TEST REPORT

of

FCC Part 15 Subpart C

☒ New Application; ☐ Class I PC; ☐ Class II PC

Product :	**TPMS**
Brand:	**MOBILETRON**
Model:	**TX-K001; TX-K002 and other models listed in page 6**
Model Difference:	**Model differences in appearance and market segmentation**
FCC ID:	**ULZ-TXK001**
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 Corp.

<LT Lab.>
*Site Registration No.
BSMI: SL2-IN-E-0013; MRA TW0997; TAF: 0997
*Address:
No. 120, Lane 180, Hsin Ho Rd., Lung-Tan Dist., Tao Yuan City 325, Taiwan
*Tel : 886-3-407-1718; Fax: 886-3-407-1738

Report No.: **ISL-19LR306FC315**
Issue Date : **2019/11/22**

Testing Laboratory
0997

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.
This report MUST not be used to claim product endorsement by TAF or any agency of the Government.
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VERIFICATION OF COMPLIANCE

Applicant:	Mobiletron Electronics Co., Ltd.
Product Description:	TPMS
Brand Name:	MOBILETRON
FCC ID:	ULZ-TXK001
FCC Rule Part:	§15.231 (e)
Model No.:	TX-K001; TX-K002 and other models listed in page 6
Model Difference:	Model differences in appearance and market segmentation
Date of test:	2019/10/13 ~ 2019/10/23
Date of EUT Received:	2019/10/09

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:	Bill Huang ***Bill Huang / Engineer***	***Date:***	2019/11/22
Prepared By:	Elisa Chen ***Elisa Chen / Sr. Engineer***	***Date:***	2019/11/22
Approved By:	Jerry Liu ***Jerry Liu / Technical Manager***	***Date:***	2019/11/22

Version

Version No.	Date	Description
00	2019/11/22	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%

Table of Contents

1. General Information

1.1 Product Description

Product Name	TPMS
Brand Name	MOBILETRON
Model Name	TX-K001; TX-K002 and models listed below
Serial Models	TX-K001-BL; TX-K002-BL; TX-S001; TX-S002; TX-S003; TX-S004; TX-S004L; TX-S004R; TX-S005; TX-S005L; TX-S005R; TX-S006; TX-S007; TX-S008; TX-S009; TX-S010; TX-S010L; TX-S010R; TX-S011; TX-S012; TX-S013; TX-S014; TX-S015; TX-S016; TX-S017; TX-S018; TX-S019; TX-S020; TX-S021; TX-S022; TX-S023; TX-S024; TX-S025; TX-S026; TX-S027; TX-S028; TX-S029; TX-S030; TX-S031; TX-S032; TX-S033; TX-S033L; TX-S033R; TX-S034; TX-S035; TX-S036; TX-S037; TX-S038; TX-S039; TX-S040; TX-S041; TX-S042; TX-S043; TX-S044; TX-S045; TX-S046; TX-S047; TX-S048; TX-S049; TX-S050; TX-S051; TX-S052; TX-S052L; TX-S052R; TX-S053; TX-S054; TX-S055; TX-S056; TX-S057; TX-S058; TX-S058L; TX-S058R; TX-S059; TX-S060; TX-S061; TX-S062; TX-S063; TX-S064; TX-S065; TX-S066; TX-S067; TX-S068; TX-S069; TX-S070; TX-S071; TX-S071L; TX-S071R; TX-S072; TX-S073; TX-S074; TX-S075; TX-S076; TX-S077; TX-S078; TX-S079; TX-S080; TX-S081; TX-S082; TX-S083; TX-S084; TX-S085; TX-S086; TX-S086L; TX-S086R; TX-S087; TX-S087L; TX-S087R; TX-S088; TX-S089; TX-S090; TX-S091; TX-S092; TX-S093; TX-S094; TX-S095; TX-S096; TX-S097; TX-S098; TX-S099; TX-S100; TX-S101; TX-S102; TX-S103; TX-S104; TX-S105; TX-S106; TX-S107; TX-S108; TX-S109; TX-S110; TX-S111; TX-S112; TX-S113; TX-S114; TX-S115; TX-S116; TX-S117; TX-S118; TX-S119; TX-S120; TX-S121; TX-S122; TX-S123; TX-S124; TX-S125; TX-S126; TX-S127; TX-S128; TX-S129; TX-S130; TX-S131; TX-S132; TX-S133; TX-S134; TX-S135; TX-S136; TX-S137; TX-S138; TX-S139; TX-S140; TX-S141; TX-S142; TX-S143; TX-S144; TX-S145; TX-S146; TX-S147; TX-S148; TX-S149; TX-S150; TX-S151; TX-S152; TX-S153; TX-S154; TX-S155; TX-S156; TX-S157; TX-S158; TX-S159; TX-S160; TX-S161; TX-S162; TX-S163; TX-S164; TX-S165; TX-S166; TX-S167; TX-S168; TX-S169; TX-S170; TX-S171; TX-S172; TX-S173; TX-S174; TX-S175; TX-S176; TX-S177; TX-S178; TX-S179; TX-S180; TX-S181; TX-S182; TX-S183; TX-S184; TX-S185; TX-S186; TX-S187; TX-S188; TX-S189; TX-S190; TX-S191; TX-S192; TX-S193; TX-S194; TX-S195; TX-S196; TX-S197; TX-S198; TX-S199; TX-S200; TX-S201; TX-S202; TX-S203; TX-S204; TX-S205; TX-S206; TX-S207; TX-S208; TX-S209; TX-S210; TX-S211; TX-S212; TX-S213; TX-S214; TX-S215; TX-S216; TX-S217; TX-S218; TX-S219; TX-S220; TX-S221; TX-S222; TX-S223; TX-S224; TX-S225; TX-S226; TX-S227; TX-S228; TX-S229; TX-S230; TX-S231; TX-S232; TX-S233; TX-S234; TX-S235; TX-S236; TX-S237; TX-S238; TX-S239; TX-S240; TX-S241; TX-S242; TX-S243; TX-S244; TX-S245; TX-S246; TX-S247; TX-S248; TX-S249; TX-S250; TX-S251; TX-S252; TX-S253; TX-S254; TX-S255; TX-S256; TX-S257; TX-S258; TX-S259; TX-S260; TX-S261; TX-S262; TX-S263; TX-S264; TX-S265; TX-S266; TX-S267; TX-S268; TX-S269; TX-S270; TX-S271; TX-S272; TX-S273; TX-S274; TX-S275; TX-S276; TX-S277; TX-S278; TX-S279; TX-S280; TX-S281; TX-S282; TX-S283; TX-S284; TX-S285; TX-S286; TX-S287; TX-S288; TX-S289; TX-S290; TX-S291; TX-S292; TX-S293; TX-S294; TX-S295; TX-S296; TX-S297; TX-S298; TX-S299; TX-S300; TX-K001 EU; TX-K002 EU; TX-K001 EU-BL; TX-K002 EU-BL

Model Difference	Model differences in appearance and market segmentation
Power Supply	3Vdc from coin battery
Device type	safety applications

Operating Frequency	315 MHz
Transmit Power	PK: 63.68 dBuV/m at 3 m (ASK) PK: 63.47 dBuV/m at 3 m (FSK)
Modulation Technique	ASK, FSK
Number of Channels	1
Periodic Transmission Time	ASK: Transmission period : every 56.4s, Ton: 0.005s FSK: Transmission period : every 64.32s, Ton: 0.005s
Antenna Type	PIFA Antenna

1.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: **ULZ-TXK001** 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 Corp. <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

[1]Linear 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 ξ 15.205
4. Emission spurious frequency which appearing within the Restricted Bands specified in provision of ξ15.205, then the general radiated emission limits in ξ 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. 315MHz AV limit = 16.6667 * 315(MHz) – 2833.333= 2416.6775 uV/m
   = 67.7dBuV/m
7. 315MHz Peak limit = AV Limit + 20dB = 87.7MHz

2.5 Configuration of Tested System

Fig. 1 Configuration of Tested System

Tx

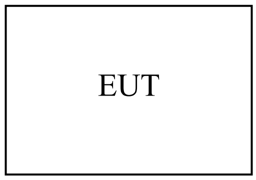


Table 2-1 Equipment Used in Tested System

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 315MHz 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)

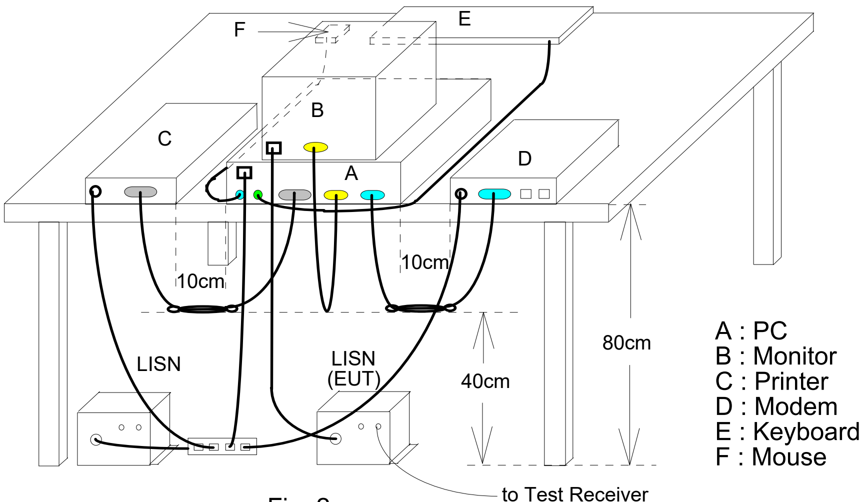


Fig. 2

5.3 Measurement Equipment Used:

Conducted Emission Test Site					
Equipment Type	**MFR**	**Model Number**	**Searial Number**	**Last Cal.**	**Cal Due.**
Chamber05 -1 Cable	WOKEN	CFD 300-NL	Chamber05 -1 Cable	08/29/2019	08/29/2020
EMI Receiver 13	ROHDE & SCHWARZ	ESCI	101015	07/25/2019	07/25/2020
LISN 15	ROHDE & SCHWARZ	ENV216	101335	11/22/2018	11/22/2019
LISN 22	ROHDE & SCHWARZ	ENV216	101478	08/13/2019	08/13/2020
Test Software	Farad	EZEMC Ver:ISL-03A2	N/A	N/A	N/A

5.4 Measurement Result:

N/A

6. Duty Cycle (Average Correction factor) Measurement

6.1 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= 100kHz, VBW= 300kHz, Span =0 Hz. Adjacent sweep.
4. Set SPA View. Mark delta.

6.2 Test SET-UP (Block Diagram of Configuration)

Same as 7.2 Radiated Emission Measurement.

6.3 Measurement Equipment Used:

Same as 7.3 Radiated Emission Measurement.

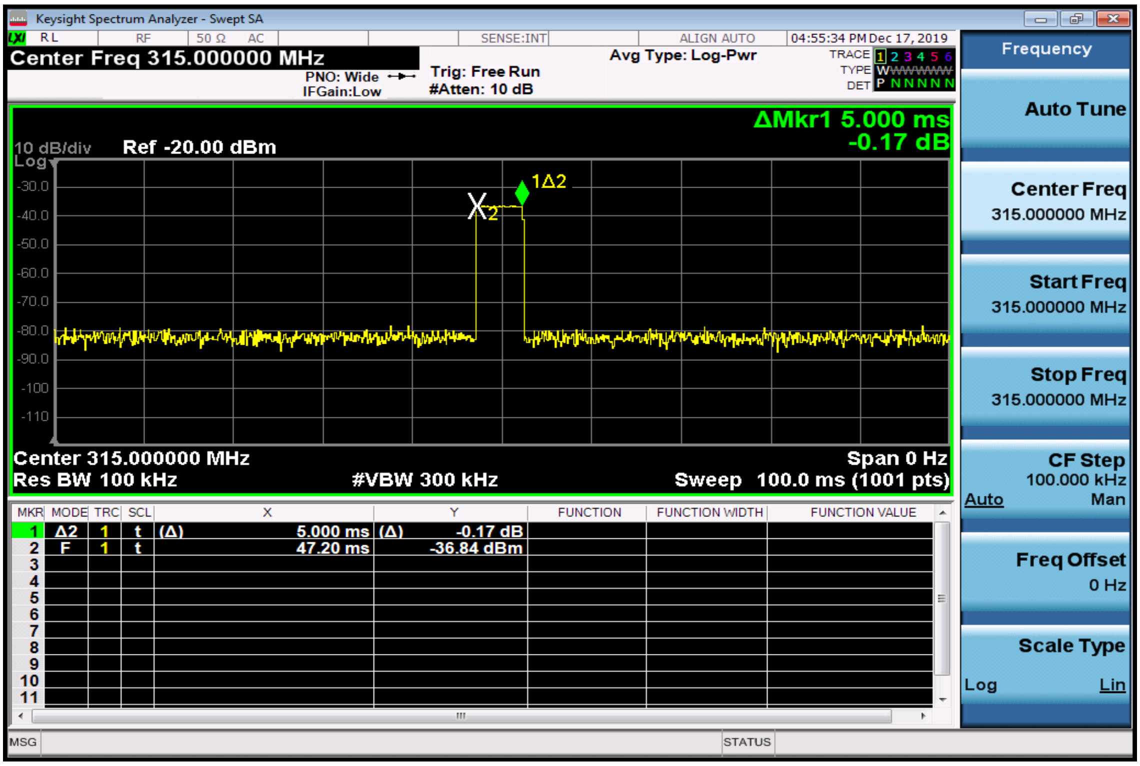
6.4 Measurement Results:

Averaging factor in dB =20*Log (duty cycle)

Duty cycle =5ms/100ms=0.05

Average Factor=20log(0.05)=-26.021

Ton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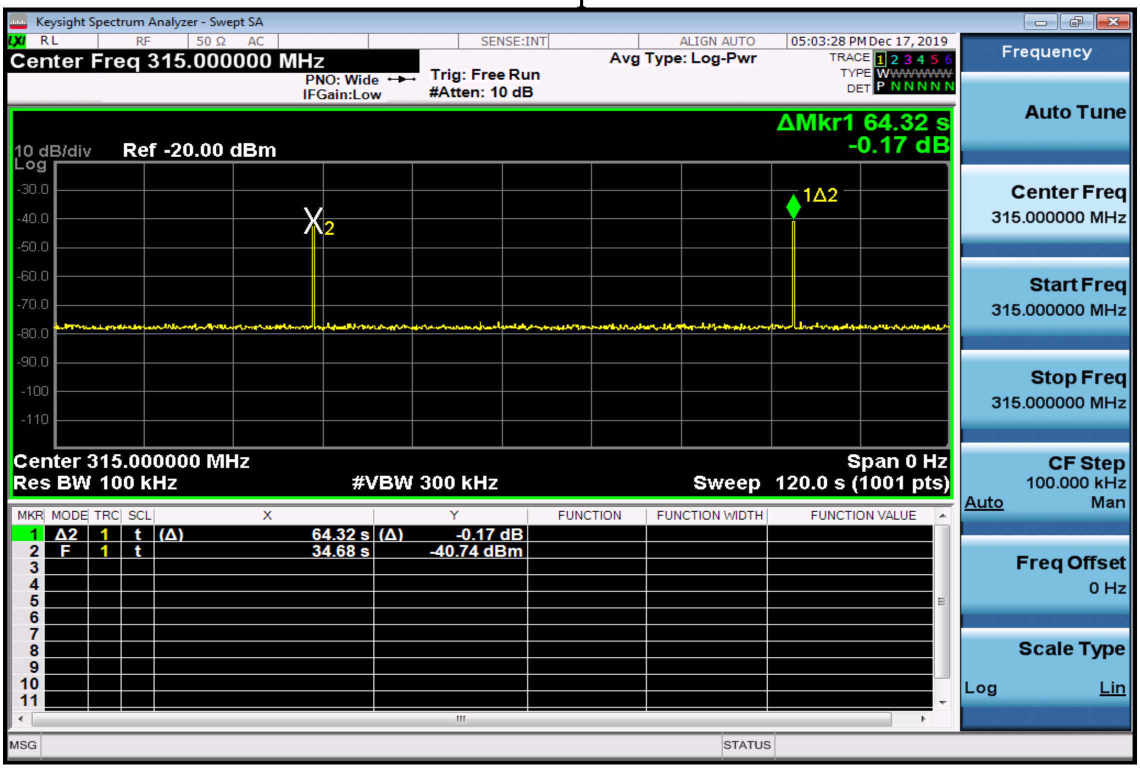
Center Freq 315.000000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 10 dB
Avg Type: Log-Pwr
04:55:34 PM Dec 17, 2019
ΔMkr1 5.000 ms
-0.17 dB
10 dB/div Ref -20.00 dBm
Center 315.000000 MHz
Span 0 Hz
Res BW 100 kHz
#VBW 300 kHz
Sweep 100.0 ms (1001 pts)
1 Δ2 1 t (Δ) 5.000 ms (Δ) -0.17 dB
2 F 1 t 47.20 ms -36.84 dBm
Frequency
Auto Tune
Center Freq 315.000000 MHz
Start Freq 315.000000 MHz
Stop Freq 315.000000 MHz
CF Step 100.000 kHz
Freq Offset 0 Hz
Scale Type

Tp


Keysight Spectrum Analyzer - Swept SA
Center Freq 315.000000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 10 dB
Avg Type: Log-Pwr
05:03:28 PM Dec 17, 2019
ΔMkr1 64.32 s
-0.17 dB
10 dB/div Ref -20.00 dBm
Center 315.000000 MHz
Span 0 Hz
Res BW 100 kHz
#VBW 300 kHz
Sweep 120.0 s (1001 pts)
1 Δ2 1 t (Δ) 64.32 s (Δ) -0.17 dB
2 F 1 t 34.68 s -40.74 dBm
Frequency
Auto Tune
Center Freq 315.000000 MHz
Start Freq 315.000000 MHz
Stop Freq 315.000000 MHz
CF Step 100.000 kHz
Freq Offset 0 Hz
Scale Type

7. Radiated Emission Test

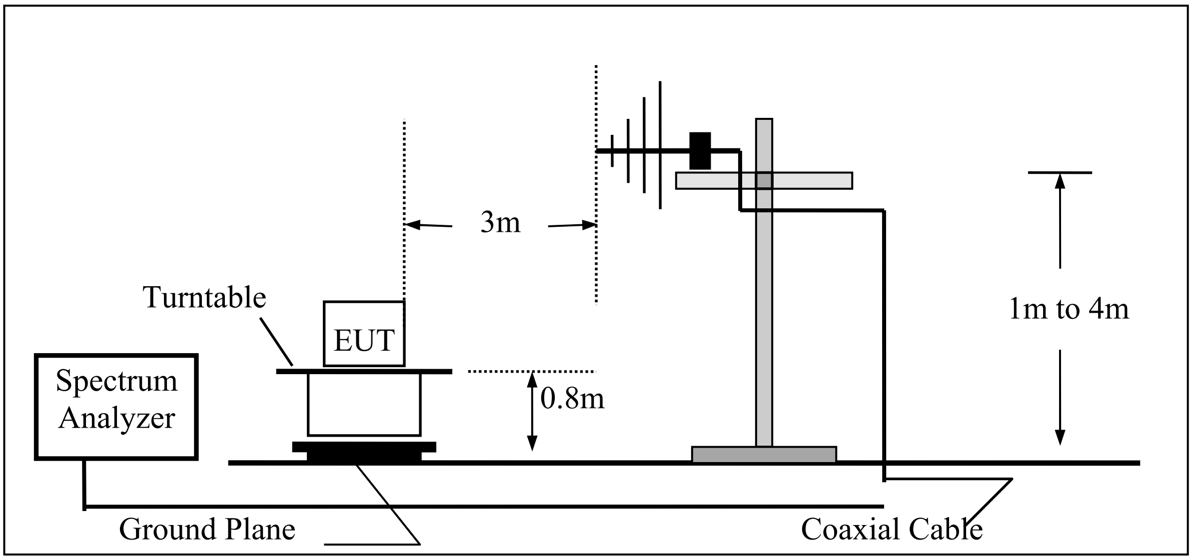
15.231 (e) Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation, including operation prohibited in paragraph (a) of this section, provided the intentional radiator complies with the provisions of paragraphs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

7.1 Measurement Procedure

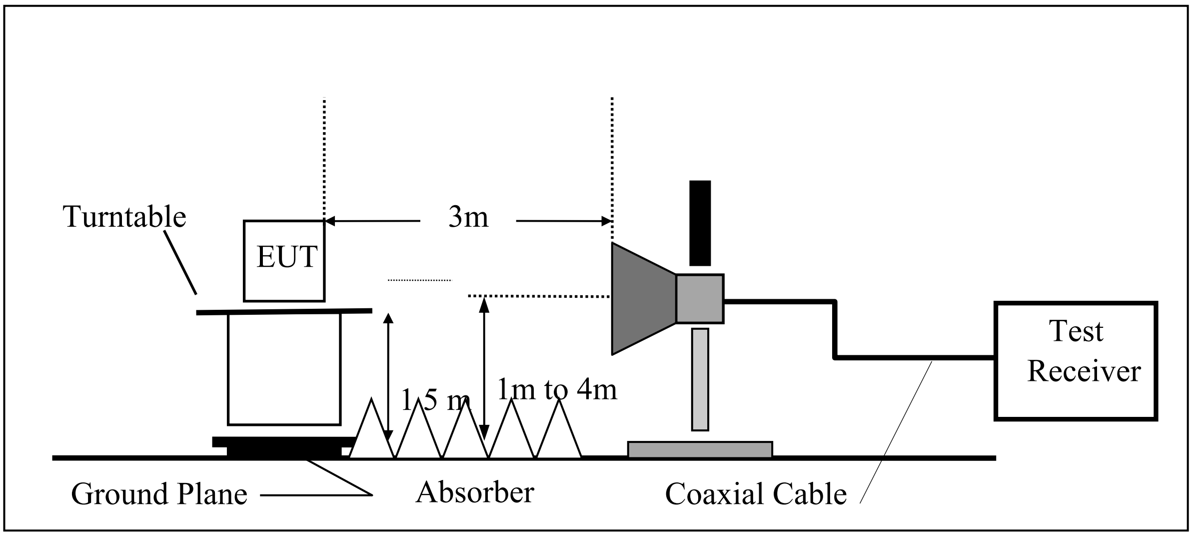
1. The EUT was placed on a turn table which is 0.8/1.5m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat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

7.2 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



7.3 Measurement Equipment Used:

Location	Equipment Name	Brand	Model	S/N	Last Cal. Date	Next Cal. Date
Chamber 19	Spectrum analyzer	R&S	FSP40	100116	01/10/2019	01/010/2020
Chamber 19	EMI Receiver	R&S	ESR3	102461	08/08/2018	08/08/2020
Chamber 19	Loop Antenna	EM	EM-6879	271	05/31/2019	05/31/2020
Chamber 19	Bilog Antenna (30MHz-1GHz)	Schwarzbeck	VULB9168 w 5dB Att.	736	01/29/2019	01/29/2020
Chamber 19	Horn antenna (1GHz-18GHz)	Schwarzbeck	9120D	9120D-1627	06/17/2019	06/17/2020
Chamber 19	Horn antenna (18GHz-26GHz)	Com-power	AH-826	081001	11/21/2017	11/21/2019
Chamber 19	Horn antenna (26GHz-40GHz)	Com-power	AH-640	100A	03/29/2019	03/29/2021
Chamber 19	Preamplifier (9kHz-1GHz)	HP	8447F	3113A06362	01/14/2019	01/14/2020
Chamber 19	Preamplifier (1GHz-26GHz)	Agilent	8449B	3008A02471	10/05/2019	10/05/2020
Chamber 19	Preamplifier (26GHz-40GHz)	MITEQ	JS4-26004000-27-5A	818471	05/06/2019	05/06/2020
Chamber 19	RF Cable (9kHz-18GHz)	HUBER SUHNER	Sucoflex 104A	MY1397/4A	01/17/2019	01/17/2020
Chamber 19	RF Cable (18GHz-40GHz)	HUBER SUHNER	Sucoflex 102	27963/2&374 21/2	11/27/2017	11/27/2019
Chamber 19	Signal Generator	Anritsu	MG3692A	20311	01/09/2019	01/09/2020
Chamber 19	Test Software	Audix	E3 Ver:6.12023	N/A	N/A	N/A
Chamber 19	Magnetic Field Meter	Combinova	MFM-10	645	10/16/2019	10/16/2020
Chamber 19	Magnetic Field Meter	Combinova	MFM-1000	619	12/06/2018	12/06/2019
Chamber 19	Electric Field Meter	Combinova	EFM-200	402	10/16/2019	10/16/2020
Chamber 19	E-field probe	Narda / Wandel & Goltermann	EF-0691 + NBM-520	D-0135 + D-0526	03/02/2019	03/02/2020

7.4 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	

7.5 Measurement Result

Fundamental Measurement Result

Operation Mode:	Transmitting Mode	Test Date:	2019/10/23
Fundamental Frequency:	315MHz	Test By:	Bill
Temp:	25 ℃	Hum.:	60%

FSK

Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
315.04	65.95	-3.54	62.41	87.70	-25.29	Peak	VERTICAL
314.96	67.01	-3.54	63.47	87.70	-24.23	Peak	HORIZONTAL

ASK

Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
315.03	65.82	-3.54	62.28	87.70	-25.42	Peak	VERTICAL
315.04	67.22	-3.54	63.68	87.70	-24.02	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 (FSK)	Test Date:	2019/10/23
Fundamental Frequency:	315MHz	Test By:	Bill
Temperature :	25 ℃	Humidity :	60 %

No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	161.92	26.07	-5.00	21.07	43.50	-22.43	Peak	VERTICAL
2	298.69	26.50	-3.85	22.65	46.00	-23.35	Peak	VERTICAL
3	390.84	27.02	-2.15	24.87	46.00	-21.13	Peak	VERTICAL
4	519.85	26.36	0.05	26.41	46.00	-19.59	Peak	VERTICAL
5	716.76	27.83	3.23	31.06	46.00	-14.94	Peak	VERTICAL
6	860.32	27.40	5.48	32.88	46.00	-13.12	Peak	VERTICAL
1	153.19	26.75	-5.16	21.59	43.50	-21.91	Peak	HORIZONTAL
2	347.19	27.09	-3.00	24.09	46.00	-21.91	Peak	HORIZONTAL
3	495.60	27.45	-0.68	26.77	46.00	-19.23	Peak	HORIZONTAL
4	592.60	29.00	1.37	30.37	46.00	-15.63	Peak	HORIZONTAL
5	702.21	26.33	3.16	29.49	46.00	-16.51	Peak	HORIZONTAL
6	866.14	27.03	5.56	32.59	46.00	-13.41	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.

Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode: Transmitting Mode (FSK) Test Date: 2019/10/23
Fundamental Frequency: 315MHz Test By: Bill
Temperature : 25 ℃ Humidity : 60 %

No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2422.00	56.64	-15.86	40.78	67.70	-26.92	Peak	VERTICAL
2	2536.00	38.23	-15.74	22.49	47.70	-25.21	Average	VERTICAL
3	2536.00	64.25	-15.74	48.51	67.70	-19.19	Peak	VERTICAL
1	2113.00	50.56	-16.43	34.13	67.70	-33.57	Peak	HORIZONTAL
2	2521.00	40.93	-15.78	25.15	47.70	-22.55	Average	HORIZONTAL
3	2521.00	66.95	-15.78	51.17	67.70	-16.53	Peak	HORIZONTAL

Remark:

1 Measuring frequencies from the lowest internal frequency to the 10th of fundamental frequency
2 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
3 Measurement of data 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.
4 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 3 MHz.
5 Average Value = Peak Value + 20 Log (Ton/Tp)……Pulse Modulation Duty Cycle Corrction Factor.

Radiated Spurious Emission Measurement Result (below 1GHz)

Operation Mode:	Transmitting Mode (ASK)	Test Date:	2019/10/23
Fundamental Frequency:	315MHz	Test By:	Bill
Temperature :	25 ℃	Humidity :	60 %

No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	156.10	26.66	-5.08	21.58	43.50	-21.92	Peak	VERTICAL
2	321.00	27.25	-3.39	23.86	46.00	-22.14	Peak	VERTICAL
3	482.99	26.56	-0.84	25.72	46.00	-20.28	Peak	VERTICAL
4	610.06	28.39	1.65	30.04	46.00	-15.96	Peak	VERTICAL
5	706.09	27.40	3.18	30.58	46.00	-15.42	Peak	VERTICAL
6	878.75	28.48	5.76	34.24	46.00	-11.76	Peak	VERTICAL
1	152.22	27.45	-5.19	22.26	43.50	-21.24	Peak	HORIZONTAL
2	364.65	27.07	-2.66	24.41	46.00	-21.59	Peak	HORIZONTAL
3	480.08	27.40	-0.89	26.51	46.00	-19.49	Peak	HORIZONTAL
4	605.21	27.34	1.59	28.93	46.00	-17.07	Peak	HORIZONTAL
5	718.70	27.41	3.24	30.65	46.00	-15.35	Peak	HORIZONTAL
6	832.19	28.81	5.17	33.98	46.00	-12.02	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.

Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode: Transmitting Mode (ASK) Test Date: 2019/10/23
Fundamental Frequency: 315MHz Test By: Bill
Temperature : 25 ℃ Humidity : 60 %

No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	1846.00	55.56	-18.68	36.88	67.70	-30.82	Peak	VERTICAL
2	2521.00	61.39	-15.78	45.61	67.70	-22.09	Peak	VERTICAL
1	2116.00	55.94	-16.41	39.53	67.70	-28.17	Peak	HORIZONTAL
2	2521.00	41.38	-15.78	25.60	47.70	-22.10	Average	HORIZONTAL
3	2521.00	67.40	-15.78	51.62	67.70	-16.08	Peak	HORIZONTAL
4	2539.00	40.76	-15.73	25.03	47.70	-22.67	Average	HORIZONTAL
5	2539.00	66.78	-15.73	51.05	67.70	-16.65	Peak	HORIZONTAL

Remark:

1. Measuring frequencies from the lowest internal frequency to the 10th of fundamental frequency
2. Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
3. Measurement of data 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.
4. Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 3 MHz.
5. Average Value = Peak Value + 20 Log (Ton/Tp)……Pulse Modulation Duty Cycle Corrction Factor.

8. 20dB Occupied Bandwidth

8.1 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.

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

Refer to attached data chart.

The center frequency **f_c is 315MHz,** according to the Rules, section 15.231(C), the Bandwidth of Center Frequency at-20dB should be calculated as following:

315 X 0.0025 = 0.7875(MHz)

8.5 Measurement Result:

ASK:
74.8 kHz < limit 0.7875MHz
FSK:
124.9 kHz < limit 0.7875MHz

20dB Band Width Test Data

ASK:

FSK:

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: 5.3 ms < 1s

Tp: 56.4 s

silent period limit: 10s or 0.005s *30 = 0.15s

T silent period = 56.4s – 0.005s = 55.995s > 10s

The result: PASS

FSK:

Ton: 5.0 ms < 1s

Tp: 64.32 s

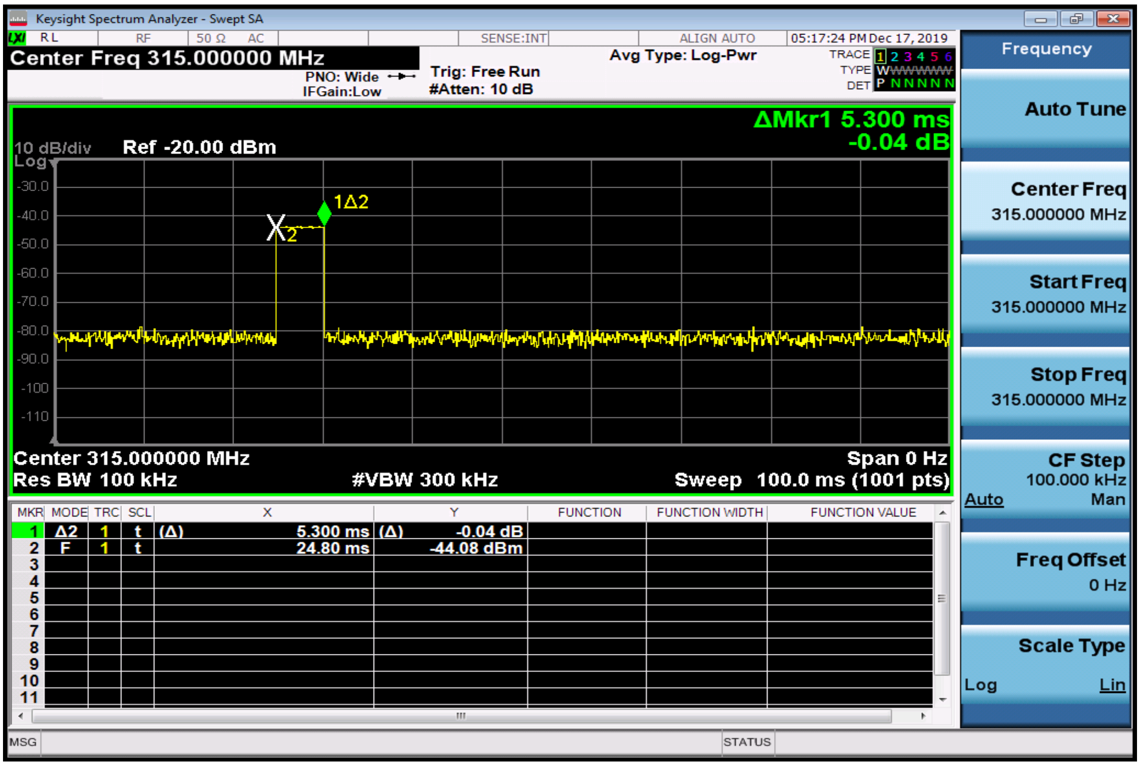
silent period limit: 10s or 0.005s *30 = 0.15s

T silent period = 64.32s – 0.005s = 64.315s > 10s

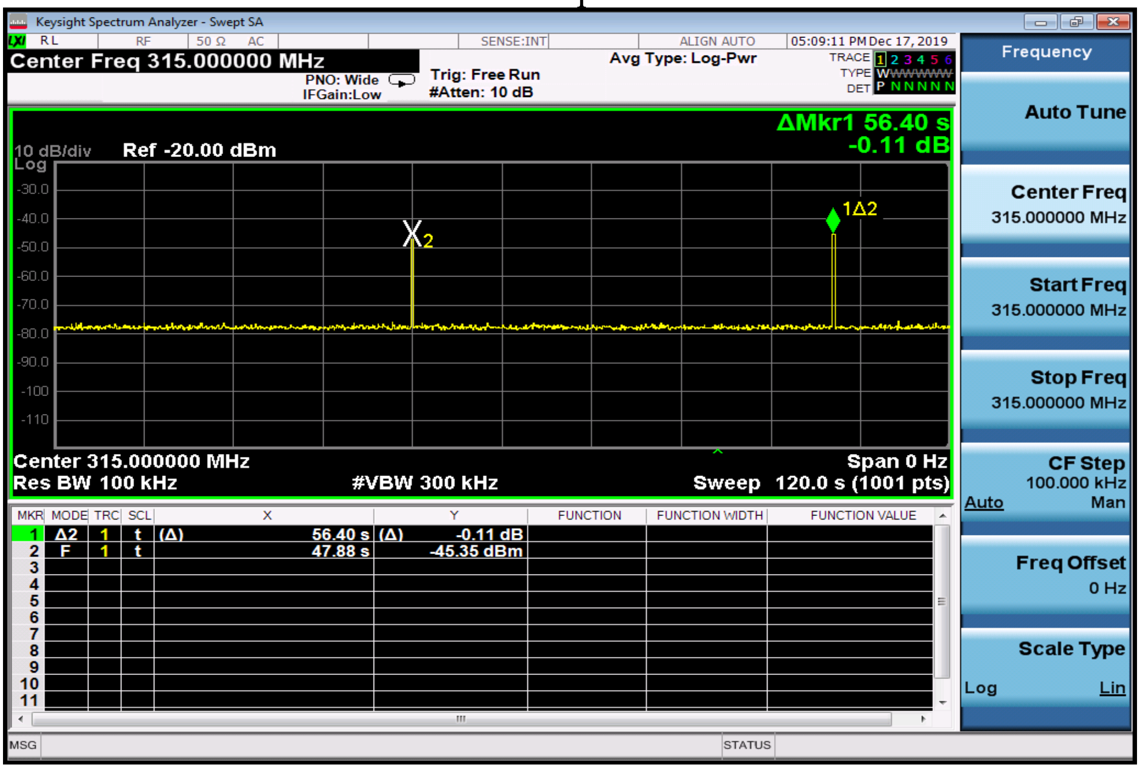
The result: PASS.

ASK:

Ton

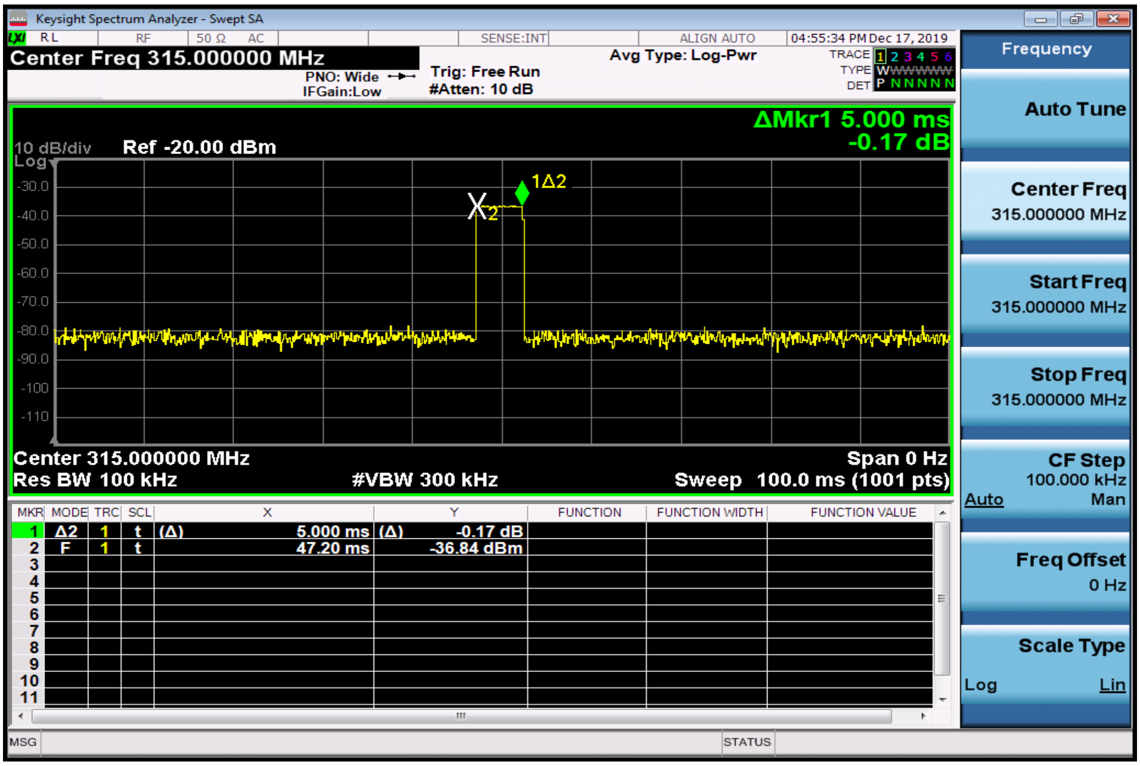

Keysight Spectrum Analyzer - Swept SA
Center Freq 315.000000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 10 dB
Avg Type: Log-Pwr
05:17:24 PM Dec 17, 2019
ΔMkr1 5.300 ms
-0.04 dB
10 dB/div
Ref -20.00 dBm
1Δ2
Center 315.000000 MHz
Res BW 100 kHz
#VBW 300 kHz
Span 0 Hz
Sweep 100.0 ms (1001 pts)
1 Δ2 1 t (Δ) 5.300 ms (Δ) -0.04 dB
2 F 1 t 24.80 ms -44.08 dBm
Frequency
Auto Tune
Center Freq 315.000000 MHz
Start Freq 315.000000 MHz
Stop Freq 315.000000 MHz
CF Step 100.000 kHz
Freq Offset 0 Hz
Scale Type

Tp

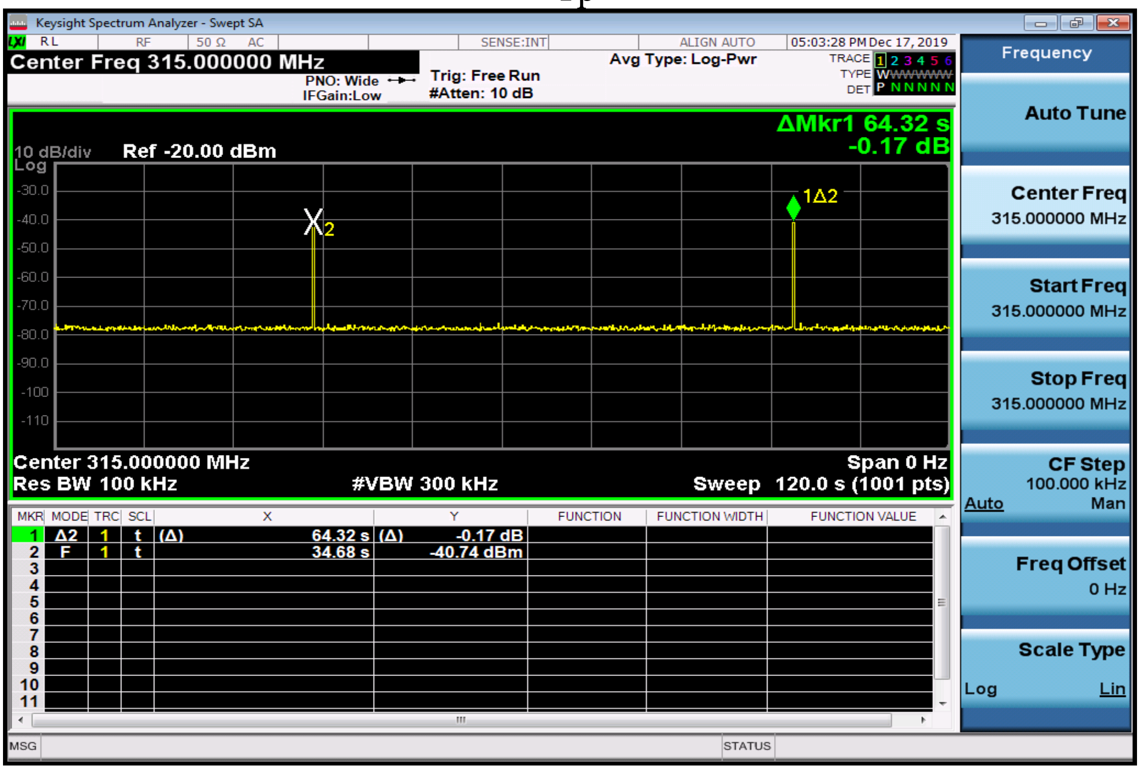

Keysight Spectrum Analyzer - Swept SA
Center Freq 315.000000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 10 dB
Avg Type: Log-Pwr
05:09:11 PM Dec 17, 2019
ΔMkr1 56.40 s
-0.11 dB
10 dB/div
Ref -20.00 dBm
1Δ2
Center 315.000000 MHz
Res BW 100 kHz
#VBW 300 kHz
Span 0 Hz
Sweep 120.0 s (1001 pts)
1 Δ2 1 t (Δ) 56.40 s (Δ) -0.11 dB
2 F 1 t 47.88 s -45.35 dBm
Frequency
Auto Tune
Center Freq 315.000000 MHz
Start Freq 315.000000 MHz
Stop Freq 315.000000 MHz
CF Step 100.000 kHz
Freq Offset 0 Hz
Scale Type

FSK:

Ton


Keysight Spectrum Analyzer - Swept SA
Center Freq 315.000000 MHz
Trig: Free Run
#Atten: 10 dB
Avg Type: Log-Pwr
04:55:34 PM Dec 17, 2019
ΔMkr1 5.000 ms
-0.17 dB
10 dB/div Ref -20.00 dBm
Center 315.000000 MHz
Res BW 100 kHz
#VBW 300 kHz
Span 0 Hz
Sweep 100.0 ms (1001 pts)
1 Δ2 1 t (Δ) 5.000 ms (Δ) -0.17 dB
2 F 1 t 47.20 ms -36.84 dBm
Frequency
Auto Tune
Center Freq 315.000000 MHz
Start Freq 315.000000 MHz
Stop Freq 315.000000 MHz
CF Step 100.000 kHz
Freq Offset 0 Hz
Scale Type

Tp


Keysight Spectrum Analyzer - Swept SA
Center Freq 315.000000 MHz
Trig: Free Run
#Atten: 10 dB
Avg Type: Log-Pwr
05:03:28 PM Dec 17, 2019
ΔMkr1 64.32 s
-0.17 dB
10 dB/div Ref -20.00 dBm
Center 315.000000 MHz
Res BW 100 kHz
#VBW 300 kHz
Span 0 Hz
Sweep 120.0 s (1001 pts)
1 Δ2 1 t (Δ) 64.32 s (Δ) -0.17 dB
2 F 1 t 34.68 s -40.74 dBm
Frequency
Auto Tune
Center Freq 315.000000 MHz
Start Freq 315.000000 MHz
Stop Freq 315.000000 MHz
CF Step 100.000 kHz
Freq Offset 0 Hz
Scale Type