# POWER SPECTRAL DENSITY - 2 PORT MODE

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 |
| Block - DC | Fairview Microwave | SD3379 | AMM | 21-Sep-20 | 21-Sep-21 |
| Generator - Signal | Agilent | N5173B | TIW | 17-Jul-20 | 17-Jul-23 |

**TEST DESCRIPTION**

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The fundamental emission power spectral density 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 of section 5.2.4.5 of ANSI C63.26 was used to make the measurement. The method uses trace averaging across ON and OFF times of EUT transmissions using the spectrum analyzer's RMS detector. Following the measurement a duty cycle correction was applied by adding [10log(1/D)], where D is the duty cycle, to the measured power to compute the PSD during the transmit times.

RF conducted emissions testing was performed on one port. The FRIG antenna ports are essentially electrically identical (the RF power variation between antenna ports is small) and 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 PSD of all antenna ports (at the radio output) was determined per ANSI C63.26-2015 paragraph 6.4.3.2.4.

The EIRP calculations were based upon ANSI C63.26-2015 sections 6.4.3.2.4, section 6.4.6.3, section 6.4.5.3 and section 6.4.5.2

The applicable FCC and ISED regulatory requirements for EIRP are as follows.
FCC Requirements:
27.50(d) The following power and antenna height requirements apply to stations transmitting in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz and 2180-2200 MHz bands:
(1) The power of each fixed or base station transmitting in the 1995-2000 MHz, 2110-2155 MHz, 2155-2180 MHz or 2180-2200 MHz band and located in any county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, is limited to:
(ii) An EIRP of 3280 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.Ð2) The power of each fixed or base station transmitting in the 1995-2000 MHz, the 2110-2155 MHz 2155-2180 MHz band, or 2180-2200 MHz band and situated in any geographic location other than that described in paragraph (d)(1) of this section is limited to:
(ii) An EIRP of 1640 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.
ISED Requirements RSS-139 Section 6.5/SRSP-513 Section 5.1.1
SRSP-513 5.1 Radiated Power and Antenna Height Limits
5.1.1 Fixed and Base Stations
5.1.1.2 For fixed and base stations operating within the frequency range 2110-2180 MHz with a channel bandwidth greater than 1 MHz, the maximum permissible e.i.r.p. is 1640 watts/MHz e.i.r.p. (i.e. no more than 1640 watts e.i.r.p. in any 1 MHz band segment) with an antenna height above average terrain (HAAT) up to 300 metres.
5.1.1.3 Fixed and base stations located in geographic areas at a distance greater than 26 km from large or medium population centres and transmitting within the frequency range 2110-2180 MHz, may increase their e.i.r.p. up to a maximum of 3280 watts/MHz (i.e. no more than 3280 watts e.i.r.p. in any 1 MHz band segment), with an antenna HAAT up to 300 metres. …….
5.1.1.4 Fixed and base station antenna heights above average terrain may exceed 300 metres with a reduction in e.i.r.p. The maximum permissible e.i.r.p. for installations with antenna HAAT in excess of 300 metres is given in the following table:

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| | | | |
|---|---|---|---|
| EUT: | FRIG (C2PC FCC/ISED Approval for 5G) | Work Order: | NOKI0025 |
| Serial Number: | RY142309120 | Date: | 2-Dec-20 |
| Customer: | Nokia Solutions and Networks | Temperature: | 24.2 °C |
| Attendees: | Mitchell Hill, John Rattanavong | Humidity: | 29.3% RH |
| Project: | None | Barometric Pres.: | 1021 mbar |
| Tested by: | Brandon Hobbs | Power: 54 VDC | Job Site: TX05 |

| TEST SPECIFICATIONS | Test Method |
|---|---|
| FCC 27:2020 | ANSI C63.26:2015 |
| RSS-139:2015 | RSS-139:2015 |

**COMMENTS**

All measurement path losses were accounted for in the reference level offest including any attenuators, filters and DC blocks. AWS Band 1 carriers are enabled at maximum power (60 watts/carrier). The PSD was measured for a single carrier over the carrier channel bandwidth on port 1. The total PSD for multiport (2x2 MIMO) operation was determined based upon ANSI 63.26 clause 6.4.3.2.4 (10 log Nout). The total PSD for two port operation is single port PSD + 3dB [i.e. 10log(2)].

**DEVIATIONS FROM TEST STANDARD**

None

| Configuration # | 2 | Signature |
|---|---|---|

| | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD |
|---|---|---|---|---|
| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz | | | | |
| 5 MHz Bandwidth | | | | |
| QPSK Modulation | | | | |
| Low Channel 2112.5 MHz | 41.579 | 0 | 41.58 | 44.58 |
| Mid Channel 2132.5 MHz | 41.606 | 0 | 41.61 | 44.61 |
| High Channel 2152.5 MHz | 41.648 | 0 | 41.65 | 44.65 |
| 16-QAM Modulation | | | | |
| Low Channel 2112.5 MHz | 41.606 | 0 | 41.61 | 44.61 |
| Mid Channel 2132.5 MHz | 41.604 | 0 | 41.60 | 44.60 |
| High Channel 2152.5 MHz | 41.693 | 0 | 41.69 | 44.69 |
| 64-QAM Modulation | | | | |
| Low Channel 2112.5 MHz | 41.610 | 0 | 41.61 | 44.61 |
| Mid Channel 2132.5 MHz | 41.647 | 0 | 41.65 | 44.65 |
| High Channel 2152.5 MHz | 41.646 | 0 | 41.65 | 44.65 |
| 256-QAM Modulation | | | | |
| Low Channel 2112.5 MHz | 41.519 | 0 | 41.52 | 44.52 |
| Mid Channel 2132.5 MHz | 41.539 | 0 | 41.54 | 44.54 |
| High Channel 2152.5 MHz | 41.456 | 0 | 41.46 | 44.46 |
| 10 MHz Bandwidth | | | | |
| QPSK Modulation | | | | |
| Low Channel 2115 MHz | 38.371 | 0 | 38.37 | 41.37 |
| Mid Channel 2132.5 MHz | 38.488 | 0 | 38.49 | 41.49 |
| High Channel 2150 MHz | 38.515 | 0 | 38.52 | 41.52 |
| 16-QAM Modulation | | | | |
| Low Channel 2115 MHz | 39.118 | 0 | 39.12 | 42.12 |
| Mid Channel 2132.5 MHz | 39.250 | 0 | 39.25 | 42.25 |
| High Channel 2150 MHz | 39.169 | 0 | 39.17 | 42.17 |
| 64-QAM Modulation | | | | |
| Low Channel 2115 MHz | 38.496 | 0 | 38.50 | 41.50 |
| Mid Channel 2132.5 MHz | 38.761 | 0 | 38.76 | 41.76 |
| High Channel 2150 MHz | 38.590 | 0 | 38.59 | 41.59 |
| 256-QAM Modulation | | | | |
| Low Channel 2115 MHz | 38.431 | 0 | 38.43 | 41.43 |
| Mid Channel 2132.5 MHz | 38.628 | 0 | 38.63 | 41.63 |
| High Channel 2150 MHz | 38.479 | 0 | 38.48 | 41.48 |
| 15 MHz Bandwidth | | | | |
| QPSK Modulation | | | | |
| Low Channel 2117.5 MHz | 36.449 | 0 | 36.45 | 39.45 |
| Mid Channel 2132.5 MHz | 36.702 | 0 | 36.70 | 39.70 |
| High Channel 2147.5 MHz | 36.673 | 0 | 36.67 | 39.67 |
| 16-QAM Modulation | | | | |
| Low Channel 2117.5 MHz | 37.975 | 0 | 37.98 | 40.98 |
| Mid Channel 2132.5 MHz | 38.162 | 0 | 38.16 | 41.16 |
| High Channel 2147.5 MHz | 38.128 | 0 | 38.13 | 41.13 |
| 64-QAM Modulation | | | | |
| Low Channel 2117.5 MHz | 36.517 | 0 | 36.52 | 39.52 |
| Mid Channel 2132.5 MHz | 36.814 | 0 | 36.81 | 39.81 |
| High Channel 2147.5 MHz | 36.810 | 0 | 36.81 | 39.81 |
| 256-QAM Modulation | | | | |
| Low Channel 2117.5 MHz | 36.505 | 0 | 36.51 | 39.51 |
| Mid Channel 2132.5 MHz | 36.781 | 0 | 36.78 | 39.78 |
| High Channel 2147.5 MHz | 36.760 | 0 | 36.76 | 39.76 |
| 20 MHz Bandwidth | | | | |
| QPSK Modulation | | | | |
| Low Channel 2120 MHz | 35.259 | 0 | 35.26 | 38.26 |
| Mid Channel 2132.5 MHz | 35.532 | 0 | 35.53 | 38.53 |
| High Channel 2145 MHz | 35.490 | 0 | 35.49 | 38.49 |
| 16-QAM Modulation | | | | |
| Low Channel 2120 MHz | 36.886 | 0 | 36.89 | 39.89 |
| Mid Channel 2132.5 MHz | 37.141 | 0 | 37.14 | 40.14 |
| High Channel 2145 MHz | 37.139 | 0 | 37.14 | 40.14 |
| 64-QAM Modulation | | | | |
| Low Channel 2120 MHz | 35.487 | 0 | 35.49 | 38.49 |
| Mid Channel 2132.5 MHz | 35.514 | 0 | 35.51 | 38.51 |
| High Channel 2145 MHz | 35.677 | 0 | 35.68 | 38.68 |
| 256-QAM Modulation | | | | |
| Low Channel 2120 MHz | 35.405 | 0 | 35.41 | 38.41 |
| Mid Channel 2132.5 MHz | 35.591 | 0 | 35.59 | 38.59 |
| High Channel 2145 MHz | 35.718 | 0 | 35.72 | 38.72 |

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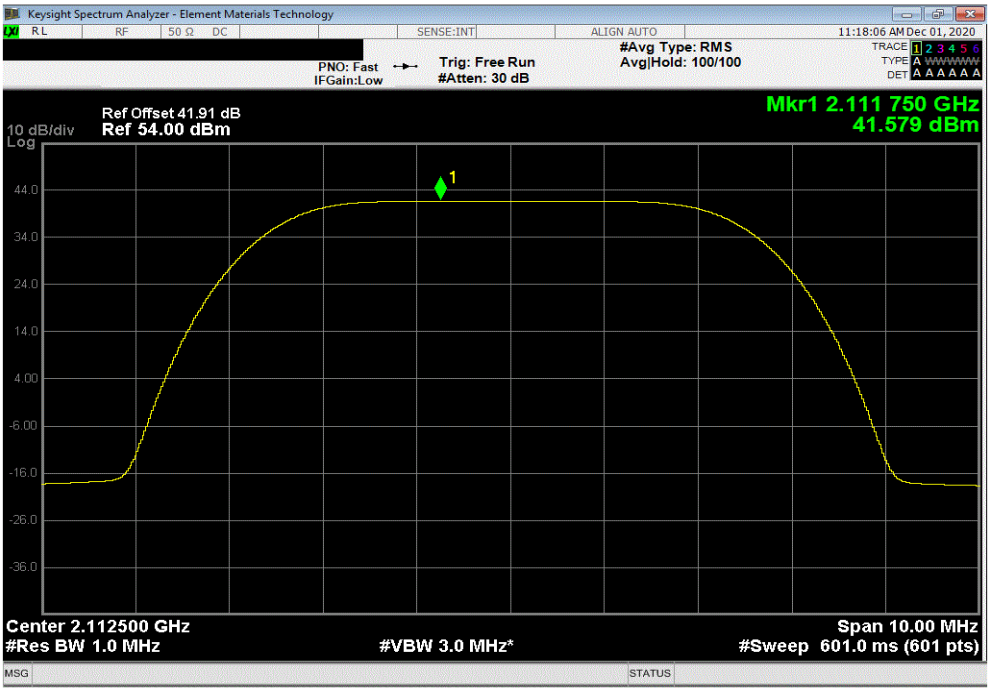
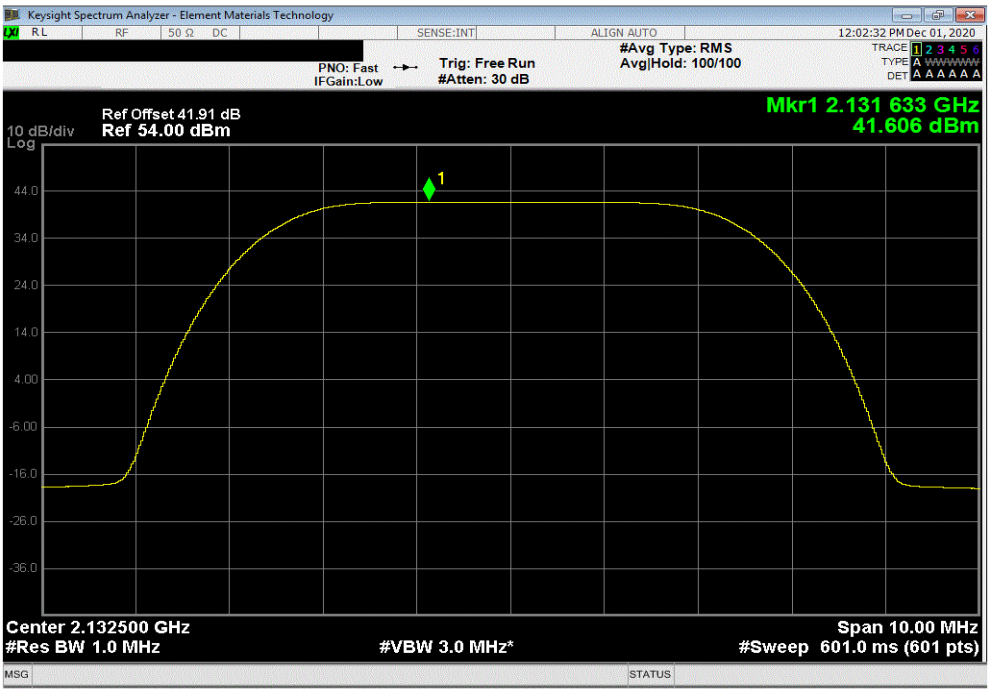
| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 5 MHz Bandwidth , QPSK Modulation, Low Channel 2112.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 41.579 | 0 | 41.6 | 44.6 | |



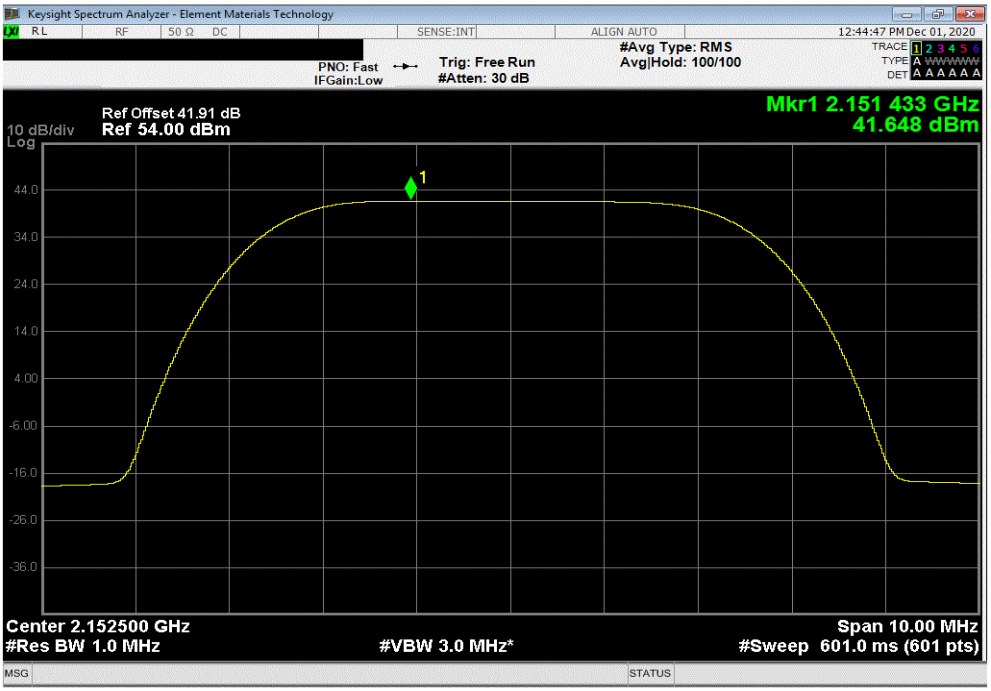

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 5 MHz Bandwidth , QPSK Modulation, Mid Channel 2132.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 41.606 | 0 | 41.6 | 44.6 | |



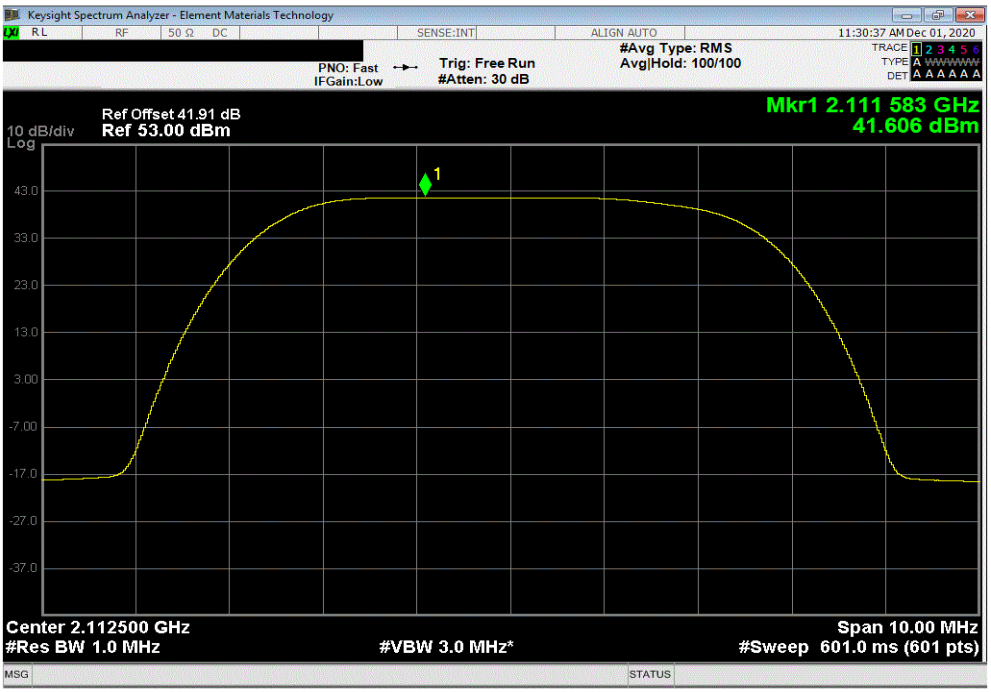
# POWER SPECTRAL DENSITY - 2 PORT MODE

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 5 MHz Bandwidth , QPSK Modulation, High Channel 2152.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 41.648 | 0 | 41.6 | 44.6 | |



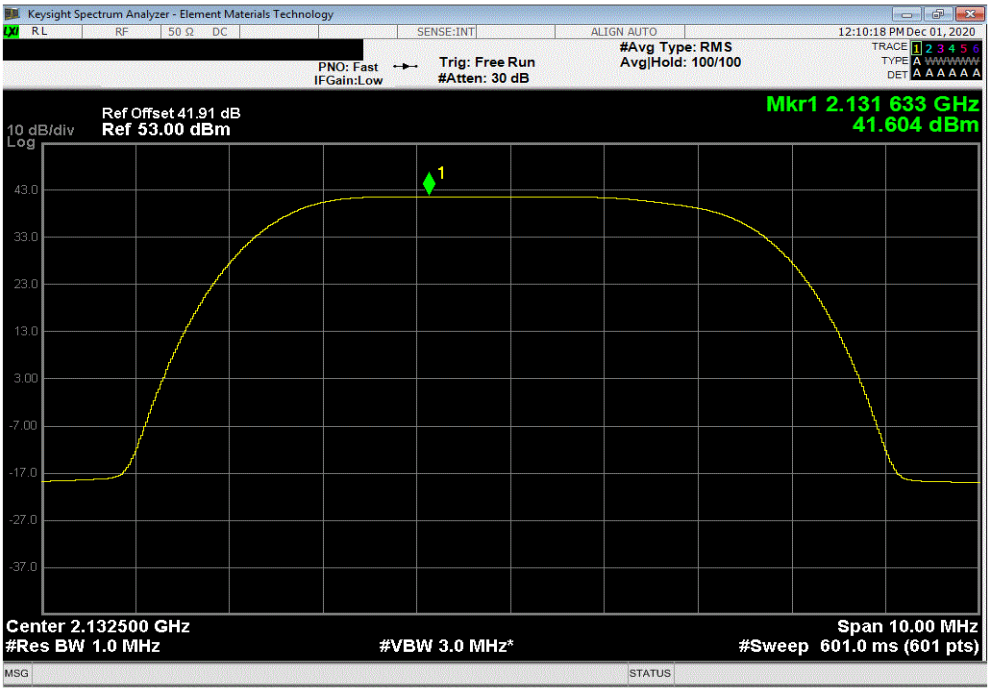

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 5 MHz Bandwidth , 16-QAM Modulation, Low Channel 2112.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 41.606 | 0 | 41.6 | 44.6 | |



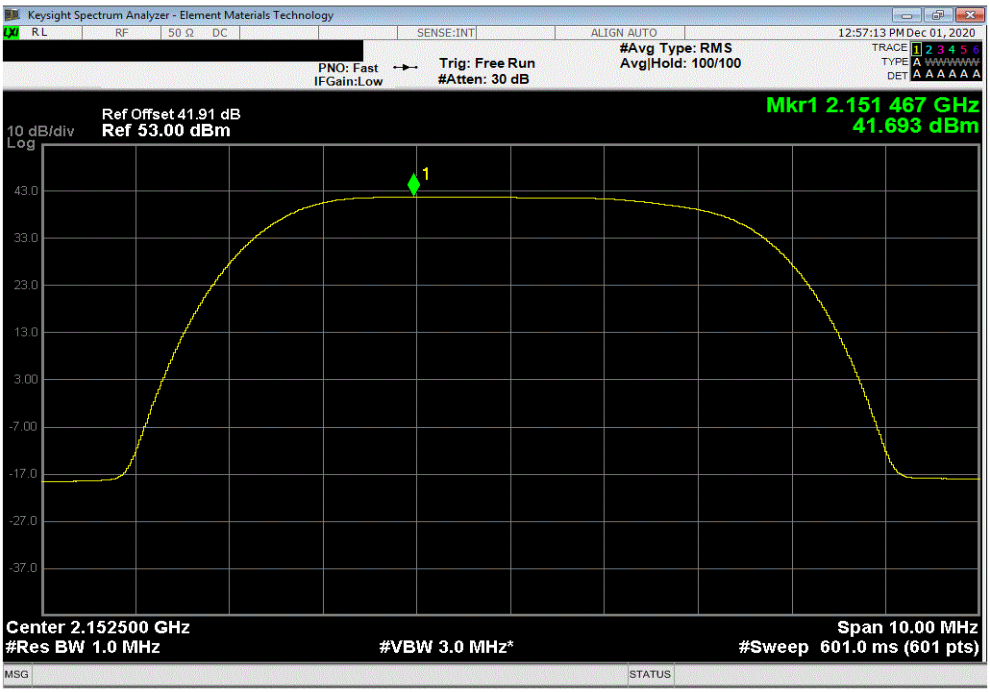
# POWER SPECTRAL DENSITY - 2 PORT MODE

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 5 MHz Bandwidth , 16-QAM Modulation, Mid Channel 2132.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 41.604 | 0 | 41.6 | 44.6 | |



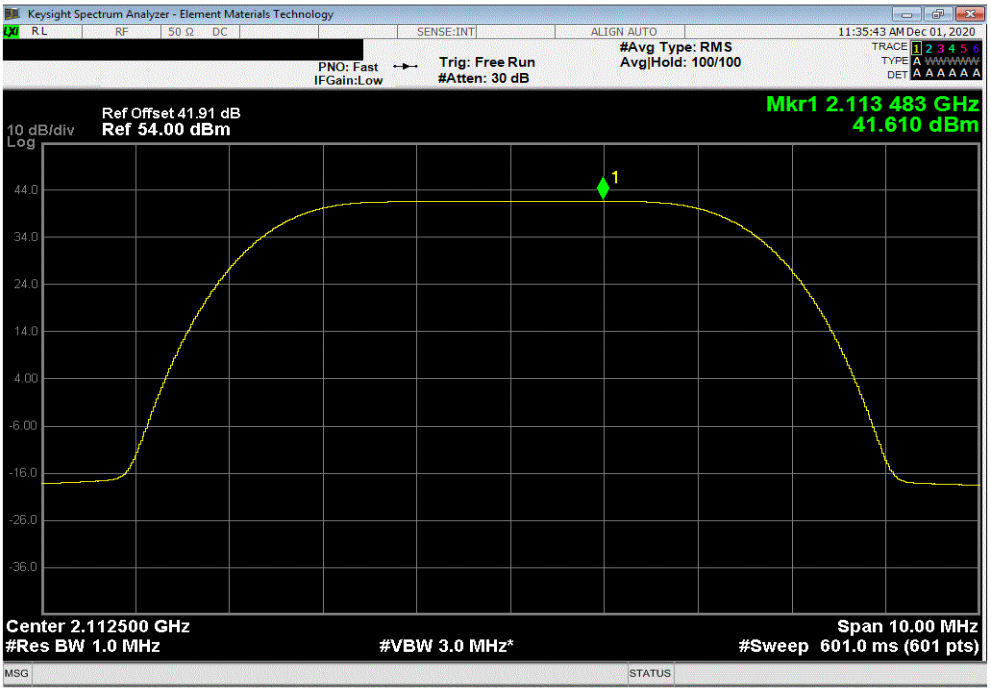

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 5 MHz Bandwidth , 16-QAM Modulation, High Channel 2152.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 41.693 | 0 | 41.7 | 44.7 | |



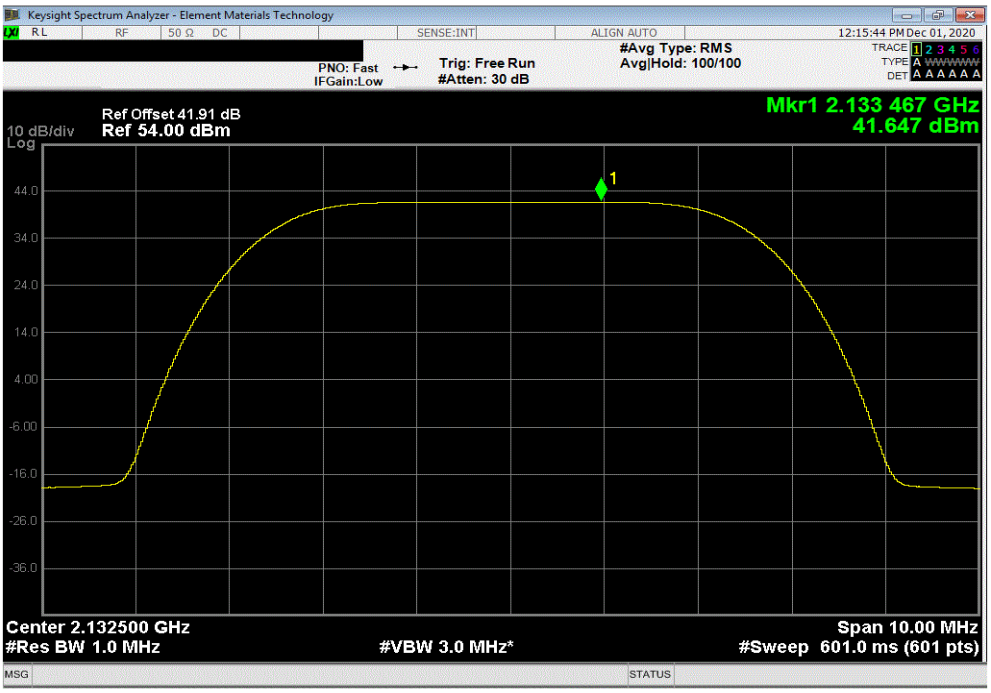
# POWER SPECTRAL DENSITY - 2 PORT MODE

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 5 MHz Bandwidth , 64-QAM Modulation, Low Channel 2112.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 41.61 | 0 | 41.6 | 44.6 | |




| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 5 MHz Bandwidth , 64-QAM Modulation, Mid Channel 2132.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 41.647 | 0 | 41.6 | 44.6 | |



# POWER SPECTRAL DENSITY - 2 PORT MODE

element

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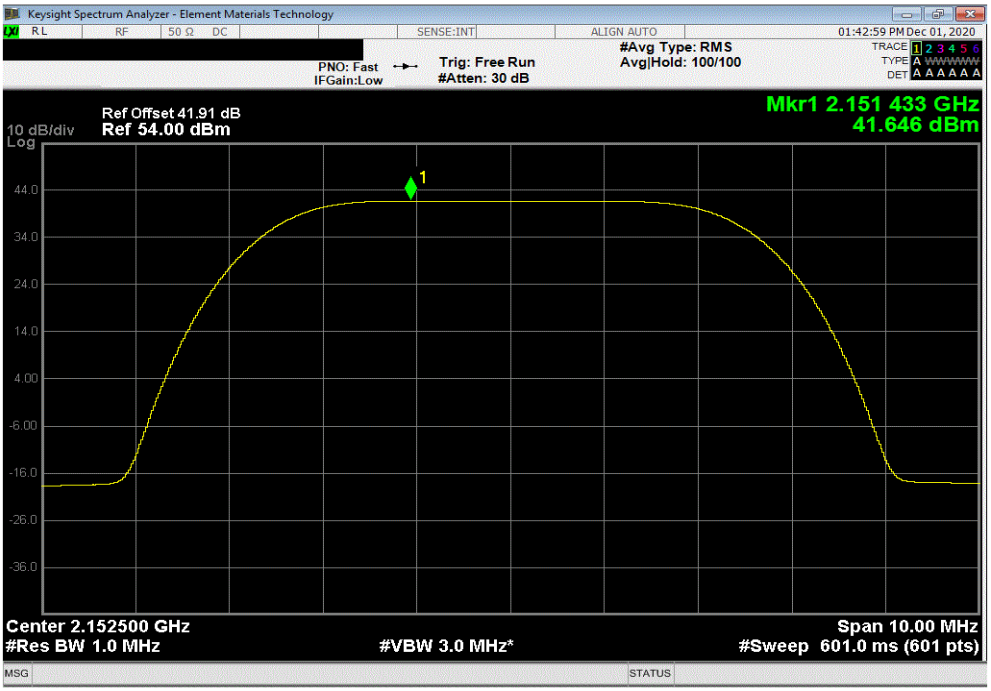
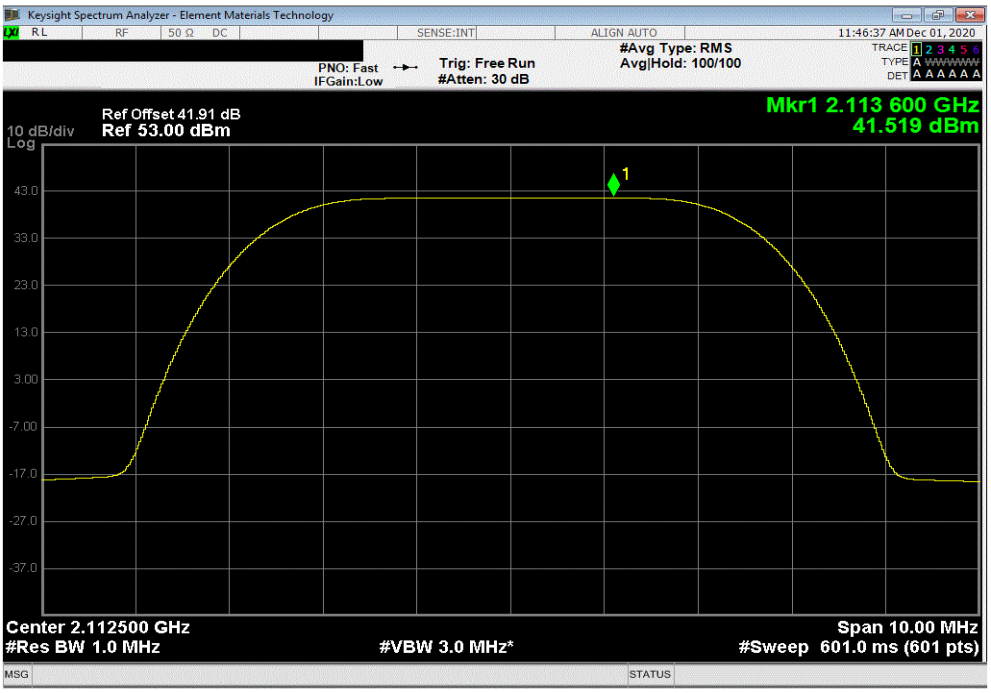
| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 5 MHz Bandwidth , 64-QAM Modulation, High Channel 2152.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 41.646 | 0 | 41.6 | 44.6 | |



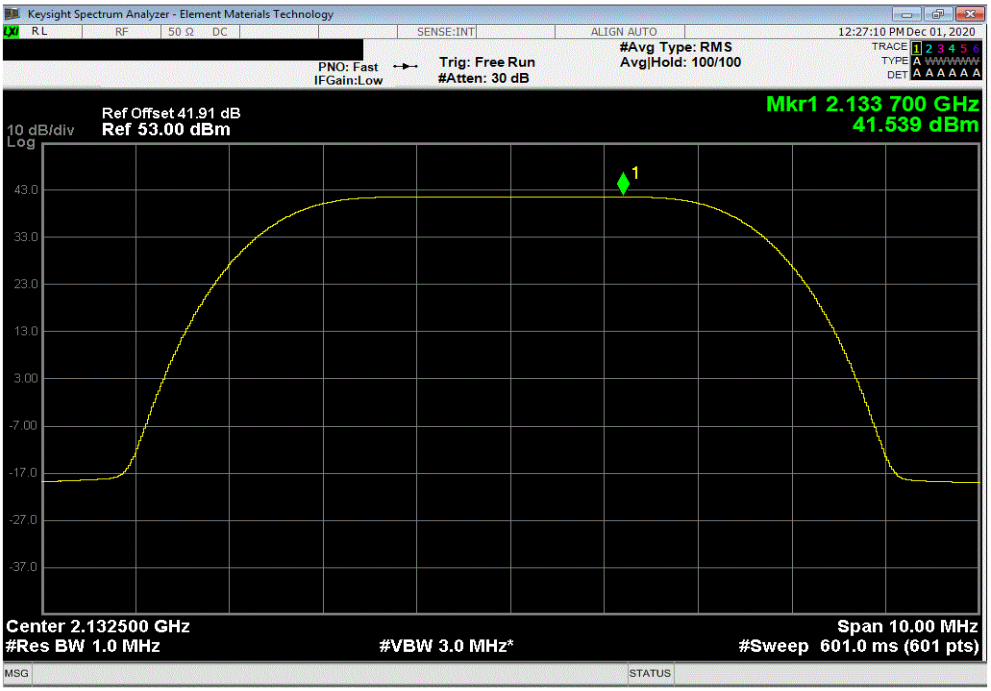

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 5 MHz Bandwidth , 256-QAM Modulation, Low Channel 2112.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 41.519 | 0 | 41.5 | 44.5 | |



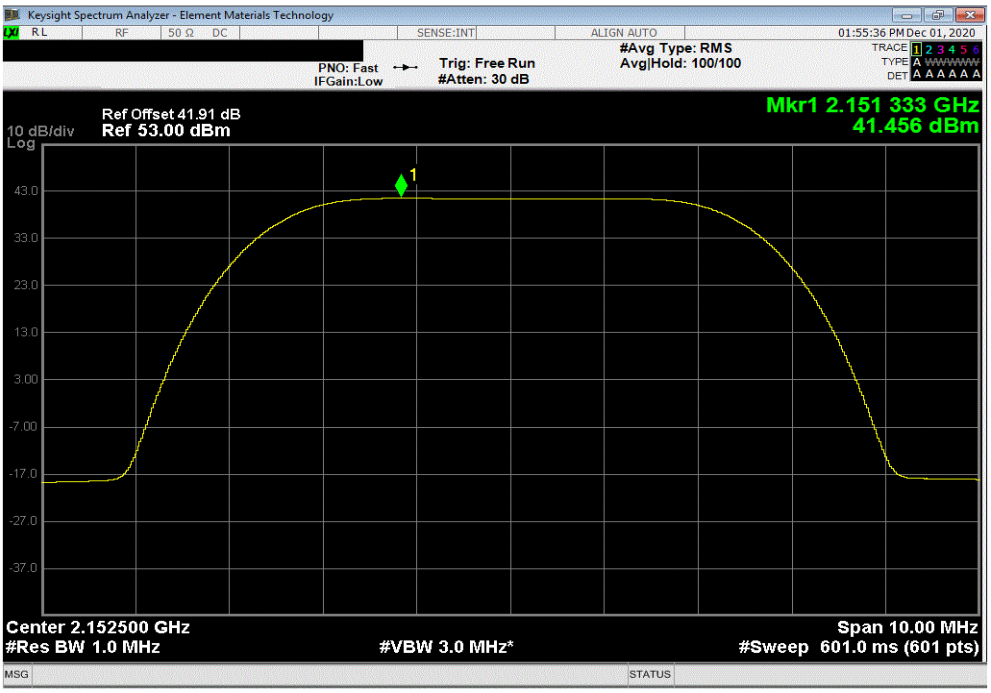
# POWER SPECTRAL DENSITY - 2 PORT MODE

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 5 MHz Bandwidth , 256-QAM Modulation, Mid Channel 2132.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 41.539 | 0 | 41.5 | 44.5 | |




| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 5 MHz Bandwidth , 256-QAM Modulation, High Channel 2152.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 41.456 | 0 | 41.5 | 44.5 | |



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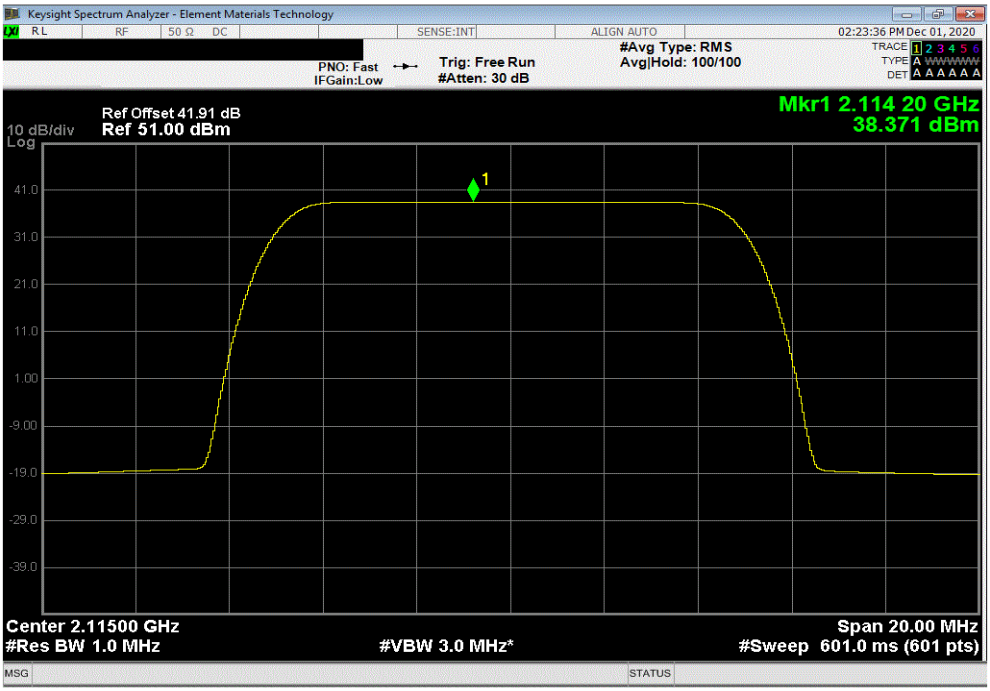
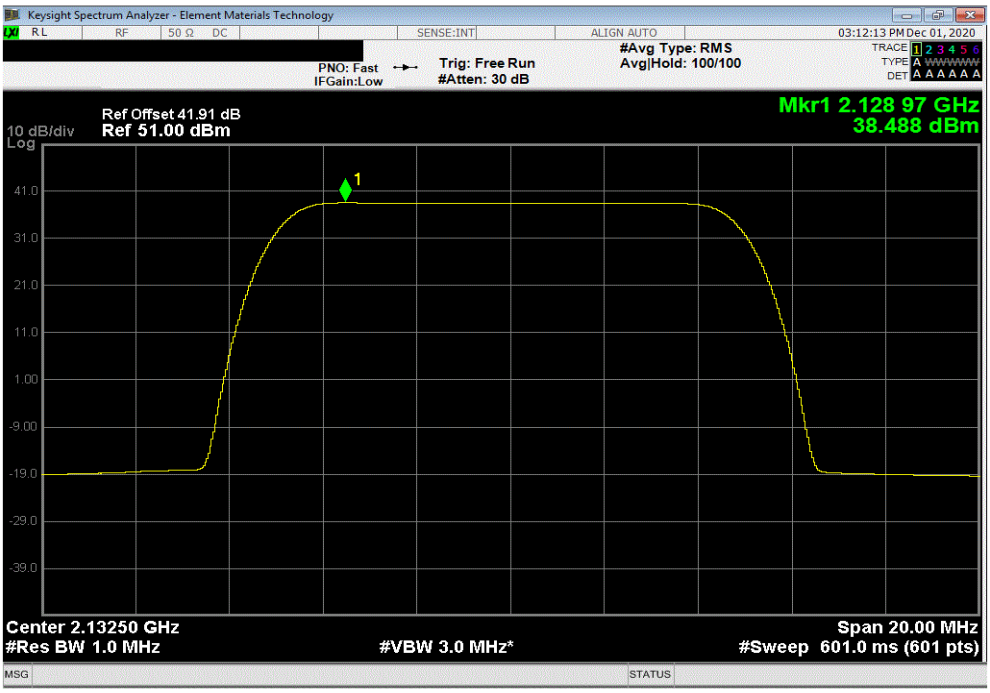
| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 10 MHz Bandwidth , QPSK Modulation, Low Channel 2115 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 38.371 | 0 | 38.4 | 41.4 | |




| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 10 MHz Bandwidth , QPSK Modulation, Mid Channel 2132.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 38.488 | 0 | 38.5 | 41.5 | |



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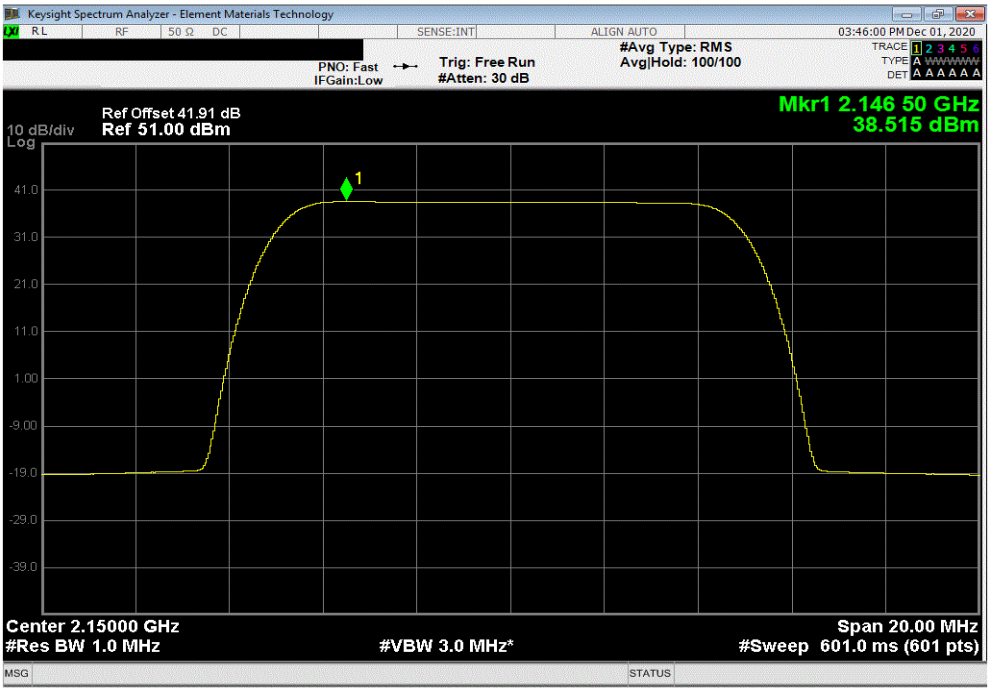
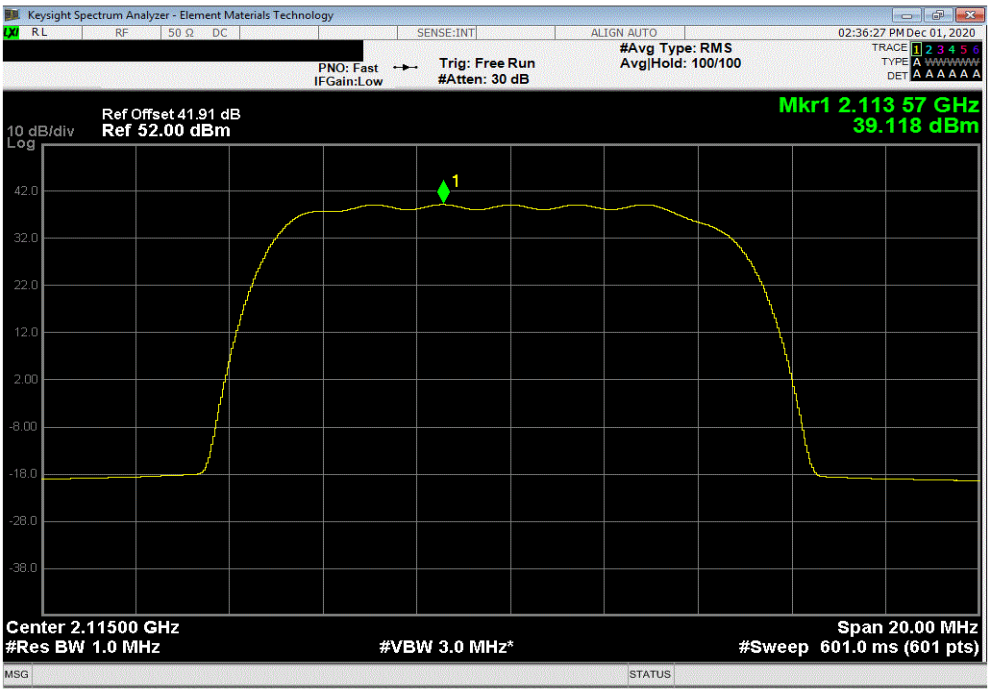
TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 10 MHz Bandwidth , QPSK Modulation, High Channel 2150 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 38.515 | 0 | 38.5 | 41.5 | |



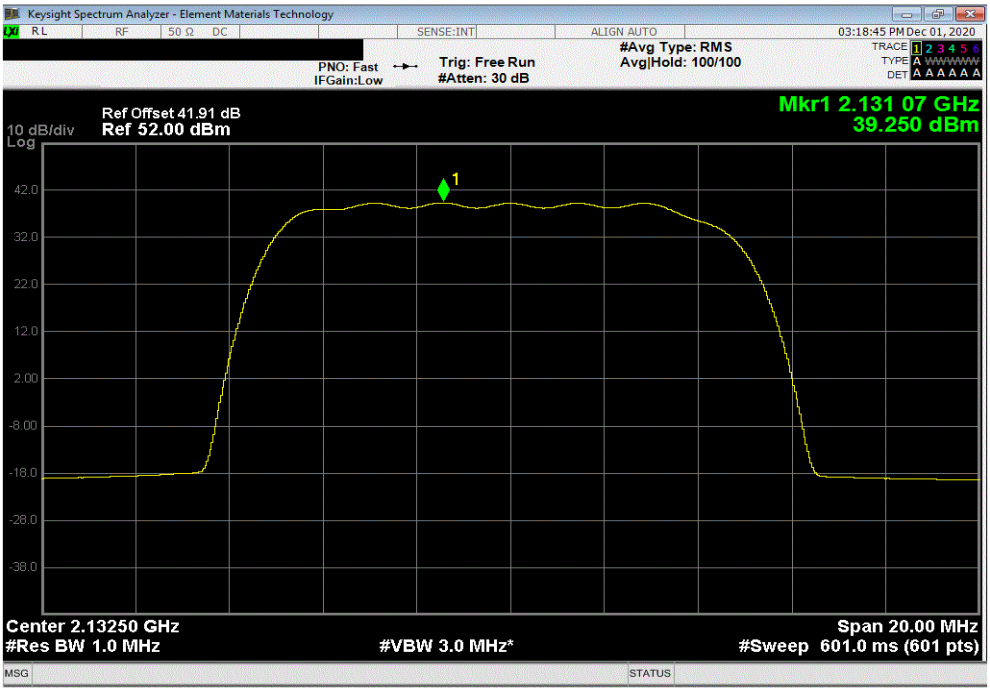

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 10 MHz Bandwidth , 16-QAM Modulation, Low Channel 2115 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 39.118 | 0 | 39.1 | 42.1 | |



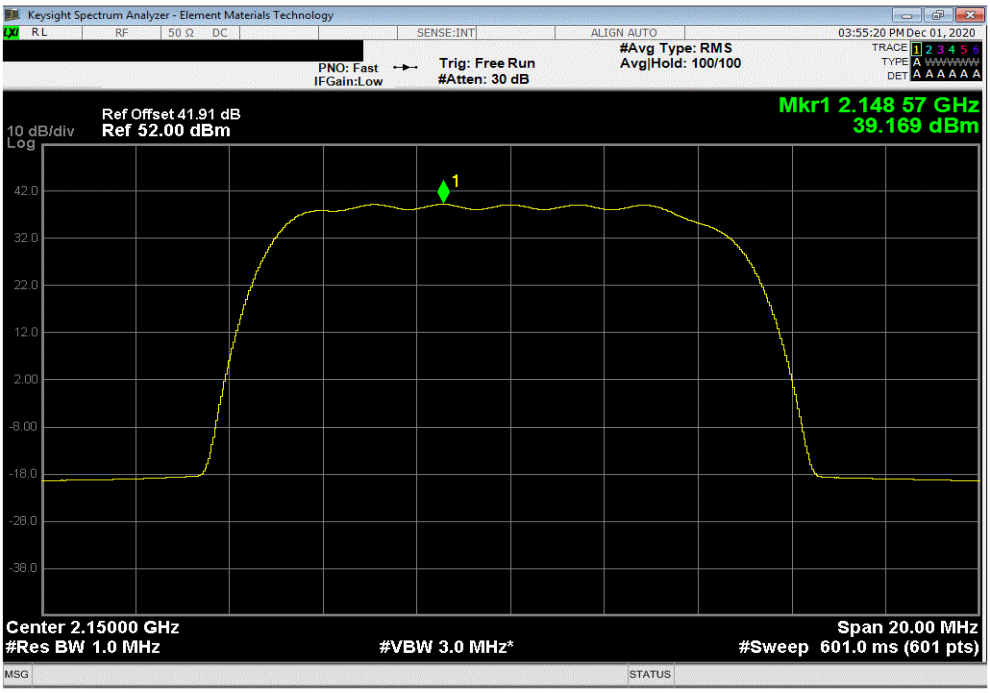
# POWER SPECTRAL DENSITY - 2 PORT MODE

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 10 MHz Bandwidth , 16-QAM Modulation, Mid Channel 2132.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 39.25 | 0 | 39.3 | 42.3 | |



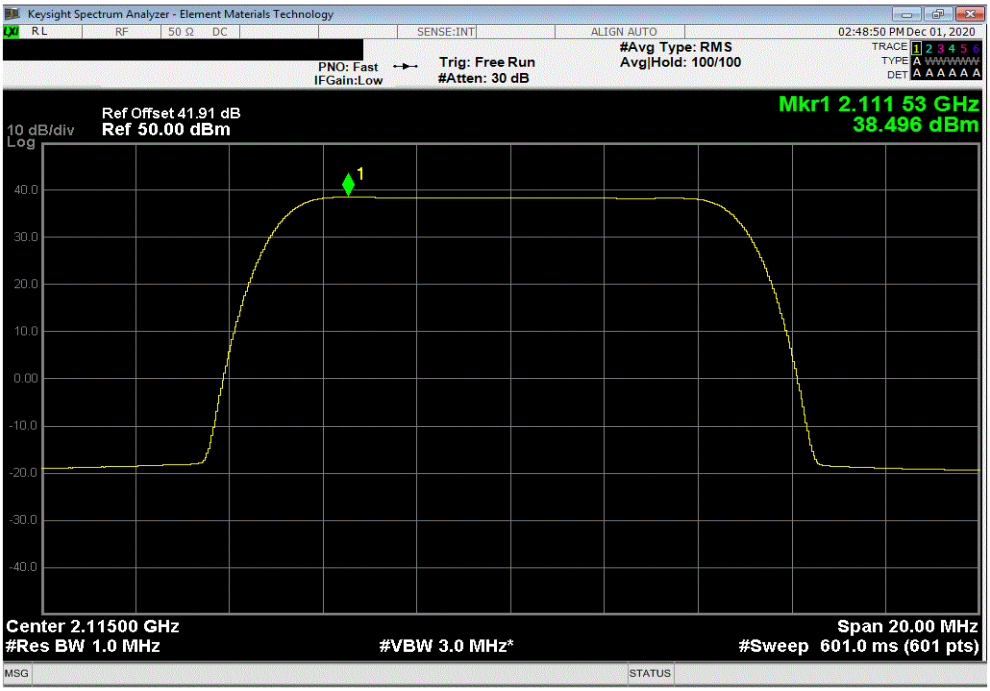

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 10 MHz Bandwidth , 16-QAM Modulation, High Channel 2150 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 39.169 | 0 | 39.2 | 42.2 | |



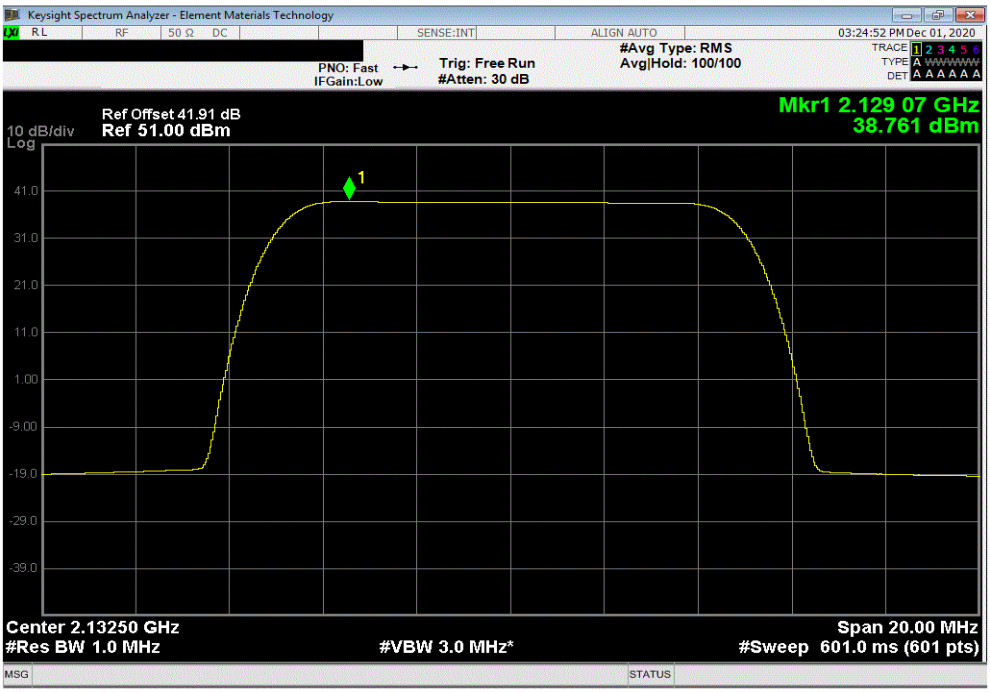
# POWER SPECTRAL DENSITY - 2 PORT MODE

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 10 MHz Bandwidth , 64-QAM Modulation, Low Channel 2115 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 38.496 | 0 | 38.5 | 41.5 | |



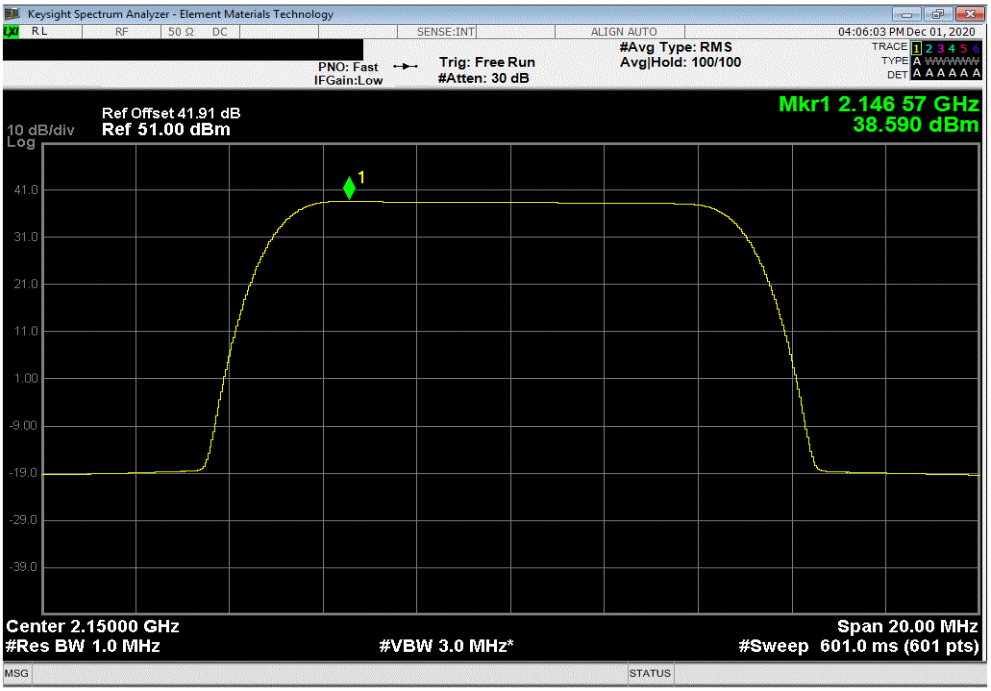

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 10 MHz Bandwidth , 64-QAM Modulation, Mid Channel 2132.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 38.761 | 0 | 38.8 | 41.8 | |



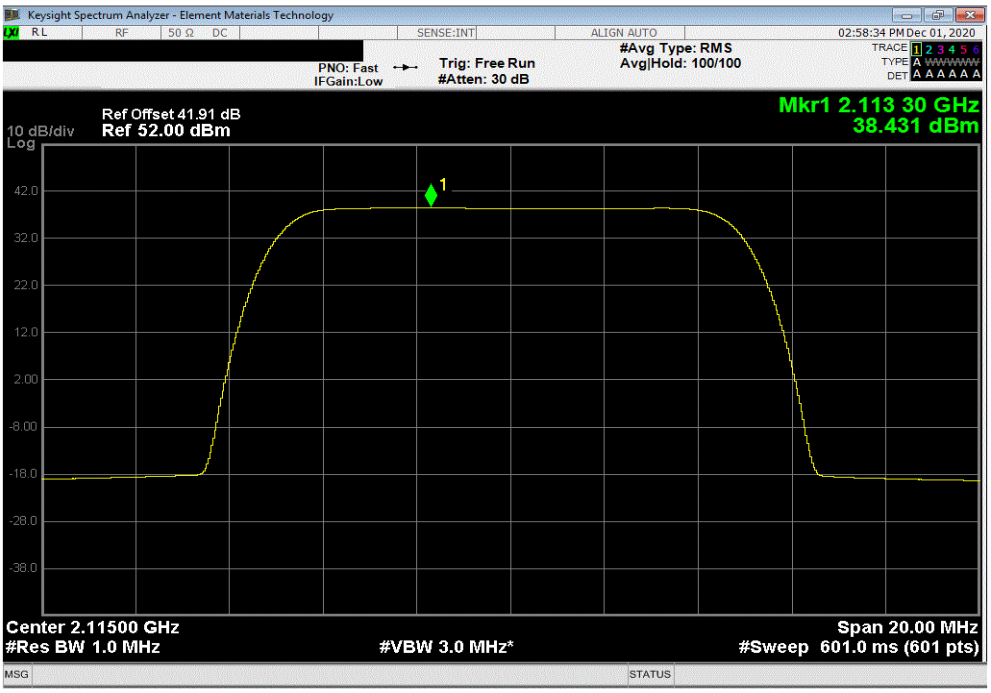
# POWER SPECTRAL DENSITY - 2 PORT MODE

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 10 MHz Bandwidth , 64-QAM Modulation, High Channel 2150 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 38.59 | 0 | 38.6 | 41.6 | |



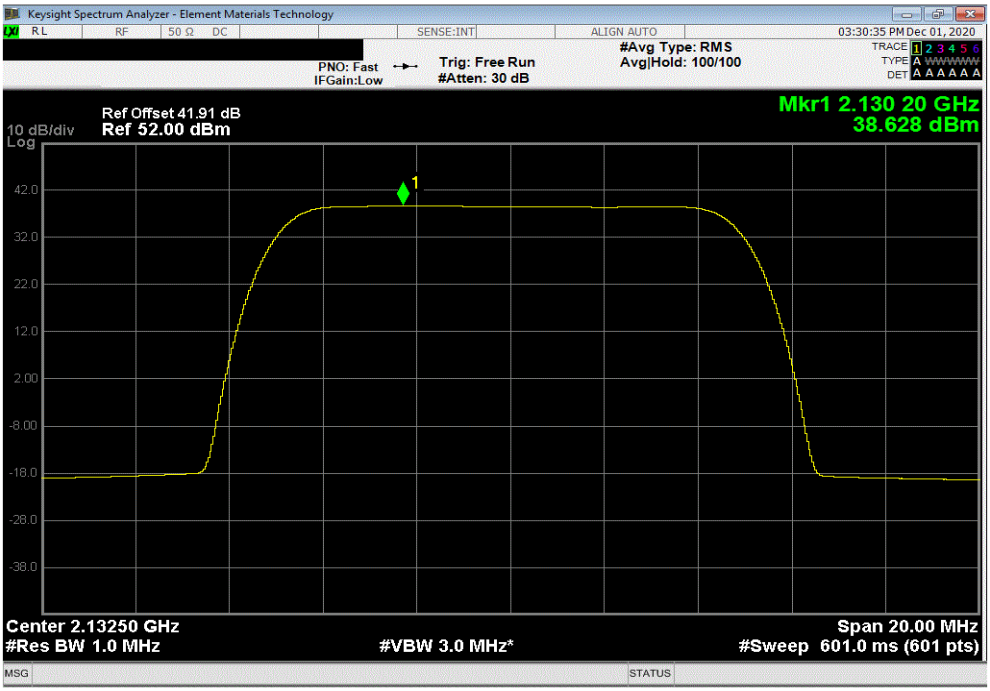

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 10 MHz Bandwidth , 256-QAM Modulation, Low Channel 2115 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 38.431 | 0 | 38.4 | 41.4 | |



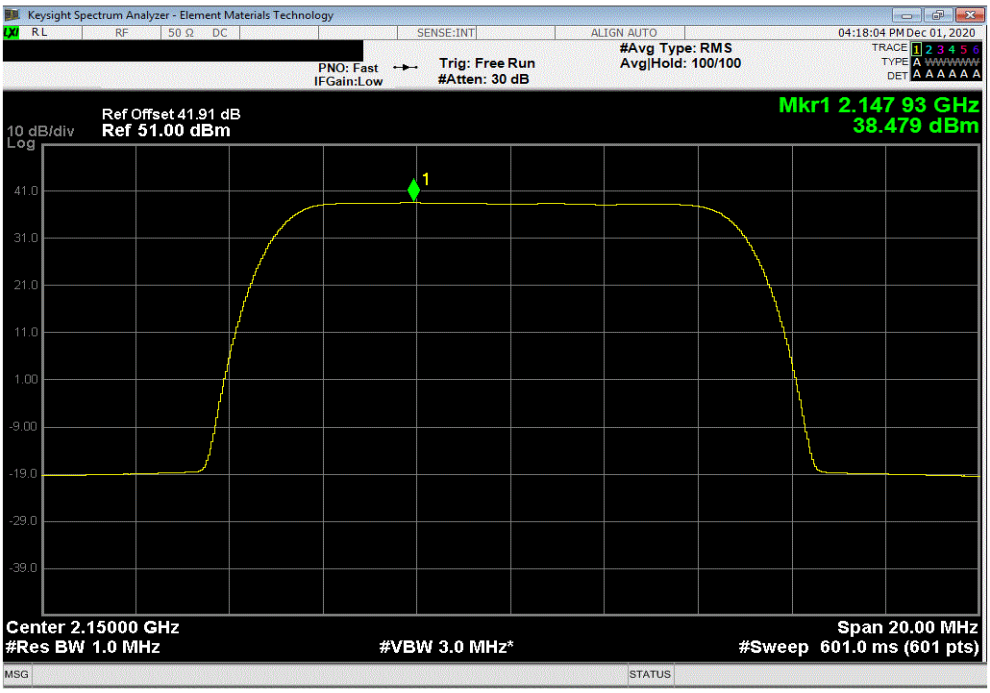
# POWER SPECTRAL DENSITY - 2 PORT MODE

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 10 MHz Bandwidth , 256-QAM Modulation, Mid Channel 2132.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 38.628 | 0 | 38.6 | 41.6 | |



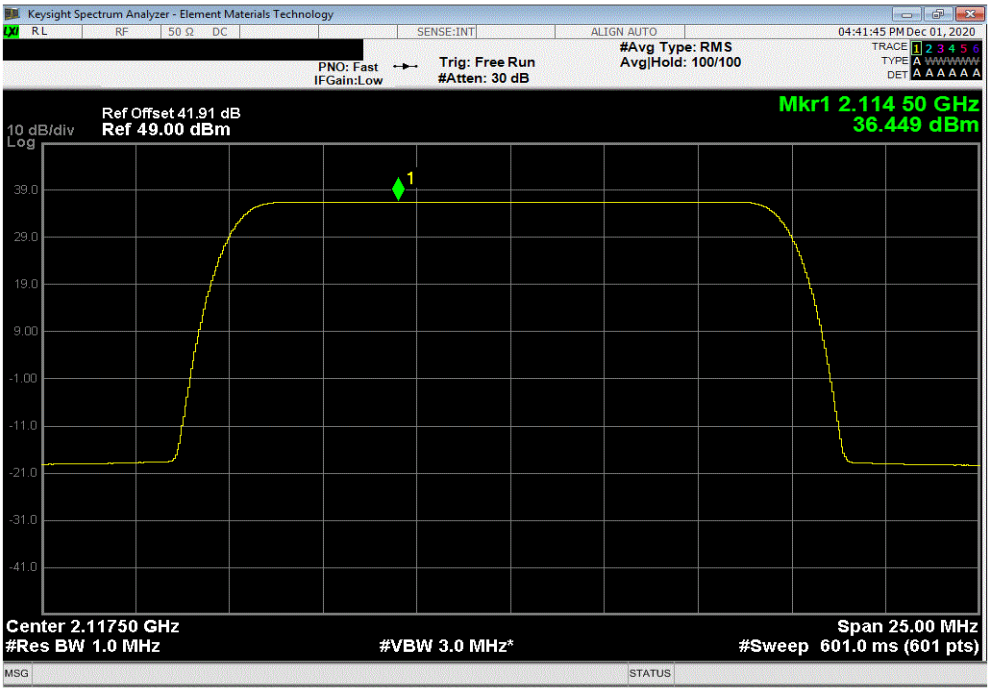

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 10 MHz Bandwidth , 256-QAM Modulation, High Channel 2150 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 38.479 | 0 | 38.5 | 41.5 | |



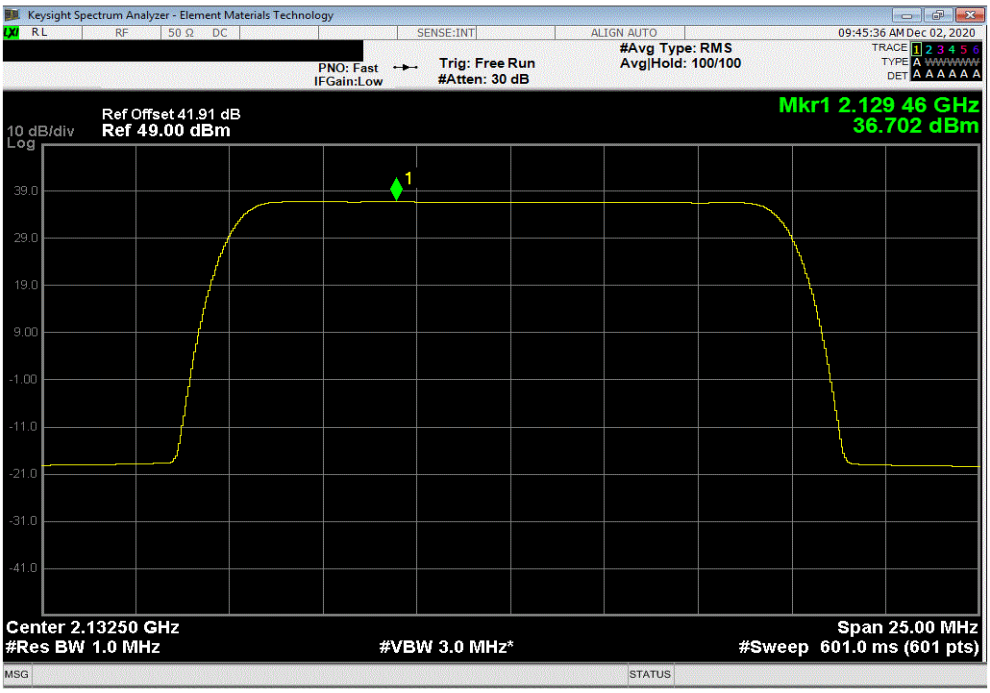
# POWER SPECTRAL DENSITY - 2 PORT MODE

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 15 MHz Bandwidth , QPSK Modulation, Low Channel 2117.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 36.449 | 0 | 36.4 | 39.4 | |



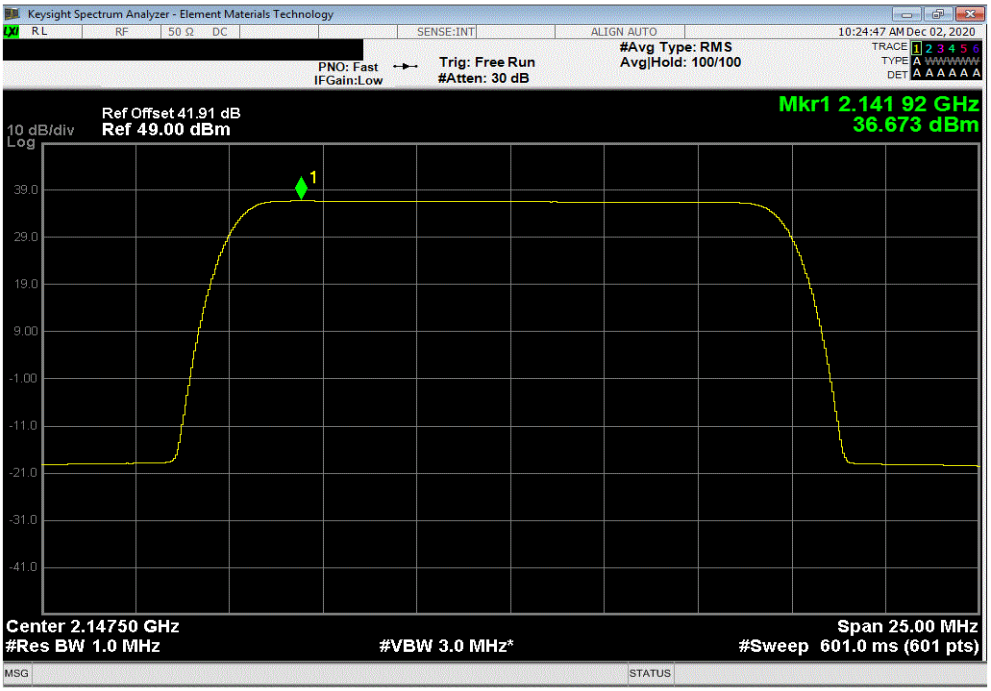

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 15 MHz Bandwidth , QPSK Modulation, Mid Channel 2132.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 36.702 | 0 | 36.7 | 39.7 | |



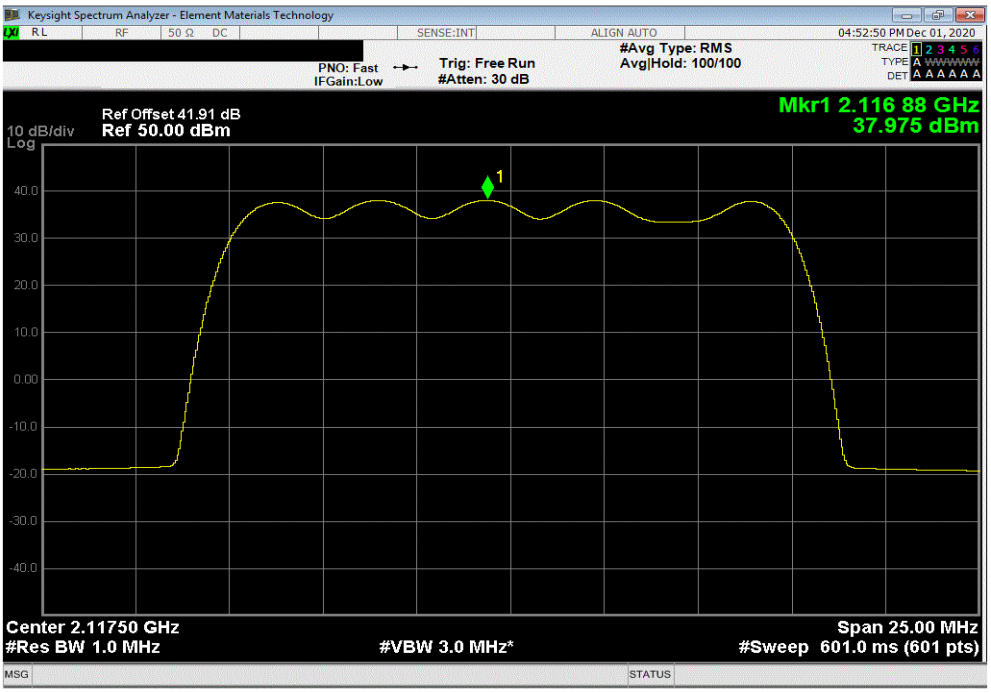
# POWER SPECTRAL DENSITY - 2 PORT MODE

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 15 MHz Bandwidth , QPSK Modulation, High Channel 2147.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 36.673 | 0 | 36.7 | 39.7 | |



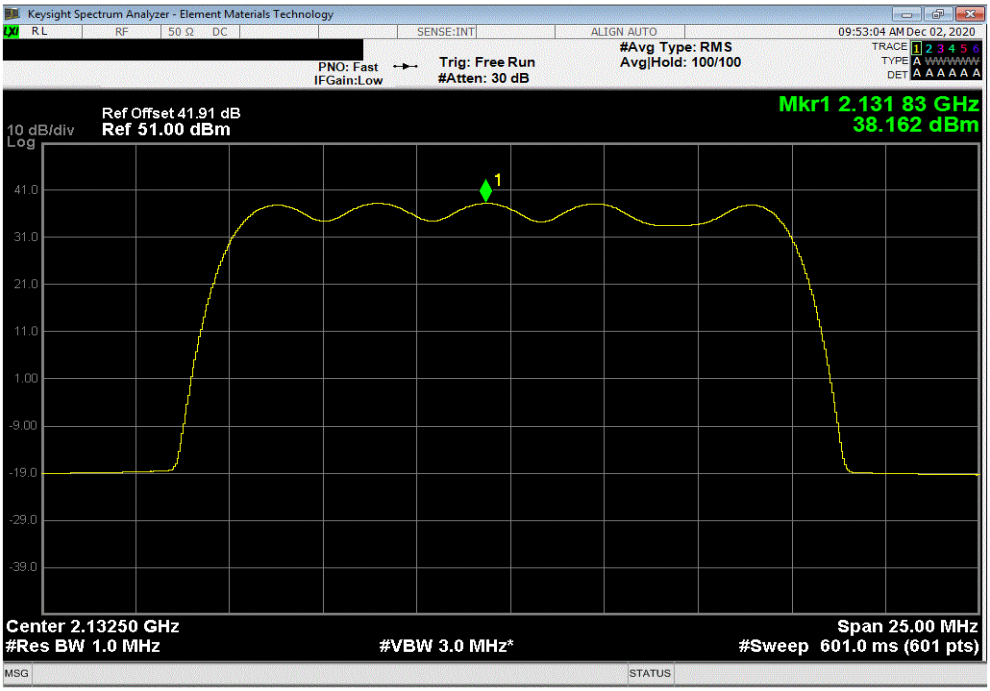

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 15 MHz Bandwidth , 16-QAM Modulation, Low Channel 2117.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 37.975 | 0 | 38.0 | 41.0 | |



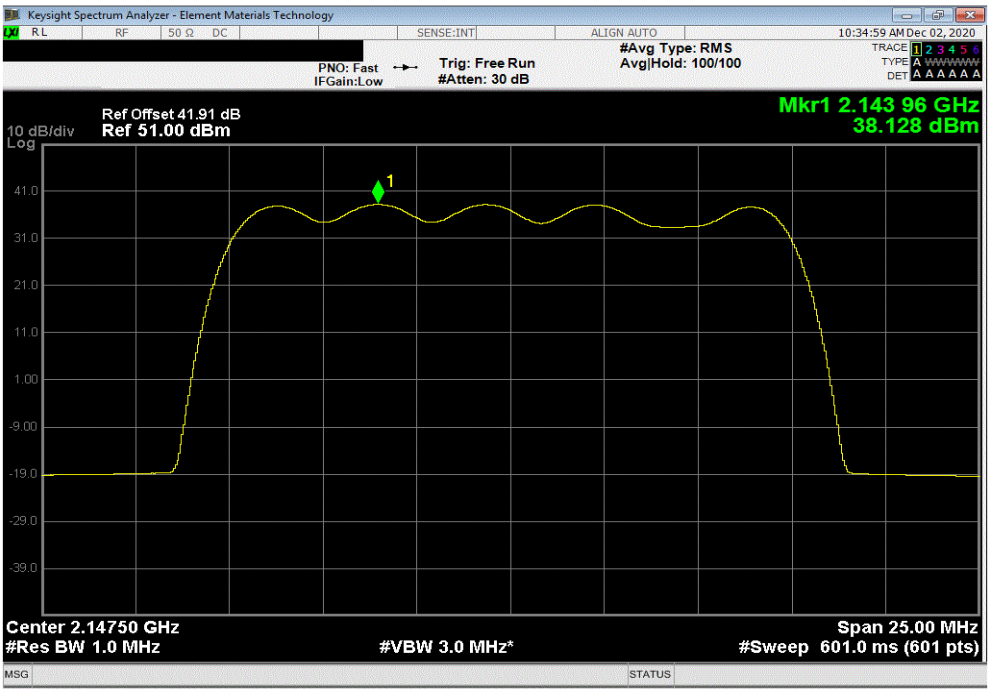
# POWER SPECTRAL DENSITY - 2 PORT MODE

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 15 MHz Bandwidth , 16-QAM Modulation, Mid Channel 2132.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 38.162 | 0 | 38.2 | 41.2 | |



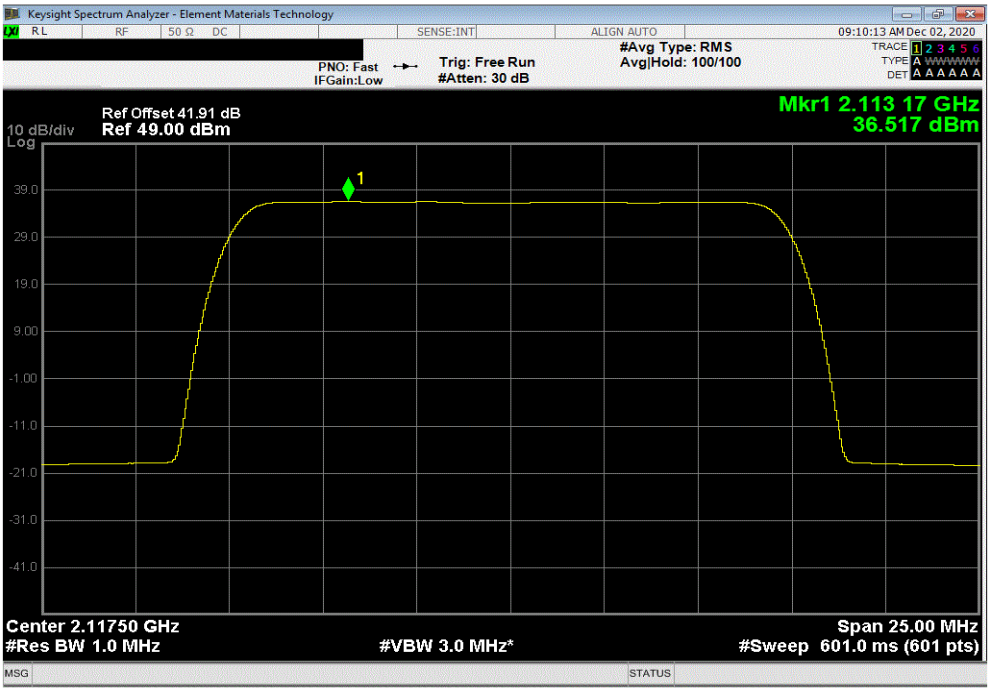

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 15 MHz Bandwidth , 16-QAM Modulation, High Channel 2147.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 38.128 | 0 | 38.1 | 41.1 | |



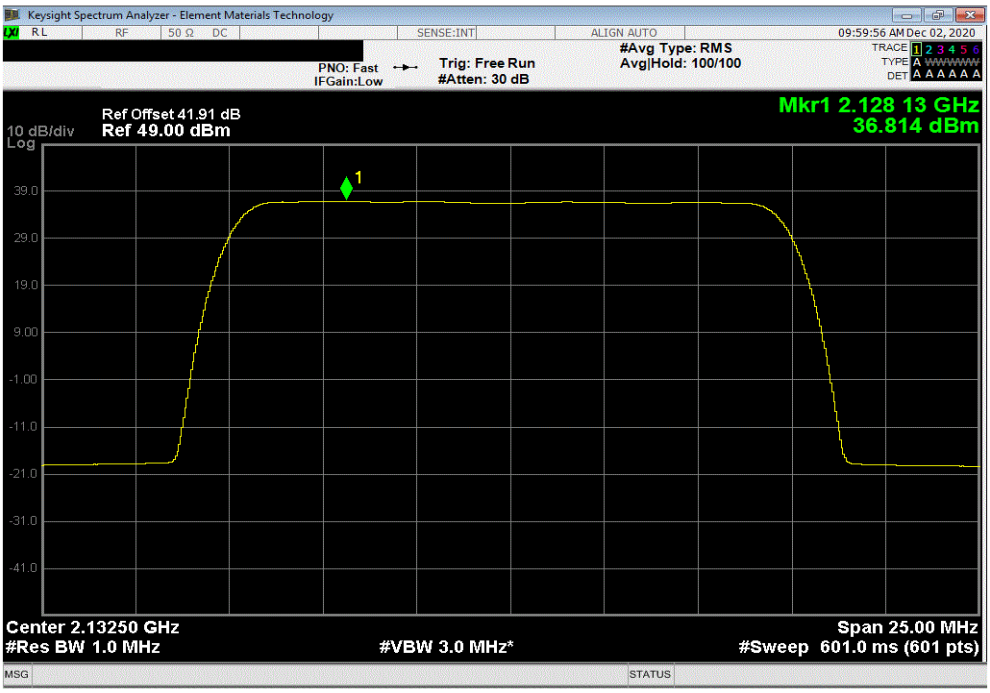
# POWER SPECTRAL DENSITY - 2 PORT MODE

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 15 MHz Bandwidth , 64-QAM Modulation, Low Channel 2117.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 36.517 | 0 | 36.5 | 39.5 | |



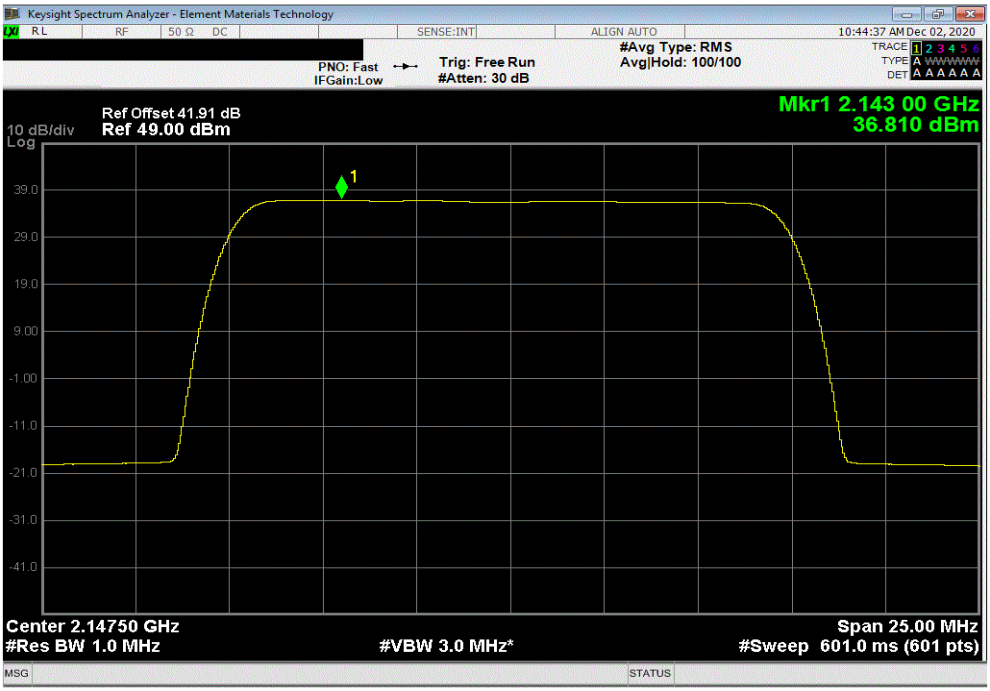

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 15 MHz Bandwidth , 64-QAM Modulation, Mid Channel 2132.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 36.814 | 0 | 36.8 | 39.8 | |



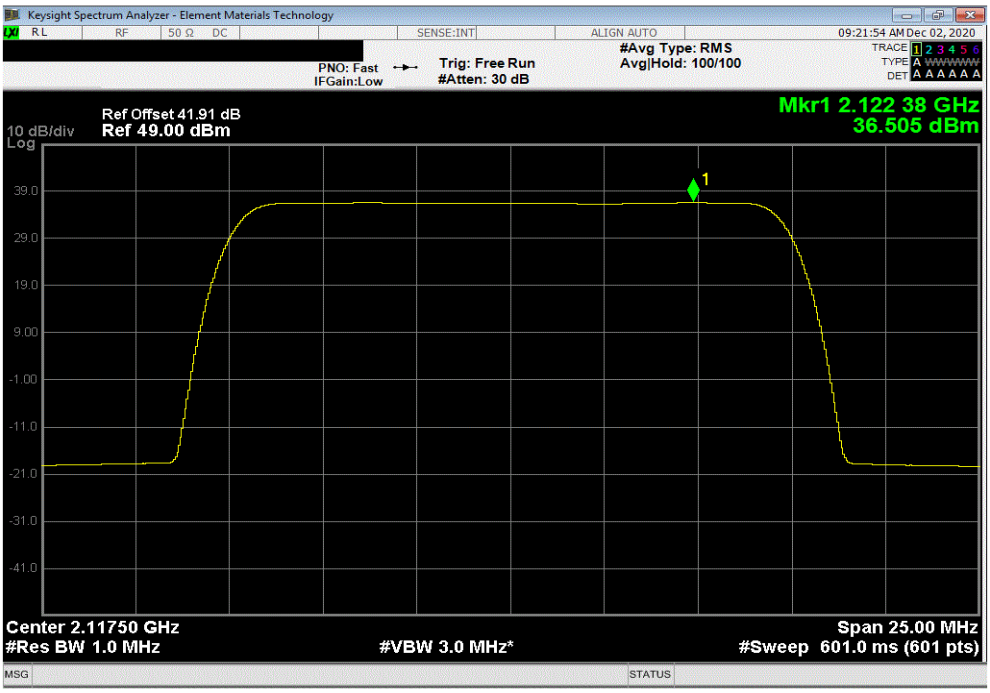
# POWER SPECTRAL DENSITY - 2 PORT MODE

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 15 MHz Bandwidth , 64-QAM Modulation, High Channel 2147.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 36.81 | 0 | 36.8 | 39.8 | |



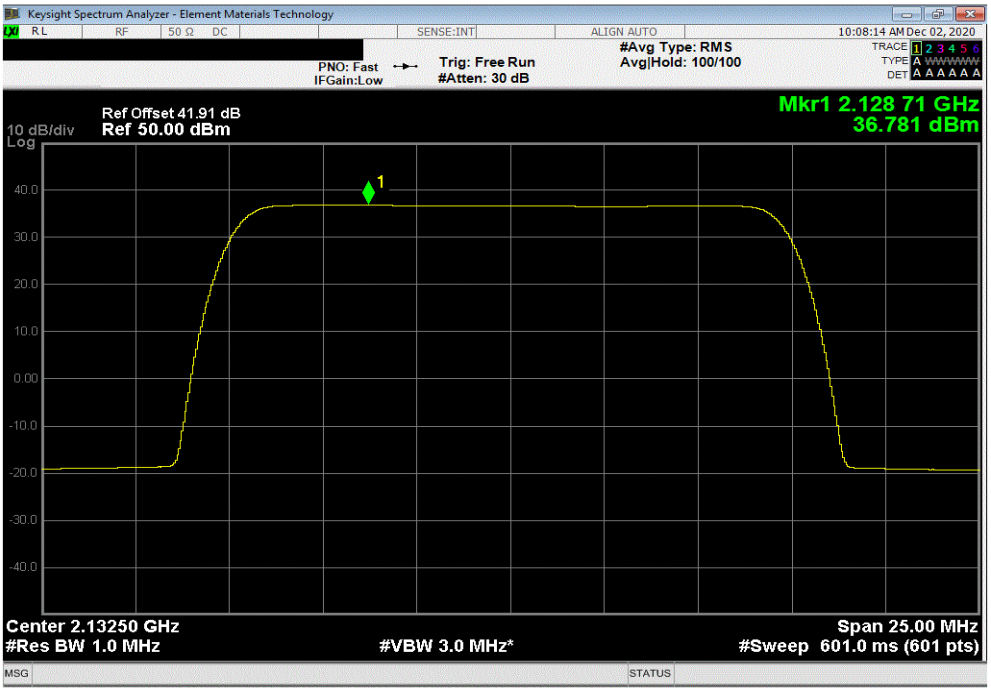

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 15 MHz Bandwidth , 256-QAM Modulation, Low Channel 2117.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 36.505 | 0 | 36.5 | 39.5 | |



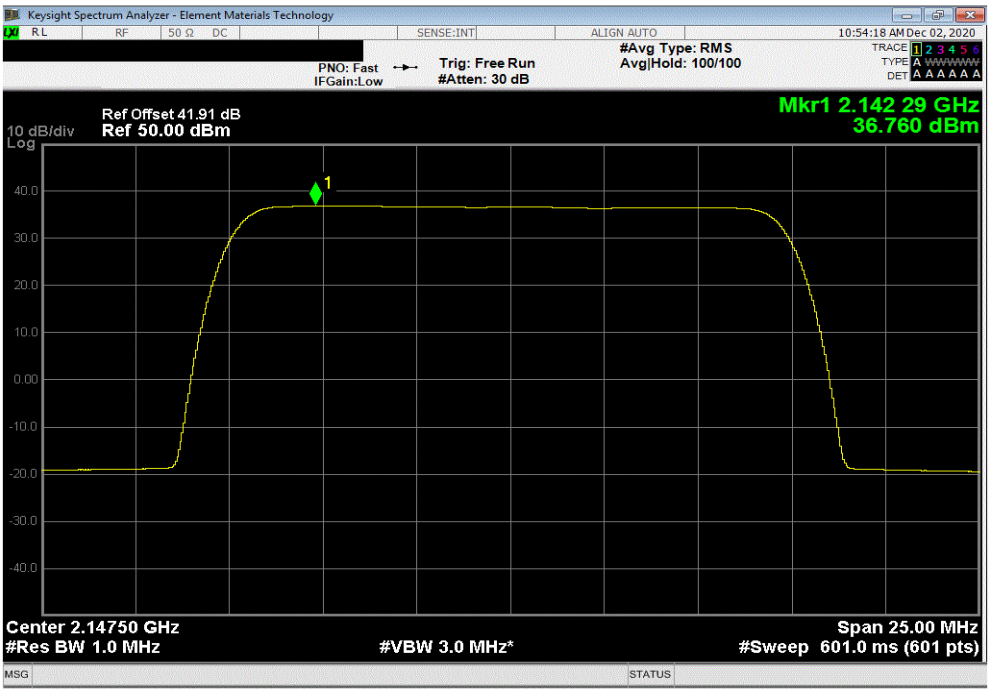
# POWER SPECTRAL DENSITY - 2 PORT MODE

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 15 MHz Bandwidth , 256-QAM Modulation, Mid Channel 2132.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 36.781 | 0 | 36.8 | 39.8 | |



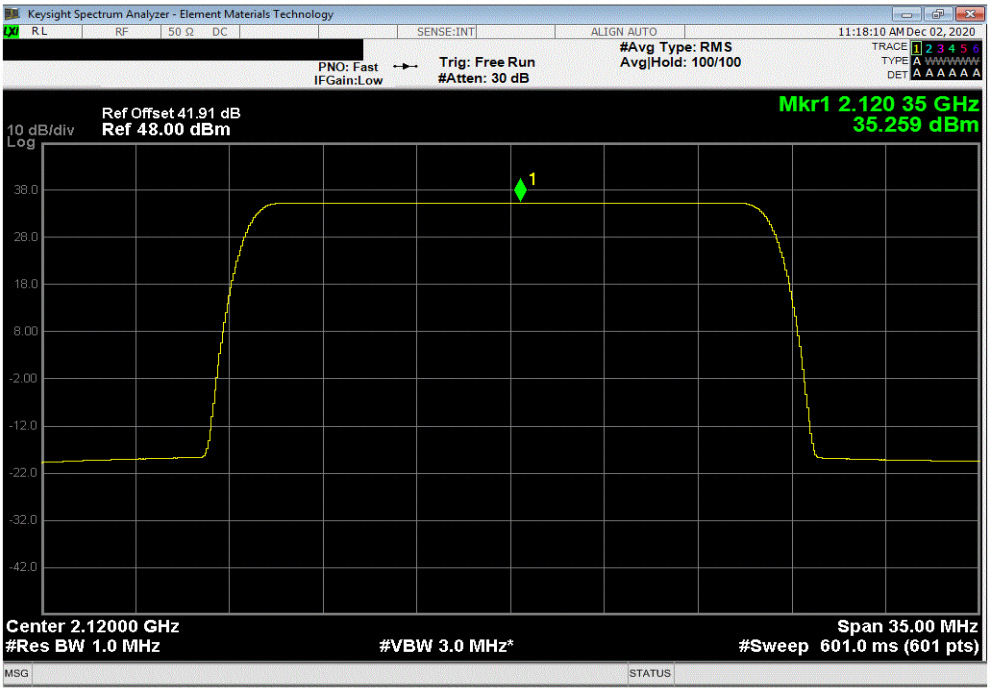

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 15 MHz Bandwidth , 256-QAM Modulation, High Channel 2147.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 36.76 | 0 | 36.8 | 39.8 | |



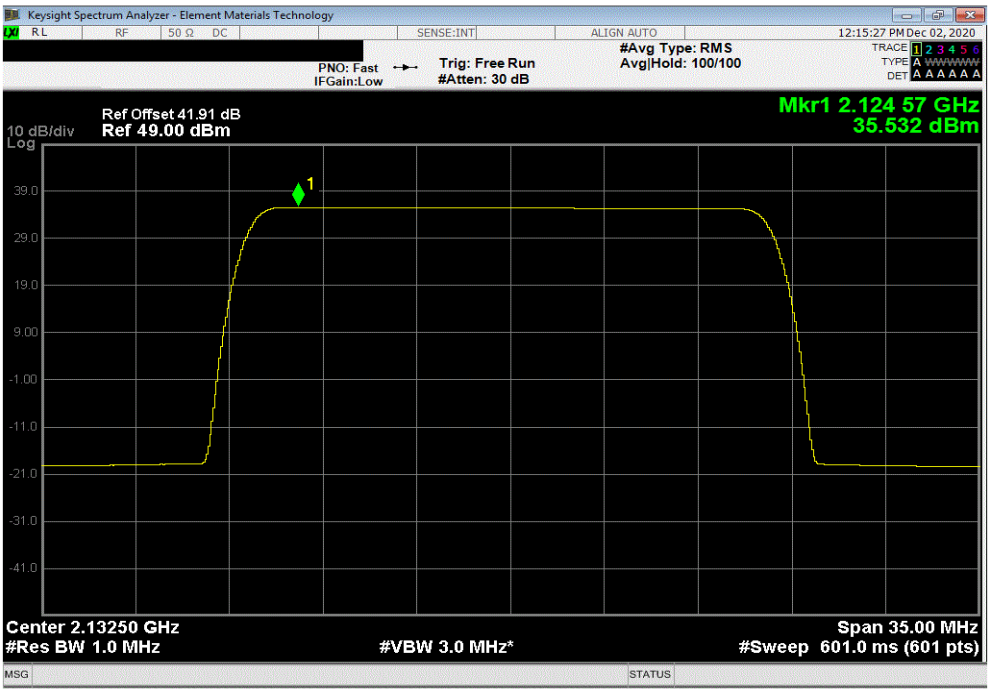
# POWER SPECTRAL DENSITY - 2 PORT MODE

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 20 MHz Bandwidth, QPSK Modulation, Low Channel 2120 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 35.259 | 0 | 35.3 | 38.3 | |



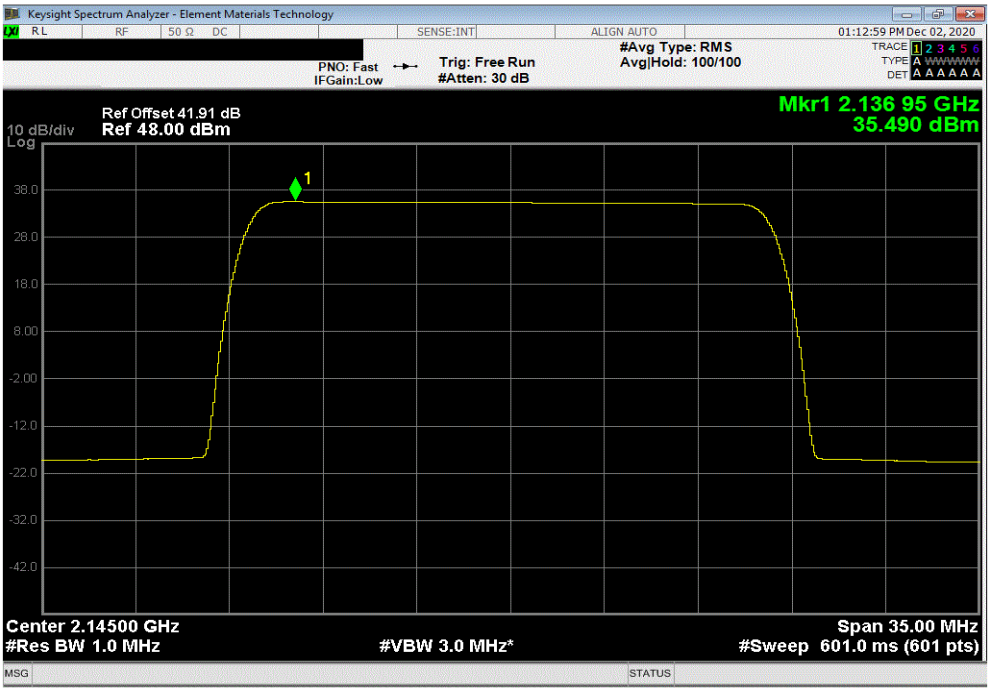

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 20 MHz Bandwidth, QPSK Modulation, Mid Channel 2132.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 35.532 | 0 | 35.5 | 38.5 | |



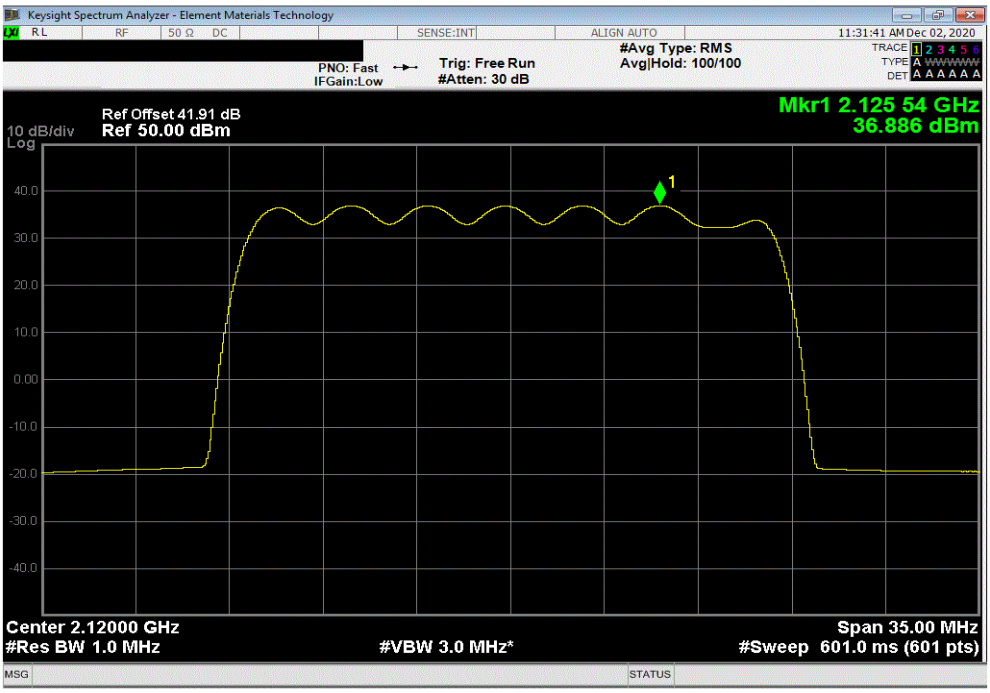
# POWER SPECTRAL DENSITY - 2 PORT MODE

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 20 MHz Bandwidth, QPSK Modulation, High Channel 2145 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 35.49 | 0 | 35.5 | 38.5 | |



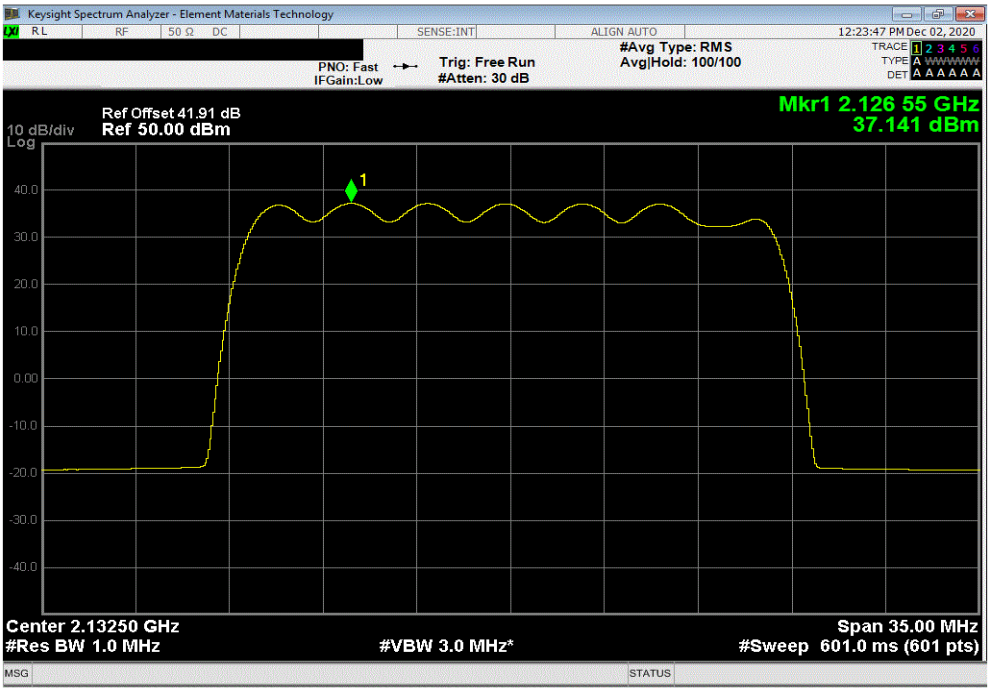

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 20 MHz Bandwidth, 16-QAM Modulation, Low Channel 2120 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 36.886 | 0 | 36.9 | 39.9 | |



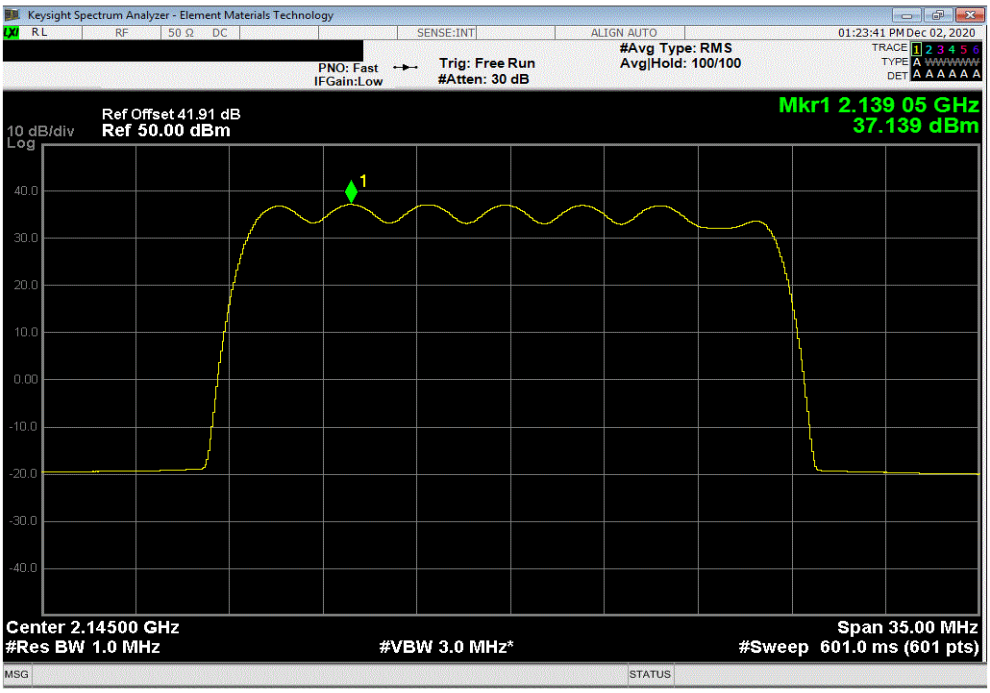
# POWER SPECTRAL DENSITY - 2 PORT MODE

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 20 MHz Bandwidth, 16-QAM Modulation, Mid Channel 2132.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 37.141 | 0 | 37.1 | 40.1 | |



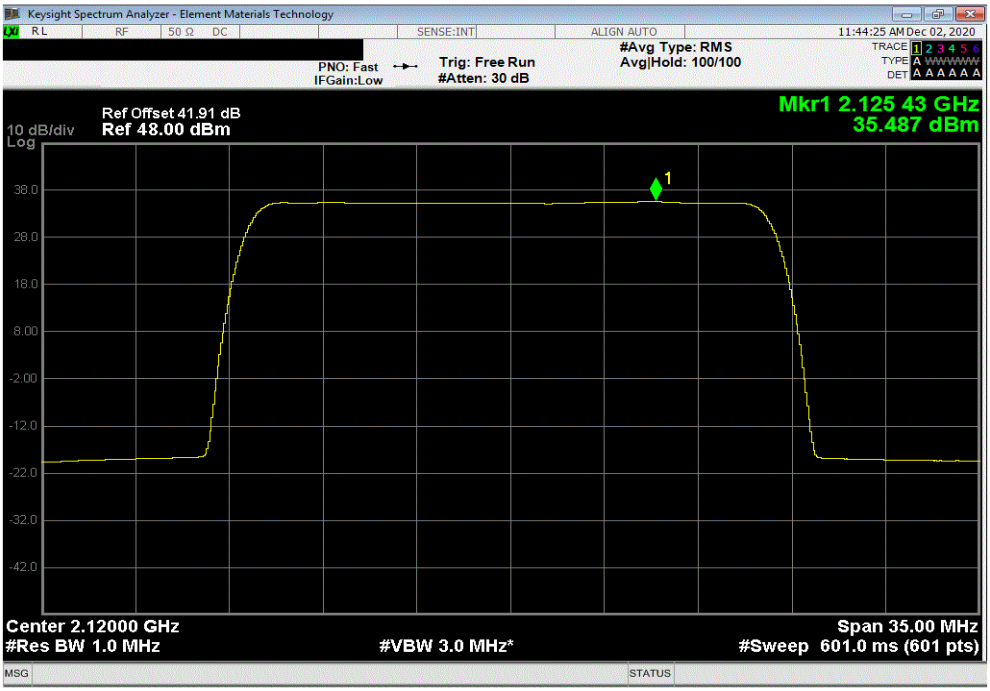

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 20 MHz Bandwidth, 16-QAM Modulation, High Channel 2145 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 37.139 | 0 | 37.1 | 40.1 | |



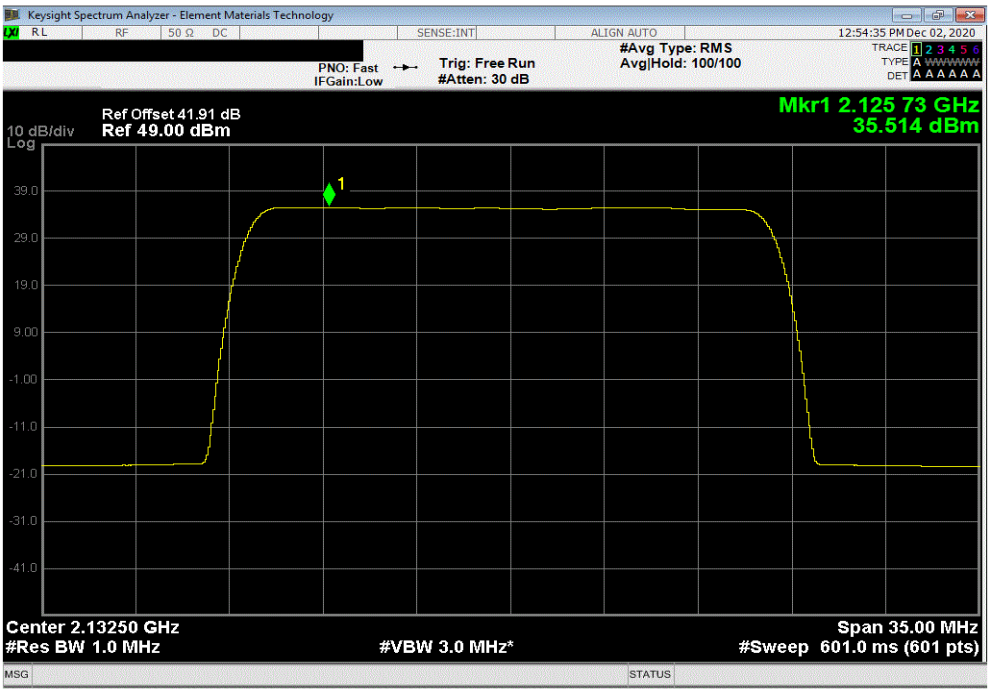
# POWER SPECTRAL DENSITY - 2 PORT MODE

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 20 MHz Bandwidth, 64-QAM Modulation, Low Channel 2120 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 35.487 | 0 | 35.5 | 38.5 | |



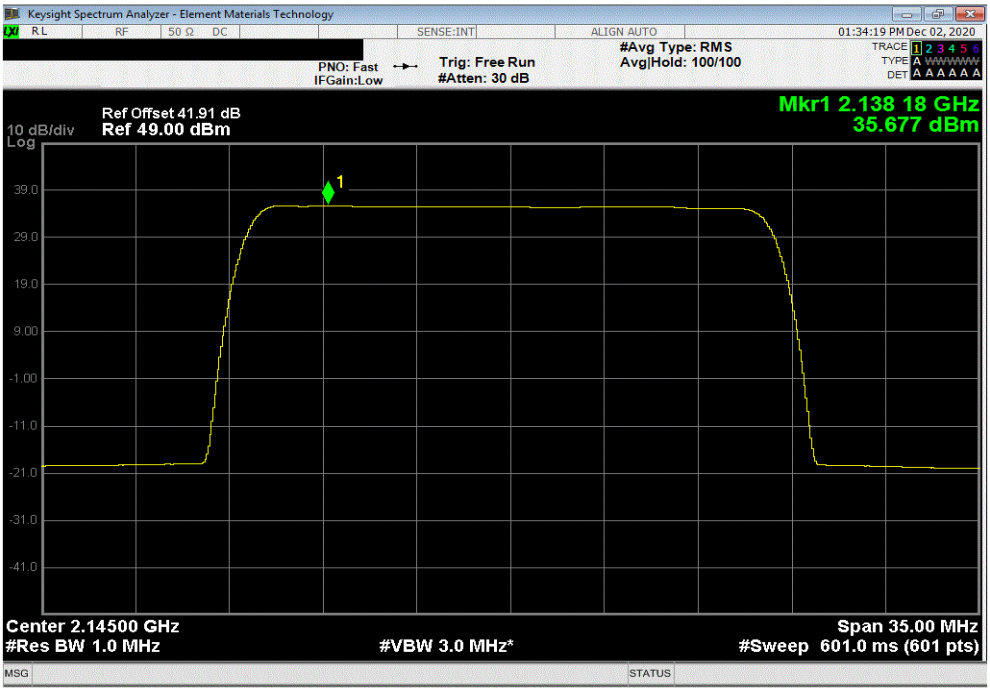

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 20 MHz Bandwidth, 64-QAM Modulation, Mid Channel 2132.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 35.514 | 0 | 35.5 | 38.5 | |



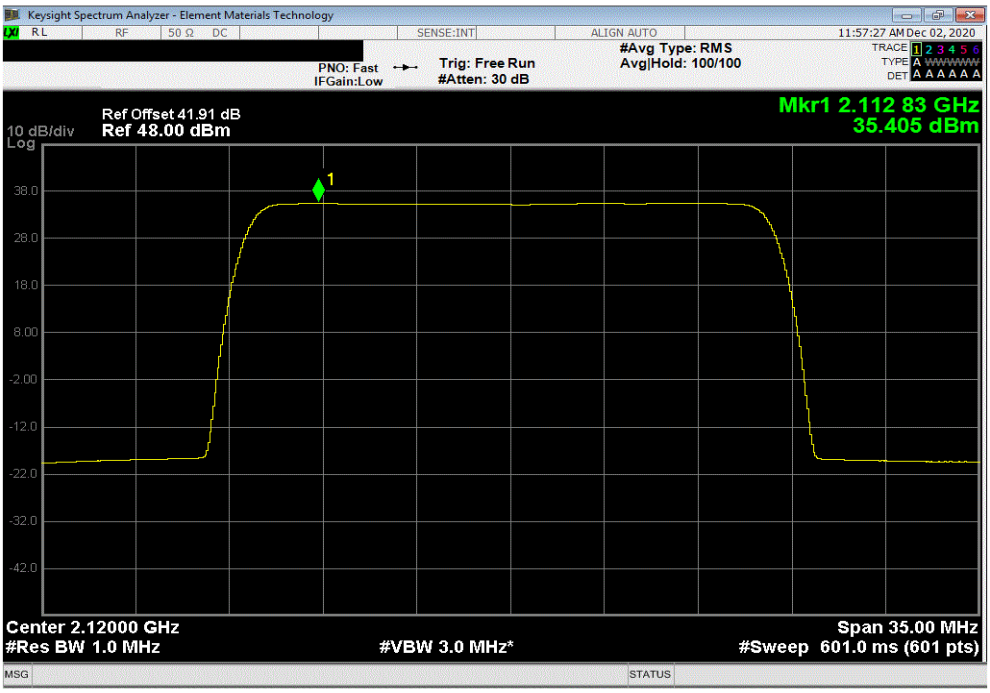
# POWER SPECTRAL DENSITY - 2 PORT MODE

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 20 MHz Bandwidth, 64-QAM Modulation, High Channel 2145 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 35.677 | 0 | 35.7 | 38.7 | |



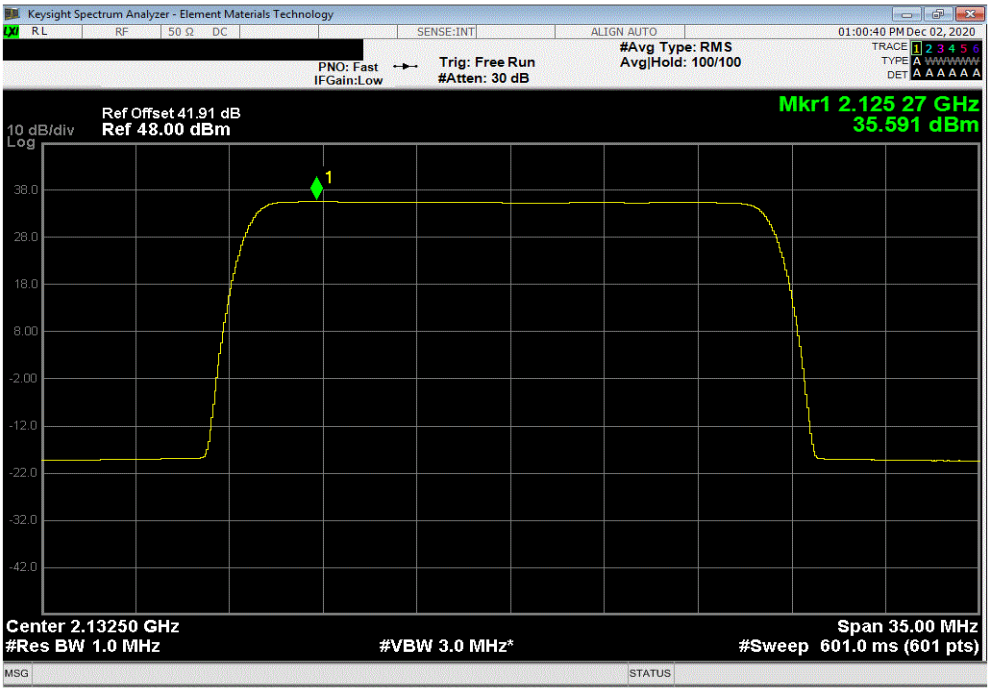

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 20 MHz Bandwidth, 256-QAM Modulation, Low Channel 2120 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 35.405 | 0 | 35.4 | 38.4 | |



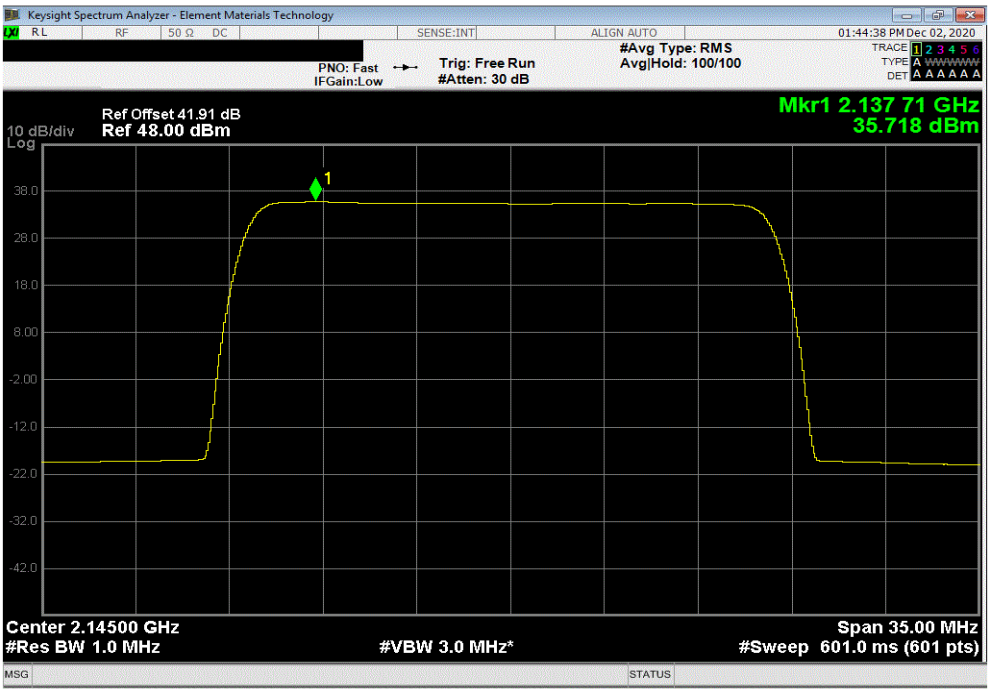
# POWER SPECTRAL DENSITY - 2 PORT MODE

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 20 MHz Bandwidth, 256-QAM Modulation, Mid Channel 2132.5 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 35.591 | 0 | 35.6 | 38.6 | |




| 60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 20 MHz Bandwidth, 256-QAM Modulation, High Channel 2145 MHz | | | | | | |
|---|---|---|---|---|---|---|
| | | Initial Value dBm/MHz | Duty Cycle Factor (dB) | Single Port dBm/MHz == PSD | Two Port (2x2 MIMO) dBm/MHz == PSD | |
| | | 35.718 | 0 | 35.7 | 38.7 | |



### EIRP Calculations for Two Port MIMO Operations_ FRIG in two transmit port (60W per port) mode of operation

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 (whether to operate two port or four port MIMO, carrier power level, channel bandwidth, modulation type, etc.) to optimize performance. Transmitter output power may be reduced in 0.1dB increments (from maximum) by base station setup parameters. Base station antennas are selected by the customer.

Kathrein antenna assembly model "80011867(Y2)" has a gain (dBi) of 17.3 ±0.3dB (maximum gain of 17.6dBi was used for the EIRP calculation) for AWS Band 1. This antenna assembly has a pair of ±45° cross-polarized radiators used for AWS Band 1. The four antenna RF inputs (used for AWS Band 1) on the antenna assembly are as follows: Y1+ L5 (+45°), Y1- L6 (-45°), Y2+ R7 (+45°) and Y2- R8 (-45°). The two FRIG transmitter outputs for two port operation (ports 1 & 3) are connected to the antenna assembly RF inputs (Y1 or Y2). For two port operation the transmitter ports should be connected to one of the cross-polarized antenna pairs (Y2 was used for this example since it has the largest gain).

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 PSD for each channel bandwidth type). The maximum antenna 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 two port MIMO are as follows:

| Parameter | 5 MHz Ch BW | 10 MHz Ch BW | 15 MHz Ch BW | 20 MHz Ch BW |
|---|---|---|---|---|
| Worst Case PSD/Antenna Port | 41.7 dBm/MHz | 39.3 dBm/MHz | 38.2 dBm/MHz | 37.1 dBm/MHz |
| Cable Loss (site dependent) | 0 dB | 0 dB | 0 dB | 0 dB |
| Maximum Antenna Gain ($G_{Ant}$) | 17.6 dBi | 17.6 dBi | 17.6 dBi | 17.6 dBi |
| Directional Gain = $G_{Ant}$ See Note 1 | 17.6 dBi | 17.6 dBi | 17.6 dBi | 17.6 dBi |
| EIRP for Antenna Y2 +45° | 59.3 dBm/MHz | 56.9 dBm/MHz | 55.8 dBm/MHz | 54.7 dBm/MHz |
| EIRP for Antenna Y2 -45° | 59.3 dBm/MHz | 56.9 dBm/MHz | 55.8 dBm/MHz | 54.7 dBm/MHz |
| EIRP Total for Y2 +45° and Y2 -45° See Note 2 | 59.3 dBm/MHz or 851 Watts/MHz | 56.9 dBm/MHz or 490 Watts/MHz | 55.8 dBm/MHz or 380 Watts/MHz | 54.7 dBm/MHz or 295 Watts/MHz |

Note 1: The directional gain is the gain of an individual antenna for cross-polarized radiators being driven by two transmit outputs. See ANSI C63.26 sections 6.4.5.3.3a) and KDB 662911D01v02r01 paragraphs F)2)c)(i) for guidance.
Note 2: 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).

### Calculation Summary

The worst case FRIG two port MIMO EIRP levels using antenna assembly model "80011867" are:

(1) Less than the FCC and ISED (3280 W/MHz or 65.16 dBm/MHz) EIRP Regulatory Limits for all (5, 10, 15 & 20MHz) channel bandwidths
(2) Less than the FCC and ISED (1640 W/MHz or 62.15 dBm/MHz) EIRP Regulatory Limits for all (5, 10, 15 & 20MHz) channel bandwidths