FCC Test Report

for
Alcatel-Lucent USA Inc.

WCS LTE
Remote Radio Head 4x25 Band 30
(RRH4x25-B30)

Transceiver System

FCC ID: AS5BBTRX-19

11. Exhibit 11 FCC Filing Test Report

11.1. Listing of Required Measurements

The data required by Section 2.1046 through 2.1057, inclusive, measured in accordance with the procedures set out in Section 2.1041.

Response: In Alcatel-Lucent's WCS LTE Remote Radio Head 4x25-Band 30 Transceiver System, FCC ID: AS5BBTRX-19, the lowest clock frequency is the 10 MHz reference oscillator. Conducted spurious measurements were performed over the range of 10 MHz to 23.75 GHz which is above the tenth harmonic of the transmit frequency range.

The following pages document the data required for the Product Certification authorization of the Alcatel-Lucent's Remote Radio Head 4x25-B30 Transceiver System / FCC ID: AS5BBTRX-19, measured in accordance with the procedures set out in Section 2.1041 of the Rules. The Unit under Test, UUT Herein, was identified as serial number ALLU13-YD71000024.

Each required measurement and its corresponding exhibit number are:

FCC Filing Exhibit	FCC Regulation	Description
Exhibit 12	Section 2.1046	Measurement of Radio Frequency Power Output
Exhibit 13	Section 2.1047	Measurement of Modulation Characteristics
Exhibit 14	Section 2.1049	Measurement of Occupied Bandwidth
Exhibit 15	Section 2.1051	Measurement of Spurious Emissions at Antenna
Exhibit 16	Section 2.1053	Field Strength of Spurious Radiation
Exhibit 17	Section 2.1055	Measurement of Frequency Stability

11.2. Test Equipment

11.2.1. Antenna Port Measurements Test Equipment

The following Equipment used for RF Power, Modulation, Occupied bandwidth, Conducted Spurious and Radiated Spurious Measurements. Antenna Port Measurements Test Equipment

Equipment	Description	Reference Num	Calibration Date
Power Meter:	Agilent N1912A P Series Power Meter	E949	01/02/2013
Power Head	Agilent N1921A 0.05-18 GHz Wideband Power Sensor	E950	01/30/2013
EMC Spectrum Analyzer	Rohde & Schwarz FSEM-30	E927 / 167437	04/24/2013
EMC Receiver / SA	Rohde & Schwarz ESIB-40	E936 / 166737	06/04/2013
EMC Receiver / SA	Rohde & Schwarz ESIB-40	E907 / 1000101	09/20/2013
Code Domain Analyzer	Agilent E4440A PSA with 896012A VSA Software.	E935/ MY45304655	1/29/2013
Computer Controller:	EG Technology, Intel Pentium PC w/WIN 2000 OS	POR-2, 4 & 6	N/A
Low Pass Filter:	10 MHz-1.93 GHz, Custom manufactured	E980 WCS LPF-12	05/15/13
High Pass Filters:	3.5--25 GHz, Custom manufactured |	HP-SN-008	11/14/13

11.2.1.1. Antenna Port Measurements Test Coupler

The RF Test coupler used for antenna port conducted testing is maintained calibration verified as a unit. The individual components are listed below. It is identified as **White LP 50W-Mule-Lim** for White-Low Power-50W-Multi Use Laboratory Equipment **(MULE)**-Low Intermod.

Equipment	Description	Reference Num	Calibration Date
Directional Coupler:	HP 772D 2-18 GHz	s/n 772D	12/04/13
Attenuator, Variable	HP 8494B DC-18 GHz digital attenuator	MY42140028	12/04/13
Attenuator, Variable	HP 8495B DC-18 GHz digital attenuator	MY42140034	12/04/13
Attenuator, Fixed	MCE/Weinschel 6528-30-34 LIM 150W	BN4170	12/04/13
Test Cables:	Low loss test cables custom mfg.	White A, B & C	12/04/13

11.2.2. Radiated Spurious Emissions Equipment

Manufacturer	Model Number	Serial Number	Type	Description	GPCL ID	Last Cal	Interval
A.H. Systems Inc.	SAS-521-2	457	Bilogical Antenna	25 - 2000 MHz	E766	12/26/2012	24
Hewlett Packard	8593E	3911A04009	Spectrum Analyzer	9 KHz-22 GHz	E375	2/18/2013	24
Sonoma Instrument Co.	310N	186744	Amplifier	9 kHz-1GHz	E812	8/21/2013	12
Weinschel	2-6	BW2239	Attenuator	6 dB DC-18GHz 5 Watt	E890	6/5/2013	24
Hewlett Packard	8449B	3008A01270	Pre-Amplifier	Preamplifier 1-26.5 GHz	E376	12/22/2013	24
Rohde & Schwarz	ESIB40	100100	Test Receiver	EMI (20Hz to 40 GHz)-150 +30dBM	E908	6/12/2013	24
EMCO	3115	9903-5769	Horn Antenna	Double Ridged Horn 1-18 GHz	E393	1/30/2013	24
ETS Lindgren	3117	00135194	Horn Antenna	Double-Ridged Waveguide Horn 1-18 GHz	E1074	11/19/2012	24
EMC Test Systems	3116	2539	Horn Antenna	Double Ridged Horn 18-40 GHz	E513	3/22/2013	24

11.2.3. Frequency Stability Equipment

Manufacturer	Model Number	Serial Number	Instrument Type	Calibration Due Date
Agilent	MXA N9020A	MY52091771	MXA Signal Analyzer	07/01/14
Hewlett Packard	EPM-4422A	GB37480779	Power Meter	05/25/14
Hewlett Packard	8481A	3318A7816	Power Sensor	09/10/14
Fluke	Fluke 45	6609008	Dual Display Bench Multi-meter	01/08/15
Thurlby Thandar Instruments	QPX1200L	331936	Power supply	N/A
Heraeus	HC7120	522/780893	Thermal Chamber	05/12/15

12. Exhibit 12 - Measurement Of Radio Frequency Power Output
FCC SECTION 2.1046 RF power output.

For 10 and 5 MHz LTE transmit carrier operation, the Alcatel-Lucent's Remote Radio Head 4x25-B30 Transceiver System is specified to provide a continuous maximum power output of 50 Watt at each of its two transmit antenna terminals (47 dBm +2/-4 dB for each of the carriers). It also has a minimum power output at the antenna terminals of 0.5 Watts (27.0 dBm +2 / -4 dB). This power capability was demonstrated across the WCS downlink Band of 2350 MHz to 2360 MHz.

12.1. RF Power Measurements

In order to adequately evaluate performance, the occupied bandwidth was measured with each of the sub-carrier modulation factors and co-plotted. The applied signal from an Alcatel-Lucent's Remote Radio Head 4x25-B30 Transceiver System / AS5BBTRX-19, met the recommended characteristics as defined in 3GPP TS 36.211 V9.1.0 (2010-03) titled: 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation (Release 9).

The power was set to the specified 50 W maximum at each measurement frequency to verify the spectral performance at that power level at each specific frequency of interest. Power was verified for the QPSK, 16QAM and 64QAM modulation configurations.

The test arrangements used to measure the radio frequency power output of the Alcatel-Lucent's Remote Radio Head 4x25-B30 Transceiver System / AS5BBTRX-19 is on the following page in Figure 12. Measurements were made respectively at each frequency where Occupied Bandwidth measurements were performed and compliance was documented.

12.2. RF Power Measurements Results

The Alcatel-Lucent's Remote Radio Head 4x25-B30 Transceiver System / FCC ID: AS5BBTRX-19 was configured in the test setup shown in Figure 12A. For the Primary and Diversity antenna ports the LTE RRH 4x25-B30 delivered a minimum of 50 Watts 47 dBm +2/-0 dB when measured at the antenna output connection. This data is tabulated above and was recorded on the Occupied Bandwidth Data Sheets for each frequency Block. The Peak to Average Ratio (PAR/CCDF) was recorded as part of the Modulation verification documented in Exhibit 13. The measurements verify that the Peak to Average Ratio were less than13 dB

Table of Measurements Results, RF power output.

WCS - Block/s	WCS - Channel / Earfcn DL	Carrier BW	Number of Primary carriers	Power, W	Results Primary Terminal RF Power	Number of Diversity carriers	Power, W	Results Diversity Terminal RF Power
AB	100 / 9820	10 MHz	1	50	Compliant	1	50	Compliant
A	50 / 9795	5 MHz	1	50	Compliant	1	50	Compliant
B	150 / 9845	5 MHz	1	50	Compliant	1	50	Compliant

Figure 12, Antenna Port Test Configuration

13. Exhibit 13 Measurement Of Modulation And Signal Characteristic

FCC SECTION 2.1047 Measurement of Modulation Characteristics

The modulation characteristics and accuracy of the Alcatel-Lucent's Remote Radio Head 4x25-B30 Transceiver System/ FCC ID: AS5BBTRX-19 output signal is a function of the Digital Radio and RF assembly.

13.1. Modulation Description

The LTE spectrum while appearing similar to CDMA differs greatly in complexity. The modulation used in evaluating the WCS LTE RRH 4x25-B30 / FCC ID: AS5BBTRX-19 are described in the pertinent standards documents which include 3GPP TS 36.211 V9.1.0 (2010-03) titled: 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation (Release 9). The modulation is Orthogonal Frequency Division Multiple Access (OFDMA) which is processed into an uplink IF signal. The input data stream is divided into several parallel sub-streams of reduced data rate and each sub-stream is transmitted on a separate orthogonal sub-carrier. The sub-carriers are modulated using either QPSK, 16QAM or 64QAM. There is no single measure of the modulation quality other than to verify that the subcarrier modulation constellations visual orientation match the symbol and amplitude criteria is consistent with QPSK, 16QAM and 64QAM. However, while performing and recording the Modulation characteristics it is advantageous to record the transmit signals Peak to Average Ratio (PAR) using the complementary cumulative distribution function (CCDF). Measurement of each signal evaluated for RF Power and Occupied Bandwidth was evaluated for Modulation and CCDF/PAR.

13.2. Measurements Results

The Alcatel-Lucent's Remote Radio Head 4x25-B30 Transceiver System was configured in the test setup shown in Figure 13A. The antenna connection output was evaluated with an Agilent Transmitter Analyzer consisting of an Agilent E4440A PSA Spectrum Analyzer with 896012A VSA Software. Measurements were performed at the WCS Channels shown in Table 13.2.

The Alcatel-Lucent's Remote Radio Head 4x25-B30 Transceiver System transmit signal modulation parameters and constellation are shown below for WCS channel 100 in Figure 13A for a 10 MHz bandwidth 64QAM and for WCS channel 50 in Figure 13B for a 5 MHz bandwidth QPSK.

The 99%/-26dB signal bandwidth was measured using the setup of Figure 13A. The measurement performed with a resolution bandwidth of 300 kHz verified the signal is within the parameters of the emissions designator and is documented below in Figure 13D.

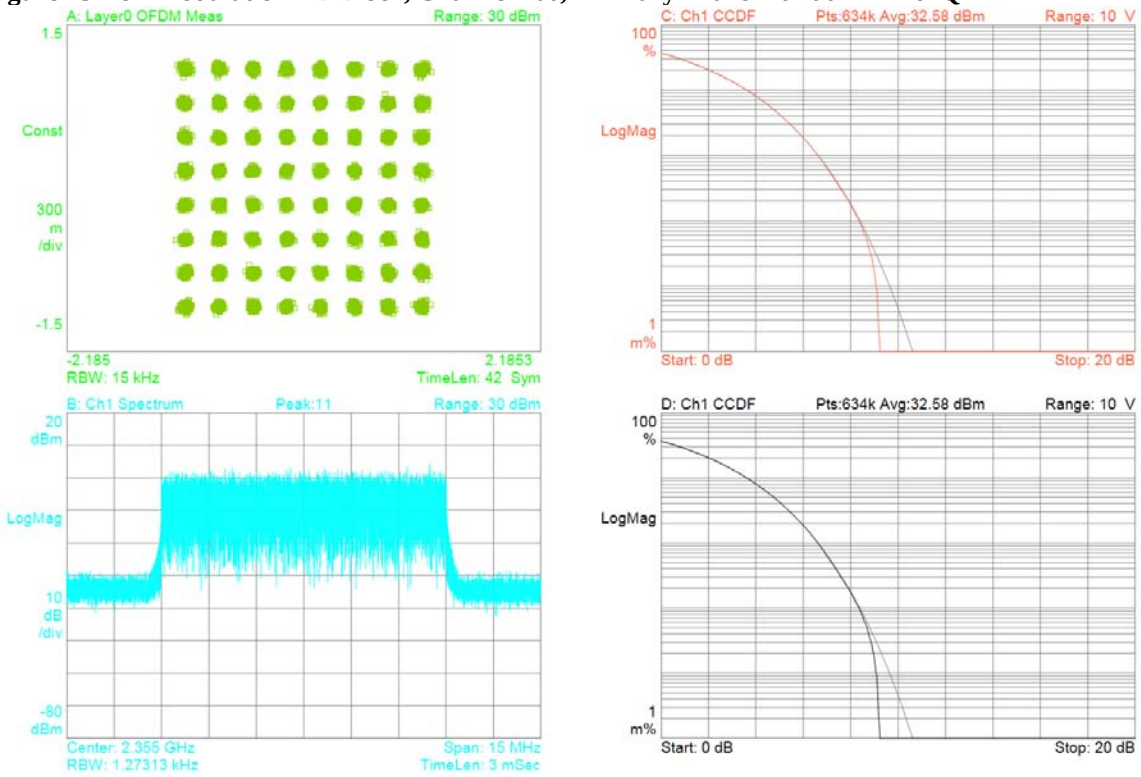
13.2.1. Results Summary

For each of the WCS channels tested, the Alcatel-Lucent's Remote Radio Head 4x25-B30 Transceiver System modulated sub-carriers constellations were consistent for the modulation type. All of the modulation plots include the CCDF plot which indicates the Peak to Average Ratio (PAR) of the transmitted signal. For all measurements the PAR was between 7.5 and 9 dB which is compliant with the CFR which specifies that the PAR be less than 13 dB.

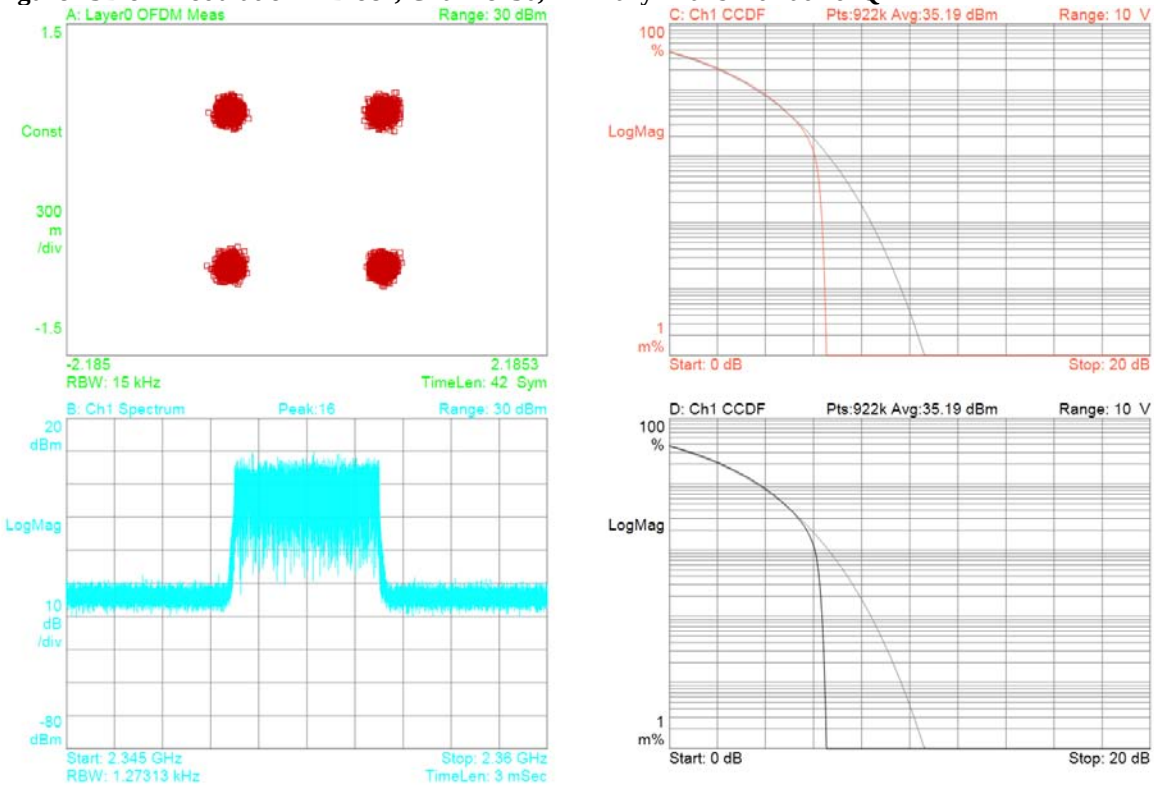
Table of Tested Modulation Configurations and Results.

WCS Block	WCS – Channel # / EARFCN	Signal Band width	Modulation Type	Primary Tx1	Results Modulation	Results PAR	Diversity Tx2	Results Modulation	Results PAR
AB	100 / 9820	10 MHz	QPSK	Tested	Compliant	Compliant			
AB	100 / 9820	10 MHz	16QAM	Tested	Compliant	Compliant			
AB	100 / 9820	10 MHz	64QAM	Tested	Compliant	Compliant	Tested	Compliant	Compliant
A	50 / 9795	5 MHz	QPSK	Tested	Compliant	Compliant			
A	50 / 9795	5 MHz	16QAM	Tested	Compliant	Compliant			
A	50 / 9795	5 MHz	64QAM	Tested	Compliant	Compliant	Tested	Compliant	Compliant
B	150 / 9845	5 MHz	QPSK	Tested	Compliant	Compliant			
B	150 / 9845	5 MHz	16QAM	Tested	Compliant	Compliant			
B	150 / 9845	5 MHz	64QAM	Tested	Compliant	Compliant	Tested	Compliant	Compliant

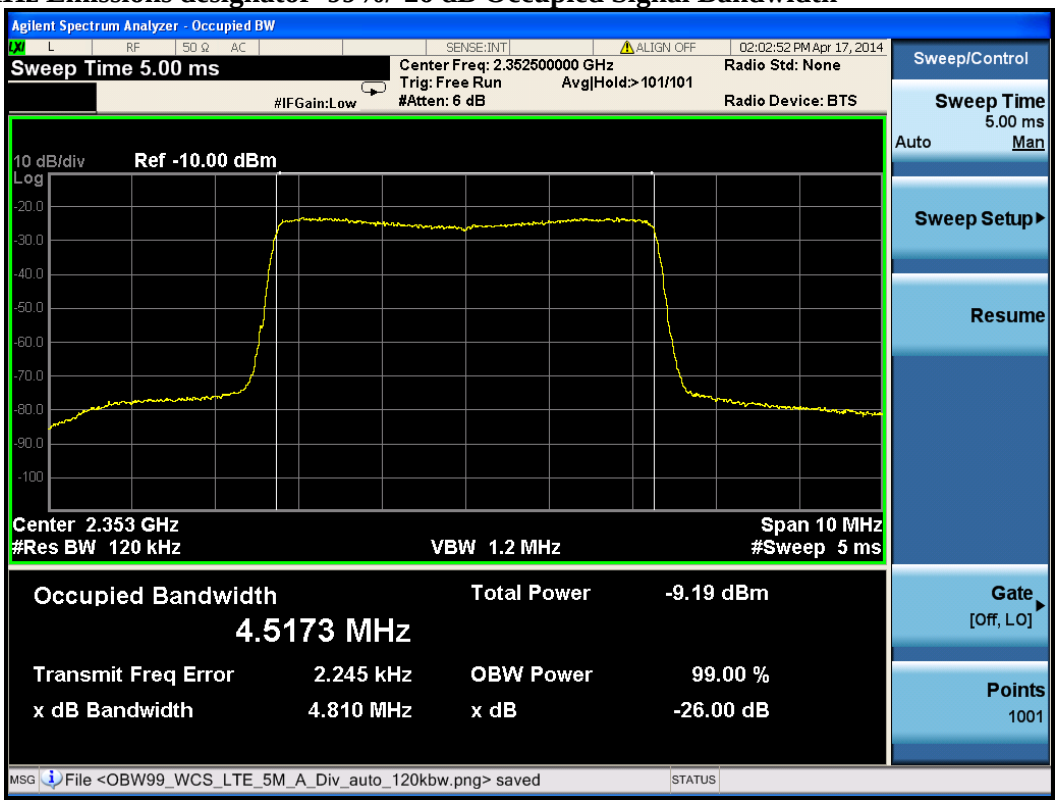
13.3. Figure 13A of Modulation AB Block, Channel 100, Primary Transmit Path Tx1 64QAM



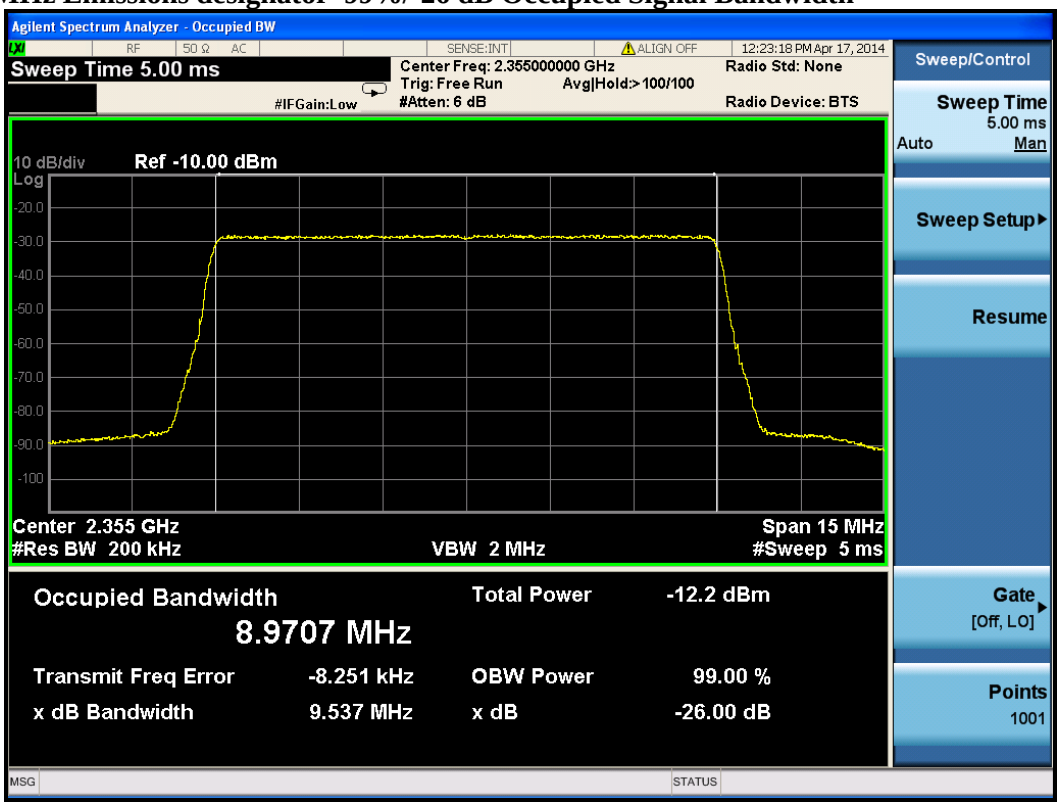
13.4. Figure 13B of Modulation A Block, Channel 50, Primary Transmit Path 64QAM



13.5. 5 MHz Emissions designator 99%/-26 dB Occupied Signal Bandwidth



13.6. 10 MHz Emissions designator 99%/-26 dB Occupied Signal Bandwidth



14. Exhibit 14 Measurement Of Occupied Bandwidth
FCC SECTION 2.1049 Measurement Of Occupied Bandwidth

14.1. Occupied Bandwidth Description

Occupied bandwidth measurements were performed for the 10M00F9W test configurations pertinent to full bandwidth AB Block operation of the Alcatel-Lucent's Remote Radio Head 4x25-B30 Transceiver System/ FCC ID: AS5BBTRX-19. This documents the typical performance of the WCS LTE RRH 4x25-B30 while operating with one 10MHz LTE carrier in the combined WCS A+B Blocks. All power adjustments were performed prior to other measurements. The measurements are described below.

Occupied bandwidth measurements were also performed for the 5M00F9W test configuration for both A and B Block operation of the Alcatel-Lucent's Remote Radio Head 4x25-B30 Transceiver System/ FCC ID: AS5BBTRX-19. This documents the typical performance of the WCS LTE RRH 4x25-B30 while operating with one 5 MHz LTE carrier in either WCS A or B Blocks. All power adjustments were performed prior to other measurements. The measurements are described below.

The occupied bandwidth of the Alcatel-Lucent's Remote Radio Head 4x25-B30 Transceiver System/ FCC ID: AS5BBTRX-19 was measured using a Rohde & Schwarz FSEM-30 Spectrum Analyzer, a PC based instrumentation controller using TILE™ software and calibrated RF attenuation and coupled signal path. The RF power level was measured and adjusted via the test setup in Figure 12A. The RF output from the transmitter antenna port was reduced by a calibrated broadband attenuator to amplitudes usable by the spectrum analyzer and power meter. The attenuation factors are reflected in the displayed values of the charts.

14.2. Measurement Configuration and Power Calibration

14.2.1. Measurement Configuration and Power Calibration 10 MHz Emissions Designator

The occupied bandwidth measurement displays the 10 MHz Emissions Designator signal adjusted to the -20.0 dBc level corresponding to the corrected RF power level for a 100 kHz resolution bandwidth (RBW). This set-point was performed as follows:

For each test the power calibration was individually verified at the transmitter antenna connection (J4) with a power meter by using the test setup depicted in Figure 12. The power calibration was performed to calibrate the setting power meter measurement as a reference for both the measured 100 kHz Occupied Bandwidth signal at the -20.0 dBc line and a 3 MHz RBW measurement against the power calibration line which is -5.229 dB below the "Top of Mask" limit. The "Top of Mask" limit corresponds to a single carrier signal at the specified power level of 50W / 47dBm if measured with an RBW of > 10 MHz. Since the power calibration measurements was performed with a 3 MHz RBW a power calibration line equal to 10 log(3MHz/10MHz)= -5.229 dB below the top of mask at 41.76 dBm is used as the power set point.

Each of the two 2x50W transmitter outputs can provide a single 10 MHz 50W / 47dBm LTE carrier. In each occupied bandwidth measurement there are two traces which track each other a given distance apart in amplitude. One trace is the power calibration trace and this carrier is set to the power calibration line. The second trace is the occupied bandwidth measurement. The power calibration measurement is performed along with each occupied bandwidth measurement. The measurement recorded the respective signals, measured at a RBW's of 3 MHz and 100 kHz, corrected them for path loss and plots them against the mask limit. A power calibration process is used to align the EMI test receivers measurement against the more accurate power meter measurement. Software was then used to place the 3 MHz RBW signal at the carrier power calibration line. The carrier as measured with 3 MHz and 100 kHz RBW were corrected with the same attenuation factors and were then co-plotted on the same graph.

The test procedure above, calibrates the carrier power against the Mask and accurately and consistently places the occupied bandwidth measured carrier at the -20.00dBc reference line. All of the plots are presented with a sufficiently wide frequency span for the specific signals or Block of interest. This allows for ease of comparison of broadband carrier signal performance. This data was electronically recorded using the TILE™ software and electronically placed in the Occupied Bandwidth Data Sheets. These sheets present data for "Left Edge of Block", and "Right Edge of Block" for each WCS frequency Block.

14.2.2. Measurement Configuration and Power Calibration 5 MHz Emissions Designator

The occupied bandwidth measurement displays the 5 MHz Emissions Designator signal adjusted to the -22.2 dBc level corresponding to the corrected RF power level for a 30 kHz resolution bandwidth (RBW). This set-point was performed as follows:

For each test the power calibration was individually verified at the transmitter antenna connection (J4) with a power meter by using the test setup depicted in Figure 12. The power calibration was performed to calibrate the setting power meter measurement as a reference for both the measured 30 kHz Occupied Bandwidth signal at the -22.2 dBc line and a 3 MHz RBW measurement against the power calibration line which is -2.22 dB below the "Top of Mask" limit. The "Top of Mask" limit corresponds to a single carrier signal at the specified power level of 50W / 46.99 dBm if measured with an RBW of > 5 MHz. Since the power calibration measurements was performed with a 3 MHz RBW a power calibration line equal to 10 log(3MHz/5MHz)= -2.22 dB below the top of mask at 44.77 dBm which is used as the power set point.

Each of the two 2x50W transmitter outputs can provides a single 5 MHz 50W / 47dBm LTE carrier. In each occupied bandwidth measurement there are two traces which track each other a given distance apart in amplitude. One trace is the power calibration trace and this carrier is set to the power calibration line. The second trace is the occupied bandwidth measurement.

The power calibration measurement is performed along with each occupied bandwidth measurement. The measurement recorded the respective signals, measured at a RBW's of 3 MHz and 30 kHz, corrected them for path loss and plots them against the mask limit. A power calibration process is used to align the EMI test receivers measurement against the more accurate power meter measurement. Software was then used to place the 3 MHz RBW signal at the carrier power calibration line. The carrier as measured with 3 MHz and 30 kHz RBW were corrected with the same attenuation factors and were then co-plotted on the same graph
The test procedure above, calibrates the carrier power against the Mask and accurately places the occupied bandwidth measured carrier at the -22.2 dBc reference line. All of the plots are presented with a sufficiently wide frequency span for the specific signals or Block of interest. This allows for ease of comparison of broadband carrier signal performance. This data was electronically recorded using the TILE™ software and electronically placed in the Occupied Bandwidth Data Sheets. The measurements are 25x to 50x averages of sample detector sweeps with a sweep time of 100 milliseconds per 7.5 MHz of bandwidth. The Data plots present data for "Left Edge of Block", and "Right Edge of Block" for each WCS frequency Block.

14.3. Block Organization and Tests Performed

The RRH 4x25-B30 product uses a 10 MHz bandwidth transmit filter. The use of EDPD provides the in band spurious control which allows the use of a wide bandwidth filter while demonstrating compliance within the WCS band at all individual block edges. The testing of the product documented herein was performed with a single 10 MHz WCS band filter assembly.

The demonstrations of compliance for the 10 MHz LTE carrier configuration were performed for operation in the combined WCS Block A+B

The demonstrations of compliance for the 5 MHz LTE carrier configurations were performed for operation in WCS Block A and Block B.

The presented data for this initial product certification demonstrates the configurations compliance.

In order to adequately evaluate performance the modulation standards were used from the governing documents. Thus, the applied signal, from Alcatel-Lucent's Remote Radio Head 4x25-B30 Transceiver System/ AS5BBTRX-19, met the recommended characteristics.

The modulation used in evaluating the Alcatel-Lucent's Remote Radio Head 4x25-B30 Transceiver System/ FCC ID: AS5BBTRX-19 are described in the pertinent standards documents which include 3GPP TS 36.211 V9.1.0 (2010-03) titled: 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation (Release 9). The modulation is Orthogonal Frequency Division Multiple Access (OFDMA) which is processed into an uplink IF signal. The input data stream is divided into several parallel sub-streams of reduced data rate and each sub-stream is transmitted on a separate orthogonal sub-carrier. The sub-carriers are modulated using either QPSK or 64QAM. There is no single measure of the modulation quality other than to verify that the subcarrier modulation constellations visual orientation match the symbol and amplitude criteria is consistent with QPSK and 64QAM.

14.4. Measurement Offset

The spectrum analysis output plots shows the peak of the 10 MHz bandwidth LTE channel signal 20.0 dB below the top of Mask reference of the spectrum analyzer for the following reason: For the LTE system there is no carrier without modulation. Since the LTE signal is broadband and 10 MHz wide, all measurements performed at narrower resolution bandwidths need be adjusted for the reduction in signal energy. The following relationship was used to provide the correct level for an unmodulated carrier vs. the modulated signal.

10*log (Resolution Bandwidth/ Transmit Bandwidth) = Signal Offset (1)

For the peak of the 10 MHz LTE signal measured with a RBW of 100 kHz the signal offset is:

Signal Offset = 10*log (100 kHz /10 MHz) = -20.0 dB

For the peak of the 5 MHz LTE signal measured with a RBW of 30 kHz the signal offset is:

Signal Offset = 10*log (30 kHz /10 MHz) = -22.2 dB

14.4.1. Power Calibration Offset

Since the 10 MHz LTE signal is wider than the 3 MHz spectrum analyzer setting used for power calibration a power calibration line must be placed below the top of mask. The offset for the power calibration line is:

Power Calibration Offset = 10*log (3 MHz /10 MHz) = -5.229 dB

Since the 5 MHz LTE signal is wider than the 3 MHz spectrum analyzer setting used for power calibration a power calibration line must be placed below the top of mask. The offset for the power calibration line is:

Power Calibration Offset = 10*log (3 MHz /5 MHz) = -2.218 dB

Limits which are specified as appropriate at a given RBW can be measured and evaluated at other RBW's if the limit is adjusted per equation (1)

14.5. Require Levels

The Limit in 47 CFR 27.53 for emissions in the 1 MHz band immediately outside and adjacent to a licensees frequency block is:
Emissions <1 MHz outside the Block when measured with a RBW of 1% of the emissions Bandwidth shall be attenuated by :

-{43+10log (mean power output in watts)} = -13 dBm

The Limit in 47 CFR 27.53 for emissions outside a licensees frequency block is:
Emissions >1 MHz outside the Block, when measured with a RBW of 1 MHz, shall be attenuated by :

-{43+10log (mean power output in watts)} = -13 dBm.

14.6. Adjustment for 2x MIMO s

In order to account for the spectral adding of identical signals from the primary and diversity ports, per KDB 662911 D01 Multiple Transmitter Output v01r01, the level needs be adjusted by 10LOG(n) where n= number of outputs. The adjustment for n=2 is:

3.01 dB = 10LOG(2)

Therefore the limit for emissions >1 MHz outside a licensees frequency block when measured with a RBW of 1 MHz is:

-13 dBm – 3.01 dB = -16.01 dBm

14.7. Adjusted Levels for 10 MHz Bandwidth Emission

The following levels apply when measurement of the above limits are performed with an RBW of 100 kHz. Measurement at a Resolution Bandwidth of 100 kHz is based on our experience with 47 CFR Part 2 and KDB 971168..

1. On any frequency removed from the carrier center frequency by greater than 5 MHz to 6 MHz the level shall not exceed -16. dBm when measured in a 100 kHz resolution bandwidth (Note 2 below). For a 50 Watt 2xMIMO output the required level is –16.0 dBm/ -63 dBc.

2. For any frequency > 1MHz from the edge of the Block to the 10th harmonic of the carrier the spurious shall not exceed -26 dBm when measured in a 100 kHz resolution bandwidth (Note 3 below) For a 50 Watt 2x MIMO output the required level is -26.0 dBm / -73 dBc

++

Note 2: The -16.0 dBm/ –63 dBc level was computed as follows: The limit is specified as

-{43+10log (mean power output in watts) } dB = -13 dBm

Within the 1st MHz outside the band the limit of -13 dBm is specified when measured with a 1% bandwidth. When measured with a different bandwidth the adjustment is made against 1% of the signal bandwidth.
Since the carrier is a 10 MHz bandwidth signal and the 1% signal bandwidth is 100 kHz, the limit is adjusted to

-13 + 10LOG(100kHz/100 kHz) dBm = -13.0 dBm

When accounting for a 2xMIMO signal, (per KDB 662911 D01 Multiple Transmitter Output v01r01), the level needs be adjusted by 10LOG(n) where n= number of outputs. The adjustment for n=2 is:

3.01 dB = 10LOG(2)

The resultant limit for 2xMIMO operation is -13.0 dBm – 3.01 dB = -16.01 dBm;
which given a 47 dBm carrier (50W) equals – 62.989 = -63 dBc

Note 3: The -26 dBm /-63 dBc level is computed from -13 dBm measured with a 1 MHz resolution bandwidth adjusted by :

-13 + 10LOG(100kHz/1.0 MHz) dBm = -23 dBm

When accounting for a 2x MIMO signal, (per KDB 662911 D01 Multiple Transmitter Output v01r01), the level needs be adjusted by 10LOG(n) where n= number of transmitter outputs. The adjustment for n=2 is again:

3.01 dB = 10LOG(2)

The resultant limit for 2x MIMO operation is -23 dBm – 3.01 dB = -26.01 dBm ;
which given a 47. dBm carrier (50W) equals – 73 dBc
++

14.8. Adjusted Levels for 5 MHz Bandwidth Emission

The following levels apply when measurement of the above limits are performed with an RBW of 30 kHz. Measurement at a Resolution Bandwidth of 30 kHz is based on our experience with 47 CFR Part 2 and KDB 971168.and the measurement equipment/process.

1. On any frequency removed from the carrier center frequency by greater than 2.5 MHz to 3.5 MHz the level shall not exceed -18.22 dBm when measured in a 30 kHz resolution bandwidth (Note 4 below).
For a 50 Watt 2xMIMO output the required level is –18.22 dBm/ -65.21 dBc.

2. For any frequency > 1MHz from the edge of the Block to the 10th harmonic of the carrier the spurious shall not exceed 31.24 dBm when measured in a 30 kHz resolution bandwidth (Note 5 below)
For a 50 Watt 2xMIMO output the required level is-31.24 dBm / -78.23 dBc

++

Note 4: The -18.22 dBm/ –65.21 dBc level was computed as follows: The limit is specified as

-{43+10log (mean power output in watts) } dB = -13 dBm

Within the 1st MHz outside the band the limit of -13 dBm is specified when measured with a 1% bandwidth. When measured with a different bandwidth the adjustment is made against 1% of the signal bandwidth.
Since the carrier is a 5 MHz bandwidth signal and the 1% signal bandwidth is 50 kHz, the limit is adjusted to

-13 + 10LOG(30kHz/50 kHz) dBm = -15.21 dBm

When accounting for a 2x MIMO signal, (per KDB 662911 D01 Multiple Transmitter Output v01r01), the level needs be adjusted by 10LOG(n) where n= number of outputs. The adjustment for n=2 is:

3.01 dB = 10LOG(2)

The resultant limit for MIMO operation is -15.21dBm – 3.01 dB = -18.22 dBm**;**
which given a 46.989 dBm carrier (50W) equals – 65.21 dBc

Note 5: The -31.24 dBm /-78.23 dBc level is computed from -13 dBm measured with a 1 MHz resolution bandwidth adjusted by:

-13 + 10LOG(30kHz/1.0 MHz) dBm = -28.23 dBm

When accounting for a 2x MIMO signal, (per KDB 662911 D01 Multiple Transmitter Output v01r01), the level needs be adjusted by 10LOG(n) where n= number of transmitter outputs. The adjustment for n=2 is again:

3.01 dB = 10LOG(2)

The resultant limit for MIMO operation is -28.23 dBm – 3.01 dB = -31.24 dBm **;**
which given a 46.989. dBm carrier (50W) equals – 78.23 dBc
++

14.8 Trace Description and Power Calibration Adjusted Levels

Figure 14B shows the single carrier channel 100 LTE signal measured with two different resolution bandwidths. The additional upper magenta trace displays the signal as measured with a resolution bandwidth of 3 MHz. The black trace is the same signal as measured with a 100 kHz resolution bandwidth and is the appropriate trace for the mask evaluation. The wider resolution bandwidth allows for a true power calibration of the measured signal against the power calibration line.

14.9 Mask Description for a Single 50 W 10 MHz Carrier application

The Mask limits are identical for the left and right side of the WCS Blocks and are as follows:

Figure 14A shows the 10 MHz LTE Mask limit for WCS Block A (2350-2360 MHz) for WCS channel 100. The horizontal line from a to aa (a-aa) is the 47 dBm/ 0 dBc reference level. The Power Calibration reference line g-gg is below the top of mask reference line is the 3 MHz RBW power calibration line as the measurement RBW is smaller than the 10 MHz signal bandwidth. The g-gg line is at 46.989-5.229 =41.76 dBm. The peak of the 3 MHz magenta power calibration trace is shown set to this value.

The top of a typical 47.0 dBm single 10 MHz LTE carrier signal viewed at a resolution bandwidth of 100 kHz is shown at the -26.99 dBm/ -20.0 dBc line t-tt. This line is based on equations 1 and 2, and the ratio of the 10 MHz signal bandwidth and the 100 kHz resolution bandwidth of the spectrum analyzer.

The vertical line from a to b (i.e. a-b) and aa-bb are at the block edge for A Block. The horizontal lines c-b and bb-cc represent the limit for the 1st MHz outside the block. The placement of lines c-b and bb-cc is derived from evaluation of 1% of the signal bandwidth, the 100 kHz resolution bandwidth and adjustments for 2xMIMO using the suggested value in KDB662911 D01..
Per Note 2 above, the limit for the 1st MHz outside the band with MIMO operation is 18.22 dBm/ –65.21 dBc
The vertical line, c-d and cc-dd are the transitions at 1MHz outside the specified Block.

The horizontal line d-e and dd-ee are placed at the -26.0 dBm / -73 dBc level below the 47 dBm / 0 dBc reference per Note 3 above. The rules require a 1 MHz resolution bandwidth for measurements 1 MHz or greater outside the WCS band. Again, equation (1) and the ratio of 1 MHz to 100 kHz provides this value. The same logic was used in determining the other block and band edge tolerances. Figure 14C depicts all of the WCS blocks. Performing the OBW measurement across all of the blocks evaluates intermodulation and performance outside the block but inside the band.

14.9 Mask Description for a Single 50 W 5 MHz Carrier application

The Mask limits are identical for the left and right side of the WCS Blocks and are as follows:

Figure 14B shows the 5 MHz LTE Mask limit for WCS Block B (2350-2360 MHz) for WCS channel 150. The horizontal line from a to aa (a-aa) is the 47 dBm/ 0 dBc reference level. The Power Calibration reference line g-gg is below the top of mask reference line is the 3 MHz RBW power calibration line as the measurement RBW is smaller than the 5 MHz signal bandwidth. The g-gg line is at 46.989-2.218 =44.771 dBm. The peak of the 3 MHz magenta power calibration trace is shown set to this value.

The top of a typical 47.0 dBm single 5 MHz LTE carrier signal viewed at a resolution bandwidth of 30 kHz is shown at the -24.789 dBm/ -22.2 dBc line t-tt. This line is based on equations 1 and 2, and the ratio of the 5 MHz signal bandwidth and the 30 kHz resolution bandwidth of the spectrum analyzer.

The vertical line from a to b (i.e. a-b) and aa-bb are at the block edge for A Block. The horizontal lines c-b and bb-cc represent the limit for the 1st MHz outside the block. The placement of lines c-b and bb-cc is derived

from evaluation of 1% of the signal bandwidth, the 30 kHz resolution bandwidth and adjustments for 2xMIMO using the suggested value in KDB662911 D01..
Per Note 2 above, the limit for the 1st MHz outside the band with MIMO operation is -16.0 dBm / – 63 dBc
The vertical line, c-d and cc-dd are the transitions at 1MHz outside the specified Block.

The horizontal line d-e and dd-ee are placed at the -31.24 dBm /-78.23 dBc level below the 47 dBm / 0 dBc reference per Note 3 above. The rules require a 1 MHz resolution bandwidth for measurements 1 MHz or greater outside the WCS band. Again, equation (1) and the ratio of 1 MHz to 30 kHz provides this value. The same logic was used in determining the other block and band edge tolerances. Performing the OBW measurement across all of the blocks evaluates intermodulation and performance outside the block but inside the band.

14.10 Measurement Data Collection

In order to depict the tolerance lines that are required by Sec 27.53 of the FCC Rules and 3GPP TS 36.211 V9.1.0 (2010-03, all occupied bandwidth measurements were made with the resolution bandwidth appropriate to the adjusted limits as described above.
The measurements were performed using an automated data collection system which eliminates variability and operator error. The test profile deliberately and consistently measures the occupied bandwidth using the resolution bandwidth appropriate for the signal bandwidth, a sample detector with 25X averaging and a sweep time of 100 milliseconds. The entire 30 MHz span of measurement (10 MHz authorized band +/- 10 MHz outside the band) was broken up into 4 individual 7.5 MHz spans of measurement. Each of the individual spans are less than 256 times the measurement resolution bandwidth to eliminate aliasing. The use of smaller spans and longer sweep times are the best settings to acquire all spurious signal with the equipment used. This is based on our experience with 47 CFR 27.53, the measurements performed and guidance from 971168 D01 Licensed DTS Guidance v02.

All of the tolerance lines for the output are referenced to the top of the Occupied Bandwidth mask, which is defined as 47.0 dBm/ zero dBc. For all Occupied Bandwidth measurements of the Alcatel-Lucent's Remote Radio Head 4x25-B30 Transceiver System/ AS5BBTRX-19, the output power was measured / adjusted individually to the 50 W level for each carrier and this is the 47.0 dBm value at the 0 dBc reference line.

14.11 Measurement Results

Compliance was documented in all measurements. Measurements were performed for both the Primary and Diversity Transmit ports and for each authorized Block or combined Block of operation. For both the 5 MHz and the 10 MHz Emissions designator the measurements of the transmitter output Occupied Bandwidth identify compliance at the Left Edge and the Right Edge of each WCS Block. The RF Power output level was set to the specified 50W for each channel prior to measurement.

Occupied Bandwidth measurement were performed for QPSK, 16QAM and for 64QAM operation. Modulation parameters were measured and recorded prior to OBW measurement. The Block designation, WCS channels, center frequency and Measured RF Power were also tabulated on each Occupied Bandwidth plot. The signals are plotted for each emission designator, frequency/channel of interest. These frequencies were chosen to show the occupied bandwidth for the closest block edge channels for which this product can be operated specifically to document compliance with Section 27.53 of the Commission code. The signal used to show the occupied bandwidth is defined in 3GPP TS 36.211 V9.1.0 (2010-03). The power output level was adjusted to provide the documented value on each chart. The following exhibits illustrate the spectrums investigated and document compliance. The specific data sheets follow in the appendix.

TABLE 14.11 WCS Occupied Bandwidth Compliance Tabulation

WCS Block	WCS – Channel # / EARFCN	Signal Band width	Modulation Type	Primary Tx1	Results Occupied Bandwidth	Diversity Tx2	Results Occupied Bandwidth
AB	100 / 9820	10 MHz	QPSK	Tested	Compliant		
AB	100 / 9820	10 MHz	16QAM	Tested	Compliant		
AB	100 / 9820	10 MHz	64QAM	Tested	Compliant	Tested	Compliant
A	50 / 9795	5 MHz	QPSK	Tested	Compliant		
A	50 / 9795	5 MHz	16QAM	Tested	Compliant		
A	50 / 9795	5 MHz	64QAM	Tested	Compliant	Tested	Compliant
B	150 / 9845	5 MHz	QPSK	Tested	Compliant		
B	150 / 9845	5 MHz	16QAM	Tested	Compliant		
B	150 / 9845	5 MHz	64QAM	Tested	Compliant	Tested	Compliant

Figure 14A Occupied Bandwidth Mask for 10M00F9W WCS Block AB Channel 100

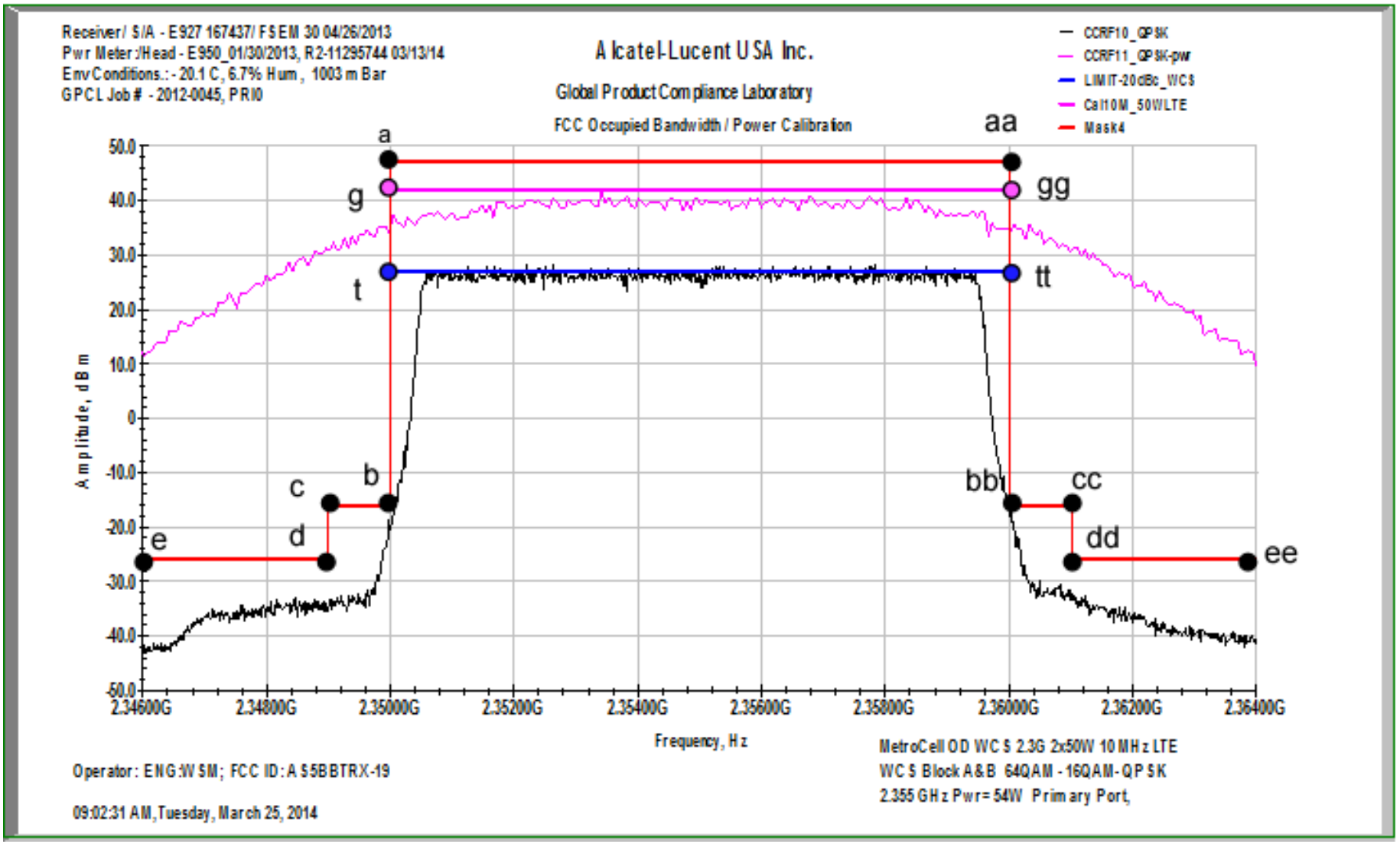
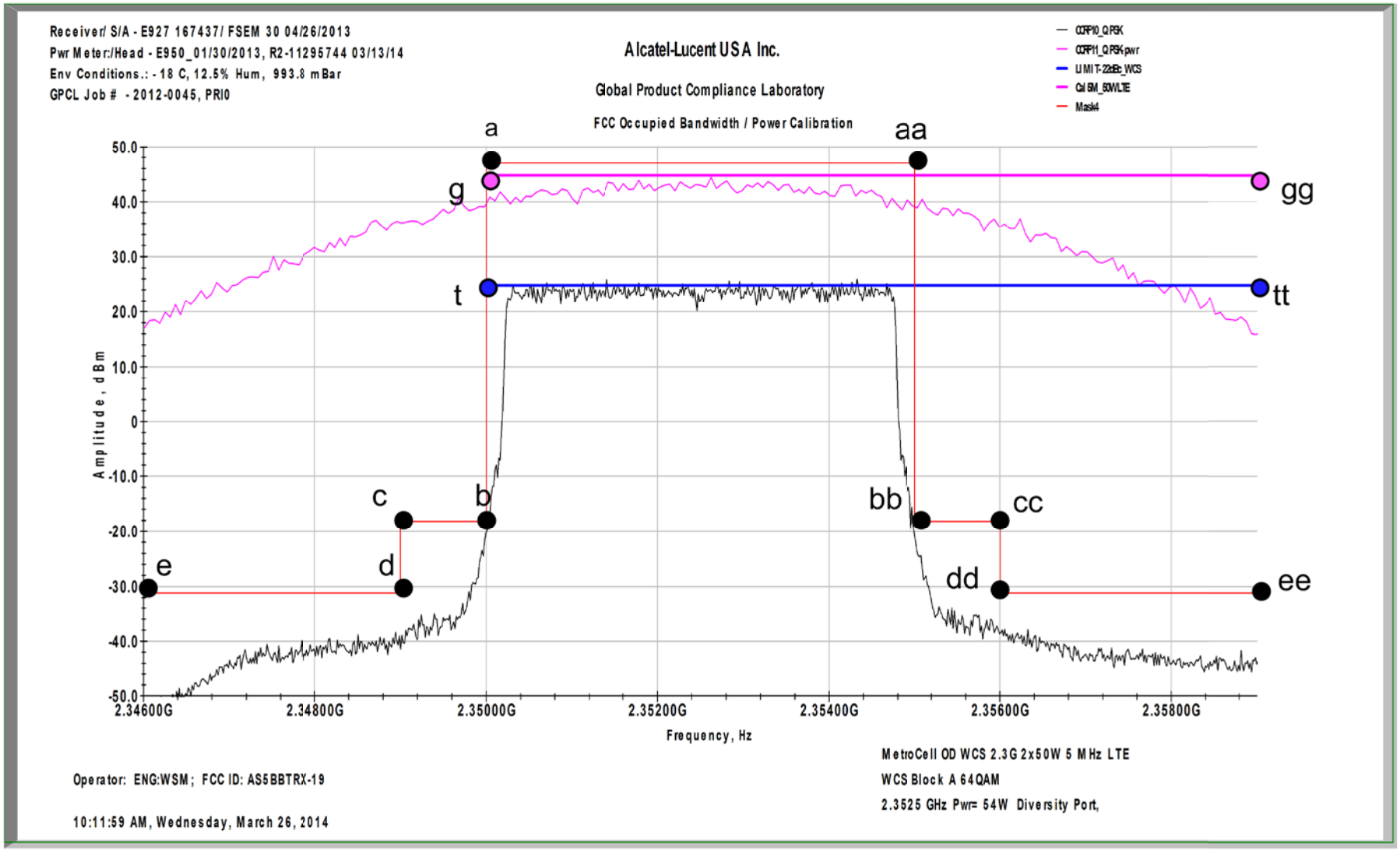


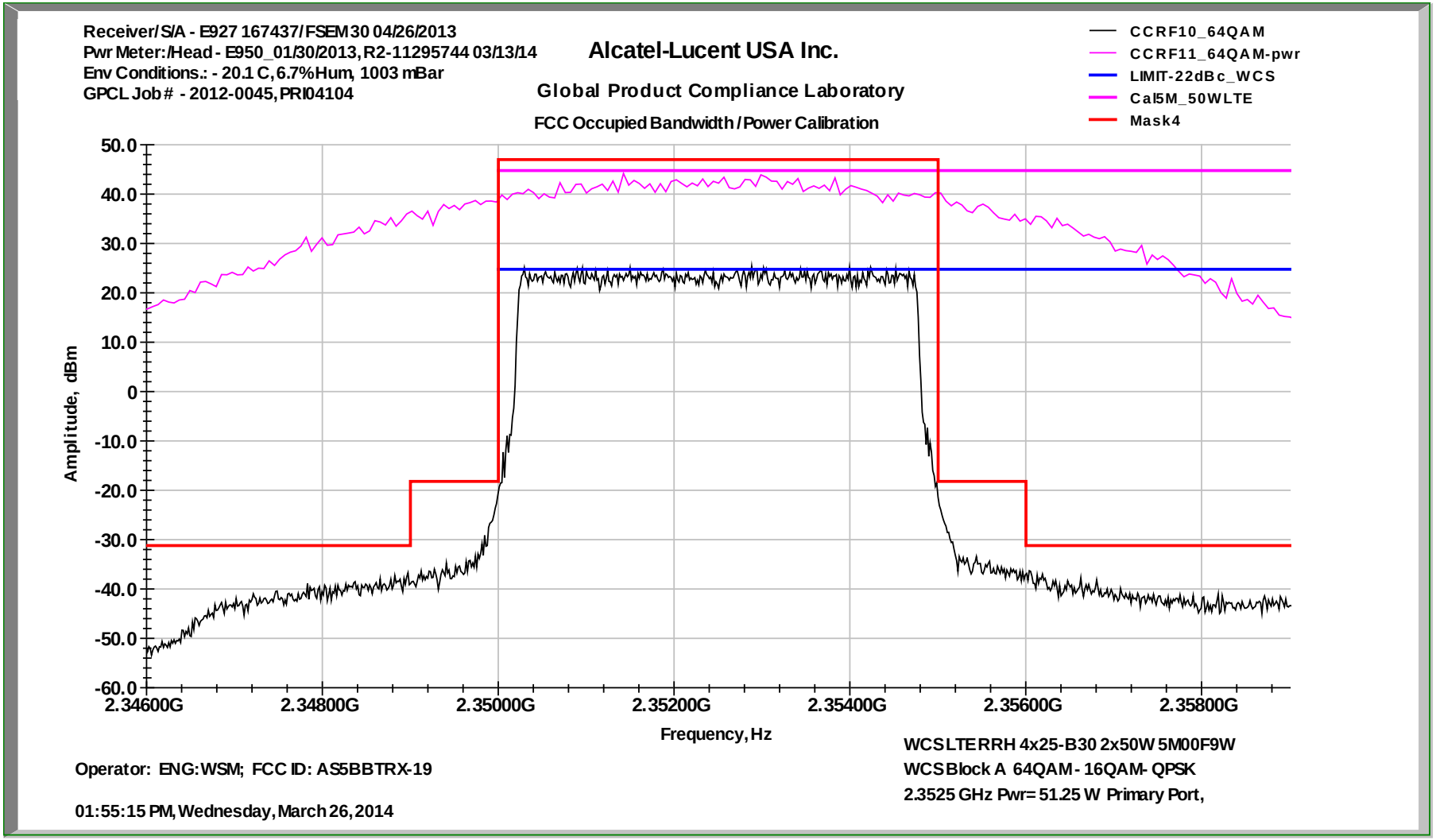
Figure 14B Occupied Bandwidth Mask for 5M00F9W WCS Block B Channel 150/



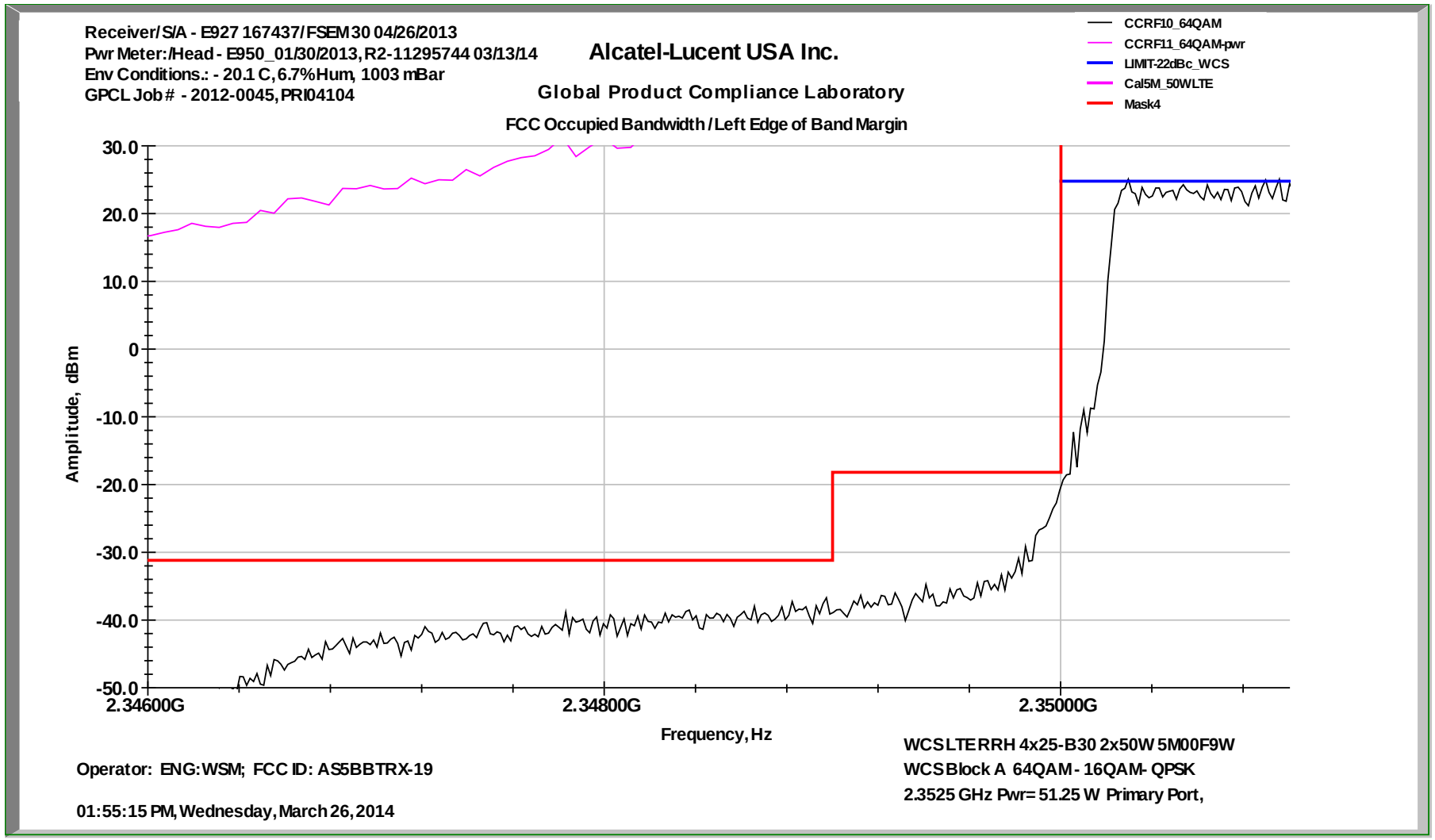
Transmitter Measurements
of
Occupied Bandwidth
for
Alcatel-Lucent USA Inc.
Alcatel-Lucent Remote Radio Head 4x25-B30 Transceiver System
FCC ID: AS5BBTRX-19

W. Steve Majkowski NCE
FCC Wireless Compliance, CDMA Filing Lead
Alcatel-Lucent USA Inc.
Global Product Compliance Laboratory
Building 28-114J
600-700 Mountain Avenue, P.O. Box 636
New Providence, NJ 07974-0636
Office: 908-582-3782
email: steve.majkowski@alcatel-lucent.com

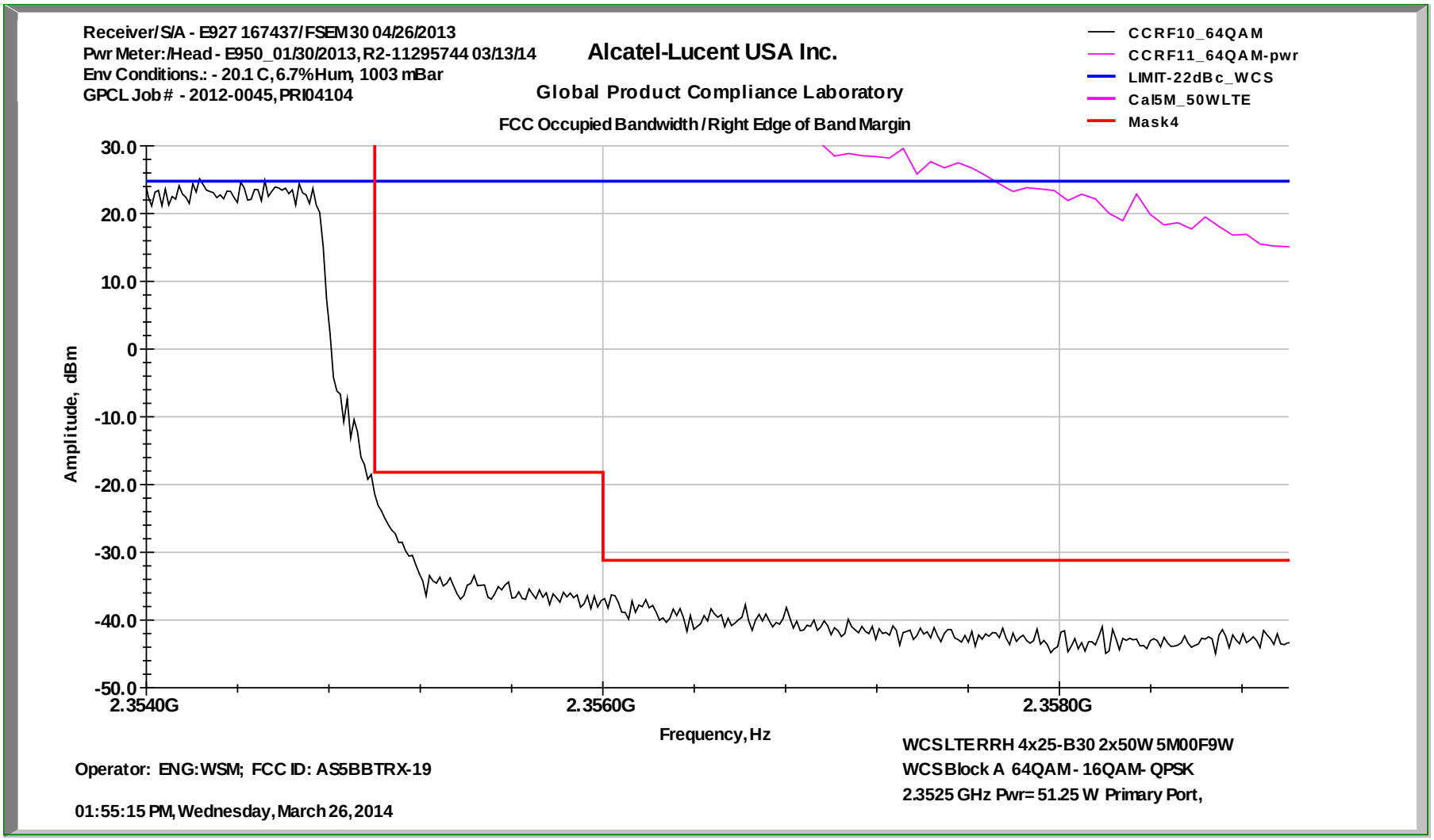
FCC Occupied Bandwidth WCS LTE 5M00F9W 64QAM 50W Block A-Ch-50 Primary Tx1 2xMIMO



FCC Left Edge of Block Margin WCS LTE 5M00F9W 64QAM 50W Block A-Ch-50 Primary Tx1 2xMIMO

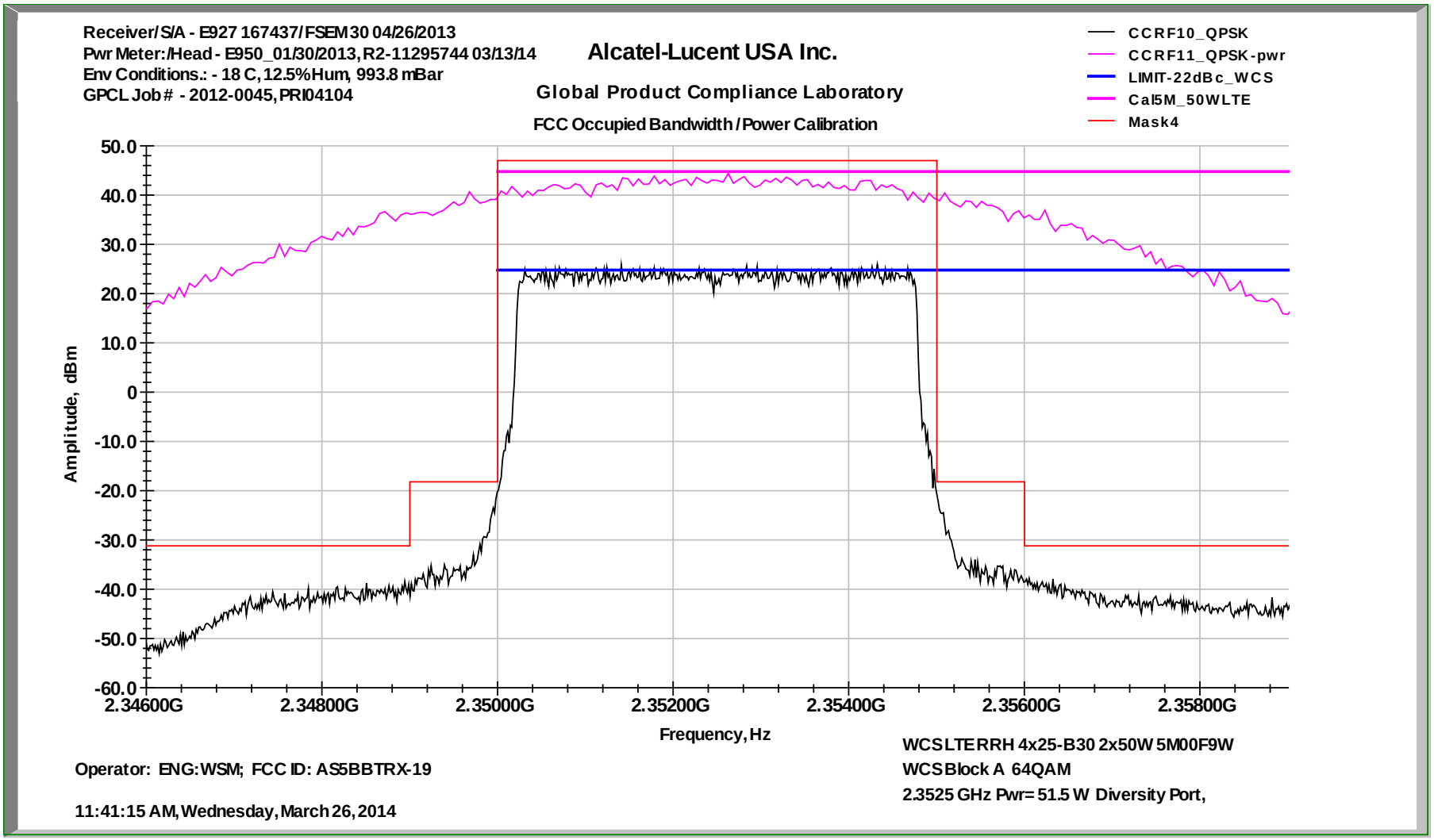


FCC Right Edge of Block Margin WCS LTE 5M00F9W 64QAM 50W Block A-Ch-50 64QAM Primary Tx1 2xMIMO

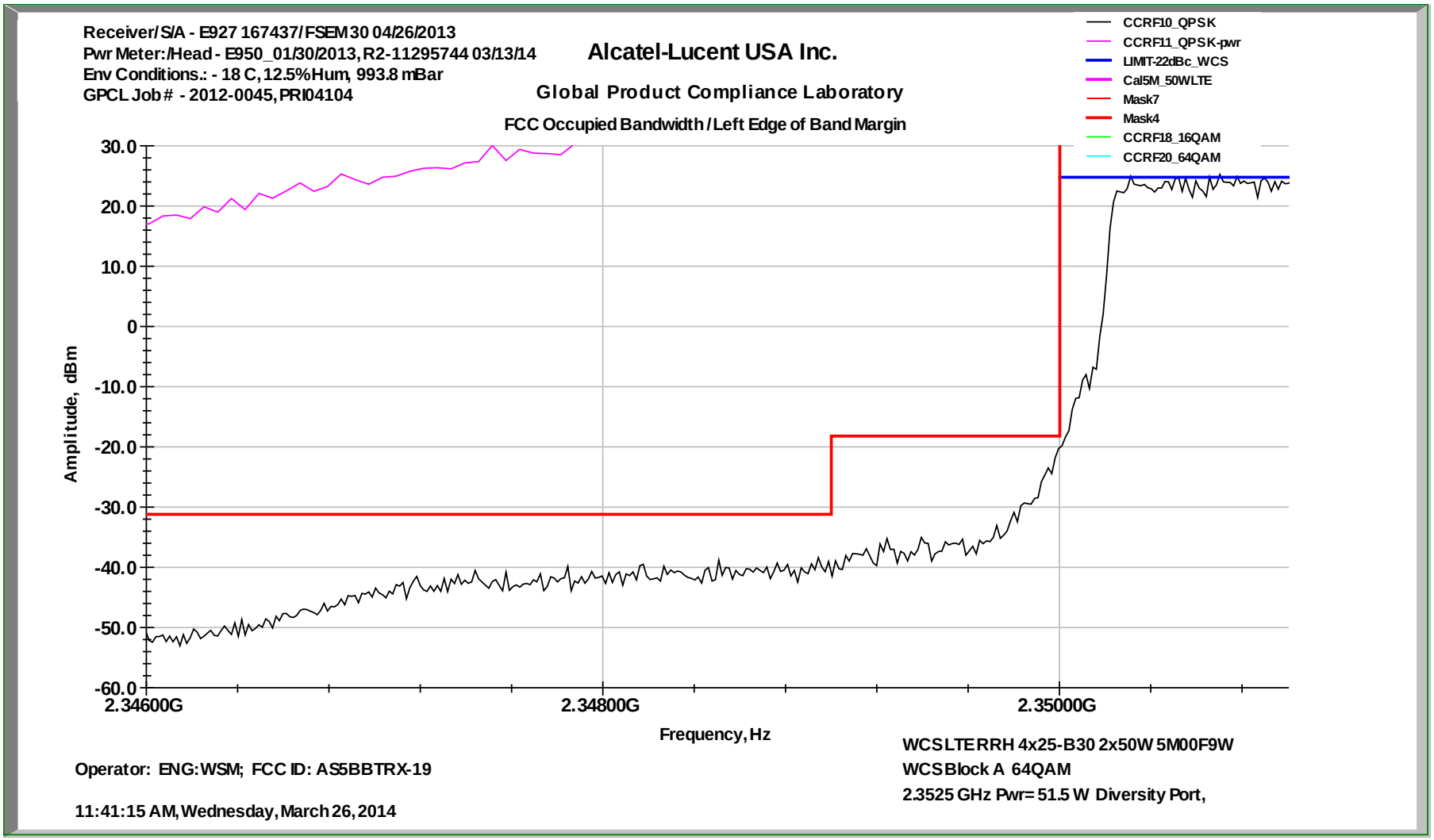


FCC Occupied Bandwidth w/ 3 Mod WCS LTE 5 MHz A-Ch-50 50W QPSK, 16 QAM, 64QAM Primary Tx1 2xMIMO

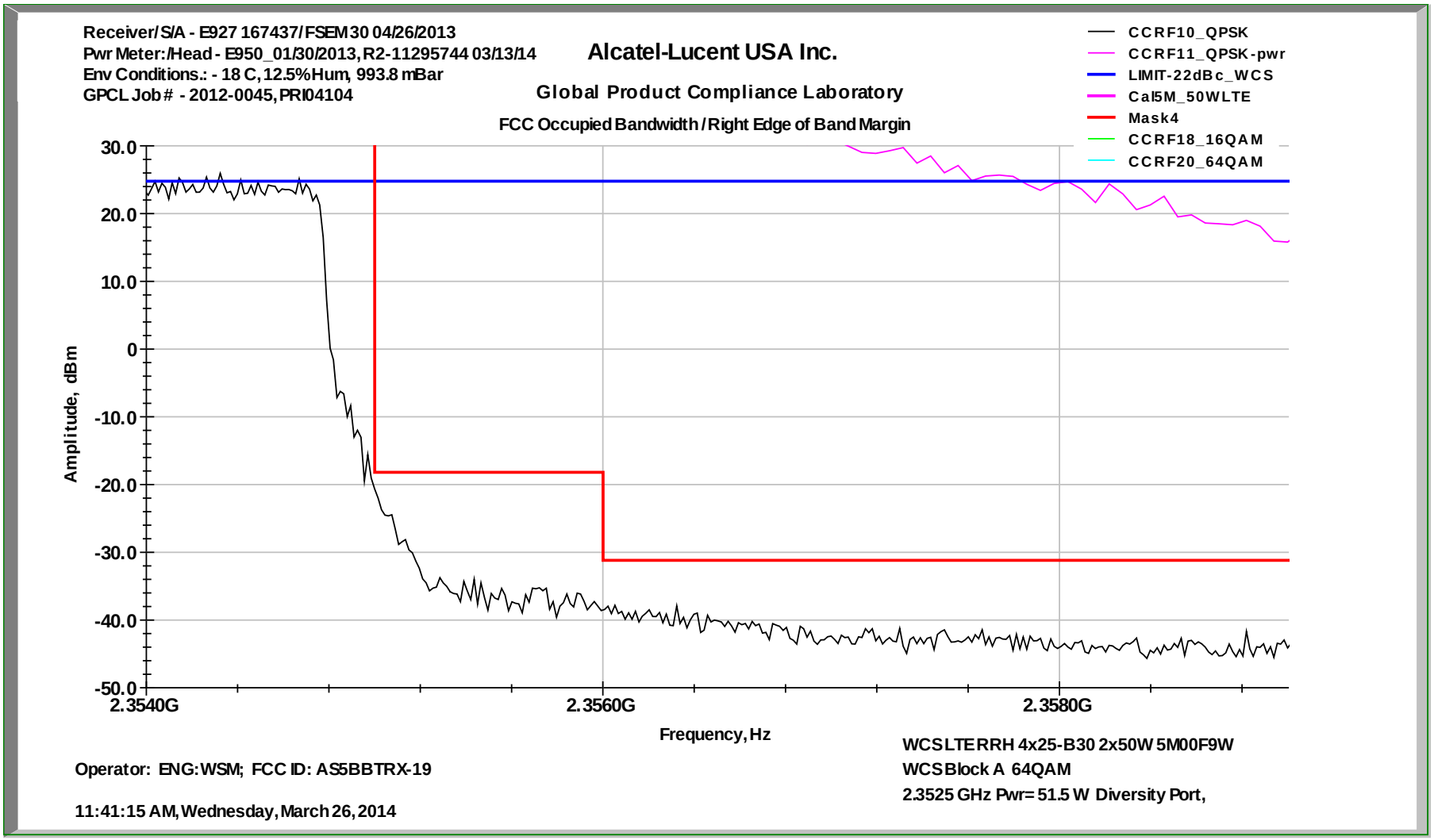
FCC Occupied Bandwidth WCS LTE 5M00F9W 64QAM 50W Block A-Ch-50 Diversity Tx2 2xMIMO



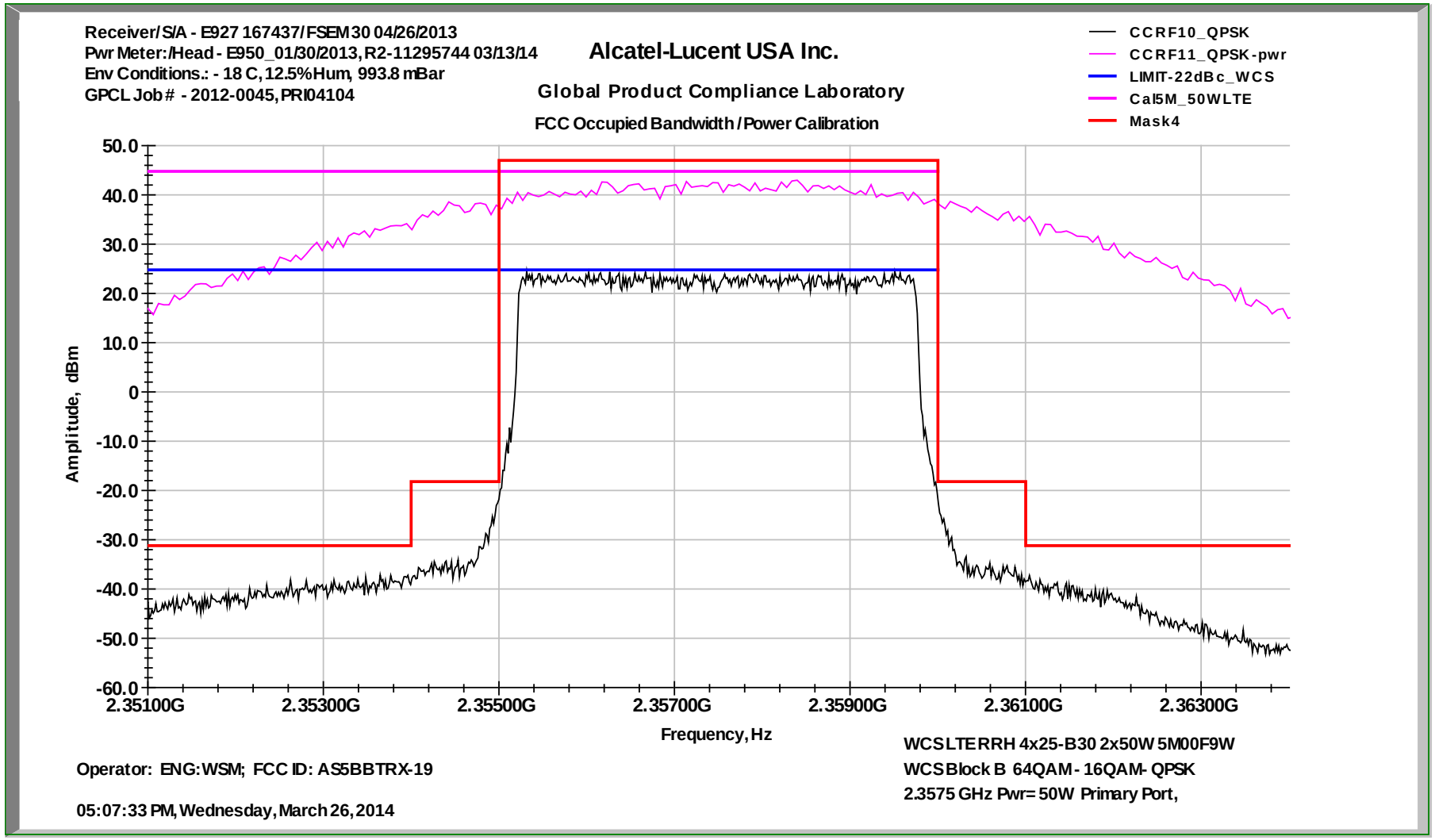
FCC Left Edge of Block Margin WCS LTE 5M00F9W 64QAM 50W Block A-Ch-50 Diversity Tx2 2xMIMO



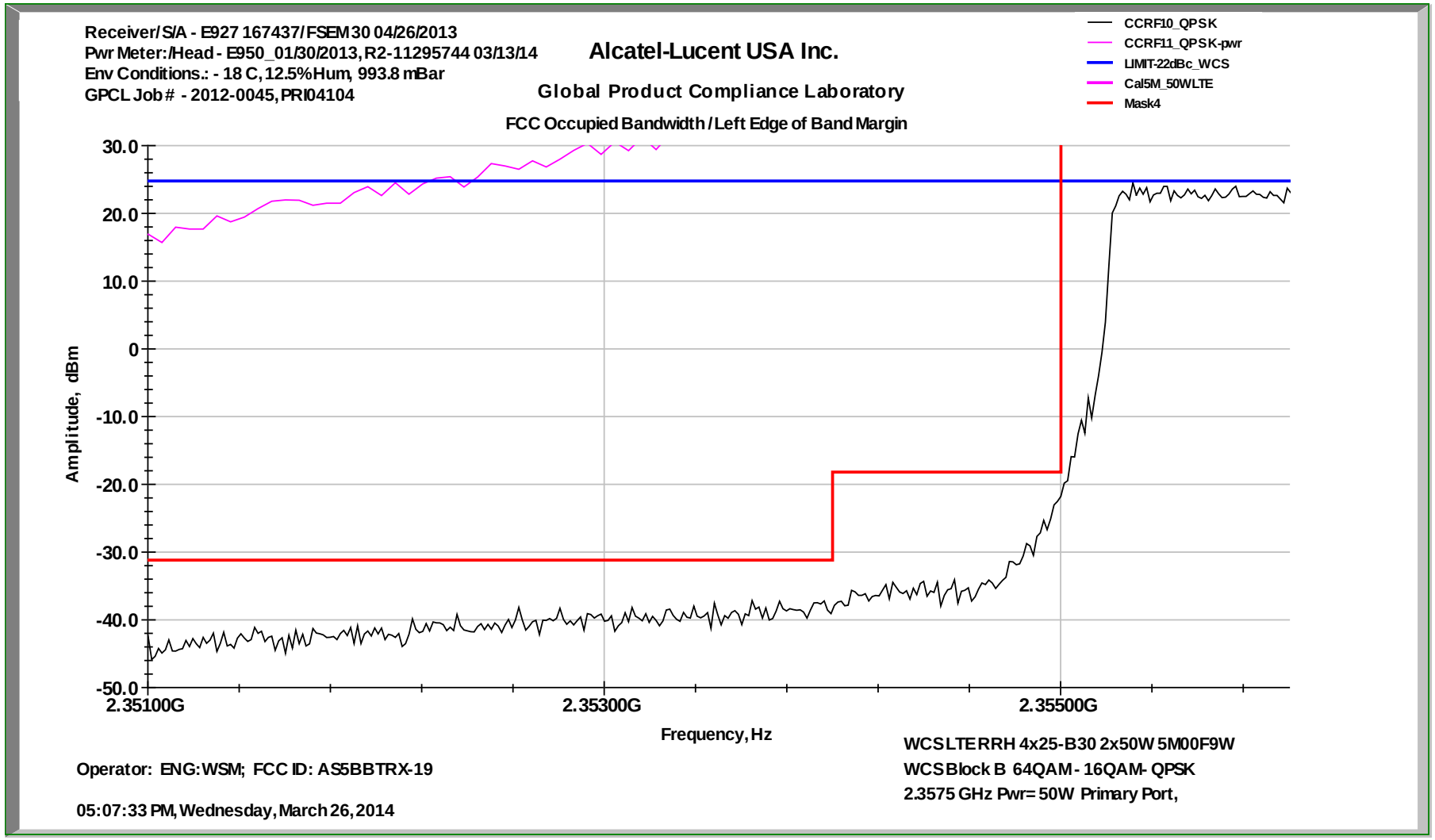
FCC Right Edge of Block Margin WCS WCS LTE 5M00F9W 64QAM 50W Block A-Ch-50 Diversity Tx2 2xMIMO



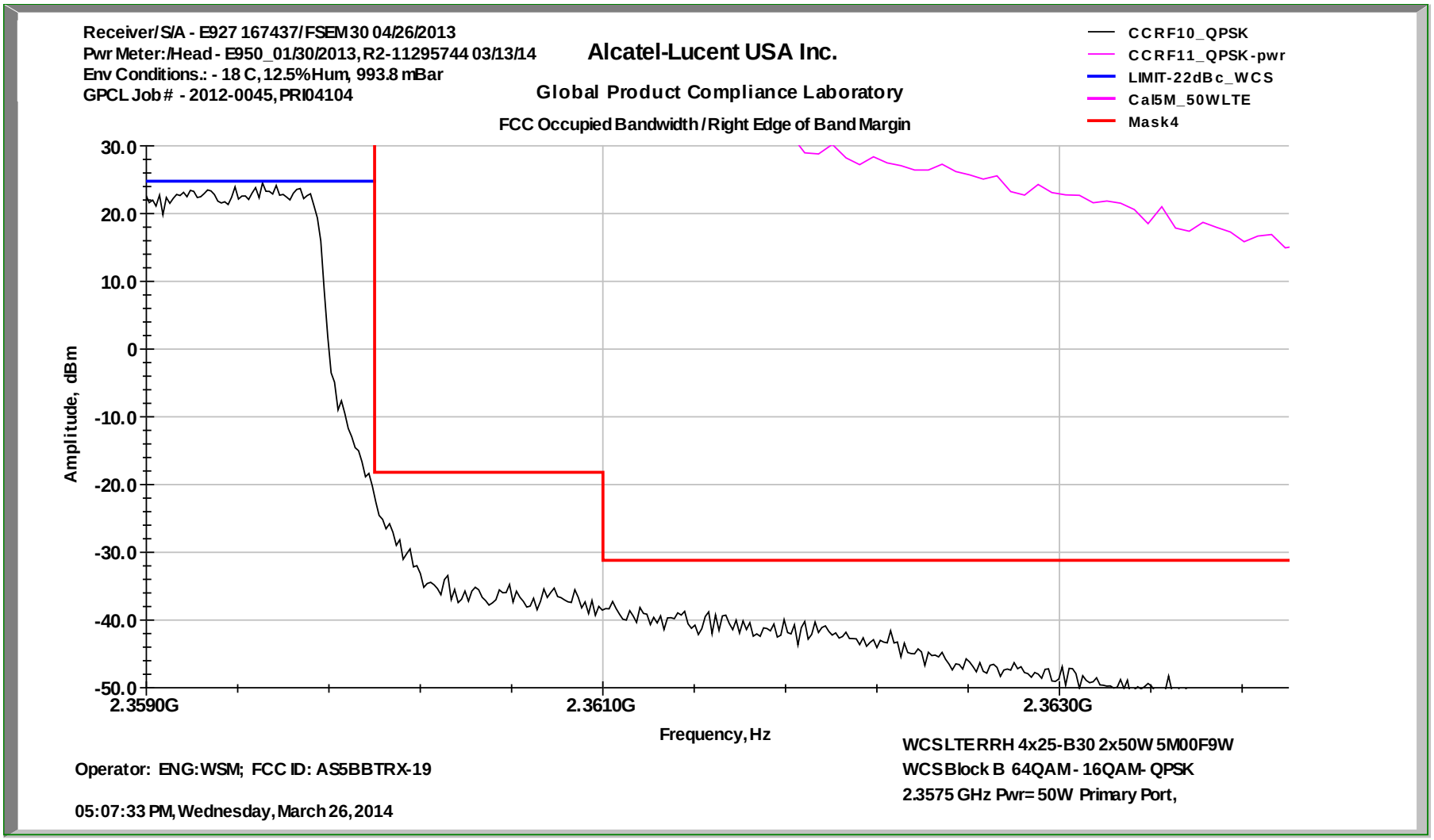
FCC Occupied Bandwidth WCS LTE 5M00F9W 64QAM 50W Block B-Ch-150 Primary Tx1 2xMIMO



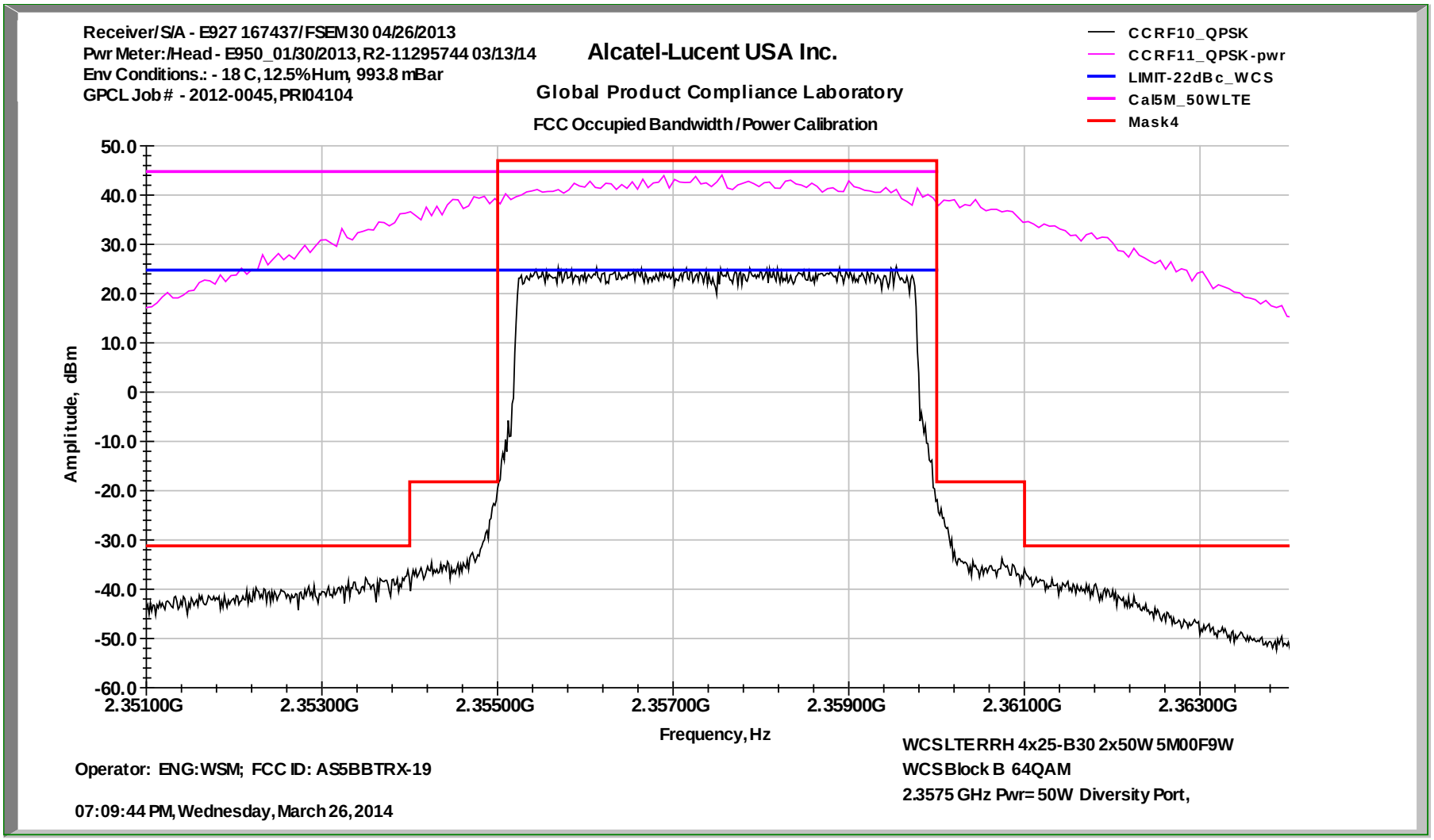
FCC Left Edge of Block Margin WCS LTE 5M00F9W 64QAM 50W Block B-Ch-150 Primary Tx1 2xMIMO



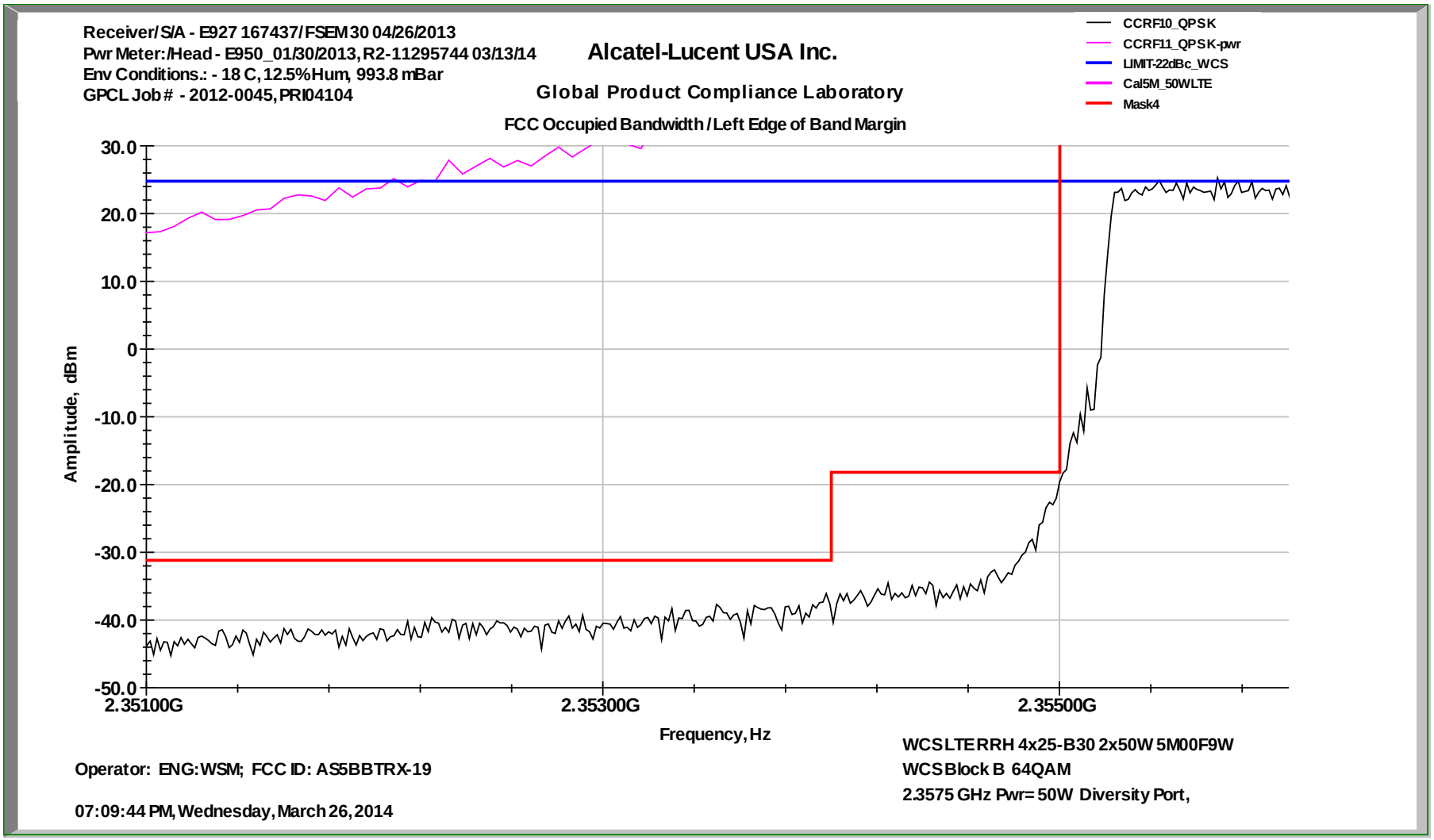
FCC Right Edge of Block Margin WCS LTE 5M00F9W 64QAM 50W Block B-Ch-150 Primary Tx1 2xMIMO



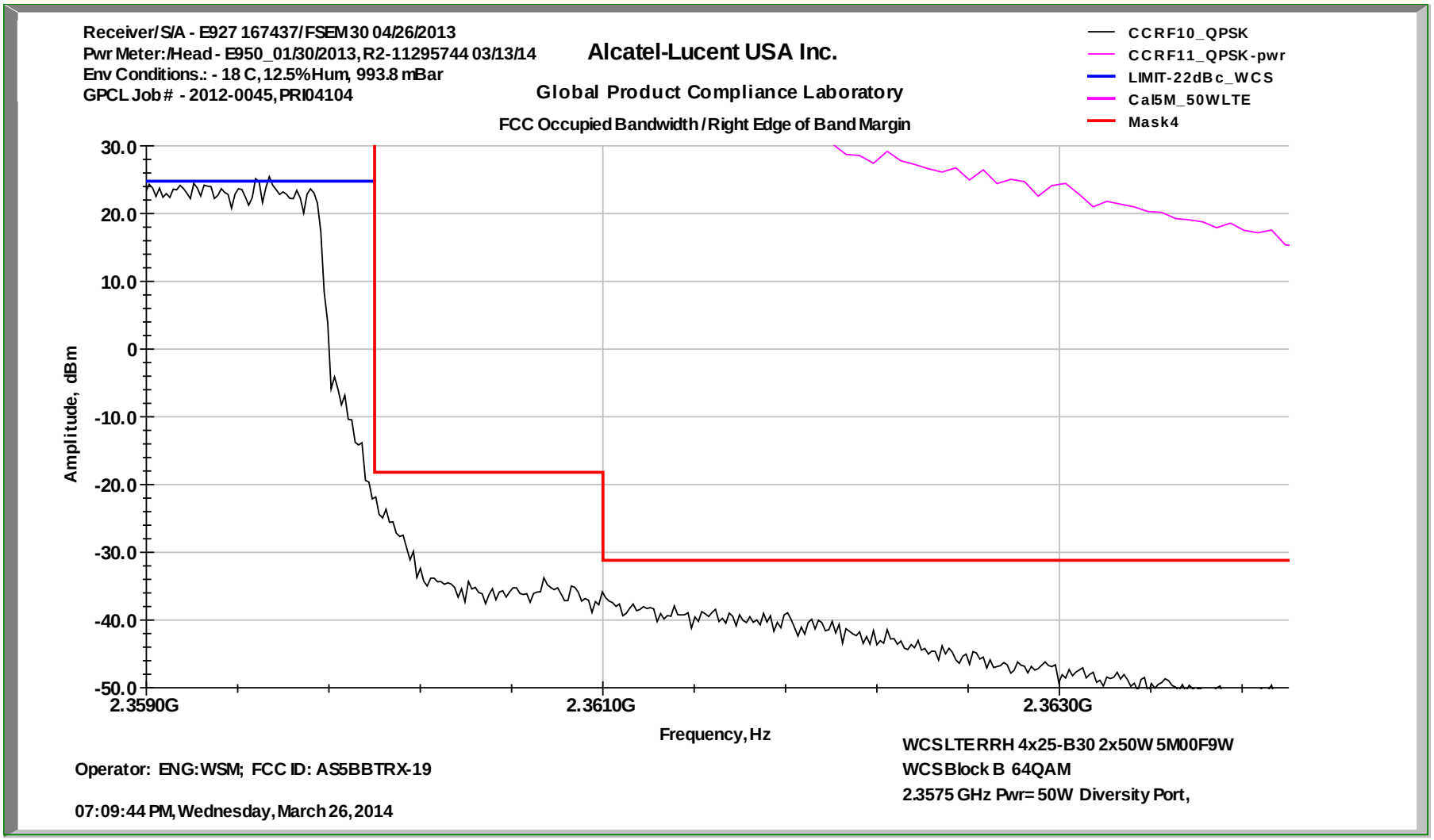
FCC Occupied Bandwidth WCS LTE 5M00F9W 64QAM 50W Block B-Ch-150 Diversity Tx2 2xMIMO



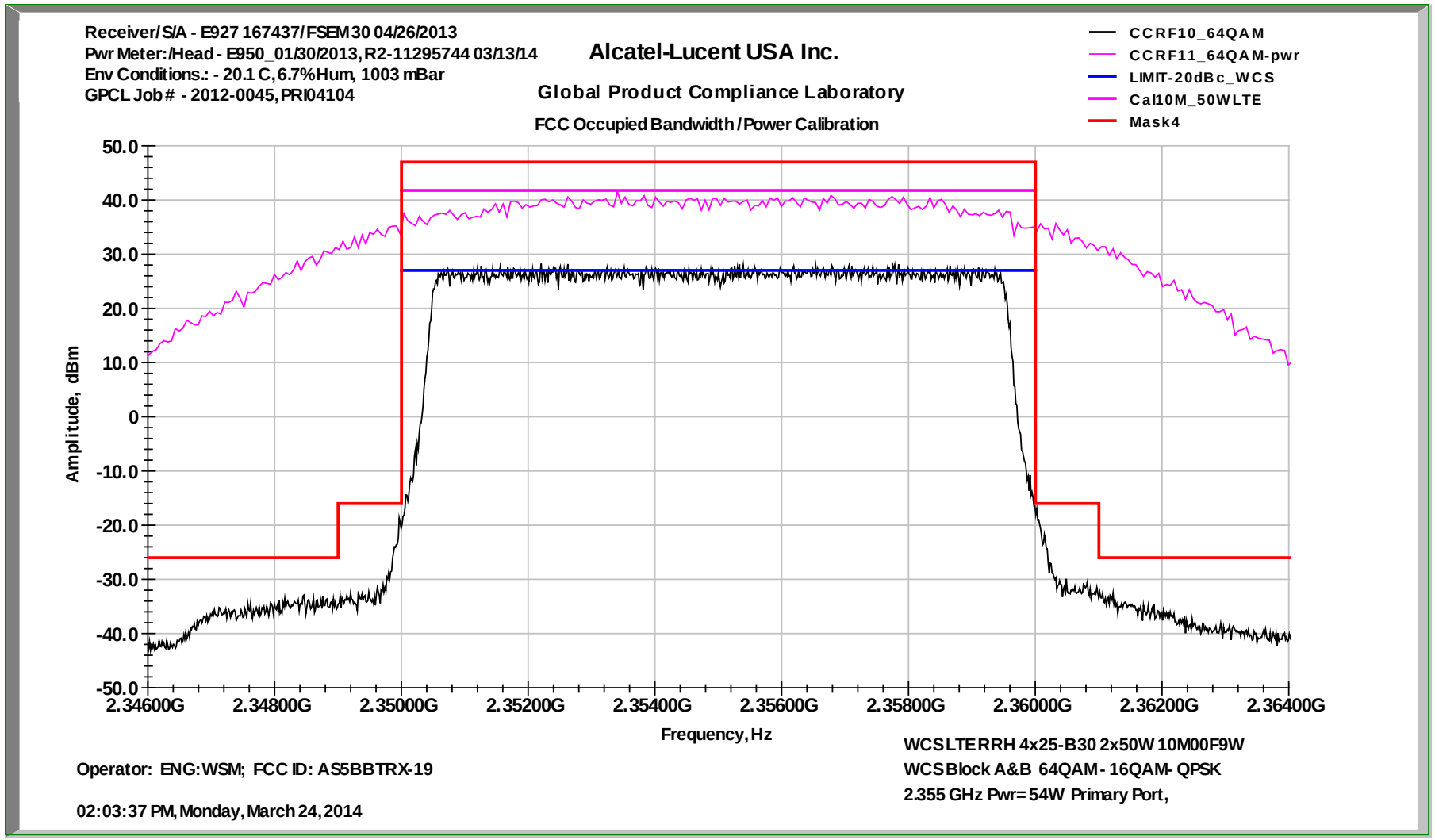
FCC Left Edge of Block Margin WCS WCS LTE 5M00F9W 64QAM 50W Block B-Ch-150 Diversity Tx2 2xMIMO



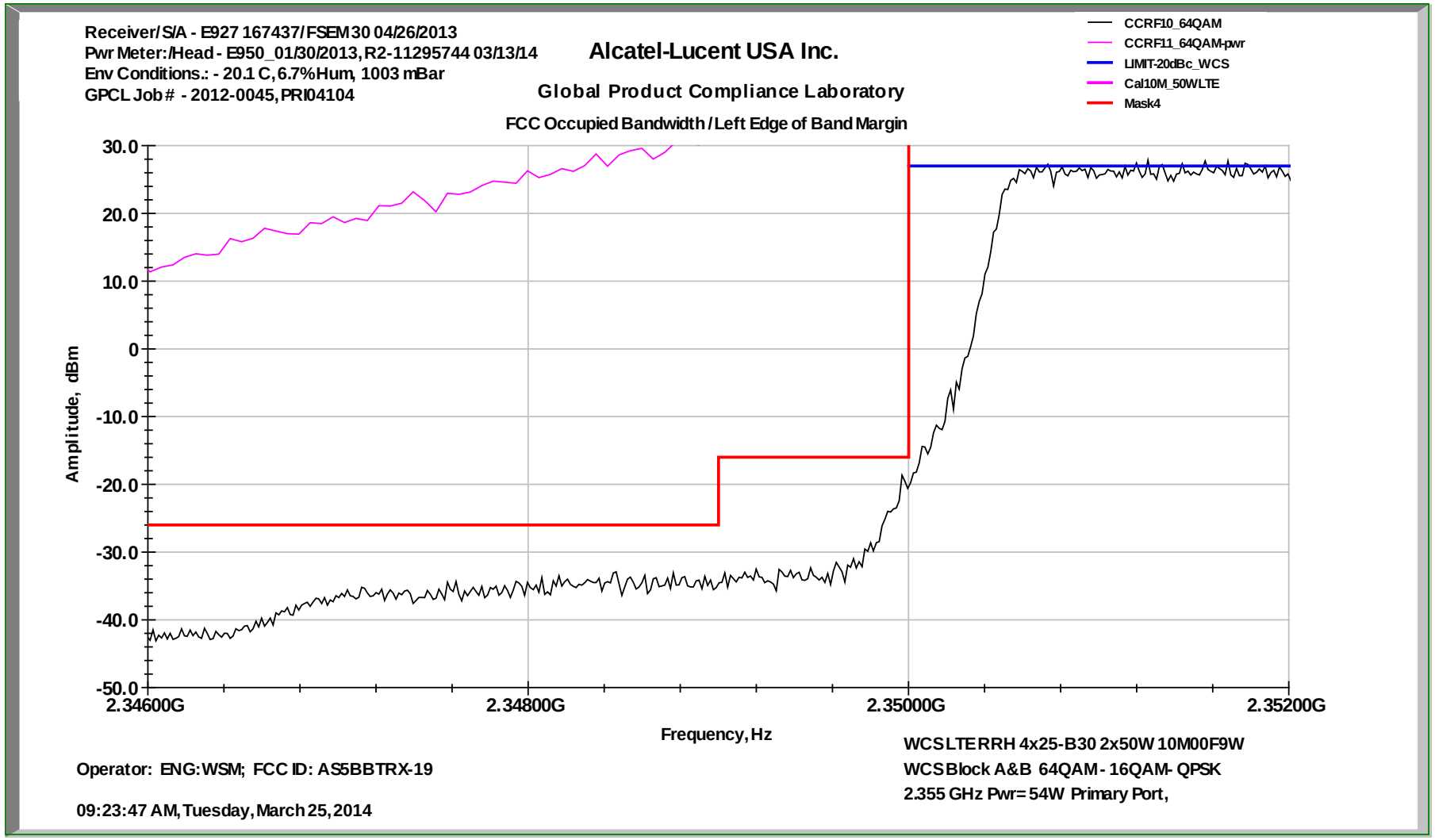
FCC Right Edge of Block Margin WCS LTE 5M00F9W 64QAM 50W Block B-Ch-150 Diversity Tx2 2xMIMO



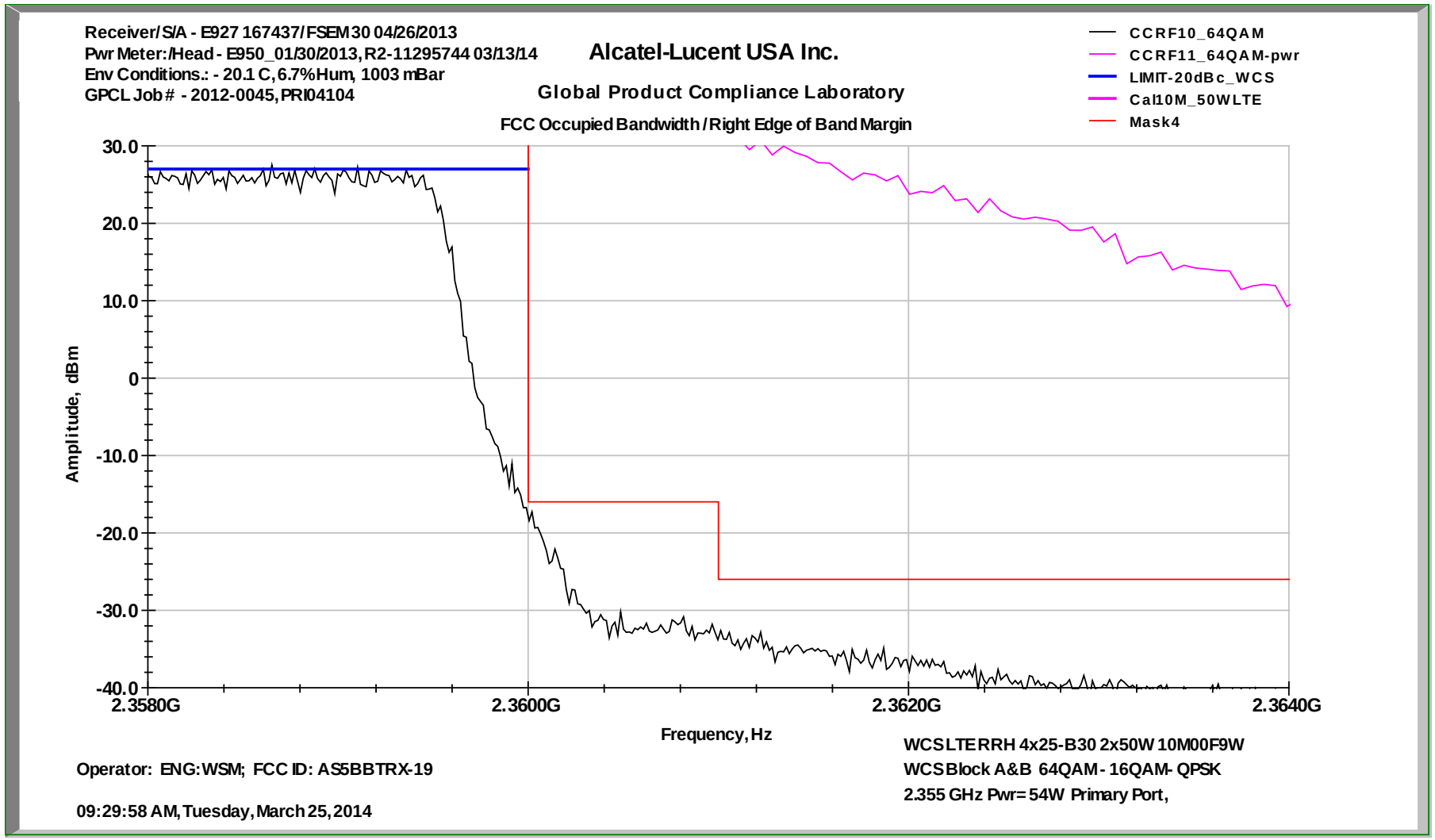
FCC Occupied Bandwidth WCS LTE 10M00F9W 64QAM 50W Block AB-Ch-100 Primary Tx1 2xMIMO



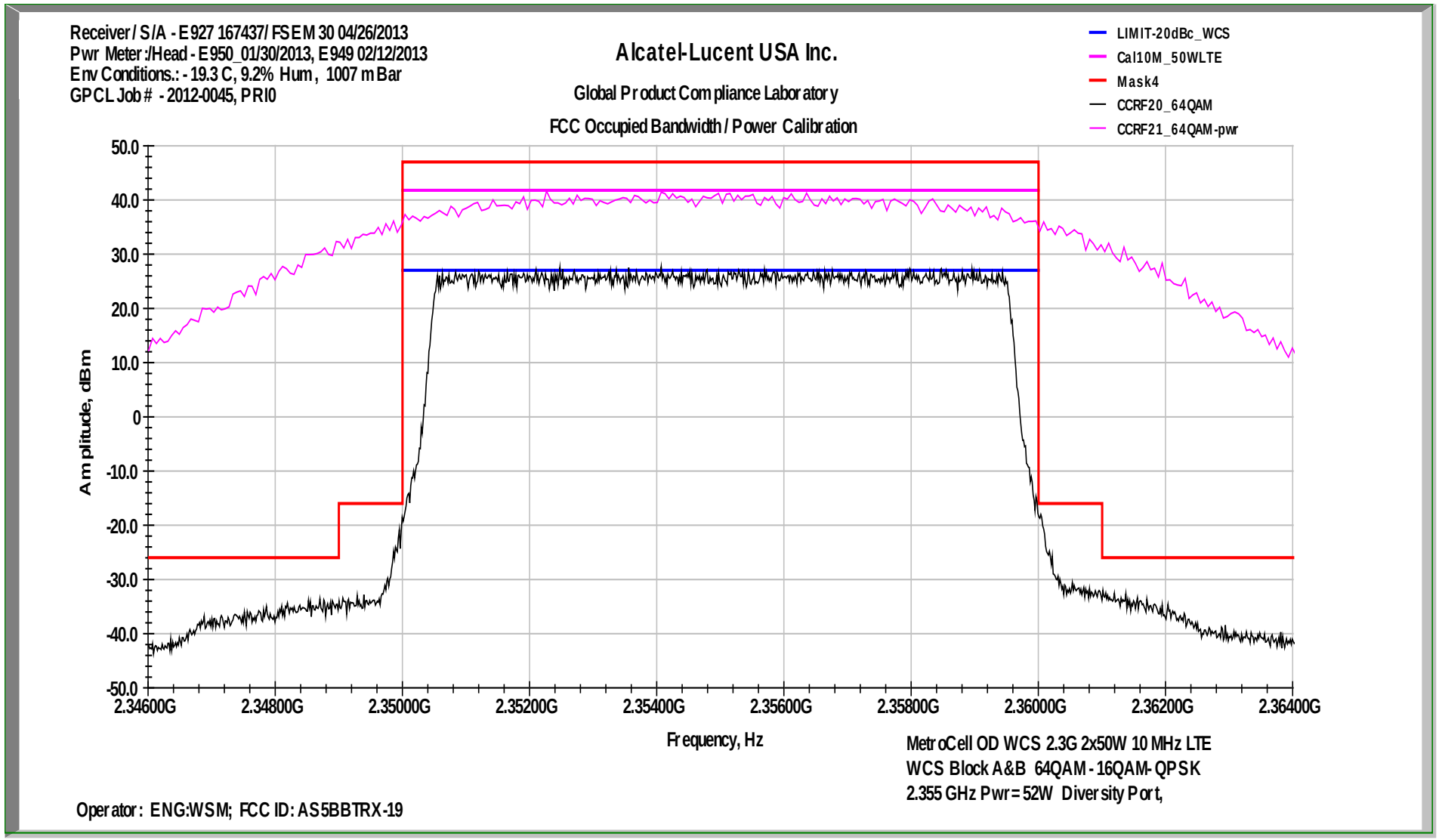
FCC Left Edge of Band Margin WCS LTE 10M00F9W 64QAM 50W Block AB-Ch-100 Primary Tx1 2xMIMO



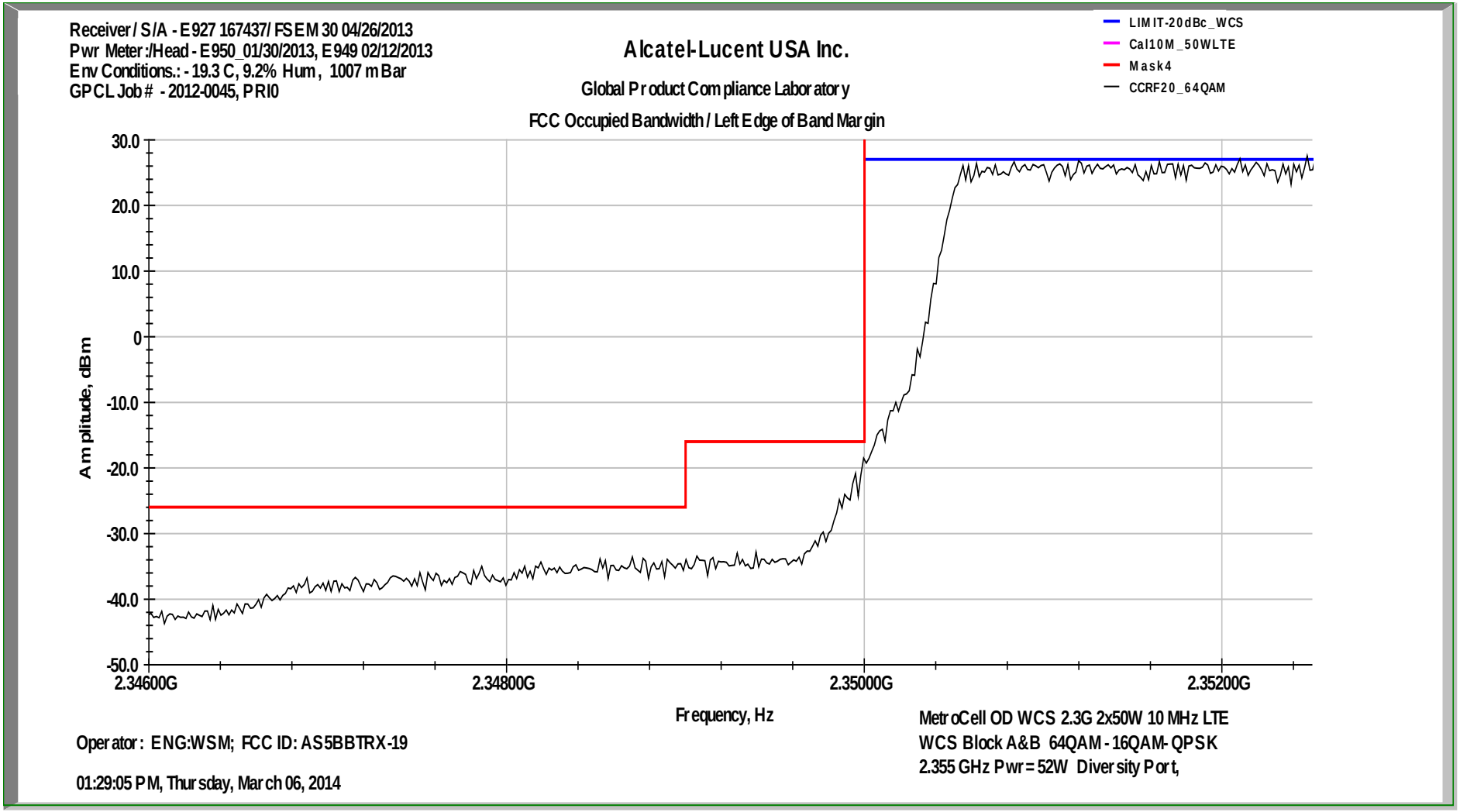
FCC Right Edge of Block Margin WCS WCS LTE 10M00F9W 64QAM 50W Block AB-Ch-100 Primary Tx1 2xMIMO



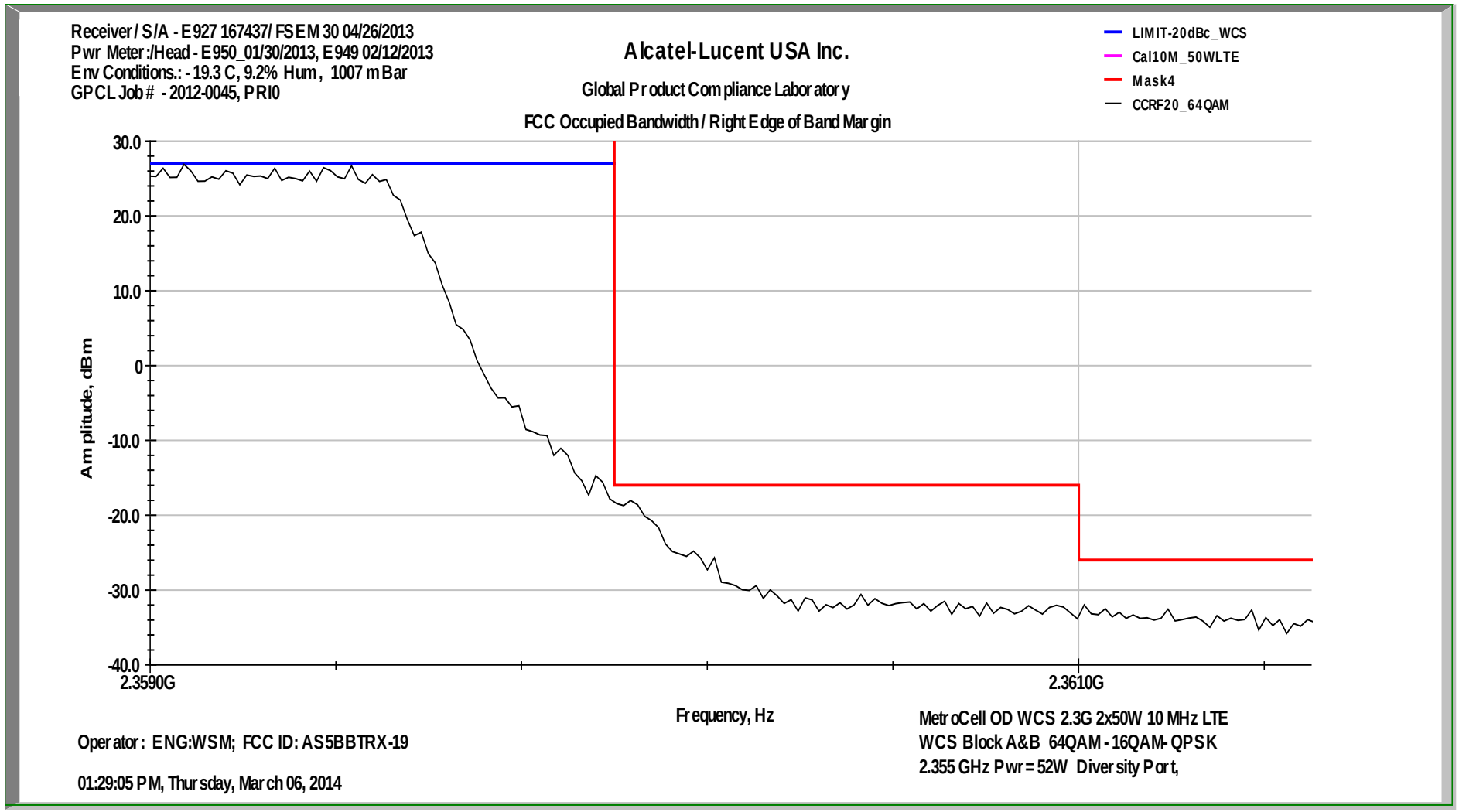
FCC Occupied Bandwidth WCS LTE 10M00F9W 64QAM 50W Block AB-Ch-100 Diversity Tx2 2xMIMO



FCC Left Edge of Block Margin WCS LTE 10M00F9W 64QAM 50W Block AB-Ch-100 Diversity Tx2 2xMIMO



FCC Right Edge of Block Margin WCS LTE 10M00F9W 64QAM 50W Block AB-Ch-100 Diversity Tx2 2xMIMO



15. Exhibit 15 Spurious Emissions at Antenna Terminals

Section 2.1051 Spurious Emissions at Antenna Terminals

15.1. Spurious Emissions at Antenna Terminals Description

Spurious Emissions at the antenna terminals were investigated over the frequency range of 10 MHz to 23.75 GHz which is beyond the 10th harmonic of the carrier frequency. A test coupler which incorporates a low inter-mod broadband RF attenuator was used to reduce the transceiver's amplitude to a level usable by the spectrum analyzer. The test coupler is shown in Figure 15A which documents the test configurations used for the measurements. This set up calibrates the complete RF test path over the 10 MHz-23.8 GHz range and it allows for RF power to be measured and monitored during the test.

The spurious measurements were made using an automated test system. The test system consists of a Rohde & Schwarz FSEM30 Spectrum Analyzer (or ESIB40 Test Receiver), a PC based computer test controller, calibrated test hardware and a TILE ™ software program to acquire the test data. This system allows measurement and presentation of the data in an accurate and compact form for FCC review. The volume of collected data is greater than 2 $x10^6$ data points over the frequency range of 10 MHz to 23.75 GHz.

15.2. Required Limit

The required emission limitation specified in **47CFR 27.53 1-Oct-2010** was applied to these tests. Based upon the criterion given in Section 27.53 of the Code and as developed in Exhibit 14, the required emission limit in 47 CFR 27.53 for emissions outside a licensees frequency block is:
Emissions >1 MHz outside the Block, *when measured with a RBW of 1 MHz,* shall be attenuated by :

$$-\{43+10\log(\text{mean power output in watts})\} = -13 \text{ dBm}.$$

In order to account for the spectral adding of identical signals from the primary and diversity ports**,** per KDB 662911 D01 Multiple Transmitter Output v01r01, the level needs be adjusted by 10LOG(n) where n= number of outputs.

The adjustment for n=2 is: 3.01 dB = 10LOG(2)

Therefore the limit for emissions >1 MHz outside a licensees frequency block when measured with a RBW of 1 MHz is:

$$-13 \text{ dBm} - 3.01 \text{ dB} = -16.01 \text{ dBm}$$

The carrier signal shown on these plots was measured at a resolution Bandwidths of 3 MHz. This was done so that the carrier plot correctly depicts the carrier output power in relation to the spurious signals and the defined limit. The out of band emissions were measured with a resolution Bandwidths of 1 MHz

15.3. Operational Configuration

The modulation used in this evaluation are described in the pertinent standards documents which include **3GPP TS 36.211 V9.1.0 (2010-03) titled:** 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation (Release 9). The modulation is Orthogonal Frequency Division Multiple Access (OFDMA) which is processed into an uplink IF signal. The input data stream is divided into several parallel sub-streams of reduced data rate and each sub-stream is transmitted on a separate orthogonal sub-carrier. The sub-carriers are modulated using either QPSK, or 64QAM. There is no single measure of the modulation quality other than to verify that the subcarrier modulation constellations visual orientation match the symbol and amplitude criteria is consistent with QPSK and 64QAM.

Exhibit 15 *continued*

TABLE 15.2 WCS Conducted Spurious Compliance Tabulation

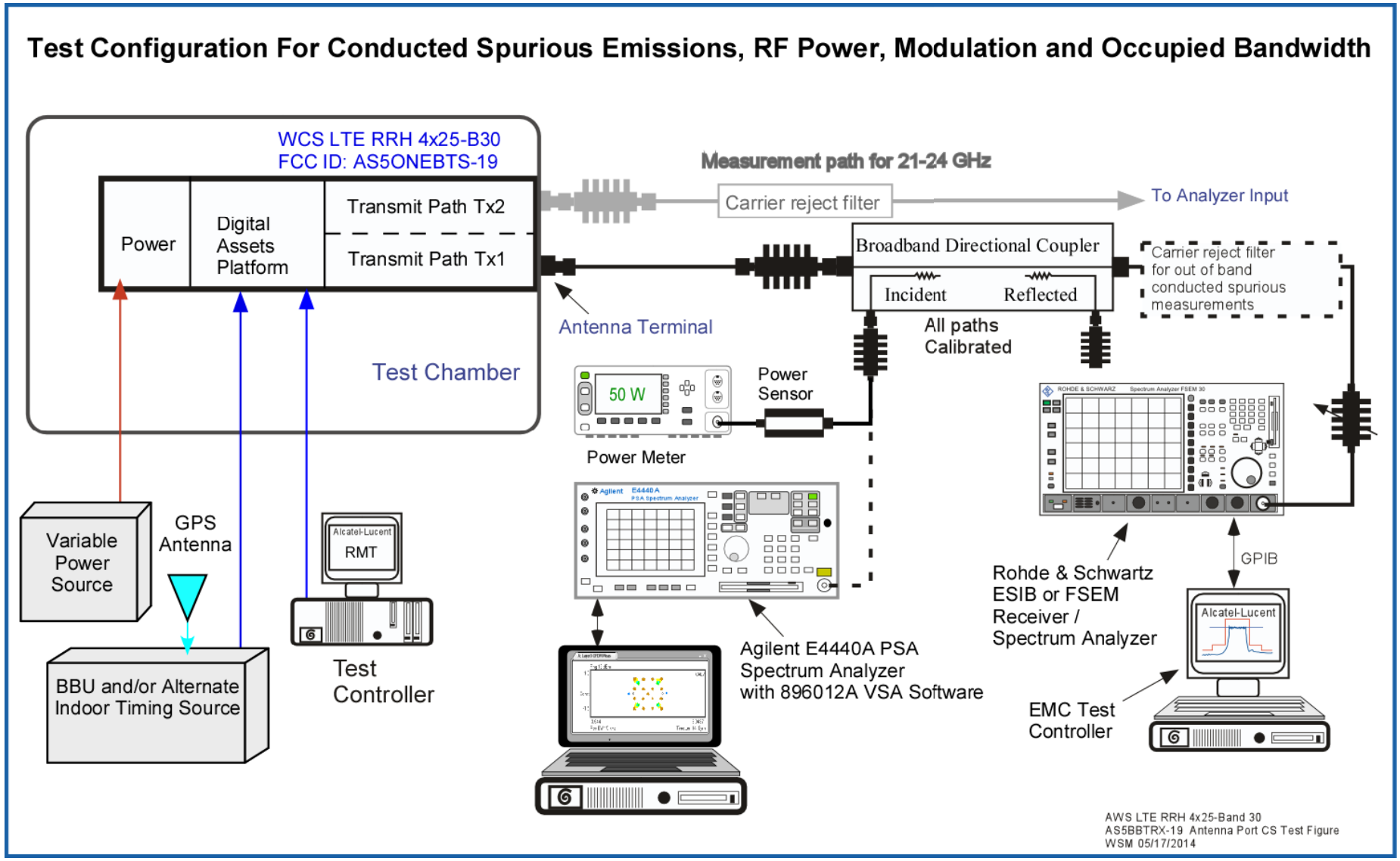
WCS Block	WCS – Channel # / EARFCN	Signal Band width	Modulation Type	Primary Tx1	Results Conducted Spurious	Diversity Tx2	Results Conducted Spurious
AB	100 / 9820	10 MHz	64QAM	Tested	Compliant	Tested	Compliant
A	50 / 9795	5 MHz	64QAM	Tested	Compliant	Tested	Compliant
B	150 / 9845	5 MHz	64QAM	Tested	Compliant	Tested	Compliant

15.4. Test Results Summary

Conducted Spurious measurements were performed for the 2x50W primary and diversity antenna ports of the **Alcatel-Lucent Remote Radio Head 4x25-B30 Transceiver System / FCC ID: AS5BBTRX-19.** The WCS LTE RRH4x25-B30 was configured with an output power of 50 watts and 64QAM. Conducted Transmit Spurious measurements were performed for every WCS Block Edge measurements configuration s as documented in Table 15.2.

The attached spectral plots are representative of the Conducted Spurious compliance performance of the **Alcatel-Lucent Remote Radio Head 4x25-B30 Transceiver System / FCC ID: AS5BBTRX-19.** The compliance for all of the representative transmit configurations are documented in Table 15.2. This Table lists WCS Blocks/ Channels tested the amplifier configuration and the status of the performance. The performance data, charts and tables all show that there are no "Out of Block" harmonics or spurious emissions above the applicable limit of –16.01 dBm. The attached table and sample data plots document the results.

Figure 15A Test Setup for Antenna Port Measurement of Conducted Spurious Emissions.

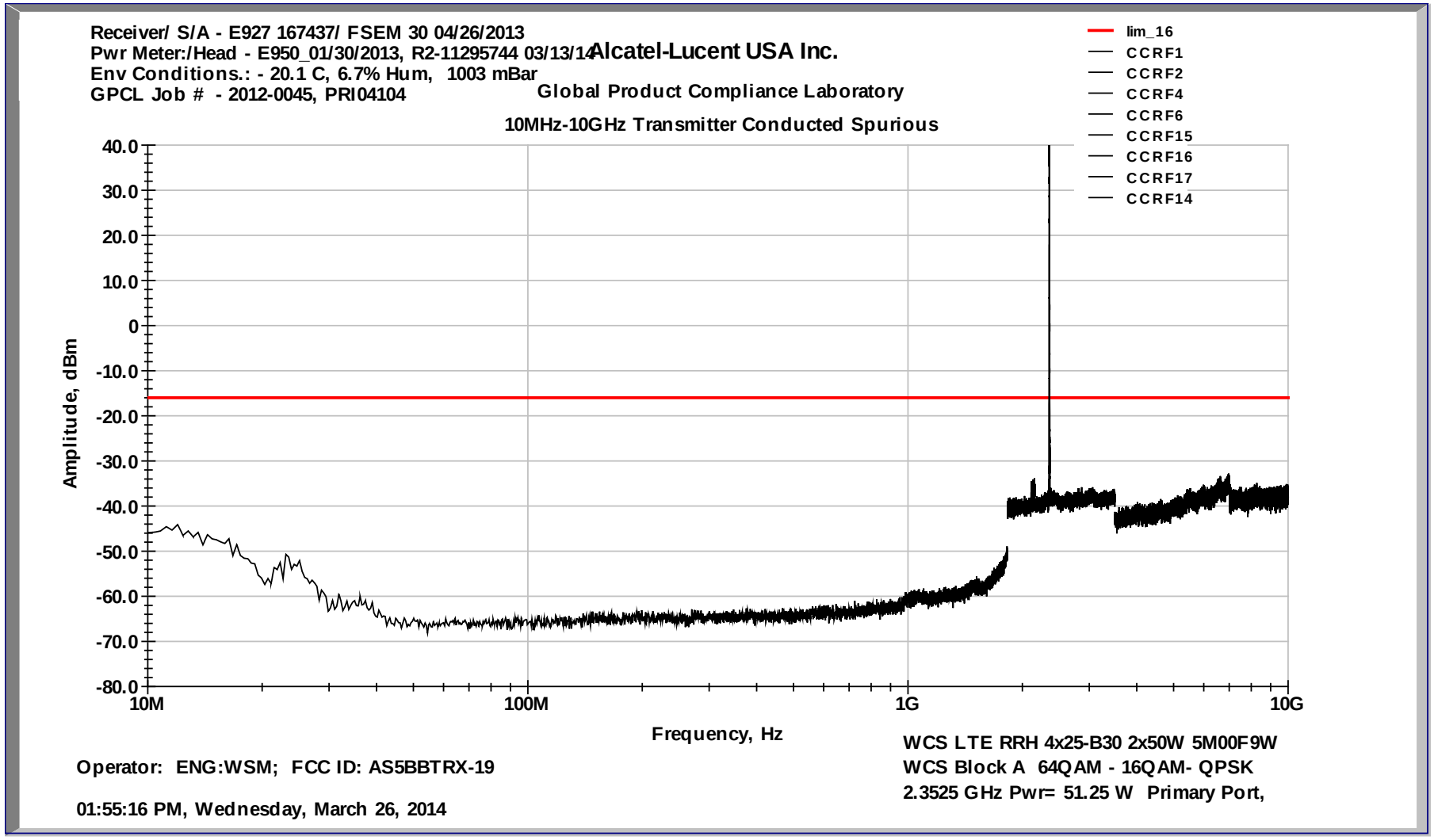


Transmitter Measurements
of
Conducted Spurious Emissions
for
Alcatel-Lucent USA Inc.

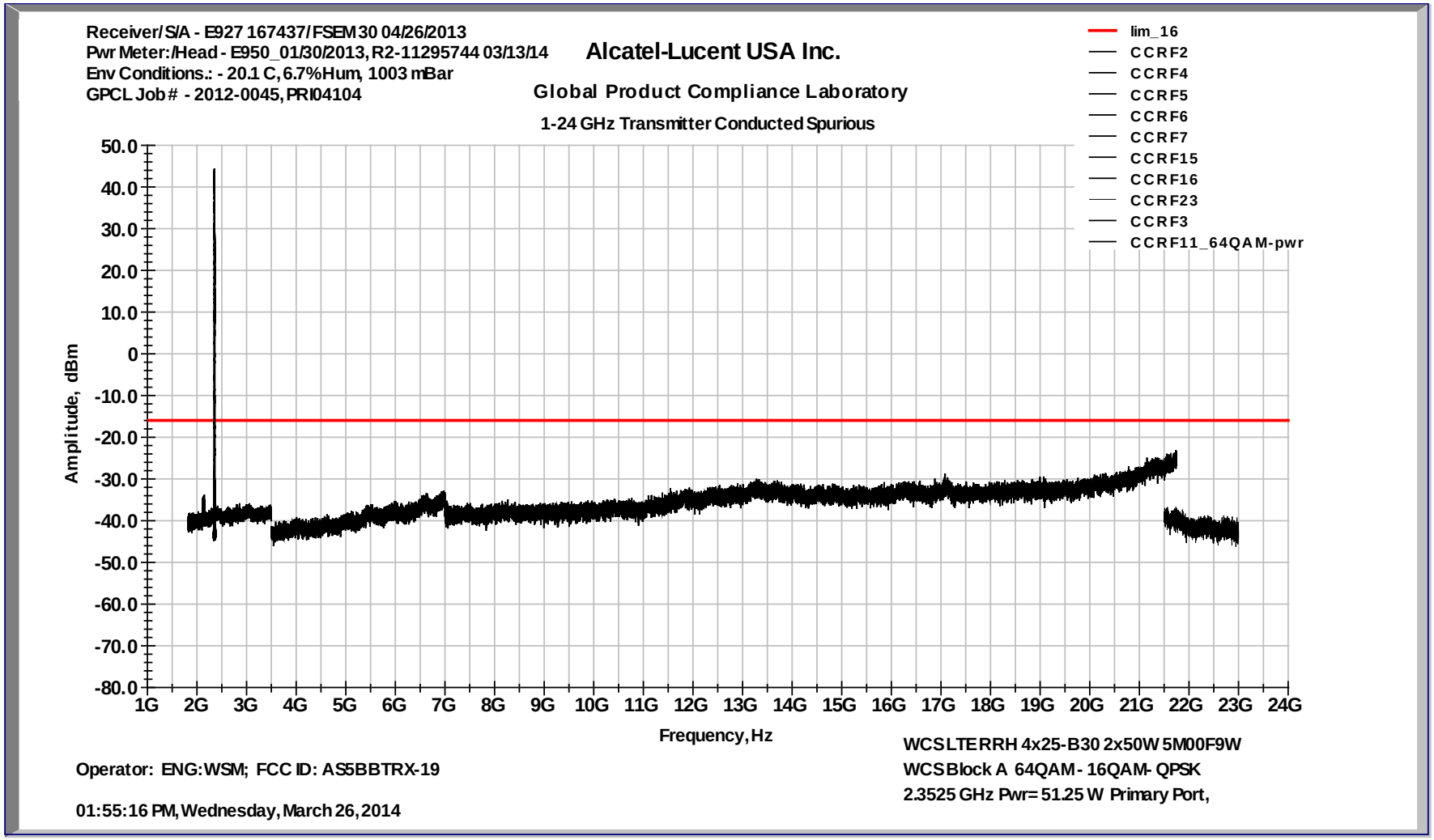
WCS LTE RRH4x25-B30 Outdoor Transceiver System
FCC ID: AS5BBTRX-19

W. Steve Majkowski NCE
FCC Wireless Compliance, CDMA Filing Lead
Alcatel-Lucent USA Inc.
Global Product Compliance Laboratory
Building 28-114J
600-700 Mountain Avenue, P.O. Box 636
New Providence, NJ 07974-0636
Office: 908-582-3782
email: steve.majkowski@alcatel-lucent.com

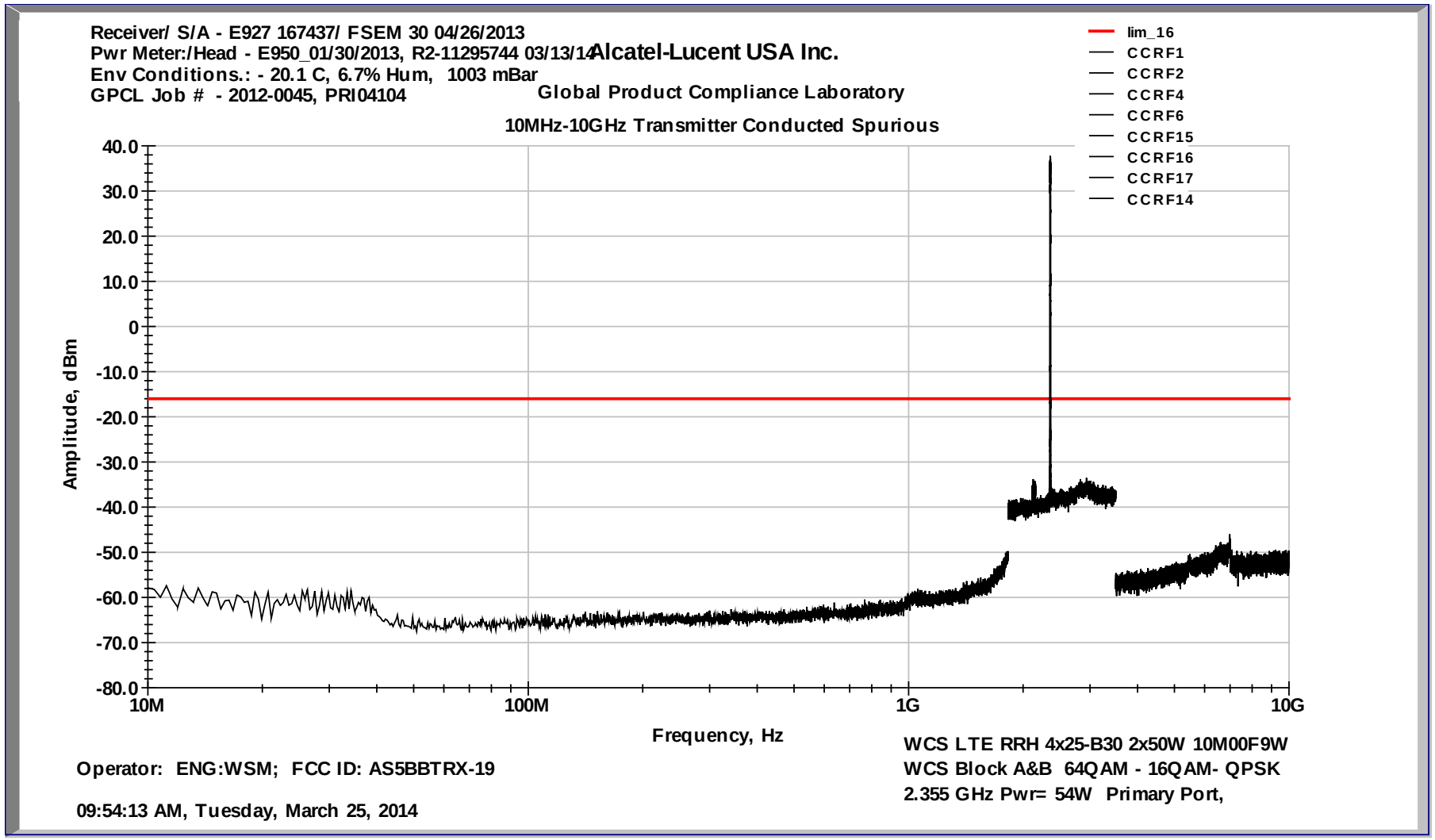
Conducted Spurious Emissions 10 MHz – 10 GHz 64QAM 5M00F9W A-Ch-50 Primary Tx1 2xMIMO



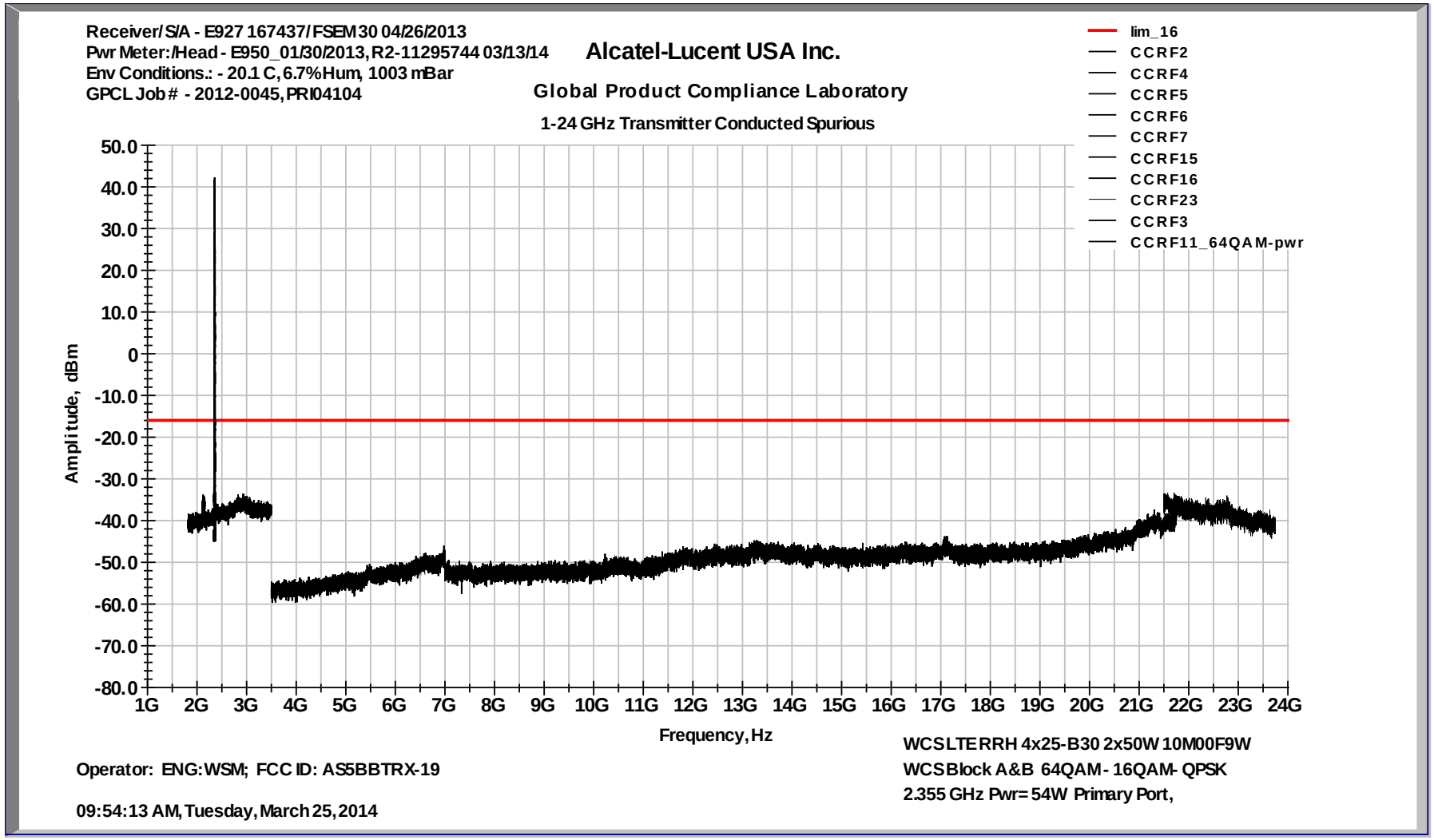
Conducted Spurious Emissions 1 – 24 GHz 64QAM 5M00F9W A-Ch-50 Primary Tx1 2xMIMO



Conducted Spurious Emissions 10 MHz – 10 GHz LTE 10M00F9W A-Ch-100 Primary Tx1 2xMIMO



Conducted Spurious Emissions 1 – 24 GHz LTE 10M00F9W A-Ch-100 Primary Tx1 2xMIMO



16. Exhibit 16 Field Strength Of Spurious Radiation

SECTION 2.1053 Field Strength Of Spurious Radiation

16.1. Description Field Strength Of Spurious Radiation

Field strength measurements of radiated spurious emissions were evaluated in the AR9 Semi-Anechoic 3m Full Compliance Chamber maintained by Alcatel-Lucent USA Inc. Global Product Compliance Laboratory in Murray Hill, New Jersey. A complete description and full measurement data for the site have been placed on file with the Commission.

The **Alcatel-Lucent Remote Radio Head 4x25-B30 Transceiver System / FCC ID: AS5BBTRX-19** was configured into a representative field installation and was tested when operating in each WCS block. The spectrum from 10 MHz to the tenth harmonic of the carrier (23.75 GHz) was searched for spurious radiation. Measurements were made using both horizontally and vertically polarized broadband antennas. Per FCC regulations, the comparison of out of band spurious emissions directly to the limit is appropriately made using the substitution method. However, when the emissions are more than 20 dB below the specification limit, the use offield strength measurements for compliance determination is acceptable and those emissions are considered not reportable (Section 2.1053 and the FCC Interpretive database for 2.1053). For this case the evaluation of acceptable radiated field strength is as follows.

The calculated emission levels were found by:

$$\text{Pmeas (dBm)} + \text{Cable Loss(dB)} + \text{Antenna Factor(dB)} + 107\ (\text{dB}\mu\text{V/dBm}) - \text{Amplifier Gain (dB)} = \text{Field Strength (dB}\mu\text{V/m)}$$

Section 24.53 and 2.1053 contains the requirements for the levels of spurious radiation as a function of the EIRP of the unmodulated carrier. The reference level for the unmodulated carrier is calculated as the field produced by an isotropic radiator excited by the transmitter output power according to the following relation taken from Reference Data for Radio Engineers, page 27-7, 6th edition, IT&T Corp.

$$E = (120\pi P)^{1/2} = [(30*P)^{1/2}] / R$$

$$20 \log (E*10^{6}) - (43 + 10 \log P) = 71.77 \text{ dB } \mu\text{V/meter}$$

Where: E = Field Intensity in Volts/ meter R = Distance in meters = 10 m
P = Transmitted Power in watts = 50 W

16.2. Results

For this particular test, the field strength of any spurious radiation, measured at 10m, is required to be less than 71.8 dBμV/meter. Emissions equal to or less than 51.8 dBμV/meter are not reportable and may be verified using field strength measurements and broadband antennas. Over the out of band spectrum investigated from 10 MHz to beyond the tenth harmonic of the carrier (23.75 GHz), no reportable spurious emissions were detected. This demonstrates that the **Alcatel-Lucent Remote Radio Head 4x25-B30 Transceiver System / FCC ID: AS5BBTRX-19**, the subject of this application, complies with Sections 2.1053, 27.53 and 2.1057 of the Rules.

Although not required for certification, additional testing to 47CFR Part 15 documented compliance with the Class B requirements for radiated emissions and power line conducted emissions.

16.3. Field Strength Of Spurious Radiation Test Equipment

Description	Manufacturer /Model/ Serial Number	GPCL ID	Last Cal	Interval
Bilogical Antenna, 25 - 2000 MHz	A.H. Systems Inc. / SAS-521-2/ 457	E766	12/26/2012	24
Spectrum Analyzer, 9 KHz-22 GHz	Hewlett Packard / 8593E /3911A04009	E375	02/18/2013	24
Amplifier, 9 kHz-1GHz	Sonoma Instrument Co. / 310N /186744	E812	8/21/2013	12
Attenuator 6 dB, DC-18GHz 5W	Weinschel / 2-6 / BW2239	E890	06/05/2013	24
Pre-Amplifier, 1-26.5 GHz	Hewlett Packard / 8449B / 3008A01270	E376	12/22/2013	24
EMI Test Receiver 20Hz-40 GHz	Rohde & Schwarz / ESIB40 / 100100	E908	06/12/2013	24
Double Ridged Horn 1-18 GHz	EMCO / 3115 / 9903-5769	E393	01/30/2013	24
Double Ridged Horn 1-18 GHz	ETS Lindgren / 3117 / 135194	E1074	11/19/2012	24
Double Ridged Horn 18-40 GHz	ETS-EMCO / 3116 /2539	E513	03/22/2013	24

17. Exhibit 17 Measurement of Frequency Stability

SECTION 2.1055 Measurement of Frequency Stability

17.1. Description Measurement of Frequency Stability

The following frequency stability test data for the Alcatel-Lucent WCS LTE **RRH 4x25-B30, FCC ID: AS5BBTRX-19** was measured as installed and tested, per Figure 17A. The -48V DC powered **RRH 4x25,** SN: ALLU13-YD71000025, was tested over the specified temperature range of -30 deg C to +50 deg C while operating at full rated power. Software and hardware controls internal to the **RRH 4x45-B30** will disable the transmitter should either the internal temperatures exceed the maximum range or the frequency stability of the transmitter be compromised.

17.2. Frequency Stability Testing

The Frequency Stability testing was performed from 8th May to 12th May 2014 in the Thermal chamber located at the Alcatel-Lucent test facility in Swindon, UK. The Frequency Stability testing was performed at a system level using the **RRH 4x25-B30** with a transmit frequency of 2355.0 MHz while operating in a 2x50W MIMO configuration. The testing subjected the UUT to comprised high temperature (+50ºC, system ambient) and low temperature (-30ºC system ambient). The system level Frequency Stability testing of the UUT yielded results in compliance with established design criteria. Frequency Stability performance was verified by measuring Frequency Tolerance at EAC using an MXA Signal Analyzer. Frequency Tolerance is a measurement of the difference between the actual transmit frequency and the assigned frequency (2355.0 MHz). The frequency stability performance of the **RRH 4x25-B30**, was also investigated over the voltage range of 85% to 115% of nominal line voltage. (-48VDC +/- 15%) .

The frequency stability performance of the **RRH 4x25-B30, FCC ID: AS5BBTRX-19**, complies with the 0.05 ppm performance criteria as stated in the 731 form and it meets the requirements of 47 CFR Part 27.54. The summary of the results are below followed by the data.

17.3. Results

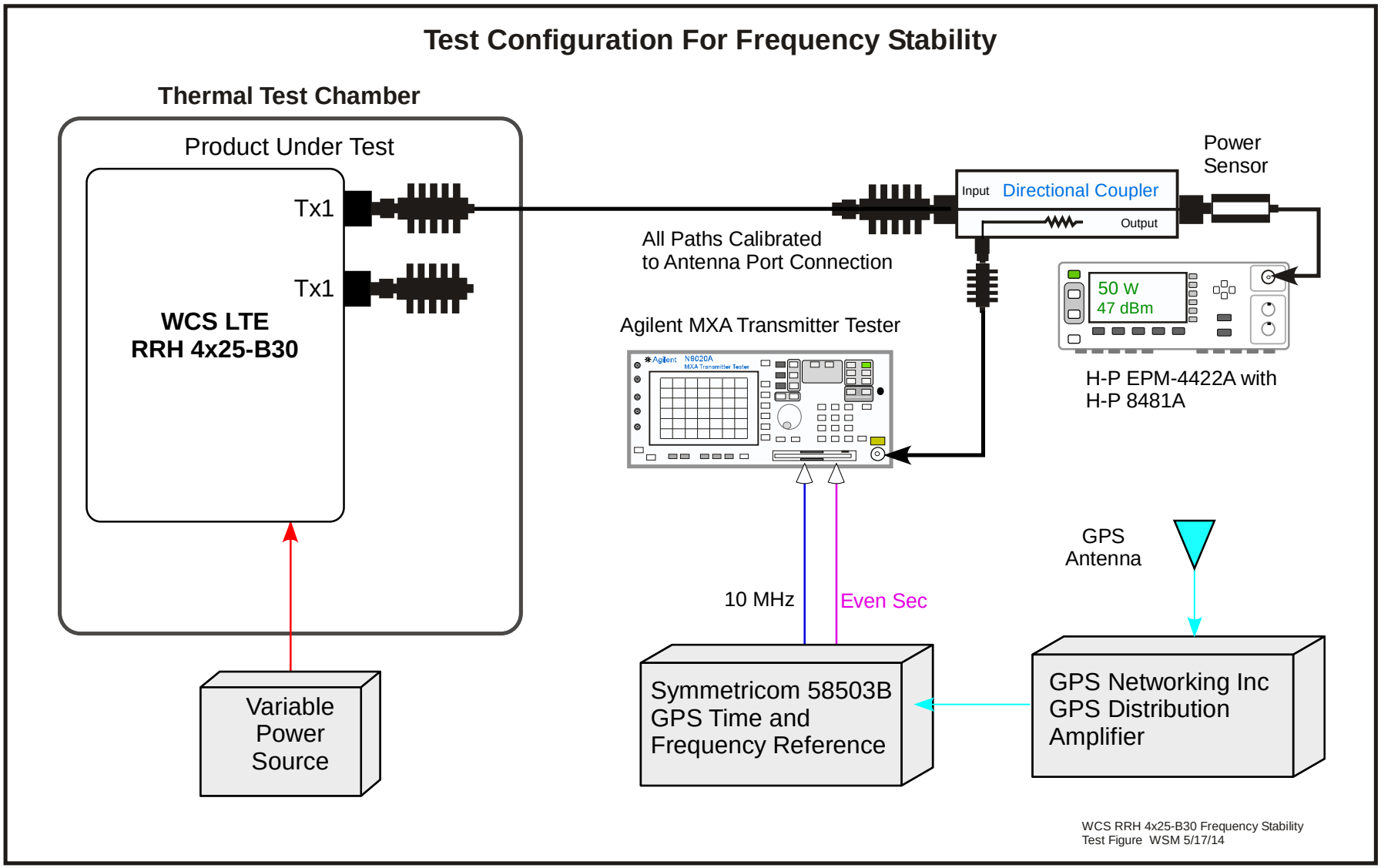
The test data documented that the maximum frequency deviation of the **RRH 4x25-B30** 2355.0 MHz transmit carrier, when measured over voltage and temperature, was +0.00217 ppm (5.113 Hz). The specification for conformance with the 731 form is +/- 0.05 ppm (+/- 117.75 Hz). The product conforms to Part 27.54 requirements.

Frequency Stability performance was verified by measuring Frequency Tolerance at EAC using an MXA Signal Analyzer. Frequency Tolerance is a measurement of the difference between the actual transmit frequency and the assigned frequency (2355.0 MHz).

17.4. Test Equipment

Manufacturer	Model Number	Serial Number	Instrument Type	Calibration Due Date
Agilent	MXA N9020A	MY52091771	MXA Signal Analyzer	07/01/14
Hewlett Packard	EPM-4422A	GB37480779	Power Meter	05/25/14
Hewlett Packard	8481A	3318A7816	Power Sensor	09/10/14
Fluke	Fluke 45	6609008	Dual Display Bench Multi-meter	01/08/15
Thurlby Thandar Instruments	QPX1200L	331936	Power supply	N/A
Heraeus	HC7120	522/780893	Thermal Chamber	05/12/15

Figure 17A


Test Configuration For Frequency Stability
Thermal Test Chamber
Product Under Test
Tx1
Tx1
WCS LTE
RRH 4x25-B30
Power
Sensor
Input
Directional Coupler
Output
All Paths Calibrated
to Antenna Port Connection
50 W
47 dBm
H-P EPM-4422A with
H-P 8481A
Agilent MXA Transmitter Tester
GPS
Antenna
10 MHz
Even Sec
Variable
Power
Source
Symmetricom 58503B
GPS Time and
Frequency Reference
GPS Networking Inc
GPS Distribution
Amplifier
WCS RRH 4x25-B30 Frequency Stability
Test Figure WSM 5/17/14

17.5. Frequency Stability Test Data

17.5.1. Temperature Variation

The following order was used for the performance of the Frequency Stability tests.

(a) Set the power supply to nominal Voltage. (b) Record the frequency at ~25°C. (c) Raise EUT operating temperature to 50°C. (d)Record the frequency difference. (e) Repeat step (d) at each 10°C step down to -30°C. Result will be 10 readings and take temperature readings to establish thermal stability at each point.

Baseline Measurement at +25°C

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-4.284
0.5	-4.133
1.0	-3.993
1.5	-4.682
2.0	-3.9357
2.5	-3.8639
3.0	-4.1719
FCC SPECIFICATION	±2355.0 MHz (±0.05ppm) ±0.05ppm = ±117.75Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +50°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-3.8489
0.5	-4.196
1.0	-4.3592
1.5	-4.494
2.0	-3.973
2.5	-4.2385
3.0	-3.8561
FCC SPECIFICATION	±2355.0 MHz (±0.05ppm) ±0.05ppm = ±117.75Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +40°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-4.2395
0.5	-3.932
1.0	-3.8610
1.5	-4.084
2.0	-4.610
2.5	-4.683
3.0	-3.799
FCC SPECIFICATION	±2355.0 MHz (±0.05ppm) ±0.05ppm = ±117.75Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +30°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-3.9564
0.5	-4.2831
1.0	-3.9805
1.5	-3.7685
2.0	-4.1726
2.5	-4.3682
3.0	-4.378
FCC SPECIFICATION	±2355.0 MHz (±0.05ppm) ±0.05ppm = ±117.75Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +20°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-4.5144
0.5	-3.798
1.0	-4.477
1.5	-3.924
2.0	-4.2922
2.5	-4.784
3.0	-4.1732
FCC SPECIFICATION	±2355.0 MHz (±0.05ppm) ±0.05ppm = ±117.75Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +10°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-4.241
0.5	-3.8262
1.0	-4.1517
1.5	-4.429
2.0	-3.9571
2.5	3.8020
3.0	-4.376
FCC SPECIFICATION	±2355.0 MHz (±0.05ppm) ±0.05ppm = ±117.75Hz
FCC RESULT	PASS

Transmit Frequency Deviation at 0°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-3.9936
0.5	-4.443
1.0	-4.284
1.5	-3.801
2.0	-4.014
2.5	-3.8979
3.0	-4.0777
FCC SPECIFICATION	±2355.0 MHz (±0.05ppm) ±0.05ppm = ±117.75Hz
FCC RESULT	PASS

Transmit Frequency Deviation at -10°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-4.2798
0.5	-3.9234
1.0	-4.777
1.5	-4.242
2.0	-3.885
2.5	-4.203
3.0	-3.8731
FCC SPECIFICATION	±2355.0 MHz (±0.05ppm) ±0.05ppm = ±117.75Hz
FCC RESULT	PASS

Transmit Frequency Deviation at -20°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-4.723
0.5	-3.926
1.0	3.8676
1.5	-4.6043
2.0	-3.8399
2.5	-4.042
3.0	-3.963
FCC SPECIFICATION	±2355.0 MHz (±0.05ppm) ±0.05ppm = ±117.75Hz
FCC RESULT	PASS

Transmit Frequency Deviation at -30°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-4.836
0.5	-3.991
1.0	-4.554
1.5	-4.342
2.0	-4.726
2.5	-5.113
3.0	-4.634
FCC SPECIFICATION	±2355.0 MHz (±0.05ppm) ±0.05ppm = ±117.75Hz
FCC RESULT	PASS

17.5.2. Supply Voltage Variation Data Temperature Variation

Upon return to +25°C.
At ambient, vary voltage to +15% and -15% of nominal and record frequency difference. Result will be 12 readings for each voltage (nominal, +103%, +106%, +109%, +112%, +115%, nominal, 97%, 94%, 91%, 88% and 85% of line voltage).

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-4.435
0.5	-3.848
1.0	-3.921
1.5	-4.497
2.0	-4.827
2.5	-3.713
3.0	-3.995
FCC SPECIFICATION	±2355.0 MHz (±0.05ppm) ±0.05ppm = ±117.75Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 103% of Nominal Voltage, -49.44VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-4.379
0.5	-3.687
1.0	-4.418
1.5	-3.749
2.0	-4.100
2.5	-3.873
3.0	-4.675
FCC SPECIFICATION	±2355.0 MHz (±0.05ppm) ±0.05ppm = ±117.75Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 106% of Nominal Voltage, -50.88VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-4.254
0.5	-3.309
1.0	-4.640
1.5	-4.373
2.0	-3.735
2.5	-3.534
3.0	-3.889
FCC SPECIFICATION	±2355.0 MHz (±0.05ppm) ±0.05ppm = ±117.75Hz
FCC RESULT	PASS

Supply Voltage Variation Data *continued*

Transmit Frequency Deviation at +25°C at 109% of Nominal Voltage, -52.32VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	4.347
0.5	-4.931
1.0	-3.779
1.5	-3.762
2.0	-4.505
2.5	-3.512
3.0	-4.607
FCC SPECIFICATION	±2355.0 MHz (±0.05ppm) ±0.05ppm = ±117.75Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 112% of Nominal Voltage, -53.76VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-4.431
0.5	-3.776
1.0	-4.424
1.5	-4.209
2.0	-4.966
2.5	-3.617
3.0	-3.944
FCC SPECIFICATION	±2355.0 MHz (±0.05ppm) ±0.05ppm = ±117.75Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 115% of Nominal Voltage, -55.20VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-4.140
0.5	-4.296
1.0	-4.218
1.5	-3.882
2.0	-4.554
2.5	-4.271
3.0	-4.859
FCC SPECIFICATION	±2355.0 MHz (±0.05ppm) ±0.05ppm = ±117.75Hz
FCC RESULT	PASS

Supply Voltage Variation Data *continued*

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48.0VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-4.980
0.5	-4.432
1.0	-3.706
1.5	-4.318
2.0	-4.466
2.5	-3.620
3.0	-3.896
FCC SPECIFICATION	±2355.0 MHz (±0.05ppm) ±0.05ppm = ±117.75Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 97% of Nominal Voltage, -46.56VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-4.214
0.5	-4.476
1.0	-3.855
1.5	-4.134
2.0	-4.320
2.5	-4.709
3.0	-3.771
FCC SPECIFICATION	±2355.0 MHz (±0.05ppm) ±0.05ppm = ±117.75Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 94% of Nominal Voltage, -45.12VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-3.736
0.5	-4.192
1.0	-4.141
1.5	-4.291
2.0	-3.874
2.5	-4.833
3.0	-4.551
FCC SPECIFICATION	±2355.0 MHz (±0.05ppm) ±0.05ppm = ±117.75Hz
FCC RESULT	PASS

Supply Voltage Variation Data *continued*

Transmit Frequency Deviation at +25°C at 91% of Nominal Voltage, -43.68VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-3.940
0.5	-4.194
1.0	-4.411
1.5	-4.916
2.0	-3.864
2.5	-3.928
3.0	-4.263
FCC SPECIFICATION	±2355.0 MHz (±0.05ppm) ±0.05ppm = ±117.75Hz
FCC RESULT	PASS

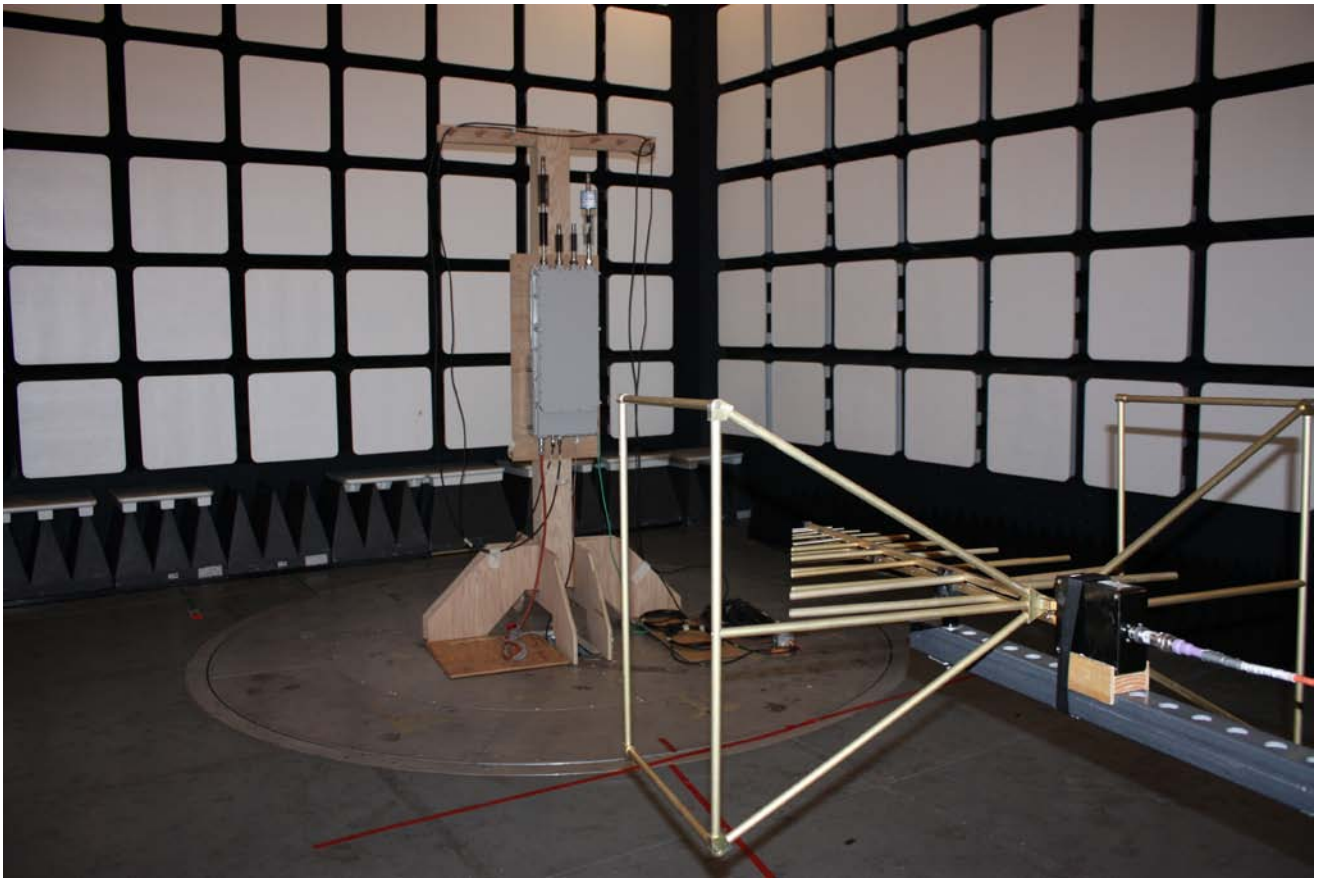
Transmit Frequency Deviation at +25°C at 88% of Nominal Voltage, -42.24VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-3.878
0.5	-4.433
1.0	-4.391
1.5	-4.583
2.0	-3.912
2.5	-4.376
3.0	-4.251
FCC SPECIFICATION	±2355.0 MHz (±0.05ppm) ±0.05ppm = ±117.75Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 85% of Nominal Voltage, -40.80VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-4.277
0.5	-4.848
1.0	-4.521
1.5	-4.372
2.0	-4.403
2.5	-3.738
3.0	-3.947
FCC SPECIFICATION	±2355.0 MHz (±0.05ppm) ±0.05ppm = ±117.75Hz
FCC RESULT	PASS

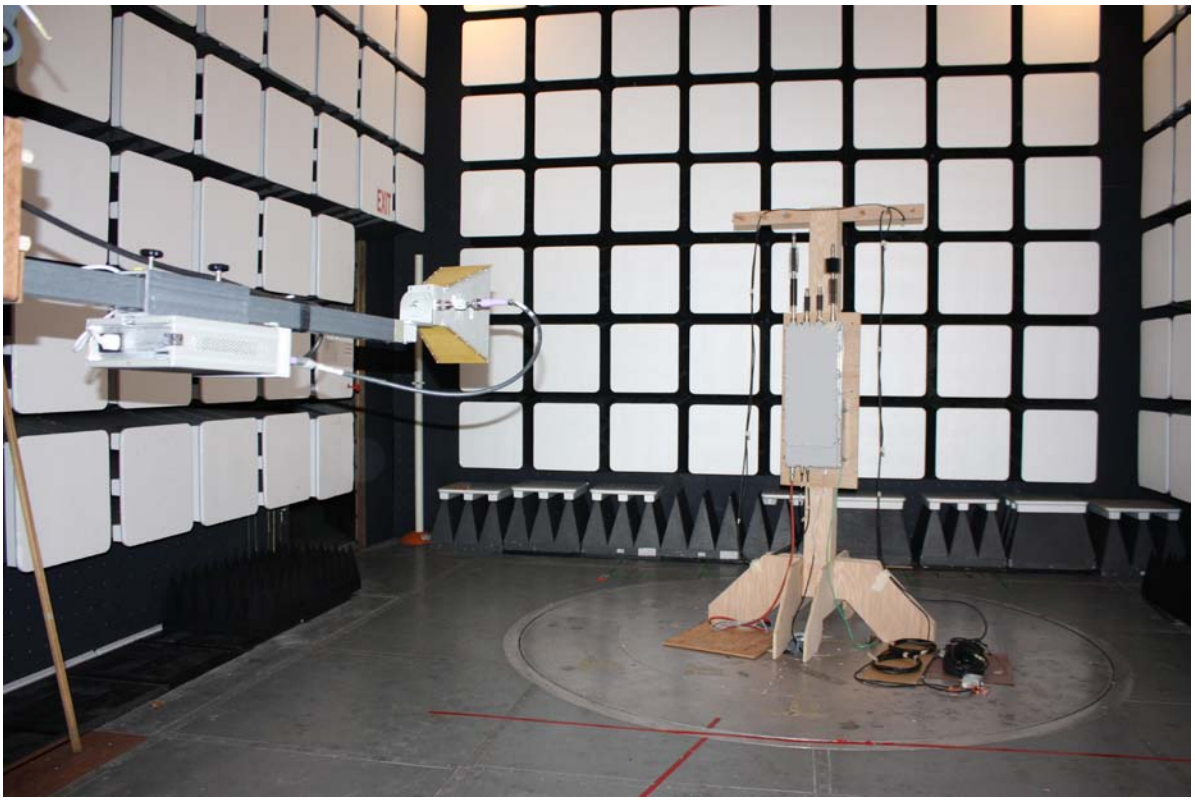
18. Exhibit 18 Photographs of the Test Setups

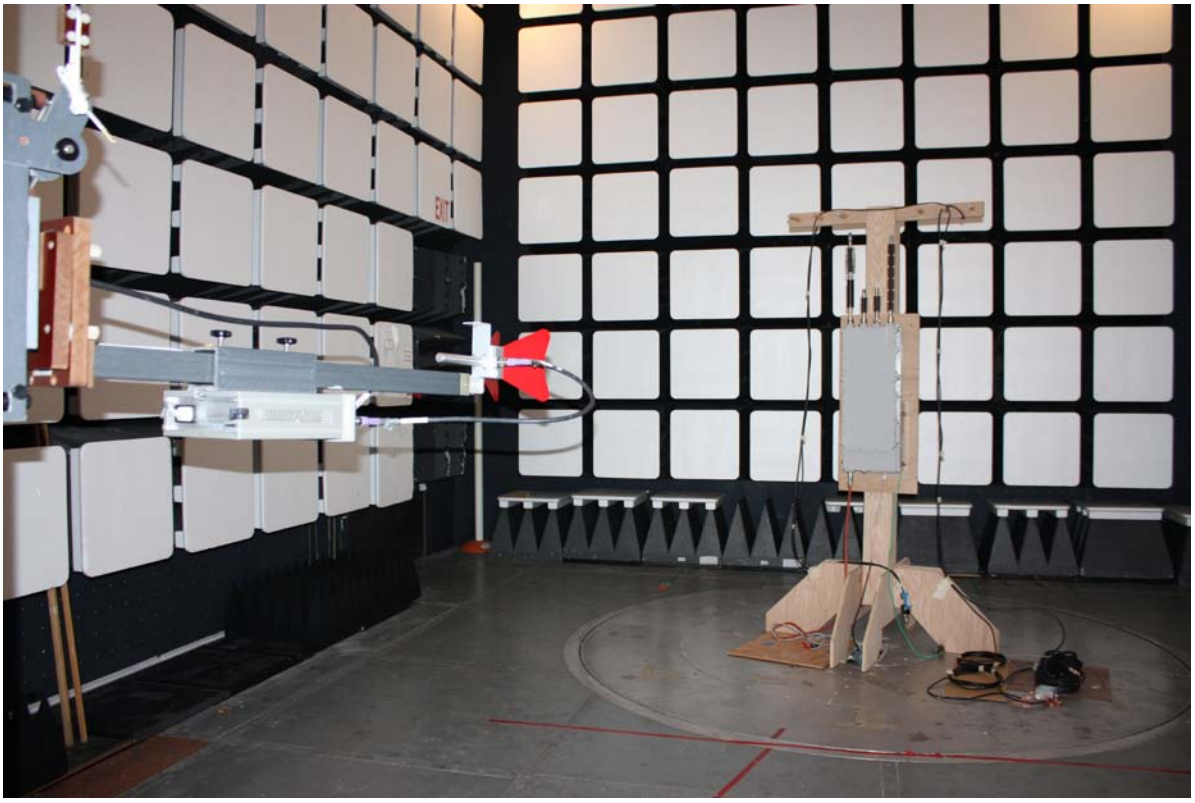
The following photographs document the test setups.

Radiated Emissions Test Photograph RRH-4x25-B 30 MHz – 1 GHz

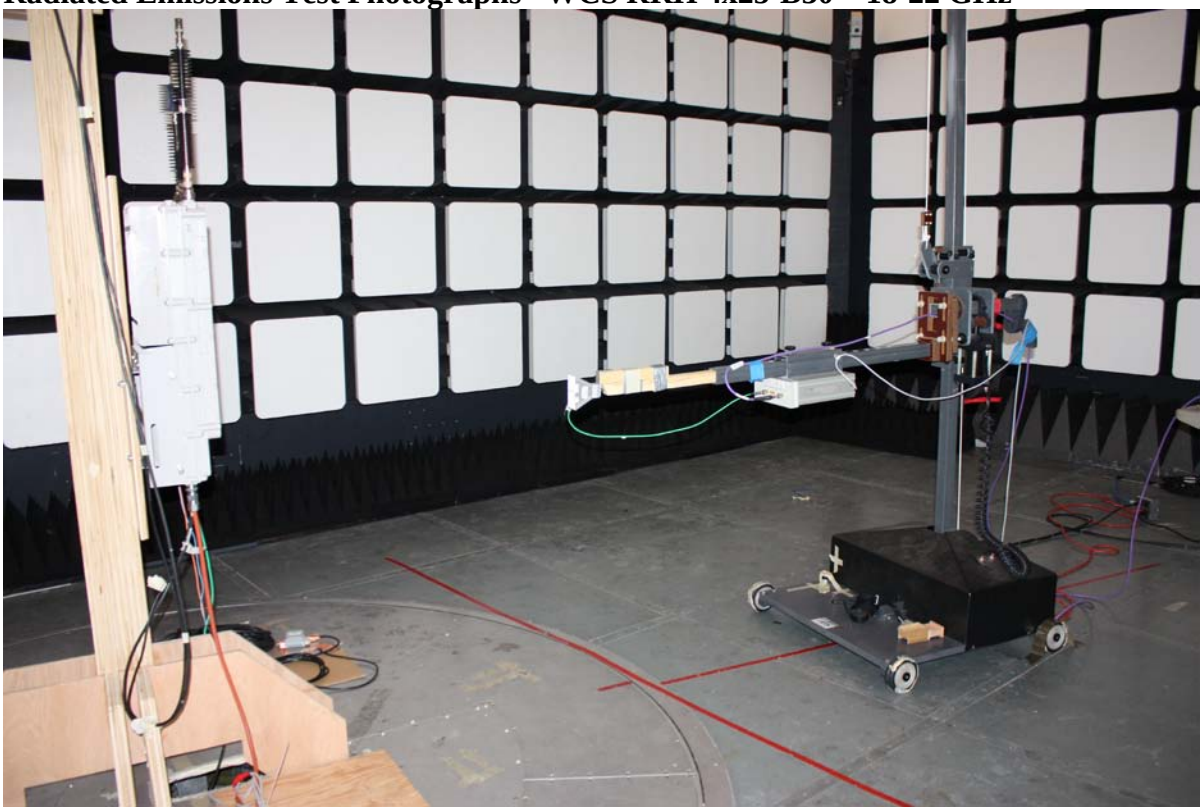


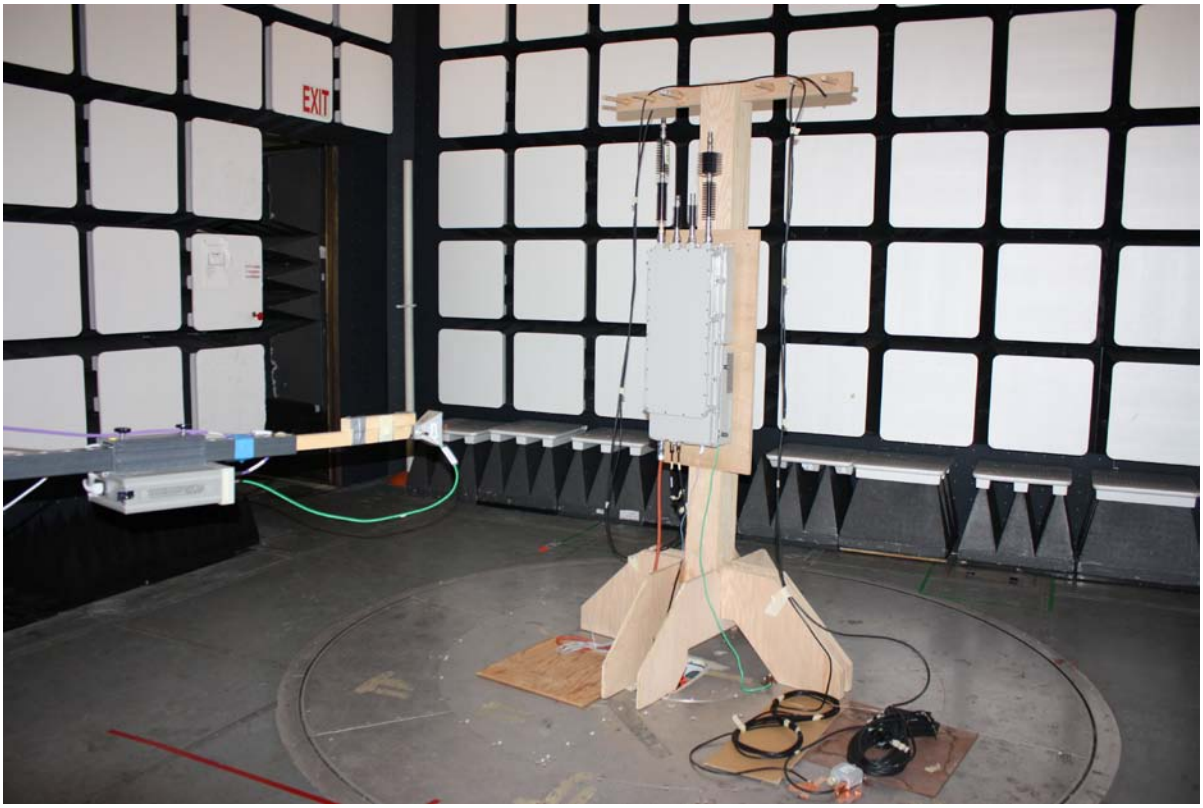
Radiated Emissions Test Photographs 1-18 GHz



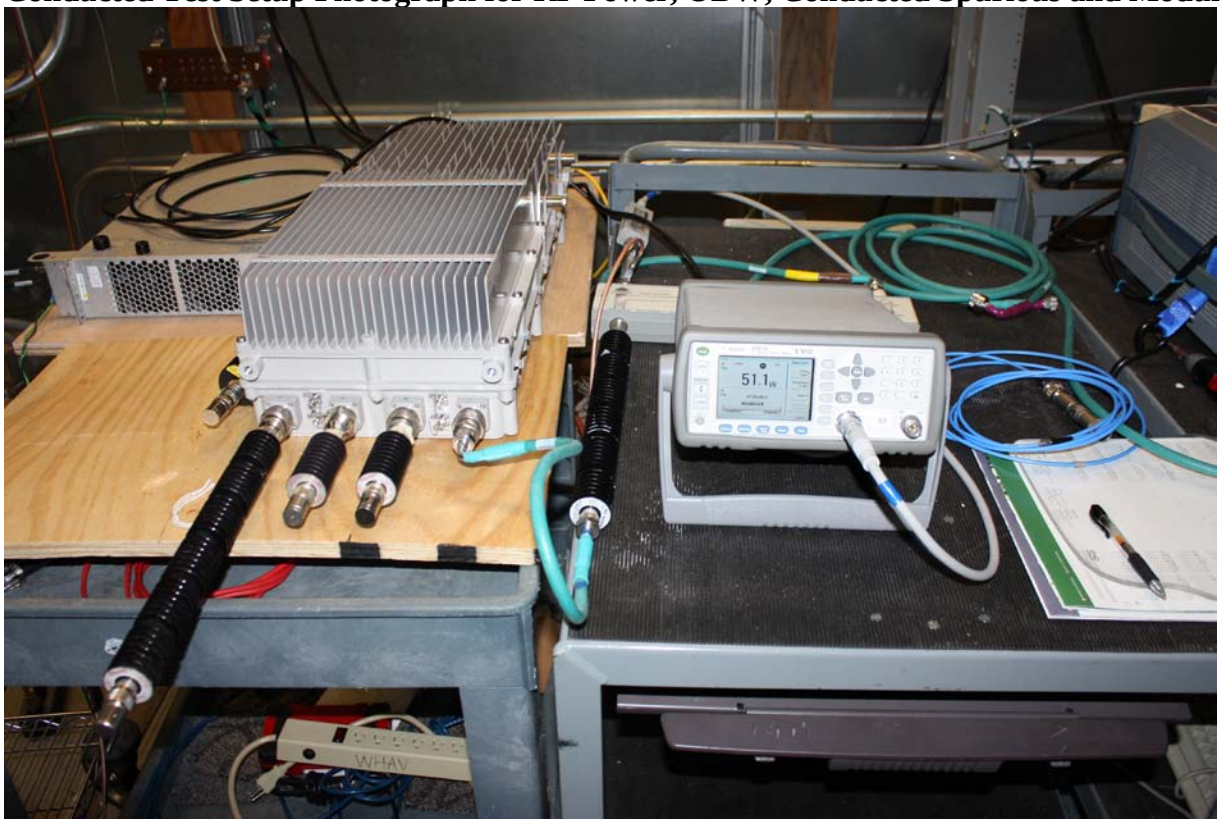


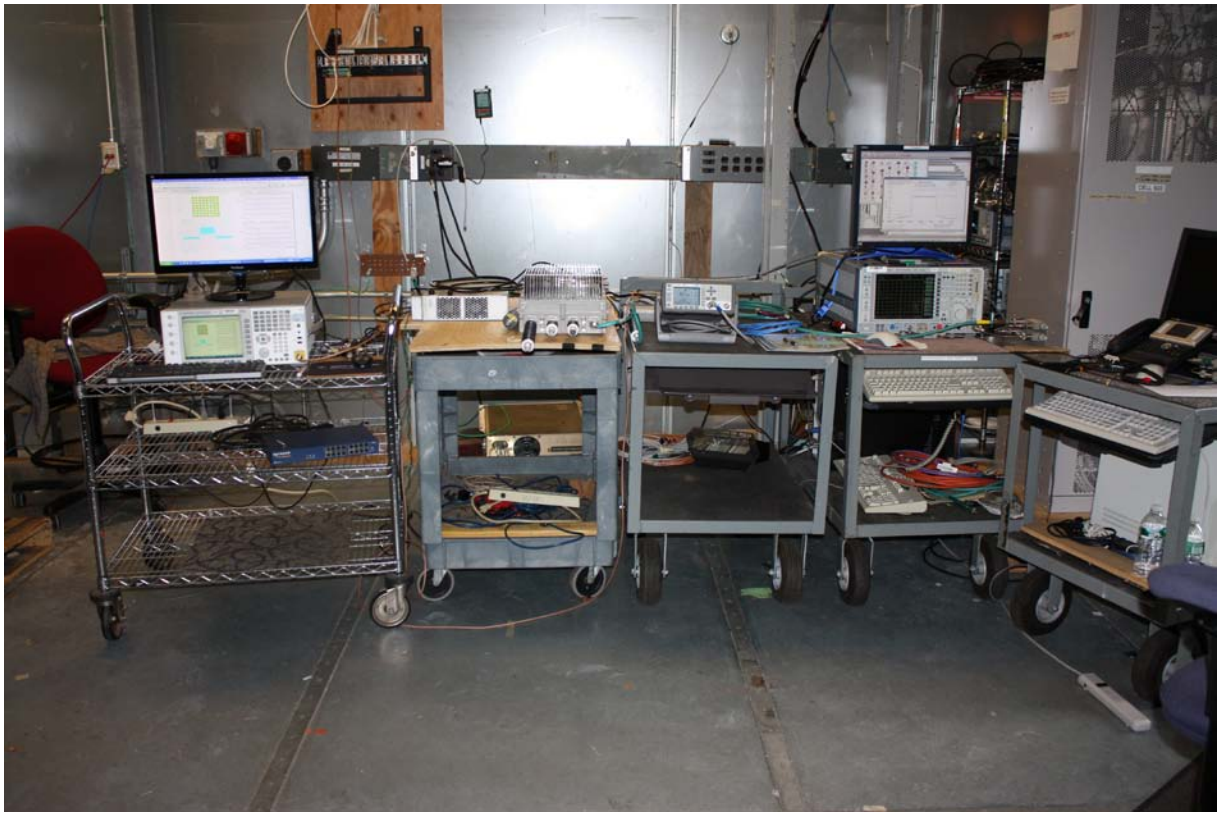
Radiated Emissions Test Photographs WCS RRH 4x25-B30 18-22 GHz





Conducted Test Setup Photograph for RF Power, OBW, Conducted Spurious and Modulation





19. Exhibit 19 RF Exposure Evaluation

The Alcatel-Lucent WCS LTE **Remote Radio Head 4x25-B30 Transceiver System / FCC ID: AS5BBTRX-19** may be sited with a variety of different antenna and installation configurations. In each case the licensed service provider is required to perform the RF exposure evaluation based upon the specifics of the particular site.

19.1. Exhibit 19 RF Exposure

Antenna installations for this equipment shall be performed in accordance with all applicable manufacturer's recommendations, and national laws and regulations. To ensure correct antenna installation, the antenna installer shall perform all necessary calculations and/or field measurements to evaluate compliance with applicable national laws or regulations regarding exposure to electromagnetic fields. The supplier of radio equipment, the supplier of antenna equipment and the integrator and builder of the site must provide sufficient information so that the limits of the exclusion zones can be determined. Any changes to the antenna or other equipment in the transmit path may require re-evaluation of the exposures to electromagnetic fields.
Pursuant to 47 CFR Part 1, Subpart I, subject to the provisions of section 1.1307, all installations must be evaluated for requirements contained in Table 1, "Limits for maximum permissible exposure," in section 1.1310.

19.1.1. RF Exposure Guidelines for antenna placement

1. Antennas should be placed sufficiently away from possible human RF exposure in order to meet FCC Guidelines.
2. When placing the antennas, please be aware of FCC 47 CFR 1.1307 - 1.1310 and FCC guidelines for public safety, for example, OET Bulletin No. 56, "Questions and Answers About the Biological Effects and Potential Hazards of Radio frequency Electromagnetic Fields" and OET Bulletin 65, "Evaluating Compliance With FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields". FCC requirements mandate maximum power density at location of possible exposure to be below 1 mW/cm^2 (10 W/m^2) at WCS frequencies (2.35GHz) for general population/uncontrolled exposure and 5 mW/cm^2 (50 W/m^2) at WCS frequencies for occupational/controlled exposure. Exposure is averaged over a 30 minute time period for general population and over a 6 minute time period for occupational/controlled exposure.

19.2. Exhibit 19 RF Exposure Calculations

The appropriate EIRP (equivalent or effective isotropic radiated power) limits can be calculated based on the relationship between power density and EIRP, i.e.,

$$S = EIRP/(4\pi R^2)$$

Where,

S is the power density in mW/cm^2,
R is the distance to the center of radiation of the antenna in cm and EIRP is in mW
EIRP in mW = (Power input to the Antenna in mW) x (Numerical Gain of the antenna)
Given the WCS LTE RRH4x25-B30 frequency of operation is 2350 to 2360 MHz; then from Table 1 in Section 1.1310 the Power density limit for General Population / Uncontrolled Exposure is 1 mW/cm^2 and The FCC Power density limit for Occupational/Controlled Exposure is 5 mW/cm^2

Therefore for the range of possible antenna and general population operating parameters:
RF Safe distance for 100W total MIMO power with 15dBi antenna and no cable loss = 5.0m
RF Safe distance for 100W total MIMO power with 6 dBi antenna and no cable loss = 1.8m

The worst case minimum safe distance for General Population / Uncontrolled Exposure is therefore 5m.

For the range of possible antenna and occupational/controlled exposure operating parameters
RF Safe distance for 100W total MIMO power with 15dBi antenna and no cable loss = 2.25m
RF Safe distance for 100W total MIMO power with 6 dBi antenna and no cable loss = 0.8m
The worst case minimum safe distance to the antenna for occupational/controlled exposure is therefore 2.25m.

Note: Losses of all components between the antenna transmit port and the antenna should be included in EIRP calculations. The RF output power of the RRH4x25-B30 may have to be lowered in indoor applications based on antenna distance to human exposure and total EIRP. Final calculations should be performed by the installing activity for the specific antenna used.