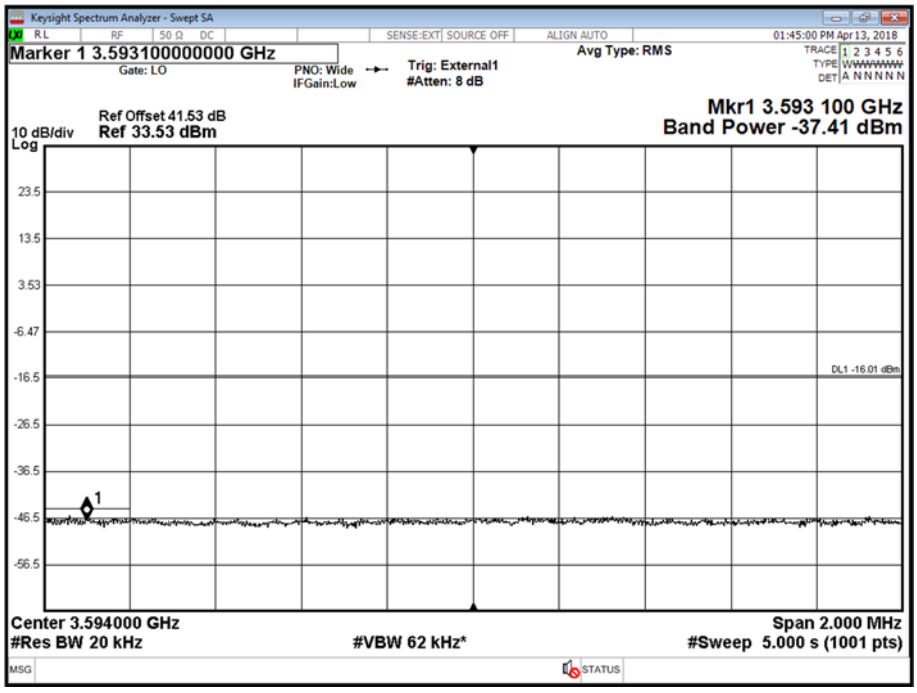
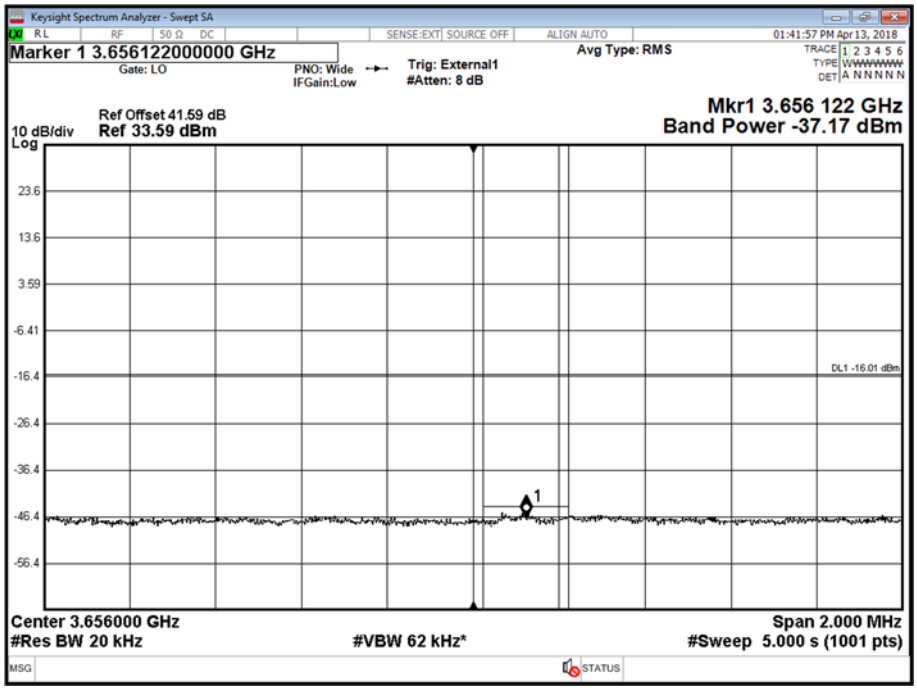
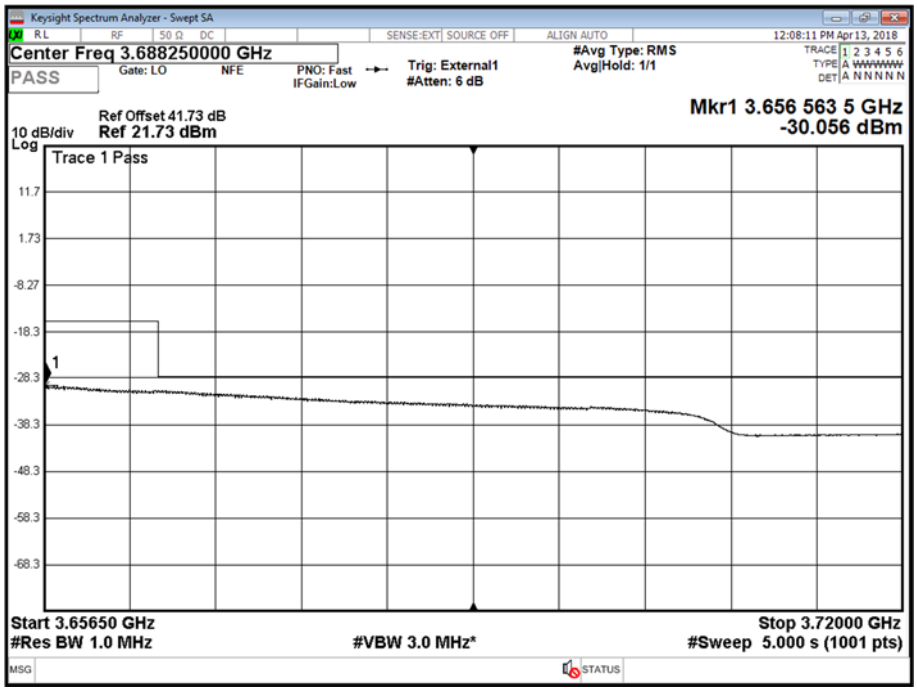
Antenna B - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position M - Band edge - Range low edge low



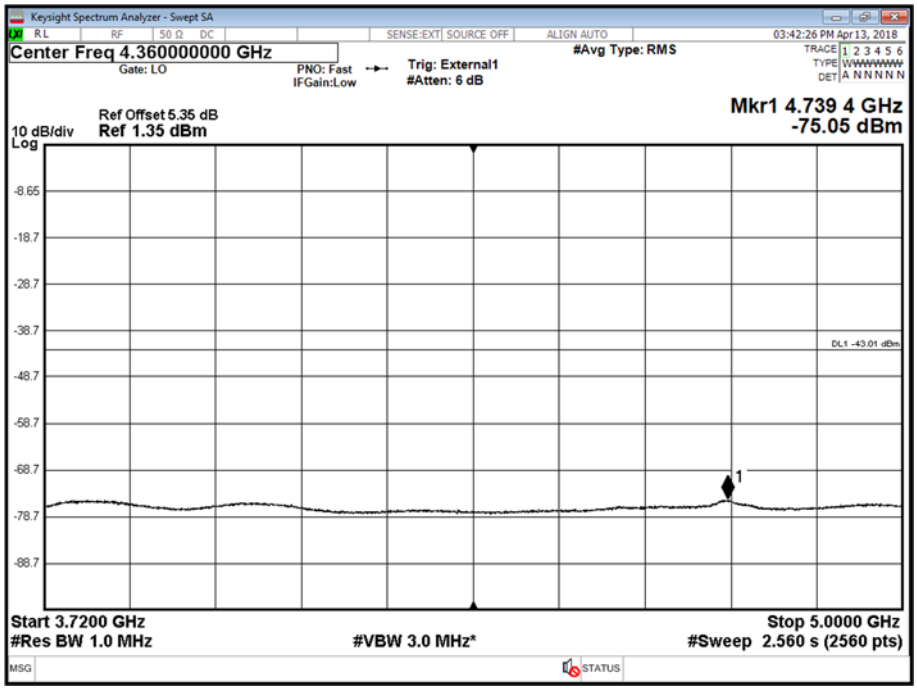
Antenna B - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position M - Band edge - Range high edge high



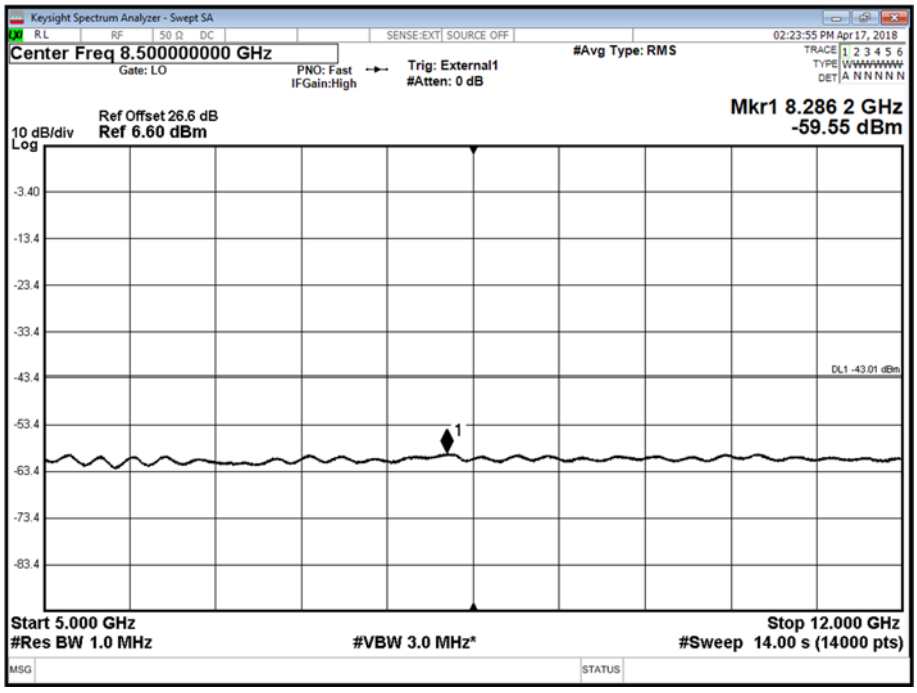
Antenna B - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position M - Band mask_high - Range High



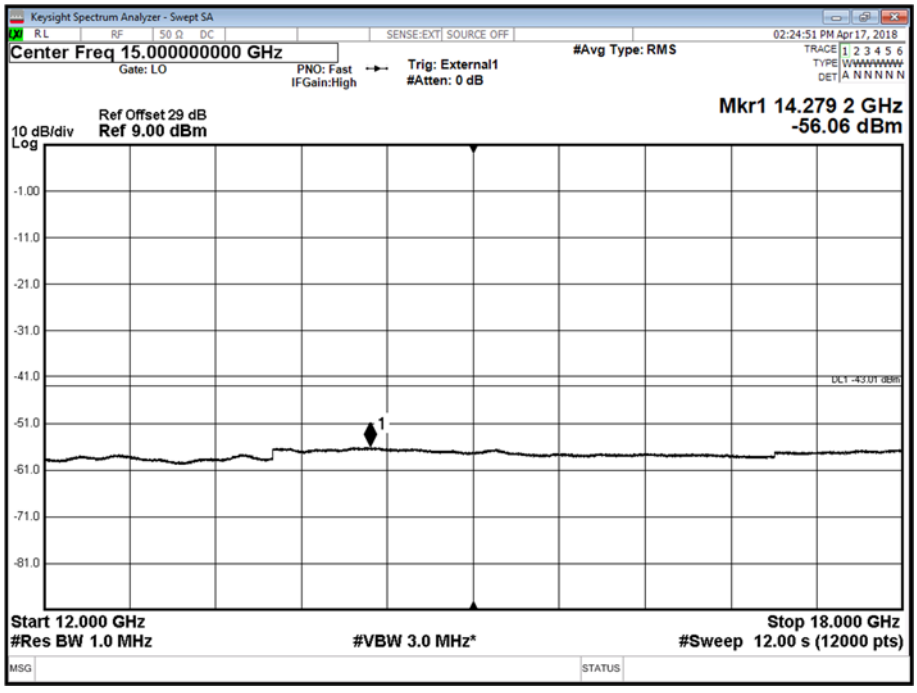
Antenna B - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position M - Band 2 - Range 3720 to 5000 MHz



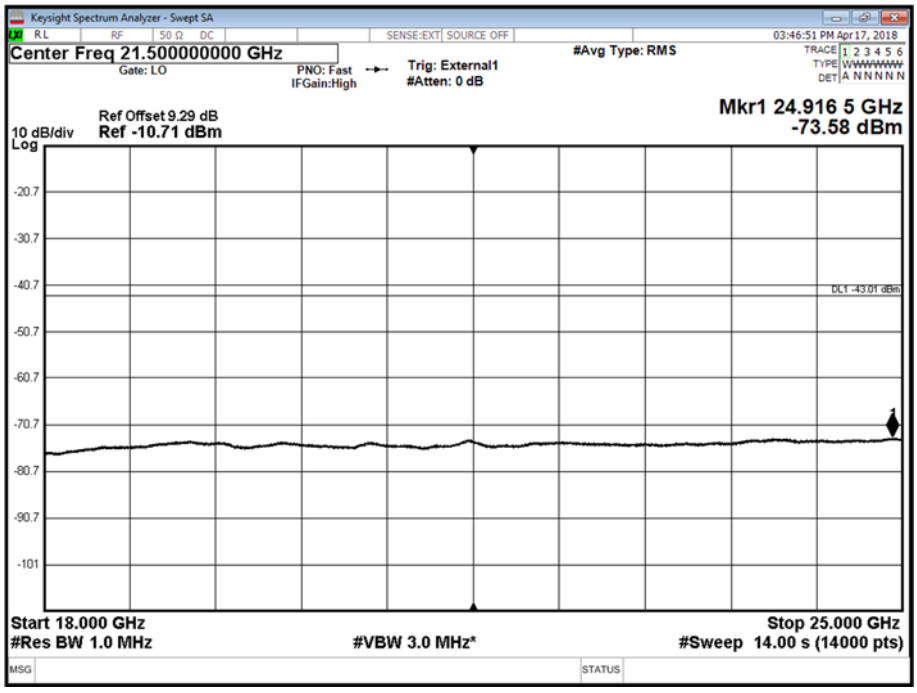
Antenna B - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position M - Band 3 - Range 5000 to 12000 MHz



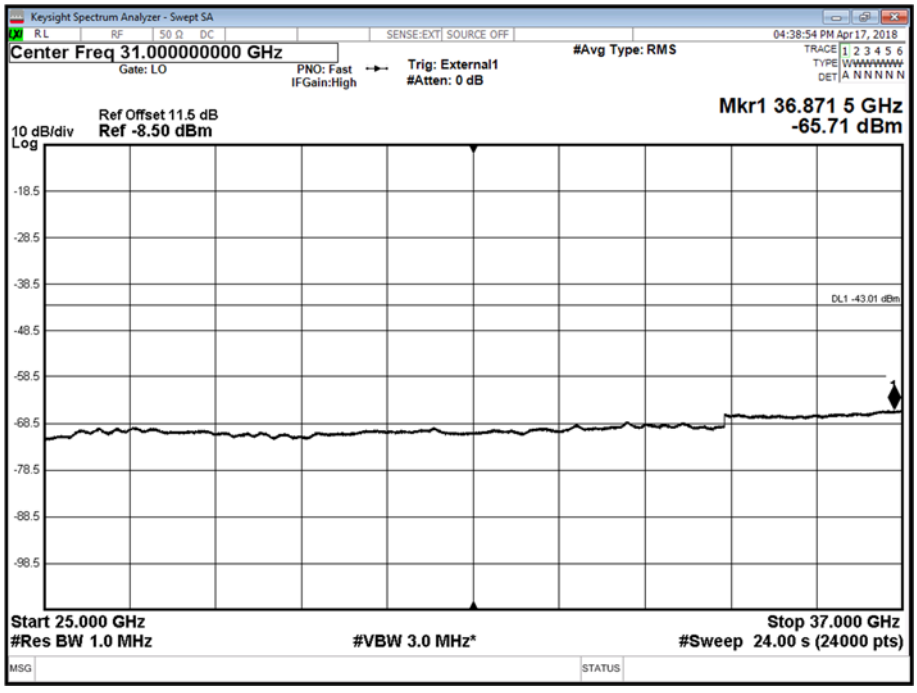
Antenna B - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position M - Band 4 - Range 12000 to 18000 MHz



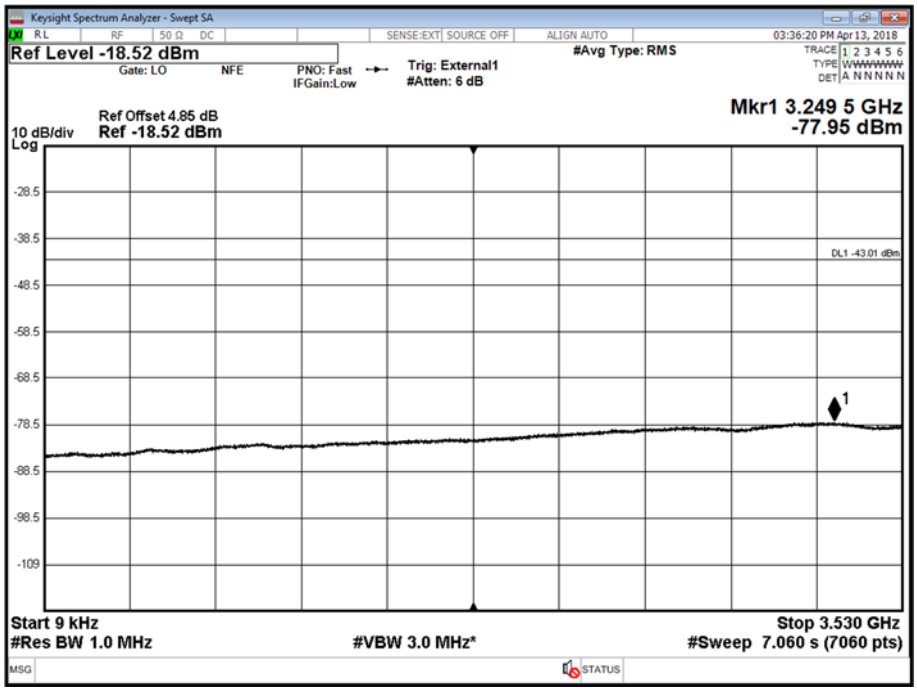
Antenna B - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position M - Band 5 - Range 18000 to 25000 MHz



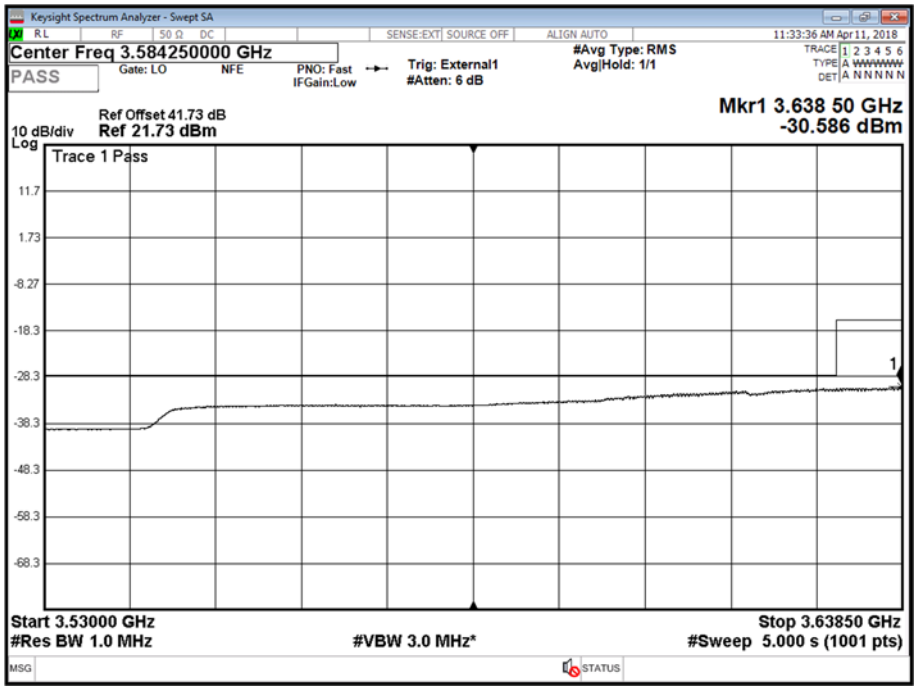
Antenna B - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position M - Band 6 - Range 25000 to 37000 MHz



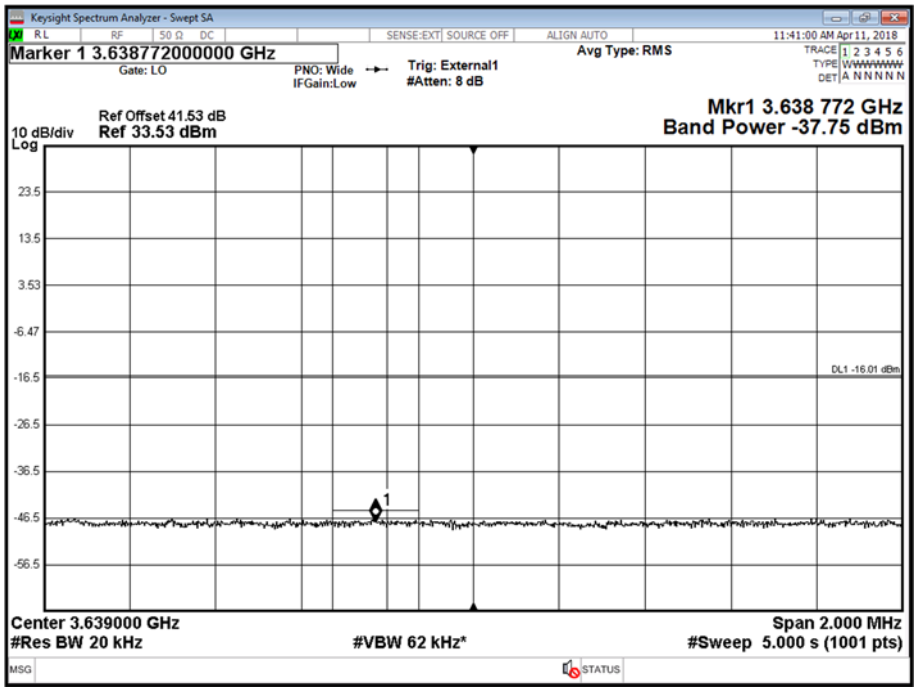
Antenna A - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position T - Band 1 - Range 0.009 to 3530 MHz



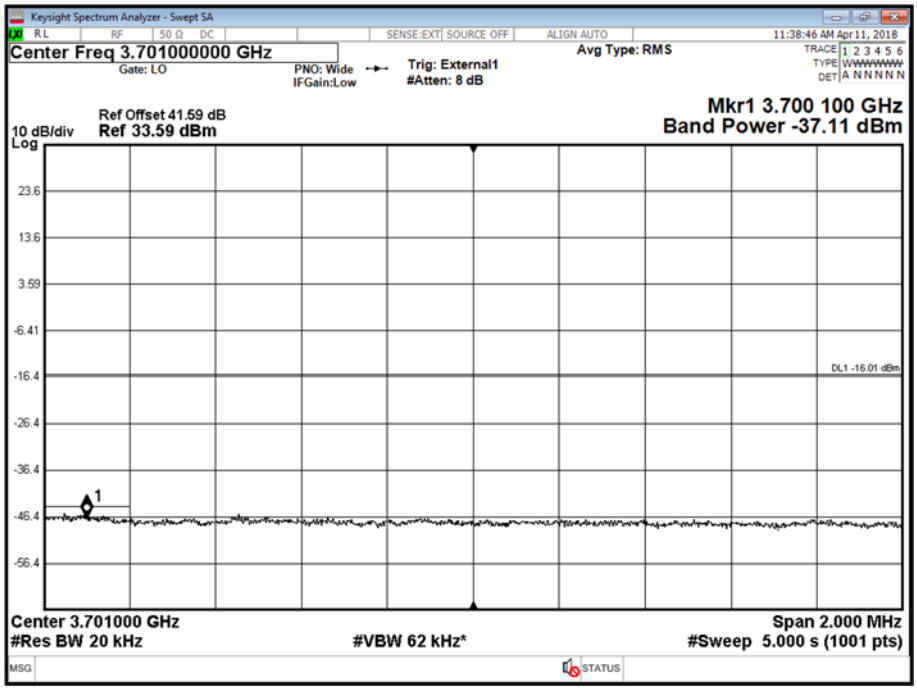
Antenna A - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position T - Band mask_low - Range Low



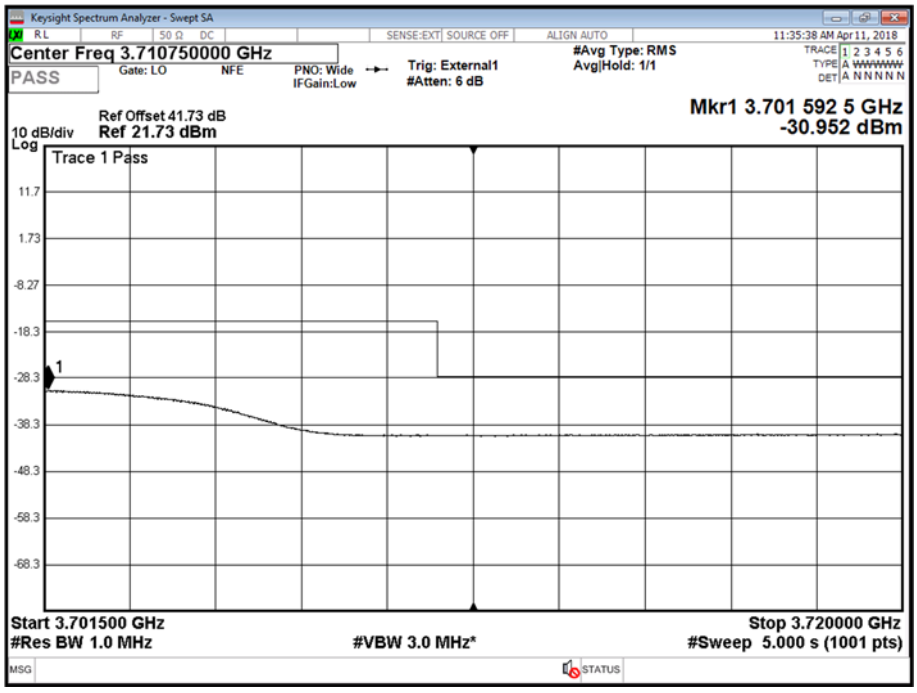
Antenna A - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position T - Band edge - Range low edge low



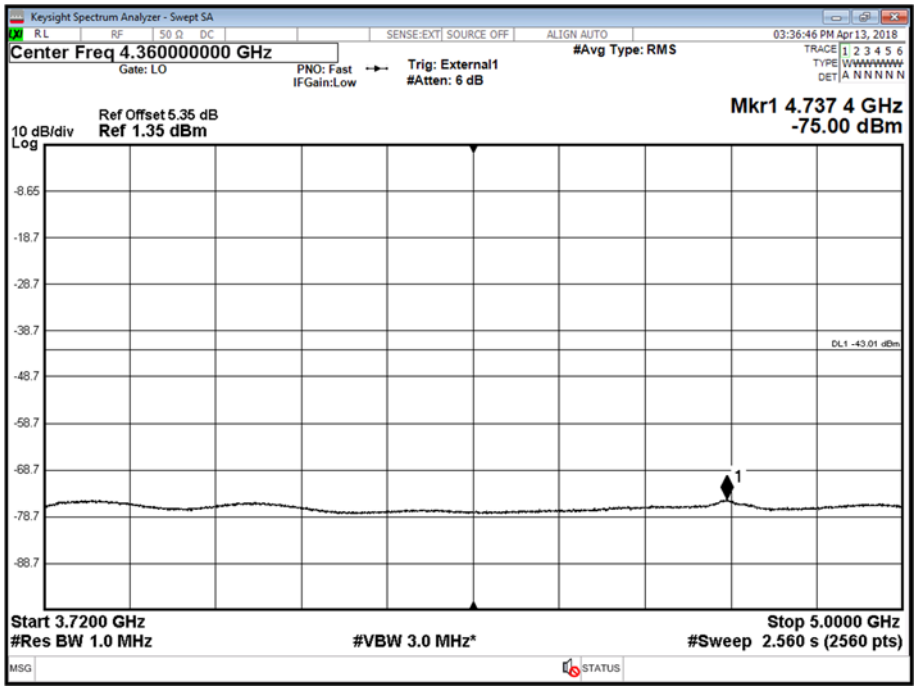
Antenna A - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position T - Band edge - Range high edge high



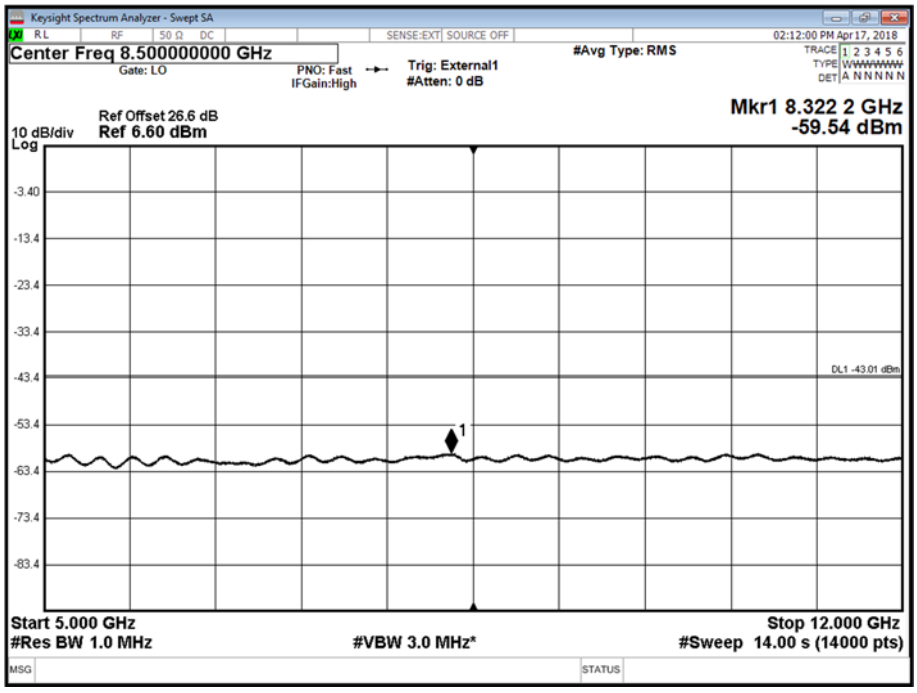
Antenna A - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position T - Band mask_high - Range High



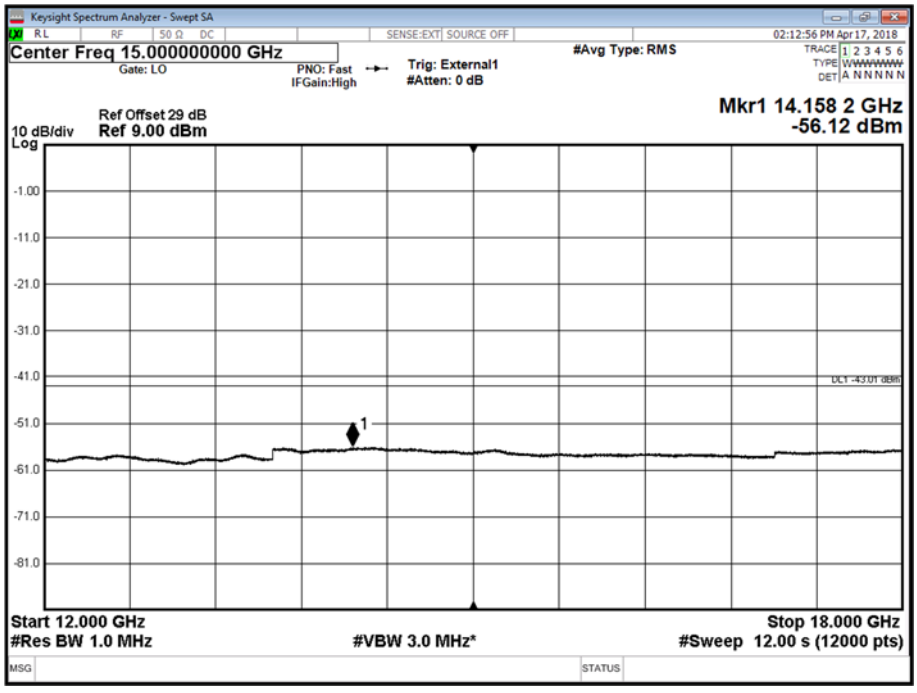
Antenna A - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position T - Band 2 - Range 3720 to 5000 MHz



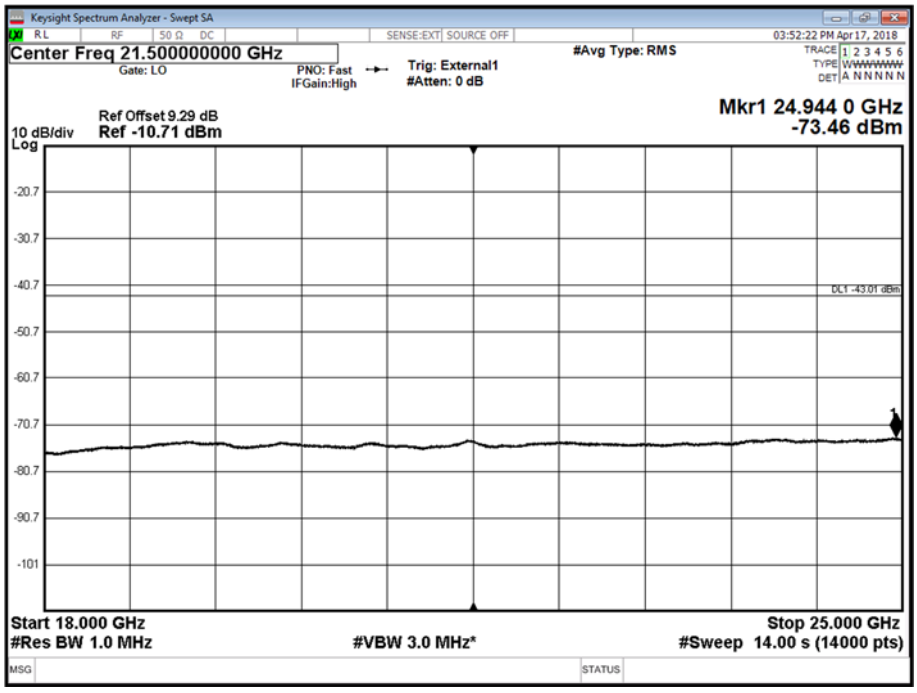
Antenna A - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position T - Band 3 - Range 5000 to 12000 MHz



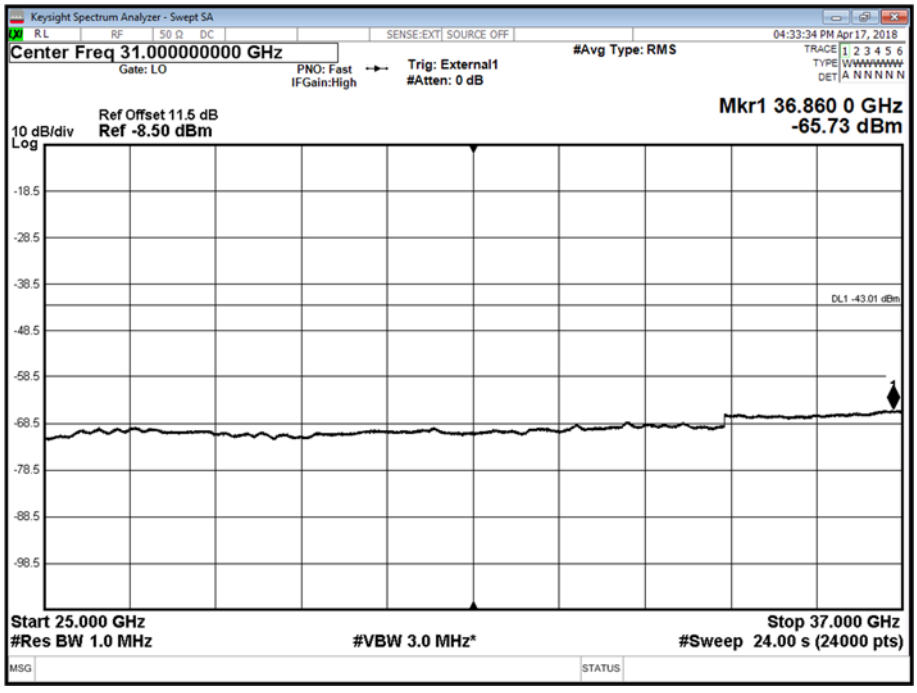
Antenna A - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position T - Band 4 - Range 12000 to 18000 MHz



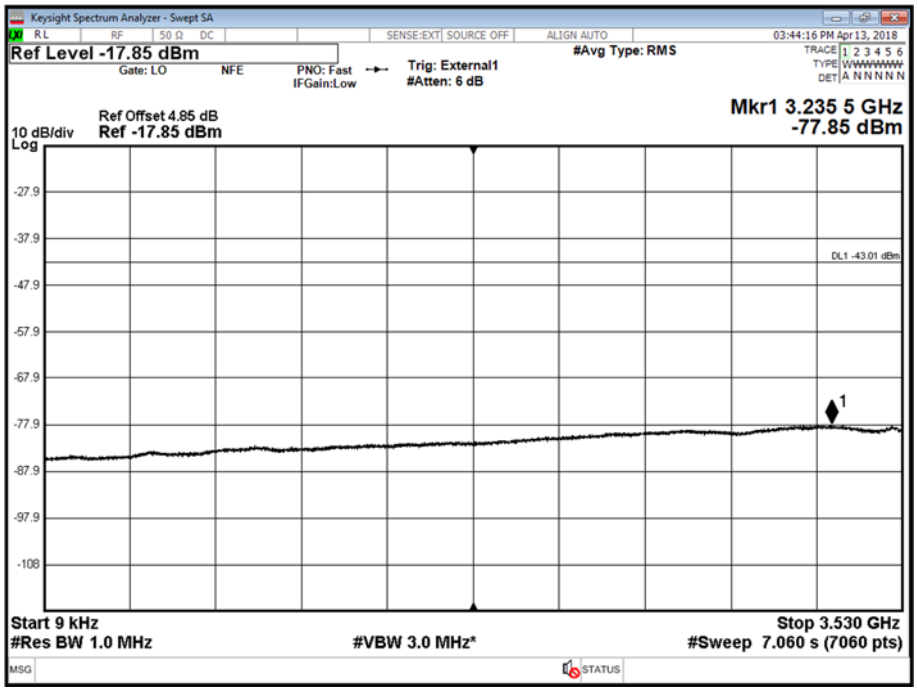
Antenna A - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position T - Band 5 - Range 18000 to 25000 MHz



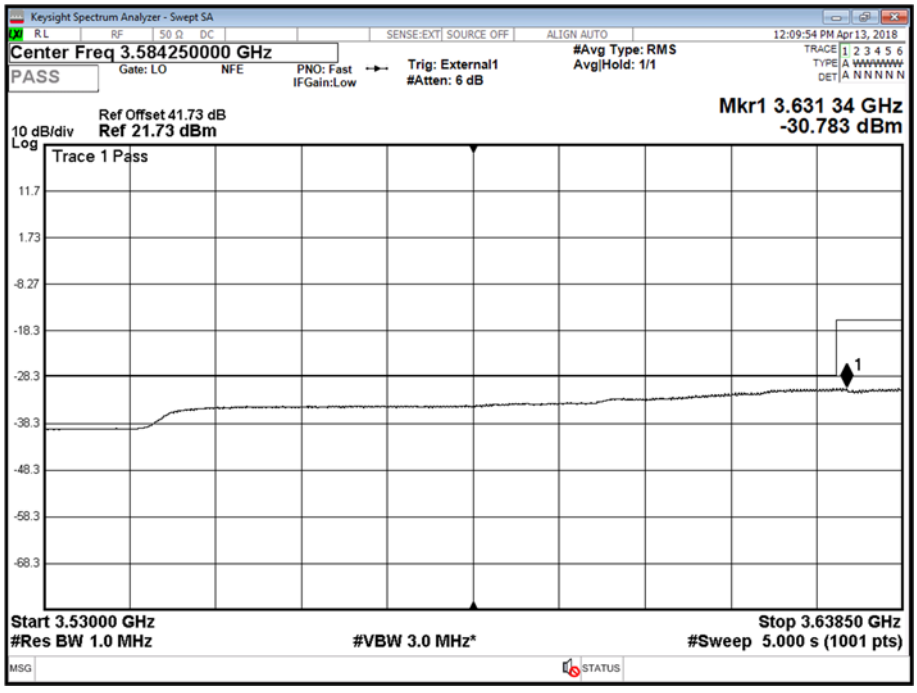
Antenna A - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position T - Band 6 - Range 25000 to 37000 MHz



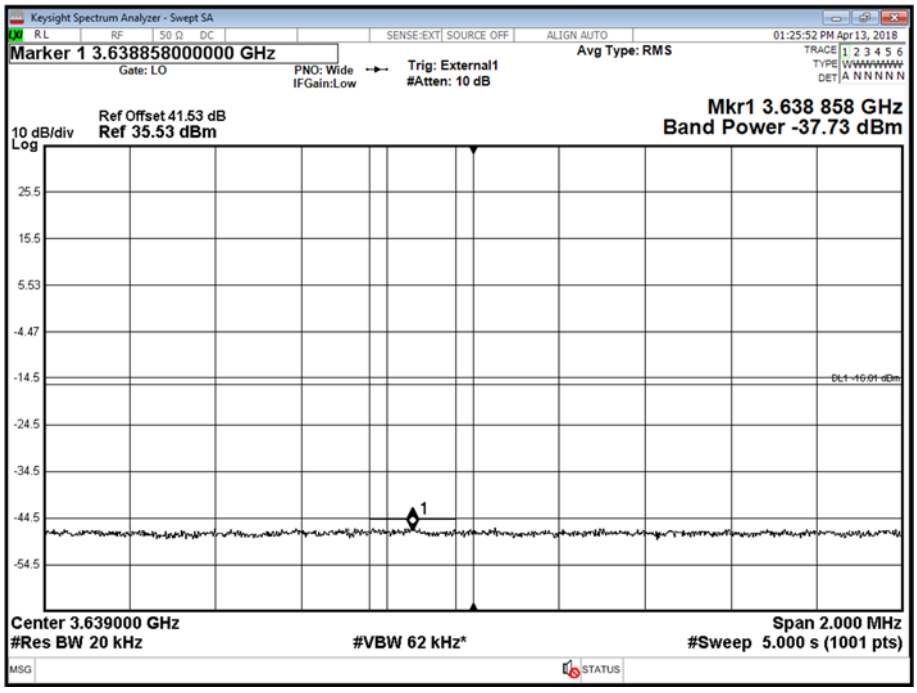
Antenna B - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position T - Band 1 - Range 0.009 to 3530 MHz



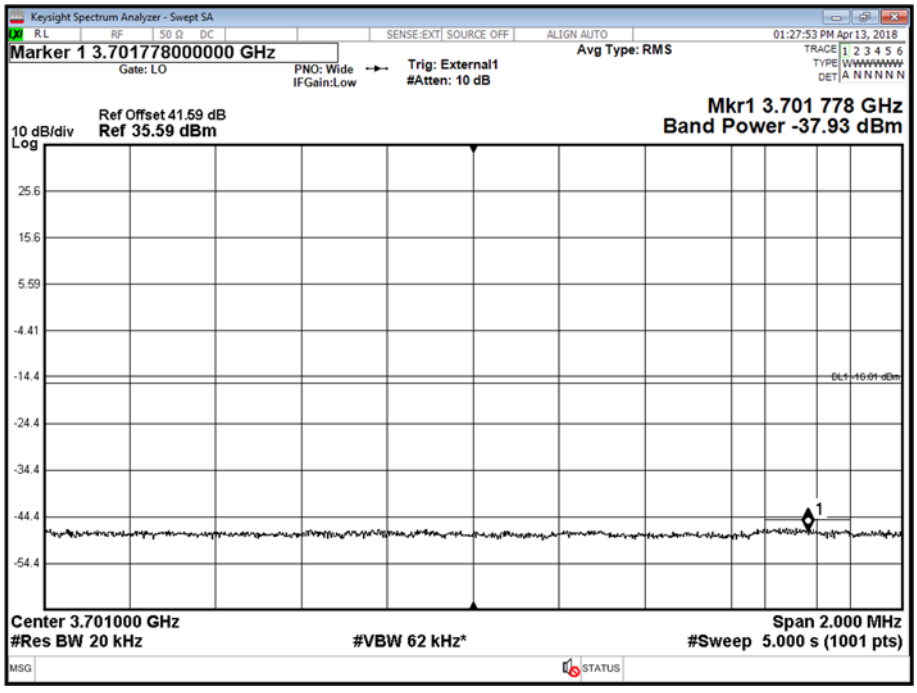
Antenna B - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position T - Band mask_low - Range Low



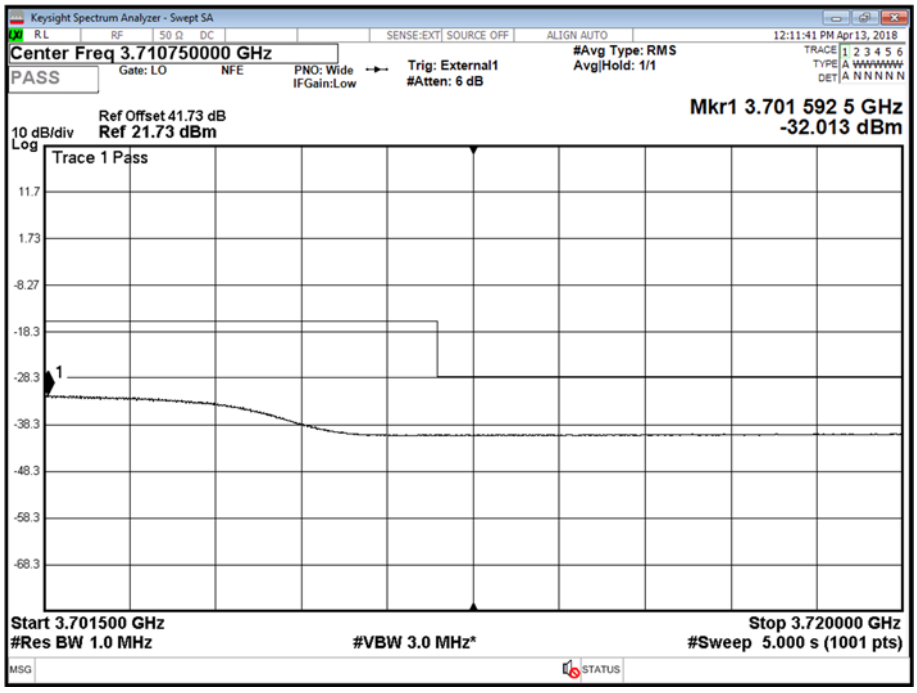
Antenna B - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position T - Band edge - Range low edge low



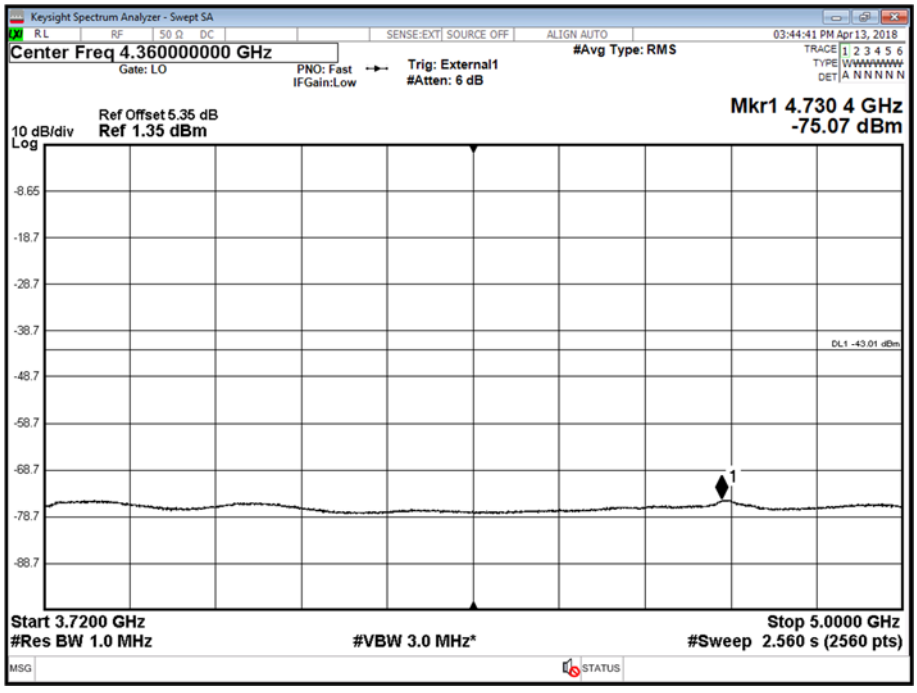
Antenna B - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position T - Band edge - Range high edge high



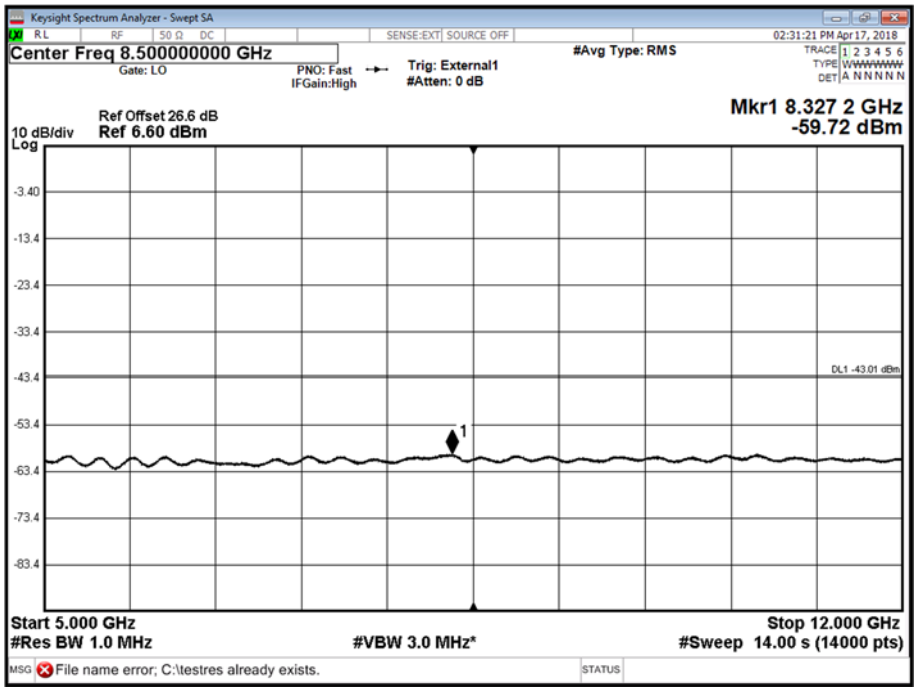
Antenna B - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position T - Band mask_high - Range High



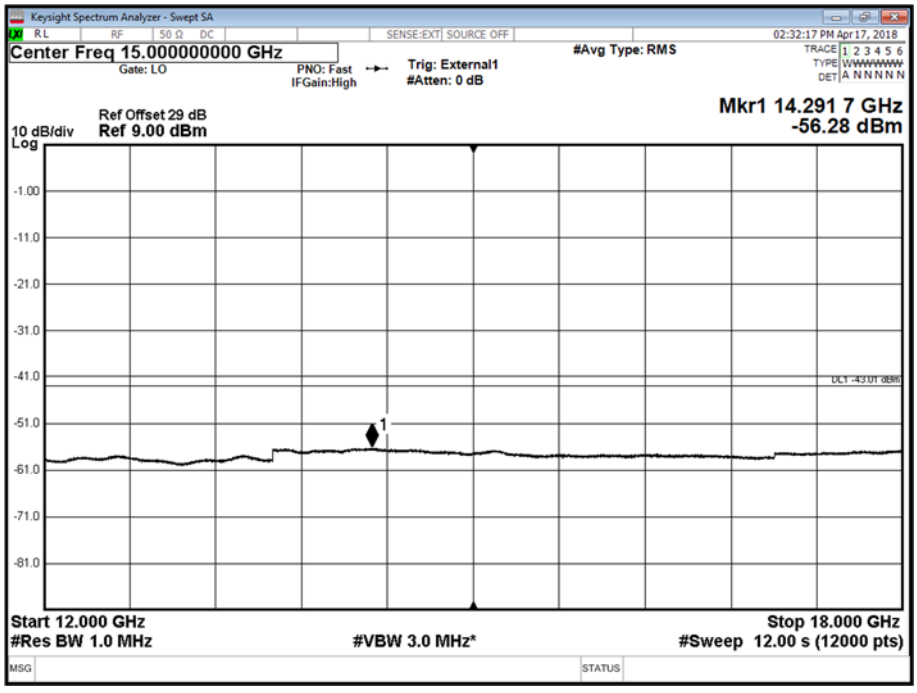
Antenna B - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position T - Band 2 - Range 3720 to 5000 MHz



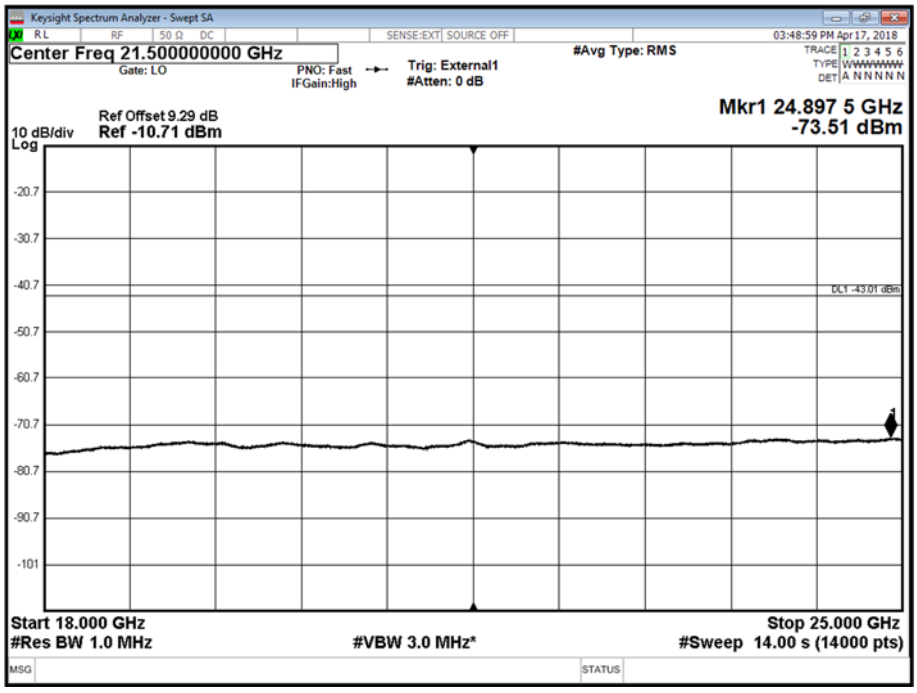
Antenna B - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position T - Band 3 - Range 5000 to 12000 MHz



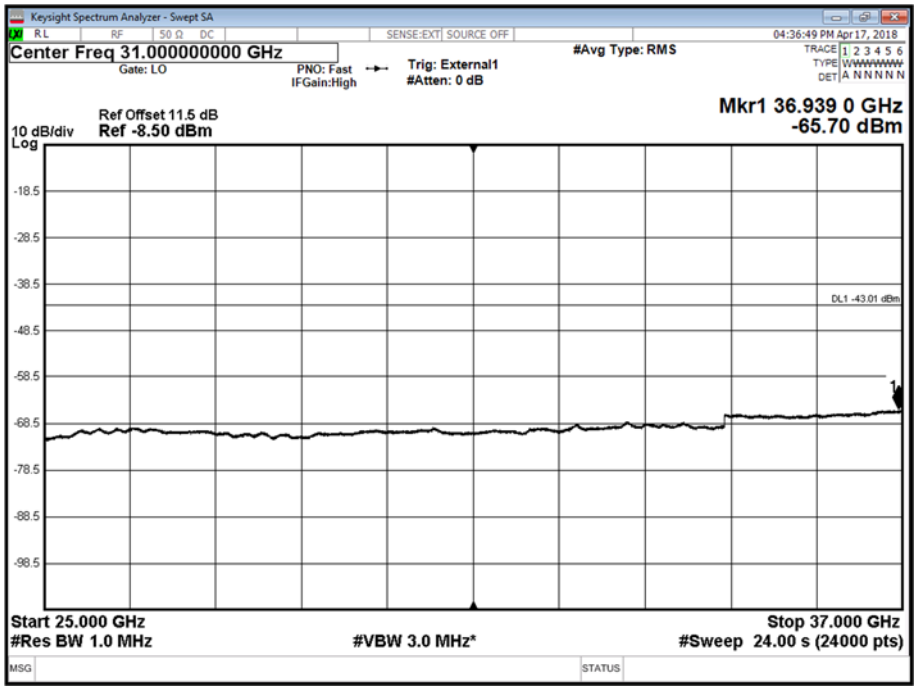
Antenna B - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position T - Band 4 - Range 12000 to 18000 MHz



Antenna B - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position T - Band 5 - Range 18000 to 25000 MHz



Antenna B - LTE Modulation 64QAM - LTE Carrier Bandwidth 20.0 MHz - Channel Position T - Band 6 - Range 25000 to 37000 MHz



Limit	<3530 MHz and >3720 MHz: -40 dBm/MHz ± 0 – 10 MHz Assigned Channel Edge: -13 dBm/MHz 3530 MHz to -10 MHz Assigned Channel Edge: -25 dBm/MHz +10 MHz Assigned Channel Edge to 3720 MHz: -25 dBm/MHz Note: Limits shown in the test plots have been reduced by 10log(2) to account for 2 Port MIMO operation

2.5 FREQUENCY STABILITY

2.5.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1055

2.5.2 Date of Test and Modification State

16 April 2018 - Modification State 0

2.5.3 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.5.4 Environmental Conditions

Ambient Temperature	23.4°C
Relative Humidity	38.3%

2.5.5 Test Method

All measurements were made in accordance with FCC KDB 971168 D01.

The EUT was setup in a Climatic Chamber and connected to a Vector Signal Analyser via attenuators. The temperature was varied over the range -30˚C to +50˚C in 10˚C steps. At each temperature interval, the EUT was left to stabilise. After this period of time, the maximum Frequency Error was measured and recorded on the Middle channel.

For LTE, testing was performed using a 10 MHz channel bandwidth with 64QAM modulation and all Resource Blocks active.

At 20˚C, the voltage was varied between 85 % and 115 % of the nominal declared voltage for both AC and DC supplies. At each extreme voltage, the maximum Frequency Error was measured and recorded.

2.5.6 Test Results

Configuration A1

Maximum Output Power 40 dBm

Temperature	Voltage	Frequency Error (Hz)	
		Channel Position M	
		Antenna A	Antenna B
-30°C	-48.0 V DC	-15.00	-12.81
-20°C	-48.0 V DC	11.53	-10.65
-10°C	-48.0 V DC	13.77	10.81
0°C	-48.0 V DC	12.50	-11.24
+10°C	-48.0 V DC	18.14	-15.07
+20°C	-40.8 V DC	10.78	11.76
+20°C	-48.0 V DC	12.62	13.94

+20°C	-55.2 V DC	10.38	12.05
+20°C	102.0 VAC	-11.36	8.71
+20°C	120.0 VAC	-11.15	-14.38
+20°C	138.0 VAC	-11.44	-10.52
+30°C	-48.0 V DC	11.19	-9.51
+40°C	-48.0 V DC	12.65	-12.08
+50°C	-48.0 V DC	-12.97	-19.31

Remarks

10 MHz carrier bandwidth

Limit	The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

2.6 RADIATED EMISSIONS

2.6.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1053
FCC CFR 47 Part 96, Clause 96.41(e)(1)(2)

2.6.2 Date of Test and Modification State

04 April 2018 - Modification State 0

2.6.3 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.6.4 Environmental Conditions

Ambient Temperature	21.0°C
Relative Humidity	31.0%

2.6.5 Test Method

The test was applied in accordance with test method requirements of ANSI/TIA-603-D-2010.

A preliminary profile of the Spurious Radiated Emissions was obtained by operating the EUT on a remotely controlled turntable within the chamber. Measurements of emissions from the EUT were obtained with the Measurement Antenna in both Horizontal and Vertical Polarisations.

The Applicant declared that the highest internally generated frequency would be up to 4000MHz and so the upper limit for measurement was calculated at 10 times this, which is 40GHz.

Emissions identified within the range 30MHz – 40GHz were then formally measured using a Peak detector as the worst case.

In the frequency Range 30MHz – 1GHz, the measurement was performed with a resolution bandwidth of 1MHz.

In the frequency Range 1GHz – 40GHz, the measurement was performed with a resolution bandwidth of 1MHz.

The measurements were performed at a 3m distance unless otherwise stated.

The limits for Spurious Emissions have been calculated, as shown below using the following formula:

EIRP[dBm] + 95.2=E[dBµV/m] = EIRP[dBm] + 95.2, for d = 3 m.

As per 96.41(e)(1)(2).

Determination of Spurious Emission Limit

The limits given in the standard are converted from EIRP to field strength using the following converstion

EIRP[dBm] + 95.2 = E[dBµV/m] , for d = 3 m.

For example

-40[dBm] + 95.2 = 55.2[dBµV/m], for d = 3m

The limits which are displayed in the plots are for ERP which is 2.15dB higher than stated above for EIRP. When assesing the plots for compliance, the limit needs to be reduced accordingly.

When testing in-band the most stringent limit was applied.

For measurements between 18 GHz and 40 GHz, the test distance was reduced from 3 m to 1 m. For this frequency range, the limit was increased by 10 dB.

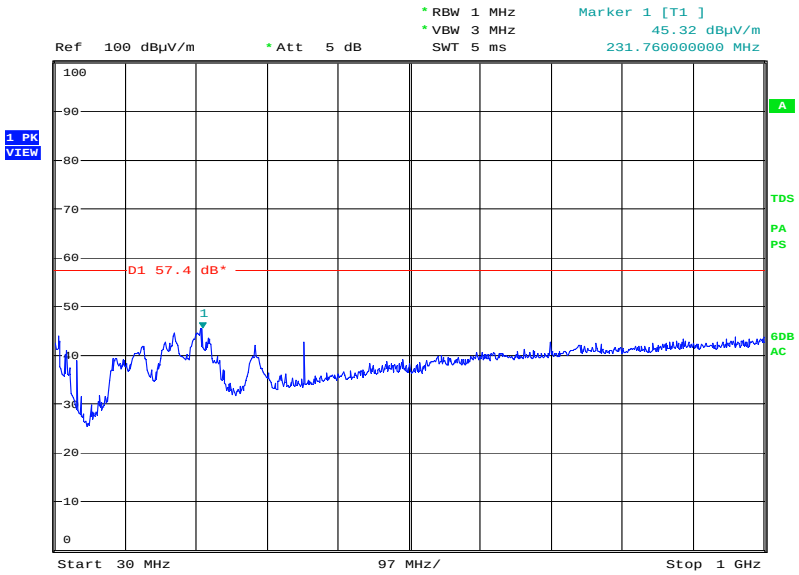
This limit has been used to determine Pass or Fail for the spurious emissions measured and detailed in the following results.

2.6.6 Test Results

Configuration A1

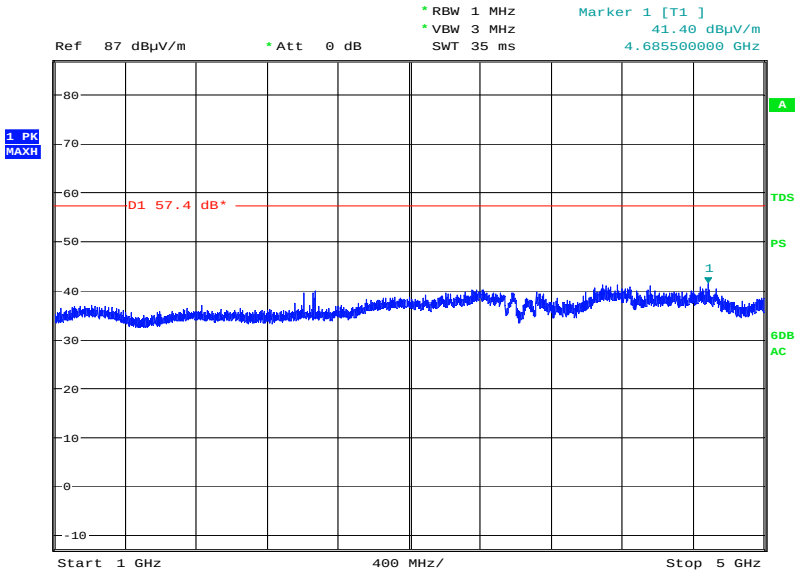
Maximum Output Power 40 dBm

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position B - Band 1 - Range 30MHz-1GHz



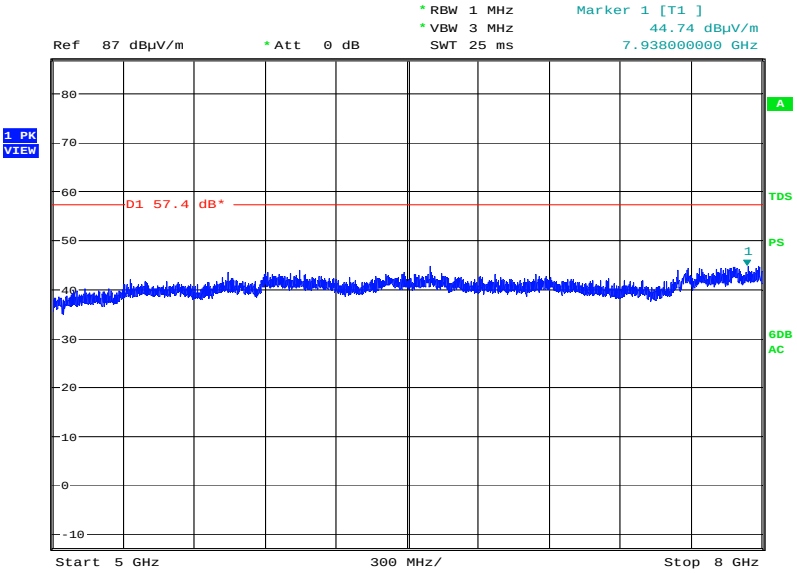
Date: 4.APR.2018 19:22:34

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position B - Band 2 - Range 1-5 GHz



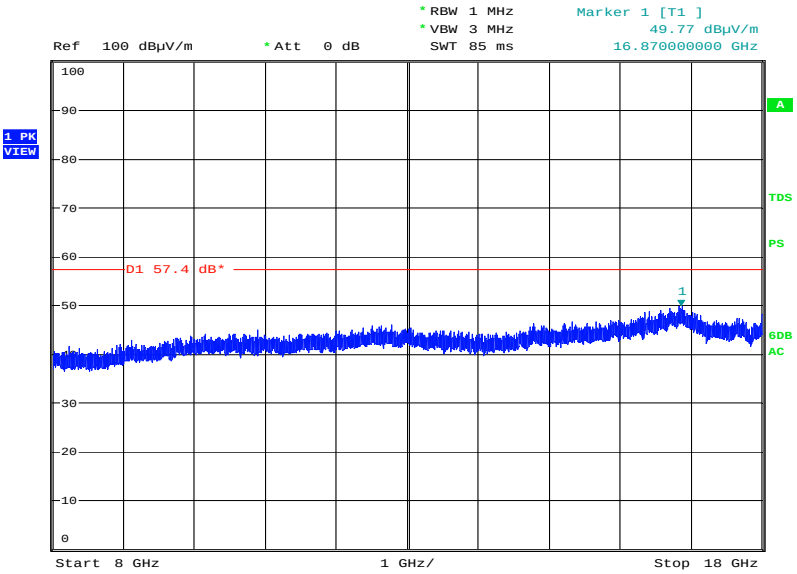
Date: 4.APR.2018 14:37:41

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position B - Band 3 - Range 5-8 GHz



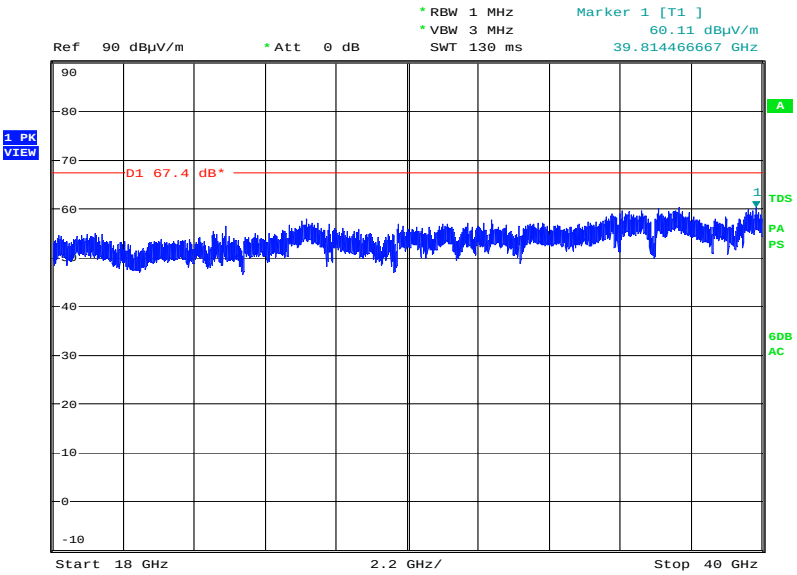
Date: 4.APR.2018 15:41:34

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position B - Band 4 - Range 8-18 GHz



Date: 4.APR.2018 16:25:15

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position B - Band 5 - Range 18-40 GHz



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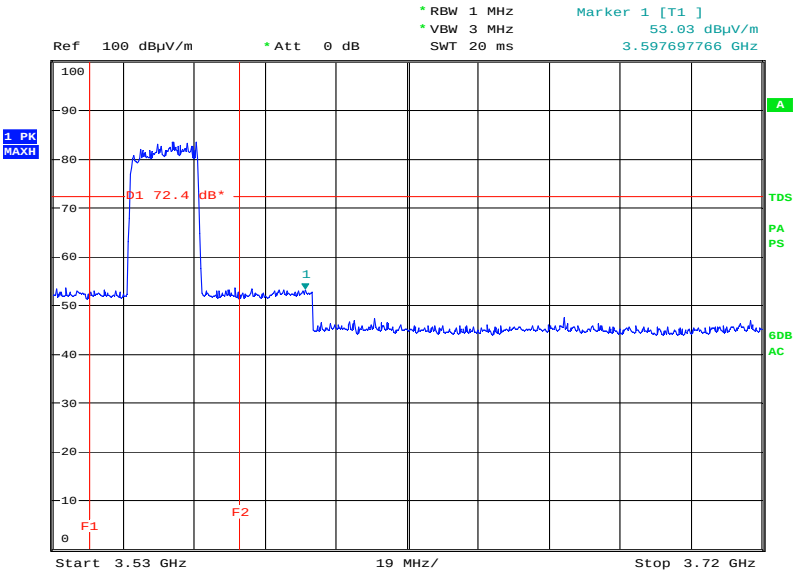
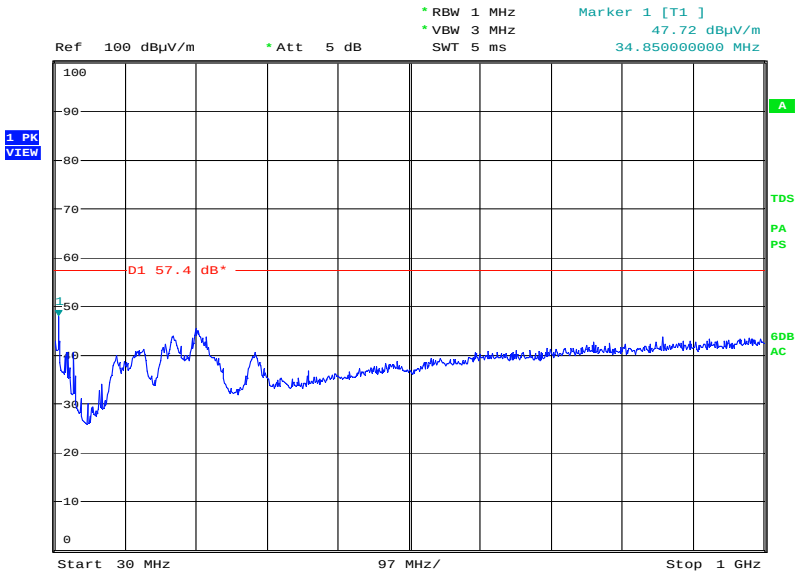
Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position B - Band 6 - Range In Band



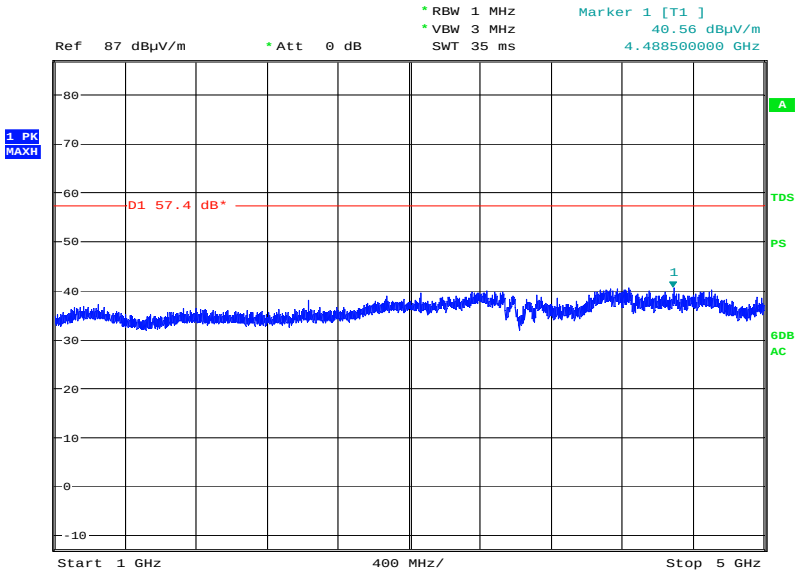
Date: 5.APR.2018 11:25:10

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position M - Band 1 - Range 30MHz-1GHz



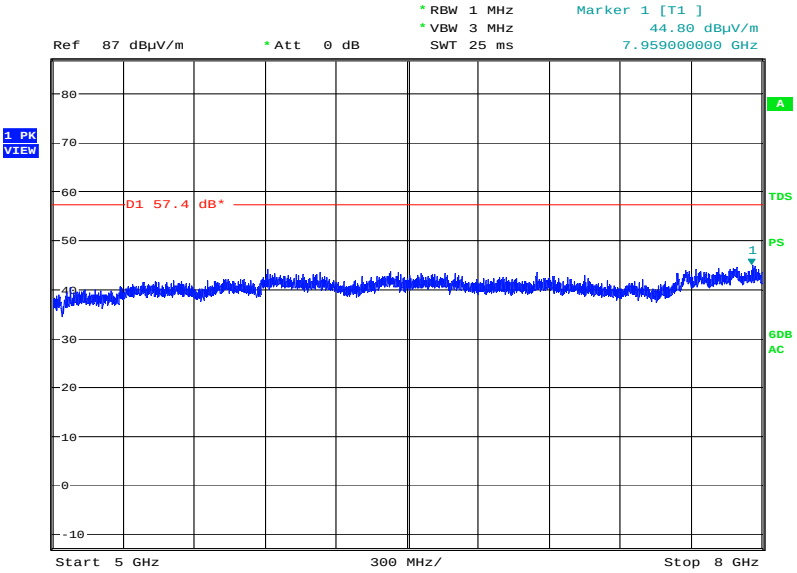
Date: 4.APR.2018 19:20:20

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position M - Band 2 - Range 1-5 GHz



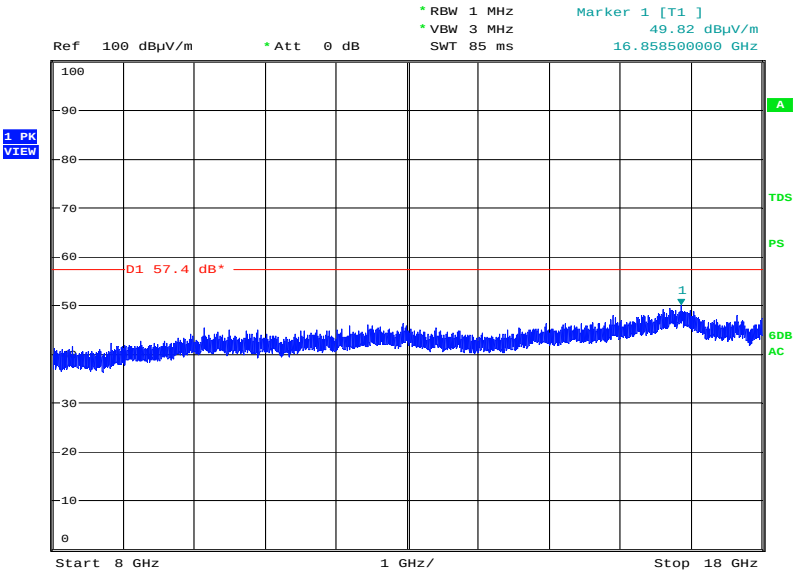
Date: 4.APR.2018 14:40:53

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position M - Band 3 - Range 5-8 GHz



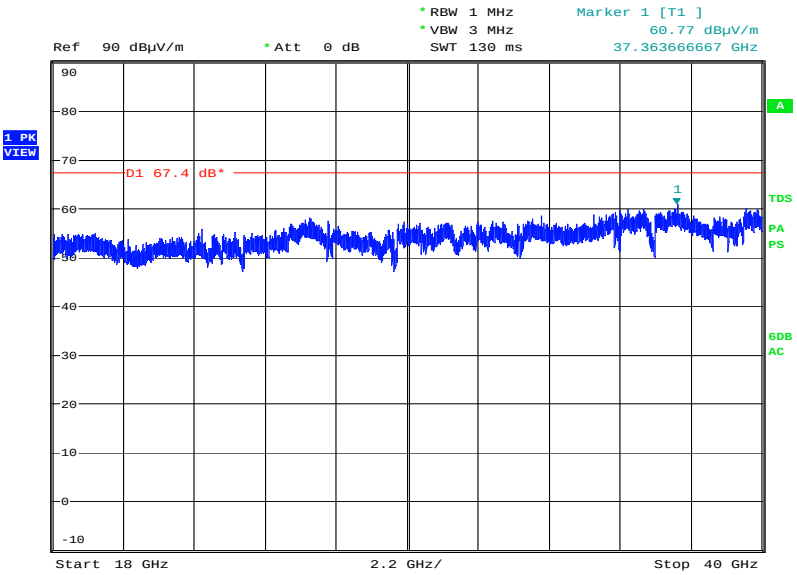
Date: 4.APR.2018 15:44:17

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position M - Band 4 - Range 8-18 GHz



Date: 4.APR.2018 16:27:40

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position M - Band 5 - Range 18-40 GHz



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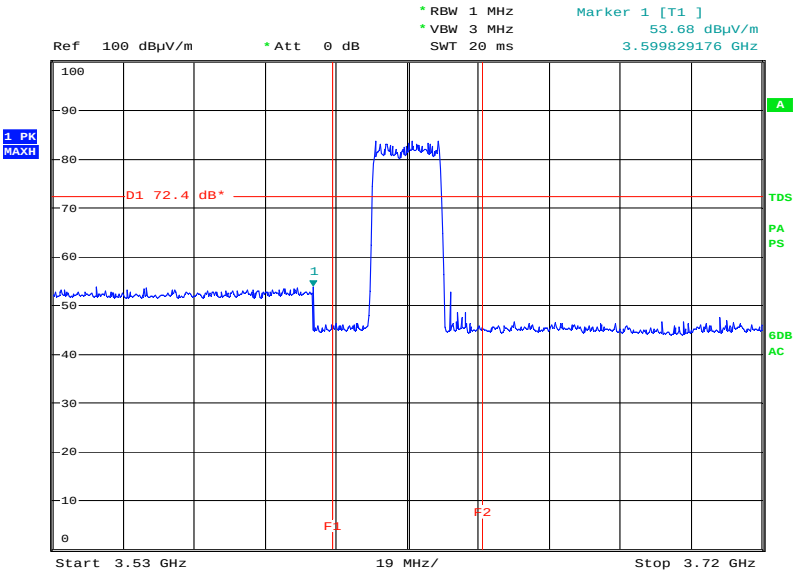
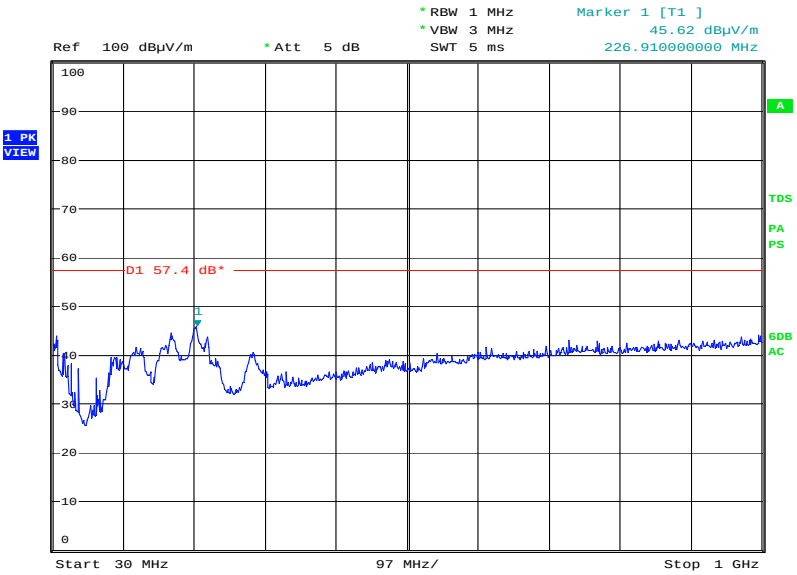
Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position M - Band 6 - Range In Band



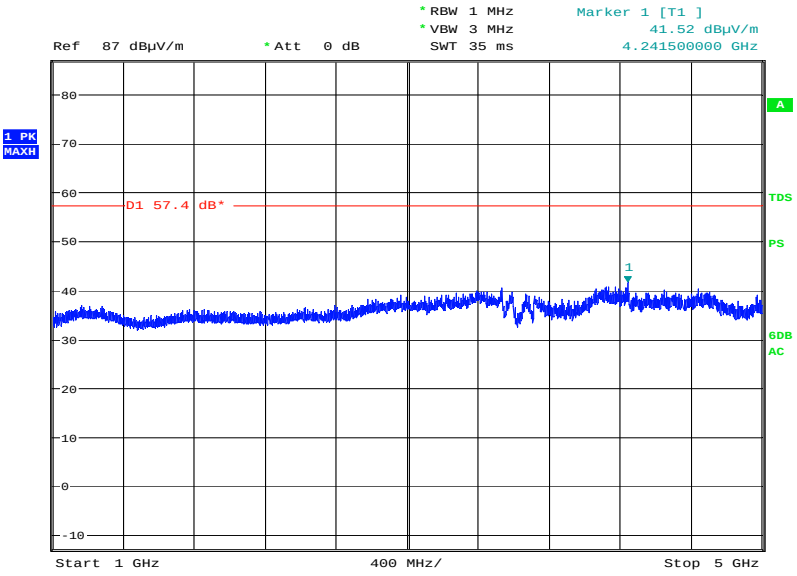
Date: 5.APR.2018 11:27:38

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position T - Band 1 - Range 30MHz-1GHz



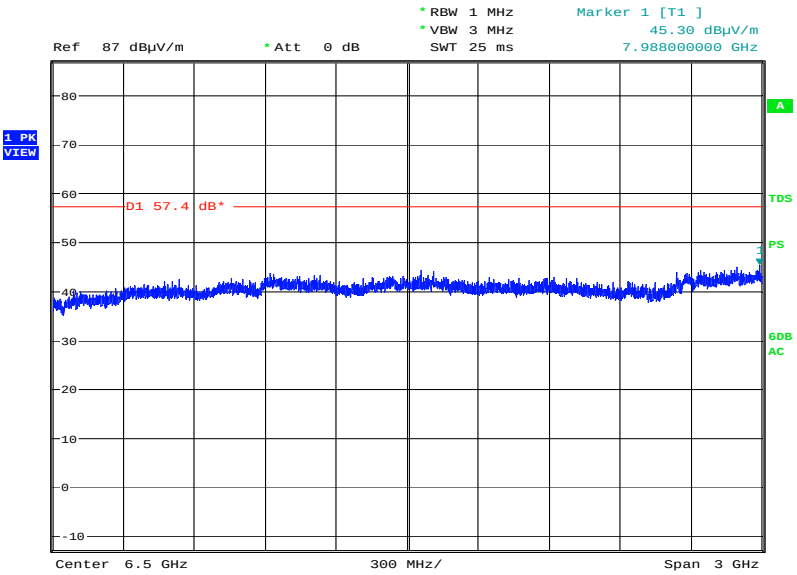
Date: 4.APR.2018 19:26:53

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position T - Band 2 - Range 1-5 GHz



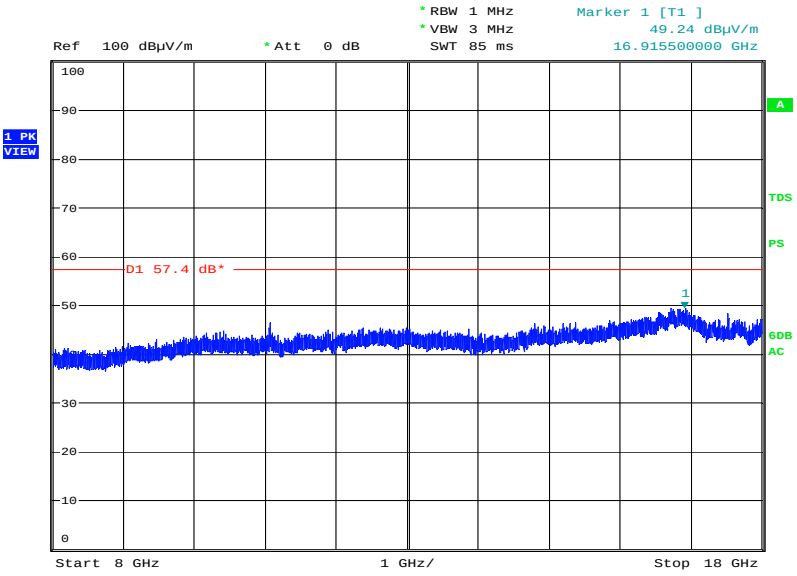
Date: 4.APR.2018 14:51:12

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position T - Band 3 - Range 5-8 GHz



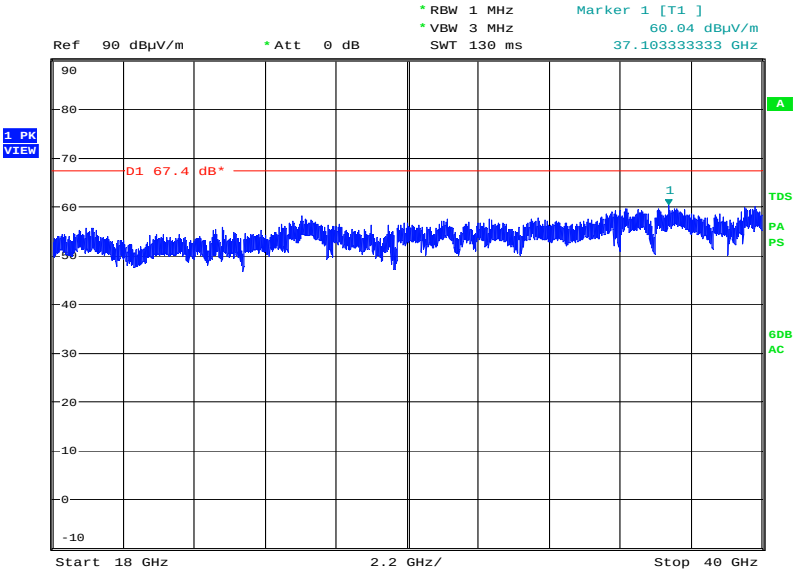
Date: 4.APR.2018 15:38:24

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position T - Band 4 - Range 8-18 GHz



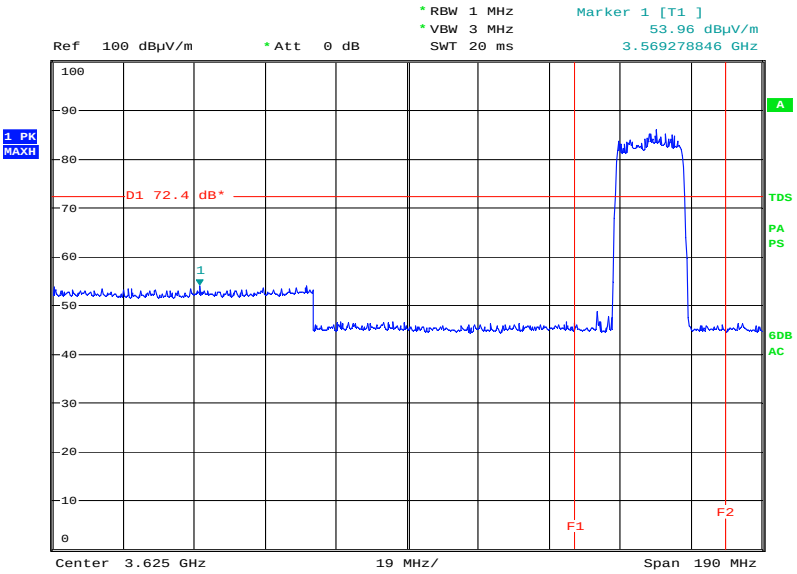
Date: 4.APR.2018 16:29:52

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position T - Band 5 - Range 18-40 GHz



Date: 4.APR.2018 17:52:11

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position T - Band 6 - Range In Band

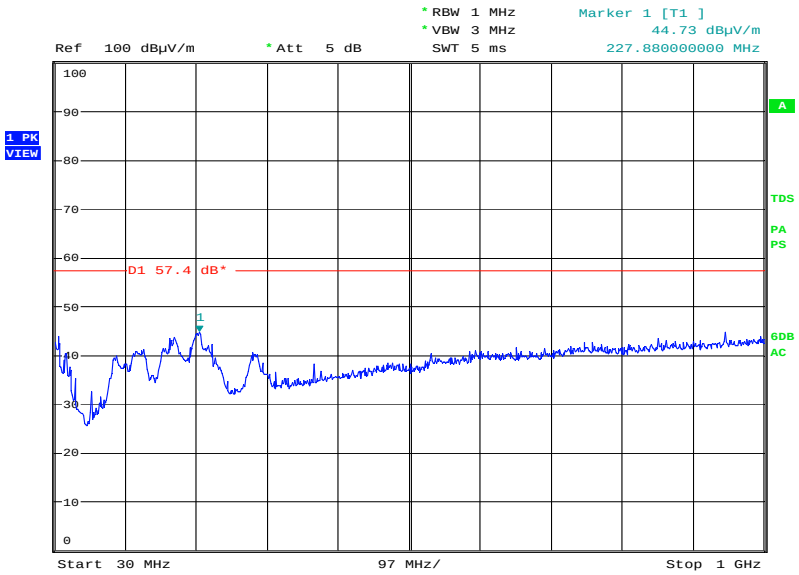


Date: 5.APR.2018 11:31:07

Configuration A2

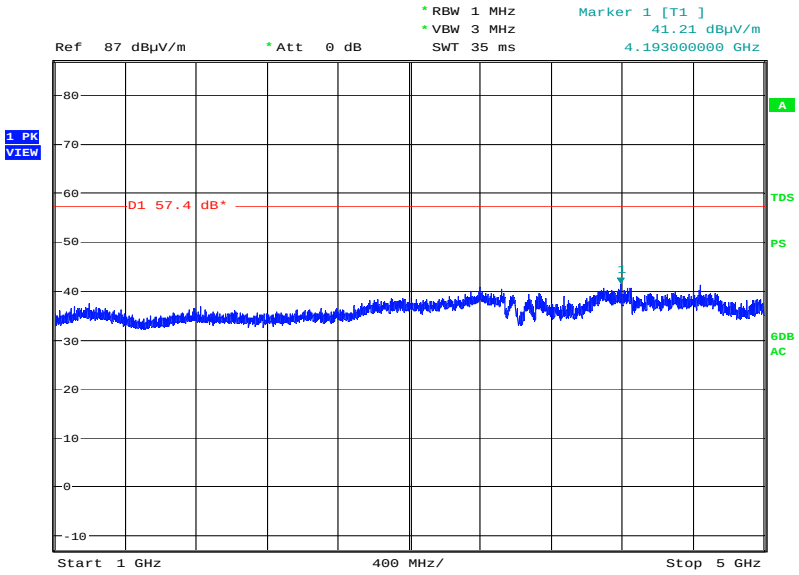
Maximum Output Power 40 dBm

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position M - Band 1 - Range 30MHz-1GHz



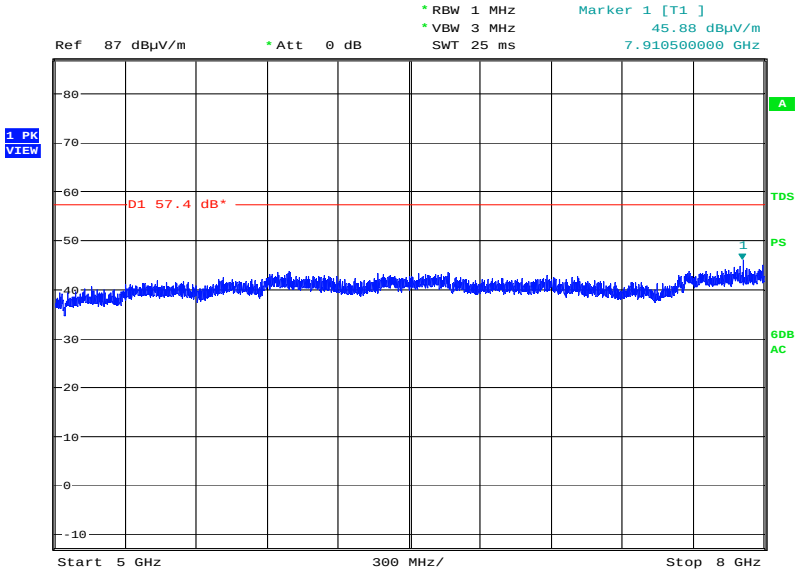
Date: 4.APR.2018 19:30:29

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position M - Band 2 - Range 1-5 GHz



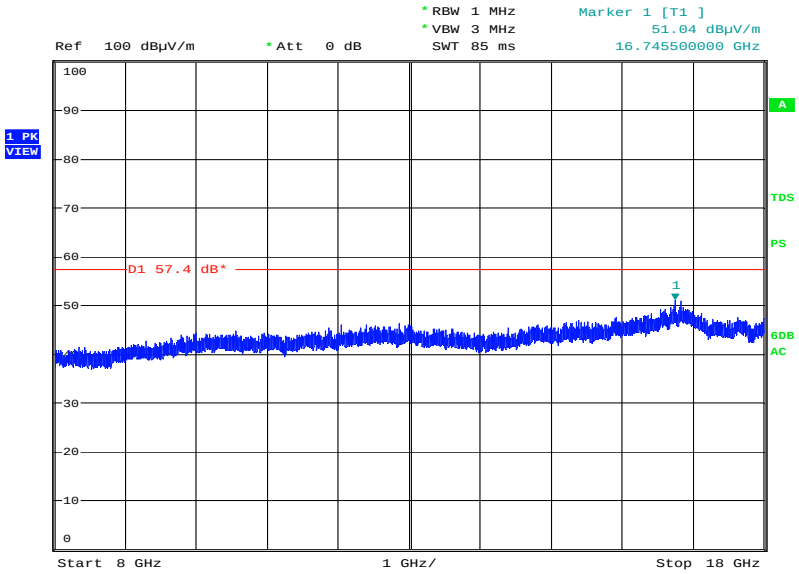
Date: 4.APR.2018 14:57:56

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position M - Band 3 - Range 5-8 GHz



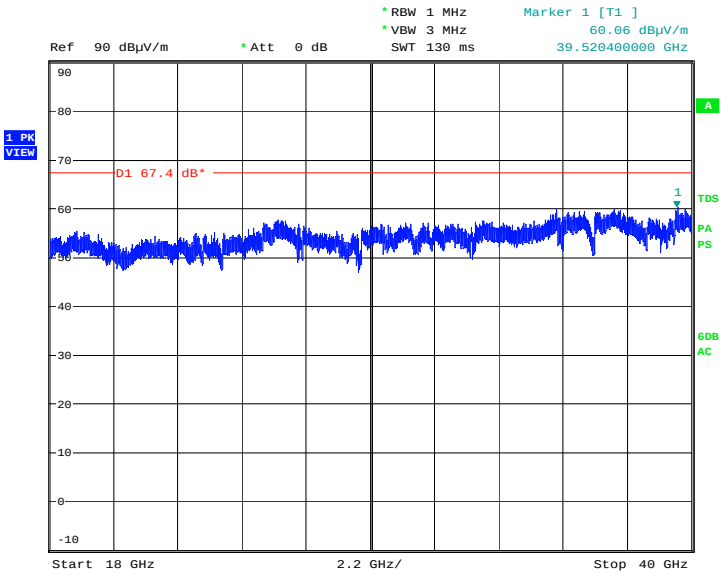
Date: 4.APR.2018 15:47:15

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position M - Band 4 - Range 8-18 GHz



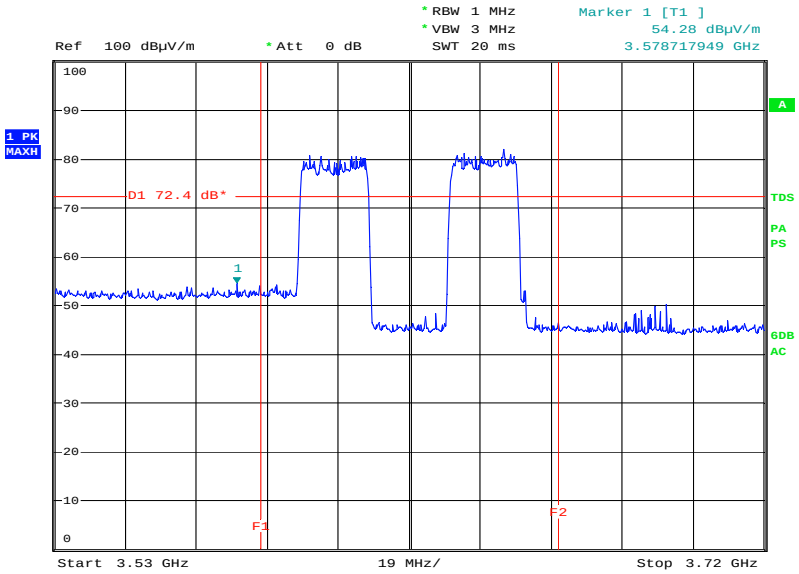
Date: 4.APR.2018 16:19:31

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position M - Band 5 - Range 18-40 GHz



Date: 4.APR.2018 17:55:39

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position M - Band 6 - Range In Band

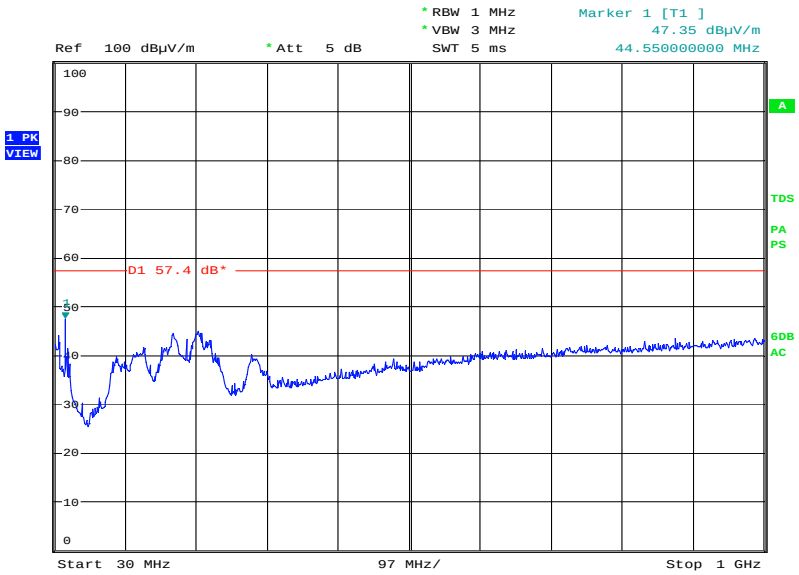


Date: 5.APR.2018 11:46:35

Configuration A3

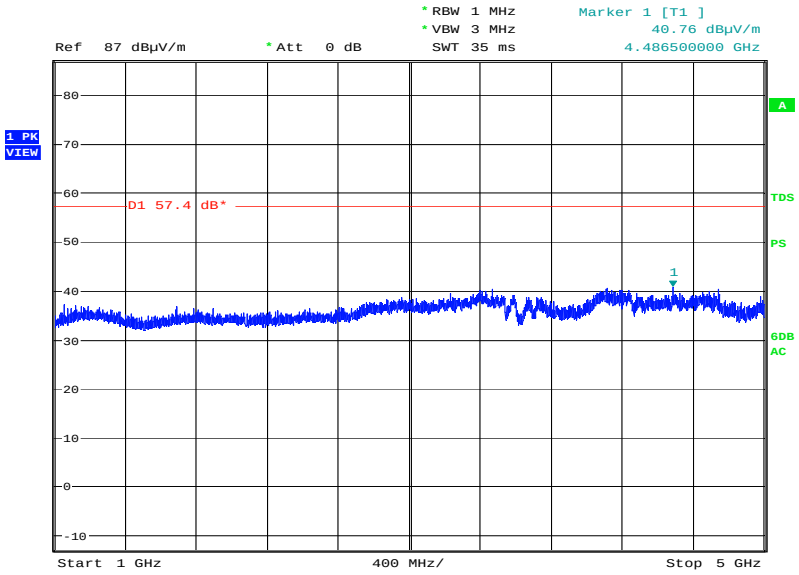
Maximum Output Power 40 dBm

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position M - Band 1 - Range 30MHz-1GHz



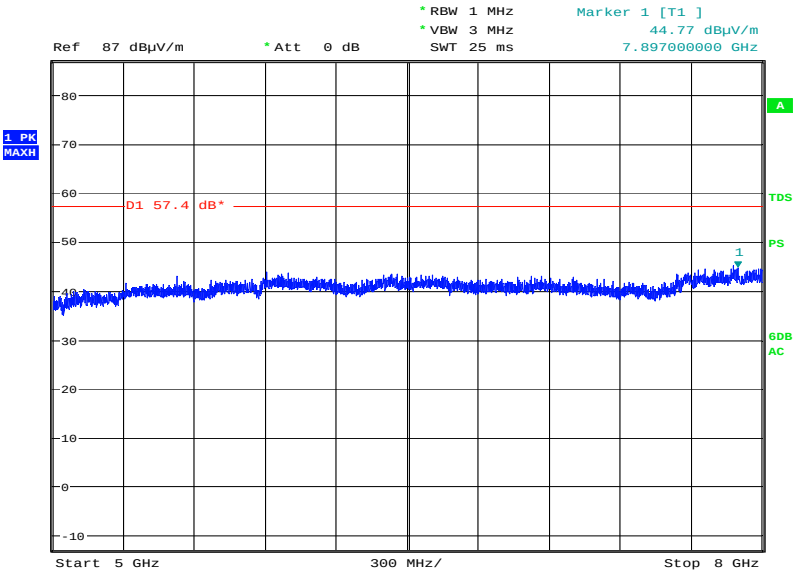
Date: 4.APR.2018 19:33:26

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position M - Band 2 - Range 1-5 GHz



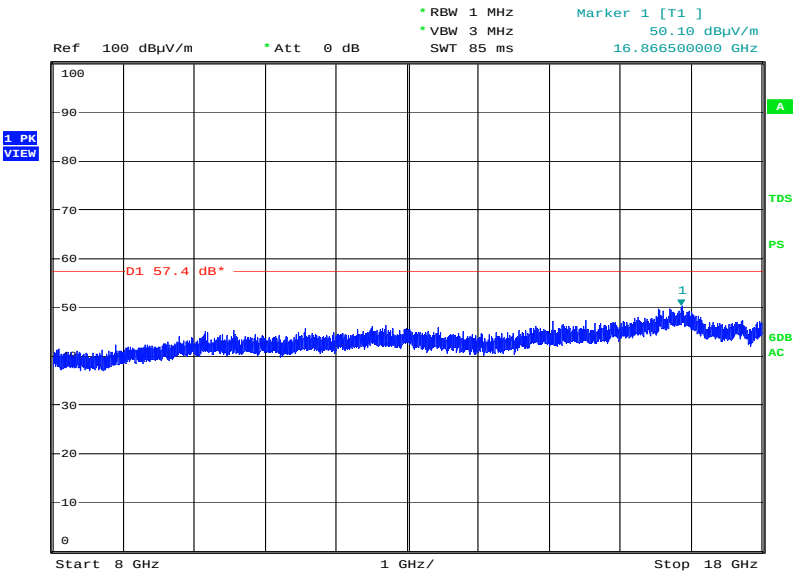
Date: 4.APR.2018 15:02:23

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position M - Band 3 - Range 5-8 GHz



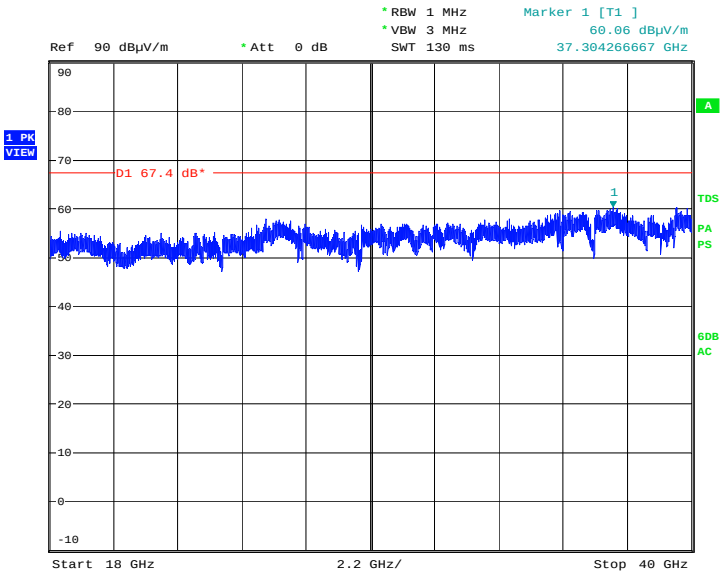
Date: 4.APR.2018 15:14:26

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position M - Band 4 - Range 8-18 GHz



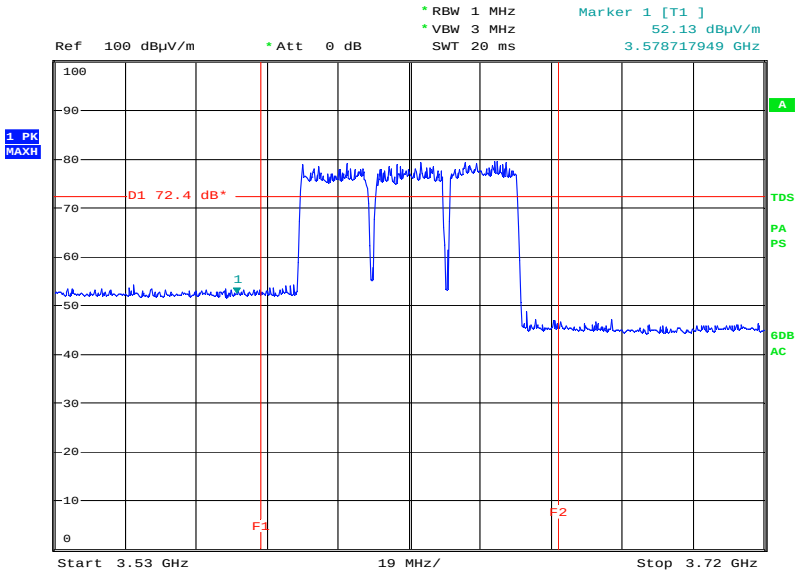
Date: 4.APR.2018 16:22:48

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position M - Band 5 - Range 18-40 GHz



Date: 4.APR.2018 17:59:23

Antenna A - LTE Modulation - LTE Carrier Bandwidth 20MHz - Channel Position M - Band 6 - Range In Band



Date: 5.APR.2018 11:50:28

Limit	<3530 MHz and >3720 MHz: -40 dBm/MHz ± 0 – 10 MHz Assigned Channel Edge: -13 dBm/MHz 3530 MHz to -10 MHz Assigned Channel Edge: -25 dBm/MHz +10 MHz Assigned Channel Edge to 3720 MHz: -25 dBm/MHz

SECTION 3

TEST EQUIPMENT USED

3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Output Power and Peak to Average Ratio - Conducted					
Hygrometer	Rotronic	A1	2677	12	07-Feb-2019
Frequency standard	Quartzlock	A10-B	0092	12	27-Feb-2019
Power supply	California Instr.	2001 RP	1898	-	O/P Mon
DMM	Fluke	179	4006	12	13-Dec-2018
Signal Analyser	Keysight	N9030A	4653	12	05-Feb-2019
Signal Analyser	Keysight	N9030A	4654	12	06-Oct-2018
Network Analyser	R&S	ZVA-40	3548	12	02-Oct-2018
Calibration kit	R&S	ZV-Z54	4368	12	06-Mar-2019
Attenuator	Weinschel	48-30-43	4871	12	03-May-2018
Attenuator	Weinschel	48-10-43	4136	12	11-Jul-2018
Attenuator	Narda	769-30	3369	12	31-May-2018
Occupied Bandwidth					
Hygrometer	Rotronic	A1	2677	12	07-Feb-2019
Frequency standard	Quartzlock	A10-B	0092	12	27-Feb-2019
Power supply	California Instr.	2001 RP	1898	-	O/P Mon
DMM	Fluke	179	4006	12	13-Dec-2018
Signal Analyser	Keysight	N9030A	4653	12	05-Feb-2019
Network Analyser	R&S	ZVA-40	3548	12	02-Oct-2018
Calibration kit	R&S	ZV-Z54	4368	12	06-Mar-2019
Attenuator	Weinschel	48-30-43	4871	12	03-May-2018
Attenuator	Weinschel	48-10-43	4136	12	11-Jul-2018
Band Edge					
Hygrometer	Rotronic	A1	2677	12	07-Feb-2019
Frequency standard	Quartzlock	A10-B	0092	12	27-Feb-2019
Power supply	California Instr.	2001 RP	1898	-	O/P Mon
DMM	Fluke	179	4006	12	13-Dec-2018
Signal Analyser	Keysight	N9030A	4653	12	05-Feb-2019
Network Analyser	R&S	ZVA-40	3548	12	02-Oct-2018
Calibration kit	R&S	ZV-Z54	4368	12	06-Mar-2019
Attenuator	Weinschel	48-30-43	4871	12	03-May-2018
Attenuator	Weinschel	48-10-43	4136	12	11-Jul-2018
Transmitter Spurious Emissions					
Hygrometer	Rotronic	A1	2677	12	07-Feb-2019
Frequency standard	Quartzlock	A10-B	0092	12	27-Feb-2019
Power supply	California Instr.	2001 RP	1898	-	O/P Mon
DMM	Fluke	179	4006	12	13-Dec-2018
Signal Analyser	Keysight	N9030A	4653	12	05-Feb-2019
Network Analyser	R&S	ZVA-40	3548	12	02-Oct-2018
Calibration kit	R&S	ZV-Z54	4368	12	06-Mar-2019

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Attenuator	Weinschel	48-30-43	4871	12	03-May-2018
Attenuator	Weinschel	48-10-43	4136	12	11-Jul-2018
High Pass Filter	Filtronic	SHX005	1873	-	O/P Mon
Diplex Filter	Creowave	DPF-3550-3700-E12-M2	1448001	-	O/P Mon
Waveguide	Flann Microwave	18-25 GHz	-	-	O/P Mon
Waveguide	Flann Microwave	25-40 GHz	-	-	O/P Mon
Attenuator	Weinschel	48-10-43	4868	12	01-Nov-2018
Frequency Stability					
Hygrometer	Rotronic	A1	2677	12	07-Feb-2019
Frequency standard	Quartzlock	A10-B	0092	12	27-Feb-2019
Power supply	California Instr.	2001 RP	1898	-	O/P Mon
DMM	Fluke	179	4006	12	13-Dec-2018
Signal Analyser	Keysight	N9030A	4654	12	06-Oct-2018
Attenuator	Weinschel	48-30-43	4871	12	03-May-2018
Attenuator	Weinschel	48-10-43	4136	12	11-Jul-2018
Climatic Chamber	Aralab	300E45	4823	-	O/P Mon
Thermometer	Fluke	51	3172	12	29-Nov-2018
Power Supply	Farnell	TSV70	2043	-	O/P Mon
Radiated Emissions					
Antenna (Bilog)	Schaffner	CBL6143	287	24	18-Apr-2018
Antenna 18-40GHz (Double Ridge Guide)	Q-Par Angus Ltd	QSH 180K	1511	24	07-Dec-2018
Pre-Amplifier	Phase One	PS04-0086	1533	12	12-Jan-2019
18GHz - 40GHz Pre-Amplifier	Phase One	PSO4-0087	1534	12	02-Feb-2019
Screened Room (5)	Rainford	Rainford	1545	36	09-Jun-2018
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	22-Nov-2018
Tilt Antenna Mast	maturo Gmbh	TAM 4.0-P	3916	-	TU
Mast Controller	maturo Gmbh	NCD	3917	-	TU
1GHz to 8GHz Low Noise Amplifier	Wright Technologies	APS04-0085	4365	12	18-Oct-2018
Double Ridged Waveguide Horn Antenna	ETS-Lindgren	3117	4722	12	01-Mar-2019
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	12-Feb-2019

N/A – Not Applicable
TU – Traceability Unscheduled
O/P Mon – Output Monitored with Calibrated Equipment

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:-

Test Discipline	Frequency / Parameter	MU
Conducted Maximum Peak Output Power	30 MHz to 20 GHz Amplitude	± 0.1 dB
Conducted Emissions	30 MHz to 20 GHz Amplitude	± 2.3 dB
Frequency Stability	30 MHz to 2 GHz	± 5.0 Hz
Occupied Bandwidth	Up to 20 MHz Bandwidth	± 1.1 Hz
Band Edge	30 MHz to 20 GHz Amplitude	± 2.3 dB
Radiated Emissions, Bilog Antenna, AOATS	30MHz to 1GHz Amplitude	5.1dB*
Radiated Emissions, Horn Antenna, AOATS	1GHz to 40GHz Amplitude	6.3dB*
Worst case error for both Time and Frequency measurement 12 parts in 10^6		

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

4.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

This report relates only to the actual item/items tested.

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation.

Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).

Product Service

ANNEX A

MODULE LIST

Configuration A1, A2 and A3			
Product	Product No	R-State	Serial No
Radio 2208 B48	KRC 161 711/1	R1B	D827120517
Software Version:	CXP9034711/2	Revision:	R1C04