Test of Tarana Wireless Absolute Air Gen 1, 2.5GHz Band

To: FCC 47 CFR Part 27 & IC RSS-199

Test Report Serial No.: TARA01-U2 Rev B

TEST REPORT

FROM

MiCOM Labs

Test of Tarana Wireless Absolute Air Gen 1, 2.5GHz Band

to

To FCC 47 CFR Part 27 & IC RSS-199

Test Report Serial No.: TARA01-U2 Rev B

This report supersedes TARA01-U2 Rev A

Applicant: Tarana Wireless
2953 Bunker Hill Lane, Suite 100
Santa Clara, California 95054
USA

Product Function: Wireless Backhaul

Copy No: pdf Issue Date: 14th August 2014

This Test Report is Issued Under the Authority of;

MiCOM Labs, Inc.
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Pleasanton, CA 94566 USA
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A2LA ACCREDITED
TESTING CERT #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

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ACCREDITATION, LISTINGS & RECOGNITION

TESTING ACCREDITATION

MiCOM Labs, Inc. an accredited laboratory complies with the international standard BS EN ISO/IEC 17025. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; http://www.a2la.org/scopepdf/2381-01.pdf

RECOGNITION

MiCOM Labs, Inc has widely recognized Electrical testing capabilities. Our international recognition includes Conformity Assessment Body designation by APEC MRA** countries. Our test reports are widely accepted for global type approvals.

Country	Recognition Body	Status	Phase	Identification No.
USA	Federal Communications Commission (FCC)	TCB	-	US0159 Listing #: 102167
Canada	Industry Canada (IC)	FCB	APEC MRA 2	US0159 Listing #: 4143A-2 4143A-3
Japan	MIC (Ministry of Internal Affairs and Communication)	CAB	APEC MRA 2	RCB 210
	VCCI	--	--	A-0012
Europe	European Commission	NB	EU MRA	NB 2280
Australia	Australian Communications and Media Authority (ACMA)	CAB	APEC MRA 1	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)	CAB	APEC MRA 1	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	CAB	APEC MRA 1	
Singapore	Infocomm Development Authority (IDA)	CAB	APEC MRA 1	
Taiwan	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)	CAB	APEC MRA 1	
Vietnam	Ministry of Communication (MIC)	CAB	APEC MRA 1	

**APEC MRA – Asia Pacific Economic Community Mutual Recognition Agreement.
Is a recognition agreement under which test lab is accredited to regulatory standards of the APEC member countries.
Phase I - recognition for product testing
Phase II – recognition for both product testing and certification
N/A – Not Applicable

**EU MRA – European Union Mutual Recognition Agreement.
Is a recognition agreement under which test lab is accredited to regulatory standards of the EU member countries.

**NB – Notified Body

PRODUCT CERTIFICATION

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard EN ISO/IEC Guide 65. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.02. MiCOM Labs test schedule is available at the following URL; http://www.a2la.org/scopepdf/2381-02.pdf

United States of America – Telecommunication Certification Body (TCB)
TCB Identifier – US0159

Industry Canada – Certification Body
CAB Identifier – US0159

Europe – Notified Body
Notified Body Identifier - 2280

Japan – Recognized Certification Body (RCB)
RCB Identifier - 210

DOCUMENT HISTORY

Document History		
Revision	**Date**	**Comments**
Draft #1	30th January 2013	
Draft #2	10th January 2014	
Rev B	14th August 2014	Amended Section 6.1.1.5 Transmitter Unwanted Emissions
Rev A	22nd January 2014	Initial release.

1. TEST RESULT SUMMARY

Applicant:	Tarana Wireless 2953 Bunker Hill Lane, Suite 100 Santa Clara, California 95054 USA	Tested By:	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California, 94566, USA
EUT:	Absolute Air Gen 1, 2.5 GHz Band	Tel:	+1 925 462 0304
Model:	Master:AAG1-M25X Slave:AAG1-S25X	Fax:	+1 925 462 0306
S/N:	Engineering Sample		
Test Date(s):	12th November to 3th December '13	Website:	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part 27 & IC RSS-199	EQUIPMENT COMPLIES

MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

Notes:

1. This document reports conditions under which testing was conducted and the results of testing performed.
2. Details of test methods used have been recorded and kept on file by the laboratory.
3. Test results apply only to the item(s) tested.

Approved & Released for MiCOM Labs, Inc. by:

A2LA ACCREDITED
TESTING CERT #2381.01

Graeme Grieve
Quality Manager MiCOM Labs,

Gordon Hurst
President & CEO MiCOM Labs, Inc.

2. REFERENCES AND MEASUREMENT UNCERTAINTY

2.1. 0Normative References

Ref.	Publication	Year	Title
(i)	FCC 47 CFR Part 27	2012	Code of Federal Regulations
(ii)	Industry Canada RSS-199	2010 Issue 1	Broadband Radio Service (BRS) Equipment Operating in the Band 2500-2690 MHz
(iii)	Industry Canada GL-07	January 2010 Issue 1	Interim Technical Guidelines for the Operation of the Broadband Radio Service (BRS) in the Band 2500-2690 MHz
(iv)	Industry Canada RSS-Gen	2010	General Requirements and Information for the Certification of Radiocommunication Equipment
(v)	ANSI C63.4	2009	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
(vi)	CISPR 22/ EN 55022	2008 2006+A1:2007	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
(vii)	M 3003	Edition 2 Jan. 2007	Expression of Uncertainty and Confidence in Measurements
(Viii)	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
(ix)	ETSI TR 100 028	2001	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
(x)	A2LA	July 2012	Reference to A2LA Accreditation Status – A2LA Advertising Policy
(xi)	FCC Public Notice – DA 02-2138	2002	Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices

2.2. Test and Uncertainty Procedures

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.

3. PRODUCT DETAILS AND TEST CONFIGURATIONS

3.1. Technical Details

Details	Description
Purpose:	Test of the Tarana Wireless Absolute Air Gen 1, 2.5GHz Band in the frequency range 2500-2690 to FCC Part 27 and Industry Canada RSS-199 Issue 1 regulations.
Applicant:	Tarana Wireless 2953 Bunker Hill Lane, Suite 100 Santa Clara, California 95054 USA
Manufacturer:	Zollner Electronics 575 Cottonwood Drive Milpitas, California 95035 USA
Laboratory performing the tests:	MiCOM Labs, Inc. 575 Boulder Court, Pleasanton, 94566 California USA
Test report reference number:	TARA01-U2 Rev B
Date EUT received:	12th November 2013
Standard(s) applied:	FCC 47 CFR Part 27 & IC RSS-199
Dates of test (from - to):	12th November to 3th December '13
No of Units Tested:	One
Type of Equipment:	Wireless Backhaul
Model(s):	Master:AAG1-M25X Slave:AAG1-S25X
Location for use:	Outdoor only
Declared Frequency Range(s):	2505 - 2690 MHz
Hardware Rev	1.0
Software Rev	0.640.002.01
Type of Modulation:	OFDM
Declared Nominal Output Power per Antenna Port (Average Power):	+25 dBm
Declared Nominal Output Power ∑Antenna Port(s) (Average Power):	+34 dBm
EUT Modes of Operation:	10 MHz Channel Spacing
Transmit/Receive Operation:	Time Division Duplex
System Beam Forming:	Antenna beam forming is available
Rated Input Voltage and Current:	Nominal: 48 Vdc (POE), Maximum 75 Vdc Minimum 36 Vdc
Operating Temperature Range:	Declared range -40 to +60ºC
ITU Emission Designator:	9M2D1D
Equipment Dimensions:	19.8 x 12.2 x 3.3 inches
Weight:	14 lbs
Primary function of equipment:	Wireless Backhaul

3.2. Scope of Test Program

Tarana Wireless Absolute Air Gen 1, 2.5GHz Band RF Testing

The scope of the test program was to test the Tarana Wireless Absolute Air Gen 1, 2.5GHz Band, in the frequency range 2500 - 2690 MHz for compliance against FCC 47 CFR Part 27 and Industry Canada RSS-199 specifications.

Absolute Air End Gen 1, 2.5 GHz
The Absolute Air End Absolute Air End Gen 1, 2.5 GHz

Tarana Wireless Absolute Air Gen 1, 2.5GHz Band

Tarana Wireless Absolute Air Gen 1, 2.5GHz Band – Back

3.3. Equipment Model(s) and Serial Number(s)

Type (EUT/ Support)	Equipment Description (Including Brand Name)	Mfr	Model No.	Serial No.
EUT	Wireless Backhaul	Tarana Wireless	Master:AAG1-M25X Slave:AAG1-S25X	Engineering Sample
Support	Laptop PC	IBM	Unknown	None

3.4. Antenna Details

The unit contains 8 dual polarized antenna columns. Each column has a gain of 9.5 dBi for each polarization. The maximum beam-forming gain is 9 dB over the antenna column gain, thus the maximum beam-formed antenna gain for each polarization is 18.5 dBi.

Antenna Type	Manufacturer	Model Number	Azimuth/Elevation	Antenna Gain (dBi)
				2.5 GHz
Integral	Tarana Wireless	Not Available	Elev BW=25°, Azimuth Coverage = 90°	18.5

3.5. Cabling and I/O Ports

Number and type of I/O ports

As ease of device installation and product ruggedness are such key design criteria, Tarana Wireless has made every effort to assure that the connector interfaces that we design into the product provide for easy connect/dis-connect and can withstand the environmental conditions of even the harshest environments. To meet these criteria, Tarana has focused on connector systems that incorporate easy-on, Push-Pull mechanisms that are certified to meet IP67 ingress protection criteria. These connections meet the requirements of IP67 in both a mated and un-mated (with dust cap installed) condition and do not require the addition of messy, time-consuming to install, self-vulcanizing sealing tape.
Power is supplied to Tarana Wireless via a Harting Push-Pull power connector system. As noted above, these connectors are easy to install/dis-connect, and are sealed to assure integrity in any environmental condition. The Gen 2 EN and CNLite devices are powered via a 4 pole, 12A, polarized connector.
Figure 1 and Figure are pictures of the device and cable side Harting Push-Pull Power connectors:

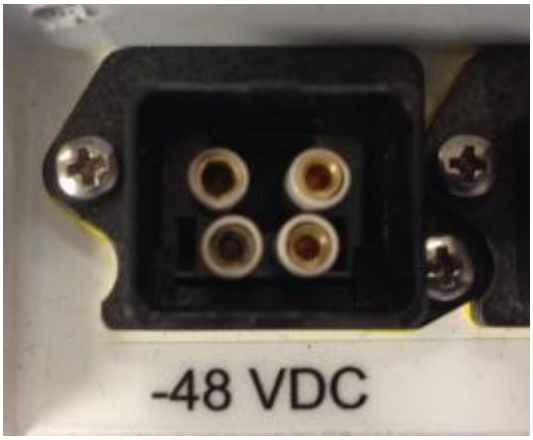


Figure 1: Device Side Harting Push-Pull Power Connector

Figure 2: Cable Side Harting Push-Pull Power Connector

Tarana Wireless Electrical Ethernet connections are provided via a Harting Push-Pull RJ-45 connector system. Much like Harting's Push-Pull power connector system, their Push-Pull RJ-45 connectors are easy to install and provide IP67 protection. Figure 2 and Figure 3 show pictures of the RJ-45 connectors:

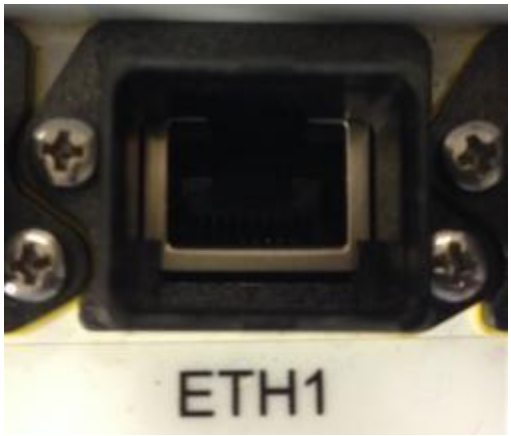


Figure 2: Device Side Harting Push-Pull RJ-45 Connector

Figure 3: Cable Side Harting Push-Pull RJ-45 Connector

Tarana Wireless provides optical ethernet connections via Radiall OSIS Push-Pull SFP connectors. The Radiall connector system, much like the Harting Push-Pull system, enables quick connection/disconnection of the SFP cable, and provides an IP67 rated connection in both the mated and un-mated (with dustcap installed) conditions.

Figure 5 : Device Side Radiall OSIS Push-Pull SFP Connector

Figure 6: Cable Side Radiall OSIS Push-Pull SFP Connector

Tarana Wireless provides a ground connection for their devices in one of two different ways. A standard telecommunications industry two-hole lug termination is provided for all devices. Some devices have an additional single terminal (M6 thread) ground connection point.

Figure 4: Standard 2 Hole Grounding Lug (2 X M6)

Figure 8: Single-Hole Ground Hole (M6)

Gen 1.0 EN Cables

Tarana Wireless offers a variety of cable options to enable termination of Gen 1 EN equipment to site infrastructure. These options include RJ-45 cables for the data and management ports, 48VDC, and copper and fiber0ptic SFP cables.
Data and management port RJ-45 cables are double-sided cables with a Harting Push-Pull IP67 rated connector on one end and a shielded RJ-45 on the other end. The cables are outdoor rated, and available in multiple lengths ranging from 1 to 100m. The cables are supplied with an additional shielded RJ-45 should the cable need to be field terminated to a specific length. To ease installation, cables are labeled with color coded designator labels that describe termination location. Figure 9 and Figure are cable drawings of the data and management port cables.

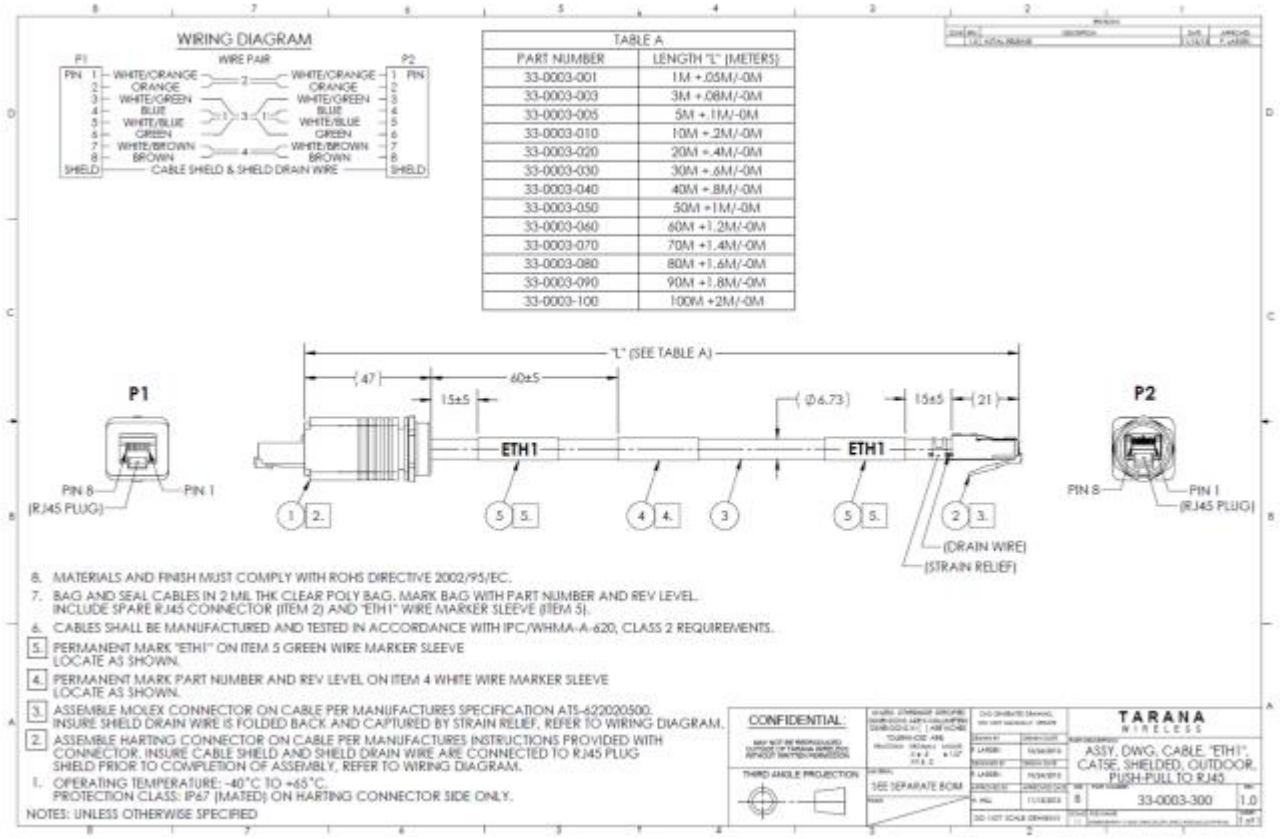


Figure 9: and Gen 2 EN_M, EN_S, and CN Lite RJ-45 "ETH1" Cable Drawing

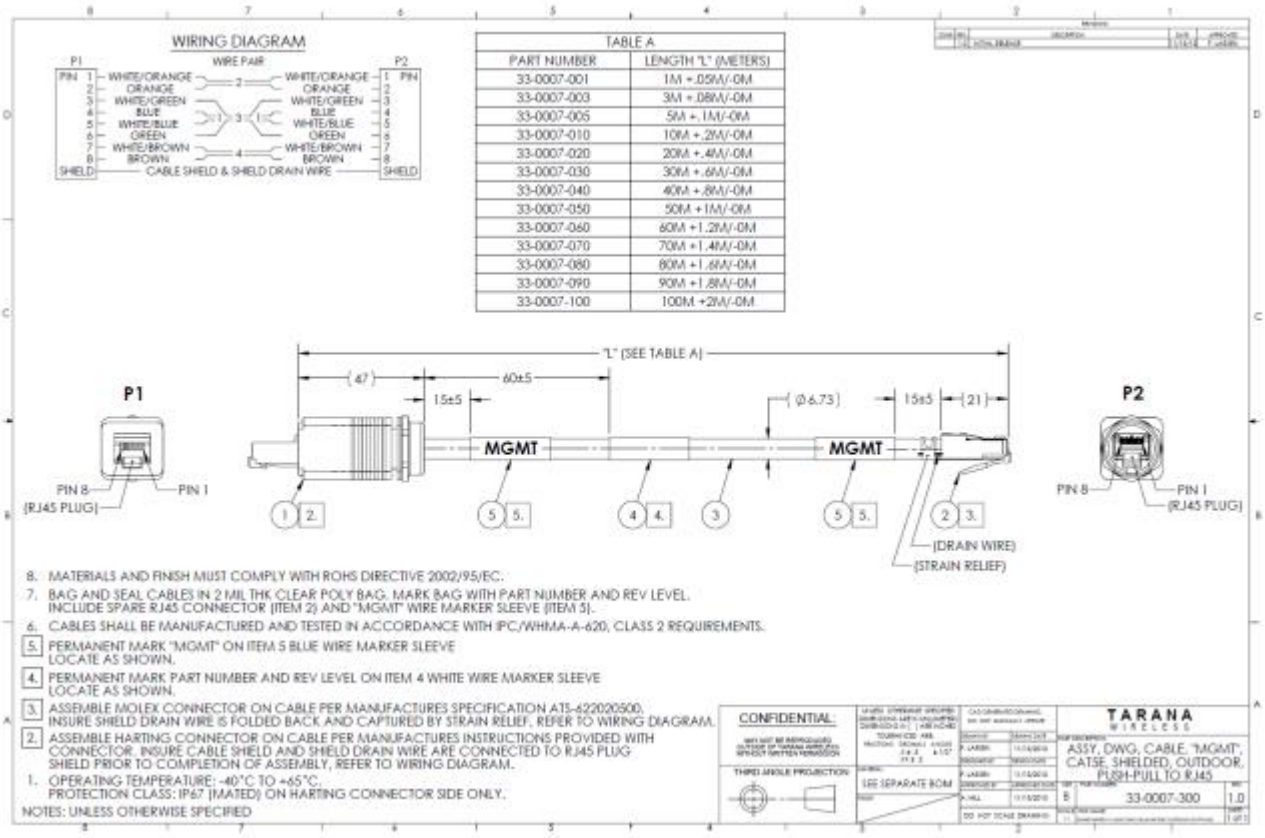


Figure 10: RJ-45 "MGMT" Cable Drawing

3.6. Test Configurations

Testing was performed to determine the highest power level versus bit rate. The variant with the highest power was used to exercise the product.

Matrix of test configurations

Operational Mode(s)	Variant	Data Rates with Highest Power	Test Frequencies (MHz)
10 MHz Bandwidth, OFDM Horizontal and Vertical Polarization	256 QAM	75 Mbit/s	2505, 2600, 2690

3.7. Equipment Modifications

The following modifications were required to bring the equipment into compliance:

1. NONE

3.8. Deviations from the Test Standard

The following deviations from the test standard were required in order to complete the test program:

1. NONE

3.9. Subcontracted Testing or Third Party Data

1. NONE

4. TESTING EQUIPMENT CONFIGURATION(S)

4.1. Conducted RF Emission Test Set-up

The following tests were performed using the conducted test set-up shown in the diagram below.

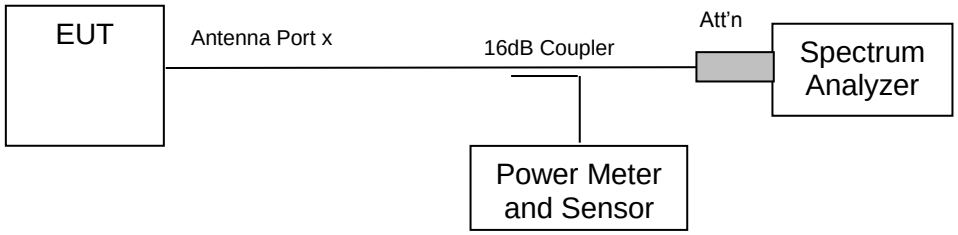
1. Section 6.1.1.2 Occupied Bandwidth
2. Section 6.1.1.4. Maximum Conducted Output Power
3. Section 6.1.1.5 Conducted Spurious Emissions
4. Section 6.1.1.5 Band-Edge Spurious Emissions
5. Section 6.1.1.6 Peak Excursion

Traceability

Test Equipment Used
0158, 0223, 0374, 088, 0252, 0310, 0314

Conducted Test Set-Up Pictorial Representation

Test Measurement Set up



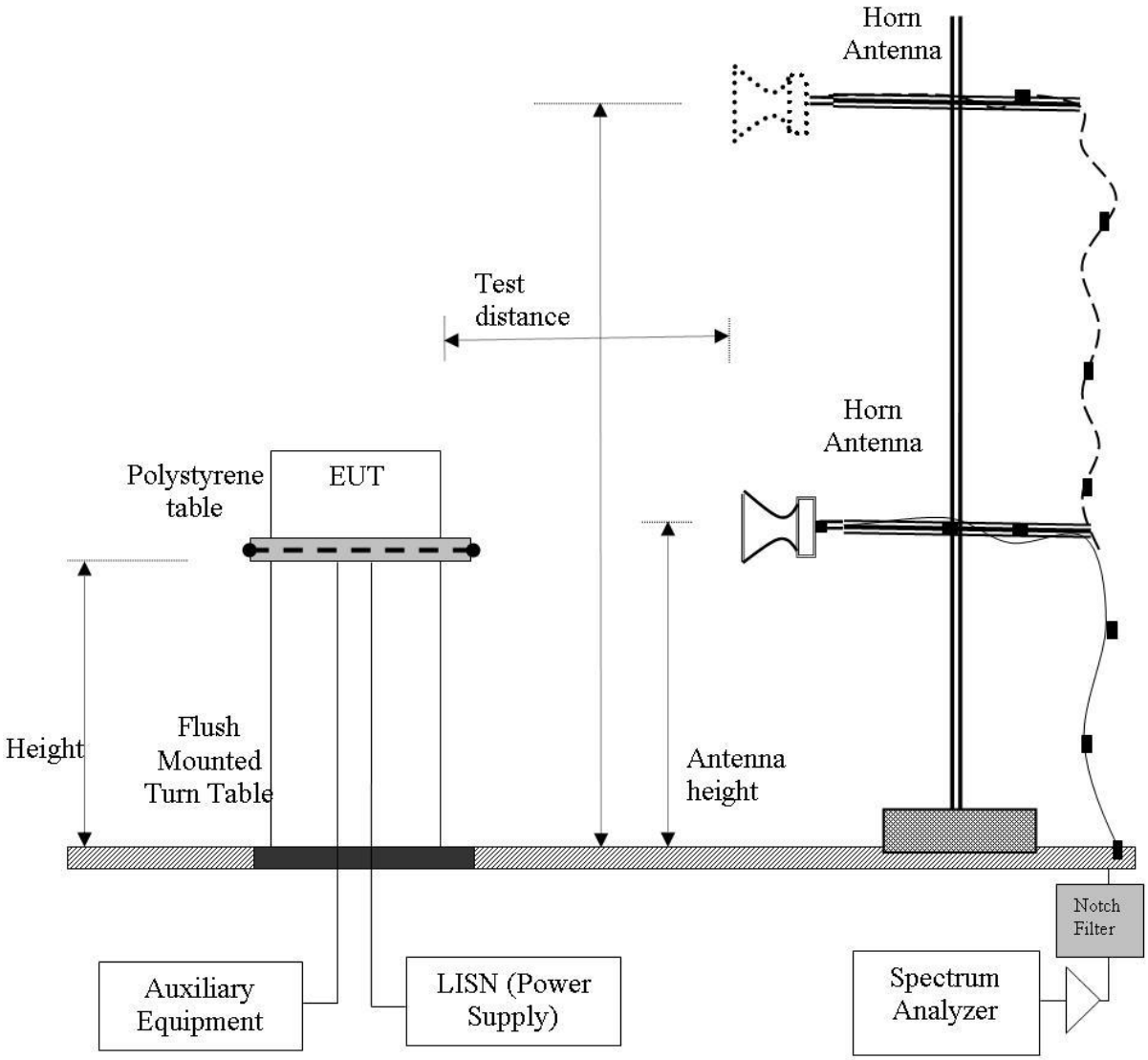
Measurement set up for all conducted testing

4.2. Radiated Spurious Emission Test Set-up > 1 GHz

The following tests were performed using the conducted test set-up shown in the diagram below.

1. Radiated spurious emissions were submitted by Tarana Wireless in a separate report. MiCOM Labs were not responsible for these measurements

Radiated Emission Measurement Setup – Above 1 GHz

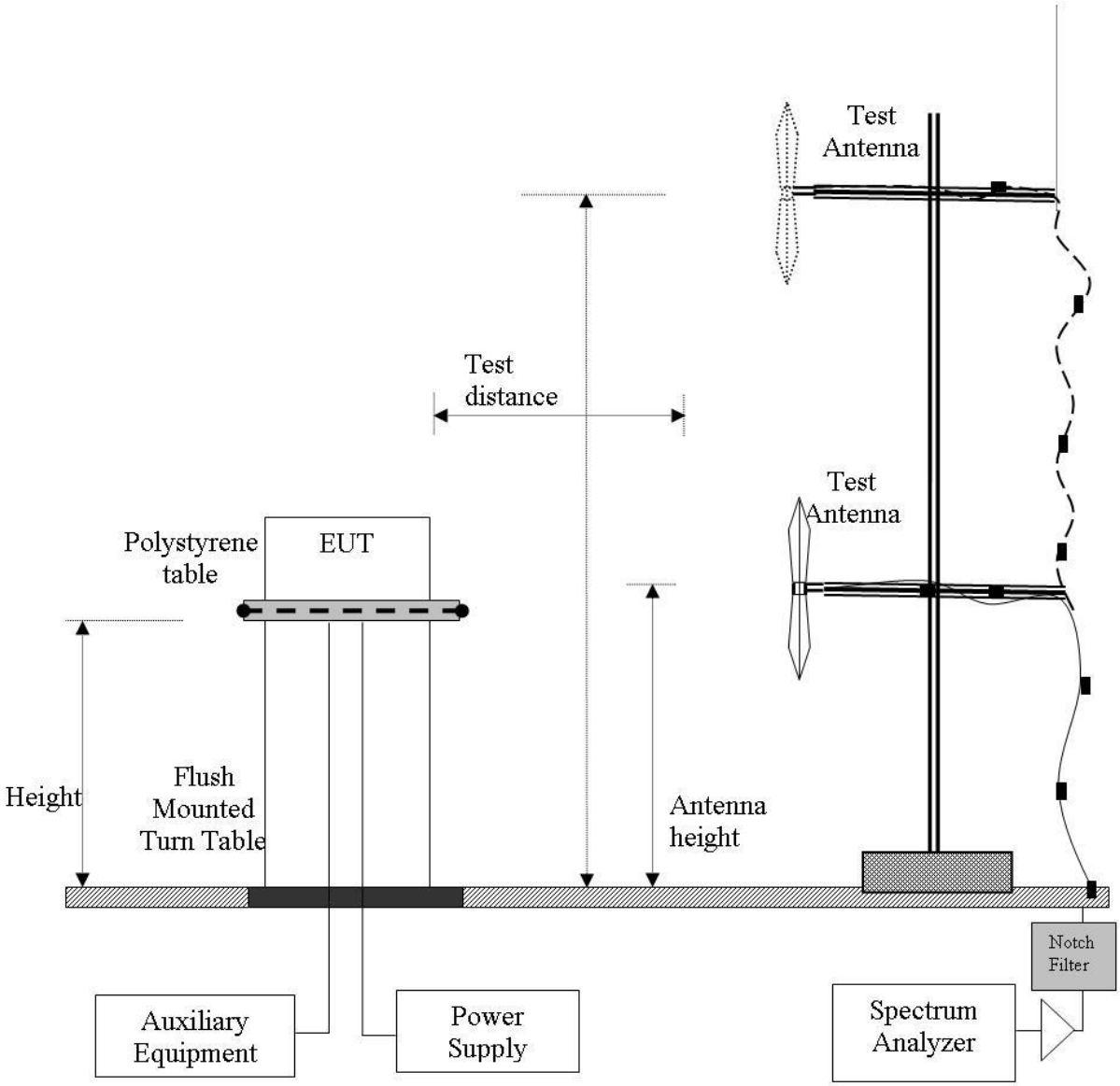


4.3. Digital Emissions Test Set-up (0.03 – 1 GHz)

The following tests were performed using the conducted test set-up shown in the diagram below.

1. Digital emissions were submitted by Tarana Wireless in a separate report, MiCOM Labs were not responsible for these measurements

Digital Emission Measurement Setup – Below 1 GHz

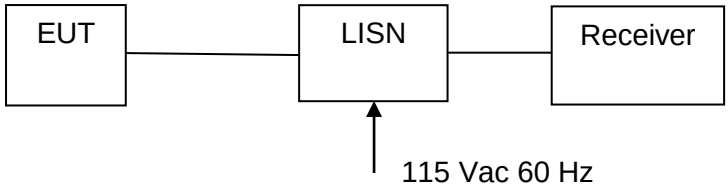


4.4. ac Wireline Emission Test Set-up

The following tests were performed using the conducted test set-up shown in the diagram below.

1. ac Wireline Emission were submitted by Tarana Wireless… MiCOM Labs were not responsible for these measurements

Conducted Test Set-Up Pictorial Representation



Measurement set up for ac Wireline Conducted Emissions Test

5. TEST SUMMARY

List of Measurements

The following table represents the list of measurements required under the **FCC CFR47 Part 27** and **Industry Canada RSS-199**, **Industry Canada RSS-Gen** **and GL-07.**

Section(s)	Test Items	Description	Condition	Result	Test Report Section
2.1033(c) **4.1**	Type of Modulation	Modulation type	Conducted	Complies	6.1.1.1
2.1033(c) **4.2**	Channel Bandwidth	99% Emission bandwidth	Conducted	Complies	6.1.1.2
2.1055, 27.54 **4.3**	Transmitter Frequency Stability	Frequency contained within band of interest	Conducted	Complies GPS Locked	6.1.1.3
2.1046 **5.2.1** **4.4**	Transmitter Output Power & EIRP	Power Measurement	Conducted	Complies	6.1.1.4
2.1051, 27.53(m) **4.5**	Transmitter Unwanted Emissions	Transmitter Spurious Emissions	Conducted	Complies	6.1.1.5
27.5	Peak Excursion Ratio	<13dB in any 1MHz bandwidth	Conducted	Complies	6.1.1.6

Note 1: Test results reported in this document relate only to the items tested

Note 2: The required tests demonstrated compliance as per client declaration of test configuration, monitoring methodology and associated pass/fail criteria

List of Measurements (continued)

The following table represents the list of measurements required under the **FCC CFR47 Part 27** and **Industry Canada RSS-199** and **Industry Canada RSS-Gen**.

NOTE:

Radiated and ac Wireline emission test results are not included in this report and were submitted through a secondary report provided by Tarana Wireless.

Section(s)	Test Items	Description	Condition	Result	Test Report Section
2.1051, 27.53(m) **4.5**	Radiated Emissions		Radiated	Results provided by Tarana Wireless	6.1.2
	Transmitter Radiated Spurious Emissions	Emissions above 1 GHz			
	Radiated Band Edge	Band edge results			
	Receiver Spurious Emissions	Emissions above 1 GHz			
2.1051, 27.53(m) **4.5**	Digital Emissions	Emissions <1 GHz (30M-1 GHz)		Results provided by Tarana Wireless	*6.1.2.1*
15.407(b)(6) **15.207** **7.2.2**	AC Wireline Conducted Emissions 150 kHz–30 MHz	Conducted Emissions	Conducted	Results provided by Tarana Wireless	6.1.3

6. TEST RESULTS

6.1. Device Characteristics

6.1.1. Conducted Testing

6.1.1.1. Type of Modulation

Conducted Test Conditions for Type of Modulation			
Standard:	FCC CFR 47:Part 27	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Type of Modulation	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	2.1033(c)	**Pressure (mBars):**	999 - 1001
Reference Document(s):			

Test Procedure for Type of Modulation

The Type of Modulation employed is OFDM a digital modulation.

Requirement

Equipment certified under the standard shall employ digital modulation

6.1.1.2. Channel Bandwidth

Conducted Test Conditions for Occupied Bandwidth			
Standard:	FCC CFR 47:Part 27	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Occupied Bandwidth	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	2.1033(c)	**Pressure (mBars):**	999 - 1001
Reference Document(s):			

Test Procedure for Channel Bandwidth Measurement

The 99 % channel bandwidth is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency. The Resolution Bandwidth was set to approximately 1% of the emission bandwidth 100 kHz, video bandwidth 300 kHz.

Limits

The channel bandwidth shall be equal to or greater than 1 MHz and shall be reported by the certification applicant. Based on the channel bandwidth, the channel edge shall be used as reference point in the measurement of the transmitter unwanted emissions power.

Measurement Results for 99 % Operational Bandwidth

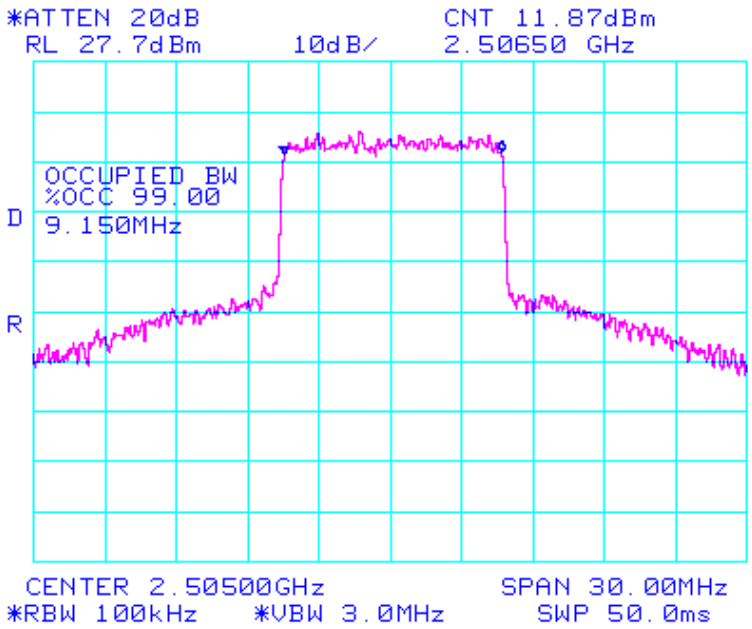
Equipment Configuration for 99% Occupied Channel Bandwidth			
Variant:	10 MHz	**Duty Cycle (%):**	100
Data Rate:	75 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	GMH
Engineering Test Notes:			

Test Measurement Results

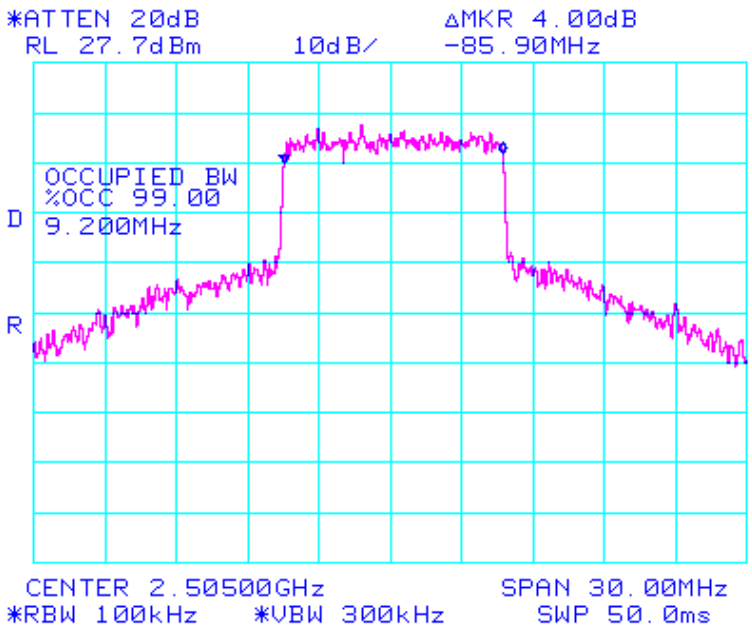
Test Frequency	Measured 99% Bandwidth (MHz)							
	Antenna							
MHz	**0**	**2**	**4**	**6**	**8**	**10**	**12**	**14**
2505.0	9.15	9.20	9.15	9.15	9.15	9.15	9.20	9.20
2600.0	9.10	9.10	9.10	9.15	9.10	9.05	9.20	9.10
2685.0	9.15	9.15	9.15	9.15	9.10	9.15	9.20	9.10

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

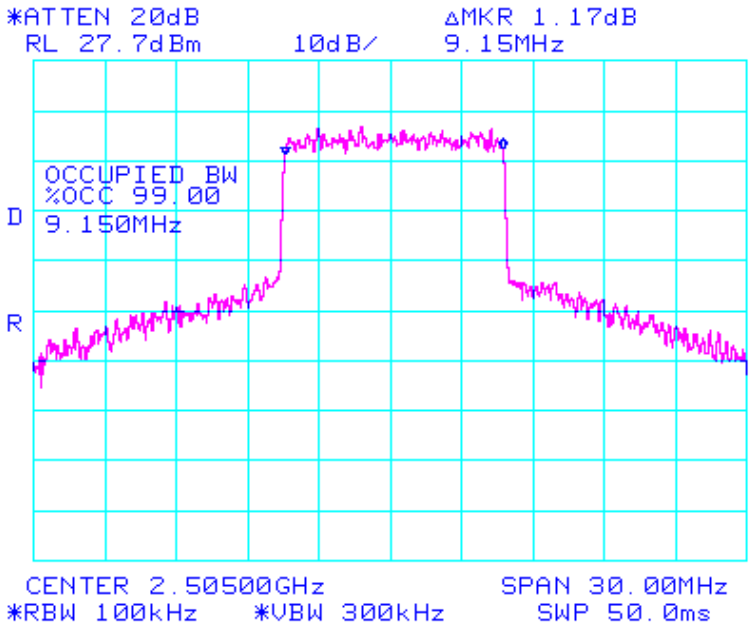
2505 MHz, Antenna 0



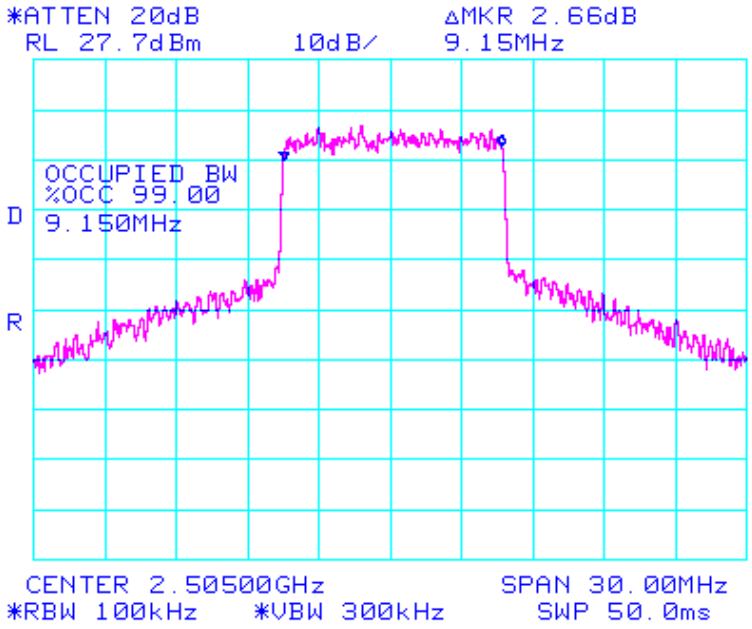
2505 MHz, Antenna 2



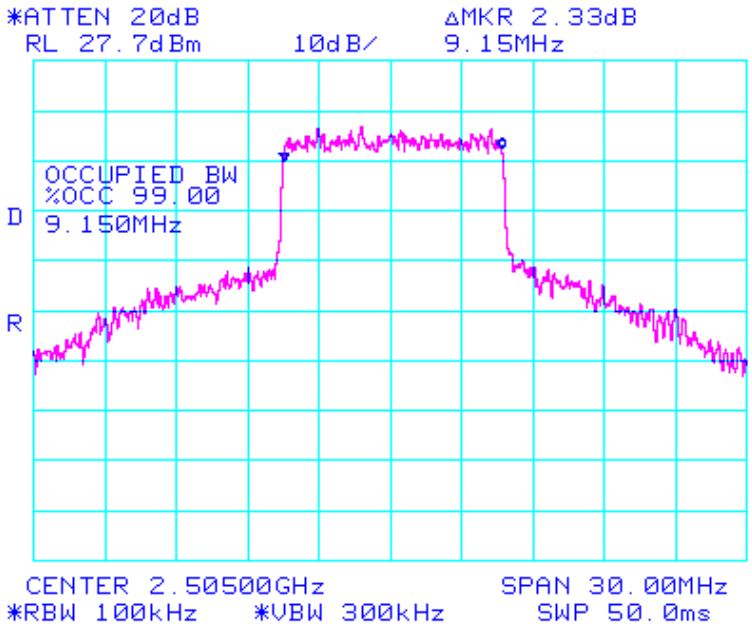
2505 MHz, Antenna 4



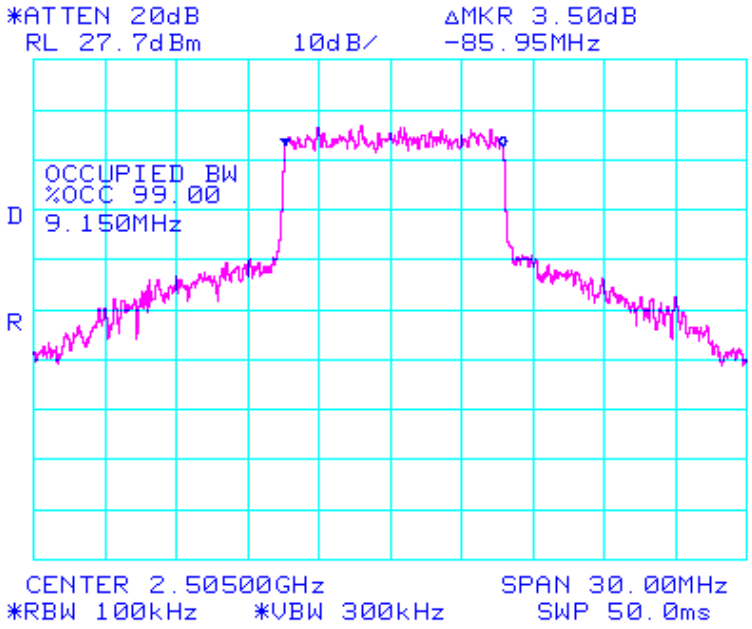
2505 MHz, Antenna 6



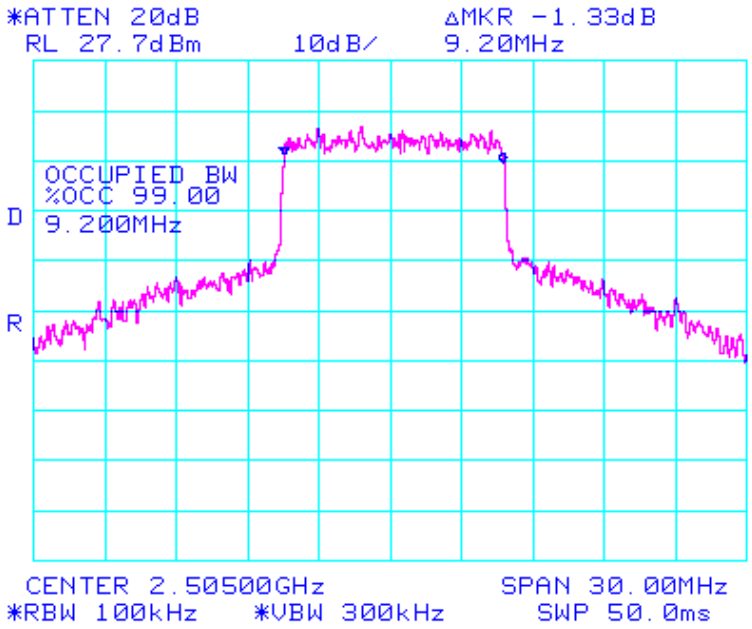
2505 MHz, Antenna 8



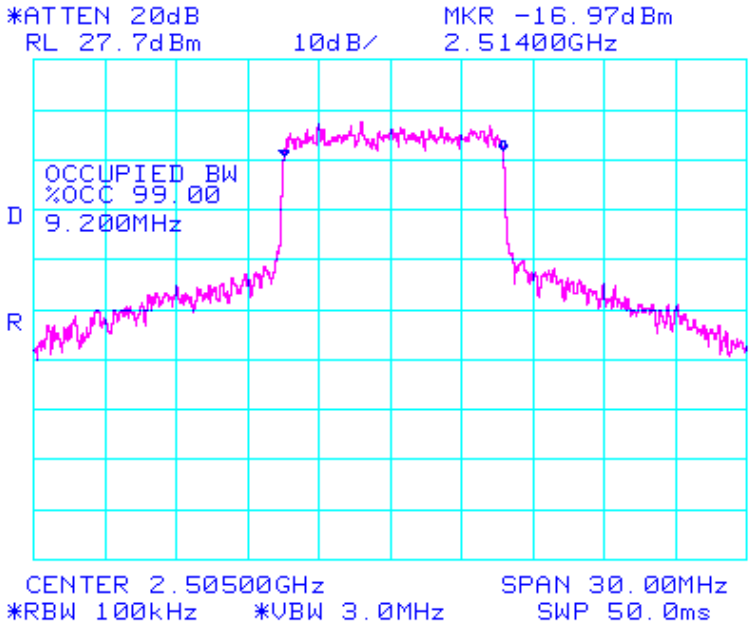
2505 MHz, Antenna 10



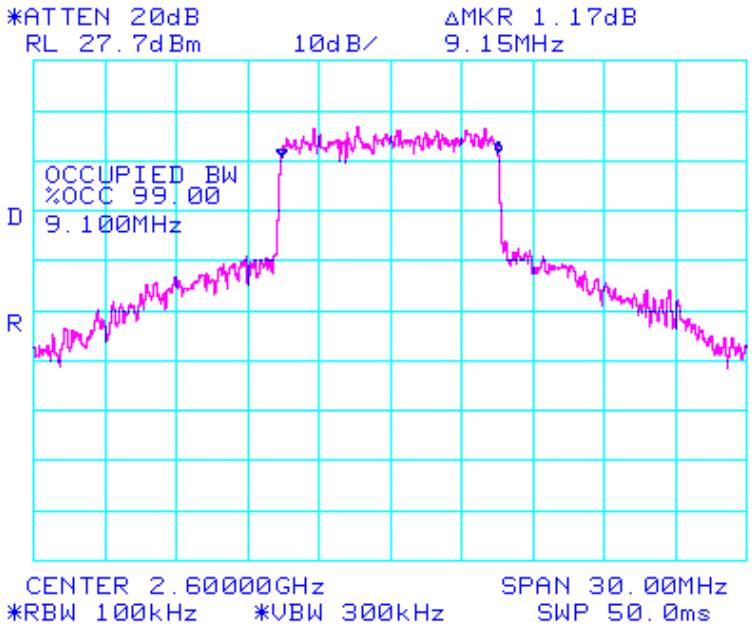
2505 MHz, Antenna 12



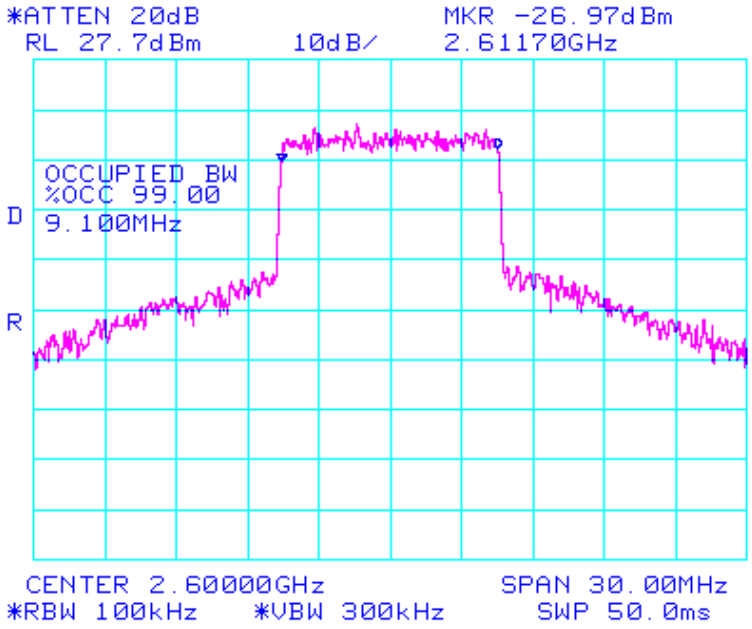
2505 MHz, Antenna 14



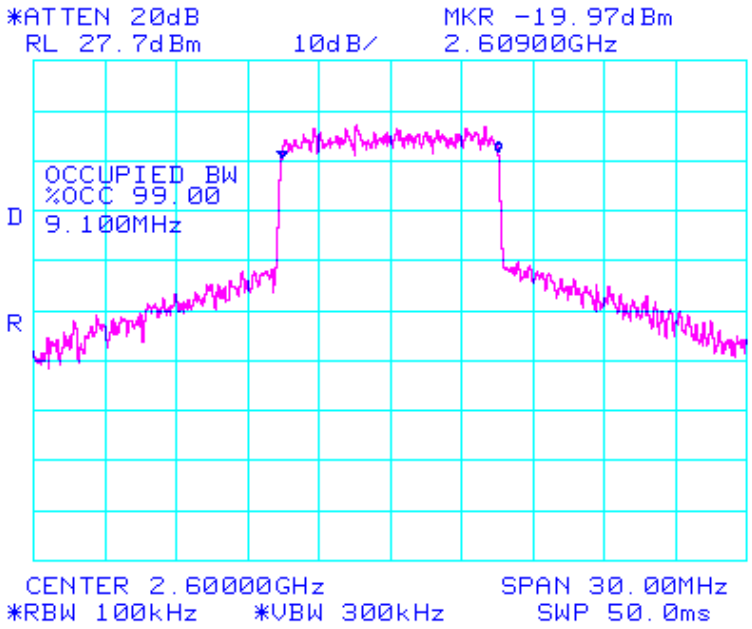
2600 MHz, Antenna 0



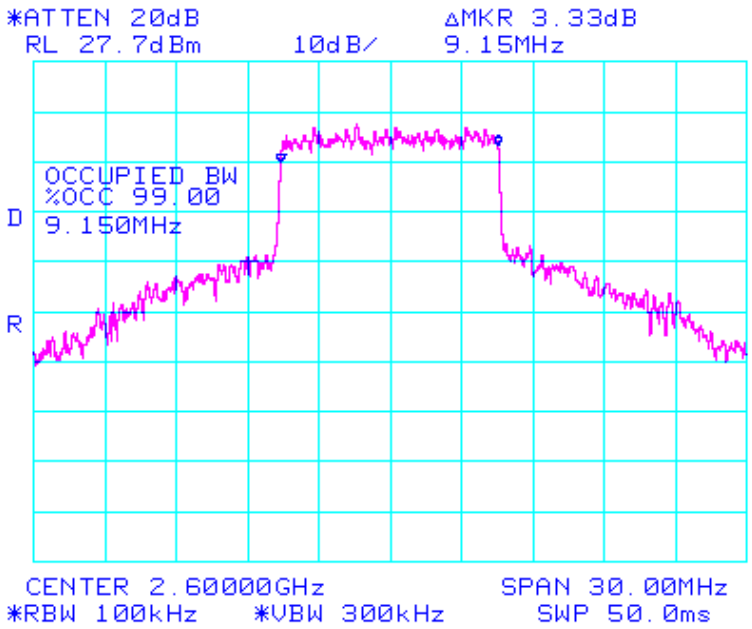
2600 MHz, Antenna 2



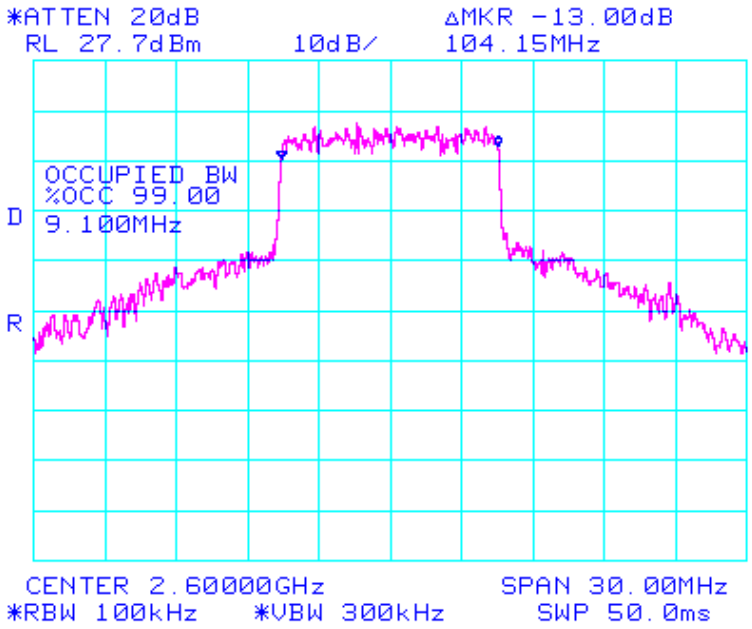
2600 MHz, Antenna 4



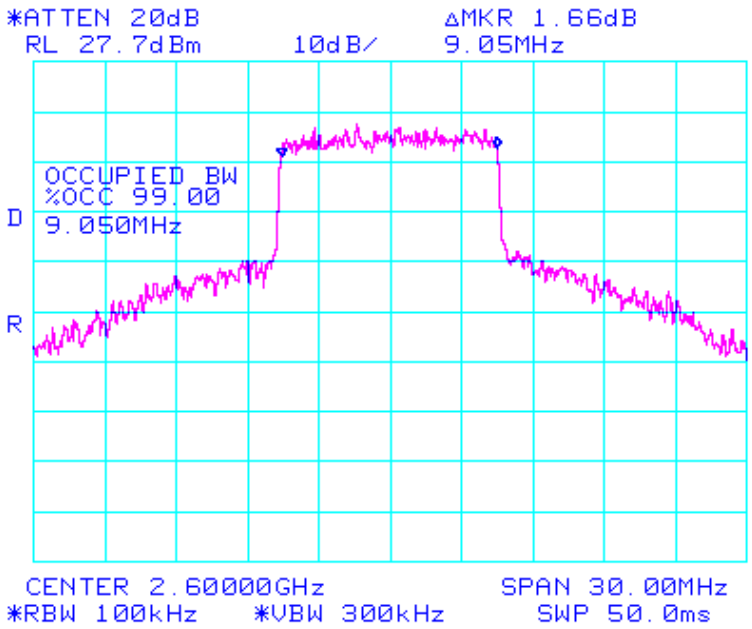
2600 MHz, Antenna 6



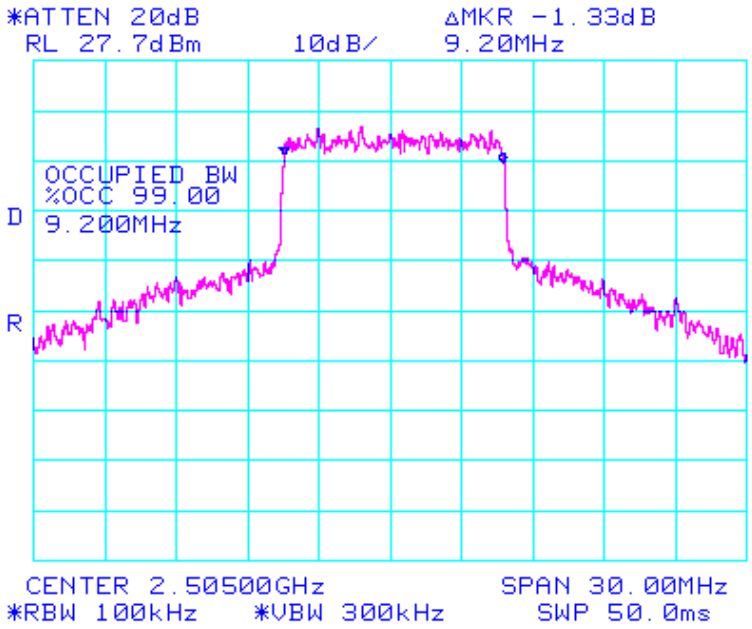
2600 MHz, Antenna 8



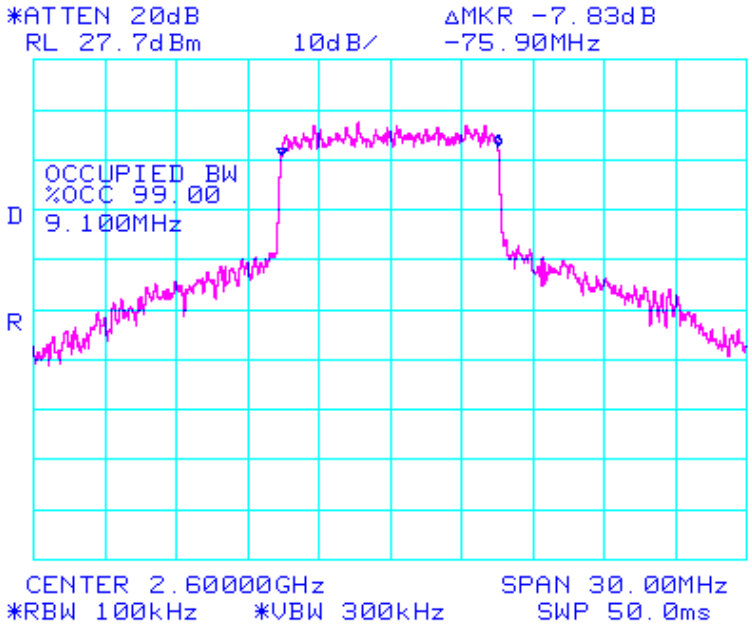
2600 MHz, Antenna 10



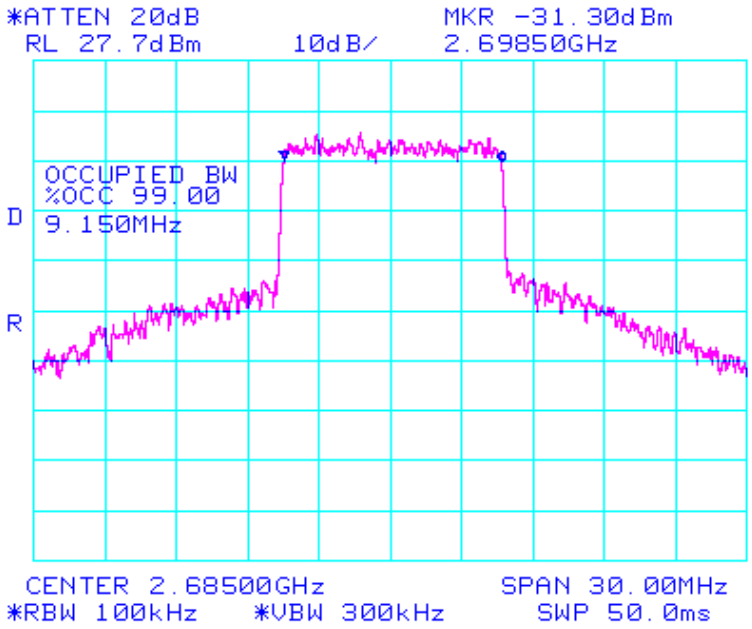
2600 MHz, Antenna 12



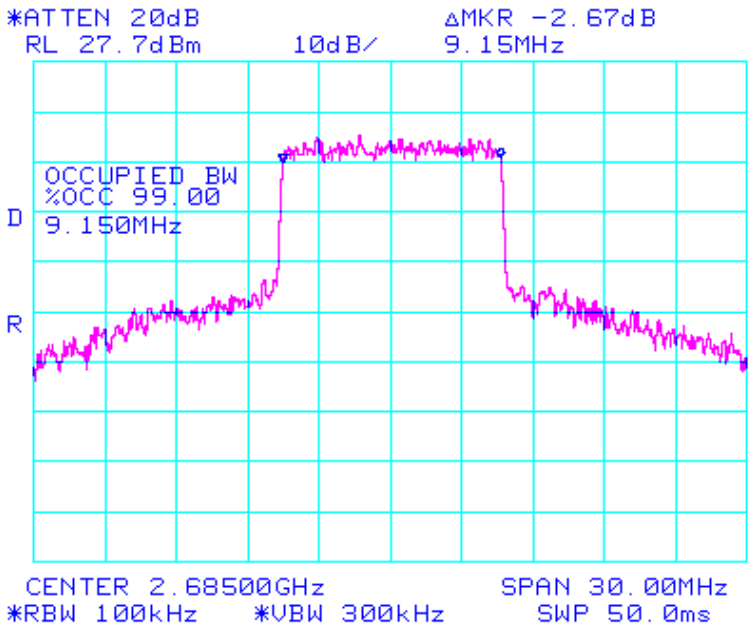
2600 MHz, Antenna 14



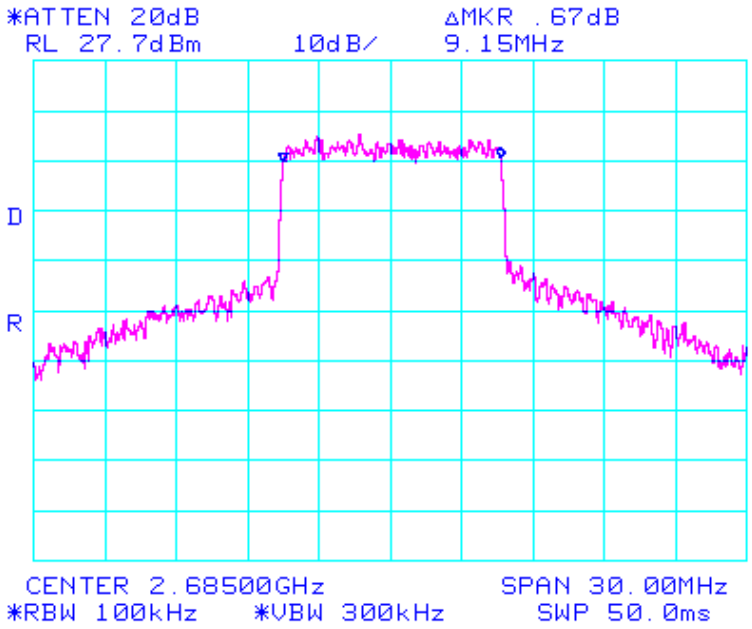
2685 MHz, Antenna 0



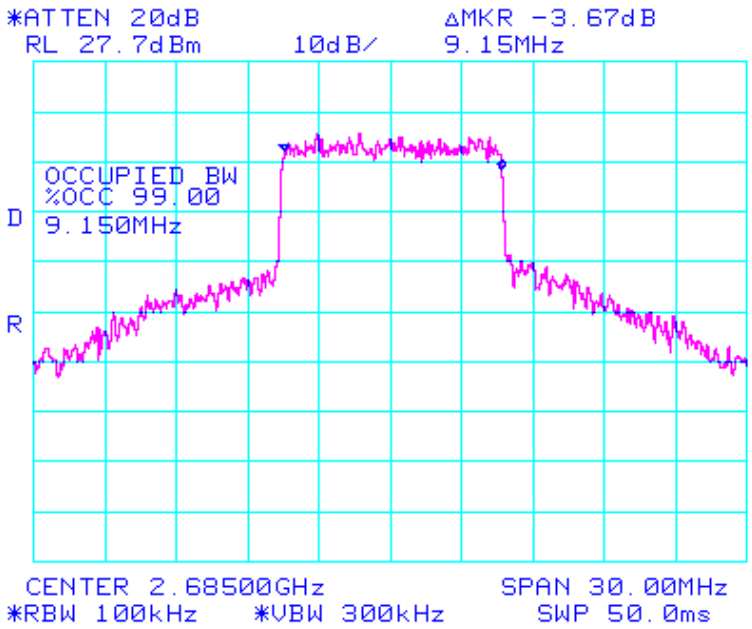
2685 MHz, Antenna 2



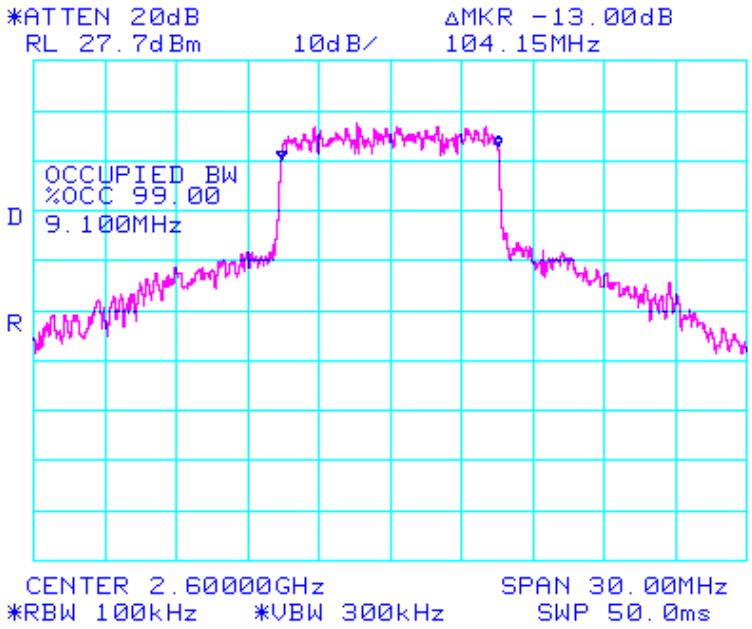
2685 MHz, Antenna 4



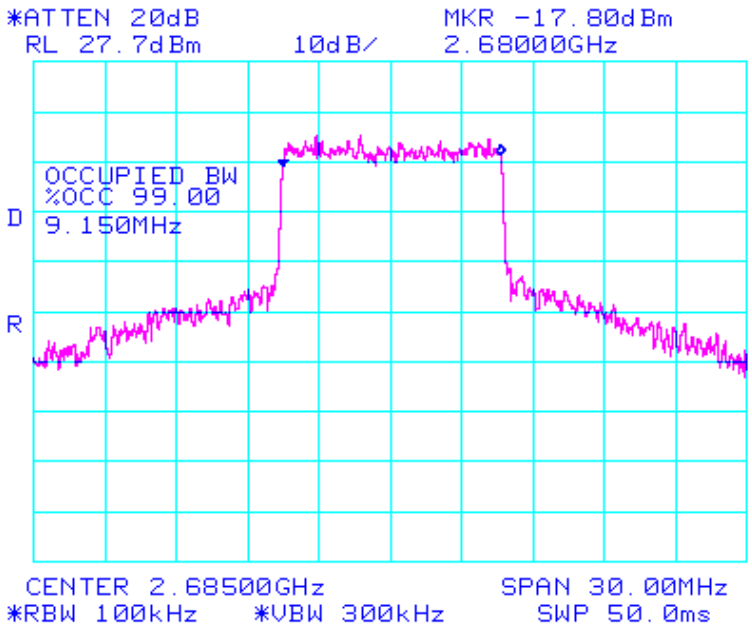
2685 MHz, Antenna 6



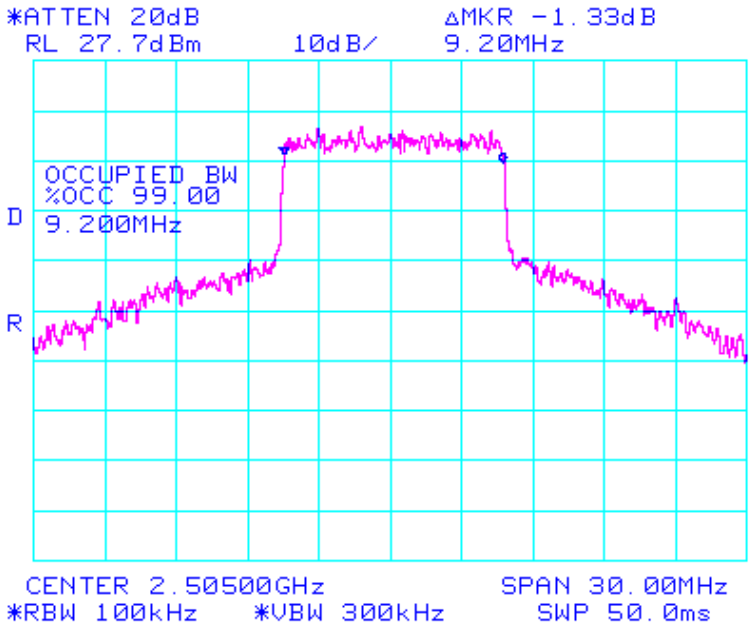
2685 MHz, Antenna 8



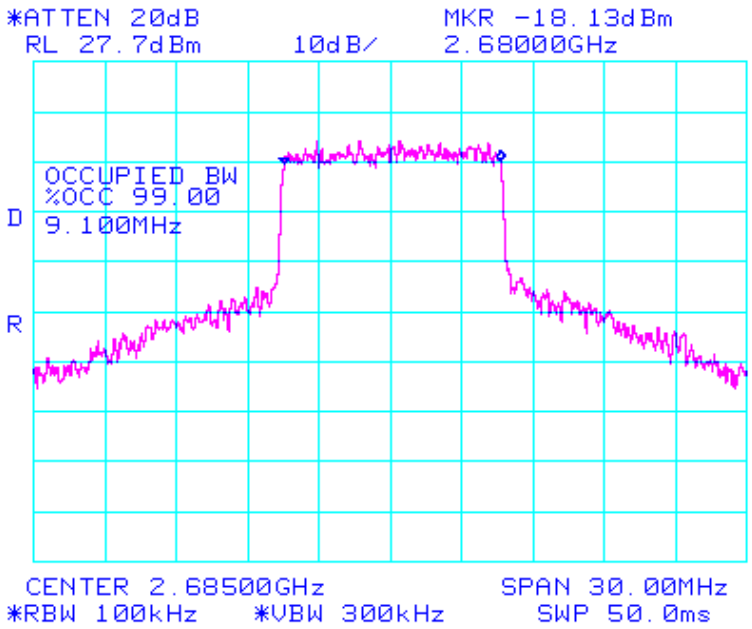
2685 MHz, Antenna 10



2685 MHz, Antenna 12



2685 MHz, Antenna 14



6.1.1.3. Transmitter Frequency Stability

Conducted Test Conditions for Maximum Conducted Output Power EIRP			
Standard:	FCC CFR 47 Part 27, RSS-199	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Transmitter Frequency Stability	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	FCC 2.1055, 27.54; IC RSS-Gen 4.3	**Pressure (mBars):**	999 - 1001
Reference Document(s):			

Test Procedure for Transmitter Frequency Stability
Transmitter Frequency Stability testing was performed over nominal voltage and ambient temperature and results reported are for a single antenna port (should the device have multiple ports i.e. MIMO device).

Definition
The center frequency is the center of the channel declared by the manufacturer as part of the declared channel plan(s).

Limits
The applicant shall ensure frequency stability by showing that fundamental emissions are maintained within the frequency band of operation when tested at the temperature and supply voltage variations specified in the relevant standard FCC Part 2.1055, 27.54 and RSS-199 4.3

Measurement Results for Transmitter Frequency Stability

Equipment Configuration for Transmitter Frequency Stability			
Variant:	10 MHz	**Duty Cycle (%):**	100
Data Rate:	Not Applicable	**Antenna Gain (dBi):**	Not Applicable
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	GMH
Engineering Test Notes:			

Test Measurement Results	
Test Frequency	**Transmitter Frequency Stability**
MHz	
2505.0	Transmitter locked to Global Positioning System (GPS), no test required
2600.0	
2685.0	

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-01 MEASURING FREQUENCY ERROR
Measurement Uncertainty:	±0.86 ppm

6.1.1.4. Maximum Conducted Output Power

Conducted Test Conditions for Maximum Conducted Output Power EIRP			
Standard:	FCC CFR 47 Part 27, RSS-199	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Maximum Conducted Output Power	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	FCC 2.1046, IC GL-07 5.2.1	**Pressure (mBars):**	999 - 1001
Reference Document(s):			

Test Procedure for Maximum Conducted Output Power Measurement (EIRP)

Test methodology used a wideband average power meter. Measurements were made while the EUT was operating in a continuous transmission mode (100% duty cycle) at the appropriate centre frequency. All cable losses and offsets were taken into consideration in the measured result. All operational modes and frequency bands were measured independently and the resultant power calculated. For multiple outputs, the measurements were made simultaneously on each output port and summed in a linear fashion. This technique was used in order to prove compliance.

Power Settings
Power settings for each of the eight antenna ports could be individually set through software control. Power measurements were made from each antenna port and the power setting logged for each measurement.

Limits
Base stations are limited to less than 33.3 W maximum equivalent isotropically radiated power (e.i.r.p.) in any 100 kHz segment.

33.3W = 45.22 dBm
Maximum measured 99% Occupied Bandwidth = 9.2 MHz

Maximum EIRP = 33.3 W + increased power due to all 100 kHz segments in 9.2 MHz

Maximum EIRP = 45.22 + 10 * Log (9.2 MHz/0.1 MHz) = 45.22 + 19.64 = 64.86 dBm

Measurement Results for Maximum Conducted Output Power

Equipment Configuration for Maximum Conducted Output Power

Variant:	10 MHz	**Duty Cycle (%):**	100
Data Rate:	75 MBit/s	**Antenna Gain (dBi):**	9.5
Modulation:	OFDM	**Beam Forming Gain:**	9.0
TPC:	Not Applicable	**Tested By:**	GMH
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Maximum Conducted Output Power (dBm)							
	Antenna							
MHz	0	2	4	6	8	10	12	14
2505.0	24.39	25.31	25.39	25.05	25.40	25.12	25.00	25.50
2600.0	25.02	25.07	25.39	25.65	25.57	25.42	25.53	25.61
2685.0	24.27	24.62	24.51	24.51	24.25	23.83	23.65	23.25

Power Settings – the following power settings were used to generate the results in the above matrix

Constant setting for all power measurements -11 dBFS (dB Full Scale)

Test Frequency	Variable Power Settings (Tx Atten)							
	Antenna							
MHz	0	2	4	6	8	10	12	14
2505.0	5.25	2.25	1.25	3.50	2.25	4.25	3.00	2.75
2600.0	4.00	3.25	1.25	3.50	2.25	5.25	4.25	4.25
2685.0	6.25	5.50	6.00	6.50	6.25	5.25	5.25	6.50

Calculated Result

Test Frequency	Maximum Conducted Output Power Total Power ∑ Antenna Ports	
MHz	∑ Antenna Ports (dBm)	dBm EIRP
2505.0	34.19	52.69
2600.0	34.44	52.94
2685.0	33.17	51.67

Traceability to Industry Recognized Test Methodologies

Work Instruction:	WI-01 MEASURING RF OUTPUT POWER
Measurement Uncertainty:	±1.33 dB

Calculation of total power = ∑ of all antenna ports;

∑ of all antenna ports = 10 * Log (10^(Port 0/10) + 10^(Port 2/10) + 10^(Port 4/10) + 10^(Port 6/10) + 10^(Port 8/10) + 10^(Port 10/10) + 10^(Port 12/10) + 10^(Port 14/10))

6.1.1.5. Transmitter Unwanted Emissions

Conducted Test Conditions for Transmitter Unwanted Emissions			
Standard:	FCC CFR 47: Part 27, RSS-199	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Transmitter Unwanted Emissions	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	FCC 2.1051, 27.53(m), IC 4.5	**Pressure (mBars):**	999 - 1001
Reference Document(s):			

Test Procedure for Transmitter Unwanted Emissions

The Transmitter Unwanted Emissions were measurement conductively. Testing was performed on individual antenna ports and limits applied to each plot respectively.

Limits

The power of any unwanted emissions measured from the channel edge of the equipment shall be attenuated below the transmitter power, P (dBW), as follows:

(a) for base station and subscriber equipment, other than mobile subscriber equipment, the attenuation shall not be less than 43 + 10 Log_{10} (p), dB;

Limit = 43 + 10 Log (P) = 43 + 10 * Log (P) = 43 – 4.365 = 38.635 dB

Limit Line = 25.65 – 38.635 = -13.0 dBm

Equipment Configuration for Transmitter Unwanted Emissions			
Variant:	10 MHz	**Duty Cycle (%):**	100
Data Rate:	75 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	GMH
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Transmitter Unwanted Emissions (dBm)							
	Antenna Port							
MHz	**0**	**2**	**4**	**6**	**8**	**10**	**12**	**14**
2505.0	-24.13	-20.30	-20.47	-21.63	-20.47	-21.47	-22.13	-21.13
2600.0	-23.97	-22.97	-21.63	-20.97	-21.97	-22.13	-21.80	-21.97
2685.0	-23.63	-20.63	-21.47	-20.80	-21.80	-21.97	-21.97	-21.80

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-01 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	≤40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

Equipment Configuration for Conducted Band-Edge Transmitter Unwanted Emissions			
Variant:	10 MHz	**Duty Cycle (%):**	100
Data Rate:	75 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	GMH
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Conducted Band-Edge Transmitter Unwanted Emissions (dBm)							
	Antenna Port							
MHz	**0**	**2**	**4**	**6**	**8**	**10**	**12**	**14**
2505.0	-14.47	-13.63	-19.63	-16.63	-17.30	-16.97	-14.13	-16.97
2685.0	-14.80	-16.47	-13.47	-13.30	-13.13	-13.97	-15.47	-14.30

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-01 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	≤40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

∑ of all band-edge spurious for each antenna port =
10*Log (10^(Port0/10)+10^(Port2/10)+10^(Port4/10)+10^(Port6/10)+10^(Port8/10)+10^(Port10/10)+10^(Port12/10)+10^(Port14/10))

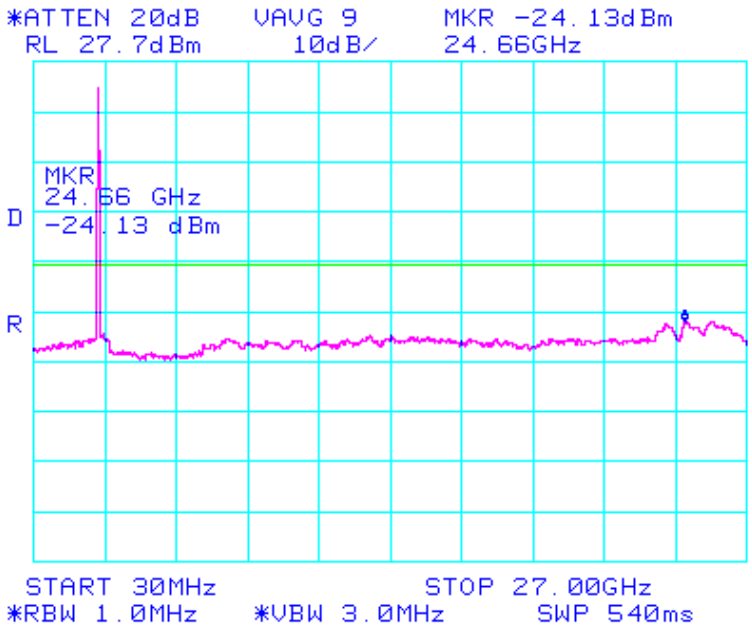
Source Based Time Averaging @ maximum 66% duty cycle = 10 * Log (66/100) = -1.8 dB

Peak to Average reduction = -8.5 dB

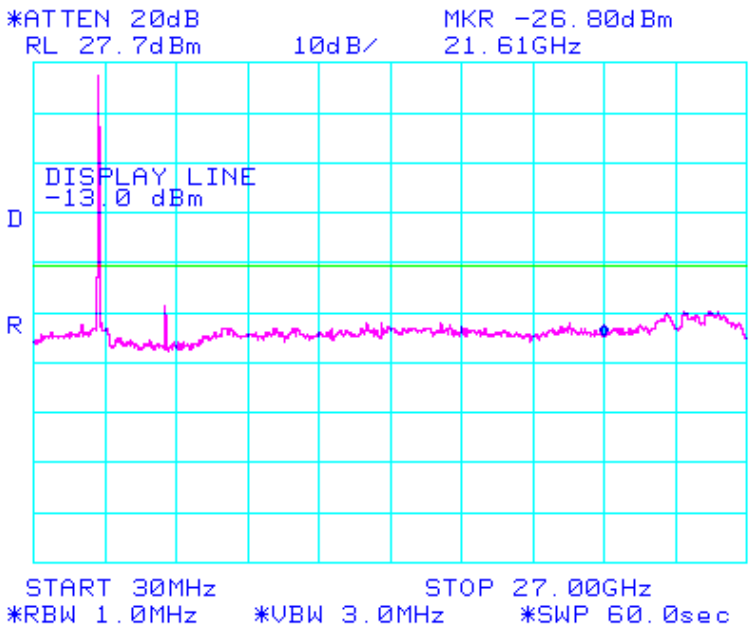
∑ Band-Edge Emissions 2505 MHz = -17.10 dBm

∑ Band-Edge Emissions 2685 MHz = -15.51 dBm

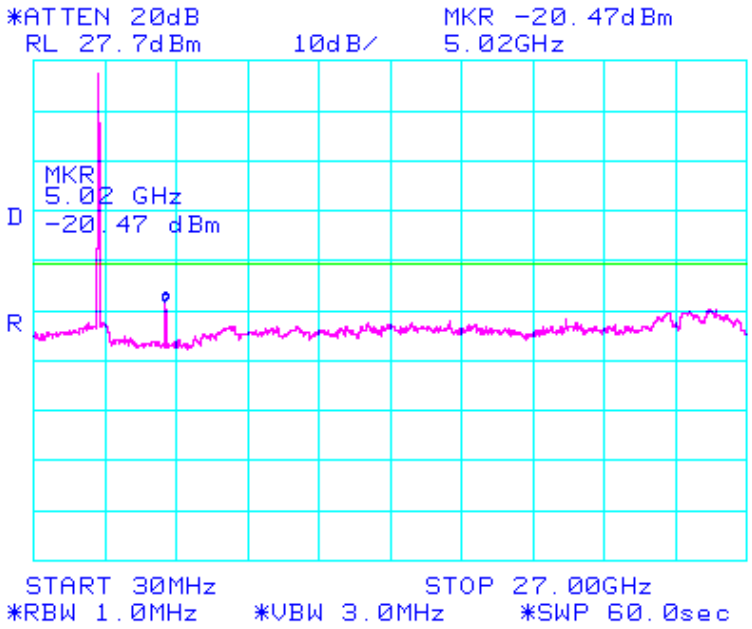
2505 MHz, Antenna 0, Spurious Emissions



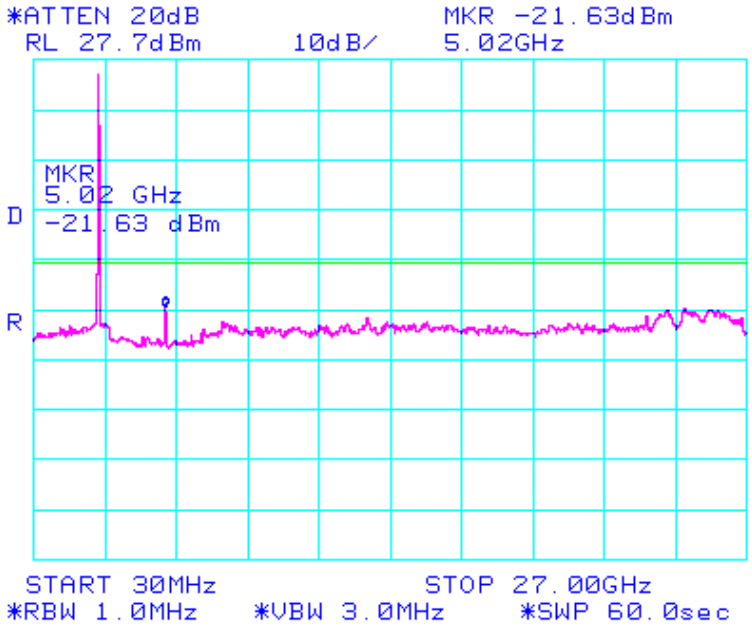
2505 MHz, Antenna 2, Spurious Emissions



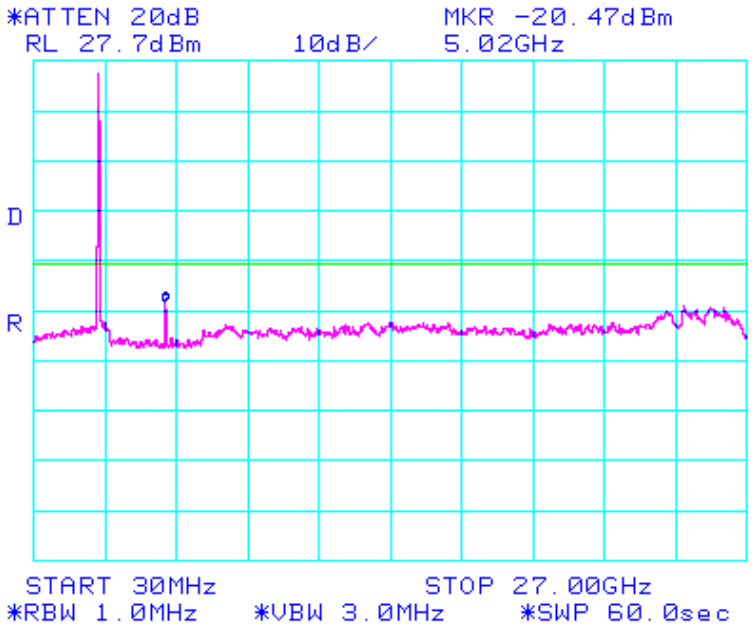
2505 MHz, Antenna 4, Spurious Emissions



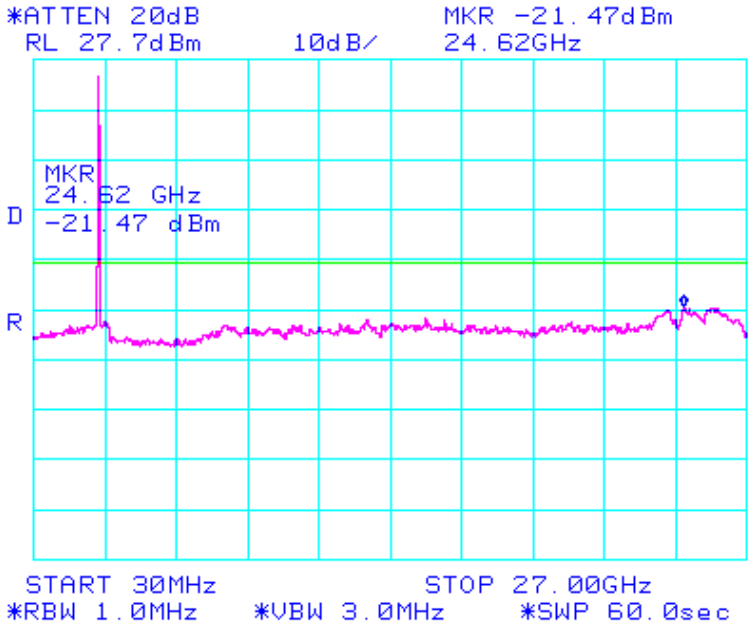
2505 MHz, Antenna 6, Spurious Emissions



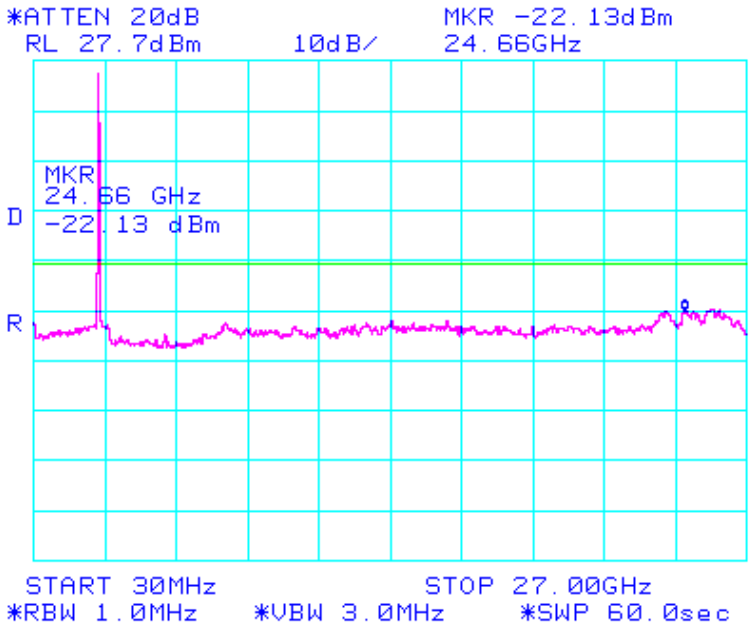
2505 MHz, Antenna 8, Spurious Emissions



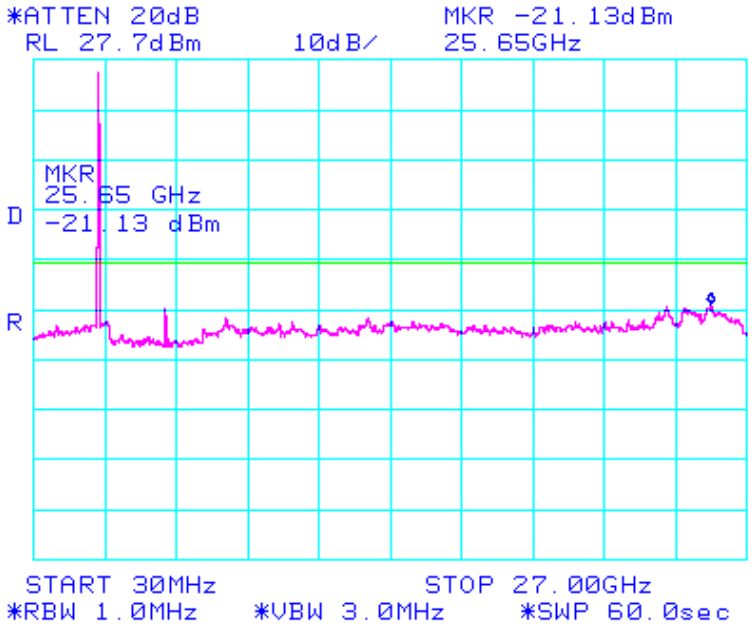
2505 MHz, Antenna 10, Spurious Emissions



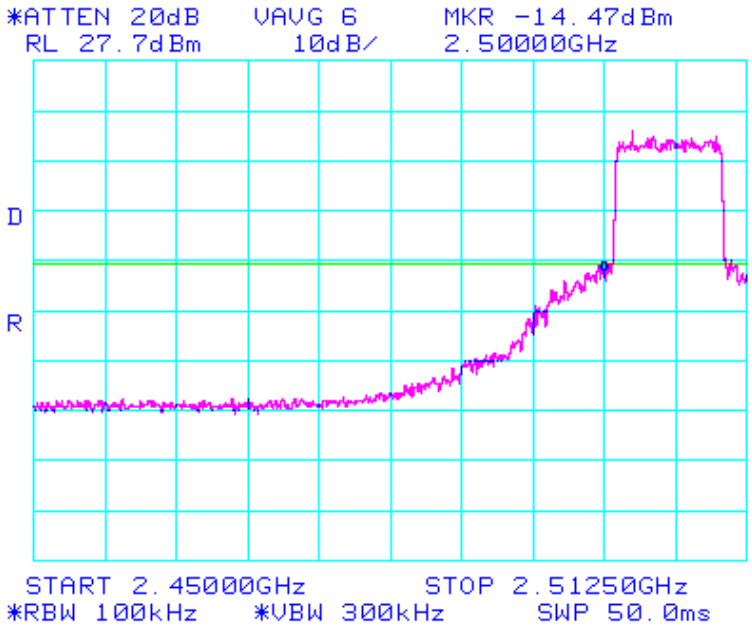
2505 MHz, Antenna 12, Spurious Emissions



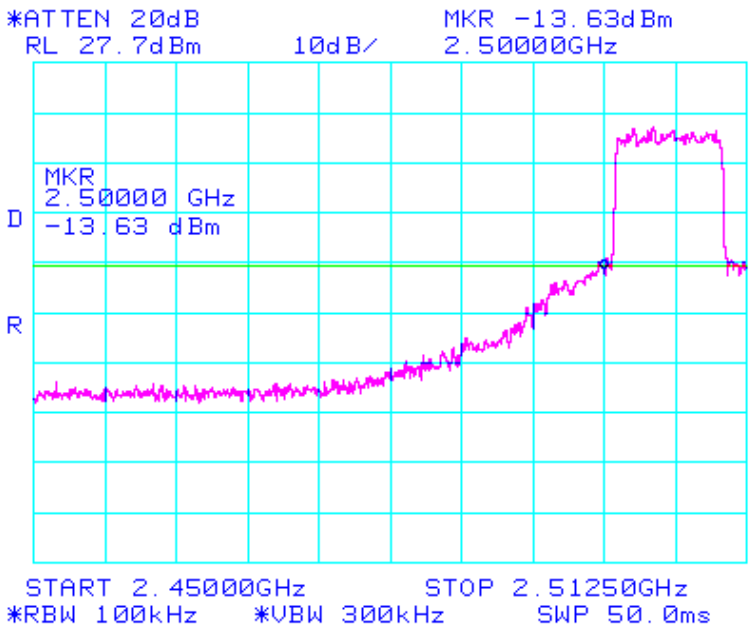
2505 MHz, Antenna 14, Spurious Emissions



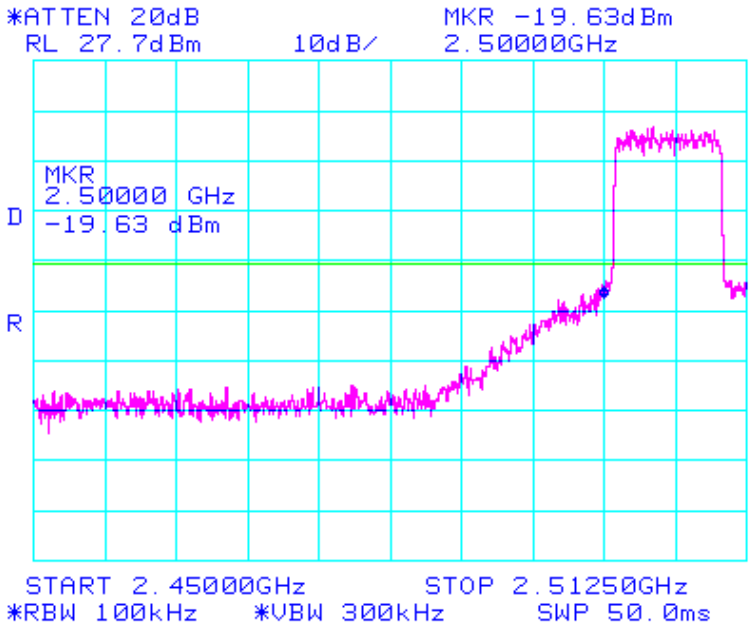
2505 MHz, Antenna 0, Conducted Band-Edge



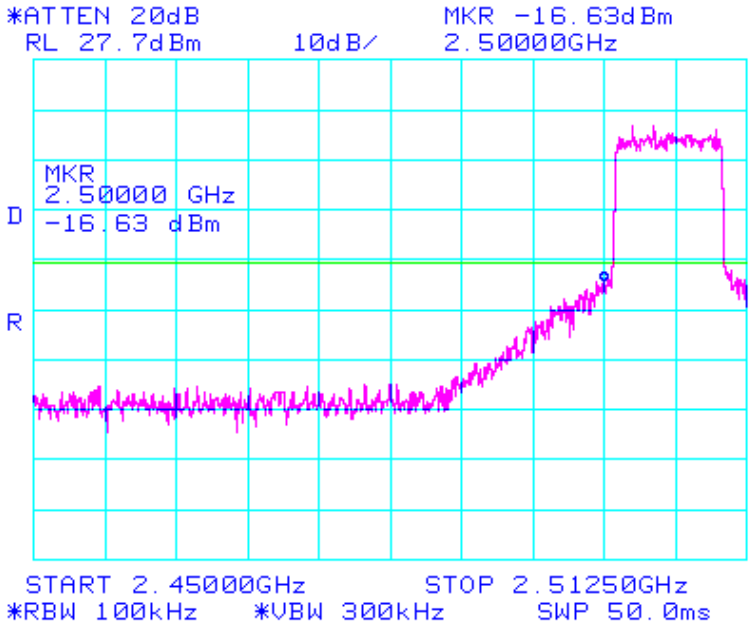
2505 MHz, Antenna 2, Conducted Band-Edge



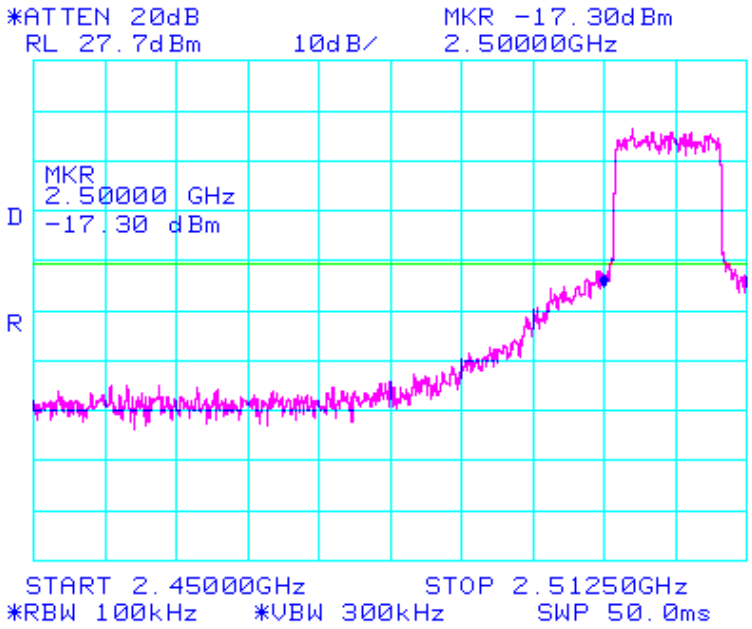
2505 MHz, Antenna 4, Conducted Band-Edge



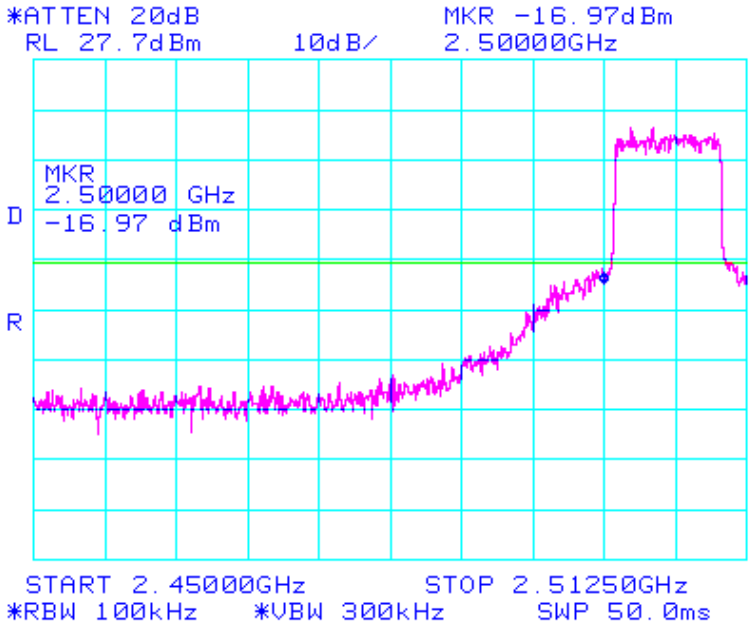
2505 MHz, Antenna 6, Conducted Band-Edge



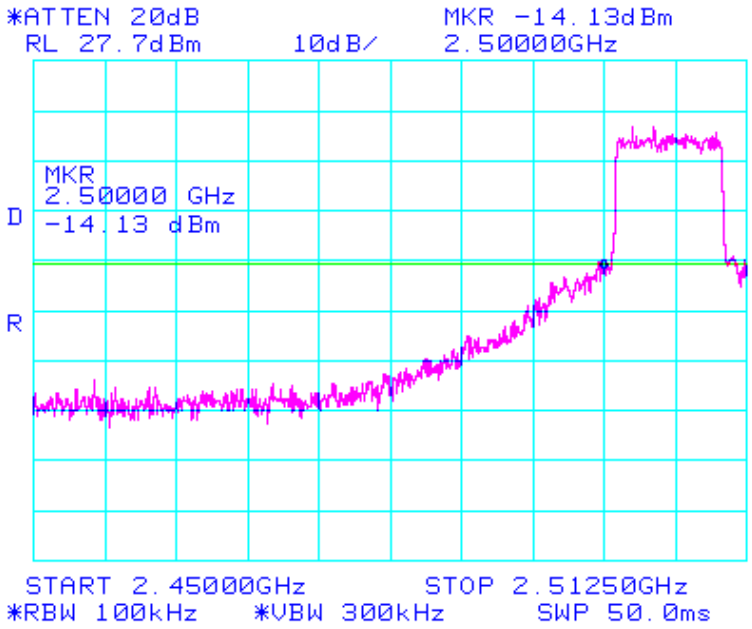
2505 MHz, Antenna 8, Conducted Band-Edge



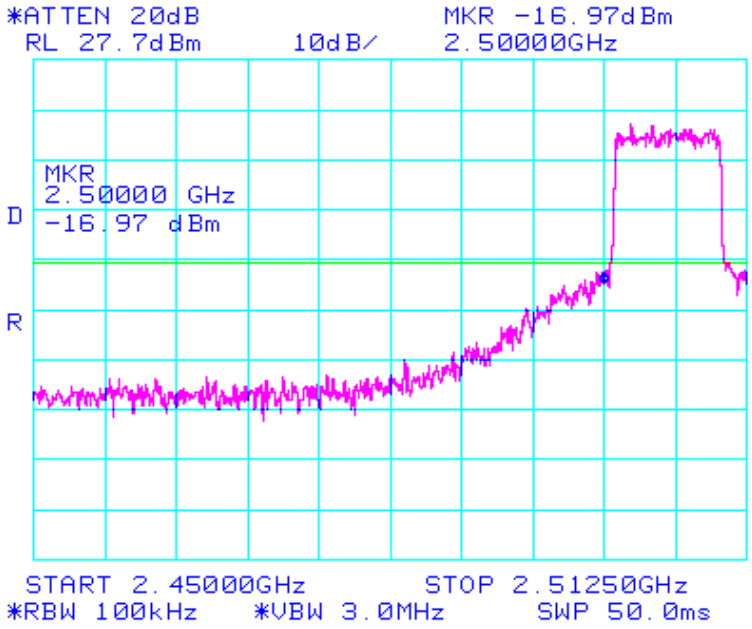
2505 MHz, Antenna 10, Conducted Band-Edge



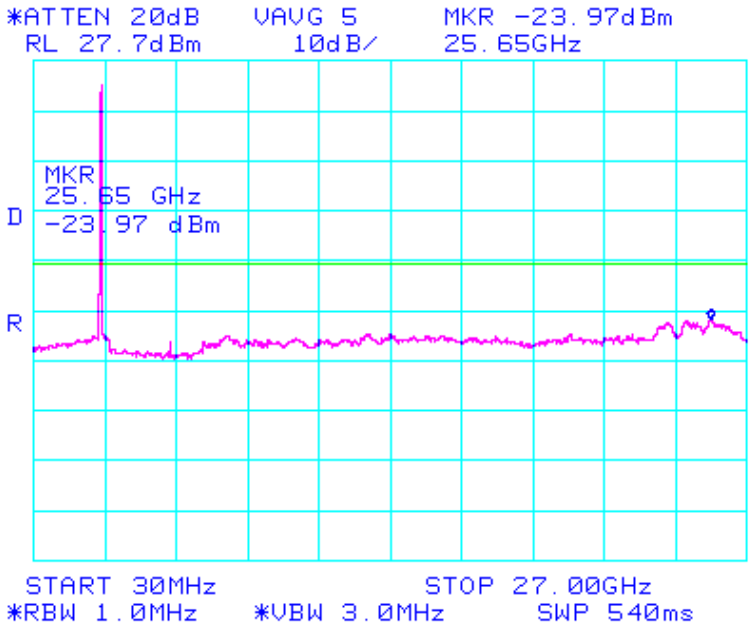
2505 MHz, Antenna 12, Conducted Band-Edge



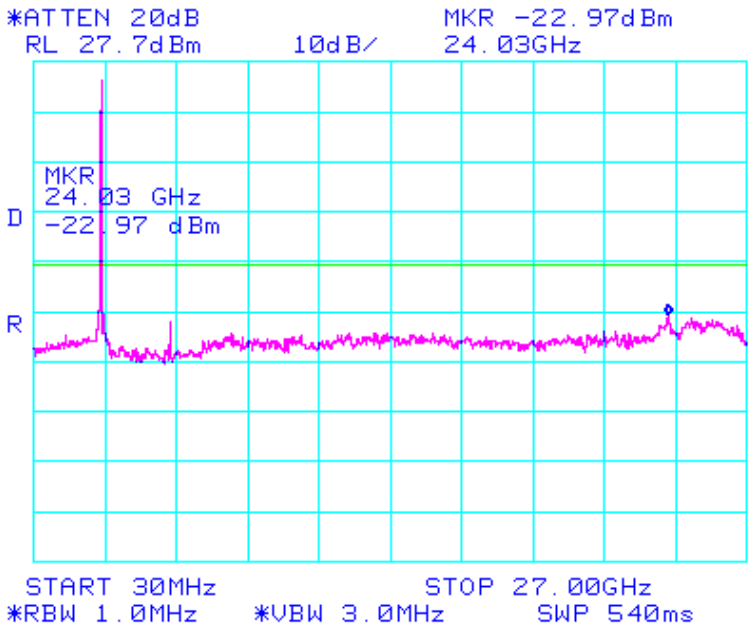
2505 MHz, Antenna 14, Conducted Band-Edge



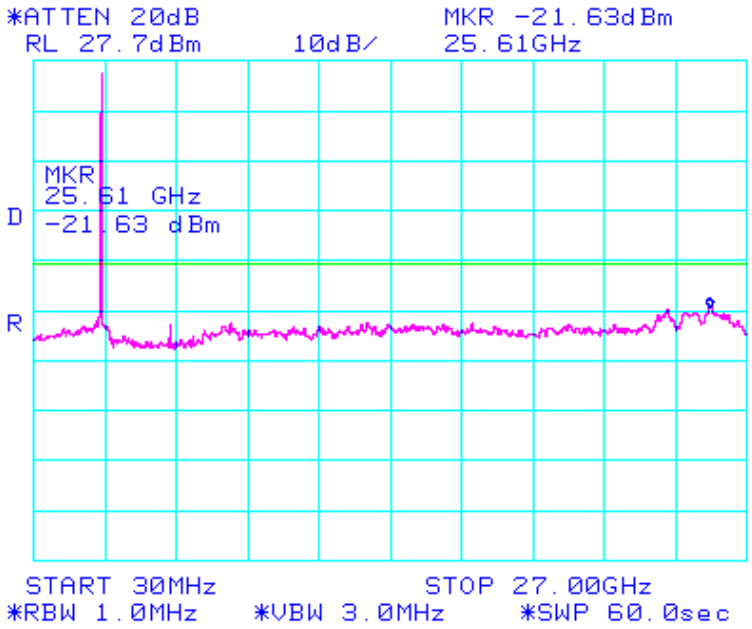
2600 MHz, Antenna 0, Spurious Emissions



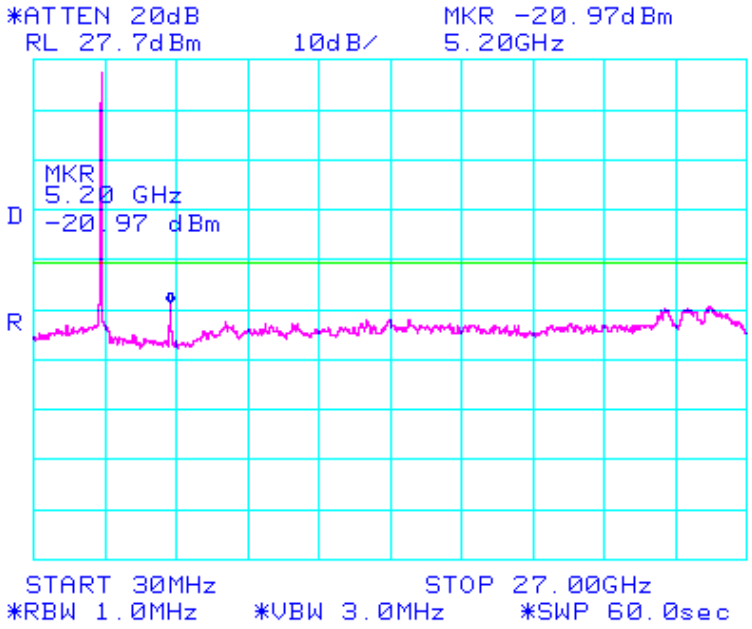
2600 MHz, Antenna 2, Spurious Emissions



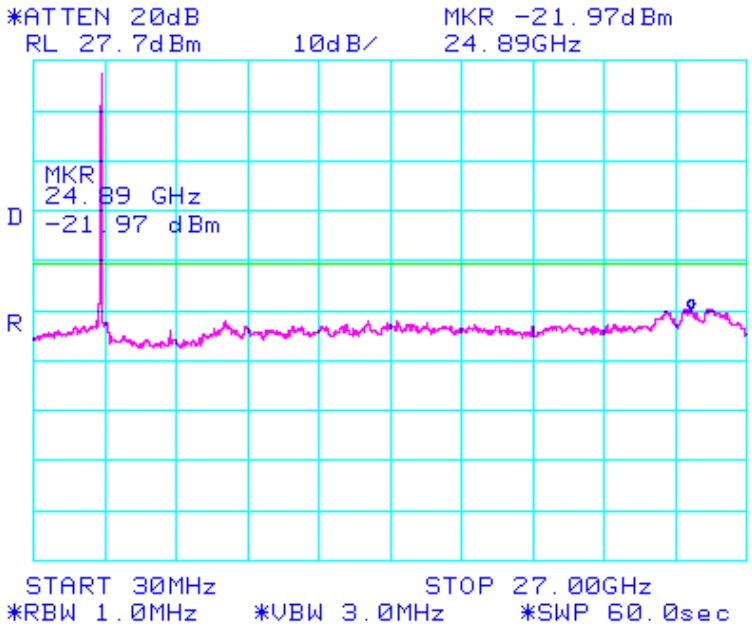
2600 MHz, Antenna 4, Spurious Emissions



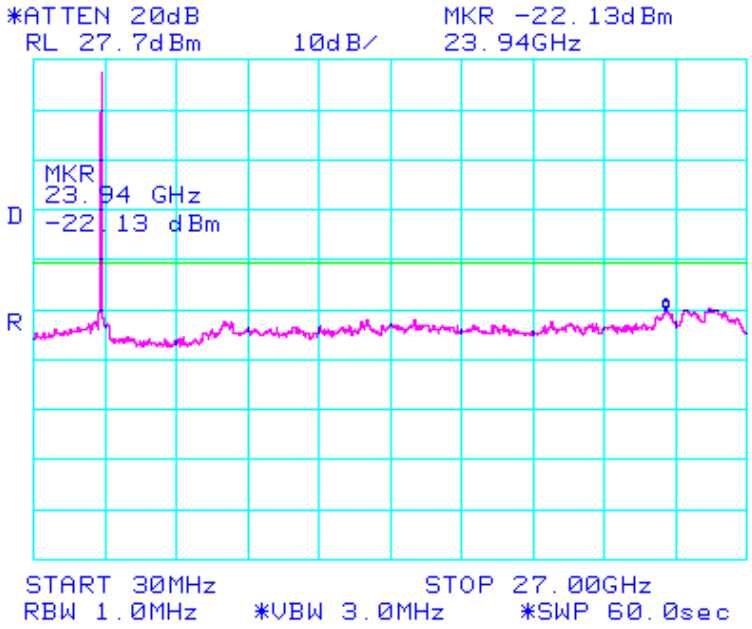
2600 MHz, Antenna 6, Spurious Emissions



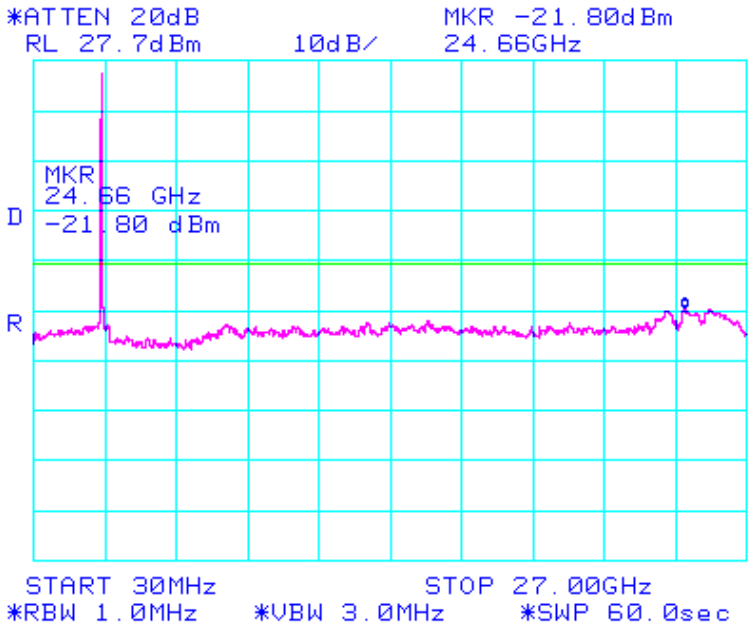
2600 MHz, Antenna 8, Spurious Emissions



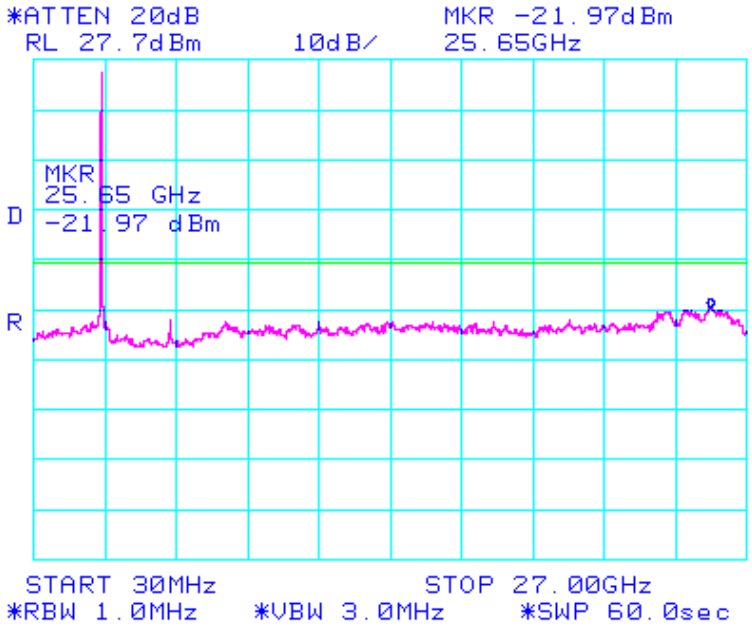
2600 MHz, Antenna 10, Spurious Emissions



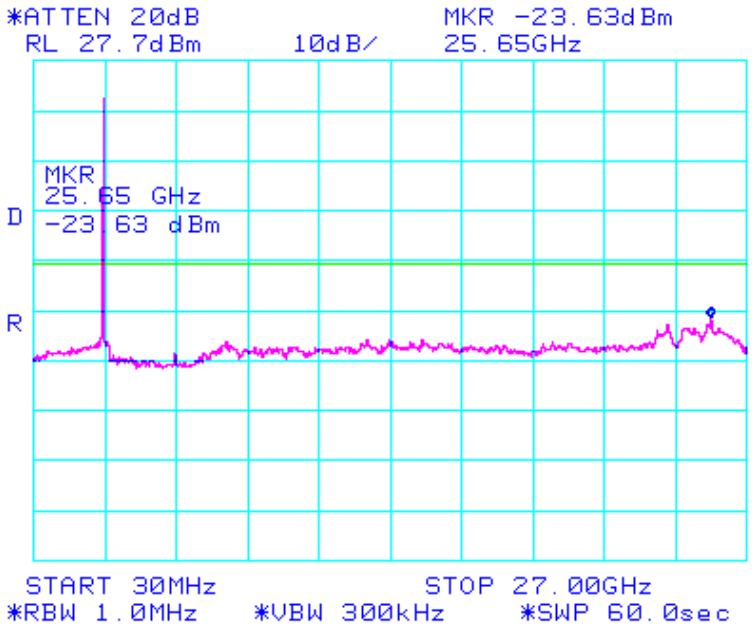
2600 MHz, Antenna 12, Spurious Emissions



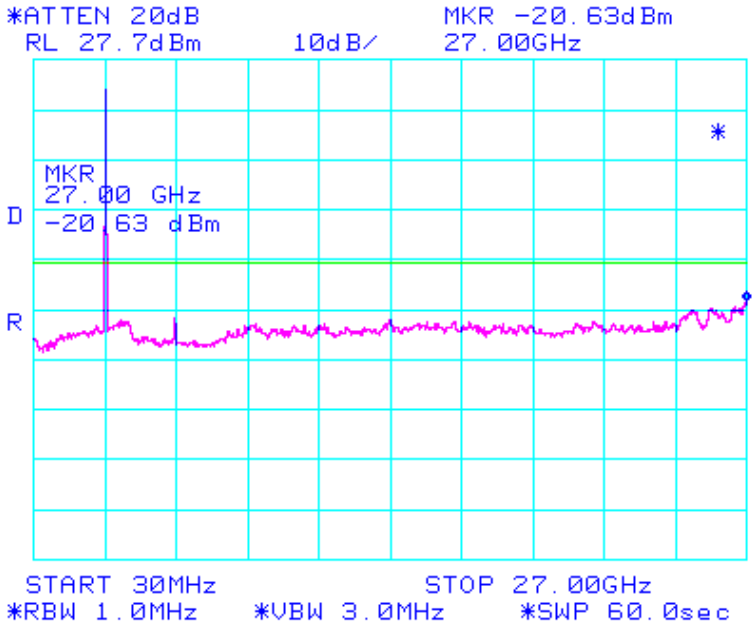
2600 MHz, Antenna 14, Spurious Emissions



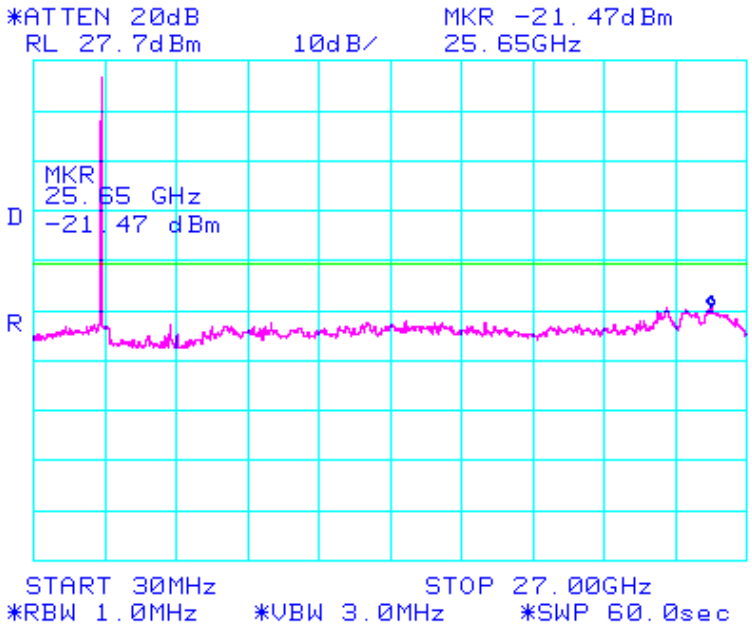
2685 MHz, Antenna 0, Spurious Emissions



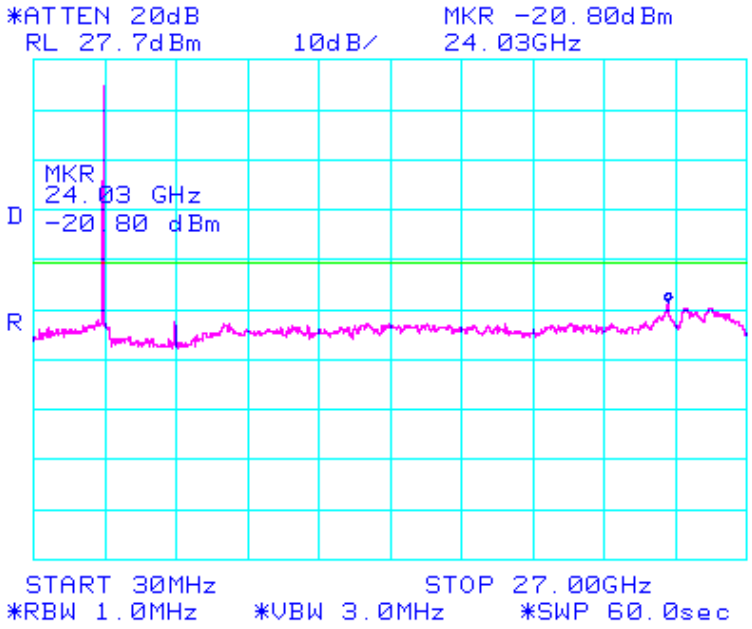
2685 MHz, Antenna 2, Spurious Emissions



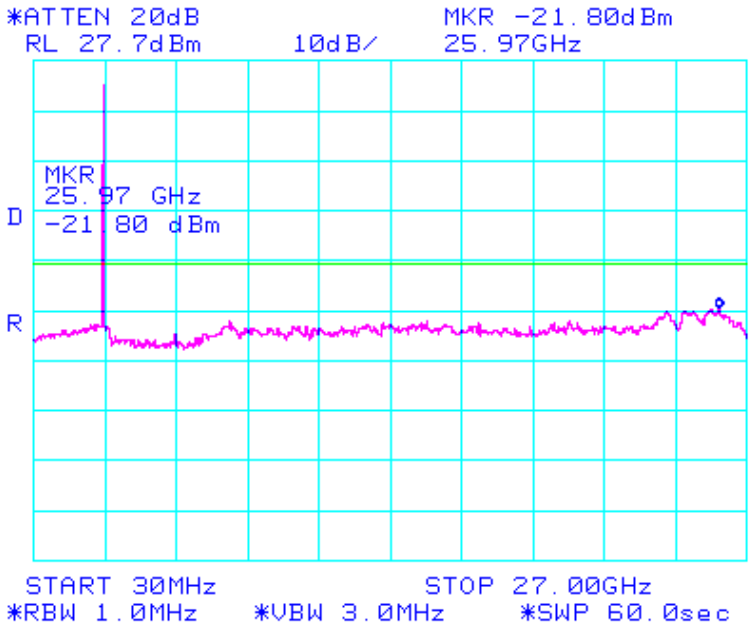
2685 MHz, Antenna 4, Spurious Emissions



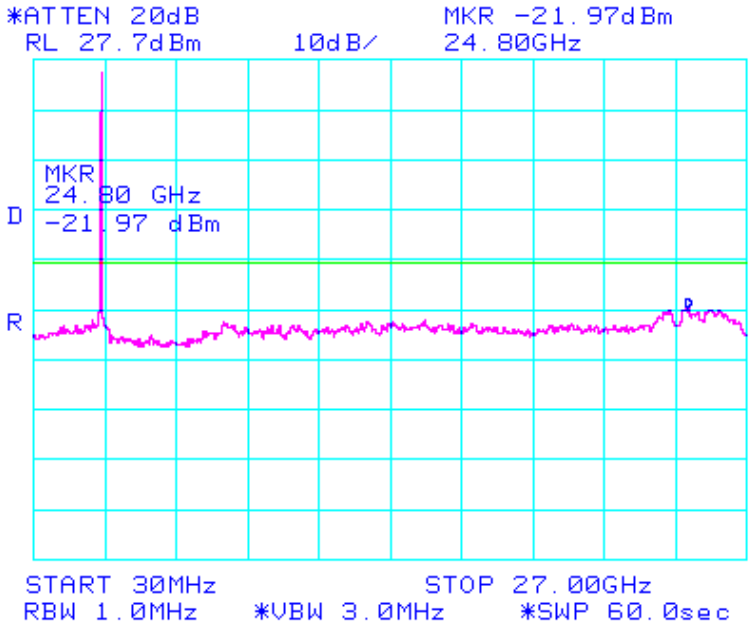
2685 MHz, Antenna 6, Spurious Emissions



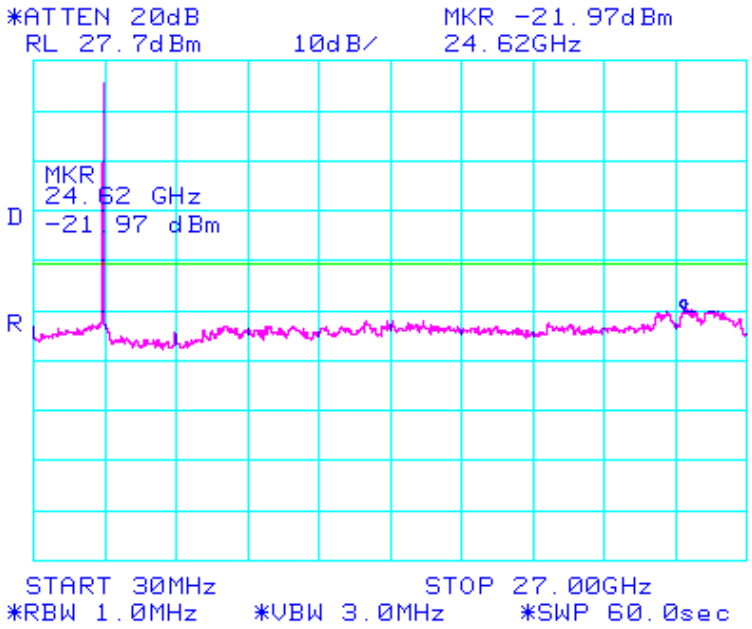
2685 MHz, Antenna 8, Spurious Emissions



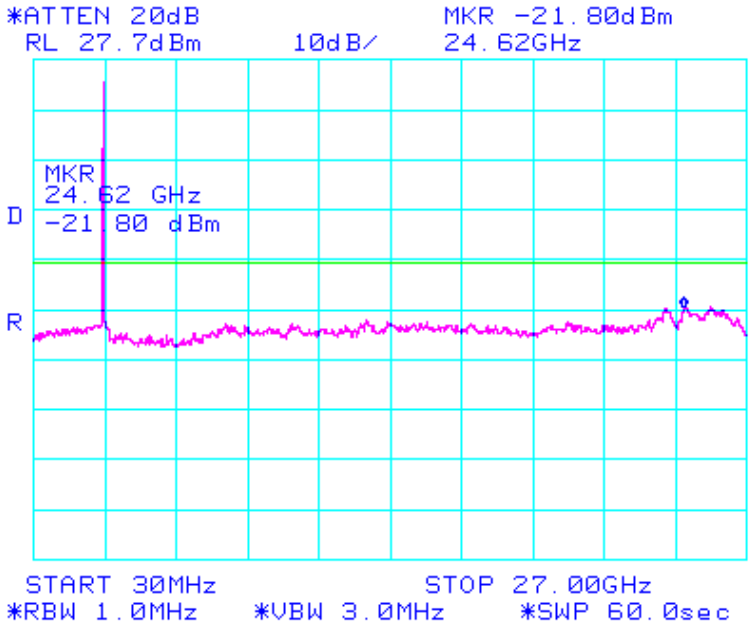
2685 MHz, Antenna 10, Spurious Emissions



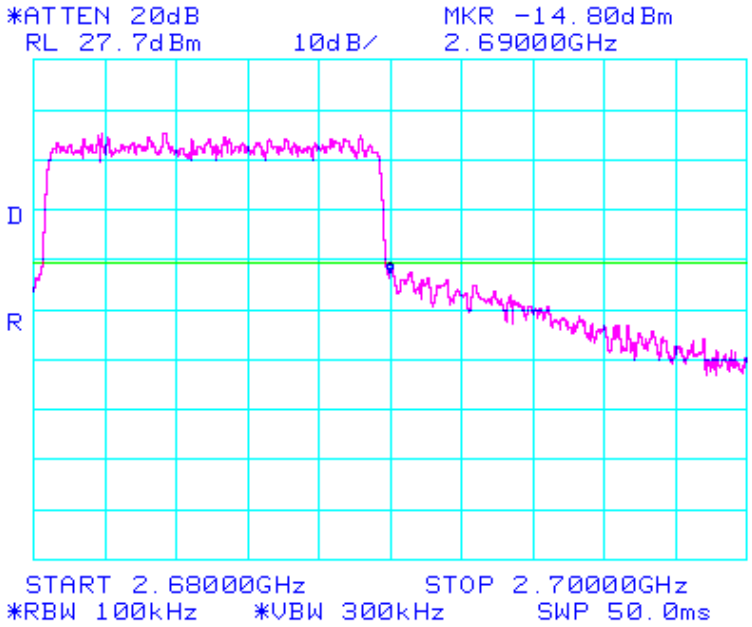
2685 MHz, Antenna 12, Spurious Emissions



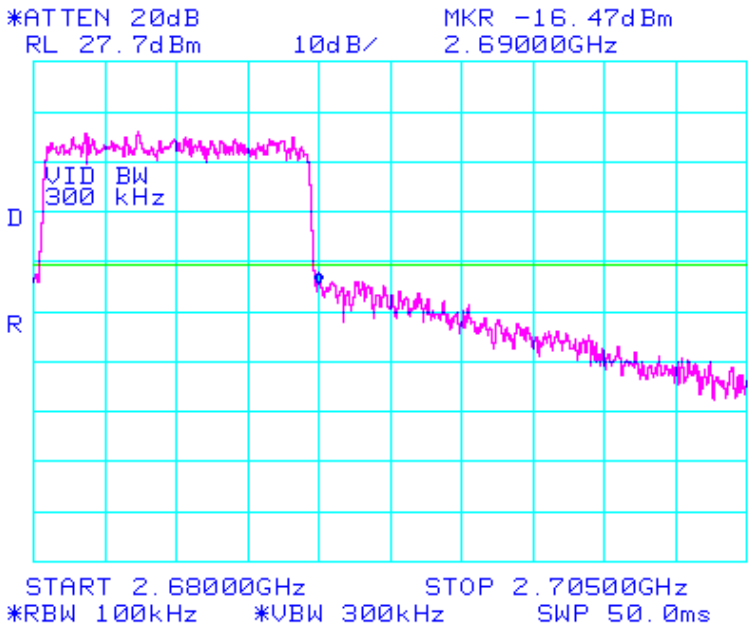
2685 MHz, Antenna 14, Spurious Emissions



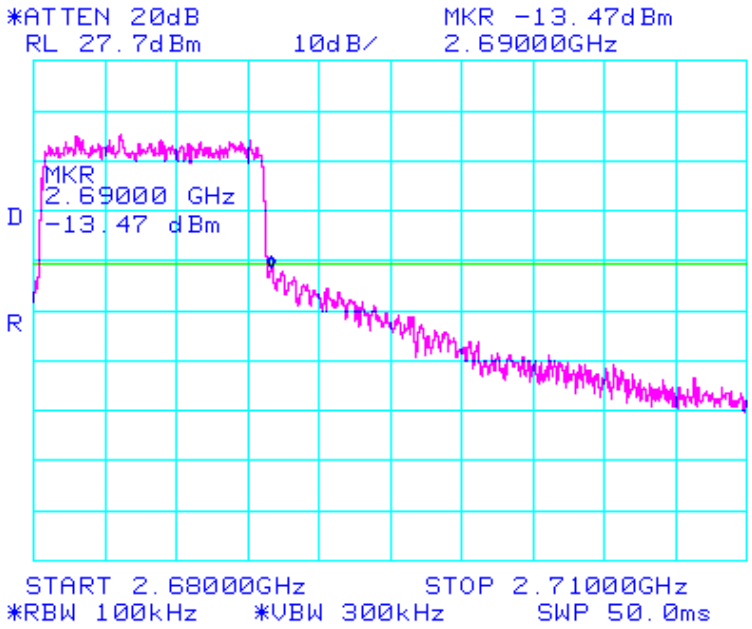
2685 MHz, Antenna 0, Conducted Band-Edge



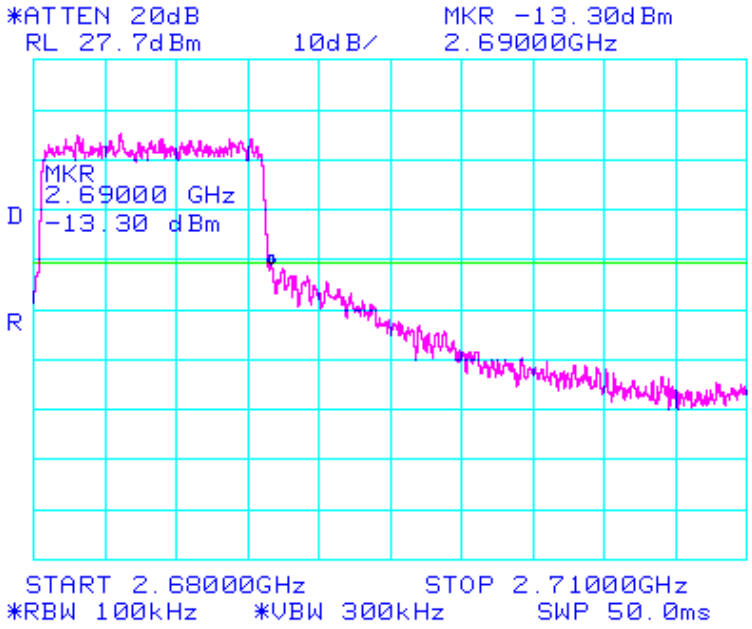
2685 MHz, Antenna 2, Conducted Band-Edge



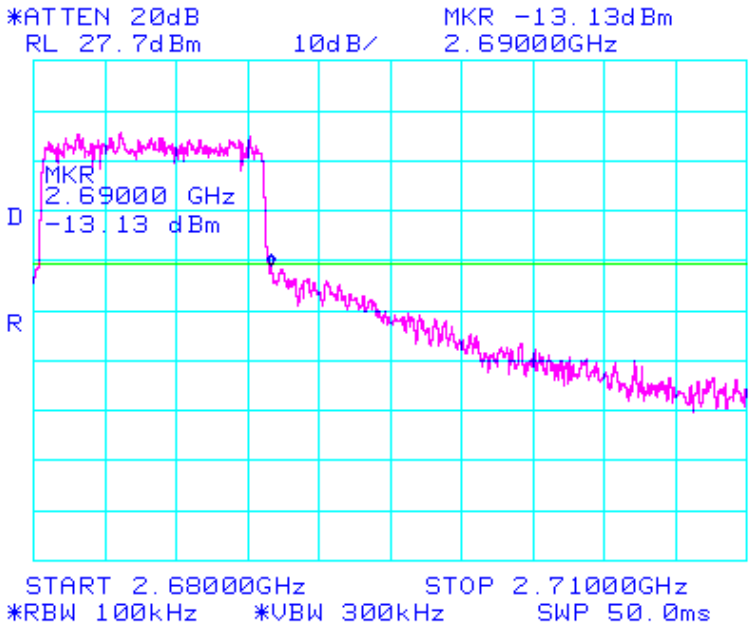
2685 MHz, Antenna 4, Conducted Band-Edge



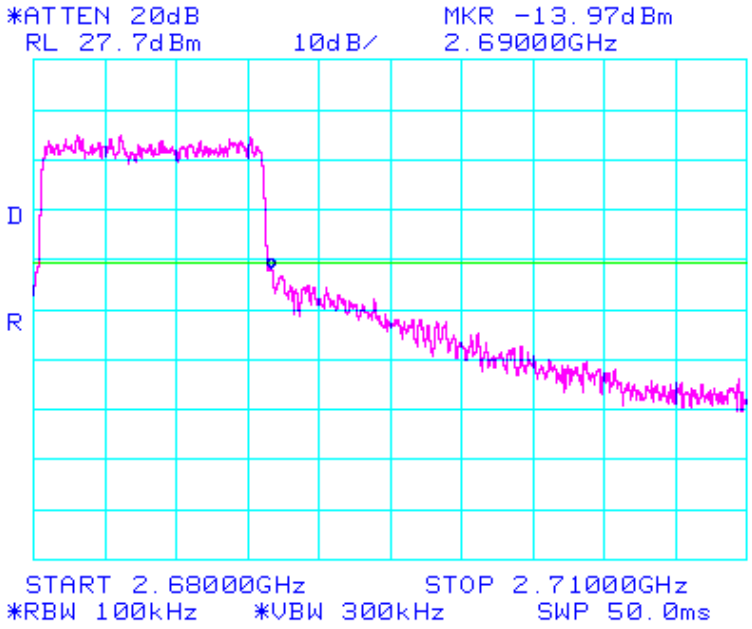
2685 MHz, Antenna 6, Conducted Band-Edge



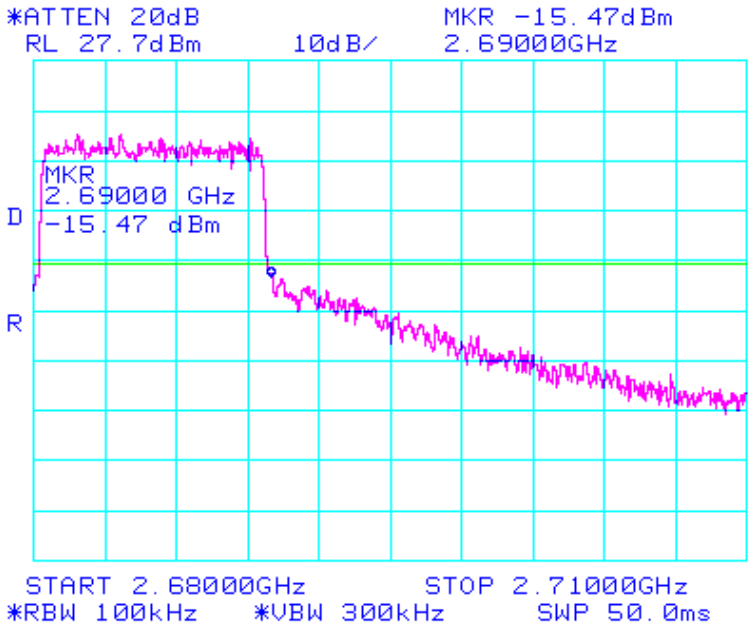
2685 MHz, Antenna 8, Conducted Band-Edge



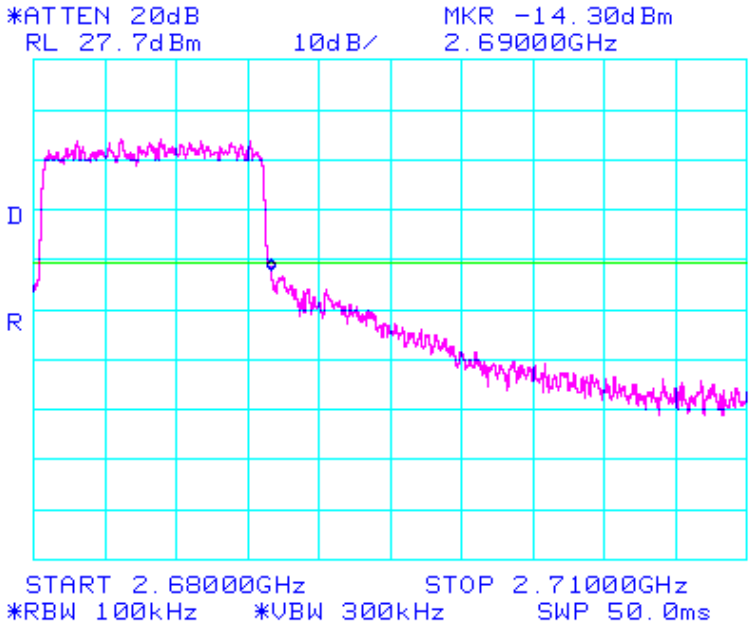
2685 MHz, Antenna 10, Conducted Band-Edge



2685 MHz, Antenna 12, Conducted Band-Edge



2685 MHz, Antenna 14, Conducted Band-Edge



6.1.1.6. Peak Excursion Ratio

Conducted Test Conditions for Peak Excursion Ratio			
Standard:	FCC CFR 47:Part 27	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Peak Excursion Ratio	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	27.5	**Pressure (mBars):**	999 - 1001
Reference Document(s):			

Test Procedure for Peak Excursion Ratio

Compliance with the peak excursion requirement is demonstrated by confirming the ratio of the maximum of the peak-hold spectrum to the maximum of the average spectrum during continuous transmission. Plots for each different operational mode was measured for compliance.

Limit

≤ 13 dB

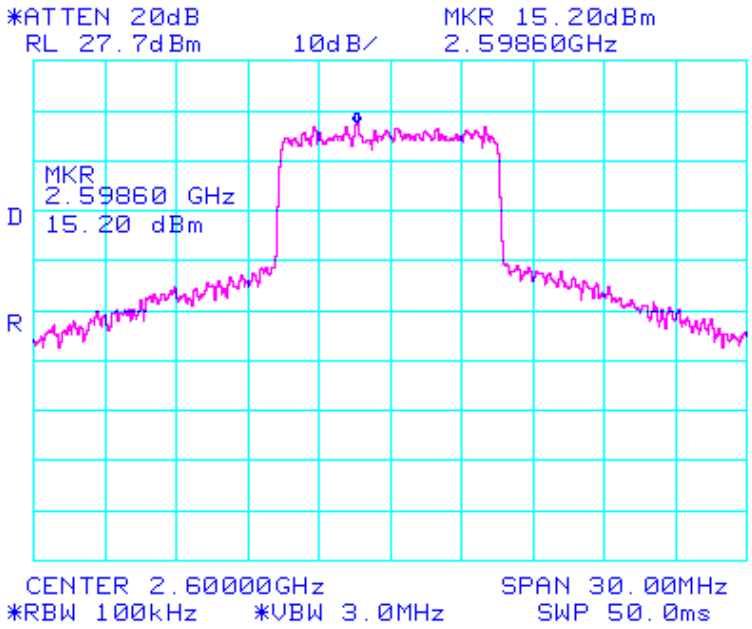
Equipment Configuration for Peak Excursion Ratio			
Variant:	802.11a	**Duty Cycle (%):**	100
Data Rate:	75 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	JMH
Engineering Test Notes:			

Test Measurement Results

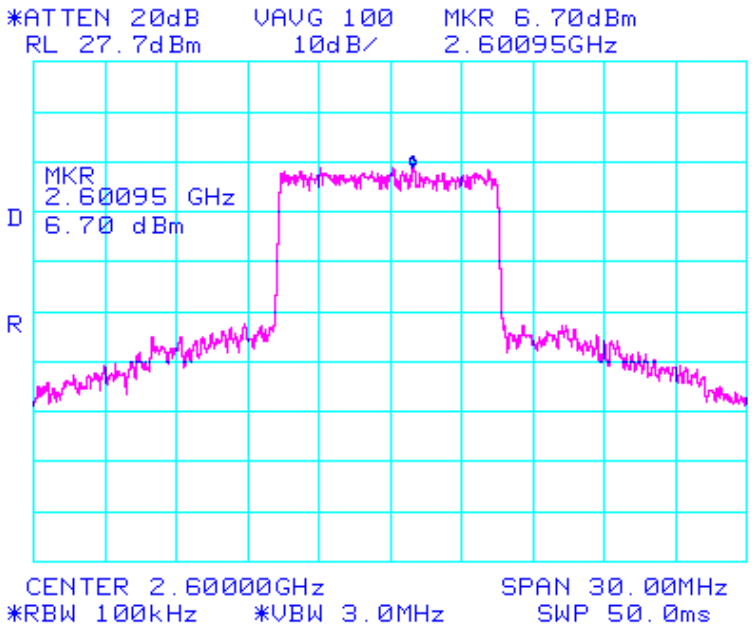
Test Frequency	Measured Peak Excursion (dBm) Antenna Port(s)		Ratio	Limit	Lowest Margin
MHz	**Peak**	**Average**	**dB**	**dB**	**MHz**
2600.0	15.20	6.70	-8.5	-13.0	-4.5

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

2600 MHz, Antenna 0, Peak Emission

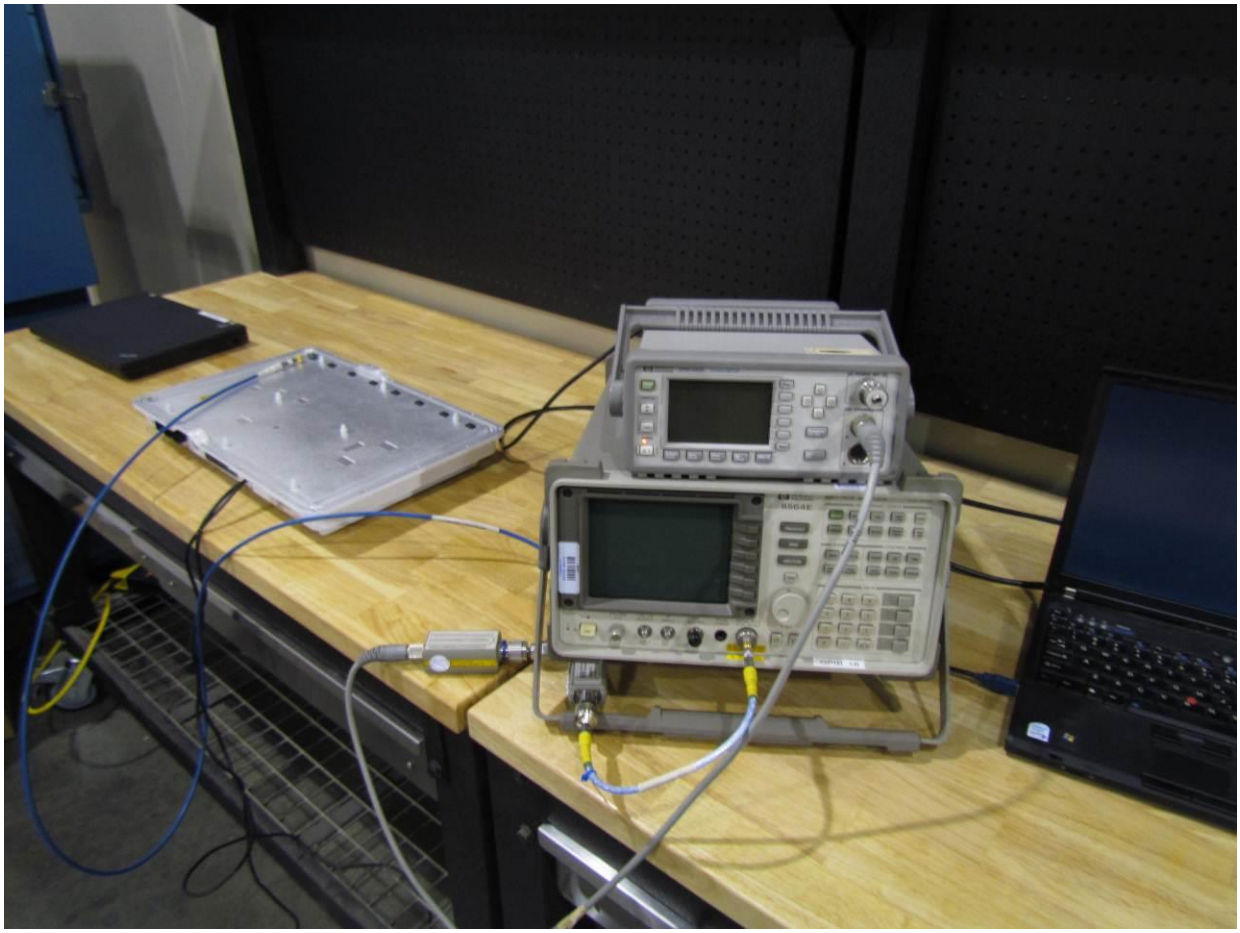


2600 MHz, Antenna 0, Average Emission



7. PHOTOGRAPHS

7.1. Conducted Test Setup



8. TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Serial #	Calibration Due Date
0158	Barometer /Thermometer	Control Co.	4196	E2846	8th Jan 14
0223	Power Meter	Hewlett Packard	EPM-442A	US37480256	18th Oct 14
0374	Power Sensor	Hewlett Packard	8485A	3318A19694	29th Nov 14
088	Spectrum Analyzer	Hewlett Packard	8540E	3410A00141	16th June 14
0252	SMA Cable	Megaphase	Sucoflex 104	None	N/A
0310	2m SMA Cable	Micro-Coax	UFA210A-0-0787-3G03G0	209089-001	N/A
0314	30dB N-Type Attenuator	ARRA	N9444-30	1623	N/A

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