

# FINAL DRAFT EN 302 264 v2.1.1

# AS REFERENCED BY TEST PLAN 11647276-TP1V6

# **TEST REPORT**

FOR

# MILLIMETERWAVE E-BAND RADAR SENSOR DEVELOPMENT BOARD

MODEL SERIES: AWR1843BOOST, IWR1843BOOST

# REPORT NUMBER: 12554995-E2V2

# ISSUE DATE: JULY 31, 2019

Prepared for TEXAS INSTRUMENTS 12500 TI BLVD. DALLAS TEXAS, 75243, USA

Prepared by UL VERIFICATION SERVICES INC 47173 BENICIA STREET FREMONT, CA 94538, U.S.A. TEL: (510) 771-1000 FAX: (510) 661-0888

## **Revision History**

Rev.	lssue Date	Revisions	Revised By
V1	7/19/2019	Initial Issue	M. Heckrotte
V2	7/31/2019	Update Test Plan Reference and Added Model Number	Conan Cheung

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# **1. ATTESTATION OF TEST RESULTS**

COMPANY NAME:	TEXAS INSTRUMENTS 12500 TI BLVD. DALLAS, TEXAS 75243 USA
EUT DESCRIPTION:	MMWAVE E-BAND RADAR SENSOR DEVELOPMENT BOARD
MODEL SERIES:	AWR1843BOOST, IWR1843BOOST
SERIAL NUMBERS:	5498400022 (Rev. A) & 5727000006 (Rev. B)
DATE TESTED:	JANUARY 17, 2019 – APRIL 17, 2019

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
Final Draft EN 302 264 v2.1.1	Complies
as referenced by Test Plan 11647276-TP1V6	

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of the U.S. government.

Approved & Released For UL Verification Services Inc. By:

M.H

MICHAEL HECKROTTE PRINCIPAL ENGINEER UL Verification Services Inc.

Tested By:

GIA-PIAO CHIN TEST ENGINEER UL Verification Services Inc.

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# 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with Final Draft EN 302 264 v2.1.1 and EN 303 396 v1.1.1, as referenced by Test Plan 11647276-TP1V6.

# 3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street	47658 Kato Rd		
Chamber A	Chamber D	Chamber I		
Chamber B	Chamber E	Chamber J		
Chamber C	Chamber F	🛛 Chamber K		
	Chamber G	Chamber L		
	Chamber H			

The above test sites and facilities are covered under FCC Test Firm Registration # 208313.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0.

The Laboratory's Scope of Accreditation does not include Final Draft EN 302 264 v2.1.1 or EN 303 396 v1.1.1.

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# 4. CALIBRATION AND UNCERTAINTY

# 4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

# 4.2. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Radio Frequency	±3.5 x 10^(-8)
Radiated RF power (up to 40 GHz)	±5.3 dB
Radiated RF power (above 40 up to 66 GHz)	±5.1 dB
Radiated RF power (above 66 up to 100 GHz)	±5.4 dB
Radiated RF power (above 100 GHz)	±5.0 dB
Temperature	±0.9 deg C
Humidity	±4.5 % RH
DC and low frequency voltages	±0.45 %

Uncertainty figures are valid to a confidence level of 95%.

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# 5. EQUIPMENT UNDER TEST

# 5.1. DESCRIPTION OF EUT

See Test Plan 11647276-TP1V6.

# 5.2. OUTPUT POWER

The highest Peak Output Power in the 1300 MHz BW mode is 20.06 dBm EIRP over normal and extreme temperature conditions.

The highest Peak Output Power in the 4 GHz BW mode is 24.05 dBm EIRP over normal and extreme temperature conditions.

# 5.3. SOFTWARE AND FIRMWARE

The software used on the support laptop is mmWave Studio 2.0.0.2 and the DFP package is mmwave\_dfp\_01.02.00.01 for the 18xx series.

Two test scripts with 1300 MHz and 4 GHz operating bandwidths, transmitting maximum power, were provided and used at all RF tests.

Texas Instruments mmWave\_Demo.Visualizer ver 3.1.0 software was utilized for the Receiver In-band, Out-of-band and Remote-band Signals Handling tests.

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# 5.4. DESCRIPTION OF TEST SETUP

## SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST								
Description	Manufacturer	Model	Serial Number					
Laptop	Dell	E7450	713FR72					
Laptop Power Supply	Dell	DA130PE-00	CN-OJU012-48661-12E-DYX1-A04					
5VDC 3A Adapter	CUI Japan	EMSA050300						
5VDC 2A Adapter	Volgen	KTPS10-05020WA						
Data Capture Board	TI	DCA1000EVM	3718DCA1000EVM0102					

## I/O CABLES

I/O Cable List									
Cable No	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks			
1	AC	1	3-prong	Unshielded	0.9				
2	DC	1	Barrel	Unshielded	1.8				
3	AC	1	3-prong	Unshielded	-				
4	DC	1	Barrel	Unshielded	1.5				
5	AC	1	3-prong	Unshielded	-				
6	DC	1	Barrel	Unshielded	1.5	Ferrite on DC			
7	60-Pin	1	60-Pin	Flat Ribbon	0.08				
8	USB	2	USB 2.0 Male - USB mini	Shielded	0.9				

#### TEST SETUP

The EUT is connected to a laptop computer. Software within the computer is used to configure and exercise the EUT.

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#### SETUP DIAGRAM FOR TESTS



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## SETUP DIAGRAM FOR TEST



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# 6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment List									
Description	Manufacturer	Model	S/N or Local ID	Cal Due					
PXA Signal Analyzer	Agilent	N9030A	T313	1/25/2020					
PSG Analog Signal Generator, 250KHz to 50GHz	Keysight	E8257D	PRE0160761	8/13/2019					
60-90 GHz Horn	CMi	HO12R	H12-2	9/20/2019					
60-90 GHz Downconverter	OML	C12H1DC01	180530-1	CNR					
Isolator, 60-90 GHz	Millitech	FBI-12-RSES0	A18672	CNR					
RF Diode Detector, 60-90 GHz	Millitech	DET-12-RPFW0	A18672	CNR					
Power Sensor, 75-110 GHz	Agilent	W8486A	T411	8/15/19					
P-Series Power Meter	Keysight	N1913A	PRE0078027	1/30/2020					
Digital Signal Analyzer, 8 GHz	Agilent	DSA90804A	PRE0079430	8/10/2019					
Low Pass Filter, 10 MHz	Solar Electric Co.	6623-10	T417	9/25/2019					
Voltage Amplifier, 200 MHz	FEMTO	HVA-200M-40-B	PRE0184145	CNR					
0.01 – 26.5 GHz Amplifier	Agilent	83006A	12020	9/25/2019					
Horn antenna, 33-50 GHz	СМі	HO22R		CNR					
LNA, 40-50 GHz	Spacek Labs	SL4510-33-4W	14J05	9/24/2019					
50-75 GHz Horn	CMi	HO15R	H15-1	9/20/2019					
LNA, 50-75 GHz	Vivatech	VTLNA-15-6018-FB	2013051	CNR					
50-75 GHz Downconverter	OML	C15H1DC01	PRE0180075	CNR					
75-110 GHz Horn	CMi	HO10R	H10-1	9/20/2019					
LNA, 75-110 GHz	Spacek	SLW-22-5	15J04	CNR					
75-110 GHz Downconverter	OML	C10H1DC01	PRE0180076	CNR					
110-170 GHz Horn	CMi	HO6R	H06-1	9/20/2019					
LNA 110-170 GHz	VivaTech	VTLNA-01S01	2015085	CNR					
110-170 GHz Downconverter	VDI	SAX 228	PRE0175814	CNR					
170-260 GHz Horn	CMi	HO4R	H04-1	9/20/2019					
170-260 GHz Downconverter	VDI	SAX 229	PRE0175628	CNR					
ESW EMI Test Receiver 44 GHz	Rohde & Schwartz	ESW44	PRE0179375	5/8/2019					
Hybrid Antenna, 30MHz to 3GHz	SunAR	JB3	PRE0184052	10/24/2019					
Amplifier, 9kHz to 1GHz, 32dB	Sonoma Instruments	310	PRE0186650	12/13/2019					
Antenna, Horn 1-18GHz	ETS Lingren	3117	T344	4/30/2019					
1-18 GHz Amplifier	Amplical	AMP1G18-35	T1569	6/3/2019					
44 GHz Test Receiver	Rohde & Schwartz	ESW	PRE0179378	5/8/2019					
HF Switch Box & Preamps 18-40 GHz	UL		PRE0183142	7/3/2019					
Antenna, Horn 18 to 26.5GHz	ARA	MW H-1826/B	T448	3/13/2019					
Antenna, Horn 26.5 to 40GHz	ARA	MW H-2640/B	T445	3/13/2019					
60-90 GHz Source	VDI	SGX 213	PRE0165570	CNR					
60-90 GHz Rotary Attenuator	Flann Microwave	26110	T1687	CNR					
50-75 GHz Power Sensor	Agilent	V8486A	T433	9/6/2019					
Signal Generator, 250kHz-40 GHz	Agilent	E8257D	T181	2/7/2020					
Environmental Chamber	Cincinnati Sub Zero	ZP8	T754	4/2/2019					
Digital Multimeter	Fluke	77 IV	30860448	4/20/2019					
UL EMC Radiated Software	Version	Rev. 9.5.22							

All horn antennas at and above the 33-50 GHz band are standard gain horns. In accordance with C63.10 clause 4.4.3 (a) these antennas do not need to be calibrated. UL measures the critical dimensions on an annual basis and checks for damage and deterioration before each test.

C63.10 clause 4.4.3 a) Standard gain horns need not be periodically recalibrated, unless damage or deterioration is suspected or known to have occurred. If a standard gain horn is not periodically recalibrated, then its critical dimensions (see IEEE Std 1309-2005) shall be verified and documented on an annual basis.

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# 7. APPLICABLE LIMITS AND TEST RESULTS

# 7.1. DUTY CYCLE

# LIMIT

None, for reporting purposes only.

# TEST PROCEDURE

The fundamental is measured using a Standard Gain Horn Antenna, Low Noise Amplifier and Downconverter feeding a Diode Detector connected to an Oscilloscope. Pulse widths, burst lengths, and periods are measured, then the duty cycle is calculated.

The total Duty Cycle is calculated as the duty cycle across bursts multiplied by the duty cycle within each burst.

The duty cycle factor is calculated as:

Duty Cycle Factor (dB) =  $10 \times Log (1 / x)$ Where X = Duty Cycle (linear)

# **RESULTS**

	BETWEEN BURST				WITHIN BURST			TOTAL			
BW	ON Time	Period	Duty Cycle		<b>ON</b> Time	Period	Duty Cycle	Duty Cycle	<b>Duty Cycle Correction</b>		
Mode	(msec)	(msec)	(linear)		(msec)	(msec)	(linear)	(linear)	(%)	(dB)	
1300 MHz	7.39	16.06	0.460		51.33	57.11	0.899	0.41	41.36	3.83	
4 GHz	5.80	13.00	0.446		37.55	45.55	0.824	0.37	36.78	4.34	

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## 1300 MHz BW Mode

#### **Between Bursts**





## Within Burst





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#### Between Bursts





# Within Burst





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# 7.2. OPERATING FREQUENCY RANGE

#### **LIMITS**

EN 302 264 Clause 4.3.1.3

The upper and lower limits of the operating frequency range shall meet the following conditions:  $F_L \ge 77 \text{ GHz}$  $F_H \le 81 \text{ GHz}$ 

## TEST PROCEDURE

The fundamental signal is measured in far-field conditions using a Standard Gain Horn Antenna, Downconverter and Pre-Amplifier.

The operating frequency range is measured as the -23 dBc BW. A manual measurement and an automatic measurement are made in far-field conditions. Automatic measurements are made in near-field conditions over extreme temperatures using an environmental chamber. Automatic measurements utilize the spectrum analyzer internal Occupied Bandwidth measurement

# **RESULTS**

BW	Temp.	Center	Freq	FL	FL	Result	F <sub>H</sub>	F <sub>H</sub>	Result	-23 dB
Mode		Freq	Error		Limit	Pass/		Limit	Pass/	Bandwidth
	(°C)	(GHz)	(GHz)	(GHz)	(GHz)	Fail	(GHz)	(GHz)	Fail	(GHz)
1300 MHz	Normal			77.103	≥ 77	Pass	78.408	≤ 81	Pass	1.305
1300 MHz	Normal	77.75	0.00880	77.109	≥ 77	Pass	78.409	≤ 81	Pass	1.300
1300 MHz	-20	77.75	0.01281	77.114	≥ 77	Pass	78.412	≤ 81	Pass	1.298
1300 MHz	60	77.75	0.00525	77.103	≥ 77	Pass	78.408	≤ 81	Pass	1.305
				_						
4 GHz	Normal			77.166	≥ 77	Pass	80.964	≤ 81	Pass	3.798
4 GHz	Normal	79	0.07248	77.179	≥ 77	Pass	80.966	≤ 81	Pass	3.787
4 GHz	-20	79	0.08033	77.187	≥ 77	Pass	80.974	≤ 81	Pass	3.787
4 GHz	60	79	0.06941	77.173	≥ 77	Pass	80.965	≤ 81	Pass	3.792

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### 1300 MHz BW Mode

#### Frequency Center Freq 77.750000000 GHz #Avg Type: RMS PNO: Fast Trig: Free Run #Atten: 10 dB DET A Mkr1 78.391 GHz -32.48 dBm Auto Tur 10 dB/div Ref 0.00 dBm Center Free 77.75000000 GH Start Free 76.750000000 GH Stop Fred 78.75000000 GH; CF Step 200.000000 1 Ма uto Freq Offset 70.00000000 GHz Freq Offset 70.000000000 GHz #VBW 3.0 MHz Center 77.750 GHz #Res BW 1.0 MHz Span 2.000 GHz #Sweep 200.0 s (2001 pts) MODE TRO N 1 f N 1 f N 1 f 78.391 GHz 77.103 GHz 78.408 GHz -32.484 dBm -56.53 dBm -56.31 dBm 2 3 STATUS

#### Normal Condition – Manual Measurement

# Automatic Measurement in Environment Chamber

#### Temperature: +20°C



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#### 1300 MHz BW Mode

#### Automatic Measurement in Environment Chamber

#### Temperature: -20°C



#### Temperature: +60°C

Agilent Spect	rum Analyzer - Occupied B	W					
(XI Center F	RF 50Ω DC	CORREC Cen	SENSE:INT ter Freg: 77.75000000	0 GHz	05:31:40 F Radio Std	MFeb 07, 2019 : None	Frequency
Conter I		#IEGain:Low #Att	Trig: Free Run Avg Hold: 1/1			vice: BTS	
	ļ	HI Gam.cow		Ν	Akr1 79	30 CH7	
10 dB/div	Ref 0.00 dBm				-35.6	62 dBm	
Log							Contor From
-20.0							77 750000000 GHz
-30.0					1		
-40.0					<u> </u>		
-50.0							
-60.0							
-70.0							
-80.0							
-90.0							
Center 7	7.75 GHz				Sp	an 2 GHz	
#Res BW	1 MHz		#VBW 3 MHz		#Swe	ep 200 s	CF Step 200.000000 MHz
Occu	pied Bandwidt	h	Total Powe	er -6.6	5 dBm		<u>Auto</u> Man
		2673 GHz					
	•.						Freq Offset
Trans	mit Freq Error	5.2487 MHz	OBW Powe	er 9	9.00 %		70.00000000 GHZ
x dB B	Bandwidth	1.305 GHz	x dB	-23	.00 dB		
				<b>r</b> 1			
MSG				10 STATU	15		

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## 4 GHz BW Mode

#### Normal Condition – Manual Measurement



# Automatic Measurement in Environment Chamber

#### Temperature: +20°C



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#### 4 GHz BW Mode

# Automatic Measurement in Environment Chamber

#### Temperature: -20°C

Agilent Spec	ctrum Analyzer -	Occupied BW										
(X) Contor	RF 50			SEI Center F	NSE:INT	00000 GHz	ALIGN AUTO	01:50:24	PMFeb 08, 2019	Frequency		
Center	Freq 79.00		3HZ ++-	Trig: Fre	e Run	Avg Hold:	: 1/1					
		#	FGain:Low	#Atten: 1	#Atten: 10 dB				vice: BTS			
	Mkr1 80.936 GHz											
10 dB/div	Ref 0.0	)0 dBm						-24.0				
-10.0										Center Freg		
-20.0									1	79.000000000 GHz		
-30.0					$\sim$	<u> </u>						
-40.0												
-50.0												
-60.0	/											
-70.0												
-80.0												
-90.0												
Center	/9 GHZ M/1 MH7			#\/F	21A7 - 2 MILI	7		5  #Sw/	Dan 5 GHZ	CF Step		
The s Di				#VL				#300	eep Jous	500.000000 MHz		
Occu	upied Ban	dwidth			Total Pe	ower	7.22	dBm		<u>Auto</u> Man		
		3 7	074 GH	17								
		0.79		12						Freq Offset		
Trans	smit Freq E	rror	80.332 M	IHz	OBW P	ower	99	.00 %		70.000000000 GHz		
x dB	Bandwidth		3.787 G	iHz	x dB		-23.	00 dB				
MSG							<b>I</b> STATUS					
								1				

#### Temperature: +60°C

Agilent Spec	ctrum Analyzer -	Occupied BW										
<mark>IXI</mark> Contor	RF 50	ο ο ο ο ο ο ο ο ο ο ο ο ο ο ο ο ο ο ο	RREC	SEI Center Fi	NSE:INT	00000 GHz	ALIGN AUTO	10:37:43	AM Feb 08, 2019	Frequency		
Center	rieq / 9.00		эп <u>г</u> •••	Trig: Free Run Avg Hold: 1/1								
		#IF	Gain:Low	#Atten: 10	DdB			Radio De	vice: BTS			
	WK11 80.93 GHZ -26 949 dBm											
10 dB/div	Ref_0.0	00 dBm			1			-20.8	49 GBM			
-10.0										Center Freq		
-20.0									1	79.00000000 GHz		
-30.0					<u> </u>	<u> </u>	<u> </u>		·			
-40.0												
-50.0									{			
-60.0												
-70.0												
-80.0												
-90.0												
Center	70 CH7								an 5 CHz			
#Res BV	N 1 MHz			#VBW 3 MHz			an #Swi	eep 500 s	CF Step			
										500.000000 MHz Auto Man		
Οςςι	upied Ban	ldwidth			Total Po	ower	5.55	dBm				
		3.71	125 GH	Ιz						Erog Offort		
T							~			70 00000000 GHz		
Trans	smit Freq E	rror	69.407 W	IHZ	OBW P	ower	95	0.00 %		10.0000000000000		
x dB	Bandwidth		3.792 G	iHz	x dB		-23.	00 dB				
MSG								3				

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# 7.3. MEAN POWER SPECTRAL DENSITY

## LIMIT

EN 302 264 Clause 4.3.2.3

Table 2: Mean power spectral density, CEPT/ERC Recommendation 70-03 [i.1]

Frequency in GHz	77 GHz to 81 GHz
Maximum radiated average power spectral density (e.i.r.p.)	-3 dBm/MHz
[dBm/MHz] of the EUT	

# TEST PROCEDURE

EN 303 396 Clause 6.3.4

The fundamental signal is measured in far-field conditions using a Standard Gain Horn Antenna, Downconverter and Pre-Amplifier.

The fundamental signal is then measured in near-field conditions using the same test setup situated outside an environmental chamber. Channel Power Integration techniques are used to measure the total power. Without moving the near-field setup, the delta between the near-field raw measurements and the far-field corrected measurements is then applied to tests at extreme temperatures.

The measured power level is converted to EIRP using the Friis equation:

## $EIRP = P_T * G_T = (P_R / G_R) * (4 * Pi * D / \lambda)^2$

where,

 $P_R$  is the received power  $G_R$  is the gain of the receive measurement antenna D is the measurement distance  $\lambda$  is the wavelength

Notes: Calculations are made in the log form equivalent to the linear form listed above.

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## FAR FIELD BOUNDARY CALCULATIONS

The far-field boundary is given as:

 $R_{far field} = (2 * L^2) / \lambda$ 

where,

- L = Largest Antenna Dimension, including the reflector, in meters
- $\lambda$  = wavelength in meters

The dimension of integral Tx patch antenna is 8.8 mm x 5.8 mm.

Frequency	L	Lambda	R (Far Field)
(GHz)	(m)	(m)	(m)
77	0.0105	0.0039	0.0566
81	0.0105	0.0037	0.0595

The dimension of receiving Rx E-band horn antenna is 22.9 mm x 30 mm.

Frequency	L	Lambda	R (Far Field)		
(GHz)	(m)	(m)	(m)		
77	0.0378	0.0039	0.7335		
81	0.0378	0.0037	0.7716		

Radiated power measurements are performed at a 1.5 meter test distance.

# **RESULTS**

Environmental	Mode	Frequency	Meas.	Meas.	Corr	Duty Cycle	Mean	Temp Chamber	Mean PSD	Margin
Condition	BW		Power	Distance	Meas	Corr Fact	PSD	Factor	Limit	
		(GHz)	(dBm)	(m)	(dBm/MHz EIRP)	(dB)	(dBm/MHz EIRP)	(dB)	(dBm/MHz EIRP)	(dB)
Far Field Ambient	1300 MHz	78.391	-32.578	1.5	-14.27	3.83	-10.44		-3	-7.44
Chamber Ambient -20°C	1300 MHz 1300 MHz	77.125 78.396	-32.767 -32.417				-10.44 -10.09	22.32	-3 -3	-7.44 -7.09
+60°C	1300 MHz	77.121	-35.678				-13.35		-3	-10.35
Far Field Ambient	4 GHz	80.929	-34.663	1.5	-14.46	4.34	-10.12		-3	-7.12
Chamber Ambient	4 GHz	80.928	-25.42				-10.12	15.30	-3	-7.12
-20°C	4 GHz	80.937	-24.986				-9.69		-3	-6.69
+60°C	4 GHz	80.929	-27.168				-11.87		-3	-8.87

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#### 1300 MHz BW Mode

#### Normal Condition – Far Field



## Environment Chamber – Near Field

#### Temperature: +20°C



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# 1300 MHz BW Bode

# Temperature: -20°C

Agilent Spectrum	n Analyzer - Swept SA							
X.	RF 50 Ω DC	CORREC	SENSE:INT	β	LIGN AUTO	07:58:00 PM	4Feb 07, 2019	Frequency
Center Fre	q 77.7500000	00 GHz		#Avg Type	: RMS	TRAC	E 1 2 3 4 5 6	Frequency
		PNO: Fast ↔ IFGain:Low	#Atten: 10 dB			DE		Auto Tune
10 dB/div	Ref 0.00 dBm				IMI	kr1 78.3 -32.4	96 GHZ 17 dBm	
Log								
								Center Freq
-10.0								77.750000000 GHz
-20.0								Start From
						<b>_</b> 1		76 75000000 CHz
-30.0	h mar					9		70.750000000 0112
-40.0								Stop Freq
								78.750000000 GHz
-50.0								
								CE Stop
-60.0								200.000000 MHz
								<u>Auto</u> Man
-70.0								
								Erea Offset
-80.0								70 00000000 GHz
								70.000000000 0112
-90.0								
Center 77.7	50 GHz	Freq Off	set 70.000000000 G	Hz		Span 2	.000 GHz	
#Res BW 1.	U IVIHZ	#VBW	3.0 IVIHZ		#Sweep	200.0 s (	2001 pts)	

#### Temperature: -+60°C

Agilent Spec	trum Analyze	r - Swept SA					
w Center I	RF Freq 77.7	50 Ω DC 7500000	CORREC	SENSE:INT	ALIGN AUTO Avg Type: RMS	05:04:40 PM Feb 07, 2019 TRACE 1 2 3 4 5 6	Frequency
10 dB/div	Ref 0.0	)0 dBm	PNO: Fast ↔ IFGain:Low	#Atten: 10 dB	M	kr1 77.121 GHz -35.678 dBm	Auto Tune
-10.0							Center Freq 77.750000000 GHz
-20.0		1					<b>Start Freq</b> 76.750000000 GHz
-40.0							<b>Stop Freq</b> 78.750000000 GHz
-60.0							CF Step 200.000000 MHz <u>Auto</u> Man
-80.0							Freq Offset 70.000000000 GHz
-90.0 Center 7 #Res BW	7.750 GH / 1.0 MHz	z	Freq Off #VBW	set 70.00000000 G 3.0 MHz*	;Hz #Sweep	Span 2.000 GHz 200.0 s (2001 pts)	
мsg 🧼 Alig	nment Cor	npleted			STATU:	3	<u></u>

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# 4 GHz BW Mode

# NORMAL CONDITION – Far Field



# Environment Chamber – Near Field

#### Temperature: +20°C

Agilent Spect	rum Analyzer - Swept SA							
w Center F	RF 50 Ω DC	CORREC	SENSE:INT	Avg Type	ALIGN AUTO	12:50:57 Pf TRAC	MFeb 08, 2019 E 1 2 3 4 5 6	Frequency
10 dB/div	Ref 0.00 dBm	PNO: Fast ↔ IFGain:Low	Atten: 10 dB	Avginoia.	M	kr1 80.9 -25.4	28 GHz 20 dBm	Auto Tune
-10.0								Center Freq 79.000000000 GHz
-20.0							1	Start Freq 76.50000000 GHz
-40.0								Stop Freq 81.500000000 GHz
-60.0								CF Step 500.000000 MHz <u>Auto</u> Man
-80.0								Freq Offset 70.000000000 GHz
Center 79	9.000 GHz 1.0 MHz	Freq Off	set 70.000000000 G 3.0 MHz*	GHz	#Sween	Span 5	.000 GHz	
MSG						3	pto,	<u>.</u>

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# 4 GHz BW Mode

#### Temperature: -20°C

Agilent Spectr	rum Analyzer - Swept SA					
LXI	RF 50 Ω DC	CORREC	SENSE:INT	ALIGN AUTO	01:23:16 PM Feb 08, 2019	En average
Center F	reg 79.000000	00 GHz		Avg Type: RMS	TRACE 1 2 3 4 5 6	Frequency
	•	PNO: Fast ↔↔ IFGain:Low	Trig: Free Run Atten: 10 dB	Avg Hold: 1/1	DET A N N N N N	
				м	kr1 80.937 GHz	Auto Tune
10 dB/div	Ref 0.00 dBm				-24.960 UBM	
						Center Freq
-10.0						79.00000000 GHz
-20.0					1	
						Start Freq
-30.0						70.30000000 GH2
-40.0						Ston Fred
						81.500000000 GHz
-50.0						
-60.0	<u>_</u>					CF Step
70.0						<u>Auto</u> Man
-70.0						
-80.0						Freq Offset
						10.000000000000
-50.0						
Center 79	.000 GHz	Freq Off	set 70.00000000 GI	lz	Span 5.000 GHz	
#Res BW	1.0 IVIMZ	#vBW	3.U IVIMZ^	#Sweep	ວບບ.ບ s (ວບບາ pts)	
MSG					s	

#### Temperature: +60°C



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# 7.4. PEAK POWER

# LIMIT

EN 302 264 Clause 4.3.3.3

The peak power for EUT with fixed beam or scanning antenna shall not be greater than 55 dBm.

# TEST PROCEDURE

EN 303 396 Clause 6.3.3

The fundamental signal is measured in far-field conditions using a Standard Gain Horn Antenna, Downconverter and Pre-Amplifier.

The fundamental signal is then measured in near-field conditions using the same test setup situated outside an environmental chamber. Without moving the near-field setup, the delta between the near-field raw measurements and the far-field corrected measurements is then applied to tests at extreme temperatures.

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# **RESULTS**

Normalized Sweep Rate Correction Factor:

FMCW	Ramp	Sweep	Sweep	RBW	Normalized	Amplitude	Amplitude
Width	Time	Rate	Rate		Sweep Rate	Loss	Loss
(MHz)	(us)	(MHz/us)	(Hz/s)	(Hz)	(lin)	(lin)	(dB)
1305	51.33	25.424	2.54E+13	8.00E+06	0.40	0.992	-0.066
3798	37.55	101.145	1.01E+14	8.00E+06	1.58	0.906	-0.861

Environmental	Mode	Freq.	Meas.	Meas.	Corr	Norm. Swp Rate	Peak	Temp Chamber	Peak	Margin
Condition	BW		Power	Dist.	Meas	Corr. Factor	Power	Factor	Limit	
		(GHz)	(dBm)	(m)	(dBm EIRP)	(dB)	(dBm EIRP)	(dB)	(dBm EIRP)	(dB)
Far Field Ambient	1300 MHz	77.137	2.25	1.5	19.41	0.066	19.47		55	-35.53
Chamber Ambient	1300 MHz	77.129	1.938				19.47	17.54	55	-35.53
-20°C	1300 MHz	77.134	2.525				20.06		55	-34.94
+60°C	1300 MHz	77.134	-0.438				17.10		55	-37.90
Far Field Ambient	4 GHz	80.931	2.176	1.5	22.32	0.861	23.18		55	-31.82
Chamber Ambient	4 GHz	80.929	11.484				23.18	11.69	55	-31.82
-20°C	4 GHz	80.938	12.351				24.05		55	-30.95
+60°C	4 GHz	80.414	10.574				22.27		55	-32.73

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### 1300 MHz BW Mode

#### Normal Condition – Far Field

Agilent Spectrum Analyzer - Swept SA				
Center Freq 77.750000000 GHz	SENSE:INT ALIG	#Avg Type: Log	-Pwr TR/	M Jan 30, 2019 ACE 1 2 3 4 5 6 Frequency
10 dB/div Ref 10.00 dBm	PNO: Fast Ing. Free Ru IFGain:Low #Atten: 20 dE	3	Mkr1 77. 2	137 GHz Auto Tune
0.00				Center Freq 77.750000000 GHz
-10.0				Start Freq 76.750000000 GHz
-20.0				Stop Freq 78.750000000 GHz
-40.0				CF Step 200.000000 MHz <u>Auto</u> Man
-50.0				Freq Offset 70.00000000 GHz
-70.0				
-80.0				
Center 77.750 GHz #Res BW 8 MHz	Freq Offset 70.000 #VBW 50 MHz	000000 GHz	Span #Sweep 200.0 s	2.000 GHz (2001 pts)
MSG		ST	TATUS	

## Environment Chamber – Near Field

#### Temperature: +20°C



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#### 1300 MHz BW Mode

# Temperature: -20°C

Agilent Spect	rum Analyzer - Swept SA					
LXI	RF 50 Ω DC	CORREC	SENSE:INT	ALIGNAUTO	08:09:18 PM Feb 07, 201	Erequency
Center F	req 77.7500000	00 GHz	Tuin: Ence Dun	#Avg Type: Log-Pwr	TRACE 1 2 3 4 5	6 Trequency
		PNO: Fast ↔ IFGain:Low	#Atten: 20 dB		DET P N N N N	N Auto Tuno
				M	kr1 77.134 GH	z Auto Tune
10 dB/div	Ref 10.00 dBm				2.525 081	
209	<b>▲</b> 1					
					-	Center Freq
0.00						77.750000000 GHz
-10.0						-
						StartFreq
-20.0						76.750000000 GHz
30.0						
-50.0					Man	Stop Freq
adara prince	states and services				- Aller and the	78.750000000 GHz
-40.0						-
-50.0						CF Step
						200.000000 MHz
60.0						<u>Auto</u> Man
-60.0						
						Fred Offset
-70.0						
						70.00000000 GHz
-80.0						_
Center 77	7.750 GHz	Freq Of	fset 70.000000000 (	GHz	Span 2.000 GH	z
#Res BW	8 MHz	#VBW	50 MHz	#Sweep	200.0 s (2001 pts	5)
					( F	, L

#### Temperature: +60°C

Agilent Spectrum Analyzer - Swept SA					
Center Freq 77.750000000	CORREC		ALIGNAUTO Avg Type: Log-Pwr	05:18:21 PM Feb 07, 2 TRACE 1 2 3	Frequency
10 dB/div Ref 10.00 dBm	PNO: Fast 🔸 1119-1 IFGain:Low #Atter	n: 20 dB	M	kr1 77.134 G -0.438 dE	Hz Auto Tune
0.00					Center Freq 77.750000000 GHz
-10.0					Start Freq 76.750000000 GHz
-30.0 -40.0					<b>Stop Freq</b> 78.75000000 GHz
-50.0					CF Step 200.000000 MHz <u>Auto</u> Man
-70.0					Freq Offset 70.000000000 GHz
-80.0	Freq Offset 70. #VBW 50 Mi	000000000 GHz	#Sween	Span 2.000 0	;Hz
MSG DAlignment Completed	" <b>1 D T T T T</b>				

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# 4 GHz BW Mode

#### Normal Condition – Far Field

Agilent Spectrum Analyzer - Swept SA				
Center Freq 79.000000000 GHz	SENSE:INT ALIG	Avg Type: Log-Pwr Avg Hold: 1/1	02:41:52 PM Jan 30, 2019 TRACE 1 2 3 4 5 6 TYPE M WARNAW	Frequency
10 dB/div Ref 10.00 dBm	IFGain:Low #Atten: 20 di	8	<u>مورد</u> Mkr1 80.931 GHz 2.176 dBm	Auto Tune
0.00			1	Center Freq 79.000000000 GHz
-10.0				Start Freq 76.50000000 GHz
-20.0				Stop Freq 81.50000000 GHz
-40.0				CF Step 500.000000 MHz Auto Man
-50.0				Freq Offset 70.00000000 GHz
-70.0				
-90.0				
Center 79.000 GHz #Res BW 8 MHz	Freq Offset 70.000 #VBW 50 MHz	000000 GHz	Span 5.000 GHz #Sweep 130.0 s (5001 pts)	
M5G		STATUS		

# Environment Chamber – Near Field

#### Temperature: +20°C



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# 4 GHz BW Mode

#### Temperature: -20°C

Agilent Spectrum Analy	zer - Swept SA					
Center Freq 79	50 Ω DC	CORREC	SENSE:INT	ALIGN AUTO Avg Type: Log-Pwr	01:34:56 PM Feb 08, 2019 TRACE 1 2 3 4 5 6	Frequency
10 dB/div <b>Ref</b> :	20.00 dBm	PNO: Fast ↔ IFGain:Low	#Atten: 30 dB	Avg Hold: 1/1	kr1 80.938 GHz 12.351 dBm	Auto Tune
10.0	~~~~					Center Freq 79.000000000 GHz
-10.0						Start Freq 76.50000000 GHz
-20.0 -30.0						<b>Stop Freq</b> 81.50000000 GHz
-40.0						CF Step 500.000000 MHz <u>Auto</u> Man
-60.0						Freq Offset 70.000000000 GHz
Center 79.000 C #Res BW 8 MHz	GHz	Freq Off #VBW	set 70.00000000 G 50 MHz	Hz #Sweep	Span 5.000 GHz 130.0 s (5001 pts)	
MSG						t

#### Temperature: +60°C



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# 7.5. UNWANTED EMISSIONS IN THE OUT-OF-BAND DOMAIN

#### <u>LIMIT</u>

EN 302 264 Clause 4.3.4.3

The RMS mean power spectral density radiated in the calculated out-of-band domain (between  $F_1$  to  $f_L$  and  $f_H$  to  $F_2$  band) shall not be greater than the values given in table 3.

Table 3: Limits for out of band radiation, C	CEPT/ERC/REC 74-01	i.3
--	--------------------	-----

Frequency [GHz]	RMS mean power spectral density [dBm/MHz]
F <sub>1</sub> ≤ f < f <sub>L</sub>	-30
f <sub>H</sub> < f ≤ F <sub>2</sub>	-30

The values fL and fH are the results of the operating frequency range conformance test, see clause 4.3.1.4.

The values F1 and F2 are calculated as in ETSI EN 303 396 [1], clause 6.2.11.

Note that the out-of-band domain may be larger or smaller than the maximum permitted range of operation.

## TEST PROCEDURE

EN 303 396 Clause 6.2.11

OOB Emissions are measured in far-field conditions using a Standard Gain Horn Antenna, Downconverter and Pre-Amplifier.

## **RESULTS**

Mode	Meas.	Freq.	Meas.	Meas.	Corr	Duty Cycle	OOB	OOB	Margin
BW	Band		Power	Dist.	Meas	Corr Fact	Power	Limit	
		(CH-)	(dBm)	(m)	(dBm/MHz	(dD)	(dBm/MHz	(dBm/MHz	(dD)
		(GHZ)	(автт)	(m)	EIRP)	(UB)	EIRP)	EIRP)	(ав)
1300 MHz	OOB LOW	77.103	-70.158	1.5	-39.63	3.83	-35.80	-30	-5.80
1300 MHz	OOB HIGH	78.408	-67.615	1.5	-38.66	3.83	-34.83	-30	-4.83
4 GHz	OOB LOW	77.166	-72.13	1.5	-37.27	4.34	-32.93	-30	-2.93
4 GHz	OOB HIGH	80.964	-70.472	1.5	-37.21	4.34	-32.87	-30	-2.87

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# 1300 MHz BW Mode

#### OOB LOW

Agilent Spectrum Analyzer - Swept SA					
Start Freq 74.493000000 GHz	SENSE:INT	ALIGNAUTO	#Avg Type: RMS	06:45:15 PM Jan 31, 2019 TRACE 1 2 3 4 5 6	Frequency
10 dB/div Ref 0.00 dBm	PNO: Fast +++ IFGain:Low	Trig:FreeRun #Atten:10 dB		Mkr1 77.103 GHz -70.158 dBm	Auto Tune
-10.0					Center Freq 75.798000000 GHz
-20.0					Start Freq 74.493000000 GHz
-30.0					Stop Freq 77.103000000 GHz
-50.0					CF Step 261.000000 MHz Auto Man
-60.0				1	Freq Offset 70.00000000 GHz
-70.0					
-90.0					
Start 74.493 GHz #Res BW 1.0 MHz	Frec #VE	9 Offset 70.000000000 GHz BW 3.0 MHz	z	Stop 77.103 GHz #Sweep 210.0 s (2611 pts)	
MSG			STATUS		

# OOB HIGH

Agilent Spectrum Analyzer - Swept SA				
Start Freq 78.408000000 GHz	SENSE:INT ALI	IGN AUTO #Avg Type: RMS Bun	06:58:49 PM Jan 31, 20 TRACE 1 2 3 4 TYPE WWWM	5 6 Frequency
10 dB/div Ref 0.00 dBm	IFGain:Low #Atten: 10 c	18	oer ANNN Mkr1 78.408 GI -67.615 dB	Auto Tune
-10.0				Center Freq 79.713000000 GHz
-20.0				Start Freq 78.408000000 GHz
-30.0				Stop Freq 81.018000000 GHz
-40.0				CF Step 261.000000 MHz Auto Man
-60.0				Freq Offset
-70.0				
-80.0				
Start 79 409 CH2	Fred Offset 75.00	0000000 GHz	Stop 91 019 C	
#Res BW 1.0 MHz	#VBW 3.0 MHz	Z	#Sweep 210.0 s (2611 p	ts)
MSG		ST	ATUS	

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# 4 GHz BW Mode

## OOB LOW

Agilent Spectrum Analyzer - Swept SA							
Start Freq 69.570000000 GHz	SENSE:INT	ALIGN AUT	Avg Type	: RMS	03:27	19 PM Jan 31, 2019 TRACE 1 2 3 4 5 6	Frequency
10 dB/div Ref 0.00 dBm	PNU: Fast IFGain:Low	#Atten: 10 dB			Mkr1 7	7.166 GHz 72.13 dBm	Auto Tune
-10.0							Center Freq 73.368000000 GHz
-20.0							Start Freq 69.570000000 GHz
-30.0							Stop Freq 77.166000000 GHz
-50.0							CF Step 759.600000 MHz Auto Man
-60.0							Freq Offset 69.00000000 GHz
-70.0							
-30.0							
Start 69.570 GHz #Res BW 1.0 MHz	Fre #V	eq Offset 69.000000 /BW 3.0 MHz*	000 GHz	#	Stoj Sweep 500.0	o 77.166 GHz ) s (7597 pts)	
MSG				STATUS			

# OOB HIGH

Agilent Spectrum Analyzer - Swept SA						
Start Freq 80.964000000 GHz	SENSE:INT	ALIGNAUTO	Avg Type: RMS	07:49:2 T	5 PM Jan 31, 2019 RACE 1 2 3 4 5 6	Frequency
10 dB/div Ref 0.00 dBm	PNO: Fast ↔→ Trig: IFGain:Low #Atte	Free Run en: 10 dB	Avg Hold: 1/100 Mkr1 80.964 GHz -70.472 dBm			Auto Tune
-10.0						Center Freq 84.762000000 GHz
-20.0					[	Start Freq 80.964000000 GHz
-30.0						<b>Stop Freq</b> 88.56000000 GHz
-50.0						CF Step 759.600000 MHz Auto Man
-60.0						Freq Offset 75.00000000 GHz
-70.0						
Start 80.964 GHz	Freq Offse	t 75.000000000 GHz		Stop	88.560 GHz	
#Res DVV 1.U WIMZ	#vBW 3.0	u winz^	STATUS	#Sweep 500.0	s (7 297 pts)	

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# 7.6. UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

#### LIMIT

EN 302 264 Clause 4.3.5.3

The effective radiated power of any radiated spurious emission shall be not greater than the values given in table 4.

Table 4: Limits of radiated spurious emissions [i.3]

Frequency range (MHz)	Limit values for spurious radiation	Detector type
47 to 74	-54 dBm e.r.p.	Quasi-Peak
87,5 to 118	-54 dBm e.r.p.	Quasi-Peak
174 to 230	-54 dBm e.r.p.	Quasi-Peak
470 to 790	-54 dBm e.r.p.	Quasi-Peak
otherwise in band 30 to 1 000	-36 dBm e.r.p.	Quasi-Peak
f > 1 000 to 300 000 (see note)	-30 dBm e.i.r.p.	mean
NOTE: According to CEPT/ERC/REC fundamental frequency.	74-01 [i.3], spurious emission is measured up to t	he 2 <sup>nd</sup> harmonic of the

## TEST PROCEDURE

EN 303 396 Clause 6.3.10

## **RESULTS**

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Rev 9.5 11 Jan 2019

# 7.6.1. TX UNWANTED EMISSIONS, 30 - 1000 MHz



#### 1300 MHz BW Mode (Rev A. Board)

38–1000MHz 1300MHz BW\_Ma× Pwr.DAT

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# 1300 MHz BW Mode (Rev A. Board)

#### **Radiated Emissions**

Marker	Frequency (MHz)	Meter Reading (dBm)	Det	AF PRE0184052 (dB/m)	Amp/Cbl (dB)	Amp/Cbl (dB)	Corrected Reading (dBm)	EN 302 264 v2.1.1 – Qp Limit	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	294.8541	-34.87	Pk	19.2	-29.8	8.2	-37.27	-	-	16	193	Н
1	294.8541	-39.64	Qp	19.2	-29.8	8.2	-42.04	-36	-6.04	16	193	Н
2	449.978	-62.78	Pk	22.7	-29.2	12.9	-56.38	-	-	349	196	Н
2	449.978	-64.17	Qp	22.7	-29.2	12.9	-57.77	-36	-21.77	349	196	Н
3	624.99	-69.84	Pk	25.3	-28.8	9.7	-63.64	-	-	117	137	Н
3	624.99	-73.03	Qp	25.3	-28.8	9.7	-66.83	-54	-12.83	117	137	Н
4	294.9829	-40.63	Pk	19.2	-29.8	8.1	-43.13	-	-	339	108	V
4	294.9829	-44.45	Qp	19.2	-29.8	8.1	-46.95	-36	-10.95	339	108	V
5	624.985	-71.63	Pk	25.3	-28.8	6.7	-68.43	-	-	153	160	V
5	624.985	-73.55	Qp	25.3	-28.8	6.7	-70.35	-54	-16.35	153	160	V
6	47.485	-55.64	Pk	14.7	-31.4	7.5	-64.84	-	-	187	111	V
6	47.485	-60.87	Qp	14.7	-31.4	7.5	-70.07	-54	-16.07	187	111	V

#### Pk - Peak detector

**Qp** - Quasi-Peak detector

30-1000MHz 1300MHz BW\_Max Pwr.DAT Rev 9.5 11 Jan 2019

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#### 1300 MHz BW Mode (Rev B. Board)





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# 1300 MHz BW Mode (Rev B. Board)

#### **Radiated Emissions**

Frequency (MHz)	Meter Reading	Det	AF PRE0184971	Amp Cbl (dB)	Amp/Cbl (dB)	Corrected Reading	EN 302 264 v2.1.1 – Qp	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
	(dBm)		(dB/m)			(dBm)	Limit				
288.1086	-37.83	Pk	19.2	-29.8	9.4	-39.03	-	-	225	179	Н
288.1086	-39.98	Qp	19.2	-29.8	9.4	-41.18	-36	-5.18	225	179	Н
843.702	-74.04	Pk	27.6	-27.9	11.5	-62.84	-	-	107	106	Н
843.702	-76.24	Qp	27.6	-27.9	11.5	-65.04	-54	-11.04	107	106	Н
624.9993	-70.87	Pk	25.2	-29	10.3	-64.37	-	-	239	204	Н
624.9993	-75.1	Qp	25.2	-29	10.3	-68.6	-54	-14.6	239	204	Н
304.3684	-41.56	Pk	19.4	-29.8	8.6	-43.36	-	-	153	213	V
304.3684	-44.25	Qp	19.4	-29.8	8.6	-46.05	-36	-10.05	153	213	V
70.9802	-59.76	Pk	13.9	-30.9	12.8	-63.96	-	-	149	170	V
70.9802	-62.77	Qp	13.9	-30.9	12.8	-66.97	-54	-12.97	149	170	V
374.9908	-58.49	Pk	20.8	-29.5	10.1	-57.09	-	-	258	100	V
374.9908	-61.47	Qp	20.8	-29.5	10.1	-60.07	-36	-24.07	258	100	V

Pk - Peak detector

Qp - Quasi-Peak detector

\*.TST Rev 9.5 11 Jan 2019

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## 4 GHz BW Mode (Rev A. Board)





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## 4 GHz BW Mode (Rev A. Board)

#### **Radiated Emissions**

Marker	Frequency (MHz)	Meter Reading (dBm)	Det	AF PRE0184052 (dB/m)	Amp/Cbl (dB)	Amp/Cbl (dB)	Corrected Reading (dBm)	EN 302 264 v2.1.1	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	292.859	-35.03	Pk	19.2	-29.8	8.3	-37.33	-	-	18	193	Н
1	292.859	-39.83	Qp	19.2	-29.8	8.3	-42.13	-36	-6.13	18	193	Н
2	449.471	-75.27	Pk	22.7	-29.2	12.9	-68.87	-	-	339	205	Н
2	449.971	-64.43	Qp	22.7	-29.2	12.9	-58.03	-36	-22.03	339	205	Н
3	499.97	-71.26	Pk	23.6	-29.2	6	-70.86	-	-	60	109	Н
3	499.97	-73.95	Qp	23.6	-29.2	6	-73.55	-54	-29.55	60	109	Н
4	289.99	-53.18	Pk	19.2	-29.9	7.5	-56.38	-	-	325	101	V
4	294.99	-45.22	Qp	19.2	-29.8	8.1	-47.72	-36	-11.72	325	101	V
5	749.968	-74.35	Pk	26.5	-28	7.8	-68.05	-	-	324	191	V
5	749.968	-76.64	Qp	26.5	-28	7.8	-70.34	-54	-16.34	324	191	V
6	899.959	-66.38	Pk	28.1	-27	7.8	-57.48	-	-	147	109	V
6	899.959	-68.05	Qp	28.1	-27	7.8	-59.15	-36	-23.15	147	109	V

#### Pk - Peak detector

**Qp** - Quasi-Peak detector

ERP EN 30-1000MHz.tst Rev 9.5 11 Jan 2019

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### 4 GHz BW Mode (Rev B. Board)





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## 4 GHz BW Mode (Rev B. Board)

#### **Radiated Emissions**

Frequency (MHz)	Meter Reading (dBm)	Det	AF PRE0184971 (dB/m)	Amp Cbl (dB)	Amp/Cbl (dB)	Corrected Reading (dBm)	EN 302 264 v2.1.1 – Qp	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
288 1931	-37 41	Pk	19.2	-29.8	9.4	-38.61	-	-	222	175	н
288,1931	-39.59	Qp	19.2	-29.8	9.4	-40.79	-36	-4.79	222	175	Н
843.7196	-76.06	Pk	27.6	-27.9	11.5	-64.86	-	-	28	127	Н
843.7196	-81.68	Qp	27.6	-27.9	11.5	-70.48	-54	-16.48	28	127	Н
659.9588	-73.72	Pk	25.5	-28.8	11.8	-65.22	-	-	127	185	Н
659.9588	-76.95	Qp	25.5	-28.8	11.8	-68.45	-54	-14.45	127	185	Н
306.5199	-41.75	Pk	19.5	-29.8	8.7	-43.35	-	-	15	107	V
306.5199	-44.6	Qp	19.5	-29.8	8.7	-46.2	-36	-10.2	15	107	V
71.0019	-57.62	Pk	13.9	-30.9	12.9	-61.72	-	-	210	159	V
71.0019	-62.29	Qp	13.9	-30.9	12.9	-66.39	-54	-12.39	210	159	V
899.9568	-67.75	Pk	28	-27.5	8.3	-58.95	-	-	232	189	V
899.9568	-69.53	Qp	28	-27.5	8.3	-60.73	-36	-24.73	232	188	V

Pk - Peak detector

Qp - Quasi-Peak detector

30-1000MHz 4000MHz BW\_Rev B Board.dat Rev 9.5 11 Jan 2019

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# 7.6.2. TX UNWANTED EMISSIONS, 1 - 18 GHz

#### 1300 MHz BW Mode



1–18GHz 1300MHz BW\_Max Pwr\_.DAT

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#### 1300 MHz BW Mode

#### **Radiated Emissions**

Marker	Frequency (GHz)	Meter Reading (dBm)	Det	AF T344 (dB/m)	Amp/Cbl (dB)	Amp/Cbl (dB)	Corrected Reading (dBm)	EN 302 264 V2.1.1	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.35	-58.59	Pk	29.4	-35.5	10	-54.69	-	-	347	156	Н
1	1.35	-64.28	Av	29.4	-35.5	10	-60.38	-30	-30.38	347	156	Н
2	1.8	-57.81	Pk	30.1	-35.4	11.7	-51.41	-	-	317	151	Н
2	1.8	-67.22	Av	30.1	-35.4	11.7	-60.82	-30	-30.82	317	151	Н
3	2	-59.99	Pk	31	-35.4	11.6	-52.79	-	-	141	181	Н
3	2	-70.12	Av	31	-35.4	11.6	-62.92	-30	-32.92	141	181	Н
4	1.35	-60.48	Pk	29.5	-35.5	9.8	-56.68	-	-	224	160	V
4	1.35	-70.3	Av	29.5	-35.5	9.8	-66.5	-30	-36.5	224	160	V
5	1.8	-59.74	Pk	30.1	-35.4	11.1	-53.94	-	-	172	139	V
5	1.8	-70.44	Av	30.1	-35.4	11.1	-64.64	-30	-34.64	172	139	V
6	2	-60.65	Pk	31	-35.4	11.2	-53.85	-	-	184	160	V
6	2	-70.89	Av	31	-35.4	11.2	-64.09	-30	-34.09	184	160	V
7	10.539	-71.7	Pk	37.6	-23.2	10.3	-47	-	-	217	297	V
7	10.539	-85.12	Av	37.6	-23.2	10.3	-60.42	-30	-30.42	217	297	V

#### Pk - Peak detector

Av - Average detection

1-18GHz 1300MHz BW\_Max Pwr\_.DAT Rev 9.5 11 Jan 2019

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## 4 GHz BW Mode





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#### 4 GHz BW Mode

#### **Radiated Emissions**

Marker	Frequency (GHz)	Meter Reading	Det	AF T344 (dB/m)	Amp/Cbl (dB)	Amp/Cbl (dB)	Corrected Reading	EN 302 264 V2.1.1	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
	()	(dBm)		(	()	()	(dBm)		()	(======)	(1.1.)	
1	1.35	-58.48	Pk	29.4	-35.5	10	-54.58	-	-	344	154	Н
1	1.35	-65.53	Av	29.4	-35.5	10	-61.63	-30	-31.63	344	154	Н
2	1.8	-56.47	Pk	30.1	-35.4	11.7	-50.07	-	-	313	162	Н
2	1.8	-66.09	Av	30.1	-35.4	11.7	-59.69	-30	-20.69	313	162	Н
3	2	-59.91	Pk	31	-35.4	11.6	-52.71	-	-	141	152	Н
3	2	-68.96	Av	31	-35.4	11.6	-61.76	-30	-31.76	141	152	Н
4	1.8	-61.5	Pk	30.1	-35.4	11	-55.8	-	-	163	160	V
4	1.8	-72.75	Av	30.1	-35.4	11	-67.05	-30	-37.05	163	160	V
5	2	-60.61	Pk	31	-35.4	11.2	-53.81	-	-	195	160	V
5	2	-70.06	Av	31	-35.4	11.2	-63.26	-30	-33.26	195	160	V
6	3.058	-62.99	Pk	32.9	-34.3	11.1	-53.29	-	-	286	180	V
6	3.058	-76.83	Av	32.9	-34.3	11.1	-67.13	-30	-37.13	286	180	V
7	9.246	-72.45	Pk	36.3	-24.3	10.4	-50.05	-	-	135	376	V
7	9.246	-84.09	Av	36.3	-24.3	10.4	-61.69	-30	-31.69	135	376	V

#### Pk - Peak detector

Av - Average detection

1-18GHz 4000MHz BW\_Max Pwr\_.DAT Rev 9.5 11 Jan 2019

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# 7.6.3. TX UNWANTED EMISSIONS, 18 - 26 GHz

## 1300 MHz BW Mode



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#### 1300 MHz BW Mode

#### **Radiated Emissions**

#### Trace Markers

Marker	Freq.	Meter	Det	AF	Amp/Cbl/	Dist	Corrected	Convert	Corr.	Av	Margin
	(GHz)	Reading		PRE0182188	20 dB Pad	Corr	Reading	dBuV to	Reading	Limit	
		(dBuV)		(dB/m)	(dB)	(dB)	(dBuVolts)	dBm	(dBm)	(dBm)	(dB)
1	19.275	70.84	Pk	33.3	-37.1	-9.5	57.54	-95.2	-37.66	-30	-7.66
2	19.588	69.3	Pk	33.4	-37.1	-9.5	56.1	-95.2	-39.1	-30	-9.1
3	19.36	70.74	Pk	33.3	-36.9	-9.5	57.64	-95.2	-37.56	-30	-7.56
4	19.289	70.71	Pk	33.2	-36.8	-9.5	57.61	-95.2	-37.59	-30	-7.59
5	19.58	68.91	Pk	33.4	-36.7	-9.5	56.11	-95.2	-39.09	-30	-9.09

Pk - Peak detector Class B 18-26GHz.TST Rev 9.5 22 Jun 2018

Note: No emission detected above the noise floor using Peak Detection. Limit is RMS Average.

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#### 4 GHz BW Mode







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#### 4 GHz BW Mode

#### **Radiated Emissions**

#### **Trace Markers**

Marker	Freq. (GHz)	Meter Reading (dBuV)	Det	AF PRE0182188 (dB/m)	Amp/Cbl/ 20 dB Pad (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)	Convert dBuV to dBm	Corr. Reading (dBm)	Av Limit (dBm)	Margin (dB)
1	19.274	71.83	Pk	33.3	-37.3	-9.5	58.33	-95.2	-36.87	-30	-6.87
2	19.273	70.78	Pk	33.3	-37.4	-9.5	57.18	-95.2	-38.02	-30	-8.02

Pk - Peak detector Class B 18-26GHz.TST Rev 9.5 22 Jun 2018

Note: No emission detected above the noise floor using Peak Detection. Limit is RMS Average.

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# 7.6.4. TX UNWANTED EMISSIONS, 26 - 40 GHz

## 1300 MHz BW Mode



#### 1300 MHz BW Mode

#### **Radiated Emissions**

#### **Trace Markers**

Marker	Freq. (GHz)	Meter Reading (dBuV)	Det	T90 AF (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)
1	28.798	63.72	Pk	35.8	-32	-9.5	58.02
2	39.197	55.4	Pk	38.3	-32.2	-9.5	52
3	38.55	58.47	Pk	36.9	-32	-9.5	53.87
4	28.798	50.81	Pk	35.8	-32	-9.5	45.11
5	39.193	50.66	Pk	38.3	-32.1	-9.5	47.36
6	38.549	50.68	Pk	36.9	-32	-9.5	46.08

Pk - Peak detector

#### **Radiated Emissions**

Marker	Freq. (GHz)	Meter Reading (dBuV)	Det	T90 AF (dB/m)	Amp/ Cbl (dB)	Dist Corr (dB)	Corr. Reading (dBuV)	Convert dBuV to dBm	Corr. Reading (dBm)	Limit (dBm)	Margin (dBm)	Polarity
1	28.798	61.18	Av	35.8	-32	-9.5	55.48	-95.2	-39.72	-30	-9.72	Н
2*	39.196	31.87	Av	37.2	-32.6	-9.5	26.97	-95.2	-68.23	-30	-38.23	Н
3*	38.548	40.75	Av	36.9	-32	-9.5	36.15	-95.2	-59.05	-30	-29.05	Н
4	28.798	51.33	Av	35.8	-32	-9.5	45.63	-95.2	-49.57	-30	-19.57	V
5*	39.197	28.34	Av	37.2	-32.6	-9.5	23.44	-95.2	-71.76	-30	-41.76	V
6*	38.548	32.34	AV	36.9	-32	-9.5	27.74	-95.2	-67.46	-30	-37.46	V

Av - Average detection

Ti1843\_26-40 GHz\_1300MHz BW.DAT 30915 6 Jan 2015 Rev 9.5 19 Oct 2016

\*Markers 2,3,5,6 are subharmonics of fundamental signals and also FMCW modulated signals, the measurement method of FMCW signal was applied at test.

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#### 4 GHz BW Mode







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## 4 GHz BW Mode

#### **Radiated Emissions**

#### **Trace Markers**

Marker	Freq (GHz)	Meter Reading (dBuV)	Det	T90 AF (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)
1	28.798	64.08	Pk	35.8	-32	-9.5	58.38
2	38.549	57.72	Pk	36.9	-32	-9.5	53.12
3	38.504	52.06	Pk	37	-32.2	-9.5	47.36
4	28.798	50.62	Pk	35.8	-32	-9.5	44.92
5	38.547	47.83	Pk	36.9	-32	-9.5	43.23
6	38.908	44.44	Pk	37	-31.9	-9.5	40.04

Pk - Peak detector

#### **Radiated Emissions**

Marker	Freq. (GHz)	Meter Reading (dBuV)	Det	T90 AF (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corr. Reading (dBuV)	Convert dBuV to dBm	Corr. Reading (dBm)	Limit (dBm)	Margin (dBm)	Polarity
1	28.798	63.73	Av	35.8	-32	-9.5	58.03	-95.2	-37.17	-30	-7.17	Н
2*	38.548	37.97	Av	36.9	-32	-9.5	33.37	-95.2	-61.83	-30	-31.83	Н
3*	38.498	33.48	Av	37	-32.1	-9.5	28.88	-95.2	-66.32	-30	-36.32	Н
4	28.798	50.98	Av	35.8	-32	-9.5	45.28	-95.2	-49.92	-30	-19.92	V
5*	38.548	27.82	Av	36.9	-32	-9.5	23.33	-95.2	-71.98	-30	-41.98	V
6*	38.908	25.40	AV	36.9	-32	-9.5	20.8	-95.2	-74.4	-30	-44.4	V

Av - Average detection Ti1843\_26-40 GHz\_1300MHz BW.DAT 30915 6 Jan 2015 Rev 9.5 19 Oct 2016

\*Markers 2,3,5,6 are subharmonics of fundamental signals and also FMCW modulated signals, the measurement method of FMCW signal was applied at test.

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# 7.6.5. TX UNWANTED EMISSIONS, 40 - 162 GHz

No unwanted emission above the noise floor of PXA using Average detection on the following bands:

- 40 50 GHz
- 50 75 GHz
- 75 77 GHz
- 81 110 GHz

Unwanted emissions were detected within the 110 - 162 GHz band.

# **RESULTS**

1300 MHz BW Mode

Frequency	Meas.	Meas.	Avg Pwr	Limit	Margin
(СЦ-)	Pwr (dBm)	Dist.		(dBm EIBD)	(dP)
(GHZ)	(ubiii)	(III)	(UDIII EIKP)	(UDIII EIKP)	(UD)
154.197	-72.56	1.0	-42.03	-30	-12.03



\*154.197 GHz signal is harmonic of fundamental signal and also FMCW modulated signal, the measurement method of FMCW signal was applied at test.

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# **RESULTS**

4 GHz BW Mode

Frequency	Meas. Avg Pwr	Meas. Dist.	Avg Pwr EIRP	Limit	Margin
(GHz)	(dBm)	(m)	(dBm EIRP)	(dBm EIRP)	(dB)
154.197	-73.45	1.0	-42.92	-30	-12.92

Agilent Spectrum Analyz	zer - Swept SA							
X EXT MIXER	SIG ID 0		SENSE:IN			11:47:49 AM	Feb 20, 2019	Frequency
Start Fred 152.		GHZ PNO: Fast ↔↔ IFGain:Low	Trig: Free Run	Avg type	. RM3	TYP	E WWWWWWW T A N N N N N	
10 dB/div Ref 0	dB/div Ref 0.00 dBm -73.45 d					97 GHz 15 dBm		
-10.0								Center Freq 158.00000000 GHz
-20.0								<b>Start Freq</b> 152.00000000 GHz
-40.0								<b>Stop Freq</b> 164.00000000 GHz
-60.0	1							<b>CF Step</b> 1.20000000 GHz <u>Auto</u> Man
-80.0								Freq Offset 0 Hz
-90.0	łz	#\/D\\\	2 O BAU-*		*0	Stop 164.	000 GHz	
#Res BW 1.0 WH	Z	#VBW	3.U IVIMZ^	7	FSweep	800.0 S (1) s	2001 pts)	

\*154.197 GHz signal is harmonic of fundamental signal and also FMCW modulated signal, the measurement method of FMCW signal was applied at test.

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# 7.7. RECEIVER SPURIOUS EMISSIONS

#### LIMIT

EN 301 091 Clause 4.4.2.3

The effective radiated power of any narrowband receiver spurious emission shall be not greater than the values given in table 5.

Frequency range	Limit	Detector type		
30 MHz to 1 GHz	-57 dBm (e.r.p.)	Quasi-Peak		
above 1 GHz to 300 GHz (see note)	-47 dBm (e.i.r.p.)	RMS		
NOTE: Measurement is only required up to the 2 <sup>nd</sup> harmonic of the fundamental				
frequency (as defined in CEPT/ERC/REC 74-01 [i.1]). In this case, the				
upper frequency limit up to	which measurements are	e performed is 162 GHz.		

#### Table 5: Narrowband spurious emission limits for receivers [i.3]

Wideband receiver spurious emissions shall be not greater than the values given in table 6.

#### Table 6: Wideband spurious emission limits for receivers [i.3]

Frequency range	Limit	Detector type				
30 MHz to 1 GHz	-47 dBm/MHz (e.r.p.)	Quasi-Peak				
above 1 GHz to 300 GHz (see note)	-37 dBm/MHz (e.i.r.p.)	RMS				
NOTE: Measurement is only required up to the 2 <sup>nd</sup> harmonic of the fundamental						
frequency (as defined in CEPT/ERC/REC 74-01 [i.1]). In this case, the						
upper frequency limit up to	which measurements a	re performed is				
162 GHz.						

## TEST PROCEDURE

EN 303 396 Clause 6.2.12

## <u>RESULT</u>

Not applicable Per 11647276-TP1V6.

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# 7.8. RECEIVER IN-BAND, OUT-OF-BAND AND REMOTE-BAND SIGNALS HANDLING

#### LIMIT

EN 302 264 Clause 4.4.3.3

The EUT shall achieve the wanted performance criterion, see clause 4.2.2, in the presence of unwanted signals defined in table 7.

The unwanted signal transmitter shall be able to transmit continuous wave signals at specific frequencies, as described in table 7.

	In-band signal	OOB signal	Remote-band signal			
Frequency	Centre frequency (fc) of the	$f = f_c \pm F$	$f = f_c \pm 3 \times F$			
	EUT modulated signal					
	(see clause 4.3.1)					
Signal level field strength at the EUT	55 mV/m	173 mV/m	173 mV/m			
Equivalent EIRP at 10m	10 dBm	20 dBm	20 dBm			
permitted frequency bandwidth (4 GHz)						

#### TEST SETUP

EN 303 396 Clause 6.3.12.2

## TEST PROCEDURE

EN 303 396 Clause 6.3.12.3

#### PERFORMANCE CRITERION

During and after the application of the unwanted signal, the EUT shall indicate the distance to the target within 20 cm of the distance indicated prior to the application of the unwanted signal.

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# **RESULTS**

4 GHz BW mode was tested.

No changes in the Range Profile, X-Y Scatter Plot or Doppler Range Plot were observed during the application of the unwanted signals in the chart below, relative to the corresponding indications with no interference signal present.

Signal	Unwanted Frequency (GHz)	+10 dBm EIRP Results	+20 dBm EIRP Results
In Band	79.0	Pass	
Remote Band	67.0		Pass
Out of Band	75.0		Pass
Out of Band	83.0		Pass
Remote Band	91.0		Pass

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O = Target

# **RESULTS**

# NO INTERFERENCE SIGNAL



## 79 GHz IN BAND +10 dBm INTERFERENCE SIGNAL



# 67 GHz REMOTE BAND +20 dBm INTERFERENCE SIGNAL



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# 75 GHz OUT-OF-BAND +20 dBm INTERFERENCE SIGNAL

miniwave Demo visualizer Optom Rep		
	Configure	
X-Y Scatter Plot	Range Profile for zero Doppler	Range Depth     10     Range Width     5     File Size Max (MB)     1       Range Profile Y max 2x00     Image Profile Log Scale     Record time max (s)     10
and the herdine Lynn state	The second secon	Extra 197  E
Distance along lateral axis (meters)	Range (meters)	InterFrameProcessingTime (usec) 747
Doppler-Range Plot	Active and Interframe CPU Load	TrenomiDuporTime (usec) 8389 Active/Interfame CPU Load (%) 0/0
6.5	100	Real-Time Turing Advanced Commands Plot SetTings
(m) j	00 00	Orsup Paaks from Same Object Stand Direction
Depth	% CI	Additional Algorithm Processing
-0.3		CFAR.Range Treehold (0-100dB) 0 100
		Doppler Range Threshold (0-100dB) 0 100
	4 <u>50 500</u>	Field of View Azimuth Devation
Range (meters)	Frames	Angle of annivel 400 00 400 90 8056T 9000
		( )

## 83 GHz OUT-OF-BAND +20 dBm INTERFERENCE SIGNAL



# 91 GHz REMOTE BAND +20 dBm INTERFERENCE SIGNAL



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# 8. SETUP PHOTOS

12511652 on the photos is for internal used only, the actual Project No. is 12554995.

#### RADIATED RF MEASUREMENT SETUP





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# **TEMPERATURE CHAMBER**





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# RADIATED EMISSIONS





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## RECEIVER IN-BAND, OUT OF BAND AND REMOTE BAND SIGNALS HANDLING



# **END OF REPORT**

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