

FCC TEST REPORT

Report Number : **709502301626-00A** Date of Issue: April 17, 2023

Model : DD251H

Product Type : Five-channel transmitter

Applicant : Markisol USA Inc

Address : 700 Pinnacle Ct Suite 170 Norcross GEORGIA 30071 USA

Production Facility : Ningbo Dooya Mechanic & Electronic Technology Co., Ltd.

Address : No.168 Shengguang Road,Luotuo,Zhenhai 315202 Ningbo,
Province, P.R. China.

Test Result : ☒ **Positive** ☐ **Negative**

Total pages including
Appendices : 16

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1 Table of Contents

1 Table of Contents 2

2 Details about the Test Laboratory..... 3

3 Description of the Equipment Under Test..... 4

4 Summary of Test Standards 5

5 Summary of Test Results 6

6 General Remarks 7

7 Systems test configuration 8

8 Test Setups..... 9

9 Test Methodology..... 10

9.1 Radiated Emission..... 10

9.2 Bandwidth Measurement 13

9.3 Deactivation Time 14

10 Test Equipment List..... 15

11 System Measurement Uncertainty 16

2 Details about the Test Laboratory

Details about the Test Laboratory

Test Site 1

Company name: TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
No.16 Lane, 1951 Du Hui Road,
Shanghai 201108,
P.R. China

Test Firm FCC
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Designation
number: CN1183

IC Company
Number: 25988

CAB identifier: CN0101

Telephone: +86 21 6141 0123
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3 Description of the Equipment Under Test

Product:	Five-channel transmitter
Model no.:	DD251H
FCC ID:	2A27U251H
Rating:	DV 3V
RF Transmission Frequency:	433.92MHz
Modulation:	FSK
Antenna Type:	PCB antenna
Antenna Gain:	-3.0dBi
Description of the EUT:	The Equipment Under Test (EUT) was a Five-channel transmitter, transmitter operated at 433. 92MHz.
Test sample no.:	SHA-716249-1

4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators

All the test methods were according to ANSI C63.10-2013.

5 Summary of Test Results

Technical Requirements				
FCC Part 15 Subpart C				
Test Condition		Pages	Test Site	Test Result
§15.205, §15.209, 15.35 (c)§15.231(b)	Radiated Emission, 30MHz to 4.5GHz	10-12	3m chamber	Pass
§15.231(c)	Bandwidth Measurement	13	Shield room	Pass
§15.231(a)(1)	Deactivation Time	14	Shield room	Pass
§15.203	Antenna requirement	--	See Note 2	Pass

Note 1: N/A=Not Applicable. Conducted emission is not apply for battery operated device.

Note 2: The EUT uses a PCB Antenna, which gain is -3.0dBi. In accordance to §15.203, It is considered sufficiently to comply with the provisions of this section.

6 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: 2A27U251H, complies with Section 15.205, 15.209, 15.231 of the FCC Part 15, Subpart C Rules.

SUMMARY:

All tests according to the regulations cited on page 5 were

■ - Performed

□ - Not Performed

The Equipment Under Test

■ - **Fulfills** the general approval requirements.

□ - **Does not** fulfill the general approval requirements.

Sample Received Date: April 11,2023

Testing Start Date: April 11,2023

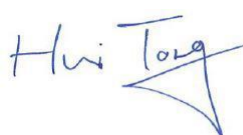
Testing End Date: April 14,2023

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch

Reviewed by:

Prepared by:

Tested by:





Hui TONG
EMC Section Manager

Jiaxi XU
EMC Project Engineer

Cheng Huali
EMC Test Engineer

7 Systems test configuration

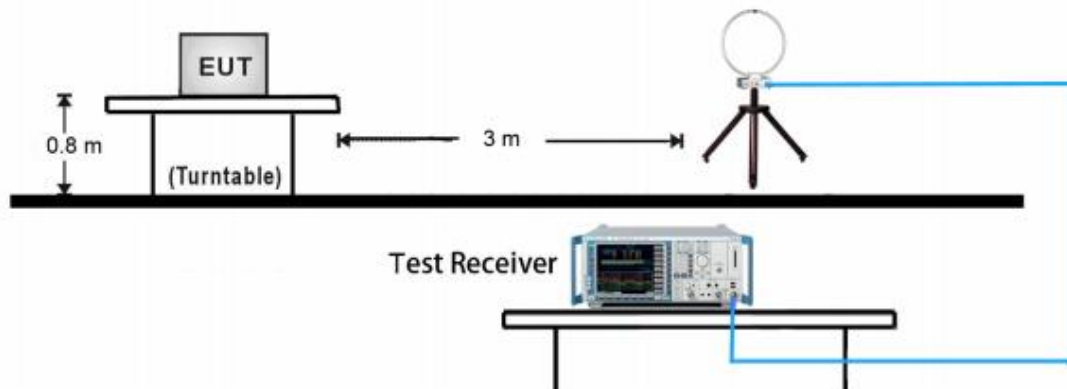
Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.(SHIELD)	S/N(LENGTH)
--	--	--	--

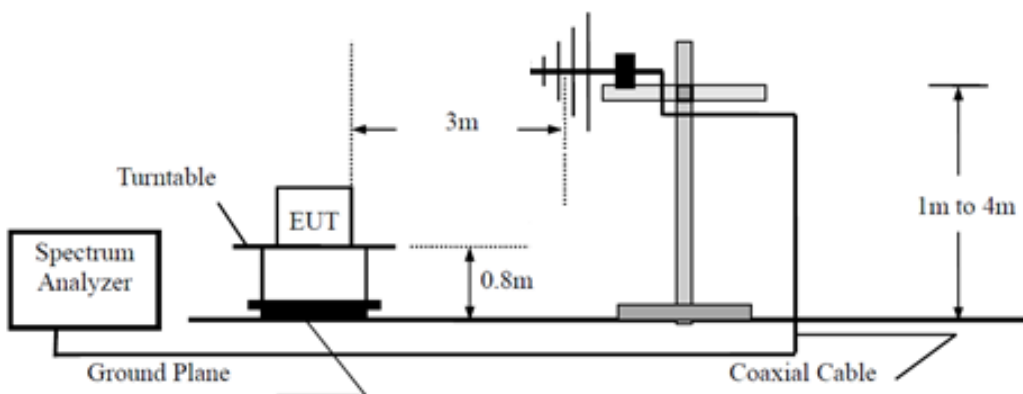
8 Test Setups

8.1 Radiated test setups

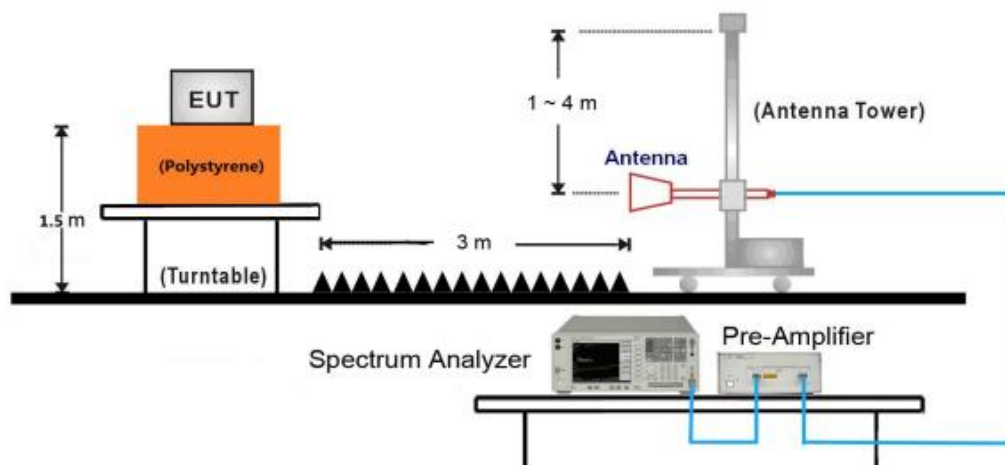
9kHz ~ 30MHz Test Setup:



30MHz ~ 1GHz Test Setup:



1GHz ~ 18GHz Test Setup:



9 Test Methodology

9.1 Radiated Emission

Test Method

1. The EUT was placed on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
3. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. Use the following spectrum analyzer settings According to C63.10:
For Above 1GHz
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 1MHz, VBW $\geq$ 3RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.
For Below 1GHz
Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 KHz, VBW $\geq$ 3RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 KHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for RMS Average (duty cycle $\geq$ 98%) for peak detection at frequency above 1GHz.
4. If the emission is pulsed (duty cycle $<$ 98%), modify the unit for continuous operation: use the settings shown above, then correct the reading by subtracting the peak to average duty cycle correction factor $20\log(\text{duty cycle})$, derived from the appropriate duty cycle calculation.

Limit

According to §15.231 (b), the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Fundamental frequency (MHz)	Field Strength of Fundamental (Microvolts /meter)	Field Strength of spurious emissions ((Microvolts /meter)
40.66-40.70	2,250	225
70-130	1,250	125
130-174	1,250 to 3,370 *	125 to 3750 *
174-260	3,750	375
260-470 √	3,750 to 12, 500*	375 to 1,250*
Above 470	12,500	1,250

Limits for 15.209 Radiated emission limits; general requirements

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Frequency	Limit at 3m (dBuV/m)
0.009 MHz – 0.490 MHz	128.5 to 93.8 ¹
0.490 MHz – 1.705 MHz	73.8 to 63 ¹
1.705 MHz – 30 MHz	69.5 ¹
30 MHz – 88 MHz	40.0 ¹
88 MHz – 216 MHz	43.5 ¹
216 MHz – 960 MHz	46.0 ¹
Above 960 MHz	54.0 ¹
Above 1000 MHz	54.0 ²
Above 1000 MHz	74.0 ³

¹Limit is with detector with bandwidths as defined in CISPR-16-1-1 except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz where an Average detector is used.

²Limit is with 1 MHz measurement bandwidth and using an Average detector

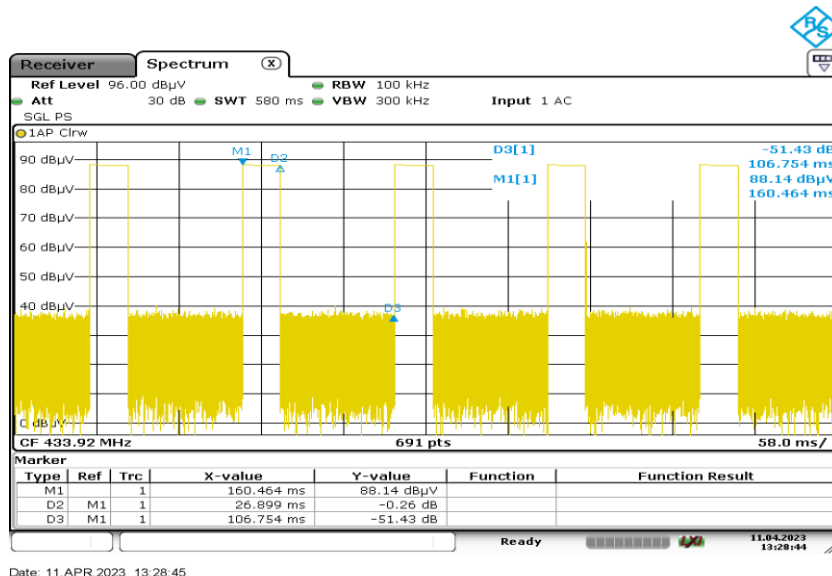
³Limit is with 1 MHz measurement bandwidth and using a Peak detector

Spurious radiated emissions for transmitter

Radiated Emission								
Value	Emissions	E-Field	PK	Average	AV	Limit		Emission Type
	Frequency	Polarity	Emission	Factor	Emission		Margin	
	MHz		dBµV/m	dB	dBµV/m	dBµV/m	dB	
Below 1GHz								
PK	433.92	H	88.03	/	/	100.80	12.77	Fundamental
AV	433.92	H	88.03	-11.40	76.63	80.80	4.17	Fundamental
PK	433.92	V	73.54	/	73.54	100.80	27.26	Fundamental
AV	433.92	V	73.54	-11.40	62.14	80.80	18.66	Fundamental
PK	867.84	H	36.66	/	36.66	80.80	44.14	Spurious
AV	867.84	H	36.66	-11.40	25.26	60.80	35.54	Spurious
PK	867.84	V	36.91	/	36.91	80.80	43.89	Spurious
AV	867.84	V	36.91	-11.40	25.51	60.80	35.29	Spurious
Above 1GHz								
PK	1301.76	H	38.21	/	38.21	74.00	35.79	Restricted band
AV	1301.76	H	35.43	-11.40	24.03	54.00	29.97	Restricted band
PK	1735.68	V	40.15	/	40.15	80.80	40.65	Spurious
AV	1735.68	V	40.15	-11.40	28.75	60.80	32.05	Spurious
PK	1301.76	V	36.19	/	36.19	74.00	37.81	Restricted band
AV	1301.76	V	33.28	-11.40	21.88	54.00	32.12	Restricted band

Remark:

- Corrected Amplitude = Read level + Corrector factor
Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
- Correct Factor = Antenna Factor + Cable Loss (+ Amplifier, for higher than 1GHz)
- Corrected Reading = Original Receiver Reading + Correct Factor
- Only the worst data listed in this report, Other frequency was 20dB below the limit
- AV Emission Level= PK Emission Level+20log(dutycycle), Duty Cycle = 26.899/100 =26.899%,Duty Cycle Factor =20log (Duty Cycle) =-11.40



9.2 Bandwidth Measurement

Test Method

1. Set to the maximum power setting and enable the EUT transmit continuously.
2. Use the following test receiver settings:
Span = approximately 5 times the 20dB bandwidth, centered on a hopping channel
RBW =1% to 5% of the 20dB bandwidth of the emission being measured, VBW≥RBW,
Sweep = auto, Detector function = peak, Trace = max hold
3. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth. Record the results.
4. Repeat above procedures until all frequencies measured were complete.

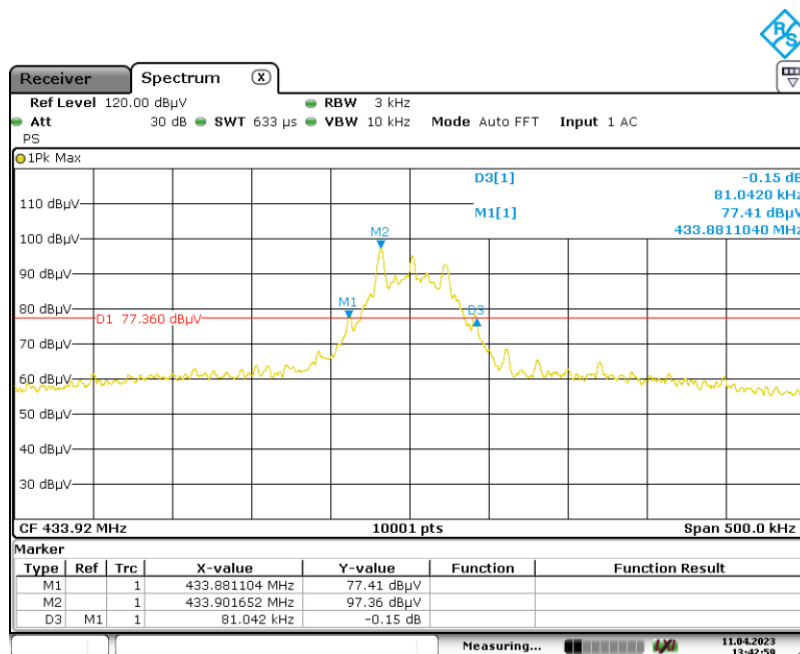
Limit

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70MHz and below 900MHz. For devices operating above 900MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20dB down from the modulated carrier.

The limit for the EUT = 0.25% * 433.92 MHz = 1084 kHz

Test Result

Channel	20dB Bandwidth (KHz)	Limit (KHz)
1	81.042	1084



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9.3 Deactivation Time

Test Method

1. Set to the maximum power setting and enable the EUT in transmitting mode.
2. Set center frequency of spectrum analyzer=operating frequency.
3. Set the spectrum analyzer as RBW=120 KHz, VBW=1MHz, Span=0Hz.
4. Repeat above procedures until all frequency measured was complete.

Limit

According to FCC Part 15.231 (a), the transmitter shall be complied the following requirements:

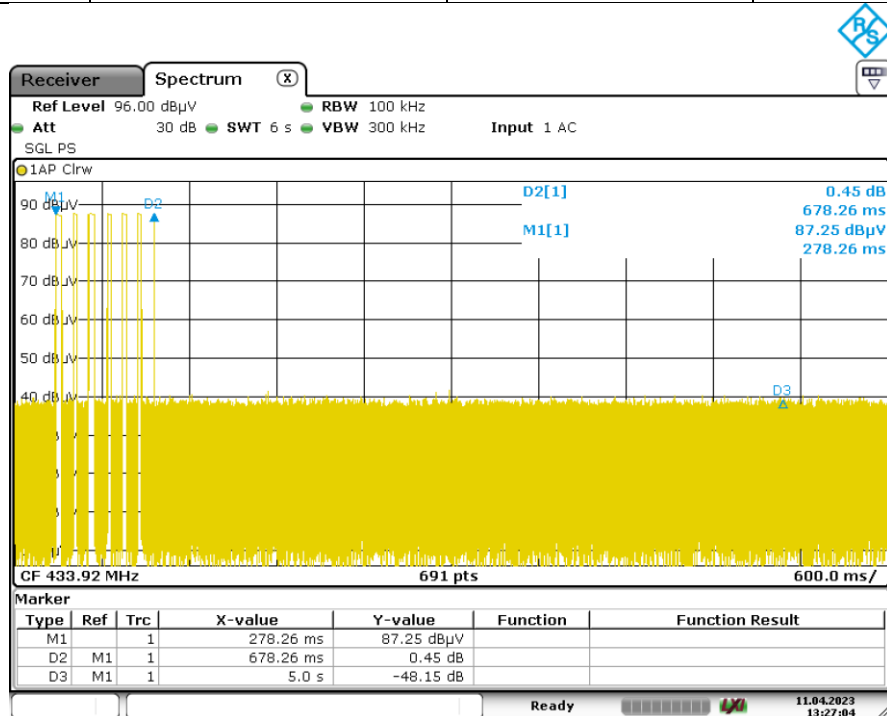
(√) (1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

(3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

Test Result

Channel	Frequency	Deactivation Time	Result
1	433.92MHz	678.26ms	Pass



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10 Test Equipment List

List of Test Instruments

RF Test

Description	Manufacturer	Model no.	Serial no.	Calibration Date	Calibration Due
Signal and spectrum analyzer	R&S	FSV40	S1503003-YQ-EMC	2022-8-01	2023-7-31

Radiated Emission Test

USED	Equipment Name	Model	Manufacturer	Equipment ID.	Calibration Date	Calibration Due
☒	EMI test receiver	ESR3	R&S	S1503109-YQ-EMC	2022-8-01	2023-7-31
☒	Trilog super broadband test antenna	SCHWARZBECK	VULB9168	S1808296-YQ-EMC	2021-9-23	2024-9-22
☒	Double-ridged waveguide horn antenna	HF907	R&S	S1503009-YQ-EMC	2021-4-13	2024-4-12
☒	Signal conditioning unit	SCU-18D	R&S	S1503012-YQ-EMC	2022-8-01	2023-7-31
☒	Signal and spectrum analyzer	FSV40	R&S	S1503003-YQ-EMC	2022-8-01	2023-7-31
☒	Loop antenna	HFH2-Z2	R&S	S1503013-YQ-EMC	2022-6-13	2023-6-12

11 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

Items	Extended Uncertainty
Radiated Disturbance	30MHz to 1GHz, 5.03dB (Horizontal)
	5.11dB (Vertical)
	1GHz to 18GHz, 5.15dB (Horizontal)
	5.12dB (Vertical)
	18GHz to 25GHz, 4.76dB

Measurement Uncertainty Decision Rule:

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115: 2021, clause 4.4.3 and 4.5.1.

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