EXHIBIT 6

HUB Test plan and Report

Date	Rev	Revision Record	Approved
12/17/99	0.9	Test plan	JR
5/15/00	1	Test Report Released	JR

PMP 39.65 to 40 GHz
Agency Certification Test Report
For
HUB High Band

Prepared for
Hughes Network Systems
11717 Exploration Lane
Germantown, MD 20876

Hughes Proprietary II

Job: 01040	Approvals	Date	
Originator:	S. Albanna	12/17/99	*Hughes Network Systems*
Approved:	J. Rymkiewicz	5/17/00	
Checked:			Title: PMP 39.65 to 40 GHz Agency Certification Test Report For HUB High Band
	Sheet 2 of 1		CAGE No. 52571 / No. 1029613

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1.0 OVERVIEW

1.1 PRODUCT DESCRIPTION

This test plan has been prepared by Hughes Network Systems to document the required RF Type Acceptance FCC101 subparts C& H (Fixed Microwave Services) on the Point to Multipoint - Aireach product (PMP). The purpose of this testing is to determine performance against the requirements for the FCC 101 subsections mentioned.

This test plan and report will demonstrate the compliance with the FCC 101 for the High Band (HB) Subscriber systems.. The following 38-40 GHz subsystems units are/will be tested and submitted:

HB SUB (High Band Subscriber unit) Tx (38606.25- 38943.75) MHz HNS **1029622**

HB HUB (High Band HUB unit) Tx (39306.25- 39643.75) MHz HNS **1029613**

In this test plan and report we are verifying the HB HUB, the HB SUB data will be in another HNS test report HNS **1029622**

The HNS PMP provides services to carry voice and data efficiently and economically. The system is based upon multi-sector cells with TDMA/TDMA air Interface. It provides sophisticated multi-mode modulation (QPSK, 64-QAM, and 16-QAM) on a per-burst basis to efficiently handle broad ranging requirements for sector capacity and sector size.

The overall PMP network Architecture includes several elements, including the radios, the transmission equipment, and the central office equipment. The HNS portion of this system is the HNS 38 GHz Point-to Multipoint (PMP). This includes subscriber premises equipment, PMP HUB radio equipment, and interfaces to commercially available multiplexing equipment. These interfaces include the (SONET) backbone and dedicated trunks to the voice switch, as well as IP routers and other data delivery systems.
The PMP product is broken into two terminals, a hub terminal (HT) and a remote Terminal (RT). The HT is responsible on routing the data/voice signals from one RT to another. The RT is at the customer premises and comprises 3 components:

ODU: Outdoor Unit: which is an integrated 38 GHz Trasnsceiver and antenna,

(IDU) the Indoor unit that provide modem and remote multiplexers function, and finally,

The Interfacility Link (IFL) which is a single coaxial cable that interconnects the ODU and IDU. The HT has the same main components, it supports one sector with one over-the air frequency (12.5 MHz subchannal).

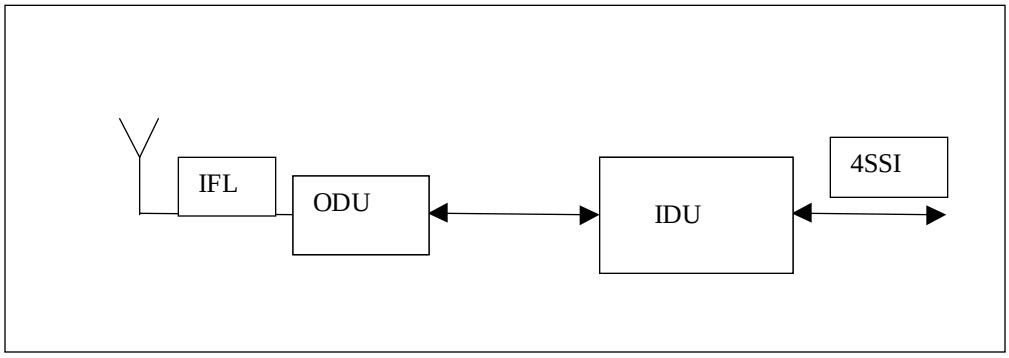


Figure 1 Basic RT/HT Terminal

Figure 1 shows a basic block diagram for the RT/HT system. The IFL cable shown carries DC power signal, reference carrier frequency, the Up-link and the Down-link IF signals and the telemetry control link signals. The IDU is installed indoors, often in a wiring closet. It includes the IF, modem, air frame formatting login, the IFL interface, and the subscriber interface multiplexer function in one unit. Each IDU has four multi-port SSI slots to allow for several different user interfaces. For more description of product, it's operation and functionality, please refer to the DDD (Detailed Design document) HNS –13880.

1.2 CHANNELIZATION

The channelization, taken from the FCC regulations, CFR-47& 101.147 Frequency assignments, is given in Table 1.1. The HNS product further devides each 50 MHz license into four 12.5 MHz subchannels (see figure 2) The first number and the first letter of each designator are the FCC number for the channel. The last number is the subchannel designator. The figure shows the designation of FCC channel 1-A. Each of these subchannel operates at a symbol rate of 10.0Msps in the TDMA mode. The QPSK Spectral Density is 20Mbps in 12.5 Mhz or 1.6 bits/s/Hz and the 64-QAM spectral density is 60Mbps in 12.5 MHz or 4.8 bits/s/Hz

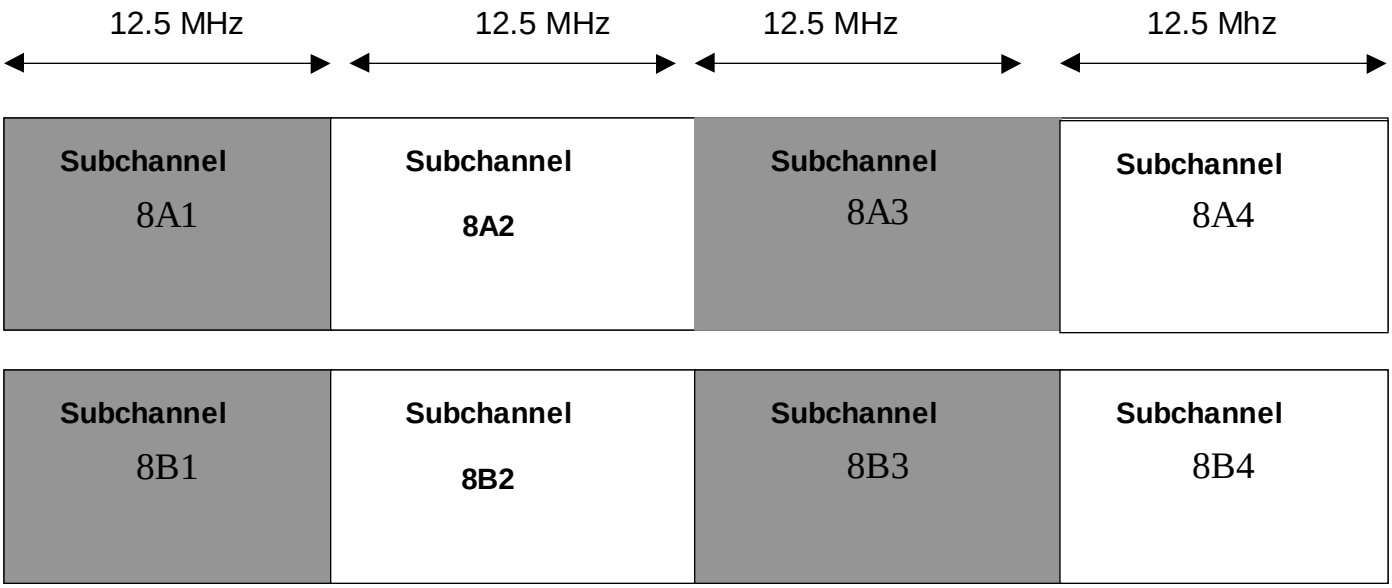


Figure 2 HNS Channelization

High Band HUB Channels		
Channel #	**Rx Frequency Band (MHz)**	**Tx Frequency Band**
8A	38950-39000	39650-39700
9A	39000-39050	39700-39750
10A	39050-39100	39750-39800
11A	39100-39150	39800-39850
12A	39200-39250	39850-39900
13A	39250-39300	39900-39950
14A	39350-39400	39950-40000
High Band HUB HNS SUB-Channels		
Channel #	**Rx Center Frequency (MHz)**	**Tx Center Frequency (MHz)**
8A1	38956.25	39656.25
8A2	38968.75	39668.75
8A3	38981.25	39681.25
8A4	38993.75	39693.75
9A1	39006.25	39706.25
9A2	39018.75	39718.75
9A3	39031.25	39731.25
9A4	39043.75	39743.75
10A1	39056.25	39756.25
10A2	39068.75	39768.75
10A3	39081.25	39781.25
10A4	39093.75	39793.75
18A1	39106.25	39806.25
11A2	39118.75	39818.75
11A3	39311.25	39831.25
11A4	39143.75	39843.75
12A1	39156.25	39856.25
12A2	39168.75	39868.75
12A3	39181.25	39881.25
12A4	39193.75	39893.75
13A1	39206.25	39906.25
13A2	39218.75	39918.75
13A3	39231.25	39931.25
13A4	39243.75	39943.75
14A1	39256.25	39956.25
14A2	39268.75	39968.75
14A3	39281.25	39981.25
14A4	39293.75	39993.75

Table 1 High Band HUB Channels

1.3 APPLICABLE STANDARDS

The considered standards are as follows:

1. FCC CFR 47 Part 101 Subparts C & H - Fixed Microwave Services
2. FCC CFR 47 Part 15 - Radio Frequency Devices
3. FCC CFR 47 Part 2 - General Rules and Regulations

1.4 REFERENCE DOCUMENTS

1. HNS-13880, 38GHz Point to Multipoint radio System Detialed Design and Requirements Documents
2. HNS 1024668, 38 Ghz Radio Integrated Outddor units for Subscribers and Hub Stations
3. ODU Detailed test data for Subscriber Remote Terminal ODU 278 rev A
4. HP 8564E Spectrum Analyzer Manual
5. Specification for the parts used during the type acceptance test.
6. 38- 40 GHz HUB Antenna Specification 1025231.
7. 38- 40 GHz SUB Antenna Specification 1028836.
8. DEMS ODU technical Specifications 1026128

2.0 SETUP

This section documents the RF transmit test setup, parts and test equipment used. Table 2 in section 2.1 lists the EUT (Equipment Under Test) that are subject for testing for FCC 101, with part numbers and revision levels. Table 3 listes the EUT equipment were used to generate the traffic to the ODU. Table 4 lists the test equipment and their calibration dates used to support the test. Section 2.2 shows the various test configuration diagrams. The measurements will be done using a HP 8564E series Spectrum Analyzer as the final measuring device. All the data plots will be captured via HP Bench screen capture software and saved as *.gif images which may then be inserted into test report documents digitally. The EUT is configured for transmission mode using custom software prepared by Hughes Network Systems for channel selection and simulation of the signals that are normally transmitted to the Hub terminal

2.1 EQUIPMENT LIST

PART NUMBER	DESCRIPTION	SERIAL NUMBER	REVISION LEVEL
1024668-0010	Out Door unit ODU HUB HB	278	A

Table 2 Equipment Under Test (EUT) that are subject to the FCC 101 filling

1027181-001	Channel and Control module (CCM) HUB Terminal HT [Indoor unit} IDU	123	B
1027181-002	Channel and Control module (CCM) SUB (Remote Terminal RT [Indoor unit} IDU	146	B
1027094-001	DS3 TDM module [Indoor unit} IDU	9	A
1027070-001	Quad DS1 module [Indoor unit} IDU	8	12
1027070-001	Quad DS1 module [Indoor unit} IDU	3	12
1027070-001	Quad DS1 module [Indoor unit} IDU	56	B
	Universal Card DS1 module [Indoor unit} IDU	71	
1025231-0001 1025231-0002 1025231-0003	38-40 GHz Antenna Assembly Subscriber	42	A

Table 3 Equipment that were used to generate the traffic to the ODU

REF #	PART NUMBER	MANUFACTURER	DESCRIPTION	Calibration Dates	SERIAL NUMBER
1	8564E	HP	40 GHz Spectrum Analyzer	12/16/00	**3846A01362**
2	UFB142A-0-0394-110110	Micro Coax	Low Loss 40 GHz cable	NA	99K1246
3	ETS42S-28S ETS28S-19R, ET28S-12R, ET28S-8R, ET28S-5R	Custom Microwave	Waveguide transitions	NA	- S0550 S0725 S0680 S0320 S0957
4	R281A	HP	Waveguide to Cable adapter 2.4mm to WR-28	NA	2687-
5	3142	EMCO	BI-Log Antenna 30 to 1000 MHz	NA	9701-1120
6	3115	EMCO	Horn Antenna 1 to 18 GHz	NA	9701-5069
7	HO42S, HO28S, HO19R, HO12R, HO8R, HO5R	Custom Microwave	Standard Gain Horn Antennas Covering 18 to 220 GHz ranges	NA	- S0656 S0750 S0746 S0683 NA
8	M19HW, M12HW, MO8HW, MO5HW, O/IFDIPLEXER	Oleson Microwave	Harmonic Mixers covering 40 to 220 GHz ranges	NA	U90108-2 E90108-1 F90108-1 G90222-1 OS 26805-
9	-	Antenna port to WR-28 adapter	-	NA	
10	N/A	Circular Waveguide to Rectangular wave Guide adapter	00010	NA	1
11		T- BERD 224	Metrology	4/15/01	12825
12	SS300e	SunSet T3 SS300e by Sunrise telecom	Sunrise telecom	NA	07373
13	HP 438	Power meter (HP)	Hewelt Packard	6/29/00	H-D24993770
14	HP 8487A	Power sensor (HP)	Hewelt Packard	3/21/00	3318A03286
15					
16					
17					

Table 4 Test Equipment used

2.2 TEST SETUPS

This section documents the test plan, and requirements for the transmitter testing.

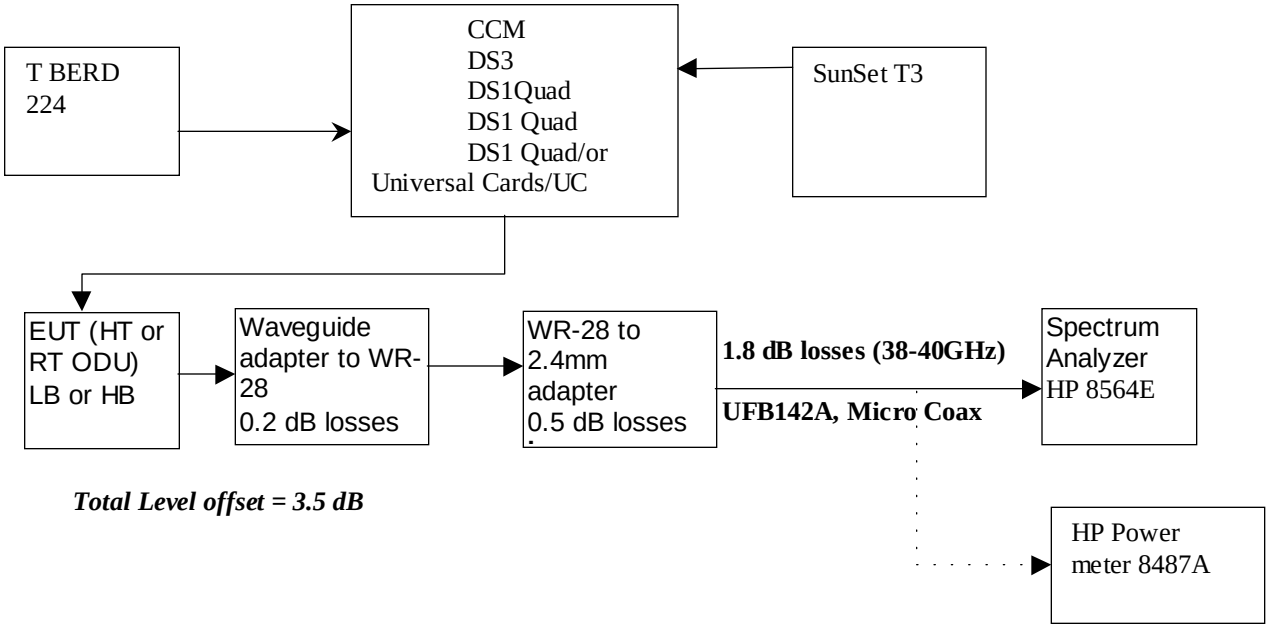


Figure 3 Transmitter Test Setup Configuration

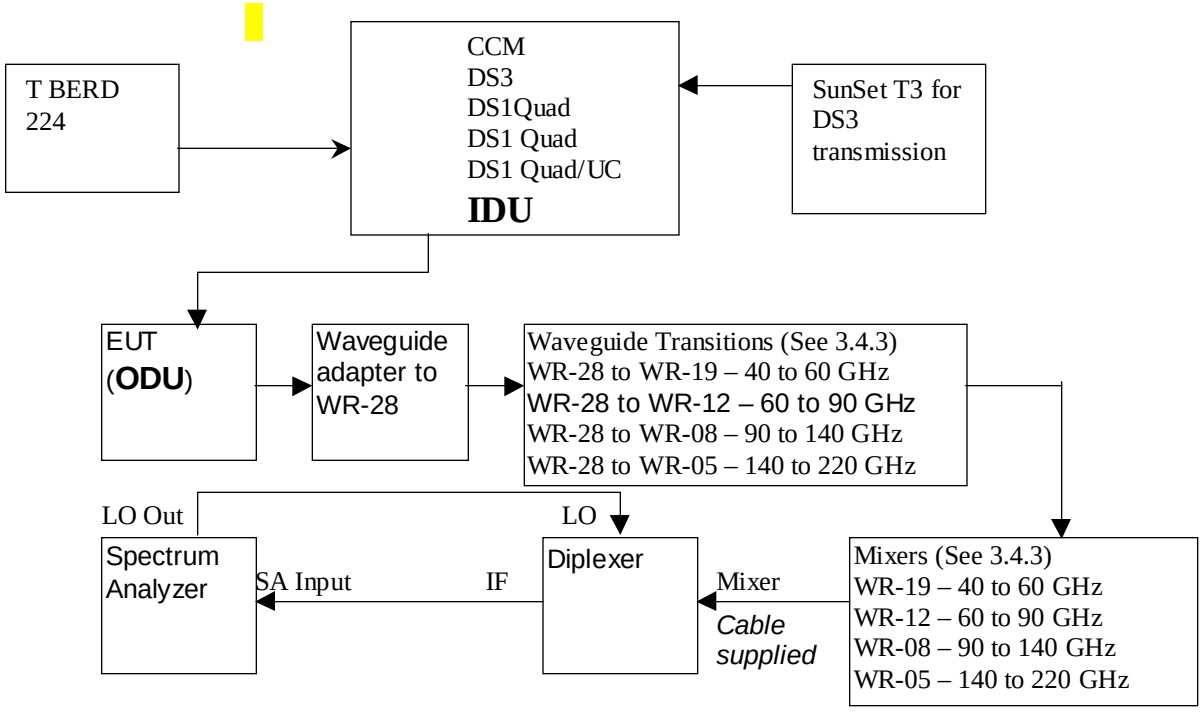


Figure 4 Transmitter Test Setup Configuration – Conducted Spurious Emissions

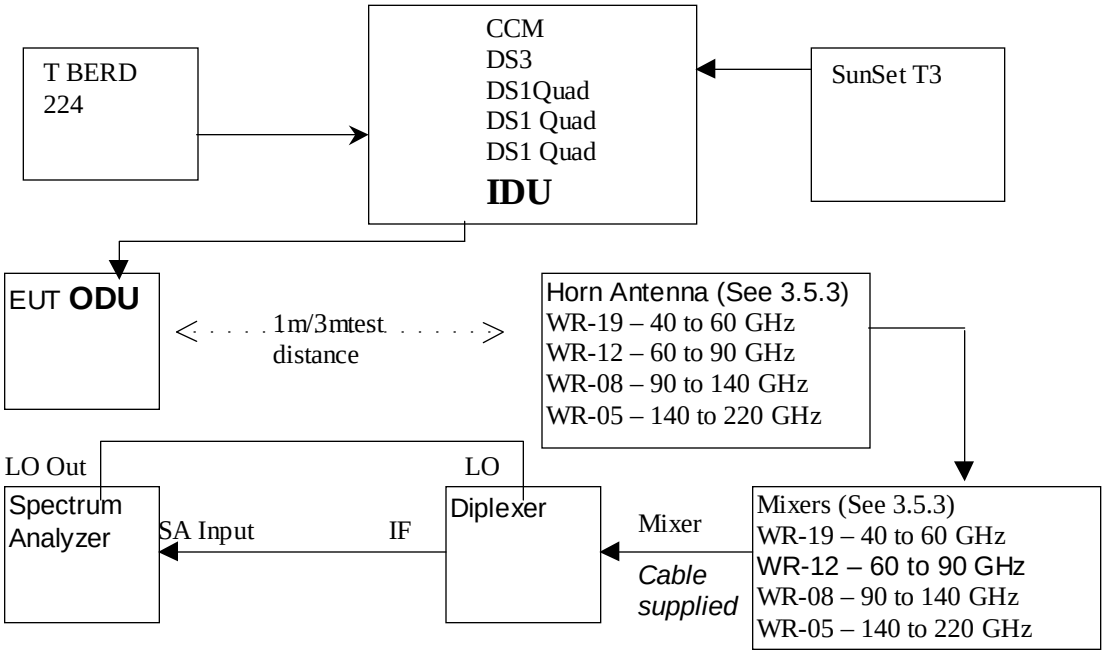


Figure 5 Transmitter Test Setup Configuration – Radiated Spurious Emissions

3.0 TRANSMITTER TESTS

3.1 THE OUTPUT POWER

This test demonstrates the maximum transmitter power level of the EUT antenna output. The maximum power transmitted will be 18.0 dBm at the Antenna port. All the measurements are with + 1dB of tolerance.

3.1.1 Performance Specifications

As per FCC CFR 47 Part 2.1046 (previously 2.985) and 101.113
EIRP Max = +55dBW after the antenna. The HUB Antenna has a maximum gain of 22 dBi .

Therefore the maximum alloweable limit is
55dBw= 85 dBm
Maximum allowable transmitted power from the Antenna port is for the transmitting bands:

PTx max = 85dBm- 22 dB = 63 dBm in 1MHz Resolution Bandwidth.

In 100kHz Resolution Bandwidth, the limit will be 10dB lower, i.e., 53dBm. HNS 38GHz High band maximum power would be 18dBm.

3.1.2 Test Procedures

The equipment under test will be operated at different frequencies across the transmit frequency band (low end, center, and high end of the FCC authorized bands. The modulated carrier and CW power levels will be monitored and data plots will be obtained for each modulation type. There are 3 types of modulations (QPSK, 16-QAM, and 64-QAM). For each antenna gain, the Gain (in dBi) will be added to the level of the transmitted power (dBm). The RMS power of the Tx signal is measured using an HP power meter with a power sensor adapter that ranges up to 50 GHz. The spectral analyzer will also be used to display the modulated Tx signal in addition to the power level of the signal. Since the spectral analyzer can't give a very accurate reading in reading the power of a modulated signal, we will base our reading on the power meter reading. The reading was taken from the Power Meter, and the difference between the SA reading of the CW transmitted power was taken into account by adding an offset to the reference level in SA.

. The following channels will be used according to the band tested.

3.1.3 Test Configuration

Please reference to Figure 3 for the test configuration used during this test.

a. Spectrum Analyzer setup:
Resolution Bandwidth - >100kHz
Video Bandwidth - >100kHz
Amplitude Units dBm

b. Power meter Setup
The actual RMS transmit power = power meter reading + attenuation + coupler losses.

Total SA and Power meter offset= 3.5 dB (cable and coupler losses)

3.1.4 Test Results

High Band HUB				
Channel	**Frequency MHz**	**QPSK**	**16-QAM**	**64-QAM**
		P_{Tx}(dBm)	**P_{Tx}(dBm)**	**P_{Tx}(dBm)**
8A1	39656.25	18	18	18
11A4	39843.75	18	18	18
14A4	39993.75	18	18	18

Table 5 Test Results for the Output Power

Please refer to the attached plots for the output power. Graphs show the carrier and the signal with different modulations (QPSK, 64-QAM, and 16-QAM), on low channel (8A1), mid-channel (11A4), and high-channel (14A4). The maximum output power is 18dBm. + 1dB tolerance.

PASS: _X_ Fail:___

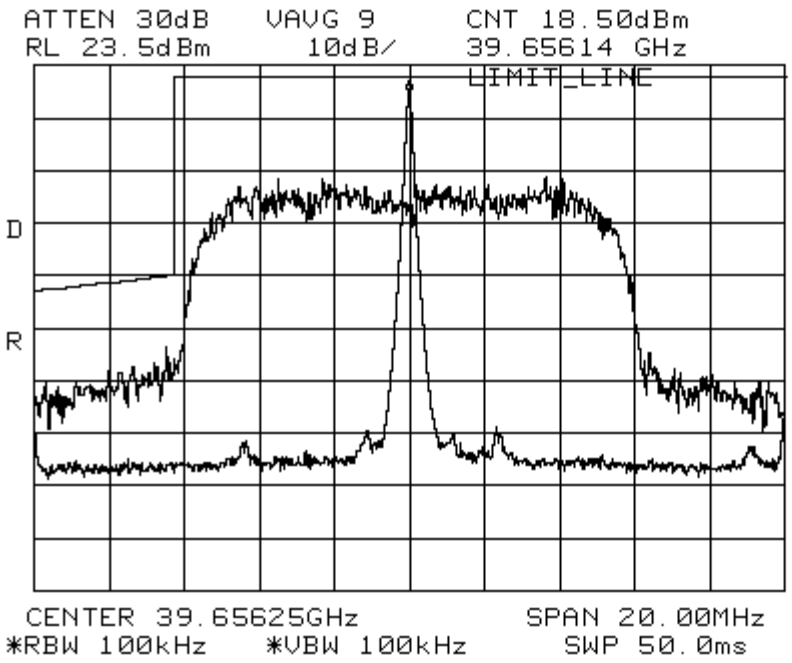


Figure 6 Output Power for QPSK modulation on Ch. 8A1

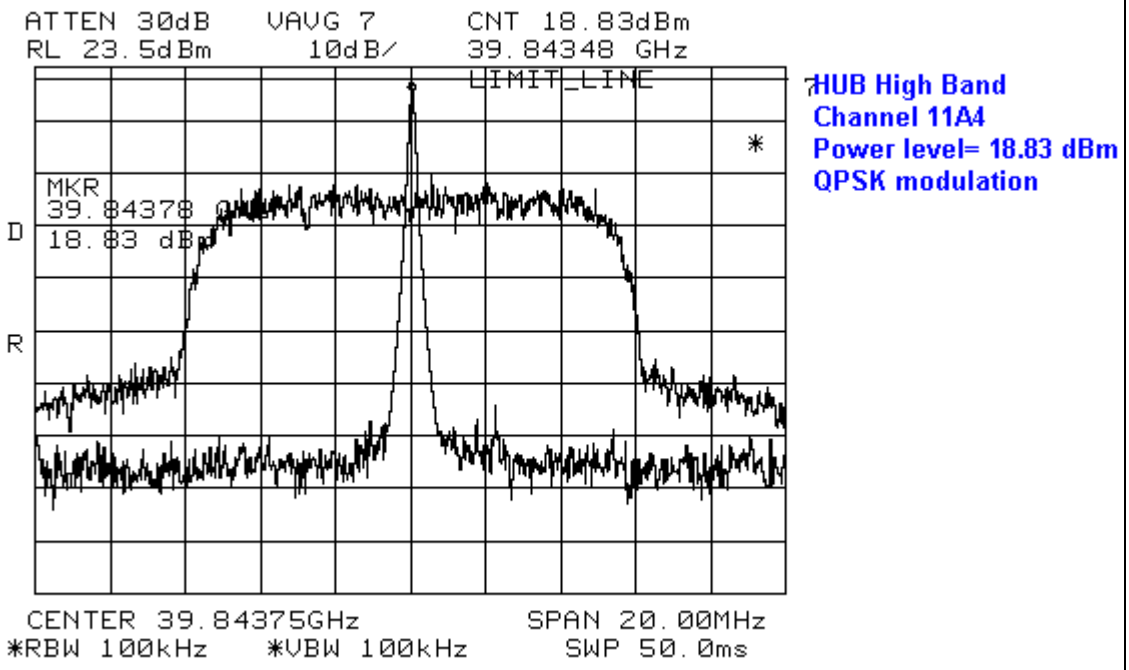
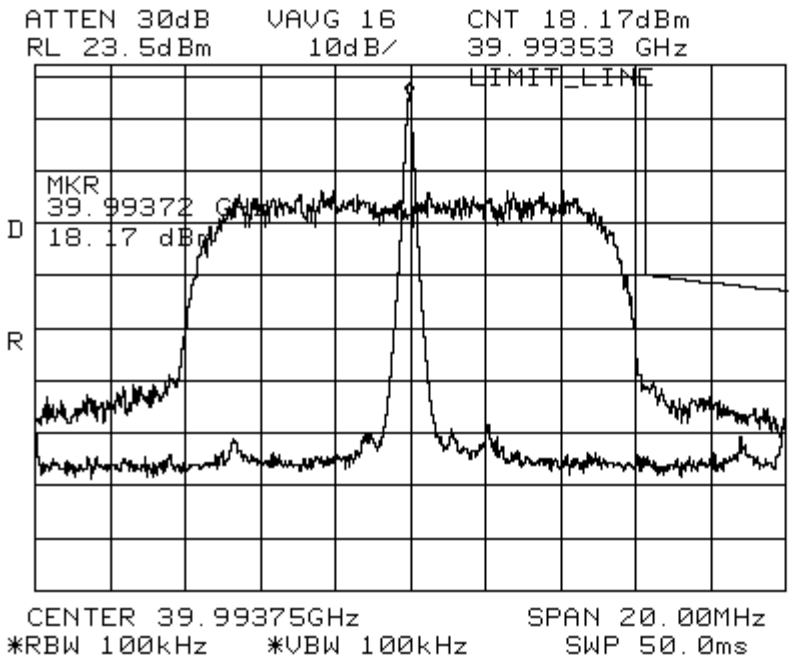
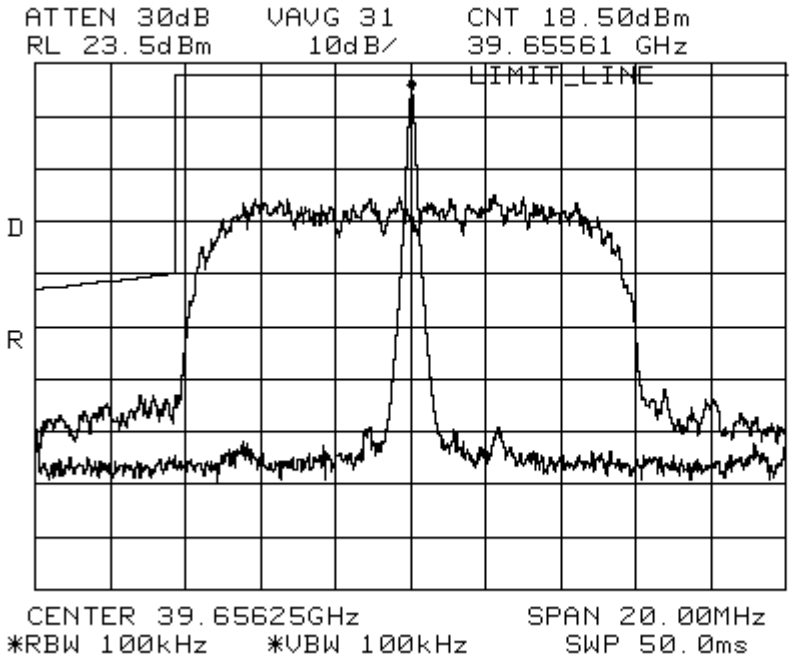


Figure 7 Output Power for QPSK modulation on Ch. 11A4



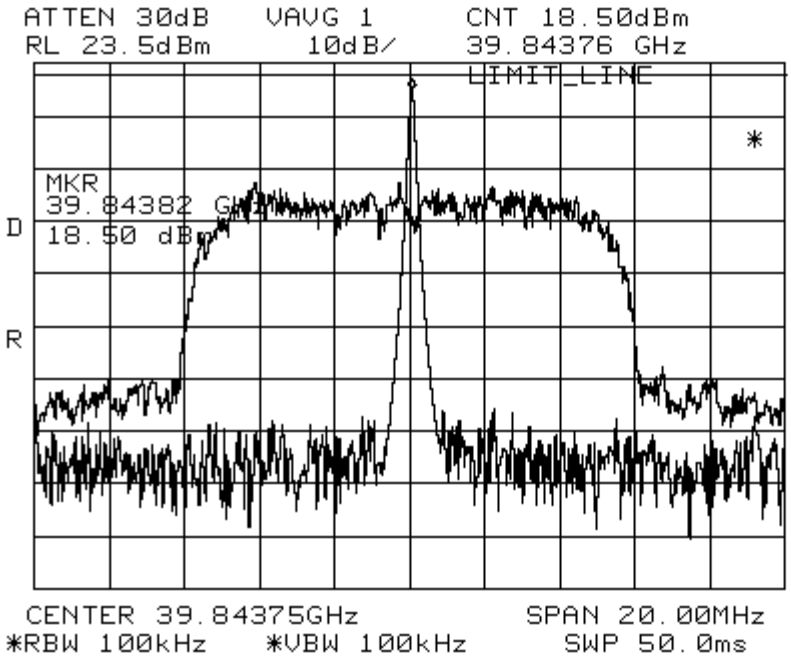
HUB High Band
Channel 14A4 (last channel in the band)
CW power level = 18.17 dBm
QPSK modulation

Figure 8Output power for QPSK modulation on Ch.14A4



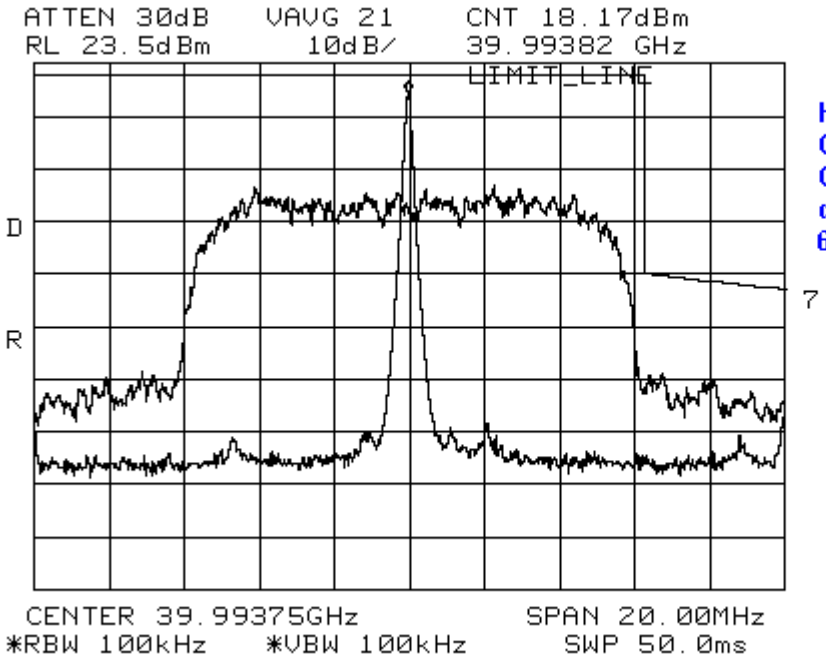
HUB High Band
Channel 8A1
Cw power level = 18.5 dbm
64-QAm modulation

Figure 9 Output power for 64-QAM modulation on Ch.8A1



HUB High Band
Channel 11A4
CW power level = 18.5dBm
64-QAm modulation

Figure 10 Output power for 64-QAM modulation on Ch.11A4



HUB high Band
Channel 14A4
CW power level = 18.17 dBm
64-QAM modulation

Figure 11 Output power for 64-QAM modulation on Ch.14A4

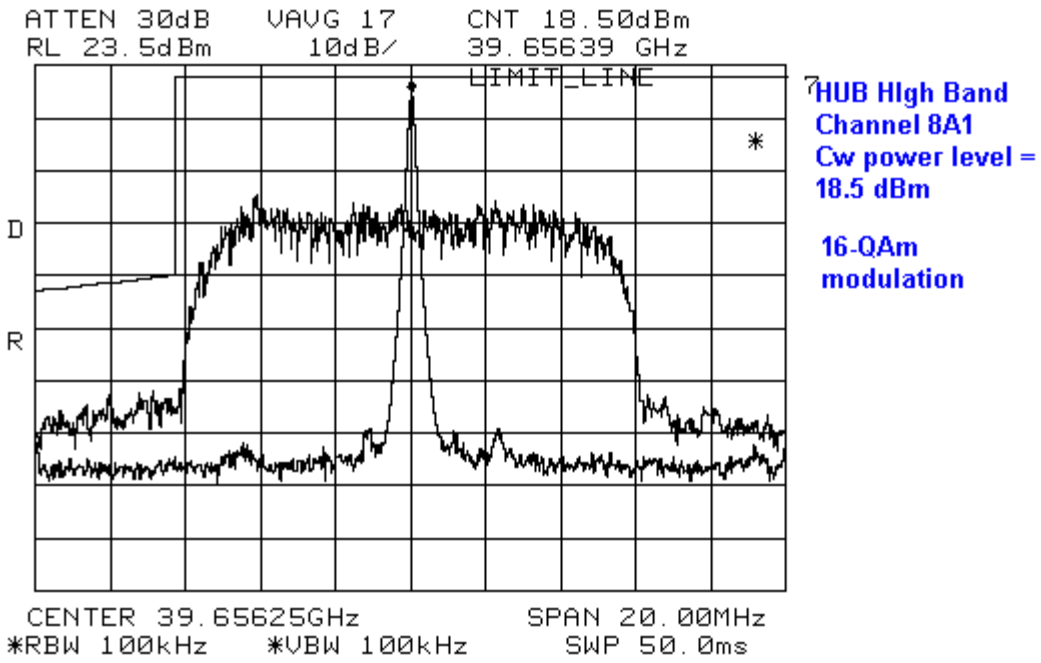


Figure 12 Output power for 16-QAM modulation on Ch.8A1

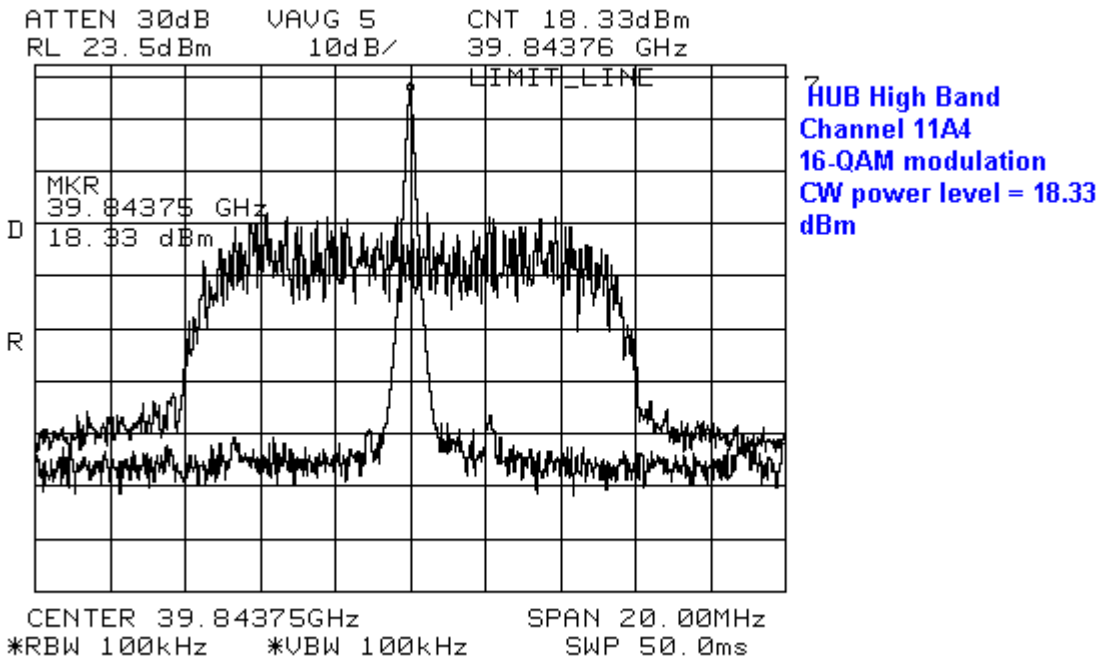


Figure 13 Output power for 16-QAM modulation on Ch.11A4

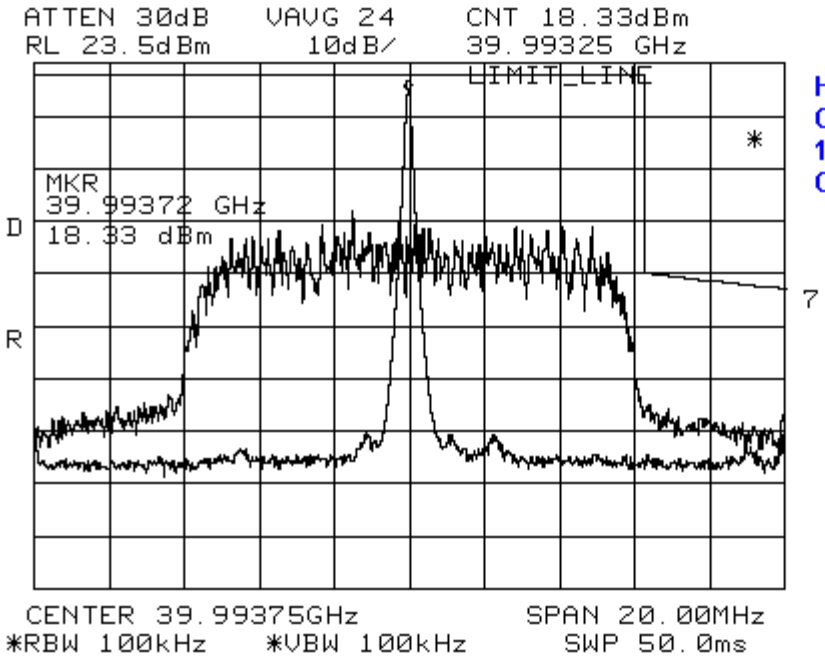


Figure 14 Output power for 16-QAM modulation on Ch.14A4.

3.2 OCCUPIED BANDWIDTH

This test demonstrates that occupied bandwidth of the transmitter is within the FCC 101.109 requirements.

3.2.1 Performance Specifications

As per FCC CFR 47 Part 2.1050 (previously 2.989) and 101.109
Maximum authorized bandwidth 50MHz.Unwanted emissions must be suppressed at the aggregate channel block edges based on the same roll-off rate as specified for a single channel block in 101.111 (a) (ii) and (iii).

(a)(2)(ii)In 1 MHz Band: 50% to 250%: A=11+0.4(P-50)+10log(B) or no less than 11dB down but no more than 56dB down is required

Where: A = Attenuation in dB below mean output power level
P = percent removed from center frequency
B = Authorized bandwidth in MHz

Example calculation:

If your bandwidth is 50 MHz
At 50 % : A=11+.4(50-50)+10log(50) = 28dB down
At 250% : A=11+.4(250-50)+10log(50) = 108 dB so use 56 dB down

In 100kHz resolution bandwidth, the limits are 10dB lower. For the maximum power of 18dBm, at 50% the limit will be 38dB down, i.e., -20dBm. At 250%, the limit will be 66 dB down, i.e., -48dBm.

(a)(2)(iii)in 4kHz band >250% at least 43+10log(output power in Watts) or 80dB

Example calculation:

If your power were = 18dBm = 63.1mW = 0.0631W
250% and out : A=43+10log(0.0631) = 31dB down, i.e., -13dBm

Note: 4 kHz Bandwidth will be difficult to use. You may adjust the limit accordingly. If it passes at the higher bandwidth , it will certainly pass at 4 kHz.

3.2.2 Test Procedures

The equipment under test will be operated at different frequencies across the transmit frequency band (low end and high end). The modulated carrier will be examined and the occupied bandwidth will be viewed for compliance.

Test Frequencies	
Channel	Frequency MHz
8A	39650-39700
14A	39950-40000

Table 6 Occupied Bandwidth Test Frequencies

3.2.3 Test Configuration

Please reference to Figure 3 for the test configuration used during this test.

The test limit has been determined as shown in the following figure. The mask is based on 100kHz Resolution Bandwidth. According to the FCC, the maximum allowable power is 34.5dBm. However, the maximum output transmit power is 18dBm.

50 % points = 39300 MHz, 39650MHz, allowable level = -20dBm
From 50% to 250% points = based on the given equation, limited to –48dBm. This point is reached at about 120% points.
250% points = 39200 MHz, 39750 MHz., allowable level = -48dBm
250% and beyond, allowable level = -13dBm.

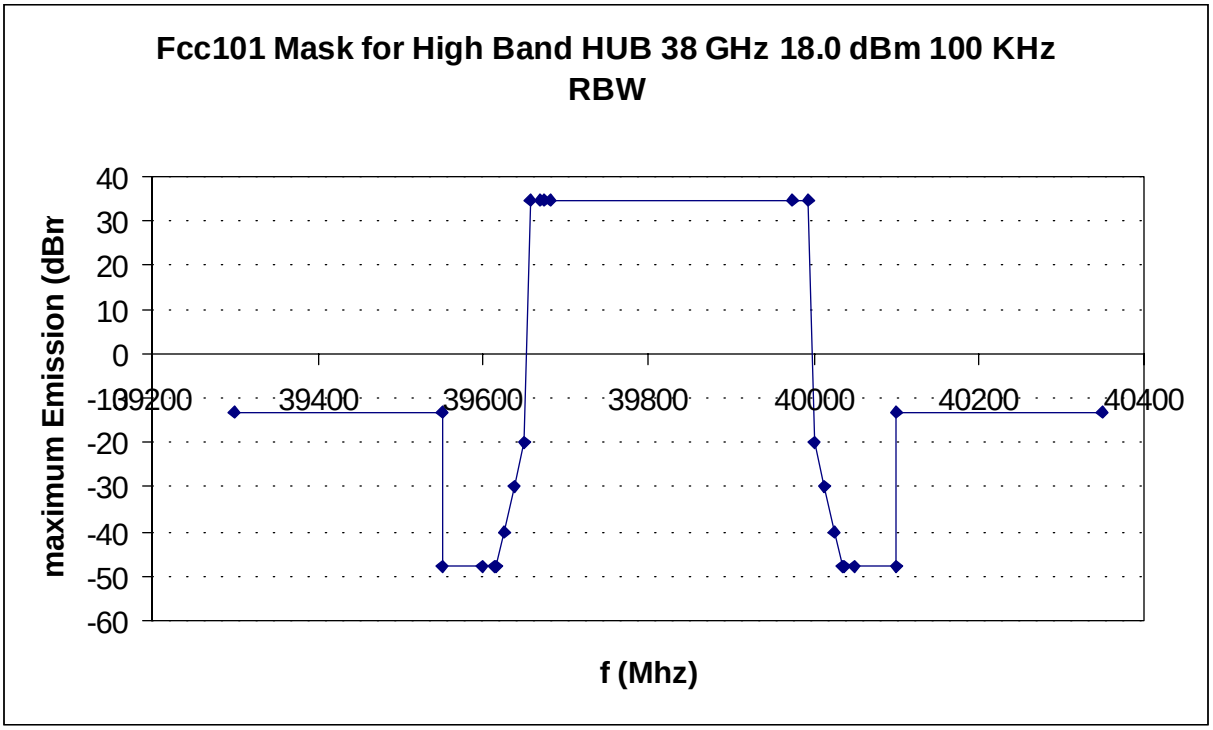


Figure 15 FCC Mask for the HUB high Band

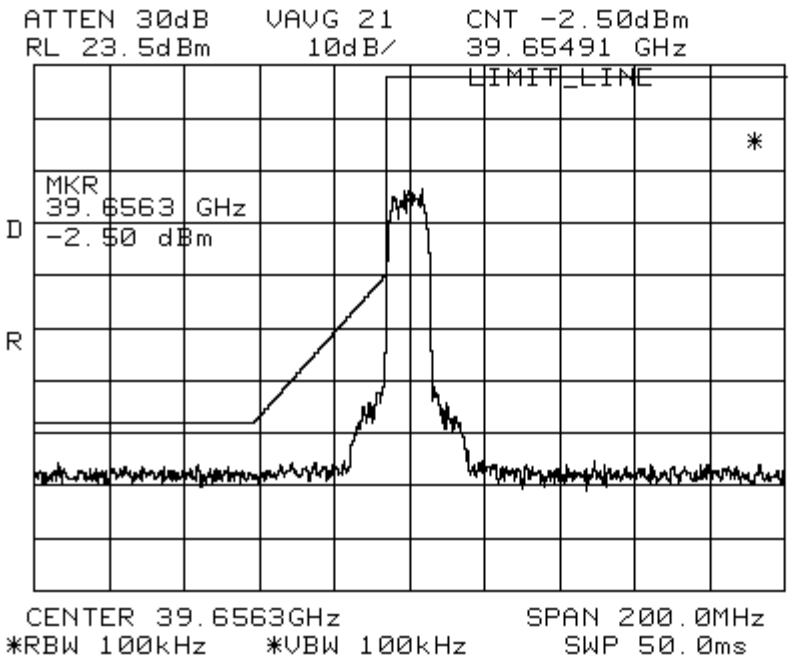
Spectrum Analyzer setup:

Occupied Bandwidth test
Resolution Bandwidth – 100 KHz
Video Bandwidth – 100 KHz

3.2.4 Test Results

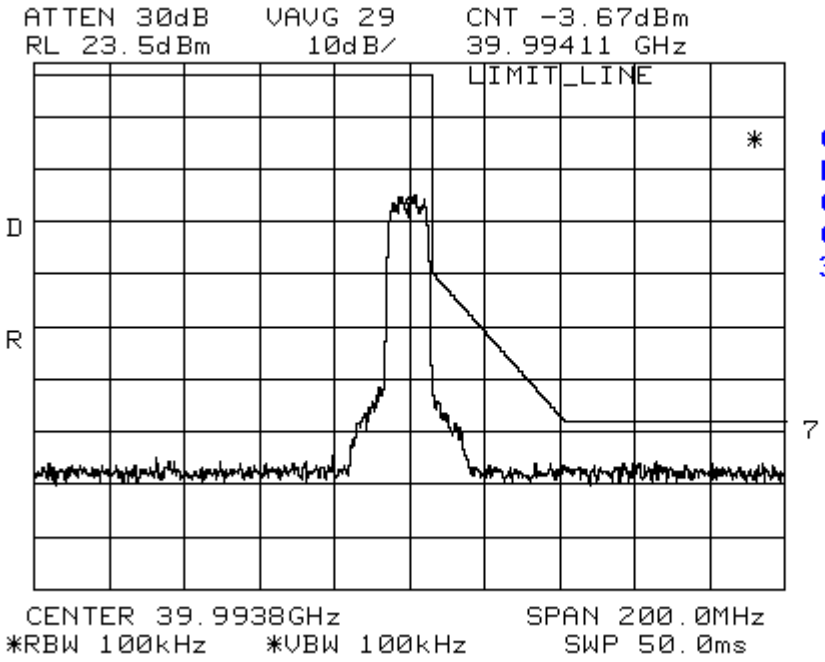
The graphs for the occupied bandwidth signals are shown in the following pages. The output transmitted channel power is 18dBm. All the modulation schemes (QPSK, 64-QAM, and 16-QAM) are investigated. The top graph shows the left hand side channel with the associated limit, and the bottom graph shows the right hand side channel with the associated limit.

PASS: _X_ Fail:___



HUB High Band
Channel 8A1
QPSK modulation
RF power level = 18.0 dBm
Occupied BW (1st subchannel of the 350 Mhz band).

Figure 16 Bandwidth for QPSK modulated signal on channel 8A1, Power=18dBm



HUB High band
Channel 14A4
Power level= 18.9 dBm
QPSK modulation
Occupied BW (end of the 350 Mhz band)

Figure 17 Bandwidth for QPSK modulated signal on channel 14A4, Power=18dBm

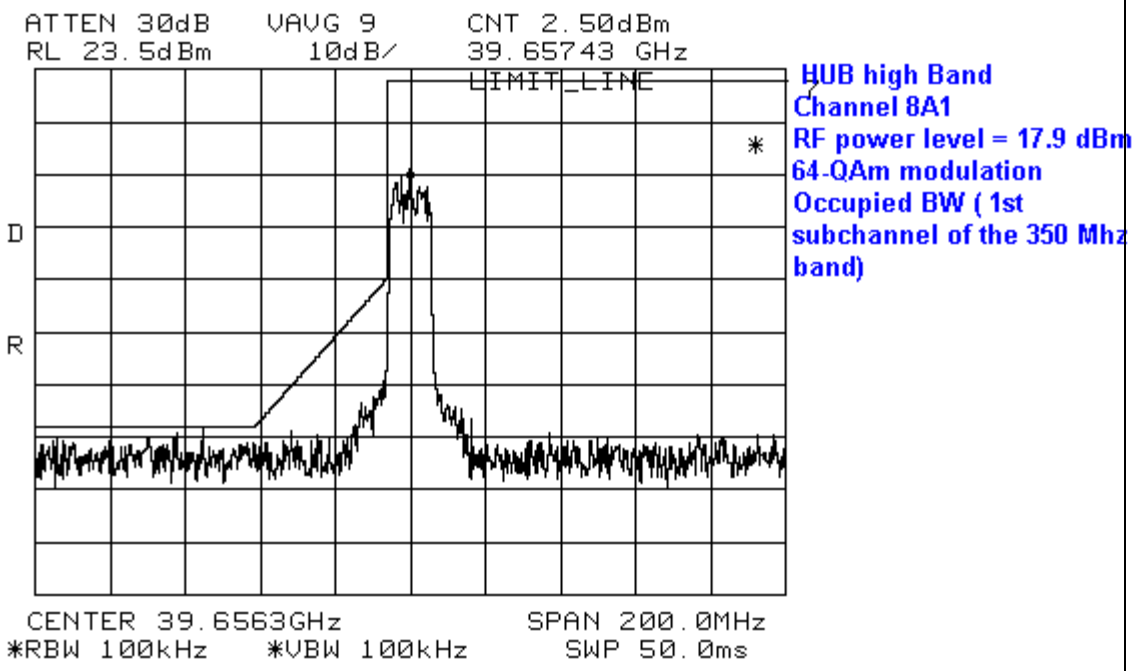


Figure 18Bandwidth for 64-QAM modulated signal on channel 8A1, Power=18dBm

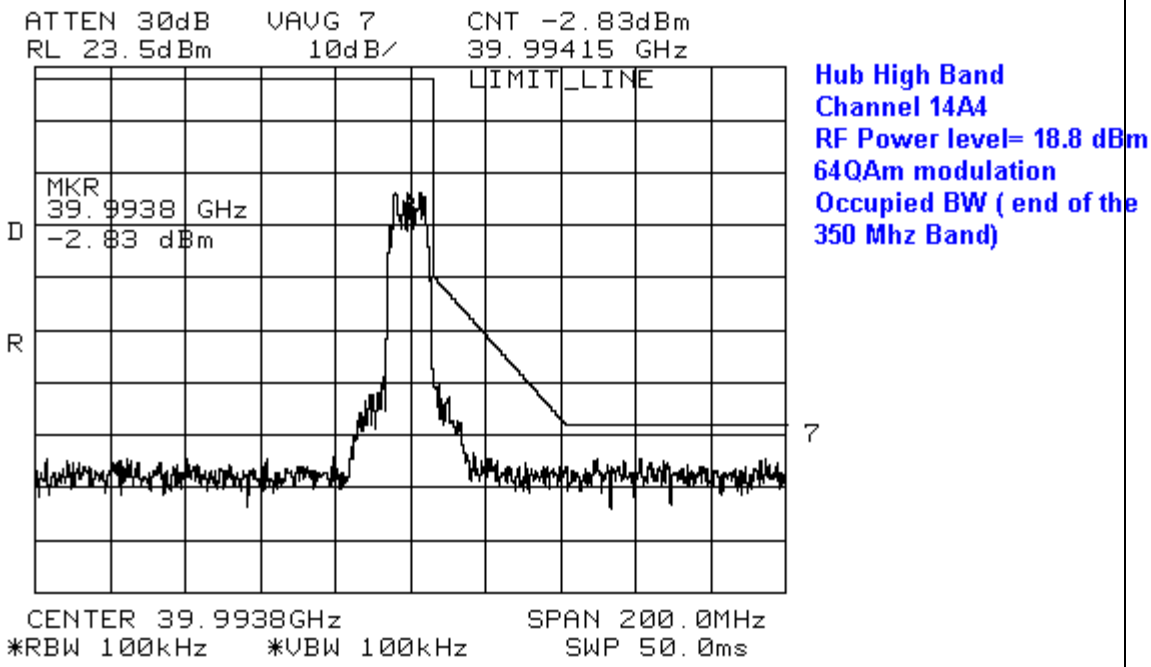


Figure 19 Bandwidth for 64-QAM modulated signal on channel 14A4, Power = 18dBm

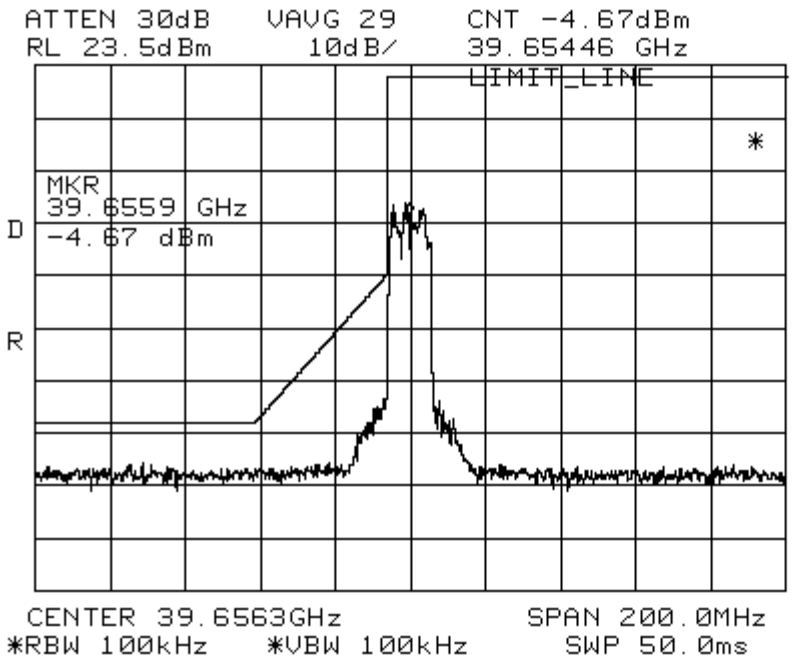


Figure 20 Bandwidth for 16-QAM modulated signal on channel 8A1, Power=18dBm

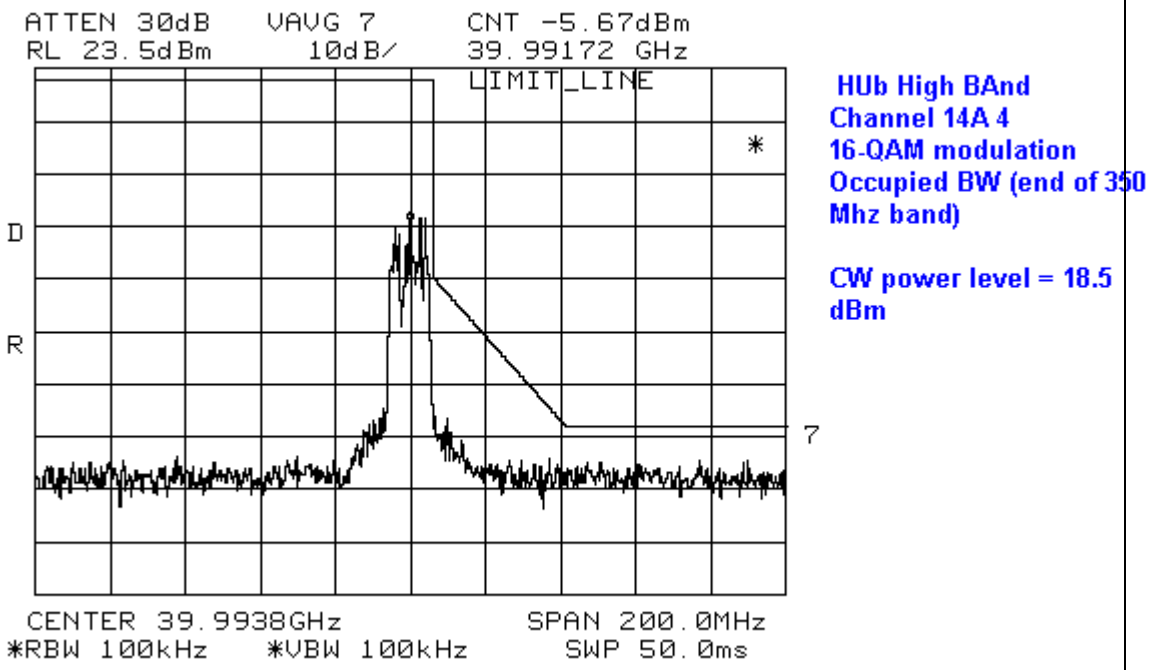


Figure 21 Bandwidth for 16-QAM modulated signal on channel 14A4, Power=18dBm

3.3 CONDUCTED SPURIOUS EMISSIONS FROM THE TRANSMITTER

These tests demonstrate the spurious emission levels which are produced by EUT at the antenna terminals. The tests for the conducted emissions document the spurious levels conducted from the transmitting filter output port (antenna connector), which connects to the transmit antenna.

3.3.1 Performance Specifications

As per FCC CFR 47 Part 2.1050 (previously 2.989) and 101.109
Maximum authorized bandwidth 50MHz.Unwanted emissions must be suppressed at the aggregate channel block edges based on the same roll-off rate as specified for a single channel block in 101.111 (a) (ii) and (iii).

(a)(2)(ii)In 1 MHz Band: 50% to 250%: A=11+0.4(P-50)+10log(B) or no less than 11dB down but no more than 56dB down is required

Where: A=Attenuation in dB below mean output power level
P=percent removed from center frequency
B=Authorized bandwidth in MHz

Example calculation:
If your bandwith is 50 MHz
At 50 %: A=11+4(50-50)+10log(50) = 28dB down
At 250%: A=11+4(250-50)+10log(50) = 108 dB so use 56 dB down

In 100kHz resolution bandwidth, the limits are 10dB lower. For the maximum power of 18dBm, at 50% the limit will be 38dB down, i.e., -20dBm. At 250%, the limit will be 66 dB down, i.e., -48dBm.

(a)(2)(iii)in 4kHz band >250% at least 43+10log(output power in Watts) or 80dB

Example calculation:
If your power were = 18dBm = 63.1mW = 0.0631W
250% and out: A=43+10log(0.0631) = 31dB down, i.e., -13dBm

Note: 4 kHz Bandwidth will be difficult to use. You may adjust the limit accordingly. If it passes at the higher bandwidth, it will certainly pass at 4 kHz.

3.3.2 Test Procedures

The EUT will be initialized in the transmit mode. The transmitted output will be connected to the spectrum analyzer. Spurious emissions measurements will be done in the frequency bands detailed above. The equipment under test will be operated at different frequencies across the transmitted frequency band (low end and high end). The entire frequency spectrum from as low as possible to 220 GHz shall be investigated and any spur or emission shall be documented.

Test Frequencies	
Channel	Center-Frequency MHz
8A	39650-39700
14A	39950-40000

Table 7 Conducted Spurious Emissions Test Frequencies

3.3.3 Test Configuration

Refer to Fig. 4 for the Basic Test configuration. Figure 4a shows a photo of the test setup.
Transitions and waveguide adapters will need to be used to connect the EUT transmit port to the various harmonic mixers. The mixers along with a Diplexer will be used to connect the signal to the spectrum analyzer and mix it down to a frequency range that can be measured. This must be done since the analyzer used only goes to 40 GHz and signals must be measured up to 220 GHz. Please refer to the documentation supplied with the mixers for instructions on how to make measurements. Also note that any measurements made over 40 GHz will not be calibrated, they will only be referenced upon the factors supplied by the mixer manufacturer. There are no NIST traceable measurements above 75GHz(they may be up to 97GHz now). Therefore, we must use engineering judgment when taking these measurements. Care must be taken to not overload the mixers. Also care must be taken when connecting and disconnecting the waveguide pieces.

The following connections will need to be made:
EUT has WR-28

Adapter	**Cable**	**Frequency Range**
WR-28 to 2.4mm connector	Low loss to 40 GHz	0 to 40 GHz
Transition	**Mixer**	**Frequency Range**
WR-28 to WR-19	WR-19	40 to 60 GHz
WR-28 to WR-12	WR-12	60 to 90 GHz
WR-28 to WR-08	WR-08	90 to 140 GHz
WR-28 to WR-05	WR-05	140 to 220 GHz

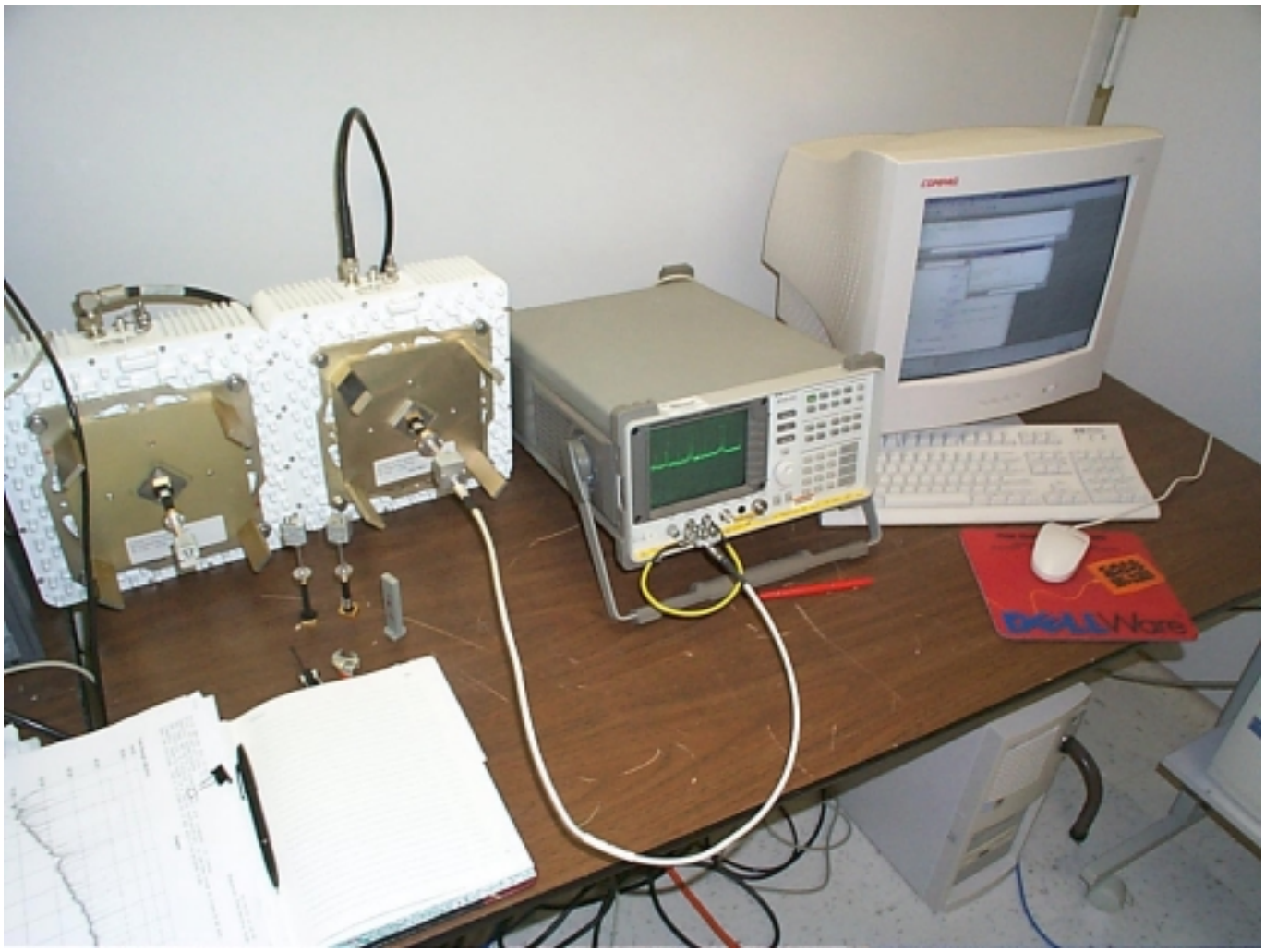


Figure 22 Test setup photo1 for Conducted Spurious Emission for Both Hub and Sub 38 GHz High band ODUS.

Figure 23 Test setup photo2 for Conducted Spurious Emission for Both Hub and Sub 38 GHz High band ODUS.

3.3.4 Test Results

The following Figures show the conducted spurious emissions, when the ODU is transmitting high power 18dBm, and low power –12dBm. Measurements are performed while transmitting on two channels (low end 8A1 and high end 14A4). The frequency of consideration is from 0Hz to 220GHz. The 250% band (39200MHz-39750MHz) is excluded as this range has been covered in the previous section (3.2)

PASS: _X_ Fail:___

3.3.4.1 Channel 8A1

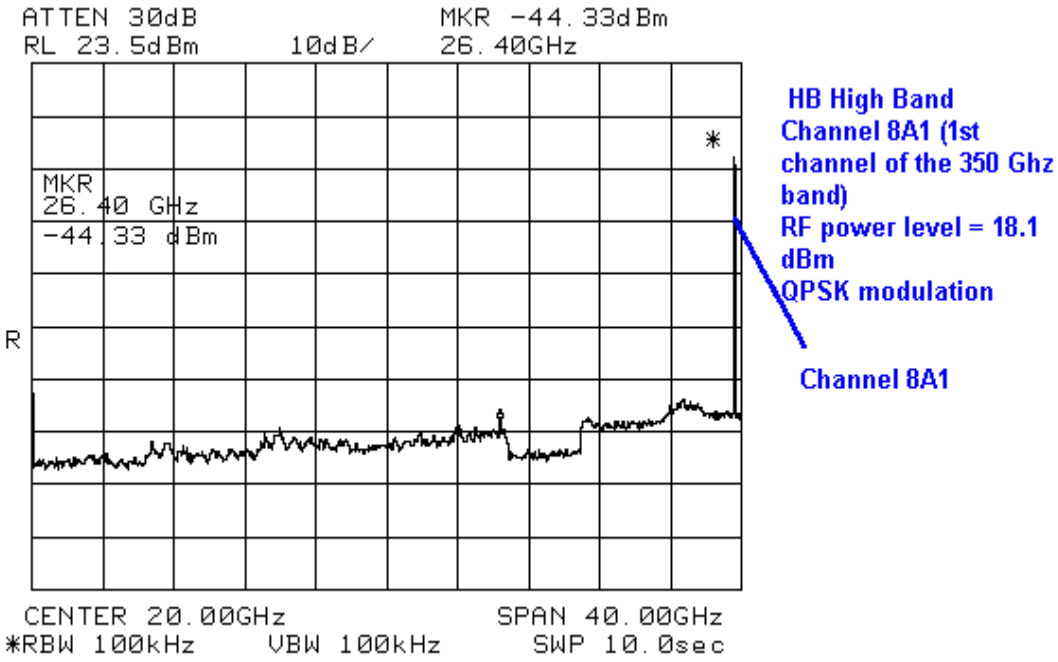


Figure 24 Conducted Emissions in 0-40GHz, for transmitting 18dBm QPSK on Channel 8A1

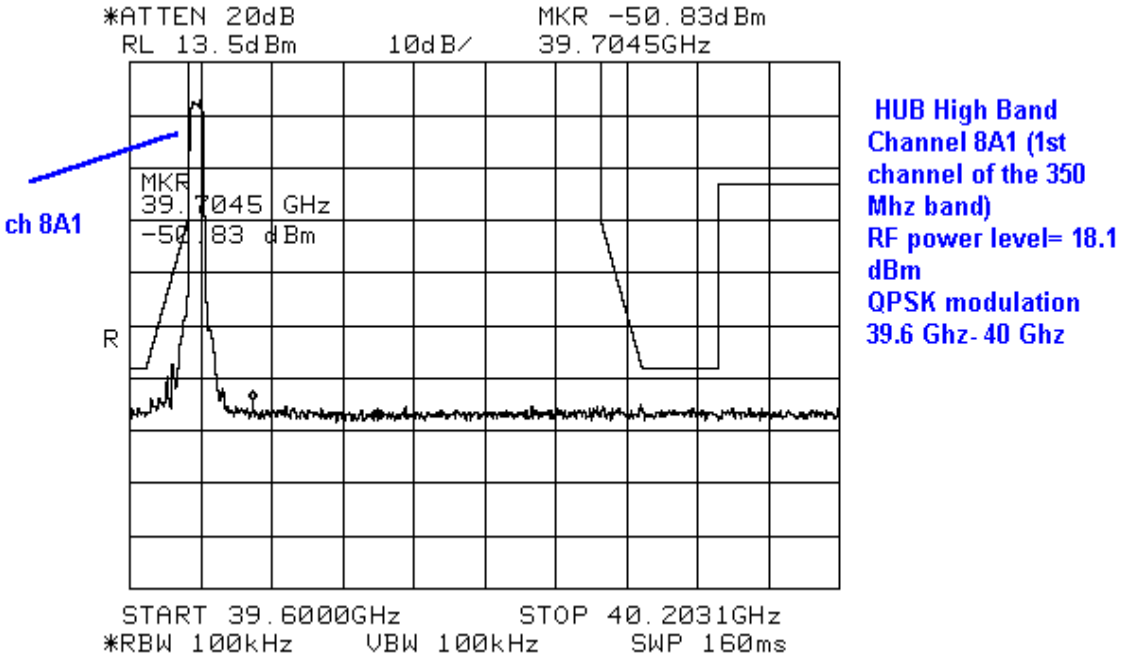
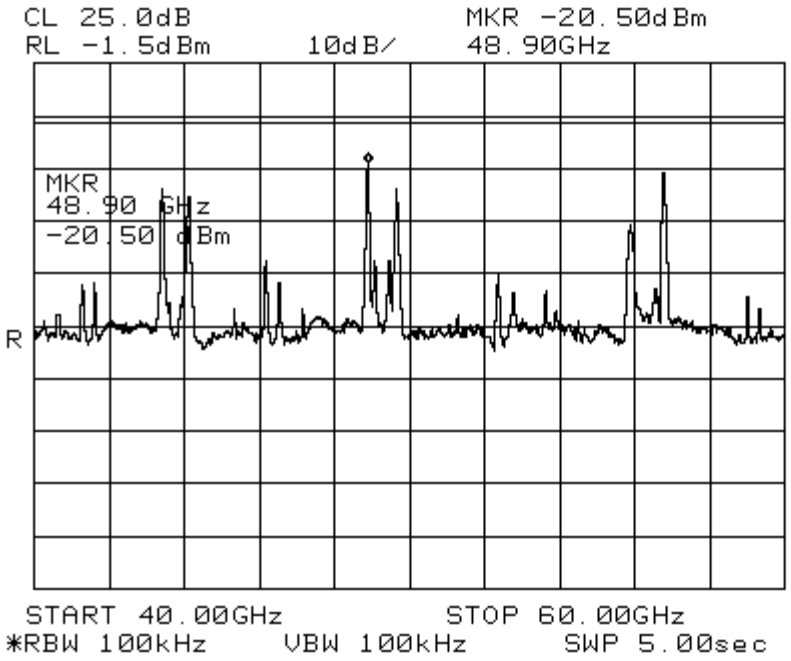
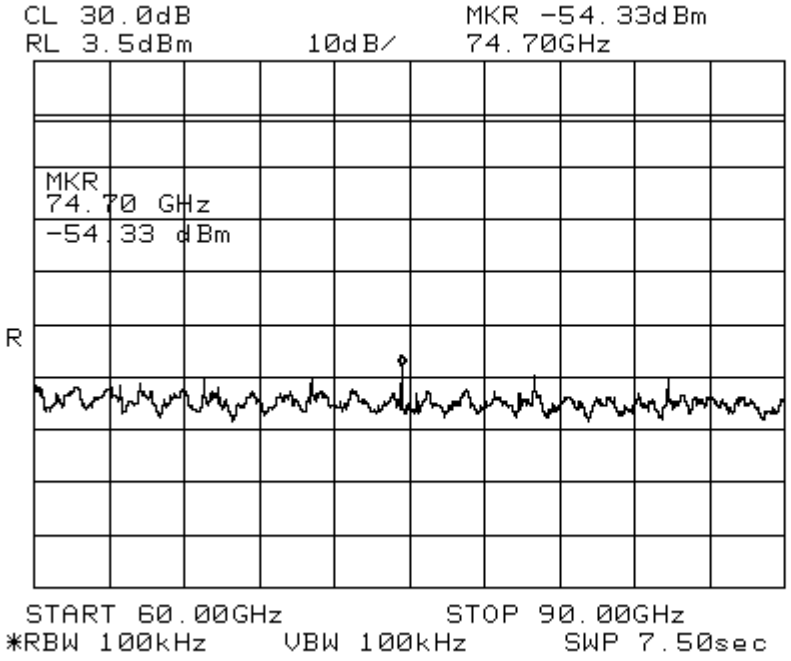


Figure 25 Conducted Emissions in 39.6-40GHz, for transmitting 18dBm QPSK on Channel 8A1



HUb High band
Channel 8A1
Power level =18.0 dBm
QOSk modulation
40-60 Ghz

Figure 26 Conducted Emissions in 40-60GHz, for transmitting 18dBm QPSK on Channel 8A1



HUB high Band
Channel 8A1
Power level = 18.0 dBm
QPSK modulation
60-90 Ghz

Figure 27 Conducted Emissions in 60-90GHz, for transmitting 18dBm QPSK on Channel 8A1

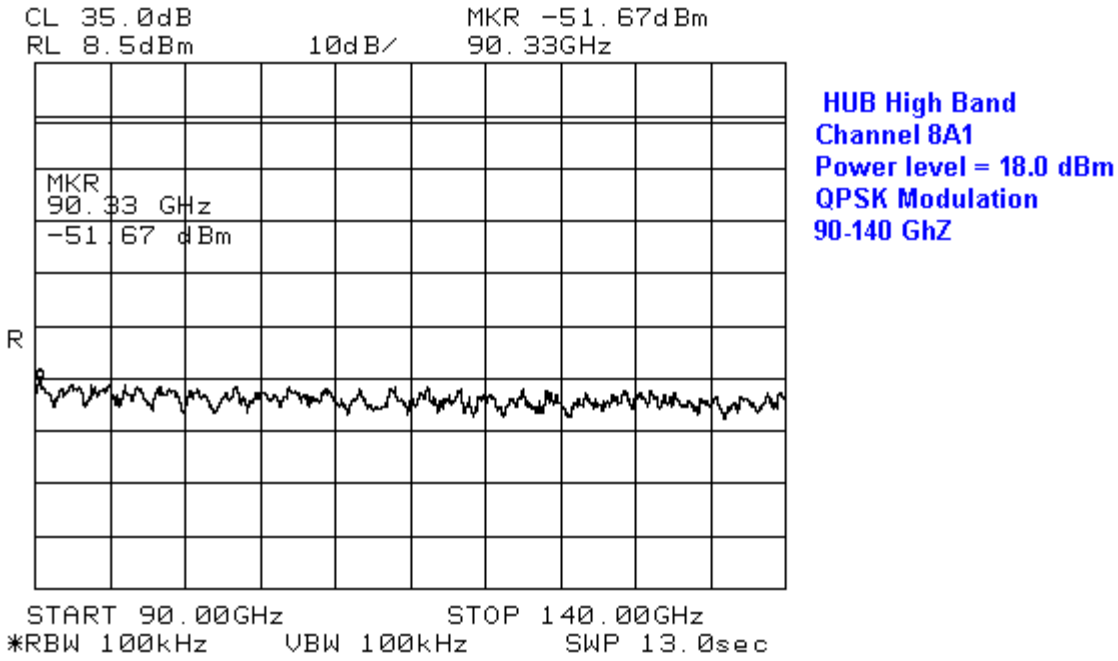


Figure 28 Conducted Emissions in 90-140GHz, for transmitting 18dBm QPSK on Channel 8A1

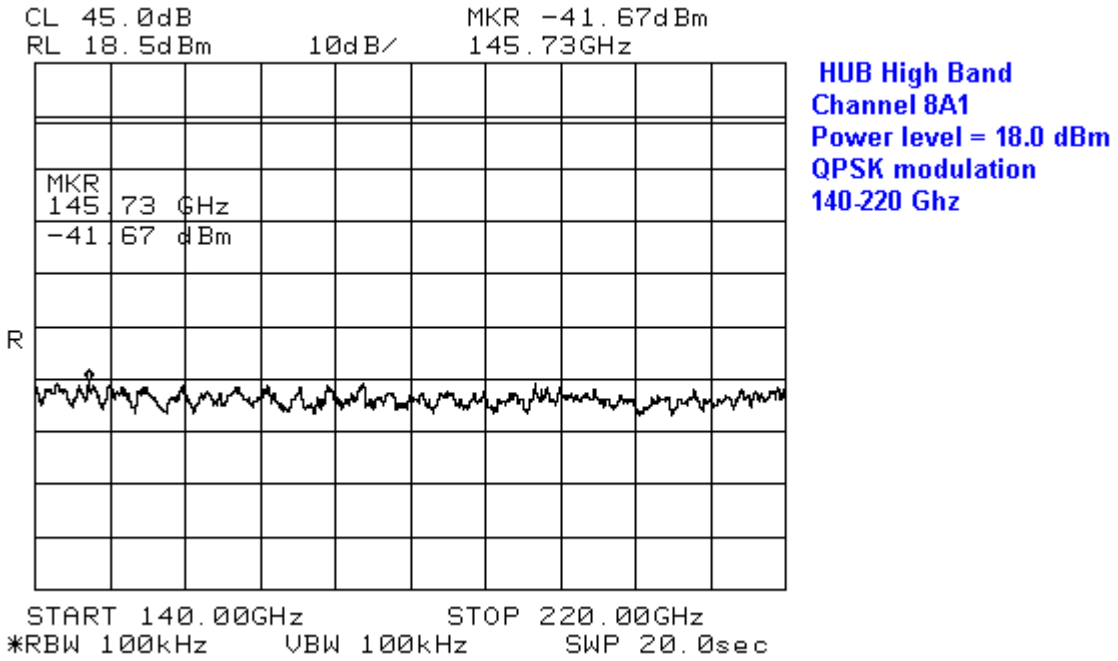


Figure 29 Conducted Emissions in 140-220GHz, for transmitting 18dBm QPSK on Channel 8A1

3.3.4.2 Channel 14A4

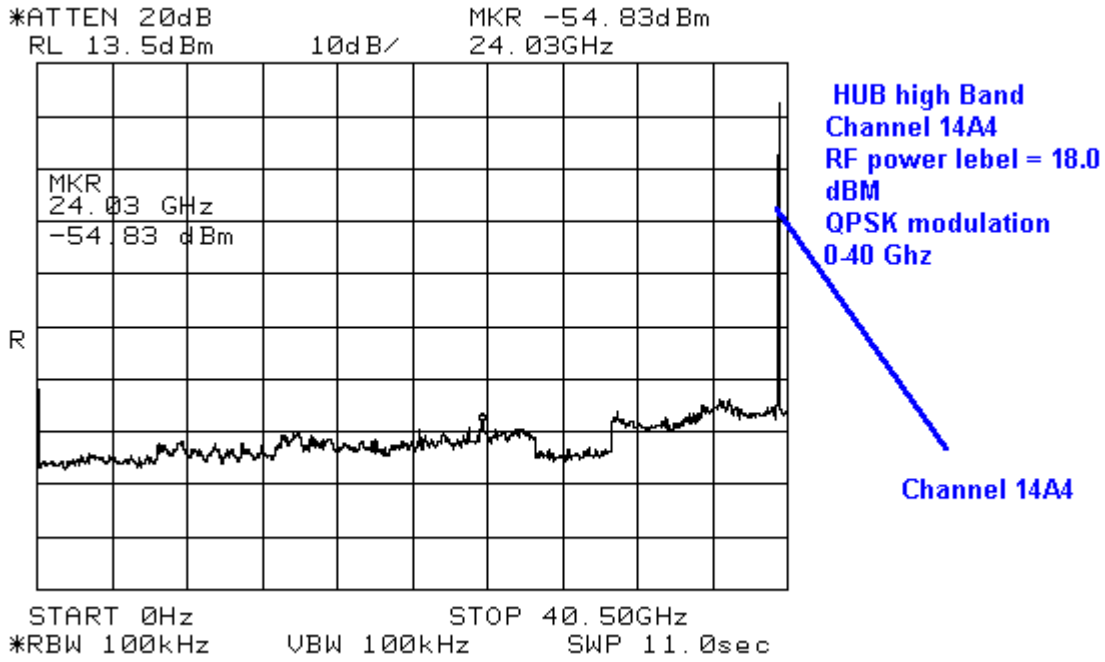


Figure 30 Conducted Emissions in 0-40.5GHz, for transmitting 18dBm QPSK on Channel 14A4

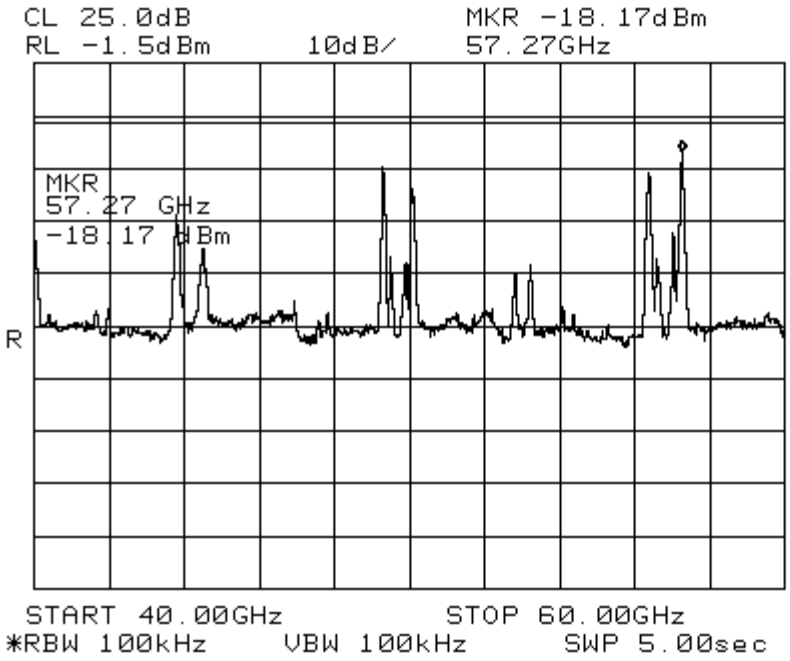


Figure 31 Conducted Emissions in 40-60GHz, for transmitting 18dBm QPSK on Channel 14A4

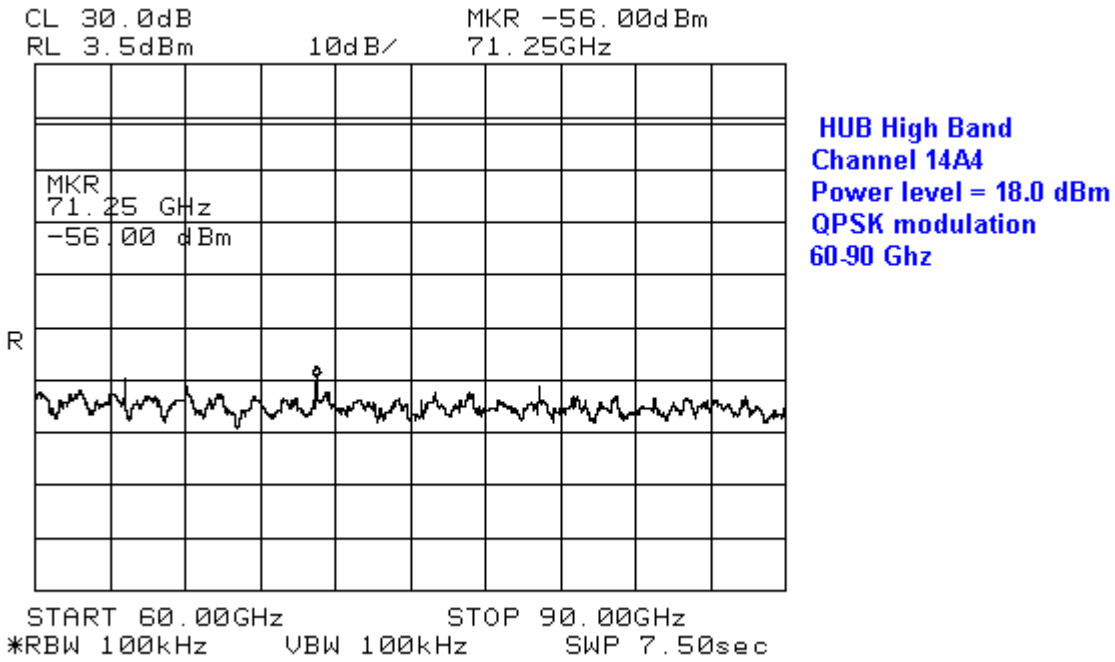
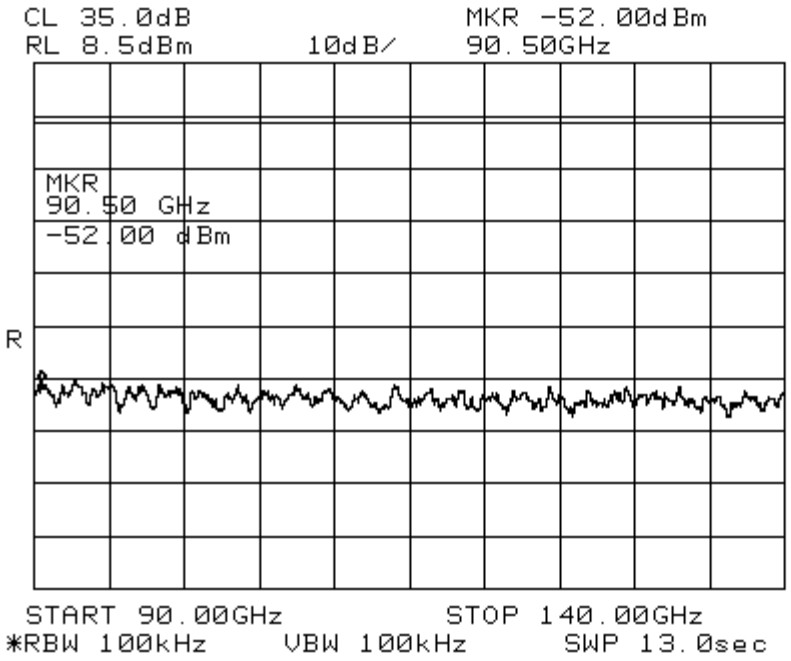
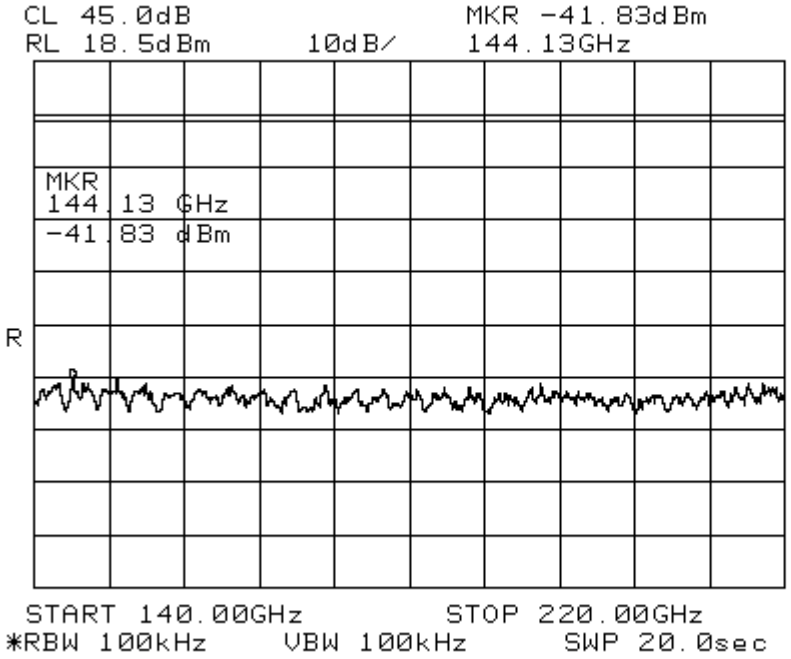


Figure 32 Conducted Emissions in 60-90GHz, for transmitting 18dBm QPSK on Channel 14A4



HUB High Band
Channel 14A4
Power level = 18.0 dBm
QPSK modulation
90-140 GHz

Figure 33 Conducted Emissions in 90-140GHz, for transmitting 18dBm QPSK on Channel 14A4



HUB High band
Channel 14A4
Power level = 18.7 dBm
QPSK modulation
140-220 GHz

Figure 34 Conducted Emissions in 140-220GHz, for transmitting 18dBm QPSK on Channel 14A4

3.4 RADIATED SPURIOUS EMISSIONS FROM THE TRANSMITTER

These tests demonstrate the spurious emission levels which are produced by EUT. The tests for the radiated emissions document the spurious levels radiated from the EUT enclosure and cables, while the transmit output port (antenna connector) will be terminated by a "dummy load".

3.4.1 Performance Specifications

As per FCC CFR 47 Part 2.1050 (previously 2.989) and 101.109
Maximum authorized bandwidth 50MHz.Unwanted emissions must be suppressed at the aggregate channel block edges based on the same roll-off rate as specified for a single channel block in 101.111 (a) (ii) and (iii).

(a)(2)(ii)In 1 MHz Band: 50% to 250% : A=11+0.4(P-50)+10log(B) or no less than 11dB down but no more than 56dB down is required

Where: A=Attenuation in dB below mean output power level
P=percent removed from center frequency
B=Authorized bandwidth in MHz

Example calculation:
If your bandwith is 50 MHz
At 50 % : A=11+.4(50-50)+10log(50) = 28dB down
At 250% : A=11+.4(250-50)+10log(50) = 108 dB so use 56 dB down

In 100kHz resolution bandwidth, the limits are 10dB lower. For the maximum power of 18dBm, at 50% the limit will be 38dB down, i.e., -20dBm. At 250%, the limit will be 66 dB down, i.e., -48dBm.

(a)(2)(iii)in 4kHz band >250% at least 43+10log(output power in Watts) or 80dB

Example calculation:
If your power were = 18dBm = 63.1mW = 0.0631W
250% and out : A=43+10log(0.0631) = 31dB down, i.e., -13dBm

Note: 4 kHz Bandwidth will be difficult to use. You may adjust the limit accordingly. If it passes at the higher bandwidth , it will certainly pass at 4 kHz.

3.4.2 Test Procedures

The EUT will be initialized in the transmit mode. The transmit output will be terminated by a "dummy load". Spurious emissions measurements will be done in the frequency bands detailed above.
The equipment under test will be operated at different frequencies across the transmit frequency band (low end, center, and high end). The entire frequency spectrum from as low as possible to 220 GHz shall be investigated and any spur or emission shall be documented.

Test Frequencies	
Channel	Center-Frequency MHz
14A4	39993.75

Table 8 Radiated Spurious Emissions Test Frequencies

3.4.3 Test Configuration

Refer to Fig. 5 for the Basic Test configuration. Figure 3.4.3 shows photos of the test setup for radiated Emission

Standard gain horn antennas and harmonic mixers will be used to take the measurements. The mixers along with a Diplexer will be used to connect the signal to the spectrum analyzer and mix it down to a frequency range that can be measured. This must be done since the analyzer used only goes to 40 GHz and signals must be measured up to 200 GHz. Please refer to the documentation supplied with the mixers for instructions on how to make measurements. Also note that any measurements made over 40 GHz will not be calibrated, they will only be referenced upon the factors supplied by the mixer manufacturer. There are no NIST traceable measurements above 75GHz(they may be up to 97GHz now). Therefore, we must use engineering judgment when taking these measurements. Care must be taken to not overload the mixers. Also care must be taken when connecting and disconnecting the waveguide pieces and horn antennas.

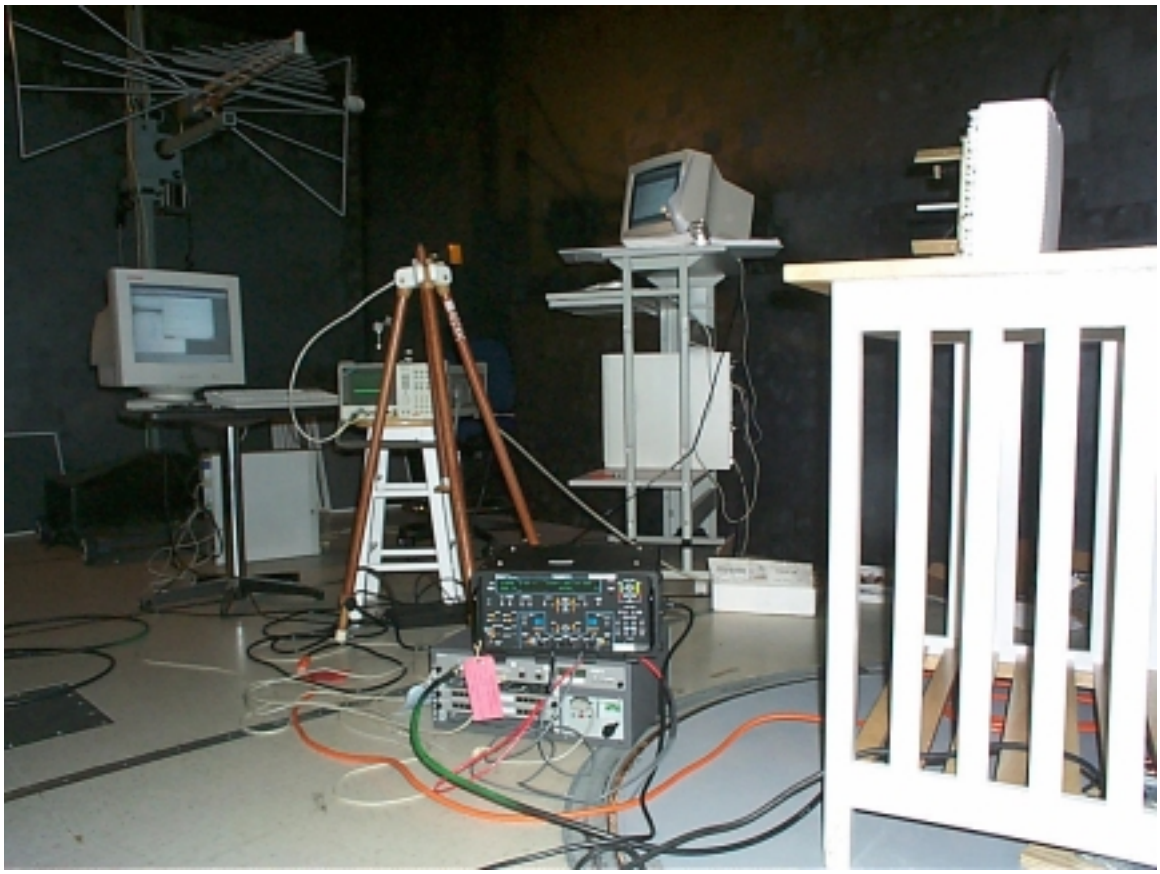


Figure 35 Test setup photo for Radiated Spurious Emission for Both Hub and Sub 38 GHz High band ODUs

Figure 36 Test setup photo1 for Radiated Spurious Emission in open field site for Both Hub and Sub 38 GHz High band ODUs (30 Mhz- 18 Ghz)

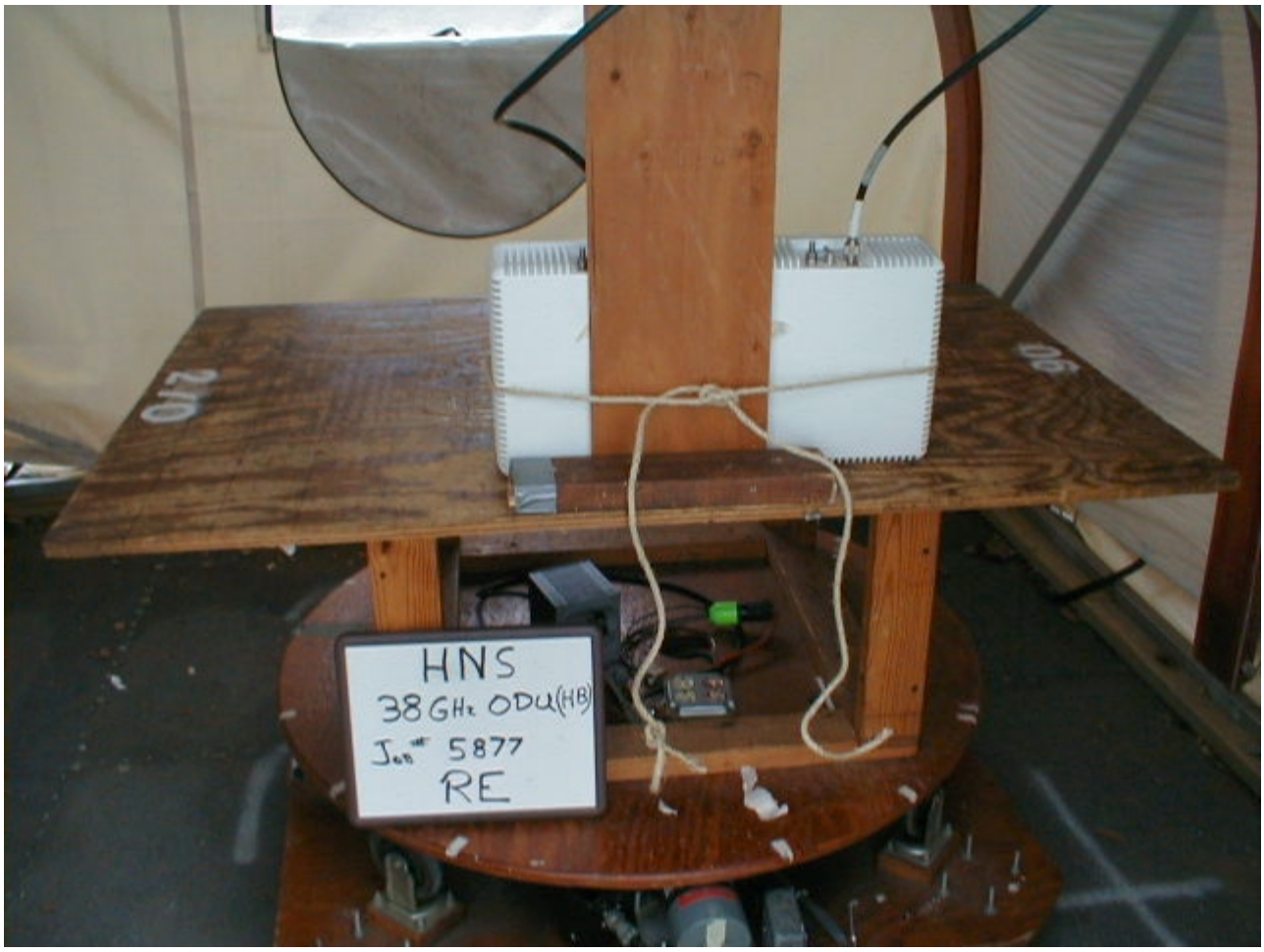


Figure 37 Test setup photo for Radiated Spurious Emission for Both Hub and Sub 38 GHz High band ODUs (30 Mhz- 18 Ghz)

The following connections will need to be made:

Antenna	**Connector**	**Adapter**	**Frequency Range**
Bi-Log	Type N	N/A	30 to 1000 MHz
Horn	Type N	N/A	1 to 18 GHz
Standard Gain Horn	WR-42	WR-42 to 3.5mm connector	18 to 26.5GHz
Standard Gain Horn	WR-28	WR-28 to 2.4mm connector	26.5 to 40 GHz
Antenna	**Connector**	**Mixer**	**Frequency Range**
Standard Gain Horn	WR-19	WR-19	40 to 60 GHz
Standard Gain Horn	WR-12	WR-12	60 to 90 GHz
Standard Gain Horn	WR-08	WR-08	90 to 140 GHz
Standard Gain Horn	WR-05	WR-05	140 to 220 GHz

Table 9 Equipment for Radiated Emissions Test

Recommend that test distance be 3m below 18Ghz and 1m above.

3.4.4 Test Results

The following Figures show the plots for the horizontal polarization (HP) for the frequency range of 1GHz-220GHz. and for the vertical polarization (VP) for the same frequency range.

PASS: X Fail:___

3.4.4.1 1-18GHz

WASHINGTON LABORATORIES,LTD
7560 LINDBERGH DRIVE
GAITHERSBURG,MD 20879
(301)417-0220 FAX:(301)417-9069

TABLE 2

FCC 3M RADIATED EMISSIONS DATA -SITE 2
PART .

CLIENT: Hughes Network Systems
MODEL NO: 38 GHz ODU Highband (Hub & Sub)
TYPE/PART: Type/Part
DATE: 05/23/2000
BY: Steve Koster
JOB #: 5877A
Tx Frequency: Hub TX :39656.25 MHz Channel:8A1
Channel: Sub TX :38956.25 MHz Channel:8A1

FREQ MHz	POL H/V	Azimuth Degree	Ant Height m	SA LEVEL (QP) dBuV	AFc dB/m	E-FIELD dBuV/m	E-FIELD uV/m	LIMIT uV/m	MRGN dB		LIMIT CALCULATION	
1500.00	V	0.00	1.0	6.3	10.2	16.5	6.7	150.0	-27.0	AMB	150.0	200.0
5000.00	V	0.00	1.0	0.0	21.1	21.1	11.3	200.0	-24.9	AMB	200.0	200.0
7500.00	V	0.00	1.0	-3.4	26.4	23.0	14.1	200.0	-23.0	AMB	200.0	200.0
3448.67	V	270.00	1.0	32.2	-3.9	28.3	26.0	500.0	-25.7		500.0	500.0
10515.20	V	270.00	1.0	31.2	4.0	35.2	57.3	500.0	-18.8	SupEq	500.0	500.0
3000.00	H	0.00	1.0	34.2	-4.5	29.7	30.6	500.0	-24.3	AMB	500.0	500.0
5000.00	H	0.00	1.0	32.2	-2.4	29.8	31.0	500.0	-24.1	AMB	500.0	500.0
7000.00	H	0.00	1.0	34.3	2.2	36.5	66.8	500.0	-17.5	AMB	500.0	500.0
10000.00	H	0.00	1.0	35.2	3.4	38.6	85.2	500.0	-15.4	AMB	500.0	500.0
13000.00	H	0.00	1.0	35.2	6.4	41.6	120.7	500.0	-12.3	AMB	500.0	500.0
15000.00	H	0.00	1.0	36.0	5.9	41.9	124.5	500.0	-12.1	AMB	500.0	500.0
17000.00	H	0.00	1.0	36.2	8.2	44.4	166.0	500.0	-9.6	AMB	500.0	500.0
18000.00	H	0.00	1.0	35.8	13.7	49.5	297.2	500.0	-4.5	AMB	500.0	500.0

Figure 38 Radiated Spurious Emissions from 1-18GHz

Radiated spurious emissions from 1GHz to 18GHz were evaluated at Washington Laboratories, Ltd. The results were enclosed above. Both the horizontal and vertical polarization were tested. There were no spurs found

3.4.4.2 Horizontal Polarization, 18-40GHz

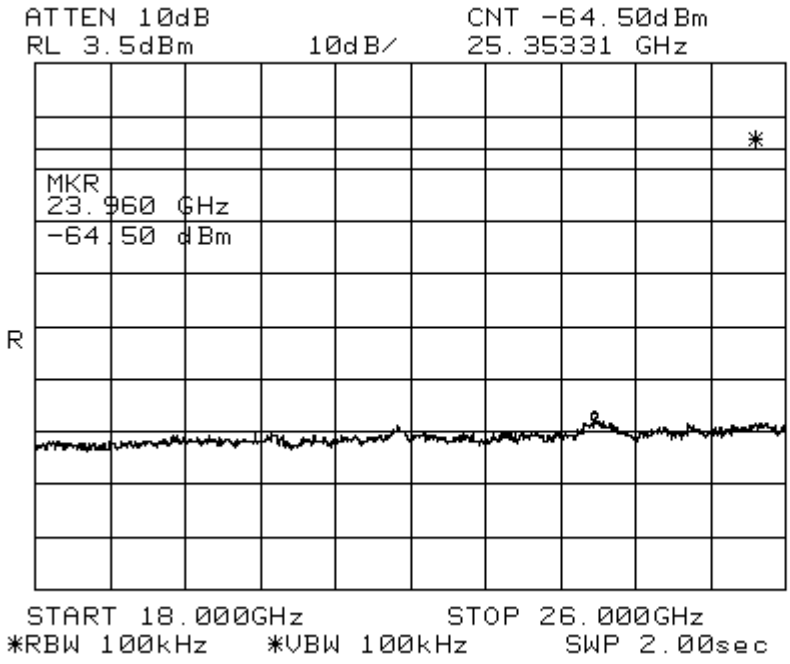


Figure 39 Radiated Emissions in 18-26GHz, HP, for transmitting 18dBm QPSK on Channel 14A4

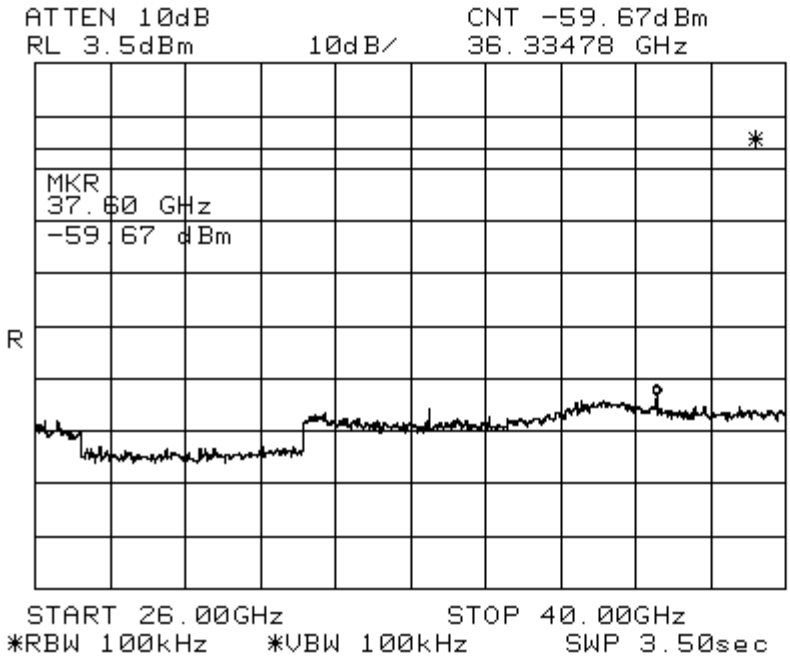


Figure 40 Radiated Emissions in 26 -40GHz, HP, for transmitting 18dBm QPSK on Channel 14A4

3.4.4.3 Horizontal Polarization, 40-60GHz

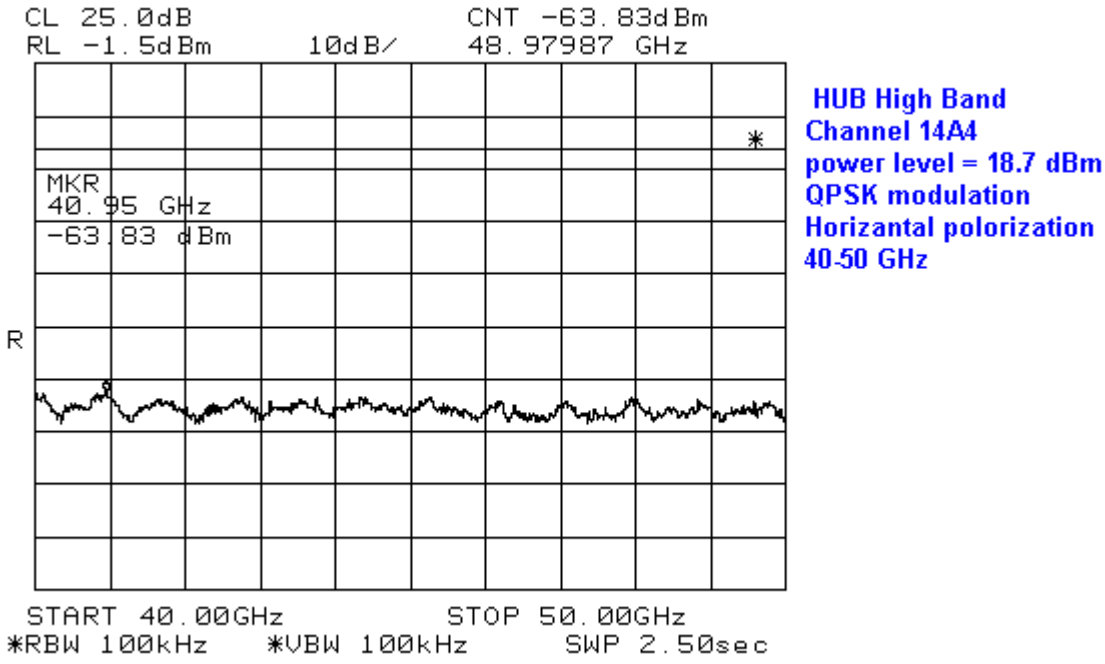


Figure 41 Radiated Emissions in 40-50GHz,HP, for transmitting 18dBm QPSK on Channel 14A4

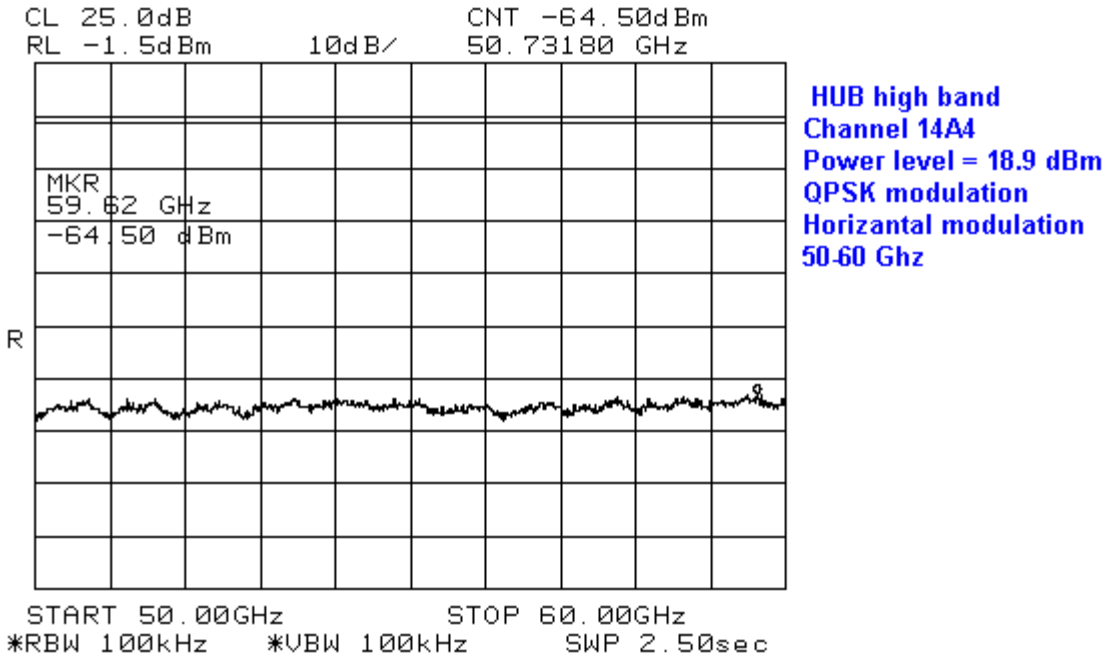


Figure 42 Radiated Emissions in 50-60GHz, HP, for transmitting 18dBm QPSK on Channel 14A4

3.4.4.4 Horizontal Polarization, 60-90GHz

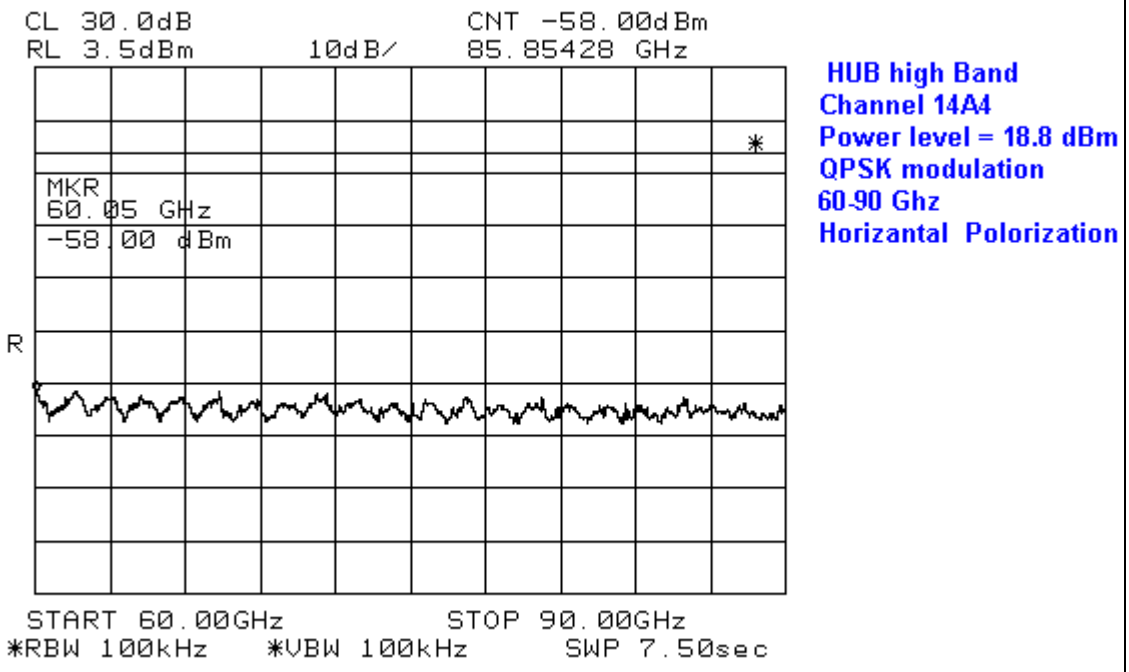


Figure 43 Radiated Emissions in 60-90GHz, HP, for transmitting 18dBm QPSK on Channel 14A4

3.4.4.5 Horizontal Polarization, 90-140GHz

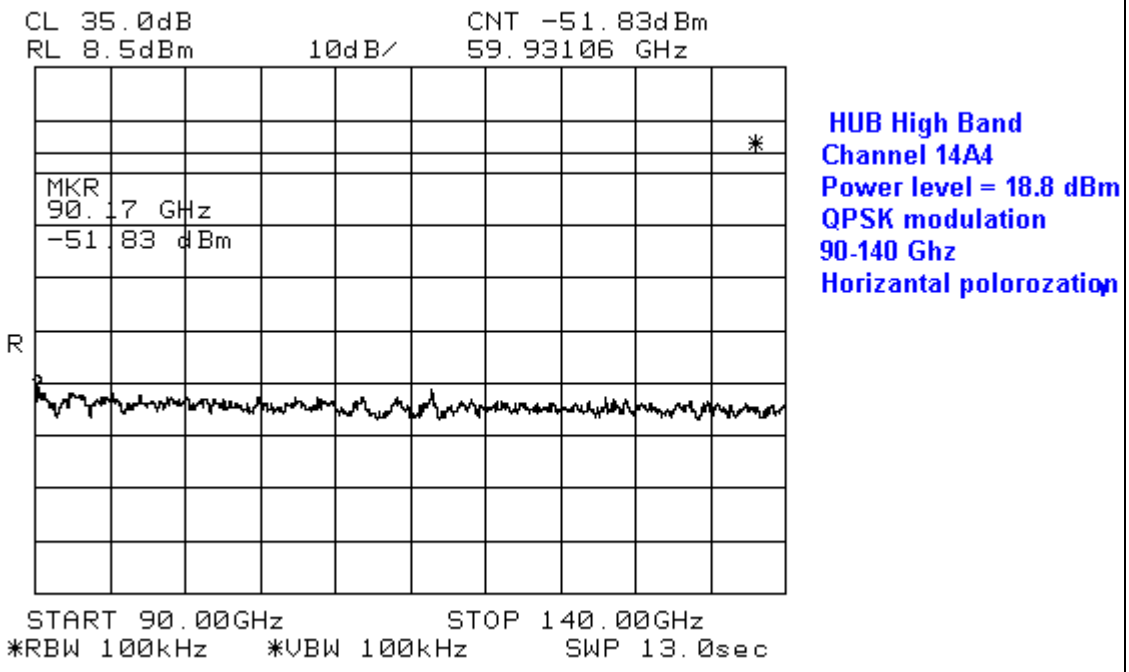


Figure 44 Radiated Emissions in 90-140GHz, HP, for transmitting 18dBm QPSK on Channel 14A4

3.4.4.6 Horizontal Polarization, 140-220GHz

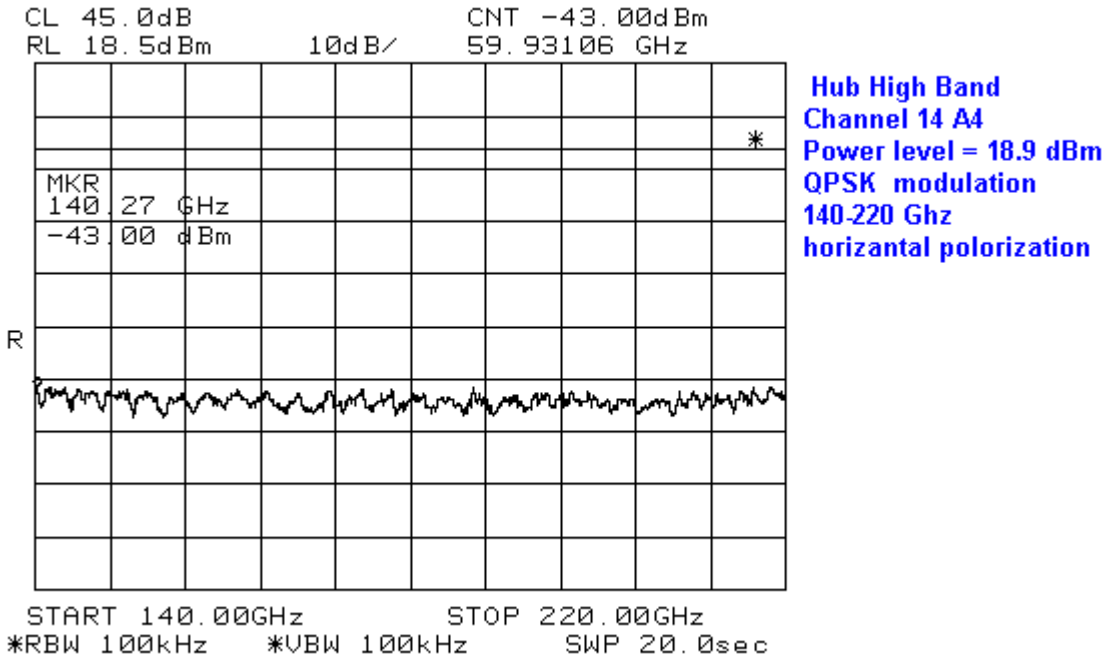


Figure 45 Radiated Emissions in 140-220GHz, HP, for transmitting 18dBm QPSK on Channel 14A4

3.4.4.7 Vertical Polarization, 18-40GHz

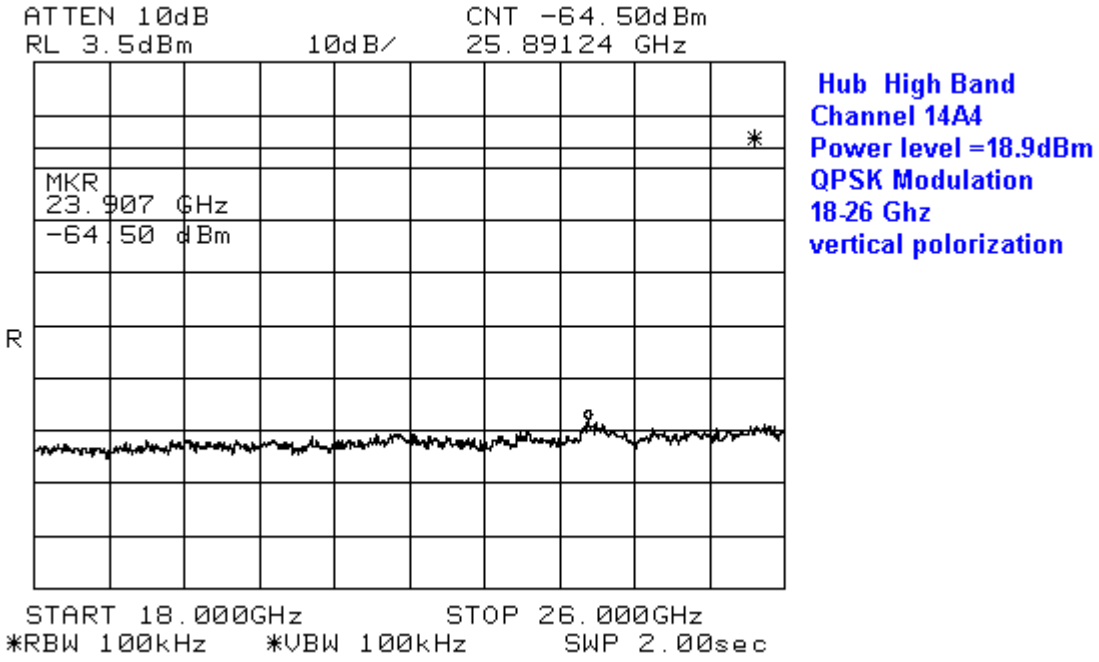


Figure 46 Radiated Emissions in 18-26GHz, VP for transmitting 18dBm QPSK on Channel 14A4

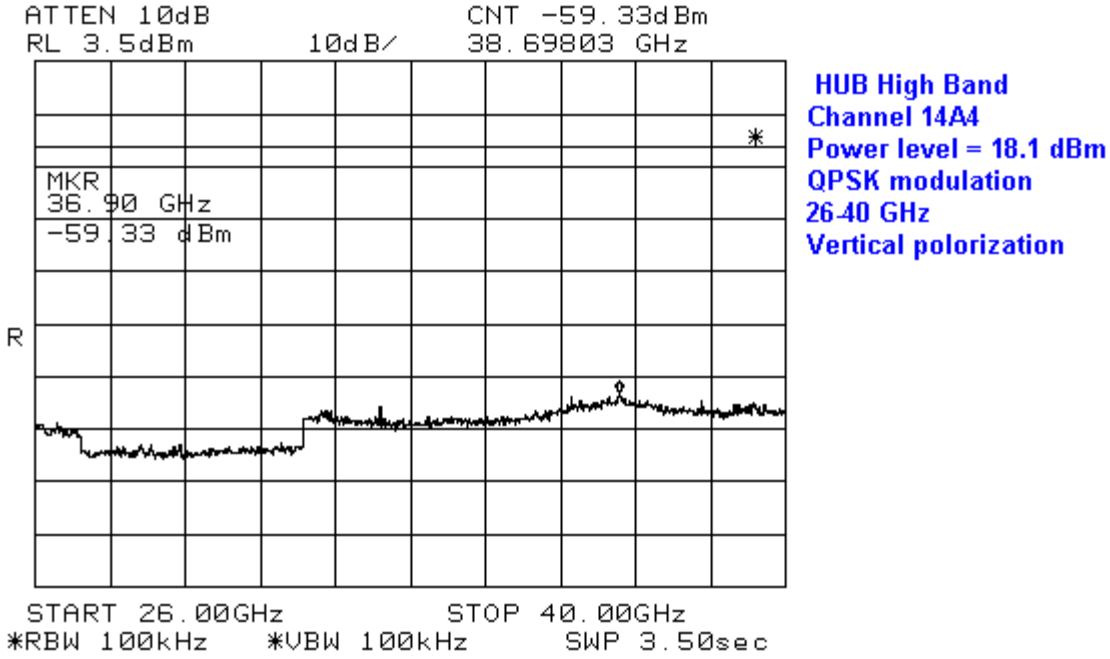


Figure 47 Radiated Emissions in 26-40GHz, VP, for transmitting 18dBm QPSK on Channel 14A4

3.4.4.8 Vertical Polarization, 40-60GHz

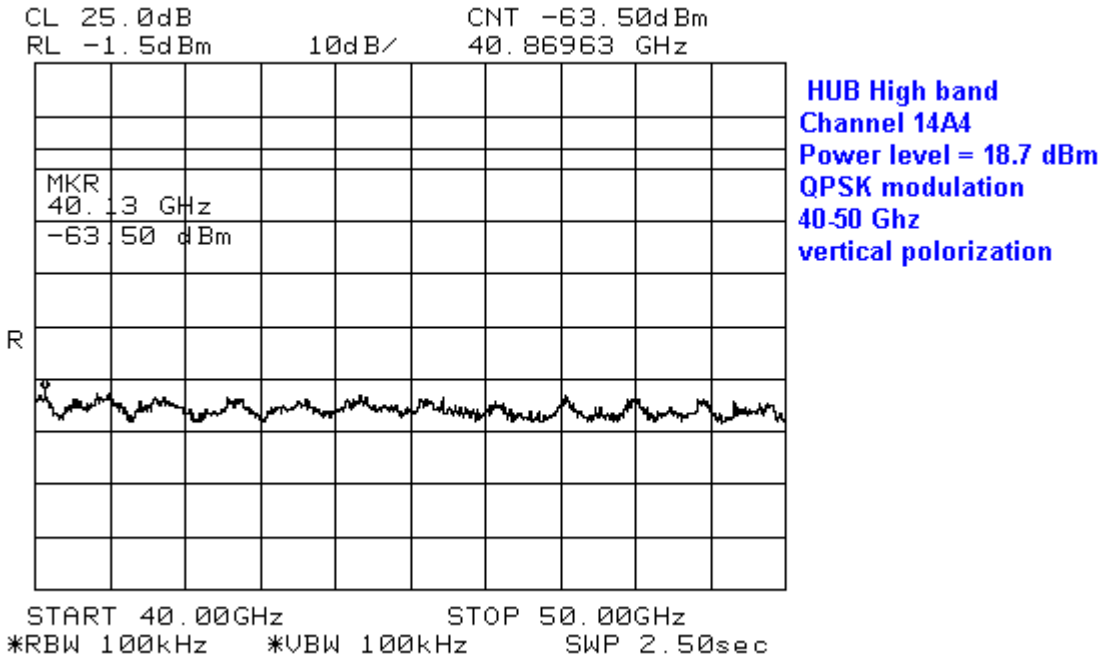


Figure 48 Radiated Emissions in 40-50GHz, VP, for transmitting 18dBm QPSK on Channel 14A4

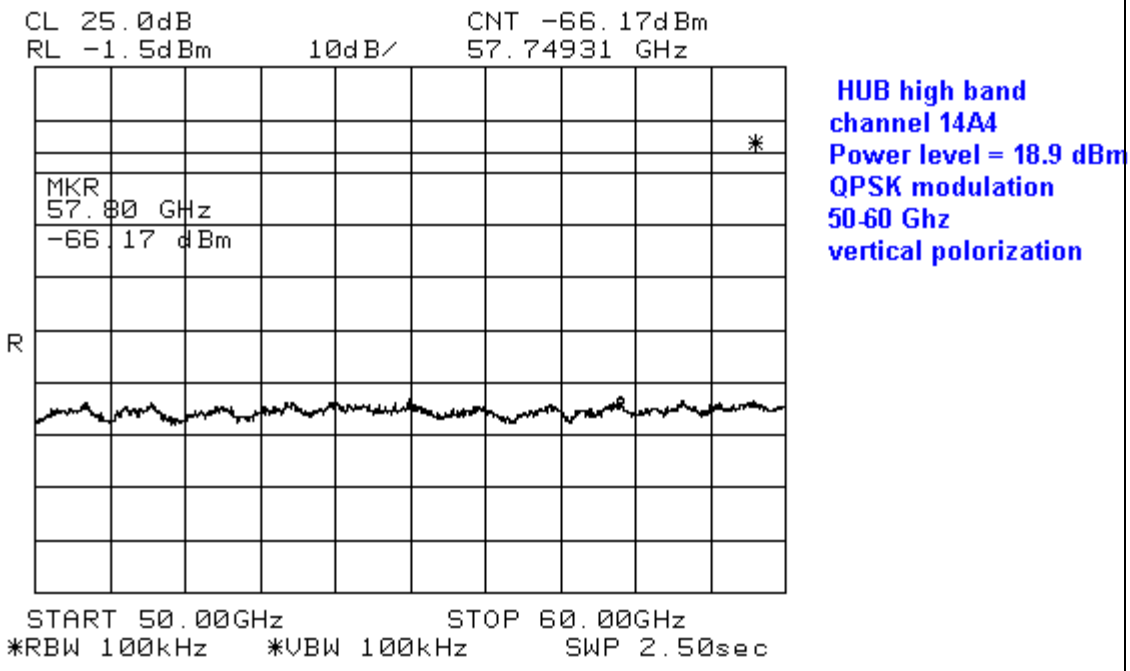


Figure 49 Radiated Emissions in 50-60GHz, VP, for transmitting 18dBm QPSK on Channel 14A4

3.4.4.9 Vertical Polarization, 60-90GHz

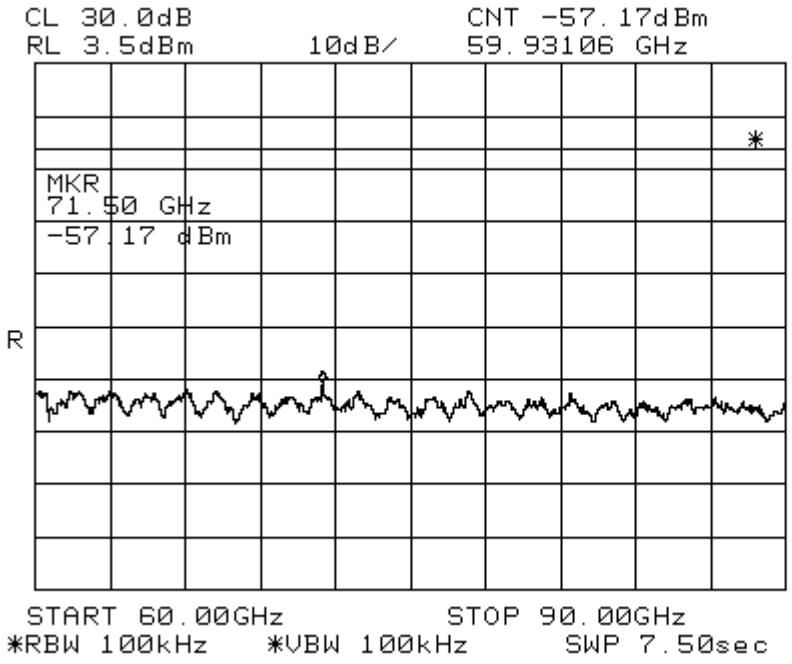


Figure 50 Radiated Emissions in 60-90GHz, VP, for transmitting 18dBm QPSK on Channel 14A4

3.4.4.10 Vertical Polarization, 90-140GHz

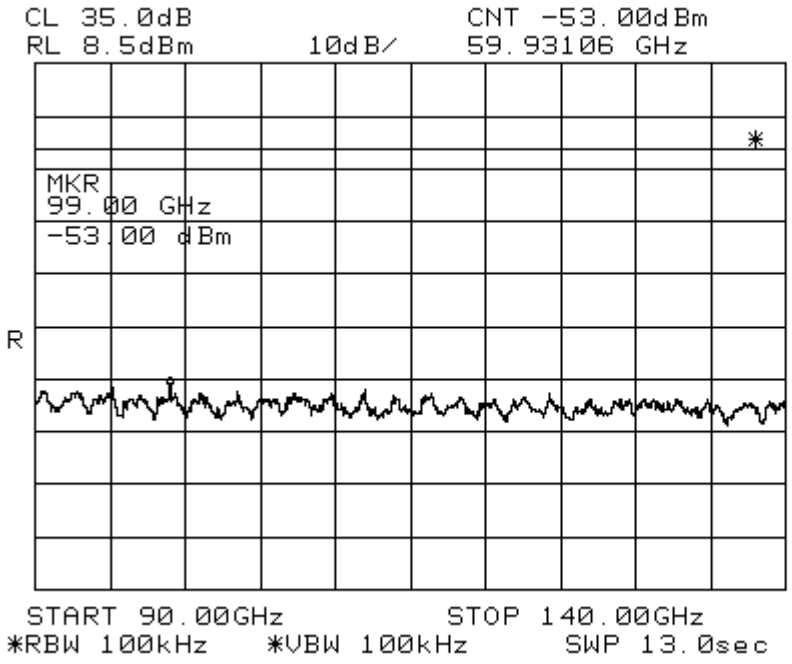


Figure 51 Radiated Emissions in 90-140GHz, VP, for transmitting 18dBm QPSK on Channel 14A4

3.4.4.11 Vertical Polarization, 140-220GHz

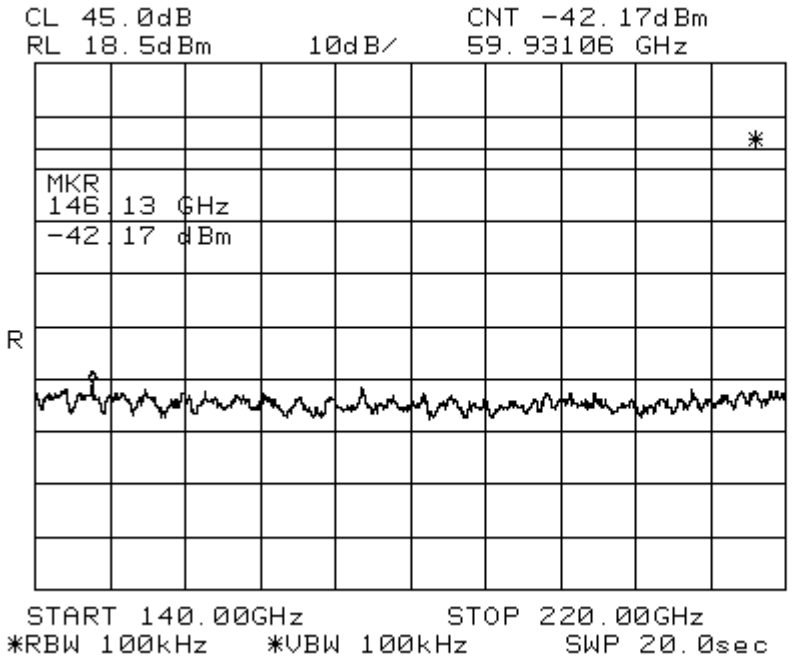


Figure 52 Radiated Emissions in 140-220GHz, VP, for transmitting 18dBm QPSK on Channel 41A4

3.5 FREQUENCY STABILITY

This test demonstrates the frequency stability of the EUT over the temperature ranges of the equipment.

3.5.1 Performance Specifications

NOTE: Equipment in the 38.6 to 40 GHz range is exempt from this requirement under 101.107

3.5.2 Test Procedures

The transmitter equipment will be placed in an environmental chamber, while the test equipment will be outside of the chamber. The chamber temperature will be set from 0°C to 50°C. The equipment under test will be allowed to temperature stabilize, at each step, before measurements will be performed. The unit will be programmed for unmodulated carrier (CW). The spectrum analyzer used had a high stability reference oscillator option, which will allowed for direct frequency measurements. Measurements of the channel output level will be monitored, for each channel, at each temperature step, and at three voltage steps when powered by DC (Low, Mid, and high Vdc). The delta output power level (output power nominal - output power measured) information will be documented in tabular form
The following channels will be used according to the band tested.

Test Frequencies	
Channel	Frequency MHz
8A	39650-39700
14A	39950-40000

3.5.3 Test Configuration

Please reference to Figure 3 for the test configuration used during this test.

3.5.4 Test Results

Our Engineering department has performed frequency stability evaluation and has provided a letter that is shown on the next page.

Memo

To: John Rymkiewicz

From: Harry Johnson

CC: Jim Worley,Dan Wendling

Date: 06/01/00

Re: Point to Multipoint Frequency Tolerance

Point to Multipoint Frequency Tolerance

The point to multipoint equipment frequency stability is traceable to the CCM crystal timebase, which in turn is phase locked to network timing with Sonet Stratum 3 stability or better. This results in frequency stability of the RF systems to within ± 4.6 ppm.

This meets the FCC 101.107 and Frequency Tolerance