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**FCC PART 80, 90 AND IC RSS-238
TEST REPORT
For
KODEN ELECTRONICS CO., LTD.**

APPLICANT	KODEN ELECTRONICS CO., LTD.
	5278 UENOHARA UENOHARA-SHI
	YAMANASHI, JAPAN 409-0112
FCC ID	O5VRB809P
IC	8477A-RB809P
MODEL NUMBER	RB809P, RB809
PRODUCT DESCRIPTION	X BAND MARINE RADAR
DATE SAMPLE RECEIVED	6/30/2016
DATE TESTED	07/25/2016 – 09/28/2016
TESTED BY	Christian Pawlak
APPROVED BY	Sid Sanders
TEST RESULTS	☒ PASS ☐ FAIL

Report Number	Version Number	Description	Issue Date
1245AZUT16TestReport_	Rev.1	Initial Issue	10/14/2016
1245AZUT16TestReport_	Rev.2	Updated freq range and added antenna information (Pg 7)	01/26/2017

**THE ATTACHED REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL
WITHOUT THE WRITTEN APPROVAL OF TIMCO ENGINEERING, INC.**

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GENERAL REMARKS

The attached report shall not be reproduced except in full without the written permission of Timco Engineering Inc.

Summary

The device under test does:

- ☒ Fulfill the general approval requirements as identified in this test report and was selected by the customer.
- ☐ Not fulfill the general approval requirements as identified in this test report

Attestations

This equipment has been tested in accordance with the standards identified in this test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report.

All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025 requirements.

I attest that the necessary measurements were made at:

Timco Engineering Inc.
849 NW State Road 45
Newberry, FL 32669



Tested by: _____

Christian Pawlak, Project Manager/Testing Technician

Date: 09/28/2016

Reviewed and approved by: _____

Name and Title: Sid Sanders, Engineer



Date: 9/28/2016

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EUT SPECIFICATION

EUT Description	X BAND MARINE RADAR
FCC ID	O5VRB809P
IC Certification	8477A-RB809P
Model Number	RB809P, RB809
Serial Number	N/A
Operating Frequency	9380 to 9440 MHz
Type of Emission	Pulse
Modulation	PON
EUT Power Source	☒ 110–120Vac/50– 60Hz Shipboard Only
	☐ DC Power ()
	☐ Battery Operated Exclusively
Test Item	☐ Prototype
	☐ Pre-Production
	☒ Production
Type of Equipment	☐ Fixed
	☒ Mobile
	☐ Portable
Antenna Gain	30 dBi

TEST SETUP INFORMATION

Test facility	Timco Engineering, Inc. 849 NW State Road 45, Newberry, FL 32669
Test Condition	Temperature: 26°C Relative humidity: 50%. Barometer: 1012.5mb
Modifications	None
Test Exercise	The EUT was placed in continuous transmit mode of operation
Applicable Standards	ANSI/TIA 603-D: 2010, FCC CFR 47, Part 80, IC RSS-238 Issue 1_July 2013, IC RSS-GEN_June2014

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TEST RESULTS SUMMARY

Test	Regulatory Body	Rule	Result
RF Power Output	FCC	Part 80.215(a)(3)	Pass
		Part 90.205(r)	Pass
	IC	RSS-238 Section 4.2	Pass
Modulation Characteristics	FCC	Part 90.207	Report Only
	IC	RSS 238 3.2(a)	Report Only
Occupied Bandwidth	FCC	Part 80.205(a)	Pass
		Part 90.209, Part 90.210(b)	Pass
	IC	RSS 238 3.2(c)	Report Only
Spurious Emissions at Antenna Terminals	FCC	Part 80.211(f)	Pass
		Part 90.210, Part 90.215	Pass
	IC	RSS 238 4.3	Pass
Field Strength of Spurious Emissions	FCC	Part 80.211(f)	Pass
		Part 90.210, Part 90.215	Pass
	IC	RSS 238 4.3	Pass
Frequency Stability	FCC	Part 80.209(b)	Pass
		Part 90.213	Pass
	IC	RSS-238 4.1	Pass

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ANTENNA INFORMATION

Rule Part No.: RSS-238 Section 3.2

TYPE: RW701A-04	
Antenna length Size	4.09 feet
Antenna Gain	27 dBi
Beamwidth_horizontal	1.8 deg.
Beamwidth_vertical	22 deg.
Side-lobe suppression	Within +/- 10 degree not to exceed -25dB Without +/- 10 degree not to exceed -30dB
Back-lobe suppression	Within +/- 10 degree not to exceed -25dB Without +/- 10 degree not to exceed -30dB
Polarization	Horizontal polarization

TYPE: RW701A-06	
Antenna length Size	6.14 feet
Antenna Gain	28.5 dBi
Beamwidth_horizontal	1.2 deg.
Beamwidth_vertical	22 deg.
Side-lobe suppression	Within +/- 10 degree not to exceed -25dB Without +/- 10 degree not to exceed -30dB
Back-lobe suppression	Within +/- 10 degree not to exceed -25dB Without +/- 10 degree not to exceed -30dB
Polarization	Horizontal polarization

TYPE: RW701B-09	
Antenna length Size	8.63 feet
Antenna Gain	30 dBi
Beamwidth_horizontal	0.8 deg.
Beamwidth_vertical	25 deg.
Side-lobe suppression	Within +/- 10 degree not to exceed -25dB Without +/- 10 degree not to exceed -30dB
Back-lobe suppression	Within +/- 10 degree not to exceed -25dB Without +/- 10 degree not to exceed -30dB
Polarization	Horizontal polarization

Applicant: KODEN ELECTRONICS CO., LTD.

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RF POWER OUTPUT

Rule Part No.: Part 2.1046(a), Part 80.215(a)(3), Part 90.205(r), RSS-238 Section 4.2

Requirements:

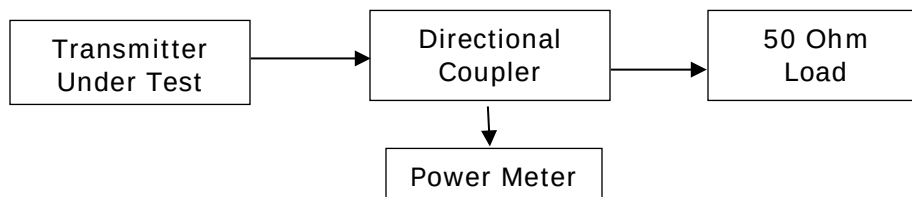
Part 90.205(r) – Power will be authorized on a case-by-case basis.

RSS-238 Section 4.2 – The output power shall not exceed 60 kW and the antenna gain shall not exceed 35 dBi.

Method of Measurement: RF power is measured by connecting a 50-ohm, Peak Power meter to the RF output connector.

Test Setup Diagram:

b) Method of Measurement



Test Data:

OUTPUT POWER:

Pulse Type	Peak Power (dBm)	Peak Power (Watts)	Duty Cycle (%)	Average Power (Watts)
S1	70.801	12025.41	0.029%	3.51
S2	72.441	17542.84	0.042%	7.32
M1	72.842	19239.78	0.076%	14.69
M3	73.278	21271.59	0.084%	17.79
L1	73.533	22557.97	0.081%	18.29
L2	73.945	24802.76	0.072%	17.83

Results Meet Requirements

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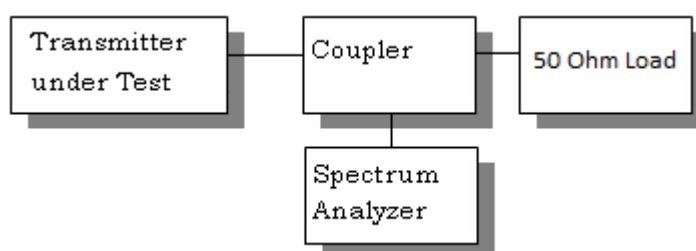
MODULATION CHARACTERISTICS

Rule Part No.: Part 90.207, RSS-238 Section 3.2(a)

Requirements: None

Method of Measurement: Modulation Characteristics are reported using a 50-ohm peak power sensor or spectrum analyzer in zero span mode. A directional coupler is used to sample output power.

Test Setup Diagram:



The device under test is capable of multiple pulse styles and durations.

Detailed specifications are contained in “product specifications” manual.

Plots of these pulse groups are shown below.

Pulse Type	Pulse Width (us)	Rise Time (us)	Period Min (us)	Period Max (us)	Period Avg (us)	Duty Cycle (%)
S1	0.112	0.007	371	397	384	0.029%
S2	0.160	0.007	370	397	383.5	0.042%
M1	0.313	0.008	397	423	410	0.076%
M3	0.582	0.011	663	729	696	0.084%
L1	0.788	0.012	925	1019	972	0.081%
L2	1.159	0.066	1550	1675	1612.5	0.072%

Results Meet Requirements

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Applicant: KODEN ELECTRONICS CO., LTD.

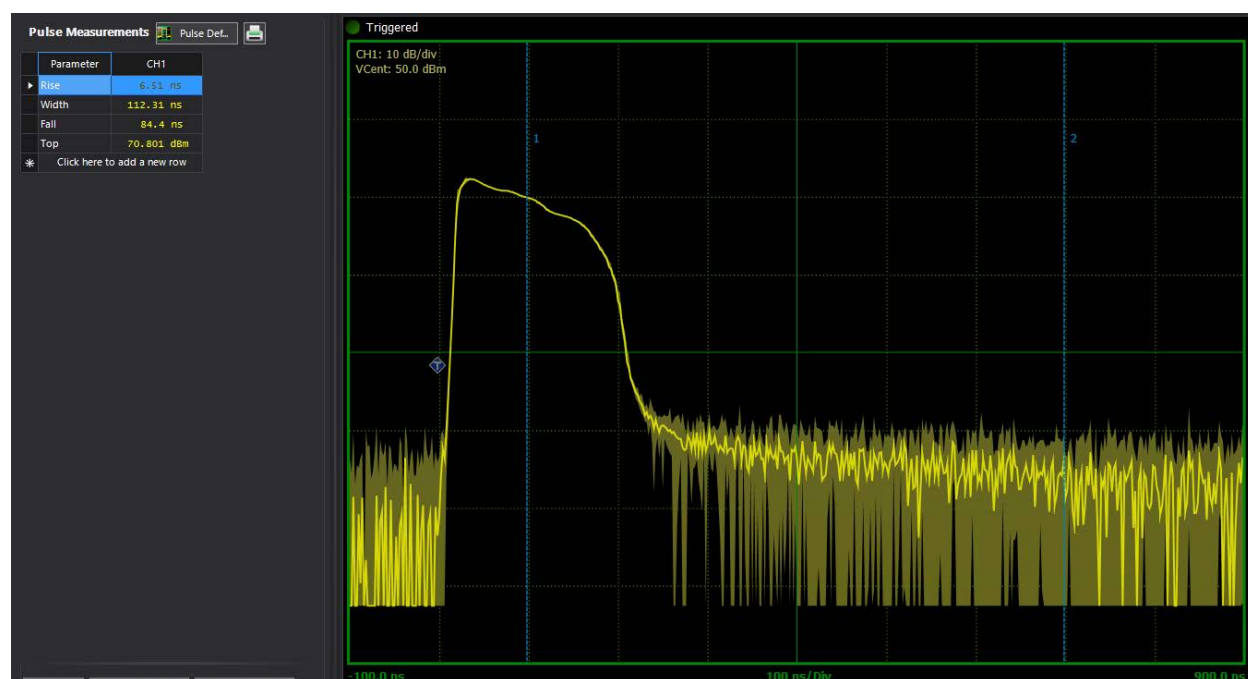
FCC ID: O5VRB809P

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MODULATION CHARACTERISTICS PLOTS

MODULATION CHARACTERISTICS – PULSE PROFILE – S1



Results Meet Requirements

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Applicant: KODEN ELECTRONICS CO., LTD.

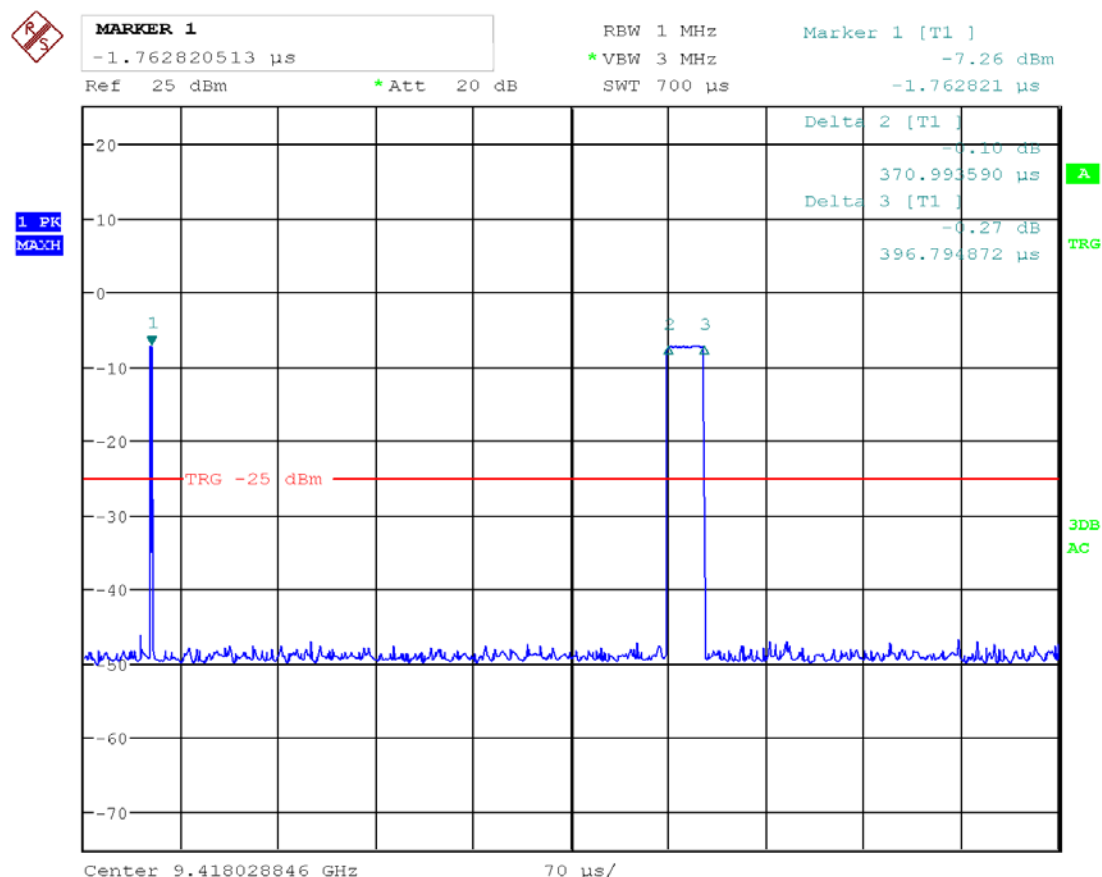
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MODULATION CHARACTERISTICS PLOTS

MODULATION CHARACTERISTICS - PULSE INTERVAL - S1



Date: 26.SEP.2016 14:09:17

Results Meet Requirements

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Applicant: KODEN ELECTRONICS CO., LTD.

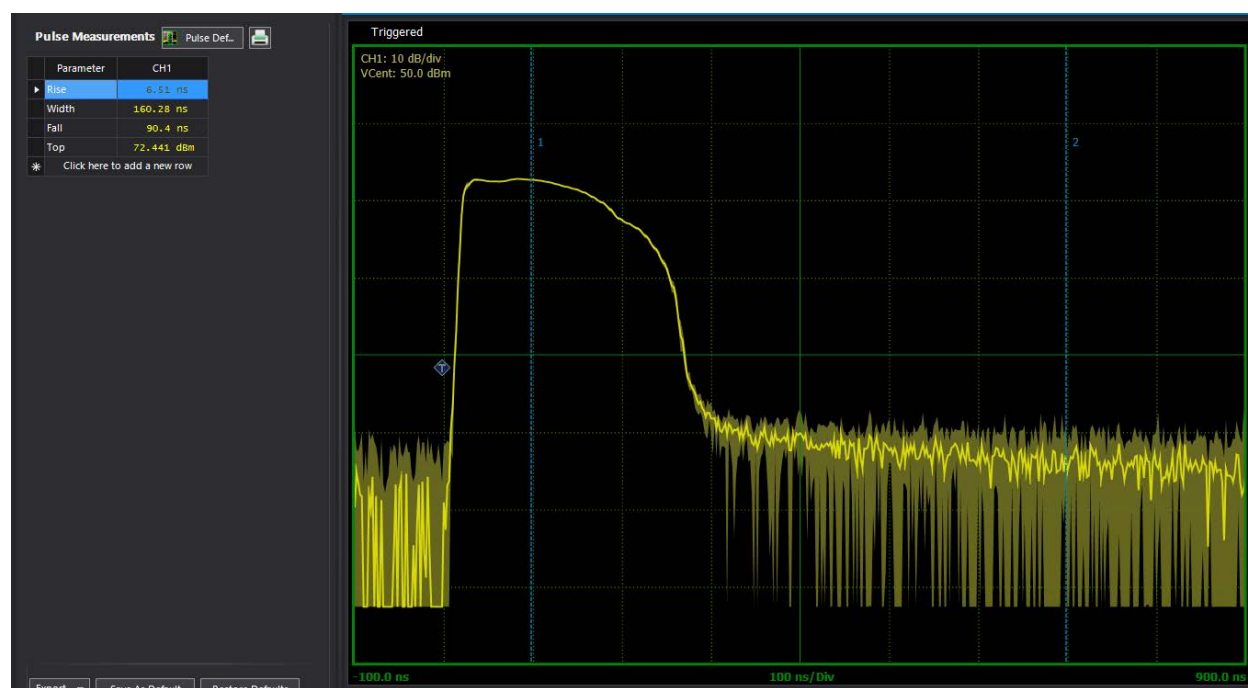
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IC: 8477A-RB809P

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MODULATION CHARACTERISTICS PLOTS

MODULATION CHARACTERISTICS – PULSE PROFILE – S2



Results Meet Requirements

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Applicant: KODEN ELECTRONICS CO., LTD.

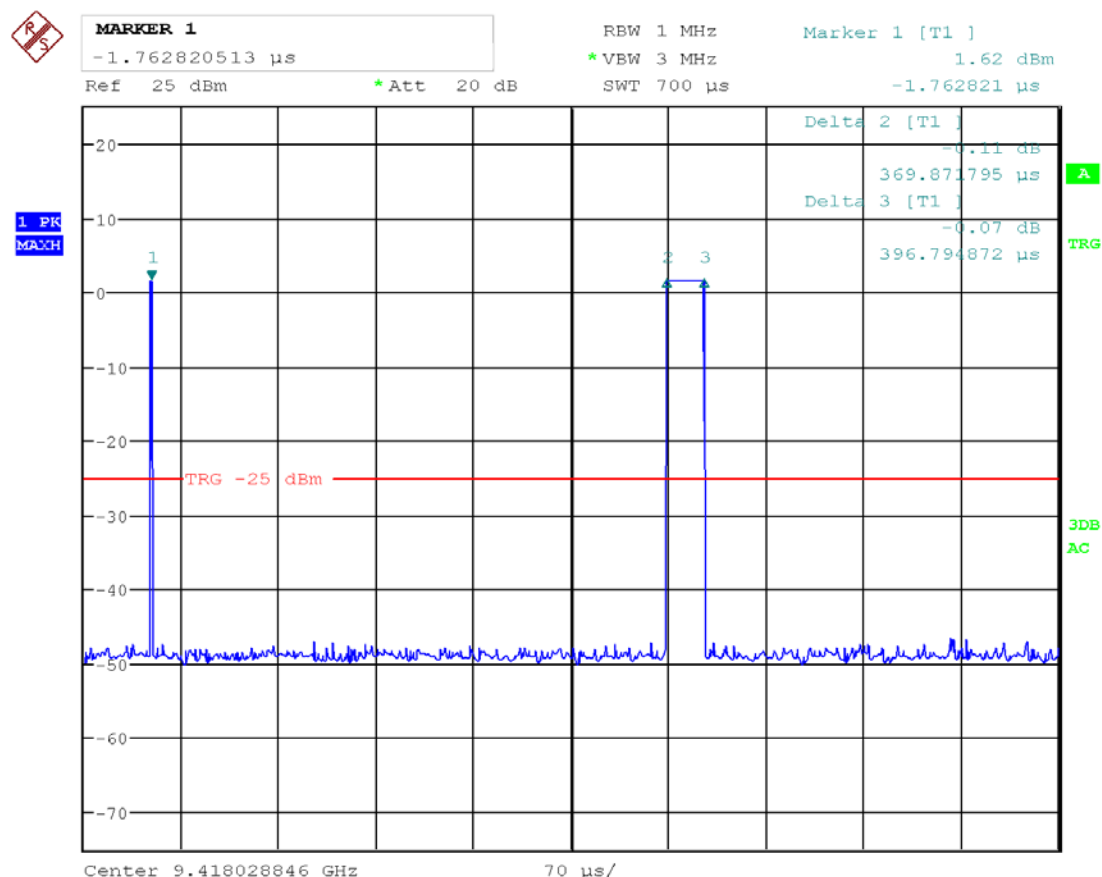
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IC: 8477A-RB809P

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MODULATION CHARACTERISTICS PLOTS

MODULATION CHARACTERISTICS - PULSE INTERVAL - S2



Date: 26.SEP.2016 14:08:32

Results Meet Requirements

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Applicant: KODEN ELECTRONICS CO., LTD.

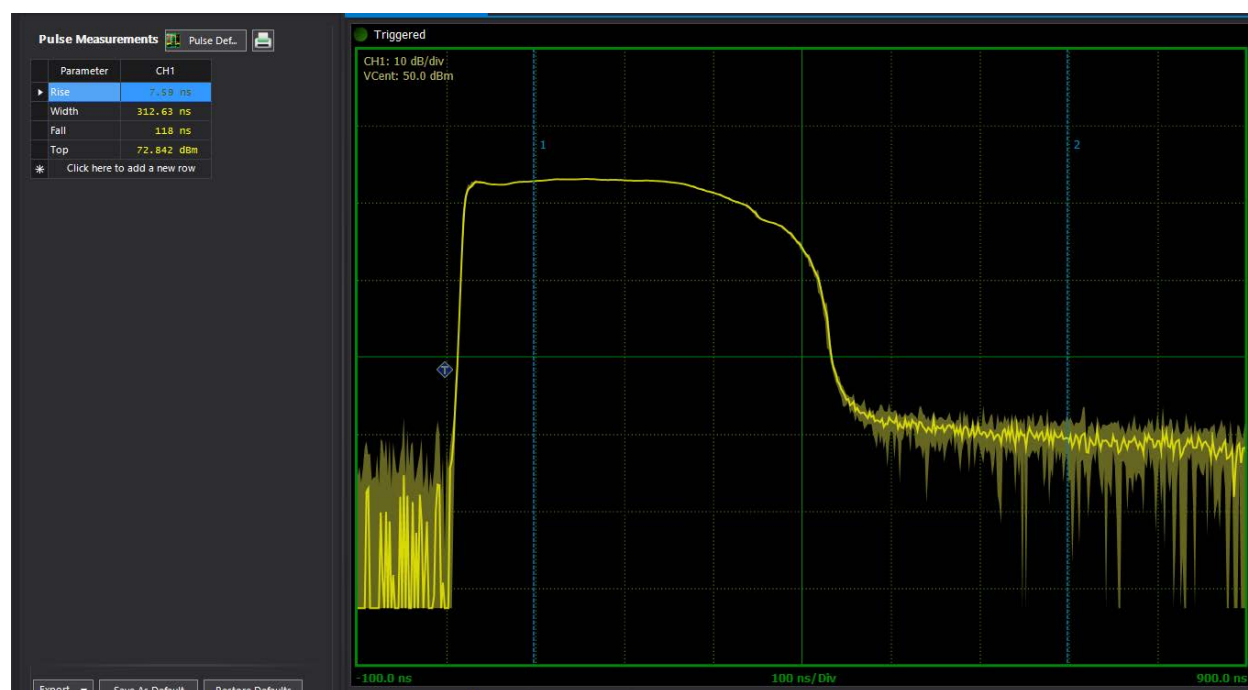
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IC: 8477A-RB809P

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MODULATION CHARACTERISTICS PLOTS

MODULATION CHARACTERISTICS – PULSE PROFILE – M1



Results Meet Requirements

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Applicant: KODEN ELECTRONICS CO., LTD.

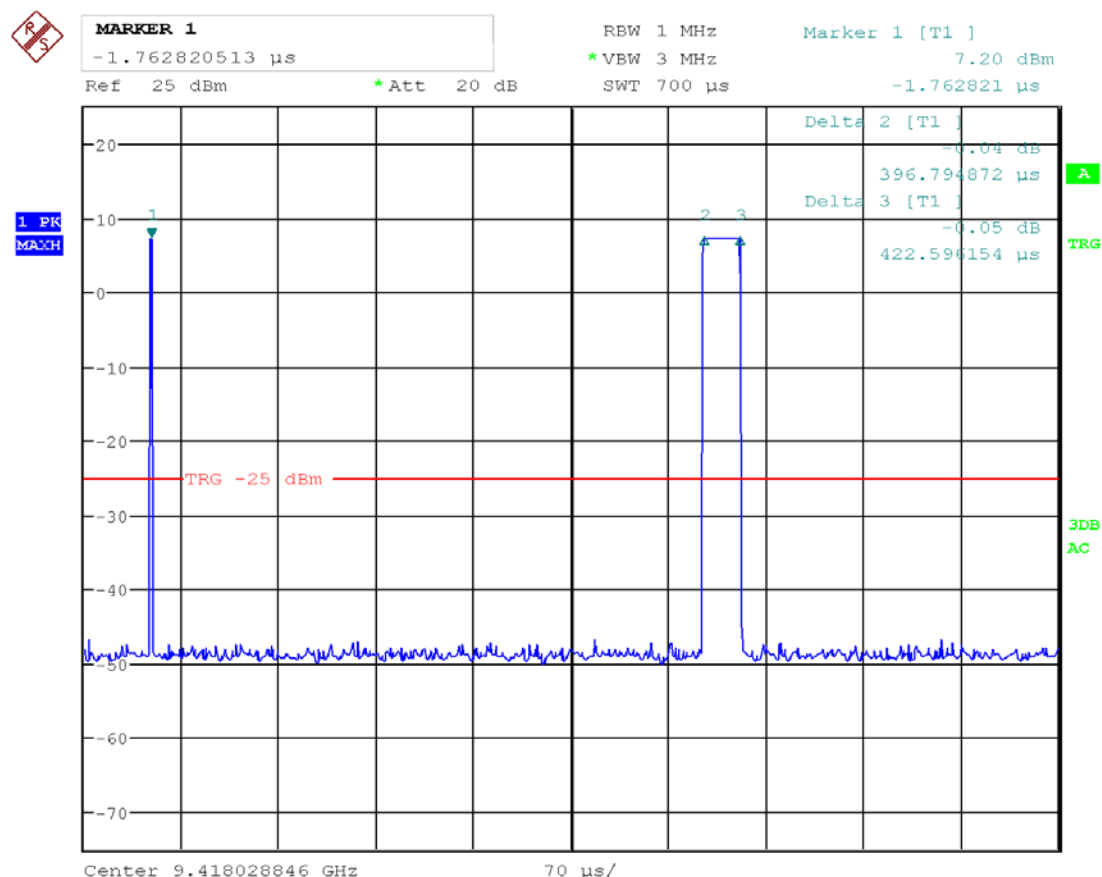
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IC: 8477A-RB809P

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MODULATION CHARACTERISTICS PLOTS

MODULATION CHARACTERISTICS - PULSE INTERVAL - M1



Date: 26.SEP.2016 14:07:47

Results Meet Requirements

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Applicant: KODEN ELECTRONICS CO., LTD.

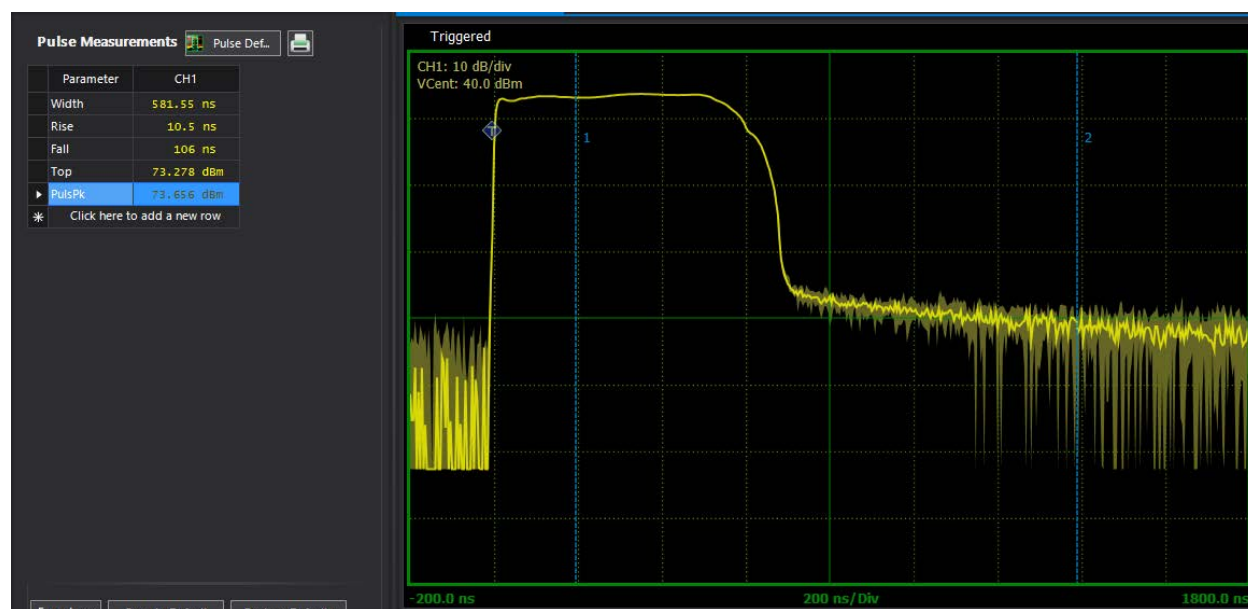
FCC ID: O5VRB809P

IC: 8477A-RB809P

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MODULATION CHARACTERISTICS PLOTS

MODULATION CHARACTERISTICS – PULSE PROFILE - M3



Results Meet Requirements

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Applicant: KODEN ELECTRONICS CO., LTD.

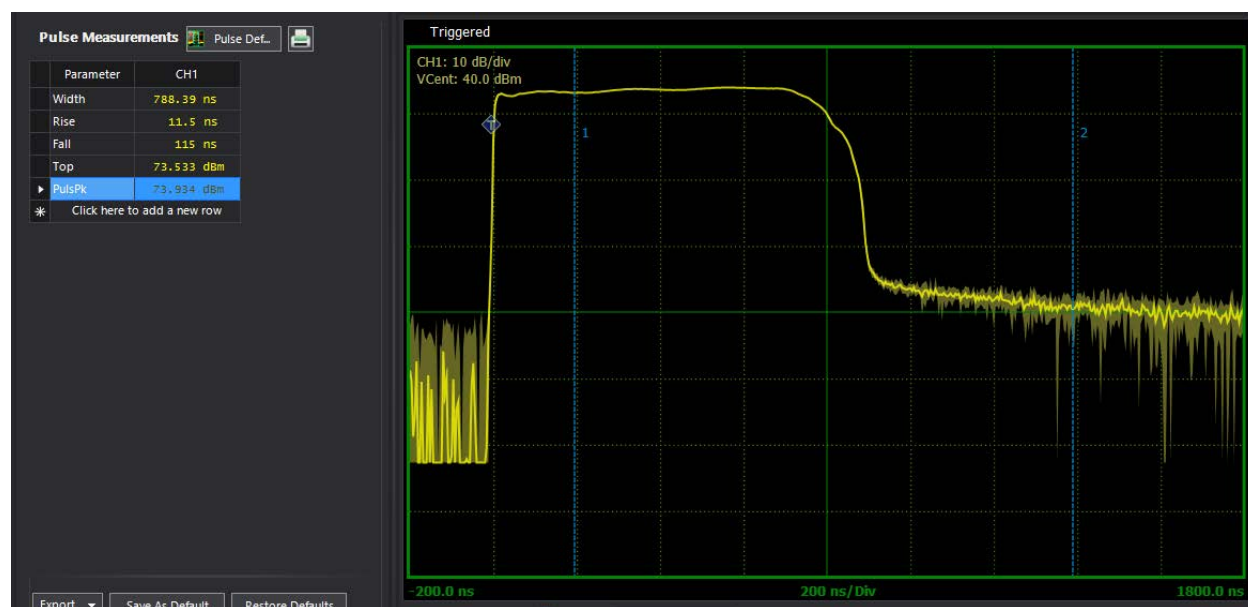
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IC: 8477A-RB809P

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MODULATION CHARACTERISTICS PLOTS

MODULATION CHARACTERISTICS – PULSE PROFILE – L1



Results Meet Requirements

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Applicant: KODEN ELECTRONICS CO., LTD.

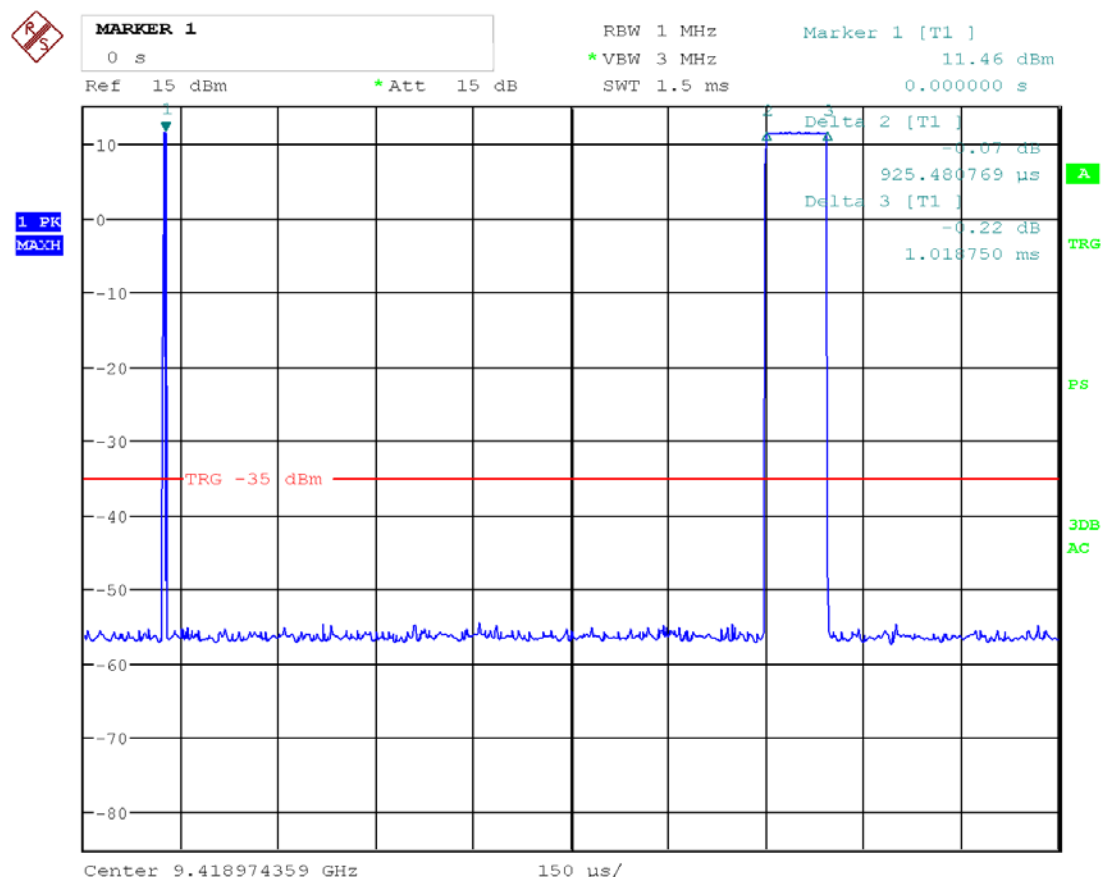
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IC: 8477A-RB809P

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MODULATION CHARACTERISTICS PLOTS

MODULATION CHARACTERISTICS – PULSE INTERVAL - L1



Date: 25.JUL.2016 15:15:59

Results Meet Requirements

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Applicant: KODEN ELECTRONICS CO., LTD.

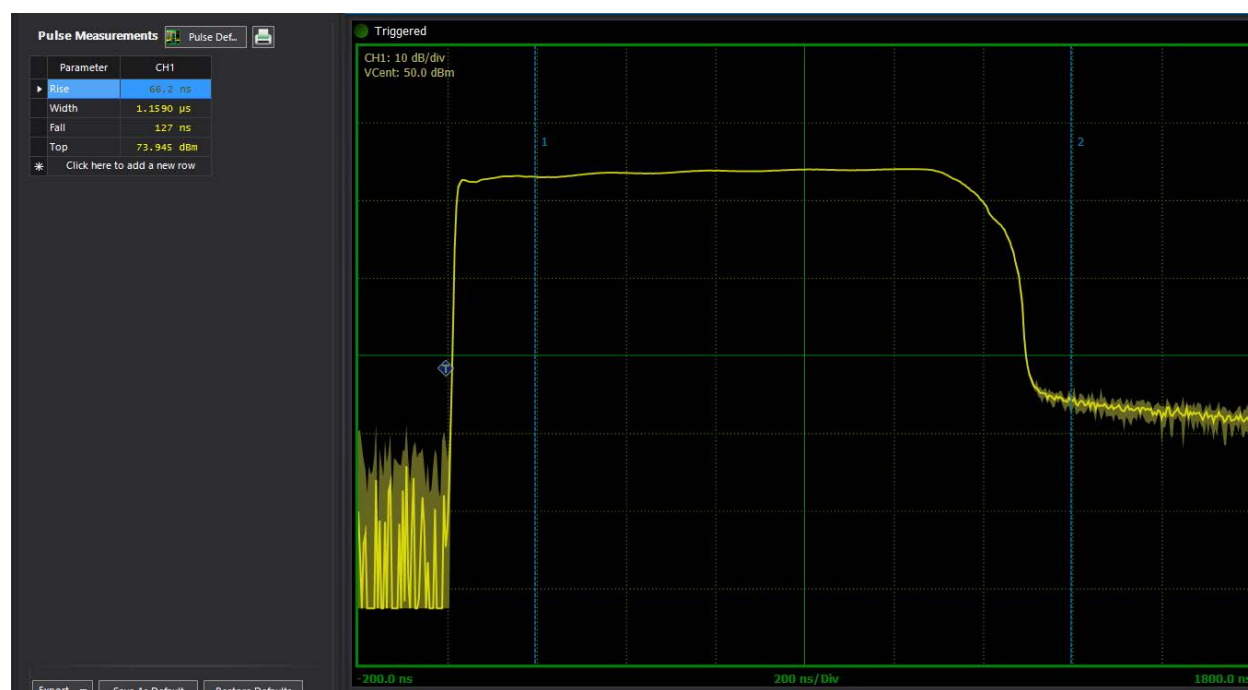
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MODULATION CHARACTERISTICS PLOTS

MODULATION CHARACTERISTICS – PULSE PROFILE – L2



Results Meet Requirements

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Applicant: KODEN ELECTRONICS CO., LTD.

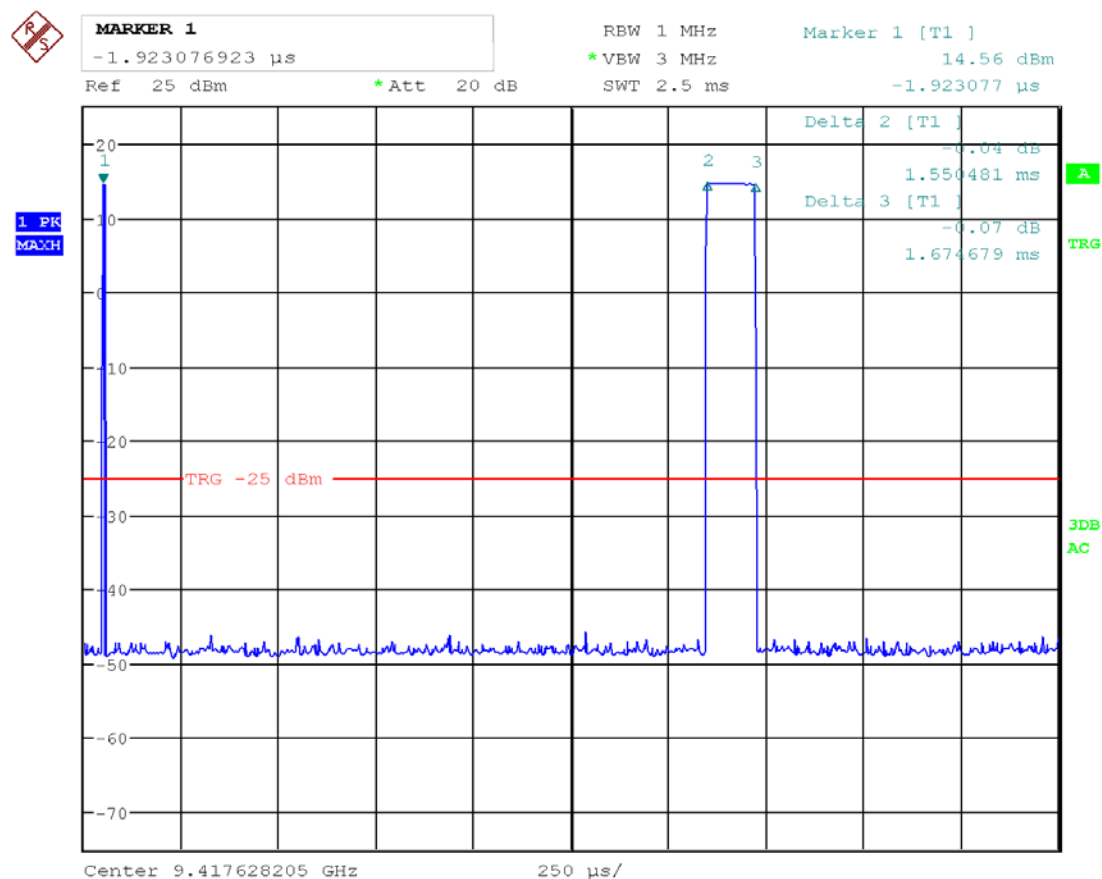
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IC: 8477A-RB809P

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MODULATION CHARACTERISTICS PLOTS

MODULATION CHARACTERISTICS - PULSE INTERVAL - L2



Date: 26.SEP.2016 14:04:39

Results Meet Requirements

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OCCUPIED BANDWIDTH

Rule Part No.: Part 90.209, Part 90.210(b), Part 80.205(a), RSS 238 3.2(c)

Requirements:

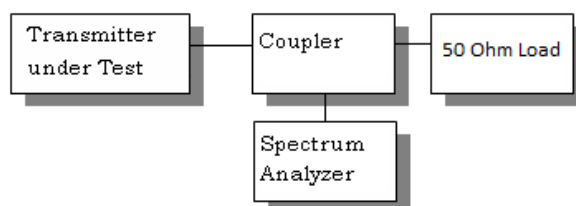
Part 80.205(a): Emissions must remain within the band

Part 90.209: Subject to case-by-case review

RSS 238 3.2(c): 40dB bandwidth measurements must be reported

Method of Measurement: Measurements were made in accordance with standard listed above.

Block Diagram:



Test Data:

Pulse Type	Measurement Type	Occupied Bandwidth (MHz)
S1	99%	55.288
	40dB	133.814
S2	99%	43.269
	40dB	111.779
M3	99%	19.231
	40dB	56.250
L1	99%	16.346
	40dB	50.000
L2	99%	14.423
	40dB	47.276

Results Meet Requirements

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Applicant: KODEN ELECTRONICS CO., LTD.

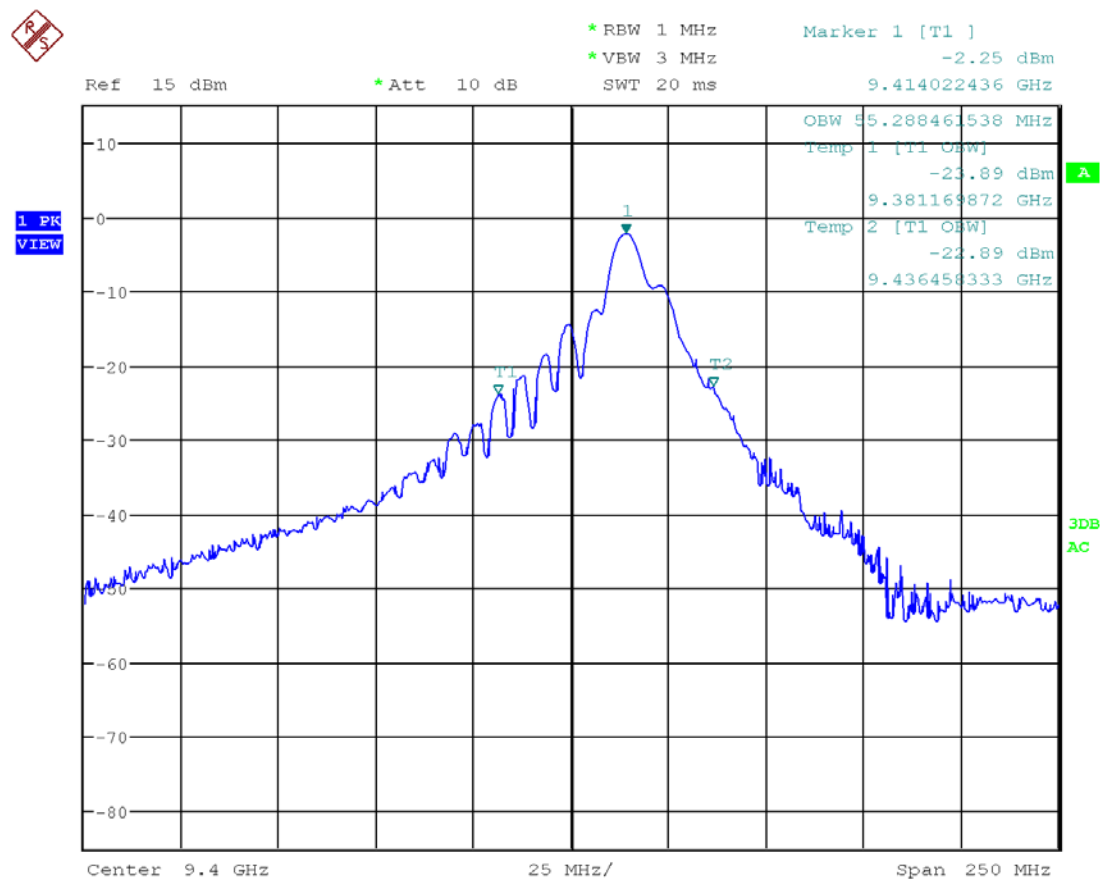
FCC ID: O5VRB809P

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OCCUPIED BANDWIDTH PLOT(S)

OCCUPIED BANDWIDTH - 99 PERCENT - S1



Date: 26.SEP.2016 14:02:54

Results Meet Requirements

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Applicant: KODEN ELECTRONICS CO., LTD.

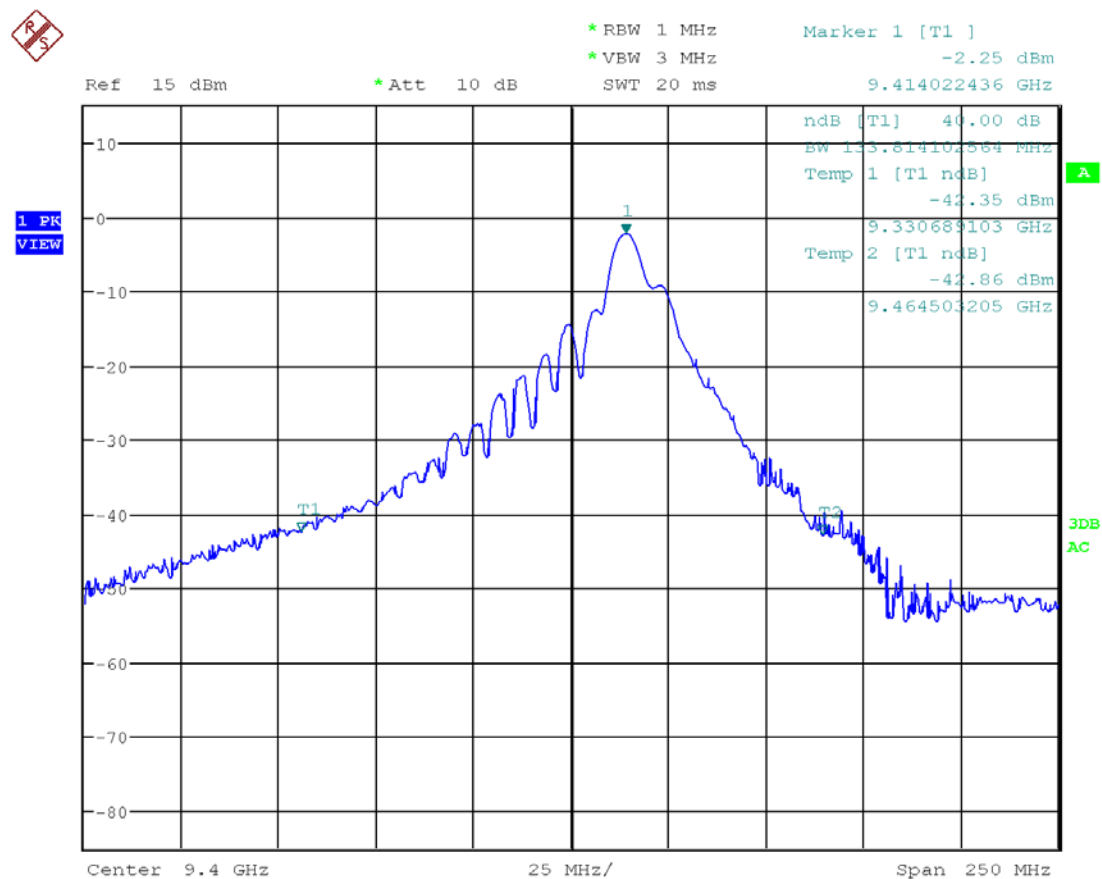
FCC ID: O5VRB809P

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OCCUPIED BANDWIDTH PLOT(S)

OCCUPIED BANDWIDTH - 40 dB - S1



Date: 26.SEP.2016 14:02:29

Results Meet Requirements

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Applicant: KODEN ELECTRONICS CO., LTD.

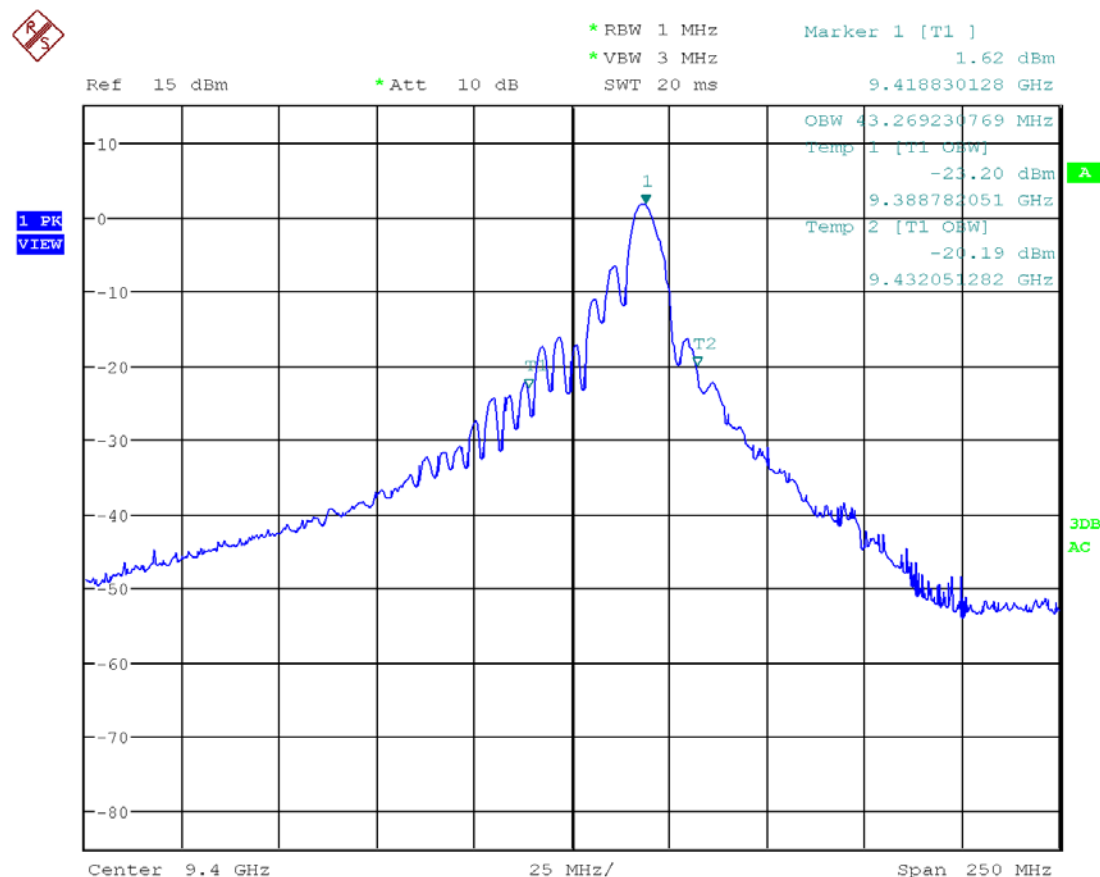
FCC ID: O5VRB809P

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OCCUPIED BANDWIDTH PLOT(S)

OCCUPIED BANDWIDTH - 99 PERCENT - S2



Date: 26.SEP.2016 14:00:56

Results Meet Requirements

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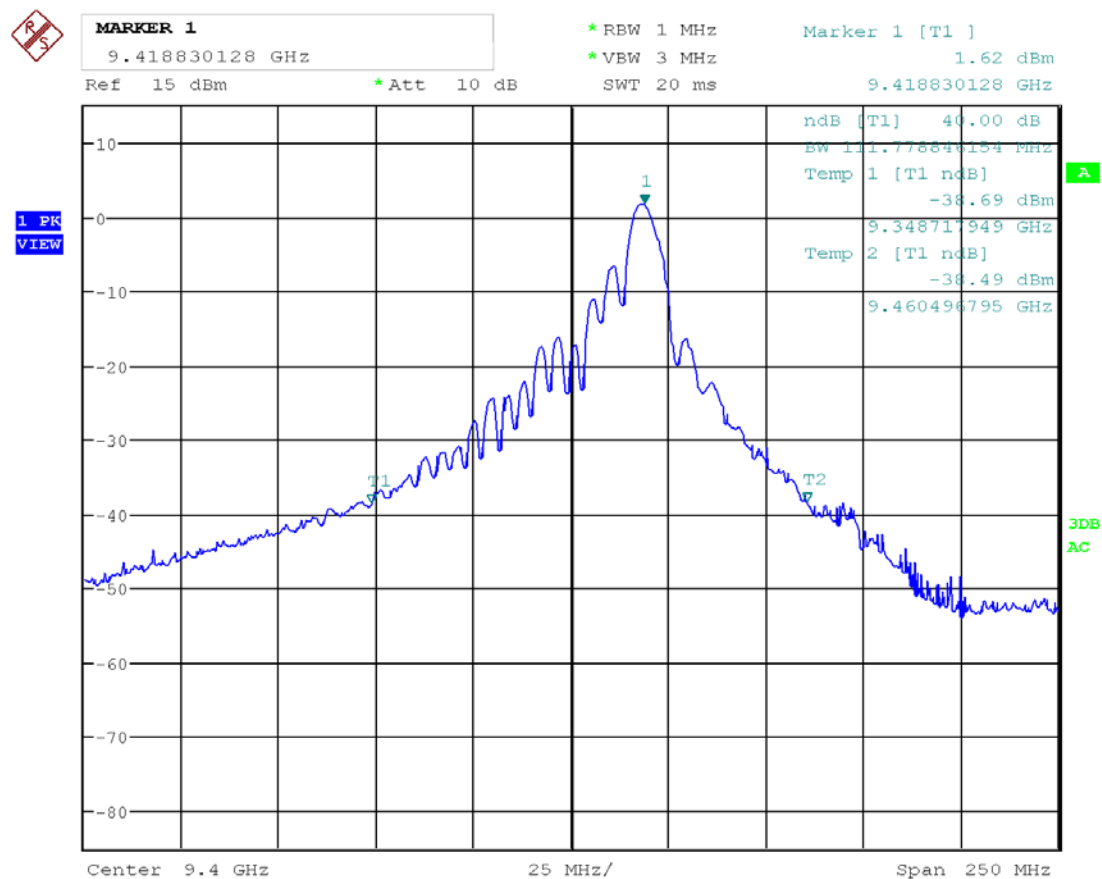
FCC ID: O5VRB809P

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OCCUPIED BANDWIDTH PLOT(S)

OCCUPIED BANDWIDTH - 40 dB - S2



Date: 26.SEP.2016 14:01:17

Results Meet Requirements

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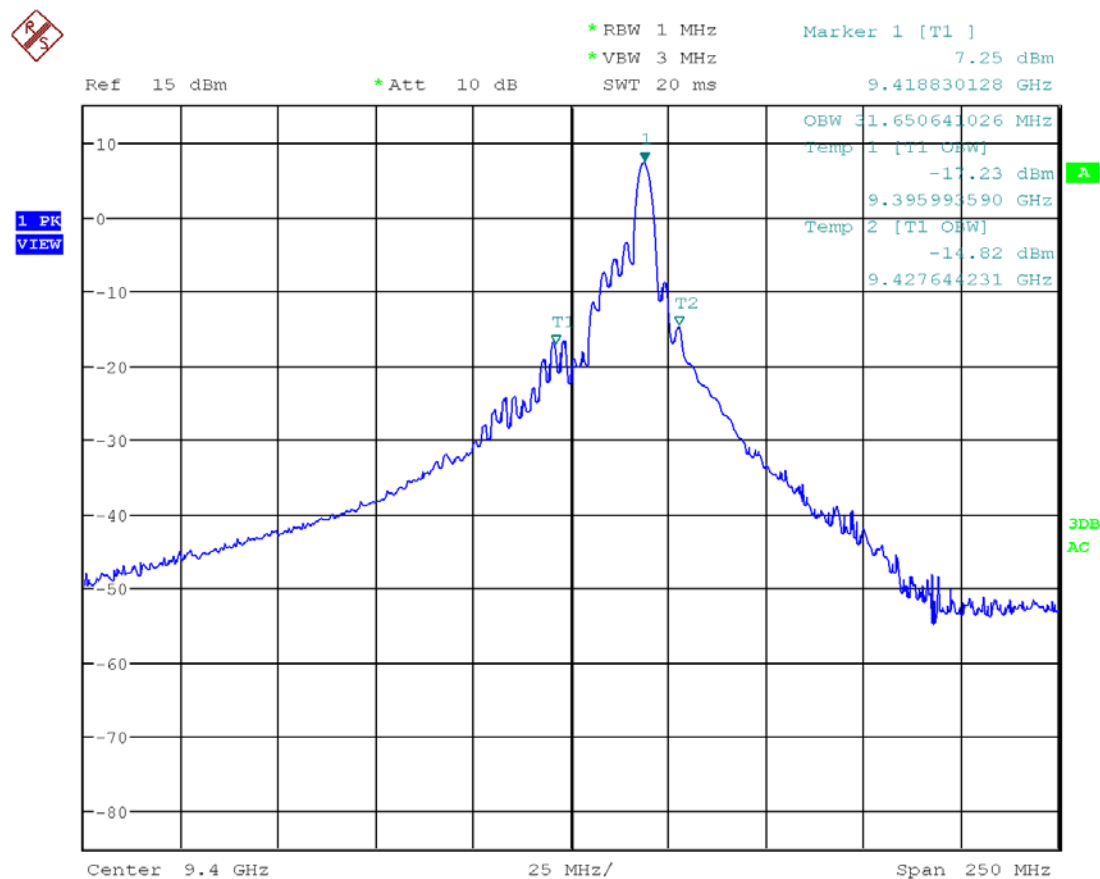
FCC ID: O5VRB809P

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OCCUPIED BANDWIDTH PLOT(S)

OCCUPIED BANDWIDTH - 99 PERCENT - M1



Date: 26.SEP.2016 13:57:56

Results Meet Requirements

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Applicant: KODEN ELECTRONICS CO., LTD.

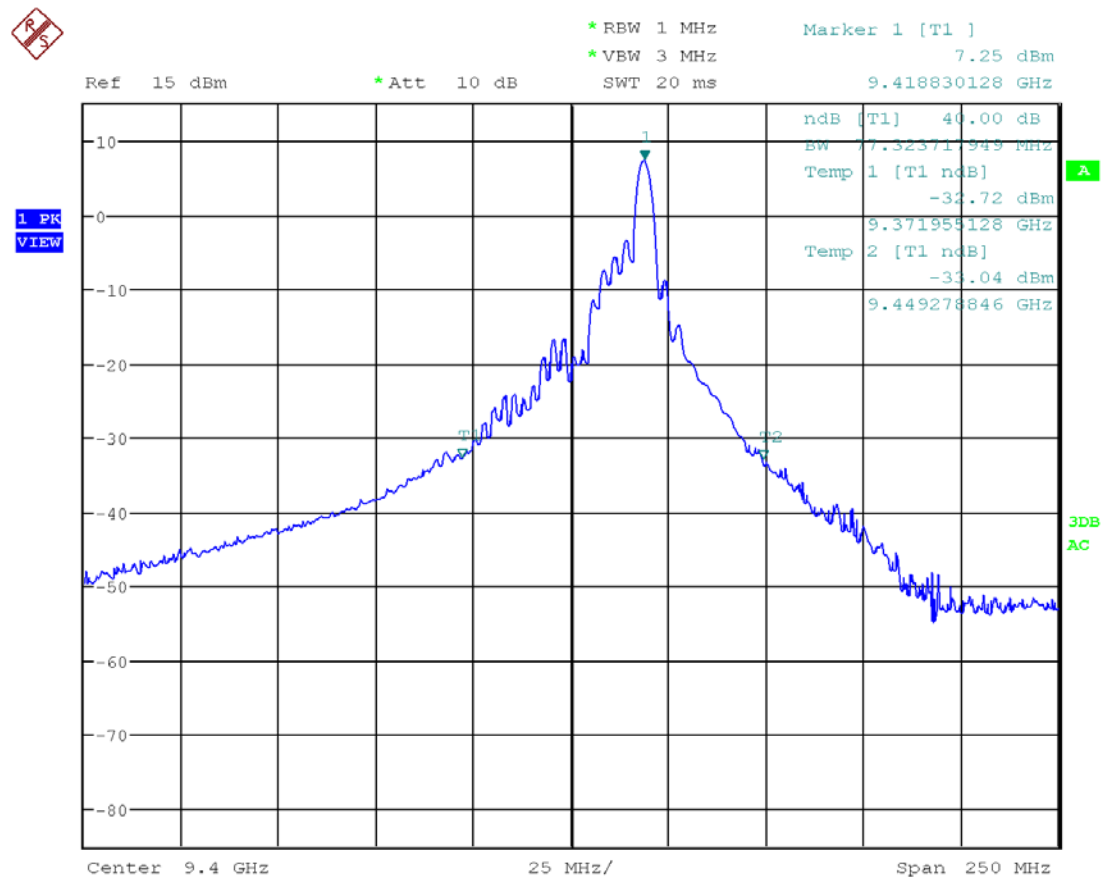
FCC ID: O5VRB809P

IC: 8477A-RB809P

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OCCUPIED BANDWIDTH PLOT(S)

OCCUPIED BANDWIDTH - 40 dB - M1



Date: 26.SEP.2016 13:57:17

Results Meet Requirements

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Applicant: KODEN ELECTRONICS CO., LTD.

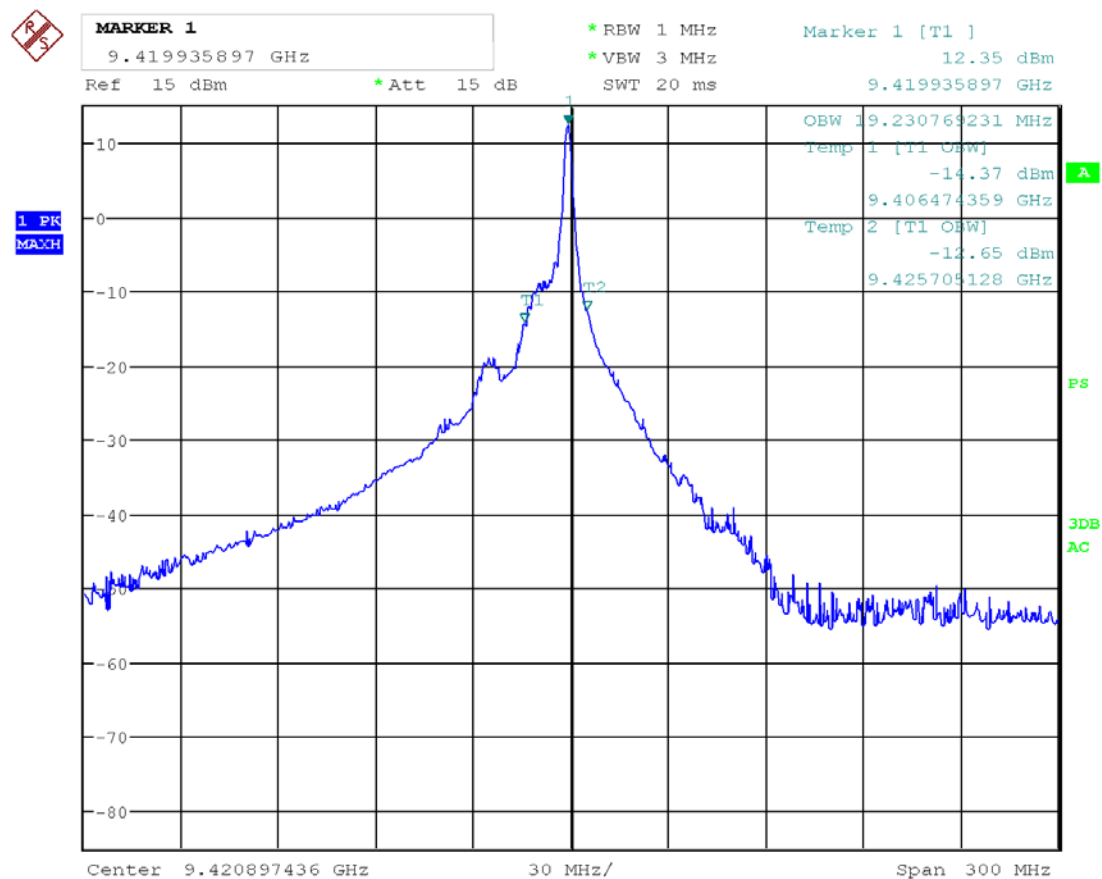
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OCCUPIED BANDWIDTH PLOT(S)

OCCUPIED BANDWIDTH - 99 PERCENT - M3



Date: 25.JUL.2016 15:07:45

Results Meet Requirements

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Applicant: KODEN ELECTRONICS CO., LTD.

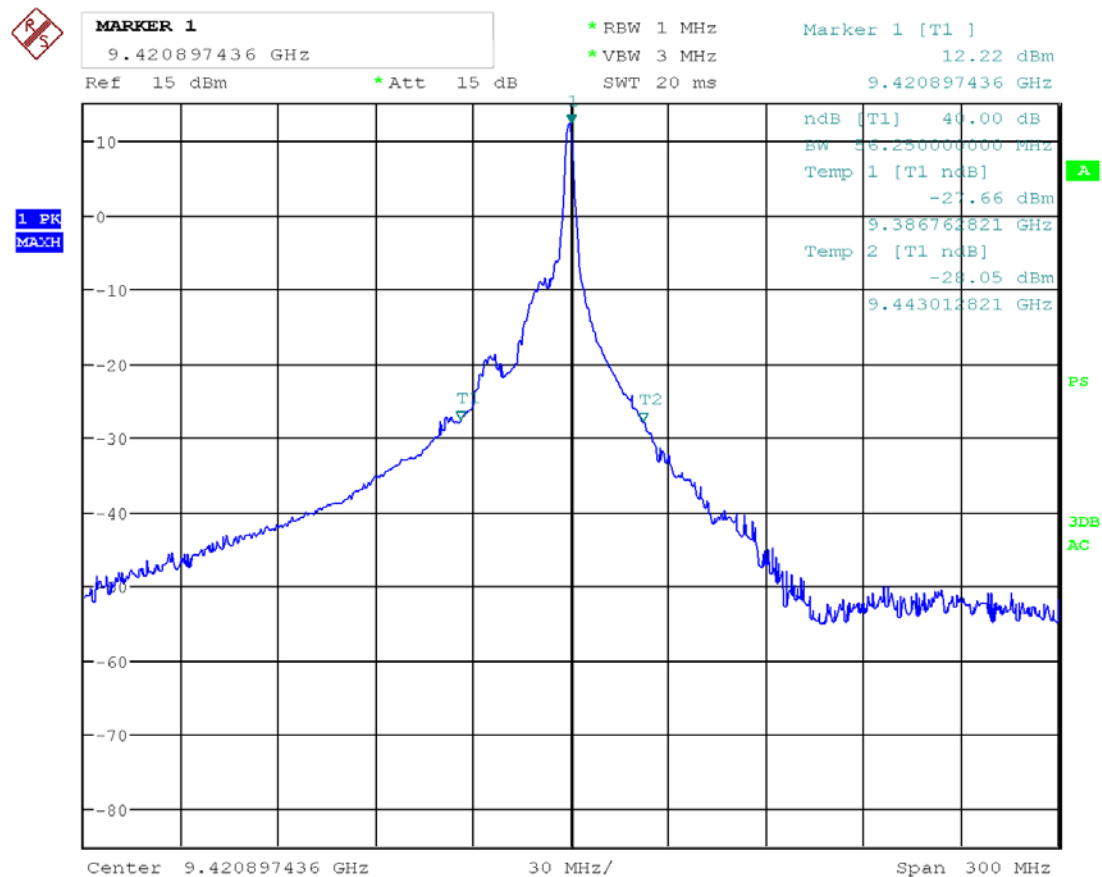
FCC ID: O5VRB809P

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OCCUPIED BANDWIDTH PLOT(S)

OCCUPIED BANDWIDTH - 40 dB - M3



Date: 25.JUL.2016 15:06:42

Results Meet Requirements

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Applicant: KODEN ELECTRONICS CO., LTD.

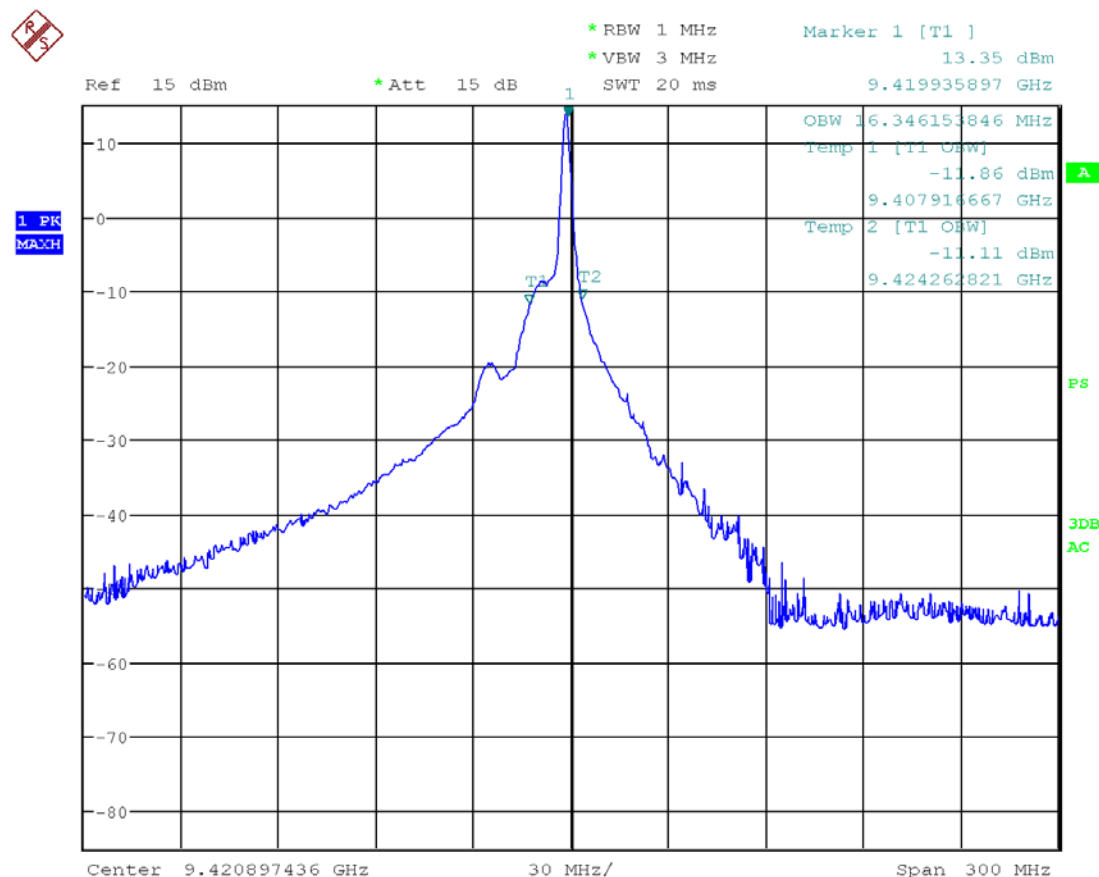
FCC ID: O5VRB809P

IC: 8477A-RB809P

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OCCUPIED BANDWIDTH PLOT(S)

OCCUPIED BANDWIDTH - 99 PERCENT - L1



Date: 25.JUL.2016 15:08:40

Results Meet Requirements

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Applicant: KODEN ELECTRONICS CO., LTD.

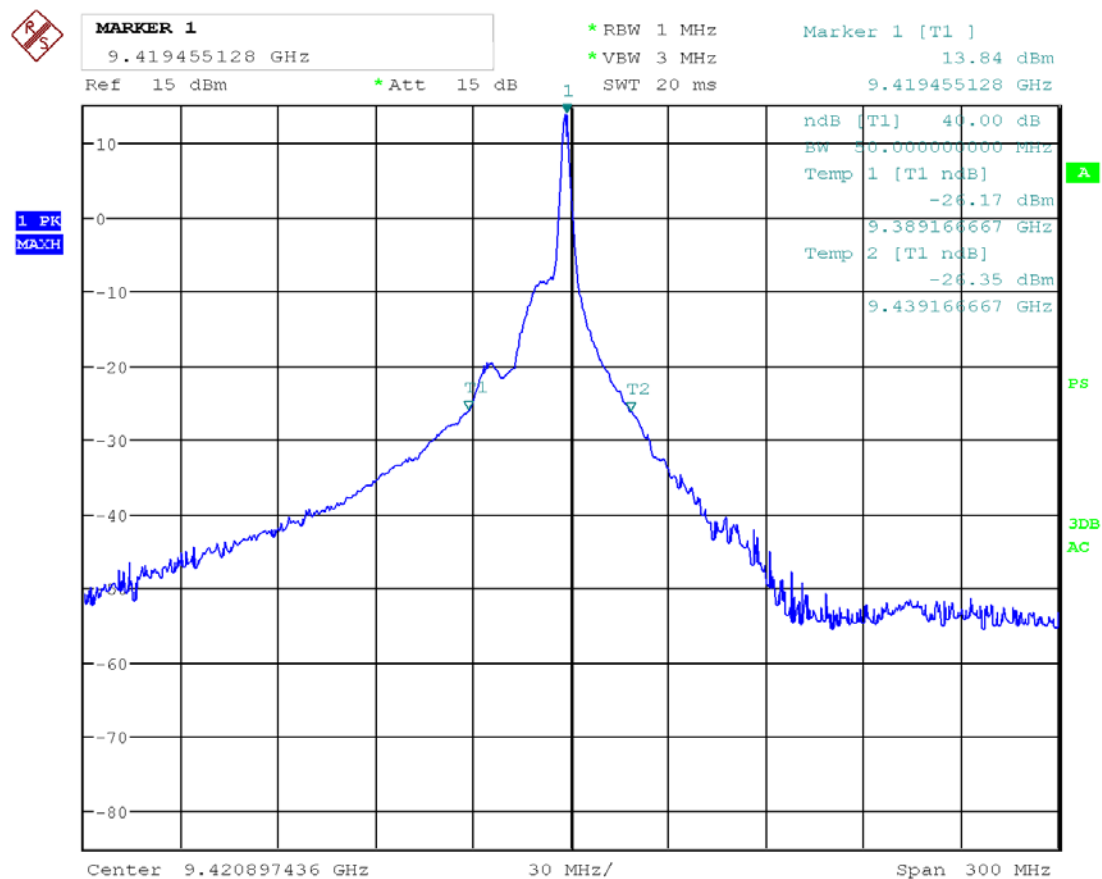
FCC ID: O5VRB809P

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OCCUPIED BANDWIDTH PLOT(S)

OCCUPIED BANDWIDTH - 40 dB - L1



Date: 25.JUL.2016 15:09:35

Results Meet Requirements

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Applicant: KODEN ELECTRONICS CO., LTD.

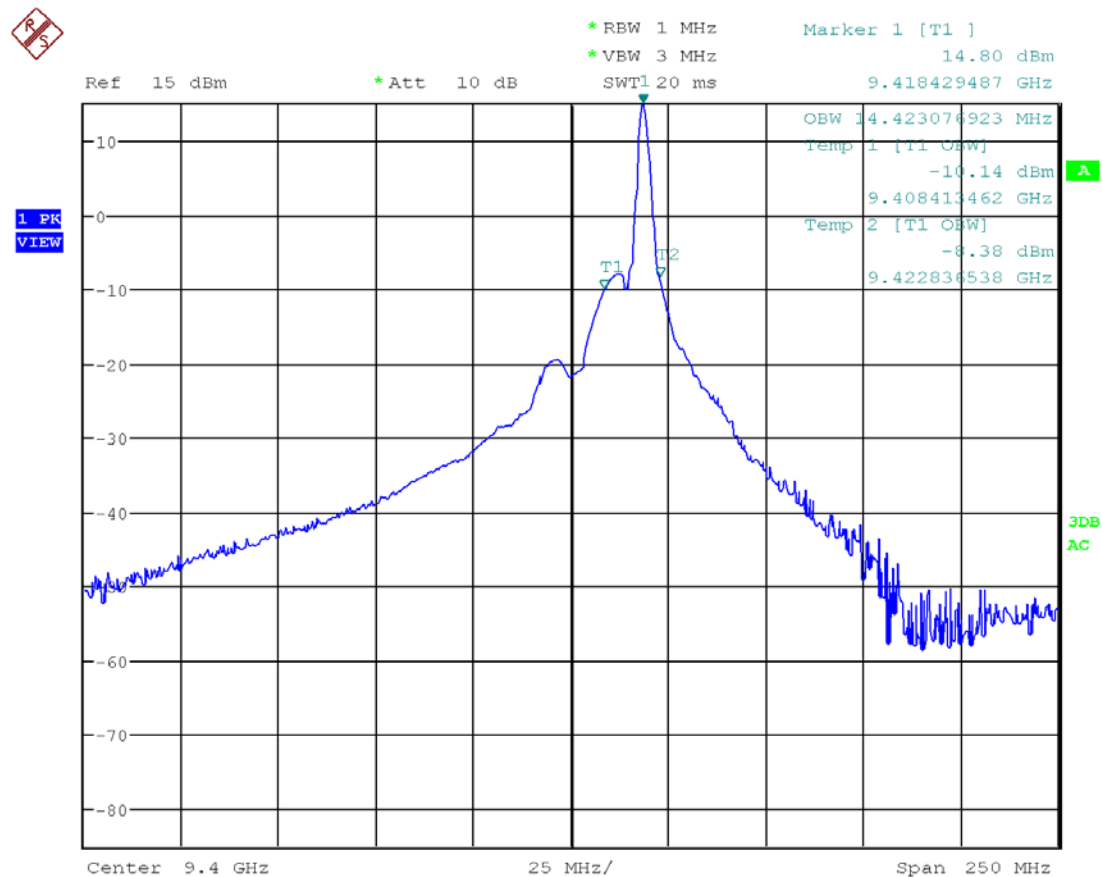
FCC ID: O5VRB809P

IC: 8477A-RB809P

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OCCUPIED BANDWIDTH PLOT(S)

OCCUPIED BANDWIDTH - 99 PERCENT - L2



Date: 26.SEP.2016 13:53:36

Results Meet Requirements

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Applicant: KODEN ELECTRONICS CO., LTD.

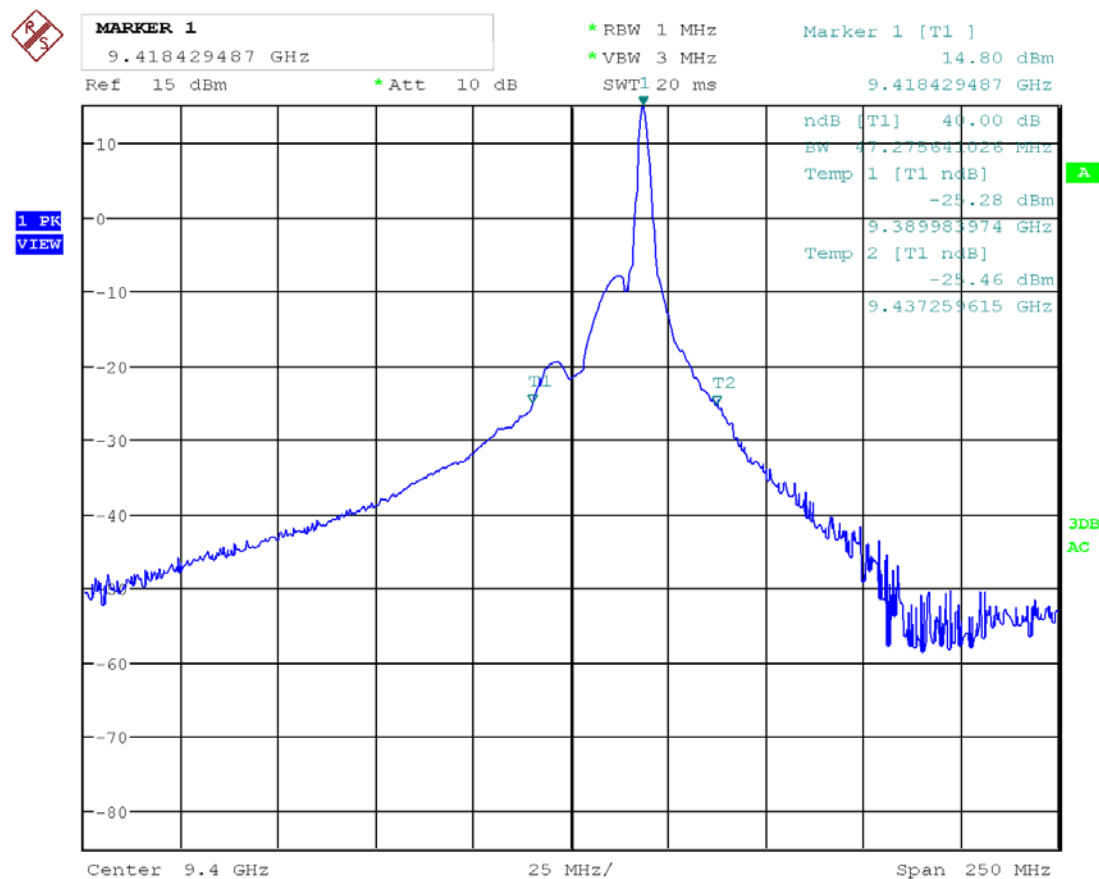
FCC ID: O5VRB809P

IC: 8477A-RB809P

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OCCUPIED BANDWIDTH PLOT(S)

OCCUPIED BANDWIDTH - 40 dB - L2



Date: 26.SEP.2016 13:54:17

Results Meet Requirements

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Applicant: KODEN ELECTRONICS CO., LTD.

FCC ID: O5VRB809P

IC: 8477A-RB809P

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SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Rule Part No.: Part 2.1051(a), Part 90.210, Part 90.215, Part 80.211(f),
RSS 238 4.3

Requirements:

Part 80.211(f): $43 + 10\log(\text{mean power in watts})$

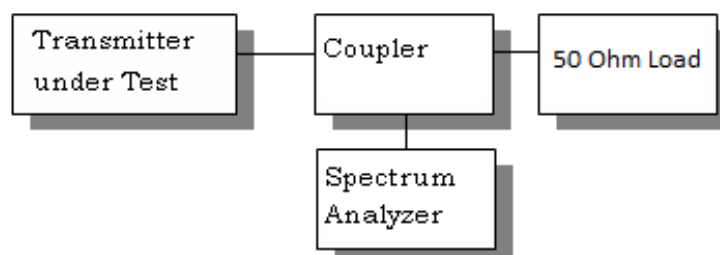
Part 90.210(c): $43 + 10\log(\text{mean power in watts})$

RSS 238 4.3: 20dB per decade from 40 dB bandwidth, not more than 60 dB

Method of Measurement: Measurements were made in accordance with standards listed.

The mean power was calculated based on the standard formula for radar systems:
 $P_a = P_m \cdot T_d \cdot f_r$. Where T_d is pulse duration, P_m is peak power, and f_r is pulse rep rate.

Block Diagram:



Test Data:

Pulse Type	Mean Power (Watts)	Emission Frequency (MHz)	Emission Level (dBc)	FCC Limit (dBc)	FCC Margin (dB)	IC Limit (dBc)	IC Margin (dB)
S1	3.51	18839.43	-45.23	-48.45	-3.22	-46.06	-0.83
S2	7.32	18838.28	-44.88	-51.65	-6.77	-46.06	-1.18
M1	14.69	18838.35	-43.74	-54.67	-10.93	-46.06	-2.32
M3	17.79	18839.64	-43.97	-55.50	-11.53	-46.06	-2.09
L1	18.29	18836.45	-43.13	-55.62	-12.49	-46.05	-2.92
L2	17.83	18836.33	-43.60	-55.51	-11.91	-46.05	-2.45

Results Meet Requirements

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Applicant: KODEN ELECTRONICS CO., LTD.

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FIELD STRENGTH OF SPURIOUS EMISSIONS

Rule Parts. No.: FCC Part 2.1053, Part 90.210, Part 90.215, Part 80.211(f), RSS-238 4.3

Requirements:

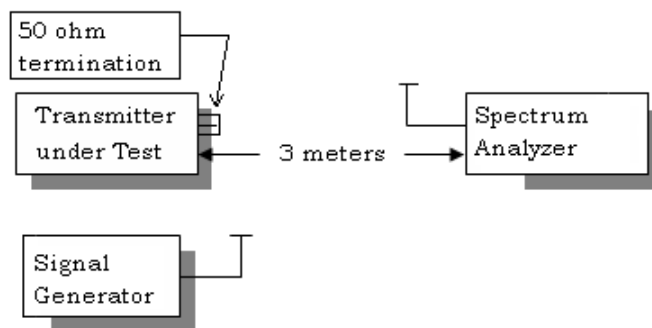
Part 80.211(f): $43 + 10\log(\text{mean power in watts})$

Part 90.210(c): $43 + 10\log(\text{mean power in watts})$

RSS 238 4.3: 20dB per decade from 40 dB bandwidth, not more than 60 dB

METHOD OF MEASUREMENT: The tabulated data shows the results of the radiated field strength emissions test. The spectrum was scanned from 30 MHz to at least the tenth harmonic of the fundamental or 40 GHz. This test was conducted per the standard listed above using the substitution method.

Test Setup Diagram:



Test Data:

No emissions present within 20dB of the limit

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FREQUENCY STABILITY

Rule Parts. No.: FCC Part 2.1055, Part 90.213, Part 80.209(b), RSS-238 4.1

Requirements

Part 80.209(b): Emissions must not be closer than $1.5/T$ MHz from the band edges, where T is the pulse duration in microseconds

Part 90.213(a) Specified in station authorization

RSS 238 4.1: The carrier frequency shall not depart from the reference frequency in excess of 800 ppm for equipment which operates in the band 2900-3100 MHz nor in excess of 1250 ppm for equipment which operates in the band 9225-9500 MHz.

Method of Measurements: The test procedure was modified to measure spurious emissions radiated from a terminating load.

Test Data:

Temperature (°C)	Frequency (MHz)	Error (ppm)	Margin (ppm)
25 (ref)	9418.8		
-20	9423.6	510	740
-10	9423.2	467	783
0	9422.0	340	910
10	9420.4	170	1080
20	9419.6	85	1165
30	9417.9	-96	1346
40	9415.2	-382	1632
50	9413.0	-616	1866

Results Meet Requirements

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EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
CHAMBER	Panashield	3M	N/A	04/25/16	12/31/17
Antenna: Biconical 1096 Chamber	Eaton	94455-1	1096	07/14/15	07/14/17
Antenna: Log- Periodic 1122	Electro- Metrics	LPA-25	1122	07/14/15	07/14/17
Antenna: Double- Ridged Horn/ETS Horn 2	ETS-Lindgren Chamber	3117	00041534	02/25/15	02/25/17
Antenna: Double- Ridged Horn	Emco	3116	9011-2145	11/18/2015	11/18/2017
EMI Test Receiver R & S ESU 40 Chamber	Rohde & Schwarz	ESU 40	100320	04/01/16	04/01/18
Coaxial Cable - Chamber 3 cable set (Primary)	Micro-Coax	Chamber 3 cable set (Primary)	KMKM-0244- 00; KMKM- 0670-00; KFKF-0198- 00	12/05/15	12/05/17
Bore-sight Antenna Positioning Tower	Sunol Sciences	TLT2	N/A	NA	NA
Pre-amp	RF-LAMBDA	RLNA00M45GA	NA	01/04/16	01/04/18
Temperature Chamber LARGE	Tenney Engineering	TTRC	11717-7	09/01/16	09/01/18
USB Peak Power Sensor 50 MHz to 18 GHz	Boonton	55318	9224	09/13/16	09/13/18
Directional Coupler	HP	X752D	1829A24209	02/12/2016	02/12/2017
Adapter Waveguide WR-62 to Waveguide WR-90	ATM	62/90-6-6-6	S539608-01	N/A	N/A
Adapter Waveguide WR-62 to Coax SMA	ATM	62-251A-6	S539808-01	N/A	N/A

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Adapter Waveguide WR-42 to Waveguide WR-90	ATM	42/90-8-6-6	S539408-01	N/A	N/A
Adapter Waveguide WR-42 to Coax K	ATM	42-25KA-6	S539508-01	N/A	N/A
Adapter Waveguide WR-28 to Waveguide WR-90	ATM	28/90-8-6-6	S539708-01	N/A	N/A
Adapter Waveguide WR-28 to Coax K	ATM	28-25KZA-6	S539908-01	N/A	N/A
WR90-Load	Pasternack	PE6824	N/A	N/A	N/A
Coaxial Cable	Micro-Coax	UFB142A-0-0720-200200	225363-002	08/05/2015	08/05/2017

***EMI RECEIVER SOFTWARE VERSION**

The receiver firmware used was version 4.43 Service Pack 3

END OF REPORT

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