

Fego Precision Industrial Co., Ltd.

TEST REPORT

SCOPE OF WORK:

47 CFR FCC Part 15.231 – Radio Spectrum report

Model:

TP50

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Radio Spectrum TEST REPORT

Applicant:	Fego Precision Industrial Co., Ltd. 947 LIN-SEN RD WU-FONG TAI-CHUNG 413 TAIWAN R.O.C.
Product:	Remote Controller
Model No.:	TP50
FCC ID:	M8C-TP50RF433
Test Method/ Standard:	47 CFR FCC Part 15.231
Test By:	Intertek Testing Services Taiwan Ltd. Hsinchu Laboratory No. 11, Lane 275, Ko-Nan 1 Street, Chia-Tung Li Shiang-Shan District, Hsinchu City, Taiwan



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Revision History

Report No.	Issue Date	Revision Summary
201200003TWN-001	Jun. 17, 2021	Original report

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Summary of Test Data

Test Requirement	Applicable Rule	Result
Radiated Emission test	15.231(b), 15.209	Pass
Measured bandwidth	15.231(c)	Pass
Timing requirement of manually operated transmitter	15.231(a)(1)	Pass
Conducted Emission test	15.207	N/A
Antenna Requirement	15.203	Pass

Note: Please note that the test results with statement of conformity, the decision rules which are based on: Safety Testing: the specification, standard or IEC Guide 115.

Other Testing: the specification, standard and not taking into account the measurement uncertainty.

1. General Information**1.1 Identification of the EUT**

Product:	Remote Controller
Model No.:	TP50
Operating Frequency:	433.92 MHz
Channel Number:	Single channel
Rated Power:	DC 3V from battery
Power Cord:	N/A
Sample receiving date:	2020/12/15
Sample condition:	Workable
Test Date(s):	2020/12/18 ~ 2020/12/22

1.2 Antenna description

Antenna Type : Printed Antenna

Connector Type : Fixed

2. Test specifications

2.1 Test standard

The EUT was performed according to the procedures in FCC Part 2.1053 and the requirement in FCC Part 15 Subpart C Section 15.231.

2.2 Operation mode

TX Operation: Press EUT button to transmit.

The signal is maximized through rotation and placement in the two orthogonal axes.



X axis



Y axis



Z axis

After verifying three axes, we found the maximum electromagnetic field was occurred at X axis. The final test data was executed under this configuration.

2.3 Peripherals equipment

Peripherals	Brand	Model No.	Serial No.	Data cable
AAA Battery	Panasonic	LR03	N/A	N/A

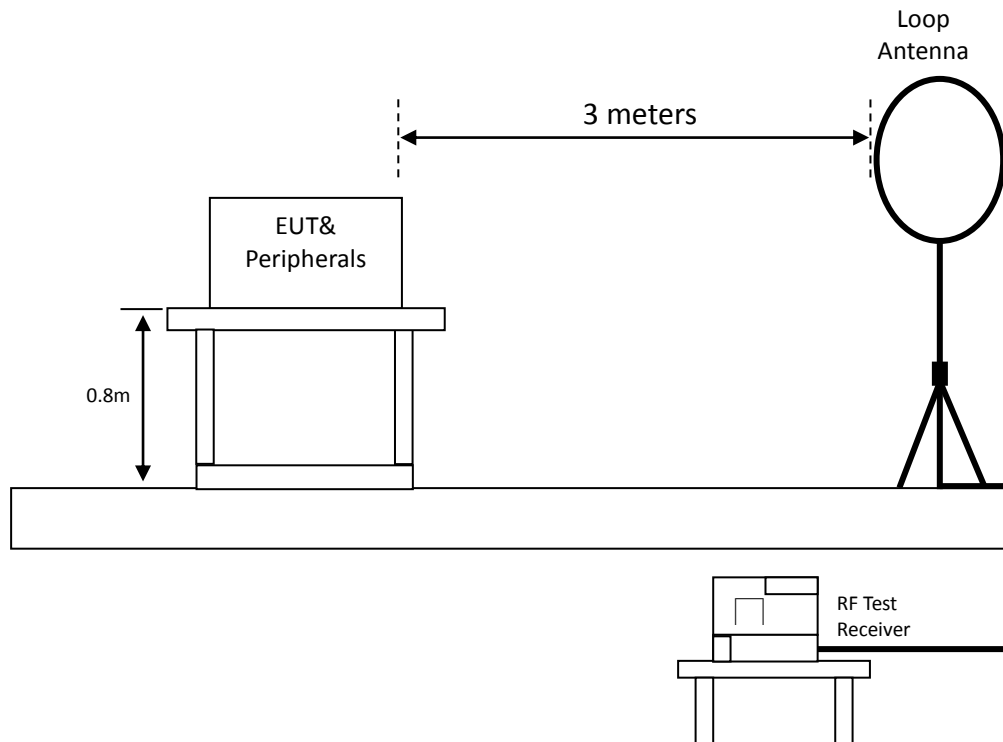
3. Radiated emission test FCC 15.231 (b)

3.1 Operating environment

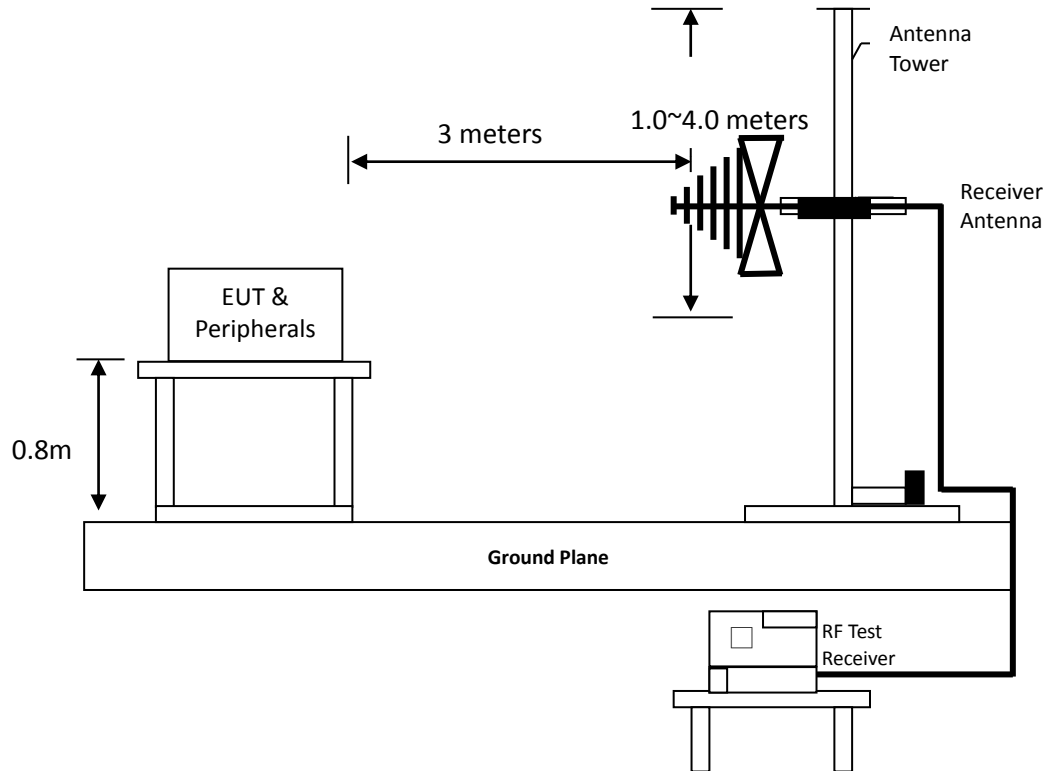
Temperature: 21 °C
Relative Humidity: 64 %

3.2 Test setup & procedure

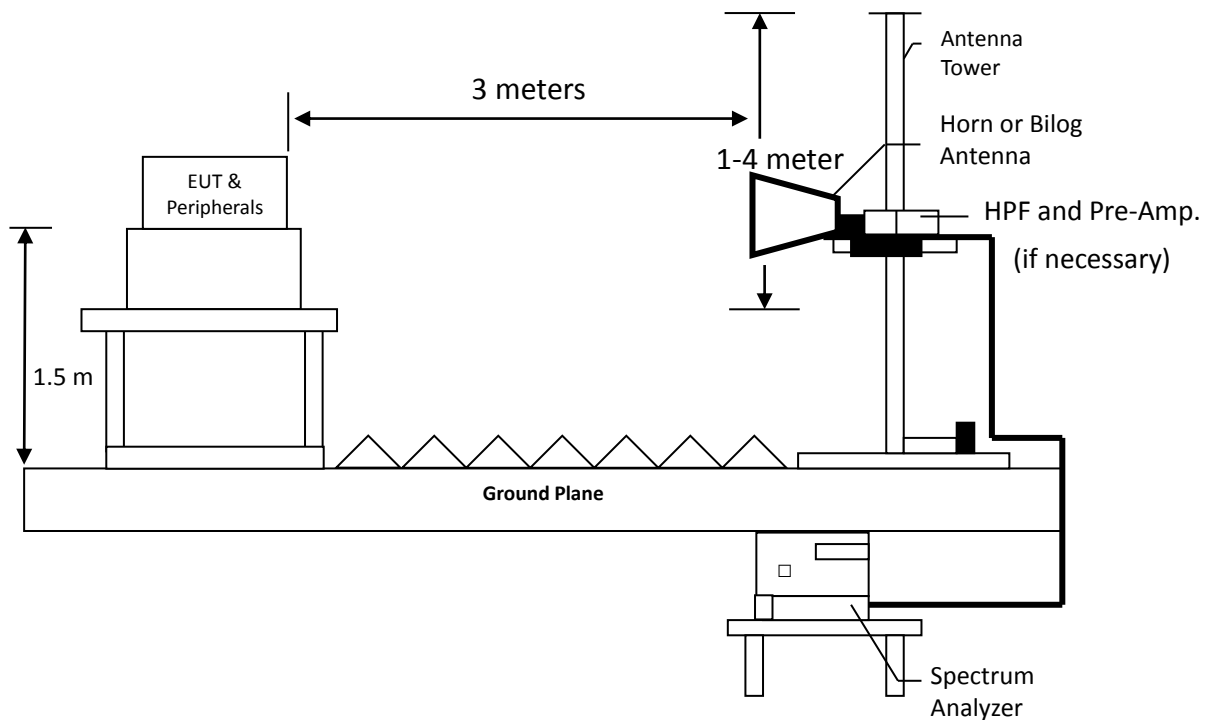
3.2.1 Radiated emission from 9kHz to 30MHz uses Loop Antenna:



3.2.2 Radiated emission below 1GHz using Bilog Antenna



3.2.3 Radiated emission above 1GHz using Horn Antenna



3.3 Radiated emission limit

3.3.1 Fundamental and harmonics emission limits

Frequency (MHz)	Field Strength of Fundamental		Field Strength of Harmonics	
	(uV/m@3 m)	(dBuV/m@3 m)	(uV/m@3 m)	(dBuV/m@3 m)
433.92	10996.68	80.82	109.9668	60.82

3.3.2 General radiated emission limit

The spurious Emission shall test through the 10th harmonic. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

Frequency MHz	15.209 Limits (dBµV/m@3m)
30-88	40
88-216	43.5
216-960	46
Above 960	54

Remark:

1. In the above table, the tighter limit applies at the band edges.
2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

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3.4 Radiated emission test data FCC 15.231

3.4.1 Measurement results: Fundamental emission

EUT : TP50

Frequency (MHz)	Spectrum Analyzer Detector	Antenna Polarization	Correction Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)
433.92	PK	Vertical	26.16	44.11	70.27	100.82	-30.55
433.92	AV	Vertical	-	-	61.29	80.82	-19.53
433.92	PK	Horizontal	26.16	58.38	84.54	100.82	-16.28
433.92	AV	Horizontal	-	-	75.56	80.82	-5.26

Remark: Correction Factor = Antenna Factor + Cable Loss

AV Corrected Reading = PK Corrected Reading + Duty cycle correction factor (-8.98)

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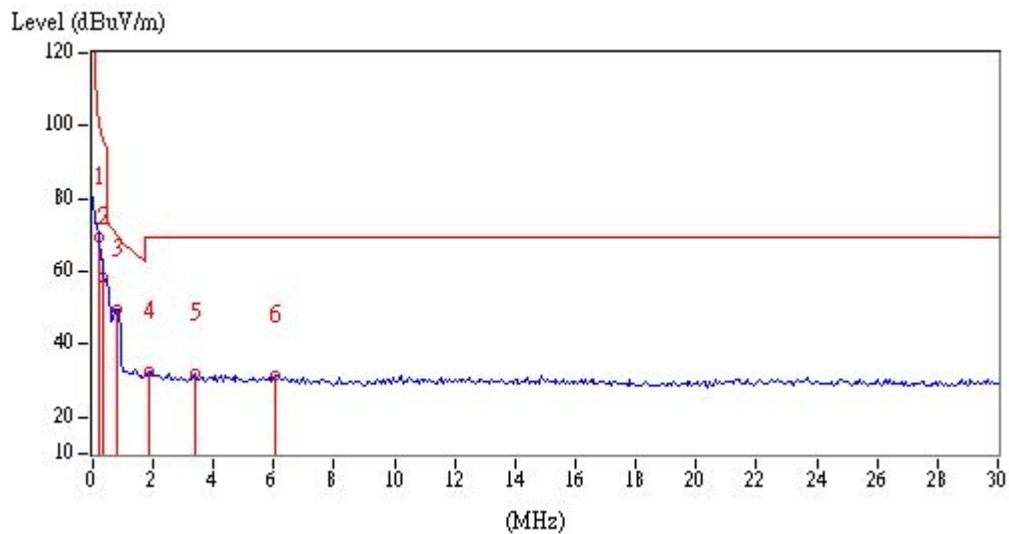
3.4.2 Measurement results: frequencies equal to or less than 1 GHz

EUT : TP50

9kHz – 30MHz

Antenna Polarization	Frequency (MHz)	Spectrum Analyzer Detector	Correction Factor (dB/m)	Reading (dB μ V)	Corrected Reading (dB μ V/m)	Limit @ 3 m (dB μ V/m)	Margin (dB)
Perpendicular	0.19	AV	18.13	51.44	69.56	102.03	-32.47
Perpendicular	0.37	AV	18.49	39.73	58.22	96.24	-38.02
Perpendicular	0.79	QP	18.45	31.34	49.79	69.65	-19.86
Perpendicular	1.87	QP	18.47	14.18	32.65	69.54	-36.89
Perpendicular	3.37	QP	18.62	13.20	31.81	69.54	-37.73
Perpendicular	6.07	QP	19.77	11.55	31.32	69.54	-38.22

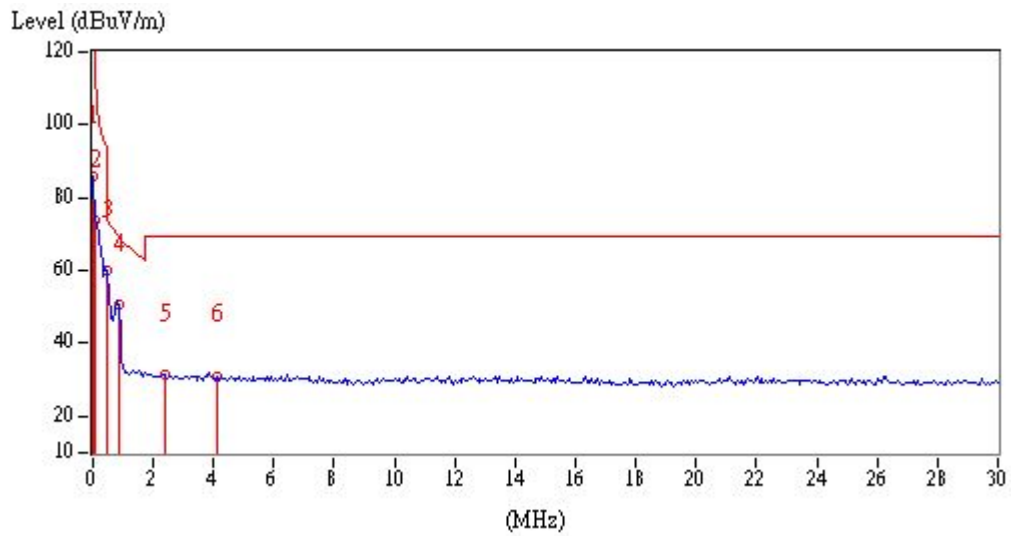
Remark: Corr. Factor = Antenna Factor + Cable Loss



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Antenna Polarization	Frequency (MHz)	Spectrum Analyzer Detector	Correction Factor (dB/m)	Reading (dB μ V)	Corrected Reading (dB μ V/m)	Limit @ 3 m (dB μ V/m)	Margin (dB)
Parallel	0.01	AV	18.28	67.56	85.84	127.60	-41.76
Parallel	0.07	AV	18.36	55.53	73.89	110.70	-36.81
Parallel	0.49	AV	18.44	41.64	60.08	93.80	-33.72
Parallel	0.85	QP	18.46	32.39	50.85	69.02	-18.17
Parallel	2.41	QP	18.48	12.88	31.36	69.54	-38.18
Parallel	4.15	QP	18.90	12.25	31.15	69.54	-38.39

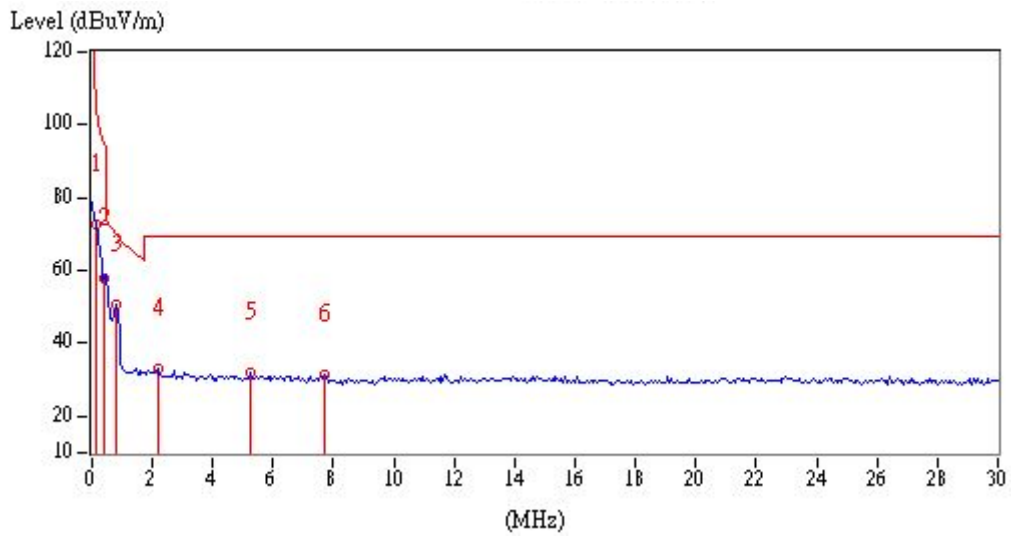
Remark: Corr. Factor = Antenna Factor + Cable Loss



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Antenna Polarization	Frequency (MHz)	Spectrum Analyzer Detector	Correction Factor (dB/m)	Reading (dB μ V)	Corrected Reading (dB μ V/m)	Limit @ 3 m (dB μ V/m)	Margin (dB)
Ground-parallel	0.13	AV	17.91	54.64	72.55	105.33	-32.78
Ground-parallel	0.43	AV	18.46	39.58	58.05	94.93	-36.88
Ground-parallel	0.79	QP	18.45	32.33	50.78	69.65	-18.87
Ground-parallel	2.17	QP	18.47	14.41	32.88	69.54	-36.66
Ground-parallel	5.23	QP	19.34	12.53	31.86	69.54	-37.68
Ground-parallel	7.69	QP	19.79	11.87	31.66	69.54	-37.88

Remark: Corr. Factor = Antenna Factor + Cable Loss

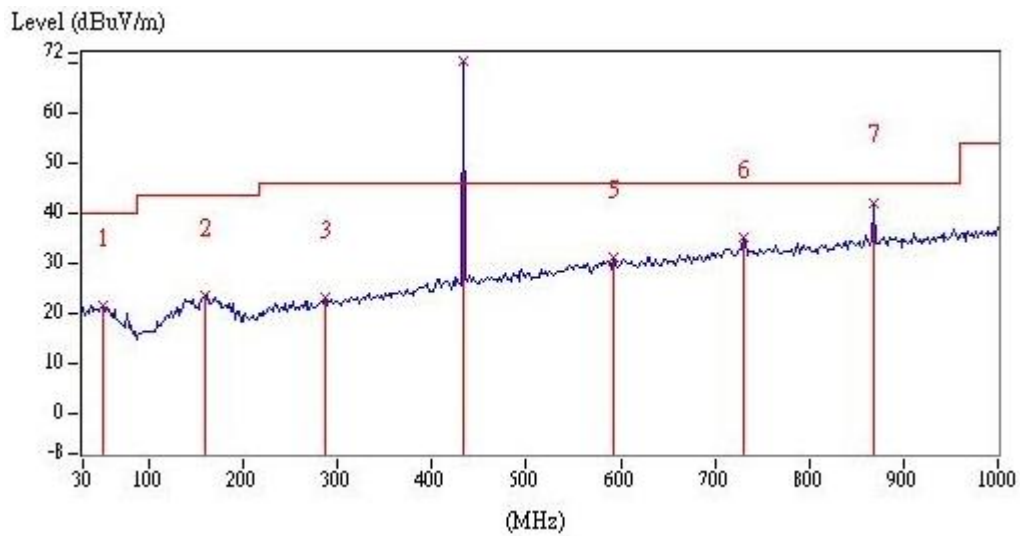


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30MHz – 1GHz

Antenna Polarization	Frequency (MHz)	Spectrum Analyzer Detector	Correction Factor (dB/m)	Reading (dB μ V)	Corrected Reading (dB μ V/m)	Limit @ 3 m (dB μ V/m)	Margin (dB)
Vertical	51.34	QP	21.93	0.43	22.36	60.82	-38.46
Vertical	159.98	QP	21.94	1.61	23.55	60.82	-37.27
Vertical	286.08	QP	22.43	0.75	23.18	60.82	-37.64
Vertical	592.60	QP	29.38	1.65	31.04	60.82	-29.78
Vertical	730.34	QP	31.69	3.31	35.01	60.82	-25.81
Vertical	867.84	QP	33.75	8.34	42.09	60.82	-18.73

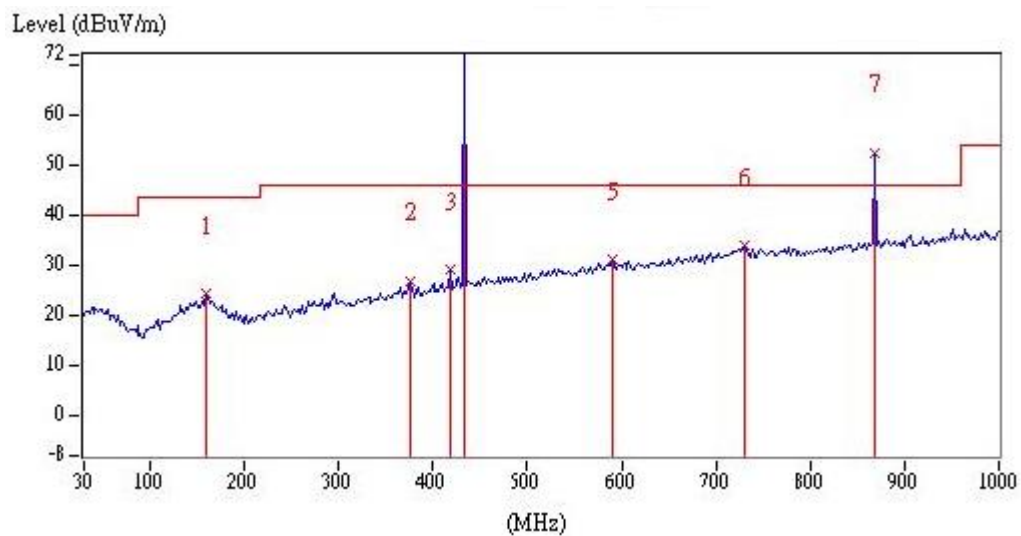
Remark: Corr. Factor = Antenna Factor + Cable Loss



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Antenna Polarization	Frequency (MHz)	Spectrum Analyzer Detector	Correction Factor (dB/m)	Reading (dB μ V)	Corrected Reading (dB μ V/m)	Limit @ 3 m (dB μ V/m)	Margin (dB)
Horizontal	159.98	QP	21.94	2.35	24.30	60.82	-36.52
Horizontal	375.32	QP	24.65	2.24	26.88	60.82	-33.94
Horizontal	418.00	QP	25.76	3.39	29.15	60.82	-31.67
Horizontal	590.66	QP	29.34	1.82	31.16	60.82	-29.66
Horizontal	730.34	QP	31.69	2.17	33.87	60.82	-26.95
Horizontal	867.84	QP	33.75	18.77	52.51	60.82	-8.31

Remark: Corr. Factor = Antenna Factor + Cable Loss



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3.4.3 Measurement results: frequency above 1GHz

EUT : TP50
 Test condition : Tx mode

Frequency (MHz)	Spectrum Analyzer Detector	Antenna Polarization	Correction Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)
1301.76	PK	V	-10.31	51.60	41.29	74.00	-32.71
1735.68	PK	V	-8.24	50.78	42.54	80.82	-38.28
2169.60	PK	V	-5.90	48.98	43.08	80.82	-37.74
2603.52	PK	V	-3.12	62.52	59.40	80.82	-21.42
3037.44	PK	V	-1.88	56.18	54.30	80.82	-26.52
3471.36	PK	V	-2.14	42.05	39.91	80.82	-40.91
3905.28	PK	V	0.83	39.22	40.05	74.00	-33.95
4339.20	PK	V	3.68	34.19	37.87	74.00	-36.13
1301.76	PK	H	-10.31	61.45	51.14	74.00	-22.86
1735.68	PK	H	-8.24	58.50	50.26	80.82	-30.56
2169.60	PK	H	-5.90	58.71	52.81	80.82	-28.01
2603.52	PK	H	-3.12	71.92	69.60	80.82	-11.22
2603.52	AV	H	-	-	60.62	60.82	-0.20
3037.44	PK	H	-1.88	64.81	63.50	80.82	-17.32
3037.44	AV	H	-	-	54.52	60.82	-6.30
3471.36	PK	H	-2.14	51.61	49.47	80.82	-31.35
3905.28	PK	H	0.83	47.47	48.31	74.00	-25.69
4339.20	PK	H	3.68	41.92	45.60	74.00	-28.40

Remark: Correction Factor = Antenna Factor + Cable Losss + High Pass Filter Loss - Pre_Amplifier Gain
 AV Corrected Reading = PK Corrected Reading + Duty cycle correction factor (-8.98)

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4. Measured bandwidth FCC 15.231(C)

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

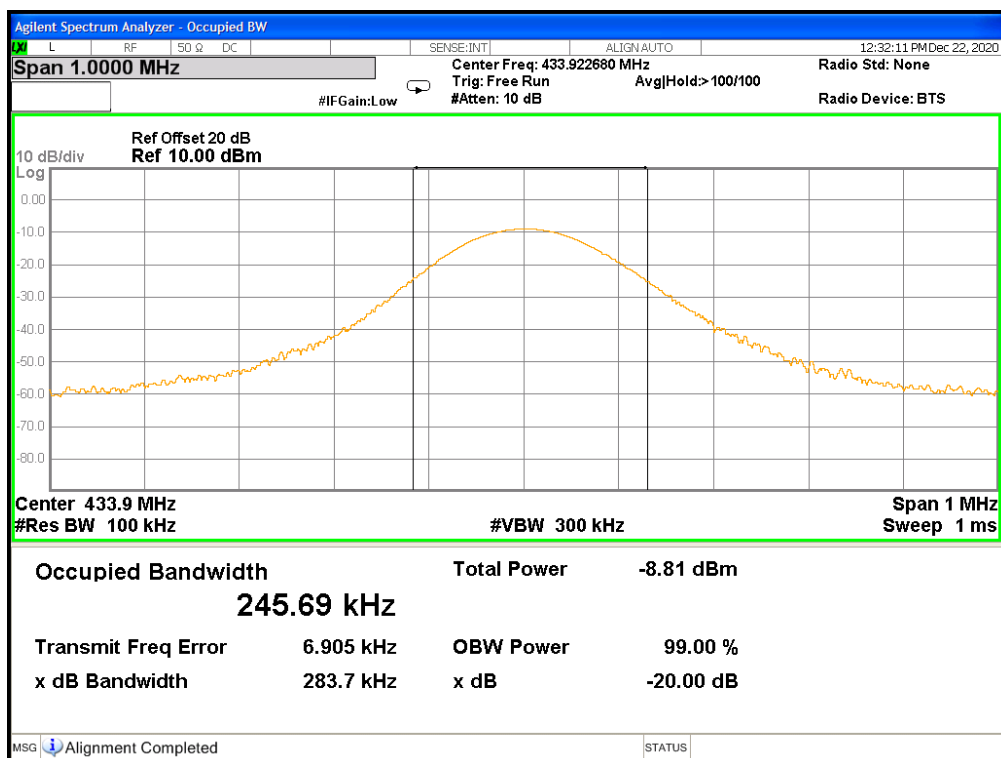
$$B.W(20dB) \text{ Limit} = 0.25\% \times f(\text{MHz}) = 0.25\% \times 433.92 \text{ MHz} = 1.085 \text{ MHz}$$

From the plot, the bandwidth is observed to be 283.7 kHz at 20dB, where the bandwidth limit is 1.085 MHz.

Please see the plot below.

Mode	Frequency (MHz)	20dB Bandwidth (MHz)	Limit (MHz)	Result
Pulse	433.92	0.284	1.085	Pass

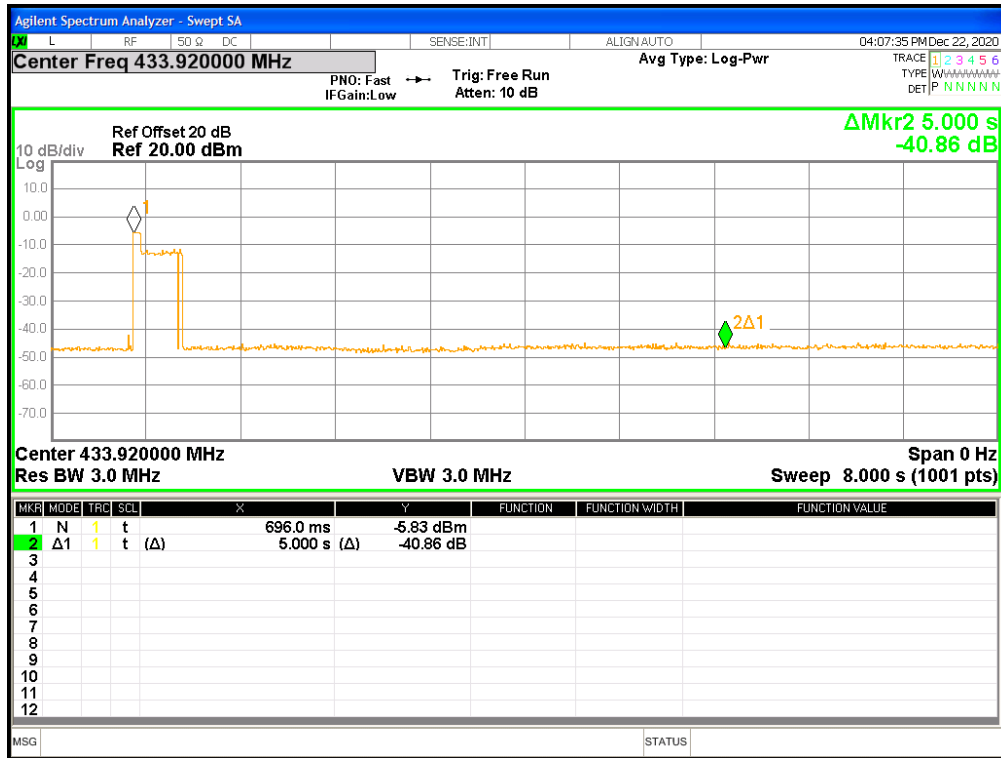
Bandwidth



5. Timing requirement of manual activation operated transmitter

A transmitter manual activation shall cease transmission within 5 seconds after activation

Transmitter pulse duration



6. Conducted emission FCC 15.207

Since the EUT is not connected to AC source, therefore, the test can be waived.

Appendix A: Test equipment list

Test Equipment/ Test site	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMI Test Receiver	Rohde & Schwarz	ESR-7	101232	2020/01/18	2021/01/16
Signal Analyzer	Agilent	N9030A	MY51380492	2020/08/17	2021/08/16
Active Loop Antenna	SCHWARZBECK MESS-ELEKTRONIK	FMZB1519	1519-067	2020/04/13	2021/04/12
Broadband Antenna	SHWARZBECK	VULB 9168	9168-172	2020/06/02	2021/06/01
Horn Antenna	SHWARZBECK	BBHA 9120 D	9120D-456	2020/01/20	2021/01/18
Pre-Amplifier	SCHWARZBECK	BBV9718	9718-004	2020/10/15	2021/10/14
966-2(A) Cable	SUHNER	SMA / EX 100	N/A	2020/08/17	2021/08/16
966-2(B) Cable	SUHNER	SUCOFLEX 104P	CB0005	2020/08/17	2021/08/16
966-2_3m Semi-Anechoic Chamber	966_2	CEM-966_2	N/A	2020/02/23	2021/02/22

Appendix B: Measurement Uncertainty

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level using a coverage factor of $k=2$.

Item	Uncertainty
Fundamental emission	4.29 dB
20dB Bandwidth	7.69 %
Frequency stability	0.01118 ppm
In band Radiated Emission	1.15 dB
Radiated disturbances from 9kHz~30MHz in a semi-anechoic chamber at a distance of 3m	3.32 dB
Vertically polarized radiated disturbances from 30MHz~1GHz in a semi-anechoic chamber at a distance of 3m	5.10 dB
Horizontally polarized radiated disturbances from 30MHz~1GHz in a semi-anechoic chamber at a distance of 3m	5.18 dB
AC Power Line Conducted Emission	2.52 dB