5.7. Transmitter Frequency Behaviour

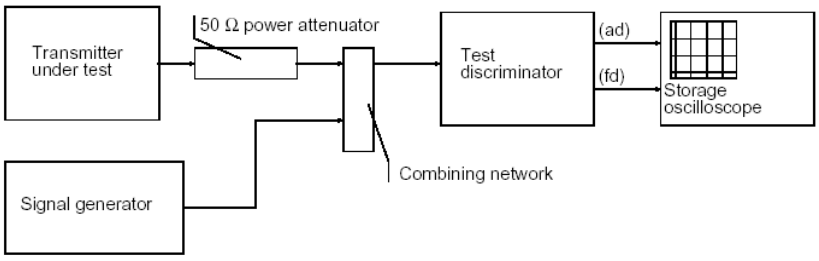
LIMIT
FCC part 90.214

Transmitters designed to operate in the 150-174 MHz and 421-512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

Time intervals[1 2]	Maximum frequency difference[3]	All equipment	
		150 to 174 MHz	421 to 512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels			
t_1[4]	±25.0 kHz	5.0 ms	10.0 ms
t_2	±12.5 kHz	20.0 ms	25.0 ms
t_3[4]	±25.0 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels			
t_1[4]	±12.5 kHz	5.0 ms	10.0 ms
t_2	±6.25 kHz	20.0 ms	25.0 ms
t_3[4]	±12.5 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels			
t_1[4]	±6.25 kHz	5.0 ms	10.0 ms
t_2	±3.125 kHz	20.0 ms	25.0 ms
t_3[4]	±6.25 kHz	5.0 ms	10.0 ms

Note:
1. On is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.
   1) t_1 is the time period immediately following ton.
   2) t_2 is the time period immediately following t_1.
   3) t_3 is the time period from the instant when the transmitter is turned off until toff.
   4) t_{off} is the instant when the 1 kHz test signal starts to rise.
2. During the time from the end of t_2 to the beginning of t_3, the frequency difference must not exceed the limits specified in §90.213.
3. Difference between the actual transmitter frequency and the assigned transmitter frequency.
4. If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

TEST CONFIGURATION



TEST PROCEDURE

According to TIA/EIA-603 2.2.19 requirement, as for the product different from PTT, we use test steps as follows:

1. Connect DUT into Test discriminator and Storage Oscilloscope and keep DUT stats ON;
2. Input 1kHz signal into DUT;
3. Set the modulation domain analyzer to trigger on the rising edge of the waveform in order to capture a single-shot turn-on of the transmitter signals;
4. Keep DUT in OFF state and Key the PTT;
5. Observe the stored oscilloscope of modulation domain analyzer. The signal trace shall be maintained within the allowable limits during the periods t_1 and t_2,and shall also remain within limits following t_2;
6. Adjust the modulation domain analyzer to trigger on the falling edge of the transmitter waveform in order to capture a single-shot turn-off transmitter of the transmitter signal.
7. Keep the digital portable radio in ON state and unkey the PTT;
8. Observe the stored oscilloscope of modulation domain analyzer, The signal trace shall be maintained within the allowable limits during the period t_3.
9. Set the signal generator to the assigned transmitter frequency and modulate it with a 1 kHz tone at ±12.5 kHz deviation and set its output level to -100dBm.
10. Turn on the transmitter.
11. Supply sufficient attenuation via the RF attenuator to provide an input level to the stored oscilloscope
12. that is 40 dB below the maximum allowed input power when the transmitter is operating at its rated power level. Note this power level on the stored oscilloscope as P_0.
13. Turn off the transmitter.
14. Adjust the RF level of the signal generator to provide RF power equal to P_0. This signal generator RF level shall be maintained throughout the rest of the measurement.
15. Remove the attenuation, so the input power to the stored oscilloscope is increased by 30 dB when the transmitter is turned on.
16. Adjust the vertical amplitude control of the stored oscilloscope to display the 1000 Hz at ±4 divisions vertically centered on the display. Set trigger mode of the Spectrum Analyzer to “Video”, and tune the “trigger level” on suitable level. Then set the “tiger offset” to -10ms for turn on and -15ms for turn off.
17. Turn on the transmitter and the transient wave will be captured on the screen of Spectrum Analyzer. Observe the stored display. The instant when the 1 kHz test signal is completely suppressed is considered to be ton. The trace should be maintained within the allowed divisions during the period t_1 and t_2.
18. Then turn off the transmitter, and another transient wave will be captured on the screen of Spectrum
19. Analyzer. The trace should be maintained within the allowed divisions during the period t_3.

TEST MODE:

Please reference to the section 3.4

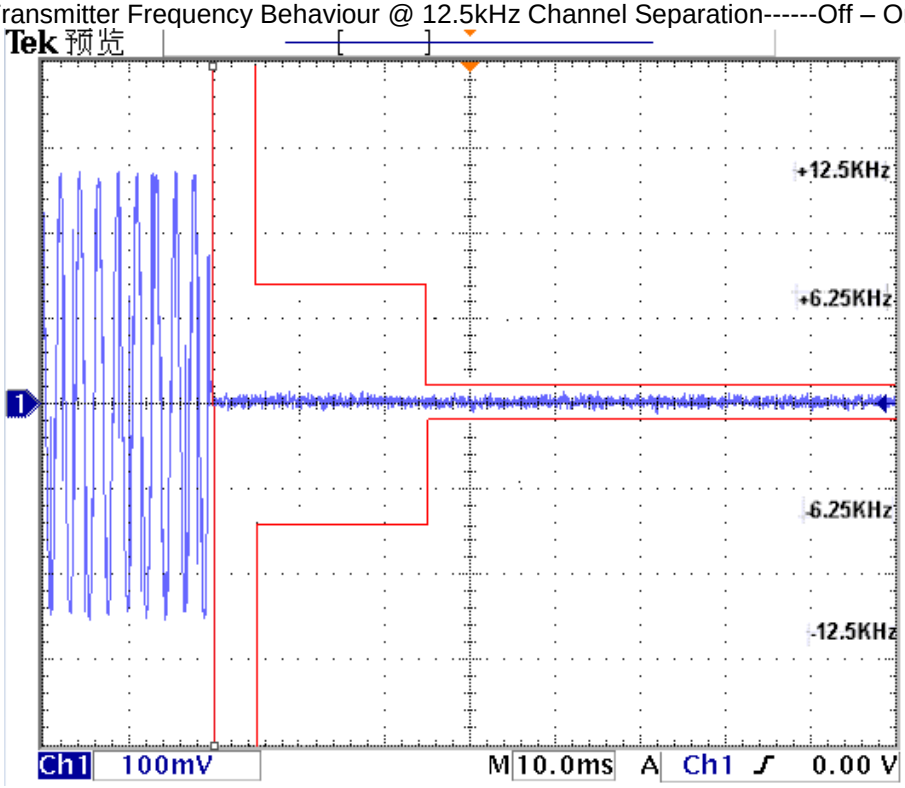
TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

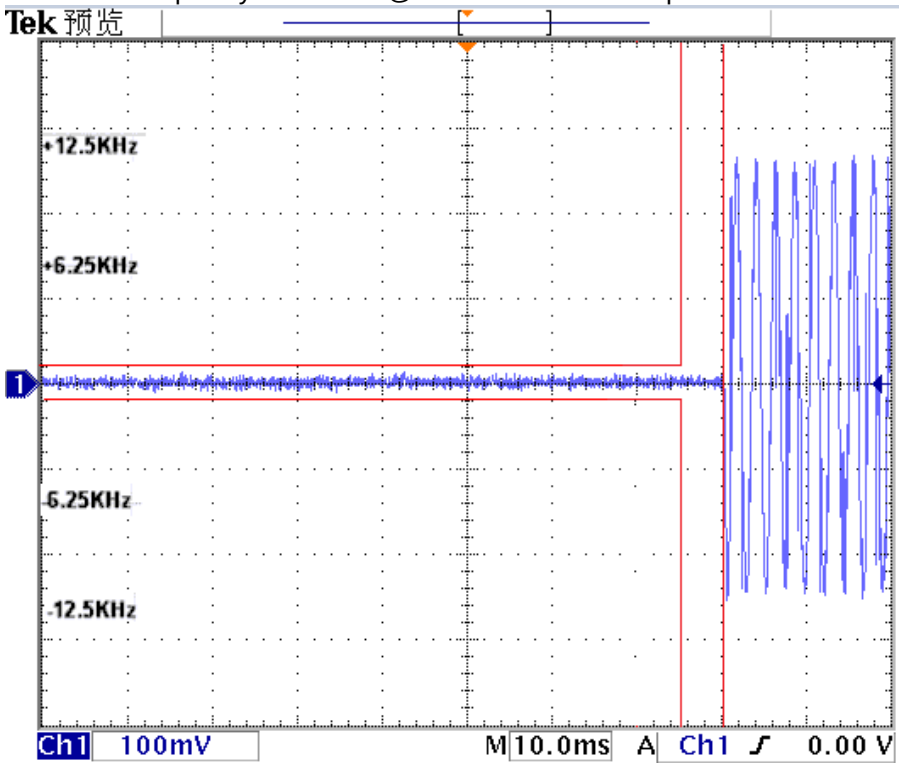
Note: Have pre-tested TX1 to TX4 mode, only record the worst case mode TX1 and TX3 @ power supply DC 13.6V on the report.

Modulation Type: 4FSK(TX1)

Transmitter Frequency Behaviour @ 12.5kHz Channel Separation------Off – On

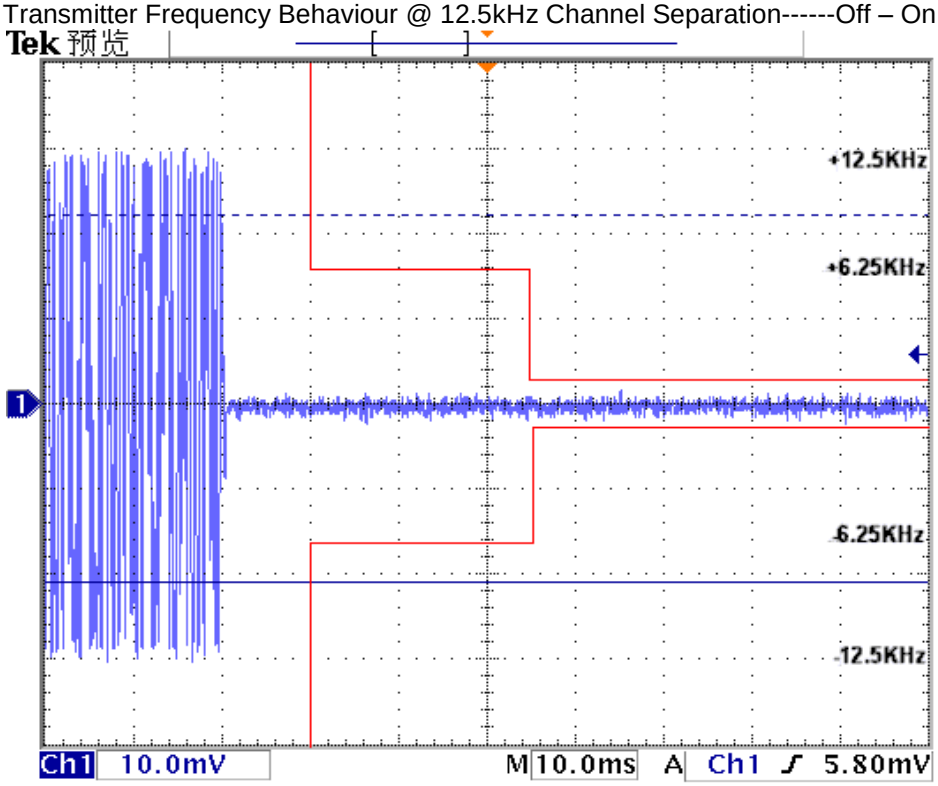


Transmitter Frequency Behaviour @ 12.5kHz Channel Separation------On – Off

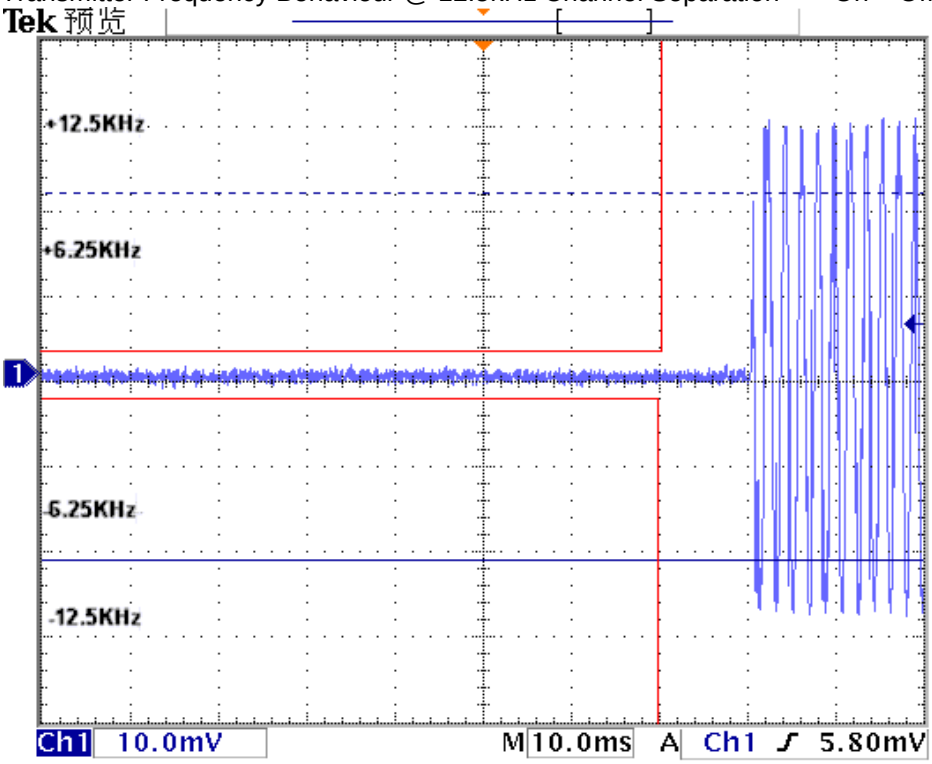


Modulation Type: FM(TX3)

Transmitter Frequency Behaviour @ 12.5kHz Channel Separation------Off – On



Transmitter Frequency Behaviour @ 12.5kHz Channel Separation------On – Off



5.8. Spurious Emission on Antenna Port

Conducted spurious emissions are emissions at the antenna terminals on a frequency or frequencies that are outside a band sufficient to ensure transmission of information of required quality for the class of communication desired

LIMIT

FCC Part 90.210， FCC Part 2.1051 (12.5 kHz Bandwidth only):

On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz at least:

50 +10 log (Pwatts)

Note: In general, the worse case attenuation requirement shown above was applied.

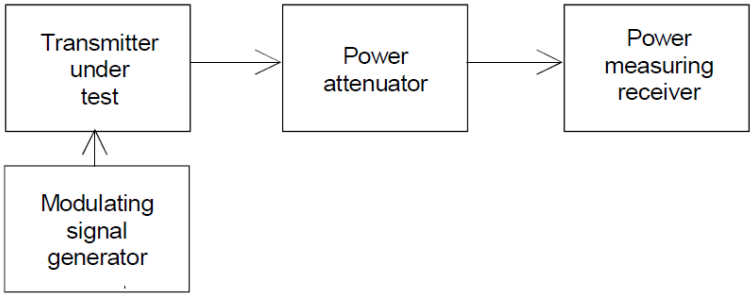
Calculation: Limit (dBm) =EL-50-10log10 (TP)

EL is the emission level of the Output Power expressed in dBm,

In this application, the EL is P(dBm)

Limit (dBm) = P(dBm)-50-10 log (Pwatts) = -20dBm

TEST CONFIGURATION



TEST PROCEDURE

1. The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation.
2. The resolution bandwidth of the spectrum analyzer was set to 100 kHz. Sufficient scans were taken to show any out of band emission up to 10th. Harmonic for the lower and the highest frequency range.
3. Set RBW 100 kHz, VBW 300 kHz in the frequency band 30MHz to 1GHz,while set RBW=1MHz.VBW=3MHz from the 1GHz to 10th Harmonic.
4. The audio input was set the unmodulated carrier, the resulting picture is print out for each channel separation.

TEST MODE:

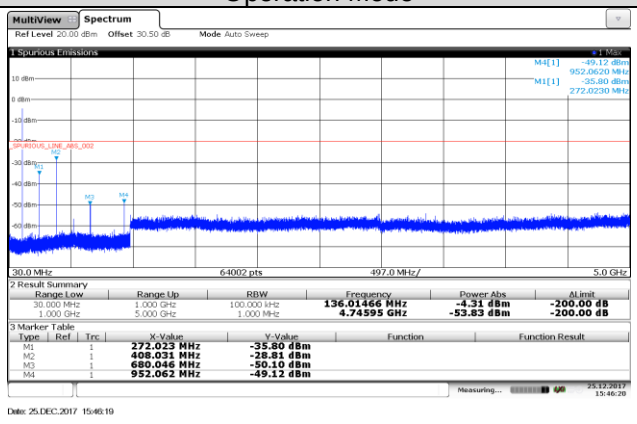
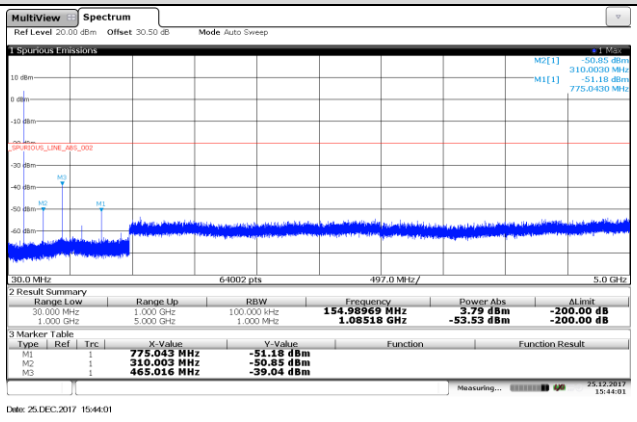
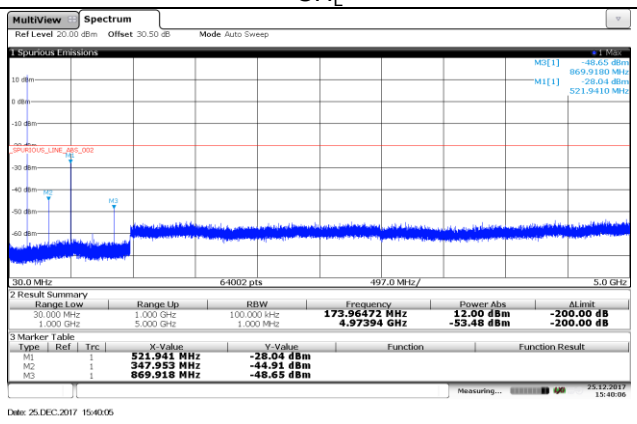
Please reference to the section 3.4

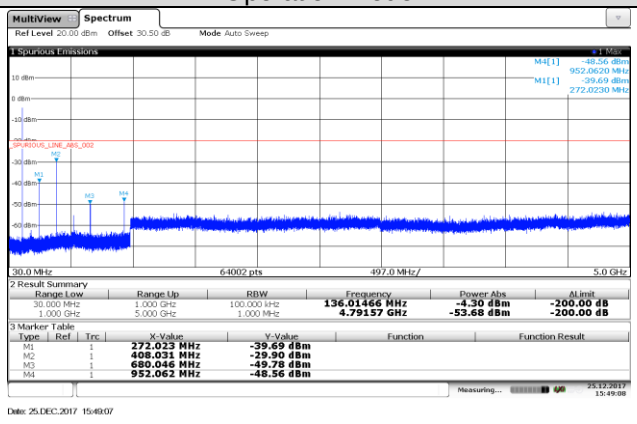
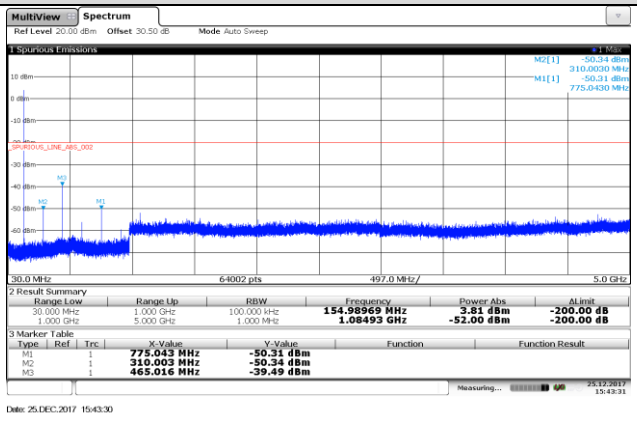
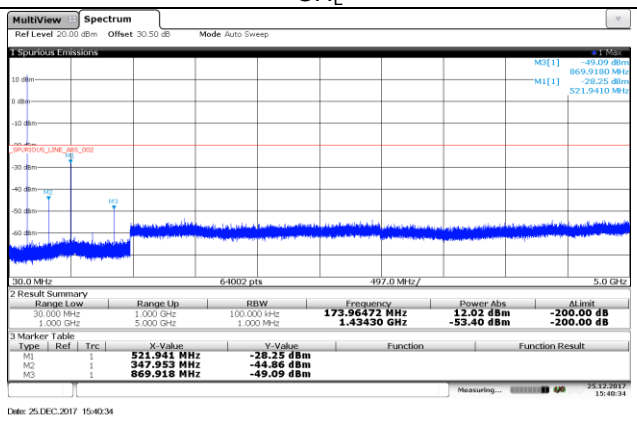
TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

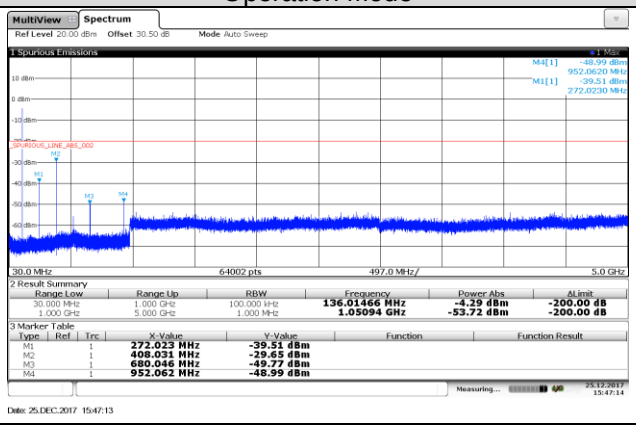
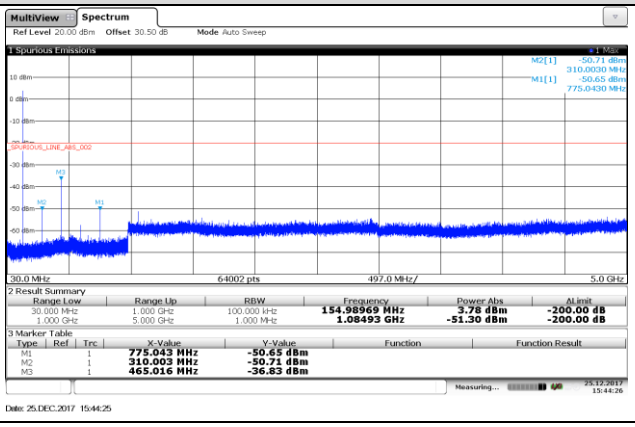
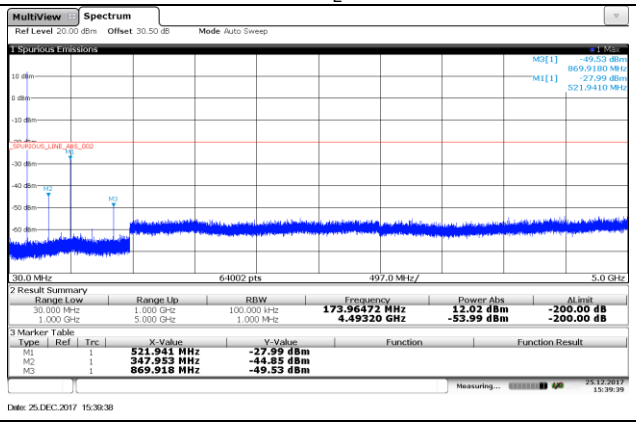
1. The measurement frequency range from 30 MHz to 5 GHz.
2. We tested TX1 to TX3 recorded worst case TX1 and TX3.

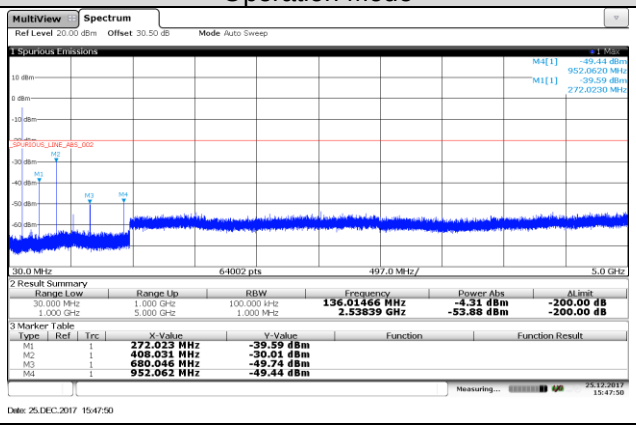
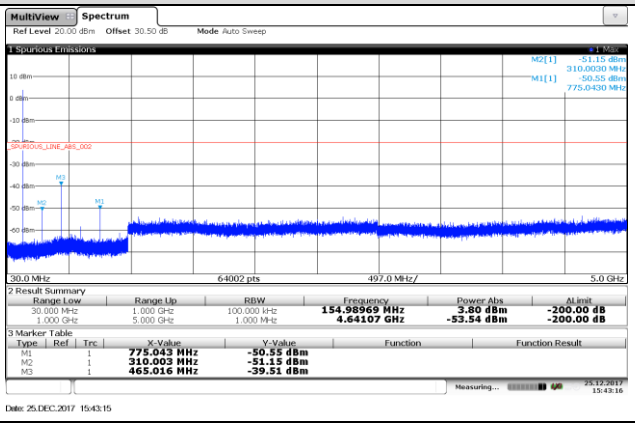
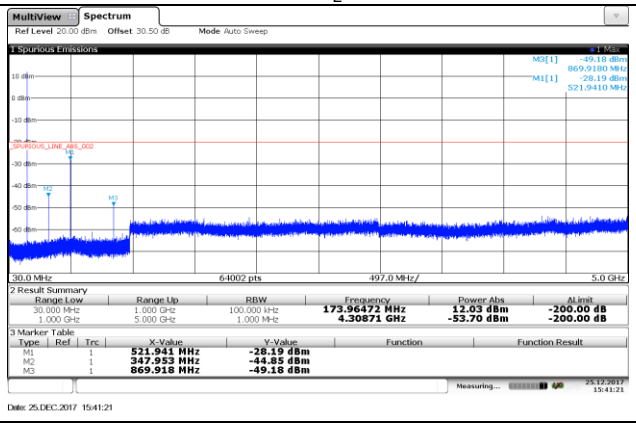
Power supply @DC13.6V:

Operation Mode	TX1
	
CH_L	CH_M
	No plot
CH_H	-

Operation Mode	TX3
	
CH_L	CH_M
	No plot
CH_H	-

Power supply @AC 110V:

Operation Mode	TX1
	
CH_L	CH_M
	No plot
CH_H	-

Operation Mode	TX3
	
CH_L	CH_M
	No plot
CH_H	-

5.9. Transmitter Radiated Spurious Emission

Radiated spurious emissions are emissions from the equipment when transmitting into a nonradiating load on a frequency or frequencies that are outside an occupied band sufficient to ensure transmission of information of required quality for the class of communications desired.

LIMIT

FCC Part 90.210， FCC Part 2.1053 (12.5 kHz Bandwidth only):

On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz at least:

50 +10 log (Pwatts)

Note: In general, the worse case attenuation requirement shown above was applied.

Calculation: Limit (dBm) =EL-50-10log10 (TP)

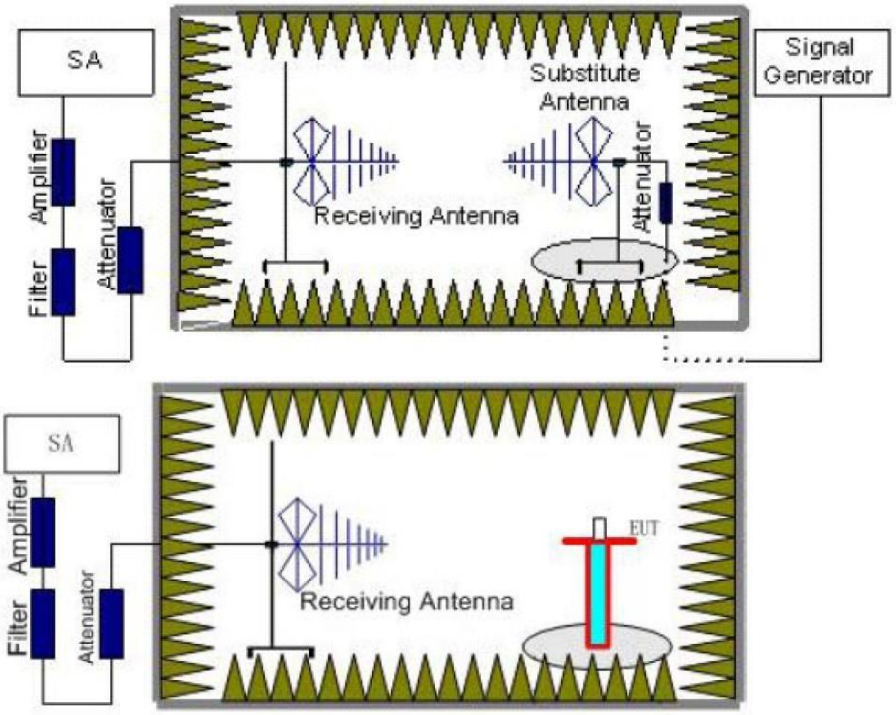
EL is the emission level of the Output Power expressed in dBm,

In this application, the EL is P(dBm)

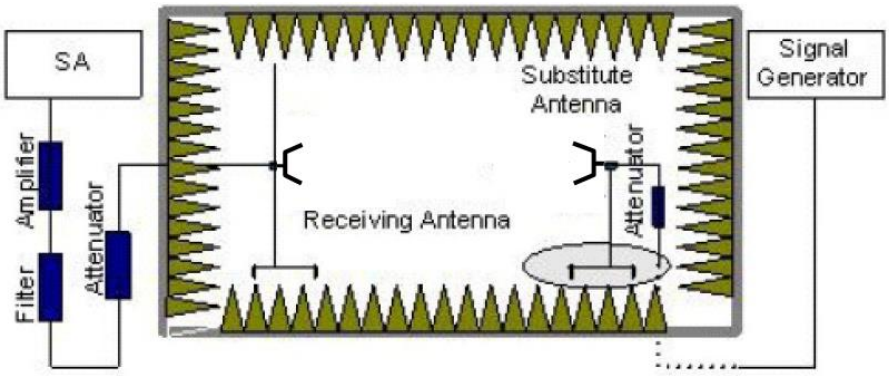
Limit (dBm) = P(dBm)-50-10 log (Pwatts) = -20dBm

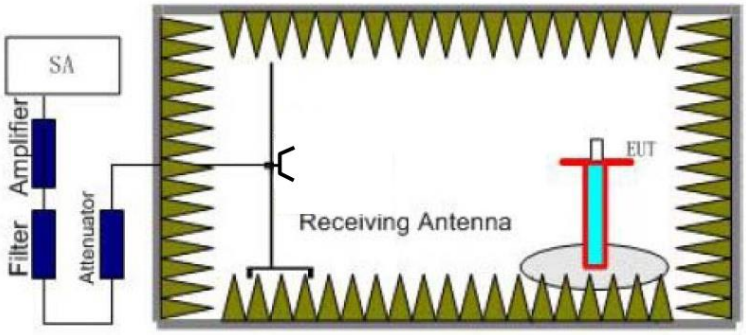
TEST CONFIGURATION

Below 1GHz:



Above 1GHz:





TEST PROCEDURE

1. Standard Transmitter Load with a 50Ω input impedance and an output impedance matched to the test equipment.
2. EUT was placed on a 0.8 meter high non-conductive stand at a 3 meter test distance from the receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT for emission measurements. The height of receiving antenna is 1. 0 m. Detected emissions were maximized at each frequency by rotating the EUT through 360° and adjusting the receiving antenna polarization. The radiated emission measurements of all transmit frequencies in six channels were measured with peak detector.
3. A log-periodic antenna or double-ridged waveguide horn antenna shall be substituted in place of the EUT. The log-periodic antenna will be driven by a signal generator and the level will be adjusted till the same power value on the spectrum analyzer or receiver. The level of the spurious emissions can be calculated through the level of the signal generator, cable loss, the gain of the substitution antenna and the reading of the spectrum analyzer or receiver.
4. The EUT is then put into continuously transmitting mode at its maximum power level during the test.Set Test Receiver or Spectrum RBW=1MHz,VBW=3MHz for above 1GHz and RBW=100kHz,VBW=300kHz for 30MHz to 1GHz, And the maximum value of the receiver should be recorded as (Pr).
5. The EUT shall be replaced by a substitution antenna. In the chamber, an substitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere with the radiation pattern of the antenna. A power (PMea) is applied to the input of the substitution antenna, and adjust the level of the signal generator output until the value of the receiver reach the previously recorded (Pr). The power of signal source (PMea) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.
6. A amplifier should be connected to the Signal Source output port. And the cable should be connect between the Amplifier and the Substitution Antenna. The cable loss (Pcl) ,the Substitution Antenna Gain (Ga) and the Amplifier Gain (PAg) should be recorded after test.
   The measurement results are obtained as described below:
   Power(EIRP)=PMea- PAg - Pcl - Ga
   We used SMF100A micowave signal generator which signal level can up to 33dBm,so we not used power Amplifier for substituation test; The measurement results are amend as described below:
   Power(EIRP)=PMea- Pcl - Ga
7. This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dBi) and known input power.
8. ERP can be calculated from EIRP by subtracting the gain of the dipole, ERP = EIRP-2.15dBi.

TEST MODE:

Please reference to the section 3.4

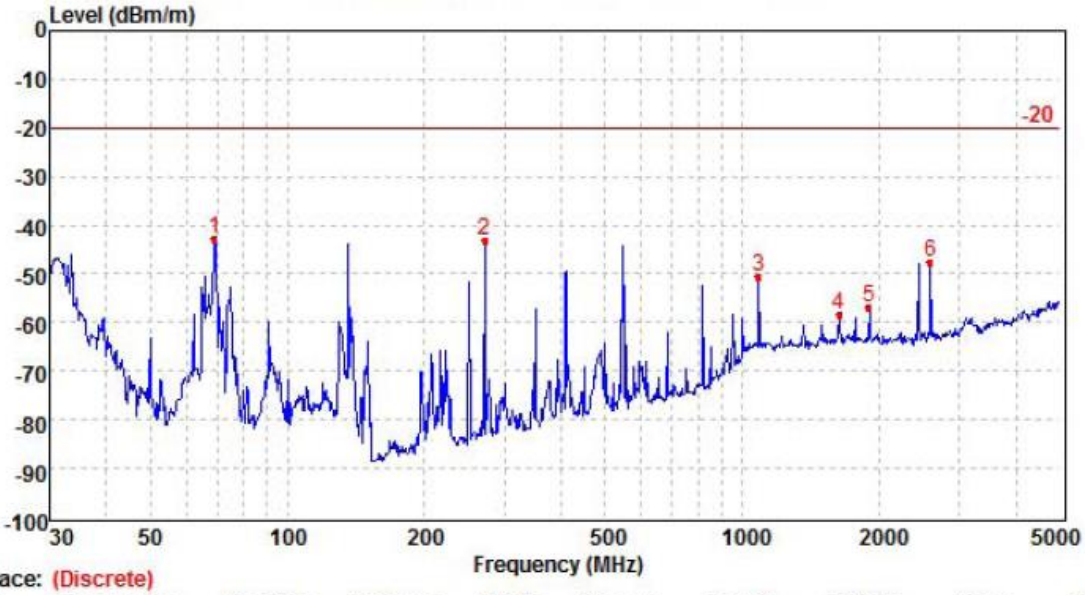
TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Note:
1. In general, the worse case attenuation requirement shown above was applied.
2. The measurement frequency range from 30 MHz to 5 GHz.
3. We tested TX1 to TX3 recorded worst case TX1 and TX3.

Power supply @DC13.6V:

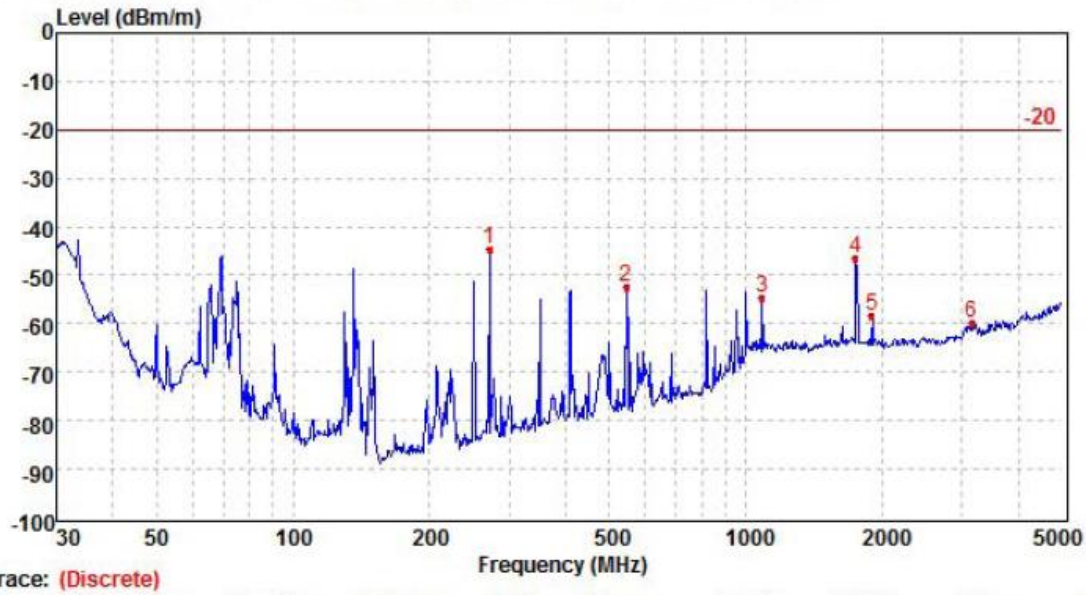
TX1			
Test Frequency:	CH_L	Polarity:	Horizontal



Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	69.03	-36.0	21.9	1.0	29.5	-42.6	-20.0	-22.6	Peak
2	272.07	-41.4	25.5	1.9	29.2	-43.2	-20.0	-23.2	Peak
3	1087.29	-57.2	38.7	4.4	36.6	-50.7	-20.0	-30.7	Peak
4	1631.12	-67.4	40.3	5.6	36.8	-58.3	-20.0	-38.3	Peak
5	1903.65	-66.8	40.9	6.1	37.2	-57.0	-20.0	-37.0	Peak
6	2597.10	-59.3	42.6	6.9	37.8	-47.6	-20.0	-27.6	Peak

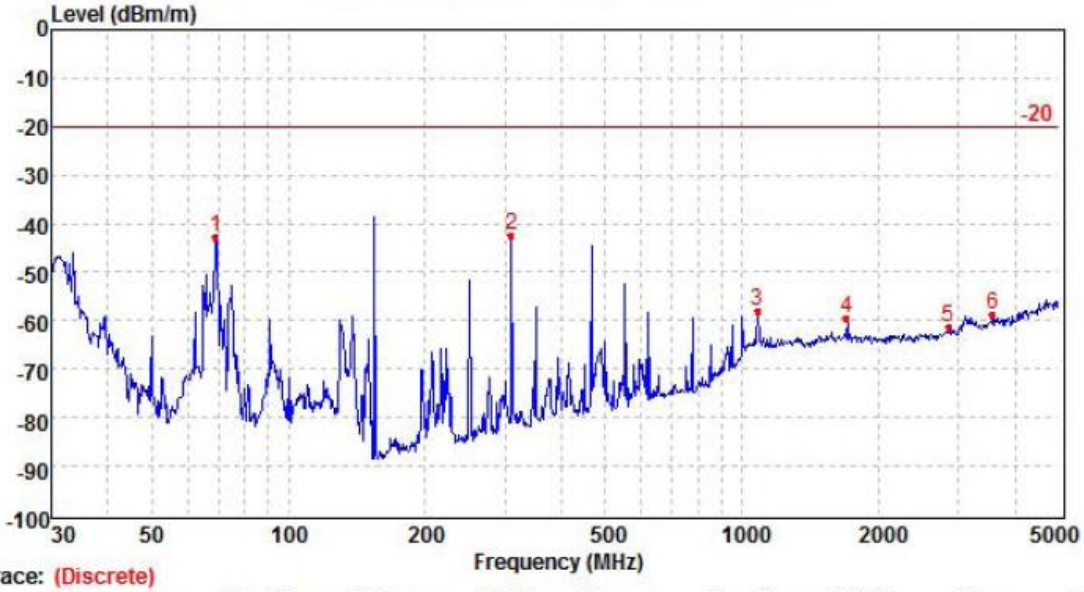
Test Frequency:	CH_L	Polarity:	Vertical



Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	272.07	-42.7	25.5	1.9	29.2	-44.5	-20.0	-24.5	Peak
2	543.92	-56.4	30.6	2.7	29.2	-52.3	-20.0	-32.3	Peak
3	1087.29	-61.0	38.7	4.4	36.6	-54.5	-20.0	-34.5	Peak
4	1750.82	-56.0	40.6	5.9	37.0	-46.5	-20.0	-26.5	Peak
5	1903.65	-68.2	40.9	6.1	37.2	-58.4	-20.0	-38.4	Peak
6	3150.40	-72.9	43.4	7.7	38.2	-60.0	-20.0	-40.0	Peak

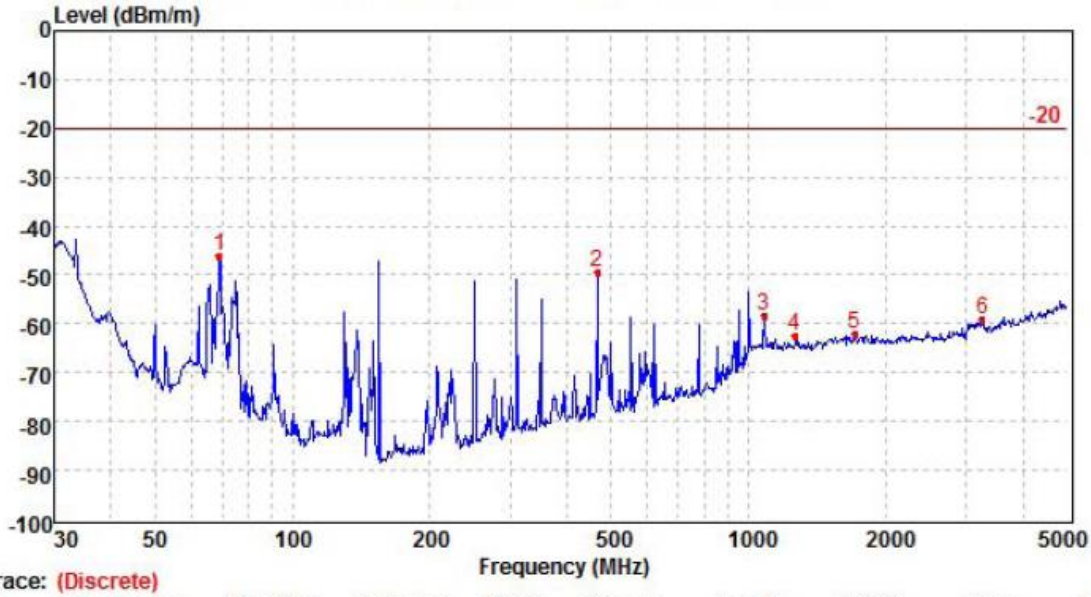
TX1			
Test Frequency:	CH_M	Polarity:	Horizontal



Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	69.03	-36.0	21.9	1.0	29.5	-42.6	-20.0	-22.6	Peak
2	309.87	-41.9	26.4	2.0	29.1	-42.6	-20.0	-22.6	Peak
3	1083.80	-64.6	38.7	4.4	36.6	-58.1	-20.0	-38.1	Peak
4	1703.57	-68.9	40.5	5.8	36.9	-59.5	-20.0	-39.5	Peak
5	2860.40	-73.6	43.0	7.4	38.3	-61.5	-20.0	-41.5	Peak
6	3566.04	-72.4	43.9	8.2	38.3	-58.6	-20.0	-38.6	Peak

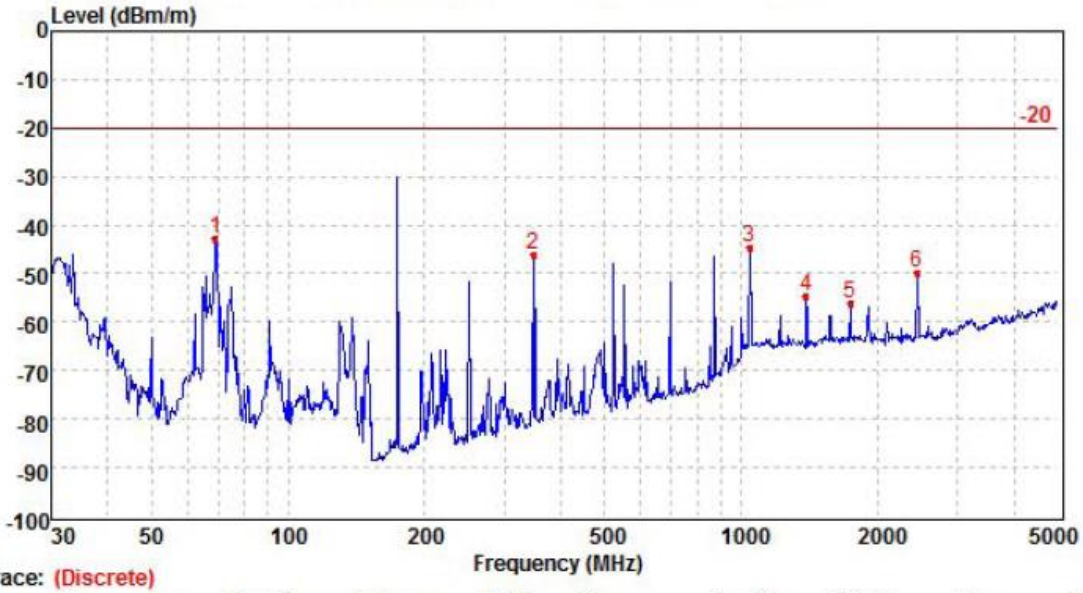
Test Frequency:	CH_M	Polarity:	Vertical



Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	69.28	-39.5	21.7	1.0	29.5	-46.3	-20.0	-26.3	Peak
2	465.95	-52.1	29.3	2.5	29.0	-49.3	-20.0	-29.3	Peak
3	1083.80	-64.7	38.7	4.4	36.6	-58.2	-20.0	-38.2	Peak
4	1266.92	-70.2	39.3	4.8	36.5	-62.6	-20.0	-42.6	Peak
5	1706.31	-71.6	40.5	5.8	36.9	-62.2	-20.0	-42.2	Peak
6	3258.70	-72.2	43.5	7.8	38.3	-59.2	-20.0	-39.2	Peak

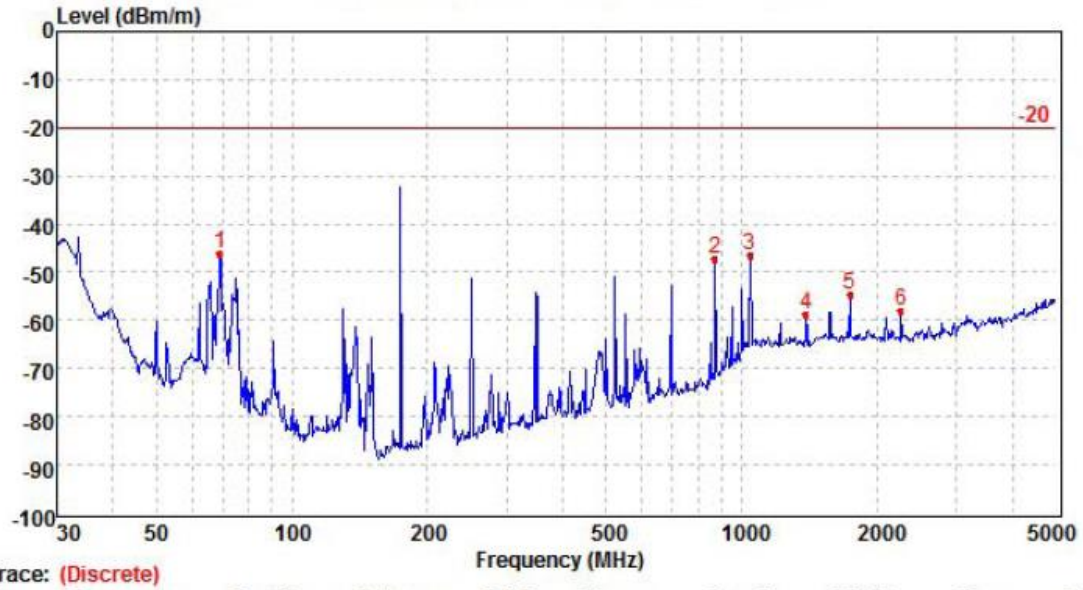
TX1			
Test Frequency:	CH_H	Polarity:	Horizontal



Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	69.03	-36.0	21.9	1.0	29.5	-42.6	-20.0	-22.6	Peak
2	348.00	-46.6	27.4	2.1	29.0	-46.1	-20.0	-26.1	Peak
3	1042.73	-50.8	38.5	4.3	36.6	-44.6	-20.0	-24.6	Peak
4	1390.88	-63.0	39.7	5.0	36.5	-54.8	-20.0	-34.8	Peak
5	1739.59	-65.6	40.6	5.8	37.0	-56.2	-20.0	-36.2	Peak
6	2446.96	-61.0	42.3	6.8	37.9	-49.8	-20.0	-29.8	Peak

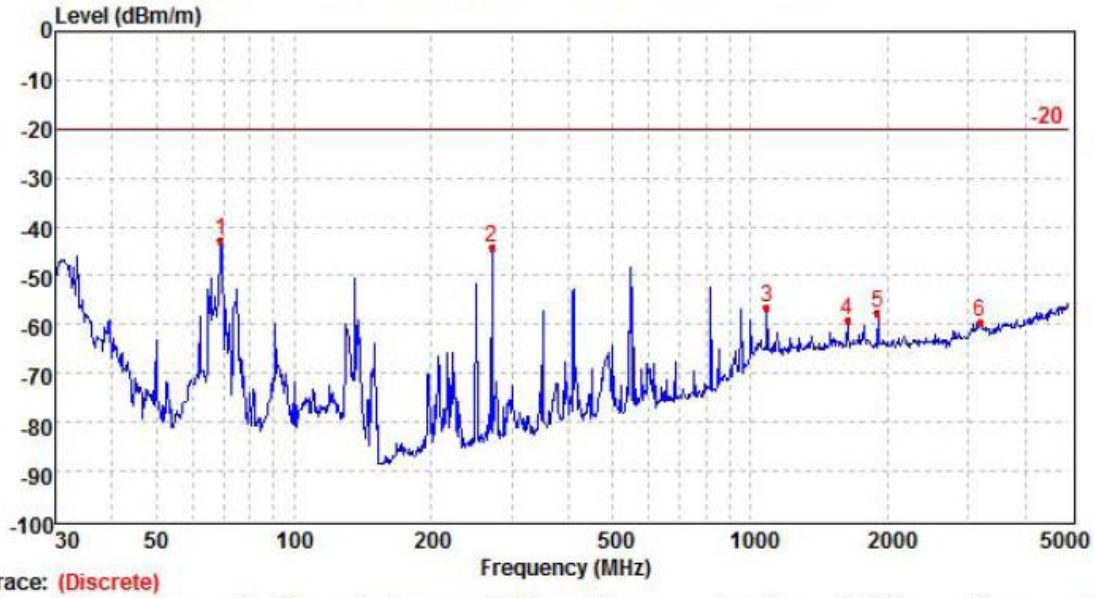
Test Frequency:	CH_H	Polarity:	Vertical



Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	69.28	-39.5	21.7	1.0	29.5	-46.3	-20.0	-26.3	Peak
2	871.32	-57.5	34.8	3.7	28.4	-47.4	-20.0	-27.4	Peak
3	1042.73	-52.6	38.5	4.3	36.6	-46.4	-20.0	-26.4	Peak
4	1390.88	-66.8	39.7	5.0	36.5	-58.6	-20.0	-38.6	Peak
5	1739.59	-63.9	40.6	5.8	37.0	-54.5	-20.0	-34.5	Peak
6	2261.40	-68.9	41.8	6.5	37.5	-58.1	-20.0	-38.1	Peak

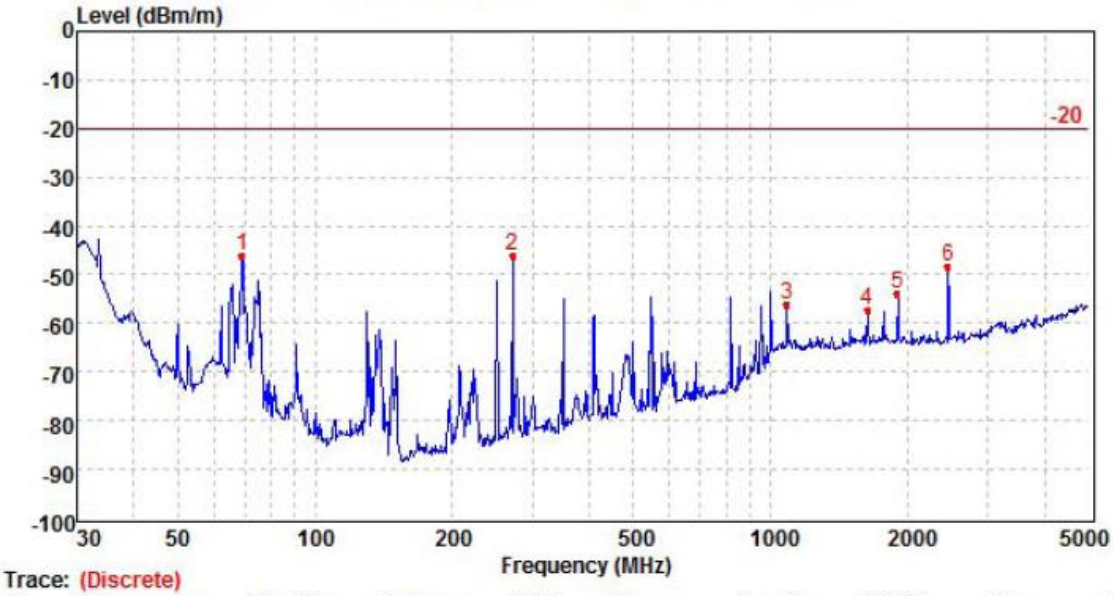
TX3			
Test Frequency:	CH_L	Polarity:	Horizontal



Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	69.03	-36.0	21.9	1.0	29.5	-42.6	-20.0	-22.6	Peak
2	272.07	-42.4	25.5	1.9	29.2	-44.2	-20.0	-24.2	Peak
3	1087.29	-63.0	38.7	4.4	36.6	-56.5	-20.0	-36.5	Peak
4	1631.12	-68.3	40.3	5.6	36.8	-59.2	-20.0	-39.2	Peak
5	1903.65	-67.3	40.9	6.1	37.2	-57.5	-20.0	-37.5	Peak
6	3191.23	-72.5	43.5	7.7	38.2	-59.5	-20.0	-39.5	Peak

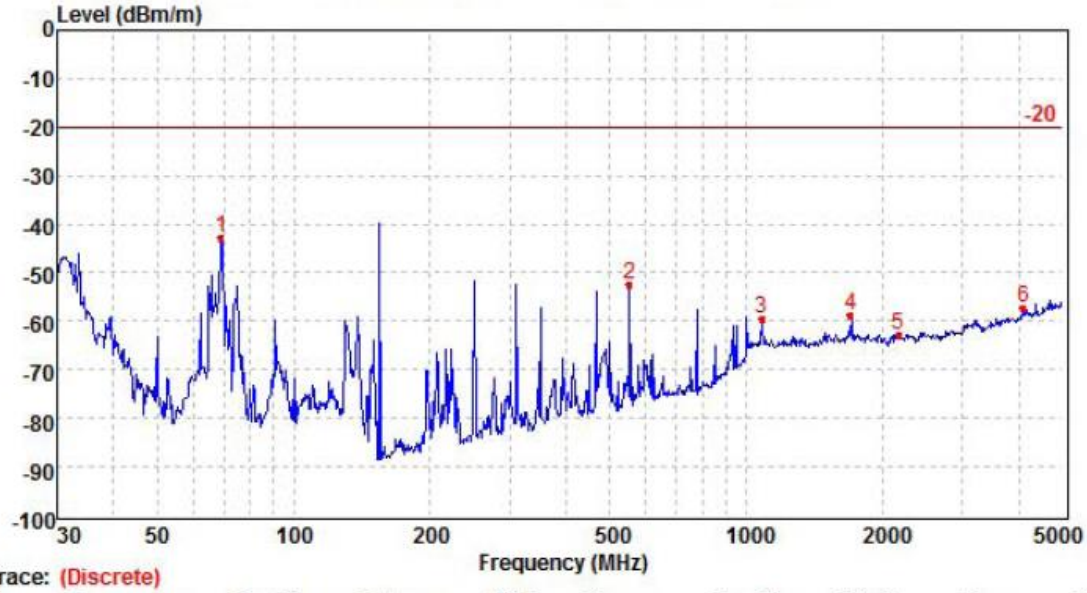
Test Frequency:	CH_L	Polarity:	Vertical



Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	69.28	-39.5	21.7	1.0	29.5	-46.3	-20.0	-26.3	Peak
2	272.07	-44.2	25.5	1.9	29.2	-46.0	-20.0	-26.0	Peak
3	1087.29	-62.5	38.7	4.4	36.6	-56.0	-20.0	-36.0	Peak
4	1631.12	-66.5	40.3	5.6	36.8	-57.4	-20.0	-37.4	Peak
5	1903.65	-63.8	40.9	6.1	37.2	-54.0	-20.0	-34.0	Peak
6	2454.85	-59.5	42.3	6.8	37.9	-48.3	-20.0	-28.3	Peak

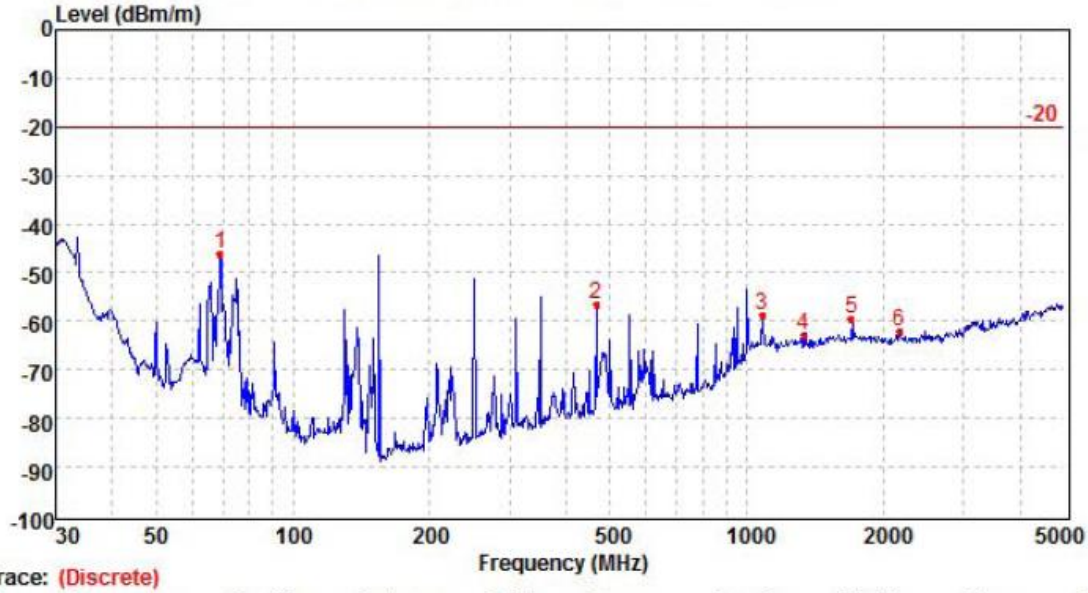
TX3			
Test Frequency:	CH_M	Polarity:	Horizontal



Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	69.03	-36.0	21.9	1.0	29.5	-42.6	-20.0	-22.6	Peak
2	551.62	-56.8	30.8	2.8	29.3	-52.5	-20.0	-32.5	Peak
3	1083.80	-66.0	38.7	4.4	36.6	-59.5	-20.0	-39.5	Peak
4	1703.57	-68.0	40.5	5.8	36.9	-58.6	-20.0	-38.6	Peak
5	2168.73	-73.6	41.5	6.4	37.3	-63.0	-20.0	-43.0	Peak
6	4088.83	-73.2	44.9	8.9	37.9	-57.3	-20.0	-37.3	Peak

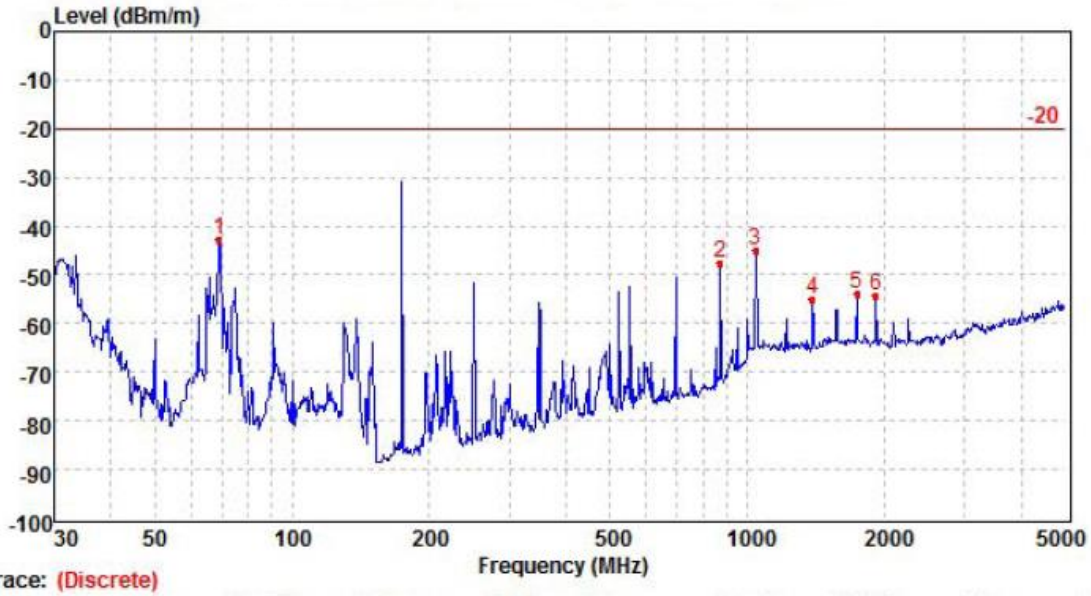
Test Frequency:	CH_M	Polarity:	Vertical



Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	69.28	-39.5	21.7	1.0	29.5	-46.3	-20.0	-26.3	Peak
2	465.95	-59.2	29.3	2.5	29.0	-56.4	-20.0	-36.4	Peak
3	1083.80	-65.2	38.7	4.4	36.6	-58.7	-20.0	-38.7	Peak
4	1333.88	-70.9	39.5	4.9	36.5	-63.0	-20.0	-43.0	Peak
5	1703.57	-68.9	40.5	5.8	36.9	-59.5	-20.0	-39.5	Peak
6	2168.73	-72.9	41.5	6.4	37.3	-62.3	-20.0	-42.3	Peak

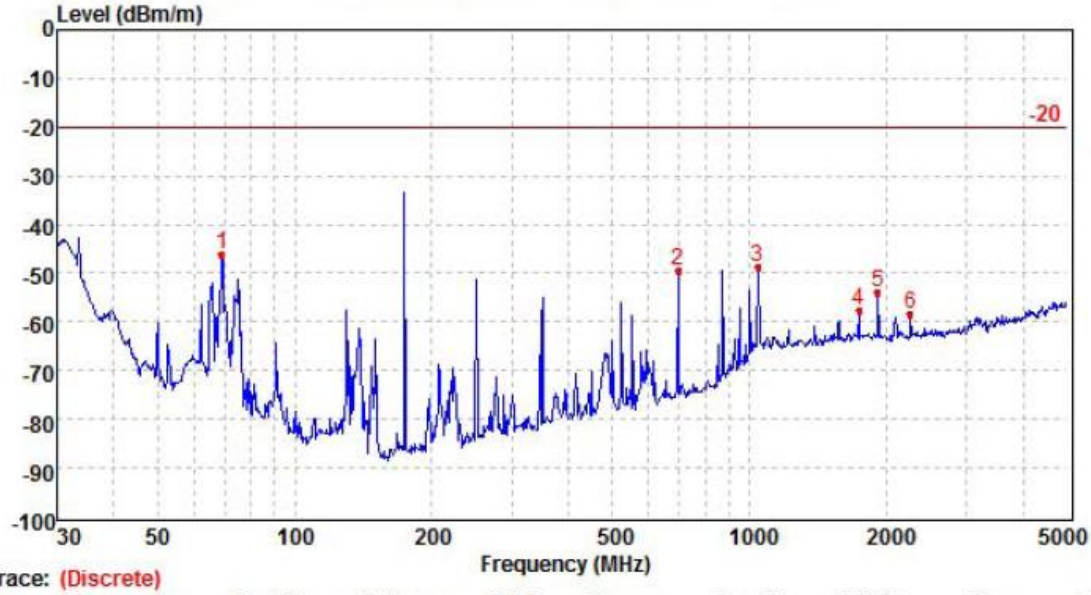
TX3			
Test Frequency:	CH_H	Polarity:	Horizontal



Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	69.03	-36.0	21.9	1.0	29.5	-42.6	-20.0	-22.6	Peak
2	871.32	-57.5	34.8	3.7	28.4	-47.4	-20.0	-27.4	Peak
3	1042.73	-51.0	38.5	4.3	36.6	-44.8	-20.0	-24.8	Peak
4	1390.88	-63.2	39.7	5.0	36.5	-55.0	-20.0	-35.0	Peak
5	1739.59	-63.2	40.6	5.8	37.0	-53.8	-20.0	-33.8	Peak
6	1912.87	-64.0	40.9	6.1	37.2	-54.2	-20.0	-34.2	Peak

Test Frequency:	CH_H	Polarity:	Vertical

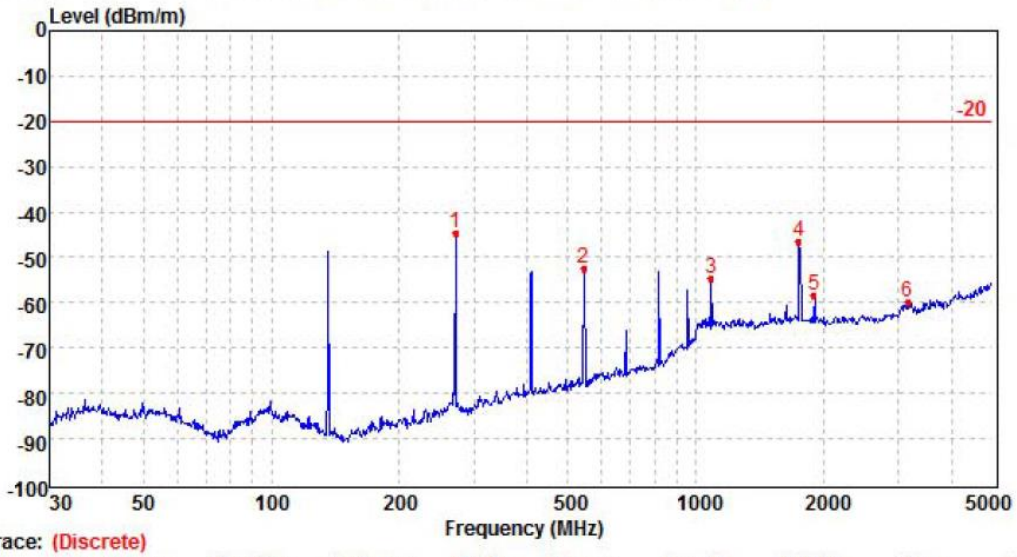


Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	69.28	-39.5	21.7	1.0	29.5	-46.3	-20.0	-26.3	Peak
2	695.73	-56.1	32.0	3.2	28.6	-49.5	-20.0	-29.5	Peak
3	1042.73	-55.0	38.5	4.3	36.6	-48.8	-20.0	-28.8	Peak
4	1739.59	-66.9	40.6	5.8	37.0	-57.5	-20.0	-37.5	Peak
5	1912.87	-63.6	40.9	6.1	37.2	-53.8	-20.0	-33.8	Peak
6	2261.40	-69.3	41.8	6.5	37.5	-58.5	-20.0	-38.5	Peak

Power supply @AC 110V

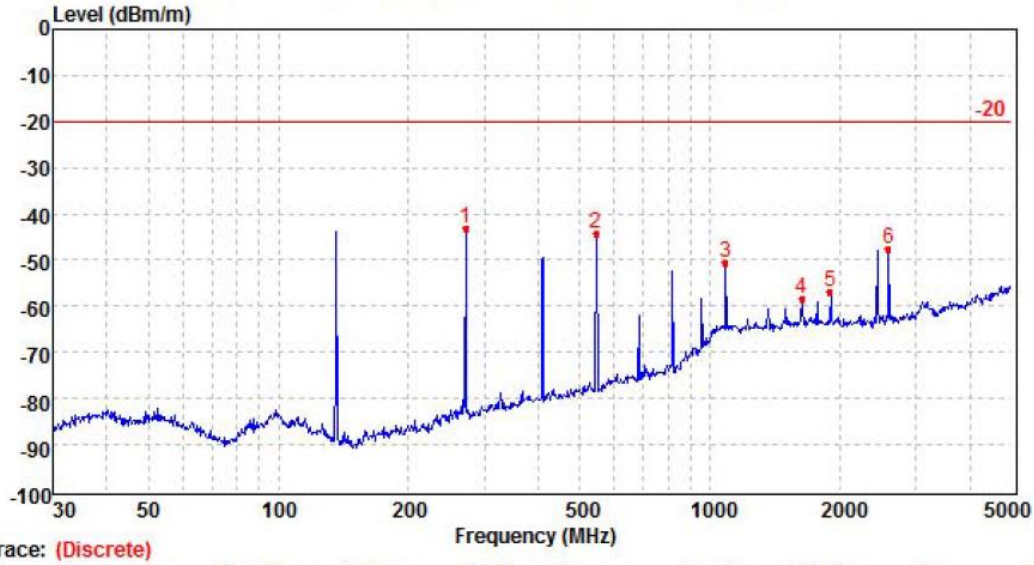
TX1			
Test Frequency:	CH_L	Polarity:	Horizontal



Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	272.07	-42.7	25.5	1.9	29.2	-44.5	-20.0	-24.5	Peak
2	543.92	-56.4	30.6	2.7	29.2	-52.3	-20.0	-32.3	Peak
3	1087.29	-61.0	38.7	4.4	36.6	-54.5	-20.0	-34.5	Peak
4	1750.82	-56.0	40.6	5.9	37.0	-46.5	-20.0	-26.5	Peak
5	1903.65	-68.2	40.9	6.1	37.2	-58.4	-20.0	-38.4	Peak
6	3150.40	-72.9	43.4	7.7	38.2	-60.0	-20.0	-40.0	Peak

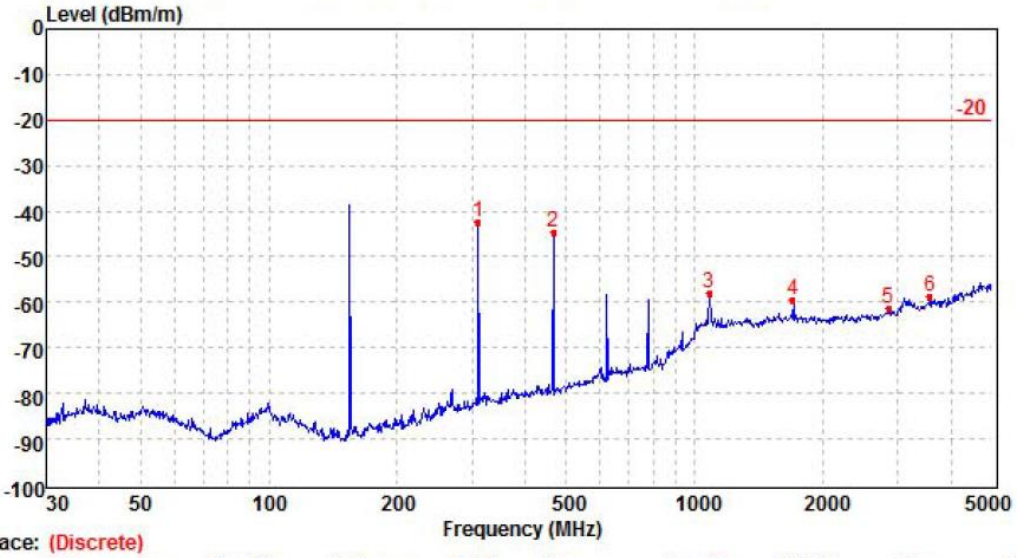
Test Frequency:	CH_L	Polarity:	Vertical



Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	272.07	-41.4	25.5	1.9	29.2	-43.2	-20.0	-23.2	Peak
2	543.92	-48.5	30.6	2.7	29.2	-44.4	-20.0	-24.4	Peak
3	1087.29	-57.2	38.7	4.4	36.6	-50.7	-20.0	-30.7	Peak
4	1631.12	-67.4	40.3	5.6	36.8	-58.3	-20.0	-38.3	Peak
5	1903.65	-66.8	40.9	6.1	37.2	-57.0	-20.0	-37.0	Peak
6	2597.10	-59.3	42.6	6.9	37.8	-47.6	-20.0	-27.6	Peak

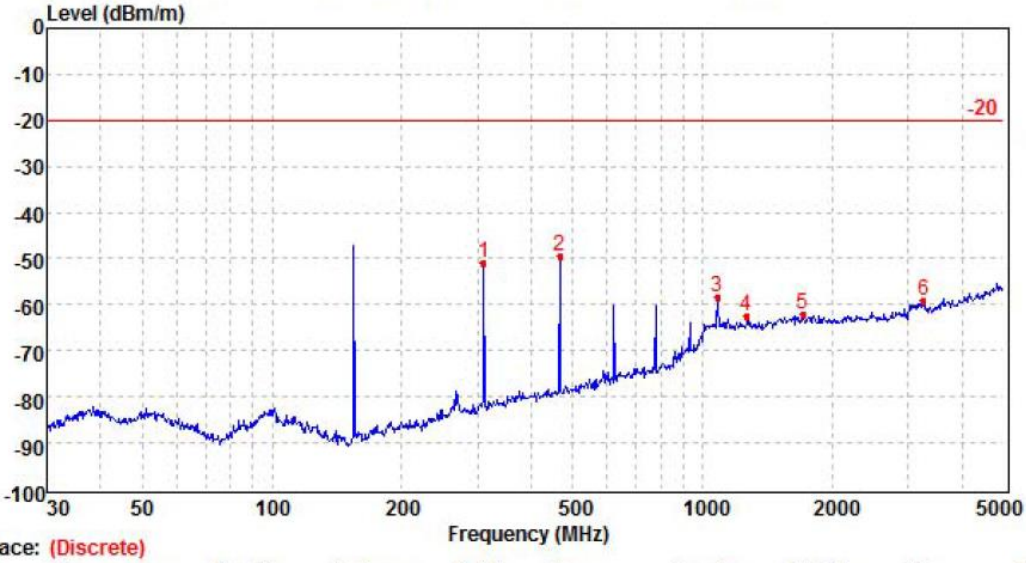
TX1			
Test Frequency:	CH_M	Polarity:	Horizontal



Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	309.87	-41.9	26.4	2.0	29.1	-42.6	-20.0	-22.6	Peak
2	465.95	-47.5	29.3	2.5	29.0	-44.7	-20.0	-24.7	Peak
3	1083.80	-64.6	38.7	4.4	36.6	-58.1	-20.0	-38.1	Peak
4	1703.57	-68.9	40.5	5.8	36.9	-59.5	-20.0	-39.5	Peak
5	2860.40	-73.6	43.0	7.4	38.3	-61.5	-20.0	-41.5	Peak
6	3566.04	-72.4	43.9	8.2	38.3	-58.6	-20.0	-38.6	Peak

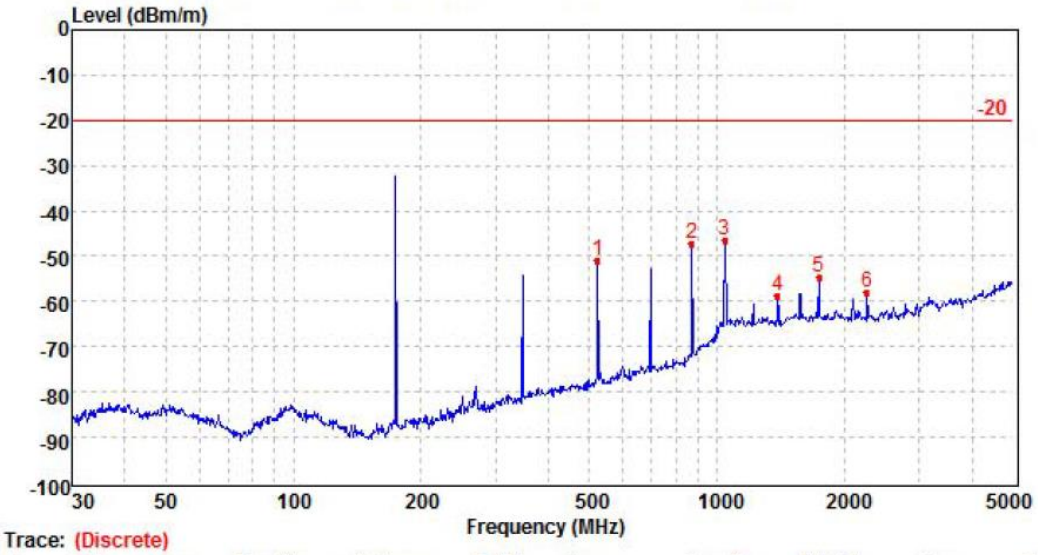
Test Frequency:	CH_M	Polarity:	Vertical



Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	309.87	-50.2	26.4	2.0	29.1	-50.9	-20.0	-30.9	Peak
2	465.95	-52.1	29.3	2.5	29.0	-49.3	-20.0	-29.3	Peak
3	1083.80	-64.7	38.7	4.4	36.6	-58.2	-20.0	-38.2	Peak
4	1266.92	-70.2	39.3	4.8	36.5	-62.6	-20.0	-42.6	Peak
5	1706.31	-71.6	40.5	5.8	36.9	-62.2	-20.0	-42.2	Peak
6	3258.70	-72.2	43.5	7.8	38.3	-59.2	-20.0	-39.2	Peak

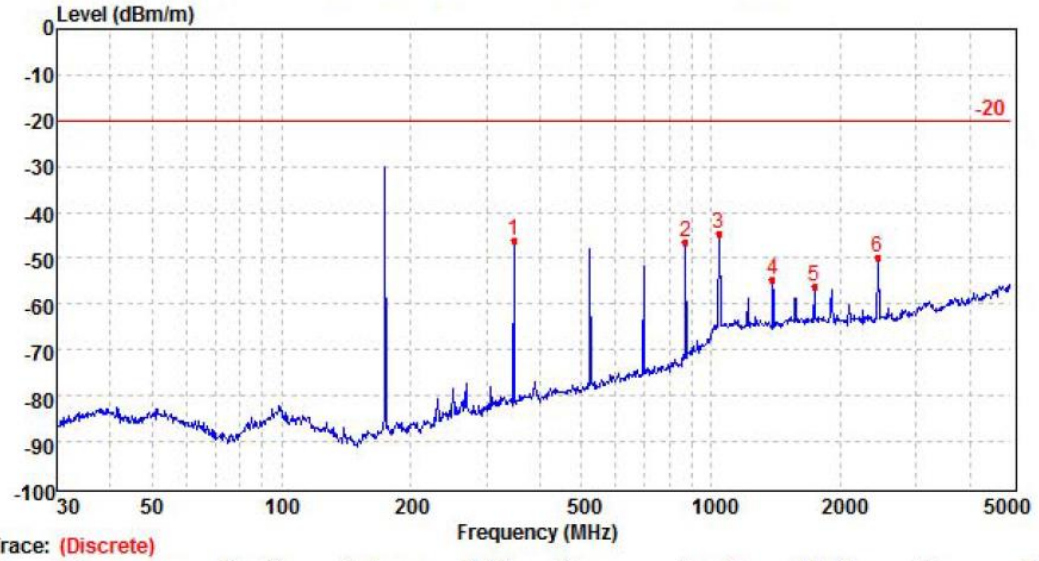
TX1			
Test Frequency:	CH_H	Polarity:	Horizontal



Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	523.28	-54.5	30.2	2.7	29.2	-50.8	-20.0	-30.8	Peak
2	871.32	-57.5	34.8	3.7	28.4	-47.4	-20.0	-27.4	Peak
3	1042.73	-52.6	38.5	4.3	36.6	-46.4	-20.0	-26.4	Peak
4	1390.88	-66.8	39.7	5.0	36.5	-58.6	-20.0	-38.6	Peak
5	1739.59	-63.9	40.6	5.8	37.0	-54.5	-20.0	-34.5	Peak
6	2261.40	-68.9	41.8	6.5	37.5	-58.1	-20.0	-38.1	Peak

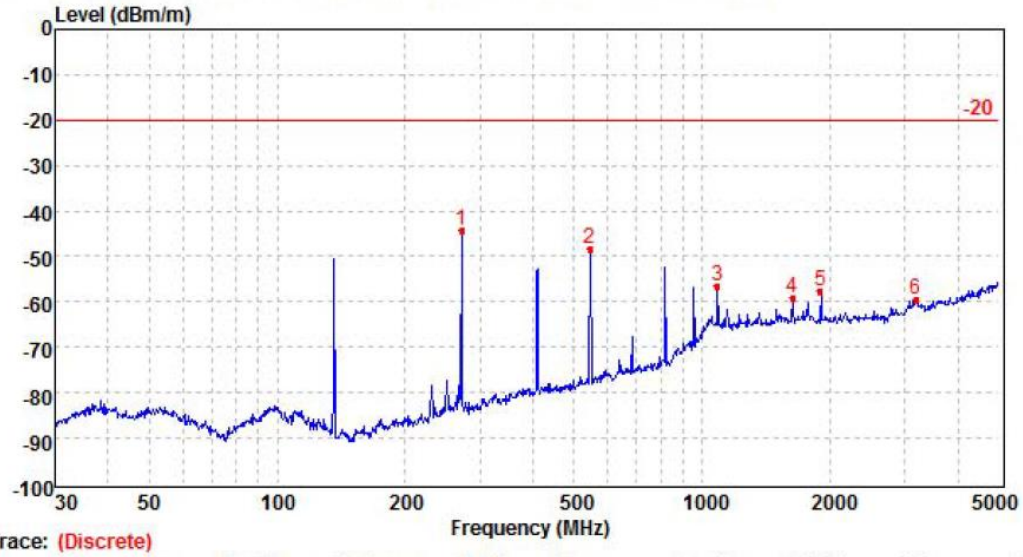
Test Frequency:	CH_H	Polarity:	Vertical



Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	348.00	-46.6	27.4	2.1	29.0	-46.1	-20.0	-26.1	Peak
2	871.32	-56.4	34.8	3.7	28.4	-46.3	-20.0	-26.3	Peak
3	1042.73	-50.8	38.5	4.3	36.6	-44.6	-20.0	-24.6	Peak
4	1390.88	-63.0	39.7	5.0	36.5	-54.8	-20.0	-34.8	Peak
5	1739.59	-65.6	40.6	5.8	37.0	-56.2	-20.0	-36.2	Peak
6	2446.96	-61.0	42.3	6.8	37.9	-49.8	-20.0	-29.8	Peak

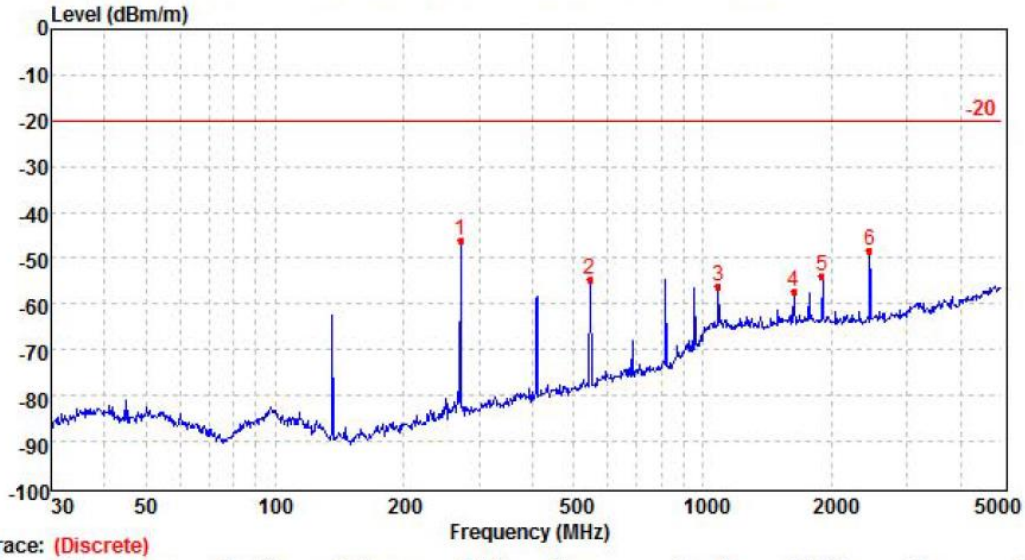
TX3			
Test Frequency:	CH_L	Polarity:	Horizontal



Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	272.07	-42.4	25.5	1.9	29.2	-44.2	-20.0	-24.2	Peak
2	543.92	-52.5	30.6	2.7	29.2	-48.4	-20.0	-28.4	Peak
3	1087.29	-63.0	38.7	4.4	36.6	-56.5	-20.0	-36.5	Peak
4	1631.12	-68.3	40.3	5.6	36.8	-59.2	-20.0	-39.2	Peak
5	1903.65	-67.3	40.9	6.1	37.2	-57.5	-20.0	-37.5	Peak
6	3191.23	-72.5	43.5	7.7	38.2	-59.5	-20.0	-39.5	Peak

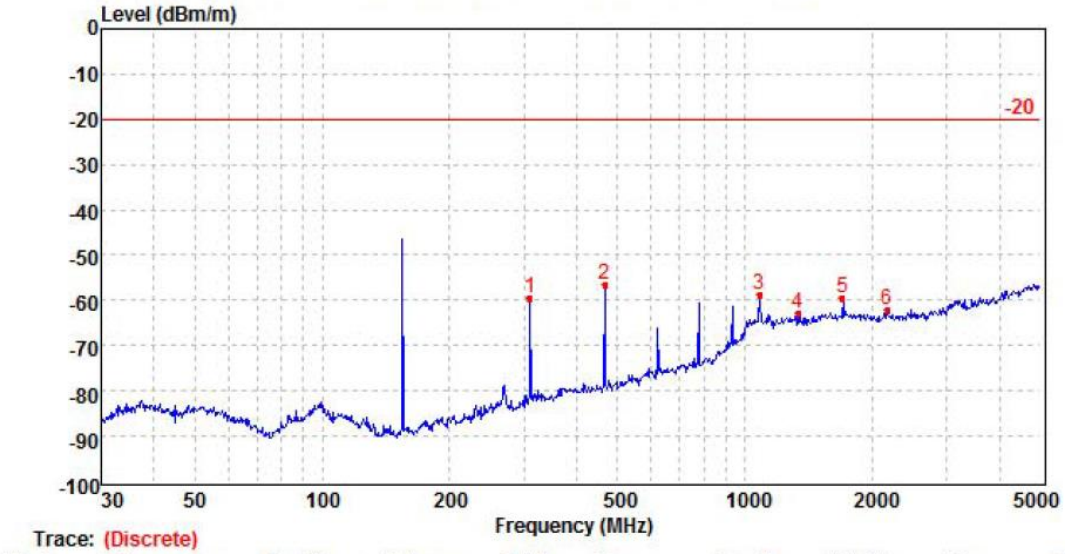
Test Frequency:	CH_L	Polarity:	Vertical



Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	272.07	-44.2	25.5	1.9	29.2	-46.0	-20.0	-26.0	Peak
2	543.92	-58.7	30.6	2.7	29.2	-54.6	-20.0	-34.6	Peak
3	1087.29	-62.5	38.7	4.4	36.6	-56.0	-20.0	-36.0	Peak
4	1631.12	-66.5	40.3	5.6	36.8	-57.4	-20.0	-37.4	Peak
5	1903.65	-63.8	40.9	6.1	37.2	-54.0	-20.0	-34.0	Peak
6	2454.85	-59.5	42.3	6.8	37.9	-48.3	-20.0	-28.3	Peak

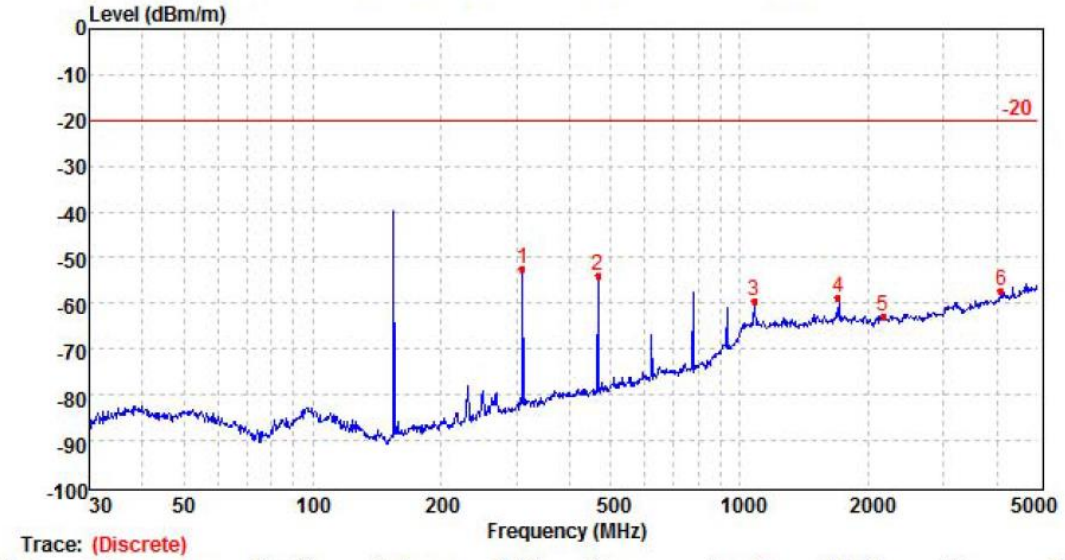
TX3			
Test Frequency:	CH_M	Polarity:	Horizontal



Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	309.87	-58.9	26.4	2.0	29.1	-59.6	-20.0	-39.6	Peak
2	465.95	-59.2	29.3	2.5	29.0	-56.4	-20.0	-36.4	Peak
3	1083.80	-65.2	38.7	4.4	36.6	-58.7	-20.0	-38.7	Peak
4	1333.88	-70.9	39.5	4.9	36.5	-63.0	-20.0	-43.0	Peak
5	1703.57	-68.9	40.5	5.8	36.9	-59.5	-20.0	-39.5	Peak
6	2168.73	-72.9	41.5	6.4	37.3	-62.3	-20.0	-42.3	Peak

Test Frequency:	CH_M	Polarity:	Vertical

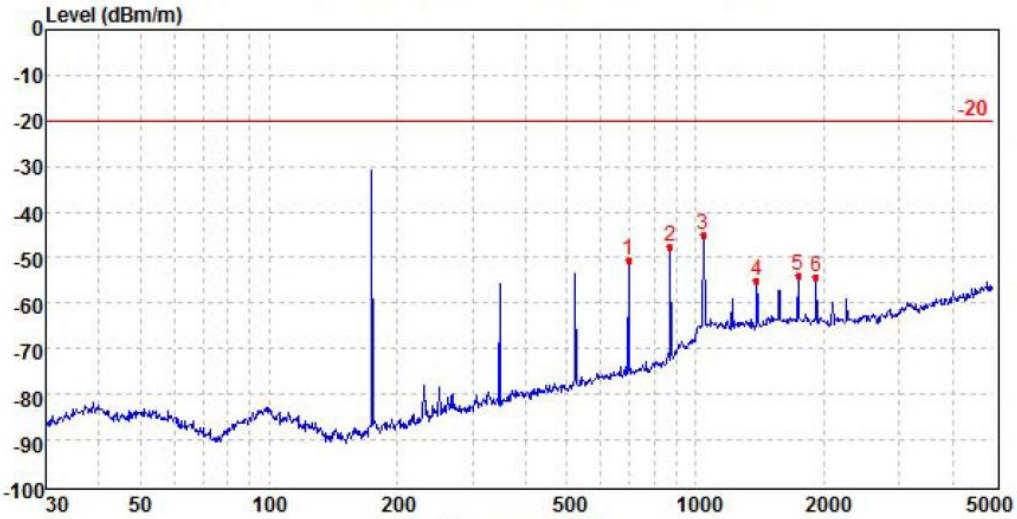


Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	309.87	-51.8	26.4	2.0	29.1	-52.5	-20.0	-32.5	Peak
2	465.95	-56.5	29.3	2.5	29.0	-53.7	-20.0	-33.7	Peak
3	1083.80	-66.0	38.7	4.4	36.6	-59.5	-20.0	-39.5	Peak
4	1703.57	-68.0	40.5	5.8	36.9	-58.6	-20.0	-38.6	Peak
5	2168.73	-73.6	41.5	6.4	37.3	-63.0	-20.0	-43.0	Peak
6	4088.83	-73.2	44.9	8.9	37.9	-57.3	-20.0	-37.3	Peak

1

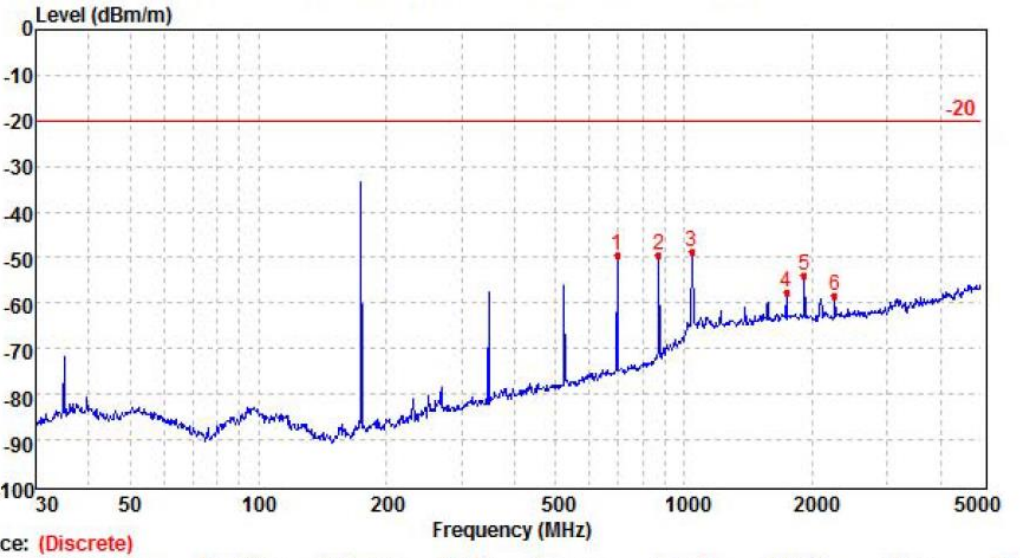
TX3			
Test Frequency:	CH_H	Polarity:	Horizontal



Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	695.73	-57.2	32.0	3.2	28.6	-50.6	-20.0	-30.6	Peak
2	871.32	-57.5	34.8	3.7	28.4	-47.4	-20.0	-27.4	Peak
3	1042.73	-51.0	38.5	4.3	36.6	-44.8	-20.0	-24.8	Peak
4	1390.88	-63.2	39.7	5.0	36.5	-55.0	-20.0	-35.0	Peak
5	1739.59	-63.2	40.6	5.8	37.0	-53.8	-20.0	-33.8	Peak
6	1912.87	-64.0	40.9	6.1	37.2	-54.2	-20.0	-34.2	Peak

Test Frequency:	CH_H	Polarity:	Vertical



Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	695.73	-56.1	32.0	3.2	28.6	-49.5	-20.0	-29.5	Peak
2	871.32	-59.5	34.8	3.7	28.4	-49.4	-20.0	-29.4	Peak
3	1042.73	-55.0	38.5	4.3	36.6	-48.8	-20.0	-28.8	Peak
4	1739.59	-66.9	40.6	5.8	37.0	-57.5	-20.0	-37.5	Peak
5	1912.87	-63.6	40.9	6.1	37.2	-53.8	-20.0	-33.8	Peak
6	2261.40	-69.3	41.8	6.5	37.5	-58.5	-20.0	-38.5	Peak

5.10. Conducted Emissions

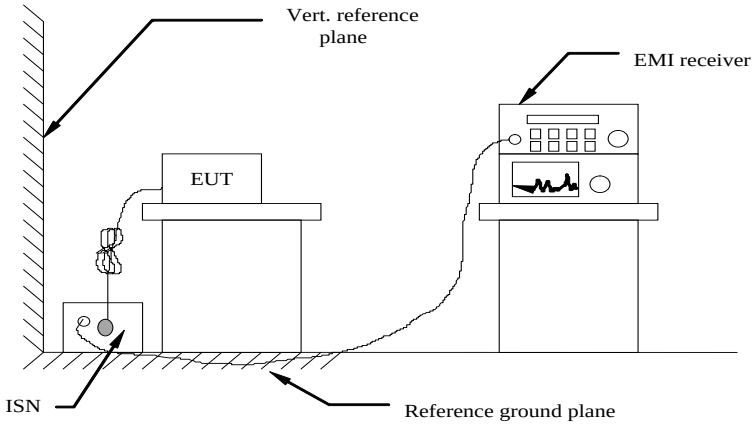
The frequency spectrum from 0.15 MHz to 30 MHz was investigated. The LISN used was 50 ohm / 50 u Henry as specified by section 5.1 of ANSI C63.4-2014. Cables and peripherals were moved to find the maximum emission levels for each frequency.

Limit

FCC part 15.107(a)

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

TEST CONFIGURATION



TEST PROCEDURE

1 The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system; a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.4-2014.
2 Support equipment, if needed, was placed as per ANSI C63.4-2014.
3 All I/O cables were positioned to simulate typical actual usage as per ANSI C63.4-2014.
4 If a EUT received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5 All support equipments received AC power from a second LISN, if any
6 The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7 Analyzer / Receiver scanned from 150 kHz to 30MHz for emissions in each of the test modes.
8 During the above scans, the emissions were maximized by cable manipulation.

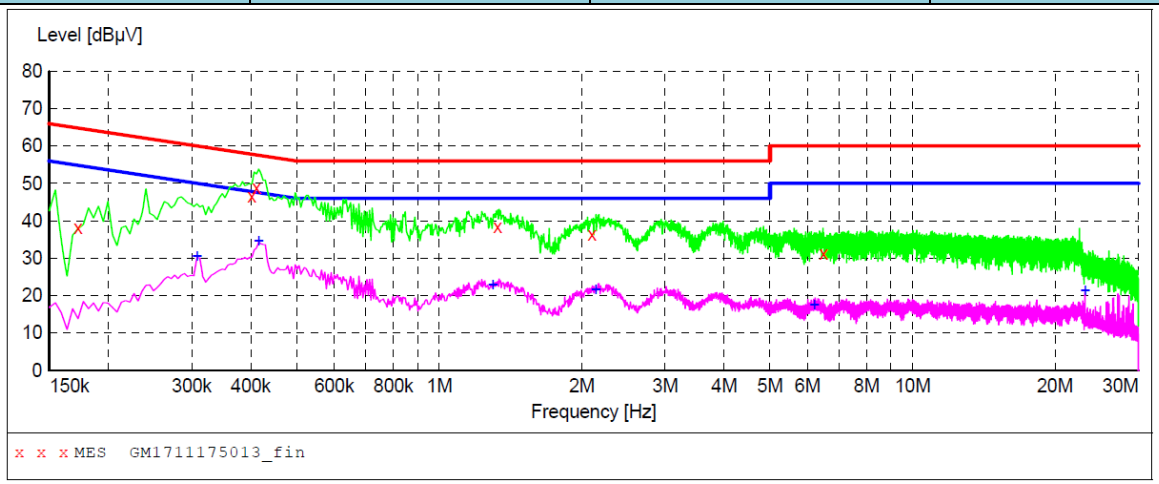
TEST MODE:

Please reference to the section 3.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

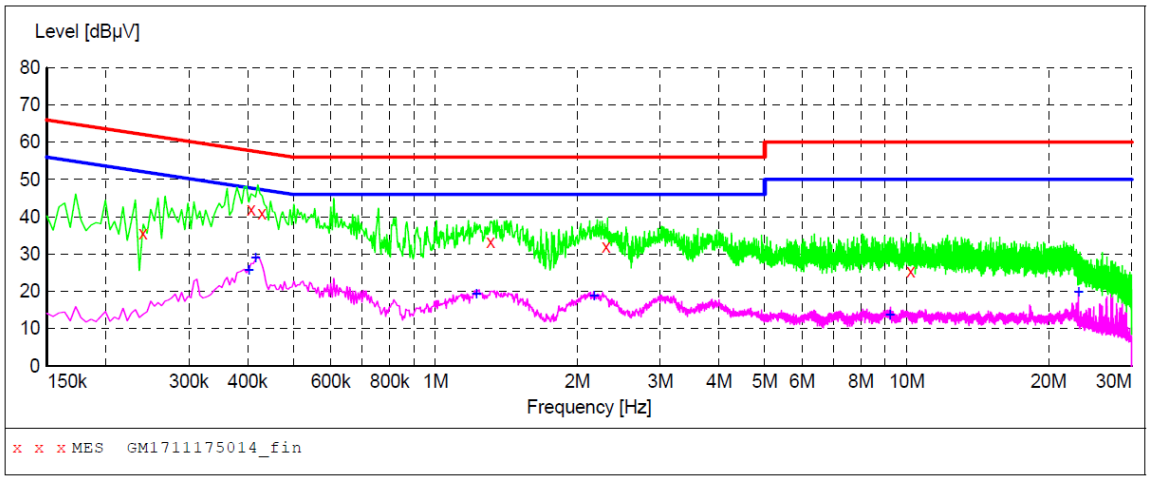
Test Mode:	RX1	Polarity:	L



Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.172500	38.20	10.4	65	26.6	QP	L1	GND
0.402000	46.60	10.2	58	11.2	QP	L1	GND
0.411000	48.80	10.2	58	8.8	QP	L1	GND
1.329000	38.40	10.2	56	17.6	QP	L1	GND
2.103000	36.30	10.2	56	19.7	QP	L1	GND
6.486000	31.40	10.3	60	28.6	QP	L1	GND

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.307500	30.60	10.2	50	19.4	AV	L1	GND
0.415500	34.50	10.2	48	13.0	AV	L1	GND
1.297500	22.90	10.2	46	23.1	AV	L1	GND
2.139000	21.70	10.2	46	24.3	AV	L1	GND
6.198000	17.40	10.3	50	32.6	AV	L1	GND
23.127000	21.40	10.7	50	28.6	AV	L1	GND

Test Mode:	RX1	Polarity:	N



Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.240000	35.50	10.3	62	26.6	QP	N	GND
0.406500	42.00	10.2	58	15.7	QP	N	GND
0.429000	41.00	10.2	57	16.3	QP	N	GND
1.311000	33.30	10.2	56	22.7	QP	N	GND
2.301000	32.00	10.2	56	24.0	QP	N	GND
10.203000	25.40	10.6	60	34.6	QP	N	GND

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.402000	25.80	10.2	48	22.0	AV	N	GND
0.415500	29.10	10.2	48	18.4	AV	N	GND
1.221000	19.30	10.2	46	26.7	AV	N	GND
2.170500	18.90	10.2	46	27.1	AV	N	GND
9.199500	13.60	10.6	50	36.4	AV	N	GND
23.127000	19.80	10.7	50	30.2	AV	N	GND

5.11. Radiated Emission

LIMIT

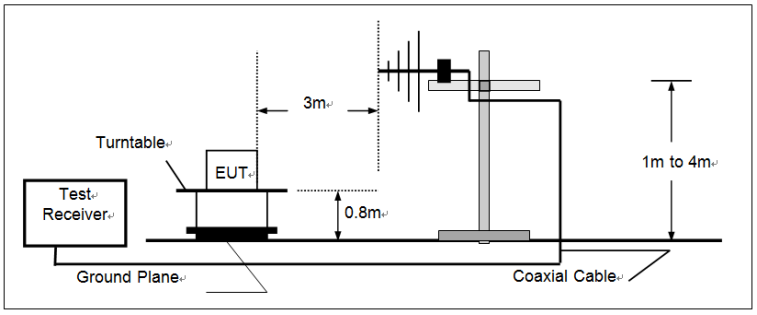
For unintentional device, according to § 15.109(a) except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values：

Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

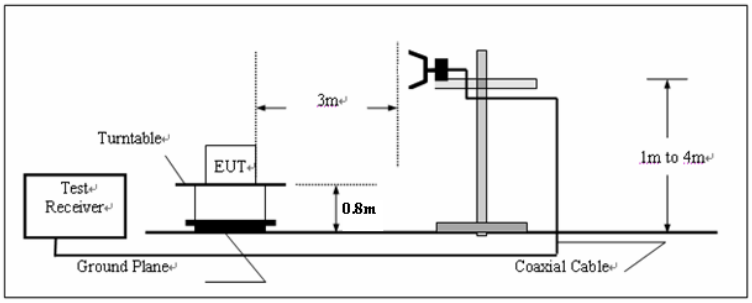
For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the above table.

TEST CONFIGURATION

(A) Radiated Emission Test Set-Up, Frequency below 1000MHz



(B) Radiated Emission Test Set-Up, Frequency above 1000MHz



TEST PROCEDURE

1 The EUT was placed on a turn table which is 0.8m above ground plane.
2 Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0°C to 360°C to acquire the highest emissions from EUT
3 And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4 Repeat above procedures until all frequency measurements have been completed.

TEST MODE:

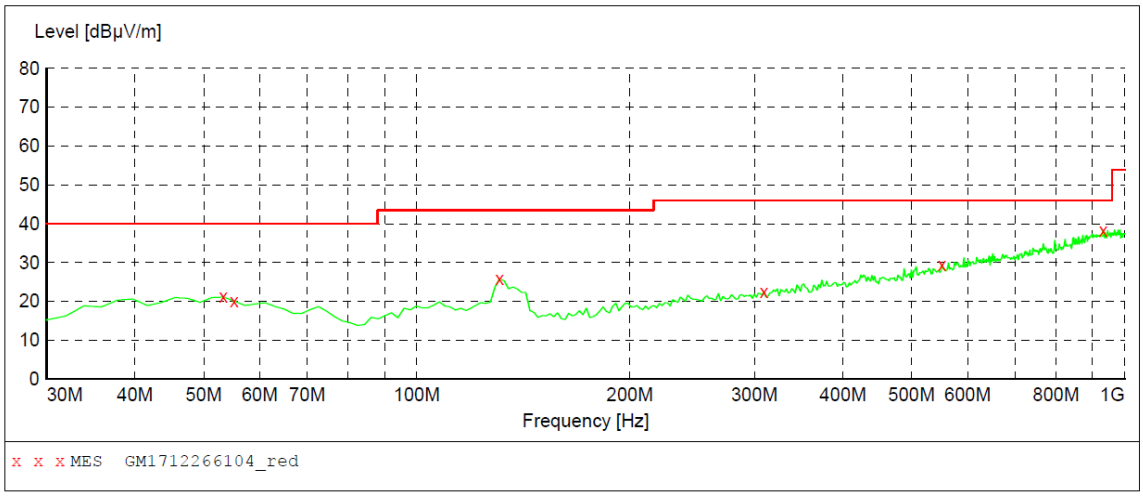
Please reference to the section 3.4

TEST RESULTS

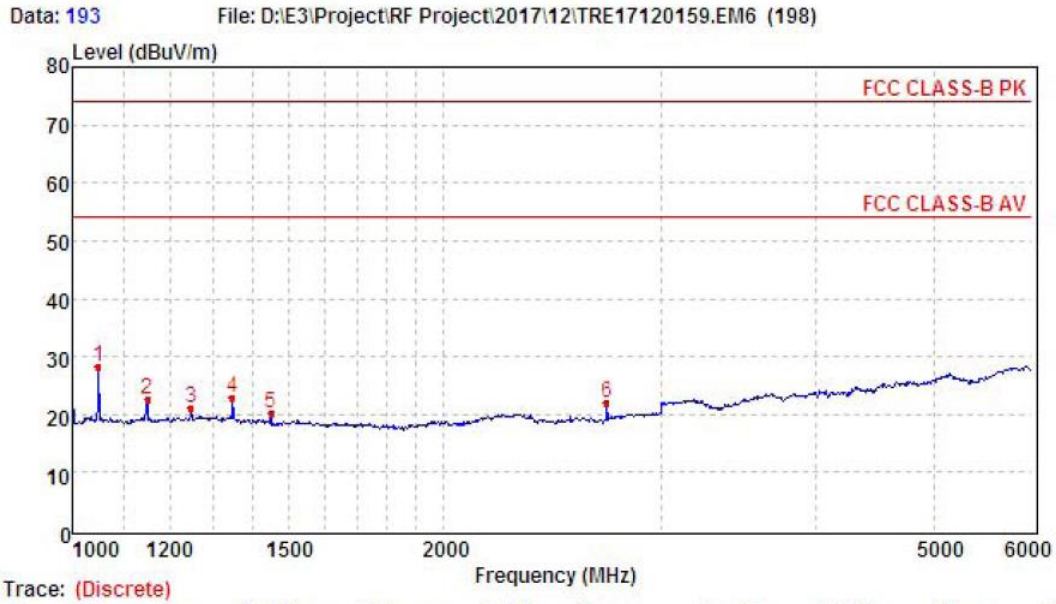
☒ **Passed** ☐ **Not Applicable**

Note:
1. The EUT shall be scanned from 30 MHz to the 5th harmonic of the highest oscillator frequency in the digital devices or 1 GHz whichever is higher.
2. Have pre-tested RX1 to RX3mode, record the worst case mode RX3 on the report.

Test Mode:	RX1	Polarity:	Horizontal



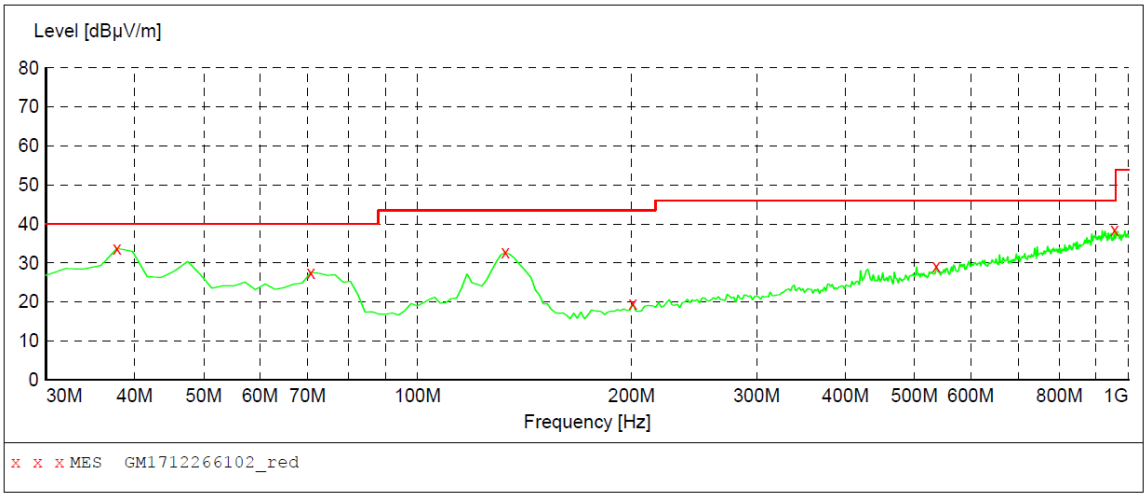
Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
53.280000	21.20	-9.0	40.0	18.8	QP	100.0	356.00	HORIZONTAL
55.220000	20.10	-9.2	40.0	19.9	QP	300.0	150.00	HORIZONTAL
130.880000	25.80	-13.4	43.5	17.7	QP	300.0	81.00	HORIZONTAL
309.360000	22.50	-7.1	46.0	23.5	QP	100.0	198.00	HORIZONTAL
551.860000	29.50	-0.7	46.0	16.5	QP	100.0	46.00	HORIZONTAL
932.100000	38.40	7.1	46.0	7.6	QP	100.0	3.00	HORIZONTAL



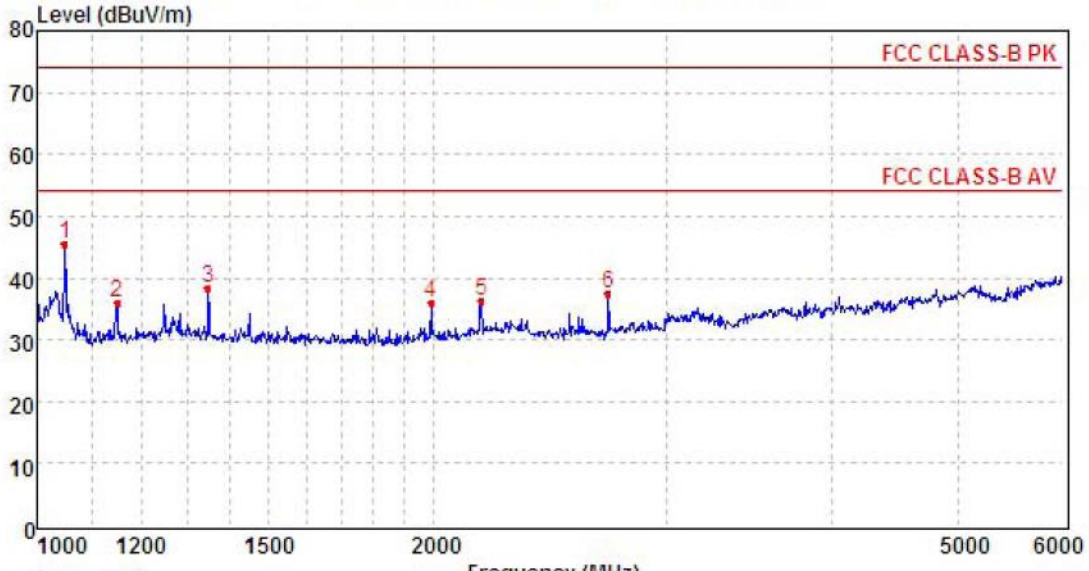
Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	1049.57	35.2	25.4	4.3	36.6	28.3	54.0	-25.7	Averag
2	1150.00	28.8	25.9	4.5	36.6	22.6	54.0	-31.4	Averag
3	1248.79	26.5	26.3	4.7	36.5	21.0	54.0	-33.0	Averag
4	1348.81	28.4	26.1	4.9	36.5	22.9	54.0	-31.1	Averag
5	1449.03	25.8	25.9	5.1	36.5	20.3	54.0	-33.7	Averag
6	2712.88	24.7	28.1	7.2	38.1	21.9	54.0	-32.1	Averag

Test Mode:	RX1	Polarity:	Vertical



Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
37.760000	33.80	-10.8	40.0	6.2	QP	100.0	186.00	VERTICAL
70.740000	27.60	-13.3	40.0	12.4	QP	100.0	171.00	VERTICAL
132.820000	32.70	-13.6	43.5	10.8	QP	100.0	171.00	VERTICAL
200.720000	19.60	-9.9	43.5	23.9	QP	100.0	346.00	VERTICAL
536.340000	29.20	-1.0	46.0	16.8	QP	100.0	318.00	VERTICAL
955.380000	38.50	7.3	46.0	7.5	QP	100.0	266.00	VERTICAL



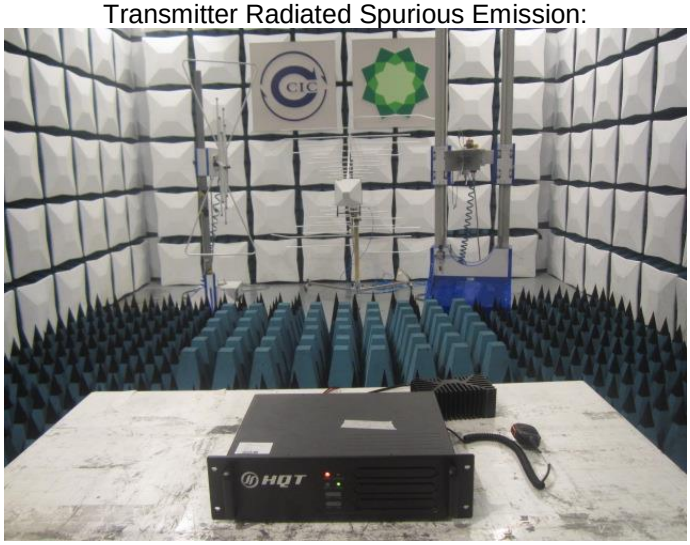
Trace: (Discrete)

Mark	Frequency MHZ	Reading dBm	Antenna dB	Cable dB	Preamp dB	Level dBm	Limit dBm	Over limit	Remark
1	1049.57	52.3	25.4	4.3	36.6	45.4	74.0	-28.6	Peak
2	1150.00	42.3	25.9	4.5	36.6	36.1	74.0	-37.9	Peak
3	1348.81	43.8	26.1	4.9	36.5	38.3	74.0	-35.7	Peak
4	1989.80	40.6	26.2	6.3	37.3	35.8	74.0	-38.2	Peak
5	2172.40	39.8	27.3	6.4	37.3	36.2	74.0	-37.8	Peak
6	2712.88	40.3	28.1	7.2	38.1	37.5	74.0	-36.5	Peak

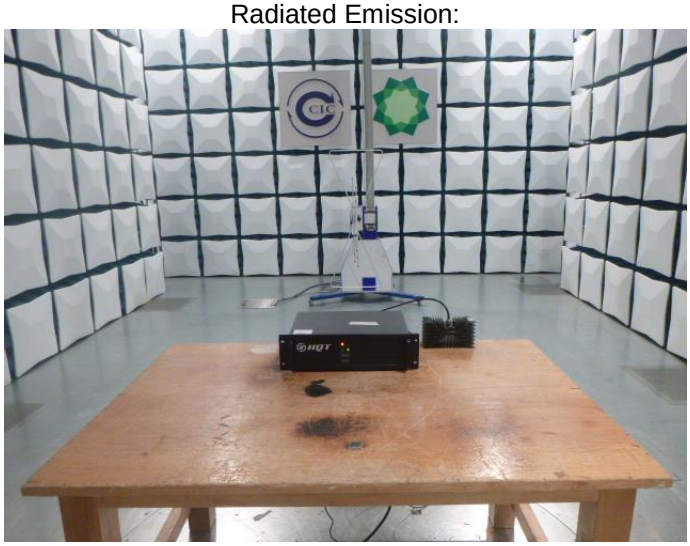
6. Test Setup Photos of the EUT

Conducted Emission:

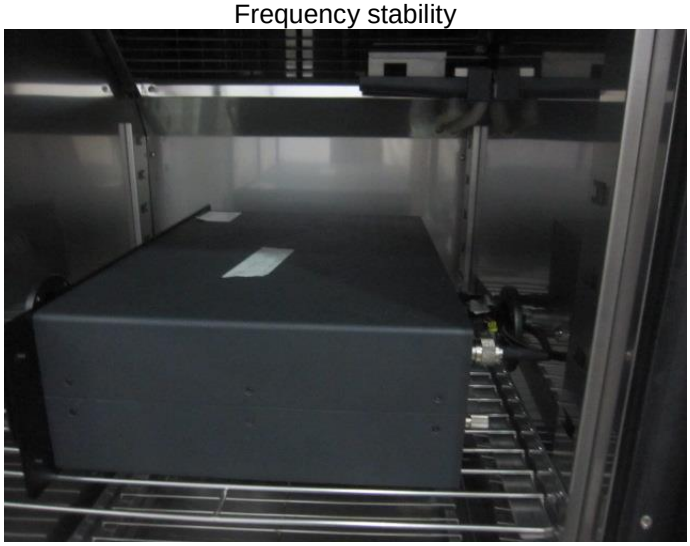
Transmitter Radiated Spurious Emission:



Radiated Emission:

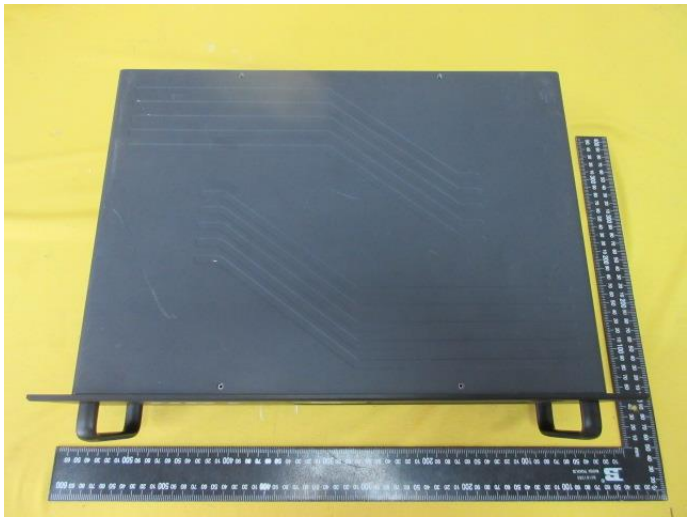


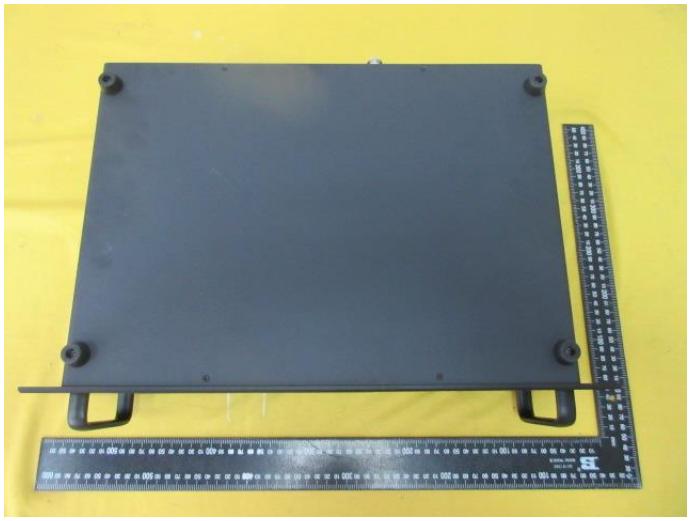
Frequency stability



7. External and Internal Photos of the EUT

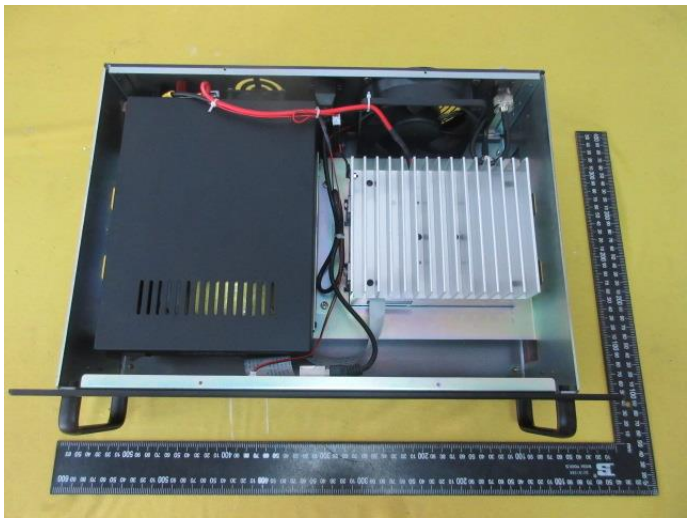
External photos of the EUT

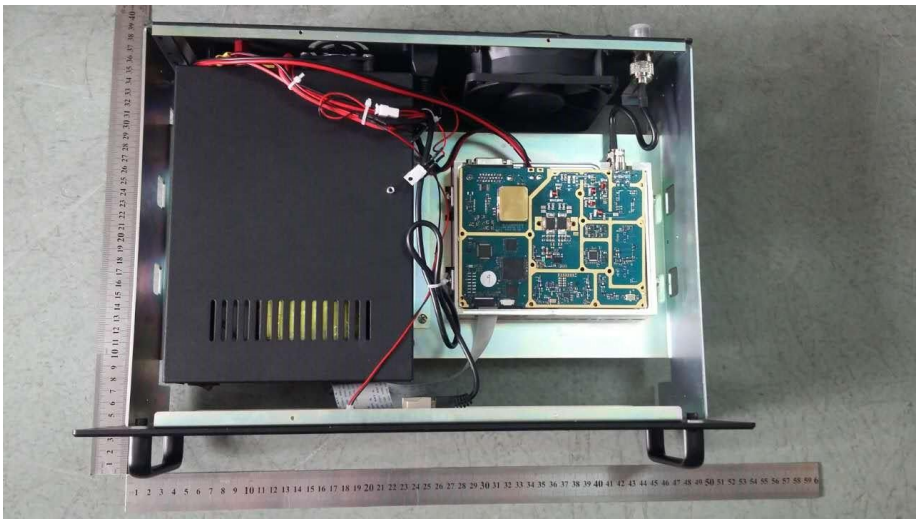


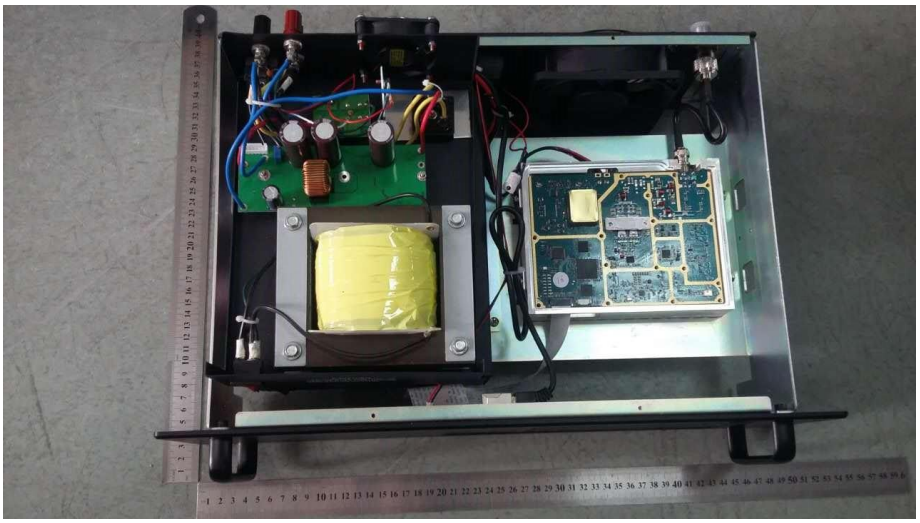


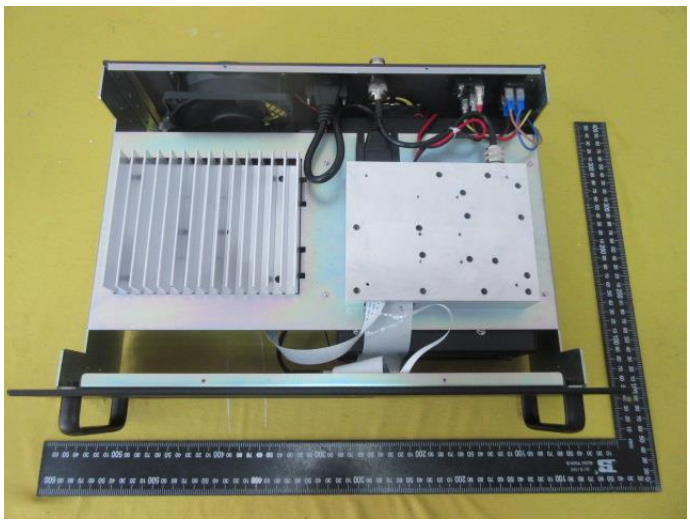

TX
ACCY
RX
DC 13.8V
AC

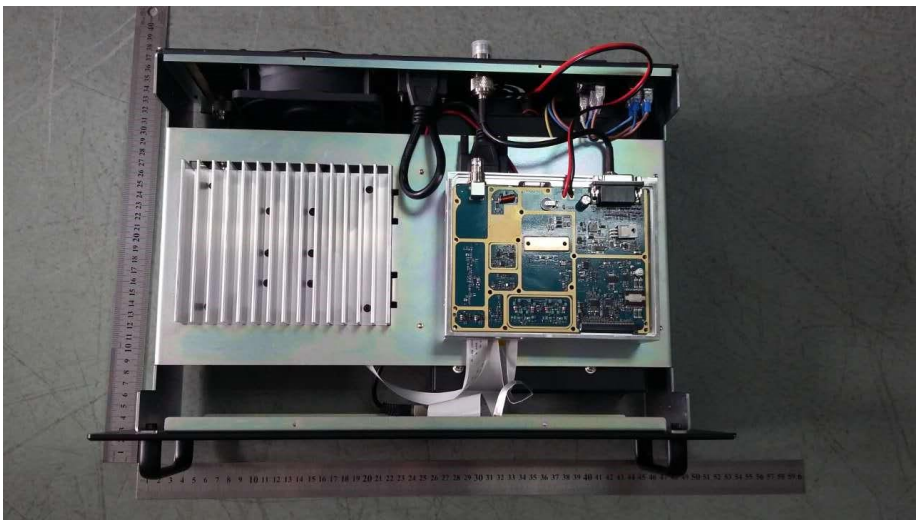
Internal photos of the EUT

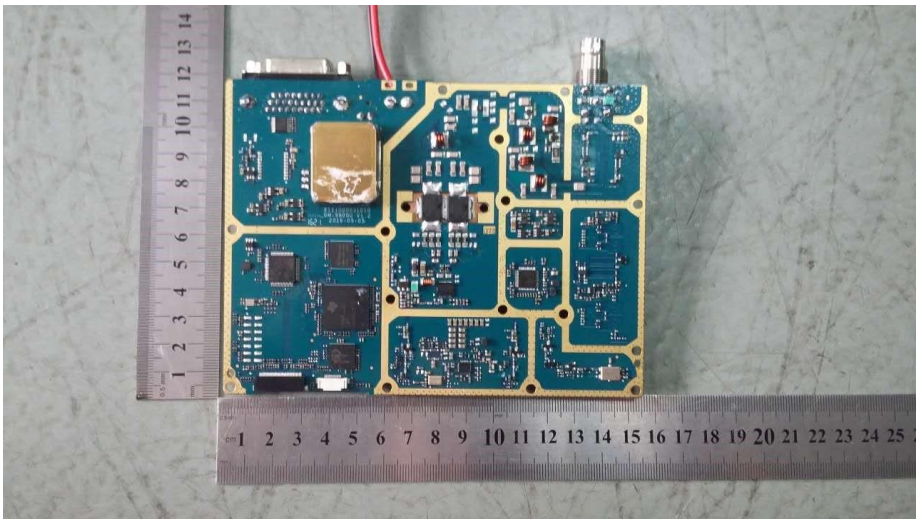


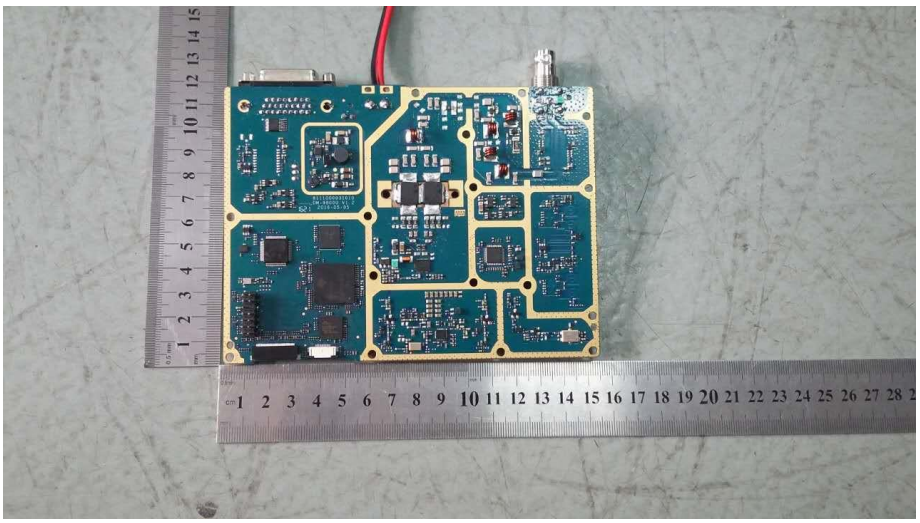


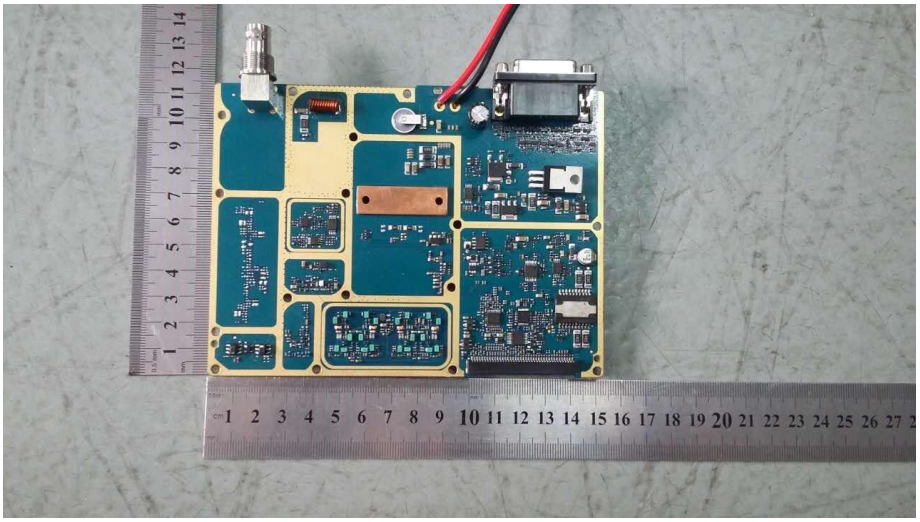


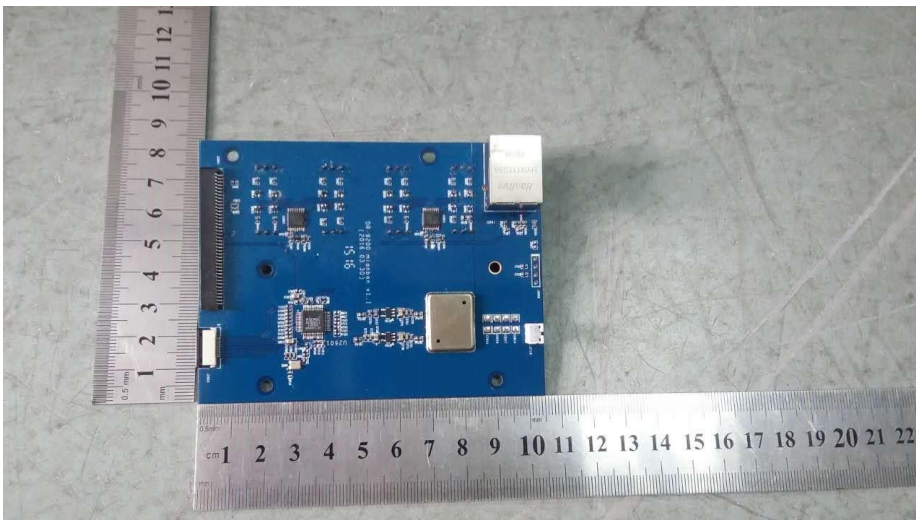


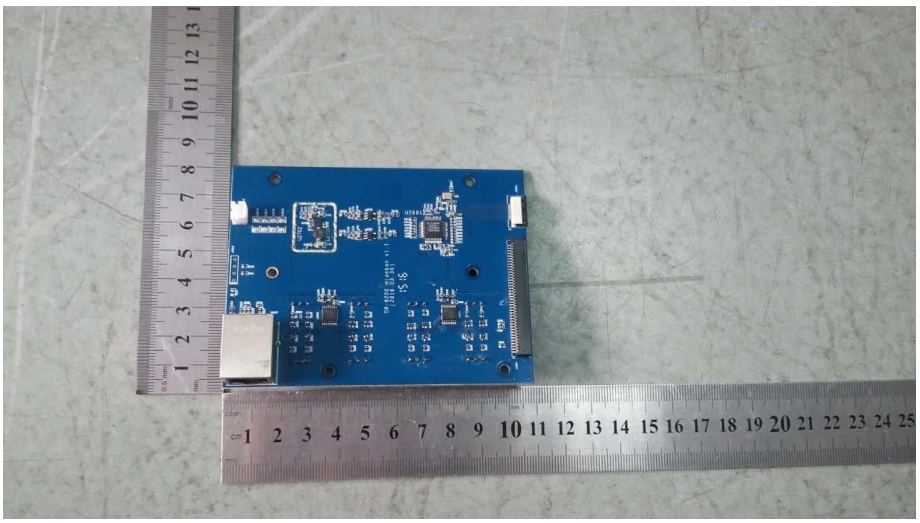


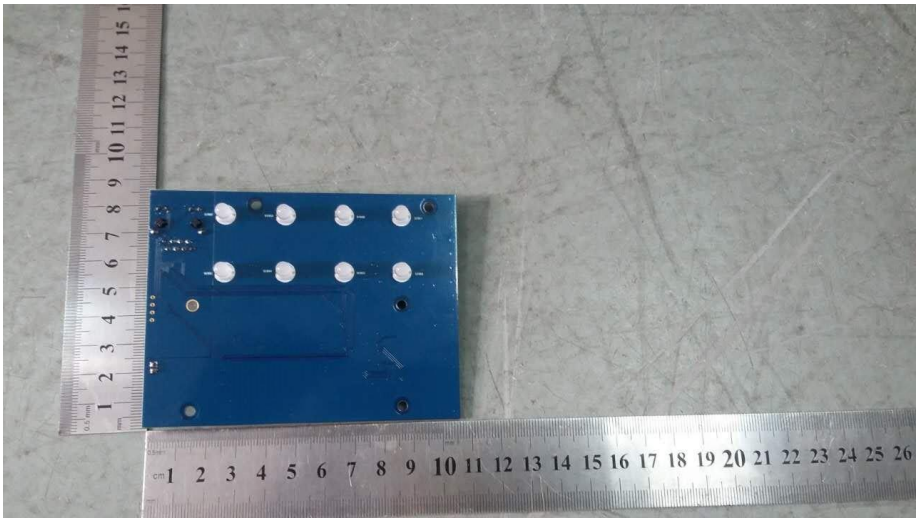












----------End of Report----------