Digitrax, Inc.
FCC Part 15, Certification Application
RF1 Modular Transmitter

September 7, 2000

MEASUREMENT/TECHNICAL REPORT

COMPANY NAME: **Digitrax, Inc.**

MODEL: **RF1 Modular Transmitter**

FCC ID: **LV3RF1**

DATE: **September 7, 2000**

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

Phone Number: (770) 740-0717
Fax Number: (770) 740-1508

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

TABLES

SECTION 1

GENERAL INFORMATION

GENERAL INFORMATION

1.1 Product Description

The Equipment Under Test (EUT) is a Digitrax, Inc. Model RF1. The EUT is a 916.5 MHz control transmitter that is typically used as part of a system including a 900 MHz receiver. The EUT and the receiver are used in Digitrax LocoNet Systems to control high end model locomotives.

The EUT has been previously approved in a Model DT100R throttle controller. The purpose of this application is to test and approve the transmitter as a stand-alone module. The EUT will only be used in Digitrax, Inc. products and in similar packaging arrangements as the previously approved DT100R. Since the EUT meets all of the module design requirements except for its own RF shielding, Digitrax, Inc. wishes to pursue a “Limited Modular Approval” (LMA).

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 submitted and approved under FCC ID: LV3UR91.

The EUT is subject to the following authorizations:

a) Certification as a transmitter

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

The sample was tested per ANSI C63.4, Methods of Measurement from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (1992). Conducted and radiated emissions data were taken with the test receiver or spectrum analyzer's resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. 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. 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 and fundamental emissions are shown in Figure 2.

The sample used for testing was received by U.S. Technologies on June 19, 2000 in good condition.

Since the EUT will be incorporated into hand held devices, it was placed into a continuous mode of transmit and rotated about all 3 axis to obtain worse case results.

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

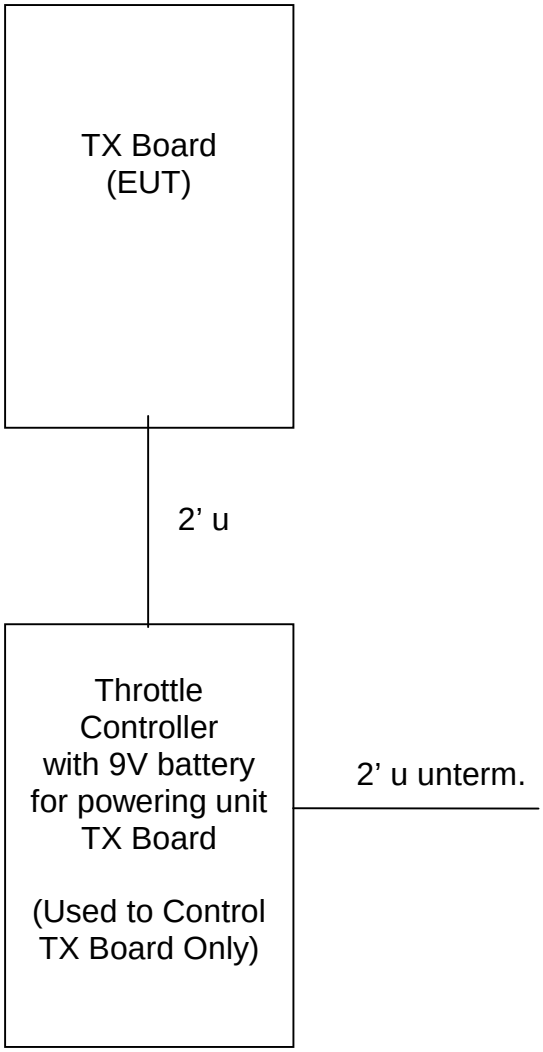
Table 2 describes test equipment used to evaluate this product.

2.4 Modifications

No modifications were made by US Tech, to bring the EUT into compliance with FCC Part 15 limits for the transmitter portion of the EUT.

FIGURE 1

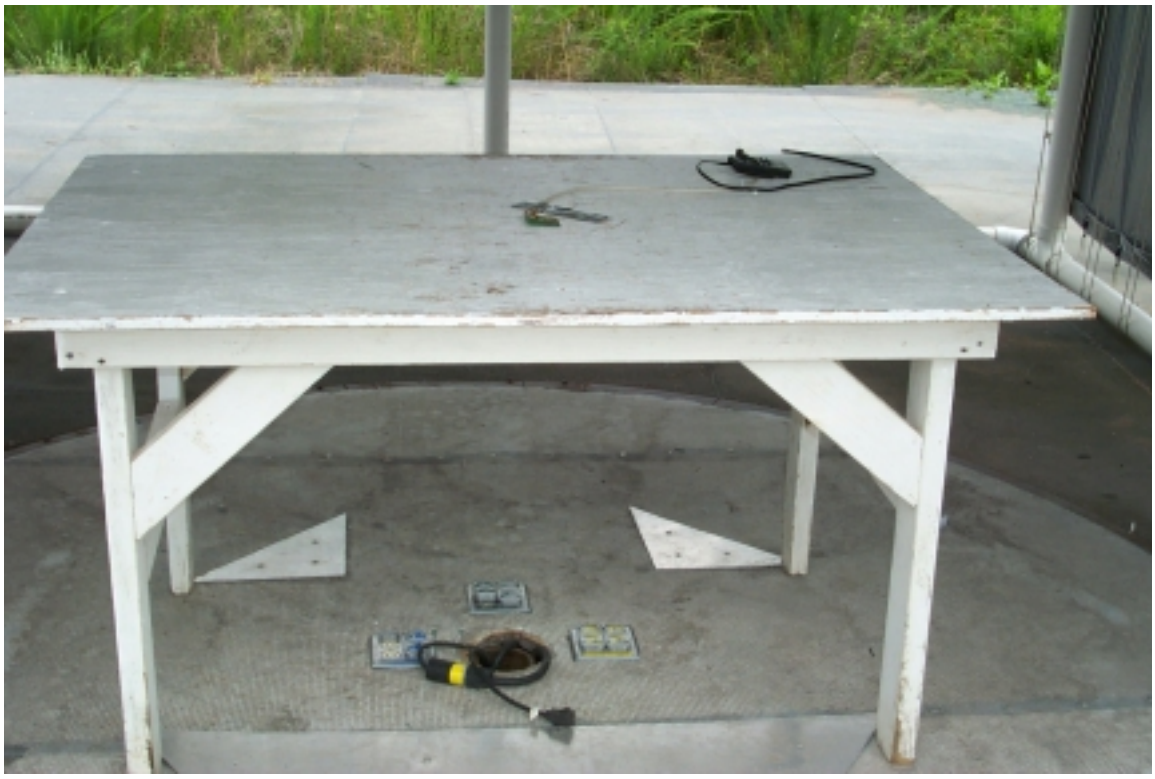
TEST CONFIGURATION



Test Date: June 19, 2000
UST Project: 00-0285
Customer: Digitrax, Inc.
Model: RF1

FIGURE 2a

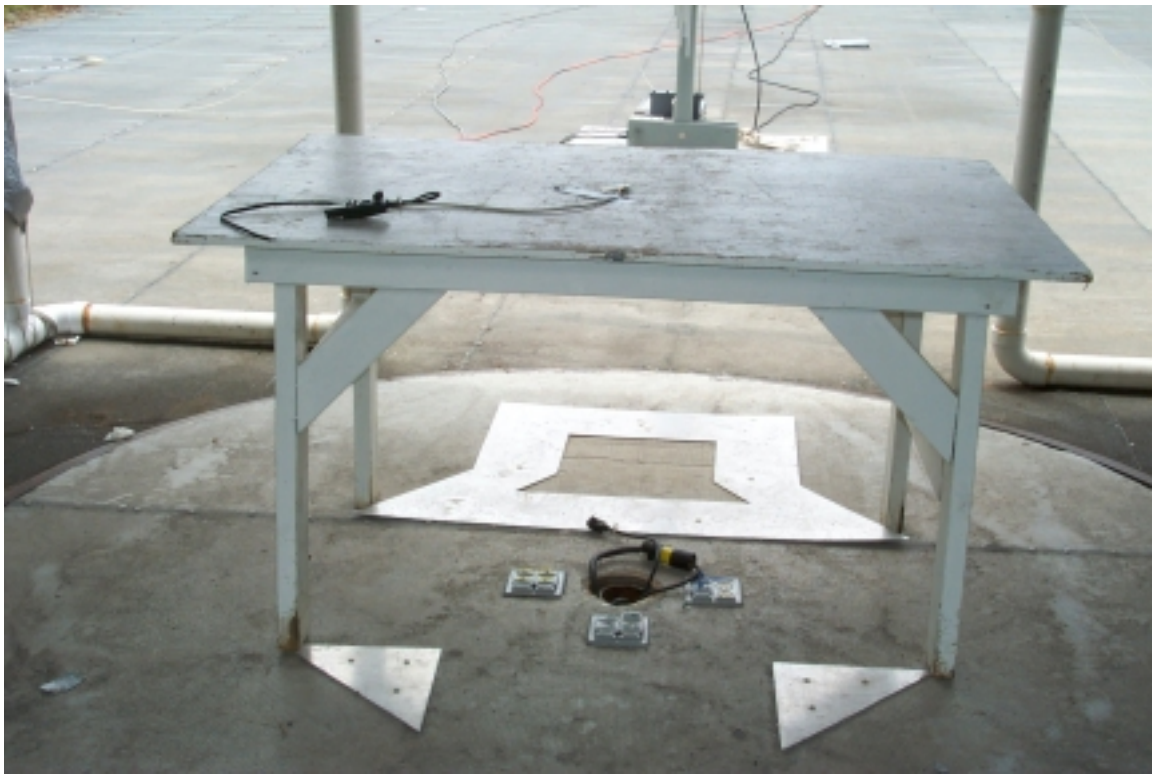
Photograph(s) for Spurious and Fundamental Emissions (Front)



Test Date: June 19, 2000
UST Project: 00-0285
Customer: Digitrax, Inc.
Model: RF1

FIGURE 2b

Photograph(s) for Spurious and Fundamental Emissions (Back)



Test Date: June 19, 2000
UST Project: 00-0285
Customer: Digitrax, Inc.
Model: RF1

FIGURE 2c

Photograph(s) for Digital Device Conducted Emissions

Since the transmitter is designed for use only in portable products operating off of battery power, conducted emissions were deemed not necessary.

TABLE 1

EUT and Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID:	CABLES P/D
Modular Transmitter Board (EUT) Digitrax, Inc.	RF1	N/A	N/A	2’ u
Throttle Controller Digitrax, Inc.	DT300	N/A	N/A	2’ u unterm.

u = unshield
s = shielded

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
HORN ANTENNA	EMCO	3115	3723
BICONICAL ANTENNA	EMCO	3110	9307-1431
LOG PERIODIC ANTENNA	EMCO	3146	9110-3600
LISN	SOLAR ELE.	8012	865577
LISN	SOLAR ELE.	8028	910494
LISN	SOLAR ELE.	8028	910495
PLOTTER	HEWLETT-PACKARD	7475A	2325A65394

2.6 Antenna Description (Paragraph 15.203)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

The Model Digitrax, Inc. RF1 incorporates an integrated PCB antenna only.

2.7 Field Strength of Fundamental within the Band 902-928 MHz per FCC Section 15.249(a)

Peak power within the band 902-928 MHz has been measured with a spectrum analyzer. Peak measurements were made using a peak or quasi-peak detector. Average emissions are not considered applicable since the measurement was below 1000 MHz.

The results of the measurements for peak fundamental emissions are given in Table 3 and Figure 3a.

Table 3
FIELD STRENGTH OF FUNDAMENTAL EMISSION

Test Date: June 19, 2000
UST Project: 00-0285
Customer: Digitrax, Inc.
Model: RF1

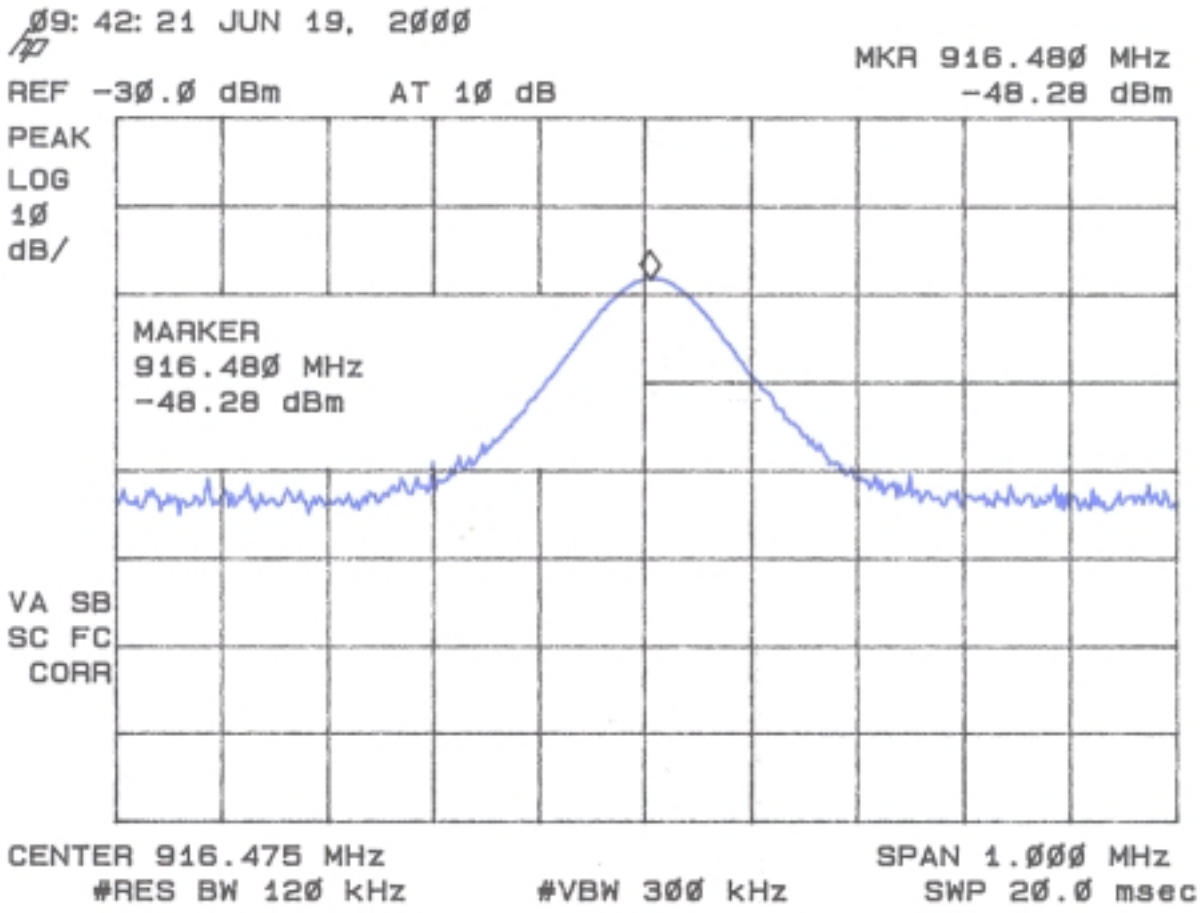
FREQ. (MHz)	TEST DATA (dBm) @ 3m	ANTENNA FACTOR + CABLE ATTENUATION	RESULTS (uV/m) @ 3m	PEAK FCC LIMITS (uV/m) @ 3m
916.5	-48.3	30.9	30,304.0	50,000

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m = Antilog ((-48.3 + 30.9 + 107)/20) = 30,304.0
CONVERSION FROM dBm TO dBuV = 107 dB

Tested By: _____ **Name:** Austin E. Thompson, Jr.

Figure 3
Field Strength of Fundamental Emissions 15.249(a)



2.8 Peak Radiated Spurious Emission in the Frequency Range 30 - 9000 MHz (FCC Section 15.247(c))

A preliminary scan was performed on the EUT to determine frequencies that were caused by the transmitter portion of the product. Significant emissions that fell within restricted bands were then measured on an OAT's site. Radiated measurements below 1 GHz were tested with a RBW = 120 kHz. Radiated measurements above 1 GHz were measured using a RBW = VBW = 1 MHz. The results of peak radiated spurious emissions are given in Table 4a (for < 1 GHz) through Table 4b (for > 1 GHz) and Figure 4a through 4c.

Table 4a. Peak Radiated Emissions Data

Test Date: June 19, 2000
UST Project: 00-0285
Customer: Digitrax, Inc.
Product: RF1

< 1 GHz

FREQ. (MHz)	TEST DATA (dBm) @ 3m	ANTENNA FACTOR + CABLE ATTENUATION	RESULTS (uV/m) @ 3m	PEAK FCC LIMITS (uV/m) @ 3m
111.4	-92.0	13.0	25.1	150.0
137.5	-90.0	14.9	39.6	150.0
160.8	-90.0	15.3	41.2	150.0

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-92.0 + 13.0 + 107)/20) = 25.1
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: _____ Name: Austin Thompson, Jr.

Table 4a. Peak Radiated Emissions Data

Test Date: June 19, 2000
UST Project: 00-0285
Customer: Digitrax, Inc.
Product: RF1

> 1 GHz

Freq. (GHz)	Test Data (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
1.83288	-49.4	35.0	28.6	3.4	537.0	5000
2.74948	-49.7	34.9	31.3	4.2	791.0	5000
3.66590	-61.8	34.6	34.0	5.3	309.3	5000

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-49.4 - 35.0 + 28.6 + 3.4 + 107)/20) = 537.0
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: _____ Name: Austin Thompson, Jr.

Figure 4a
Peak Radiated Spurious Emission 15.247(c)

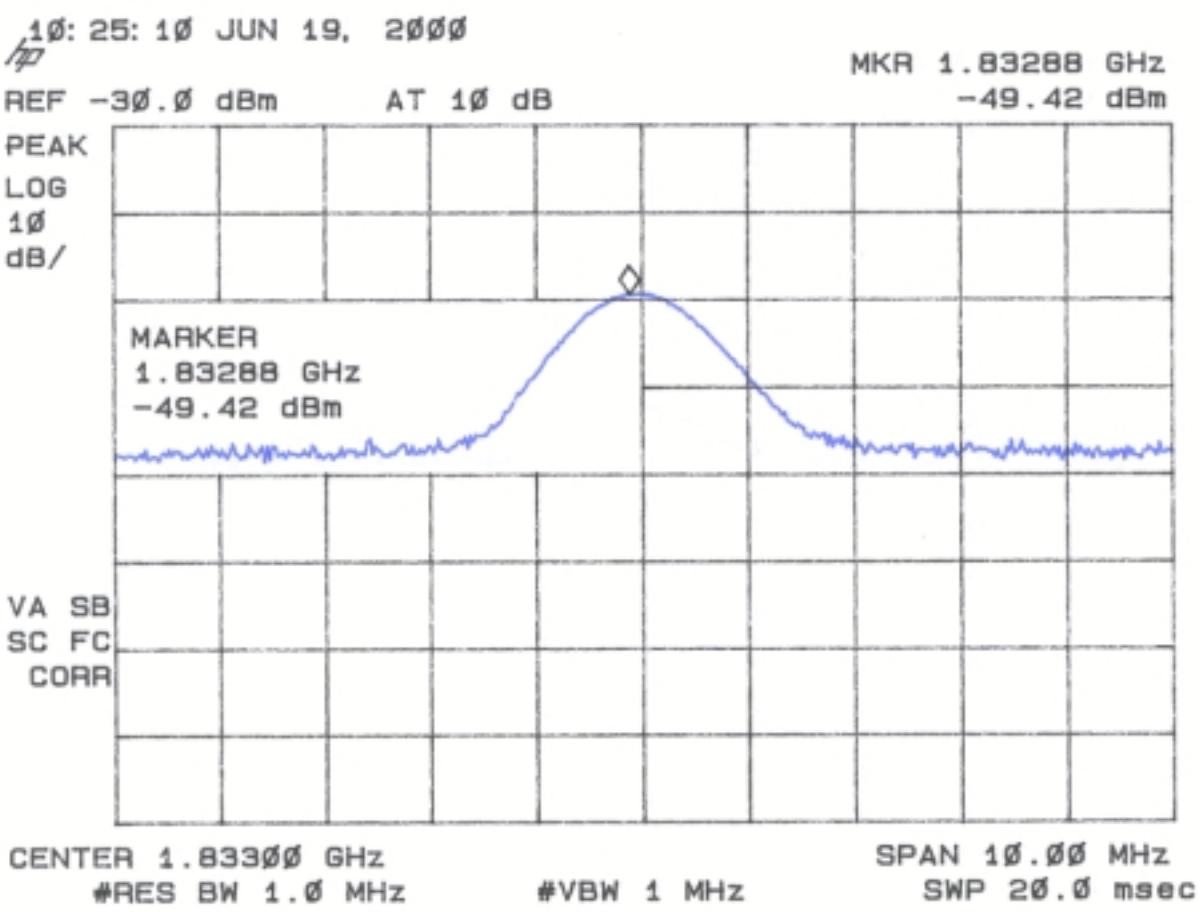


Figure 4b
Peak Radiated Spurious Emission 15.247(c)

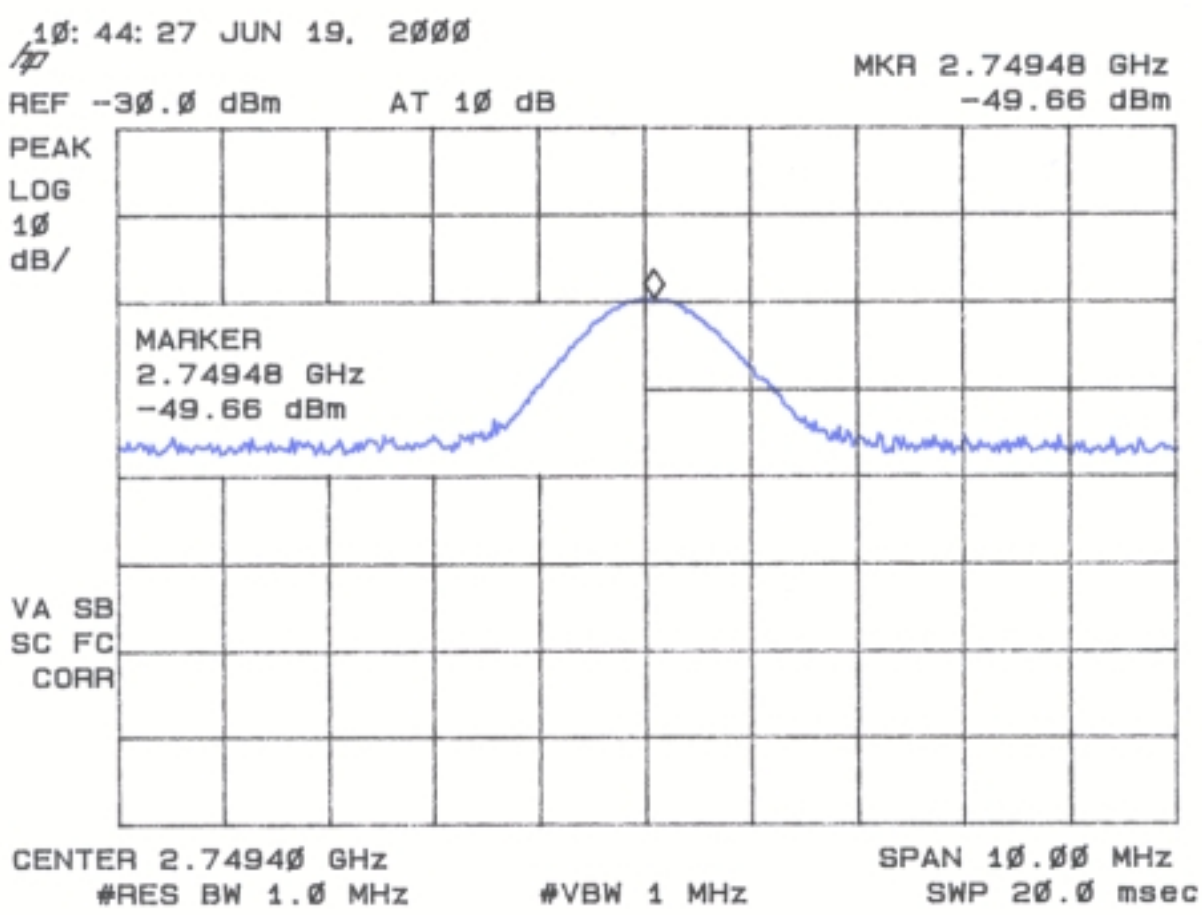
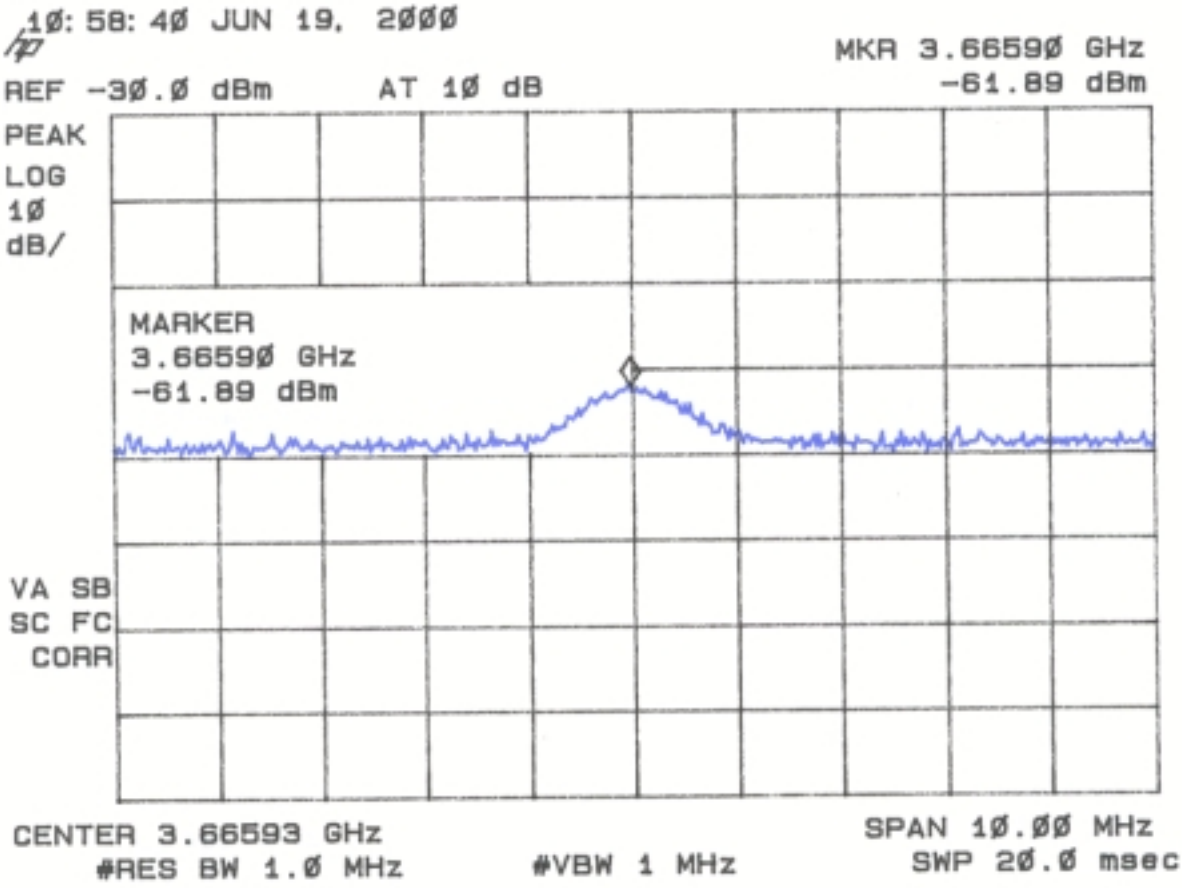


Figure 4c
Peak Radiated Spurious Emission 15.247(c)



2.9 Average Spurious Emission in the Frequency Range 1000 - 9000 MHz (FCC Section 15.247(c))

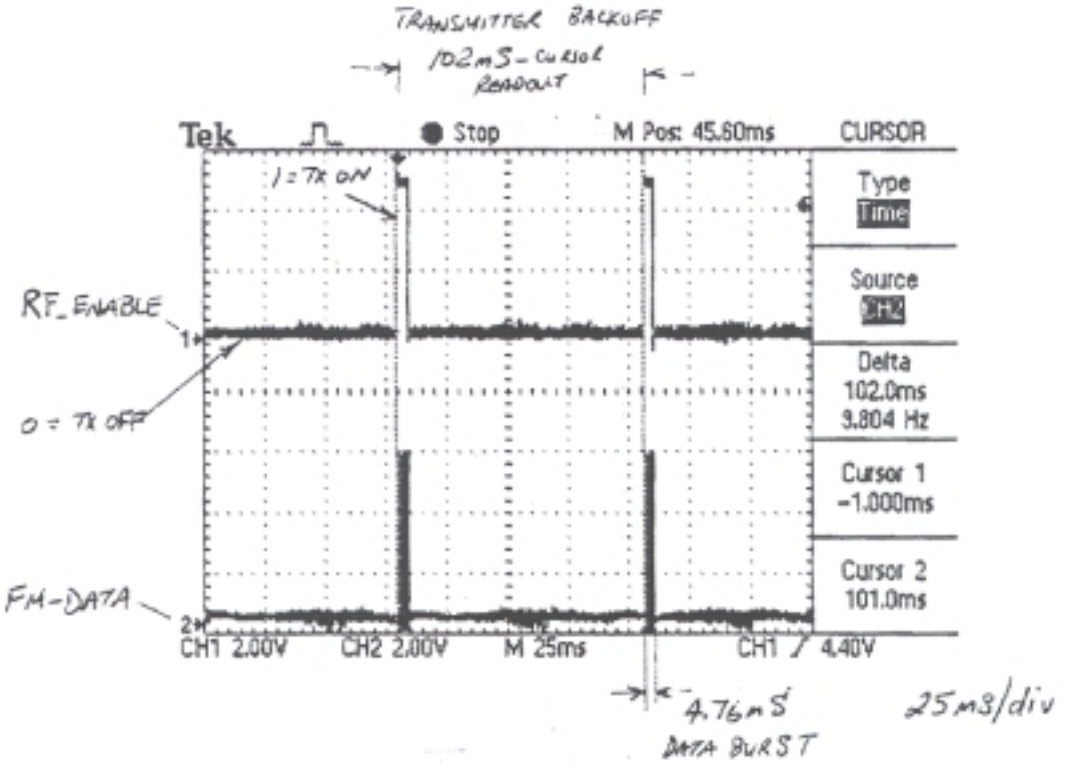
The Average measurement for measurements above 1 GHz was derived from applying the possible duty cycle correction to the peak reading. The results of average radiated spurious emissions are given in Table 5.

Duty Cycle Correction During 100 msec:

The EUT limits its duty cycle transmission to a maximum of 10 ms of burst NBFM data within any 100 ms period of time. Figures 5a - 5b show the characteristics of the pulse train.

Duty Cycle Correction = 20 log (0.10) = -20 dB

Figure 5a
Duty Cycle Characteristics



DIGITRAK DT100R : DATA BURST DUTY CYCLE

Figure 5b
Duty Cycle Characteristics

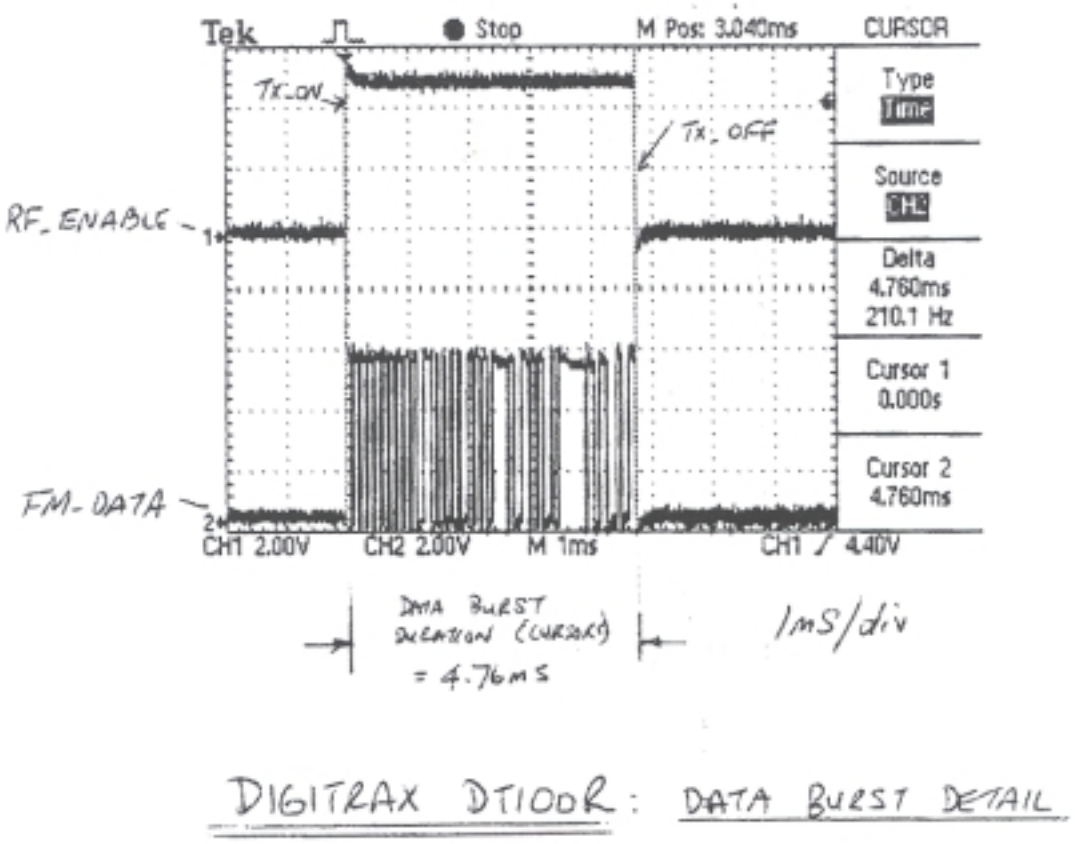


Table 5. Average Radiated Emissions Data

Test Date: **June 19, 2000**
UST Project: **00-0285**
Customer: **Digitrax, Inc.**
Product: **RF1**

> 1 GHz

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
1.83288	-69.4	35.0	28.6	3.4	53.7	500
2.74948	-69.7	34.9	31.3	4.2	79.1	500
3.66590	-81.8	34.6	34.0	5.3	30.9	500

* - Test Data corrected by 20 log (0.10) = -20 dB for duty cycle

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-69.4 - 35.0 + 28.6 + 3.4 + 107)/20) = 53.7
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: _____ Name: Austin Thompson, Jr.

2.10 Power Line Conducted Emissions for Transmitter FCC Section 15.207

The conducted voltage measurements have been carried out in accordance with FCC Section 15.207, with a spectrum analyzer connected to a LISN and the EUT placed into a continuous mode of transmit. The results are given in Table 6.

Table 6. Conducted Emissions Data
Class B

Test Date: June 19, 2000
UST Project: 00-0285
Customer: Digitrax, Inc.
Product: RF1

Frequency (MHz)	Test Data (dBm) Phase	Test Data (dBm) Neutral	RESULTS (uV) Phase	RESULTS (uV) Neutral	FCC Limits (uV)
The EUT is designed for use in equipment that is battery powered only, therefore conducted emissions were deemed unnecessary.					

Tester
Signature: _____ **Name:** Austin Thompson, Jr.