



**MOBILE DEVICES BUSINESS**

**PRODUCT SAFETY AND COMPLIANCE  
EMC LABORATORY**

**EMC TEST REPORT**

**Test Report Number** – 24934-1 BT

**Report Date** – June 6, 2012

The test results contained herein relate only to the model(s) identified. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical characteristics.

As the responsible EMC Engineer, I hereby declare that the equipment tested as specified in this report conforms to the requirements indicated.

Signature: 

Name: Albert J. Patapack

Title: EMC Engineer

Date: June 6, 2012

This report must not be reproduced, except in full, without written approval from this laboratory.

THIS REPORT MUST NOT BE USED TO CLAIM PRODUCT ENDORSEMENT BY UKAS OR ANY AGENCY OF THE U.S. GOVERNMENT.



2404

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**Test Report Details**

Tests Performed By: ADR Testing Service  
Location Code: ADR LV  
Motorola Mobility Inc  
Product Safety and Compliance Group  
600 North US Hwy 45  
Libertyville, IL 60048  
PH (847) 523-6167 Fax (847) 523-4538  
FCC Registration Number: 316588  
Industry Canada Number: 109O-1

Tests Requested By: Motorola Mobility Inc.  
600 North US Hwy 45  
Libertyville, IL 60048

Product Type: Cellular Phone

Signaling Capability: GSM 850/1900, WCDMA 850/1700/1900  
HSDPA, HSUPA, EDGE, GPRS, 802.11a/b/g/n,  
LTE Band 4/17, Bluetooth LE + EDR

FCC ID: IHDP56MB4

Serial Numbers: LDNB260042, LDNB270027

Testing Complete Date: May 23, 2012

**Applicable Standards**

All tests and measurements indicated in this document were performed in accordance with the Code of Federal Regulations Title 47 Part 2, Sub-part J as well as the following parts:

  X   Part 15 Subpart C – Intentional Radiators

Applicable Standards: ANSI 63.4 2003, RSS-210 Issue 8

DA 00-705, “Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems” published by the Federal Communications Commission was also used in the testing of this product.

**Summary of Testing**

Test	Test Name	Pass/Fail
1	Carrier Frequency Separation	Pass
2	Number of Hopping Frequencies	Pass
3	Time of Occupancy (Dwell Time)	Pass
4	20 dB Bandwidth	Pass
5	Spurious RF Conducted Emissions	Pass
6	Max Power	N/A
7	Band Edges	Pass
8	AC Line Conducted Spurious Emissions	Pass

Test	Test Name	Results
1	Carrier Frequency Separation	See plots
2	Number of Hopping	See plots
3	Time of Occupancy (Dwell Time)	See plots
4	20 dB Bandwidth	See plots
5	Spurious RF Conducted Emissions	See plots
6	Max Power	See plots
7	Band Edges	See plots
8	AC Line Conducted Spurious Emissions	See plots

**General and Special Conditions**

This product utilizes an internal battery that is not removable. When applicable, EMC testing was performed with the internal battery fully charged.

All testing was done in an indoor controlled environment. The temperature and the relative humidity were maintained within the ANSI C63.4 2003 Standard requirements during the entire duration of testing.

**Equipment and Cable Configurations**

The EUT was tested in a stand-alone configuration that is representative of typical use.

**Measuring Equipment and Calibration Information**

Manufacturer	Equipment Type	Model No.	Serial Number	Calibration Due Date
Rohde & Schwarz	Receiver	ESIB40	100001	12/30/2012
Agilent	Signal Analyzer	N9020A	US46470586	01/20/2014
Attenuator	Weinschel	AS-6	6675	NCR
Attenuator	Weinschel	AS-6	6677	NCR
ETS	LISN	3810/2NM	00023630	9/02/2012
ETS	LISN	3810/2NM	2179	9/02/2012

Note that the signal analyzer is on a two-year calibration cycle. All other equipment is on a one-year calibration cycle. All test equipment was within their calibration date during the time of testing. When equipment went out of calibration during testing it was replaced using a similar piece of calibrated equipment.

**Description of Bluetooth Transmitter**

The Equipment Under Test (EUT) offers Bluetooth LE+EDR as a feature. This report covers Bluetooth+EDR operation only. The Bluetooth+EDR spread-spectrum, frequency hopping transceiver is designed to operate between 2402 and 2480 MHz. The Bluetooth antenna is mounted inside of the EUT. The antenna installation is permanent. For a more thorough description of the functionality please refer to Exhibit 12 of this package.

As a Bluetooth transmitter, it is designed operate with other Bluetooth devices as defined by the industrial standard. In this application, the device is battery operated.

**De Facto EIRP Limit – Pursuant 47 CFR 15.247(b)(4); RSS-210 Section A8.4.**

Criterion: The conducted output power limit of 1-watt is based on the use of antennas with directional gains that do not exceed 6 dB<sub>i</sub>. If transmitting antennas of directional gain greater than 6 dB<sub>i</sub> 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 dB<sub>i</sub>.

The antenna employed by this transmitter is intended to be omni-directional, and thus will not exhibit directional gain in excess of 6 dB<sub>i</sub>. The conducted power is less than the limits set forth (see elsewhere in this report for details).

## **Measurement Procedures and Data**

### **CARRIER FREQUENCY SEPARATION**

CFR 47 Part 15.247

#### **Measurement Procedure**

The RF output port of the EUT is directly coupled to the input of the EMC analyzer through a specialized RF connector and a 10dB passive attenuator. A fully charged battery was used for the supply voltage.

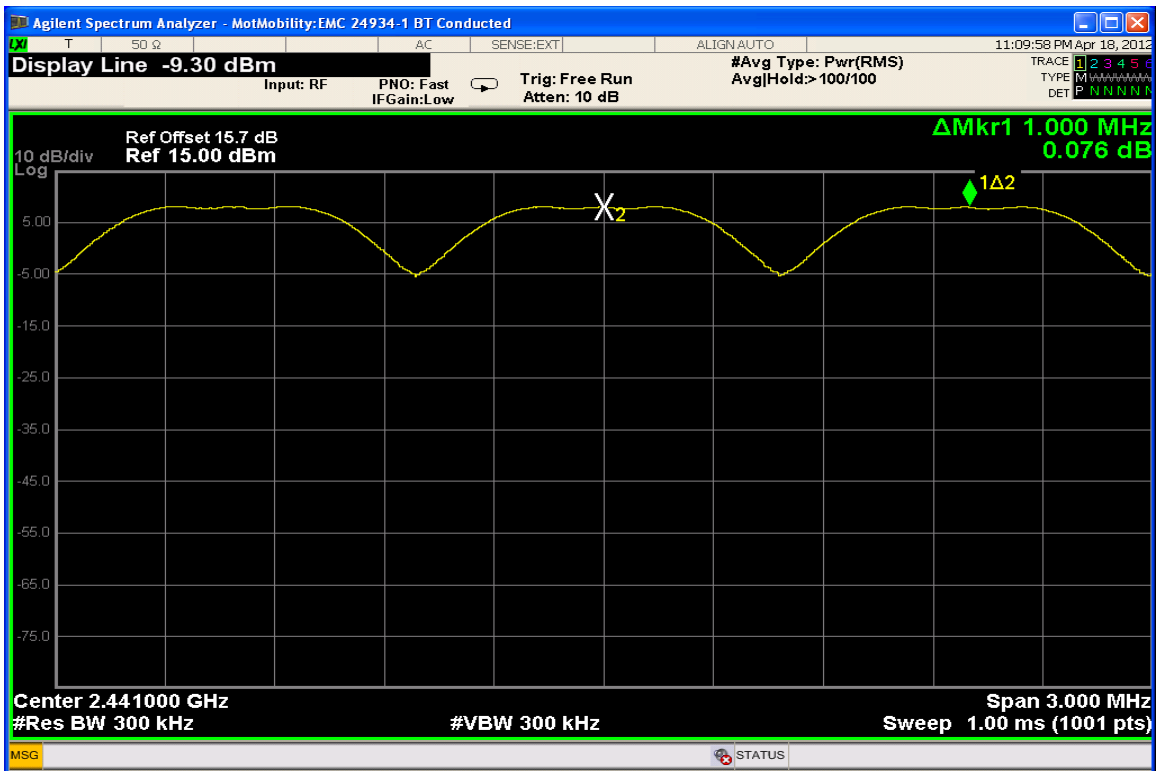
The Bluetooth transmitter of the EUT had its hopping function enabled. The following spectrum analyzer settings were used:

1. Span = wide enough to capture the peaks of two adjacent channels
2. Resolution (or IF) Bandwidth (RBW)  $\geq$  1% of the span
3. Video (or Average) Bandwidth (VBW)  $\geq$  RBW
4. Sweep = auto
5. Detector function = peak
6. Trace = max hold

The trace was allowed to stabilize. The marker-delta function was used to determine the separation between the peaks of the adjacent channels.

#### **Measurement Results**

See attached.



**Carrier Frequency Separation 1Mbps Data Rate**

## NUMBER OF HOPPING FREQUENCIES

CFR 47 Part 15.247

### **Measurement Procedure**

The RF output port of the EUT is directly coupled to the input of the EMC analyzer through a specialized RF connector and a 10dB passive attenuator. A fully charged battery was used for the supply voltage.

The Bluetooth frequency hopping function of the EUT was enabled. The spectrum analyzer used the following settings:

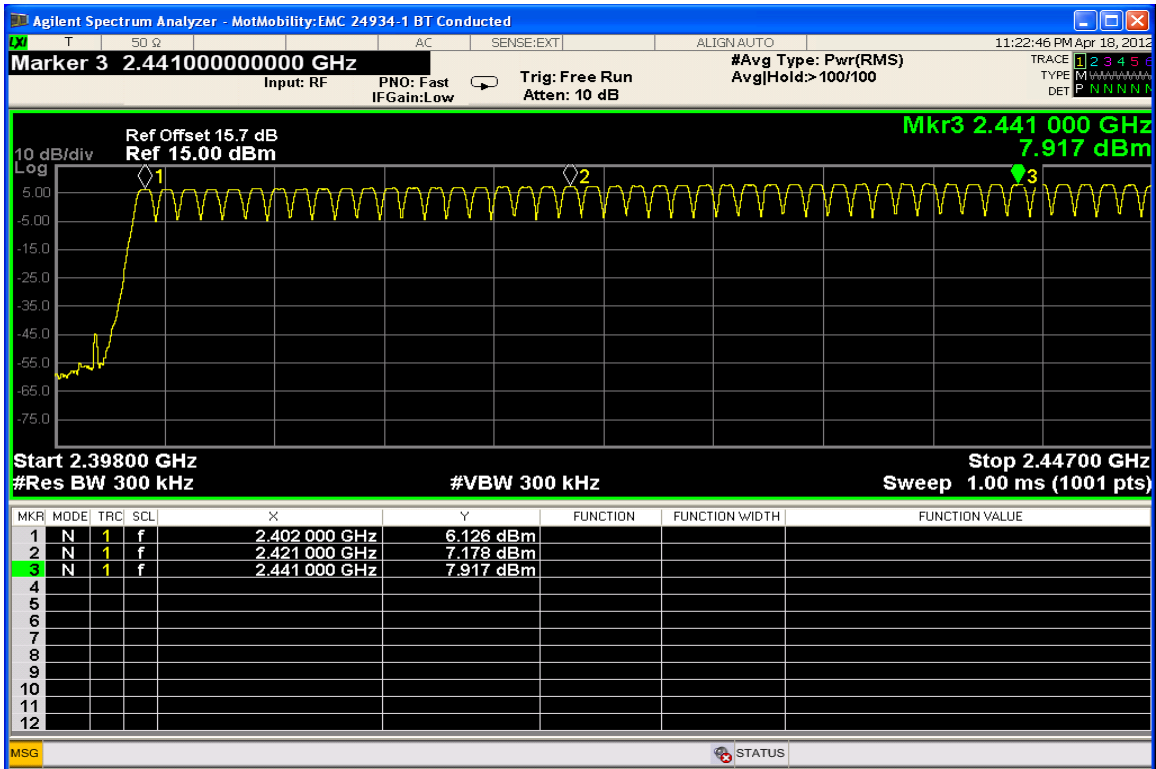
1. Span = the frequency band of operation
2. RBW  $\geq$  1% of the span
3. VBW  $\geq$  RBW
4. Sweep = auto
5. Detector function = peak
6. Trace = max hold

The trace was allowed to stabilize.

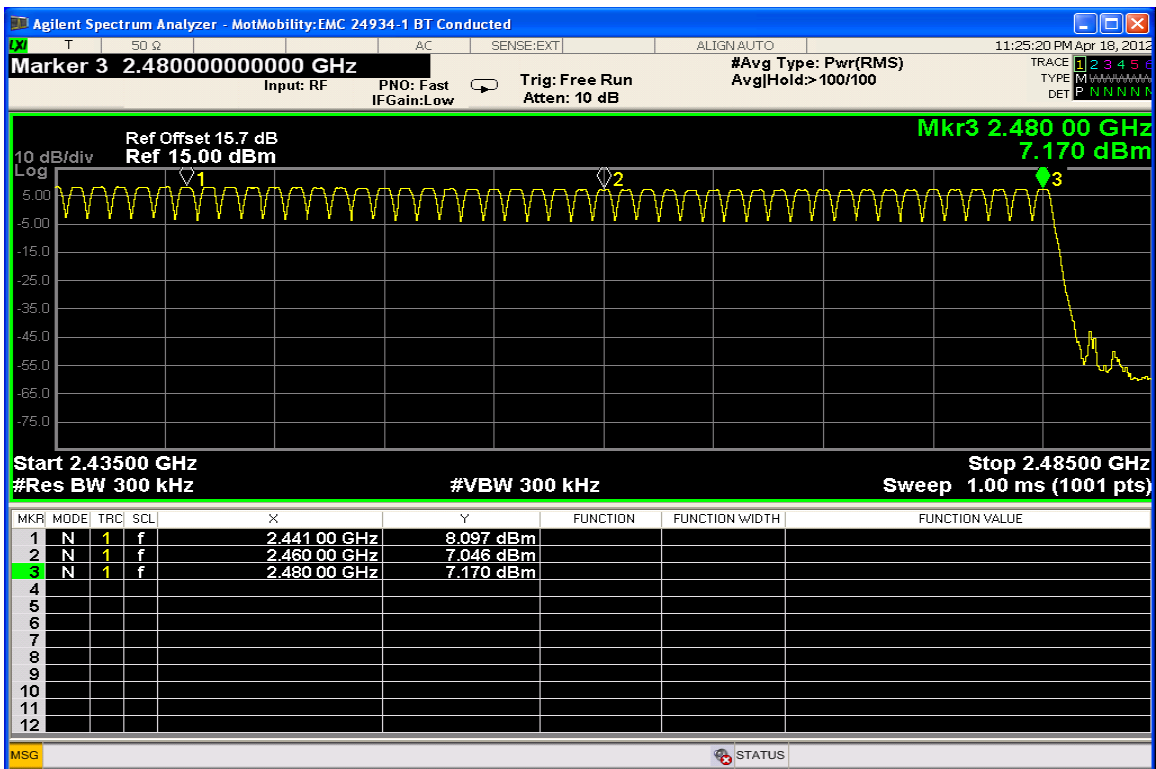
By design, the minimum number of hopping channels in AFH mode for the EUT is 20 channels.

### **Measurement Results**

See attached.



**Number of Hopping Frequencies (Channels 0 – 39) 1Mbps Data Rate**



**Number of Hopping Frequencies (Channels 39 – 78) 1Mbps Data Rate**

**TIME OF OCCUPANCY (DWELL TIME)**

CFR47 Part 15.247

**Measurement Procedure**

The RF output port of the EUT is directly coupled to the input of the EMC analyzer through a specialized RF connector and a 10dB passive attenuator. A fully charged battery was used for the supply voltage.

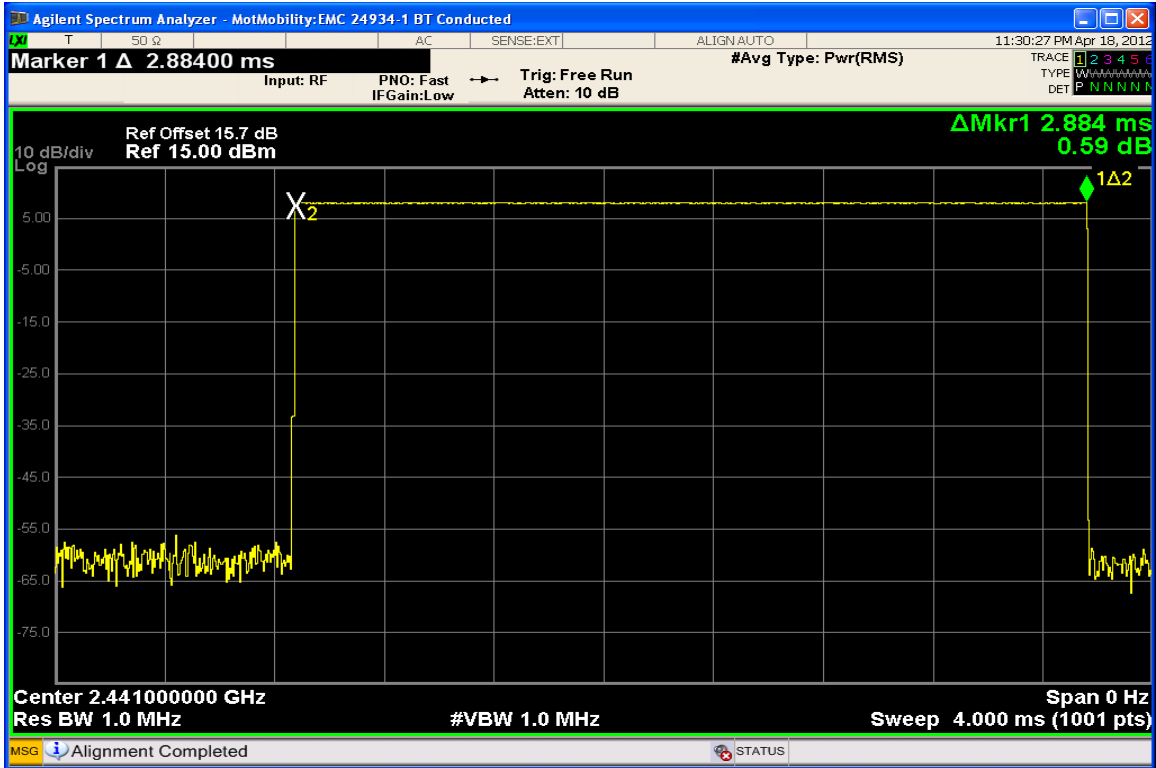
The Bluetooth hopping function of the EUT was enabled. The following spectrum analyzer settings were used:

1. Span = zero span, centered on a hopping channel
2. RBW = 1 MHz
3. VBW  $\geq$  RBW
4. Sweep = as necessary to capture the entire dwell time per hopping channel
5. Detector function = peak
6. Trace = max hold

The marker-delta function was used to determine the dwell time.

**Measurement Results**

See attached



### Dwell Time 1Mbps Data Rate

#### Bluetooth Time of Occupancy Calculation

Typically, Bluetooth 1x/EDR mode has a channel hopping rate of 1600 hops/s. Since 1x/EDR modes use 5 transmit and 1 receive slot, for a total of 6 slots, the Bluetooth transmitter is actually hopping at a rate of  $1600 \div 6 = 266.67$  hops/s/slot.

- $400\text{ms} \times 79$  hopping channels = 31.6sec (Time of Occupancy Limit)
- Worst case BT has 266.67hops/sec (for 1x/EDR modes with DH5 operation)
- $266.67\text{hops/sec} \div 79$  channels = 3.38hops/sec (# hops/sec on one channel)
- $3.38$  hops/sec/channel  $\times$  31.6sec = 106.67hops (# hops over a 31.6sec period)
- $106.67\text{hops} \times 2.884\text{ms/channel} = 307.6\text{ms}$  (worst case dwell time for on channel in 1x/EDR modes)

With AFH, the number of channels is reduced to a minimum of 20 channels and the channel hopping rate is reduced by 50% to 800 hops/sec. AFH mode also uses 6 total slots so the Bluetooth transmitter hops at a rate of  $800 \div 6 = 133.3$  hops/sec/slot

- $400\text{ms} \times 20$  hopping channels = 8sec (Time of Occupancy Limit)
- Worst case BT has 133.3hops/sec/slot (for AFH mode with DH5 operation)
- $133.3\text{hops/sec} \div 20$  channels = 6.67 hops/sec (# of hops/sec on one channel)
- $6.67$  hops/sec/channel  $\times$  8sec = 53.34hops (# of hops over an 8 sec period)
- $53.34\text{hops} \times 2.884\text{ms/channel} = 153.8\text{ms}$  (worst case dwell time for one channel in AFH mode)

**20dB Bandwidth**

CFR 47 Part 15.247

**Measurement Procedure**

The RF output port of the EUT is directly coupled to the input of the EMC analyzer through a specialized RF connector and a 10dB passive attenuator. A fully charged battery was used for the supply voltage.

The Bluetooth frequency hopping function of the EUT was disabled. The spectrum analyzer used the following settings:

1. Span = 2MHz, centered on the center channel frequency
2. RBW  $\geq$  1% of the 20dB span
3. VBW  $\geq$  RBW
4. Sweep = auto
5. Detector function = peak
6. Trace = max hold

The trace was allowed to stabilize. The EUT was transmitting at its maximum data rate. The marker-to-peak function was used to set the marker to the peak of the emission. The marker-delta function was used to measure 20dB down one side of the emission. The marker-delta function and marker was moved to the other side of the emission until it was even with the reference marker. The marker-delta reading at this point was the 20dB bandwidth of the emission.

**Measurement Results**

See attached

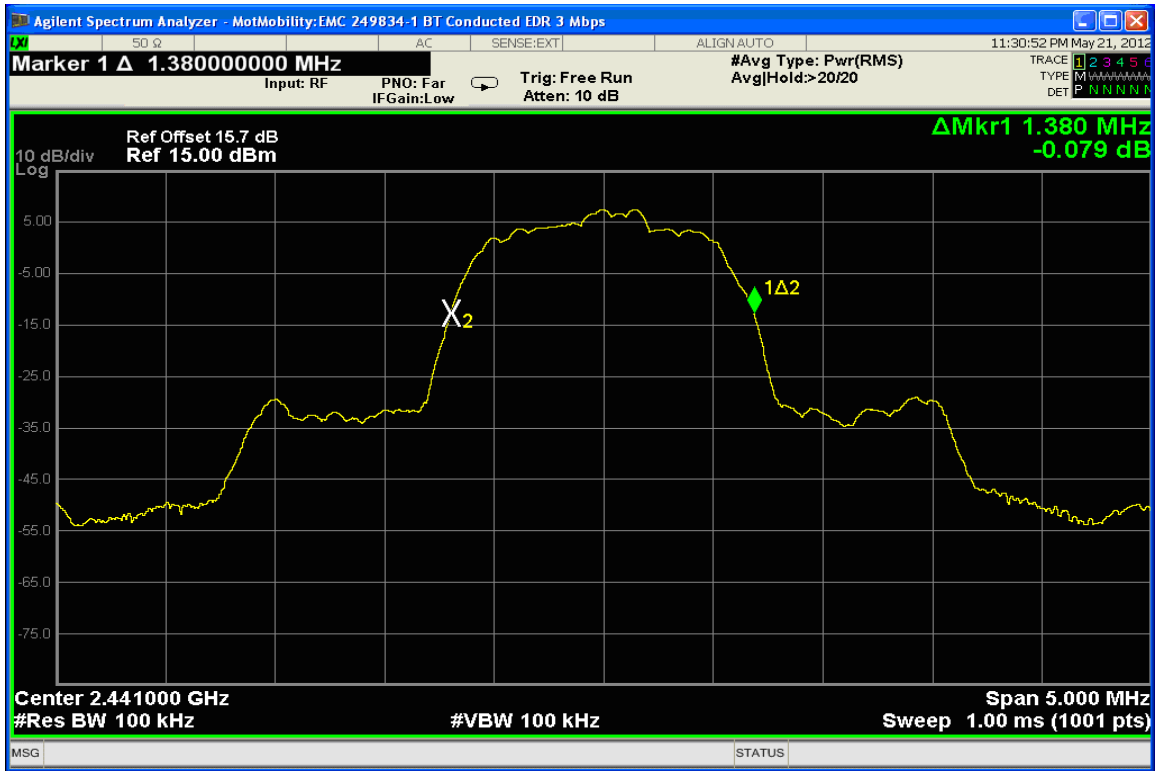
Channel	Frequency (Mhz)	20dB Bandwidth (kHz)
39 (1Mbps)	2441	954
39 (2Mbps)	2441	1375
39 (3Mbps)	2441	1380



20dB Bandwidth 1Mbps Data Rate



20dB Bandwidth EDR Mode 2Mbps Data Rate



**20dB Bandwidth EDR Mode 3Mbps Data Rate**

## **PEAK OUTPUT POWER**

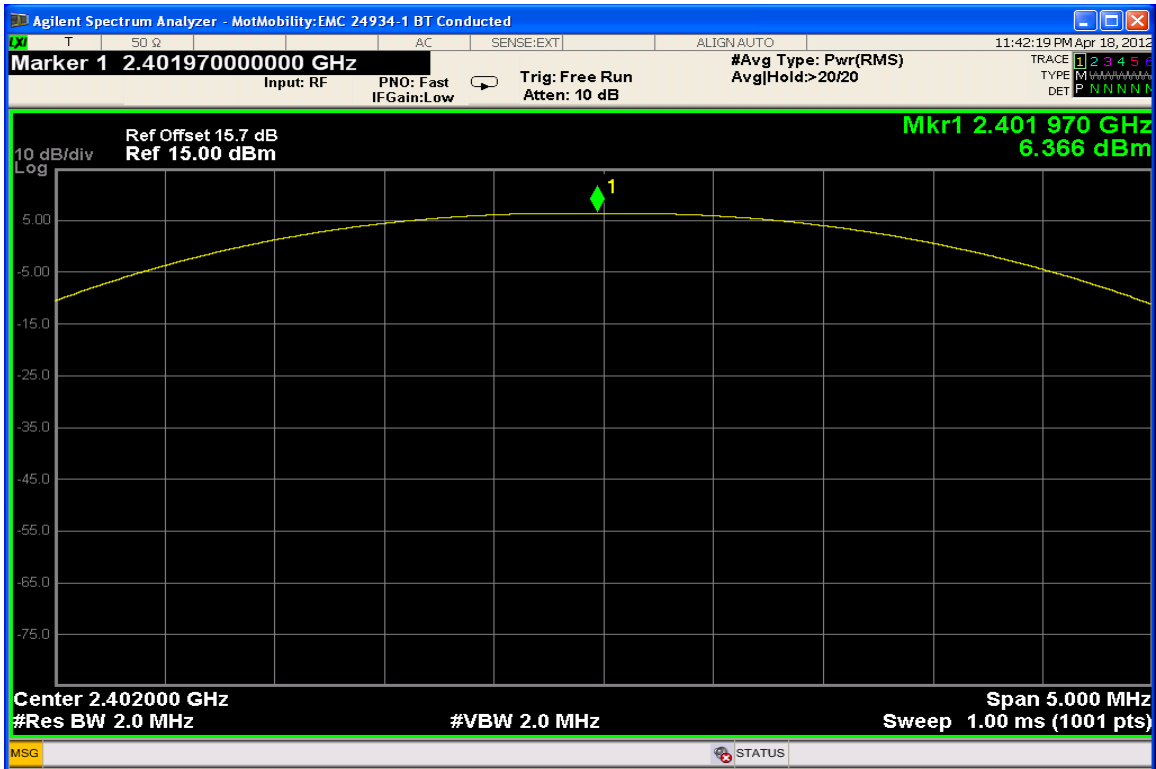
CFR 47 Part 15.247

### **Measurement Procedure**

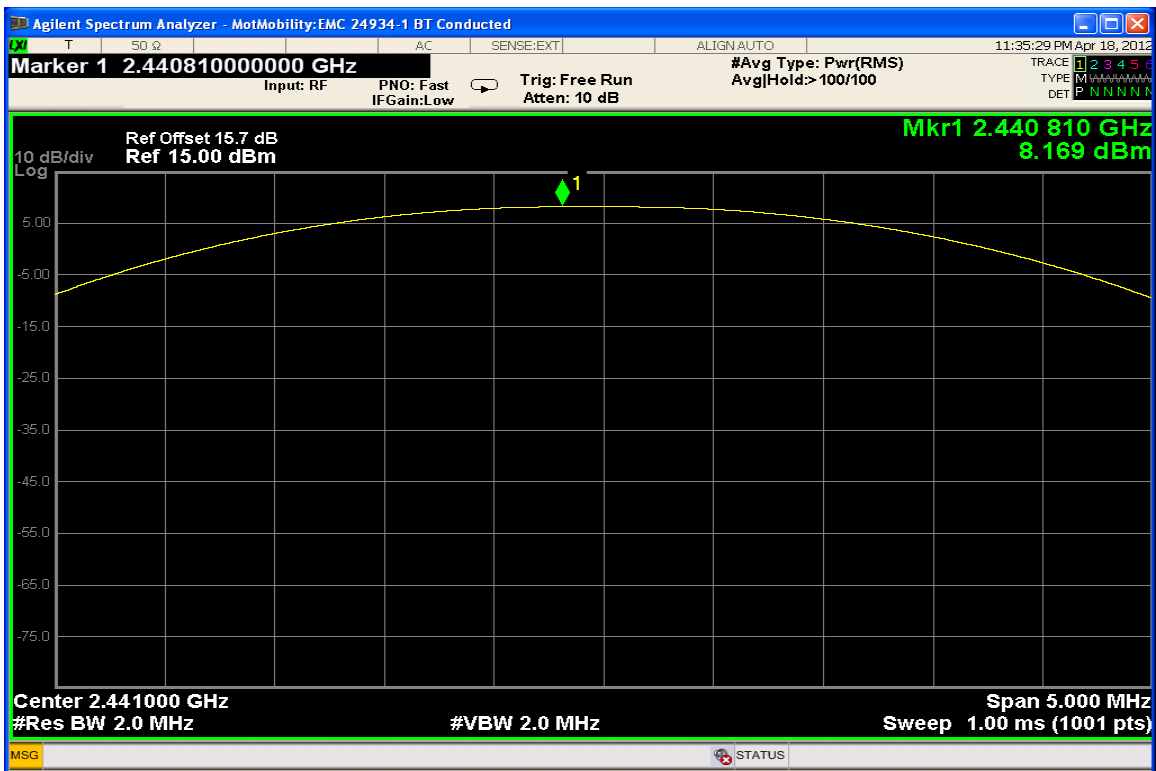
The RF output port of the Equipment-Under-Test is directly coupled to the input of the EMC analyzer through a specialized RF connector and a 10dB passive attenuator. A fully charged battery was used for the supply voltage. The peak output power was measured with the Hopping mode disabled.

### **Measurement Results**

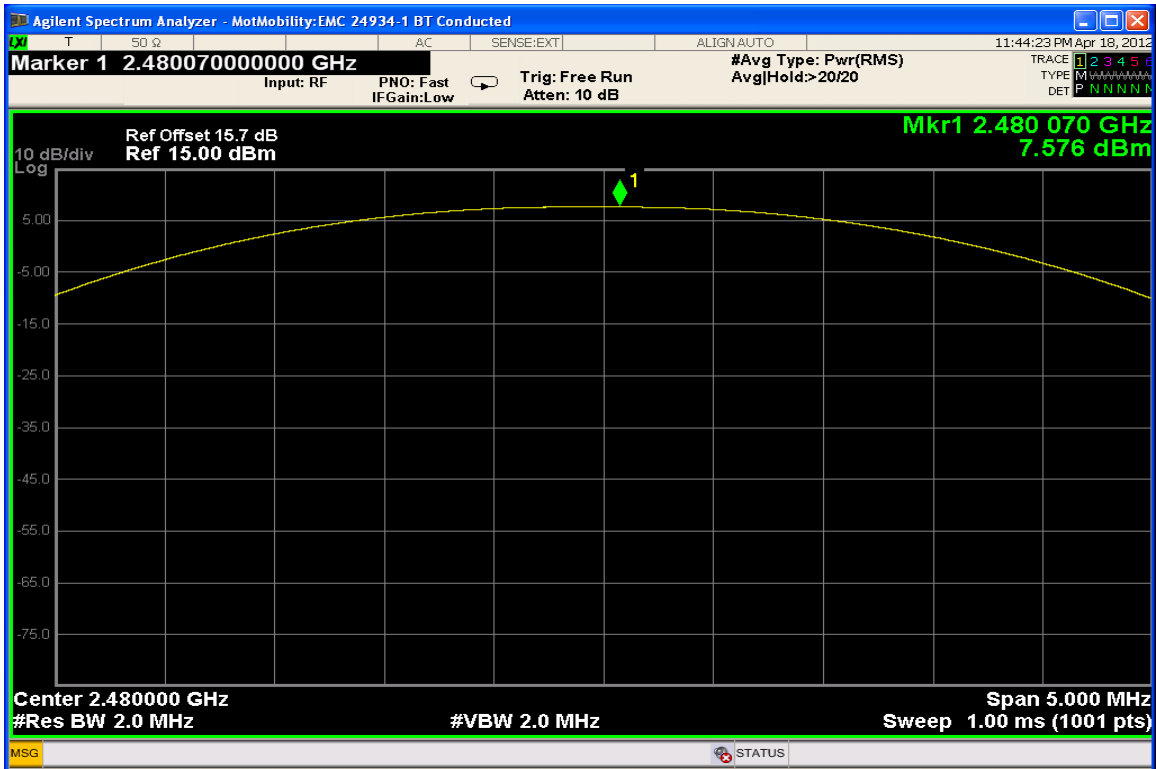
See Attached



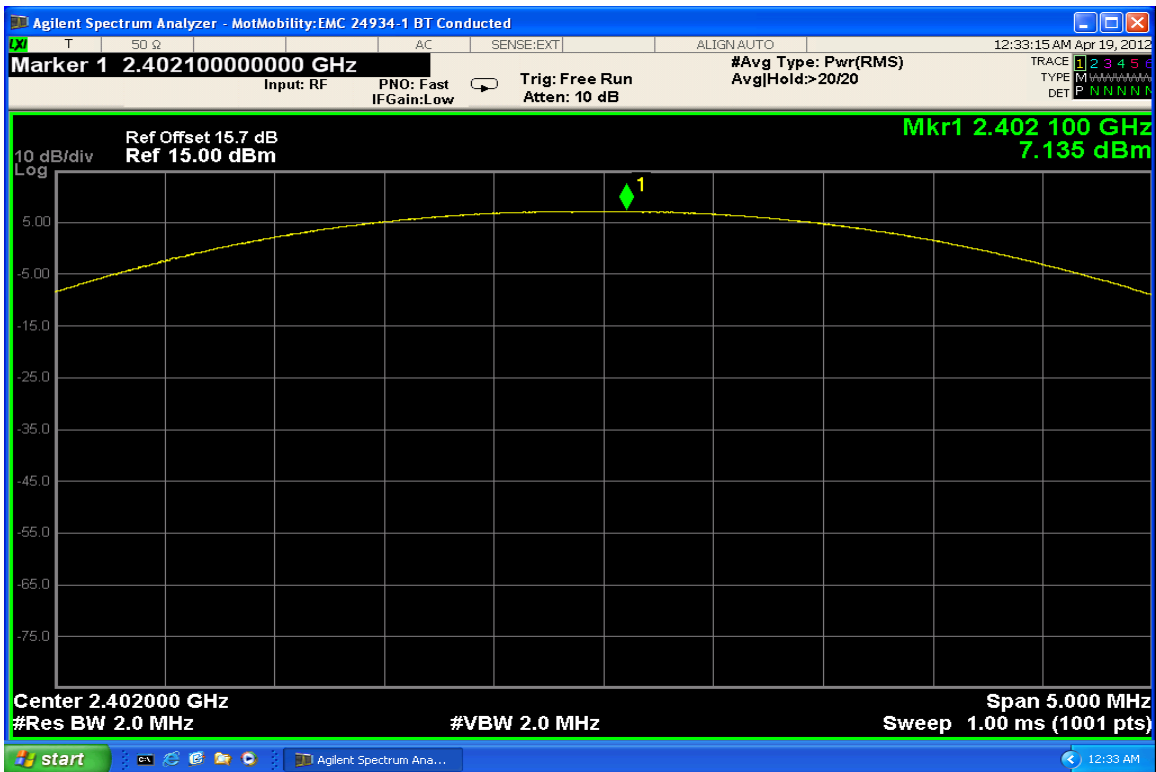
**Peak Output Power – Low Channel 1Mbps Data Rate**



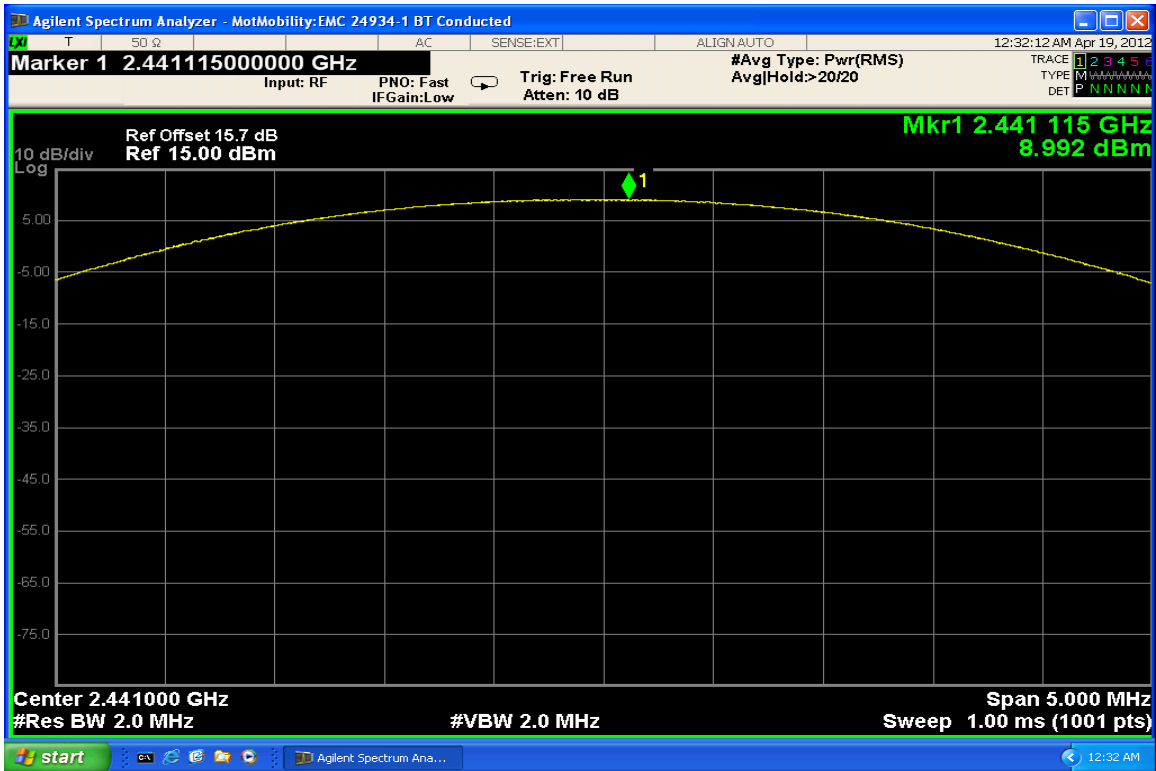
**Peak Output Power – Mid Channel 1Mbps Data Rate**



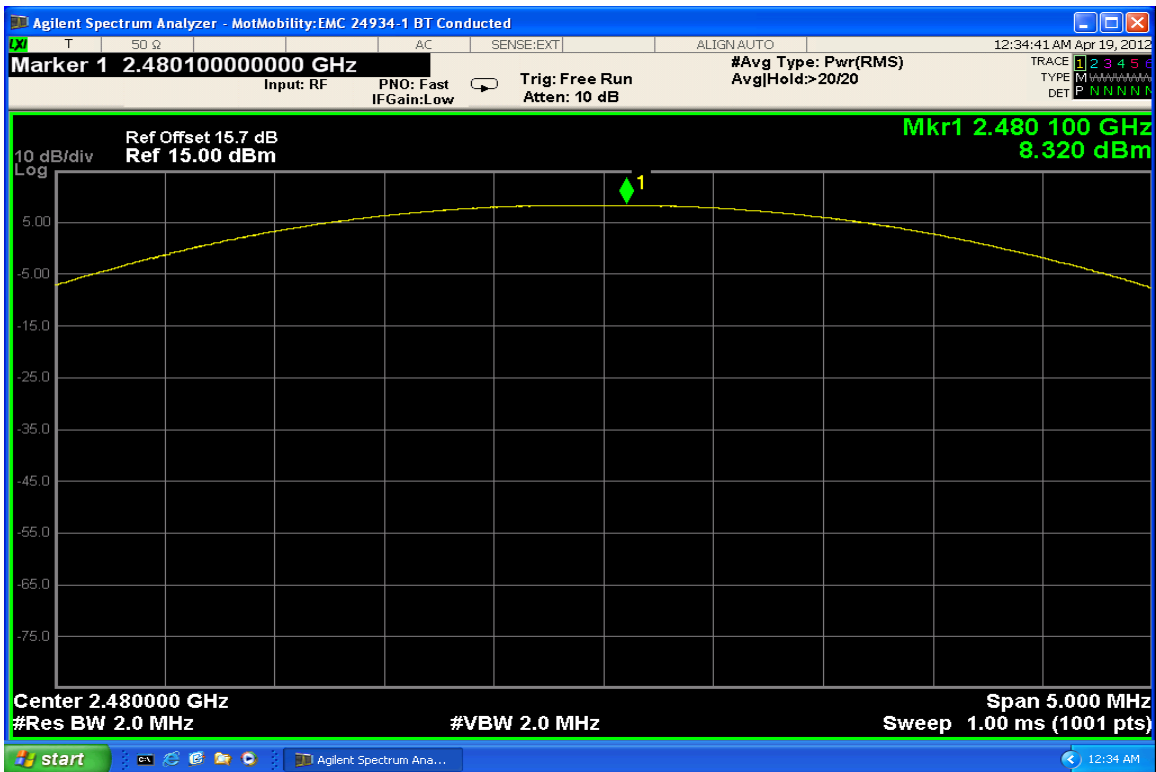
**Peak Output Power – High Channel 1Mbps Data Rate**



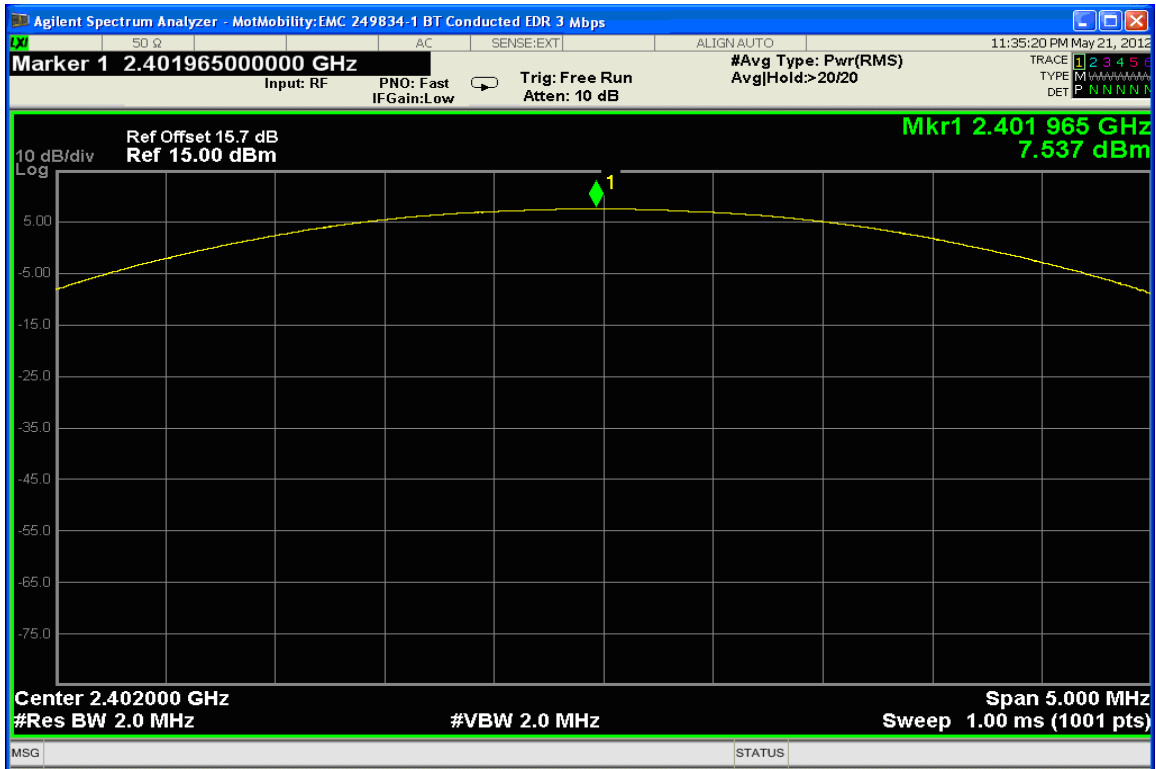
**Peak Output Power EDR Mode – Low Channel 2Mbps Data Rate**



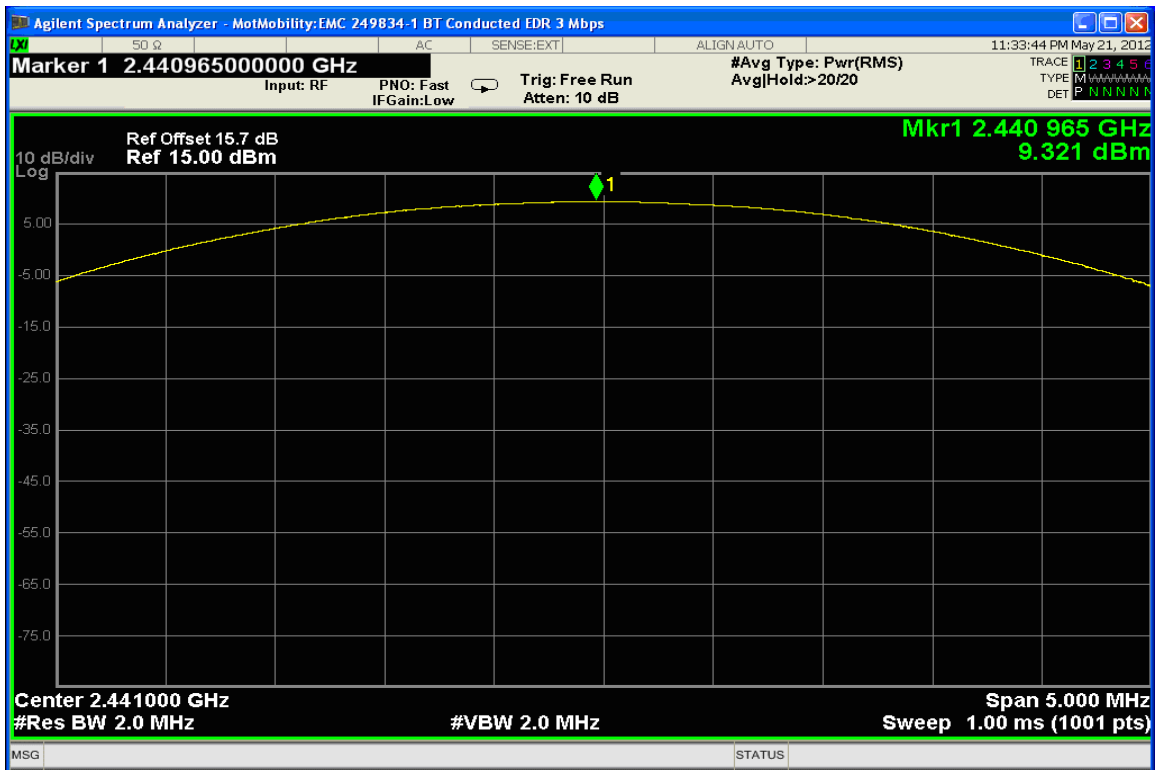
Peak Output Power EDR Mode – Mid Channel 2Mbps Data Rate



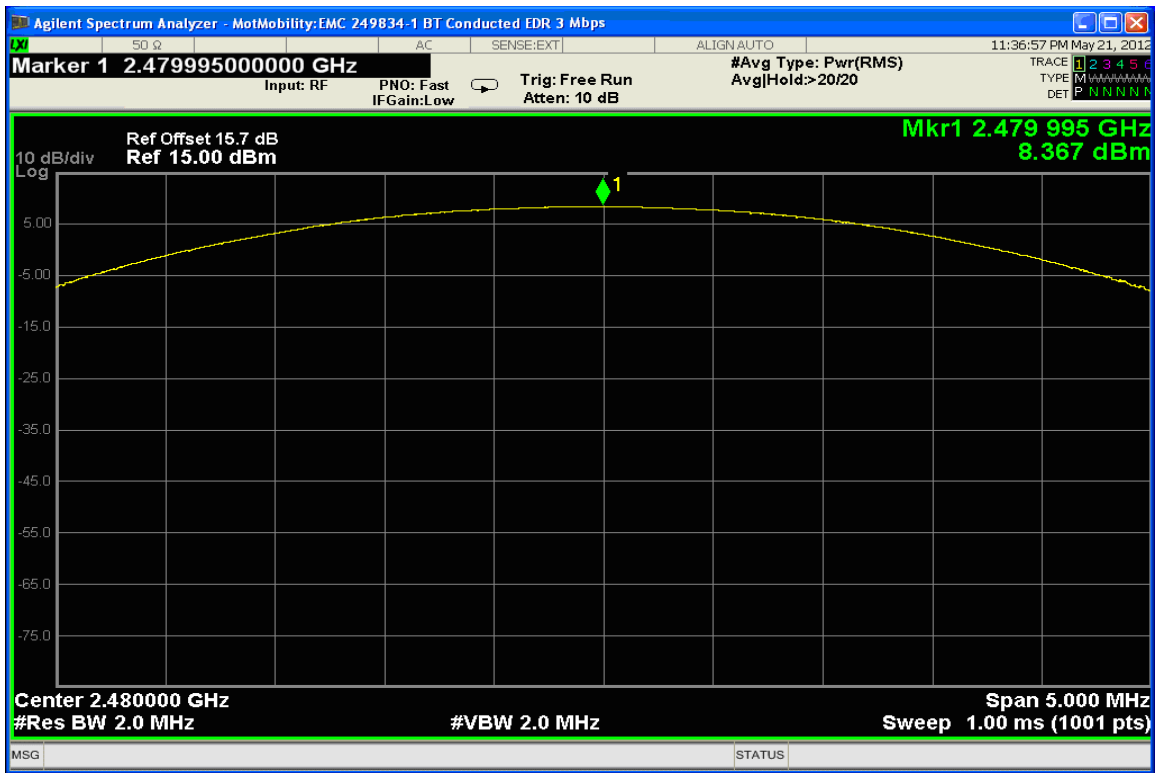
Peak Output Power EDR Mode – High Channel 2Mbps Data Rate



**Peak Output Power EDR Mode – Low Channel 3Mbps Data Rate**



**Peak Output Power EDR Mode – Mid Channel 3Mbps Data Rate**



**Peak Output Power EDR Mode – High Channel 3Mbps Data Rate**

## **BAND-EDGE COMPLIANCE OF RF CONDUCTED EMISSIONS**

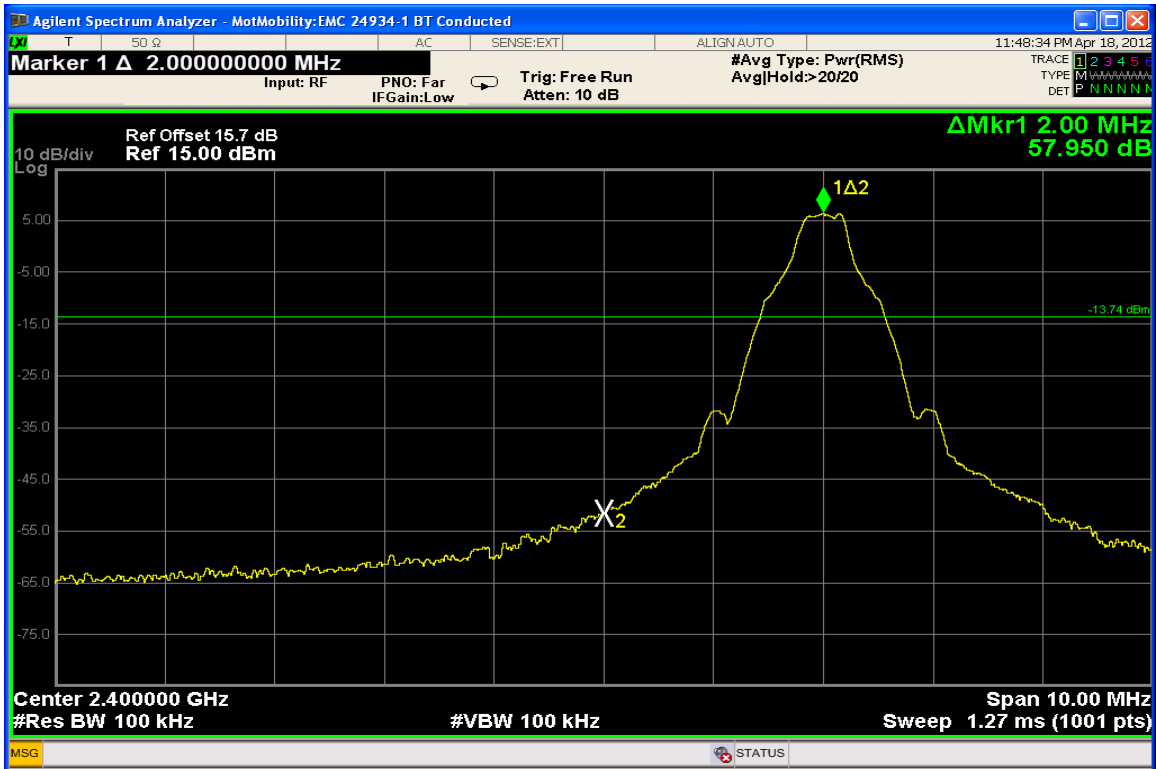
CFR 47 Part 15.247

### **Measurement Procedure**

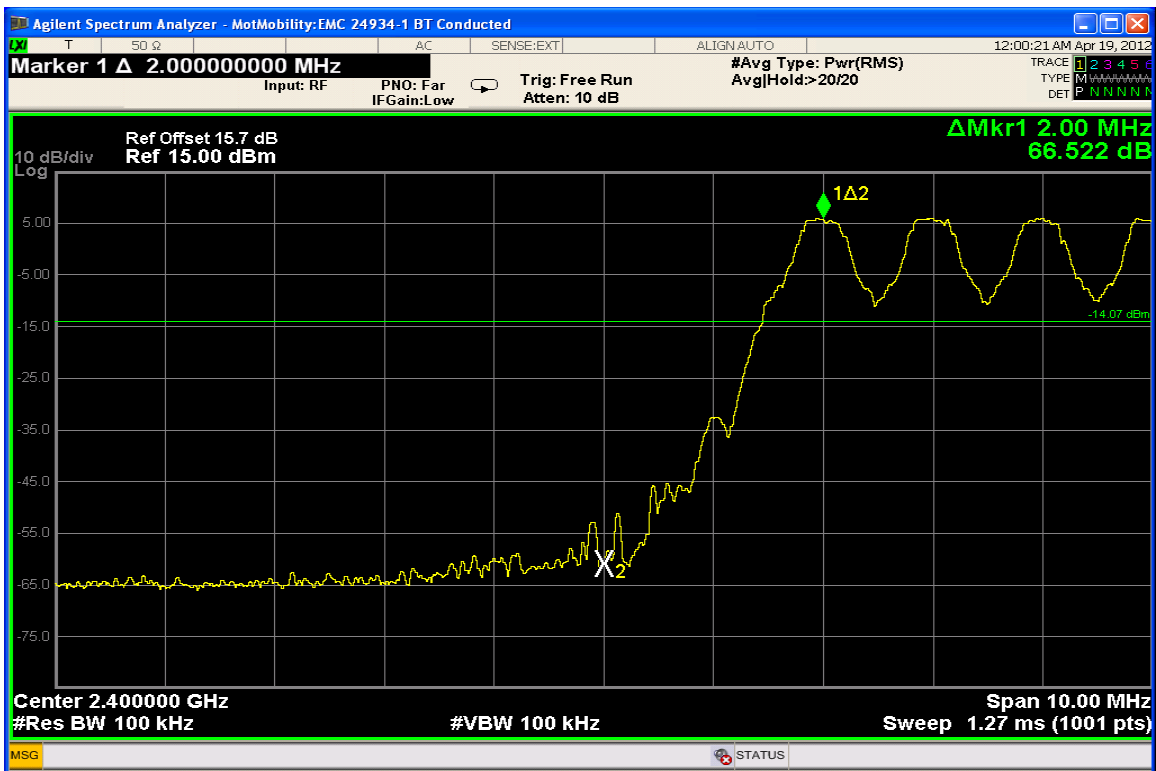
The RF output port of the Equipment-Under-Test is directly coupled to the input of the EMC analyzer through a specialized RF connector and a 10dB passive attenuator. A fully charged battery was used for the supply voltage.

### **Measurement Results**

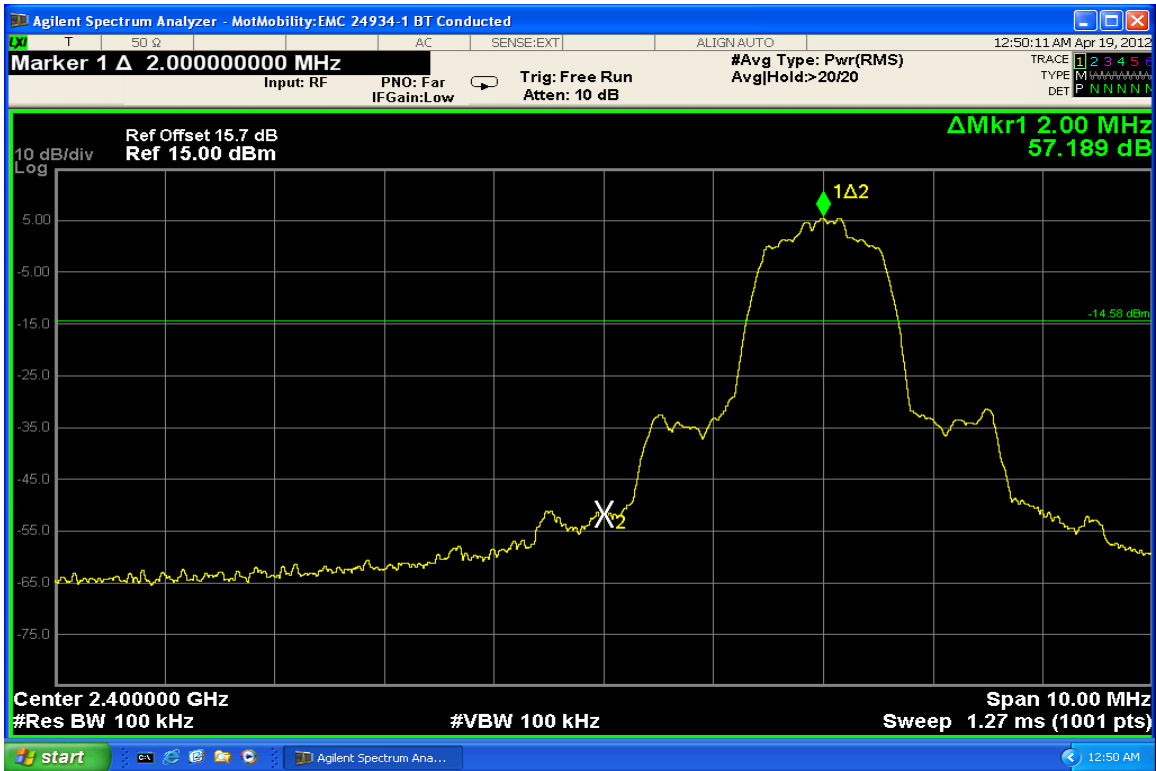
See Attached:



Low Band Edge with Hopping Disabled 1Mbps Data Rate



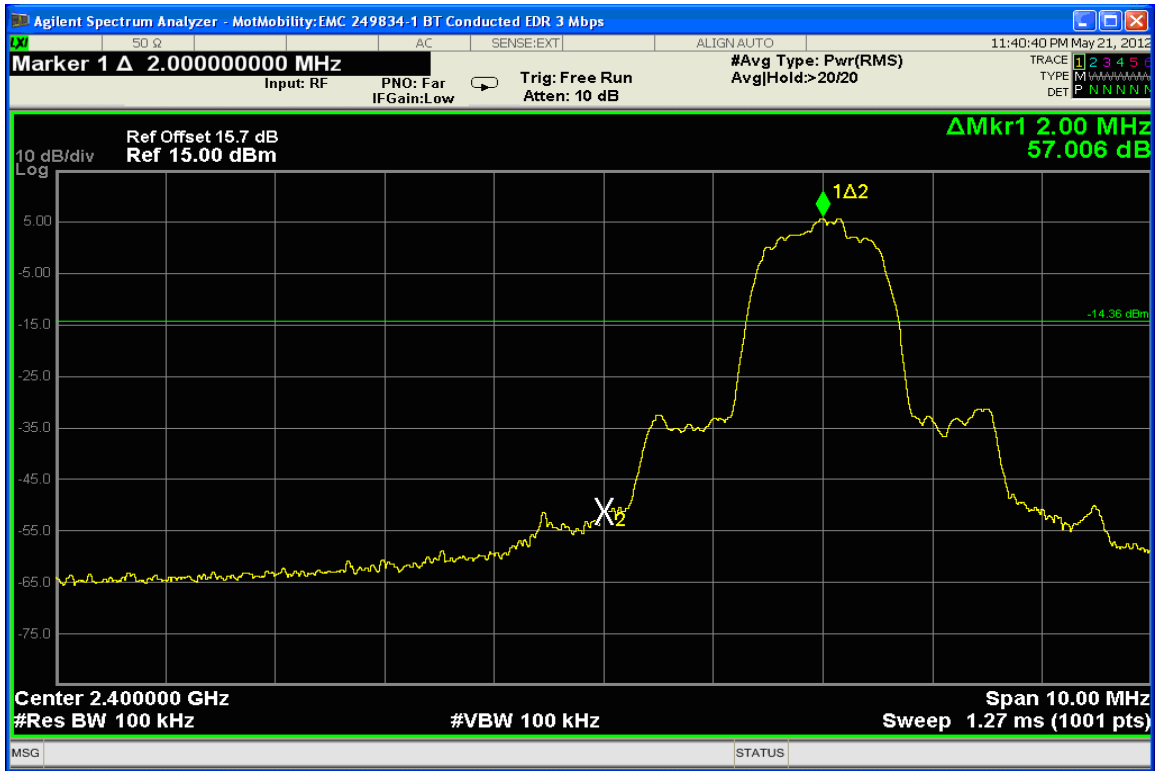
Low Band Edge with Hopping Enabled 1Mbps Data Rate



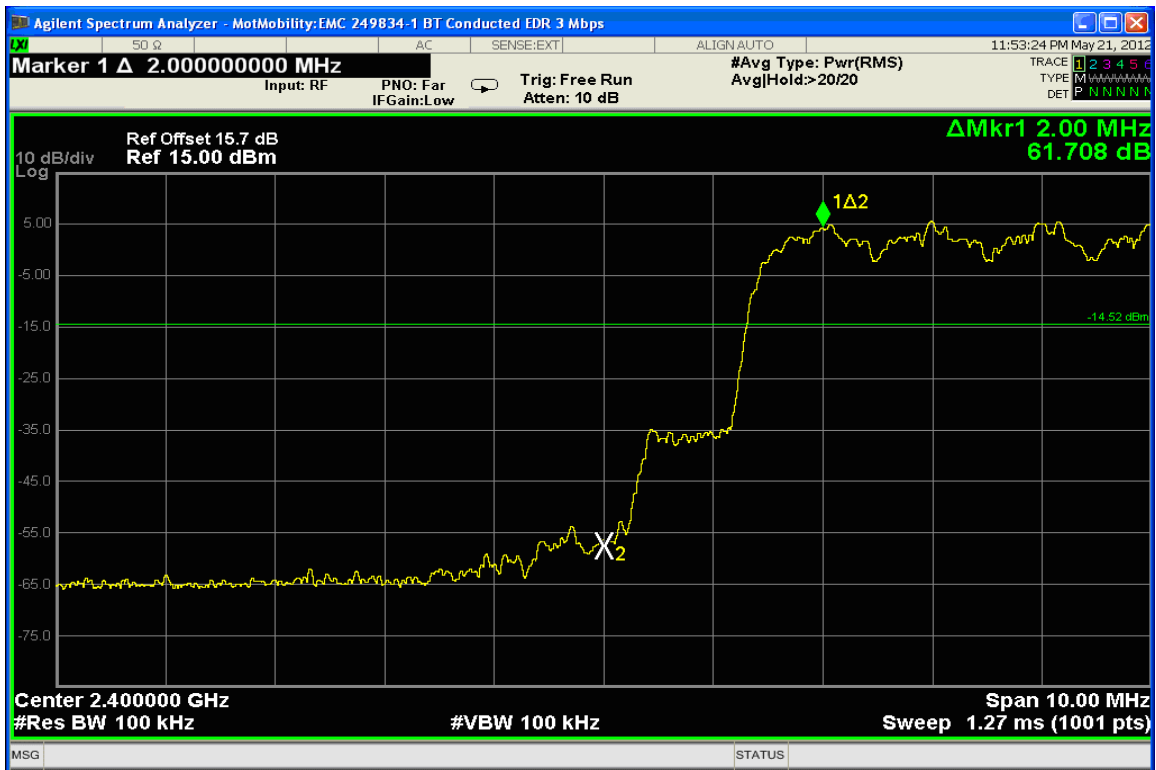
Low Band Edge with Hopping Disabled 2Mbps Data Rate



Low Band Edge with Hopping Enabled 2Mbps Data Rate



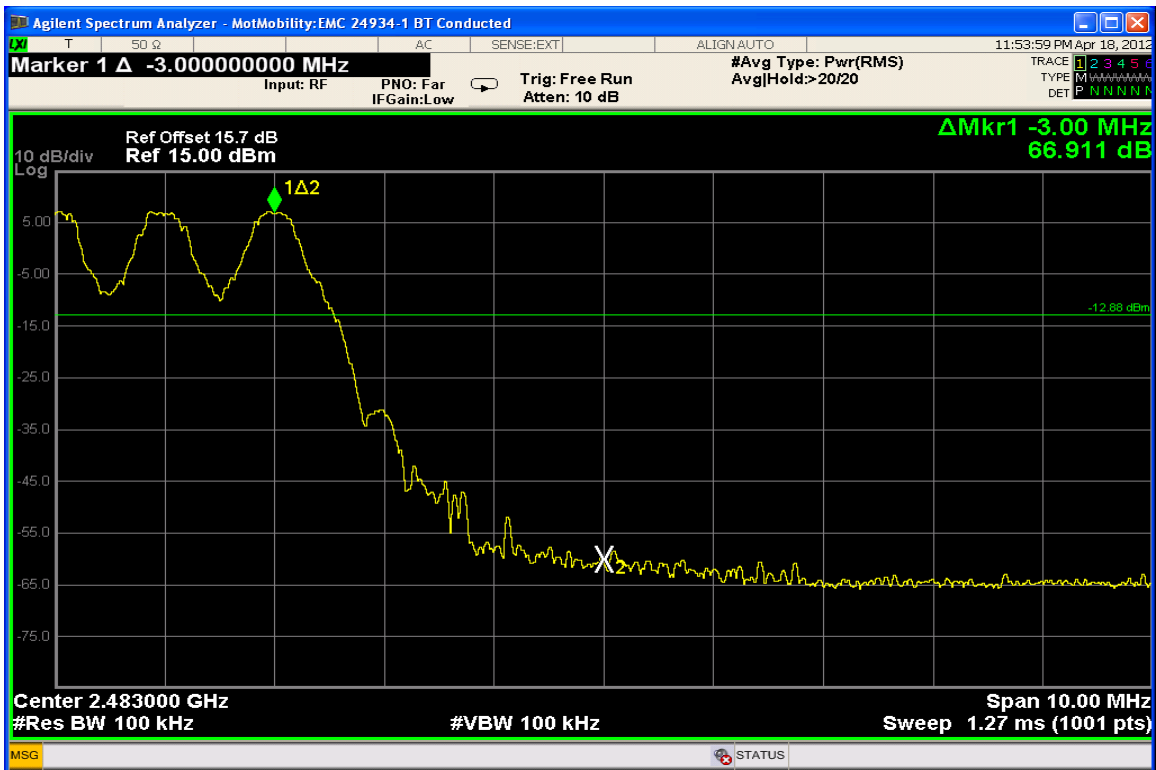
Low Band Edge with Hopping Disabled 3Mbps Data Rate



Low Band Edge with Hopping Enabled 3Mbps Data Rate



High Band edge with Hopping Disabled 1Mbps Data Rate



High Band edge with Hopping Enabled 1Mbps Data Rate



High Band Edge with Hopping Disabled 2Mbps Data Rate



High Band Edge with Hopping Enabled 2Mbps Data Rate



High Band Edge with Hopping Disabled 3Mbps Data Rate



High Band Edge with Hopping Enabled 3Mbps Data Rate

## **SPURIOUS RF CONDUCTED EMISSIONS**

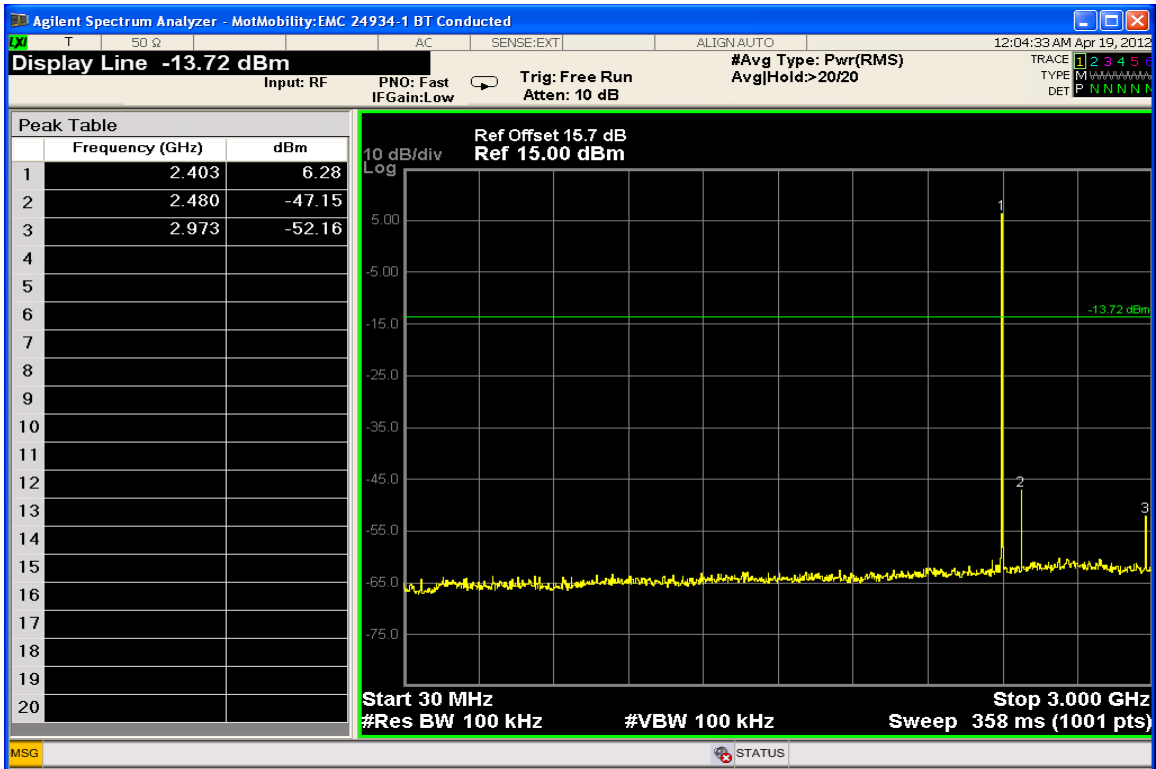
CFR 47 Part 15.247

### **Measurement Procedure**

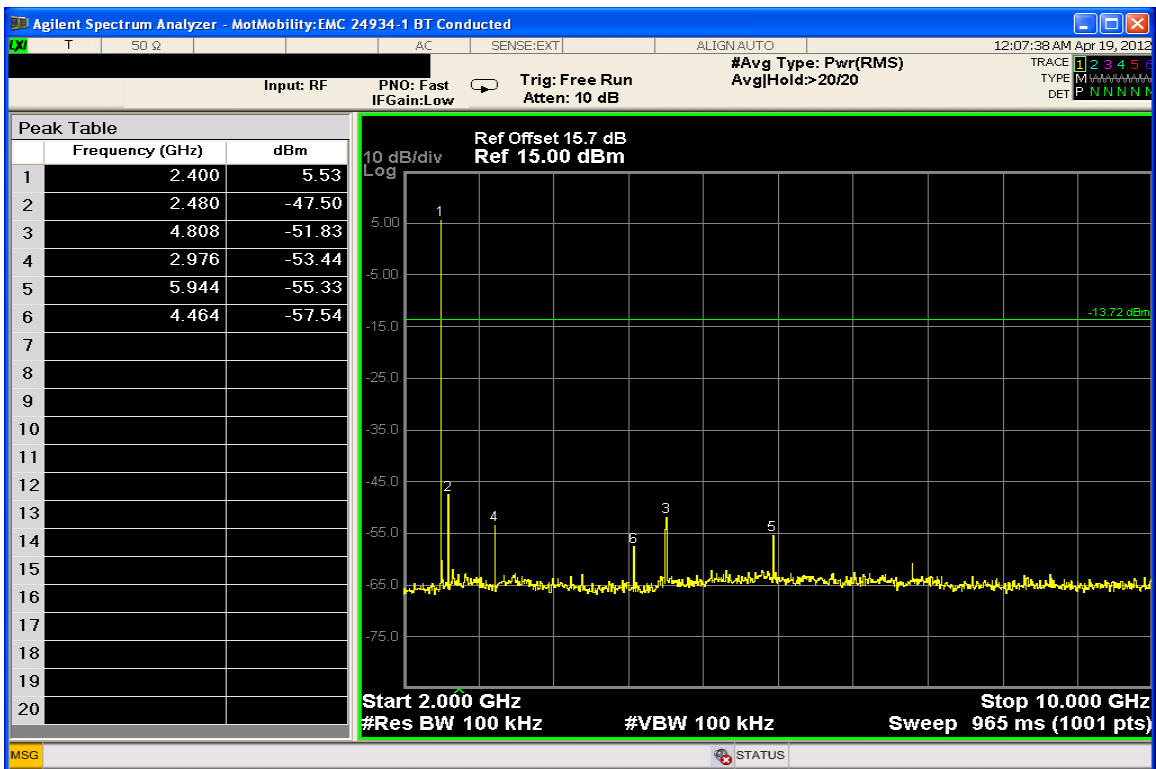
The RF output port of the Equipment-Under-Test is directly coupled to the input of the EMC analyzer through a specialized RF connector and a 10dB passive attenuator. A fully charged battery was used for the supply voltage.

### **Measurement Results**

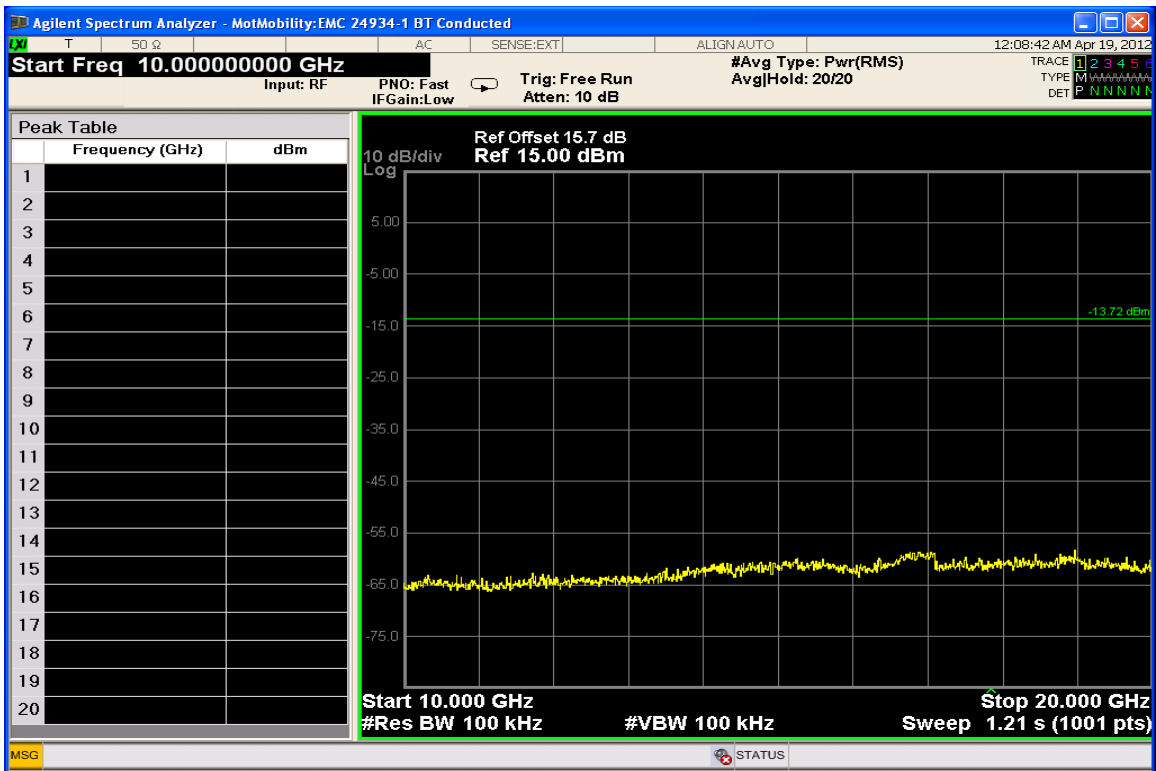
See attached:



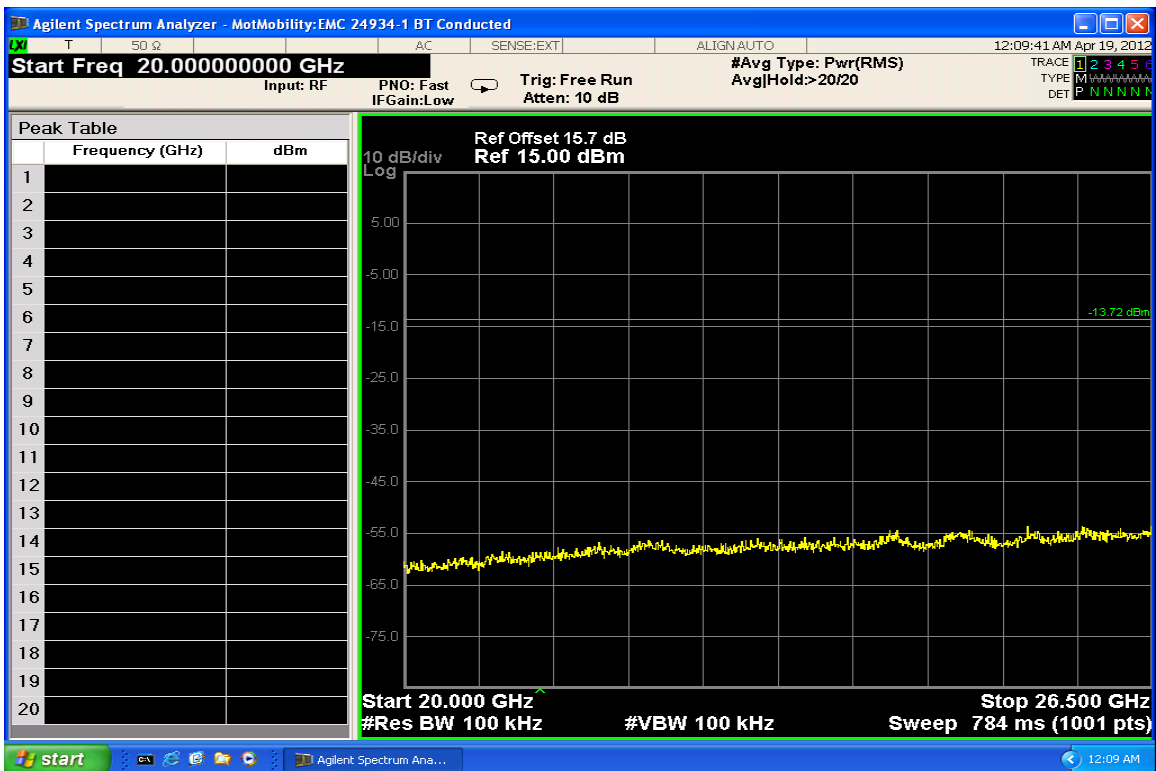
30MHz - 3000MHz (Low Channel Enabled) 1Mbps Data Rate



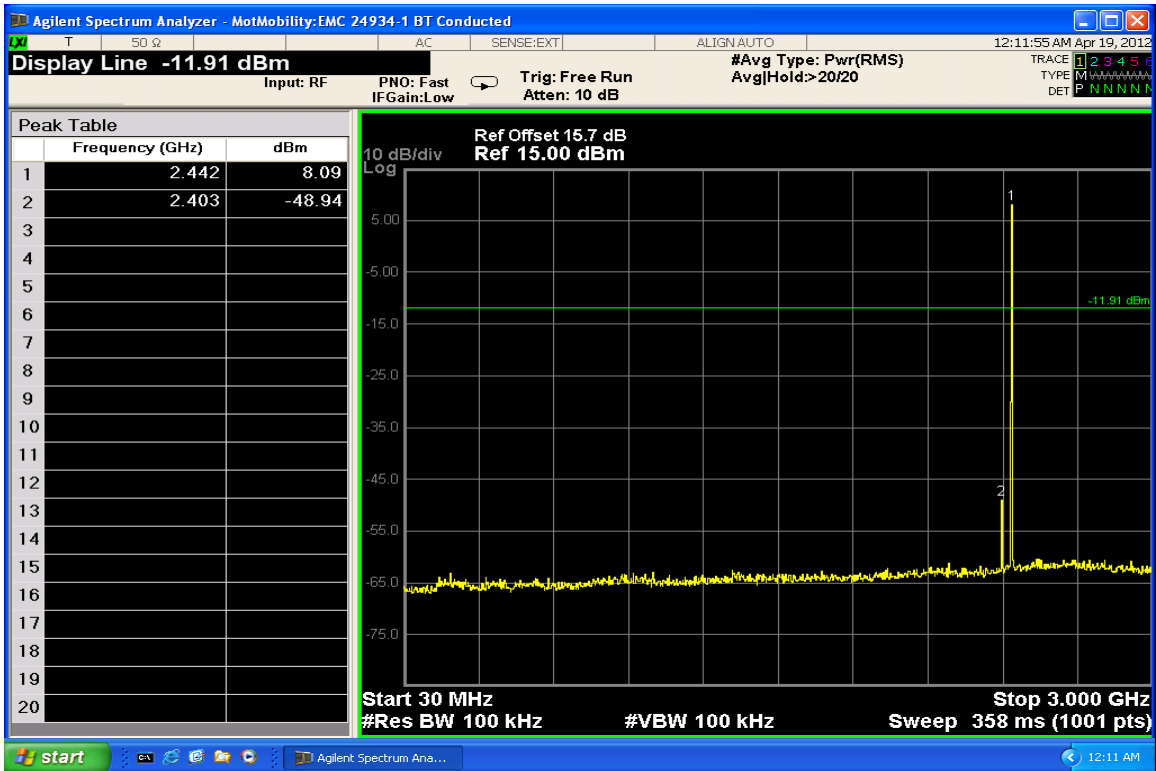
2GHz - 10GHz (Low Channel Enabled) 1Mbps Data Rate



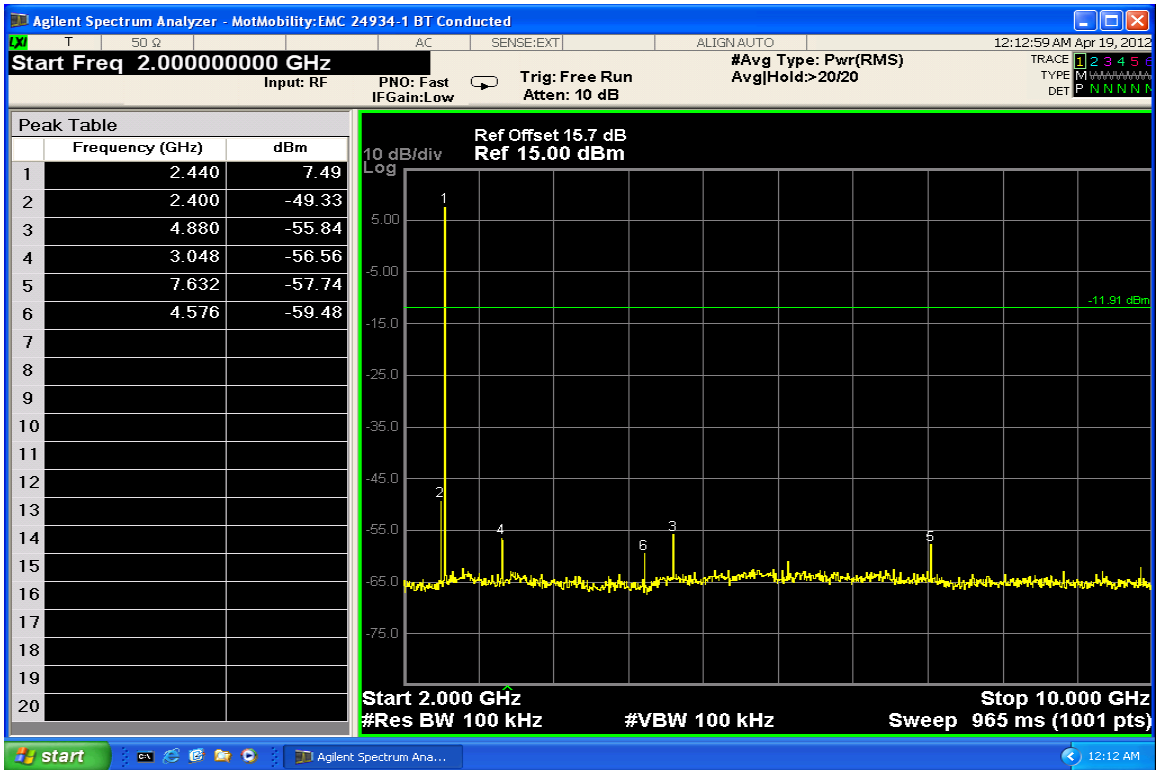
10GHz - 20GHz (Low Channel Enabled) 1Mbps Data Rate



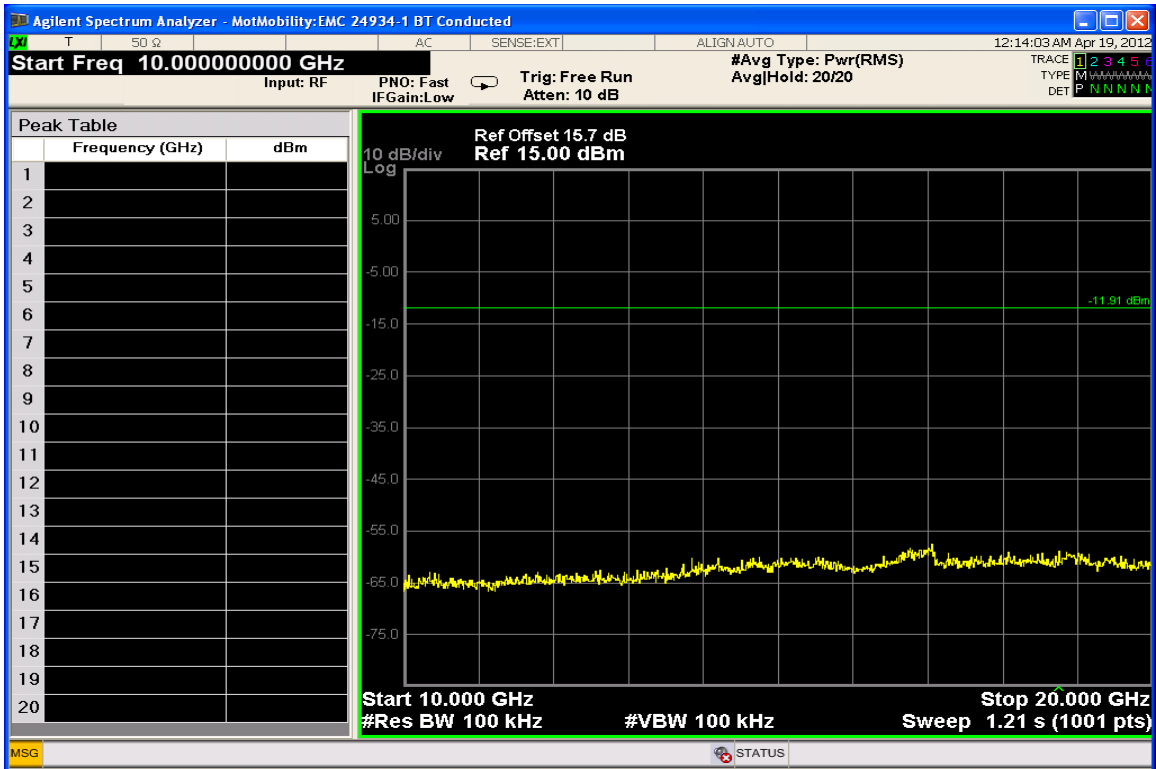
20GHz - 26.5GHz (Low Channel Enabled) 1Mbps Data Rate



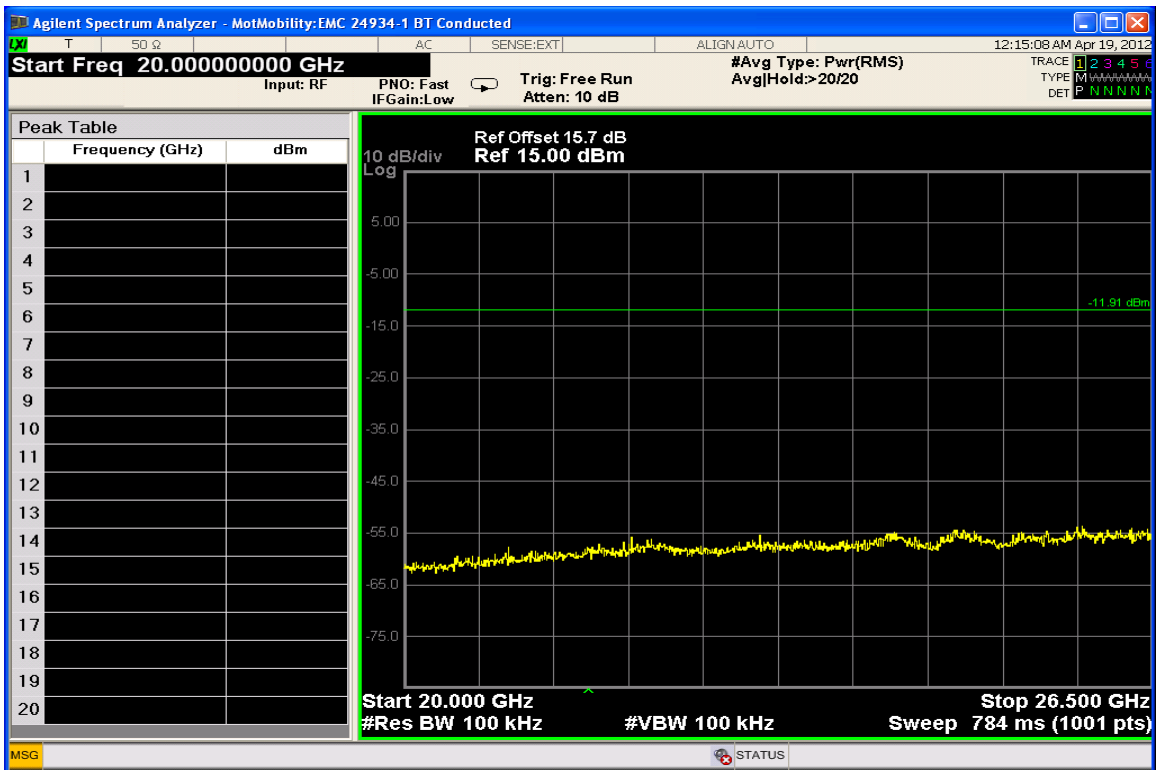
**30MHz - 3000MHz (Mid Channel Enabled) 1Mbps Data Rate**



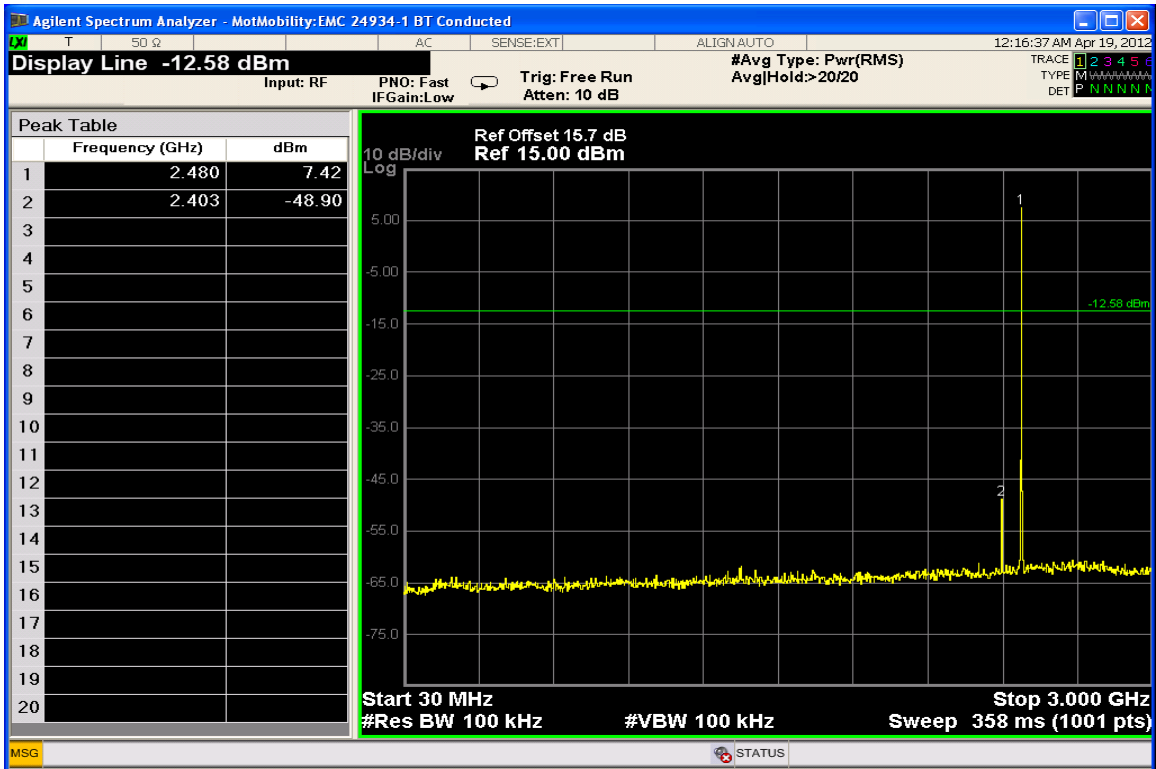
**2GHz - 10GHz (Mid Channel Enabled) 1Mbps Data Rate**



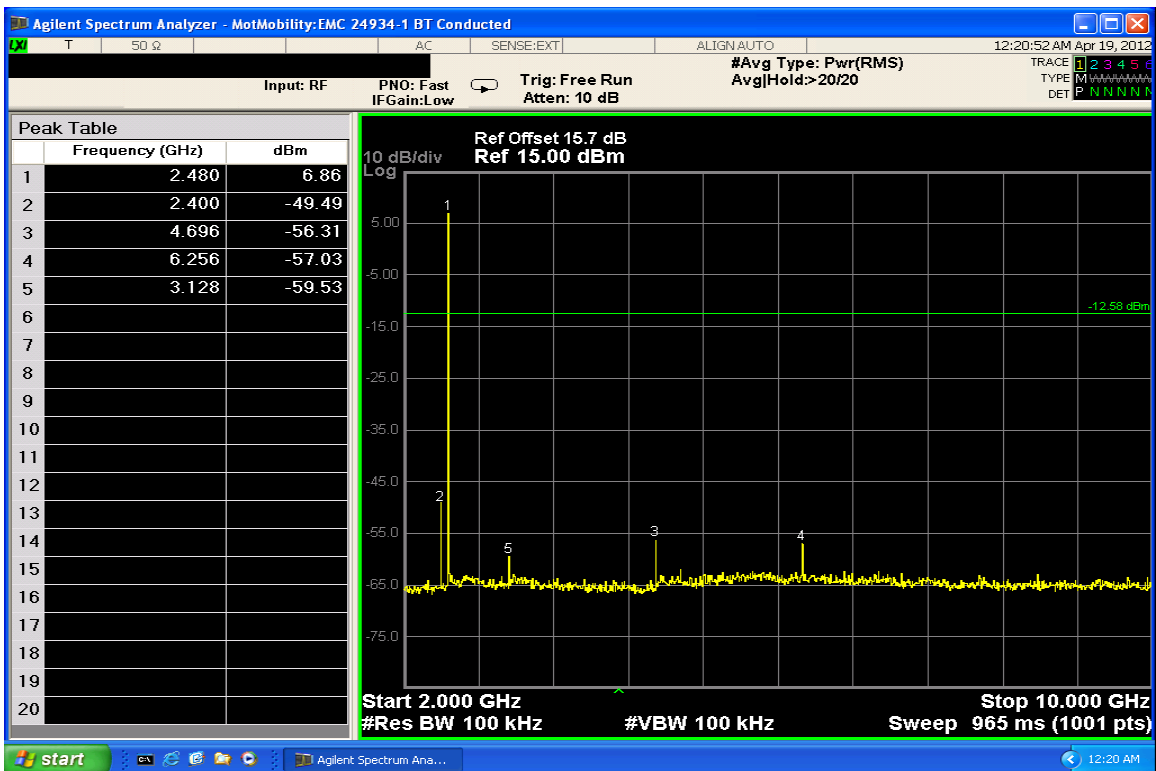
10GHz - 20GHz (Mid Channel Enabled) 1Mbps Data Rate



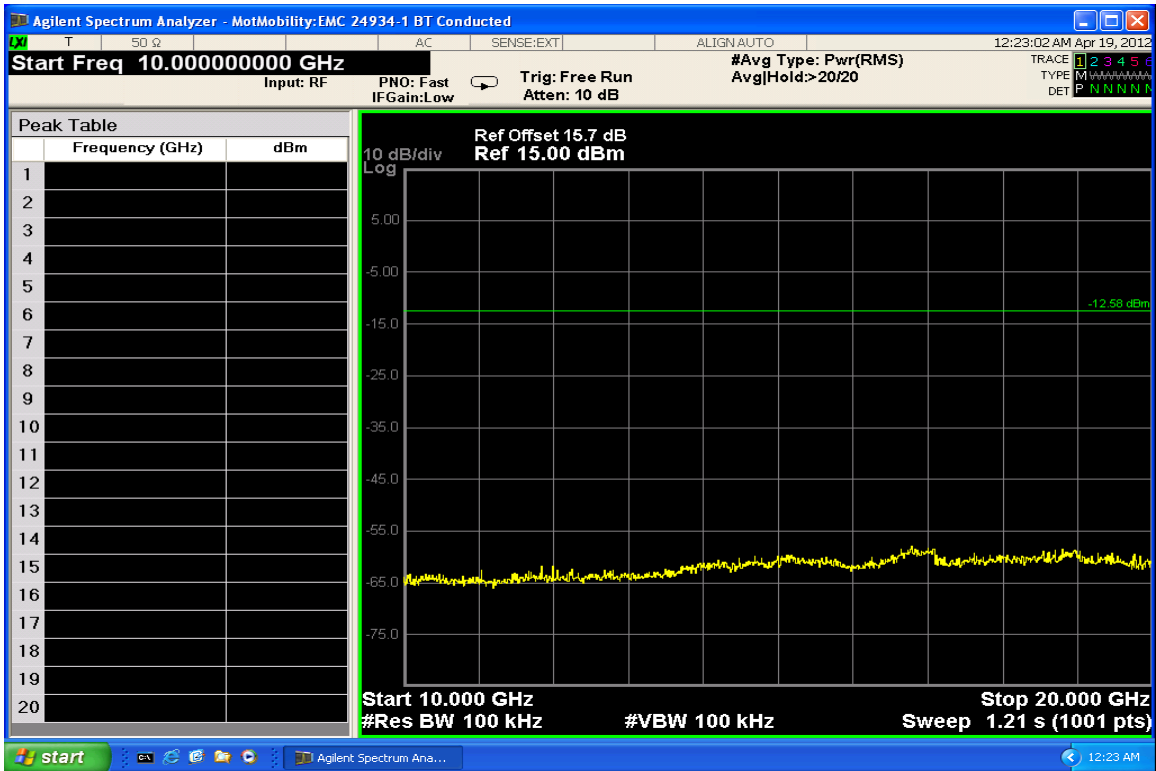
20GHz - 26.5GHz (Mid Channel Enabled) 1Mbps Data Rate



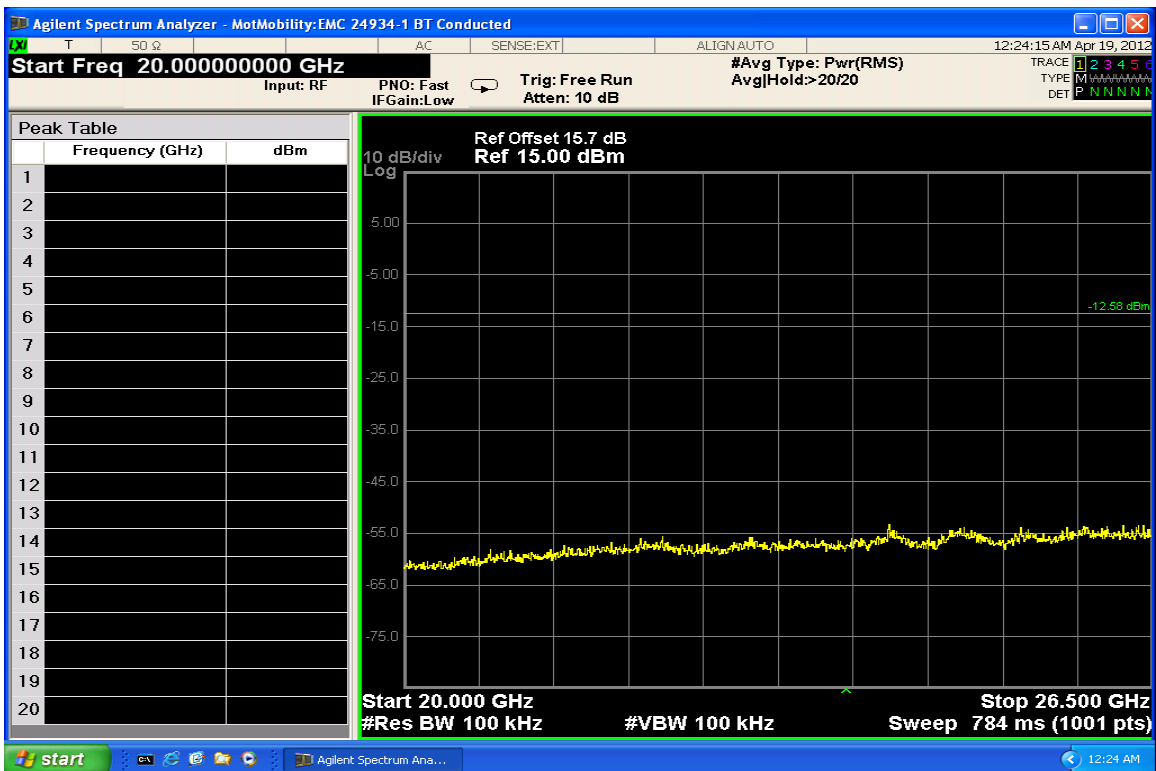
30 - 3000MHz (High Channel Enabled) 1Mbps Data Rate



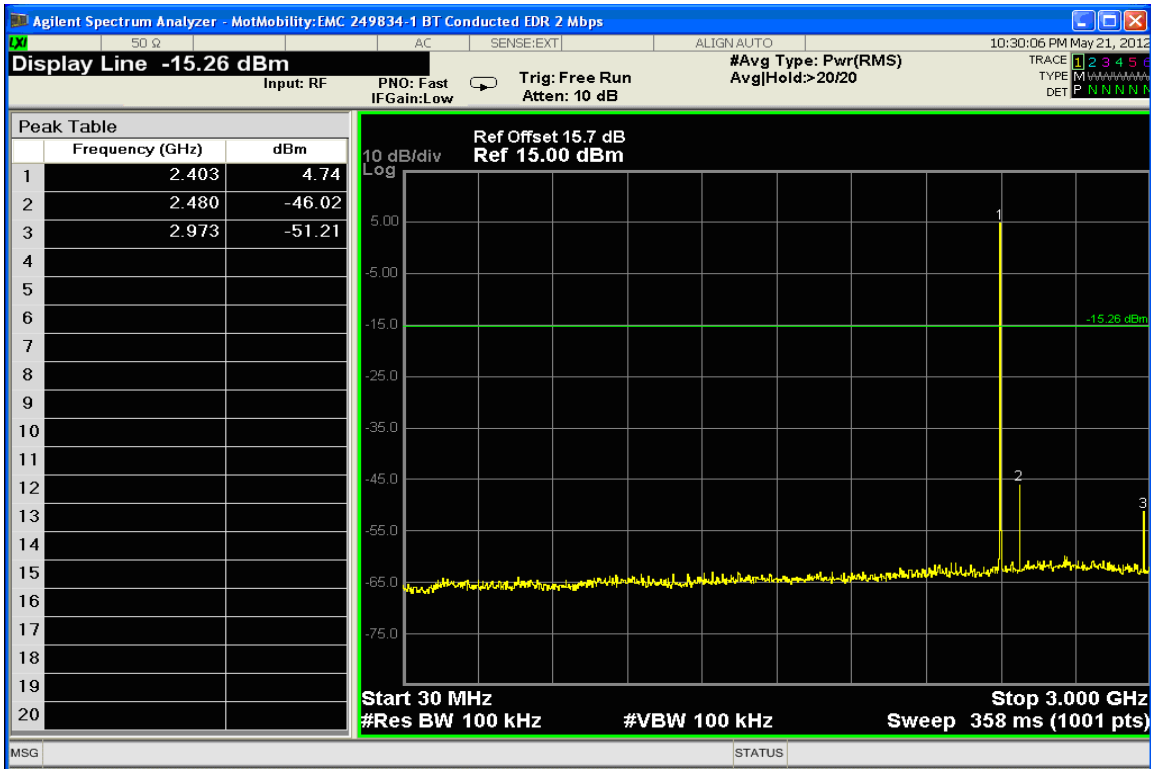
2 - 10GHz (High Channel Enabled) 1Mbps Data Rate



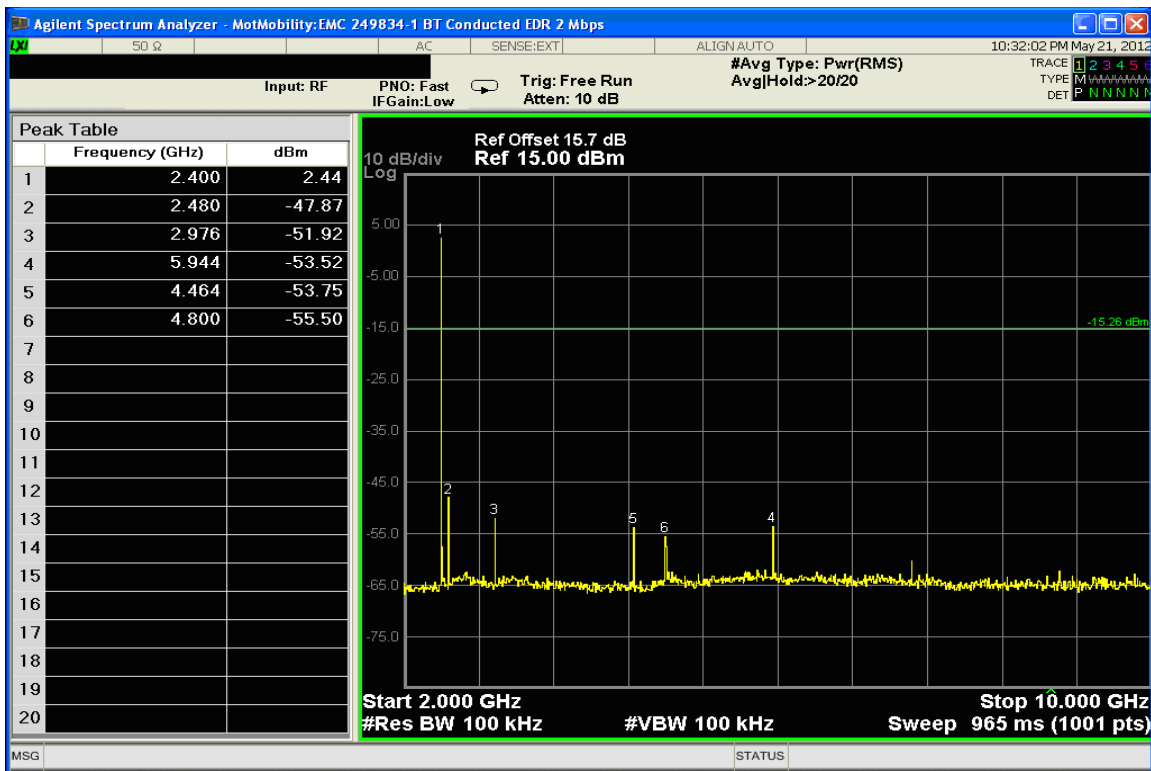
10 GHz - 20GHz (High Channel Enabled) 1Mbps Data Rate



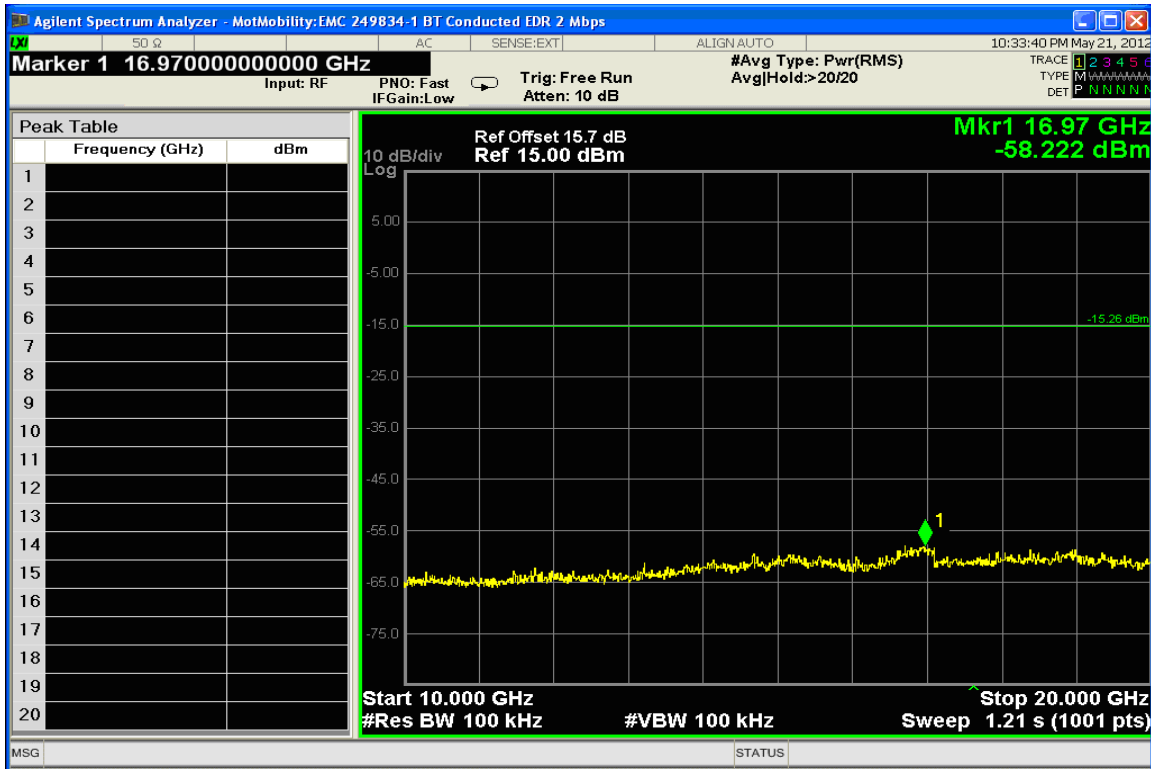
20 GHz - 26.5GHz (High Channel Enabled) 1Mbps Data Rate



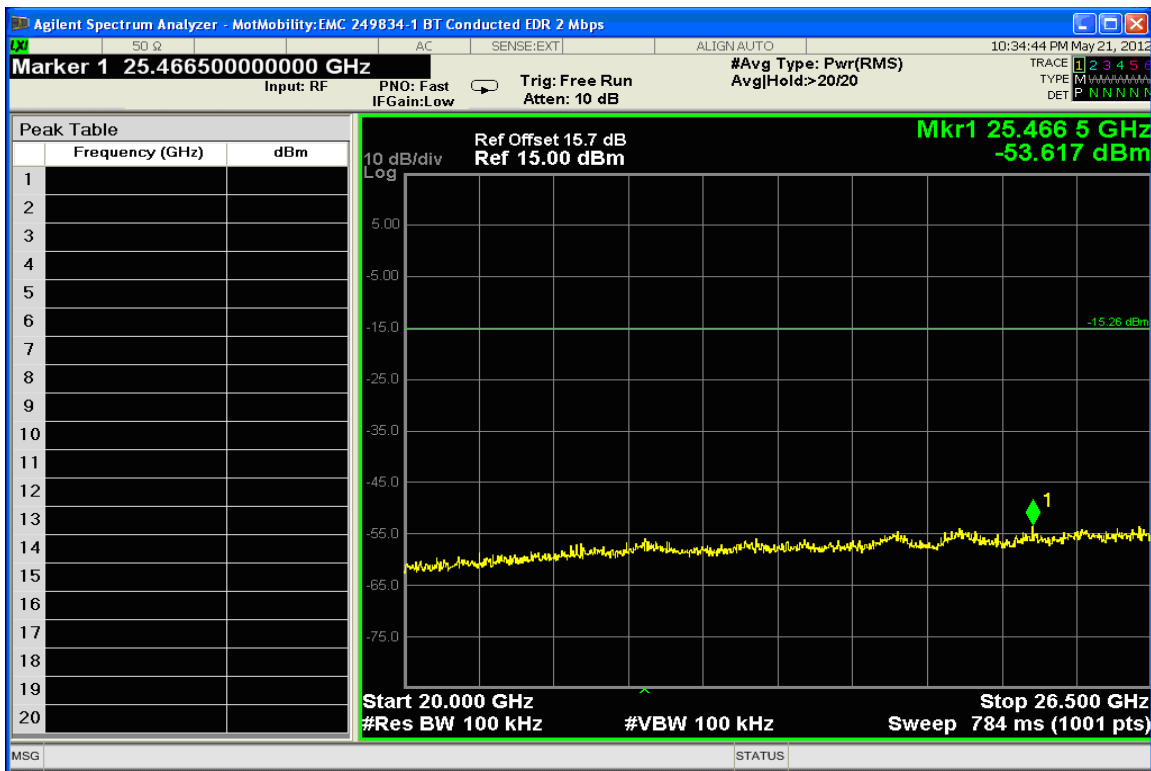
**30MHz - 3000MHz (Low Channel Enabled) 2Mbps Data Rate**



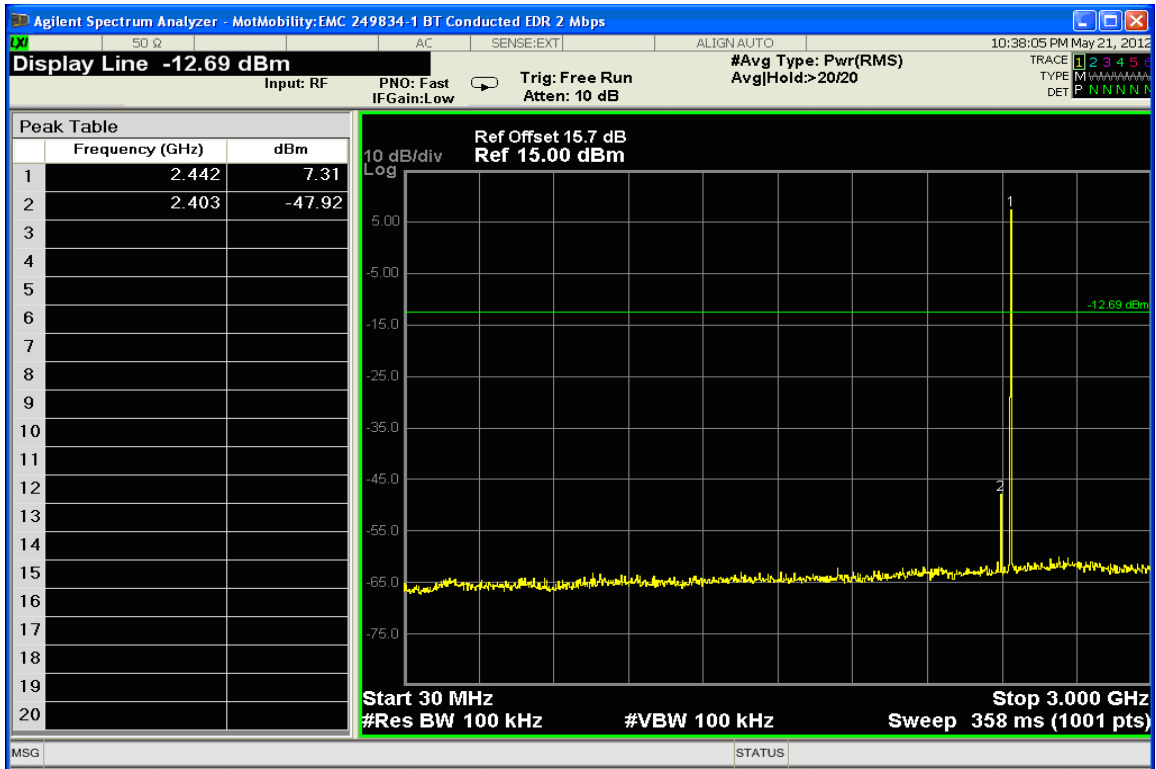
**2GHz - 10GHz (Low Channel Enabled) 2Mbps Data Rate**



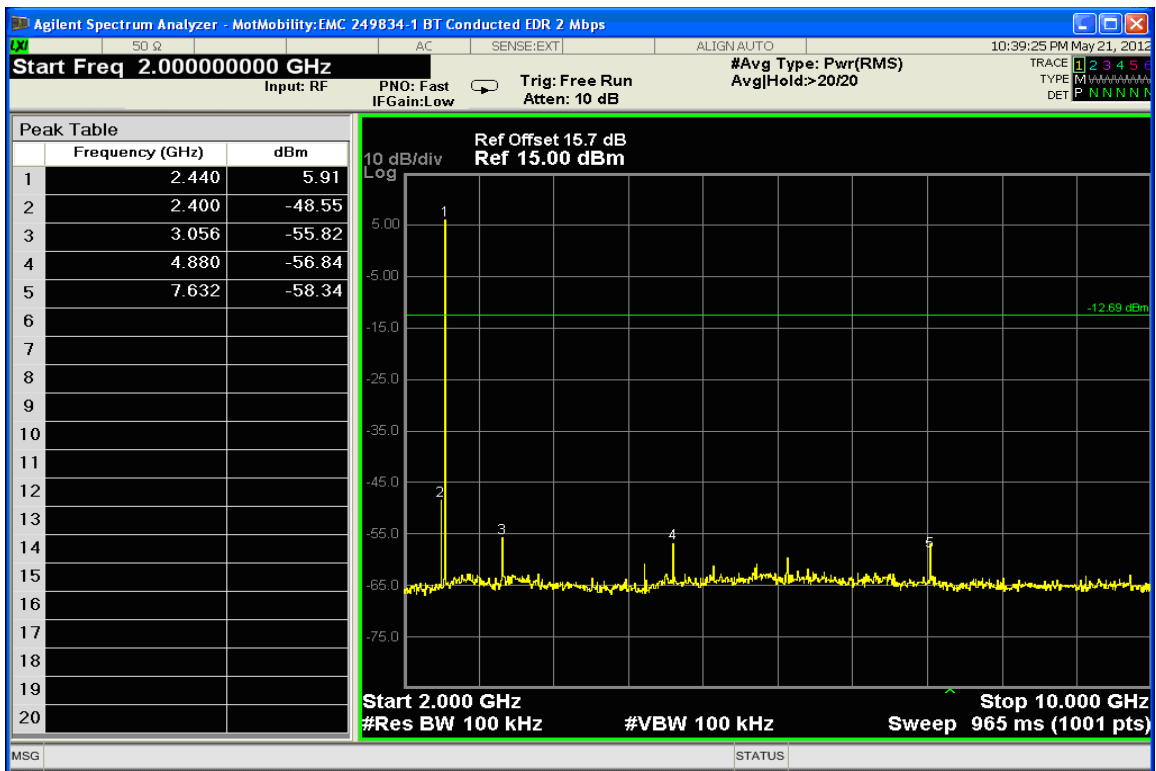
10GHz - 20GHz (Low Channel Enabled) 2Mbps Data Rate



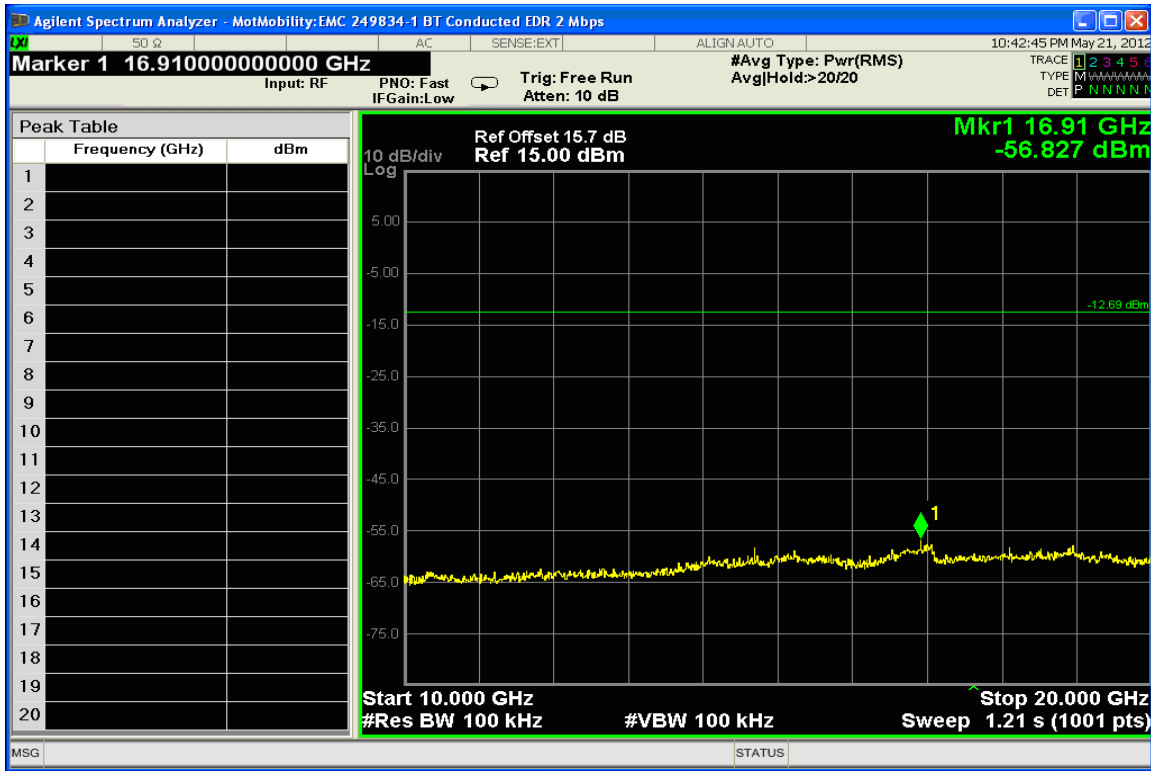
20GHz - 26.5GHz (Low Channel Enabled) 2Mbps Data Rate



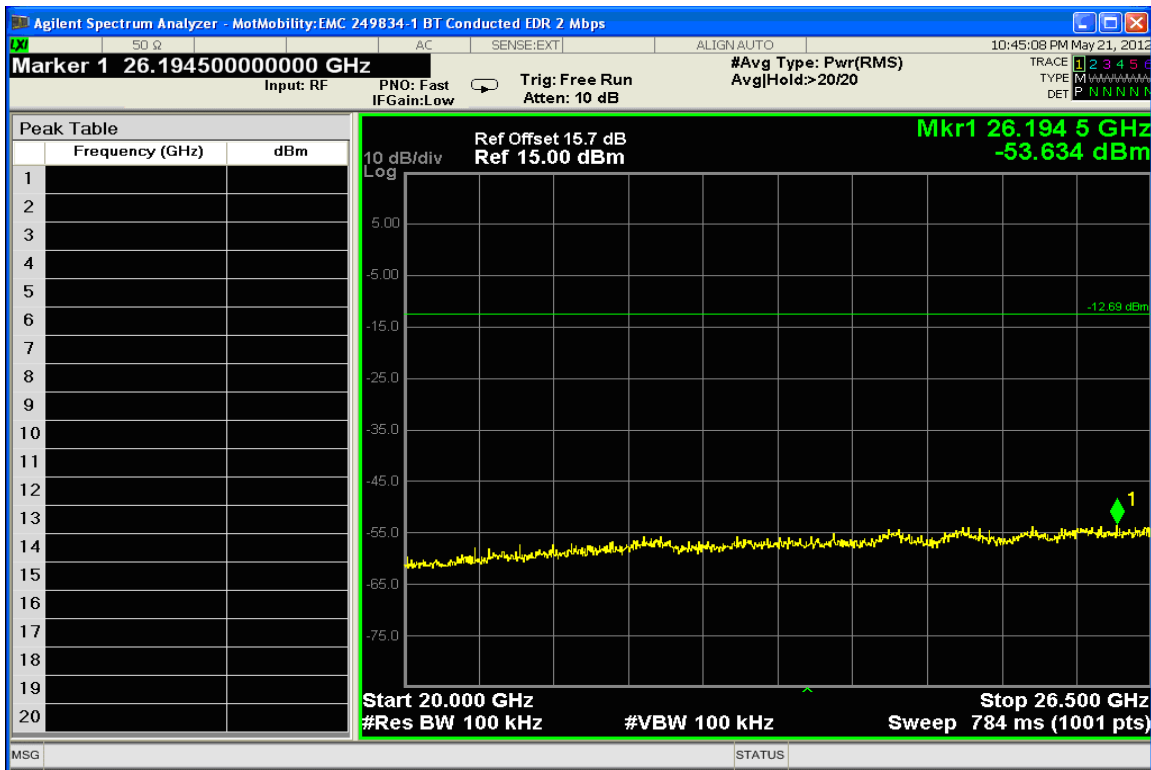
30MHz - 3000MHz (Mid Channel Enabled) 2Mbps Data Rate



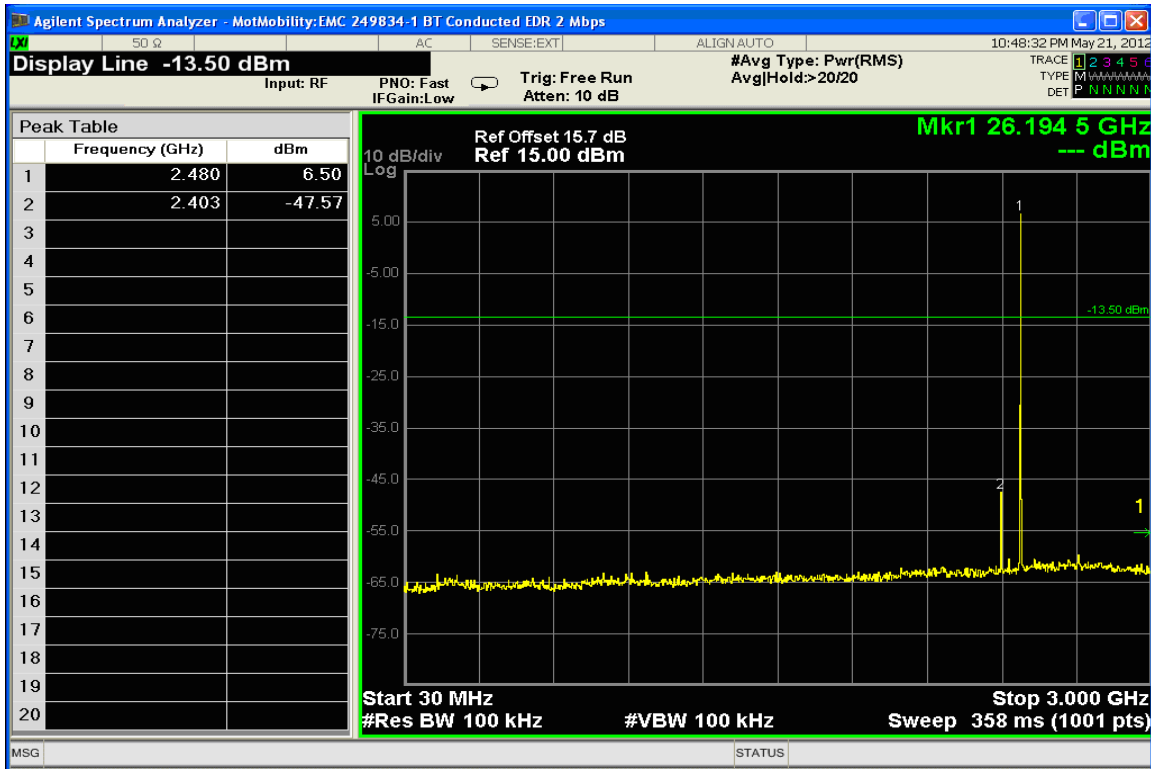
2GHz - 10GHz (Mid Channel Enabled) 2Mbps Data Rate



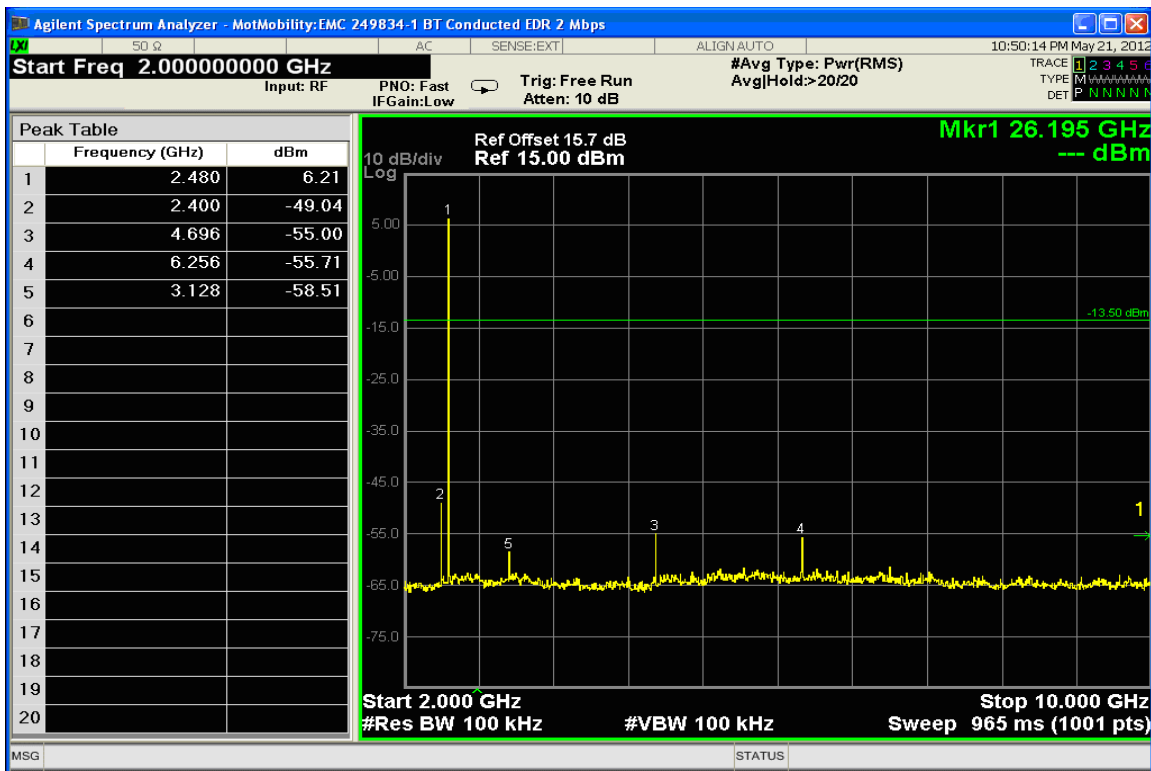
10GHz - 20GHz (Mid Channel Enabled) 2Mbps Data Rate



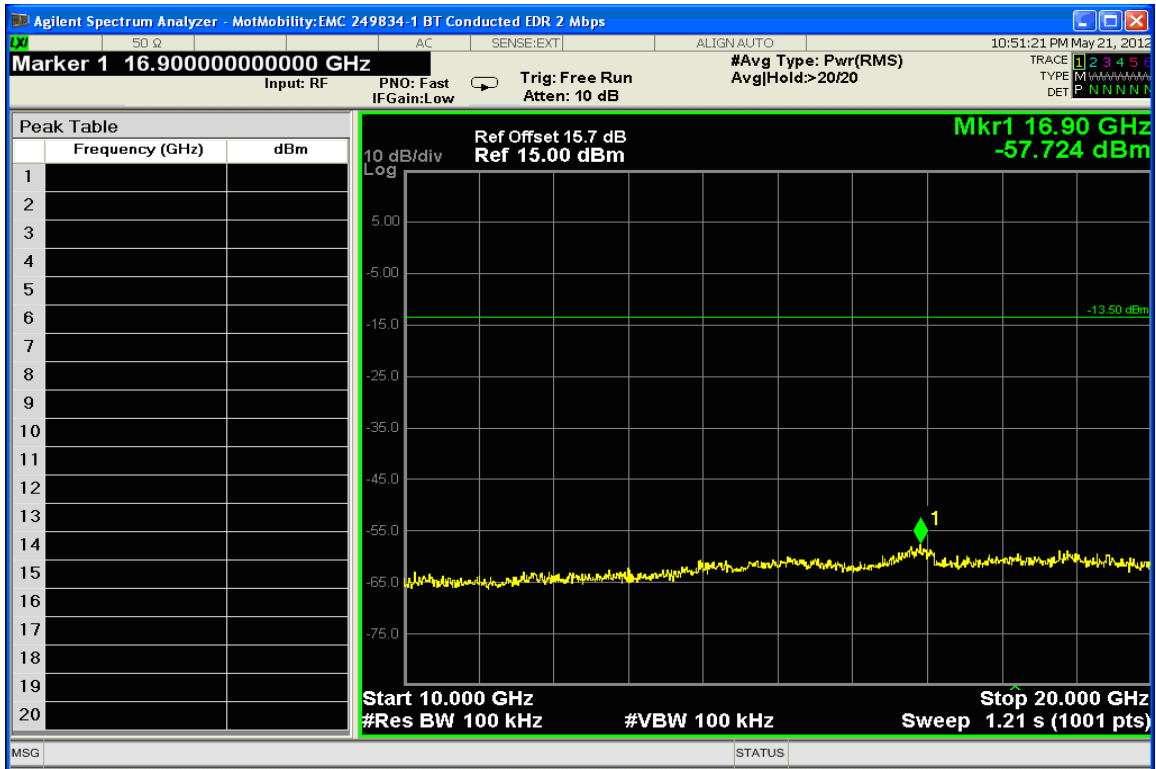
20GHz - 26.5GHz (Mid Channel Enabled) 2Mbps Data Rate



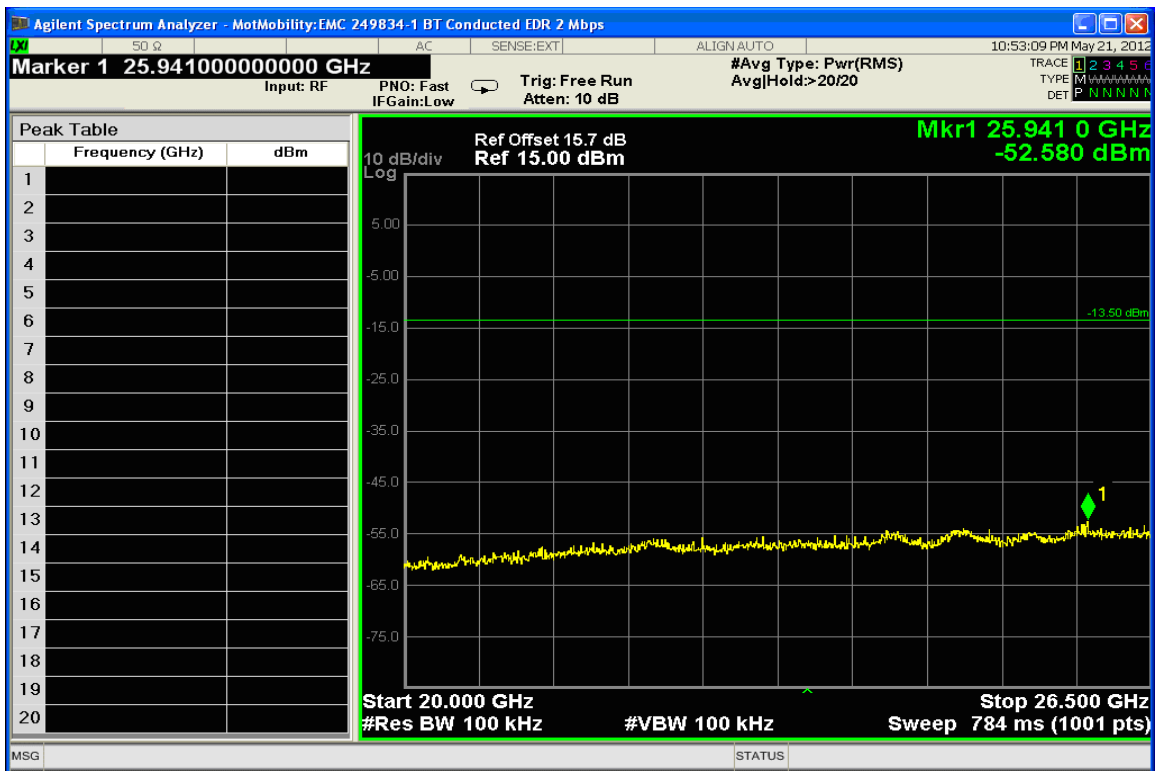
30MHz - 3000MHz (High Channel Enabled) 2Mbps Data Rate



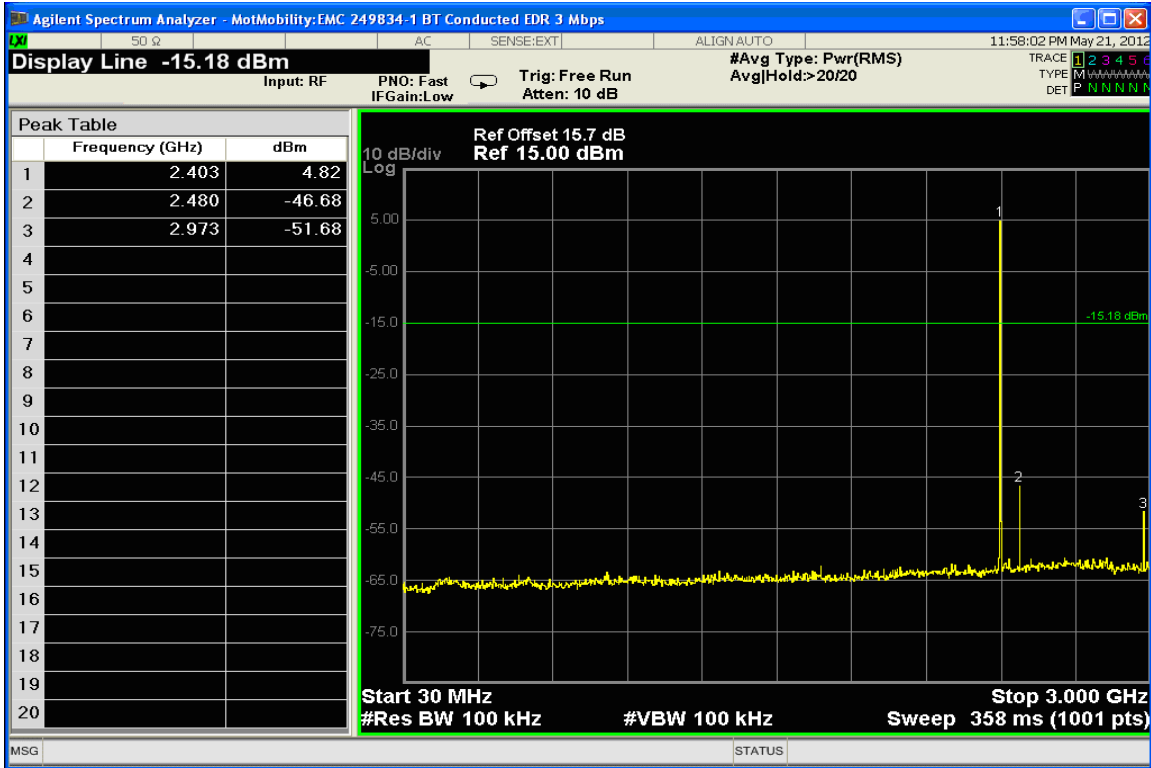
2GHz - 10GHz (High Channel Enabled) 2Mbps Data Rate



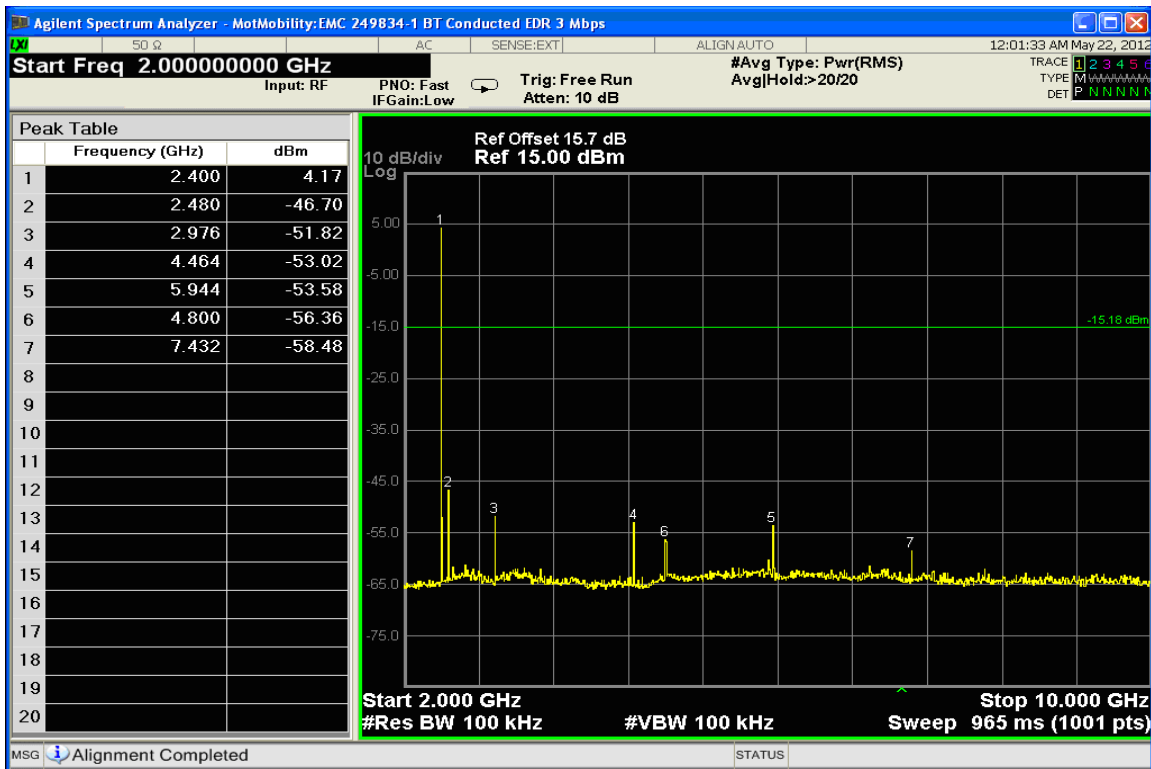
10GHz - 20GHz (High Channel Enabled) 2Mbps Data Rate



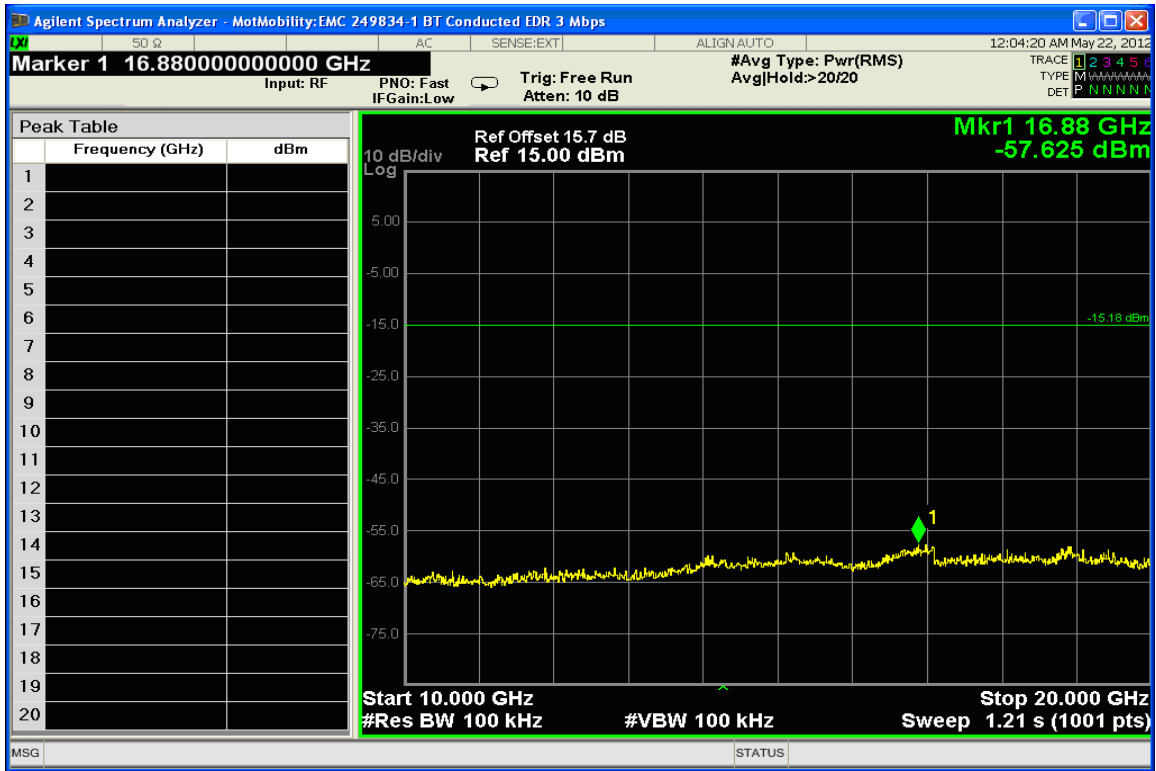
20GHz - 26.5GHz (High Channel Enabled) 2Mbps Data Rate



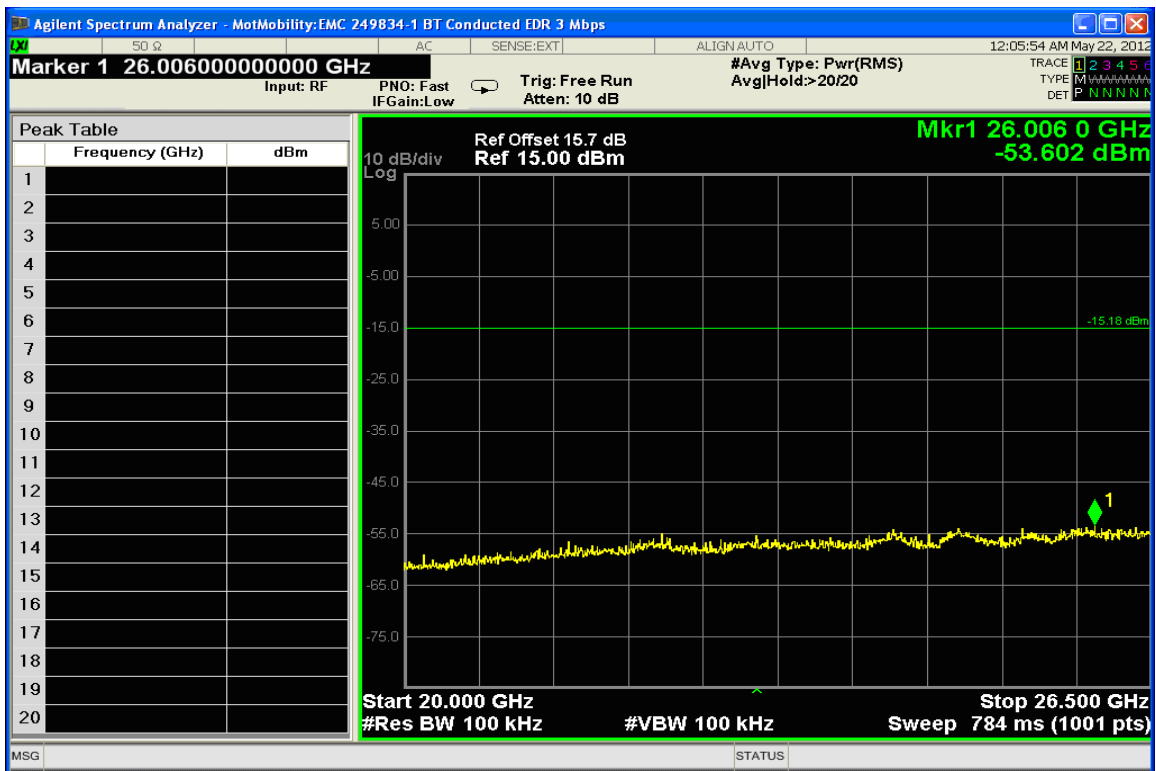
30MHz - 3000MHz (Low Channel Enabled) 3Mbps Data Rate



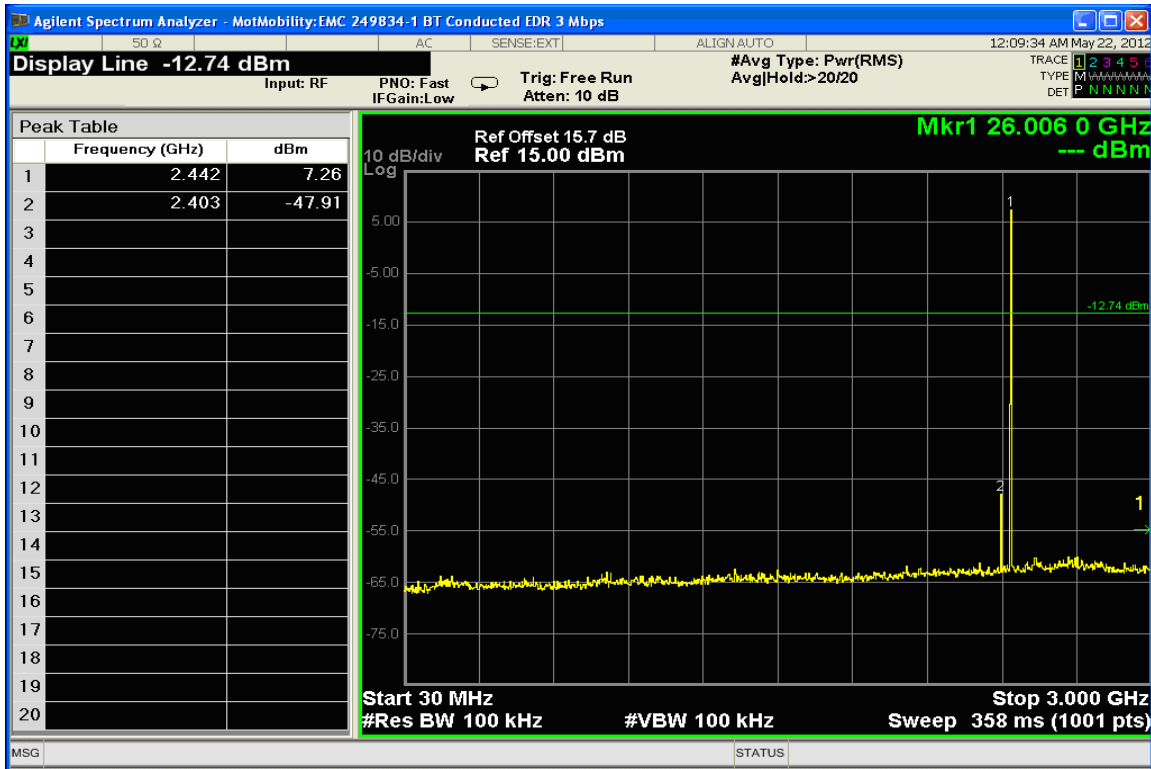
2GHz - 10GHz (Low Channel Enabled) 3Mbps Data Rate



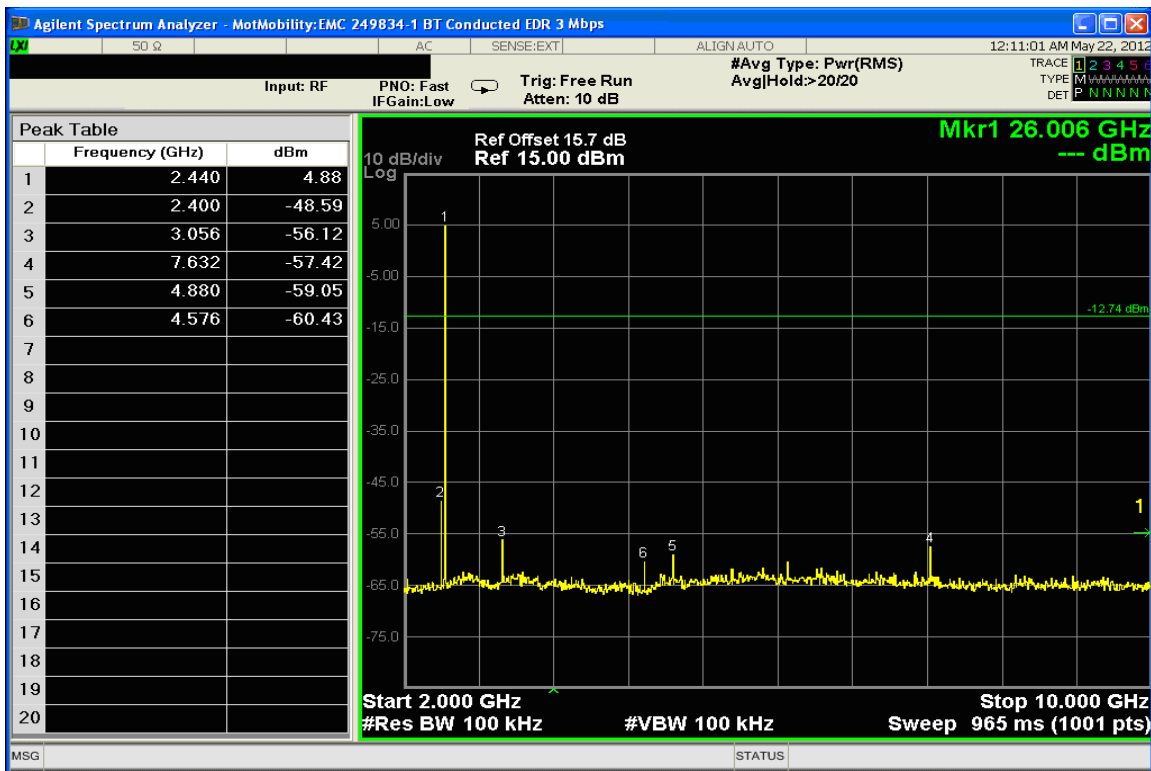
10GHz - 20GHz (Low Channel Enabled) 3Mbps Data Rate



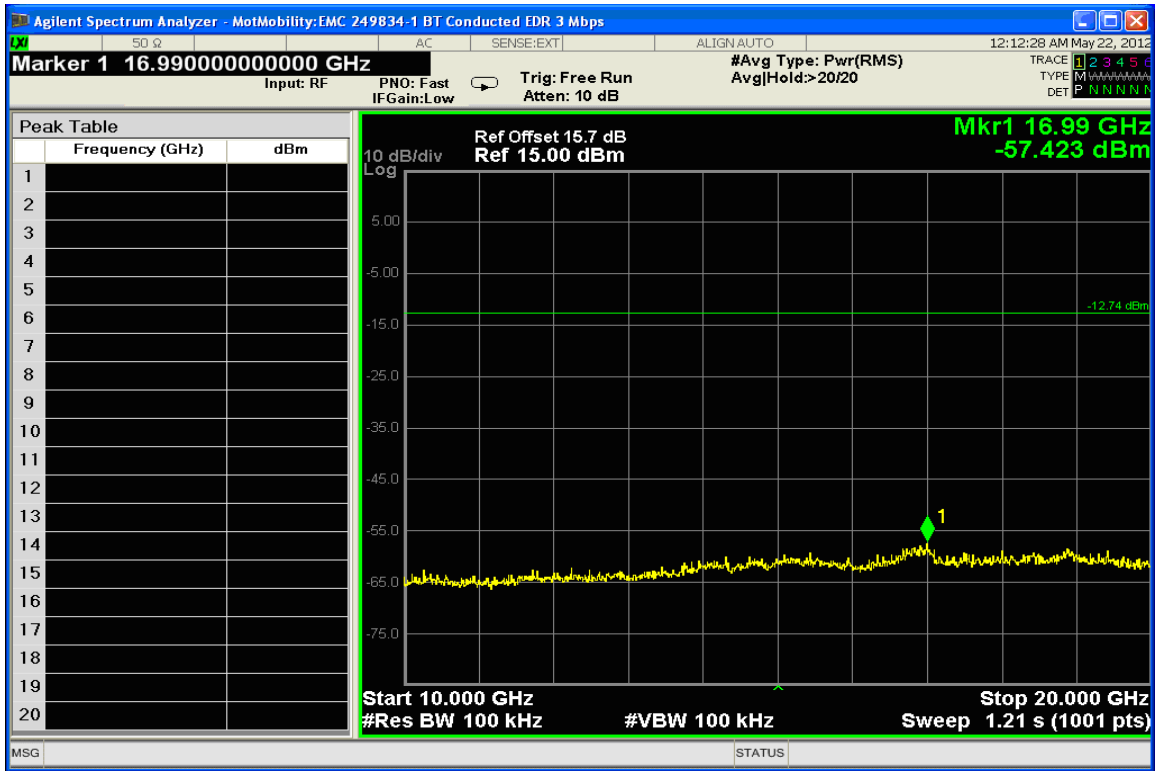
20GHz - 26.5GHz (Low Channel Enabled) 3Mbps Data Rate



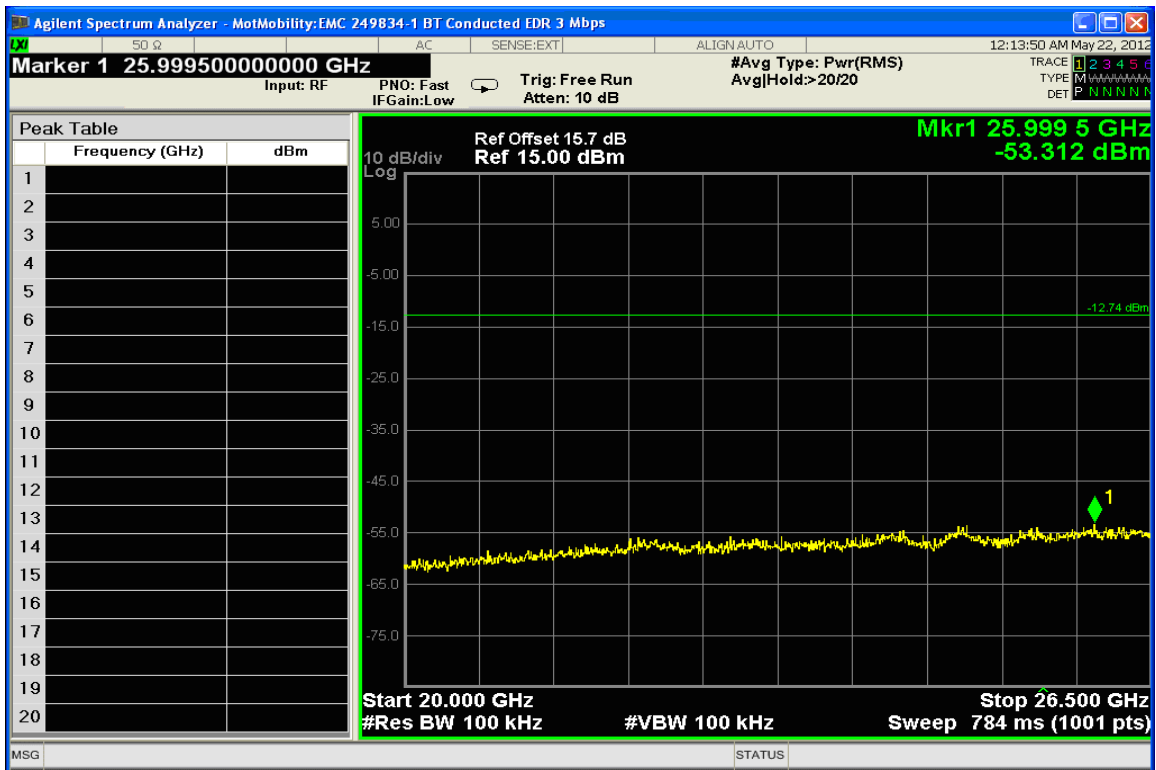
30MHz - 3000MHz (Mid Channel Enabled) 3Mbps Data Rate



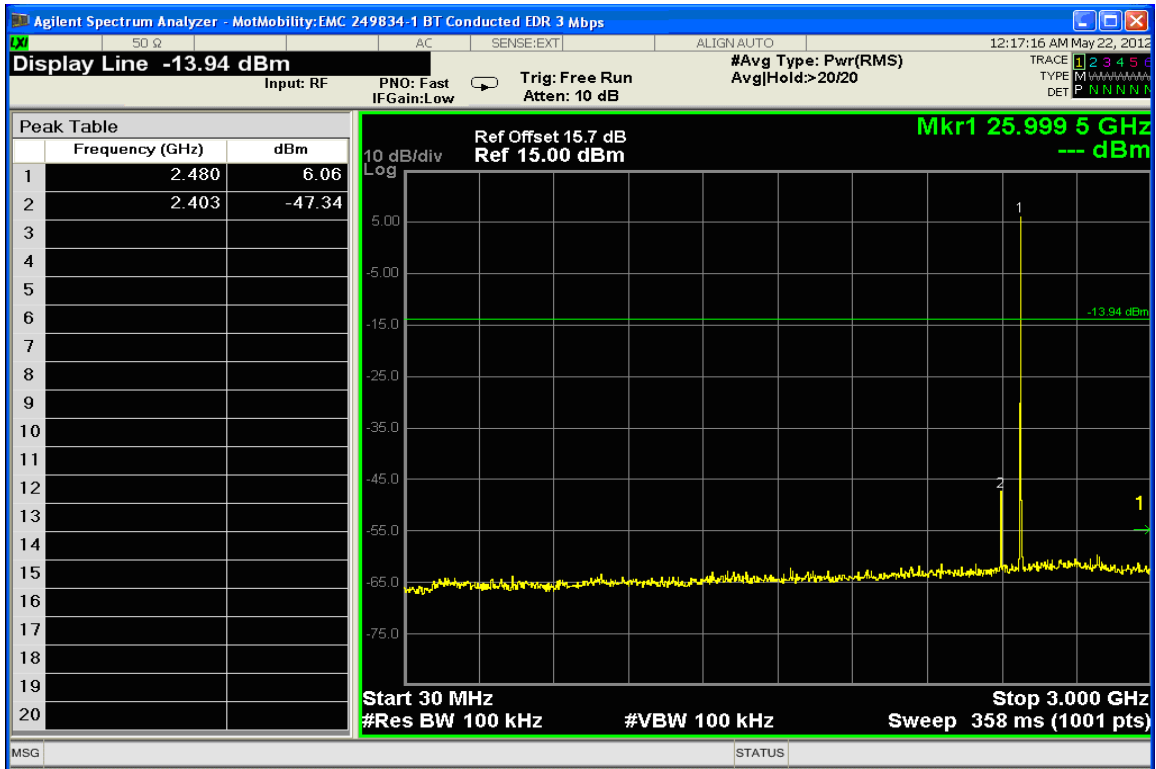
2GHz - 10GHz (Mid Channel Enabled) 3Mbps Data Rate



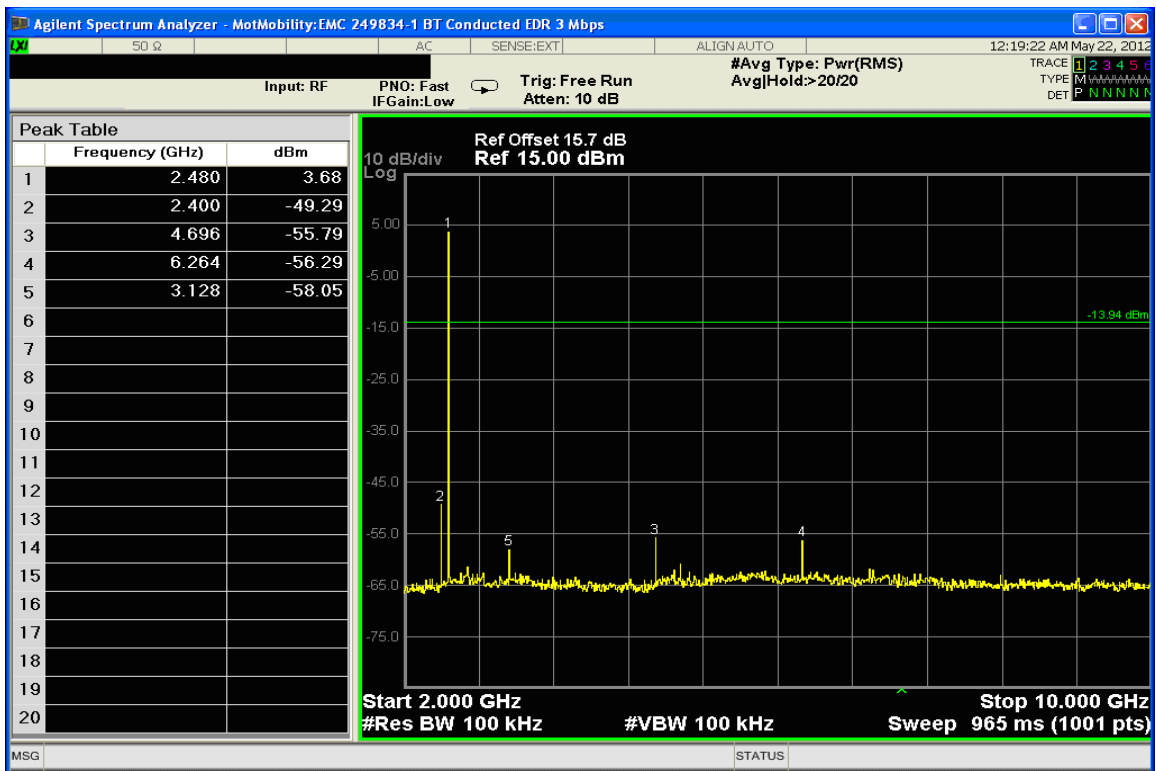
10GHz - 20GHz (Mid Channel Enabled) 3Mbps Data Rate



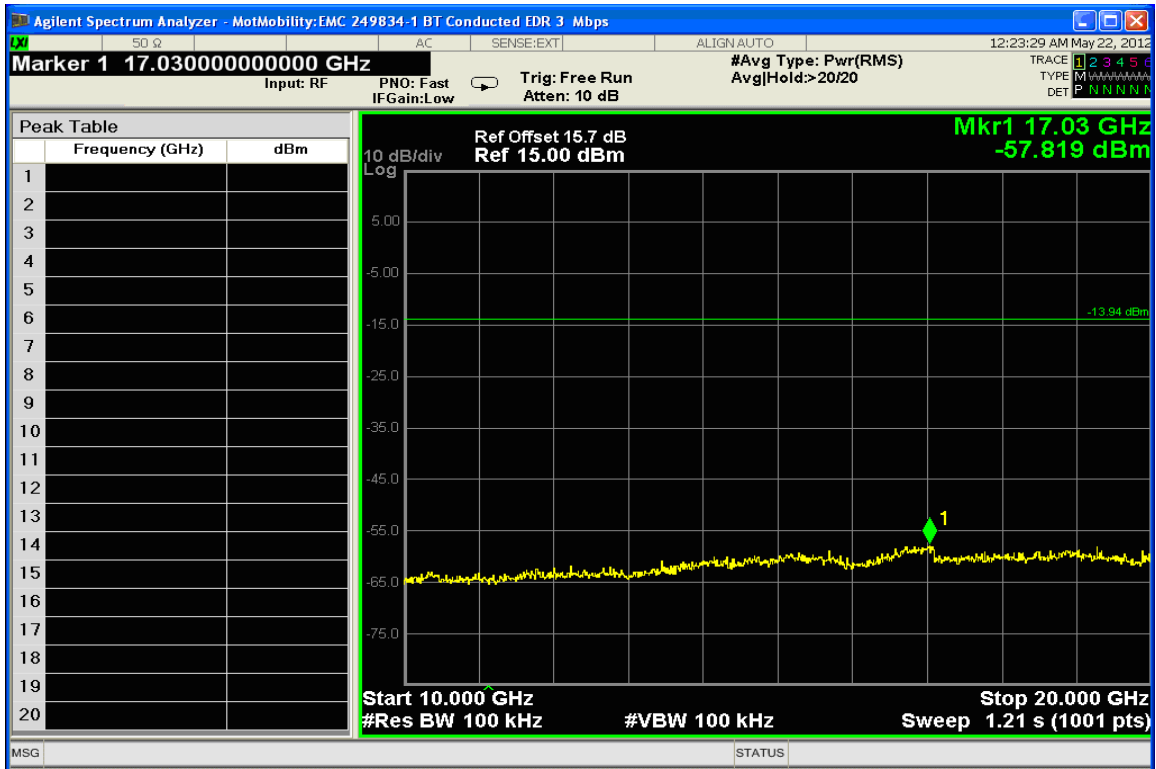
20GHz - 26.5GHz (Mid Channel Enabled) 3Mbps Data Rate



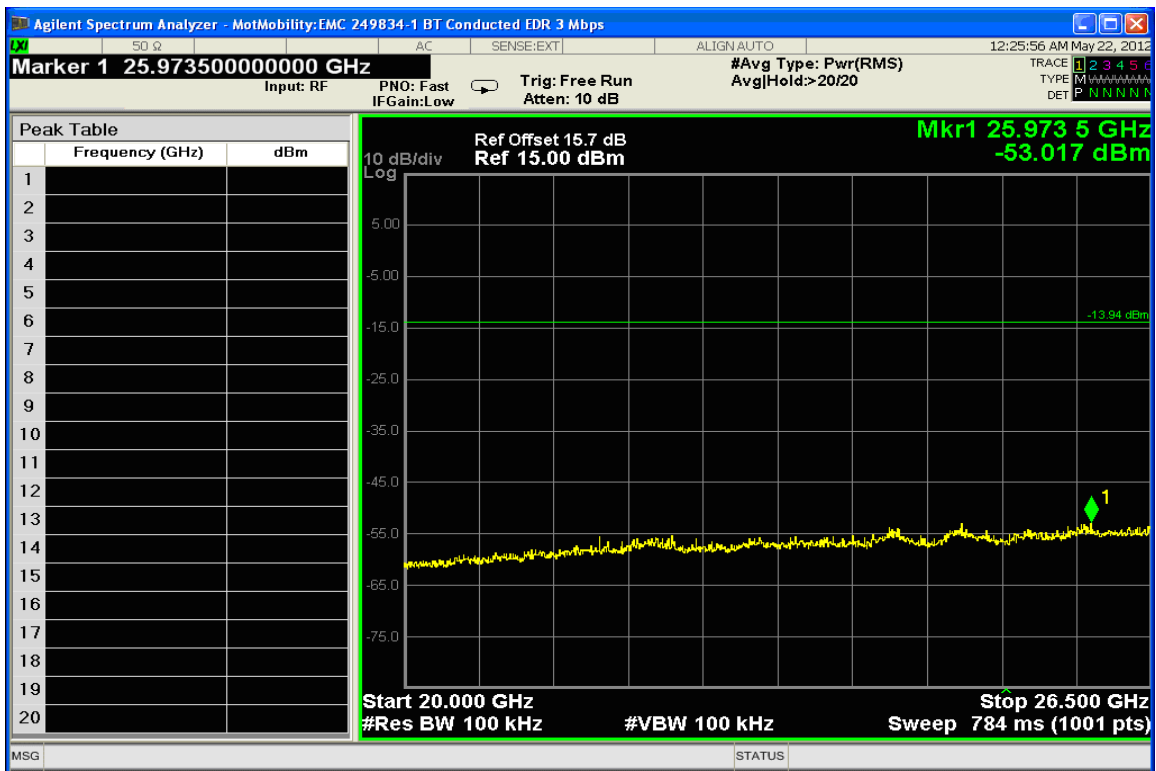
30MHz - 3000MHz (High Channel Enabled) 3Mbps Data Rate



2GHz - 10GHz (High Channel Enabled) 3Mbps Data Rate



10GHz - 20GHz (High Channel Enabled) 3Mbps Data Rate



20GHz - 26.5GHz (High Channel Enabled) 3Mbps Data Rate

## **AC LINE CONDUCTED**

CFR 47 Part 15.207

### **Measurement Procedure**

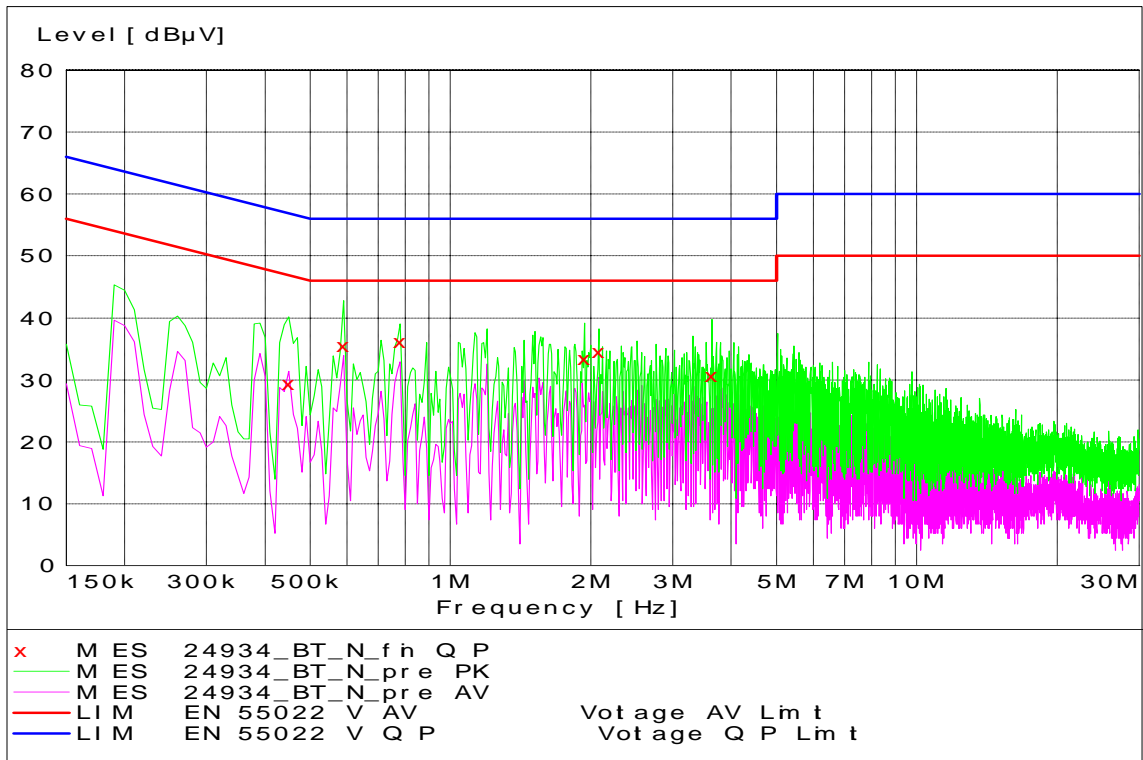
Measured levels of ac power line conducted emission shall be the radio-noise voltage from the line probe or across the 50  $\Omega$  LISN port, where permitted, terminated into a 50  $\Omega$  noise meter, or where permitted or required, the radio-noise current on the power line sensed by a current probe.

All radio-noise voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord or calibrated extension cord by the use of mating plugs and receptacles on the EUT and LISN. Equipment shall be tested with power cords that are normally supplied using an LISN, the 50  $\Omega$  measuring port is terminated by a 50  $\Omega$  radio-noise meter or a 50  $\Omega$  resistive load. All other ports are terminated in 50  $\Omega$ .

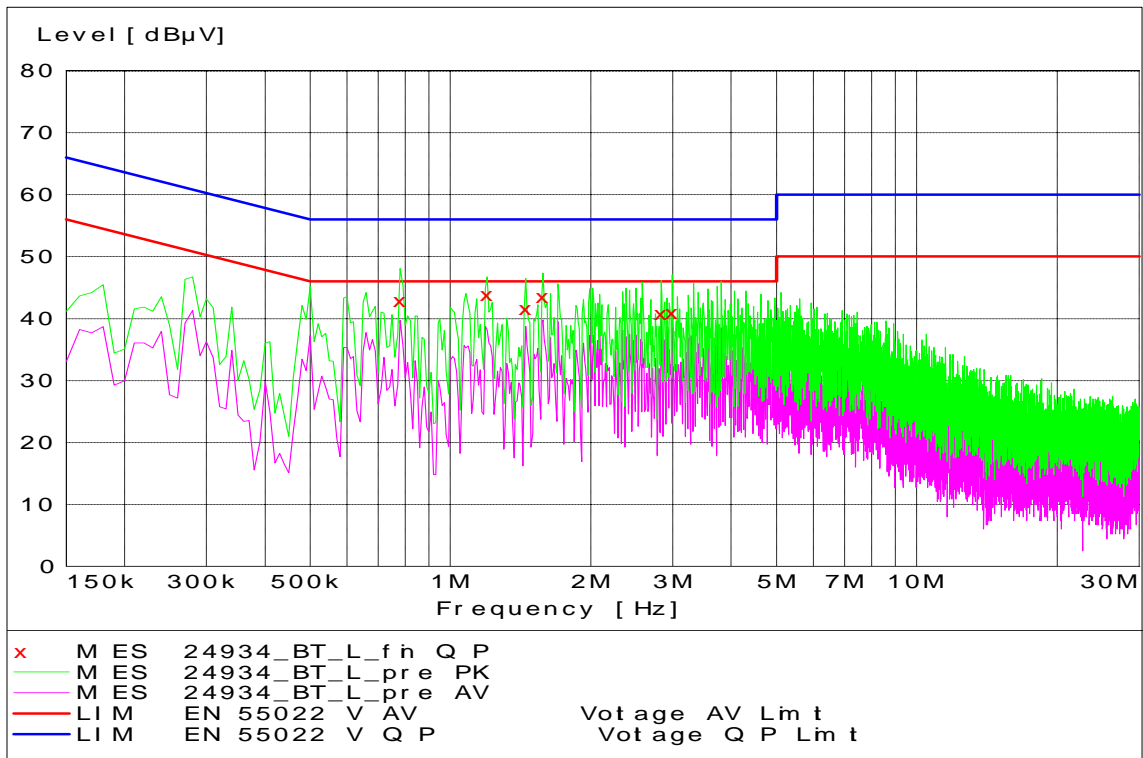
Detectors – Quasi Peak and Average Detector.

### **Measurement Results**

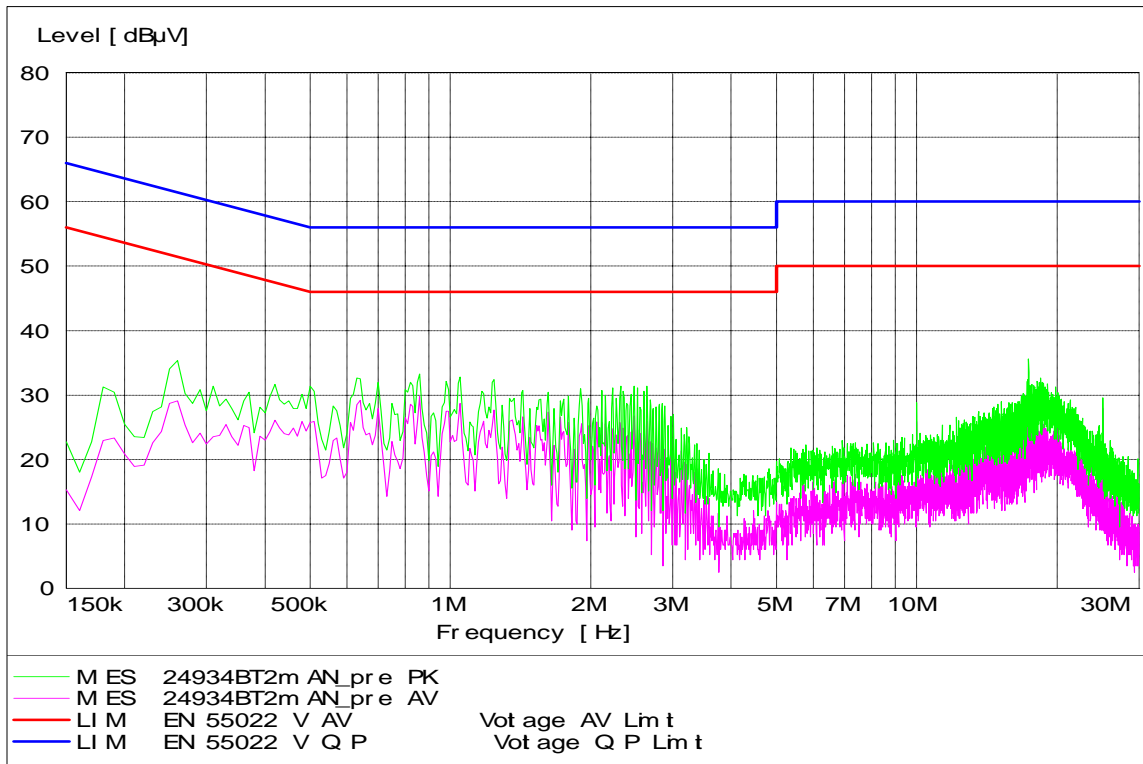
See attached:



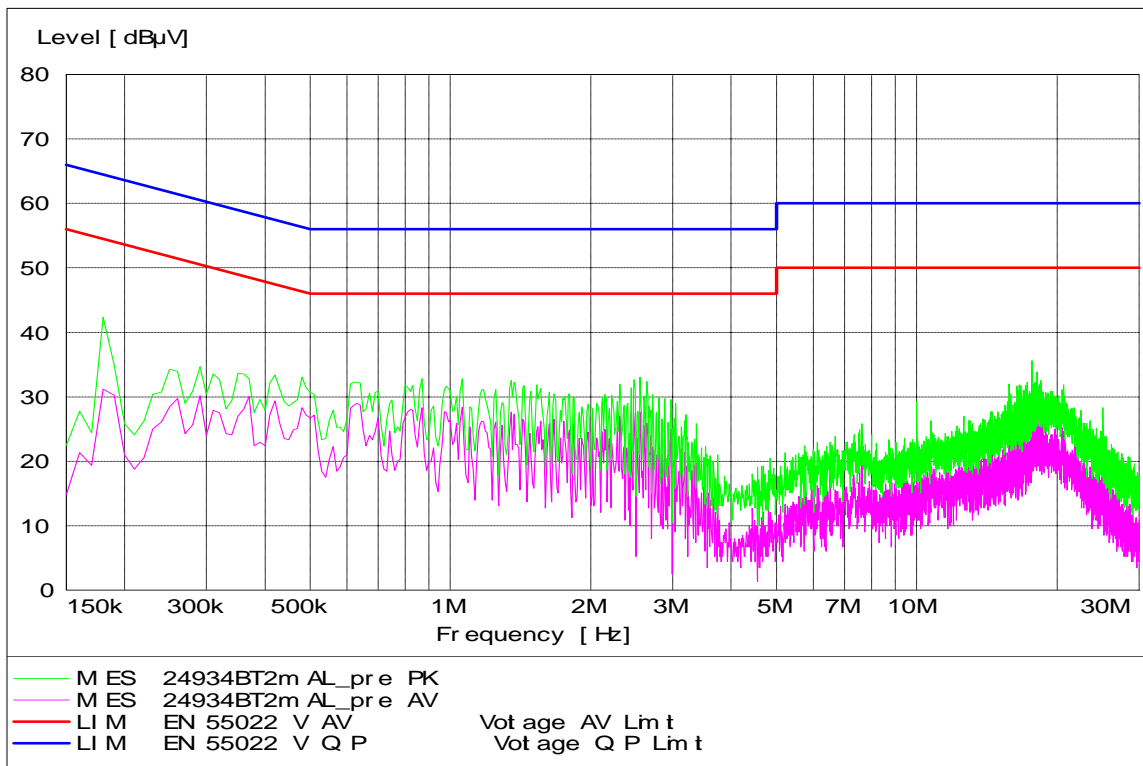
**Bluetooth – Hopping - Tx Mode - Neutral Coupling 1Mbps Data Rate**



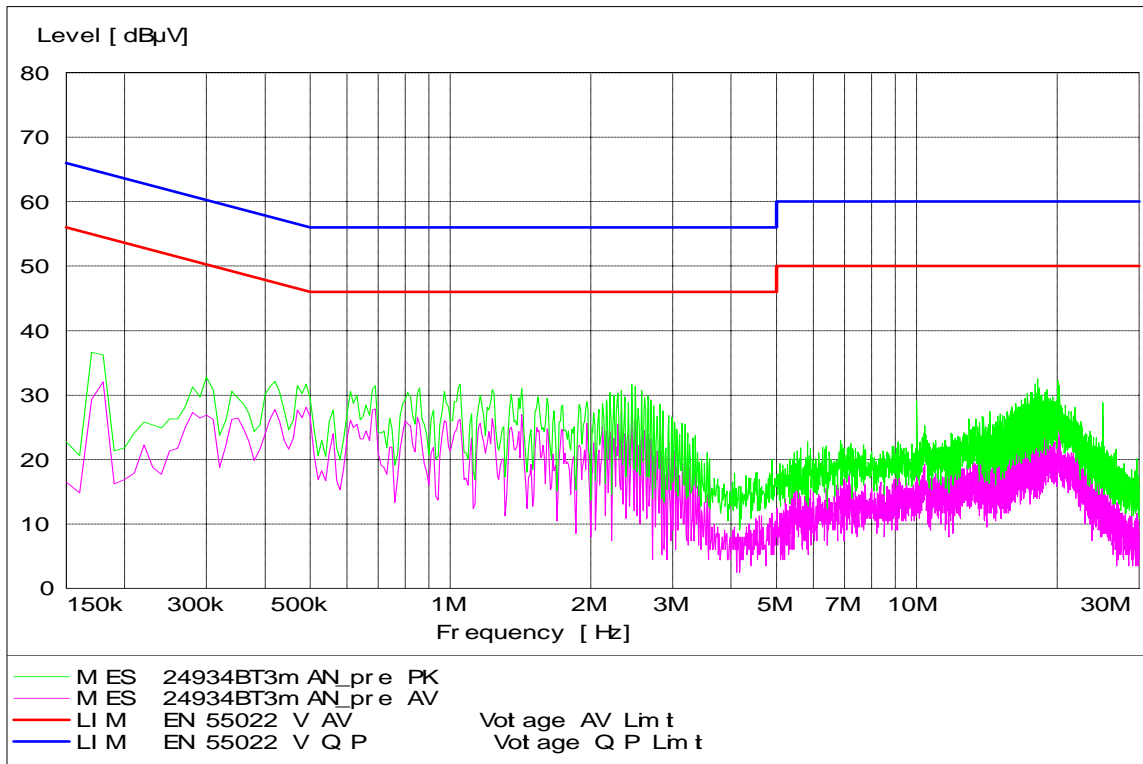
**Bluetooth – Hopping - Tx Mode - Line Coupling 1Mbps Data Rate**



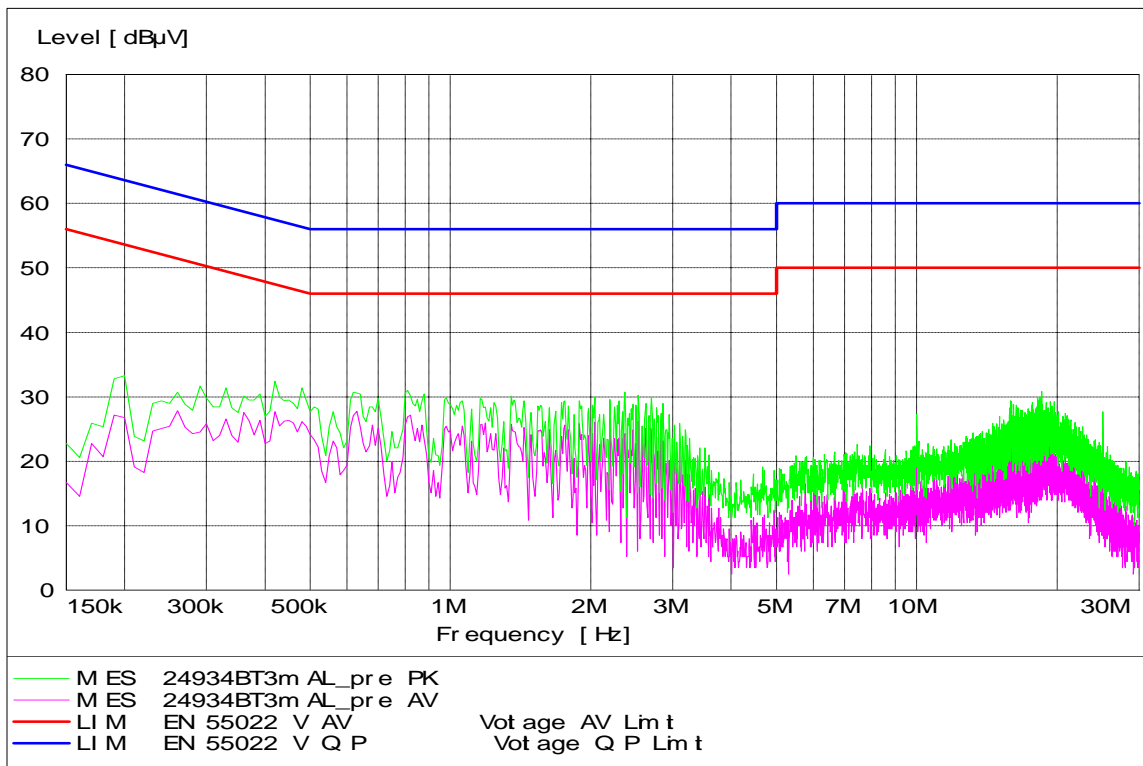
**Bluetooth – Hopping - Tx Mode - Neutral Coupling 2Mbps Data Rate**



**Bluetooth – Hopping - Tx Mode - Line Coupling 2Mbps Data Rate**



**Bluetooth – Hopping - Tx Mode - Neutral Coupling 3Mbps Data Rate**



**Bluetooth – Hopping - Tx Mode - Line Coupling 3Mbps Data Rate**

**End of Test Report**