# FCC TEST REPORT

| | |
|---|---|
| **Test report No:** | **EMC- FCC- R0085** |
| **FCC ID:** | **O6ZHR44** |
| **Type of Equipment:** | **SATELLITE RECEIVER** |
| **Model Name:** | **HR44-500** |
| **Applicant:** | **HUMAX Co., Ltd** |
| **FCC Rule Part(s):** | **FCC Part 15 Subpart C**<br>**Section 15.203, Section 15.209**<br>**Section 15.207, Section 15.247** |
| **Frequency Range:** | **2 400 MHz ~ 2 483.5 MHz,** |
| **Test result:** | **Complied** |

The above equipment was tested by EMC compliance Testing Laboratory for compliance with the requirements of FCC Rules and Regulations.
The results of testing in this report apply to the product/system which was tested only. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

**Date of test: September 24, 2012 ~ October 26, 2012**

**Issued date: November 2, 2012**

Tested by: YU, SANG HOON

Approved by: KIM, CHANG MIN


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# 1. Client information

| | |
|---|---|
| Applicant: | HUMAX Co., Ltd |
| Address: | 212-1, Yubang-dong, Cheoin-gu Yong-in-si, Gyeonggi-do, Korea |
| Telephone number: | +82-31-776-6748 |
| Facsimile number : | +82-31-776-6149 |
| Contact person: | Jaeho LEE / Manager |

| | |
|---|---|
| Manufacturer : | HUMAX Co., Ltd |
| Address: | 212-1, Yubang-dong, Cheoin-gu Yong-in-si, Gyeonggi-do, Korea |


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# 2. Laboratory information

Address
EMC Compliance Ltd.
480-5 Shin-dong, Yeongtong-gu, Suwon-city, Gyunggi-do, 443-390, Korea
Telephone Number: 82 31 336 9919  Facsimile Number: 82 31 336 4767

Certificate
CBTL Testing Laboratory, KOLAS NO.: 231
FCC Filing No.: 508785
VCCI Registration No.: C-1713, R-1606, T-258

SITE MAP



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# 3. Description of E.U.T.

## 3.1 Basic description

| | |
|---|---|
| Applicant : | HUMAX Co., Ltd |
| Address of Applicant: | 212-1, Yubang-dong, Cheoin-gu Yong-in-si, Gyeonggi-do, Korea |
| Manufacturer: | HUMAX Co., Ltd |
| Address of Manufacturer: | 212-1, Yubang-dong, Cheoin-gu Yong-in-si, Gyeonggi-do, Korea |
| Type of equipment: | SATELLITE RECEIVER |
| Basic Model: | HR44-500 |
| Serial number: | Proto Type |

## 3.2 General description

| | |
|---|---|
| Model Name | HR44-500 |
| Communication | 2.4 GHz: 802.15.4(RF4CE)<br>2.4 GHz: 802.11b/g/n(HT20, HT40),<br>5.0 GHz: 802.11a/n(HT20, HT40) |
| Frequency Range | 2.4 GHz: 2 400.0 ~ 2 483.5 MHz<br>5.0 GHz: 5 150 ~ 5 350 MHz, 5 470 ~ 5 725 MHz, 5 725 ~ 5 850 MHz |
| Type of Modulation | O-QPSK, CCK, OFDM |
| Channel capacity | **2.4 GHz:**<br>3 ch(RF4CE)<br>**2.4 GHz:**<br>11 ch(802.11b/g/n_HT20)<br>7 ch(802.11n_HT40)<br>**5.0 GHz:**<br>5 150 ~ 5 350 MHz: 8 ch(802.11a/n_HT20), 4 ch(802.11n_HT40)<br>5 470 ~ 5 725 MHz: 11 ch(802.11a/n_HT20), 5 ch(802.11n_HT40)<br>5 725 ~ 5 850 MHz: 5 ch(802.11a/n_HT20), 2 ch(802.11n_HT40) |
| Antenna Gain | 2.4 GHz : 2.89 dBi<br>2.4 GHz : 3.1 dBi,<br>5.0 GHz : 3.2 dBi |
| Type of Antenna | PCB Antenna |
| Firmware version | Wi-Fi Driver Ver: 5.90.188.59, RF4CE Driver Ver:1.5.3.1 |
| Power supply | AC 120 V |
| Operating temperature | 0 ~ 50 °C |
| Dimension | 33 mm x 25 mm x 4 mm (W x D x H) |


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## 3.3 Test frequency

For all teset items, the low, middle and high channels of the modes were tested with above worst case data rate.

2400 ~ 2483.5 (MHz) : 802.15.4(RF4CE)

| | CH | Frequency |
|---|---|---|
| Low frequency | 15 | 2 425 MHz |
| Middle frequency | 20 | 2 450 MHz |
| High frequency | 25 | 2 475 MHz |

2400 ~ 2483.5 (MHz) :802.11b/g/n(HT20, HT40)

| | Frequency | Frequency |
|---|---|---|
| Band Width | 20 MHz | 40 MHz |
| Low frequency | 2 412 MHz | 2 422 MHz |
| Middle frequency | 2 437 MHz | 2 437 MHz |
| High frequency | 2 462 MHz | 2 452 MHz |

5150~5250 (MHz) : 802.11a/n(HT20, HT40)

| | Frequency | Frequency |
|---|---|---|
| Band Width | 20 MHz | 40 MHz |
| Low frequency | 5 180 MHz | 5 190 MHz |
| Middle frequency | 5 200 MHz | - |
| High frequency | 5 240 MHz | 5 230 MHz |

5250~5350 (MHz) : 802.11a/n(HT20, HT40)

| | Frequency | Frequency |
|---|---|---|
| Band Width | 20 MHz | 40 MHz |
| Low frequency | 5 260 MHz | 5 270 MHz |
| Middle frequency | 5 300 MHz | - |
| High frequency | 5 320 MHz | 5 310 MHz |

5470~5350 (MHz) : 802.11a/n(HT20, HT40)

| | Frequency | Frequency |
|---|---|---|
| Band Width | 20 MHz | 40 MHz |
| Low frequency | 5 500 MHz | 5 510 MHz |
| Middle frequency | 5 600 MHz | 5 590 MHz |
| High frequency | 5 700 MHz | 5 670 MHz |

5250~5350 (MHz) : 802.11a/n(HT20, HT40)

| | Frequency | Frequency |
|---|---|---|
| Band Width | 20 MHz | 40 MHz |
| Low frequency | 5 745 MHz | 5 755 MHz |
| Middle frequency | 5 785 MHz | - |
| High frequency | 5 825 MHz | 5 795 MHz |


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## 3.4 Test Voltage

| mode | Voltage |
|---|---|
| Norminal voltage | AC 120V |


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# 4. Summary of test results

## 4.1 Standards & results

| Rule Reference | Parameter | Report Section | Test Result |
|---|---|---|---|
| 15.203, 15.247(b)(4) | Antenna Requirement | 5.1 | C |
| 15.247(b)(3) | Maximum Peak Output Power | 5.2 | C |
| 15.247(e) | Peak Power Spectral Density | 5.3 | C |
| 15.247(a)(2) | 6 dB Channel Bandwidth | 5.4 | C |
| 15.247(d), 15.205(a), 15.209(a) | Spurious Emission, Band Edge, and Restricted bands | 5.5 | C |
| 15.207(a) | Conducted Emissions | 5.6 | C |
| 15.247(i), 1.1307(b)(1) | RF Exposure | 5.7 | C |
| RSS-Gen, Issue 3,6 | Receiver Spurious Emission (Radiated) | 5.8 | C |

Note: C = complies
NC = Not complies
NT = Not tested
NA = Not Applicable

## 4.2 Uncertainty

| Measurement Item | Combined Standard Uncertainty Uc | Expanded Uncertainty U = KUc (K = 2) |
|---|---|---|
| Conducted RF power | ± 0.75 dB | ± 1.3 dB |
| Radiated disturbance | +2.280dB / - 2.278 dB | +4.560dB / - 4.556 dB |
| Conducted disturbance | +1.883 dB / - 1.676 dB | +3.766dB / - 3.352 dB |


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# 5. Test results

## 5.1 Antenna Requirement

### 5.1.1 Regulation

According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to §15.247(b)(4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### 5.1.2 Result

-Complied

The transmitter has an integral PCB antenna. The directional peak gain of the antenna is 2.89 dBi.


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# 5.2 Maximum Peak Output Power

## 5.2.1 Regulation

According to §15.247(b)(3), For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

According to §15.247(b)(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

## 5.2.2 Measurement Procedure

These test measurement settings are specified in section 5.2 of 558074 D01 DTS Meas Guidance.

**5.2.2.2 Measurement Procedure PK2:**

1. This procedure provides an integrated measurement alternative when the maximumavailable RBW < EBW.
2. Set the RBW = 1 MHz.
3. Set the VBW = 3 MHz.
4. Set the span to a value that is 5-30 % greater than the EBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the spectrum analyzer's integrated band power measurement function with band limits set equal to the EBW band edges (for some analyzers, this may require a manual override to ensure use of peak detector).

   If the spectrum analyzer does not have a band power function, sum the spectrum levels (in linear power units) at 1 MHz intervals extending across the EBW of the spectrum.


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## 5.2.3 Test Result

## -Complied

| Channel | Frequency (MHz) | Result (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|
| Low | 2 425 | 4.47 | 30.00 | 25.53 |
| Middle | 2 450 | 4.18 | 30.00 | 25.82 |
| High | 2 475 | 3.83 | 30.00 | 26.17 |

-NOTE:

1. Since the directional gain of the integral antenna declared by the manufacturer ($G_{ANT}$ = 2.89 dBi), does not exceed 6.0 dBi, there was no need to reduce the output power.
2. We took the insertion loss of the cable loss into consideration within the measuring instrument.


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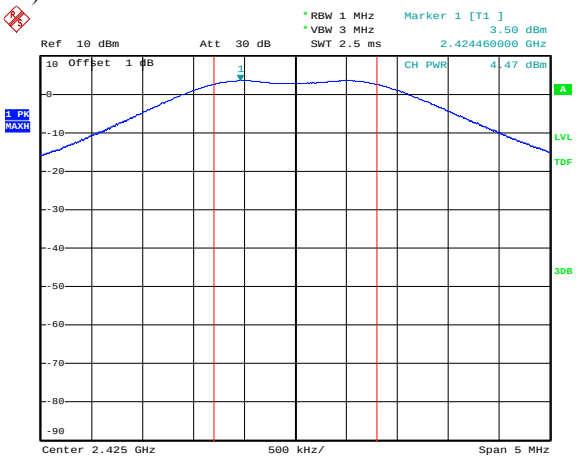
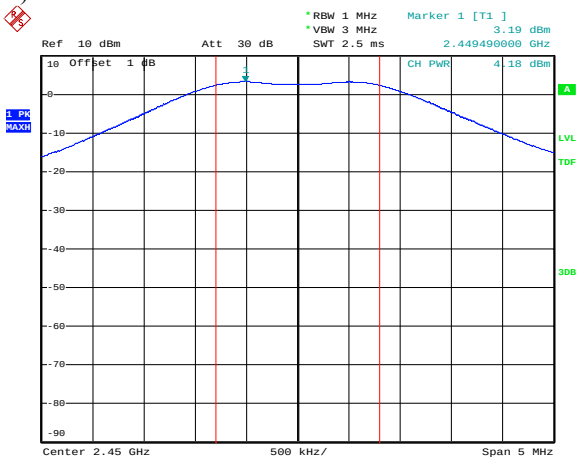
## 5.2.4 Test Plot

Figure 1. Plot of the Maximum Peak Output Power

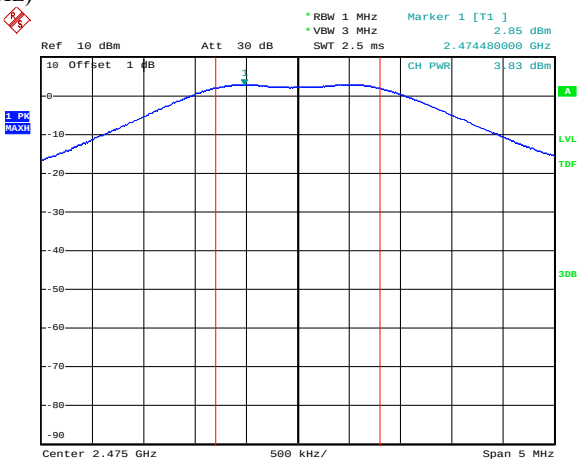
- Lowest Channel (2 425 MHz)




- Middle Chnnel (2 450 MHz)




- Highest Chnnel (2 475 MHz)





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## 5.3 Peak Power Spectral Density

### 5.3.1 Regulation

According to §15.247(e), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

### 5.3.2 Measurement Procedure

These test measurement settings are specified in section 5.3 of 558074 D01 DTS Meas Guidance.

**5.3.2.1 Measurement Procedure PKPSD:**

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW = 100 kHz.
3. Set the VBW ≥ 300 kHz.
4. Set the span to 5-30 % greater than the EBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
10. Scale the observed power level to an equivalent value in 3 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where BWCF = 10log(3 kHz/100 kHz= -15.2 dB).
11. The resulting peak PSD level must be ≤ 8 dBm.


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## 5.3.3 Test Result

## -Complied

| Channel | Reading [dBm] | BWCF [dB] | Result [dBm] | Limit [dBm] | Margin [dBm] |
|---|---|---|---|---|---|
| Low | -0.08 | -15.20 | -15.28 | 8.00 | 23.28 |
| Middle | -0.06 | -15.20 | -15.26 | 8.00 | 23.26 |
| High | -0.49 | -15.20 | -15.69 | 8.00 | 23.69 |

-NOTE:

1. Since the directional gain of the integral antenna declared by the manufacturer ($G_{ANT}$ = 2.89 dBi), does not exceed 6.0 dBi, there was no need to reduce the output power.
2. We took the insertion loss of the cable loss into consideration within the measuring instrument.


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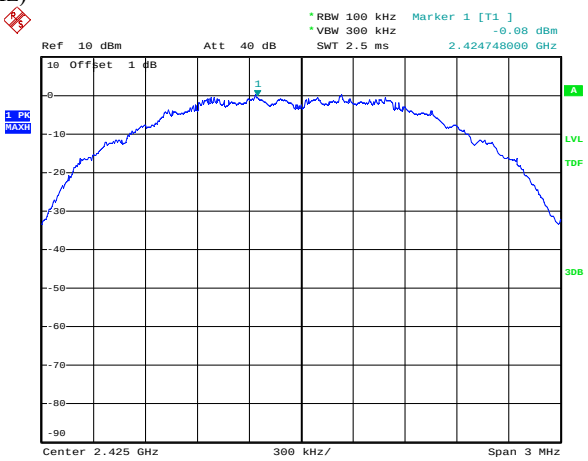
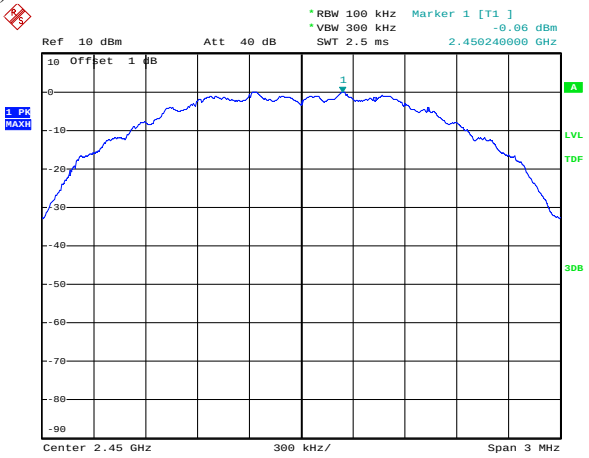
## 5.3.4 Test Plot

Figure 2. Plot of the Power Density (Conducted)

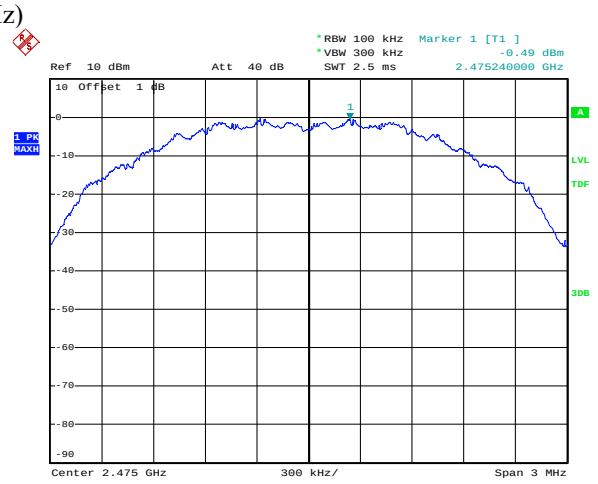
- Lowest Channel( 2 425 MHz)




- Middle Chnnel (2 450 MHz)




- Highest Chnnel (2 475 MHz)





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# 5.4 6 dB Bandwidth

## 5.4.1 Regulation

According to §15.247(a)(2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

## 5.4.2 Measurement Procedure

These test measurement settings are specified in section 5.1 of 558074 D01 DTS Meas Guidance.

**1) EBW Measurement Procedure**:

1. Set resolution bandwidth (RBW) = 1-5 % of the emission bandwidth (EBW).
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission. Compare the resultant bandwidth with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is 1-5 %.

**2) Alternate EBW Measurement Procedure**:

The automatic bandwidth measurement capability of a spectrum analyzer may be employed if it implements the functionality described above (*e.g.*, RBW = 1-5% of EBW, VBW ≥ 3 x RBW, peak detector with maximum hold). When using this capability, care should be taken to ensure that the bandwidth measurement is not influenced by any nulls in the fundamental emission.


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## 5.4.3 Test Result

-Complied

| Channel | Frequency (MHz) | 6dB Bandwidth (MHz) | Min. Limit (kHz) |
|---|---|---|---|
| Low | 2 425 | 1.600 | 500 |
| Middle | 2 450 | 1.600 | 500 |
| High | 2 475 | 1.600 | 500 |


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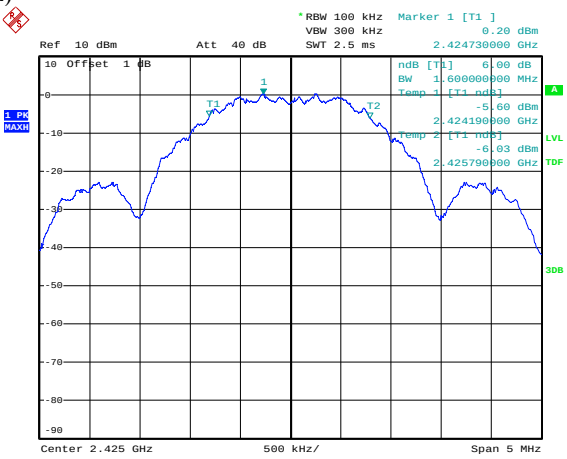
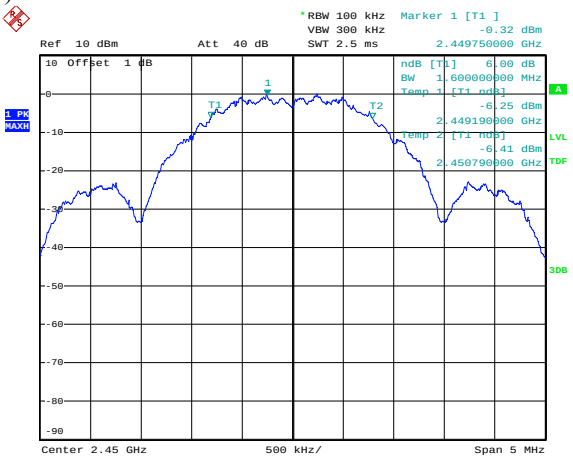
## 5.4.4 Test Plot

Figure 3. Plot of the 6dB Bandwidth (Conducted)

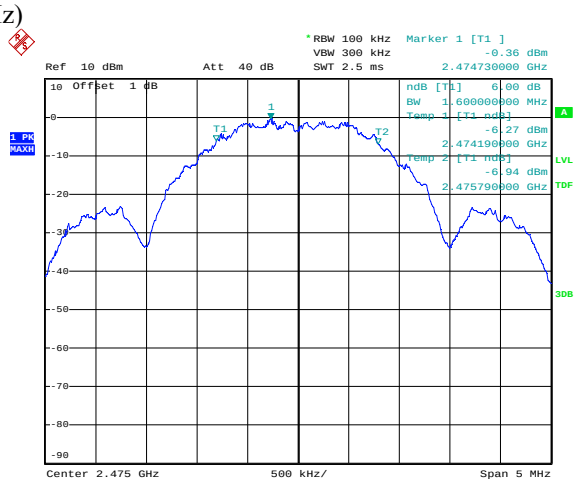
- Lowest Channel (2 425 MHz)




- Middle Channel (2 450 MHz)




- Highest Channel (2 475 MHz)





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# 5.5 SPURIOUS EMISSION, BAND EDGE, AND RESTRICTED BANDS

## 5.5.1 Regulation

According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

According to §15.209(a), for an intentional device, the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the following values:

| Frequency (MHz) | Field strength (μV/m @ 3m) | Field strength (dBμV/m @ 3m) |
|---|---|---|
| 30–88 | 100 | 40.0 |
| 88–216 | 150 | 43.5 |
| 216–960 | 200 | 46.0 |
| Above 960 | 500 | 54.0 |

According to §15.109(a), for an unintentional device, except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the above table.

** The emission limits shown in the above table are based on measurement instrumentation employing a CISPR quasi-peak detector and above 1000 MHz are based on the average value of measured emissions.


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## 5.5.2 Measurement Procedure

1) Band-edge Compliance of RF Conducted Emissions

1. Set the spectrum analyzer as follows:
   Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation
   RBW ≥ 1% of the span
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold
2. Allow the trace to stabilize. Set the marker on the emission at the band-edge, or on the highest modulation product outside of the band, if this level is greater than that at the band-edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.
3. Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit.

2) Spurious RF Conducted Emissions

1. Set the spectrum analyzer as follows:
   Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
   RBW = 100 kHz
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold
2. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.
3. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.


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3) Spurious Radiated Emissions:

1. The preliminary and final rdiated measurements were performed to determine the frequency producing the maximum emissions in at a 10m anechoic chamber. The EUT was tested at a distance 3 meters.
2. The EUT was placed on the top of the 0.8-meter height, 1 × 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360˚.
3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 9 kHz to 30 MHz using the loop antenna, and from 30 to 1000 MHz using the TRILOG broadband antenna, and from 1 000 MHz to 40 000 MHz using the horn antenna.
4. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.

- Sample calculation

The field strength is calculated adding the antenna Factor, cable loss and, Antenna pad adding, subtracting the amplifier gain from the measured reading.

The sample calculation is as follow:

Result = M.R + C.F(A.F + C.L +3 dB Att – A.G) + D.F
M.R = Meter Reading
C.F = Correction Factor
A.F = Antenna Factor
C.L = Cable Loss
A.G = Amplifier Gain
3 dB Att = 3 dB Attenuator

If M.R is 30 dB, A.F 12 dB, C.L 5 dB, 3 dB, A.G 35 dB
The result is : 30 + 12 + 5 + 3 – 35 = 15 dB($\mu$N/m)


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## 5.7.3 Test Result

## -complied

1. Band edge compliance of RF Conducted Emissions was shown in figure 4.
2. Band edge compliance of RF Radiated Emissions was shown in figure 5.
3. Spurious RF conducted Emissions were shown in the Figure 6.

   Note: We took the insertion loss of the cable into consideration within the measuring instrument.

4. Measured value of the Field strength of spurious Emissions (Radiated)

   Low channel (2 425 MHz)

| Frequency [MHz] | Receiver Bandwidth [kHz] | Pol. [V/H] | Reading [dB(μV)] | Factor [dB] | Result [dB(μV/m)] | Limit [dB(μV/m)] | Margin [dB] |
|---|---|---|---|---|---|---|---|
| **Quasi-Peak DATA. Emissions below 30 MHz (3m Distance)** | | | | | | | |
| below 30 MHz | **Not Detected** | | | | | | |
| **Quasi-Peak DATA. Emissions below 1GHz** | | | | | | | |
| 64.86 | 120 | V | 43.7 | -14.9 | 28.8 | 40.0 | 11.2 |
| 112.89 | 120 | V | 55.3 | -16.7 | 38.6 | 43.5 | 4.9 |
| 746.52 | 120 | H | 40.7 | -2.0 | 38.7 | 46.0 | 7.3 |
| 833.02 | 120 | H | 40.2 | -0.3 | 39.9 | 46.0 | 6.1 |
| **Peak DATA. Emissions above 1GHz** | | | | | | | |
| 1 199.50 | 1 000 | V | 55.3 | -7.5 | 47.8 | 74.0 | 26.2 |
| 1 492.75 | 1 000 | V | 55.6 | -5.1 | 50.5 | 74.0 | 23.5 |
| 1 800.25 | 1 000 | V | 52.1 | -3.2 | 48.9 | 74.0 | 25.1 |
| 1 943.50 | 1 000 | V | 52.4 | -2.5 | 49.9 | 74.0 | 24.1 |
| 2 996.50 | 1 000 | V | 54.4 | -0.2 | 54.2 | 74.0 | 19.8 |
| Above 3 000.00 | **Not Detected** | - | - | - | - | - | - |
| **Average DATA. Emissions above 1GHz** | | | | | | | |
| 1 199.50 | 1 000 | V | 38.9 | -7.5 | 31.4 | 54.0 | 22.6 |
| 1 492.75 | 1 000 | V | 36.9 | -5.1 | 31.8 | 54.0 | 22.2 |
| 1 800.25 | 1 000 | V | 37.8 | -3.2 | 34.6 | 54.0 | 19.4 |
| 1 943.50 | 1 000 | V | 34.5 | -2.5 | 32.0 | 54.0 | 22.0 |
| 2 996.50 | 1 000 | V | 38.5 | -0.2 | 38.3 | 54.0 | 15.7 |
| Above 3 000.00 | **Not Detected** | - | - | - | - | - | - |


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Middle channel (2 450 MHz)

| Frequency [MHz] | Receiver Bandwidth [kHz] | Pol. [V/H] | Reading [dB(μV)] | Factor [dB] | Result [dB(μV/m)] | Limit [dB(μV/m)] | Margin [dB] |
|---|---|---|---|---|---|---|---|
| **Quasi-Peak DATA. Emissions below 30 MHz (3m Distance)** | | | | | | | |
| below 30 MHz | **Not Detected** | | | | | | |
| **Quasi-Peak DATA. Emissions below 1GHz** | | | | | | | |
| 62.71 | 120 | V | 50.1 | -14.6 | 35.5 | 40.0 | 4.5 |
| 746.50 | 120 | V | 44.5 | -2.0 | 42.5 | 46.0 | 3.5 |
| 746.50 | 120 | H | 44.4 | -2.0 | 42.4 | 46.0 | 3.6 |
| **Peak DATA. Emissions above 1GHz** | | | | | | | |
| 1 199.50 | 1 000 | V | 54.5 | -7.5 | 47.0 | 74.0 | 27.0 |
| 1 493.50 | 1 000 | V | 55.6 | -5.1 | 50.5 | 74.0 | 23.5 |
| 1 799.50 | 1 000 | V | 53.2 | -3.2 | 50.0 | 74.0 | 24.0 |
| 1 947.25 | 1 000 | V | 52.2 | -2.5 | 49.7 | 74.0 | 24.3 |
| 2 249.50 | 1 000 | V | 51.6 | -1.3 | 50.3 | 74.0 | 23.7 |
| 2 994.25 | 1 000 | V | 55.2 | -0.2 | 55.0 | 74.0 | 19.0 |
| Above 3 000.00 | **Not Detected** | - | - | - | - | - | - |
| **Average DATA. Emissions above 1GHz** | | | | | | | |
| 1 199.50 | 1 000 | V | 35.4 | -7.5 | 27.9 | 54.0 | 26.1 |
| 1 493.50 | 1 000 | V | 37.9 | -5.1 | 32.8 | 54.0 | 21.2 |
| 1 799.50 | 1 000 | V | 36.9 | -3.2 | 33.7 | 54.0 | 20.3 |
| 1 947.25 | 1 000 | V | 39.8 | -2.5 | 37.3 | 54.0 | 16.7 |
| 2 249.50 | 1 000 | V | 35.7 | -1.3 | 34.4 | 54.0 | 19.6 |
| 2 994.25 | 1 000 | V | 36.9 | -0.2 | 36.7 | 54.0 | 17.3 |
| Above 3 000.00 | **Not Detected** | - | - | - | - | - | - |


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High channel (2 475 MHz)

| Frequency [MHz] | Receiver Bandwidth [kHz] | Pol. [V/H] | Reading [dB(μV)] | Factor [dB] | Result [dB(μV/m)] | Limit [dB(μV/m)] | Margin [dB] |
|---|---|---|---|---|---|---|---|
| **Quasi-Peak DATA. Emissions below 30 MHz (3m Distance)** | | | | | | | |
| below 30 MHz | **Not Detected** | | | | | | |
| **Quasi-Peak DATA. Emissions below 1GHz** | | | | | | | |
| 62.33 | 120 | V | 49.2 | -14.6 | 34.6 | 40.0 | 5.4 |
| 112.09 | 120 | V | 54.2 | -16.8 | 37.4 | 43.5 | 6.1 |
| 236.47 | 120 | H | 57.3 | -14.9 | 42.4 | 46.0 | 3.6 |
| 746.59 | 120 | H | 43.0 | -2.0 | 41.0 | 46.0 | 5.0 |
| 746.49 | 120 | V | 44.2 | -2.0 | 42.2 | 46.0 | 3.8 |
| 833.01 | 120 | V | 42.4 | -0.3 | 42.1 | 46.0 | 3.9 |
| **Peak DATA. Emissions above 1GHz** | | | | | | | |
| 1 493.50 | 1 000 | V | 54.1 | -5.1 | 49.0 | 74.0 | 25.0 |
| 1 793.50 | 1 000 | V | 51.2 | -3.2 | 48.0 | 74.0 | 26.0 |
| 1 942.00 | 1 000 | V | 53.6 | -2.5 | 51.1 | 74.0 | 22.9 |
| 2 245.00 | 1 000 | V | 51.4 | -1.3 | 50.1 | 74.0 | 23.9 |
| 2 998.75 | 1 000 | V | 55.4 | -0.2 | 55.2 | 74.0 | 18.8 |
| Above 3 000.00 | **Not Detected** | - | - | - | - | - | - |
| **Average DATA. Emissions above 1GHz** | | | | | | | |
| 1 493.50 | 1 000 | V | 36.8 | -5.1 | 31.7 | 54.0 | 22.3 |
| 1 793.50 | 1 000 | V | 38.9 | -3.2 | 35.7 | 54.0 | 18.3 |
| 1 942.00 | 1 000 | V | 37.3 | -2.5 | 34.8 | 54.0 | 19.2 |
| 2 245.00 | 1 000 | V | 36.8 | -1.3 | 35.5 | 54.0 | 18.5 |
| 2 998.75 | 1 000 | V | 36.9 | -0.2 | 36.7 | 54.0 | 17.3 |
| Above 3 000.00 | **Not Detected** | - | - | - | - | - | - |


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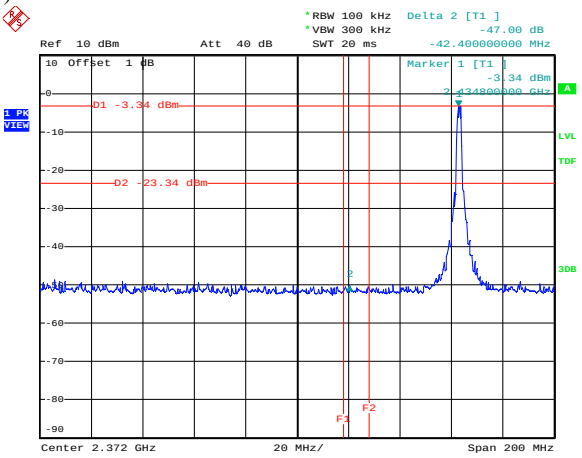
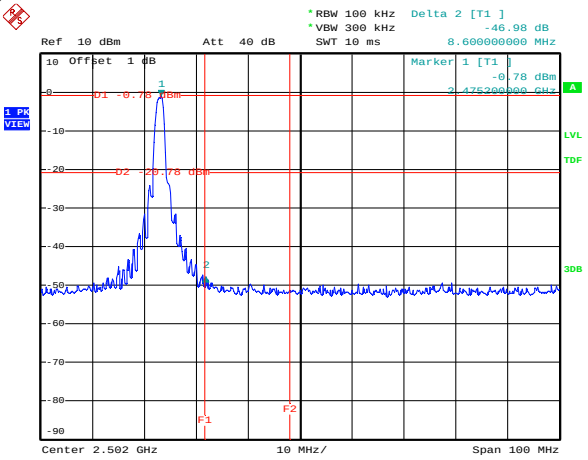
## 5.6.4 Test Plot

Figure 4. Plot of the Band Edge (Conducted)

- Lowest Channel (2 425 MHz)




- Highest Chnnel (2 475 MHz)





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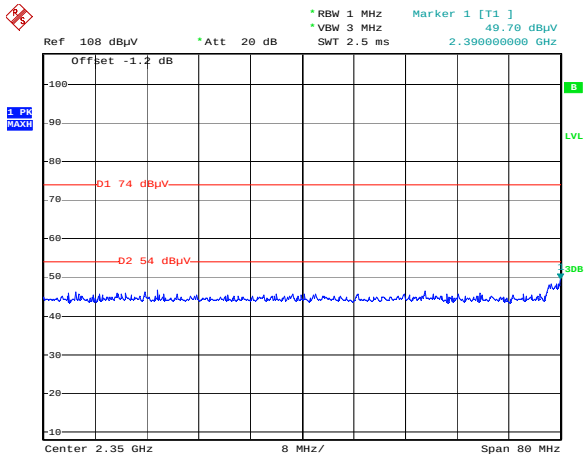
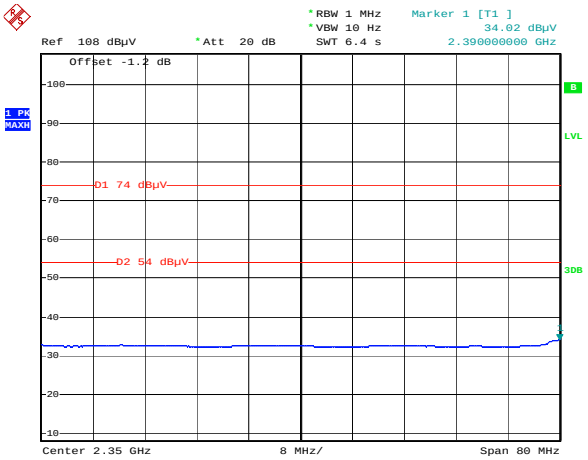
## 5.6.4 Test Plot (Continue)

Figure 5. Plot of the Band Edge (Radiated)

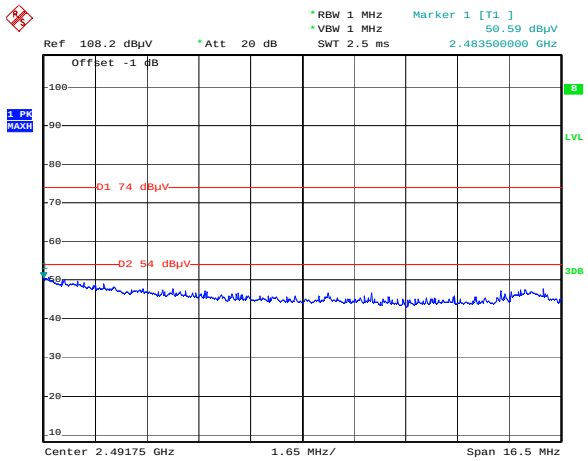
Lowest Channel(2 425 MHz): PEAK



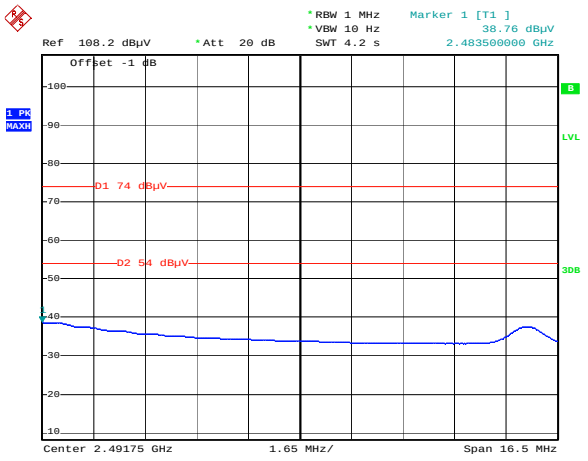

Lowest Channel(2 425 MHz): AVERAGE




Highest Channel(2 475 MHz): PEAK




Highest Channel(2 475 MHz): AVERAGE




*** offset = Factor (ANT Factor+ Amp Gain + Cable Loss) [dB]**
= -1.2 dB (2 425 MHz)
= -1.0 dB (2 475 MHz)


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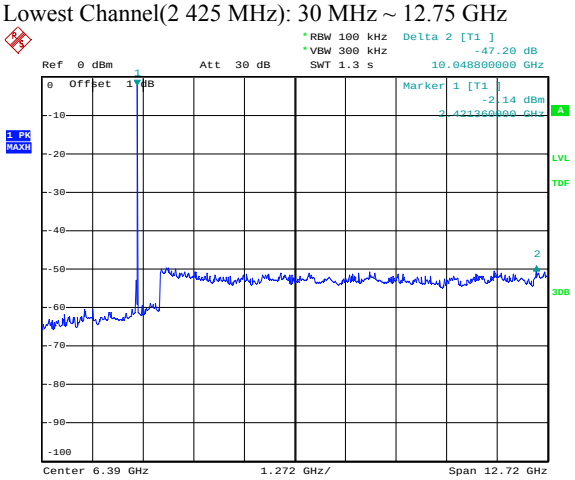
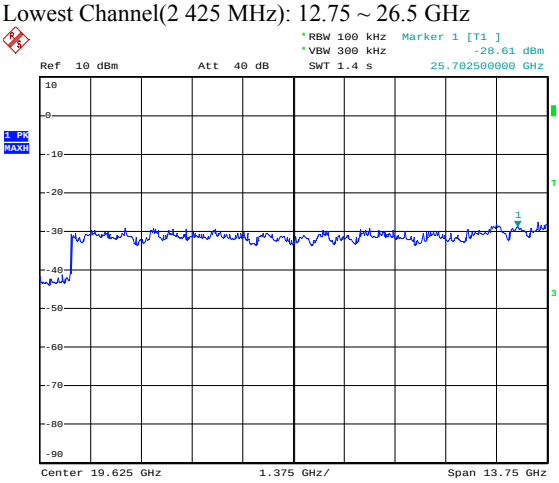
Figure 6. Plot of the Spurious RF conducted emissions

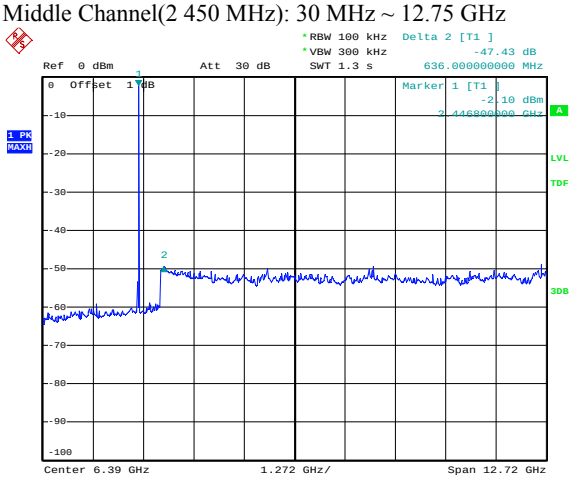
Lowest Channel(2 425 MHz): 30 MHz ~ 12.75 GHz



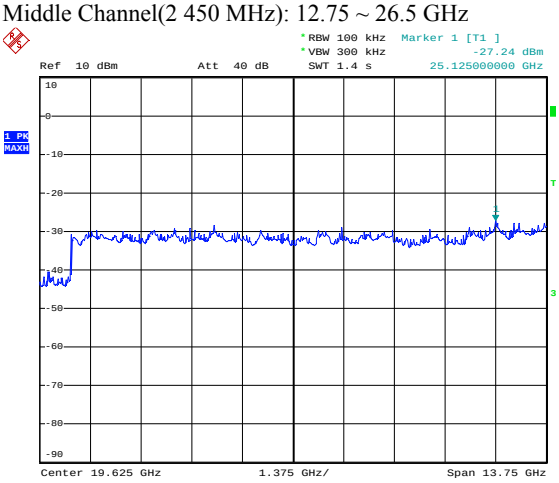

Lowest Channel(2 425 MHz): 12.75 ~ 26.5 GHz



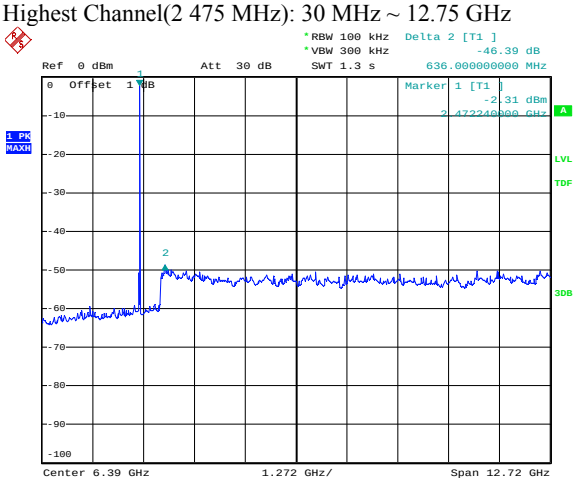

Middle Channel(2 450 MHz): 30 MHz ~ 12.75 GHz



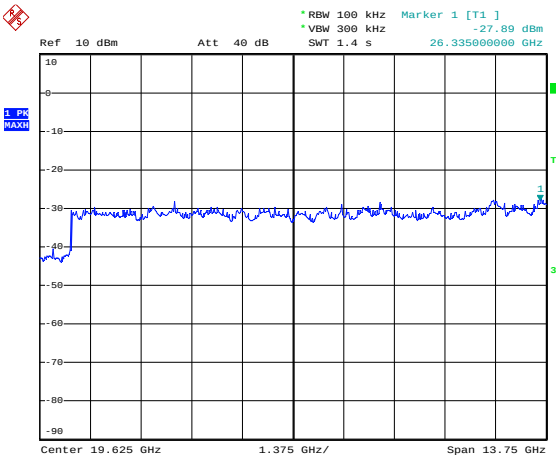

Middle Channel(2 450 MHz): 12.75 ~ 26.5 GHz




Highest Channel(2 475 MHz): 30 MHz ~ 12.75 GHz




Highest Channel(2 475 MHz): 12.75 ~ 26.5 GHz





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# 5.6 Conducted Emission

## 5.6.1 Regulation

According to §15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

| Frequency of emission (MHz) | Conducted limit (dBμV) | |
|---|---|---|
| | Qausi-peak | Average |
| 0.15 – 0.5 | 66 to 56 * | 56 to 46 * |
| 0.5 – 5 | 56 | 46 |
| 5 – 30 | 60 | 50 |

* Decreases with the logarithm of the frequency.

According to §15.107(a), for unintentional device, except for Class A digital devices, line conducted emission limits are the same as the above table.

## 5.6.2 Measurement Procedure

1. The EUT was placed on a wooden table of size, 1 m by 1.5 m, raised 80 cm in which is located 40 cm away from the vertical wall and 1.5m away from the side wall of the shielded room.
2. Each current-carrying conductor of the EUT power cord was individually connected through a 50Ω/50μH LISN, which is an input transducer to a Spectrum Analyzer or an EMI/Field Intensity Meter, to the input power source.
3. Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.
4. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 MHz to 30 MHz.
5. The measurements were made with the detector set to PEAK amplitude within a bandwidth of 10 kHz or to QUASI-PEAK and AVERAGE within a bandwidth of 9 kHz. The EUT was in transmitting mode during the measurements.


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## 5.6.3 Test Result

-complied

2 425 MHz

| Frequency [MHz] | Correction Factor | | Line | Quasi-peak | | | | Average | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | LISN | Cable | | Limit [dBuV] | Reading [dBuV] | Result [dBuV] | Margin [dB] | Limit [dBuV] | Reading [dBuV] | Result [dBuV] | Margin [dB] |
| 0.150 | 9.90 | 0.06 | H | 64.91 | 36.25 | 46.09 | 18.82 | 54.91 | 30.52 | 40.36 | 14.55 |
| 0.153 | 9.90 | 0.06 | N | 64.77 | 36.42 | 46.27 | 18.50 | 54.77 | 31.08 | 40.93 | 13.84 |
| 0.171 | 9.90 | 0.06 | N | 63.82 | 30.44 | 40.32 | 23.50 | 53.82 | 26.19 | 36.07 | 17.75 |
| 0.171 | 9.90 | 0.06 | H | 59.23 | 21.24 | 31.16 | 28.07 | 49.23 | 17.13 | 27.05 | 22.18 |
| 0.180 | 9.90 | 0.07 | H | 56.39 | 30.34 | 40.38 | 16.01 | 46.39 | 26.05 | 36.09 | 10.30 |
| 0.372 | 9.92 | 0.07 | N | 56.39 | 29.68 | 39.72 | 16.67 | 46.39 | 23.62 | 33.66 | 12.73 |
| 0.471 | 10.02 | 0.07 | N | 56.00 | 29.68 | 39.72 | 16.28 | 46.00 | 25.85 | 35.89 | 10.11 |
| 0.477 | 9.95 | 0.07 | H | 56.00 | 26.20 | 36.04 | 19.96 | 46.00 | 20.04 | 29.88 | 16.12 |
| 0.507 | 9.94 | 0.07 | N | 56.00 | 24.68 | 34.52 | 21.48 | 46.00 | 17.21 | 27.05 | 18.95 |
| 0.525 | 9.94 | 0.07 | H | 56.00 | 26.69 | 36.41 | 19.59 | 46.00 | 21.37 | 31.09 | 14.91 |
| 0.540 | 9.94 | 0.07 | N | 56.00 | 27.43 | 37.15 | 18.85 | 46.00 | 21.16 | 30.88 | 15.12 |
| 0.543 | 9.95 | 0.07 | H | 60.00 | 31.02 | 40.78 | 19.22 | 50.00 | 25.33 | 35.09 | 14.91 |
| 0.744 | 9.95 | 0.07 | N | 60.00 | 30.43 | 40.22 | 19.78 | 50.00 | 24.50 | 34.29 | 15.71 |
| 2.007 | 9.96 | 0.09 | H | 60.00 | 32.14 | 41.92 | 18.08 | 50.00 | 26.43 | 36.21 | 13.79 |
| 12.520 | 10.45 | 0.17 | N | 60.00 | 29.59 | 39.38 | 20.62 | 50.00 | 23.50 | 33.29 | 16.71 |
| 12.810 | 10.37 | 0.17 | H | 60.00 | 30.09 | 39.87 | 20.13 | 50.00 | 23.96 | 33.74 | 16.26 |

Note:

1. This measurement was performed the worst case data were reported.


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5 450 MHz

| Frequency [MHz] | Correction Factor | | Line | Quasi-peak | | | | Average | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | LISN | Cable | | Limit [dBuV] | Reading [dBuV] | Result [dBuV] | Margin [dB] | Limit [dBuV] | Reading [dBuV] | Result [dBuV] | Margin [dB] |
| 0.168 | 9.90 | 0.06 | H | 65.06 | 31.79 | 41.75 | 23.31 | 55.06 | 25.68 | 35.64 | 19.42 |
| 0.171 | 9.90 | 0.06 | N | 64.91 | 32.47 | 42.43 | 22.48 | 54.91 | 26.15 | 36.11 | 18.80 |
| 0.246 | 9.90 | 0.07 | N | 61.89 | 21.42 | 31.39 | 30.50 | 51.89 | 7.21 | 17.18 | 34.71 |
| 0.474 | 10.02 | 0.07 | N | 56.44 | 28.63 | 38.72 | 17.72 | 46.44 | 24.46 | 34.55 | 11.89 |
| 0.477 | 9.95 | 0.07 | H | 56.39 | 29.60 | 39.62 | 16.77 | 46.39 | 25.82 | 35.84 | 10.55 |
| 0.507 | 9.94 | 0.07 | N | 56.00 | 28.27 | 38.28 | 17.72 | 46.00 | 23.27 | 33.28 | 12.72 |
| 0.510 | 9.95 | 0.07 | H | 56.00 | 27.13 | 37.15 | 18.85 | 46.00 | 23.79 | 33.81 | 12.19 |
| 0.525 | 9.95 | 0.07 | H | 56.00 | 30.02 | 40.04 | 15.96 | 46.00 | 13.81 | 23.83 | 22.17 |
| 0.525 | 9.94 | 0.07 | N | 56.00 | 29.69 | 39.70 | 16.30 | 46.00 | 16.07 | 26.08 | 19.92 |
| 0.543 | 9.95 | 0.07 | H | 56.00 | 28.63 | 38.65 | 17.35 | 46.00 | 24.38 | 34.40 | 11.60 |
| 0.546 | 9.94 | 0.07 | N | 56.00 | 26.73 | 36.74 | 19.26 | 46.00 | 22.47 | 32.48 | 13.52 |
| 1.377 | 9.96 | 0.07 | H | 56.00 | 26.70 | 36.73 | 19.27 | 46.00 | 15.62 | 25.65 | 20.35 |
| 1.797 | 9.96 | 0.09 | H | 56.00 | 27.05 | 37.10 | 18.90 | 46.00 | 20.10 | 30.15 | 15.85 |
| 12.340 | 10.39 | 0.17 | H | 60.00 | 30.98 | 41.54 | 18.46 | 50.00 | 25.01 | 35.57 | 14.43 |
| 12.470 | 10.32 | 0.17 | N | 60.00 | 30.81 | 41.30 | 18.70 | 50.00 | 24.75 | 35.24 | 14.76 |
| 12.610 | 10.45 | 0.17 | H | 60.00 | 31.35 | 41.97 | 18.03 | 50.00 | 25.37 | 35.99 | 14.01 |

Note:

1. This measurement was performed the worst case data were reported.


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5 875 MHz

| Frequency [MHz] | Correction Factor | | Line | Quasi-peak | | | | Average | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | LISN | Cable | | Limit [dBuV] | Reading [dBuV] | Result [dBuV] | Margin [dB] | Limit [dBuV] | Reading [dBuV] | Result [dBuV] | Margin [dB] |
| 0.168 | 9.90 | 0.06 | H | 65.06 | 30.89 | 40.85 | 24.21 | 55.06 | 25.62 | 35.58 | 19.48 |
| 0.474 | 10.03 | 0.07 | H | 56.44 | 28.90 | 39.00 | 17.44 | 46.44 | 24.02 | 34.12 | 12.32 |
| 0.543 | 9.95 | 0.07 | H | 56.00 | 28.37 | 38.39 | 17.61 | 46.00 | 23.41 | 33.43 | 12.57 |
| 1.458 | 9.96 | 0.07 | H | 56.00 | 26.78 | 36.81 | 19.19 | 46.00 | 21.31 | 31.34 | 14.66 |
| 1.581 | 9.96 | 0.09 | H | 56.00 | 26.49 | 36.54 | 19.46 | 46.00 | 14.91 | 24.96 | 21.04 |
| 2.106 | 9.96 | 0.09 | H | 56.00 | 26.95 | 37.00 | 19.00 | 46.00 | 20.64 | 30.69 | 15.31 |
| 12.320 | 10.39 | 0.17 | H | 60.00 | 31.17 | 41.73 | 18.27 | 50.00 | 24.73 | 35.29 | 14.71 |
| 12.680 | 10.45 | 0.17 | H | 60.00 | 31.28 | 41.90 | 18.10 | 50.00 | 25.93 | 36.55 | 13.45 |
| 13.220 | 10.45 | 0.17 | H | 60.00 | 31.27 | 41.89 | 18.11 | 50.00 | 25.13 | 35.75 | 14.25 |
| 0.171 | 9.90 | 0.06 | N | 64.91 | 35.63 | 45.59 | 19.32 | 54.91 | 27.33 | 37.29 | 17.62 |
| 0.474 | 10.02 | 0.07 | N | 56.44 | 29.66 | 39.75 | 16.69 | 46.44 | 26.07 | 36.16 | 10.28 |
| 0.510 | 9.94 | 0.07 | N | 56.00 | 30.20 | 40.21 | 15.79 | 46.00 | 26.53 | 36.54 | 9.46 |
| 0.531 | 9.94 | 0.07 | N | 56.00 | 31.17 | 41.18 | 14.82 | 46.00 | 16.75 | 26.76 | 19.24 |
| 1.257 | 9.95 | 0.07 | N | 56.00 | 26.71 | 36.73 | 19.27 | 46.00 | 22.18 | 32.20 | 13.80 |
| 1.455 | 9.95 | 0.07 | N | 56.00 | 27.23 | 37.25 | 18.75 | 46.00 | 20.00 | 30.02 | 15.98 |
| 12.630 | 10.37 | 0.17 | N | 60.00 | 32.41 | 42.95 | 17.05 | 50.00 | 25.79 | 36.33 | 13.67 |
| 24.020 | 10.66 | 0.21 | N | 60.00 | 18.12 | 28.99 | 31.01 | 50.00 | 10.04 | 20.91 | 29.09 |

Note:

1. This measurement was performed the worst case data were reported.


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## 5.6.3 Test plot

2 425 MHz_H

EMC Compliance LTD

EUT:
Manuf:
Op Cond:
Operator:
Test Spec: FCC Class B Conducted Emission
Comment:

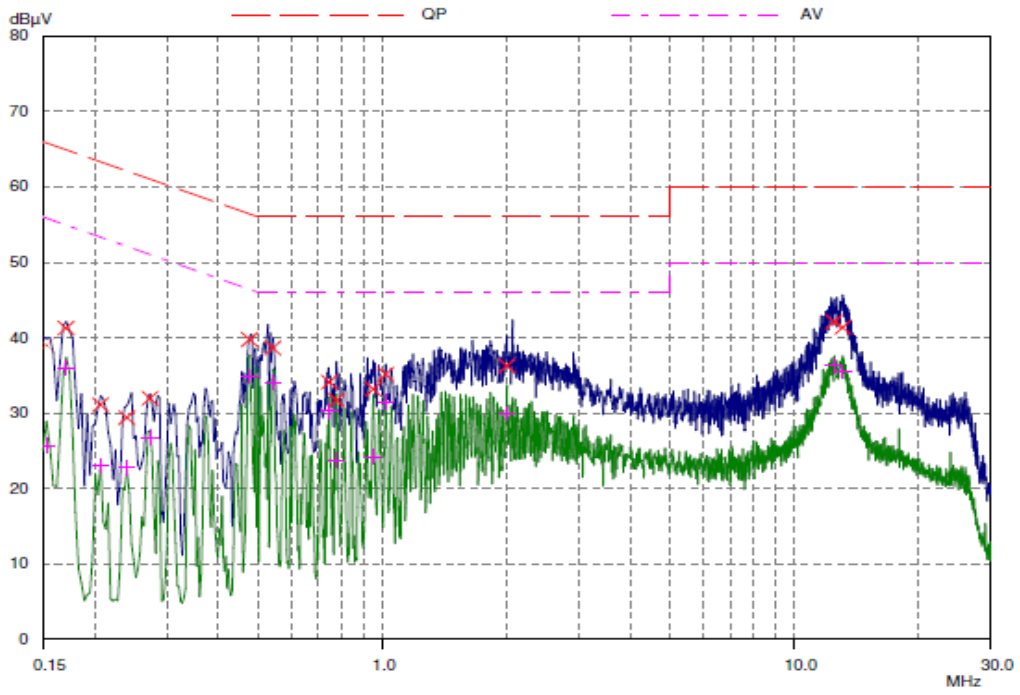
Result File: ch15_H.dat :

Scan Settings (2 Ranges)

| Frequencies | | | Receiver Settings | | | | | |
|---|---|---|---|---|---|---|---|---|
| Start | Stop | Step | IF BW | Detector | M-Time | Atten | Preamp | OpRge |
| 150kHz | 3MHz | 3kHz | 10kHz | PK+AV | 5msec | Auto | OFF | 60dB |
| 3MHz | 30MHz | 10kHz | 10kHz | PK+AV | 2msec | Auto | OFF | 60dB |

| Transducer | No. | Start | Stop | Name |
|---|---|---|---|---|
| | 22 | 150kHz | 30MHz | H |

Final Measurement: Detectors: X QP / + AV
Meas Time: 1sec
Peaks: 8
Acc Margin: 25 dB





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2 425 MHz_N

EMC Compliance LTD

EUT:
Manuf:
Op Cond:
Operator:
Test Spec: FCC Class B Conducted Emission
Comment:

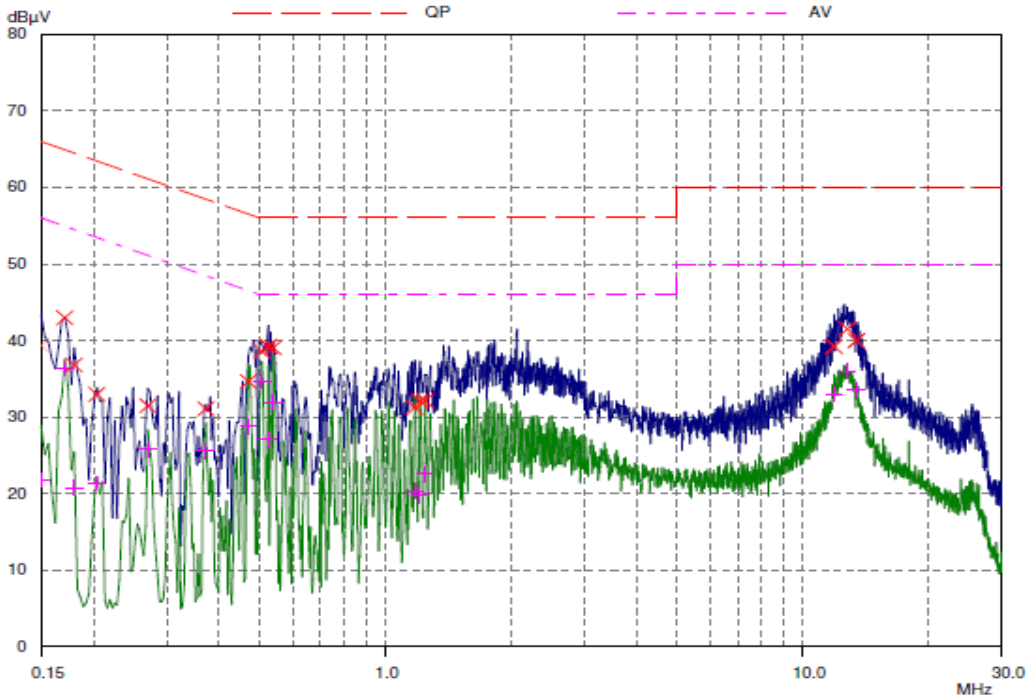
Result File: CH15_N.dat :

Scan Settings (2 Ranges)

| Frequencies | | | Receiver Settings | | | | | |
|---|---|---|---|---|---|---|---|---|
| Start | Stop | Step | IF BW | Detector | M-Time | Atten | Preamp | OpRge |
| 150kHz | 3MHz | 3kHz | 10kHz | PK+AV | 5msec | Auto | OFF | 60dB |
| 3MHz | 30MHz | 10kHz | 10kHz | PK+AV | 2msec | Auto | OFF | 60dB |

| Transducer | No. | Start | Stop | Name |
|---|---|---|---|---|
| | 22 | 150kHz | 30MHz | N |

Final Measurement: Detectors: X QP / + AV
Meas Time: 1sec
Peaks: 8
Acc Margin: 25 dB





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2 450 MHz_H

EMC Compliance LTD

EUT:
Manuf:
Op Cond:
Operator:
Test Spec: FCC Class B Conducted Emission
Comment:

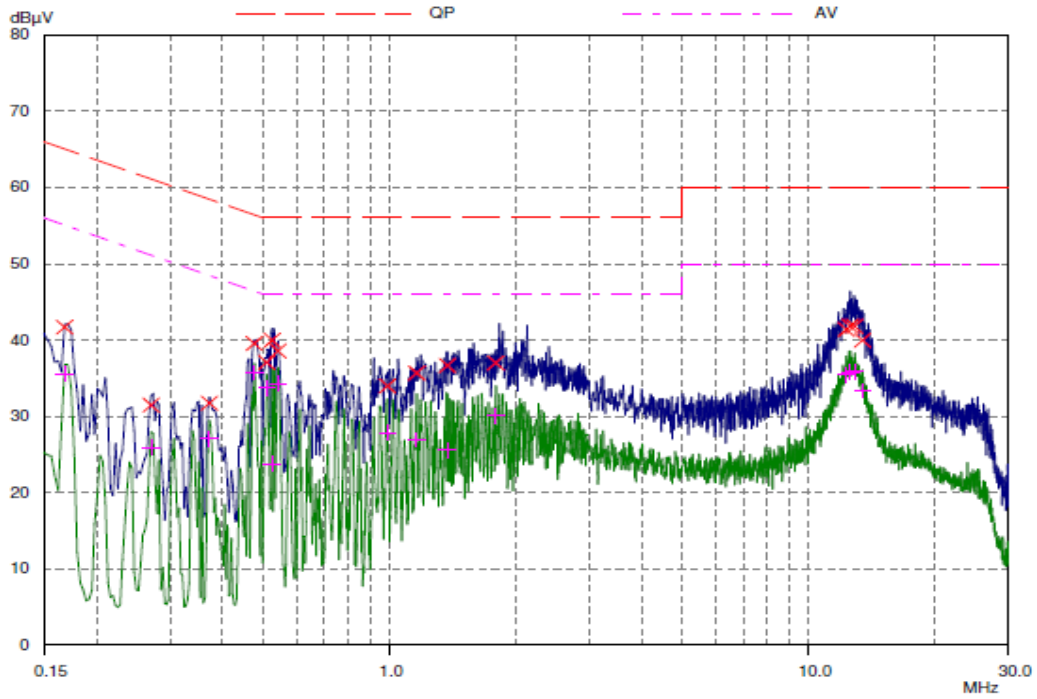
Result File: ch20_h.dat :

Scan Settings (2 Ranges)

| Frequencies | | | Receiver Settings | | | | | |
|---|---|---|---|---|---|---|---|---|
| Start | Stop | Step | IF BW | Detector | M-Time | Atten | Preamp | OpRge |
| 150kHz | 3MHz | 3kHz | 10kHz | PK+AV | 5msec | Auto | OFF | 60dB |
| 3MHz | 30MHz | 10kHz | 10kHz | PK+AV | 2msec | Auto | OFF | 60dB |

| Transducer | No. | Start | Stop | Name |
|---|---|---|---|---|
| | 22 | 150kHz | 30MHz | H |

Final Measurement: Detectors: X QP / + AV
Meas Time: 1sec
Peaks: 8
Acc Margin: 25 dB





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2 450 MHz_N

EMC Compliance LTD

EUT:
Manuf:
Op Cond:
Operator:
Test Spec: FCC Class B Conducted Emission
Comment:

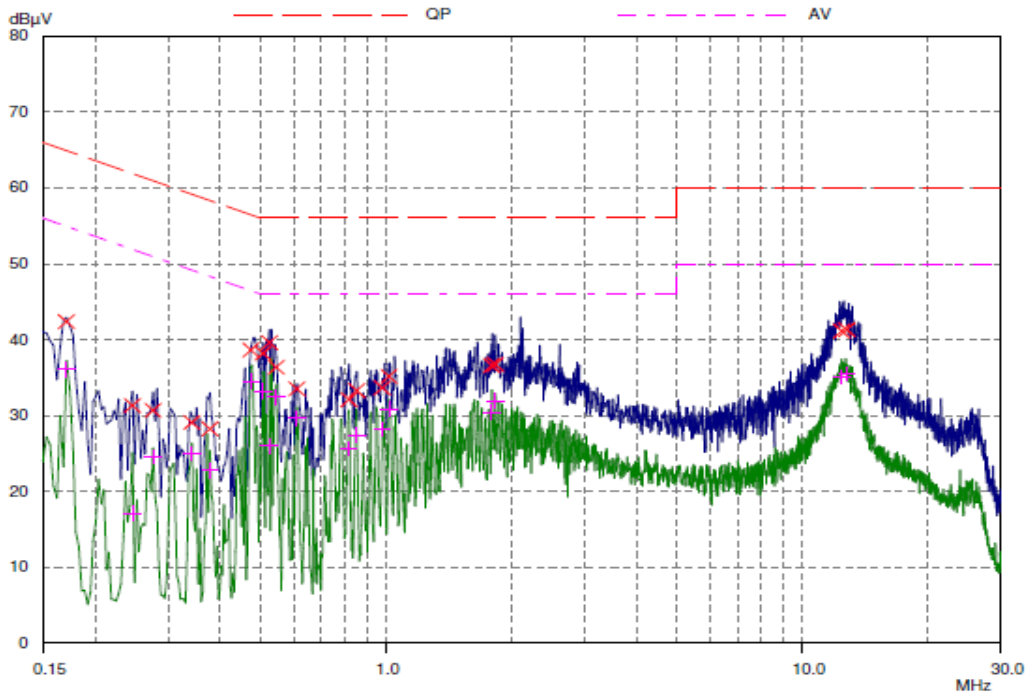
Result File: ch20_N.dat :

Scan Settings (2 Ranges)

| Frequencies | | | Receiver Settings | | | | | |
|---|---|---|---|---|---|---|---|---|
| Start | Stop | Step | IF BW | Detector | M-Time | Atten | Preamp | OpRge |
| 150kHz | 3MHz | 3kHz | 10kHz | PK+AV | 5msec | Auto | OFF | 60dB |
| 3MHz | 30MHz | 10kHz | 10kHz | PK+AV | 2msec | Auto | OFF | 60dB |

| Transducer | No. | Start | Stop | Name |
|---|---|---|---|---|
| | 22 | 150kHz | 30MHz | N |

Final Measurement: Detectors: X QP / + AV
Meas Time: 1sec
Peaks: 8
Acc Margin: 25 dB





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2 475 MHz_H

EMC Compliance LTD

EUT:
Manuf:
Op Cond:
Operator:
Test Spec: FCC Class B Conducted Emission
Comment:

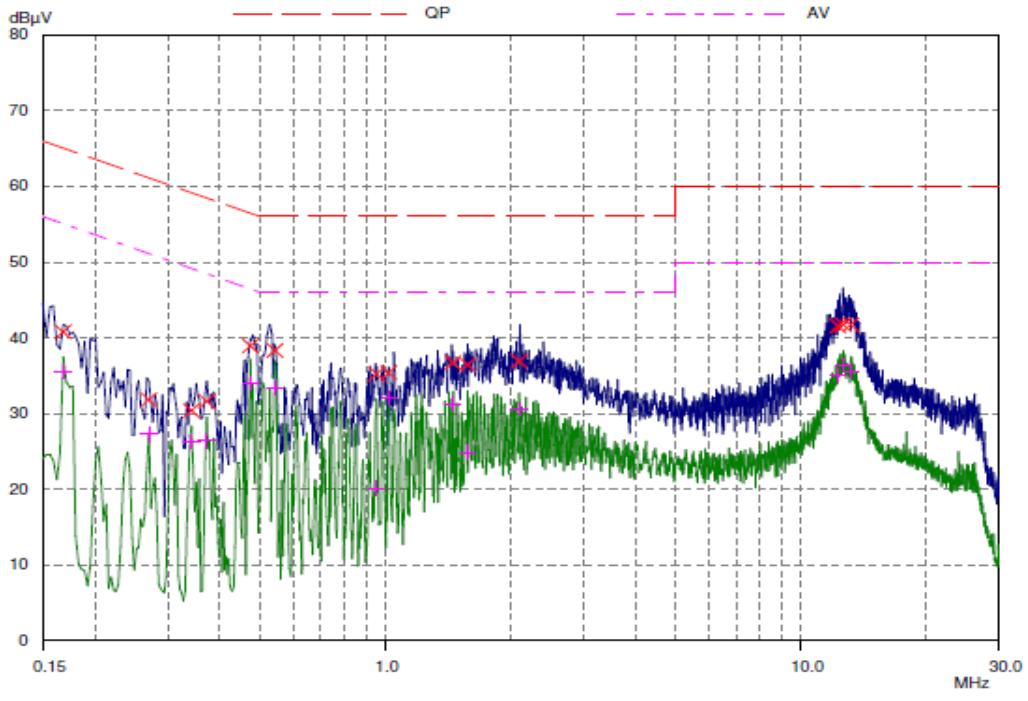
Result File: ch25_H.dat :

Scan Settings (2 Ranges)

| Frequencies | | | Receiver Settings | | | | | |
|---|---|---|---|---|---|---|---|---|
| Start | Stop | Step | IF BW | Detector | M-Time | Atten | Preamp | OpRge |
| 150kHz | 3MHz | 3kHz | 10kHz | PK+AV | 5msec | Auto | OFF | 60dB |
| 3MHz | 30MHz | 10kHz | 10kHz | PK+AV | 2msec | Auto | OFF | 60dB |

| Transducer | No. | Start | Stop | Name |
|---|---|---|---|---|
| | 22 | 150kHz | 30MHz | H |

Final Measurement: Detectors: X QP / + AV
Meas Time: 1sec
Peaks: 8
Acc Margin: 25 dB





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2 475 MHz_N

EMC Compliance LTD

EUT:
Manuf:
Op Cond:
Operator:
Test Spec: FCC Class B Conducted Emission
Comment:

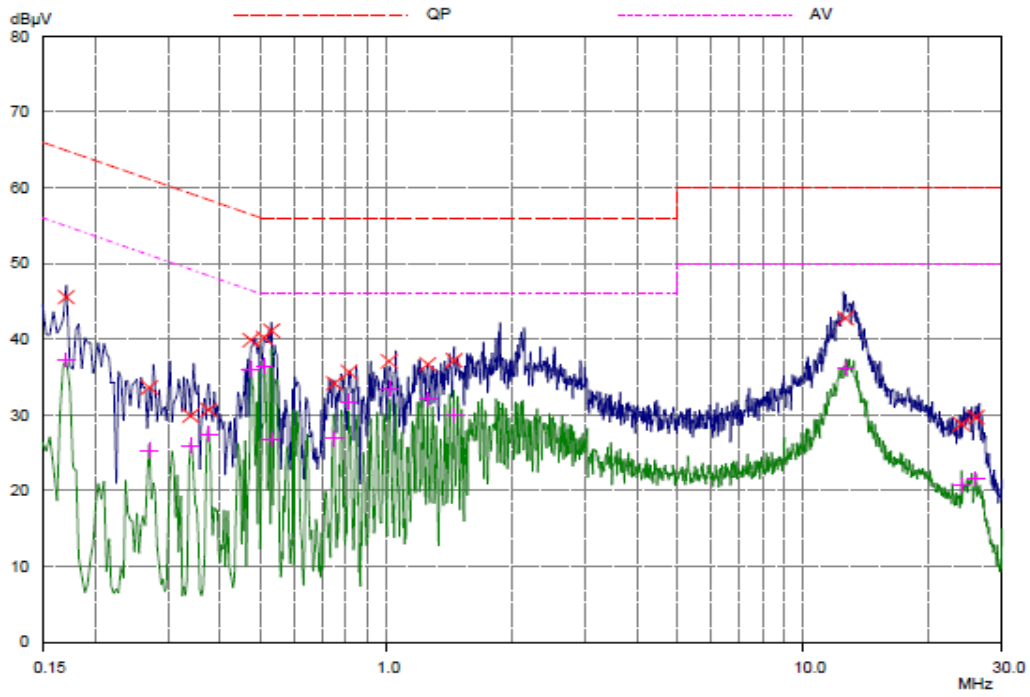
Result File: ch25_n#2.dat :

Scan Settings (2 Ranges)

| Frequencies | | | Receiver Settings | | | | | |
|---|---|---|---|---|---|---|---|---|
| Start | Stop | Step | IF BW | Detector | M-Time | Atten | Preamp | OpRge |
| 150kHz | 3MHz | 3kHz | 10kHz | PK+AV | 5msec | Auto | OFF | 60dB |
| 3MHz | 30MHz | 10kHz | 10kHz | PK+AV | 2msec | Auto | OFF | 60dB |

| Transducer | No. | Start | Stop | Name |
|---|---|---|---|---|
| | 22 | 150kHz | 30MHz | N |

Final Measurement: Detectors: X QP / + AV
Meas Time: 1sec
Peaks: 8
Acc Margin: 25 dB





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## 5.7 RF Exposure

### 5.7.1 Regulation

According to §15.247(i), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this Chapter.

Limits for Maximum Permissive Exposure: RF exposure is calculated.

| Frequency Range | Electric Field Strength [V/m] | Magnetic Field Strength [A/m] | Power Density [mW/cm$^2$] | Averaging Time [minute] |
|---|---|---|---|---|
| Limits for General Population / Uncontrolled Exposure | | | | |
| 0.3 ~ 1.34 | 614 | 1.63 | *(100) | 30 |
| 1.34 ~ 30 | 824 /f | 2.19/f | *(180/f$^2$) | 30 |
| 30 ~ 300 | 27.5 | 0.073 | 0.2 | 30 |
| 300 ~ 1500 | / | / | f/1500 | 30 |
| 1500 ~ 15000 | / | / | 1.0 | 30 |

*f=frequency in MHz, *= plane-wave equivalent power density*

**MPE (Maximum Permissive Exposure) Prediction**
Predication of MPE limit at a given distance: Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2 \quad \left(\Rightarrow R = \sqrt{PG/4\pi S}\right)$$

S=power density [mW/cm$^2$]
P=Power input to antenna [mW]
G=Power gain of the antenna in the direction of interest relative to an isotropic radiator
R= distance to the center of radiation of the antenna [cm]

### 5.7.2 RF Exposure Compliance Issue

The information should be included in the user's manual:
This appliance and its antenna must not be co-located or operation in conjunction with any other antenna or transmitter. A minimum separation distance of 20 cm must be maintained between the antenna and the person for this appliance to satisfy the RF exposure requirements.

| Band [MHz] | Mode | Antenna Selection | Channel | Channel Frequency [MHz] | Ant Gain [mW] | power [dBm] | power [mW] | Power Density at 20 cm [mW/Cm2] |
|---|---|---|---|---|---|---|---|---|
| 2 400 ~ 2 483.5 | 11n HT40 | ANT0 + ANT1 | Middle | 2 437 | 4.08 | 27.71 | 589.78 | 0.479 09 |
| 5 745 ~ 5 850 | 11n HT20 | ANT0 + ANT1 | Highest | 5 825 | 4.18 | 27.78 | 600.03 | 0.498 78 |
| | | | | | | | | 0.977 87 |


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## 5.7.3 Calculation Result of RF Exposure

### - 2 400 ~ 2 483.5 MHz (RF4CE)

| Channel | Channel Frequency [MHz] | Ant Gain [mW] | power [dBm] | power [mW] | Power Density at 20 cm [mW/Cm2] |
|---|---|---|---|---|---|
| Lowest | 2 425 | 1.95 | 24.64 | 291.07 | 0.112 65 |
| Middle | 2 450 | 1.95 | 24.52 | 283.14 | 0.109 58 |
| Highest | 2 475 | 1.95 | 24.22 | 264.24 | 0.102 27 |

### - 2 400 ~ 2 483.5 MHz (WIFI)

| mode | Antenna Selection | Channel | Channel Frequency [MHz] | Ant Gain [mW] | power [dBm] | power [mW] | Power Density at 20 cm [mW/Cm2] |
|---|---|---|---|---|---|---|---|
| 11b | ANT0 | Lowest | 2 412 | 2.04 | 24.64 | 291.07 | 0.118 23 |
| | | Middle | 2 437 | 2.04 | 24.52 | 283.14 | 0.115 01 |
| | | Highest | 2 462 | 2.04 | 24.22 | 264.24 | 0.107 33 |
| | ANT1 | Lowest | 2 412 | 2.04 | 23.95 | 248.31 | 0.100 86 |
| | | Middle | 2 437 | 2.04 | 23.80 | 239.88 | 0.097 44 |
| | | Highest | 2 462 | 2.04 | 23.76 | 237.68 | 0.096 55 |
| 11g | ANT0 | Lowest | 2 412 | 2.04 | 27.53 | 566.24 | 0.230 00 |
| | | Middle | 2 437 | 2.04 | 27.30 | 537.03 | 0.218 14 |
| | | Highest | 2 462 | 2.04 | 26.20 | 416.87 | 0.169 33 |
| | ANT1 | Lowest | 2 412 | 2.04 | 27.29 | 535.80 | 0.217 64 |
| | | Middle | 2 437 | 2.04 | 27.27 | 533.33 | 0.216 64 |
| | | Highest | 2 462 | 2.04 | 25.50 | 354.81 | 0.144 12 |
| 11n HT20 | ANT0 | Lowest | 2 412 | 2.04 | 27.11 | 514.04 | 0.208 80 |
| | | Middle | 2 437 | 2.04 | 27.98 | 628.06 | 0.255 11 |
| | | Highest | 2 462 | 2.04 | 27.28 | 534.56 | 0.217 14 |
| | ANT1 | Lowest | 2 412 | 2.04 | 27.18 | 522.40 | 0.212 19 |
| | | Middle | 2 437 | 2.04 | 27.80 | 602.56 | 0.244 75 |
| | | Highest | 2 462 | 2.04 | 27.31 | 538.27 | 0.218 64 |
| | ANT0 + ANT1 | Lowest | 2 412 | 4.08 | 27.33 | 540.30 | 0.438 90 |
| | | Middle | 2 437 | 4.08 | 27.65 | 581.75 | 0.472 57 |
| | | Highest | 2 462 | 4.08 | 26.95 | 495.51 | 0.402 51 |
| 11n HT40 | ANT0 + ANT1 | Lowest | 2 422 | 4.08 | 27.51 | 563.67 | 0.457 88 |
| | | Middle | 2 437 | 4.08 | 27.71 | 589.78 | 0.479 09 |
| | | Highest | 2 452 | 4.08 | 27.65 | 582.54 | 0.473 21 |


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- 5 150 ~ 5 250 MHz

| mode | Antenna Selection | Channel | Channel Frequency [MHz] | Ant Gain [mW] | power [dBm] | power [mW] | Power Density at 20 cm [mW/Cm2] |
|---|---|---|---|---|---|---|---|
| 11a | ANT0 | Lowest | 5 180 | 2.09 | 12.56 | 18.03 | 0.007 49 |
| | | Middle | 5 200 | 2.09 | 12.57 | 18.07 | 0.007 51 |
| | | Highest | 5 240 | 2.09 | 12.72 | 18.71 | 0.007 78 |
| | ANT1 | Lowest | 5 180 | 2.09 | 13.38 | 21.78 | 0.009 05 |
| | | Middle | 5 200 | 2.09 | 13.68 | 23.33 | 0.009 70 |
| | | Highest | 5 240 | 2.09 | 13.75 | 23.71 | 0.009 86 |
| 11n HT20 | ANT0 | Lowest | 5 180 | 2.09 | 12.94 | 19.68 | 0.008 18 |
| | | Middle | 5 200 | 2.09 | 12.61 | 18.24 | 0.007 58 |
| | | Highest | 5 240 | 2.09 | 12.79 | 19.01 | 0.007 90 |
| | ANT1 | Lowest | 5 180 | 2.09 | 13.47 | 22.23 | 0.009 24 |
| | | Middle | 5 200 | 2.09 | 13.91 | 24.60 | 0.010 23 |
| | | Highest | 5 240 | 2.09 | 14.02 | 25.23 | 0.010 49 |
| | ANT0 + ANT1 | Lowest | 5 180 | 4.18 | 12.78 | 18.95 | 0.015 76 |
| | | Middle | 5 200 | 4.18 | 12.88 | 19.40 | 0.016 13 |
| | | Highest | 5 240 | 4.18 | 12.58 | 18.10 | 0.015 05 |
| 11n HT40 | ANT0 + ANT1 | Lowest | 5 190 | 4.18 | 14.49 | 28.14 | 0.023 39 |
| | | Middle | 5 230 | 4.18 | 14.38 | 27.42 | 0.022 79 |

- 5 250 ~ 5 350 MHz

| mode | Antenna Selection | Channel | Channel Frequency [MHz] | Ant Gain [mW] | power [dBm] | power [mW] | Power Density at 20 cm [mW/Cm2] |
|---|---|---|---|---|---|---|---|
| 11a | ANT0 | Lowest | 5 260 | 2.09 | 18.90 | 77.62 | 0.032 26 |
| | | Middle | 5 300 | 2.09 | 19.03 | 79.98 | 0.033 25 |
| | | Highest | 5 320 | 2.09 | 19.19 | 82.99 | 0.034 49 |
| | ANT1 | Lowest | 5 260 | 2.09 | 20.06 | 101.39 | 0.042 14 |
| | | Middle | 5 300 | 2.09 | 20.11 | 102.57 | 0.042 63 |
| | | Highest | 5 320 | 2.09 | 20.30 | 107.15 | 0.044 54 |
| 11n HT20 | ANT0 | Lowest | 5 260 | 2.09 | 19.22 | 83.56 | 0.034 73 |
| | | Middle | 5 300 | 2.09 | 19.34 | 85.90 | 0.035 71 |
| | | Highest | 5 320 | 2.09 | 19.54 | 89.95 | 0.037 39 |
| | ANT1 | Lowest | 5 260 | 2.09 | 20.28 | 106.66 | 0.044 33 |
| | | Middle | 5 300 | 2.09 | 20.70 | 117.49 | 0.048 83 |
| | | Highest | 5 320 | 2.09 | 20.88 | 122.46 | 0.050 90 |
| | ANT0 + ANT1 | Lowest | 5 260 | 4.18 | 21.17 | 131.04 | 0.108 93 |
| | | Middle | 5 300 | 4.18 | 21.30 | 135.02 | 0.112 24 |
| | | Highest | 5 320 | 4.18 | 21.47 | 140.29 | 0.116 61 |
| 11n HT40 | ANT0 + ANT1 | Lowest | 5 270 | 4.18 | 21.26 | 133.53 | 0.111 00 |
| | | Middle | 5 310 | 4.18 | 18.64 | 73.12 | 0.060 78 |


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- 5 470 ~ 5 725 MHz

| mode | Antenna Selection | Channel | Channel Frequency [MHz] | Ant Gain [mW] | power [dBm] | power [mW] | Power Density at 20 cm [mW/Cm2] |
|---|---|---|---|---|---|---|---|
| 11a | ANT0 | Lowest | 5 500 | 2.09 | 17.52 | 56.49 | 0.023 48 |
| | | Middle | 5 600 | 2.09 | 18.37 | 68.71 | 0.028 56 |
| | | Highest | 5 700 | 2.09 | 17.98 | 62.81 | 0.026 11 |
| | ANT1 | Lowest | 5 500 | 2.09 | 18.60 | 72.44 | 0.030 11 |
| | | Middle | 5 600 | 2.09 | 19.93 | 98.40 | 0.040 90 |
| | | Highest | 5 700 | 2.09 | 18.12 | 64.86 | 0.026 96 |
| 11n HT20 | ANT0 | Lowest | 5 500 | 2.09 | 17.38 | 54.70 | 0.022 74 |
| | | Middle | 5 600 | 2.09 | 18.40 | 69.18 | 0.028 76 |
| | | Highest | 5 700 | 2.09 | 16.61 | 45.81 | 0.019 04 |
| | ANT1 | Lowest | 5 500 | 2.09 | 18.50 | 70.79 | 0.029 43 |
| | | Middle | 5 600 | 2.09 | 20.13 | 103.04 | 0.042 83 |
| | | Highest | 5 700 | 2.09 | 18.15 | 65.31 | 0.027 15 |
| | ANT0 + ANT1 | Lowest | 5 500 | 4.18 | 20.74 | 118.53 | 0.098 53 |
| | | Middle | 5 600 | 4.18 | 21.17 | 130.84 | 0.108 76 |
| | | Highest | 5 700 | 4.18 | 20.20 | 104.73 | 0.087 05 |
| 11n HT40 | ANT0 + ANT1 | Lowest | 5 510 | 4.18 | 15.78 | 37.88 | 0.031 49 |
| | | Middle | 5 590 | 4.18 | 21.68 | 147.19 | 0.122 35 |
| | | Highest | 5 670 | 4.18 | 21.59 | 144.15 | 0.119 82 |

- 5 725 ~ 5 850 MHz

| mode | Antenna Selection | Channel | Channel Frequency [MHz] | Ant Gain [mW] | power [dBm] | power [mW] | Power Density at 20 cm [mW/Cm2] |
|---|---|---|---|---|---|---|---|
| 11a | ANT0 | Lowest | 5 745 | 2.09 | 25.57 | 360.58 | 0.149 88 |
| | | Middle | 5 785 | 2.09 | 25.95 | 393.55 | 0.163 58 |
| | | Highest | 5 825 | 2.09 | 25.97 | 395.37 | 0.164 34 |
| | ANT1 | Lowest | 5 745 | 2.09 | 27.42 | 552.08 | 0.229 47 |
| | | Middle | 5 785 | 2.09 | 27.47 | 558.47 | 0.232 13 |
| | | Highest | 5 825 | 2.09 | 27.99 | 629.51 | 0.261 66 |
| 11n HT20 | ANT0 | Lowest | 5 745 | 2.09 | 25.46 | 351.56 | 0.146 13 |
| | | Middle | 5 785 | 2.09 | 25.62 | 364.75 | 0.151 61 |
| | | Highest | 5 825 | 2.09 | 26.06 | 403.65 | 0.167 78 |
| | ANT1 | Lowest | 5 745 | 2.09 | 27.43 | 553.35 | 0.230 00 |
| | | Middle | 5 785 | 2.09 | 27.59 | 574.12 | 0.238 63 |
| | | Highest | 5 825 | 2.09 | 27.94 | 622.30 | 0.258 66 |
| | ANT0 + ANT1 | Lowest | 5 745 | 4.18 | 27.52 | 565.52 | 0.470 09 |
| | | Middle | 5 785 | 4.18 | 27.63 | 579.51 | 0.481 71 |
| | | Highest | 5 825 | 4.18 | 27.78 | 600.03 | 0.498 78 |
| 11n HT40 | ANT0 + ANT1 | Lowest | 5 755 | 4.18 | 27.59 | 574.72 | 0.477 74 |
| | | Middle | 5 795 | 4.18 | 27.61 | 576.97 | 0.479 61 |


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# 6. Test equipment used for test

| | Description | Manufacture | Model No. | Serial No. | Next Cal Date. |
|---|---|---|---|---|---|
| □ | Temp & humidity chamber | taekwang | TK-04 | TK001 | 12.12.10 |
| ■ | Temp & humidity chamber | taekwang | TK-500 | TK002 | 13.09.03 |
| □ | Power Meter | Agilent | E4416A | GB41292365 | 12.10.26 |
| □ | Frequency Counter | HP | 53150A | US39250565 | 12.09.07 |
| □ | Spectrum Analyzer | Agilent | E4407B | US39010142 | 13.10.23 |
| ■ | Spectrum Analyzer | R & S | FSP40 | 100209 | 13.10.23 |
| ■ | Signal Generator | R & S | SMR40 | 100007 | 13.06.27 |
| ■ | Vector Signal Generator | R & S | SMBV100A | 257566 | 13.01.31 |
| □ | Modulation Analyzer | HP | 8901B | 3538A05527 | 13.10.25 |
| □ | Audio Analyzer | HP | 8903B | 3729A19213 | 13.10.23 |
| ■ | AC Power Supply | KIKUSUI | PCR2000W | GB001619 | 13.10.23 |
| □ | DC Power Supply | Tektronix | PS2520G | TW50517 | 12.10.25 |
| □ | DC Power Supply | Tektronix | PS2521G | TW53135 | 13.02.23 |
| □ | Dummy Load | BIRD | 8141 | 7560 | - |
| □ | Dummy Load | BIRD | 8401-025 | 799 | - |
| ■ | EMI Test Receiver | R&S | ESCI | 100001 | 13.07.10 |
| ■ | Attenuator | HP | 8494A | 2631A09825 | 13.10.24 |
| ■ | Attenuator | HP | 8496A | 3308A16640 | 13.10.24 |
| ■ | Attenuator set | HP | 11581A | 42946/29738 | 13.01.13 |
| □ | Attenuator | R&S | RBS1000 | D67079 | 13.10.24 |
| □ | Power sensor | Agilent | E9321A | US40390422 | 12.10.26 |
| ■ | EMI Test Receiver | R&S | ESCI | 100710 | 12.11.28 |
| ■ | LOOP Antenna | EMCO | EMCO6502 | 9205-2745 | 13.05.23 |
| ■ | BILOG Antenna | Schwarzbeck | VULB 9168 | 9168-440 | 13.09.21 |
| ■ | HORN Antenna | ETS | 3115 | 00086706 | 13.11.21 |
| ■ | HORN Antenna | ETS | 3116 | 00086632 | 13.11.15 |
| ■ | Amplifier | SONOMA | 310N | 293004 | 12.11.28 |
| ■ | Amplifier | AGILENT | 8449B | 3008A01802 | 13.05.04 |
| ■ | Power Divider | Weinschel | 1580-1 | NX375 | 13.10.23 |
| ■ | Power Divider | Weinschel | 1580-1 | NX380 | 13.09.09 |
| □ | Power Divider | Weinschel | 1594 | 671 | 13.09.14 |
| ■ | Test Receiver | R&S | ESHS10 | 843276/003 | 13.06.15 |
| ■ | LISN | R&S | ESH3-Z5 | 100267 | 13.07.05 |
| ■ | LISN | Schwarzbeck | NNLK8121 | 8121-472 | 13.07.13 |


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