

Appendix D

RF Test Data for BT V4.0(BT LE) (Conducted Measurement)

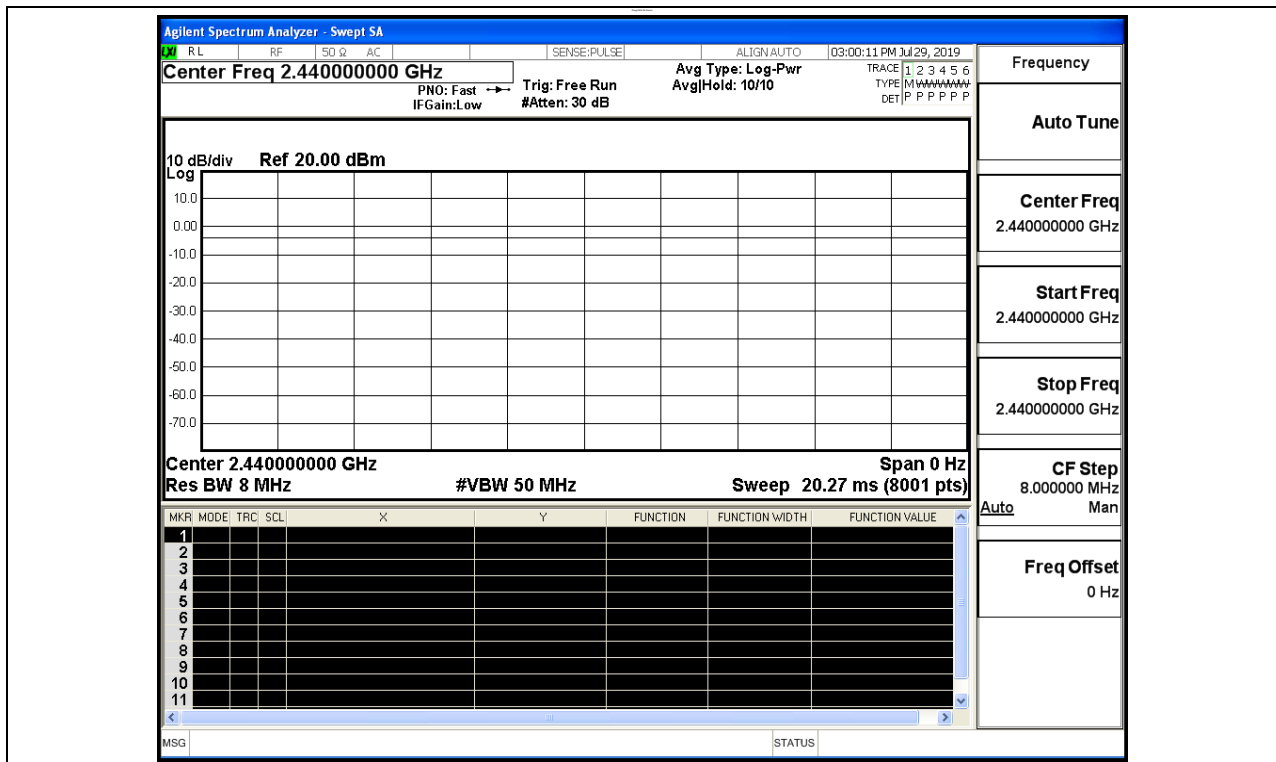
Product Name: Battery Operated LTE Cellular GPS Tracker
Test Model: CUT-4LH

Environmental Conditions

Temperature:	22.9 ° C
Relative Humidity:	53.9%
ATM Pressure:	100.0 kPa
Test Engineer:	Diamond Lu
Supervised by:	Wang Chuang

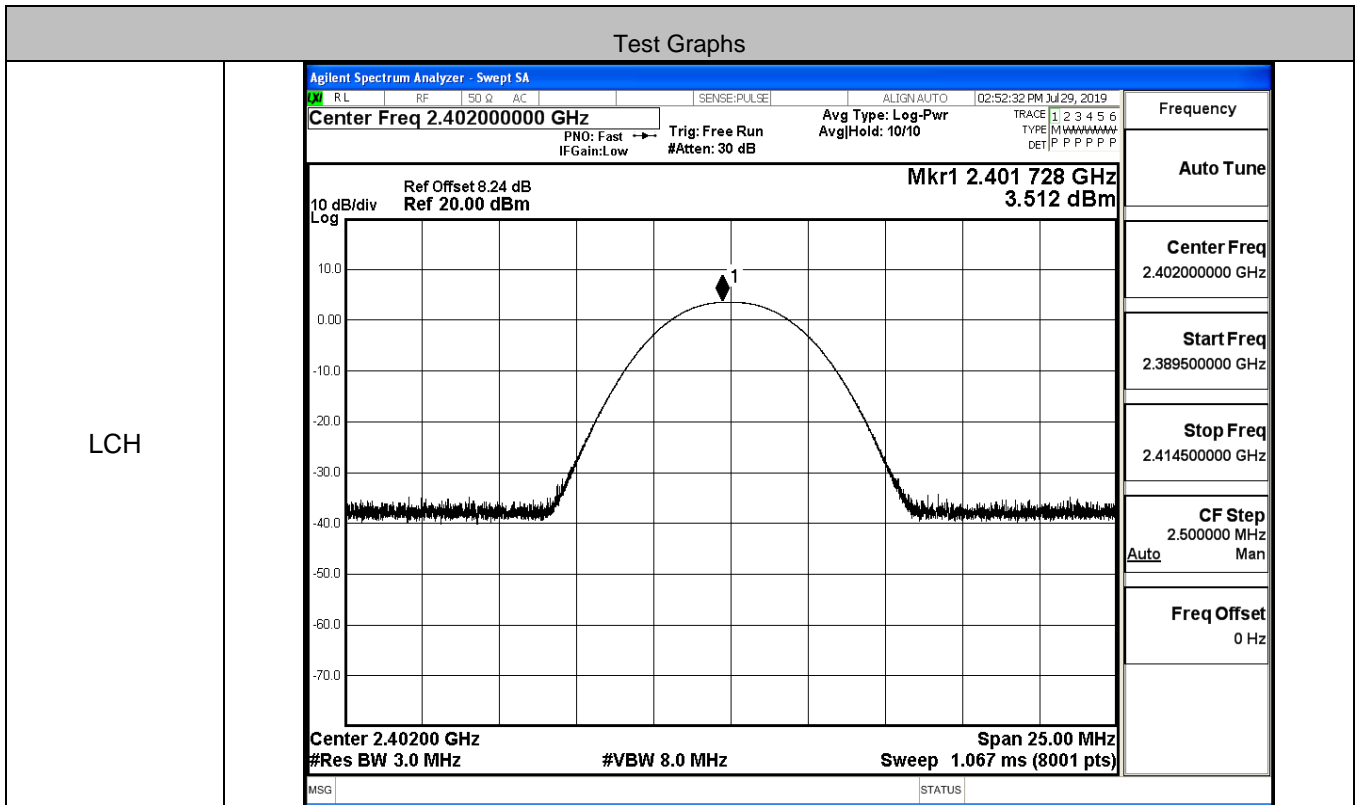
D.1 Duty Cycle

Test Mode	Test Channel	Ant	Duty Cycle[%]	Verdict
BT LE	2440	Ant1	100	PASS

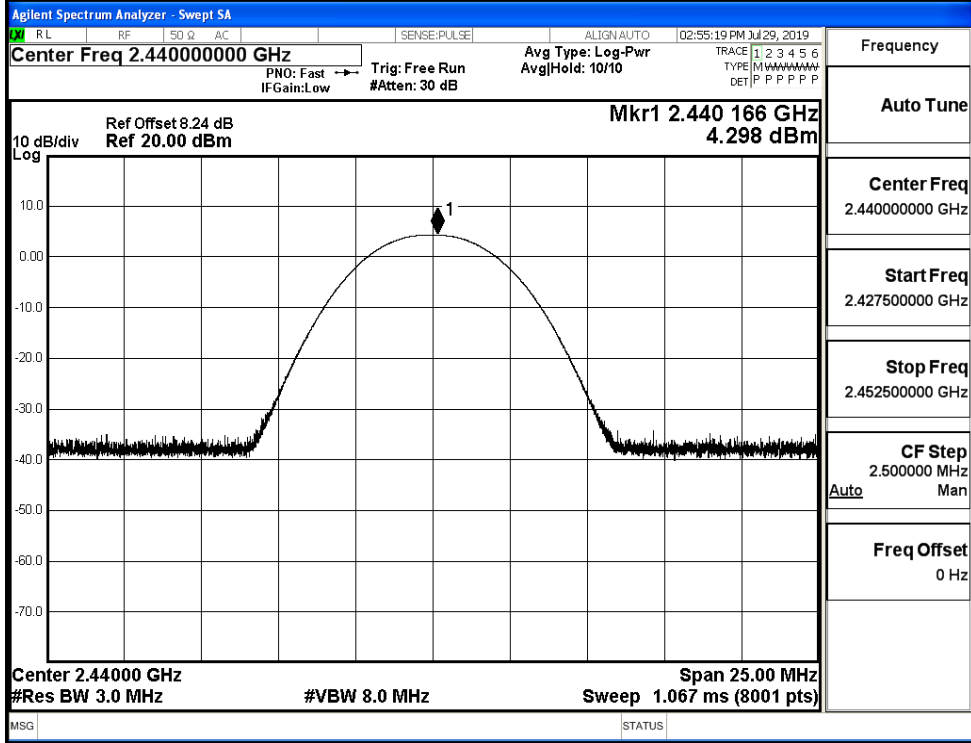


D.2 Maximum Conducted Peak Output Power

Mode	Channel	Conduct Peak Power[dBm]	Conduct Average Power[dBm]	Limit [dBm]	Verdict
BT LE	LCH	3.512	3.308	30	PASS
BT LE	MCH	4.298	4.138	30	PASS
BT LE	HCH	2.930	2.795	30	PASS

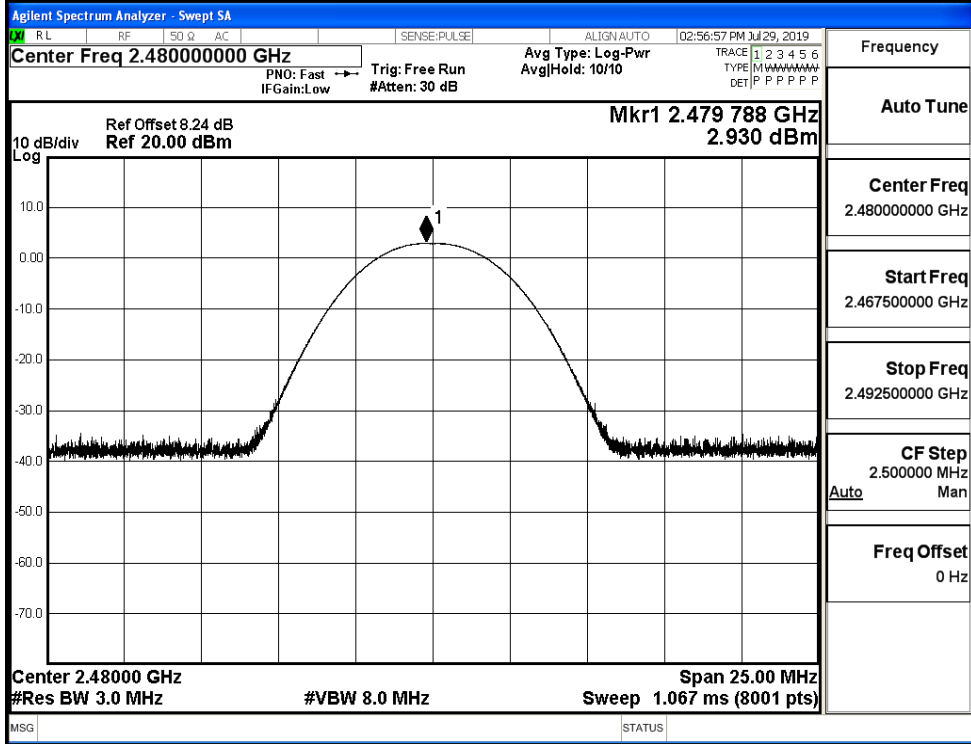


MCH



Frequency	
Auto Tune	
Center Freq	2.440000000 GHz
Start Freq	2.427500000 GHz
Stop Freq	2.452500000 GHz
CF Step	2.500000 MHz
Auto	Man
Freq Offset	0 Hz

HCH

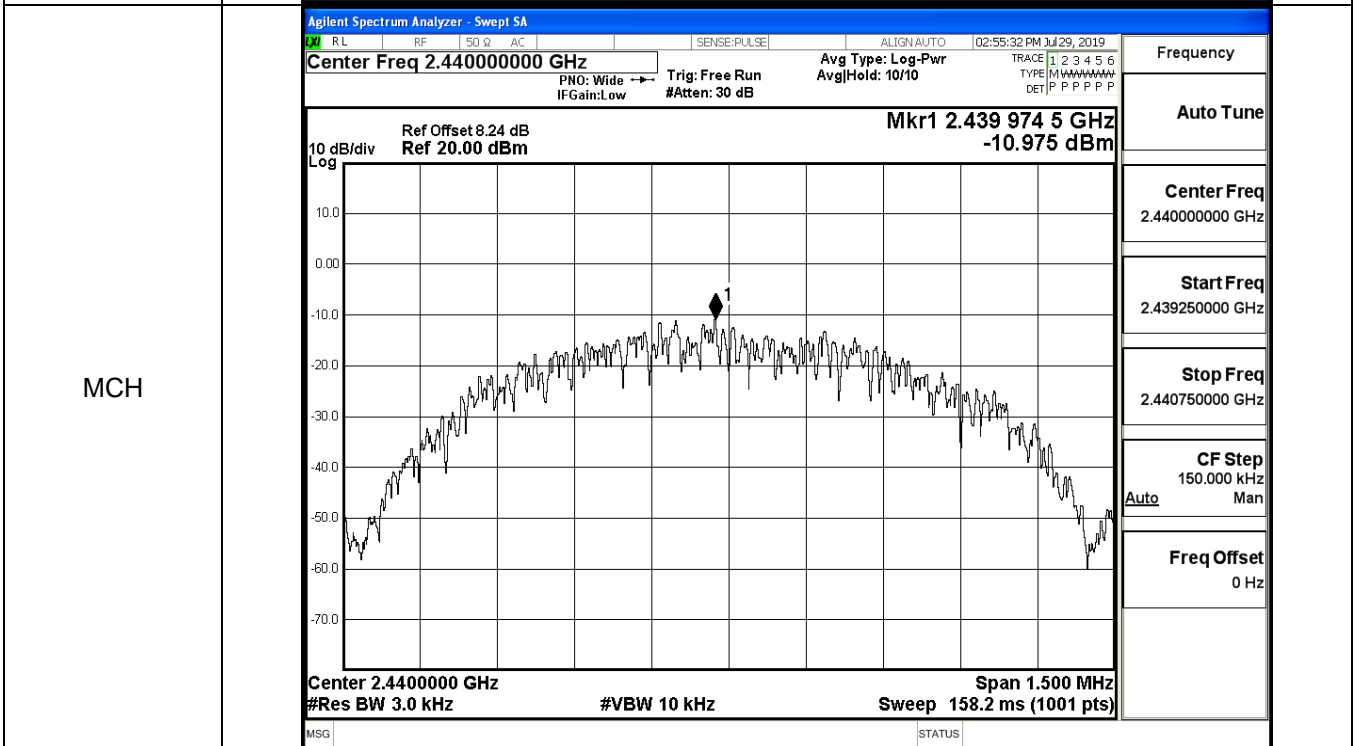
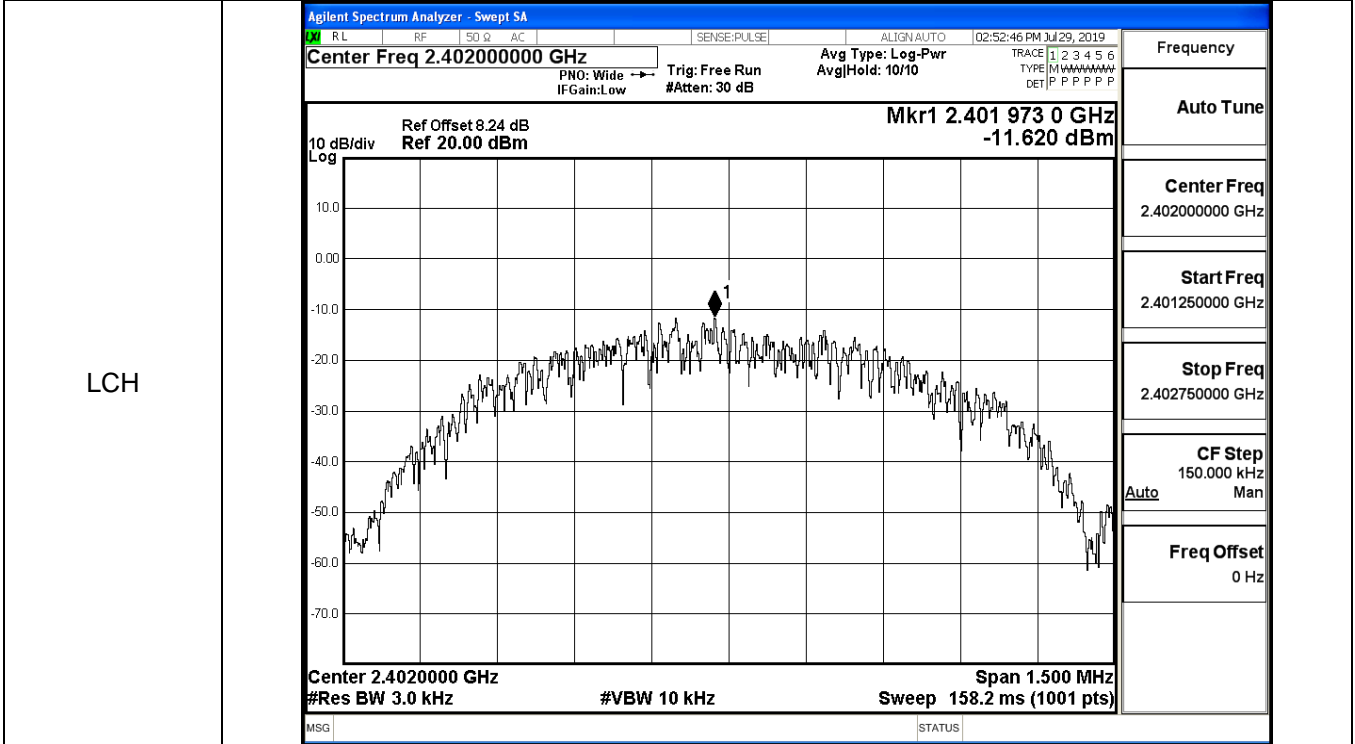


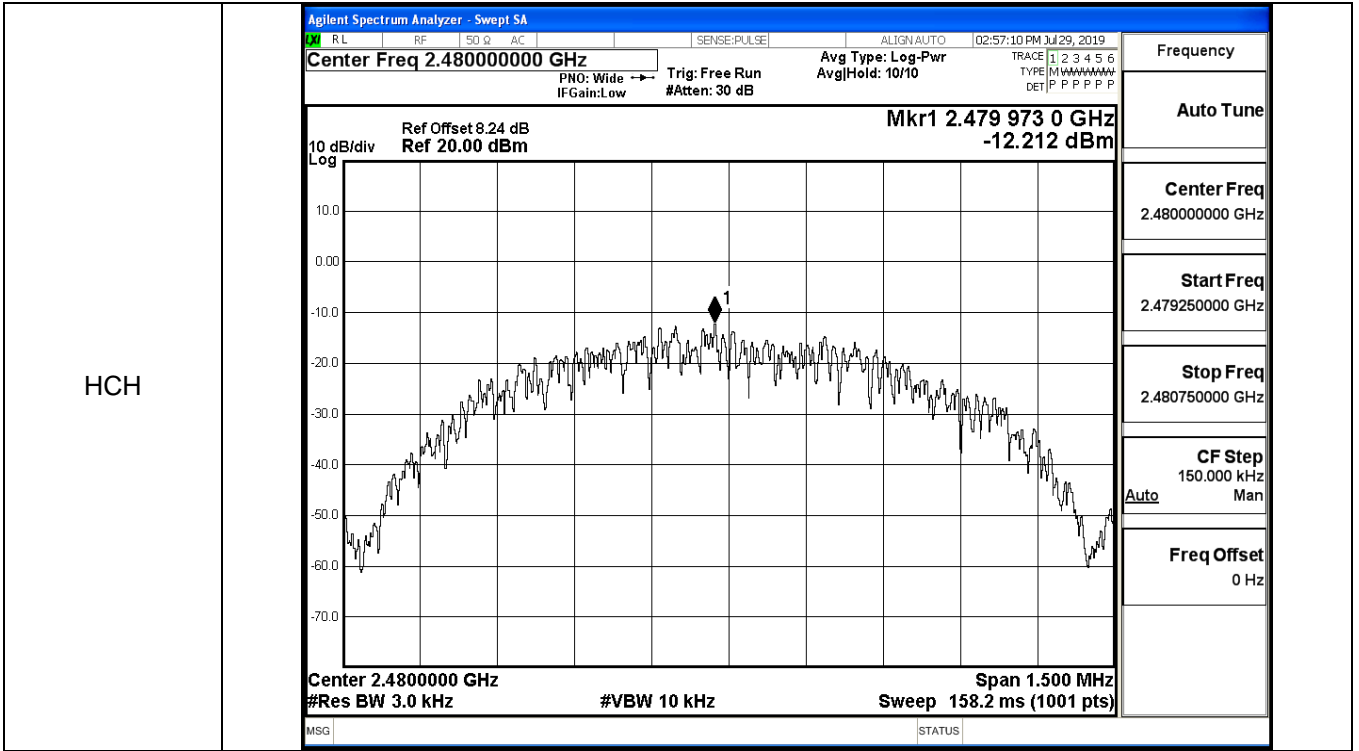
Frequency	
Auto Tune	
Center Freq	2.480000000 GHz
Start Freq	2.467500000 GHz
Stop Freq	2.492500000 GHz
CF Step	2.500000 MHz
Auto	Man
Freq Offset	0 Hz

D.3 Maximum Power Spectral Density

Mode	Channel	PSD [dBm/3KHz]	Limit [dBm/3KHz]	Verdict
BT LE	LCH	-11.620	8	PASS
BT LE	MCH	-10.975	8	PASS
BT LE	HCH	-12.212	8	PASS

Test Graphs





HCH

D.4 6dB Bandwidth

Mode	Channel	6dB Bandwidth [MHz]	Limit [MHz]	Verdict
BT LE	LCH	0.7001	≥0.5	PASS
BT LE	MCH	0.6923	≥0.5	PASS
BT LE	HCH	0.6964	≥0.5	PASS

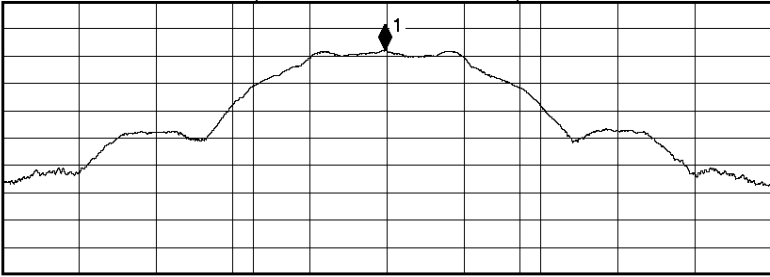
Test Graphs																			
LCH	<div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center; margin: 0;">Agilent Spectrum Analyzer - Occupied BW</p> <p style="font-size: small; margin: 0;">RL RF 50 Ω AC SENSE:PULSE ALIGN:AUTO 02:51:11 PM Jul 29, 2019</p> <p style="margin: 0;">Center Freq 2.402000000 GHz Center Freq: 2.402000000 GHz Radio Std: None Trig: Free Run AvgHold: 1/1 #IFGain:Low #Atten: 30 dB Radio Device: BTS</p> <div style="display: flex; justify-content: space-between;"> <div style="font-size: x-small;"> 10 dB/div Log Ref Offset 8.24 dB Ref 20.00 dBm </div> <div style="text-align: right;"> Mkr1 2.401994 GHz 5.4750 dBm </div> </div> <div style="display: flex; justify-content: space-between; font-size: x-small; margin-top: 5px;"> <div>Center 2.402 GHz</div> <div>#Res BW 100 kHz</div> <div>#VBW 300 kHz</div> <div>Span 3 MHz</div> <div>Sweep 1.067 ms</div> </div> <table border="0" style="width: 100%; font-size: small; margin-top: 5px;"> <tr> <td>Occupied Bandwidth</td> <td>Total Power</td> <td>12.6 dBm</td> </tr> <tr> <td style="text-align: center;">1.0454 MHz</td> <td></td> <td></td> </tr> <tr> <td>Transmit Freq Error</td> <td>-1.525 kHz</td> <td>OBW Power</td> </tr> <tr> <td>x dB Bandwidth</td> <td>700.1 kHz</td> <td>x dB</td> </tr> <tr> <td></td> <td></td> <td>99.00 %</td> </tr> <tr> <td></td> <td></td> <td>-6.00 dB</td> </tr> </table> <p style="font-size: x-small; margin-top: 5px;">MSG STATUS</p> </div>	Occupied Bandwidth	Total Power	12.6 dBm	1.0454 MHz			Transmit Freq Error	-1.525 kHz	OBW Power	x dB Bandwidth	700.1 kHz	x dB			99.00 %			-6.00 dB
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MCH	<div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center; margin: 0;">Agilent Spectrum Analyzer - Occupied BW</p> <p style="font-size: small; margin: 0;">RL RF 50 Ω AC SENSE:PULSE ALIGN:AUTO 02:55:07 PM Jul 29, 2019</p> <p style="margin: 0;">Center Freq 2.440000000 GHz Center Freq: 2.440000000 GHz Radio Std: None Trig: Free Run AvgHold: 1/1 #IFGain:Low #Atten: 30 dB Radio Device: BTS</p> <div style="display: flex; justify-content: space-between;"> <div style="font-size: x-small;"> 10 dB/div Log Ref Offset 8.24 dB Ref 20.00 dBm </div> <div style="text-align: right;"> Mkr1 2.4399843 GHz 3.3678 dBm </div> </div> <div style="display: flex; justify-content: space-between; font-size: x-small; margin-top: 5px;"> <div>Center 2.44 GHz</div> <div>#Res BW 100 kHz</div> <div>#VBW 300 kHz</div> <div>Span 3 MHz</div> <div>Sweep 1.067 ms</div> </div> <table border="0" style="width: 100%; font-size: small; margin-top: 5px;"> <tr> <td>Occupied Bandwidth</td> <td>Total Power</td> <td>10.5 dBm</td> </tr> <tr> <td style="text-align: center;">1.0425 MHz</td> <td></td> <td></td> </tr> <tr> <td>Transmit Freq Error</td> <td>-1.694 kHz</td> <td>OBW Power</td> </tr> <tr> <td>x dB Bandwidth</td> <td>692.3 kHz</td> <td>x dB</td> </tr> <tr> <td></td> <td></td> <td>99.00 %</td> </tr> <tr> <td></td> <td></td> <td>-6.00 dB</td> </tr> </table> <p style="font-size: x-small; margin-top: 5px;">MSG STATUS</p> </div>	Occupied Bandwidth	Total Power	10.5 dBm	1.0425 MHz			Transmit Freq Error	-1.694 kHz	OBW Power	x dB Bandwidth	692.3 kHz	x dB			99.00 %			-6.00 dB
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		99.00 %																	
		-6.00 dB																	

HCH

Agilent Spectrum Analyzer - Occupied BW

RL	RF	50 Ω	AC	SENSE:PULSE	ALIGN:AUTO	02:56:46 PM Jul 29, 2019
Center Freq 2.480000000 GHz			Center Freq: 2.480000000 GHz		Radio Std: None	
			Trig: Free Run		AvgHold>1/1	
#IFGain:Low			#Atten: 30 dB		Radio Device: BTS	

10 dB/div	Ref Offset 8.24 dB	Mkr1 2.4799933 GHz
Log	Ref 20.00 dBm	1.9553 dBm



Center 2.48 GHz	#VBW 300 kHz	Span 3 MHz
#Res BW 100 kHz		Sweep 1.067 ms

Occupied Bandwidth	Total Power	9.07 dBm
1.0404 MHz		
Transmit Freq Error	-1.545 kHz	OBW Power
x dB Bandwidth	696.4 kHz	99.00 %
	x dB	-6.00 dB

Frequency	2.480000000 GHz
Center Freq	2.480000000 GHz
CF Step	300.000 kHz
Auto	Man
Freq Offset	0 Hz

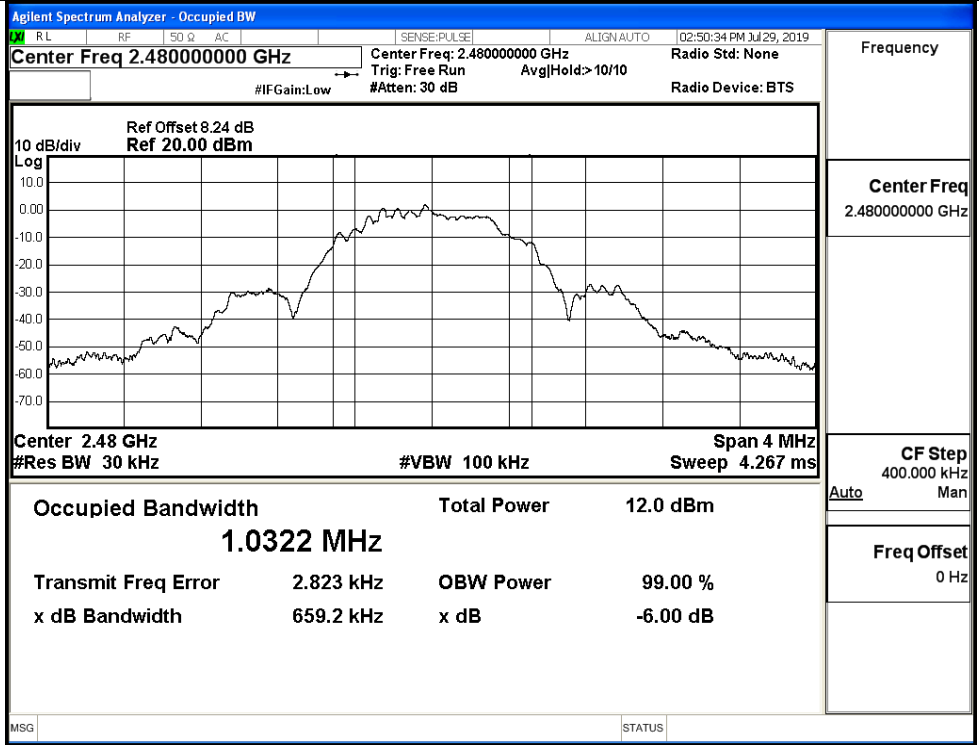
D.5 Occupied Bandwidth

Mode	Channel	Occupied Bandwidth [MHz]	Limit [MHz]	Verdict
BT LE	LCH	1.0334	≥0.5	PASS
BT LE	MCH	1.0320	≥0.5	PASS
BT LE	HCH	1.0322	≥0.5	PASS

Test Graphs

LCH	<p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq 2.40200000 GHz Center Freq: 2.402000000 GHz Radio Std: None</p> <p>Trig: Free Run Avg/Hold: 10/10 #Atten: 30 dB Radio Device: BTS</p> <p>Ref Offset 8.24 dB Ref 20.00 dBm</p> <p>Center 2.402 GHz Span 4 MHz #Res BW 30 kHz #VBW 100 kHz Sweep 4.267 ms</p> <table border="1"> <tr> <td>Occupied Bandwidth</td> <td>Total Power</td> <td>12.6 dBm</td> </tr> <tr> <td colspan="3" style="text-align: center;">1.0334 MHz</td> </tr> <tr> <td>Transmit Freq Error</td> <td>4.566 kHz</td> <td>OBW Power 99.00 %</td> </tr> <tr> <td>x dB Bandwidth</td> <td>653.9 kHz</td> <td>x dB -6.00 dB</td> </tr> </table> <p>MSG STATUS</p>	Occupied Bandwidth	Total Power	12.6 dBm	1.0334 MHz			Transmit Freq Error	4.566 kHz	OBW Power 99.00 %	x dB Bandwidth	653.9 kHz	x dB -6.00 dB	<p>Frequency</p> <p>Center Freq 2.402000000 GHz</p> <p>CF Step 400.000 kHz Auto Man</p> <p>Freq Offset 0 Hz</p>
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MCH	<p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq 2.44000000 GHz Center Freq: 2.440000000 GHz Radio Std: None</p> <p>Trig: Free Run Avg/Hold: 10/10 #Atten: 30 dB Radio Device: BTS</p> <p>Ref Offset 8.24 dB Ref 20.00 dBm</p> <p>Center 2.44 GHz Span 4 MHz #Res BW 30 kHz #VBW 100 kHz Sweep 4.267 ms</p> <table border="1"> <tr> <td>Occupied Bandwidth</td> <td>Total Power</td> <td>13.4 dBm</td> </tr> <tr> <td colspan="3" style="text-align: center;">1.0320 MHz</td> </tr> <tr> <td>Transmit Freq Error</td> <td>4.027 kHz</td> <td>OBW Power 99.00 %</td> </tr> <tr> <td>x dB Bandwidth</td> <td>657.7 kHz</td> <td>x dB -6.00 dB</td> </tr> </table> <p>MSG STATUS</p>	Occupied Bandwidth	Total Power	13.4 dBm	1.0320 MHz			Transmit Freq Error	4.027 kHz	OBW Power 99.00 %	x dB Bandwidth	657.7 kHz	x dB -6.00 dB	<p>Frequency</p> <p>Center Freq 2.440000000 GHz</p> <p>CF Step 400.000 kHz Auto Man</p> <p>Freq Offset 0 Hz</p>
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Transmit Freq Error	4.027 kHz	OBW Power 99.00 %												
x dB Bandwidth	657.7 kHz	x dB -6.00 dB												

HCH



D.6 RF Conducted Spurious Emissions

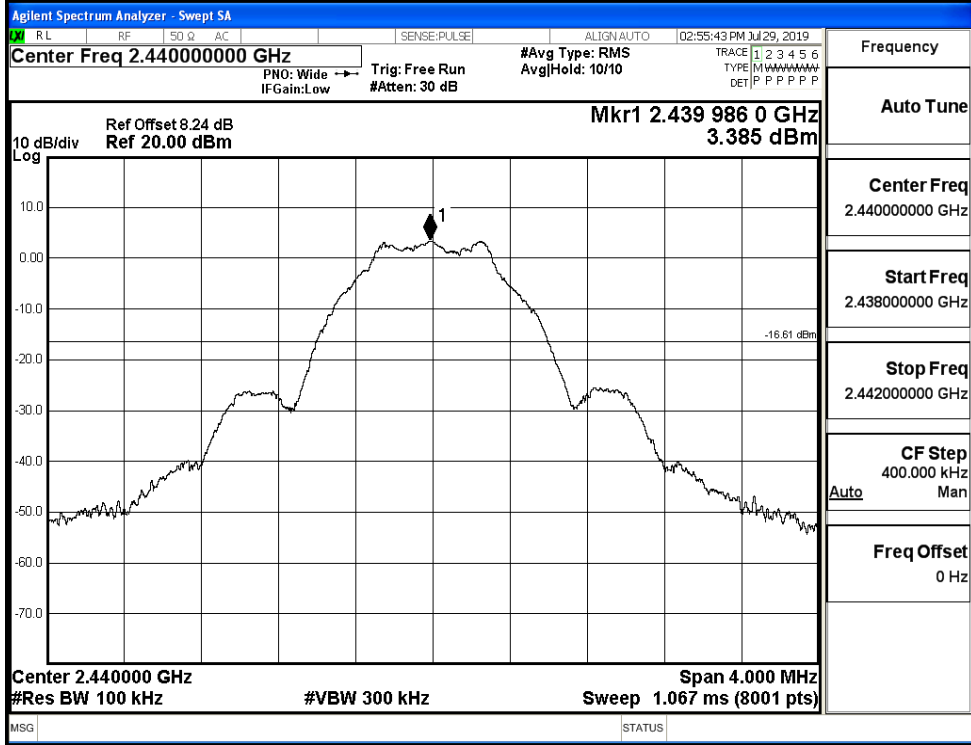
Mode	Channel	Pref [dBm]	Max. Level [dBm]	Limit [dBm]	Verdict
BT LE	LCH	2.609	-43.044	-17.391	PASS
BT LE	MCH	3.385	-43.928	-16.615	PASS
BT LE	HCH	1.923	-43.636	-18.077	PASS

BT LE_LCH_Graphs

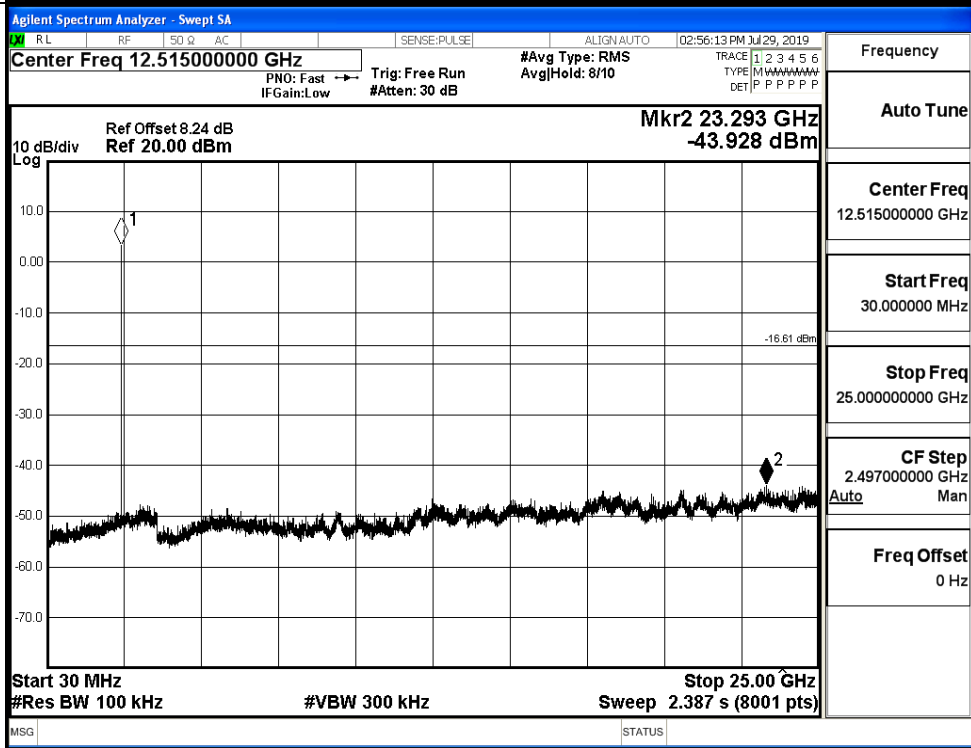
Pref/BT LE/LCH		<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Frequency</td></tr> <tr><td>Auto Tune</td></tr> <tr><td>Center Freq 2.402000000 GHz</td></tr> <tr><td>Start Freq 2.400000000 GHz</td></tr> <tr><td>Stop Freq 2.404000000 GHz</td></tr> <tr><td>CF Step 400.000 kHz Auto Man</td></tr> <tr><td>Freq Offset 0 Hz</td></tr> </table>	Frequency	Auto Tune	Center Freq 2.402000000 GHz	Start Freq 2.400000000 GHz	Stop Freq 2.404000000 GHz	CF Step 400.000 kHz Auto Man	Freq Offset 0 Hz
Frequency									
Auto Tune									
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Stop Freq 2.404000000 GHz									
CF Step 400.000 kHz Auto Man									
Freq Offset 0 Hz									
Puw/BT LE/LCH		<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Frequency</td></tr> <tr><td>Auto Tune</td></tr> <tr><td>Center Freq 12.515000000 GHz</td></tr> <tr><td>Start Freq 30.000000000 MHz</td></tr> <tr><td>Stop Freq 25.000000000 GHz</td></tr> <tr><td>CF Step 2.497000000 GHz Auto Man</td></tr> <tr><td>Freq Offset 0 Hz</td></tr> </table>	Frequency	Auto Tune	Center Freq 12.515000000 GHz	Start Freq 30.000000000 MHz	Stop Freq 25.000000000 GHz	CF Step 2.497000000 GHz Auto Man	Freq Offset 0 Hz
Frequency									
Auto Tune									
Center Freq 12.515000000 GHz									
Start Freq 30.000000000 MHz									
Stop Freq 25.000000000 GHz									
CF Step 2.497000000 GHz Auto Man									
Freq Offset 0 Hz									

BT LE_MCH_Graphs

Pref/BT LE/MCH

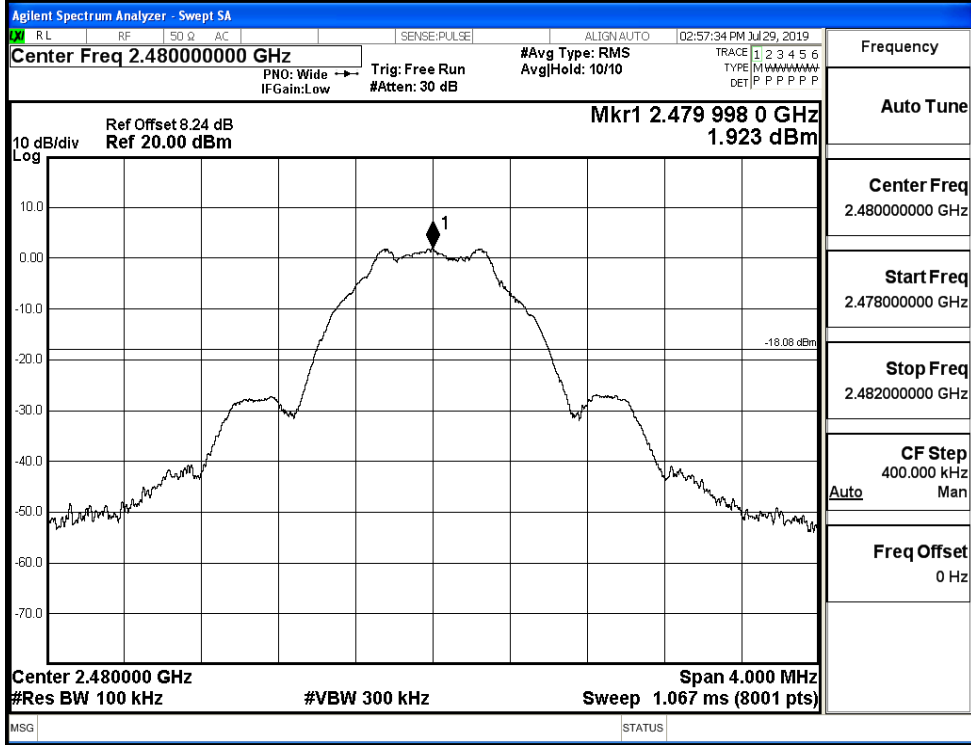


Puw/BT LE/MCH

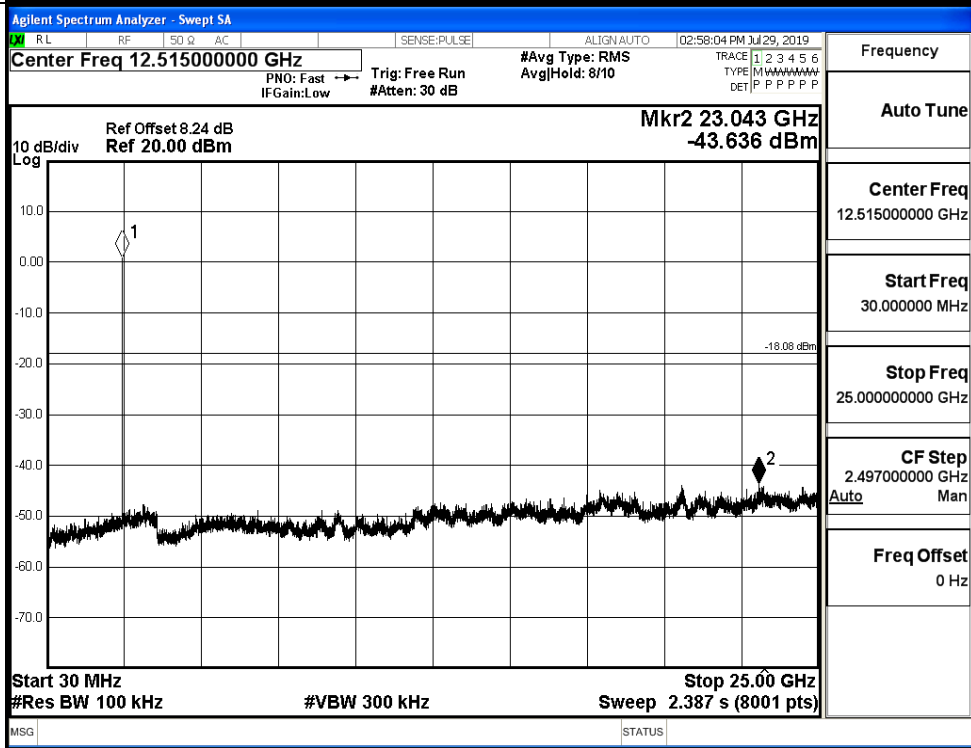


BT LE_HCH_Graphs

Pref/BT LE/HCH



Puw/BT LE/HCH



D.7 Band-edge for RF Conducted Emissions

Mode	Channel	Carrier Power[dBm]	Max.Spurious Level [dBm]	Limit [dBm]	Verdict
BT LE	LCH	2.732	-49.687	-17.27	PASS
BT LE	HCH	2.234	-49.918	-17.77	PASS

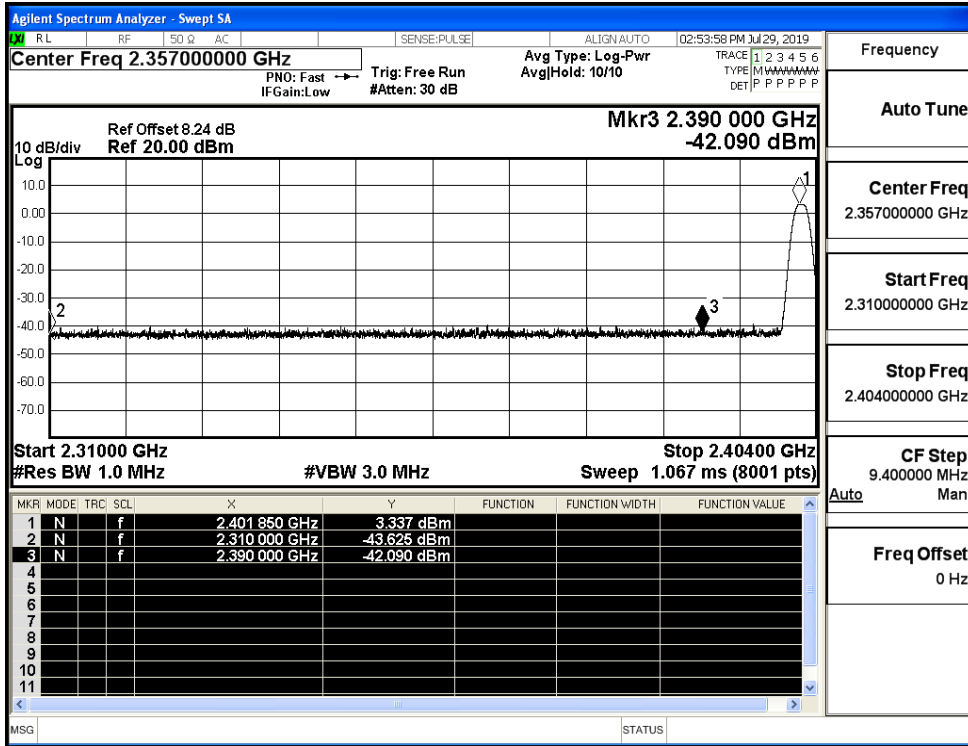
Test Graphs

LCH	<p>Agilent Spectrum Analyzer - Swept SA Center Freq 2.35700000 GHz #Ave Type: RMS AvgHold: 10/10 Mkr4 2.353 557 GHz -49.687 dBm Ref Offset 8.24 dB Ref 20.00 dBm Start 2.31000 GHz #Res BW 100 kHz #VBW 300 kHz Stop 2.40400 GHz Sweep 9.067 ms (8001 pts)</p> <table border="1" style="width: 100%; border-collapse: collapse; font-size: small;"> <thead> <tr> <th>MKR</th> <th>MODE</th> <th>TRC</th> <th>SCL</th> <th>X</th> <th>Y</th> <th>FUNCTION</th> <th>FUNCTION WIDTH</th> <th>FUNCTION VALUE</th> </tr> </thead> <tbody> <tr><td>1</td><td>N</td><td>f</td><td></td><td>2.402 003 GHz</td><td>2.732 dBm</td><td></td><td></td><td></td></tr> <tr><td>2</td><td>N</td><td>f</td><td></td><td>2.400 000 GHz</td><td>-52.672 dBm</td><td></td><td></td><td></td></tr> <tr><td>3</td><td>N</td><td>f</td><td></td><td>2.390 000 GHz</td><td>-55.412 dBm</td><td></td><td></td><td></td></tr> <tr><td>4</td><td>N</td><td>f</td><td></td><td>2.353 557 GHz</td><td>-49.687 dBm</td><td></td><td></td><td></td></tr> </tbody> </table>	MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	1	N	f		2.402 003 GHz	2.732 dBm				2	N	f		2.400 000 GHz	-52.672 dBm				3	N	f		2.390 000 GHz	-55.412 dBm				4	N	f		2.353 557 GHz	-49.687 dBm				Frequency Auto Tune Center Freq 2.35700000 GHz Start Freq 2.310000000 GHz Stop Freq 2.404000000 GHz CF Step 9.400000 MHz Freq Offset 0 Hz
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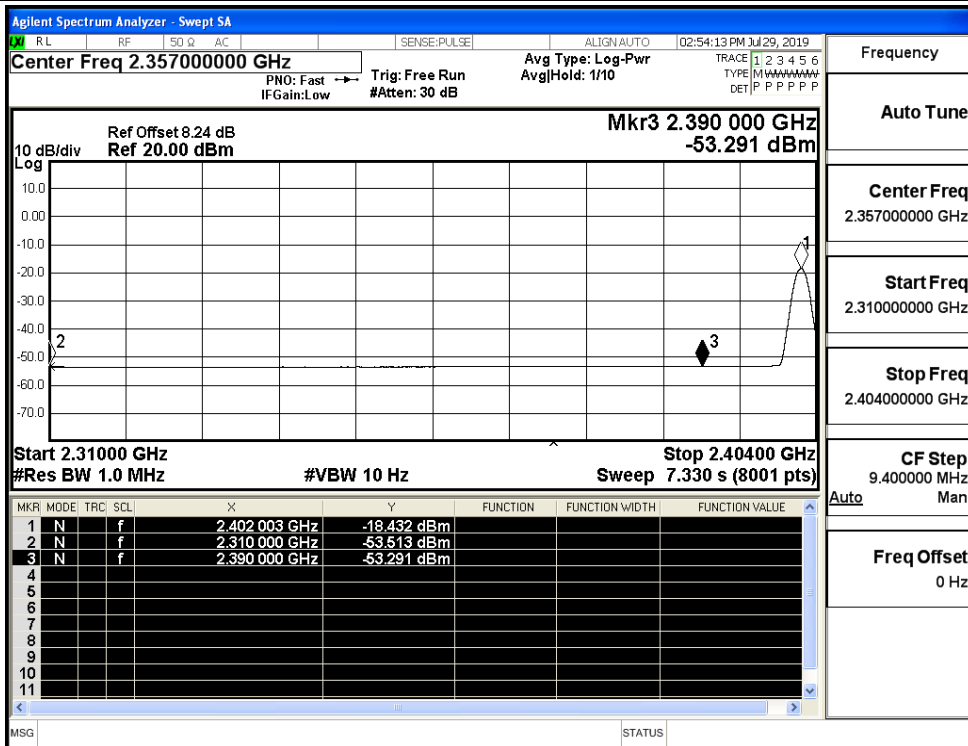
D.8 Restrict-band band-edge measurements

Test Mode	Test Channel	Ant	Freq.	Power [dBm]	Gain	Ground Factor	E [dBuV/m]	Detector	Limit [dBuV/m]	Verdict
BT LE	2402	Ant1	2310.0	-43.63	2.0	0	53.63	PEAK	74	PASS
		Ant1	2310.0	-53.51	2.0	0	43.75	AV	54	PASS
		Ant1	2390.0	-42.09	2.0	0	55.17	PEAK	74	PASS
		Ant1	2390.0	-53.29	2.0	0	43.97	AV	54	PASS
	2480	Ant1	2483.5	-41.94	2.0	0	55.32	PEAK	74	PASS
		Ant1	2483.5	-52.96	2.0	0	44.30	AV	54	PASS
		Ant1	2500.0	-41.98	2.0	0	55.28	PEAK	74	PASS
		Ant1	2500.0	-52.91	2.0	0	44.35	AV	54	PASS

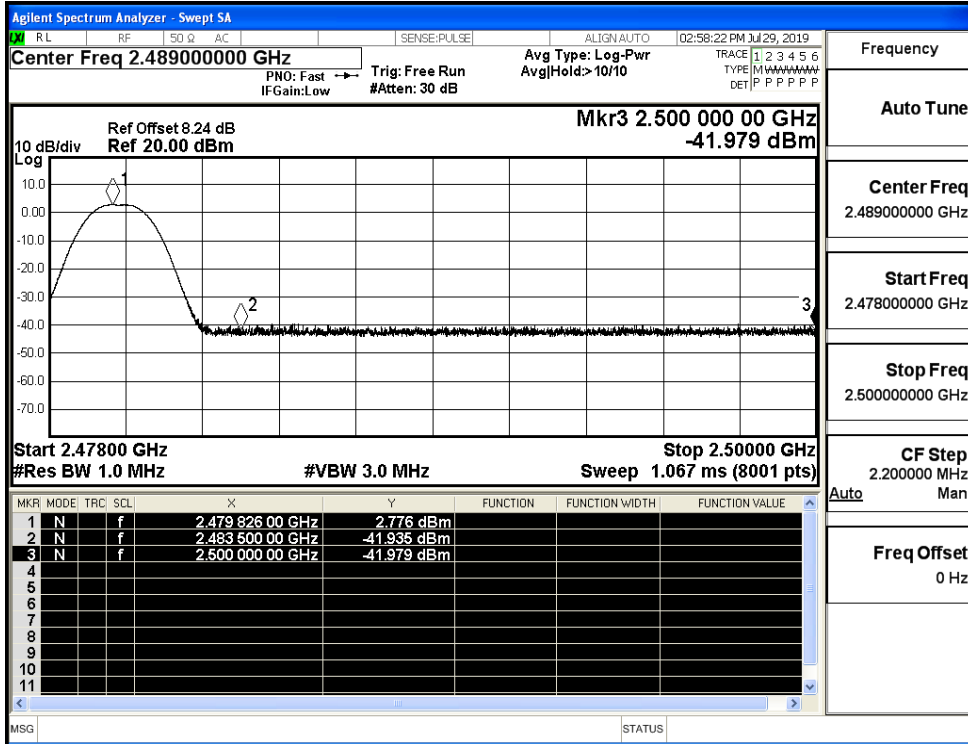
Restrict-band band-edge measurements_BT LE_2402_Ant1_PEAK



Restrict-band band-edge measurements_BT LE_2402_Ant1_AV



Restrict-band band-edge measurements_BT LE_2480_Ant1_PEAK



Restrict-band band-edge measurements_BT LE_2480_Ant1_AV

