U. S. Telemetry Corporation
FCC Part 95, Certification Application
USTC-TED-0002 with Internal Antenna

March 5, 2001

MEASUREMENT/TECHNICAL REPORT

COMPANY NAME: **U. S. Telemetry Corporation**

MODEL: **USTC-TED-0002 with Internal Antenna**

FCC ID: **OZ9USTC-TED-0002I**

DATE: **March 5, 2001**

This report concerns (check one): Original grant_X__
Class II change_____

Equipment type: _____

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes_____ No_X_

If yes, defer until:_____
date

__N.A.__ agrees to notify the Commission by__N.A.____
date
of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

United States Technologies, Inc.
3505 Francis Circle
Alpharetta, GA 30004

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SECTION 1

GENERAL INFORMATION

GENERAL INFORMATION

1.1 Product Description

The Equipment Under Test (EUT) is a U. S. Telemetry Corporation, Model USTC-TED-0002. The EUT incorporates an internal antenna. The EUT operates on the following frequency list:

Total number of channels 20

Channel	Lower Band Frequency (MHz)	Channel	Upper Band Frequency (MHz)
1	218.025829	11	218.524973
2	218.075744	12	218.574887
3	218.125658	13	218.524801
4	218.175572	14	218.674716
5	218.225487	15	218.724630
6	218.275401	16	218.774544
7	218.325315	17	218.824459
8	218.325230	18	218.874373
9	218.425144	19	218.924288
10	218.475058	20	218.974202

The EUT operates as a Response Transmitter Unit (RTU) under the operating conditions set forth by the FCC for the 218-219 MHz service. The unit is a one-way device, transmitting data generated by its internal microprocessor dependent on pre-programmed test data or external inputs to the device. The EUT may be powered from battery, or external 12 VAC or 9/12 VDC inputs. The EUT is offered either with an external antenna or an integrated permanently mounted antenna. The plastic case that the EUT is mounted in may be offered in different sizes in the future, however the labeling will still be displayed on the external case of the transmitter.

The unit is manufactured by the following company:

Axonn Corporation
101 West Robert E. Lee Blvd.
Suite 202
New Orleans, LA 70124

1.2 Related Submittal(s)/Grant(s)

The EUT will be used with part of a system to send/receive data. The transmitter presented in this report will be used with a receiver which has been previously approved under a DoC authorization.

The EUT is subject to the following authorizations:

a) Certification as a transmitter as specified by Part 95.851.

The information contained in this report is presented for the certification authorization(s) for the EUT.

SECTION 2

TESTS AND MEASUREMENTS

TEST AND MEASUREMENTS

2.1 Configuration of Tested System

Prepared in accordance with the requirements of the FCC Rules and Regulations Part 95. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was off throughout the evaluation process. Interconnecting cables were manipulated as necessary to maximize emissions. A block diagram of the tested system is shown in Figure 1. Test configuration photographs for spurious emissions are shown in Figure 2.

The EUT is almost identical to another version, with the exception that the antenna is located external to the unit (other unit is FCC ID: OZ9USTC-TED-0002E). Due to the similarity of the two units, all data has been taken from this application with the exception of tests which could be affected (for example radiated power output and spurious emissions).

The sample used for additional testing was received by U.S. Technologies on February 6, 2001 in good condition.

2.2 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA. This site has been fully described and submitted to the FCC, and accepted in their letter marked 31040/SIT. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number IC2982.

2.3 Test Equipment

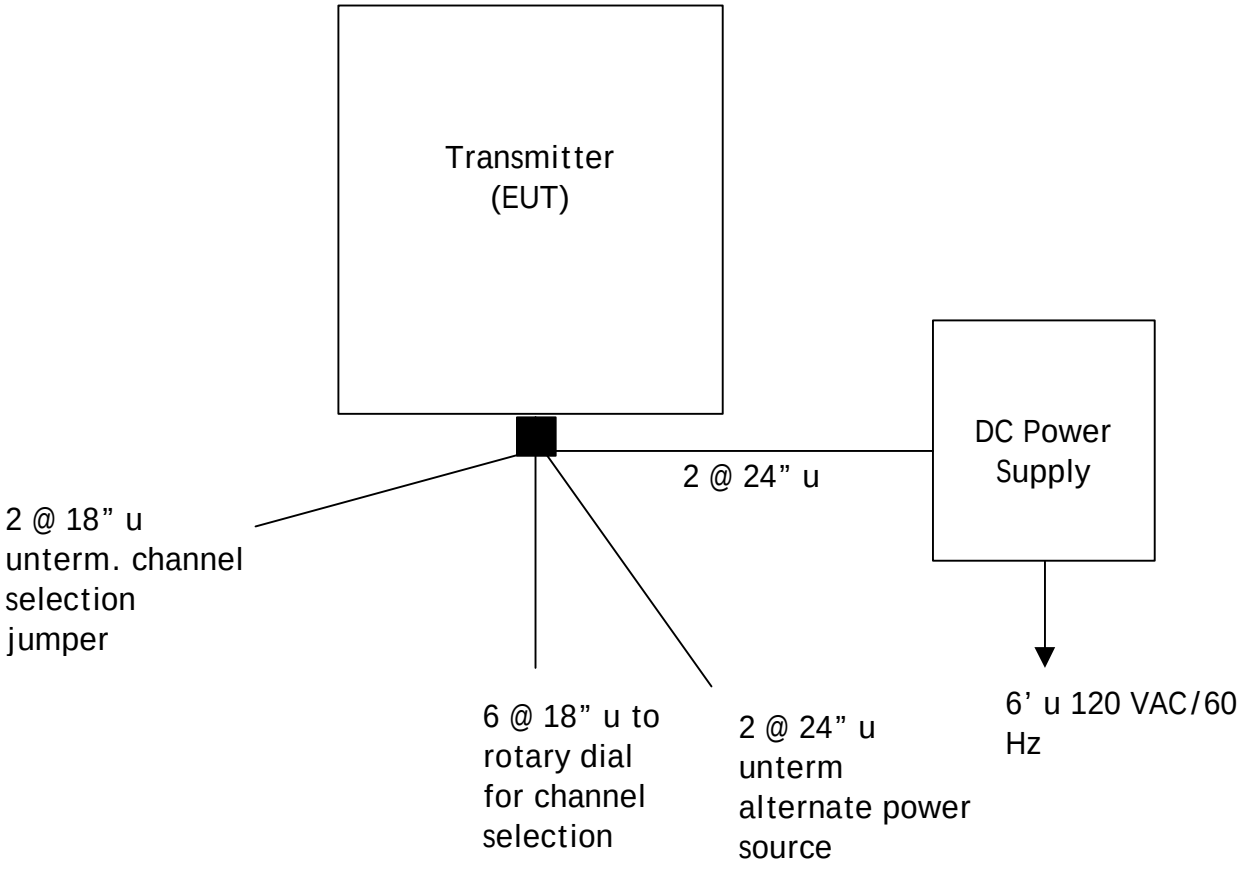
Table 2 describes test equipment used to evaluate this product.

2.4 Modifications

No modifications were made by US Tech, to bring the EUT into compliance with FCC Part 95 limits for the transmitter portion of the EUT.

FIGURE 1

TEST CONFIGURATION



Test Date: February 9 & 12, 2001
UST Project: 00-0589
Customer: U. S. Telemetry Corporation
Model: USTC-TED-0002

FIGURE 2a

Photograph(s) for Spurious Emissions (Front)

Photographs Not Available

Test Date: February 9 & 12, 2001
UST Project: 00-0589
Customer: U. S. Telemetry Corporation
Model: USTC-TED-0002

FIGURE 2b

Photograph(s) for Spurious Emissions (Back)

Photographs Not Available

TABLE 1

EUT and Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID:	CABLES P/D
Transmitter (EUT) Axonn Corporation	USTC-TED-0002	001000241	OZ9USTC-TED-0002I (Pending)	2 @ 18 “ u unterm 6 @ 18” u to rotary dial 2 @ 24” u unterm 2 @ 24” u to DC power source
DC Power Supply Hewlett Packard	E3610A	KR41808243	None	6’u Power Cord to 120 VAC/60 Hz

TABLE 2
TEST INSTRUMENTS

TYPE	MANUFACTURER	MODEL	SN.
SPECTRUM ANALYZER	HEWLETT-PACKARD	8593E	3205A00124
SPECTRUM ANALYZER	HEWLETT-PACKARD	8558B	2332A09900
S A DISPLAY	HEWLETT-PACKARD	853A	2404A02387
COMB GENERATOR	HEWLETT-PACKARD	8406A	1632A01519
RF PREAMP	HEWLETT-PACKARD	8447D	1937A03355
RF PREAMP	HEWLETT-PACKARD	8449B	3008A00480
BILOG ANTENNA	CHASE	DBL6112B	2584
HORN ANTENNA	EMCO	3115	3723
HORN ANTENNA	EMCO	3105	2060
ROBERTS ANTENNAS	COMPLIANCE DESIGN	A100	None
TEMPERATURE CHAMBER	THERMOTRON	SM16	17095
MULTIMETER	FLUKE	85	53710469
PLOTTER	HEWLETT-PACKARD	7475A	2325A65394

2.5 Antenna Description (FCC Section 95.859)

Connectors that are used to connect RTU to external antenna shall not be of the types generally known as “F-type” or “BNC type”.

The Model U. S. Telemetry Corporation USTC-TED-0002 incorporates either an external antenna or internal permanently mounted antenna.

Manufacturer:	Axonn Corporation 101 West Robert E. Lee Blvd. Suite 202 New Orleans, LA 70124
Type:	Printed Circuit Board Antenna(s)
Model Number:	Unknown
Gain:	-2 dBi
Connector:	permanently attached internally

2.6 RF Power Output (FCC Section 2.1046)

The effective radiated power (ERP) of each CTS and RTU shall be limited to the minimum necessary for successful communications. No CTS or fixed RTU may transmit with an ERP exceeding 20 Watts.

EUT was modulated by its own internal sources. The EUT was placed on an open area test site and the effective radiated power (ERP) tested as stipulated by EIT/TIA-603: 1992 section 2.2.17. A prescan was performed on Channels 1, 10, 11, and 20 to determine the worse case channel to test. The prescan showed that channel 20 was the worse case channel. The measured worse case results for this channel are shown in Table 3.

FCC Minimum Standard (FCC Section 95.855)

P_{ERP} < 20 Watts for Fixed RTU

TABLE 3
RF POWER OUTPUT

Test Date: **February 9, 2001**
UST Project: **00-0589**
Customer: **U. S. Telemetry Corporation**
Model: **USTC-TED-0002**

Worse Case Result = Channel 20

Frequency of Fundamental (MHz)	EUT Angle	LVL_I (dBm)	LOSS (dB)	Corr. Level (dBm)	ERP (mW)	FCC Limit (mW)
218.974202	0	-3.1	-29.4	+26.3	426.6	20,000
218.974202	45	-10.1	-29.4	+19.3	85.1	20,000
218.974202	90	-1.1	-29.4	+28.3	676.1	20,000
218.974202	135	+1.1	-29.4	+30.5	1122.0	20,000
218.974202	180	-1.9	-29.4	+27.5	562.3	20,000
218.974202	225	-6.6	-29.4	+22.8	190.5	20,000
218.974202	270	0.0	-29.4	+29.4	870.9	20,000
218.974202	315	-0.6	-29.4	+28.8	758.6	20,000
Average Radiated Power					586.5	

Sample Calculations:

Corrected Level (dBm) = LVL_I (dBm) – LOSS (dB)
ERP (mW) = Antilog ((Corrected Level in dBm)/10))

Results: Maximum Radiated Output (mW) = 1122.0 mW
Average Radiated Output (ERP) = 586.5 mW

Tester
Signature: _____ Name: Timothy R. Johnson

Figure 3.
RF Power Output

No plots were taken since EIA/TIA-603 substitution method was applied

2.7 Modulation Characteristics (FCC Section 2.1047)

Where applicable, the modulation characteristics of the EUT have been supplied as stipulated by the following FCC requirements:

a) Equipment which utilizes voice modulated communication shall show the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz. For equipment which is required to have a low pass filter, the frequency response of the filter, or all of the circuitry installed between the modulation limited and the modulated stage shall be supplied.

b) Equipment which employs modulation limiting, a curve showing the percentage of modulation versus the modulation input voltage shall be supplied.

FCC Minimum Standard

None

Figure 4.
Modulation Characteristics

The EUT uses digital modulation techniques only which were employed during the tests for occupied bandwidth.

2.8 Occupied Bandwidth (FCC Section 2.1049)

EUT was modulated by its own internal sources. Channels 1, 10, 11, and 20 were tested which correspond to the lowest and highest channels in each frequency segment. The bandwidth of the fundamental was measured using a spectrum analyzer, as shown in Figure 5a through Figure 5f.

Information Required Calculate Necessary Bandwidth

B= 4160 baud
M = 4160
D = 9150
K = 1.2 from table III-A

2M + 2DK = 30,280

FCC Minimum Standard (FCC Section 95.857)

For out-of-band emissions for frequencies removed from the midpoint of the assigned frequency segment (218.000-218.500 & 218.501-219.000 MHz) by more than 250 kHz up to and including 750 kHz, at least 28 dB.

For out-of-band emissions for frequencies removed from the midpoint of the assigned frequency segment (218.000-218.500 & 218.501-219.000 MHz) by more than 750 kHz up to and including 1250 kHz, at least 35 dB.

For out-of-band emissions for frequencies removed from the midpoint of the assigned frequency segment (218.000-218.500 & 218.501-219.000 MHz) by more than 1250 kHz, at least

$$43 + 10 \log (P_{Watts}) = 43 + 10 \log (1.10) = 43.4 \text{ dB}$$

The resolution bandwidth was 100 Hz or greater for measuring up to 250 kHz from the edge of the authorized frequency segment, and 10 kHz for measuring more than 250 kHz from the authorized frequency segment.

Figure 5a.
Occupied Bandwidth < 250 kHz From Edge of Band (Frequency Segment A)

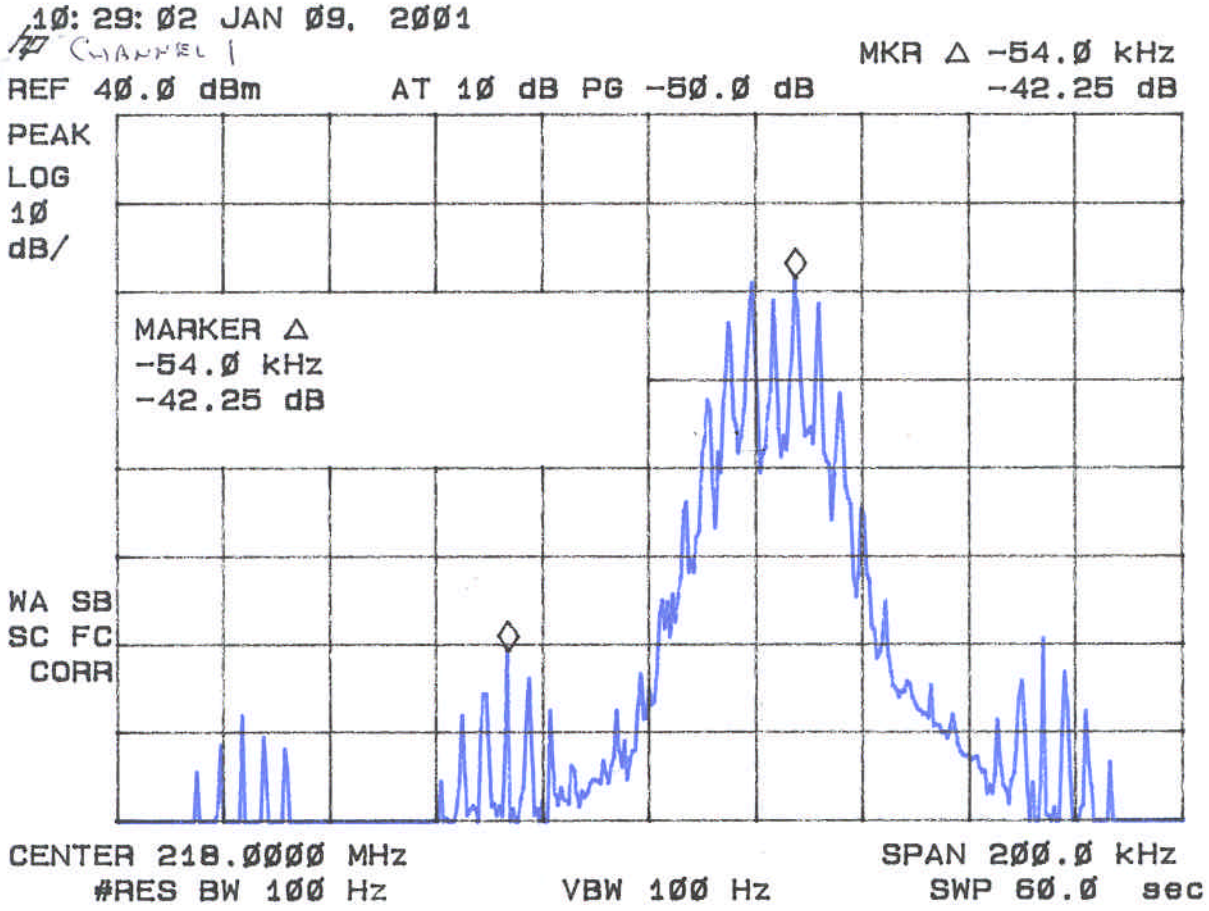


Figure 5b.
Occupied Bandwidth < 250 kHz From Edge of Band (Frequency Segment A)

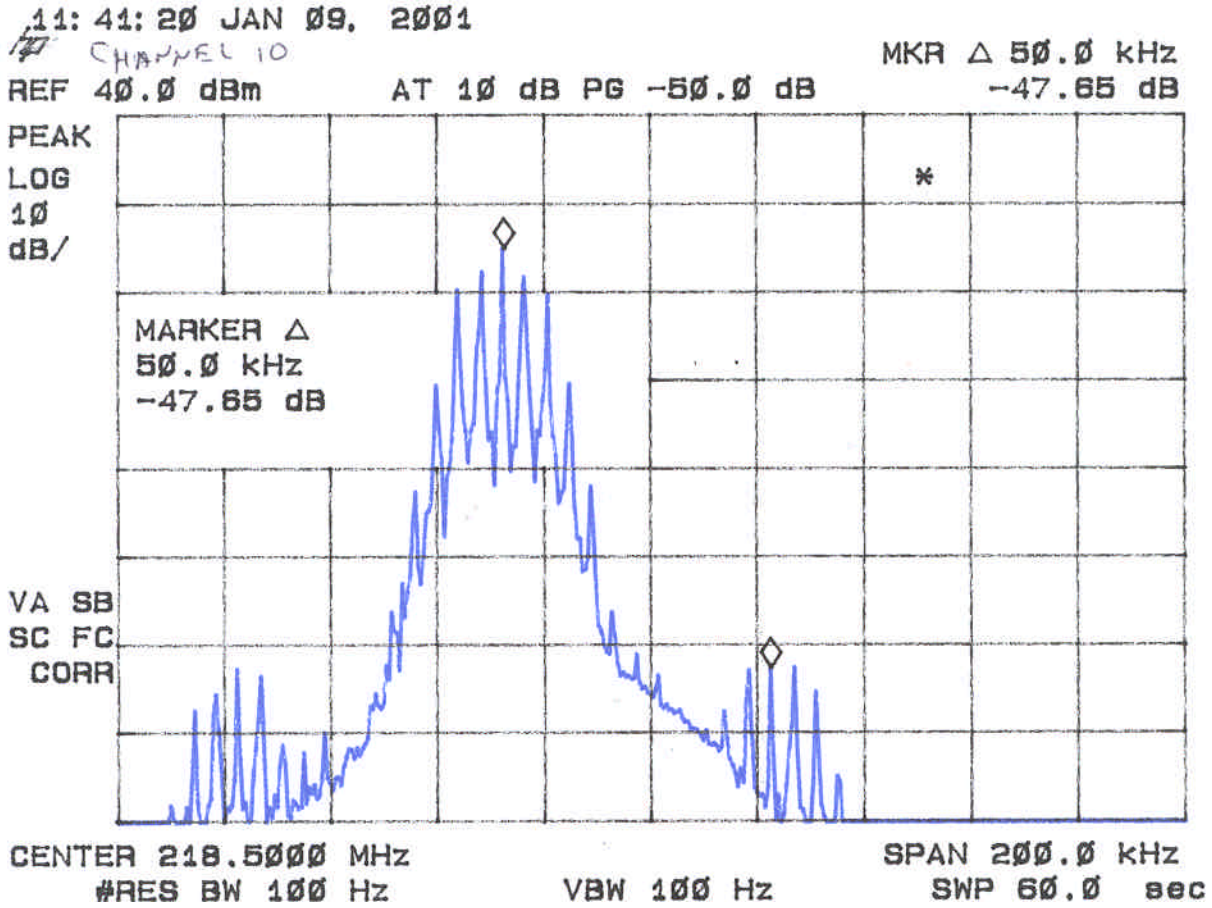
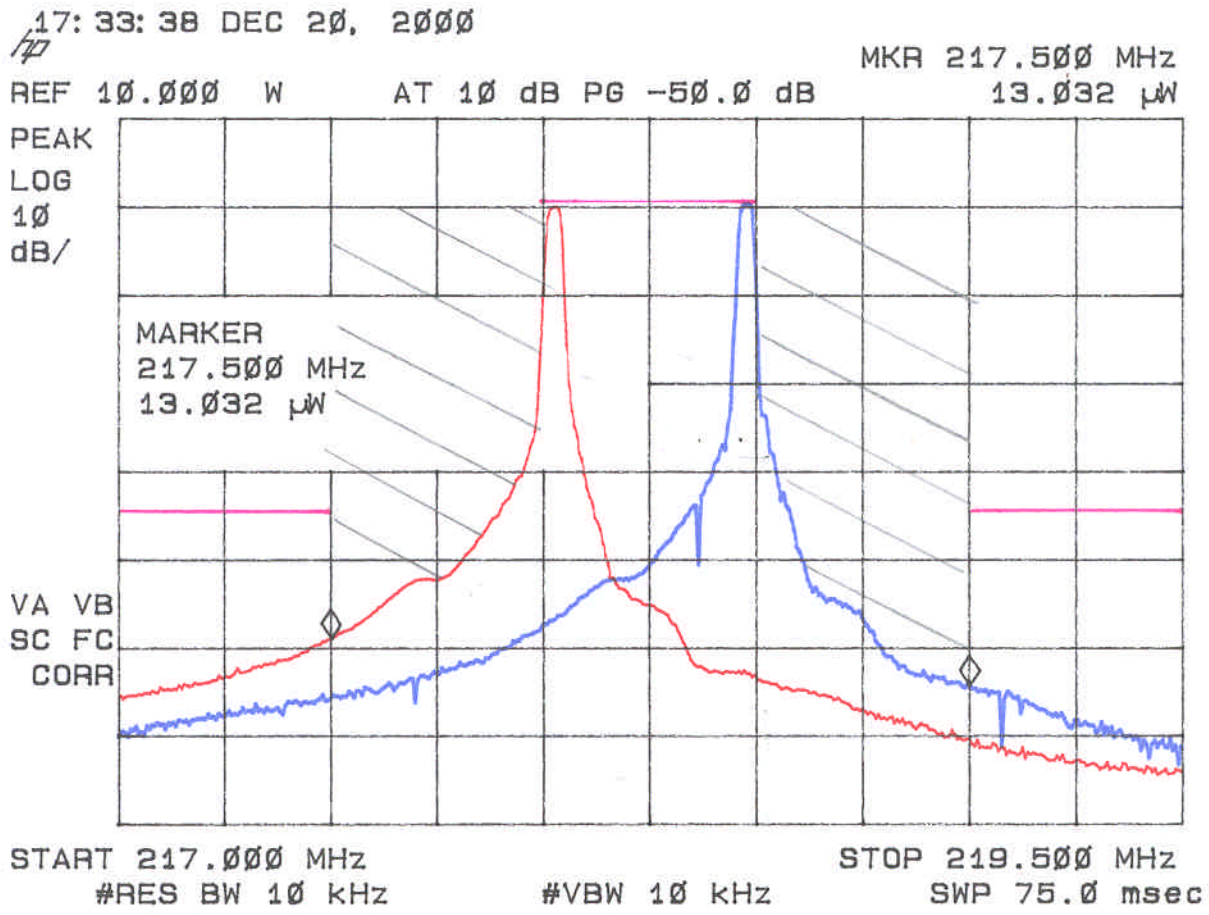


Figure 5c.
Occupied Bandwidth < 250 kHz From Edge of Band (Frequency Segment A)



red trace = lowest channel in frequency band (1)
blue trace = highest channel in frequency band (10)

Figure 5d.
Occupied Bandwidth > 250 kHz From Edge of Band (Frequency Segment B)

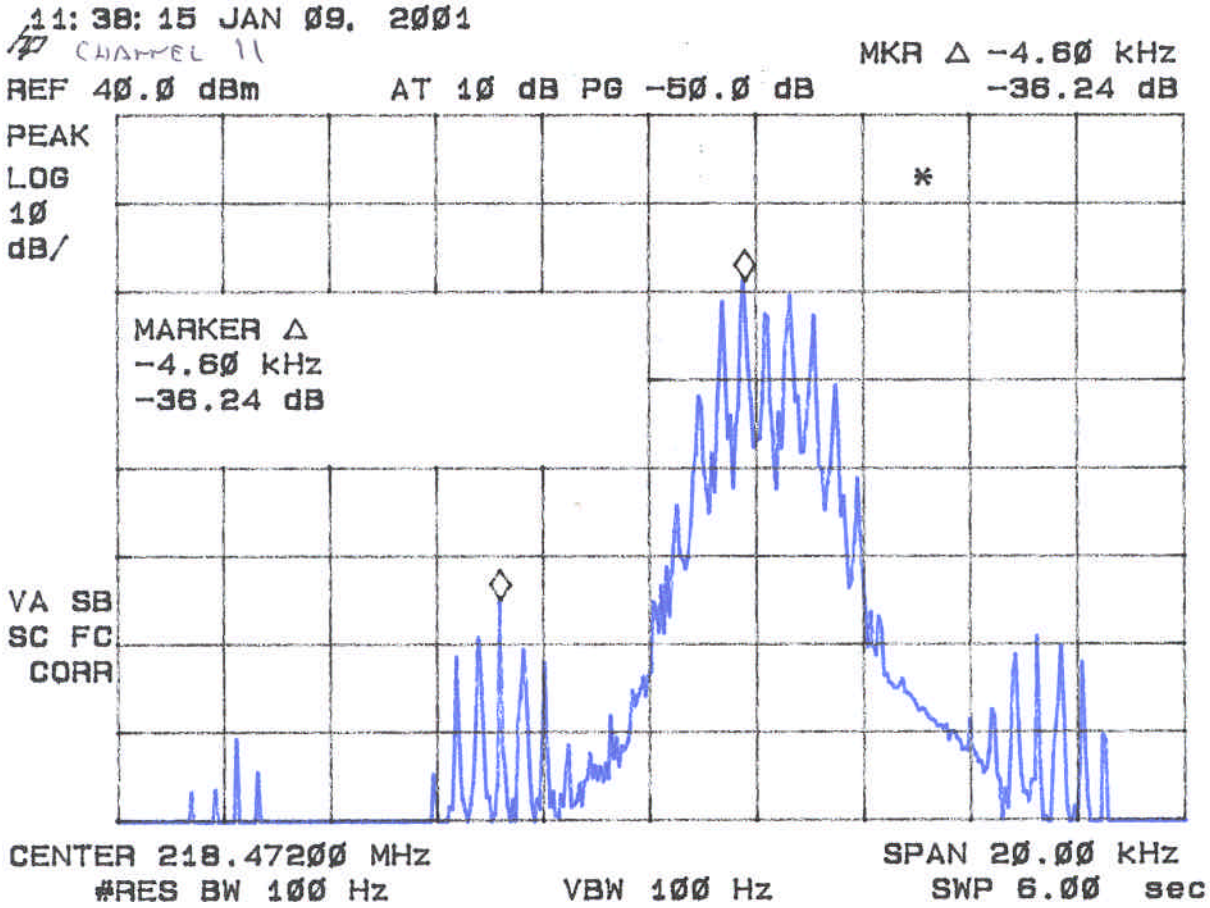


Figure 5e.
Occupied Bandwidth > 250 kHz From Edge of Band (Frequency Segment B)

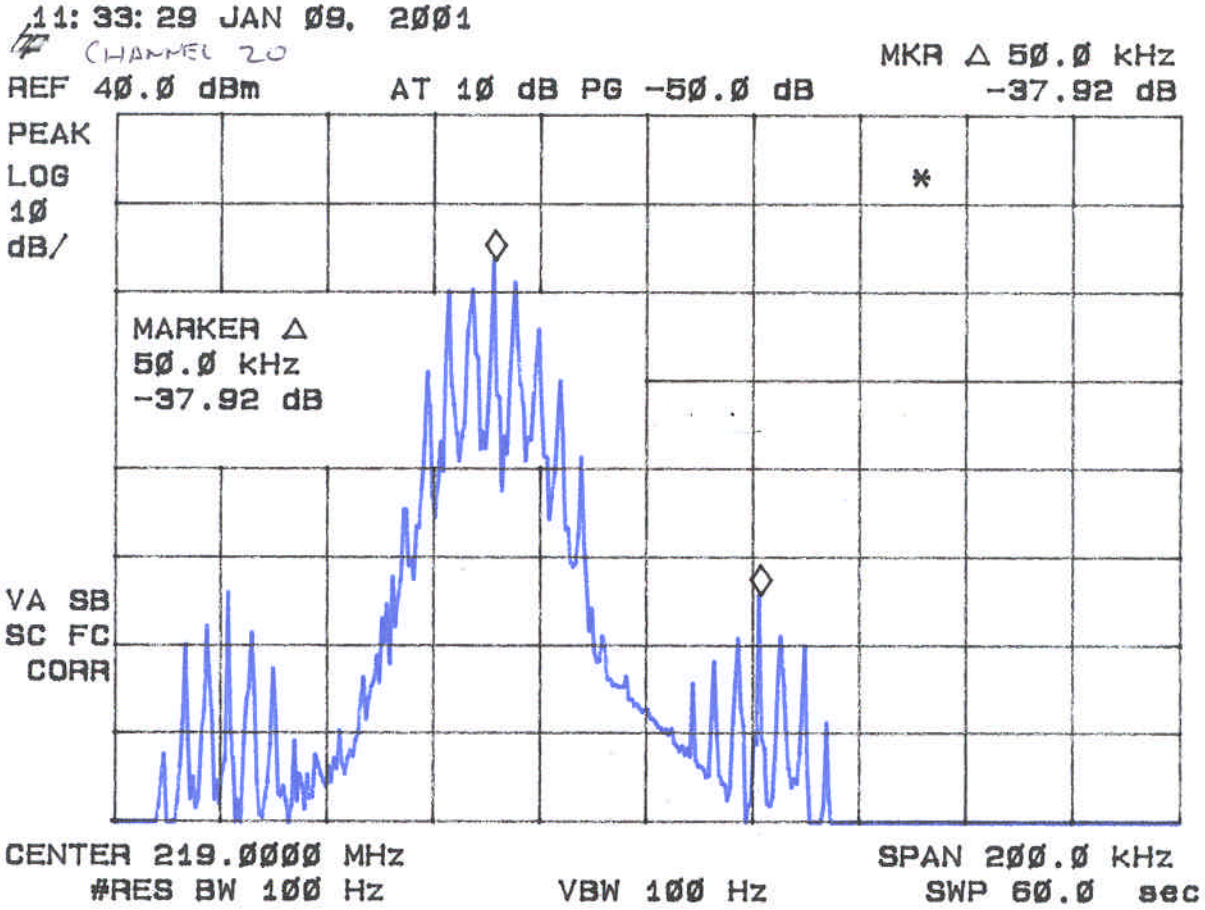
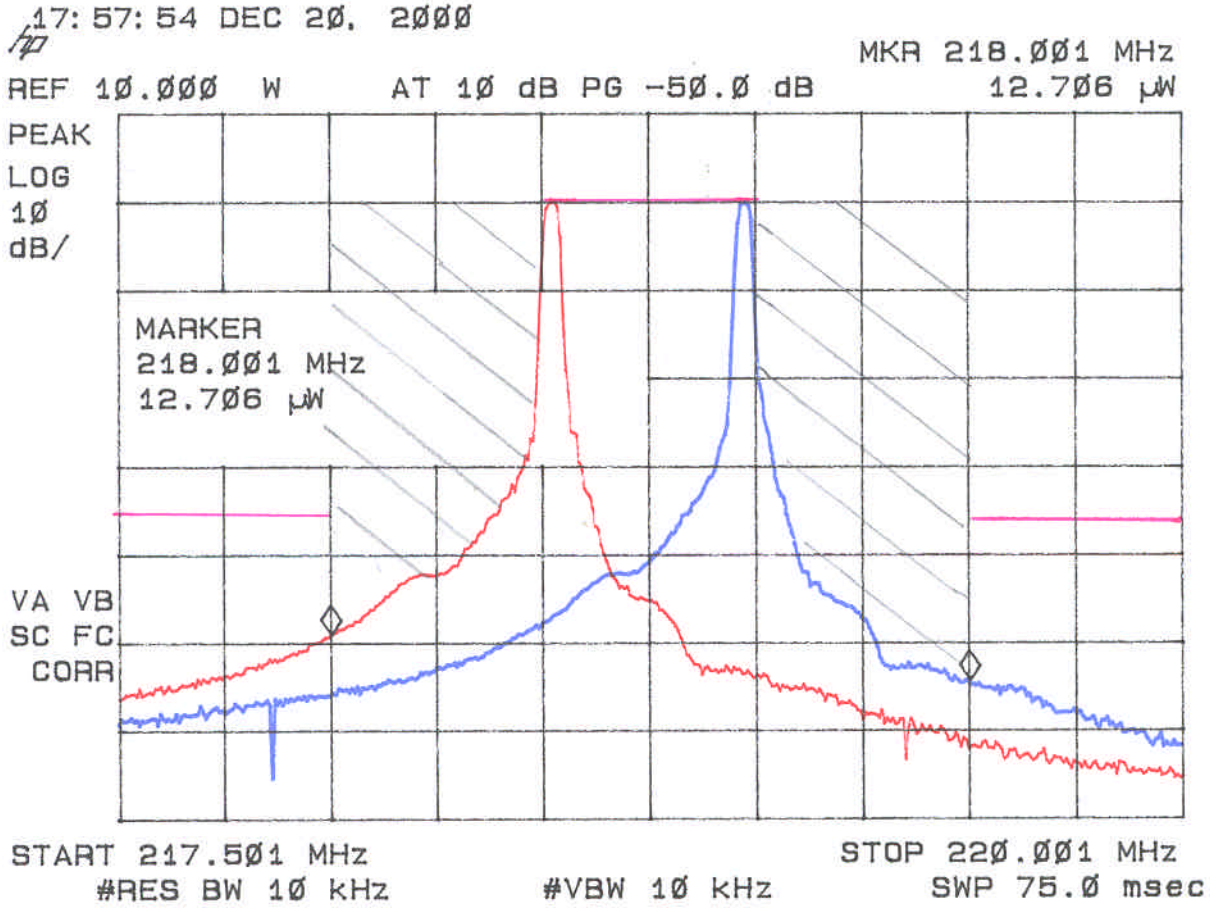


Figure 5f.
Occupied Bandwidth > 250 kHz From Edge of Band (Frequency Segment B)



red trace = lowest channel in frequency band (11)
blue trace = highest channel in frequency band (20)

2.9 Spurious Emissions at Antenna Terminals (FCC Section 2.1051)

Spurious emissions appearing at the antenna terminals were measured with a spectrum analyzer by connecting the spectrum analyzer directly via a short cable to the antenna output terminals or across the antenna leads on the PCB as specified by the manufacturer. Results are shown in Figure 6.

FCC Minimum Standard (FCC Section 95.855)

For out-of-band emissions for frequencies removed from the midpoint of the assigned frequency segment by more than 1250 kHz, at least

$$43 + 10 \log (P_{Watts}) = 43 + 10 \log(1.10) = 43.4 \text{ dB}$$

Figure 6
Spurious Emissions at Antenna Terminals

Spurious Emissions are considered not applicable since the antenna is permanently attached.

2.10 Field Strength of Spurious Radiation (FCC Section 2.1053)

Spurious emissions were evaluated from 30 MHz to 2.2 GHz at an EUT to antenna distance of 3 meters. The EUT was tested with an external power source and modulated by its own internal sources. A typical channel was selected for test. The EUT was placed on an open area test site and the spurious emissions tested as stipulated by EIT/TIA-603: 1992 section 2.2.12. Measurements for 30 to 1000 MHz were made with the analyzer's bandwidth set to 120 kHz. Measurements above 1 GHz were made with the analyzer's bandwidth set to 1 MHz. Results are shown in Table 4a and Table 4b.

FCC Minimum Standard

For out-of-band emissions for frequencies removed from the midpoint of the assigned frequency segment by more than 1250 kHz, at least

$$43 + 10 \log (P_{Watts}) = 43 + 10 \log(1.10) = 43.4 \text{ dB}$$

FIELD STRENGTH OF SPURIOUS RADIATION

Test Date: February 12, 2001
UST Project: 00-0589
Customer: U. S. Telemetry Corporation
Model: USTC-TED-0002

FCC Minimum Standard: 43 + 10 log (1.10) = 43.4 dB

TABLE 4a

Frequency (MHz)	Polarity (H or V)	Substitution Antenna Level (dBm)	Antenna Correction for Reference to Dipole (dB)	Corrected Substitution Level (dBm)	Attenuated Level Below Carrier Power (dB)
438.0	H	-25.3	N/A	-25.3	55.7
1095.0	H	-40.8	-2.6	-43.4	73.8
1315.0	H	-36.1	-3.9	-40.0	70.4
1533.0	H	-41.0	-4.7	-45.7	76.1

SAMPLE CALCULATION:

Attenuated Level Below Carrier Power =
10 log (TX Power in mW) – Corrected Substitution Level (dBm)
10 log (1100) - -25.3 = 55.7

Test Results
Reviewed By: _____ Name: Tim R. Johnson

FIELD STRENGTH OF SPURIOUS RADIATION

Test Date: February 12, 2001
UST Project: 00-0589
Customer: U. S. Telemetry Corporation
Model: USTC-TED-0002

FCC Minimum Standard: 43 + 10 log (1.10) = 43.4 dB

TABLE 4b

Frequency (MHz)	Polarity (H or V)	Substitution Antenna Level (dBm)	Antenna Correction for Reference to Dipole (dB)	Corrected Substitution Level (dBm)	Attenuated Level Below Carrier Power (dB)
438.0	V	-37.3	N/A	-37.3	67.7
1095.0	V	-43.5	-2.6	-46.1	76.5
1315.0	V	-34.7	-3.9	-38.6	69.0
1533.0	V	-41.0	-4.7	-45.7	76.1

SAMPLE CALCULATION:

Attenuated Level Below Carrier Power =
10 log (TX Power in mW) – Corrected Substitution Level (dBm)
10 log (1100) - -37.3 = 67.7

Test Results
Reviewed By: _____ Name: Tim R. Johnson

2.11 Frequency Stability (FCC Section 2.1055)

The frequency tolerance of the carrier signal was measured by while ambient temperature was varied from -30 to 50 degrees centigrade. The frequency tolerance was verified at 10 degree increments. The EUT was tested with fully charged batteries. Additionally, the supply voltage was varied from 85% to 115% of the nominal value (except for hand carried, battery powered equipment which was additionally measured at battery endpoint). The data is shown in the following tables and figures.

FCC Minimum Standard

None

FCC Certification
U.S. Telemetry Model USTC-TED-0002
Frequency Stability vs. Temperature (At Startup)

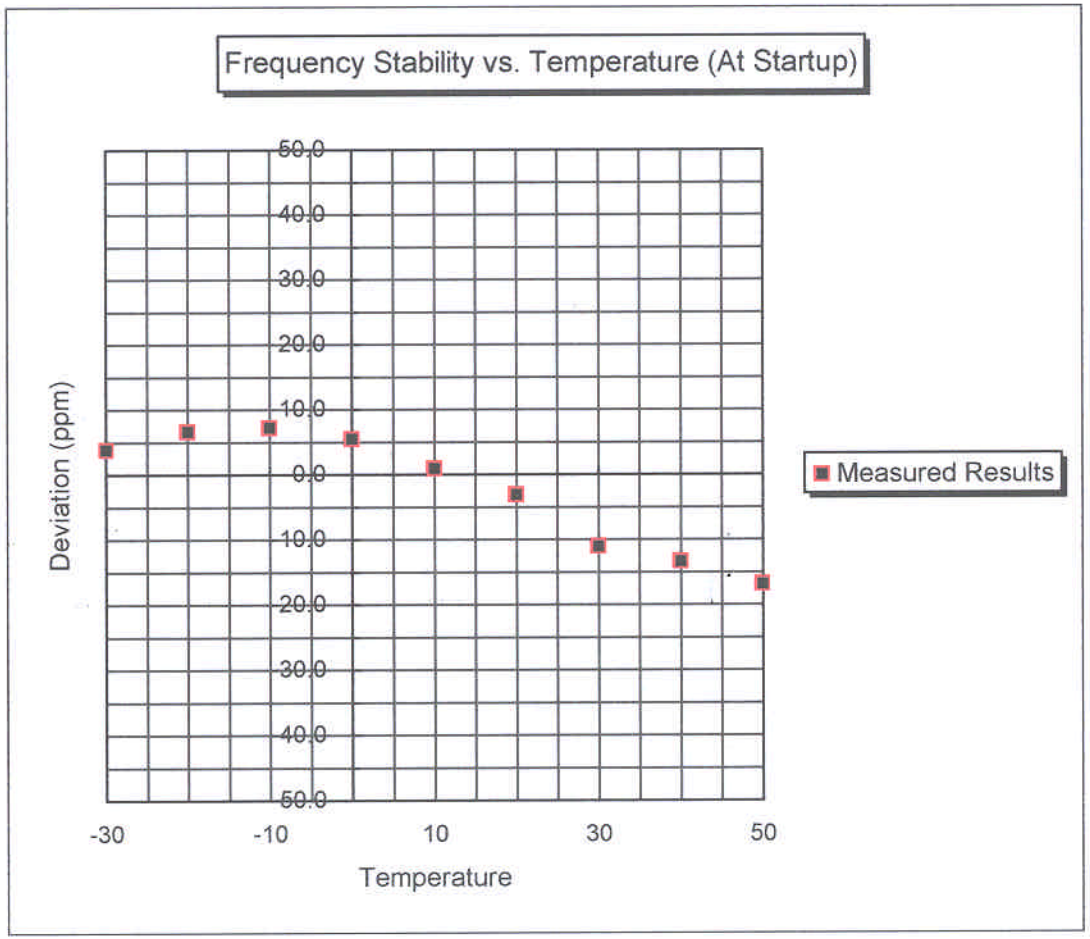
Test Results Reviewed By:

Tim Johnson
NARTE Certified Engineer

Temperature (degrees C)	Measured Frequency (MHz)	Deviation (ppm)
-30	218.475880	3.8
-20	218.476500	6.6
-10	218.476630	7.2
0	218.476250	5.5
10	218.475250	0.9
20	218.474380	-3.1
30	218.472630	-11.1
40	218.472130	-13.4
50	218.471380	-16.8

Actual TX Frequency was: 218.475058 MHz

Maximum Deviation = N/A



FCC ID: OZ9USTC-TED-0002I

FCC Certification
U.S. Telemetry Model USTC-TED-0002
Frequency Stability vs. Temperature (2 Minutes After Startup)

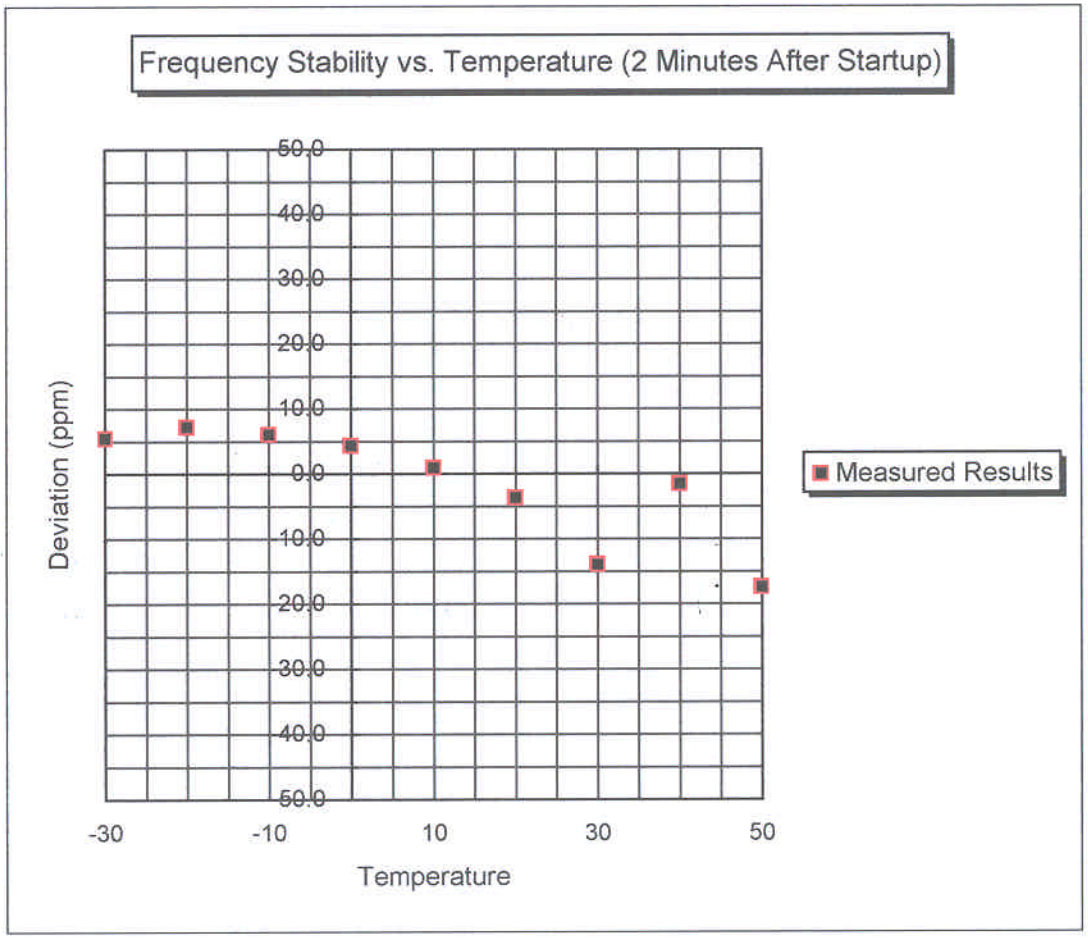
Test Results Reviewed By:

Tim Johnson
NARTE Certified Engineer

Temperature (degrees C)	Measured Frequency (MHz)	Deviation (ppm)
-30	218.476250	5.5
-20	218.476630	7.2
-10	218.476380	6.1
0	218.476000	4.3
10	218.475250	0.9
20	218.474250	-3.7
30	218.472000	-14.0
40	218.474720	-1.5
50	218.471250	-17.4

Actual TX Frequency was: 218.475058 MHz

Maximum Deviation = N/A



FCC ID: OZ9USTC-TED-0002

FCC Certification
U.S. Telemetry Model USTC-TED-0002
Frequency Stability vs. Temperature (5 Minutes After Startup)

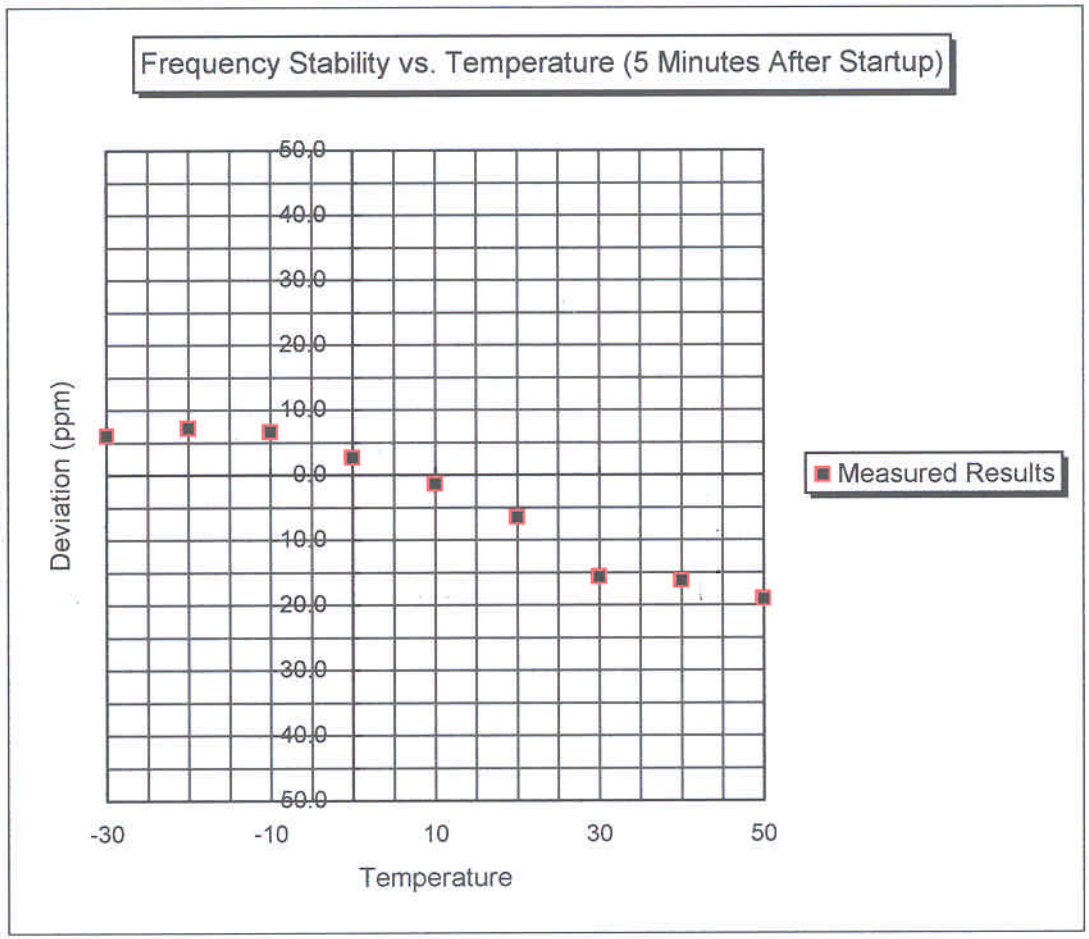
Test Results Reviewed By:

Tim Johnson
NARTE Certified Engineer

Temperature (degrees C)	Measured Frequency (MHz)	Deviation (ppm)
-30	218.476380	6.1
-20	218.476630	7.2
-10	218.476500	6.6
0	218.475630	2.6
10	218.474750	-1.4
20	218.473630	-6.5
30	218.471630	-15.7
40	218.471500	-16.3
50	218.470880	-19.1

Actual TX Frequency was: 218.475058 MHz

Maximum Deviation = N/A



FCC ID: OZ9USTC-TED-0002I

FCC Certification
U.S. Telemetry Model USTC-TED-0002
Frequency Stability vs. Temperature (10 Minutes After Startup)

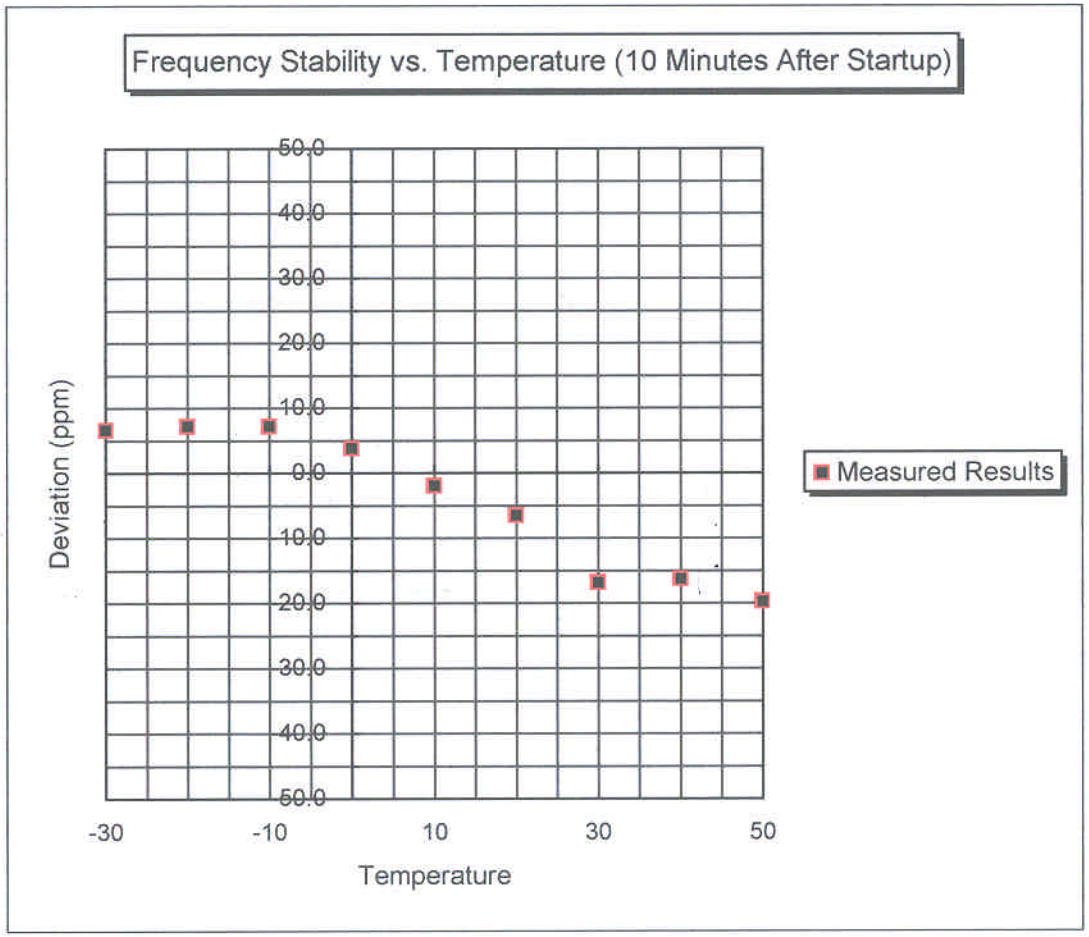
Test Results Reviewed By:

Tim Johnson
NARTE Certified Engineer

Temperature (degrees C)	Measured Frequency (MHz)	Deviation (ppm)
-30	218.476500	6.6
-20	218.476630	7.2
-10	218.476630	7.2
0	218.475880	3.8
10	218.474630	-2.0
20	218.473630	-6.5
30	218.471380	-16.8
40	218.471500	-16.3
50	218.470750	-19.7

Actual TX Frequency was: 218.475058 MHz

Maximum Deviation = N/A



FCC ID: OZ9USTC-TED-0002I

FCC Certification
U.S. Telemetry Model USTC-TED-0002
Frequency Stability vs. Voltage

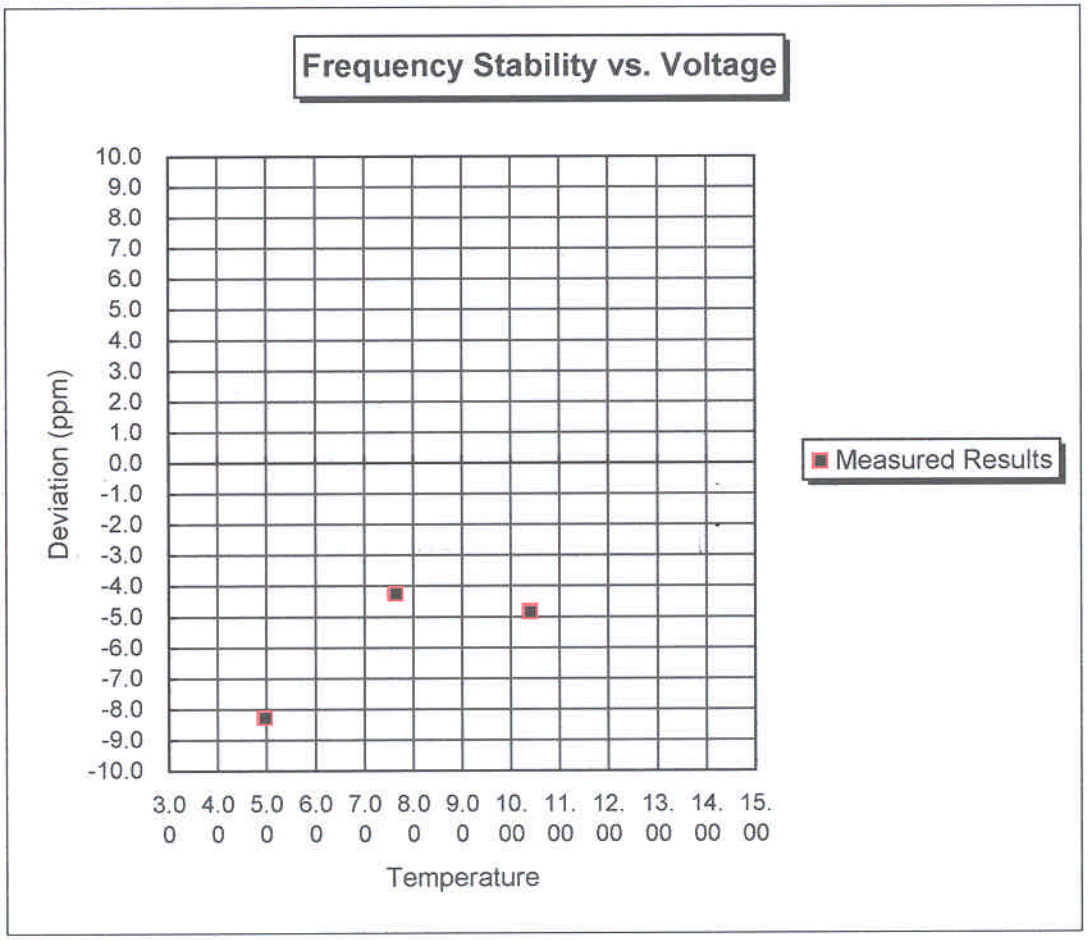
Test Results Reviewed By:

Timothy R. Johnson
NARTE Certified Engineer

Voltage (V DC)	Measured Frequency (MHz)	Deviation (ppm)
4.97	218.473250	-8.3
7.65	218.474130	-4.2
10.40	218.474000	-4.8

Actual TX Frequency was: 218.475058 MHz

Maximum Deviation = N/A



FCC ID: OZ9USTC-TED-0002I