

TEST REPORT

of

FCC Part 15 Subpart C

New Application; Class I PC; Class II PC

Product : TPMS
Brand: MOBILETRON
Model: TX-C001; TX-C002
Model Difference: Variant in exterior looks.
FCC ID: ULZ-TXC001
FCC Rule Part: §15.231 (e)
Applicant: Mobiletron Electronics Co., Ltd.
Address: 85, Sec.4, Chung-Ching Rd., Ta-Ya District, Taichung
428, Taiwan

Test Performed by:

International Standards Laboratory

<LT Lab.>

*Site Registration No.

BSMI: SL2-IN-E-0013; MRA TW1036; TAF: 0997; IC: IC4067B-4;

*Address:

No. 120, Lane 180, Hsin Ho Rd.

Lung-Tan Dist., Tao Yuan City 325, Taiwan

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Report No.: **ISL-18LR305FC433**

Issue Date : **2018/10/22**



Test results given in this report apply only to the specific sample(s) tested and are traceable to national or international standard through calibration of the equipment and evaluating measurement uncertainty herein.

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VERIFICATION OF COMPLIANCE

Applicant: Mobiletron Electronics Co., Ltd.
Product Description: TPMS
Brand Name: MOBILETRON
FCC ID: ULZ-TXC001
FCC Rule Part: §15.231 (e)
Model No.: TX-C001; TX-C002
Model Difference: Variant in exterior looks.
Date of test: 2018/10/03 ~ 2018/10/19
Date of EUT Received: 2018/10/03

We hereby certify that:

All the tests in this report have been performed and recorded in accordance with the standards described above and performed by an independent electromagnetic compatibility consultant, International Standards Laboratory.

The test results contained in this report accurately represent the measurements of the characteristics and the energy generated by sample equipment under test at the time of the test. The sample equipment tested as described in this report is in compliance with the limits of above standards.

Test By: Barry Lee **Date:** 2018/10/22

Barry Lee / Sr. Engineer

Prepared By: Gigi yeh **Date:** 2018/10/22

Gigi Yeh / Sr. Engineer

Approved By: DinoChen **Date:** 2018/10/22

Dino Chen / Sr. Engineer

Version

Version No.	Date	Description
00	2018/10/22	Initial creation of document

Uncertainty of Measurement

Description Of Test	Uncertainty
Conducted Emission (AC power line)	2.586 dB
Field Strength of Spurious Radiation	<=30MHz: 2.96dB 30-1GHz: 4.22 dB 1-40 GHz: 4.08 dB
Conducted Power	2.412 GHz: 1.30 dB 5.805 GHz: 1.55 dB
Power Density	2.412 GHz:1.30 dB 5.805 GHz: 1.67 dB
Frequency	0.0032%
Time	0.01%
DC Voltage	1%

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1. GENERAL INFORMATION

1.1 Product Description

Product Name	TPMS
Brand Name	MOBILETRON
Model Name	TX-C001; TX-C002
Model Difference	Variant in exterior looks.
Power Supply	3Vdc from coin battery
Device type	safety applications

TX:

Operating Frequency	433.92 MHz
Transmit Power	PK: 58.74 dBuV/m at 3 m (ASK) PK: 57.57 dBuV/m at 3 m (FSK)
Modulation Technique	ASK, FSK
Number of Channels	1
Periodic Transmission Time	ASK: Transmission period : every 0.038s, Ton: 60.082 FSK: Transmission period : every 0.036s, Ton: 61.882
Antenna Type	Loop Antenna

1.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: **ULZ-TXC001** filing to comply with Section 15.231 (e) of the FCC Part 15, Subpart C., Subpart C Rules filing to comply.

1.3 Test Methodology

Both conducted and radiated testing were performed according to the procedures in C63.10: 2013. Radiated testing was performed at an antenna to EUT distance 3 meters.

1.4 Test Facility

The measurement facilities used to collect the 3m Radiated Emission and AC power line conducted data are located on the address of **International Standards Laboratory** <LT Lab.> No. 120, Lane 180, Hsin Ho Rd., Lung-Tan Dist., Tao Yuan City 325, Taiwan which are constructed and calibrated to meet the FCC requirements in documents ANSI C63.10: 2013. FCC Registration Number is: 487532; Designation Number is: TW0997.

1.5 Special Accessories

Not available for this EUT intended for grant.

1.6 Equipment Modifications

Not available for this EUT intended for grant.

2. SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

The EUT (Transmitter) was tested with a test program to fix the Tx frequency that was for the purpose of the measurements. For more information please see test data and APPENDIX 1 for set-up photographs.

2.3 Test Procedure

2.3.1 Conducted Emissions (Not apply in the report)

The EUT is a placed on as turn table which is 0.8 m above ground plane. According to the requirements in Section 6.2 of ANSI C63.10: 2013. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR 16-1-1 Quasi-Peak and Average detector mode.

2.3.2 Radiated Emissions

The EUT is a placed on as turn table which is 0.8 m/1.5m(Frequency above 1GHz) above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter(EUT) was rotated through three orthogonal axes according to the requirements in Section 6 and 11 of ANSI C63.10: 2013.

2.4 Limitation

(1) Conducted Emission

Frequency range MHz	Limits dB (uV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

Note

- 1.The lower limit shall apply at the transition frequencies
- 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

(2) Radiated Emission

According to (e) Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation, including operation prohibited in paragraph (a) of this section, provided the intentional radiator complies with the provisions of paragraphs (b) through (d) of this section, except the field strength table in paragraph (b) of this section is replaced by the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emission (microvolts/meter)
40.66-40.70	1,000	100
70-130	500	50
130-174	500 to 1,500 ¹	50 to 150 ¹
174-260	1,500	150
260-470	1,500 to 5,000 ¹	150 to 500 ¹
Above 470	5,000	500

¹Linear interpolations.

- Remark:
1. Emission level in dBuV/m=20 log (uV/m)
 2. Measurement was performed at an antenna to the closed point of EUT distance of meters.
 3. Only spurious frequency is permitted to locate within the Restricted Bands specified in provision of § 15.205
 4. Emission spurious frequency which appearing within the Restricted Bands specified in provision of §15.205, then the general radiated emission limits in § 15.209 apply.
 5. For the band 130-174MHz, uV/m at 3meters = 22.72727 * F(MHz) – 2454.545;
For the band 260-470MHz uV/m at 3meters = 16.6667 * F(MHz) – 2833.333;
Where F is the frequency in MHz.
 6. 433.92MHz AV limit = 16.6667 * 433.92(MHz) – 2833.333= 4398.68 uV/m
= 72.86dBuV/m
 7. 433.92MHz Peak limit = AV Limit + 20dB = 92.86MHz

2.5 Configuration of Tested System

Fig. 1 Configuration of Tested System

Tx

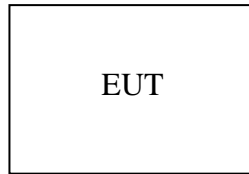


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/ Type No.	Series No.	Data Cable	Power Cord
1.	N/A					

3. SUMMARY OF TEST RESULTS

FCC /IC Rules	Description Of Test	Result
§15.207	Conducted Emission	N/A
§15.231(e)	Radiated Emission	Compliant
§15.231(c)	20dB Bandwidth	Compliant
	Duty Cycle Test (Pulse Modulation)	N/A
§15.231(e)	transmission time, silent period	Compliant
§15.203	Antenna Requirement	Compliant

4. Description of test modes

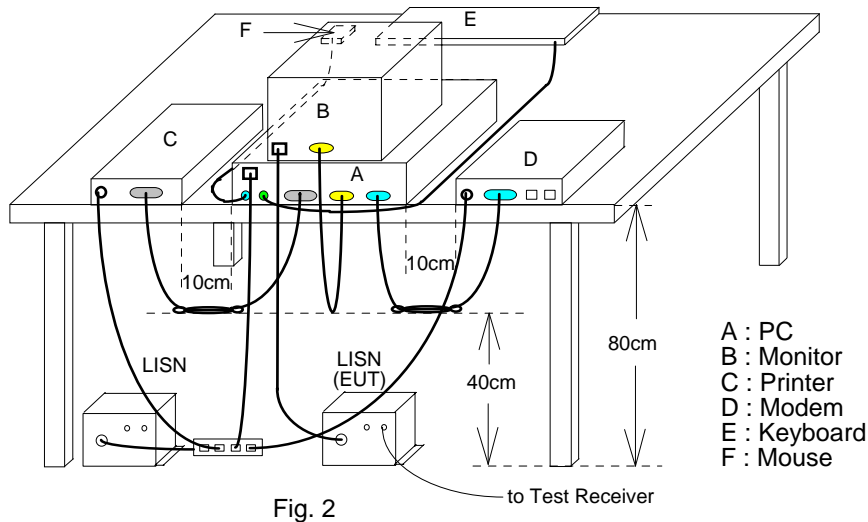
The EUT has been tested under engineering test mode condition and the EUT staying in continuous transmitting mode. The Frequency 433.92 MHz is chosen for testing.

5. AC CONDUCTED EMISSIONS TEST

5.1 Measurement Procedure:

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

5.2 Test SET-UP (Block Diagram of Configuration)



5.3 Measurement Equipment Used:

Conducted Emission Test Site					
Equipment Type	MFR	Model Number	Searial Number	Last Cal.	Cal Due.
Conduction 04-3 Cable	WOKEN	CFD 300-NL	Conduction 04 -3	09/11/2018	09/10/2019
EMI Receiver 17	Rohde & Schwarz	ESCI 7	100887	10/23/2017	10/22/2018
LISN 18	ROHDE & SCHWARZ	ENV216	101424	02/04/2018	02/03/2019
LISN 19	ROHDE & SCHWARZ	ENV216	101425	03/06/2018	03/05/2019
Test Software	Farad	EZEMC Ver:ISL-03A2	N/A	N/A	N/A

5.4 Measurement Result:

N/A

6. RADIATED EMISSION TEST

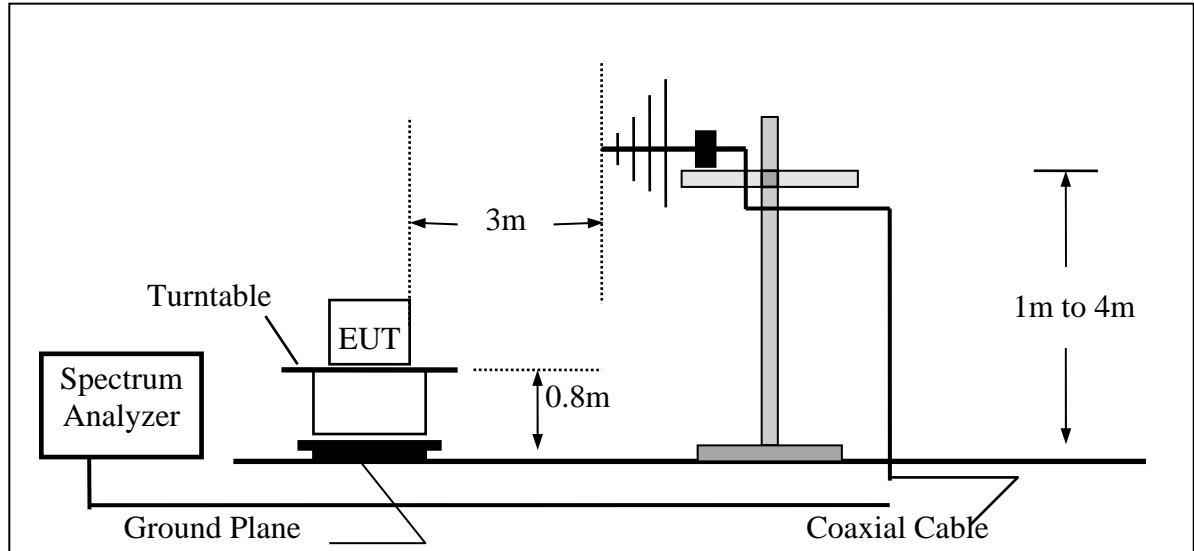
15.231 (e) Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation, including operation prohibited in paragraph (a) of this section, provided the intentional radiator complies with the provisions of paragraphs (b) through (d) of this section, except the field strength table in paragraph (b) of this section is replaced by the following:

6.1 Measurement Procedure

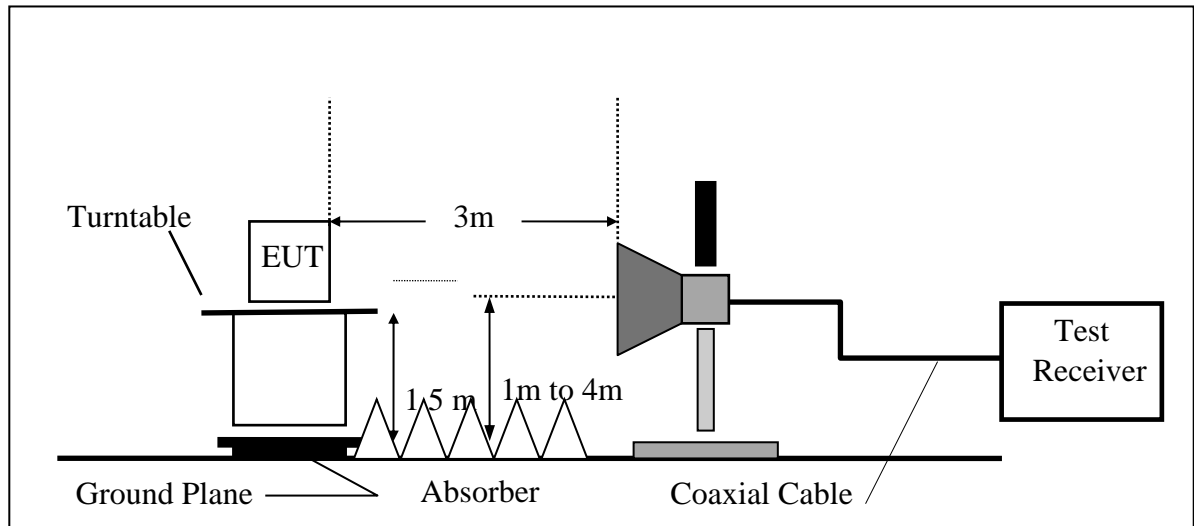
1. The EUT was placed on a turn table which is 0.8/1.5m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measured were complete.

6.2 Test SET-UP (Block Diagram of Configuration)

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



(B) Radiated Emission Test Set-UP Frequency Over 1 GHz



6.3 Measurement Equipment Used:

Chamber 1166					
Equipment Type	MFR	Model Number	Searial Number	Last Cal.	Cal Due.
Spectrum Analyzer 21(26.5GHz)	Agilent	N9010A	MY52100117	11/20/2017	11/19/2018
Dipole antenna	SCHWARZBECK	VHAP,30-300	919	12/28/2017	12/27/2019
Dipole antenna	SCHWARZBECK	UHAP,300-1000	1195	12/28/2017	12/27/2019
Loop Antenna	EM	EM-6879	271	06/06/2018	06/05/2020
Loop Antenna	A.H.SYSTEM	SAS-564	294	06/16/2018	06/15/2020
Bilog Antenna	Schaffner	9168	9168-495	10/26/2017	10/25/2018
Horn antenna1-18G	EM	EM-AH-10180	2011090207	11/27/2017	11/26/2018
Horn antenna18-26G	Com-power	AH-826	081001	11/21/2017	11/20/2019
Horn antenna26-40G(05)	Com-power	AH-640	100A	02/22/2017	02/21/2019
Preamplifier9-1.3G	HP	8447F	NA	12/08/2017	12/07/2018
Preamplifier1-26G	EM	EM01M26G	NA	11/24/2017	11/23/2018
Preamplifier26-40G	MITEQ	JS4-26004000-27-5A	818471	11/20/2017	11/19/2019

6.4 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

Average Value = Peak Value + 20 Log (Ton/Tp)Pulse Modulation Duty Cycle Correction Factor

Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

6.5 Measurement Result

Fundamental Measurement Result

Operation Mode:	Transmitting Mode	Test Date:	2018/10/09
Fundamental Frequency:	433.92MHz	Test By:	Barry
Temp:	25 °C	Hum.:	60%

ASK:

Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
433.96	59.40	-2.36	57.04	92.86	-35.82	Peak	VERTICAL
433.96	61.10	-2.36	58.74	92.86	-34.12	Peak	HORIZONTAL

FSK:

Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
433.96	57.86	-2.36	55.50	92.86	-37.36	Peak	VERTICAL
433.89	59.93	-2.36	57.57	92.86	-35.29	Peak	HORIZONTAL

Remark:

- 1 Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using Peak / QP detector mode.
- 2 The IF bandwidth of SPA between 30MHz to 1GHz was 100kHz, VBW=300kHz.
- 3 Average Value = Peak Value + 20 Log (Ton/Tp)Pulse Modulation Duty Cycle Correction Factor

Radiated Spurious Emission Measurement Result (below 1GHz)

Operation Mode: Transmitting Mode Test Date: 2018/10/09
 Fundamental Frequency: 433.92MHz Test By: Barry
 Temperature : 25 °C Humidity : 60 %

FSK:

No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	343.31	27.18	-4.12	23.06	46.00	-22.94	Peak	VERTICAL
2	446.13	27.28	-2.14	25.14	46.00	-20.86	Peak	VERTICAL
3	497.54	39.94	-1.68	38.26	46.00	-7.74	Peak	VERTICAL
4	515.00	36.70	-1.40	35.30	46.00	-10.70	Peak	VERTICAL
5	743.92	28.02	2.94	30.96	46.00	-15.04	Peak	VERTICAL
6	831.22	27.03	4.07	31.10	46.00	-14.90	Peak	VERTICAL
1	373.38	27.35	-3.52	23.83	46.00	-22.17	Peak	HORIZONTAL
2	419.94	27.94	-2.62	25.32	46.00	-20.68	Peak	HORIZONTAL
3	497.54	38.52	-1.68	36.84	46.00	-9.16	Peak	HORIZONTAL
4	514.03	38.99	-1.42	37.57	46.00	-8.43	Peak	HORIZONTAL
5	670.20	27.55	1.35	28.90	46.00	-17.10	Peak	HORIZONTAL
6	765.26	28.09	3.24	31.33	46.00	-14.67	Peak	HORIZONTAL

Remark:

- 1 No further spurious emissions detected from the lowest internal frequency and 30MHz.
- 2 Measuring frequencies from the lowest internal frequency to the 1GHz.
- 3 Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using Peak / QP detector mode.
- 4 Measurement result within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 5 The IF bandwidth of SPA between 30MHz to 1GHz was 100kHz, VBW=300kHz.

7. 20DB OCCUPIED BANDWIDTH

7.1 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set EUT as normal operation
3. Set SPA Center Frequency = fundamental frequency, RBW= 10kHz, VBW= 30kHz, Span =3MHz.
4. Set SPA Max hold. Mark peak, -20dB.

7.2 Test SET-UP (Block Diagram of Configuration)

Same as 6.2 Radiated Emission Measurement.

7.3 Measurement Equipment Used:

Same as 6.3 Radiated Emission Measurement.

7.4 Measurement Results

Refer to attached data chart.

The center frequency f_c is **433.92MHz**, according to the Rules, section 15.231(C), the Bandwidth of Center Frequency at-20dB should be calculated as following:

$$433.92 \times 0.0025 = 1.0848(\text{MHz})$$

So, the Uper/Lower frequencies limit should be specified as:

$$f_{(U)} = f_c + \Delta f/2 = 433.92 + 0.5424 = 434.46(\text{MHz})$$

$$f_{(L)} = f_c - \Delta f/2 = 433.92 - 0.5424 = 433.377 (\text{MHz})$$

7.5 Measurement Result:

ASK:

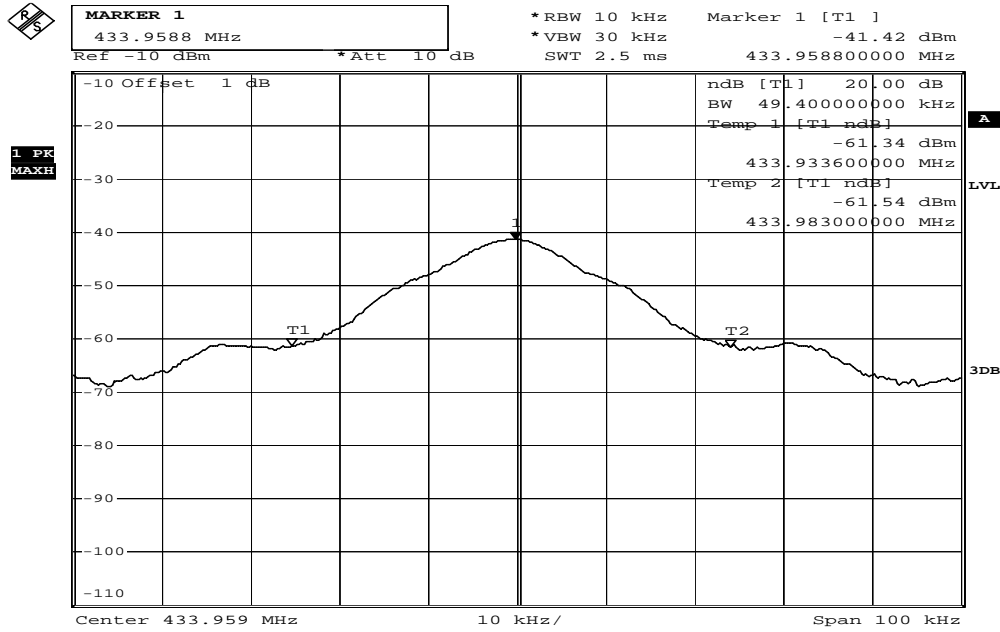
49.4 kHz < limit 1.0848MHz

FSK:

117 kHz < limit 1.0848MHz

ASK:

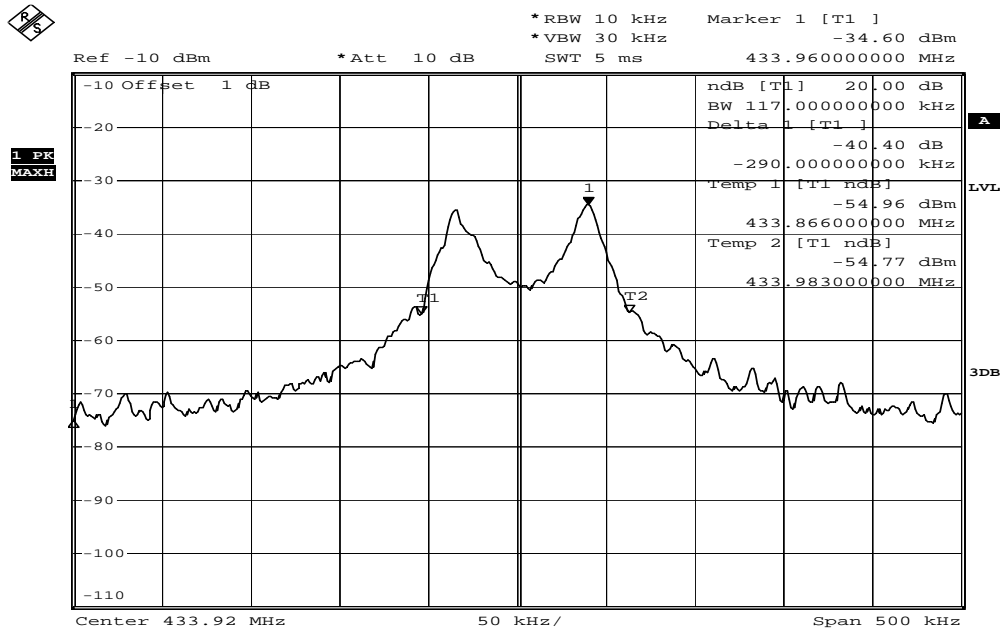
20dB Band Width Test Data



Date: 8.JAN.2003 10:05:27

FSK:

20dB Band Width Test Data



Date: 8.JAN.2003 10:04:04

8. DUTY CYCLE (AVERAGE CORRECTION FACTOR) MEASUREMENT

8.1 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set ETU normal operating mode.
3. Set SPA Center Frequency = fundamental frequency, RBW, VBW= 1.0MHz, Span =0 Hz. Adjacent sweep.
4. Set SPA View. Mark delta.

8.2 Test SET-UP (Block Diagram of Configuration)

Same as 6.2 Radiated Emission Measurement.

8.3 Measurement Equipment Used:

Same as 6.3 Radiated Emission Measurement.

8.4 Measurement Results: N/A

Duty cycle correction factor is not used for average value.

9. SILENT PERIOD TIME MEASUREMENT:

15.231 (e)

devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

9.1 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set SPA Center Frequency = fundamental frequency, RBW, VBW= 1MHz, Span =0Hz
3. Set EUT Power on as normal operation
4. Set SPA Max hold. Delta Mark.

9.2 Test SET-UP (Block Diagram of Configuration)

Same as 6.2 Radiated Emission Measurement.

9.3 Measurement Equipment Used:

Same as 6.3 Radiated Emission Measurement.

9.4 Measurement Results

Total transmission time of transmissions calculation:

ASK:

Ton: 0.038s, < 1s

Tp: 60.12s

silent period limit: 10s or $0.038s * 30 = 1.14s$

T silent period = $60.12s - 0.038s = 60.082 s > 10s$

The result : PASS.

FSK:

Ton: 0.036s, < 1s

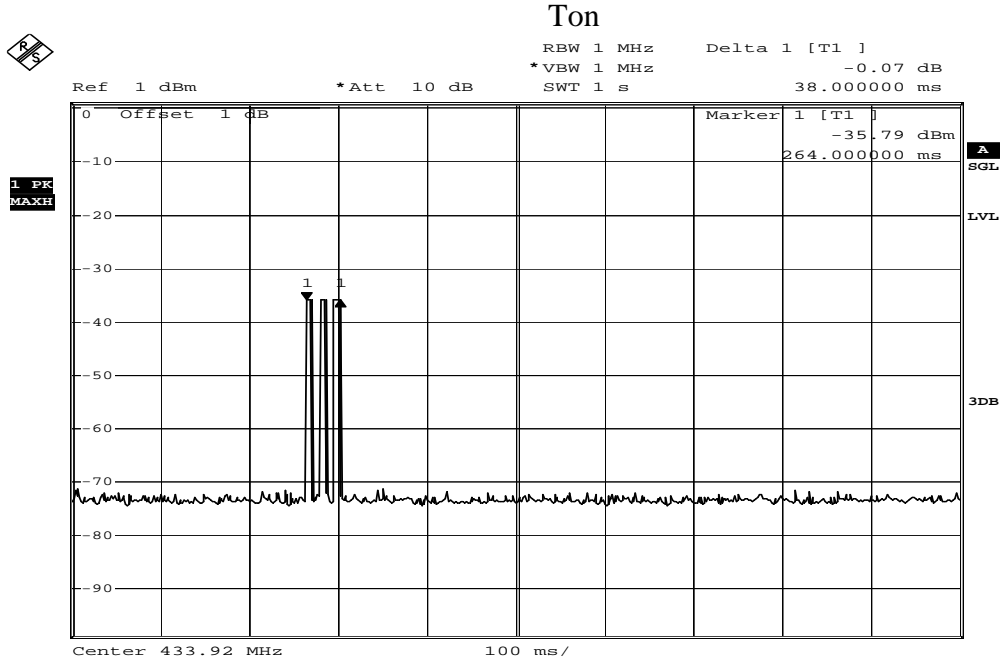
Tp: 61.92s

silent period limit: 10s or $0.036s * 30 = 1.08s$

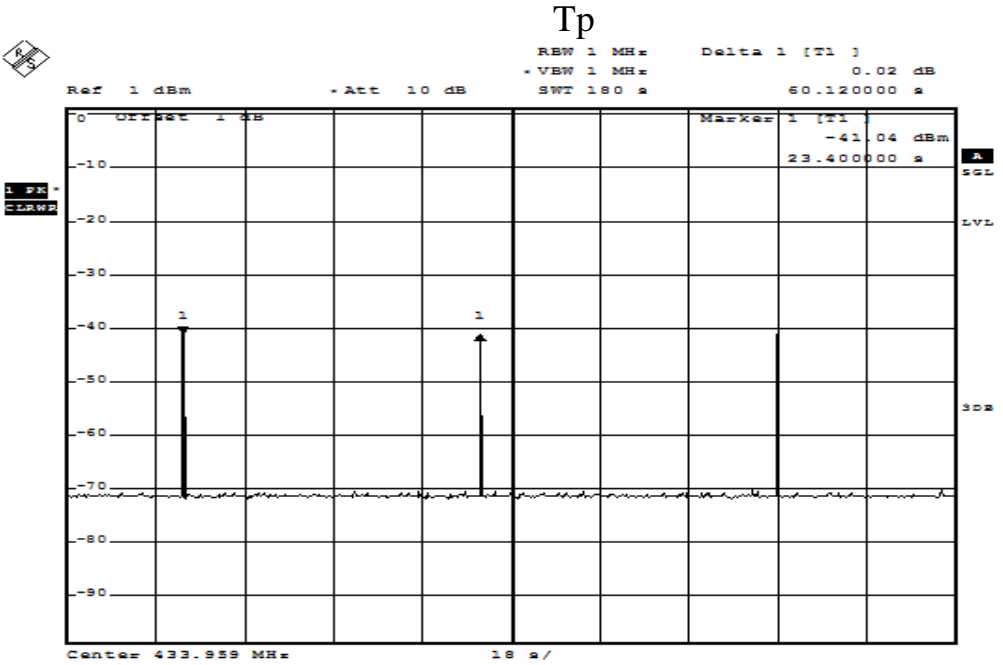
T silent period = $61.92s - 0.036s = 61.882 s > 10s$

The result : PASS.

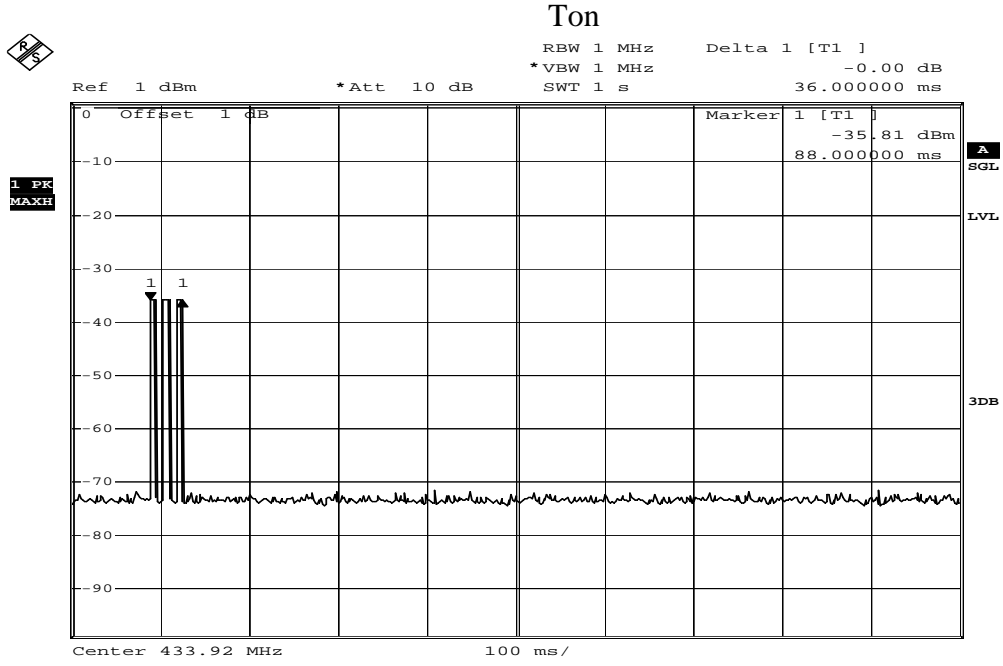
ASK:



Date: 8.JAN.2003 11:09:07



FSK:



Date: 8.JAN.2003 11:16:23

