



TEST REPORT

N°: 159389-732090-A (FILE#1015443)

Version : 02

Subject Electromagnetic compatibility and Radio spectrum Matters (ERM) tests according to standards:
FCC CFR 47 Part 15, Subpart C
RSS-247 Issue 2.0

Issued to **HIKOB SAS**
55 Chemin du vieux chêne
38240 - MEYLAN
FRANCE

Apparatus under test
↳ Product Zigbee Repeater
↳ Trade mark **HIKOB**
↳ Manufacturer **HIKOB**
↳ Model under test **PAL2A**
↳ Serial number **CPAL2210568451003ED2n**
↳ FCCID **2ARX6-PAL20**

Conclusion See Test Program chapter §1
Test date January 28, 2019 to June 3, 2019
Test location MOIRANS
IC Test site 6500A-1 & 6500A-3
Composition of document 28 pages

Document issued on June 13, 2019

Written by :

Jonathan PAUC

Tests operator

Approved by :

Anthony MERLIN

Technical manager



This document shall not be reproduced, except in full, without the written approval of the LCIE. This document contains results related only to the items tested. It does not imply the conformity of the whole production to the items tested. Unless otherwise specified, the decision of conformity takes into account the uncertainty of measurement. This document doesn't anticipate any certification decision.

LCIE

Laboratoire Central des Industries Electriques
Une société de Bureau Veritas

ZI Centr'Alp
170 rue de Chatagnon
38430 Moirans FRANCE

Tél : +33 4 76 07 36 36
contact@lcie.fr
www.lcie.fr



L C I E

PUBLICATION HISTORY

Version	Date	Author	Modification
01	March 13, 2019	Jonathan PAUC	Creation of the document
02	June 13, 2019	Jonathan PAUC	Adding of tests



L C I E

SUMMARY

1. TEST PROGRAM	4
2. SYSTEM TEST CONFIGURATION.....	5
3. RADIATED EMISSION DATA	8
4. BANDWIDTH (15.247)	13
5. MAXIMUM PEAK OUTPUT POWER (15.247)	16
6. POWER SPECTRAL DENSITY (15.247)	19
7. BAND EDGE MEASUREMENT (15.247)	22
8. UNCERTAINTIES CHART	28



L C I E

1. TEST PROGRAM

Standard:

- FCC Part 15, Subpart C 15.247
- ANSI C63.10 (2013)
- RSS-247 Issue 2.0 / RSS-Gen Issue 5
- 558074 D01 DTS Measurement Guidance v05

EMISSION TEST	LIMITS			RESULTS
	Frequency	Quasi-peak value (dB μ V)	Average value (dB μ V)	
Limits for conducted disturbance at mains ports 150kHz-30MHz	150-500kHz	66 to 56	56 to 46	<input type="checkbox"/> PASS <input type="checkbox"/> FAIL <input checked="" type="checkbox"/> NA <input type="checkbox"/> NP
	0.5-5MHz	56	46	
	5-30MHz	60	50	
Radiated emissions 9KHz-30MHz CFR 47 §15.209 (a) CFR 47 §15.247 (d) RSS-247 §5.5	Measure at 300m 9kHz-490kHz : 67.6dB μ V/m /F(kHz) Measure at 30m 490kHz-1.705MHz : 87.6dB μ V/m /F(kHz) 1.705MHz-30MHz : 29.5 dB μ V/m			<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP
Radiated emissions 30MHz-25GHz* CFR 47 §15.209 (a) CFR 47 §15.247 (d) RSS-247 §5.5 Highest frequency : (Declaration of provider)	Measure at 3m 30MHz-88MHz : 40 dB μ V/m 88MHz-216MHz : 43.5 dB μ V/m 216MHz-960MHz : 46.0 dB μ V/m Above 960MHz : 54.0 dB μ V/m			<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP
Bandwidth 6dB CFR 47 §15.247 (a) (2) RSS-247 §5.2	At least 500kHz			<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP
Power spectral Density CFR 47 §15.247 (e) RSS-247 §5.2	Limit: 8dBm/3kHz			<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP
Maximum Peak Output Power CFR 47 §15.247 (b) RSS-247 §5.4	Limit: 30dBm Conducted or Radiated measurement			<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP
Band Edge Measurement CFR 47 §15.209 (a) CFR 47 §15.247 (d) RSS-247 §5.5	Limit: -20dBc or Radiated emissions limits in restricted bands			<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input type="checkbox"/> NP
Occupied bandwidth RSS-Gen §6.7	No limit			<input type="checkbox"/> PASS <input type="checkbox"/> FAIL <input type="checkbox"/> NA <input checked="" type="checkbox"/> NP
Receiver Spurious Emission** RSS-Gen §7.3	Measure at 3m 30MHz-88MHz : 40 dB μ V/m 88MHz-216MHz : 43.5 dB μ V/m 216MHz-960MHz : 46.0 dB μ V/m Above 960MHz : 54.0 dB μ V/m			<input type="checkbox"/> PASS <input type="checkbox"/> FAIL <input checked="" type="checkbox"/> NA <input type="checkbox"/> NP

*§15.33: The highest internal source of a testing device is defined like more the highest frequency generated or used in the testing device or on which the testing device works or agrees.

- If the highest frequency of the internal sources of the testing device is lower than 108 MHz, measurement must be only performed until 1GHz.
- If the highest frequency of the internal sources of the testing device ranges between 108 MHz and 500 MHz, measurement must be only performed until 2GHz.
- If the highest frequency of the internal sources of the testing device ranges between 500 MHz and 1 GHz, measurement must be only performed until 5GHz.

If the highest frequency of the internal sources of the testing device is above 1 GHz, measurement must be only performed until 5 times the highest frequency or 40 GHz, while taking smallest of both.

**Testing covered the receive mode, and receiver spurious emissions are considered to be the same as transmitter.



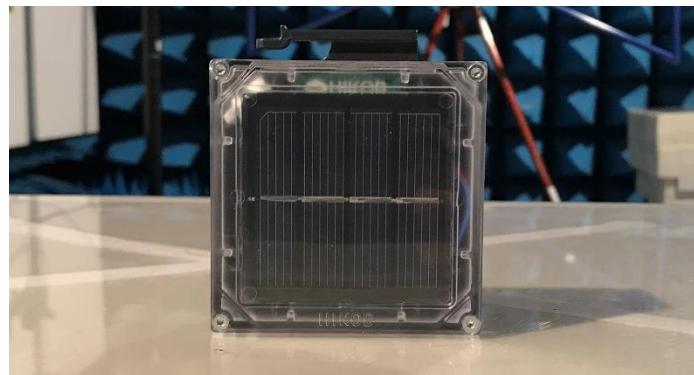
2. SYSTEM TEST CONFIGURATION

2.1. HARDWARE IDENTIFICATION (EUT AND AUXILIARIES):

Equipment under test (EUT):

PAL2A

Serial Number: CPAL2210568451003ED2n



Photography of EUT

Power supply:

During all the tests, EUT is supplied by V_{nom} :3.6 Vdc

For measurement with different voltage, it will be presented in test method.

Name	Type	Rating	LP	Comments
Supply1	<input type="checkbox"/> AC <input type="checkbox"/> DC <input checked="" type="checkbox"/> Battery	3.6V 6Ah	Lithium LP103448	/

Inputs/outputs - Cable:

Access	Type	Length used (m)	Declared <3m	Shielded	Under test	Comments
			None			

Auxiliary equipment used during test:

Type	Reference	Sn	Comments
GATEWAY	HIKOB GATEWAY	BA:BD:0B:01:13:00:11:7B	
POE Power supply	AXIS POE MIDSPAN 1-PORT / PD-3001.AC	/	



L C I E

Equipment information:

Type:	ZIGBEE		
Frequency band:	[2400 – 2483.5] MHz		
Sub-band REC7003:	Annex 3 (a)		
Spectrum Modulation:	<input checked="" type="checkbox"/> DSSS		
Number of Channel:	16		
Spacing channel:	5MHz		
Channel bandwidth:	2MHz		
Antenna Type:	<input checked="" type="checkbox"/> Integral	<input type="checkbox"/> External	<input type="checkbox"/> Dedicated
Antenna connector:	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Temporary for test
Transmit chains:	1 Single antenna Gain 1: 3dBi		
Beam forming gain:	No		
Receiver chains	1		
Type of equipment:	<input checked="" type="checkbox"/> Stand-alone	<input type="checkbox"/> Plug-in	<input type="checkbox"/> Combined
Ad-Hoc mode:	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Duty cycle:	<input checked="" type="checkbox"/> Continuous duty	<input type="checkbox"/> Intermittent duty	<input type="checkbox"/> 100% duty
Equipment type:	<input checked="" type="checkbox"/> Production model <input type="checkbox"/> Pre-production model		
Type of power source:	<input type="checkbox"/> AC power supply	<input type="checkbox"/> DC power supply	<input checked="" type="checkbox"/> Battery (Lithium)
Operating voltage range:	Vmin:	<input type="checkbox"/> 207V/50Hz	<input checked="" type="checkbox"/> 2.9Vdc
	Vnom:	<input type="checkbox"/> 230V/50Hz	<input checked="" type="checkbox"/> 3.6Vdc
	Vmax	<input type="checkbox"/> 253V/50Hz	<input checked="" type="checkbox"/> 4.2Vdc

NC: Not communicated by customer

CHANNEL PLAN

Channel	Frequency (MHz)
Cmin: 11	2405
12	2410
13	2415
14	2420
15	2425
16	2430
17	2435
Cmid: 18	2440
19	2445
20	2450
21	2455
22	2460
23	2465
24	2470
Cmax : 25	2475

DATA RATE

Data Rate (Mbps)	Modulation Type	Worst Case Modulation
0.25	O-QPSK	<input checked="" type="checkbox"/>

2.2. EUT CONFIGURATION

The EUT is set in the following modes during tests with software:

- Permanent emission with modulation on a fixed channel in the data rate that produced the highest power
- Permanent reception



L C I E

2.1. MARKING PLATE



2.2. EQUIPMENT MODIFICATIONS

None Modification:

2.3. FIELD STRENGTH CALCULATION

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

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

Where
FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Factor
AG = Amplifier Gain

Assume a receiver reading of 52.5dB μ V is obtained. The antenna factor of 7.4 and a cable factor of 1.1 are added. The amplifier gain of 29dB is subtracted, giving a field strength of 32 dB μ V/m.

$$FS = 52.5 + 7.4 + 1.1 - 29 = 32 \text{ dB}\mu\text{V/m}$$

The 32 dB μ V/m value can be mathematically converted to its corresponding level in μ V/m.

Level in μ V/m = Common Antilogarithm $[(32 \text{ dB}\mu\text{V/m})/20] = 39.8 \mu\text{V/m}$.

2.4. CALIBRATION DATE

The calibration intervals are extended at 12+2 months. This extended interval is based on the fact that there is sufficient calibration data to statistically establish a trend or based on experience of use of the test equipment to assure good measurement results for a longer period



3. RADIATED EMISSION DATA

3.1. ENVIRONMENTAL CONDITIONS

Date of test : January 28, 2019
Test performed by : Jonathan PAUC
Atmospheric pressure (hPa) : 991
Relative humidity (%) : 23
Ambient temperature (°C) : 23

3.2. TEST SETUP

The installation of EUT is identical for pre-characterization measures in a 3 meters semi-anechoic chamber and for measures on the 10 meters Open site.

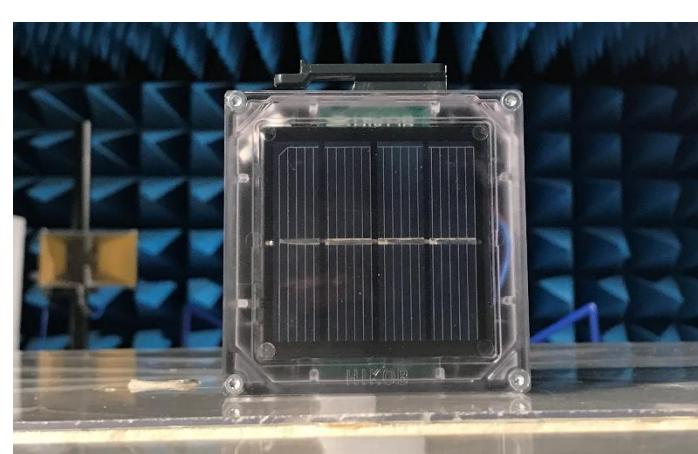
The EUT and auxiliaries are set:

- 80cm above the ground on the non-conducting table (Table-top equipment) - Below 1GHz
- 150cm above the ground on the non-conducting table (Table-top equipment) - Above 1GHz
- 10cm above the ground on isolating support (Floor standing equipment)

The EUT is powered by V_{nom} .



L C I E



Test setup in anechoic chamber (test setup > 1GHz)



3.3. TEST METHOD

The product has been tested according to ANSI C63.10, FCC part 15 subpart C.

Pre-characterisation measurement: (9kHz – 25GHz)

A pre-scan of all the setup has been performed in a 3 meters semi-anechoic chamber for frequency from 30MHz to 12.75GHz. Test is performed in horizontal (H) and vertical (V) polarization, the loop antenna was rotated during the test to maximize the emission measurement. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurement performed on all axis of EUT used in normal configuration.

The pre-characterization graphs are obtained in PEAK detection and PEAK/AVERAGE from 1GHz to 12.75GHz. Manual investigation is performed in PEAK detection and PEAK/AVERAGE from 12.75GHz to 25GHz.

*See §7, conducted measurements are performed,
characterisation are done on frequencies observed in restricted band*

Characterization on 10 meters open site from 9kHz to 1GHz:

Radiated Emissions were measured on an open area test site. A description of the facility is on file with the FCC. The product has been tested at a distance of **10 meters** from the antenna and compared to the FCC part 15 subpart C limits. Measurement bandwidth was 9kHz below 30MHz and 120kHz from 30 MHz to 1GHz. Test is performed in horizontal (H) and vertical (V) polarization, the loop antenna was rotated during the test to maximize the emission measurement. The height antenna is varied from 1m to 4m. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurement performed on all axis of EUT used in normal configuration. A summary of the worst case emissions found in all test configurations and modes is shown.

Frequency list has been created with anechoic chamber pre-scan results.

Characterization on 3 meters full anechoic chamber from 1GHz to 25GHz:

The product has been tested at a distance of **3 meters** from the antenna and compared to the FCC part 15 subpart C limits. Measurement bandwidth was 1MHz from 1GHz to 25GHz.

Test is performed in horizontal (H) and vertical (V) polarization. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurement performed on all axis of EUT used in normal configuration. A summary of the worst case emissions found in all test configurations and modes is shown. The height antenna is

On mast, varied from 1m to 4m

Fixed and centered on the EUT (EUT smaller than the beamwidth of the measurement antenna, ANSI C63.10 §6.6.5)

Frequency list has been created with anechoic chamber pre-scan results.

A duty cycle factor is applied to have average value C63.10 §7.5

DUT not emitted more than 15ms in 100ms observation time

Duty cycle Factor = $20 \cdot \log(15/100) = -16.5 \text{ dB}$



3.4. TEST EQUIPMENT LIST

ANECHOIC CHAMBER					
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal Date	Cal Due
Thermo-hygrometer (C3)	OREGON	BAR206	B4204078	10/18	10/20
Semi-Anechoic chamber #3	SIEPEL	-	D3044017	03/16	03/19
Turntable chamber (Cage#3)	ETS Lingren	Model 2165	F2000371	-	-
Turntable controller (Cage#3)	ETS Lingren	Model 2090	F2000444	-	-
Table C3	LCIE	-	F2000461	-	-
Rehausse Table C3	LCIE	-	F2000511	-	-
BAT EMC	NEXIO	v3.9.0.10	L1000115	-	-
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060050	12/17	12/18
Amplifier 9kHz - 40GHz	LCIE SUD EST		A7102082	10/18	10/19
Cable 1 < GHz	-	< 1GHz	A5329637	02/18	02/19
Cable Measure @3m 18GHz	-	18GHz	A5329038	12/17	12/18
Cable Measure Analyzer-Amplifier SMA	STORMFLEX	26GHz	A5329681	12/17	12/18
Cable Measure @1m	STORMFLEX	26GHz	A5329682	12/17	12/18
Cable Measure @1m	STORMFLEX	26GHz	A5329680	12/17	12/18
Antenna Bi-log	CHASE	CBL6111A	C2040172	09/18	09/20
Antenna horn 18GHz	EMCO	3115	C2042029	09/18	09/20
Radiated emission comb generator	BARDET	-	A3169050	-	-
HF Radiated emission comb generator	LCIE SUD EST	-	A3169088	-	-
Antenna horn 15-40GHz	SCHWARZBECK	SCHWARZBECK	C2042028	09/18	09/20

Note: In our quality system, the test equipment calibration due is more & less 2 months

3.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None

Divergence:



L C I E

3.6. TEST RESULTS

Worst case final data result:

The frequency list is created from the results obtained during the pre-characterization in anechoic chamber. Measurements are performed using a PEAK and AVERAGE detection.

Test Frequency (MHz)	Meter Reading dB(µV)	Detector (Pk/QP/Av)	Polarity (V/H)	Azimuth (Degrees)	Antenna Height (cm)	Transducer Factor (dB)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
4810.200	75.5	Pk	V	320	150	-24.1	51.4	74.0	-22.6
7214.153	70.0	Pk	V	41	150	-19.9	50.1	74.0	-23.9
12026.484	74.5	Pk	V	255	150	-16.9	57.6	74.0	-16.4
4810.200	66.5	Av	V	320	150	-24.1	42.4	54.0	-11.6
7214.153	58.5	Av	V	41	150	-19.9	38.6	54.0	-15.4
12026.484	66.8	Av	V	255	150	-16.9	49.9	54.0	-4.1
4879.380	75.5	Pk	V	320	150	-24.1	51.4	74.0	-22.6
7319.375	70.0	Pk	V	41	150	-19.9	50.1	74.0	-23.9
12197.600	65.4	Pk	V	255	150	-16.9	48.5	74.0	-25.5
4879.380	66.5	Av	V	320	150	-24.1	42.4	54.0	-11.6
7319.375	58.5	Av	V	41	150	-19.9	38.6	54.0	-15.4
12197.600	57.4	Av	V	255	150	-16.9	40.5	54.0	-13.5
2390.131	88.8	Pk	V	0	150	-30.6	58.2	74.0	-15.8
2484.123	87.8	Pk	V	0	150	-30.6	57.2	74.0	-16.8
2486.127	84.8	Pk	V	0	150	-30.6	54.2	74.0	-19.8
2490.136	80.7	Pk	V	0	150	-30.6	50.1	74.0	-23.9
2499.035	78.8	Pk	V	0	150	-30.6	48.2	74.0	-25.8
2390.131	79.8	Av	V	0	150	-30.6	49.2	54.0	-4.8
2484.123	76.0	Av	V	0	150	-30.6	45.4	54.0	-8.6
2486.127	71.8	Av	V	0	150	-30.6	41.2	54.0	-12.8
2490.136	69.0	Av	V	0	150	-30.6	38.4	54.0	-15.6
2499.035	65.8	Av	V	0	150	-30.6	35.2	54.0	-18.8
4950.950	67.1	Pk	V	320	150	-24.1	43.0	74.0	-31.0
7425.375	84.4	Pk	V	41	150	-19.9	64.5	74.0	-9.5
12376.400	56.9	Pk	V	255	150	-16.9	40.0	74.0	-34.0
4950.950	74.4	Av	V	320	150	-24.1	50.3	54.0	-3.7
7425.375	58.3	Av	V	41	150	-19.9	38.4	54.0	-15.6
12376.400	63.4	Av	V	255	150	-16.9	46.5	54.0	-7.5

Note: Measures have been done at 3m distance.

3.7. CONCLUSION

Radiated emission data measurement performed on the sample of the product PAL2A, SN: CPAL2210568451003ED2n, in configuration and description presented in this test report, show levels *below* the FCC CFR 47 Part 15 and RSS-247 limits.



4. BANDWIDTH (15.247)

4.1. TEST CONDITIONS

Date of test : Jonathan PAUC
Test performed by : June 3rd, 2019
Atmospheric pressure (hPa) : 1003
Relative humidity (%) : 40
Ambient temperature (°C) : 24

4.2. SETUP

Conducted measurement:

The EUT is turned ON and connected to measurement instrument; the center frequency of the spectrum analyzer is set to the fundamental frequency. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.

Offset: Attenuator+cable 10.6dB

Radiated measurement:

The EUT is placed in an anechoic chamber; the center frequency of the spectrum analyzer is set to the fundamental frequency. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete, a delta marker is used to measure the frequency difference as the emission bandwidth.

Measurement Procedure: §8.1 Option 1 (DTS Measurement Guidance)

1. Set resolution bandwidth (RBW) = 100kHz.
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission. Compare the resultant bandwidth with the RBW setting of the analyzer.

4.3. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	CA_DATE	CAIDUE
Attenuator 10dB	JFW	-	A7122166	10/18	10/19
Spectrum Analyzer 9kHz - 6GHz	ROHDE & SCHWARZ	FSL6	A2642049	12/18	12/19
Cable	-	-	A5329603	12/18	12/19

4.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None

Divergence:



L C I E

4.5. TEST SEQUENCE AND RESULTS

Channel	Channel Frequency (MHz)	6dB Bandwidth (MHz)	Bandwidth Limit (MHz)
Cmin	2405	1.657	>0.5
Cmid	2440	1.577	>0.5
Cmax	2475	1.637	>0.5

Offs 10.6 dB * RBW 100 kHz
* Att 20 dB * VBW 300 kHz
Batt Ref 20.6 dBm SWT 2.5ms

1Pk View

CF 2.405 GHz Span 10.0 MHz

Offs 10.6 dB * RBW 100 kHz
* Att 20 dB * VBW 300 kHz
Batt Ref 20.6 dBm SWT 2.5ms

1Pk View

CF 2.44 GHz Span 10.0 MHz

Offs 10.6 dB * RBW 100 kHz
* Att 20 dB * VBW 300 kHz
Batt Ref 20.6 dBm SWT 2.5ms

1Pk View

CF 2.475 GHz Span 10.0 MHz



4.6. CONCLUSION

Bandwidth measurement performed on the sample of the product PAL2A, SN: CPAL2210568451003ED2n, in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-247 limits.



5. MAXIMUM PEAK OUTPUT POWER (15.247)

5.1. TEST CONDITIONS

Date of test : January 28, 2019
Test performed by : Jonathan PAUC
Atmospheric pressure (hPa) : 990
Relative humidity (%) : 31
Ambient temperature (°C) : 22

5.2. SETUP

Conducted measurement:

The EUT is turned ON and connected to measurement instrument; the center frequency of the spectrum analyzer is set to the fundamental frequency.

Offset: Attenuator+cable 10.3dB

Radiated measurement:

The EUT is placed in an anechoic chamber; the center frequency of the spectrum analyzer is set to the fundamental frequency.

The product has been tested at a distance of 3 meters from the antenna. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurement performed on 3 axis of EUT. A summary of the worst case emissions found in all test configurations and modes is shown on following table. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.

To demonstrate compliance with peak output power requirement of section 15.247 (b), the transmitter's peak output power is calculated using the following equation:

$$E = \frac{\sqrt{30PG}}{d}$$

Where:

- E is the measured maximum fundamental field strength in V/m.
- G is the numeric gain of the transmitting antenna with reference to an isotropic radiator.
- d is the distance in meters from which the field strength was measured.
- P is the power in watts for which you are solving:

$$P = \frac{(Ed)^2}{30G}$$



Maximum peak conducted output power

One of the following procedures may be used to determine the maximum peak conducted output power of a DTS EUT.

- **RBW ≥ DTS bandwidth §9.1.1 (DTS Measurement Guidance)**

This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

- Set the RBW \geq DTS bandwidth.
- Set VBW $\geq 3 \times$ RBW.
- Set span $\geq 3 \times$ RBW
- Sweep time = auto couple.
- Detector = peak.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use peak marker function to determine the peak amplitude level.

- **Integrated band power method**

This procedure may be used when the maximum available RBW of the measurement instrument is less than the DTS bandwidth.

- Set the RBW = 1 MHz.
- Set the VBW $\geq 3 \times$ RBW
- Set the span $\geq 1.5 \times$ DTS bandwidth.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the instrument's band/channel power measurement function with the band limits set equal to the DTS bandwidth edges

5.3. TEST EQUIPMENT LIST

ANECHOIC CHAMBER					
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal Date	Cal Due
Attenuator 10dB	AEROFLEX	-	A7122268	06/17	06/19
Cable SMA 60cm	STORMFLEX	6GHz	A5329681	02/19	02/20
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060051	03/18	03/20

5.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None

Divergence:

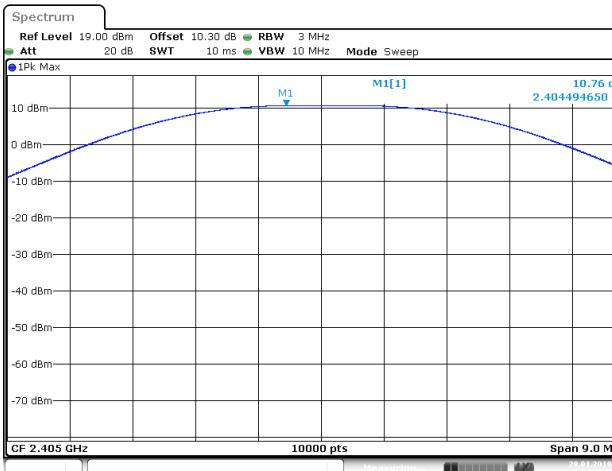


L C I E

5.5. TEST SEQUENCE AND RESULTS

Modulation:

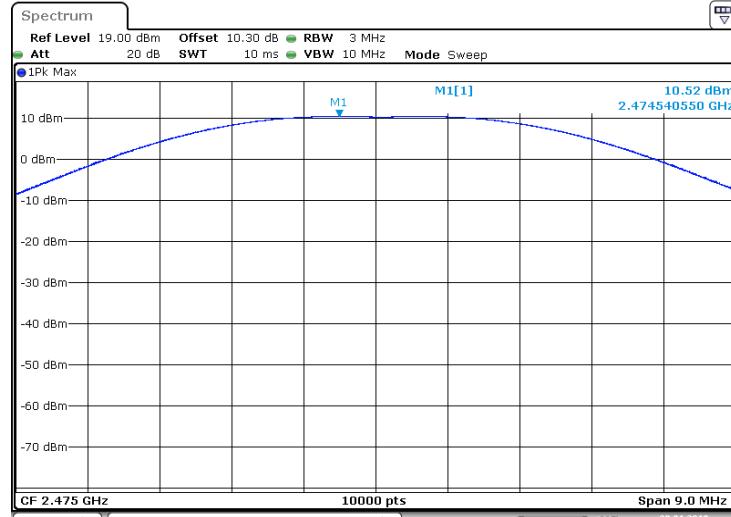
Channel	Channel Frequency (MHz)	Peak Output Power (dBm)	Power Limit (dBm)	FC (dB)
Cmin	2405	10.8	30.0	10.3
Cmid	2440	10.7	30.0	10.3
Cmax	2475	10.5	30.0	10.3



Date: 28 JAN 2019 17:14:48



Date: 28 JAN 2019 17:16:16



Date: 28 JAN 2019 17:13:00

5.6. CONCLUSION

Maximum Peak Output Power measurement performed on the sample of the product PAL2A, SN: CPAL2210568451003ED2n, in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-247 limits.



6. POWER SPECTRAL DENSITY (15.247)

6.1. TEST CONDITIONS

Date of test : Jonathan PAUC
Test performed by : June 3rd, 2019
Atmospheric pressure (hPa) : 1003
Relative humidity (%) : 40
Ambient temperature (°C) : 24

6.2. SETUP

Conducted measurement:

The EUT is turned ON and connected to measurement instrument; the center frequency of the spectrum analyzer is set to the fundamental frequency.

Offset: Attenuator+cable 10.6dB

Radiated measurement:

The EUT is placed in an anechoic chamber; the center frequency of the spectrum analyzer is set to the fundamental frequency.

The product has been tested at a distance of 3 meters from the antenna. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurement performed on 3 axis of EUT. A summary of the worst case emissions found in all test configurations and modes is shown on following table. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.

To demonstrate compliance with peak output power requirement of section 15.247 (b), the transmitter's peak output power is calculated using the following equation:

$$E = \frac{\sqrt{30PG}}{d}$$

Where:

- E is the measured maximum fundamental field strength in V/m.
- G is the numeric gain of the transmitting antenna with reference to an isotropic radiator.
- d is the distance in meters from which the field strength was measured.
- P is the power in watts for which you are solving:

$$P = \frac{(Ed)^2}{30G}$$

Measurement Procedure PKPSD: §10.2 (DTS Measurement Guidance)

- a) Set analyzer center frequency to DTS channel center frequency.
- b) Set the span to 1.5 times the DTS bandwidth.
- c) Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- d) Set the VBW $\geq 3 \text{ } \square \text{ RBW}$.
- e) Detector = peak.
- f) Sweep time = auto couple.
- g) Trace mode = max hold.
- h) Allow trace to fully stabilize.
- i) Use the peak marker function to determine the maximum amplitude level within the RBW.
- j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.



6.3. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	CA_DATE	CAIDUE
Attenuator 10dB	JFW	-	A7122166	10/14	10/15
Spectrum Analyzer 9kHz - 6GHz	ROHDE & SCHWARZ	FSL6	A2642049	12/14	12/15
Cable	-	-	A5329603	12/14	12/15

6.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None Divergence:

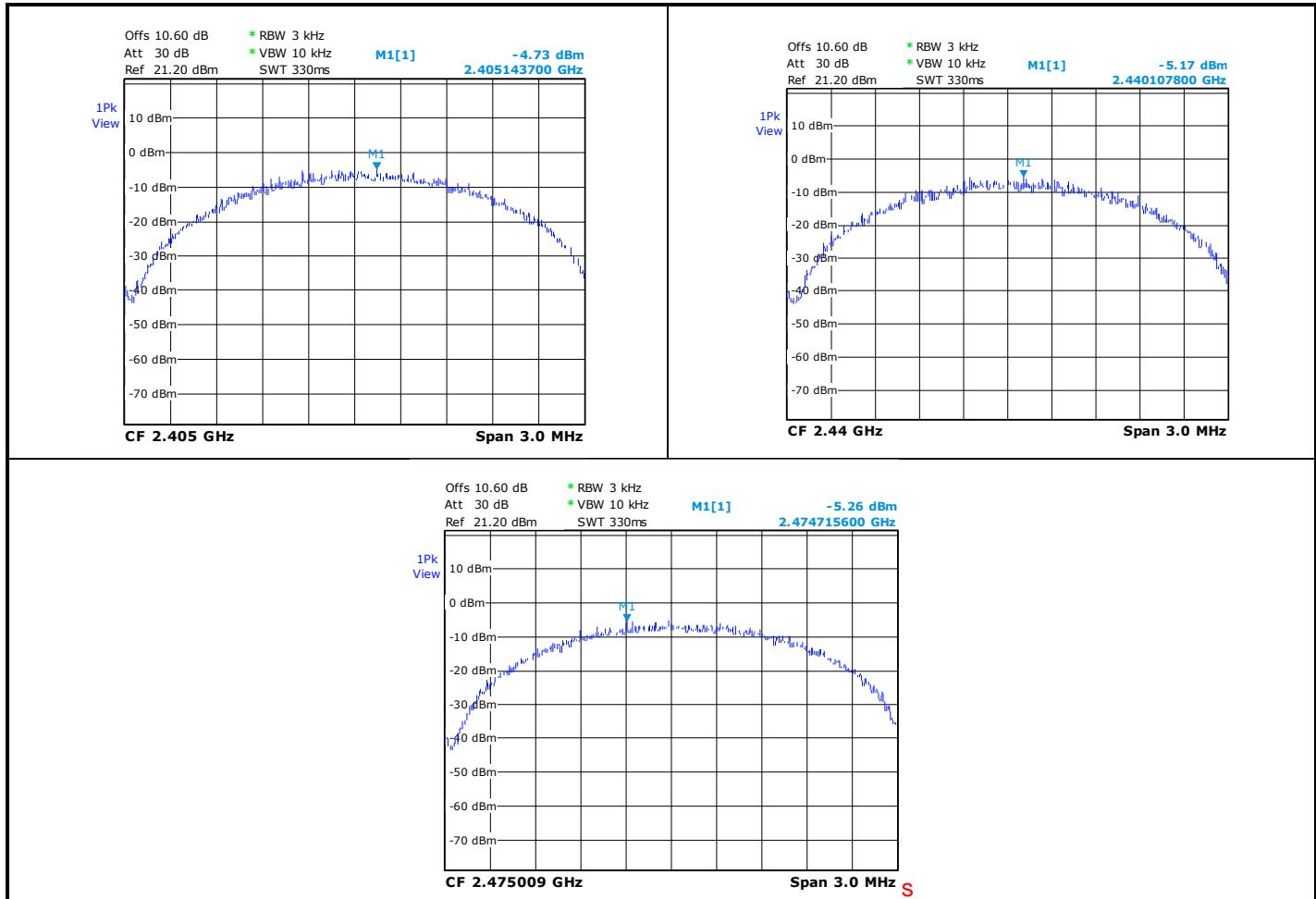
6.5. TEST SEQUENCE AND RESULTS

Modulation:

Channel	Channel Frequency (MHz)	Power Spectral Density (dBm)	PSD Limit (dBm)
Cmin	2405	-4.7	8.0
Cmid	2440	-5.2	8.0
Cmax	2475	-5.3	8.0



L C I E



6.6. CONCLUSION

Power Spectral Density measurement performed the sample of the product PAL2A, SN: CPAL2210568451003ED2n, in configuration and description presented in this test report, show levels below the FCC CFR 47 Part 15 and RSS-247 limits.



7. BAND EDGE MEASUREMENT (15.247)

7.1. TEST CONDITIONS

Date of test : January 28, 2019
Test performed by : Jonathan PAUC
Atmospheric pressure (hPa) : 990
Relative humidity (%) : 31
Ambient temperature (°C) : 22

7.2. LIMIT

RF antenna conducted test: § 11 (DTS Measurement Guidance)

Set RBW = 100 kHz, Video bandwidth (VBW) > RBW, scan up through 10th harmonic. All harmonics/spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW. Note: If the device complies with the use of power option 2 the attenuation under this paragraph shall be 30 dB instead of 20 dB. *For -20dBc limit, lowest power output level is considered, worst case.*

Radiated emission test: § 12 (DTS Measurement Guidance)

Applies to harmonics/spurs that fall in the restricted bands listed in Section 15.205. The maximum permitted average field strength is listed in Section 15.209. For measurements above 1 GHz, set RBW = 1MHz, VBW = 10 Hz, Sweep: Auto. If the emission is pulsed, modify the unit for continuous operation; use the settings shown above, then correct the reading by subtracting the peak-average correction factor, derived from the appropriate duty cycle calculation. See results in Radiated emissions section before.

7.3. SETUP

The EUT is placed in an anechoic chamber; levels have been corrected to be in compliant with Peak Output Power measurement. The EUT is turn ON; the graphs of the restrict frequency band are recorded with a display line indicating the highest level and other the 20dB offset below to show compliance with 15.247 (d) and 15.205. The emissions in restricted bands are compared to 15.209 limits.

RBW: 100kHz

VBW: 300kHz

7.4. TEST EQUIPMENT LIST

ANECHOIC CHAMBER					
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal Date	Cal Due
Attenuator 10dB	AEROFLEX	-	A7122268	06/17	06/19
Cable SMA 60cm	STORMFLEX	6GHz	A5329681	02/19	02/20
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060051	03/18	03/20

7.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

None

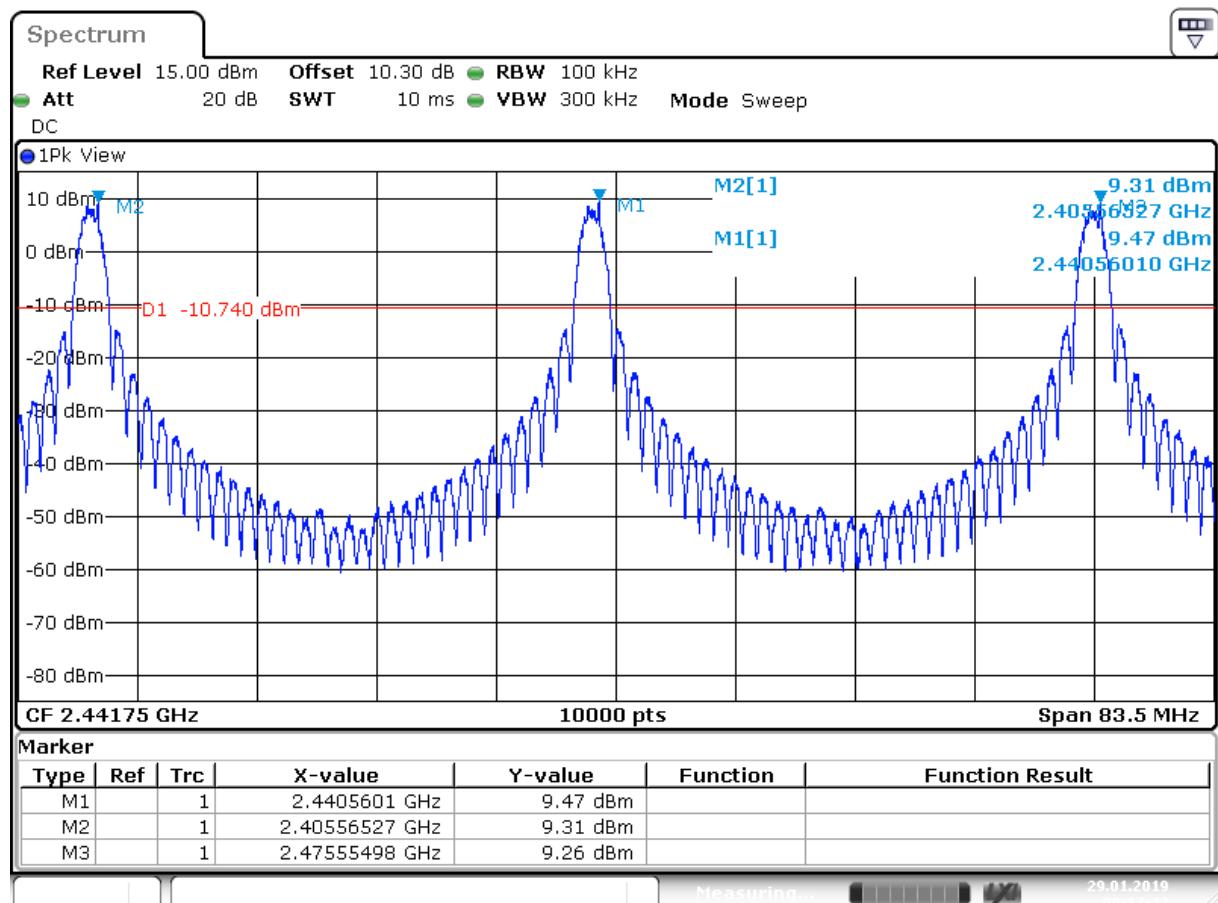
Divergence:



L C I E

7.6. TEST SEQUENCE AND RESULTS

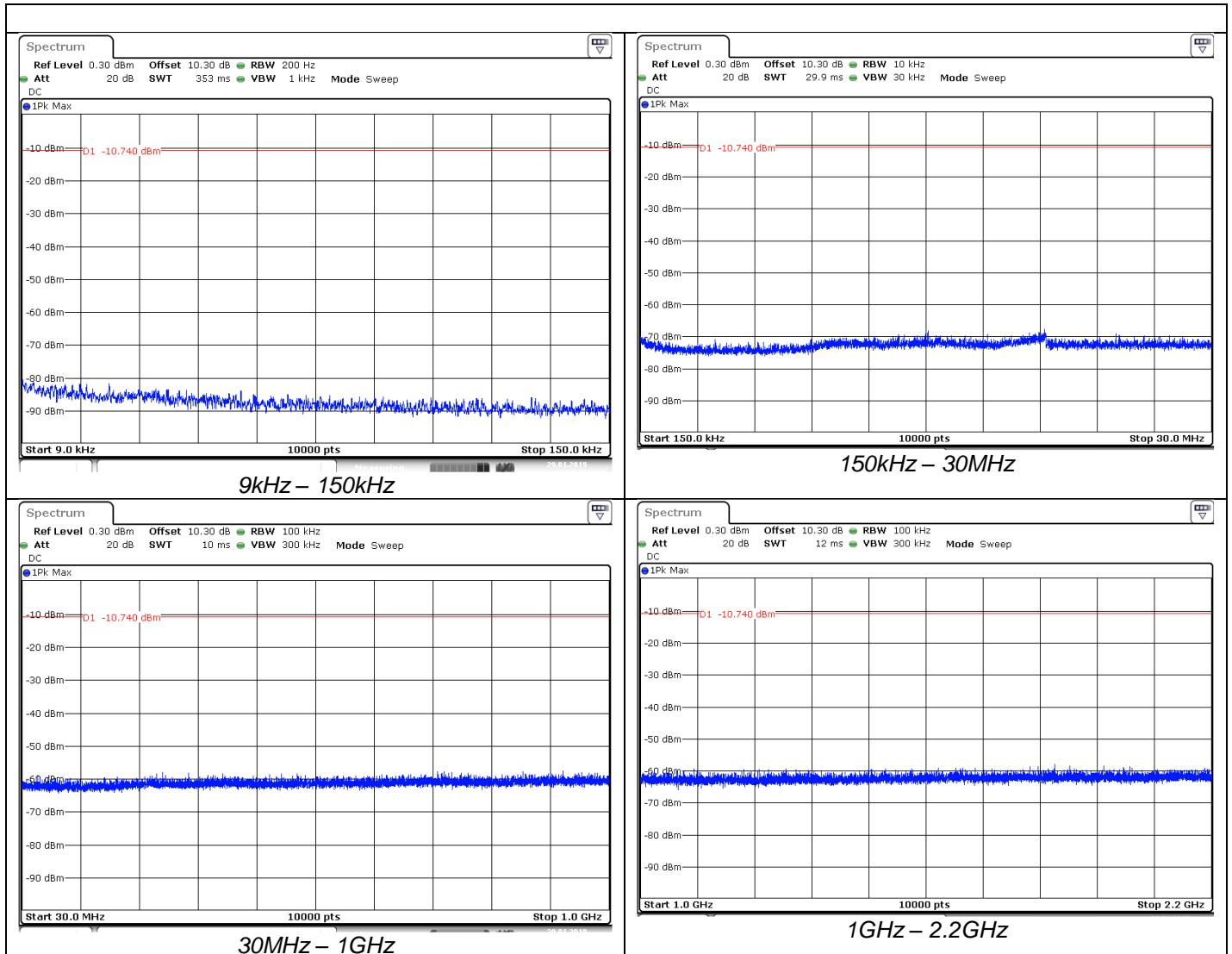
Offset: Attenuator+cable 10.3dB



Date: 29 JAN 2019 09:17:42

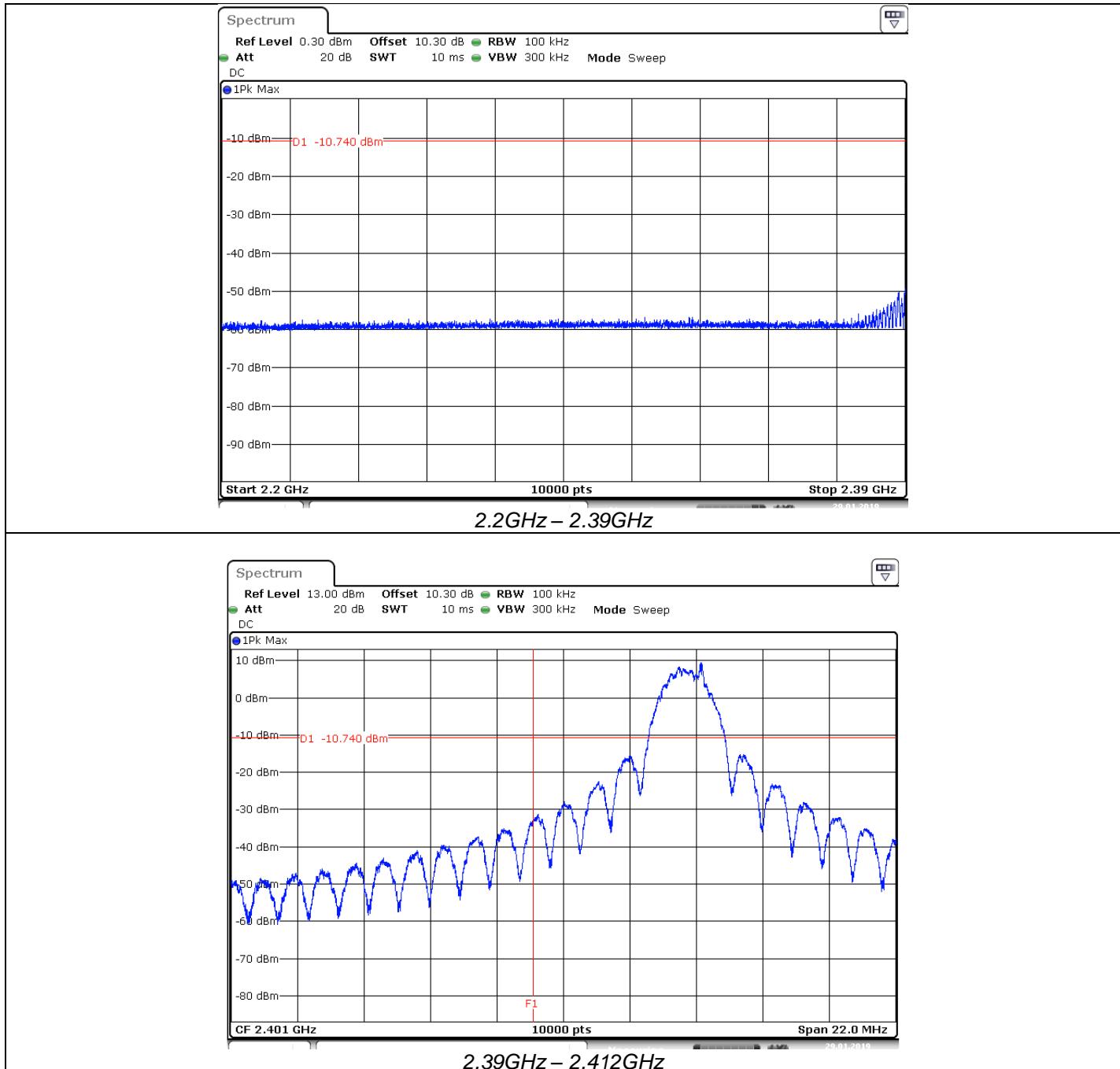


L C I E



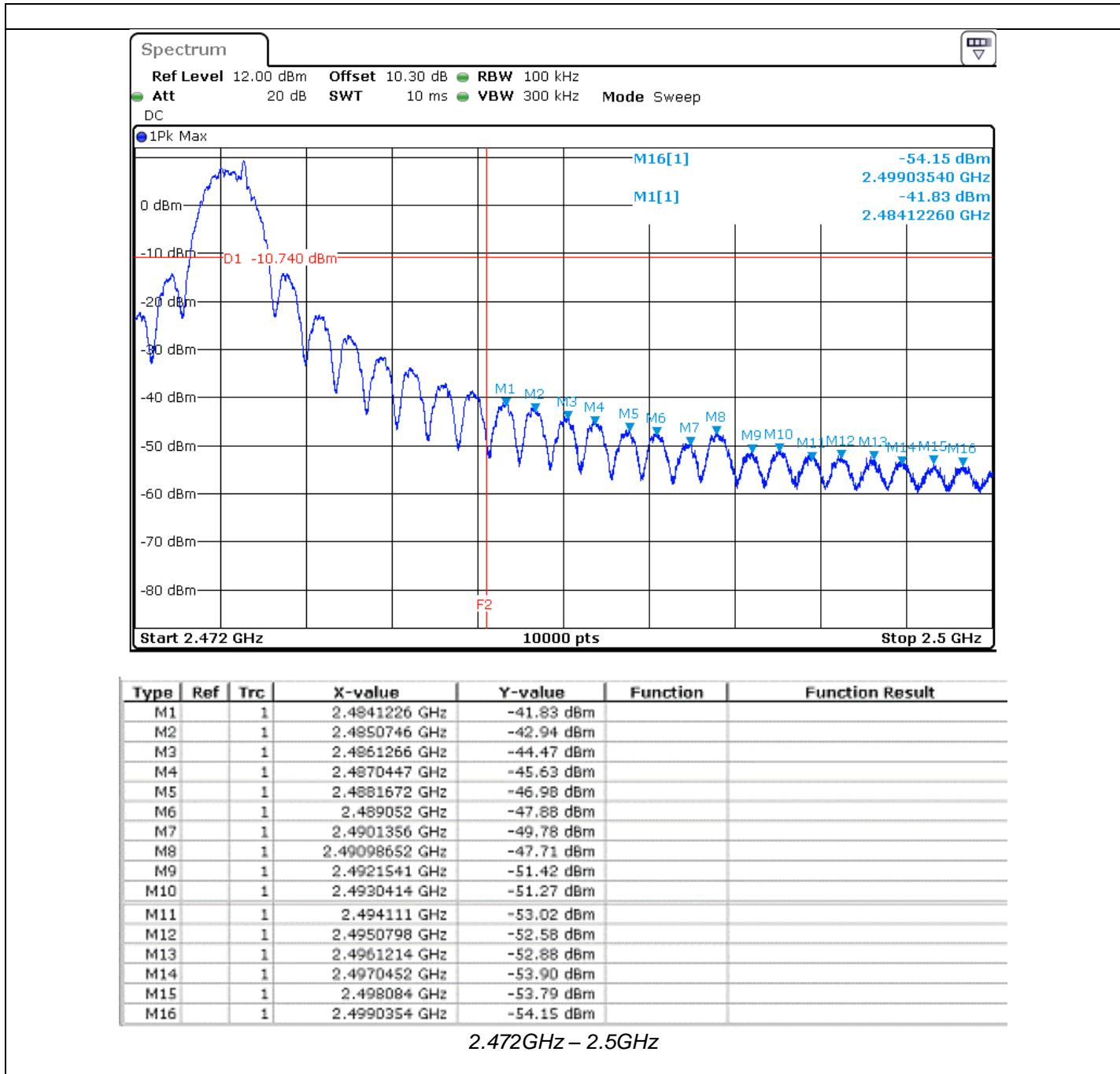


L C I E



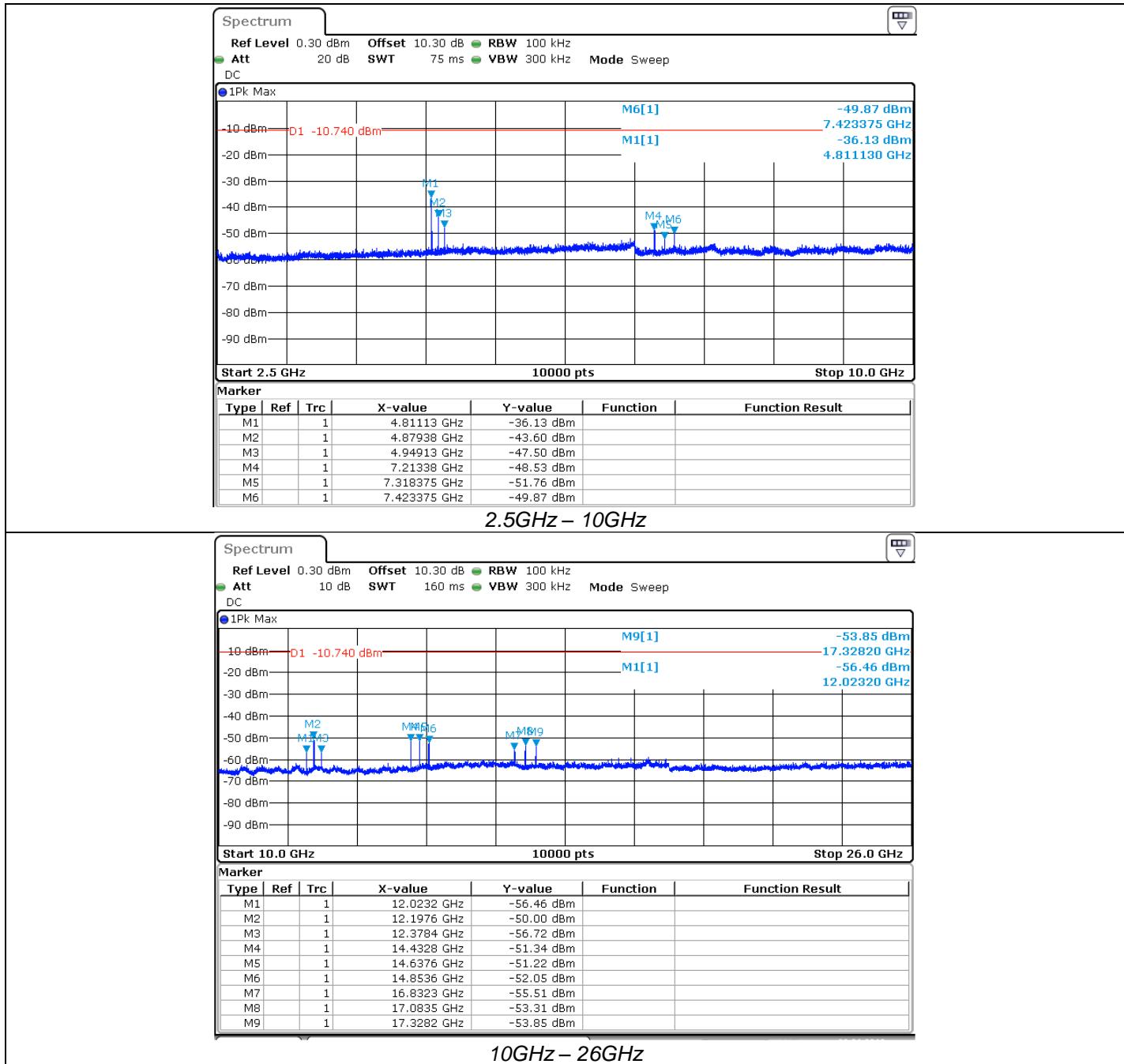


L C I E





L C I E



7.7. CONCLUSION

Band Edge Measurement performed on the sample of the product PAL2A, SN: CPAL2210568451003ED2n, in configuration and description presented in this test report, show levels *below* the FCC CFR 47 Part 15 and RSS-247 limits.



8. UNCERTAINTIES CHART

Type de mesure / Kind of measurement	Incertitude élargie laboratoire / Wide uncertainty laboratory (k=2) ± x	Incertitude limite du CISPR / CISPR uncertainty limit ± y
Mesure des perturbations conduites en tension sur le réseau d'énergie <i>Measurement of conducted disturbances in voltage on the power port</i>	3.51 dB	3.6 dB
Mesure des perturbations conduites en tension sur le réseau de télécommunication <i>Measurement of conducted disturbances in voltage on the telecommunication port.</i>	3.26 dB	A l'étude / Under consid.
Mesure des perturbations discontinues conduites en tension <i>Measurement of discontinuous conducted disturbances in voltage</i>	3.45 dB	3.6 dB
Mesure des perturbations conduites en courant <i>Measurement of conducted disturbances in current</i>	3.09 dB	A l'étude / Under consid.
Mesure du champ électrique rayonné sur le site en espace libre de Moirans <i>Measurement of radiated electric field on the Moirans open area test site</i>	5.20 dB	6.3 dB

Les valeurs d'incertitudes calculées du laboratoire étant inférieures aux valeurs d'incertitudes limites établies par la norme, la conformité de l'échantillon est établie directement par les niveaux limites applicables. / The uncertainty values calculated by the laboratory are lower than limit uncertainty values defined by the standard. The conformity of the sample is directly established by the applicable limits values.