

# 1 CO-LOCATION

## 1.1 Transmitter Radiated Unwanted Emissions

### 1.1.1 Transmitter Radiated Unwanted Emissions Limit

| Restricted Band Emissions Limit |                       |                         |                      |
|---------------------------------|-----------------------|-------------------------|----------------------|
| Frequency Range (MHz)           | Field Strength (uV/m) | Field Strength (dBuV/m) | Measure Distance (m) |
| 0.009~0.490                     | 2400/F(kHz)           | 48.5 - 13.8             | 300                  |
| 0.490~1.705                     | 24000/F(kHz)          | 33.8 - 23               | 30                   |
| 1.705~30.0                      | 30                    | 29                      | 30                   |
| 30~88                           | 100                   | 40                      | 3                    |
| 88~216                          | 150                   | 43.5                    | 3                    |
| 216~960                         | 200                   | 46                      | 3                    |
| Above 960                       | 500                   | 54                      | 3                    |

Note 1: Test distance for frequencies at or above 30 MHz, measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).

Note 2: Test distance for frequencies at below 30 MHz, measurements may be performed at a distance closer than the EUT limit distance; however, an attempt should be made to avoid making measurements in the near field. When performing measurements below 30 MHz at a closer distance than the limit distance, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two or more distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). The test report shall specify the extrapolation method used to determine compliance of the EUT.

| Un-restricted Band Emissions Limit |            |
|------------------------------------|------------|
| RF output power procedure          | Limit (dB) |
| Peak output power procedure        | 20         |
| Average output power procedure     | 30         |

Note 1: If the peak output power procedure is used to measure the fundamental emission power to demonstrate compliance to requirements, then the peak conducted output power measured within any 100 kHz outside the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum measured in-band peak PSD level.

Note 2: If the average output power procedure is used to measure the fundamental emission power to demonstrate compliance to requirements, then the power in any 100 kHz outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum measured in-band average PSD level.

### 1.1.2 Measuring Instruments

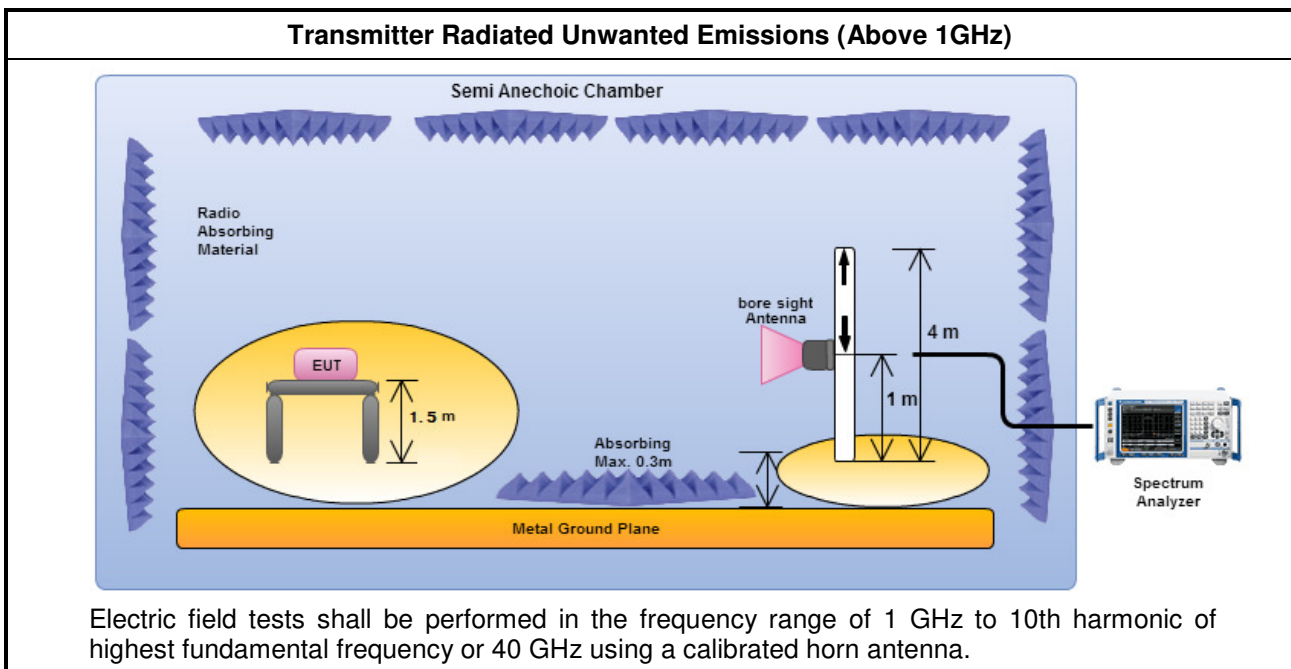
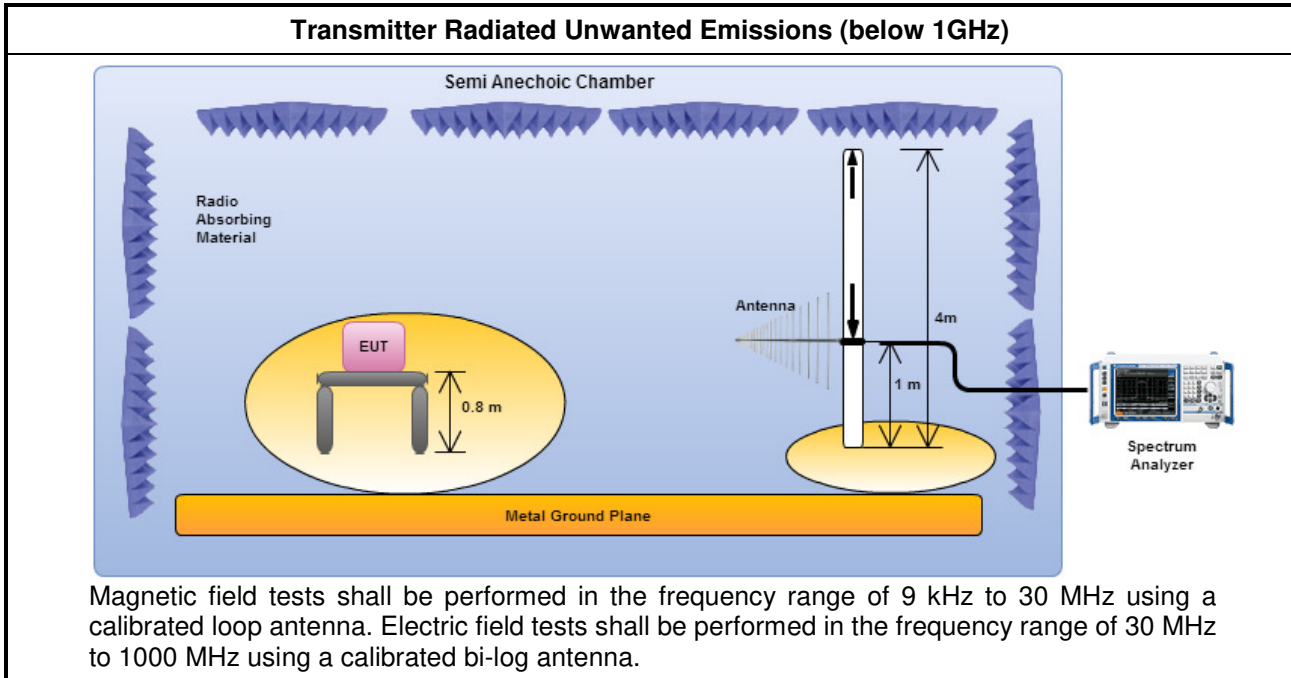
Refer a test equipment and calibration data table in this test report.

### 1.1.3 Test Procedures

| Test Method                         |   |
|-------------------------------------|---|
| <input checked="" type="checkbox"/> | Measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements). |
| <input checked="" type="checkbox"/> | Measurements in the frequency range 10 GHz - 18GHz are typically made at a closer distance 1m, because the instrumentation noise floor is typically close to the radiated emission limit.   |
| <input checked="" type="checkbox"/> | Measurements in the frequency range above 18 GHz - 25GHz are typically made at a closer distance 0.5m, because the instrumentation noise floor is typically close to the radiated emission limit.   |
| <input checked="" type="checkbox"/> | The average emission levels shall be measured in [duty cycle $\geq$ 98 or duty factor].   |
| <input checked="" type="checkbox"/> | For the transmitter unwanted emissions shall be measured using following options below:   |
| <input checked="" type="checkbox"/> | Refer as FCC KDB 558074, clause 10.1 for unwanted emissions into non-restricted bands.  |
| <input checked="" type="checkbox"/> | Refer as FCC KDB 558074, clause 10.2 for unwanted emissions into restricted bands.  |
| <input type="checkbox"/>            | Refer as FCC KDB 558074, clause 10.2.3.3 and 8.2.1 Option 1 (spectral trace averaging)  |
| <input type="checkbox"/>            | Refer as FCC KDB 558074, clause 10.2.3.3 and 8.2.1 Option 2 (slow sweep speed).   |
| <input checked="" type="checkbox"/> | Refer as ANSI C63.10, clause 4.2.3.2.3 (Reduced VBW). VBW $\geq$ 1/T, where T is pulse time.  |
| <input type="checkbox"/>            | Refer as ANSI C63.10, clause 4.2.3.2.4 average value of pulsed emissions.   |
| <input checked="" type="checkbox"/> | Refer as FCC KDB 558074, clause 10.2.3.2 and 8.1.1 measurement procedure peak limit.  |
| <input type="checkbox"/>            | Refer as FCC KDB 558074, clause 10.2.3.1 measurement procedure Quasi-Peak limit.  |
| <input checked="" type="checkbox"/> | For radiated measurement, refer as FCC KDB 558074, clause 10.2.1.   |
| <input checked="" type="checkbox"/> | Refer as ANSI C63.10, clause 6.4 for radiated emissions below 30 MHz and test distance is 3m.   |
| <input checked="" type="checkbox"/> | Refer as ANSI C63.10, clause 6.5 for radiated emissions 30 MHz to 1 GHz and test distance is 3m.  |
| <input checked="" type="checkbox"/> | Refer as ANSI C63.10, clause 6.6 for radiated emissions above 1 GHz and test distance is 3m.  |
| <input type="checkbox"/>            | For conducted and cabinet radiation measurement, refer as FCC KDB 558074, clause 10.2.2.  |
| <input type="checkbox"/>            | For conducted unwanted emissions into non-restricted bands (relative emission limits).<br>Devices with multiple transmit chains:<br>Refer as FCC KDB 662911, when testing out-of-band and spurious emissions against relative emission limits, tests may be performed on each output individually without summing or adding 10 log(N) if the measurements are made relative to the in-band emissions on the individual outputs.   |
| <input type="checkbox"/>            | For conducted unwanted emissions into restricted bands (absolute emission limits).<br>Devices with multiple transmit chains using options given below:<br>(1) Measure and sum the spectra across the outputs or<br>(2) Measure and add 10 log(N) dB   |

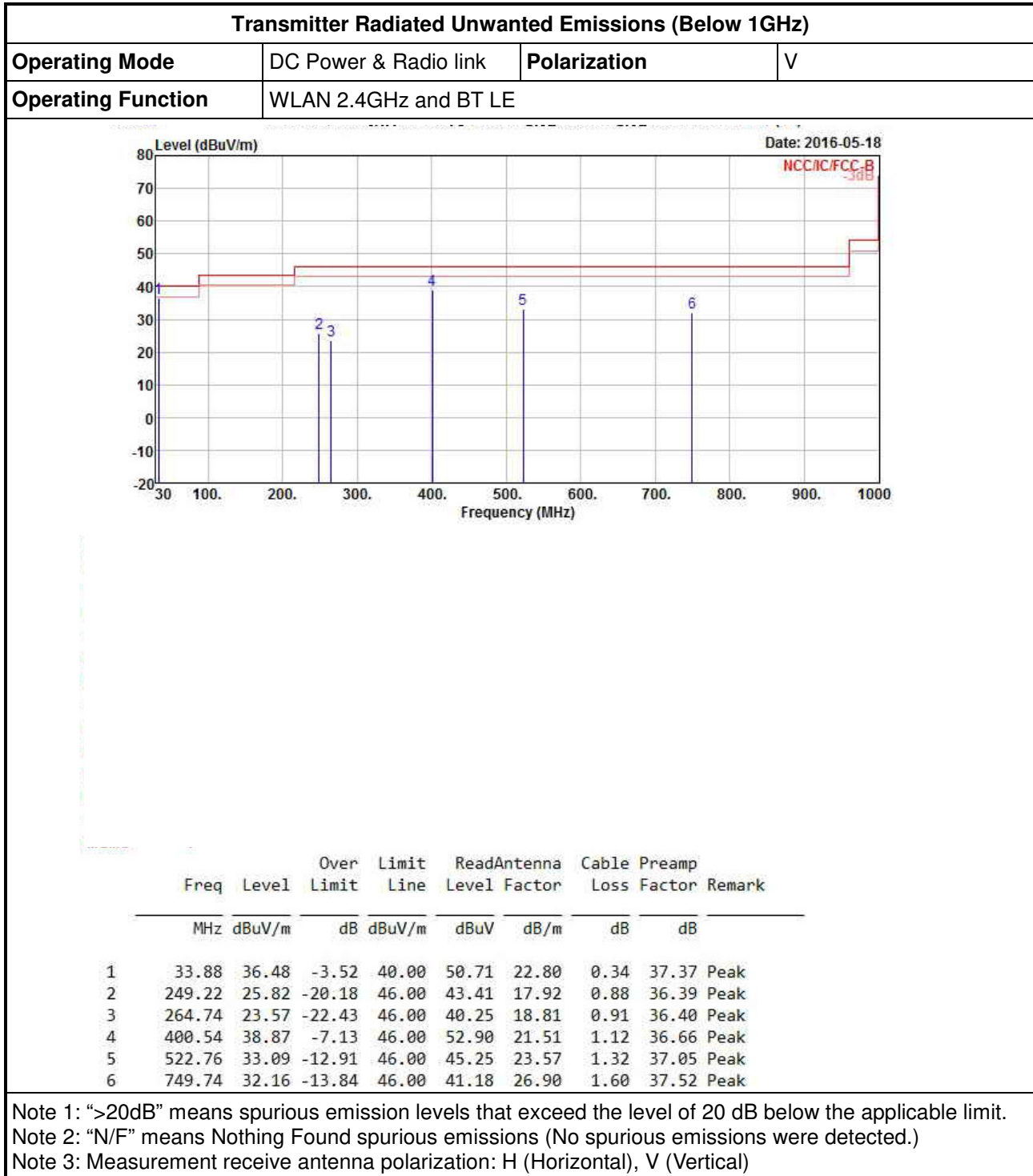
FCC KDB 558074

### 1.1.4 Test Setup



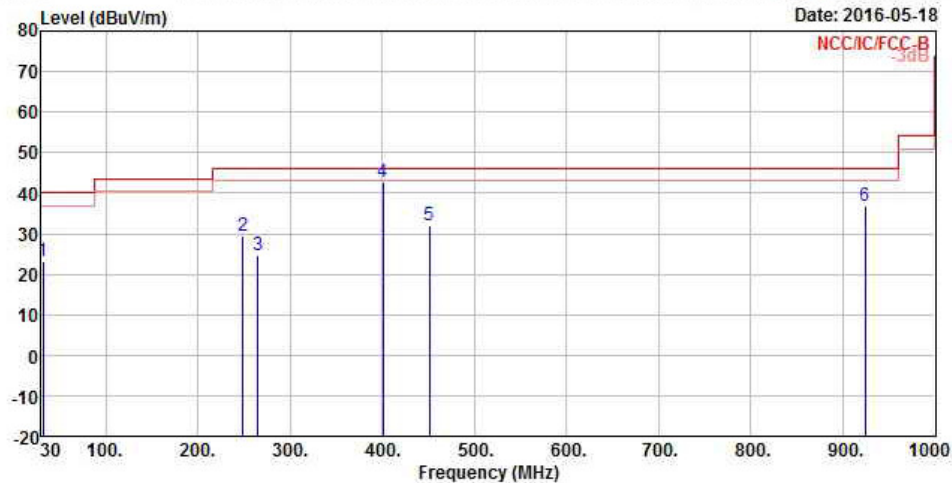
### 1.1.5 Transmitter Radiated Unwanted Emissions (Below 30MHz)

All amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

**1.1.6 Results of Radiated Emissions (30MHz~1GHz)**


**Transmitter Radiated Unwanted Emissions (Below 1GHz)**

|                           |                       |                     |   |
|---------------------------|-----------------------|---------------------|---|
| <b>Operating Mode</b>     | DC Power & Radio link | <b>Polarization</b> | H |
| <b>Operating Function</b> | WLAN 2.4GHz and BT LE |                     |   |

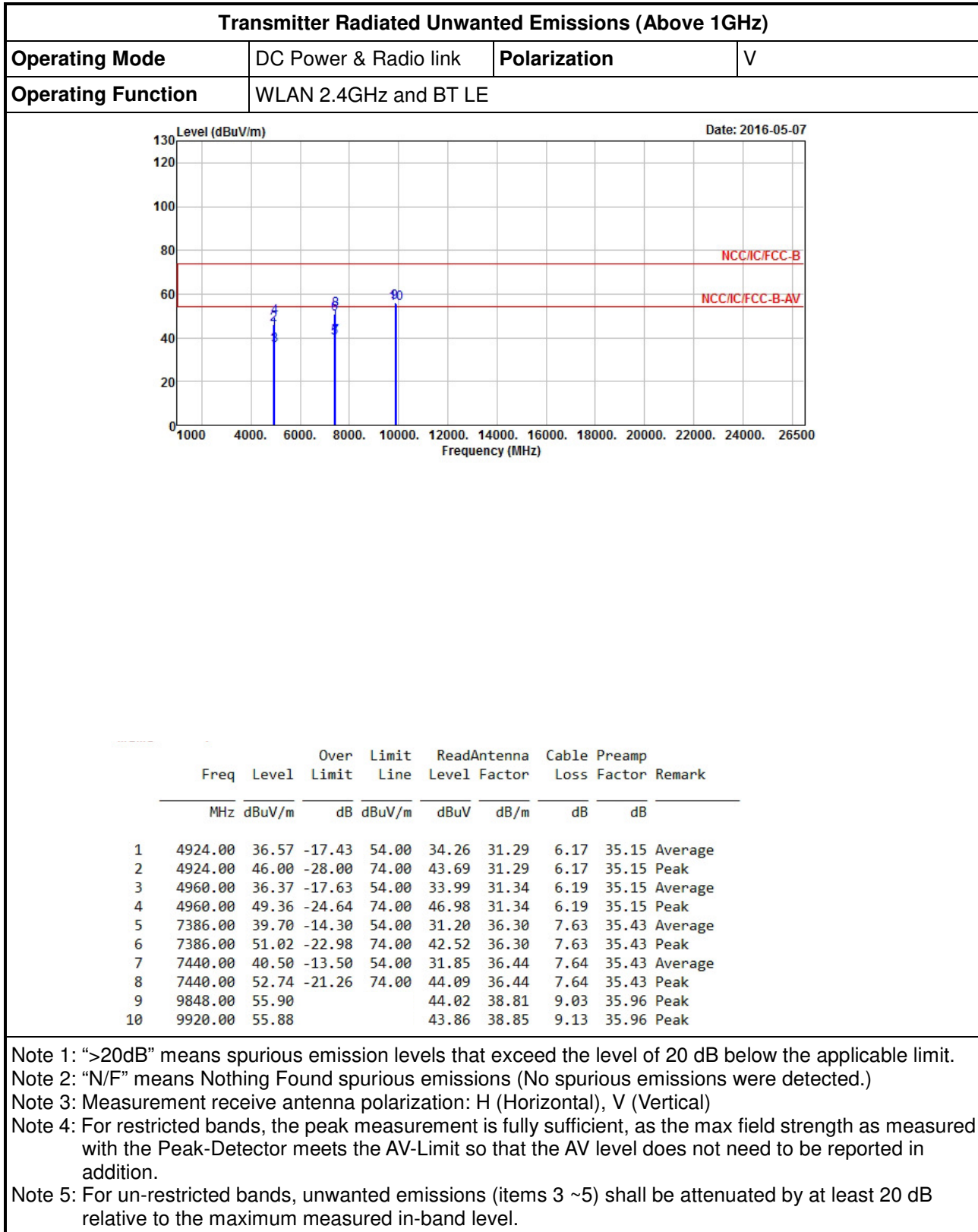


|   | Freq   | Level  | Over Limit | Limit Line | ReadAntenna Level | Cable Factor | Preamp Loss | Remark     |
|---|--------|--------|------------|------------|-------------------|--------------|-------------|------------|
|   | MHz    | dBuV/m | dB         | dBuV/m     | dBuV              | dB/m         | dB          | dB         |
| 1 | 31.94  | 23.03  | -16.97     | 40.00      | 36.24             | 23.85        | 0.33        | 37.39 Peak |
| 2 | 249.22 | 29.49  | -16.51     | 46.00      | 47.08             | 17.92        | 0.88        | 36.39 Peak |
| 3 | 264.74 | 24.58  | -21.42     | 46.00      | 41.26             | 18.81        | 0.91        | 36.40 Peak |
| 4 | 400.54 | 42.86  | -3.14      | 46.00      | 56.89             | 21.51        | 1.12        | 36.66 QP   |
| 5 | 450.98 | 32.11  | -13.89     | 46.00      | 45.30             | 22.42        | 1.21        | 36.82 Peak |
| 6 | 924.34 | 36.64  | -9.36      | 46.00      | 43.17             | 29.23        | 1.82        | 37.58 Peak |

Note 1: ">20dB" means spurious emission levels that exceed the level of 20 dB below the applicable limit.

Note 2: "N/F" means Nothing Found spurious emissions (No spurious emissions were detected.)

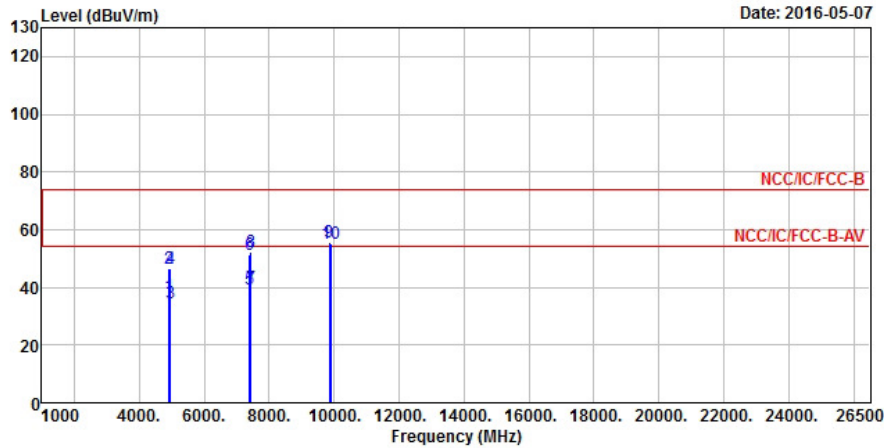
Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)

**1.1.7 Results for Radiated Emissions (1GHz~10<sup>th</sup> Harmonic)**




## Transmitter Radiated Unwanted Emissions (Below 1GHz)

|                    |                       |              |   |
|--------------------|-----------------------|--------------|---|
| Operating Mode     | DC Power & Radio link | Polarization | H |
| Operating Function | WLAN 2.4GHz and BT LE |              |   |



|    | Freq    | Level  | Over   | Limit  | ReadAntenna | Cable | Preamp |               |
|----|---------|--------|--------|--------|-------------|-------|--------|---------------|
|    | MHz     | dBuV/m | Limit  | Line   | Level       | Loss  | Factor | Remark        |
|    |         |        | dB     | dBuV/m | dBuV        | dB    | dB     |               |
| 1  | 4924.00 | 37.09  | -16.91 | 54.00  | 34.78       | 31.29 | 6.17   | 35.15 Average |
| 2  | 4924.00 | 46.56  | -27.44 | 74.00  | 44.25       | 31.29 | 6.17   | 35.15 Peak    |
| 3  | 4960.00 | 34.59  | -19.41 | 54.00  | 32.21       | 31.34 | 6.19   | 35.15 Average |
| 4  | 4960.00 | 46.74  | -27.26 | 74.00  | 44.36       | 31.34 | 6.19   | 35.15 Peak    |
| 5  | 7386.00 | 39.46  | -14.54 | 54.00  | 30.96       | 36.30 | 7.63   | 35.43 Average |
| 6  | 7386.00 | 51.35  | -22.65 | 74.00  | 42.85       | 36.30 | 7.63   | 35.43 Peak    |
| 7  | 7440.00 | 39.74  | -14.26 | 54.00  | 31.09       | 36.44 | 7.64   | 35.43 Average |
| 8  | 7440.00 | 52.34  | -21.66 | 74.00  | 43.69       | 36.44 | 7.64   | 35.43 Peak    |
| 9  | 9848.00 | 55.84  |        |        | 43.96       | 38.81 | 9.03   | 35.96 Peak    |
| 10 | 9920.00 | 55.01  |        |        | 42.99       | 38.85 | 9.13   | 35.96 Peak    |

Note 1: ">20dB" means spurious emission levels that exceed the level of 20 dB below the applicable limit.

Note 2: "N/F" means Nothing Found spurious emissions (No spurious emissions were detected.)

Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)

Note 4: For restricted bands, the peak measurement is fully sufficient, as the max field strength as measured with the Peak-Detector meets the AV-Limit so that the AV level does not need to be reported in addition.

Note 5: For un-restricted bands, unwanted emissions (items 3 ~5) shall be attenuated by at least 20 dB relative to the maximum measured in-band level.

## 2 TEST EQUIPMENT AND CALIBRATION DATA

| Instrument                     | Manufacturer | Model No.           | Serial No.         | Characteristics    | Calibration Last Cal. | Calibration Due Date |
|--------------------------------|--------------|---------------------|--------------------|--------------------|-----------------------|----------------------|
| 3m Semi Anechoic Chamber       | TDK          | SAC-3M              | 03CH09-HY          | 30MHz ~ 1GHz<br>3m | Jul. 01, 2015         | Jun. 30, 2016        |
| 3m Semi Anechoic Chamber       | TDK          | SAC-3M              | 03CH09-HY          | 1GHz ~ 18GHz<br>3m | Jul. 01, 2015         | Jun. 30, 2016        |
| Amplifier                      | EMC          | EMC9135             | 980232             | 9kHz ~ 1.0GHz      | Jan. 29, 2016         | Jan. 28, 2017        |
| Amplifier                      | Agilent      | 8449B               | 3008A02096         | 1GHz ~ 26.5GHz     | Apr.11.2016           | Apr.10.2017          |
| Spectrum                       | KEYSIGHT     | N9010A              | MY54200885         | 10Hz ~ 44GHz       | Jul. 15, 2015         | Jul. 14, 2016        |
| Bilog Antenna & 5dB Attenuator | TESEQ & MTJ  | CBL 6111D & MTJ6102 | 35418              | 30MHz ~ 1GHz       | Mar. 31, 2016         | Mar. 30, 2017        |
| Horn Antenna                   | SCHWARZBECK  | BBHA 9120D          | BBHA 9120D<br>1534 | 1GHz ~ 18GHz       | Apr. 22, 2016         | Apr. 21, 2017        |
| Horn Antenna                   | SCHWARZBECK  | BBHA9170            | BBHA9170614        | 18GHz ~ 40GHz      | Jan. 04, 2016         | Jan. 03, 2017        |