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DATE: 2021-07-01

REPORT NO: 4789899747-E2V3 FCC ID: A3LSMH111U



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REPORT NO: 4789899747-E2V3 FCC ID: A3LSMH111U NR Band 66 CP-OFDM



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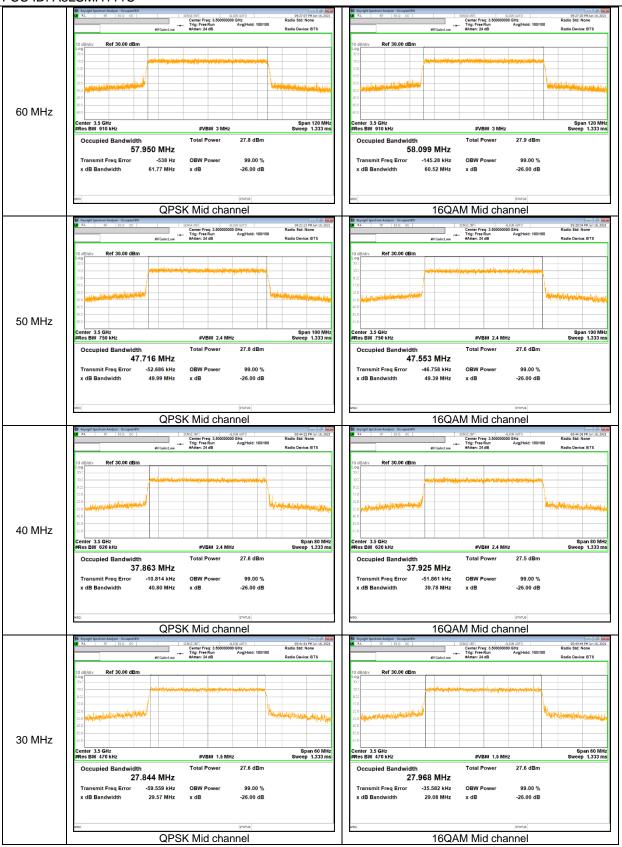
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NR Band 77 (3450 - 3550 MHz) CP-OFDM 09:45:37 PM3 Radio Std: None 09:45:20 PM Ju Radio Std: None Center Freq: 3.50 Trig: Free Run Center Freq: 3.5 Trig: Free Run 00 GHz GHz Avg Radio Device: BTS Radio Device: BTS Ref 30.00 dBm Ref 30.00 dBr 100 MHz enter 3.5 GHz Res BW 1.5 MHz Span 200 MH Sweep 1.333 ms enter 3.5 GHz Res BW 1.5 MHz Span 200 MH Sweep 1.333 ms #VBW 5 MHz #VBW 5 MHz 27.7 dBm 28.8 dBm Occupied Bandwid Total Power Occupied Bandwid Total Powe 97.363 MHz 97.384 MHz Transmit Freg Error 19.099 kHz OBW Power 99.00 % Transmit Freg Error -83.002 kHz OBW Power 99.00 % x dB Bandwidth 101.1 MHz x dB -26.00 dB x dB Bandwidth 101.2 MHz x dB -26.00 dE **QPSK Mid channel** 16QAM Mid channel 09:42:18 PH Jun 16, 20 Radio Std: None 09:41:57 PM Jun 16, 20 Radio Std: None Radio Device: BTS Radio Device: BTS Ref 30.00 dBm Ref 30.00 dBm 90 MHz enter 3.5 GHz Res BW 1.3 MHz Span 180 MH: Sweep 1.333 ms enter 3.5 GHz Res BW 1.3 MHz Span 180 MH Sweep 1.333 m #VBW 5 MHz #VBW 5 MHz 27.8 dBm 28.1 dBm Occupied Bandwidth Total Power Occupied Bandwidth Total Power 87.579 MHz 87.445 MHz Transmit Freq Error -111.26 kHz 99.00 % Transmit Freq Error 47.367 kHz 99.00 % **OBW** Powe **OBW** Power x dB Bandwidth 90.74 MHz x dB -26.00 dB x dB Bandwidth 90.73 MHz x dB -26.00 dB **QPSK Mid channel** 16QAM Mid channel (9:39:29 PM Jun 16, 202 Radio Std: None 69:09:03 PH Ju Radio Std: None Center Freq: 3.50 Trig: Free Run er Freg: 3.50 Radio Device: BTS Radio Device: BTS Ref 30.00 dBn Ref 30.00 dB 80 MHz Span 160 MH Sweep 1.333 ms nter 3.5 GHz es BW 1.2 MHz Span 160 MHz Sweep 1.333 ms nter 3.5 GHz es BW 1.2 MHz #VBW 4 MHz #VBW 4 MHz Occupied Bandwid Total Powe 27.9 dBm Occupied Bandwid Total Powe 27.9 dBm 77.528 MHz 77.627 MHz Transmit Freq Error -14.285 kHz OBW Power 99.00 % Transmit Freg Error -17.285 kHz OBW Power 99.00 % 80.48 MHz -26.00 dB 80.55 MHz x dB -26.00 dB x dB Bandwidth x dB x dB Bandwidth QPSK Mid channel 16QAM Mid channel 09:35:21 PMJur Radio Std: None 69:35:04 PMJ Radio Std: None Center Freq: 3.5 Trig: Free Run Center Freq: 3. Trig: Free Run GHz Avg|Hold: 100/100 GHz AvaiHold: 100/100 Ref 30.00 dBm Ref 30.00 dBr 70 MHz nter 3.5 GHz es BW 1.1 MH Span 140 MH Sweep 1.333 ms nter 3.5 GHz es BW 1.1 MHz Span 140 MH veep 1.333 m #VBW 4 MHz #VBW 4 MHz Occupied Bandwidth Total Power 27.7 dBm Occupied Bandwidth Total Power 27.7 dBm 67.556 MHz 67.537 MHz Transmit Freq Error 67.137 kHz OBW Powe 99.00 % Transmit Freq Error -78.429 kHz OBW Power 99.00 % x dB Bandwidth 70.68 MHz x dB -26.00 dB x dB Bandwidth 70.15 MHz x dB -26.00 dB QPSK Mid channel 16QAM Mid channel

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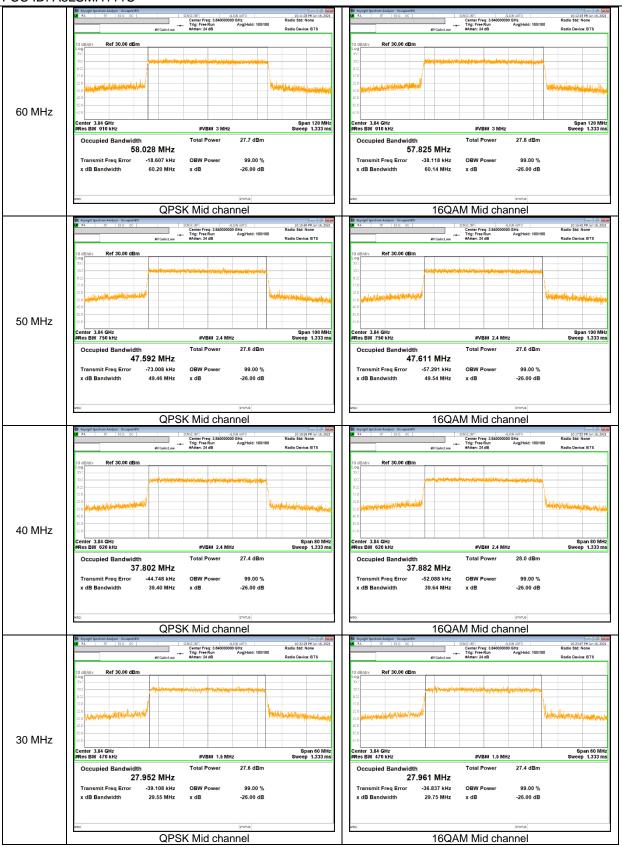
NR Band 77 (3700 - 3980 MHz) CP-OFDM 09:49:27 PMJ Radio Std: None 09:50:00 PM Ju Radio Std: None Center Freq: 3.84 Trig: Free Run 00 GHz Center Freq Trig: Free R GHz Avg| Radio Device: BTS Radio Device: BTS Ref 30.00 dBm Ref 30.00 dBr 100 MHz enter 3.84 GHz Res BW 1.5 MHz Span 200 MH Sweep 1.333 ms enter 3.84 GHz Res BW 1.5 MHz Span 200 MH Sweep 1.333 ms #VBW 5 MHz #VBW 5 MHz 27.5 dBm 27.7 dBm Occupied Bandwid Total Power Occupied Bandwid Total Powe 97.302 MHz 97.284 MHz Transmit Freg Error -152.52 kHz OBW Power 99.00 % Transmit Freg Error -140.92 kHz OBW Power 99.00 % x dB Bandwidth 101.3 MHz x dB -26.00 dB x dB Bandwidth 101.3 MHz x dB -26.00 dE **QPSK Mid channel** 16QAM Mid channel 09:55:17 PH Jun 16, 20 Radio Std: None 09:55:53 PM Jun 16, 20 Radio Std: None Radio Device: BTS Radio Device: BTS Ref 30.00 dBm Ref 30.00 dBm 90 MHz enter 3.84 GHz Res BW 1.3 MH Span 180 MH: Sweep 1.333 ms enter 3.84 GHz Res BW 1.3 MH Span 180 MH Sweep 1.333 m #VBW 5 MHz #VBW 5 MHz 27.5 dBm 27.7 dBm Occupied Bandwidth Total Power Occupied Bandwidth Total Power 87.340 MHz 87.529 MHz Transmit Freq Error -67.989 kHz 99.00 % Transmit Freq Error -107.06 kHz 99.00 % **OBW** Powe **OBW** Power x dB Bandwidth 90.68 MHz x dB -26.00 dB x dB Bandwidth 90.63 MHz x dB -26.00 dB **QPSK Mid channel** 16QAM Mid channel 09:57:29 PH Jun 16, 202 Radio Std: None 09:58:00 PH Ju Radio Std: None Center Freq: 3.84 Trig: Free Run er Freg: 3.84 Radio Device: BTS Radio Device: BTS Ref 30.00 dBn Ref 30.00 dB 80 MHz nter 3.84 GHz Span 160 MHz Sweep 1.333 ms nter 3.84 GHz Span 160 MHz Sweep 1.333 ms #VBW 4 MHz #VBW 4 MHz Occupied Bandwid Total Powe 27.8 dBm Occupied Bandwid Total Powe 27.2 dBm 77.605 MHz 77.688 MHz Transmit Freq Error -50.320 kHz OBW Powe 99.00 % Transmit Freg Error 10.597 kHz OBW Power 99.00 % 82.20 MHz -26.00 dB 80.59 MHz x dB -26.00 dB x dB Bandwidth x dB x dB Bandwidth QPSK Mid channel 16QAM Mid channel 10:04:01 PMJ Radio Std: Non-10:03:08 PH Ju Radio Std: None Center Freq: 3.8 Trig: Free Run GHz Avg|Hold: 100/100 GHz AvaiHold: 100/10 Center Freq: 3 Trig: Free Run Ref 30.00 dBm Ref 30.00 dBr 70 MHz enter 3.84 GHz Res BW 1.1 MH Span 140 MH Sweep 1.333 ms r 3.84 GHz BW 1.1 MHz Span 140 MH veep 1.333 m nter es Bl #VBW 4 MHz #VBW 4 MHz Occupied Bandwidth Total Power 27.3 dBm Occupied Bandwidth Total Power 27.1 dBm 67.580 MHz 67.625 MHz Transmit Freq Error -74.575 kHz OBW Powe 99.00 % Transmit Freq Error -66.703 kHz OBW Power 99.00 % x dB Bandwidth 70.24 MHz x dB -26.00 dB x dB Bandwidth 70.61 MHz x dB -26.00 dB

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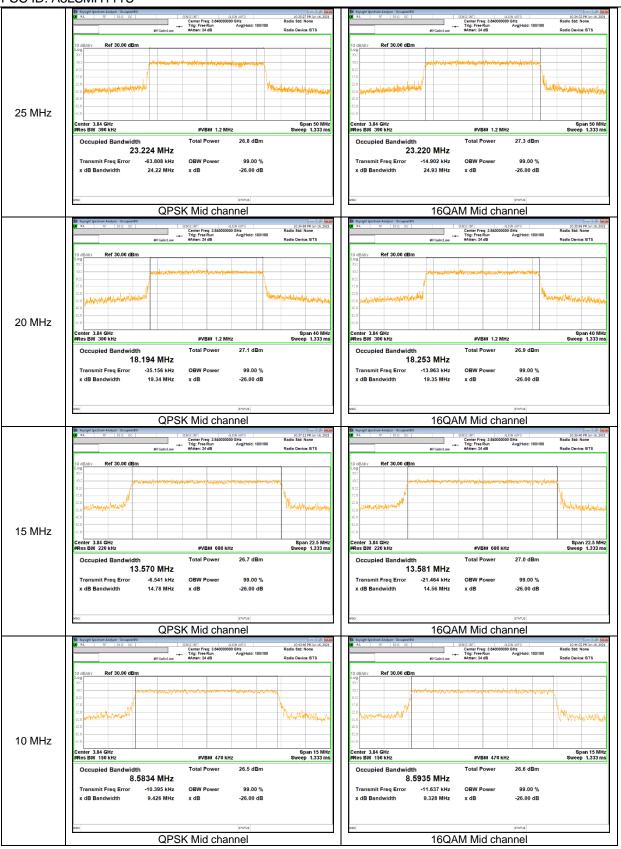
16QAM Mid channel

QPSK Mid channel

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9.2. BAND EDGE EMISSIONS

RULE PART(S)

FCC: §22.359, §22.917, §24.238, §27. 53, and §90.543

<u>LIMITS</u>

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB.

Part 27.53:

(a) (4) For mobile and portable stations operating in the 2305-2315 MHz and 2350-2360 MHz bands:
(i) By a factor of not less than: 43 + 10 log (P) dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band(s) of operation, not less than 55 + 10 log (P) dB on all frequencies between 2320 and 2324 MHz and on all frequencies between 2345 MHz, not less than 61 + 10 log (P) dB on all frequencies between 2324 and 2328 MHz and on all frequencies between 2337 and 2341 MHz, and not less than 67 + 10 log (P) dB on all frequencies between 2327 MHz;

(ii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2300 and 2305 MHz, 55 + 10 log (P) dB on all frequencies between 2296 and 2300 MHz, 61 + 10 log (P) dB on all frequencies between 2292 and 2296 MHz, 67 + 10 log (P) dB on all frequencies between 2288 and 2292 MHz, and 70 + 10 log (P) dB below 2288 MHz;

(iii) By a factor of not less than $43 + 10 \log (P) dB$ on all frequencies between 2360 and 2365 MHz, and not less than $70 + 10 \log (P) dB$ above 2365 MHz.

(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

- (2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;
- (4) On all frequencies between 763-775 MHz and 793-806 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations;

(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

(h) The power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10} (P) dB$.

(I)(2) For mobile operations in the 3700-3980 MHz band, the conducted power of any emission outside the licensee's authorized bandwidth shall not exceed –13 dBm/MHz. Compliance with this paragraph (I)(2) is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, the minimum resolution bandwidth for the measurement shall be either one percent of the emission bandwidth of the fundamental emission of the transmitter or 350 kHz. In the bands between 1 and 5 MHz removed from the licensee's frequency block, the minimum resolution bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

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(m) (4) For mobile digital stations, the attenuation factor shall be not less than 40 + 10 log (P) dB on all frequencies between the channel edge and 5 megahertz from the channel edge, 43 + 10 log (P) dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and 55 + 10 log (P) dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less that 43 + 10 log (P) dB on all frequencies between 2490.5 MHz and 2496 MHz and 55 + 10 log (P) dB at or below 2490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

(n)(2) For mobile operations in the 3450-3550 MHz band, the conducted power of any emission outside the licensee's authorized bandwidth shall not exceed -13 dBm/MHz. Compliance with this paragraph (n)(2) is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed, but limited to a maximum of 200 kHz. In the bands between 1 and 5 MHz removed from the licensee's frequency block, the minimum resolution bandwidth for the measurement shall be 500 kHz. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

Part 90.691:

(a) Out-of-band emission requirement shall apply only to the "outer" channels included in an EA license and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:

(1) For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 116 Log10(f/6.1) decibels or 50 + 10 Log10(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.

(2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 43 + 10Log10(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

Part 90.543:

(e) For operations in the 758-768 MHz and the 788-798 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations.

(2) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations.

(3) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least 43 + 10 log (P) dB.

(4) Compliance with the provisions of paragraphs (e)(1) and (2) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

(5) Compliance with the provisions of paragraph (e)(3) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 kHz may be employed.

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TEST PROCEDURE

Per KDB 971168 D01 Power Meas License Digital Systems v03r01

The transmitter output was connected to a CMW500 Test Set and configured to operate at maximum power. The band edge emissions were measured at the required operating frequencies in each band on the Spectrum Analyzer.

<u>GSM</u>

- a) Set the RBW = 1 ~ 5% of OBW(GSM850 8.2KHz, GSM1900 9.1KHz)
- b) Set VBW \geq 3 × RBW;
- c) Set span \geq 1.5 times the OBW;
- d) Sweep time = 1S;
- e) Detector = RMS;
- f) Ensure that the number of measurement points $\geq 2^{Span/RBW}$;
- g) Trace mode = Average(100);
- h) Add duty cycle correction factor (9dB)

WCDMA/LTE/5G NR

- a) Set the RBW = 1 ~ 1.5 % of OBW(Typically limited to a minimum RBW of 1% of the OBW)
- b) Set VBW \geq 3 × RBW;
- c) Set span \geq 1.5 times the OBW;
- d) Sweep time = Auto;
- e) Detector = RMS;
- f) Ensure that the number of measurement points $\geq 2^{*}$ Span/RBW;
- g) Trace mode = Average (100);

NOTE 1: For frequency range of 763-775 MHz and 793-806 MHz, 769-775 MHz and 799-805 MHz. (LTE Band 13, 14)

- a) Set the RBW = 6.8kHz
- b) Set VBW \geq 3 × RBW;
- c) Sweep time = Auto ;
- d) Detector = RMS;
- e) Ensure that the number of measurement points $\geq 2^{*}$ Span/RBW;
- f) Trace mode = Average;

<u>NOTE 2</u>

Note that the spurious emissions outside of the channel include narrowband signals. These signals are all below the -13dBm / -25dBm / -40dBm limits. Although the measurement bandwidth is less than the reference bandwidth of 1MHz no addental correction is applied as ANSI C63.26 section 4.2.3 only requires the correction to be applied when the OBW of the emission being measured is wider than the measurement bandwidth (Where the OBW of the signal under measurement is less than the RBW of the measuring instrument, no bandwidth correction or integration will be required.) Plots for low and high channels show the level of the emission measured with the reduced bandwidth and the level of the same emission measured using the integration method over the 1MHz reference bandwidth are very close, indicating the emissions are narrowband.

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For LTE B12, B13, B14 Band-Edge:

| CH BW | RB Used | CF for emissions more than 100kHz |
|-------|---------|-----------------------------------|
| 1.4 | 30 | +5.2 dB |
| 3 | 30 | +5.2 dB |
| 5 | 51 | +2.9 dB |
| 10 | 100 | N/A |

For 1.4MHz & 3MHz bandwidths:

For emissions more than 100kHz from the band edge the value measured in 30kHz, after correction of 10log(30/100), 5.2dB, to account for reference bandwidth of 100kHz and measurement bandwidth of 30 kHz, are below -13dBm.

For 5MHz bandwidths:

For emissions more than 100kHz from the band edge the value measured in 51kHz, after correction of 10log(51/100), 2.9dB, to account for reference bandwidth of 100kHz and measurement bandwidth of 51 kHz, are below -13dBm.

NOTE 4

For 5G NR n41 Emission Mask (Gate trigger off): RF Path Loss: 16.76 dB & DCF 7 dB: 10log(1/5) Measure offset: 16.76 dB+7 dB = 23.76 dB

| | | nalyzer - Swept SA | | | | | | | | JGN AUTO | | | | |
|----------------------|---------------|---|---------|----------|--------|------------|-----------------|-------------|---|-------------------|--------|---|-------------------------|--|
| RL | RL RF 50 Ω DC | | | | | | SENSE:INT | | | | Log-Pv | 04:48:19 PM Jun 08, 2021 TRACE 1 2 3 4 5 | | |
| | | | | F | NO: E | ast 🛶 | | FBurst | | Avg type: | Log-Pv | " | | TYPE WWWWW |
| | | | | | Gain:L | | #Atter | : 20 dB | | | | | | DETPNNN |
| | Def (| Offset 16.76 d | | | | | | | | | | | ΔMkr3 | 5.000 m |
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| enter 2.5 es BW 8 | | 0000 GHz | | | | #VB | W 50 M | H7 | | | 5 | ween | 20.00 ms | Span 0 H (20001 pt) |
| | | | | | | | VV 30 10 | | | | | <u>.</u> | | (20001 pt. |
| R MODE TRO | t sci |) | × 00 | 99 ms | | Y 12.41 | dBm | FUNCTION | FUNC | TION WIDTH | | FL | JNCTION VALUE | |
| 2 Δ1 1 | t | (Δ) | 1.0 | 00 ms | (Δ) | 1.4 | 13 dB | | | | | | | |
| Δ1 1 | t | (Δ) | 5.0 | 00 ms | (Δ) | 5.3 | 27 dB | | | | | | | |
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<u>NOTE 5</u>

5GNR: All waveforms(CP-OFDM vs DFT-OFDM) were investigated to determine the worst case configuration. All mode of operation were investigated and the worst case configuration results are reported in tis section.

RESULTS

See the following pages.

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