FCC CFR47 PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 8

CLASS III PERMISSIVE CHANGE

CERTIFICATION TEST REPORT

FOR

Intelligent Backhaul Radio ISM 5.8GHz band

MODEL NUMBER: IBR-1A

FCC ID: 2AAEH-101

IC: 11158A-101

REPORT NUMBER: 14U18437-1 Revision A

ISSUE DATE: September 24, 2014

Prepared for
CBF NETWORKS, INC., DBA FASTBACK NETWORKS
2460 N. FIRST STREET, SUITE 200
SAN JOSE, CA 95131

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Revision History

Rev.	Issue Date	Revisions	Revised By
--	09/23/14	Initial Issue	F. de Anda
A	09/24/14	Updated section 5.2	F. de Anda

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: CBF NETWORKS, INC., DBA FASTBACK NETWORKS
2460 N. FIRST STREET, SUITE 200
SAN JOSE, CA 95131

EUT DESCRIPTION: Intelligent Backhaul Radio ISM 5.8GHz band

MODEL: IBR-1A

SERIAL NUMBER: 40314030189 (Radiated) 40313440132 (Conducted)

DATE TESTED: August 4 – September 15, 2014

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-210 Issue 8 Annex 8	Pass
INDUSTRY CANADA RSS-GEN Issue 3	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, any agency of the Federal Government, or any agency of any government.

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UL VERIFICATION SERVICES INC.

Tested By:

TONY WAGONER
EMC TECHNICIAN
UL VERIFICATION SERVICES INC.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 3, and RSS-210 Issue 8.

3. FACILITIES AND ACCREDITATION

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

4.1. 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.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	± 3.52 dB
Radiated Disturbance, 30 to 1000 MHz	± 4.94 dB
Radiated Disturbance, 1 to 6 GHz	± 3.86 dB
Radiated Disturbance, 6 to 18 GHz	± 4.23 dB
Radiated Disturbance, 18 to 26 GHz	± 5.30 dB
Radiated Disturbance, 26 to 40 GHz	± 5.23 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

P-P outdoor radio in 5GHz unlicensed with a proprietary communication management interface Intelligent Backhaul Radio model IBR-1A.

Overview:

IBR combines a Carrier Ethernet switch and an AnyLOS™ radio that can simultaneously operate in non-, near-, and clear line of sight radio conditions. It is designed for small cell deployment in dense urban environments where line of sight between radios is difficult or impossible to achieve.
IBR is small, passively-cooled, and environmentally protected for use mainly in macro-cellular backhaul, commercial services fiber fill-in, and small cell backhaul applications. It can be mounted on masts, poles, walls, cell towers, or in other such locations and requires little or no alignment when the radios are pointed in the general direction of one another.

Transmit & Receive Frequencies:

There are two versions of IBR that operate together to form the two ends of a link.
IBR-1A, a 5.8 GHz radio, transmits in the band from 5.725 GHz to 5.85 GHz and receives in the band from 5.25 GHz to 5.35 GHz.
IBR-1B, a 5.3 GHz radio, transmits in the band from 5.25 GHz to 5.35 GHz and receives in the band from 5.725 GHz to 5.85 GHz.

Radio Features:

IBR uses adaptive rate modulation, proprietary interference avoidance and cancellation techniques, and antenna array signal processing to deliver reliable and secure high speed data transmission over links where line-of-sight between radios is difficult or impossible to achieve.

This device uses 40MHz, 20MHzand 10MHz bandwidths with QPSK, QAM16, QAM64, QAM256 modulation. It transmits either single stream (SISO) or dual stream uncorrelated MIMO.

Note: J48 and J49 are utilized throughout the report this indication is identical to Chain 0 and Chain 1 which indicates two antennas there is no difference in this labeling except for the client identifies the two antenna ports as J48 and J49.

5.2. DESCRIPTION OF CLASS III PERMISSIVE CHANGE

The change filed under this application is for the bandwidth support. The original filing was for 9, 18 and 35 MHZ BW support. The update increases the BW to 10, 20 and 40 MHz bandwidth.

Changes in bandwidth are done by using only software modifications. No hardware modifications were made. No changes were made to the Software Distribution and Security mechanisms.

5.3. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

5.8 GHz BAND

Bandwidth (MHz)	Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5.8 GHz Band				
10	5731-5844	FDD	25.80	380.19
20	5736-5839	FDD	26.95	495.45
40	5747-5828	FDD	27.24	529.66

5.4. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a Dipole array antenna, with a maximum gain of 10.5 dBi.

5.5. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was Build SVN Revision: 4486

The test utility software used during testing was Micro Monitor 1.18.0.

5.6. WORST-CASE CONFIGURATION AND MODE

Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

The fundamental of the EUT was investigated in three orthogonal orientations X, Y, Z, it was determined that X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X orientation.

Based on the baseline scan, the worst-case data rates were:

40MHz bandwidth QAM 4
20MHz bandwidth QAM 4
10MHz bandwidth QAM 4
Data rate 30 Msamples/s

KDB 662911 D01 V02r01 has been followed where applicable to the MIMO device.

5.6 DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Lenovo	Think pad	R9-D497T 11/04	QDS-BRCM1046
POE	PHIHONG	POE 36U-1AT-R	P30300375D1	N/A
AC/DC Adapter	Lenovo	N/A	11S45N0113Z1ZH819P0FN	N/A

I/O CABLES

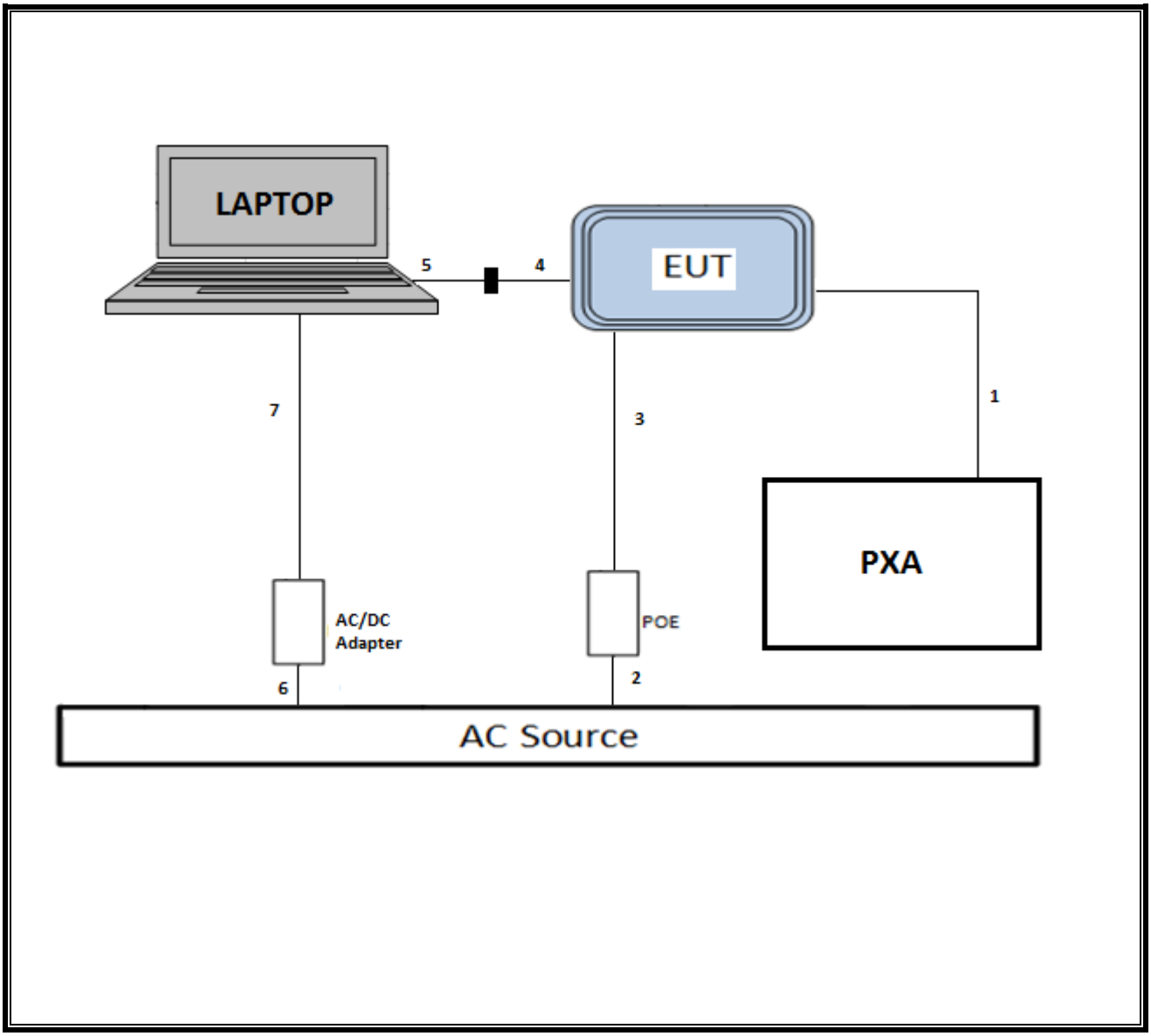
I/O Cable List						
Cable No	Port	# of identical	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Antenna	1	U.FL	Sheilded	0.3	N/A
2	AC	1	3 Prong	Un-Sheilded	1	N/A
3	POE/LAN	1	RJ45	Sheilded	1	N/A
4	USB	1	USB	Sheilded	0.3	N/A
5	Serial	1	9 Pin Sub D	Sheilded	1	N/A
6	AC	1	3 Prong	Un-Sheilded	1	N/A
7	DC	1	Barrel	Un-Sheilded	1	N/A

TEST SETUP

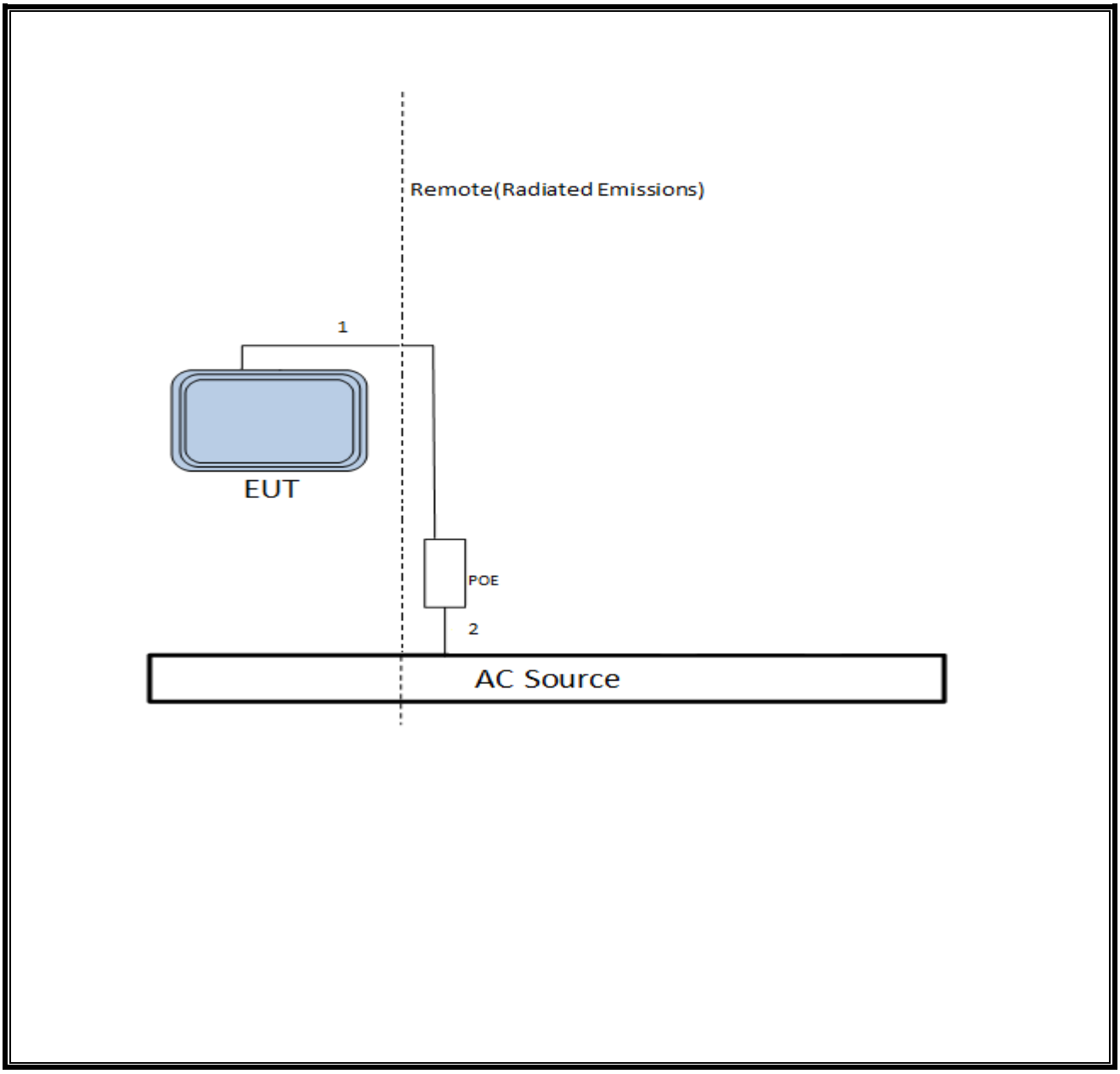
The EUT is a P-P outdoor radio used as a stand-alone device. Test software exercised the radio module

SETUP DIAGRAM FOR TESTS

Conducted



Radiated



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**	**Asset**	**Cal Date**	**Cal Due**
Antenna, Horn, 18 GHz	ETS Lindgren	3117	C01005	3/20/2014	3/20/2015
Antenna, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB1	C01011	4/22/2014	4/22/2015
High Pass Filter, fc: 3.0GHz, 50 Ohms	Micro-Tronics	HPM17543	F00181	1/20/2014	1/20/2015
Low Pass Filter, fc: 5GHz, 50 Ohms	Micro-Tronics	LPS17541	F00175	1/20/2014	1/20/2015
High Pass Filter, fc: 6GHz, 50 Ohms	Micro-Tronics	HPS17542	F00179	1/20/2014	1/20/2015
RF PreAmplifier, 1-18GHz	Miteq	AFS42-00101800-25-S-42	F00354	1/20/2014	1/20/2015
Preamp, 1000MHz	Sonoma	310N	N02891	12/30/2013	12/30/2014
Spectrum Analyzer	Agilent	N9030A	F00128	2/12/2014	2/12/2015
Spectrum Analyzer, 40 GHz	Agilent	8564E	C00951	8/6/2014	8/6/2015
PreAmplifier, 1-26.5GHz	Agilent	8449B	F00167	3/25/2014	3/25/2015
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	9/3/2014	9/3/2015
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00980	11/26/2013	11/26/2014
Antenna, Horn, 40 GHz	ARA	MWH-2640/B	C00981	7/15/2014	7/15/2015
Single Channel PK Power Meter	Agilent	N1911A	F00024	3/7/2014	3/7/2015
Peak and Average Power Sensor	Agilent	E9323A	F00159	5/2/2014	5/2/2015

7. MEASUREMENT METHODS

6 dB BW: KDB 558074 D01 v03r01, Section 8.1.

Output Power: KDB 558074 D01 v03r01, Section 9.1.2.

Band-edge: KDB 558074 D01 v03r01, Section 13.3.1.

Out-of-band emissions in non-restricted bands: KDB 558074 D01 v03r01, Section 11.0.

Out-of-band emissions in restricted bands: KDB 558074 D01 v03r01, Section 12.1.

8. ANTENNA PORT TEST RESULTS

8.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

IC RSS-210 A8.2 (a)

The minimum 6 dB bandwidth shall be at least 500 kHz.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer with the RBW set at 100 KHz and VBW at 300 KHz.

RESULTS 40MHz

Channel	Frequency (MHz)	6 dB BW Chain 0 (MHz)	6 dB BW Chain 1 (MHz)	Minimum Limit (MHz)
Low	5747	38.976	38.570	0.5
Mid	5788	39.208	38.802	0.5
High	5828	38.860	38.744	0.5

Note: Chain 0=J48 Chain1=J49, 40MHz bandwidth QAM4

RESULTS 20MHz

Channel	Frequency (MHz)	6 dB BW Chain 0 (MHz)	6 dB BW Chain 1 (MHz)	Minimum Limit (MHz)
Low	5736	19.488	19.460	0.5
Mid	5788	19.376	19.600	0.5
High	5839	18.956	19.516	0.5

Note: Chain 0=J48 Chain1=J49, 20MHz bandwidth QAM4

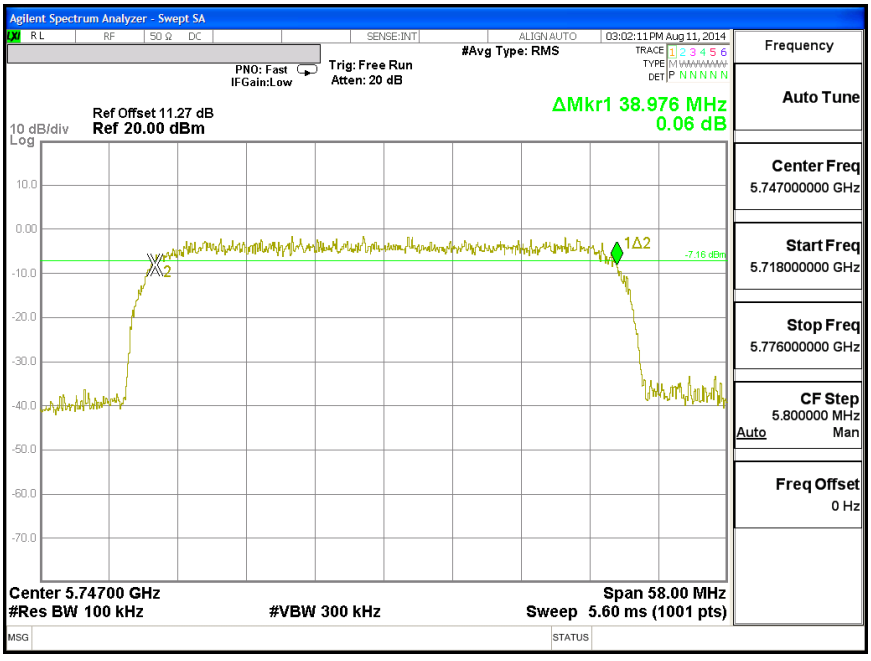
RESULTS 10MHz

Channel	Frequency (MHz)	6 dB BW Chain 0 (MHz)	6 dB BW Chain 1 (MHz)	Minimum Limit (MHz)
Low	5731	9.716	9.674	0.5
Mid	5788	9.534	9.604	0.5
High	5844	9.520	9.338	0.5

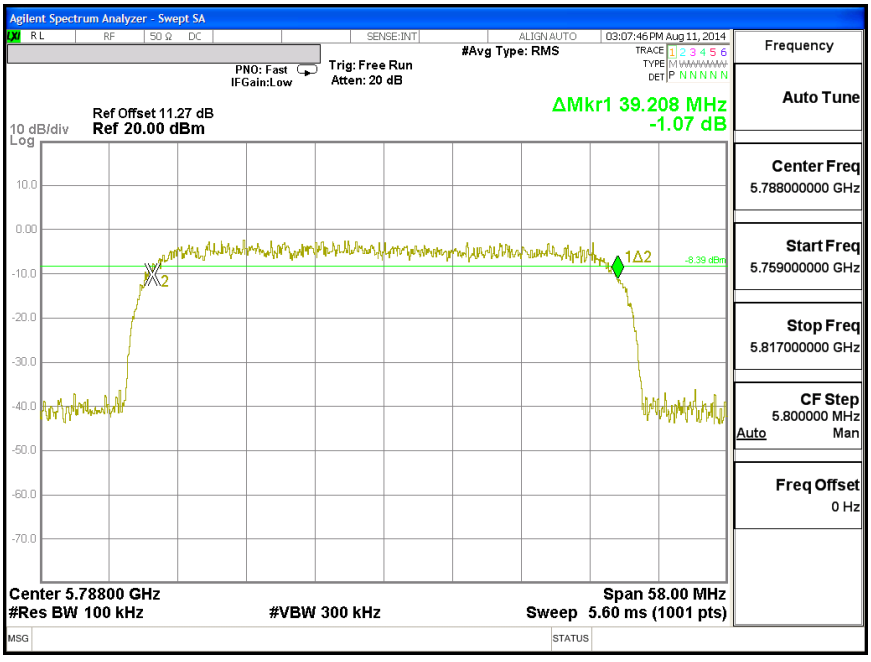
Note: Chain 0=J48 Chain1=J49, 10MHz bandwidth QAM4

6 dB BANDWIDTH, Chain 0 40MHz setting

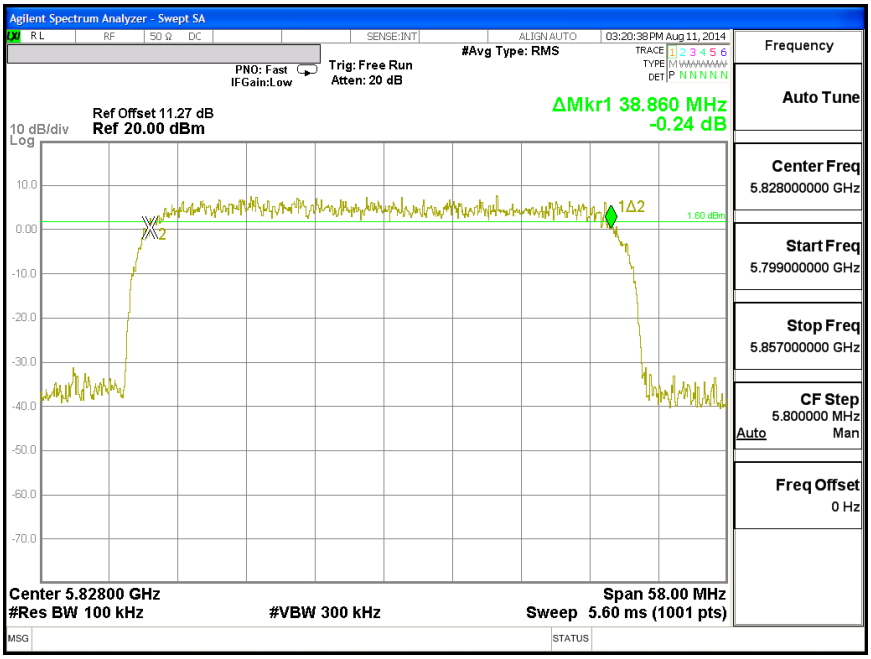
6 dB BANDWIDTH Chain 0 LOW CH



6 dB BANDWIDTH Chain 0 MID CH

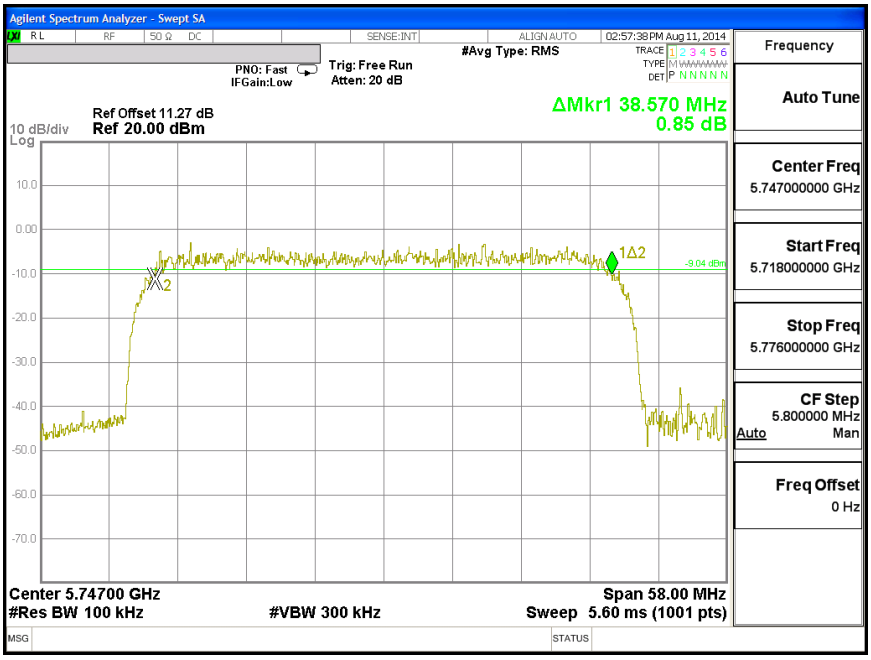


6 dB BANDWIDTH Chain 0 HIGH CH

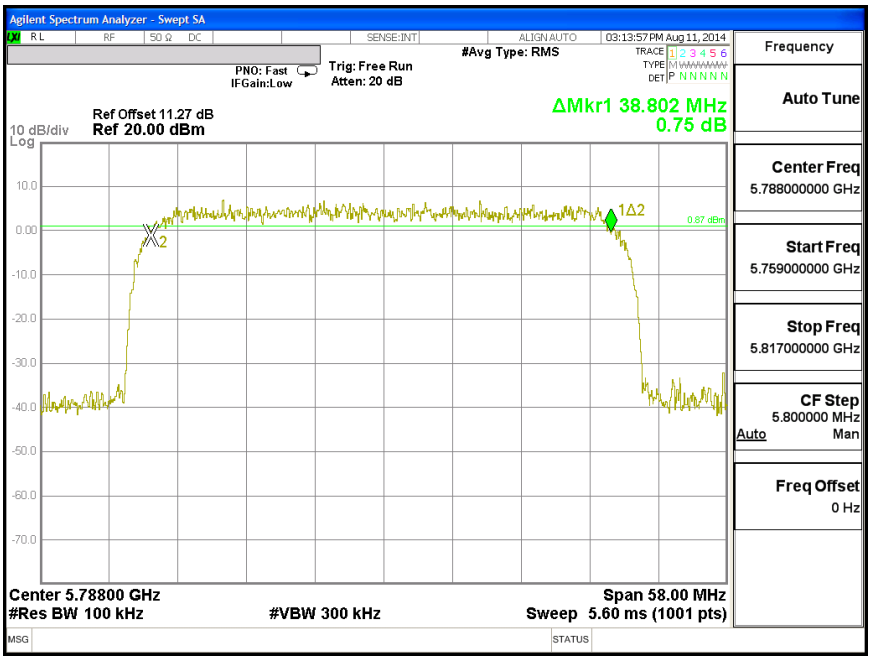


6 dB BANDWIDTH, Chain 1 40MHz setting

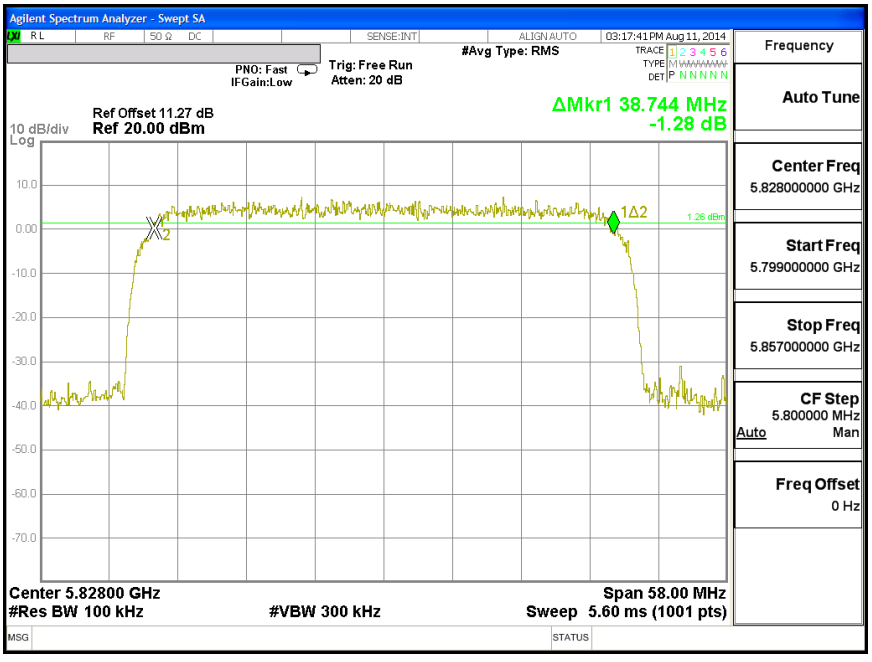
6 dB BANDWIDTH Chain 1 LOW CH



6 dB BANDWIDTH Chain 1 MID CH

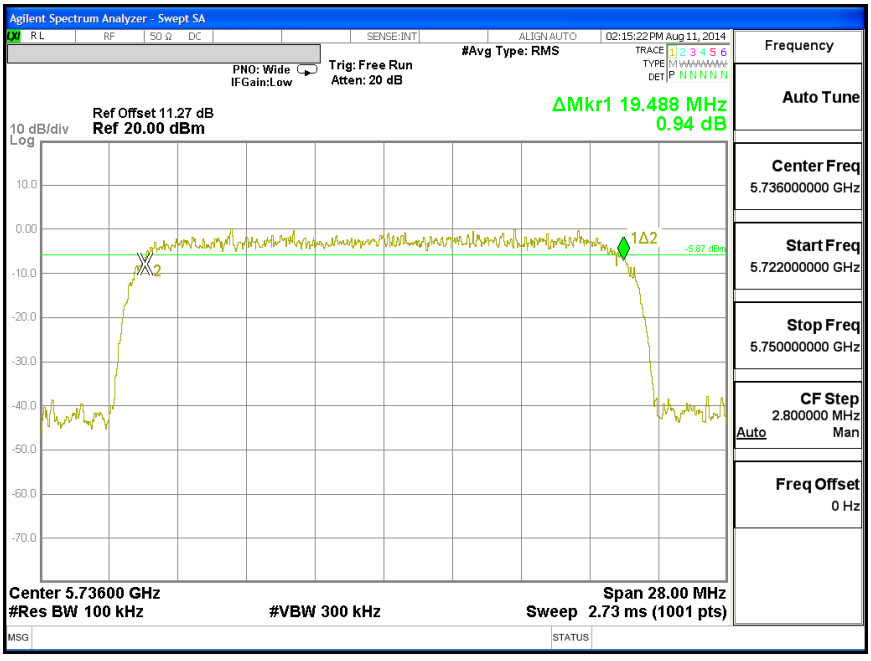


6 dB BANDWIDTH Chain 1 HIGH CH

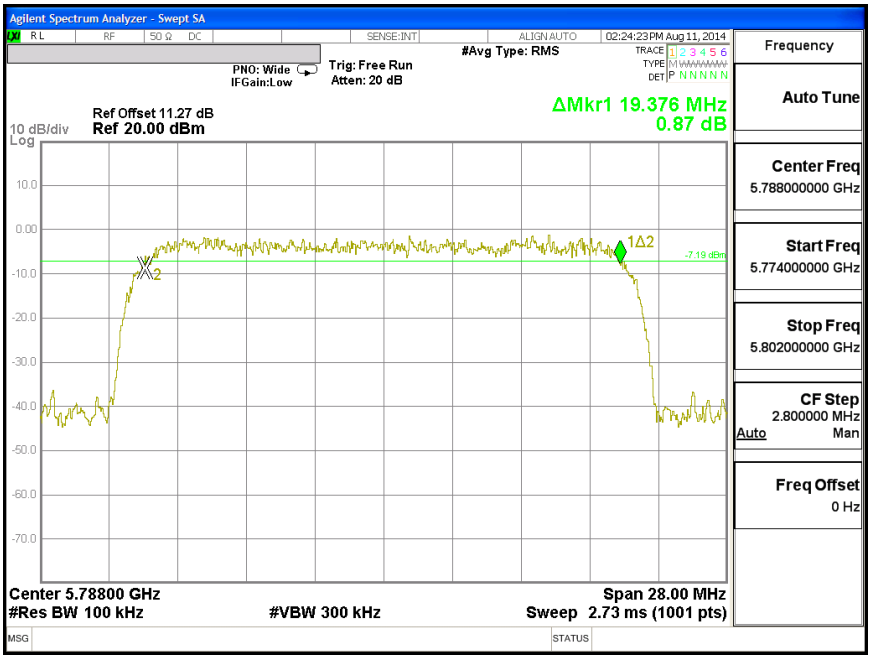


6 dB BANDWIDTH, Chain 0 20MHz setting

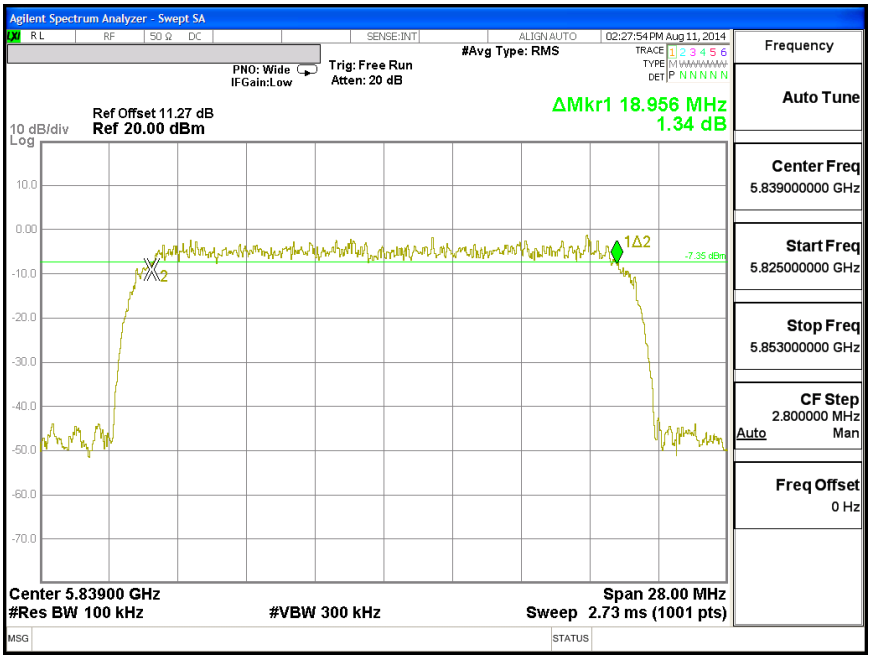
6 dB BANDWIDTH Chain 0 LOW CH



6 dB BANDWIDTH Chain 0 MID CH

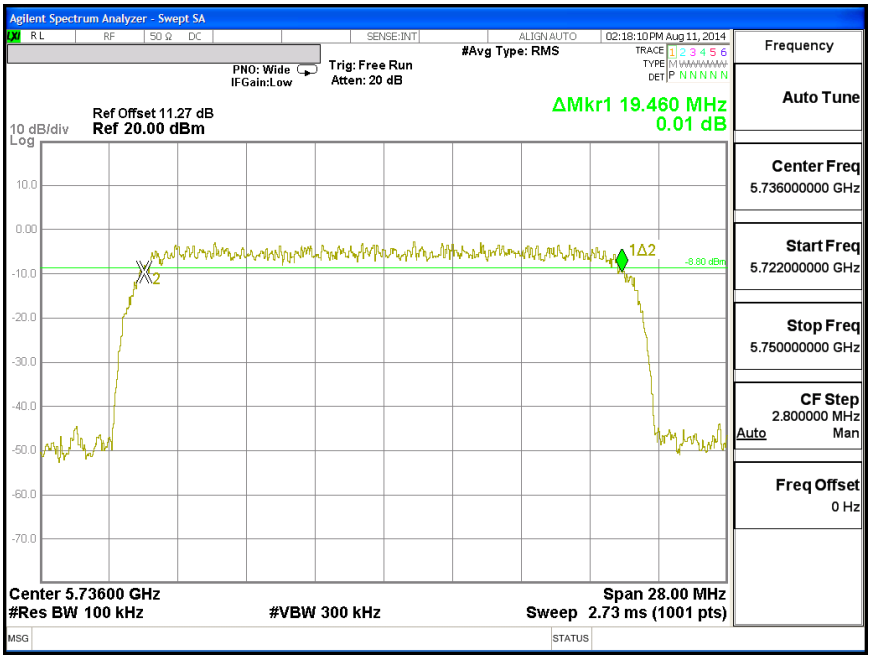


6 dB BANDWIDTH Chain 0 HIGH CH

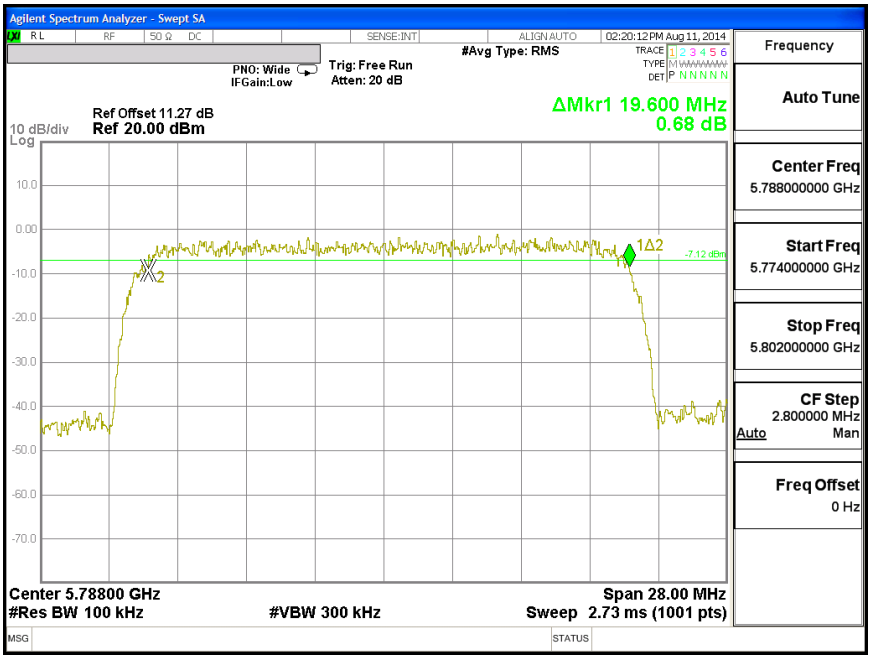


6 dB BANDWIDTH, Chain 1 20MHz setting

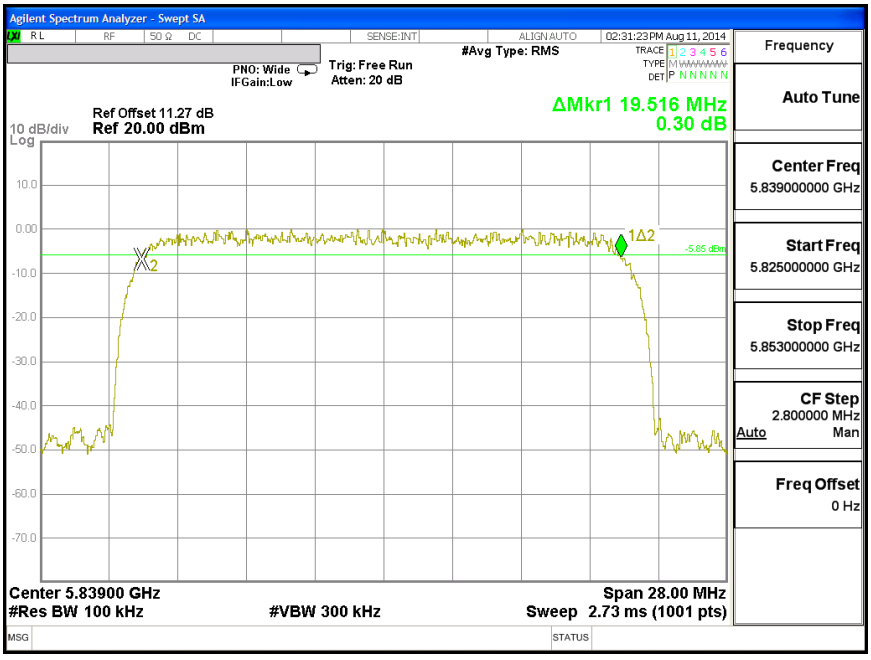
6 dB BANDWIDTH Chain 1 LOW CH



6 dB BANDWIDTH Chain 1 MID CH

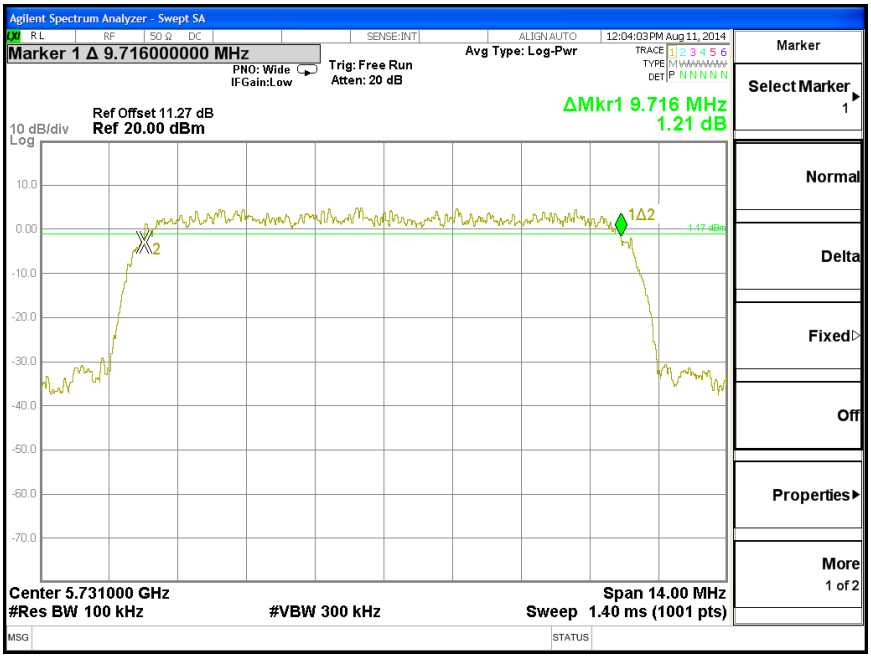


6 dB BANDWIDTH Chain 1 HIGH CH

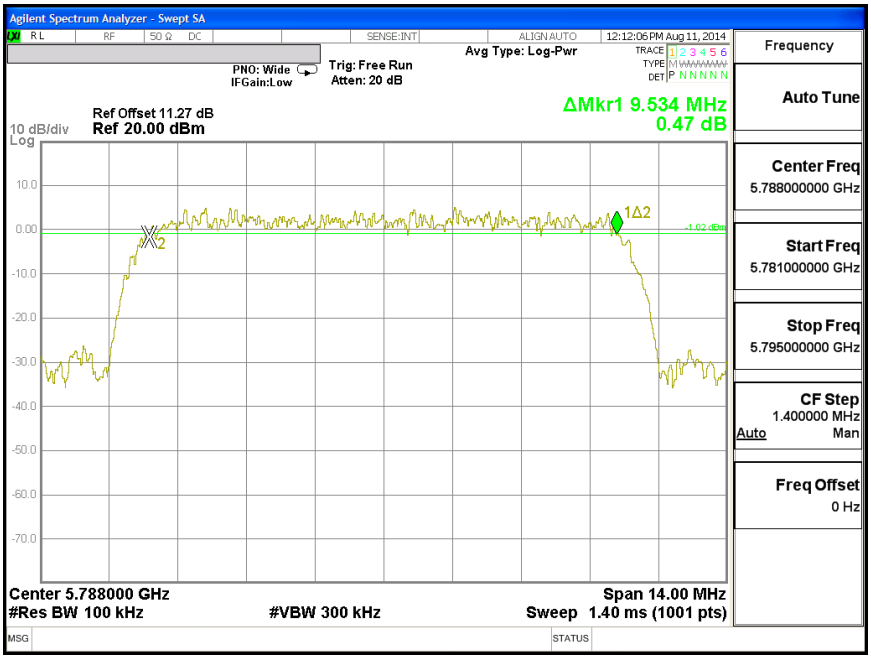


6 dB BANDWIDTH, Chain 0 10MHz setting

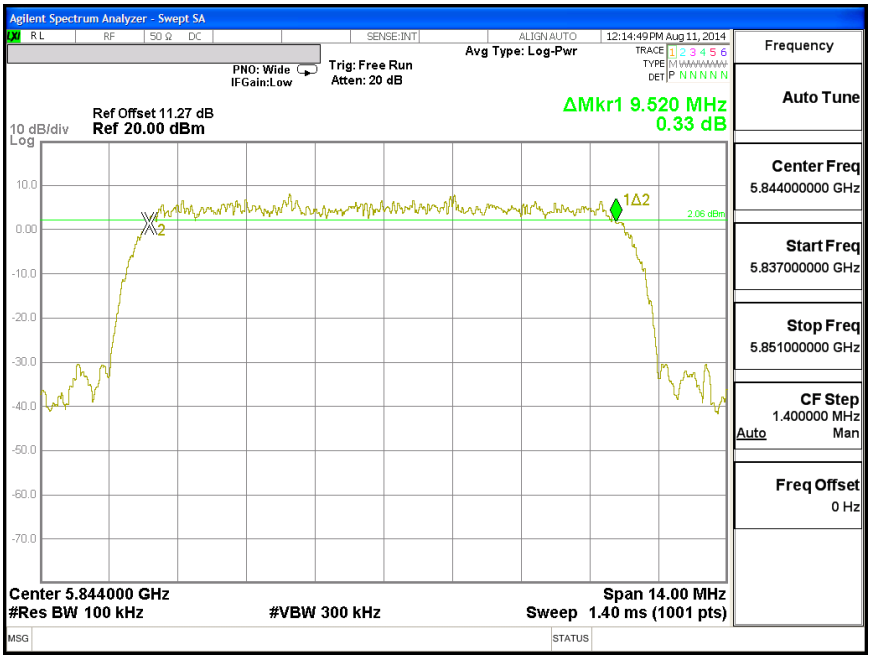
6 dB BANDWIDTH Chain 0 LOW CH



6 dB BANDWIDTH Chain 0 MID CH

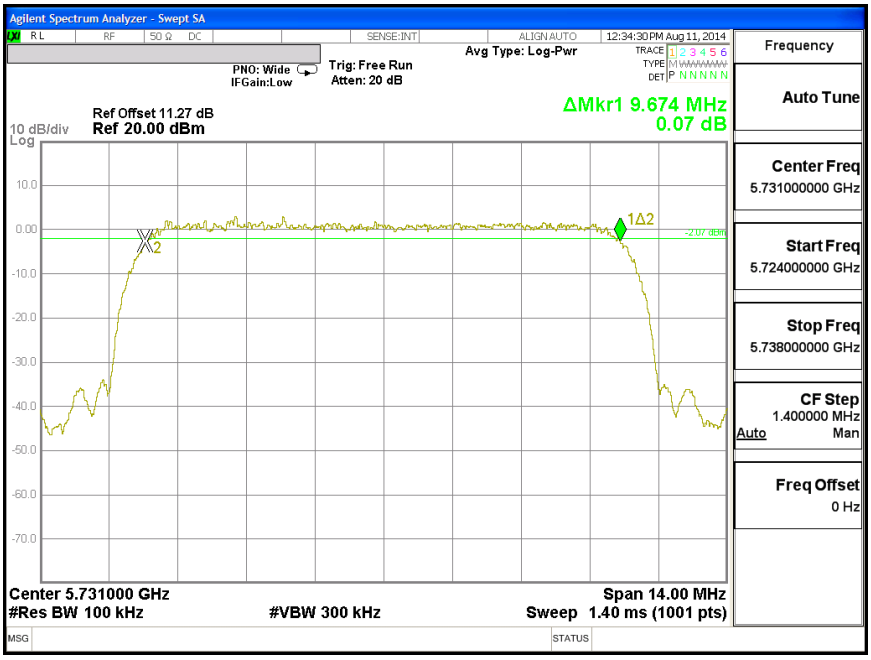


6 dB BANDWIDTH Chain 0 HIGH CH

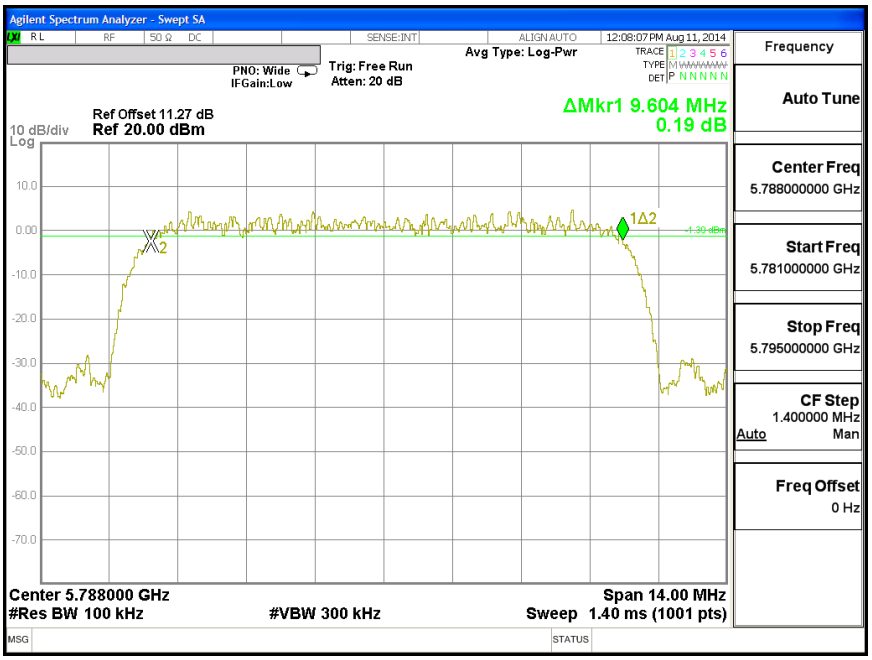


6 dB BANDWIDTH, Chain 1 10MHz setting

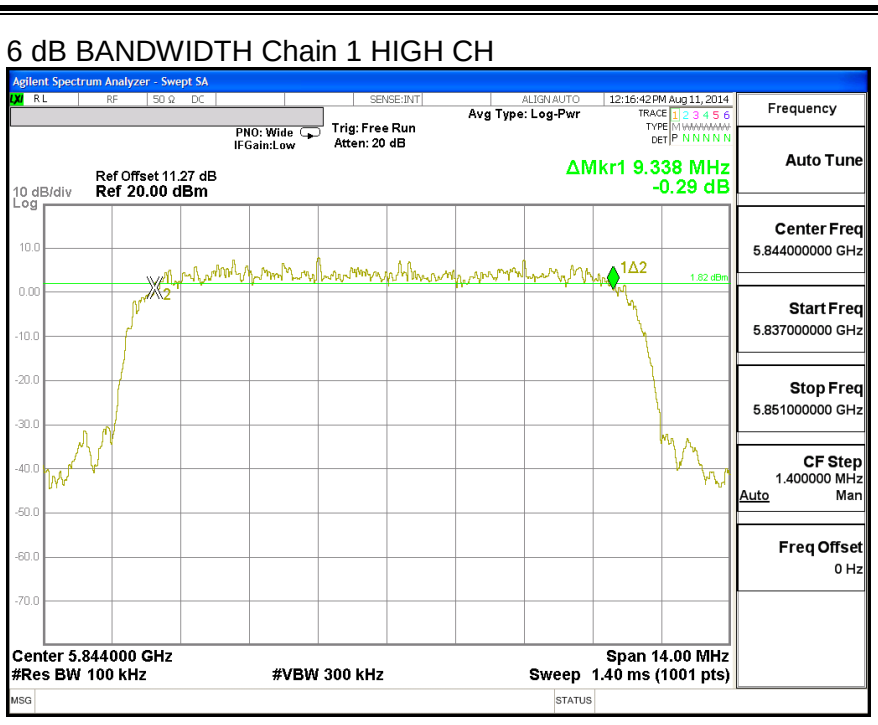
6 dB BANDWIDTH Chain 1 LOW CH



6 dB BANDWIDTH Chain 1 MID CH



6 dB BANDWIDTH Chain 1 HIGH CH



8.2. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 11.33 dB (including 10 dB pad and 1.33 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Sample calculation for total power 40MHz: 10*LOG (10^ (C4/10) +10^ (D4/10))

Where C4= Chain 0(22.18dBm) measured power and D4= Chain 1(21.41dBm)

RESULTS 40MHz

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low	5747	23.18	21.64	25.49
Mid	5788	23.54	23.40	26.48
High	5828	22.74	22.01	25.40

Note: Chain 0=J48 Chain1=J49 40MHz bandwidth QAM4

RESULTS 20MHz

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low	5736	23.02	23.28	26.16
Mid	5788	22.89	22.78	25.85
High	5839	22.81	22.48	25.66

Note: Chain 0=J48 Chain1=J49 20MHz bandwidth QAM4

RESULTS 10MHz

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low	5731	21.24	21.08	24.17
Mid	5788	21.12	20.14	23.67
High	5844	20.61	20.64	23.64

Note: Chain 0=J48 Chain1=J49 10MHz bandwidth QAM4

8.3. OUTPUT POWER

LIMITS

FCC §15.247

IC RSS-210 A8.4

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt, based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 5725-5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

For Point to Point applications in the 5.8 GHz DTS band, the limit of the output peak power shall be the same as specified without any reduction due to antenna gain being higher than 6 dBi.

DIRECTIONAL ANTENNA GAIN

The TX chains are uncorrelated and the antenna gain is the same for each chain. The directional gain is equal to the antenna gain.

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
10.50	10.50	10.50

Sample calculation for total corrected power 40MHz: 10*LOG (10^ (C15/10) +10^ (D15/10))
C15= Chain 0(24.62) measured power and D15= Chain 1(24.07) measured power

Sample calculation for Max power: 36-10.5 = 25.50dBm

Max power = EIRP (36) – Antenna gain (10.5)

RESULTS 40MHz

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low	5747	10.50	30.00	30	36	30.00
Mid	5788	10.50	30.00	30	36	30.00
High	5828	10.50	30.00	30	36	30.00

Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low	5747	23.945	24.157	27.06	30.00	-2.94
Mid	5788	24.309	24.150	27.24	30.00	-2.76
High	5828	23.644	22.941	26.32	30.00	-3.68

RESULTS 20MHz

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low	5736	10.50	25.50	30	36	30.00
Mid	5788	10.50	25.50	30	36	30.00
High	5839	10.50	25.50	30	36	30.00

Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low	5736	23.981	23.904	26.95	30.00	-3.05
Mid	5788	23.579	23.482	26.54	30.00	-3.46
High	5839	23.600	23.269	26.45	30.00	-3.55

RESULTS 10MHz

Limits

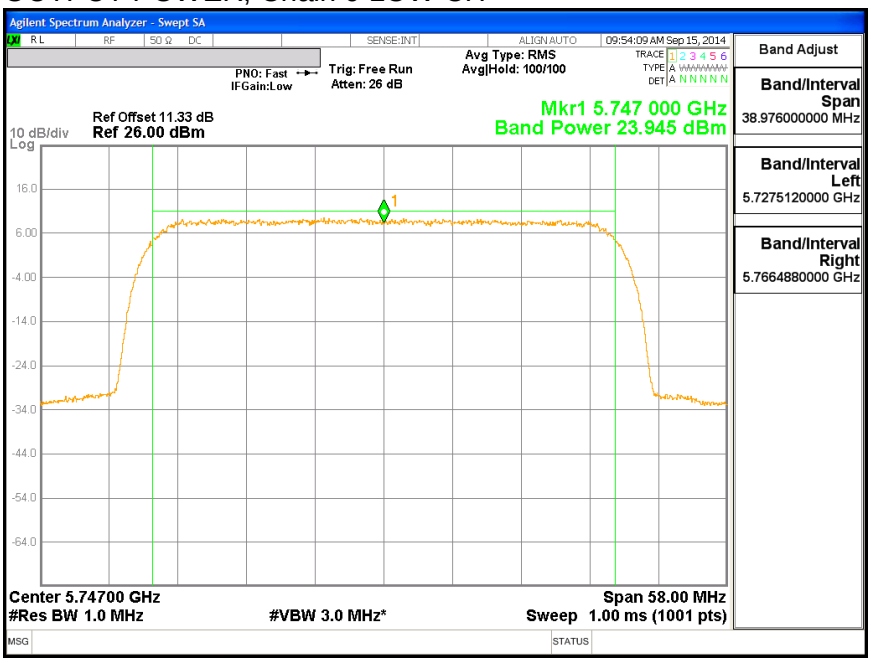
Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low	5731	10.50	25.50	30	36	30.00
Mid	5788	10.50	25.50	30	36	30.00
High	5844	10.50	25.50	30	36	30.00

Results

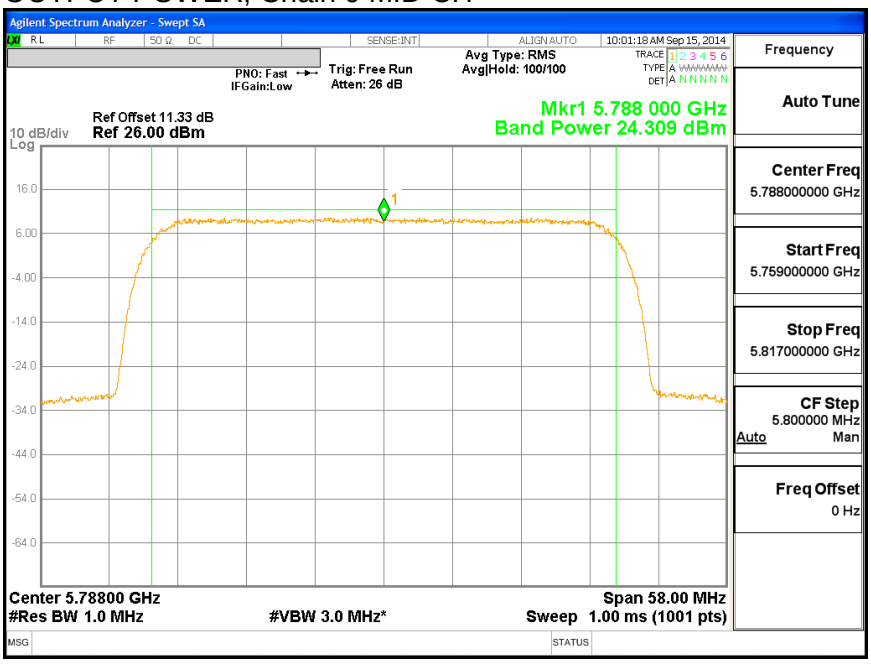
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low	5731	22.898	22.678	25.80	30.00	-4.20
Mid	5788	22.339	21.739	25.06	30.00	-4.94
High	5844	21.883	22.096	25.00	30.00	-5.00

OUTPUT POWER, Chain 0 40MHz setting

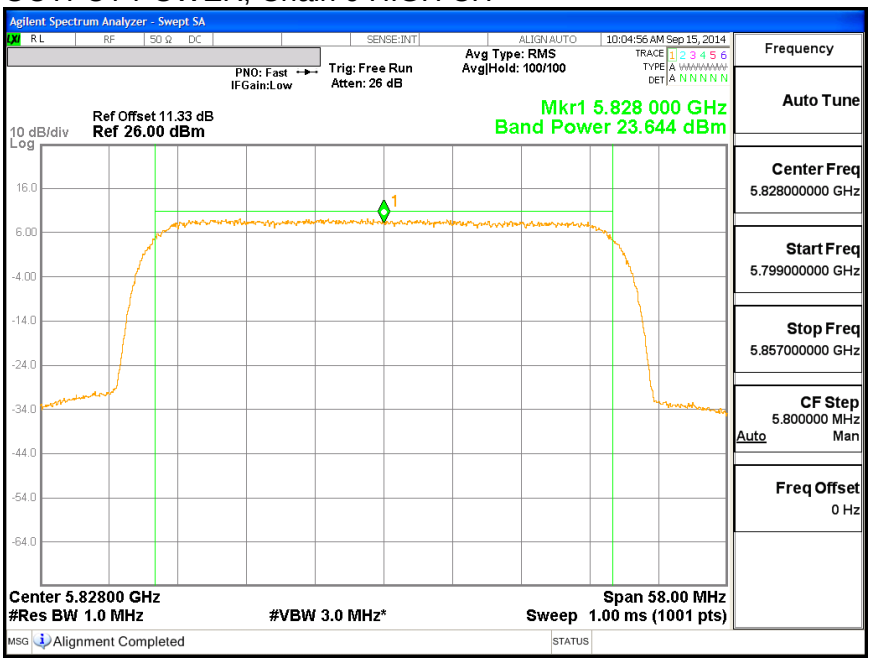
OUTPUT POWER, Chain 0 LOW CH



OUTPUT POWER, Chain 0 MID CH

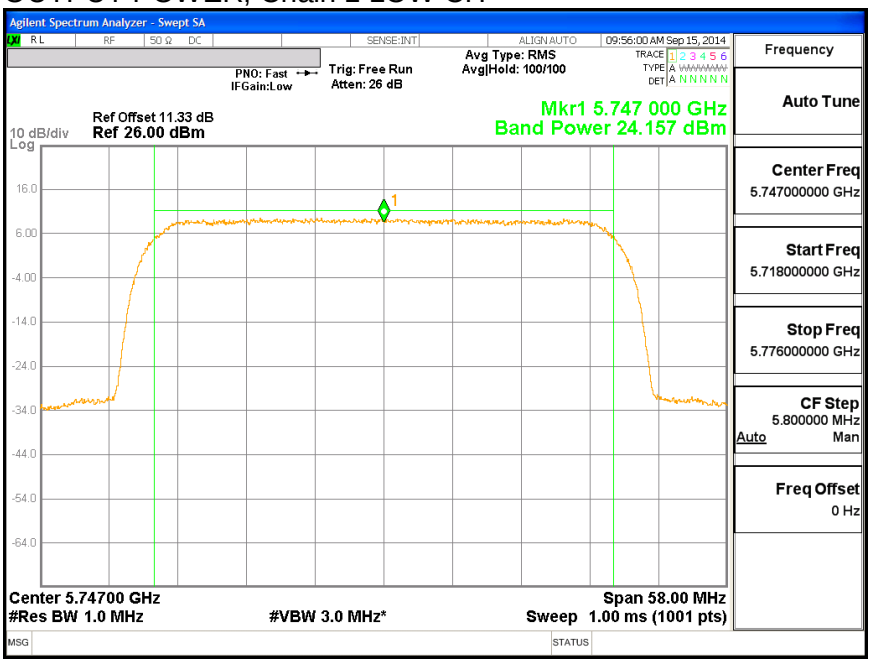


OUTPUT POWER, Chain 0 HIGH CH

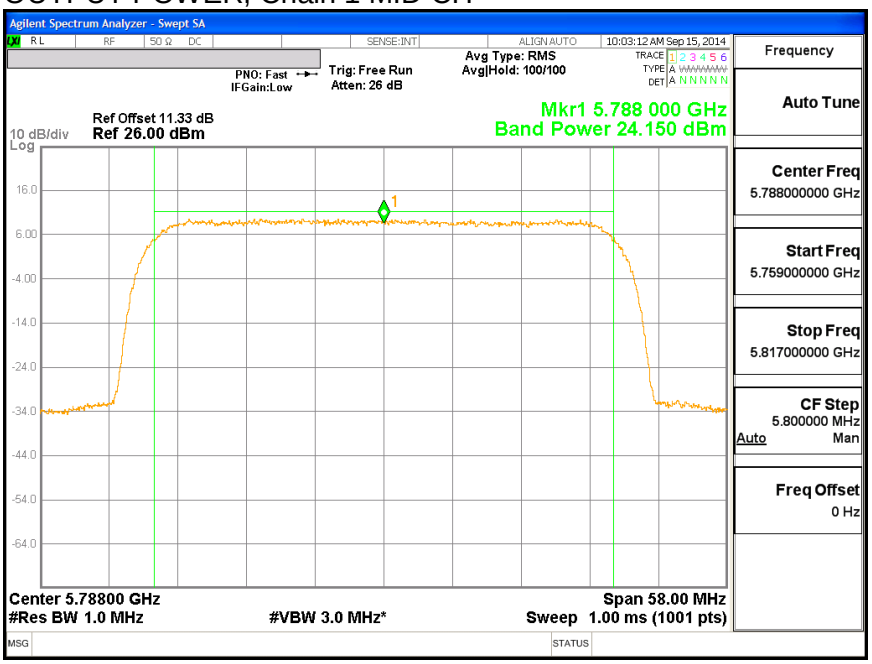


OUTPUT POWER, Chain 1 40MHz setting

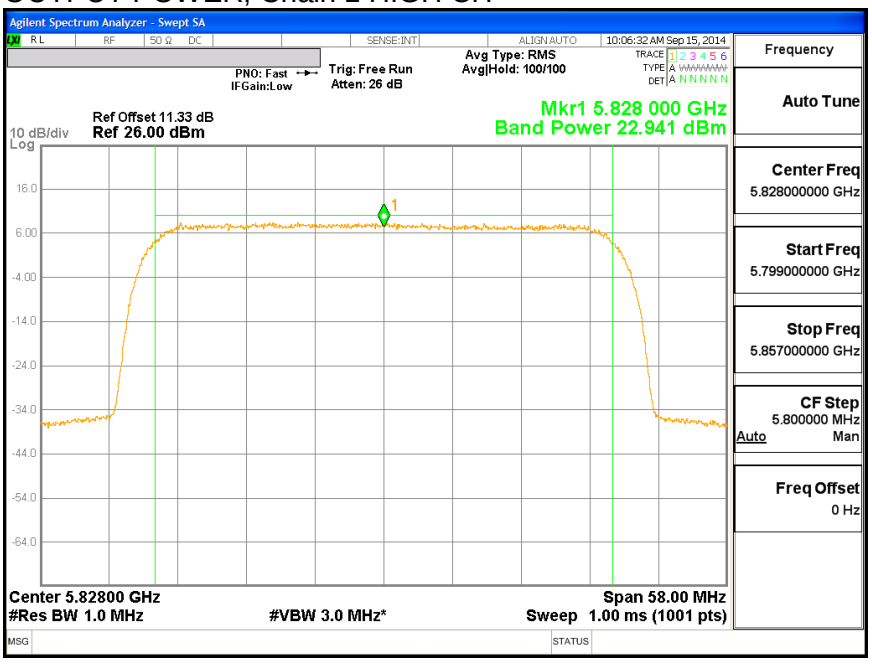
OUTPUT POWER, Chain 1 LOW CH



OUTPUT POWER, Chain 1 MID CH

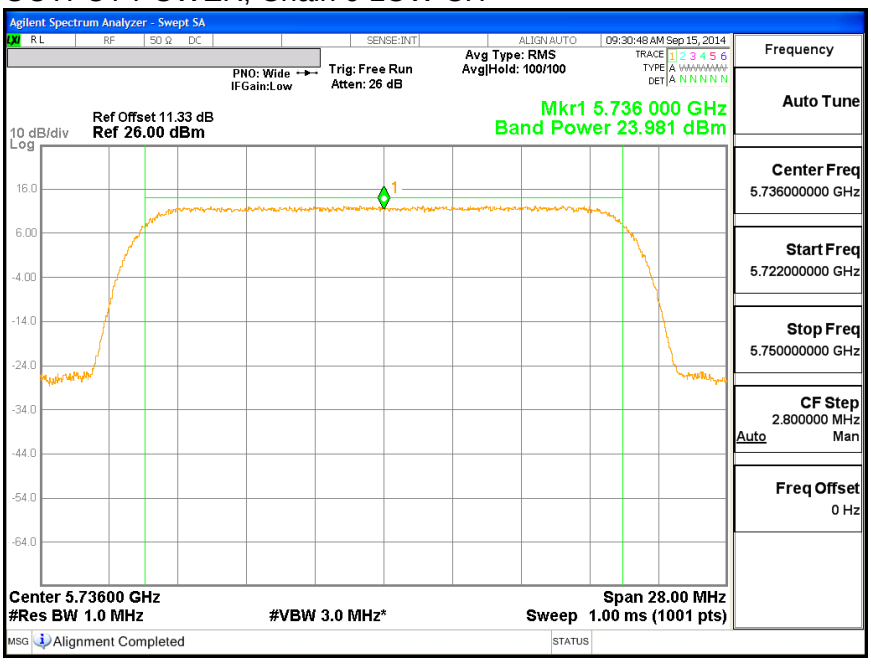


OUTPUT POWER, Chain 1 HIGH CH

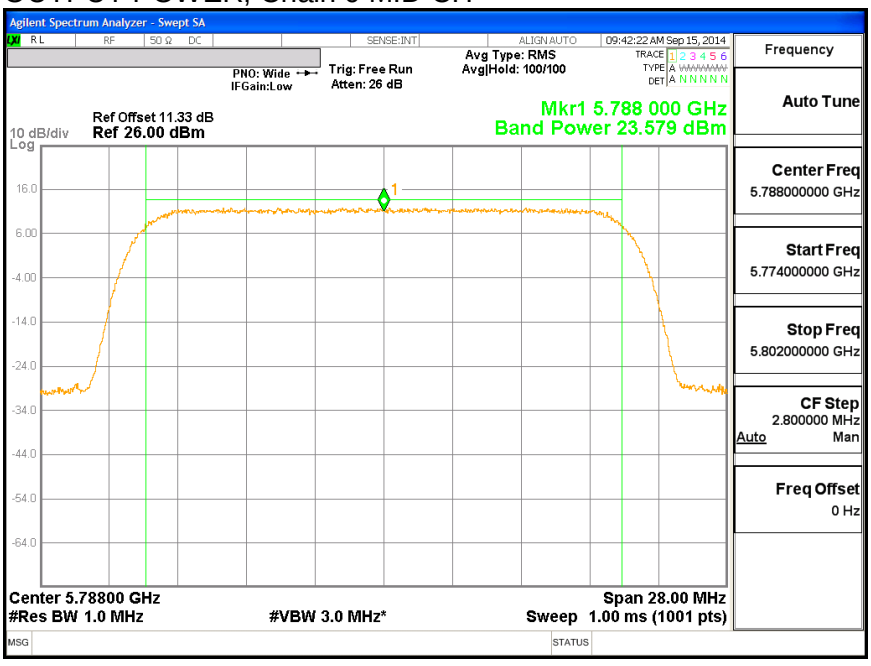


OUTPUT POWER, Chain 0 20MHz setting

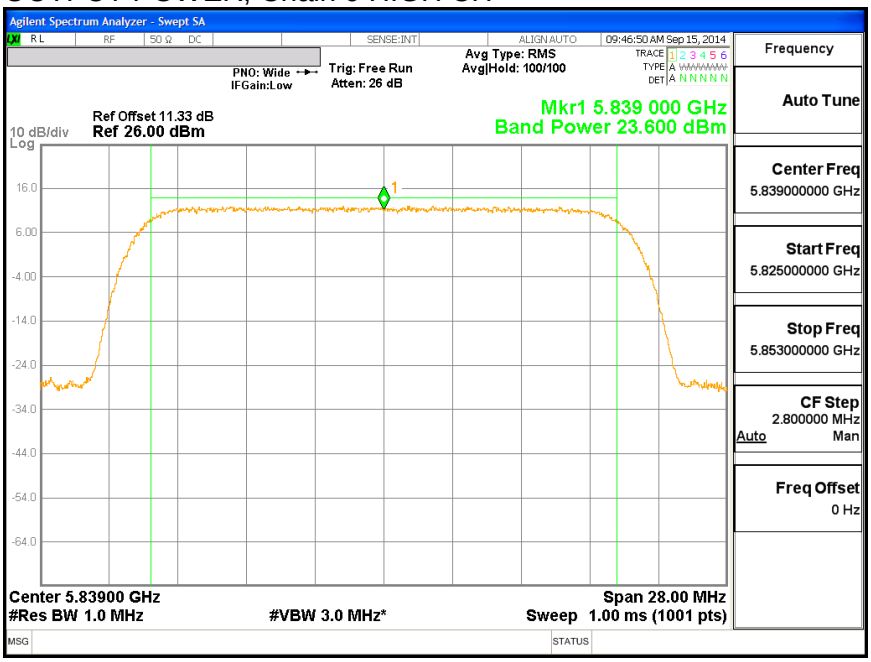
OUTPUT POWER, Chain 0 LOW CH



OUTPUT POWER, Chain 0 MID CH

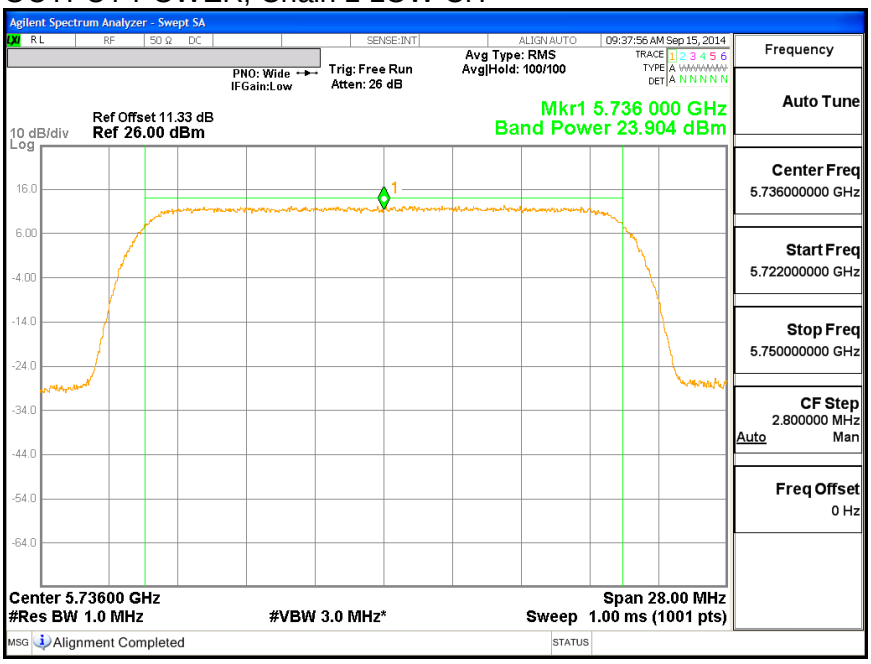


OUTPUT POWER, Chain 0 HIGH CH

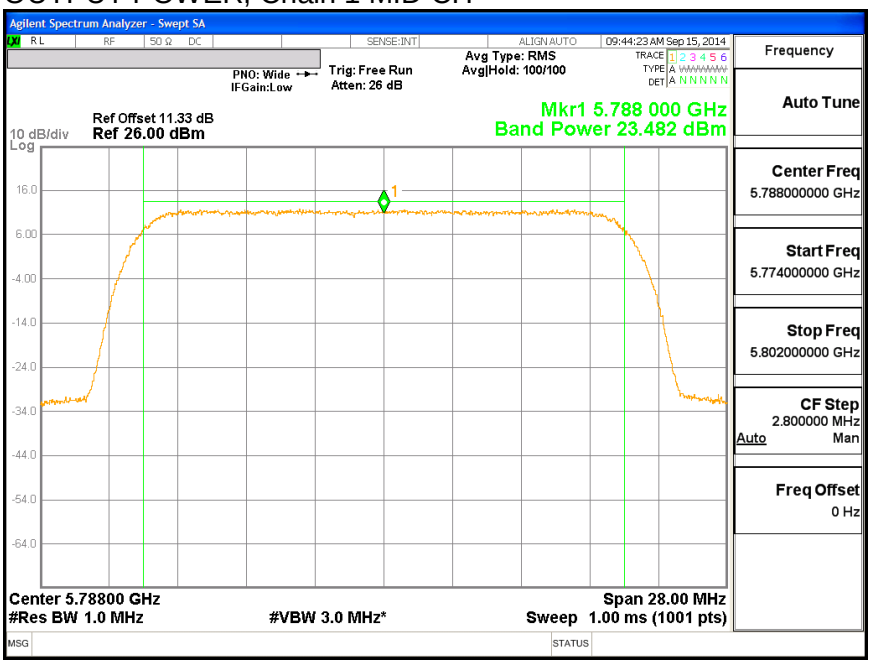


OUTPUT POWER, Chain 1 20MHz setting

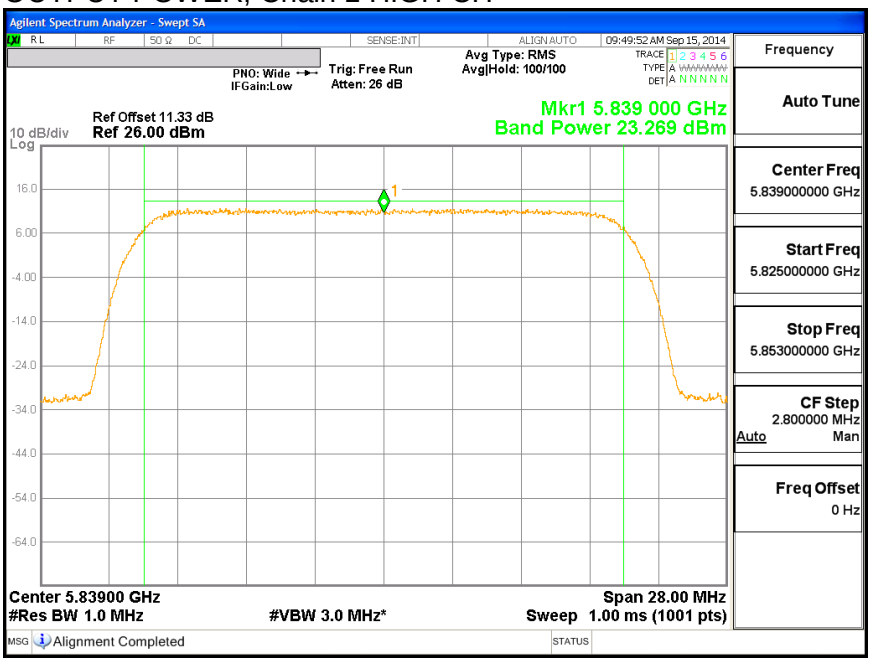
OUTPUT POWER, Chain 1 LOW CH



OUTPUT POWER, Chain 1 MID CH

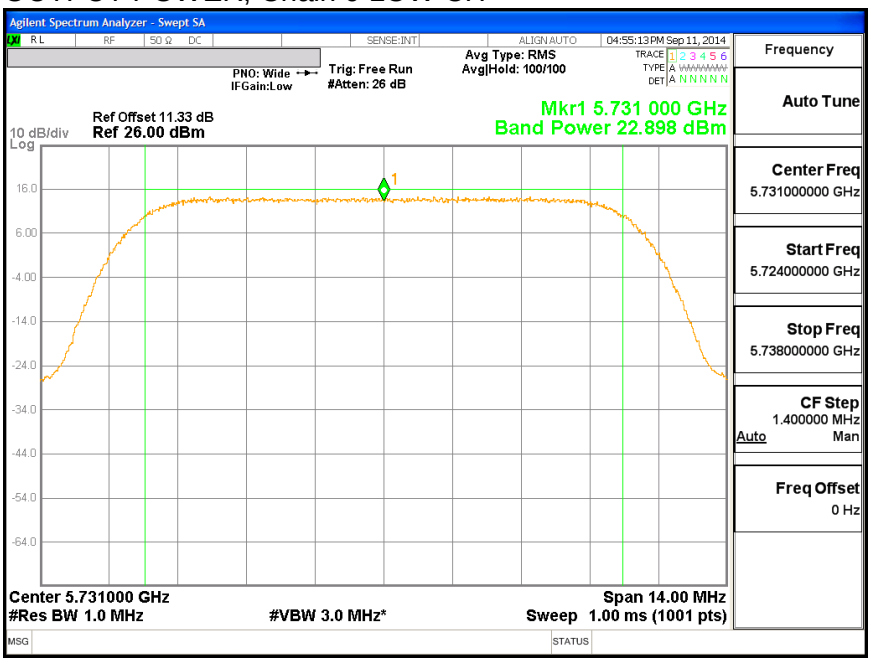


OUTPUT POWER, Chain 1 HIGH CH

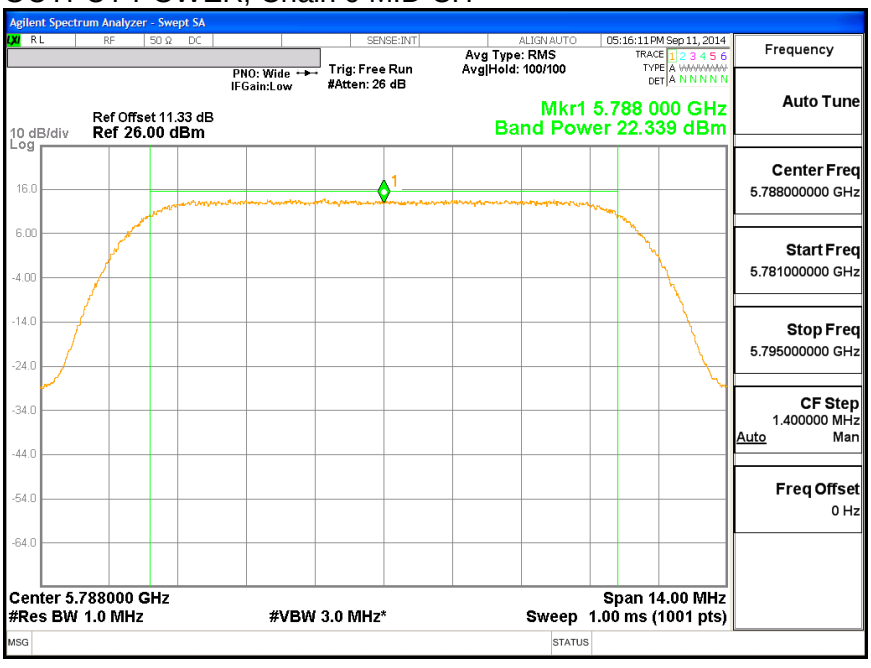


OUTPUT POWER, Chain 0 10MHz setting

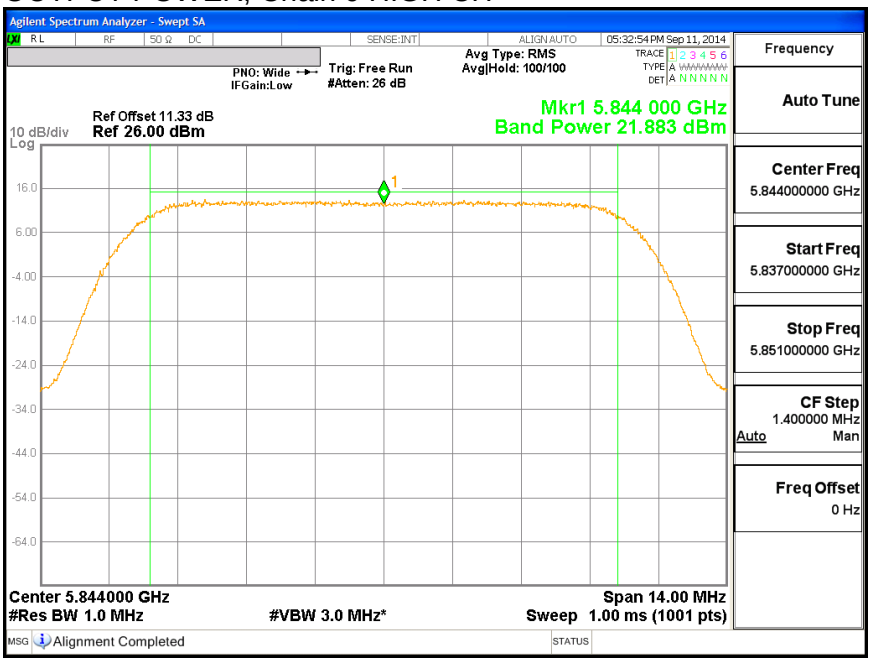
OUTPUT POWER, Chain 0 LOW CH



OUTPUT POWER, Chain 0 MID CH

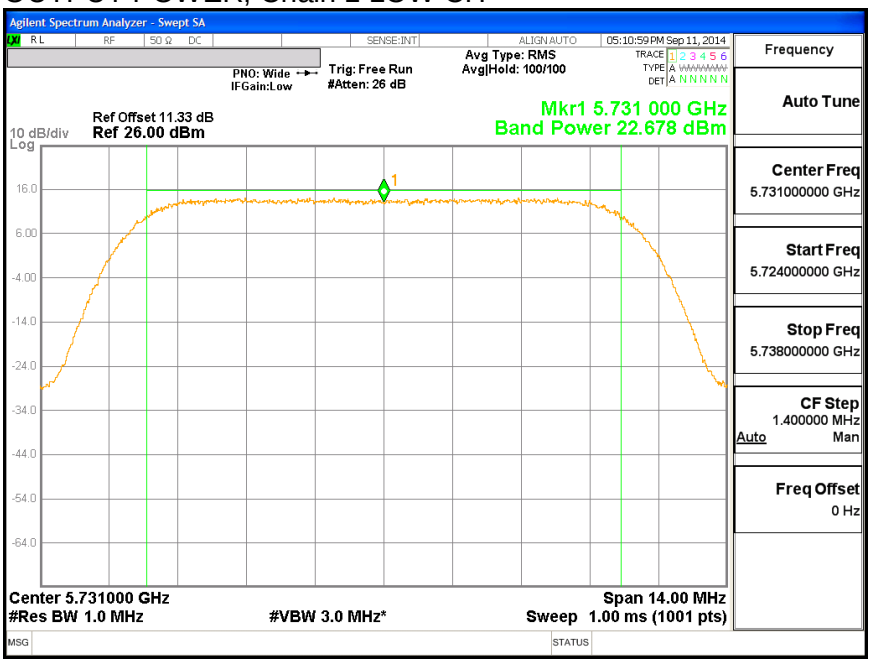


OUTPUT POWER, Chain 0 HIGH CH

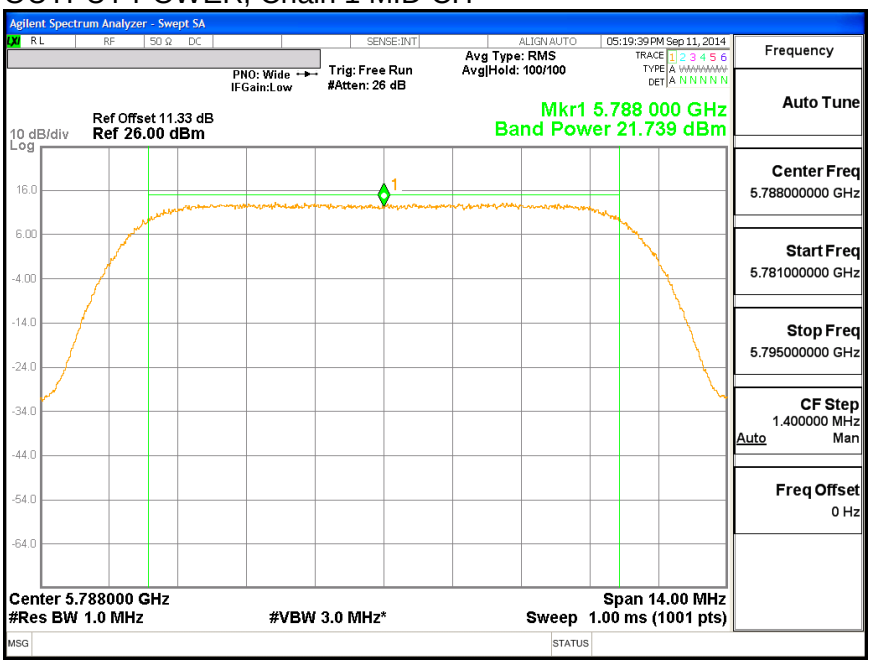


OUTPUT POWER, Chain 1 10MHz setting

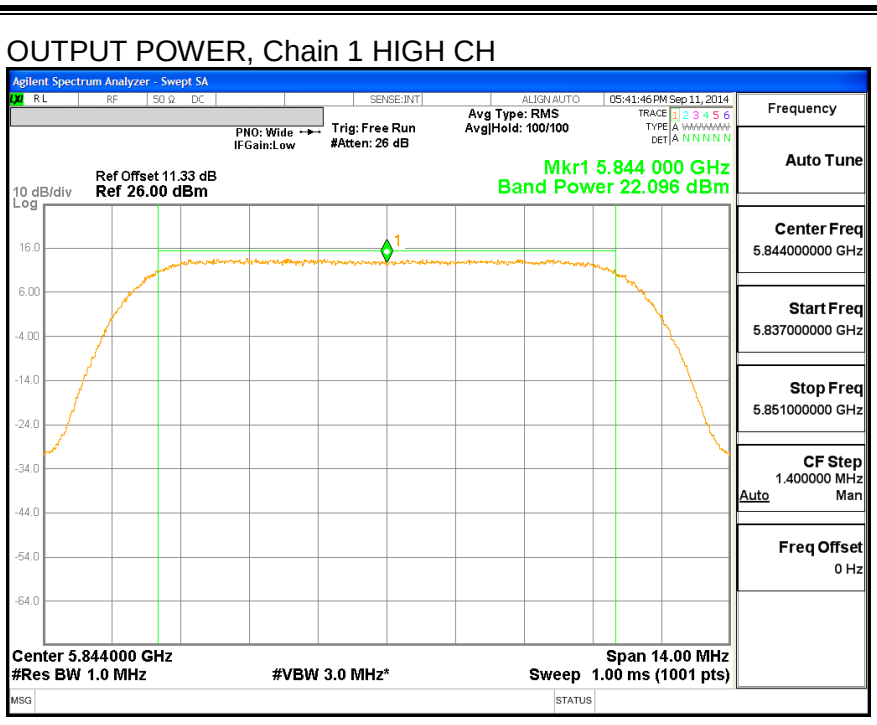
OUTPUT POWER, Chain 1 LOW CH



OUTPUT POWER, Chain 1 MID CH



OUTPUT POWER, Chain 1 HIGH CH



8.4. OUT-OF-BAND EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

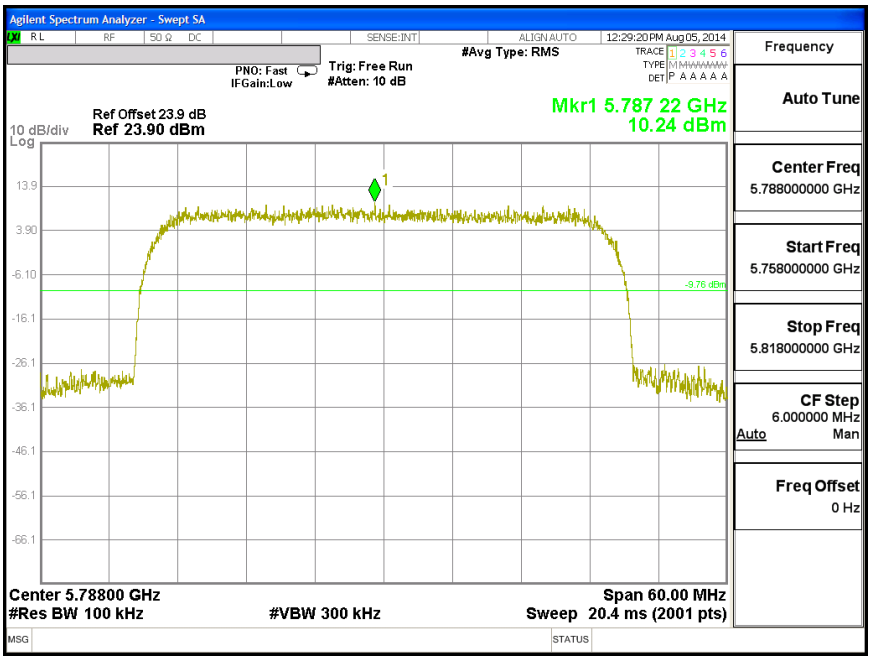
TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer with RBW = 100 kHz, VBW = 300 kHz, peak detector, and max hold. Measurements utilizing these settings are made of the in-band reference level, bandedge (where measurements to the general radiated limits will not be made) and out-of-band emissions.

RESULTS 40MHz

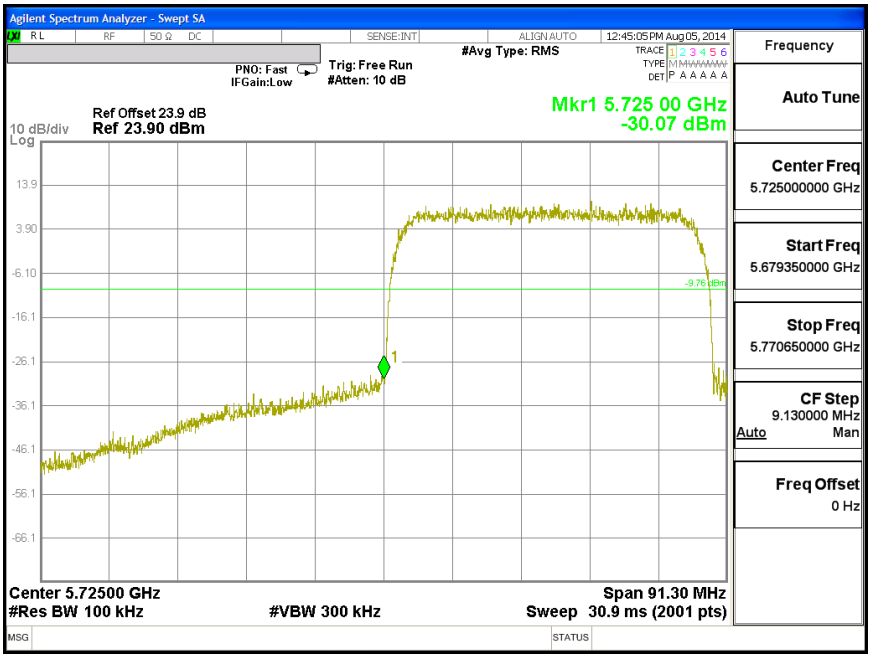
IN-BAND REFERENCE LEVEL, Chain 0

REFERENCE LEVEL Chain 0 MID CH



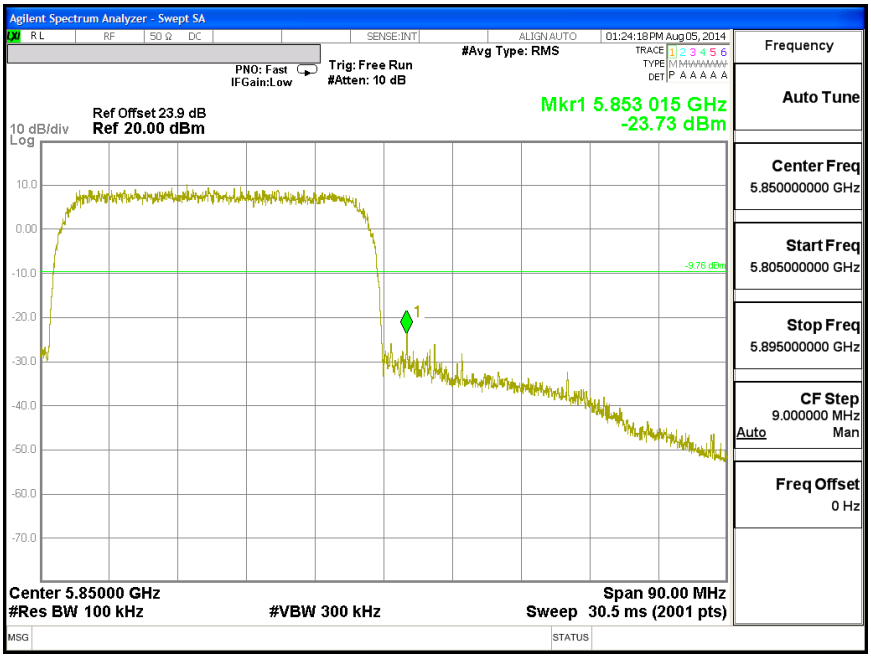
LOW CHANNEL BANDEDGE, Chain 0

AUTHORIZED BAND EDGE Chain 0 LOW CH



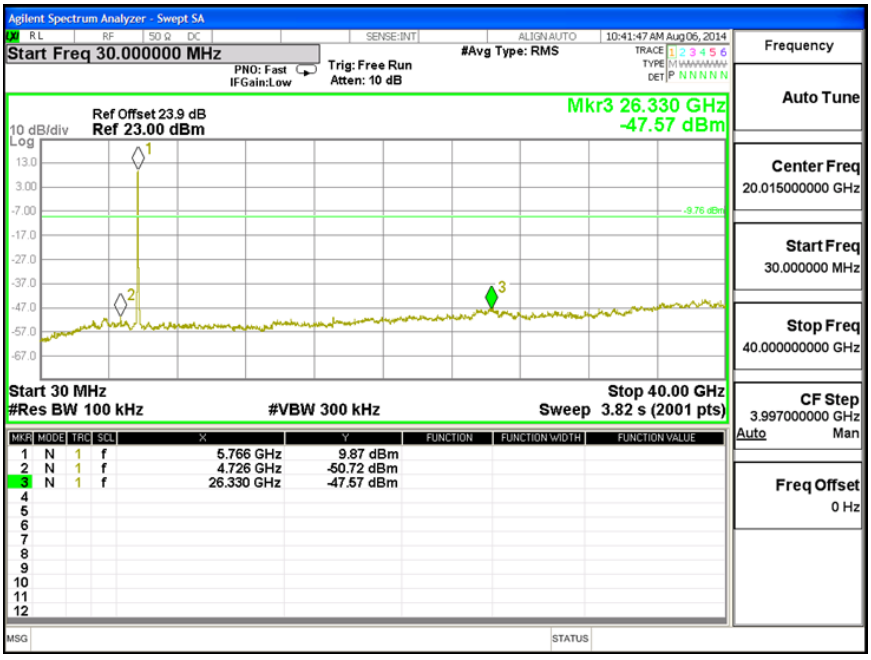
HIGH CHANNEL BANDEDGE, Chain 0

AUTHORIZED BAND EDGE Chain 0 HIGH CH

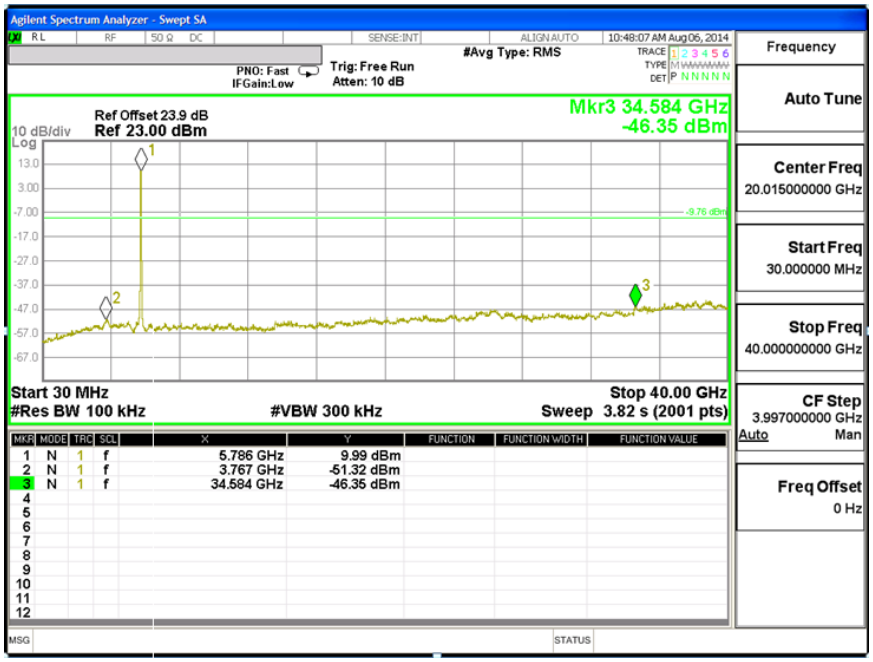


OUT-OF-BAND EMISSIONS, Chain 0

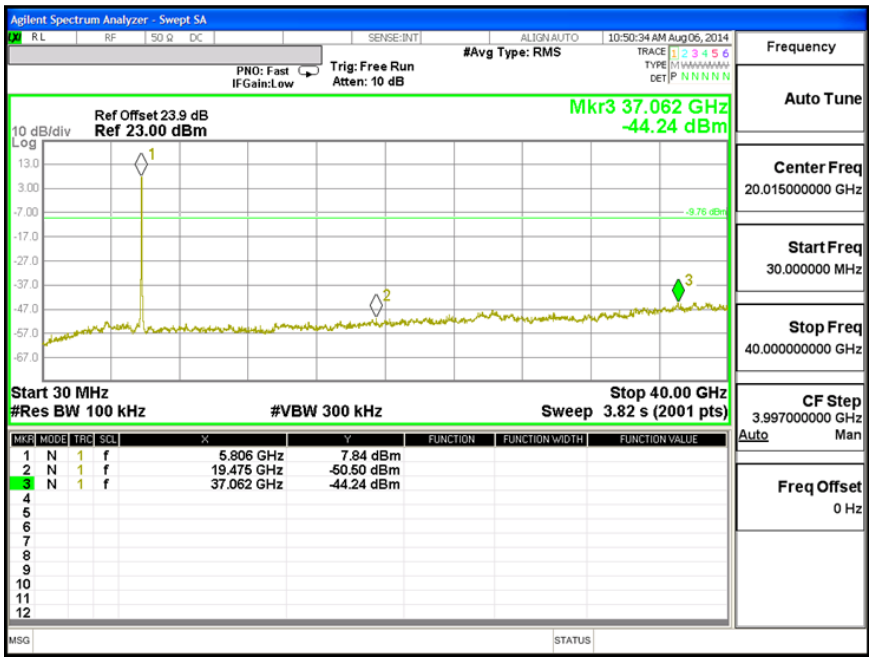
OUT OF BAND Chain 0 LOW CH



OUT OF BAND Chain 0 MID CH



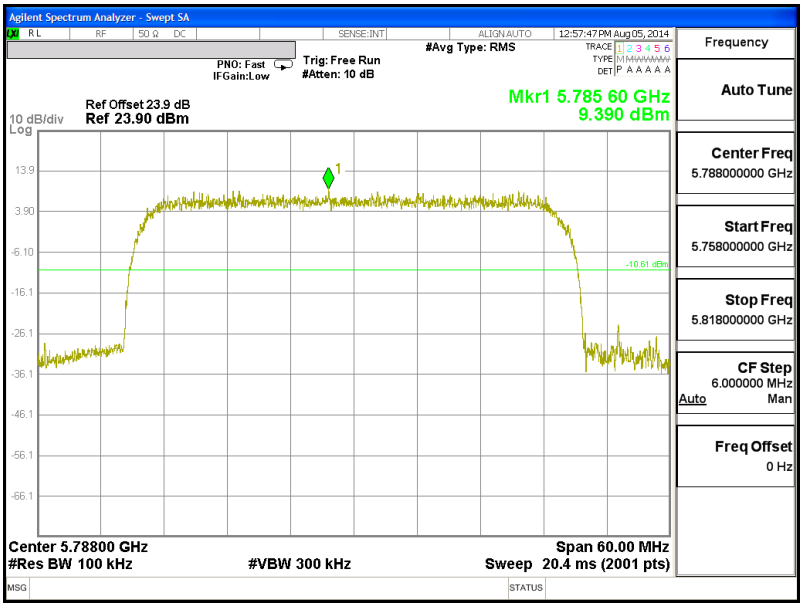
OUT OF BAND Chain 0 HIGH CH



RESULTS 40MHz

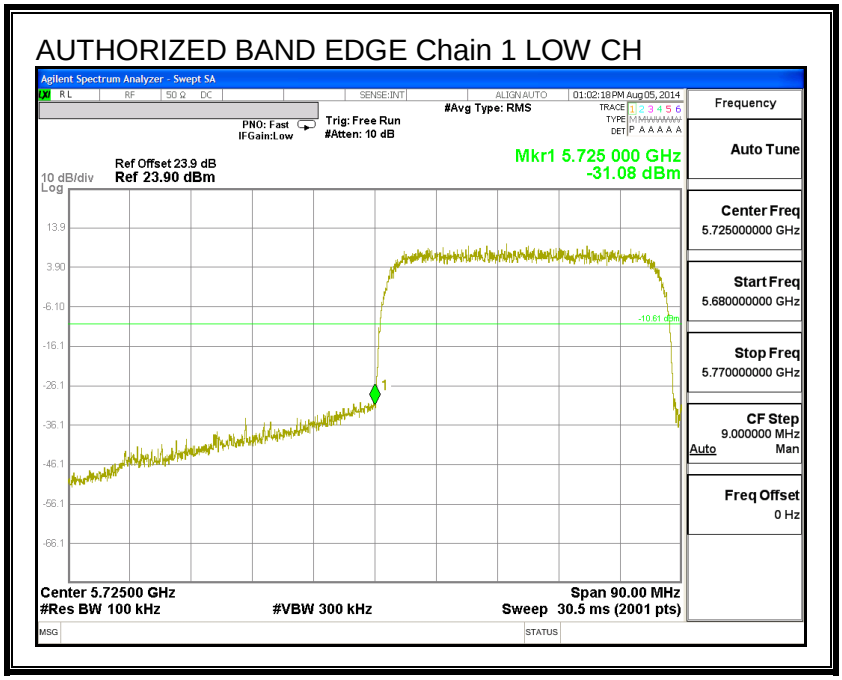
IN-BAND REFERENCE LEVEL, Chain 1

REFERENCE LEVEL Chain 1 MID CH



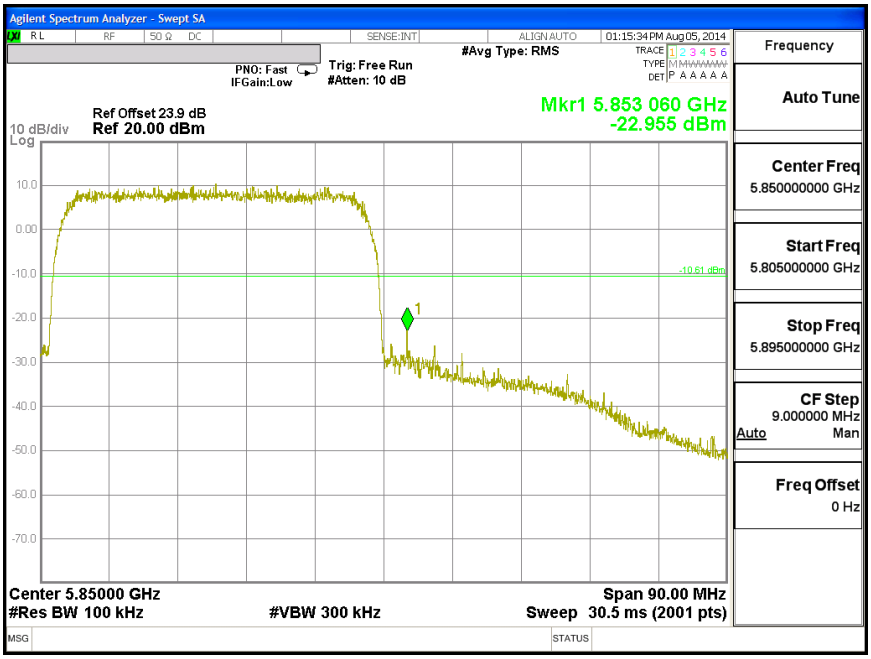
LOW CHANNEL BANDEDGE, Chain 1

AUTHORIZED BAND EDGE Chain 1 LOW CH



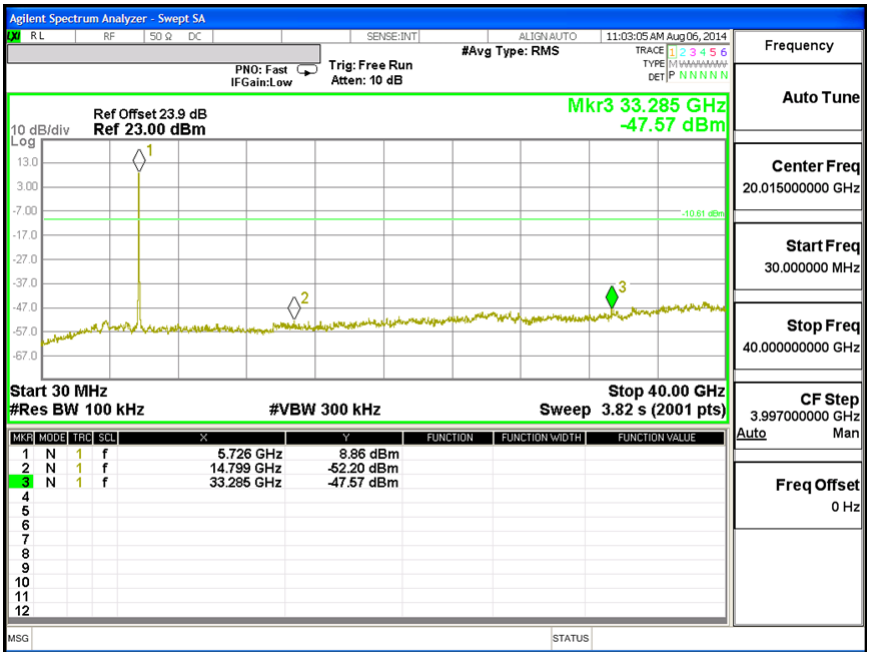
HIGH CHANNEL BANDEDGE, Chain 1

AUTHORIZED BAND EDGE Chain 1 HIGH CH

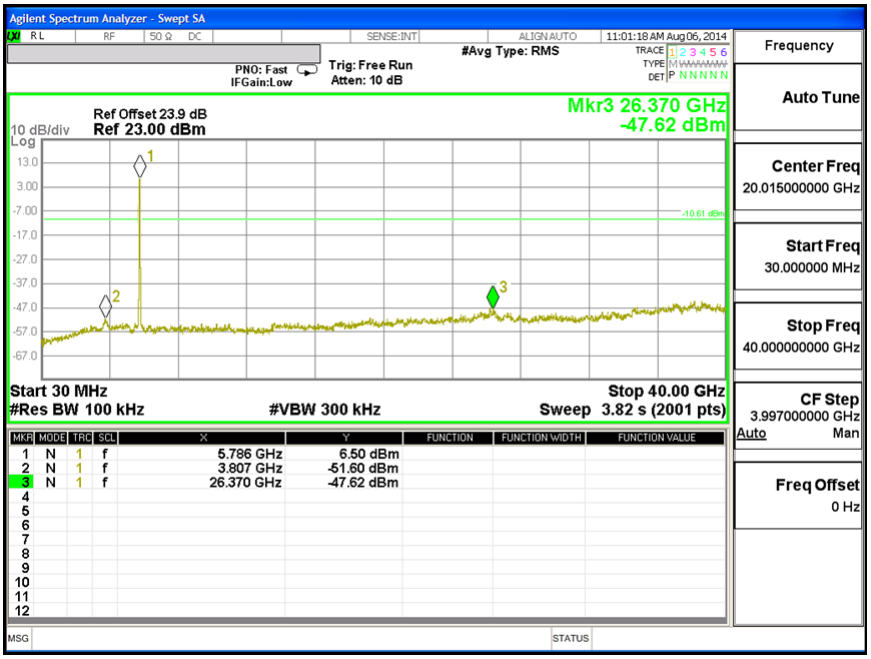


OUT-OF-BAND EMISSIONS, Chain 1

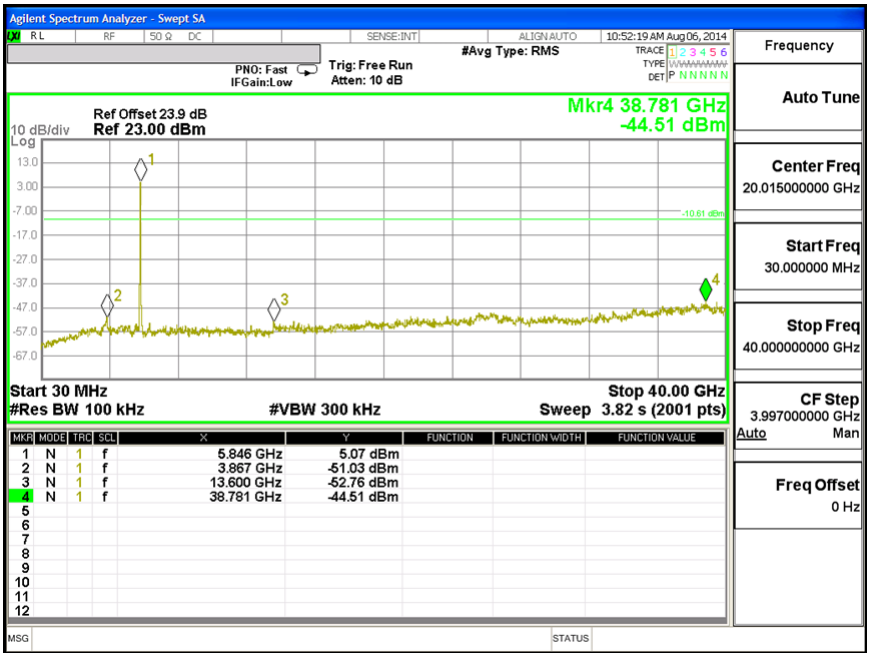
OUT OF BAND Chain 1 LOW CH



OUT OF BAND Chain 1 MID CH



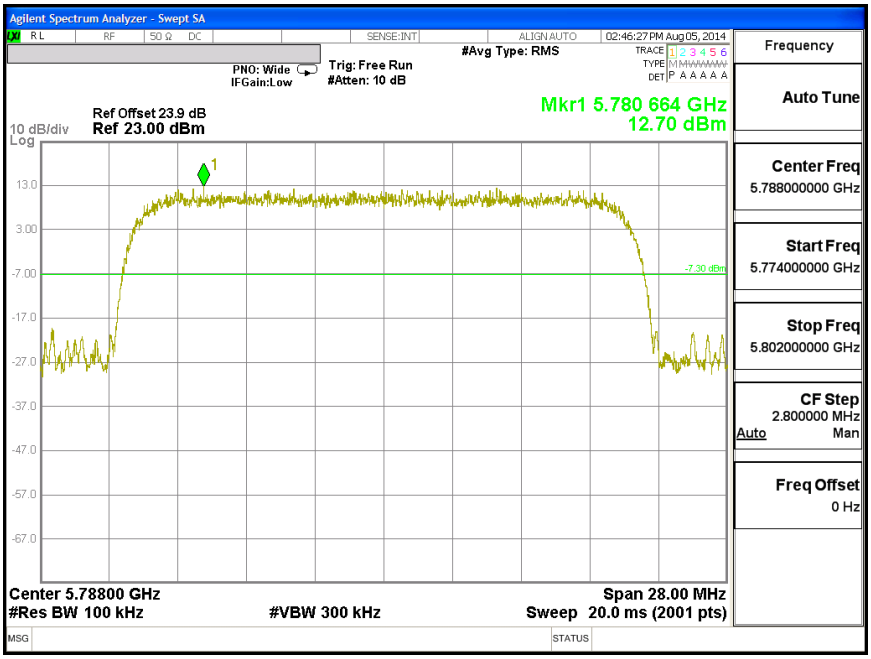
OUT OF BAND Chain 1 HIGH CH



RESULTS 20MHz

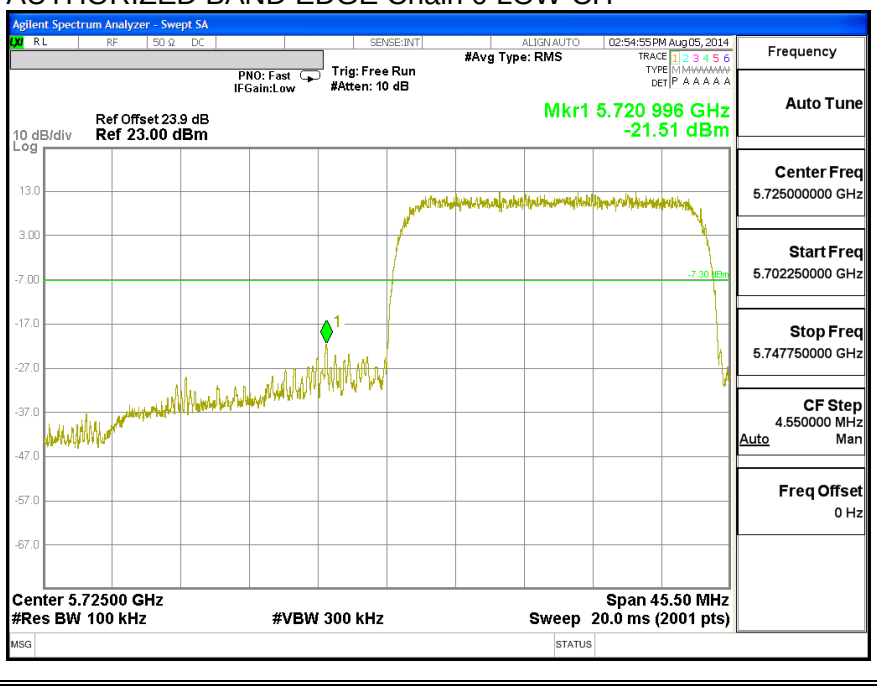
IN-BAND REFERENCE LEVEL, Chain 0

REFERENCE LEVEL Chain 0 MID CH



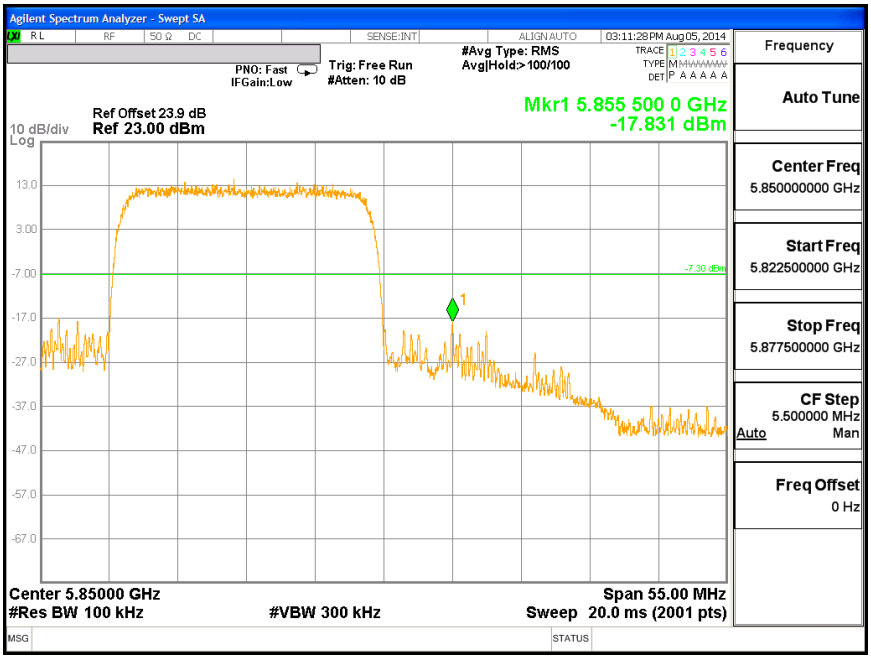
LOW CHANNEL BANDEDGE, Chain 0

AUTHORIZED BAND EDGE Chain 0 LOW CH



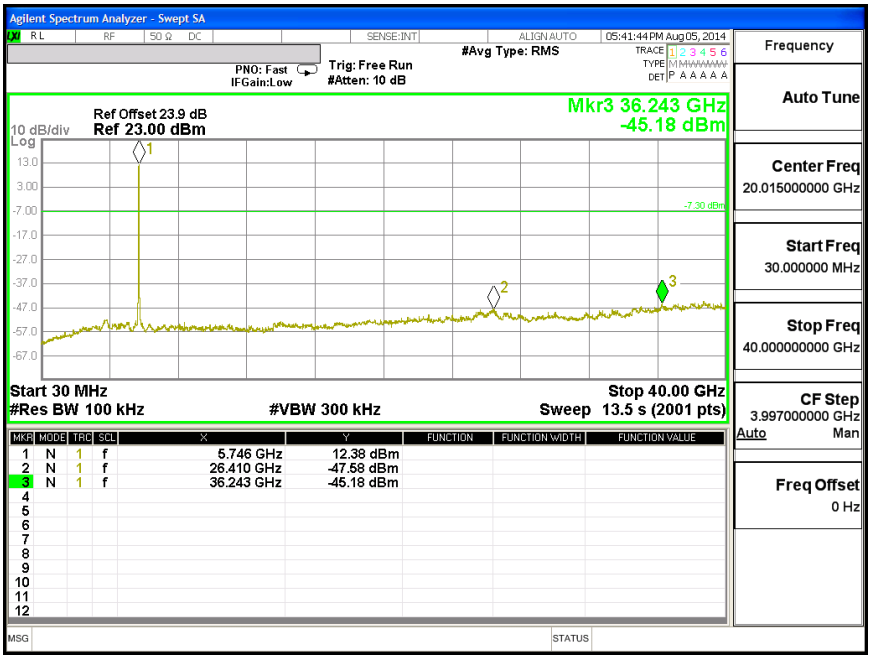
HIGH CHANNEL BANDEDGE, Chain 0

AUTHORIZED BAND EDGE Chain 0 HIGH CH

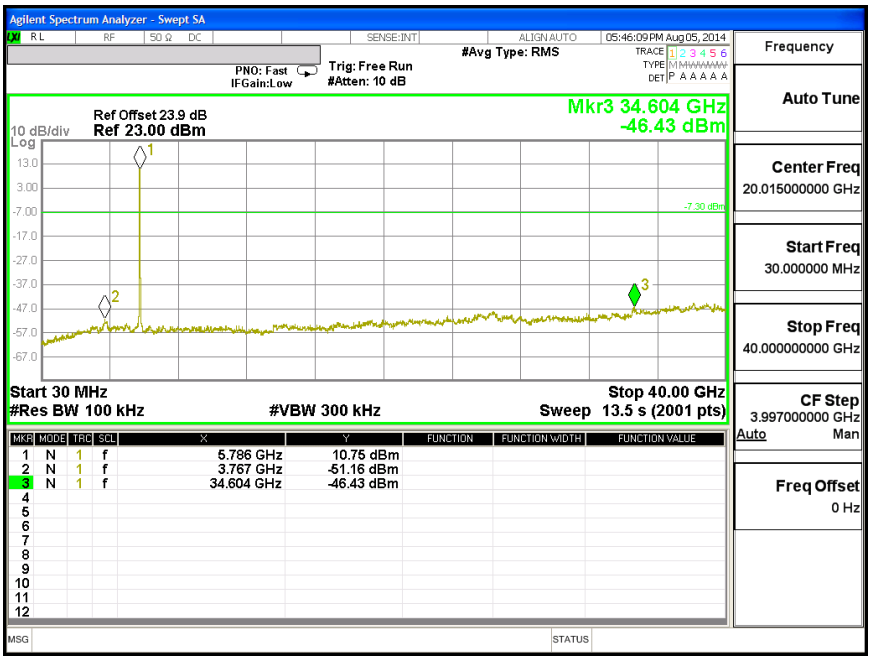


OUT-OF-BAND EMISSIONS, Chain 0

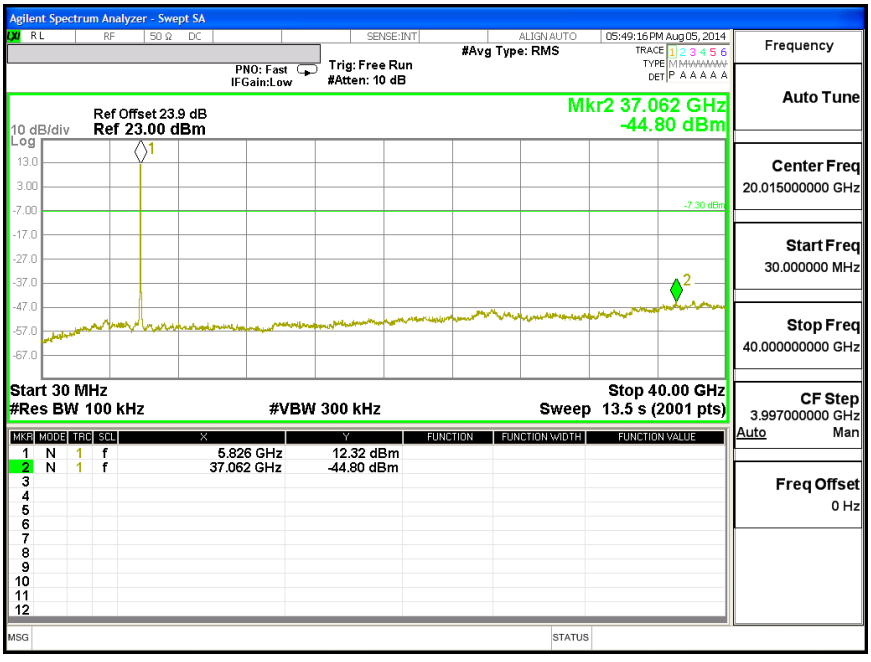
OUT OF BAND Chain 0 LOW CH



OUT OF BAND Chain 0 MID CH



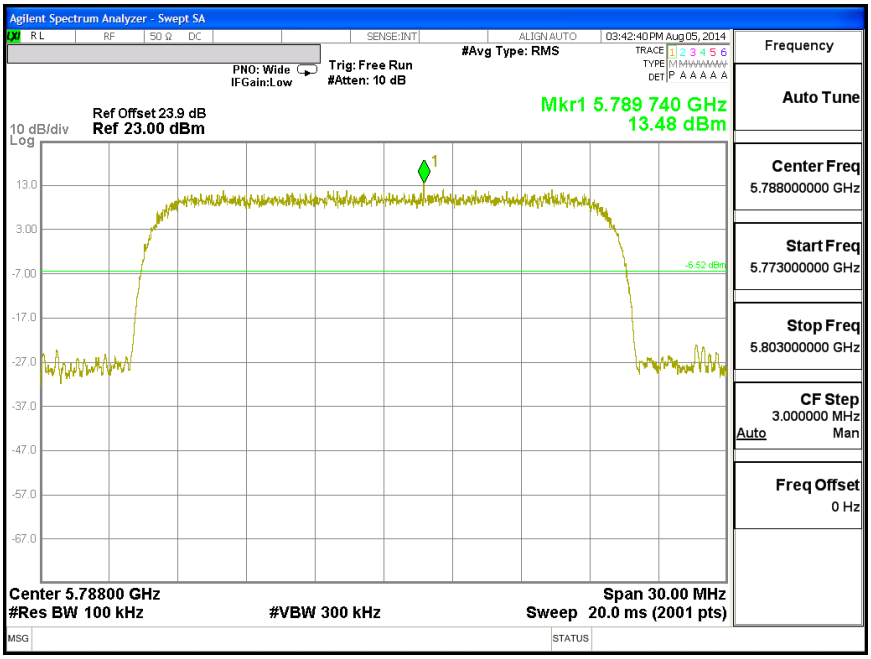
OUT OF BAND Chain 0 HIGH CH



RESULTS 20MHz

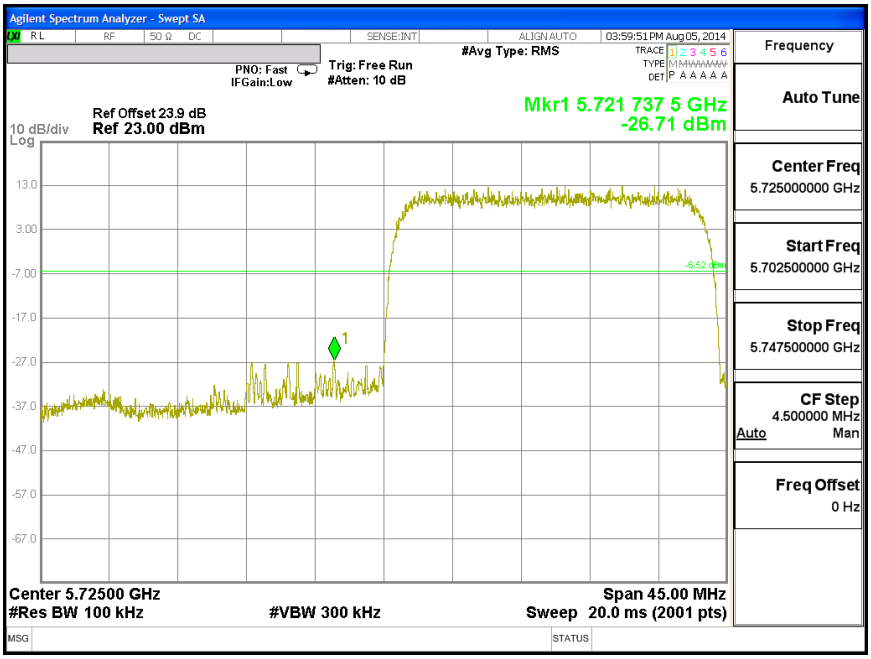
IN-BAND REFERENCE LEVEL, Chain 1

REFERENCE LEVEL Chain 1 MID CH



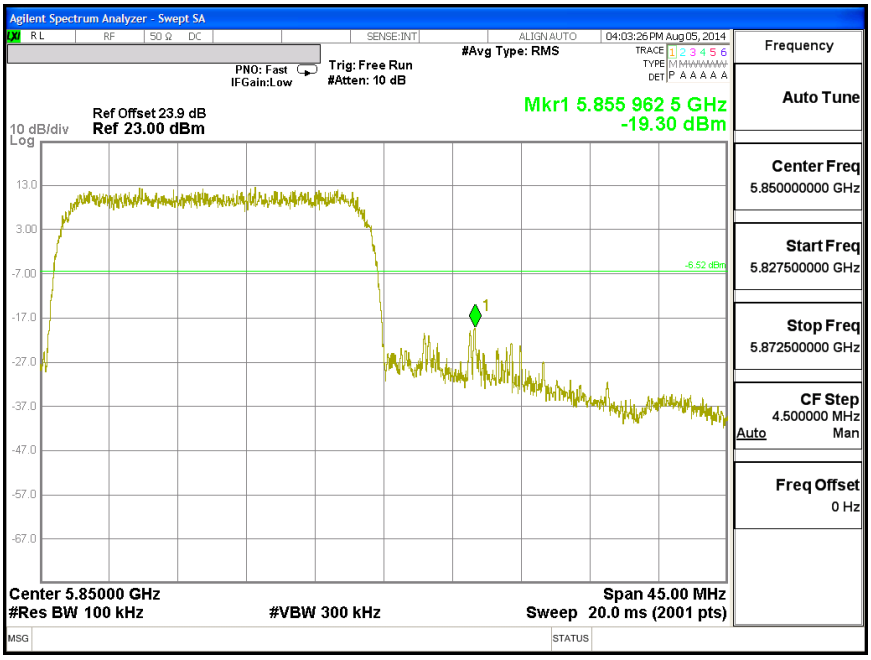
LOW CHANNEL BANDEDGE, Chain 1

AUTHORIZED BAND EDGE Chain 1 LOW CH



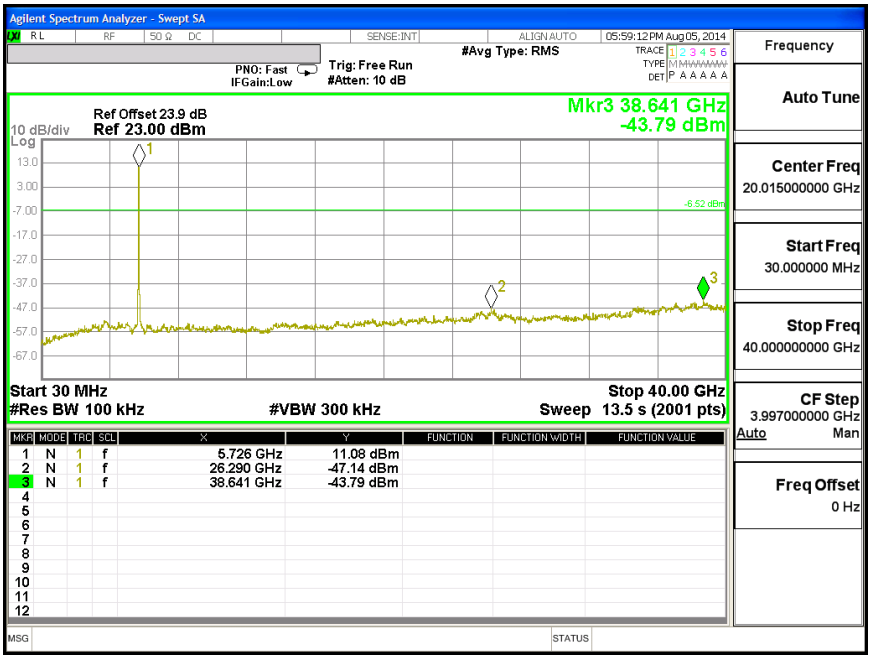
HIGH CHANNEL BANDEDGE, Chain 1

AUTHORIZED BAND EDGE Chain 1 HIGH CH

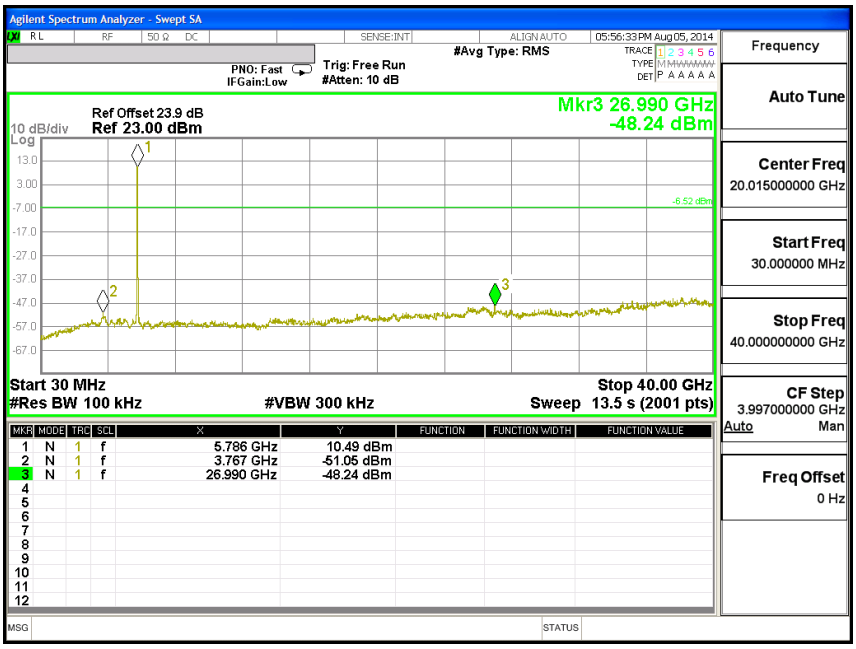


OUT-OF-BAND EMISSIONS, Chain 1

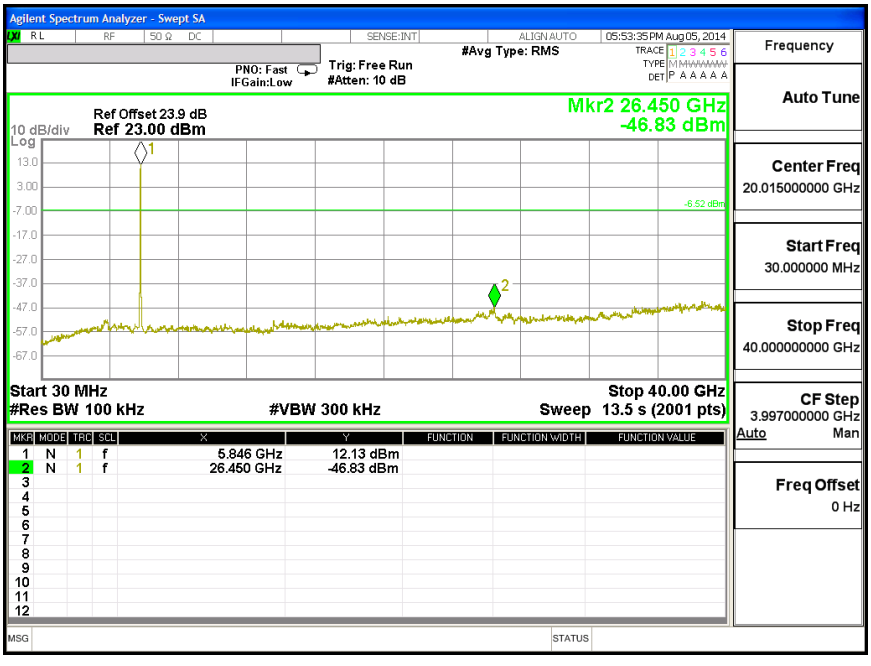
OUT OF BAND Chain 1 LOW CH



OUT OF BAND Chain 1 MID CH



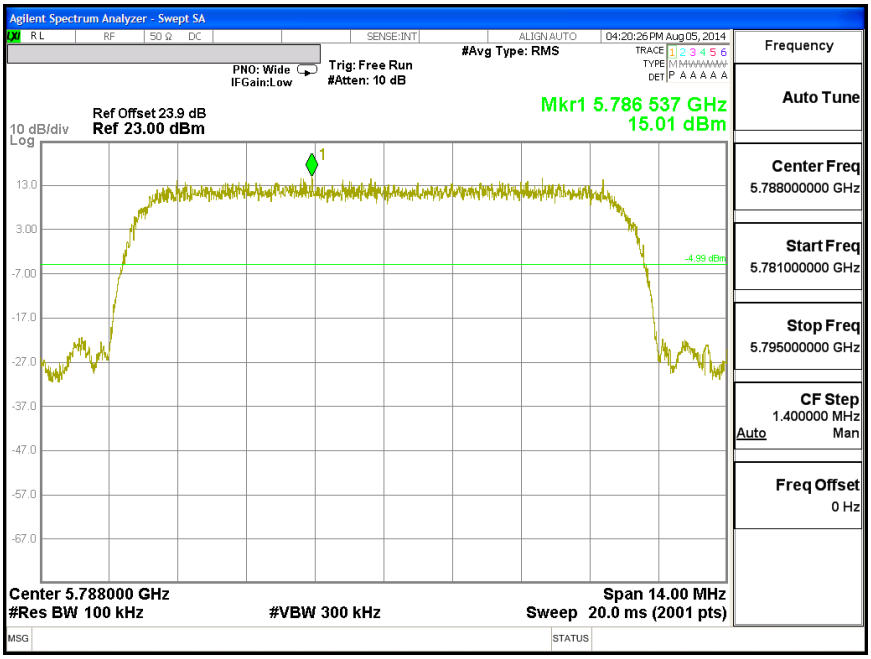
OUT OF BAND Chain 1 HIGH CH



RESULTS 10MHz setting

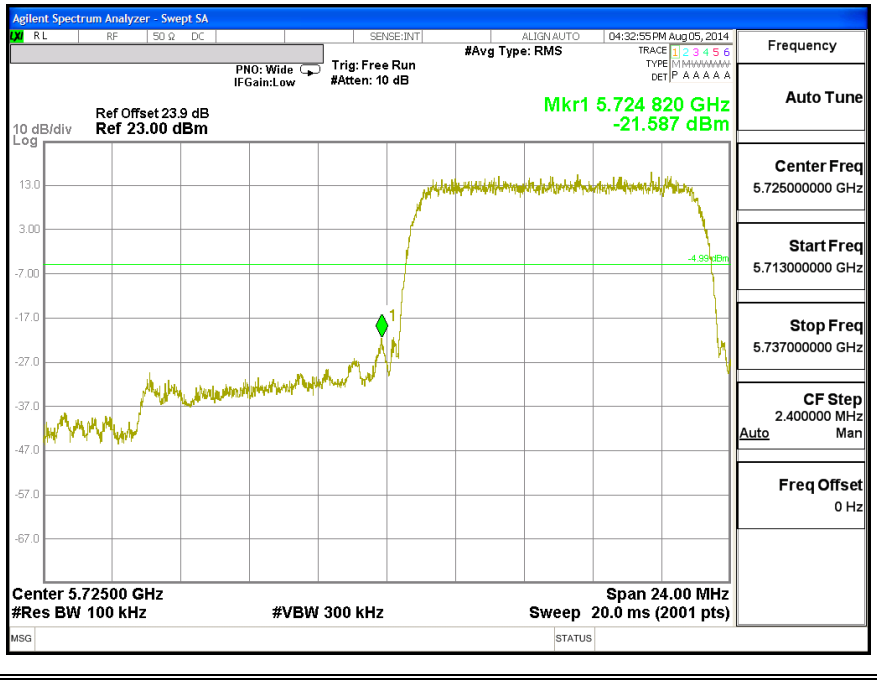
IN-BAND REFERENCE LEVEL, Chain 0

REFERENCE LEVEL Chain 0 MID CH



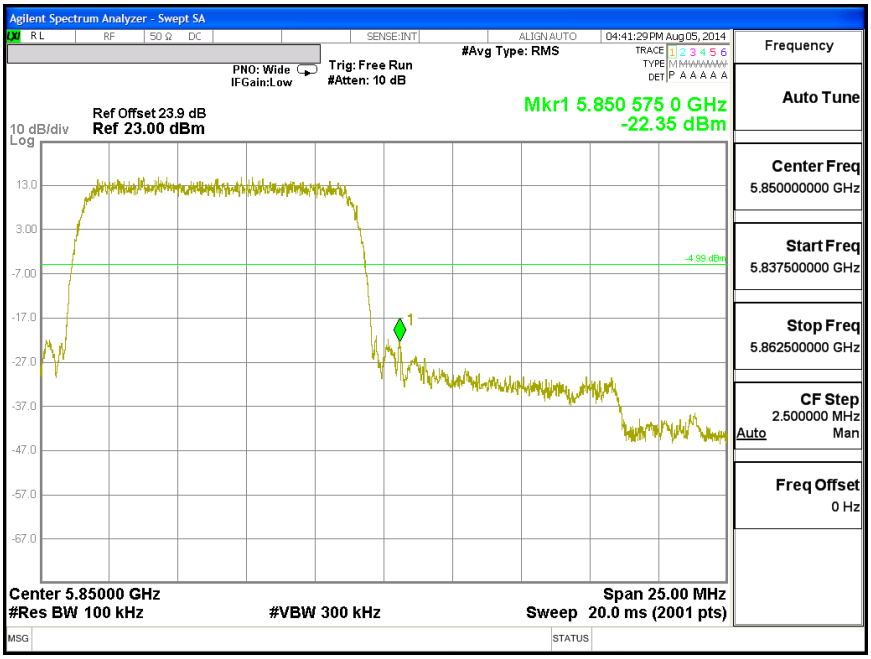
LOW CHANNEL BANDEDGE, Chain 0

AUTHORIZED BAND EDGE Chain 0 LOW CH



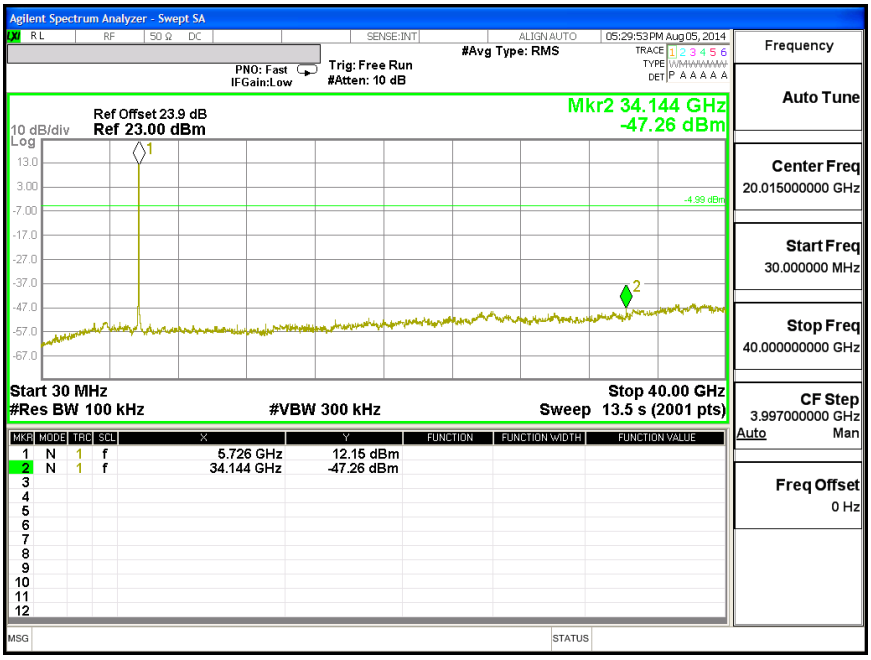
HIGH CHANNEL BANDEDGE, Chain 0

AUTHORIZED BAND EDGE Chain 0 HIGH CH

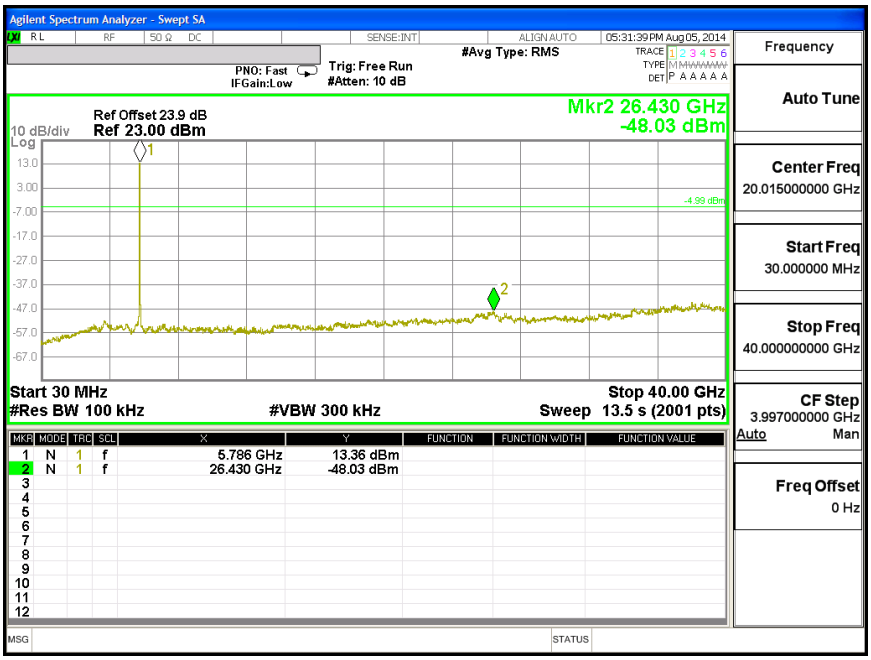


OUT-OF-BAND EMISSIONS, Chain 0

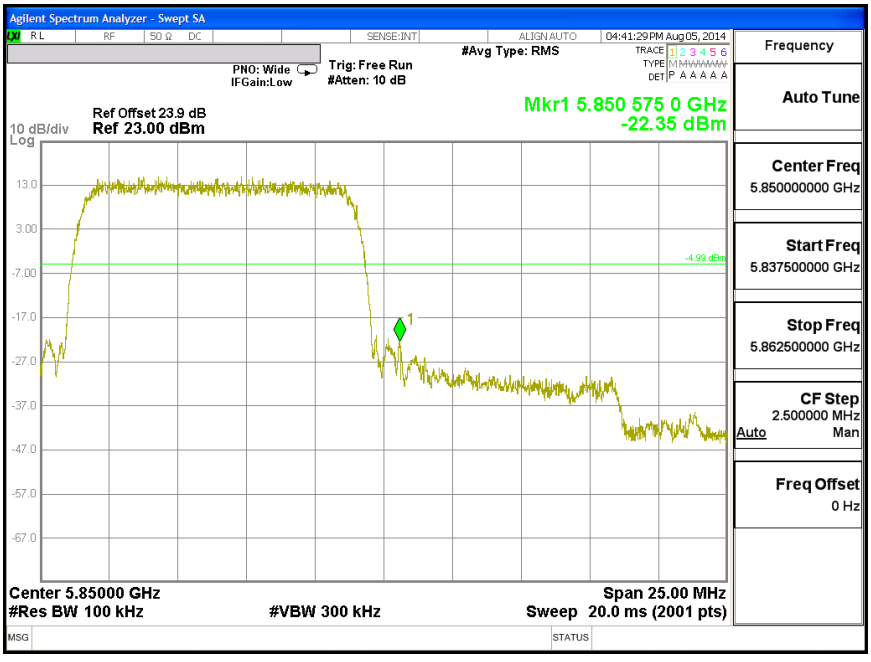
OUT OF BAND Chain 0 LOW CH



OUT OF BAND Chain 0 MID CH



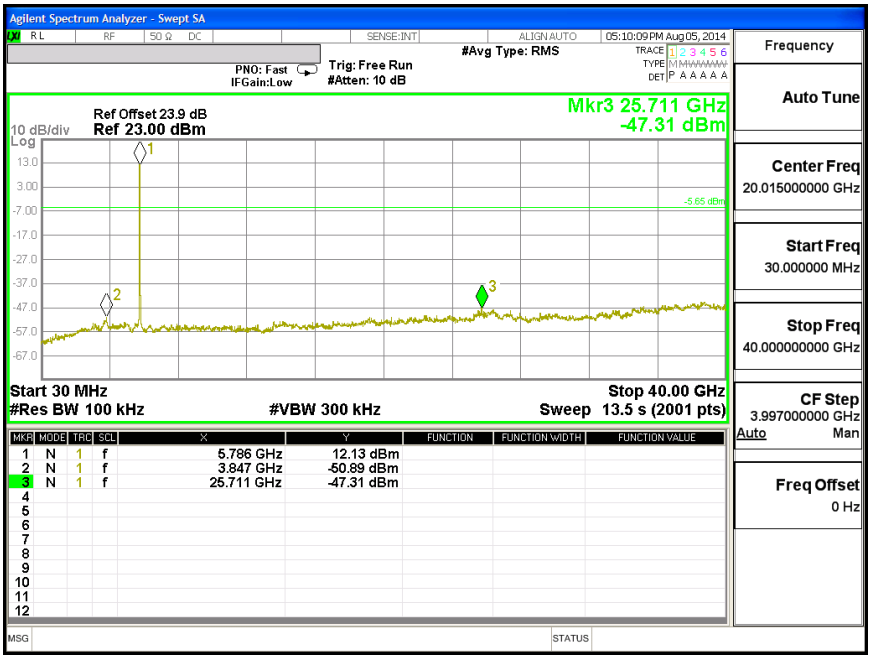
OUT OF BAND Chain 0 HIGH CH



RESULTS 10MHz setting

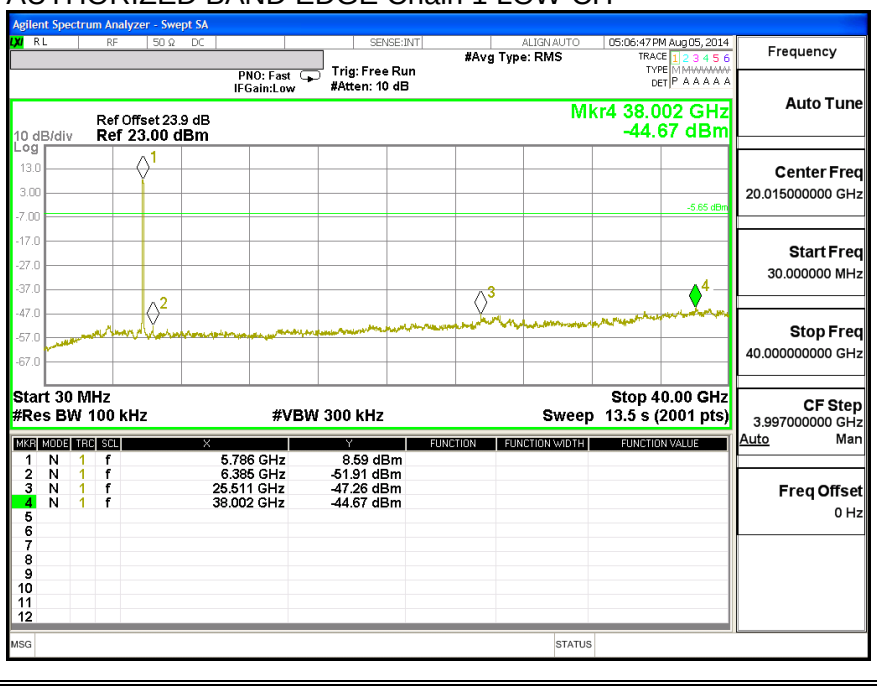
IN-BAND REFERENCE LEVEL, Chain 1

REFERENCE LEVEL Chain 1 MID CH



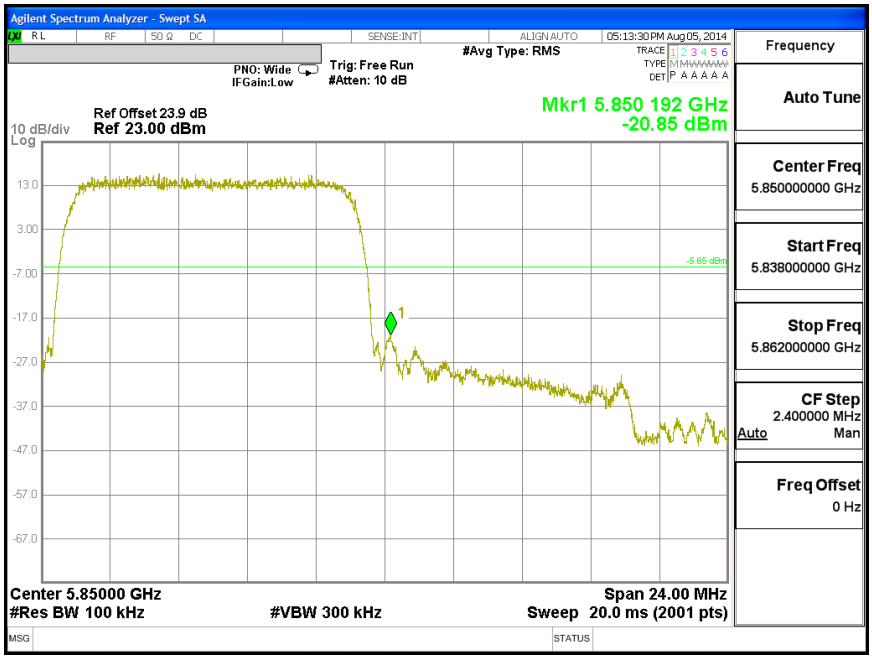
LOW CHANNEL BANDEDGE, Chain 1

AUTHORIZED BAND EDGE Chain 1 LOW CH



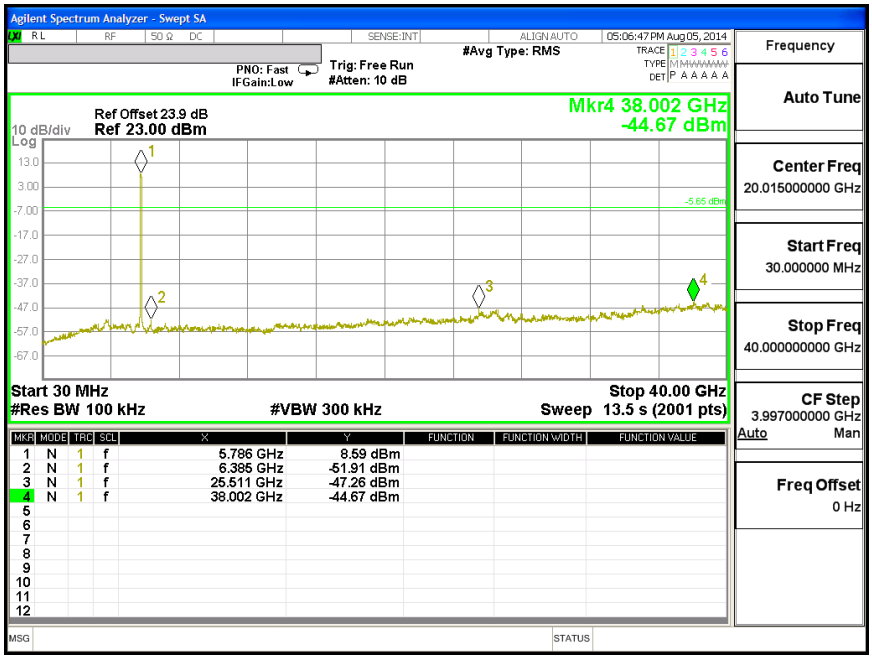
HIGH CHANNEL BANDEDGE, Chain 1

AUTHORIZED BAND EDGE Chain 1 HIGH CH

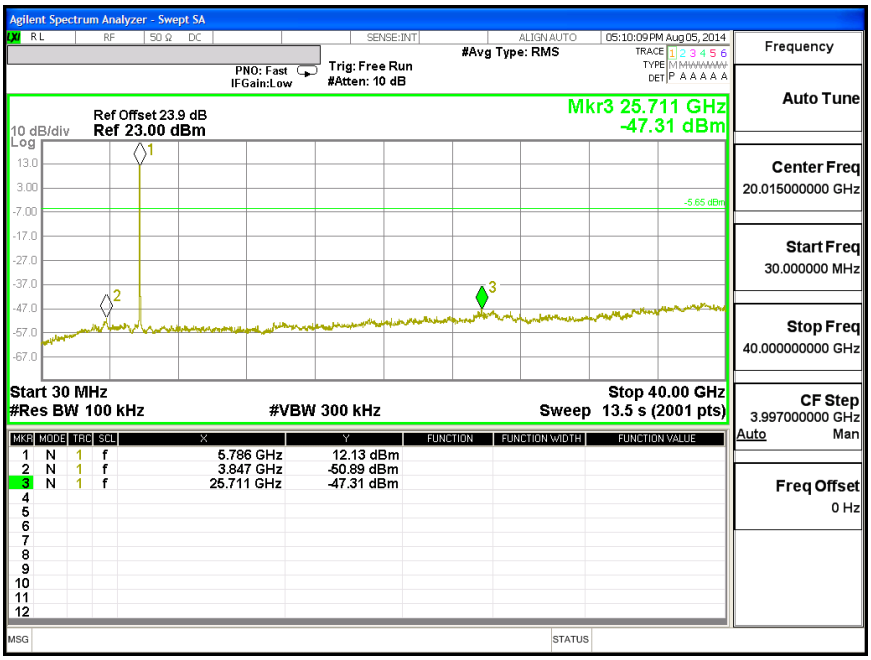


OUT-OF-BAND EMISSIONS, Chain 1

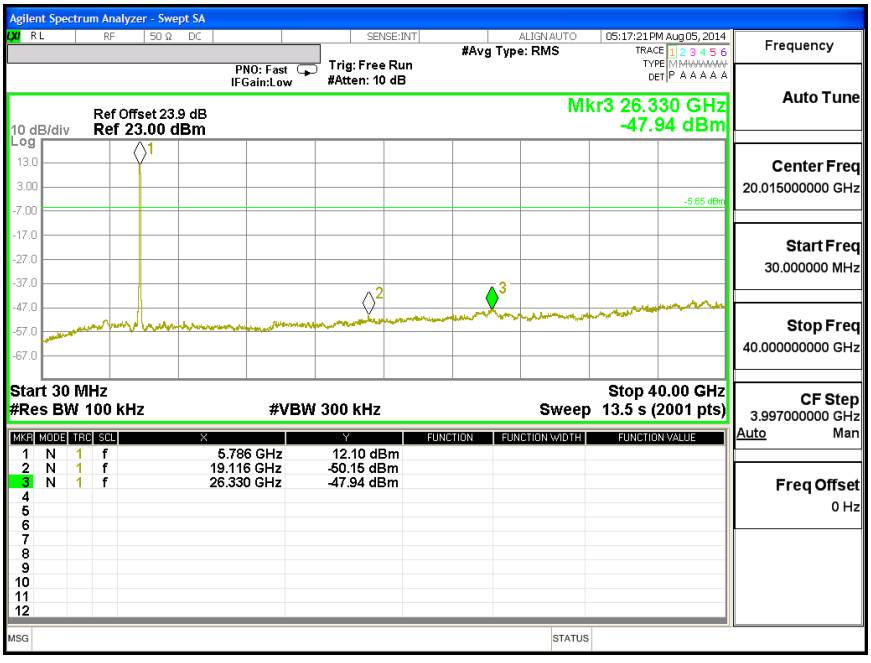
OUT OF BAND Chain 1 LOW CH



OUT OF BAND Chain 1 MID CH



OUT OF BAND Chain 1 HIGH CH



9. RADIATED TEST RESULTS

9.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (Receiver)

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane. The antenna to EUT distance is 3 meters.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

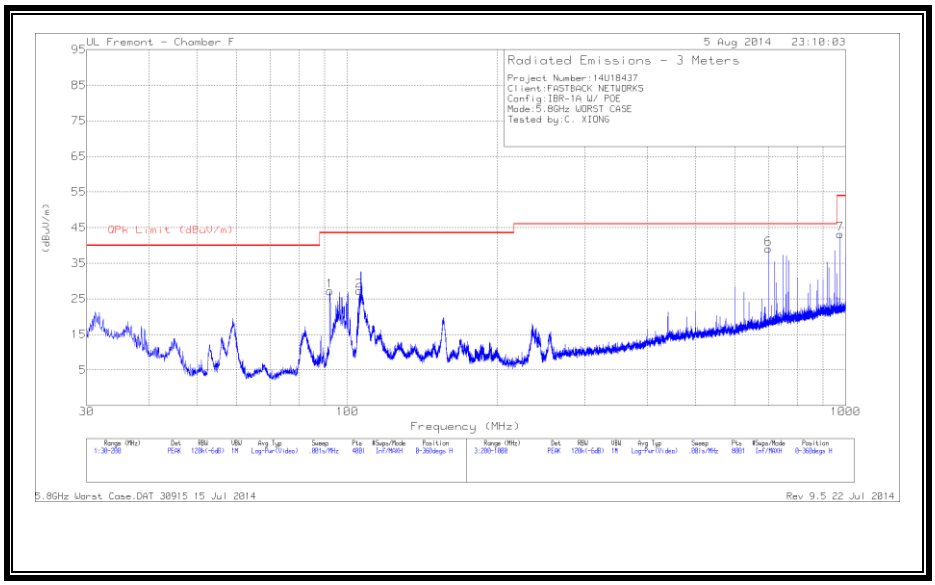
For measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 1 MHz for peak measurements and as applicable for average measurements.

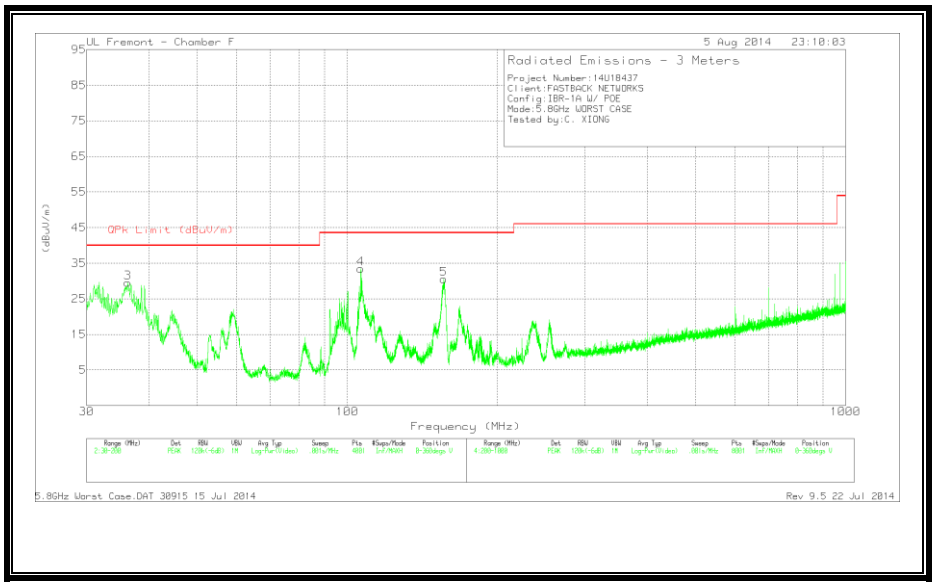
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

9.2. WORST-CASE BELOW 1 GHz

SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL AND VERTICAL)





HORIZONTAL AND VERTICAL DATA

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T122 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	92.305	50.59	PK	8.2	-31.6	27.19	43.52	-16.33	0-360	301	H
2	105.735	46.9	PK	11.8	-31.5	27.2	43.52	-16.32	0-360	301	H
3	36.29	44.78	PK	16.7	-31.9	29.58	40	-10.42	0-360	100	V
4	106.415	53.01	PK	12	-31.5	33.51	43.52	-10.01	0-360	100	V
5	156.31	49.35	PK	12.5	-31.3	30.55	43.52	-12.97	0-360	100	V
6	700	48.42	PK	20.3	-29.7	39.02	46.02	-7	0-360	100	H
7	* 975	47.88	PK	23.1	-27.8	43.18	53.97	-10.79	0-360	100	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band
PK - Peak detector

Radiated Emissions

Frequency (MHz)	Meter Reading (dBuV)	Det	AF T122 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
699.984	47.5	QP	20.3	-29.7	38.1	46.02	-7.92	341	106	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band
QP - Quasi-Peak detector

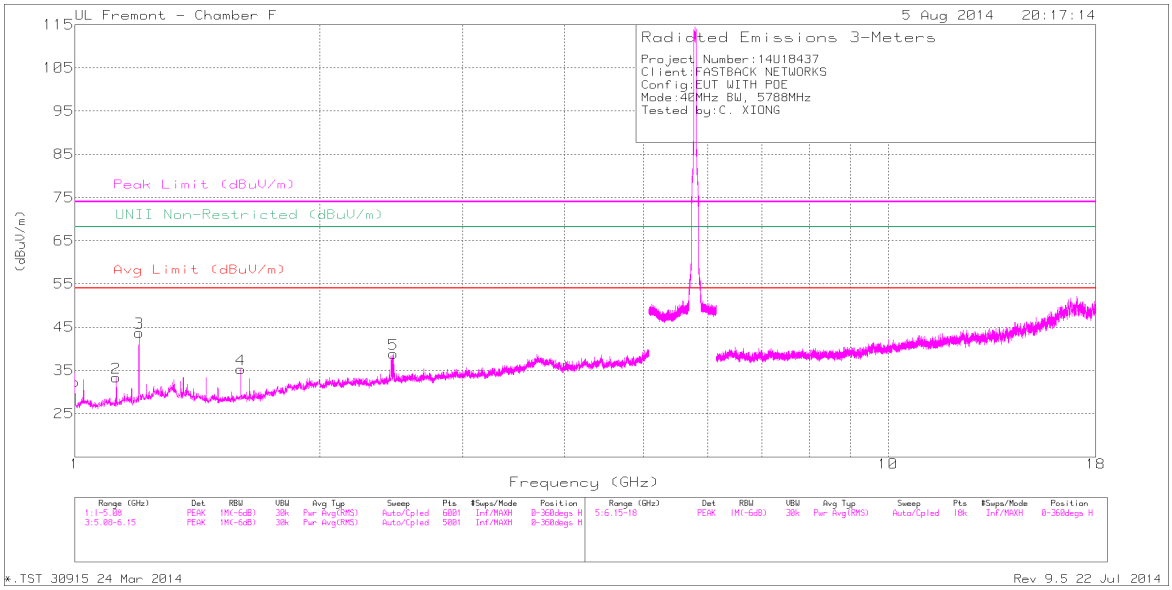
5.8GHz Worst Case.DAT 30915 15 Jul 2014
Rev 9.5 22 Jul 2014

9.3. TRANSMITTER ABOVE 1 GHz

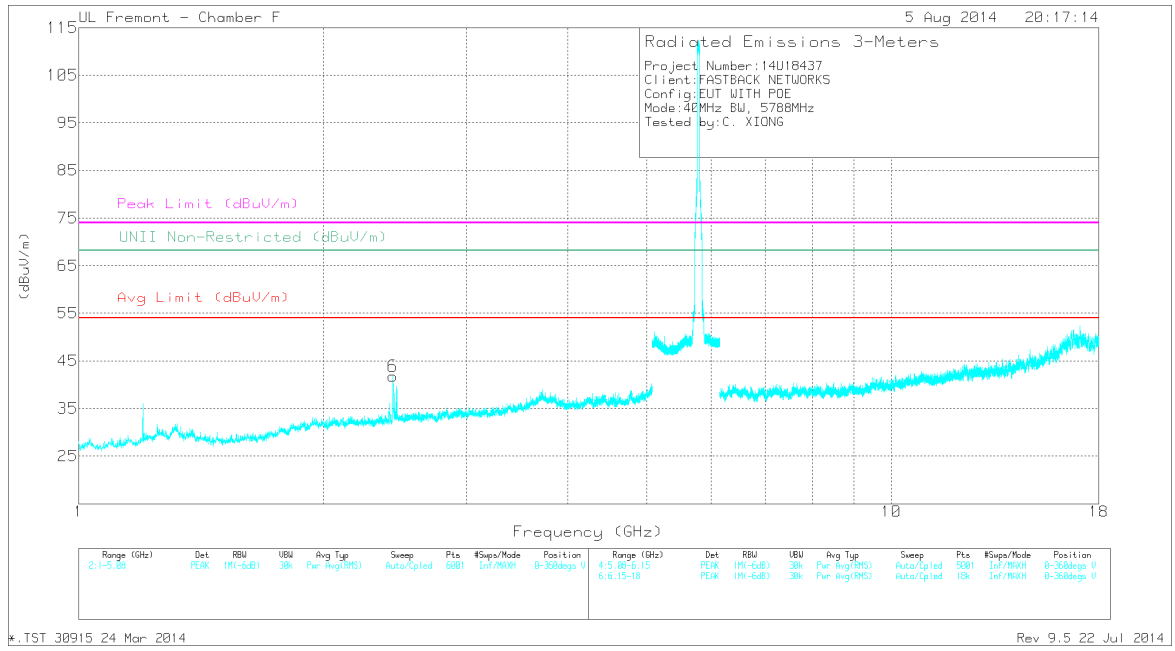
TX ABOVE 1 GHz IN THE 5.8 GHz BAND

HARMONICS AND SPURIOUS EMISSIONS 40MHz Bandwidth

HORIZONTAL



VERTICAL



HORIZONTAL AND VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	UNII Non-Restricted (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.001	37.34	PK	27.6	-32.6	32.34	-	-	74	-41.66	-	-	0-360	201	H
2	* 1.125	37.9	PK	27.9	-32.5	33.3	-	-	74	-40.7	-	-	0-360	100	H
3	* 1.2	47.22	PK	29	-32.5	43.72	-	-	74	-30.28	-	-	0-360	100	H
4	* 1.6	38.45	PK	28.5	-31.7	35.25	-	-	74	-38.75	-	-	0-360	201	H
5	2.465	37.02	PK	32.5	-30.7	38.82	-	-	-	-	68.2	-29.38	0-360	201	H
6	2.435	40.31	PK	32.4	-30.9	41.81	-	-	-	-	68.2	-26.39	0-360	201	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band
PK - Peak detector

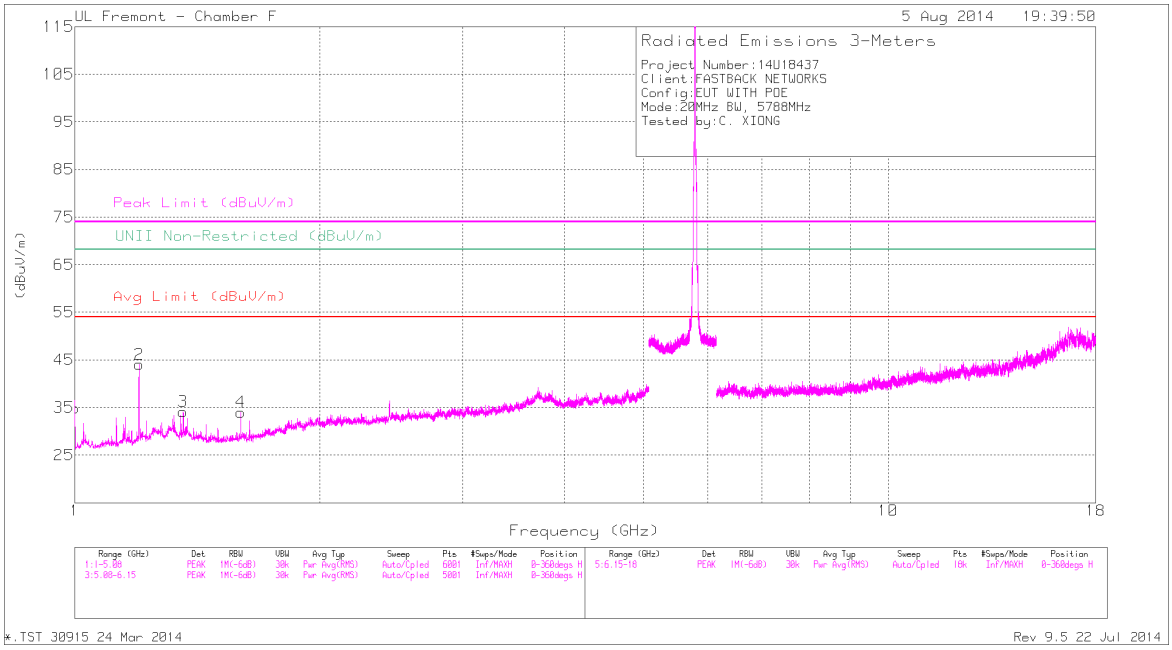
Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	UNII Non-Restricted (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 1	47.85	PK2	27.6	-32.6	42.85	-	-	74	-31.15	-	-	34	137	H
* 1	40.68	MAv1	27.6	-32.6	35.68	54	-18.32	-	-	-	-	34	137	H
* 1.125	44.15	PK2	27.9	-32.5	39.55	-	-	74	-34.45	-	-	78	164	H
* 1.125	36.33	MAv1	27.9	-32.5	31.73	54	-22.27	-	-	-	-	78	164	H
* 1.2	50.85	PK2	29	-32.5	47.35	-	-	74	-26.65	-	-	25	109	H
* 1.2	46.86	MAv1	29	-32.5	43.36	54	-10.64	-	-	-	-	25	109	H
* 1.6	43.86	PK2	28.5	-31.7	40.66	-	-	74	-33.34	-	-	80	192	H
* 1.6	37.28	MAv1	28.5	-31.7	34.08	54	-19.92	-	-	-	-	80	192	H

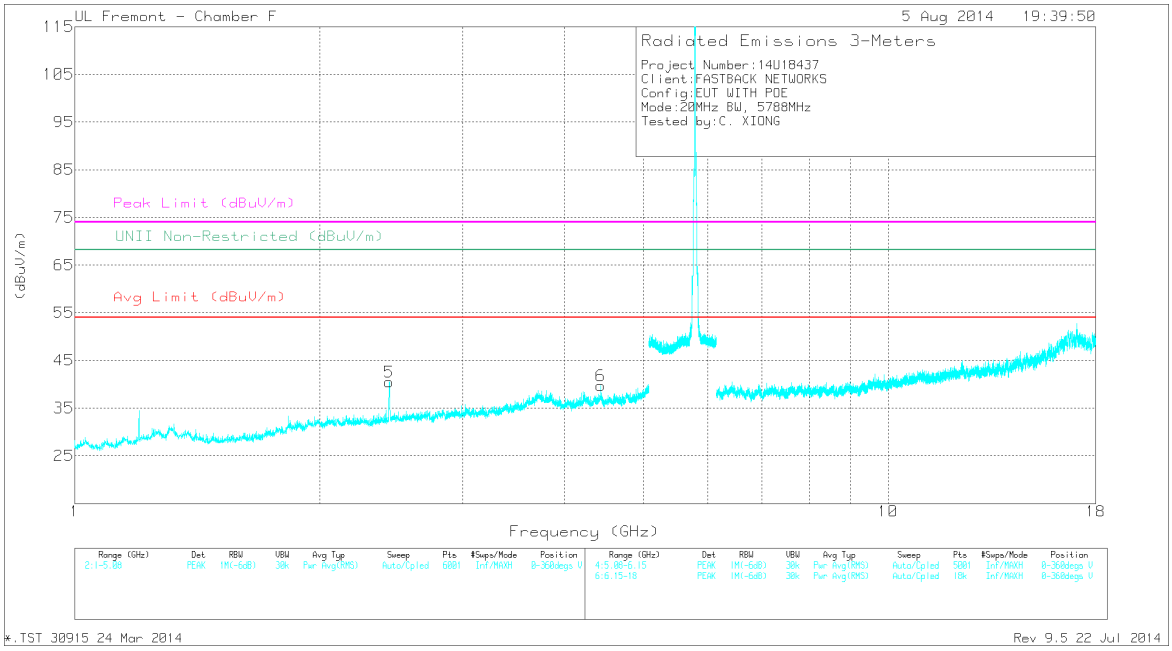
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band
PK2 - KDB558074 Method: Maximum Peak
MAv1 - KDB558074 Option 1 Maximum RMS Average

HARMONICS AND SPURIOUS EMISSIONS-20MHz Bandwidth

HORIZONTAL



VERTICAL



HORIZONTAL AND VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp /Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	UNII Non-Restricted (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.001	39.91	PK	27.6	-32.6	34.91	-	-	74	-39.09	-	-	0-360	201	H
2	* 1.2	47.54	PK	29	-32.5	44.04	-	-	74	-29.96	-	-	0-360	101	H
3	* 1.36	36.26	PK	29.6	-31.7	34.16	-	-	74	-39.84	-	-	0-360	101	H
4	* 1.6	37.22	PK	28.5	-31.7	34.02	-	-	74	-39.98	-	-	0-360	201	H
5	2.434	38.99	PK	32.4	-30.9	40.49	-	-	-	-	68.2	-27.71	0-360	201	V
6	4.433	33.03	PK	33.9	-27.2	39.73	-	-	-	-	68.2	-28.47	0-360	201	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band
PK - Peak detector

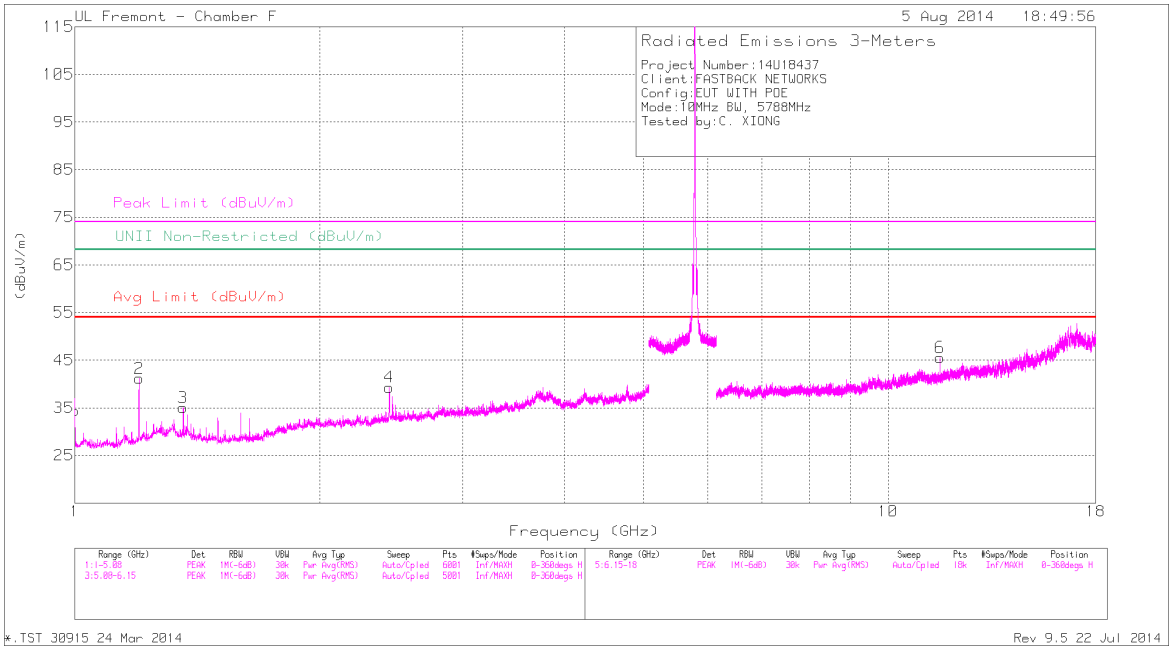
Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	UNII Non-Restricted (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 1	47.69	PK2	27.6	-32.6	42.69	-	-	74	-31.31	-	-	37	139	H
* 1	41.12	MAv1	27.6	-32.6	36.12	54	-17.88	-	-	-	-	37	139	H
* 1.2	51.29	PK2	29	-32.5	47.79	-	-	74	-26.21	-	-	25	109	H
* 1.2	46.77	MAv1	29	-32.5	43.27	54	-10.73	-	-	-	-	25	109	H
* 1.36	43.69	PK2	29.6	-31.7	41.59	-	-	74	-32.41	-	-	69	156	H
* 1.36	34.34	MAv1	29.6	-31.7	32.24	54	-21.76	-	-	-	-	69	156	H
* 1.6	44.47	PK2	28.5	-31.7	41.27	-	-	74	-32.73	-	-	78	193	H
* 1.6	37.31	MAv1	28.5	-31.7	34.11	54	-19.89	-	-	-	-	78	193	H
**2.434	38.99	PK	32.4	-30.9	40.49	-	-	-	-	68.2	-27.71	0-360	201	V
**4.433	33.03	PK	33.9	-27.2	39.73	-	-	-	-	68.2	-28.47	0-360	201	V

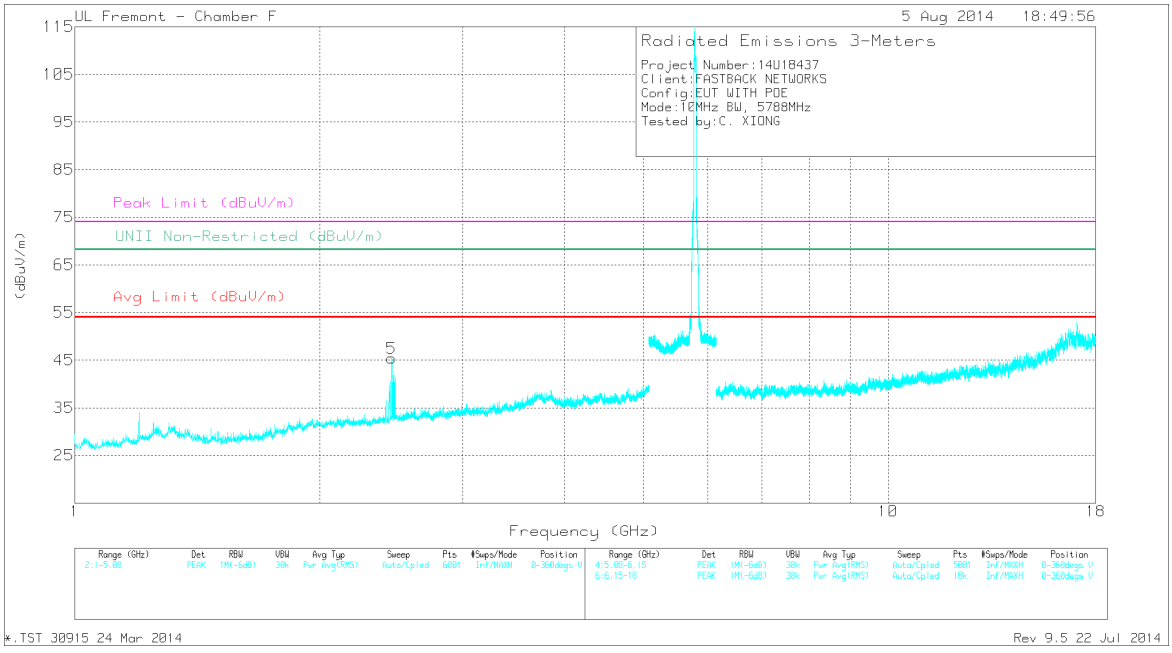
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band
** - covered by conducted spurious
PK2 - KDB558074 Method: Maximum Peak
MAv1 - KDB558074 Option 1 Maximum RMS Average

HARMONICS AND SPURIOUS EMISSIONS-10MHz

HORIZONTAL



VERTICAL



HORIZONTAL AND VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	UNII Non-Restricted (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.001	39.4	PK	27.6	-32.6	34.4	-	-	74	-39.6	-	-	0-360	102	H
2	* 1.2	44.66	PK	29	-32.5	41.16	-	-	74	-32.84	-	-	0-360	201	H
3	* 1.36	37.15	PK	29.6	-31.7	35.05	-	-	74	-38.95	-	-	0-360	102	H
4	2.435	37.84	PK	32.4	-30.9	39.34	-	-	-	-	68.2	-28.86	0-360	201	H
5	2.454	43.92	PK	32.4	-30.9	45.42	-	-	-	-	68.2	-22.78	0-360	201	V
6	* 11.576	30.17	PK	38.5	-23.1	45.57	-	-	74	-28.43	-	-	0-360	101	H

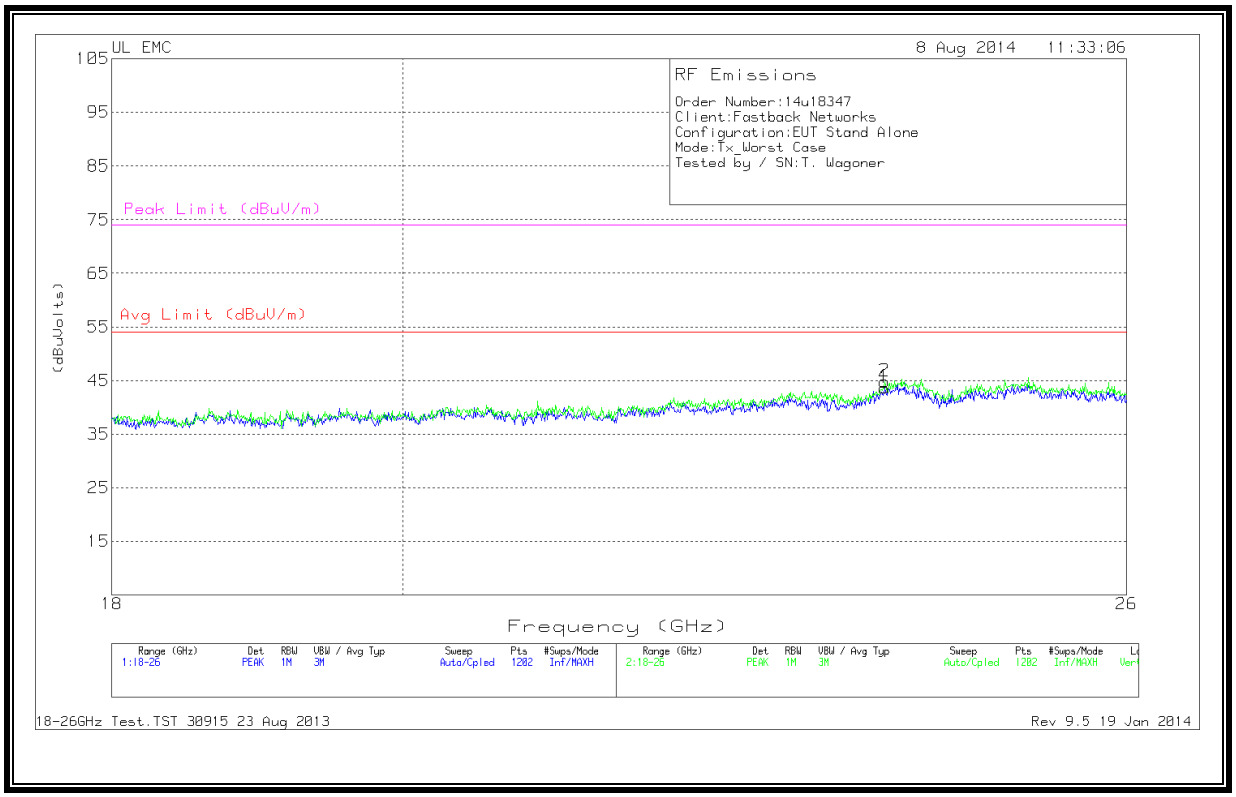
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band
PK - Peak detector

Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	UNII Non-Restricted (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 1	47.53	PK2	27.6	-32.6	42.53	-	-	74	-31.47	-	-	40	137	H
* 1	40.79	MAv1	27.6	-32.6	35.79	54	-18.21	-	-	-	-	40	137	H
* 1.2	50.75	PK2	29	-32.5	47.25	-	-	74	-26.75	-	-	64	123	H
* 1.2	46.47	MAv1	29	-32.5	42.97	54	-11.03	-	-	-	-	64	123	H
* 1.361	43.95	PK2	29.6	-31.7	41.85	-	-	74	-32.15	-	-	62	156	H
* 1.36	35.53	MAv1	29.6	-31.7	33.43	54	-20.57	-	-	-	-	62	156	H
2.435	37.84	PK	32.4	-30.9	39.34	-	-	-	-	68.2	-28.86	0-360	201	H
2.454	43.92	PK	32.4	-30.9	45.42	-	-	-	-	68.2	-22.78	0-360	201	V
* 11.576	35.84	PK2	38.5	-23.1	51.24	-	-	74	-22.76	-	-	80	105	H
* 11.576	25.72	MAv1	38.5	-23.1	41.12	54	-12.88	-	-	-	-	80	105	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band
PK2 - KDB558074 Method: Maximum Peak
Av1 - KDB558074 Option 1 Maximum RMS Average

9.4. TX 18-26 GHz IN THE 5.8 GHz BAND



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T89 (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)
1	23.815	41.87	PK	33.7	-22.4	-9.5	43.6	54	-10.33	74	-30.33
2	23.815	43.03	PK	33.7	-22.4	-9.5	44.83	54	-9.16	74	-29.16

PK - Peak detector

9.5. TX 26-40 GHz IN THE 5.8 GHz BAND