

COMPLIANCE WORLDWIDE INC. TEST REPORT 481-16R2

In Accordance with the Requirements of

FCC PART 22:2015 Subpart H
FCC PART 20:2015
IC RSS-132, Issue 3
824-849 MHz & 869-894 MHz

Issued to

Westell, Inc.
750 North Commons Drive
Aurora, IL 60504

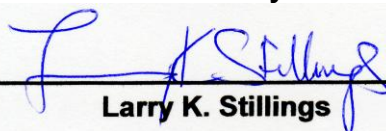
for

DSP85 Series Digital Repeater
DSP85-CELL
Representing Model DSP85-U7C/C

FCC ID: NVRDSP85-U7CC
IC: 4307A-DSP85U7CC

Original Report Issued on October 24, 2016
R2 Report Issued on January 11, 2017

Tested by



Larry K. Stillings

Reviewed By



Brian F. Breault

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Table of Contents

1. Scope	3
2. Product Details	3
2.1. Manufacturer	3
2.2. Model Number	3
2.3. Serial Number	3
2.4. Description	3
2.5. Power Source	3
2.6. Software Version	3
2.7. EMC Modifications	3
3. Product Configuration	4
3.1. Support Equipment	4
3.2. Cables	4
3.3. Operational Characteristics & Software	5
3.4. Block Diagram	5
4. Measurement Parameters	6
4.1. Measurement Equipment Used to Perform Test	6
4.2. Measurement & Equipment Setup	6
4.3. Test Procedure	6
5. Measurement Summary	7
6. Measurement Data	8
6.1. Power and Antenna Height Limits 22.913 (a)	8
6.2. Bandwidth Limitations 2.1049	22
6.3. Spurious Emissions at the Antenna Terminals 22.917	35
6.4. Field Strength of Spurious Emissions 22.917	52
6.5. Frequency Stability 22.355	56
6.6. Out of Band Rejection	57
6.7. Public Exposure to Radio Frequency Energy Levels 1.1307 (b)(1)	59
7. Test Site Description	60
8. Test Setup Photographs	61
Appendix A	66

1. Scope

This test report certifies that the Westell DSP85-U7C/C, as tested, meets the FCC Part 22 Subpart H and IC RSS-132, Issue 3 requirements. The scope of this test report is limited to the test sample provided by the client, only in as much as that sample represents other production units. If any significant changes are made to the unit, the changes shall be evaluated and a retest may be required. Revision R2 updates references in Section 4.3 to ANSI/TIA-603-D 2010 and ANSI C63.26 2015, and replaces the radiated data in section 6.4 with Substitution Measurement data

2. Product Details

2.1. Manufacturer: Westell Technologies, Inc.

2.2. Model Numbers: DSP85-CELL tested also represents Model DSP85-U7C/C

2.3. Serial Number: C6ZZ00001

2.4. Description: An in-building digital repeater is utilized to propagate over-the-air radio frequency signals from a local cell tower into buildings via a fiber or coax distributed antenna system (DAS). Once installed, a digital repeater provides the signal power necessary for wireless devices in the building to operate seamlessly.

2.5. Power Source: 120 VAC, 60 Hz via APX Technologies AS4528R

2.6. Software Version: 03.00.09 REL

2.7. EMC Modifications: None

3. Product Configuration

3.1. Support Equipment

Device	Manufacturer	Model	Serial No.	Comment
RF Signal Generator	R & S	SMIQ06B	10090	Generating W-CDMA Signals
IQ Modulation Generator	R & S	AMIQ04	100540	Generating AWS Signals
Power Supply	APX Technologies	AS4528R	101710062	
Notebook PC	Dell	Latitude C400	9760689253	Configuring Unit

3.2. Cables

Cable Type	Length	Shield	From	To
RF, 50 Ω , N male – N male	1M	Yes	DUT	Signal Generator
RF, 50 Ω , N male – N male	1M	Yes	DUT	50 Ω Load
Power Supply	2M + 2M	Yes	DUT	120 VAC, 60 Hz
Serial	2M	Yes	DUT	Notebook PC
USB	2M	Yes	DUT	Notebook PC
Ethernet	2M	No	DUT	Notebook PC

Notebook PC is connected only during setup

3.3. Operational Characteristics & Software

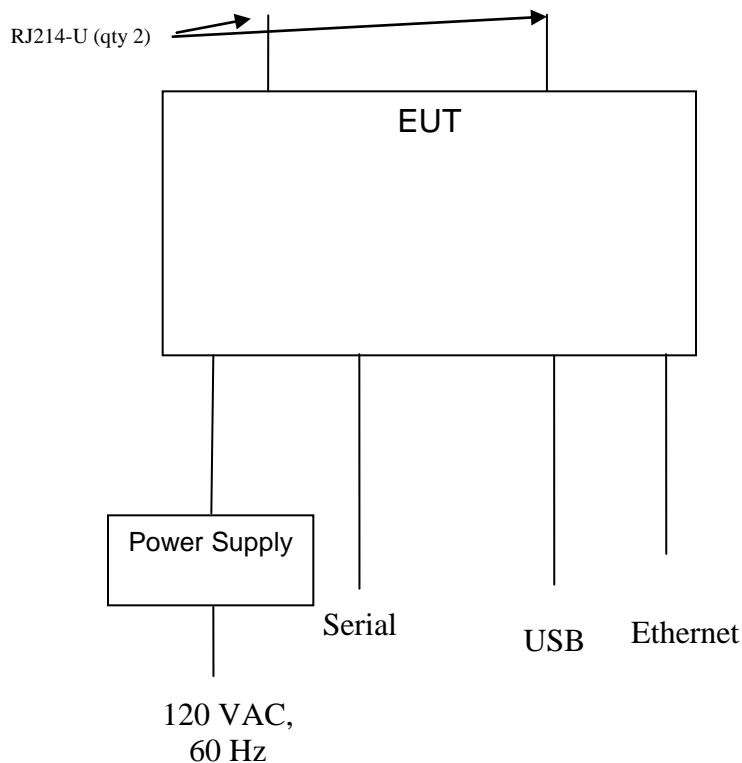
Emission Designator	Modulation	Occupied Bandwidth	Channel Bandwidth
4M18F9W	AWGN	4180 kHz	5 MHz
1M24F9W	CDMA	1274 kHz	1.25 MHz
246KGXW	GSM	246 kHz	200 kHz

3. Product Configuration (continued)

3.3. Operational Characteristics & Software

- (1) The unit was allowed to power up normally and go through its configuration cycle.
- (2) Using an RF Signal Generator on the Input and a Spectrum Analyzer on the output Downlink or Uplink frequencies a signal was generated over the intended bandwidth of operation.
- (3) The signal generator was configured to provide AWS / LTE 4.1 MHz AWGN digital modulation to the input of the amplifier across the Cell bands to be used by the product.
- (4) The units internal AGC threshold was determined by applying an input signal until a 1 dB increase in input signal did not cause a 1 dB in output signal for each of the Uplink and Downlink frequencies.
- (5) The signal generator was then configured to provide narrowband GSM and CDMA signals.

3.4. Block Diagram



4. Measurements Parameters

4.1. Measurement Equipment Used to Perform Test

Device	Manufacturer	Model No.	Serial No.	Cal Due	Interval
EMI Test Receiver, 9kHz - 7GHz ¹	Rohde & Schwarz	ESR7	101156	7/23/2017	2 Years
Spectrum Analyzer 20 Hz – 40 GHz ²	Rohde & Schwarz	FSV40	100899	7/23/2017	2 Years
Spectrum Analyzer, 9 kHz to 40 GHz ³	Rohde & Schwarz	FSVR40	100909	7/23/2017	2 Years
EMI Receiver, 9 kHz to 6.5 GHz	Hewlett Packard	8546A	3650A00360	6/4/2017	3 Years
Comilog Antenna, 30 MHz to 2 GHz	Com-Power	AC-220	25509	5/12/2018	2 Years
Horn Antenna 1 to 18 GHz	ETS-Lindgren	3117	00143292	2/22/2019	3 Years
Preamplifier, 1 GHz to 26.5 GHz	Hewlett Packard	8449B	3008A01323	7/21/2017	2 Years
Digital Barometer	Control Company	4195	ID236	10/8/2017	2 Years

¹ ESR7 Firmware revision: V2.28,SP1

Date installed: 9/2/2016

Previous V2.26, installed 8/15/2014.

² FSV40 Firmware revision: V2.30 SP4,

Date installed: 5/4/2016

Previous V2.30 SP1, installed 10/22/2014.

³ FSVR40 Firmware revision: V2.23,

Date installed: 10/20/2014

Previous V1.63 SP1, installed 8/28/2013.

⁴ FSW26 Firmware revision: V2.50,

Date installed: 9/12/2016

Previous V2.40, installed 5/4/2016.

4.2. Measurement & Equipment Setup

Test Dates: 7/27/2016, 7/28/2016, 9/26/2016,
9/27/2016, 1/9/2017

Test Engineers: Larry Stillings, Mark McSweeney

Normal Site Temperature (15 – 35°C): 24

Relative Humidity (20 -75%RH): 33

4.3. Test Procedure

The test measurements contained in this report are based on the requirements detailed in FCC Part 22, Subpart H and RSS-132, Issue 3.

The test methods used to generate the data in this test report are in accordance with ANSI C63.26:2015, American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services, FCC OET KDB 935210 D05 Indus Booster Basic Meas v01r01 dated 2-12-2016, Measurements Guidance for Industrial and Non-Consumer Signal Booster, Repeater and Amplifier Devices and FCC OET KDB 971168 D01 Power Meas License Digital Systems v02r02 dated 10-17-2014.

Measurements were also made in accordance with ANSI/TIA-603-D 2010, Land Mobile FM or PM Communications Equipment Measurement and Performance Standard.

5. Measurement Summary

Section Description or Test Requirement	FCC Part Reference	IC RSS-132 Reference	Test Report Section	Result	Comment
Effective Radiated Power Limits	22.913 (a)	5.4	6.1	Compliant	
Occupied Bandwidth	2.1049	3.1 RSS-GEN 6.6	6.2	Compliant	
Spurious Emissions at Antenna Terminals	22.917	5.5	6.3	Compliant	
Field Strength of Spurious Emissions	22.917	5.5	6.4	Compliant	
Frequency Stability / Tolerance	22.355	5.3	6.5	N/A	The EUT does not translate the frequency of the input signal
Out of Band Rejection	N/A	N/A	6.6	Compliant	FCC KDB 935210
Public Exposure to Radio Frequency Energy Levels	Section 1.1307 (b)(1)	RSS-GEN 3.2 RSS-102	6.7	Compliant	

6. Measurement Data

6.1. Power and Antenna Height Limits 22.913 (a), RSS-132 Section 5.4

Requirements:FCC: Maximum ERP. In general, the effective radiated power (ERP) of base transmitters and cellular repeaters must not exceed 500 Watts.

IC: Base station transmitters operating in the band 1930-1995 MHz shall not have output power exceeding 100 Watts.

Test Method: KDB 935210 Section 3.5 & KDB 971168 Section 5.2

6.1.1. Mean Transmitter Output Power, Transmitter Only

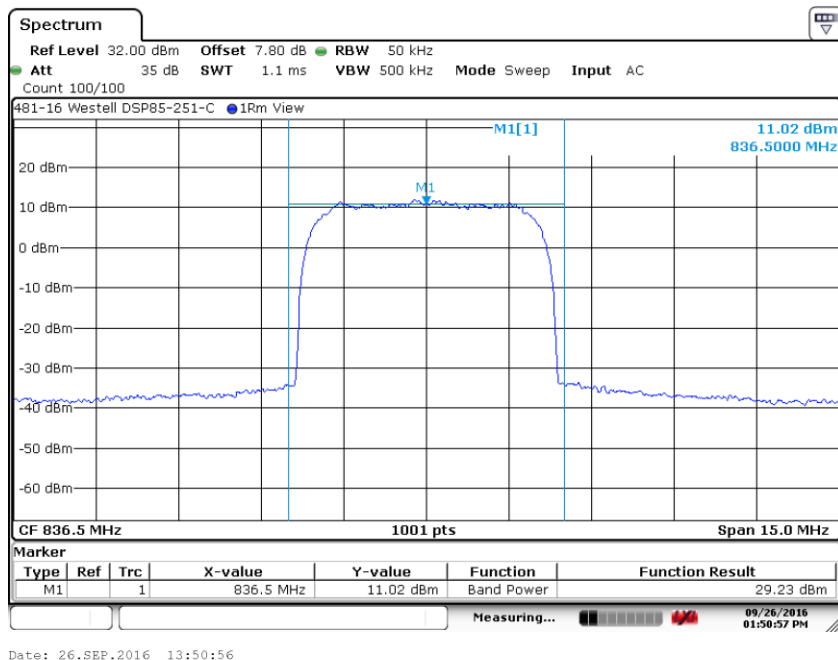
Description of Measurement	Center Frequency	Output Power	
	(MHz)	(dBm)	(Watts)
Output Power - AWGN	836.5	29.23	0.838
Output Power - GSM	836.5	29.50	0.891
Output Power - CDMA	836.5	29.38	0.867
Output Power - AWGN	881.5	29.38	0.867
Output Power - GSM	881.5	29.77	0.948
Output Power - CDMA	881.5	29.33	0.857
3 dB Above AGC - AWGN	836.5	29.35	0.861
3 dB Above AGC - GSM	836.5	29.62	0.916
3 dB Above AGC - CDMA	836.5	29.32	0.855
3 dB Above AGC - AWGN	881.5	29.70	0.933
3 dB Above AGC - GSM	881.5	29.55	0.902
3 dB Above AGC - CDMA	881.5	29.26	0.843
Input Power - AWGN	836.5	-57.17	N/A
Input Power - GSM	836.5	-56.86	N/A
Input Power - CDMA	836.5	-57.05	N/A
Input Power - AWGN	881.5	-57.10	N/A
Input Power - GSM	881.5	-56.88	N/A
Input Power - CDMA	881.5	-57.09	N/A

Notes: Input Power is AGC threshold Level, Center Frequencies are determined from Out of Band Rejection f_0 measurement.

6. Measurement Data

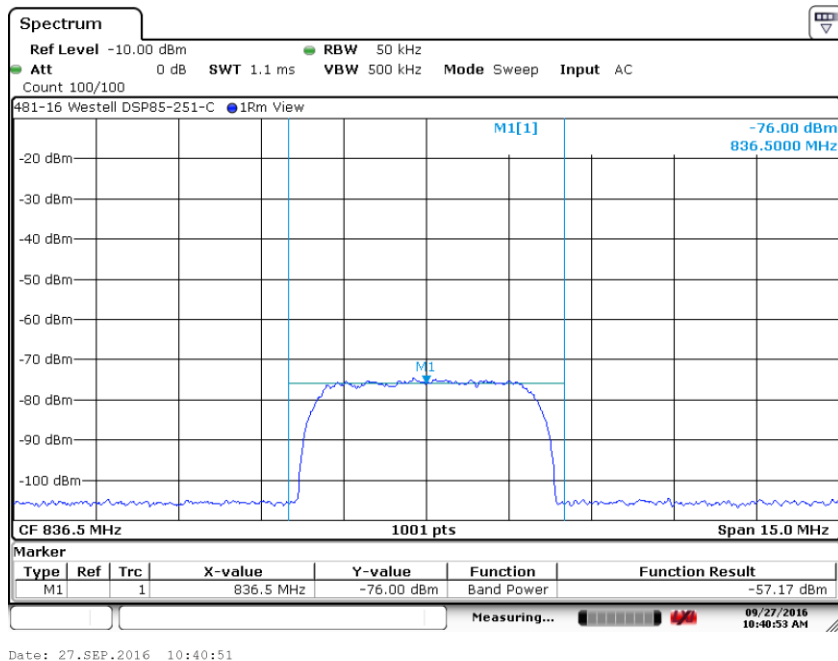
6.1. Power and Antenna Height Limits 22.913 (a), RSS-132 Section 5.4 (cont)

6.1.2. Mean Transmitter Output Power, 836.5 MHz AWGN



Date: 26.SEP.2016 13:50:56

6.1.3. Mean Transmitter Output Power, 836.5 MHz – Input Power AWGN

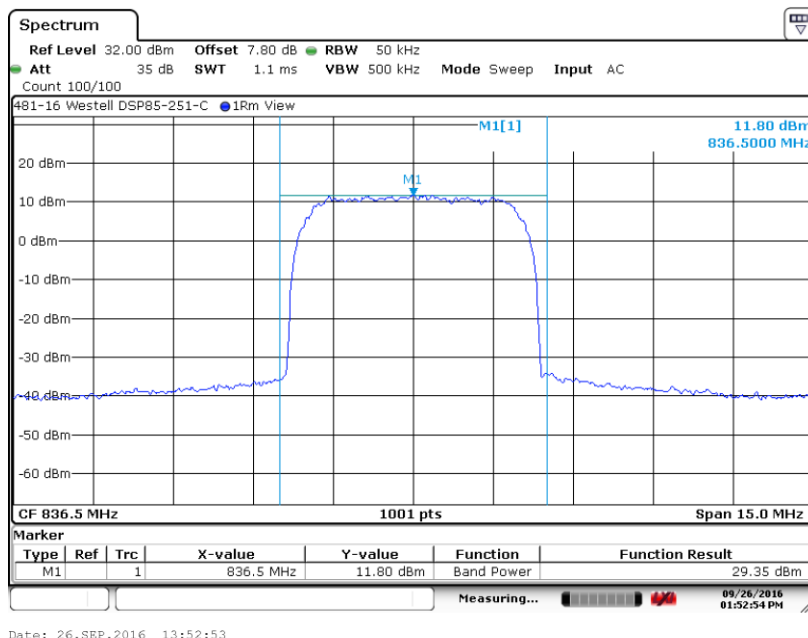


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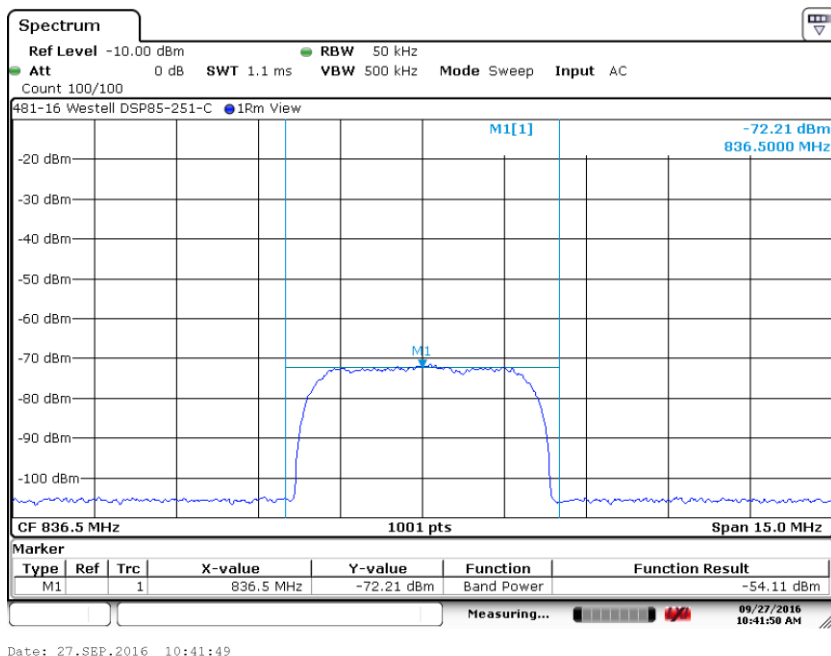
6. Measurement Data

6.1. Power and Antenna Height Limits 22.913 (a), RSS-132 Section 5.4 (cont)

6.1.4. Mean Transmitter Output Power, 836.5 MHz AWGN plus 3 dB



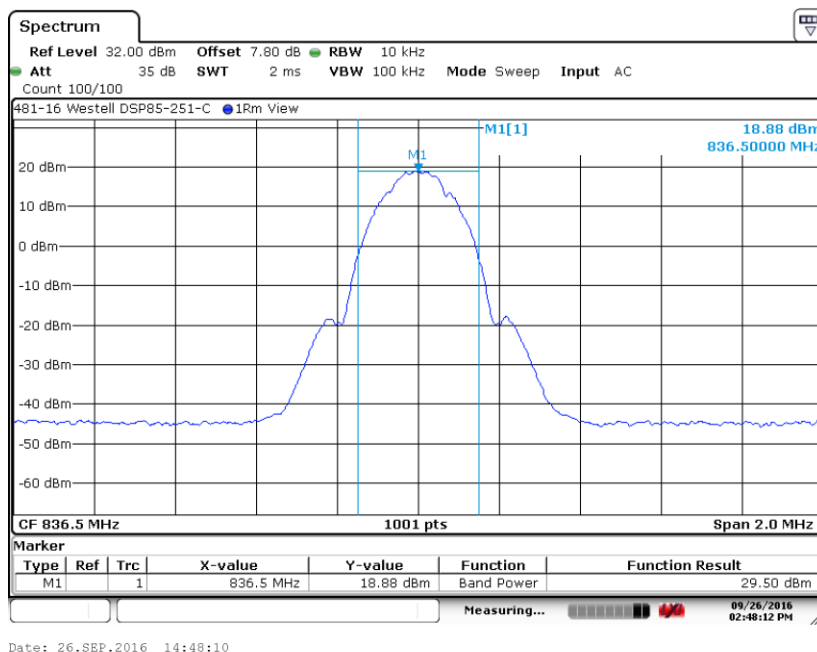
6.1.5. Mean Transmitter Output Power, 836.5 MHz – Input Power AWGN plus 3 dB



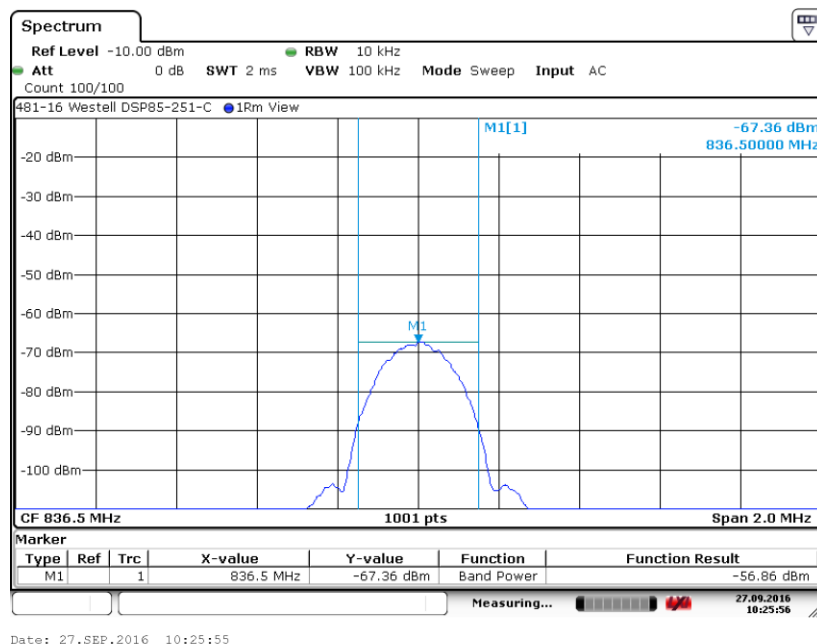
6. Measurement Data

6.1. Power and Antenna Height Limits 22.913 (a), RSS-132 Section 5.4 (cont)

6.1.6. Mean Transmitter Output Power, 836.5 MHz GSM



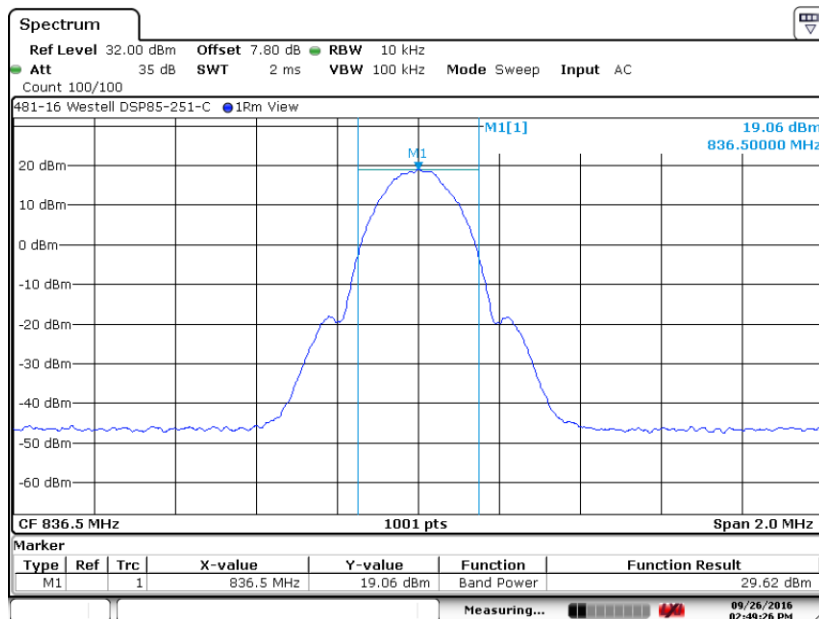
6.1.7. Mean Transmitter Output Power, 836.5 MHz – Input Power GSM



6. Measurement Data

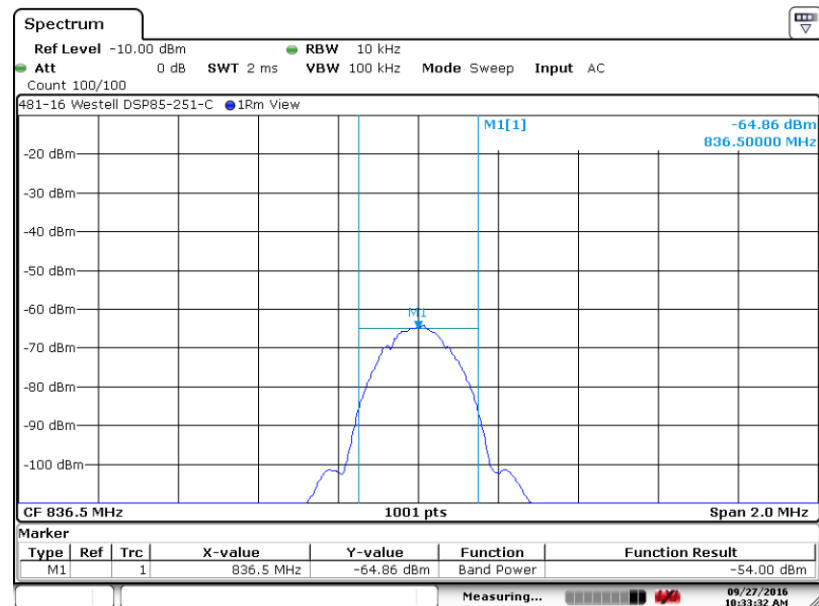
6.1. Power and Antenna Height Limits 22.913 (a), RSS-132 Section 5.4 (cont)

6.1.8. Mean Transmitter Output Power, 836.5 MHz GSM plus 3 dB



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6.1.9. Mean Transmitter Output Power, 836.5 MHz – Input Power GSM plus 3 dB

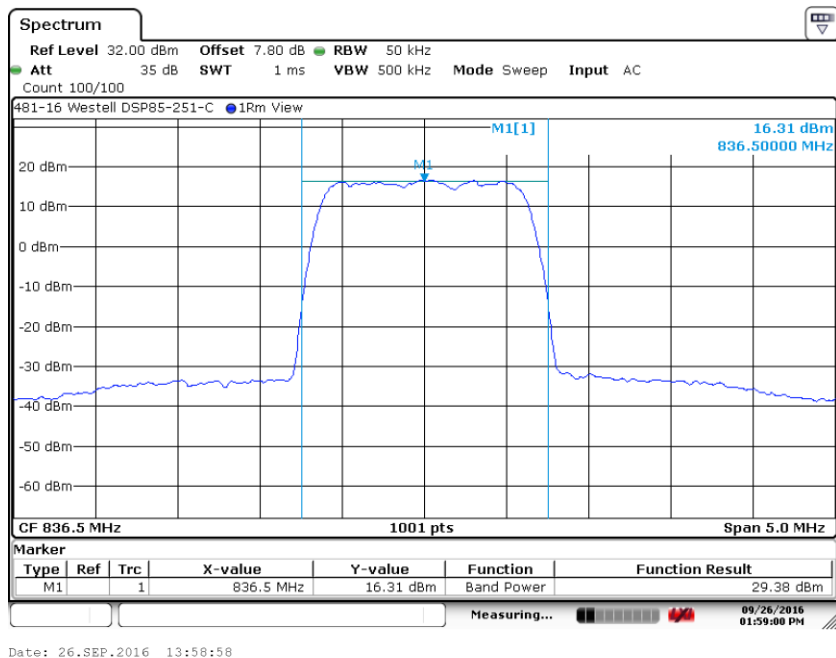


Date: 27.SEP.2016 10:33:31

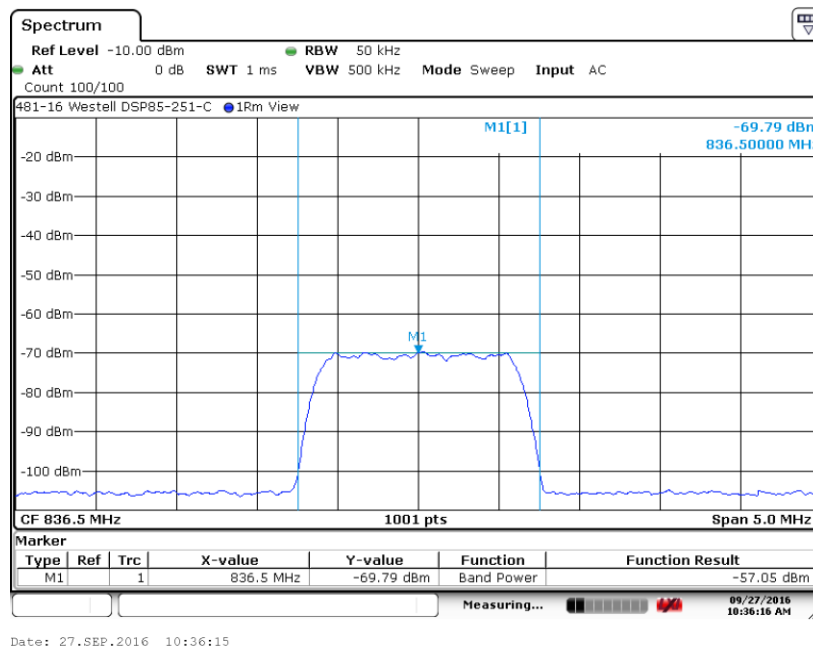
6. Measurement Data

6.1. Power and Antenna Height Limits 22.913 (a), RSS-132 Section 5.4 (cont)

6.1.10. Mean Transmitter Output Power, 836.5 MHz, CDMA



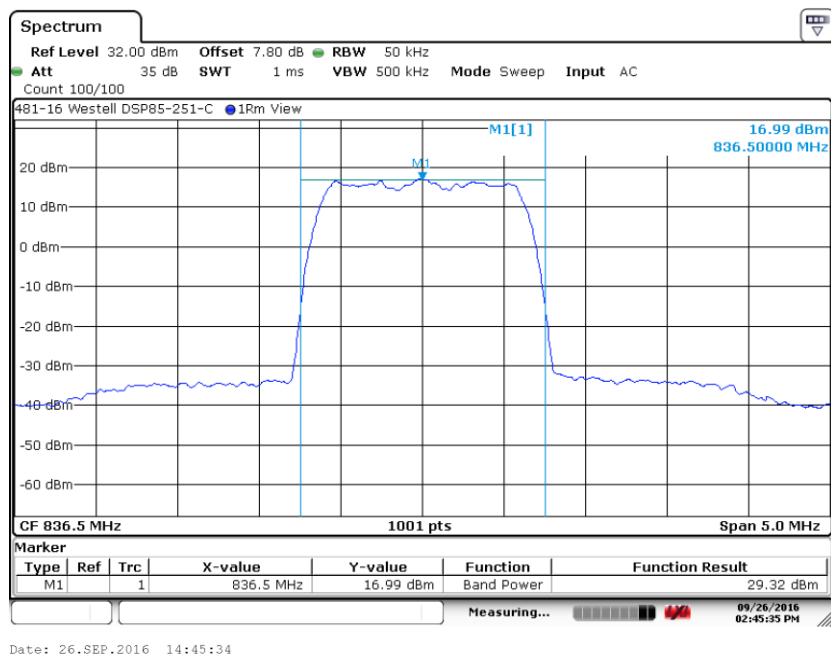
6.1.11. Mean Transmitter Output Power, 836.5 MHz – Input Power CDMA



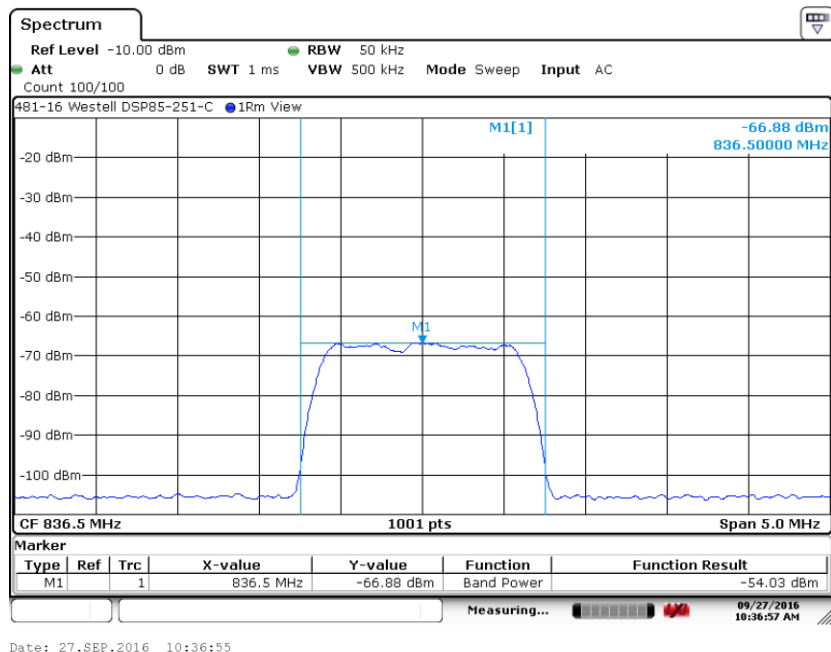
6. Measurement Data

6.1. Power and Antenna Height Limits 22.913 (a), RSS-132 Section 5.4 (cont)

6.1.12. Mean Transmitter Output Power, 836.5 MHz, CDMA plus 3 dB



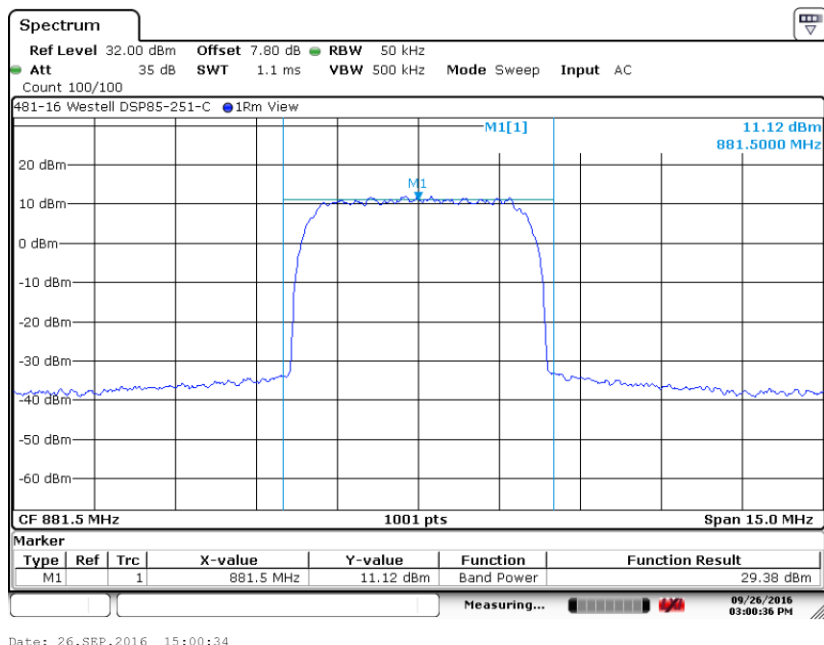
6.1.13. Mean Transmitter Output Power, 836.5 MHz – Input Power CDMA plus 3 dB



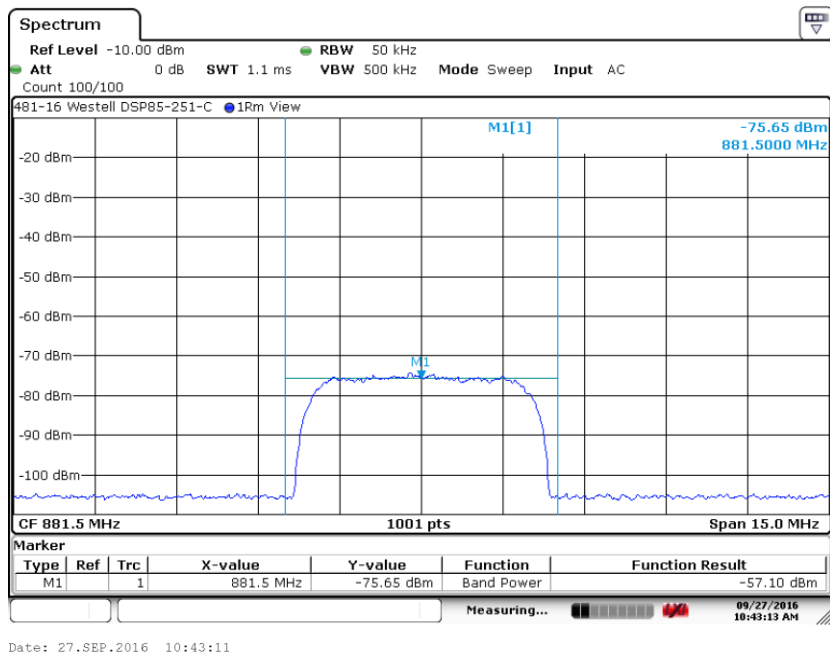
6. Measurement Data

6.1. Power and Antenna Height Limits 22.913 (a), RSS-132 Section 5.4 (cont)

6.1.14. Mean Transmitter Output Power, 881.5 MHz AWGN



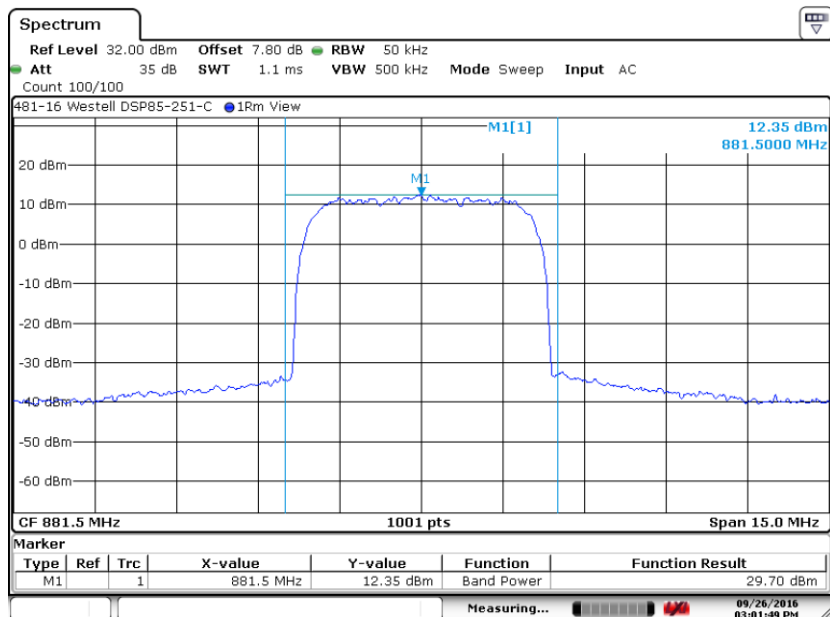
6.1.15. Mean Transmitter Output Power, 881.5 MHz – Input Power AWGN



6. Measurement Data

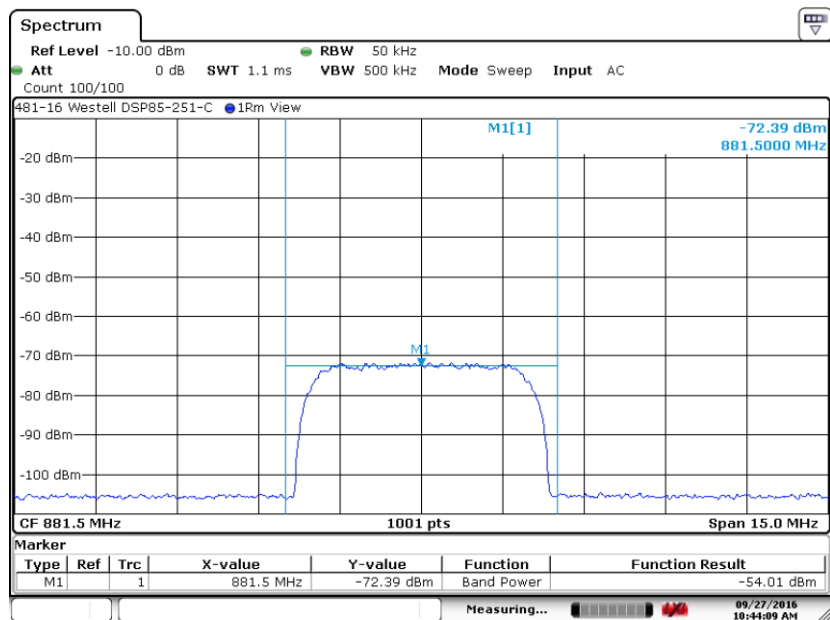
6.1. Power and Antenna Height Limits 22.913 (a), RSS-132 Section 5.4 (cont)

6.1.16. Mean Transmitter Output Power, 881.5 MHz AWGN plus 3 dB



Date: 26.SEP.2016 15:01:48

6.1.17. Mean Transmitter Output Power, 881.5 MHz – Input Power AWGN plus 3 dB

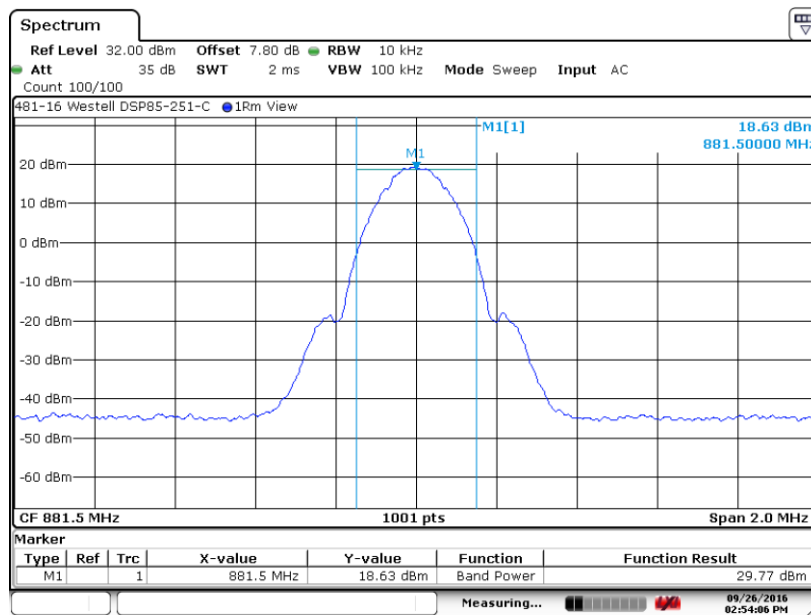


Date: 27.SEP.2016 10:44:07

6. Measurement Data

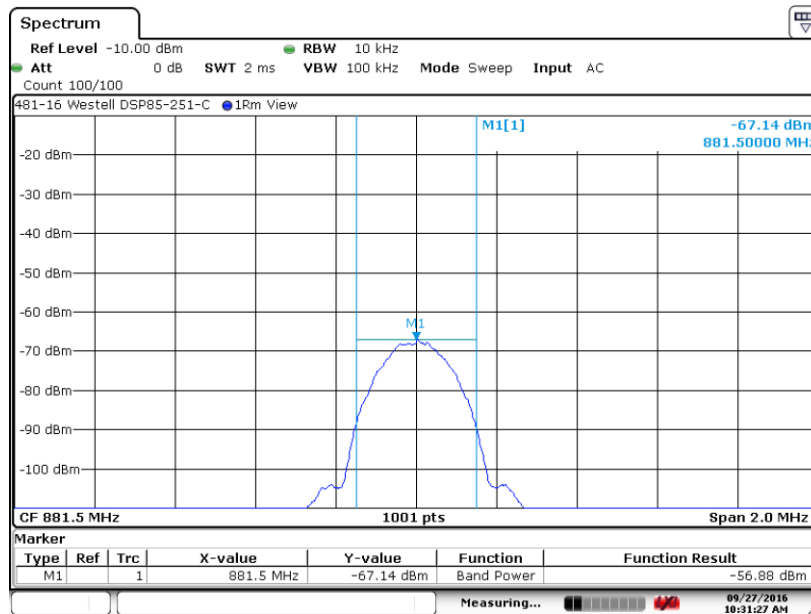
6.1. Power and Antenna Height Limits 22.913 (a), RSS-132 Section 5.4 (cont.)

6.1.18. Mean Transmitter Output Power, 881.5 MHz GSM



Date: 26.SEP.2016 14:54:05

6.1.19. Mean Transmitter Output Power, 881.5 MHz – Input Power GSM

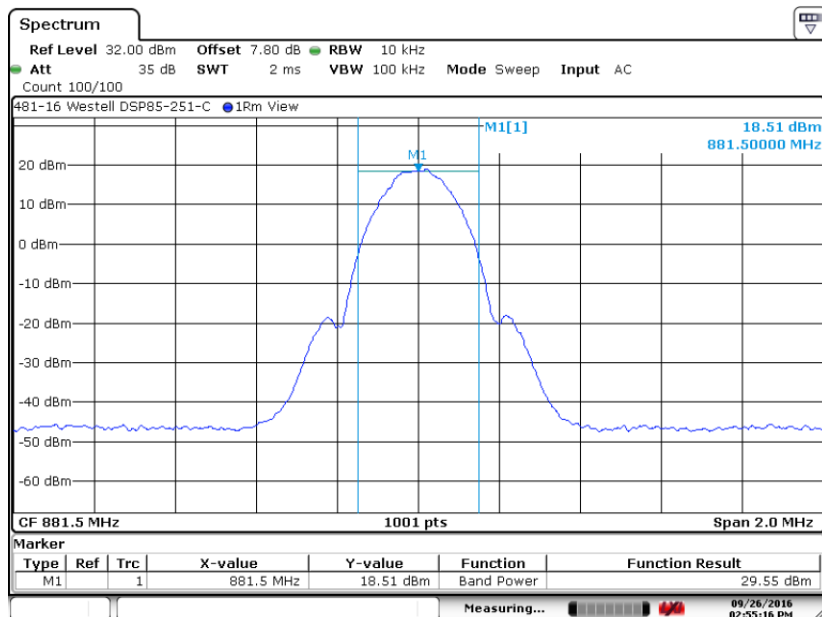


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6. Measurement Data

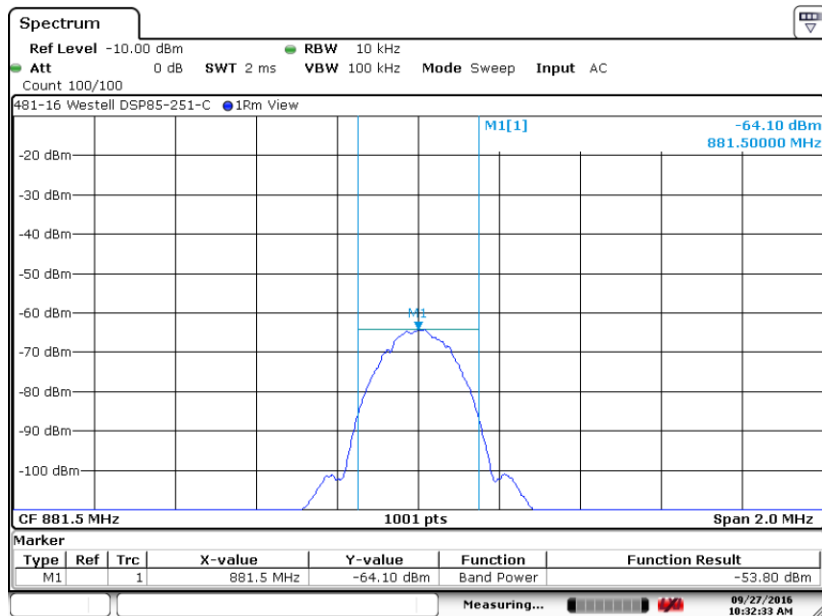
6.1. Power and Antenna Height Limits 22.913 (a), RSS-132 Section 5.4 (cont.)

6.1.20. Mean Transmitter Output Power, 881.5 MHz GSM plus 3 dB



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6.1.21. Mean Transmitter Output Power, 881.5 MHz – Input Power GSM plus 3 dB

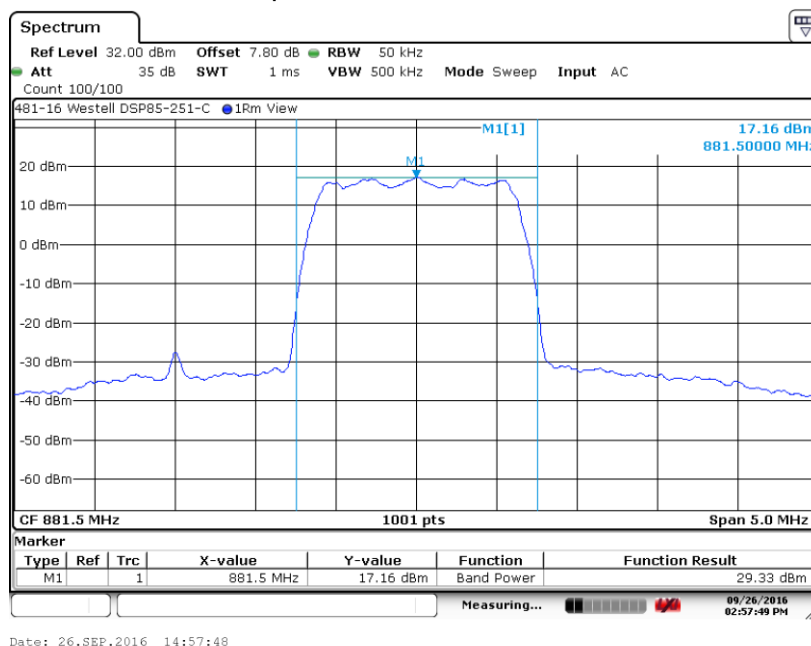


Date: 27.SEP.2016 10:32:32

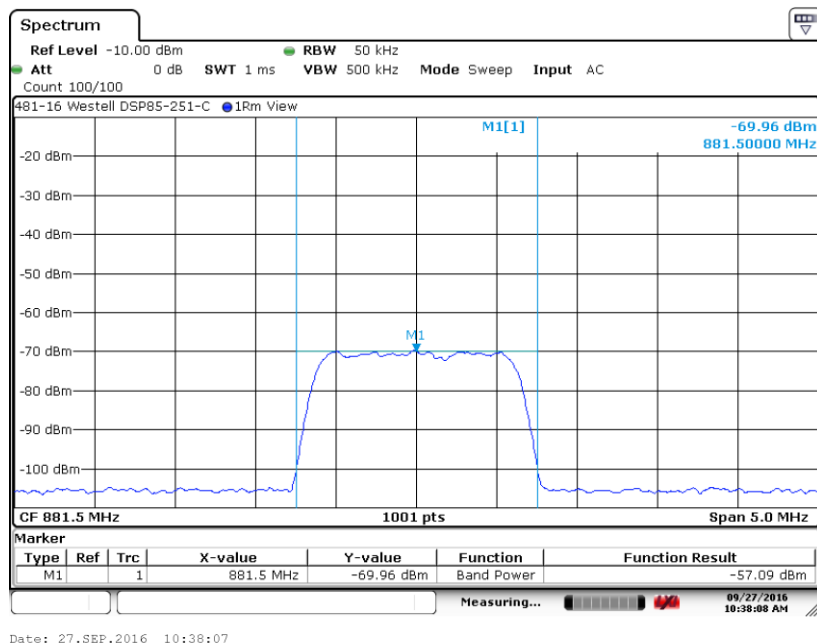
6. Measurement Data

6.1. Power and Antenna Height Limits 22.913 (a), RSS-132 Section 5.4 (cont)

6.1.22. Mean Transmitter Output Power, 881.5 MHz CDMA



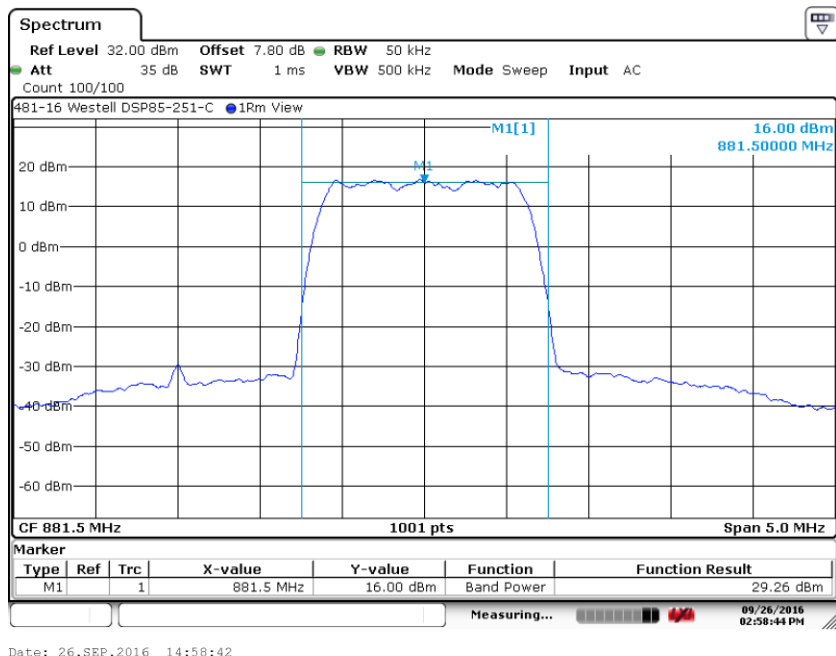
6.1.23. Mean Transmitter Output Power, 881.5 MHz – Input Power CDMA



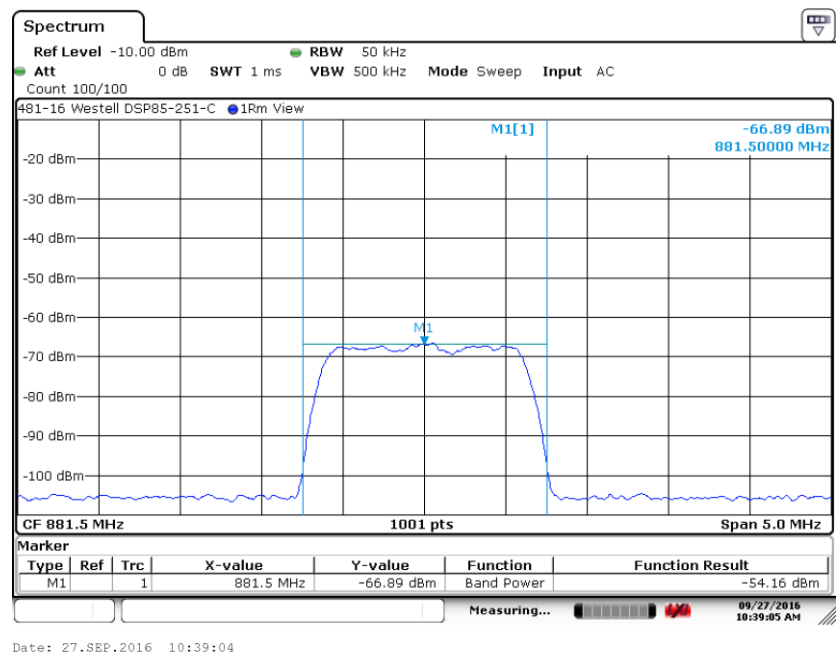
6. Measurement Data

6.1. Power and Antenna Height Limits 22.913 (a), RSS-132 Section 5.4 (cont)

6.1.24. Mean Transmitter Output Power, 881.5 MHz CDMA plus 3 dB



6.1.25. Mean Transmitter Output Power, 881.5 MHz – Input Power CDMA plus 3 dB



6. Measurement Data

6.1. Power and Antenna Height Limits 22.913 (a), RSS-132 Section 5.4 (continued)

6.1.2. Maximum ERP

ERP is defined in FCC Title 47, Chapter I, Part 2, Subpart A, Section 2.1 as "Effective Radiated Power. The product of the power supplied to the antenna and its gain relative to a half-wave dipole in a given direction."

$$\text{ERP} = \text{Transmitter Power (dBm)} - \text{Cable Loss (dB)} + \text{Antenna Gain (dBi)}$$

The manufacturer of the device under test recommends one antenna and cable combination for use with their product. The following table provides the worst case effective radiated power based on the measured transmitter output power and the antenna gain:

Description of Measurement	Center Frequency	Transmitter Power ¹	Cable Insertion Loss	Antenna Gain ²	Total Output Power	
	(MHz)	(dBm)	(dB)	(dBi)	(dBm)	(Watts)
Output Power - AWGN	836.5	29.23	0.00	3.00	32.23	1.67
Output Power - GSM	836.5	29.50	0.00	3.00	32.50	1.78
Output Power - CDMA	836.5	29.38	0.00	3.00	32.38	1.73
Output Power - AWGN	881.5	29.38	0.00	3.00	32.38	1.73
Output Power - GSM	881.5	29.77	0.00	3.00	32.77	1.89
Output Power - CDMA	881.5	29.33	0.00	3.00	32.33	1.71
3 dB Above AGC - AWGN	836.5	29.35	0.00	3.00	32.35	1.72
3 dB Above AGC - GSM	836.5	29.62	0.00	3.00	32.62	1.83
3 dB Above AGC - CDMA	836.5	29.32	0.00	3.00	32.32	1.71
3 dB Above AGC - AWGN	881.5	29.70	0.00	3.00	32.70	1.86
3 dB Above AGC - GSM	881.5	29.55	0.00	3.00	32.55	1.80
3 dB Above AGC - CDMA	881.5	29.26	0.00	3.00	32.26	1.68

¹ Measured. See section 6.1.1.

² Customer supplied 3 dBi for gain. Factor is a combination of both antenna gain and cable loss.

6.1.3. Booster gain – 85 dB Nominal

Description of Measurement	Center Frequency	Output Power	Input Power	Gain
	(MHz)	(dBm)	(dBm)	dB
Output Power - AWGN	836.5	29.23	-57.17	86.40
Output Power - GSM	836.5	29.50	-56.86	86.36
Output Power - CDMA	836.5	29.38	-57.05	86.43
Output Power - AWGN	881.5	29.38	-57.10	86.48
Output Power - GSM	881.5	29.77	-56.88	86.65
Output Power - CDMA	881.5	29.33	-57.09	86.42

6. Measurement Data (continued)
6.2. Bandwidth Limitations FCC Part 2.1049, RSS-GEN 6.6

Requirement: Each authorization issued to a station licensed under this part will show an emission designator representing the class of emission authorized. The designator will be prefixed by a specified necessary bandwidth. This number does not necessarily indicate the bandwidth occupied by the emission at any instant.

Test Method: KDB 935210 Section 3.4

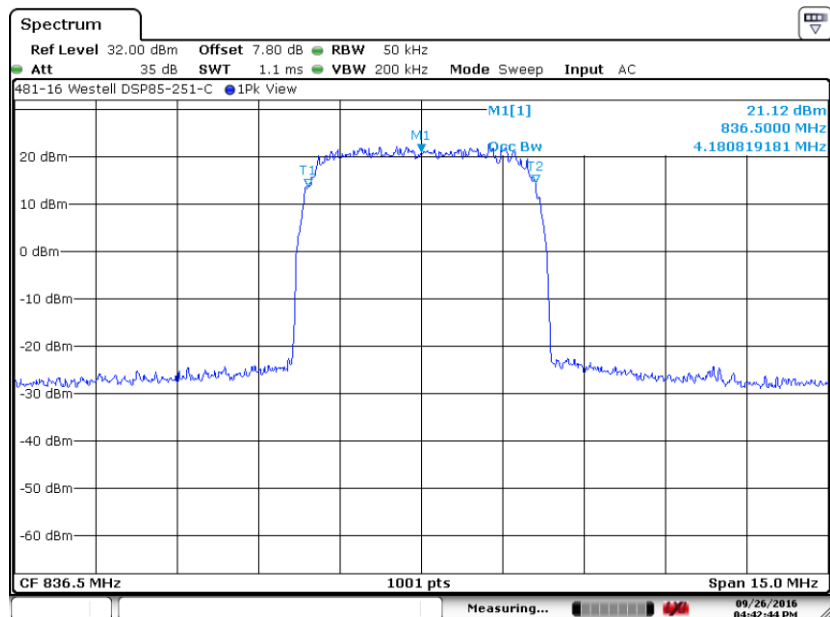
6.2.1. Occupied (99% Power) Bandwidth

Modulation Type	Center Frequency	Output Occupied Bandwidth	Input Occupied Bandwidth	Difference	Result
	MHz	kHz	kHz	kHz	
AWGN	836.5	4180.80	4255.70	-74.90	Compliant
AWGN + 3dB	836.5	4180.80	4210.80	-30.00	Compliant
GSM	836.5	245.75	245.75	0.00	Compliant
GSM + 3dB	836.5	241.76	243.76	-2.00	Compliant
CDMA	836.5	1273.70	1278.70	-5.00	Compliant
CDMA + 3dB	836.5	1273.70	1278.70	-5.00	Compliant
AWGN	881.5	4180.80	4255.70	-74.90	Compliant
AWGN + 3dB	881.5	4180.80	4210.80	-30.00	Compliant
GSM	881.5	241.76	243.76	-2.00	Compliant
GSM + 3dB	881.5	241.76	245.75	-4.00	Compliant
CDMA	881.5	1273.70	1278.70	-5.00	Compliant
CDMA + 3dB	881.5	1273.70	1278.70	-5.00	Compliant

6. Measurement Data (continued)

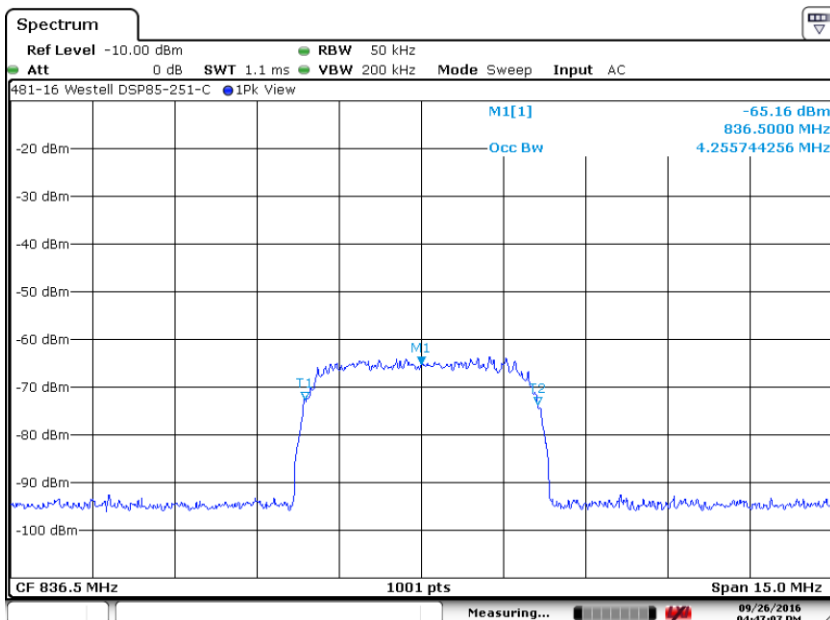
6.2. Bandwidth Limitations FCC Part 2.1049, RSS-GEN 6.6 (continued)

6.2.1.1. Occupied (99% Power) Bandwidth Measurement, 836.5 MHz AWGN



Date: 26.SEP.2016 16:42:43

6.2.1.2. Occupied (99% Power) Bandwidth Input Signal, 836.5 MHz AWGN



Date: 26.SEP.2016 16:47:06

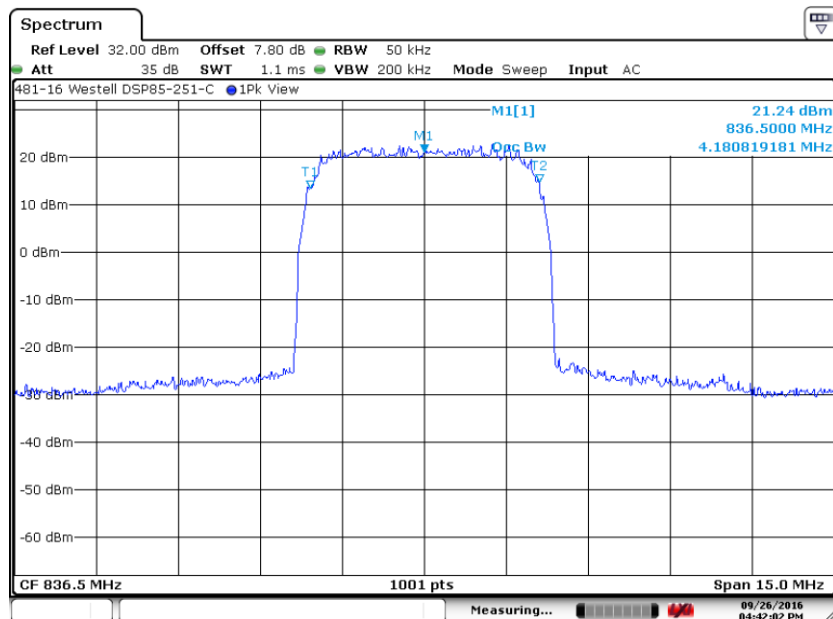
Test Number: 481-16R2

Issue Date: 1/11/2017

6. Measurement Data (continued)

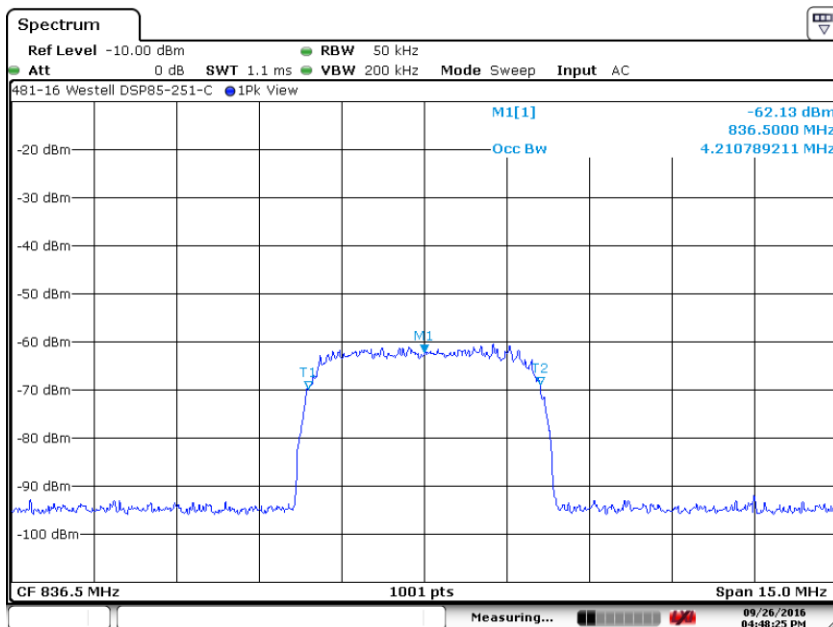
6.2. Bandwidth Limitations FCC Part 2.1049, RSS-GEN 6.6 (continued)

6.2.1.3. Occupied (99% Power) Bandwidth Measurement, 836.5 MHz AWGN +3dB



Date: 26.SEP.2016 16:42:00

6.2.1.4. Occupied (99% Power) Bandwidth Input Signal, 836.5 MHz AWGN + 3dB



Date: 26.SEP.2016 16:48:24

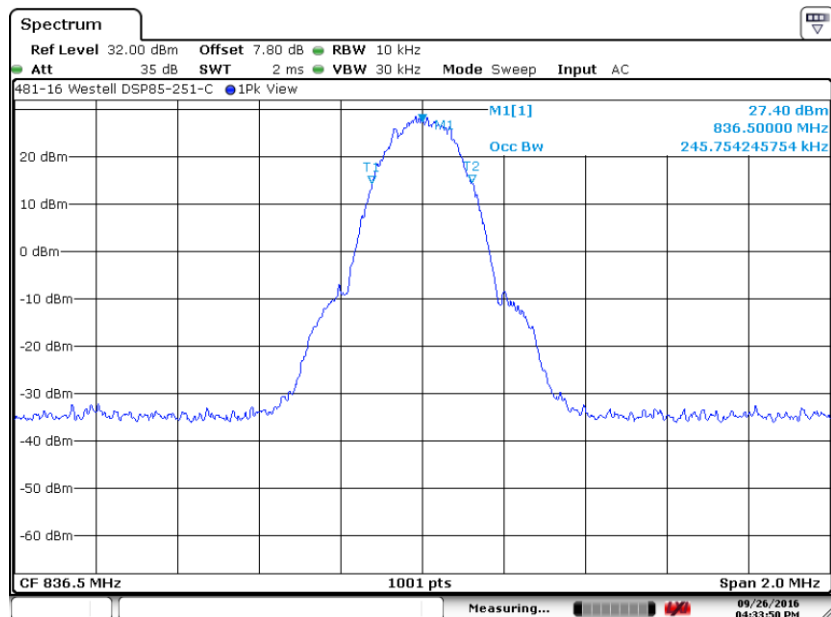
Test Number: 481-16R2

Issue Date: 1/11/2017

6. Measurement Data (continued)

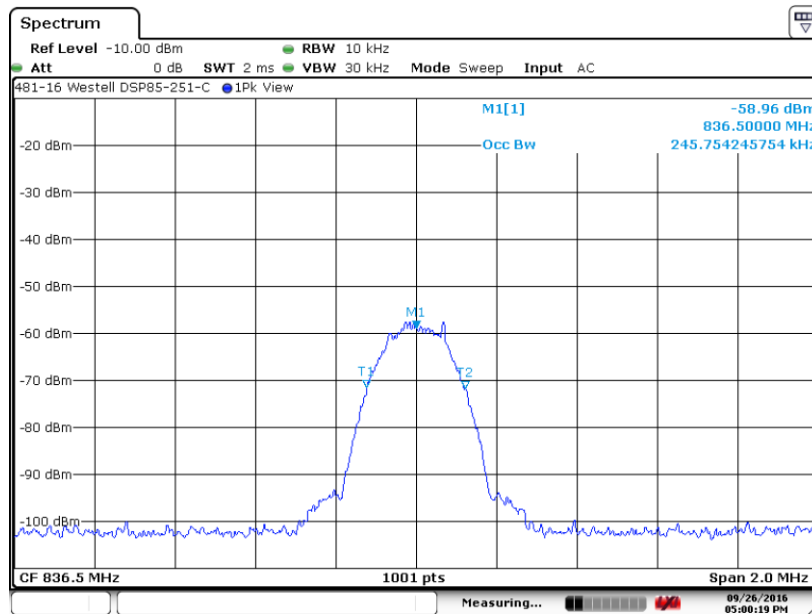
6.2. Bandwidth Limitations FCC Part 2.1049, RSS-GEN 6.6 (continued)

6.2.1.5. Occupied (99% Power) Bandwidth Measurement, 836.5 MHz GSM



Date: 26.SEP.2016 16:33:48

6.2.1.6. Occupied (99% Power) Bandwidth Input Signal, 836.5 MHz GSM



Date: 26.SEP.2016 17:00:17

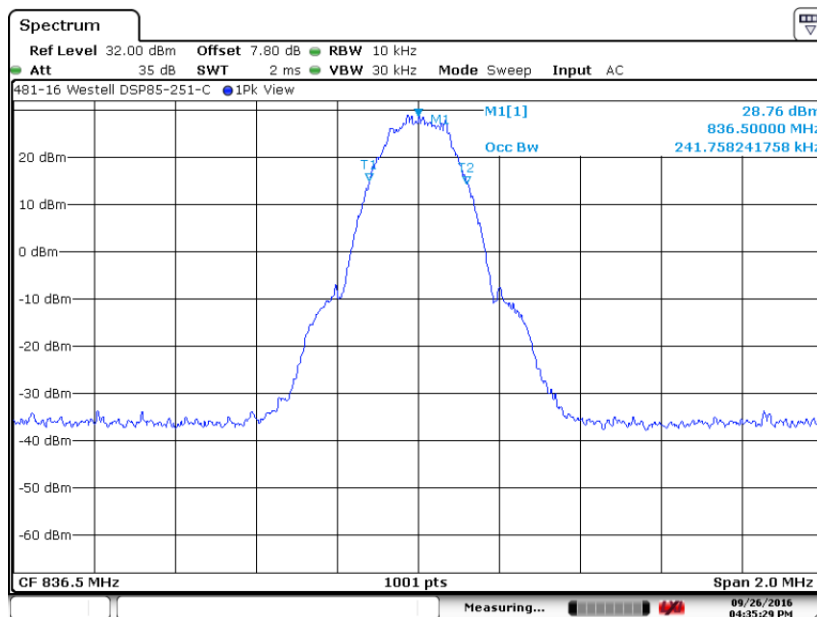
Test Number: 481-16R2

Issue Date: 1/11/2017

6. Measurement Data (continued)

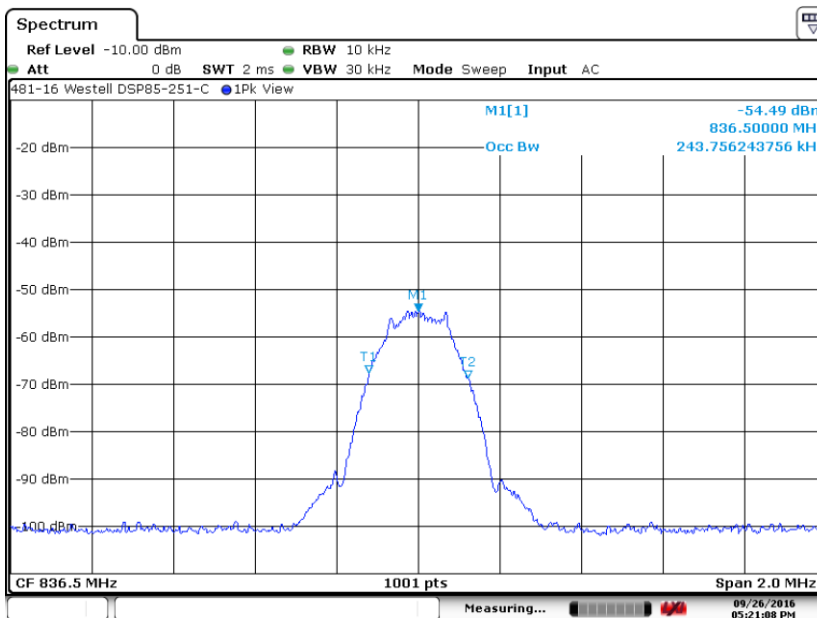
6.2. Bandwidth Limitations FCC Part 2.1049, RSS-GEN 6.6 (continued)

6.2.1.7. Occupied (99% Power) Bandwidth Measurement, 836.5 MHz GSM +3dB



Date: 26.SEP.2016 16:35:28

6.2.1.8. Occupied (99% Power) Bandwidth Input Signal, 836.5 MHz GSM + 3dB

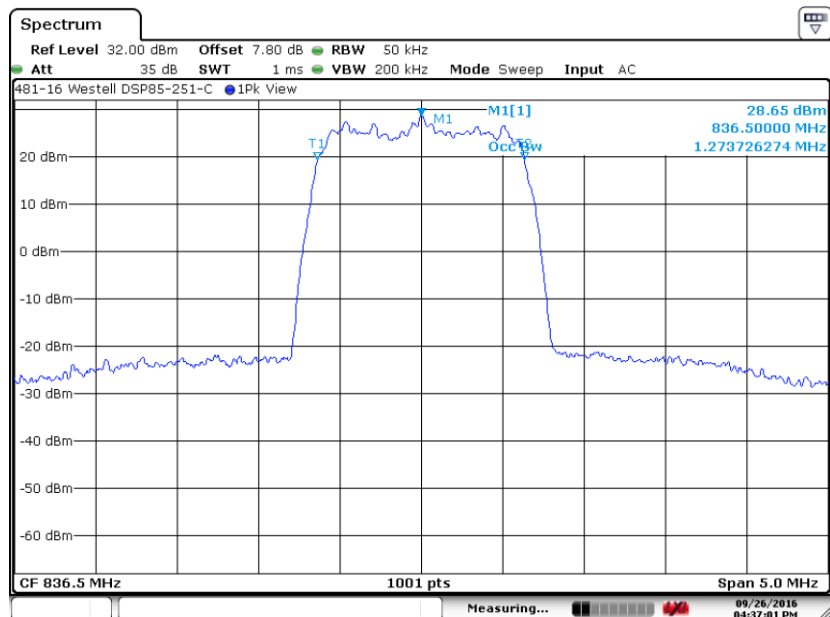


Date: 26.SEP.2016 17:21:07

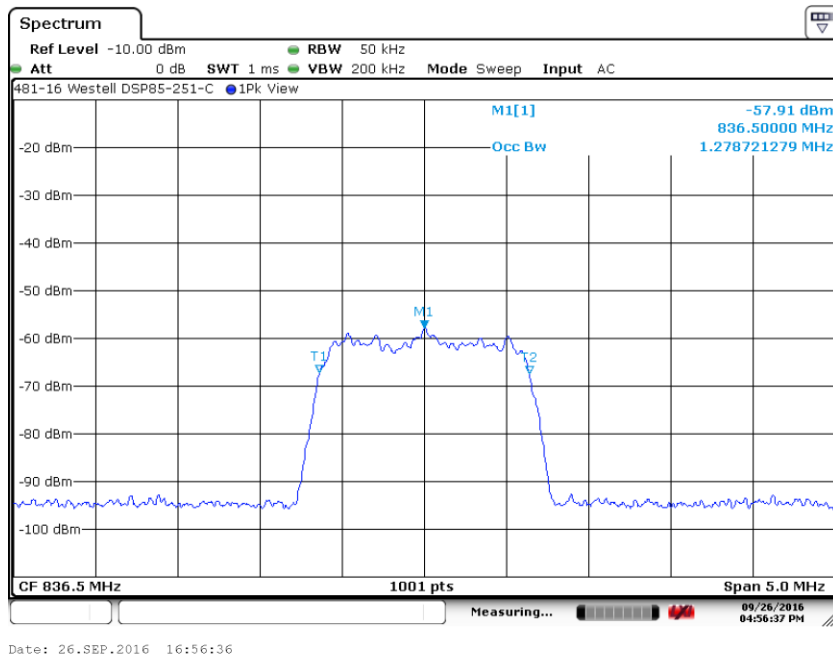
6. Measurement Data (continued)

6.2. Bandwidth Limitations FCC Part 2.1049, RSS-GEN 6.6 (continued)

6.2.1.9. Occupied (99% Power) Bandwidth Measurement, 836.5 MHz CDMA



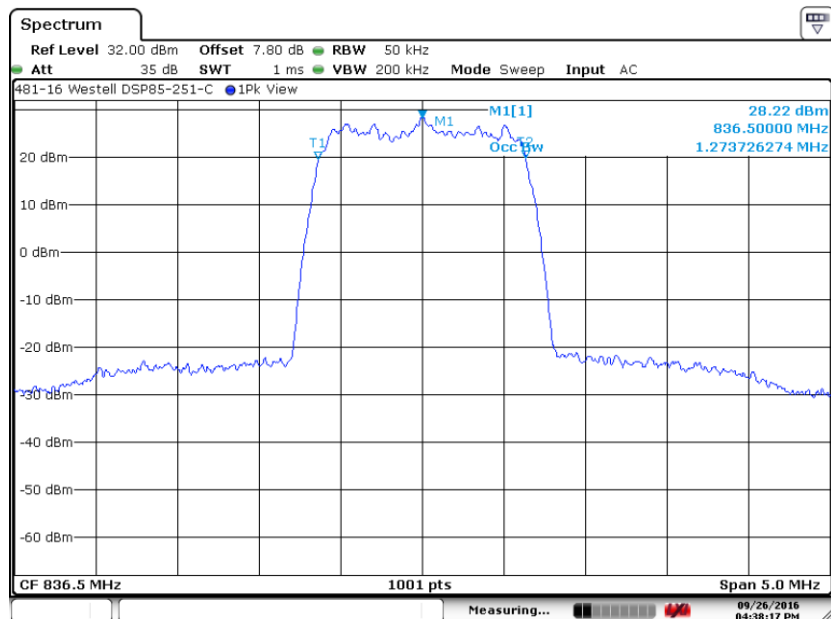
6.2.1.10. Occupied (99% Power) Bandwidth Input Signal, 836.5 MHz CDMA



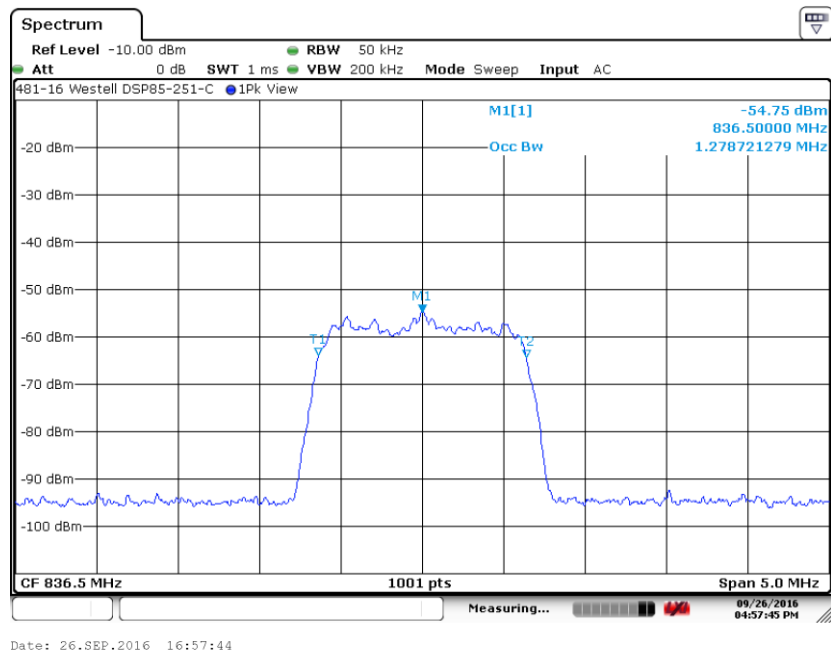
6. Measurement Data (continued)

6.2. Bandwidth Limitations FCC Part 2.1049, RSS-GEN 6.6 (continued)

6.2.1.11. Occupied (99% Power) Bandwidth Measurement 836.5 MHz CDMA +3dB



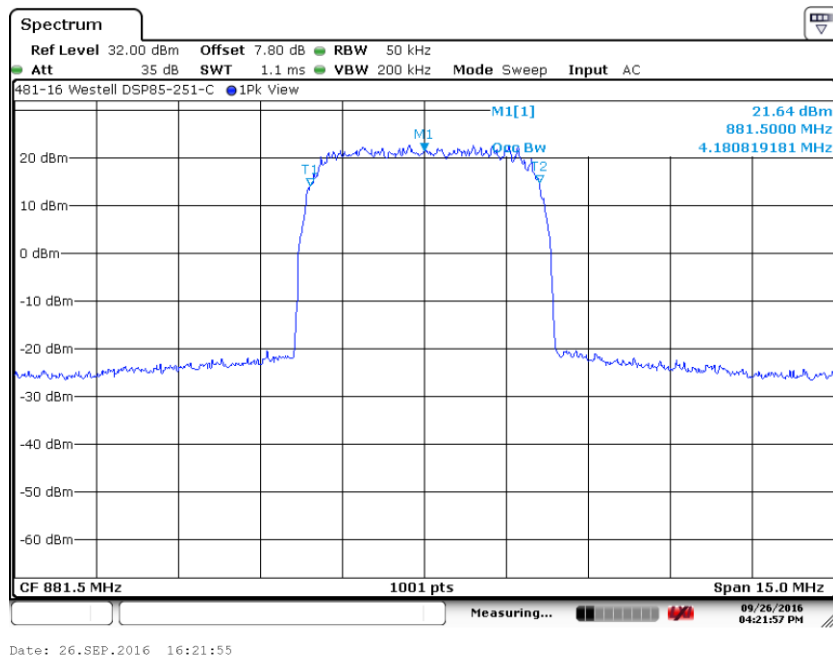
6.2.1.12. Occupied (99% Power) Bandwidth Input Signal, 836.5 MHz CDMA +3dB



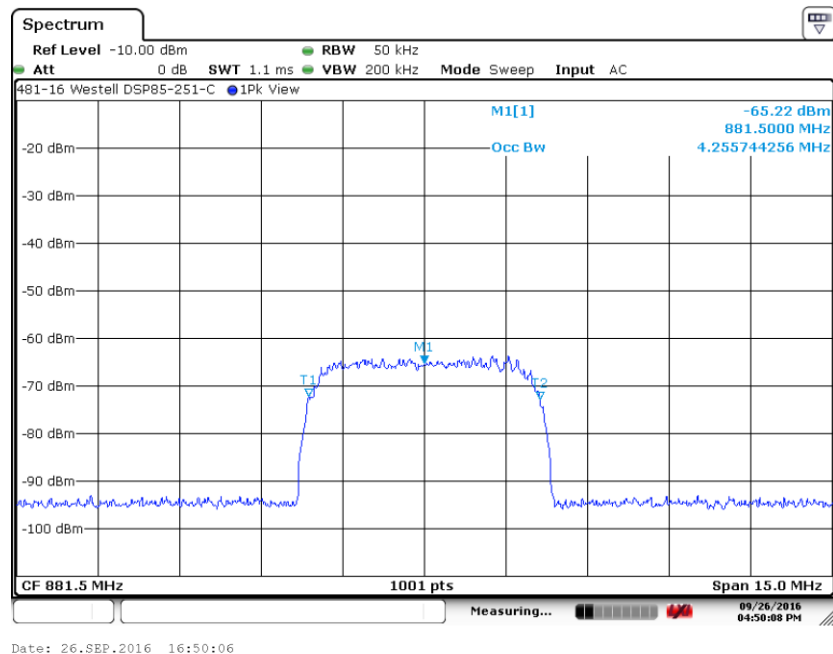
6. Measurement Data (continued)

6.2. Bandwidth Limitations FCC Part 2.1049, RSS-GEN 6.6 (continued)

6.2.1.13. Occupied (99% Power) Bandwidth Measurement, 881.5 MHz AWGN



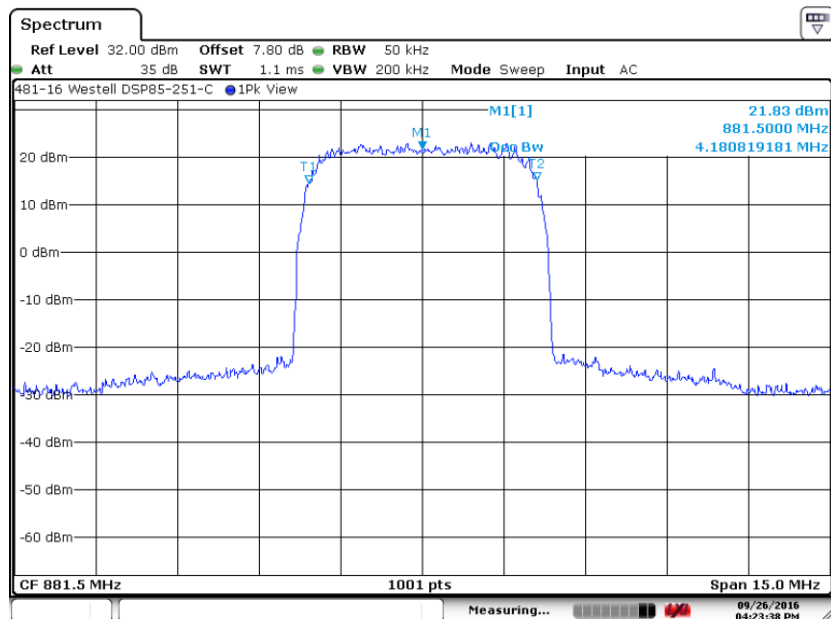
6.2.1.14. Occupied (99% Power) Bandwidth Input Signal, 881.5 MHz AWGN



6. Measurement Data (continued)

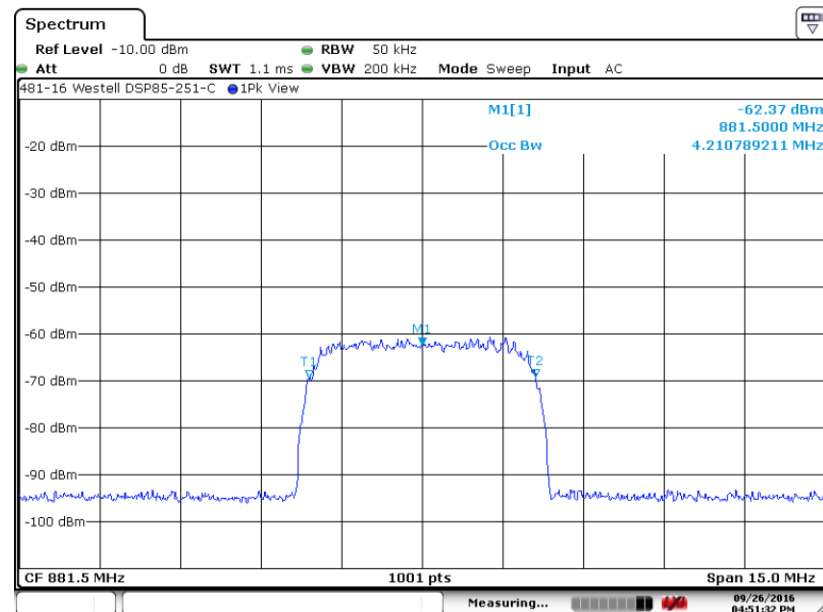
6.2. Bandwidth Limitations FCC Part 2.1049, RSS-GEN 6.6 (continued)

6.2.1.15. Occupied (99% Power) Bandwidth Measurement, 881.5 MHz AWGN + 3dB



Date: 26.SEP.2016 16:23:37

6.2.1.16. Occupied (99% Power) Bandwidth Input Signal, 881.5 MHz AWGN +3dB



Date: 26.SEP.2016 16:51:31

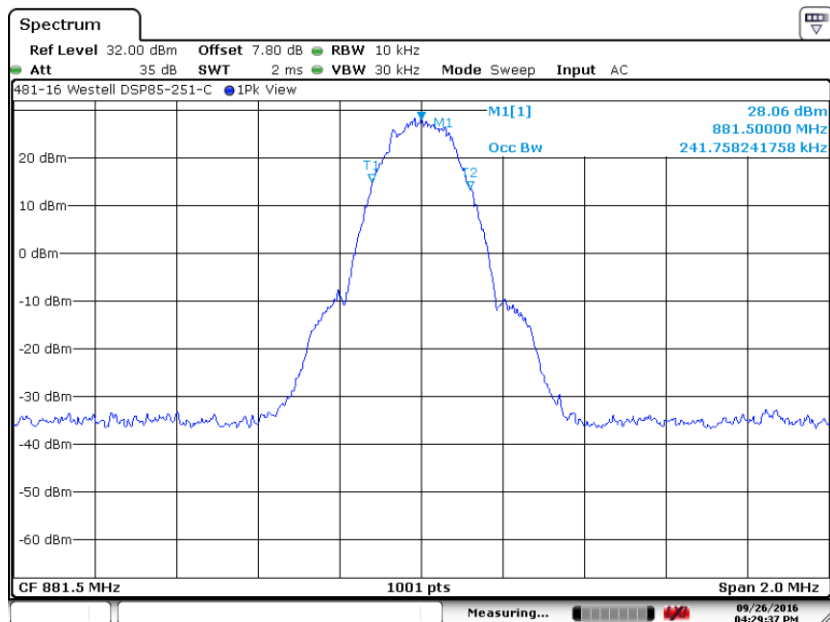
Test Number: 481-16R2

Issue Date: 1/11/2017

6. Measurement Data (continued)

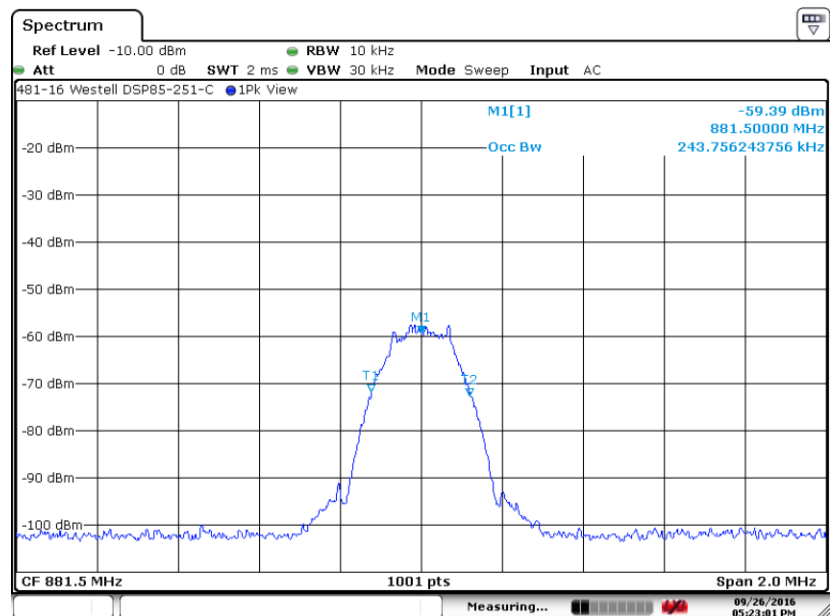
6.2. Bandwidth Limitations FCC Part 2.1049, RSS-GEN 6.6 (continued)

6.2.1.17. Occupied (99% Power) Bandwidth Measurement, 881.5 MHz GSM



Date: 26.SEP.2016 16:29:36

6.2.1.18. Occupied (99% Power) Bandwidth Input Signal, 881.5 MHz GSM



Date: 26.SEP.2016 17:23:00

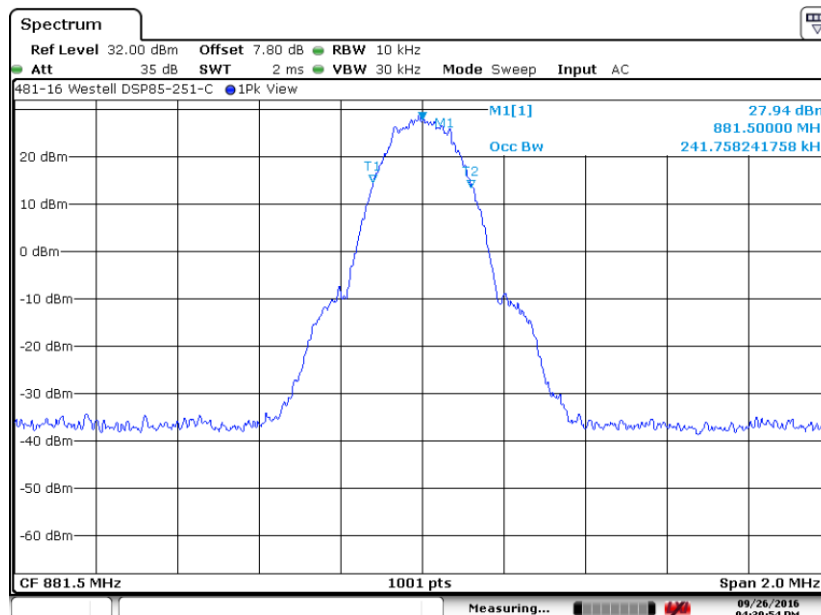
Test Number: 481-16R2

Issue Date: 1/11/2017

6. Measurement Data (continued)

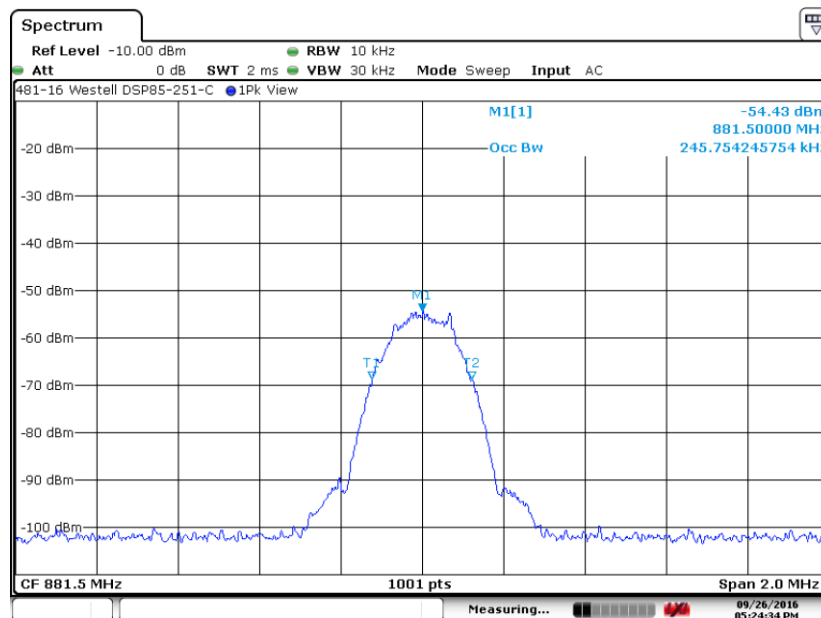
6.2. Bandwidth Limitations FCC Part 2.1049, RSS-GEN 6.6 (continued)

6.2.1.19. Occupied (99% Power) Bandwidth Measurement, 881.5 MHz GSM +3dB



Date: 26.SEP.2016 16:30:52

6.2.1.20. Occupied (99% Power) Bandwidth Input Signal, 881.5 MHz GSM +3dB

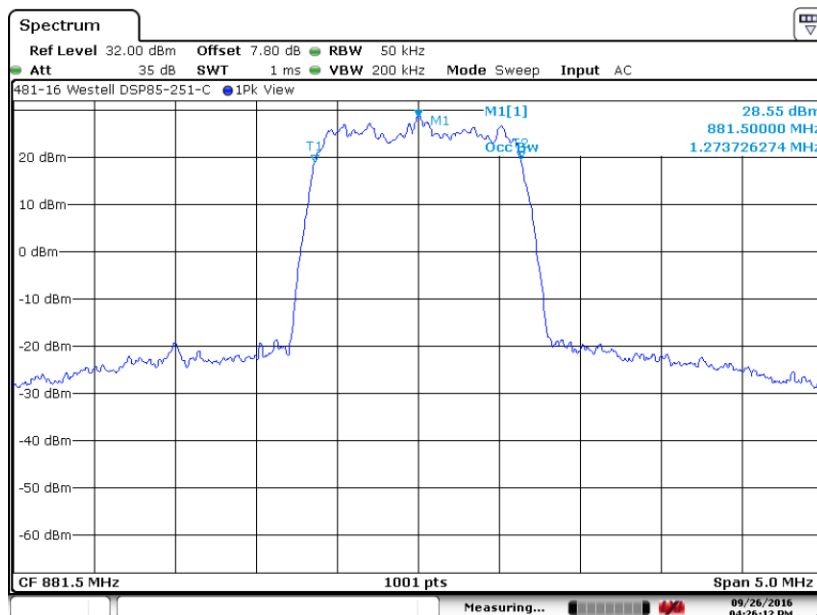


Date: 26.SEP.2016 17:24:33

6. Measurement Data (continued)

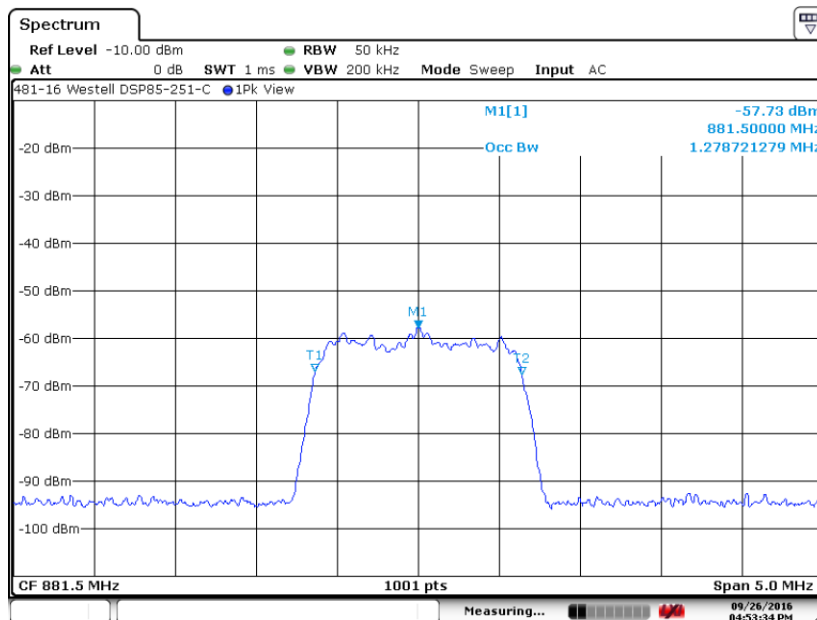
6.2. Bandwidth Limitations FCC Part 2.1049, RSS-GEN 6.6 (continued)

6.2.1.21. Occupied (99% Power) Bandwidth Measurement, 881.5 MHz CDMA



Date: 26.SEP.2016 16:26:11

6.2.1.22. Occupied (99% Power) Bandwidth Input Signal, 881.5 MHz CDMA



Date: 26.SEP.2016 16:53:32

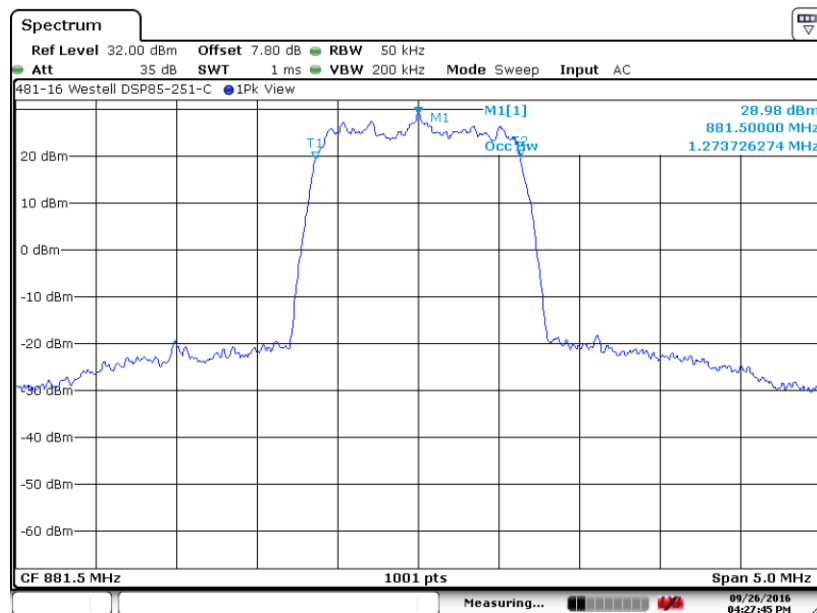
Test Number: 481-16R2

Issue Date: 1/11/2017

6. Measurement Data (continued)

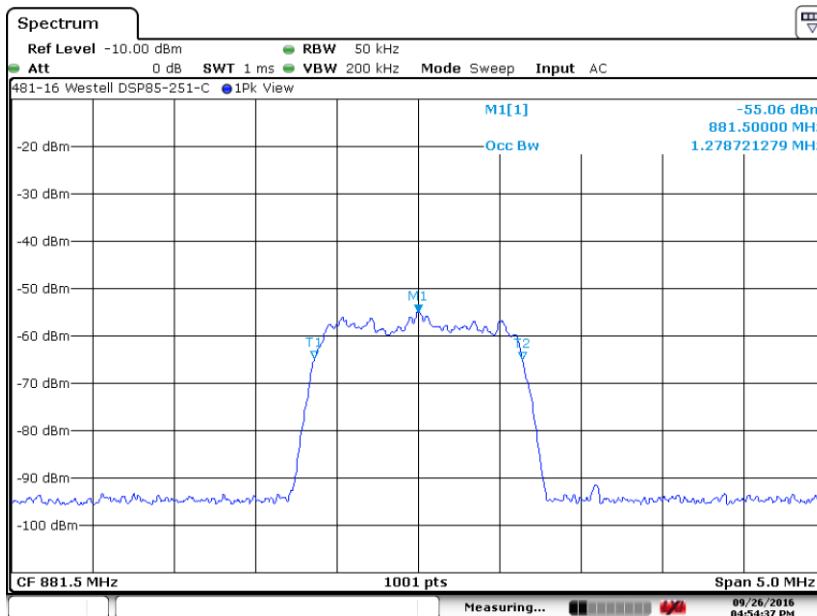
6.2. Bandwidth Limitations FCC Part 2.1049, RSS-GEN 6.6 (continued)

6.2.1.23. Occupied (99% Power) Bandwidth Measurement, 881.5 MHz CDMA +3dB



Date: 26.SEP.2016 16:27:44

6.2.1.24. Occupied (99% Power) Bandwidth Input Signal, 881.5 MHz CDMA + 3dB



Date: 26.SEP.2016 16:54:36

6. Measurement Data (continued)

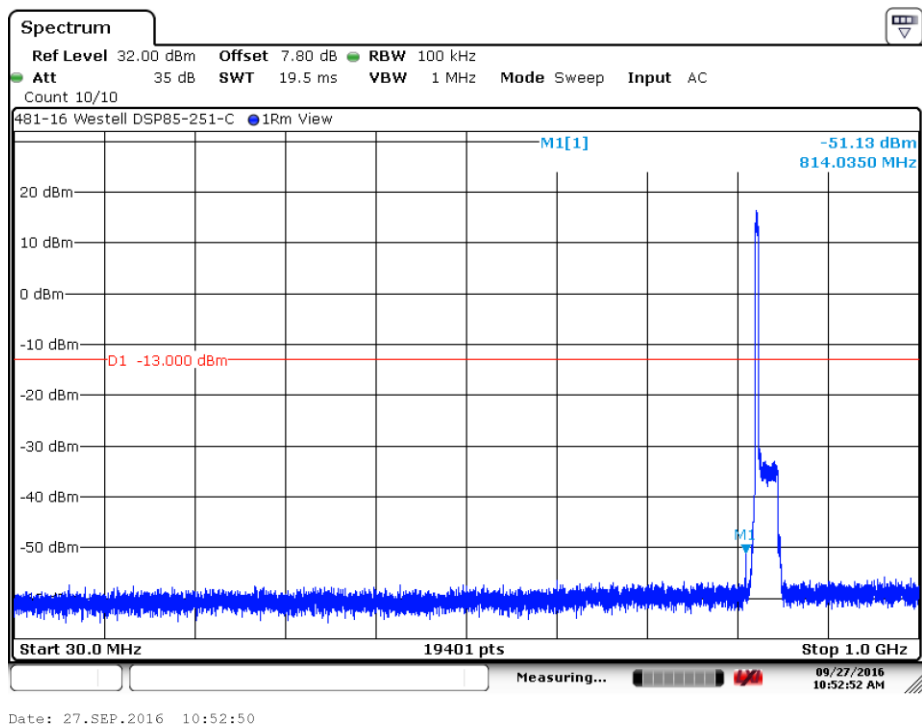
6.3. Spurious Emissions at the Antenna Terminals 22.917, RSS-132 5.5

Requirement: For operations in the 824-849 MHz and 869-894 MHz bands, the power of any emission outside of the licensee's frequency block shall be attenuated below the transmitter power (P) by at least $43 + 10 \log (P)$ dB.

Compliance with this provision is based upon the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the licensee's frequency block a resolution bandwidth of at least one percent of the emissions bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emission are attenuated at least 26 dB below the transmitter power.

Test Method: KDB 935210 Section 3.6.3

6.3.1. 824 MHz, 30 MHz to 1 GHz, AWGN



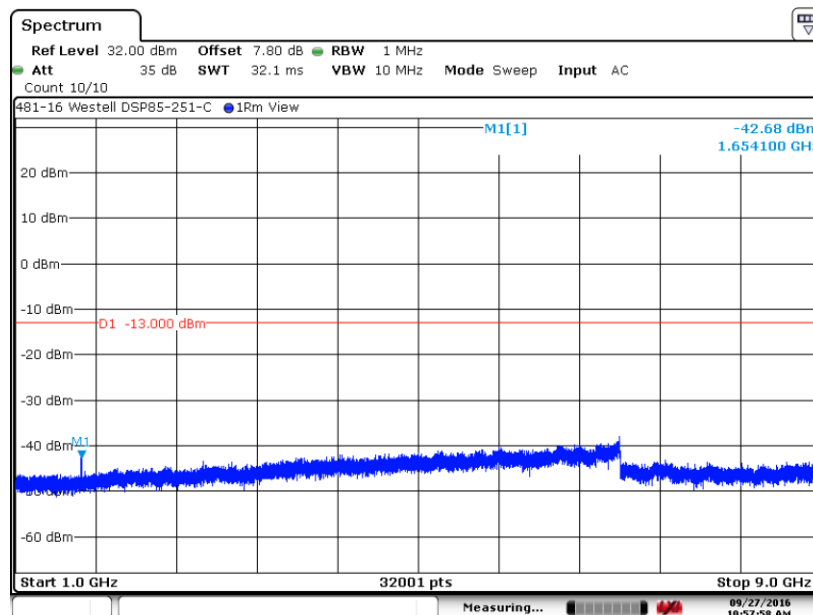
Test Number: 481-16R2

Issue Date: 1/11/2017

6. Measurement Data (continued)

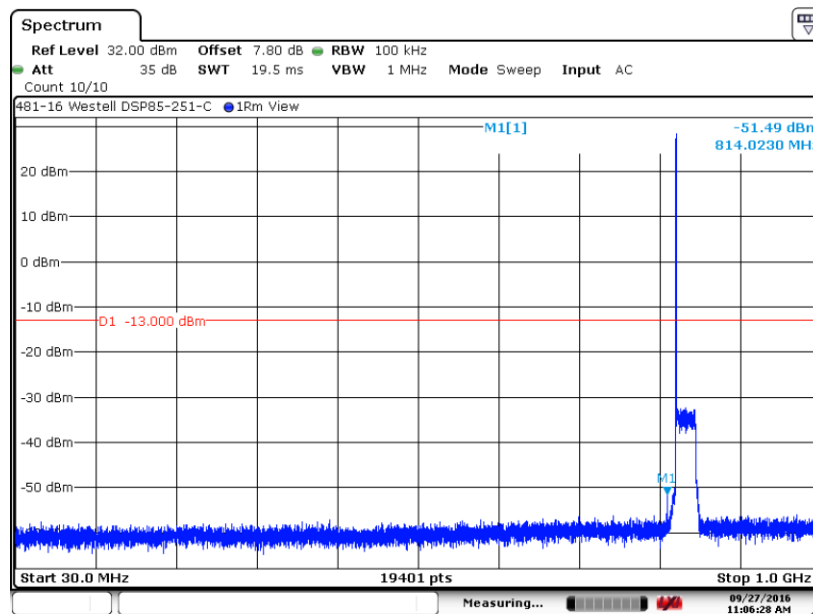
6.3. Spurious Emissions at the Antenna Terminals 22.917, RSS-132 5.5 (continued)

6.3.2. 824 MHz, 1 to 9 GHz, AWGN



Date: 27.SEP.2016 10:57:57

6.3.3. 824 MHz, 30 MHz to 1 GHz, GSM



Date: 27.SEP.2016 11:06:26

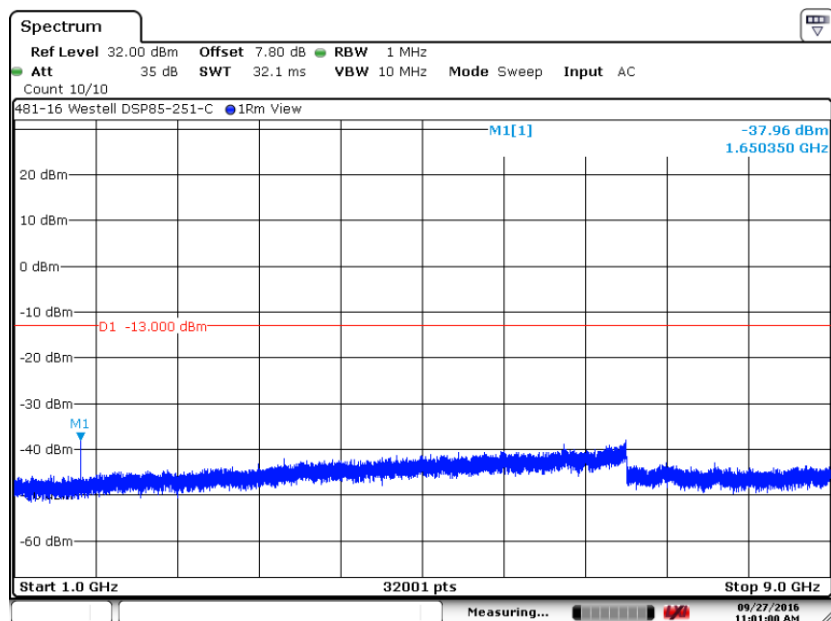
Test Number: 481-16R2

Issue Date: 1/11/2017

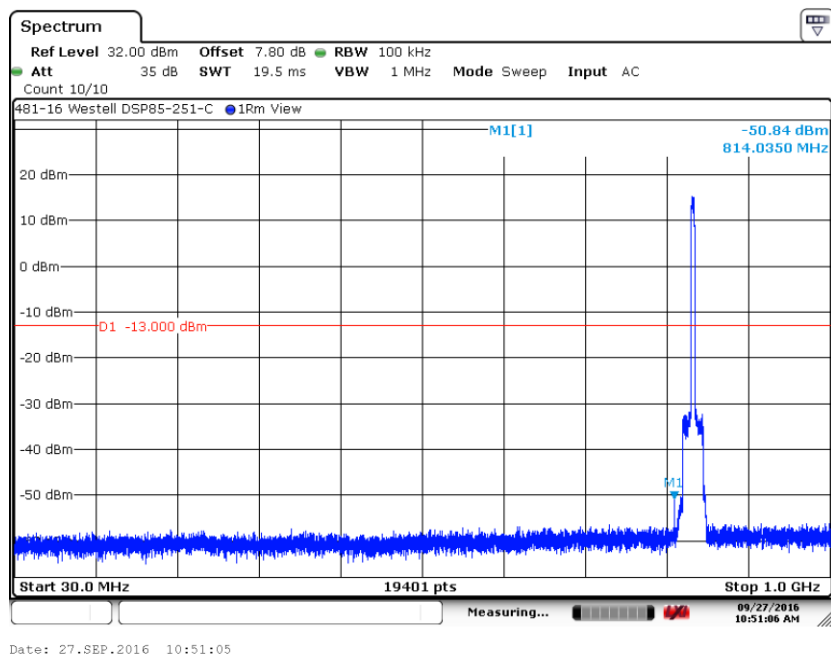
6. Measurement Data (continued)

6.3. Spurious Emissions at the Antenna Terminals 22.917, RSS-132 5.5 (continued)

6.3.4. 824 MHz, 1 to 9 GHz, GSM



6.3.5. 836.5 MHz, 30 MHz to 1 GHz, AWGN



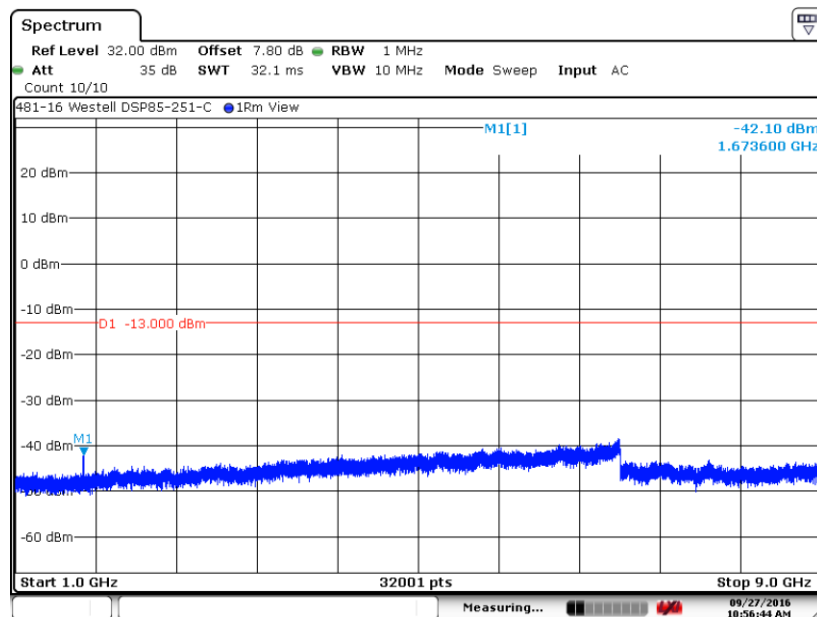
Test Number: 481-16R2

Issue Date: 1/11/2017

6. Measurement Data (continued)

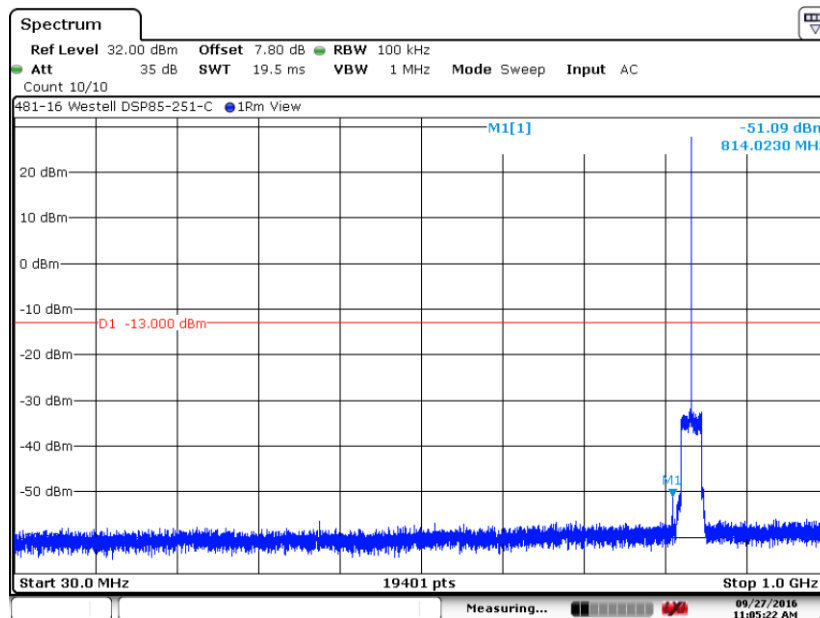
6.3. Spurious Emissions at the Antenna Terminals 22.917, RSS-132 5.5 (continued)

6.3.6. 836.5 MHz, 1 to 9 GHz, AWGN



Date: 27.SEP.2016 10:56:43

6.3.7. 836.5 MHz, 30 MHz to 1 GHz, GSM



Date: 27.SEP.2016 11:05:21

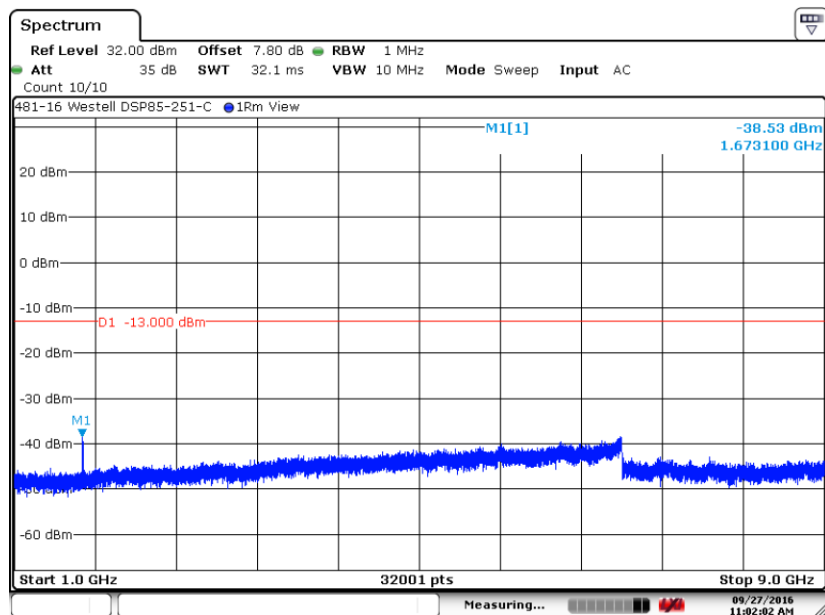
Test Number: 481-16R2

Issue Date: 1/11/2017

6. Measurement Data (continued)

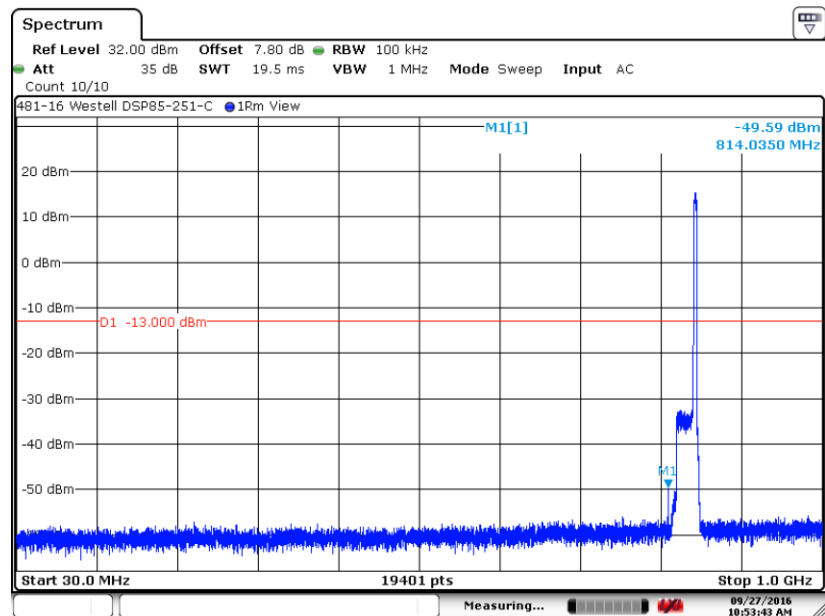
6.3. Spurious Emissions at the Antenna Terminals 22.917, RSS-132 5.5 (continued)

6.3.8. 836.5 MHz, 1 to 9 GHz, GSM



Date: 27.SEP.2016 11:02:00

6.3.9. 849 MHz, 30 MHz to 1 GHz, AWGN



Date: 27.SEP.2016 10:53:42

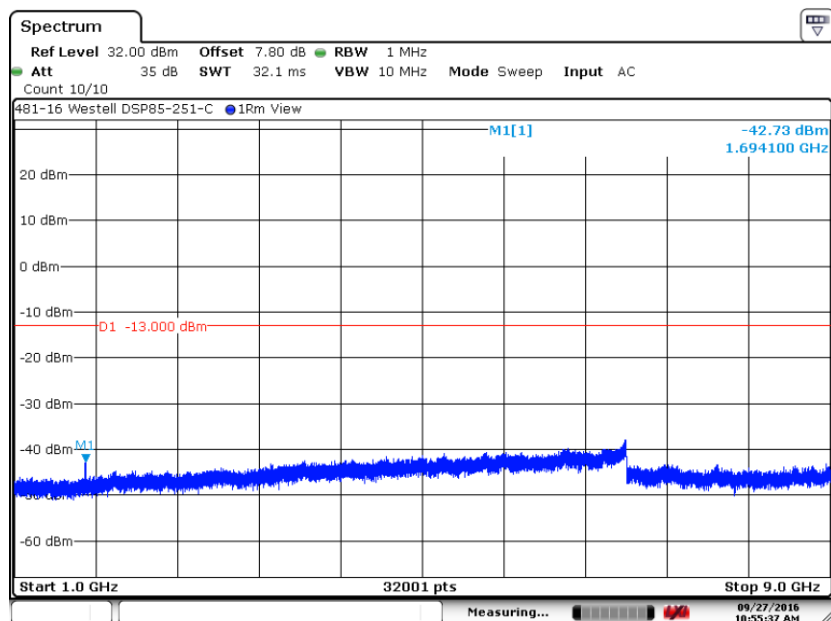
Test Number: 481-16R2

Issue Date: 1/11/2017

6. Measurement Data (continued)

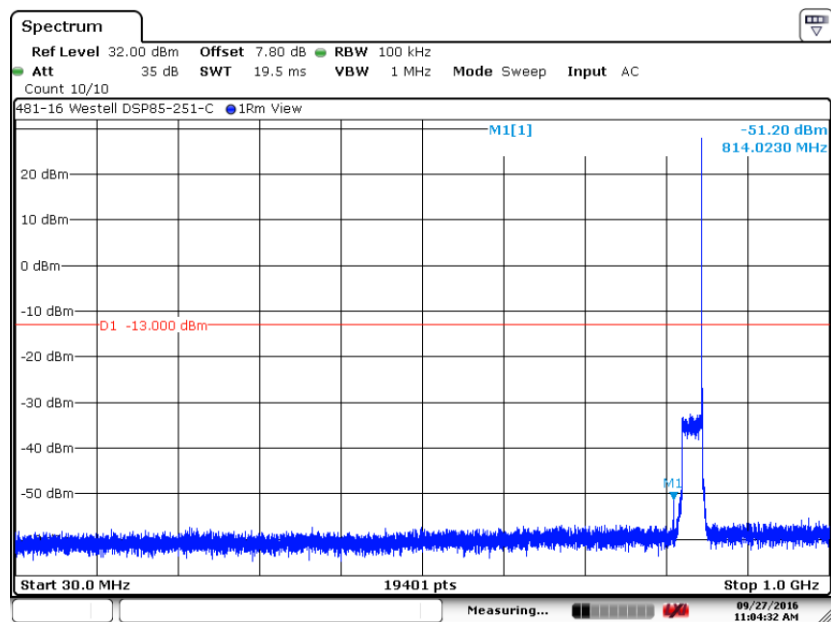
6.3. Spurious Emissions at the Antenna Terminals 22.917, RSS-132 5.5 (continued)

6.3.10. 849 MHz, 1 to 9 GHz, AWGN



Date: 27.SEP.2016 10:55:36

6.3.11. 849 MHz, 30 MHz to 1 GHz, GSM



Date: 27.SEP.2016 11:04:30

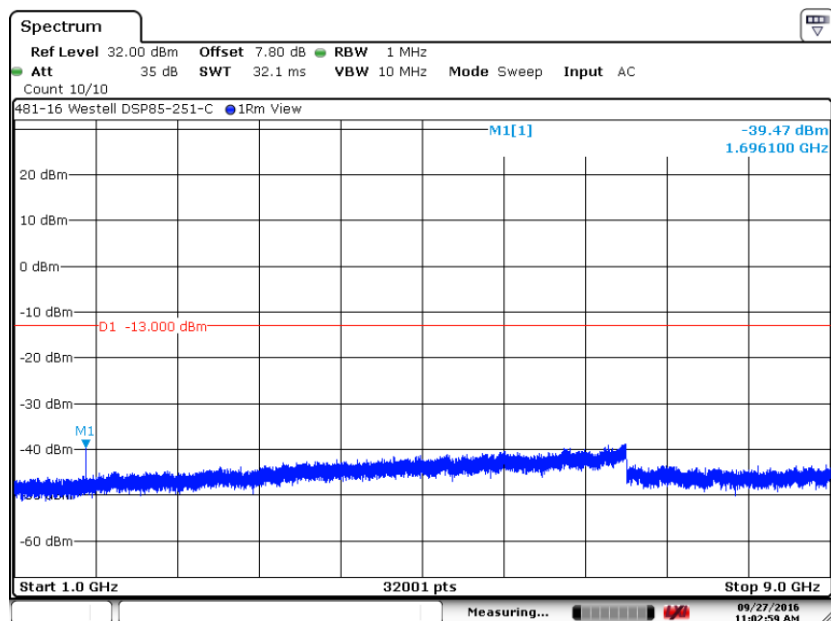
Test Number: 481-16R2

Issue Date: 1/11/2017

6. Measurement Data (continued)

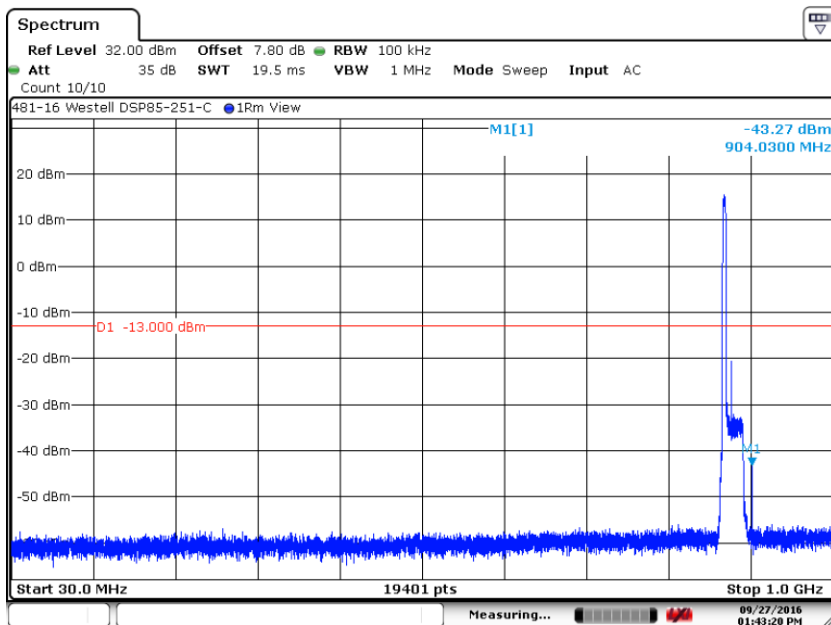
6.3. Spurious Emissions at the Antenna Terminals 22.917, RSS-132 5.5 (continued)

6.3.12. 849 MHz, 1 to 9 GHz, GSM



Date: 27.SEP.2016 11:02:58

6.3.13. 869 MHz, 30 MHz to 1 GHz, AWGN



Date: 27.SEP.2016 13:43:18

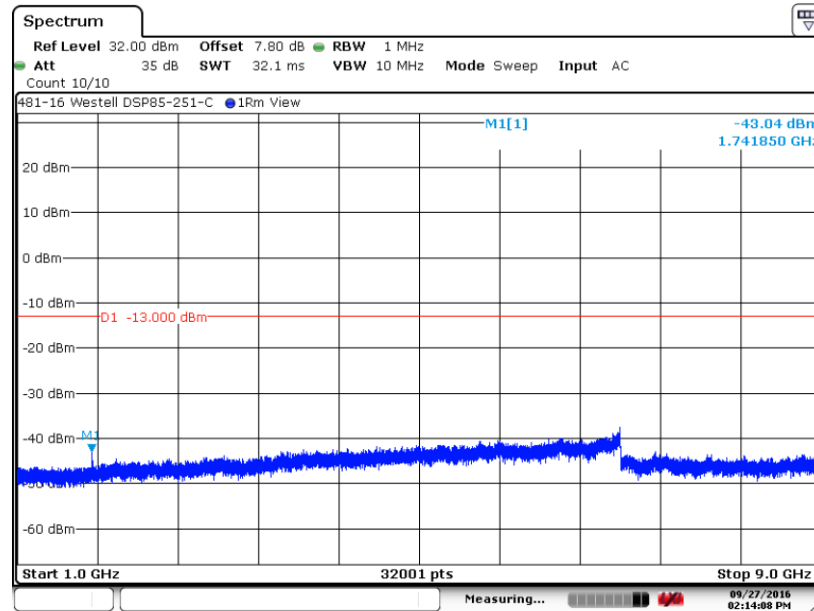
Test Number: 481-16R2

Issue Date: 1/11/2017

6. Measurement Data (continued)

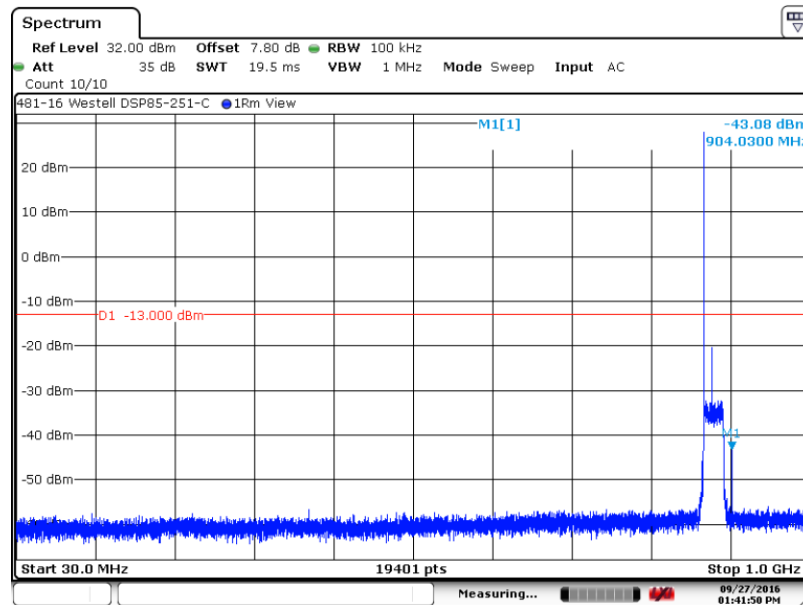
6.3. Spurious Emissions at the Antenna Terminals 22.917, RSS-132 5.5 (continued)

6.3.14. 869 MHz, 1 to 9 GHz, AWGN



Date: 27.SEP.2016 14:14:06

6.3.15. 869 MHz, 30 MHz to 1 GHz, GSM



Date: 27.SEP.2016 13:41:48

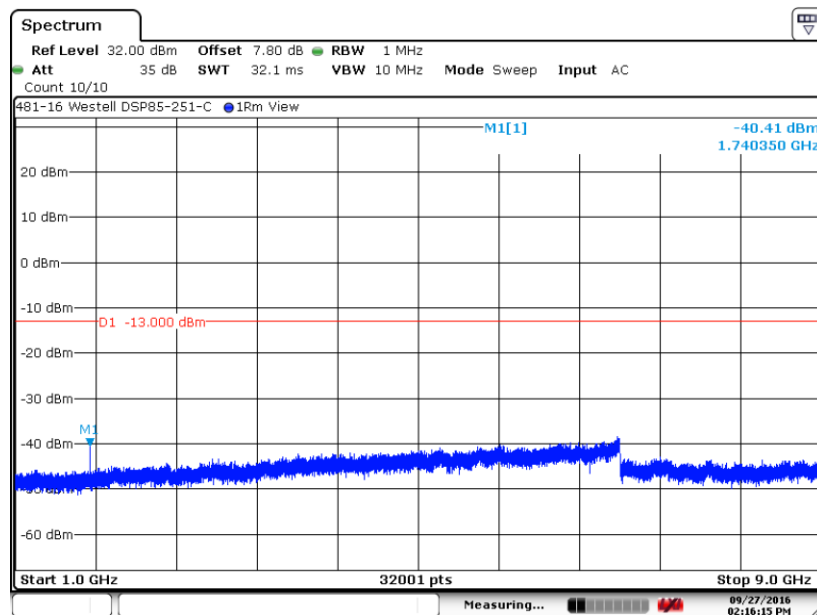
Test Number: 481-16R2

Issue Date: 1/11/2017

6. Measurement Data (continued)

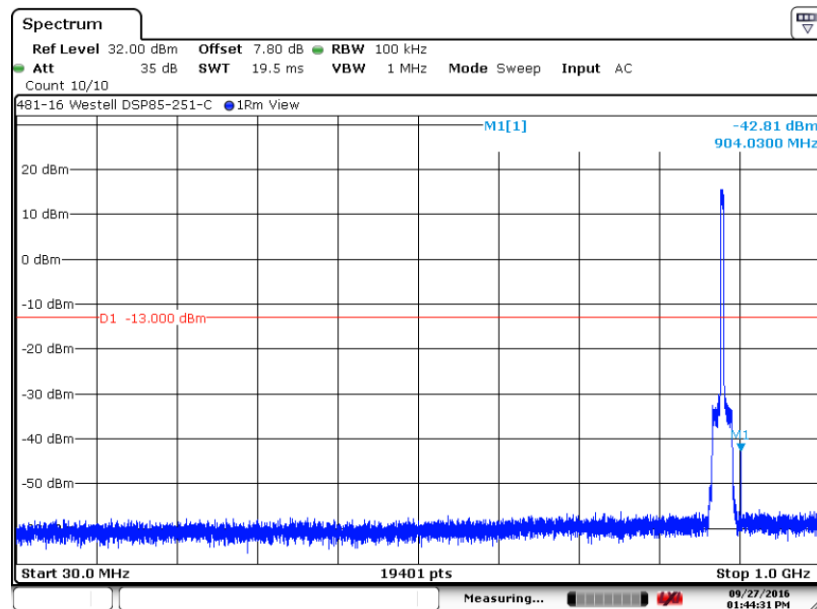
6.3. Spurious Emissions at the Antenna Terminals 22.917, RSS-132 5.5 (continued)

6.3.16. 869 MHz, 1 to 9 GHz, GSM



Date: 27.SEP.2016 14:16:14

6.3.17. 881.5 MHz, 30 MHz to 1 GHz, AWGN



Date: 27.SEP.2016 13:44:29

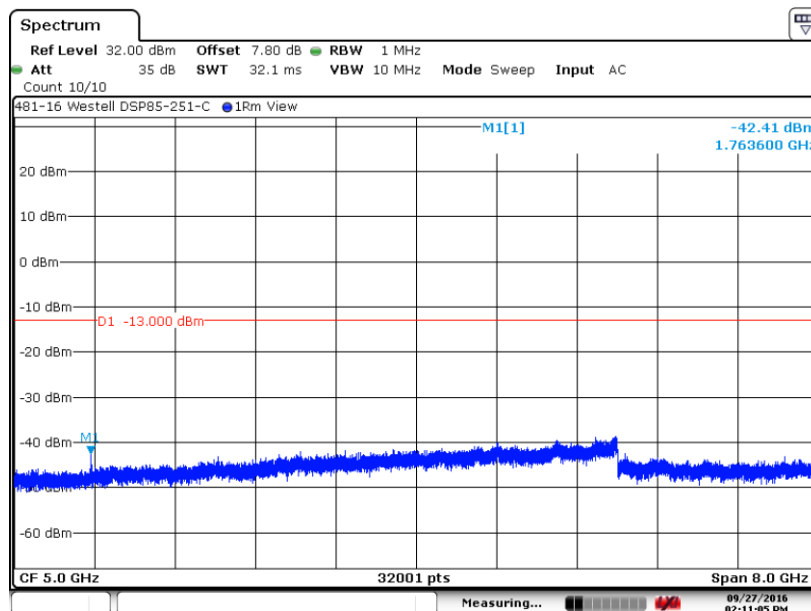
Test Number: 481-16R2

Issue Date: 1/11/2017

6. Measurement Data (continued)

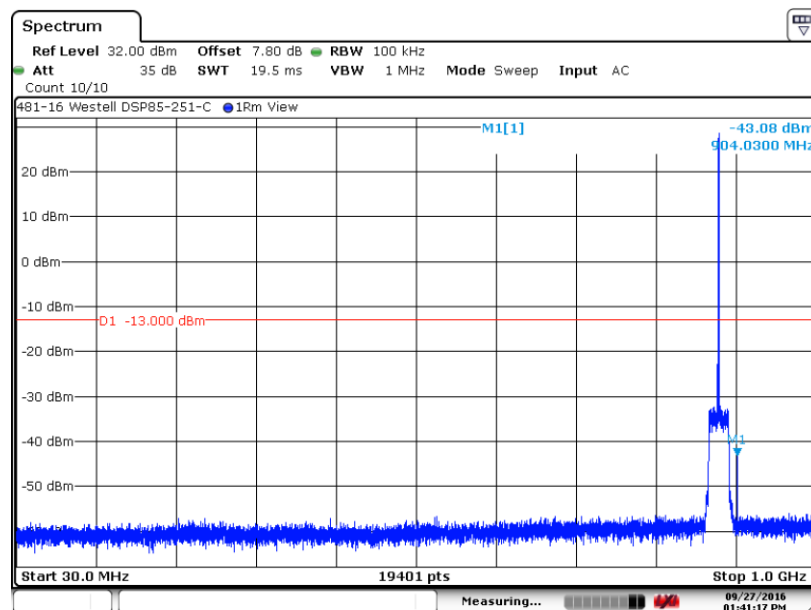
6.3. Spurious Emissions at the Antenna Terminals 22.917, RSS-132 5.5 (continued)

6.3.18. 881.5 MHz, 1 to 9 GHz, AWGN



Date: 27.SEP.2016 14:11:04

6.3.19. 881.5 MHz, 30 MHz to 1 GHz, GSM



Date: 27.SEP.2016 13:41:16

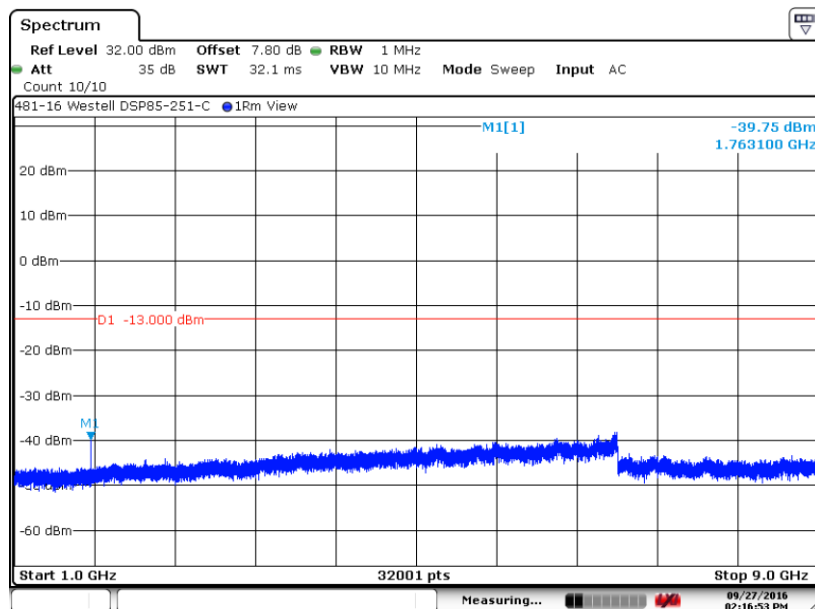
Test Number: 481-16R2

Issue Date: 1/11/2017

6. Measurement Data (continued)

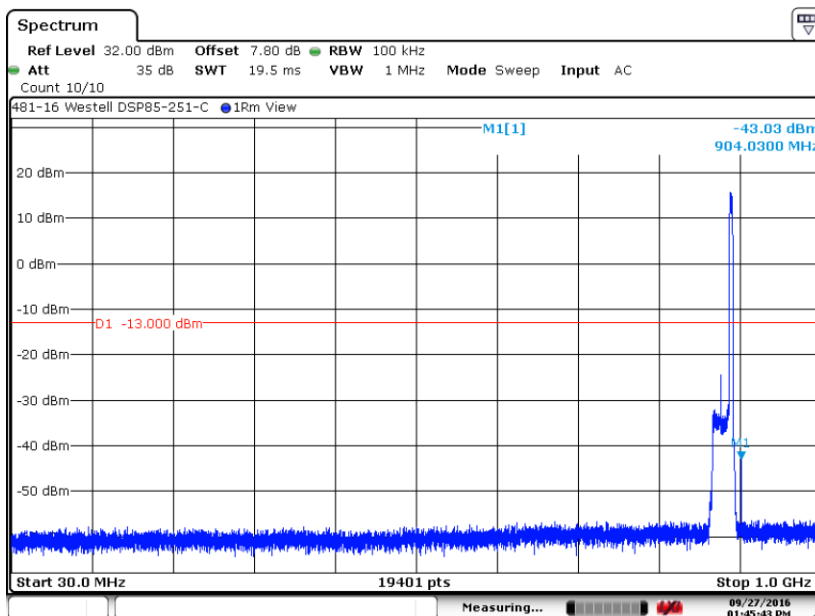
6.3. Spurious Emissions at the Antenna Terminals 22.917, RSS-132 5.5 (continued)

6.3.20. 881.5 MHz, 1 to 9 GHz, GSM



Date: 27.SEP.2016 14:16:51

6.3.21. 894 MHz, 30 MHz to 1 GHz, AWGN



Date: 27.SEP.2016 13:45:42

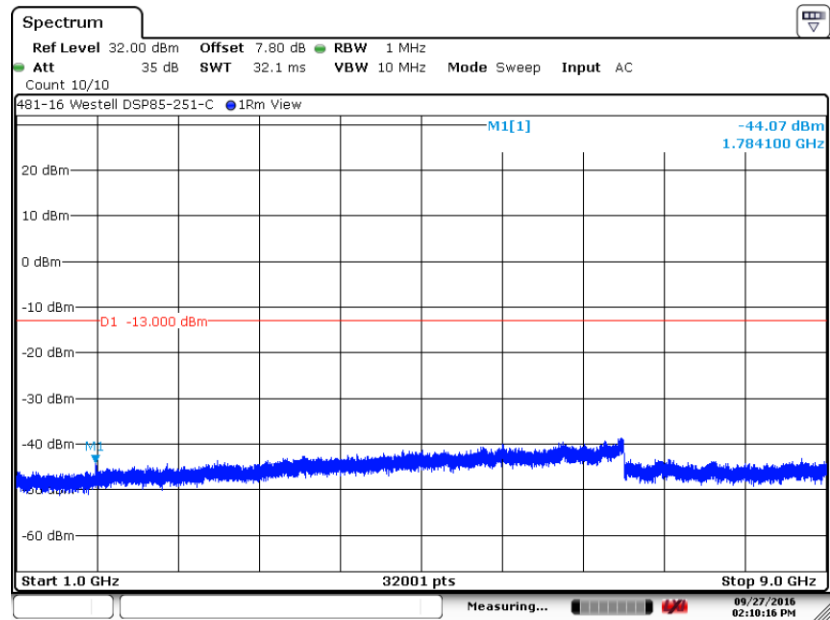
Test Number: 481-16R2

Issue Date: 1/11/2017

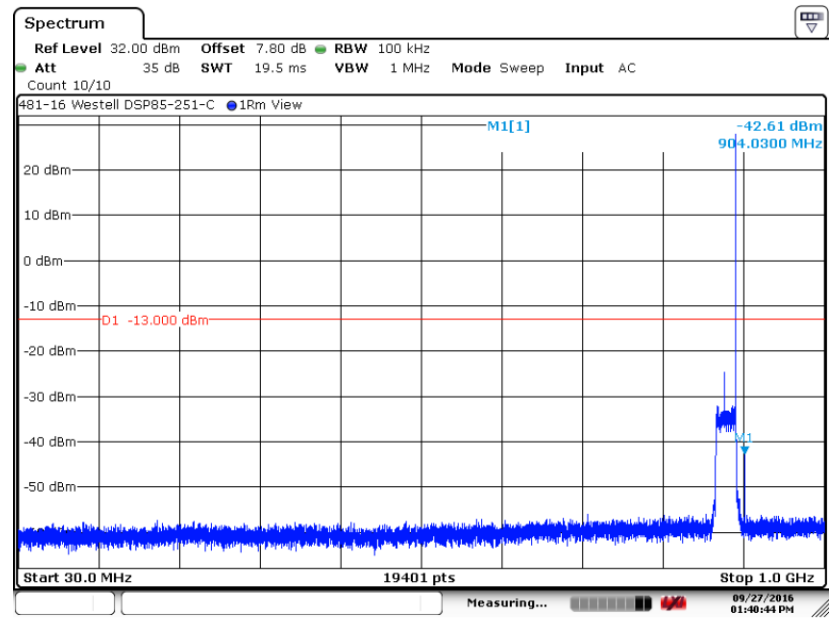
6. Measurement Data (continued)

6.3. Spurious Emissions at the Antenna Terminals 22.917, RSS-132 5.5 (continued)

6.3.22. 894 MHz, 1 to 9 GHz, AWGN



6.3.23. 894 MHz, 30 MHz to 1 GHz, GSM



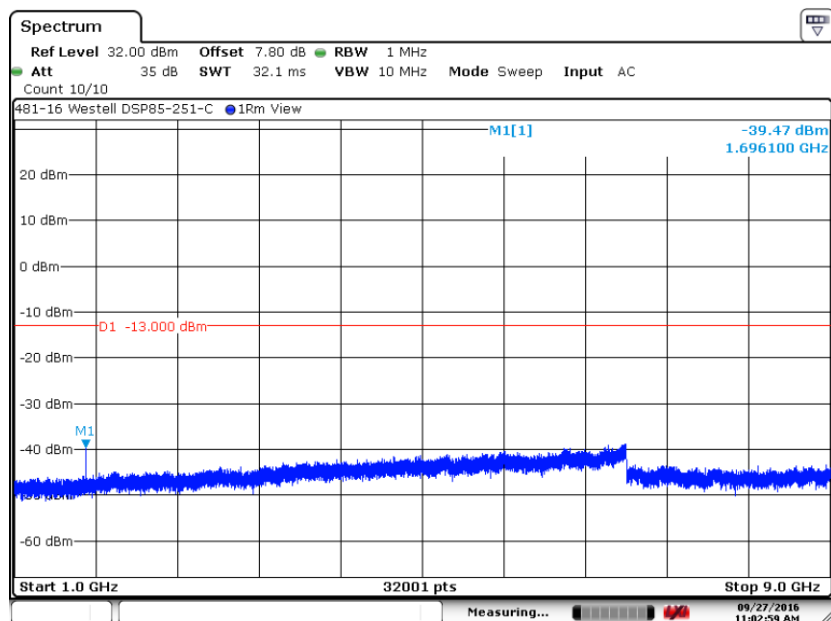
Test Number: 481-16R2

Issue Date: 1/11/2017

6. Measurement Data (continued)

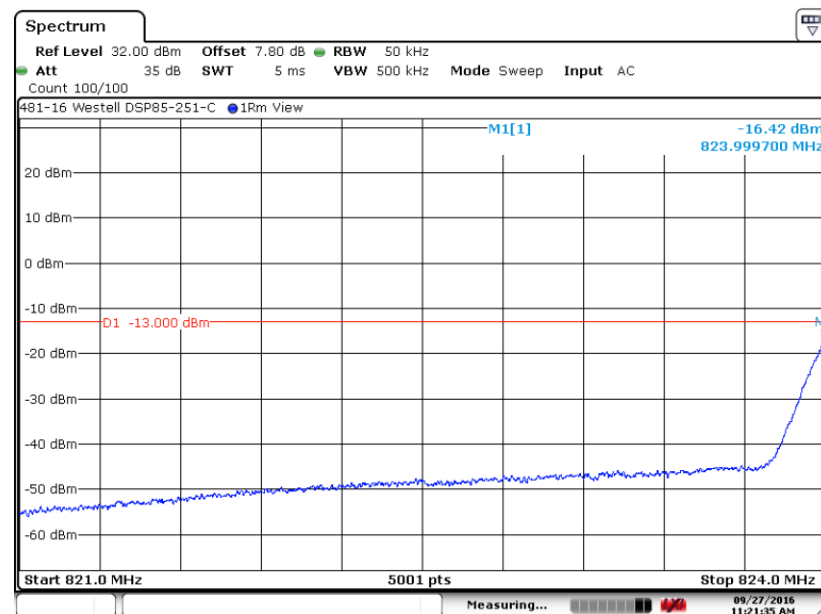
6.3. Spurious Emissions at the Antenna Terminals 22.917, RSS-132 5.5 (continued)

6.3.24. 894 MHz, 1 to 9 GHz, GSM



Date: 27.SEP.2016 11:02:58

6.3.25. 824 MHz Lower Bandedge, AWGN

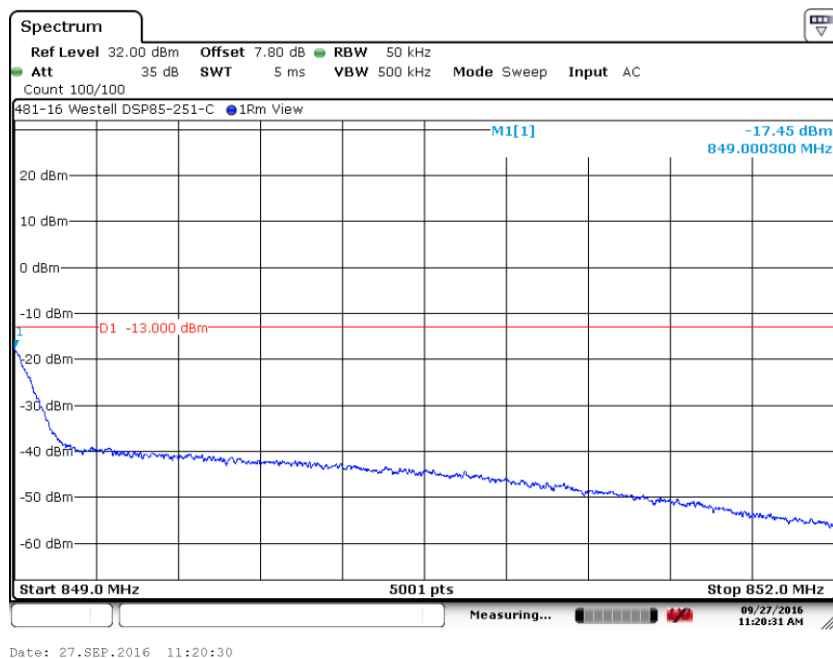


Date: 27.SEP.2016 11:21:33

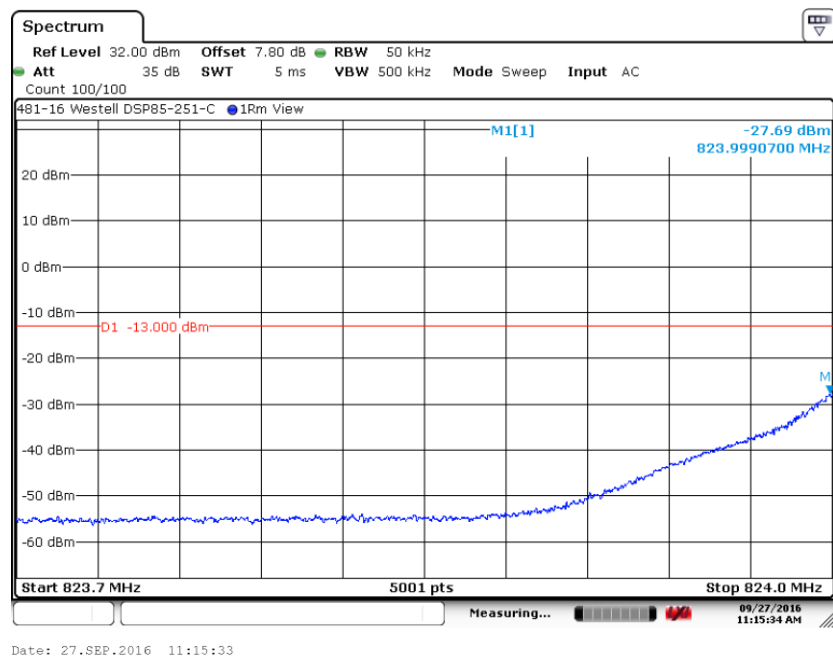
6. Measurement Data (continued)

6.3. Spurious Emissions at the Antenna Terminals 22.917, RSS-132 5.5 (continued)

6.3.26. 849 MHz Upper Bandedge, AWGN



6.3.27. 824 MHz Lower Bandedge, GSM



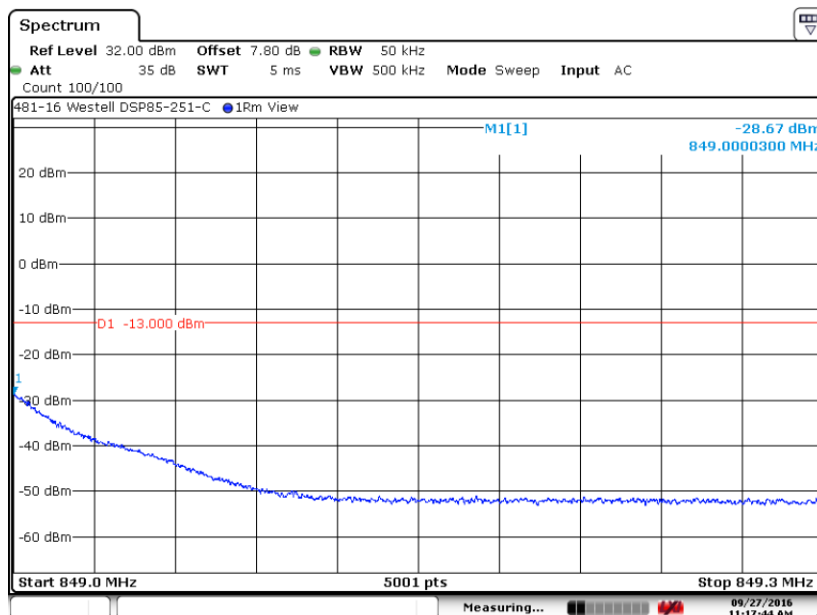
Test Number: 481-16R2

Issue Date: 1/11/2017

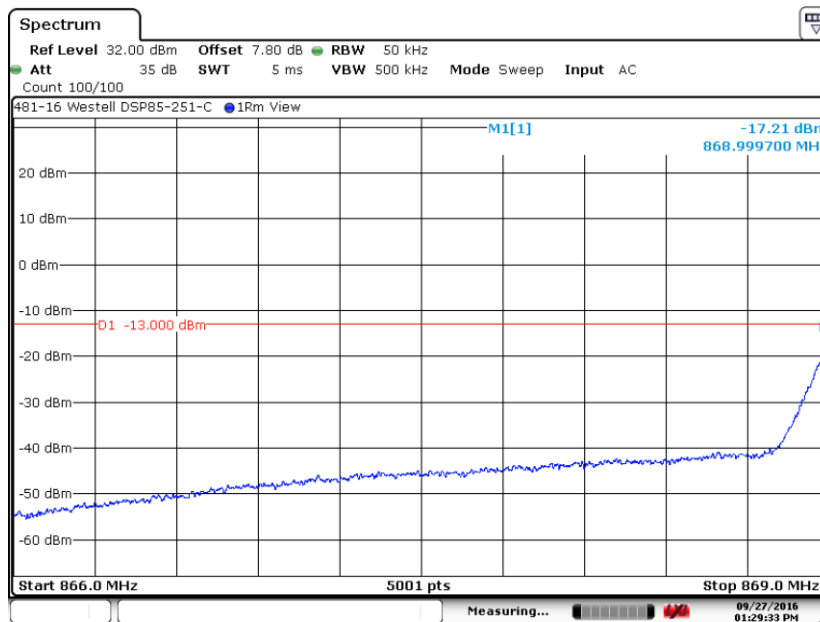
6. Measurement Data (continued)

6.3. Spurious Emissions at the Antenna Terminals 22.917, RSS-132 5.5 (continued)

6.3.26. 849 MHz Upper Bandedge, GSM



6.3.27. 869 MHz, Lower bandedge, AWGN



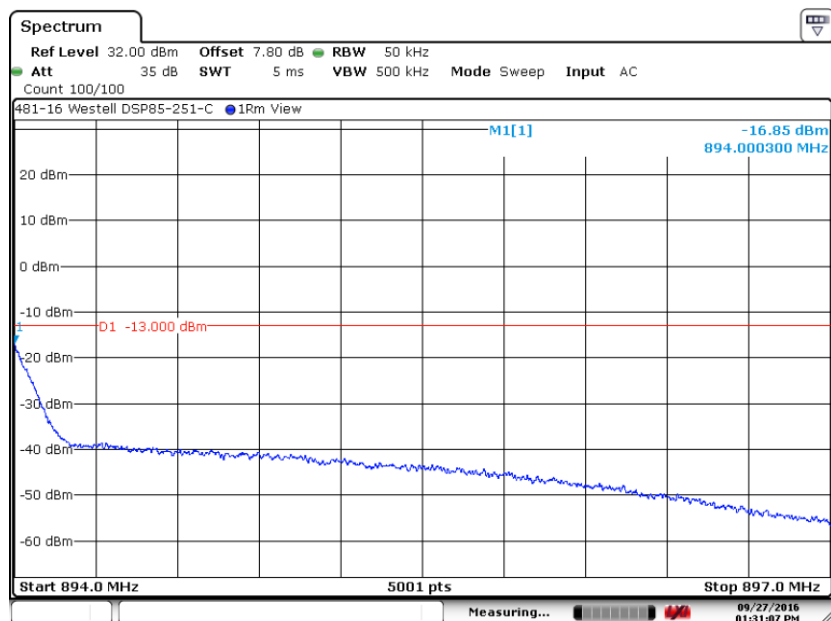
Test Number: 481-16R2

Issue Date: 1/11/2017

6. Measurement Data (continued)

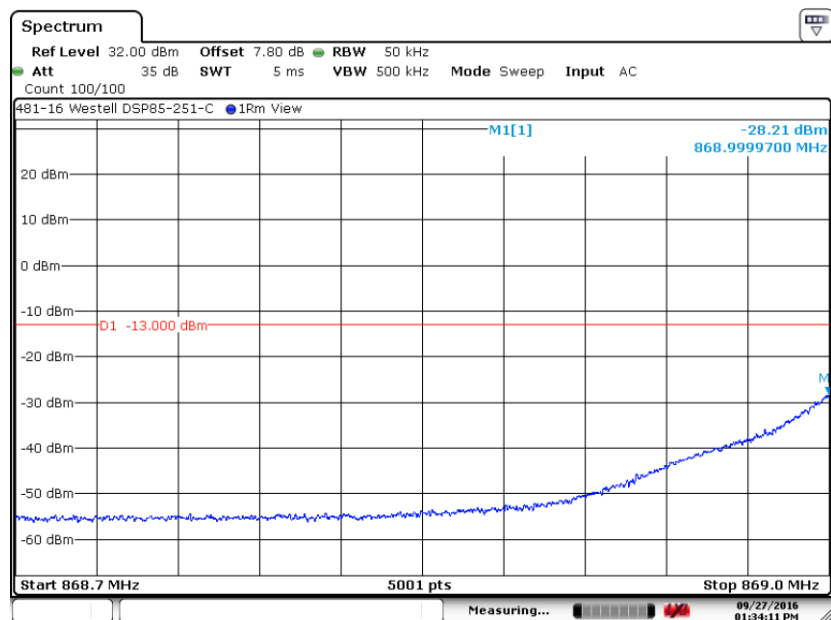
6.3. Spurious Emissions at the Antenna Terminals 22.917, RSS-132 5.5 (continued)

6.3.28. 894 MHz, Upper bandedge, AWGN



Date: 27.SEP.2016 13:31:05

6.3.29. 869 MHz, Lower bandedge, GSM



Date: 27.SEP.2016 13:34:09

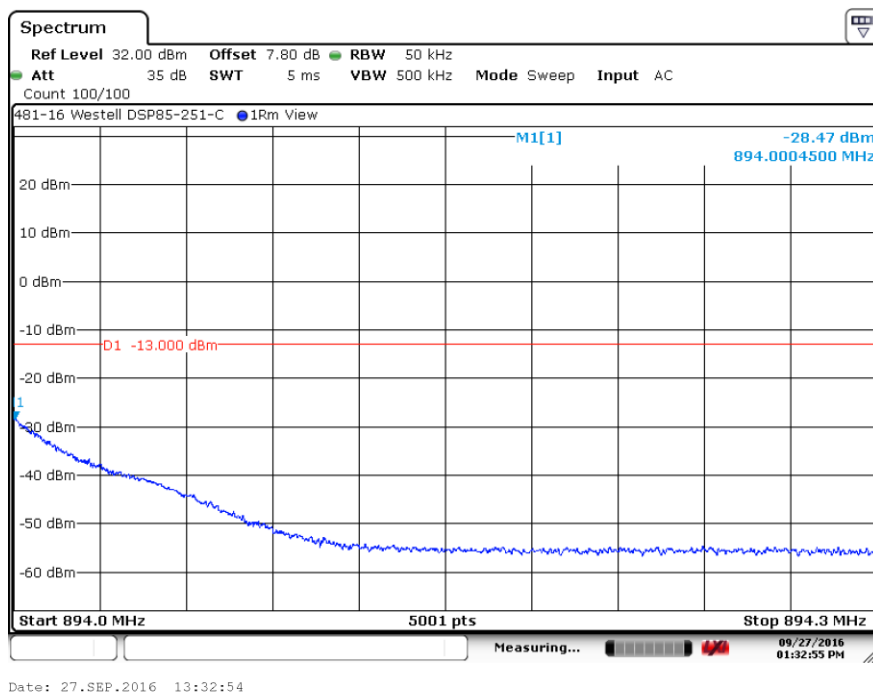
Test Number: 481-16R2

Issue Date: 1/11/2017

6. Measurement Data (continued)

6.3. Spurious Emissions at the Antenna Terminals 22.917, RSS-132 5.5 (continued)

6.3.30. 894 MHz, Upper bandedge, GSM



6. Measurement Data (continued)**6.4. Field Strength of Spurious Emissions 22.917, RSS-132 5.5**

Requirement: For operations in the 824-849 MHz and 869-894 MHz bands, the power of any emission outside of the licensee's frequency block shall be attenuated below the transmitter power (P) by at least $43 + 10 \log (P)$ dB.

Compliance with this provision is based upon the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the licensee's frequency block a resolution bandwidth of at least one percent of the emissions bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emission are attenuated at least 26 dB below the transmitter power.

Test Method: KDB 935210 Section 3.8

6.4.1. Measurement and Equipment Setup

Test Date:	7/28/2016, 1/9/2017
Test Engineer:	Cody Merry, Mark McSweeney
Site Temperature (°C):	22
Relative Humidity (%RH):	32
Frequency Range:	30 MHz to 1 GHz
Measurement Distance:	3 Meters
EMI Receiver IF Bandwidth:	120 kHz
EMI Receiver Avg Bandwidth:	300 kHz
Detector Functions:	Peak and Quasi-Peak.
Antenna Height:	1 to 4 meters

6.4.2 Test Procedure

Test measurements were made in accordance with ANSI/TIA-603-D 2010 Land Mobile FM or PM Communications Equipment Measurement and Performance Standards and ANSI C63.26 2015 American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services, Substitution Measurement Procedures.

6. Measurement Data (continued)
6.4. Field Strength of Spurious Emissions 22.917, RSS-132 5.5 (continued)
6.4.3. Horizontal Polarity

Frequency (MHz)	Antenna Height (cm)	Signal Gen Amp (dBm)	At Antenna Level (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)
74.9936	302	-50.32	-50.94	-8.3	-59.24	-13.00	-46.24
100.0069	305	-43.64	-44.70	-7.3	-52.00	-13.00	-39.00
124.9984	254	-48.65	-49.43	-8.0	-57.43	-13.00	-44.43
174.9952	146	-52.94	-52.70	-7.6	-60.30	-13.00	-47.30
200.0258	150	-47.06	-47.92	-8.0	-55.92	-13.00	-42.92
203.3532	142	-55.00	-52.75	-8.0	-60.75	-13.00	-47.75
225.0034	140	-42.52	-43.79	-8.1	-51.89	-13.00	-38.89
275.0239	110	-47.34	-47.79	-8.4	-56.19	-13.00	-43.19
300.0586	100	-40.14	-41.79	-8.1	-49.89	-13.00	-36.89
324.9784	100	-46.36	-47.29	-7.7	-54.99	-13.00	-41.99
425.0159	100	-44.42	-46.12	-7.2	-53.32	-13.00	-40.32
475.0140	180	-57.43	-52.37	-6.2	-58.57	-13.00	-45.57
575.0151	136	-46.90	-48.68	-7.3	-55.98	-13.00	-42.98
639.9872	130	-42.04	-44.89	-8.0	-52.89	-13.00	-39.89
700.0547	108	-46.38	-49.72	-8.2	-57.92	-13.00	-44.92
775.0439	190	-47.75	-50.01	-8.1	-58.11	-13.00	-45.11
825.0280	100	-41.08	-44.04	-8.2	-52.24	-13.00	-39.24
875.0601	156	-33.00	-36.58	-8.5	-45.08	-13.00	-32.08
925.0558	146	-47.60	-50.09	-8.6	-58.69	-13.00	-45.69
959.9788	133	-41.30	-45.33	-8.6	-53.93	-13.00	-40.93
975.0616	137	-51.00	-54.23	-8.5	-62.73	-13.00	-49.73

6. Measurement Data (continued)
6.4. Field Strength of Spurious Emissions 22.917, RSS-132 5.5 (continued)
6.4.4. Vertical Polarity

Frequency (MHz)	Antenna Height (cm)	Signal Gen Amp (dBm)	At Antenna Level (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)
74.9987	100	-48.60	-48.52	-7.7	-56.22	-13.00	-43.22
100.0142	100	-40.80	-41.36	-8.5	-49.86	-13.00	-36.86
124.9913	100	-64.58	-59.70	-8.0	-67.70	-13.00	-54.70
175.0142	100	-40.84	-42.37	-7.6	-49.97	-13.00	-36.97
200.0434	100	-33.75	-33.38	-8.0	-41.38	-13.00	-28.38
225.0041	220	-37.00	-38.73	-8.4	-47.13	-13.00	-34.13
274.9978	200	-43.50	-45.43	-8.1	-53.53	-13.00	-40.53
300.0461	201	-42.90	-45.00	-8.1	-53.10	-13.00	-40.10
325.0123	160	-44.54	-46.67	-7.7	-54.37	-13.00	-41.37
400.0653	130	-47.67	-49.92	-7.8	-57.72	-13.00	-44.72
625.0297	100	-52.11	-54.68	-7.9	-62.58	-13.00	-49.58
639.9886	100	-44.10	-47.08	-8.0	-55.08	-13.00	-42.08
700.1280	160	-44.80	-47.33	-8.2	-55.53	-13.00	-42.53
725.0376	144	-53.35	-56.48	-8.1	-64.58	-13.00	-51.58
775.0468	130	-46.64	-50.01	-8.1	-58.11	-13.00	-45.11
825.0301	120	-42.87	-46.43	-8.2	-54.63	-13.00	-41.63
875.0461	105	-32.75	-36.44	-8.5	-44.94	-13.00	-31.94
900.1825	115	-52.88	-57.18	-8.7	-65.88	-13.00	-52.88
959.9864	100	-41.51	-45.42	-8.6	-54.02	-13.00	-41.02
975.0526	105	-51.88	-55.80	-8.5	-64.30	-13.00	-51.30

6. Measurement Data (continued)**6.4. Field Strength of Spurious Emissions 22.917, RSS-132 5.5 (continued)****6.4.5. Measurement and Equipment Setup**

Test Date:	7/28/2016
Test Engineer:	Cody Merry
Site Temperature (°C):	24
Relative Humidity (%RH):	33
Frequency Range:	Above 1 GHz
Measurement Distance:	3 Meters
EMI Receiver IF Bandwidth:	1 MHz
EMI Receiver Avg Bandwidth:	3 MHz
Detector Functions:	Peak and Average
Antenna Height:	1 to 4 meters

6.4.6. Radiated Emissions above 1 GHz

There were no measureable emissions within 10 dB of the limit above 1 GHz

6. Measurement Data (continued)

6.5. Frequency Stability / Tolerance 22.355, RSS-132 5.3

Requirement: The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized band of operation.

Test Method: KDB 935210 Section 3.7

Note: The EUT does not translate the input frequency and therefore this testing was not performed.

Test Number: 481-16R2

Issue Date: 1/11/2017

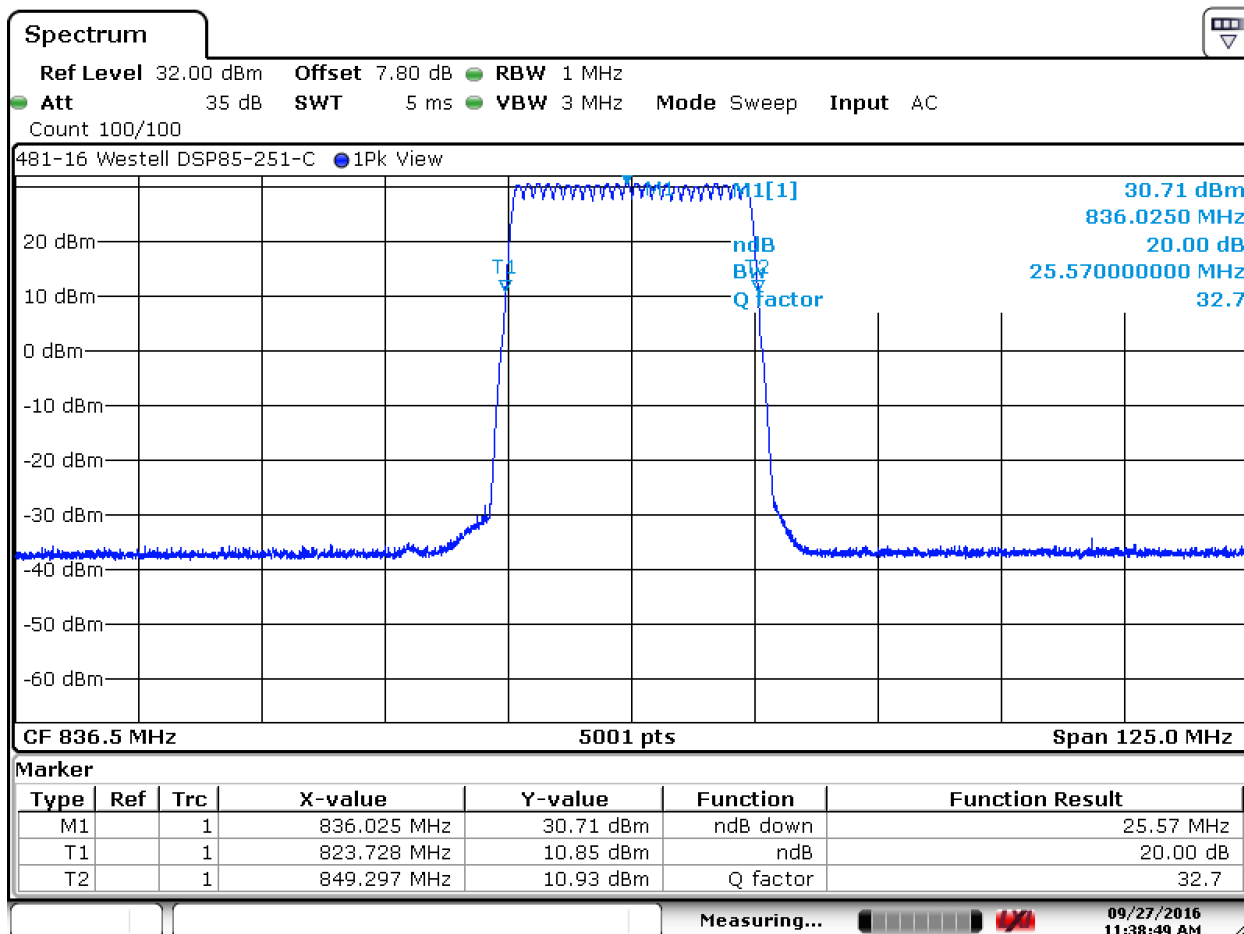
6. Measurement Data (continued)

6.6. Out of Band Rejection FCC KDB 935210

Requirement: Over a +/- 250 % span of the passband of the EUT measure the 20 dB bandwidth of the pass band of the EUT.

Test Method: KDB 935210 Section 3.3

6.6.1. 836.5 MHz Center Frequency, $f_0 = 836.025$ MHz



Date: 27.SEP.2016 11:38:47

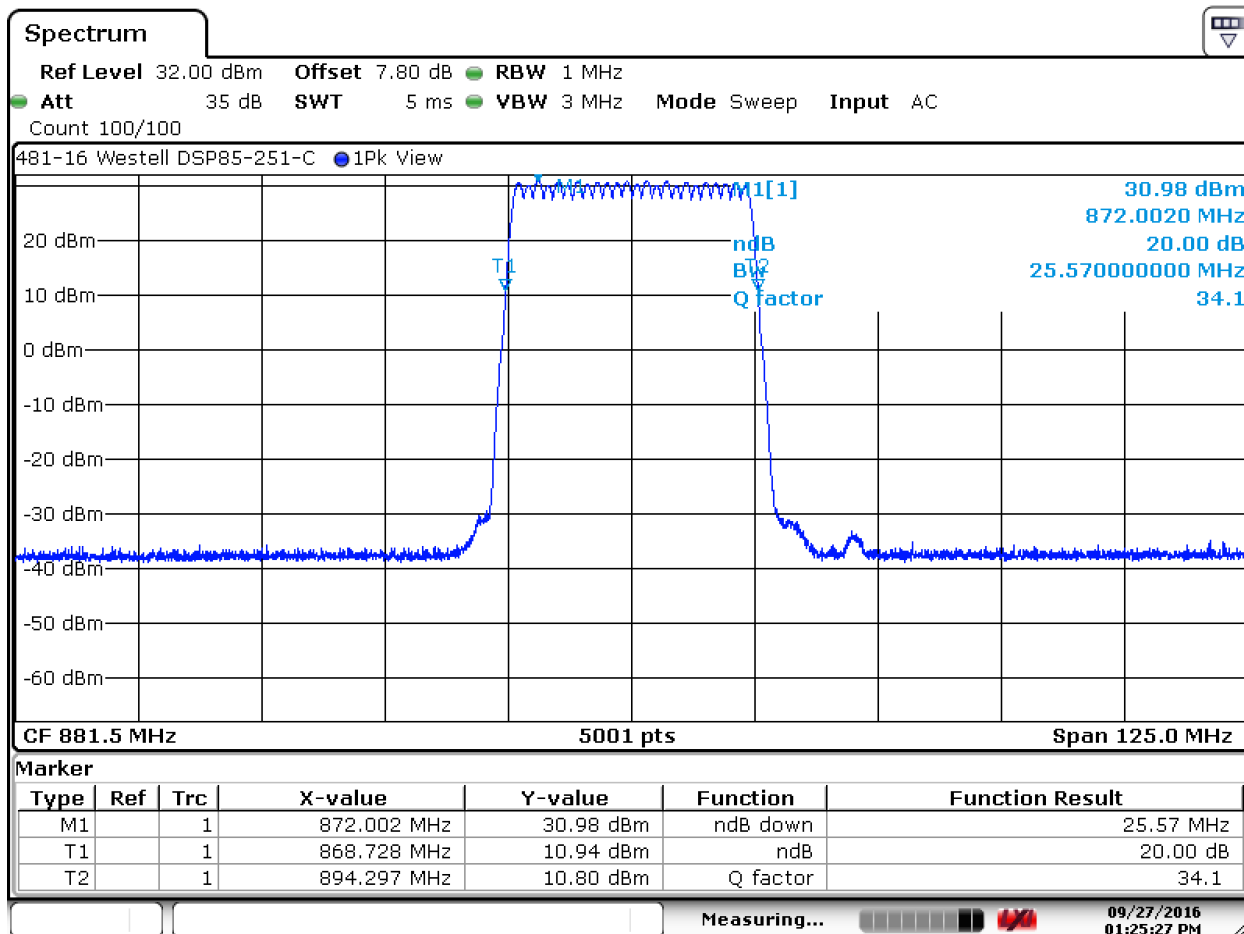
Test Number: 481-16R2

Issue Date: 1/11/2017

6. Measurement Data (continued)

6.6. Out of Band Rejection FCC KDB 935210 (continued)

6.6.2. 881.5 MHz, Center Frequency, $f_0 = 872.002$ MHz



Date: 27.SEP.2016 13:25:25

6. Measurement Data (continued)

6.7. Public Exposure to Radio Frequency Energy Levels 1.1307 (b)(1), RSS-GEN, Issue 4 Section 3.2, RSS 102

Center Frequency (MHz)	MPE Distance (cm)	DUT Output Power (dBm)	DUT Antenna Gain (dBi)	Power Density		FCC Limit (mW/cm ²)	IC Limit (W/m ²)
				(mW/cm ²)	(W/m ²)		
	(1)	(2)	(3)	(4)		(5)	(6)
836.5	20.0	29.23	3.00	0.3324529	3.3245291	2.79	18.67
836.5	20.0	29.50	3.00	0.3537774	3.5377745	2.79	18.67
836.5	20.0	29.38	3.00	0.3441360	3.4413603	2.79	18.67
881.5	20.0	29.38	3.00	0.3441360	3.4413603	2.94	19.16
881.5	20.0	29.77	3.00	0.3764698	3.7646980	2.94	19.16
881.5	20.0	29.33	3.00	0.3401967	3.4019674	2.94	19.16

$$PD = \frac{OP + AG}{(4 \times \pi \times d^2)}$$

1. Reference CFR 2.1093(b): For purposes of this section, a portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user.
2. Section 6.1.2 of this test report. Note that the value has been adjusted to include the cable insertion loss.
3. Data supplied by the client for combination of cable loss and antenna gain.
4. Power density is calculated from field strength measurement and antenna gain.
5. Reference CFR 1.1310, Table 1: Limits for Maximum Permissible Exposure (MPE), Section (A): Limits for Occupational/Controlled Exposure.
6. Reference IC RSS-102 Section 4 Table 6 Controlled Use Devices (Controlled Environment) for equipment operating from 100 to 6000 MHz, the W/m² limit is determined by the formula $0.6455 \times F \text{ (MHz)}^{0.5}$

7. Test Site Description

Compliance Worldwide is located at 357 Main Street in Sandown, New Hampshire. The test sites at Compliance Worldwide are used for conducted and radiated emissions testing in accordance with the Federal Communications Commission (FCC) and Industry Canada standards. Through our American Association for Laboratory Accreditation (A2LA) ISO Guide 17025:2005 Accreditation our test sites are designated with the FCC (designation number **US1091**), Industry Canada (file number **IC 3023A-1**) and VCCI (Member number 3168) under registration number A-0208.

Compliance Worldwide is also designated as a Phase 1 CAB under APEC-MRA (US0132) for Australia/New Zealand AS/NZS CISPR 22, Chinese-Taipei (Taiwan) BSMI CNS 13438 and Korea (RRA) KN 11, KN 13, KN 14-1, KN 22, KN 32, KN 61000-6-3, KN 61000-6-4.

The radiated emissions test site is a 3 and 10 meter enclosed open area test site (OATS). Personnel, support equipment and test equipment are located in the basement beneath the OATS ground plane.

The conducted emissions site is part of a 16' x 20' x 12' ferrite tile chamber and uses one of the walls for the vertical ground plane required by EN 55022. A second conducted emissions site is also located in the basement of the OATS site with a 2.3 x 2.5 meter ground plane and a 2.4 x 2.4 meter vertical wall.

Both sites are designed to test products or systems 1.5 meters W x 1.5 meters L x 2.0 meters H, floor standing or table top.

8. Test Setup Photographs

8.1 Antenna Port Conducted Emissions



8. Test Setup Photographs (cont)

8.2 Radiated Emissions (Front) 30 MHz to 1 GHz



8. Test Setup Photographs (cont)

8.3 Radiated Emissions (Rear) 30 MHz to 1 GHz



8. Test Setup Photographs (cont)

8.4 Radiated Emissions (Front) 1 to 18 GHz



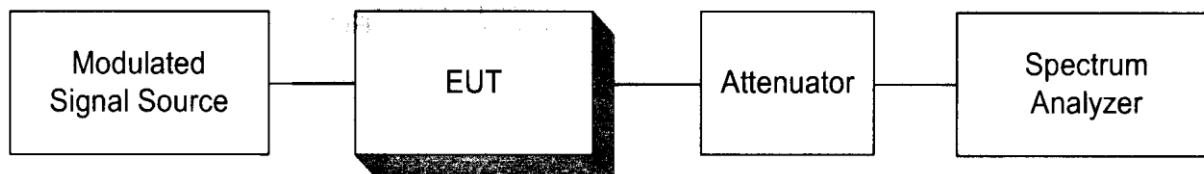
8. Test Setup Photographs (cont)

8.5 Radiated Emissions (Rear) 1 to 18 GHz

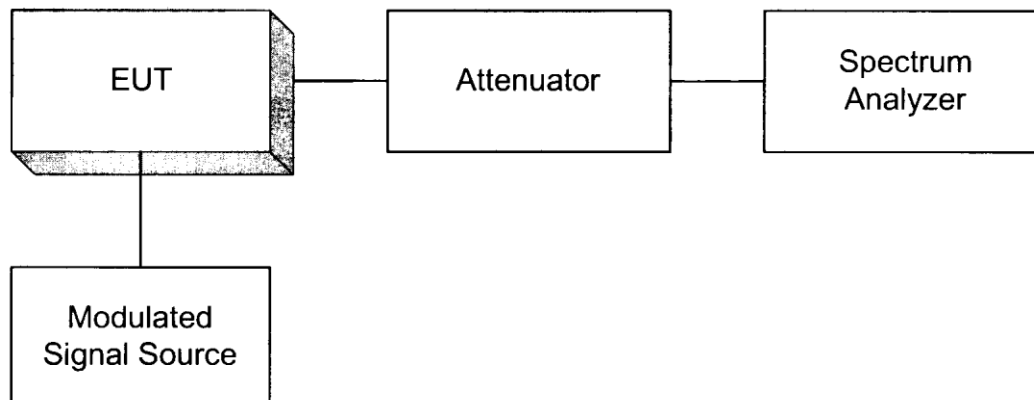


Appendix A

RF Output Power

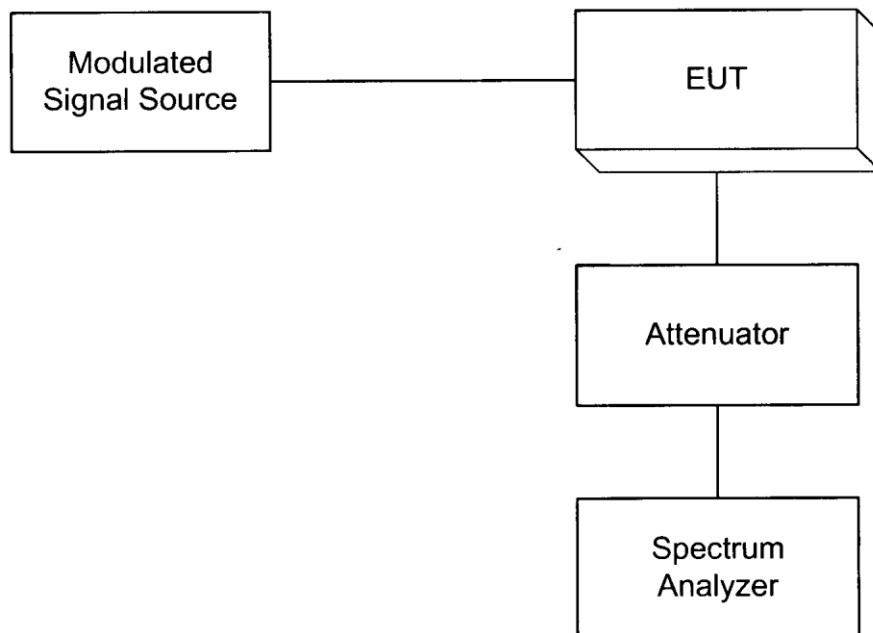


Occupied Bandwidth



Appendix A

Spurious Emissions at the Antenna Terminals



Field Strength of Spurious Radiation

