Type Acceptance Test Report

UHF Data Transmit Module

FCC ID: B2FTALON-V

FCC Rule Part: 90

ACS Report Number: 03-0101-90TA

Manufacturer: Kantronics
Model: Talon UDC

Test Begin Date: May 15, 2003
Test End Date: June 20, 2003

Report Issue Date: July 4, 2003

Prepared by: _____
R. Sam Wismer
Engineering Manager
ACS, Inc.

Reviewed by: _____
Richard Bianco
EMI/EMC Approvals Engineer
ACS, Inc.

This report contains 16 pages

Table of Contents

Additional Exhibits Included In Filing
Data Plots
Internal Photographs
External Photographs
Test Setup Photographs
Product Labeling
RF Exposure – MPE Calculations
Technical Documentation
Installation/Users Guide
Theory of Operation and System Block Diagram

1.0 GENERAL

1.1 Introduction
The purpose of this report is to demonstrate compliance with the relevant portions of Parts 2, 15 and 90 of the FCC's Code of Federal Regulations.

1.2 Product Description
The EUT, Talon UDC, is an FCC Part 90 VHF 12.5kHz data transceiver operating in the 150 - 174 MHz band.

Detailed photographs of the EUT are included separately with this filing.

1.2.1 Intended Use
The Kantronics Talon UDC module is intended for use as a base station or a mobile device for use in vehicles. It is marketed as ideal for the following applications:

- Asset and vehicle tracking
- Gas/oil production monitoring
- Traffic control
- Industrial process control
- Water management
- Utility monitoring
- Public safety
- Text messaging
- Emergency management

1.2.2 Technical Specifications

Table 1.2.2-1: General Specifications

FCC Identifier	B2FTALON-V
FCC Rule Part	90
Frequency Range	150 – 174 MHz
Number of channels	1 RX and 1 TX
Transmit/Receive Spacing	20 MHz maximum
Mode of Operation	Simplex or Half Duplex
Frequency Control	PLL Synthesizer
Frequency Step Size	5 or 6.25 kHz
Emissions Bandwidth	
Frequency Stability (-30 to +60 °C)	1.5 PPM
Supply Voltage	8 to 15 V dc (< 50 mV rms. noise)
Supply Current	RX: ????? TX: ????? w/GPS???????
RF I/O Connector	N(f)
Power Connector	COMBICON 2-pin
Programming/Data Interface	9-terminal D-subminiature female
Sensor Interfaces?	
Operating Temperature	-30 to +60 °C
Humidity	90 % maximum non-condensing
GPS Receiver (if installed)	
Dimensions w/o Protrusions	H x W x D
Weight/Mass	

Table 1.2.2-1 Transmitter Specifications

Operating Bandwidth	20 MHz
RF Output Power	S/W adjustable up to 6 W
Duty Cycle	5 to 100 % depending upon supply voltage, power level, and ambient temperature
RF Z_{load}	50 Ω
Attack time	15 ms maximum
Spurious and Harmonics	-20 dBm maximum
Group Delay Variation (w/in Frequency Response)??	5 μs maximum
Current Drain	2.4 A + ? ?????

Table 1.2.2-3: Receiver Specifications

Operating Bandwidth	20 MHz
Sensitivity	-115 dBm? (for 1 x 10^{-9} BER)??
RF Zin	50 Ω
Adjacent Channel Selectivity	60 dB minimum
Spurious and Image Rejection	70 dB minimum
Intermodulation Rejection	70 dB minimum
FM Hum and Noise (per TIA/EIA 603)???	40 dB minimum ?????
Conducted Spurious	-57 dBm maximum
Receive Attack Time (TX to RX)	15 ms maximum??????
RSSI Squelch Attack Time??????	5 ms maximum
Audio Distortion (per TIA/EIA 603)????	5 % maximum?????
Group Delay Variation (w/in Frequency Response)	20 μs maximum
Current Drain	75 mA maximum

2.0 LOCATION OF TEST FACILTY

All testing was performed by qualified ACS personnel located at the following address:

ACS, Inc.
5015 B.U. Bowman Drive
Buford, GA 30518

2.1 DESCRIPTION OF TEST FACILITY

Both the Open Area Test Site(OATS) and Conducted Emissions site have been fully described, submitted to, and accepted by the FCC, Industry Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

The following certification numbers have been issued in recognition of these accreditations and certifications:

FCC Registration Number: 89450
Industry Canada Lab Code: IC 4175
VCCI Member Number: 1831

- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

2.1.1 Open Area Test Site

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane, however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 2.1-1 below:

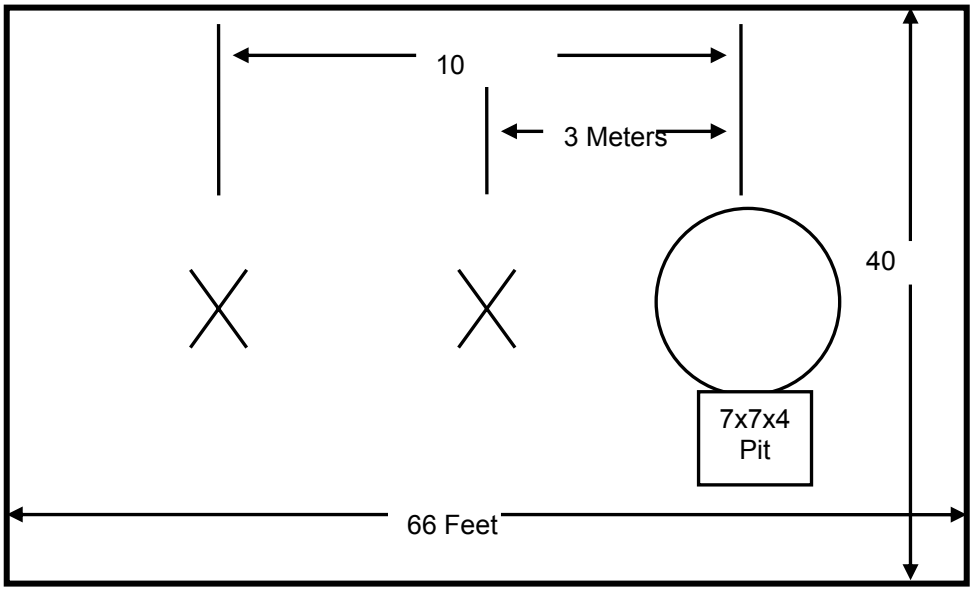


Figure 2.1-1: Open Area Test Site

2.1.2 Conducted Emissions Test Site Description

The AC mains conducted EMI site is a shielded room with the following dimensions:

- Height: 3.0 Meters
- Width: 3.6 Meters
- Length: 4.9 Meters

The room is manufactured by Rayproof Corporation and installed by Panashield, Inc. Earth ground is provided to the room via an 8' copper ground rod. Each panel of the room is connected electrically at intervals of 4".

Power to the room is filtered to prevent ambient noise from coupling to the EUT and measurement equipment. Filters are models 1B42-60P manufactured by Rayproof Corporation.

The room is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4.

A diagram of the room is shown below in figure 2.1.2-1:

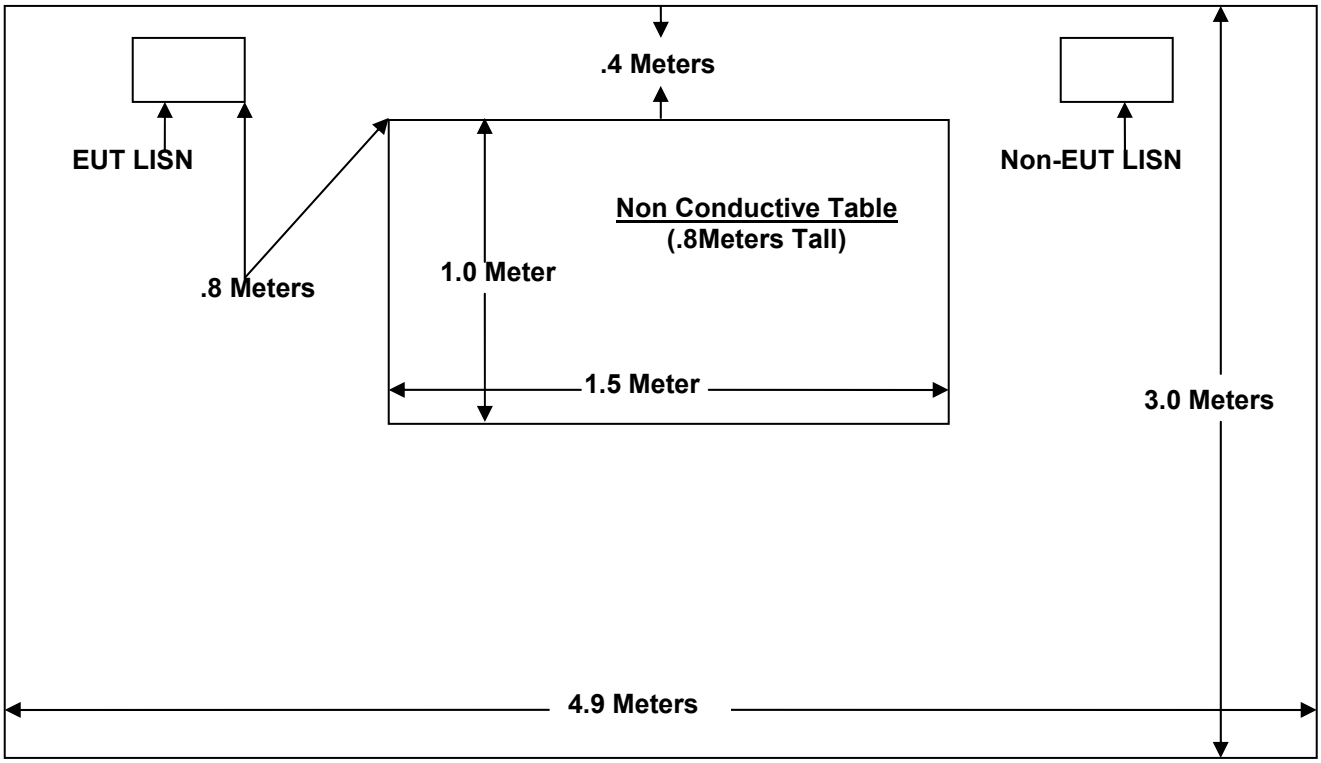


Figure 2.1.2-1: AC Mains Conducted EMI Site

3.0 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-1992: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures (October 2002)
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators (October 2002)
- US Code of Federal Regulations (CFR): Title 47, Part 90: Private Land Mobile Radio Services(October 2002)
- FCC OET Bulletin 65 Appendix C - Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields
- ANSI/TIA/EIA – 603 – A – 2001: Land Mobile or PM Communications Equipment and Performance Standards (August 15, 2001)

4.0 LIST OF TEST EQUIPMENT

All test equipment used for regulatory testing is calibrated yearly or according to manufacturer's specifications.

Table 4-1: Test Equipment

Radiated, Radiated Spurious and Conducted Emissions

Equipment Calibration Information					
ACS #	**Mfg.**	**Eq. type**	**Model**	**S/N**	**Cal. Due**
4	Rohde & Schwarz	Spectrum Analyzer	ESMI	833827/003	8/16/03
3	Rohde & Schwarz	Display Unit	ESDI	839379/011	8/16/03
2	Rohde & Schwarz	Spectrum Analyzer	ESMI	839587/003	12/23/03
1	Rohde & Schwarz	Display Unit	ESDI	839379/011	12/26/03
26	Chase	Bi-Log Antenna	CBL6111	1044	8/26/03
25	Chase	Bi-Log Antenna	CBL6111	1043	9/19/03
71	Chase	LISN	ALN2070A	1028	8/23/03
152	EMCO	LISN	3825/2	9111-1905	12/11/03
153	EMCO	LISN	3825/2	9411-2268	12/11/03
30	Spectrum Technologies	Horn Antenna	DRH-0118	970102	9/17/03
16	ACS	Cable	RG8	16	9/17/03
23	ACS	Cable	RG8	23	1/3/04
24	ACS	Cable	Heliax	24	04/07/04
5	ACS	Cable	LL-335	None	7/31/03
6	ACS	Cable	LL-335	None	7/31/03
22	Agilent	Pre-Amplifier	8449B	3008A00526	9/21/03
73	Agilent	Pre-Amplifier	8447D	272A05624	04/15/04
30	Spectrum Technologies	Horn Antenna	DRH-0118	970102	9/17/03
105	Microwave Circuits	High Pass Filter	H1G810G1	2123-01 DC0225	6/17/04
---	Agilent Technologies	Frequency Counter	AT-5381A	1191075D	06/05/04
---	Hewlett Packard	Modulation Analyzer	778D	991-02848	06/13/04

5.0 SYSTEM BLOCK DIAGRAM

Table 5.0: System Block Diagram

Diagram Number	Manufacturer	Equipment Type	Model Number	Serial Number	FCC ID
1	EUT	Radio Module	Kantronics Talon UDC	None	B2FTALON-V
2	IBM	Laptop	Thinkpad 9547	78-7FN16	AN00CF2704AT
3	HP	DC Power Supply	6286A	2109A-06095	None
4	Termaline	Attenuator	8085	14281	None

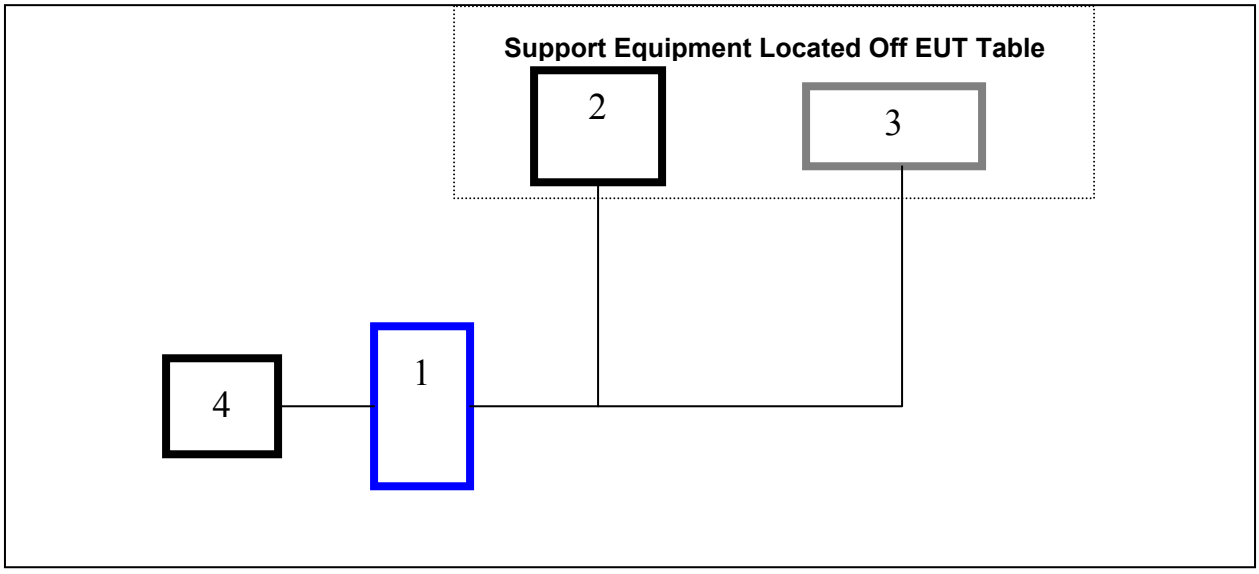


Figure 5.0-1: EUT Test Setup

6.0 SUMMARY OF TESTS

6.1 Power Line Conducted Emissions - FCC Section 15.207

6.1.1 Test Methodology

ANSI C63.4 sections 6 and 7 were the guiding documents for this evaluation. Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz.

6.1.2 Test Results

The EUT is powered from an external DC source and there is no connection to the AC mains, therefore this requirement is not applicable to the EUT.

6.2 Radiated Emissions - FCC Section 15.209(Unintentional Radiation)

6.2.1 Test Methodology

ANSI C63.4 Sections 6 and 8 were the guiding documents for this evaluation. Radiated emissions tests were performed over the frequency range of 30MHz to 1000. Measurements of the radiated field strength were made at a distance of 3m from the boundary of the equipment under test (EUT) and the receiving antenna. The antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. Radiated measurements were made with the Spectrum Analyzer's resolution bandwidth set to 120KHz for measurements above 30MHz.

The RF connector was terminated with a 50W, 50Ohm terminator and the EUT was set for an idle state where no transmissions were occurring.

6.2.2 Test Results

Results of the test are given in Table 6.2.2-1 below:

Table 6.2.2-1: Radiated Emissions Tabulated Data (Unintentional Radiators)

Frequency (MHz)	Uncorrected Reading (dBµV)	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Position (°)	Total Correction Factor (dB)	Corrected Reading (dBµV)	Limit (dBµV)	Margin (dB)	Results
30	7.95	v	100	205	19.50	27.45	39	11.6	**Pass**
39	13.5	v	150	352	14.80	28.30	39	10.7	**Pass**
51.5	9.45	v	100	0	8.69	18.14	39	20.9	**Pass**
176.4	15.3	v	100	351	11.24	26.54	43.5	17.0	**Pass**
192.3	19.3	v	100	174	10.80	30.10	43.5	13.4	**Pass**
194.1	18.5	v	100	269	10.80	29.30	43.5	14.2	**Pass**
317.8	36.5	v	350	314	-11.65	24.85	46.5	21.7	**Pass**
476.9	36.3	v	100	139	-6.74	29.56	46.5	16.9	**Pass**
954.6	21.5	v	100	0	1.23	22.73	46.5	23.8	**Pass**
30.3	7.5	h	100	0	19.34	26.84	39	12.2	**Pass**
38.8	7.5	h	100	0	14.90	22.40	39	16.6	**Pass**
52	8.3	h	100	0	8.52	16.82	39	22.2	**Pass**
175.2	10.3	h	100	0	11.29	21.59	43.5	21.9	**Pass**
191.9	8.13	h	100	0	10.80	18.93	43.5	24.6	**Pass**
195.7	21.1	h	100	0	10.81	31.91	43.5	11.6	**Pass**
317.9	44.5	h	200	263	-11.65	32.85	46.5	13.7	**Pass**
476.9	42.6	h	200	69	-6.74	35.86	46.5	10.6	**Pass**
954.7	21.5	h	100	0	1.24	22.74	46.5	23.8	**Pass**

6.3 Peak Output Power Requirement - FCC Section 2.1046 & 90.205

6.3.1 Test Methodology

TIA/EIA-603-A, section 2.2.1 was the guiding document for this evaluation. The EUT was caused to generate a modulated carrier on low, mid and high channels.

The measurement setup is as shown below in figure 6.3.1-1.

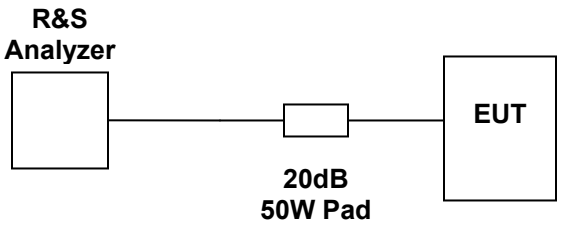


Figure 6.3.1-1: RF Output Power Test Setup

6.3.2 Test Results

Results are given in table 6.3.2-1.

Table 6.3.2-1: RF Output Power

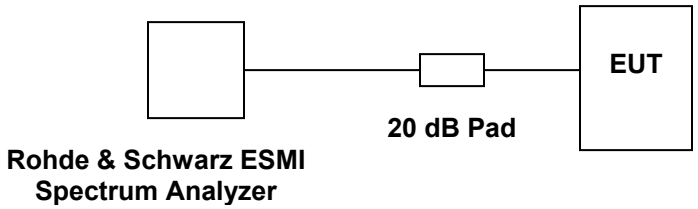
Frequency (MHz)	Power Meter Reading (dBm)	Corrected Power Reading (dBm)
150	17.78	37.78
162	17.79	37.79
174	17.82	37.82

Corrected Reading = Meter Reading + 20dB Pad

6.4 Occupied Bandwidth/Emission Mask – FCC Section 2.1049 & 90.210

6.4.1 Test Methodology

TIA/EIA-603-A section 2.2.11 was the guiding document for this evaluation. The EUT must meet the Emission Mask D requirements. The EUT was caused to generate a modulated signal on low, mid and high channels. The measurement setup is as shown below in figure 6.4.1-1:



6.4.2 Test Results

Results are shown below in figures 6.4.2-1 through 6.4.2-3:

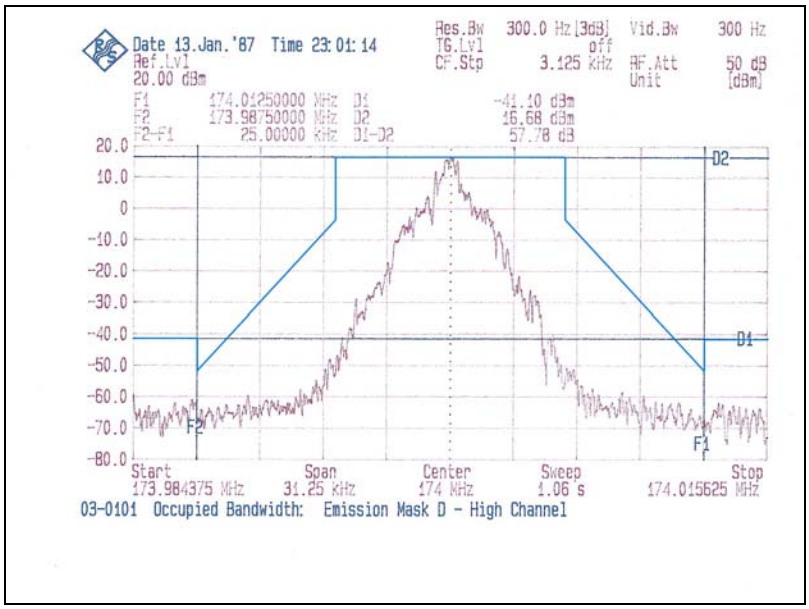


Figure 6.4.2-1: Occupied Bandwidth – High Channel

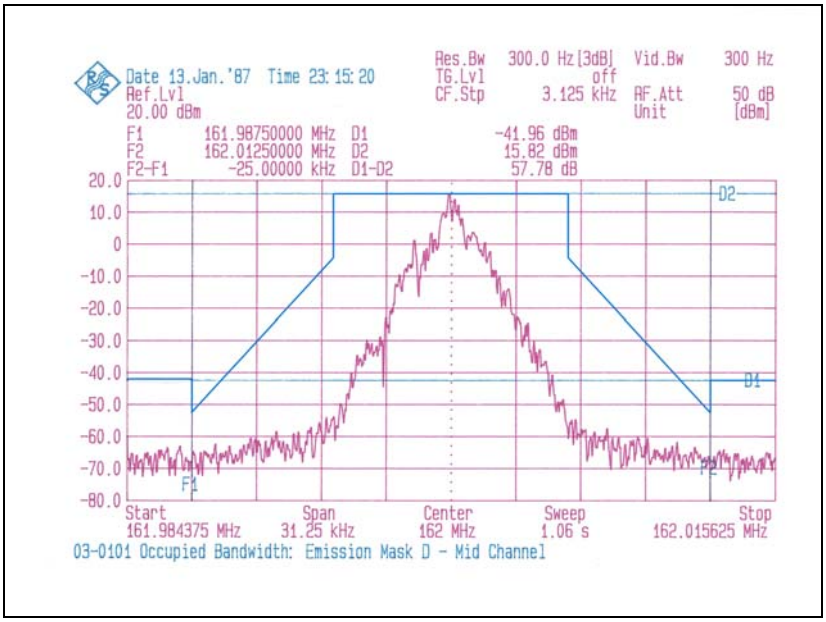


Figure 6.4.2-2: Occupied Bandwidth – Mid Channel

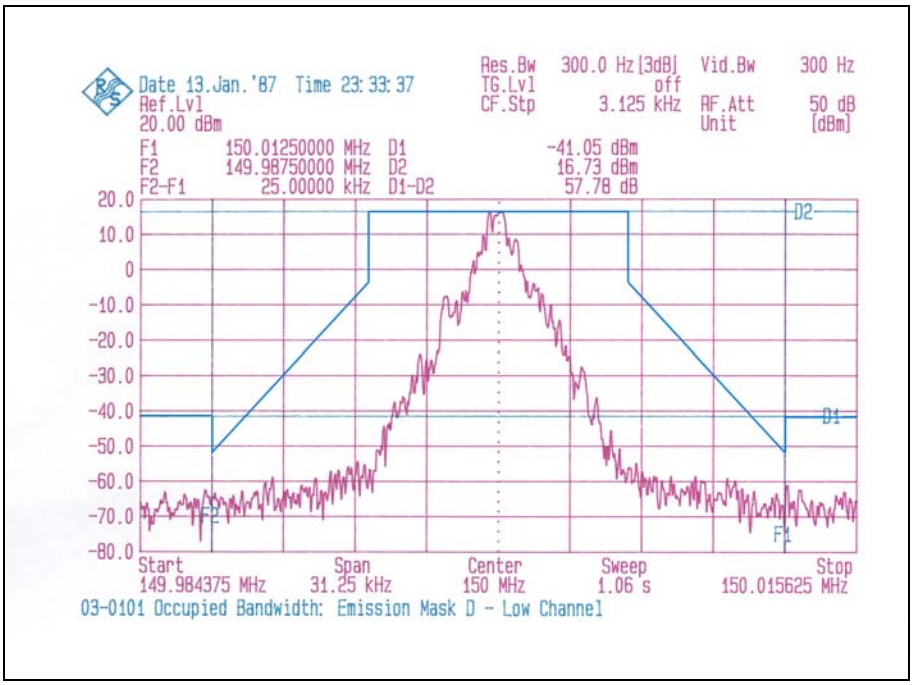


Figure 6.4.2-1: Occupied Bandwidth – Low Channel

6.5 Spurious Emissions

6.5.1 RF Antenna Conducted Spurious Emissions – FCC Section 2.1051 & 90.210

6.5.1.1 Test Methodology

TIA/EIA-603-A section 2.2.13 was the guiding document for this evaluation. Spurious emissions were measured at high, mid and low channels.

6.5.1.2 Test Results

See file "03-0101 Data Plots.pdf" submitted separately for results.

6.5.2 Radiated Spurious Emissions – FCC Section 2.1053 & 90.210

6.5.2.1 Test Methodology

TIA 603-A section 2.2.12 was the guiding document for this test. The RF connector was terminated with a 50W, 50Ohm terminator.

6.5.2.2 Test Results

The limit for this test is determined by the formula 50+10log(Pwatts).

Radiated spurious emissions found in the band of 30MHz to 2GHz GHz are reported in Table 6.5.2.2-1.

Table 6.5.2.2-1: Radiated Spurious Emissions

Frequency (MHz)	Meter Reading (dBµV)	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Position (°)	Total Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)	Results
317.99	40.97	V	100	270	-11.65	-77.68	-20	57.7	**Pass**
476.98	44.14	V	100	249	-6.74	-69.60	-20	49.6	**Pass**
635.98	18.96	V	100	270	-3.33	-91.37	-20	71.4	**Pass**
794.98	36.38	V	100	270	-1.91	-72.53	-20	52.5	**Pass**
953.98	35.08	V	100	283	1.21	-70.71	-20	50.7	**Pass**
317.98	26.42	H	150	270	-11.65	-92.23	-20	72.2	**Pass**
476.97	32.39	H	100	202	-6.74	-81.35	-20	61.4	**Pass**
635.98	25.26	H	100	345	-3.33	-85.07	-20	65.1	**Pass**
794.98	10.08	H	100	0	-1.91	-98.83	-20	78.8	**Pass**
953.98	38.71	H	150	273	1.21	-67.08	-20	47.1	**Pass**

Results: Pass

6.6 Frequency Stability – FCC Sections 2.1055 & 90.213

6.6.1 Temperature

6.6.1.1 Test Methodology

TIA/EIA-603-A section 2.2.2 was the guiding document for this evaluation. The EUT was soaked at each temperature for 30 minutes to allow the RF circuitry to stabilize before making each measurement. The test was performed on the EUT on low, middle and high channels. The test setup is shown below in figure 6.6.1.1-1.

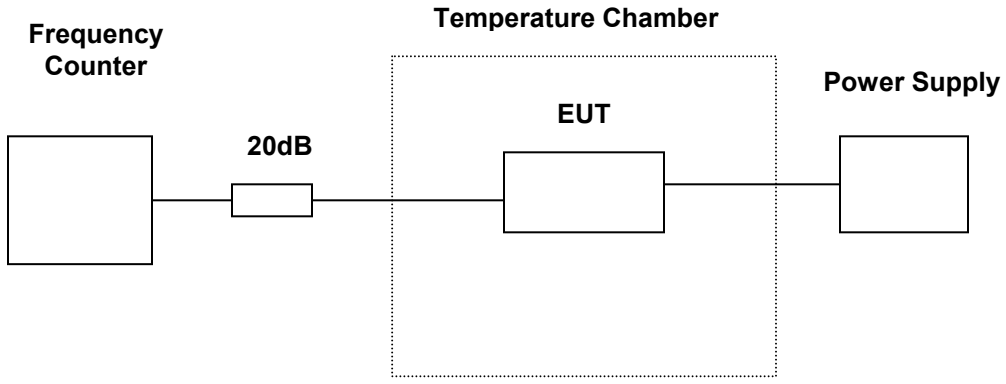


Figure 6.6.1.1-1: Frequency Stability Test Set-Up

6.6.1.2 Test Results

The EUT can be considered fixed or a base station and is subject to note 5 in 90.213(a). The frequency stability limit for such devices is 2.5ppm. Test results are shown below in table's 6.6.1.2-1 through 6.6.1.2-3:

Table 6.6.1.2-1: Low Channel

Assigned Carrier Frequency (MHz)	Measured Frequency (MHz)	Temperature (C)	Frequency Stability (ppm)	Limit (ppm)
150	149.99998	-30	-0.113333333	2.5
	149.99999	-20	-0.066666667	2.5
	149.99998	-10	-0.133333333	2.5
	149.99999	0	-0.066666667	2.5
	149.99999	10	-0.066666667	2.5
	149.99999	20	-0.066666667	2.5
	149.99998	30	-0.133333333	2.5
	149.99998	40	-0.133333333	2.5
	149.99999	50	-0.066666667	2.5

Table 6.6.1.2-2: Middle Channel

Assigned Carrier Frequency (MHz)	Measured Frequency (MHz)	Temperature (C)	Frequency Stability (ppm)	Limit (ppm)
159	158.99993	-30	-0.471069182	2.5
	158.99995	-20	-0.313836478	2.5
	158.99996	-10	-0.24591195	2.5
	159.00000	0	0.008805031	2.5
	159.00004	10	0.237106918	2.5
	159.00000	20	-0.005031447	2.5
	158.99996	30	-0.277987421	2.5
	158.99990	40	-0.620125786	2.5
	158.99989	50	-0.718867925	2.5

Table 6.6.1.2-1: Low Channel

Assigned Carrier Frequency (MHz)	Measured Frequency (MHz)	Temperature (C)	Frequency Stability (ppm)	Limit (ppm)
174	173.99999	-30	-0.057471264	2.5
	173.99999	-20	-0.063218391	2.5
	173.99999	-10	-0.057471264	2.5
	173.99998	0	-0.114942529	2.5
	173.99998	10	-0.114942529	2.5
	173.99998	20	-0.114942529	2.5
	173.99998	30	-0.114942529	2.5
	173.99998	40	-0.114942529	2.5
	173.99998	50	-0.114942529	2.5

6.6.2 Voltage

6.6.2.1 Test Methodology

TIA/EIA-603-A section 2.2.2 was the guiding document for this evaluation. The EUT voltage range is 8 to 15 VDC. Frequency stability was measured at voltages of 85% of the minimum voltage and 115% of the maximum voltage. The test setup is shown below in Figure 6.6.2.1-1:

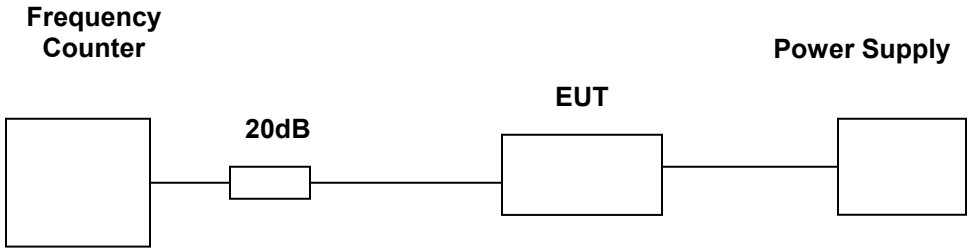


Figure 6.6.2.1-1: Frequency Stability – Voltage Setup

6.6.2.2 Test Results

The test results are shown below in table's 6.6.2.2-1 through 6.6.2.2-3:

Table 6.6.2.2-1: Low Channel

Assigned Carrier Frequency (MHz)	Meter Reading (MHz)	Voltage(%)	Frequency Stability (ppm)	Limit (ppm)
150	149.99989	100	-0.733333333	2.5
	149.99991	115	-0.6	2.5
	149.99988	85	-0.8	2.5

Table 6.6.2.2-1: Middle Channel

Assigned Carrier Frequency (MHz)	Meter Reading (MHz)	Voltage(%)	Frequency Stability (ppm)	Limit (ppm)
159	158.99990	100	-0.628930818	2.5
	158.99989	115	-0.691823899	2.5
	158.99989	85	-0.691823899	2.5

Table 6.6.2.2-3: High Channel

Assigned Carrier Frequency (MHz)	Meter Reading (MHz)	Voltage(%)	Frequency Stability (ppm)	Limit (ppm)
174	173.99999	100	-0.057471264	2.5
	173.99999	115	-0.057471264	2.5
	173.99999	85	-0.057471264	2.5

7.0 CONCLUSION

In the opinion of ACS, Inc. the Talon UDC, manufactured by Kantronics meets the relevant requirements of FCC Parts 2, 15 and 90 as required.