

OCCUPIED BANDWIDTH LTE



XMIT 2020.03.25.0

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFL	27-Feb-20	27-Feb-21
Generator - Signal	Keysight	N5171B-506	TEW	2-May-18	2-May-21

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and the spectrum analyzer. The method in section 5.4 of ANSI C63.26 was used to make this measurement. The spectrum analyzer settings were as follows:

- RBW is 1% - 5% of the occupied bandwidth
- VBW is $\geq 3 \times$ the RBW
- Peak Detector was used
- Trace max hold was used

RF conducted emissions testing was performed only on one port. The AZHL antenna ports are essentially electrically identical (the RF power variation between antenna ports is small as shown during output power testing on 8 ports) and antenna port 1 was selected to perform the testing under this effort as allowed by ANSI C63.26-2015 paragraphs 5.2.5.3, 5.7.2i, and 6.4.

The 99% bandwidth was measured utilizing the analyzer's peak detector and measuring the carrier's 26 dB occupied bandwidth based on the peak output power level measured. A plot was taken to show the occupied bandwidth is contained within the allowable transmit band. FCC 27.53(m)(6) defines the emission bandwidth to be used as 26dB down.

The occupied bandwidth was measured with the EUT configured in the modes called out in the data sheets.

Band 41 (2496 MHz to 2690 MHz) Emission Designators derived from the measurement results:

FCC Emission Designators for Band 41 (2496MHz to 2690MHz)					
Channel Bandwidth	Radio Channel	4G-LTE: QPSK	4G-LTE: 16QAM	4G-LTE: 64QAM	4G-LTE: 256QAM
10M	Low				9M68F9W
	Mid	9M77F9W	9M68F9W	9M70F9W	9M74F9W
	High				9M68F9W
15M	Low				14M6F9W
	Mid	14M5F9W	14M5F9W	14M6F9W	14M6F9W
	High				14M6F9W
20M	Low				19M4F9W
	Mid	19M4F9W	19M2F9W	19M4F9W	19M4F9W
	High				19M4F9W

Note: FCC Emission Designators are based on 26dB emission bandwidth

OCCUPIED BANDWIDTH LTE



TstTx 2019.08.30.0 XMI 2020.12.30.0

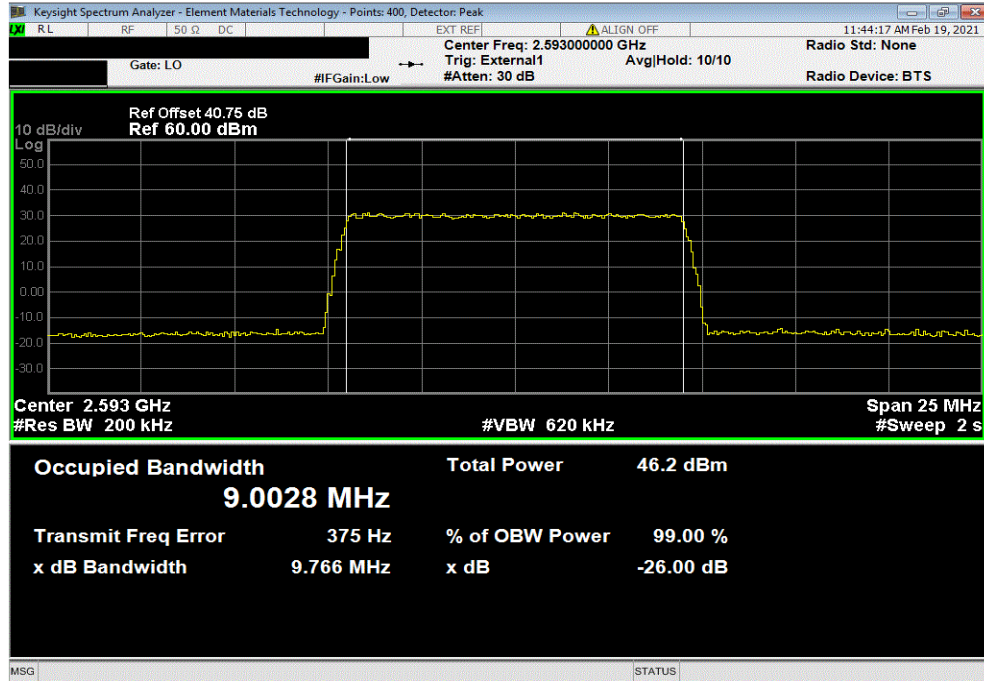
EUT: AZHL		Work Order: NOKI0018	
Serial Number: YK203400016		Date: 22-Feb-21	
Customer: Nokia Solutions and Networks		Temperature: 23.6 °C	
Attendees: John Rattavong, Mitchell Hill, David Le		Humidity: 14.9% RH	
Project: None		Barometric Pres.: 1037 mbar	
Tested by: Mark Baytan		Power: 54 VDC	
TEST SPECIFICATIONS		Test Method	
FCC 27:2021		ANSI C63.26:2015	
COMMENTS			
External 1 gating was set using a trig delay = 5.0us and a gate length = 6.786ms. Reference level offset adjusted to include (2) coax cables, DC block, and attenuator. The carrier power was set to maximum for all testing.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	2	Signature	
		Value (26 dB)	Limit Result
4G LTE, Band 41, 2496 MHz - 2690 MHz			
Port 1			
LTE10 (10MHz)			
QPSK			
	Mid Channel 2593 MHz	9.766 MHz	Within Band Pass
16QAM			
	Mid Channel 2593 MHz	9.682 MHz	Within Band Pass
64QAM			
	Mid Channel 2593 MHz	9.7 MHz	Within Band Pass
256QAM			
	Low Channel 2501 MHz	9.68 MHz	Within Band Pass
	Mid Channel 2593 MHz	9.736 MHz	Within Band Pass
	High Channel 2685 MHz	9.684 MHz	Within Band Pass
LTE15 (15MHz)			
QPSK			
	Mid Channel 2593 MHz	14.549 MHz	Within Band Pass
16QAM			
	Mid Channel 2593 MHz	14.498 MHz	Within Band Pass
64QAM			
	Mid Channel 2593 MHz	14.608 MHz	Within Band Pass
256QAM			
	Low Channel 2503.5 MHz	14.586 MHz	Within Band Pass
	Mid Channel 2593 MHz	14.585 MHz	Within Band Pass
	High Channel 2682.5 MHz	14.573 MHz	Within Band Pass
LTE20 (20MHz)			
QPSK			
	Mid Channel 2593 MHz	19.361 MHz	Within Band Pass
16QAM			
	Mid Channel 2593 MHz	19.177 MHz	Within Band Pass
64QAM			
	Mid Channel 2593 MHz	19.393 MHz	Within Band Pass
256QAM			
	Low Channel 2506 MHz	19.403 MHz	Within Band Pass
	Mid Channel 2593 MHz	19.404 MHz	Within Band Pass
	High Channel 2680 MHz	19.422 MHz	Within Band Pass

OCCUPIED BANDWIDTH LTE

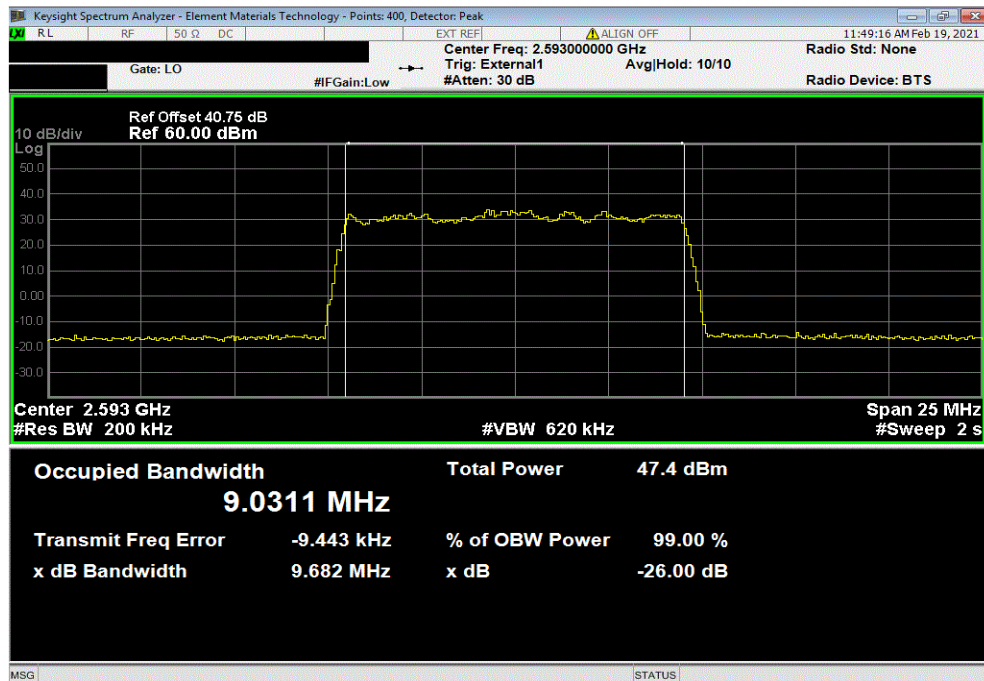


TbTx 2019.08.30.0 XbTx 2020.12.30.0

4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE10 (10MHz), QPSK, Mid Channel 2593 MHz						
				Value (26 dB)	Limit	Result
				9.766 MHz	Within Band	Pass



4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE10 (10MHz), 16QAM, Mid Channel 2593 MHz						
				Value (26 dB)	Limit	Result
				9.682 MHz	Within Band	Pass

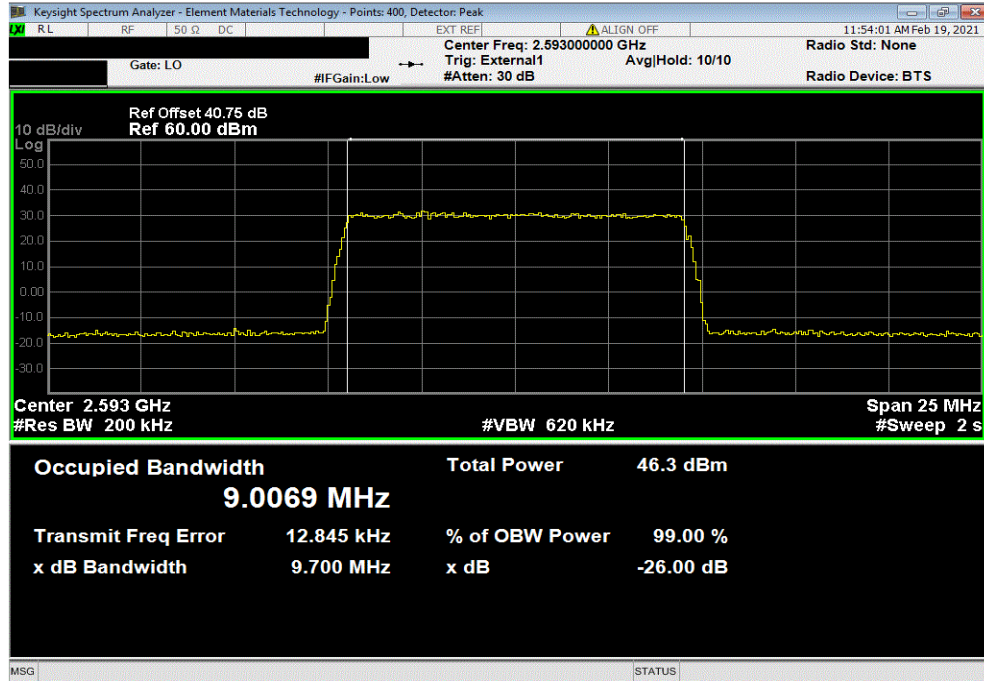


OCCUPIED BANDWIDTH LTE

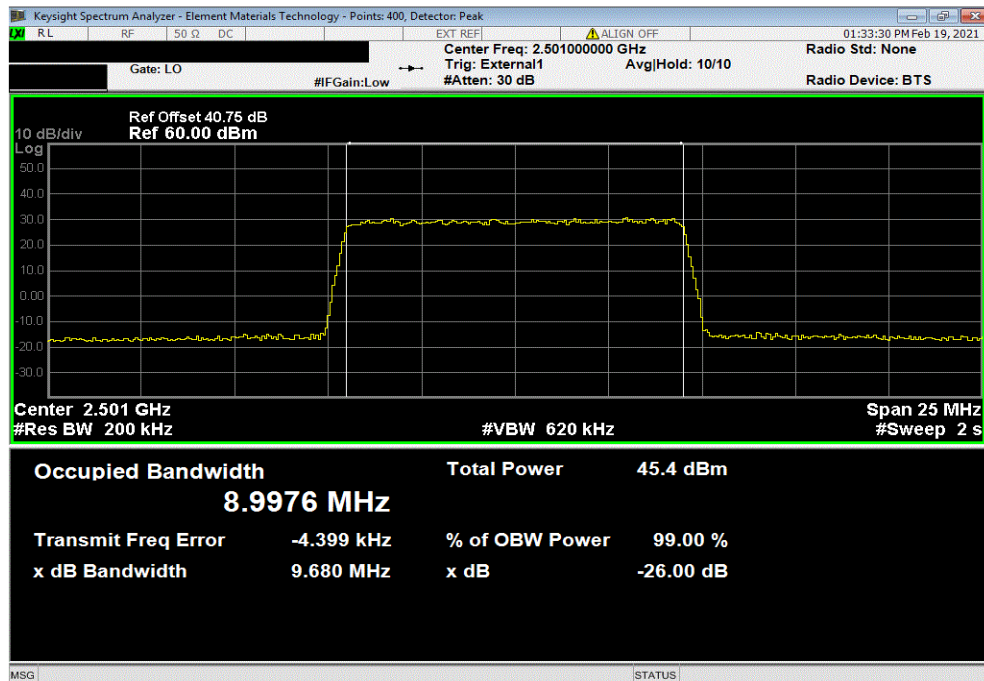


TbTx 2019.08.30.0 XMI 2020.12.30.0

4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE10 (10MHz), 64QAM, Mid Channel 2593 MHz						
				Value (26 dB)	Limit	Result
				9.7 MHz	Within Band	Pass



4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE10 (10MHz), 256QAM, Low Channel 2501 MHz						
				Value (26 dB)	Limit	Result
				9.68 MHz	Within Band	Pass

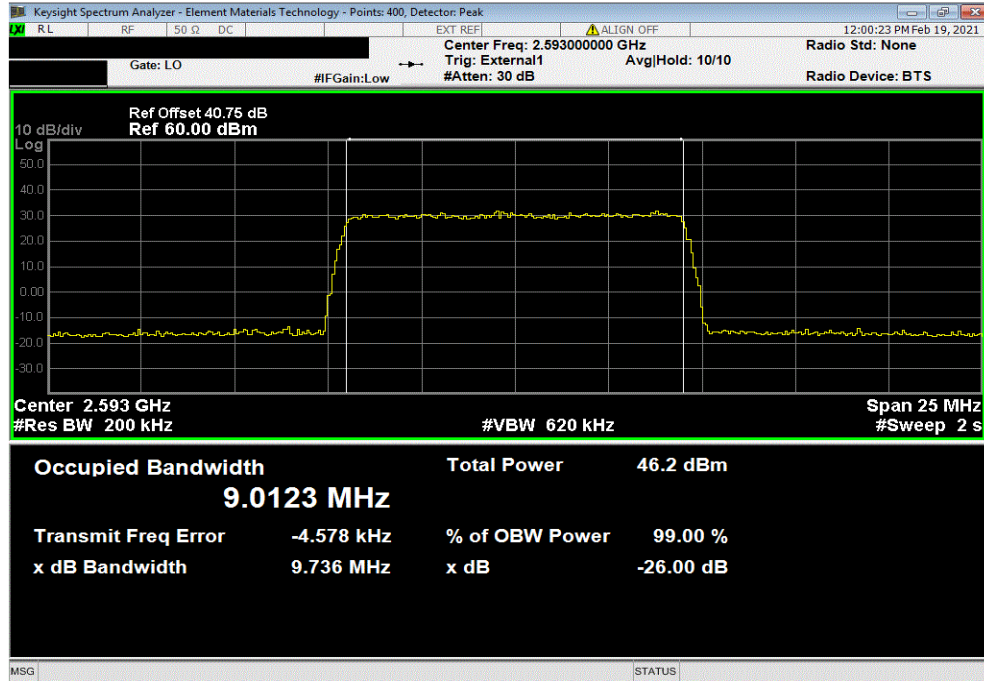


OCCUPIED BANDWIDTH LTE

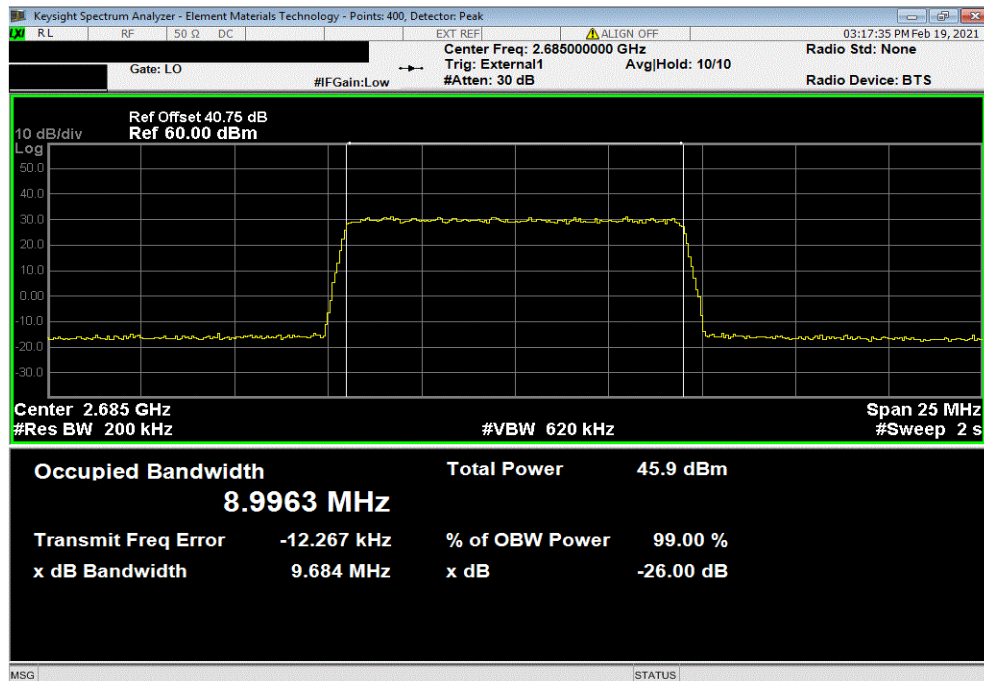


TbTx 2019.08.30.0 XMI 2020.12.30.0

4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE10 (10MHz), 256QAM, Mid Channel 2593 MHz						
				Value (26 dB)	Limit	Result
				9.736 MHz	Within Band	Pass



4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE10 (10MHz), 256QAM, High Channel 2685 MHz						
				Value (26 dB)	Limit	Result
				9.684 MHz	Within Band	Pass

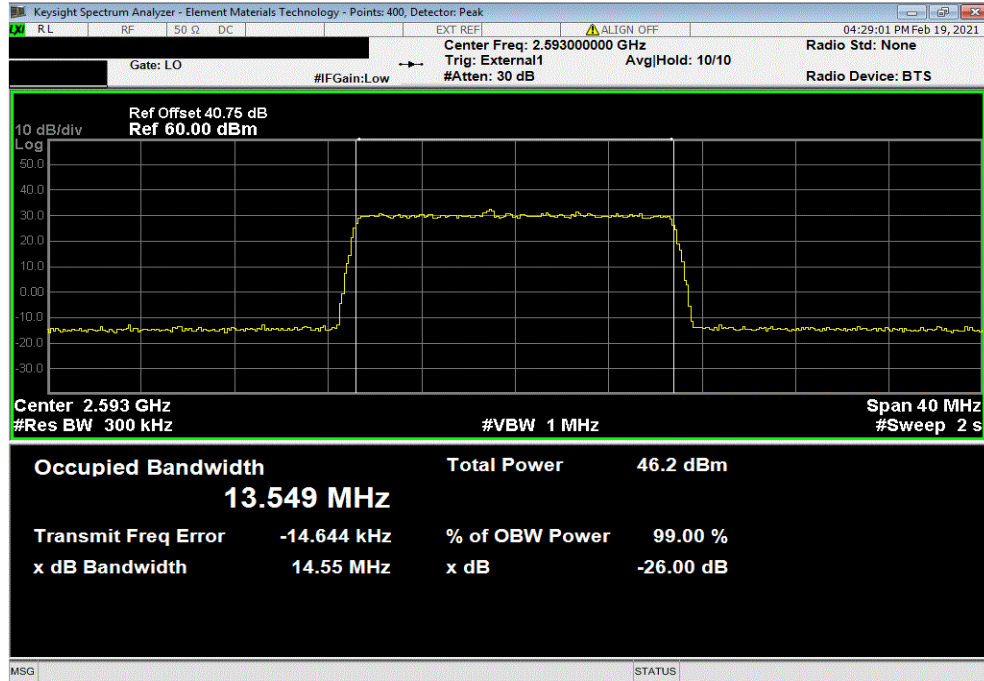


OCCUPIED BANDWIDTH LTE

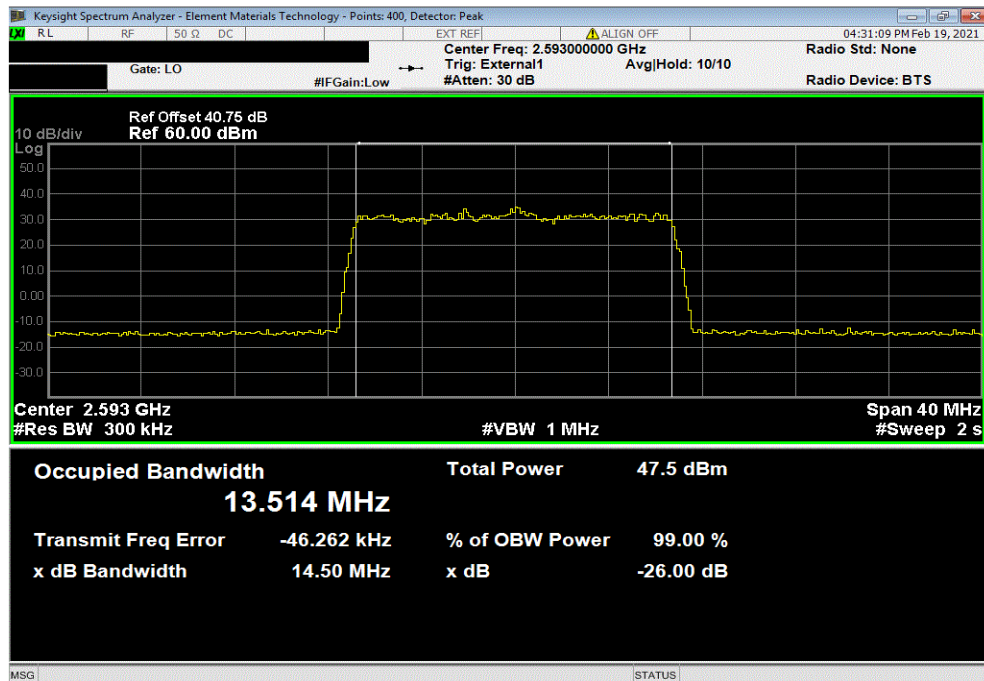


TbTx 2019.08.30.0 XMit 2020.12.30.0

4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE15 (15MHz), QPSK, Mid Channel 2593 MHz						
	Value	Limit	Result			
	(26 dB)					
	14.549 MHz	Within Band	Pass			



4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE15 (15MHz), 16QAM, Mid Channel 2593 MHz						
	Value	Limit	Result			
	(26 dB)					
	14.498 MHz	Within Band	Pass			

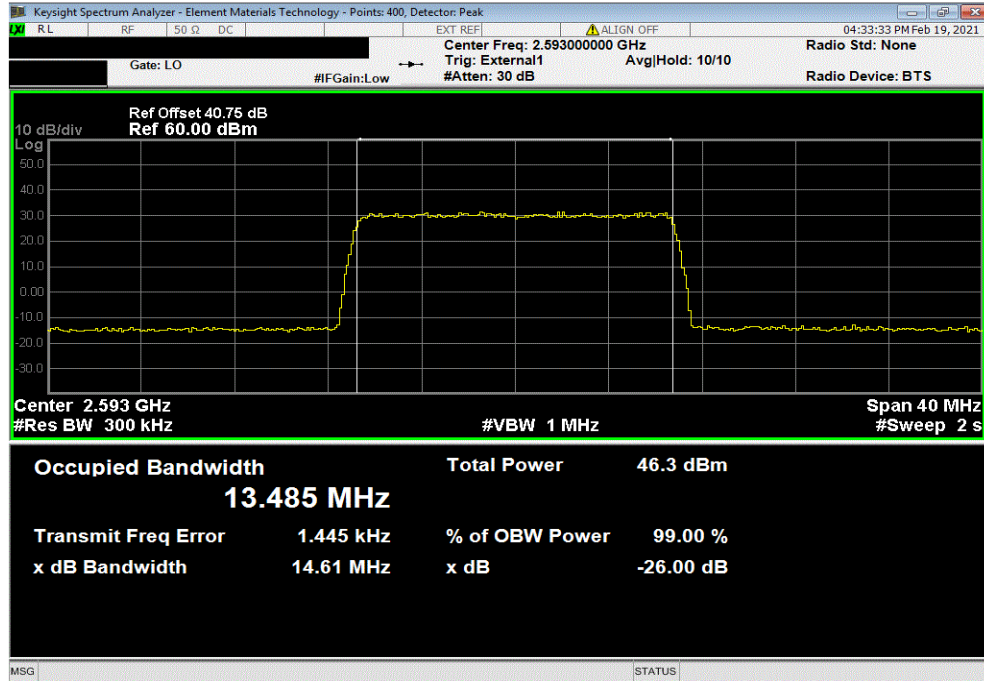


OCCUPIED BANDWIDTH LTE

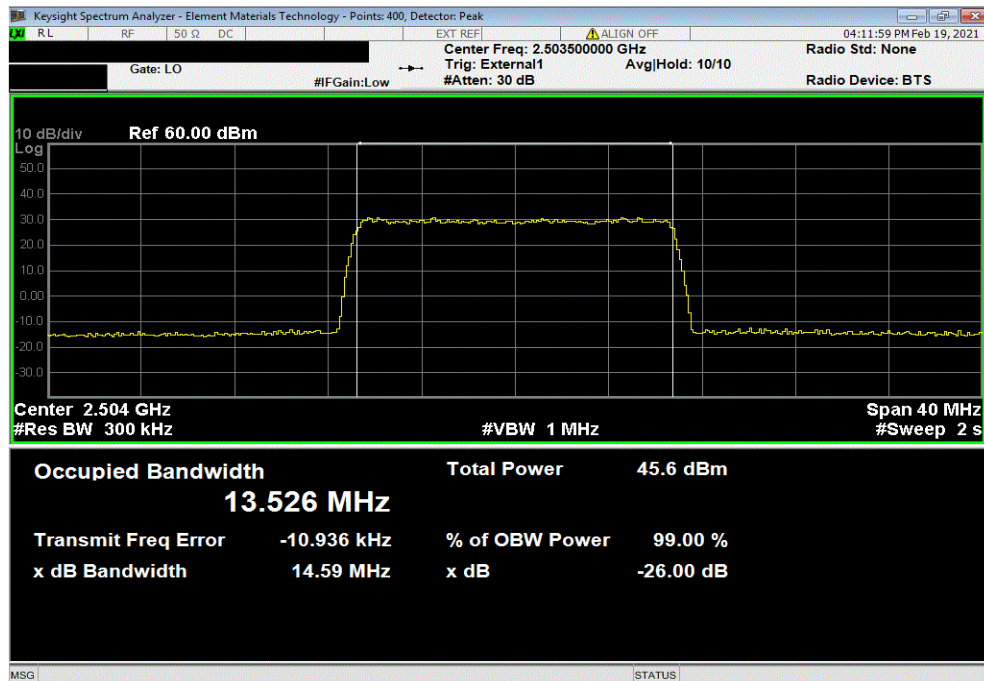


TbTx 2019.08.30.0 XMit 2020.12.30.0

4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE15 (15MHz), 64QAM, Mid Channel 2593 MHz						
				Value	Limit	Result
				(26 dB)		
				14.608 MHz	Within Band	Pass



4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE15 (15MHz), 256QAM, Low Channel 2503.5 MHz						
				Value	Limit	Result
				(26 dB)		
				14.586 MHz	Within Band	Pass

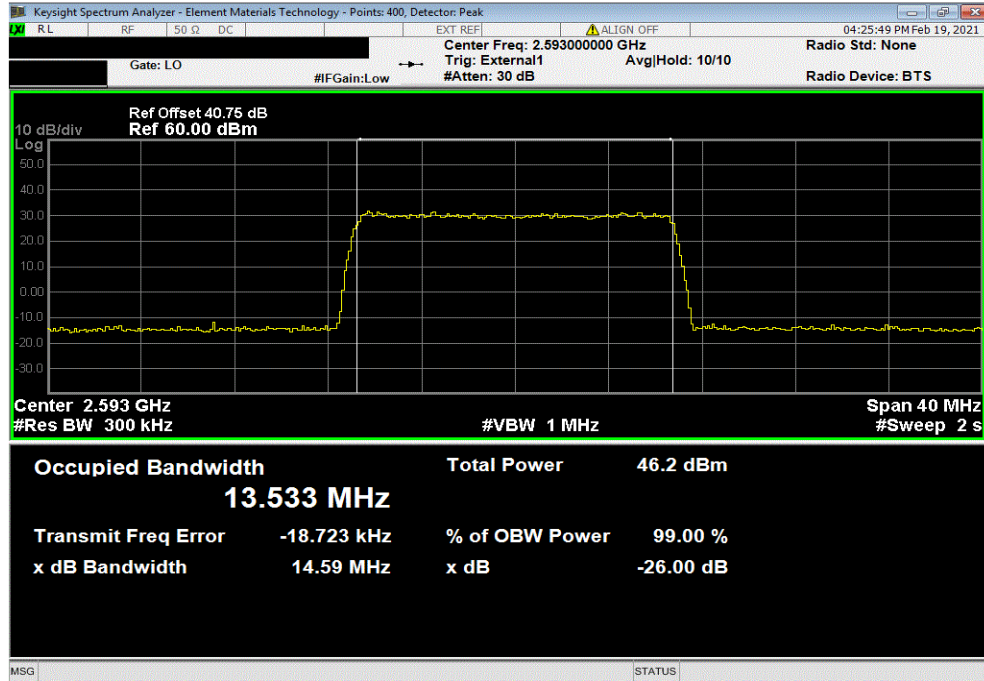


OCCUPIED BANDWIDTH LTE

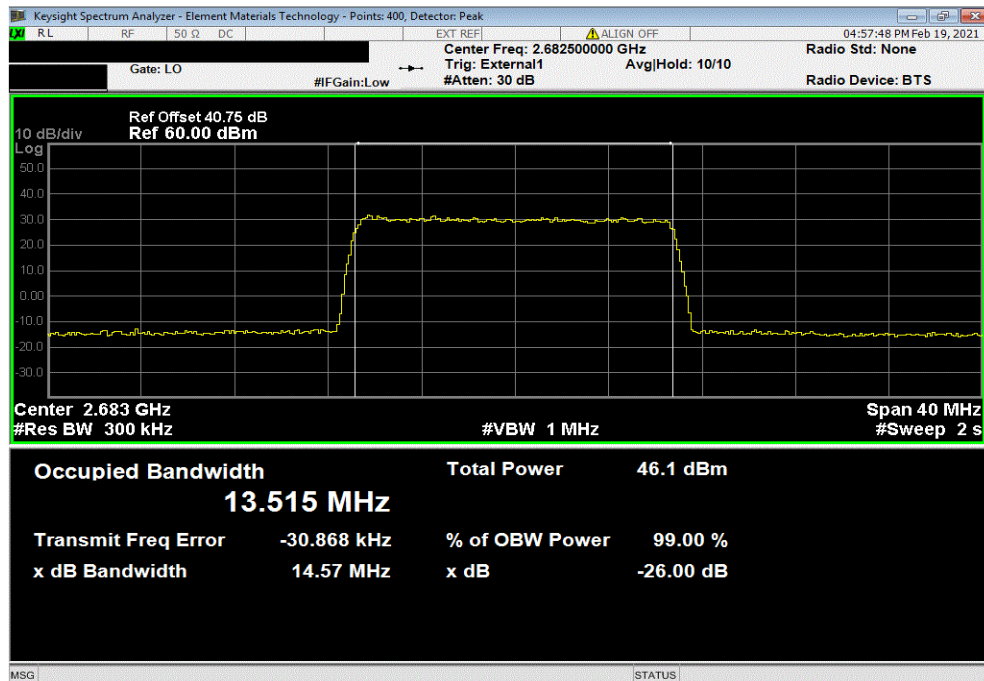


TbTx 2019.08.30.0 XMit 2020.12.30.0

4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE15 (15MHz), 256QAM, Mid Channel 2593 MHz						
				Value (26 dB)	Limit	Result
				14.585 MHz	Within Band	Pass



4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE15 (15MHz), 256QAM, High Channel 2682.5 MHz						
				Value (26 dB)	Limit	Result
				14.573 MHz	Within Band	Pass

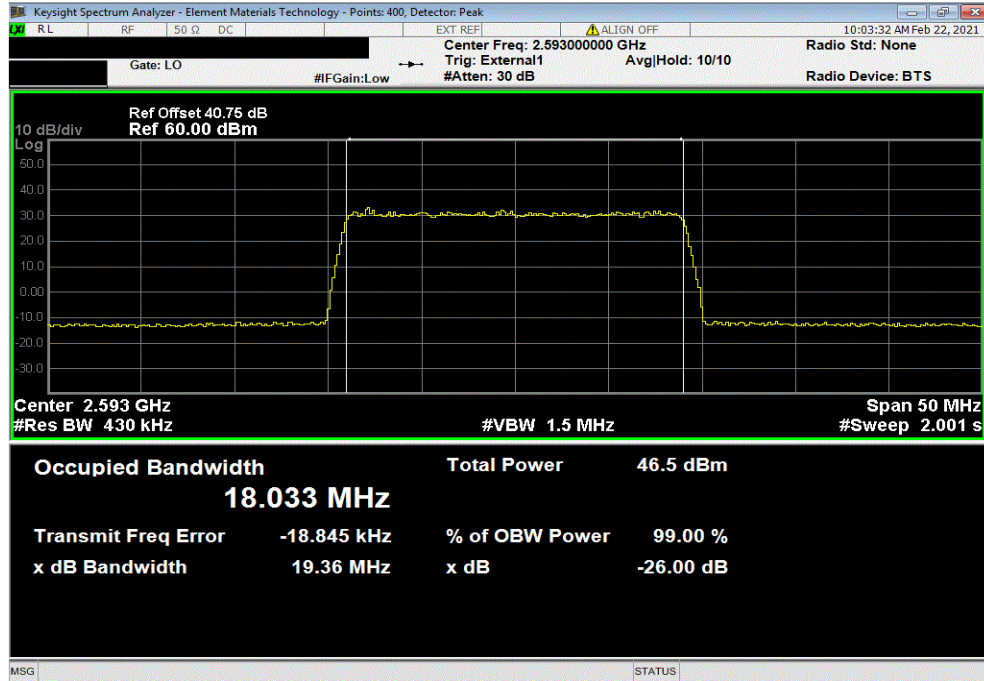


OCCUPIED BANDWIDTH LTE

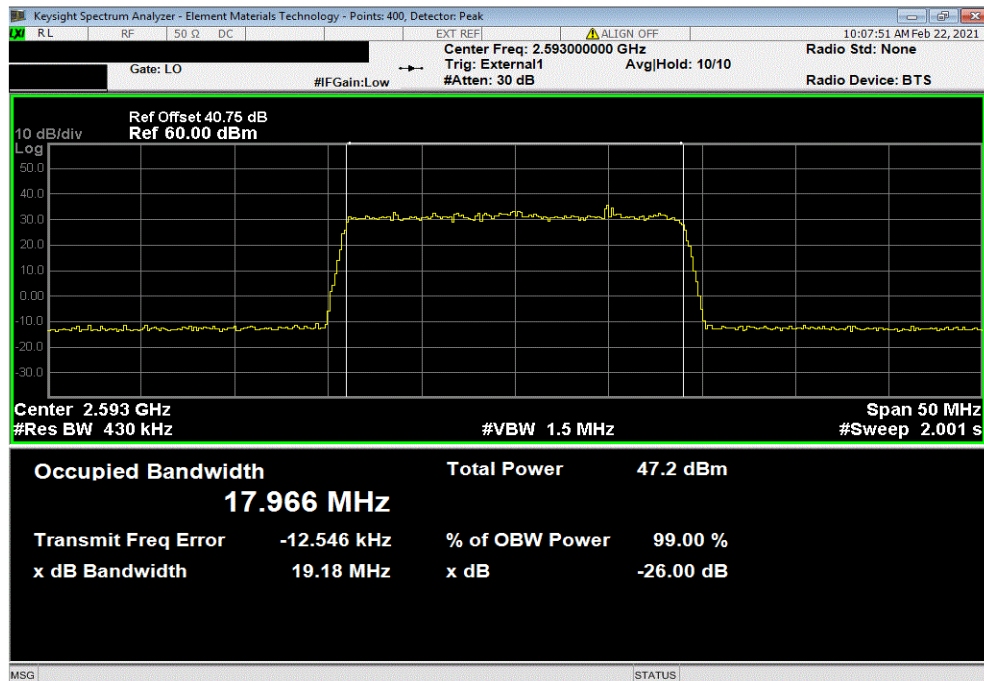


TbTx 2019.08.30.0 XMit 2020.12.30.0

4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE20 (20MHz), QPSK, Mid Channel 2593 MHz						
				Value (26 dB)	Limit	Result
				19.361 MHz	Within Band	Pass



4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE20 (20MHz), 16QAM, Mid Channel 2593 MHz						
				Value (26 dB)	Limit	Result
				19.177 MHz	Within Band	Pass

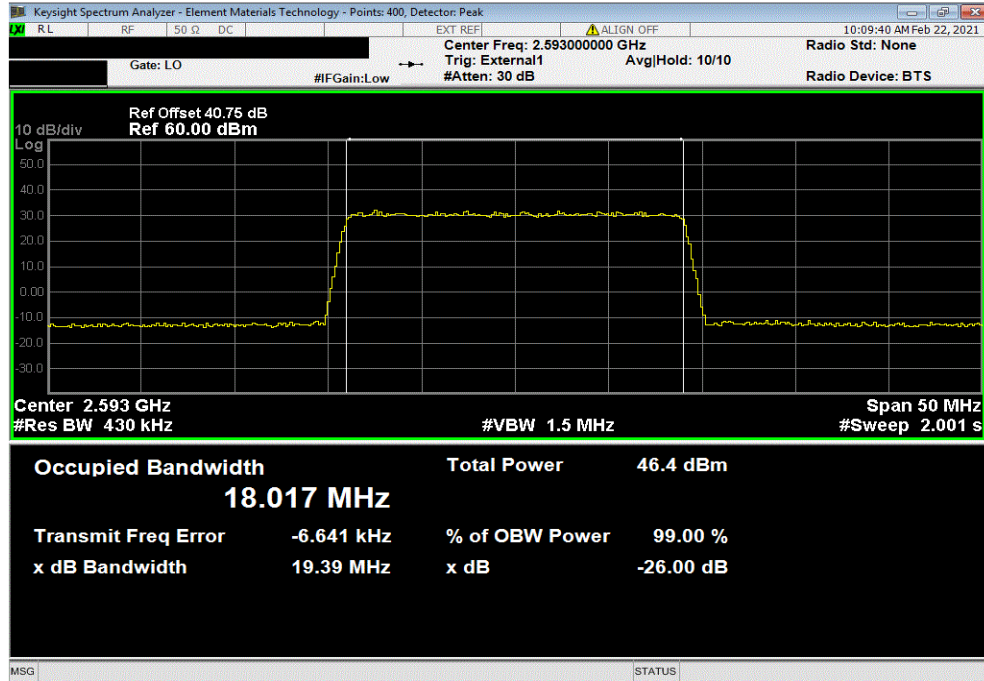


OCCUPIED BANDWIDTH LTE

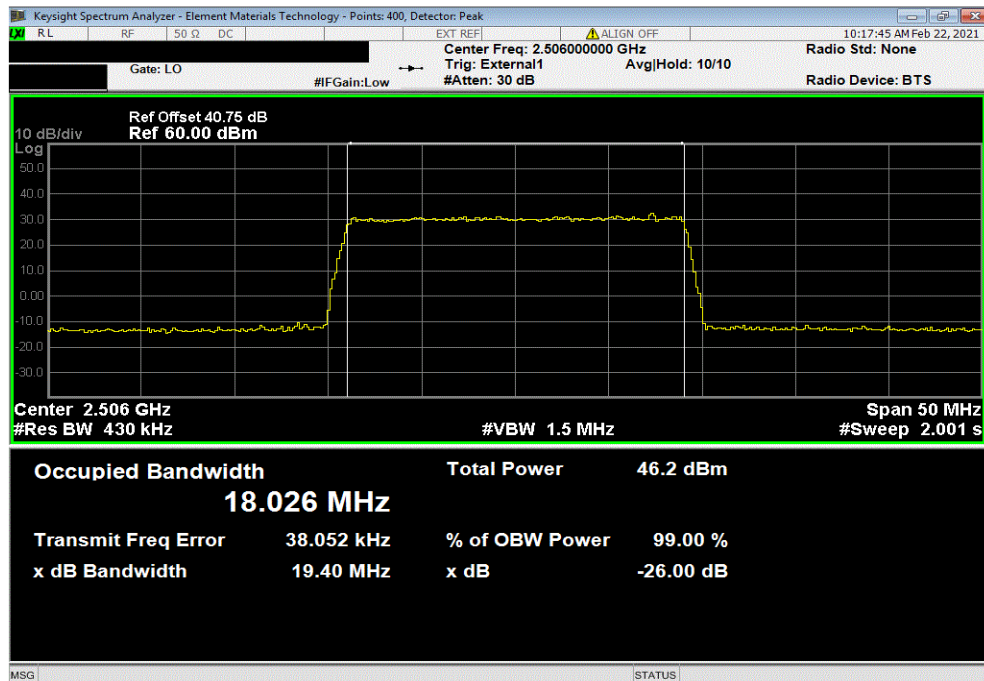


TbTx 2019.08.30.0 XMit 2020.12.30.0

4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE20 (20MHz), 64QAM, Mid Channel 2593 MHz						
				Value	Limit	Result
				(26 dB)		
				19.393 MHz	Within Band	Pass



4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE20 (20MHz), 256QAM, Low Channel 2506 MHz						
				Value	Limit	Result
				(26 dB)		
				19.403 MHz	Within Band	Pass

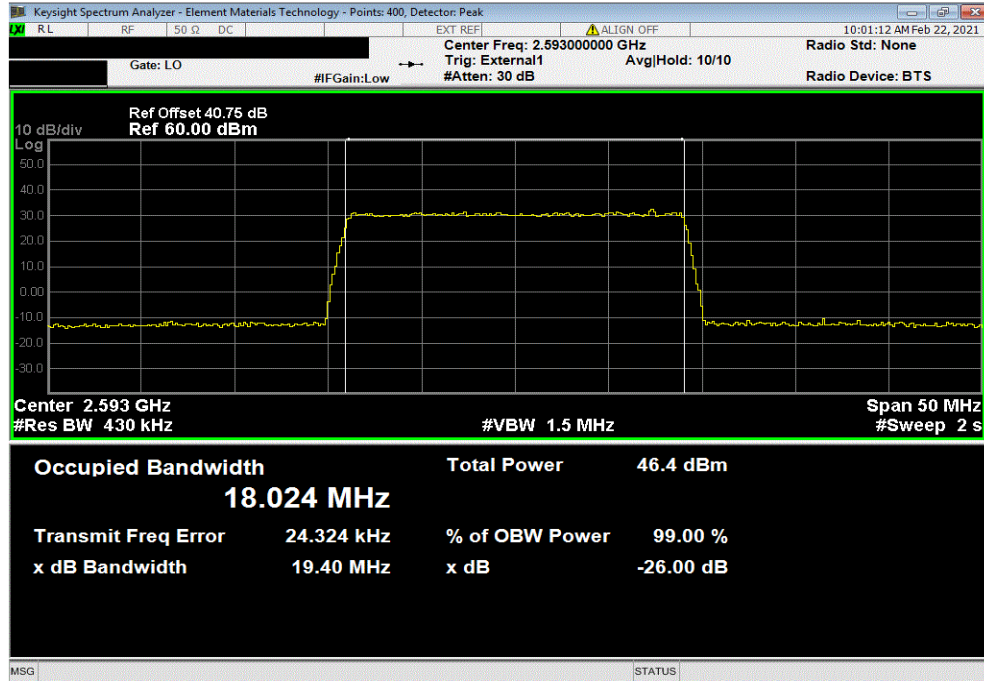


OCCUPIED BANDWIDTH LTE

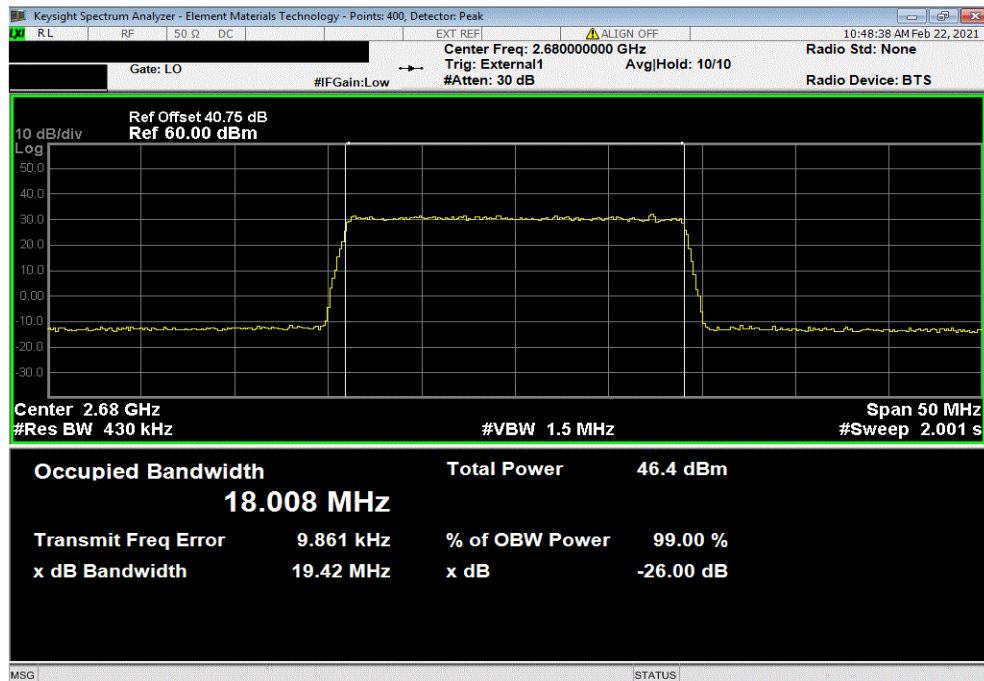


TbTx 2019.08.30.0 XMit 2020.12.30.0

4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE20 (20MHz), 256QAM, Mid Channel 2593 MHz						
				Value (26 dB)	Limit	Result
				19.404 MHz	Within Band	Pass



4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE20 (20MHz), 256QAM, High Channel 2680 MHz						
				Value (26 dB)	Limit	Result
				19.422 MHz	Within Band	Pass



FREQUENCY STABILITY



XMIT 2020.12.30.0

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Thermometer	Omega Engineering, Inc.	HH311	DUI	2021-02-02	2024-02-02
Chamber - Temperature/Humidity	Cincinnati Sub Zero (CSZ)	ZPH-8-2-SCT/AC	TBH	NCR	NCR
Meter - Multimeter	Fluke	77-IV	MLT	2020-10-15	2023-10-15
Block - DC	Fairview Microwave	SD3379	AMT	2020-09-18	2021-09-18
Analyzer - Signal Analyzer	Keysight Technologies	N9030B	R275	2020-06-13	2021-06-13

TEST DESCRIPTION

The spectrum analyzer is equipped with a precision frequency reference that exceeds the stability requirement of the EUT.

Measurements were made on the single transmit frequency as called out on the data sheets. Testing was done while the EUT was continuously operating.

The primary supply voltage was varied from 85 % to 115% of the nominal voltage while at ambient temperature. Using a temperature chamber, the transmit frequency was recorded at the extremes of the specified temperature range of -30 ° to +50° C and at 10°C intervals.

FCC Part 27.54 defines the frequency deviation limit as follows: "The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation."

While there are no specific limits defined, results with a frequency error of less than 1000 Hz will show the carrier to be operating within the band. The frequency stability/accuracy radio design is the same for all radio technologies and modulation types. The radio was configured for 5G NR100 to show compliance.

FREQUENCY STABILITY



XMIT 2020.12.30.0

EUT: AZHL		Work Order: NOKI0018	
Serial Number: YK203400016		Date: 26-Feb-21	
Customer: Nokia Solutions and Networks		Temperature: 23.9 °C	
Attendees: John Rattanaovong, David Le		Humidity: 31% RH	
Project: None		Barometric Pres.: 1018 mbar	
Tested by: Marty Martin	Power: Refer to Chart	Job Site: TX05	
TEST SPECIFICATIONS			
FCC 27:2021		Test Method: ANSI C63.26:2015	
COMMENTS			
All measurement path losses were accounted for in the reference level offset including any attenuators, filters and DC blocks. The EUT temperature was stabilized at each temperature step (for a minimum of 30 minutes) prior to measurements. EUT operated at 100% duty cycle.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	6	Signature <i>Marty Martin</i>	
		Frequency Error Value in Hz	Limit
			Result
5G NR Band n41 Carrier 2592.99 MHz NR 100			
-30 °C			
	48 VDC	-1.16	1000 Hz Pass
-20 °C			
	48 VDC	-1.19	1000 Hz Pass
-10 °C			
	48 VDC	-1.09	1000 Hz Pass
0 °C			
	48 VDC	-1.14	1000 Hz Pass
10 °C			
	48 VDC	-1.27	1000 Hz Pass
20 °C			
	40.8 VDC	-1.24	1000 Hz Pass
	48 VDC	-1.15	1000 Hz Pass
	55.2 VDC	-1.41	1000 Hz Pass
30 °C			
	48 VDC	-1.65	1000 Hz Pass
40 °C			
	48 VDC	-1.39	1000 Hz Pass
50 °C			
	48 VDC	-1.5	1000 Hz Pass

FREQUENCY STABILITY



XMII 2020.12.30.0

5G NR Band n41 Carrier 2592.99 MHz NR 100, -30 °C, 48 VDC						
Frequency Error				Limit	Result	
Value in Hz				1000 Hz	Pass	
				-1.16		

5G NR 1 Modulation Analysis

KEYSIGHT Input RF Coupling: DC Align: Auto Input Z: 50 Ω Corrections: Off Freq Ref: External Atten: 10 dB (e0) Preamp: Off #PNO: Best Wide Trng: External 1 Trng Delay: 86.2 μs IF Gain: 15 dB Carrier Ref Freq: 2.592990000 GHz AvgHld: 5/5 CC Info: Downlink, 1 CC, SISO

4 CC0 Error Summary

Channel Power	39.18 dBm
Channel Power (Active)	40.47 dBm
EVM	2.58 %
EVM Peak	11.78 %
Frequency Error	-1.16 Hz
Symbol Clock Error	0.001 ppm
IQ Offset	-35.32 dB
Time Offset	-281 ns
Sync Correlation	99.9 %
Sync Source	PDSCH DMRS
Magnitude Error	1.82 %
Phase Error	0.02 rad
Gain Imbalance	---
Quad Error	---
Timing Skew	---

Meas Setup

Component Carrier CC0

AvgHld Number 5

Averaging On

Average Mode Repeat

Acquisition Mode Sequential

Optimize EVM

Allow Re-Calculation On

Auto Couple

Meas Preset

Feb 25, 2021 10:56:45 AM

5G NR Band n41 Carrier 2592.99 MHz NR 100, -20 °C, 48 VDC						
Frequency Error				Limit	Result	
Value in Hz				1000 Hz	Pass	
				-1.19		

5G NR 1 Modulation Analysis

KEYSIGHT Input RF Coupling: DC Align: Auto Input Z: 50 Ω Corrections: Off Freq Ref: External Atten: 10 dB (e0) Preamp: Off #PNO: Best Wide Trng: External 1 Trng Delay: 86.2 μs IF Gain: 15 dB Carrier Ref Freq: 2.592990000 GHz AvgHld: 25/25 CC Info: Downlink, 1 CC, SISO

4 CC0 Error Summary

Channel Power	39.33 dBm
Channel Power (Active)	40.62 dBm
EVM	2.47 %
EVM Peak	11.66 %
Frequency Error	-1.19 Hz
Symbol Clock Error	0.001 ppm
IQ Offset	-35.34 dB
Time Offset	-281 ns
Sync Correlation	99.8 %
Sync Source	PDSCH DMRS
Magnitude Error	1.74 %
Phase Error	0.02 rad
Gain Imbalance	---
Quad Error	---
Timing Skew	---

Frequency

Carrier Reference Frequency 2.592990000 GHz

Feb 25, 2021 10:02:42 AM

FREQUENCY STABILITY



XMIT 2020.12.30.0

5G NR Band n41 Carrier 2592.99 MHz NR 100, -10 °C, 48 VDC						
Frequency Error				Limit	Result	
Value in Hz				1000 Hz	Pass	
				-1.09		

5G NR 1 Modulation Analysis

KEYSIGHT Input: RF Coupling: DC Align: Auto Input Z: 50 Ω Corrections: Off Freq Ref: External Atten: 10 dB (e0) Preamp: Off #PNO: Best Wide Trig: External 1 Trng Delay: 88.2 μs IF Gain: 15 dB Carrier Ref Freq: 2.592990000 GHz Avg/Hold: 25/25 CC Info: Downlink, 1 CC, SISO

Carrier Reference Frequency: 2.592990000 GHz

4 CC0 Error Summary

Channel Power	39.45 dBm
Channel Power (Active)	40.74 dBm
EVM	2.46 %
EVM Peak	12.40 %
Frequency Error	-1.09 Hz
Symbol Clock Error	0.001 ppm
IQ Offset	-35.31 dB
Time Offset	-280 ns
Sync Correlation	99.8 %
Sync Source	PDSCH DMRS
Magnitude Error	1.74 %
Phase Error	0.02 rad
Gain Imbalance	---
Quad Error	---
Timing Skew	---

Feb 25, 2021 9:36:11 AM

5G NR Band n41 Carrier 2592.99 MHz NR 100, 0 °C, 48 VDC						
Frequency Error				Limit	Result	
Value in Hz				1000 Hz	Pass	
				-1.14		

5G NR 1 Modulation Analysis

KEYSIGHT Input: RF Coupling: DC Align: Auto Input Z: 50 Ω Corrections: Off Freq Ref: External Atten: 10 dB (e0) Preamp: Off #PNO: Best Wide Trig: External 1 Trng Delay: 88.2 μs IF Gain: 15 dB Carrier Ref Freq: 2.592990000 GHz Avg/Hold: 25/25 CC Info: Downlink, 1 CC, SISO

Carrier Reference Frequency: 2.592990000 GHz

4 CC0 Error Summary

Channel Power	39.28 dBm
Channel Power (Active)	40.57 dBm
EVM	2.37 %
EVM Peak	11.55 %
Frequency Error	-1.14 Hz
Symbol Clock Error	0.002 ppm
IQ Offset	-35.24 dB
Time Offset	-281 ns
Sync Correlation	99.9 %
Sync Source	PDSCH DMRS
Magnitude Error	1.67 %
Phase Error	0.02 rad
Gain Imbalance	---
Quad Error	---
Timing Skew	---

Feb 25, 2021 8:16:02 AM

FREQUENCY STABILITY



XMt 2020.12.30.0

5G NR Band n41 Carrier 2592.99 MHz NR 100, 10 °C, 48 VDC						
Frequency Error				Limit	Result	
Value in Hz						
				-1.27	1000 Hz	Pass

5G NR 1 Modulation Analysis

KEYSIGHT Input: RF Coupling: DC Align: Auto Input Z: 50 Ω Corrections: Off Freq Ref: External Atten: 10 dB (e0) Preamp: Off #PNO: Best Wide Trig: External 1 Trig Delay: 86.2 μs IF Gain: 15 dB Carrier Ref Freq: 2.592990000 GHz Avg/Hold: 25/25 CC Info: Downlink, 1 CC, SISO

Carrier Reference Frequency: 2.592990000 GHz

4 CC0 Error Summary

Channel Power	38.84 dBm
Channel Power (Active)	40.14 dBm
EVM	2.35 %
EVM Peak	11.75 %
Frequency Error	-1.27 Hz
Symbol Clock Error	0.002 ppm
IQ Offset	-35.27 dB
Time Offset	-280 ns
Sync Correlation	99.9 %
Sync Source	PDSCH DMRS
Magnitude Error	1.65 %
Phase Error	0.02 rad
Gain Imbalance	---
Quad Error	---
Timing Skew	---

Feb 25, 2021 7:33:16 AM

5G NR Band n41 Carrier 2592.99 MHz NR 100, 20 °C, 40.8 VDC						
Frequency Error				Limit	Result	
Value in Hz						
				-1.24	1000 Hz	Pass

5G NR 1 Modulation Analysis

KEYSIGHT Input: RF Coupling: DC Align: Auto Input Z: 50 Ω Corrections: Off Freq Ref: External Atten: 10 dB (e0) Preamp: Off #PNO: Best Wide Trig: External 1 Trig Delay: 86.2 μs IF Gain: 15 dB Carrier Ref Freq: 2.592990000 GHz Avg/Hold: 25/25 CC Info: Downlink, 1 CC, SISO

Carrier Reference Frequency: 2.592990000 GHz

4 CC0 Error Summary

Channel Power	38.63 dBm
Channel Power (Active)	39.92 dBm
EVM	2.35 %
EVM Peak	11.44 %
Frequency Error	-1.24 Hz
Symbol Clock Error	0.002 ppm
IQ Offset	-35.29 dB
Time Offset	-283 ns
Sync Correlation	99.9 %
Sync Source	PDSCH DMRS
Magnitude Error	1.66 %
Phase Error	0.02 rad
Gain Imbalance	---
Quad Error	---
Timing Skew	---

Feb 25, 2021 6:52:58 AM

FREQUENCY STABILITY

5G NR Band n41 Carrier 2592.99 MHz NR 100, 20 °C, 48 VDC						
Frequency Error				Limit	Result	
Value in Hz				1000 Hz	Pass	
				-1.15		

5G NR 1 Modulation Analysis

KEYSIGHT Input RF: Coupling DC Align: Auto Input Z: 50 Ω Corrections: Off Freq Ref: External Atten: 10 dB (e0) Preamp: Off #PNO: Best Wide Trng: External 1 Trng Delay: 86.2 μs IF Gain: 15 dB Carrier Ref Freq: 2.592990000 GHz Avg/Hold: 25/25 CC Info: Downlink, 1 CC, SISO

Carrier Reference Frequency: 2.592990000 GHz

4 CC0 Error Summary

Channel Power	38.56 dBm
Channel Power (Active)	39.85 dBm
EVM	2.30 %
EVM Peak	11.57 %
Frequency Error	-1.15 Hz
Symbol Clock Error	0.002 ppm
IQ Offset	-35.33 dB
Time Offset	-277 ns
Sync Correlation	99.9 %
Sync Source	PDSCH DMRS
Magnitude Error	1.62 %
Phase Error	0.02 rad
Gain Imbalance	---
Quad Error	---
Timing Skew	---

Feb 25, 2021 6:46:42 AM

5G NR Band n41 Carrier 2592.99 MHz NR 100, 20 °C, 55.2 VDC						
Frequency Error				Limit	Result	
Value in Hz				1000 Hz	Pass	
				-1.41		

5G NR 1 Modulation Analysis

KEYSIGHT Input RF: Coupling DC Align: Auto Input Z: 50 Ω Corrections: Off Freq Ref: External Atten: 10 dB (e0) Preamp: Off #PNO: Best Wide Trng: External 1 Trng Delay: 86.2 μs IF Gain: 15 dB Carrier Ref Freq: 2.592990000 GHz Avg/Hold: 25/25 CC Info: Downlink, 1 CC, SISO

Carrier Reference Frequency: 2.592990000 GHz

4 CC0 Error Summary

Channel Power	38.70 dBm
Channel Power (Active)	39.99 dBm
EVM	2.33 %
EVM Peak	11.90 %
Frequency Error	-1.41 Hz
Symbol Clock Error	0.002 ppm
IQ Offset	-35.28 dB
Time Offset	-279 ns
Sync Correlation	99.9 %
Sync Source	PDSCH DMRS
Magnitude Error	1.64 %
Phase Error	0.02 rad
Gain Imbalance	---
Quad Error	---
Timing Skew	---

Feb 25, 2021 7:00:00 AM

FREQUENCY STABILITY



XMII 2020.12.30.0

5G NR Band n41 Carrier 2592.99 MHz NR 100, 30 °C, 48 VDC						
Frequency Error				Limit	Result	
Value in Hz				1000 Hz	Pass	
				-1.65		

5G NR 1 Modulation Analysis

KEYSIGHT Input RF Coupling: DC Align: Auto Input Z: 50 Ω Corrections: Off Freq Ref: External Atten: 10 dB (e0) Preamp: Off #PNO: Best Wide Trng: External 1 Trng Delay: 86.2 μs IF Gain: 15 dB Carrier Ref Freq: 2.592990000 GHz Avg/Hold: 5/5 CC Info: Downlink, 1 CC, SISO

4 CC0 Error Summary

Channel Power	38.64 dBm
Channel Power (Active)	39.93 dBm
EVM	2.32 %
EVM Peak	10.83 %
Frequency Error	-1.65 Hz
Symbol Clock Error	0.002 ppm
IQ Offset	-35.28 dB
Time Offset	-283 ns
Sync Correlation	99.9 %
Sync Source	PDSCH DMRS
Magnitude Error	1.64 %
Phase Error	0.02 rad
Gain Imbalance	---
Quad Error	---
Timing Skew	---

Component Carrier CC0

Avg/Hold Number 5

Averaging On

Average Mode Exponential

Acquisition Mode Sequential

Optimize EVM

Allow Re-Calculation On

Auto Couple

Meas Preset

Feb 25, 2021 11:38:38 AM

5G NR Band n41 Carrier 2592.99 MHz NR 100, 40 °C, 48 VDC						
Frequency Error				Limit	Result	
Value in Hz				1000 Hz	Pass	
				-1.39		

5G NR 1 Modulation Analysis

KEYSIGHT Input RF Coupling: DC Align: Auto Input Z: 50 Ω Corrections: Off Freq Ref: External Atten: 10 dB (e0) Preamp: Off #PNO: Best Wide Trng: External 1 Trng Delay: 86.2 μs IF Gain: 15 dB Carrier Ref Freq: 2.592990000 GHz Avg/Hold: 5/5 CC Info: Downlink, 1 CC, SISO

4 CC0 Error Summary

Channel Power	38.51 dBm
Channel Power (Active)	39.80 dBm
EVM	2.39 %
EVM Peak	11.48 %
Frequency Error	-1.39 Hz
Symbol Clock Error	0.002 ppm
IQ Offset	-35.26 dB
Time Offset	-282 ns
Sync Correlation	99.9 %
Sync Source	PDSCH DMRS
Magnitude Error	1.69 %
Phase Error	0.02 rad
Gain Imbalance	---
Quad Error	---
Timing Skew	---

Component Carrier CC0

Avg/Hold Number 5

Averaging On

Average Mode Exponential

Acquisition Mode Sequential

Optimize EVM

Allow Re-Calculation On

Auto Couple

Meas Preset

Feb 25, 2021 12:10:27 PM

FREQUENCY STABILITY



XMM 2020.12.30.0

5G NR Band n41 Carrier 2592.99 MHz NR 100, 50 °C, 48 VDC						
Frequency Error				Limit	Result	
Value in Hz				1000 Hz	Pass	
				-1.5		

5G NR 1
Modulation Analysis

Input RF

Input Z: 50 Ω

Atten: 10 dB (e0)

Trig: External 1

Carrier Ref Freq: 2.592990000 GHz

Coupling: DC

Align: Auto

Corrections: Off

Freq Ref: External

#PNO: Best Wide

IF Gain: 15 dB

CC Info: Downlink, 1 CC, SISO

4 CC0 Error Summary

Channel Power	38.52 dBm
Channel Power (Active)	39.81 dBm
EVM	2.23 %
EVM Peak	9.87 %
Frequency Error	-1.50 Hz
Symbol Clock Error	0.002 ppm
IQ Offset	-35.27 dB
Time Offset	-281 ns
Sync Correlation	99.9 %
Sync Source	PDSCH DMRS
Magnitude Error	1.57 %
Phase Error	0.02 rad
Gain Imbalance	---
Quad Error	---
Timing Skew	---

Meas Setup

Component Carrier

CC0

Avg/Hold Number

5

Averaging

On

Average Mode

Exponential

Acquisition Mode

Sequential

Copy CC0 to

1/1

Copy CC0 to

1/1

Optimize EVM

Allow Re-Calculation

On

Auto Couple

Meas Preset

OUTPUT POWER 01 - 8 PORTS

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFL	27-Feb-20	27-Feb-21
Generator - Signal	Keysight	N5171B-506	TEW	2-May-18	2-May-21

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The fundamental emission output power (maximum average conducted output power) was measured using the channels and modes as called out on the following data sheets. The transmit power was set to its default maximum.

The method in section 5.2.4.4 of ANSI C63.26 was used to make the measurements. This method uses trace averaging across the ON and OFF times of the EUT transmissions in the spectrum analyzer channel power function using an RMS detector. Following the measurement a duty cycle correction was applied by adding $[10 \log (1/D)]$, where D is the duty cycle in decimal, to the measured power to compute the average power during the actual transmission times.

RF conducted emissions testing was performed on all ports at NR100 middle channel in order to prove the AZHL antenna ports are essentially electrically identical. Antenna port 1 was selected to perform the testing under this effort as allowed by ANSI C63.26-2015 paragraphs 5.2.5.3, 5.7.2i and 6.4.

OUTPUT POWER 01 - 8 PORTS



TstTx 2019.08.30.0 XMI 2020.12.30.0

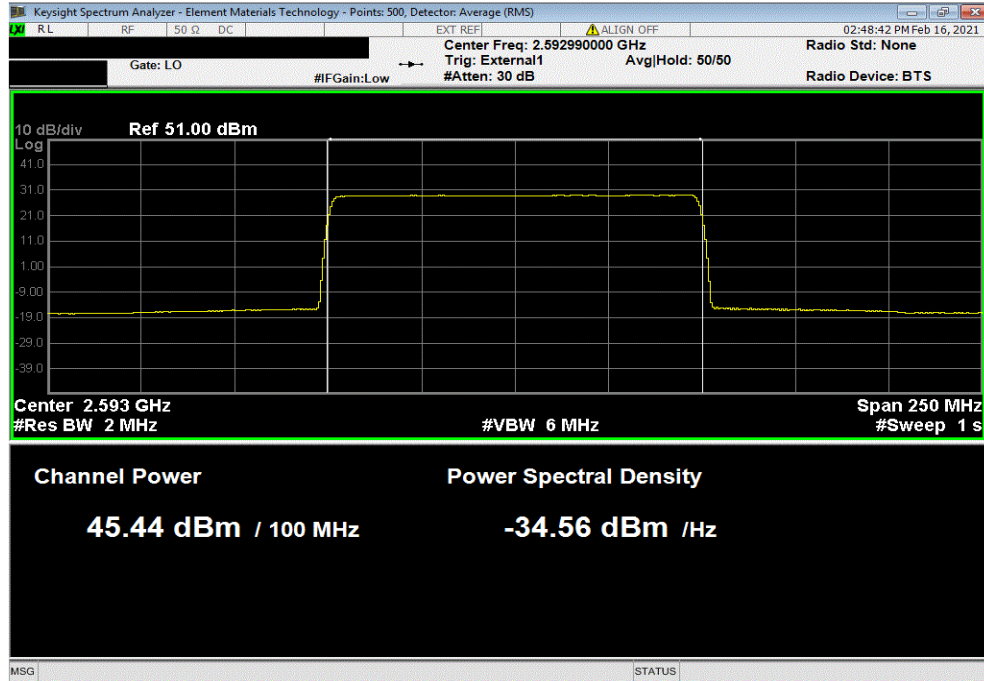
EUT: AZHL		Work Order: NOKI0018	
Serial Number: YK203400016		Date: 19-Feb-21	
Customer: Nokia Solutions and Networks		Temperature: 23.6 °C	
Attendees: John Rattavong, Mitchell Hill, David Le		Humidity: 14.9% RH	
Project: None		Barometric Pres.: 1037 mbar	
Tested by: Mark Baytan		Power: 54 VDC	
Job Site: TX05			
TEST SPECIFICATIONS		Test Method	
FCC 27:2021		ANSI C63.26:2015	
COMMENTS			
External 1 gating was set using a trig delay = 86.2us and a gate length = 3.714ms. Reference level offset adjusted to include (2) coax cables, DC block, and attenuator. The carrier power was set to maximum for all testing. The following is the output power measurements at the radio output ports. The output power was measured for a single carrier channel bandwidth on ports 1-8.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	2	Signature 	
		Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)
5G NR, Band n41, 2496 MHz - 2690 MHz			
Port 1	NR100 (100MHz) 256QAM	Middle Ch. 2592.99 MHz	45.444
Port 2	NR100 (100MHz) 256QAM	Middle Ch. 2592.99 MHz	45.626
Port 3	NR100 (100MHz) 256QAM	Middle Ch. 2592.99 MHz	45.864
Port 4	NR100 (100MHz) 256QAM	Middle Ch. 2592.99 MHz	45.894
Port 5	NR100 (100MHz) 256QAM	Middle Ch. 2592.99 MHz	45.805
Port 6	NR100 (100MHz) 256QAM	Middle Ch. 2592.99 MHz	45.516
Port 7	NR100 (100MHz) 256QAM	Middle Ch. 2592.99 MHz	45.534
Port 8	NR100 (100MHz) 256QAM	Middle Ch. 2592.99 MHz	45.632
			0
			45.4
			45.6
			45.9
			45.9
			45.8
			45.5
			45.5
			45.6

OUTPUT POWER 01 - 8 PORTS

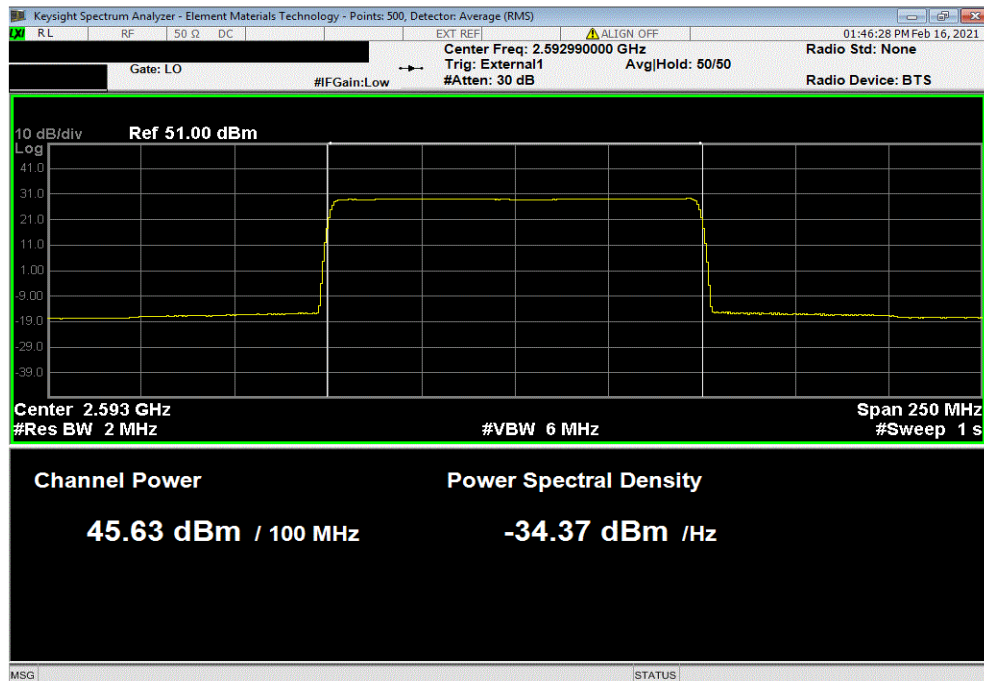


TbTx 2019.08.30.0 XMI 2020.12.30.0

5G NR, Band n41, 2496 MHz - 2690 MHz, Port 1, NR100 (100MHz), 256QAM, Middle Ch. 2592.99 MHz					
Avg Cond	Duty Cycle	Value			
Pwr (dBm)	Factor (dB)	(dBm)			
45.444	0	45.4			



5G NR, Band n41, 2496 MHz - 2690 MHz, Port 2, NR100 (100MHz), 256QAM, Middle Ch. 2592.99 MHz					
Avg Cond	Duty Cycle	Value			
Pwr (dBm)	Factor (dB)	(dBm)			
45.626	0	45.6			

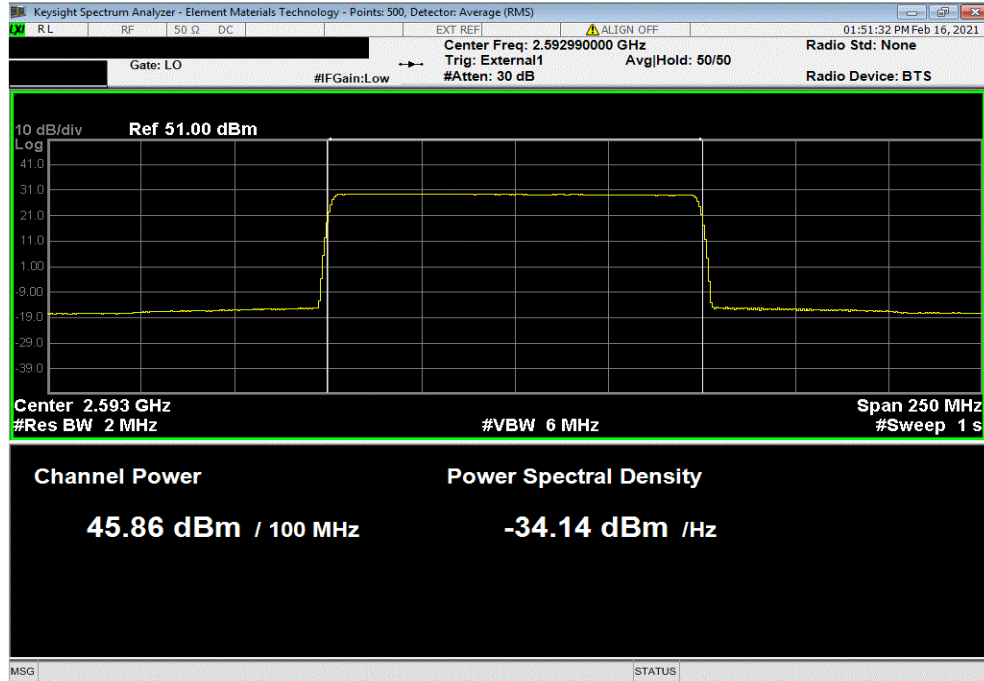


OUTPUT POWER 01 - 8 PORTS

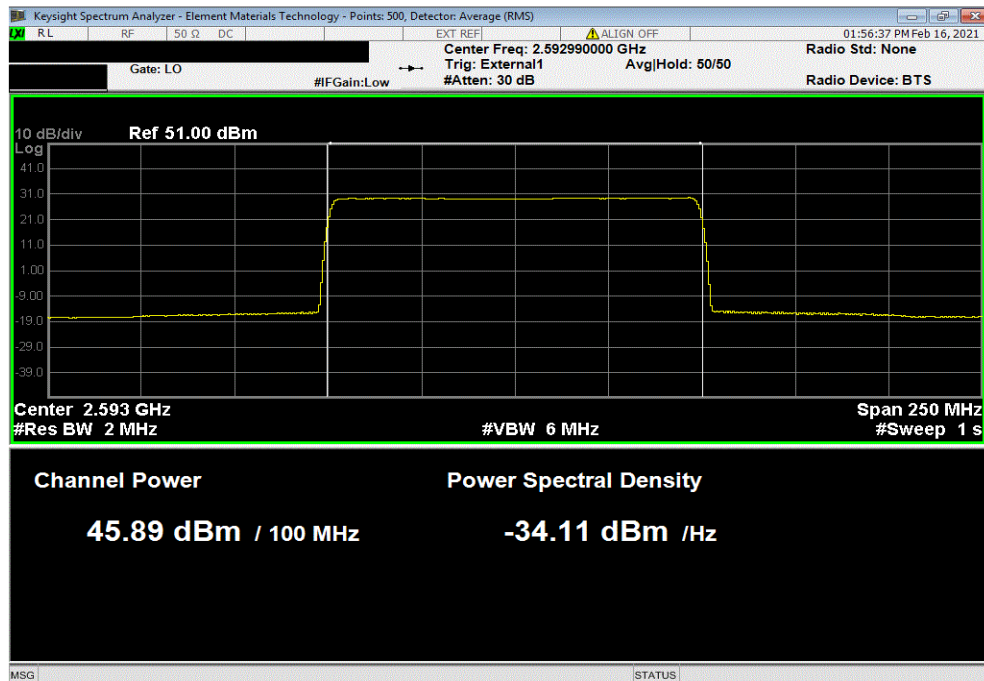


TbTx 2019.08.30.0 XMI 2020.12.30.0

5G NR, Band n41, 2496 MHz - 2690 MHz, Port 3, NR100 (100MHz), 256QAM, Middle Ch. 2592.99 MHz					
Avg Cond	Duty Cycle	Value			
Pwr (dBm)	Factor (dB)	(dBm)			
45.864	0	45.9			



5G NR, Band n41, 2496 MHz - 2690 MHz, Port 4, NR100 (100MHz), 256QAM, Middle Ch. 2592.99 MHz					
Avg Cond	Duty Cycle	Value			
Pwr (dBm)	Factor (dB)	(dBm)			
45.894	0	45.9			

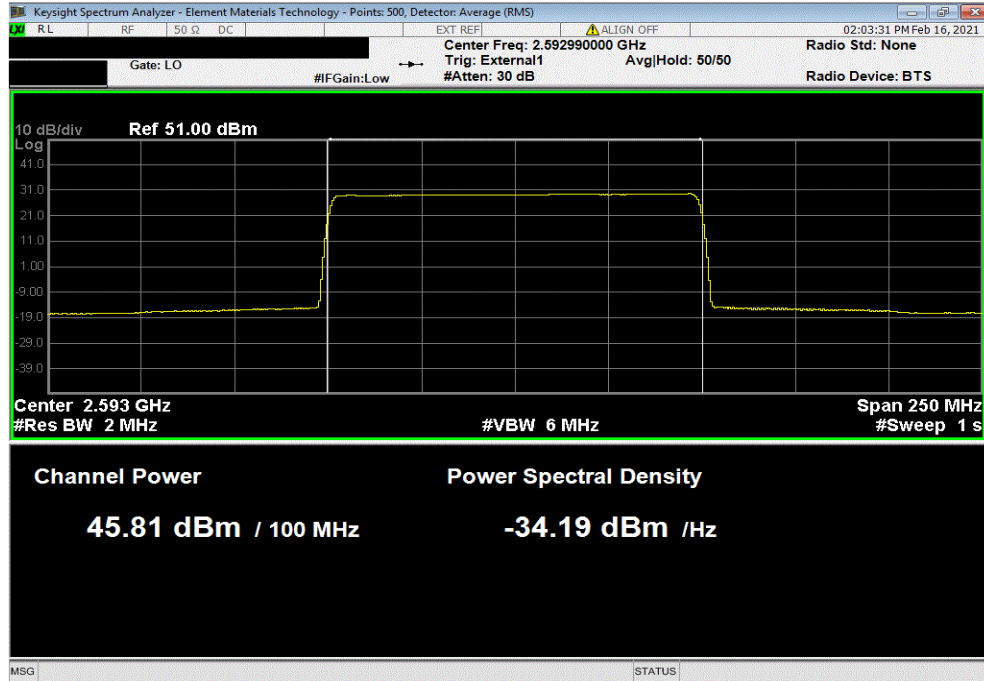


OUTPUT POWER 01 - 8 PORTS

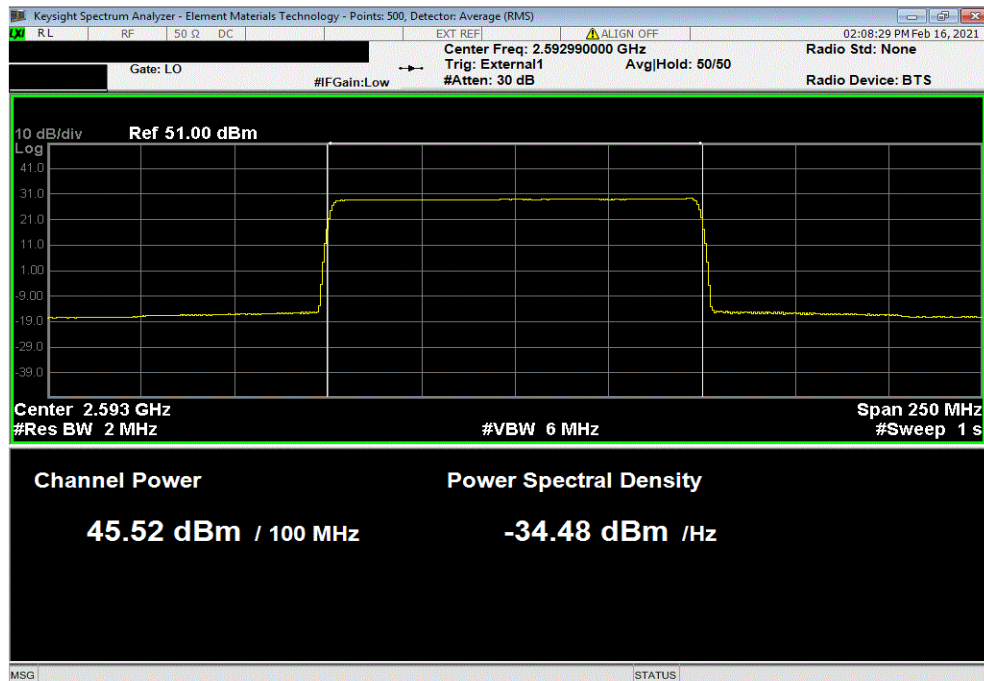


TbTx 2019.08.30.0 XMill 2020.12.30.0

5G NR, Band n41, 2496 MHz - 2690 MHz, Port 5, NR100 (100MHz), 256QAM, Middle Ch. 2592.99 MHz					
Avg Cond	Duty Cycle	Value			
Pwr (dBm)	Factor (dB)	(dBm)			
45.805	0	45.8			



5G NR, Band n41, 2496 MHz - 2690 MHz, Port 6, NR100 (100MHz), 256QAM, Middle Ch. 2592.99 MHz					
Avg Cond	Duty Cycle	Value			
Pwr (dBm)	Factor (dB)	(dBm)			
45.516	0	45.5			

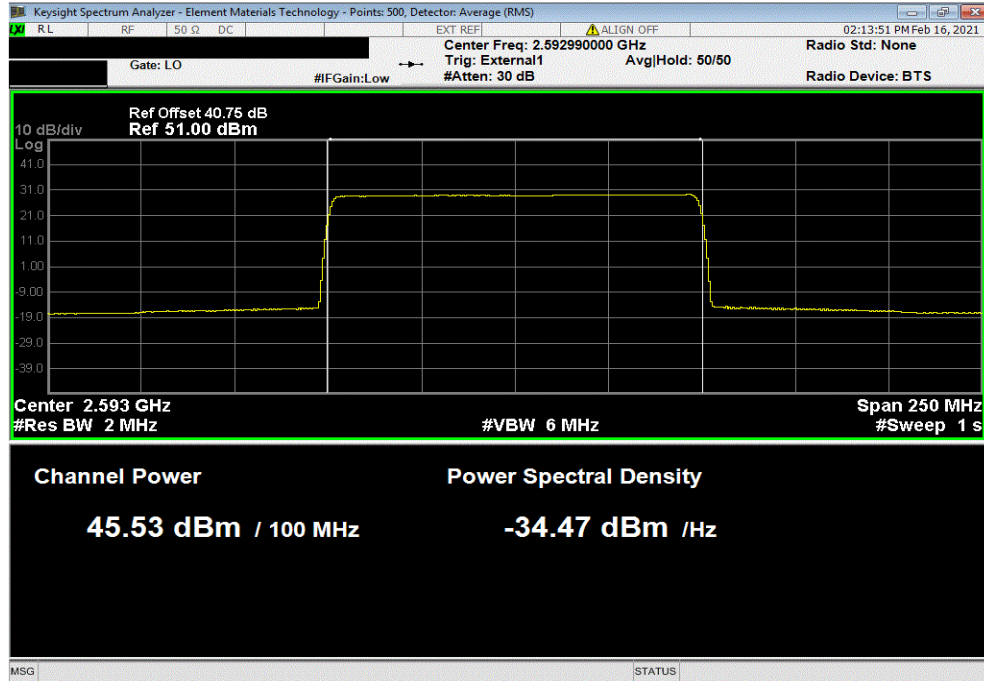


OUTPUT POWER 01 - 8 PORTS

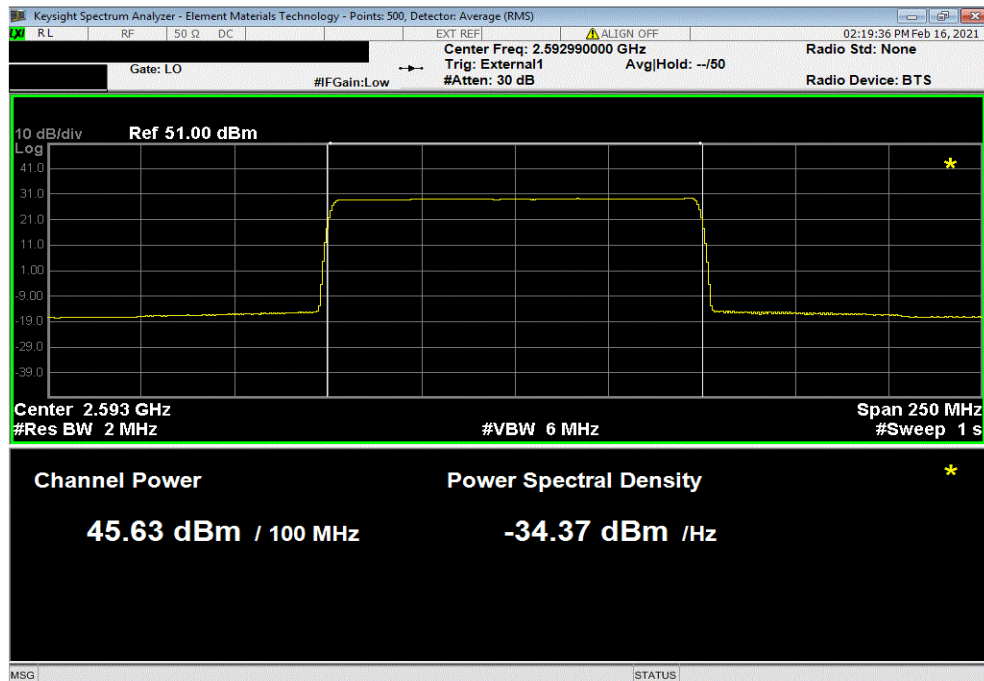


TbTx 2019.08.30.0 XMI 2020.12.30.0

5G NR, Band n41, 2496 MHz - 2690 MHz, Port 7, NR100 (100MHz), 256QAM, Middle Ch. 2592.99 MHz					
Avg Cond	Duty Cycle	Value			
Pwr (dBm)	Factor (dB)	(dBm)			
45.534	0	45.5			



5G NR, Band n41, 2496 MHz - 2690 MHz, Port 8, NR100 (100MHz), 256QAM, Middle Ch. 2592.99 MHz					
Avg Cond	Duty Cycle	Value			
Pwr (dBm)	Factor (dB)	(dBm)			
45.632	0	45.6			



OUTPUT POWER 02 5G & EIRP CALCULATION



XMH 2020.03.25.0

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFL	27-Feb-20	27-Feb-21
Generator - Signal	Keysight	N5171B-506	TEW	2-May-18	2-May-21

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The fundamental emission output power (maximum average conducted output power) was measured using the channels and modes as called out on the following data sheets. The transmit power was set to its default maximum.

The method in section 5.2.4.4 of ANSI C63.26 was used to make the measurements. This method uses trace averaging across the ON and OFF times of the EUT transmissions in the spectrum analyzer channel power function using an RMS detector. Following the measurement a duty cycle correction was applied by adding $[10 \log (1/D)]$, where D is the duty cycle in decimal, to the measured power to compute the average power during the actual transmission times.

RF conducted emissions testing was performed only on one port. The AZHL antenna ports are essentially electrically identical (the RF power variation between antenna ports is small as shown during 8 port output power testing) and antenna port 1 was selected to perform the testing under this effort as allowed by ANSI C63.26-2015 paragraphs 5.2.5.3, 5.7.2i and 6.4.

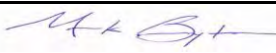
The total average transmit power of all antenna ports was determined per ANSI C63.26-2105 paragraph 6.4.3.1.

The EIRP limit is defined by FCC Part 27.50(h)(ii) as $33\text{dBW} + 10\log(X/Y) \text{ dBW} + 10 \log(360/\text{beamwidth}) \text{ dBW}$ where X is the channel width in MHz and Y is 5.5 or 6MHz. PSD (power/1MHz) measurements are not required for this radio since the FCC limits for EIRP are defined in watts.

OUTPUT POWER 02 5G & EIRP CALCULATION



TestX 2019.08.30.0 XMI 2020.12.30.0

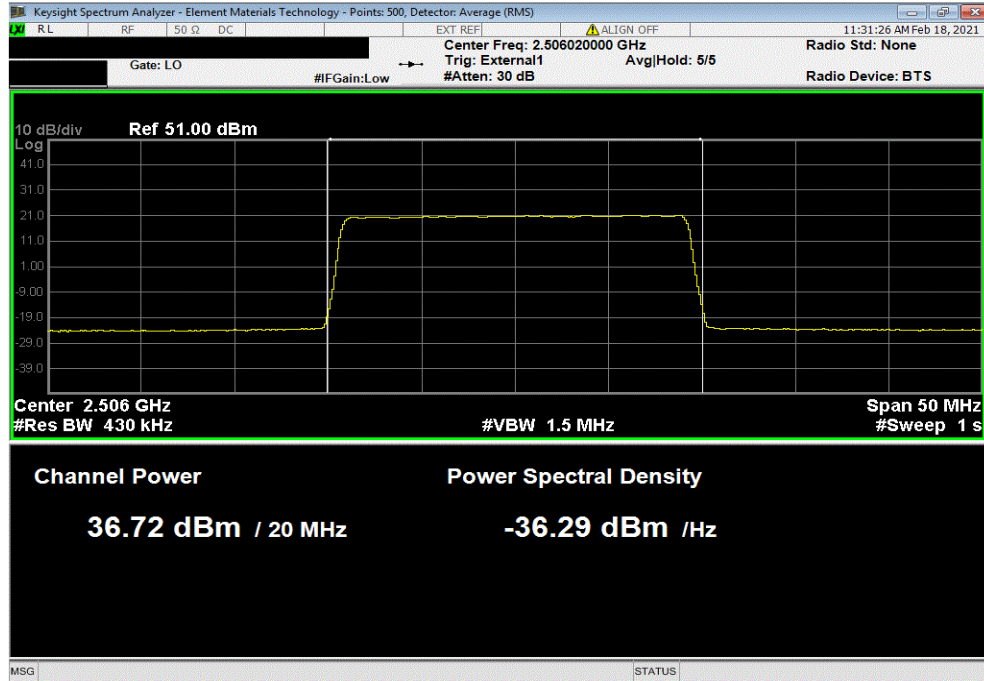
EUT: AZHL			Work Order: NOKI0018		
Serial Number: YK203400016			Date: 19-Feb-21		
Customer: Nokia Solutions and Networks			Temperature: 23.6 °C		
Attendees: John Rattanavong, Mitchell Hill, David Le			Humidity: 14.9% RH		
Project: None			Barometric Pres.: 1037 mbar		
Tested by: Mark Baytan		Power: 54 VDC	Job Site: TX05		
TEST SPECIFICATIONS		Test Method			
FCC 27:2021		ANSI C63.26:2015			
COMMENTS					
External 1 gating was set using a trig delay = 86.2us and a gate length = 3.714ms. Reference level offset adjusted to include (2) coax cables, DC block, and attenuator. The carrier power was set to maximum for all testing. The following is the output power measurements at the radio output ports. The output power was measured for a single carrier channel bandwidth on port 1. The total output power for multiport (2x2 MIMO, 4x4 MIMO and 8x8 MIMO) operation was determined based upon ANSI C63.26 clauses 6.4.3.1 and 6.4.3.2.4 (10 Log Nout). The total output power for two port operation is single port power + 3dB [i.e.: 10 Log(2)]. The total output power for four port operation is single port power + 6dB [i.e.: 10 Log(4)]. The total output power for eight port operation is single port power + 9dB [i.e.: 10 Log(8)].					
DEVIATIONS FROM TEST STANDARD					
None					
Configuration #	2				
		Initial Value dBm/Carrier BW	Duty Cycle	Single Port dBm/Carrier BW	2 Port (2x2 MIMO) 4 Port (4x4 MIMO) 8 Port (8x8 MIMO) dBm/Carrier BW dBm/Carrier BW dBm/Carrier BW
5G NR, Band n41, 2496 MHz - 2690 MHz					
Port 1					
NR20 (20MHz)					
256QAM					
Low Channel 2506.02 MHz		36.718	0	36.718	39.718 42.718 45.718
Mid Channel 2592.99 MHz		37.313	0	37.313	40.313 43.313 46.313
High Channel 2679.99 MHz		37.477	0	37.477	40.477 43.477 46.477
NR40 (40MHz)					
256QAM					
Low Channel 2516.01 MHz		39.229	0	39.229	42.229 45.229 48.229
Mid Channel 2592.99 MHz		39.562	0	39.562	42.562 45.562 48.562
High Channel 2670 MHz		39.788	0	39.788	42.788 45.788 48.788
NR60 (60MHz)					
256QAM					
Low Channel 2526 MHz		40.992	0	40.992	43.992 46.992 49.992
Mid Channel 2592.99 MHz		41.206	0	41.206	44.206 47.206 50.206
High Channel 2659.98 MHz		41.443	0	41.443	44.443 47.443 50.443
NR80 (80MHz)					
256QAM					
Low Channel 2536.02 MHz		42.264	0	42.264	45.264 48.264 51.264
Mid Channel 2592.99 MHz		42.239	0	42.239	45.239 48.239 51.239
High Channel 2649.99 MHz		42.648	0	42.648	45.648 48.648 51.648
NR100 (100MHz)					
QPSK					
Mid Channel 2592.99 MHz		45.381	0	45.381	48.381 51.381 54.381
16QAM					
Mid Channel 2592.99 MHz		45.313	0	45.313	48.313 51.313 54.313
64QAM					
Mid Channel 2592.99 MHz		45.375	0	45.375	48.375 51.375 54.375
256QAM					
Low Channel 2546.01 MHz		45.69	0	45.69	48.69 51.69 54.69
Mid Channel 2592.99 MHz		45.53	0	45.53	48.53 51.53 54.53
High Channel 2640 MHz		45.293	0	45.293	48.293 51.293 54.293

OUTPUT POWER 02 5G & EIRP CALCULATION

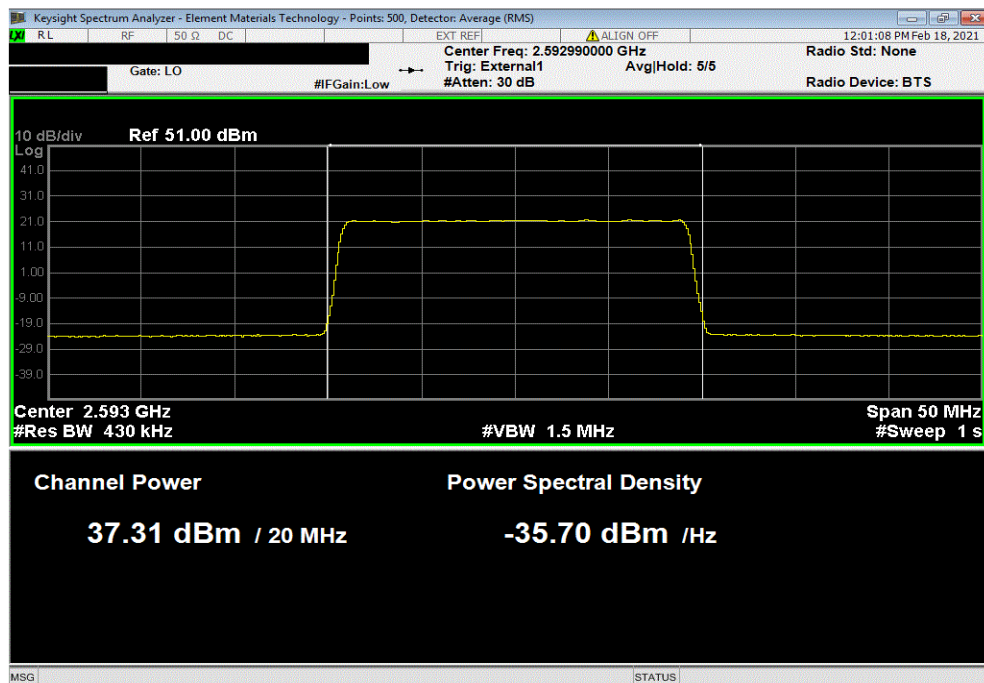


TbTx 2019.08.30.0 XMit 2020.12.30.0

5G NR, Band n41, 2496 MHz - 2690 MHz, Port 1, NR20 (20MHz), 256QAM, Low Channel 2506.02 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	
36.718	0	36.718	39.718	42.718	45.718	



5G NR, Band n41, 2496 MHz - 2690 MHz, Port 1, NR20 (20MHz), 256QAM, Mid Channel 2592.99 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	
37.313	0	37.313	40.313	43.313	46.313	

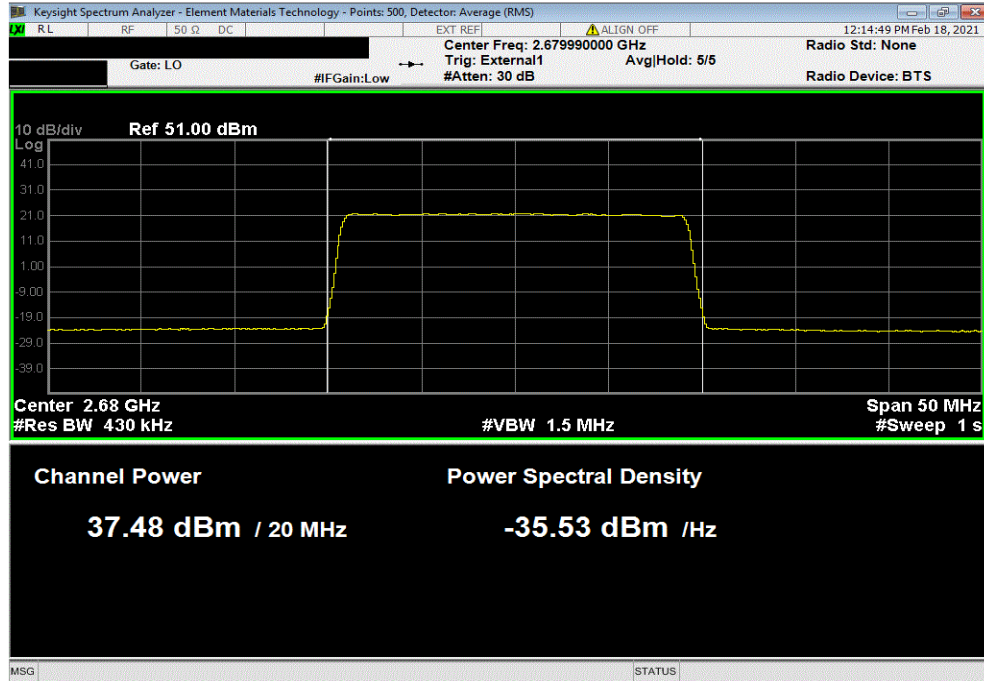


OUTPUT POWER 02 5G & EIRP CALCULATION

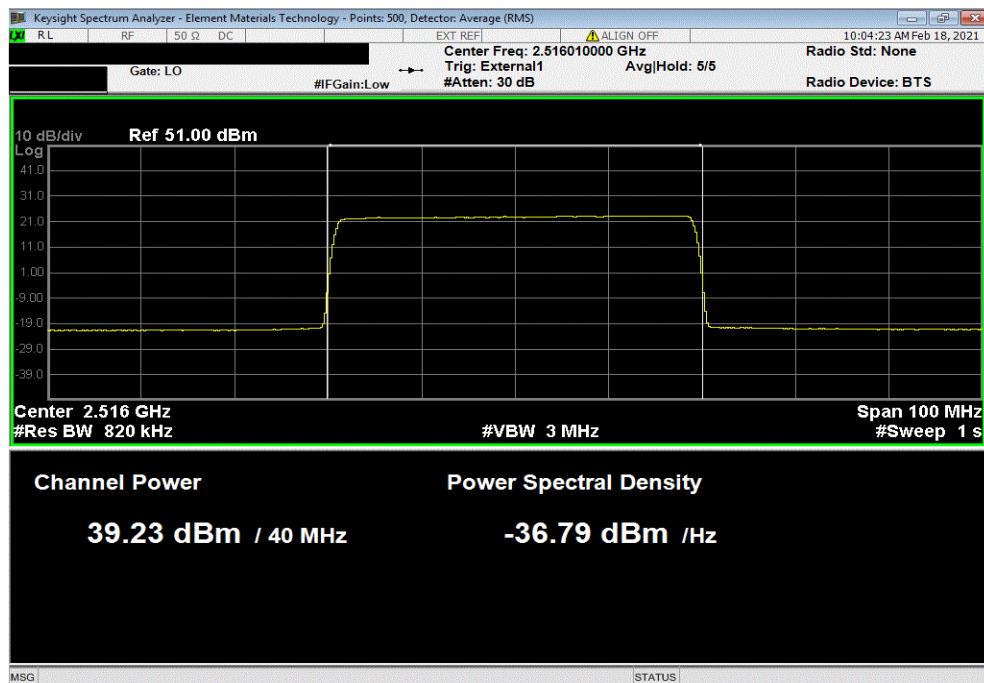


TbTx 2019.08.30.0 XMI 2020.12.30.0

5G NR, Band n41, 2496 MHz - 2690 MHz, Port 1, NR20 (20MHz), 256QAM, High Channel 2679.99 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	
37.477	0	37.477	40.477	43.477	46.477	



5G NR, Band n41, 2496 MHz - 2690 MHz, Port 1, NR40 (40MHz), 256QAM, Low Channel 2516.01 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	
39.229	0	39.229	42.229	45.229	48.229	

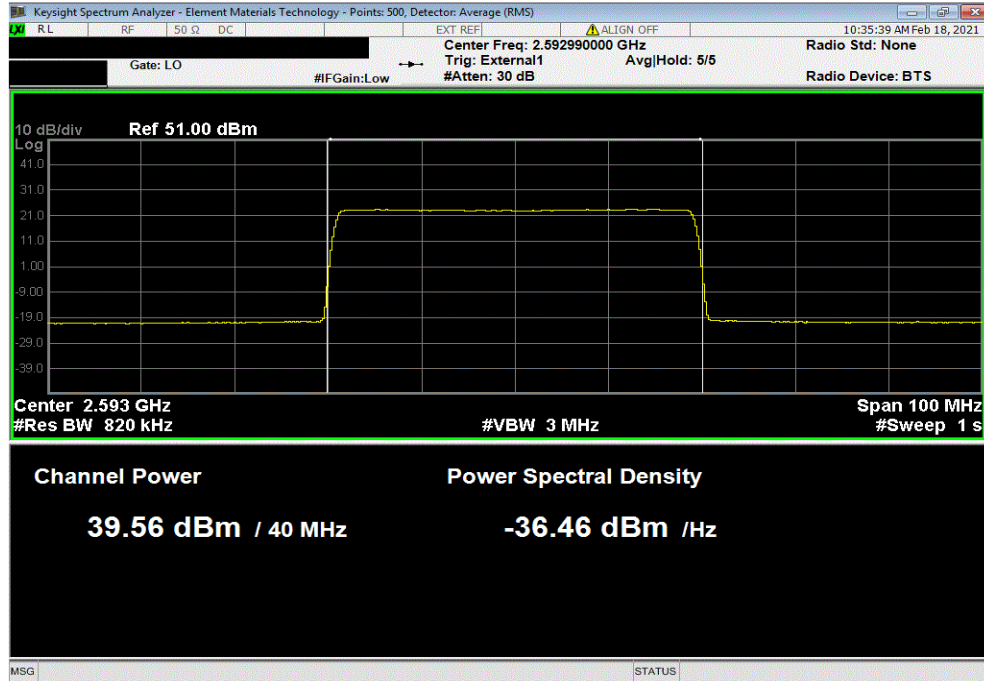


OUTPUT POWER 02 5G & EIRP CALCULATION

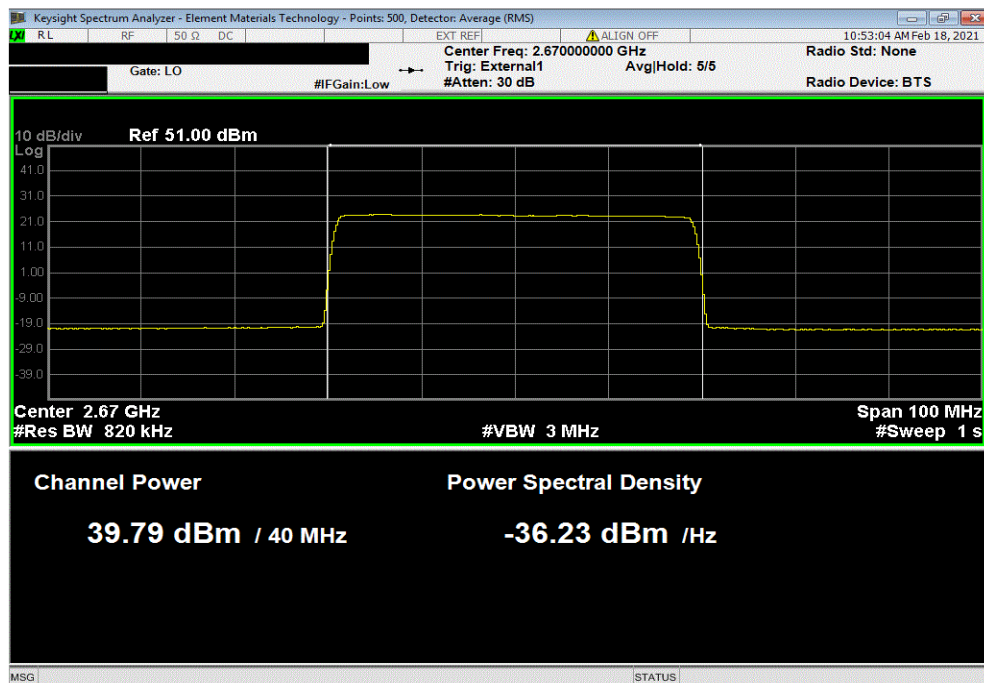


TbTx 2019.08.30.0 XMI 2020.12.30.0

5G NR, Band n41, 2496 MHz - 2690 MHz, Port 1, NR40 (40MHz), 256QAM, Mid Channel 2592.99 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	
39.562	0	39.562	42.562	45.562	48.562	



5G NR, Band n41, 2496 MHz - 2690 MHz, Port 1, NR40 (40MHz), 256QAM, High Channel 2670 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	
39.788	0	39.788	42.788	45.788	48.788	

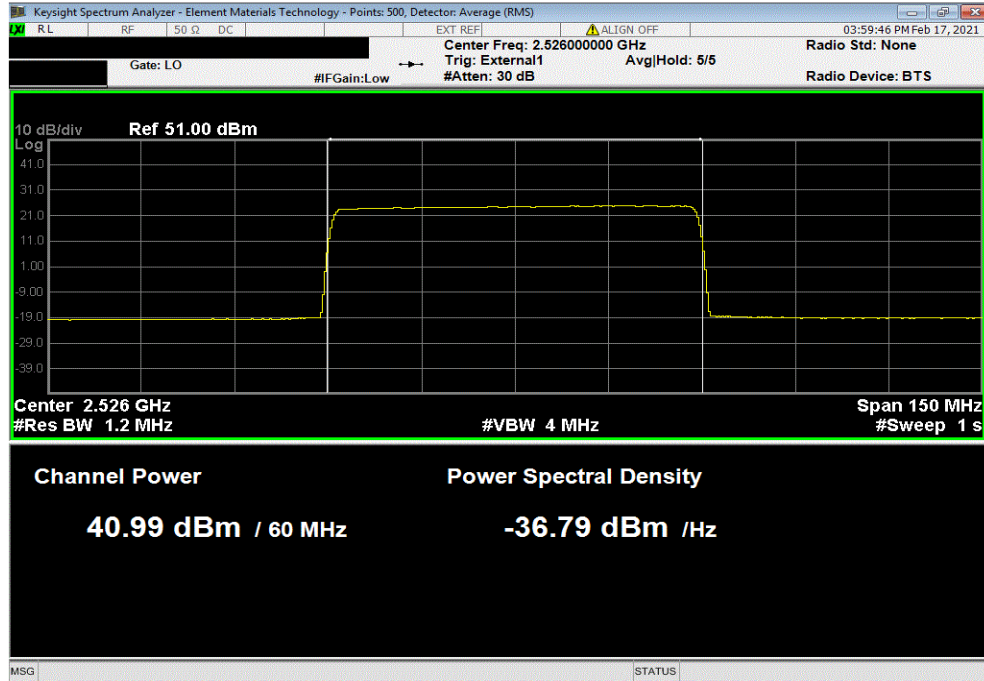


OUTPUT POWER 02 5G & EIRP CALCULATION

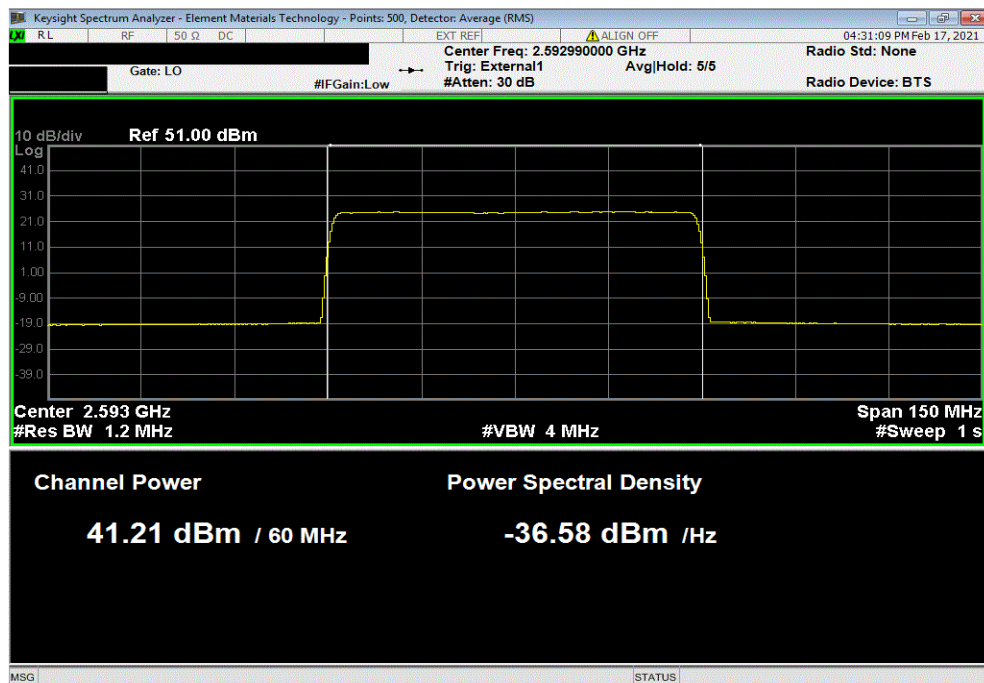


TbTx 2019.08.30.0 XMI 2020.12.30.0

5G NR, Band n41, 2496 MHz - 2690 MHz, Port 1, NR60 (60MHz), 256QAM, Low Channel 2526 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	
40.992	0	40.992	43.992	46.992	49.992	



5G NR, Band n41, 2496 MHz - 2690 MHz, Port 1, NR60 (60MHz), 256QAM, Mid Channel 2592.99 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	
41.206	0	41.206	44.206	47.206	50.206	

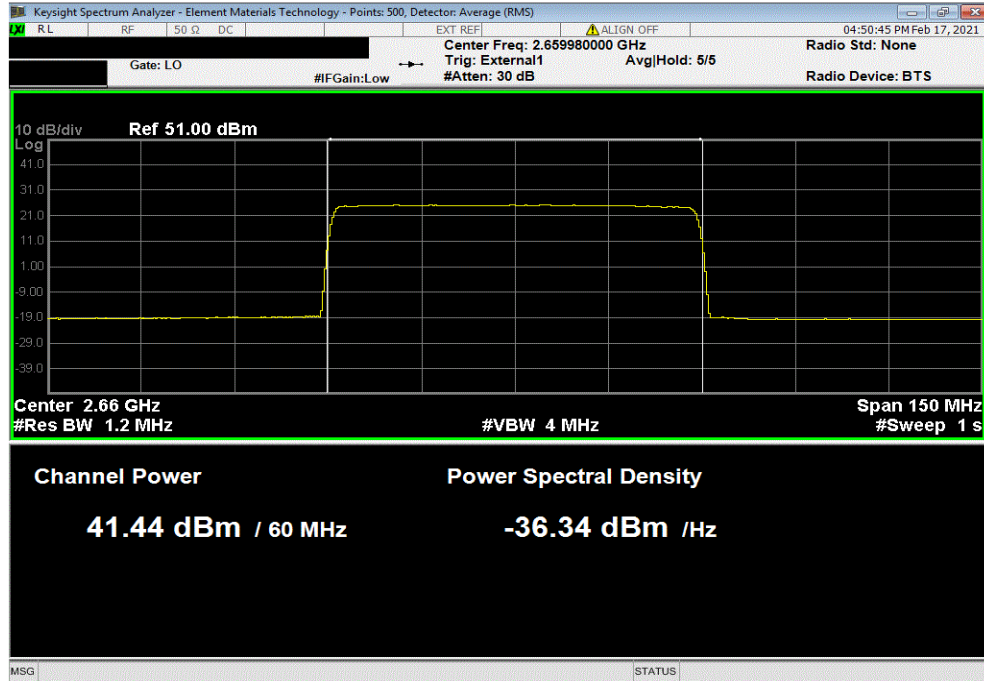


OUTPUT POWER 02 5G & EIRP CALCULATION

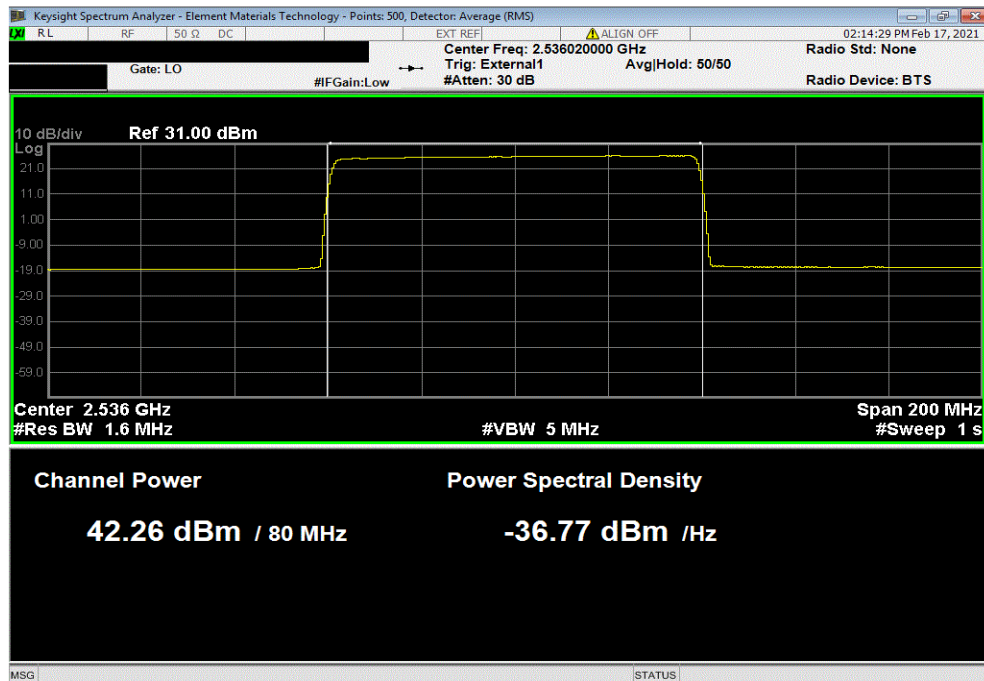


TbTx 2019.08.30.0 XMI 2020.12.30.0

5G NR, Band n41, 2496 MHz - 2690 MHz, Port 1, NR60 (60MHz), 256QAM, High Channel 2659.98 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	
41.443	0	41.443	44.443	47.443	50.443	



5G NR, Band n41, 2496 MHz - 2690 MHz, Port 1, NR80 (80MHz), 256QAM, Low Channel 2536.02 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	
42.264	0	42.264	45.264	48.264	51.264	

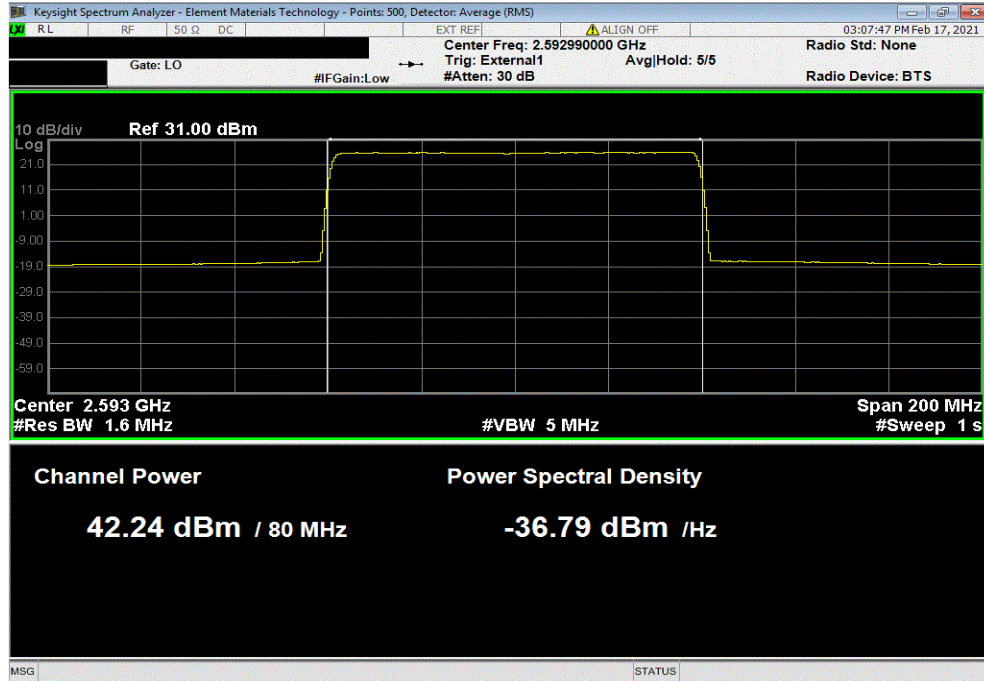


OUTPUT POWER 02 5G & EIRP CALCULATION

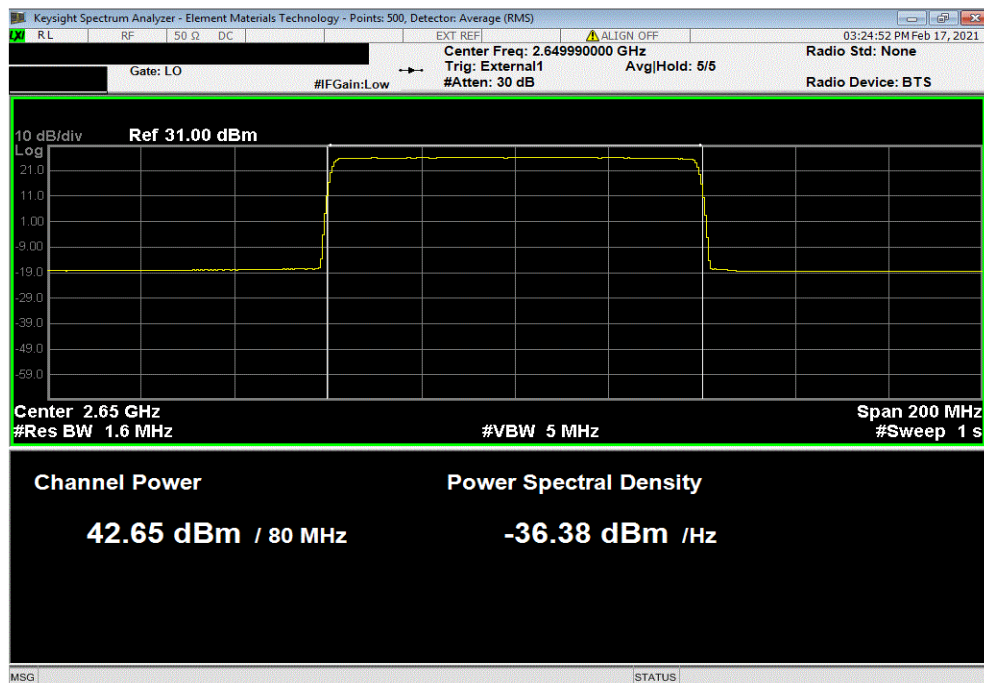


TbTx 2019.08.30.0 XbM 2020.12.30.0

5G NR, Band n41, 2496 MHz - 2690 MHz, Port 1, NR80 (80MHz), 256QAM, Mid Channel 2592.99 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	
42.239	0	42.239	45.239	48.239	51.239	



5G NR, Band n41, 2496 MHz - 2690 MHz, Port 1, NR80 (80MHz), 256QAM, High Channel 2649.99 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	
42.648	0	42.648	45.648	48.648	51.648	

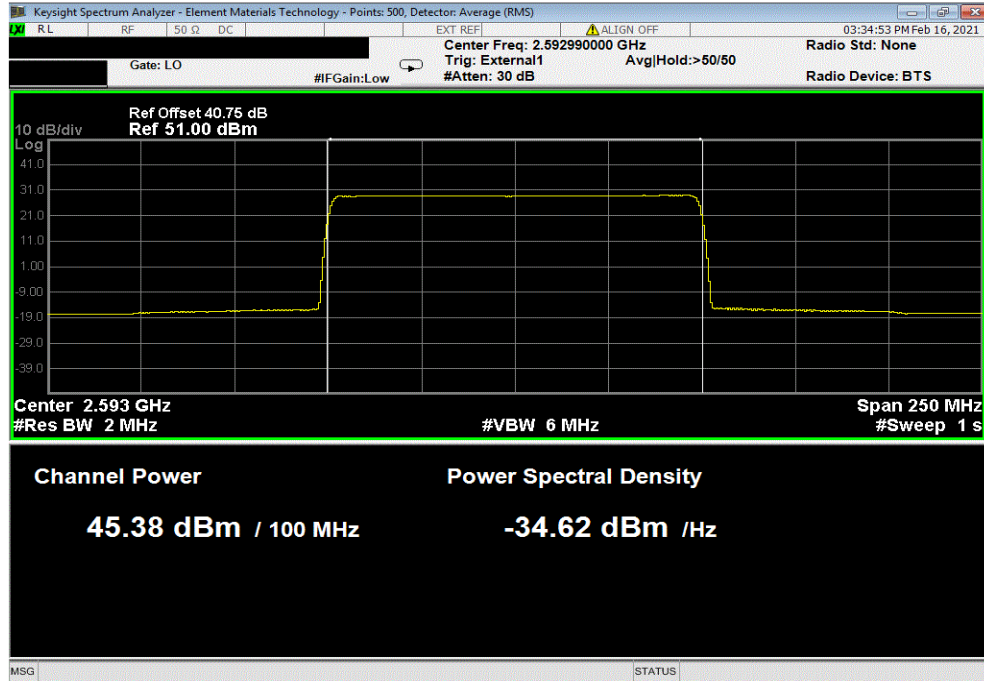


OUTPUT POWER 02 5G & EIRP CALCULATION

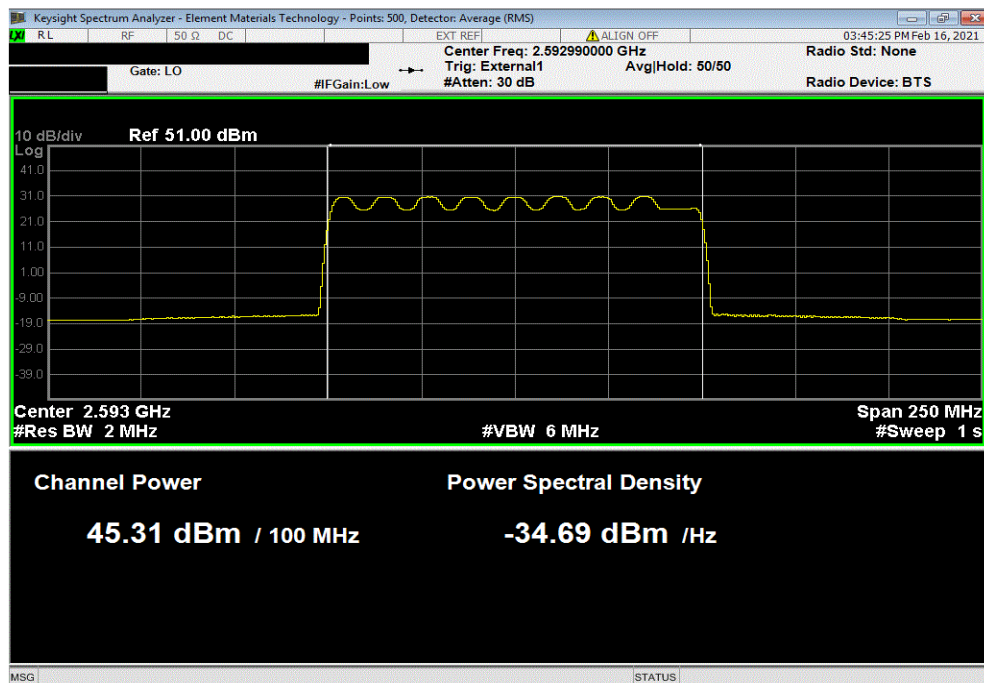


TbTx 2019.08.30.0 XMI 2020.12.30.0

5G NR, Band n41, 2496 MHz - 2690 MHz, Port 1, NR100 (100MHz), QPSK, Mid Channel 2592.99 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW
45.381	0	45.381	48.381	51.381	54.381	



5G NR, Band n41, 2496 MHz - 2690 MHz, Port 1, NR100 (100MHz), 16QAM, Mid Channel 2592.99 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW
45.313	0	45.313	48.313	51.313	54.313	

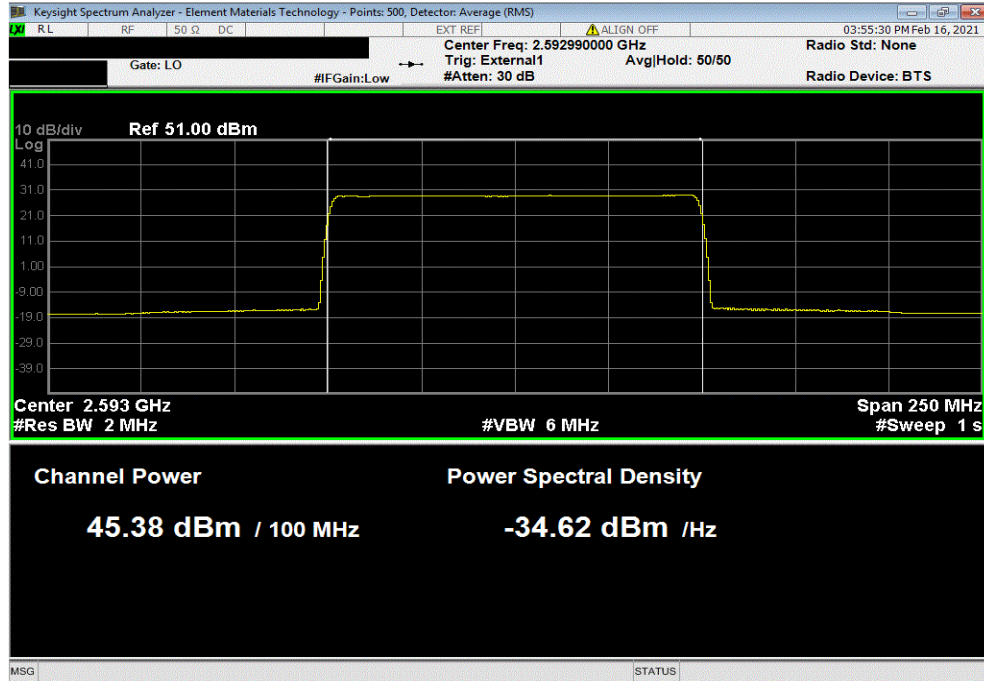


OUTPUT POWER 02 5G & EIRP CALCULATION

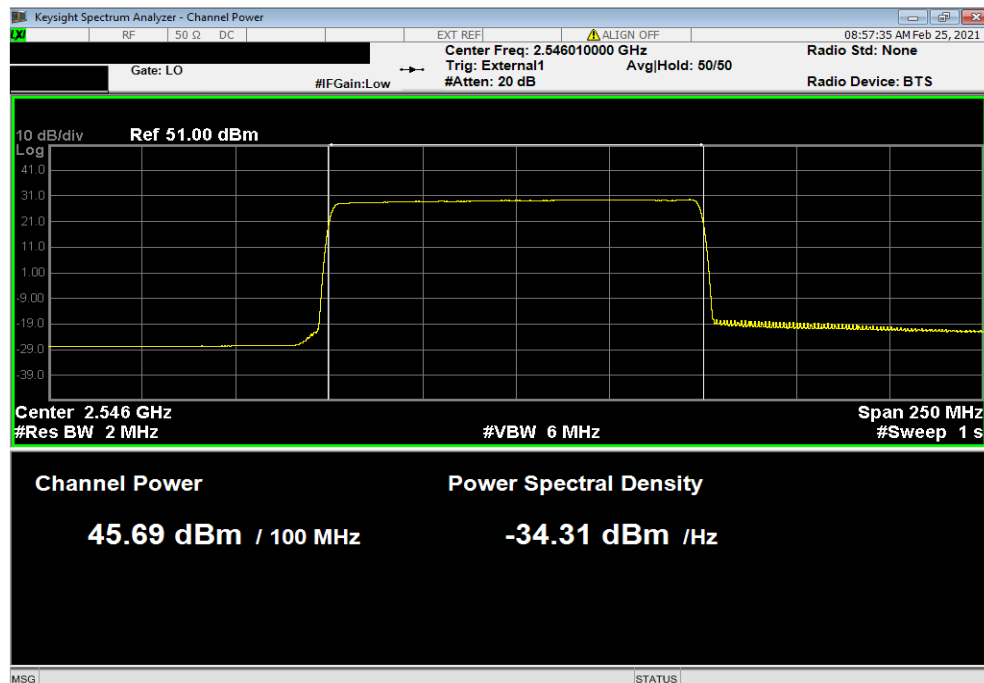


TbTx 2019.08.30.0 XMI 2020.12.30.0

5G NR, Band n41, 2496 MHz - 2690 MHz, Port 1, NR100 (100MHz), 64QAM, Mid Channel 2592.99 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	
45.375	0	45.375	48.375	51.375	54.375	



5G NR, Band n41, 2496 MHz - 2690 MHz, Port 1, NR100 (100MHz), 256QAM, Low Channel 2546.01 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	
45.69	0	45.69	48.69	51.69	54.69	

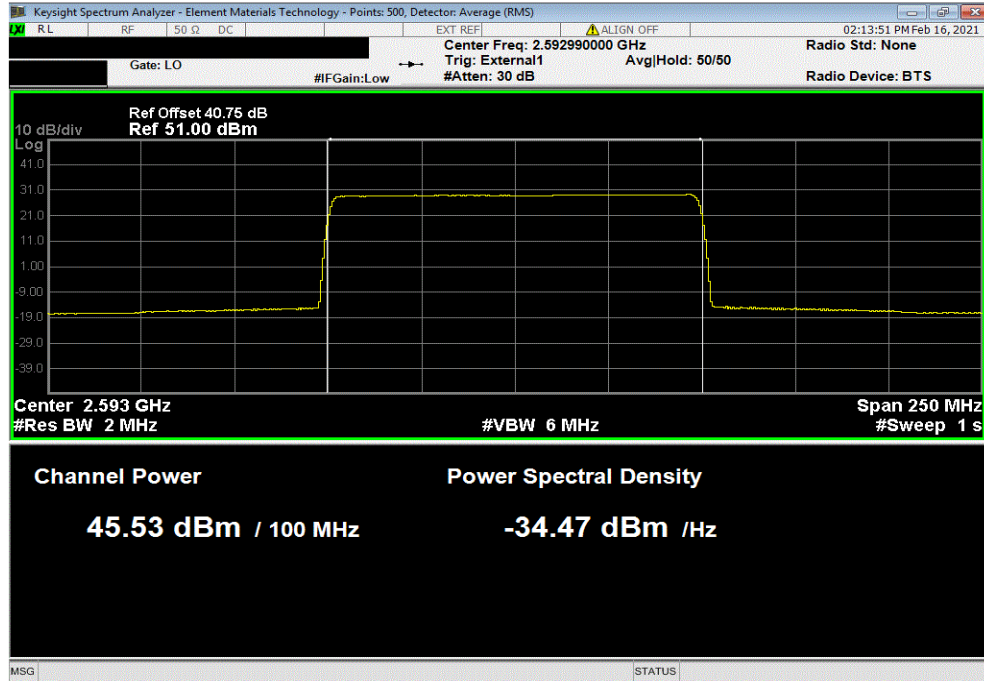


OUTPUT POWER 02 5G & EIRP CALCULATION

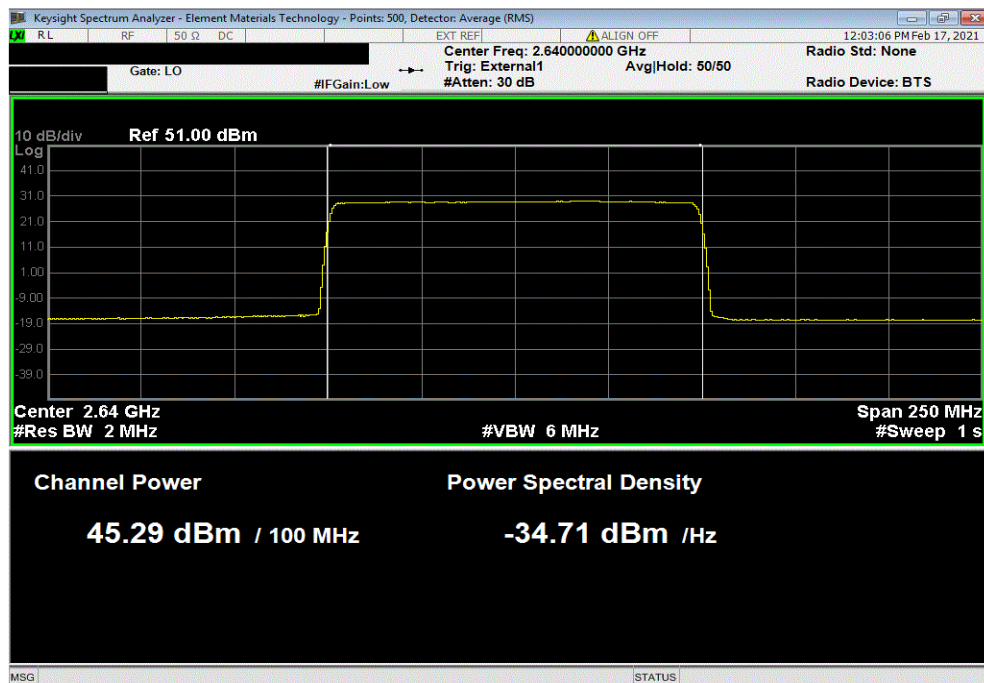


TbTx 2019.08.30.0 XbTx 2020.12.30.0

5G NR, Band n41, 2496 MHz - 2690 MHz, Port 1, NR100 (100MHz), 256QAM, Mid Channel 2592.99 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	
45.53	0	45.53	48.53	51.53	54.53	



5G NR, Band n41, 2496 MHz - 2690 MHz, Port 1, NR100 (100MHz), 256QAM, High Channel 2640 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	
45.293	0	45.293	48.293	51.293	54.293	



OUTPUT POWER 02 5G & EIRP CALCULATION



TbTx 2019.08.30.0 XMt 2020.12.30.0

5G NR EIRP Calculations for Eight Port MIMO Operations

EIRP calculations are needed at each transmitter location to optimize base station operational performance while meeting regulatory requirements. Each cell site installation needs to consider the power measurements in the radio certification report as well as site specific regulatory requirements (such as antenna height, population density, etc.), site installation parameters (line loss between antenna and radio, antenna parameters, etc.) and base station operational parameters (MIMO operational setup, carrier power level, channel bandwidth, modulation type, etc.) to optimize performance. Transmitter output power may be reduced (from maximum) by base station setup parameters. Base station antennas are selected by the customer.

The base station antenna is selected by the customer and this EIRP calculation is based upon a sample worst case antenna. The EIRP calculation is based upon the Commscope Planar Array Antenna model T4-90A-R1-V2. This antenna assembly has four columns with a maximum beamforming gain of 22.3 ± 0.8 dBi. The columns within the antenna have $\pm 45^\circ$ cross-polarized (orthogonal) radiators. The eight AZHL transmitter outputs are connected to the columns (four are connected to $+45^\circ$ radiators/antennas and four are connected to the -45° radiators/antennas). The AZHL provides transmitter outputs for one 4-column antenna.

Equivalent Isotropically Radiated Power (EIRP) is calculated (as specified in ANSI C63.26-2015 section 6.4 for a system of correlated output signals) from the results of power measurements (highest measured average power for each channel bandwidth type). The maximum antenna assembly beamforming gain was used for this calculation. The cable loss between the antenna and transmitter is site dependent (will not be 0 dB) but for this worst case EIRP calculation 0 dB was used. Calculations of worst-case EIRP for eight port MIMO are as follows:

Parameter	20 MHz Ch BW	40 MHz Ch BW	60 MHz Ch BW	80 MHz Ch BW	100 MHz Ch BW
Power Out /Radio Antenna Port	37.5 dBm or 5.62 W	39.8 dBm or 9.55 W	41.4 dBm or 13.8 W	42.7 dBm or 18.6 W	45.7 dBm or 37.2 W
Cable Loss	0 dB	0 dB	0 dB	0 dB	0 dB
Number of Ant Ports per Polarization	4	4	4	4	4
Total Power per Polarization	22.5 Watts or 43.5 dBm	38.2 Watts or 45.8 dBm	55.2 Watts or 47.4 dBm	74.4 Watts or 48.7 dBm	149 Watts or 51.7 dBm
Maximum Antenna Beamforming Gain per Polarization	23.1 dBi	23.1 dBi	23.1 dBi	23.1 dBi	23.1 dBi
EIRP per Polarization	66.6 dBm or 4.57 kW	68.9 dBm or 7.76 kW	70.5 dBm or 11.2 kW	71.8 dBm or 15.1 kW	74.8 dBm or 30.2 kW
Number of Polarizations	2	2	2	2	2
EIRP Total (See Note 1)	66.6 dBm or 4.57 kW	68.9 dBm or 7.76 kW	70.5 dBm or 11.2 kW	71.8 dBm or 15.1 kW	74.8 dBm or 30.2 kW
EIRP Limit Calculation (See Note 2)	79.6 dBm	82.6 dBm	84.4 dBm	85.6 dBm	86.6 dBm

Note 1: The EIRP per antenna polarity is required to be below the regulatory limit as described in ANSI C63.26-2015 section 6.4.6.3 b)2) and KDB 662911 D02v01 page 3 example (2) since the two transmitter outputs to each antenna are 90 degree-phase shifted relative to each other (cross-polarized radiators).

Note 2: The EIRP limit is defined by FCC part 27.50(h)(ii) as $33\text{dBW} + 10\text{Log}(X/Y) \text{ dBW} + 10\text{log}(360/\text{beamwidth}) \text{ dBW}$ where X is the channel width in MHz and Y is 5.5 or 6MHz. The Commscope model T4-90A-R1-V2 antenna has a horizontal beamwidth of 26 degrees. Y was selected to be 6MHz for this calculation.

Calculation Summary

The worst case AZHL eight port MIMO EIRP levels for all 5G NR channel bandwidths using the Commscope antenna assembly model "T4-90A-R1-V2" are less than the FCC regulatory limits.

OUTPUT POWER 03 LTE & EIRP CALCULATION



XMH 2020.03.25.0

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFL	27-Feb-20	27-Feb-21
Generator - Signal	Keysight	N5171B-506	TEW	2-May-18	2-May-21

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The fundamental emission output power (maximum average conducted output power) was measured using the channels and modes as called out on the following data sheets. The transmit power was set to its default maximum.

The method in section 5.2.4.4 of ANSI C63.26 was used to make the measurements. This method uses trace averaging across the ON and OFF times of the EUT transmissions in the spectrum analyzer channel power function using an RMS detector. Following the measurement a duty cycle correction was applied by adding $[10 \log (1/D)]$, where D is the duty cycle in decimal, to the measured power to compute the average power during the actual transmission times.

RF conducted emissions testing was performed only on one port. The AZHL antenna ports are essentially electrically identical (the RF power variation between antenna ports is small as shown during 8 port output power testing) and antenna port 1 was selected to perform the testing under this effort as allowed by ANSI C63.26-2015 paragraphs 5.2.5.3, 5.7.2i and 6.4.

The total average transmit power of all antenna ports was determined per ANSI C63.26-2015 paragraph 6.4.3.1.

The EIRP limit is defined by FCC Part 27.50(h)(ii) as $33\text{dBW} + 10\log(X/Y) \text{ dBW} + 10 \log(360/\text{beamwidth}) \text{ dBW}$ where X is the channel width in MHz and Y is 5.5 or 6MHz. PSD (power/1MHz) measurements are not required for this radio since the FCC limits for EIRP are defined in watts.

OUTPUT POWER 03 LTE & EIRP CALCULATION



TstTx 2019.08.30.0 XMI 2020.12.30.0

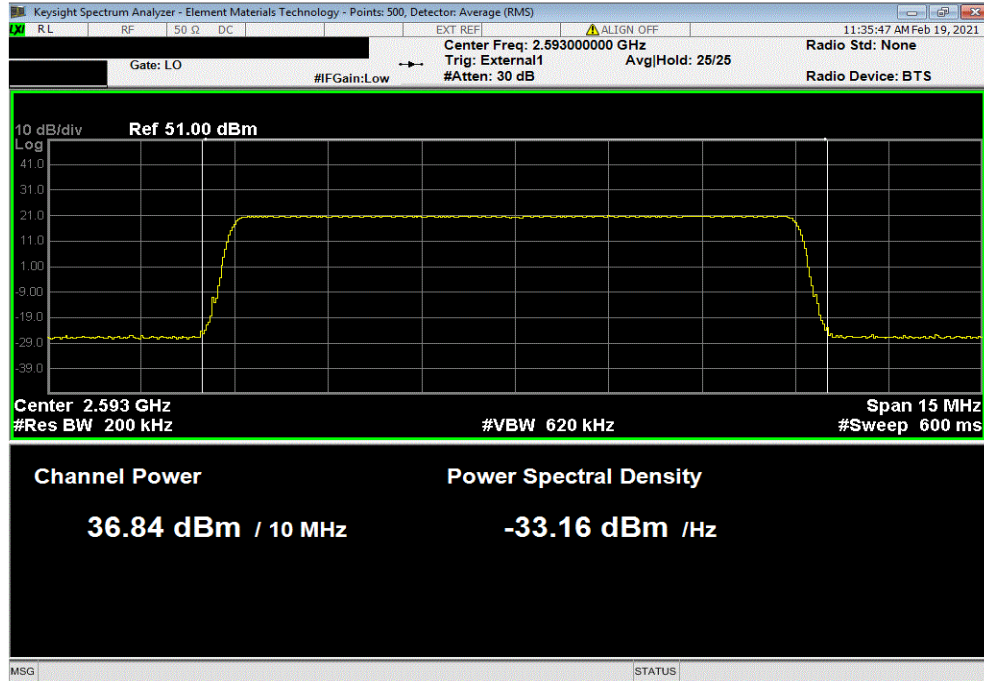
EUT: AZHL		Work Order: NOKI0018	
Serial Number: YK203400016		Date: 22-Feb-21	
Customer: Nokia Solutions and Networks		Temperature: 23.6 °C	
Attendees: John Rattanaovong, Mitchell Hill, David Le		Humidity: 14.9% RH	
Project: None		Barometric Pres.: 1037 mbar	
Tested by: Mark Baytan		Power: 54 VDC	
TEST SPECIFICATIONS		Job Site: TX05	
FCC 27:2021		Test Method	
		ANSI C63.26:2015	
COMMENTS			
External 1 gating was set using a trig delay = 5.0us and a gate length = 6.786ms. Reference level offset adjusted to include (2) coax cables, DC block, and attenuator. The carrier power was set to maximum for all testing. The following is the output power measurements at the radio output ports. The output power was measured for a single carrier channel bandwidth on port 1. The total output power for multiport (2x2 MIMO, 4x4 MIMO and 8x8 MIMO) operation was determined based upon ANSI C63.26 clauses 6.4.3.1 and 6.4.3.2.4 (10 Log Nout). The total output power for two port operation is single port power + 3dB [i.e.: 10 Log(2)]. The total output power for four port operation is single port power + 6dB [i.e.: 10 Log(4)]. The total output power for eight port operation is single port power + 9dB [i.e.: 10 Log(8)].			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	2	Signature	
		Initial Value dBm/Carrier BW	Duty Cycle
		Single Port dBm/Carrier BW	2 Port (2x2 MIMO) dBm/Carrier BW
		4 Port (4x4 MIMO) dBm/Carrier BW	8 Port (8x8 MIMO) dBm/Carrier BW
4G LTE, Band 41, 2496 MHz - 2690 MHz			
Port 1			
LTE10 (10MHz)			
QPSK			
	Mid Channel 2593 MHz	36.842	0
		36.842	39.842
			42.842
			45.842
16QAM			
	Mid Channel 2593 MHz	36.855	0
		36.855	39.855
			42.855
			45.855
64QAM			
	Mid Channel 2593 MHz	36.867	0
		36.867	39.867
			42.867
			45.867
256QAM			
	Low Channel 2501 MHz	36.385	0
	Mid Channel 2593 MHz	36.815	0
	High Channel 2685 MHz	36.607	0
		36.385	39.385
		36.815	39.815
		36.607	39.607
			42.385
			42.815
			42.607
			45.385
			45.815
			45.607
LTE15 (15MHz)			
256QAM			
	Low Channel 2503.5 MHz	36.41	0
	Mid Channel 2593 MHz	36.847	0
	High Channel 2682.5 MHz	36.849	0
		36.41	39.41
		36.847	39.847
		36.849	39.849
			42.41
			42.847
			42.849
			45.41
			45.847
			45.849
LTE20 (20MHz)			
256QAM			
	Low Channel 2506 MHz	36.525	0
	Mid Channel 2593 MHz	36.908	0
	High Channel 2680 MHz	37.105	0
		36.525	39.525
		36.908	39.908
		37.105	40.105
			42.525
			42.908
			43.105
			45.525
			45.908
			46.105

OUTPUT POWER 03 LTE & EIRP CALCULATION

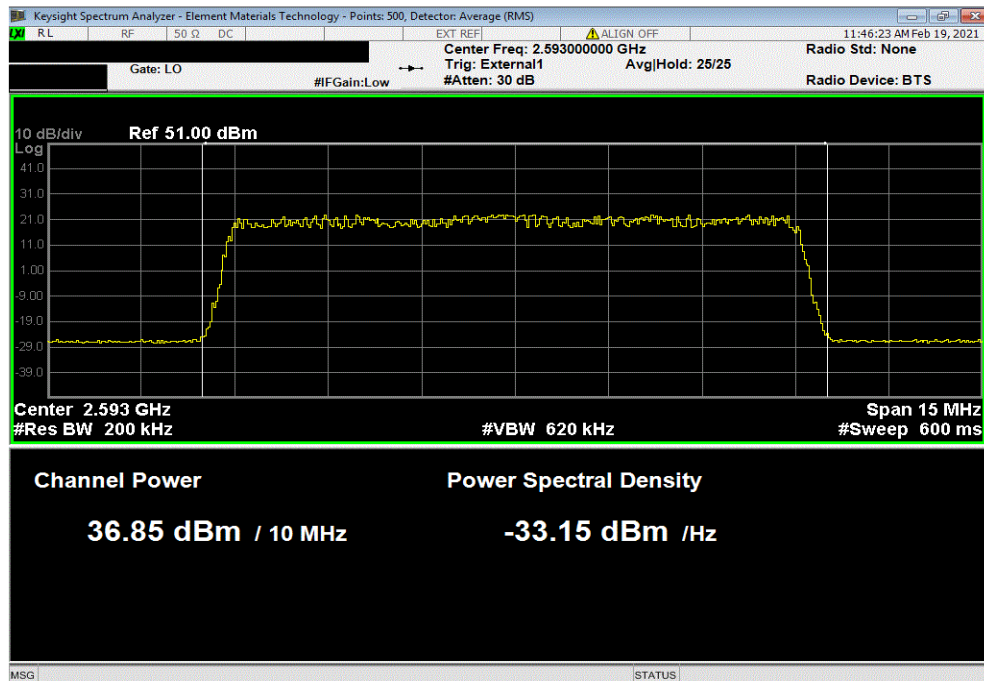


TbTx 2019.08.30.0 XMI 2020.12.30.0

4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE10 (10MHz), QPSK, Mid Channel 2593 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	
36.842	0	36.842	39.842	42.842	45.842	



4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE10 (10MHz), 16QAM, Mid Channel 2593 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	
36.855	0	36.855	39.855	42.855	45.855	

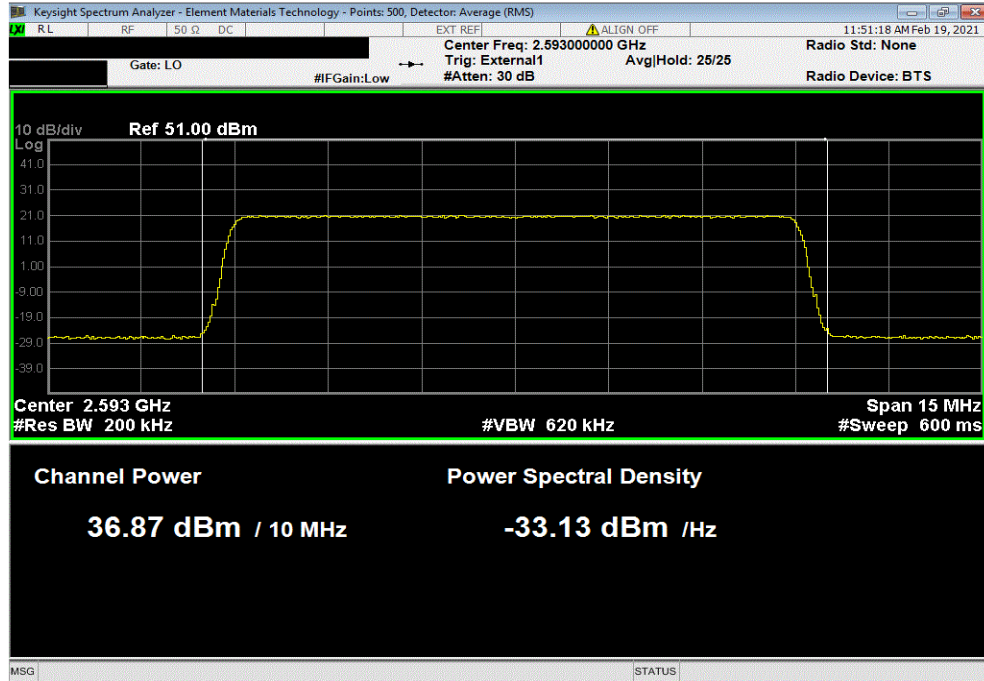


OUTPUT POWER 03 LTE & EIRP CALCULATION

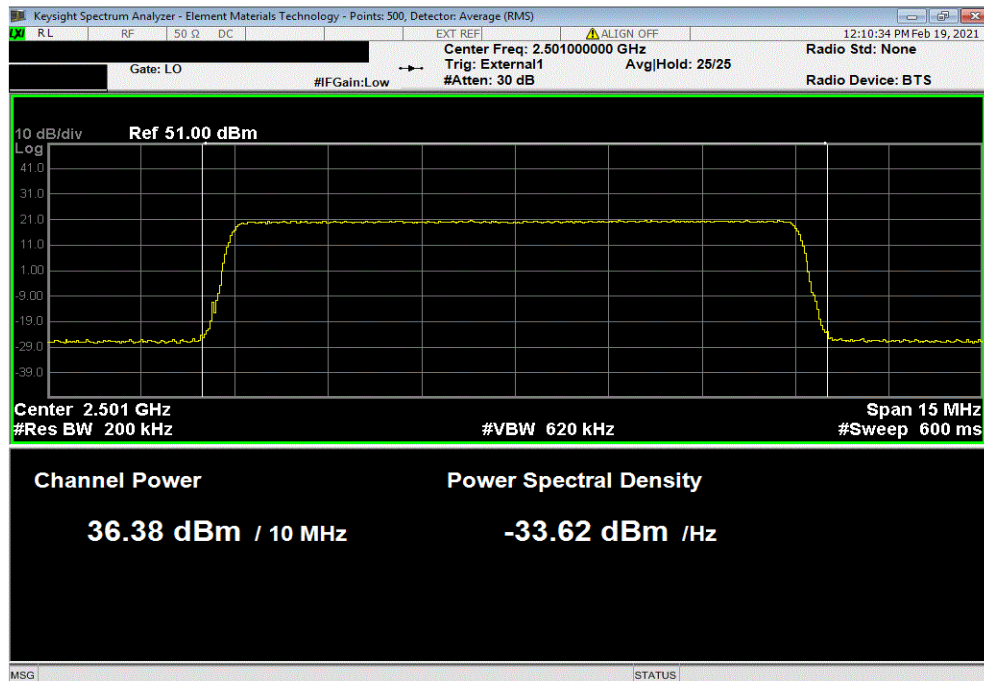


TbTx 2019.08.30.0 XMI 2020.12.30.0

4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE10 (10MHz), 64QAM, Mid Channel 2593 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	
36.867	0	36.867	39.867	42.867	45.867	



4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE10 (10MHz), 256QAM, Low Channel 2501 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	
36.385	0	36.385	39.385	42.385	45.385	

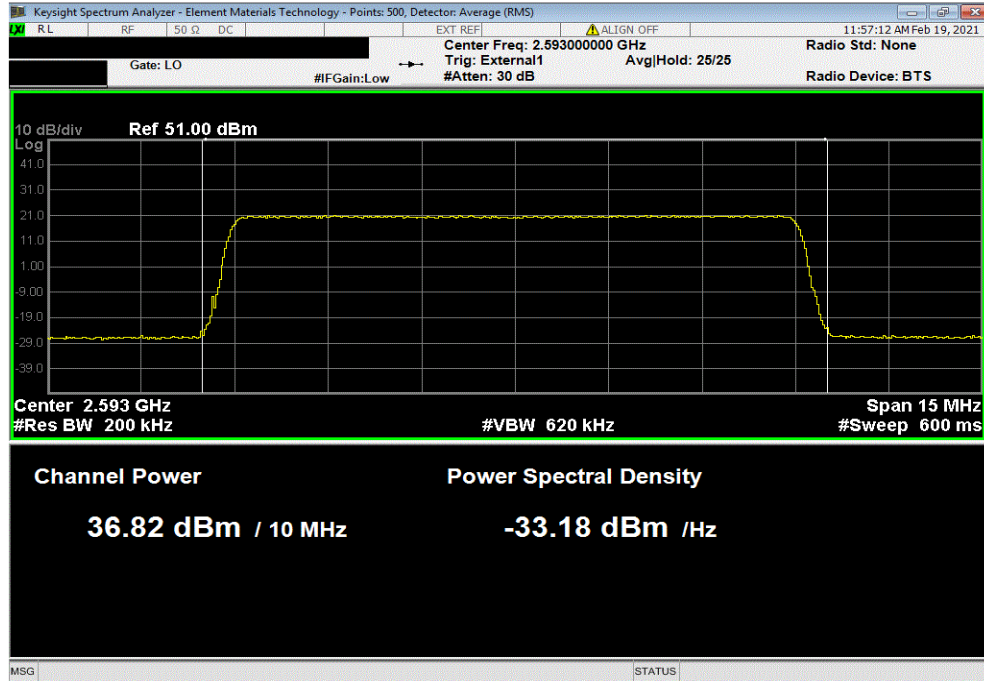


OUTPUT POWER 03 LTE & EIRP CALCULATION

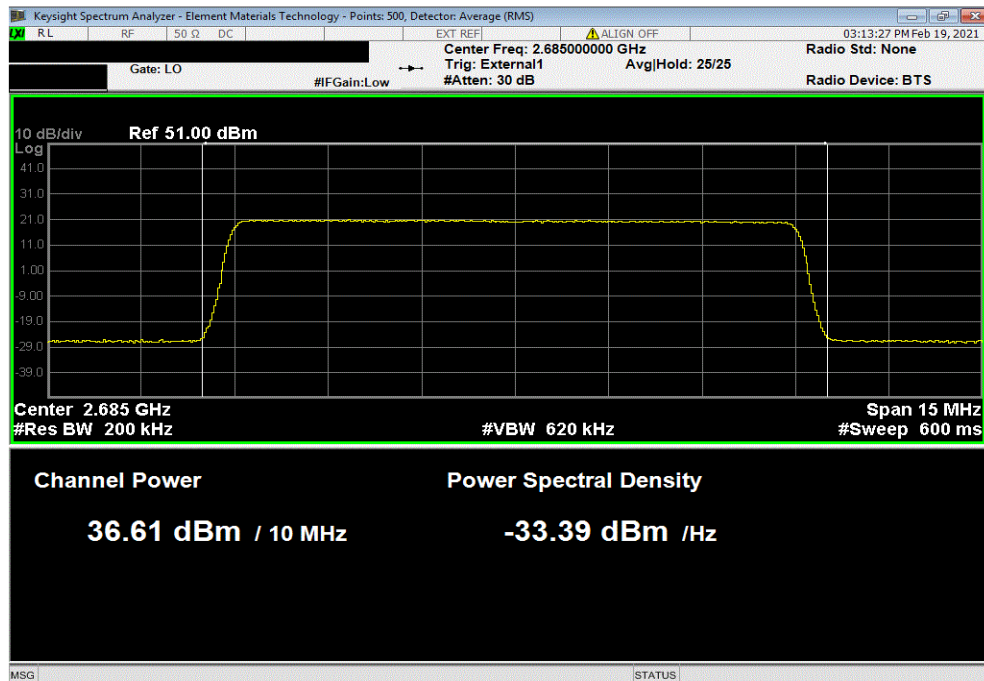


TbTx 2019.08.30.0 XMI 2020.12.30.0

4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE10 (10MHz), 256QAM, Mid Channel 2593 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	
36.815	0	36.815	39.815	42.815	45.815	



4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE10 (10MHz), 256QAM, High Channel 2685 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	
36.607	0	36.607	39.607	42.607	45.607	

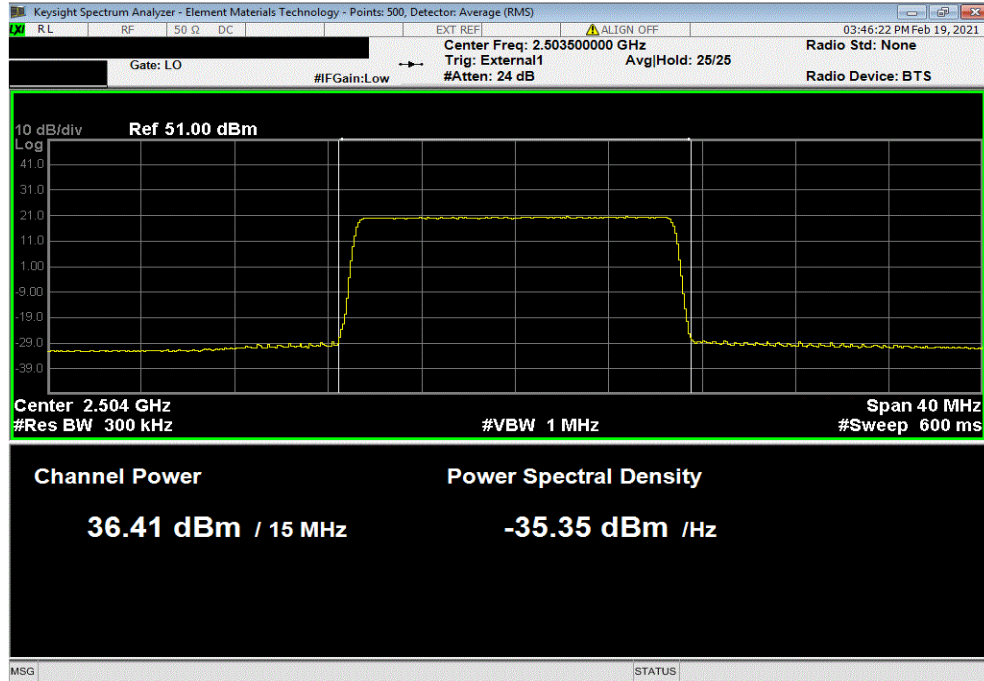


OUTPUT POWER 03 LTE & EIRP CALCULATION

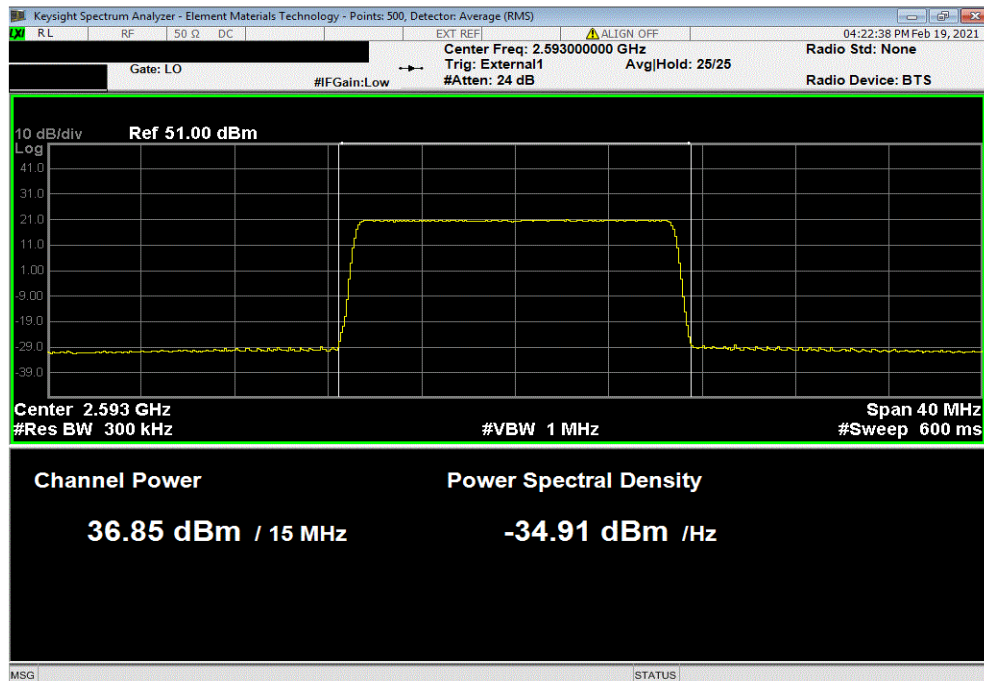


TbTx 2019.08.30.0 XbM 2020.12.30.0

4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE15 (15MHz), 256QAM, Low Channel 2503.5 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	
36.41	0	36.41	39.41	42.41	45.41	



4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE15 (15MHz), 256QAM, Mid Channel 2593 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	
36.847	0	36.847	39.847	42.847	45.847	

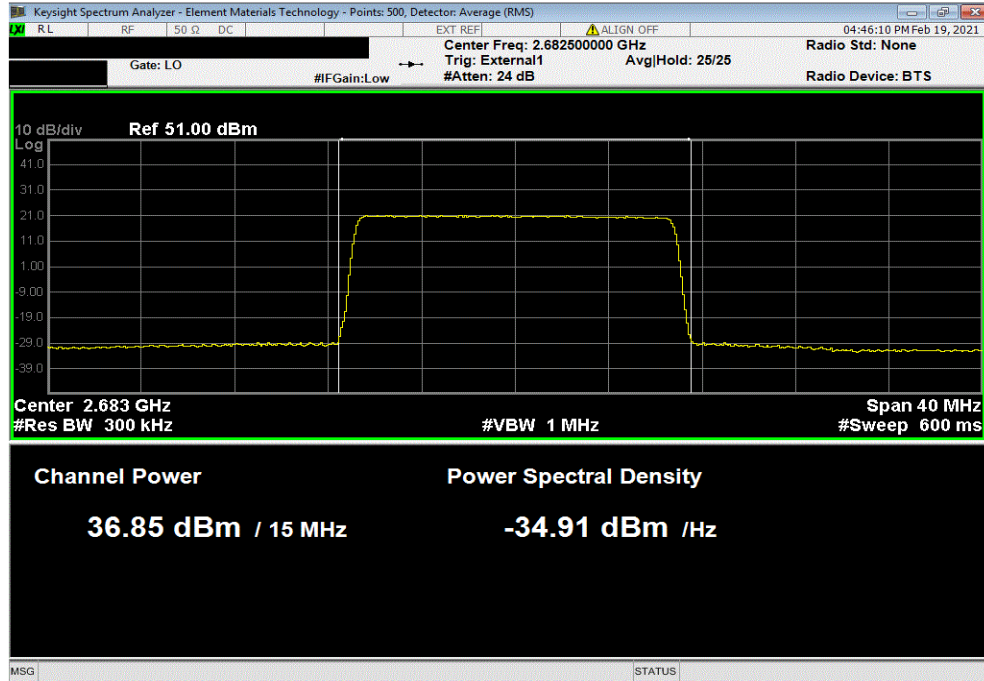


OUTPUT POWER 03 LTE & EIRP CALCULATION

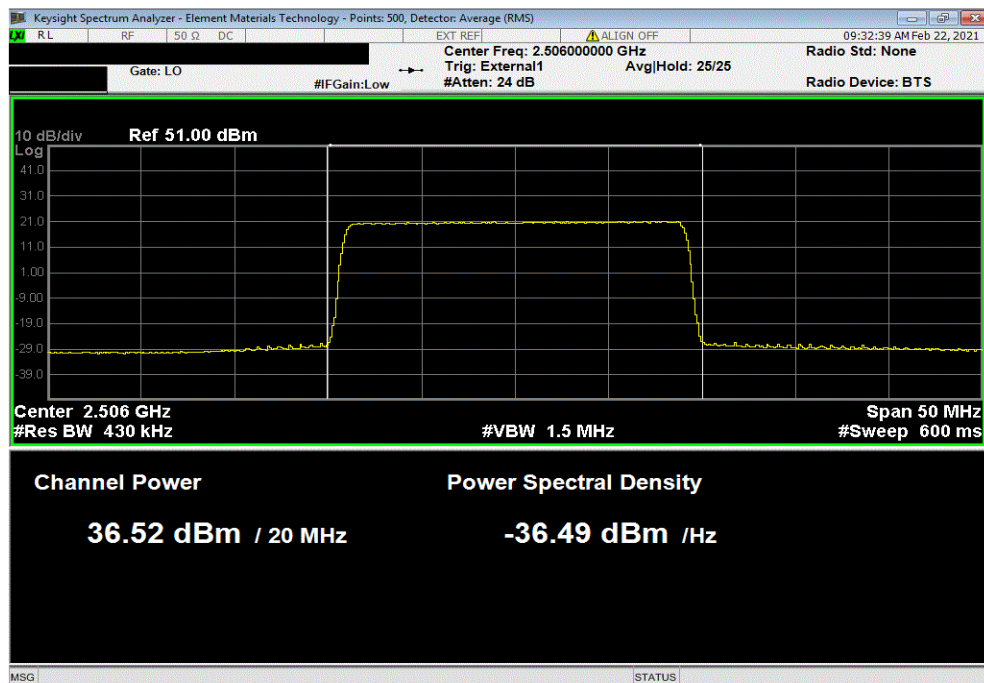


TbTx 2019.08.30.0 XbM 2020.12.30.0

4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE15 (15MHz), 256QAM, High Channel 2682.5 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW
36.849	0	36.849	39.849	42.849	45.849	



4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE20 (20MHz), 256QAM, Low Channel 2506 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW
36.525	0	36.525	39.525	42.525	45.525	

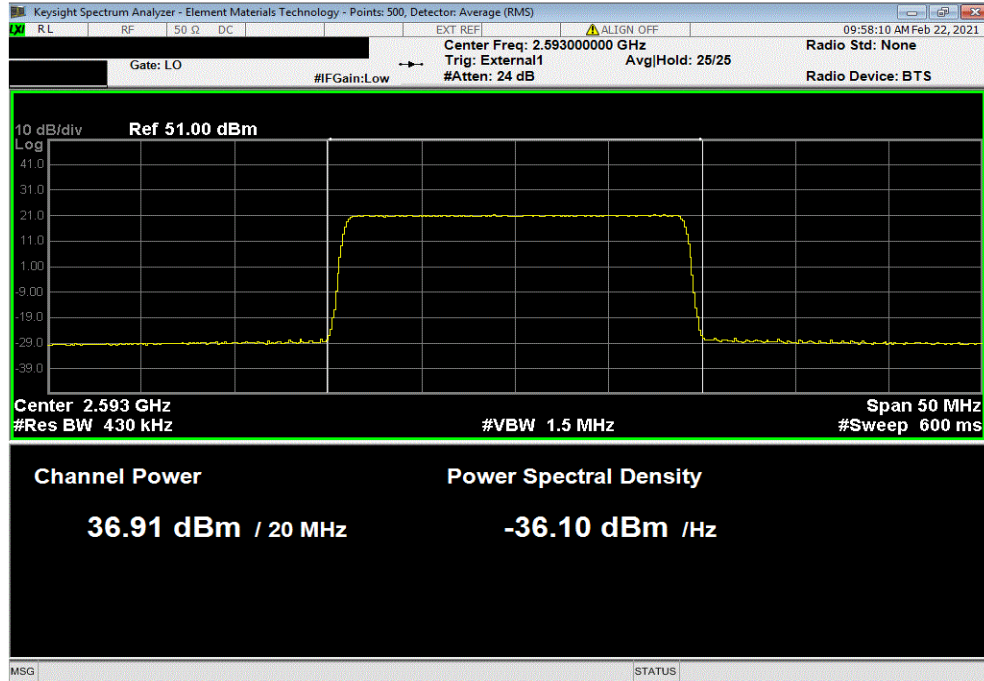


OUTPUT POWER 03 LTE & EIRP CALCULATION

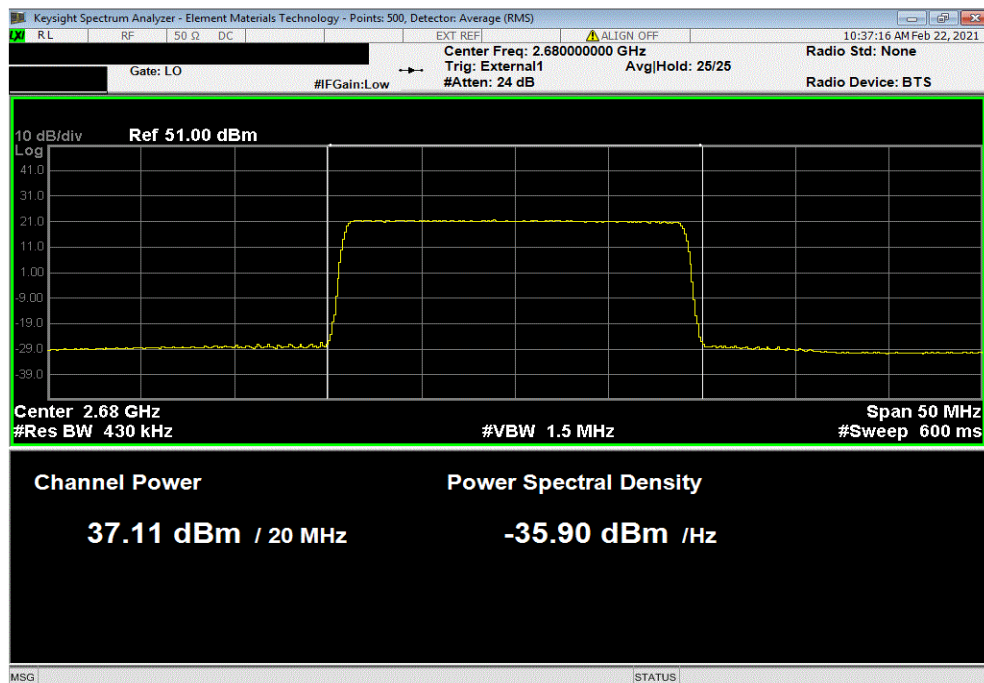


TbTx 2019.08.30.0 XMI 2020.12.30.0

4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE20 (20MHz), 256QAM, Mid Channel 2593 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW
36.908	0	36.908	39.908	42.908	45.908	



4G LTE, Band 41, 2496 MHz - 2690 MHz, Port 1, LTE20 (20MHz), 256QAM, High Channel 2680 MHz						
Initial Value	Duty Cycle	Single Port	Port (2x2 MIMO)	Port (4x4 MIMO)	Port (8x8 MIMO)	
dBm/Carrier BW		dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW	dBm/Carrier BW
37.105	0	37.105	40.105	43.105	46.105	



OUTPUT POWER 03 LTE & EIRP CALCULATION



TbTx 2019.08.30.0 XMt 2020.12.30.0

4G LTE EIRP Calculations for Eight Port MIMO Operations

EIRP calculations are needed at each transmitter location to optimize base station operational performance while meeting regulatory requirements. Each cell site installation needs to consider the power measurements in the radio certification report as well as site specific regulatory requirements (such as antenna height, population density, etc.), site installation parameters (line loss between antenna and radio, antenna parameters, etc.) and base station operational parameters (MIMO operational setup, carrier power level, channel bandwidth, modulation type, etc.) to optimize performance. Transmitter output power may be reduced (from maximum) by base station setup parameters. Base station antennas are selected by the customer.

The base station antenna is selected by the customer and this EIRP calculation is based upon a sample worst case antenna. The EIRP calculation is based upon the Commscope Planar Array Antenna model T4-90A-R1-V2. This antenna assembly has four columns with a maximum beamforming gain of 22.3 ± 0.8 dBi. The columns within the antenna have $\pm 45^\circ$ cross-polarized (orthogonal) radiators. The eight AZHL transmitter outputs are connected to the columns (four are connected to $+45^\circ$ radiators/antennas and four are connected to the -45° radiators/antennas). The AZHL provides transmitter outputs for one 4-column antenna.

Equivalent Isotropically Radiated Power (EIRP) is calculated (as specified in ANSI C63.26-2015 section 6.4 for a system of correlated output signals) from the results of power measurements (highest measured average power for each channel bandwidth type). The maximum antenna assembly beamforming gain was used for this calculation. The cable loss between the antenna and transmitter is site dependent (will not be 0 dB) but for this worst case EIRP calculation 0 dB was used. Calculations of worst-case EIRP for eight port MIMO are as follows:

Parameter	10 MHz Ch BW	15 MHz Ch BW	20 MHz Ch BW
Power Out /Radio Antenna Port	36.9 dBm or 4.90 W	36.9 dBm or 4.90 W	37.1 dBm or 5.13 W
Cable Loss	0 dB	0 dB	0 dB
Number of Ant Ports per Polarization	4	4	4
Total Power per Polarization	19.6 Watts or 42.9 dBm	19.6 Watts or 42.9 dBm	20.5 Watts or 43.1 dBm
Maximum Antenna Beamforming Gain per Polarization	23.1 dBi	23.1 dBi	23.1 dBi
EIRP per Polarization	66.0 dBm or 3.98 kW	66.0 dBm or 3.98 kW	66.2 dBm or 4.17 kW
Number of Polarizations	2	2	2
EIRP Total (See Note 1)	66.0 dBm or 3.98 kW	66.0 dBm or 3.98 kW	66.2 dBm or 4.17 kW
EIRP Limit Calculation (See Note 2)	76.6 dBm	78.4 dBm	79.6 dBm

Note 1: The EIRP per antenna polarity is required to be below the regulatory limit as described in ANSI C63.26-2015 section 6.4.6.3 b)2) and KDB 662911 D02v01 page 3 example (2) since the two transmitter outputs to each antenna are 90 degree-phase shifted relative to each other (cross-polarized radiators).

Note 2: The EIRP limit is defined by FCC part 27.50(h)(ii) as $33\text{dBW} + 10\text{Log}(X/Y)$ dBW + $10\text{log}(360/\text{beamwidth})$ dBW where X is the channel width in MHz and Y is 5.5 or 6MHz. The Commscope model T4-90A-R1-V2 antenna has a horizontal beamwidth of 26 degrees. Y was selected to be 6MHz for this calculation.

Calculation Summary

The worst case AZHL eight port MIMO EIRP levels for all 4G LTE channel bandwidths using the Commscope antenna assembly model "T4-90A-R1-V2" are less than the FCC regulatory limits.