FCC Test Report

Alcatel-Lucent
PCS LTE RRH 4x30 Band 25
Outdoor Transceiver System

FCC ID: AS5BBTRX-22

11. Exhibit 11 FCC Filing Test Report

11.1 *Listing of Required Measurements*

SECTION 2.1033(c)(14)
The data required by Section 2.1046 through 2.1057, inclusive, measured in accordance with the procedures set out in Section 2.1041.

Response: **PCS LTE RRH 4x30 Band 25 Outdoor Transceiver System FCC ID: AS5BBTRX-22**
The lowest clock frequency in the **Alcatel-Lucent's PCS LTE RRH 4x30 Band 25 Outdoor Transceiver System / FCC ID: AS5BBTRX-22** is the 10 MHz reference oscillator. Conducted spurious measurements were performed over the range of 10 MHz to 20 GHz which is above the tenth harmonic of the transmit frequency range.

The following pages include the data required for the Product Certification authorization of the **PCS LTE RRH 4x30 Band 25 Outdoor Transceiver System / FCC ID: AS5BBTRX-22**, 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 **LBALLU-YD1436000LU.**

Each required measurement and its corresponding exhibit number are:

FCC Filing Exhibit	FCC Regulation	Description
Exhibit 11.1	Section 2.1033(c)(14)	Listing of Required Measurements , Test Equipment
Exhibit 11.2	Section 2.1046	Measurement of Radio Frequency Power Output
Exhibit 11.3	Section 2.1047	Measurement of Modulation Characteristics
Exhibit 11.4	Section 2.1049	Measurement of Occupied Bandwidth
Exhibit 11.5	Section 2.1051	Measurement of Spurious Emissions at Antenna
Exhibit 11.6	Section 2.1053	Field Strength of Spurious Radiation
Exhibit 11.7	Section 2.1055	Measurement of Frequency Stability

11.1.1 Test Equipment

11.1.2 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

11.1.3 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

11.1.4 Radiated Spurious Emissions Equipment

Manufacturer	Model	Serial Number	Type	Description	GPCL ID	Last Cal	Interval	Status
Hewlett Packard	8593E	3926A 04192	Spectrum Analyzer	9kHz-22GHz	E454	4/17/14	24	Active
Sonoma Instrument Co.	310N	185785	Amplifier	9kHz-1GHz	E494	11/26/13	24	Active
Weinschel	2-6	BX3433	Attenuator	6dB 5 Watt DC-18GHz	E888	3/5/14	24	Active
A.H. Systems Inc.	SAS-521-2	410	Bilogical Antenna	25-2000MHz	E602	10/22/14	24	Active
Rohde & Schwarz	ESIB40	100044	Test Receiver	EMI (20Hz-40GHz)	E567	2/7/14	24	Active
Hewlett Packard	8449B	3008A 00426	Pre-Amplifier	Preamplifier 1- 26.5GHz	E123	8/19/15	24	Active
Trilithic	5HC2850/ 18050-1.8-KK	200113078	High Pass Filter	PCS 2.85-18 GHz	E1116	N/A	0	Active
EMCO	3115	9006-3460	Horn Antenna	Double Ridged Horn 1-18GHz	E057	2/10/15	24	Active
EMC Test Systems	3116	2539	Horn Antenna	Double Ridged Horn 18-40GHz	E513	3/19/15	24	Active

11.2 Measurements of Radio Frequency Power Output

11.2.1 Section 2.1046 -Measurement Required RF Power Output

For 20 MHz LTE transmit carrier operation, the **PCS LTE RRH 4x30 Band 25 Outdoor Transceiver System** is specified to provide a continuous maximum power output of 120 Watts as the sum total of RF output power of its Transmit antenna terminals. It does this by either providing 60W (47.78 dBm +2/-4 dB) for all of the carriers at either its Tx1 / Tx2 transmit antenna terminals or by providing 30W (44.77 dBm +2/-4 dB) for all of the carriers at the Tx1, Tx2, Tx3 & Tx4 transmit antenna terminals.

It has a 30 dB attenuation range thereby the minimum power output at the antenna terminals is 0.03 Watts (14.77 dBm +2 / -4 dB). This power capability was demonstrated across the PCS downlink Band of 1930 MHz to 1995 MHz.

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 **PCS LTE RRH 4x30 Band 25 Outdoor Transceiver System / AS5BBTRX-22**, 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).

11.2.1 RF Power Output Measurement

The power was set to the specified maximum at each measurement frequency to verify the spectral performance at that power level at each specific frequency of interest. Power was also verified for the QPSK and 64QAM modulation configurations. Results are documented on each Occupied Bandwidth Data Sheet.

The 99%/-26dB signal bandwidth was measured using the setup of Figure 14A for the left most and rightmost channels in the PCS Band. 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.

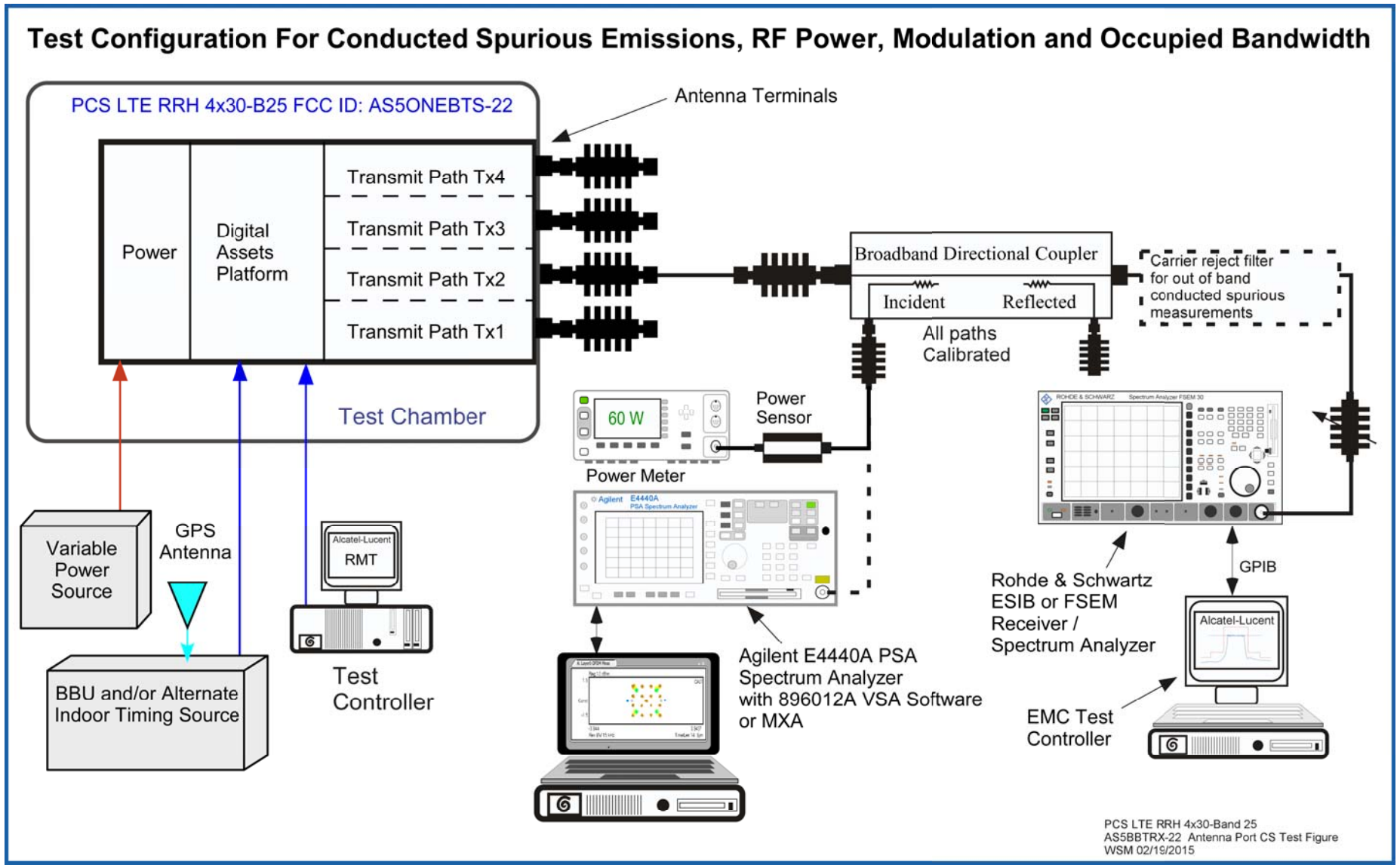
The test arrangements used to measure the radio frequency power output of the **Alcatel-Lucent's PCS LTE RRH 4x30 Band 25 Outdoor Transceiver System / AS5BBTRX-22** is on the following page. Measurements were made respectively at each frequency where Occupied Bandwidth measurements were performed and compliance was documented.

11.2.1 Results RF power output

The **PCS LTE RRH 4x30 Band 25 Outdoor Transceiver System / AS5BBTRX-22**was configured in the test setup shown in Figure 12A. For antenna ports tested the **LTE RRH 4x30 Band 25** delivered a summed total of 120 Watts 50.79 dBm +2/-0 dB when measured at the antenna output connections.
This was the result of two terminals providing 60Watts each or four terminals providing 30W each.

This data is tabulated above and was recorded on the Occupied Bandwidth Data Sheets for "Left edge" and "Right Edge" of each frequency Block.

Exhibit 11.2 RF Power Test Configuration



11.3 Exhibit 11.3 Measurements of Modulation Requirements

11.3.1 Section 2.1047 Measurements of Modulation Characteristics

The modulation characteristics and accuracy of the output signal of the **PCS LTE RRH 4x30 Band 25 Outdoor Transceiver System / FCC ID: AS5BBTRX-22** is a function its **Digital Analog and Power Amplifier** assembly.

11.3.2 Modulation Description

The LTE spectrum while appearing similar to CDMA differs greatly in complexity . The modulation used in evaluating the **PCS LTE RRH 4x30 Band 25 / AS5BBTRX-22** 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 with either QPSK, 16QAM or 64QAM coding. 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.

11.3.3 Results

The **PCS LTE RRH 4x30 Band 25 Outdoor 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 PCS Channels shown in the table below.
The 99%/-26 dB Occupied Signal Bandwidth was measured at 100 kHz, 300 kHz and 510 kHz and is documented below.

11.3.4 Results Summary

For each of the PCS channels tested, the **PCS LTE RRH 4x30 Band 25 Outdoor 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 and 11 dB which is compliant with the CFR which specifies that the PAR be less than 13 dB. The **PCS LTE RRH 4x30 Band 25 Outdoor Transceiver System** transmit signal modulation parameters and constellation for PCS is shown in Figures 11.3B, 11.3C and 11.3D below for QPSK, 16QAM and 64QAM.

Figure 11.3A

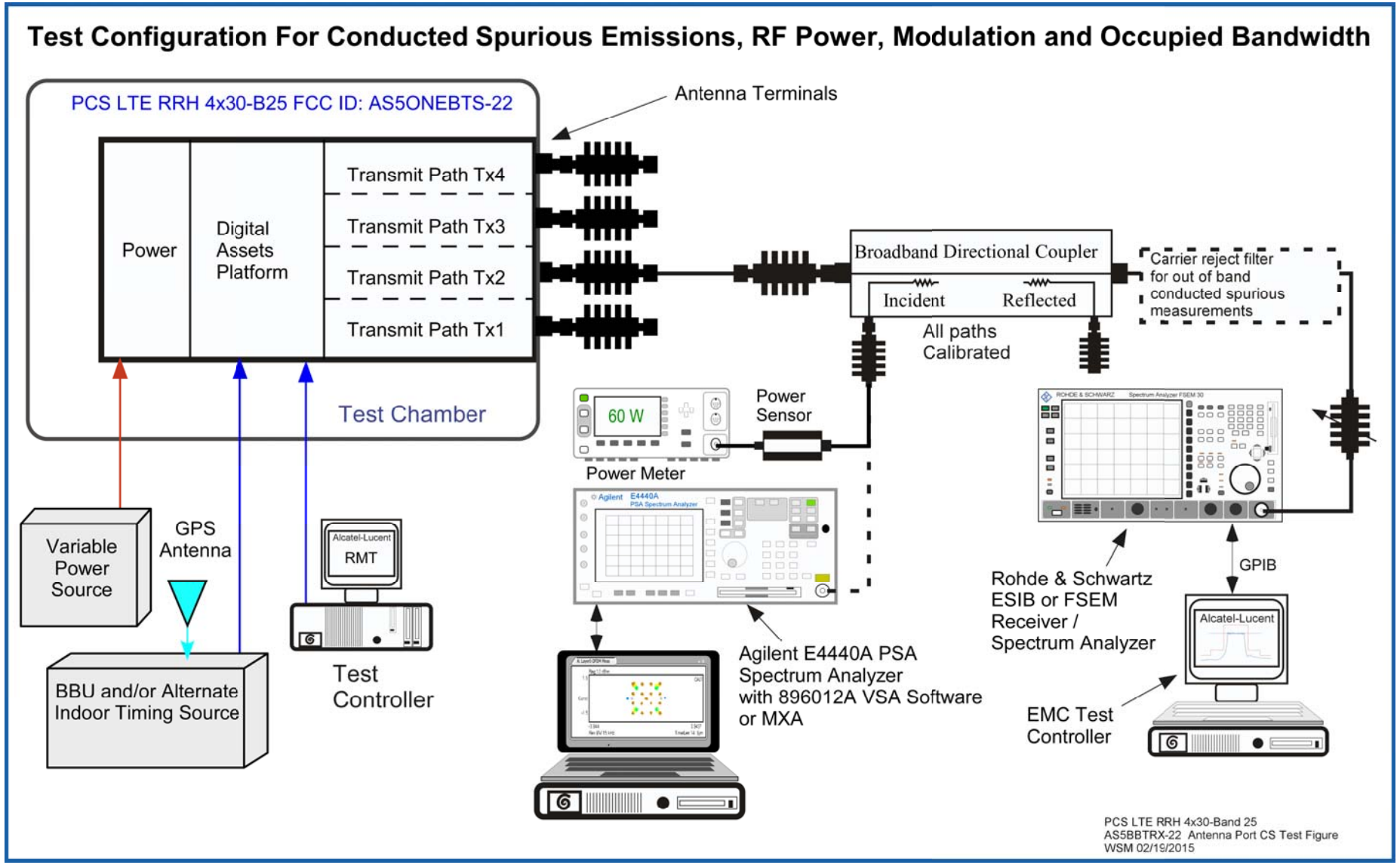

Test Configuration For Conducted Spurious Emissions, RF Power, Modulation and Occupied Bandwidth
PCS LTE RRH 4x30-B25 FCC ID: AS5ONEBTS-22
Antenna Terminals
Power
Digital Assets Platform
Transmit Path Tx4
Transmit Path Tx3
Transmit Path Tx2
Transmit Path Tx1
Test Chamber
Broadband Directional Coupler
Incident
Reflected
All paths Calibrated
Carrier reject filter for out of band conducted spurious measurements
60 W
Power Sensor
Power Meter
Agilent E4440A PSA Spectrum Analyzer
Variable Power Source
GPS Antenna
BBU and/or Alternate Indoor Timing Source
Alcatel-Lucent RMT
Test Controller
Agilent E4440A PSA Spectrum Analyzer with 896012A VSA Software or MXA
Rohde & Schwartz ESIB or FSEM Receiver / Spectrum Analyzer
GPIB
Alcatel-Lucent
EMC Test Controller
PCS LTE RRH 4x30-Band 25
AS5BBTRX-22 Antenna Port CS Test Figure
WSM 02/19/2015

Figure 11.3B Code Domain AD Block, 1940 MHz QPSK

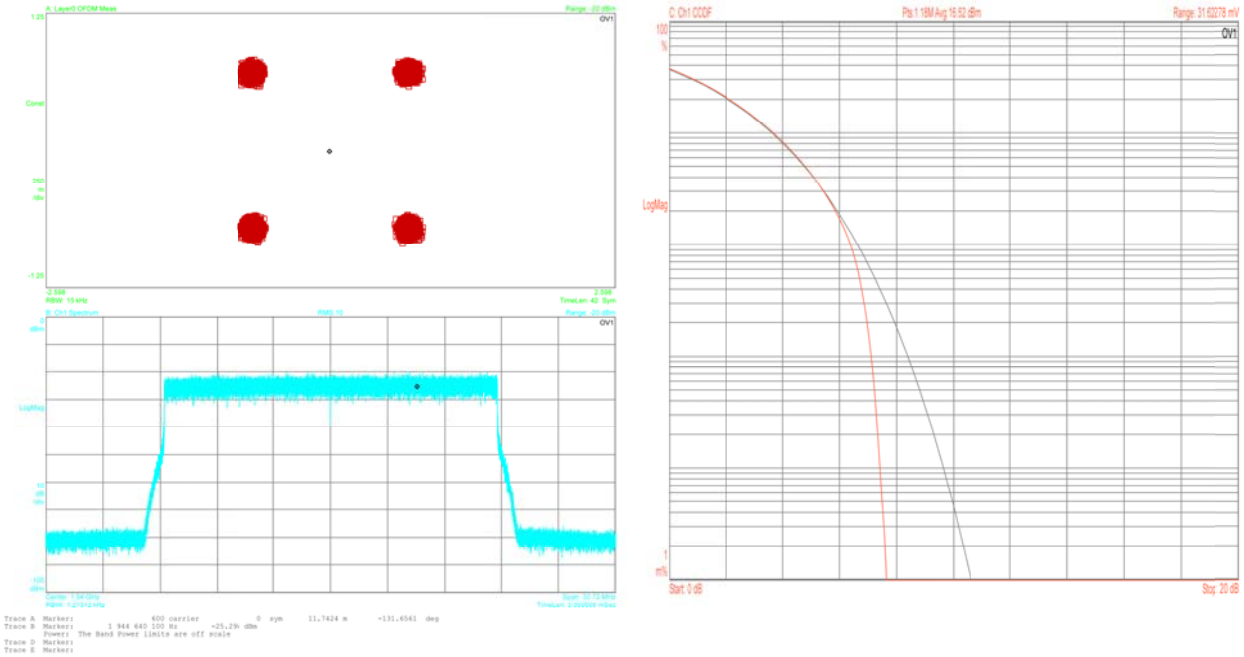


Figure 11.3C Code Domain BE Block, 1960 MHz 16QAM

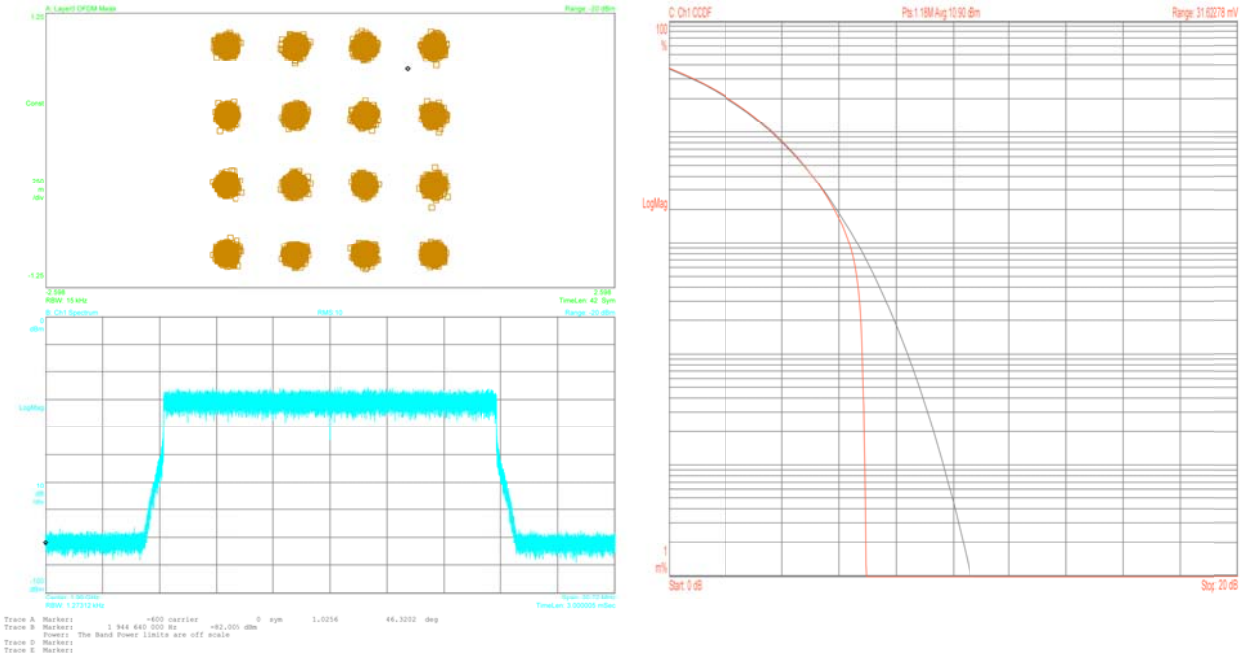
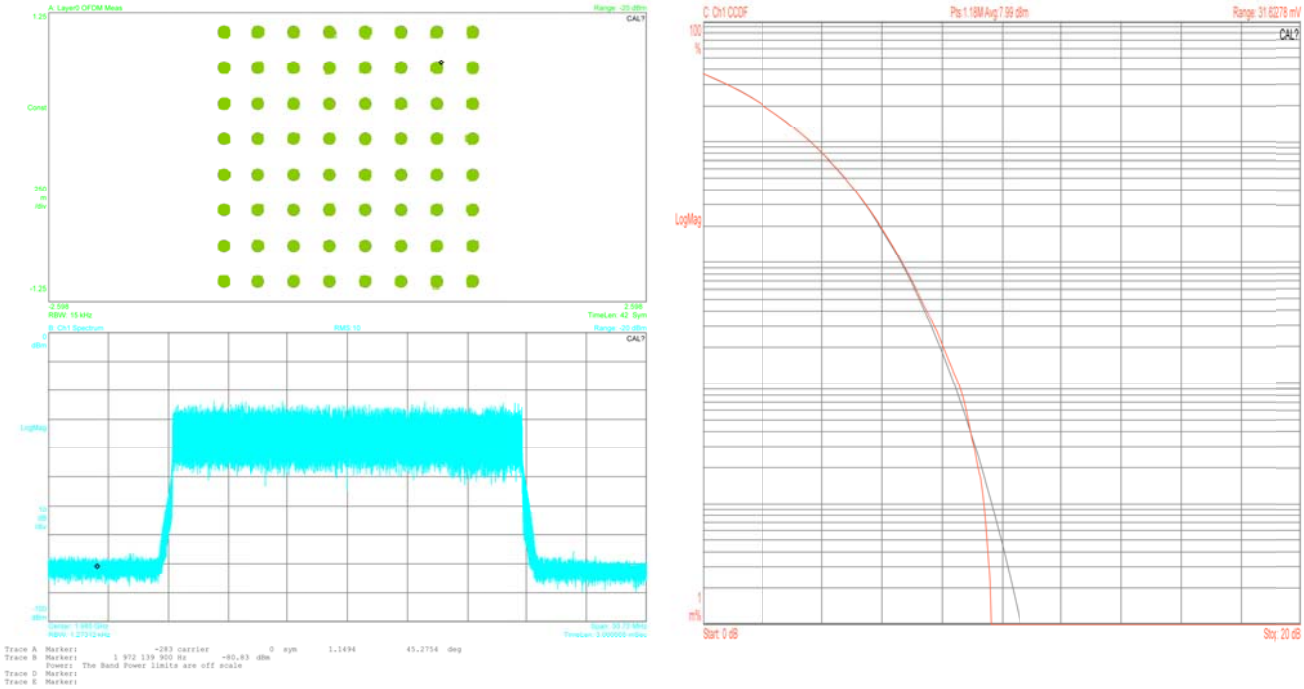
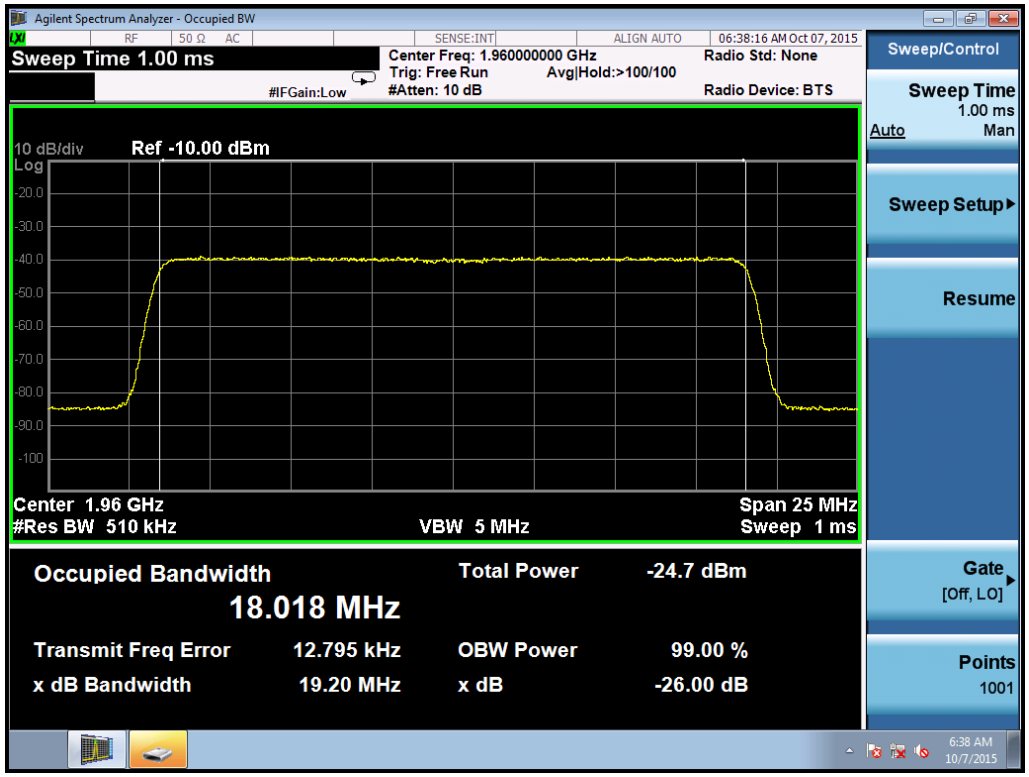


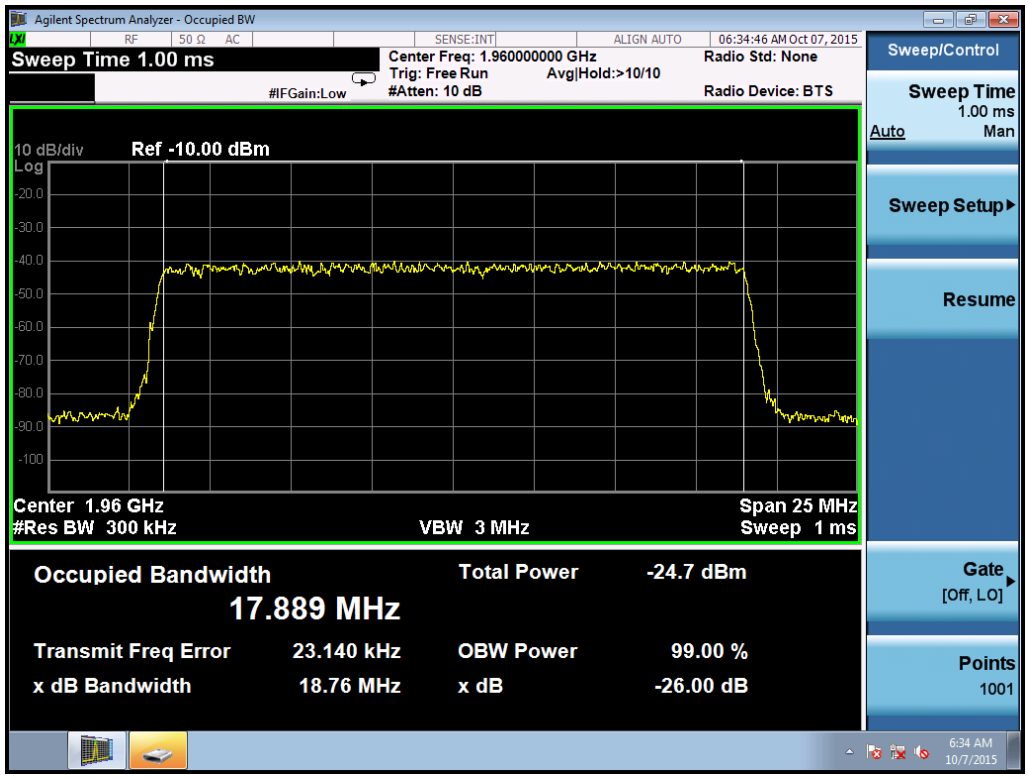
Figure 11.3D Code Domain CG Block, 1985 MHz 64QAM



The 99%/-26 dB Occupied Signal Bandwidth at 510 kHz RBW



The 99%/-26 dB Occupied Signal Bandwidth at 300 kHz RBW



11.4 Exhibit 11.4 Measurements of Occupied Bandwidth

11.4.1 Section 2.1049 Measurement Of Occupied Bandwidth

Occupied bandwidth measurements were performed for the test configurations pertinent to full bandwidth A through G Block operation of the **PCS LTE RRH 4x30 Band 25 Outdoor Transceiver System / AS5BBTRX-22**. This documents the typical performance of the **PCS LTE RRH 4x30 Band 25** while operating with a 20 MHz LTE carrier. All power adjustments were performed prior to other measurements. The measurements are described below for the 60W carrier case. The values for the 30W carrier will follow in a table.

The occupied bandwidth of the **PCS LTE RRH 4x30 Band 25 Outdoor Transceiver System / AS5BBTRX-22** 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 11.4A. The set RF output from the transmitter was reduced by calibrated broadband attenuators to amplitudes usable by the spectrum analyzer and power meter. The attenuation factors are reflected in the displayed values of the charts. The typical occupied bandwidth measurement displays the signal adjusted to the -23.01 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 11.4A. 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 –23.01 dBc line and a 3 MHz RBW measurement against the power calibration line which is -8.239 dB below the "Top of Mask" limit. The "Top of Mask" limit corresponds to a single carrier signal at the specified power level of 60W / 47.78 dBm if measured with an RBW of $\geq$20 MHz. Since the power calibration measurements was performed with a 3 MHz RBW a power calibration line equal to 10 log(3MHz/20MHz)= -8.239 dB below the top of mask at 39.54 dBm is used as the power set point.

The maximum transmitter output is a single 20 MHz 60 W/ 47.78 dBm 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. These power calibration measurements is performed along with each Occupied Bandwidth measurement. The signals measured at RBW's of 3 MHz and 100 kHz were corrected for path loss and were plotted against the mask limit. As part of the calibration between the power meter measurement and the test analyzer, software was used to place the 3 MHz RBW signal either at the "Top of Mask" for carriers $\leq$ 3MHz or at the carrier power calibration line for single or multi carriers signals $\geq$ 3MHz. The carrier as measured with 3 MHz and 100 kHz RBW were corrected with the same attenuation factors. The two measurements are co-plotted on the same graph. A typical single carrier example is shown in Figure 11.4B. There are no single blocks within the PCS band that have enough spectrum for a 20 MHz signal. Therefore all measurements were performed using adjacent Block combinations of AD, BE, FC and CG. A typical single carrier example is shown in Figure 11.4B. which depicts a single carrier inside the mask for the 20 MHz wide A+D Block.

The test procedure above, calibrates the carrier power against the Mask and accurately places the occupied bandwidth measured carrier at the -23.01dBc 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 the multi-carrier performance. This data was electronically recorded using the TILE™ software and electronically placed in the Occupied Bandwidth Data Sheets. These sheets contain data for "Left Edge of Block", and "Right Edge of Block" for each PCS frequency Block.

11.4.2 Block Organization and Tests Performed

The RRH 4x30 Band 25 product line uses a 65 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 PCS band at all individual block edges.. The testing of the product documented herein was performed with a single 65 MHz PCS band filters.

The demonstrations of compliance for the 20 MHz LTE carrier configurations were performed for operation in all PCS Blocks. The presented data for this initial product certification demonstrates the configurations compliance.

In order to adequately evaluate performance the modulation factors were used from the governing documents. Thus, the applied signal, from **PCS LTE RRH 4x30 Band 25 Outdoor Transceiver System / AS5BBTRX-22**, met the recommended characteristics

The modulation used in evaluating the **PCS LTE RRH 4x30 Band 25 Outdoor Transceiver System / AS5BBTRX-22** 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.

11.4.3 Measurement Offset

The spectrum analysis output plots shows the peak of the LTE channel signal 23.01 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 20 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 20 MHz LTE signal measured with a RBW of 100 kHz the signal offset is:

Signal Offset = 10*log (100 kHz /20 MHz) = -23.01 dB

Since the 20 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 /20 MHz) = -8.239 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)

11.4.4 Require Levels

The Limit in 47 CFR 24.238(a)(b) 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

For a 100 kHz measurement of a 20 MHz signal the adjusted value is -16.01 dBm

The Limit in 47 CFR 24.238(a) 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.

11.4.5 Adjustment for 2x and 4x MIMO

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)

The adjustment for n=4 is: 6.02 dB = 10LOG(4)

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 for a 2x MIMO

-13 dBm – 6.02 dB = -19.01 dBm for a 4x MIMO

11.4.5.1Adjusted Levels

The following levels apply when measurement of the above limits are performed with an RBW of 100 kHz. Measurement at a Resolution Bandwidth of 10 kHz is based on our experience with 47 CFR 24.238 and KDB 662911 D1.

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 -19.0 dBm when measured in a 100 kHz resolution bandwidth (Note 2 below).
   For a 60 Watts 2x MIMO output the required level is -19.02 dBm/ -66.8 dBc.

2. For any frequency > 1MHz from the edge of the Block to the 10th harmonic of the carrier the spurious shall not exceed -26.0 dBm when measured in a 100 kHz resolution bandwidth (Note 3 below)
   For a 60 Watts MIMO output the required level is -26.0 dBm / -73.78 dBc

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Note 2: The -19.0 dBm/ -66.78 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 20 MHz bandwidth signal and the 1% signal bandwidth is 200 kHz, the limit is adjusted to:

-13 + 10LOG(100kHz/200 kHz) dBm = -16.01 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 **-16.01dBm – 3.01 dB = -19.02 dBm**;
which given a 47.78 dBm carrier (60W) equals -66.8 dBc

Note 3: The -26.0 dBm / -73.78 dBc level is computed from -13 dBm measured with a 1 MHz resolution bandwidth adjusted by :

-13 + 10LOG(100kHz/1.0 MHz) dBm = -23.0 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:

3.01 dB = 10LOG(2)

The resultant limit for MIMO operation is **-23.0 dBm – 3.01 dB = -26.01 dBm** ;
which given a 47.78. dBm carrier (60W) equals -73.798 dBc

11.4.6 Trace Description and Power Calibration

Figure 11.4B shows the single 20 MHz LTE carrier at1940 MHz. The displayed signal is shown as 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.

11.4.7 Mask Description for a Single 60 W Carrier application

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

Figure 11.4B shows the 20 MHz LTE Mask limit for PCS Block AD (1930-1950) for PCS channel 200. The horizontal line from a to aa (a-aa) is the 47.78 dBm/ 0 dBc reference level. The Power Calibration reference line g-gg is below the top of mask reference line as the 3 MHz power calibration resolution bandwidth differs from the 20 MHz signal bandwidth. The g-gg line is at 47.78-8.239 = 39.54 dBm. The peak of the 3 MHz magenta power calibration trace is shown set to this value.

The top of a typical 47.78dBm single 20 MHz LTE 64QAM carrier signal viewed at a resolution bandwidth of 100 kHz is shown at the 24.77 dBm/ -23.01 dBc line t-tt. This line is based on equations 1 and 2, and the ratio of the 20 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 the combined AD 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 MIMO using the suggested value in of the rules.

Per Note 2 above, the limit for the 1st MHz outside the band with MIMO operation is **-19.0 dBm/ -66.78 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 / -73.78 level below the 47.78 dBm / 0 dBc reference per Note 3 above. The rules require a 1 MHz resolution bandwidth for measurements 1 MHz or greater outside the AWS band. Again, equation (1) and the ratio of 1 MHz to 100 kHz provides this value.

The same method as used was used in determining the other block and band edge tolerances.

11.4.8 Mask Description for a Single 30 W Carrier application

The same method as used above for 60W 2x MIMO was used in determining the other block and band edge tolerances for the 4x MIMO mask for 30W operation. Figure 11.4C shows the mask for the 4xMIMO 30W configuration. The mask values are detailed in Table 11.4A.

11.4.9 Entire Band Plots for Intermodulation

Figure 11.4D shows the performance of a BE Block 20 MHz carrier at 1960 MHz as plotted against all of the PCS blocks. Performing the OBW measurement across all of the blocks evaluates intermodulation and performance outside the block but inside the band.

11.4.10 Measurement

In order to depict the tolerance lines that are required by Sec 24.238 of the FCC Rules and **3GPP TS 36.211 V9.1.0 (2010-03**, all measurements were made with a resolution bandwidth of 100 kHz and the limits were adjusted as described above using equation (1).

The measurement was performed using a automated data collection system which eliminates variability and operator error. The test profile deliberately and consistently measures the occupied bandwidth using a resolution bandwidth of 100 kHz and a sample detector with 25X averaging. The entire 75 MHz span of measurement (65 MHz +/- 5 MHz outside the band) was broken up into 14 individual 5.36 MHz span of measurement. Each of the individual spans are less than 256 times the 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 24.238 and KDB 662911. The measurements performed also meet the criteria of ANSI C63.26.

All of the tolerance lines for the output are referenced to the top of the Occupied Bandwidth mask, which is defined as 47.78dBm/ zero dBc. For all measurements of the **PCS LTE RRH 4x30 Band 25 Outdoor Transceiver System / AS5BBTRX-22** Occupied Bandwidth, the output power was measured / adjusted individually to the 60 W level for each carrier and this is the 47.78dBm value at the 0 dBc reference line.

TABLE 11.4A Mask values for OBW and Conducted Spurious measurements at various bandwidths

Mask values for Occupied Bandwidth and Conducted Spurious measurements at various bandwidths

Carrier Power		Signal BW	Measurement RBW		Power Calibration		Signal Offset Reference level		"n" x MIMO	MIMO Factor	1st MHz limit		Beyond the 1st MHz Limit	
			OBW	RF Power	Offset	Level								
W	dBm	MHz	MHz	MHz	db or dBc	dBm	dBc	dBm	integer	dB	dBm	dBc	dBm	dBc
60	47.78	20	0.1	3	-8.24	39.54	-23.01	24.77	2	3.01	-19.02	-66.80	-26.01	-73.79
30	44.77	20	0.1	3	-8.24	36.53	-23.01	21.76	4	6.02	-22.03	-66.80	-29.02	-73.79

TABLE 11.4D PCS Occupied Bandwidth Compliance Tabulation

Combined PCS Blocks	Center Frequency MHz	Mode of Operation	Port Power, W	Results Occupied Bandwidth
AD	1940	2xMIMO	60.0	Compliant
BE	1960	2xMIMO	60.0	Compliant
FC	1980	2xMIMO	60.0	Compliant
CG	1985	2xMIMO	60.0	Compliant
AD	1940	4xMIMO	30.0	Compliant
BE	1960	4xMIMO	30.0	Compliant
FC	1980	4xMIMO	30.0	Compliant
CG	1985	4xMIMO	30.0	Compliant

11.4.11 Results

Identical Occupied Bandwidth measurements were performed for 2x60W and 4x30W configurations on Primary and Diversity Transmit ports. In each case the transmitter output Occupied Bandwidth measurement was performed for the combined AD, BE, FC and CG PCS Blocks. Occupied Bandwidth measurements were performed for QPSK, 16QAM and 64QAM operation. The Modulation parameters were measured and recorded prior to each Occupied Bandwidth measurement. A minimum margin of 6 dB was documented on each plot. The Block designation, PCS channels, frequencies and Measured RF Power were also tabulated on each Occupied Bandwidth plot. The signals are plotted for each 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 24.229 and 24.238 (c) of the Commission code. The signal used to show the occupied bandwidth is the signal recommended in **3GPP TS 36.211 V9.1.0 (2010-03**. The power output level was adjusted to provide the documented value on each chart.

RESULTS: The following exhibits illustrate the spectrums investigated and document compliance.

W. Steve Majkowski NCE

Figure 11.4A Test Setup for Antenna Port Measurements of RF Power, Occupied Bandwidth & Conducted Spurious Emissions

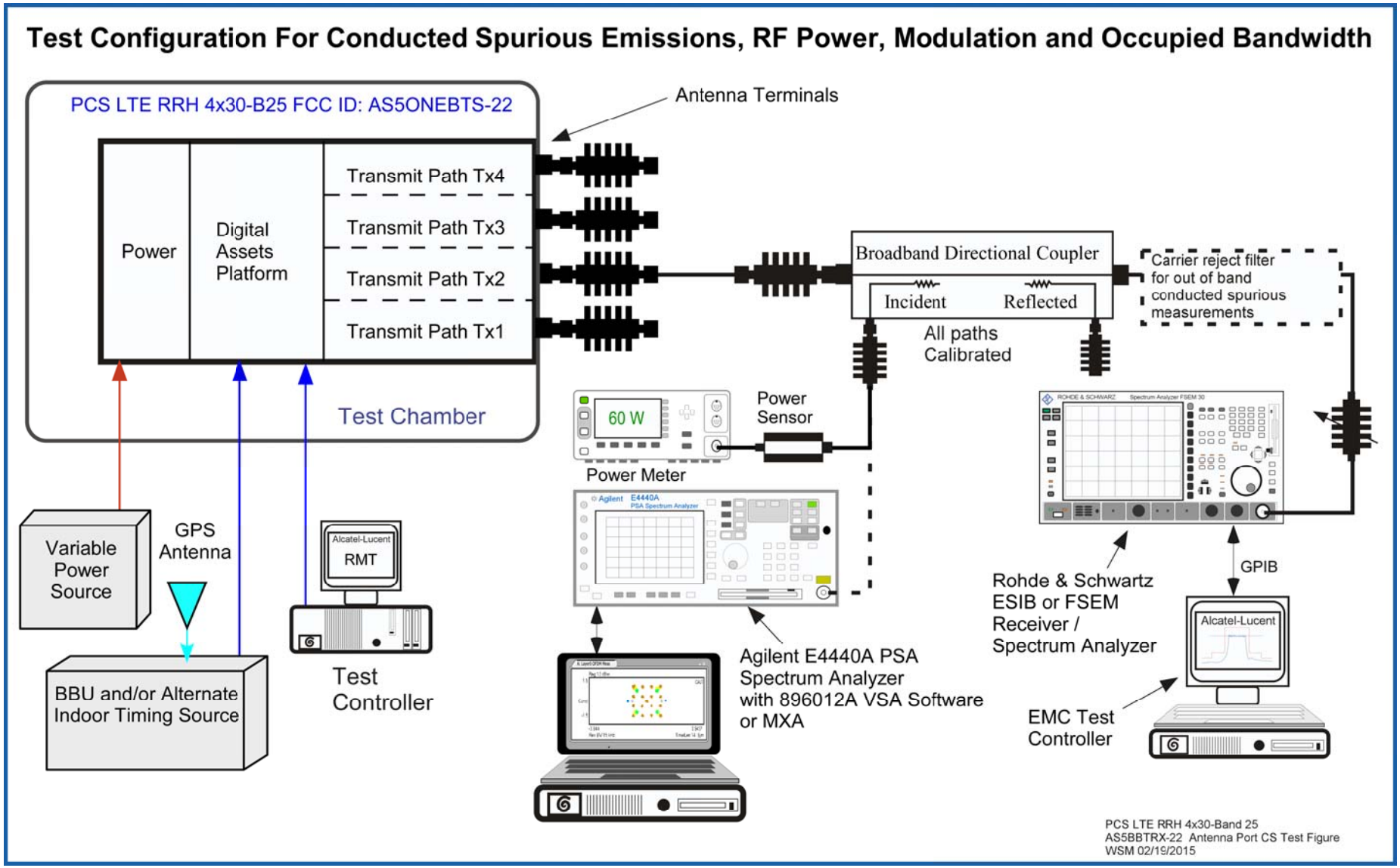


Figure 11.4B Occupied Bandwidth Mask for PCS 2x60W Operation AD Block, Fc= 1940 MHz

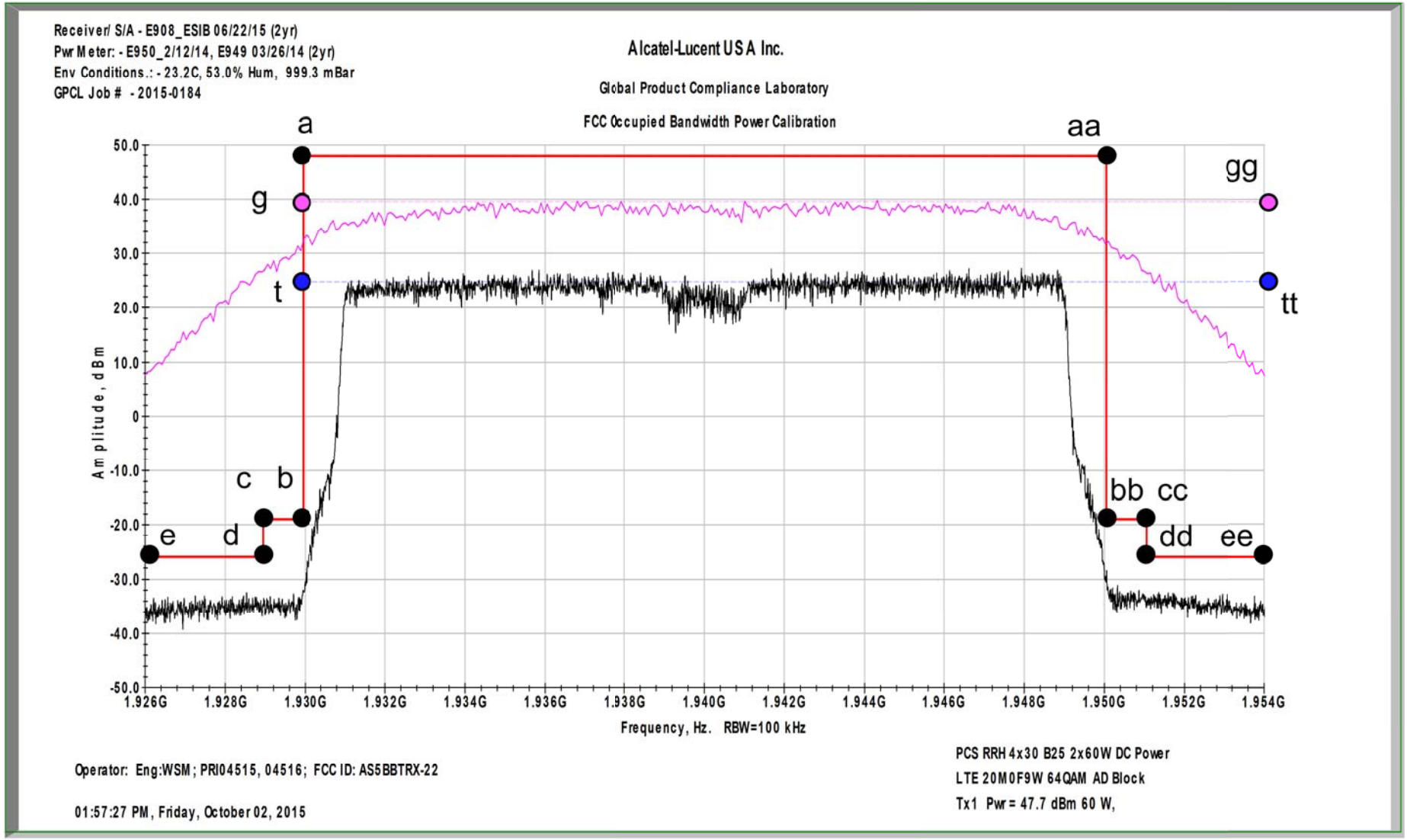


Figure 11.4C Occupied Bandwidth Mask for PCS 2x60W Operation CG Block, Fc= 1985 MHz

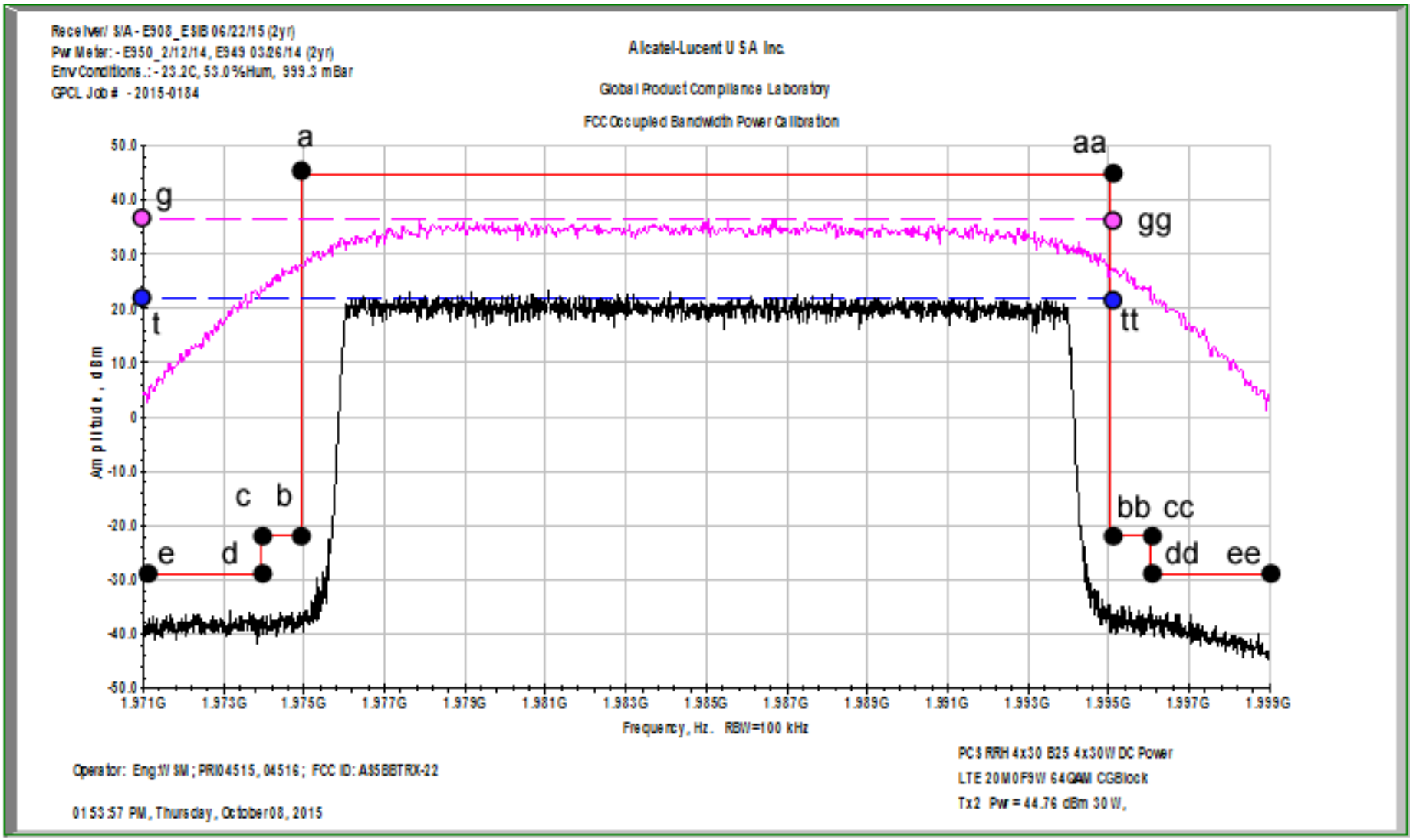
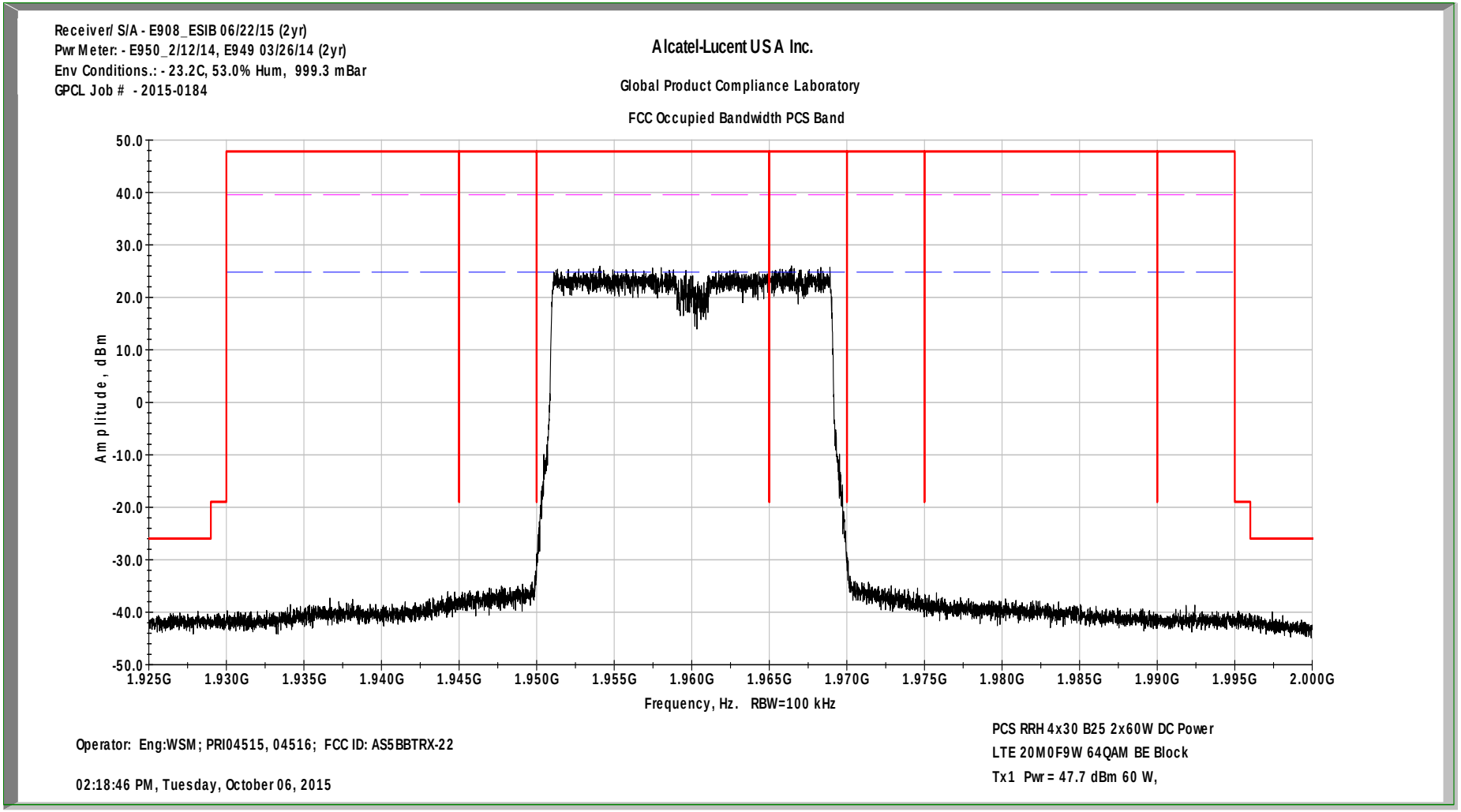


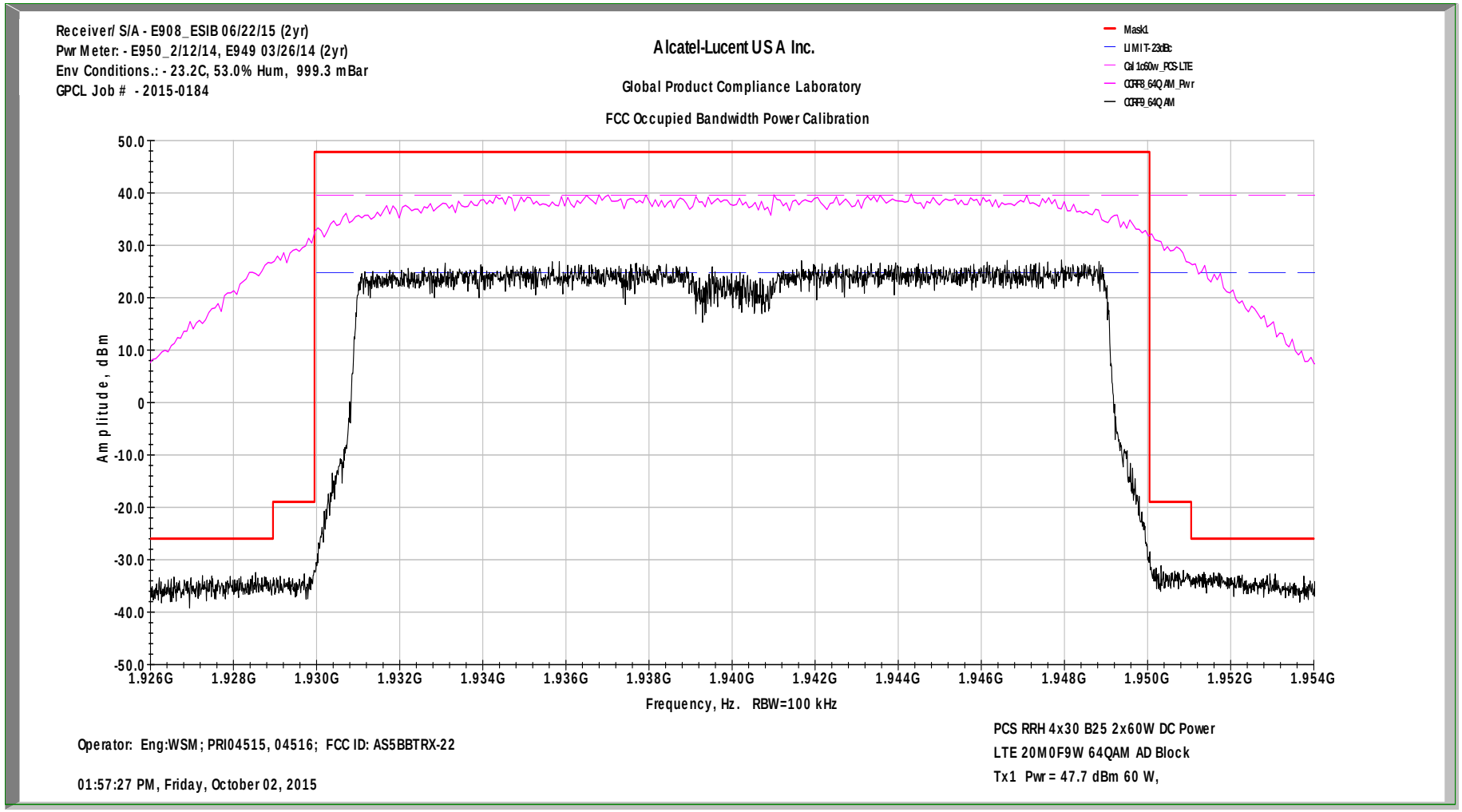
Figure 11.4D Occupied Bandwidth Entire PCS Band View, Showing 20M0F9W Operation in Combined BE Block at Fc=1960MHz



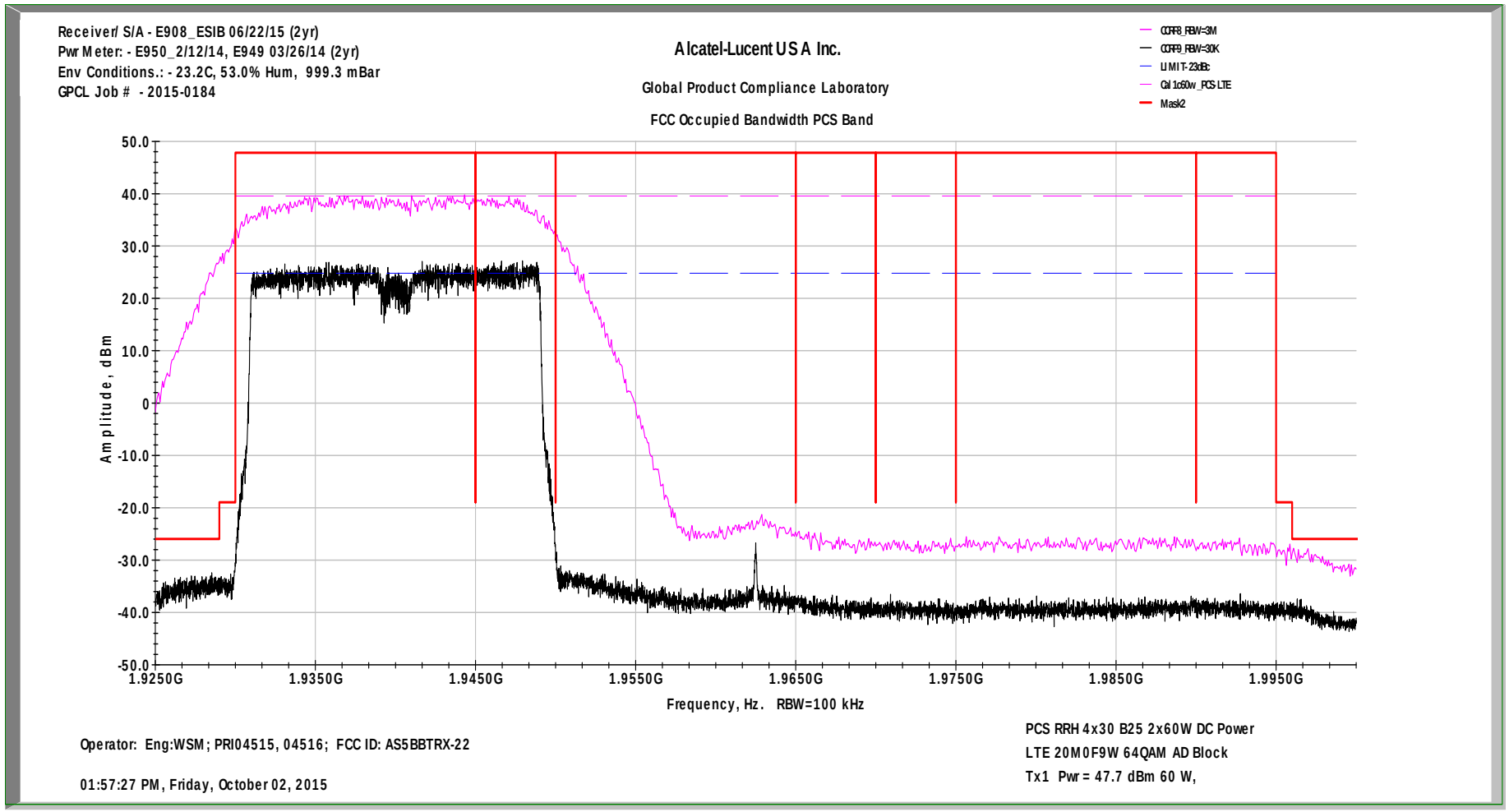
Transmitter Measurements
of
Occupied Bandwidth
for
Alcatel-Lucent USA Inc.
PCS LTE RRH 4x30 Band 25 Outdoor Transceiver System
20M0F9W Emissions Designator
2x60W Mode

FCC ID: AS5BBTRX-22

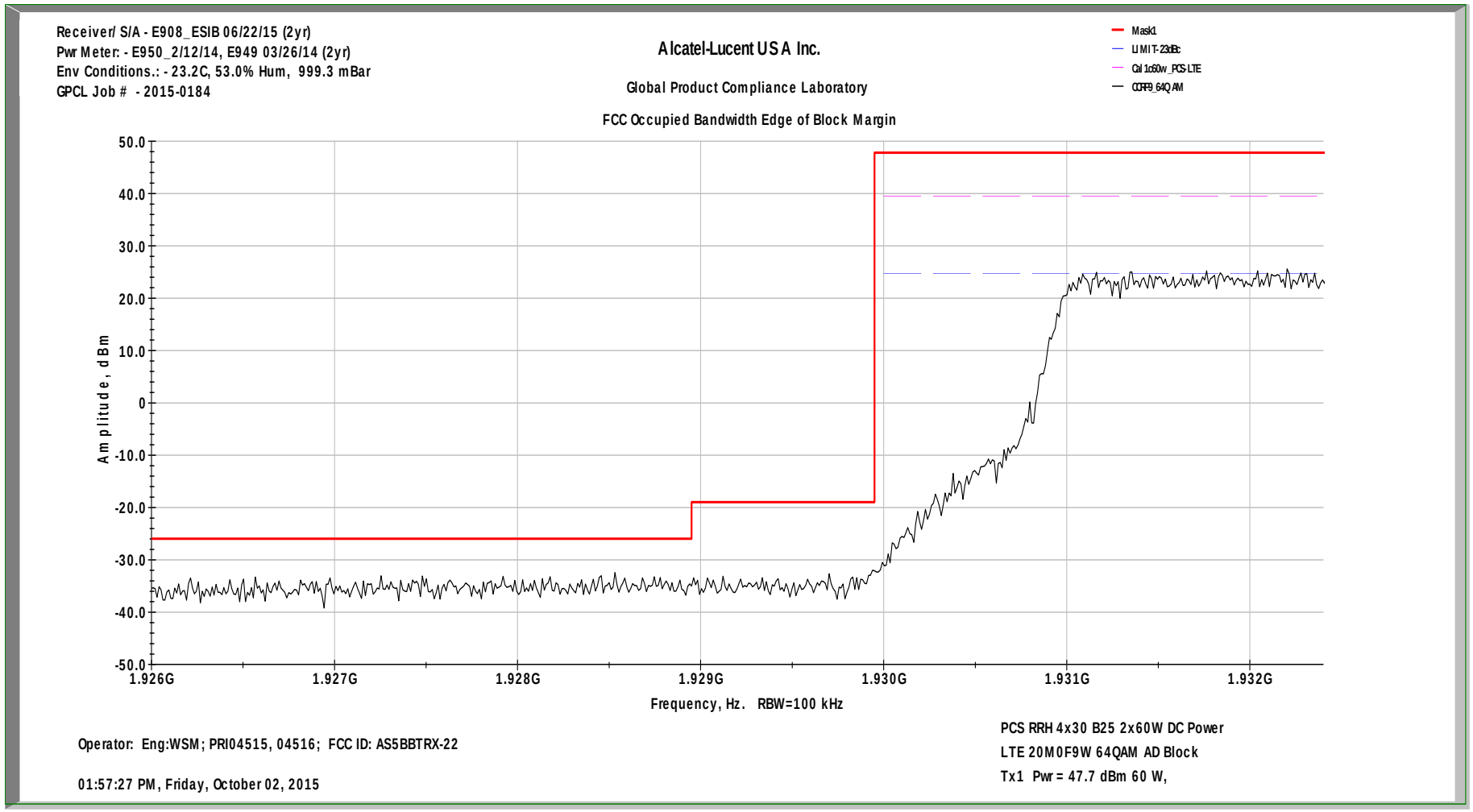
Occupied Bandwidth **PCS RRH 4x30 B25** **2x60W Mode** **Primary Port Tx1; AD Block,** **20M0F9W**



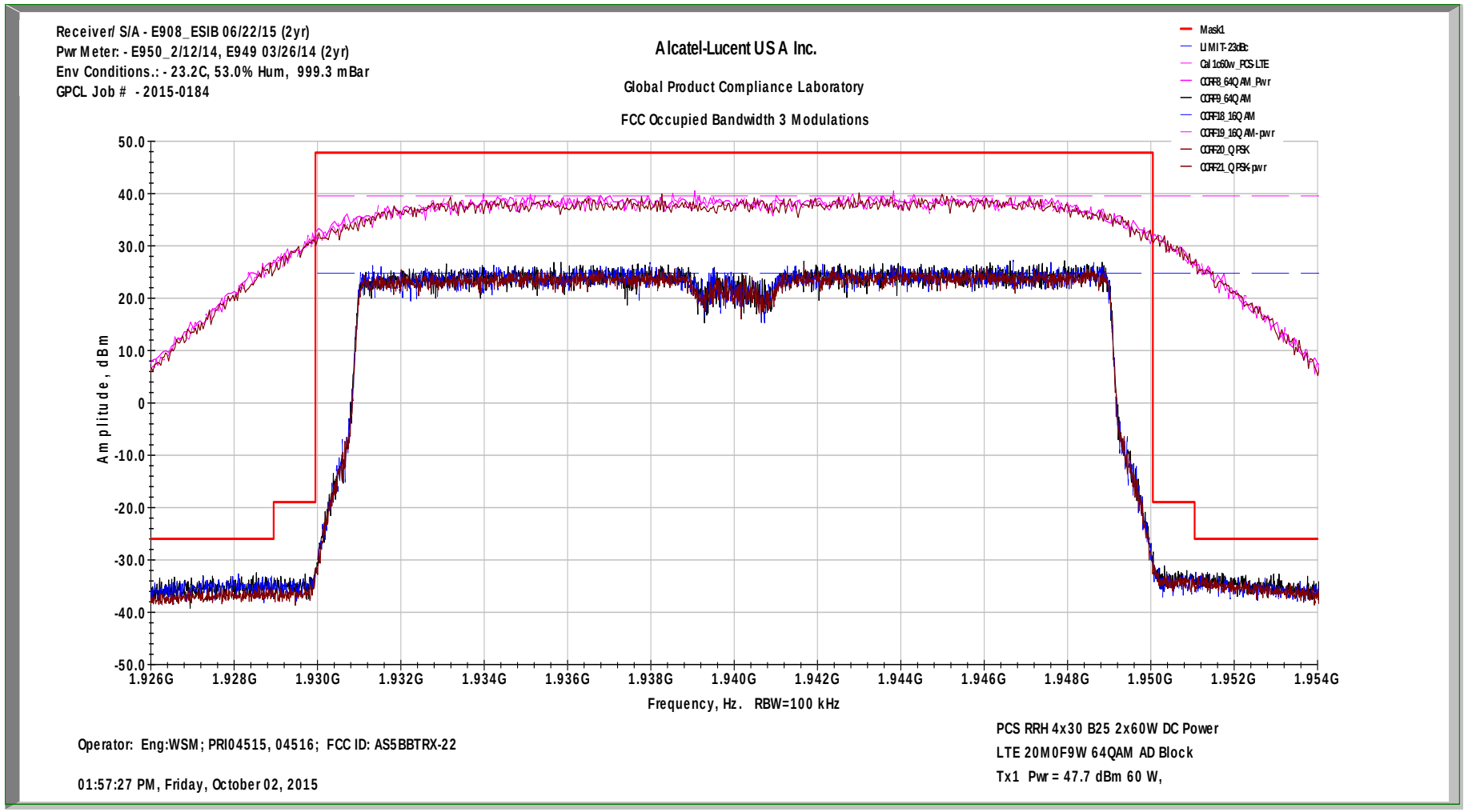
Occupied Bandwidth Band View PCS RRH 4x30 B25 2x60W Mode Primary Port Tx1; AD Block, 20M0F9W



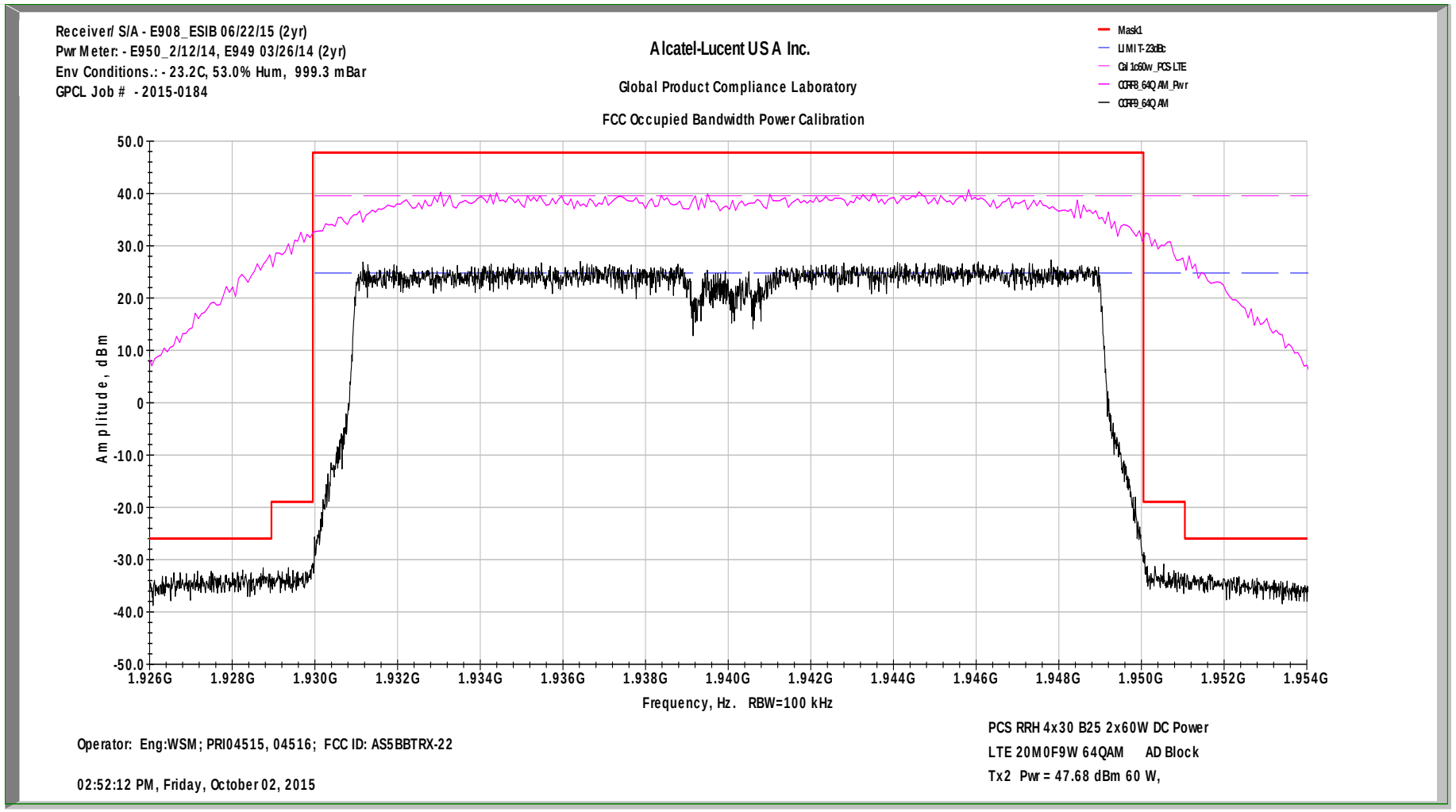
Occupied Bandwidth Edge of Block PCS RRH 4x30 B25 2x60W Mode Primary Port Tx1; AD Block, 20M0F9W



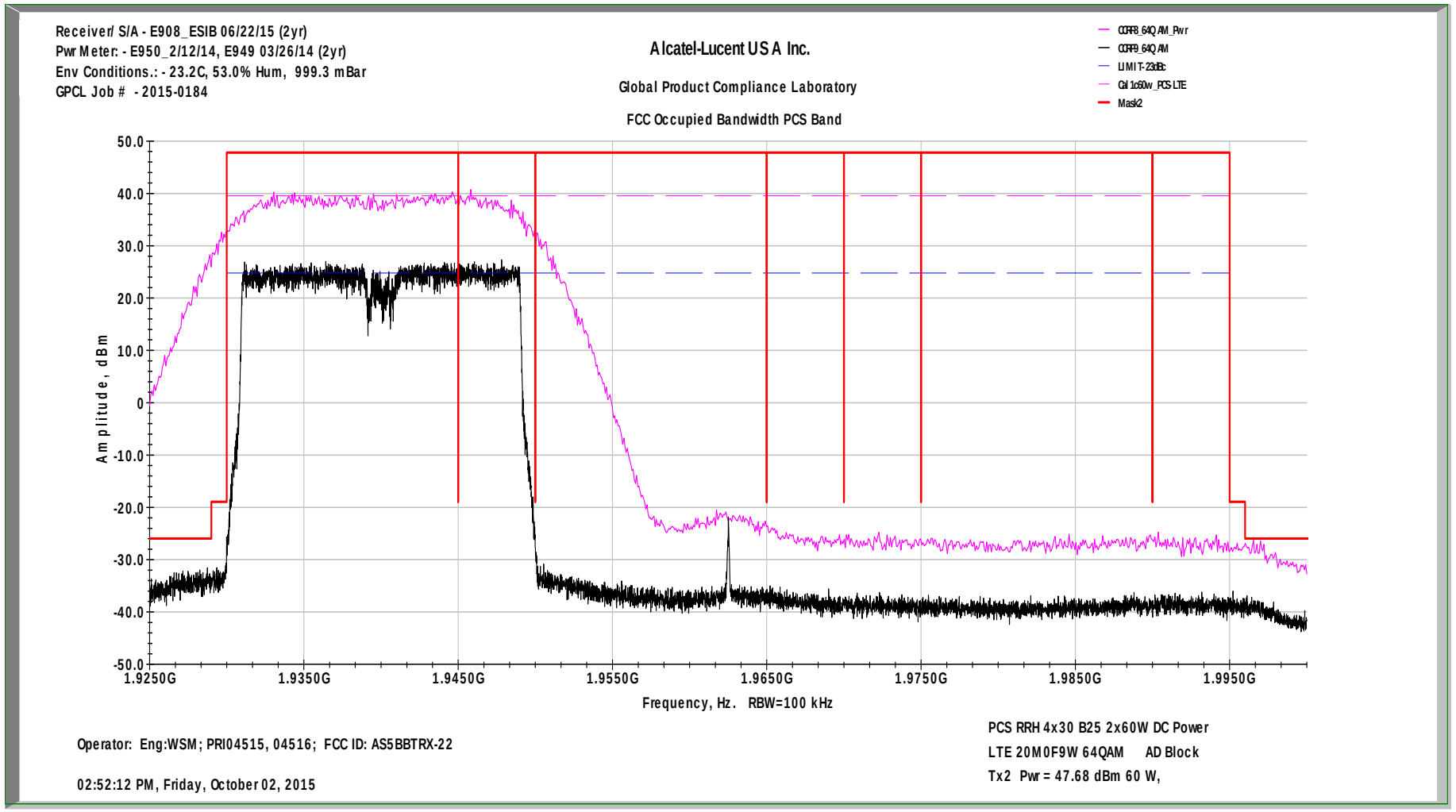
Occupied Bandwidth Multiple Modulations PCS RRH 4x30 B25 2x60W Mode Primary Port Tx1; AD Block, 20M0F9W



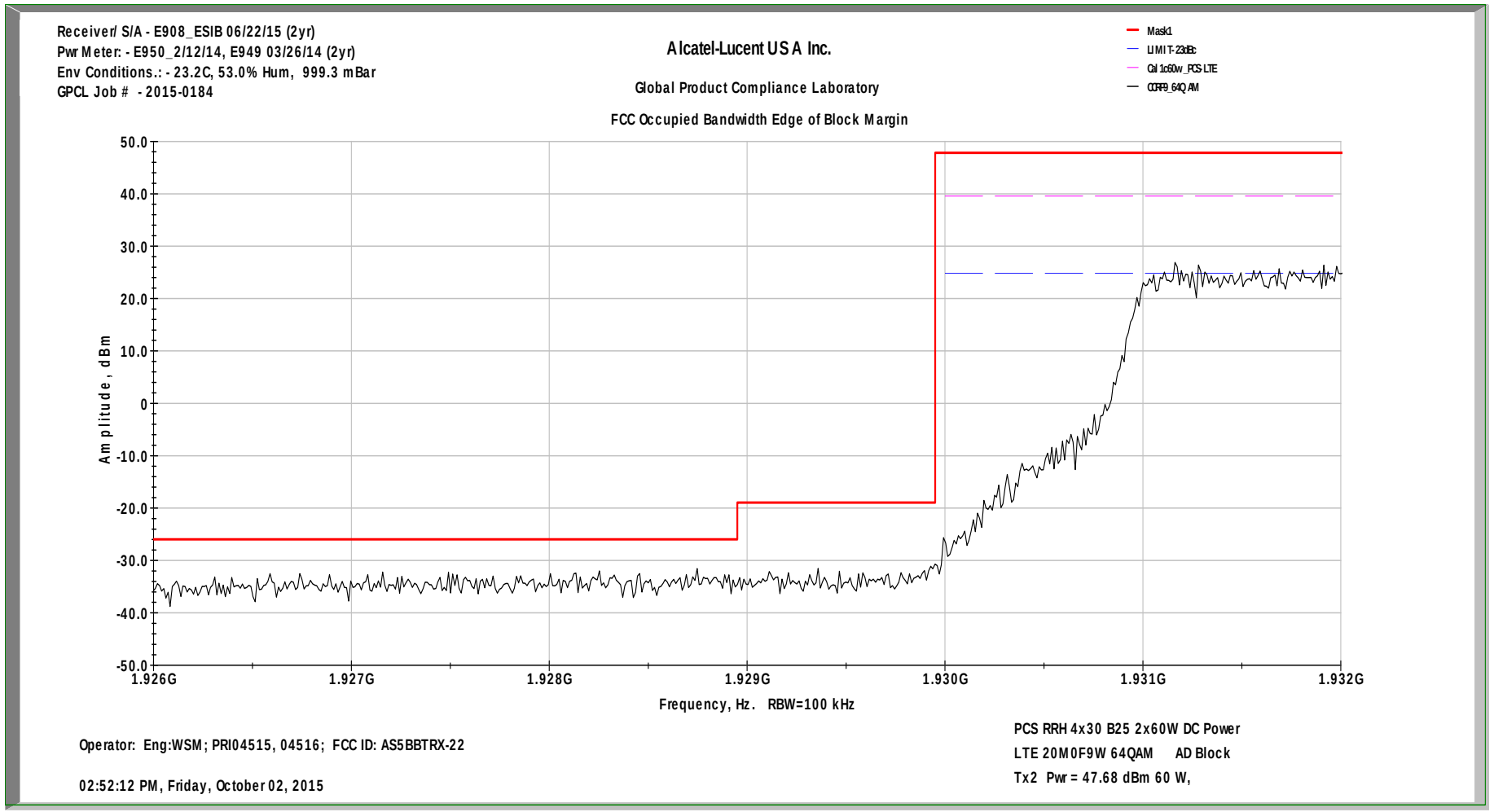
Occupied Bandwidth **PCS RRH 4x30 B25** **2x60W Mode** **Primary Port Tx2; AD Block,** **20M0F9W**



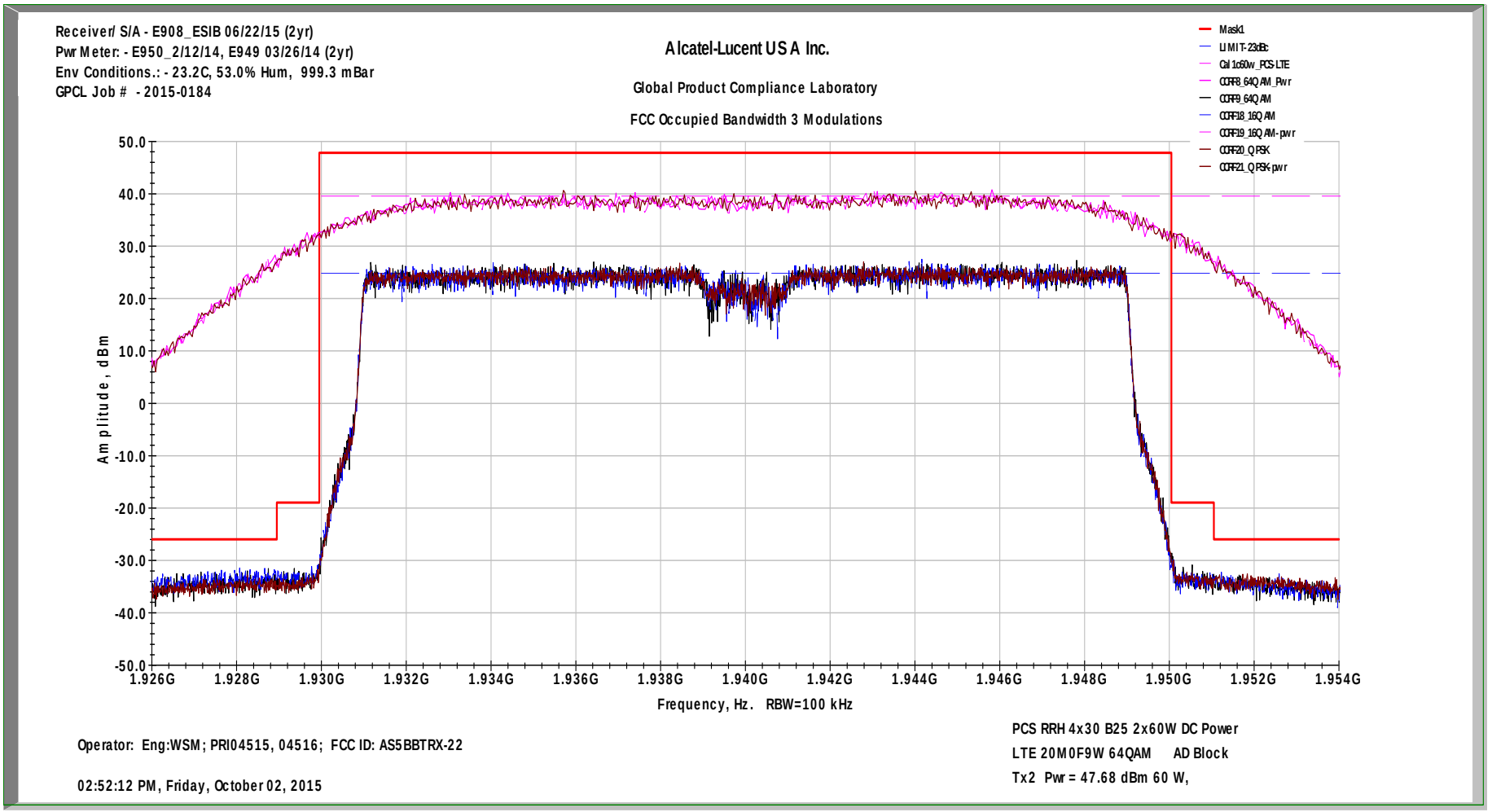
Occupied Bandwidth Band View PCS RRH 4x30 B25 2x60W Mode Primary Port Tx2; AD Block, 20M0F9W



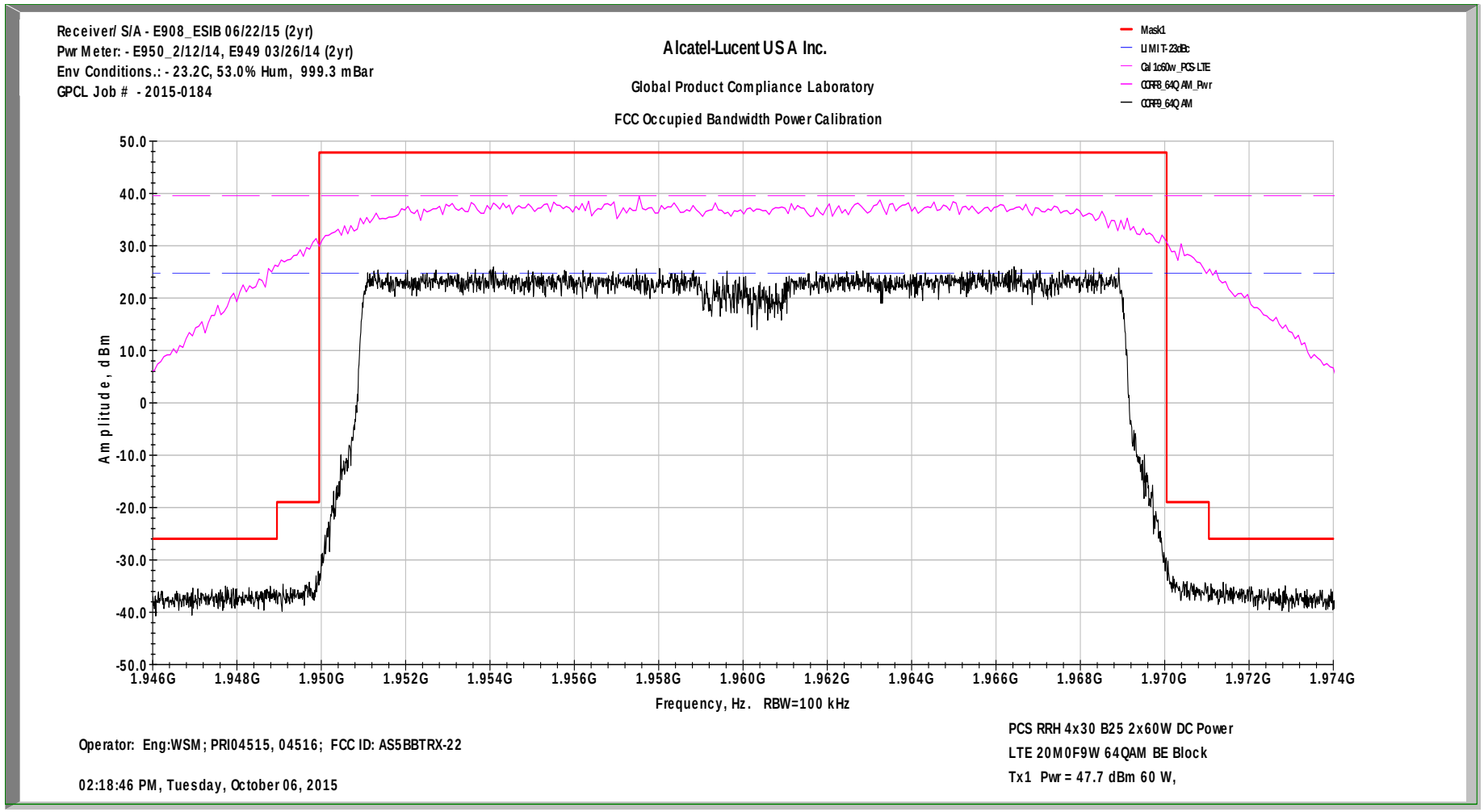
Occupied Bandwidth Edge of Block PCS RRH 4x30 B25 2x60W Mode Primary Port Tx2; AD Block, 20M0F9W



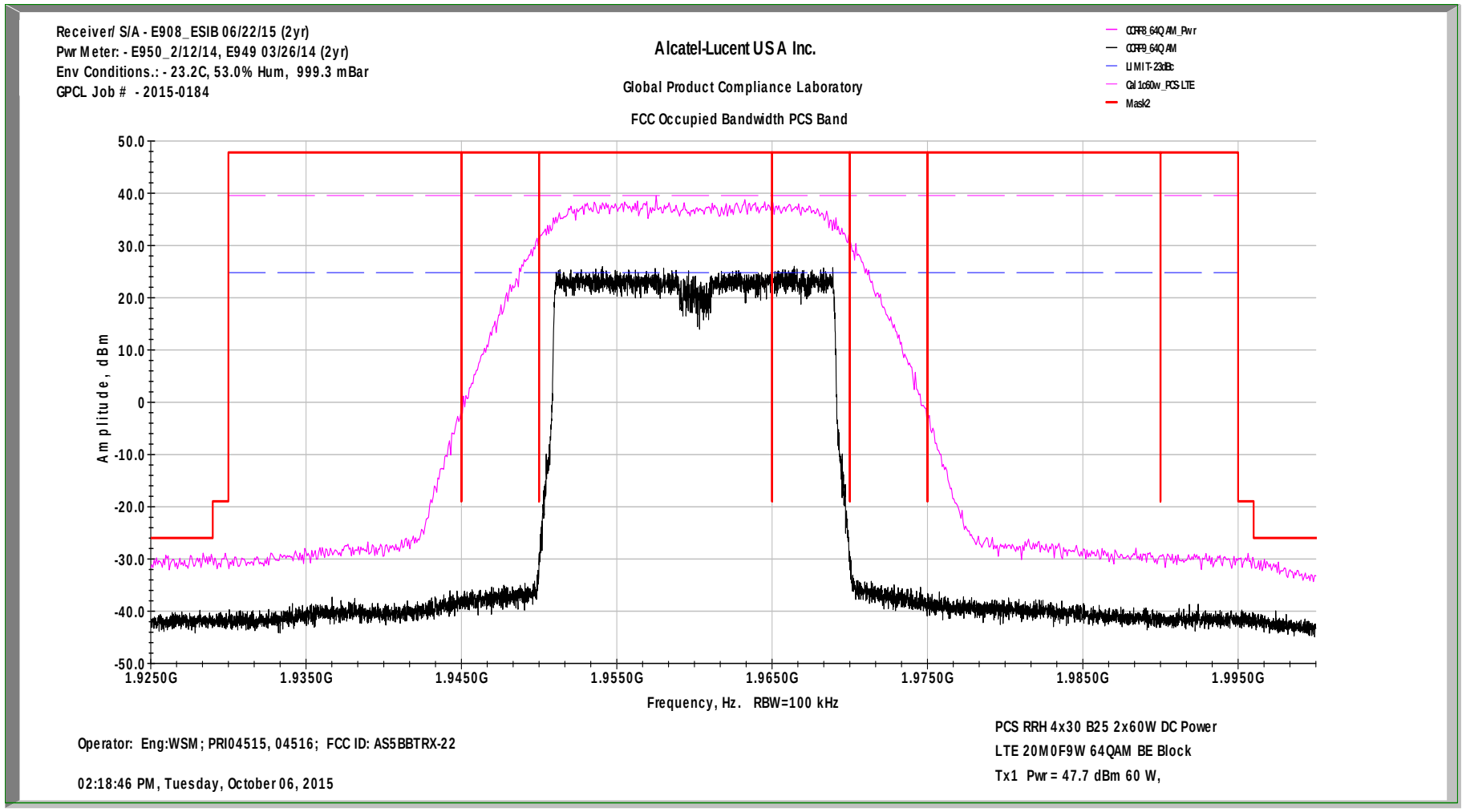
Occupied Bandwidth Multiple Modulations PCS RRH 4x30 B25 2x60W Mode Primary Port Tx2; AD Block, 20M0F9W



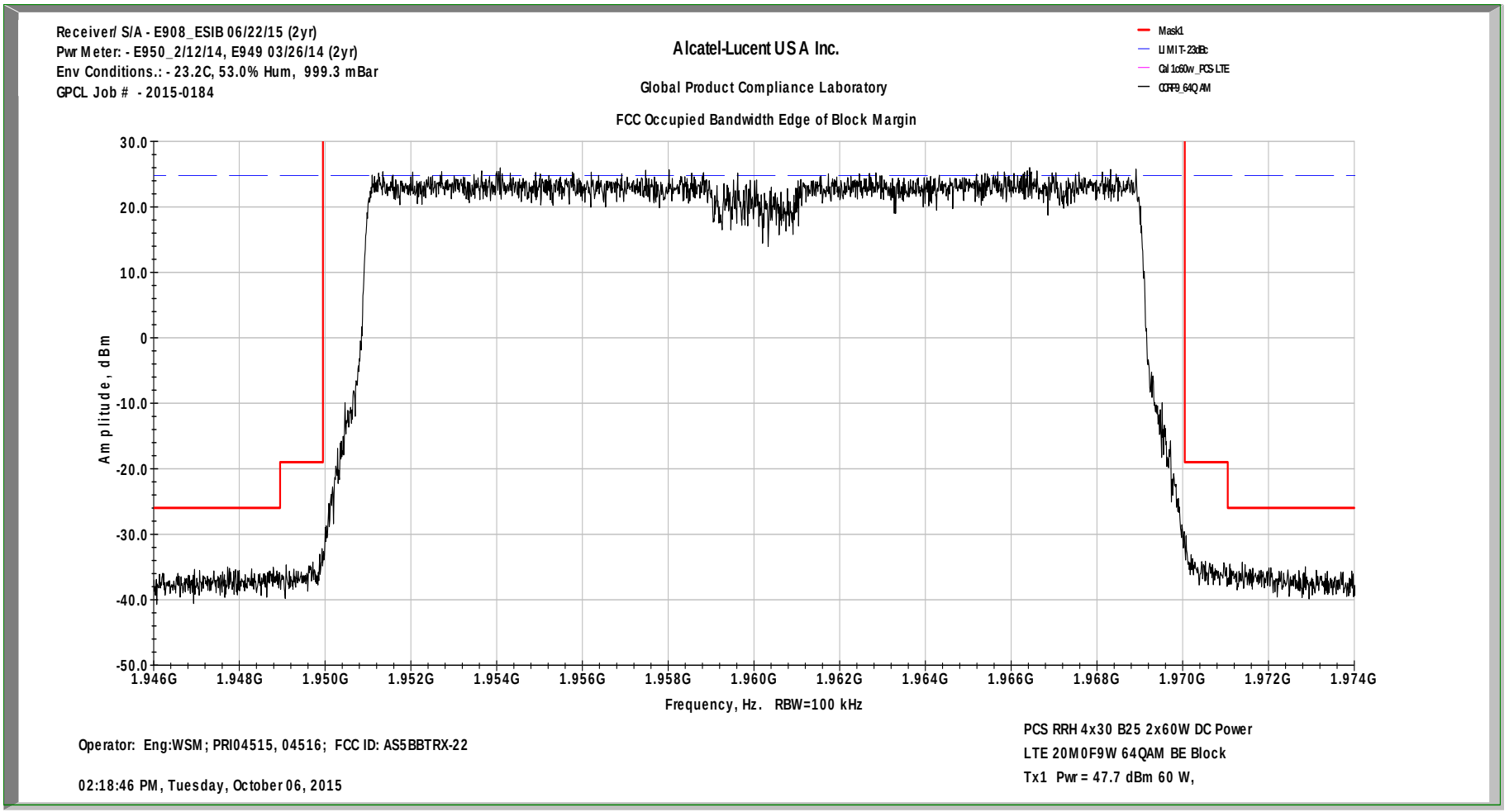
Occupied Bandwidth **PCS RRH 4x30 B25** **2x60W Mode** **Primary Port Tx1; BE Block,** **20M0F9W**



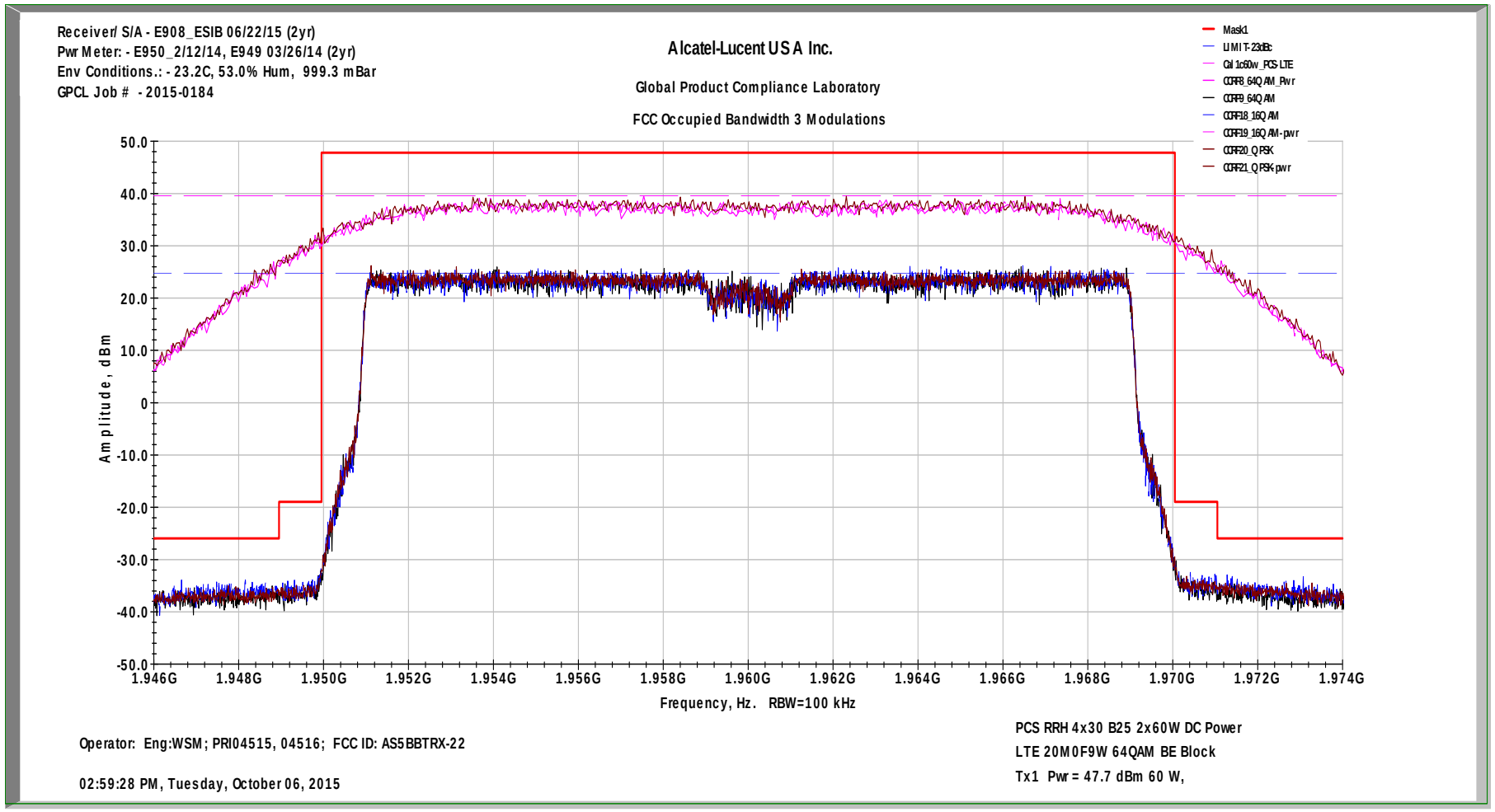
Occupied Bandwidth Band View PCS RRH 4x30 B25 2x60W Mode Primary Port Tx1; BE Block, 20M0F9W



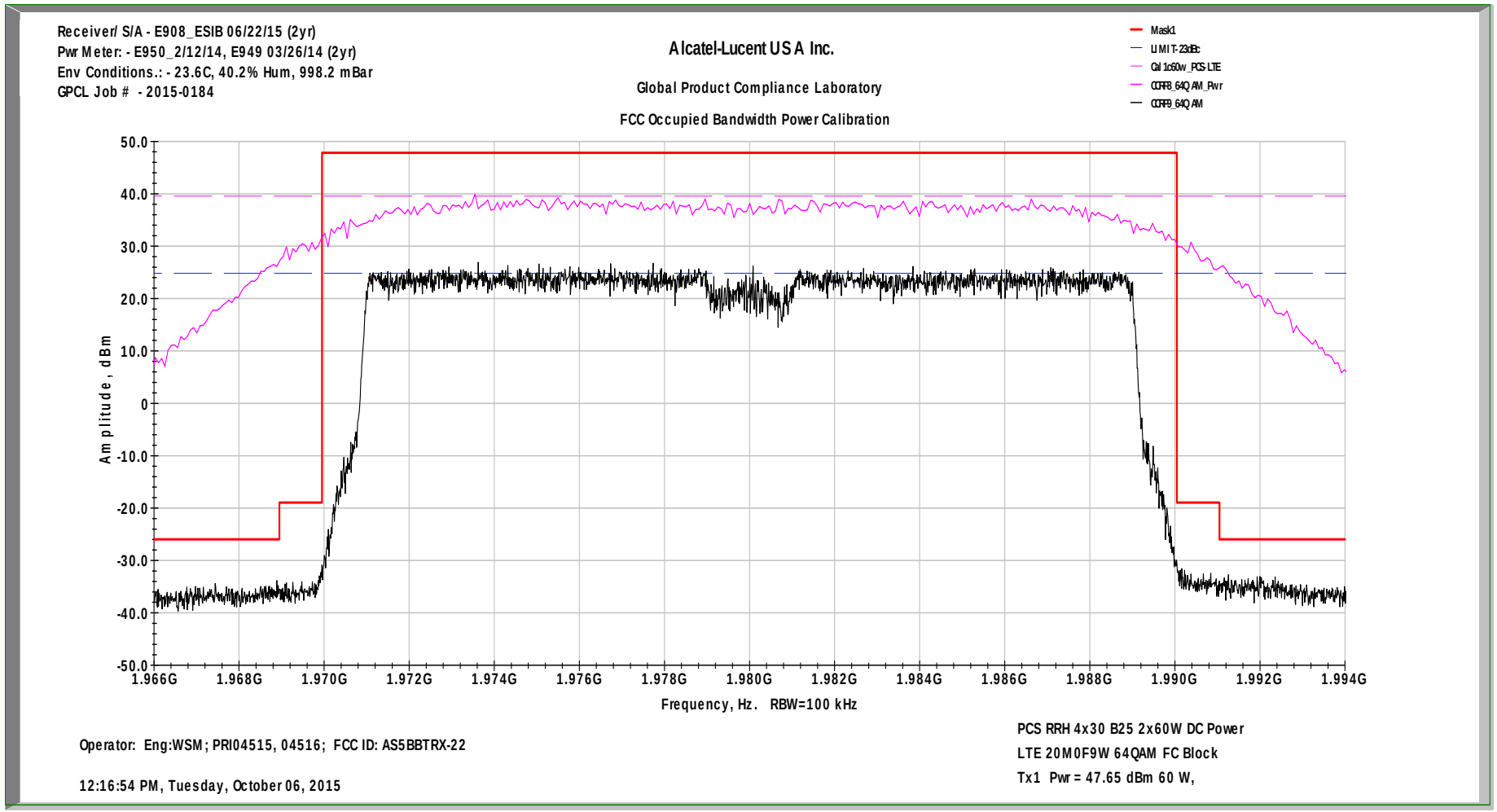
Occupied Bandwidth Edge of Block PCS RRH 4x30 B25 2x60W Mode Primary Port Tx1; BE Block, 20M0F9W



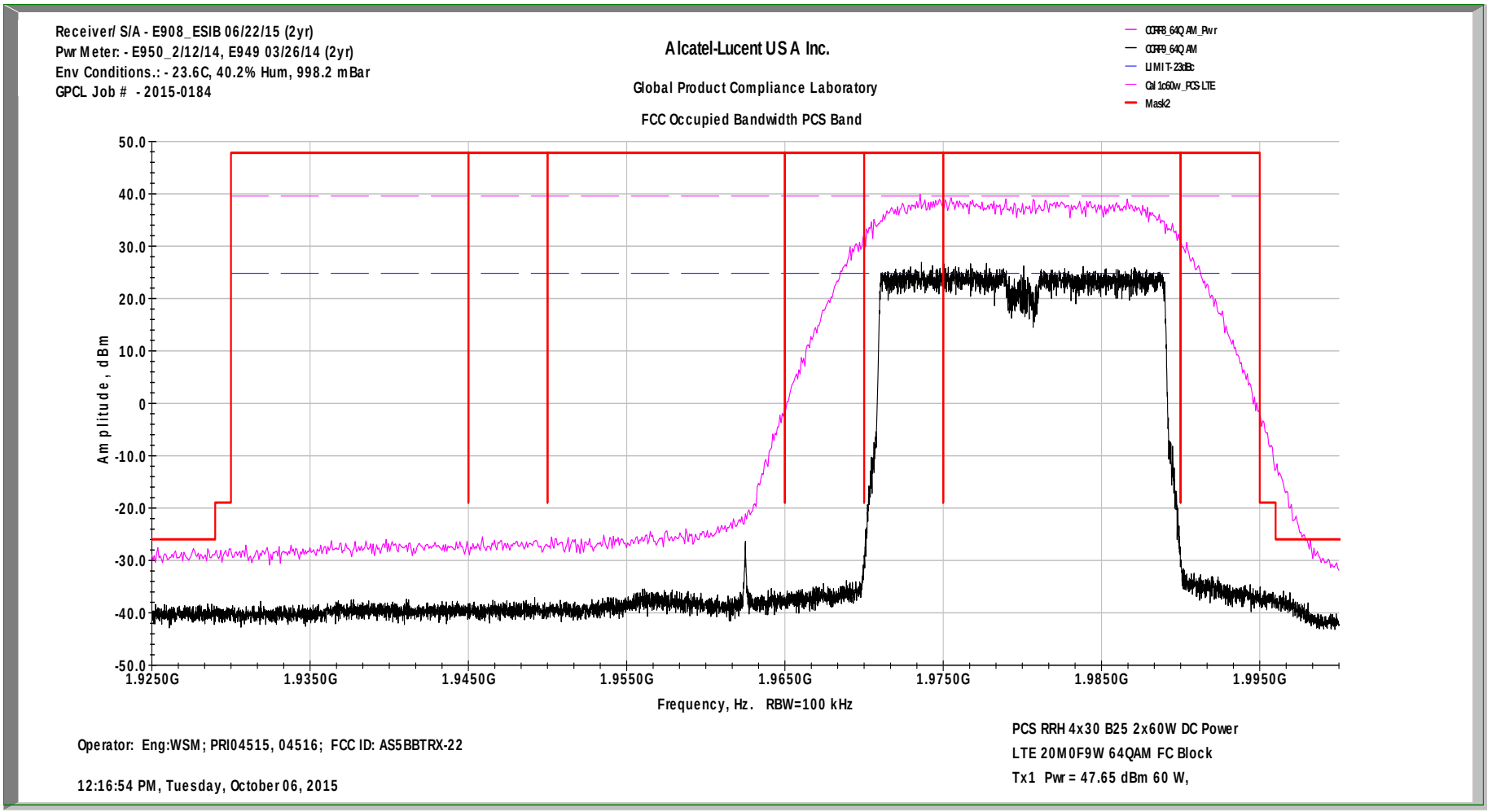
Occupied Bandwidth Multiple Modulations PCS RRH 4x30 B25 2x60W Mode Primary Port Tx1; BE Block, 20M0F9W



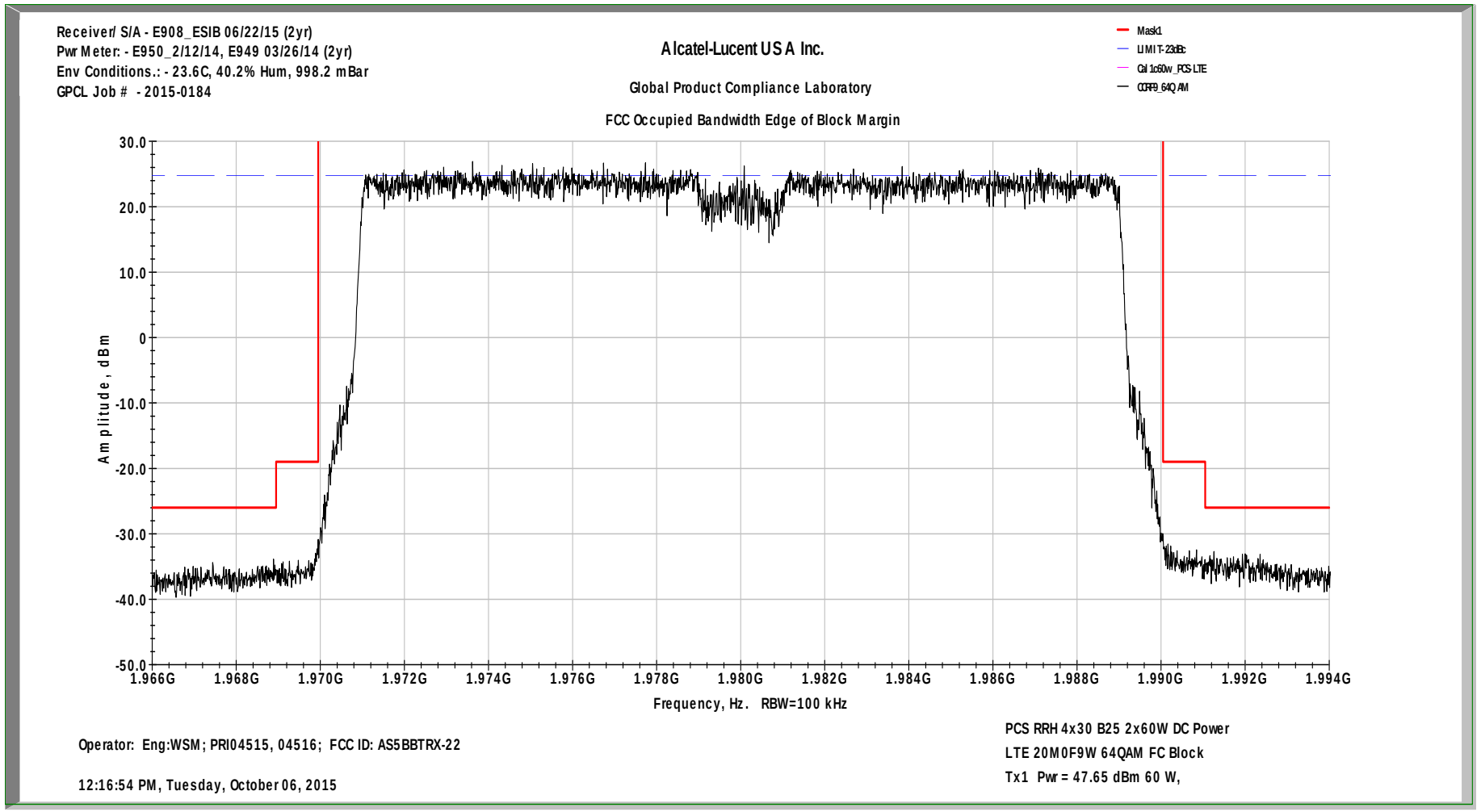
Occupied Bandwidth **PCS RRH 4x30 B25** **2x60W Mode** **Primary Port Tx1; FC Block,** **20M0F9W**



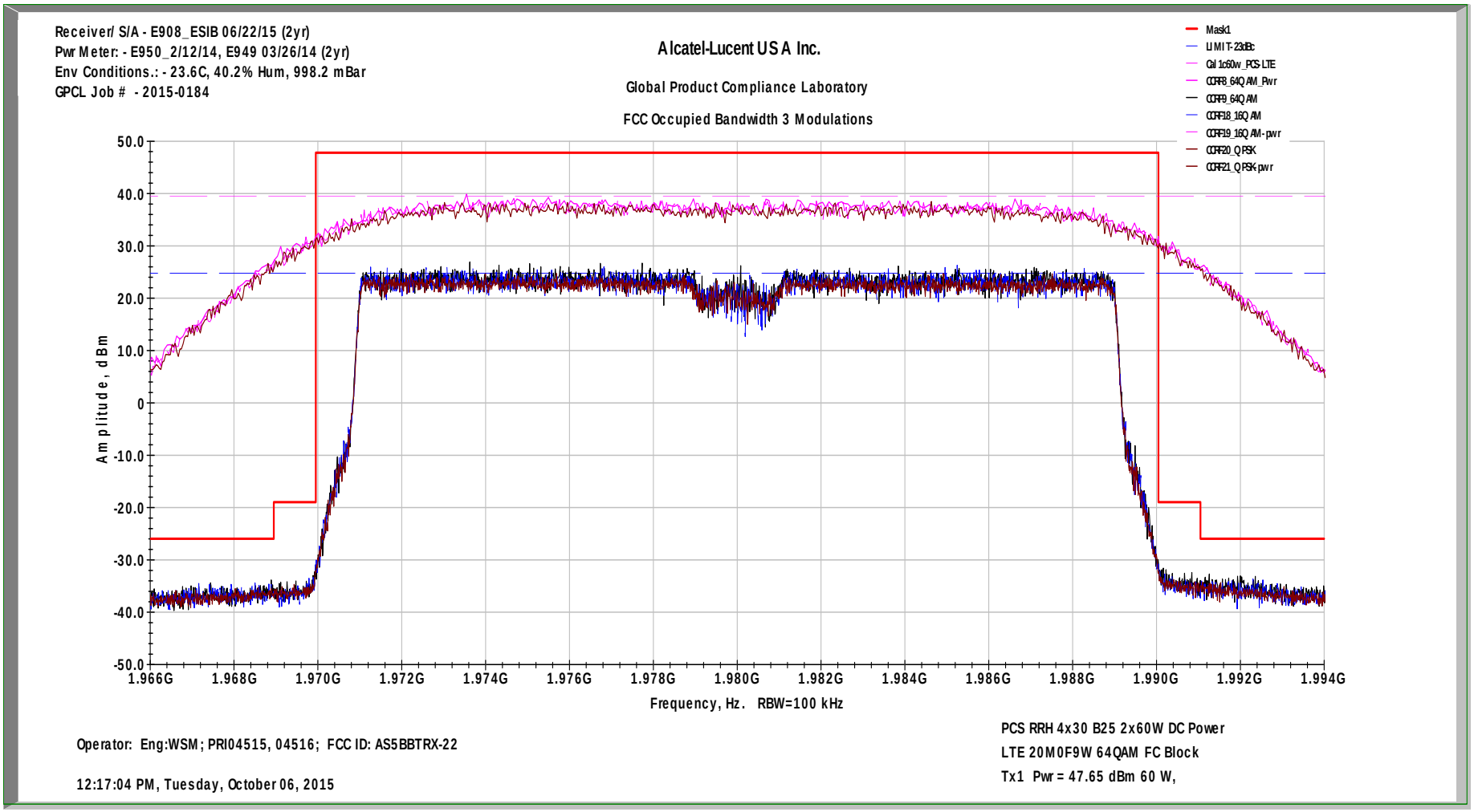
Occupied Bandwidth Band View PCS RRH 4x30 B25 2x60W Mode Primary Port Tx1; FC Block, 20M0F9W



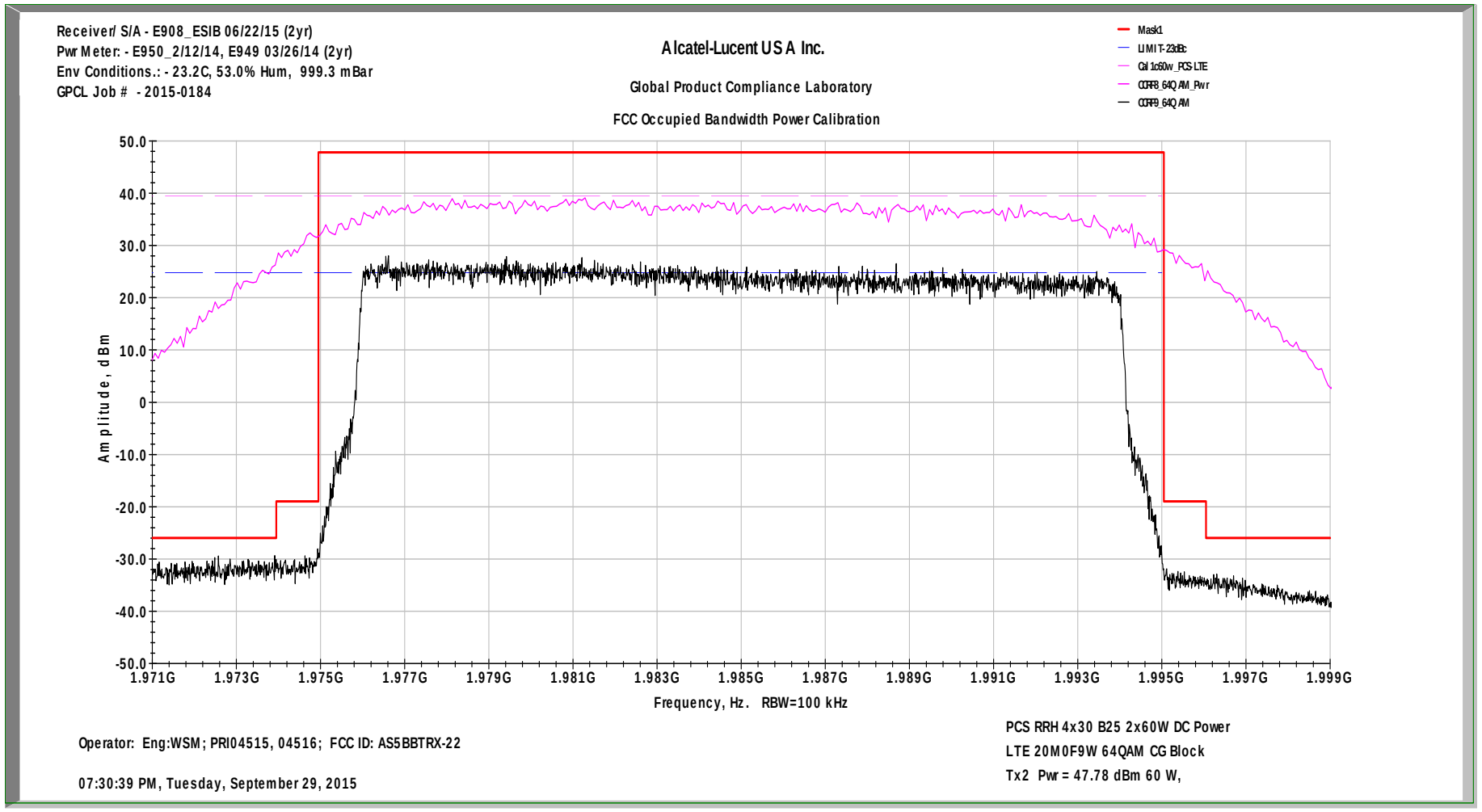
Occupied Bandwidth Edge of Block PCS RRH 4x30 B25 2x60W Mode Primary Port Tx1; FC Block, 20M0F9W



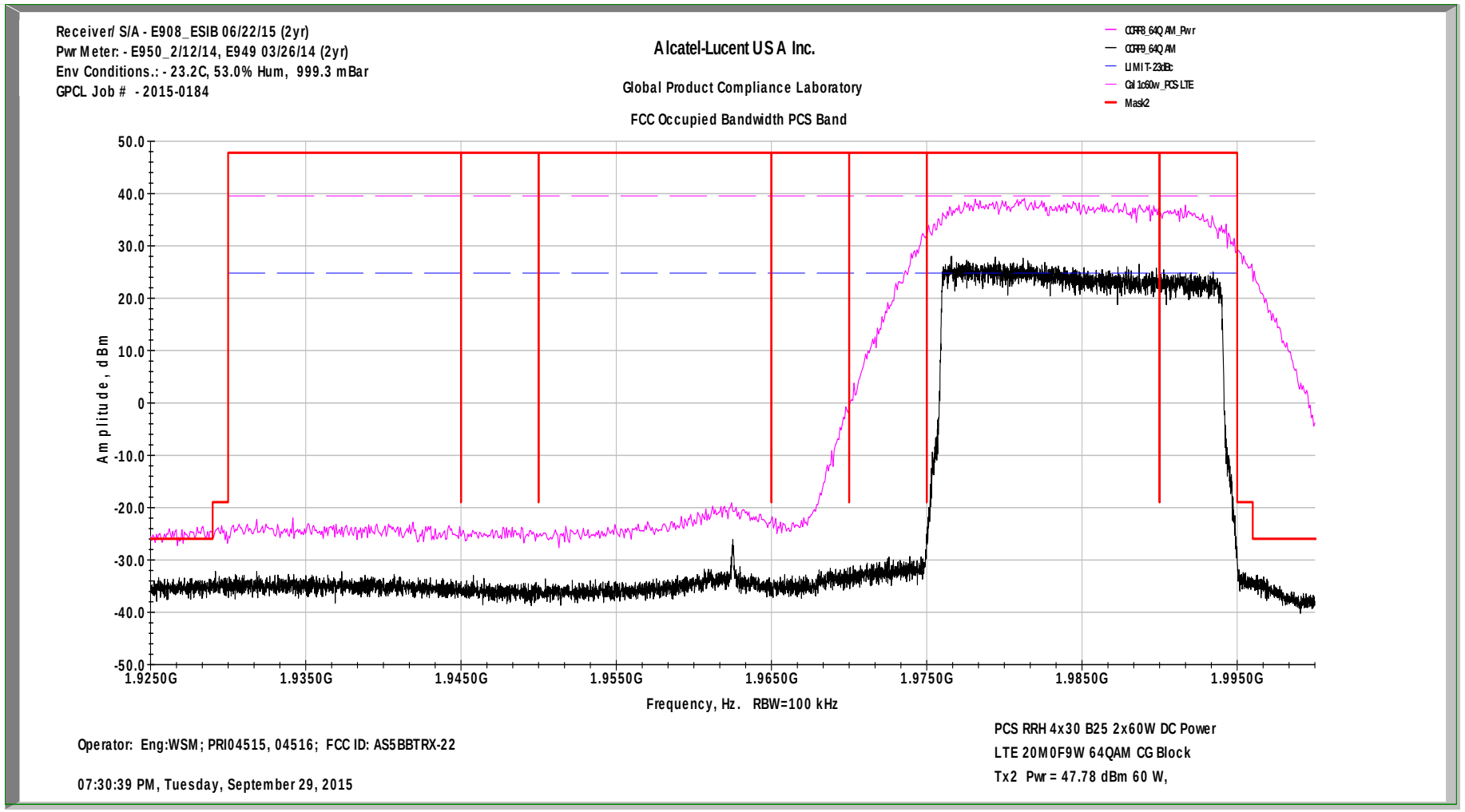
Occupied Bandwidth Multiple Modulations PCS RRH 4x30 B25 2x60W Mode Primary Port Tx1; FC Block, 20M0F9W



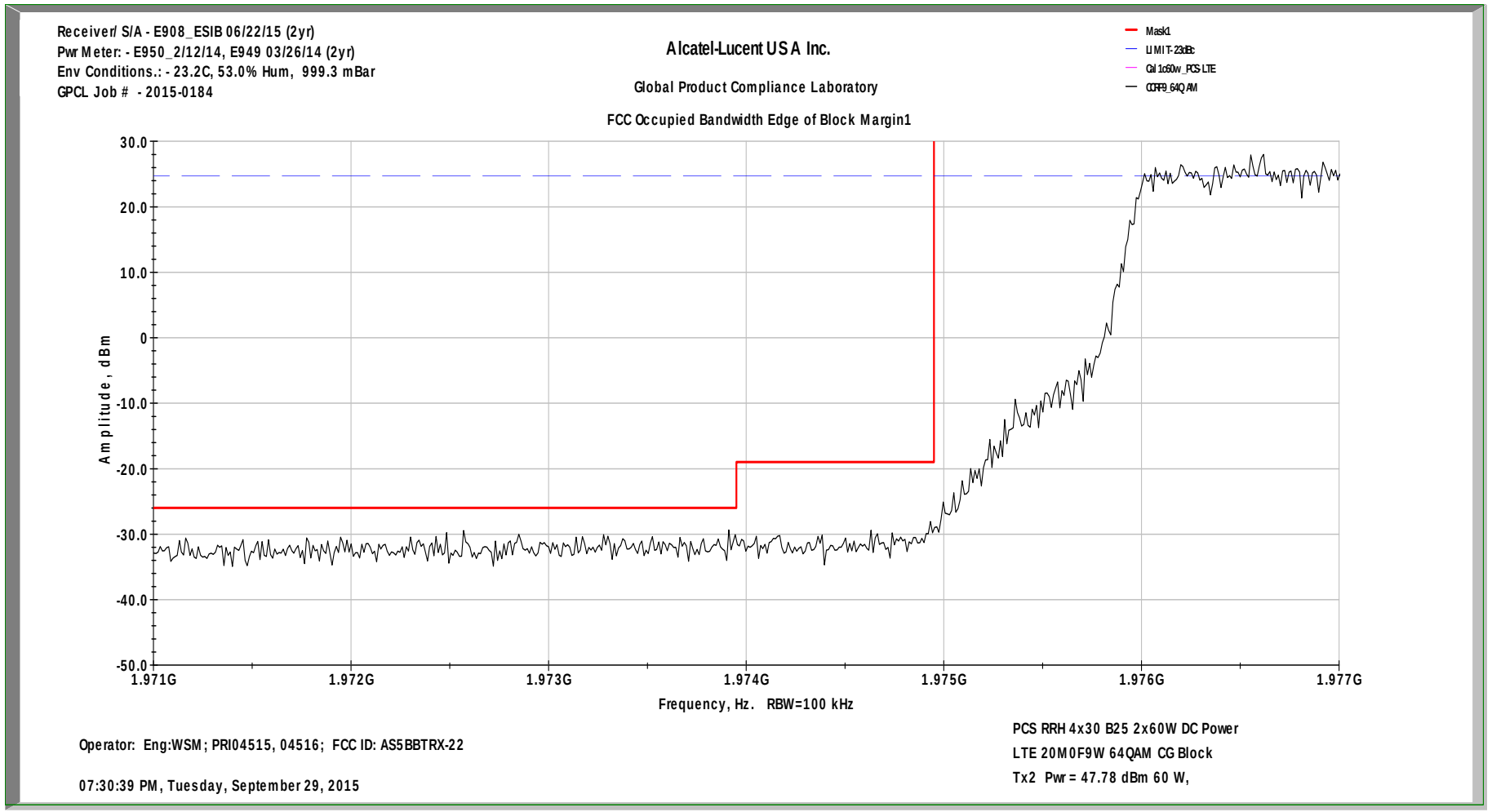
Occupied Bandwidth **PCS RRH 4x30 B25** **2x60W Mode** **Primary Port Tx2; CG Block,** **20M0F9W**



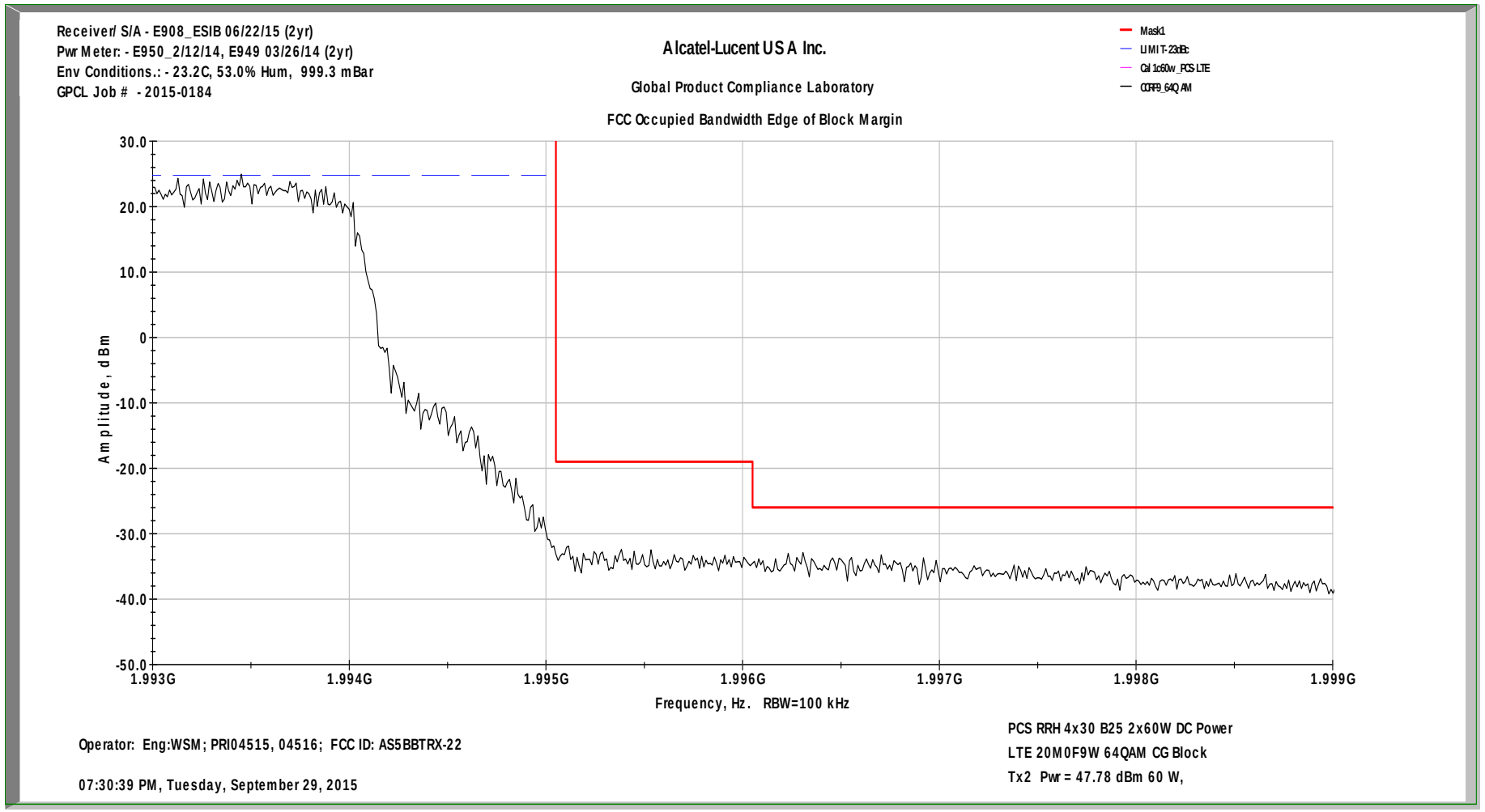
Occupied Bandwidth Band View PCS RRH 4x30 B25 2x60W Mode Primary Port Tx2; CG Block, 20M0F9W



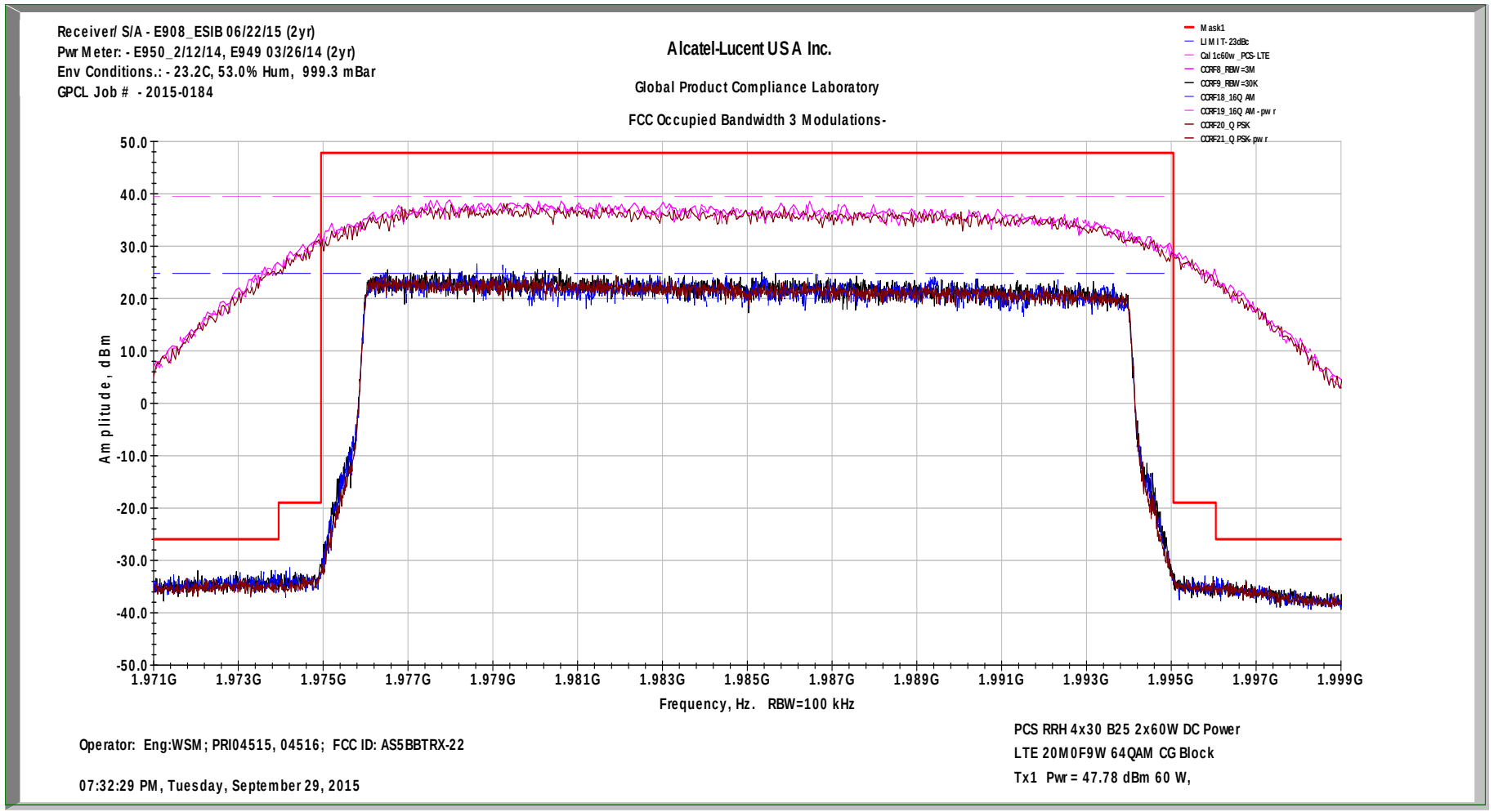
Occupied Bandwidth Edge of Block PCS RRH 4x30 B25 2x60W Mode Primary Port Tx2; CG Block, 20M0F9W



Occupied Bandwidth Edge of Block PCS RRH 4x30 B25 2x60W Mode Primary Port Tx2; CG Block, 20M0F9W



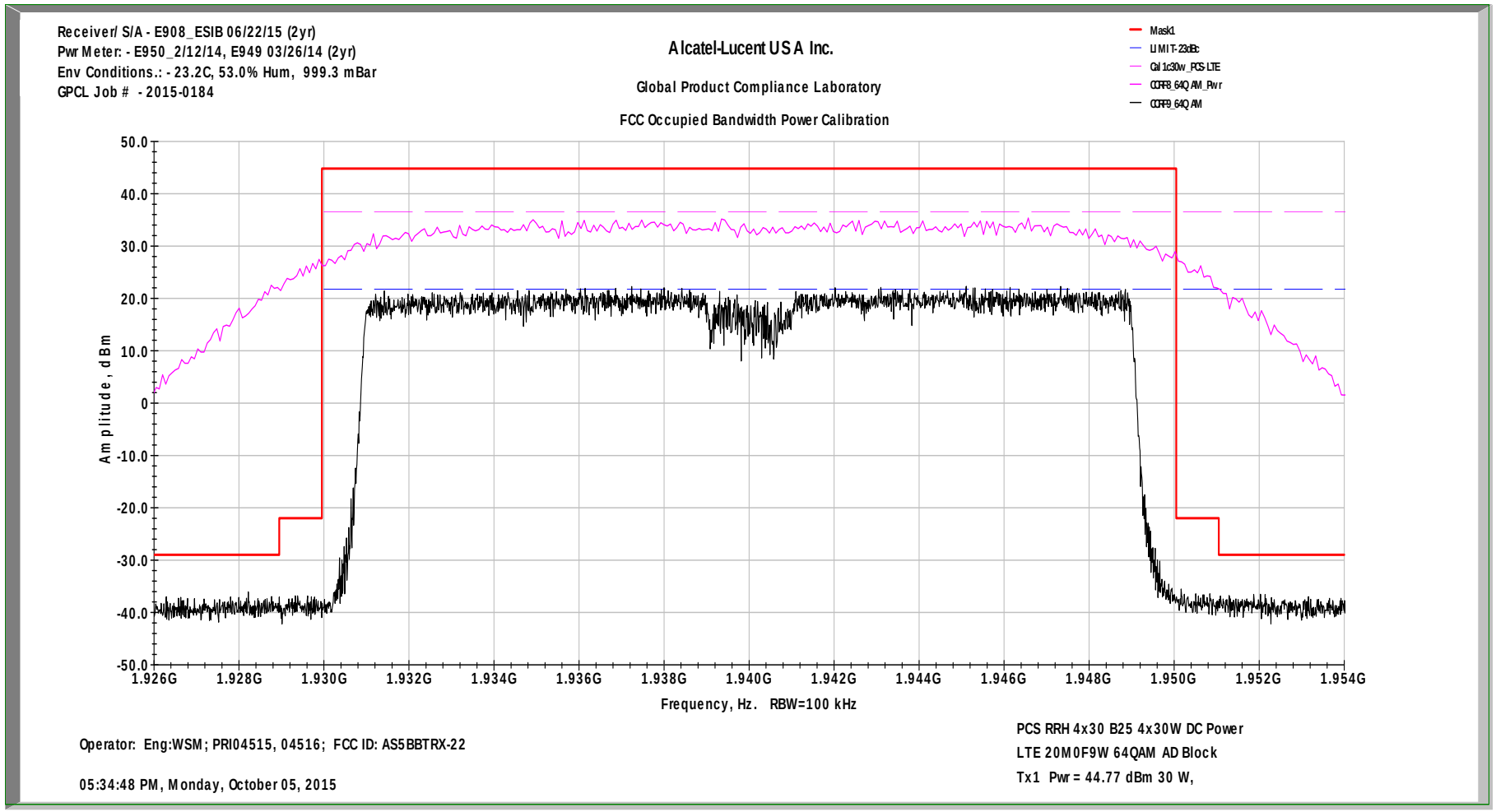
Occupied Bandwidth Multiple Modulations PCS RRH 4x30 B25 2x60W Mode Primary Port Tx2; CG Block, 20M0F9W



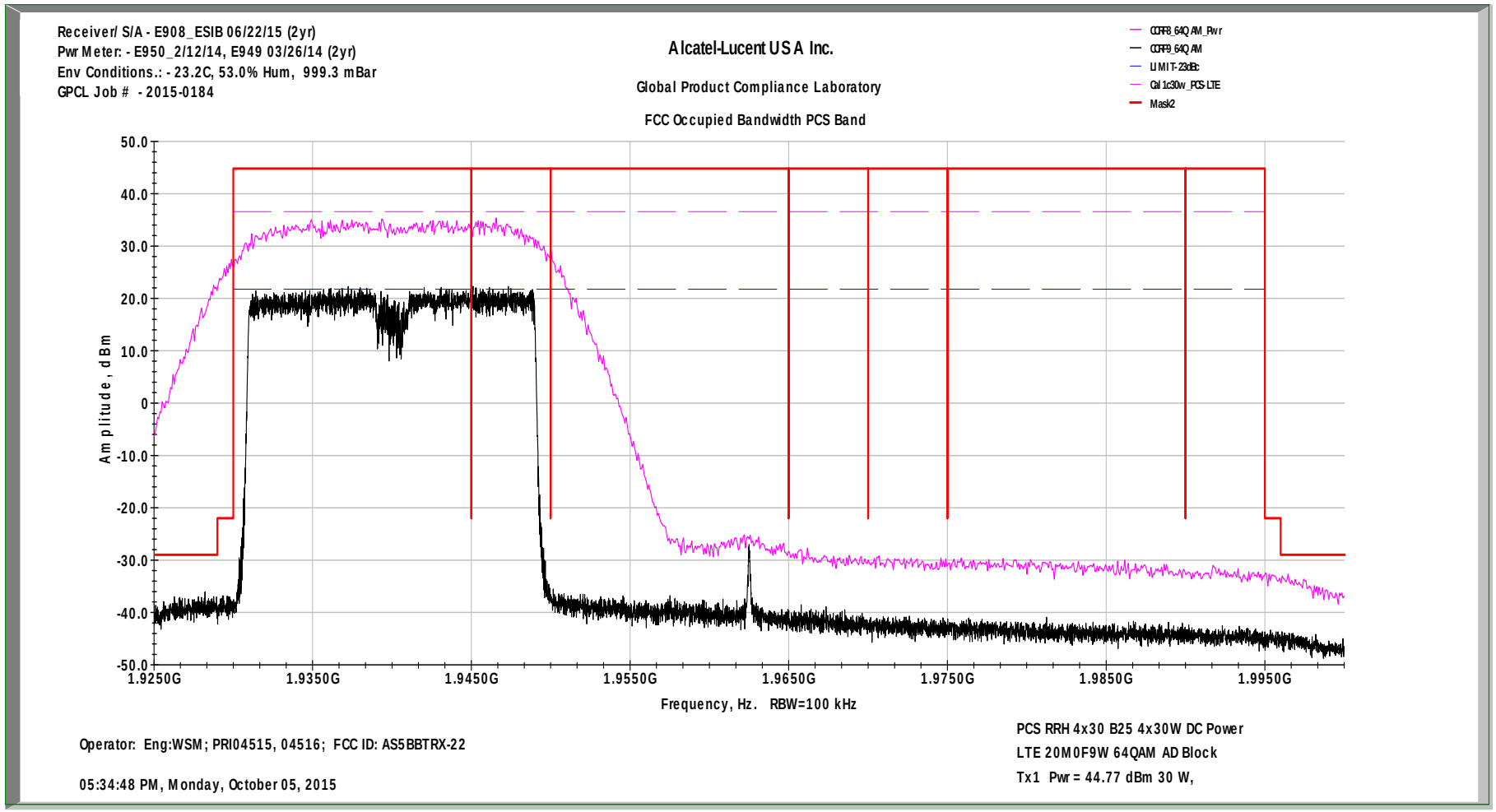
Transmitter Measurements
of
Occupied Bandwidth
for
Alcatel-Lucent USA Inc.
PCS LTE RRH 4x30 Band 25 Outdoor Transceiver System
20M0F9W Emissions Designator
4x30W Mode

FCC ID: AS5BBTRX-22

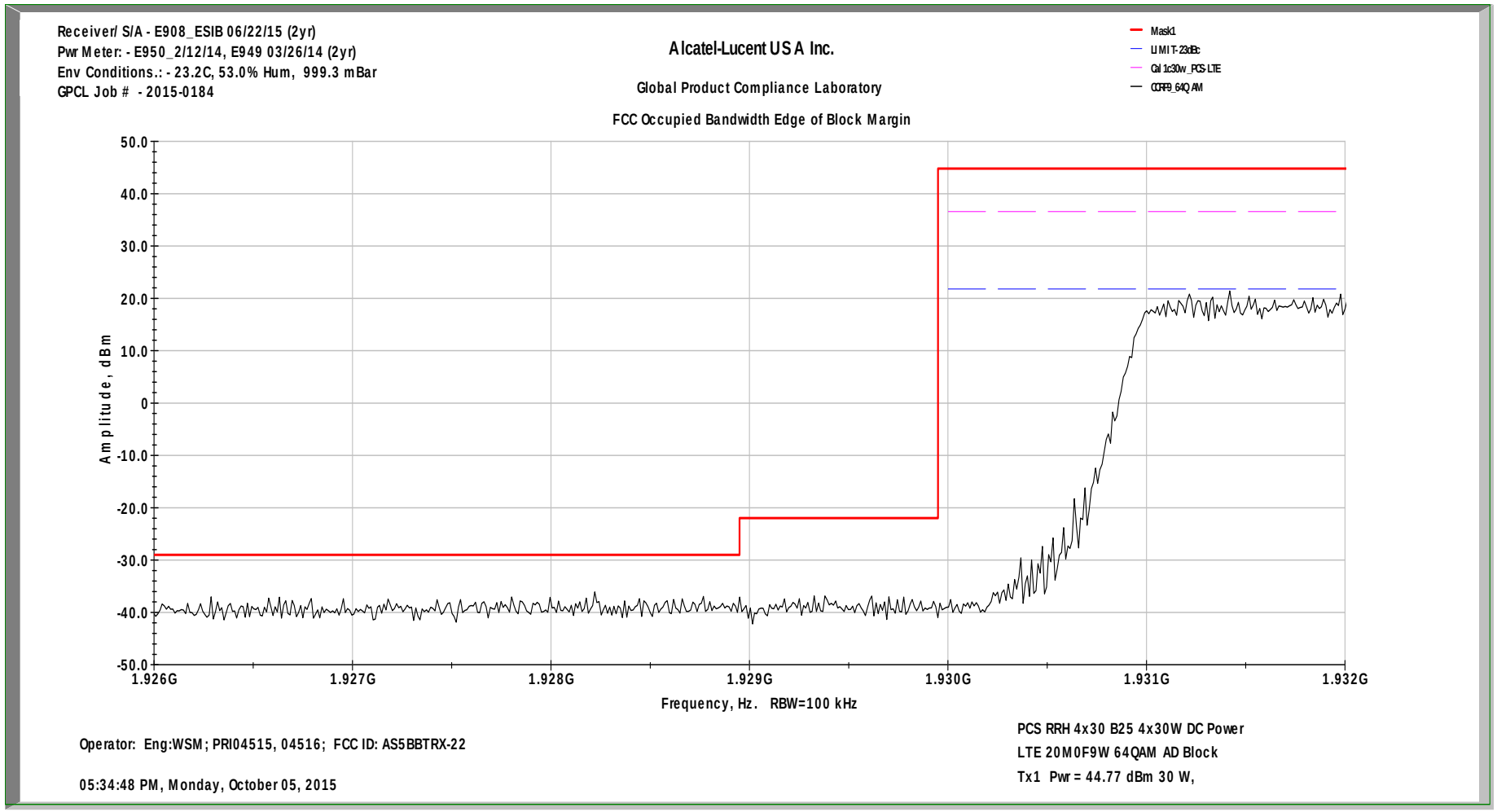
Occupied Bandwidth **PCS RRH 4x30 B25** **4x30W Mode** **Primary Port Tx1; AD Block,** **20M0F9W**



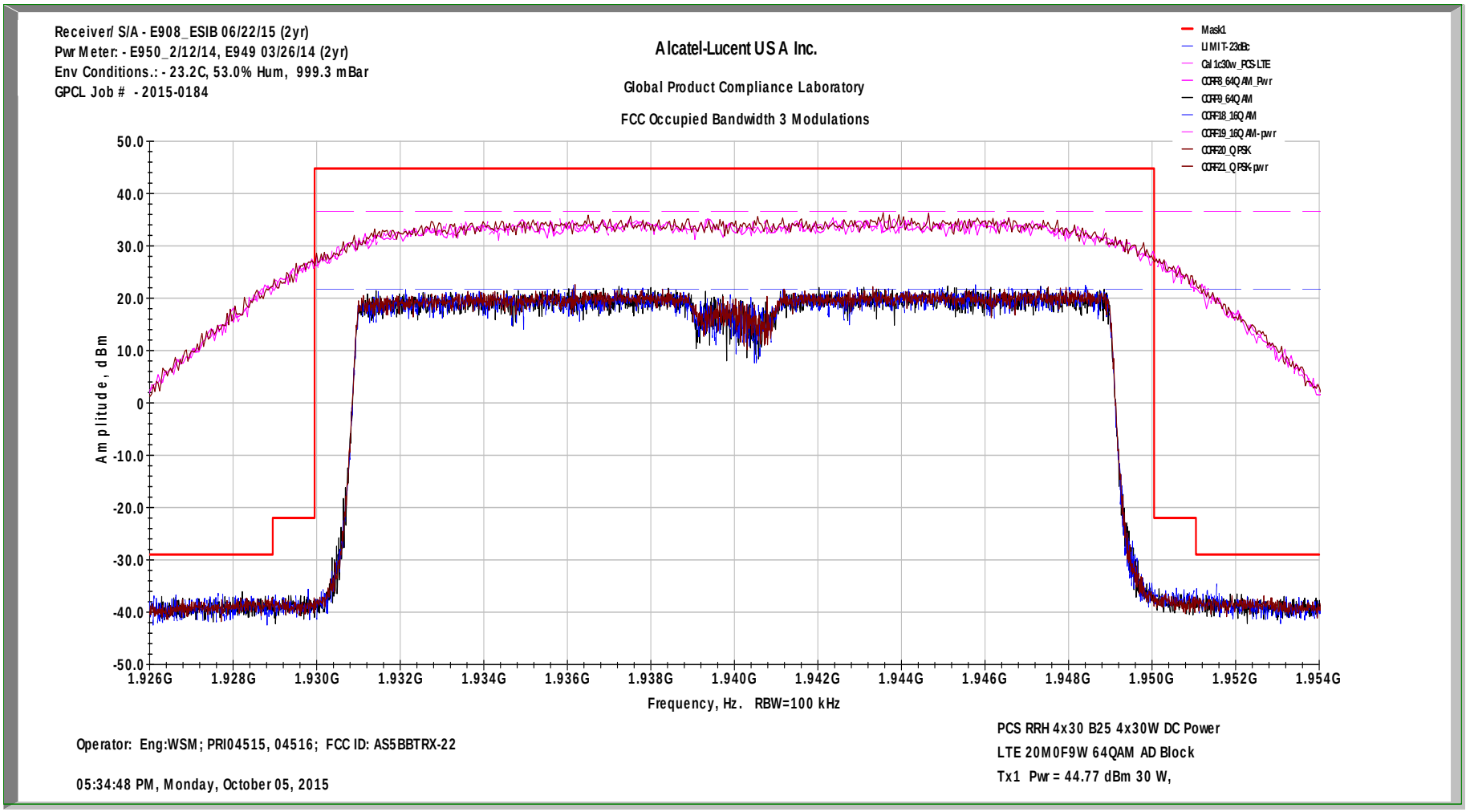
Occupied Bandwidth Band View PCS RRH 4x30 B25 4x30W Mode Primary Port Tx1; AD Block, 20M0F9W



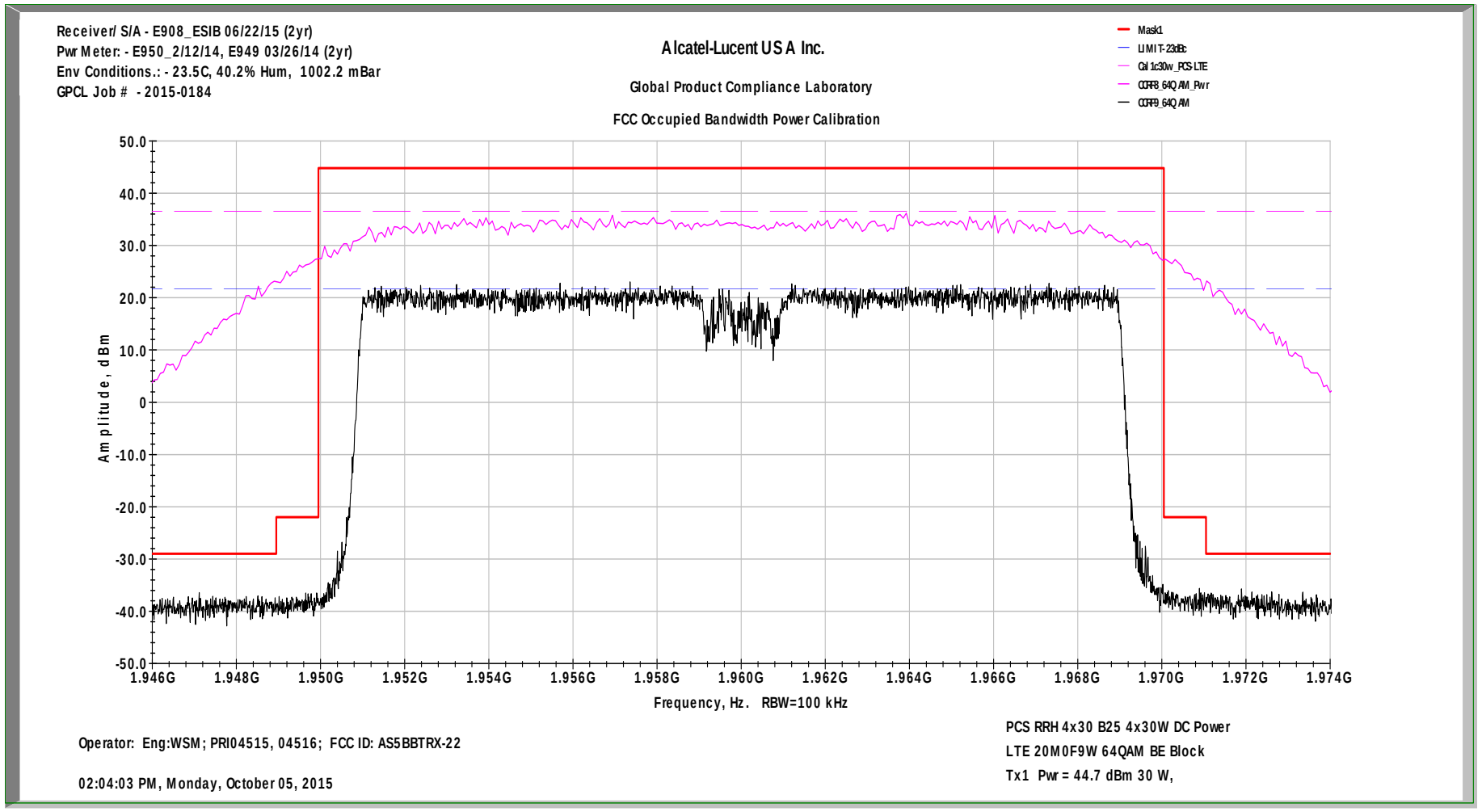
Occupied Bandwidth Edge of Block PCS RRH 4x30 B25 4x30W Mode Primary Port Tx1; AD Block, 20M0F9W



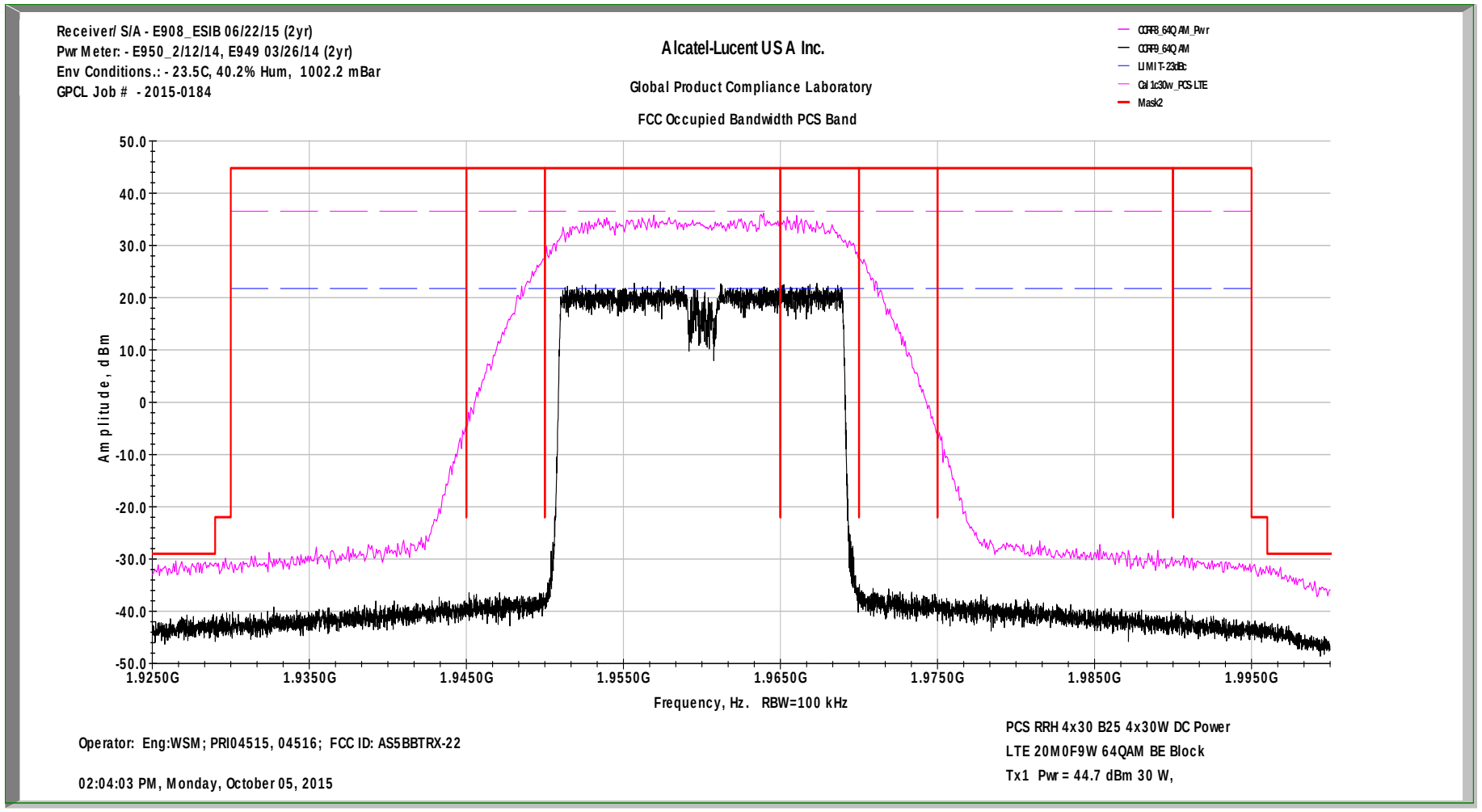
Occupied Bandwidth Multiple Modulations PCS RRH 4x30 B25 4x30W Mode Primary Port Tx1; AD Block, 20M0F9W



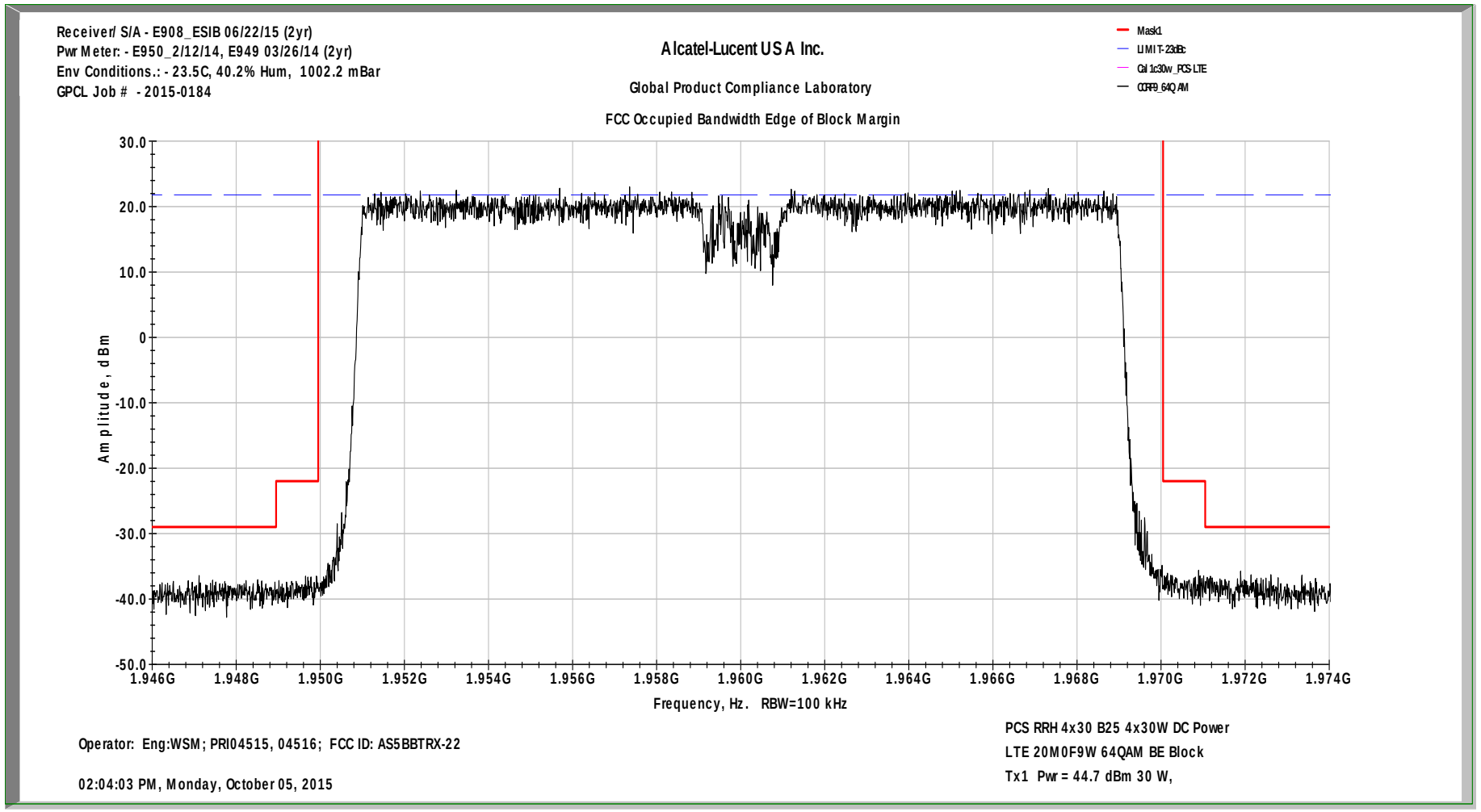
Occupied Bandwidth **PCS RRH 4x30 B25** **4x30W Mode** **Primary Port Tx1; BE Block,** **20M0F9W**



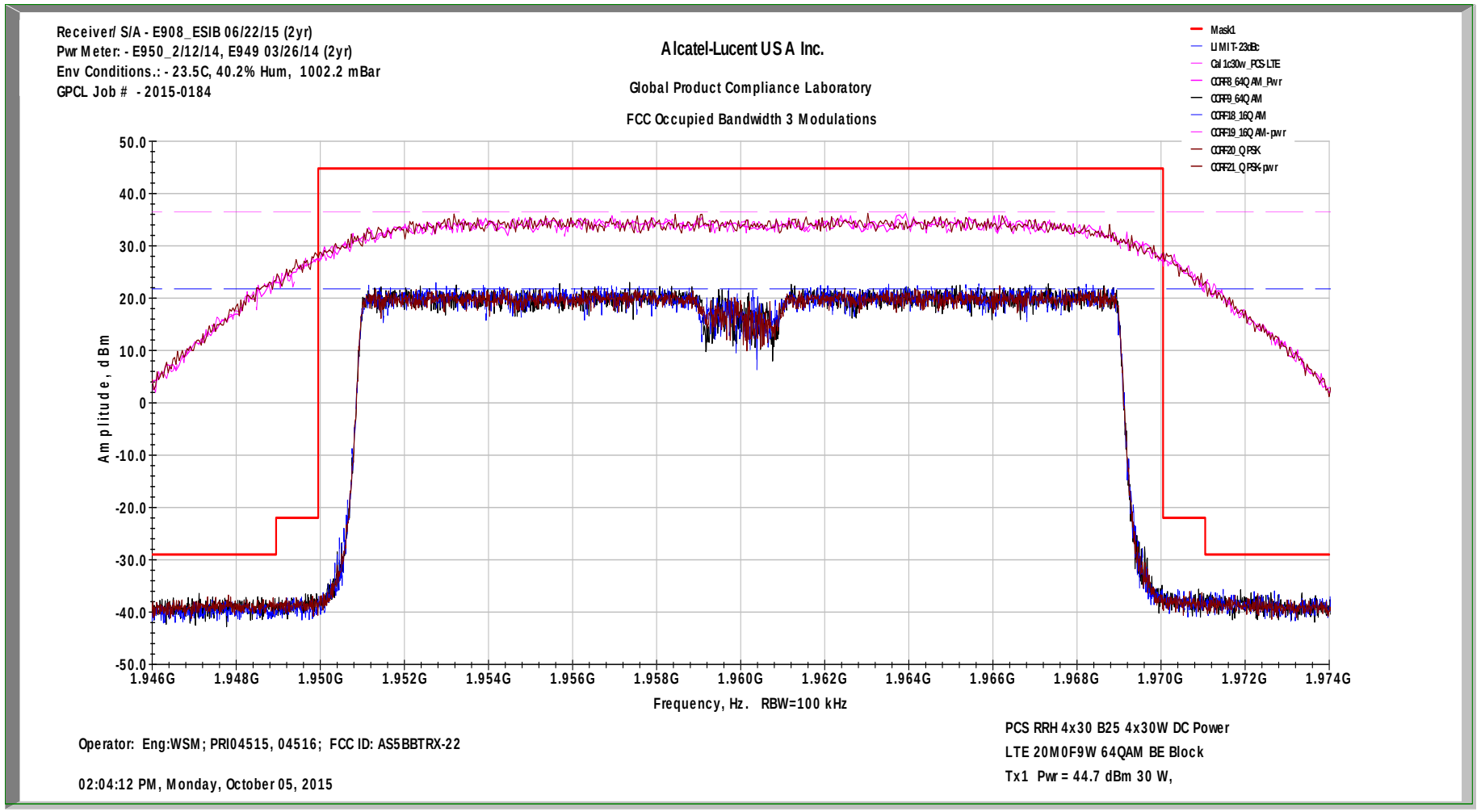
Occupied Bandwidth Band View PCS RRH 4x30 B25 4x30W Mode Primary Port Tx1; BE Block, 20M0F9W



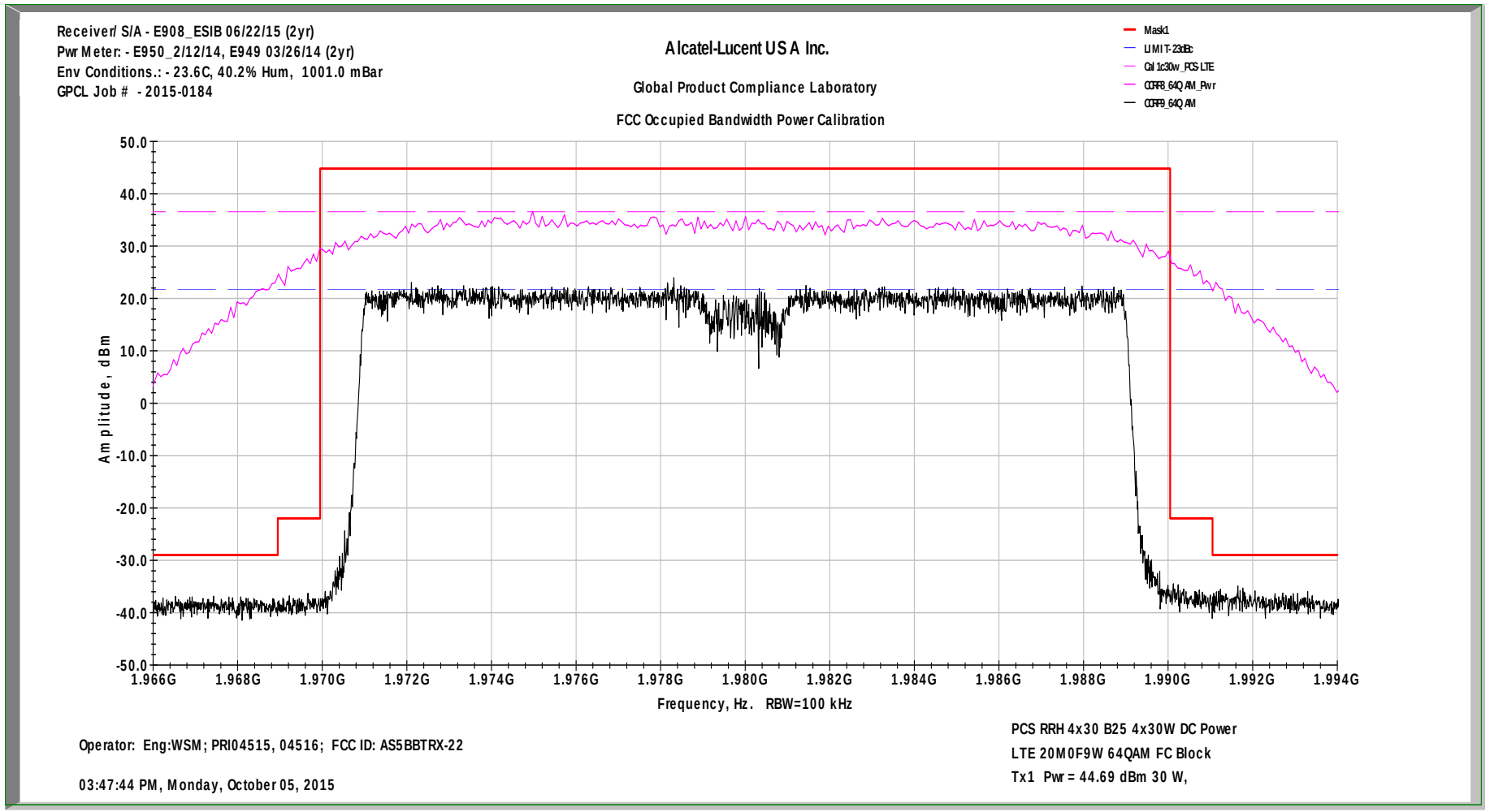
Occupied Bandwidth Edge of Block PCS RRH 4x30 B25 4x30W Mode Primary Port Tx1; BE Block, 20M0F9W



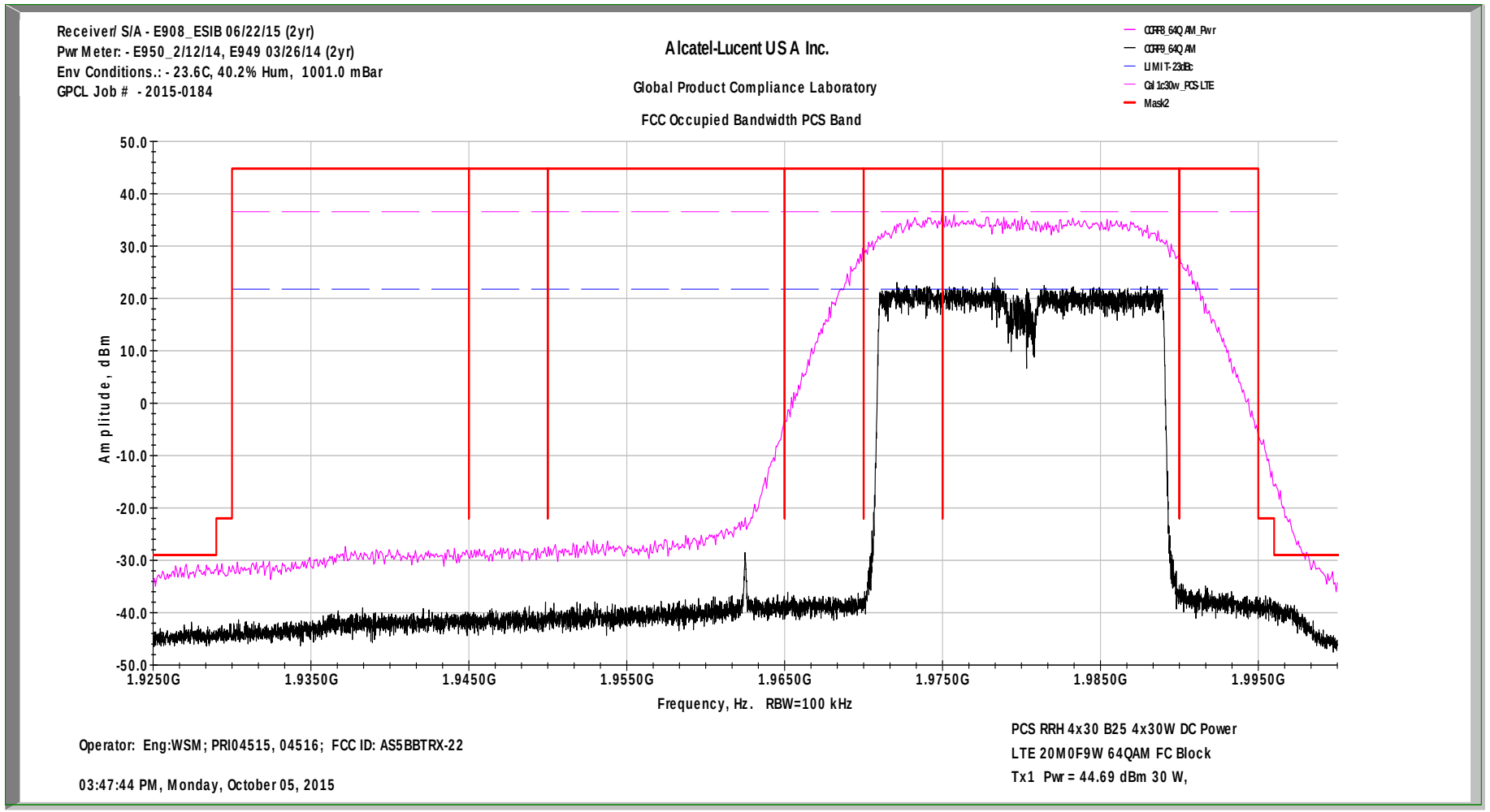
Occupied Bandwidth Multiple Modulations PCS RRH 4x30 B25 4x30W Mode Primary Port Tx1; BE Block, 20M0F9W



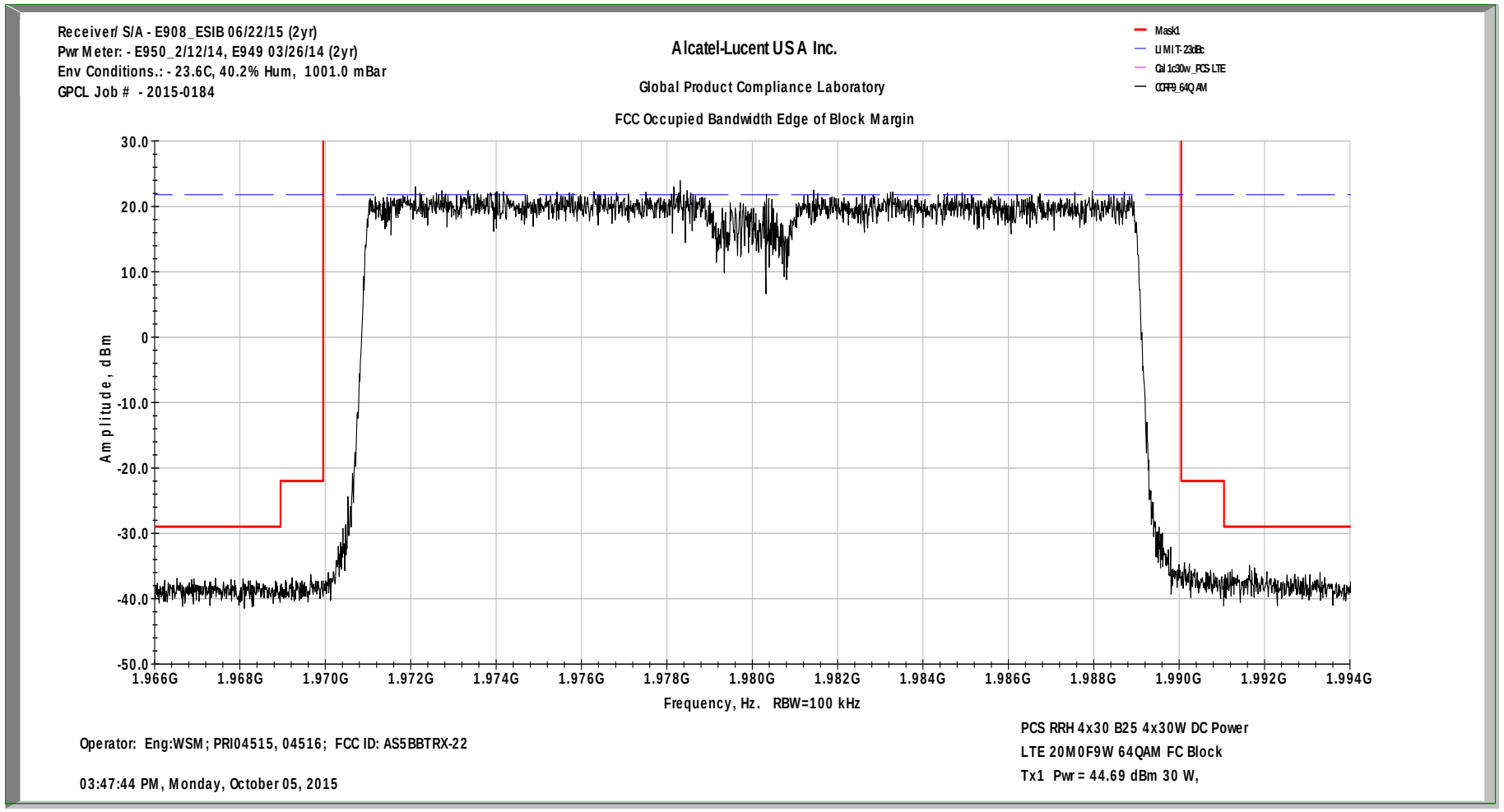
Occupied Bandwidth **PCS RRH 4x30 B25** **4x30W Mode** **Primary Port Tx1; FC Block,** **20M0F9W**



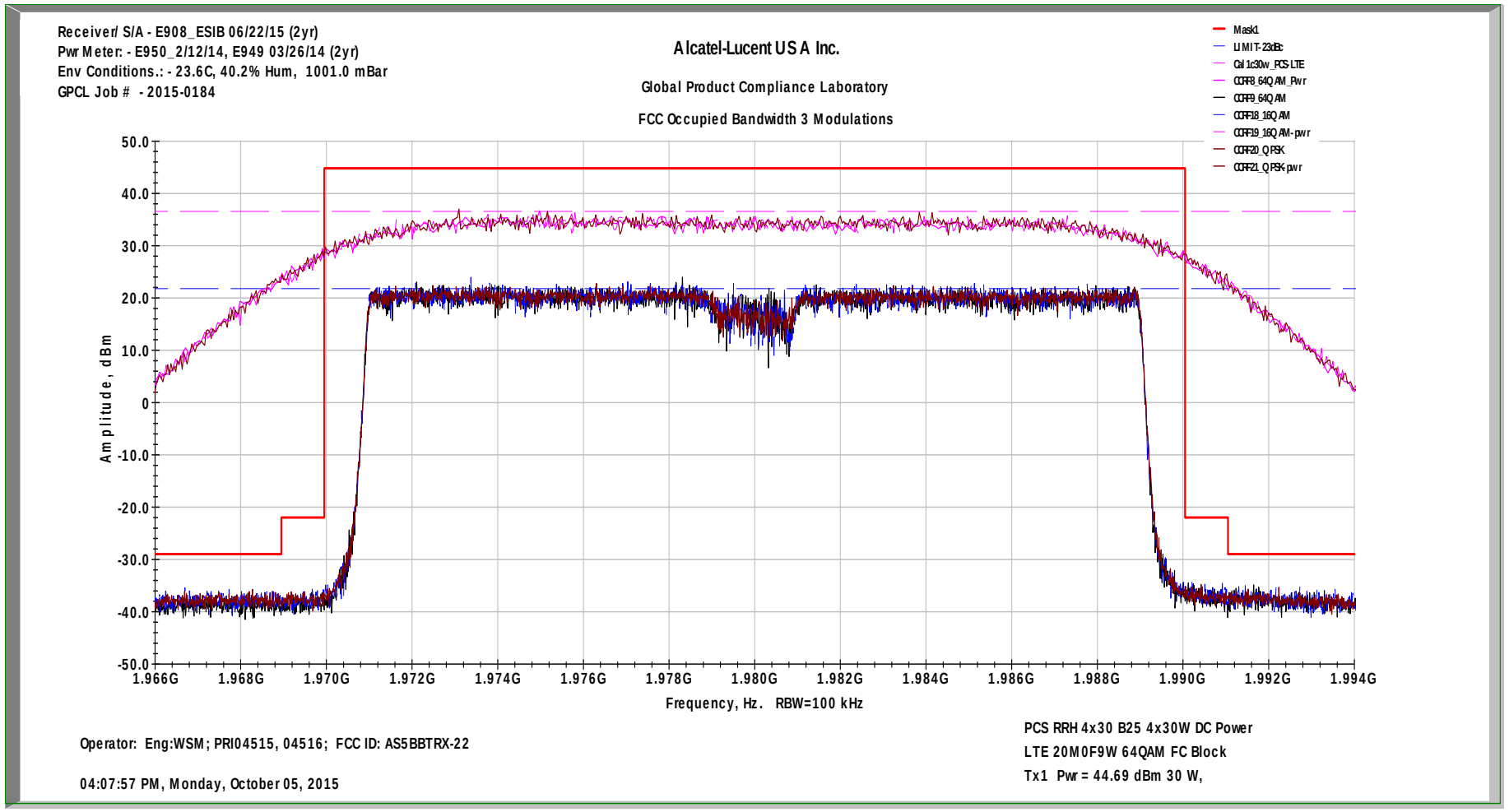
Occupied Bandwidth Band View PCS RRH 4x30 B25 4x30W Mode Primary Port Tx1; FC Block, 20M0F9W



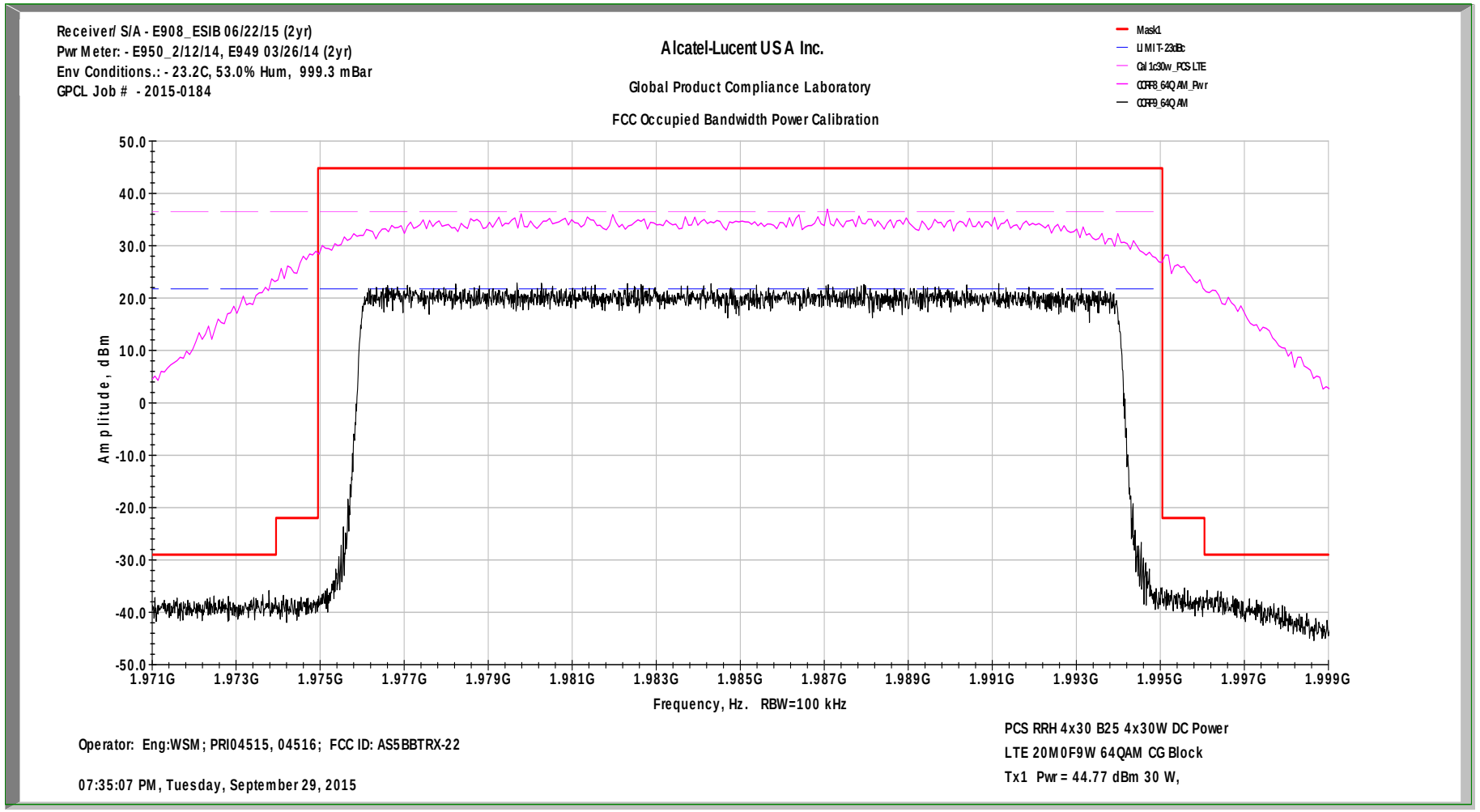
Occupied Bandwidth Edge of Block PCS RRH 4x30 B25 4x30W Mode Primary Port Tx1; FC Block, 20M0F9W



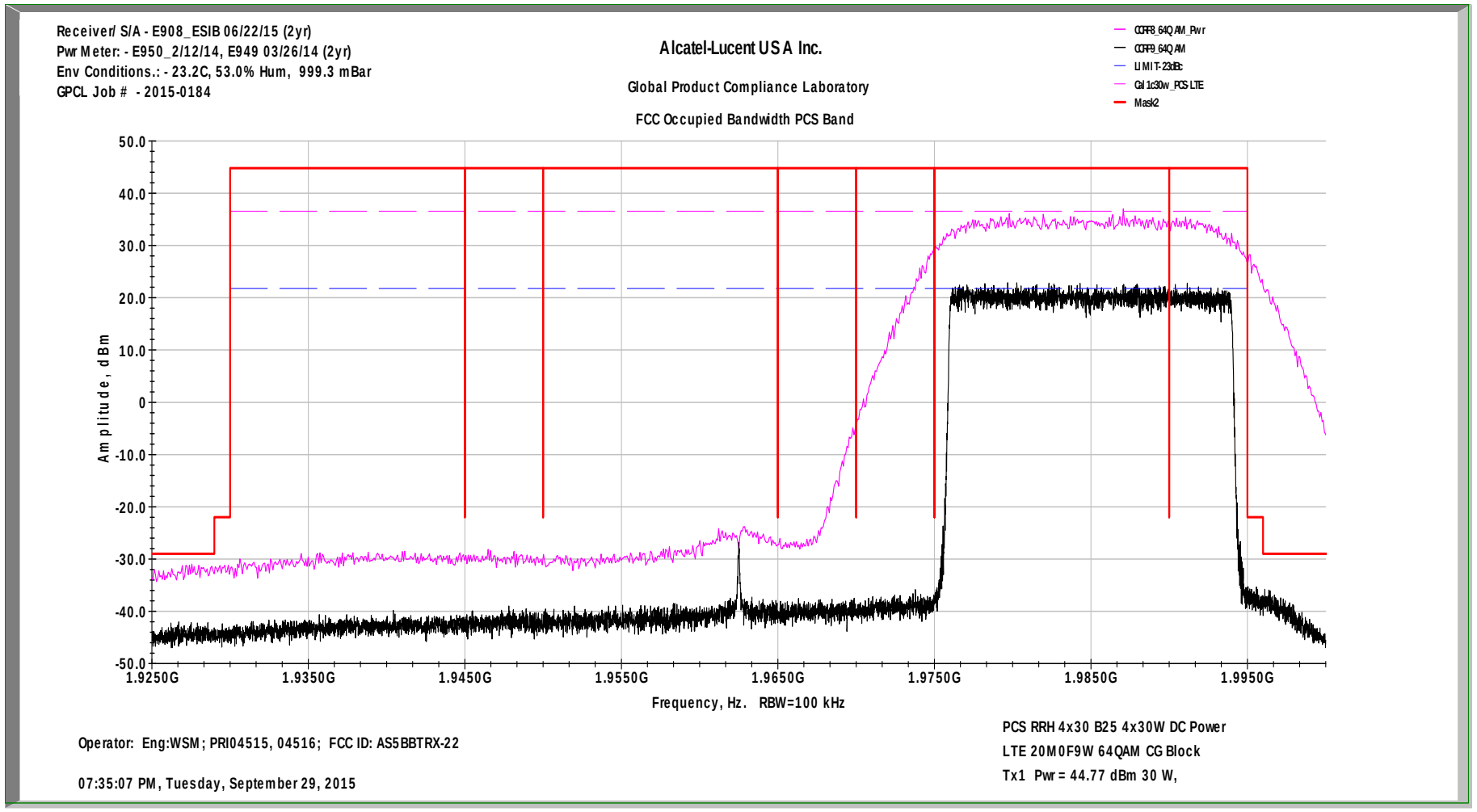
Occupied Bandwidth Multiple Modulations PCS RRH 4x30 B25 4x30W Mode Primary Port Tx1; FC Block, 20M0F9W



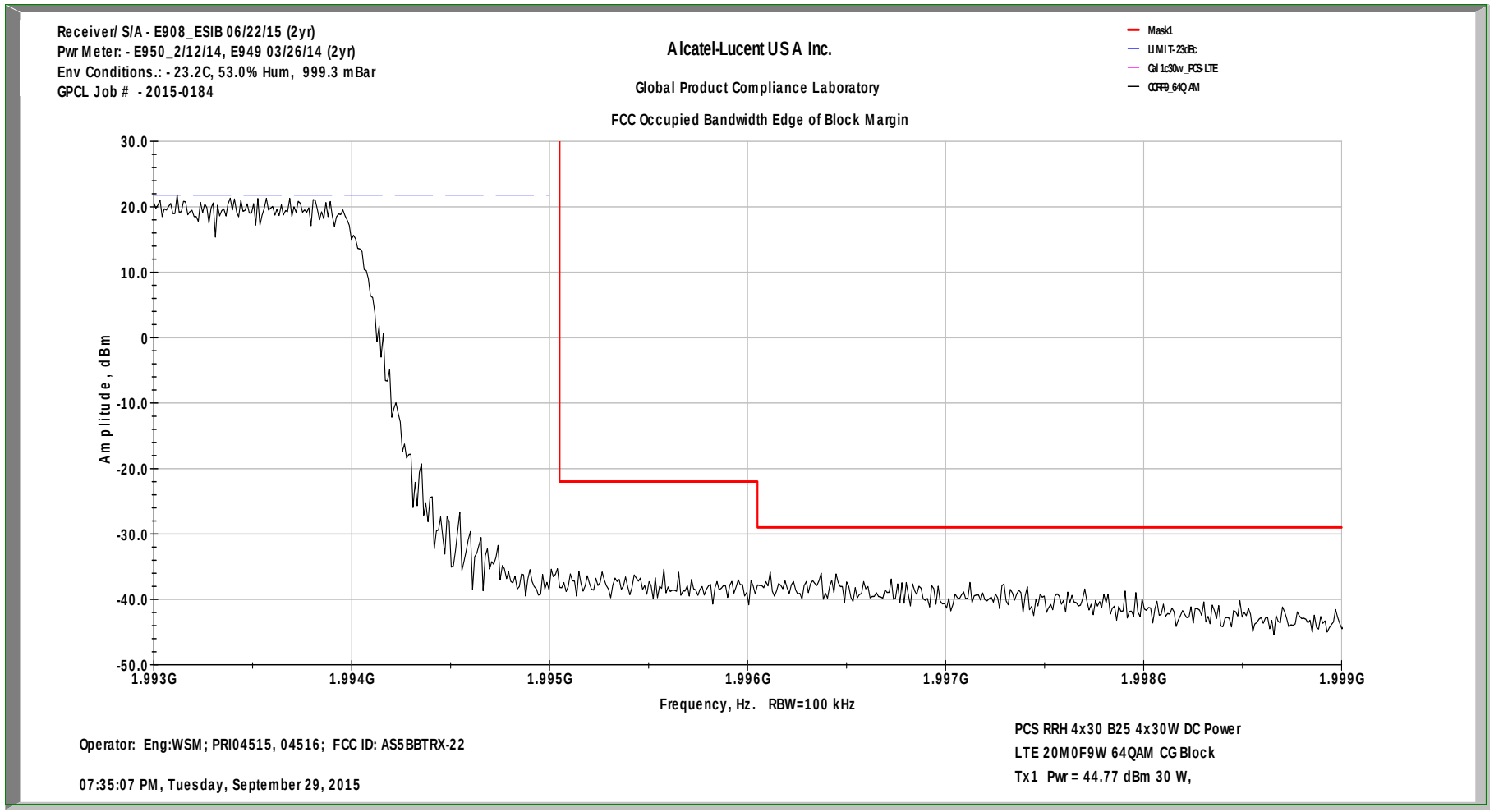
Occupied Bandwidth **PCS RRH 4x30 B25** **4x30W Mode** **Primary Port Tx1; CG Block,** **20M0F9W**



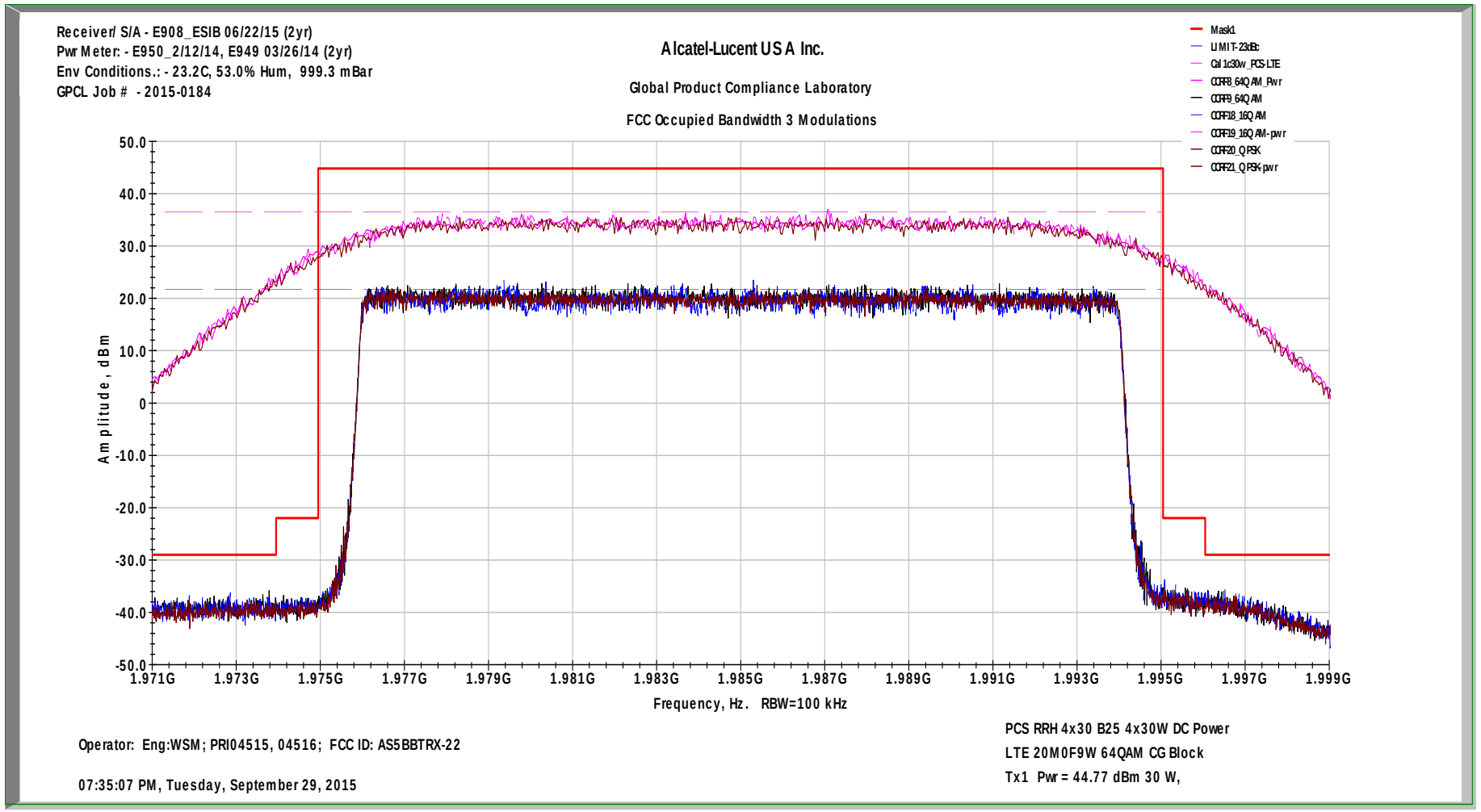
Occupied Bandwidth Band View PCS RRH 4x30 B25 4x30W Mode Primary Port Tx1; CG Block, 20M0F9W



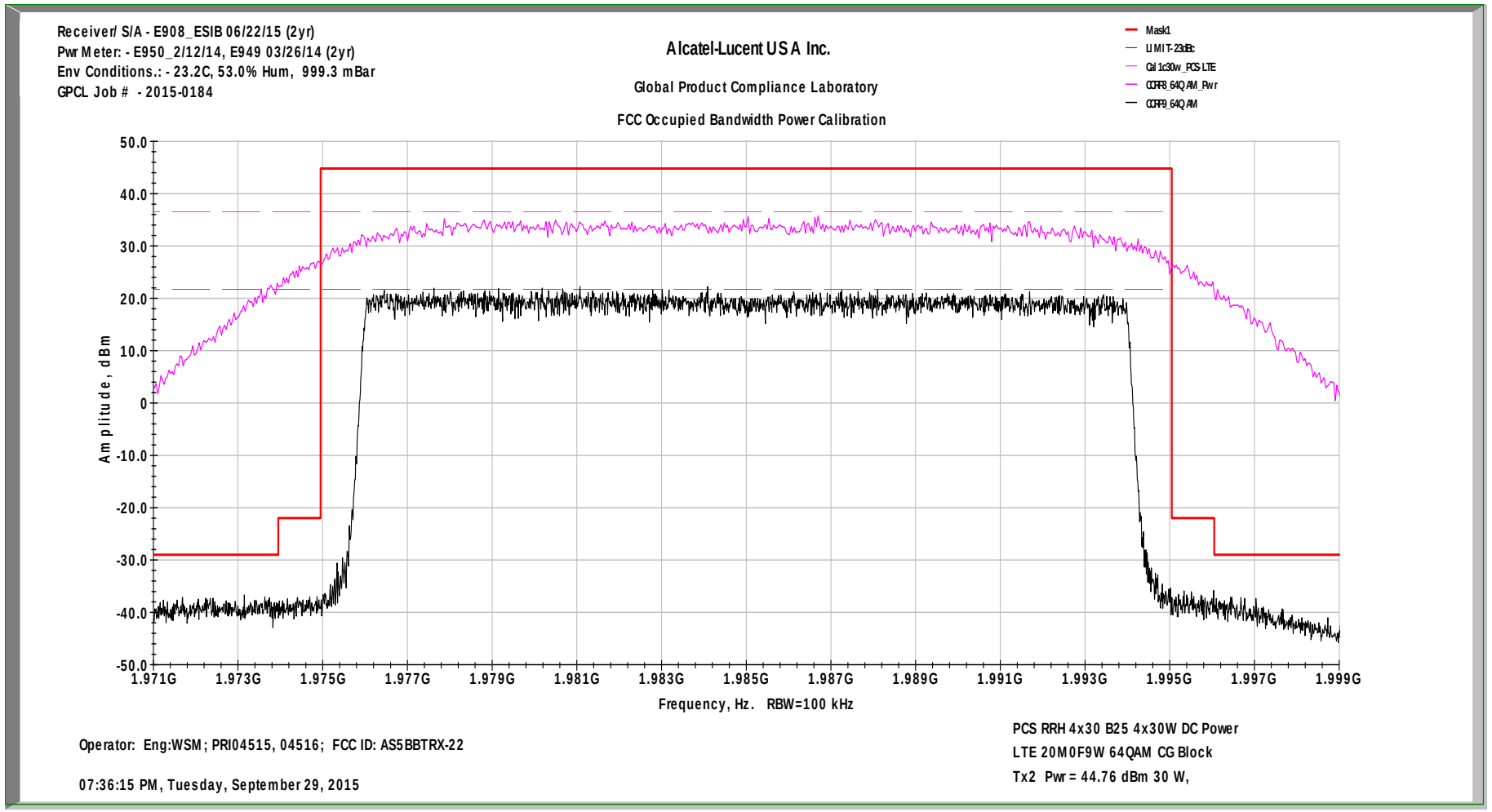
Occupied Bandwidth Edge of Block PCS RRH 4x30 B25 4x30W Mode Primary Port Tx1; CG Block, 20M0F9W



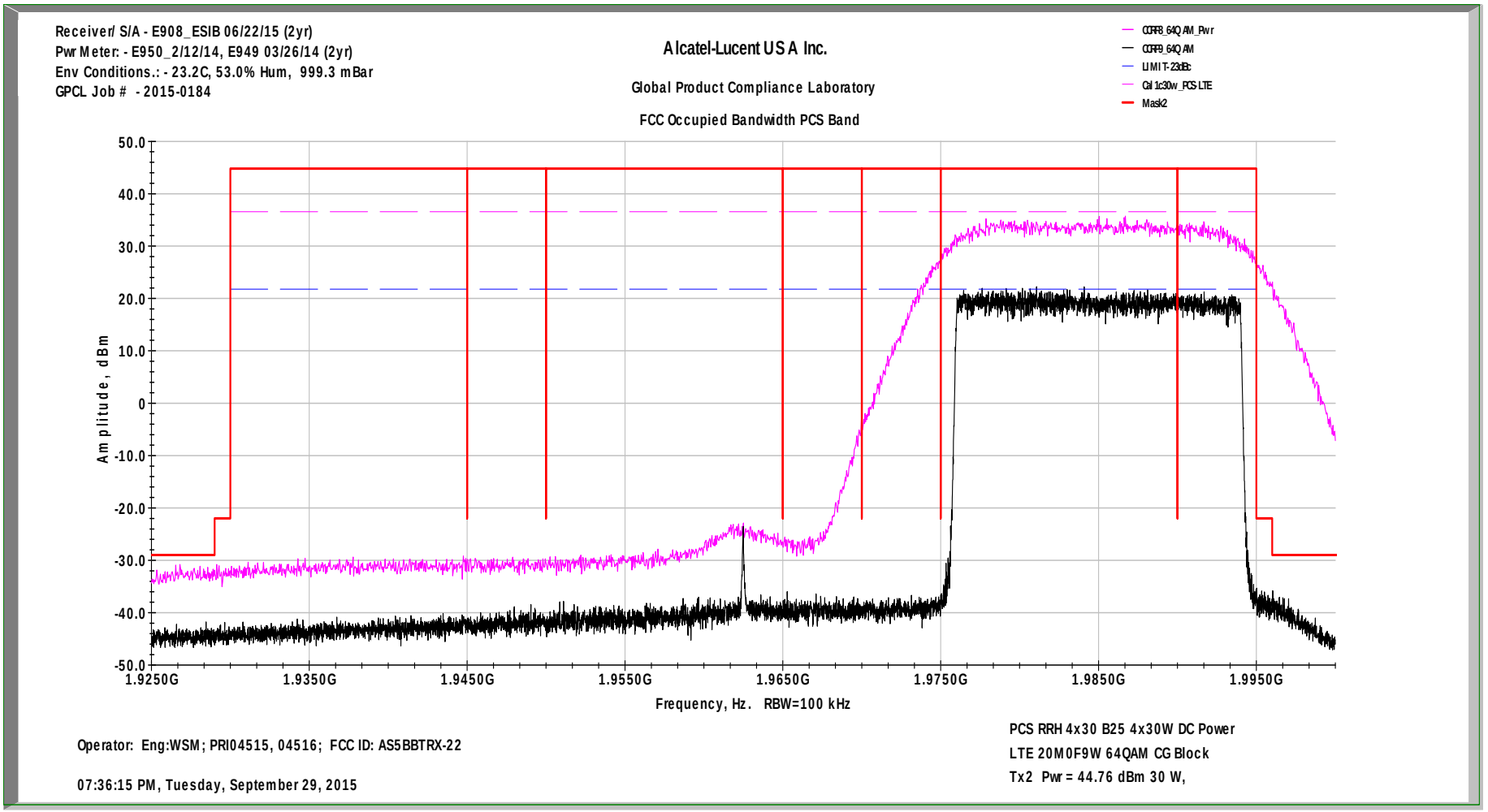
Occupied Bandwidth Multiple Modulations PCS RRH 4x30 B25 4x30W Mode Primary Port Tx1; CG Block, 20M0F9W



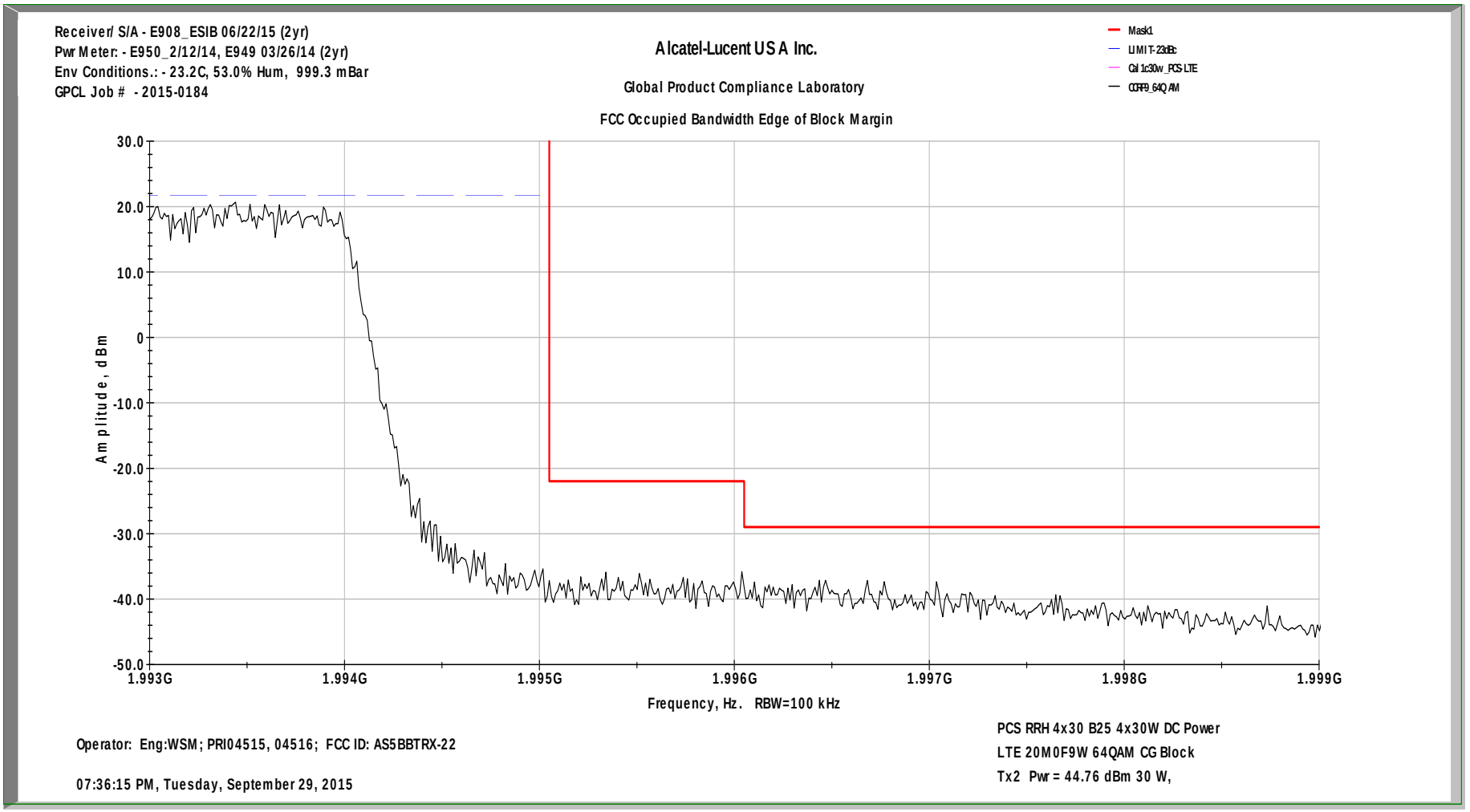
Occupied Bandwidth **PCS RRH 4x30 B25** **4x30W Mode** **Primary Port Tx2; CG Block,** **20M0F9W**



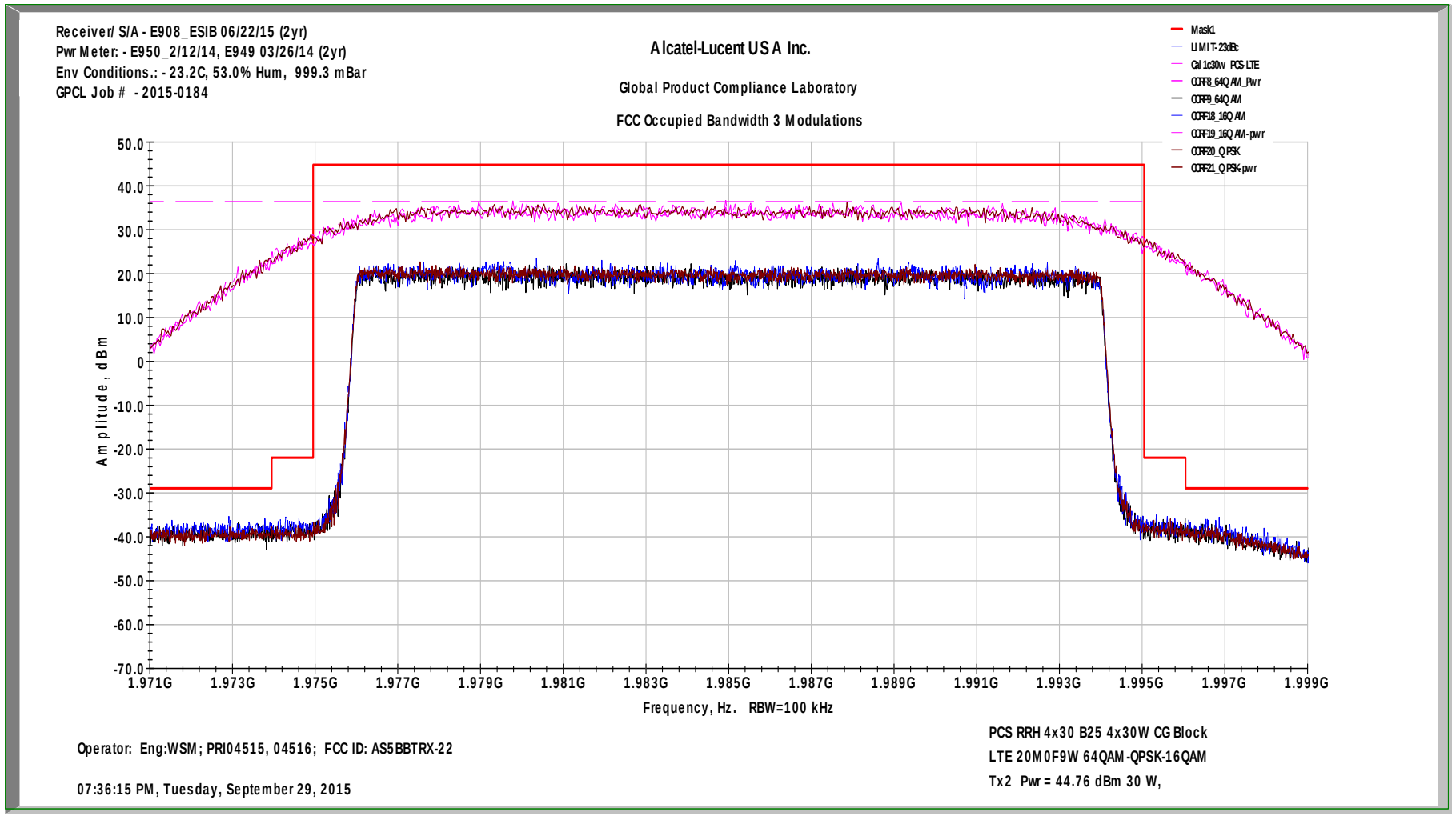
Occupied Bandwidth Band View PCS RRH 4x30 B25 4x30W Mode Primary Port Tx2; CG Block, 20M0F9W



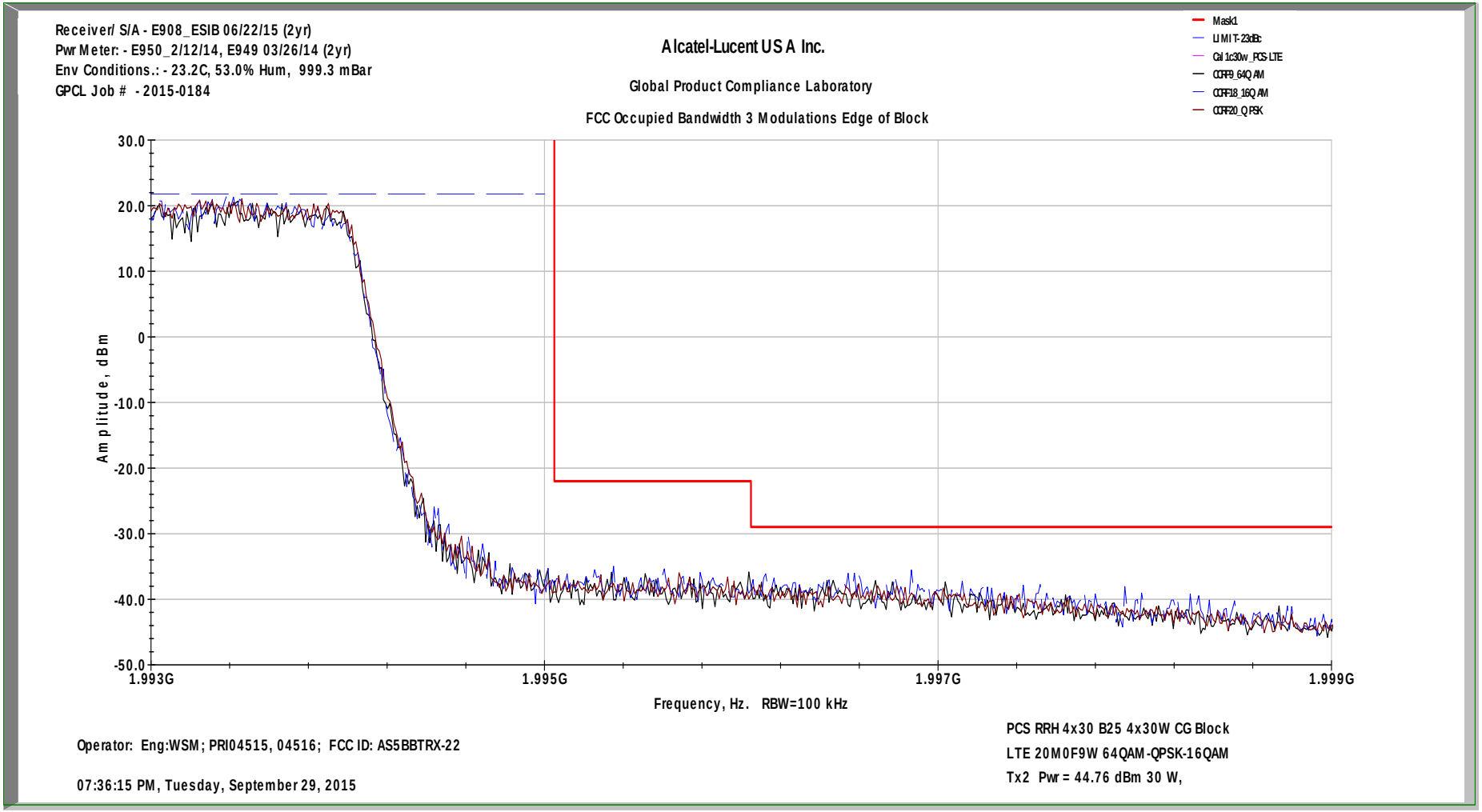
Occupied Bandwidth Edge of Block PCS RRH 4x30 B25 4x30W Mode Primary Port Tx2; CG Block, 20M0F9W



Occupied Bandwidth Multiple Modulations PCS RRH 4x30 B25 4x30W Mode Primary Port Tx2; CG Block, 20M0F9W



Occupied Bandwidth Edge of Block - Multiple Modulations PCS RRH 4x30 B25 4x30W Mode Primary Port Tx2; CG Block, 20M0F9W



11.5 Conducted Spurious Emissions at Antenna Terminals

11.5.1 Section 2.1051 Conducted Spurious Emissions at Antenna Terminals

Spurious Emissions at the antenna terminals were investigated over the frequency range of 10 MHz to 20 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 11.4A which documents the test configuration used for the measurements. In this set up the complete RF test path was calibrated over the 10 MHz-20 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 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 $x10^5$ data points over the frequency range of 10 MHz to 20 GHz.

*11.5.2 **Required Limit***

The required emission limitation specified in **47CFR 24.238 1-Oct-2010** was applied to these tests. Based upon the criterion given in Section 24.238 of the Code and as developed in Exhibit 14, the required emission limit in 47 CFR 24.238(a) 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.

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

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 and accurately depicts the carrier output power in relation to the spurious signals and the defined limit.

11.5.3 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.

TABLE 15.2 PCS Conducted Spurious Compliance Tabulation

Combined PCS Blocks	Center Frequency MHz	Mode of Operation	Port Power, W	Results Conducted Spurious
AD	1940	2xMIMO	60.0	Compliant
BE	1960	2xMIMO	60.0	Compliant
FC	1980	2xMIMO	60.0	Compliant
CG	1985	2xMIMO	60.0	Compliant
AD	1940	4xMIMO	30.0	Compliant
BE	1960	4xMIMO	30.0	Compliant
FC	1980	4xMIMO	30.0	Compliant
CG	1985	4xMIMO	30.0	Compliant

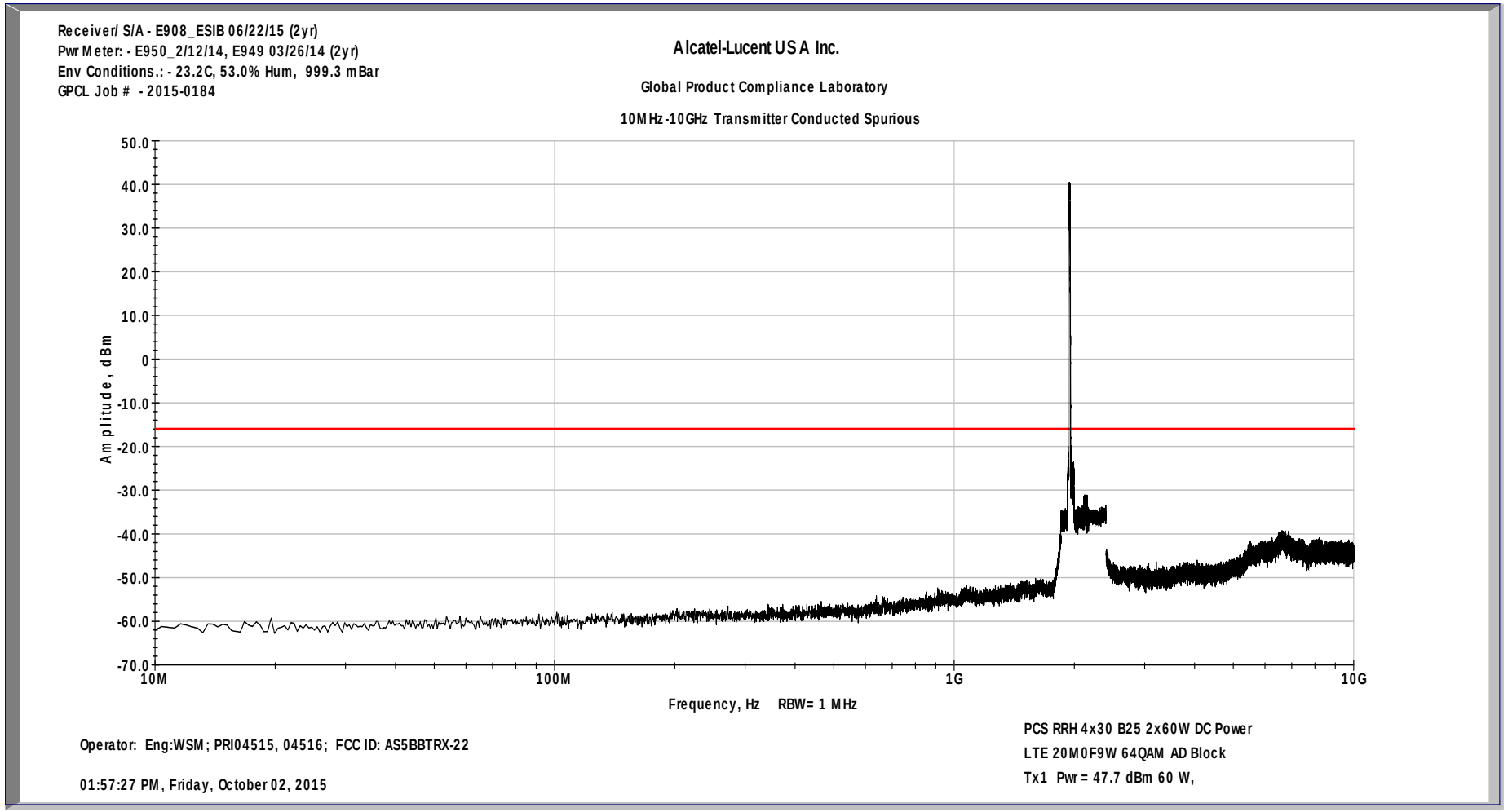
11.5.4 Test Results Summary

Conducted Spurious measurements were performed for the Primary and Diversity antenna ports of the **PCS LTE RRH 4x30 Band 25 Outdoor Transceiver System / FCC ID: AS5BBTRX-22.** The PCS LTE RRH 4x30 Band 25 was configured with an output power of either 60W for the 2xMIMO or 30W for the 4x MIMO configurations. Conducted Transmit Spurious measurements were performed as part of the automated test profile for Occupied bandwidth. Every combined PCS Block and Port that was measured for Occupied Bandwidth therefore included a Conducted Spurious measurements at the antenna transmit port as documented in Table 15.2.

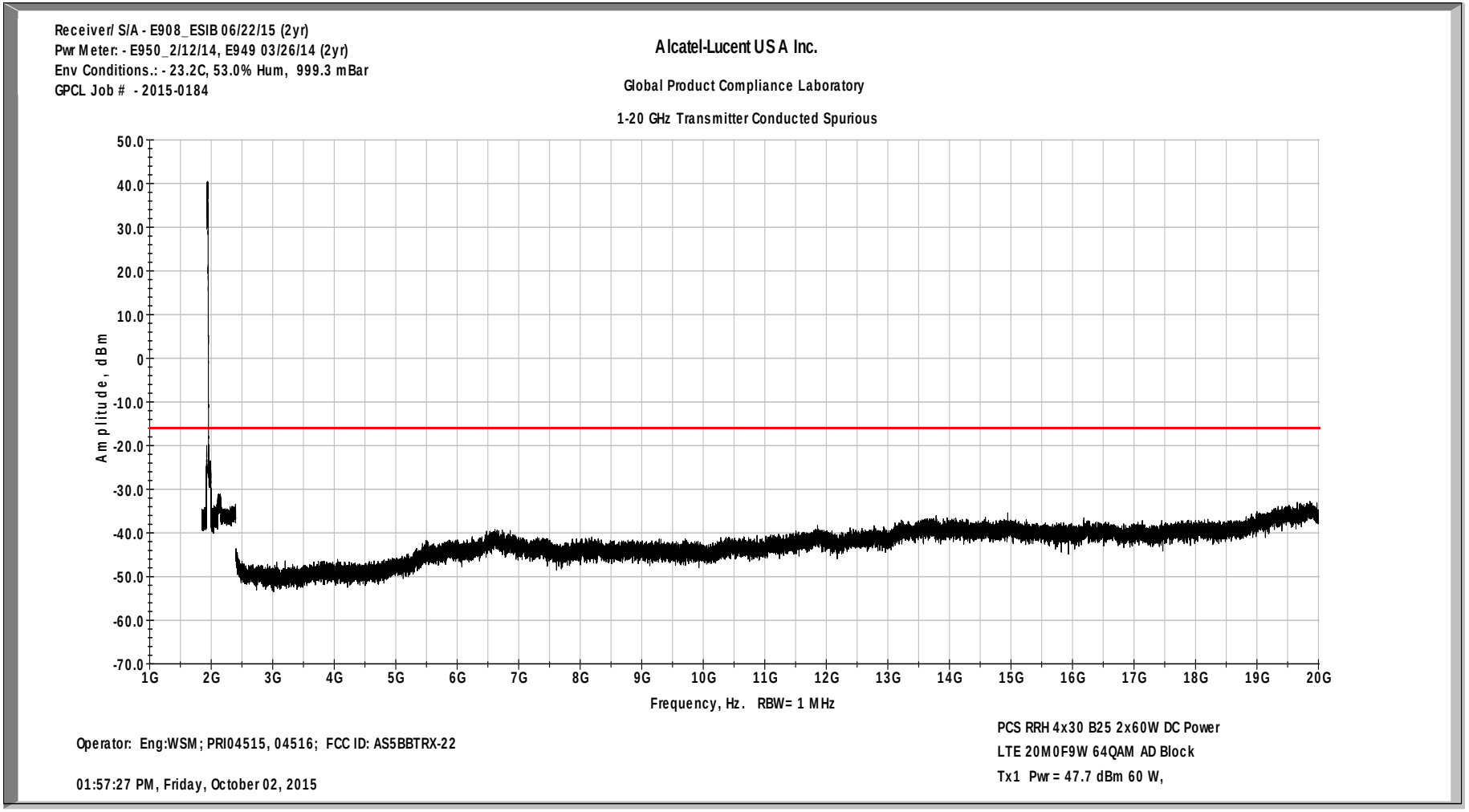
The attached spectral plots are representative of the Conducted Spurious compliance performance of the **PCS LTE RRH 4x30 Band 25 Outdoor Transceiver System / FCC ID: AS5BBTRX-22.** The compliance for all of the representative transmit configurations are documented in Table 15.2. This Table lists PCS 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 for 2x MIMO or -19 dBm for 4x MIMO. The attached table and sample data plots document the results.

Transmitter Measurements
of
Conducted Spurious Emissions
for
Alcatel-Lucent USA Inc.
20M0F9W Emissions Designator
2x60W and 4x30W configurations
PCS LTE RRH 4x30 Band 25 Outdoor Transceiver System
FCC ID: AS5BBTRX-22

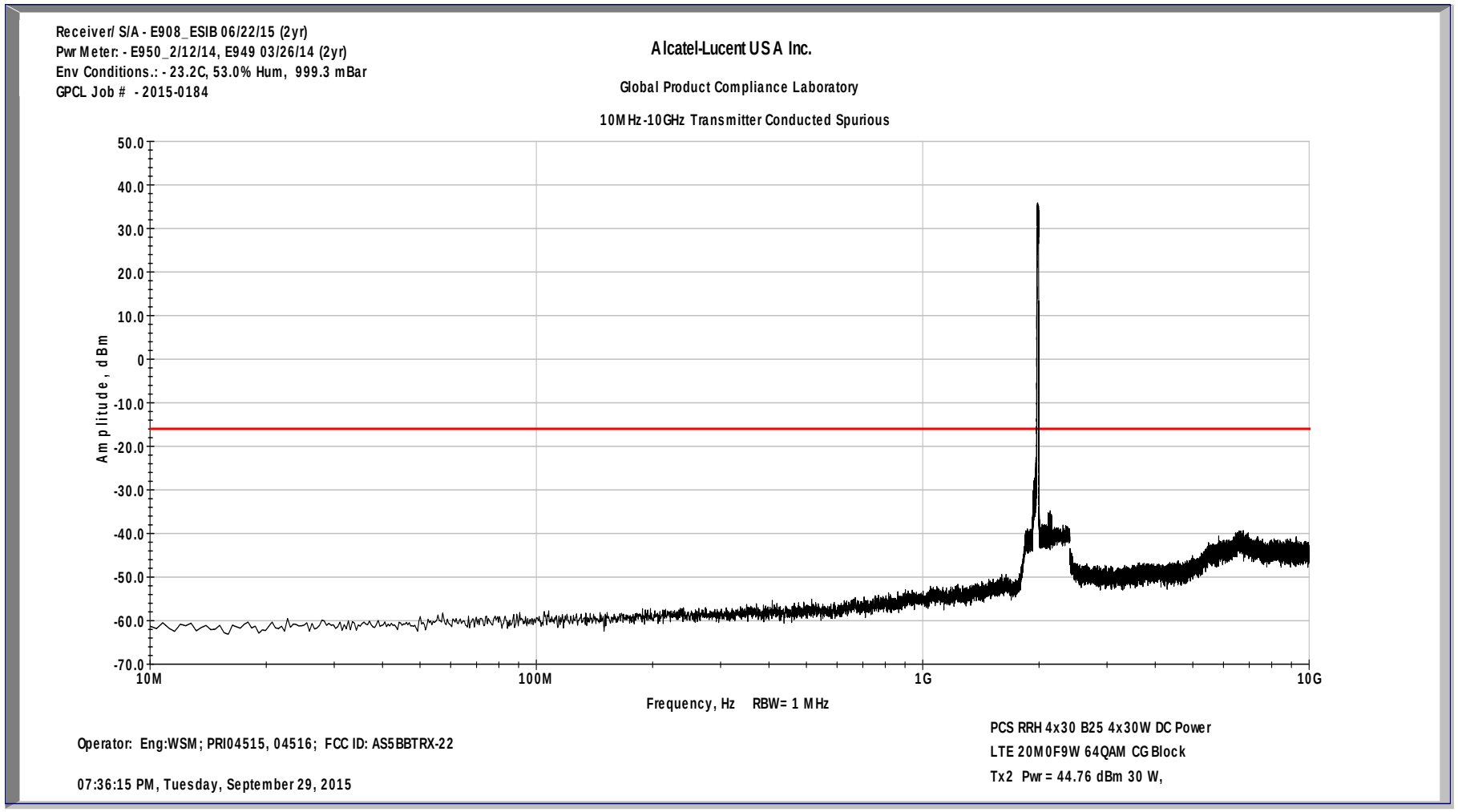
Conducted Spurious 10 MHz - 10 GHz PCS RRH 4x30 B25 2x60W Mode Primary Port Tx1; AD Block, 20M0F9W



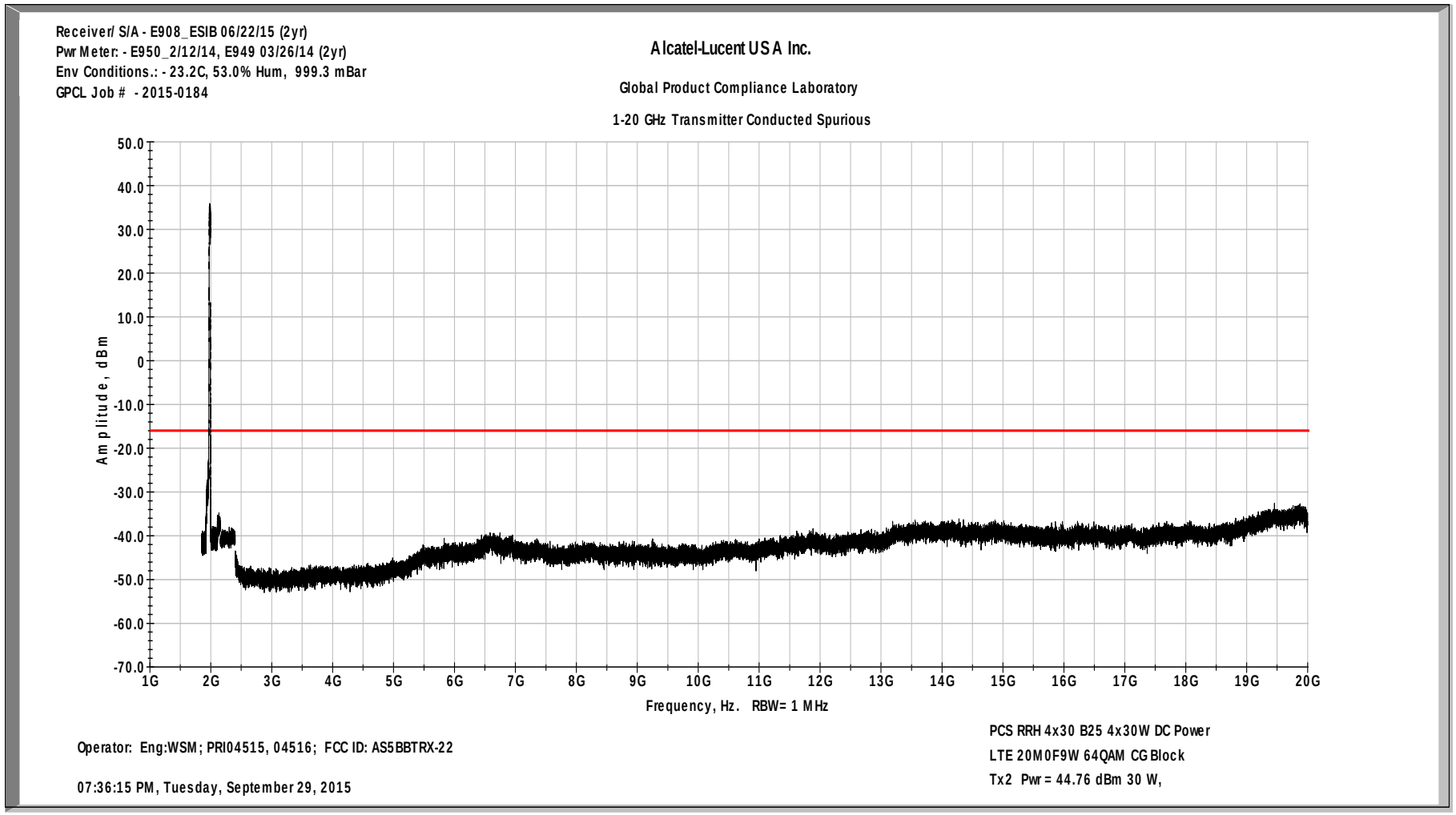
Conducted Spurious 1 GHz - 20 GHz PCS RRH 4x30 B25 2x60W Mode Primary Port Tx1; AD Block, 20M0F9W



Conducted Spurious 10 MHz - 10 GHz PCS RRH 4x30 B25 4x30W Mode Primary Port Tx2; CG Block, 20M0F9W



Conducted Spurious 1 GHz - 20 GHz PCS RRH 4x30 B25 4x30W Mode Primary Port Tx2; CG Block, 20M0F9W



11.6 Exhibit 16 FIELD STRENGTH OF SPURIOUS RADIATION

SECTION 2.1053 Field Strength Of Spurious Radiation

Field strength measurements of radiated spurious emissions were evaluated in the AR7 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 **PCS LTE RRH 4x30 Band 25 Outdoor Transceiver System / FCC ID: AS5BBTRX-22** was configured into a representative field installation and was tested when operating in the combined PCS block. The spectrum from 10 MHz to the tenth harmonic of the carrier (20 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 of field 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 24.238 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 = 120W

11.6.1 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 (20GHz), no reportable spurious emissions were detected. This demonstrates that the **PCS LTE RRH 4x30 Band 25 Outdoor Transceiver System / FCC ID: AS5BBTRX-22**, the subject of this application, complies with Sections 2.1053, 24.238 and 2.1057 of the Rules.

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