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FCC PART 90 VHF DATA RADIO

TEST REPORT

APPLICANT	Rothenbuhler Engineering Inc.
ADDRESS	524 Rhodes Road PO Box 708
	Sedro Woolley, WA 98284 – 0708 USA
FCC ID	CW21669-20
MODEL NUMBER	1669-19, 1669-20
PRODUCT DESCRIPTION	VHF Controller
DATE SAMPLE RECEIVED	January 23, 2007
DATE TESTED	January 23, 2007
TESTED BY	Mario de Aranzeta
APPROVED BY	Mario de Aranzeta
TIMCO REPORT NO.	174AUT7TestReport.PDF
TEST RESULTS	☒ PASS ☐ FAIL

ACCREDITED
Certificate # 0955-01

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STATEMENT OF COMPLIANCE

This equipment has been tested in accordance with the standards identified in the referenced test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report and demonstrate that the equipment complies with the appropriate standards. No modifications were made to the equipment during testing in order to demonstrate compliance with these standards.

ACCREDITED

Certificate #0955-01

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 by me or under my supervision, at Timco Engineering, Inc. located at 849 N.W. State Road 45, Newberry, Florida 32669 USA.

Authorized by: Mario de Aranzeta

Signature: On File

Function: Engineer

Date: January 30, 2007

REPORT SUMMARY

Disclaimer	The test results relate only to the items tested.
Purpose of Test	To show the DUT in compliance with FCC CFR 47, Part 90 requirements for VHF radios.
Test Standards	ANSI/TIA 603-C: 2004, FCC CFR 47 Part 90, ANSI C63.4: 2003
Related Approval	There is no significant emissions for receiver portion.

TEST ENVIRONMENT AND TEST SETUP

Test Facility	RF output power and radiated emission were conducted by Timco Engineering Inc. located at 849 NW State Road 45, Newberry, FL 32669 USA
Laboratory Test Condition	The temperature was 26ºC with a relative humidity of 50%.
Deviation from the standards	No deviation
Modification to the DUT	No modification was made.
Test Exercise (software etc.)	The DUT was placed in continuous transmitting mode of operation.
System Setup	Stand alone device.

DUT DESCRIPTION

Manufactured by	Rothenbuhler Engineering Inc.
Product Description	VHF Controller
FCC ID	CW21669-20
M/N	1669-20
Family M/Ns	1669-19
S/N	N/A
Operating Freq	150 ~ 174 MHz
Max. Output Pwr	2 W
Bandwidth	12.5 kHz
Emission Designator(s)	A3D
Modulation	AFSK
Power Source	Rechargeable NiMH battery, 7.5 VDC
Test Item	Preproduction
Type of DUT	Portable
Antenna Spec	Unique
Calculation of Designator(s)	Bn = 2(M) + 2DK M = 3000 D = 2600 K=1 Bn = 2(3000) + 2(2600) = 11200

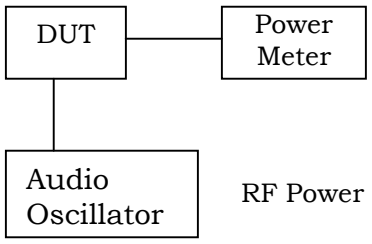
TEST EQUIPMENT

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Analyzer Tan Tower Spectrum Analyzer	HP	8566B Opt 462	3138A07786 3144A20661	CAL 12/7/05	12/7/07
Analyzer Tan Tower RF Preselector	HP	85685A	3221A01400	CAL 12/7/05	12/7/07
Analyzer Tan Tower Quasi-Peak Adapter	HP	85650A	3303A01690	CAL 12/8/05	12/8/07
Analyzer Tan Tower Preamplifier	HP	8449B-H02	3008A00372	CAL 12/8/05	12/8/07
Antenna: Biconnical	Electro-Metrics	BIA-25	1171	CAL 4/29/05	4/29/07
Antenna: Double-Ridged Horn	Electro-Metrics	RGA-180	2319	CAL 12/29/06	12/29/08
Termaline Wattmeter	Bird Electronic Corporation	611	16405	CAL 7/16/06	7/16/08

TEST PROCEDURE

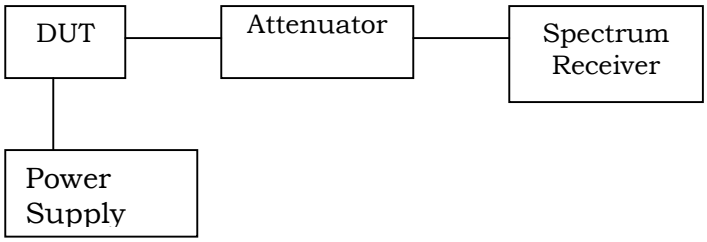
Power Line Conducted Interference
The procedure used was ANSI 63.4-2003 using a 50uH LISN. Both lines were observed with the DUT transmitting. The bandwidth of the spectrum analyzer was 10 kHz with an appropriate sweep speed.

RF Power Output
The RF power output was measured at the antenna feed point using a peak power meter. A 50-ohm, resistive wattmeter was connected to the RF output connector. With a nominal battery voltage, and the transmitter properly adjusted the RF output measures:



RF Power Output Test Setup

Spurious Emissions At Antenna Terminals (Conducted)
The carrier was modulated 100%. The spectrum was scanned from 0.4 to at least the 10th harmonic of the fundamental. Above 1 GHz the resolution bandwidth was 1 MHz and the VBW = 3 MHz and the span to 50 MHz. The measurements were made in accordance with standard ANSI/TIA-603-C: 2004



Radiation Interference
The test procedure used was ANSI/TIA-603-C: 2004 and ANSI C63.4-2003 using an Agilent spectrum receiver with pre-selector. The bandwidth (RBW) of the spectrum receiver was 100 kHz up to 1 GHz and 1 MHz above 1 GHz with an appropriate sweep speed. The VBW above 1 GHz was 3 MHz. The analyzer was calibrated in dB above a microvolt at the output of the antenna.

Modulation Characteristic

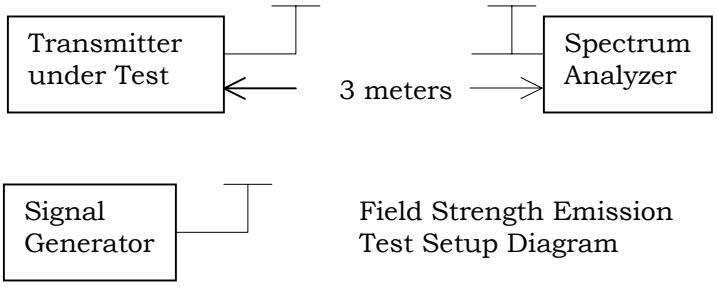
Audio frequency response
The audio frequency response was measured in accordance with ANSI/TIA 603-C: 2004.

Audio Low Pass Filter
The audio low pass filter for voice-modulated equipment was measured in accordance with ANSI/TIA 603-C: 2004.

Audio Input versus modulation
The audio input level needed for a particular percentage of modulation was measured in accordance with ANSI/TIA 603-C: 2004. Curves are provided for audio input frequencies of 300, 1000, and 3000 Hz.

Frequency Stability
The frequency stability was measured per ANSI/TIA 603-C: 2004.

Field Strength of Spurious Emissions
The spectrum was scanned from 30 MHz to at least the tenth harmonic of the fundamental. This test was conducted per ANSI/TIA 603-C: 2004 using the substitution method.



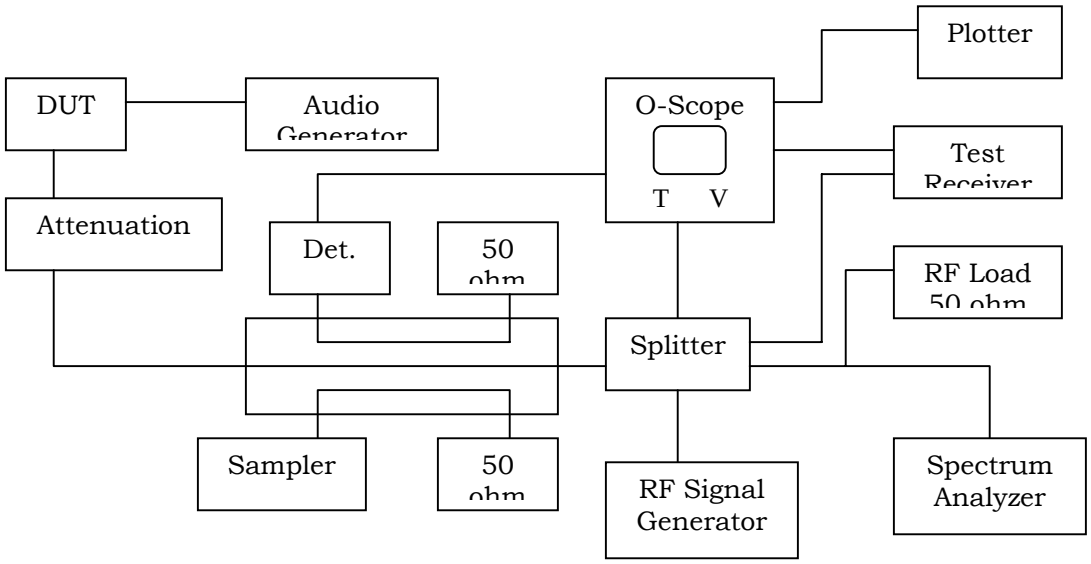
Field Strength Emission Test Setup Diagram

Transient Frequency Behavior

The test procedure was ANSI/TIA 603-C: 2004 Para 2.2.19.

- Using the variable attenuator. The transmitter level was set to 40 dB below the test receivers maximum input level,
- Then the transmitter was turned off.
- With the transmitter off the signal generator was set 20dB below the level of the transmitter in the above step, this level will be maintained with the signal generator through-out the test.
- Reduce the attenuation between the transmitter and the RF detector by 30 dB.
- With the levels set as above the transient frequency behavior was observed & recorded.

Transient Frequency Response Test setup



TEST RESULT

RF POWER OUTPUT

Rule Part No.: Part 2.1046(a), Part 90

Requirements: Part 2.1046

Test Data: Tested by the applicant

Nominal Battery at 7.5 Vdc

Frequency	Power (Watts)
150	2.05
161	2.01
174	2.01

MODULATION CHARACTERISTICS

Rule Parts No.: Part 2.1047(a)(b), Part 90

Requirements: A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 – 5000Hz shall be submitted.

For voice modulated communication equipment, a curve or equivalent data showing audio low pass filter shall be submitted.

Audio input versus modulation cannot exceed 100%.

Test Data: Not applicable. The DUT is a data radio.

OCCUPIED BANDWIDTH

Rule Parts No: 2.1049, Pt 90.210(b)

Test Requirement:

Part 90.210(b) 25kHz Channel Spacing
Data in the plots show that on any frequency removed from the assigned frequency by more than 50%, but not more than 100%: At least 25dB. On any frequency removed from the assigned frequency by more than 100%, but not more than 250%: At least 35 dB. On any frequency removed from the assigned frequency by more than 250%, of the authorized bandwidth: At least 43 + 10log(P)dB.

Part 90.210(c) 12.5kHz Channel Spacing Not Equipped with a Low Pass Filter
For transmitters that are not equipped with an audio low pass filter pursuant to S90.211 (b), the power of any emission must be attenuated below the un-modulated carrier output power as follows; (1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5 kHz but not more than10 kHz: At least 83 log (fd/5) dB; (2) ON any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 10 kHz, but not more than 250% of the authorized bandwidth: At least 29 log(fd2/11)dB or 50 dB, whichever is the lesser attenuation; (3) On any frequency removed from the center of the authorized bandwidth by more than 250% of the authorized bandwidth: At least 43+10 log(Po)dB.

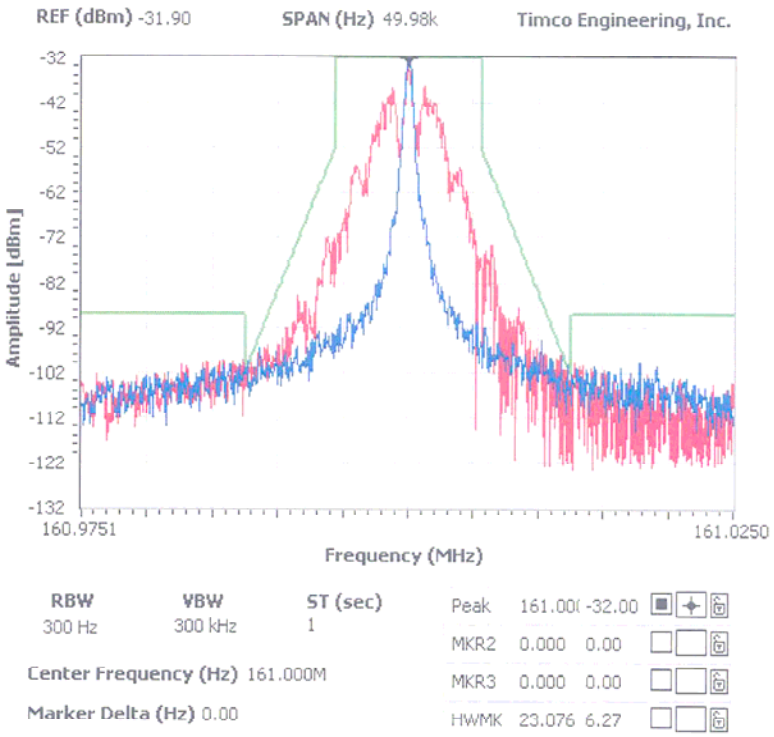
Part 90.210(d) Emission Mask D - 12.5 kHz channel BW equipment.
For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f0 to 5.625 kHz removed from f0: Zero dB.
(2) On any frequency from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27 (fd - 2.88 kHz) dB.
(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10log(P) dB or 70 dB, whichever is the lesser attenuation.

Test Data - Plot - Part 90.210(d) Emission Mask D - 12.5 kHz channel spacing.

NOTES:
Rothenbuhler Engineering Inc. - FCC ID: CW2TBD
OCCUPIED BANDWIDTH PLOT - 12.5 KHz

FCC 90.210 Mask D



SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Rule Part No.: Part 2.1051(a)

Requirements: 12.5 kHz Spacing =50+10log(Po)=50+10log(5)=57 dB

Test Data:

Emission Frequency MHz	dB Below Carrier (dBc)
150	0
300	88
450	103
600	93
750	98.4
900	*
1050	*
1200	*
1350	*
1500	*

Emission Frequency MHz	dB Below Carrier (dBc)
161	0
322	80.8
483	72.9
644	77
805	*
966	*
1127	*
1288	*
1449	*
1610	*

Emission Frequency MHz	dB Below Carrier (dBc)
174	0
348	84.5
522	86.5
696	102.7
870	*
1044	*
1218	*
1392	98.1
1566	98.9
1740	98.8

* Emissions are in the noise level and not reported.

FIELD STRENGTH OF SPURIOUS EMISSIONS (RADIATED)

Rule Parts. No.: Part 2.1053

Requirements: Same as conducted emissions

Test Data: 12.5 kHz Spacing

Emission Frequency MHz	Ant. Polarity V/H	dB Below Carrier (dBc)
150.00	0	0
300.00	V	111.9
450.00	H	110.4
600.00	H	107.3
750.00	V	85.4
900.00	V	100.3
1050.00	V	92.6
1200.00	V	90.4
1350.00	H	90.3
1500.00	V	90.5

Emission Frequency MHz	Ant. Polarity V/H	dB Below Carrier (dBc)
161.00	0	0
322.00	V	110.0
483.00	V	103.6
644.00	V	99.3
805.00	V	89.6
966.00	V	96.8
1127.00	V	92.4
1288.00	V	89.2
1449.00	H	91.00
1610.00	V	88.3

Emission Frequency MHz	Ant. Polarity V/H	dB Below Carrier (dBc)
174.00	0	0
348.00	V	107.7
522.00	V	94.1
696.00	V	105.1
870.00	V	83.1
1044.00	V	93.1
1218.00	H	90.5
1392.00	V	89.3
1566.00	V	89.9
1740.00	V	83.2

FREQUENCY STABILITY

Rule Parts. No.: Part 2.1055, Part 90.213

Requirements: Temperature range requirements: -30 to +50° C.
Voltage Variation +, -15%
±2.5 PPM

Test Data: Tested by the applicant

Test Voltage (Vdc) Test Temperature (°C]	Frequency [MHz]	Unit
7.5 Vdc	161 MHz	
-30	-0.05	[ppm]
-20	-2.04	[ppm]
-10	-1.85	[ppm]
0	-0.85	[ppm]
10	-0.42	[ppm]
20	0.05	[ppm]
30	-0.07	[ppm]
40	-0.01	[ppm]
50	0.57	[ppm]
60	1.66	[ppm]

Test Voltage [Vdc] Test Temperature (°C]	Frequency [MHz]	Unit
6.5 Vdc	161 MHz	]
20	0.07	[ppm]

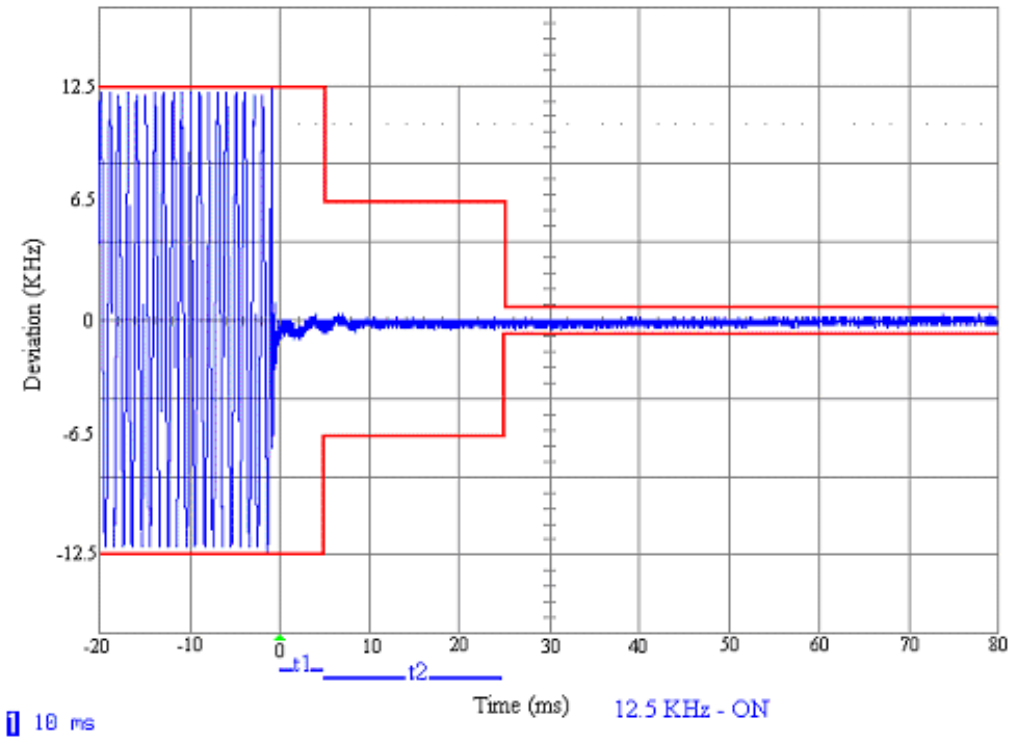
TRANSIENT FREQUENCY BEHAVIOR

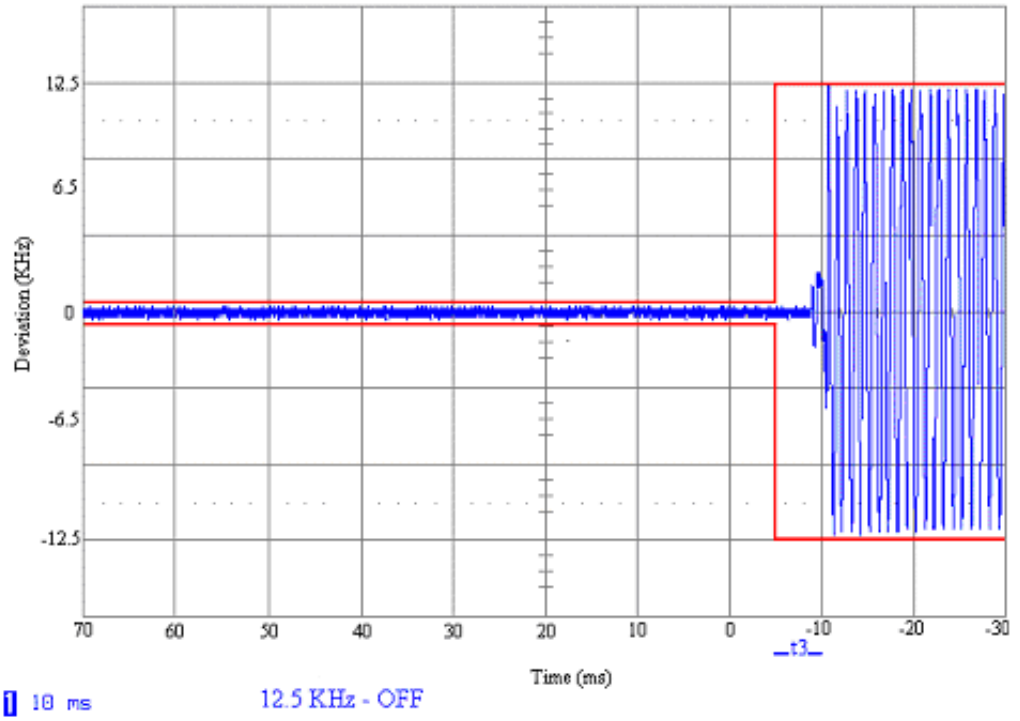
Rule Parts: Part 90.214

Requirements: Transmitters designed to operate in the 150-174 MHz and 421-512 MHz frequency bands must maintain transient frequencies within the maximum transient frequencies within the maximum frequency difference limits during the time intervals indicated:

Time Intervals	Maximum frequency difference	All Equipment	
		150-174 MHz	421-512 MHz
Equipment Designed to Operate on 25 kHz Channels			
t_1[4]	±25.0 kHz	5.0 mS	10.0 mS
t_2	±12.5 kHz	20.0 mS	25.0 mS
t_3[4]	±25.0 kHz	5.0 mS	10.0 mS
Equipment Designed to Operate on 12.5 kHz Channels			
t_1[4]	±12.5 kHz	5.0 mS	10.0 mS
t_2	±6.25 kHz	20.0 mS	25.0 mS
t_3[4]	±12.5 kHz	5.0 mS	10.0 mS
Equipment Designed to Operate on 6.25 kHz Channels			
t_1[4]	±6.25 kHz	5.0 mS	10.0 mS
t_2	±3.125 kHz	20.0 mS	25.0 mS
t_3[4]	±6.25 kHz	5.0 mS	10.0 mS

Test Data: Please see the plots hereinafter.


12.5
6.5
0
-6.5
-12.5
Deviation (KHz)
-20
-10
0
10
20
30
40
50
60
70
80
t1
t2
Time (ms)
10 ms
12.5 KHz - ON


12.5
6.5
0
-6.5
-12.5
Deviation (KHz)
70
60
50
40
30
20
10
0
-10
-20
-30
t3
Time (ms)
10 ms
12.5 KHz - OFF

POWER LINE CONDUCTED INTERFERENCE

Rules Part No.: Part 15.207

Requirements:

Frequency (MHz)	Quasi Peak Limits (dBuv)	Average Limits (dBuV)
0.15 – 0.5	66 – 56	56 – 46
0.5 – 5.0	56	46
5.0 – 30	60	50

Test Data: Not applicable DUT is battery operated exclusively.