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FCC PART 90 RADAR TEST REPORT

APPLICANT	Enterprise Electronics Corporation
	128 South Industrial Blvd.
	Enterprise Alabama 36330 USA
FCC ID	BUVRANGERX5
MODEL NUMBER	RANGER X5
PRODUCT DESCRIPTION	Ranger-X5 RADAR
DATE SAMPLE RECEIVED	2/7/2017
FINAL TEST DATE	2/10/2017
TESTED BY	Cory Leverett, Tim Royer
APPROVED BY	Sid Sanders
TEST RESULTS	<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL

Report Number	Version Number	Description	Issue Date
214AUT17TestReport_	Rev1	Initial Issue	2/14/2017
	Rev2	Revised EUT power source, & ant list pg. 4, Corrected Mean Power pg. 7, Updated reference power level Pg. 20, & 21	3/23/2017
	Rev3	Change emission designator pg 4, Added units to Mean Power and Input Power formula pg 6, Added 99% OBW Measurements pg 15,16 updated emission mask plots pg 17 - 20	3/30/2017
	Rev4	Replaced Mean power formula with equivalent formula on page 6	3/31/2017
	Rev5	Removed Emission mask plots	4/5/2017

THE ATTACHED REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT
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GENERAL REMARKS



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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:

Name and Title: Cory Leverett, Project Manager/Testing Technician

Name and Title: Tim Royer, Project Manager/Testing Technician

Date: 3/30/2017

Reviewed and approved by: _____

Name and Title: Sid Sanders, Engineer

Date: 3/30/17

Applicant: Enterprise Electronics Corporation
FCC ID: BUVRANGERX5
Report: 214AUT17TestReport_Rev5

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EUT SPECIFICATION



EUT Description	Ranger-X5 RADAR
FCC ID	BUVRANGERX5
Model Number	RANGER X5
Operating Frequency	9275 – 9275 MHz
Type of Emission	6M8P0N
Modulation	Pulse Compression FM
EUT Power Source	<input checked="" type="checkbox"/> 110–240Vac/50– 60Hz
	<input checked="" type="checkbox"/> DC Power (48 VDC)
	<input type="checkbox"/> Battery Operated Exclusively
Test Item	<input type="checkbox"/> Prototype
	<input type="checkbox"/> Pre-Production
	<input checked="" type="checkbox"/> Production
Type of Equipment	<input checked="" type="checkbox"/> Fixed
	<input type="checkbox"/> Mobile
	<input type="checkbox"/> Portable
Antenna	1.8 Meter Parabolic Reflector with dual polarization tuned feed horn Option 1: 1.0 Meter diameter – Gain 36.0 ± 0.5 dBi Option 2: 1.8 Meter diameter - Gain 42.0 ± 0.5 dBi Option 3: 2.4 Meter diameter - Gain 44.5 ± 0.5 dBi

TEST SETUP INFORMATION

Test facility	Enterprise Electronics Corporation 128 South Industrial Blvd. Enterprise Alabama 36330 USA
Test Condition	The EUT was tested under normal temperature and humidity. The temperature was 20-26°C with a relative humidity of 35 - 55%.
Modifications	None
Test Exercise	The EUT was transmitting a modulated pulse with a 100 us pulse at a 1200 Hz rep rate, with the exception of frequency stability testing in which CW signal was used.
Regulatory Standards	FCC CFR 47 Part 2, 90
Measurement Standards	TIA_603-D:2010, KDB 662911 D01 MULTIPLE TRANSMITTER OUTPUT V02R01, KDB 662911 D02 MIMO WITH CROSS-POLARIZED ANTENNAS V01, ITU-R M.1177-4 (04/2011), CISPR 16-2-3 ED 3.1

TEST REPORT SUMMARY



Rule Part No.	Test Item	Status Pass/Fail/NA
2.1046, 90.205	RF Power Output	Pass
2.1047, 90.207, 90.209	Modulation Characteristics	Pass
2.1049, 90.210 (b)(1)(2)(3)	Occupied Bandwidth	Pass
2.1051, 90.210 (b)(3)	Antenna Conducted Emissions	Pass
2.1053, 90.210(b)(3)	Field Strength Spurious Emissions	Pass
2.1055, 90.213	Frequency Stability	Pass

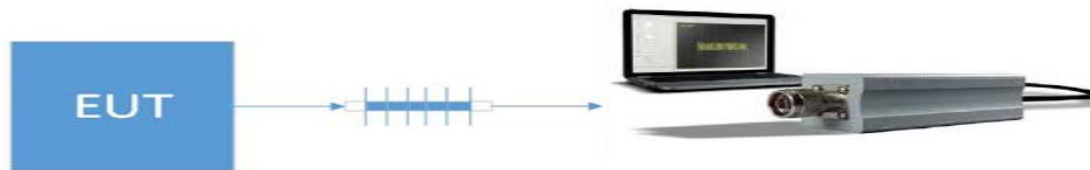
RF POWER OUTPUT

Rule Part No.: 2.1046, 90.205

Requirements: Manufacturers specifications

Procedure: RF power is measured by connecting a 50-ohm, Peak Power Watt meter to the RF output connector. The EUT was supplied with a nominal voltage, and the transmitter properly adjusted for the target output power.

Setup Diagram:



Notes: The EUT has 2 transmitters; all conducted measurement results are summed and compared to the limit following the procedures listed above

The mean power was calculated based on formula:

$$P_a = P_m \cdot DC$$

P_a is Mean linear power in watts

P_m is Peak linear power in watts

DC is duty cycle in %

Example: $404.79 \text{ (W)} \cdot (91.6/833) = 44.51 \text{ (w)}$

Test Data: Measurement Table

Pulse Type	Tuned Freq (MHz)	T_d (uSec)	Period (uSec)	DC (%)	Ant 1 Peak Power (dBm)	Ant 2 Peak Power (dBm)	Ant 1 + 2 Peak Power (W)	Ant 1 + 2 Mean Power (W)
100 uS	9275	91.60	833.00	11.00%	53.19	52.93	404.79	44.51
2 uS	9275	1.35	833.00	0.16%	57.19	56.75	996.75	1.62

Part 2.1033 (C) (8) DC Input into the final amplifier

INPUT POWER: $P(W) = E(V) \cdot I(A) = 48 \text{ VDC} \cdot 44.6 \text{ Amps} = 2040 \text{ Watts}$

MODULATION CHARACTERISTICS

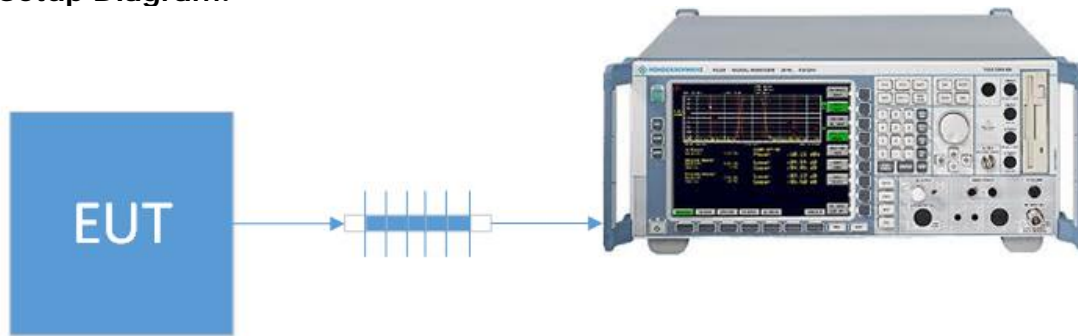


Rule Part No.: 2.1047, 90.207, 90.209

Requirements: Manufacturers specification, authorization reviewed on a case-by case-basis

Procedure: As detailed in the procedures listed above

Setup Diagram:



Notes: The manufacturer specifications declare that the EUT is normally operated with a pulse compression modulation scheme with a pulse durations of 100 μ S.

Further detailed specifications are contained in "product specifications" manual.

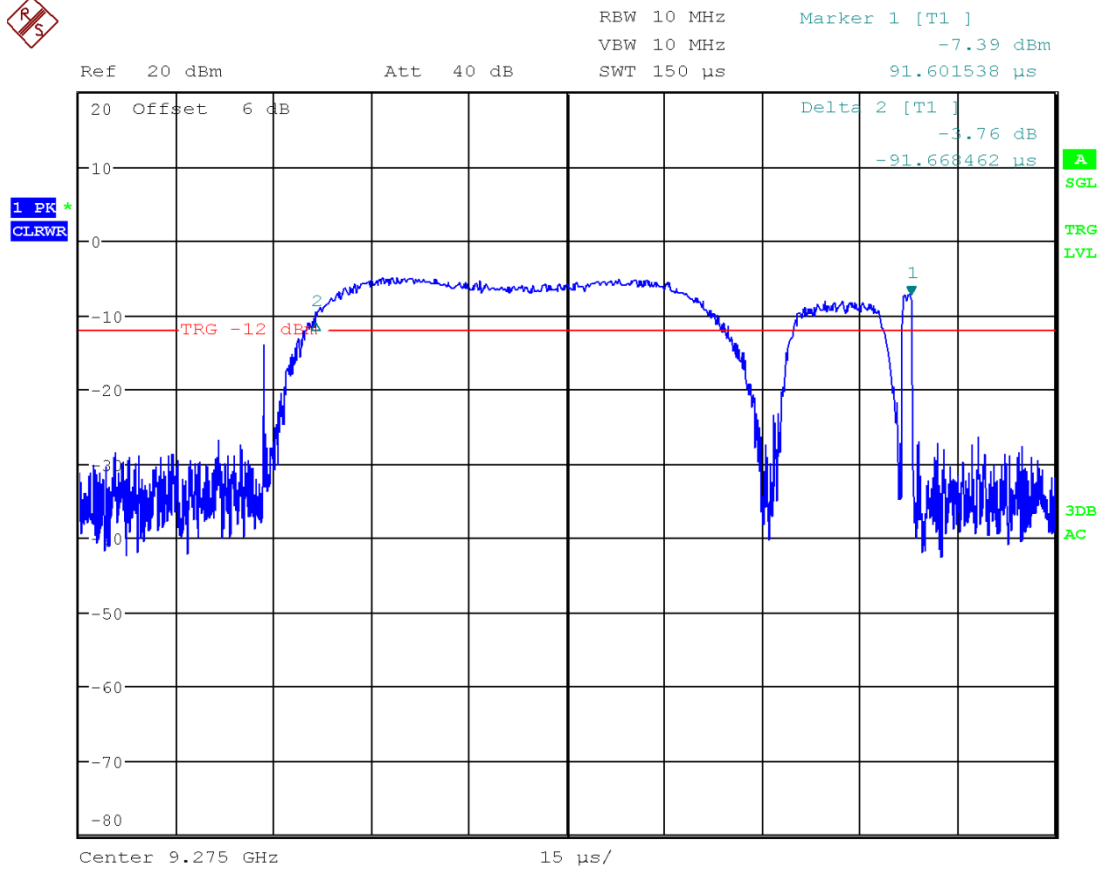
Test Data: Measurement Table

Pulse Type	Pulse widths (μ s)	Pulse rep. rate (Hz)	Chirp BW (MHz)	40 dB BW (MHz)
100 μ S	91.6	1200	2.5	15.81
2 μ S	1.35	1200	2.5	20.5

MODULATION CHARACTERISTICS



Test Data: 100 uS Pulse width Plot

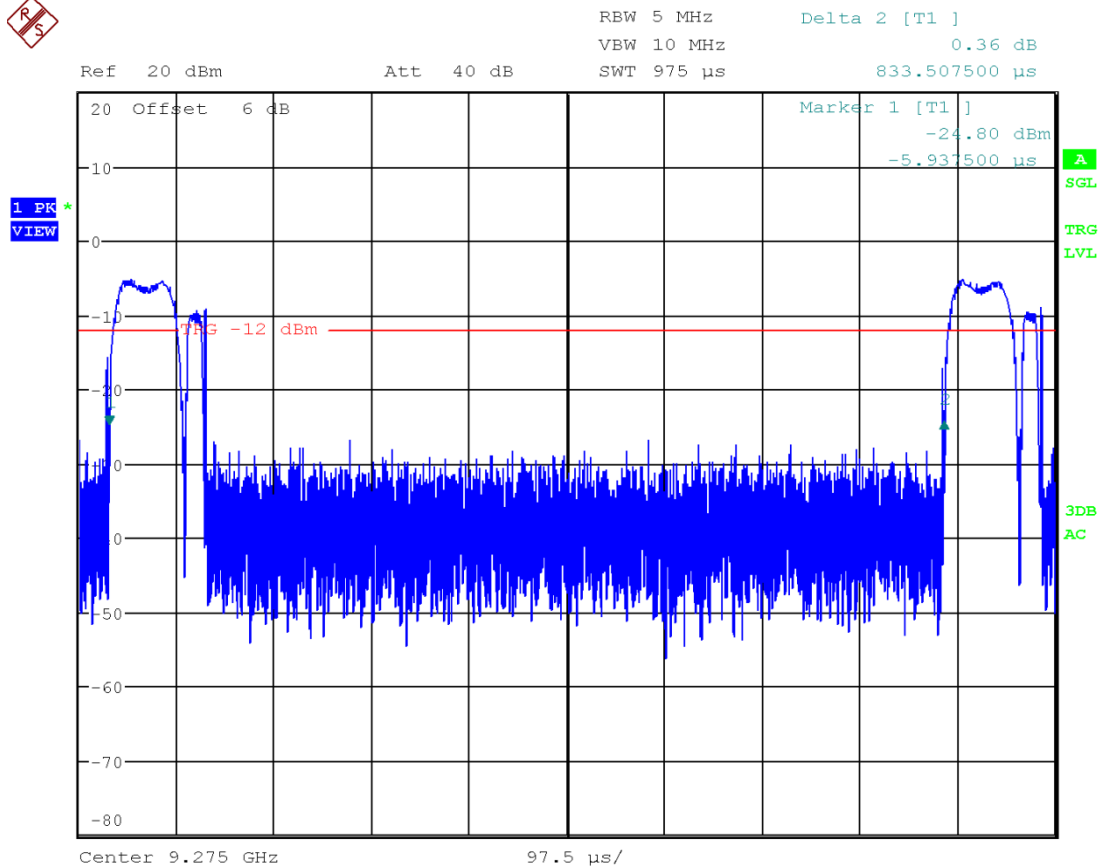


Date: 7.FEB.2017 16:28:55

MODULATION CHARACTERISTICS



Test Data: 100 uS Rep Rate Plot



Date: 7.FEB.2017 16:24:46

Applicant: Enterprise Electronics Corporation
FCC ID: BUVRANGERX5
Report: 214AUT17TestReport_Rev5

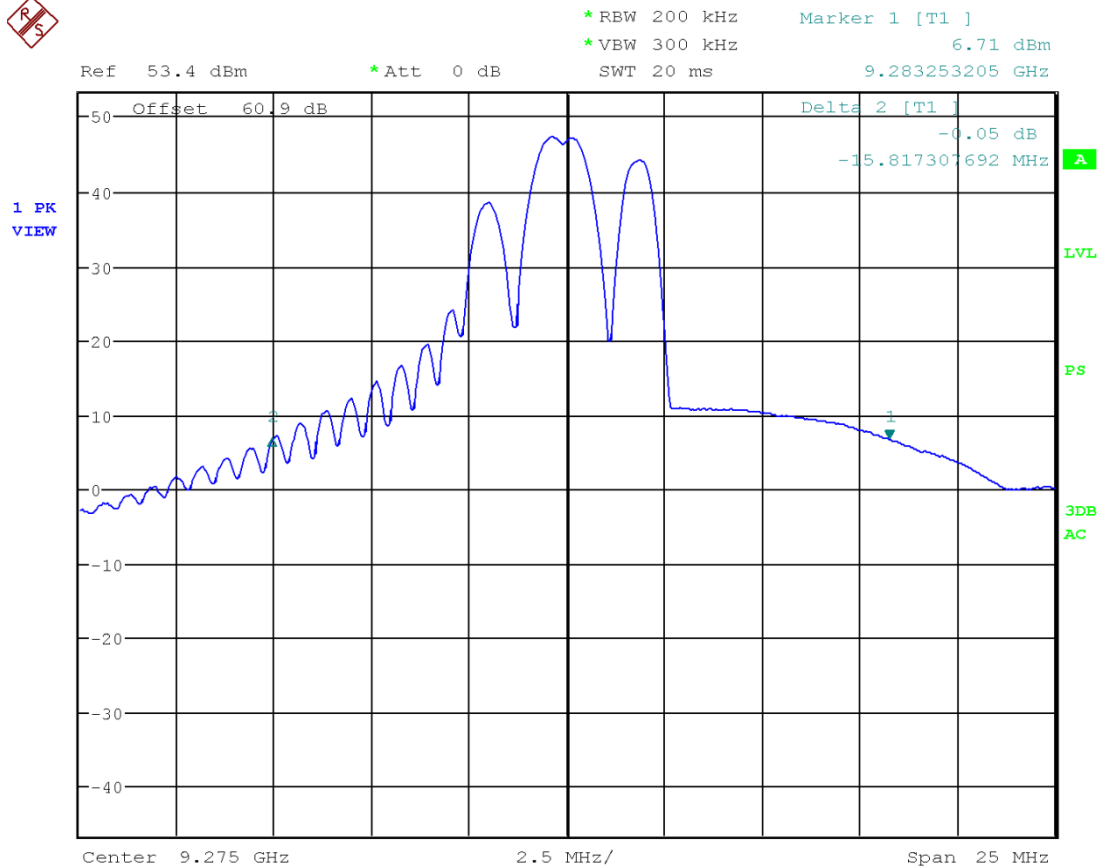
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MODULATION CHARACTERISTICS



Test Data: 100 uS 40 dBW Plot



Date: 10.FEB.2017 14:28:02

Applicant: Enterprise Electronics Corporation
FCC ID: BUVRANGERX5
Report: 214AUT17TestReport_Rev5

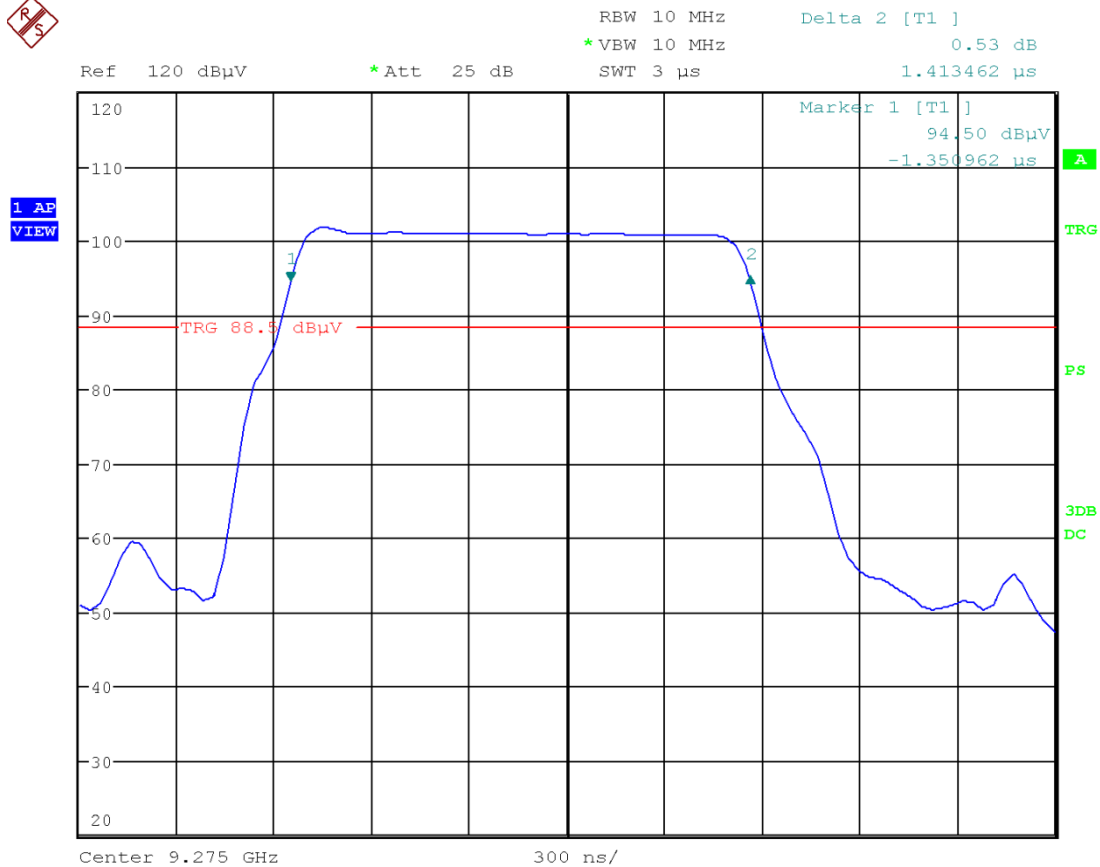
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MODULATION CHARACTERISTICS



Test Data: 2 μ S Pulse width Plot

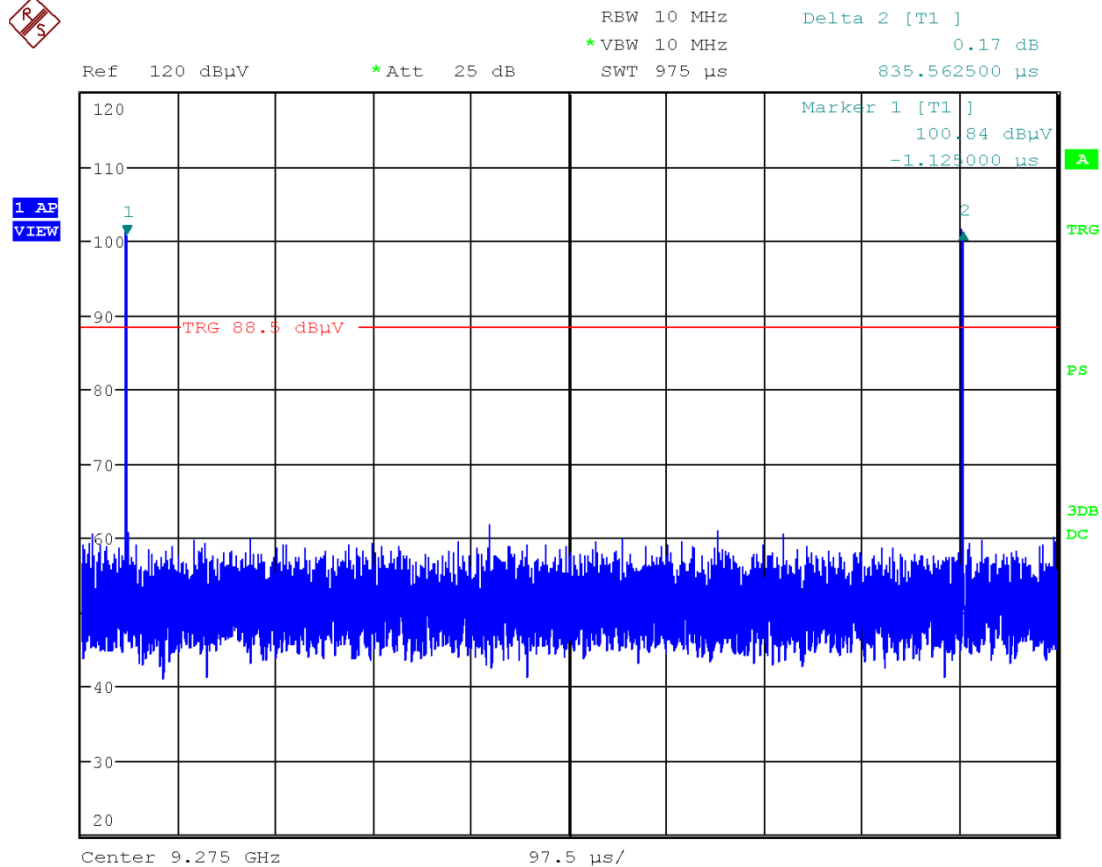


Date: 9.FEB.2017 13:10:44

MODULATION CHARACTERISTICS



Test Data: 2 μ S Rep Rate Plot



Date: 9.FEB.2017 13:20:26

Applicant: Enterprise Electronics Corporation
FCC ID: BUVRANGERX5
Report: 214AUT17TestReport_Rev5

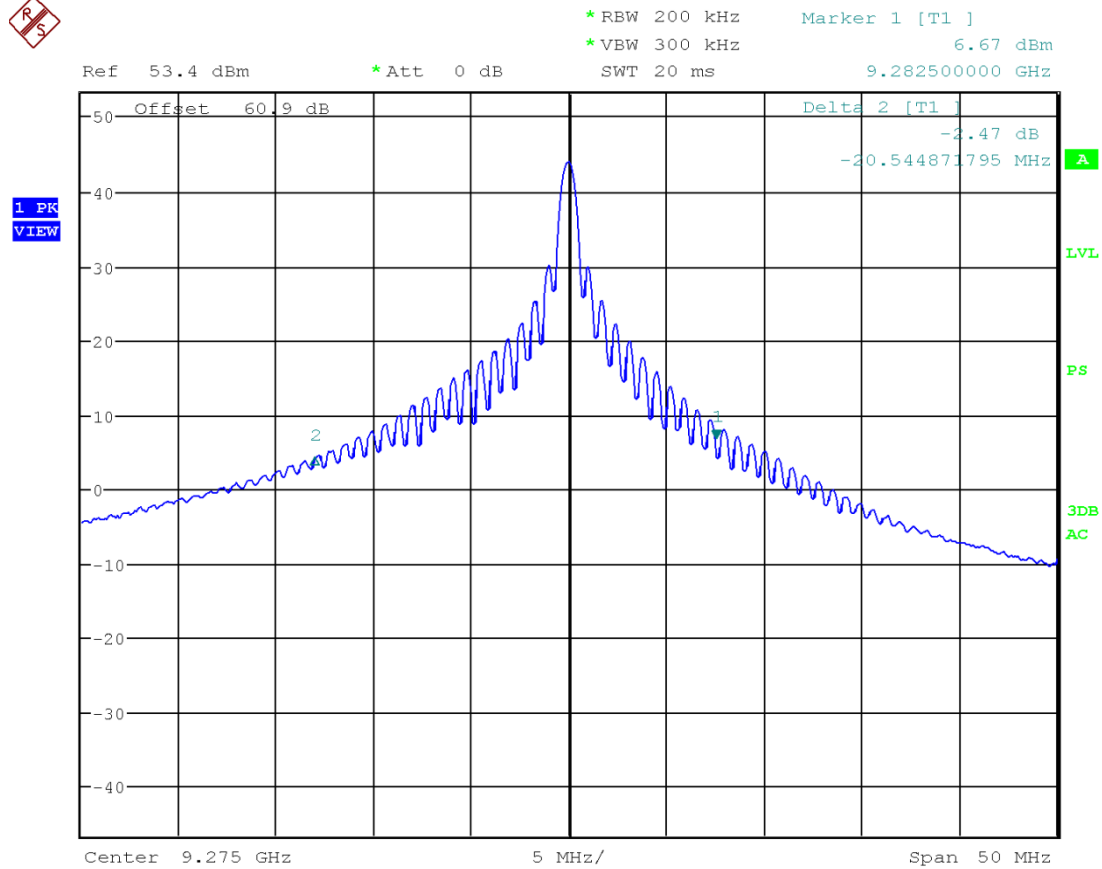
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MODULATION CHARACTERISTICS



Test Data: 2 uS 40 dBBW Plot



Date: 10.FEB.2017 14:51:17

Applicant: Enterprise Electronics Corporation
 FCC ID: BUVRANGERX5
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OCCUPIED BANDWIDTH

Rule Part No.: 2.1049, 90.210 (b)(1)(2)(3)

Requirements: 99% OBW Reporting Only

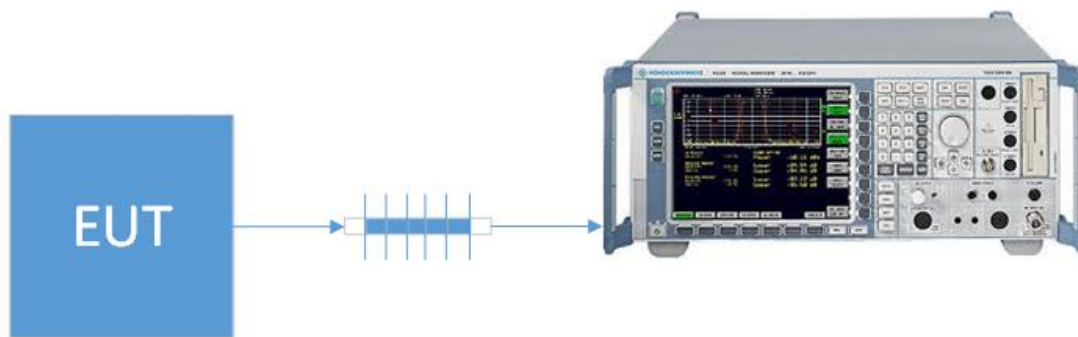
(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.

(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least $43 + 10 \log (P)$ dB.

Procedure:

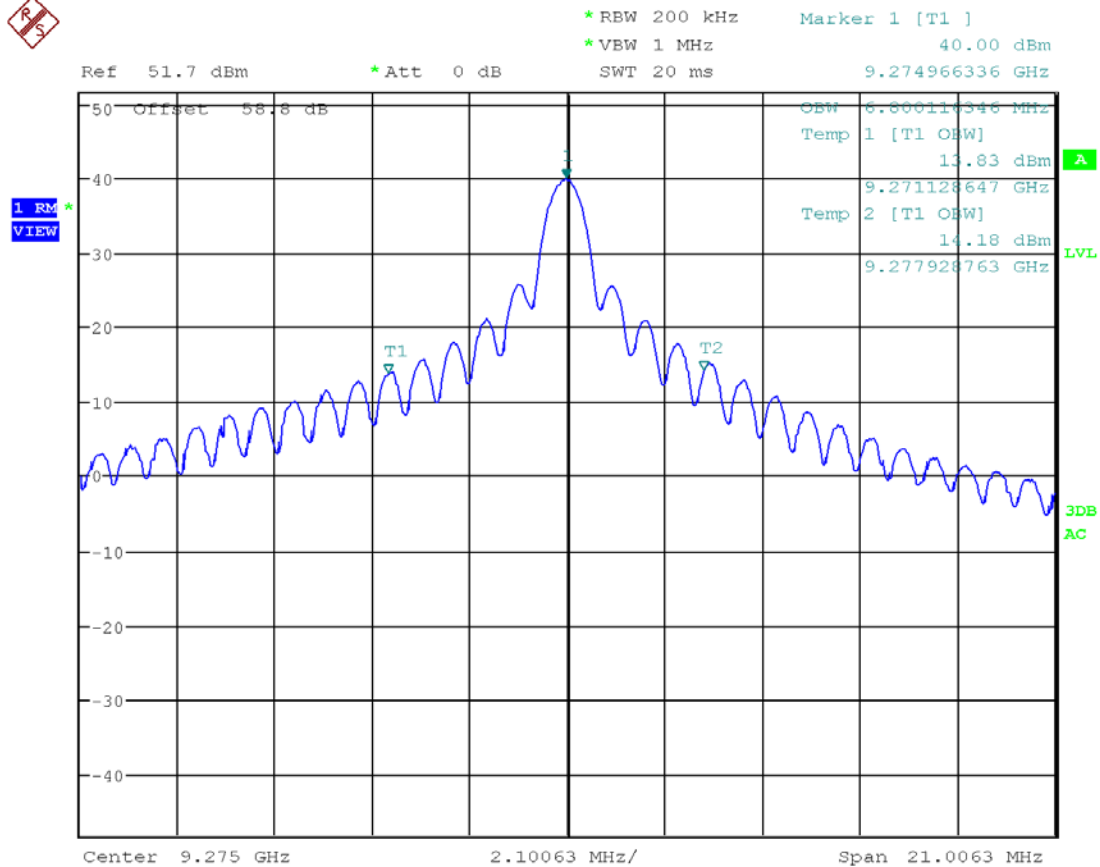
Setup Diagram:



OCCUPIED BANDWIDTH



Test Data: 2uS 99% OBW Plot

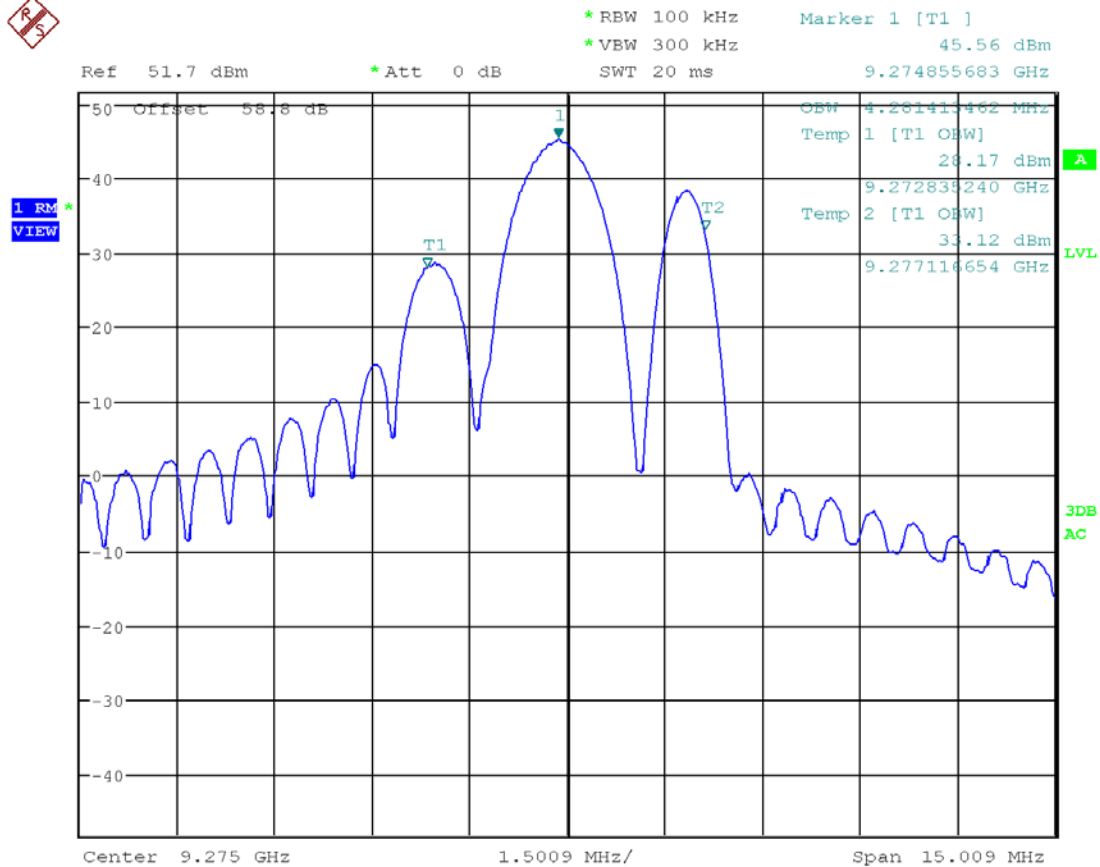


Date: 8.FEB.2017 11:53:12

OCCUPIED BANDWIDTH



Test Data: 100uS 99% OBW Plot



Date: 8.FEB.2017 12:01:33

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)



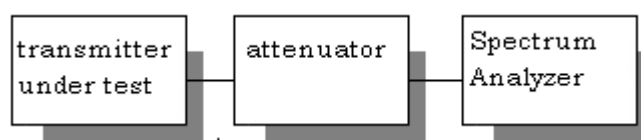
Rule Part No.: 2.1051, 90.210 (b)(3)

Requirements: $43 + 10\log(P)$

Procedure: The spectrum was scanned from 9 KHz - 40 GHz. The measurements were made in accordance with standard that is listed above.

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

Setup Diagram:



Notes: Only emissions that are within 20 dB of the limit are reported

Test Data: Measurement Table

Peak Power Output				
Tuned Frequency (MHz)	Ant 1 (dBm)	Ant 2 (dBm)	Ant 1 + 2 (W)	Limit (dBc)
9275	57.19	56.75	996.75	72.99
Emission Frequency (MHz)	Ant 1 Level (dBm)	Ant 2 Level (dBm)	Ant 1 + 2 Level (dBc)	Margin (dB)
18550	-18.78	-19.38	76.05	3.06
27825	-28.68	-33.98	87.54	14.56
37100	-53.88	-34.78	94.71	21.73

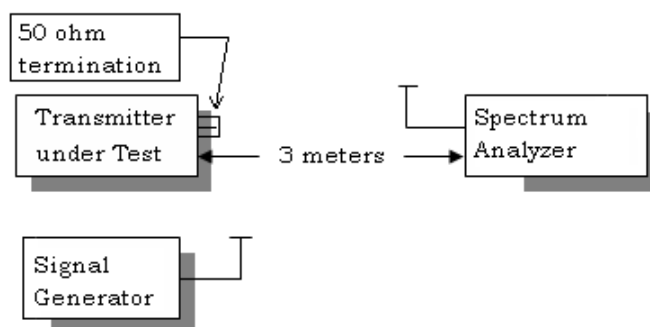
FIELD STRENGTH OF SPURIOUS EMISSIONS

Rule Parts. No.: 2.1053, 90.210(b)(3)

Requirements: $43 + 10\log(P)$

Procedure: The tabulated data shows the results of the substitution measurement of radiated field strength emissions test. The spectrum was scanned from 9 KHz - 40 GHz.

Setup Diagram:



Notes: Only emissions that are within 20 dB of the limit are reported

Test Data: Measurement Table

Tuned Frequency (MHz)	Power Mode (Hi/Lo)	Power Output (dBm)	Power Output (Watts)	FCC Requirement (dB)	Measured BW (MHz)
9275	Hi	59.99	996.76	72.99	20.5
Emission Frequency (MHz)	Ant. Polarity		Below Carrier (dBc)		Margin
18,550.00	V		81.1459		8.16
27,825.00	H		83.1759		10.19
37,100.00	H		88.8459		15.86

FREQUENCY STABILITY

Rule Parts. No.: 2.1055, 90.213

Requirements: Manufacturers specification, authorization reviewed on a case-by-case basis.

Procedure: The test procedures used are detailed in the standard listed that is listed above.

Test Data Measurement Table

Temperature	Frequency MHz	Cycles	PPM
25°C (reference)	9274.942333		
-30°C	9274.973366	31033	3.346
-20°C	9274.962000	19667	2.120
-10°C	9274.971167	28834	3.109
0°C	9274.968667	26334	2.839
10°C	9274.957500	15167	1.635
20°C	9274.968167	25834	2.785
30°C	9274.962000	19667	2.120
40°C	9274.928667	-13666	-1.473
50°C	9274.960500	18167	1.959
Input Voltage	Frequency	Cycles	PPM
-15%	9274.964833	22500	2.426
15%	9274.942333	0	0.000

EQUIPMENT LIST



Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Attenuator K 6dB W DC-	Narda	476-6	044-3	06/25/15	06/25/17
Antenna: Biconical 1096 Chamber	Eaton	94455-1	1096	07//15	07/14/17
Antenna: Log-Periodic 1122	Electro-Metrics	LPA-25	1122	07/14/15	07/14/17
Antenna: Dile Kit 153	Electro-Metrics	TDA-30/1-4	153		
Digital Multimeter	Fluke	77	35053830	10/21/15	10/21/17
Antenna: Standard Gain Horn 1.0-2.4 GHz	Polarad	CA-L	5	NA	NA
Antenna: Standard Gain Horn 2.14-4.34 GHz	Polarad	CA-S	203	NA	NA
Antenna: Standard Gain Horn 3.95-5.85 GHz	Scientific-Atlanta Inc.	12-3.9	8105CF	NA	NA
Antenna: Standard Gain Horn 8.2-12.5 GHz	Systron Donner	DBG-520-20	Not Serialized	NA	NA
Antenna: Standard Gain Horn 18.0-26.3 GHz	Systron Donner	DBE-520-20	Not Serialized	NA	NA
Antenna: Standard Gain Horn 26.5-40.2 GHz	Systron Donner	DBD-520-20	Not Serialized	NA	NA
Antenna: Standard Gain Horn 5.85-8.2 GHz	ATM	137-442-2	D261908-01	NA	NA
Coaxial Cable - Chamber 3 cable set (backup)	Micro-Coax	Chamber 3 cable set (backup)	KMKM-0244-02 ; KMKM-0670-01; KFKF-0197-00	NA	NA
Sweep/Signal Generator	Anritsu	68369B	985112	10/28/15	10/28/17
Antenna: Double-Ridged Horn/ETS Horn 2	ETS-Lindgren Chamber	3117	00041534	02/25/15	02/25/17
Software: Field Strength Program	Timco	N/A	Version 4.0	NA	NA
Antenna: Active Loop	ETS-Lindgren	6502	00062529	11/18/15	11/18/17
USB Peak Power Sensor 50 MHz to 18 GHz	Boonton	55318	9224	09/13/16	09/13/18
Coaxial Cable #103 - KMKM-0180-01 Aqua	Micro-Coax	UFB142A-0-0720-200200	225363-002 (#103)	08/05/15	08/05/17
Type K J Thermometer	Martel	303	080504494	10/26/15	10/26/17

Applicant: Enterprise Electronics Corporation
 FCC ID: BUVRANGERX5
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EMI Test Receiver R & S ESU 40 Chamber	Rohde & Schwarz	ESU 40	100320	04/01/16	04/01/18
High Pass Filter 18GHz	Micro-Tronics	HPS18771	-002	05/13/16	05/13/18
Adapter Waveguide WR-42 to Waveguide WR-90	ATM	42/90-8-6-6	S539408-01	NA	NA
Adapter Waveguide WR-62 to Coax SMA	ATM	62-251A-6	S539808-01	NA	NA
Adapter Waveguide WR-28 to Waveguide WR-90	ATM	28/90-8-6-6	S539708-01	NA	NA
Directional Coupler 20dB	HP	X752D	1829A24209	NA	NA
Adapter Waveguide WR-62 to Waveguide WR-90	ATM	62/90-6-6-6	S539608-01	NA	NA
Adapter Waveguide WR-28 to Coax K	ATM	28-25KZA-6	S539908-01	NA	NA
Attenuator K 6dB 2W DC-40G	Narda	4768-6	1044-2	06/25/15	06/25/17
Attenuator N 30dB 20W DC-4G	CLASS III	34078	M3933/10-5	05/19/15	05/19/17
Adapter Waveguide WR-42 to Coax K	ATM	42-25KA-6	S539508-01	NA	NA
Low Pass Filter WR-90 9.4 GHz	UNK	WR-90 9.4 GHz	N/A	07/27/16	07/27/18
High Pass Filter 980MHz	Microlab	HA-20N	NA	NA	06/17/17
Antenna: Double-Ridged Horn 18-40 GHz	EMCO	3116	9011-2145	11/18/15	11/18/17

*EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3

END OF REPORT