

Co-Location Test

EUT Name: Wireless RF Bridge Module

EUT Model: CC-WF25

FCC ID: 2ALBX-CAMWFCLR01 and 2ALBX-CAMPRMR01

IC ID: 22533-CAMWFCLR01 and 22533-CAMPRMR01

662911 D01 Multiple Transmitter Output v02r01

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Report/Issue Date: 21 April 2017

Report Number: Supplement to 31750770.001 and 31750771.001; Co-Location

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1 Antenna Colocation Test

1.1 Radiated Emissions of both Transmitters

This test measures the effects of operating two transmitters in close proximity.

This device is categorized as "Completely Uncorrelated" per 662911 D01 Multiple Transmitter Output v02r01, Clause F).

The EUT is tested to the guidance of KDB # 662911 D01 Multiple Transmitter Output v02r01 Clauses E) and F).

1.1.1 Over View of Test

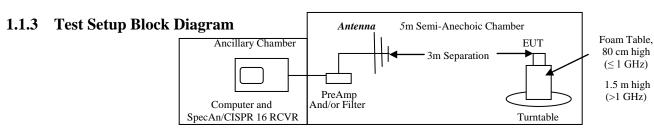
| Results | Complies (as tested | l per this | s report) | | | Date | 17 Marc | h 2017 | | | |
|-----------------------|-----------------------|---|-----------|---------|---------|---------|--------------|--------------|--|--|--|
| Standard | KDB # 662911 D01 | Multiple | e Transmi | tter Oı | tput v0 | 2r01 | | | | | |
| Product Model | CONCENTRATOR | | | Sei | rial# | C4:B | E:84:F2:FA | :40 | | | |
| Test Set-up | Tested in shielded ro | ested in shielded room. EUT placed on table, see test plans for details | | | | | | | | | |
| EUT Powered By | 5 V DC USB Powered | V DC Tomp 7/0 F Humidity 20% Pressure 101 | | | | | | 1014 mbar | | | |
| Frequency Range | 150 kHz – 30 MHz | | | | | | | | | | |
| Perf. Criteria | (Below Limit) | Perf. | Verificat | ion | Readi | ngs Und | er Limit for | L1 & Neutral | | | |
| Mod. to EUT | None | one Test Performed By Mark Ryan | | | | | | | | | |

1.1.1 Test Procedure

The EUT has both transmitters activated. The combined transmissions are scanned and checked for compliance to the requirements of KDB # 662911 D01 Multiple Transmitter Output v02r01.

1.1.2 Deviations

There were no deviations from the test methodology.



1.1.4 Test Parameters

EUT set to the highest emissions of the Nemko Test report (Section 8.4.4 on page 22)

Mid-Band V TI Transmitter:

Modulation: 802.11g

Frequency: 2437 MHz (Channel 6)

TI Settings:

18Mbps (OFDM) Data, Pattern: All 1s, Overwrite CCA: checked, Power: 0 (max).

Dust Transmitter:

Modulation: Continuous

Frequency: 2450 MHz (Channel 9)

Dust Settings:

Radiotest tx cm 0x200 8

Worst-case emissions were Orientation A for both TI and Dust Transmitters.

1.1.5 Final Test

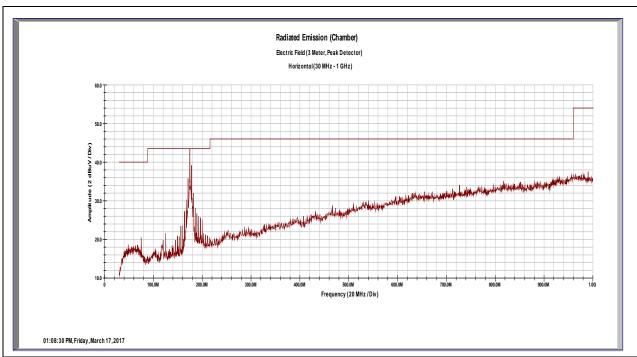
All final radiated emissions measurements were below (in compliance) the limits.

Report Number: Supplement to 31750770.001 and 31750771.001; Co-Location

EUT: Wireless RF Bridge Module, Model: CC-WF25

1.1.6 Final Data and Graphs

Radiated Emissions - 30 to 1000 MHz Horizontal

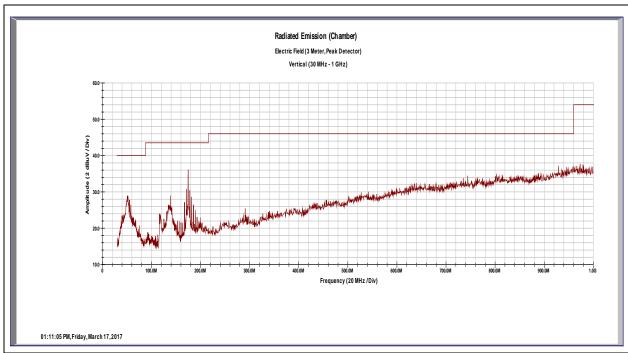


| Emission | ANT | ANT | Table | FIM | Amp | Cable | ANT | E-Field | Spec | Spec |
|----------|-------|-----|-------|--------|------|-------|--------|----------|----------|--------|
| Freq | Polar | Pos | Pos | Value | Gain | Loss | Factor | Value | Limit | Margin |
| (MHz) | (H/V) | (m) | (deg) | (dBµV) | (dB) | (dB) | (dB/m) | (dBµV/m) | (dBµV/m) | (dB) |
| 174.52 | Н | 1.6 | 10 | 27.55 | 0.00 | 1.51 | 13.08 | 42.14 | 43.50 | -1.36 |
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Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor

Notes: Emissions above are not attributable to the intentional Radiators.

Radiated Emissions - 30 to 1000 MHz Vertical

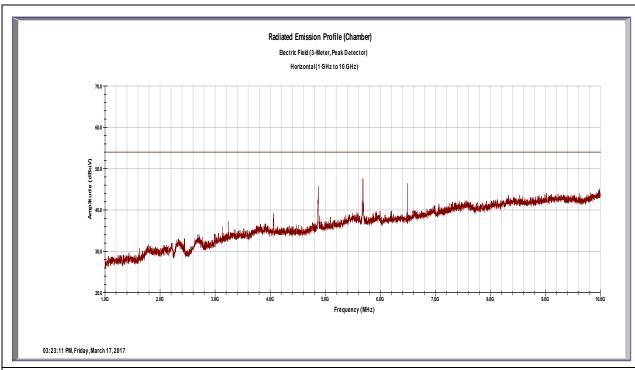


| Emission Freq | ANT Polar | ANT Pos | Table Pos | FIM Value | Amp Gain | Cable Loss | ANT Factor | E-Field Value | Spec Limit | Spec Margin |
|------------------|--------------|------------|--------------|--------------|-------------|---------------|---------------|------------------|---------------|----------------|
| (MHz) | (H/V) | (m) | (deg) | (dBµV) | (dB) | (dB) | (dB/m) | (dBµV/m) | (dBµV/m) | (dB) |
| 50.84 | V | 1 | 355 | 8.77 | 0.00 | 0.84 | 14.03 | 23.64 | 40.00 | -16.36 |
| 138.20 | V | 1 | 271 | 11.91 | 0.00 | 1.35 | 11.92 | 25.18 | 43.50 | -18.32 |
| 174.52 | V | 1 | 260 | 20.17 | 0.00 | 1.51 | 13.08 | 34.77 | 43.50 | -8.73 |
| | | | | | | | | | | |
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Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor

Notes: Emissions above are not attributable to the intentional Radiators.

Radiated Emissions - 1 to 10 GHz Horizontal



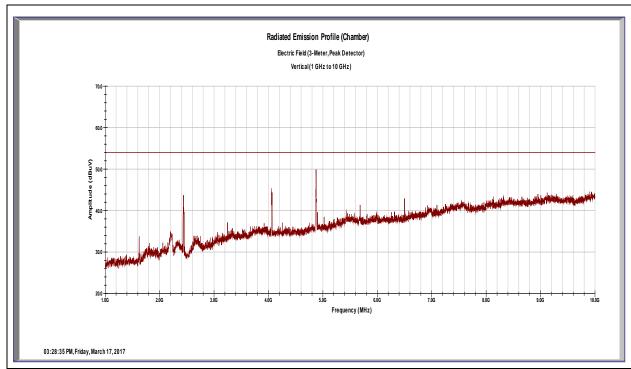
| Emission Freq (MHz) | ANT Polar (H/V) | ANT Pos (m) | Table Pos (deg) | FIM Value (dBµV) | Amp Gain (dB) | Cable Loss (dB) | ANT Factor (dB/m) | E-Field Value (dBµV/m) | Spec Limit (dBµV/m) | Spec Margin (dB) |
|---------------------------|-----------------------|-------------------|-----------------------|------------------------|---------------------|-----------------------|-------------------------|------------------------------|---------------------------|------------------------|
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Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor Notes: Above 1 GHz requires that both the **Peak** and **Average** values are below the respective limits.

The signal level of the fundamental was high enough to require the use of a Notch filter.

The signal at 2.44 GHz is the fundamental frequency of the transmitter

Radiated Emissions - 1 to 10 GHz Vertical



| Emission | ANT | ANT | Table | FIM | Amp | Cable | ANT | E-Field | Spec | Spec |
|----------|-------|-----|-------|--------|-------|-------|--------|----------|----------|--------|
| Freq | Polar | Pos | Pos | Value | Gain | Loss | Factor | Value | Limit | Margin |
| (MHz) | (H/V) | (m) | (deg) | (dBµV) | (dB) | (dB) | (dB/m) | (dBµV/m) | (dBµV/m) | (dB) |
| 4870.40 | V | 2.3 | 349 | 25.01 | 33.77 | 11.69 | 32.99 | 35.92 | 54.00 | -18.08 |
| 4870.40 | V | 2.3 | 349 | 44.67 | 33.77 | 11.69 | 32.99 | 55.58 | 74.00 | -18.42 |
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Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor

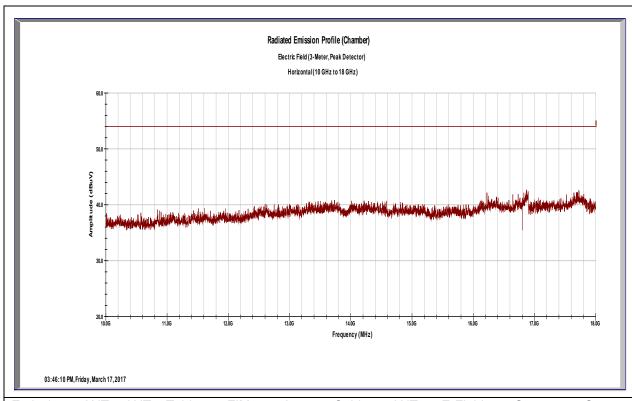
Notes: Above 1 GHz requires that both the **Peak** and **Average** values are below the respective limits. The signal level of the fundamental was high enough to require the use of a Notch filter.

The worst-case harmonic is shown in the table above.

There is no additive effect of both transmitter being on at the same time.

The signal at 2.44 GHz range are both the Wi-Fi and Dust transmitters.

Radiated Emissions – 10 to 18 GHz Horizontal

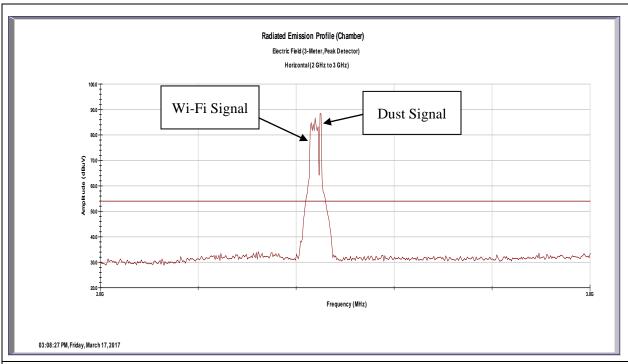


| Emission Freq (MHz) | ANT Polar (H/V) | ANT Pos (m) | Table Pos (deg) | FIM Value (dBµV) | Amp Gain (dB) | Cable Loss (dB) | ANT Factor (dB/m) | E-Field Value (dBµV/m) | Spec Limit (dBµV/m) | Spec Margin (dB) |
|---------------------------|-----------------------|-------------------|-----------------------|------------------------|---------------------|-----------------------|-------------------------|------------------------------|---------------------------|------------------------|
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Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor

Notes: No measurable signals found.

Worst-Case Radiated Emissions 2GHz to 3GHz Horizontal

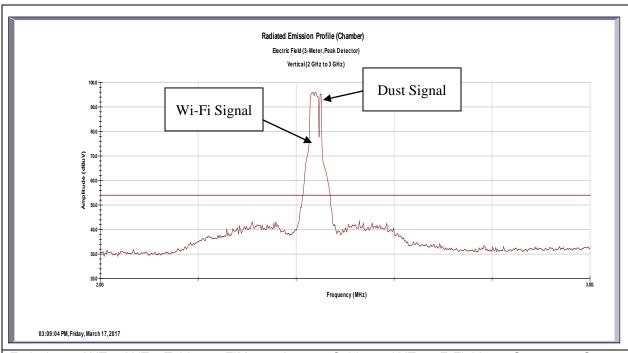


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|---|----------|-------|-----|-------|--------|------|-------|--------|----------|----------|----------------|
| | Emission | ANT | ANT | Table | FIM | Amp | Cable | ANT | E-Field | Spec | Spec Margin |
| | Freq | Polar | Pos | Pos | Value | Gain | Loss | Factor | Value | Limit | Margin |
| | (MHz) | (H/V) | (m) | (deg) | (dBuV) | (dB) | (dB) | (dB/m) | (dBuV/m) | (dBuV/m) | (dB) |
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Notes: Above 1 GHz requires that both the **Peak** and **Average** values are below the respective limits. Vertical Emissions were worst case.

All Peak emissions other than the fundamental frequency is below the restricted-band average limits. This measurement was made without the 2.4 GHz notch filter for in-band emissions.

Worst-Case Radiated Emissions 2GHz to 3GHz Vertical

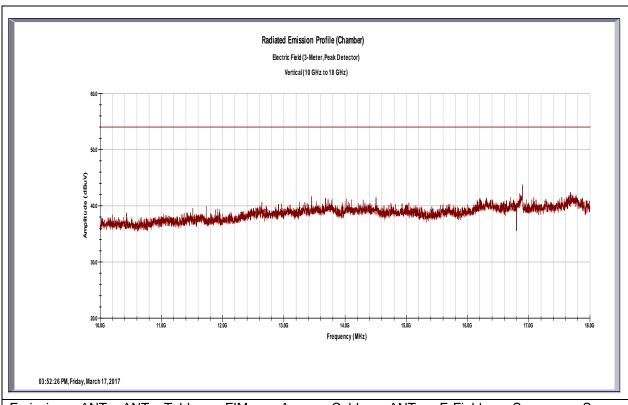


| Emission | ANT | ANT | Table | FIM | Amp | Cable | ANT | E-Field | Spec | Spec |
|----------|-------|-----|-------|--------|------|-------|--------|----------|----------|--------|
| Freq | Polar | Pos | Pos | Value | Gain | Loss | Factor | Value | Limit | Margin |
| (MHz) | (H/V) | (m) | (deg) | (dBuV) | (dB) | (dB) | (dB/m) | (dBuV/m) | (dBuV/m) | (dB) |
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Notes: Vertical Emissions were worst case.

All Peak emissions other than the fundamental frequency is below the restricted-band average limits. This measurement was made without the 2.4 GHz notch filter for in-band emissions.

Radiated Emissions - 10 to 18 GHz Vertical



| Emission Freq (MHz) | ANT Polar | ANT Pos | Table Pos | FIM Value | Amp Gain | Cable Loss | ANT Factor (dB/m) | E-Field Value | Spec Limit | Spec Margin |
|---------------------------|--------------|------------|--------------|--------------|-------------|---------------|-------------------------|------------------|---------------|----------------|
| (IVITZ) | (H/V) | (m) | (deg) | (dBµV) | (dB) | (dB) | (ub/III) | (dBµV/m) | (dBµV/m) | (dB) |
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Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor

Notes: No measureable signals found.

Radiated Emissions – 18 to 25 GHz Horizontal

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| Res BV | | | | | | VBW : | 3 MHz | | Swe | ep 80 ms (8 | |
| | | | | | | | | | | | |
| Emissi | | ANT | ANT | Table | FIM | Amp | Cable | ANT | E-Field | Spec | Spec |
| Freq | | Polar | Pos | Pos | Value | Gain | Loss | Factor | Value | Limit | Margin |
| (MHz | <u>') (</u> | (H/V) | (m) | (deg) | (dBµV) | (dB) | (dB) | (dB/m) | (dBµV/m) | (dBµV/m) | (dB) |
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| Spec Ma Notes: | | | | | | ue = FIIVI | value - Am | ip Gain + t | Jable Loss + | - ANT FACIOI | |
| | | | | | | ue = Filvi | value - Am | ip Gain + G | Jable Loss + | - AINT FACTOR | |

Radiated Emissions - 18 to 25 GHz Vertical

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| art 1 | | | | | | VBW 3 | 3 MHz | | Swee | Sto ep 80 ms (80 | p 26 GH 000 pts) |
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| Emiss Free (MH: | q | ANT Pola (H/V | r Pos | Table Pos (deg) | FIM Value (dBµV) | Amp Gain (dB) | Cable Loss (dB) | ANT Factor (dB/m) | E-Field Value (dBµV/m) | Spec Limit (dBµV/m) | Spec Margi (dB) |
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1.1.7 Test Setup Photos:



Figure 1: Typical Radiated Emissions – 30 MHz to 1 GHz shown, Front view Orientation "A" shown

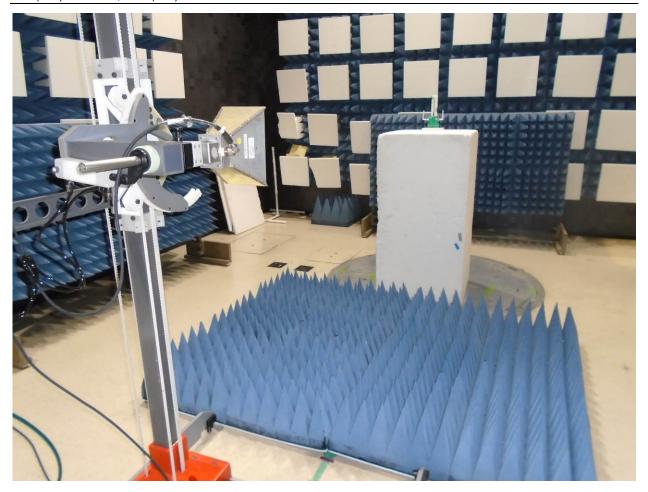


Figure 2: Typical Radiated Emissions – 1 GHz to 18 GHz shown, to ANSI C63.10:2009

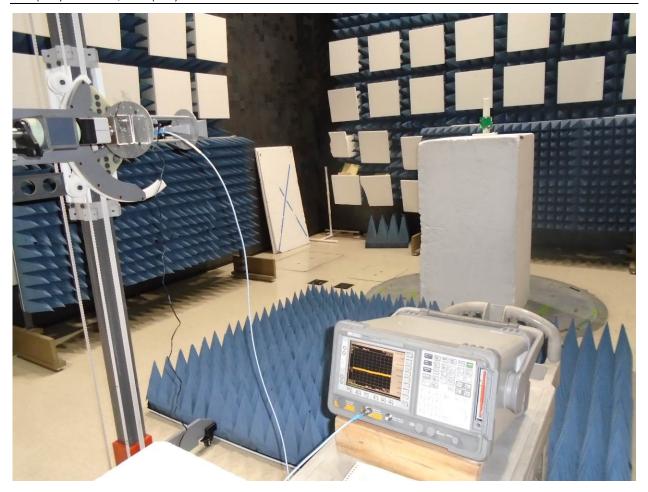


Figure 3: Typical Radiated Emissions – 18 GHz to 25 GHz shown

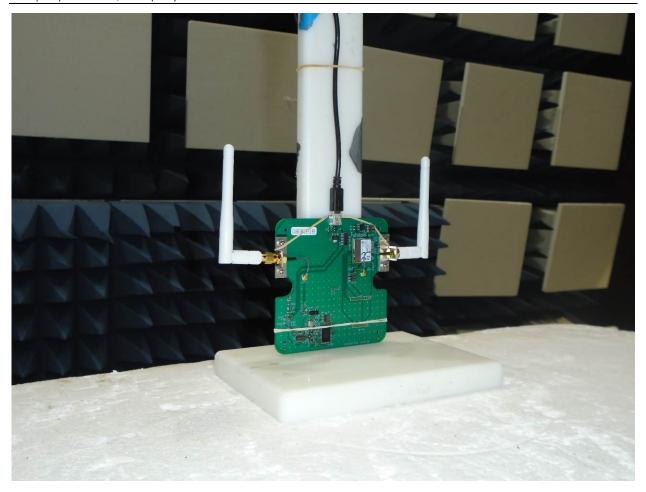


Figure 4: Typical Radiated Emissions co-location Test Setup

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1.2 Conducted RF Measurements of both transmitters

1.2.1 Test Over View

| Results | Complies (as tested per this report) | | | | Date | 15 | March 2017 | |
|----------------------|---|------|--------------------------|------|-------------------|----------------------|------------|-----------|
| Standard | KDB # 662911 D01 Multiple Transmitter Output v02r01 | | | | | | | |
| Product Model | CONCENTRATOR Serial# | | | C4:E | C4:BE:84:F2:FA:40 | | | |
| Test Set-up | Direct Measurement from antenna port | | | | | | | |
| EUT Powered By | 5 VDC (USB) | Temp | 70° F | H | umidity | 18% | Pressure | 1002 mbar |
| Perf. Criteria | (Below Limit) | | Perf. Verification | | Read | Readings Under Limit | | |
| Mod. to EUT | None | | Test Performed By | | Mark | Mark Ryan | | |

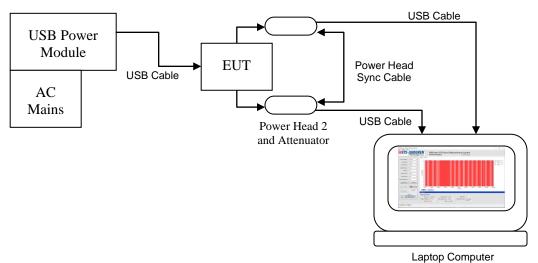
1.2.2 Test Procedure

The EUT is tested to the guidance of KDB # 662911 D01 Multiple Transmitter Output v02r01 Clauses E) and F).

1.2.3 Deviations

There were no deviations from the test methodology listed in the test plan for the Radiated Immunity test.



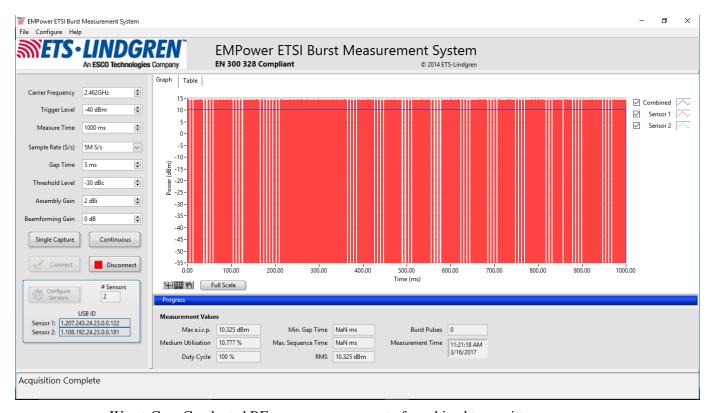


1.2.5 Final Results

Peak Output Conducted Power Measurements:

| | Emission Freq (MHz) | Combined Eirp Output (dBm) | Eirp Power Limit (dBi) | Margin to limit (dB - EIRP) | Results |
|---|---------------------------|----------------------------------|------------------------------|-----------------------------|---------|
| I | 2412.00 (f _L) | 8.854 | 36.0 | -27.15 | PASS |
| | 2462.00 (f _M) | 10.325 | 36.0 | -25.68 | PASS |
| ſ | 2475.00 (f _H) | 8.526 | 36.0 | -27.47 | PASS |

Note: These measurements include the maximum antenna gain of 2 dBi and a Duty Cycle of 100%



Worst-Case Conducted RF power measurement of combined transmitters.

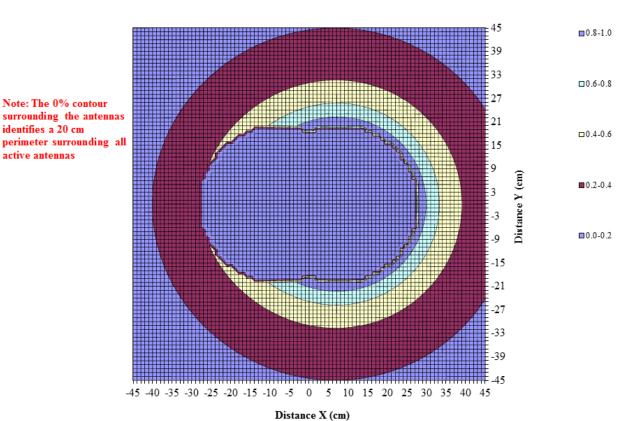
Note: The 10.325 dBm value shown includes the 2dBi Maximum Gain of the antenna.

The Power Output with the antenna would be 10.325 dBm eirp.

identifies a 20 cm

active antennas

% MPE Contour



Parameters used for Contour Map:

| Turdineters used for contour true. | | | | | | | |
|------------------------------------|--------------------|-------|-------|-------|--|--|--|
| Antenna No. | | Total | 1 | 2 | | | |
| Tx Status | | | On | On | | | |
| Frequency | MHz | | 2450 | 2437 | | | |
| MPE Limit | mW/cm ² | | 1.00 | 1.00 | | | |
| Max % MPE | % | 1.0 | 0.1 | 0.9 | | | |
| Power | (W) | 0.032 | 0.003 | 0.029 | | | |
| Antenna Gain | dBi | | 2.00 | 2.00 | | | |
| EIRP | (W) | 0.05 | 0.005 | 0.046 | | | |
| X | (cm) | | -8.0 | 8.0 | | | |
| Υ | (cm) | | 0.0 | 0.0 | | | |

%MPE Contour, using the MPE-mobile.xls spreadsheet.

1.2.6 Photos:



Figure 5: Close-up view of Conducted RF Emissions Test Setup for Co-Location Power test setup

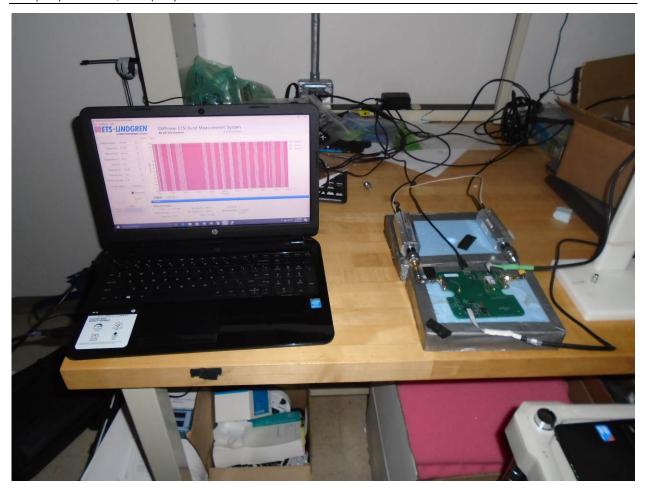


Figure 6: View of Conducted RF Emissions Test Setup for Co-Location Power test setup