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## DR-145 Test Results

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**MANUFACTURER:** RITRON, INC.  
505 West Carmel Drive  
Carmel, IN 46032

**MODEL:** DR-145

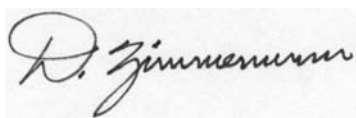
**TYPE OF UNIT:** VHF-FM Receiver Module

**FCC ID:** AIERIT17-145R

**DATE:** Jan 7, 2011

The following is a list of attached exhibits required by the Federal Communications Commission for the application to and grant of FCC Type Acceptance. They were taken by myself, by Dennis Zimmerman, at the Ritron indoor lab facilities and outdoor antenna test range in Carmel, IN.

	<b>FCC Rule</b>	<b>Page</b>
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Required Measurements	2.1033 (c)(14)	
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Spurious Emissions at antenna terminal	2.1051	pg 5
AC Conducted limits	2.1033	pg 6



Dennis Zimmerman  
Project Engineer  
RITRON, Inc.

**TYPE OF EXHIBIT:** TEST EQUIPMENT LIST

**FCC PART:** 2.947 (d)

**MANUFACTURER:** RITRON, INC.  
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**MODEL:** DR-145

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The measured data in this report was obtained using one or more of the following pieces of equipment. The particular equipment used in any one test is detailed in the procedure for that test.

<u>ITEM</u>	<u>MANUFACTURER</u>	<u>MODEL NO.</u>	<u>SERIAL NO.</u>	<u>Last Cal</u>	<u>EXP Cal</u>
Comms Test Set	Hewlett-Packard	HP8920A	3352A03633	9-2-10	8-6-11
Signal generator	Hewlett-Packard	HP8657B	3315V04378	9-2-10	8-6-11
Spectrum Analyzer	Hewlett-Packard	8560E	3720A02980	9-2-10	8-6-11

Support equipment:

<u>ITEM</u>	<u>MANUFACTURER</u>	<u>MODEL NO.</u>	<u>SERIAL NO.</u>
Log Periodic Antenna	Electro-Metrics	LPA-25	8-102
Power Supply	BK/Precision	1730	263-023610

**TYPE OF TEST:** RADIATED SPURIOUS EMISSIONS

**FCC PART:** 2.1053 per 15.109 & 15.33 (b) (3)

**MANUFACTURER:** RITRON, INC.  
505 West Carmel Drive  
Carmel, IN 46032

**MODEL:** DR-145

**TYPE OF UNIT:** VHF-FM Receiver Module

**FCC ID:** AIERIT17-145R

**DATE:** Aug 31, 2010

**PROCEDURE:**

Field strength of spurious radiation of the DR-145 was taken on the RITRON three meter test range up to 436 MHz, the second harmonic of the highest local oscillator, using the substitution method. The following procedure was used.

1. The DR-145 was programmed to receive at the middle of each of the three bands which is 136.1, 161.1 and 174.1 MHz. The units were powered by a BK Precision power supply at 15 VDC.
2. The DR-145 was then terminated at the antenna port with a RAM-1545 antenna.
3. All field strength measurements were made with the Hewlett-Packard Model 8560E Spectrum Analyzer connected to the Electro-Metrics LPA-25 log periodic receive antenna with 25 feet of RG-55 cable.
5. For each emission, the height and polarization of the field strength measuring antenna and orientation of the DTX-145 were varied to find maximum field strength.
6. The worse case emissions levels at each of the frequencies were noted.
7. Calculations were then performed to confirm compliance with the FCC limits.

**SAMPLE CALCULATION:**

$$\text{ERP(dBm)} = \text{Rspur} - \text{Rref} + \text{Pref}$$

where: Rspur and Rref are received power levels of the spur and reference signals respectively. Pref is the reference generator power.

$$\text{Pspur} = 10^{(\text{ERP}-30)/10}$$

converts spur ERP(dBm) to power in watts

$$\text{E(V/m)} = \sqrt{(49.2 \times \text{Pspur})} / r$$

field strength a distance r in meters

$$\text{E(uV/m)} = \text{E(V/m)} \times 10^6$$

A spurious reading of -104 dBm at 179.75 MHz was made. Setting the generator to 0 dBm at the same frequency a substitution level of -17 dBm was read. The power of the spur is thus:

$$\text{Pspur} = -104 - (-17) = -87 \text{ dBm}$$

$$\text{E(V/m)} = \sqrt{(49.2 \times 10^{((-87-30)/10)})} / 3 = 3.3 \times 10^{-6}$$

**TYPE OF TEST:** RADIATED SPURIOUS EMISSIONS  
**FCC PART:** 2.1053 per 15.109  
**MANUFACTURER:** RITRON, INC.  
 505 West Carmel Drive  
 Carmel, IN 46032  
**MODEL:** DR-145  
**TYPE OF UNIT:** VHF-FM Receiver Module  
**FCC ID:** AIERIT17-145R  
**DATE:** Aug 31, 2010

**RESULT SUMMARY:**

		Substitution power(dBm)	Sub Vert reading(dBm)	Max read (dBm)	Max Spur ERP(dBm)	E(uV/m)	FCC limit E(uV/m)
179.75	Horz	0	-17.0	-104	-87.0	3.3	150
	Vert	0	-26.0	-104	-78.0	9.3	150
204.75	Horz	0	-19.0	-105	-86.0	3.7	150
	Vert	0	-27.0	-105	-78.0	9.3	150
217.75	Horz	0	-22.0	-105	-83.0	5.2	150
	Vert	0	-27.0	-105	-78.0	9.3	150

The worse case spurious was 9.3 uV/m which is well below the 150 uV/m FCC limit.

**TYPE OF TEST:** CONDUCTED EMISSIONS AT ANTENNA

**FCC PART:** 2.1051 per 15.111

**MANUFACTURER:** RITRON, INC.  
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Carmel, IN 46032

**MODEL:** DR-145

**TYPE OF UNIT:** VHF-FM Receiver Module

**FCC ID:** AIERIT17-145R

**DATE:** Jan 7, 2011

**PROCEDURE:**

The DR-145 was programmed for receiving at 136.1, 155.1 and 174.1 MHz. Power was supplied to the DR-145 by a BK Precision Model 1730 Power Supply set to 15 VDC. A 3 foot coaxial cable connected the antenna receive port directly the HP8560E spectrum analyzer input. The highest emissions occurred at the local oscillator frequencies. The following table summarizes the measurements. All are well below the FCC required 2 nW conducted emissions.

**RESULTS SUMMARY:**

RX Freq(MHz)	LO Freq(MHz)	Level (dBm)	FCC limit (dBm)	Margin (dB)
136.1	179.75	-72	-57	15
155.1	198.75	-92	-57	35
174.1	217.75	-93	-57	36

**TYPE OF TEST:** AC POWERLINE CONDUCTED EMISSIONS

**FCC PART:** 2.1033 per 15.107

**MANUFACTURER:** RITRON, INC.  
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**MODEL:** DR-145

**TYPE OF UNIT:** VHF-FM Receiver Module

**FCC ID:** AIERIT17-145R

**DATE:** Jan 9, 2011

The DR-145 was powered by a RITRON RPS-1A power supply plugged into a line impedance stabilization network. The outputs were monitored by an HP8560E from 150 kHz to 30 MHz. The following table shows the FCC limits and conversion calculations to dBm for spectrum analyzer measurement:

Frequency of Emission (MHz)	FCC Conducted limit, Quasi-peak (dBuV)	(volts)	(dBm)
0.15	66*	.002	-41
0.5	56	.00063	-51
0.5-5	56	.00063	-51
5-30	60	.001	-47

\*Decrease with the log of frequency

In the above table volts are derived from dBuV as  $v = .000001 * 10^{(dBuV/20)}$

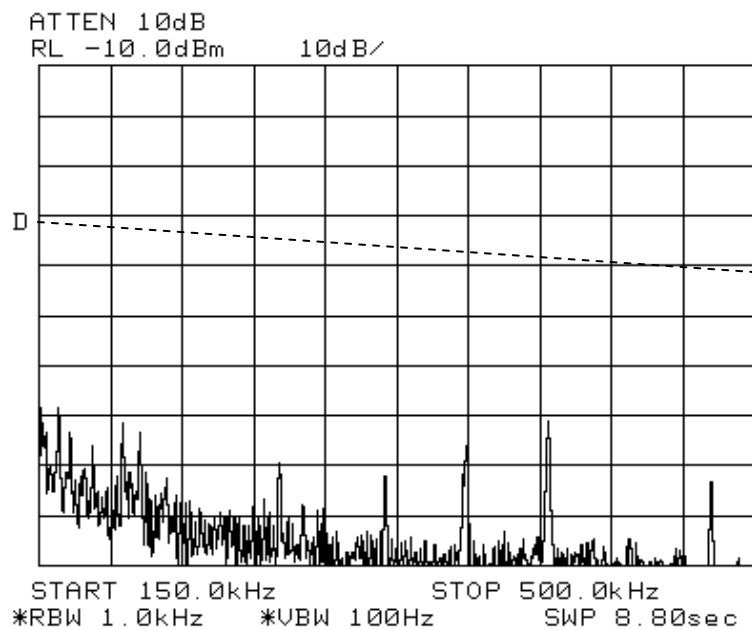
Power is derived as:

$$P(\text{watts}) = V^2/R$$

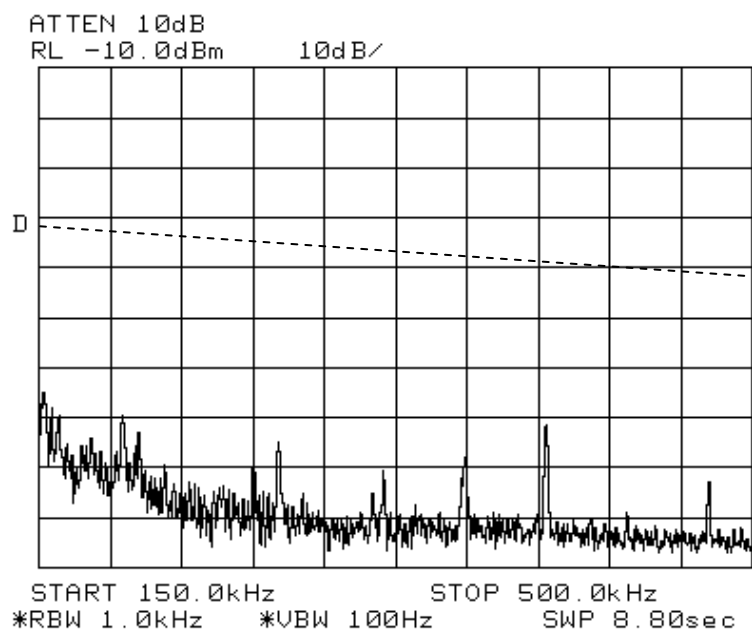
$$P(\text{dBm}) = 10 * \log(P/.001)$$

Where: P is power in watts or dB compared to a milliwatt  
V is voltage in volts  
R is the analyzer input impedance in ohms (50)

The following spectrum analyzer plots show the conducted emissions on the neutral and line for three frequency bands. An FCC limit line is drawn on each of the plots. All conducted emissions fall below FCC limits.

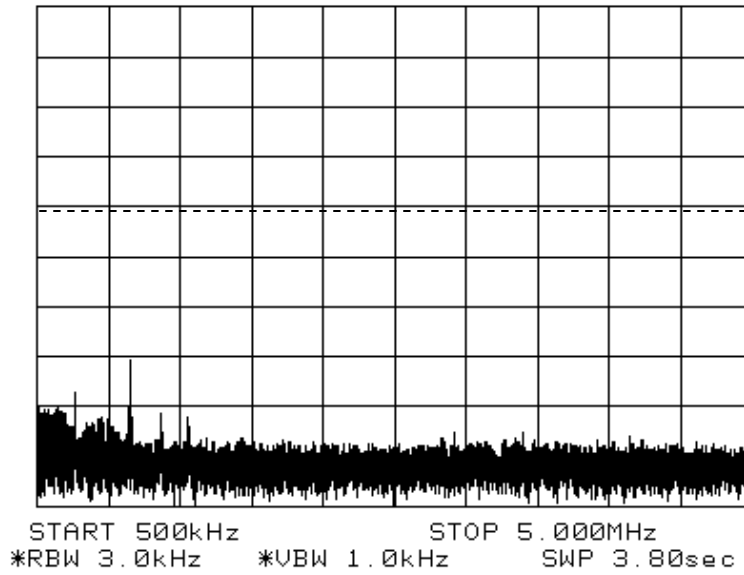


DR-145 AC conducted emissions on line side



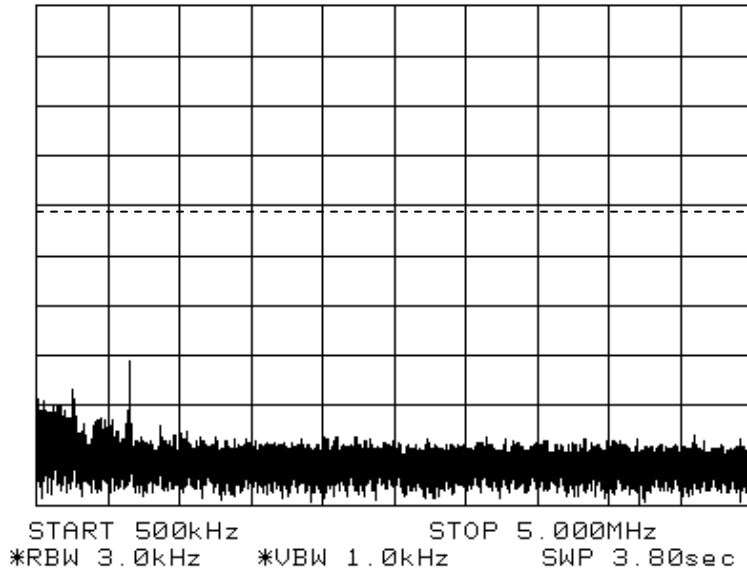
DR-145 AC conducted emissions on neutral side

ATTEN 10dB  
RL -10.0dBm 10dB/



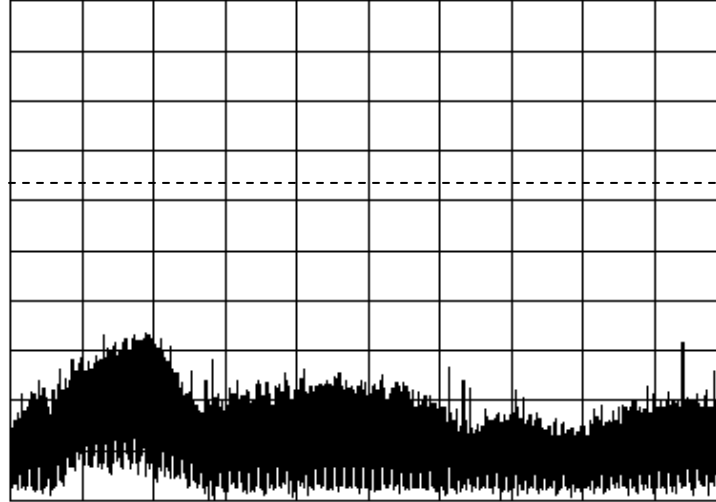
DR-145 AC conducted emissions on line side

ATTEN 10dB  
RL -10.0dBm 10dB/



DR-145 AC conducted emissions on neutral side

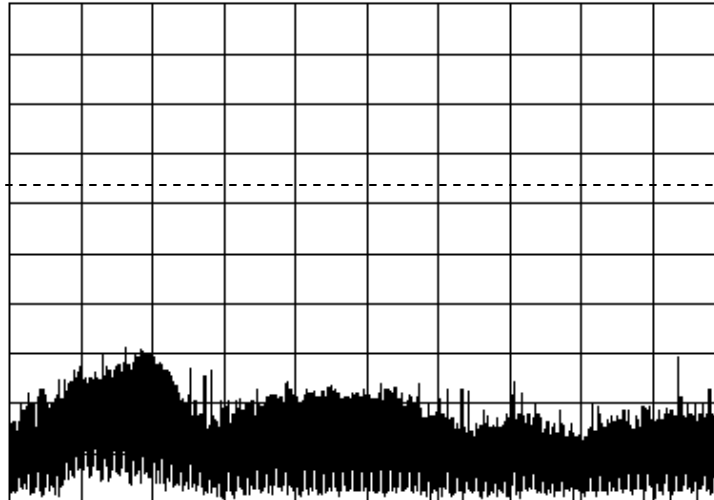
ATTEN 10dB  
RL -10.0dBm 10dB/



START 5.00MHz STOP 30.00MHz  
\*RBW 3.0kHz \*VBW 1.0kHz SWP 21.0sec

DR-145 AC conducted emissions on line side

ATTEN 10dB  
RL -10.0dBm 10dB/



START 5.00MHz STOP 30.00MHz  
\*RBW 3.0kHz \*VBW 1.0kHz SWP 21.0sec

DR-145 AC conducted emissions on neutral side