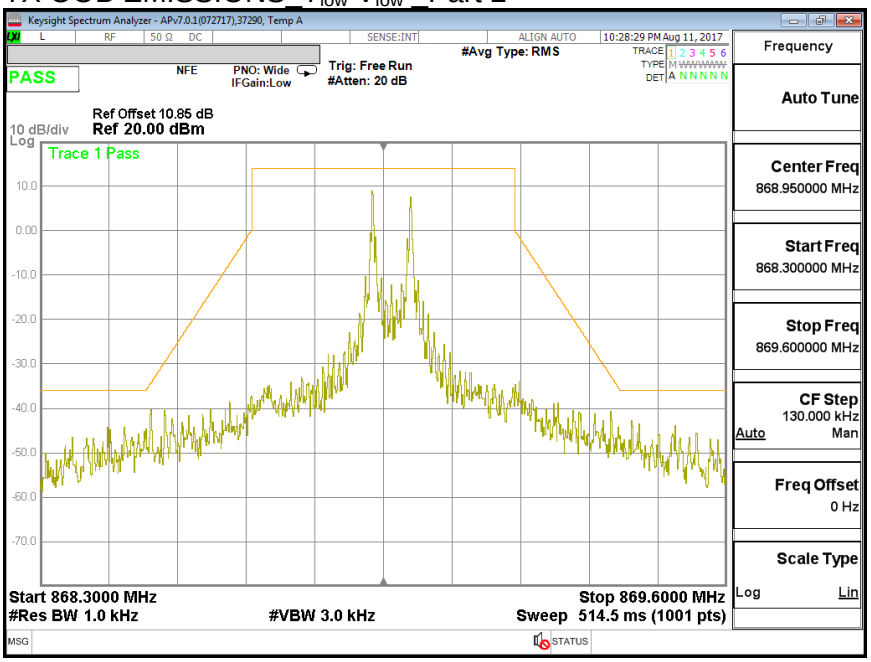
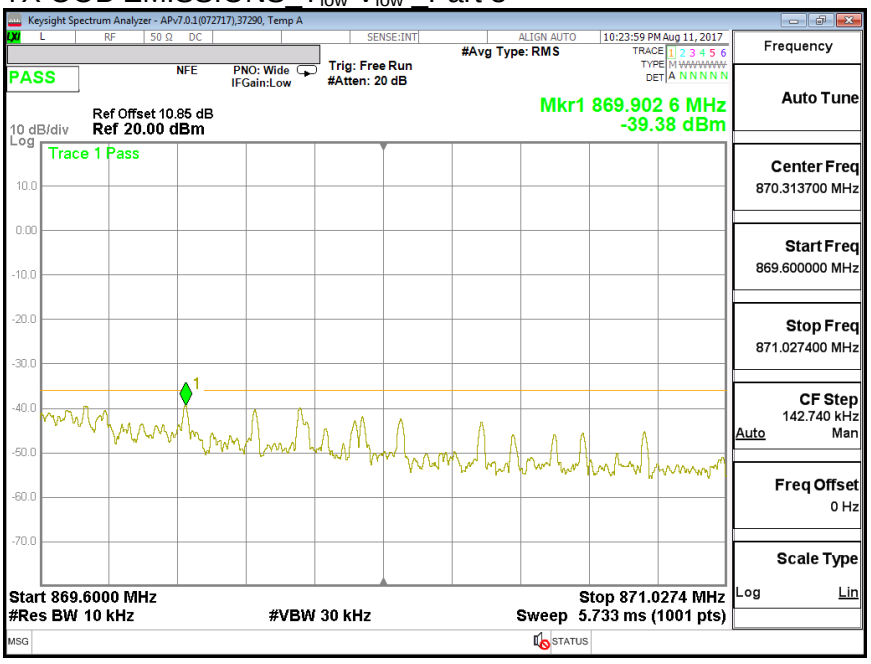
TX OOB EMISSIONS_T_{low} V_{low} _Part 2



TX OOB EMISSIONS_T_{low} V_{low} _Part 3



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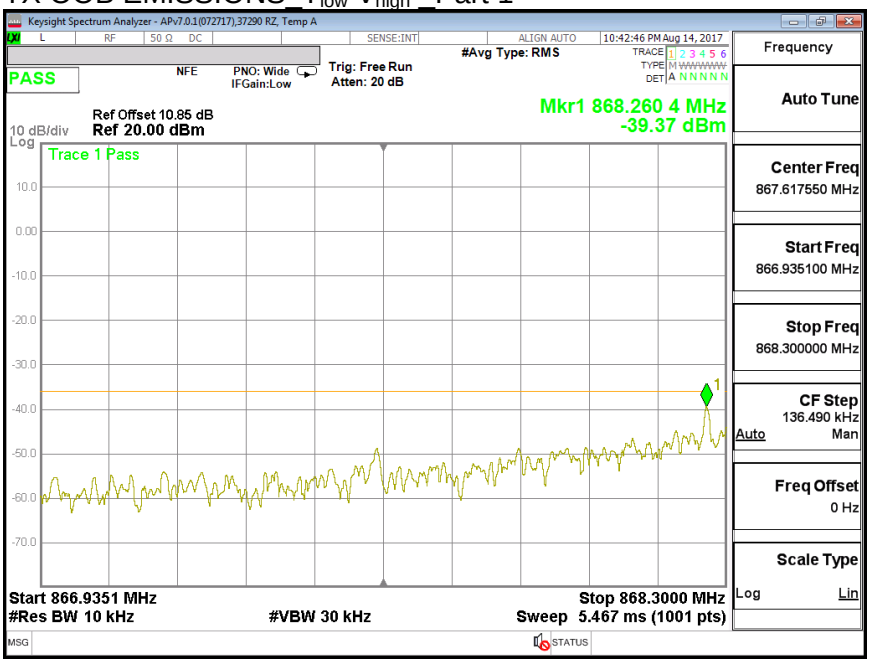
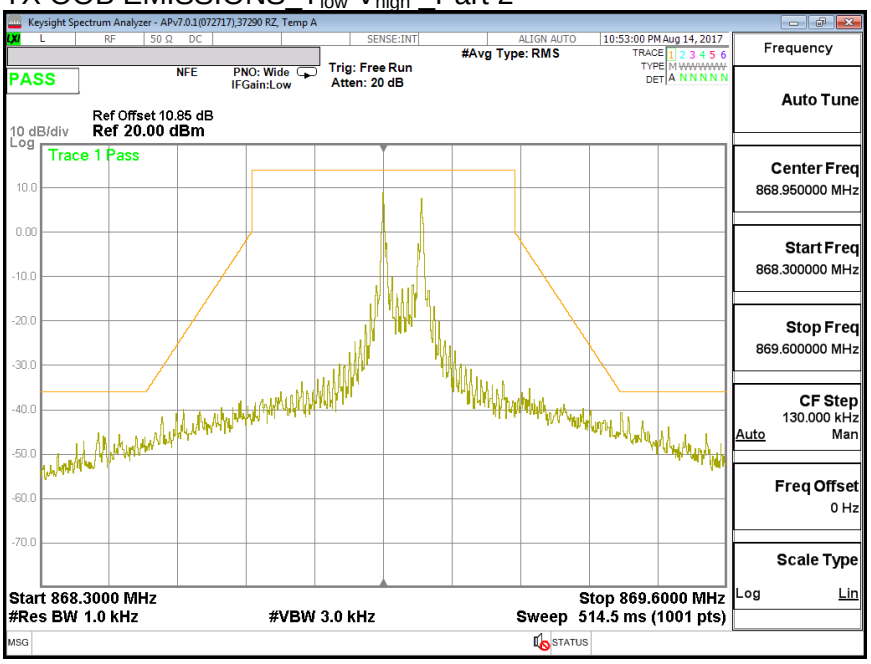
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



TX OOB EMISSIONS_T_{low} V_{high} _Part 2



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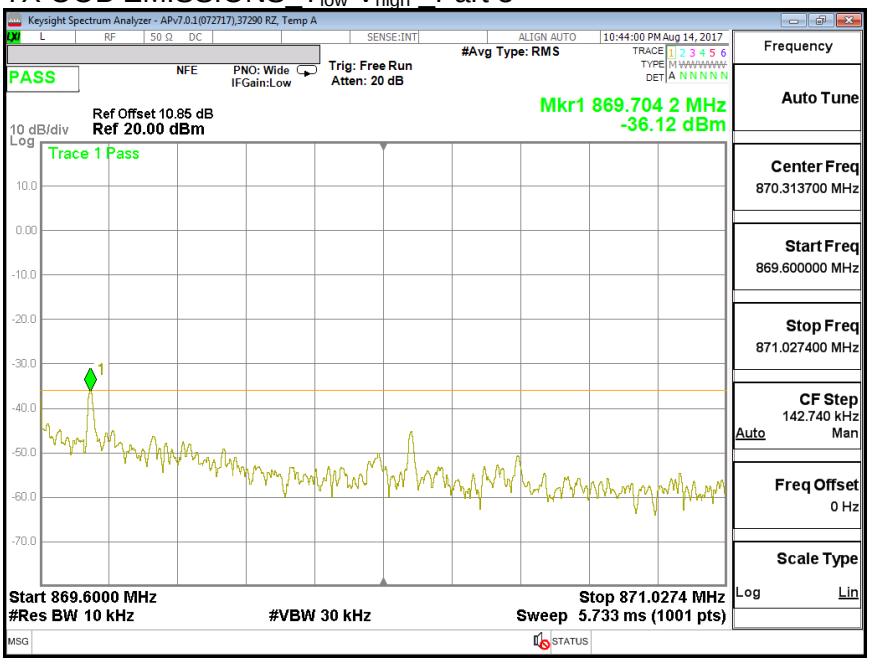
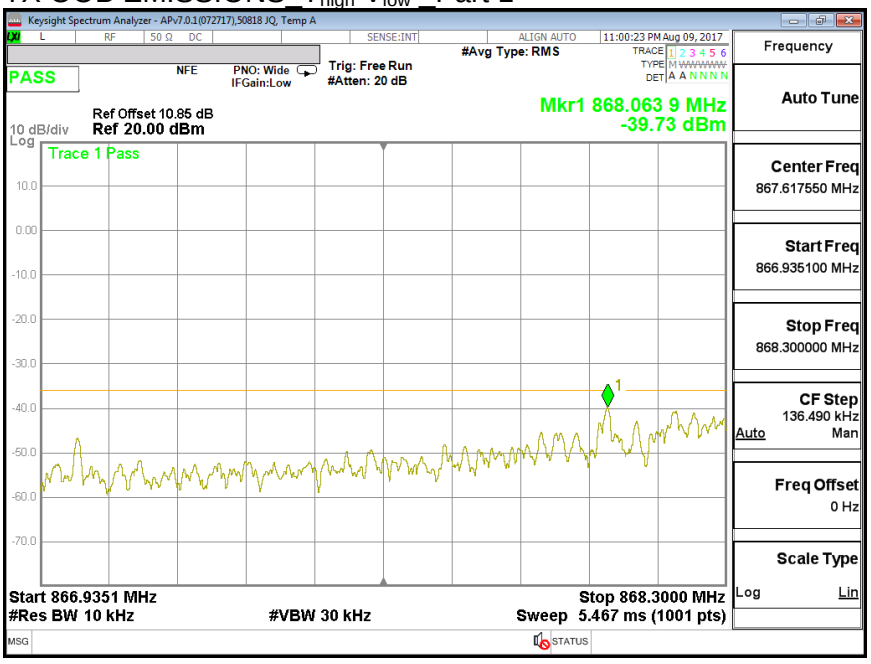
TX OOB EMISSIONS_T_{low} V_{high} _Part 3



TX OOB EMISSIONS_T_{high} V_{low} _Part 1



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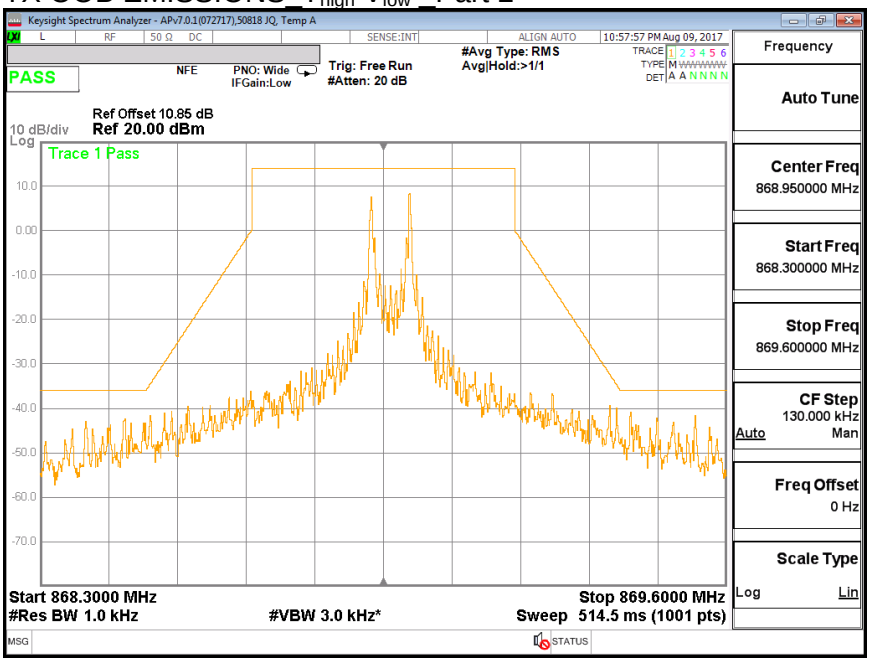
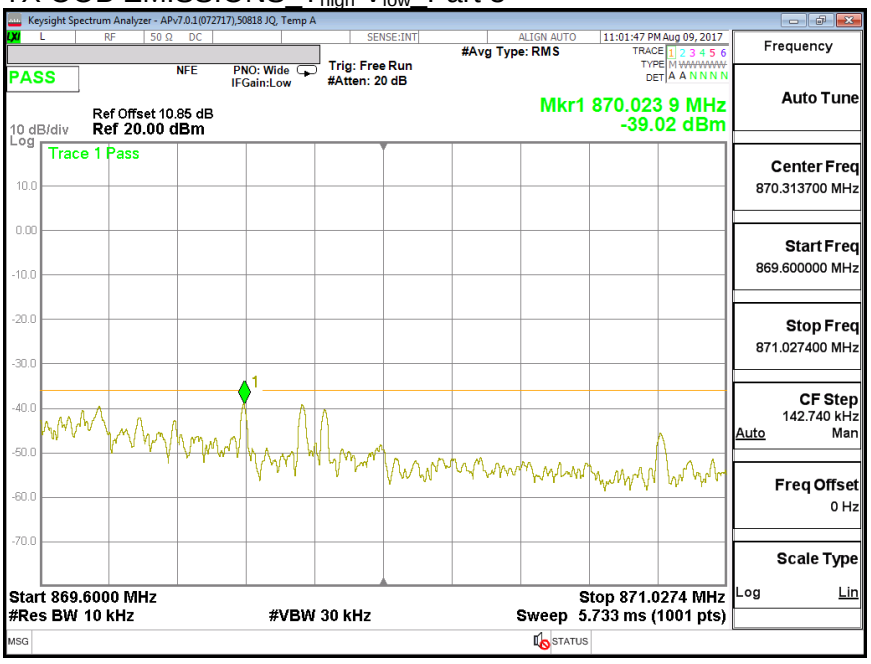
TX OOB EMISSIONS_T_{high} V_{low} _Part 2



TX OOB EMISSIONS_T_{high} V_{low}_Part 3



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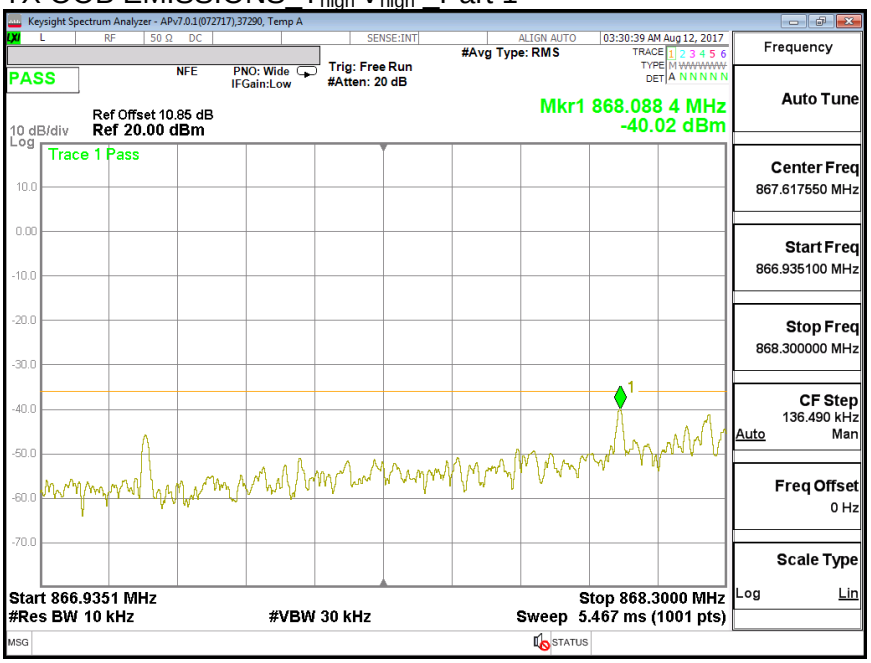
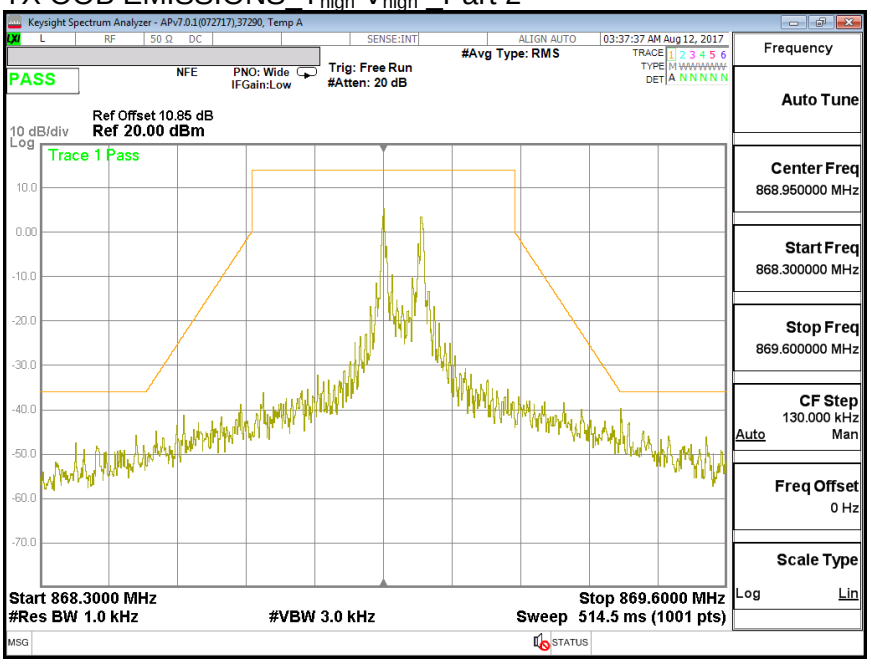
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



TX OOB EMISSIONS_T_{high} V_{high} _Part 2



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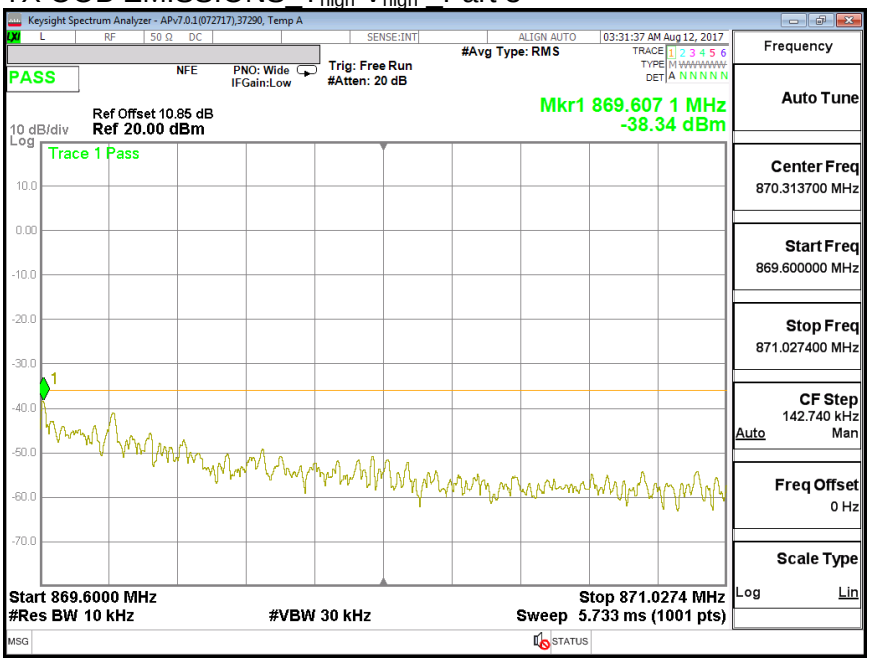
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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7.9.5. TX UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.2.2.2
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.1.1
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.2

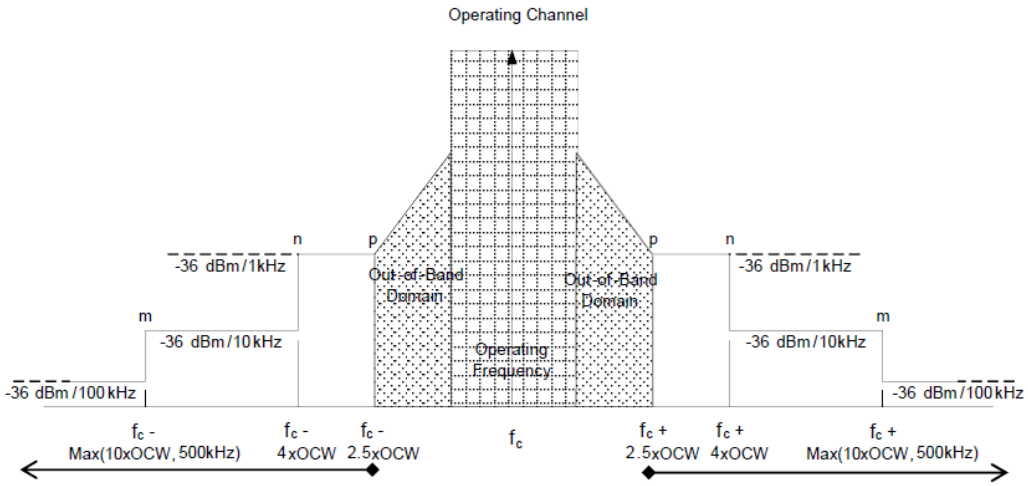

Figure 7: Spectrum Mask for Unwanted Emissions in the Spurious Domain with reference BW

Reference Limit:

The power of any unwanted emission in the spurious domain shall not exceed the values given in Table 19.

Table 19: Spurious domain emission limits

Frequency / State	47 MHz to 74 MHz 87,5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 790 MHz	Other frequencies below 1 000 MHz	Frequencies above 1 000 MHz
TX mode	-54 dBm	-36 dBm	-30 dBm
RX and all other modes	-57 dBm	-57 dBm	-47 dBm

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.3.3.1 (Conducted Measurement)
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.3.3.2 (Radiated Measurement)

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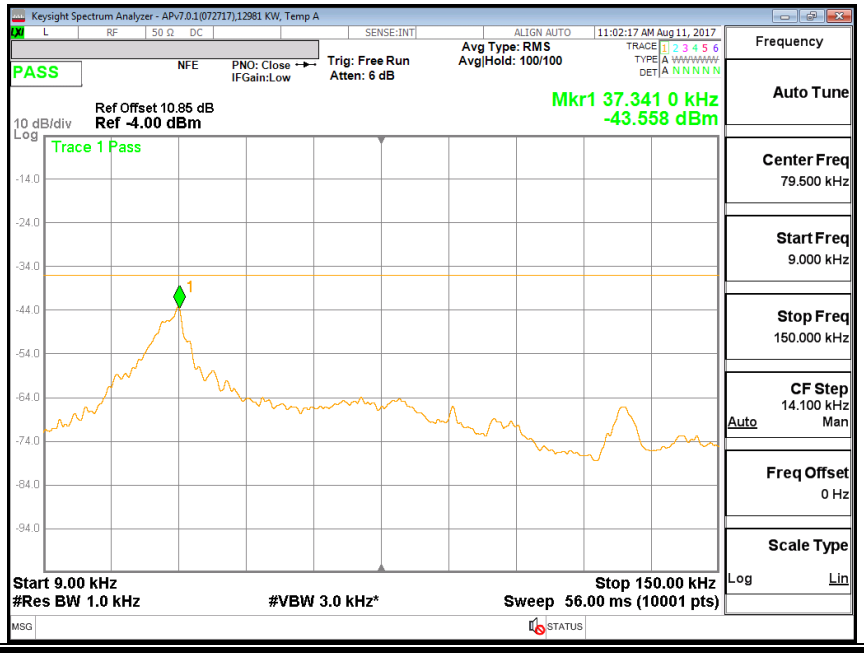
RESULTS

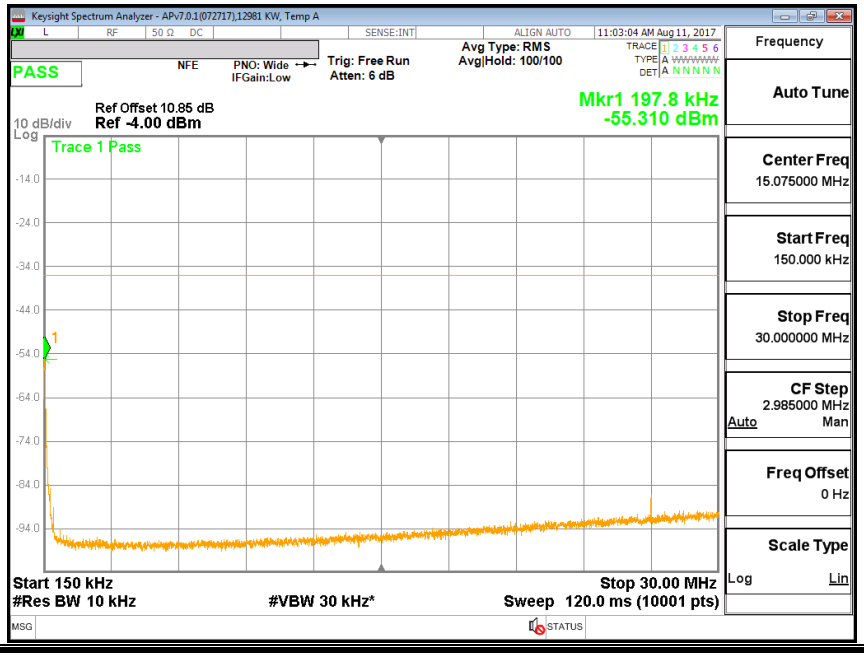
CONDUCTED SPURIOUS EMISSIONS

THE WORST CASE OF 2-FSK LOW CHANNEL

9kHz to 150kHz



150kHz to 30MHz



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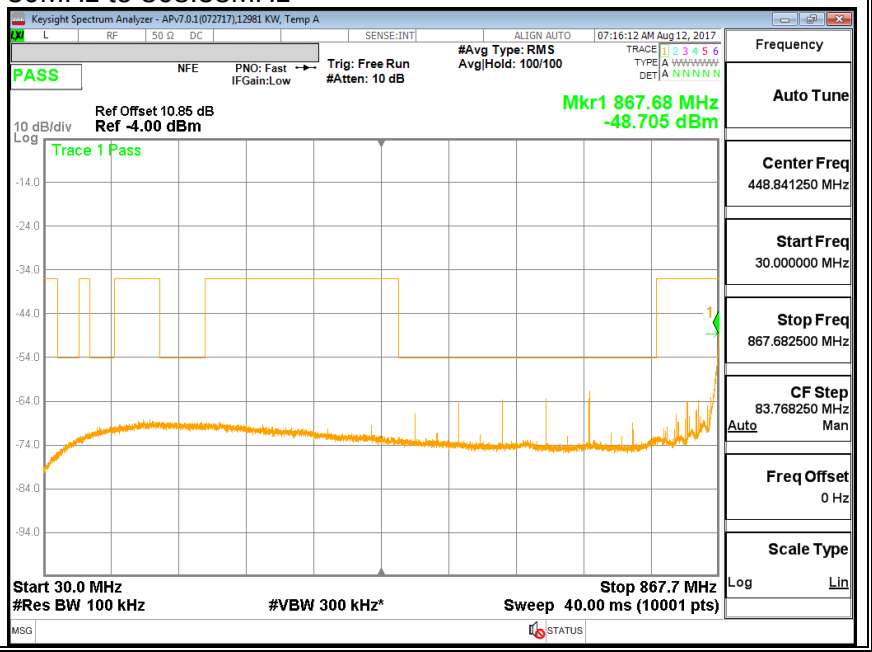
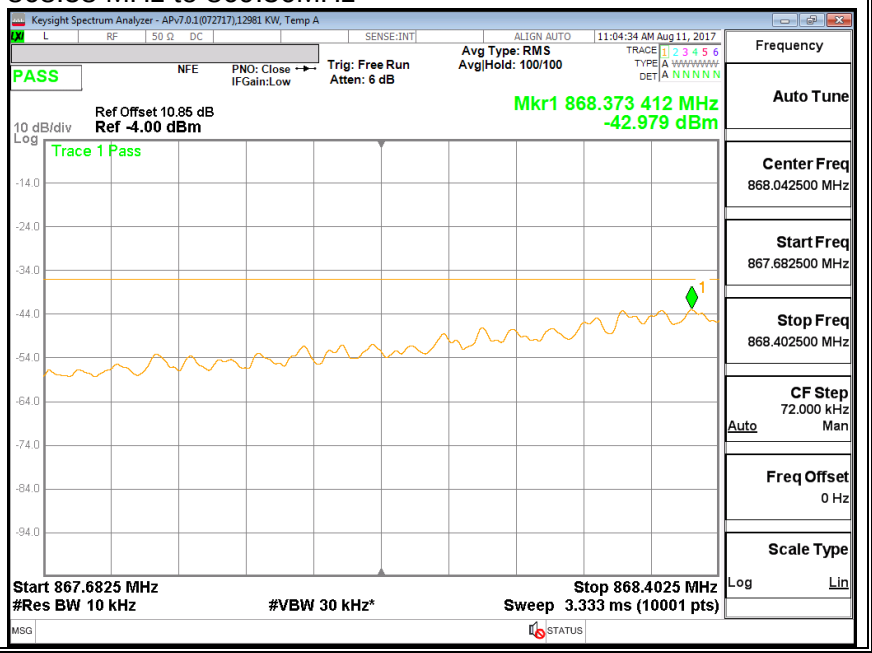
30MHz to 868.58MHz



868.58 MHz to 869.36MHz



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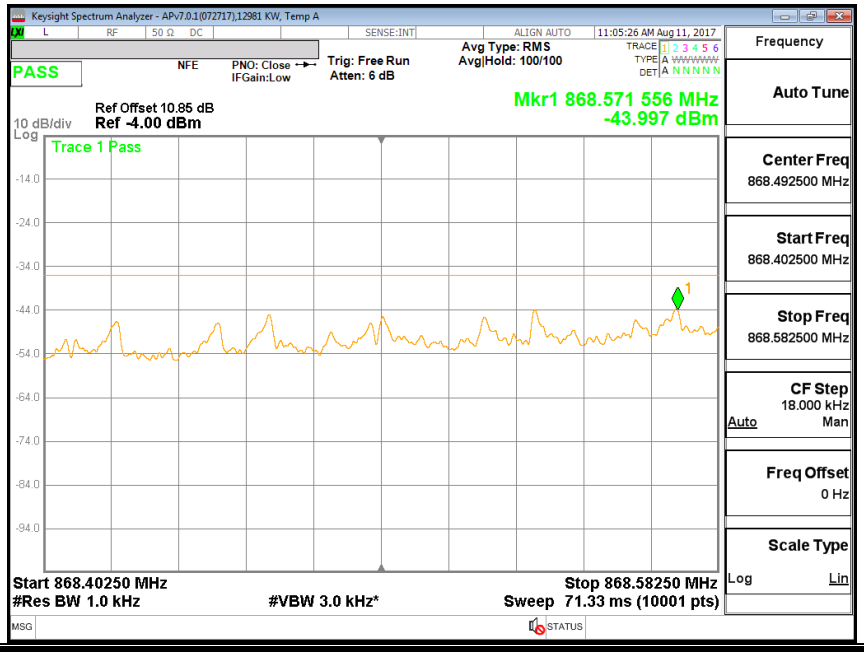
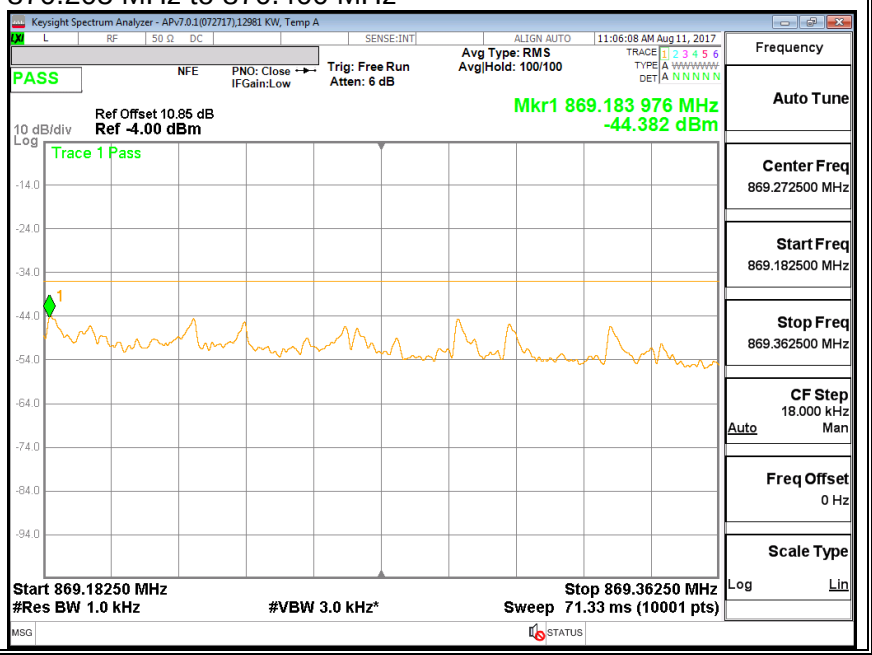
869.36 MHz to 869.555 MHz



870.205 MHz to 870.400 MHz



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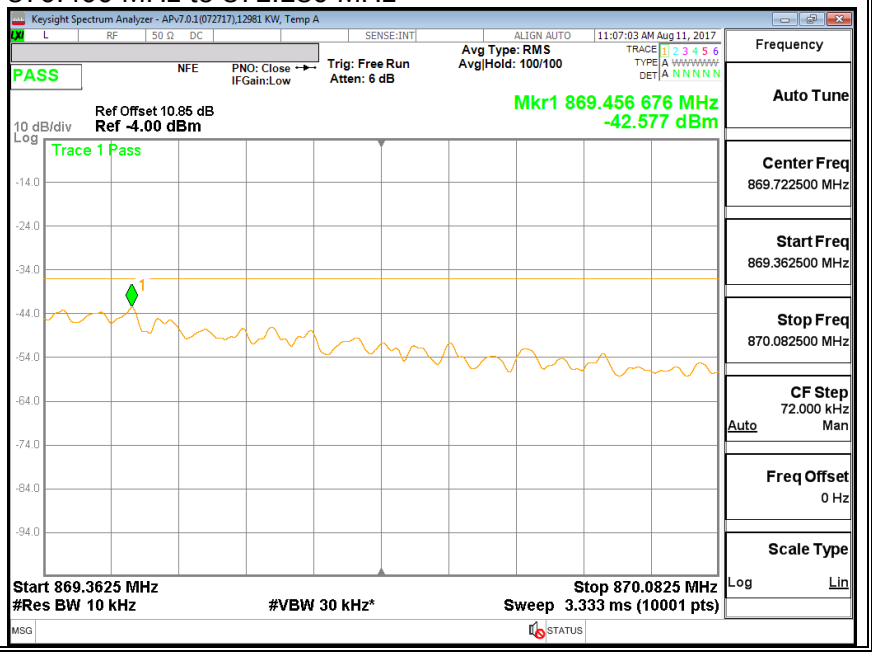
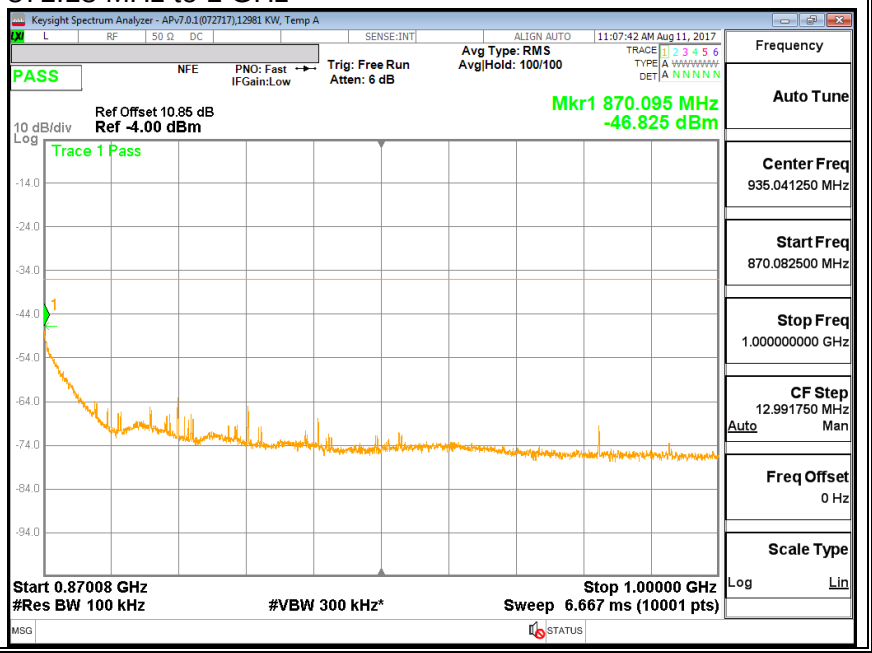
870.400 MHz to 871.180 MHz



871.18 MHz to 1 GHz



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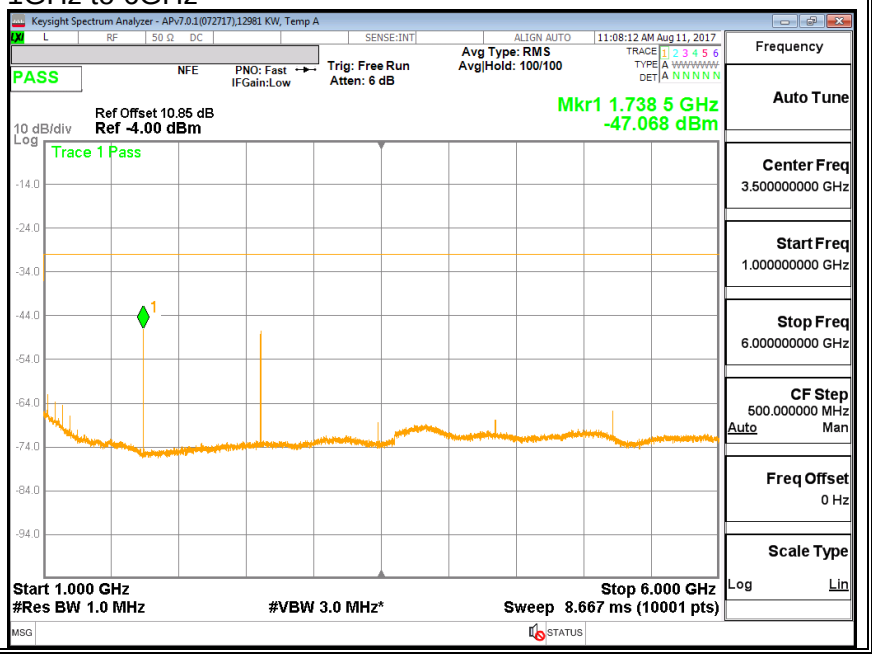
1GHz to 6GHz



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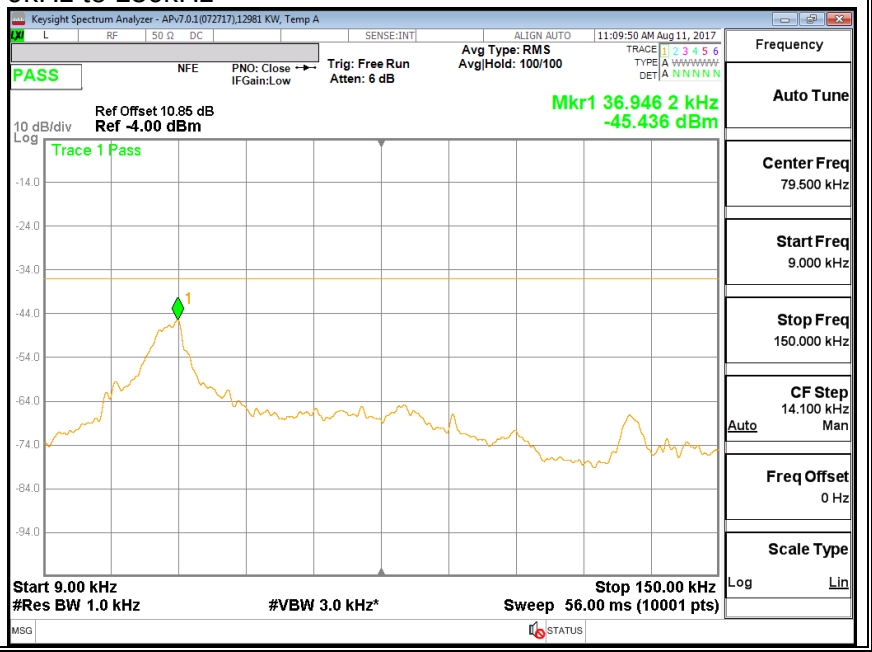
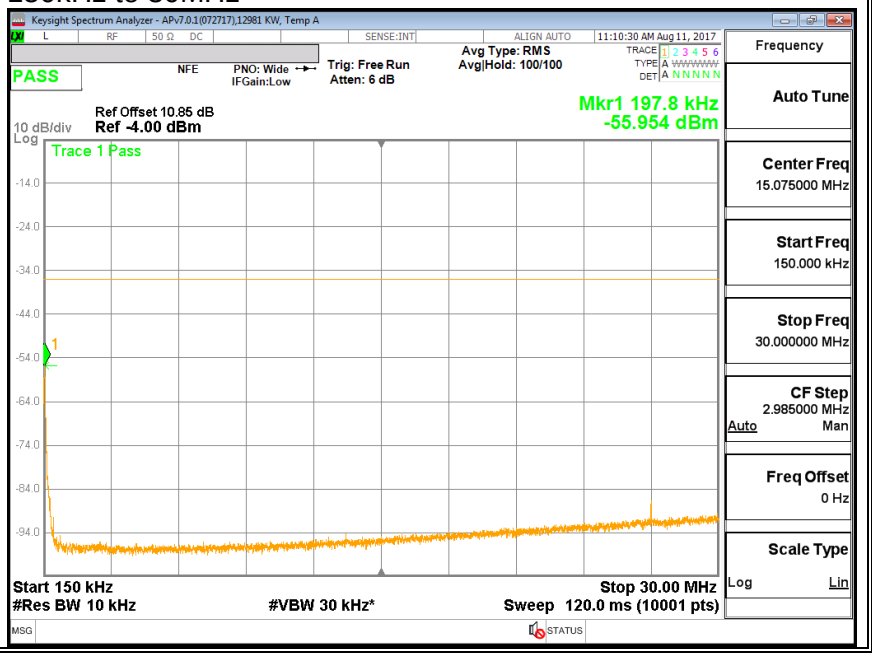
THE WORST CASE OF 2-FSK HIGH CHANNEL

9kHz to 150kHz



150kHz to 30MHz



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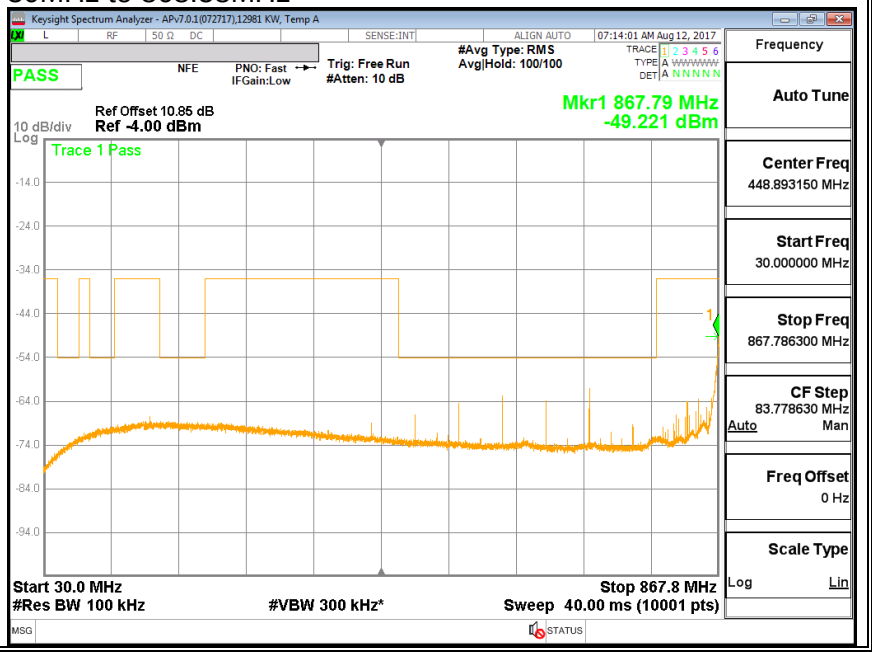
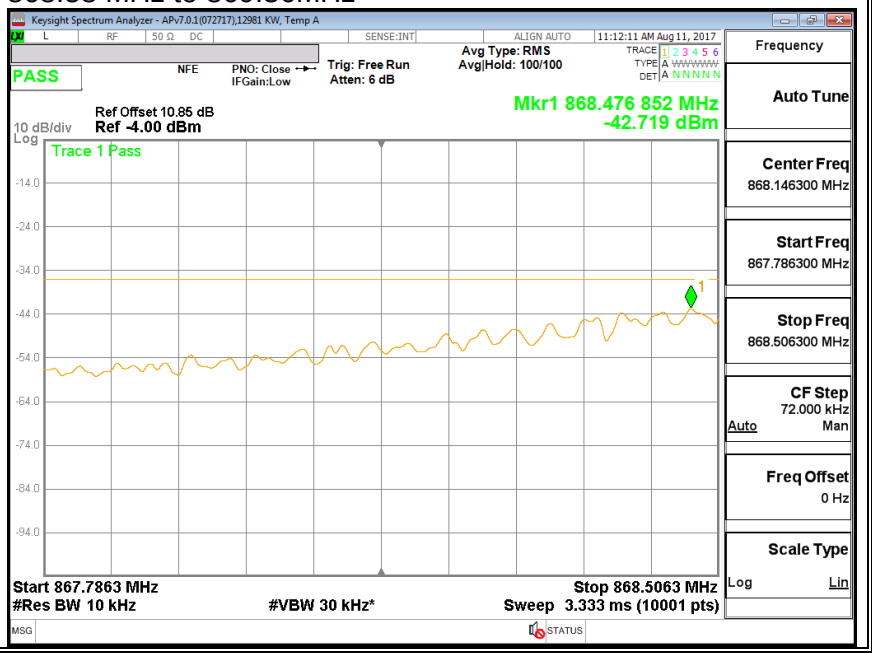
30MHz to 868.58MHz



868.58 MHz to 869.36MHz



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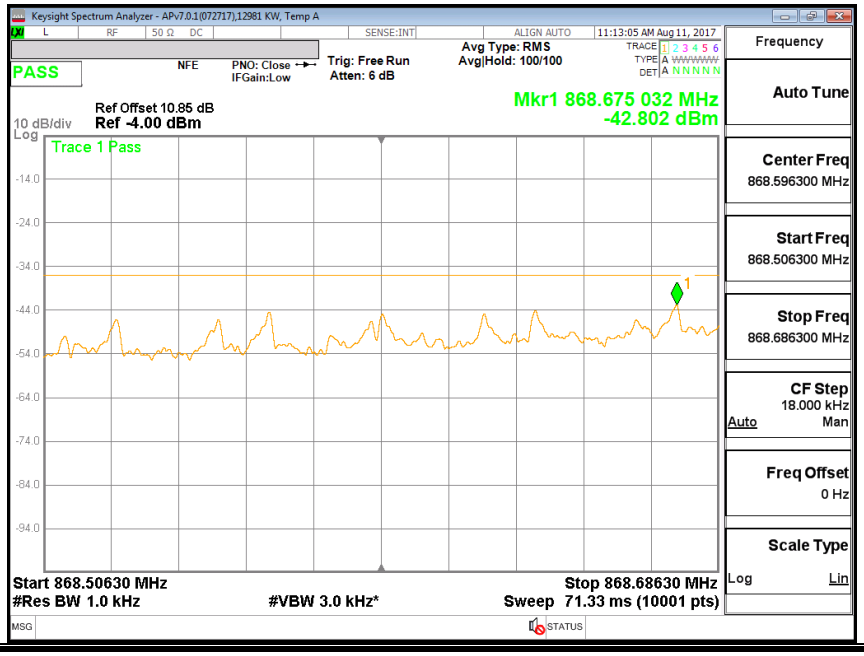
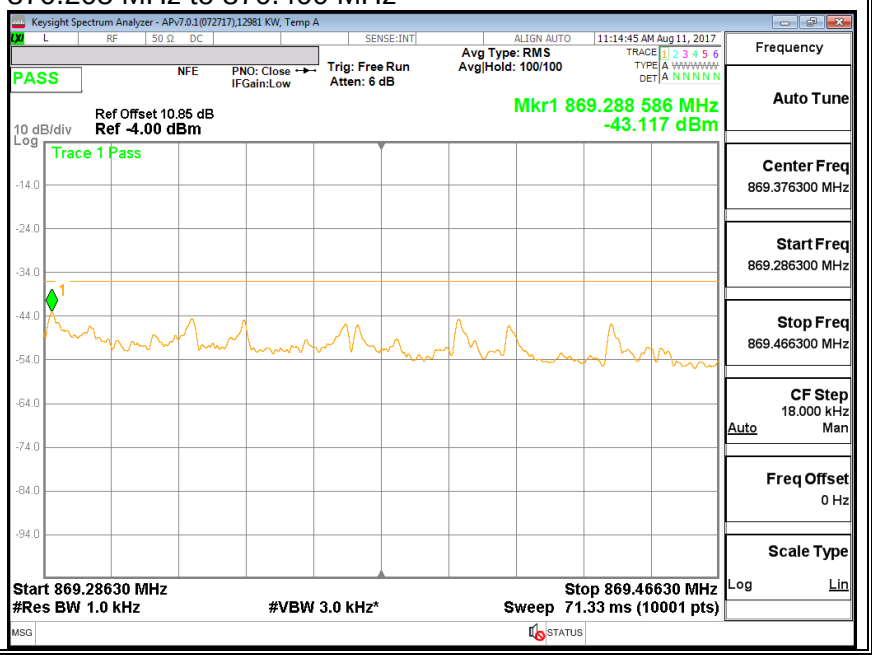
869.36 MHz to 869.555 MHz



870.205 MHz to 870.400 MHz



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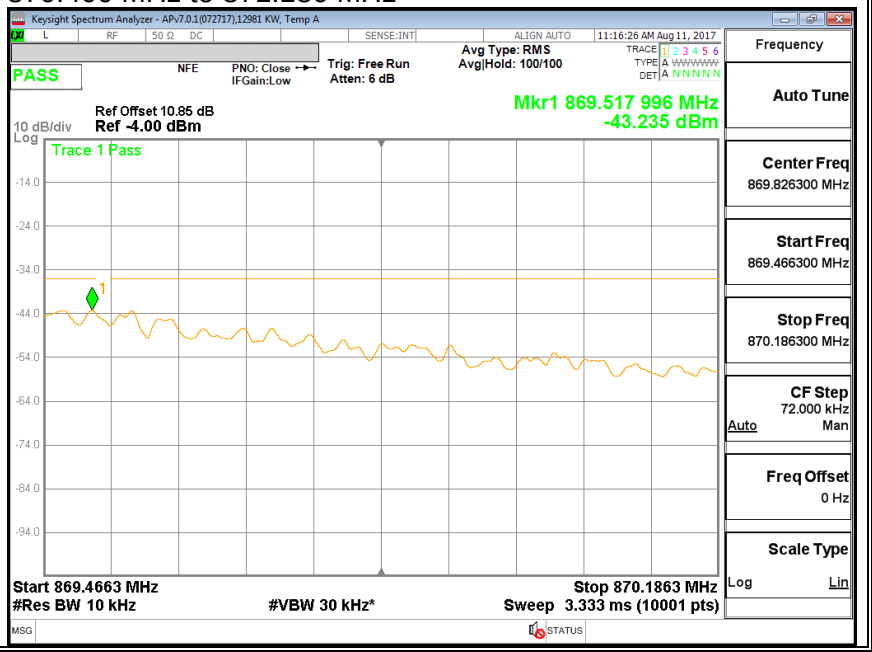
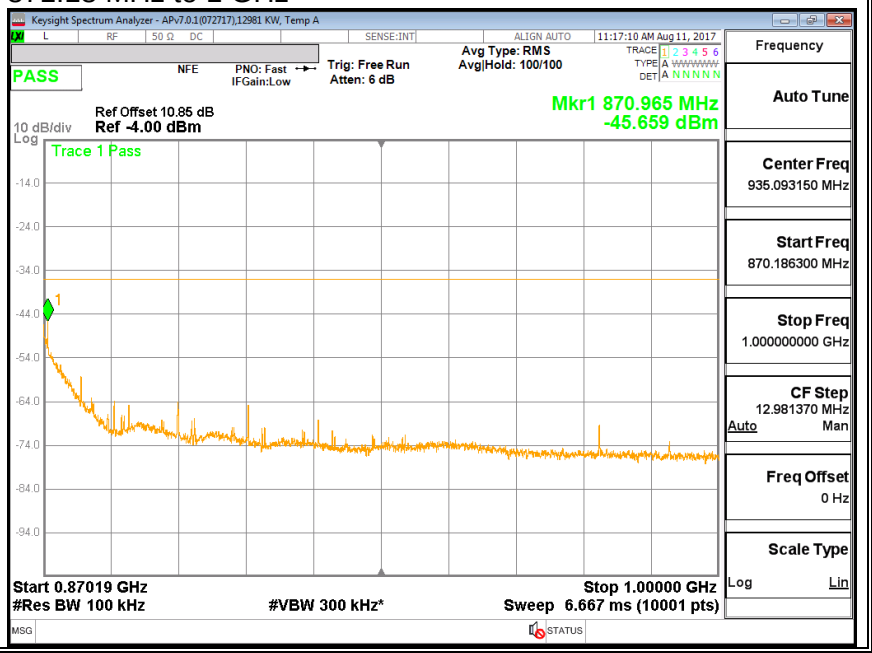
870.400 MHz to 871.180 MHz



871.18 MHz to 1 GHz



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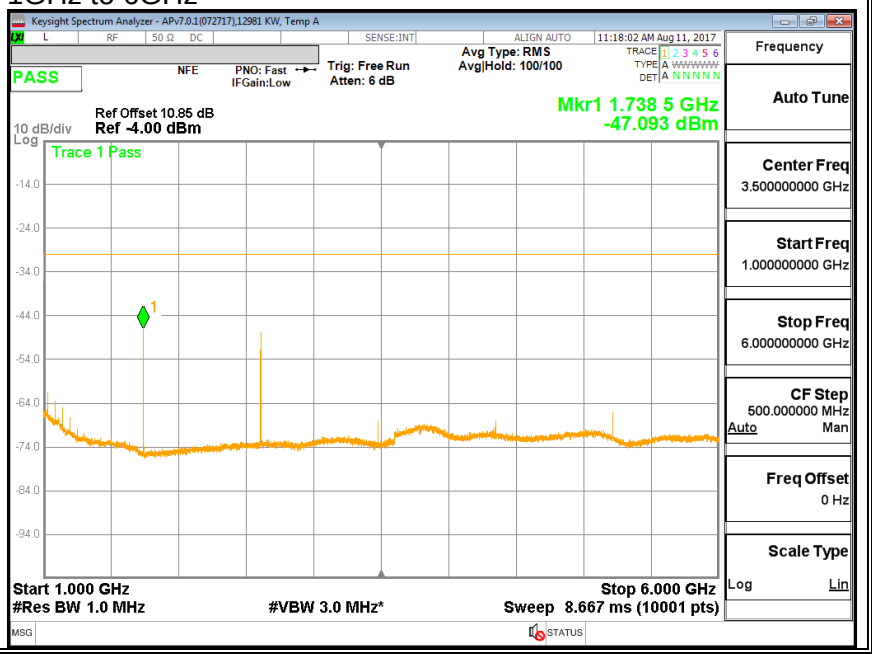
1GHz to 6GHz



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RADIATED SPURIOUS EMISSIONS

3m Radiated Emissions Chamber
30 - 1000MHz Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/13/2017
Test Engineer: 50818
Configuration: EUT with 50Ohm load and a support laptop
Mode: TX Below 1GHz 2FSK N band worst case

Chamber	Pre-amplifer	Attenuator	Limit
3m Chamber B	3m-B T10		ETSI 300 220 Tx

Frequency (MHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Attenuator (dB)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel										
433.12	-71.8	H	3.0	25.0	28.8		-75.6	-36.0	-39.6	
701.32	-71.1	H	3.0	29.0	28.6		-70.8	-54.0	-16.8	
801.39	-69.6	H	3.0	30.2	28.4		-67.8	-54.0	-13.8	
432.22	-71.2	V	3.0	26.6	28.8		-73.4	-36.0	-37.4	
767.88	-71.9	V	3.0	31.9	28.4		-68.4	-54.0	-14.4	
798.51	-73.1	V	3.0	32.5	28.4		-69.0	-54.0	-15.0	
High Channel										
432.16	-70.8	H	3.0	24.9	28.8		-74.6	-36.0	-38.6	
660.12	-72.4	H	3.0	28.7	28.9		-72.6	-54.0	-18.6	
799.33	-71.9	H	3.0	30.1	28.4		-70.1	-54.0	-16.1	
432.22	-70.2	V	3.0	26.6	28.8		-72.4	-36.0	-36.4	
767.59	-71.2	V	3.0	31.9	28.4		-67.7	-54.0	-13.7	
818.42	-71.3	V	3.0	33.0	28.2		-66.5	-54.0	-12.5	

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3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/13/2017
Test Engineer: 50818
Configuration: EUT with 50Ohm load and a support laptop
Mode: TX Above 1GHz N band 2FSK worst case

Chamber	Pre-amplifer	Filter	Limit
3m Chamber B	3m Chamber B	Filter	ETSI 300 220 Tx

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss @ SG End (dBm)	Preamp (dB)	Attenuator (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel										
1.611	-62.13	H	3.0	-17.3	38.7	1.0	-54.9	-30.0	-24.9	
2.394	-58.92	H	3.0	-9.4	38.6	1.0	-47.1	-30.0	-17.1	
5.212	-57.43	H	3.0	-2.7	38.7	1.0	-40.5	-30.0	-10.5	
1.196	-56.38	V	3.0	-14.2	38.5	1.0	-51.7	-30.0	-21.7	
1.611	-59.23	V	3.0	-14.4	38.7	1.0	-52.0	-30.0	-22.0	
1.989	-60.22	V	3.0	-11.8	38.0	1.0	-48.8	-30.0	-18.8	
High Channel										
1.609	-60.37	H	3.0	-15.5	38.7	1.0	-53.2	-30.0	-23.2	
2.392	-61.28	H	3.0	-11.8	38.6	1.0	-49.5	-30.0	-19.5	
5.210	-57.42	H	3.0	-2.7	38.7	1.0	-40.5	-30.0	-10.5	
1.198	-57.74	V	3.0	-15.5	38.5	1.0	-53.0	-30.0	-23.0	
1.611	-61.04	V	3.0	-16.2	38.7	1.0	-53.8	-30.0	-23.8	
1.997	-60.94	V	3.0	-12.5	38.0	1.0	-49.5	-30.0	-19.5	

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7.9.6. TX TRANSIENT POWER

REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.10.2

The TX TRANSIENT POWER shall not exceed the values given in Table 23.

Table 23: Transmitter Transient Power limits

Absolute offset from centre frequency	RBW_{REF}	Peak power limit applicable at measurement points
≤ 400 kHz	1 kHz	0 dBm
> 400 kHz	1 kHz	-27 dBm

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.10.3.2

RESULTS

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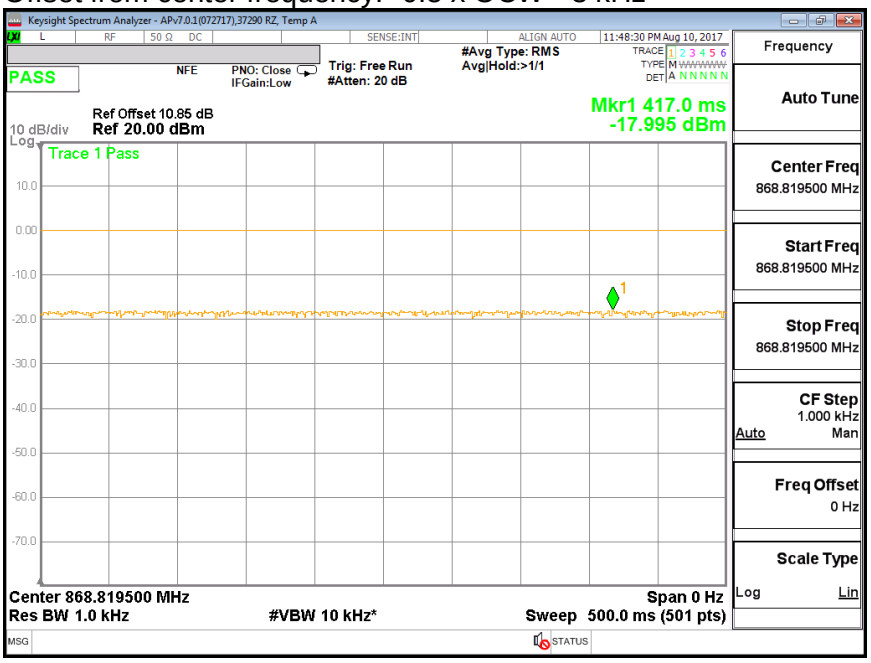
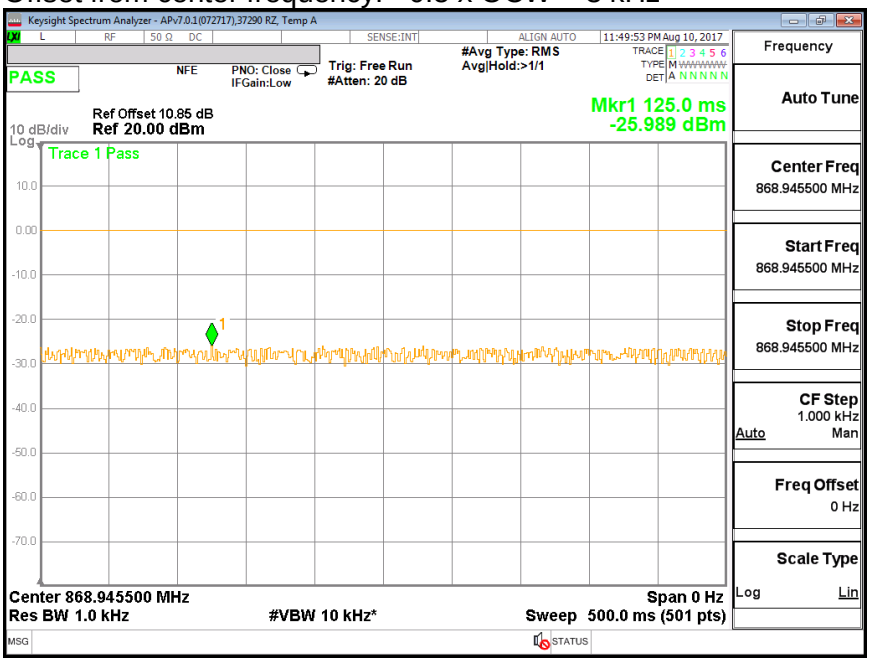
THE WORST CASE OF 2-FSK LOW CHANNEL

TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 3 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 3 kHz



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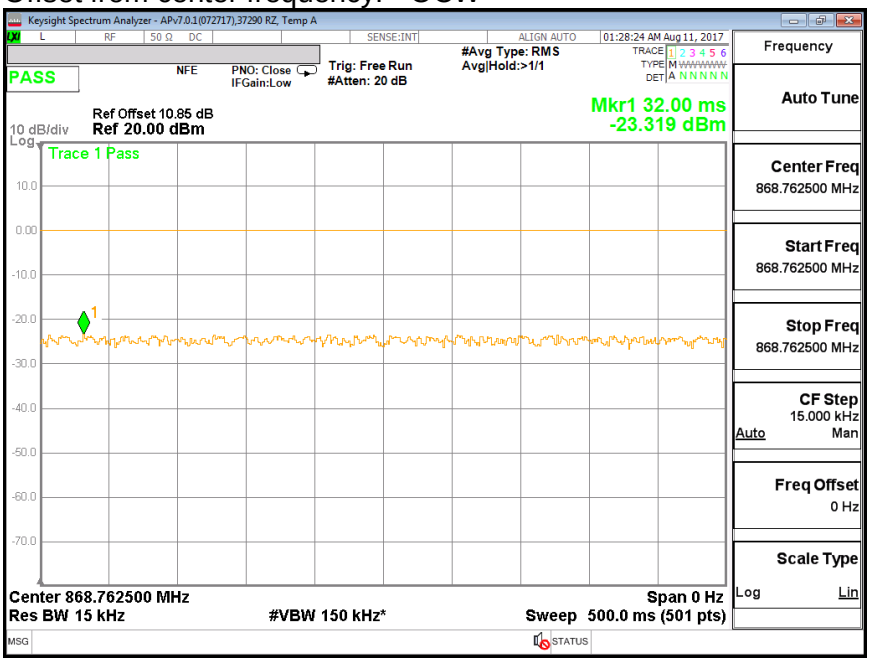
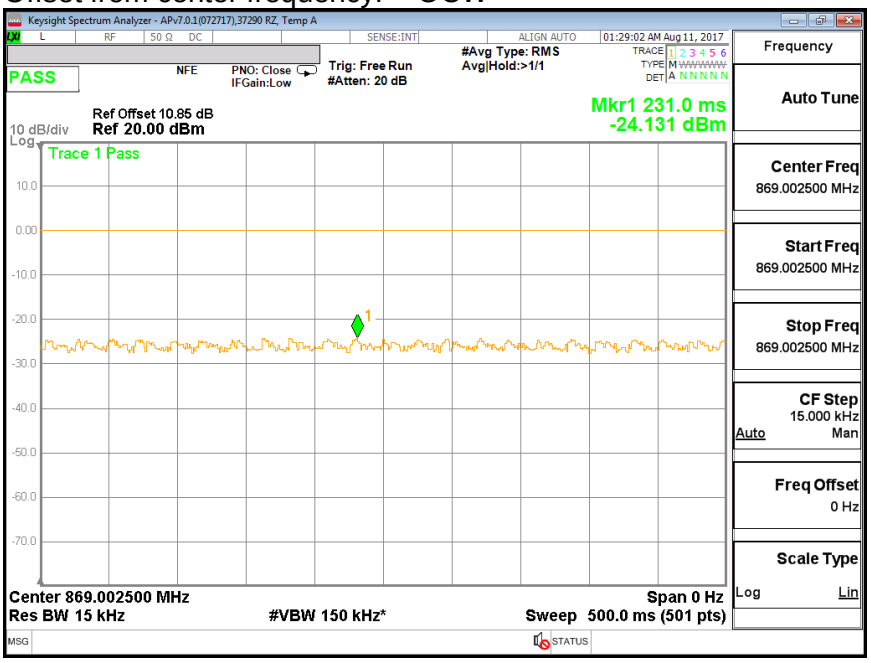
TX TRANSIENT
Offset from center frequency: - OCW



TX TRANSIENT
Offset from center frequency: + OCW



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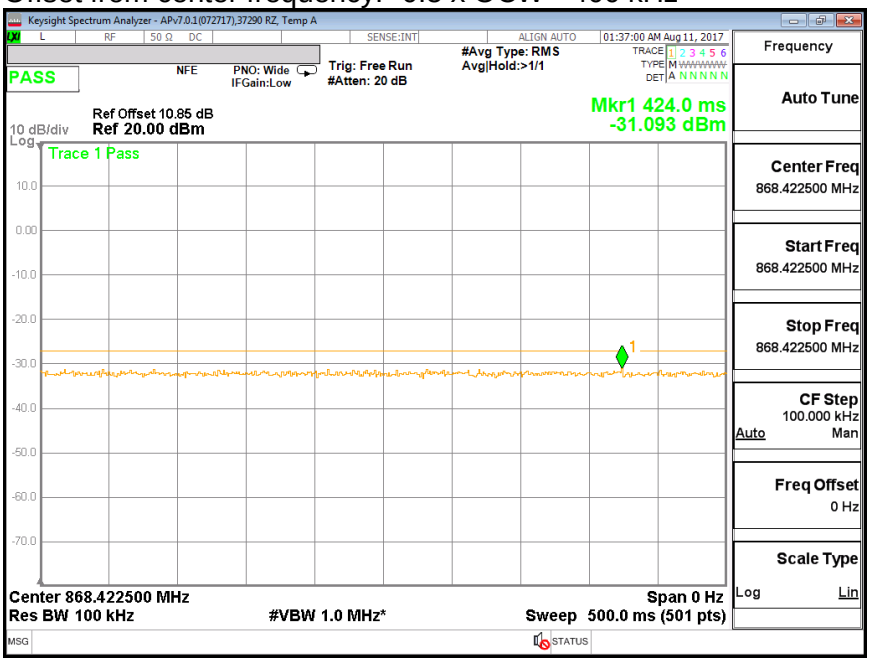
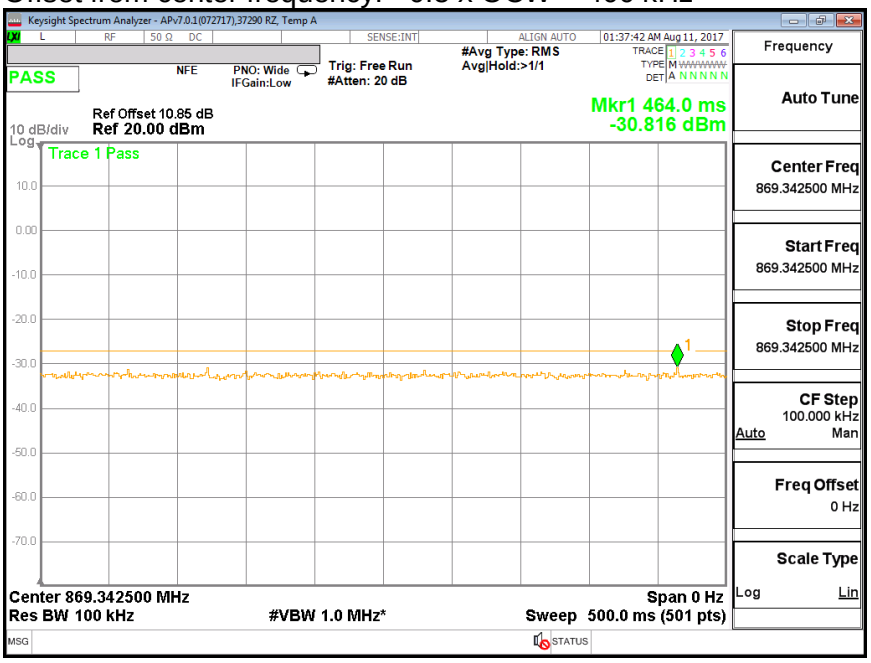
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 400 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 400 kHz



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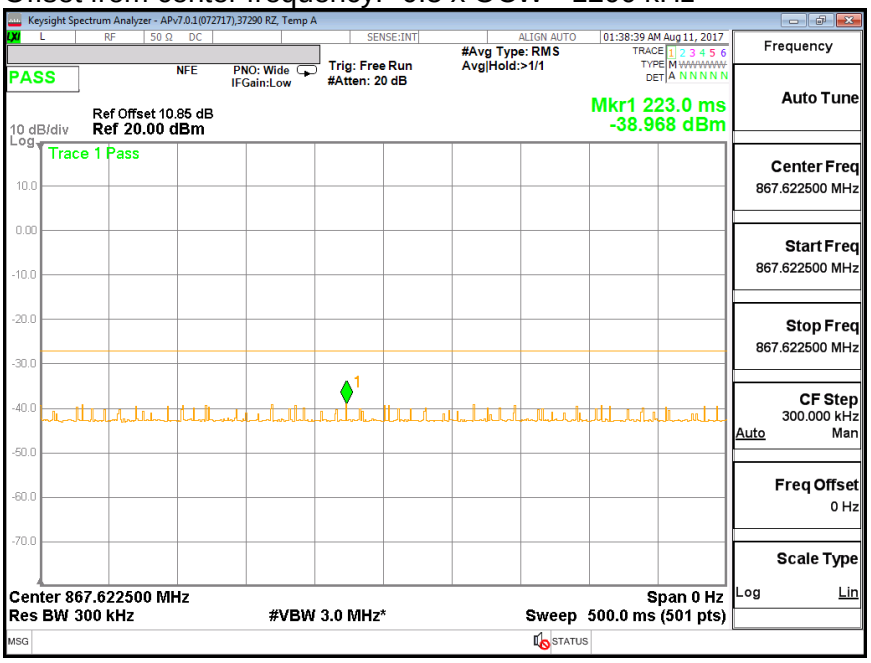
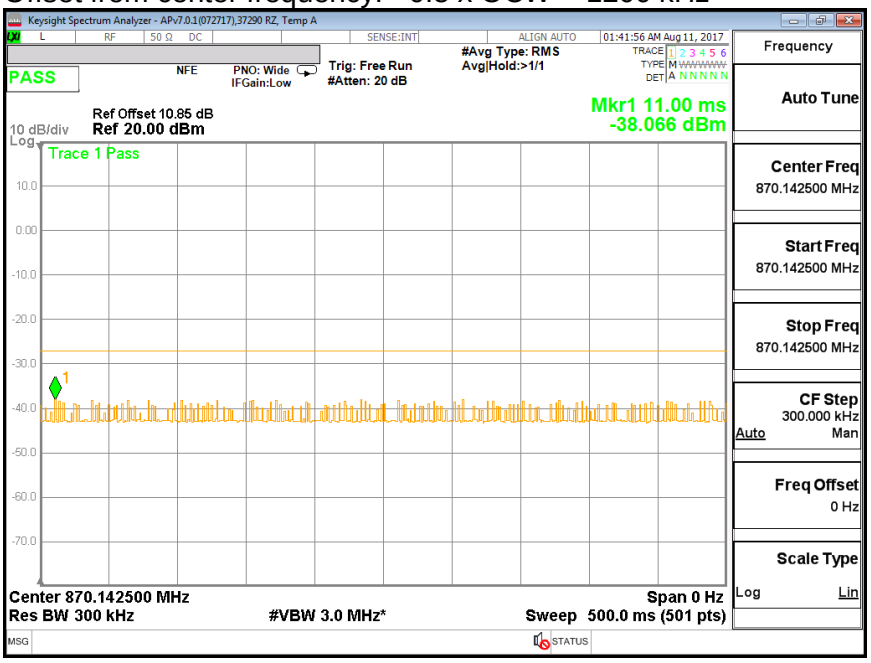
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 1200 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 1200 kHz



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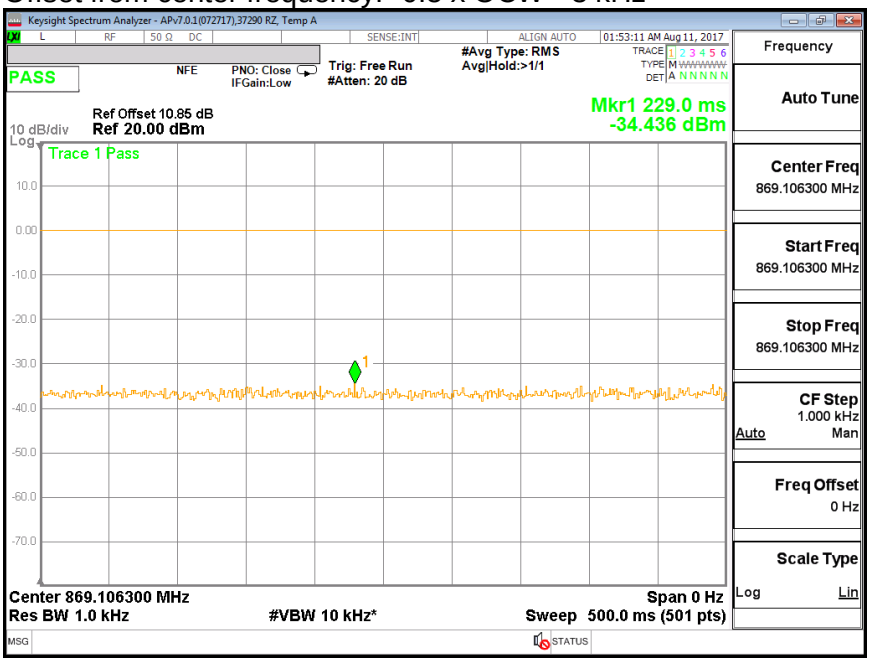
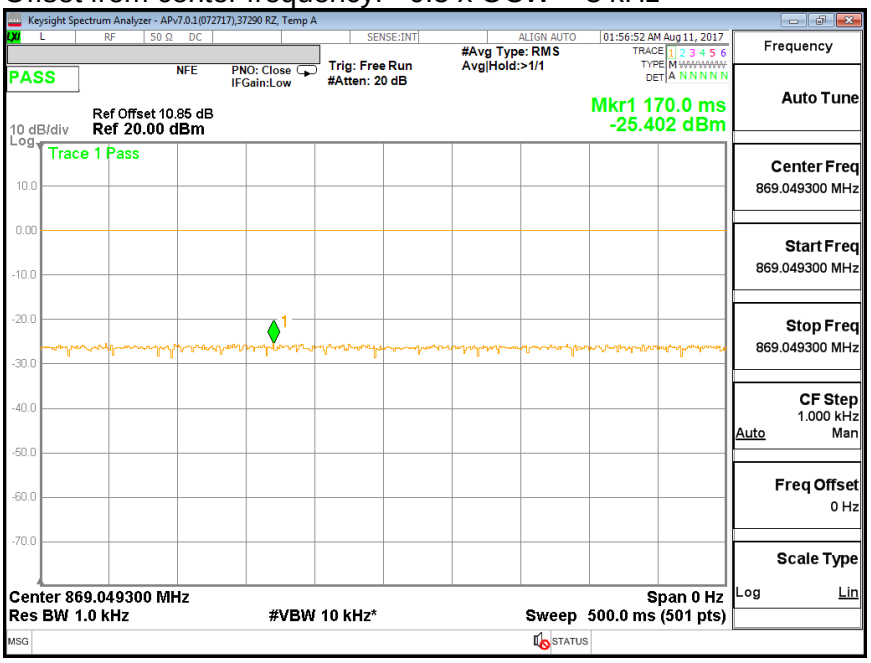
THE WORST CASE OF 2-FSK HIGH CHANNEL

TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 3 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 3 kHz



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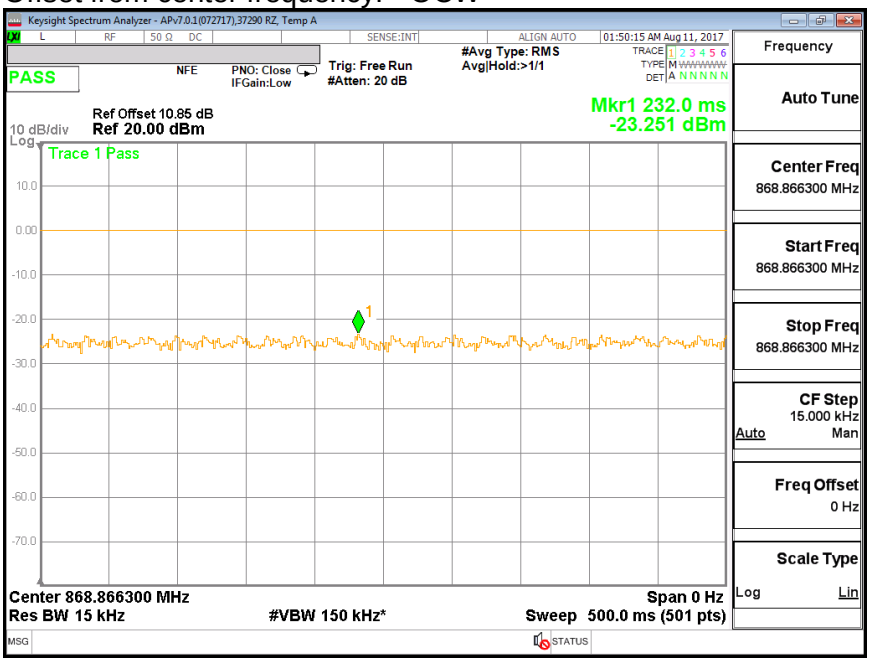
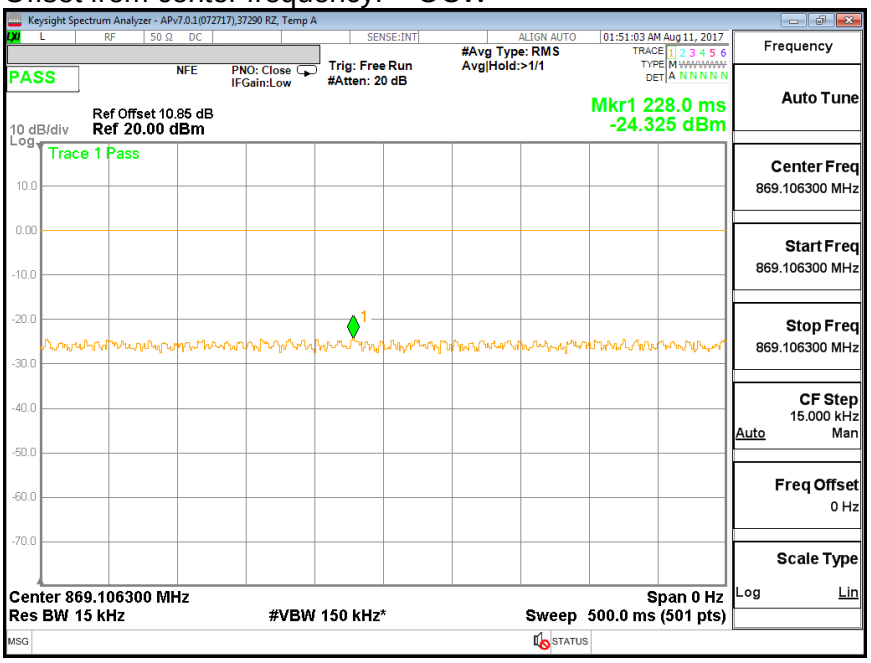
TX TRANSIENT
Offset from center frequency: - OCW



TX TRANSIENT
Offset from center frequency: + OCW



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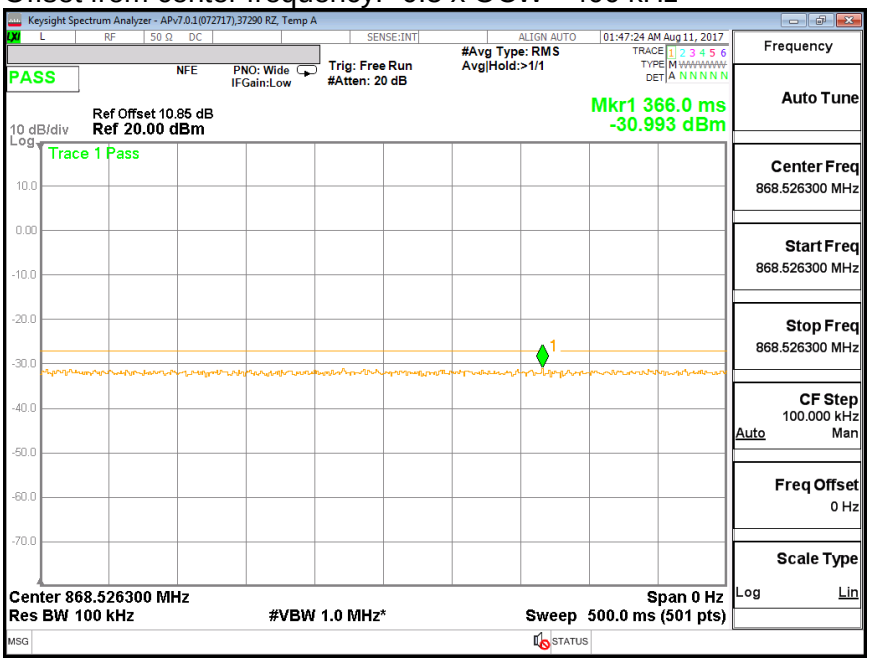
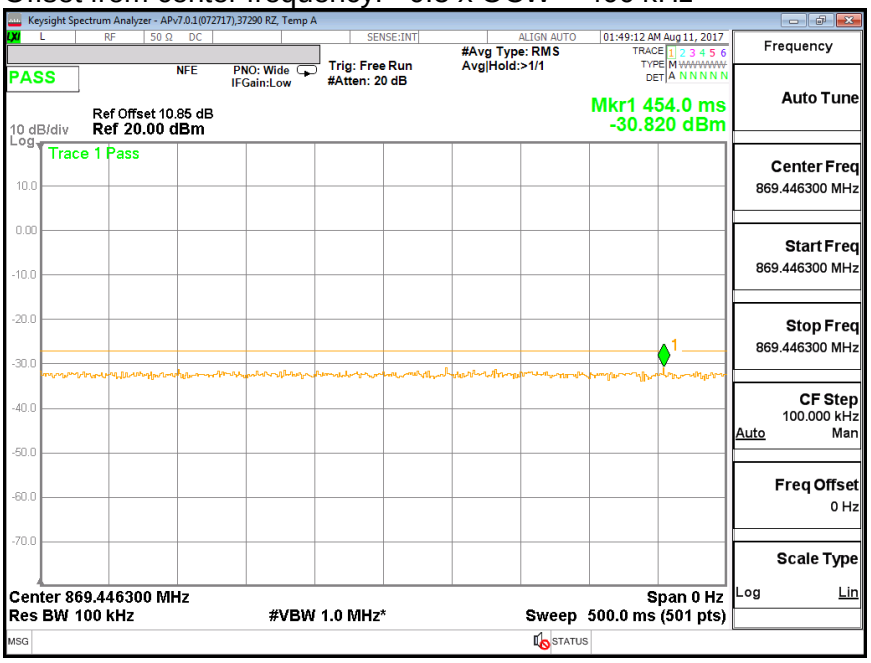
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 400 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 400 kHz



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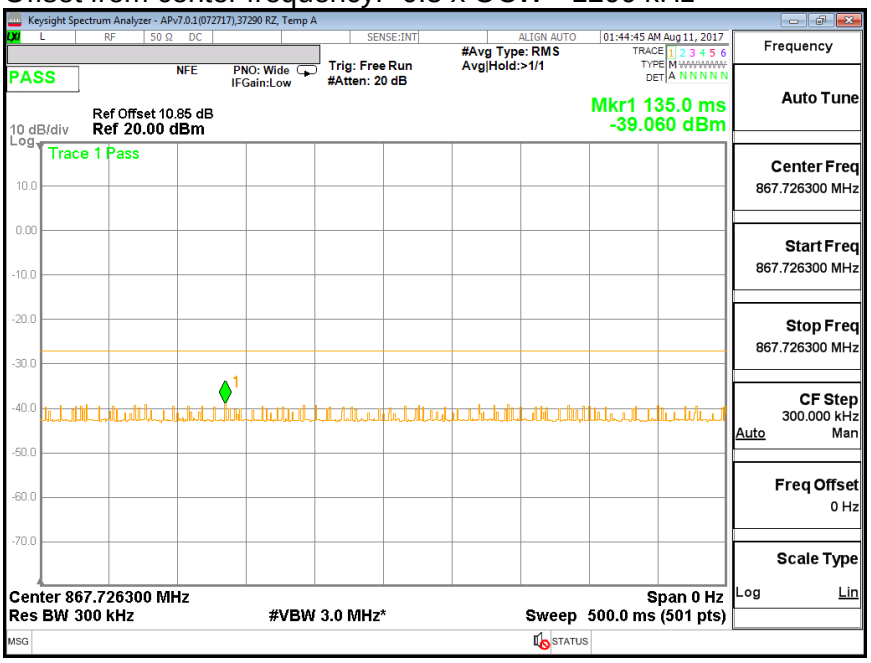
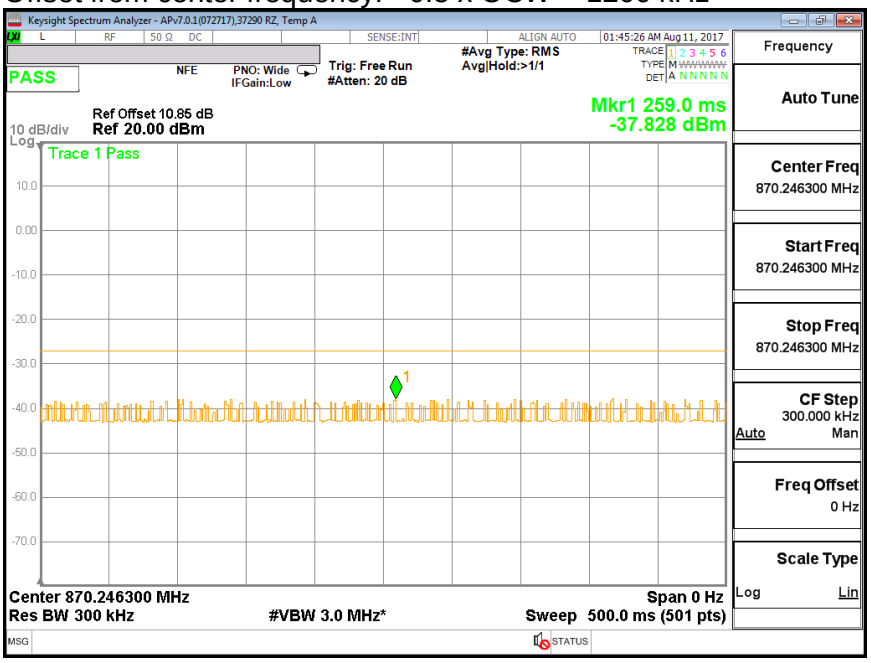
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 1200 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 1200 kHz



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7.10. 2-FSK MODULATION IN P BAND

7.10.1. OPERATING FREQUENCY

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.2.1.2

The manufacturer may declare either one or more operating frequencies and operating channels.
Operating channel(s) shall be entirely within operational frequency bands allowed by annexes B, C or any NRI.

22 ETSI EN 300 220-2 V3.1.1 (2017-02)

Operational Frequency Band		Maximum effective radiated power, e.r.p.	Channel access and occupation rules (e.g. Duty cycle or LBT + AFA)	Maximum occupied bandwidth	Other usage restrictions	Band number from EC Decision 2013/752/EU [i.3]	Class 1 sub-class number according Commission Decision 2000/299/EU [i.7]
M	868,000 MHz to 868,600 MHz	25 mW e.r.p.	≤ 1 % duty cycle or polite spectrum access	The whole band except for audio & video applications limited to 300 kHz		48	28
N	868,700 MHz to 869,200 MHz	25 mW e.r.p.	≤ 0,1% duty cycle or polite spectrum access	The whole sub-band except for audio & video applications limited to 300 kHz		50	29
O	869,400 MHz to 869,650 MHz	25 mW e.r.p.	≤ 0.1% duty cycle or polite spectrum access	The whole band	.	54a	130
P	869,400 MHz to 869,650 MHz	500 mW e.r.p.	≤ 10 % duty cycle or polite spectrum access	The whole band		54b	30
Q	869,700 MHz to 870,000 MHz	5 mW e.r.p.	No requirement	The whole band	Audio and video applications are excluded.	56a	31
R	869,700 MHz to 870,000 MHz	25 mW e.r.p.	≤ 1% duty cycle or polite spectrum access	The whole band	Analogue audio applications are excluded. Analogue video applications are excluded.	56b	69

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.1.2

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RESULTS

Parameter	Values as declared by the manufacturer
M4, 2-FSK	
Operational Frequency band or bands	869.400 - 869.650
Nominal Operating Frequencies (MHz)	869.868759 - 869.920670
Operating Channel width(s) - OCW	80 kHz
M11, 2-FSK	
Operational Frequency band or bands	869.400 - 869.650
Nominal Operating Frequencies (MHz)	869.868759 - 869.920670
Operating Channel width(s) - OCW	40 kHz

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7.10.2. TX EFFECTIVE RADIATED POWER

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.3.1.2

The effective radiated power shall not be greater than the value allowed in annexes B or C for the chosen operational frequency band(s).

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.2.2.1.2

RESULTS

Date: 08/11/17
Project No: 11773240
Tester: 50818_JQ

CHANNELS FOR MODULATION CODE: M4

EUT Antenna Gain (dBi) =	2.00

Condition	Output Power (dBm)	EIRP (dBm)	ERP (dBm)	Limit (dBm)	Margin (dB)
Operating Channel, CH30					
Normal	11.75	13.75	11.60	27	-15.40
Extreme T low, V low	12.50	14.50	12.35	27	-14.65
Extreme T low, V high	12.49	14.49	12.34	27	-14.66
Extreme T high, V low	11.20	13.20	11.05	27	-15.95
Extreme T high, V high	11.19	13.19	11.04	27	-15.96

Note: Cable loss correction factor is included in the Power Meter Reading

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7.10.3. TX OCCUPIED BANDWIDTH

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.3.4.2

The occupied bandwidth of the EUT according to ETSI EN 300 220-1 [1], clause 5.6.2 shall comply with the limits in annex B or C.

Reference Limit:

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.6.2

The Operating Channel shall be declared and shall reside entirely within the Operational Frequency Band. The Maximum Occupied Bandwidth at 99 % shall reside entirely within the Operating Channel defined by F_{low} and F_{high}.

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.6.3.3 (Conducted Measurement)

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RESULTS

BAND P

Condition	Low CH (MHz)	High CH (MHz)	Low CH OBW (kHz)	High CH OBW (kHz)	F_{Low} (MHz)	F_{Low} Limit (MHz)	F_{High} (MHz)	F_{High} Limit (MHz)
M4, 2-FSK								
Normal	869.5573	869.5573	64.841	64.841	869.52	> 869.4	869.59	< 869.65
T low, V low	869.5573	869.5573	64.487	64.487	869.53	> 869.4	869.59	< 869.65
T low, V high	869.5573	869.5573	64.510	64.510	869.53	> 869.4	869.59	< 869.65
T high, V low	869.5573	869.5573	64.691	64.691	869.52	> 869.4	869.59	< 869.65
T high, V high	869.5573	869.5573	64.321	64.321	869.53	> 869.4	869.59	< 869.65
M11, 2-FSK								
Normal	869.5573	869.5573	38.483	38.483	869.54	> 869.4	869.58	< 869.65
T low, V low	869.5573	869.5573	37.726	37.726	869.54	> 869.4	869.58	< 869.65
T low, V high	869.5573	869.5573	38.333	38.333	869.54	> 869.4	869.58	< 869.65
T high, V low	869.5573	869.5573	38.498	38.498	869.54	> 869.4	869.58	< 869.65
T high, V high	869.5573	869.5573	38.542	38.542	869.54	> 869.4	869.58	< 869.65

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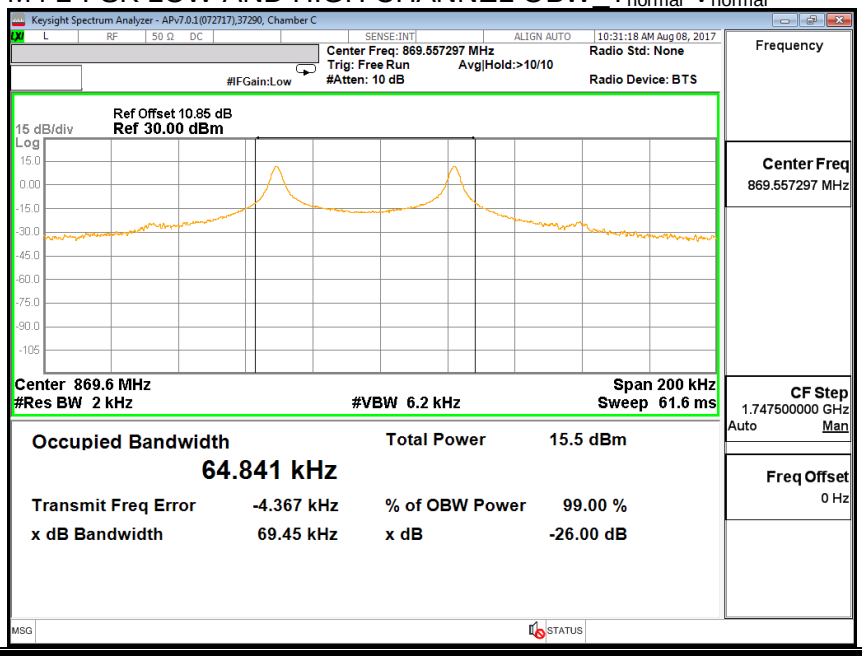
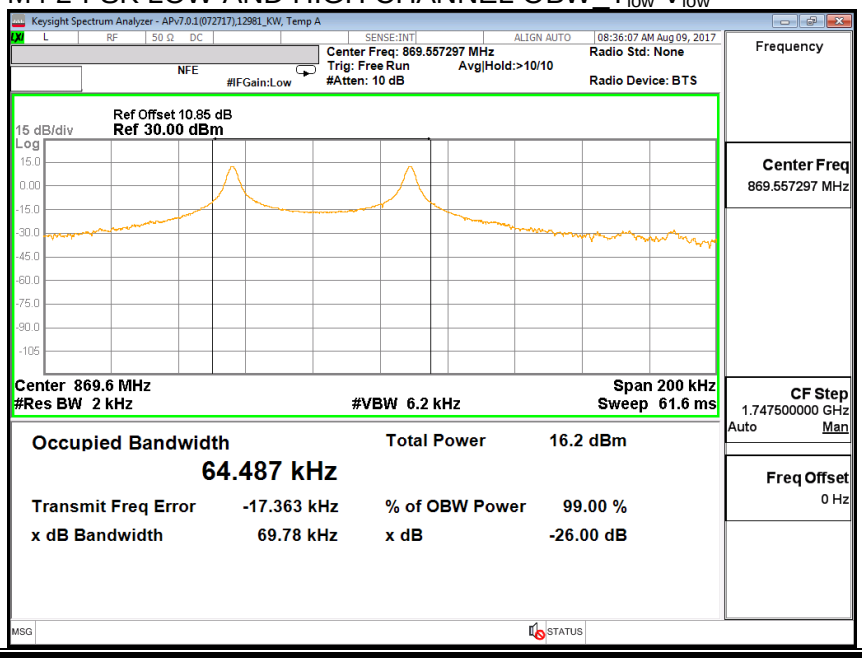
M4 2-FSK LOW AND HIGH CHANNEL OBW_T_{normal} V_{normal}



M4 2-FSK LOW AND HIGH CHANNEL OBW_T_{low} V_{low}



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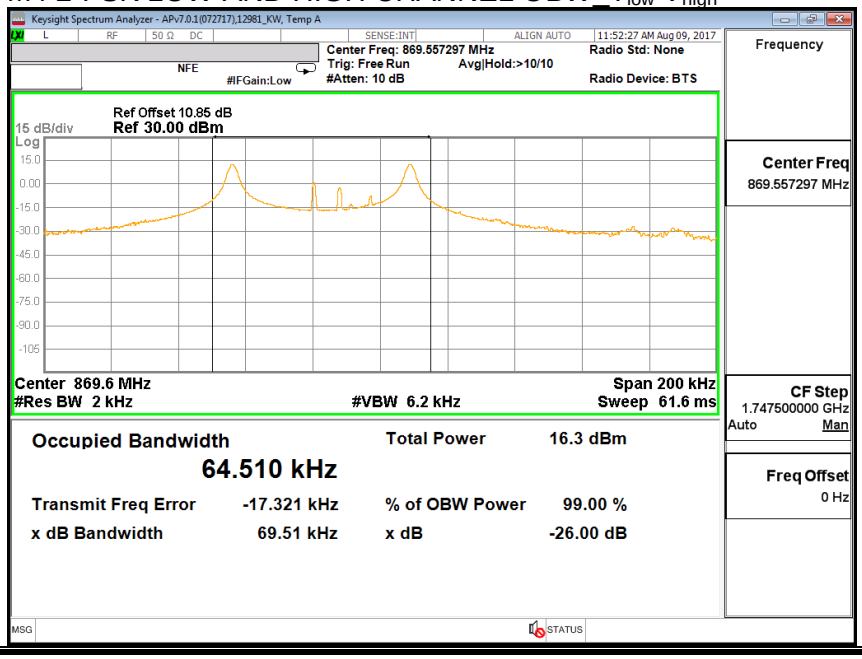
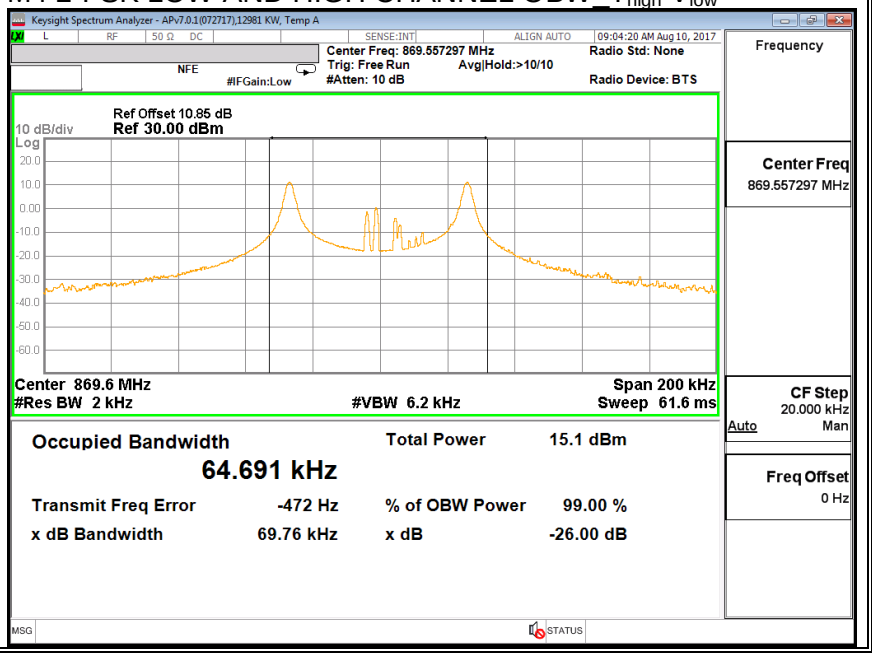
M4 2-FSK LOW AND HIGH CHANNEL OBW_T_{low} V_{high}



M4 2-FSK LOW AND HIGH CHANNEL OBW_T_{high} V_{low}



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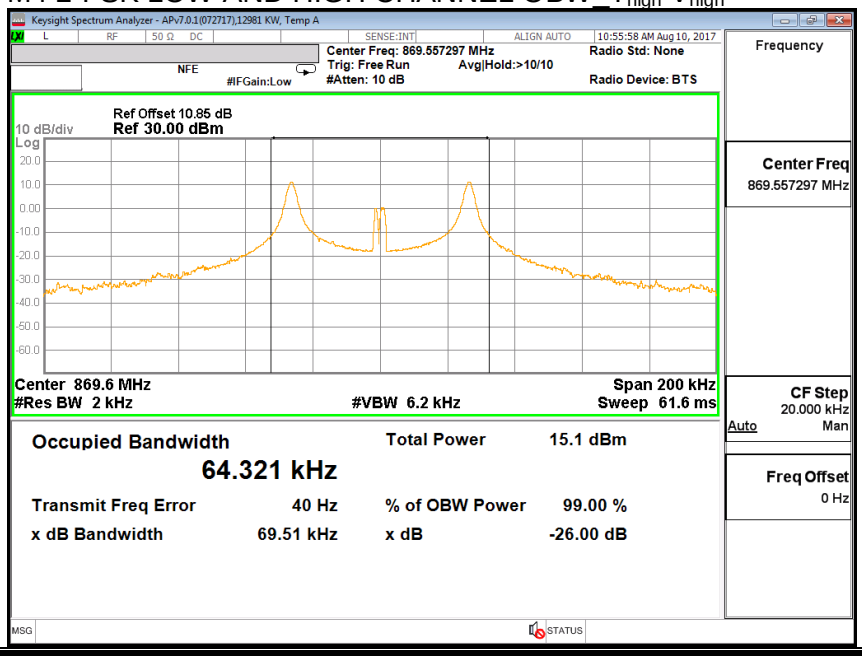
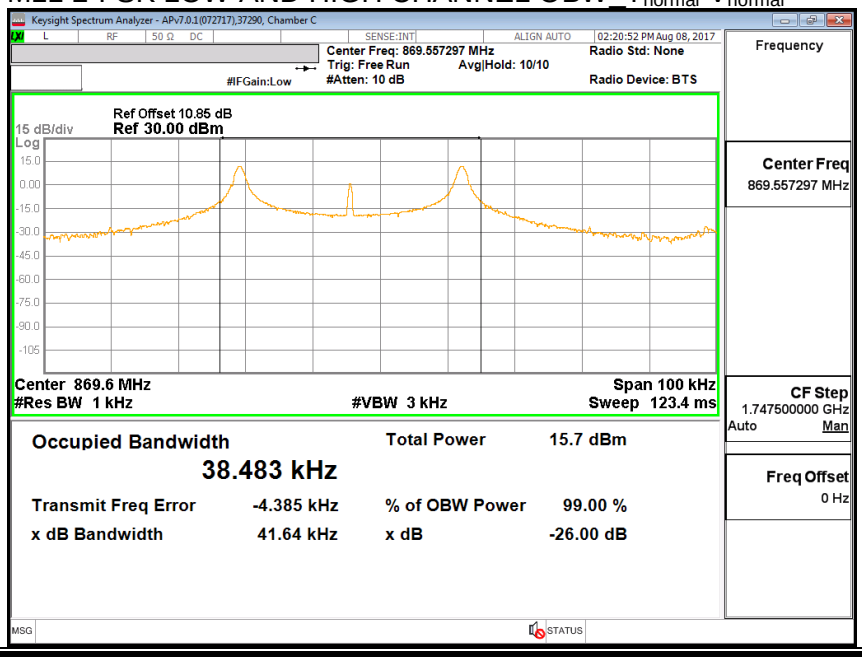
M4 2-FSK LOW AND HIGH CHANNEL OBW_T_{high} V_{high}



M11 2-FSK LOW AND HIGH CHANNEL OBW_T_{normal} V_{normal}



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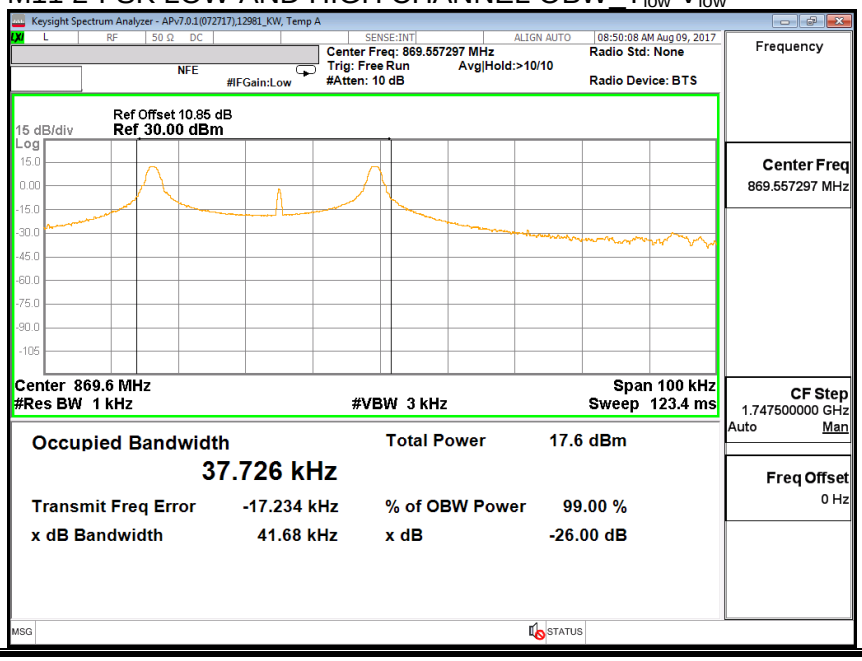
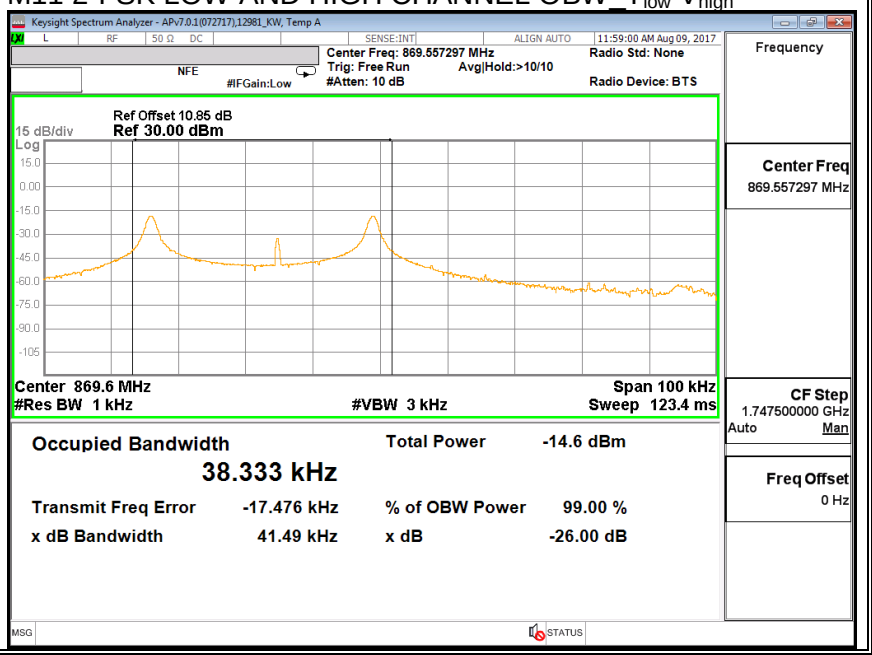
M11 2-FSK LOW AND HIGH CHANNEL OBW_T_{low} V_{low}



M11 2-FSK LOW AND HIGH CHANNEL OBW_T_{low} V_{high}



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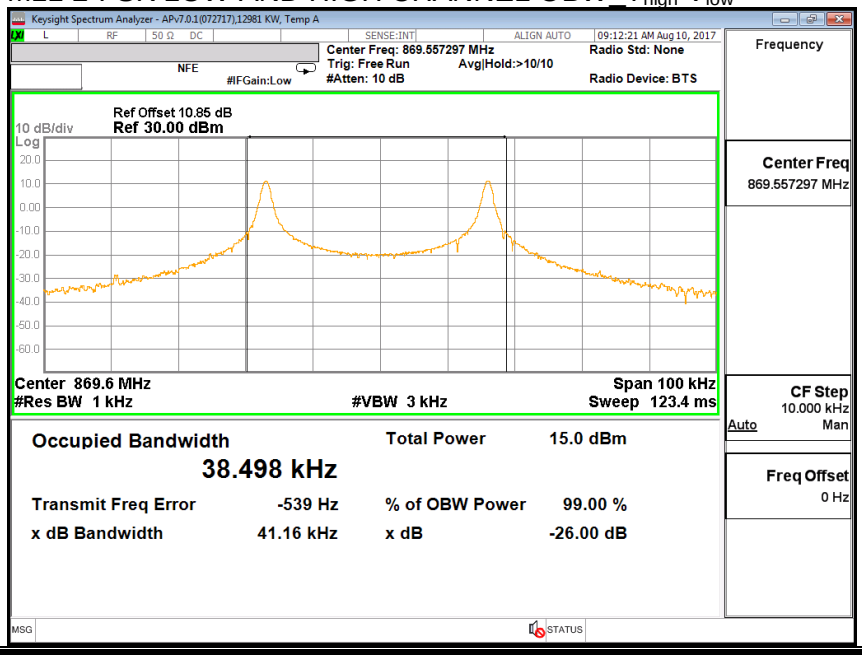
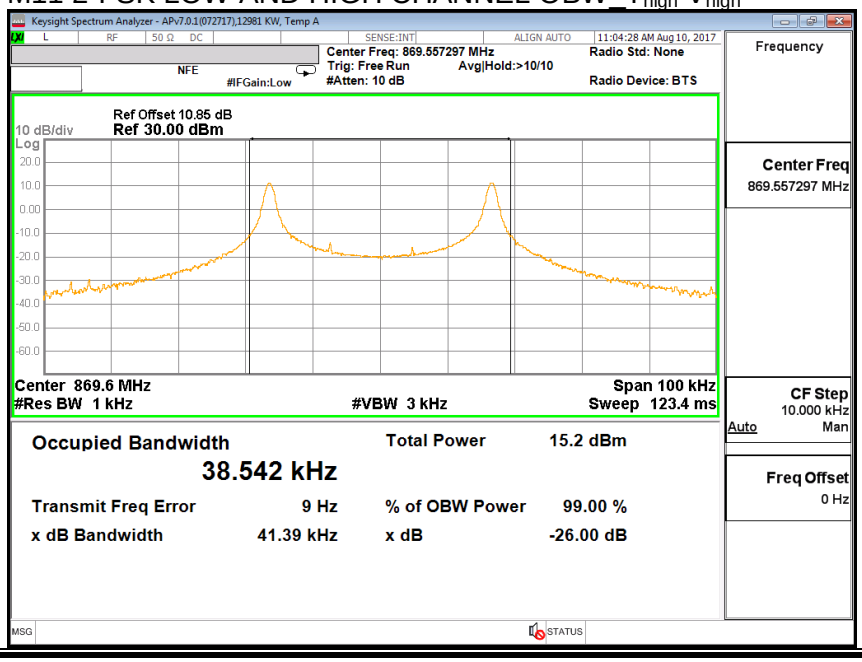
M11 2-FSK LOW AND HIGH CHANNEL OBW_T_{high} V_{low}



M11 2-FSK LOW AND HIGH CHANNEL OBW_T_{high} V_{high}



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7.10.4. TX OUT OF BAND EMISSIONS

REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.1

Two OOB domains are defined, one for OC (see Figure 5) and one for Operational Frequency band (see Figure 6). The spectrum masks for these two OOB domains may overlap.

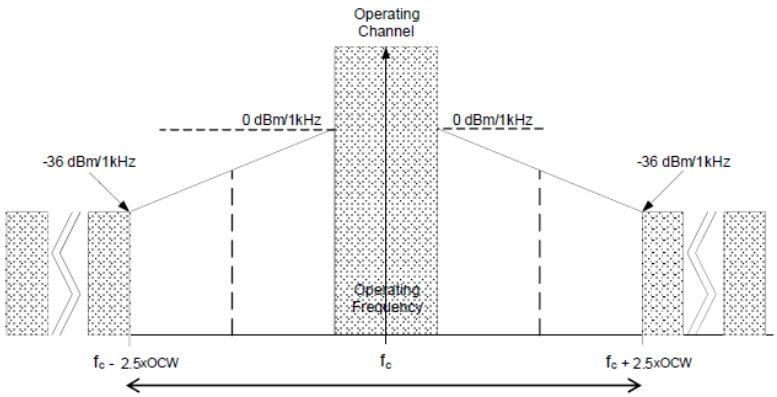

Figure 5: Out Of Band Domain for Operating Channel with reference BW

Unwanted emissions in the Out Of Band domain are those falling in the frequency range immediately below the lower, and above the upper, frequency of the Operating Channel. The OOB domain includes both frequencies outside the Operating Channel within the Operational Frequency Band and frequencies outside the Operational Frequency Band.
The relevant Out Of Band domain is shown in Figure 5 and applies within the Operational Frequency Band.

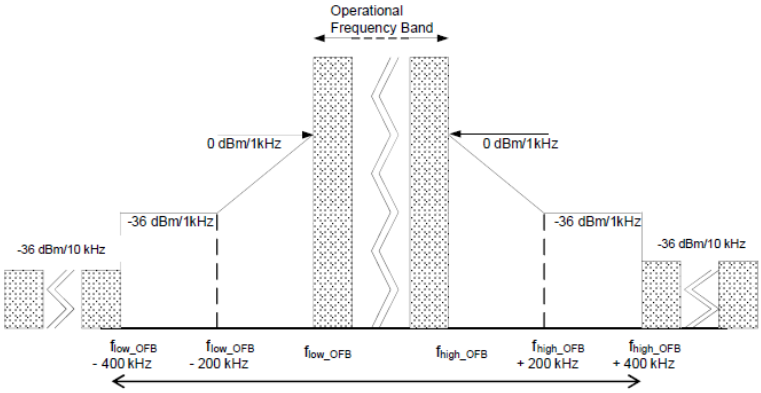

Figure 6: Out Of Band Domain for Operational Frequency Band with reference BW

Specific limits apply at frequencies immediately above and below the Operational Frequency Band as shown in Figure 6.
NOTE: f_{low}_OFB is the lower edge of the Operational Frequency Band. f_{high}_OFB is the upper edge of the Operational Frequency Band.

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REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.2

The EUT emissions level in OOB domains for the Operating Channel and the Operational Frequency Band shall be less or equal to Table 15 spectrum mask.

Table 15: Emission limits in the Out Of Band domains

Domain	Frequency Range	RBW_{REF}	Max power limit
OOB limits applicable to Operational Frequency Band (See Figure 6)	$f \le f_{low_OFB}$ - 400 kHz	10 kHz	-36 dBm
	F_{low_OFB} - 400 kHz ≤ f ≤ f_{low_OFB} - 200 kHz	1 kHz	-36 dBm
	f_{low} - 200 kHz ≤ f < f_{low_OFB}	1 kHz	See Figure 6
	$f = f_{low_OFB}$	1 kHz	0 dBm
	$f = f_{high_OFB}$	1 kHz	0 dBm
	F_{high_OFB} < f ≤ f_{high_OFB} + 200 kHz	1 kHz	See Figure 6
	F_{high_OFB} + 200 kHz ≤ f ≤ f_{high_OFB} + 400 kHz	1 kHz	-36 dBm
	F_{high_OFB} + 400 kHz ≤ f	10 kHz	-36 dBm
OOB limits applicable to Operating Channel (See Figure 5)	$f = f_c$- 2.5 x OCW	1 kHz	-36 dBm
	f_c - 2,5 x OCW ≤ f ≤ f_c - 0,5 x OCW	1 kHz	See Figure 5
	$f = f_c$ - 0,5 x OCW	1 kHz	0 dBm
	$f = f_c$ + 0,5 x OCW	1 kHz	0 dBm
	f_c + 0,5 x OCW ≤ f ≤ f_c + 2,5 x OCW	1 kHz	See Figure 5
	$f = f_c$+ 2,5 x OCW	1 kHz	-36 dBm

NOTE: f is the measurement frequency.
f_c is the Operating Frequency.
F_{low_OFB} is the lower edge of the Operational Frequency Band.
F_{high_OFB} is the upper edge of the Operational Frequency Band.
OCW is the operating channel bandwidth.

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.3.3 (Conducted Measurement)

RESULTS

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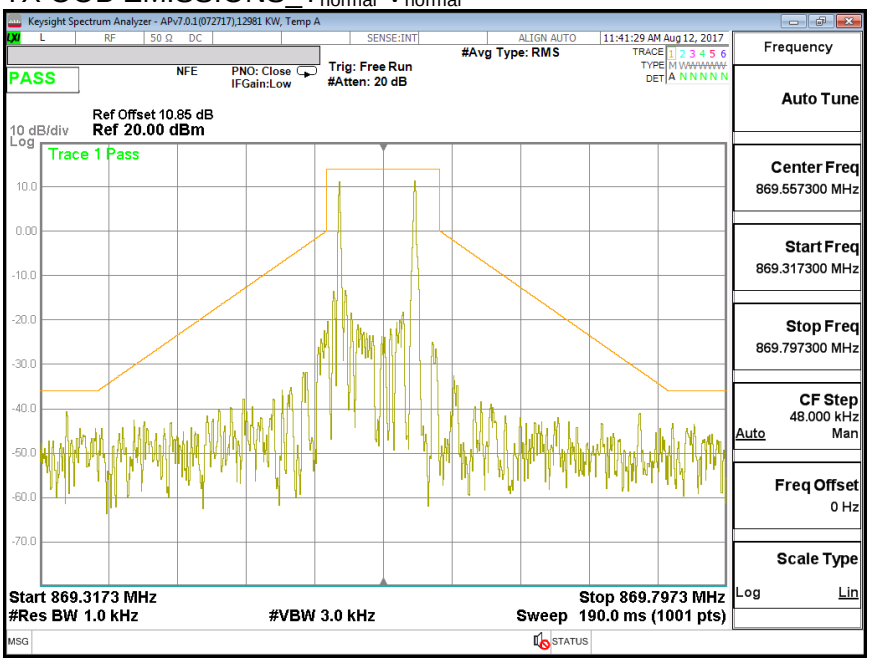
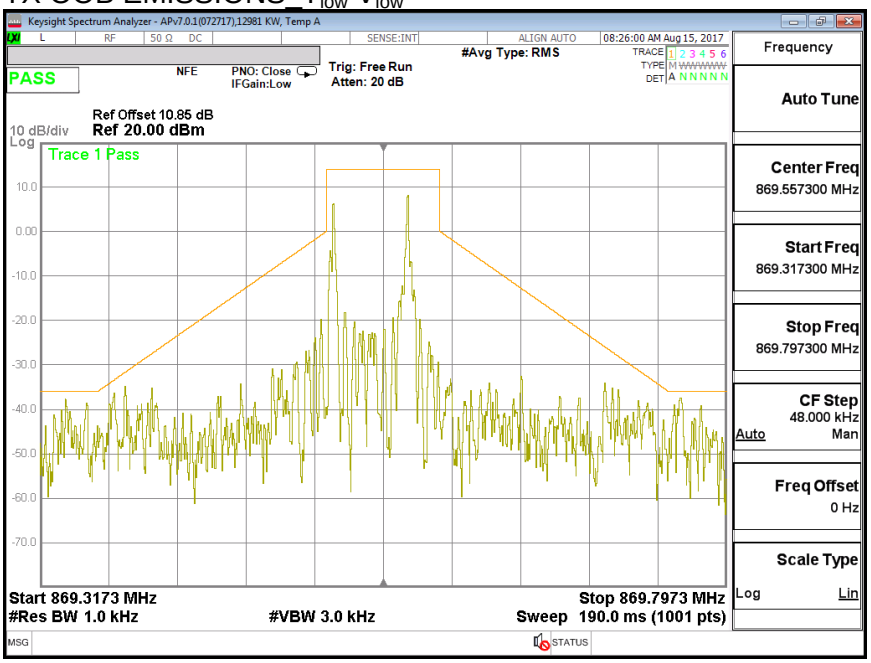
TX OUT OF BAND EMISSIONS (APPLICABLE TO OPERATING CHANNEL)

M4 OPERATING CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal}



TX OOB EMISSIONS_T_{low} V_{low}



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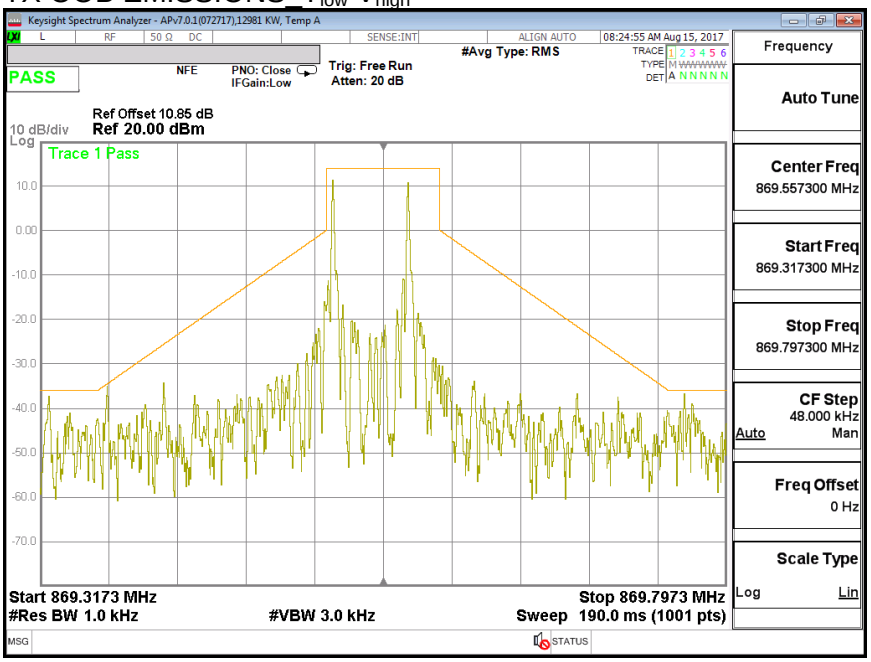
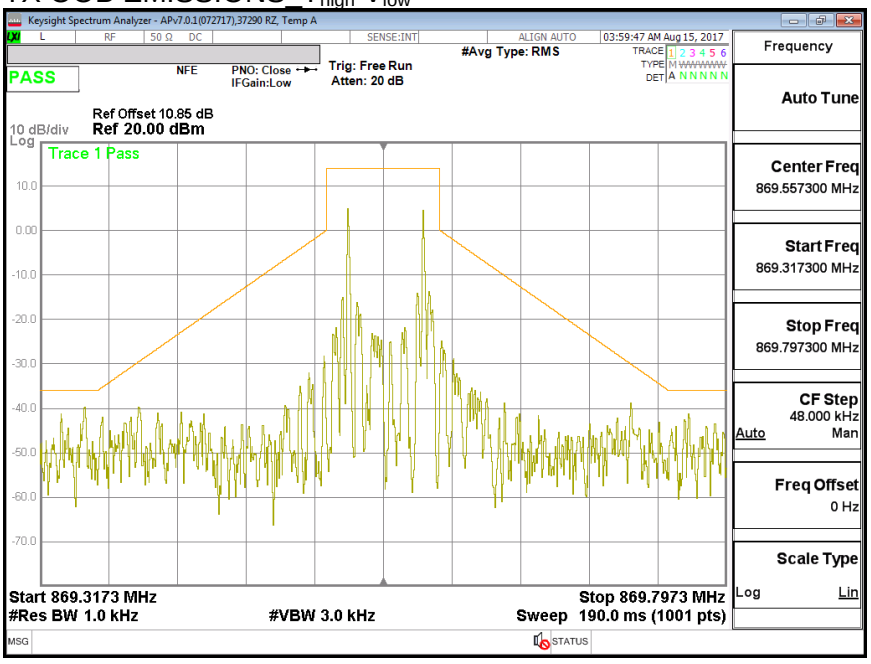
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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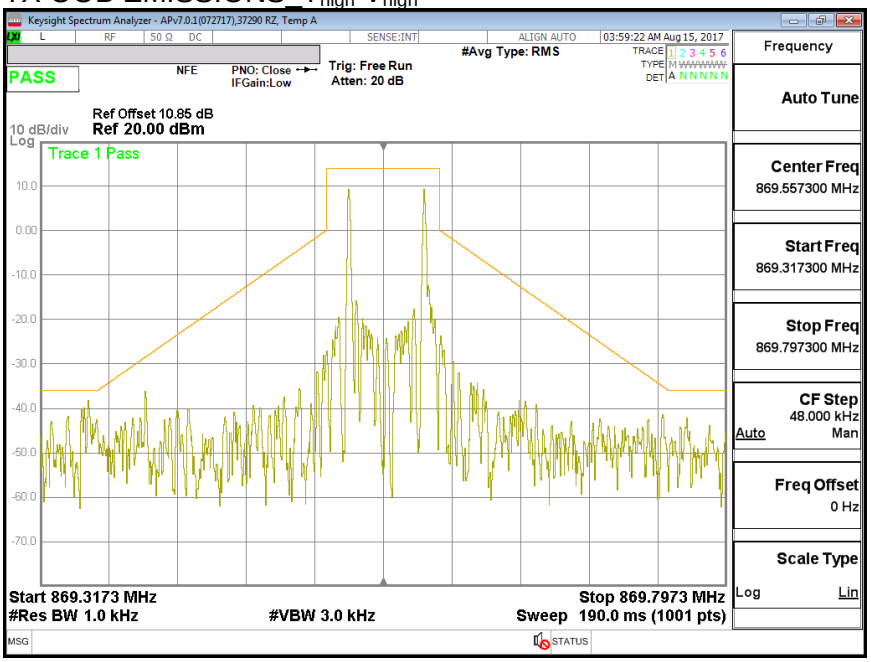
TX OOB EMISSIONS_T_{high} V_{high}



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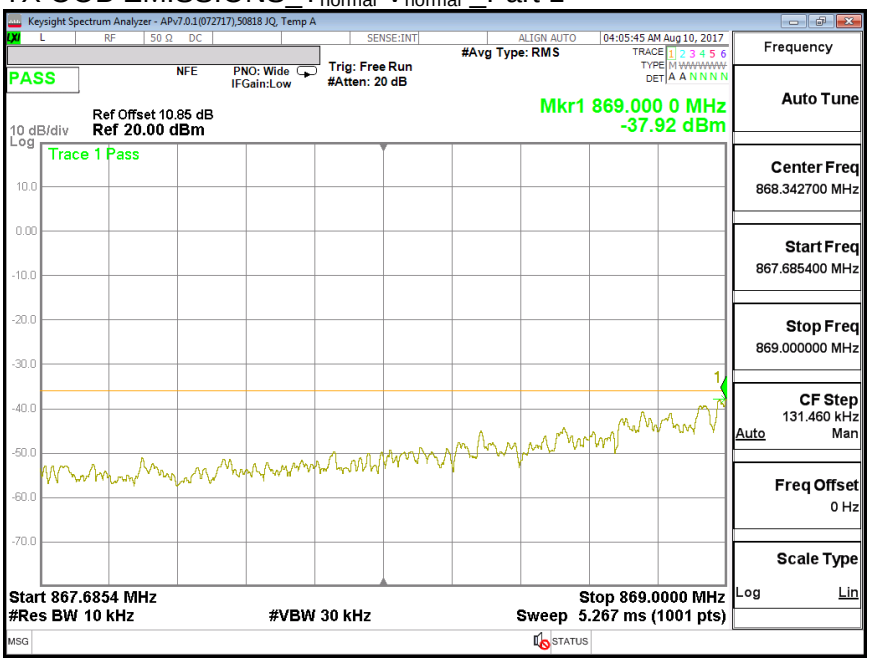
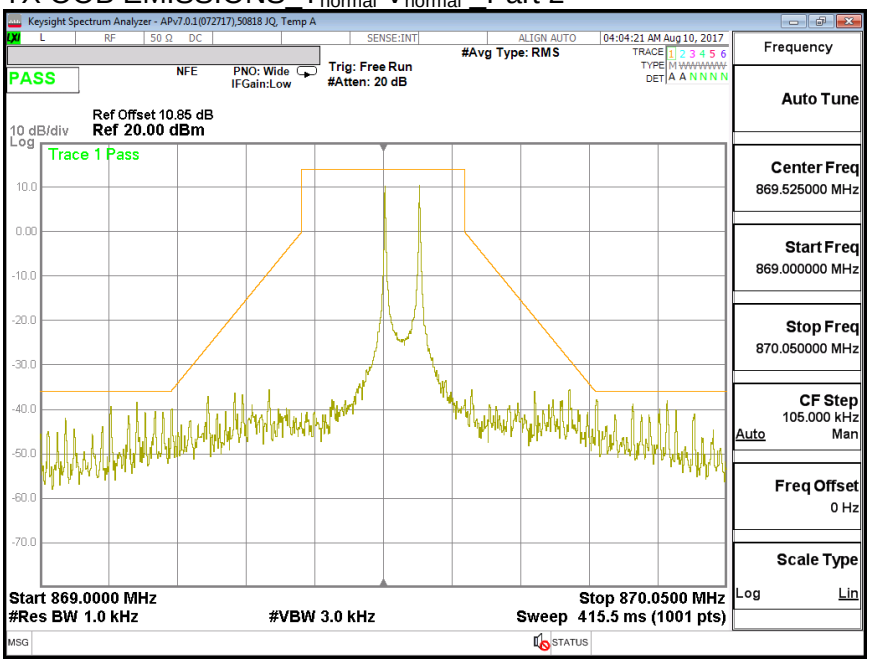
TX OUT OF BAND EMISSIONS (APPLICABLE TO OPERATIONAL FREQUENCY BANDS)

M4 OPERATING CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal} _Part 1



TX OOB EMISSIONS_T_{normal} V_{normal} _Part 2



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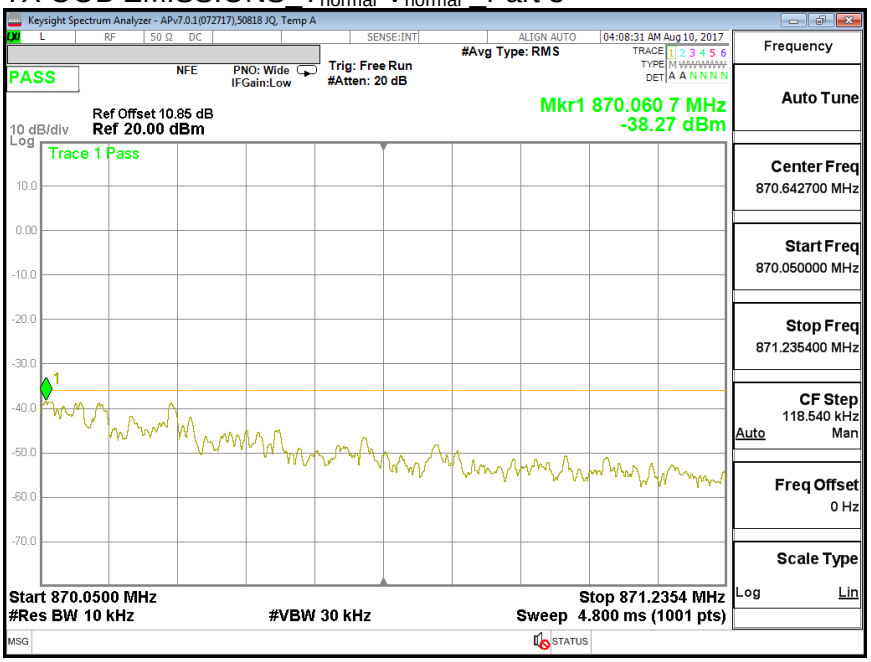
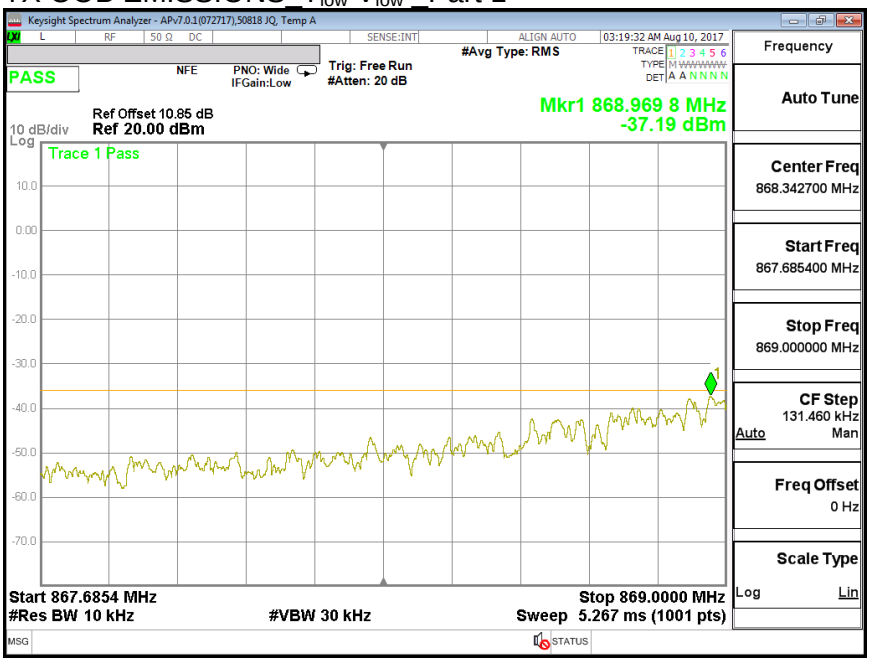
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3



TX OOB EMISSIONS_T_{low} V_{low} _Part 1



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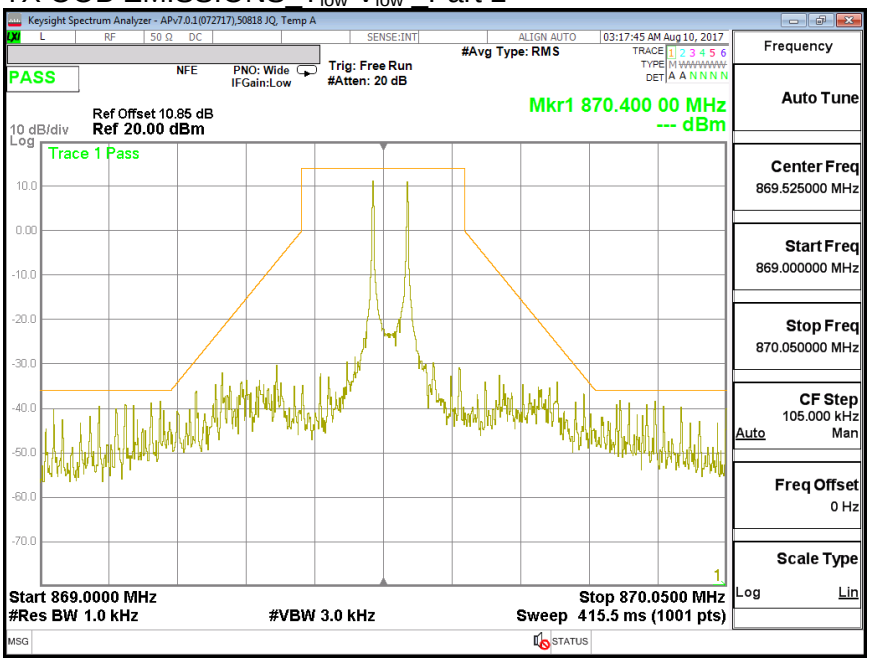
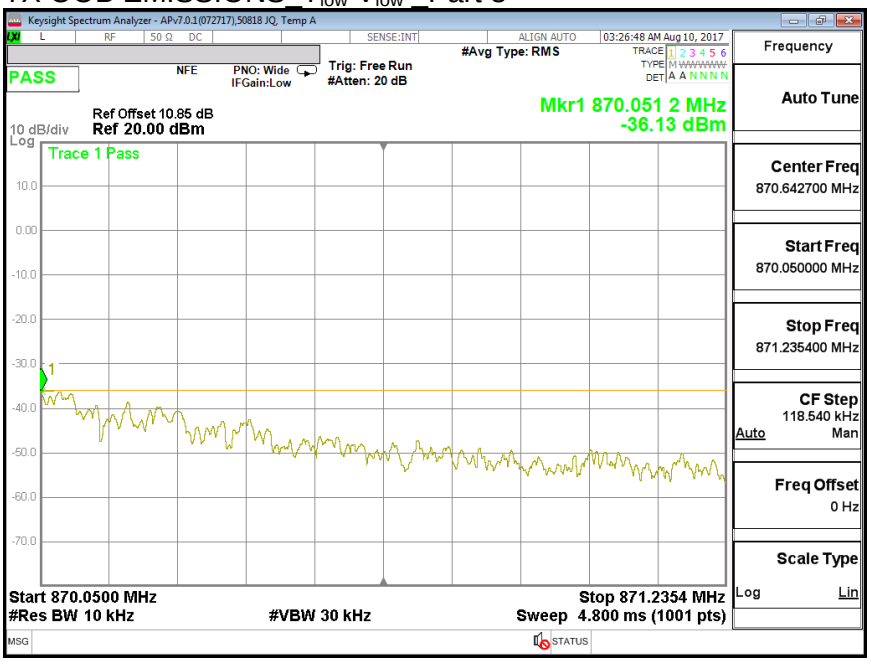
TX OOB EMISSIONS_T_{low} V_{low} _Part 2



TX OOB EMISSIONS_T_{low} V_{low} _Part 3



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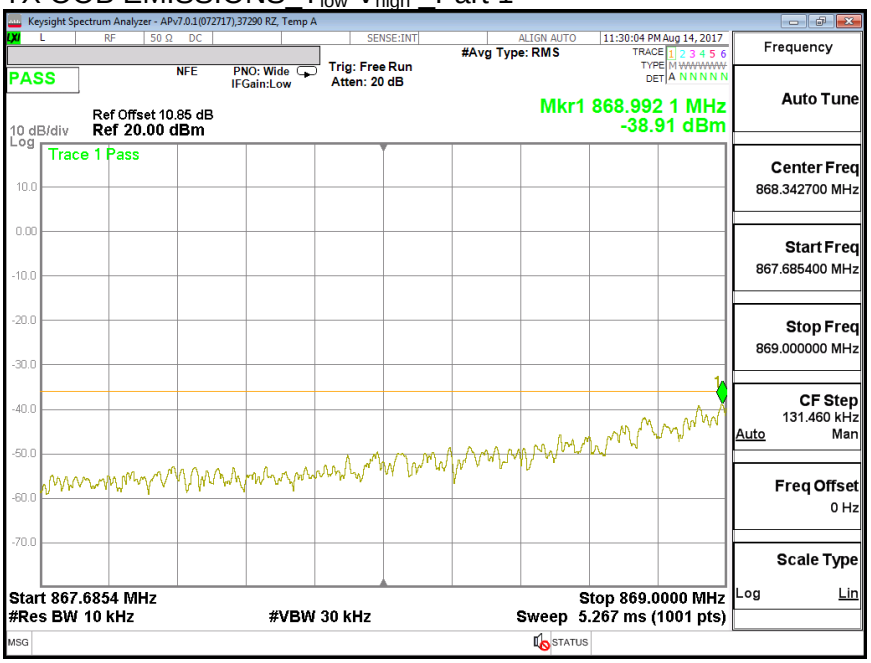
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



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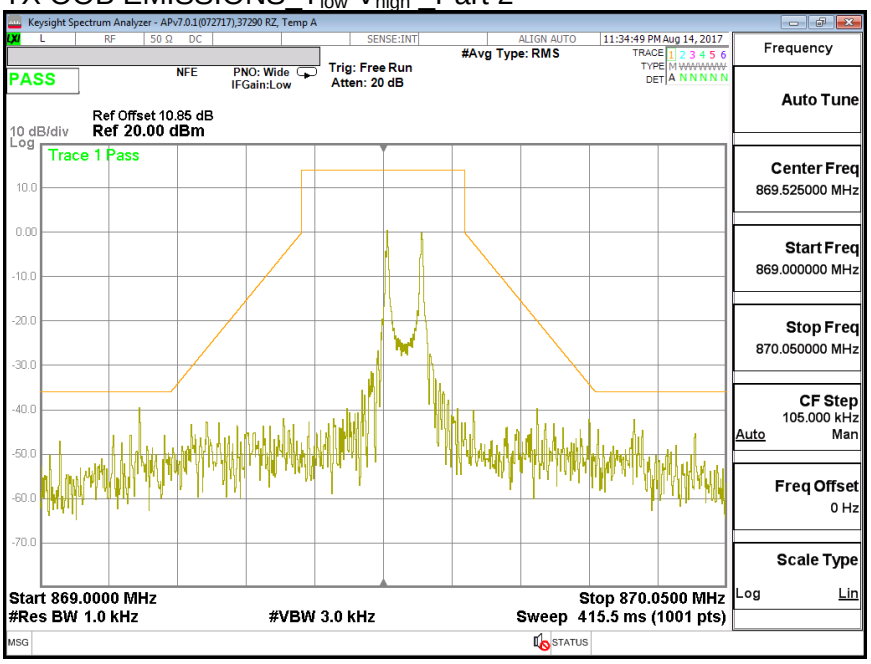

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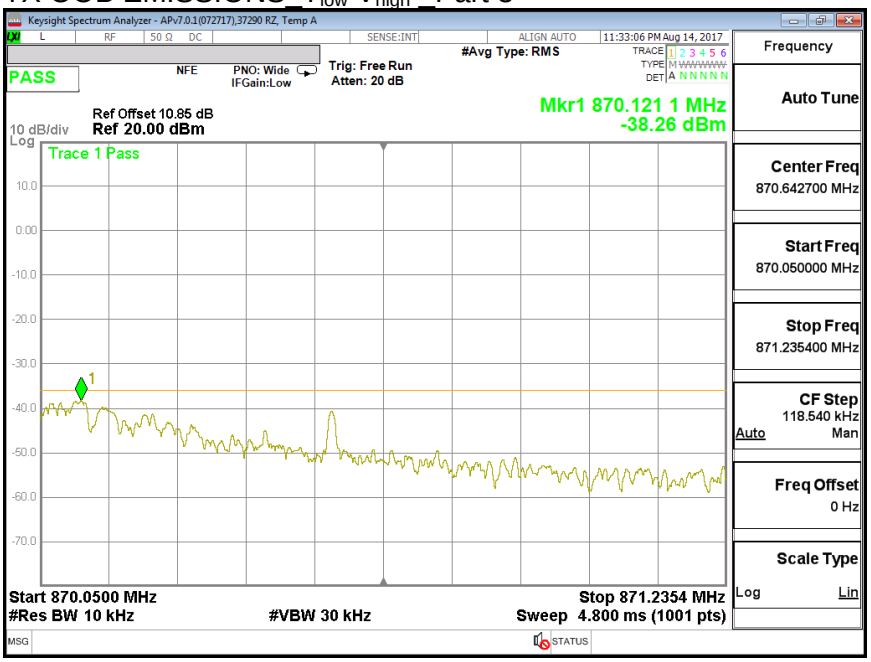
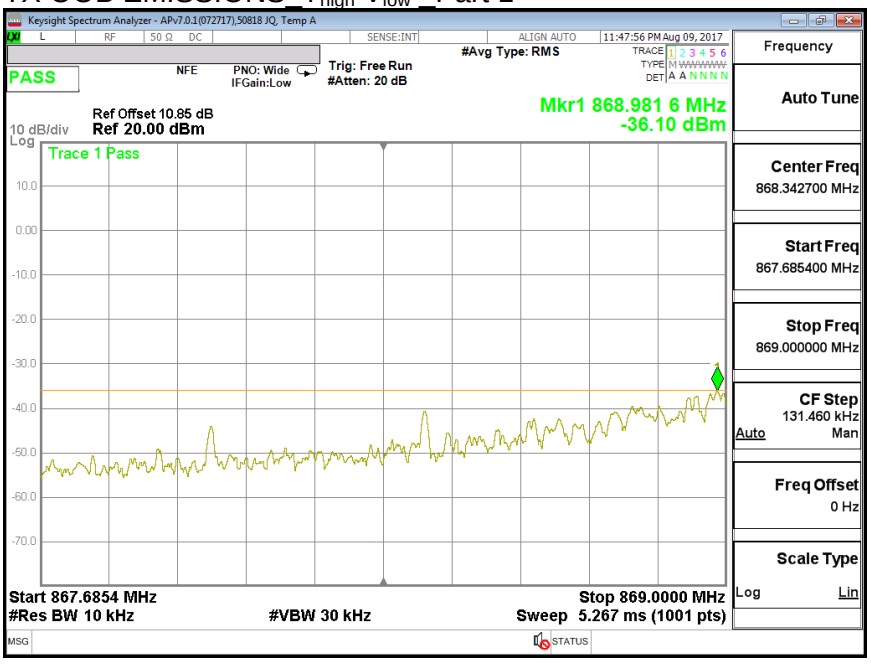
TX OOB EMISSIONS_T_{low} V_{high} _Part 3



TX OOB EMISSIONS_T_{high} V_{low} _Part 1



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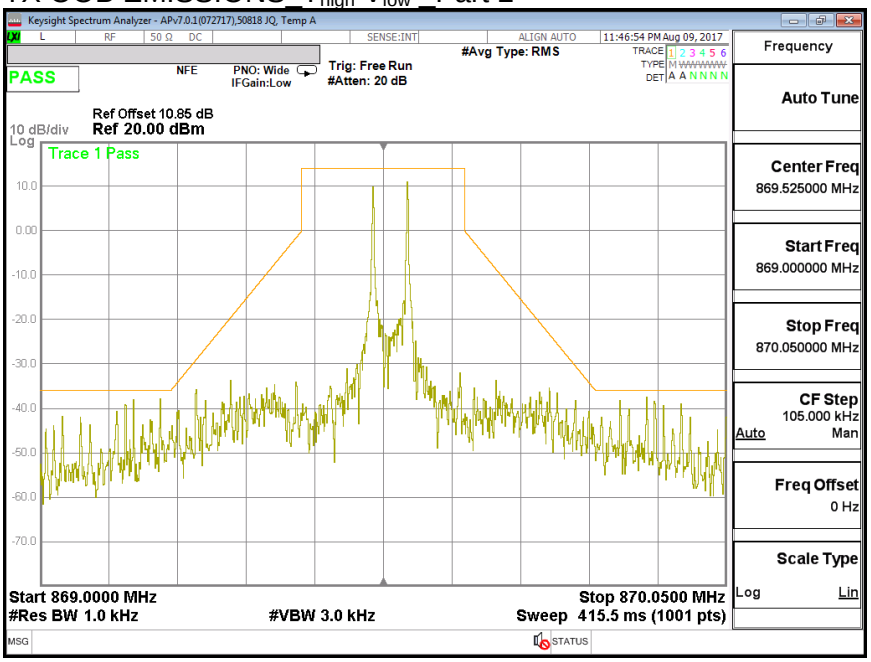
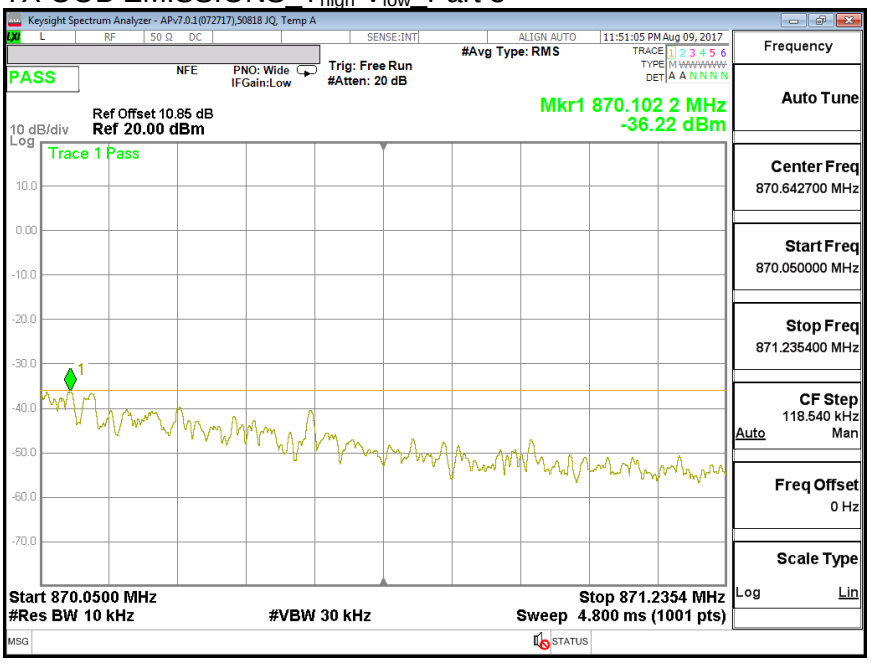
TX OOB EMISSIONS_T_{high} V_{low} _Part 2



TX OOB EMISSIONS_T_{high} V_{low}_Part 3



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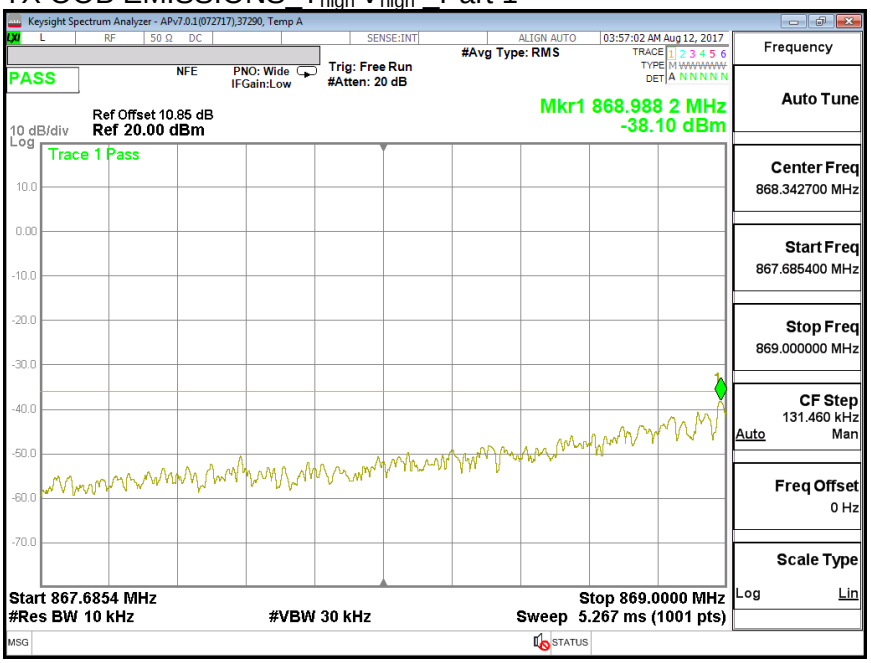
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



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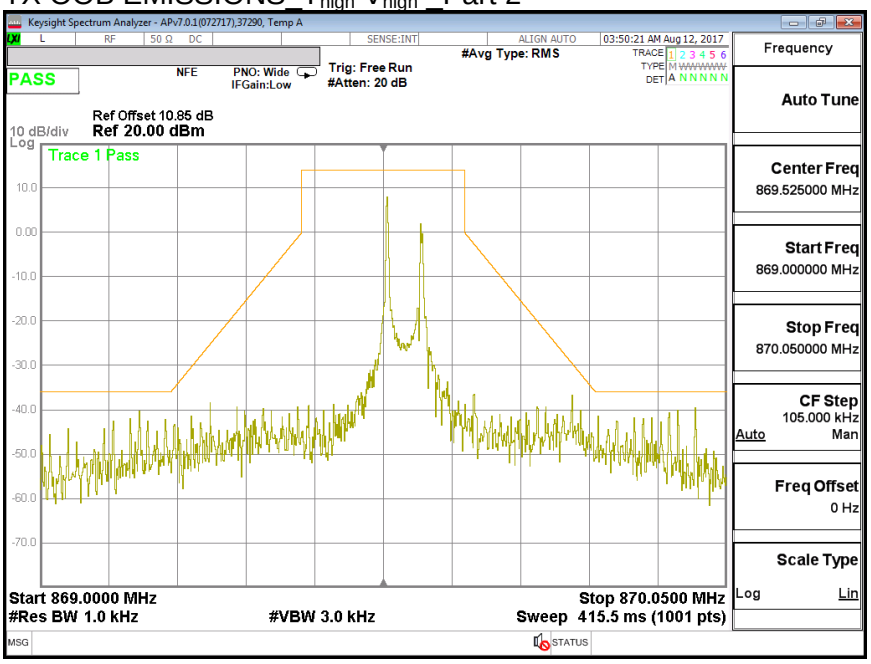

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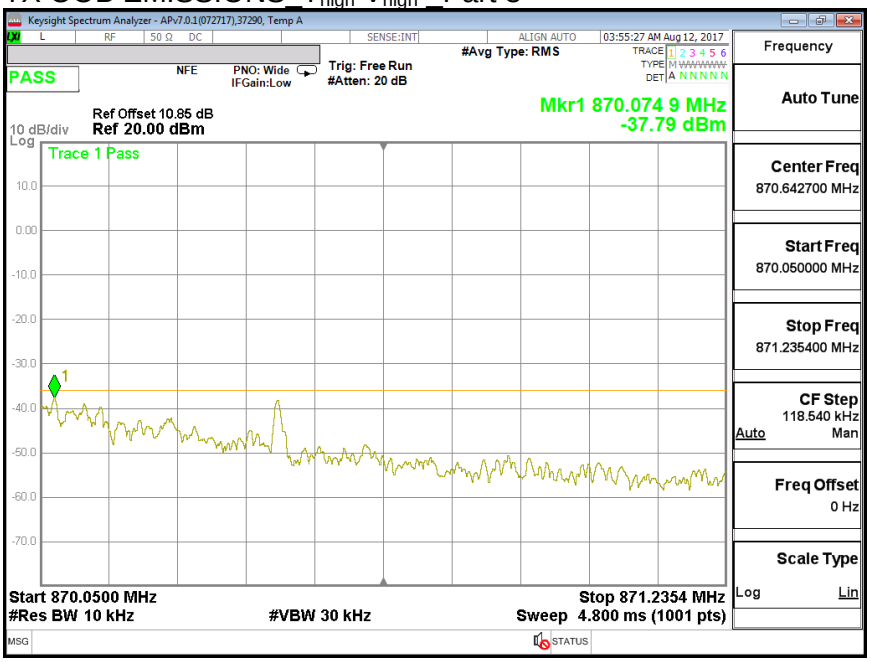
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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7.10.5. TX UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.2.2.2
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.1.1
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.2

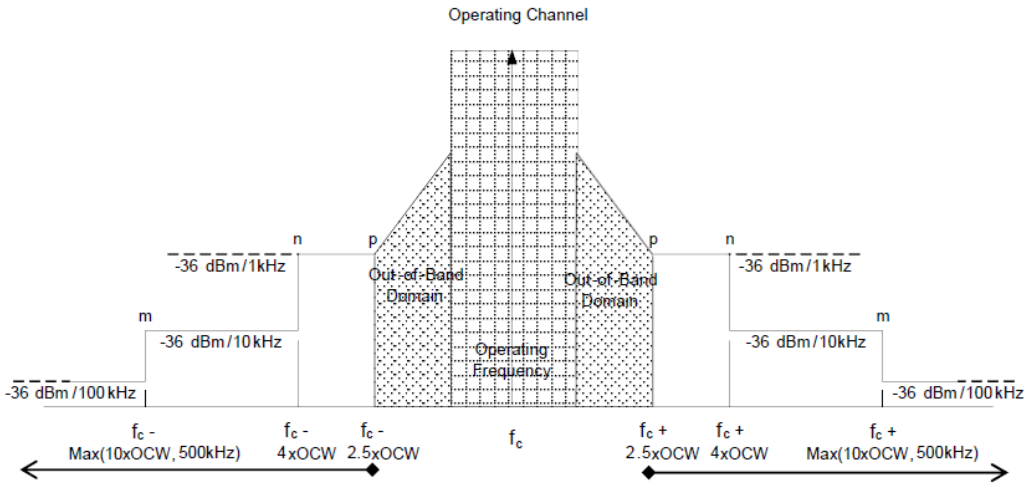

Figure 7: Spectrum Mask for Unwanted Emissions in the Spurious Domain with reference BW

Reference Limit:

The power of any unwanted emission in the spurious domain shall not exceed the values given in Table 19.

Table 19: Spurious domain emission limits

Frequency / State	47 MHz to 74 MHz 87,5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 790 MHz	Other frequencies below 1 000 MHz	Frequencies above 1 000 MHz
TX mode	-54 dBm	-36 dBm	-30 dBm
RX and all other modes	-57 dBm	-57 dBm	-47 dBm

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.3.3.1 (Conducted Measurement)
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.3.3.2 (Radiated Measurement)

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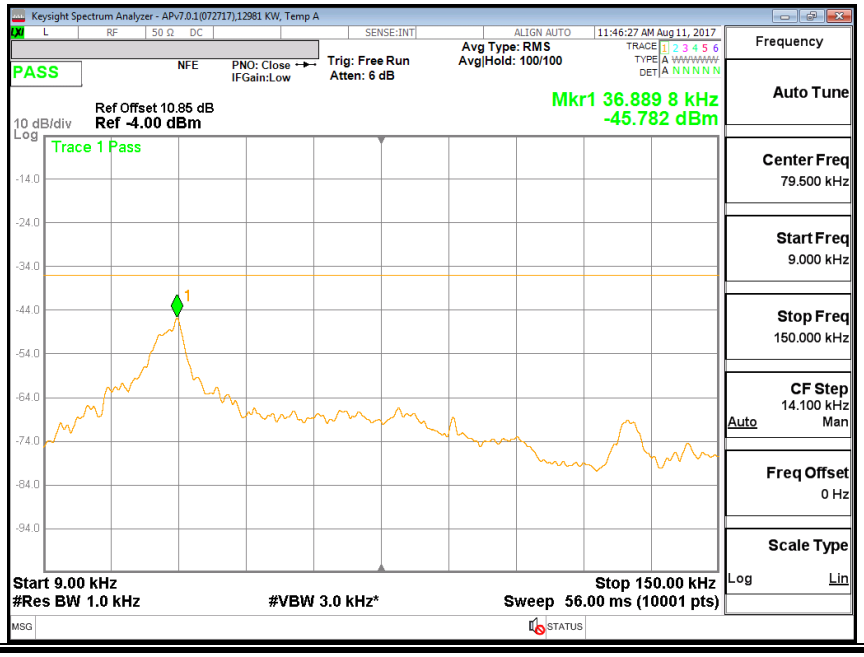
RESULTS

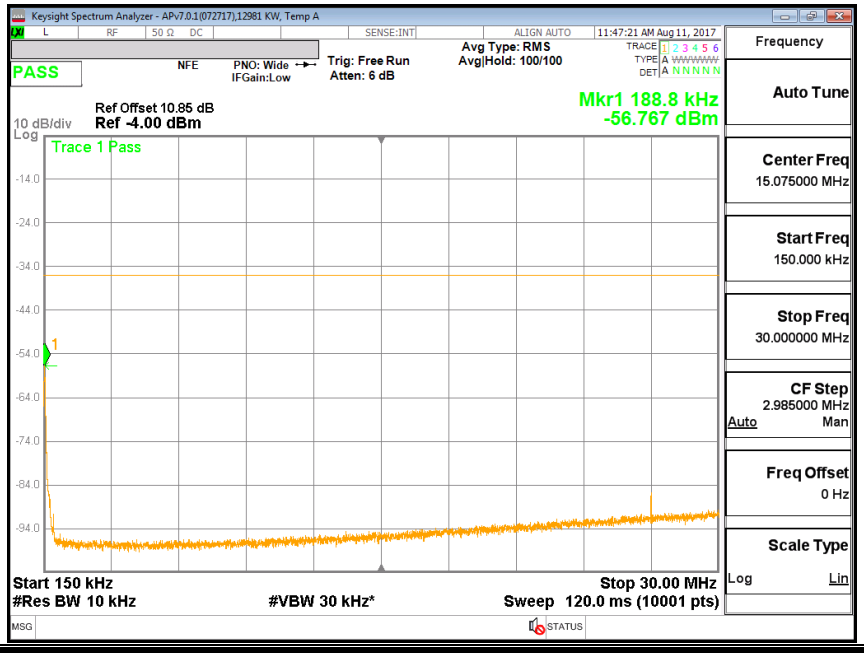
CONDUCTED SPURIOUS EMISSIONS

THE WORST CASE OF 2-FSK OPERATING CHANNEL

9kHz to 150kHz



150kHz to 30MHz



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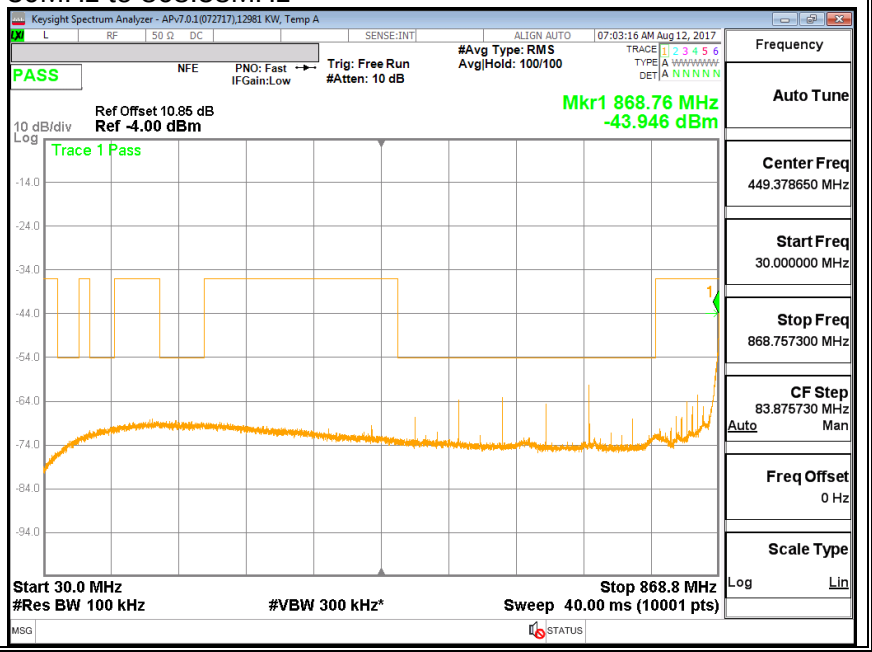
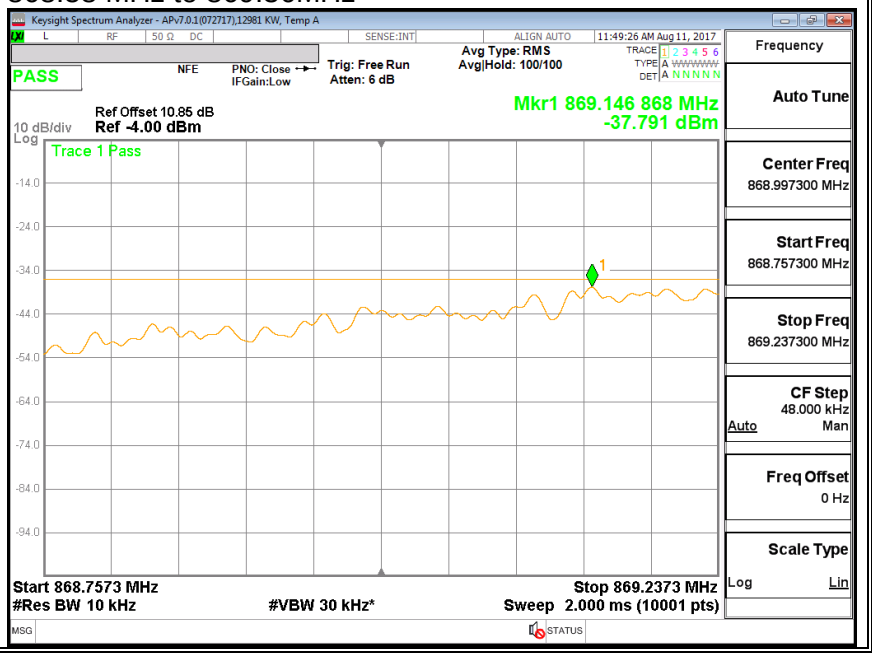
30MHz to 868.58MHz



868.58 MHz to 869.36MHz



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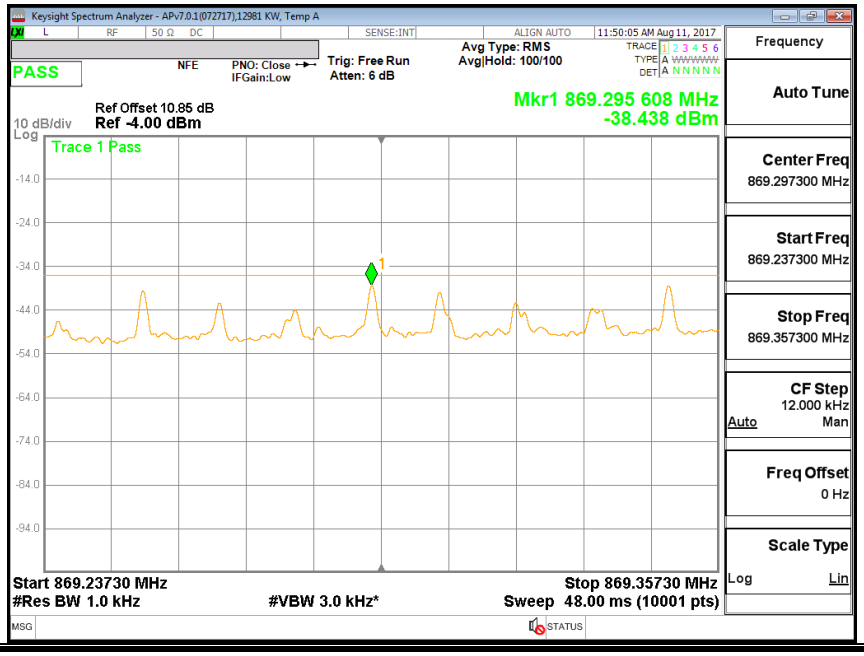
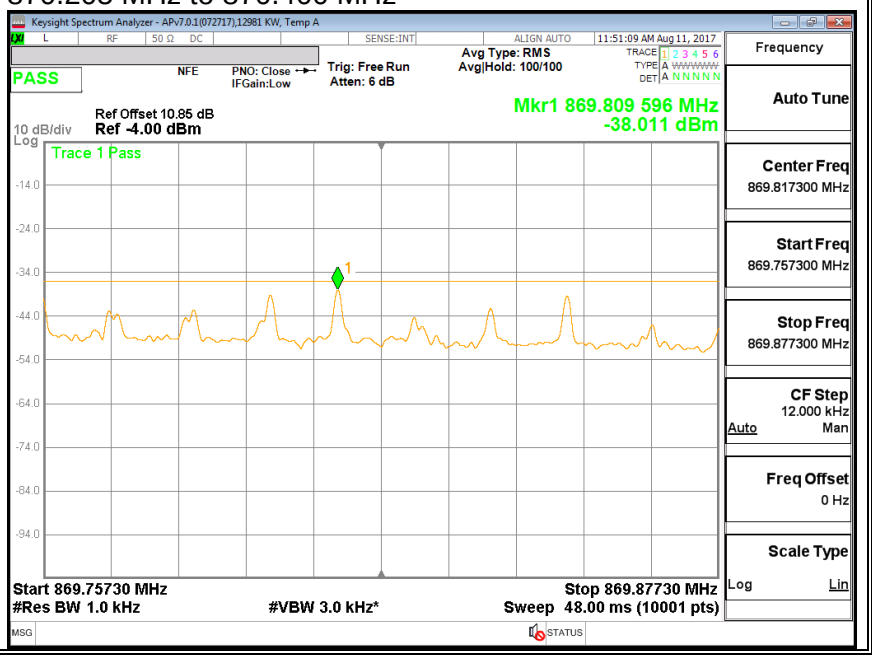
869.36 MHz to 869.555 MHz



870.205 MHz to 870.400 MHz



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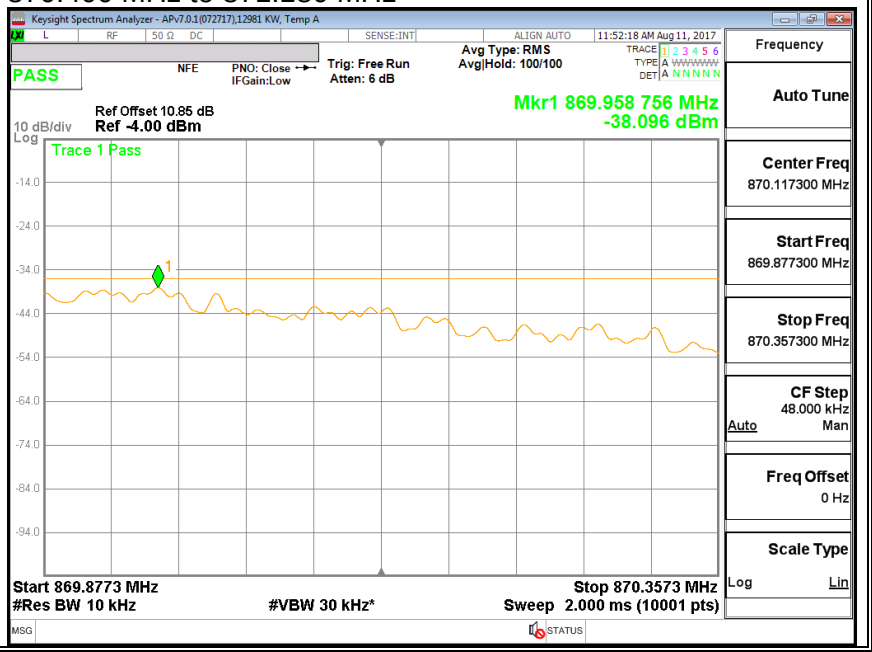
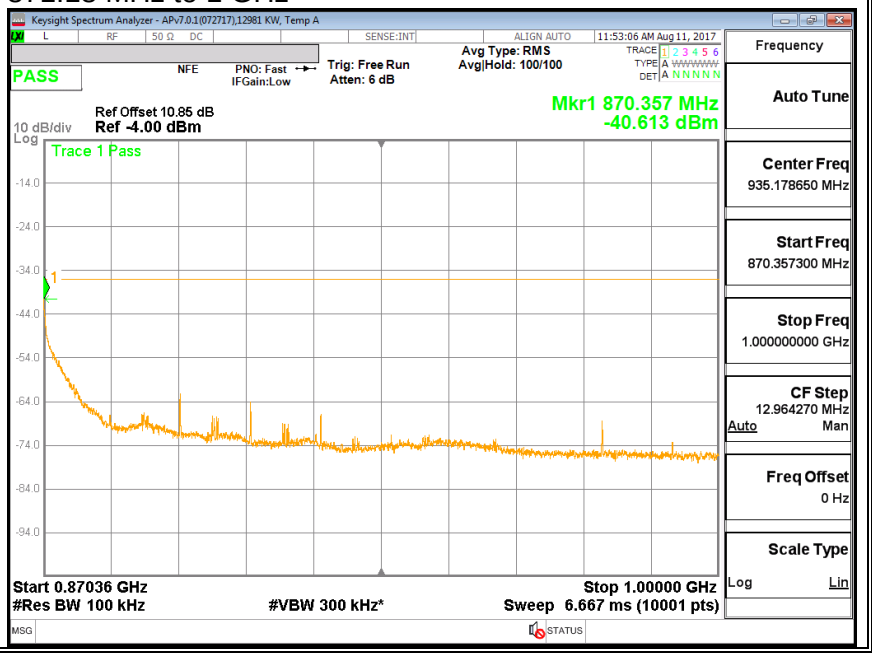
870.400 MHz to 871.180 MHz



871.18 MHz to 1 GHz



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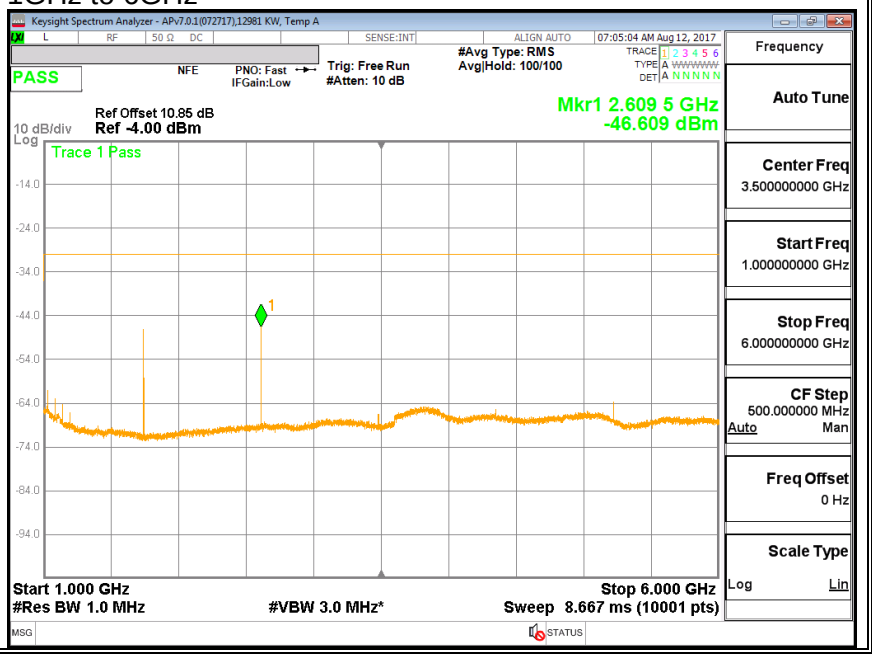
1GHz to 6GHz



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RADIATED SPURIOUS EMISSIONS

3m Radiated Emissions Chamber
30 - 1000MHz Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/13/2017
Test Engineer: 50818
Configuration: EUT with 50Ohm load and a support laptop
Mode: TX Below 1GHz 2FSK P band worst case

Chamber	Pre-amplifer	Attenuator	Limit
3m Chamber B	3m-B T10		ETSI 300 220 Tx

Frequency (MHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Attenuator (dB)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel										
432.11	-71.8	H	3.0	24.9	28.8		-75.6	-36.0	-39.6	
699.34	-71.1	H	3.0	29.0	28.6		-70.8	-54.0	-16.8	
801.59	-72.3	H	3.0	30.2	28.4		-70.5	-54.0	-16.5	
432.18	-70.1	V	3.0	26.6	28.8		-72.3	-36.0	-36.3	
767.42	-71.5	V	3.0	31.9	28.4		-68.0	-54.0	-14.0	
801.42	-72.3	V	3.0	32.5	28.4		-68.2	-54.0	-14.2	

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3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/13/2017
Test Engineer: 50818
Configuration: EUT with 50Ohm load and a support laptop
Mode: TX Above 1GHz P band 2FSK worst case

Chamber	Pre-amplifer	Filter	Limit
3m Chamber B	3m Chamber B	Filter	ETSI 300 220 Tx

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss @ SG End (dBm)	Preamp (dB)	Attenuator (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Operating Channel 30										
1.694	-58.49	H	3.0	-12.9	38.5	1.0	-50.4	-30.0	-20.4	
2.397	-56.22	H	3.0	-6.7	38.7	1.0	-44.4	-30.0	-14.4	
5.213	-58.92	H	3.0	-4.2	38.7	1.0	-42.0	-30.0	-12.0	
1.122	-55.33	V	3.0	-13.5	38.4	1.0	-50.9	-30.0	-20.9	
1.731	-56.17	V	3.0	-10.2	38.5	1.0	-47.6	-30.0	-17.6	
2.738	-57.07	V	3.0	-6.6	38.6	1.0	-44.2	-30.0	-14.2	

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7.10.6. TX TRANSIENT POWER

REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.10.2

The TX TRANSIENT POWER shall not exceed the values given in Table 23.

Table 23: Transmitter Transient Power limits

Absolute offset from centre frequency	RBW_{REF}	Peak power limit applicable at measurement points
≤ 400 kHz	1 kHz	0 dBm
> 400 kHz	1 kHz	-27 dBm

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.10.3.2

RESULTS

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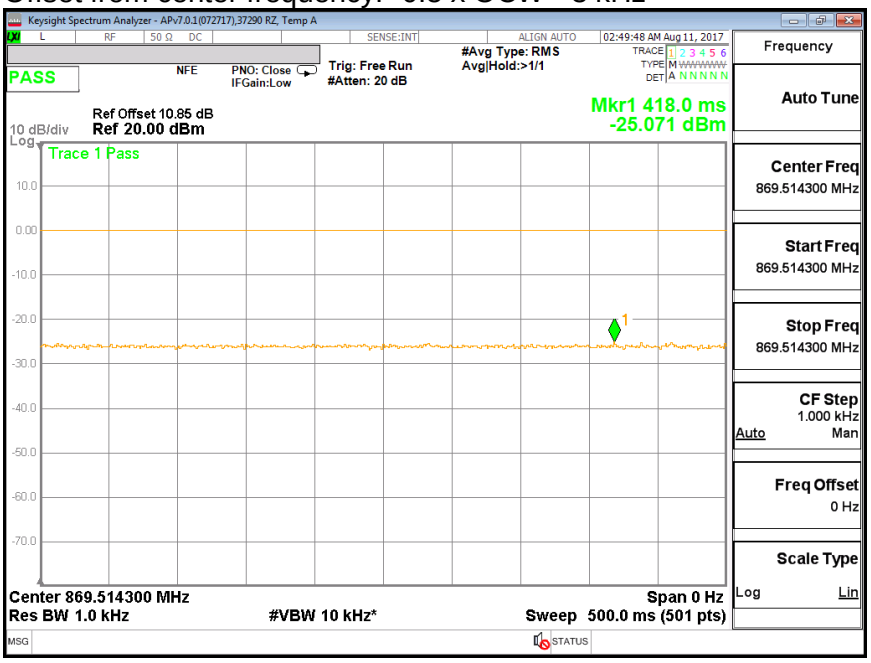
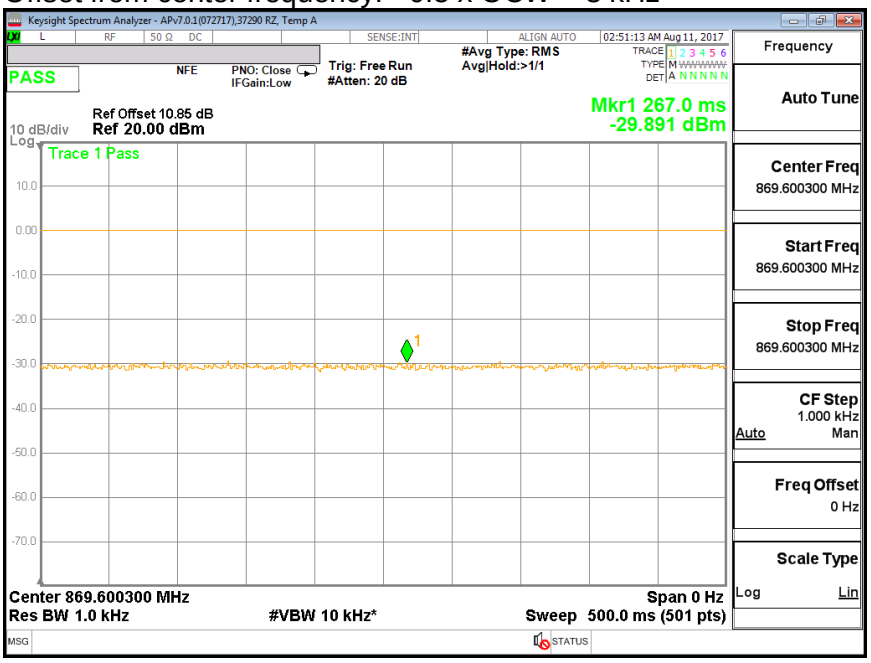
THE WORST CASE OF 2-FSK OPERATING CHANNEL

TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 3 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 3 kHz



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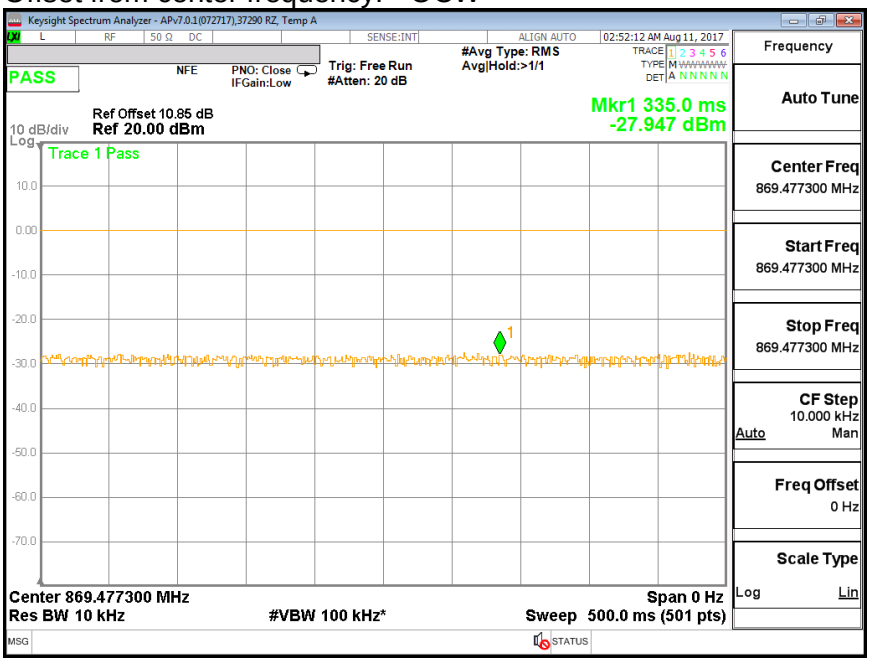
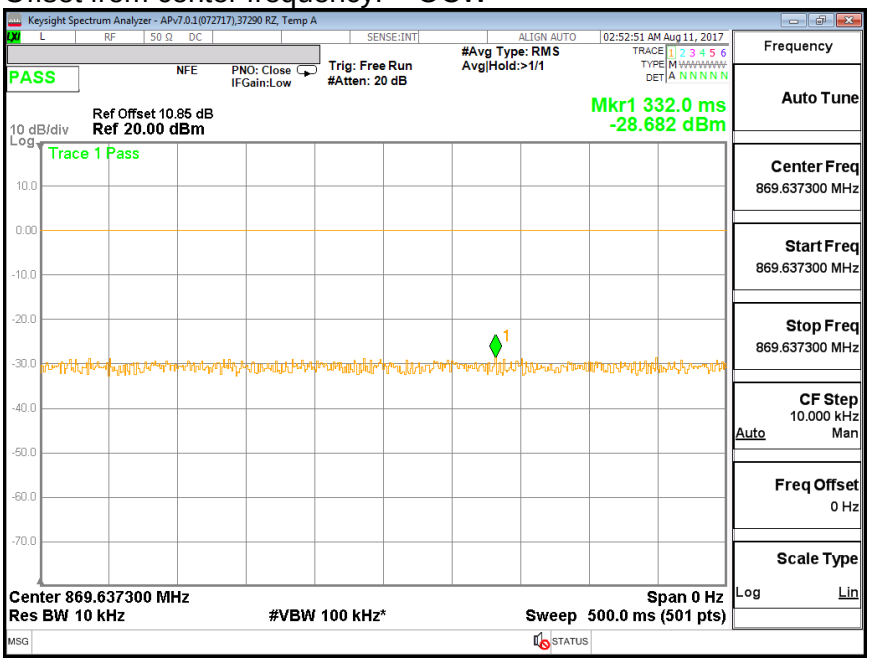
TX TRANSIENT
Offset from center frequency: - OCW



TX TRANSIENT
Offset from center frequency: + OCW



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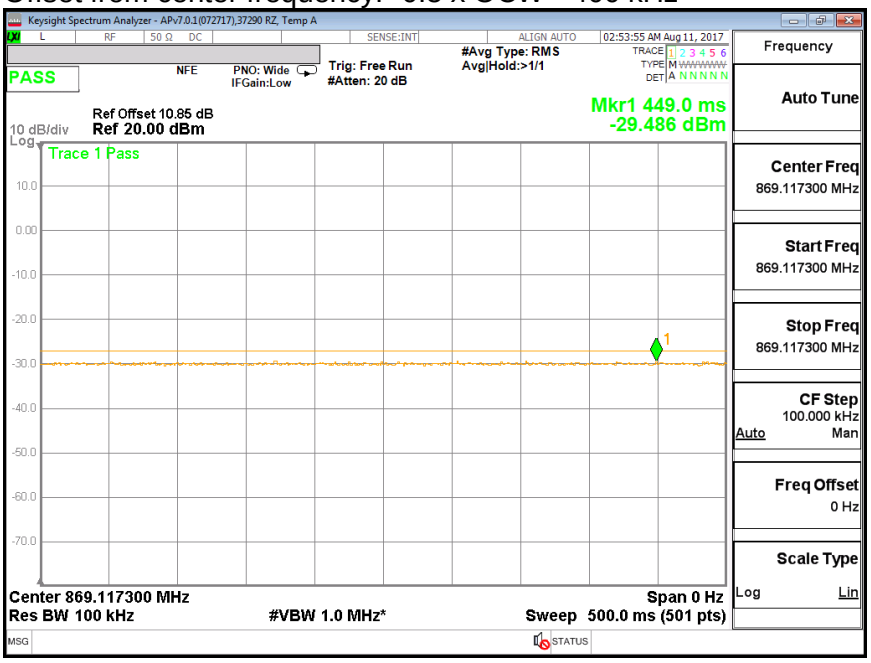
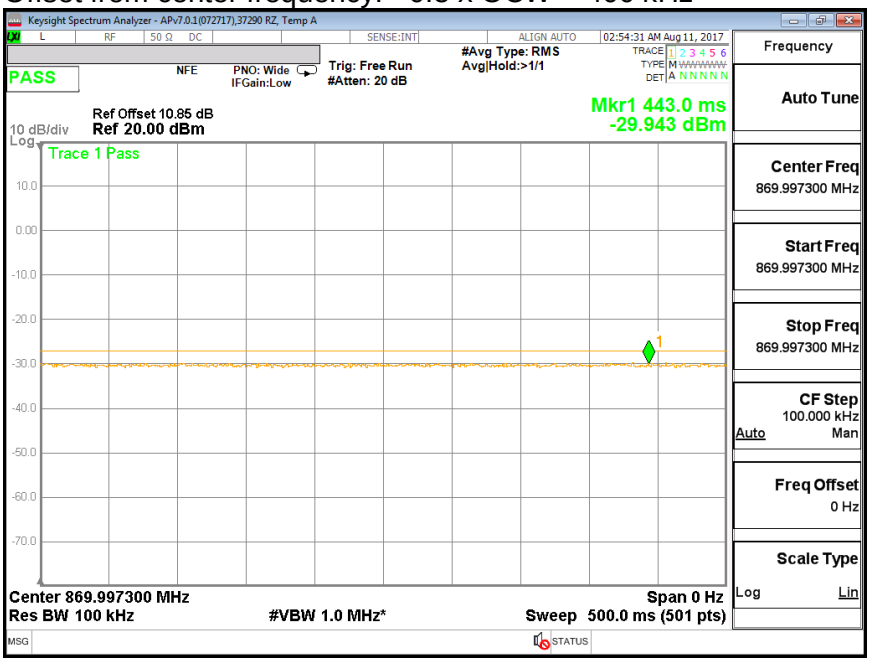
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 400 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 400 kHz



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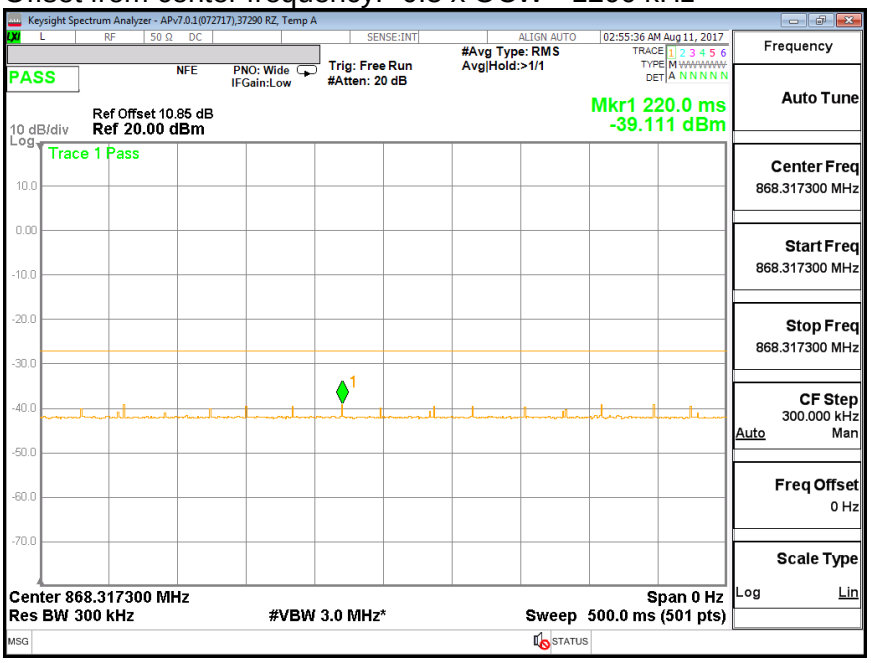
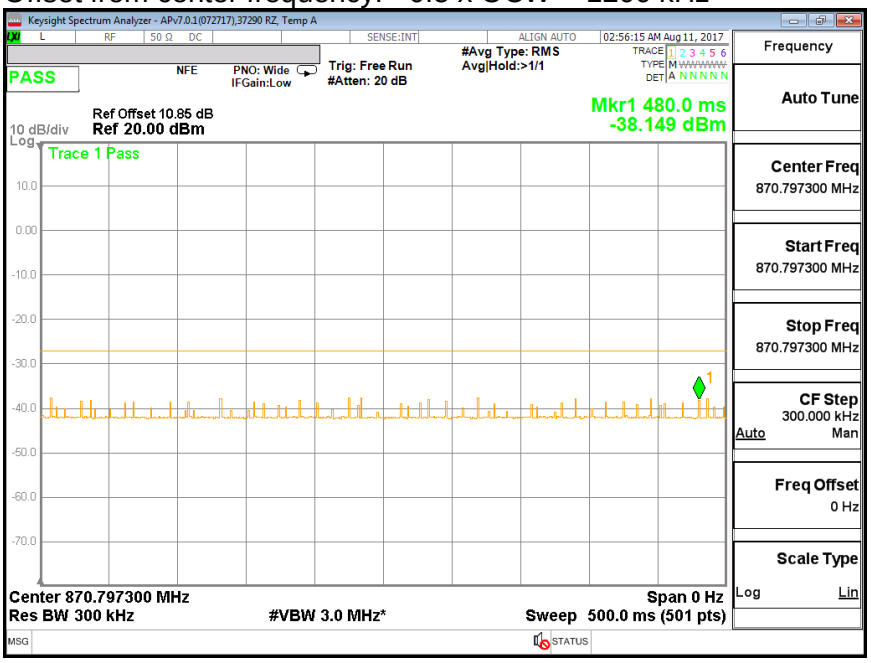
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 1200 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 1200 kHz



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7.11. 2-FSK MODULATION IN Q BAND

7.11.1. OPERATING FREQUENCY

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.2.1.2

The manufacturer may declare either one or more operating frequencies and operating channels.
Operating channel(s) shall be entirely within operational frequency bands allowed by annexes B, C or any NRI.

22 ETSI EN 300 220-2 V3.1.1 (2017-02)

Operational Frequency Band		Maximum effective radiated power, e.r.p.	Channel access and occupation rules (e.g. Duty cycle or LBT + AFA)	Maximum occupied bandwidth	Other usage restrictions	Band number from EC Decision 2013/752/EU [i.3]	Class 1 sub-class number according Commission Decision 2000/299/EU [i.7]
M	868,000 MHz to 868,600 MHz	25 mW e.r.p.	≤ 1 % duty cycle or polite spectrum access	The whole band except for audio & video applications limited to 300 kHz		48	28
N	868,700 MHz to 869,200 MHz	25 mW e.r.p.	≤ 0,1% duty cycle or polite spectrum access	The whole sub-band except for audio & video applications limited to 300 kHz		50	29
O	869,400 MHz to 869,650 MHz	25 mW e.r.p.	≤ 0.1% duty cycle or polite spectrum access	The whole band	.	54a	130
P	869,400 MHz to 869,650 MHz	500 mW e.r.p.	≤ 10 % duty cycle or polite spectrum access	The whole band		54b	30
Q	869,700 MHz to 870,000 MHz	5 mW e.r.p.	No requirement	The whole band	Audio and video applications are excluded.	56a	31
R	869,700 MHz to 870,000 MHz	25 mW e.r.p.	≤ 1% duty cycle or polite spectrum access	The whole band	Analogue audio applications are excluded. Analogue video applications are excluded.	56b	69

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.1.2

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RESULTS

Parameter	Values as declared by the manufacturer
M4, 2-FSK	
Operational Frequency band or bands	869.700 - 870.000
Nominal Operating Frequencies (MHz)	869.868759 - 869.920670
Operating Channel width(s) - OCW	80 kHz
M11, 2-FSK	
Operational Frequency band or bands	869.700 - 870.000
Nominal Operating Frequencies (MHz)	869.868759 - 869.920670
Operating Channel width(s) - OCW	40 kHz

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7.11.2. TX EFFECTIVE RADIATED POWER

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.3.1.2

The effective radiated power shall not be greater than the value allowed in annexes B or C for the chosen operational frequency band(s).

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.2.2.1.2

RESULTS

Date: 08/11/17
Project No: 11773240
Tester: 50818_JQ

CHANNELS FOR MODULATION CODE: M4

EUT Antenna Gain (dBi) =	2.00

Condition	Output Power (dBm)	EIRP (dBm)	ERP (dBm)	Limit (dBm)	Margin (dB)
Low Channel, CH36					
Normal	5.74	7.74	5.59	6.99	-1.40
Extreme T low, V low	6.83	8.83	6.68	6.99	-0.31
Extreme T low, V high	6.84	8.84	6.69	6.99	-0.30
Extreme T high, V low	5.03	7.03	4.88	6.99	-2.11
Extreme T high, V high	5.02	7.02	4.87	6.99	-2.12
High Channel, CH37					
Normal	5.73	7.73	5.58	6.99	-1.41
Extreme T low, V low	6.83	8.83	6.68	6.99	-0.31
Extreme T low, V high	6.83	8.83	6.68	6.99	-0.31
Extreme T high, V low	5.03	7.03	4.88	6.99	-2.11
Extreme T high, V high	5.02	7.02	4.87	6.99	-2.12

Note: Cable loss correction factor is included in the Power Meter Reading

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7.12. 2-FSK MODULATION IN R BAND

7.12.1. OPERATING FREQUENCY

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.2.1.2

The manufacturer may declare either one or more operating frequencies and operating channels.
Operating channel(s) shall be entirely within operational frequency bands allowed by annexes B, C or any NRI.

22 ETSI EN 300 220-2 V3.1.1 (2017-02)

Operational Frequency Band		Maximum effective radiated power, e.r.p.	Channel access and occupation rules (e.g. Duty cycle or LBT + AFA)	Maximum occupied bandwidth	Other usage restrictions	Band number from EC Decision 2013/752/EU [i.3]	Class 1 sub-class number according Commission Decision 2000/299/EU [i.7]
M	868,000 MHz to 868,600 MHz	25 mW e.r.p.	≤ 1 % duty cycle or polite spectrum access	The whole band except for audio & video applications limited to 300 kHz		48	28
N	868,700 MHz to 869,200 MHz	25 mW e.r.p.	≤ 0,1% duty cycle or polite spectrum access	The whole sub-band except for audio & video applications limited to 300 kHz		50	29
O	869,400 MHz to 869,650 MHz	25 mW e.r.p.	≤ 0.1% duty cycle or polite spectrum access	The whole band	.	54a	130
P	869,400 MHz to 869,650 MHz	500 mW e.r.p.	≤ 10 % duty cycle or polite spectrum access	The whole band		54b	30
Q	869,700 MHz to 870,000 MHz	5 mW e.r.p.	No requirement	The whole band	Audio and video applications are excluded.	56a	31
R	869,700 MHz to 870,000 MHz	25 mW e.r.p.	≤ 1% duty cycle or polite spectrum access	The whole band	Analogue audio applications are excluded. Analogue video applications are excluded.	56b	69

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.1.2

UL VERIFICATION SERVICES INC. FORM NO: CCSUP4701I
47173 BENICIA STREET, FREMONT, CA 94538, USA TEL: (510) 771-1000 FAX: (510) 661-0888
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RESULTS

Parameter	Values as declared by the manufacturer
M4, 2-FSK	
Operational Frequency band or bands	869.700 - 870.000
Nominal Operating Frequencies (MHz)	869.868759 - 869.920670
Operating Channel width(s) - OCW	80 kHz
M11, 2-FSK	
Operational Frequency band or bands	869.700 - 870.000
Nominal Operating Frequencies (MHz)	869.868759 - 869.920670
Operating Channel width(s) - OCW	40 kHz

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7.12.2. TX EFFECTIVE RADIATED POWER

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.3.1.2

The effective radiated power shall not be greater than the value allowed in annexes B or C for the chosen operational frequency band(s).

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.2.2.1.2

RESULTS

Date: 08/11/17
Project No: 11773240
Tester: 50818_JQ

CHANNELS FOR MODULATION CODE: M4

EUT Antenna Gain (dBi) =	2.00

Condition	Output Power (dBm)	EIRP (dBm)	ERP (dBm)	Limit (dBm)	Margin (dB)
Low Channel, CH36					
Normal	11.75	13.75	11.60	13.98	-2.38
Extreme T low, V low	12.50	14.50	12.35	13.98	-1.63
Extreme T low, V high	12.48	14.48	12.33	13.98	-1.65
Extreme T high, V low	11.20	13.20	11.05	13.98	-2.93
Extreme T high, V high	11.21	13.21	11.06	13.98	-2.92
High Channel, CH37					
Normal	11.74	13.74	11.59	13.98	-2.39
Extreme T low, V low	12.49	14.49	12.34	13.98	-1.64
Extreme T low, V high	12.48	14.48	12.33	13.98	-1.65
Extreme T high, V low	11.20	13.20	11.05	13.98	-2.93
Extreme T high, V high	11.20	13.20	11.05	13.98	-2.93

Note: Cable loss correction factor is included in the Power Meter Reading

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7.12.3. TX OCCUPIED BANDWIDTH

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.3.4.2

The occupied bandwidth of the EUT according to ETSI EN 300 220-1 [1], clause 5.6.2 shall comply with the limits in annex B or C.

Reference Limit:

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.6.2

The Operating Channel shall be declared and shall reside entirely within the Operational Frequency Band. The Maximum Occupied Bandwidth at 99 % shall reside entirely within the Operating Channel defined by F_{low} and F_{high}.

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.6.3.3 (Conducted Measurement)

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RESULTS

BAND R

Condition	Low CH (MHz)	High CH (MHz)	Low CH OBW (kHz)	High CH OBW (kHz)	F_{Low} (MHz)	F_{Low} Limit (MHz)	F_{High} (MHz)	F_{High} Limit (MHz)
M4, 2-FSK								
Normal	869.8688	869.9207	64.966	64.365	869.84	> 869.7	869.95	< 870
T low, V low	869.8688	869.9207	64.638	64.129	869.84	> 869.7	869.95	< 870
T low, V high	869.8688	869.9207	64.565	64.634	869.84	> 869.7	869.95	< 870
T high, V low	869.8688	869.9207	63.354	63.167	869.84	> 869.7	869.95	< 870
T high, V high	869.8688	869.9207	64.406	64.218	869.84	> 869.7	869.95	< 870
M11, 2-FSK								
Normal	869.8688	869.9207	38.306	38.441	869.85	> 869.7	869.94	< 870
T low, V low	869.8688	869.9207	37.620	37.955	869.85	> 869.7	869.94	< 870
T low, V high	869.8688	869.9207	37.589	38.052	869.85	> 869.7	869.94	< 870
T high, V low	869.8688	869.9207	38.464	38.064	869.85	> 869.7	869.94	< 870
T high, V high	869.8688	869.9207	38.127	38.275	869.85	> 869.7	869.94	< 870

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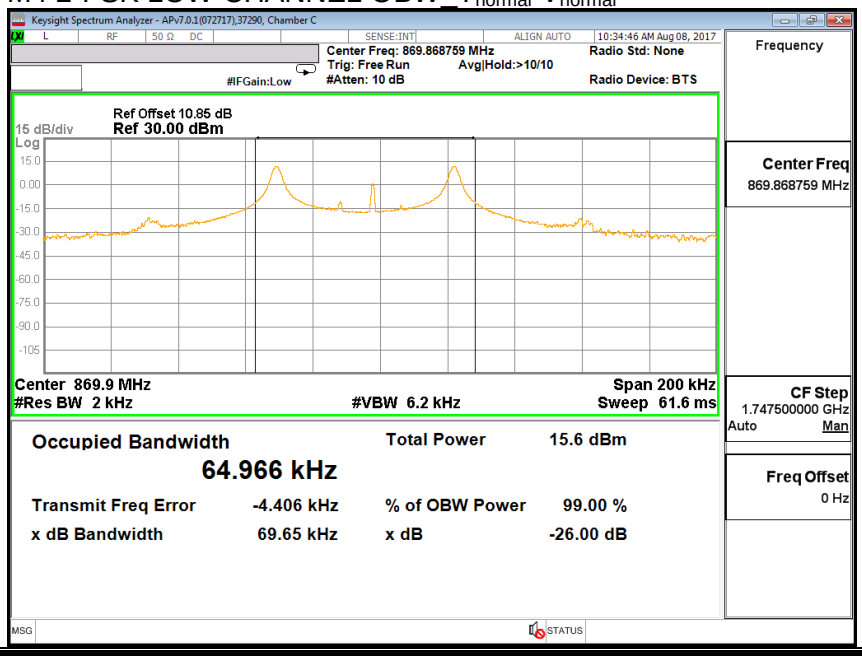
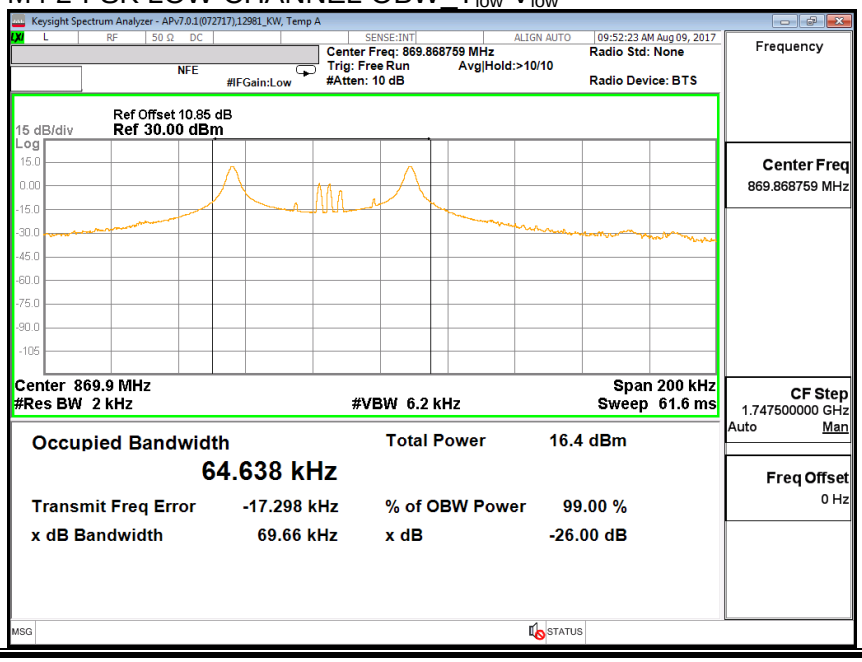
M4 2-FSK LOW CHANNEL OBW_T_{normal} V_{normal}



M4 2-FSK LOW CHANNEL OBW_T_{low} V_{low}



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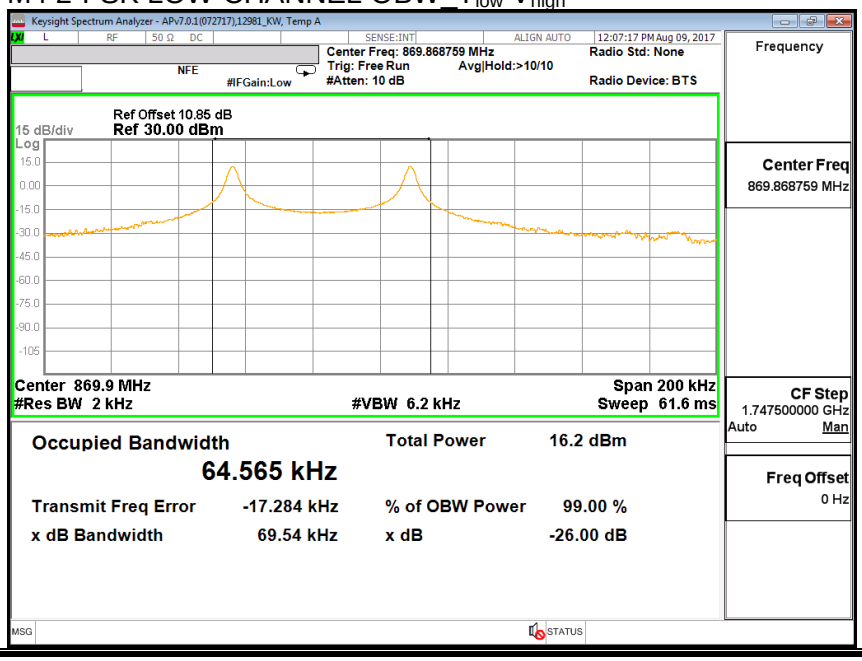
M4 2-FSK LOW CHANNEL OBW_T_{low} V_{high}



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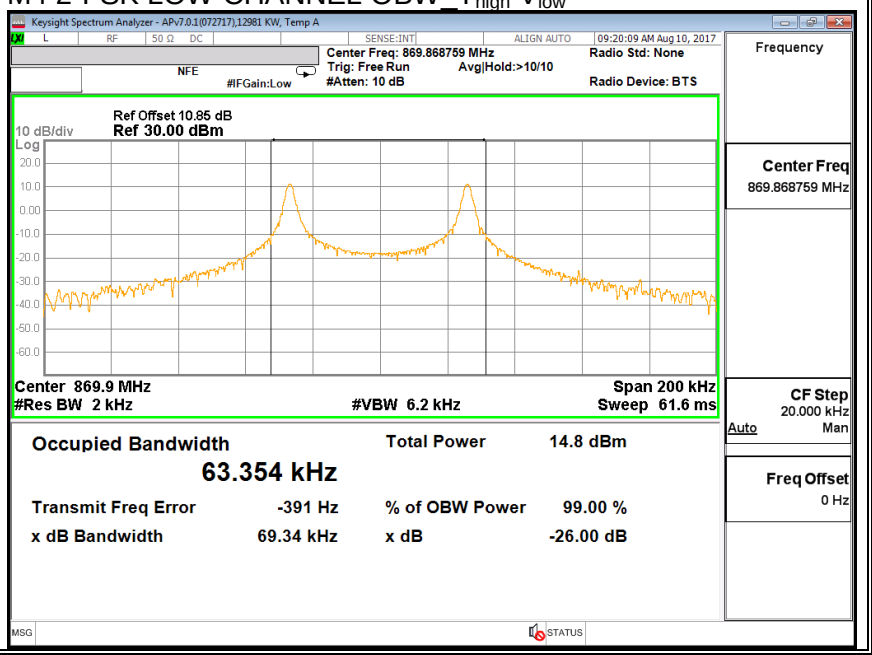

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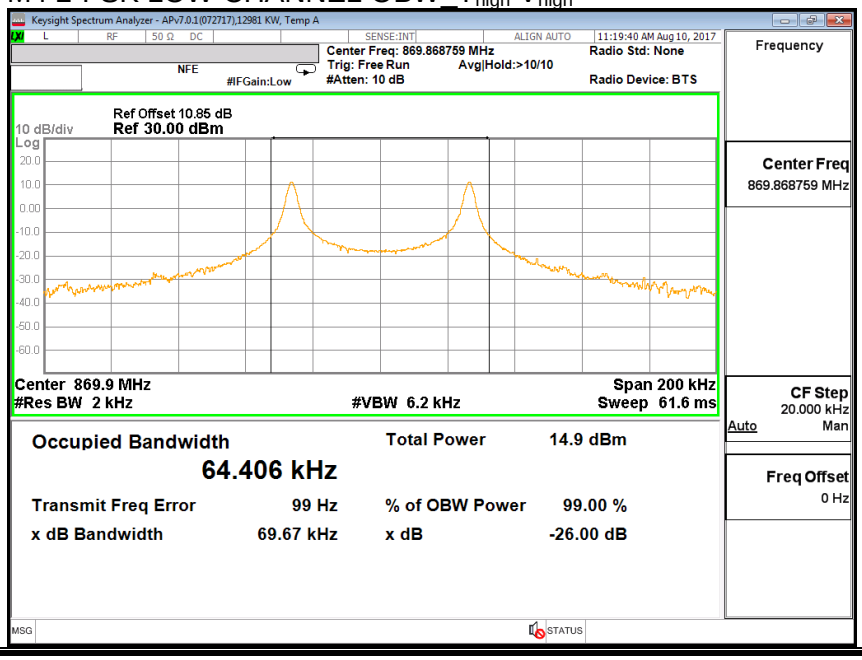
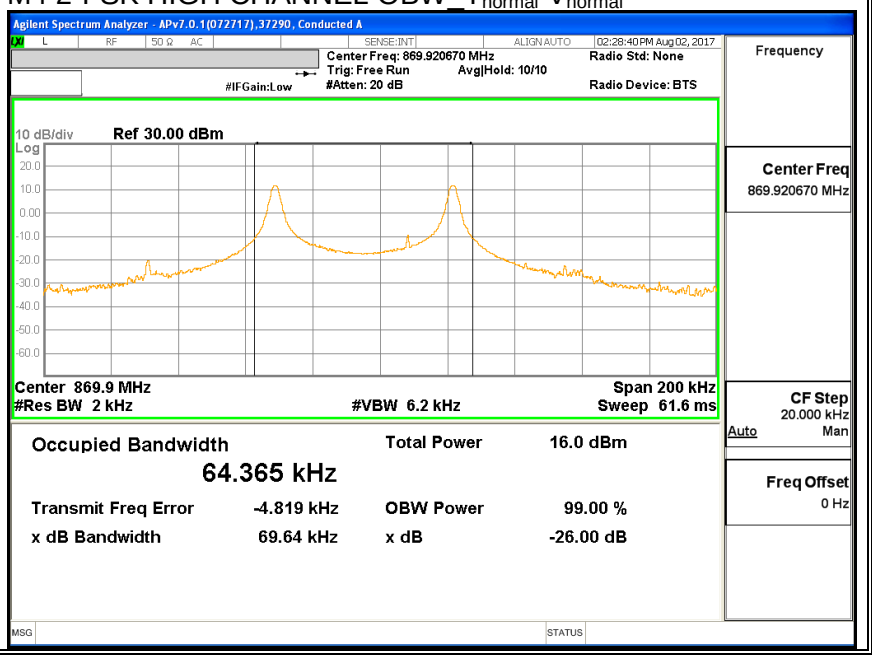
M4 2-FSK LOW CHANNEL OBW_T_{high} V_{high}



M4 2-FSK HIGH CHANNEL OBW_T_{normal} V_{normal}



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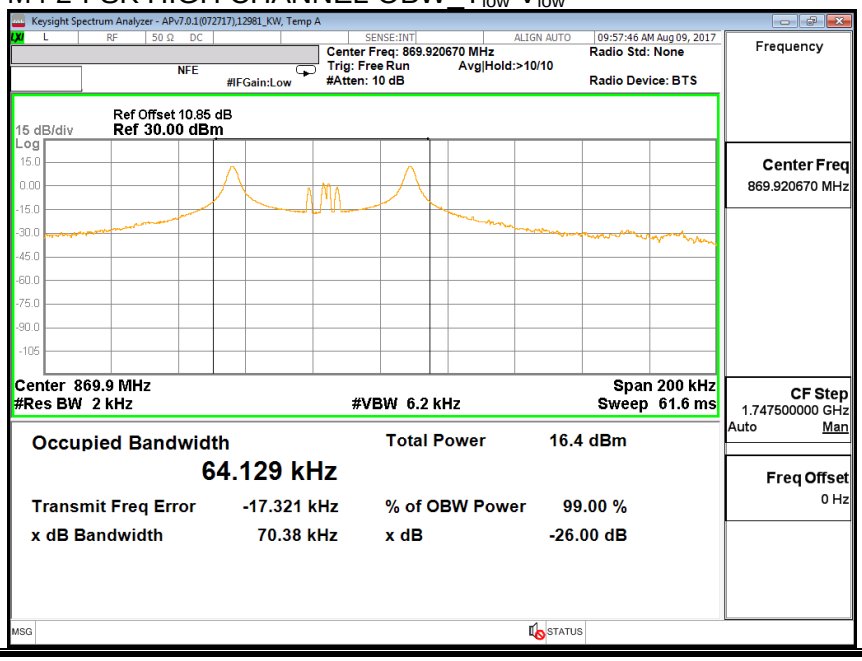
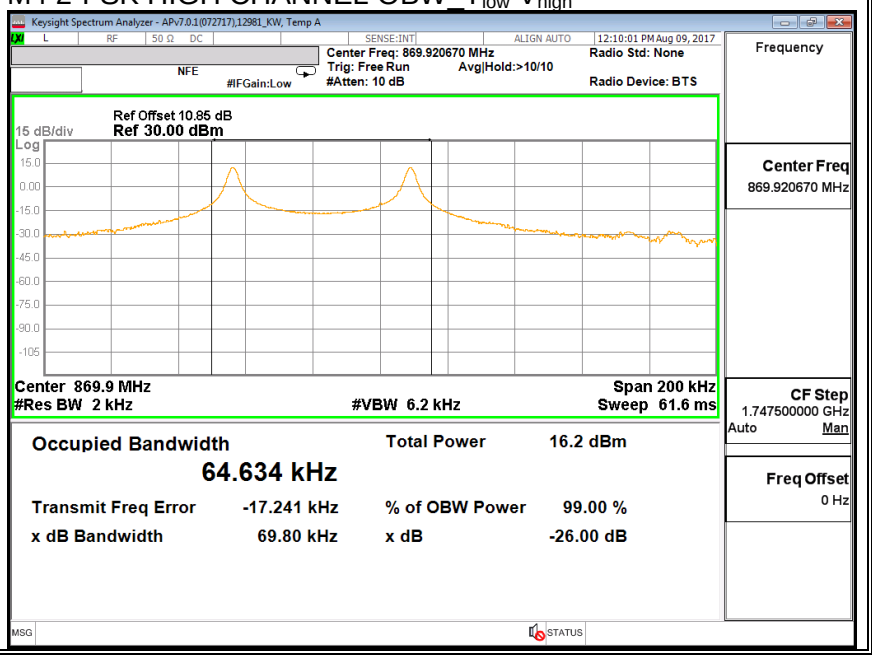
M4 2-FSK HIGH CHANNEL OBW_T_{low} V_{low}



M4 2-FSK HIGH CHANNEL OBW_T_{low} V_{high}



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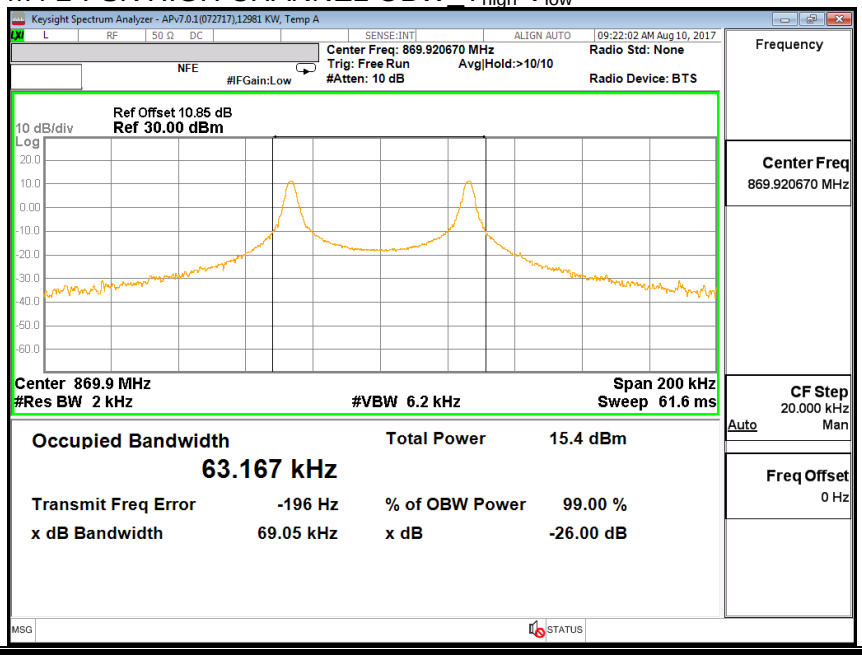
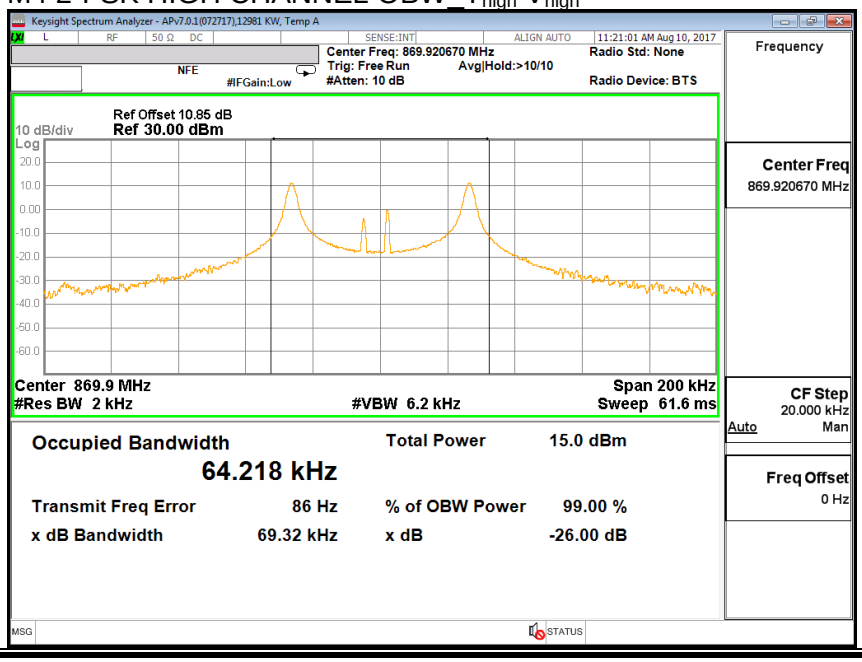
M4 2-FSK HIGH CHANNEL OBW_T_{high} V_{low}



M4 2-FSK HIGH CHANNEL OBW_T_{high} V_{high}



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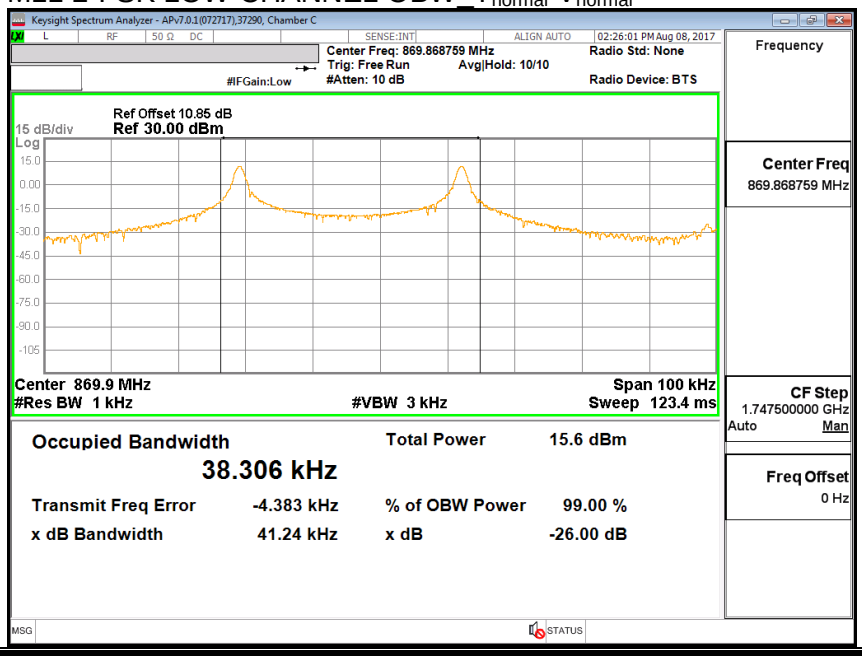
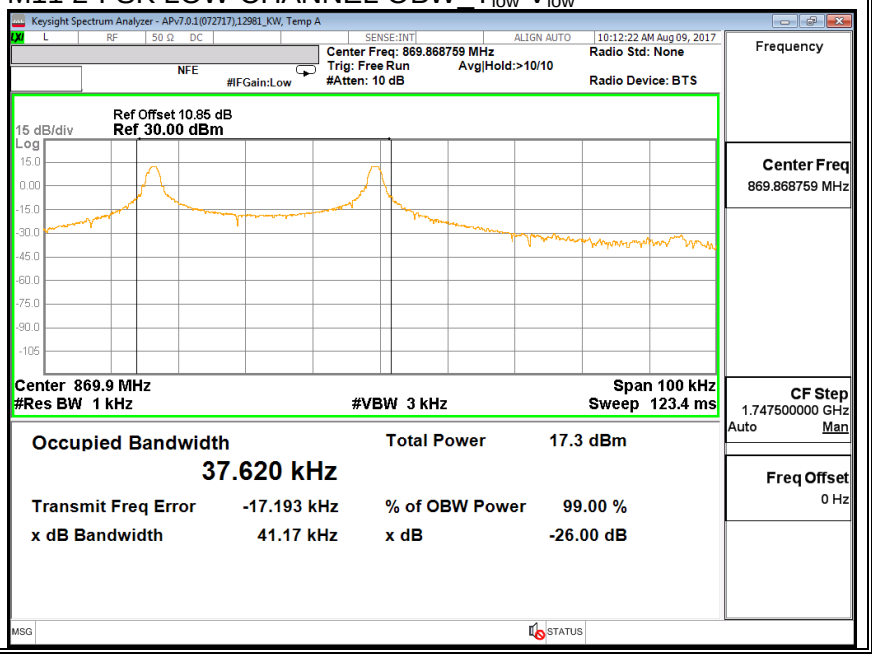
M11 2-FSK LOW CHANNEL OBW_T_{normal} V_{normal}



M11 2-FSK LOW CHANNEL OBW_T_{low} V_{low}



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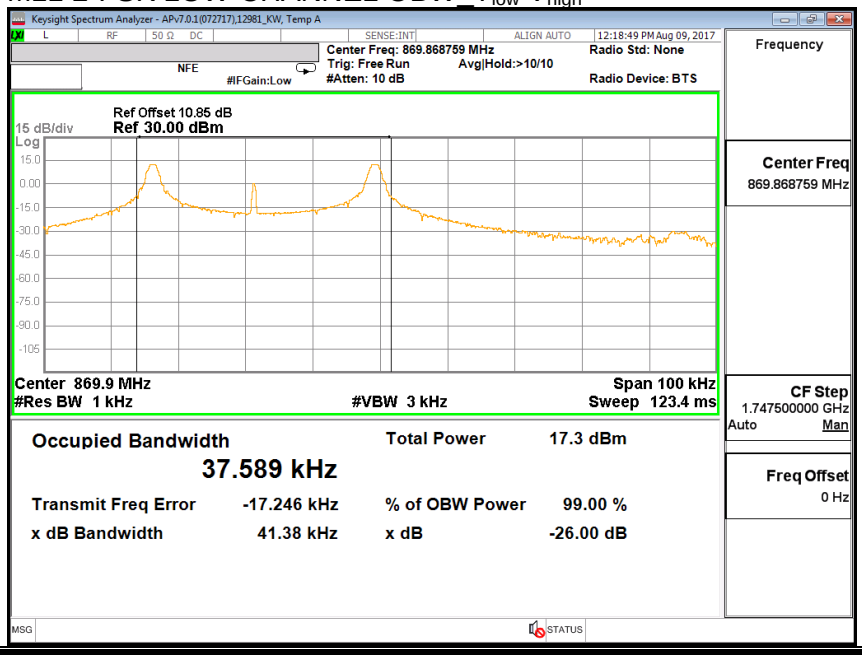
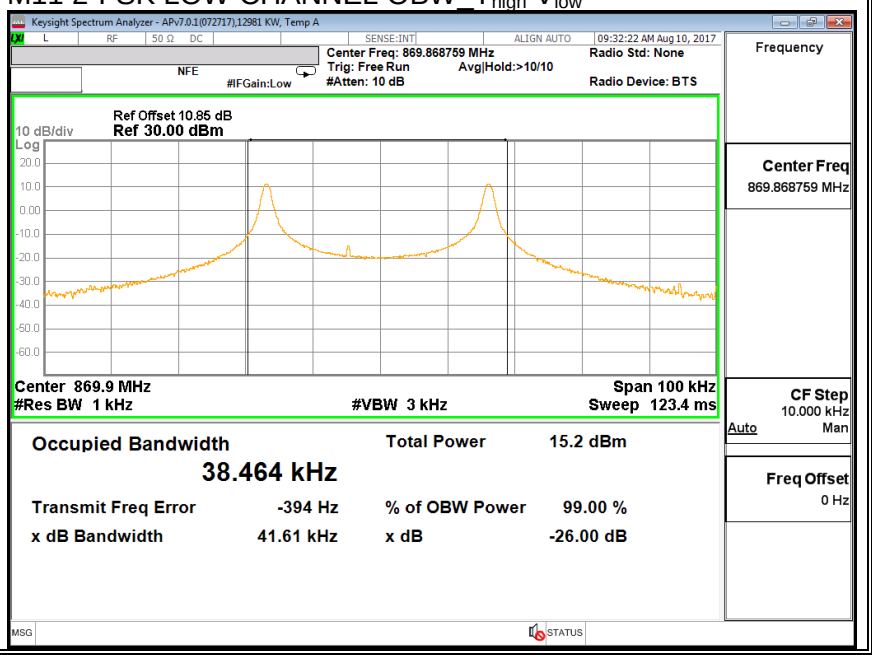
M11 2-FSK LOW CHANNEL OBW_T_{low} V_{high}



M11 2-FSK LOW CHANNEL OBW_T_{high} V_{low}



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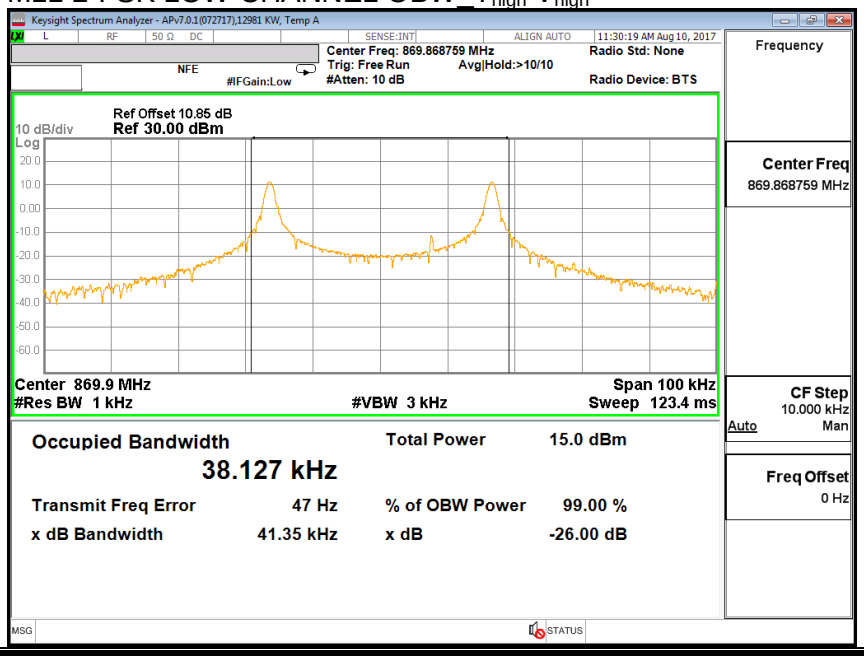
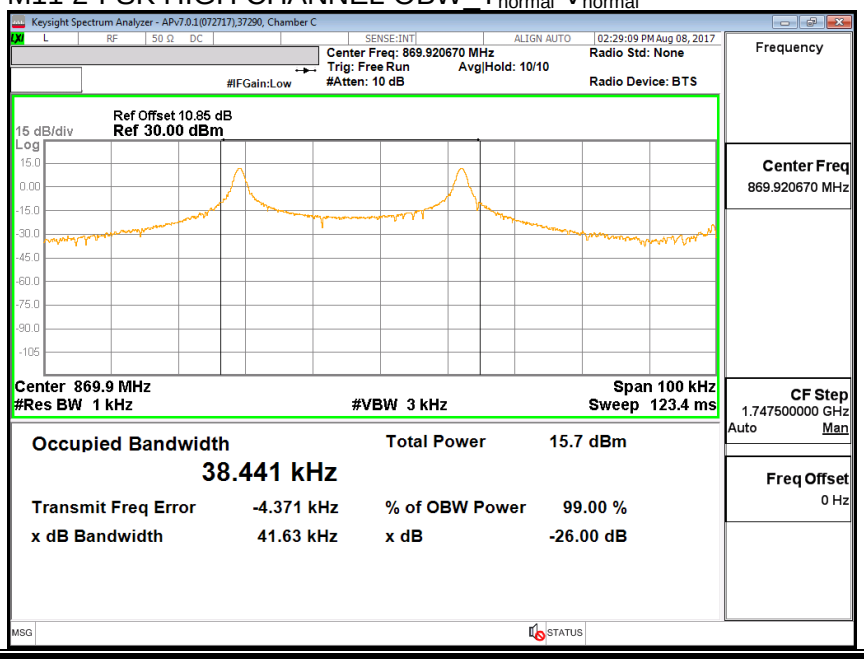
M11 2-FSK LOW CHANNEL OBW_T_{high} V_{high}



M11 2-FSK HIGH CHANNEL OBW_T_{normal} V_{normal}



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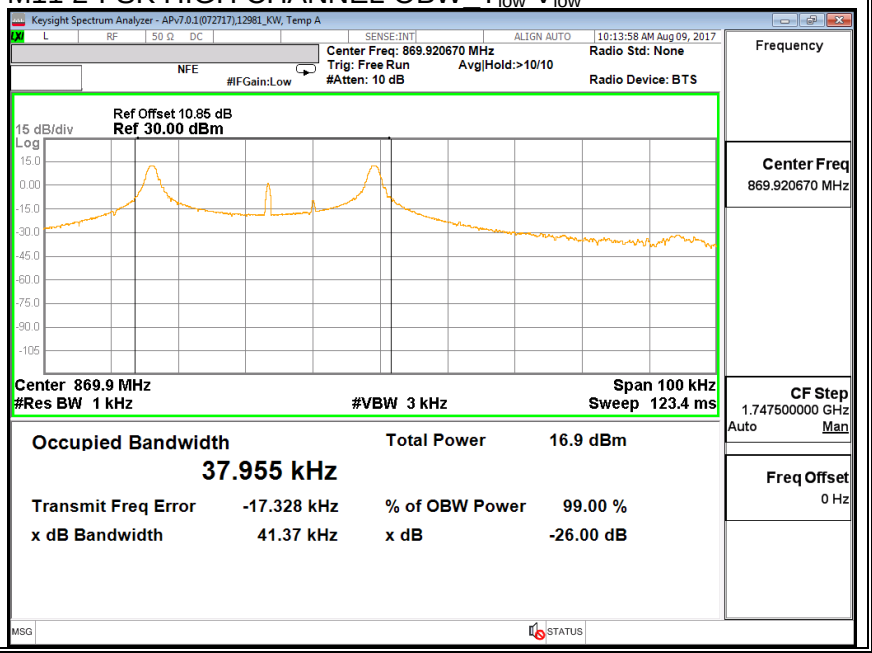
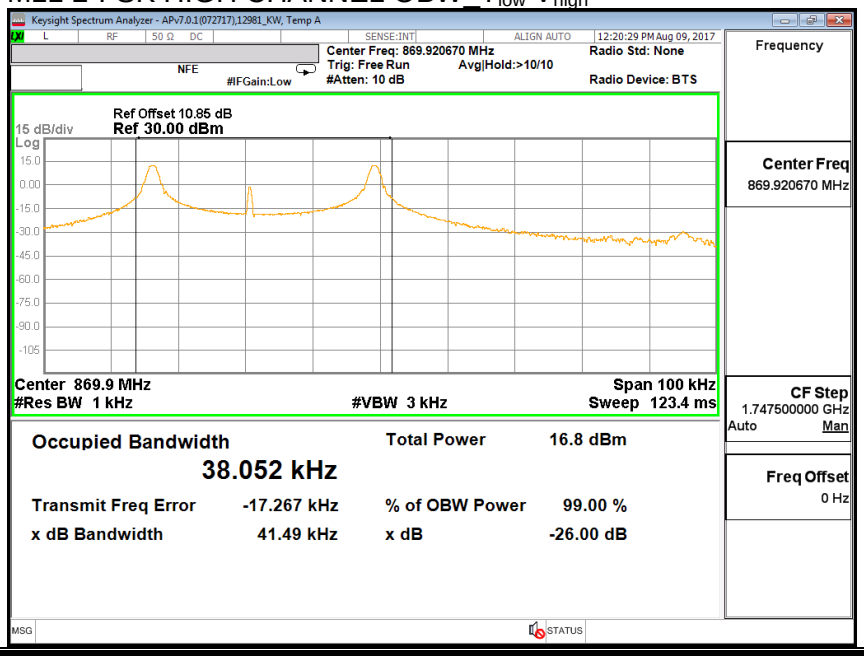
M11 2-FSK HIGH CHANNEL OBW_T_{low} V_{low}



M11 2-FSK HIGH CHANNEL OBW_T_{low} V_{high}



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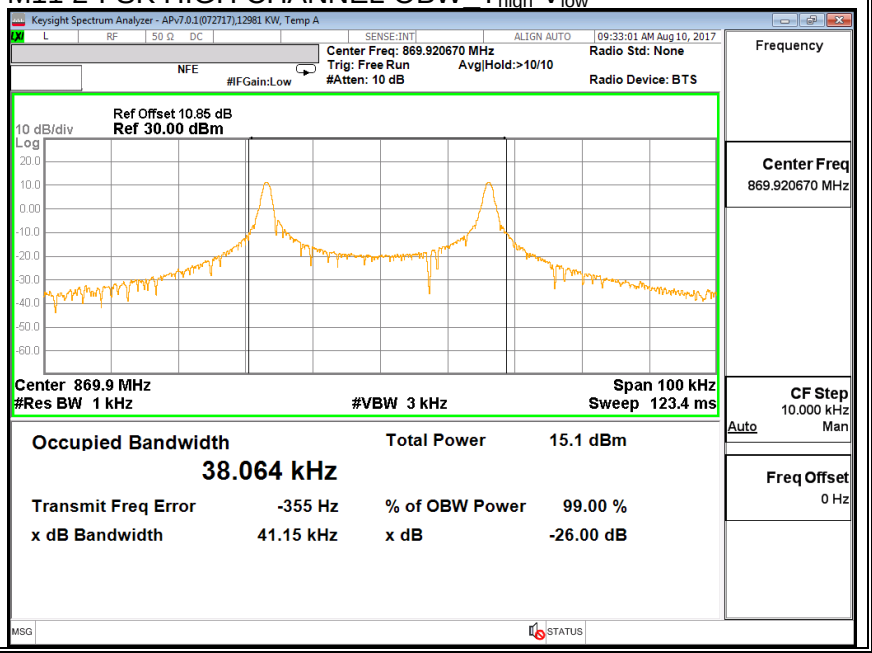
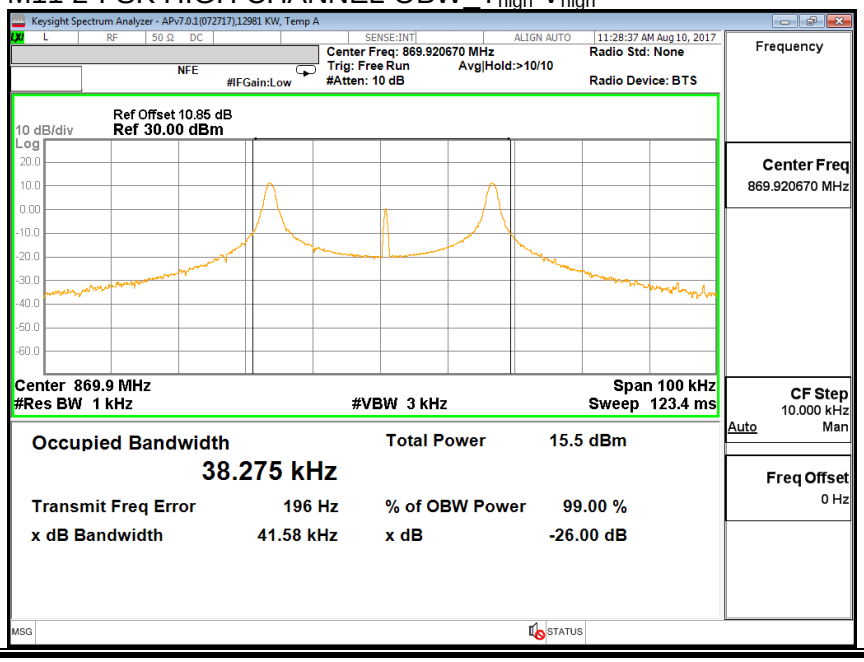
M11 2-FSK HIGH CHANNEL OBW_T_{high} V_{low}



M11 2-FSK HIGH CHANNEL OBW_T_{high} V_{high}



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7.12.4. TX OUT OF BAND EMISSIONS

REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.1

Two OOB domains are defined, one for OC (see Figure 5) and one for Operational Frequency band (see Figure 6). The spectrum masks for these two OOB domains may overlap.

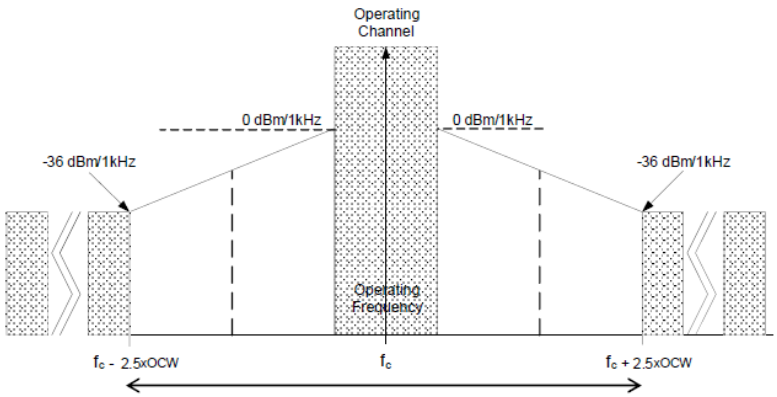

Figure 5: Out Of Band Domain for Operating Channel with reference BW

Unwanted emissions in the Out Of Band domain are those falling in the frequency range immediately below the lower, and above the upper, frequency of the Operating Channel. The OOB domain includes both frequencies outside the Operating Channel within the Operational Frequency Band and frequencies outside the Operational Frequency Band.
The relevant Out Of Band domain is shown in Figure 5 and applies within the Operational Frequency Band.

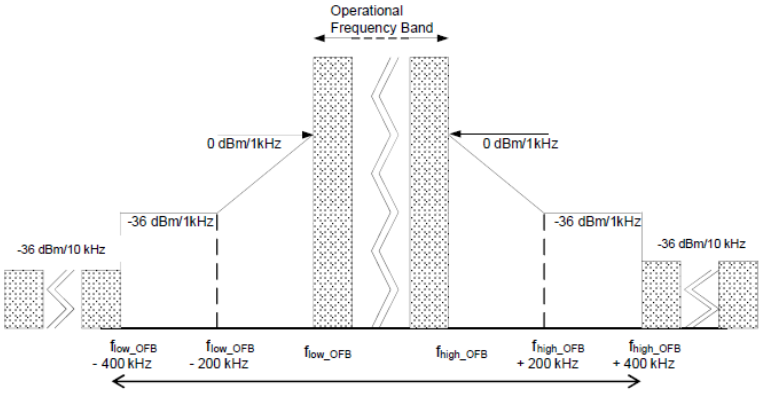

Figure 6: Out Of Band Domain for Operational Frequency Band with reference BW

Specific limits apply at frequencies immediately above and below the Operational Frequency Band as shown in Figure 6.
NOTE: f_{low}_OFB is the lower edge of the Operational Frequency Band. f_{high}_OFB is the upper edge of the Operational Frequency Band.

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REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.2

The EUT emissions level in OOB domains for the Operating Channel and the Operational Frequency Band shall be less or equal to Table 15 spectrum mask.

Table 15: Emission limits in the Out Of Band domains

Domain	Frequency Range	RBW_{REF}	Max power limit
OOB limits applicable to Operational Frequency Band (See Figure 6)	$f \le f_{low_OFB}$ - 400 kHz	10 kHz	-36 dBm
	F_{low_OFB} - 400 kHz ≤ f ≤ f_{low_OFB} - 200 kHz	1 kHz	-36 dBm
	f_{low} - 200 kHz ≤ f < f_{low_OFB}	1 kHz	See Figure 6
	$f = f_{low_OFB}$	1 kHz	0 dBm
	$f = f_{high_OFB}$	1 kHz	0 dBm
	F_{high_OFB} < f ≤ f_{high_OFB} + 200 kHz	1 kHz	See Figure 6
	F_{high_OFB} + 200 kHz ≤ f ≤ f_{high_OFB} + 400 kHz	1 kHz	-36 dBm
	F_{high_OFB} + 400 kHz ≤ f	10 kHz	-36 dBm
OOB limits applicable to Operating Channel (See Figure 5)	$f = f_c$- 2.5 x OCW	1 kHz	-36 dBm
	f_c - 2,5 x OCW ≤ f ≤ f_c - 0,5 x OCW	1 kHz	See Figure 5
	$f = f_c$ - 0,5 x OCW	1 kHz	0 dBm
	$f = f_c$ + 0,5 x OCW	1 kHz	0 dBm
	f_c + 0,5 x OCW ≤ f ≤ f_c + 2,5 x OCW	1 kHz	See Figure 5
	$f = f_c$+ 2,5 x OCW	1 kHz	-36 dBm

NOTE: f is the measurement frequency.
f_c is the Operating Frequency.
F_{low_OFB} is the lower edge of the Operational Frequency Band.
F_{high_OFB} is the upper edge of the Operational Frequency Band.
OCW is the operating channel bandwidth.

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.3.3 (Conducted Measurement)

RESULTS

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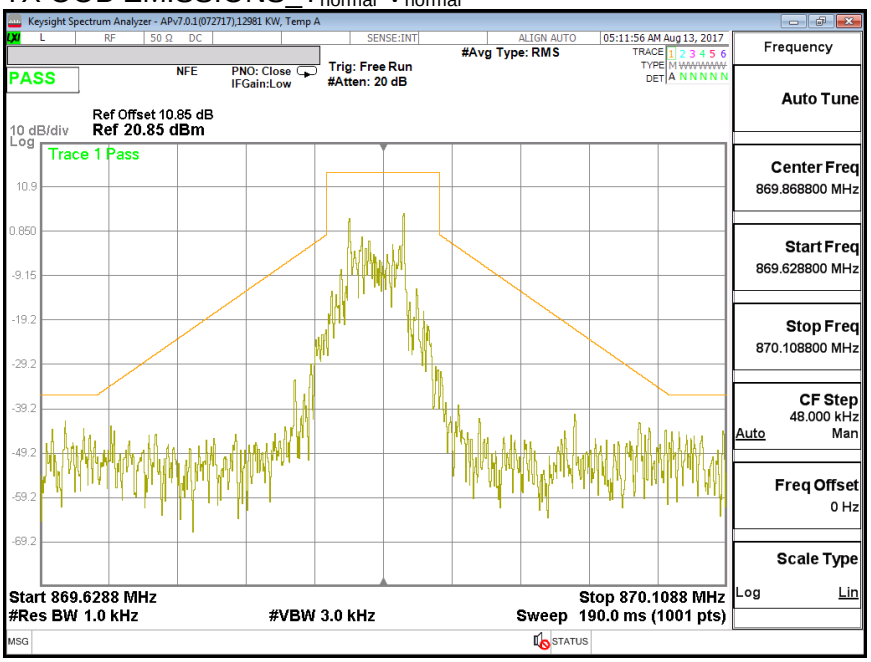
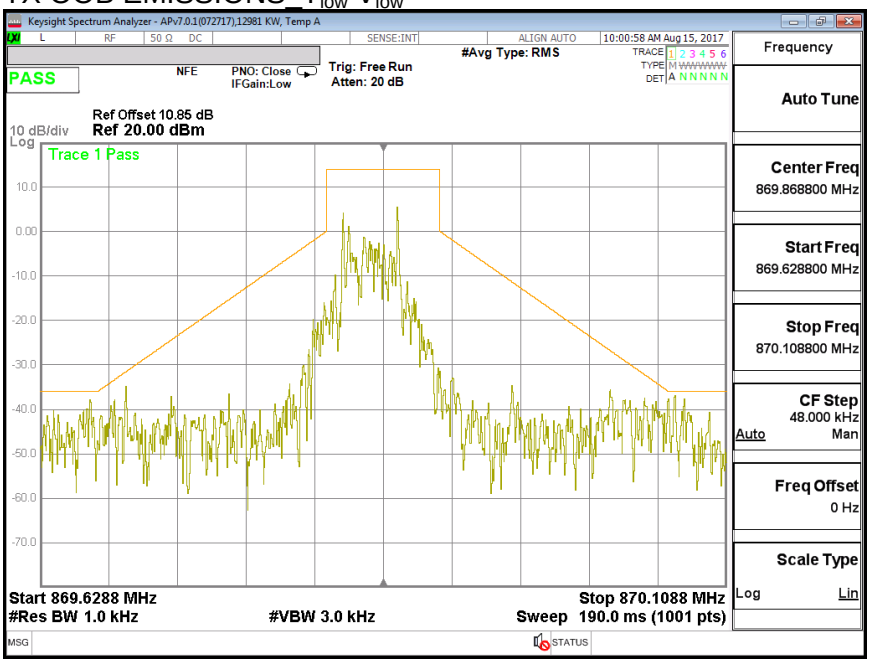
TX OUT OF BAND EMISSIONS (APPLICABLE TO OPERATING CHANNEL)

M4 LOW CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal}



TX OOB EMISSIONS_T_{low} V_{low}



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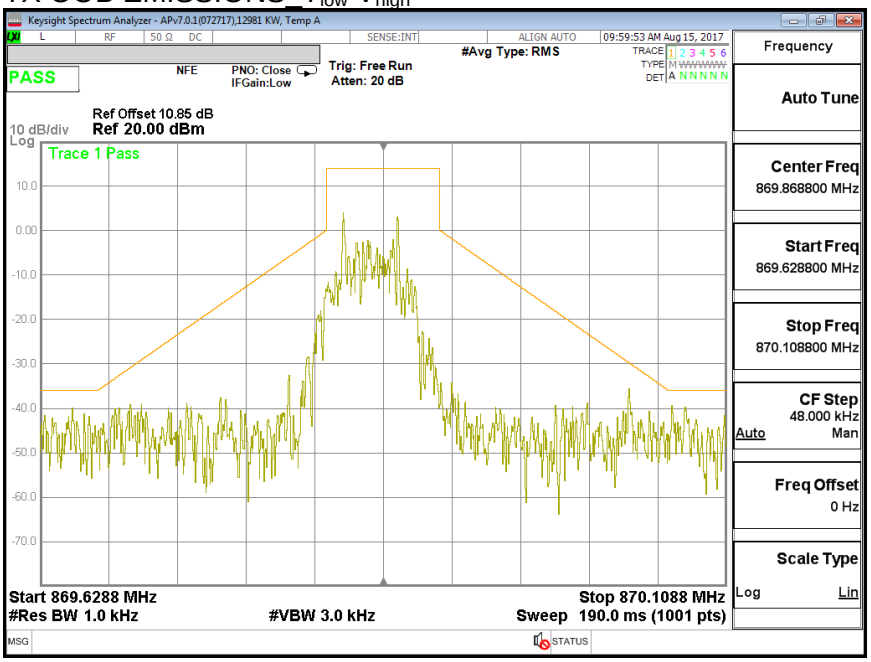
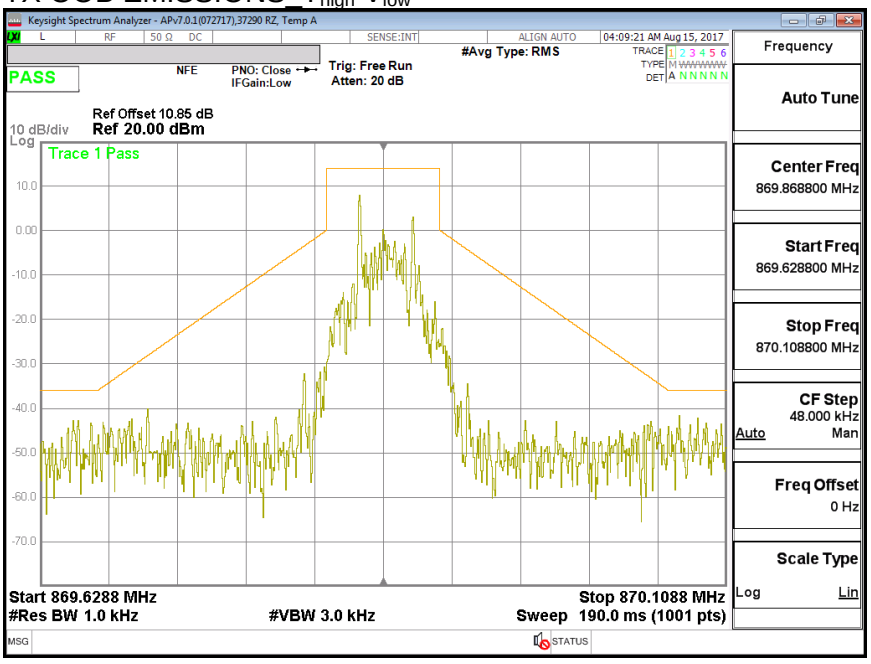
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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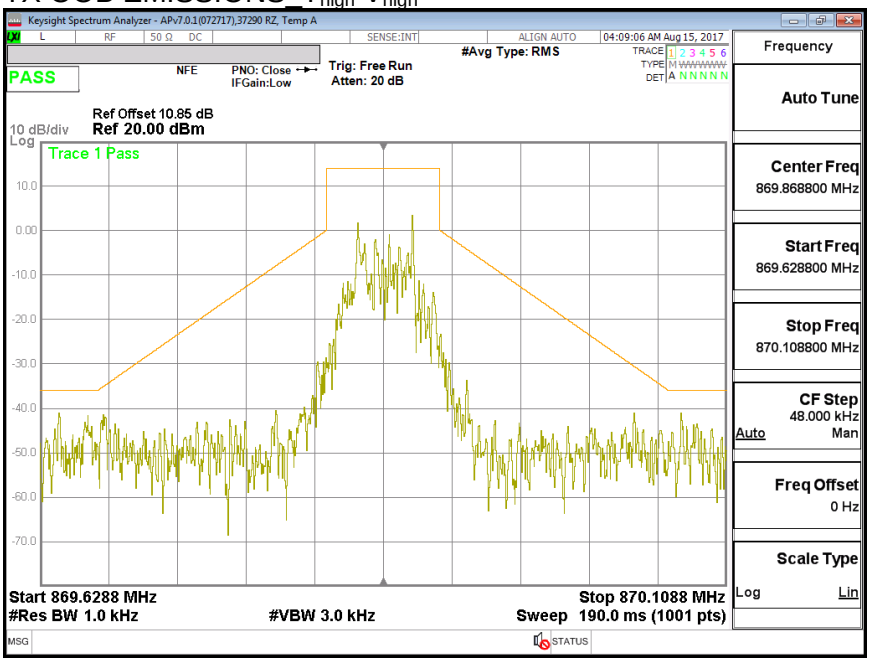
TX OOB EMISSIONS_T_{high} V_{high}



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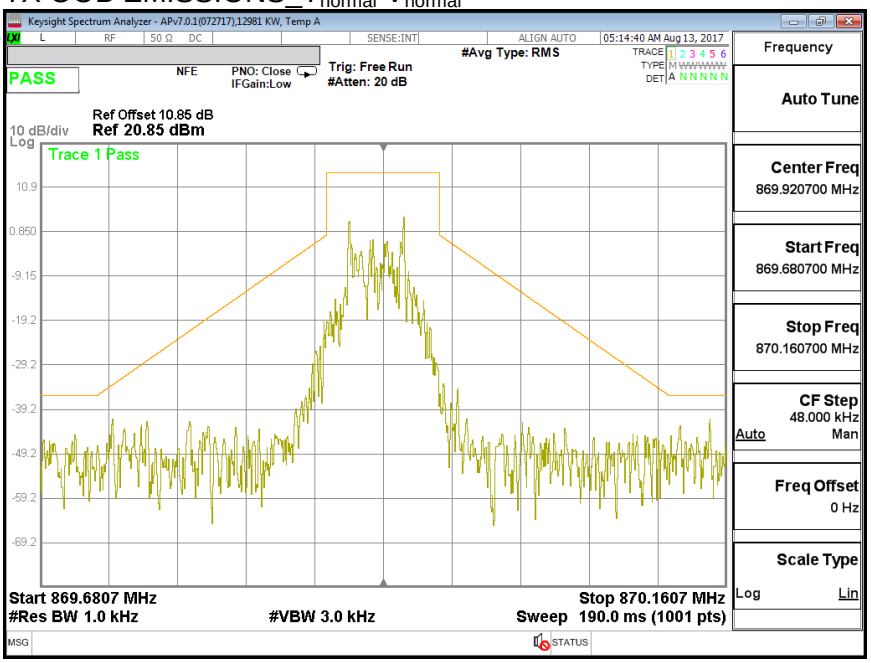
M4 HIGH CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$



TX OOB EMISSIONS_T$_{low}$ V$_{low}$

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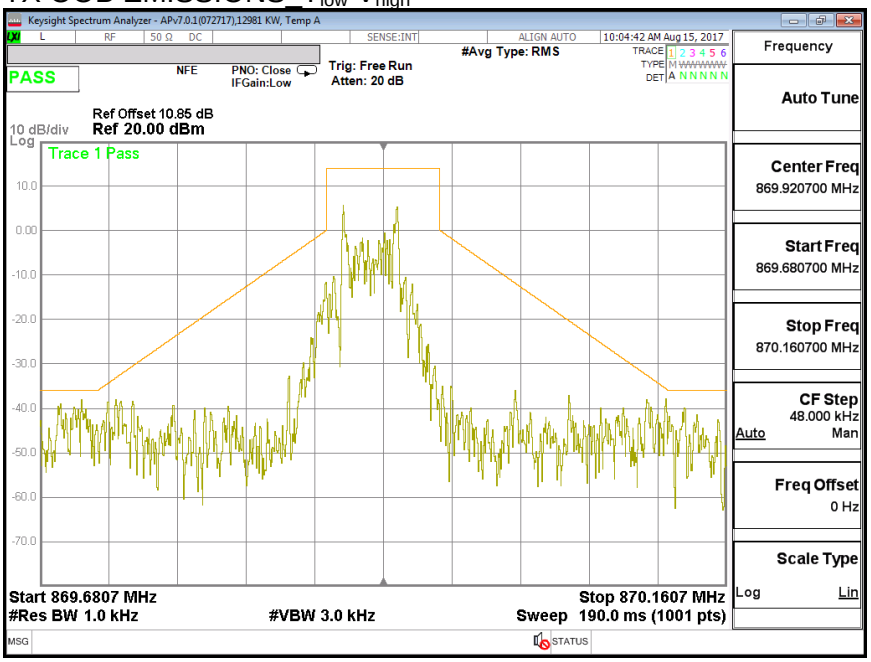
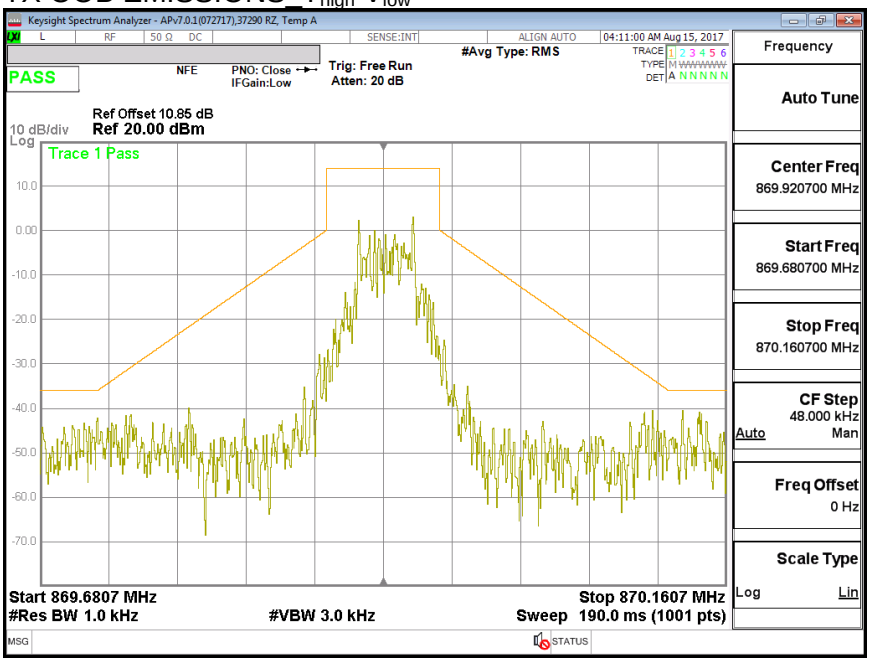
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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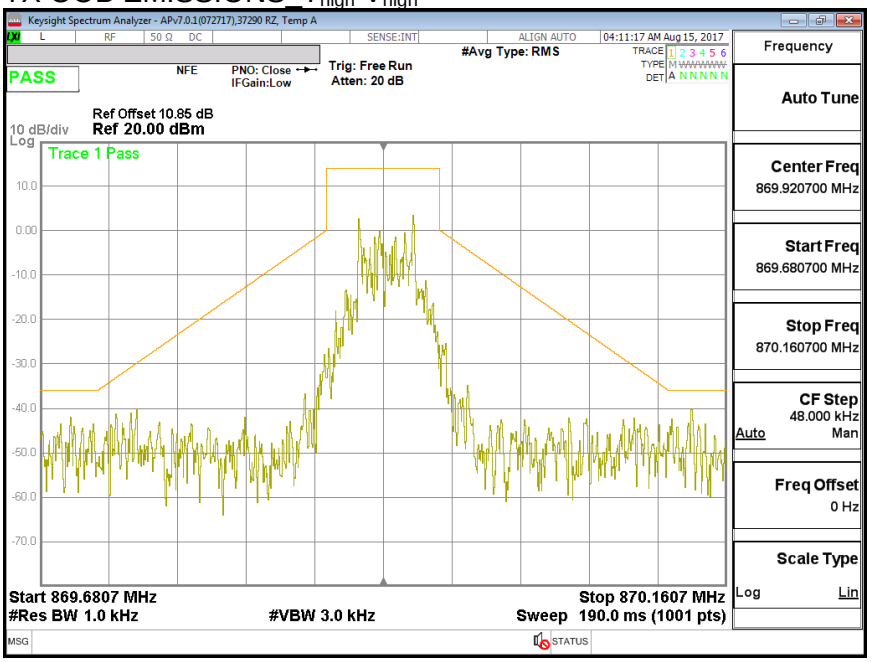
TX OOB EMISSIONS_T_{high} V_{high}



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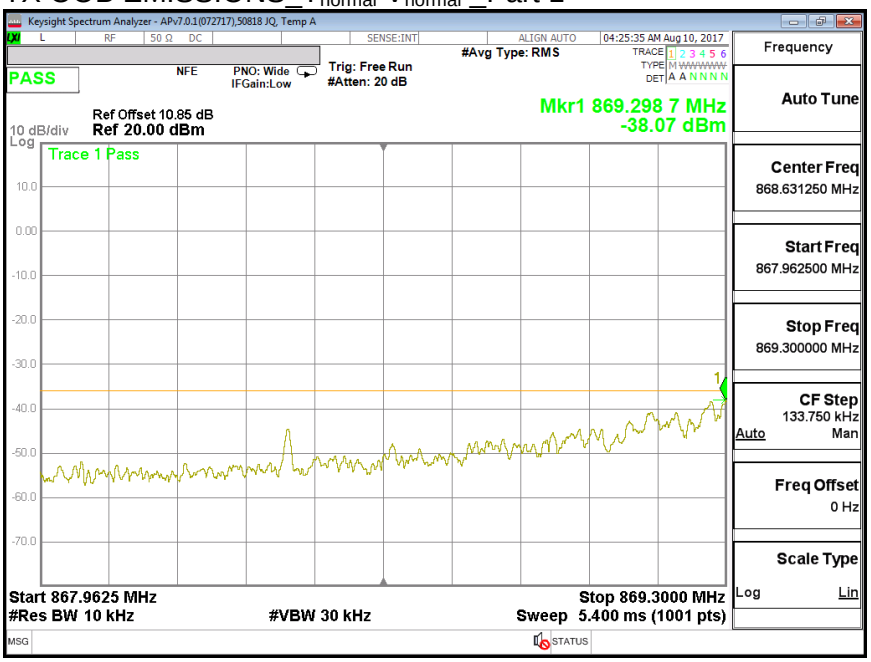
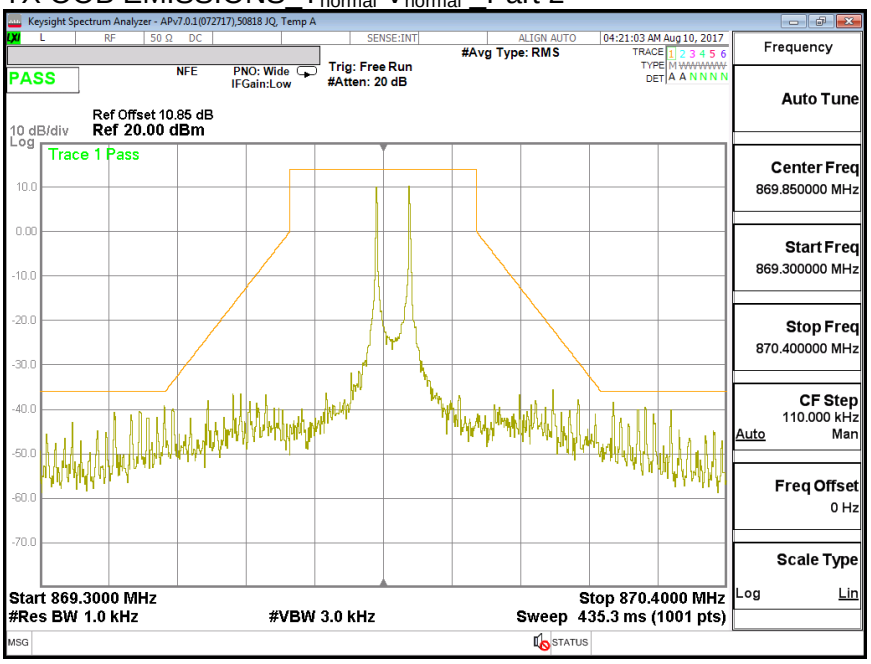
TX OUT OF BAND EMISSIONS (APPLICABLE TO OPERATIONAL FREQUENCY BANDS)

M4 LOW CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 1



TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 2



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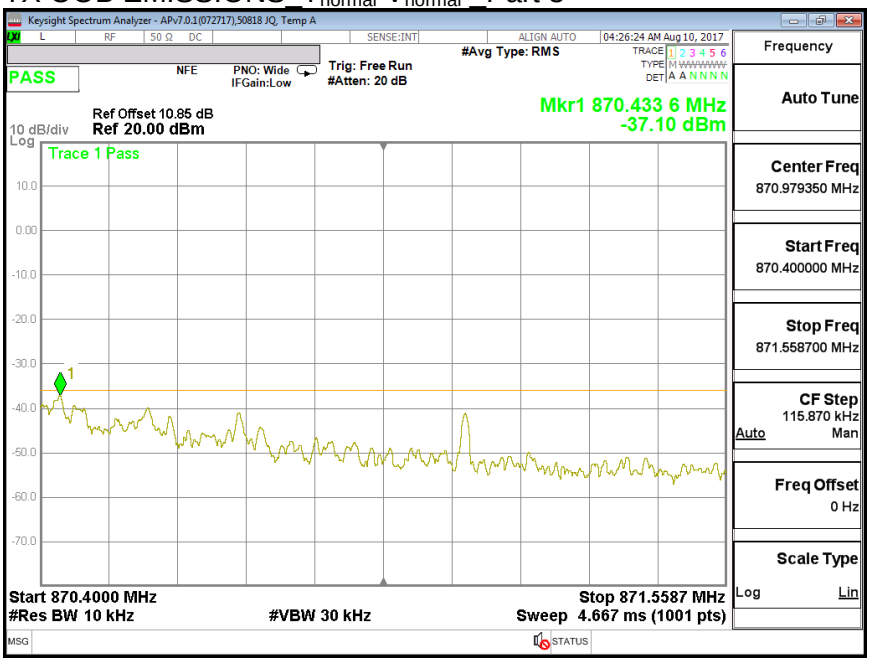
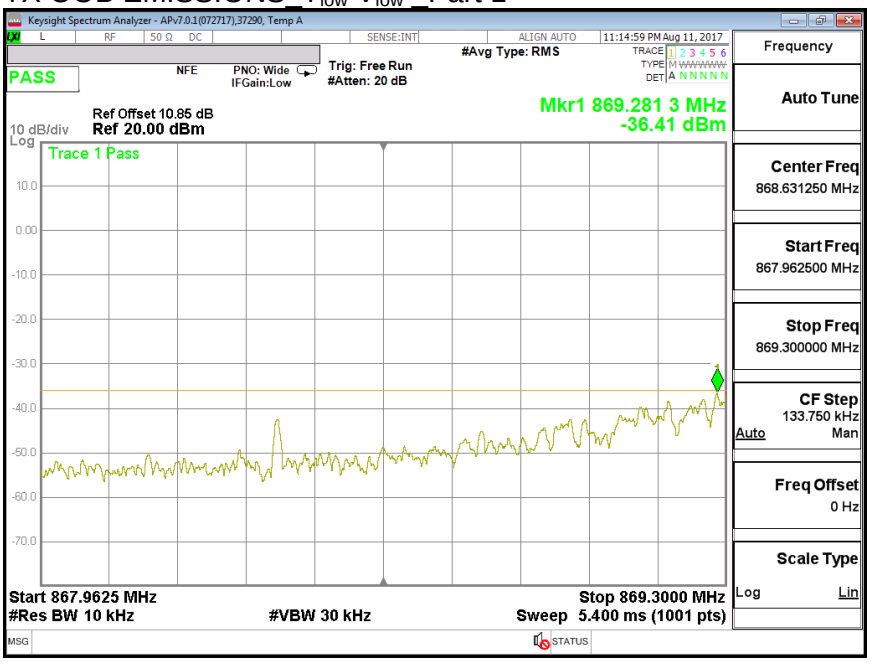
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3



TX OOB EMISSIONS_T_{low} V_{low} _Part 1



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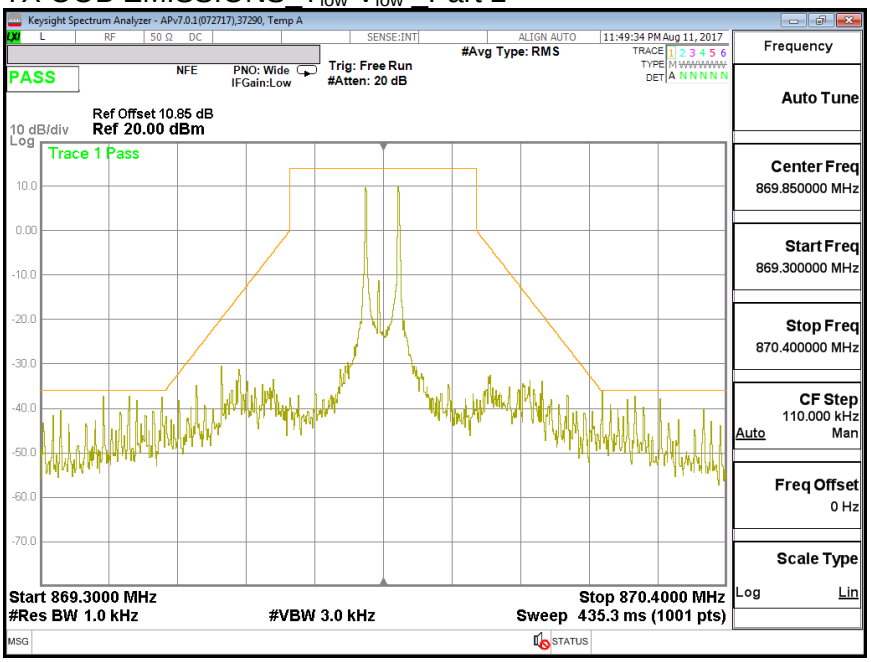
TX OOB EMISSIONS_T_{low} V_{low} _Part 2



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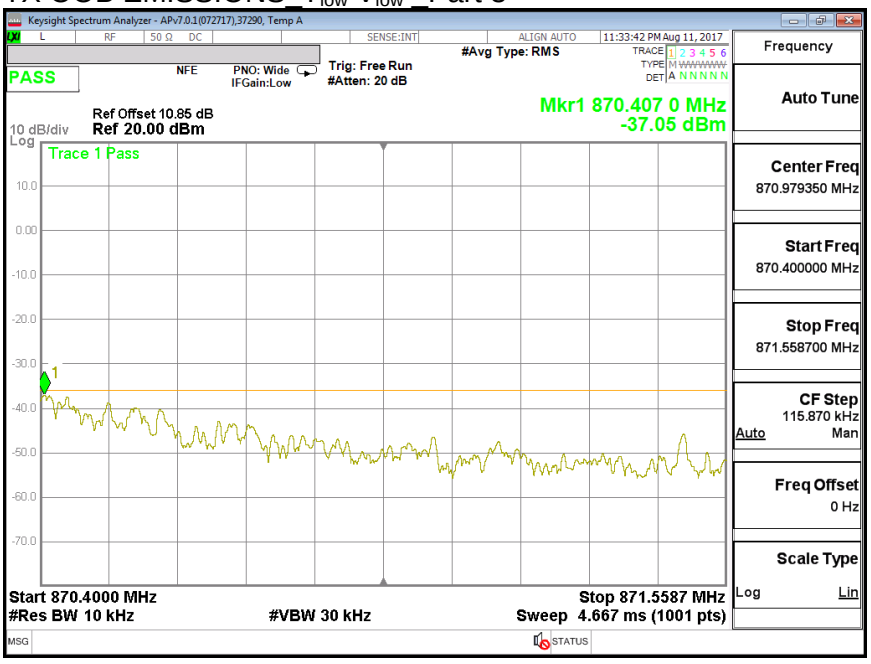

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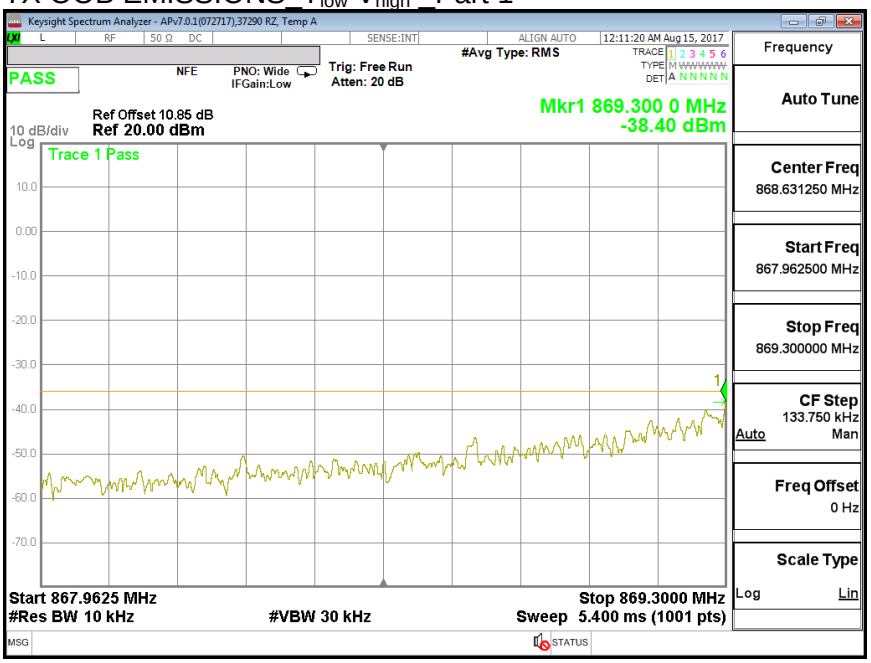
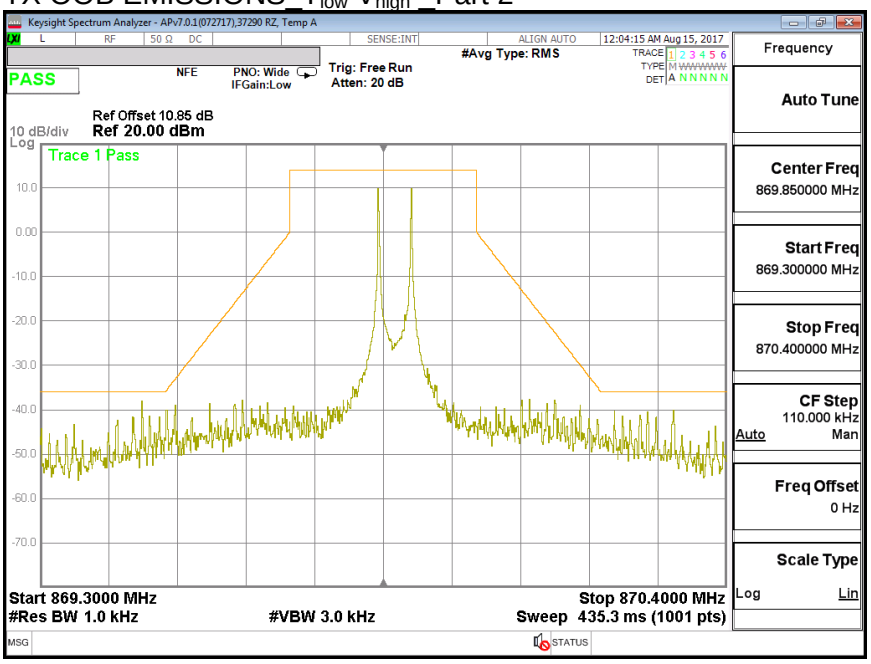
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



TX OOB EMISSIONS_T_{low} V_{high} _Part 2



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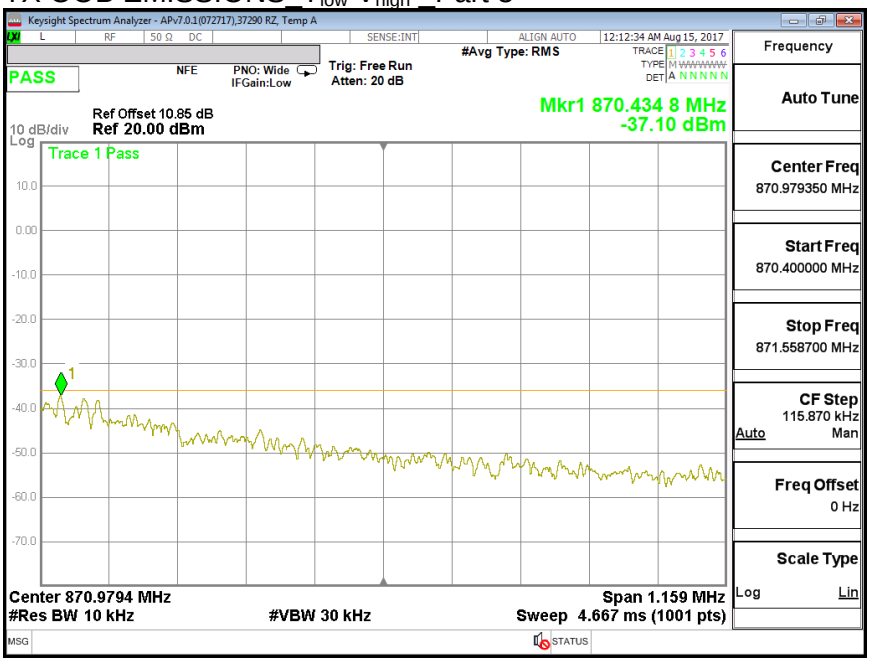
TX OOB EMISSIONS_T_{low} V_{high} _Part 3



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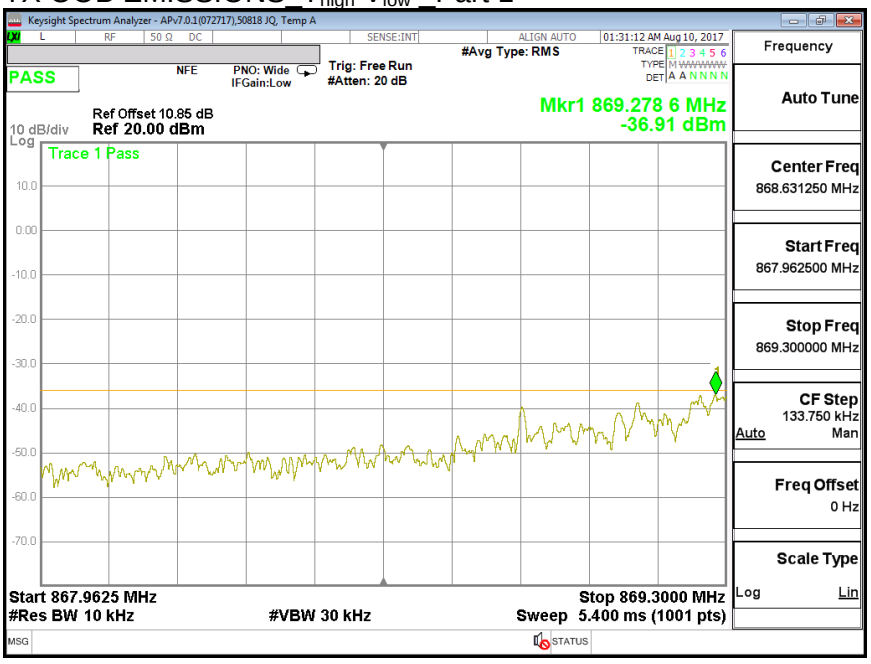

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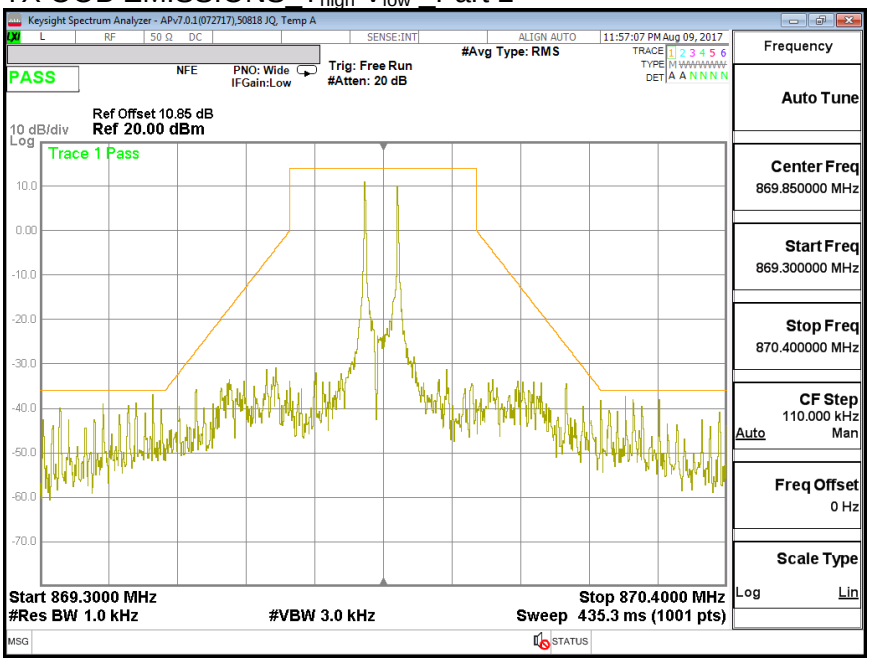
TX OOB EMISSIONS_T_{high} V_{low} _Part 2



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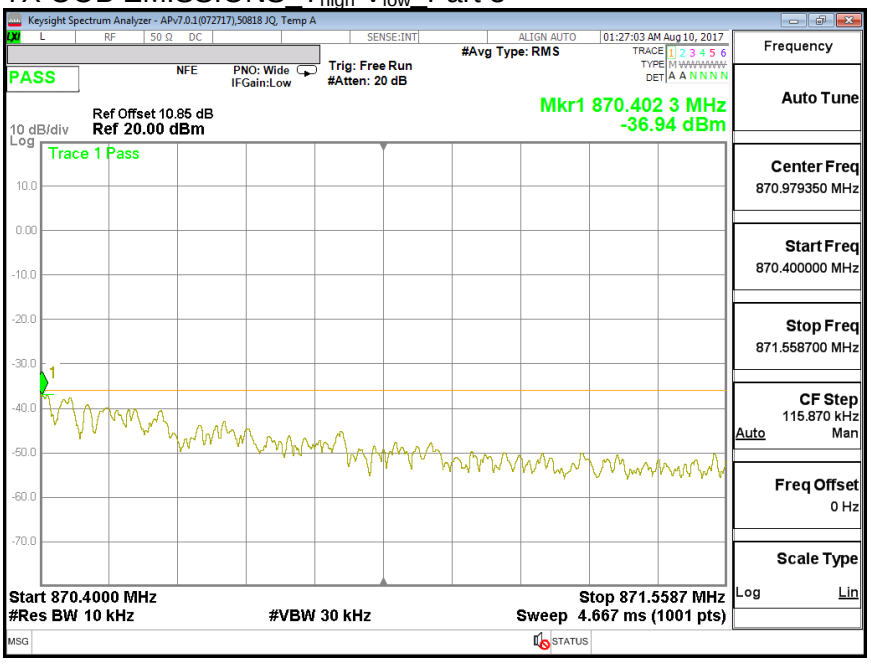

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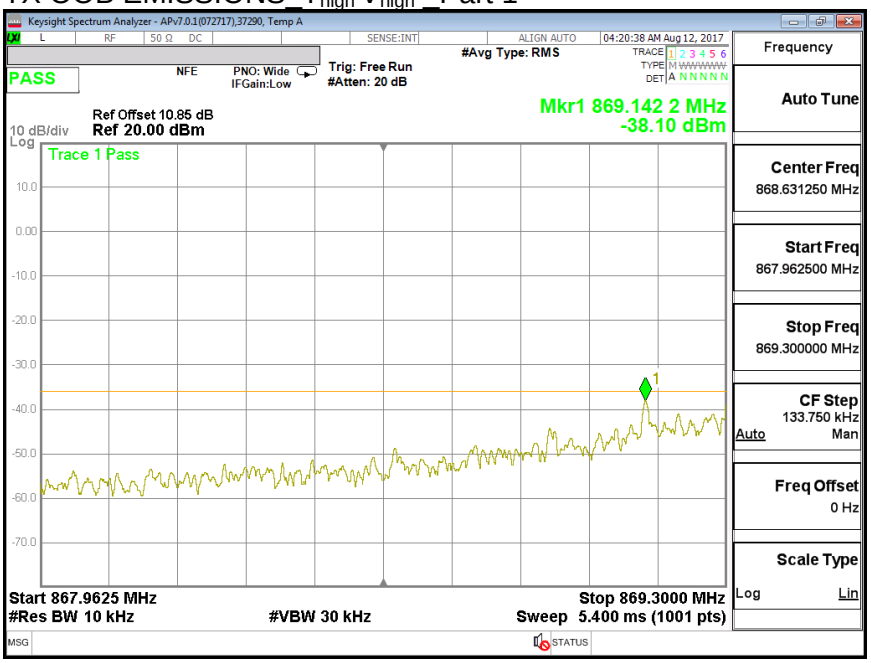
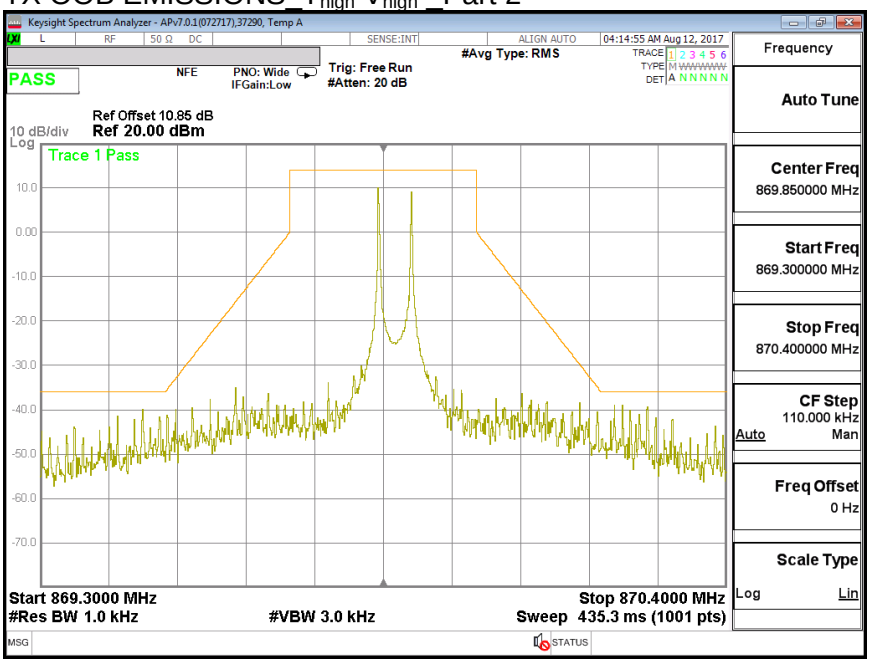
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



TX OOB EMISSIONS_T_{high} V_{high} _Part 2



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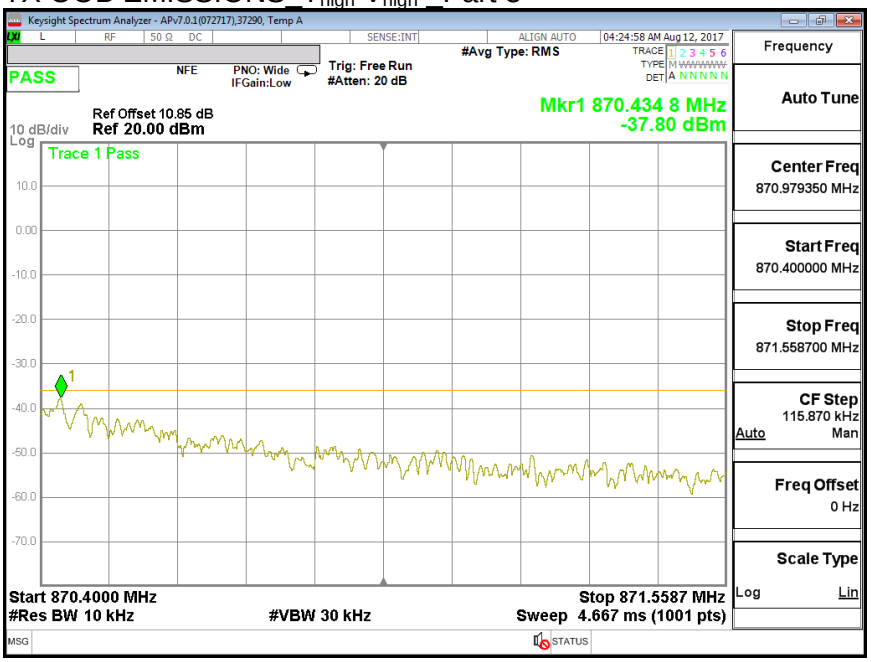
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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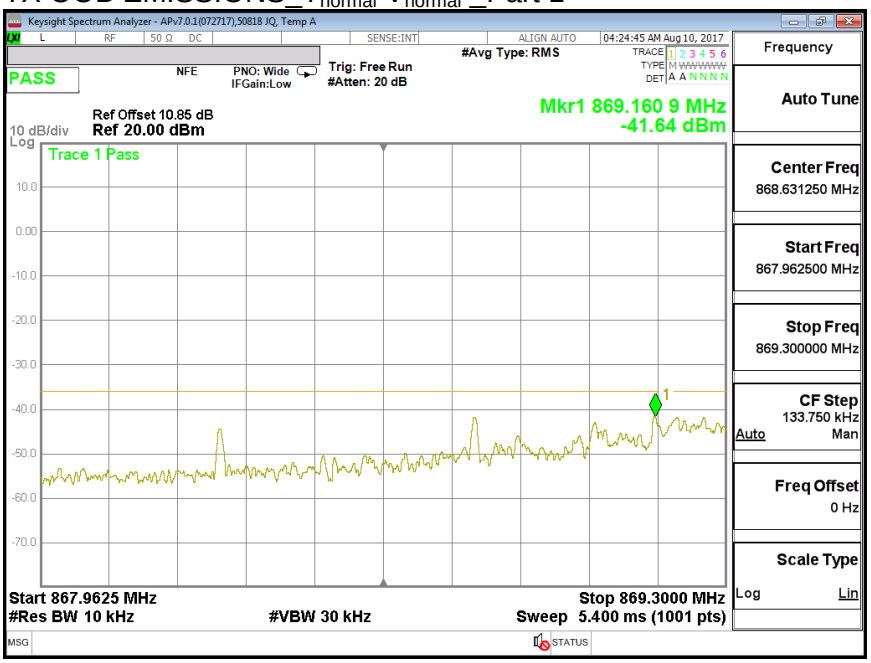
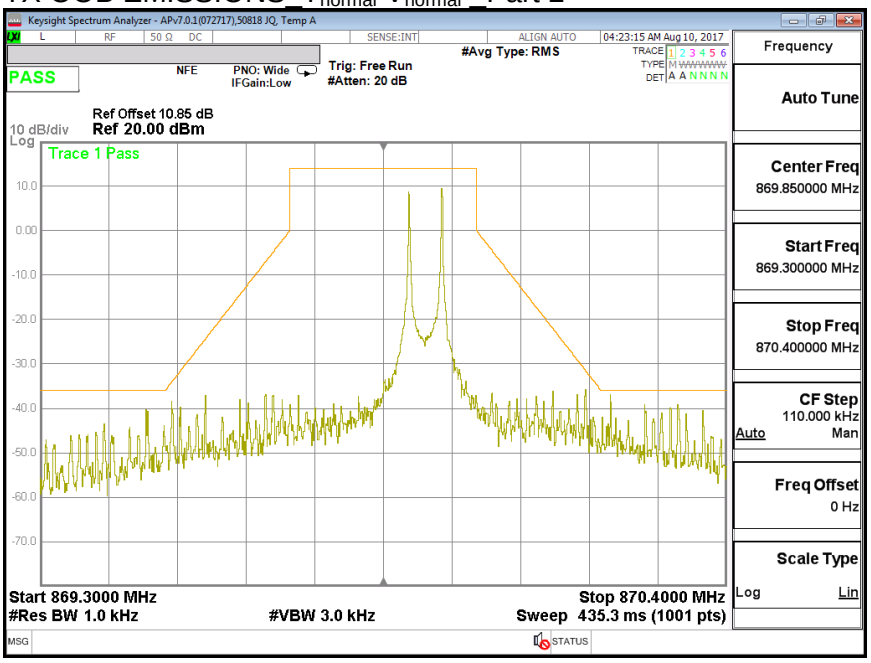
M4 HIGH CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 1



TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$ _Part 2



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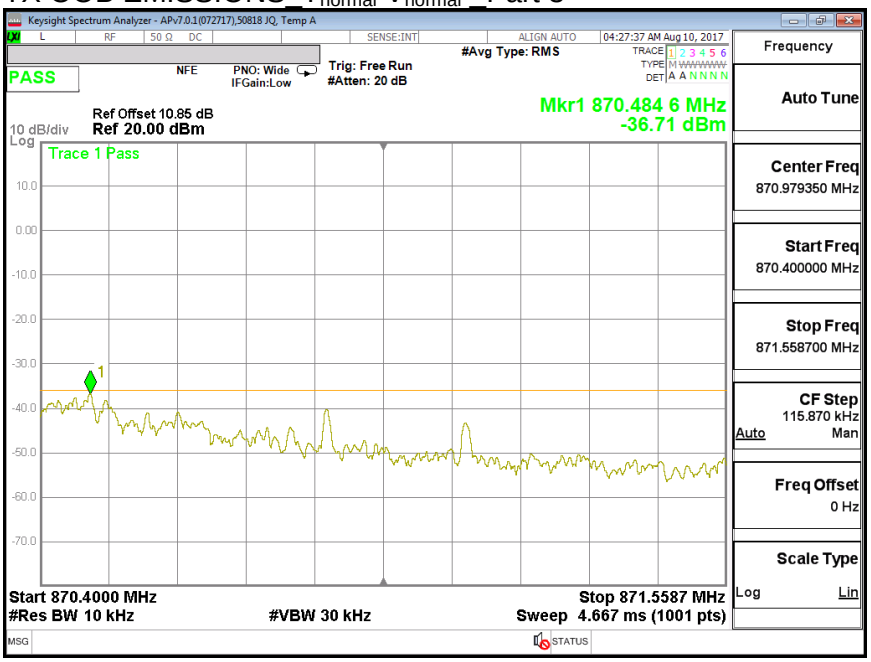
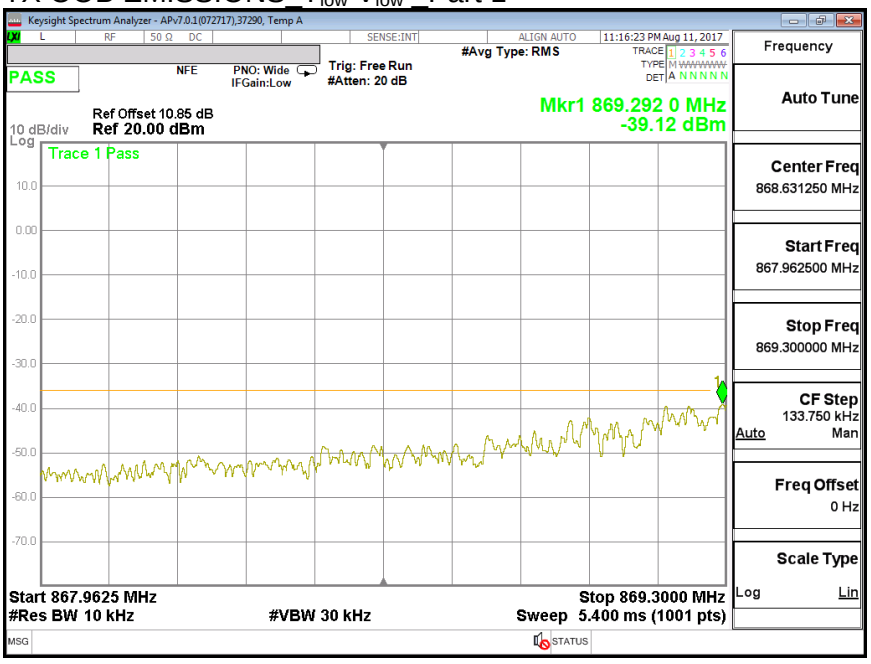
TX OOB EMISSIONS_T_{normal} V_{normal} _Part 3



TX OOB EMISSIONS_T_{low} V_{low} _Part 1



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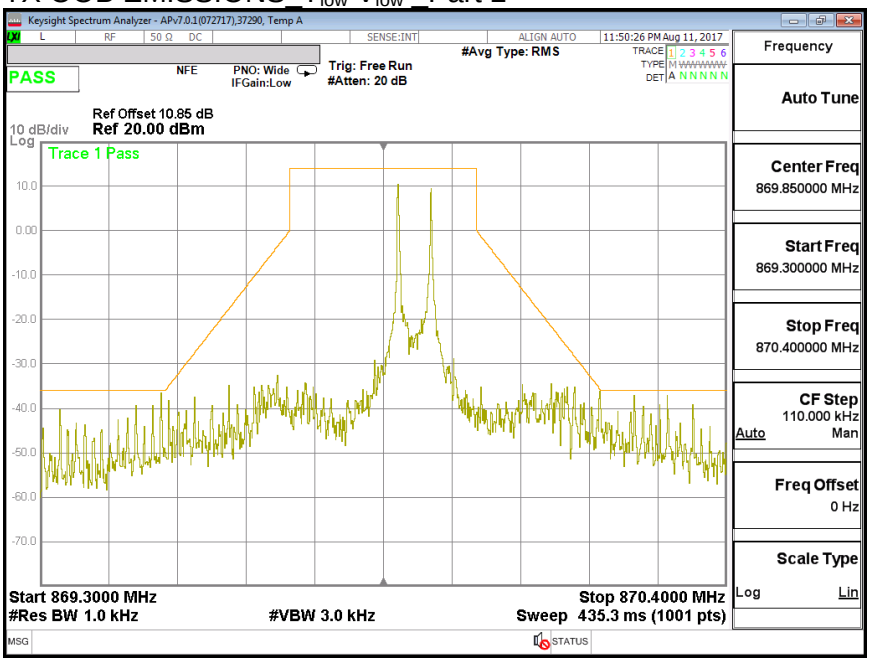
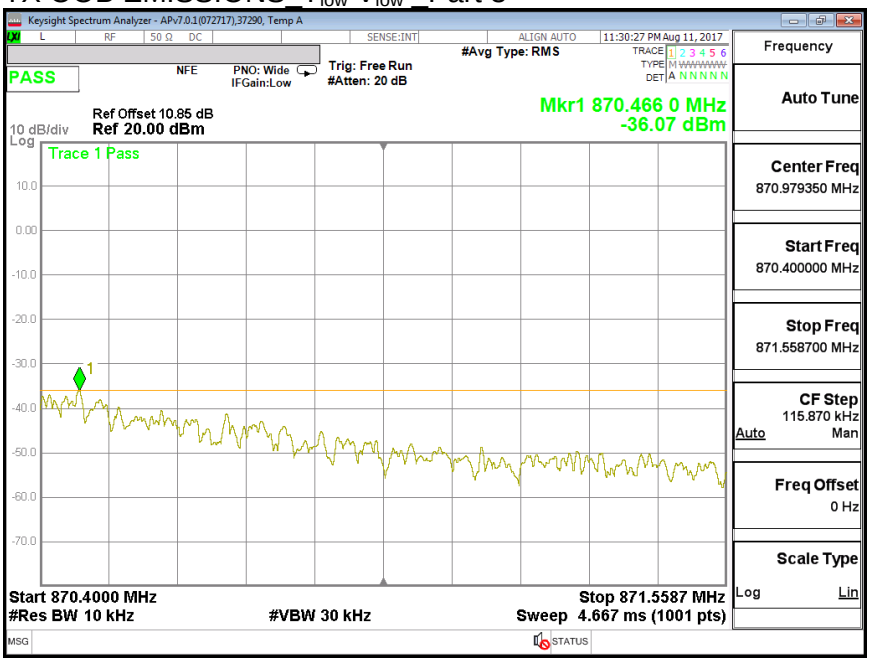
TX OOB EMISSIONS_T_{low} V_{low} _Part 2



TX OOB EMISSIONS_T_{low} V_{low} _Part 3



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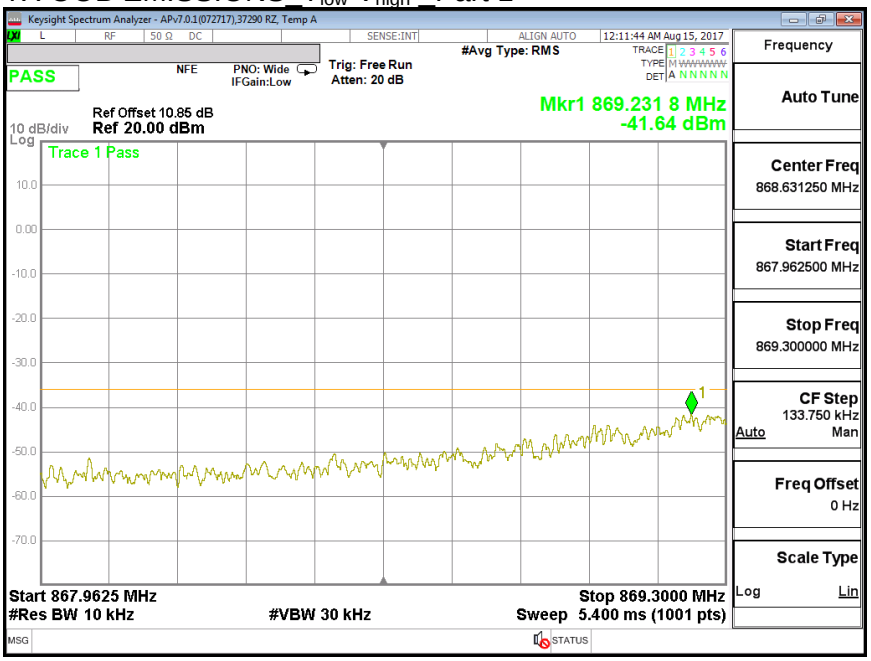
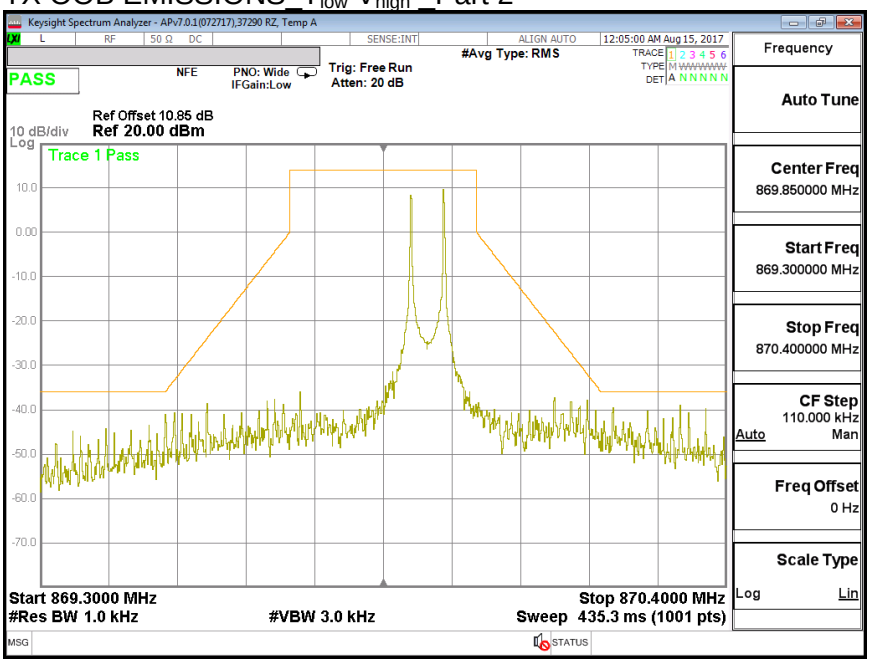
TX OOB EMISSIONS_T_{low} V_{high} _Part 1



TX OOB EMISSIONS_T_{low} V_{high} _Part 2



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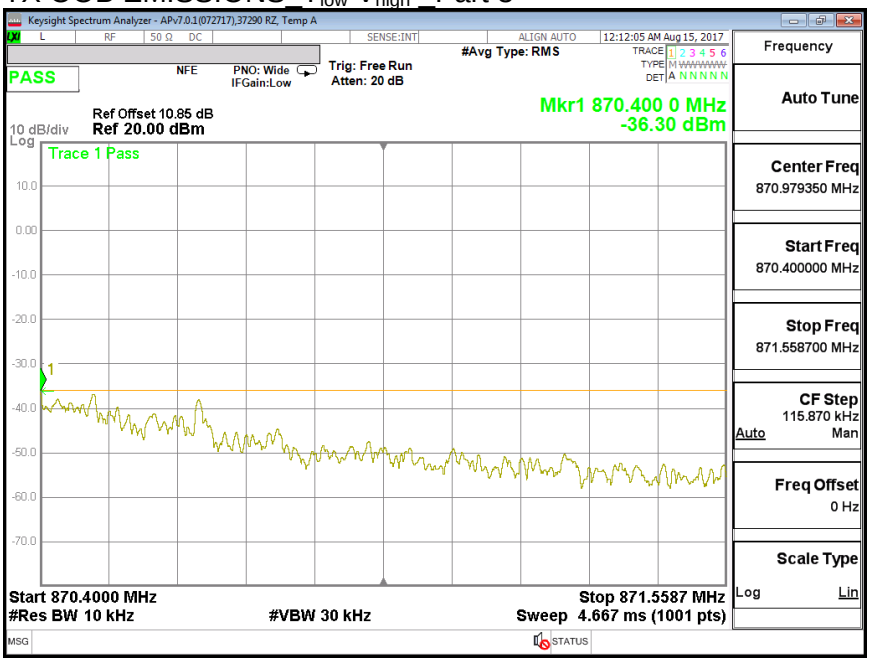
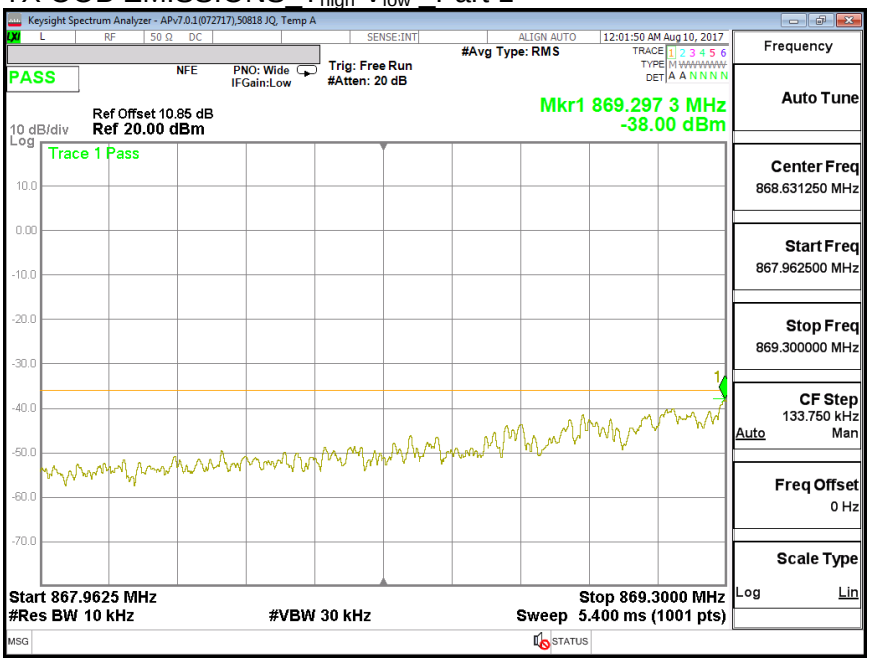
TX OOB EMISSIONS_T_{low} V_{high} _Part 3



TX OOB EMISSIONS_T_{high} V_{low} _Part 1



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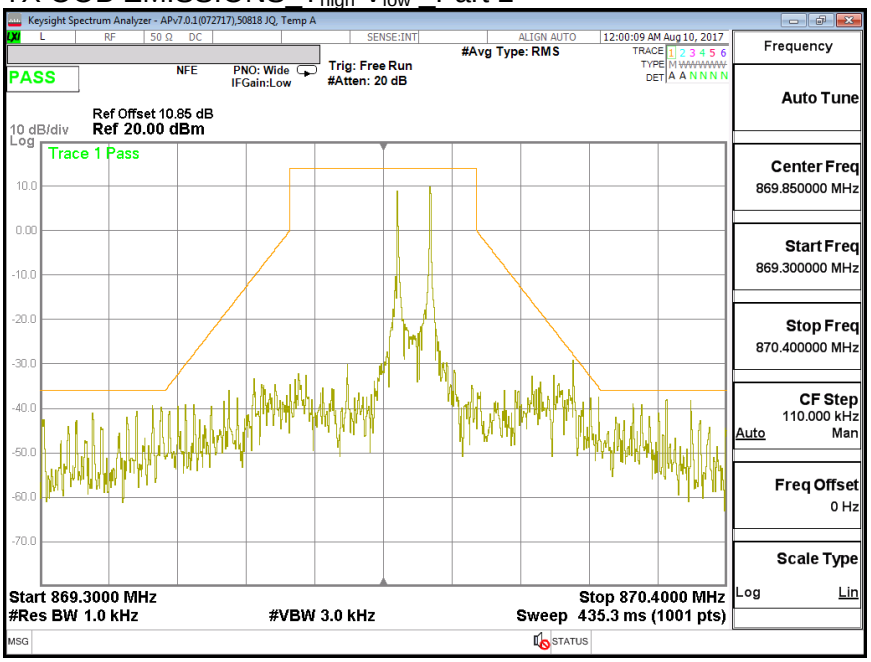
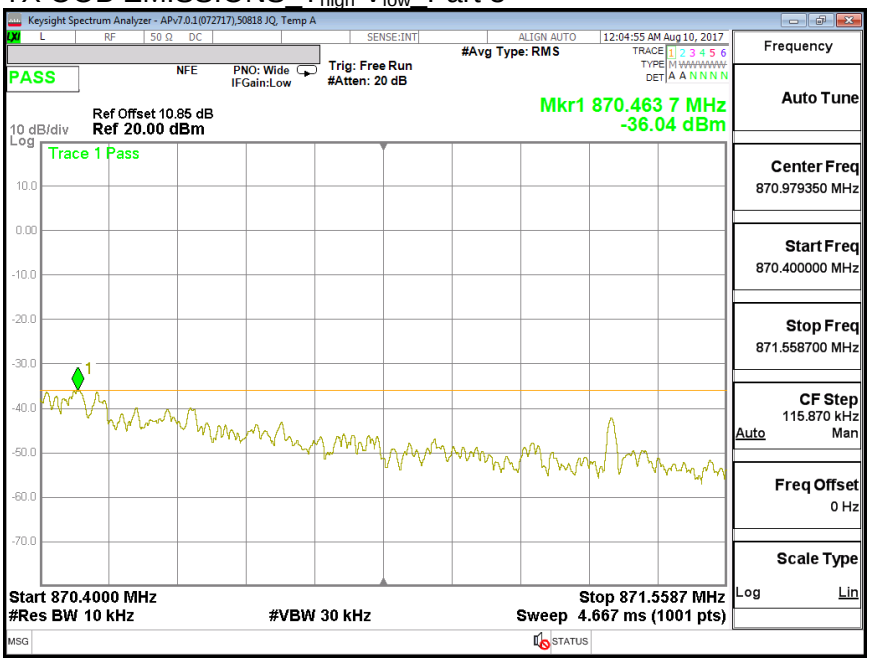
TX OOB EMISSIONS_T_{high} V_{low} _Part 2



TX OOB EMISSIONS_T_{high} V_{low}_Part 3



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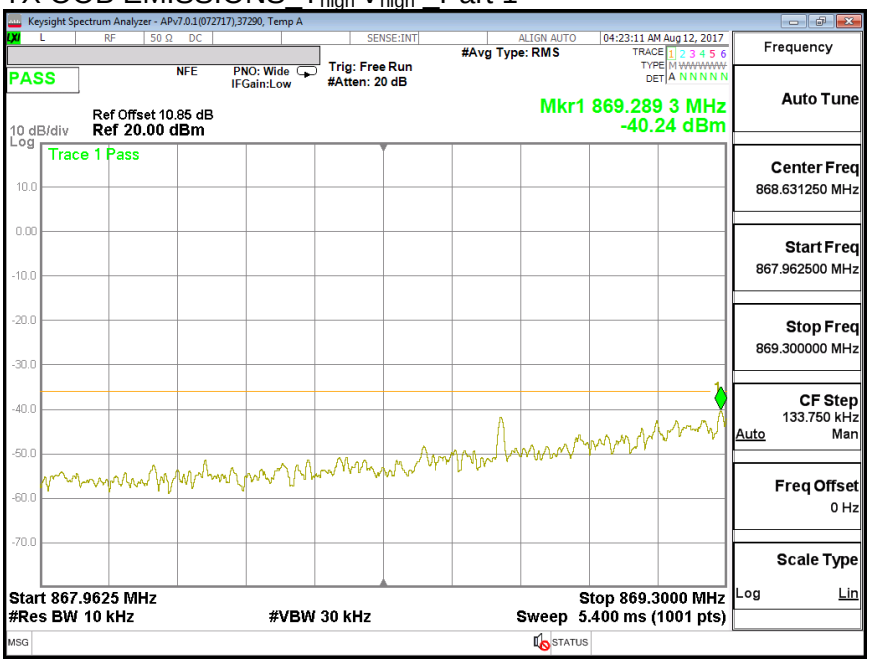
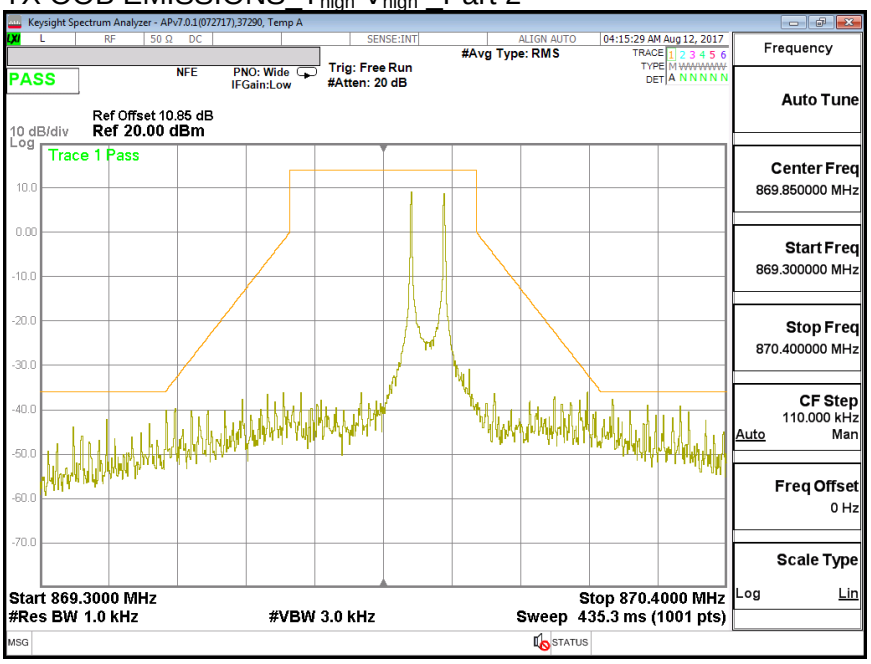
TX OOB EMISSIONS_T_{high} V_{high} _Part 1



TX OOB EMISSIONS_T_{high} V_{high} _Part 2



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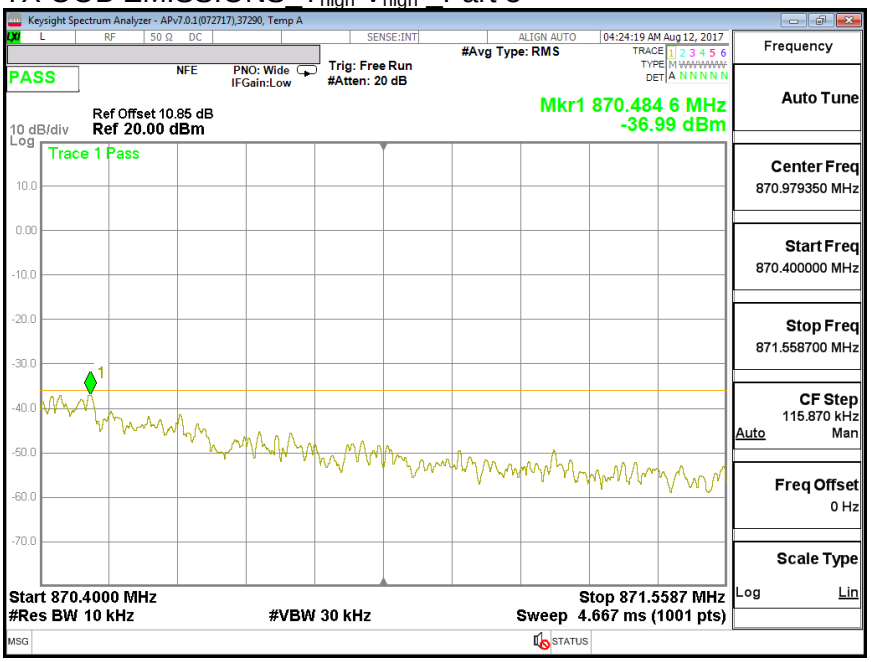
TX OOB EMISSIONS_T_{high} V_{high} _Part 3



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7.12.5. TX UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.2.2.2
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.1.1
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.2

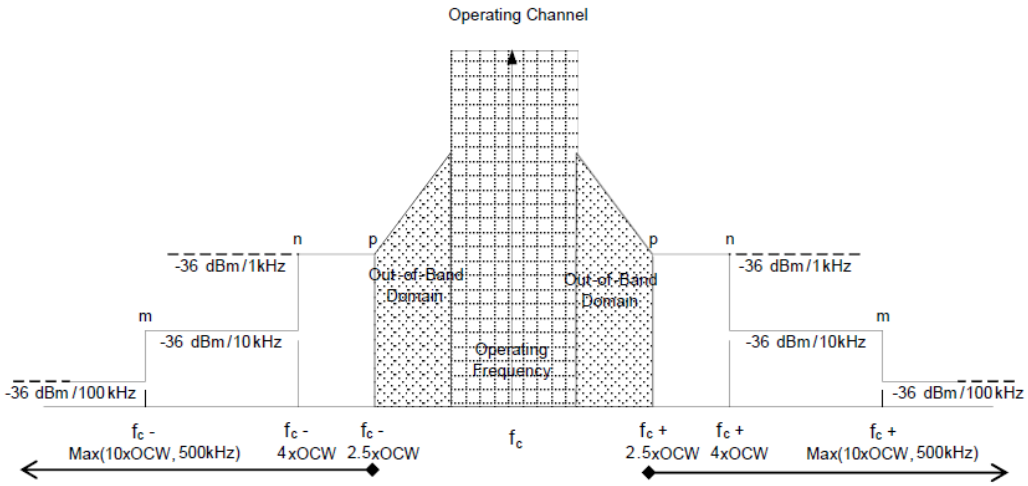

Figure 7: Spectrum Mask for Unwanted Emissions in the Spurious Domain with reference BW

Reference Limit:

The power of any unwanted emission in the spurious domain shall not exceed the values given in Table 19.

Table 19: Spurious domain emission limits

Frequency / State	47 MHz to 74 MHz 87,5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 790 MHz	Other frequencies below 1 000 MHz	Frequencies above 1 000 MHz
TX mode	-54 dBm	-36 dBm	-30 dBm
RX and all other modes	-57 dBm	-57 dBm	-47 dBm

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.3.3.1 (Conducted Measurement)
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.3.3.2 (Radiated Measurement)

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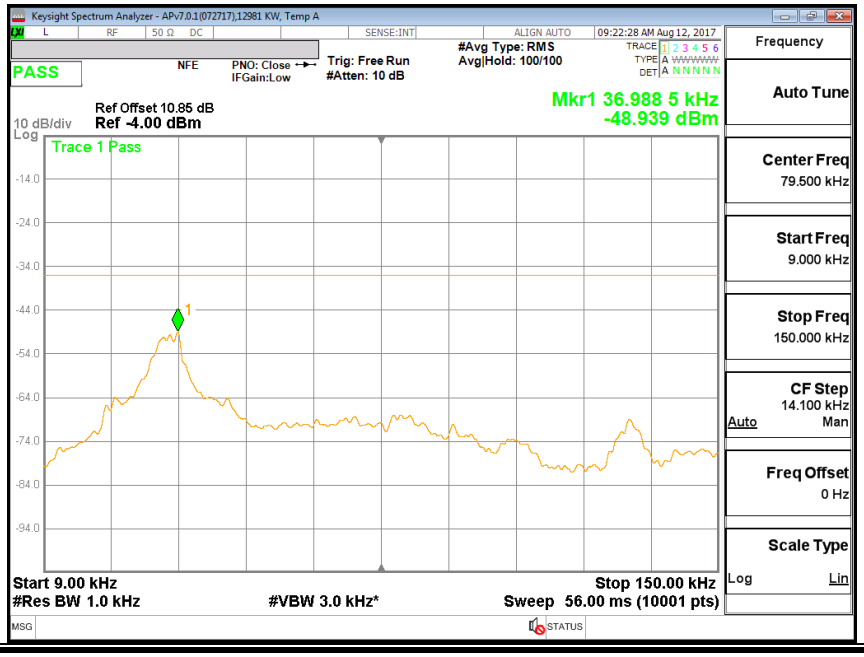
RESULTS

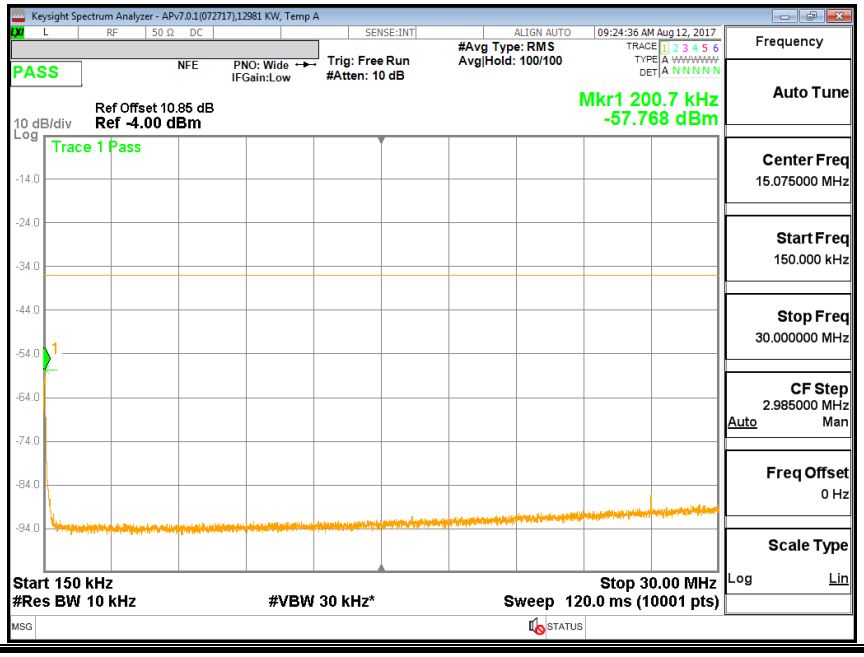
CONDUCTED SPURIOUS EMISSIONS

THE WORST CASE OF 2-FSK LOW CHANNEL

9kHz to 150kHz



150kHz to 30MHz



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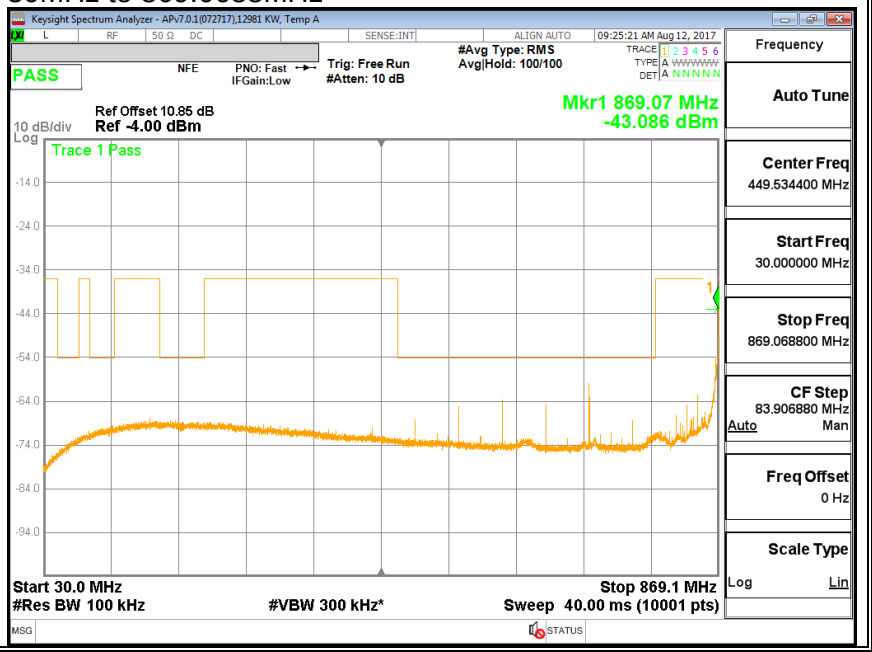
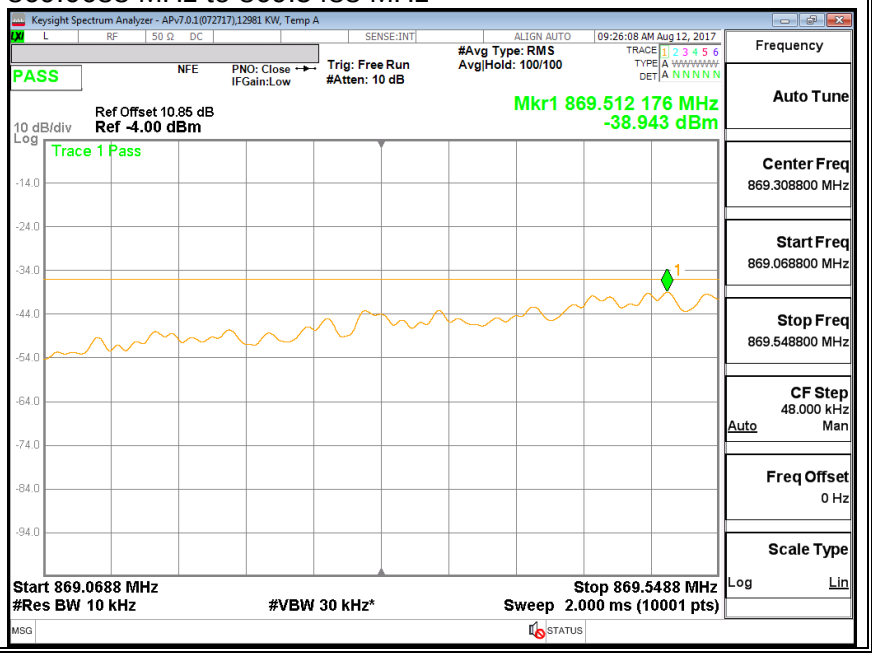
30MHz to 869.0688MHz



869.0688 MHz to 869.5488 MHz



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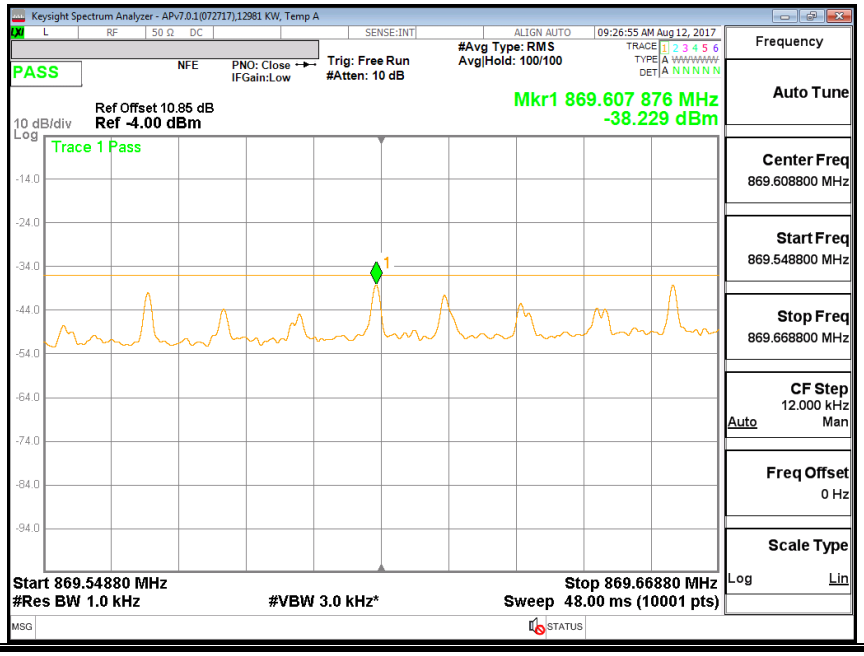
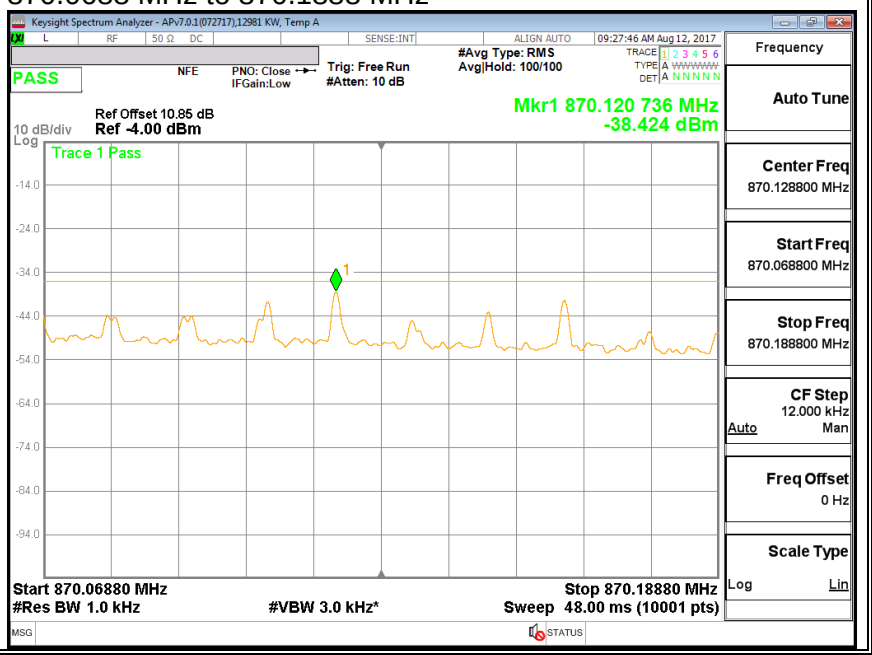
869.5488 MHz to 869.6688 MHz



870.0688 MHz to 870.1888 MHz



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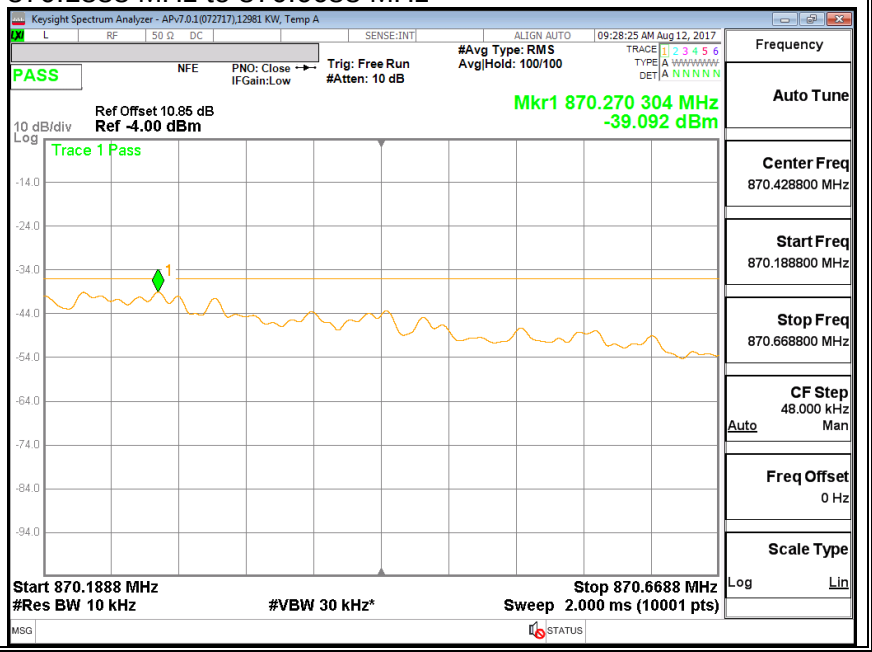
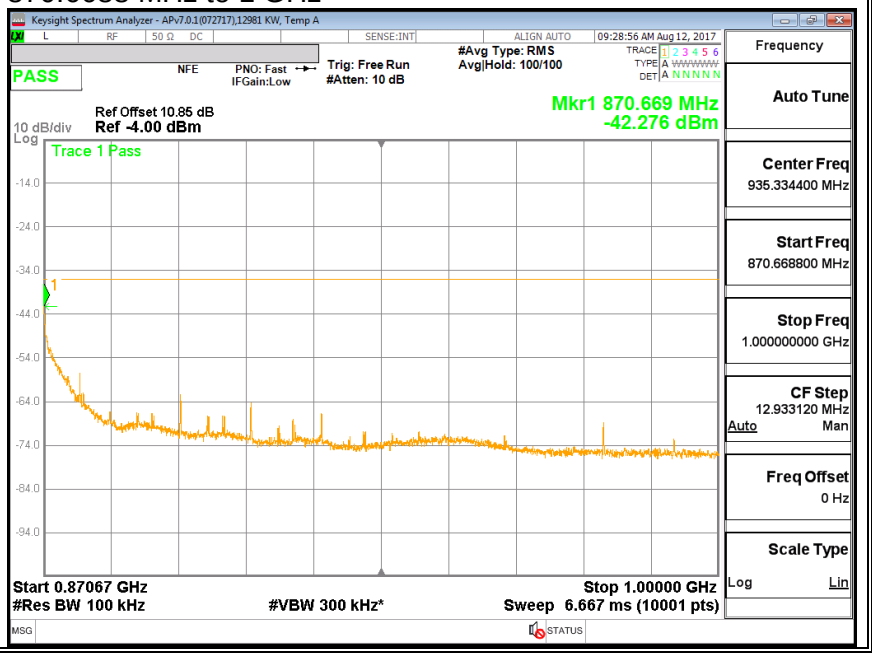
870.1888 MHz to 870.6688 MHz



870.6688 MHz to 1 GHz



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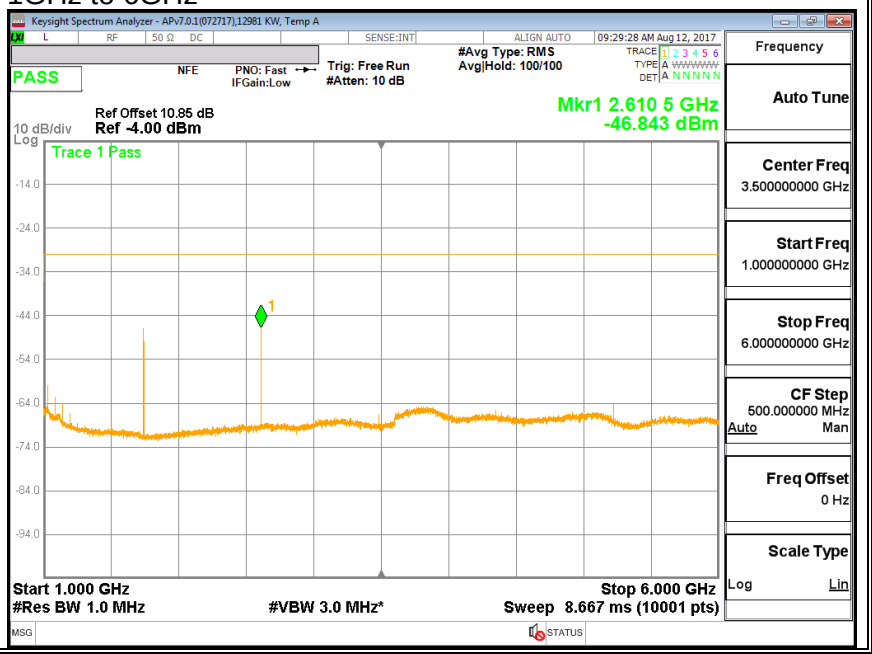
1GHz to 6GHz



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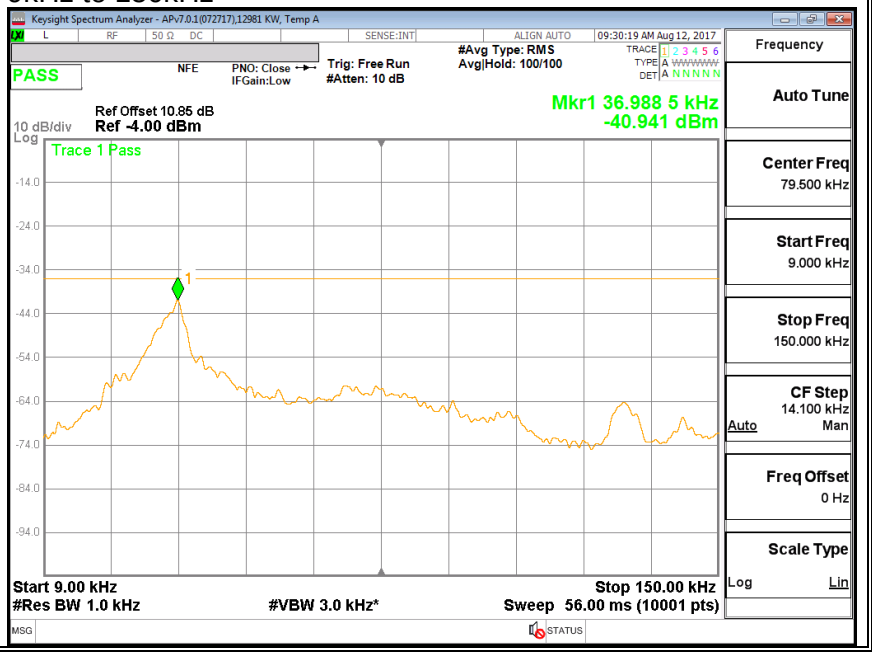
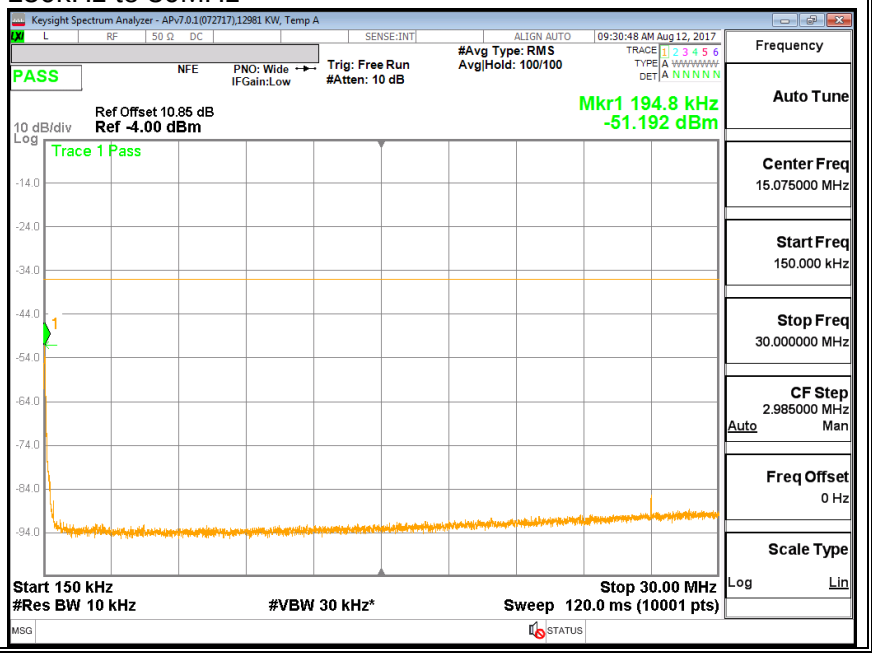
THE WORST CASE OF 2-FSK HIGH CHANNEL

9kHz to 150kHz



150kHz to 30MHz



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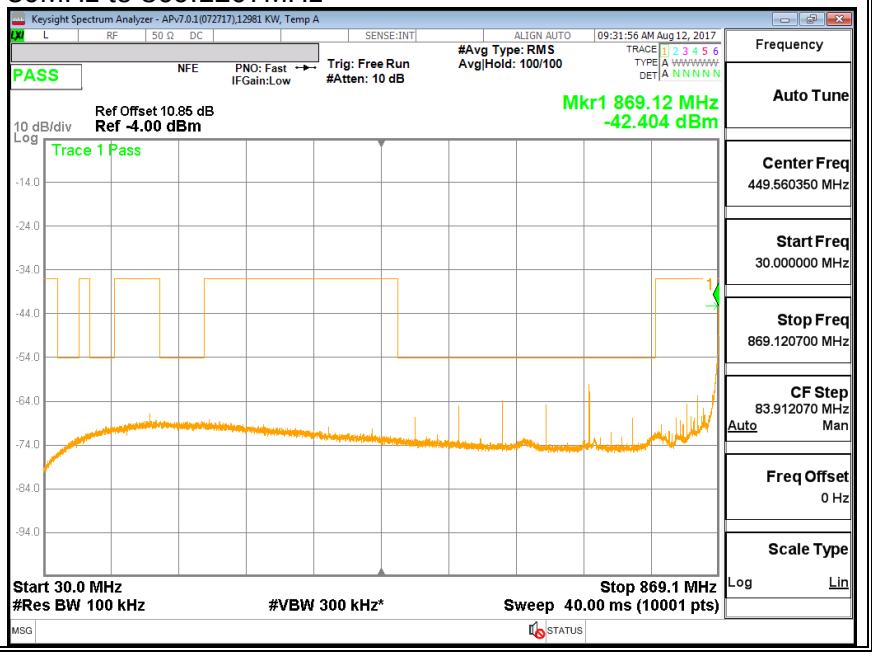
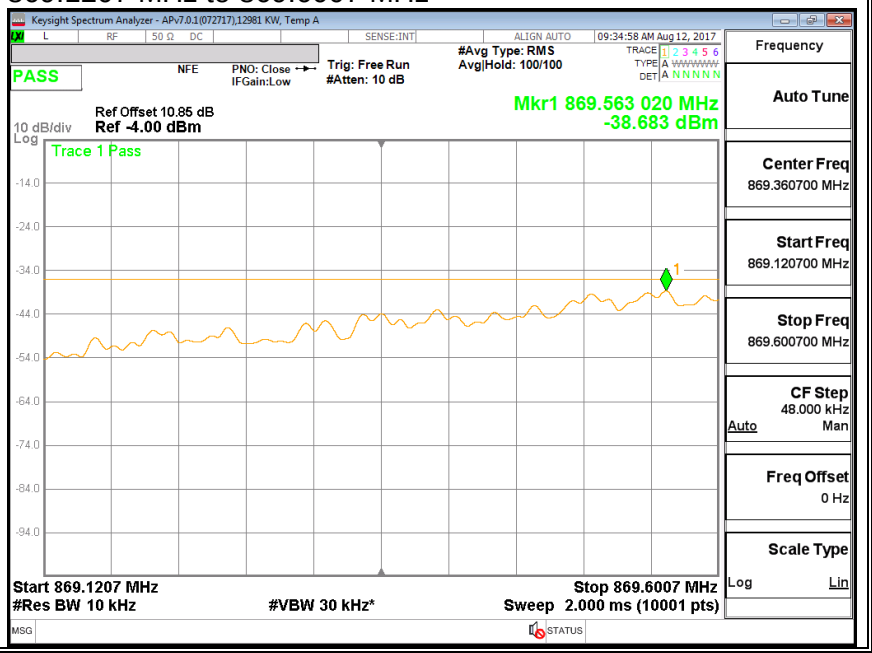
30MHz to 869.1207MHz



869.1207 MHz to 869.6007 MHz



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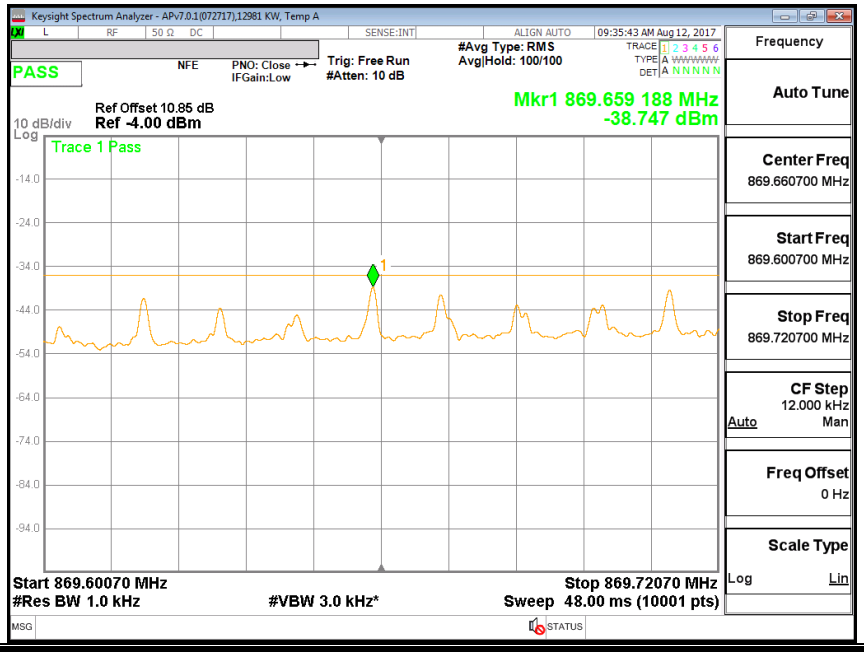
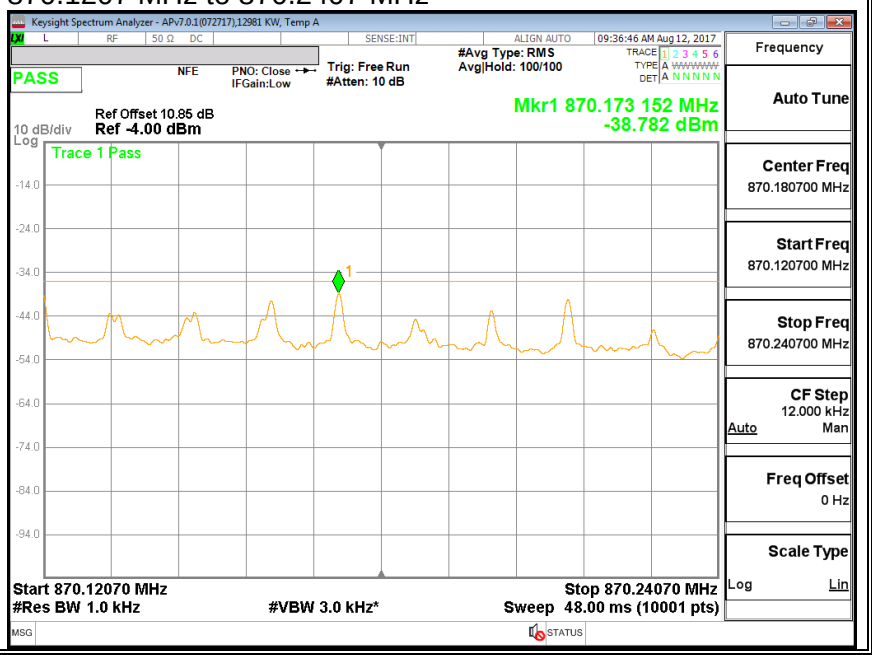
869.6007 MHz to 869.7207 MHz



870.1207 MHz to 870.2407 MHz



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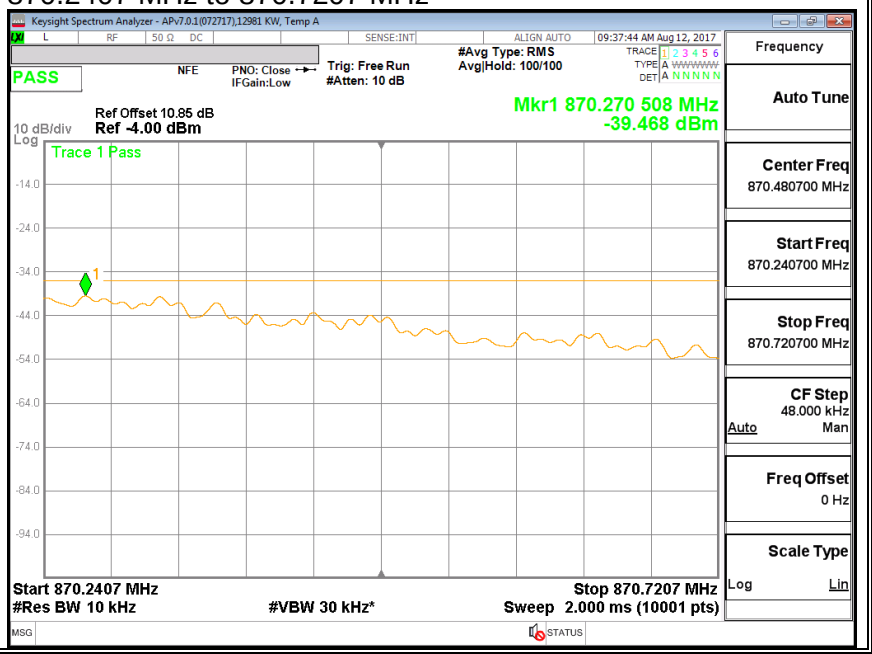
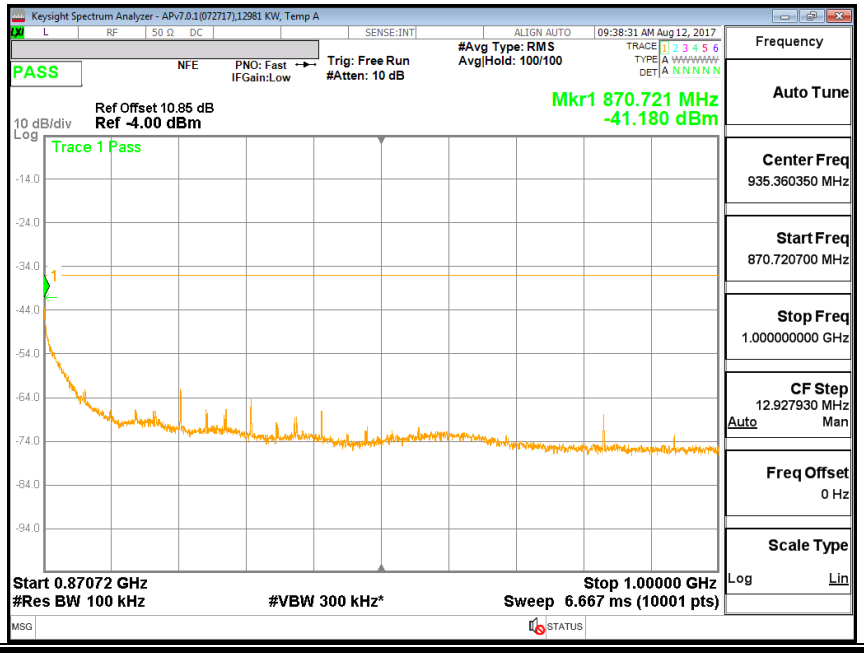
870.2407 MHz to 870.7207 MHz



870.7207 MHz to 1 GHz



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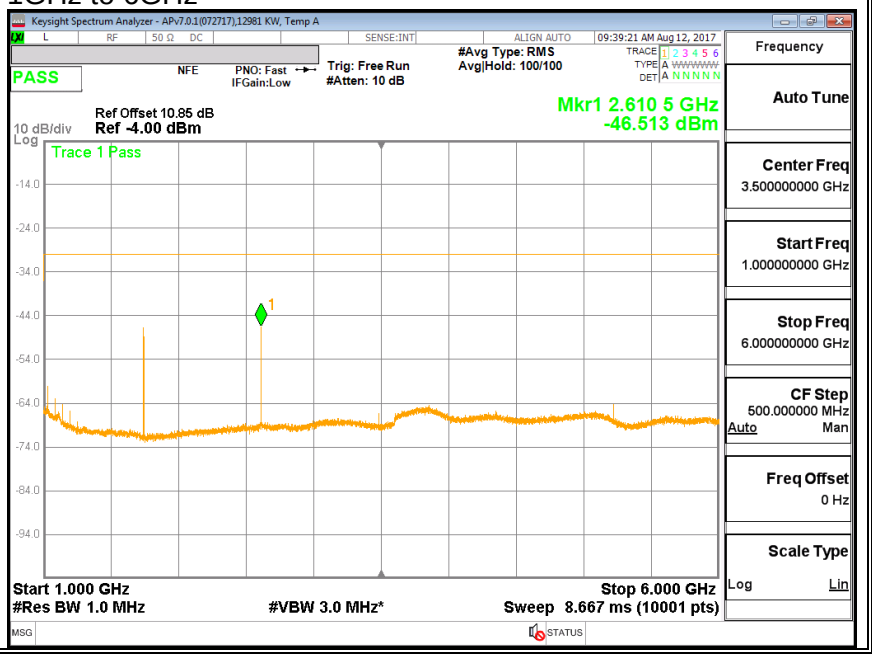
1GHz to 6GHz



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RADIATED SPURIOUS EMISSIONS

3m Radiated Emissions Chamber
30 - 1000MHz Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/13/2017
Test Engineer: 50818
Configuration: EUT with 50Ohm load and a support laptop
Mode: TX Below 1GHz 2FSK R band worst case

Chamber	Pre-amplifer	Attenuator	Limit
3m Chamber B	3m-B T10		ETSI 300 220 Tx

Frequency (MHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Attenuator (dB)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel										
432.11	-70.1	H	3.0	24.9	28.8		-73.9	-36.0	-37.9	
699.31	-70.2	H	3.0	29.0	28.6		-69.9	-54.0	-15.9	
800.14	-71.6	H	3.0	30.2	28.4		-69.8	-54.0	-15.8	
432.17	-71.8	V	3.0	26.6	28.8		-74.0	-36.0	-38.0	
767.88	-72.3	V	3.0	31.9	28.4		-68.8	-54.0	-14.8	
799.48	-72.5	V	3.0	32.5	28.4		-68.4	-54.0	-14.4	
High Channel										
432.12	-71.2	H	3.0	24.9	28.8		-75.0	-36.0	-39.0	
659.74	-72.6	H	3.0	28.7	28.9		-72.8	-54.0	-18.8	
799.31	-71.8	H	3.0	30.1	28.4		-70.0	-54.0	-16.0	
433.26	-70.3	V	3.0	26.6	28.8		-72.5	-36.0	-36.5	
767.89	-70.1	V	3.0	31.9	28.4		-66.6	-54.0	-12.6	
820.56	-72.1	V	3.0	33.1	28.2		-67.2	-54.0	-13.2	

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3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/13/2017
Test Engineer: 50818
Configuration: EUT with 50Ohm load and a support laptop
Mode: TX Above 1GHz R band 2FSK worst case

Chamber	Pre-amplifer	Filter	Limit
3m Chamber B	3m Chamber B	Filter	ETSI 300 220 Tx

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss @ SG End (dBm)	Preamp (dB)	Attenuator (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel										
1.757	-59.72	H	3.0	-13.6	38.4	1.0	-51.0	-30.0	-21.0	
2.397	-59.82	H	3.0	-10.3	38.7	1.0	-48.0	-30.0	-18.0	
5.210	-58.62	H	3.0	-3.9	38.7	1.0	-41.7	-30.0	-11.7	
1.198	-57.42	V	3.0	-15.2	38.5	1.0	-52.7	-30.0	-22.7	
1.733	-59.38	V	3.0	-13.4	38.4	1.0	-50.8	-30.0	-20.8	
2.012	-58.39	V	3.0	-9.9	38.0	1.0	-46.9	-30.0	-16.9	
High Channel										
1.768	-58.86	H	3.0	-12.7	38.4	1.0	-50.1	-30.0	-20.1	
2.393	-61.57	H	3.0	-12.1	38.6	1.0	-49.7	-30.0	-19.7	
5.211	-59.44	H	3.0	-4.8	38.7	1.0	-42.5	-30.0	-12.5	
1.198	-57.99	V	3.0	-15.8	38.5	1.0	-53.3	-30.0	-23.3	
1.731	-57.85	V	3.0	-11.9	38.5	1.0	-49.3	-30.0	-19.3	
1.999	-58.91	V	3.0	-10.4	38.0	1.0	-47.4	-30.0	-17.4	

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7.12.6. TX TRANSIENT POWER

REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.10.2

The TX TRANSIENT POWER shall not exceed the values given in Table 23.

Table 23: Transmitter Transient Power limits

Absolute offset from centre frequency	RBW_{REF}	Peak power limit applicable at measurement points
≤ 400 kHz	1 kHz	0 dBm
> 400 kHz	1 kHz	-27 dBm

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.10.3.2

RESULTS

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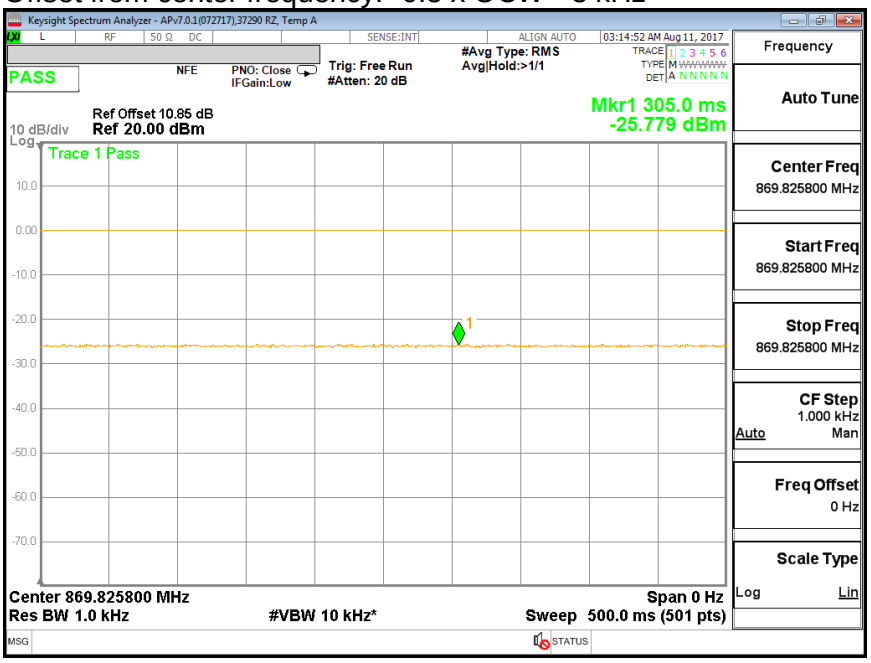
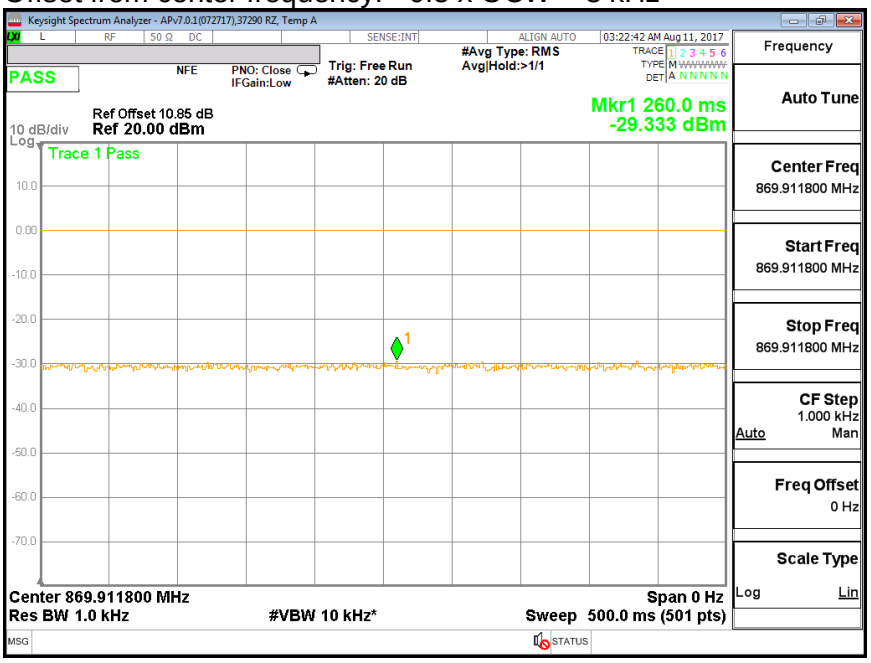
THE WORST CASE OF 2-FSK LOW CHANNEL

TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 3 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 3 kHz



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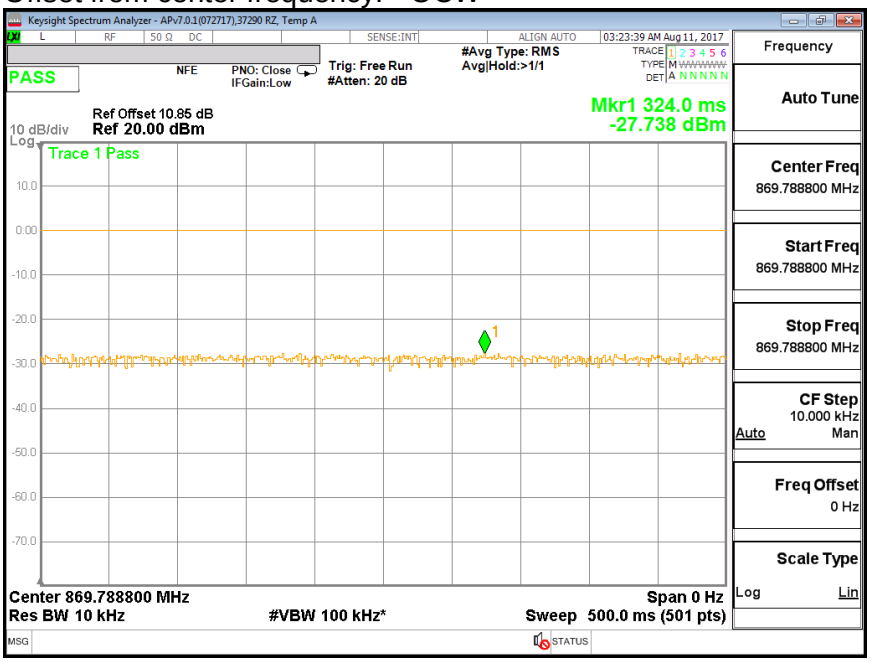
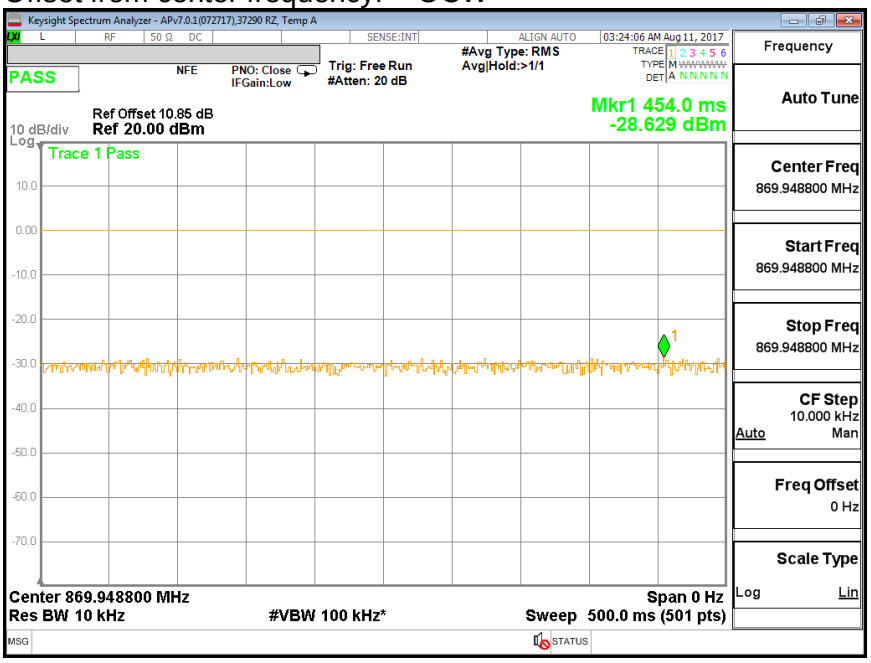
TX TRANSIENT
Offset from center frequency: - OCW



TX TRANSIENT
Offset from center frequency: + OCW



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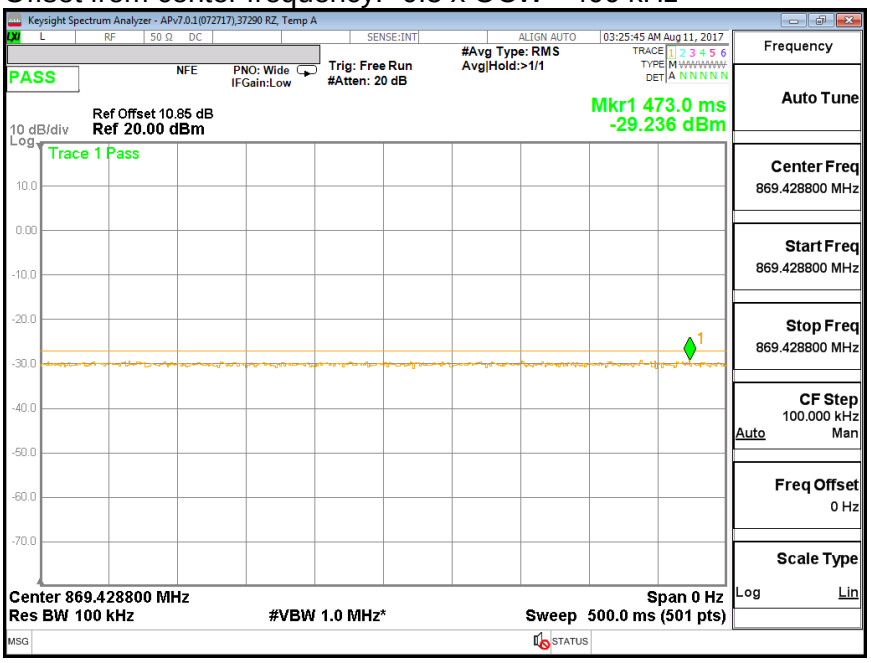
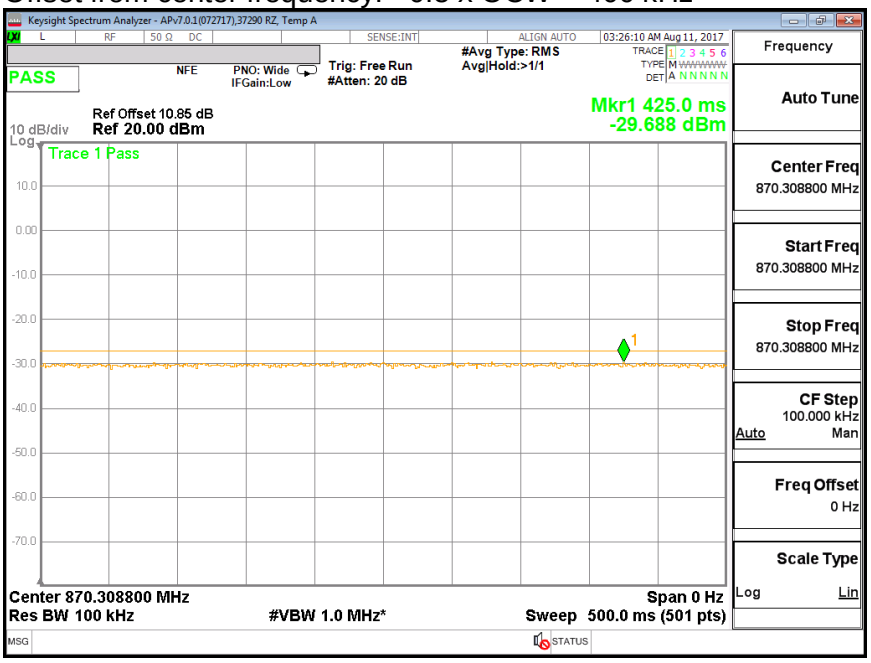
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 400 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 400 kHz



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TX TRANSIENT
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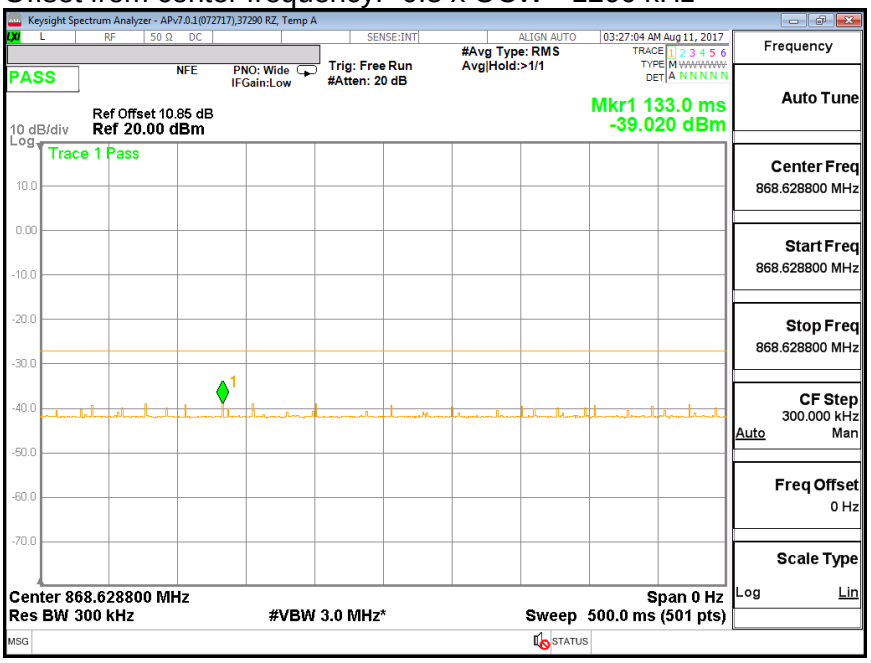

TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 1200 kHz

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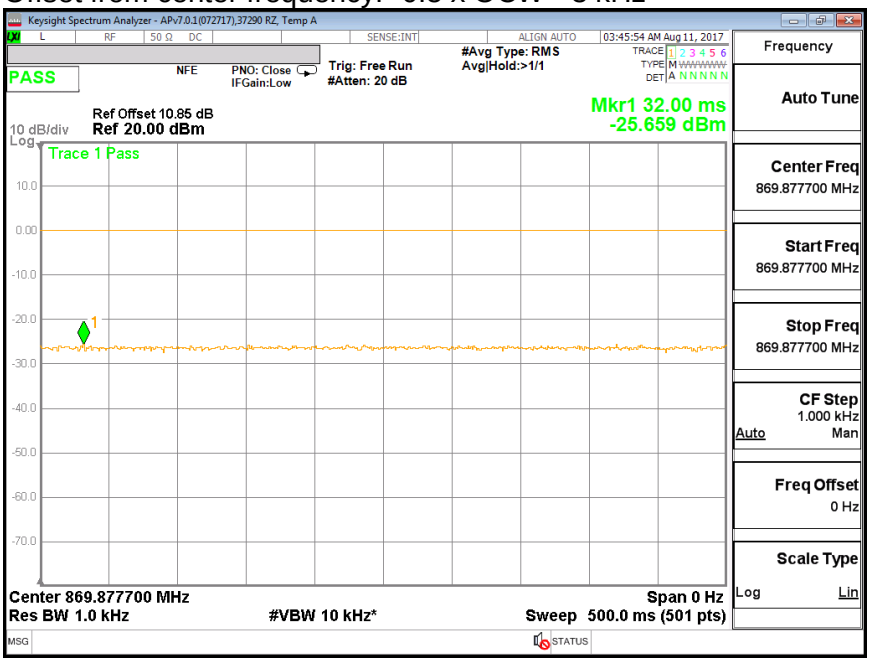
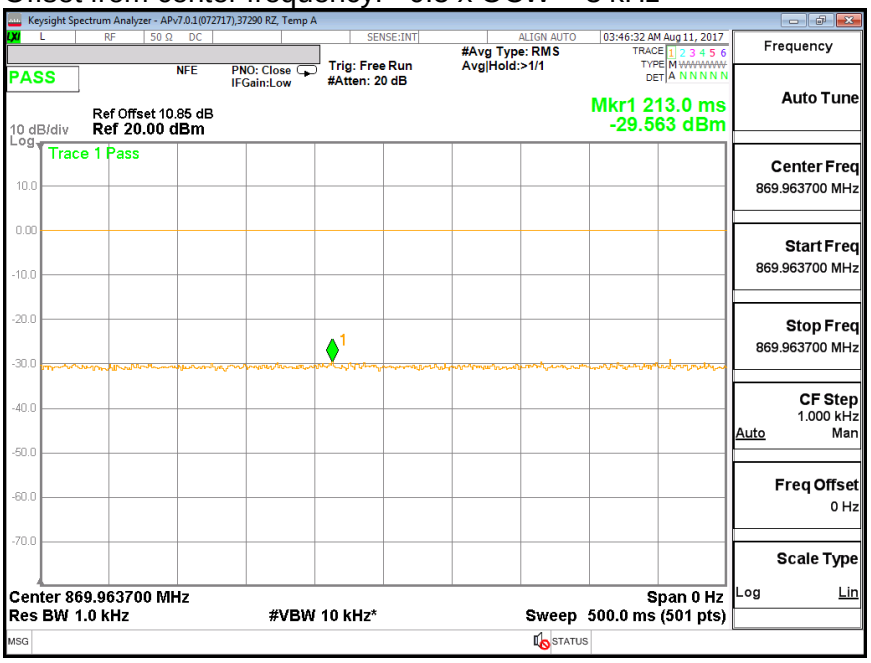
THE WORST CASE OF 2-FSK HIGH CHANNEL

TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 3 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 3 kHz



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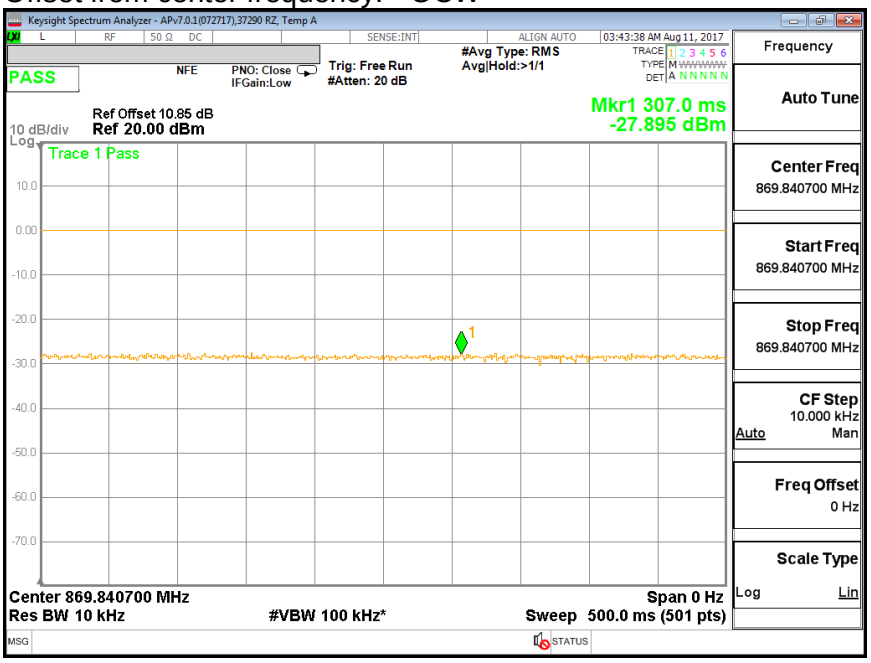
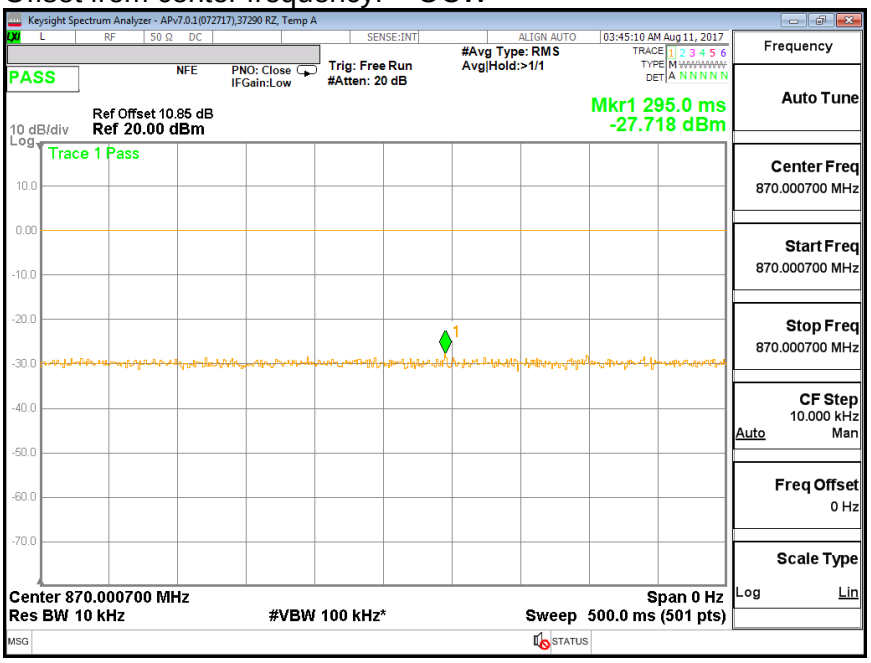
TX TRANSIENT
Offset from center frequency: - OCW



TX TRANSIENT
Offset from center frequency: + OCW



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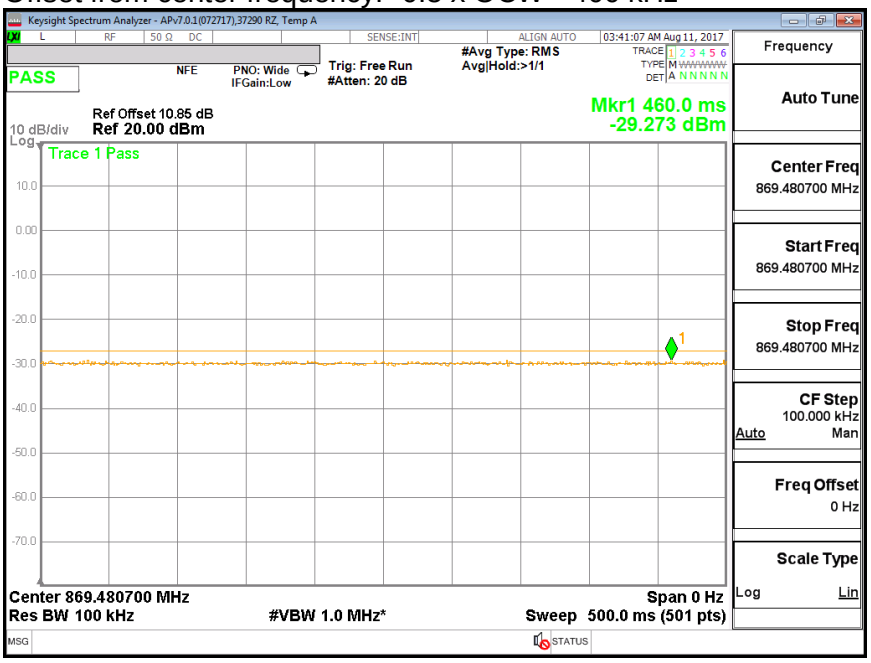
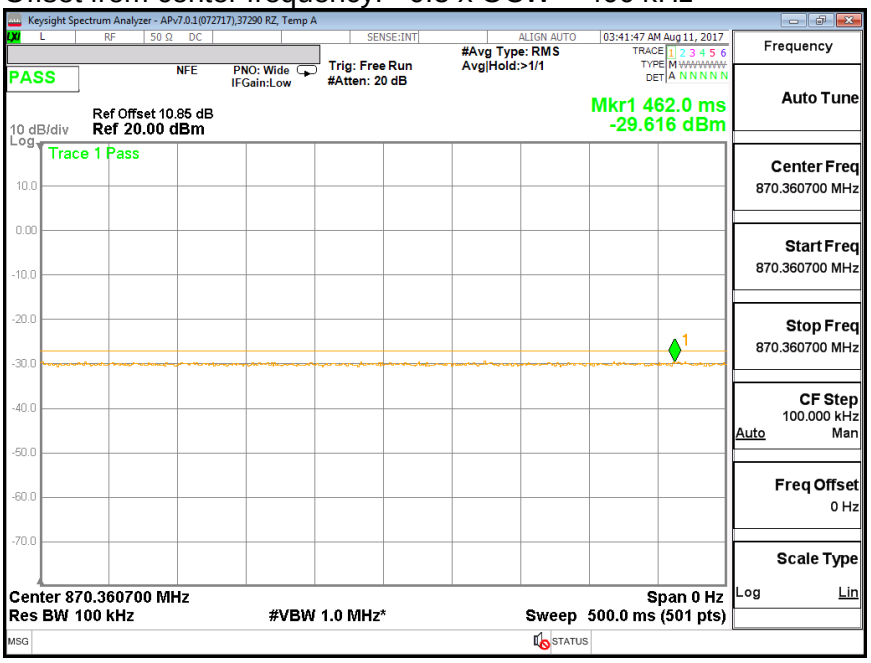
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 400 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 400 kHz



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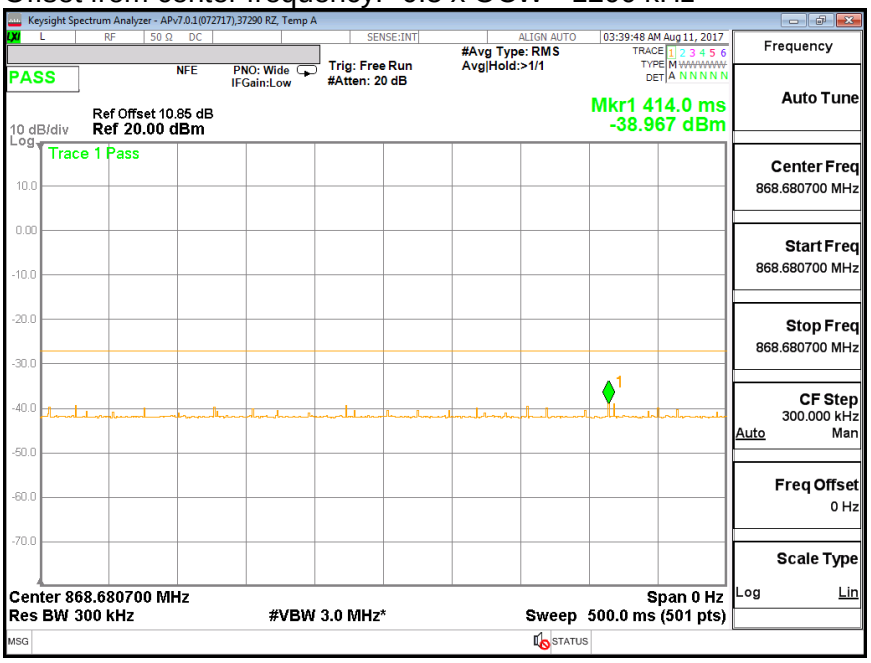
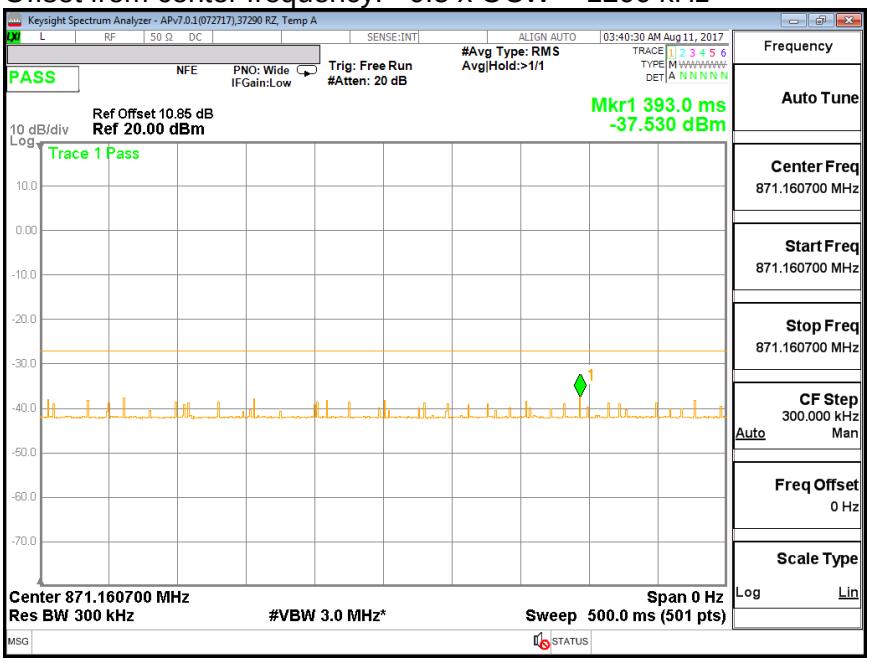
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 1200 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 1200 kHz



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7.13. 4-FSK MODULATION IN X BAND

7.13.1. OPERATING FREQUENCY

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.2.1.2

The manufacturer may declare either one or more operating frequencies and operating channels.
Operating channel(s) shall be entirely within operational frequency bands allowed by annexes B, C or any NRI.

Operational Frequency Band		Maximum Effective Radiated Power	Channel access and occupation rules	Additional/other spectrum access parameters	Maximum occupied bandwidth	Other usage restriction	Notes	CEPT/ERC/REC 70-03 [i.1] implementation status
X	863 MHz to 870 MHz	25 mW e.r.p.	≤ 0,1 % duty cycle or polite spectrum access	≤ 1 % Duty Cycle if the band is limited to 865 MHz to 868 MHz	100 kHz for 47 or more channels	FHSS	Sub-bands for alarms [868,6 MHz to 868,7 MHz], [869,250 - 869,4 MHz], [869,650 MHz to 869,700 MHz] are excluded.	90 %
		25 mW e.r.p. Power density: -4,5 dBm/100 kHz. The power density can be increased to +6,2 dBm/100 kHz if the band of operation is limited to 865 MHz to 868 MHz. The power density can be increased to -0,8 dBm/100 kHz, if the band of operation is limited 865 MHz to 870 MHz.	≤ 0,1 % duty cycle or polite spectrum access	Duty cycle may be increased to 1 % if the band is limited to 865 MHz to 868 MHz and power limited to 10 mW e.r.p.	The whole band except for audio & video limited to 300 kHz and voice limited to 25 kHz		DSSS and any techniques other than FHSS Sub-bands [868,6 MHz to 868,7 MHz], [869,250 MHz to 869,4 MHz], [869,650 MHz to 869,700 MHz] for alarms are excluded.	90 %
		25 mW e.r.p.	≤ 0,1 % duty cycle or polite spectrum access		300 kHz except for voice limited to 25 kHz		Sub-bands [868,6 MHz to 868,7 MHz], [869,250 - 869,4 MHz], [869,650 MHz to 869,700 MHz] for alarms are excluded.	90 %

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.1.2

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RESULTS

Parameter	Values as declared by the manufacturer
ML3, 4-FSK	
Operational Frequency band or bands	863 - 870
Nominal Operating Frequencies (MHz)	868.259537 - 869.764938
Operating Channel width(s) - OCW	230 kHz
M14, 4-FSK	
Operational Frequency band or bands	863 - 870
Nominal Operating Frequencies (MHz)	868.62291 - 869.349655
Operating Channel width(s) - OCW	1040 kHz

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7.13.2. TX EFFECTIVE RADIATED POWER

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.3.1.2

The effective radiated power shall not be greater than the value allowed in annexes B or C for the chosen operational frequency band(s).

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.2.2.1.2

RESULTS

Date: 08/11/17
Project No: 11773240
Tester: 50818_JQ

CHANNELS FOP MODULATION CODE: ML3

EUT Antenna Gain (dBi) =	2.00

Condition	Output Power (dBm)	EIRP (dBm)	ERP (dBm)	Limit (dBm)	Margin (dB)
Low Channel, CH5					
Normal	11.58	13.58	11.43	13.98	-2.55
Extreme T low, V low	12.23	14.23	12.08	13.98	-1.90
Extreme T low, V high	12.22	14.22	12.07	13.98	-1.91
Extreme T high, V low	11.18	13.18	11.03	13.98	-2.95
Extreme T high, V high	11.19	13.19	11.04	13.98	-2.94
High Channel, CH34					
Normal	11.58	13.58	11.43	13.98	-2.55
Extreme T low, V low	12.23	14.23	12.08	13.98	-1.90
Extreme T low, V high	12.23	14.23	12.08	13.98	-1.90
Extreme T high, V low	11.17	13.17	11.02	13.98	-2.96
Extreme T high, V high	11.17	13.17	11.02	13.98	-2.96

Note: Cable loss correction factor is included in the Power Meter Reading

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MODULATION CODE: M14

EUT Antenna Gain (dBi) =	2.00

Condition	Output Power (dBm)	EIRP (dBm)	ERP (dBm)	Limit (dBm)	Margin (dB)
Low Channel, CH12					
Normal	11.93	13.93	11.78	13.98	-2.20
Extreme T low, V low	12.57	14.57	12.42	13.98	-1.56
Extreme T low, V high	12.56	14.56	12.41	13.98	-1.57
Extreme T high, V low	11.53	13.53	11.38	13.98	-2.60
Extreme T high, V high	11.52	13.52	11.37	13.98	-2.61
High Channel, CH26					
Normal	11.94	13.94	11.79	13.98	-2.19
Extreme T low, V low	12.58	14.58	12.43	13.98	-1.55
Extreme T low, V high	12.57	14.57	12.42	13.98	-1.56
Extreme T high, V low	11.52	13.52	11.37	13.98	-2.61
Extreme T high, V high	11.52	13.52	11.37	13.98	-2.61

Note: Cable loss correction factor is included in the Power Meter Reading

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7.13.3. TX OCCUPIED BANDWIDTH

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.3.4.2

The occupied bandwidth of the EUT according to ETSI EN 300 220-1 [1], clause 5.6.2 shall comply with the limits in annex B or C.

Reference Limit:

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.6.2

The Operating Channel shall be declared and shall reside entirely within the Operational Frequency Band. The Maximum Occupied Bandwidth at 99 % shall reside entirely within the Operating Channel defined by F_{low} and F_{high}.

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.6.3.3 (Conducted Measurement)

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RESULTS

BAND X

Condition	Low CH (MHz)	High CH (MHz)	Low CH OBW (kHz)	High CH OBW (kHz)	F_{Low} (MHz)	F_{Low} Limit (MHz)	F_{High} (MHz)	F_{High} Limit (MHz)
ML3, 4-FSK								
Normal	868.2595	869.7649	220.390	218.760	868.15	> 863	869.87	< 870
T low, V low	868.2595	869.7649	227.980	222.510	868.15	> 863	869.88	< 870
T low, V high	868.2595	869.7649	227.650	221.720	868.15	> 863	869.88	< 870
T high, V low	868.2595	869.7649	218.840	218.380	868.15	> 863	869.87	< 870
T high, V high	868.2595	869.7649	219.480	220.790	868.15	> 863	869.88	< 870
M14, 4-FSK								
Normal	868.1557	868.3634	1009.600	1005.200	867.65	> 863	868.87	< 870
T low, V low	868.1557	868.3634	1019.100	1025.900	867.64	> 863	868.88	< 870
T low, V high	868.1557	868.3634	1017.800	1021.500	867.64	> 863	868.87	< 870
T high, V low	868.1557	868.3634	1003.900	1033.300	867.64	> 863	868.88	< 870
T high, V high	868.1557	868.3634	1003.600	1024.400	867.64	> 863	868.88	< 870

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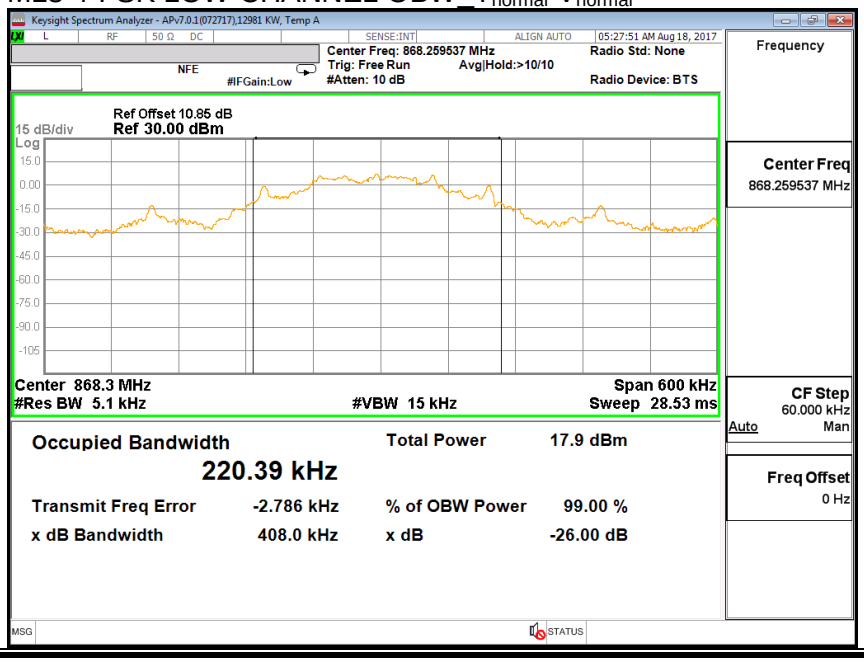
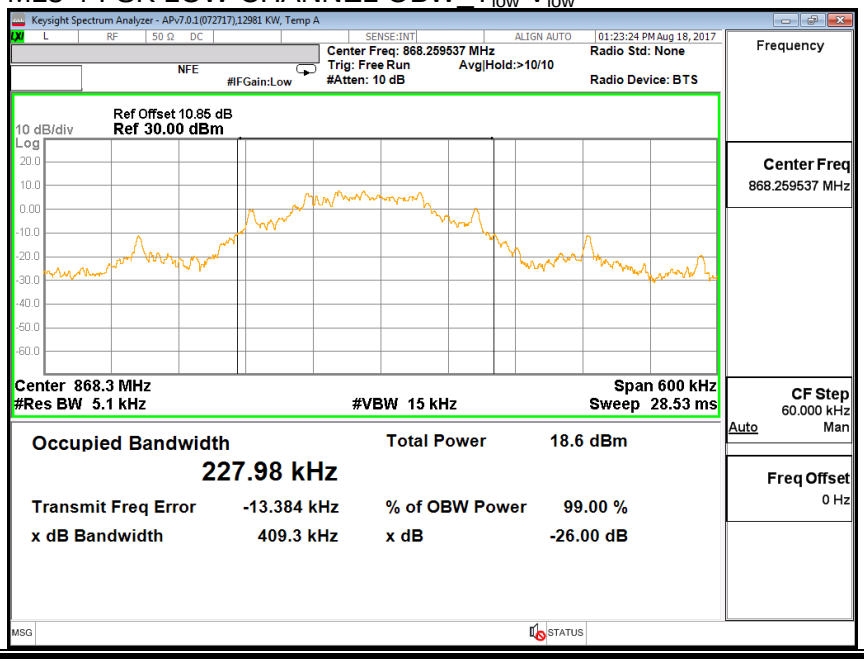
ML3 4-FSK LOW CHANNEL OBW_T_{normal} V_{normal}



ML3 4-FSK LOW CHANNEL OBW_T_{low} V_{low}



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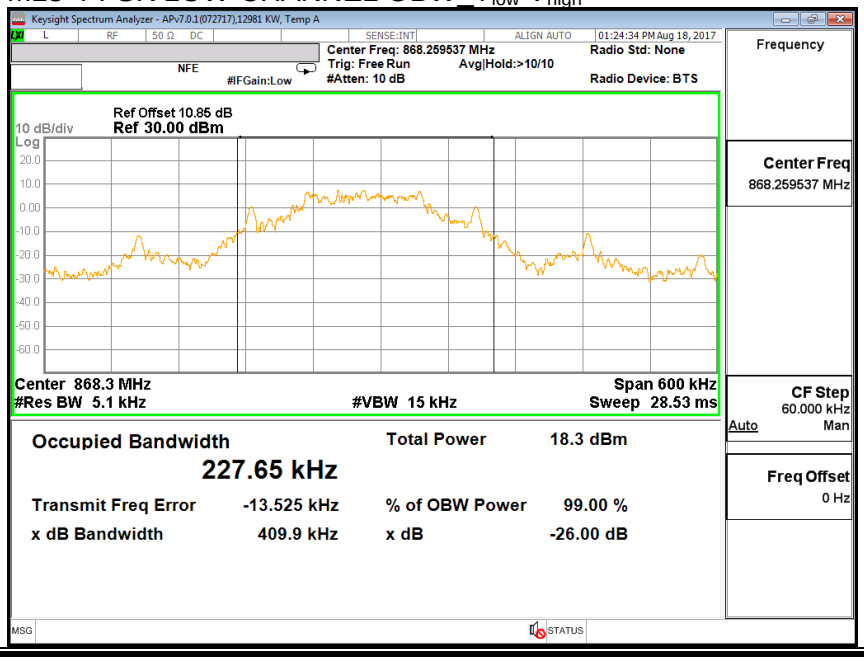
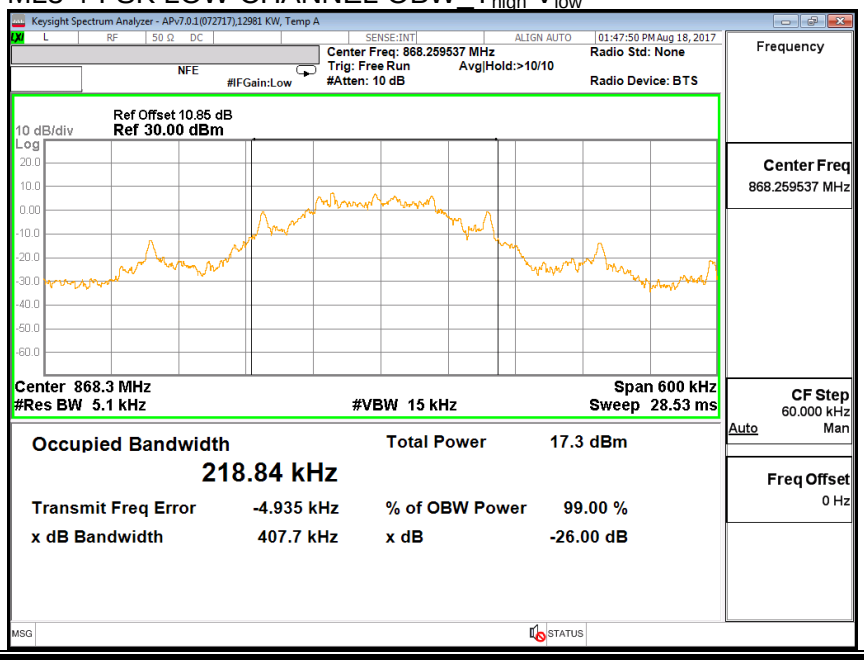
ML3 4-FSK LOW CHANNEL OBW_T_{low} V_{high}



ML3 4-FSK LOW CHANNEL OBW_T_{high} V_{low}



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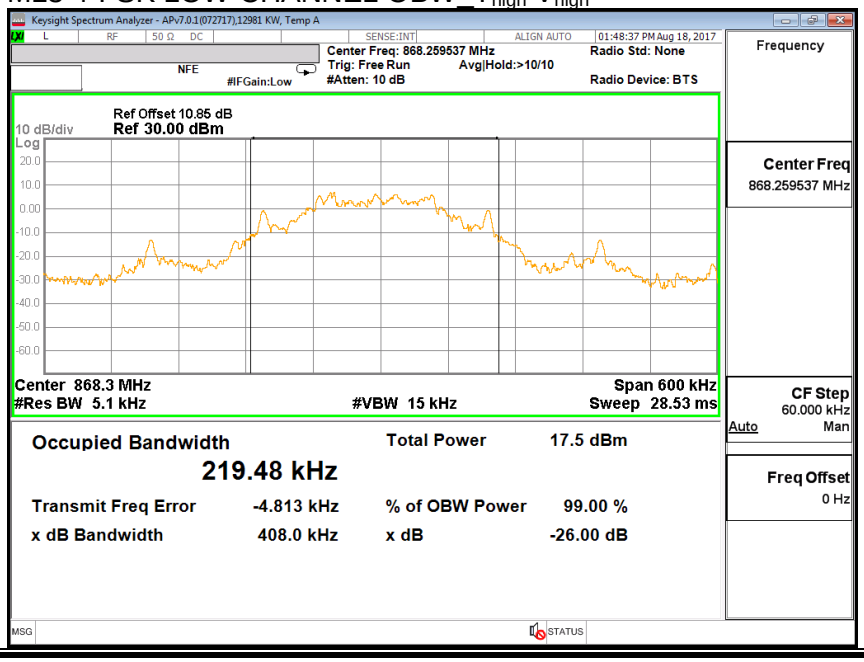
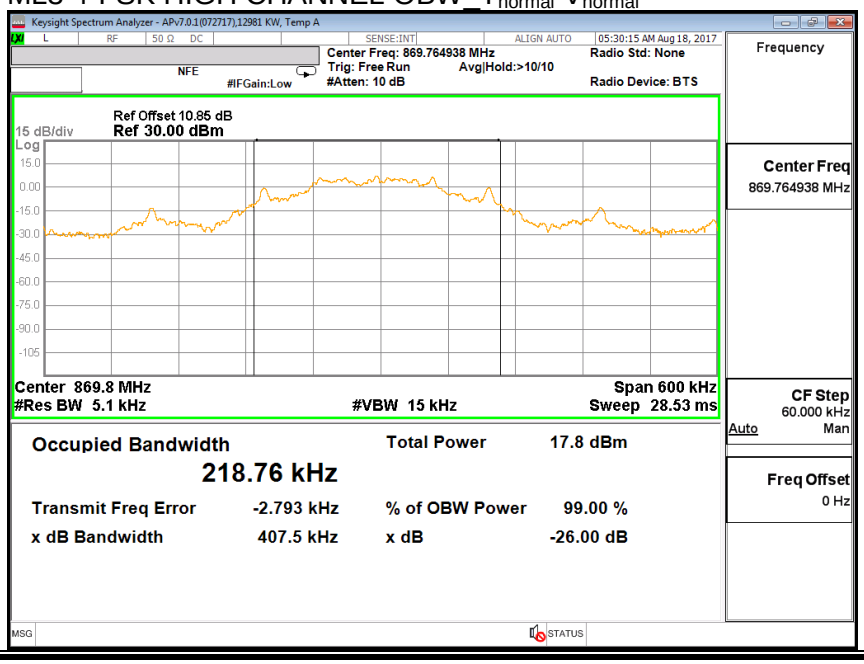
ML3 4-FSK LOW CHANNEL OBW_T_{high} V_{high}



ML3 4-FSK HIGH CHANNEL OBW_T_{normal} V_{normal}



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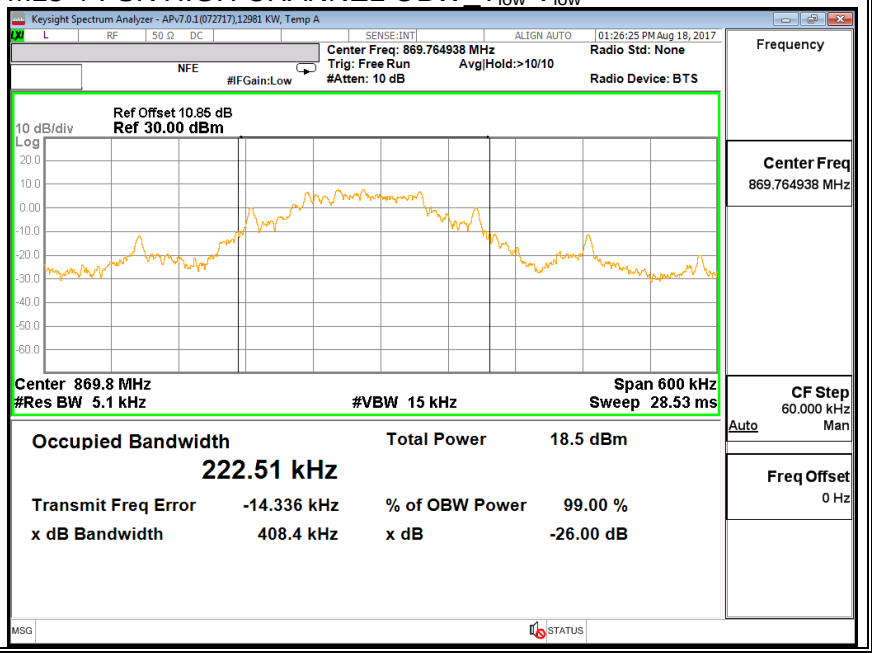
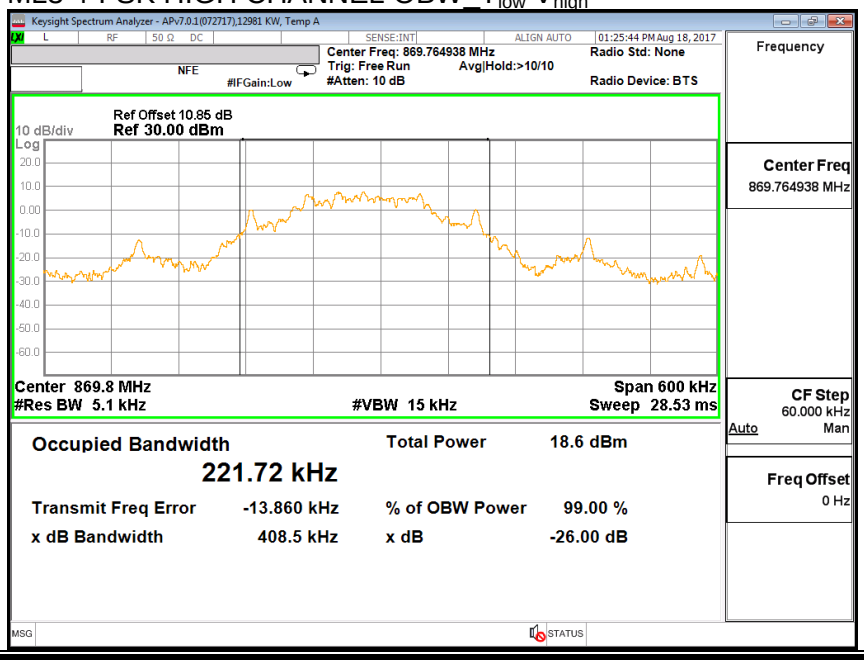
ML3 4-FSK HIGH CHANNEL OBW_T_{low} V_{low}



ML3 4-FSK HIGH CHANNEL OBW_T_{low} V_{high}



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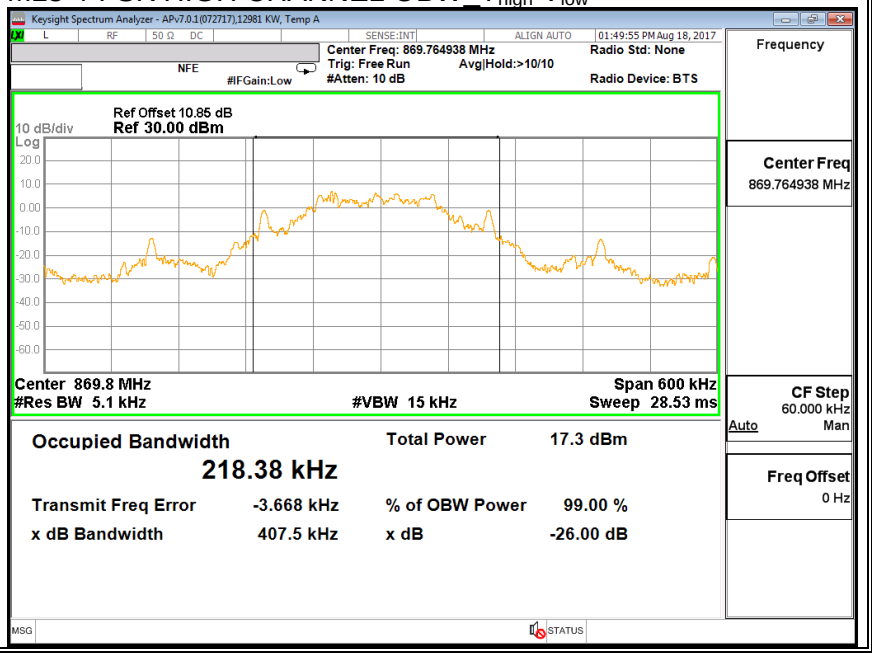
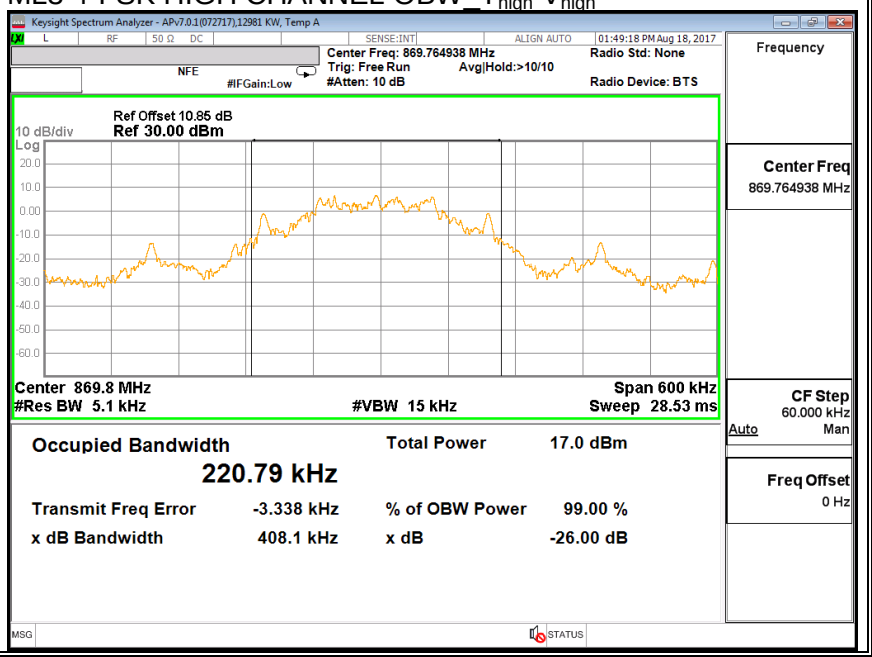
ML3 4-FSK HIGH CHANNEL OBW_T_{high} V_{low}



ML3 4-FSK HIGH CHANNEL OBW_T_{high} V_{high}



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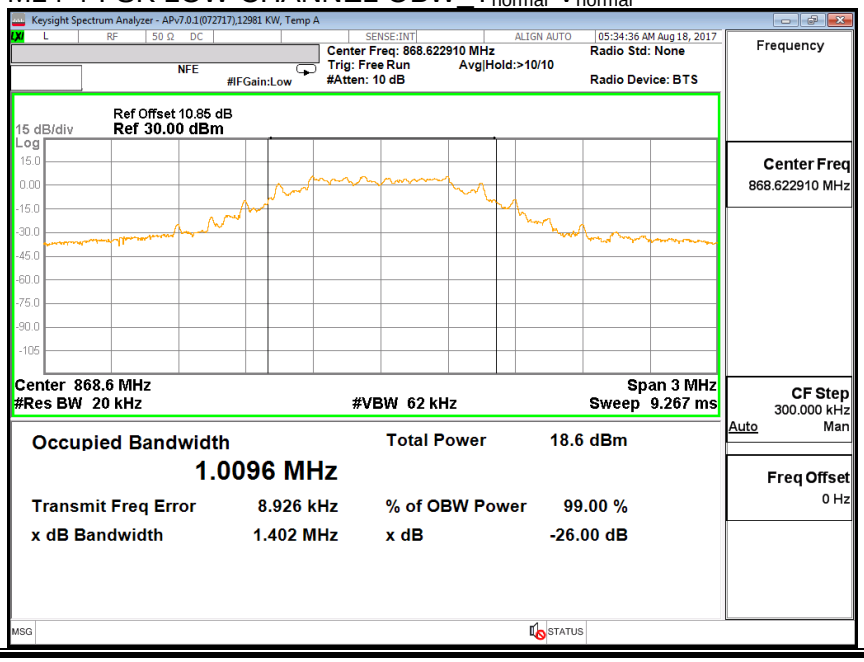
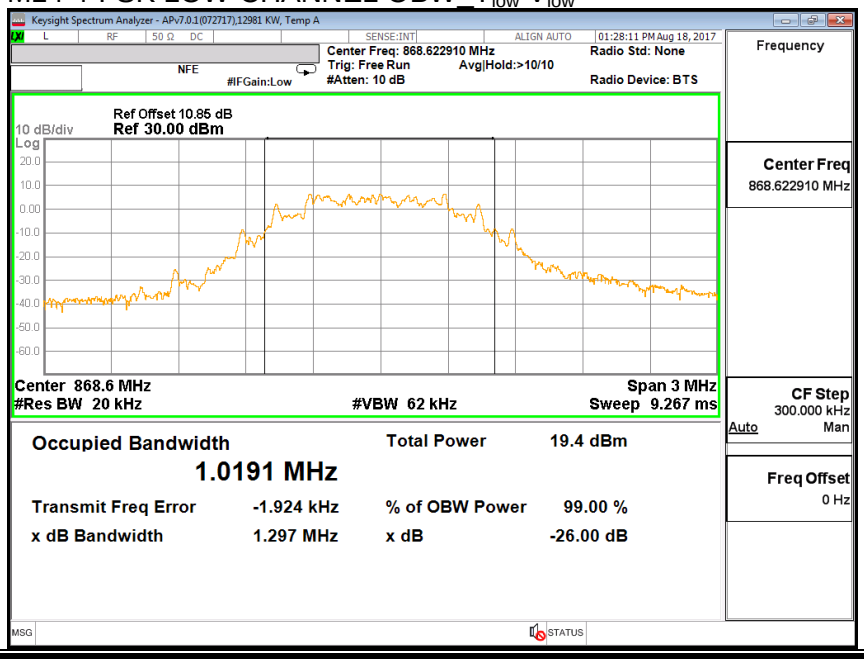
M14 4-FSK LOW CHANNEL OBW_T_{normal} V_{normal}



M14 4-FSK LOW CHANNEL OBW_T_{low} V_{low}



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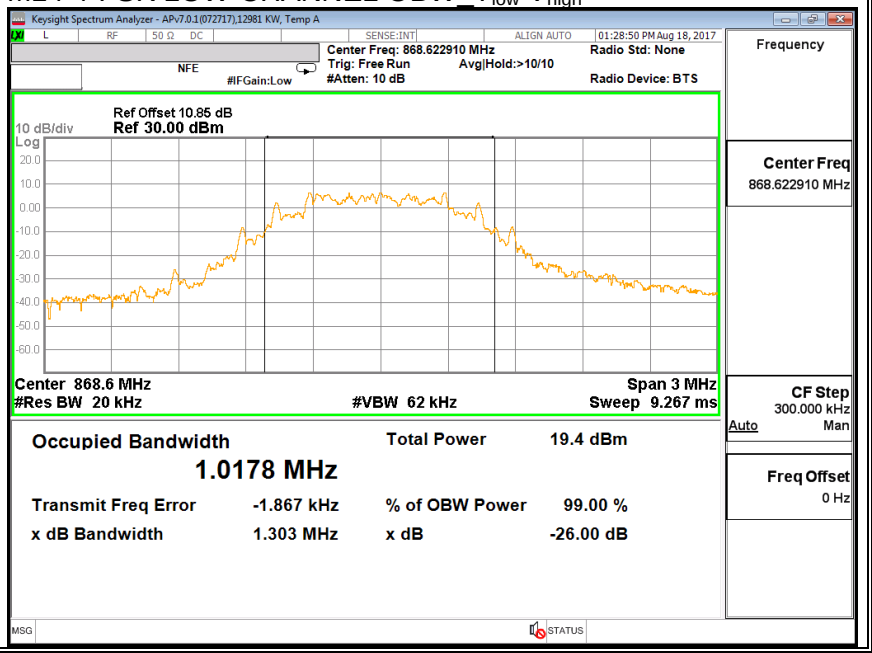
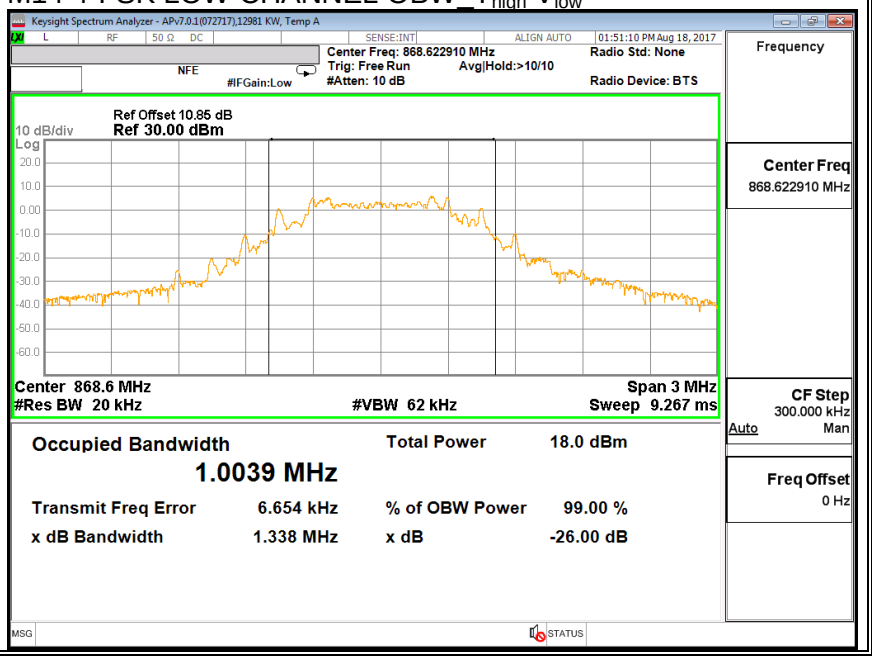
M14 4-FSK LOW CHANNEL OBW_T_{low} V_{high}



M14 4-FSK LOW CHANNEL OBW_T_{high} V_{low}



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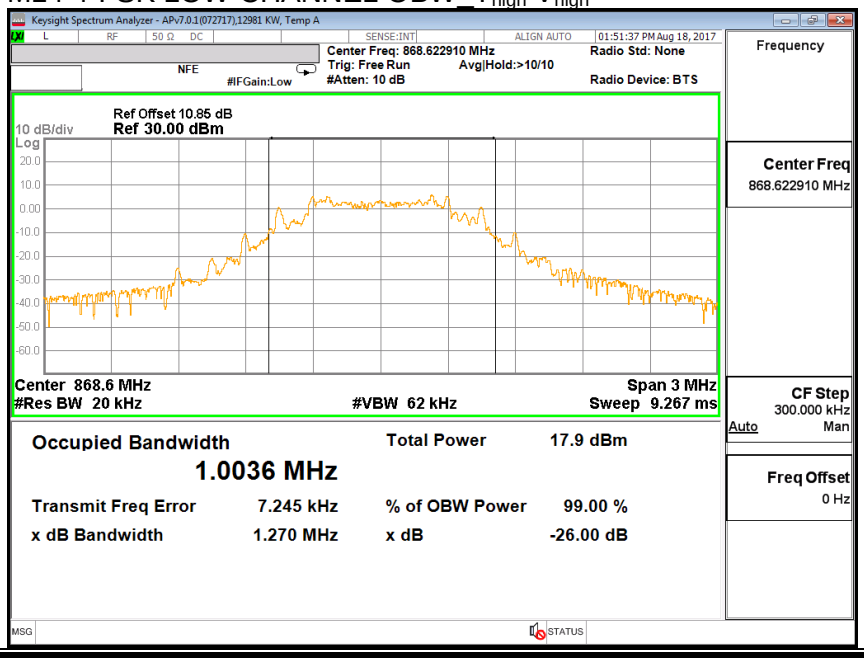
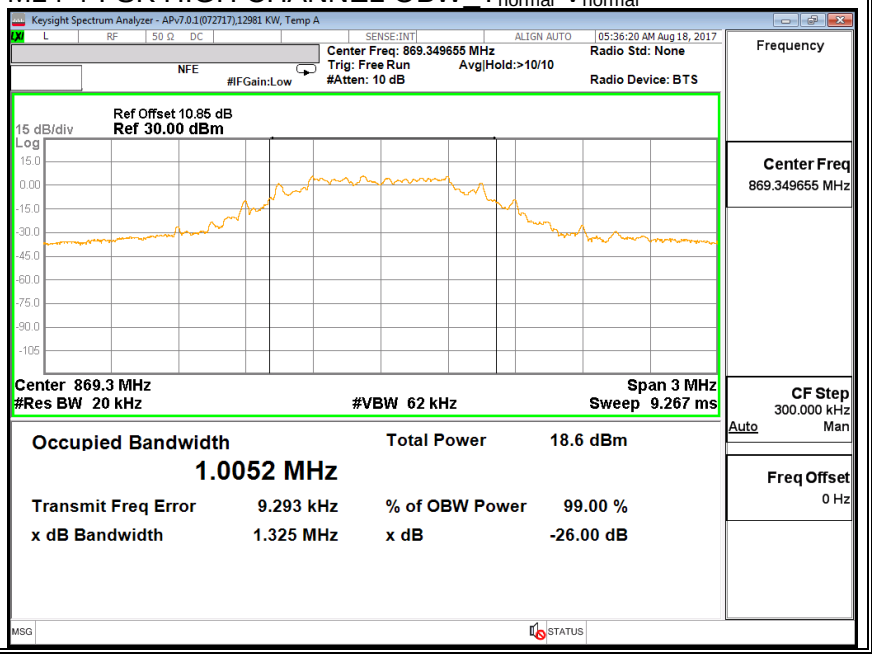
M14 4-FSK LOW CHANNEL OBW_T_{high} V_{high}



M14 4-FSK HIGH CHANNEL OBW_T_{normal} V_{normal}



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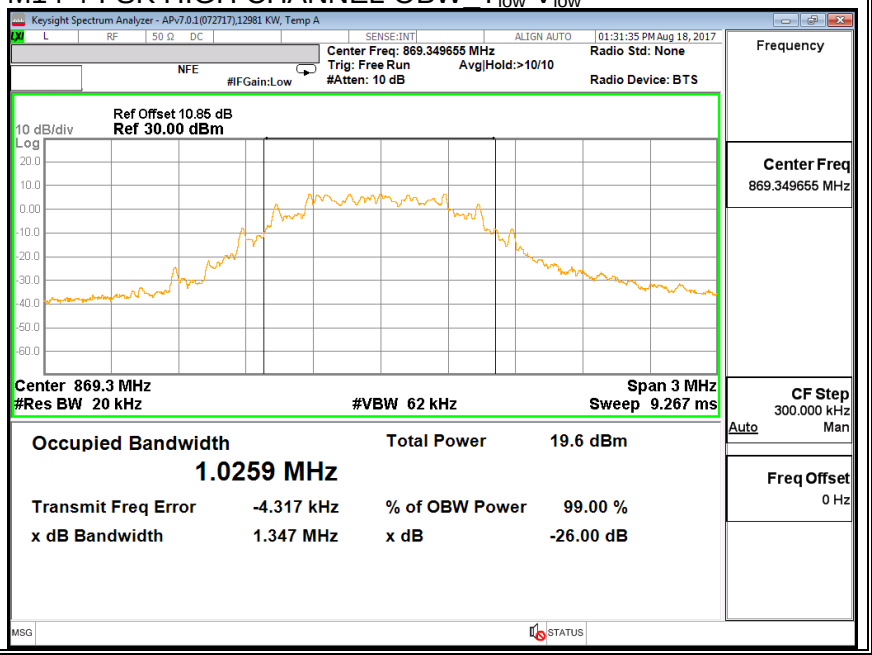
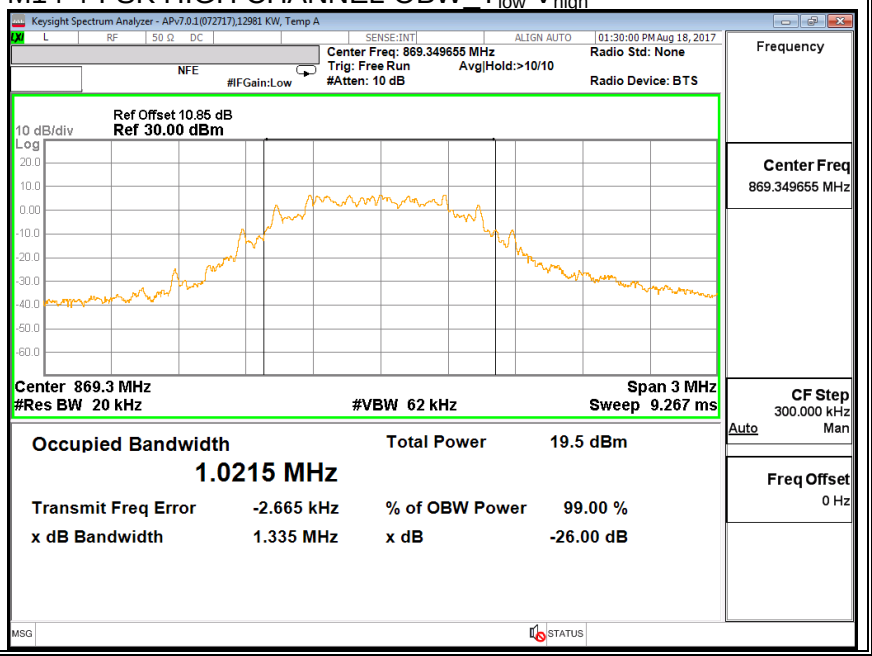
M14 4-FSK HIGH CHANNEL OBW_T_{low} V_{low}



M14 4-FSK HIGH CHANNEL OBW_T_{low} V_{high}



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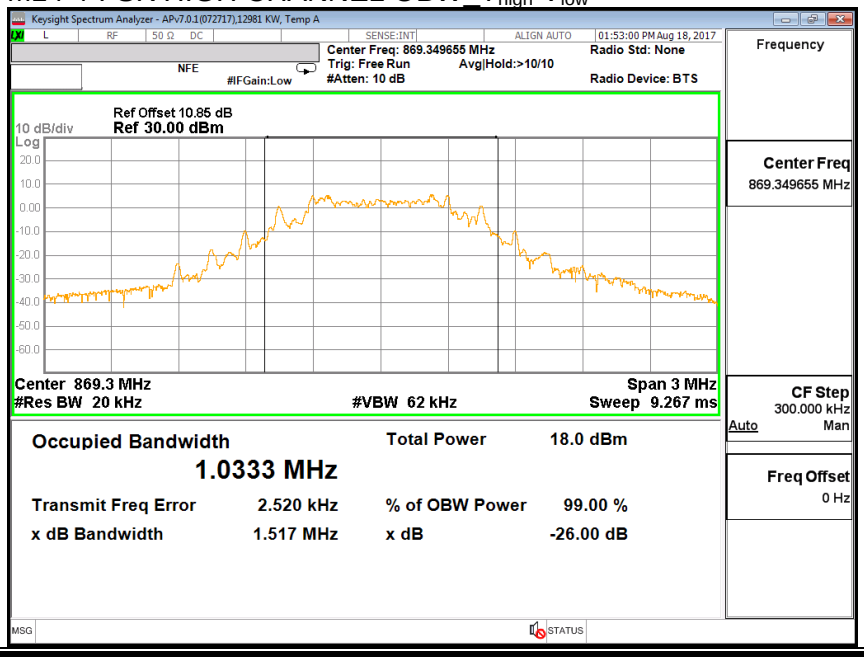
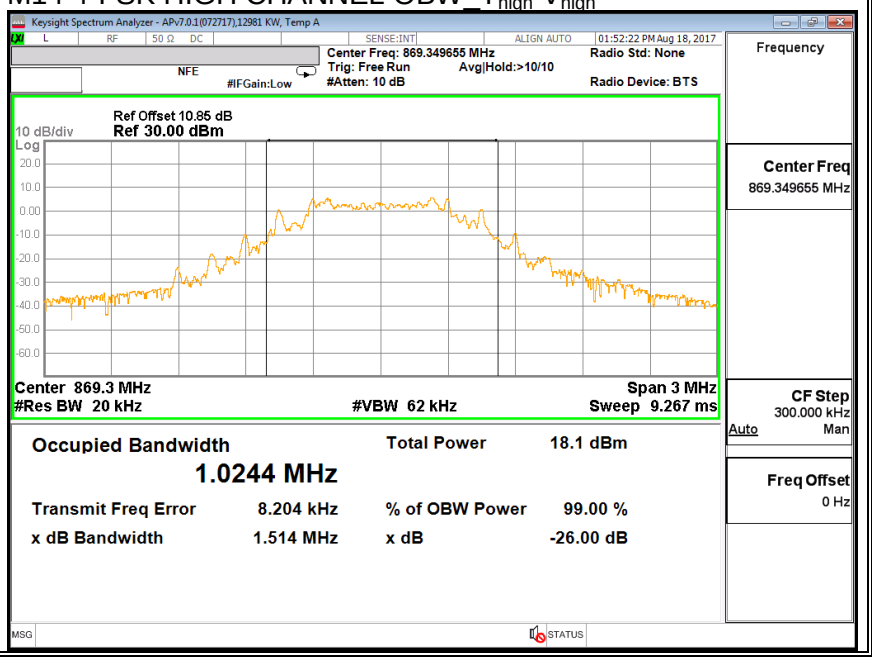
M14 4-FSK HIGH CHANNEL OBW_T_{high} V_{low}



M14 4-FSK HIGH CHANNEL OBW_T_{high} V_{high}



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7.13.4. MAXIMUM E.R.P SPECTRAL DENSITY

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.3.2.2

The Maximum e.r.p. spectral density shall not be greater than the value allowed in annexes B or C for the chosen operational frequency band(s).

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.3.2.1.2

RESULTS

BAND X

EUT Antenna Gain (dBi) =	2.00

Condition	SPECTRAL DENSITY (dBm/100kHz)	E.R.P SPECTRAL DENSITY (dBm/100kHz)	Limit (dBm/100kHz)	Margin (dB)
ML3, Low Channel, CH5				
Normal	-1.15	-1.30	-0.8	-0.50
ML3, High Channel, CH34				
Normal	-1.16	-1.31	-0.8	-0.51
M14, Low Channel, CH12				
Normal	-1.55	-1.70	-0.8	-0.90
M14, High Channel, CH26				
Normal	-1.59	-1.74	-0.8	-0.94

Note: E.R.P Spectral Density = Spectral Density + EUT Antenna Gain – 2.15

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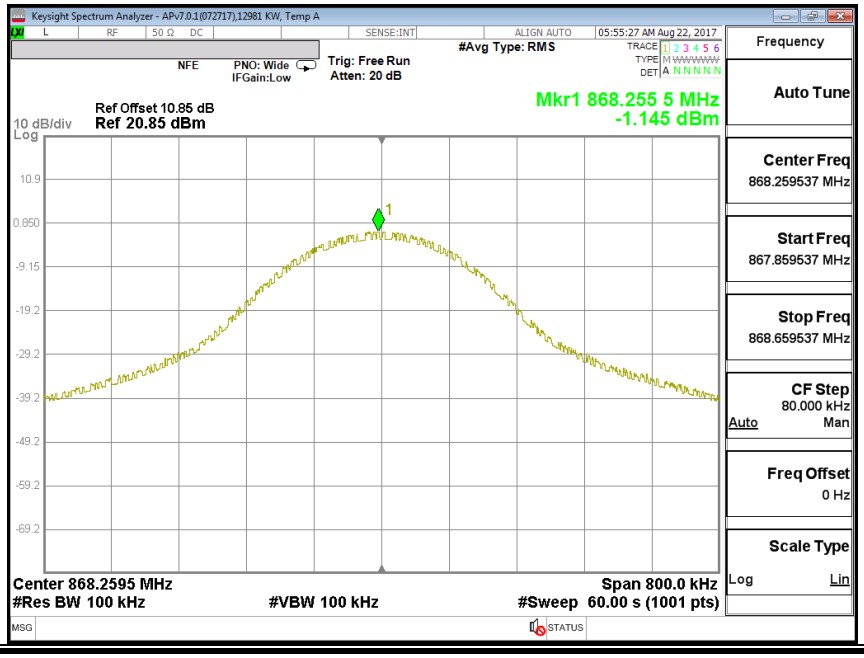
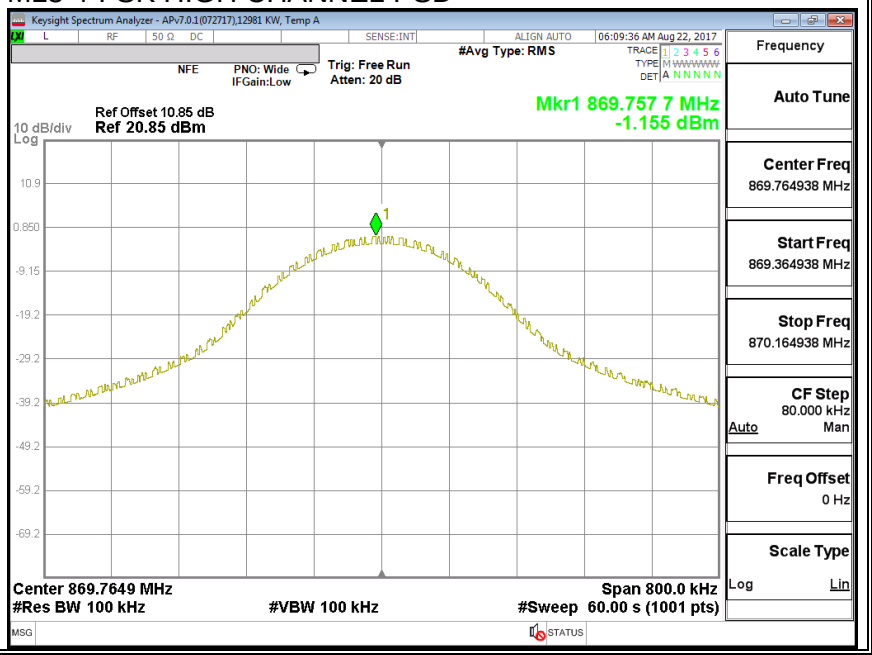
ML3 4-FSK LOW CHANNEL PSD



ML3 4-FSK HIGH CHANNEL PSD



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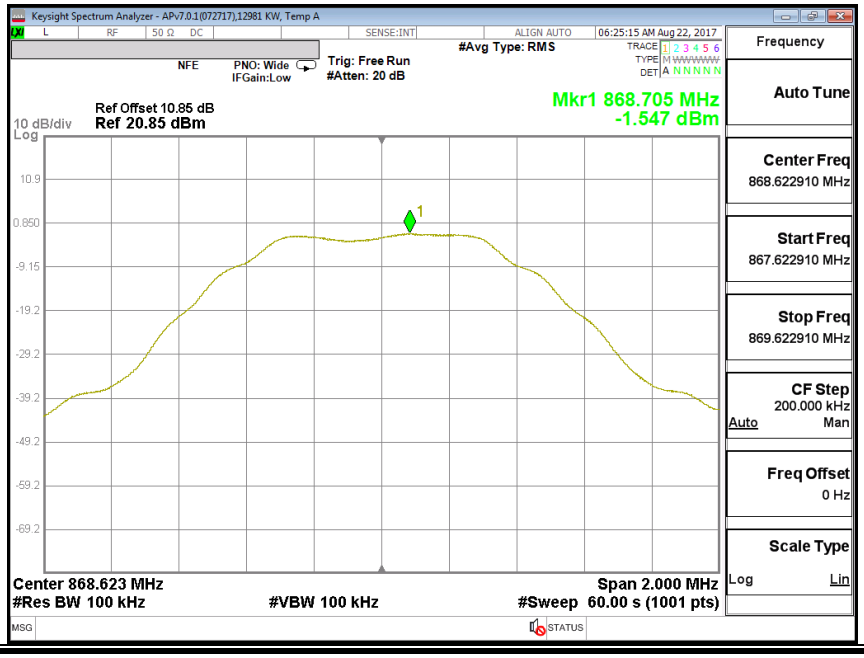
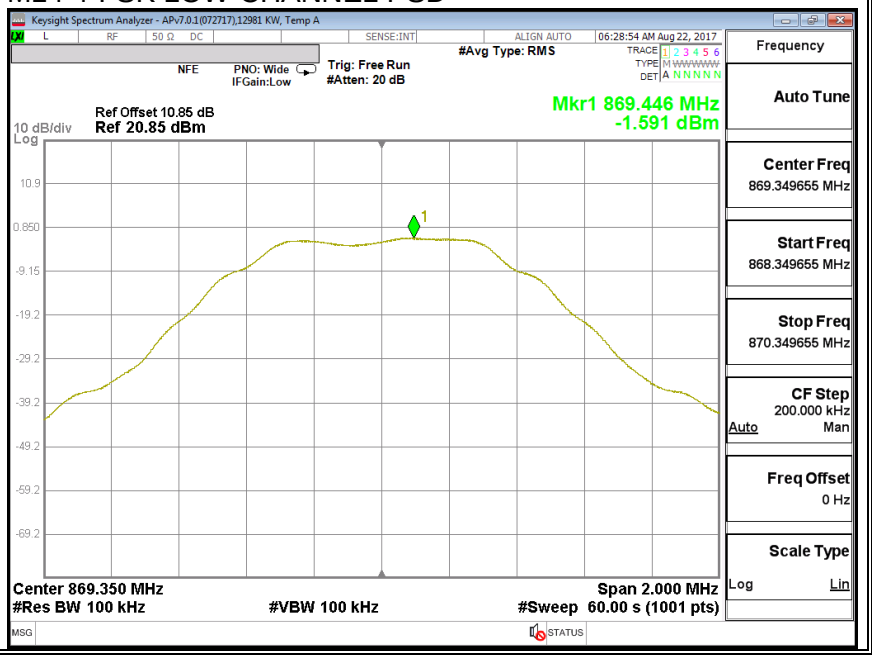
M14 4-FSK LOW CHANNEL PSD



M14 4-FSK LOW CHANNEL PSD



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7.13.5. TX OUT OF BAND EMISSIONS

REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.1

Two OOB domains are defined, one for OC (see Figure 5) and one for Operational Frequency band (see Figure 6). The spectrum masks for these two OOB domains may overlap.

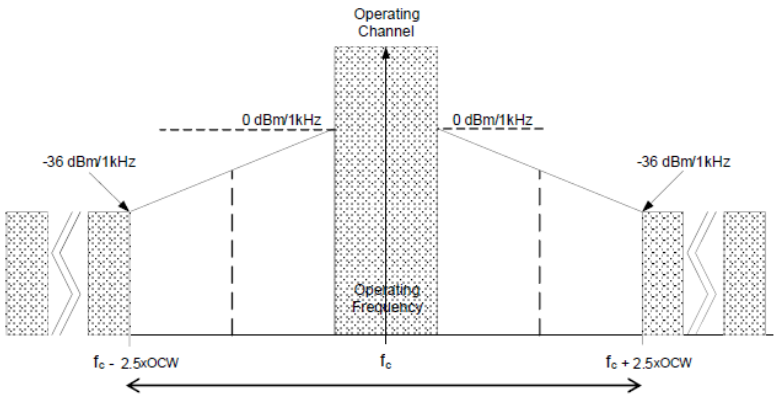

Figure 5: Out Of Band Domain for Operating Channel with reference BW

Unwanted emissions in the Out Of Band domain are those falling in the frequency range immediately below the lower, and above the upper, frequency of the Operating Channel. The OOB domain includes both frequencies outside the Operating Channel within the Operational Frequency Band and frequencies outside the Operational Frequency Band.
The relevant Out Of Band domain is shown in Figure 5 and applies within the Operational Frequency Band.

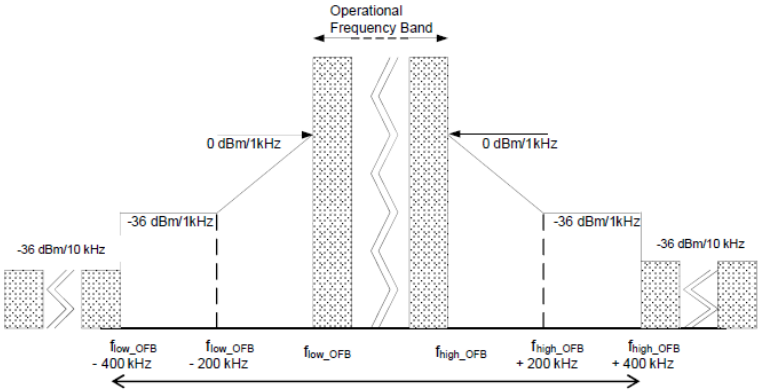

Figure 6: Out Of Band Domain for Operational Frequency Band with reference BW

Specific limits apply at frequencies immediately above and below the Operational Frequency Band as shown in Figure 6.
NOTE: f_{low}_OFB is the lower edge of the Operational Frequency Band. f_{high}_OFB is the upper edge of the Operational Frequency Band.

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REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.2

The EUT emissions level in OOB domains for the Operating Channel and the Operational Frequency Band shall be less or equal to Table 15 spectrum mask.

Table 15: Emission limits in the Out Of Band domains

Domain	Frequency Range	RBW_{REF}	Max power limit
OOB limits applicable to Operational Frequency Band (See Figure 6)	$f \le f_{low_OFB}$ - 400 kHz	10 kHz	-36 dBm
	F_{low_OFB} - 400 kHz ≤ f ≤ f_{low_OFB} - 200 kHz	1 kHz	-36 dBm
	f_{low} - 200 kHz ≤ f < f_{low_OFB}	1 kHz	See Figure 6
	$f = f_{low_OFB}$	1 kHz	0 dBm
	$f = f_{high_OFB}$	1 kHz	0 dBm
	F_{high_OFB} < f ≤ f_{high_OFB} + 200 kHz	1 kHz	See Figure 6
	F_{high_OFB} + 200 kHz ≤ f ≤ f_{high_OFB} + 400 kHz	1 kHz	-36 dBm
	F_{high_OFB} + 400 kHz ≤ f	10 kHz	-36 dBm
OOB limits applicable to Operating Channel (See Figure 5)	$f = f_c$- 2.5 x OCW	1 kHz	-36 dBm
	f_c - 2,5 x OCW ≤ f ≤ f_c - 0,5 x OCW	1 kHz	See Figure 5
	$f = f_c$ - 0,5 x OCW	1 kHz	0 dBm
	$f = f_c$ + 0,5 x OCW	1 kHz	0 dBm
	f_c + 0,5 x OCW ≤ f ≤ f_c + 2,5 x OCW	1 kHz	See Figure 5
	$f = f_c$+ 2,5 x OCW	1 kHz	-36 dBm

NOTE: f is the measurement frequency.
f_c is the Operating Frequency.
F_{low_OFB} is the lower edge of the Operational Frequency Band.
F_{high_OFB} is the upper edge of the Operational Frequency Band.
OCW is the operating channel bandwidth.

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.8.3.3 (Conducted Measurement)

RESULTS

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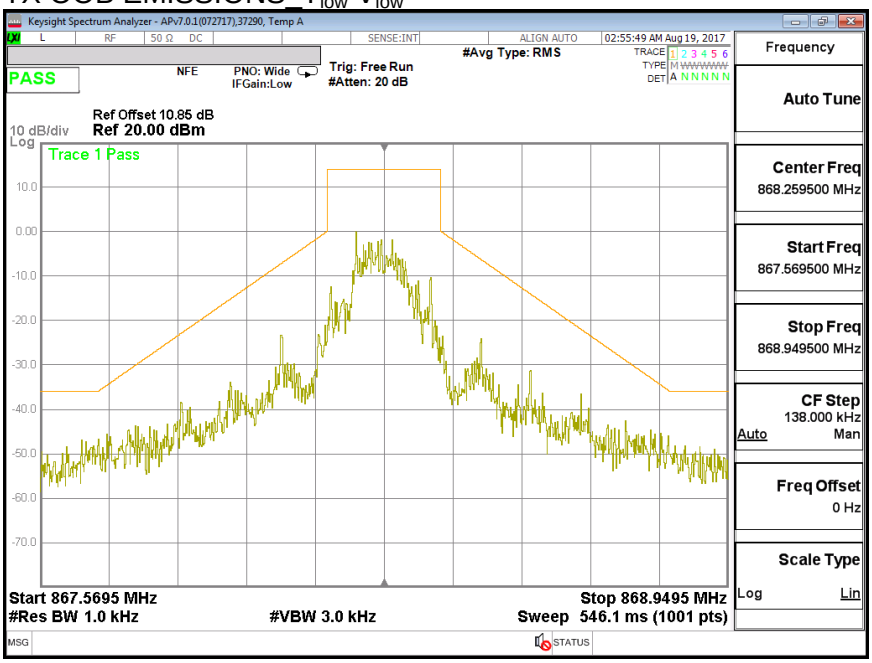
TX OUT OF BAND EMISSIONS (APPLICABLE TO OPERATING CHANNEL)

ML3 LOW CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal}

TX OOB EMISSIONS_T_{low} V_{low}



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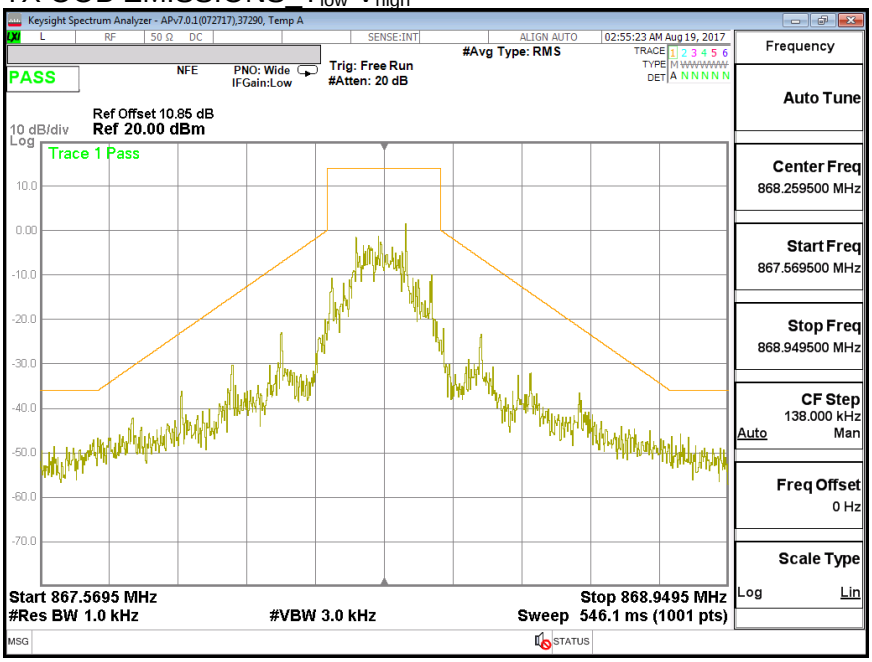
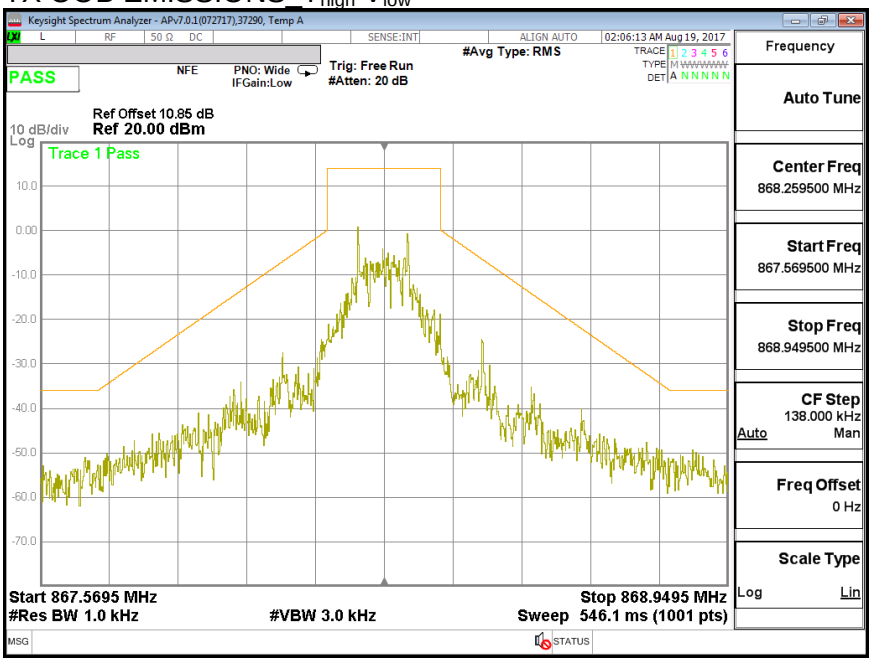
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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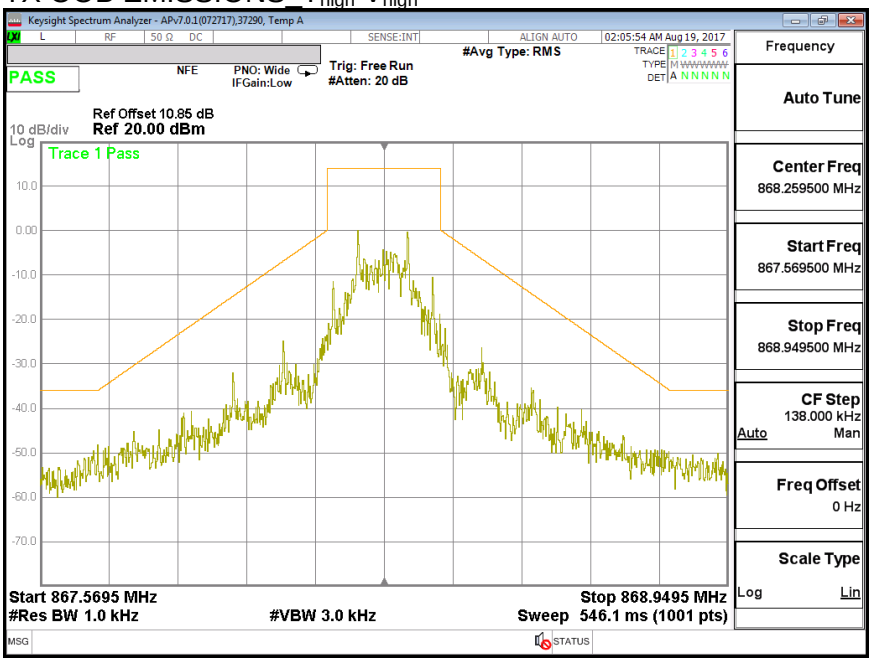
TX OOB EMISSIONS_T_{high} V_{high}



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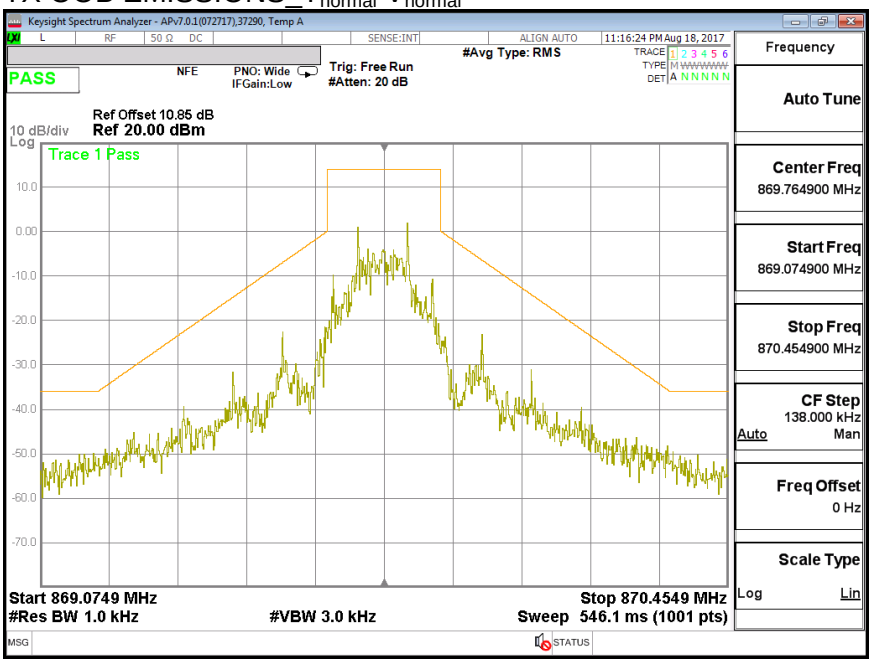
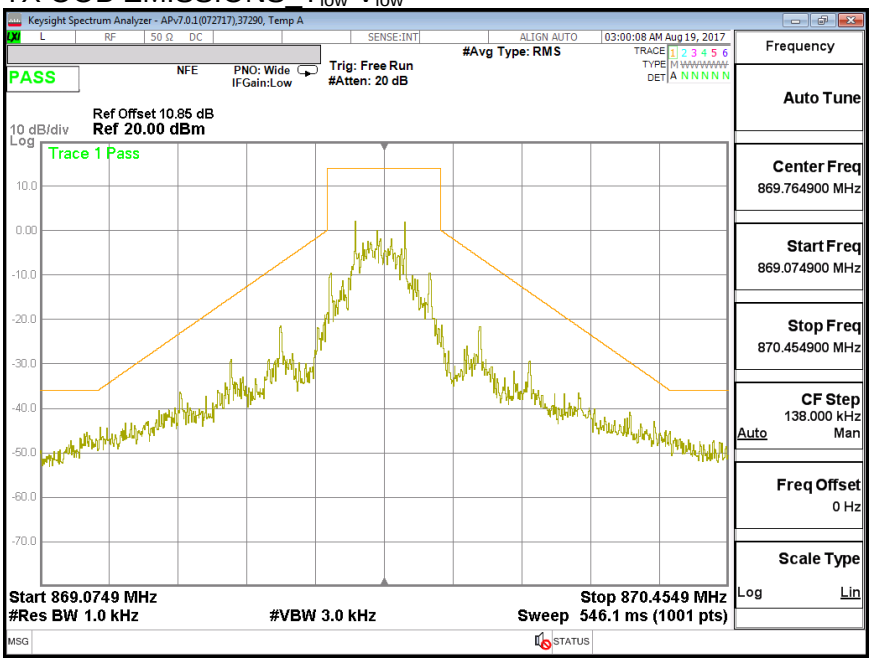
ML3 HIGH CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$



TX OOB EMISSIONS_T$_{low}$ V$_{low}$



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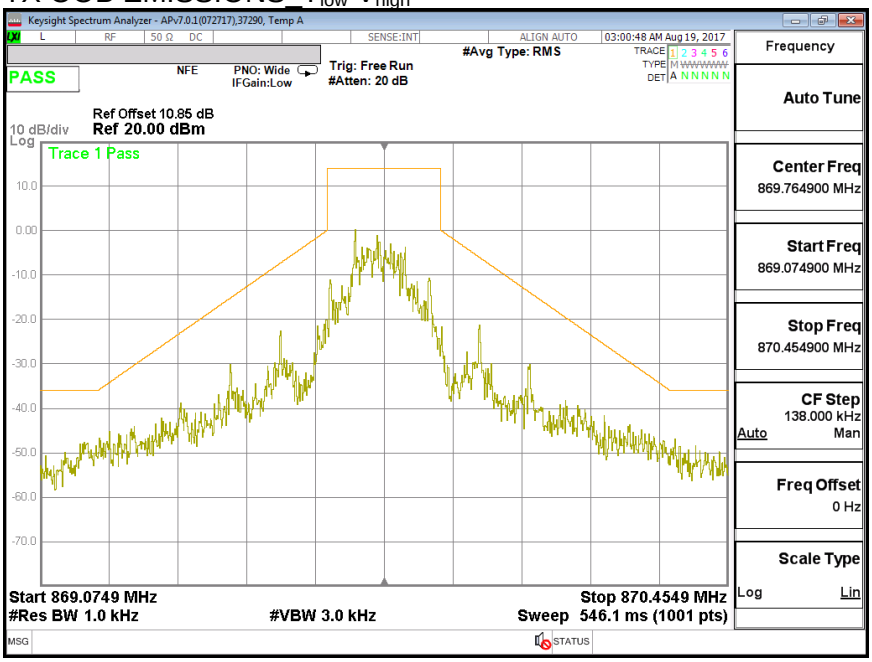
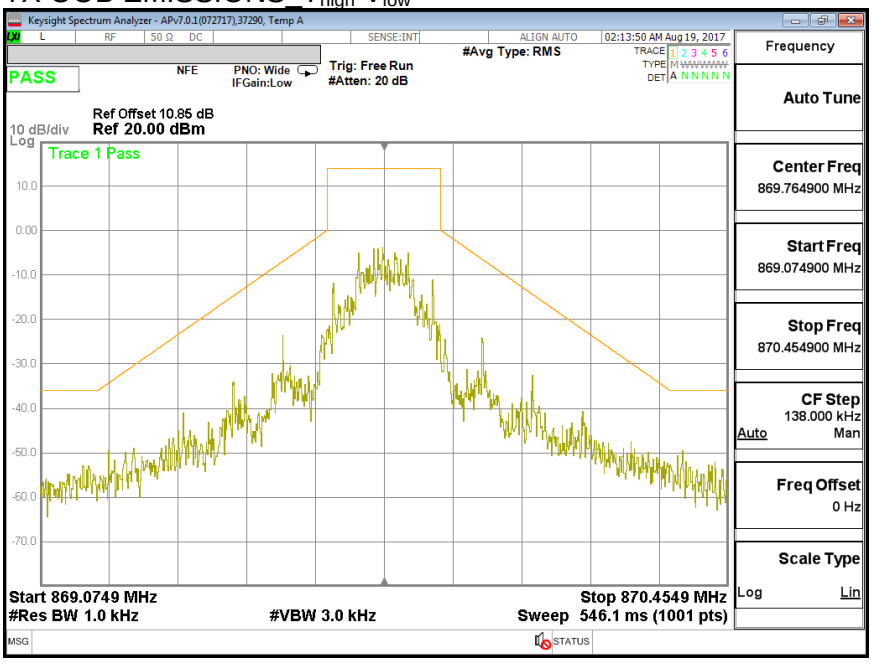
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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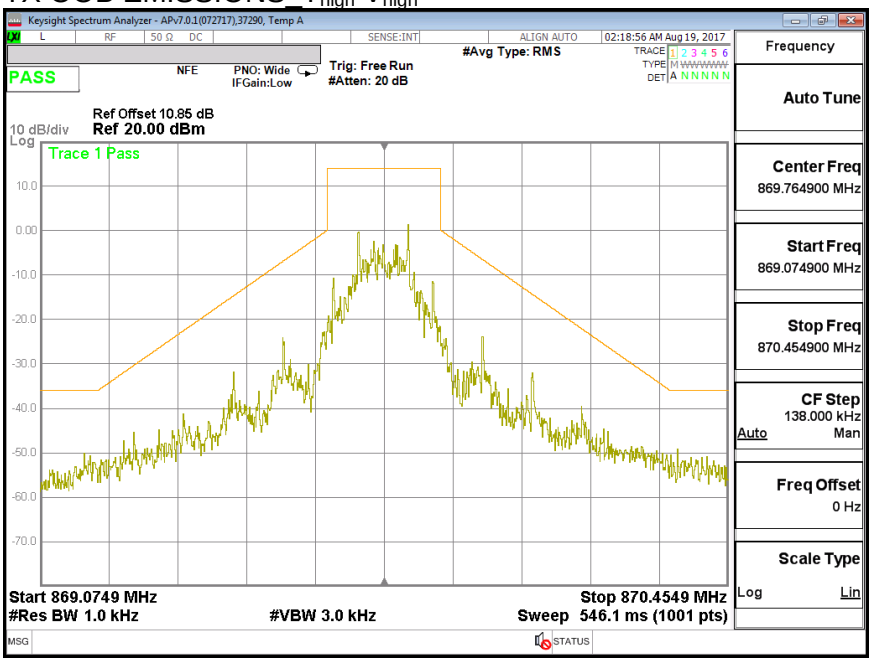
TX OOB EMISSIONS_T_{high} V_{high}



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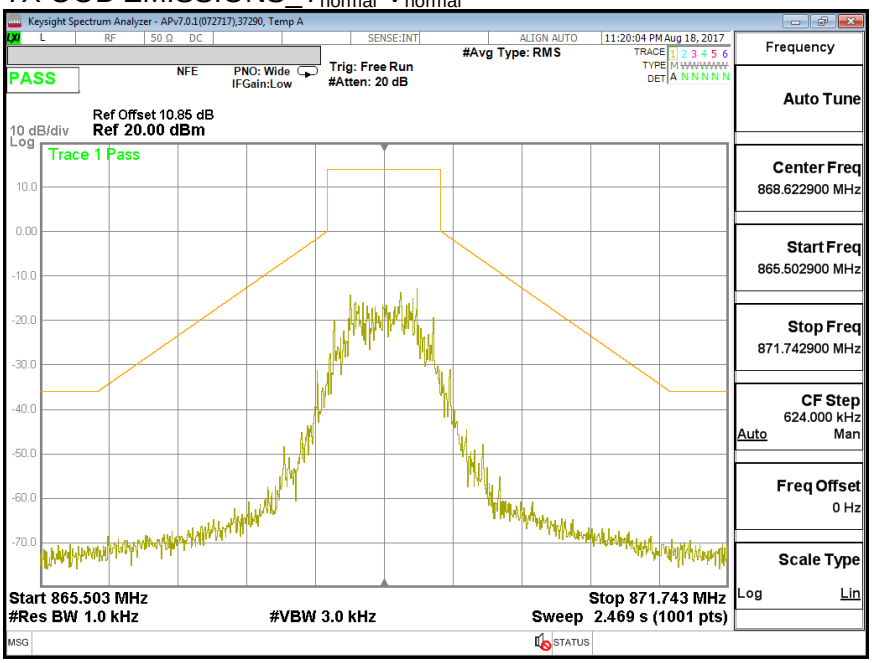
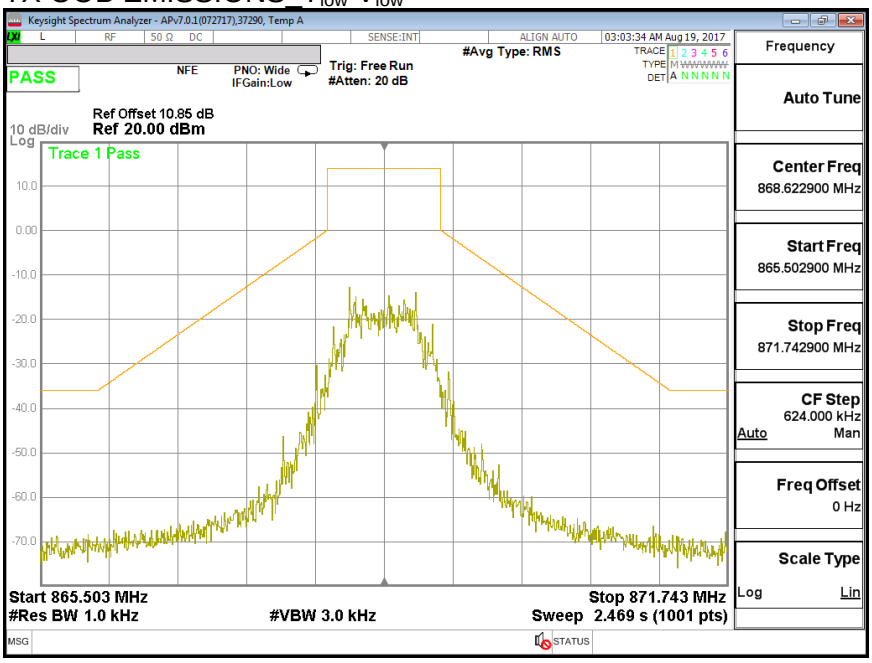
M14 LOW CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$



TX OOB EMISSIONS_T$_{low}$ V$_{low}$



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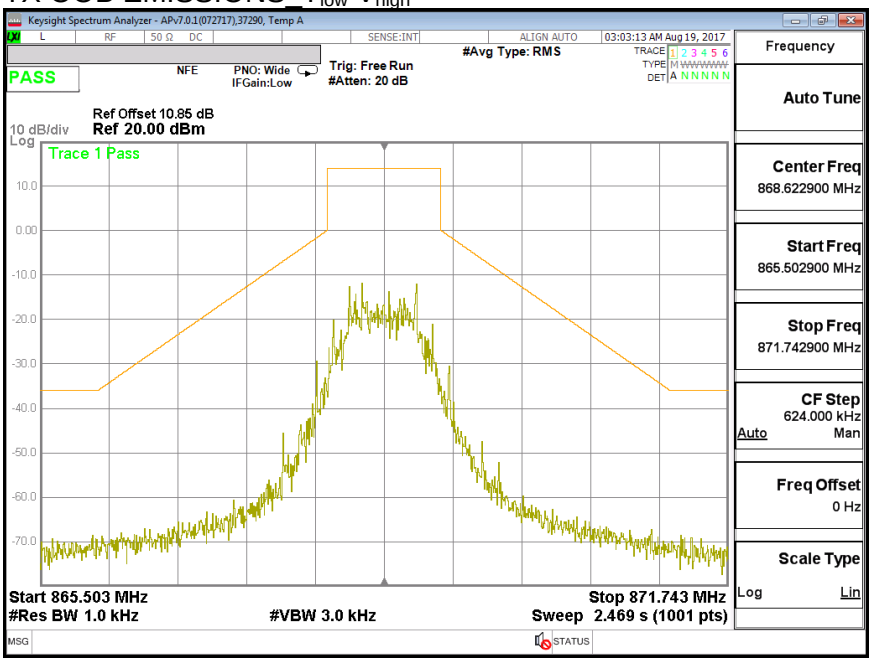
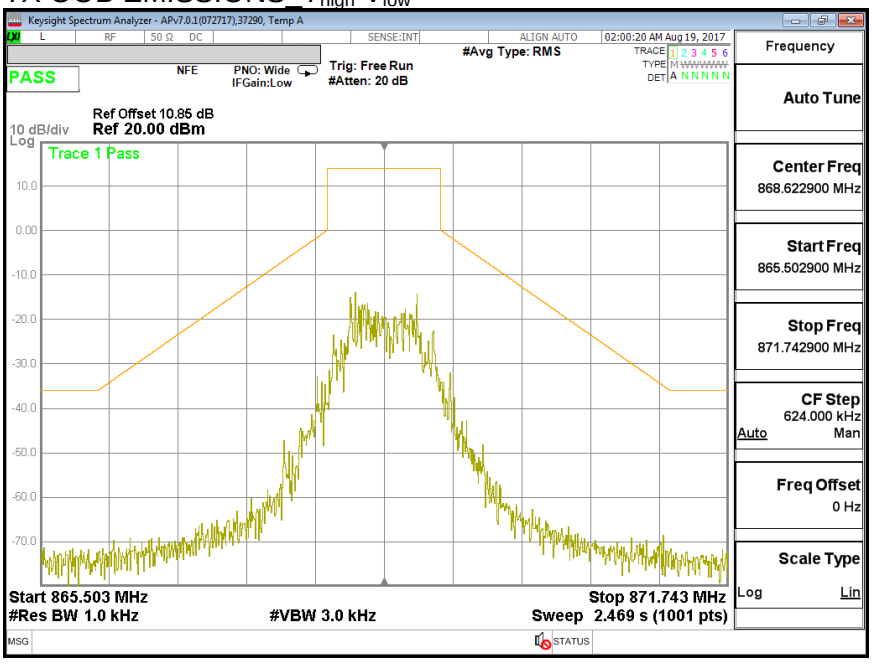
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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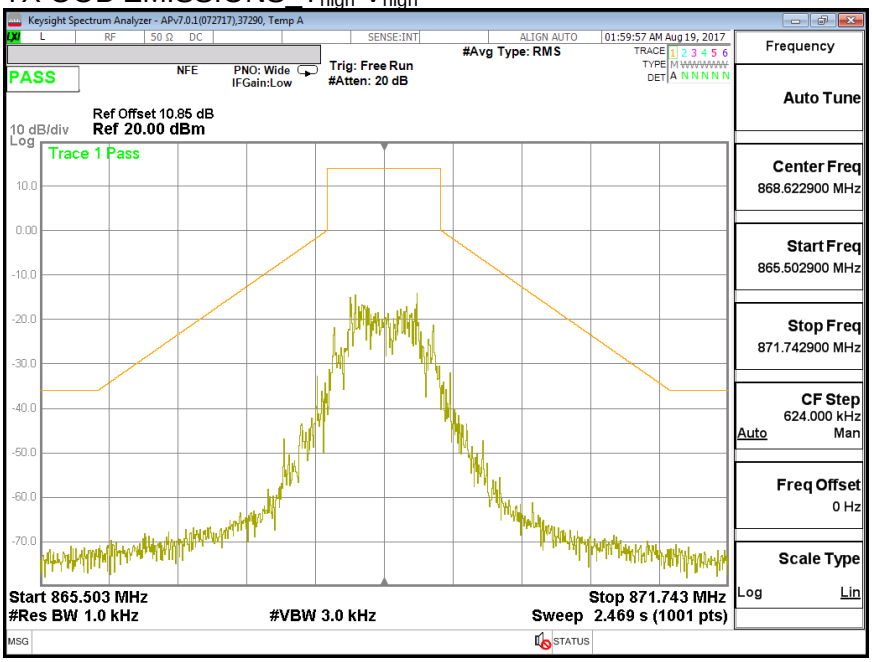
TX OOB EMISSIONS_T_{high} V_{high}



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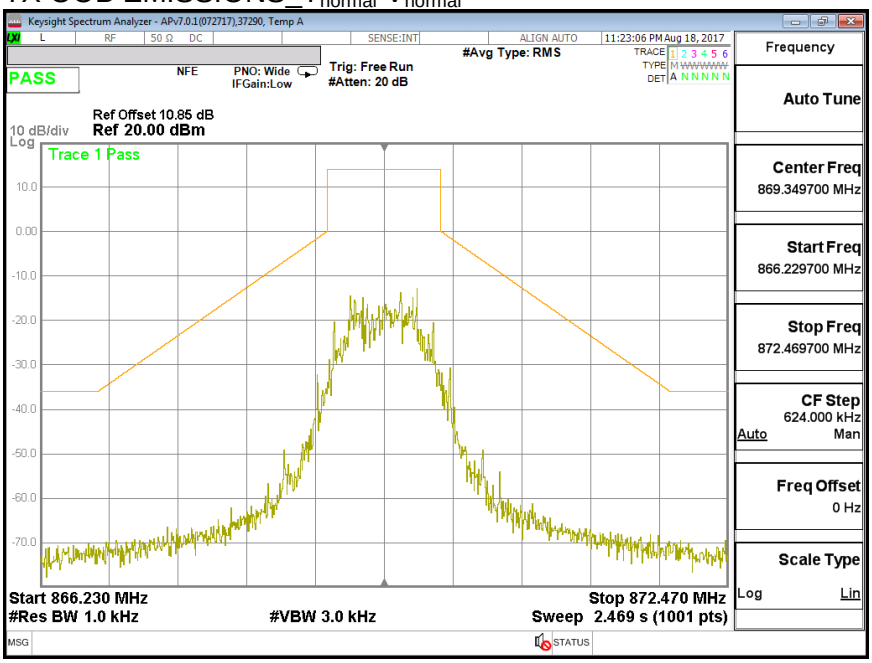
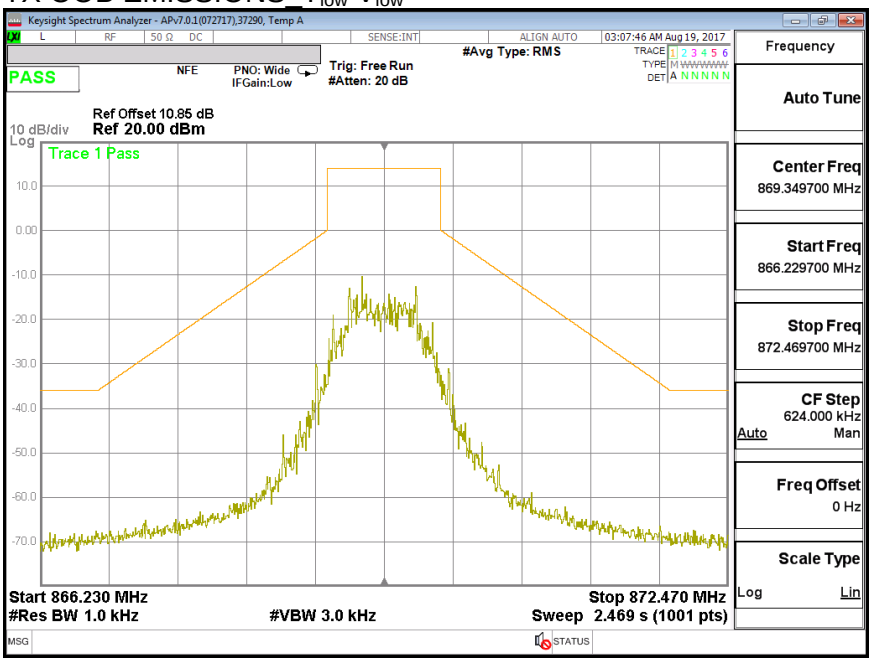
M14 HIGH CHANNEL

TX OOB EMISSIONS_T$_{normal}$ V$_{normal}$



TX OOB EMISSIONS_T$_{low}$ V$_{low}$



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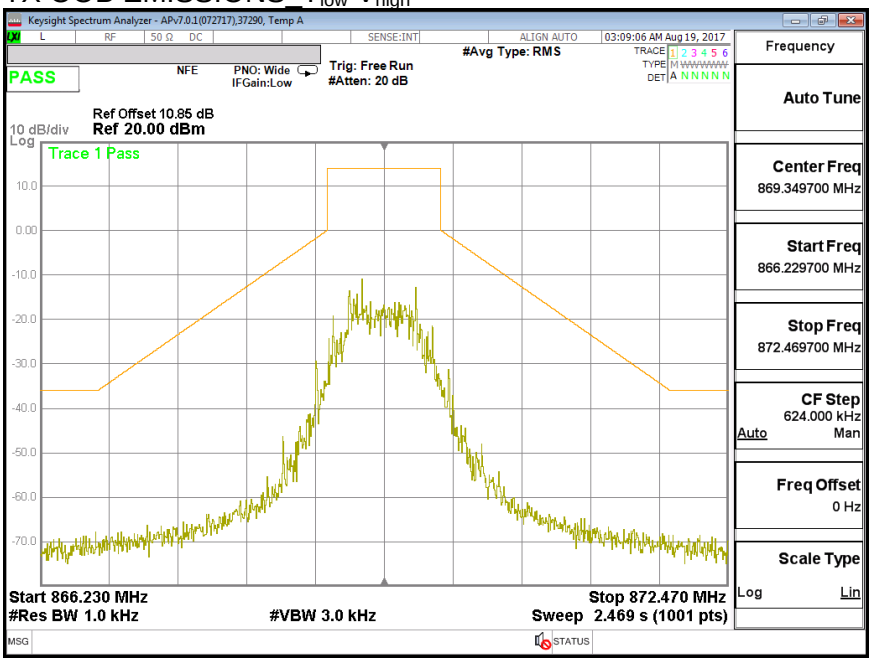
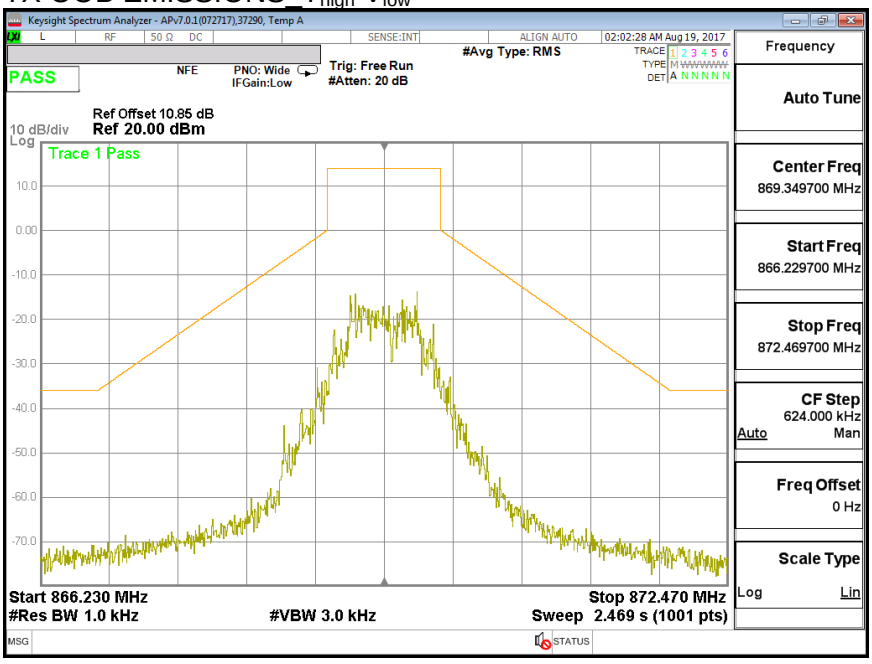
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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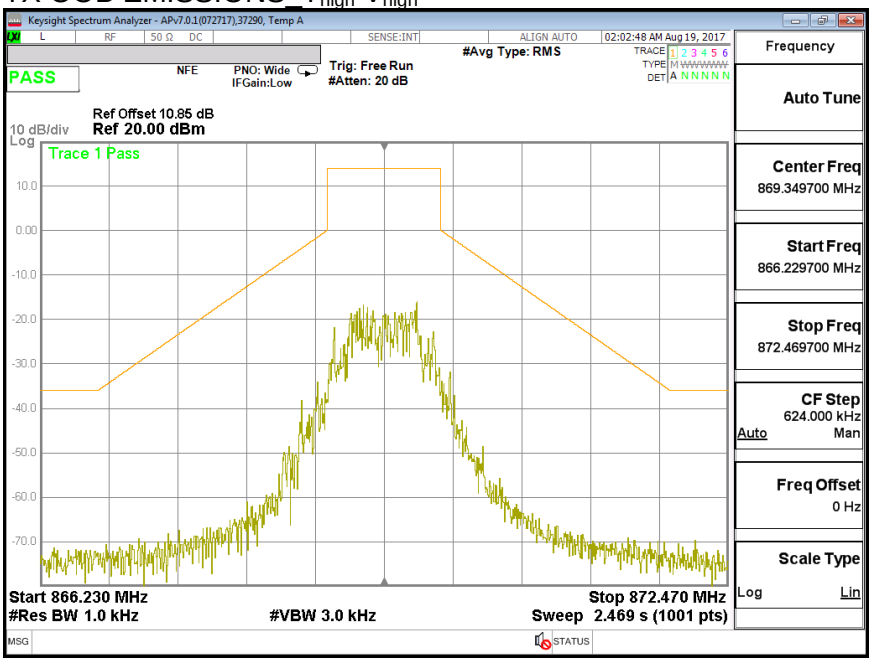
TX OOB EMISSIONS_T_{high} V_{high}



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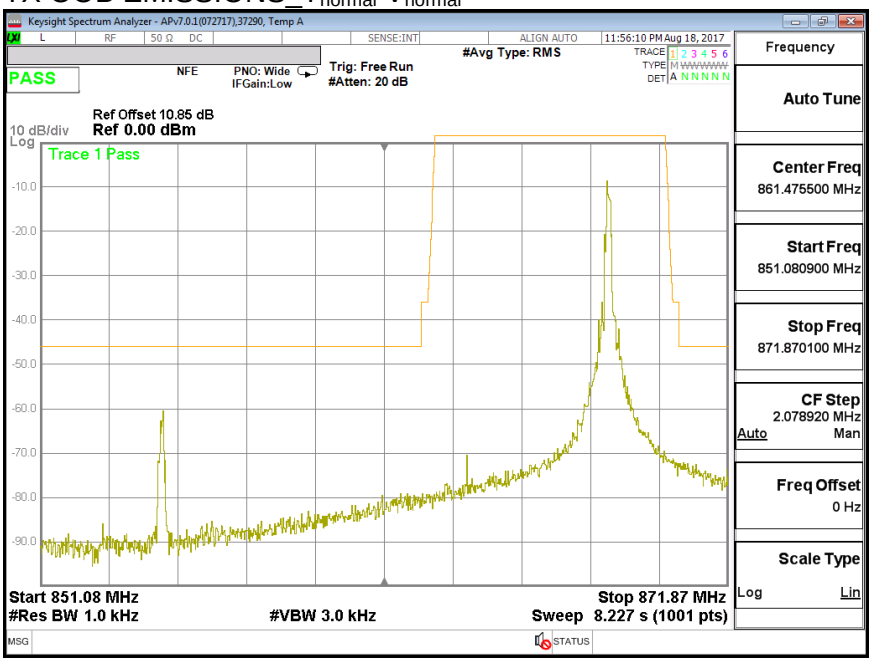
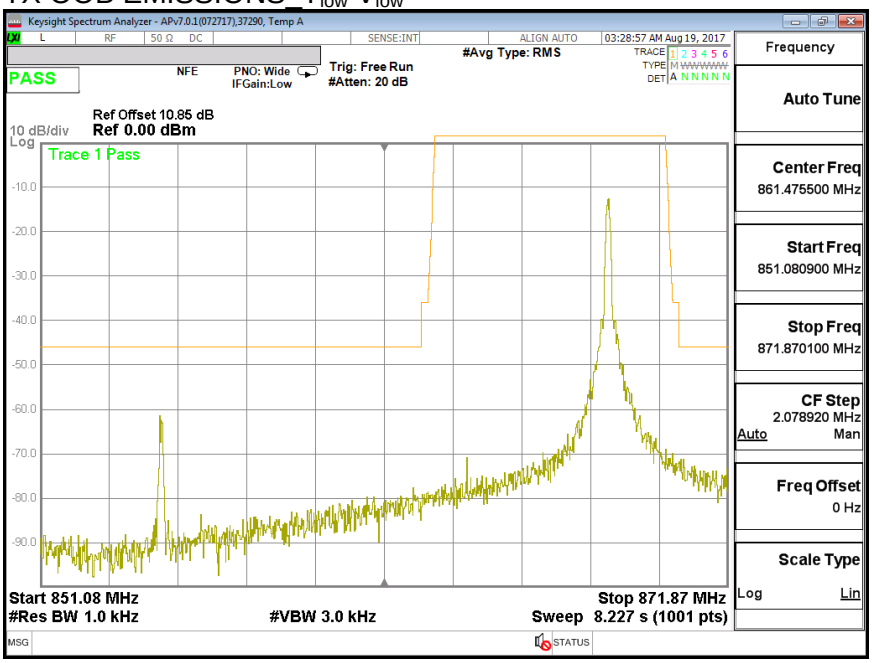
TX OUT OF BAND EMISSIONS (APPLICABLE TO OPERATIONAL FREQUENCY BANDS)

ML3 LOW CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal}



TX OOB EMISSIONS_T_{low} V_{low}



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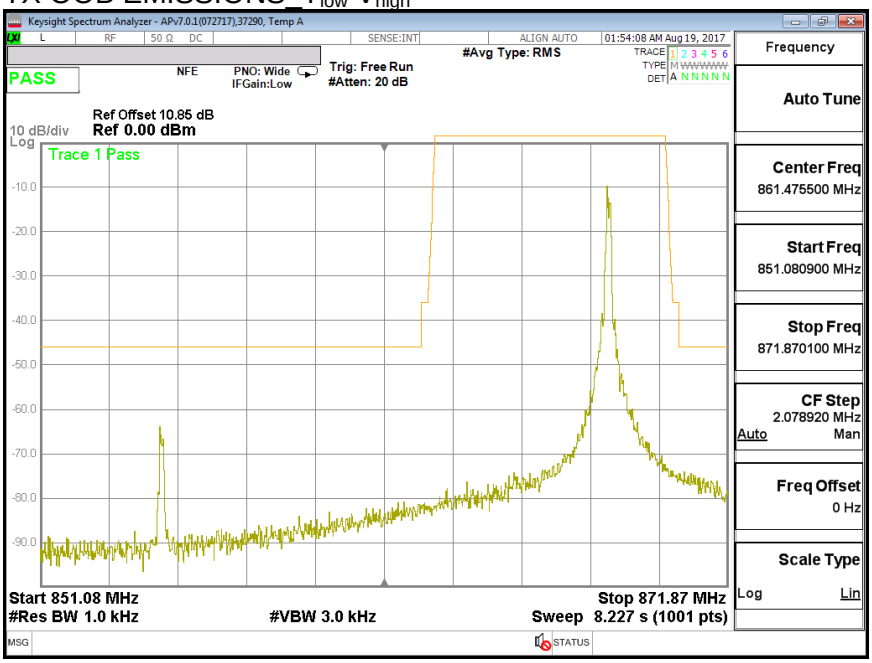
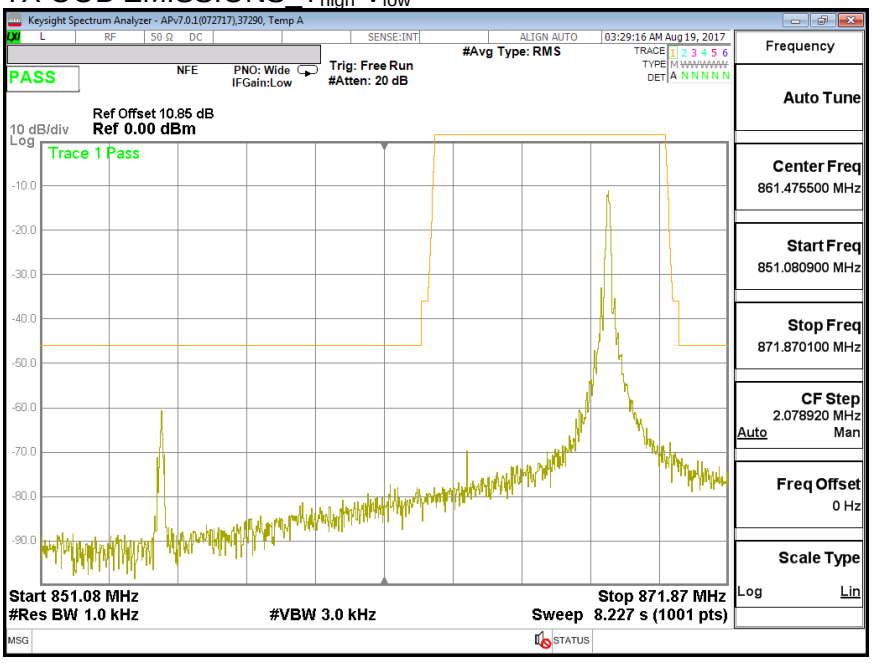
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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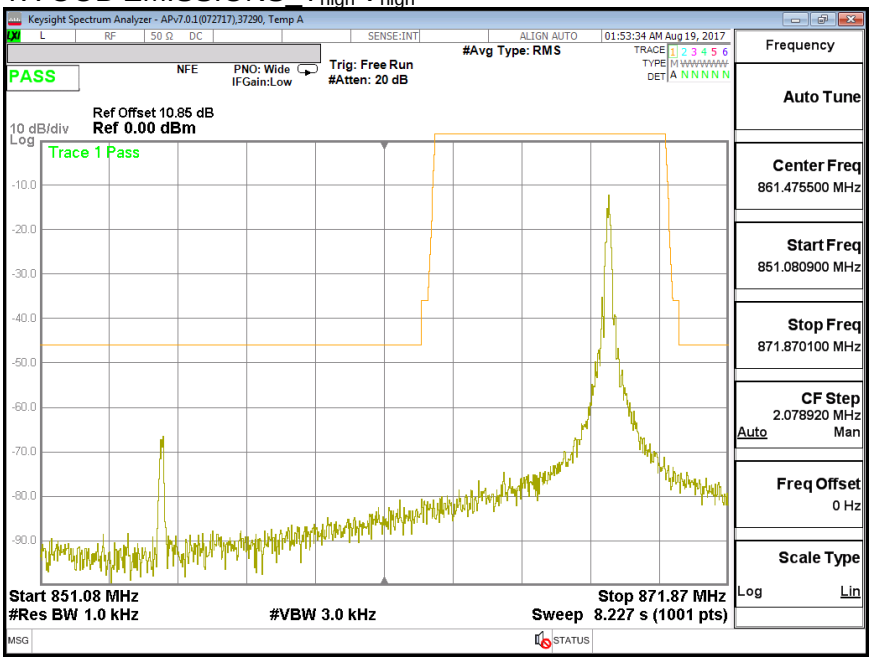
TX OOB EMISSIONS_T_{high} V_{high}



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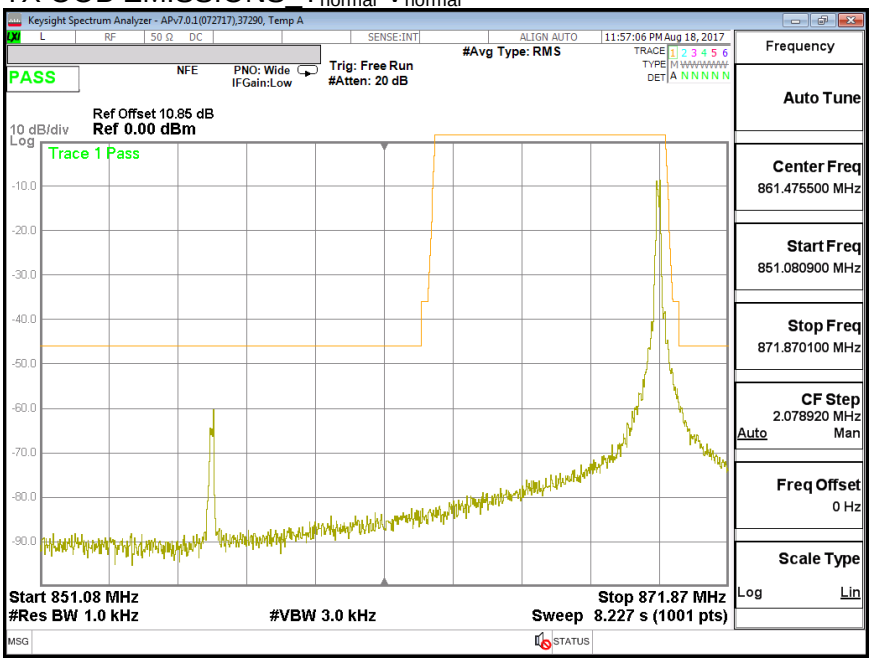
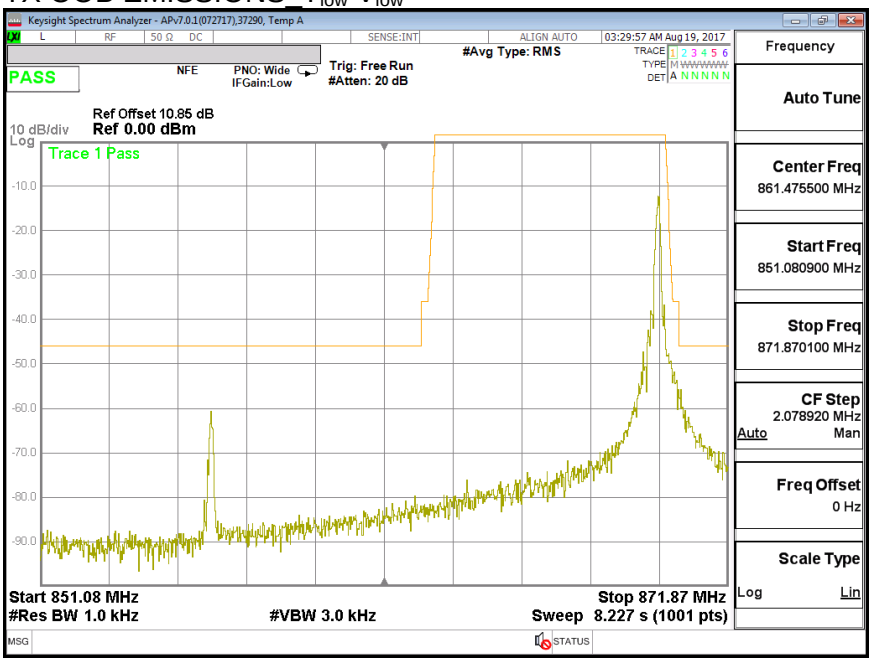
ML3 HIGH CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal}



TX OOB EMISSIONS_T_{low} V_{low}



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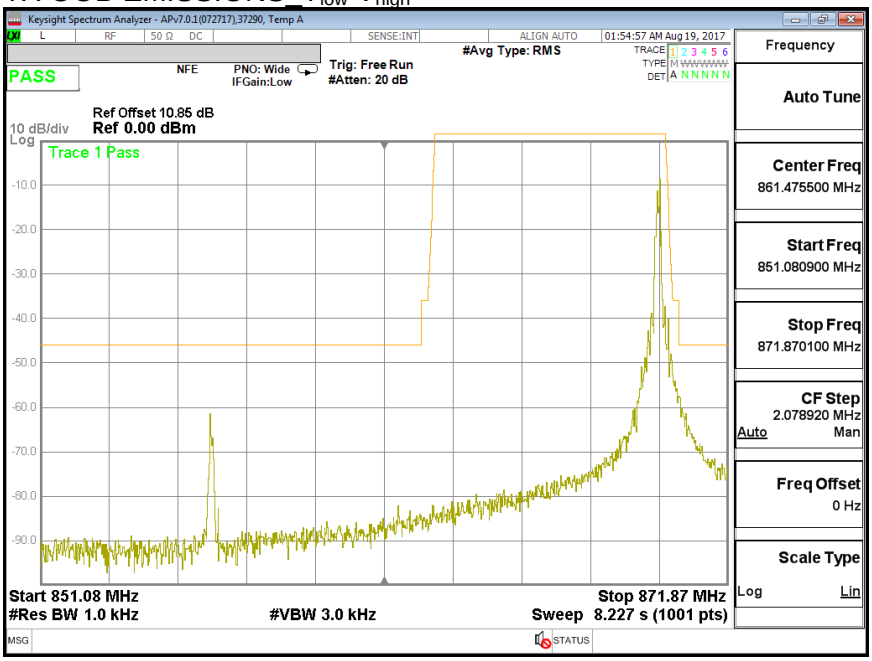
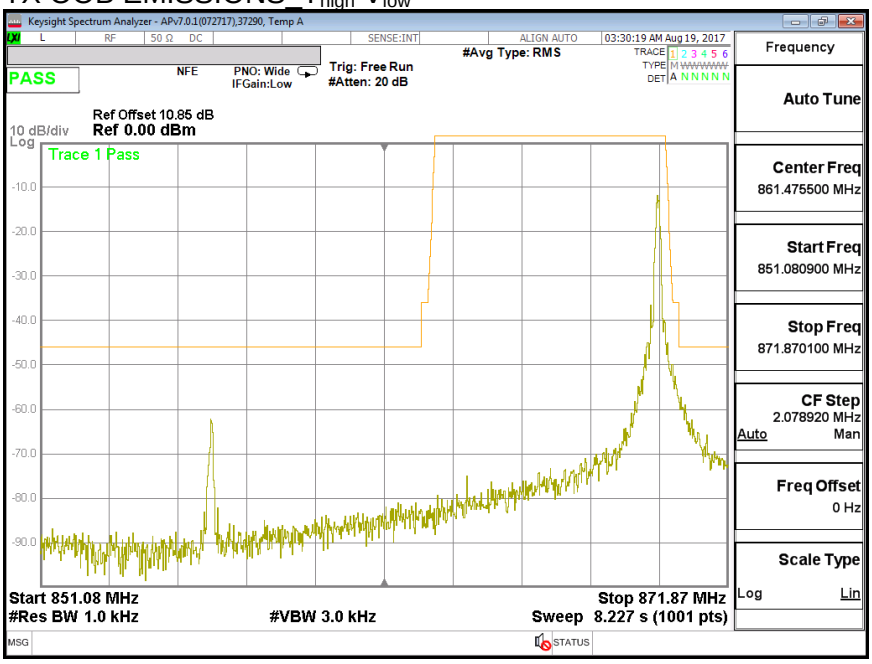
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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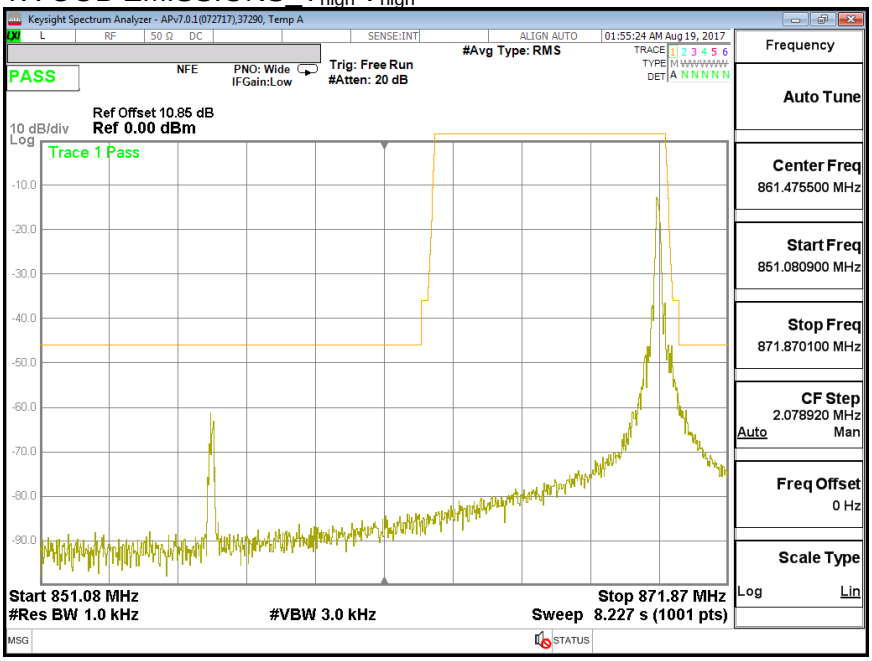
TX OOB EMISSIONS_T_{high} V_{high}



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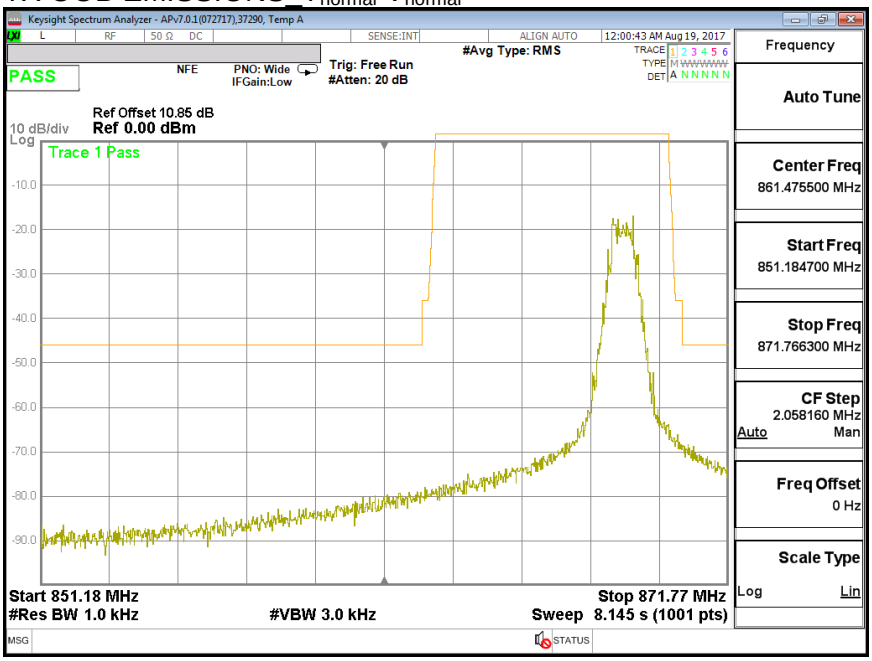
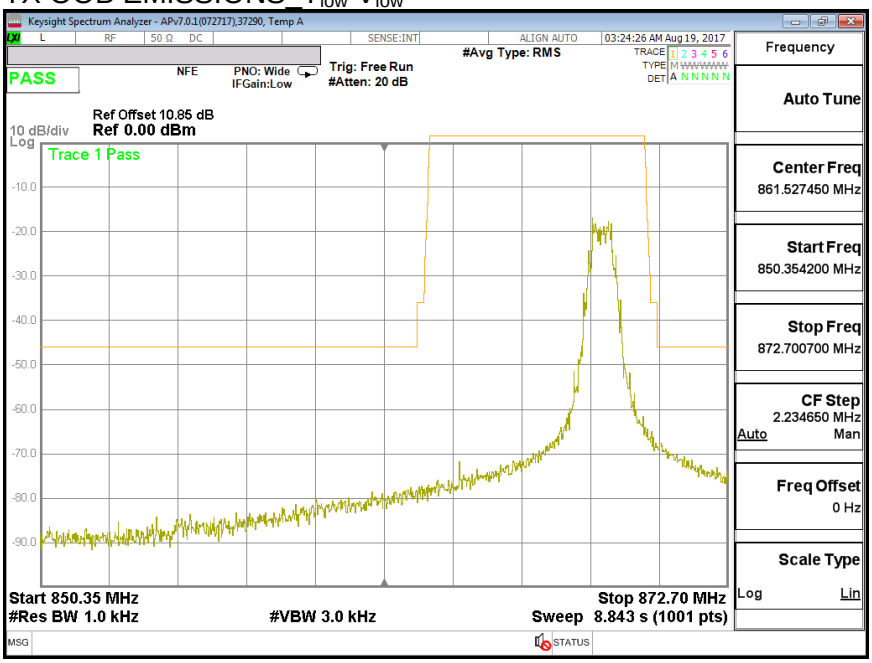
M14 LOW CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal}



TX OOB EMISSIONS_T_{low} V_{low}



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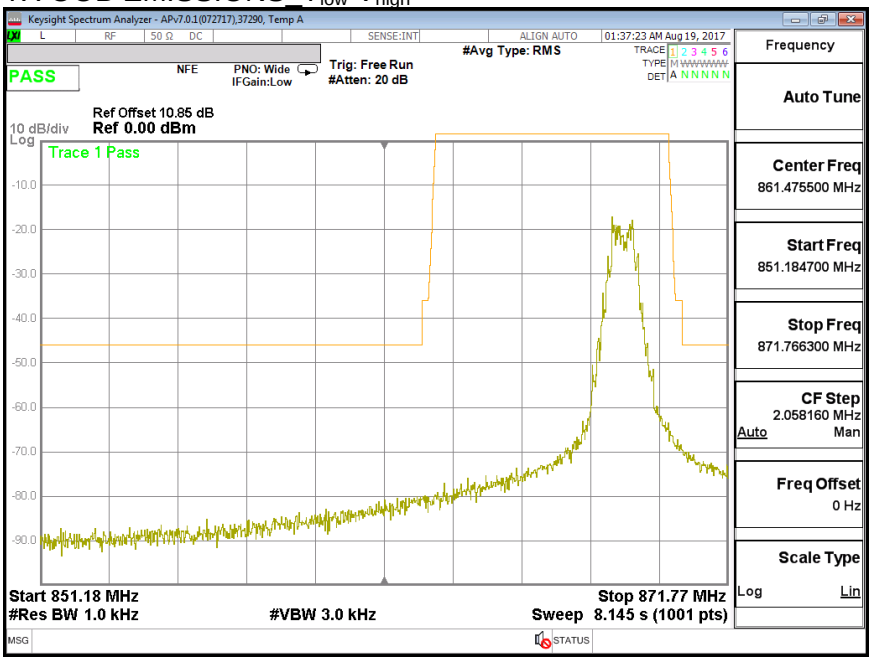
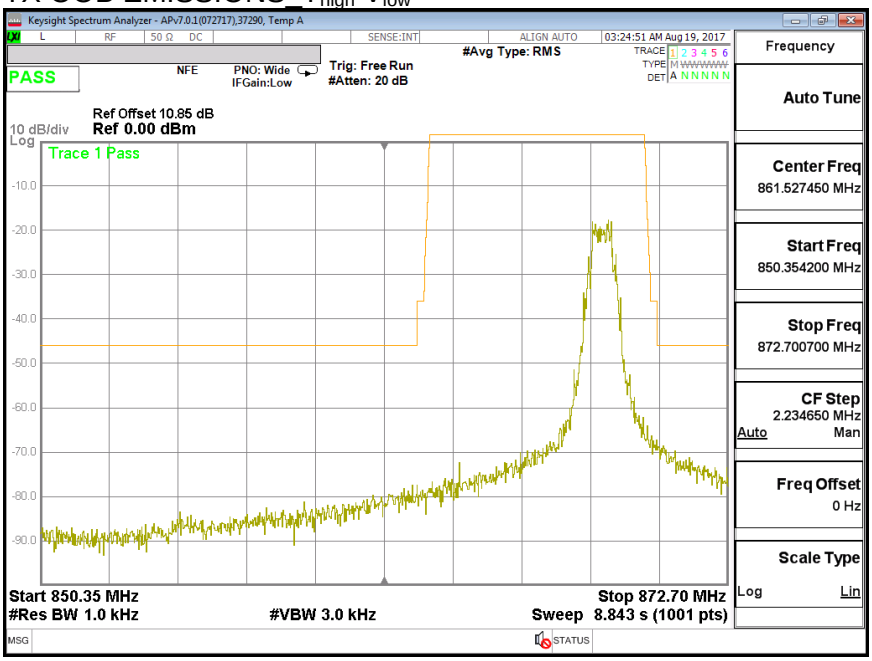
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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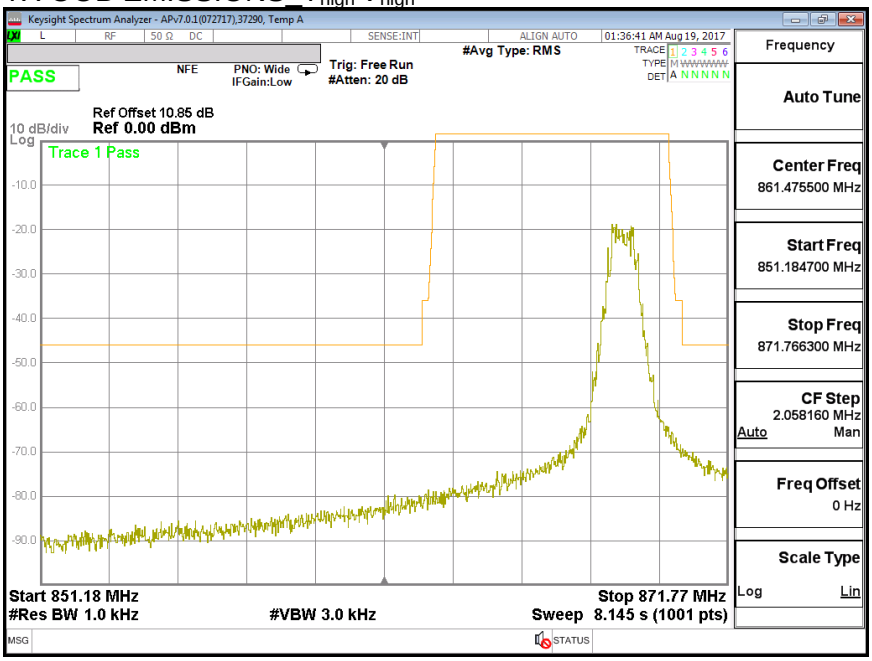
TX OOB EMISSIONS_T_{high} V_{high}



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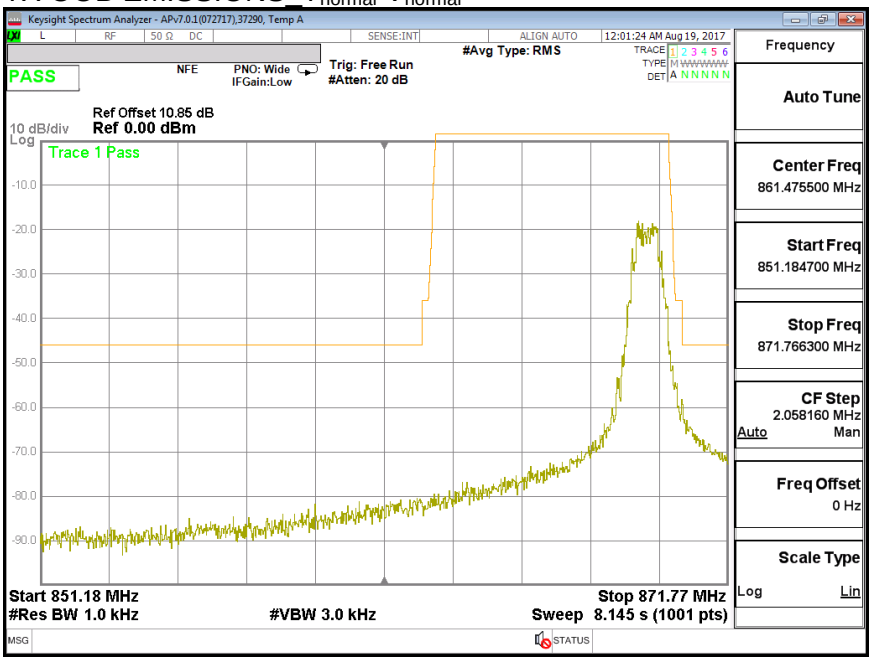
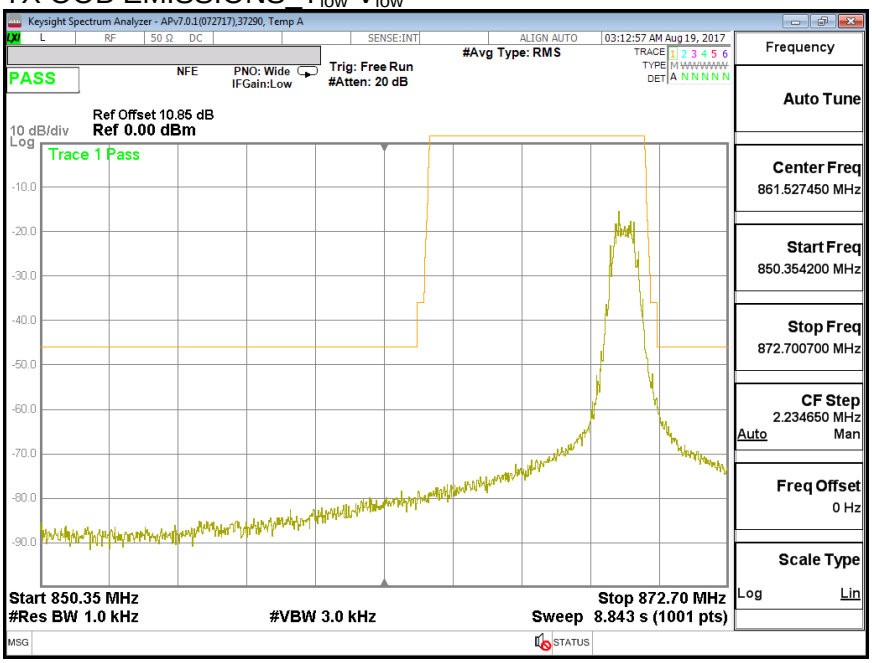
M14 HIGH CHANNEL

TX OOB EMISSIONS_T_{normal} V_{normal}



TX OOB EMISSIONS_T_{low} V_{low}



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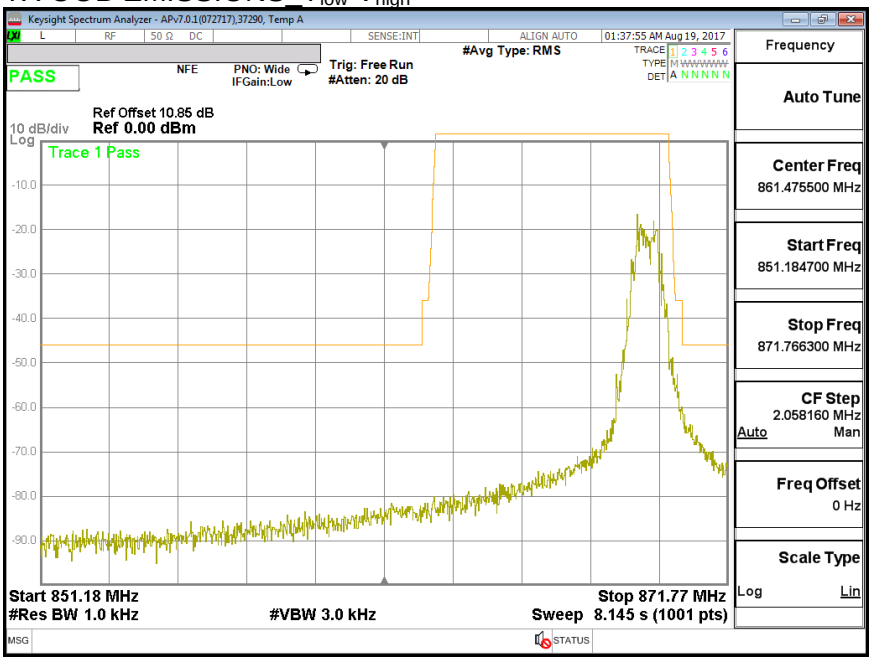
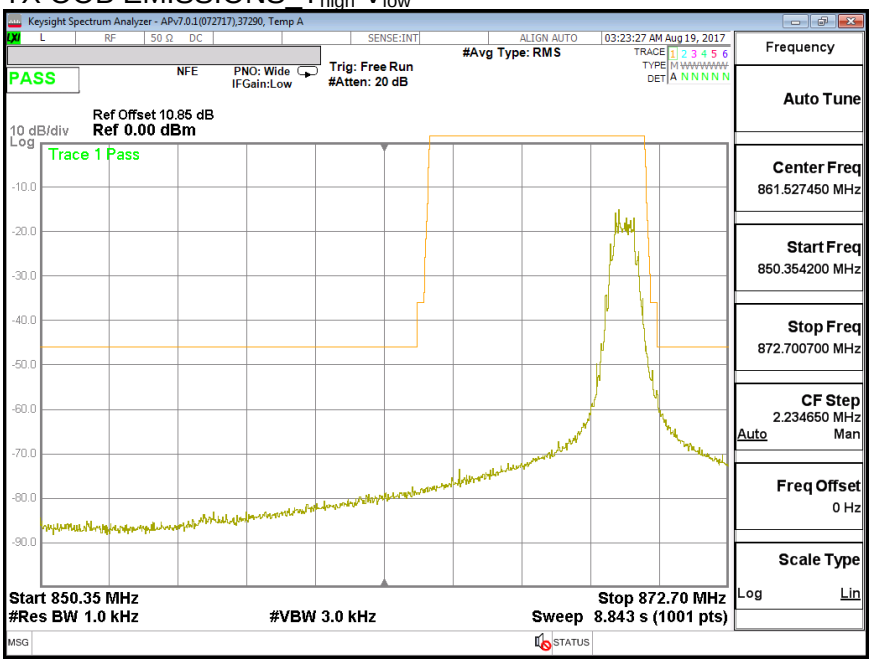
TX OOB EMISSIONS_T_{low} V_{high}



TX OOB EMISSIONS_T_{high} V_{low}



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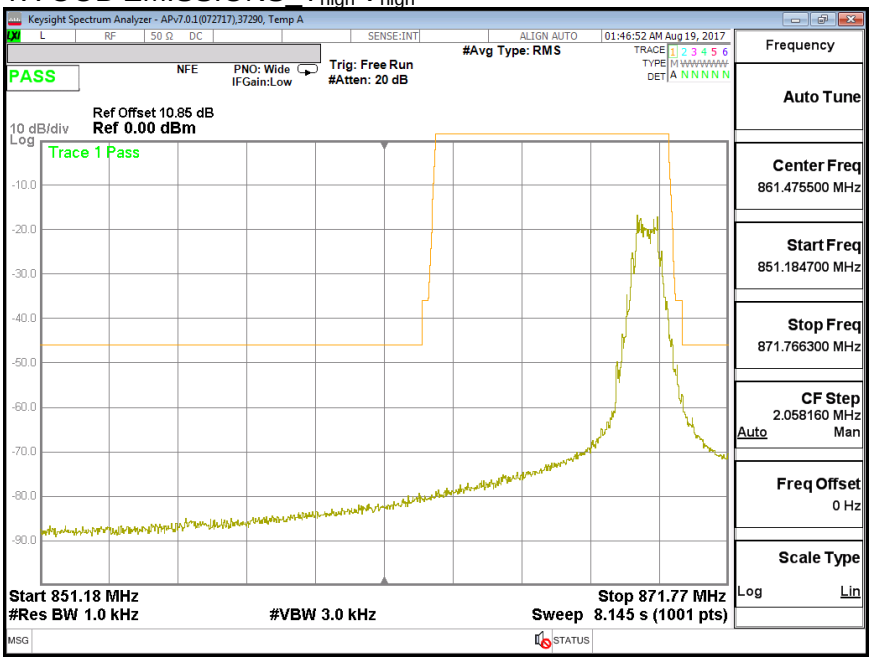
TX OOB EMISSIONS_T_{high} V_{high}



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7.13.6. TX UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

REFERENCE LIMIT

ETSI EN 300 220-2 V3.1.1 (2017-02) Clause 4.2.2.2
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.1.1
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.2

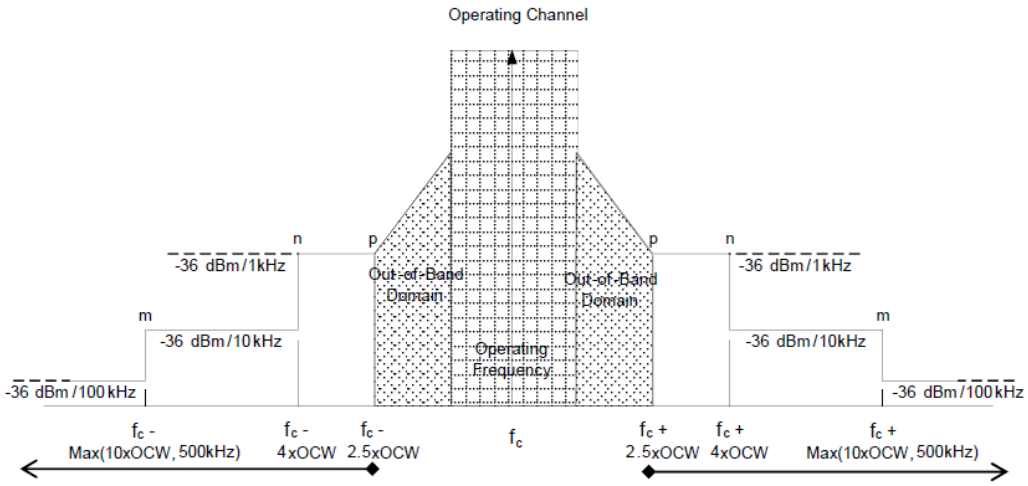

Figure 7: Spectrum Mask for Unwanted Emissions in the Spurious Domain with reference BW

Reference Limit:

The power of any unwanted emission in the spurious domain shall not exceed the values given in Table 19.

Table 19: Spurious domain emission limits

Frequency / State	47 MHz to 74 MHz 87,5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 790 MHz	Other frequencies below 1 000 MHz	Frequencies above 1 000 MHz
TX mode	-54 dBm	-36 dBm	-30 dBm
RX and all other modes	-57 dBm	-57 dBm	-47 dBm

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.3.3.1 (Conducted Measurement)
ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.3.3.2 (Radiated Measurement)

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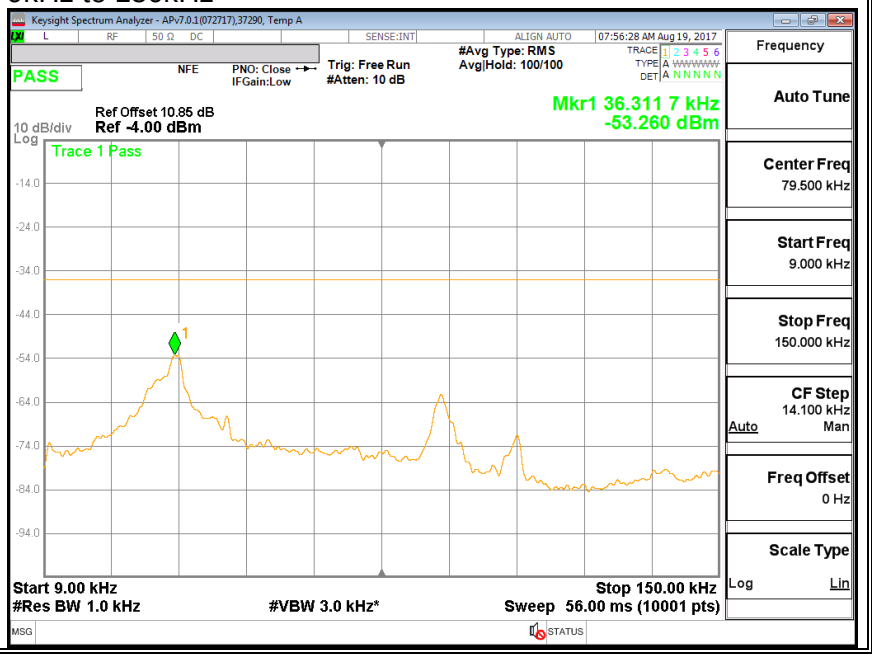
RESULTS

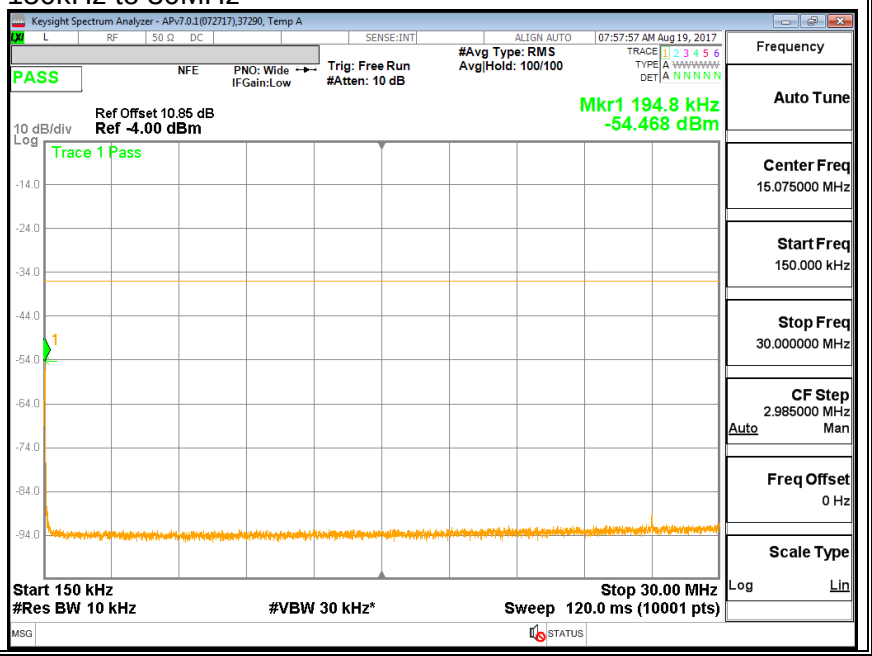
CONDUCTED SPURIOUS EMISSIONS

THE WORST CASE OF 4-FSK LOW CHANNEL

9kHz to 150kHz



150kHz to 30MHz



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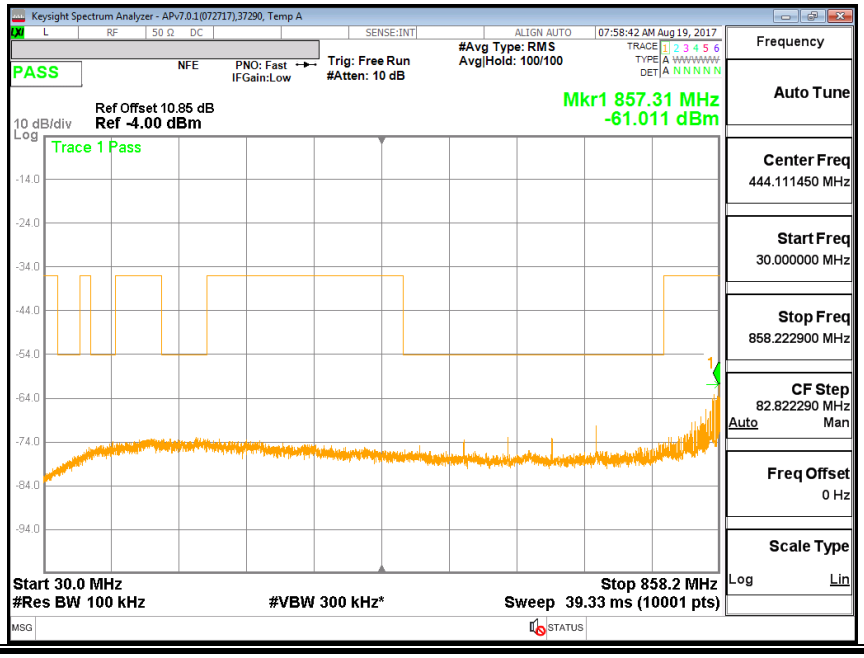
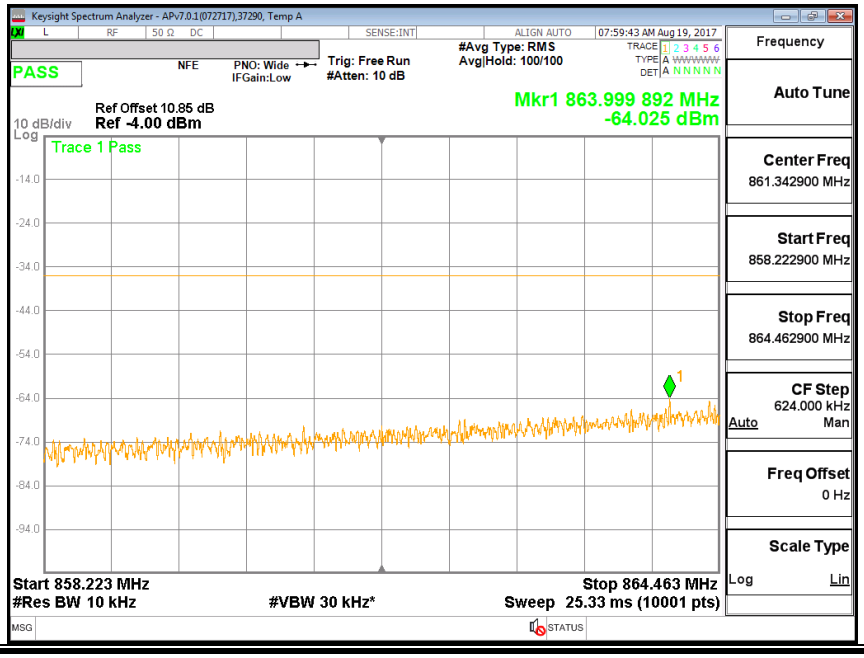
30MHz to 858.2229MHz



858.2229 MHz to 864.4629MHz



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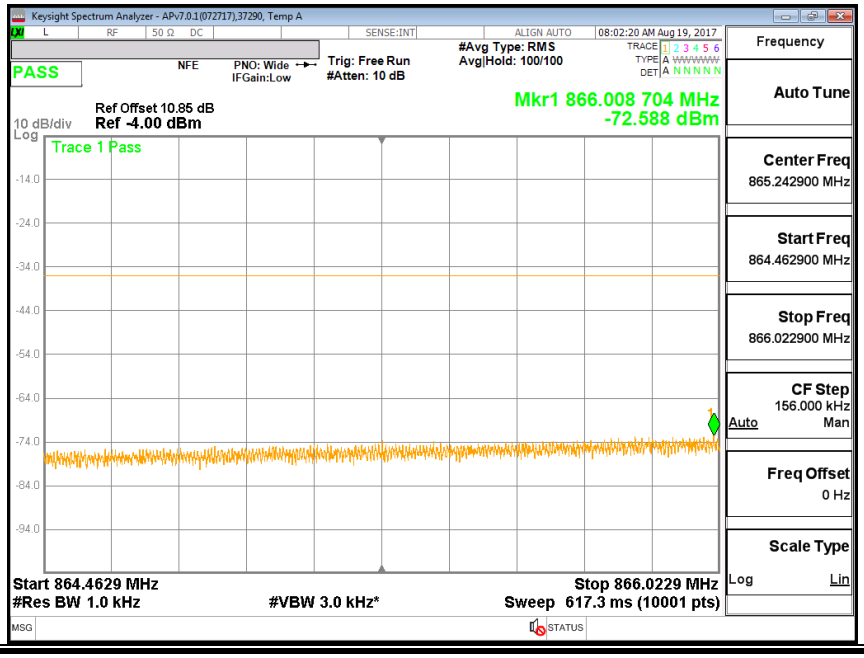
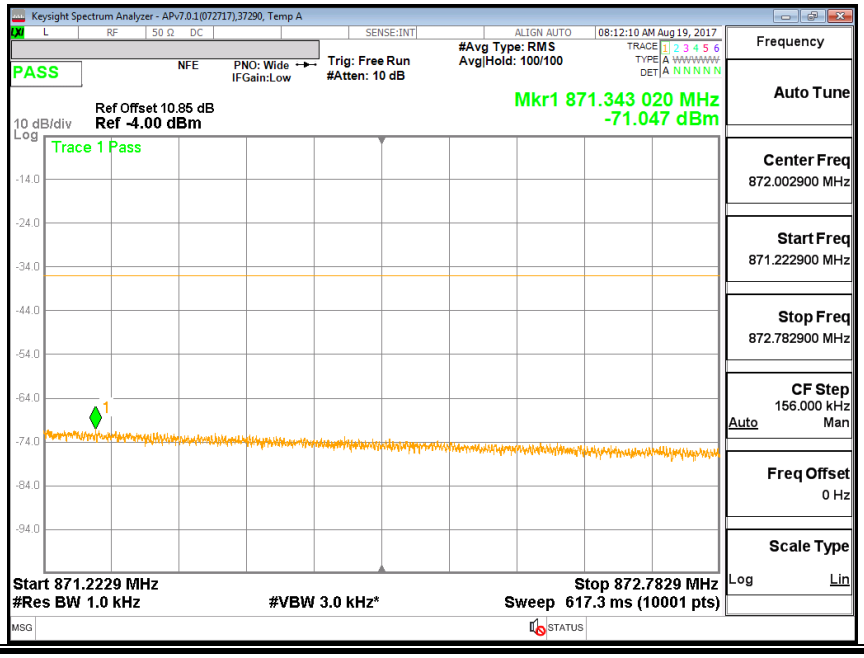
864.4629 MHz to 866.0229 MHz



871.2229 MHz to 872.7829 MHz



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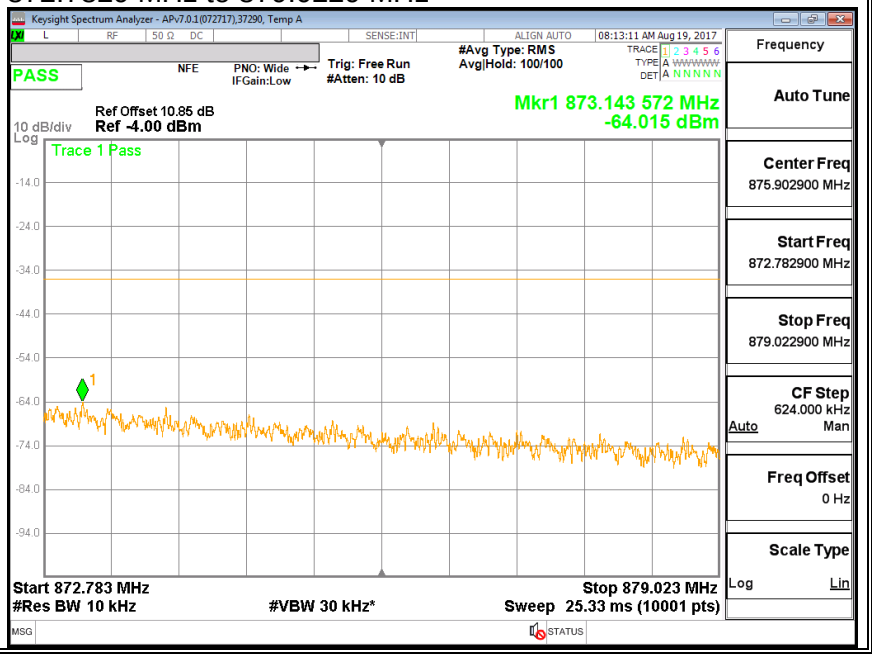
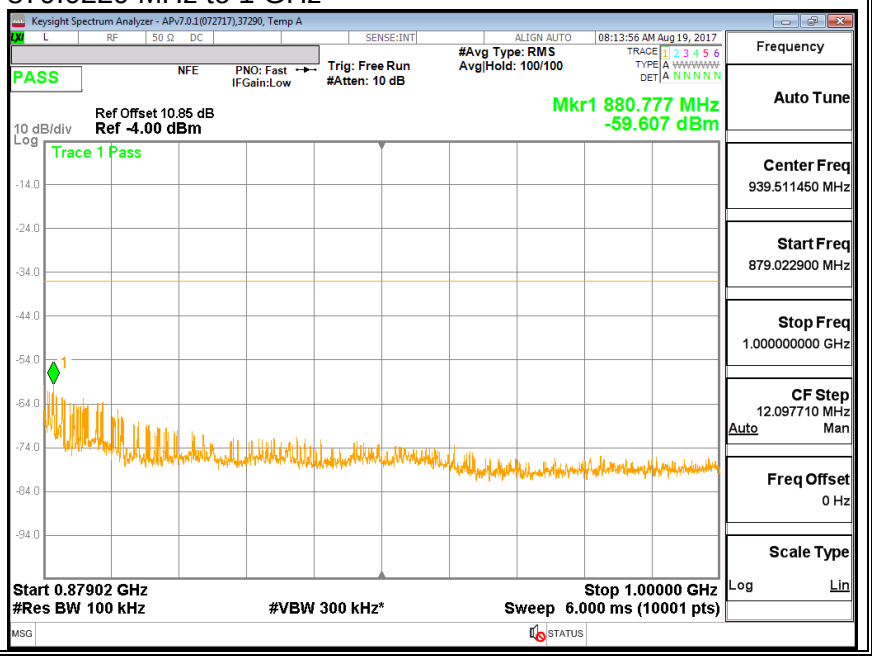
872.7829 MHz to 879.0229 MHz



879.0229 MHz to 1 GHz



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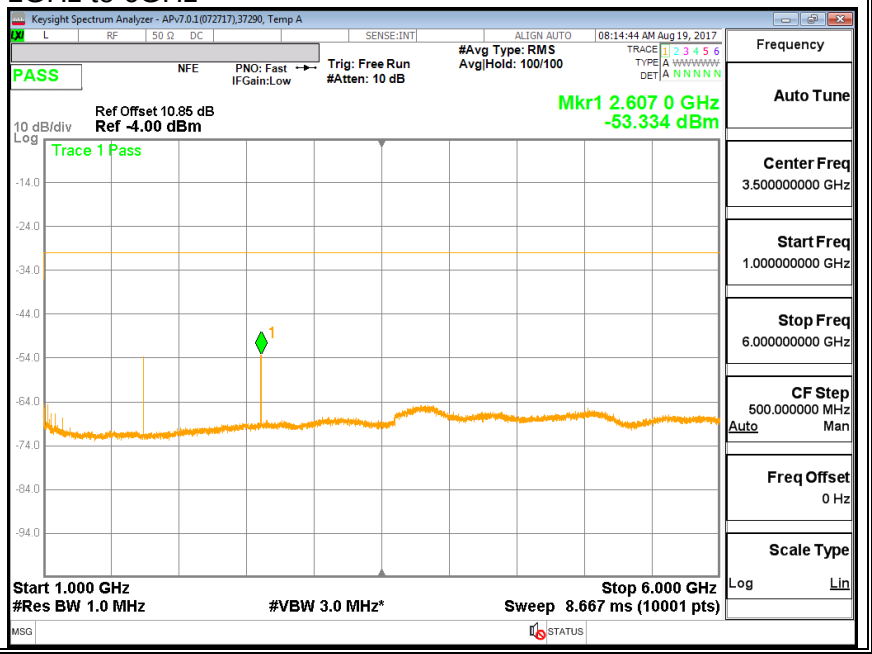
1GHz to 6GHz



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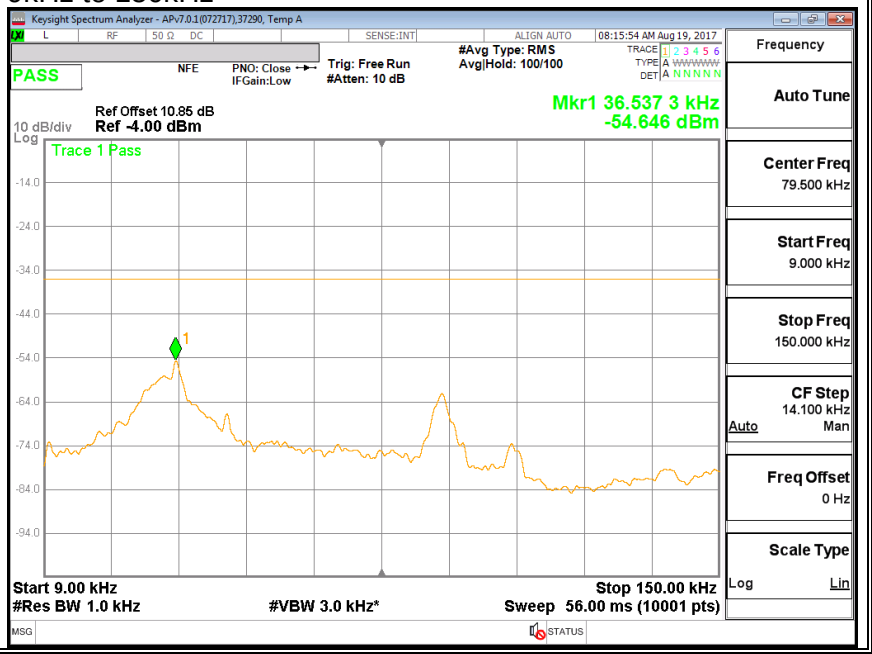
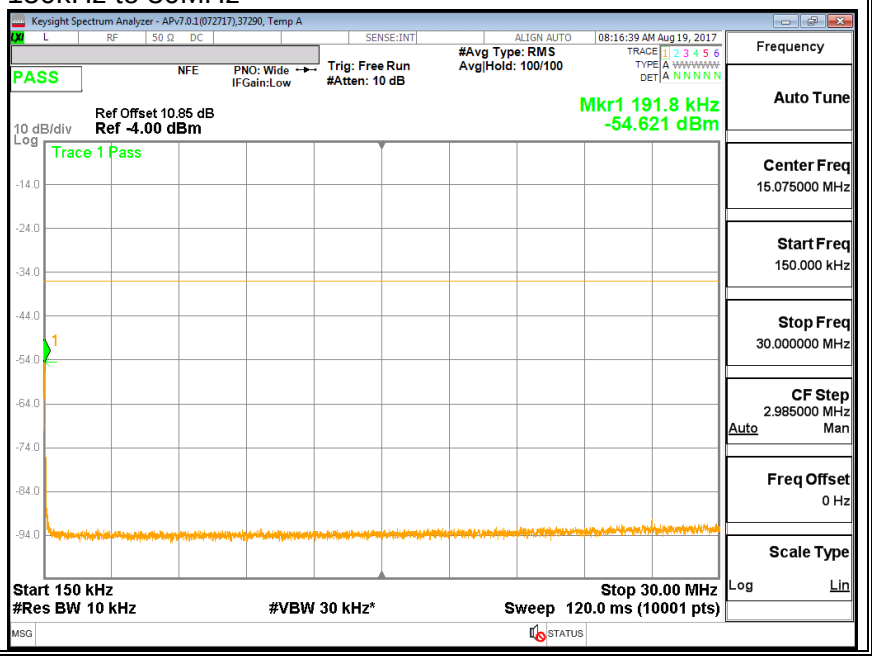
THE WORST CASE OF 4-FSK HIGH CHANNEL

9kHz to 150kHz



150kHz to 30MHz



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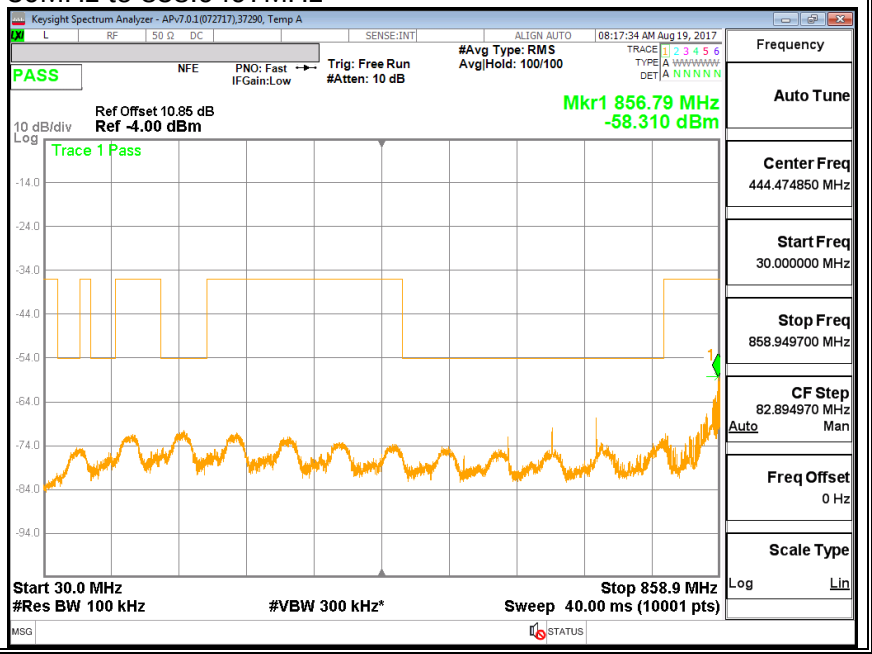
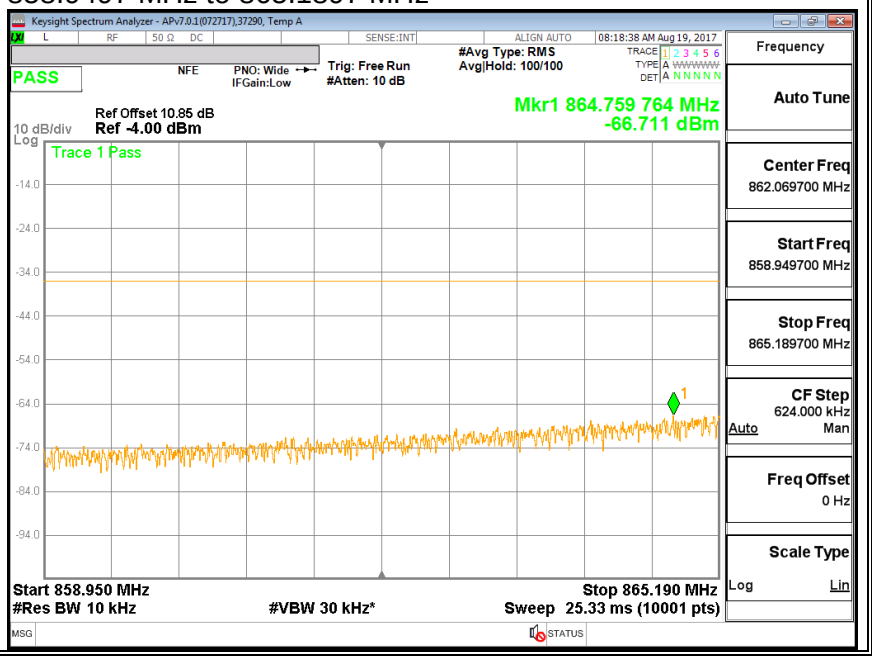
30MHz to 858.9497MHz



858.9497 MHz to 865.1897 MHz



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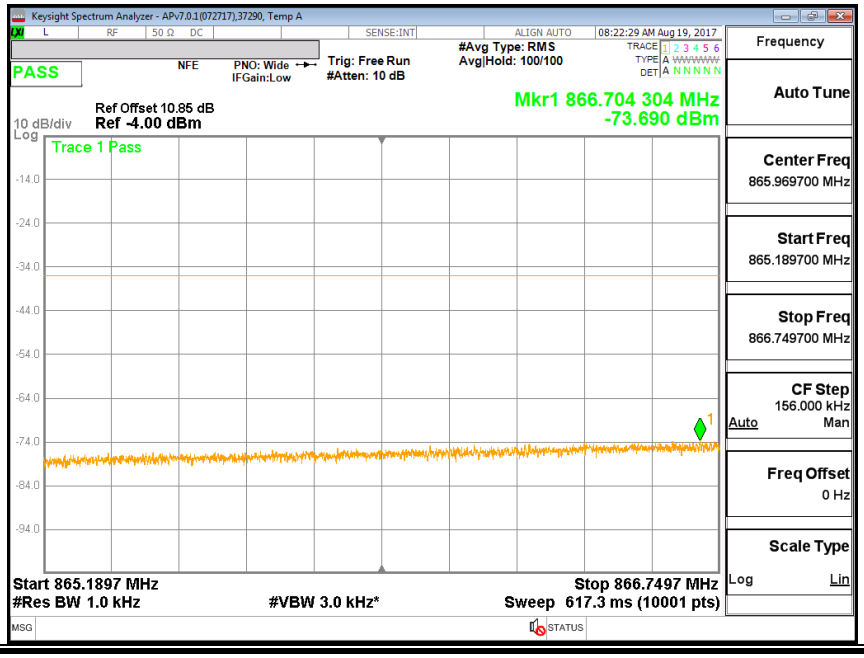
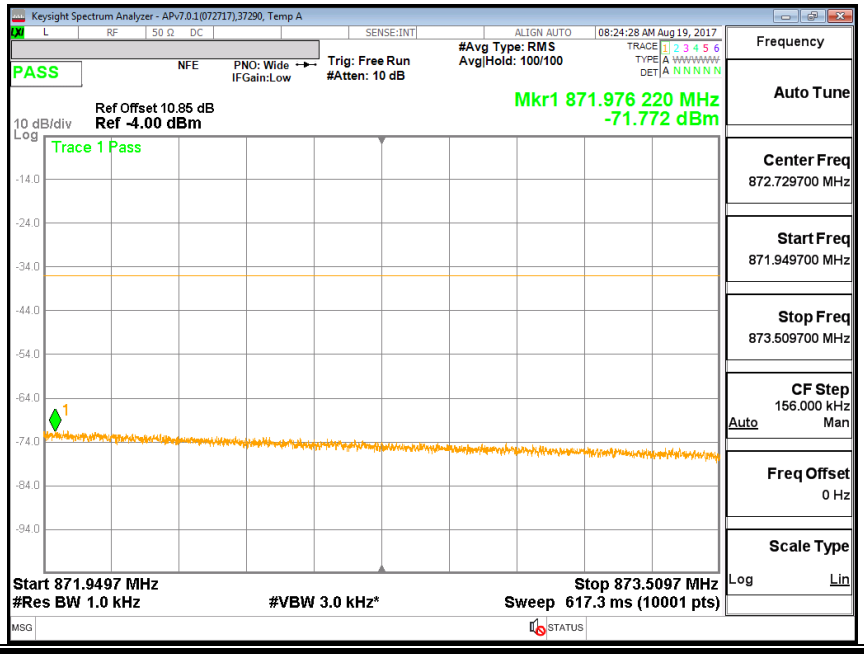
865.1897 MHz to 866.7497 MHz



871.9497 MHz to 873.5097 MHz



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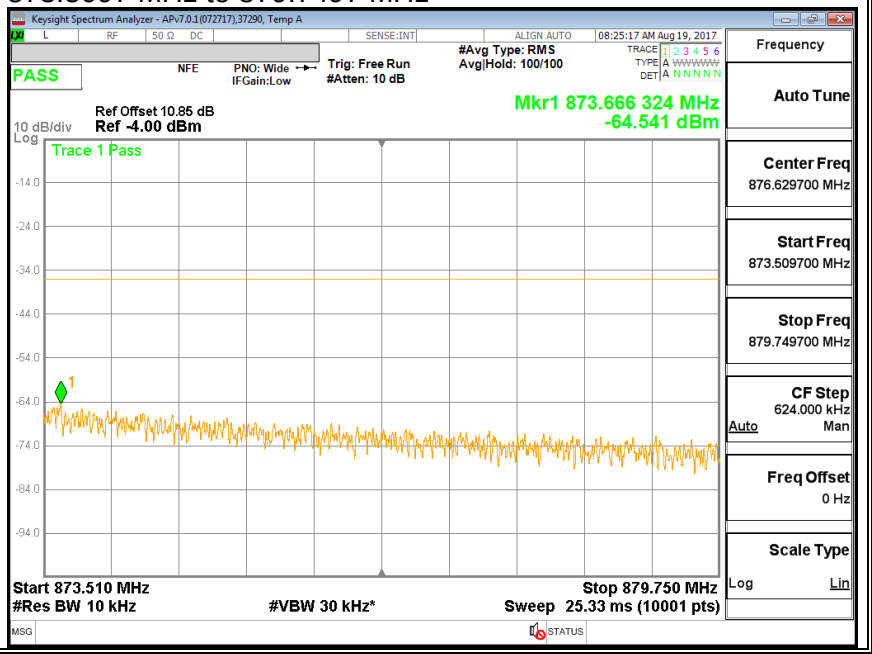
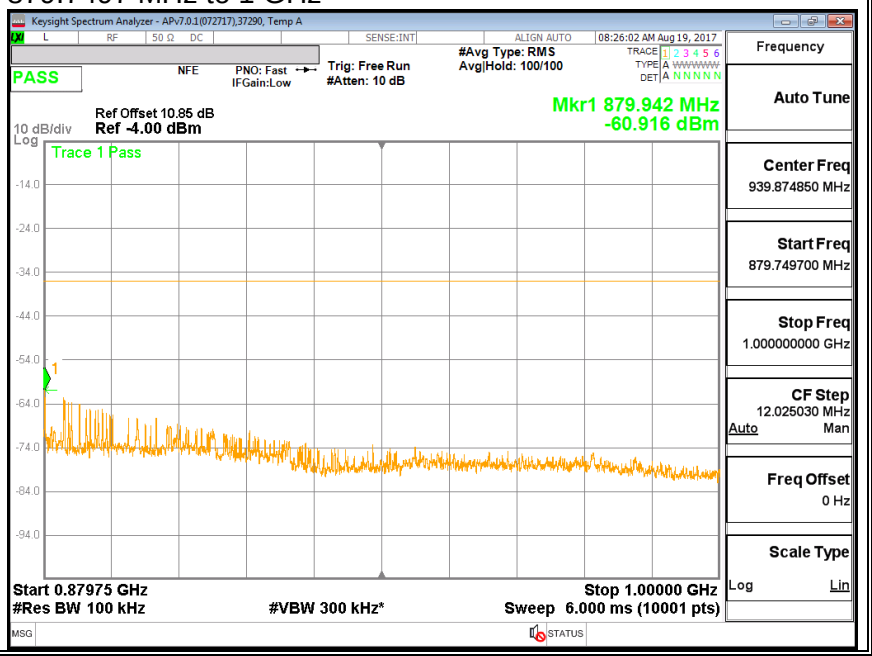
873.5097 MHz to 879.7497 MHz



879.7497 MHz to 1 GHz



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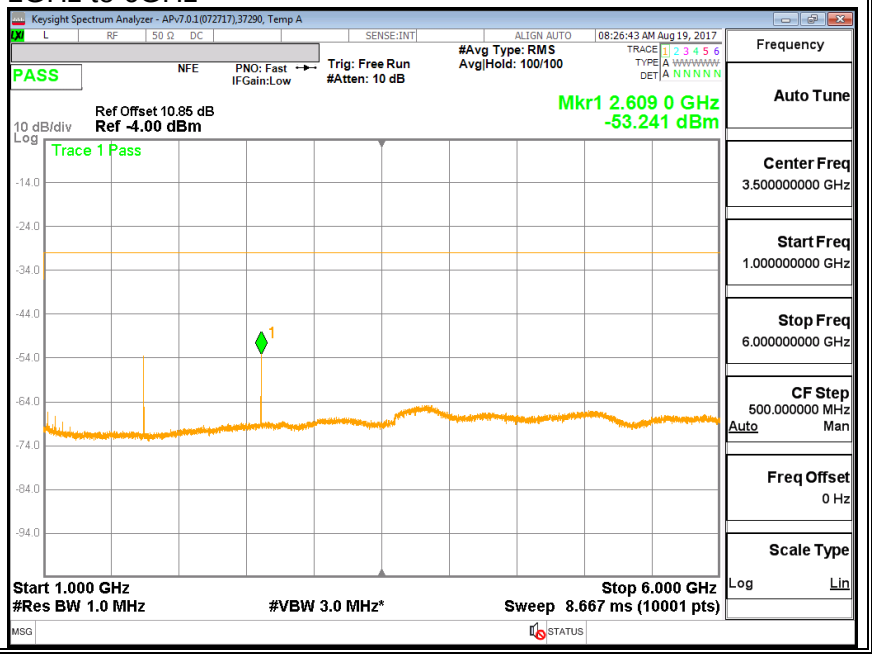
1GHz to 6GHz



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RADIATED SPURIOUS EMISSIONS

3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/21/2017
Test Engineer: 37290
Configuration: EUT with 50Ohm load and a support laptop
Mode: TX Above 1GHz R band 4FSK worst case

Chamber	Pre-amplifer	Filter	Limit
3m Chamber B	3m Chamber B	Filter	ETSI 300 220 Tx

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss @ SG End (dBm)	Preamp (dB)	Attenuator (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel										
1.042	-61.60	H	3.0	-20.1	38.3	1.0	-57.4	-30.0	-27.4	
1.594	-62.30	H	3.0	-17.6	38.7	1.0	-55.3	-30.0	-25.3	
8.689	-67.90	H	3.0	-8.0	37.6	1.0	-44.6	-30.0	-14.6	
2.399	-61.88	V	3.0	-12.5	38.7	1.0	-50.1	-30.0	-20.1	
3.747	-64.28	V	3.0	-12.1	38.4	1.0	-49.5	-30.0	-19.5	
6.950	-62.87	V	3.0	-5.3	38.6	1.0	-42.9	-30.0	-12.9	
High Channel										
1.039	-63.87	H	3.0	-22.4	38.3	1.0	-59.7	-30.0	-29.7	
6.520	-66.44	H	3.0	-9.4	38.6	1.0	-47.1	-30.0	-17.1	
8.687	-66.06	H	3.0	-6.2	37.6	1.0	-42.8	-30.0	-12.8	
1.034	-60.21	V	3.0	-18.9	38.3	1.0	-56.2	-30.0	-26.2	
2.392	-61.28	V	3.0	-11.9	38.6	1.0	-49.5	-30.0	-19.5	
6.948	-59.00	V	3.0	-1.5	38.6	1.0	-39.1	-30.0	-9.1	

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3m Radiated Emissions Chamber
30 - 1000MHz Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/21/2017
Test Engineer: 37290
Configuration: EUT with 50Ohm load and a support laptop
Mode: TX Below 1GHz 4FSK X band worst case

Chamber	Pre-amplifer	Attenuator	Limit
3m Chamber B	3m-B T10		ETSI 300 220 Tx

Frequency (MHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Attenuator (dB)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel										
43.04	-54.2	H	3.0	21.2	29.0		-61.9	-36.0	-25.9	
302.35	-56.7	H	3.0	22.3	28.0		-62.3	-36.0	-26.3	
868.55	-52.0	H	3.0	30.4	28.0		-49.7	-36.0	-13.7	
45.37	-52.3	V	3.0	18.0	28.9		-63.2	-36.0	-27.2	
210.79	-67.4	V	3.0	22.1	28.4		-73.8	-54.0	-19.8	
868.84	-55.4	V	3.0	-5.1	28.0		-88.5	-36.0	-52.5	
High Channel										
43.04	-56.5	H	3.0	21.2	29.0		-64.2	-36.0	-28.2	
215.94	-61.4	H	3.0	20.0	28.4		-69.8	-54.0	-15.8	
868.84	-52.8	H	3.0	30.4	28.0		-50.4	-36.0	-14.4	
44.98	-57.6	V	3.0	18.0	29.0		-68.5	-36.0	-32.5	
215.94	-66.0	V	3.0	21.9	28.4		-72.5	-54.0	-18.5	
868.55	-61.7	V	3.0	-5.5	28.0		-95.2	-36.0	-59.2	

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7.13.7. TX TRANSIENT POWER

REFERENCE LIMIT

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.10.2

The TX TRANSIENT POWER shall not exceed the values given in Table 23.

Table 23: Transmitter Transient Power limits

Absolute offset from centre frequency	RBW_{REF}	Peak power limit applicable at measurement points
≤ 400 kHz	1 kHz	0 dBm
> 400 kHz	1 kHz	-27 dBm

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.10.3.2

RESULTS

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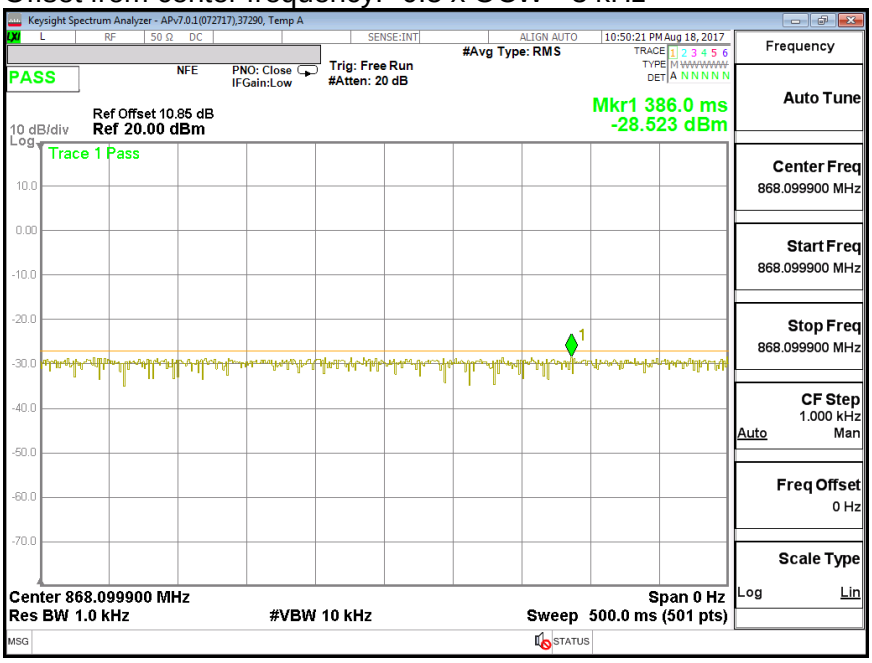
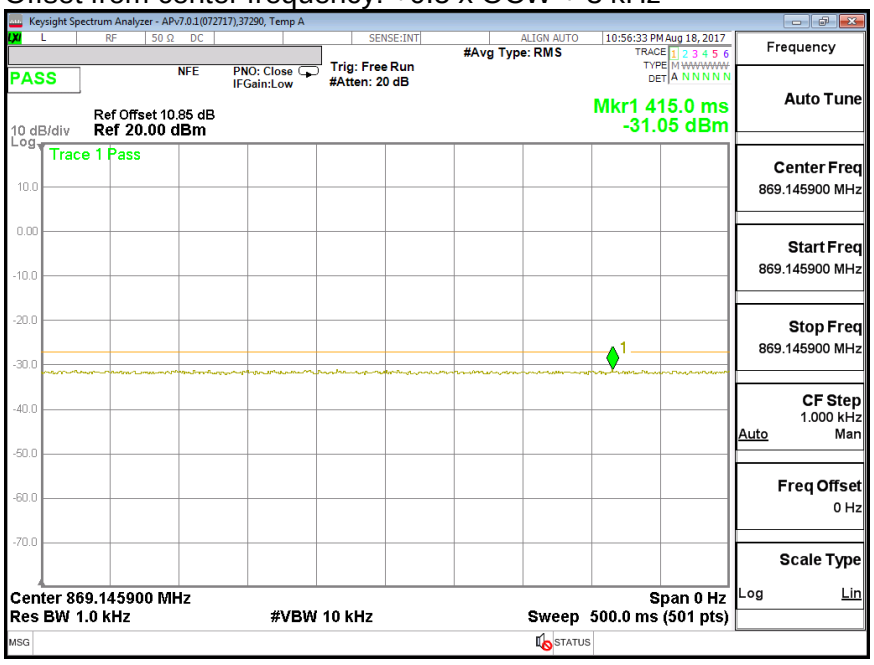
THE WORST CASE OF 4-FSK LOW CHANNEL

TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 3 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 3 kHz



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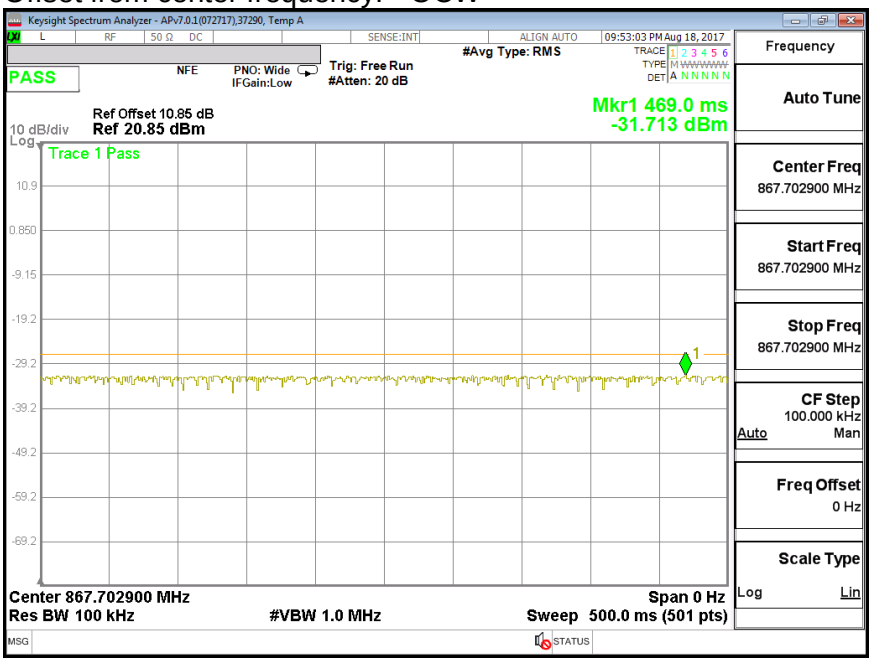
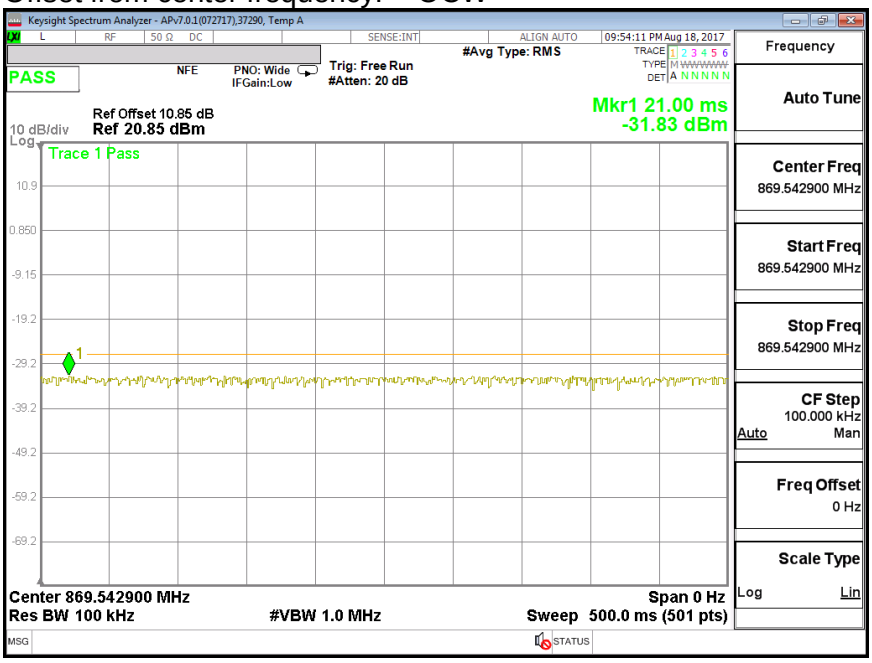
TX TRANSIENT
Offset from center frequency: - OCW



TX TRANSIENT
Offset from center frequency: + OCW



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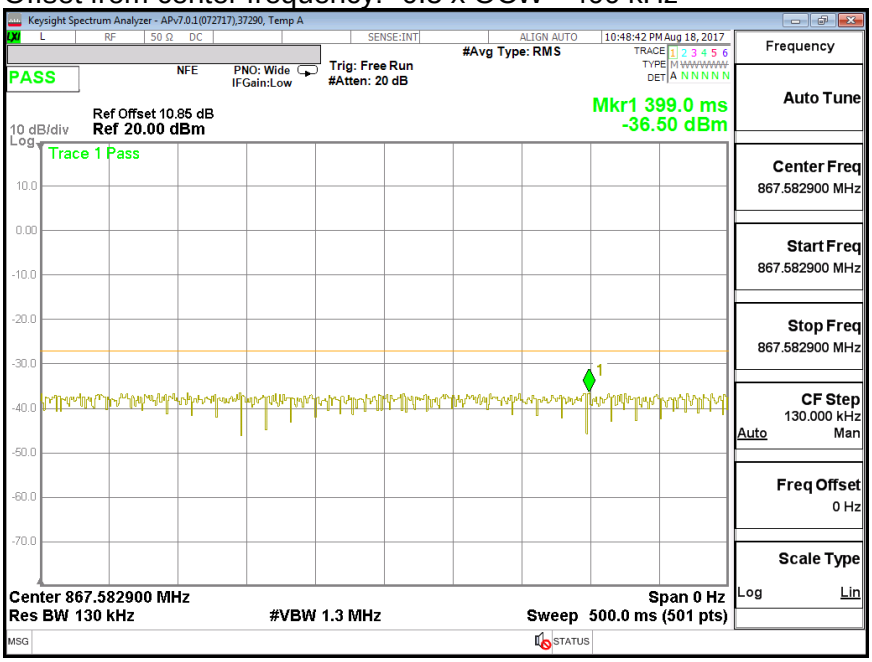
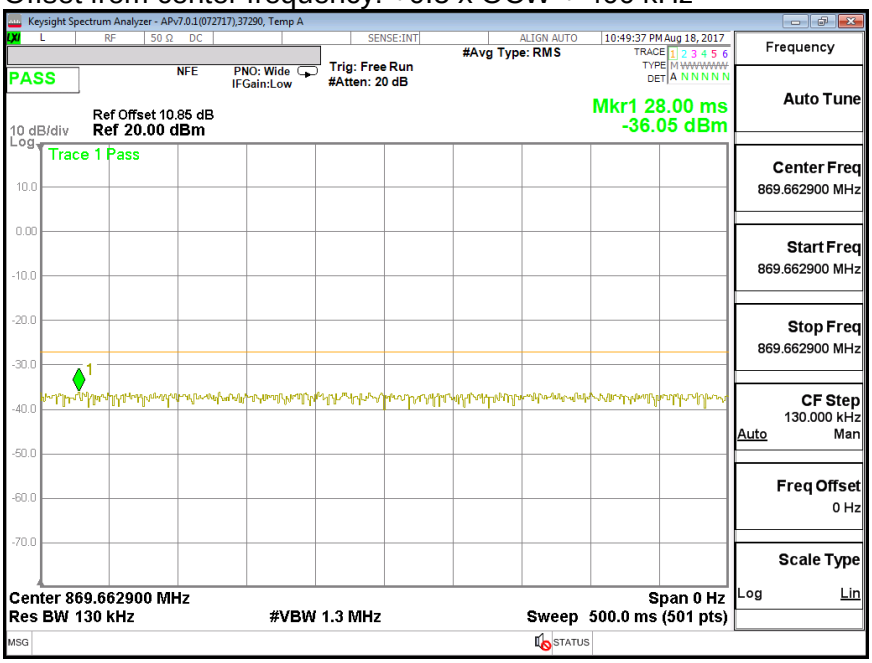
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 400 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 400 kHz



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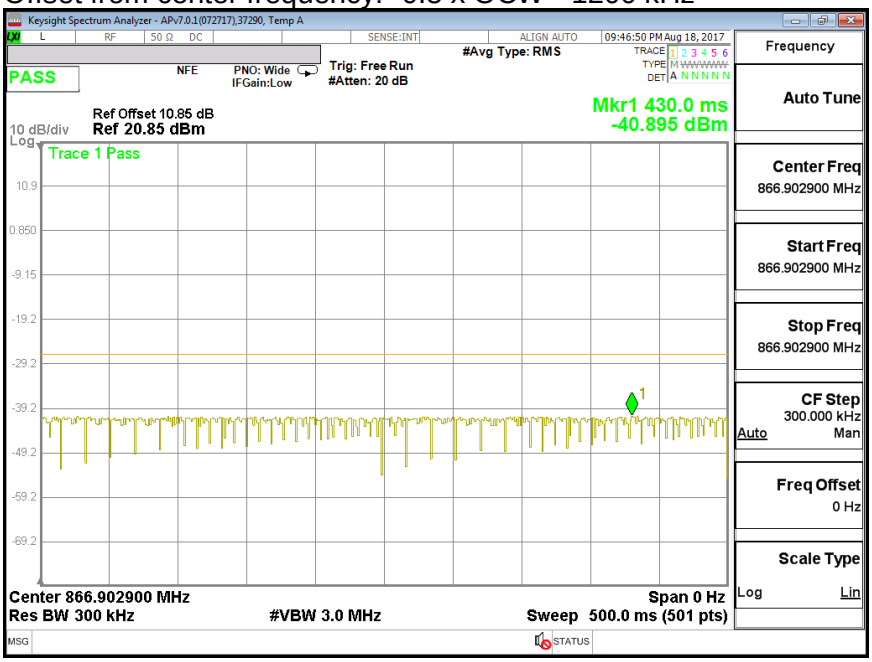
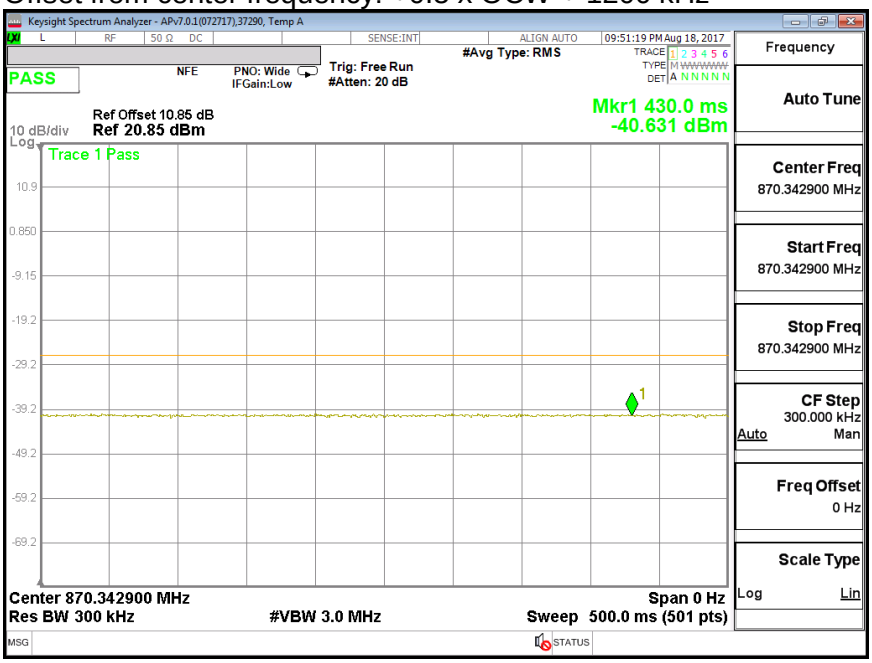
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 1200 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 1200 kHz



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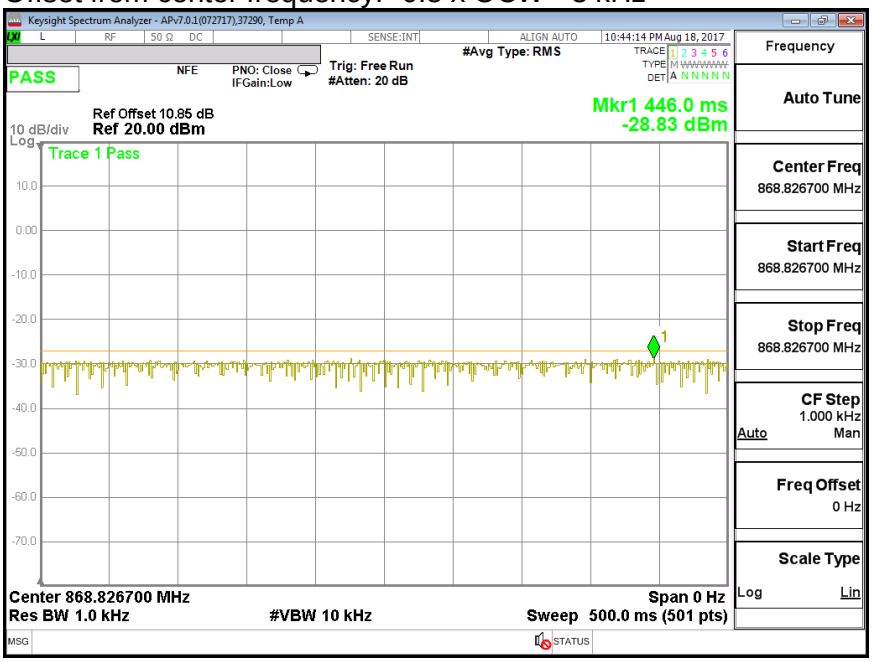
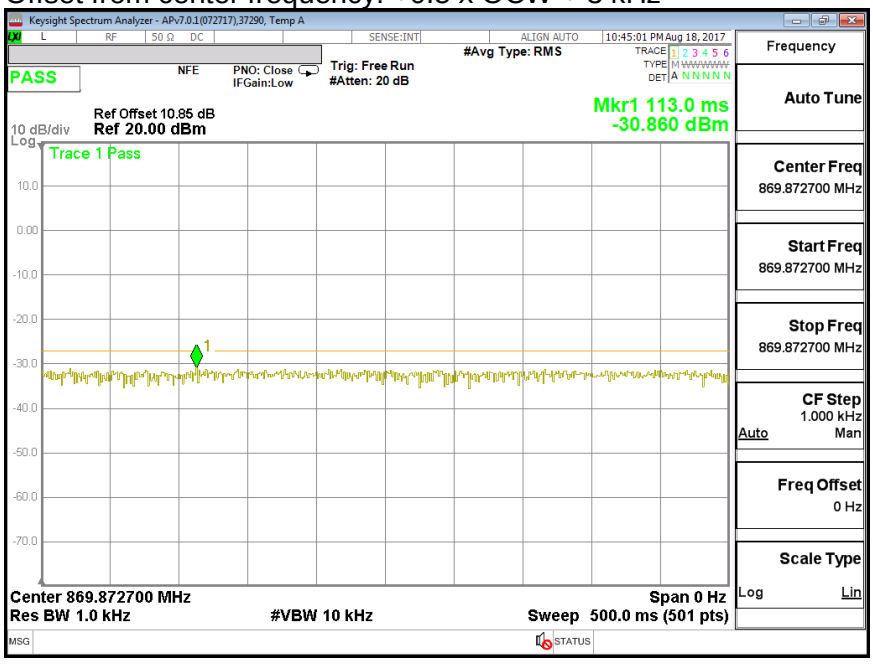
THE WORST CASE OF 4-FSK HIGH CHANNEL

TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 3 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 3 kHz



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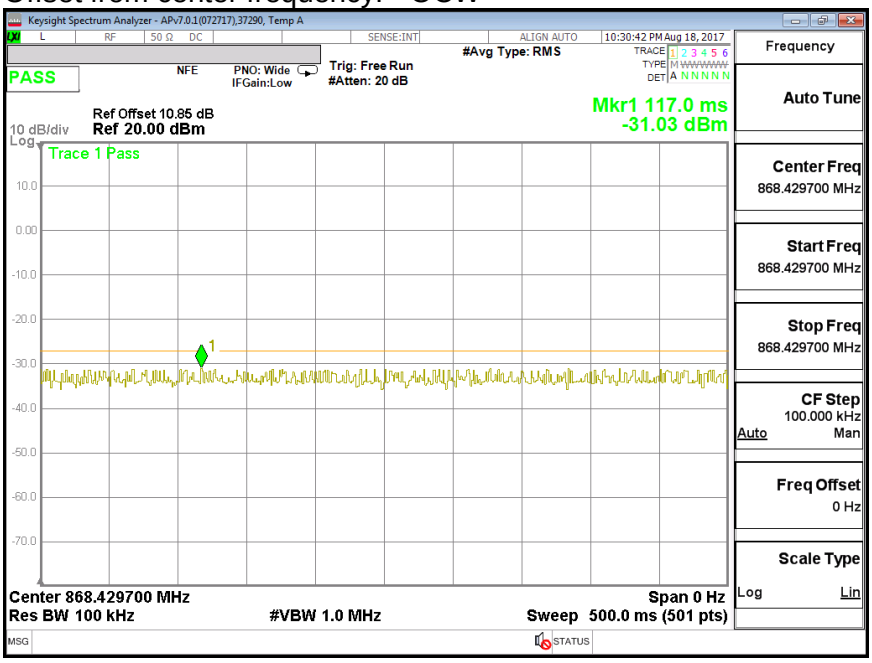
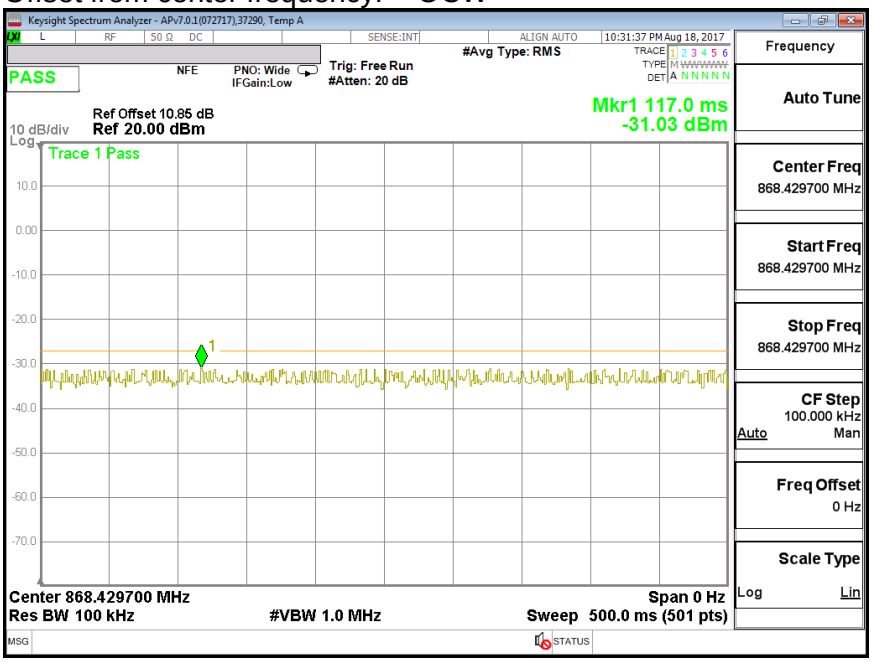
TX TRANSIENT
Offset from center frequency: - OCW



TX TRANSIENT
Offset from center frequency: + OCW



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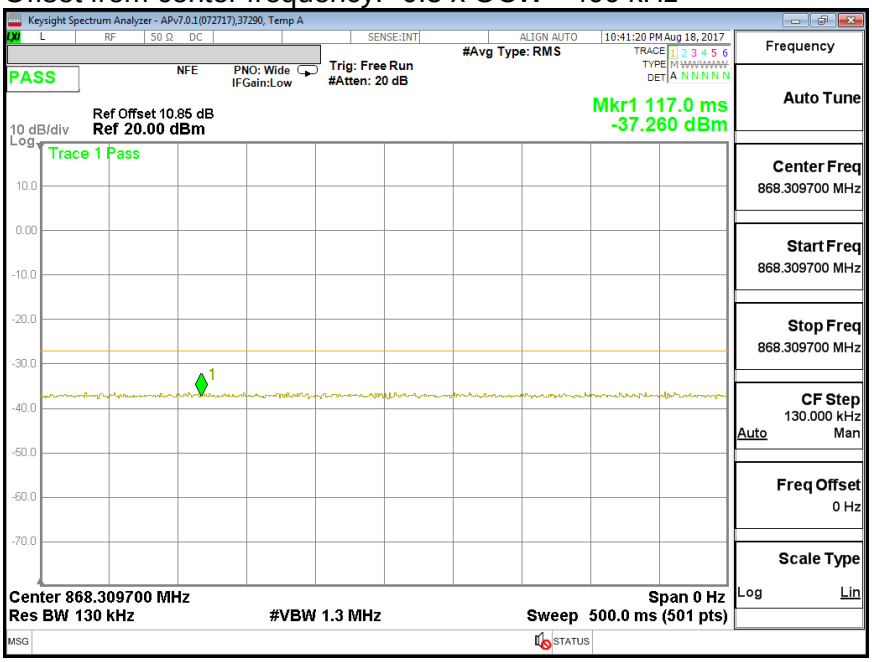
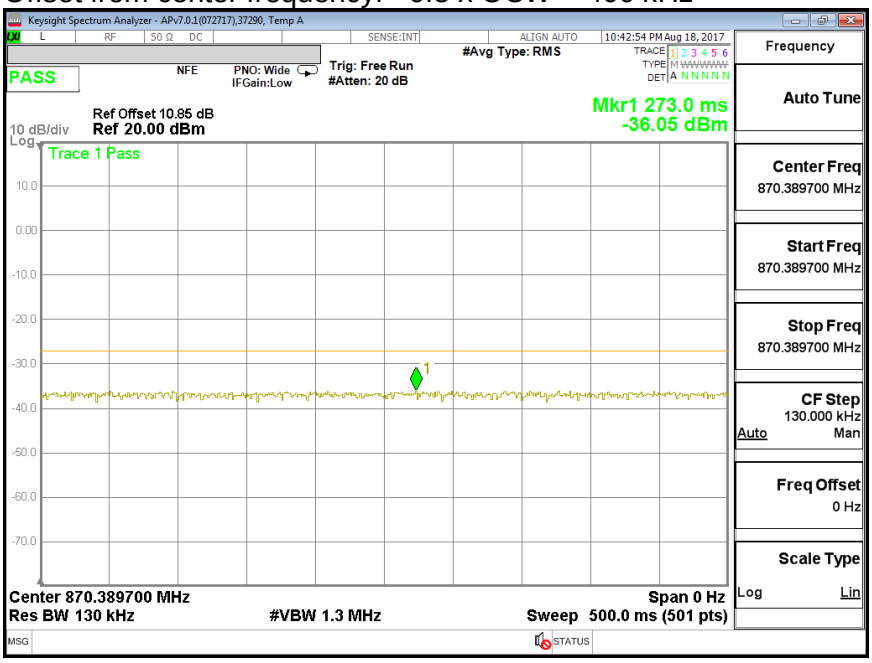
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 400 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 400 kHz



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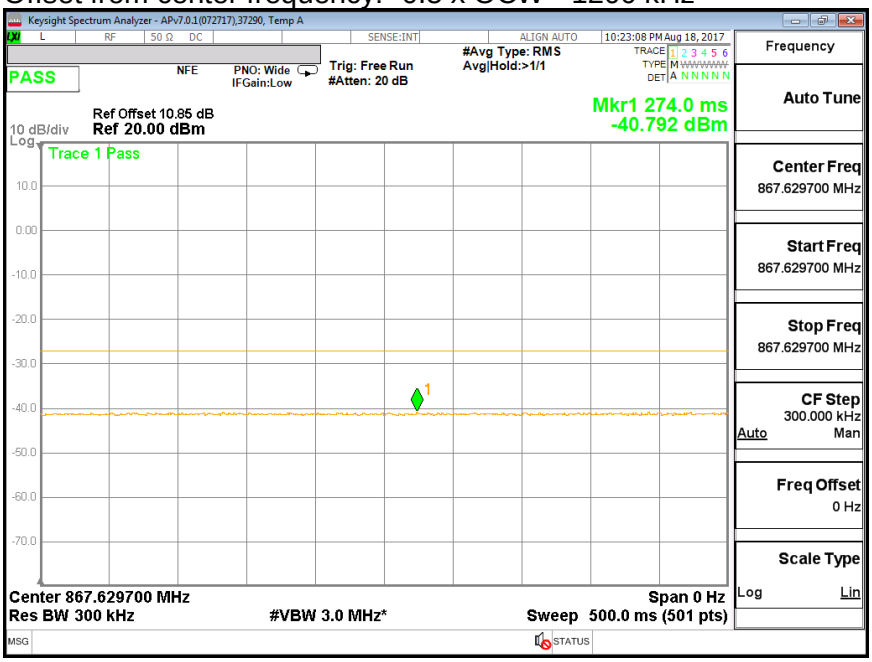
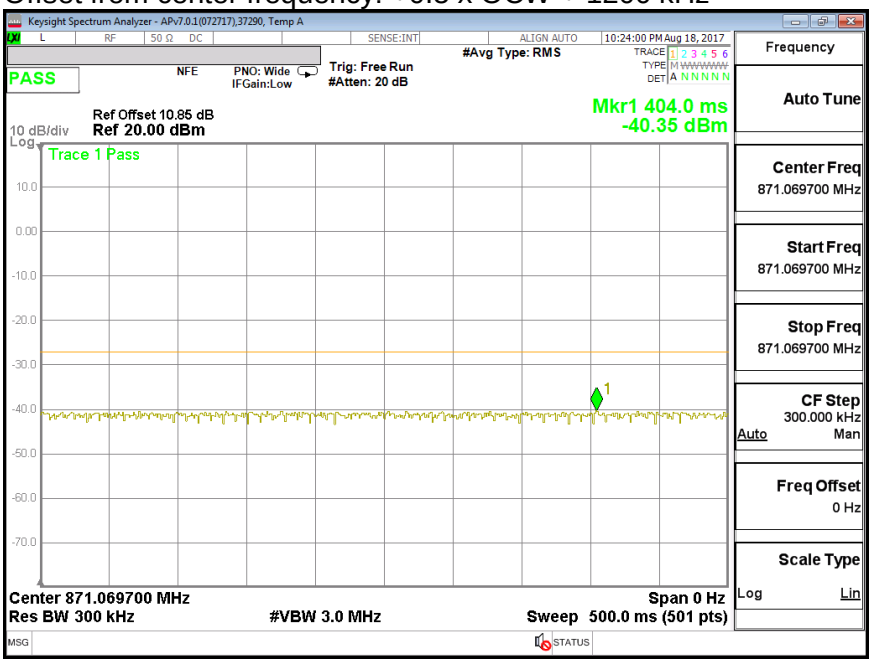
TX TRANSIENT
Offset from center frequency: -0.5 x OCW - 1200 kHz



TX TRANSIENT
Offset from center frequency: +0.5 x OCW + 1200 kHz



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7.14. RX UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

REFERENCE LIMIT

ETSI EN 300 220-1 v3.1.1 (2017-02) Clause 5.9.2

Table 19: Spurious domain emission limits

Frequency / State	47 MHz to 74 MHz 87,5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 790 MHz	Other frequencies below 1 000 MHz	Frequencies above 1 000 MHz
TX mode	-54 dBm	-36 dBm	-30 dBm
RX and all other modes	-57 dBm	-57 dBm	-47 dBm

TEST PROCEDURE

ETSI EN 300 220-1 V3.1.1 (2017-02) Clause 5.9.3.3.2 (Radiated Measurement)

UL VERIFICATION SERVICES INC. FORM NO: CCSUP4701I
47173 BENICIA STREET, FREMONT, CA 94538, USA TEL: (510) 771-1000 FAX: (510) 661-0888
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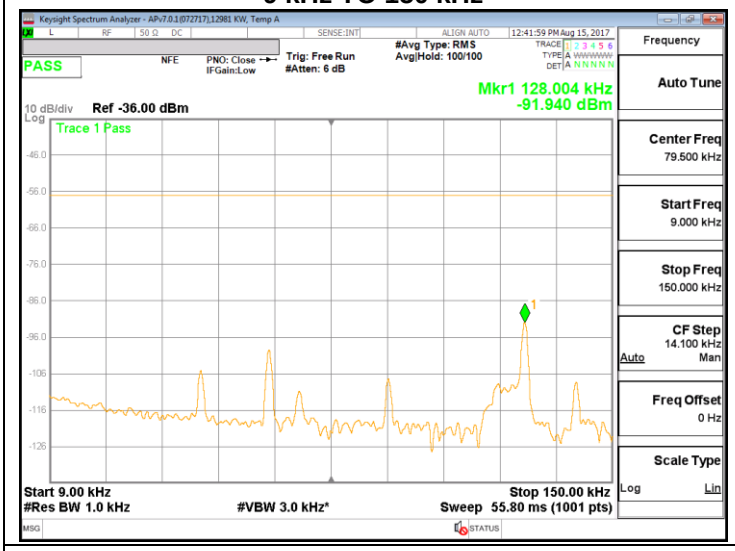
RESULTS

THE WORST CASE OF M BAND

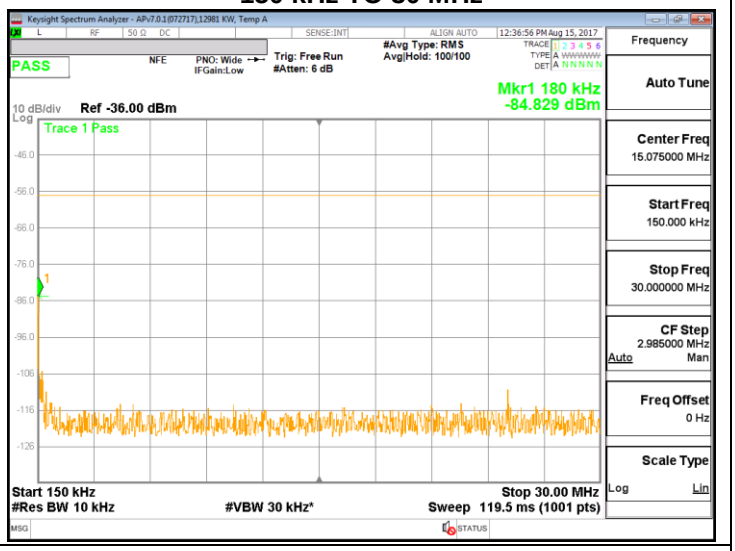
CONDUCTED SPURIOUS EMISSIONS

LOW CHANNEL

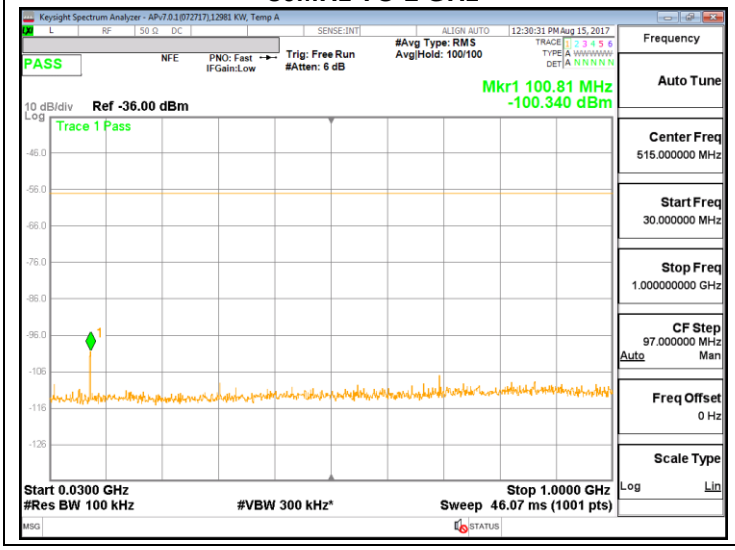
9 kHz TO 150 kHz



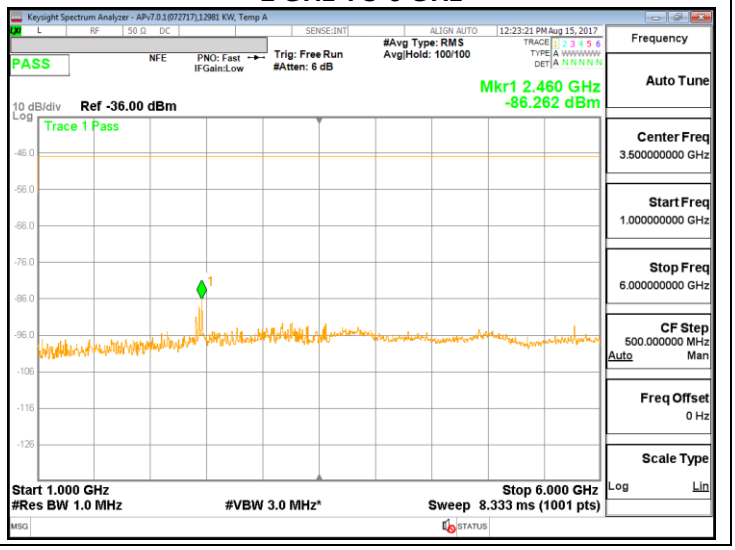
150 kHz TO 30 MHz



30MHz TO 1 GHz



1 GHz TO 6 GHz



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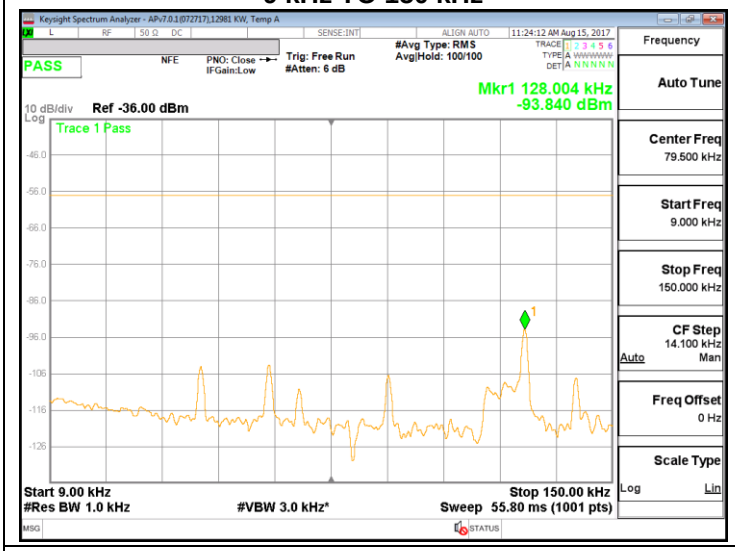
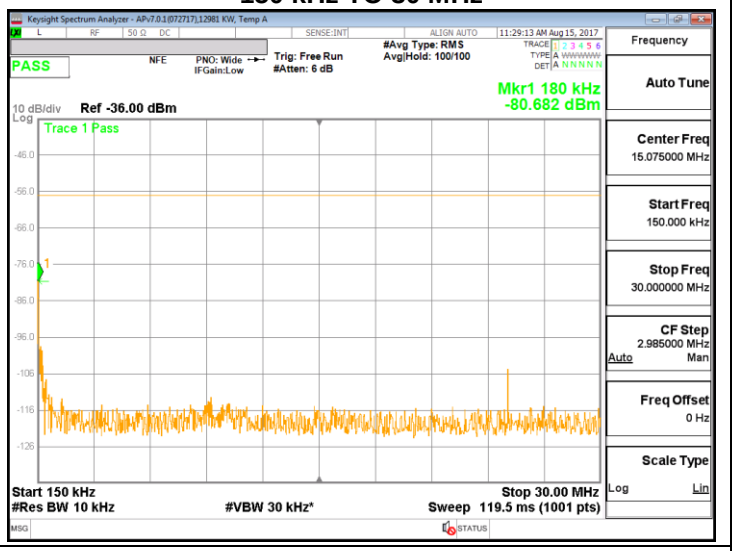
HIGH CHANNEL

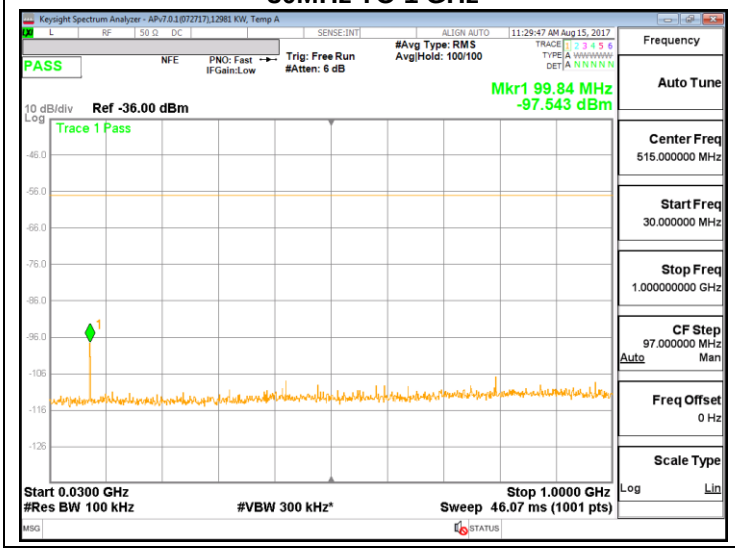
9 kHz TO 150 kHz



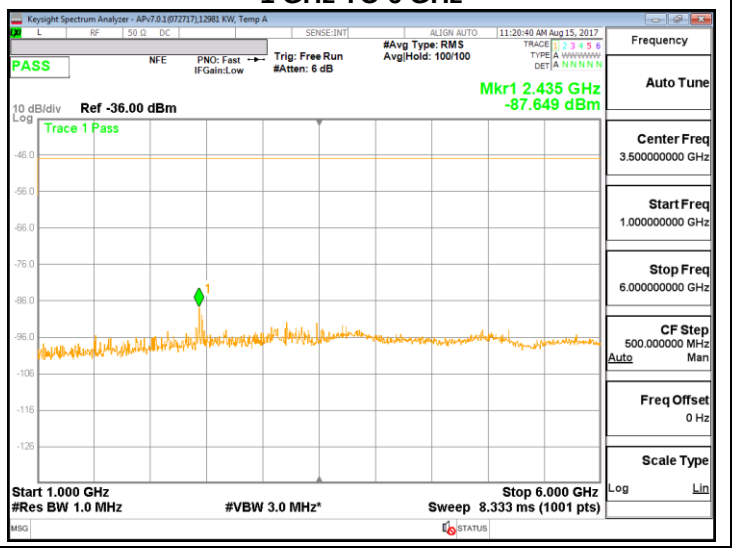
150 kHz TO 30 MHz



30MHz TO 1 GHz



1 GHz TO 6 GHz



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RADIATED SPURIOUS EMISSIONS

3m Radiated Emissions Chamber
30 - 1000MHz Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/3/2017
Test Engineer: 37290
Configuration: EUT with support laptop
Mode: Rx Below 1GHz M band worst case

Chamber	Pre-amplifer	Attenuator	Limit
3m Chamber C	3m-C T15		ETSI 300 220 Rx

Frequency (MHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Attenuator (dB)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel										
66.86	-73.7	H	3.0	15.8	28.0		-85.9	-57.0	-28.9	
167.74	-66.4	H	3.0	19.6	27.5		-74.3	-57.0	-17.3	
268.62	-73.2	H	3.0	22.4	27.2		-78.0	-57.0	-21.0	
50.82	-69.1	V	3.0	15.6	28.1		-81.6	-57.0	-24.6	
89.94	-64.7	V	3.0	20.7	27.9		-72.0	-57.0	-15.0	
210.79	-72.8	V	3.0	23.2	27.3		-76.8	-57.0	-19.8	
High Channel										
66.78	-71.9	H	3.0	15.8	28.0		-84.1	-57.0	-27.1	
167.10	-67.5	H	3.0	19.8	27.5		-75.3	-57.0	-18.3	
268.10	-72.2	H	3.0	22.4	27.2		-77.0	-57.0	-20.0	
47.90	-71.1	V	3.0	17.5	28.1		-81.8	-57.0	-24.8	
66.39	-66.5	V	3.0	16.6	28.0		-78.0	-57.0	-21.0	
159.80	-74.1	V	3.0	22.9	27.6		-78.9	-57.0	-21.9	

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3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/3/2017
Test Engineer: 37290
Configuration: EUT with support laptop
Mode: Rx Above 1GHz M band worst case

Chamber	Pre-amplifer	Filter	Limit
3m Chamber C	3m Chamber C		ETSI 300 220 Rx

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss @ SG End (dBm)	Preamp (dB)	Attenuator (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel										
1.216	-65.17	H	3.0	-22.6	36.6		-59.2	-47.0	-12.2	
2.056	-65.84	H	3.0	-17.5	35.9		-53.4	-47.0	-6.4	
3.089	-67.52	H	3.0	-17.2	34.9		-52.1	-47.0	-5.1	
1.594	-60.70	V	3.0	-16.2	36.6		-52.8	-47.0	-5.8	
2.668	-69.66	V	3.0	-19.9	35.1		-55.0	-47.0	-8.0	
3.085	-67.35	V	3.0	-16.3	34.9		-51.1	-47.0	-4.1	
High Channel										
1.169	-65.49	H	3.0	-23.0	36.6		-59.6	-47.0	-12.6	
1.812	-66.15	H	3.0	-20.0	36.3		-56.3	-47.0	-9.3	
2.841	-65.04	H	3.0	-15.2	35.0		-50.2	-47.0	-3.2	
1.109	-64.29	V	3.0	-22.0	36.6		-58.5	-47.0	-11.5	
1.597	-66.21	V	3.0	-21.7	36.6		-58.3	-47.0	-11.3	
3.162	-65.78	V	3.0	-14.6	34.8		-49.4	-47.0	-2.4	

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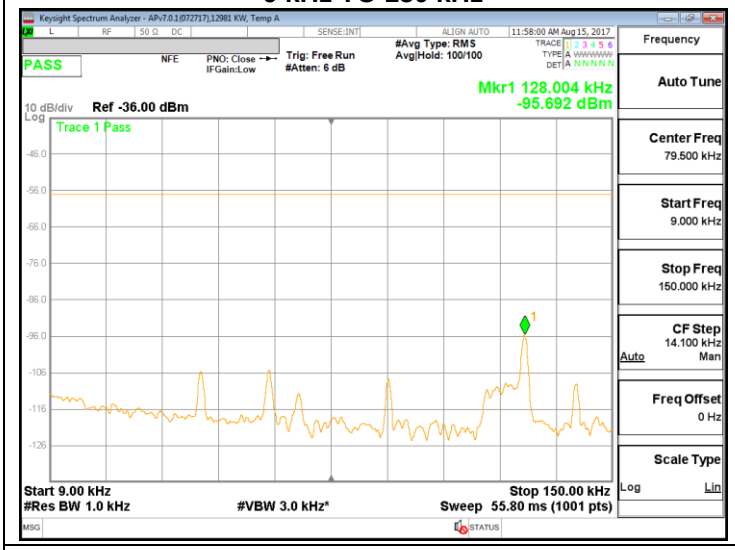
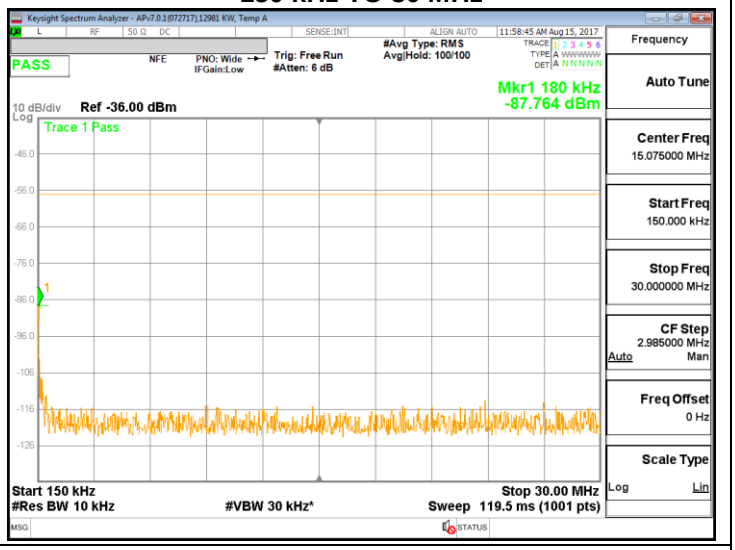
THE WORST CASE OF N BAND
CONDUCTED SPURIOUS EMISSIONS

LOW CHANNEL

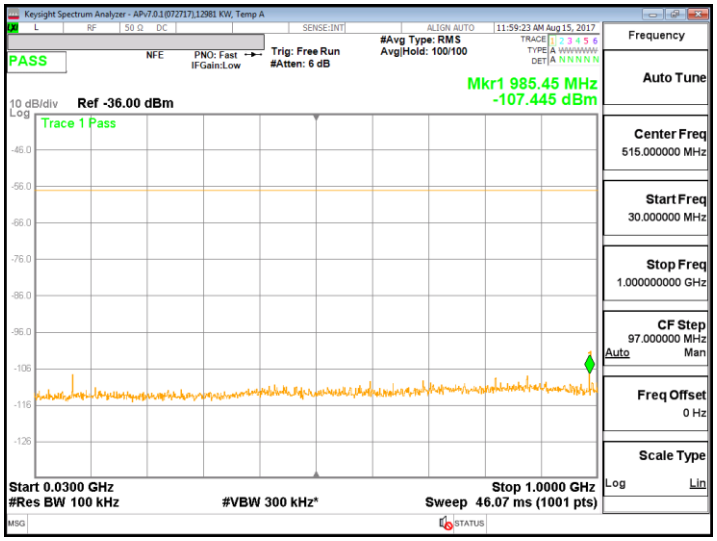
9 kHz TO 150 kHz



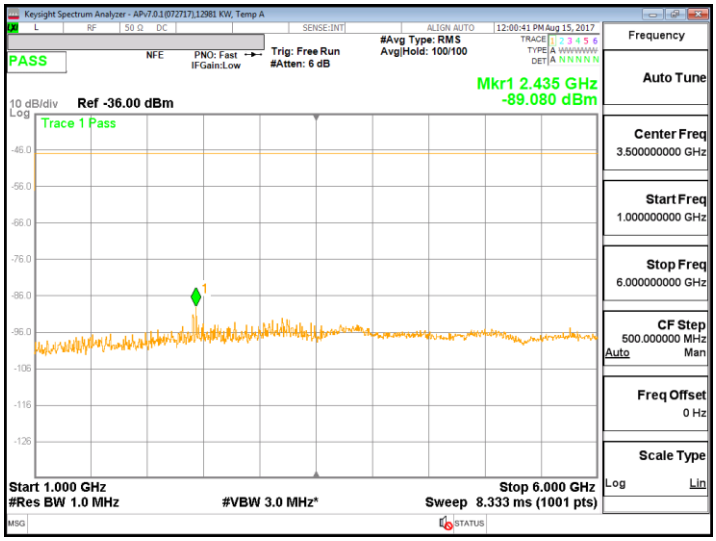
150 kHz TO 30 MHz



30MHz TO 1 GHz



1 GHz TO 6 GHz



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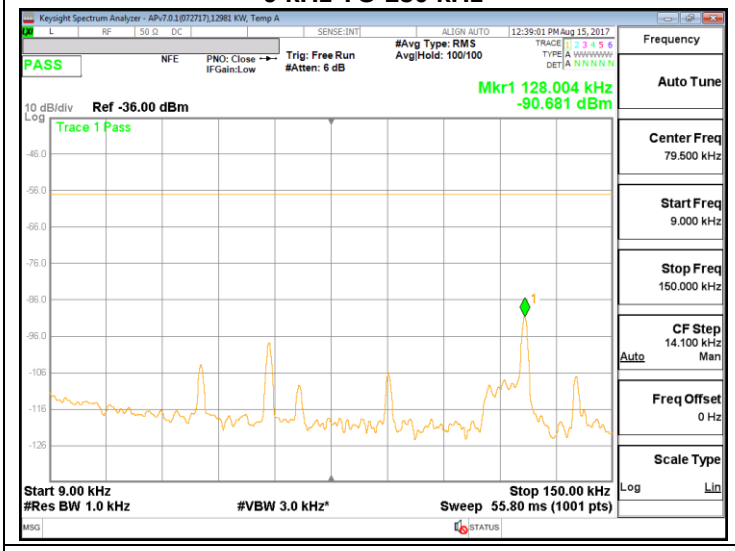
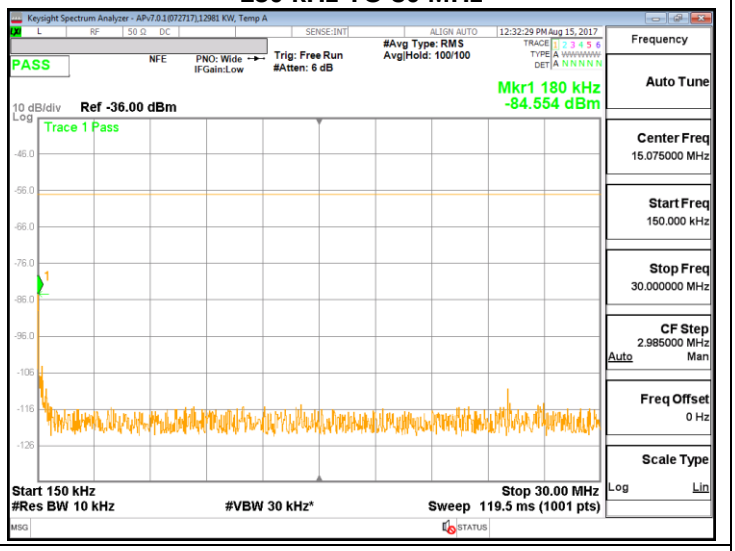
HIGH CHANNEL

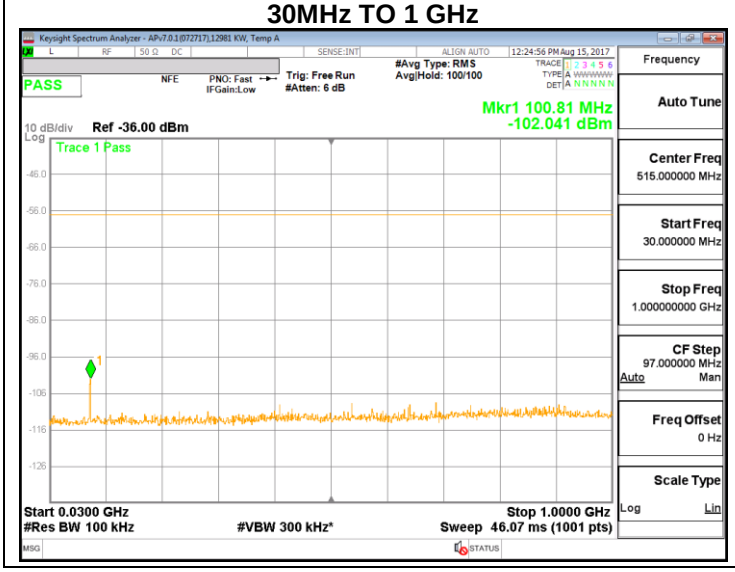
9 kHz TO 150 kHz



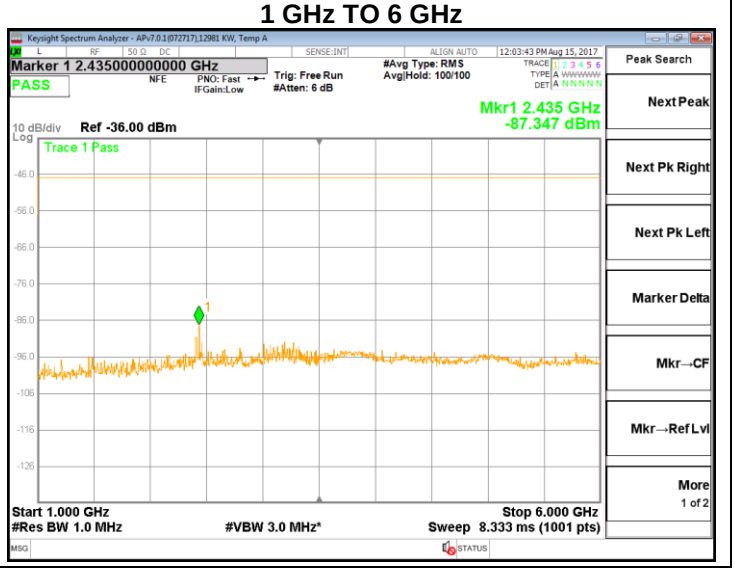
150 kHz TO 30 MHz



30MHz TO 1 GHz



1 GHz TO 6 GHz



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RADIATED SPURIOUS EMISSIONS

3m Radiated Emissions Chamber
30 - 1000MHz Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/3/2017
Test Engineer: 37290
Configuration: EUT with support laptop
Mode: Rx Below 1GHz N band worst case

Chamber	Pre-amplifer	Attenuator	Limit
3m Chamber C	3m-C T15		ETSI 300 220 Rx

Frequency (MHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Attenuator (dB)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel										
39.44	-66.2	H	3.0	25.9	28.2		-68.4	-57.0	-11.4	
167.20	-66.1	H	3.0	19.7	27.5		-73.9	-57.0	-16.9	
268.19	-71.1	H	3.0	22.4	27.2		-75.9	-57.0	-18.9	
66.59	-65.4	V	3.0	16.7	28.0		-76.8	-57.0	-19.8	
95.48	-69.1	V	3.0	22.8	28.0		-74.3	-57.0	-17.3	
210.79	-71.0	V	3.0	23.2	27.3		-75.1	-57.0	-18.1	
High Channel										
95.78	-73.8	H	3.0	15.2	28.0		-86.6	-57.0	-29.6	
167.20	-66.9	H	3.0	19.7	27.5		-74.7	-57.0	-17.7	
268.29	-72.7	H	3.0	22.4	27.2		-77.5	-57.0	-20.5	
66.59	-65.1	V	3.0	16.7	28.0		-76.5	-57.0	-19.5	
93.25	-64.0	V	3.0	21.9	28.0		-70.1	-57.0	-13.1	
209.91	-72.8	V	3.0	23.3	27.3		-76.8	-57.0	-19.8	

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3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/3/2017
Test Engineer: 37290
Configuration: EUT with support laptop
Mode: Rx Above 1GHz N band worst case

Chamber	Pre-amplifer	Filter	Limit
3m Chamber C	3m Chamber C		ETSI 300 220 Rx

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss @ SG End (dBm)	Preamp (dB)	Attenuator (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel										
1.316	-67.07	H	3.0	-24.5	36.6		-61.1	-47.0	-14.1	
1.604	-67.35	H	3.0	-23.5	36.6		-60.1	-47.0	-13.1	
2.779	-69.13	H	3.0	-19.4	35.1		-54.5	-47.0	-7.5	
1.597	-61.32	V	3.0	-16.8	36.6		-53.4	-47.0	-6.4	
2.596	-70.18	V	3.0	-20.7	35.1		-55.8	-47.0	-8.8	
3.290	-67.56	V	3.0	-16.3	34.6		-50.9	-47.0	-3.9	
High Channel										
1.249	-66.77	H	3.0	-24.2	36.6		-60.8	-47.0	-13.8	
1.756	-66.48	H	3.0	-20.9	36.4		-57.3	-47.0	-10.3	
2.846	-66.28	H	3.0	-16.4	35.0		-51.5	-47.0	-4.5	
1.155	-66.08	V	3.0	-23.6	36.6		-60.2	-47.0	-13.2	
1.657	-67.88	V	3.0	-22.6	36.5		-59.1	-47.0	-12.1	
3.324	-67.42	V	3.0	-16.1	34.6		-50.7	-47.0	-3.7	

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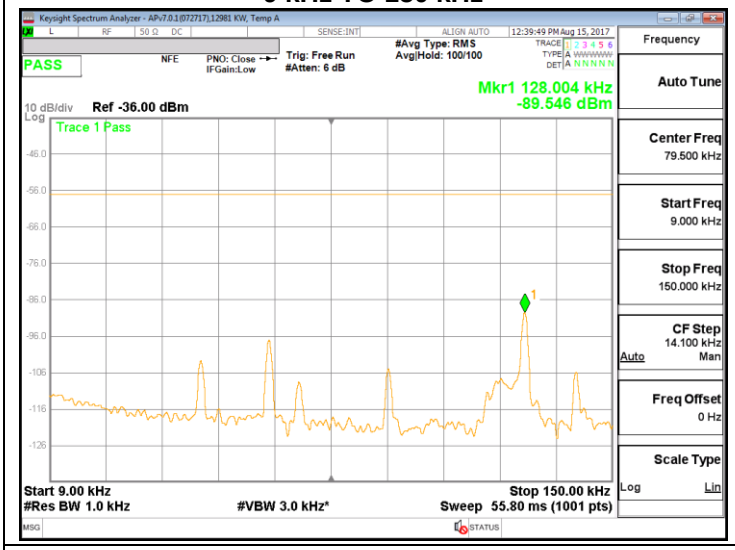
THE WORST CASE OF P BAND

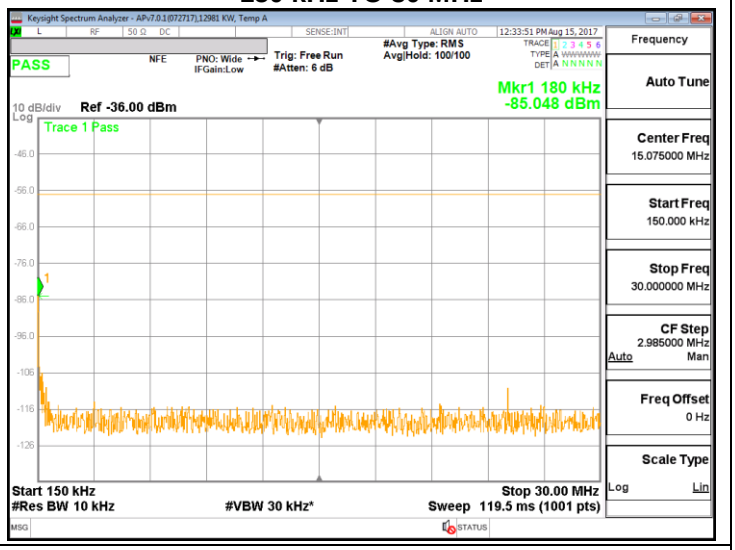
CONDUCTED SPURIOUS EMISSIONS

OPERATING CHANNEL

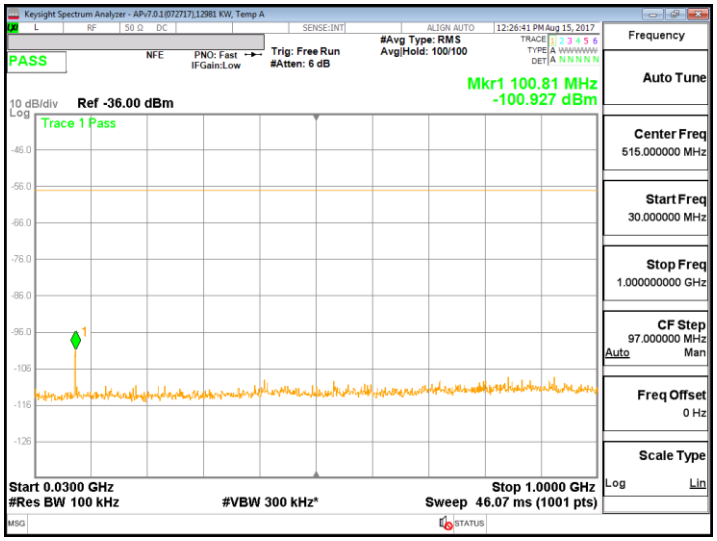
9 kHz TO 150 kHz



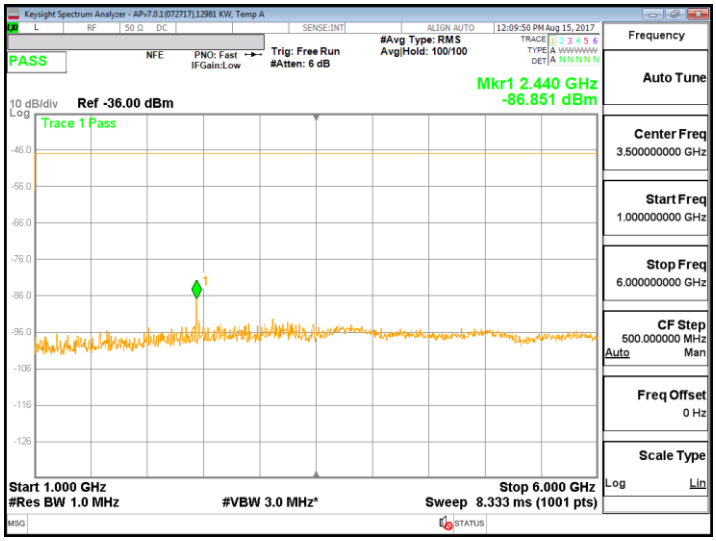
150 kHz TO 30 MHz



30MHz TO 1 GHz



1 GHz TO 6 GHz



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RADIATED SPURIOUS EMISSIONS

3m Radiated Emissions Chamber
30 - 1000MHz Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/3/2017
Test Engineer: 37290
Configuration: EUT with support laptop
Mode: Rx Below 1GHz P band worst case

Chamber	Pre-amplifer	Attenuator	Limit
3m Chamber C	3m-C T15		ETSI 300 220 Rx

Frequency (MHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Attenuator (dB)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Operating Channel										
89.06	-70.2	H	3.0	14.8	28.0		-83.4	-57.0	-26.4	
167.20	-67.1	H	3.0	19.7	27.5		-74.9	-57.0	-17.9	
268.29	-71.9	H	3.0	22.4	27.2		-76.7	-57.0	-19.7	
66.59	-64.9	V	3.0	16.7	28.0		-76.2	-57.0	-19.2	
95.78	-69.3	V	3.0	22.9	28.0		-74.4	-57.0	-17.4	
210.79	-73.9	V	3.0	23.2	27.3		-78.0	-57.0	-21.0	

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3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/3/2017
Test Engineer: 37290
Configuration: EUT with support laptop
Mode: Rx Above 1GHz P band worst case

Chamber	Pre-amplifer	Filter	Limit
3m Chamber C	3m Chamber C		ETSI 300 220 Rx

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss @ SG End (dBm)	Preamp (dB)	Attenuator (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Operating Channel										
1.155	-63.98	H	3.0	-21.5	36.6		-58.0	-47.0	-11.0	
1.593	-62.84	H	3.0	-19.1	36.6		-55.7	-47.0	-8.7	
3.490	-66.69	H	3.0	-15.8	34.4		-50.2	-47.0	-3.2	
1.099	-64.08	V	3.0	-21.8	36.6		-58.3	-47.0	-11.3	
2.400	-66.29	V	3.0	-17.3	35.2		-52.5	-47.0	-5.5	
3.012	-66.04	V	3.0	-15.0	35.0		-50.0	-47.0	-3.0	

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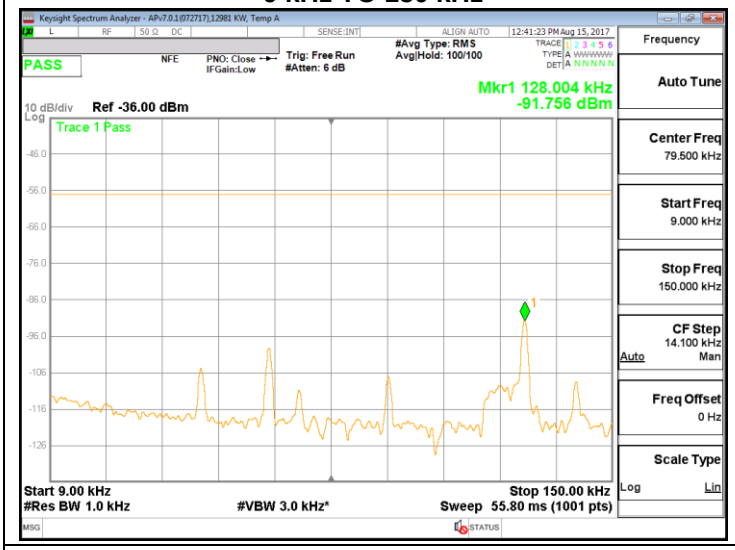
THE WORST CASE OF R AND Q BAND

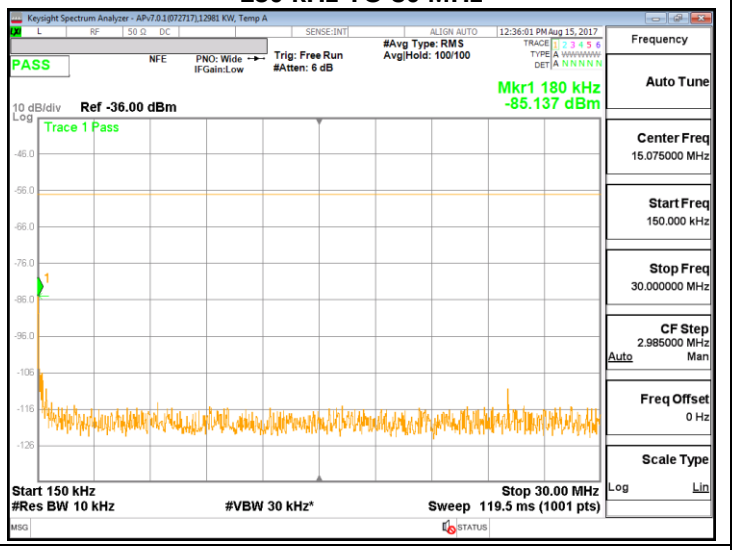
CONDUCTED SPURIOUS EMISSIONS

OPERATING CHANNEL

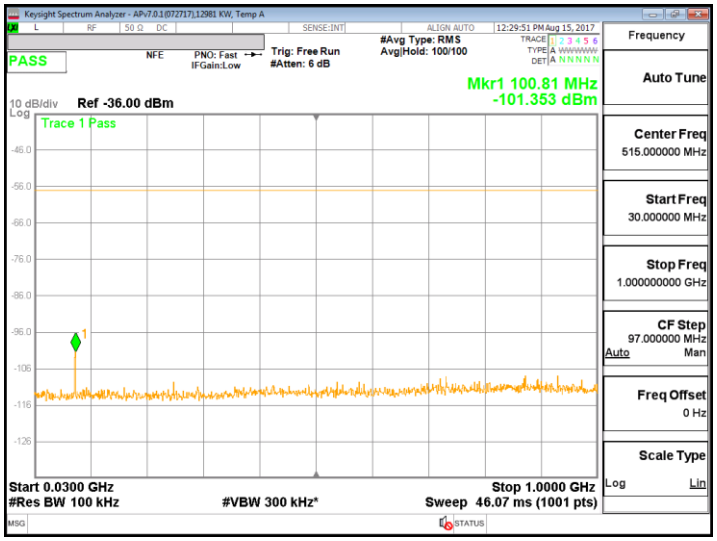
9 kHz TO 150 kHz



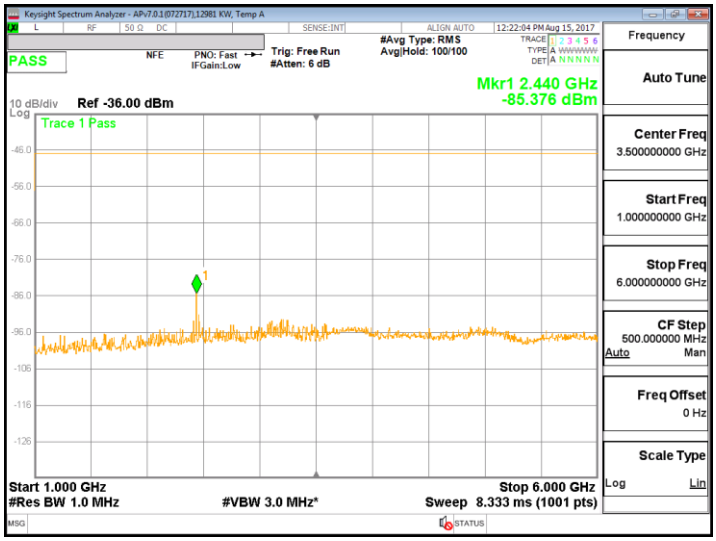
150 kHz TO 30 MHz



30MHz TO 1 GHz



1 GHz TO 6 GHz



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RADIATED SPURIOUS EMISSIONS

3m Radiated Emissions Chamber
30 - 1000MHz Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/3/2017
Test Engineer: 37290
Configuration: EUT with support laptop
Mode: Rx Below 1GHz Q and R band worst case

Chamber	Pre-amplifer	Attenuator	Limit
3m Chamber C	3m-C T15		ETSI 300 220 Rx

Frequency (MHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Attenuator (dB)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Operating Channel										
87.12	-69.2	H	3.0	15.1	28.0		-82.1	-57.0	-25.1	
167.20	-67.3	H	3.0	19.7	27.5		-75.1	-57.0	-18.1	
268.39	-71.7	H	3.0	22.4	27.2		-76.5	-57.0	-19.5	
66.39	-68.3	V	3.0	16.6	28.0		-79.7	-57.0	-22.7	
96.38	-70.2	V	3.0	23.2	28.0		-75.0	-57.0	-18.0	
255.74	-74.2	V	3.0	21.7	27.2		-79.7	-57.0	-22.7	

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3m Radiated Emissions Chamber
Above 1GHz High Frequency Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/3/2017
Test Engineer: 37290
Configuration: EUT with support laptop
Mode: Rx Above 1GHz Q and R band worst case

Chamber	Pre-amplifer	Filter	Limit
3m Chamber C	3m Chamber C		ETSI 300 220 Rx

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss @ SG End (dBm)	Preamp (dB)	Attenuator (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Operating Channel										
1.195	-64.00	H	3.0	-21.5	36.6		-58.1	-47.0	-11.1	
1.690	-66.41	H	3.0	-21.6	36.4		-58.0	-47.0	-11.0	
2.442	-65.44	H	3.0	-16.5	35.2		-51.6	-47.0	-4.6	
1.223	-64.38	V	3.0	-21.7	36.6		-58.3	-47.0	-11.3	
1.779	-67.39	V	3.0	-20.7	36.3		-57.0	-47.0	-10.0	
2.576	-66.90	V	3.0	-17.5	35.1		-52.6	-47.0	-5.6	

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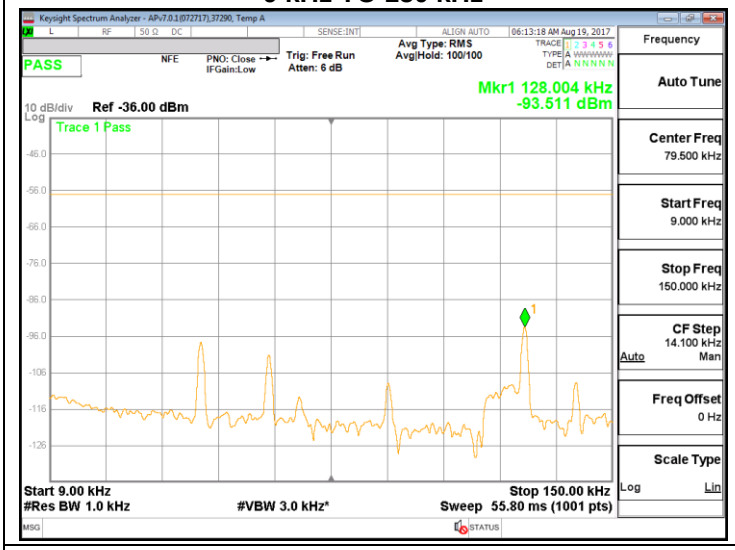
THE WORST CASE OF X BAND

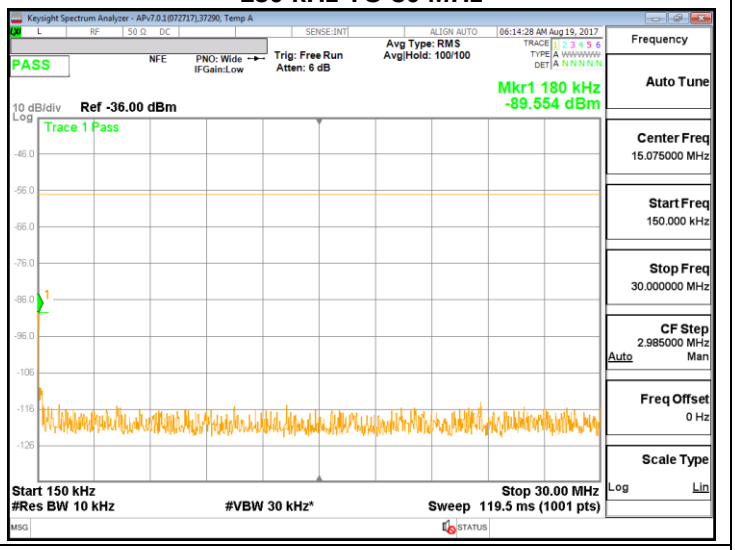
CONDUCTED SPURIOUS EMISSIONS

LOW CHANNEL

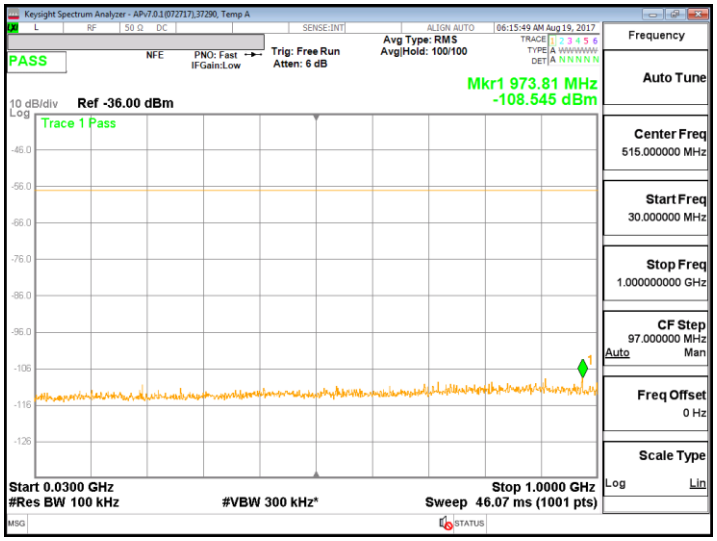
9 kHz TO 150 kHz



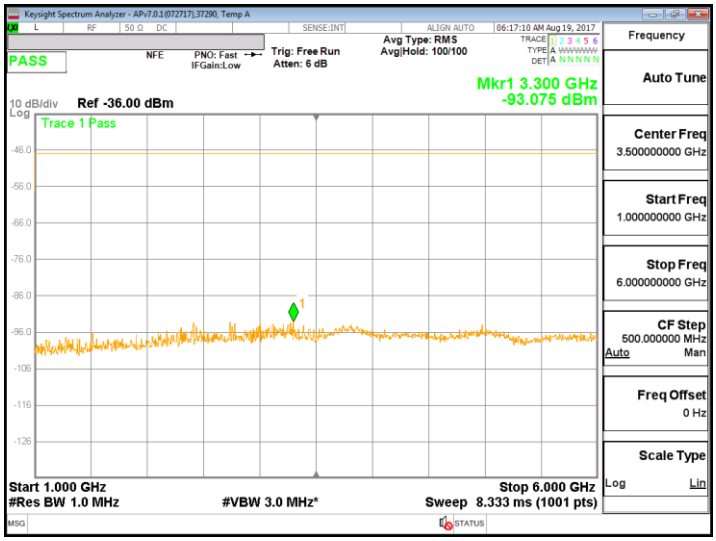
150 kHz TO 30 MHz



30MHz TO 1 GHz



1 GHz TO 6 GHz



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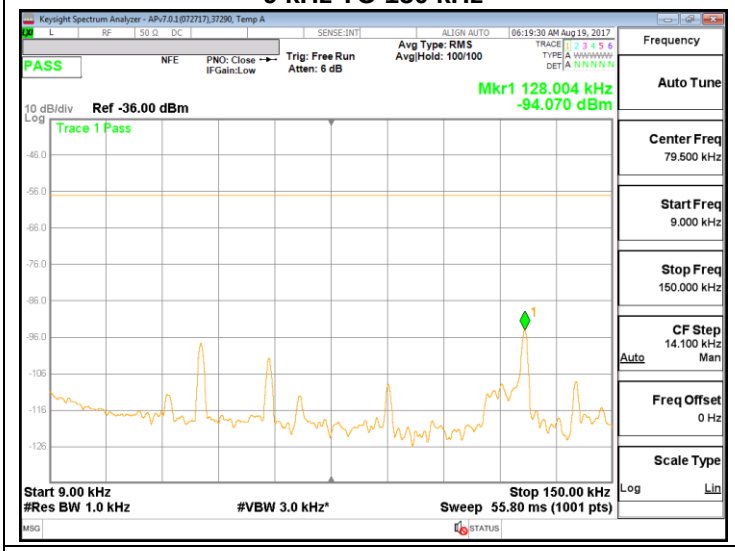
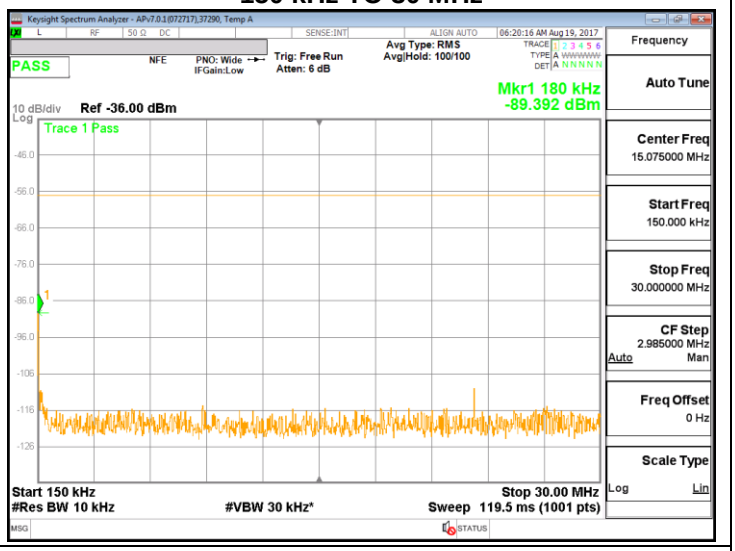
HIGH CHANNEL

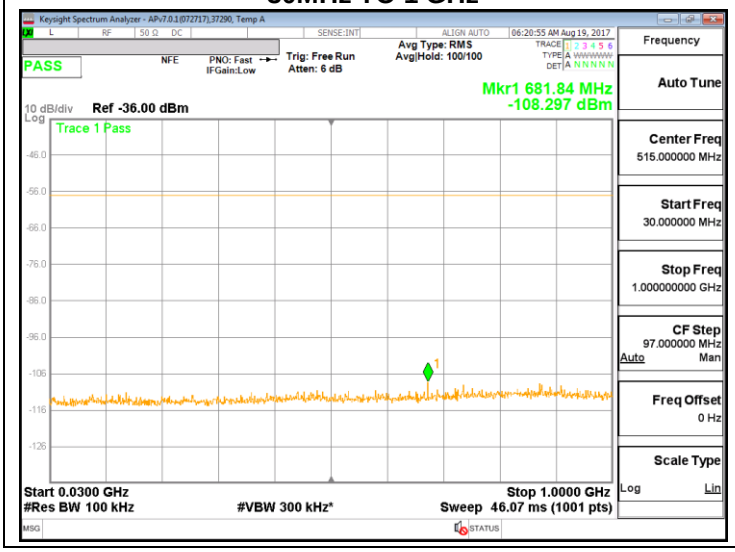
9 kHz TO 150 kHz



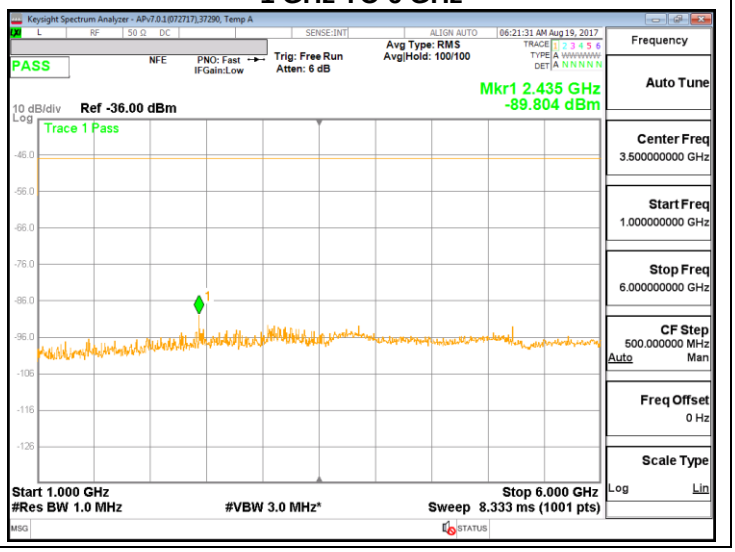
150 kHz TO 30 MHz



30MHz TO 1 GHz



1 GHz TO 6 GHz



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RADIATED SPURIOUS EMISSIONS

3m Radiated Emissions Chamber
30 - 1000MHz Substitution Measurement

Company: Anaren
Project #: 11773240
Date: 8/21/2017
Test Engineer: 37290
Configuration: EUT with 50Ohm load and a support laptop
Mode: RX Below 1GHz 4FSK X band worst case

Chamber	Pre-amplifer	Attenuator	Limit
3m Chamber B	3m-B T10		ETSI 300 220 Rx

Frequency (MHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Attenuator (dB)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel										
84.00	-64.9	H	3.0	14.8	28.7		-78.8	-57.0	-21.8	
167.97	-72.1	H	3.0	19.9	28.5		-80.7	-57.0	-23.7	
215.94	-64.2	H	3.0	20.0	28.4		-72.6	-57.0	-15.6	
44.00	-50.0	V	3.0	18.5	29.0		-60.5	-57.0	-3.5	
87.21	-59.9	V	3.0	20.6	28.7		-68.1	-57.0	-11.1	
159.31	-57.5	V	3.0	23.2	28.5		-62.9	-57.0	-5.9	
High Channel										
44.10	-58.0	H	3.0	20.3	29.0		-66.7	-57.0	-9.7	
210.88	-68.5	H	3.0	19.9	28.4		-77.1	-57.0	-20.1	
292.13	-67.6	H	3.0	22.0	28.0		-73.6	-57.0	-16.6	
96.36	-55.0	V	3.0	19.4	28.7		-64.3	-57.0	-7.3	
215.94	-63.0	V	3.0	21.9	28.4		-69.4	-57.0	-12.4	
359.95	-71.9	V	3.0	25.4	28.3		-74.8	-57.0	-17.8	

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Company: Anaren
Project #: 11773240
Date: 8/21/2017
Test Engineer: 37290
Configuration: EUT with 50Ohm load and a support laptop
Mode: RX Above 1GHz R band 4FSK worst case

Chamber	Pre-amplifer	Filter	Limit
3m Chamber B	3m Chamber B	Filter	ETSI 300 220 Rx

Frequency (GHz)	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss @ SG End (dBm)	Preamp (dB)	Attenuator (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Channel										
1.167	-64.30	H	3.0	-22.1	38.5	1.0	-59.6	-47.0	-12.6	
1.392	-64.50	H	3.0	-21.1	38.7	1.0	-58.9	-47.0	-11.9	
3.670	-65.65	H	3.0	-13.8	38.4	1.0	-51.3	-47.0	-4.3	
1.598	-60.93	V	3.0	-16.2	38.7	1.0	-53.9	-47.0	-6.9	
2.393	-62.62	V	3.0	-13.2	38.6	1.0	-50.9	-47.0	-3.9	
2.916	-67.46	V	3.0	-16.8	38.6	1.0	-54.4	-47.0	-7.4	
High Channel										
1.200	-61.14	H	3.0	-18.8	38.5	1.0	-56.3	-47.0	-9.3	
2.196	-61.96	H	3.0	-13.2	38.3	1.0	-50.5	-47.0	-3.5	
3.676	-66.29	H	3.0	-14.5	38.4	1.0	-51.9	-47.0	-4.9	
1.097	-62.76	V	3.0	-21.1	38.4	1.0	-58.5	-47.0	-11.5	
1.391	-64.09	V	3.0	-20.8	38.7	1.0	-58.6	-47.0	-11.6	
2.389	-65.36	V	3.0	-16.0	38.6	1.0	-53.6	-47.0	-6.6	

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8. SETUP PHOTOS

RF CONDUCTED MEASUREMENT AT ANTENNA PORT

ENVIRONMENTAL CHAMBER SETUP

ANTENNA PORT CONDUCTED PHOTO

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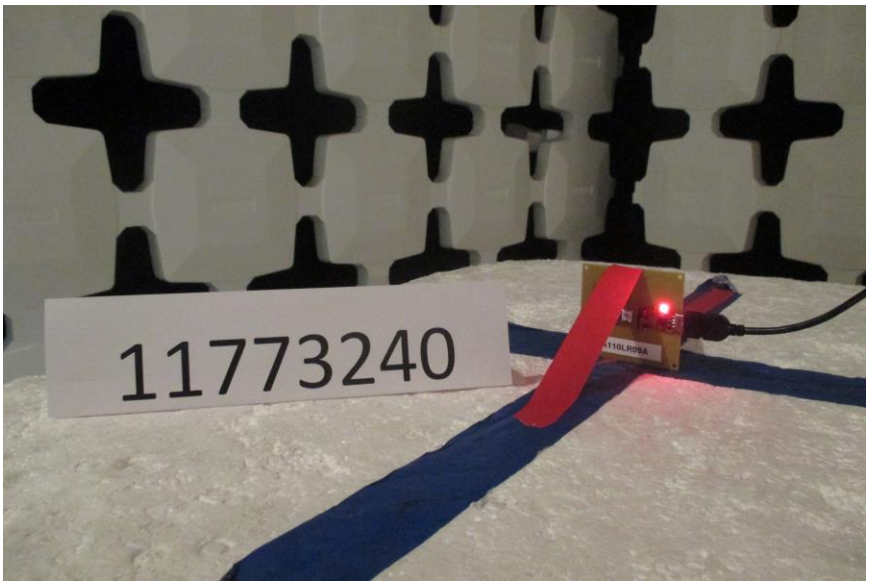
RADIATED RF MEASUREMENT SETUP FOR PORTABLE CONFIGURATION

X-AXIS PHOTO

Y-AXIS PHOTO



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Z-AXIS PHOTO

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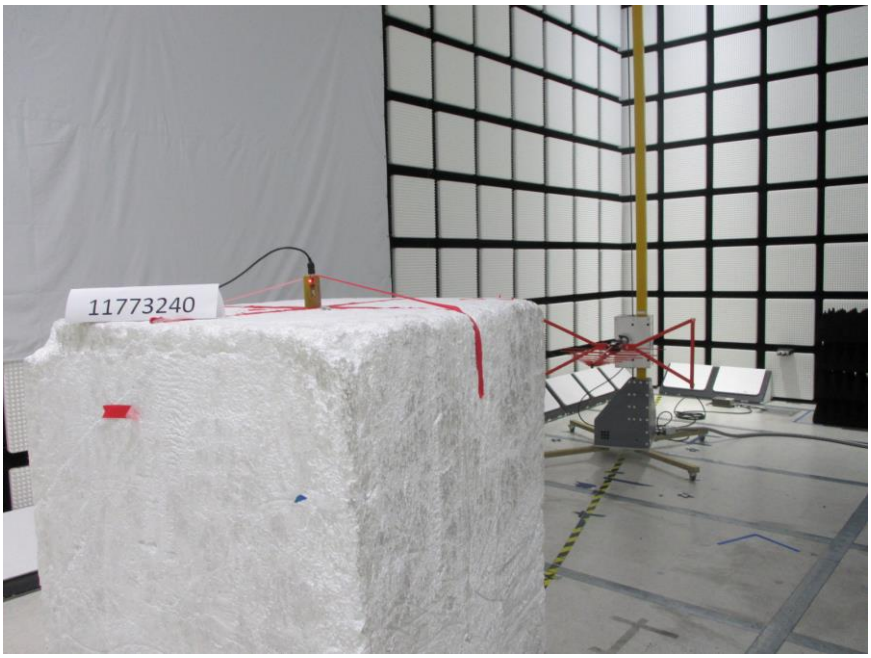
RADIATED SPURIOUS EMISSIONS

RADIATED SPURIOUS BELOW 1GHz FRONT PHOTO

RADIATED SPURIOUS BELOW 1GHz BACK PHOTO



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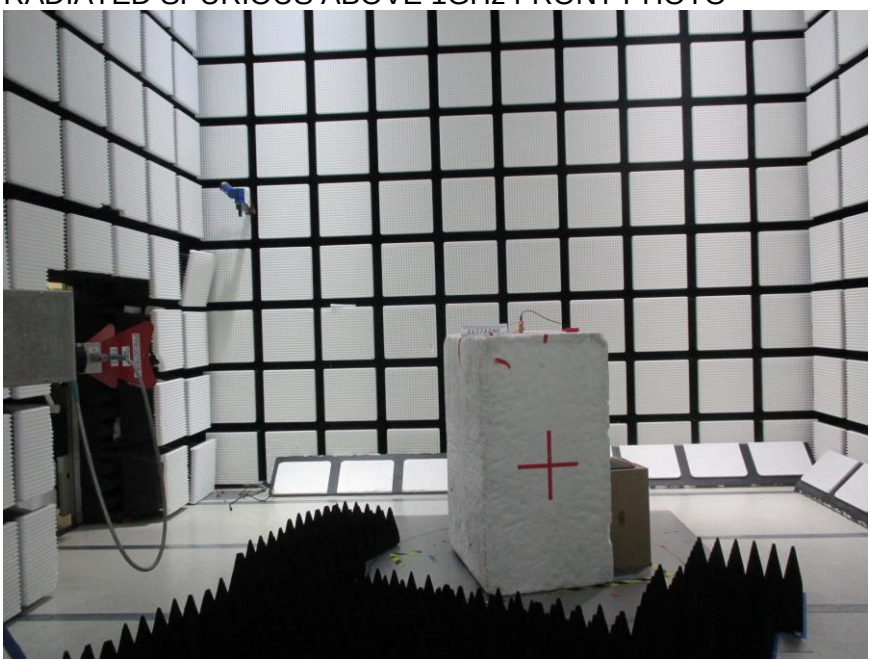
RADIATED SPURIOUS ABOVE 1GHz FRONT PHOTO



RADIATED SPURIOUS ABOVE 1GHz BACK PHOTO

END OF REPORT

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