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TEST REPORT

ACCORDING TO: FCC CFR 47 PART 90, section 90.219/ §20.21 reference

FOR:

Axell Wireless Israel Ltd.

CMRS booster

Model: D-SBR4008-PS-NFPA-24-DC-CLASS-A

FCC ID:NEODSBR4008CLA

This report is in conformity with ISO/ IEC 17025. The "A2LA Accredited" symbol endorsement applies only to the tests and calibrations that are listed in the scope of Hermon Laboratories accreditation. The test results relate only to the items tested.
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1 Applicant information

Client name: Axell Wireless Israel Ltd.
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Telephone: +972 3918 0180
Fax: +972 3918 0190
E-mail: alex.garkin@axellwireless.com
Contact name: Mr. Alexander Garkin

2 Equipment under test attributes

Product name: High power repeater
Product type: Booster
Model(s): D-SBR4008-PS-NFPA-24-DC-CLASS-A
Part number: DSBR011
Serial number: 16038001
Hardware version: DMBR024_Rev1A
Software release: File System: 24_03_15
CCD Application: 6.2.2
Receipt date 06-Mar-16

3 Manufacturer information

Manufacturer name: Axell Wireless Israel Ltd.
Address: 6 Bareket street, Petach Tikva 49002, Israel
Telephone: +972 3918 0180
Fax: +972 3918 0190
E-Mail: alex.garkin@axellwireless.com
Contact name: Mr. Alexander Garkin

4 Test details




Project ID: 28127
Location: Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel
Test started: 23-Feb-16
Test completed: 6-Jun-16
Test specification(s): 47CFR §90.219, §20.21

5 Tests summary

Test	Status
Transmitter characteristics	
Section 90.219(e)(1), Automatic gain control (AGC) threshold	Pass
Section 90.219(e)(1), Radiated output power	Pass
Section 90.219(a), Occupied bandwidth	Pass
Section 90.210(b), Intermodulation product	Pass
Section 90.219(e)(3), Radiated spurious emissions	Pass
Section 90.219(e)(3), Conducted spurious emissions	Pass
Section 2.1091, RF radiation exposure evaluation	Pass, exhibit provided in Application for certification

Testing was completed against all relevant requirements of the test standard. The results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested. Pass/ fail decision was based on nominal values.

This test report supersedes the previously issued test report identified by Doc ID:AXERAD_FCC.28127A_CMRS.

	Name and Title	Date	Signature
Tested by:	Mr. S. Samokha, test engineer	June 6, 2016	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	December 20, 2016	
Approved by:	Mr. M. Nikishin, EMC and Radio group manager	December 20, 2016	



6 EUT description

6.1 General information

The EUT, D-SBR4008-PS-NFPA-24-DC-CLASS-A is a high-power digital multi-channel signal booster (DCSB) that features an array of up to 12 DSP based, softwarecontrolled, variable bandwidth filters, user-programmable across the 800 MHz bands.

The D-SBR4008-PS-NFPA-24-DC-CLASS-A supports all public safety technologies. In addition to specifying the centre frequency of each filter, the user can select a filter from a drop down list that has several choices for each pass band that vary in time delay and filter slope. This gives the engineer the unique ability to trade off the adjacent channel rejection and time delay interference for the coverage area permitting the use of the D-SBR4008-PS-NFPA-24-DC-CLASS-A in applications where no other booster solution will work.

Every parameter of D-SBR4008-PS-NFPA-24-DC-CLASS-A including filter tuning and selection, is software controlled via Web management. The patented Axell Wireless' digital RF filter not only enables simple initial setup for any channel plan, but if necessary even permits a simple reconfiguration because of re-banding.

This test report represents test results for CMRS booster part.

6.2 EUT options/configurations

Number	Operating mode description	Configuration
1	Transmit 862-869 MHz, Downlink	1
2	Transmit 817-824 MHz, Uplink	2

6.3 Ports and lines

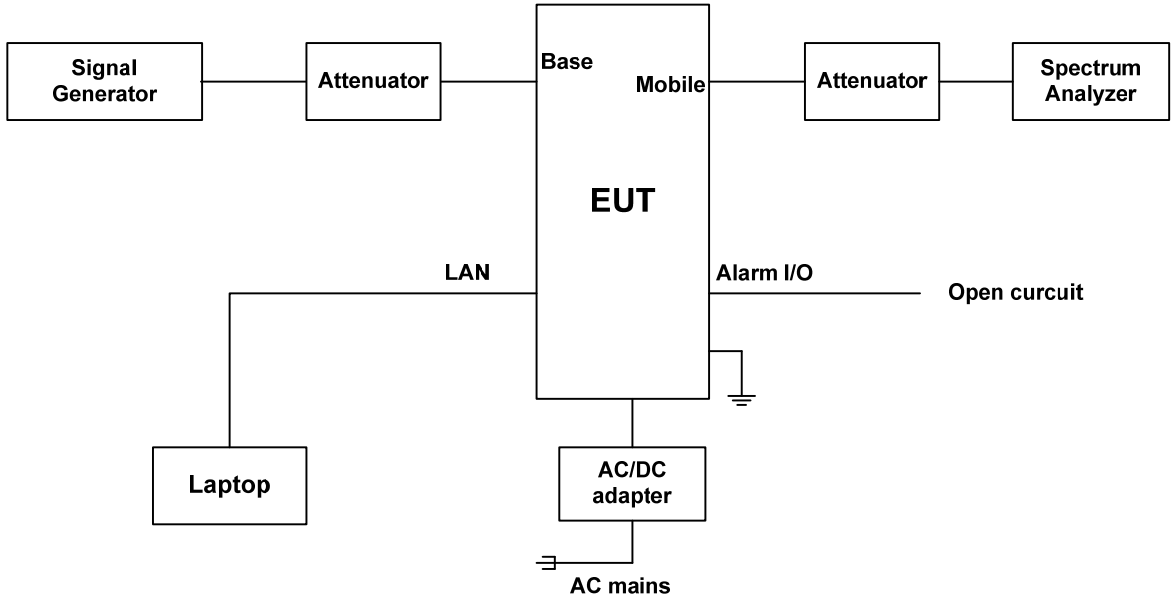
Port type	Port description	Connected from	Connected to	Qty.	Cable type	Cable length, m
Power	AC	AC mains	AC/DC adapter	1	Unshielded	1.5
Power	DC	AC/DC adapter	EUT	1	Unshielded	0.3
Signal	Ethernet	EUT	PC	1	UTP	5
Signal	Antenna	EUT	Antenna	2	Coax	NA
Signal	Alarm I/O	EUT	OC	1	Unshielded	3

6.4 Support and test equipment

Description	Manufacturer	Model number	Serial number
Laptop	DELL	PP20L	5QXF83G
AC/DC adapter	DELL	LA65N80	0DF263-71615-7QF-E850
Mouse	Logitech	810-001317	NA



6.5 Test configuration





6.6 Transmitter characteristics

Type of equipment					
V	Stand-alone (Equipment with or without its own control provisions)				
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)				
	Plug-in card (Equipment intended for a variety of host systems)				
Intended use		Condition of use			
V	fixed	Always at a distance more than 2 m from all people			
	mobile	Always at a distance more than 20 cm from all people			
	portable	May operate at a distance closer than 20 cm to human body			
Assigned frequency range		DL 862-869 MHz; UL 817 – 824 MHz			
Maximum rated output power		At maximum gain, Output port		DL: 40 dBm each band UL: 28 dBm each band	
Is transmitter output power variable?			No		
	V	Yes	continuous variable		
			V	stepped variable with stepsize	1.0 dB
			minimum RF power		NA
			maximum RF power		DL: 40 dBm UL: 28 dBm
Antenna connection					
unique coupling	V	standard connector	Integral	with temporary RF connector without temporary RF connector	
Antenna/s technical characteristics					
Type	Manufacturer	Model number	Antenna gain, dBi	Cable loss, dB	
External (Indoor)	Galtronics	02121261-05542	1.5-3.5	External (Indoor)	
External (Indoor)	Galtronics	PEAR S4935i	1.5-2.5	External (Indoor)	
External (Outdoor)	Galtronics	PEAR S5591i	5	External (Outdoor)	
Transmitter aggregate data rate/s, Mbps					
Transmitter 99% power bandwidth		Type of modulation			
		C4FM	iDEN QAM	Analog FM	
		9.6 kbps	64 kbps	9.6 kbps	
Type of multiplexing					
Modulating test signal (baseband)					
Maximum transmitter duty cycle in normal use					
Transmitter power source					
	DC	Nominal rated voltage			
V	AC	Nominal rated voltage		From 120 VAC via AC/DC adapter	
Common power source for transmitter and receiver			V	yes no	



Test specification: Section 90.219(e)(1), AGC threshold test for CMRS			
Test procedure: KDB 935210 D05 v01r01, section 3			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Mar-16 - 29-Mar-16			
Temperature: 23.2 °C	Relative Humidity: 48 %	Air Pressure: 1015 hPa	Power supply: 120 VAC
Remarks:			

7 Transmitter tests

7.1 Automatic gain control (AGC) threshold test for CMRS

7.1.1 General

This test was performed to measure the peak output power at RF antenna connector. Specification test limits are given in Table 7.1.1.

Table 7.1.1 ERPlimits

Assigned frequency range, MHz	Maximum ERP	
	W	dBm
862.0 – 869.0	5.0	37.0
817.0 – 824.0	5.0	37.0

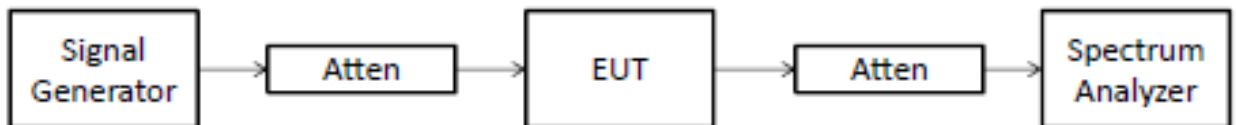
7.1.2 Test procedure

7.1.2.1 The EUT was set up as shown in Figure 7.1.1, energized and its proper operation was checked.

7.1.2.2 The EUT was adjusted to produce maximum available to the end user RF output power.

7.1.2.3 The peak output power was measured with spectrum analyzer as provided in Table 7.1.2 and associated plots.

Figure 7.1.1 AGC threshold test setup





Test specification: Section 90.219(e)(1), AGC threshold test for CMRS			
Test procedure: KDB 935210 D05 v01r01, section 3			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Mar-16 - 29-Mar-16			
Temperature: 23.2 °C	Relative Humidity: 48 %	Air Pressure: 1015 hPa	Power supply: 120 VAC
Remarks:			

Table 7.1.2 AGC Threshold test results

OPERATING FREQUENCY RANGE: 862 - 869 MHz (downlink)
817 - 824 MHz (uplink)

DETECTOR USED: Average

MEASUREMENT METHOD: Spectrum Analyzer

CONFIGURATION: Single Channel

MODULATING SIGNAL: AWGN

Frequency, MHz	Input port	Input level, dBm	Power meter reading, dBm	AGC threshold level, dBm	Margin*, dB	Verdict
Downlink transmit mode						
865.5	Base	-53.88	39.98	-53.88	NA	Pass
Uplink transmit mode						
820.5	Mobile	-68.79	26.62	-68.79	NA	Pass

MODULATING SIGNAL: GSM

Frequency, MHz	Input port	Input level, dBm	Power meter reading, dBm	AGC threshold level, dBm	Margin*, dB	Verdict
Downlink transmit mode						
865.5	Base	-55.66	39.56	-55.66	NA	Pass
Uplink transmit mode						
820.5	Mobile	-68.96	26.53	-68.96	NA	Pass

* - Margin = Maximum ERP – specification limit

Reference numbers of test equipment used

HL 0539	HL 1876	HL 2909	HL 3779	HL 3787	HL 3903	HL 4273	HL 4275
HL 4364							

Full description is given in Appendix A.



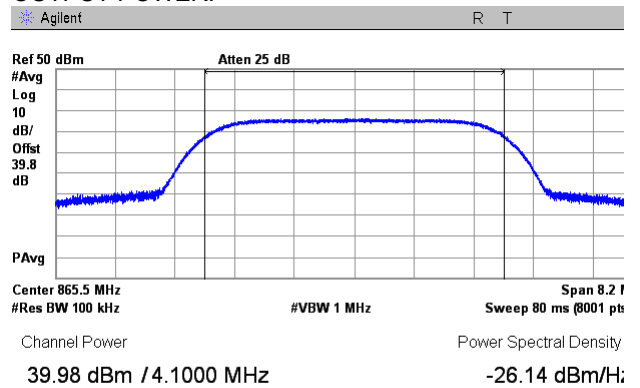
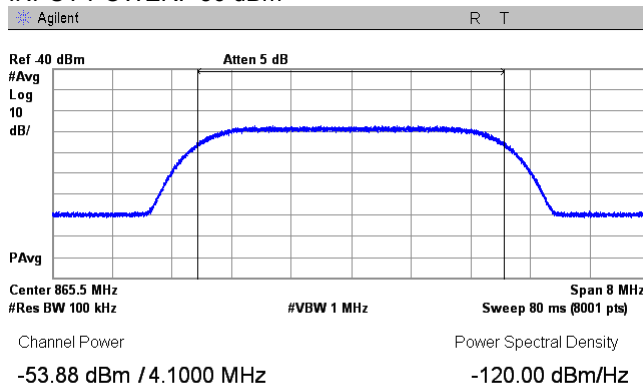
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Test specification: Section 90.219(e)(1), AGC threshold test for CMRS			
Test procedure: KDB 935210 D05 v01r01, section 3			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Mar-16 - 29-Mar-16			
Temperature: 23.2 °C	Relative Humidity: 48 %	Air Pressure: 1015 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.1.1 AGC threshold test results at mid frequency carrier, Port 1

FREQUENCY RANGE:
OPERATIONAL MODE:
CONFIGURATION:
INPUT PORT:
INPUT POWER: -56 dBm

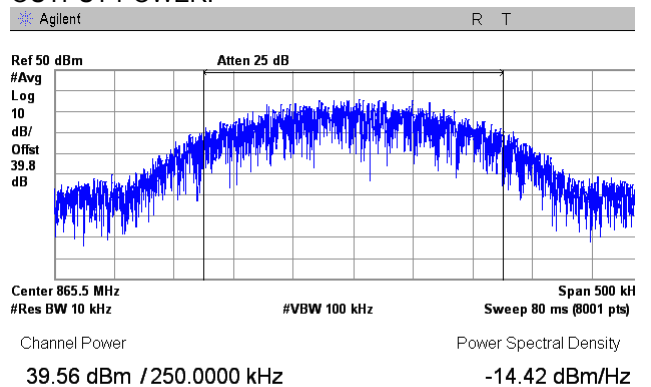
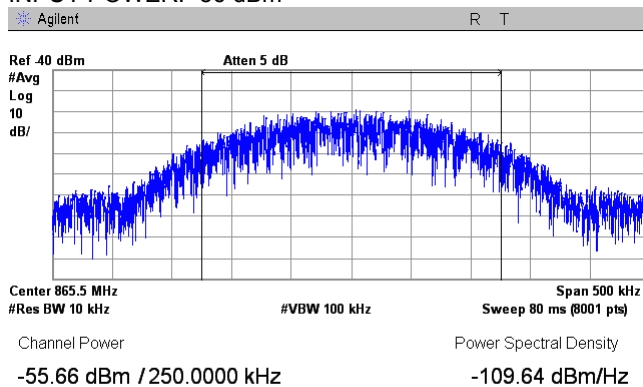
862 - 869 MHz
AWGN downlink transmit
Single Channel
Base
OUTPUT POWER:



Plot 7.1.2 AGC threshold test results at mid frequency carrier, Port 1

FREQUENCY RANGE:
OPERATIONAL MODE:
CONFIGURATION:
INPUT PORT:
INPUT POWER: -56 dBm

862 - 869 MHz
GSM downlink transmit
Single Channel
Base
OUTPUT POWER:





Test specification: Section 90.219(e)(1), Mean output power and booster gain test for CMRS			
Test procedure: KDB 935210 D05 v01r01, section 3.5			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Mar-16 - 29-Mar-16			
Temperature: 23.2 °C	Relative Humidity: 48 %	Air Pressure: 1015 hPa	Power supply: 120 VAC
Remarks:			

7.2 Mean output power and booster gain test for CMRS

7.2.1 General

This test was performed to measure the peak output power at RF antenna connector. Specification test limits are given in Table 7.2.1.

Table 7.2.1 ERPlimits

Assigned frequency range, MHz	Maximum ERP	
	W	dBm
862.0 – 869.0	5.0	37.0
817.0 – 824.0	5.0	37.0

7.2.2 Test procedure

7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and its proper operation was checked.

7.2.2.2 The EUT was adjusted to produce maximum available to the end user RF output power.

7.2.2.3 The peak output power was measured with spectrum analyzer as provided in Table 7.2.2 and associated plots.

Figure 7.2.1 Mean output power and booster gain test setup





Test specification: Section 90.219(e)(1), Mean output power and booster gain test for CMRS			
Test procedure: KDB 935210 D05 v01r01, section 3.5			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Mar-16 - 29-Mar-16			
Temperature: 23.2 °C	Relative Humidity: 48 %	Air Pressure: 1015 hPa	Power supply: 120 VAC
Remarks:			

Table 7.2.2 Mean output power and booster gain test results

OPERATING FREQUENCY RANGE: 862 - 869 MHz (downlink)
817 - 824 MHz (uplink)

DETECTOR USED: Peak

RESOLUTION BANDWIDTH: 100 kHz

VIDEO BANDWIDTH: 300 kHz

RF SIGNAL: AWGN

Carrier frequency, MHz	Input port	SA reading, dBm		Booster gain**, dB	Antenna assembly gain***, dBd	ERP, dBm	Limit, dBm	Margin*, dB	Verdict
		Input	Output						
Downlink transmit mode									
865.5	Base	-53.88	39.98	93.86	-3.0	36.98	37.0	-0.02	Pass
Uplink transmit mode									
820.5	Mobile	-67.07	26.42	93.49	-3.0	23.42	37.0	-13.78	Pass

RF SIGNAL: GSM

Carrier frequency, MHz	Input port	SA reading, dBm		Booster gain**, dB	Antenna assembly gain***, dBd	ERP, dBm	Limit, dBm	Margin*, dB	Verdict
		Input	Output						
Downlink transmit mode									
865.5	Base	-55.66	39.56	95.22	-3.0	36.56	37.0	-0.02	Pass
Uplink transmit mode									
820.5	Mobile	-68.83	26.37	95.2	-3.0	23.37	37.0	-13.63	Pass

* - Margin = ERP – specification limit

** - Booster Gain = Output SA reading – Input SA reading

*** - ERP = Output SA reading + Gmax antenna gain (dBi) – 2.15 – Insertion loss = Pout + Antenna assembly gain (dBi) – 2.15

Where Antenna assembly gain = Gmax antenna gain (dBi) – Cable loss – Splitter loss

Note 1: In DAS system, we suppose a loss due to cable insertion, splitter, etc, about of 12dB:

There are no specific antennas supplied as a part of the unit that is why the maximum antenna assembly gain in dBd shall not exceed the value in -3 dB.

Reference numbers of test equipment used

HL 0539	HL 1876	HL 2909	HL 3779	HL 3787	HL 3903	HL 4273	HL 4275
HL 4364							

Full description is given in Appendix A.



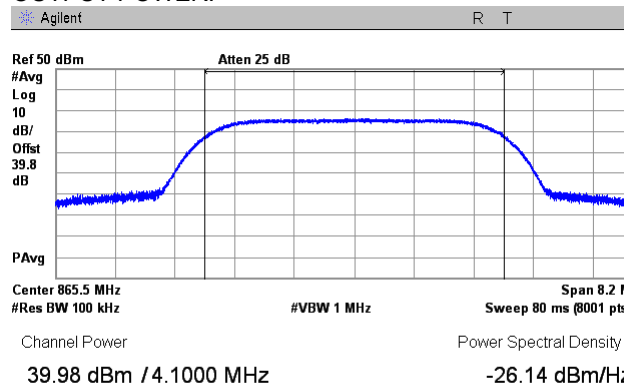
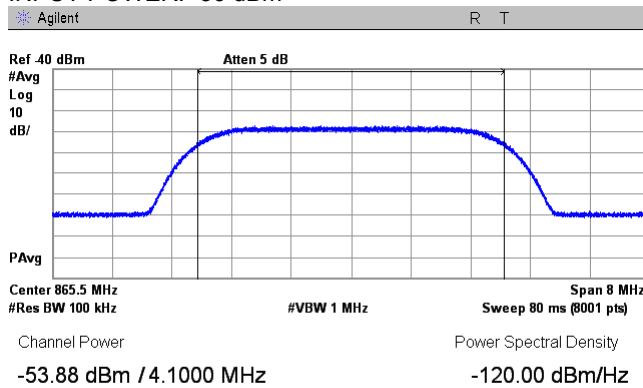
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Test specification: Section 90.219(e)(1), Mean output power and booster gain test for CMRS			
Test procedure: KDB 935210 D05 v01r01, section 3.5			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Mar-16 - 29-Mar-16			
Temperature: 23.2 °C	Relative Humidity: 48 %	Air Pressure: 1015 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.2.1 Mean output power and booster gain test results at mid carrier frequency

FREQUENCY RANGE:
OPERATIONAL MODE:
CONFIGURATION:
INPUT PORT:
INPUT POWER: -56 dBm

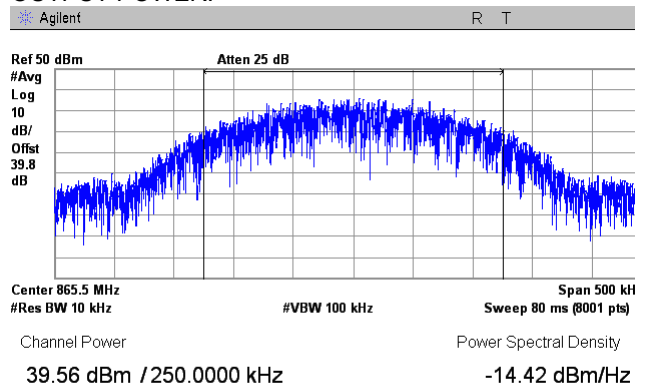
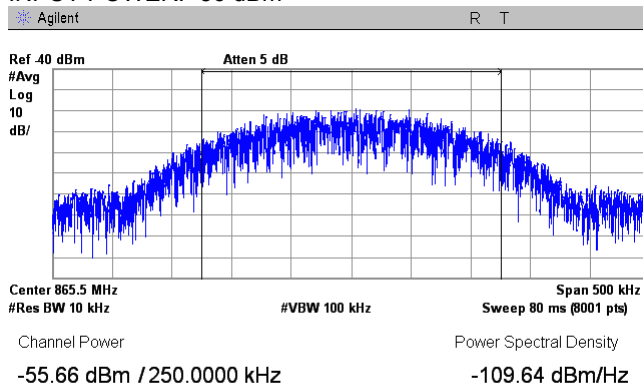
862 - 869 MHz
AWGN downlink transmit
Single Channel
Base
OUTPUT POWER:



Plot 7.2.2 Mean output power and booster gain test results at mid carrier frequency

FREQUENCY RANGE:
OPERATIONAL MODE:
CONFIGURATION:
INPUT PORT:
INPUT POWER: -56 dBm

862 - 869 MHz
GSM downlink transmit
Single Channel
Base
OUTPUT POWER:





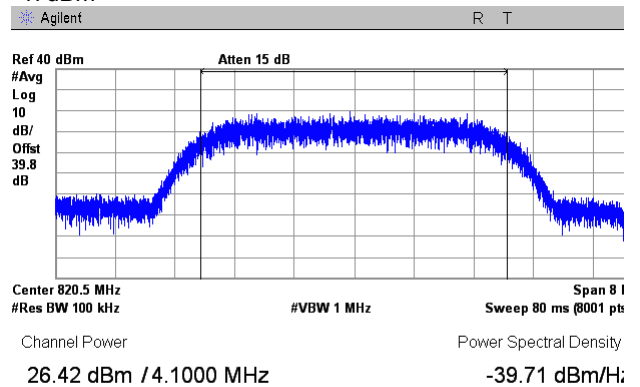
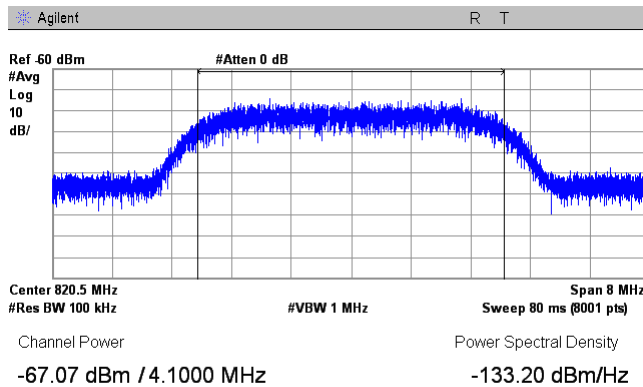
HERMON LABORATORIES

Test specification: Section 90.219(e)(1), Mean output power and booster gain test for CMRS			
Test procedure: KDB 935210 D05 v01r01, section 3.5			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Mar-16 - 29-Mar-16			
Temperature: 23.2 °C	Relative Humidity: 48 %	Air Pressure: 1015 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.2.3 Mean output power and booster gain test results at mid carrier frequency

FREQUENCY RANGE:
OPERATIONAL MODE:
CONFIGURATION:
INPUT PORT:
INPUT POWER: -69 dBm

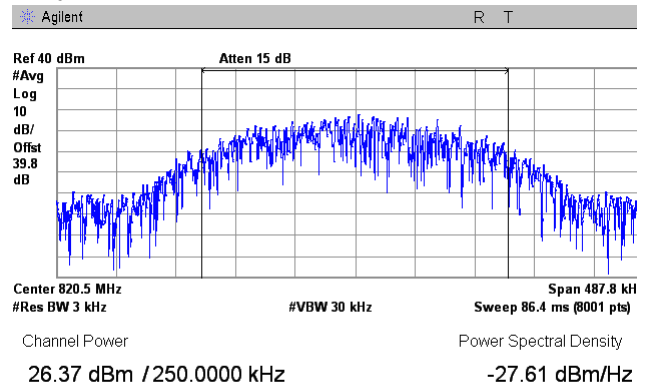
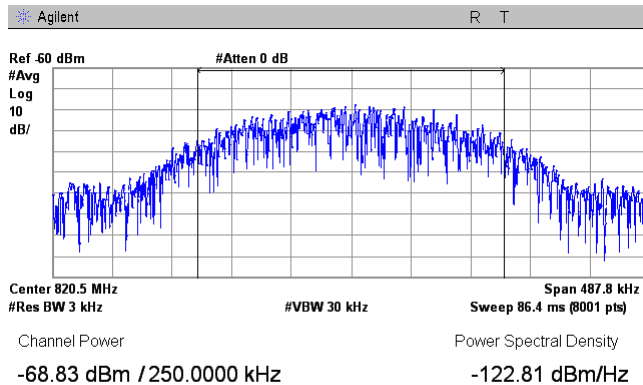
817 - 824 MHz
AWGN uplink transmit
Single Channel
Mobile
OUTPUT POWER:
-47dBm



Plot 7.2.4 Mean output power and booster gain at mid carrier frequency

FREQUENCY RANGE:
OPERATIONAL MODE:
CONFIGURATION:
INPUT PORT:
INPUT POWER: -69 dBm

817 - 824 MHz
GSM uplink transmit
Single Channel
Mobile
OUTPUT POWER:
-47 dBm





Test specification: Section 90.219(a), Out-of-band rejection test for CMRS			
Test procedure: KDB 935210 D05 v01r01, section 3.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 27-Mar-16 - 29-Mar-16			
Temperature: 23.2 °C	Relative Humidity: 47 %	Air Pressure: 1015 hPa	Power supply: 120 VAC
Remarks:			

7.3 Out-of-band rejection test for CMRS

7.3.1 General

This test was performed to measure transmitter occupied bandwidth. Specification test limits are given in Table 7.3.1.

Table 7.3.1 Out-of-band rejection limits

Assigned frequency range, MHz	Tested frequency range	Modulation envelope reference points*, dBc	Maximum allowed Gain versus frequency response, dB
817.0 – 824.0 862.0 – 869.0	F ₀ ±250%BW	20	≤1 dB nominal gain

* - Modulation envelope reference points are provided in terms of attenuation below the unmodulated carrier.

7.3.2 Test procedure

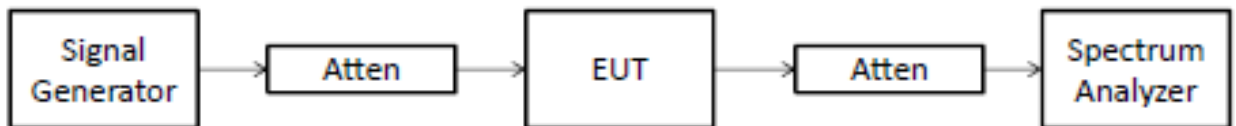
7.3.2.1 The EUT was set up as shown in Figure 7.3.1, energized and its proper operation was checked.

7.3.2.2 The EUT was set to transmit the unmodulated carrier and the reference peak power level was measured.

7.3.2.3 The EUT was set to transmit the normally modulated carrier.

7.3.2.4 The transmitter occupied bandwidth was measured with spectrum analyzer as a frequency delta between the reference points on modulation envelope and provided in Table 7.3.2, Table 7.3.3 and the associated plots.

Figure 7.3.1 Out-of-band rejection test setup





Test specification: Section 90.219(a), Out-of-band rejection test for CMRS			
Test procedure: KDB 935210 D05 v01r01, section 3.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 27-Mar-16 - 29-Mar-16			
Temperature: 23.2 °C	Relative Humidity: 47 %	Air Pressure: 1015 hPa	Power supply: 120 VAC
Remarks:			

Table 7.3.2 Out-of-band rejection test results

FREQUENCY RANGE: 862.0 – 869.0 MHz Downlink
 DETECTOR USED: Peak hold
 RESOLUTION BANDWIDTH: 100 kHz
 VIDEO BANDWIDTH: 300 kHz
 MODULATION ENVELOPE REFERENCE POINTS: 20 dBc

Input Power, dBm	Start Band frequency, MHz	Stop Band frequency, MHz	Occupied bandwidth, MHz	Limit, MHz	Verdict
-58	862.101	868.860	6.759	851.0 – 869.0	Pass
-28	862.088	868.891	6.803	851.0 – 862.0	Pass

Table 7.3.3 Out-of-band rejection test results

FREQUENCY RANGE: 817.0 – 824.0 MHz Uplink
 DETECTOR USED: Peak hold
 RESOLUTION BANDWIDTH: 100 kHz
 VIDEO BANDWIDTH: 300 kHz
 MODULATION ENVELOPE REFERENCE POINTS: 20 dBc

Input Power, dBm	Start Band frequency, MHz	Stop Band frequency, MHz	Occupied bandwidth, MHz	Limit, MHz	Verdict
-69	817.109	823.878	6.769	851.0 – 869.0	Pass
-39	817.070	824.000	6.930	851.0 – 862.0	Pass

Reference numbers of test equipment used

HL 0557	HL 2909	HL 3434	HL 3787	HL 3788	HL 3818	HL 3903	HL 4068
HL 4097	HL 4273	HL 4274	HL 4275	HL 4354	HL 4413		

Full description is given in Appendix A.

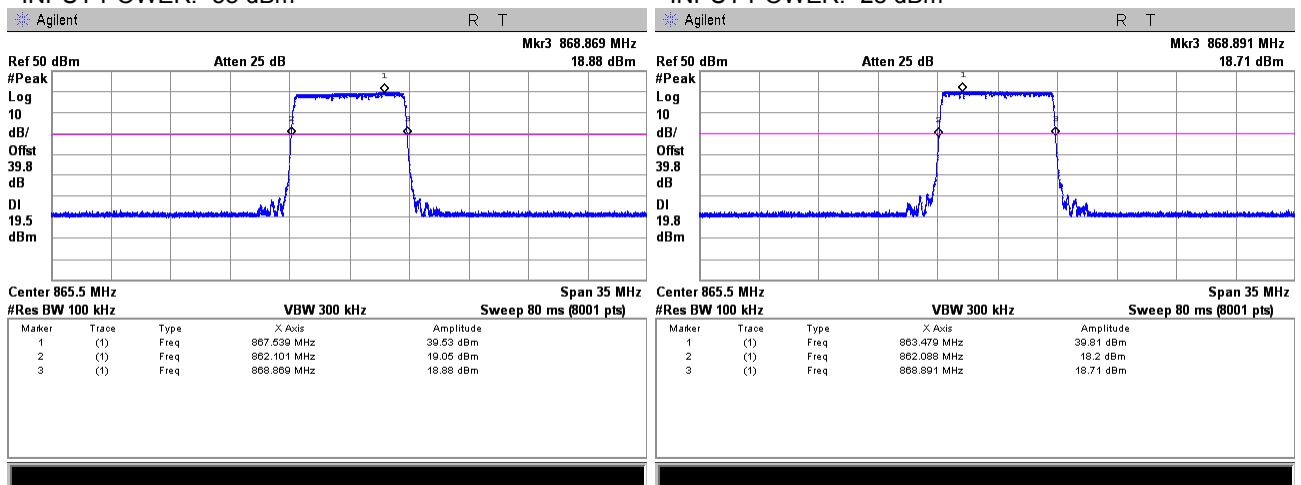


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Test specification: Section 90.219(a), Out-of-band rejection test for CMRS			
Test procedure: KDB 935210 D05 v01r01, section 3.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 27-Mar-16 - 29-Mar-16			
Temperature: 23.2 °C	Relative Humidity: 47 %	Air Pressure: 1015 hPa	Power supply: 120 VAC
Remarks:			

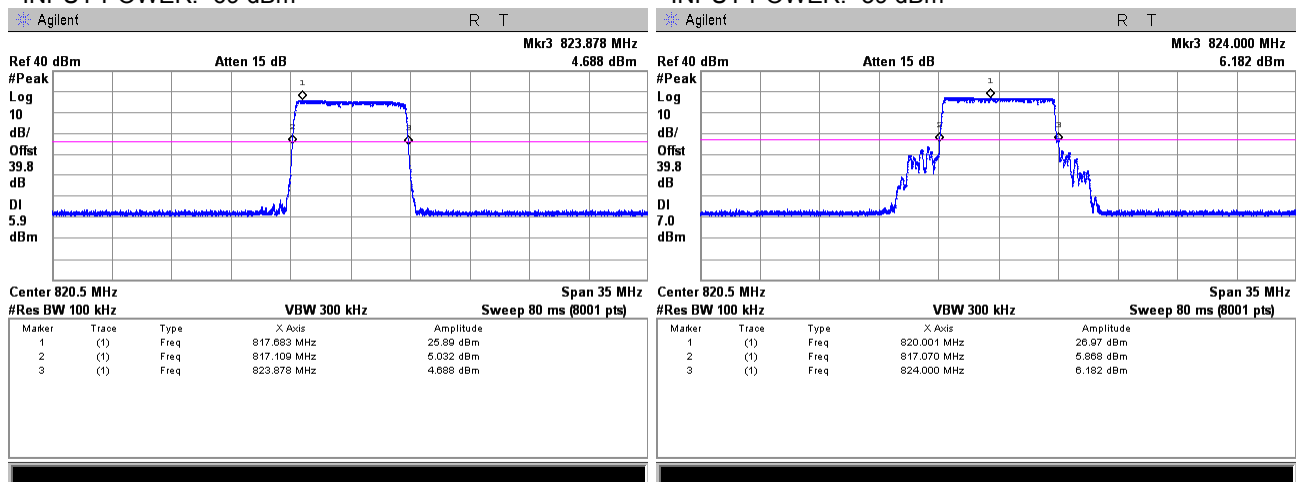
Plot 7.3.1 Out-of-band rejection test result, CMRS

FREQUENCY RANGE: 862.0 – 869.0 MHz, Frequency band =6.2 MHz
 MIDBAND FREQUENCY: 865.5 MHz
 SWEEP FREQUENCY RANGE: 848.0 – 883.0 MHz
 INPUT PORT: Base
 INPUT POWER: -58 dBm



Plot 7.3.2 Out-of-band rejection test result, CMRS

FREQUENCY RANGE: 817.0 – 824.0 MHz Uplink, Frequency band =6.2 MHz
 MIDBAND FREQUENCY: 820.5 MHz
 SWEEP FREQUENCY RANGE: 771.0 – 861.0 MHz
 INPUT PORT: Mobile
 INPUT POWER: -69 dBm





Test specification: Section 90.219(a), Occupied bandwidth for CMRS			
Test procedure: KDB 935210 D05 v01r01, section 3.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 23-Feb-16 - 29-Mar-16			
Temperature: 23.4 °C	Relative Humidity: 49 %	Air Pressure: 1019 hPa	Power supply: 120 VAC
Remarks:			

7.4 Occupied bandwidth test for CMRS

7.4.1 General

This test was performed to measure transmitter occupied bandwidth. Specification test limits are given in Table 7.4.1.

Table 7.4.1 Occupied bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points*, %	Maximum allowed bandwidth, kHz
862 – 869 / 817 – 824	99	NA

* - Modulation envelope reference points are provided in terms of attenuation below the unmodulated carrier.

7.4.2 Test procedure

7.4.2.1 The EUT was set up as shown in Figure 7.4.1, energized and its proper operation was checked.

7.4.2.2 The EUT was set to transmit the unmodulated carrier and the reference peak power level was measured.

7.4.2.3 The EUT was set to transmit the normally modulated carrier.

7.4.2.4 The transmitter occupied bandwidth was measured with spectrum analyzer as a frequency delta between the reference points on modulation envelope and provided in Table 7.4.2, Table 7.4.3 and the associated plots.

Figure 7.4.1 Occupied bandwidth test setup





Test specification: Section 90.219(a), Occupied bandwidth for CMRS			
Test procedure: KDB 935210 D05 v01r01, section 3.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 23-Feb-16 - 29-Mar-16			
Temperature: 23.4 °C	Relative Humidity: 49 %	Air Pressure: 1019 hPa	Power supply: 120 VAC
Remarks:			

Table 7.4.2 Occupied bandwidth test results

DETECTOR USED: Average
 MODULATION ENVELOPE REFERENCE POINTS: 99%
 OPERATING FREQUENCY RANGE: 862 - 869 MHz (downlink)
 817 - 824 MHz (uplink)
 RESOLUTION BANDWIDTH: 100 kHz
 VIDEO BANDWIDTH: 1000 kHz
 MODULATING SIGNAL: AWGN
 CONFIGURATION: Below AGC threshold level

Carrier frequency, MHz	Output port	Occupied bandwidth, kHz		Limit, kHz	Margin, kHz	Verdict
		Input signal	Output signal			
Downlink						
865.5	Base	4173.1	4166.4	NA	NA	Pass
Uplink						
820.5	Mobile	4174.1	4183.8	NA	NA	Pass

CONFIGURATION: Above AGC threshold level

Carrier frequency, MHz	Output port	Occupied bandwidth, kHz		Limit, kHz	Margin, kHz	Verdict
		Input signal	Output signal			
Downlink						
865.5	Base	4173.1	4173.5	NA	NA	Pass
Uplink						
820.5	Mobile	4162.7	4162.1	NA	NA	Pass



Test specification: Section 90.219(a), Occupied bandwidth for CMRS			
Test procedure: KDB 935210 D05 v01r01, section 3.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 23-Feb-16 - 29-Mar-16			
Temperature: 23.4 °C	Relative Humidity: 49 %	Air Pressure: 1019 hPa	Power supply: 120 VAC
Remarks:			

Table 7.4.3 Occupied bandwidth test results

RESOLUTION BANDWIDTH: 100 kHz
 VIDEO BANDWIDTH: 1000 kHz
 MODULATING SIGNAL: GSM
 CONFIGURATION: Below AGC threshold level

Carrier frequency, MHz	Output port	Occupied bandwidth, kHz		Limit, kHz	Margin, kHz	Verdict
		Input signal	Output signal			
Downlink						
865.5	Base	244.8879	248.9844	NA	NA	Pass
Uplink						
820.5	Mobile	245.2824	244.6540	NA	NA	Pass

CONFIGURATION: Above AGC threshold level

Carrier frequency, MHz	Output port	Occupied bandwidth, kHz		Limit, kHz	Margin, kHz	Verdict
		Input signal	Output signal			
Downlink						
865.5	Base	244.5392	247.0168	NA	NA	Pass
Uplink						
820.5	Mobile	244.8527	246.9563	NA	NA	Pass

Reference numbers of test equipment used

HL 0557	HL 2909	HL 3434	HL 3787	HL 3788	HL 3818	HL 3903	HL 4068
HL 4097	HL 4273	HL 4274	HL 4275	HL 4354	HL 4413		

Full description is given in Appendix A.



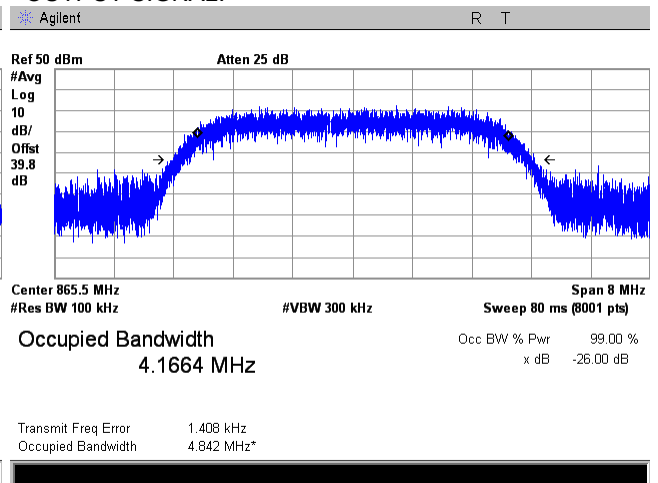
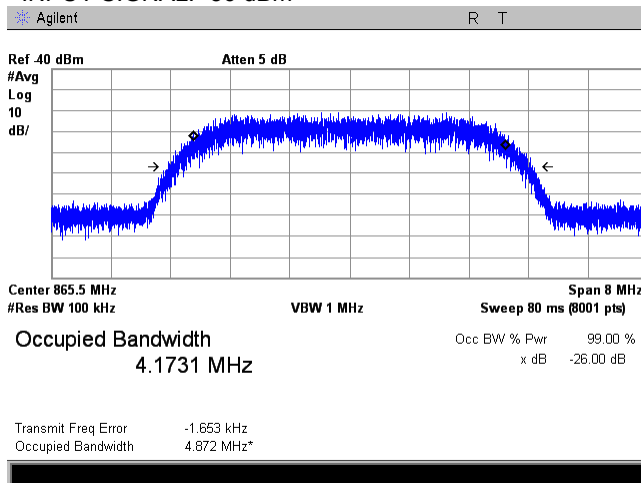
HERMON LABORATORIES

Test specification: Section 90.219(a), Occupied bandwidth for CMRS			
Test procedure: KDB 935210 D05 v01r01, section 3.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 23-Feb-16 - 29-Mar-16			
Temperature: 23.4 °C	Relative Humidity: 49 %	Air Pressure: 1019 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.4.1 Occupied bandwidth test result at mid frequency carrier, Port 1

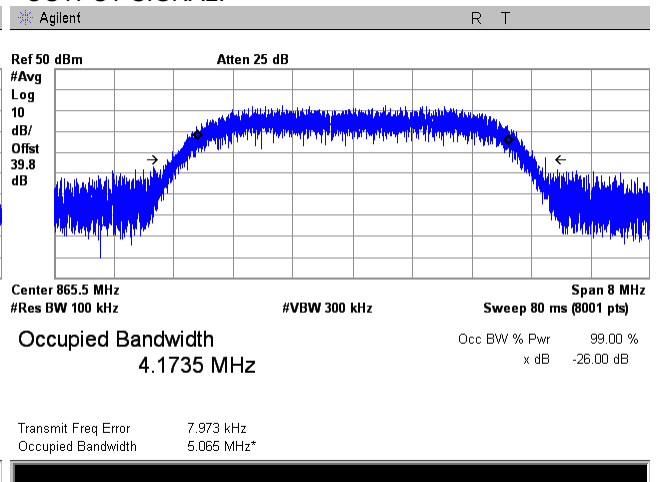
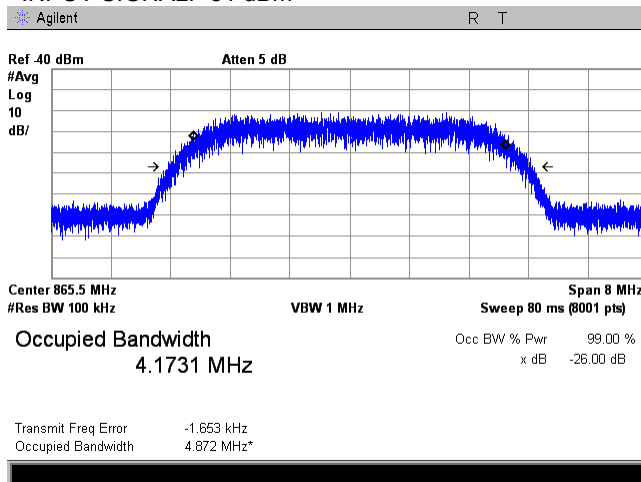
FREQUENCY RANGE:
OPERATIONAL MODE:
INPUT PORT:
CONFIGURATION:
INPUT SIGNAL: -56 dBm

862 - 869 MHz
AWGN uplink transmit
Mobile
Below AGC threshold
OUTPUT SIGNAL:



CONFIGURATION:
INPUT SIGNAL: -51 dBm

Above AGC threshold +3 dB
OUTPUT SIGNAL:





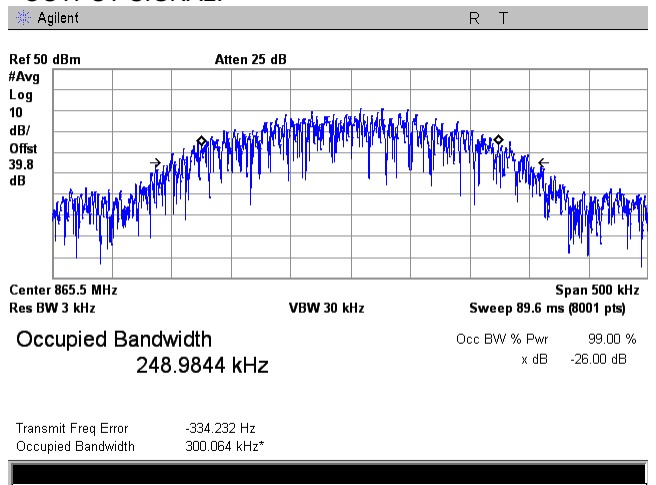
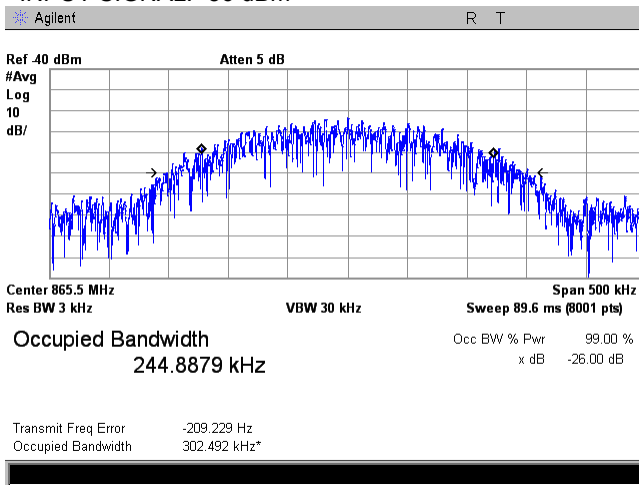
HERMON LABORATORIES

Test specification: Section 90.219(a), Occupied bandwidth for CMRS			
Test procedure: KDB 935210 D05 v01r01, section 3.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 23-Feb-16 - 29-Mar-16			
Temperature: 23.4 °C	Relative Humidity: 49 %	Air Pressure: 1019 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.4.2 Occupied bandwidth test result at mid frequency carrier, Port 1

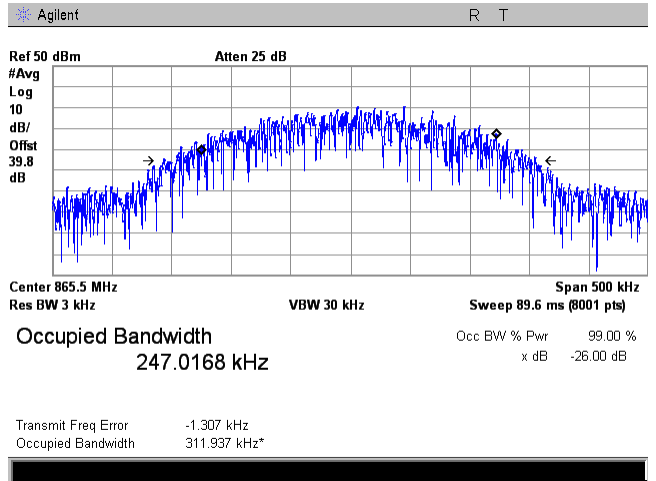
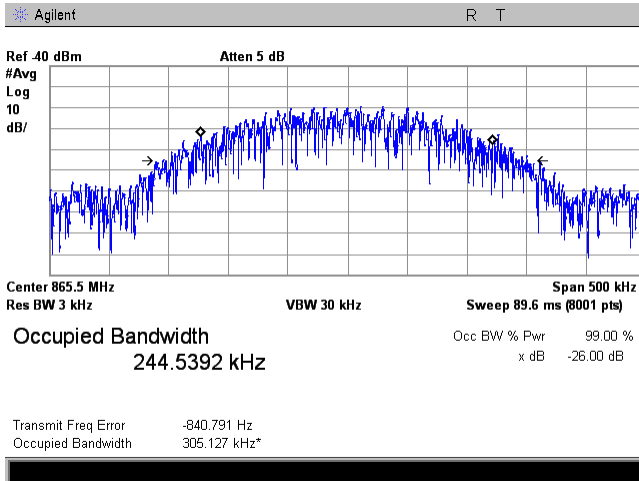
FREQUENCY RANGE:
OPERATIONAL MODE:
INPUT PORT:
CONFIGURATION:
INPUT SIGNAL: -56 dBm

862 - 869 MHz
GSM uplink transmit
Mobile
Below AGC threshold
OUTPUT SIGNAL:



CONFIGURATION:
INPUT SIGNAL: -56 dBm

Above AGC threshold +3 dB
OUTPUT SIGNAL:





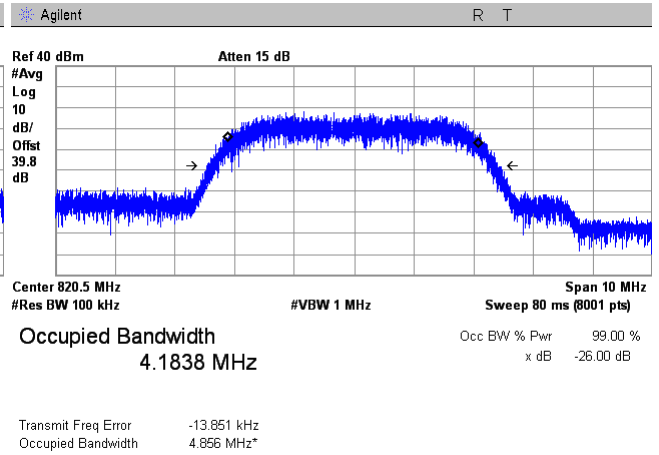
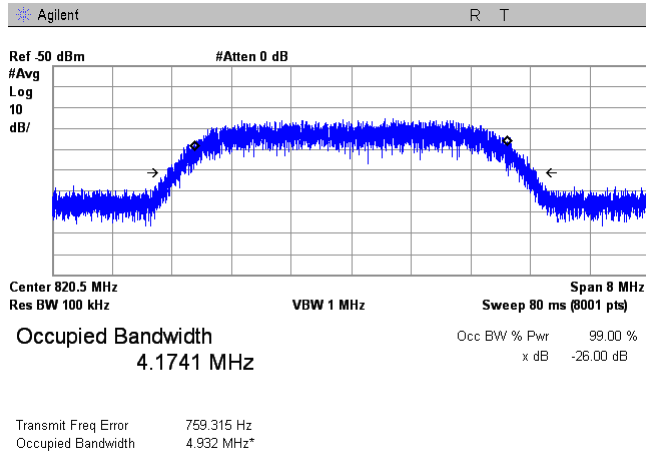
HERMON LABORATORIES

Test specification: Section 90.219(a), Occupied bandwidth for CMRS			
Test procedure: KDB 935210 D05 v01r01, section 3.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 23-Feb-16 - 29-Mar-16			
Temperature: 23.4 °C	Relative Humidity: 49 %	Air Pressure: 1019 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.4.3 Occupied bandwidth test result at mid frequency carrier, Port 2

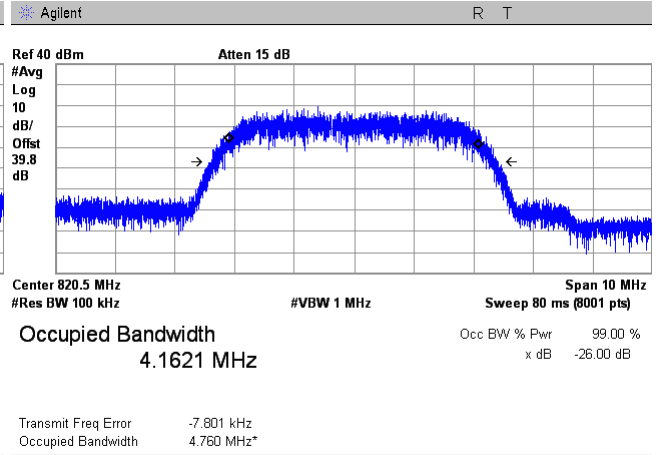
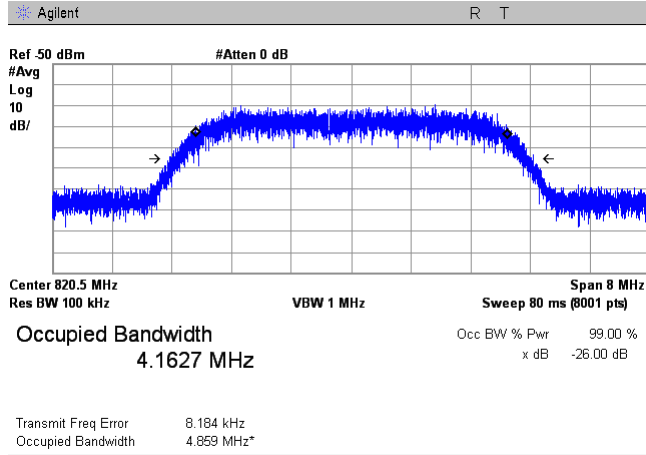
FREQUENCY RANGE:
OPERATIONAL MODE:
INPUT PORT:
CONFIGURATION:
INPUT SIGNAL: -69 dBm

817 - 824 MHz
AWGN uplink transmit
Mobile
Below AGC threshold
OUTPUT SIGNAL:



CONFIGURATION:
INPUT SIGNAL: -64 dBm

Above AGC threshold +3 dB
OUTPUT SIGNAL:





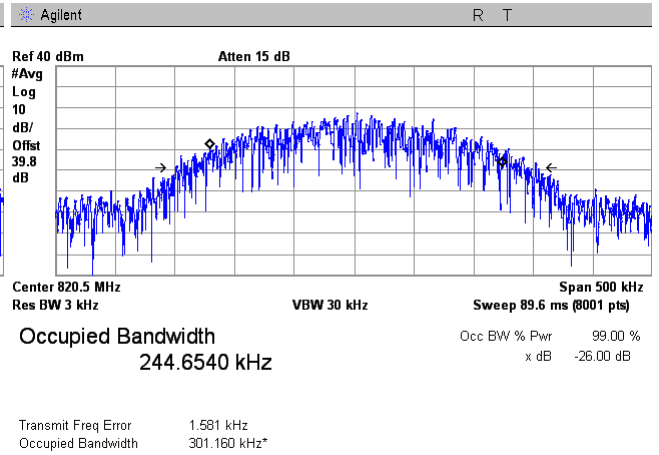
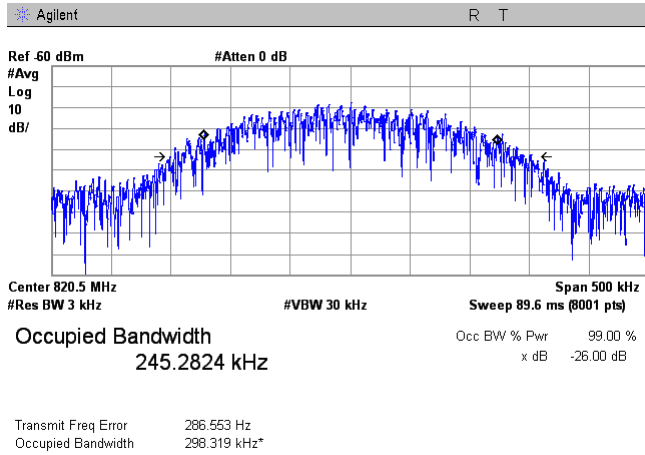
HERMON LABORATORIES

Test specification: Section 90.219(a), Occupied bandwidth for CMRS			
Test procedure: KDB 935210 D05 v01r01, section 3.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 23-Feb-16 - 29-Mar-16			
Temperature: 23.4 °C	Relative Humidity: 49 %	Air Pressure: 1019 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.4.4 Occupied bandwidth test result at mid frequency carrier, Port 2

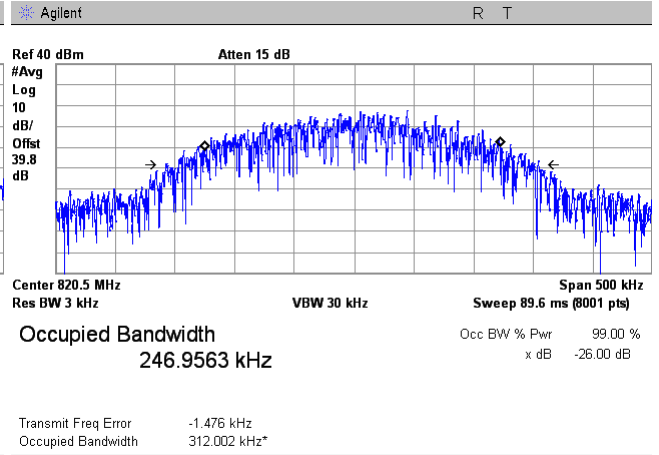
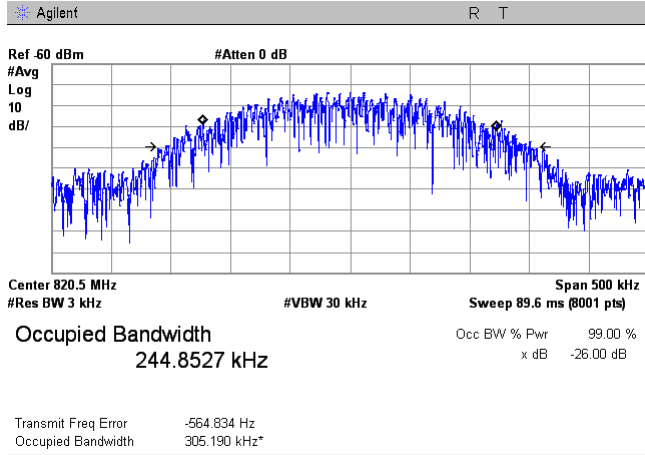
FREQUENCY RANGE:
OPERATIONAL MODE:
INPUT PORT:
CONFIGURATION:
INPUT SIGNAL: -69 dBm

817 - 824 MHz
GSM uplink transmit
Mobile
Below AGC threshold
OUTPUT SIGNAL:



CONFIGURATION:
INPUT SIGNAL: -64 dBm

Above AGC threshold +3 dB
OUTPUT SIGNAL:





Test specification: Section 90.210(b), Intermodulation product test			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01, section 3.6.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 04-Apr-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1007 hPa	Power supply: 120 VAC
Remarks:			

7.5 ERP intermodulation product test for CMRS

7.5.1 General

This test was performed to measure spurious emissions at RF antenna connector. Specification test limits are given in Table 7.5.1.

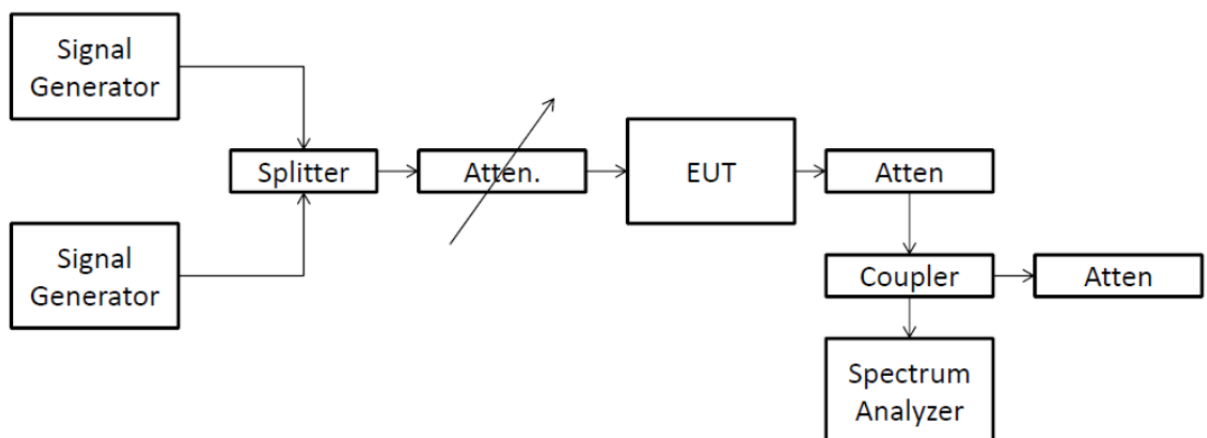
Table 7.5.1 ERP intermodulation product limits

Frequency, MHz	Attenuation below carrier, dBc	ERP Intermodulation product limit, dBm
862 – 869 / 817 - 824	43+10logP**	-13.0

7.5.2 Test procedure

- 7.5.2.1 The EUT was set up as shown in Figure 7.5.1, energized and its proper operation was checked.
- 7.5.2.1 Signal generator A was configured for CW operation at the f0 frequency of appropriate frequency band,
- 7.5.2.2 Signal generator B was configured for CW operation tuned available channel spacing (e.g. 25, 12.5 or 6.25 kHz) above the frequency f0 or below the frequency f0 of the same frequency band.
- 7.5.2.3 The generator amplitudes were set so that the power from each into RF combiner was equivalent.
- 7.5.2.4 The signal generator's amplitudes were increased equally until just below the EUT's AGC threshold level was reached and all intermodulation products were measured.
- 7.5.2.5 Signal generator B was varied in frequency to check if intermodulation products were produced.
- 7.5.2.6 The intermodulation products were measured with spectrum analyzer as provided in the associated plots.
- 7.5.2.7 The EUT was tested with the composite input power level was set to 3 dB above the AGC threshold level to show AGC operation, worst case results taken.
- 7.5.2.8 The test was repeated for all uplink and downlink operational bands. The test results are provided in Table 7.5.2 and the associated plots.

Figure 7.5.1 ERP intermodulation product test setup





Test specification: Section 90.210(b), Intermodulation product test			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01, section 3.6.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 04-Apr-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1007 hPa	Power supply: 120 VAC
Remarks:			

Table 7.5.2 ERP intermodulation product test results

ASSIGNED FREQUENCY RANGE: 862 – 869 MHz Downlink
817 – 824 MHz Uplink
DETECTOR USED: Average
VIDEO BANDWIDTH: ≥ Resolution bandwidth
MODULATING SIGNAL: PRBS

CONFIGURATION: Two signals
MODULATION: AWGN/GSM

Frequency, MHz	SA reading below AGC, dBm	SA reading above AGC, dBm	RBW, kHz	Spurious emission, dBm	Limit, dBm	Margin, dB*	Verdict
Downlink							
Lower band edge							
861.826	-22.23	NA	100	-22.23	-13.0	-9.23	Pass
861.954	NA	-14.99	100	-14.99	-13.0	-1.99	Pass
Upper band edge							
869.131	-19.48	NA	100	-19.48	-13.0	-6.48	Pass
869.050	NA	-14.35	100	-14.35	-13.0	-1.35	Pass
Uplink							
Lower band edge							
816.999	-15.93	NA	100	-15.93	-13.0	-2.93	Pass
816.999	NA	-16.36	100	-16.36	-13.0	-3.36	Pass
Upper band edge							
824.001	-18.64	NA	100	-18.64	-13.0	-5.64	Pass
824.001	NA	-18.87	100	-18.87	-13.0	-5.87	Pass

CONFIGURATION: Two signals
MODULATION: GSM/GSM

Frequency, MHz	SA reading below AGC, dBm	SA reading above AGC, dBm	RBW, kHz	Spurious emission, dBm	Limit, dBm	Margin, dB*	Verdict
Downlink							
Lower band edge							
861.995	-18.14	NA	3	-18.14	-13.0	-5.14	Pass
861.997	NA	-15.43	3	-15.43	-13.0	-2.43	Pass
Upper band edge							
869.000	-18.12	NA	3	-18.12	-13.0	-5.12	Pass
869.000	NA	-18.73	3	-18.73	-13.0	-5.73	Pass
Uplink							
Lower band edge							
817.000	-18.28	NA	3	-18.28	-13.0	-5.28	Pass
816.999	NA	-17.3	3	-17.30	-13.0	-4.30	Pass
Upper band edge							
824.000	-17.83	NA	3	-17.83	-13.0	-4.83	Pass
824.000	NA	-18.20	3	-18.2	-13.0	-5.20	Pass

*- Margin = Spurious emission – specification limit.

Reference numbers of test equipment used

HL 2015	HL 2909	HL 3433	HL 3434	HL 3787	HL 3788	HL 4273	HL 4274
HL 4068	HL 4097	HL 4354	HL 4413				

Full description is given in Appendix A.



HERMON LABORATORIES

Test specification: Section 90.210(b), Intermodulation product test			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01, section 3.6.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 04-Apr-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1007 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.5.1 Intermodulation test results in the 862 - 869 MHz frequency range, Lower band edge

OPERATING FREQUENCY RANGE:

862 – 869 MHz

DETECTOR USED:

Average

CONFIGURATION:

Downlink

MODULATION:

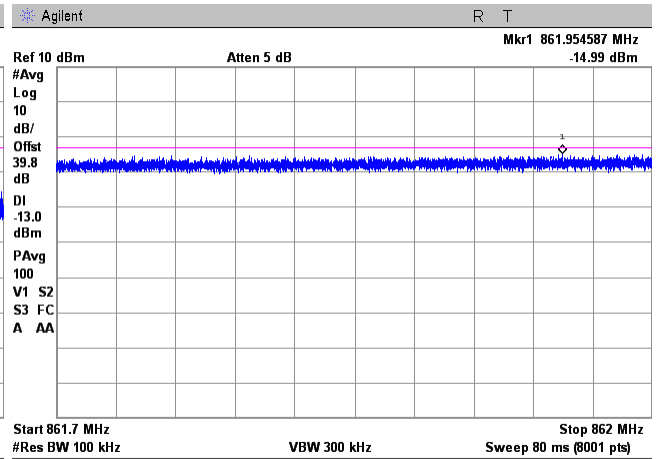
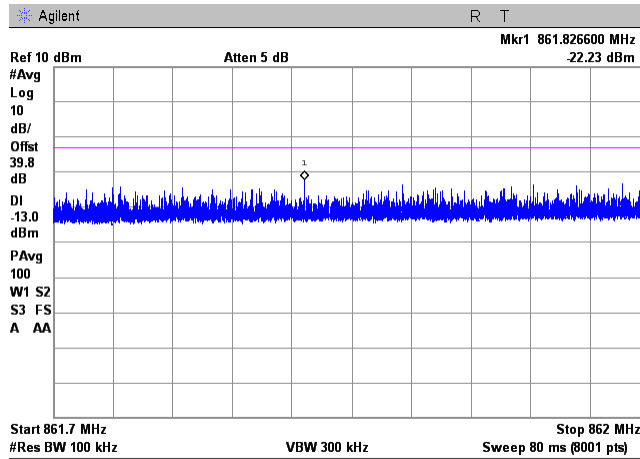
AWGN/GSM

COMPOSITE INPUT SIGNAL:

-56 dBm

CONFIGURATION: Below AGC threshold

CONFIGURATION: Above AGC threshold +3dB

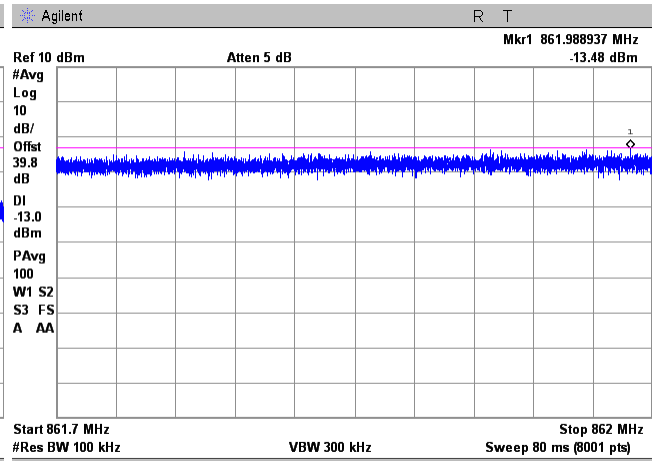
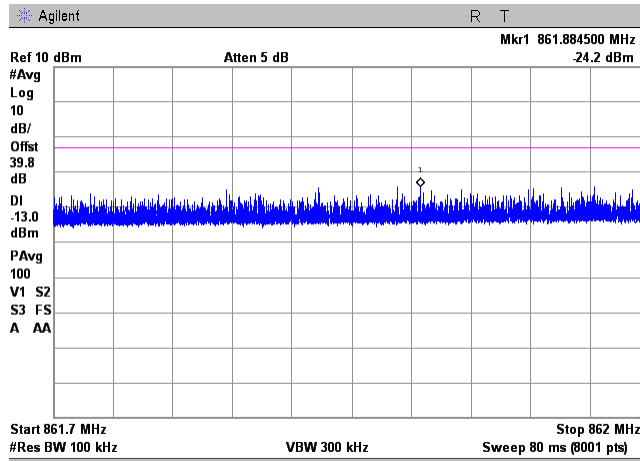


SINGLE TEST SIGNAL INPUT:

-56 dBm

CONFIGURATION: Below AGC threshold

CONFIGURATION: Above AGC threshold +3dB





HERMON LABORATORIES

Test specification: Section 90.210(b), Intermodulation product test			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01, section 3.6.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 04-Apr-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1007 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.5.2 Intermodulation test results in the 862 - 869 MHz frequency range, Upper band edge

OPERATING FREQUENCY RANGE:

862 – 869 MHz

DETECTOR USED:

Average

CONFIGURATION:

Downlink

MODULATION:

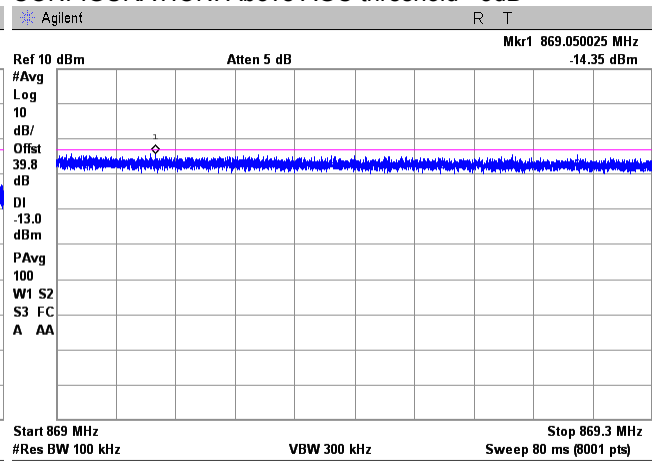
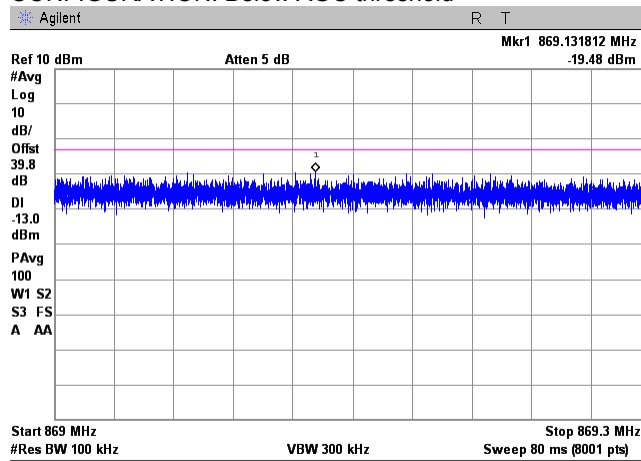
AWGN/GSM

COMPOSITE INPUT SIGNAL:

-56 dBm

CONFIGURATION: Below AGC threshold

CONFIGURATION: Above AGC threshold +3dB

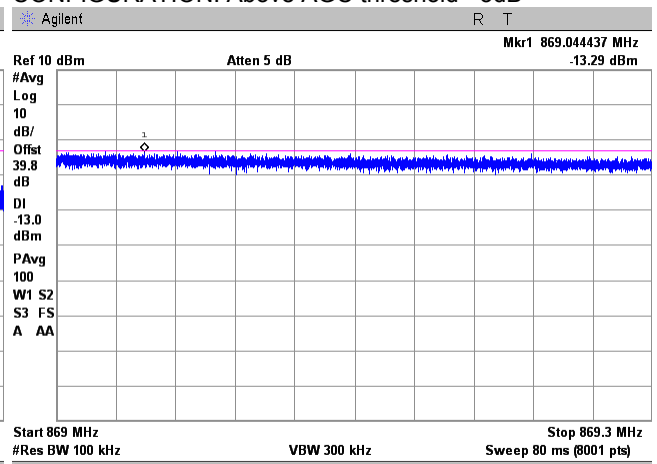
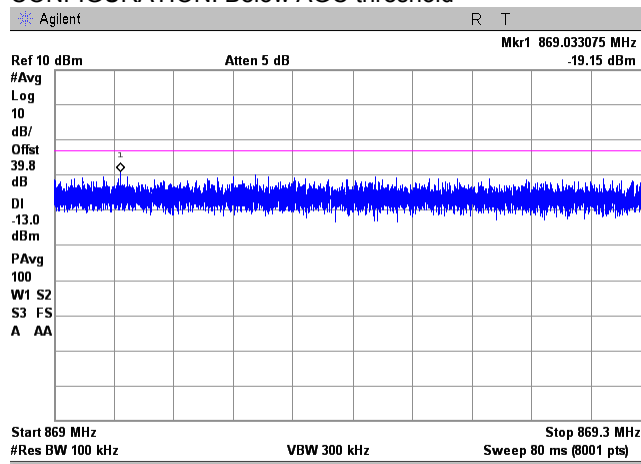


SINGLE TEST SIGNAL INPUT:

-56 dBm

CONFIGURATION: Below AGC threshold

CONFIGURATION: Above AGC threshold +3dB





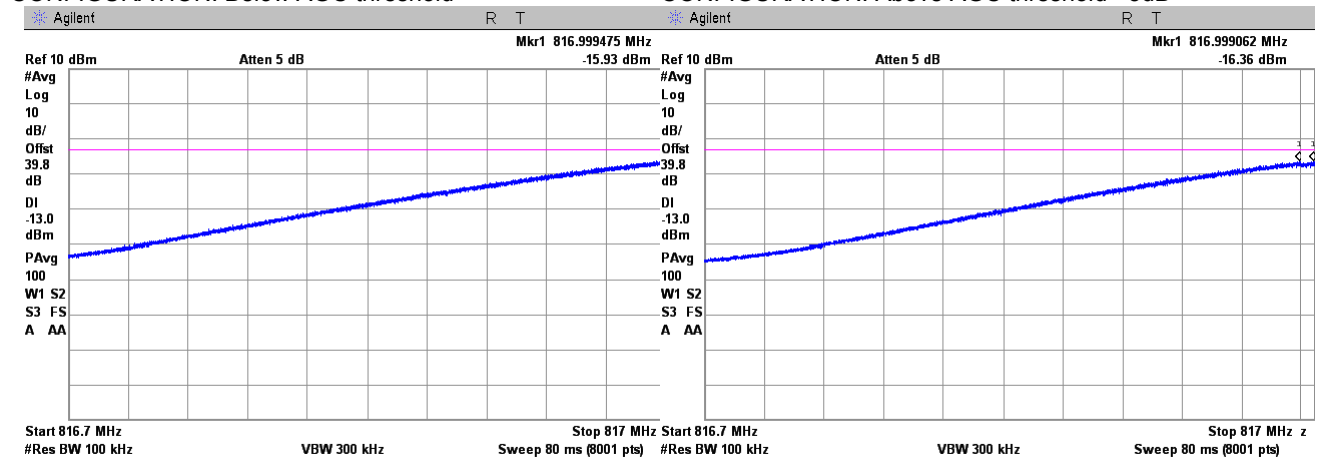
HERMON LABORATORIES

Test specification: Section 90.210(b), Intermodulation product test			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01, section 3.6.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 04-Apr-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1007 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.5.3 Intermodulation test results in the 817 - 824 MHz frequency range, Lower band edge

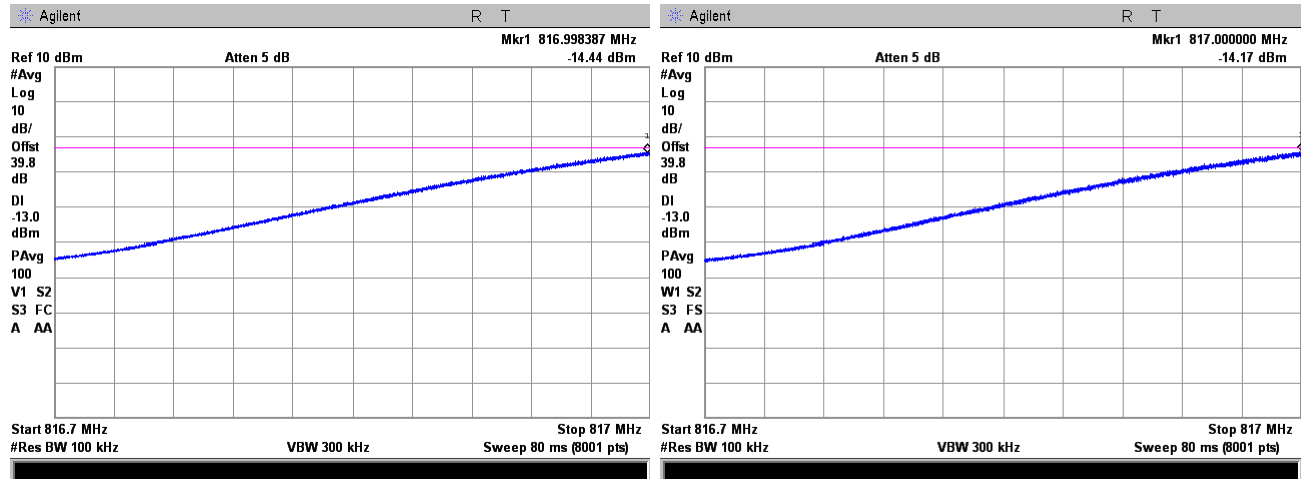
OPERATING FREQUENCY RANGE: 817 – 824 MHz
DETECTOR USED: Average
CONFIGURATION: Uplink
MODULATION: AWGN/GSM
COMPOSITE INPUT SIGNAL: -56 dBm
CONFIGURATION: Below AGC threshold

817 – 824 MHz
Average
Uplink
AWGN/GSM
-56 dBm
CONFIGURATION: Above AGC threshold +3dB



SINGLE TEST SIGNAL INPUT: -56 dBm
CONFIGURATION: Below AGC threshold

-56 dBm
CONFIGURATION: Above AGC threshold +3dB





HERMON LABORATORIES

Test specification: Section 90.210(b), Intermodulation product test			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01, section 3.6.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 04-Apr-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1007 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.5.4 Intermodulation test results in the 817 - 824 MHz frequency range, Upper band edge

OPERATING FREQUENCY RANGE:

817 – 824 MHz

DETECTOR USED:

Average

CONFIGURATION:

Uplink

MODULATION:

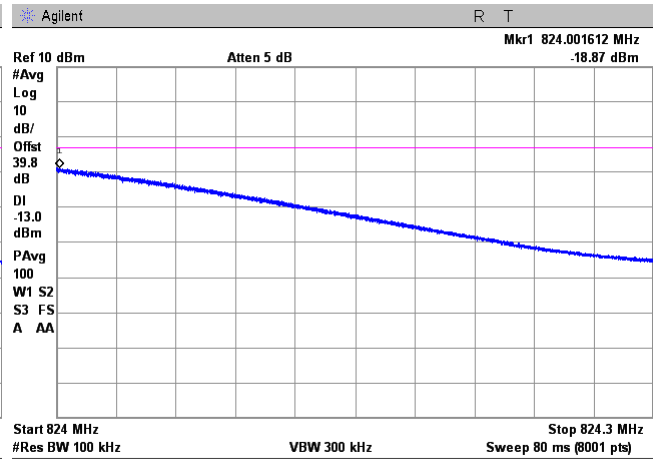
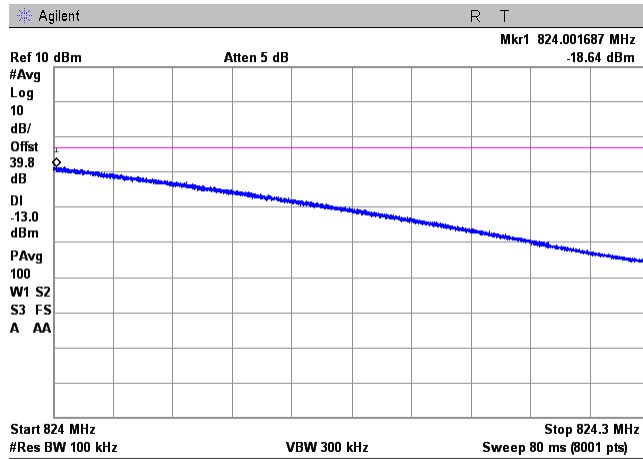
AWGN/GSM

COMPOSITE INPUT SIGNAL:

-56 dBm

CONFIGURATION: Below AGC threshold

CONFIGURATION: Above AGC threshold +3dB

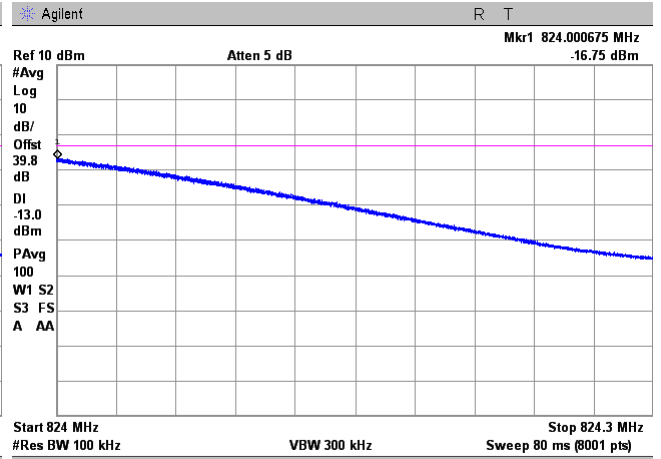
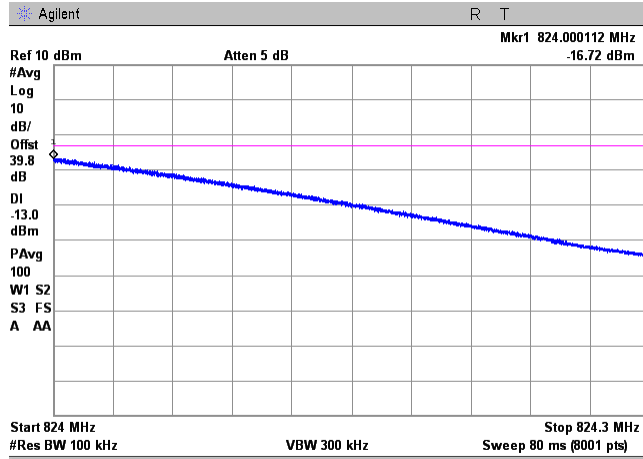


SINGLE TEST SIGNAL INPUT:

-56 dBm

CONFIGURATION: Below AGC threshold

CONFIGURATION: Above AGC threshold +3dB





HERMON LABORATORIES

Test specification: Section 90.210(b), Intermodulation product test			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01, section 3.6.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 04-Apr-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1007 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.5.5 Intermodulation test results in the 862 - 869 MHz frequency range, Lower band edge

OPERATING FREQUENCY RANGE:

862 – 869 MHz

DETECTOR USED:

Average

CONFIGURATION:

Downlink

MODULATION:

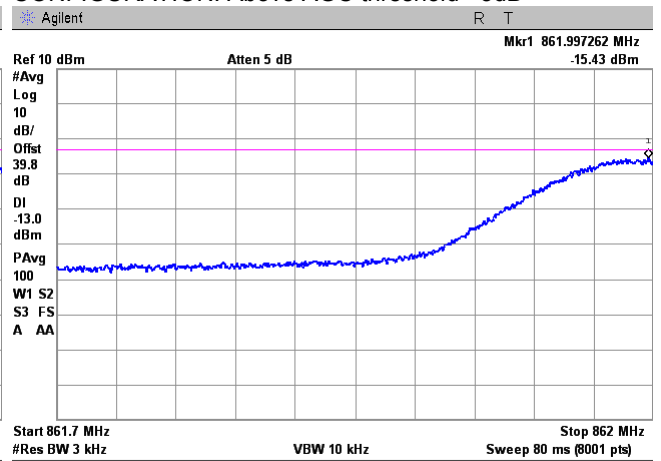
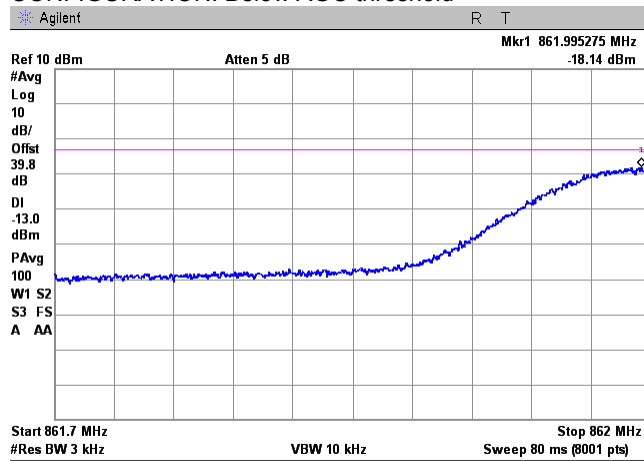
GSM/GSM

COMPOSITE INPUT SIGNAL:

-56 dBm

CONFIGURATION: Below AGC threshold

CONFIGURATION: Above AGC threshold +3dB

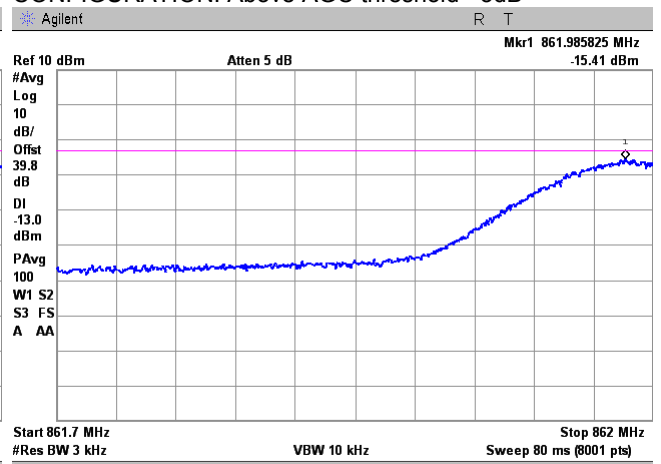
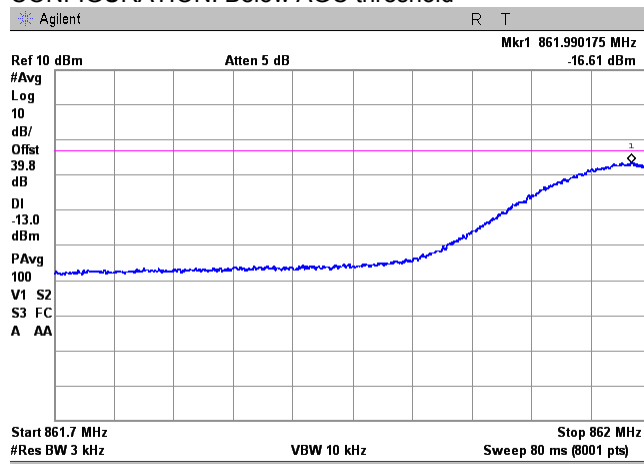


SINGLE TEST SIGNAL INPUT:

-56 dBm

CONFIGURATION: Below AGC threshold

CONFIGURATION: Above AGC threshold +3dB





HERMON LABORATORIES

Test specification: Section 90.210(b), Intermodulation product test			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01, section 3.6.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 04-Apr-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1007 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.5.6 Intermodulation test results in the 862 - 869 MHz frequency range, Upper band edge

OPERATING FREQUENCY RANGE:

862 – 869 MHz

DETECTOR USED:

Average

CONFIGURATION:

Downlink

MODULATION:

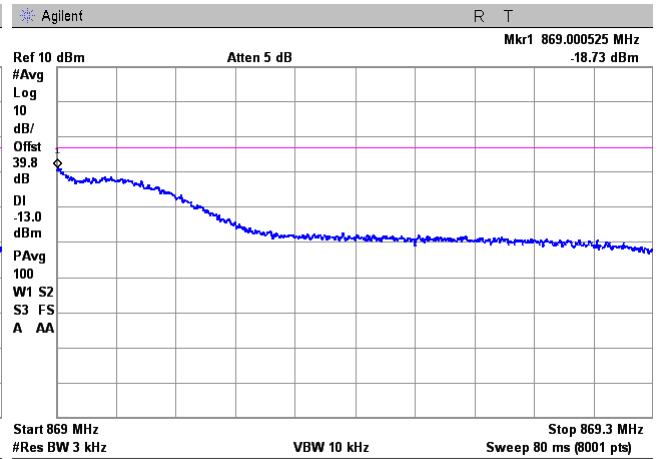
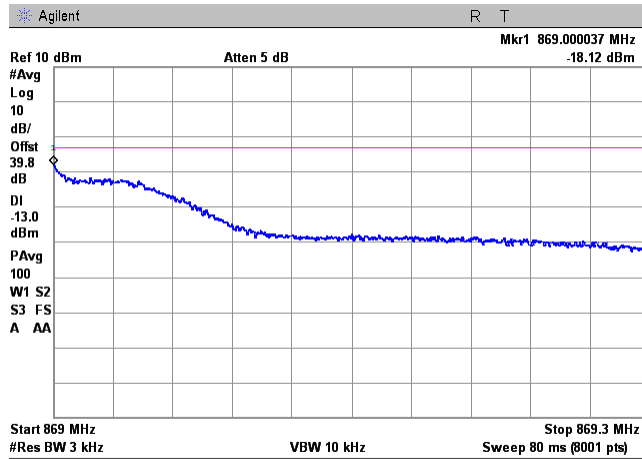
GSM/GSM

COMPOSITE INPUT SIGNAL:

-56 dBm

CONFIGURATION: Below AGC threshold

CONFIGURATION: Above AGC threshold +3dB

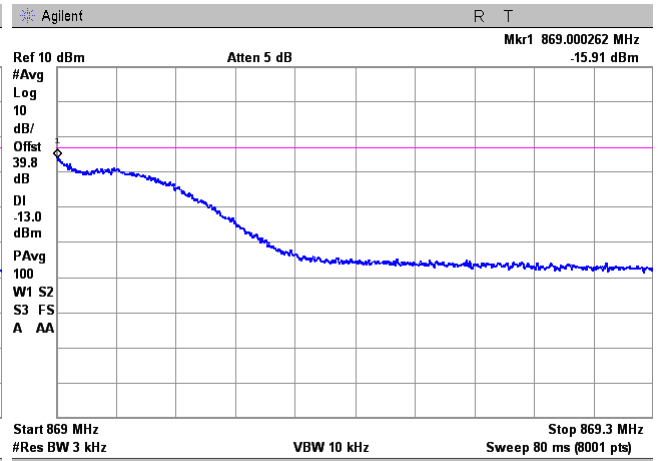
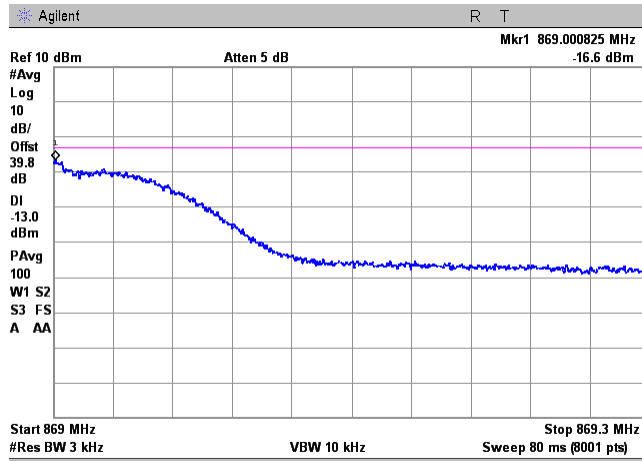


SINGLE TEST SIGNAL INPUT:

-56 dBm

CONFIGURATION: Below AGC threshold

CONFIGURATION: Above AGC threshold +3dB





HERMON LABORATORIES

Test specification: Section 90.210(b), Intermodulation product test			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01, section 3.6.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 04-Apr-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1007 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.5.7 Intermodulation test results in the 817 - 824 MHz frequency range, Lower band edge

OPERATING FREQUENCY RANGE:

817 – 824 MHz

DETECTOR USED:

Average

CONFIGURATION:

Uplink

MODULATION:

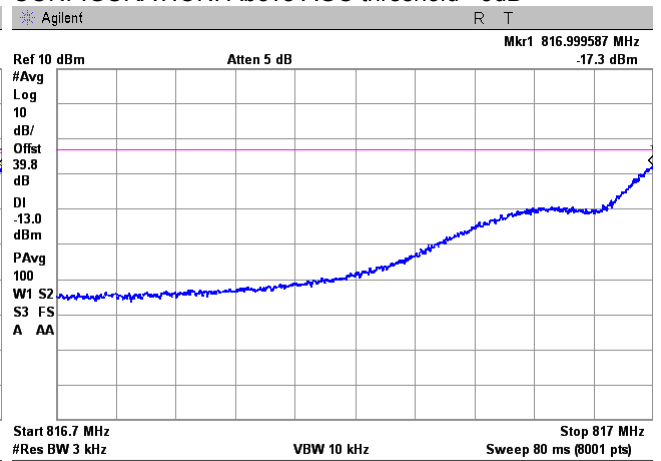
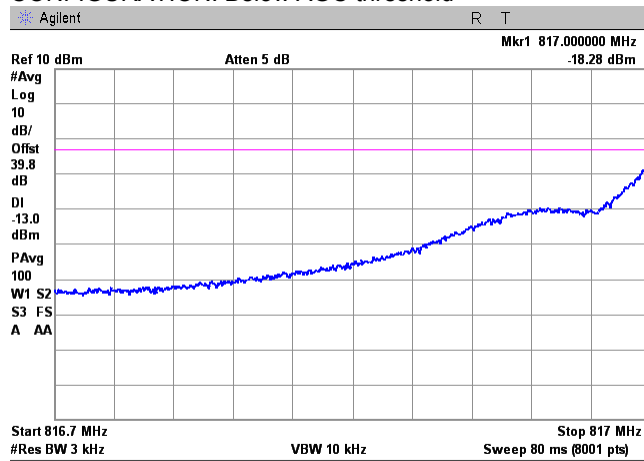
GSM/GSM

COMPOSITE INPUT SIGNAL:

-69 dBm

CONFIGURATION: Below AGC threshold

CONFIGURATION: Above AGC threshold +3dB

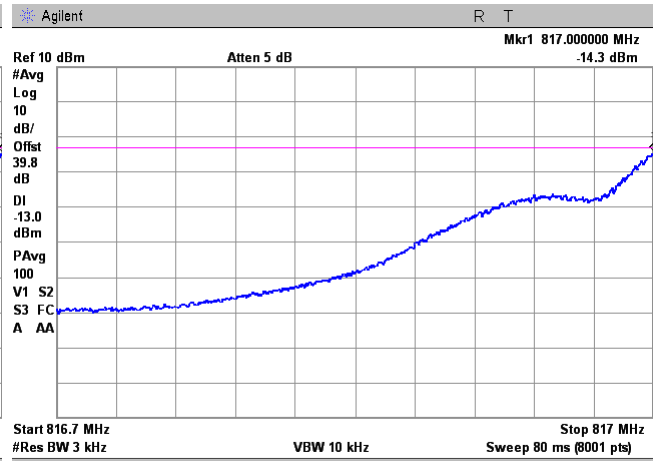
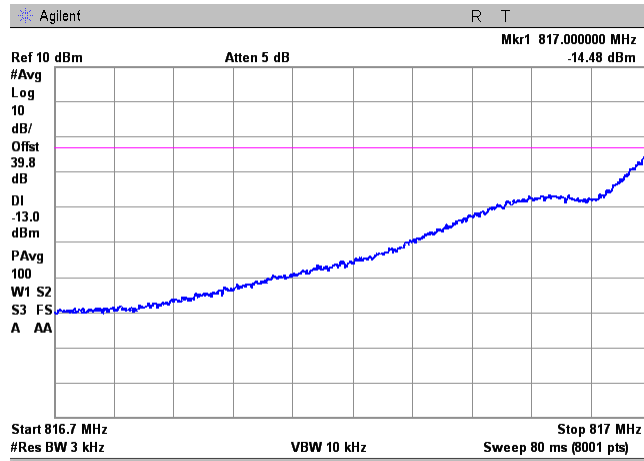


SINGLE TEST SIGNAL INPUT:

-69 dBm

CONFIGURATION: Below AGC threshold

CONFIGURATION: Above AGC threshold +3dB





HERMON LABORATORIES

Test specification: Section 90.210(b), Intermodulation product test			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01, section 3.6.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 04-Apr-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1007 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.5.8 Intermodulation test results in the 817 - 824 MHz frequency range, Upper band edge

OPERATING FREQUENCY RANGE:

817 – 824 MHz

DETECTOR USED:

Average

CONFIGURATION:

Uplink

MODULATION:

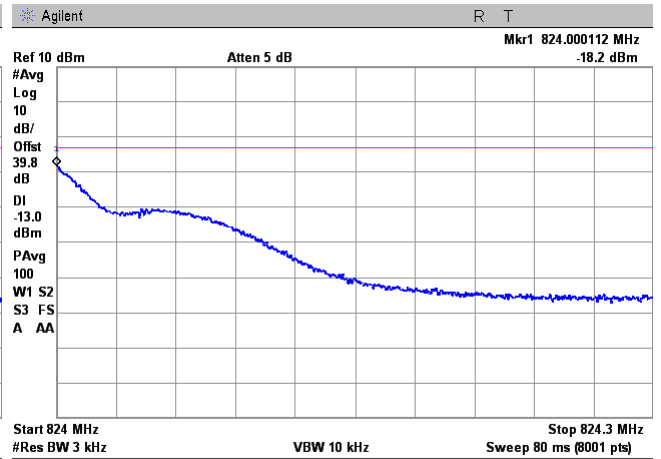
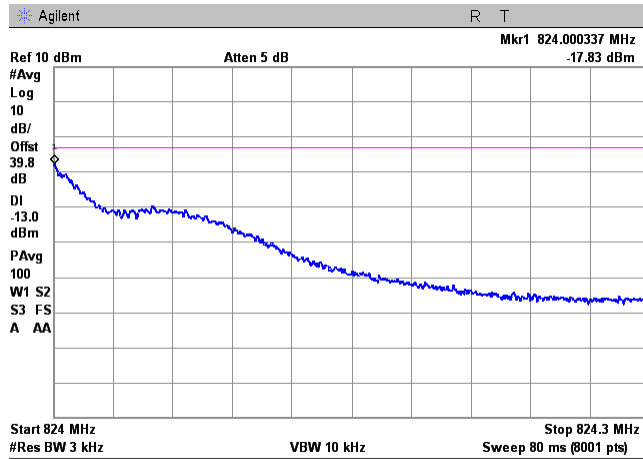
GSM/GSM

COMPOSITE INPUT SIGNAL:

-69 dBm

CONFIGURATION: Below AGC threshold

CONFIGURATION: Above AGC threshold +3dB

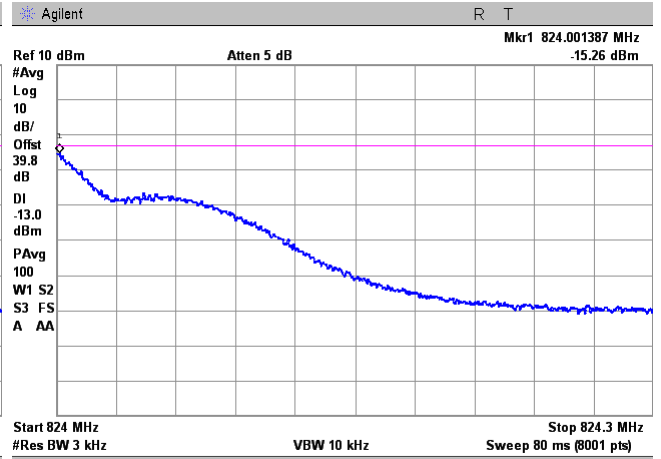
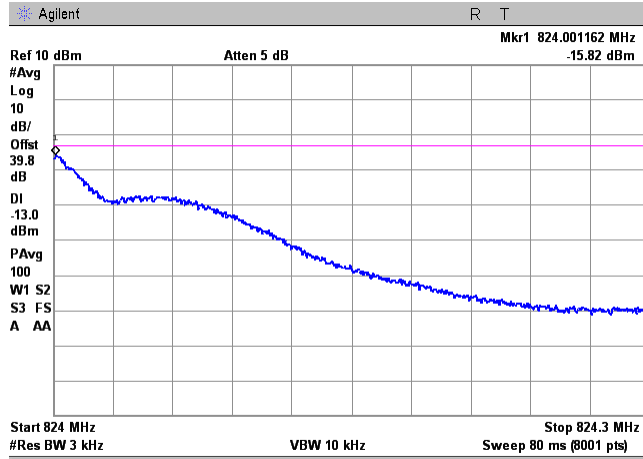


SINGLE TEST SIGNAL INPUT:

-69 dBm

CONFIGURATION: Below AGC threshold

CONFIGURATION: Above AGC threshold +3dB





Test specification: Section 90.219(e)(3), Radiated spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1053; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 29-Mar-16			
Temperature: 22.4 °C	Relative Humidity: 47 %	Air Pressure: 1015 hPa	Power supply: 120 VAC
Remarks:			

7.6 Radiated spurious emission measurements for CMRS

7.6.1 General

This test was performed to measure radiated spurious emissions from the EUT. Specification test limits are given in Table 7.6.1.

Table 7.6.1 Radiated spurious emission test limits

Frequency, MHz	Attenuation below carrier, dBc	ERP of spurious, dBm	Equivalent field strength limit @ 3m, dB(μV/m)***
0.009 – 10 th harmonic*	43+10logP**	-13	84.4

* - Excluding the in band emission within ± 250 % of the authorized bandwidth from the carrier

** - P is transmitter output power in Watts

*** - Equivalent field strength limit was calculated from maximum allowed ERP of spurious as follows: $E = \sqrt{30 \times P \times 1.64} / r$, where P is ERP in Watts, 1.64 is numeric gain of ideal dipole and r is antenna to EUT distance in meters

7.6.2 Test procedure for spurious emission field strength measurements in 9 kHz to 30 MHz band

7.6.2.1 The EUT was set up as shown in Figure 7.6.1, energized and the performance check was conducted.

7.6.2.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360° and the measuring antenna was rotated around its vertical axis.

7.6.2.3 The worst test results (the lowest margins) were recorded in Table 7.6.2 and shown in the associated plots.

7.6.3 Test procedure for spurious emission field strength measurements above 30 MHz

7.6.3.1 The EUT was set up as shown in Figure 7.6.2, energized and the performance check was conducted.

7.6.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360° and the measuring antenna height was swept from 1 to 4 m in both, vertical and horizontal, polarizations.

7.6.3.3 The worst test results (the lowest margins) were recorded in Table 7.6.2 and shown in the associated plots..



Test specification: Section 90.219(e)(3), Radiated spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1053; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 29-Mar-16			
Temperature: 22.4 °C	Relative Humidity: 47 %	Air Pressure: 1015 hPa	Power supply: 120 VAC
Remarks:			

Figure 7.6.1 Setup for spurious emission field strength measurements in 9 kHz to 30 MHz band

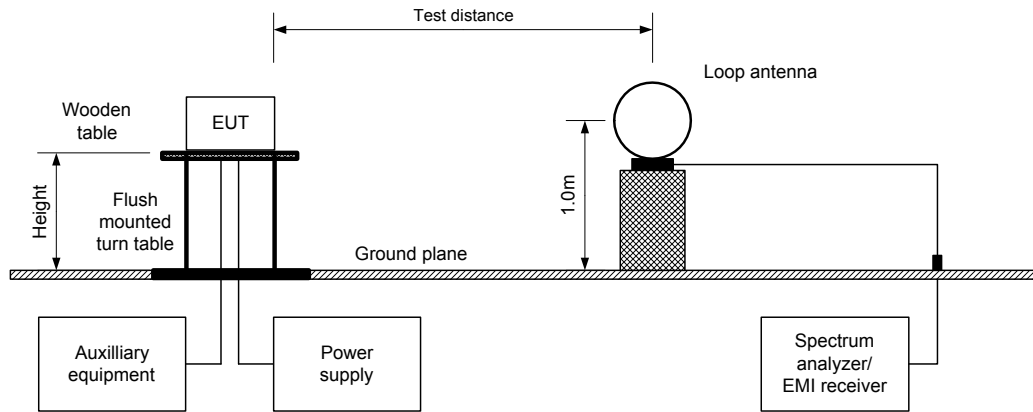
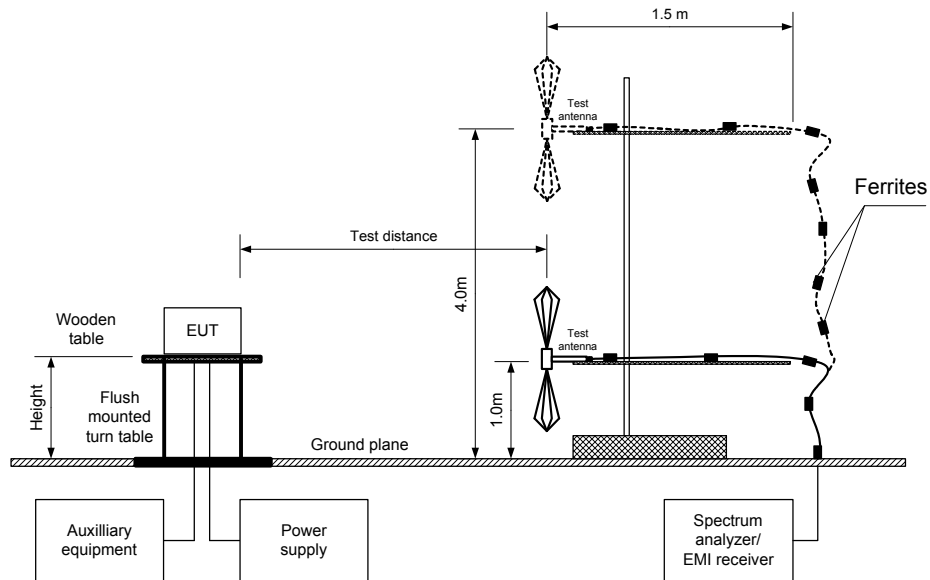


Figure 7.6.2 Setup for spurious emission field strength measurements above 30 MHz





Test specification: Section 90.219(e)(3), Radiated spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1053; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 29-Mar-16			
Temperature: 22.4 °C	Relative Humidity: 47 %	Air Pressure: 1015 hPa	Power supply: 120 VAC
Remarks:			

Table 7.6.2 Spurious emission field strength test results

ASSIGNED FREQUENCY RANGE: 862 – 869 MHz Downlink
817 – 824 MHz Uplink

TEST DISTANCE: 3 m

TEST SITE: Semi anechoic chamber

EUT HEIGHT: 0.8 m

INVESTIGATED FREQUENCY RANGE: 0.009 – 8700 MHz

DETECTOR USED: Peak

VIDEO BANDWIDTH: > Resolution bandwidth

TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
Biconilog (30 MHz – 1000 MHz)
Double ridged guide (above 1000 MHz)

MODULATION: Unmodulated

Frequency, MHz	Field strength, dB(µV/m)	Limit, dB(µV/m)	Margin, dB*	RBW, kHz	Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
Downlink								
Low carrier frequency 862.0 MHz								
All emissions were found more than 20dB below limit								Pass
Mid carrier frequency 865.5 MHz								
All emissions were found more than 20dB below limit								Pass
High carrier frequency 869.0 MHz								
All emissions were found more than 20dB below limit								Pass
Uplink								
Low carrier frequency 817.0 MHz								
All emissions were found more than 20dB below limit								Pass
Mid carrier frequency 820.5 MHz								
All emissions were found more than 20dB below limit								Pass
High carrier frequency 824.0 MHz								
All emissions were found more than 20dB below limit								Pass

*- Margin = Field strength of spurious – calculated field strength limit.

** - EUT front panel refers to 0 degrees position of turntable.

Reference numbers of test equipment used

HL 0446	HL 0521	HL 0557	HL 0604	HL 2909	HL 3622	HL 3623	HL 4276
HL 4278	HL 4353	HL 4722	HL 4933				

Full description is given in Appendix A.



HERMON LABORATORIES

Test specification: Section 90.219(e)(3), Radiated spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1053; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 29-Mar-16			
Temperature: 22.4 °C	Relative Humidity: 47 %	Air Pressure: 1015 hPa	Power supply: 120 VAC
Remarks:			

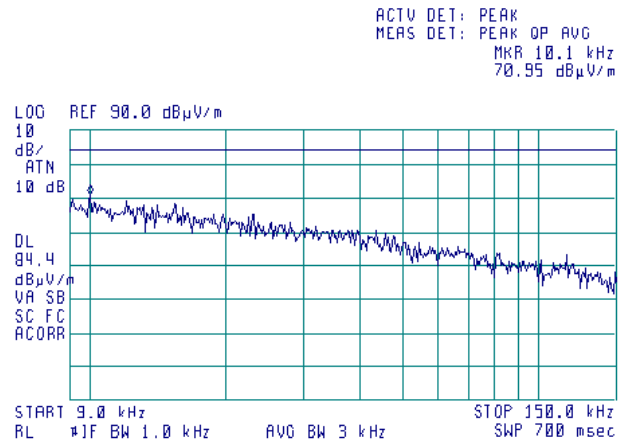
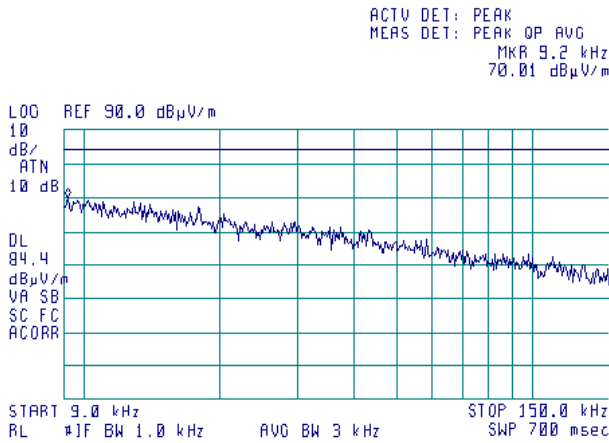
Plot 7.6.1 Radiated emission measurements in 9 - 150 kHz range

TEST SITE:
ASSIGNED FREQUENCY RANGES:

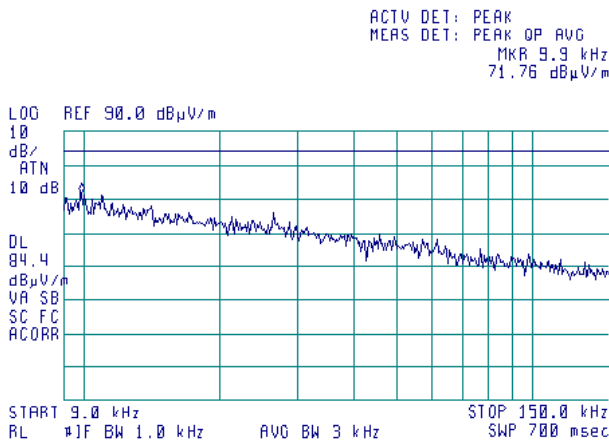
Semi anechoic chamber
862 – 869 MHz Downlink
817 – 824 MHz Uplink

ANTENNA POLARIZATION:
TEST DISTANCE:
CONFIGURATION:
CARRIER FREQUENCY: Low

Vertical and Horizontal
3 m
CW
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





HERMON LABORATORIES

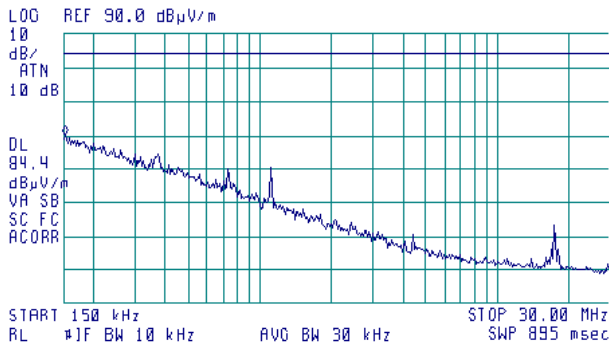
Test specification: Section 90.219(e)(3), Radiated spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1053; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 29-Mar-16			
Temperature: 22.4 °C	Relative Humidity: 47 %	Air Pressure: 1015 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.6.2 Radiated emission measurements in 0.15 - 30 MHz range

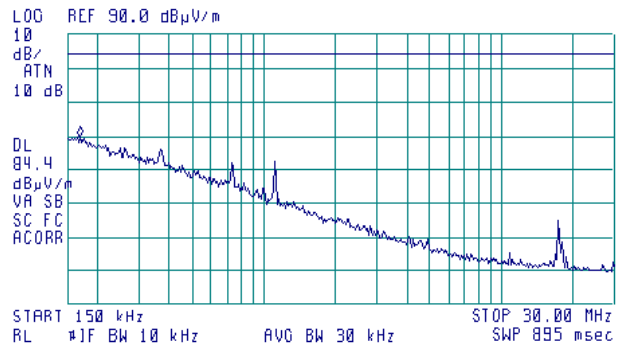
TEST SITE:	Semi anechoic chamber
ASSIGNED FREQUENCY RANGES:	862 – 869 MHz Downlink 817 – 824 MHz Uplink
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m
CONFIGURATION:	CW
CARRIER FREQUENCY: Low	CARRIER FREQUENCY: Mid



ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 150 kHz
60.02 dBµV/m



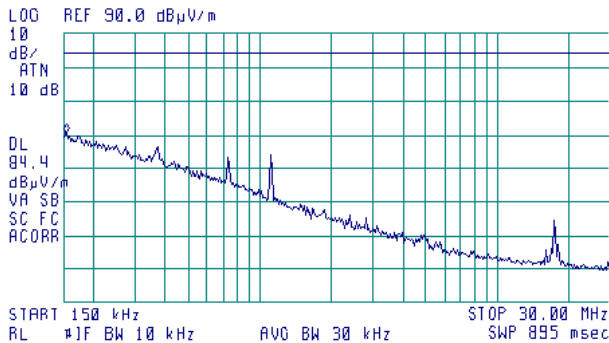
ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 170 kHz
59.65 dBµV/m



CARRIER FREQUENCY: High



ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 150 kHz
60.55 dBµV/m



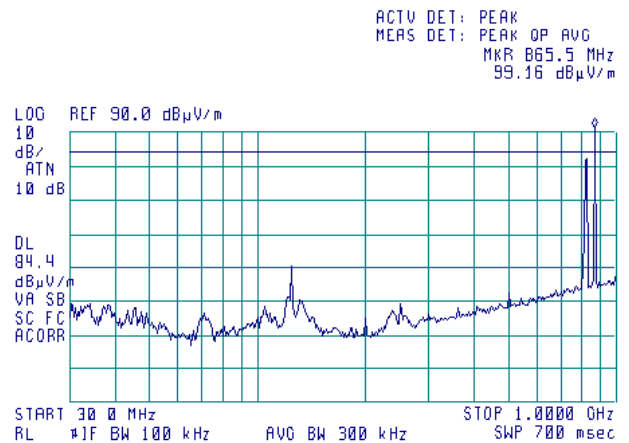
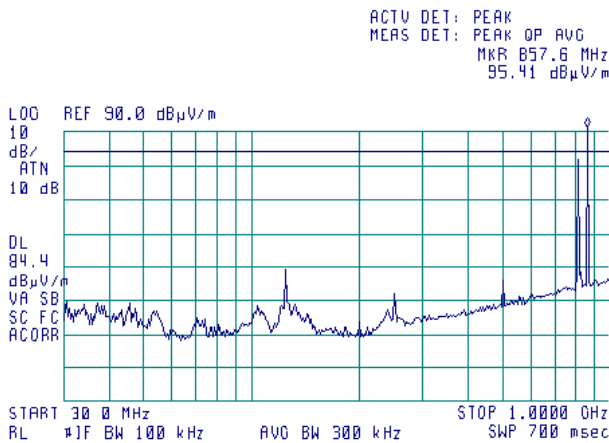


HERMON LABORATORIES

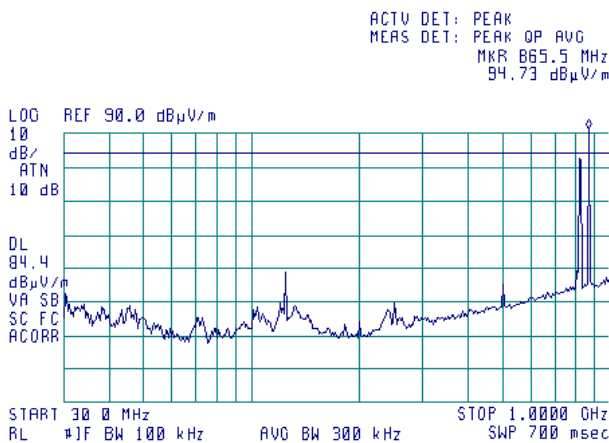
Test specification: Section 90.219(e)(3), Radiated spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1053; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 29-Mar-16			
Temperature: 22.4 °C	Relative Humidity: 47 %	Air Pressure: 1015 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.6.3 Radiated emission measurements in 30 - 1000 MHz range

TEST SITE:	Semi anechoic chamber
ASSIGNED FREQUENCY RANGES:	862 – 869 MHz Downlink 817 – 824 MHz Uplink
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m
CONFIGURATION:	CW
CARRIER FREQUENCY: Low	CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High



862/865.5/869 MHz – Downlink frequencies; 817/820.5/824 MHz – Uplink frequencies



HERMON LABORATORIES

Test specification: Section 90.219(e)(3), Radiated spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1053; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 29-Mar-16			
Temperature: 22.4 °C	Relative Humidity: 47 %	Air Pressure: 1015 hPa	Power supply: 120 VAC
Remarks:			

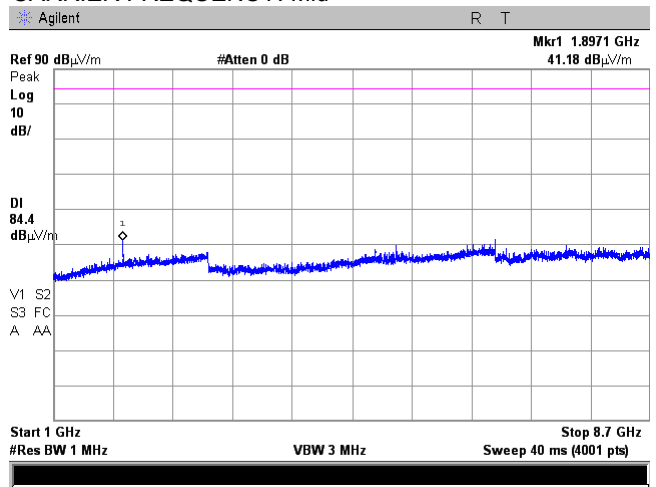
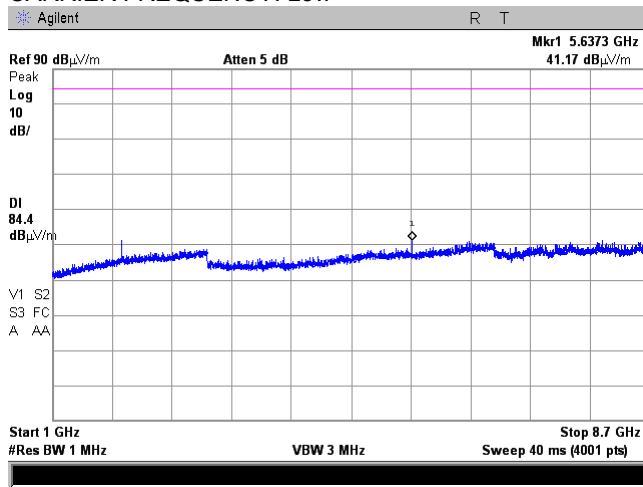
Plot 7.6.4 Radiated emission measurements in 1000 – 8700 MHz range

TEST SITE:
ASSIGNED FREQUENCY RANGES:

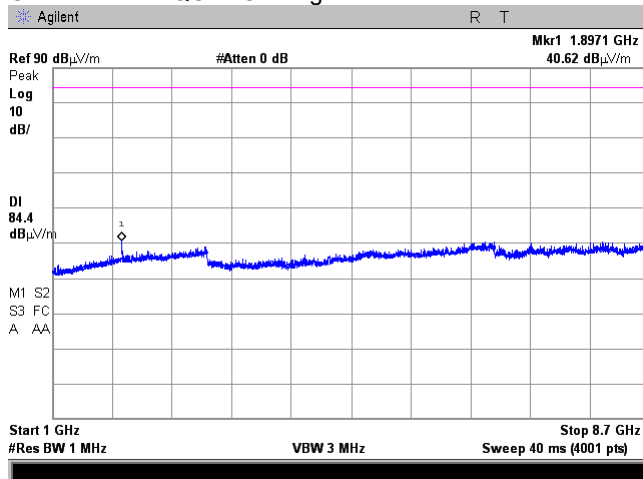
Semi anechoic chamber
862 – 869 MHz Downlink
817 – 824 MHz Uplink

ANTENNA POLARIZATION:
TEST DISTANCE:
CONFIGURATION:
CARRIER FREQUENCY: Low

Vertical and Horizontal
3 m
CW
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





Test specification: Section 90.219(e)(3), Conducted spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 24-Mar-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1005 hPa	Power supply: 120 VAC
Remarks:			

7.7 Spurious emissions at RF antenna connector test for CMRS

7.7.1 General

This test was performed to measure spurious emissions at RF antenna connector. Specification test limits are given in Table 7.7.1.

Table 7.7.1 Spurious emission limits

Frequency, MHz	Attenuation below carrier, dBc	ERP of spurious, dBm
0.009 – 10th harmonic*	43+10logP**	-13.0

* - spurious emission limits do not apply to the in band emission within ± 250 % of the authorized bandwidth from the carrier; investigated in course of emission mask testing

** - P is transmitter output power in Watts

7.7.2 Test procedure

7.7.2.1 The EUT was set up as shown in Figure 7.7.1, energized and its proper operation was checked.

7.7.2.2 The EUT was adjusted to produce maximum available for end user RF output power.

7.7.2.3 The spurious emission was measured with spectrum analyzer as provided in Table 7.7.2 and the associated plots.

Figure 7.7.1 Spurious emission test setup





HERMON LABORATORIES

Test specification: Section 90.219(e)(3), Conducted spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 24-Mar-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1005 hPa	Power supply: 120 VAC
Remarks:			

Table 7.7.2 Spurious emission test results

ASSIGNED FREQUENCY RANGE: 862 – 869 MHz
817 – 824 MHz
INVESTIGATED FREQUENCY RANGE: 0.009 – 8700 MHz
DETECTOR USED: Peak
VIDEO BANDWIDTH: ≥ Resolution bandwidth
MODULATING SIGNAL: PRBS
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

MODULATION: AWGN

Frequency, MHz	SA reading, dBm	Attenuator, dB	Cable loss, dB	RBW, kHz		Spurious emission, dBm	Limit, dBm	Margin, dB*	Verdict
Downlink									
Low carrier frequency									
All emissions were found more than 20 dB below limit									Pass
Mid carrier frequency									
All emissions were found more than 20 dB below limit									Pass
High carrier frequency									
All emissions were found more than 20 dB below limit									Pass
Uplink									
Low carrier frequency									
All emissions were found more than 20 dB below limit									Pass
Mid carrier frequency									
All emissions were found more than 20 dB below limit									Pass
High carrier frequency									
All emissions were found more than 20 dB below limit									Pass

MODULATION: GSM

Frequency, MHz	SA reading, dBm	Attenuator, dB	Cable loss, dB	RBW, kHz		Spurious emission, dBm	Limit, dBm	Margin, dB*	Verdict
Downlink									
Low carrier frequency									
831.35	-29.94	Included	Included	100		-29.94	-13.0	-16.94	Pass
Mid carrier frequency									
854.75	-29.19	Included	Included	100		-29.19	-13.0	-16.19	Pass
High carrier frequency									
858.10	-30.62	Included	Included	100		-30.62	-13.0	-17.62	Pass
Uplink									
Low carrier frequency									
All emissions were found more than 20 dB below limit									Pass
Mid carrier frequency									
All emissions were found more than 20 dB below limit									Pass
High carrier frequency									
All emissions were found more than 20 dB below limit									Pass

*- Margin = Spurious emission – specification limit.

Reference numbers of test equipment used

HL 2015	HL 2909	HL 3433	HL 3434	HL 3787	HL 3788	HL 4273	HL 4274
HL 4068	HL 4097	HL 4354	HL 4413				

Full description is given in Appendix A.



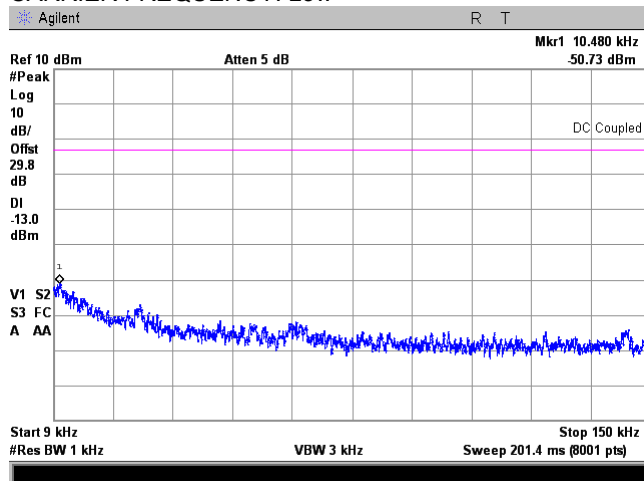
HERMON LABORATORIES

Test specification: Section 90.219(e)(3), Conducted spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 24-Mar-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1005 hPa	Power supply: 120 VAC
Remarks:			

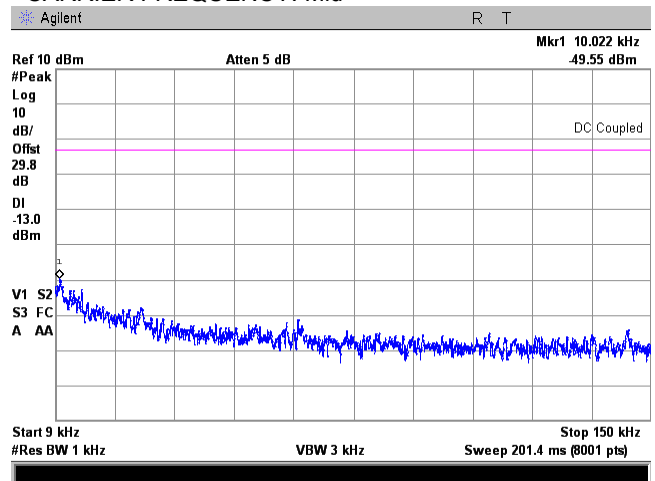
Plot 7.7.1 Spurious emission measurements in 9 - 150 kHz range at carrier frequency

FREQUENCY RANGE: 862 – 869 MHz
 OPERATIONAL MODE: AWGN downlink transmit
 INPUT PORT: Base
 CONFIGURATION: Below AGC level
 INPUT POWER: -56 dBm

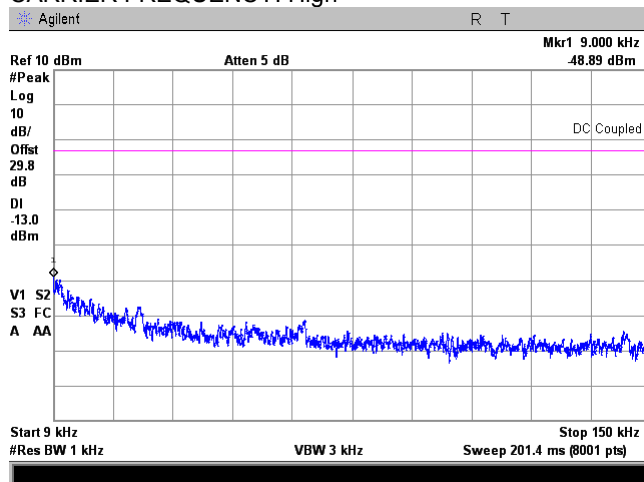
CARRIER FREQUENCY: Low



CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





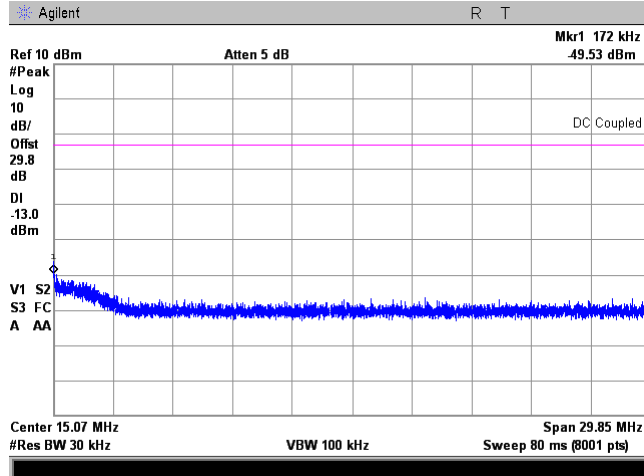
HERMON LABORATORIES

Test specification: Section 90.219(e)(3), Conducted spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 24-Mar-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1005 hPa	Power supply: 120 VAC
Remarks:			

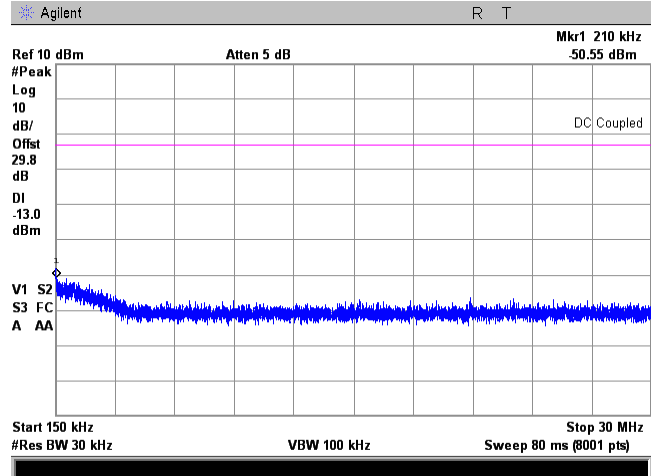
Plot 7.7.2 Spurious emission measurements in 0.15 - 30.0 MHz range at low carrier frequency

FREQUENCY RANGE: 862 – 869 MHz
 OPERATIONAL MODE: AWGN downlink transmit
 INPUT PORT: Base
 CONFIGURATION: Below AGC level
 INPUT POWER: -56 dBm

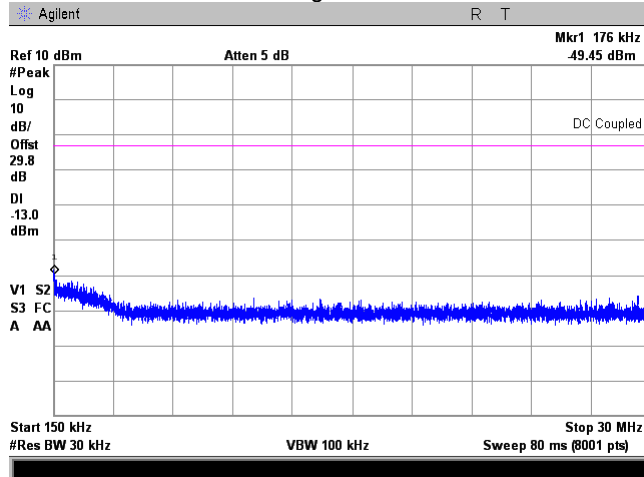
CARRIER FREQUENCY: Low



CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





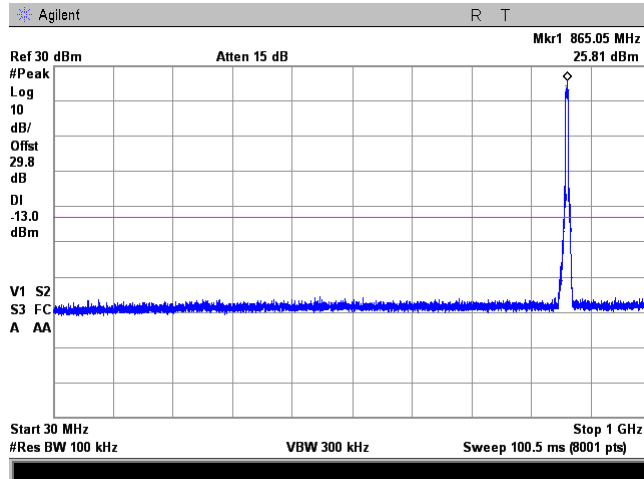
HERMON LABORATORIES

Test specification: Section 90.219(e)(3), Conducted spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 24-Mar-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1005 hPa	Power supply: 120 VAC
Remarks:			

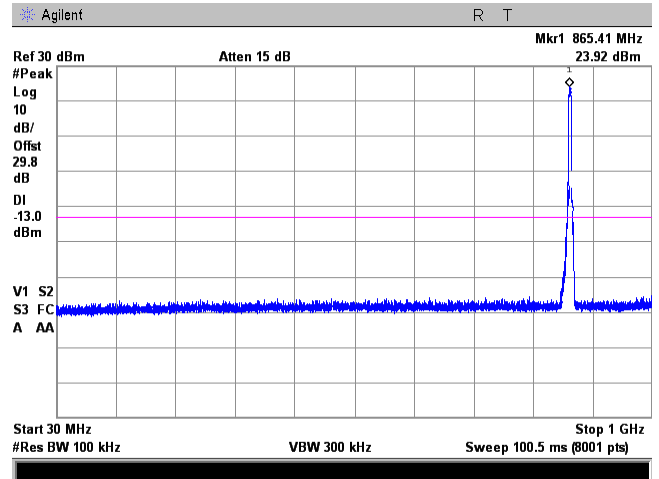
Plot 7.7.3 Spurious emission measurements in 30.0 - 1000 MHz range at low carrier frequency

FREQUENCY RANGE: 862 – 869 MHz
 OPERATIONAL MODE: AWGN downlink transmit
 INPUT PORT: Base
 CONFIGURATION: Below AGC level
 INPUT POWER: -56 dBm

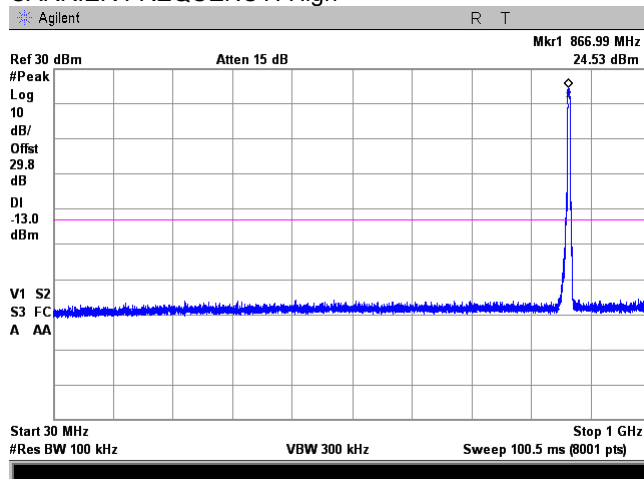
CARRIER FREQUENCY: Low



CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





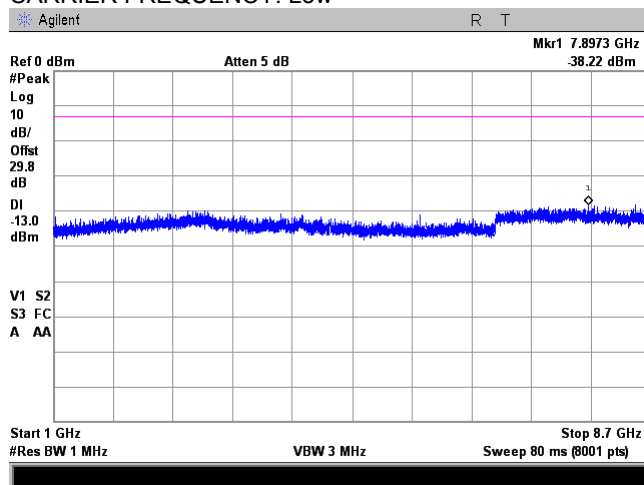
HERMON LABORATORIES

Test specification: Section 90.219(e)(3), Conducted spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 24-Mar-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1005 hPa	Power supply: 120 VAC
Remarks:			

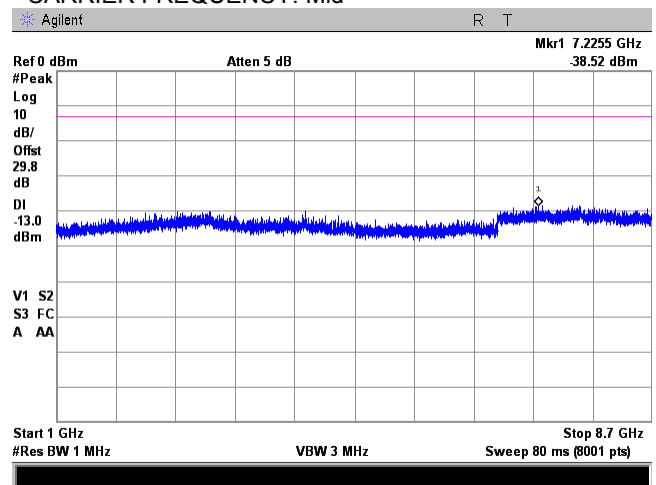
Plot 7.7.4 Spurious emission measurements in 1000 - 8700 MHz range at low carrier frequency

FREQUENCY RANGE: 862 – 869 MHz
 OPERATIONAL MODE: AWGN downlink transmit
 INPUT PORT: Base
 CONFIGURATION: Below AGC level
 INPUT POWER: -56 dBm

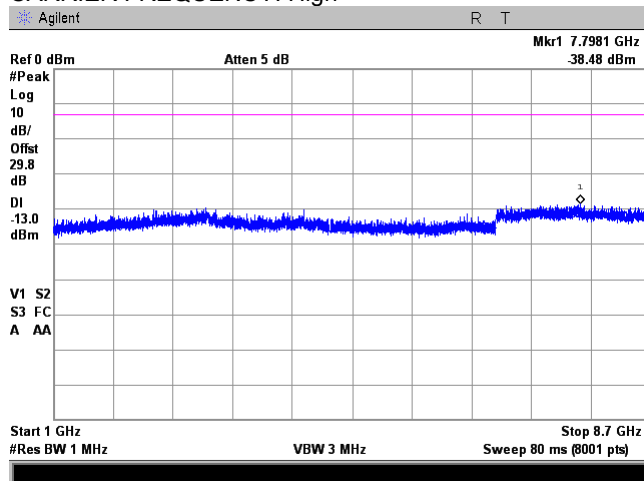
CARRIER FREQUENCY: Low



CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





HERMON LABORATORIES

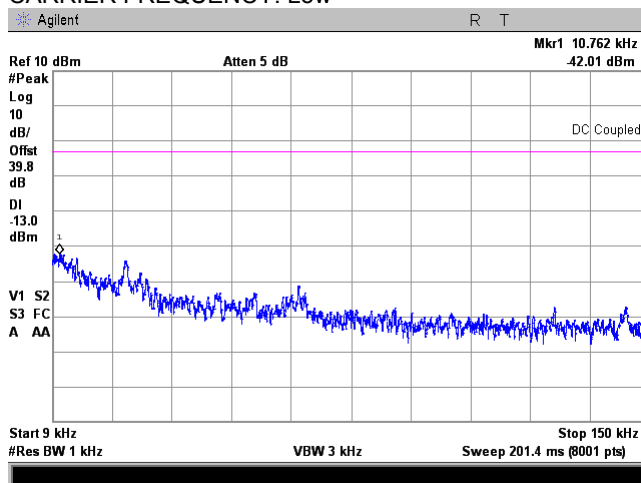
Test specification: Section 90.219(e)(3), Conducted spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 24-Mar-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1005 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.7.5 Spurious emission measurements in 9 - 150 kHz range at low carrier frequency

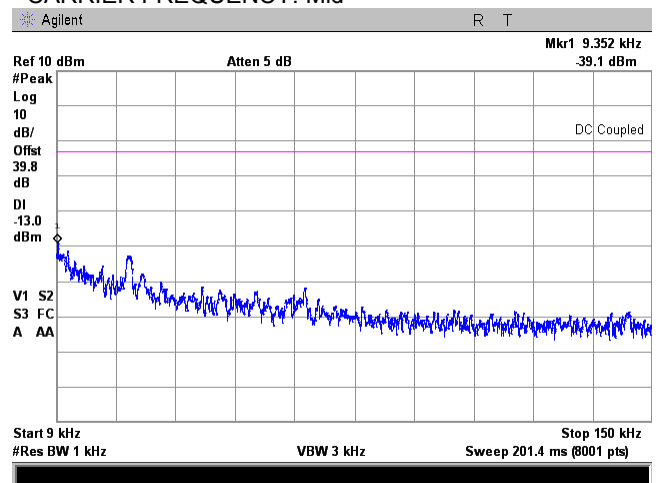
FREQUENCY RANGE:
OPERATIONAL MODE:
INPUT PORT:
CONFIGURATION:
INPUT POWER:

862 – 869 MHz
GSM downlink transmit
Base
Below AGC level
-56 dBm

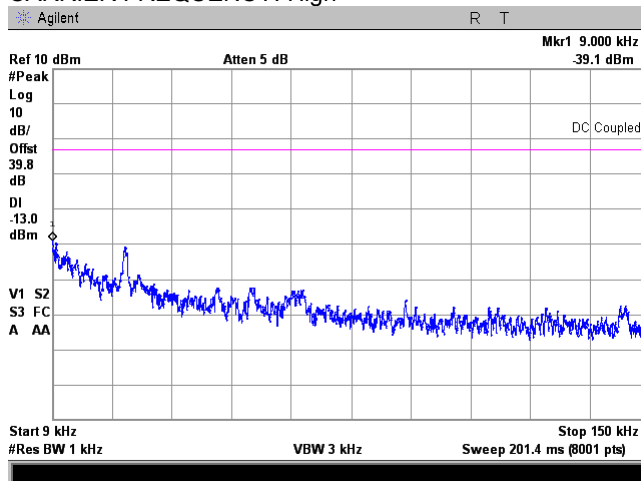
CARRIER FREQUENCY: Low



CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





HERMON LABORATORIES

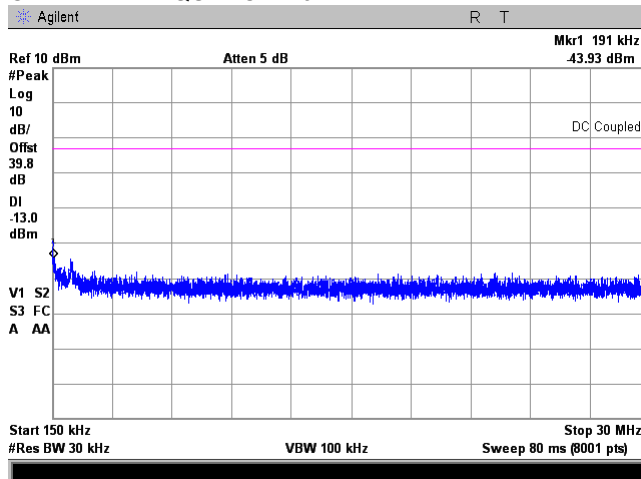
Test specification: Section 90.219(e)(3), Conducted spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 24-Mar-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1005 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.7.6 Spurious emission measurements in 0.15 - 30.0 MHz range at low carrier frequency

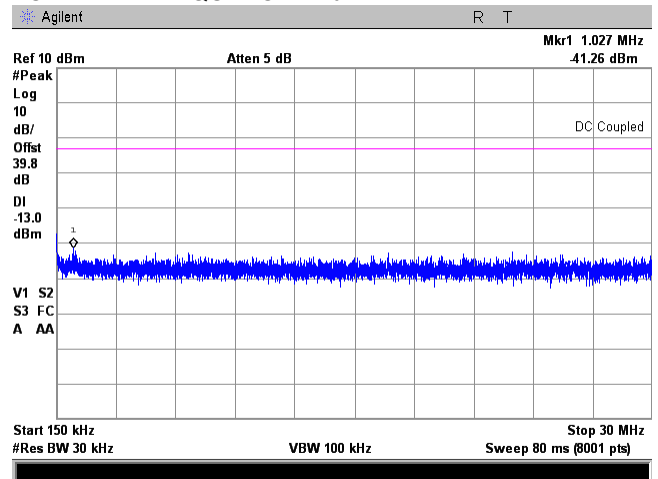
FREQUENCY RANGE:
OPERATIONAL MODE:
INPUT PORT:
CONFIGURATION:
INPUT POWER:

862 – 869 MHz
GSM downlink transmit
Base
Below AGC level
-56 dBm

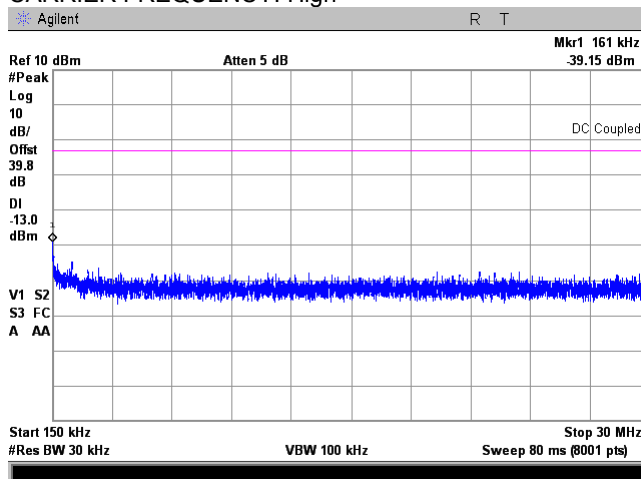
CARRIER FREQUENCY: Low



CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





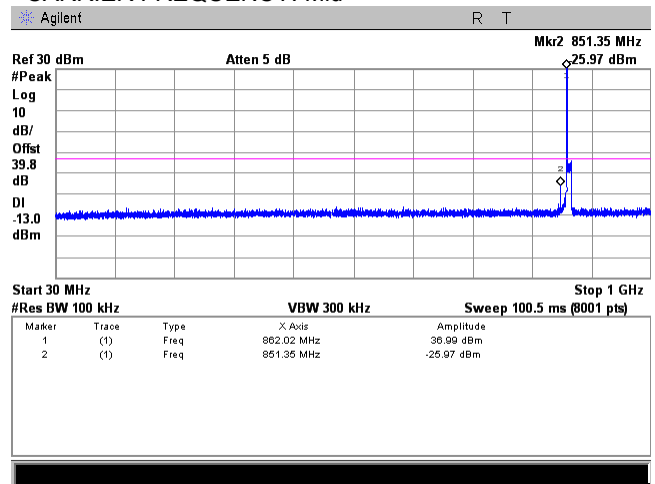
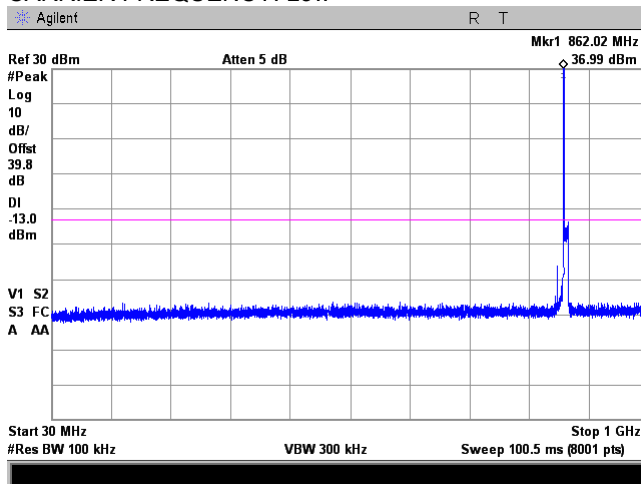
HERMON LABORATORIES

Test specification: Section 90.219(e)(3), Conducted spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 24-Mar-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1005 hPa	Power supply: 120 VAC
Remarks:			

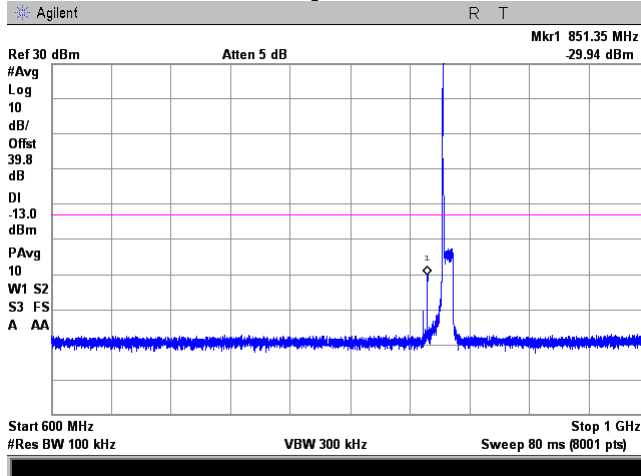
Plot 7.7.7 Spurious emission measurements in 30.0 - 1000 MHz range at low carrier frequency

FREQUENCY RANGE:
OPERATIONAL MODE:
INPUT PORT:
CONFIGURATION:
INPUT POWER:
CARRIER FREQUENCY: Low

862 – 869 MHz
GSM downlink transmit
Base
Below AGC level
-56 dBm
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





HERMON LABORATORIES

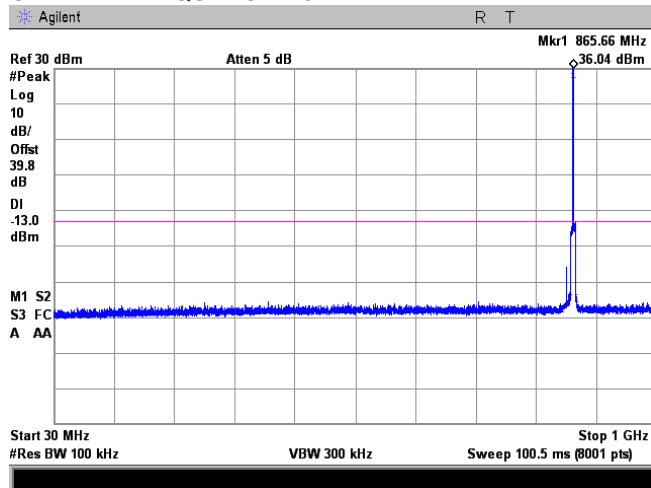
Test specification: Section 90.219(e)(3), Conducted spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 24-Mar-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1005 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.7.8 Spurious emission measurements in 30.0 - 1000 MHz range at mid carrier frequency

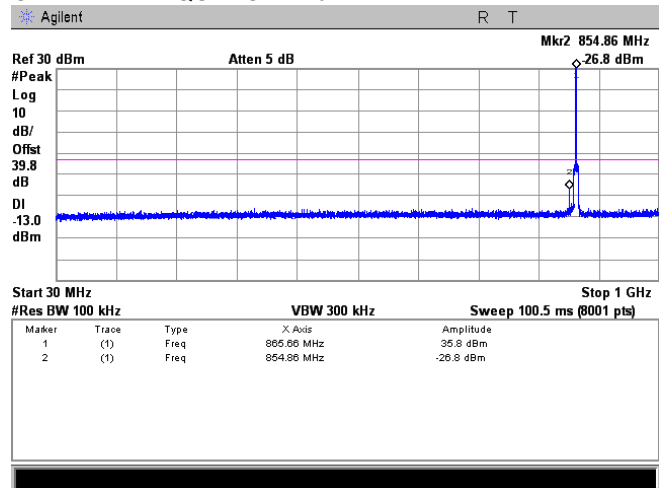
FREQUENCY RANGE:
OPERATIONAL MODE:
INPUT PORT:
CONFIGURATION:
INPUT POWER:

862 – 869 MHz
GSM downlink transmit
Base
Below AGC level
-56 dBm

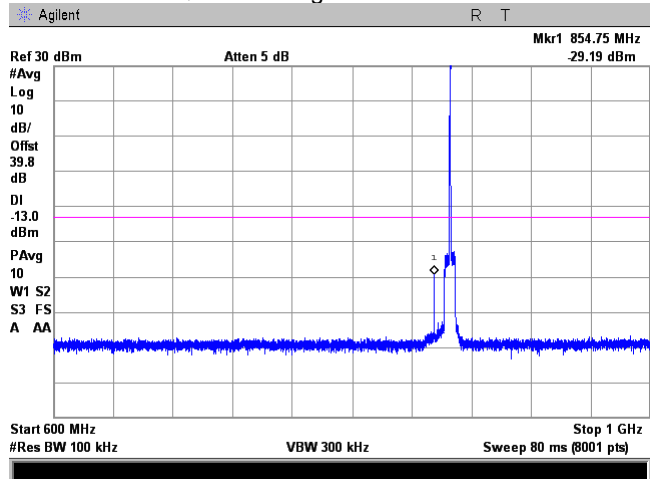
CARRIER FREQUENCY: Low



CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





HERMON LABORATORIES

Test specification: Section 90.219(e)(3), Conducted spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 24-Mar-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1005 hPa	Power supply: 120 VAC
Remarks:			

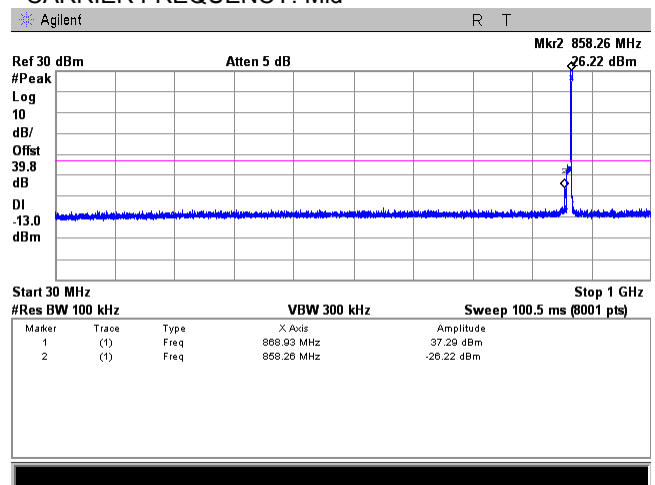
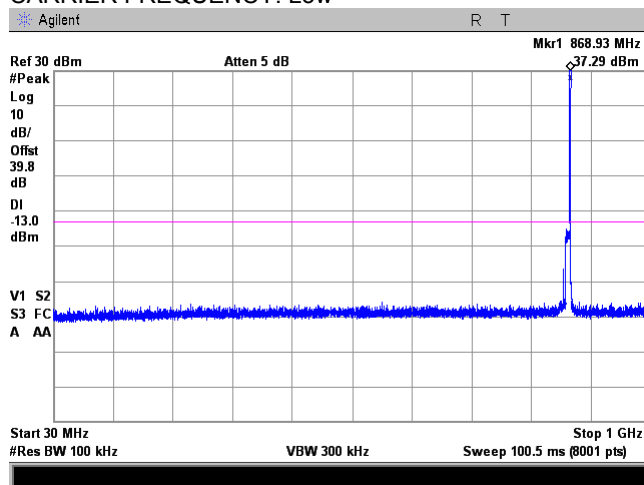
Plot 7.7.9 Spurious emission measurements in 30.0 - 1000 MHz range at high carrier frequency

FREQUENCY RANGE:
OPERATIONAL MODE:
INPUT PORT:
CONFIGURATION:
INPUT POWER:

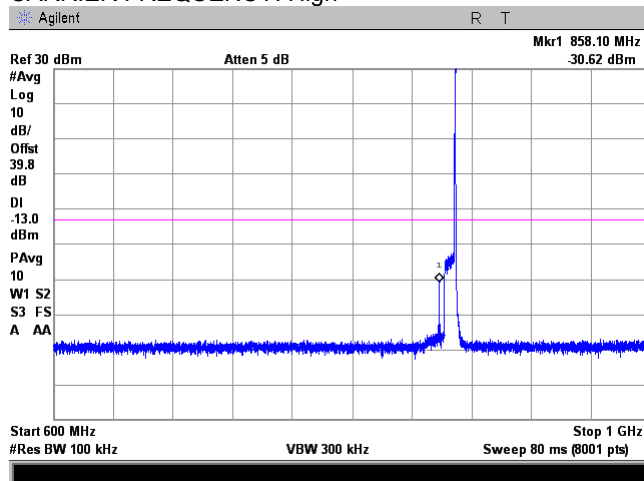
862 – 869 MHz
GSM downlink transmit
Base
Below AGC level
-56 dBm

CARRIER FREQUENCY: Low

CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





HERMON LABORATORIES

Test specification: Section 90.219(e)(3), Conducted spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 24-Mar-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1005 hPa	Power supply: 120 VAC
Remarks:			

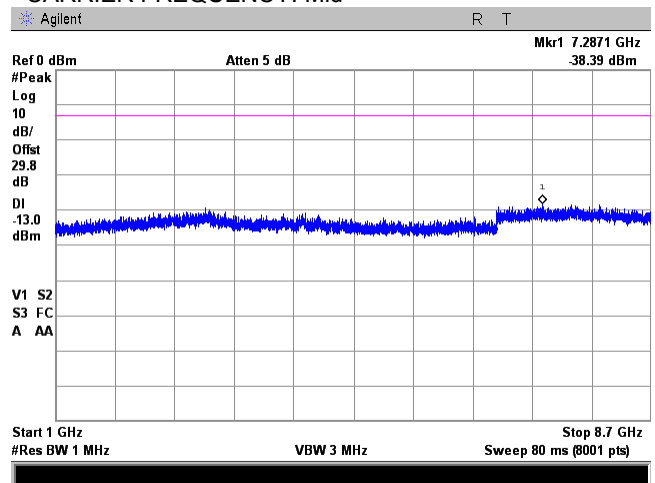
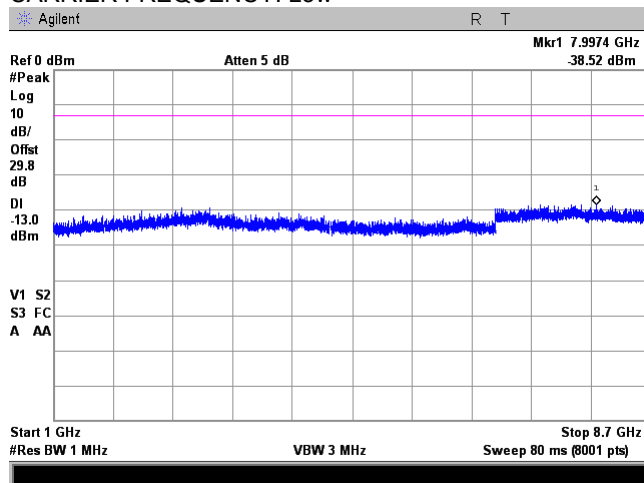
Plot 7.7.10 Spurious emission measurements in 1000 - 8700 MHz range at low carrier frequency

FREQUENCY RANGE:
OPERATIONAL MODE:
INPUT PORT:
CONFIGURATION:
INPUT POWER:

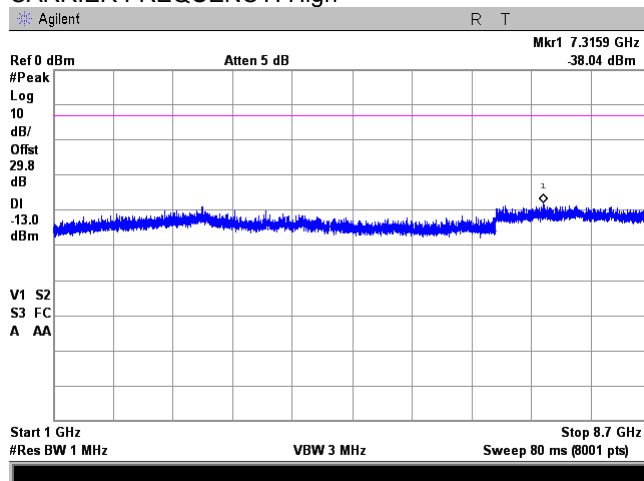
862 – 869 MHz
GSM downlink transmit
Base
Below AGC level
-56 dBm

CARRIER FREQUENCY: Low

CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





HERMON LABORATORIES

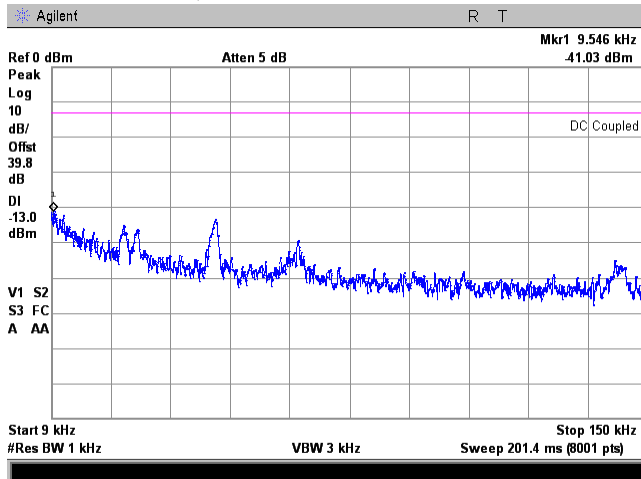
Test specification: Section 90.219(e)(3), Conducted spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 24-Mar-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1005 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.7.11 Spurious emission measurements in 9 - 150 kHz range at carrier frequency

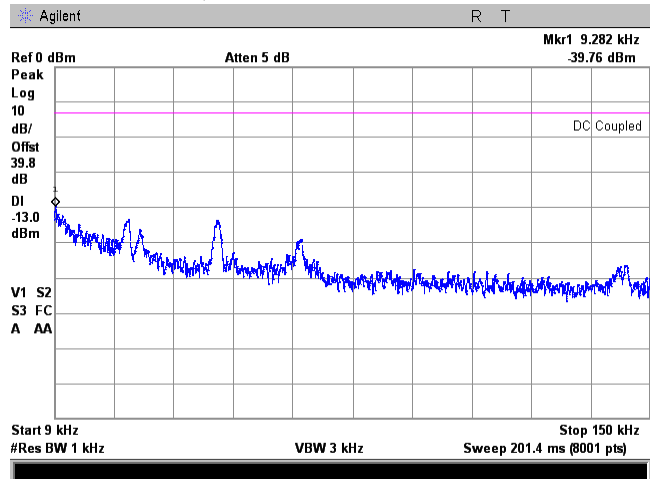
FREQUENCY RANGE:
OPERATIONAL MODE:
INPUT PORT:
CONFIGURATION:
INPUT POWER:

817 – 824 MHz
AWGN uplink transmit
Mobile
Below AGC level
-56 dBm

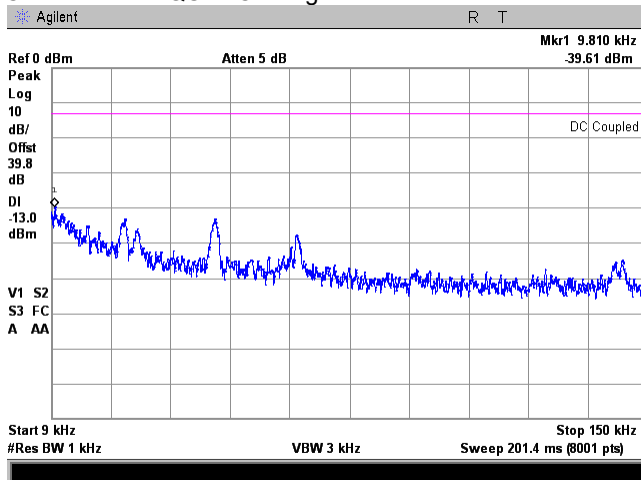
CARRIER FREQUENCY: Low



CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





HERMON LABORATORIES

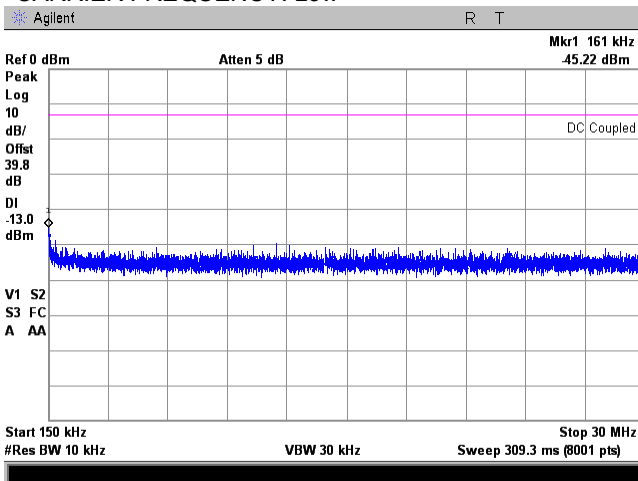
Test specification: Section 90.219(e)(3), Conducted spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 24-Mar-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1005 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.7.12 Spurious emission measurements in 0.15 - 30.0 MHz range at low carrier frequency

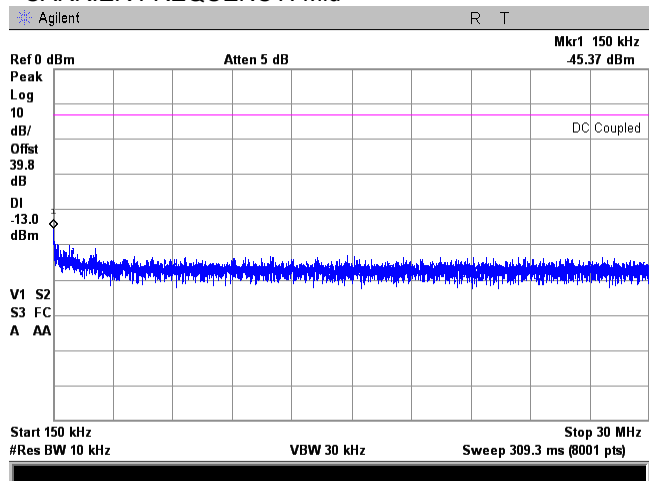
FREQUENCY RANGE:
OPERATIONAL MODE:
INPUT PORT:
CONFIGURATION:
INPUT POWER:

817 – 824 MHz
AWGN uplink transmit
Mobile
Below AGC level
-56 dBm

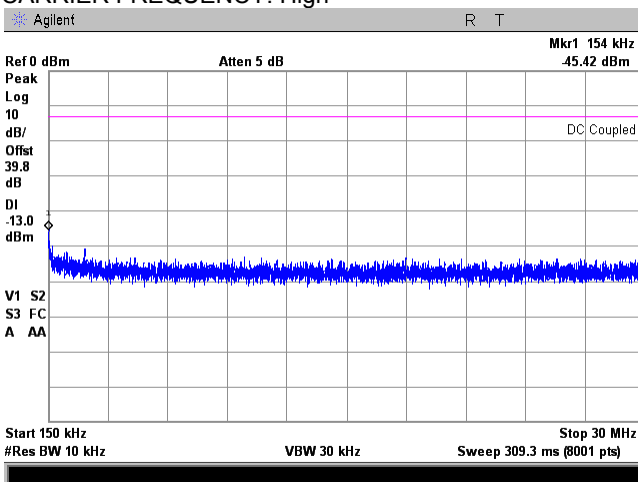
CARRIER FREQUENCY: Low



CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





HERMON LABORATORIES

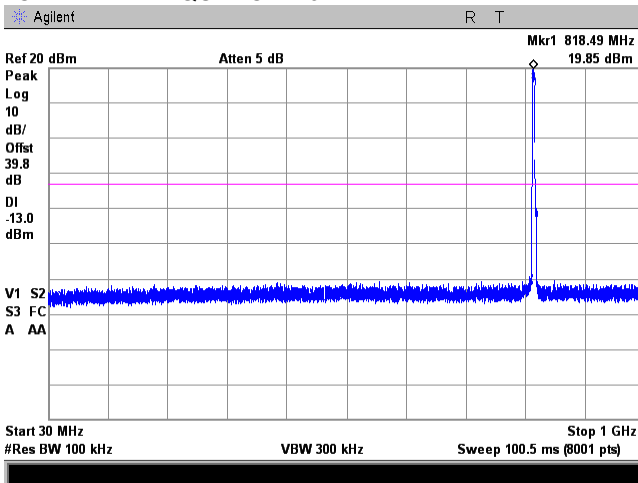
Test specification: Section 90.219(e)(3), Conducted spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 24-Mar-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1005 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.7.13 Spurious emission measurements in 30.0 - 1000 MHz range at low carrier frequency

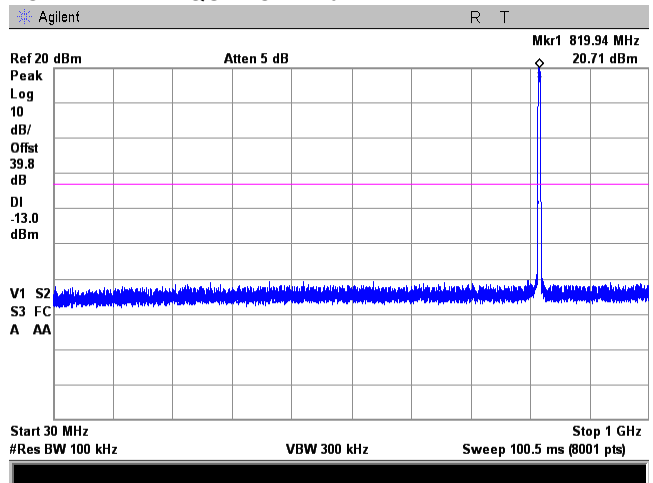
FREQUENCY RANGE:
OPERATIONAL MODE:
INPUT PORT:
CONFIGURATION:
INPUT POWER:

817 – 824 MHz
AWGN uplink transmit
Mobile
Below AGC level
-56 dBm

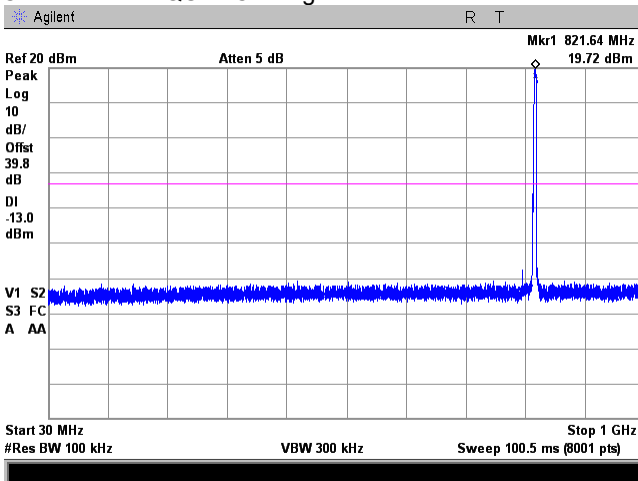
CARRIER FREQUENCY: Low



CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





HERMON LABORATORIES

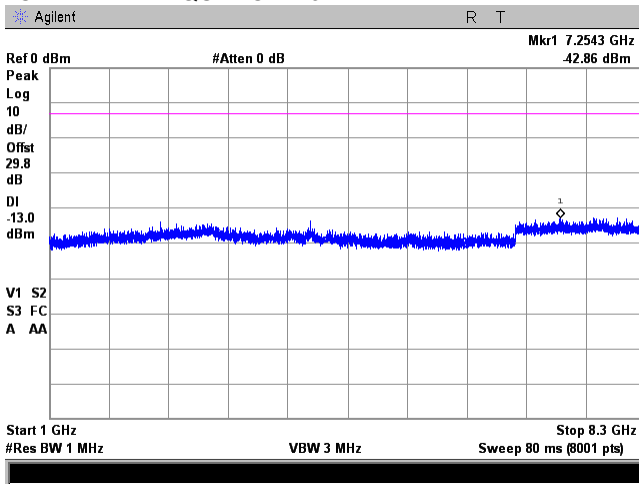
Test specification: Section 90.219(e)(3), Conducted spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 24-Mar-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1005 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.7.14 Spurious emission measurements in 1000 - 8700 MHz range at low carrier frequency

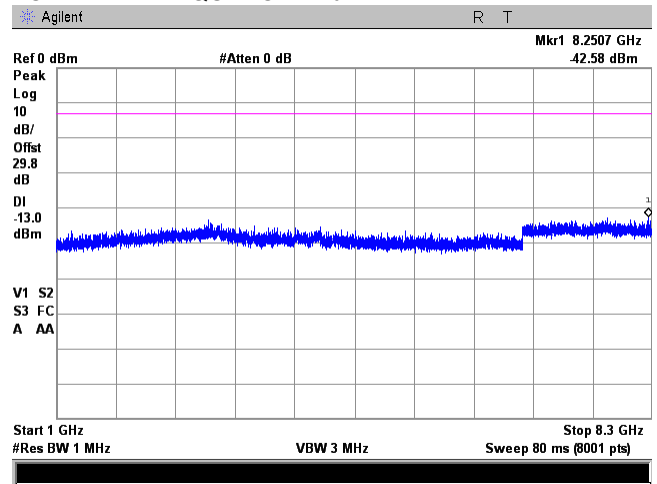
FREQUENCY RANGE:
OPERATIONAL MODE:
INPUT PORT:
CONFIGURATION:
INPUT POWER:

817 – 824 MHz
AWGN uplink transmit
Mobile
Below AGC level
-56 dBm

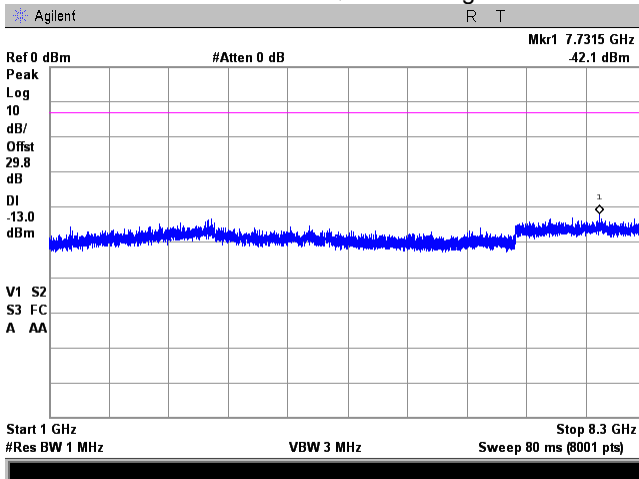
CARRIER FREQUENCY: Low



CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





HERMON LABORATORIES

Test specification: Section 90.219(e)(3), Conducted spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 24-Mar-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1005 hPa	Power supply: 120 VAC
Remarks:			

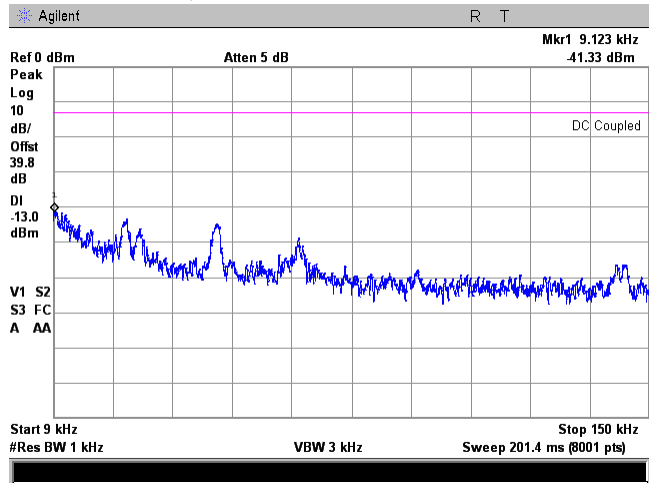
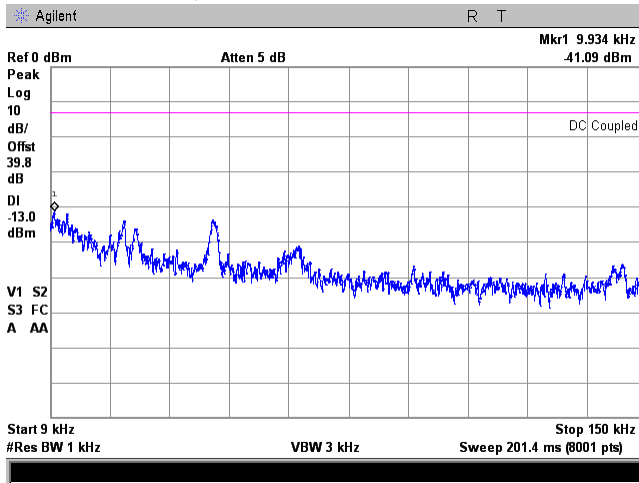
Plot 7.7.15 Spurious emission measurements in 9 - 150 kHz range at low carrier frequency

FREQUENCY RANGE:
OPERATIONAL MODE:
INPUT PORT:
CONFIGURATION:
INPUT POWER:

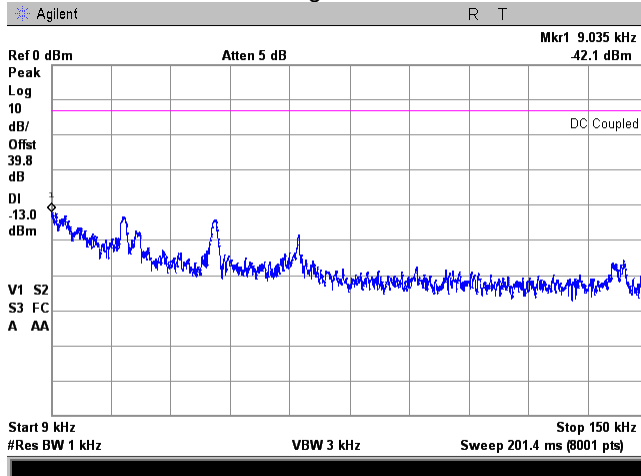
817 – 824 MHz
GSM uplink transmit
Mobile
Below AGC level
-56 dBm

CARRIER FREQUENCY: Low

CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





HERMON LABORATORIES

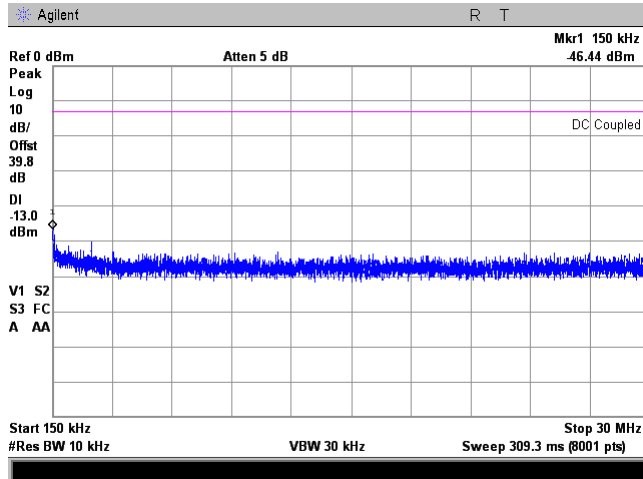
Test specification: Section 90.219(e)(3), Conducted spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 24-Mar-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1005 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.7.16 Spurious emission measurements in 0.15 - 30.0 MHz range at low carrier frequency

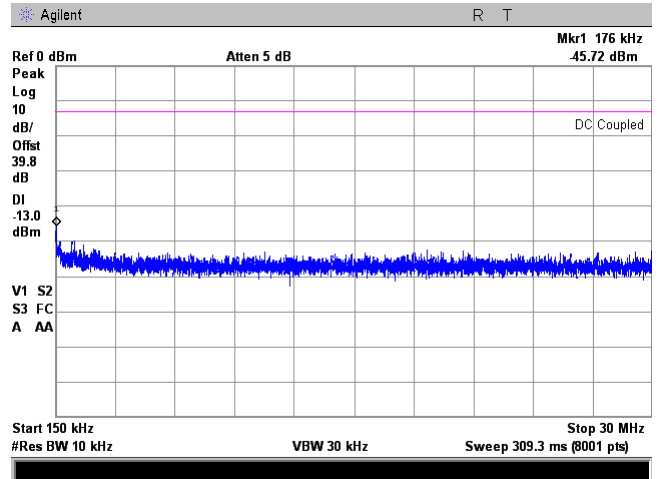
FREQUENCY RANGE:
OPERATIONAL MODE:
INPUT PORT:
CONFIGURATION:
INPUT POWER:

817 – 824 MHz
GSM uplink transmit
Mobile
Below AGC level
-56 dBm

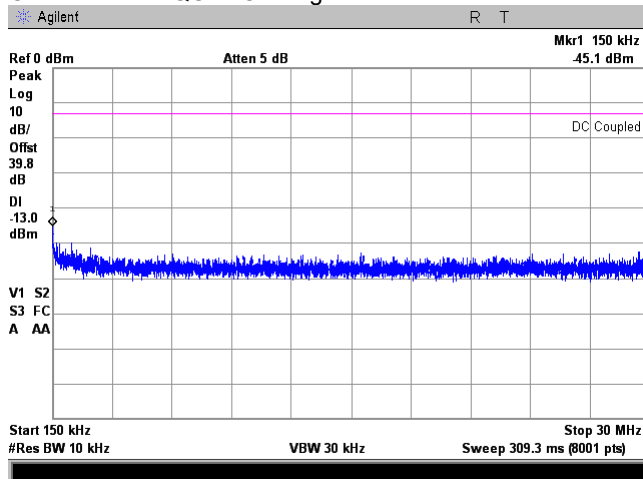
CARRIER FREQUENCY: Low



CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





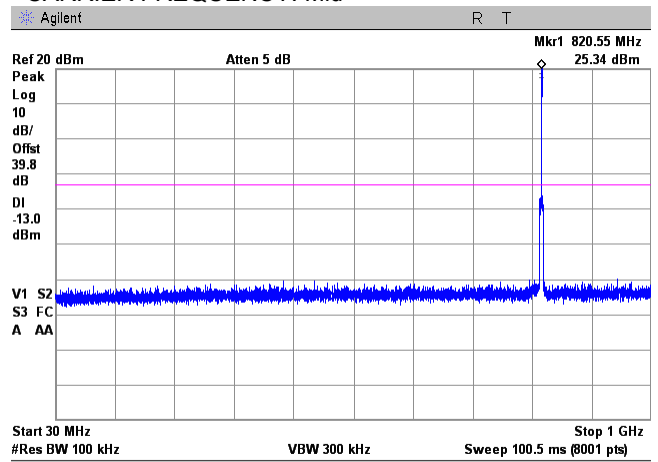
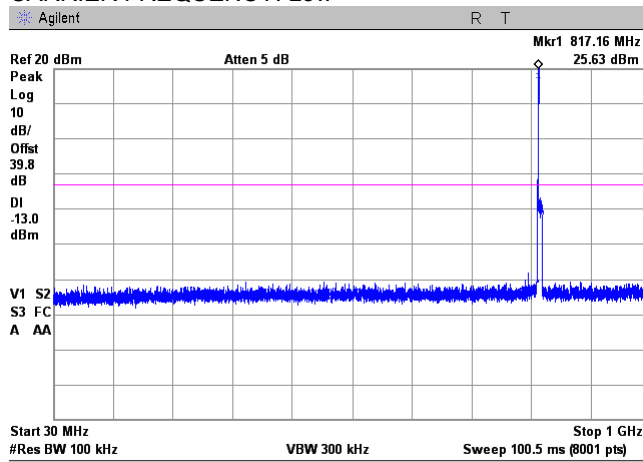
HERMON LABORATORIES

Test specification: Section 90.219(e)(3), Conducted spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 24-Mar-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1005 hPa	Power supply: 120 VAC
Remarks:			

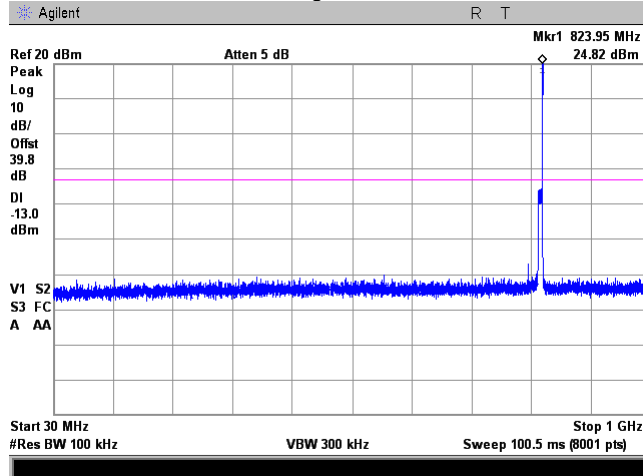
Plot 7.7.17 Spurious emission measurements in 30.0 - 1000 MHz range at low carrier frequency

FREQUENCY RANGE:
OPERATIONAL MODE:
INPUT PORT:
CONFIGURATION:
INPUT POWER:
CARRIER FREQUENCY: Low

817 – 824 MHz
GSM uplink transmit
Mobile
Below AGC level
-56 dBm
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





HERMON LABORATORIES

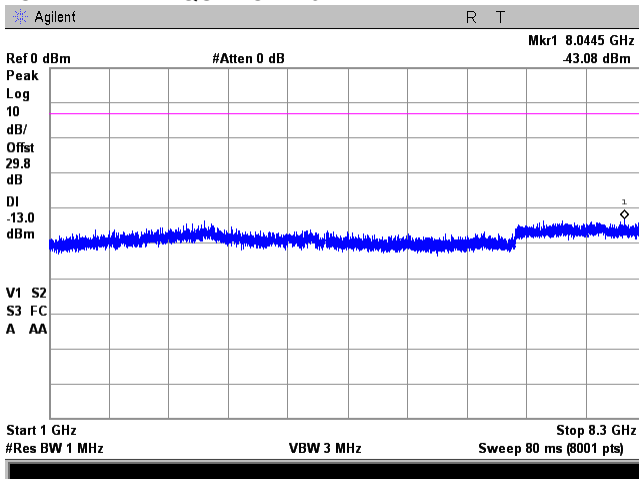
Test specification: Section 90.219(e)(3), Conducted spurious emissions for CMRS			
Test procedure: 47 CFR, Sections 2.1051; KDB 935210 D05 v01r01 section 3.6.3			
Test mode: Compliance		Verdict: PASS	
Date(s): 24-Mar-16 - 13-Apr-16			
Temperature: 22.3 °C	Relative Humidity: 48 %	Air Pressure: 1005 hPa	Power supply: 120 VAC
Remarks:			

Plot 7.7.18 Spurious emission measurements in 1000 - 8700 MHz range at low carrier frequency

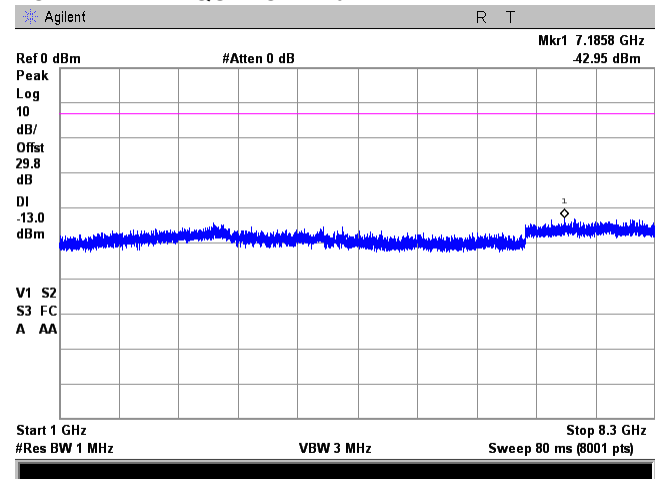
FREQUENCY RANGE:
OPERATIONAL MODE:
INPUT PORT:
CONFIGURATION:
INPUT POWER:

817 – 824 MHz
GSM uplink transmit
Mobile
Below AGC level
-56 dBm

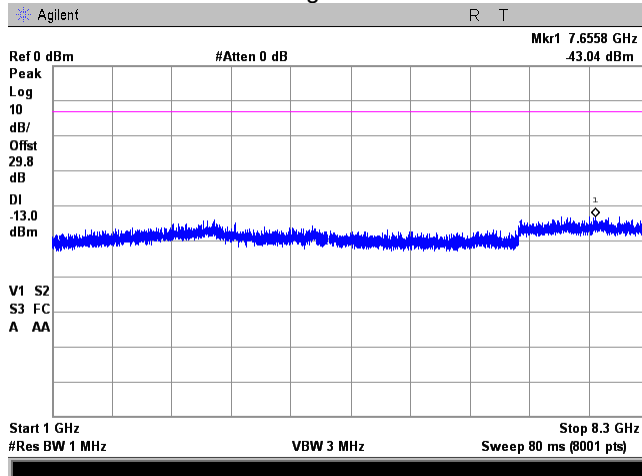
CARRIER FREQUENCY: Low



CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High



**8 APPENDIX A Test equipment and ancillaries used for tests**

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check*	Due Cal./ Check*
0446	Antenna, Loop, Active, 10 kHz - 30 MHz	EMCO	6502	2857	18-Jan-16	18-Jan-17
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz	Hewlett Packard	8546A	3617A 00319, 3448A002 53	27-Oct-15	27-Oct-16
0539	Generator Signal, 10 kHz - 1.2 GHz	Marconi Instruments	2023	112121/04 1	31-Aug-15	31-Aug-16
0557	Generator Signal, 9 KHz - 1.2 GHz	Marconi Instruments	2023	112225/08 0	02-Jul-16	02-Jul-17
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	10-May-16	10-May-17
1876	Attenuator, 50 Ohm, 100 W, 20 dB	Bird Electronic Corp.	8343-200	2200	03-Feb-16	03-Feb-17
2015	Power Divider, 0.5-18.0 GHz, 80 W	Omni Spectra	2090- 6204-00	NA	01-Dec-14	01-Dec-16
2909	Spectrum analyzer, ESA-E, 100 Hz to 26.5 GHz	Agilent Technologies	E4407B	MY414447 62	30-Dec-15	30-Dec-16
3433	Test Cable , DC-18 GHz, 1.5 m, SMA - SMA	Mini-Circuits	CBL-5FT- SMSM+	25679	20-Mar-16	20-Mar-17
3434	Test Cable , DC-18 GHz, 1.5 m, SMA - SMA	Mini-Circuits	CBL-5FT- SMSM+	25683	20-Mar-16	20-Mar-17
3622	Cable RF, 6.0 m, N type-N type, DC-6.5 GHz	Alpha Wire	RG 214/U	NA	15-Dec-15	15-Dec-16
3623	Cable RF, 6.0 m, N type-N type, DC-6.5 GHz	Belden	MIL C-17	NA	09-Sep-15	09-Sep-16
3768	Attenuator, N-type, 20 dB, DC to 18 GHz, 5 W	Mini-Circuits	BW- N20W5+	NA	18-Aug-15	18-Aug-16
3772	Attenuator, N-type, 10 dB, DC to 18 GHz, 5 W	Mini-Circuits	BW- N10W5+	NA	17-Aug-15	17-Sep-16
3779	Attenuator, N-type, 10 dB, DC to 18 GHz, 5 W	Mini-Circuits	BW- N10W5+	NA	31-May-16	31-May-17
3787	Precision Fixed Attenuator, 50 Ohm, 5 W, 10 dB, DC to 18 GHz	Mini-Circuits	BW- S10W5+	NA	01-Dec-15	01-Dec-16
3788	Precision Fixed Attenuator, 50 Ohm, 5 W, 10 dB, DC to 18 GHz	Mini-Circuits	BW- S10W5+	NA	01-Dec-15	01-Dec-16
3818	PSA Series Spectrum Analyzer, 3 Hz- 44 GHz	Agilent Technologies	E4446A	MY482502 88	03-May-16	03-May-17
3901	Microwave Cable Assembly, 40.0 GHz, 3.5 m, SMA/SMA	Huber-Suhner	SUCOFLE X 102A	1225/2A	15-Feb-16	15-Feb-17
3903	Microwave Cable Assembly, 40.0 GHz, 1.5 m, SMA/SMA	Huber-Suhner	SUCOFLE X 102A	1226/2A	15-Feb-16	15-Feb-17
4068	Attenuator, SMA, 30 dB, DC to 12.4 GHz	Midwest Microwave	ATT- 0527-30- SMA-07	NA	13-Jul-15	13-Jul-16
4097	Attenuator, Manual Step, 0-60/10 dB, 0-9/1 dB, 0-4.0 GHz	Weinschel	AC9003- 69-11	17416	09-Mar-16	09-Mar-17



HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check*	Due Cal./ Check*
4273	Test Cable , DC-18 GHz, 1.8 m, SMA/M - N/M	Mini-Circuits	CBL-6FT-SMNM+	70045	30-May-16	30-May-17
4274	Test Cable , DC-18 GHz, 1.8 m, SMA/M - N/M	Mini-Circuits	CBL-6FT-SMNM+	70047	30-May-16	30-May-17
4275	Test Cable , DC-18 GHz, 1.8 m, SMA/M - N/M	Mini-Circuits	CBL-6FT-SMNM+	70050	22-Nov-15	22-Nov-16
4276	Test Cable , DC-18 GHz, 3.05 m, N/M - N/M	Mini-Circuits	APC-10FT-NMNM+	0747A	22-Nov-15	22-Nov-16
4278	Test Cable , DC-18 GHz, 4.6 m, N/M - N/M	Mini-Circuits	APC-15FT-NMNM+	0755A	22-Nov-15	22-Nov-16
4353	Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M	MegaPhase	NC29-N1N1-244	12025101003	15-Mar-16	15-Mar-17
4354	Vector Signal Generator, 100 kHz to 6.0 GHz	Rohde & Schwarz	SMJ 100A	1403.4507 K02-101777-rc	27-Jun-16	27-Jun-17
4364	iKey 1000, USB, EMI Autotest (multi-user license), Software	Rohde & Schwarz	EMC32_M K10	101279	30-Dec-15	30-Dec-16
4413	Resistive divider, DC to 1.5 GHz, 2 W	Microlab	DA-3FN	NA	15-Jul-14	15-Jul-16
4722	Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M	MegaPhase	NC29-N1N1-244	51228701001	30-Dec-15	30-Dec-16
4933	Active Horn Antenna, 1 GHz to 18 GHz	Com-Power Corporation	AHA-118	701046	04-Sep-15	04-Sep-16

*Note: the calibration was valid at the testing time.

8.1 Test equipment and ancillaries used for tests

HL No.	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
NA	Noise Figure Analyzer	Agilent	N8973A	GB39490364	20-Aug-15	19-Aug-17
NA	SNS Series Noise Source	Agilent	N4000A	MY44420199	20-Aug-15	19-Aug-17

**9 APPENDIX B Measurement uncertainties****Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements**

Test description	Expanded uncertainty
Transmitter tests	
Carrier power conducted at antenna connector	± 1.7 dB
Carrier power radiated (substitution method)	± 4.5 dB
Occupied bandwidth	$\pm 8\%$
Conducted emissions at RF antenna connector	9 kHz to 2.9 GHz: ± 2.6 dB 2.9 GHz to 6.46 GHz: ± 3.5 dB 6.46 GHz to 13.2 GHz: ± 4.3 dB 13.2 GHz to 22.0 GHz: ± 5.0 dB 22.0 GHz to 26.8 GHz: ± 5.5 dB 26.8 GHz to 40.0 GHz: ± 4.8 dB
Spurious emissions radiated 30 MHz – 40 GHz (substitution method)	± 4.5 dB
Frequency error	30 – 300 MHz: ± 50.5 Hz (1.68 ppm) 300 – 1000 MHz: ± 168 Hz (0.56 ppm)
Transient frequency behaviour	187 Hz $\pm 13.9\%$
Duty cycle, timing (Tx ON / OFF) and average factor measurements	$\pm 1.0\%$

Hermon Laboratories is accredited by A2LA for calibration according to present requirements of ISO/IEC 17025 and NCSL Z540-1. The accreditation is granted to perform calibration of parameters that are listed in the Scope of Hermon Laboratories Accreditation.

Hermon Laboratories calibrates its reference and transfer standards by calibration laboratories accredited to ISO/IEC 17025 by a mutually recognized Accreditation Body or by a recognized national metrology institute. All reference and transfer standards used in the calibration system are traceable to national or international standards.

In-house calibration of all test and measurement equipment is performed on a regular basis according to Hermon Laboratories calibration procedures, manufacturer calibration/verification procedures or procedures defined in the relevant standards. The Hermon Laboratories test and measurement equipment is calibrated within the tolerances specified by the manufacturers and/or by the relevant standards.



10 APPENDIX C Test facility description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private, EMC, safety, environmental and telecommunication testing facility.

Hermon Laboratories is listed by the Federal Communications Commission (USA) for all parts of Code of Federal Regulations 47 (CFR 47), Registration Numbers 90624 for OATS and 90623 for the anechoic chamber; by Industry Canada for electromagnetic emissions (file number IC 2186A-1 for OATS), certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, G-27 for full-anechoic chamber for RE measurements above 1 GHz, C-845 for conducted emissions site, T-1606 for conducted emissions at telecommunication ports), has a status of a Telefication - Listed Testing Laboratory, Certificate No. L138/00. The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for electromagnetic compatibility, product safety, telecommunications testing and environmental simulation (for exact scope please refer to Certificate No. 839.01). The FCC Designation Number is IL1001.

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11 APPENDIX D Specification references

47CFR part 90: 2015	Private land mobile radio services
47CFR part 1: 2015	Practice and procedure
47CFR part 2: 2015	Frequency allocations and radio treaty matters; general rules and regulations
ANSI C63.2: 1996	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications.
ANSI/TIA/EIA-603-D:2010	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
KDB 935210 D02 v03r02:8.04.2016	Signal Boosters Certification Requirements
KDB 935210 D05 v01r01:12.02.2016	Measurements Guidance for Industrial and Non-consumer Signal Booster, Repeater and Amplifier Devices



12 APPENDIX E Test equipment correction factors

Antenna factor
Active loop antenna
Model 6502, S/N 2857, HL 0446

Frequency, MHz	Magnetic antenna factor, dB	Electric antenna factor, dB
0.009	-32.8	18.7
0.010	-33.8	17.7
0.020	-38.3	13.2
0.050	-41.1	10.4
0.075	-41.3	10.2
0.100	-41.6	9.9
0.150	-41.7	9.8
0.250	-41.6	9.9
0.500	-41.8	9.8
0.750	-41.9	9.7
1.000	-41.4	10.1
2.000	-41.5	10.0
3.000	-41.4	10.2
4.000	-41.4	10.1
5.000	-41.5	10.1
10.000	-41.9	9.6
15.000	-41.9	9.6
20.000	-42.2	9.3
25.000	-42.8	8.7
30.000	-44.0	7.5

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μ V) to convert it into field strength in dB(μ V/m).



Antenna factor
Biconilog antenna EMCO Model 3141
Ser.No.1011, HL 0604

Frequency, MHz	Antenna factor, dB(1/m)	Frequency, MHz	Antenna factor, dB(1/m)	Frequency, MHz	Antenna factor, dB(1/m)
26	7.8	580	20.6	1320	27.8
28	7.8	600	21.3	1340	28.3
30	7.8	620	21.5	1360	28.2
40	7.2	640	21.2	1380	27.9
60	7.1	660	21.4	1400	27.9
70	8.5	680	21.9	1420	27.9
80	9.4	700	22.2	1440	27.8
90	9.8	720	22.2	1460	27.8
100	9.7	740	22.1	1480	28.0
110	9.3	760	22.3	1500	28.5
120	8.8	780	22.6	1520	28.9
130	8.7	800	22.7	1540	29.6
140	9.2	820	22.9	1560	29.8
150	9.8	840	23.1	1580	29.6
160	10.2	860	23.4	1600	29.5
170	10.4	880	23.8	1620	29.3
180	10.4	900	24.1	1640	29.2
190	10.3	920	24.1	1660	29.4
200	10.6	940	24.0	1680	29.6
220	11.6	960	24.1	1700	29.8
240	12.4	980	24.5	1720	30.3
260	12.8	1000	24.9	1740	30.8
280	13.7	1020	25.0	1760	31.1
300	14.7	1040	25.2	1780	31.0
320	15.2	1060	25.4	1800	30.9
340	15.4	1080	25.6	1820	30.7
360	16.1	1100	25.7	1840	30.6
380	16.4	1120	26.0	1860	30.6
400	16.6	1140	26.4	1880	30.6
420	16.7	1160	27.0	1900	30.6
440	17.0	1180	27.0	1920	30.7
460	17.7	1200	26.7	1940	30.9
480	18.1	1220	26.5	1960	31.2
500	18.5	1240	26.5	1980	31.6
520	19.1	1260	26.5	2000	32.0
540	19.5	1280	26.6		
560	19.8	1300	27.0		

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μ V) to convert it into field strength in dB(μ V/m).



Antenna factor, HL 4933



Active Horn Antenna Factor Calibration

1 GHz to 18 GHz

Equipment:	ACTIVE HORN ANTENNA
Model:	AHA-118
Serial Number:	701046
Calibration Distance:	3 Meter
Polarization:	Horizontal
Calibration Date:	11/12/2014

Frequency (GHz)	Preamplifier Gain (dB)	Antenna Factor with pre-amp (dB/m)	Frequency (GHz)	Preamplifier Gain (dB)	Antenna Factor with pre-amp (dB/m)
1	40.96	-16.47	10	40.94	-1.97
1.5	41.21	-14.53	10.5	40.63	-1.06
2	41.44	-13.30	11	40.74	-1.50
2.5	41.71	-12.87	11.5	40.65	-0.52
3	41.96	-12.26	12	40.76	-0.15
3.5	42.14	-11.77	12.5	41.03	-0.85
4	42.13	-10.91	13	41.37	-0.81
4.5	41.79	-9.41	13.5	41.18	0.05
5	41.44	-7.54	14	40.98	0.36
5.5	40.91	-6.47	14.5	40.81	1.26
6	40.69	-5.48	15	40.65	0.25
6.5	40.64	-5.53	15.5	40.93	-1.05
7	40.76	-4.12	16	41.31	-1.44
7.5	40.94	-3.12	16.5	40.96	-0.80
8	40.68	-1.69	17	40.64	-0.02
8.5	40.08	-1.71	17.5	40.57	1.81
9	40.41	-1.86	18	40.08	3.63
9.5	41.21	-2.73			

Calibration according to ARP 958

Antenna Factor to be added to receiver reading:

Meter Reading (dBuV) + Antenna Factor (dB/m) = Corrected Reading (dBuV/m)



Cable loss
Test Cable, Mini-Circuits, CBL-5FT-SMSM+, SMA-SMA, 18 GHz, 1.5 m, S/N 25679
Mini-Circuits, HL 3433

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10.0	0.06	9000	2.01
100	0.17	9500	2.06
500	0.41	10000	2.05
1000	0.58	10500	2.18
1500	0.72	11000	2.26
2000	0.86	11500	2.28
2500	0.96	12000	2.43
3000	1.04	12500	2.53
3500	1.13	13000	2.52
4000	1.23	13500	2.56
4500	1.31	14000	2.60
5000	1.41	14500	2.59
5500	1.49	15000	2.67
6000	1.55	15500	2.76
6500	1.63	16000	2.86
7000	1.71	16500	2.91
7500	1.78	17000	2.95
8000	1.86	17500	3.02
8500	1.92	18000	3.07



Cable loss
Test Cable, Mini-Circuits, CBL-5FT-SMSM+, SMA-SMA, 18 GHz, 1.5 m, S/N 25683
Mini-Circuits, HL 3434

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10.0	0.06	9000	1.96
100	0.16	9500	2.01
500	0.40	10000	2.01
1000	0.57	10500	2.14
1500	0.72	11000	2.21
2000	0.85	11500	2.24
2500	0.95	12000	2.36
3000	1.03	12500	2.47
3500	1.11	13000	2.46
4000	1.21	13500	2.50
4500	1.29	14000	2.53
5000	1.39	14500	2.53
5500	1.46	15000	2.62
6000	1.52	15500	2.70
6500	1.60	16000	2.80
7000	1.68	16500	2.86
7500	1.75	17000	2.88
8000	1.83	17500	2.94
8500	1.88	18000	3.00



Cable loss
Cable coaxial, RG-214/U, N type-N type, 6 m
Alpha Wire, HL 3622

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.13	2100	2.95	4400	4.99
30	0.24	2200	2.99	4500	5.00
50	0.32	2300	3.11	4600	5.17
100	0.47	2400	3.16	4700	5.18
200	0.70	2500	3.31	4800	5.33
300	0.88	2600	3.36	4900	5.34
400	1.05	2700	3.46	5000	5.50
500	1.21	2800	3.52	5100	5.56
600	1.36	2900	3.65	5200	5.76
700	1.49	3000	3.70	5300	5.76
800	1.63	3100	3.82	5400	5.85
900	1.72	3200	3.88	5500	5.88
1000	1.84	3300	3.99	5600	5.96
1100	1.96	3400	4.08	5700	6.02
1200	2.06	3500	4.19	5800	6.06
1300	2.15	3600	4.28	5900	6.14
1400	2.28	3700	4.42	6000	6.17
1500	2.35	3800	4.40	6100	6.28
1600	2.43	3900	4.51	6200	6.36
1700	2.57	4000	4.62	6300	6.47
1800	2.62	4100	4.70	6400	6.51
1900	2.75	4200	4.78	6500	6.65
2000	2.80	4300	4.83		



Cable loss
Cable coaxial, MIL C-17, N type-N type, 6 m
Belden, HL 3623

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.10	2600	4.35	5300	7.67
50	0.30	2700	4.54	5400	7.79
100	0.45	2800	4.70	5500	7.89
200	0.69	2900	4.87	5600	7.94
300	0.89	3000	5.04	5700	8.01
400	1.06	3100	5.19	5800	8.12
500	1.24	3200	5.35	5900	8.19
600	1.38	3300	5.50	6000	8.30
700	1.54	3400	5.65	6100	8.35
800	1.69	3500	5.79	6200	8.45
900	1.83	3600	5.92	6300	8.55
1000	1.96	3700	6.07	6400	8.65
1100	2.14	3800	6.17	6500	8.75
1200	2.31	3900	6.30		
1300	2.38	4000	6.43		
1400	2.51	4100	6.53		
1500	2.63	4200	6.65		
1600	2.76	4300	6.75		
1700	2.90	4400	6.85		
1800	3.04	4500	7.01		
1900	3.19	4600	7.09		
2000	3.35	4700	7.20		
2100	3.51	4800	7.24		
2200	3.67	4900	7.31		
2300	3.84	5000	7.41		
2400	4.01	5100	7.48		
2500	4.18	5200	7.56		



Cable loss
Microwave Cable Assembly, Huber-Suhner, 40 GHz, 3.5 m, SMA-SMA, S/N 1225/2A
HL 3901

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.09	9500	4.29	21000	6.67
100	0.41	10000	4.40	22000	6.92
500	0.93	10500	4.52	23000	7.00
1000	1.33	11000	4.64	24000	7.18
1500	1.63	11500	4.76	25000	7.29
2000	1.90	12000	4.87	26000	7.55
2500	2.12	12500	4.99	27000	7.70
3000	2.33	13000	5.11	28000	7.88
3500	2.50	13500	5.20	29000	8.02
4000	2.67	14000	5.31	30000	8.15
4500	2.82	14500	5.42	31000	8.35
5000	2.99	15000	5.51	32000	8.40
5500	3.16	15500	5.58	33000	8.62
6000	3.32	16000	5.68	34000	8.73
6500	3.51	16500	5.78	35000	8.78
7000	3.65	17000	5.91	36000	8.94
7500	3.79	17500	5.99	37000	9.21
8000	3.92	18000	6.07	38000	9.37
8500	4.04	19000	6.36	39000	9.45
9000	4.18	20000	6.49	40000	9.52



Cable loss
Microwave Cable Assembly, Huber-Suhner, 40 GHz, 1.5 m, SMA-SMA, S/N 1226/2A
HL 3903

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	-0.02	9500	1.84	21000	2.98
100	0.15	10000	1.86	22000	3.07
500	0.38	10500	1.93	23000	3.13
1000	0.56	11000	1.99	24000	3.21
1500	0.69	11500	2.04	25000	3.26
2000	0.82	12000	2.10	26000	3.48
2500	0.90	12500	2.15	27000	3.44
3000	0.98	13000	2.21	28000	3.53
3500	1.06	13500	2.25	29000	3.59
4000	1.11	14000	2.29	30000	3.66
4500	1.17	14500	2.34	31000	3.70
5000	1.24	15000	2.36	32000	3.79
5500	1.32	15500	2.40	33000	3.88
6000	1.40	16000	2.45	34000	3.94
6500	1.50	16500	2.48	35000	3.91
7000	1.56	17000	2.56	36000	4.05
7500	1.62	17500	2.58	37000	4.22
8000	1.68	18000	2.60	38000	4.25
8500	1.74	19000	2.84	39000	4.27
9000	1.78	20000	2.88	40000	4.33



Cable loss
Test cable, Mini-Circuits, S/N 70045, 18 GHz, 1.8 m, SMA/M - N/M
CBL-6FT-SMNM+, HL 4273

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.09	4800	1.76	9800	2.70	14800	3.59
30	0.11	4900	1.78	9900	2.71	14900	3.59
50	0.14	5000	1.81	10000	2.73	15000	3.60
100	0.20	5100	1.82	10100	2.75	15100	3.63
200	0.30	5200	1.86	10200	2.76	15200	3.67
300	0.38	5300	1.89	10300	2.79	15300	3.70
400	0.45	5400	1.92	10400	2.81	15400	3.68
500	0.50	5500	1.96	10500	2.82	15500	3.70
600	0.55	5600	2.00	10600	2.83	15600	3.71
700	0.60	5700	2.03	10700	2.87	15700	3.77
800	0.65	5800	2.04	10800	2.87	15800	3.75
900	0.69	5900	2.07	10900	2.88	15900	3.77
1000	0.73	6000	2.10	11000	2.89	16000	3.79
1100	0.77	6100	2.10	11100	2.91	16100	3.85
1200	0.80	6200	2.11	11200	2.92	16200	3.82
1300	0.84	6300	2.11	11300	2.94	16300	3.83
1400	0.88	6400	2.14	11400	2.95	16400	3.88
1500	0.92	6500	2.15	11500	2.98	16500	3.89
1600	0.95	6600	2.15	11600	3.00	16600	3.92
1700	0.98	6700	2.16	11700	3.02	16700	3.88
1800	1.01	6800	2.19	11800	3.04	16800	3.95
1900	1.04	6900	2.22	11900	3.08	16900	3.91
2000	1.07	7000	2.24	12000	3.09	17000	3.97
2100	1.09	7100	2.26	12100	3.12	17100	3.92
2200	1.13	7200	2.29	12200	3.13	17200	3.94
2300	1.15	7300	2.32	12300	3.16	17300	3.94
2400	1.18	7400	2.36	12400	3.17	17400	3.98
2500	1.21	7500	2.39	12500	3.19	17500	3.93
2600	1.24	7600	2.41	12600	3.20	17600	3.95
2700	1.27	7700	2.43	12700	3.21	17700	3.96
2800	1.30	7800	2.46	12800	3.21	17800	3.97
2900	1.34	7900	2.49	12900	3.22	17900	3.96
3000	1.36	8000	2.52	13000	3.22	18000	3.97
3100	1.38	8100	2.52	13100	3.24		
3200	1.41	8200	2.54	13200	3.24		
3300	1.45	8300	2.59	13300	3.27		
3400	1.46	8400	2.61	13400	3.28		
3500	1.49	8500	2.60	13500	3.31		
3600	1.51	8600	2.63	13600	3.31		
3700	1.55	8700	2.65	13700	3.35		
3800	1.34	8800	2.65	13800	3.37		
3900	1.36	8900	2.65	13900	3.40		
4000	1.38	9000	2.66	14000	3.43		
4100	1.41	9100	2.66	14100	3.45		
4200	1.45	9200	2.67	14200	3.46		
4300	1.46	9300	2.67	14300	3.46		
4400	1.49	9400	2.67	14400	3.49		
4500	1.51	9500	2.68	14500	3.50		
4600	1.55	9600	2.69	14600	3.50		
4700	1.34	9700	2.69	14700	3.52		



Cable loss
Test cable, Mini-Circuits, S/N 70047, 18 GHz, 1.8 m, SMA/M - N/M
CBL-6FT-SMNM+, HL 4274

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.07	4800	1.69	9800	2.62	14800	3.42
30	0.11	4900	1.70	9900	2.63	14900	3.39
50	0.14	5000	1.72	10000	2.64	15000	3.38
100	0.21	5100	1.75	10100	2.64	15100	3.40
200	0.26	5200	1.76	10200	2.66	15200	3.41
300	0.30	5300	1.77	10300	2.67	15300	3.40
400	0.37	5400	1.79	10400	2.68	15400	3.39
500	0.44	5500	1.82	10500	2.68	15500	3.41
600	0.49	5600	1.85	10600	2.70	15600	3.44
700	0.54	5700	1.86	10700	2.71	15700	3.46
800	0.58	5800	1.87	10800	2.73	15800	3.45
900	0.63	5900	1.91	10900	2.74	15900	3.47
1000	0.67	6000	1.94	11000	2.76	16000	3.51
1100	0.71	6100	1.97	11100	2.77	16100	3.56
1200	0.75	6200	1.98	11200	2.78	16200	3.55
1300	0.78	6300	1.99	11300	2.79	16300	3.54
1400	0.81	6400	2.02	11400	2.80	16400	3.57
1500	0.85	6500	2.05	11500	2.82	16500	3.62
1600	0.88	6600	2.06	11600	2.83	16600	3.61
1700	0.91	6700	2.06	11700	2.84	16700	3.60
1800	0.94	6800	2.08	11800	2.85	16800	3.62
1900	0.97	6900	2.10	11900	2.87	16900	3.68
2000	1.00	7000	2.12	12000	2.88	17000	3.70
2100	1.03	7100	2.12	12100	2.89	17100	3.68
2200	1.06	7200	2.13	12200	2.90	17200	3.70
2300	1.08	7300	2.16	12300	2.92	17300	3.80
2400	1.11	7400	2.19	12400	2.94	17400	3.84
2500	1.14	7500	2.22	12500	2.95	17500	3.83
2600	1.16	7600	2.23	12600	2.96	17600	3.83
2700	1.19	7700	2.26	12700	2.98	17700	3.86
2800	1.21	7800	2.30	12800	3.00	17800	3.86
2900	1.27	7900	2.33	12900	3.02	17900	3.80
3000	1.29	8000	2.35	13000	3.03	18000	3.79
3100	1.32	8100	2.37	13100	3.06		
3200	1.35	8200	2.41	13200	3.08		
3300	1.37	8300	2.44	13300	3.09		
3400	1.38	8400	2.47	13400	3.10		
3500	1.41	8500	2.48	13500	3.13		
3600	1.43	8600	2.51	13600	3.17		
3700	1.46	8700	2.53	13700	3.17		
3800	1.47	8800	2.55	13800	3.18		
3900	1.49	8900	2.56	13900	3.22		
4000	1.52	9000	2.57	14000	3.26		
4100	1.55	9100	2.58	14100	3.28		
4200	1.56	9200	2.59	14200	3.30		
4300	1.58	9300	2.59	14300	3.35		
4400	1.60	9400	2.60	14400	3.39		
4500	1.63	9500	2.60	14500	3.39		
4600	1.65	9600	2.61	14600	3.39		
4700	1.67	9700	2.61	14700	3.41		



Cable loss
Test cable, Mini-Circuits, S/N 70050, 18 GHz, 1.8 m, SMA/M - N/M
CBL-6FT-SMNM+, HL 4275

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.08	5000	1.71	10200	2.64	15400	3.46
30	0.11	5100	1.73	10300	2.65	15500	3.47
50	0.14	5200	1.75	10400	2.66	15600	3.52
100	0.21	5300	1.76	10500	2.67	15700	3.55
200	0.30	5400	1.77	10600	2.70	15800	3.55
300	0.37	5500	1.82	10700	2.71	15900	3.55
400	0.43	5600	1.84	10800	2.72	16000	3.61
500	0.49	5700	1.86	10900	2.73	16100	3.62
600	0.54	5800	1.86	11000	2.75	16200	3.63
700	0.58	5900	1.89	11100	2.77	16300	3.62
800	0.62	6000	1.94	11200	2.78	16400	3.66
900	0.66	6100	1.95	11300	2.80	16500	3.71
1000	0.70	6200	1.96	11400	2.82	16600	3.71
1100	0.74	6300	1.97	11500	2.83	16700	3.67
1200	0.78	6400	2.01	11600	2.84	16800	3.69
1300	0.81	6500	2.03	11700	2.86	16900	3.74
1400	0.84	6600	2.02	11800	2.88	17000	3.73
1500	0.88	6700	2.02	11900	2.89	17100	3.71
1600	0.91	6800	2.05	12000	2.90	17200	3.73
1700	0.94	6900	2.06	12100	2.92	17300	3.77
1800	0.97	7000	2.07	12200	2.93	17400	3.77
1900	1.00	7100	2.07	12300	2.94	17500	3.76
2000	1.02	7200	2.08	12400	2.96	17600	3.76
2100	1.05	7300	2.11	12500	2.98	17700	3.78
2200	1.07	7400	2.13	12600	2.99	17800	3.80
2300	1.10	7500	2.15	12700	3.01	17900	3.79
2400	1.13	7600	2.16	12800	3.03	18000	3.78
2500	1.15	7700	2.18	12900	3.05		
2600	1.18	7800	2.21	13000	3.07		
2700	1.20	7900	2.24	13100	3.09		
2800	1.24	8000	2.25	13200	3.12		
2900	1.26	8100	2.26	13300	3.13		
3000	1.28	8200	2.29	13400	3.14		
3100	1.30	8300	2.31	13500	3.16		
3200	1.33	8400	2.33	13600	3.18		
3300	1.36	8500	2.33	13700	3.19		
3400	1.37	8600	2.34	13800	3.21		
3500	1.39	8700	2.36	13900	3.23		
3600	1.42	8800	2.38	14000	3.25		
3700	1.45	8900	2.39	14100	3.26		
3800	1.46	9000	2.40	14200	3.27		
3900	1.48	9100	2.42	14300	3.30		
4000	1.50	9200	2.45	14400	3.32		
4100	1.53	9300	2.46	14500	3.33		
4200	1.55	9400	2.48	14600	3.34		
4300	1.57	9500	2.50	14700	3.36		
4400	1.59	9600	2.52	14800	3.39		
4500	1.61	9700	2.54	14900	3.40		
4600	1.64	9800	2.56	15000	3.41		
4700	1.66	9900	2.58	15100	3.41		
4800	1.67	10000	2.60	15200	3.44		
4900	1.69	10100	2.61	15300	3.46		



Cable loss
Test cable, Mini-Circuits, S/N 0747A, 18 GHz, 3.05 m, N/M - N/M
APC-10FT-NMNM+, HL 4276

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.11	4500	2.81	9300	4.30	14100	5.59
30	0.19	4600	2.85	9400	4.33	14200	5.61
50	0.25	4700	2.88	9500	4.36	14300	5.63
100	0.36	4800	2.92	9600	4.39	14400	5.66
150	0.44	4900	2.95	9700	4.42	14500	5.68
200	0.52	5000	3.00	9800	4.46	14600	5.70
300	0.64	5100	3.03	9900	4.49	14700	5.72
400	0.75	5200	3.08	10000	4.53	14800	5.75
500	0.84	5300	3.11	10100	4.56	14900	5.77
600	0.93	5400	3.13	10200	4.60	15000	5.80
700	1.01	5500	3.16	10300	4.64	15100	5.82
800	1.08	5600	3.20	10400	4.66	15200	5.85
900	1.15	5700	3.22	10500	4.68	15300	5.88
1000	1.22	5800	3.26	10600	4.70	15400	5.91
1100	1.28	5900	3.30	10700	4.73	15500	5.93
1200	1.34	6000	3.34	10800	4.75	15600	5.97
1300	1.40	6100	3.39	10900	4.77	15700	5.99
1400	1.46	6200	3.42	11000	4.80	15800	6.02
1500	1.51	6300	3.47	11100	4.83	15900	6.07
1600	1.57	6400	3.50	11200	4.86	16000	6.08
1700	1.62	6500	3.52	11300	4.88	16100	6.11
1800	1.68	6600	3.55	11400	4.90	16200	6.12
1900	1.72	6700	3.58	11500	4.92	16300	6.14
2000	1.77	6800	3.60	11600	4.94	16400	6.17
2100	1.82	6900	3.62	11700	4.96	16500	6.19
2200	1.87	7000	3.64	11800	4.98	16600	6.21
2300	1.92	7100	3.66	11900	5.01	16700	6.22
2400	1.96	7200	3.68	12000	5.03	16800	6.24
2500	2.01	7300	3.71	12100	5.06	16900	6.26
2600	2.05	7400	3.74	12200	5.09	17000	6.28
2700	2.10	7500	3.78	12300	5.12	17100	6.31
2800	2.14	7600	3.81	12400	5.15	17200	6.33
2900	2.18	7700	3.84	12500	5.17	17300	6.36
3000	2.23	7800	3.87	12600	5.20	17400	6.39
3100	2.27	7900	3.90	12700	5.22	17500	6.42
3200	2.31	8000	3.93	12800	5.25	17600	6.45
3300	2.35	8100	3.96	12900	5.28	17700	6.48
3400	2.39	8200	4.00	13000	5.32	17800	6.50
3500	2.42	8300	4.03	13100	5.35	17900	6.52
3600	2.46	8400	4.06	13200	5.38	18000	6.55
3700	2.50	8500	4.08	13300	5.40		
3800	2.54	8600	4.11	13400	5.42		
3900	2.58	8700	4.13	13500	5.44		
4000	2.61	8800	4.16	13600	5.46		
4100	2.65	8900	4.18	13700	5.48		
4200	2.69	9000	4.21	13800	5.51		
4300	2.73	9100	4.24	13900	5.53		
4400	2.77	9200	4.27	14000	5.56		



Cable loss
Test cable, Mini-Circuits, S/N 0755A, 18 GHz, 4.6 m, N/M - N/M
APC-15FT-NMNM+, HL 4278

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.24	4900	4.19	10000	6.47	15100	8.33
30	0.26	5000	4.25	10100	6.50	15200	8.35
50	0.34	5100	4.29	10200	6.52	15300	8.37
100	0.50	5200	4.32	10300	6.57	15400	8.40
200	0.72	5300	4.38	10400	6.59	15500	8.42
300	0.90	5400	4.41	10500	6.61	15600	8.46
400	1.06	5500	4.46	10600	6.64	15700	8.50
500	1.20	5600	4.51	10700	6.64	15800	8.52
600	1.32	5700	4.56	10800	6.65	15900	8.56
700	1.44	5800	4.59	10900	6.68	16000	8.61
800	1.54	5900	4.64	11000	6.68	16100	8.64
900	1.64	6000	4.69	11100	6.69	16200	8.66
1000	1.74	6100	4.72	11200	6.70	16300	8.70
1100	1.83	6200	4.77	11300	6.74	16400	8.73
1200	1.92	6300	4.80	11400	6.78	16500	8.74
1300	2.01	6400	4.83	11500	6.81	16600	8.75
1400	2.09	6500	4.89	11600	6.84	16700	8.78
1500	2.18	6600	4.90	11700	6.87	16800	8.79
1600	2.25	6700	4.95	11800	6.92	16900	8.81
1700	2.33	6800	5.01	11900	6.98	17000	8.85
1800	2.39	6900	4.99	12000	7.02	17100	8.90
1900	2.47	7000	5.04	12100	7.08	17200	8.95
2000	2.53	7100	5.11	12200	7.15	17300	8.99
2100	2.60	7200	5.14	12300	7.20	17400	9.03
2200	2.67	7300	5.21	12400	7.26	17500	9.07
2300	2.73	7400	5.29	12500	7.31	17600	9.11
2400	2.80	7500	5.33	12600	7.36	17700	9.15
2500	2.87	7600	5.38	12700	7.41	17800	9.19
2600	2.93	7700	5.46	12800	7.46	17900	9.24
2700	3.00	7800	5.52	12900	7.51	18000	9.28
2800	3.06	7900	5.58	13000	7.55		
2900	3.12	8000	5.64	13100	7.59		
3000	3.18	8100	5.69	13200	7.65		
3100	3.24	8200	5.75	13300	7.69		
3200	3.30	8300	5.80	13400	7.72		
3300	3.35	8400	5.84	13500	7.78		
3400	3.42	8500	5.90	13600	7.82		
3500	3.46	8600	5.97	13700	7.86		
3600	3.52	8700	5.99	13800	7.91		
3700	3.57	8800	6.04	13900	7.96		
3800	3.61	8900	6.10	14000	8.01		
3900	3.67	9000	6.13	14100	8.06		
4000	3.71	9100	6.17	14200	8.10		
4100	3.77	9200	6.23	14300	8.13		
4200	3.83	9300	6.27	14400	8.16		
4300	3.89	9400	6.30	14500	8.19		
4400	3.94	9500	6.35	14600	8.21		
4500	4.00	9600	6.37	14700	8.23		
4600	4.05	9700	6.40	14800	8.26		
4700	4.10	9800	6.44	14900	8.28		
4800	4.16	9900	6.45	15000	8.30		



Cable loss
Low Loss Armored Test Cable, MegaPhase, 18 GHz, 6.2 m, N type-M/N type-M,
NC29-N1N1-244S/N 12025101 003,
HL 4353

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
50	0.20	9000	2.71
100	0.27	9500	2.81
300	0.47	10000	2.90
500	0.61	10500	2.97
1000	0.87	11000	3.06
1500	1.07	11500	3.13
2000	1.24	12000	3.20
2500	1.39	12500	3.26
3000	1.53	13000	3.34
3500	1.65	13500	3.39
4000	1.77	14000	3.47
4500	1.89	14500	3.54
5000	1.99	15000	3.62
5500	2.07	15500	3.69
6000	2.20	16000	3.76
6500	2.30	16500	3.83
7000	2.39	17000	3.86
7500	2.51	17500	3.94
8000	2.58	18000	4.02
8500	2.65		



Cable loss
Low Loss Armored Test Cable, MegaPhase, 18 GHz, 6.2 m, N type-M/N type-M,
NC29-N1N1-244, S/N 51228701001
HL 4722

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
50	0.22	9000	2.93
100	0.30	9500	3.06
300	0.52	10000	3.16
500	0.66	10500	3.20
1000	0.93	11000	3.34
1500	1.15	11500	3.39
2000	1.33	12000	3.48
2500	1.49	12500	3.55
3000	1.64	13000	3.66
3500	1.77	13500	3.75
4000	1.90	14000	3.76
4500	2.03	14500	3.87
5000	2.17	15000	3.98
5500	2.30	15500	4.01
6000	2.39	16000	4.14
6500	2.51	16500	4.15
7000	2.59	17000	4.32
7500	2.67	17500	4.36
8000	2.76	18000	4.38
8500	2.84		



13 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
AM	amplitude modulation
AVRG	average (detector)
BB	broad band
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB(μ V)	decibel referred to one microvolt
dB(μ V/m)	decibel referred to one microvolt per meter
dB(μ A)	decibel referred to one microampere
DC	direct current
EIRP	equivalent isotropically radiated power
ERP	effective radiated power
EUT	equipment under test
F	frequency
GHz	gigahertz
GND	ground
H	height
HL	Hermon laboratories
Hz	hertz
k	kilo
kHz	kilohertz
LO	local oscillator
m	meter
MHz	megahertz
min	minute
mm	millimeter
ms	millisecond
μ s	microsecond
NA	not applicable
NB	narrow band
OATS	open area test site
Ω	Ohm
QP	quasi-peak
RE	radiated emission
RF	radio frequency
rms	root mean square
Rx	receive
s	second
T	temperature
Tx	transmit
V	volt

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