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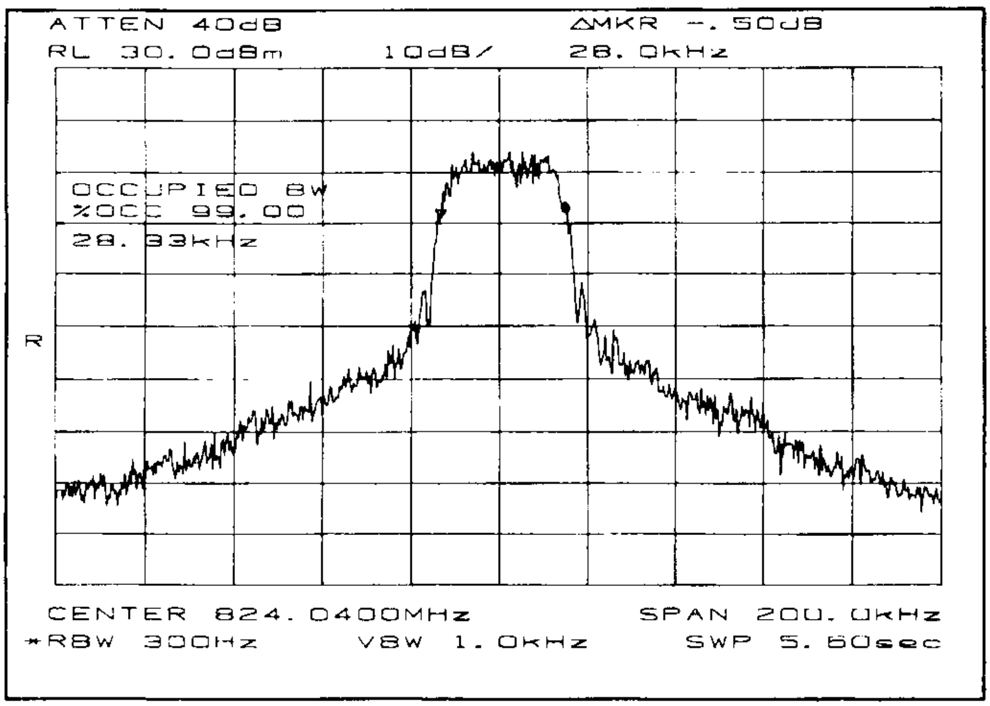
Table 1: Occupied Bandwidth Results

Channel	99% Occupied Bandwidth (kHz)
991	28.33
383	28.00
799	28.33

Figure 1: 99% Occupied Bandwidth (Channel 991)



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August 13, 1998

Mr. Joe Dichoso
Federal Communications Commission
Authorization and Evaluation Division
Equipment Authorization Branch
7435 Oakland Mills Road
Columbia, Maryland, 21046

re: Proximity T800 Line Access Unit (FCC ID: AB6NTGF75BA)

Dear Mr. Dichoso,

This is the response to the letter you sent on July23 1998 to John Shinn (Nortel) regarding the FCC Part 22 application for the Proximity T800 LAU (FCC ID: AB6NTGF75BA). In your letter, you made the request for 4 addtional items of information which are listed below.

1. *Please submit a calculation of the necessary bandwidth for the TDMA operation.*

2. *Please provide measurement data showing the occupied bandwidth for TDMA operation.*

As per our telephone discussion on August 5 1998, the measurement of the 99% occupied bandwidth for the LAU in TDMA mode should cover the two first questions. The 99% occupied bandwidth for the LAU was measured on three channels (991, 383, and 799) using a the 99% occupied bandwidth measurement feature of the HP8565 spectrum analyzer. The resolution bandwidth of the spectrum analyzer was set to a value close to 1% of the occupied bandwidth. The LAU was then put in TDMA communication mode using the Radio Transmitter Tester. The results are shown in Table 1 and Figure 1, 2, and 3. The test setup is illustrated in Figure 4.

3. *Please provide a statement of compatibility to satisfy the guidelines in Section 22.933 of the Commission's R & R. Please note that the power output values specified for Class II stations are in terms of ERP.*

The Proximity T800 LAU complies with the requirements of OST Bulletin 53 "Cellular System Mobile Station - Land Station Compatibility Specification" as specified in Section 22.933. In addition the T800 LAU complies with the requirements of IS-136 "TDMA Cellular/PCS - Radio Interface - Mobile Station - Base Station Compatibility Standard" and IS-137 "TDMA Cellular/PCS - Radio Interface - Minimum Performance Standard for Mobile Stations"

4. *Provide details how the ESN protection guidelines in Section 22.919 of the Commission's R & R are satisfied.*

Each LAU has a unique factory set ESN whose host component (EEPROM) is permanently attached to the main circuit board.

The integrity of the LAU's operating software is not alterable since the software is masked. The ESN is fused in the EEPROM making it impossible to change the contents of the EEPROM.

Any attempt to remove, tamper with, or change the ESN chip, its logic system, or firmware originally programmed by Nortel will render the transmitter inoperative since the EEPROM contains many parameters required for the operation of the LAU. The software is designed such that any malfunction sensed by the LAU will cause the transmitter to be disabled

If there is anything I can do to assist with the type acceptance, please do not hesitate to call me at (613) 763-7847.

Denis Lalonde

Radio Compliance Engineer

NORTEL
NORTHERN TELECOM

Figure 2: 99% Occupied Bandwidth (Channel 383)

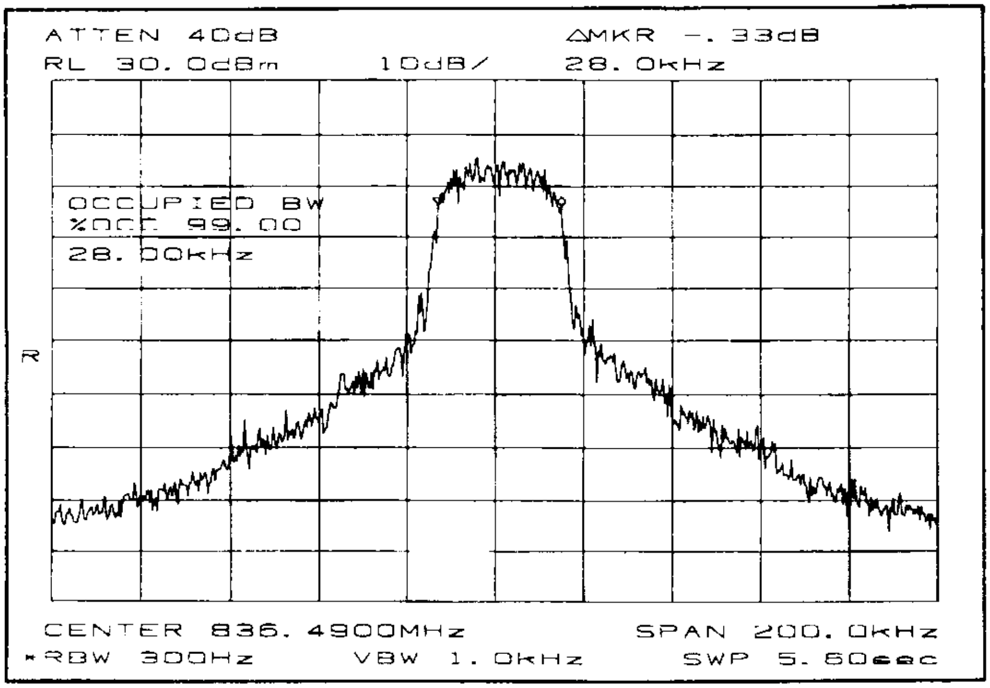

Figure 3: 99% Occupied Bandwidth (Channel 799)

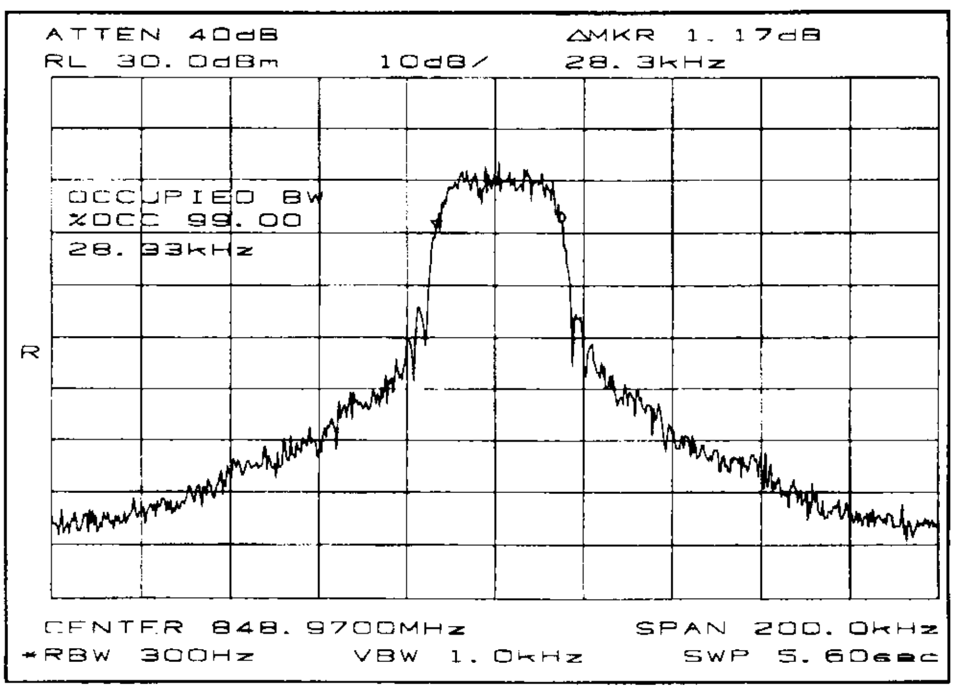

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Figure 4: Occupied Bandwidth Test Setup

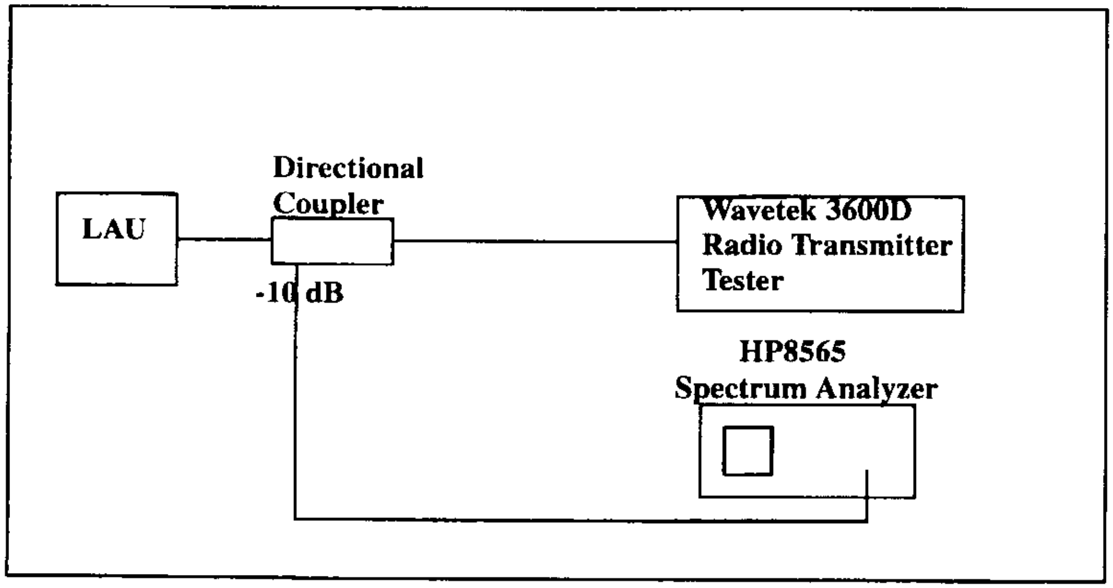


Exhibit B

Test Report

1.0 Introduction

This information is submitted in accordance with the FCC rules and regulations, Part 2, Subpart J, §2.983 through §2.1091 for Type Acceptance of the Northern Telecom Proximity-T 800 LAU (Line Access Unit).

This transceiver is intended for use in the Domestic Public Cellular Radio Telecommunications Service and is designed in accordance with the following standards:

- CFR 47, Part 22, Subpart H, *Domestic Public Cellular Radio Telecommunications Service*
- CFR 47, Part 2, Subpart J, Equipment Authorization Procedures - Type acceptance
- *TDMA Cellular/PCS - Radio Interface - Minimum Performance Standards for Mobile Stations*, TIA/EIA/IS-137-A, June 1996

2.0 Engineering Declaration

The Proximity T-800 LAU Transceiver has been tested in accordance with the requirements contained in the Federal Communications Rules and Regulations Parts 2, and 22. To the best of my knowledge, these tests were performed in accordance with good engineering practices using measurement procedures consistent with industry or commission standards and demonstrate that this equipment complies with the appropriate standards. All tests were conducted on a representative sample of the equipment for which Type acceptance is sought.

May 8, 1998

Denis Lalonde

Radio Compatibility Engineer

Nortel

Kanata, Ontario, Canada

May 8, 1998

Steve Cassidy

Radio Compatibility Engineer

Nortel

Kanata, Ontario, Canada

3.0 Type Acceptance Application Requirements

3.1 Name of applicant

The applicant is Northern Telecom Incorporated.

3.2 Identification of Equipment

The equipment in this application is referred to as the Proximity T-800 LAU (Line Access Unit). The Model Number for the terminal is NTGF75BA.

3.3 Quantity Production

The 800MHz Proximity-T LAU will be produced in quantity.

3.4 Technical Description

See Exhibit D.

3.5 Type or types of emission.

40K0F8W - Voice plus supervisory audio tone

40K0F1D- Wideband Data

30K0DXW - TDMA mode.

3.6 Frequency range

The 800 MHz Proximity-T LAU will operate in the 824 to 894 MHz band, using 824 - 849 MHz for the transmitter and 869-894 MHz for the receiver. The channel separation is 30 kHz.

3.7 Range of operating power

The transmit power can be set to levels covering the range from 6.3 mW (8dBm) to 0.631 W (28 dBm).

3.8 Maximum power rating

The maximum RF power output is 0.631 W.

3.17 Circuit description for limiting power

Power control is open loop and utilizes a temperature monitor circuit to adjust the output to maintain +2/-4 dB accuracy. Furthermore, the frequency response of the transmitting chain is compensated by factory calibrating the Tx power at several frequencies across the cellular band and then saving frequency sensitive attenuation factors in the memory circuits of the LAU.

The maximum power the unit can deliver to the antenna port, including duplexer loss, is 631 mW (28 dBm).

3.18 Modulation description for digital systems

The DSP passes encoded bits to the baseband-RF interface chip. The baseband-RF interface chip performs serial to parallel conversion of these bits and then further encodes them into pi-by-4 DQPSK I and Q samples. The I and Q samples are then square-root-raised-cosine filtered and passed to the modulator in analog I and Q form. The modulator mixes the I and Q signals with the IFLO resulting in an IF SSB signal. This signal is then up-converted to RF and amplified for radiation at the antenna.

3.19 Photographs

See Exhibit G.

3.20 Standard Test Conditions and Test Equipment

The Proximity T-800 LAU was tested under the following standard test conditions unless otherwise noted:

Ambient Temperature: 20 - 35°C

Ambient Humidity: 20 to 40%

4.0 Transmitter Test and Measurement Results

4.1 RF Power Output

Standard:

RF Power Output Requirements (FCC Sec. 2.985)

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in 2.983(d)(5). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

FCC Limit (Sec. 22.913

The maximum effective radiated power (ERP) of base transmitters and cellular transmitters must not exceed 500 Watts.

Equipment:

800 MHz Proximity-T LAU

Test Method:

Analog Mode:

The antenna connector of the T800 LAU was connected directly to the RF spectrum analyzer. The T800 LAU was set to transmit at maximum transmit power. The loss from the measurement RF cable/attenuator and the accuracy of the spectrum analyzer was calibrated with a power meter and a signal generator. A correction factor of 10.2 dB was added to the spectrum analyzer readings. The power output was measured on all power levels on 3 channels, (one at the middle, top, and bottom of the cellular band). The input impedances of the RF cable, RF attenuator, and the spectrum analyzer are all 50 Ω. The resolution bandwidth of the spectrum analyzer was 100 kHz and the video bandwidth was 300 kHz.

Digital Mode:

In digital mode, the antenna connector of the T800 was connected directly to the RF spectrum analyzer. The T800 LAU was set to transmit at maximum transmit power. The loss from the measurement RF cable/attenuator and the absolute accuracy of the spectrum analyzer was calibrated using a power meter and a signal generator (substitution method). A correction factor of 10.2 dB was added to the spectrum analyzer readings. The power output was measured on all power levels on 3 channels, (one at the middle, top, and bottom of the cellular band). The input impedances of the RF cable, RF attenuator, and the spectrum analyzer are all 50 Ω. The resolution bandwidth of the spectrum analyzer was 100 kHz and the video bandwidth was 300 kHz.

4.2 Modulation Characteristics (Audio Frequency Response)

Standard:

Modulation Characteristics Requirements (FCC Sec. 2.987)

(a) Voice modulated communication equipment: A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 cps shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.

Requirements:

From 300 to 3000 Hz the audio frequency response shall not vary more than +1/-3 dB from a true 6 dB/octave pre-emphasis characteristic with the exception of a permissible 6 dB/ octave rolloff from 2500 to 3000 Hz.

Equipment:

800 MHz Proximity-T LAU

Measurements:

The T800 transmitter was operated under the standard test conditions with the compressor disabled. A sine wave audio signal was applied to the transmitters external audio input port (RJ-11 tip and ring). The modulating frequency was varied from 300 to 3000 Hz while recording the input level necessary to maintain a constant +/-2.9 kHz system deviation. The frequency deviation was measured using a Digital Mobile Radio Transmitter Tester.

Results:

Conforms.

Figure 1 shows the Audio Frequency Response of the T800 Product.

4.3 Modulation Characteristics (Audio Filter Characteristics)

Standard:

Modulation Characteristics Requirements (FCC Sec. 2.987)

(d) Audio filter characteristics. Except as provided in §22.917, radiotelephony signals applied to the modulator from the modulation limiter must be attenuated as a function of frequency as specified in this paragraph.

(1) For mobile stations, these signals must be attenuated, relative to the level at 1 kHz, as follows:

(i) In the frequency ranges of 3.0 to 5.9 kHz and 6.1 to 15.0 kHz, signals must be attenuated by at least 40 log (f/3) dB, where f is the frequency of the signal in kHz.

(ii) In the frequency range of 5.9 to 6.1 kHz, signals must be attenuated at least 35 dB.

(iii) In the frequency range above 15 kHz, signals must be attenuated at least 28 dB.

(2) For base stations, these signals shall be attenuated, relative to the level at 1 kHz, as follows:

(i) In the frequency range of 3 to 15 kHz, signals must be attenuated by at least 40 log (f/3) dB, where f is the frequency of the signal in kHz.

(ii) In the frequency range above 15 kHz, signals must be attenuated by at least 28 dB.

(3) Filtering is not required for the supervisory audio tones, signaling tones or wideband data signals.

Equipment:

800 MHz Proximity-T LAU

Measurements:

The post-deviation limiter filter is implemented as a digital device and its input and output are not accessible as analog signals within the transceiver.

The T800 transmitter was operated under the standard test conditions with the compressor disabled. The frequency response was determined by connecting the antenna port of the T800 to the Digital Mobile Radio Transmitter Tester and then connecting the audio output from it to a dynamic signal analyzer. A sine wave at 1004 Hz was input to the T800 and the level of the tone was measured on the dynamic signal analyzer. All other input frequencies (up to 30 kHz) where then measured relative to the 1 kHz signal.

4.4 Modulation Characteristics (Modulation Limiting)

Standard:

Modulation Characteristics Requirements (FCC Sec. 2.987)

(b) Modulation levels. The levels of the modulating signals must be set to the values specified in this paragraph, and must be maintained within +/-10% of those values.

(1) The instantaneous frequency deviation resulting from the main modulating signal must be +/-12 kHz.

(2) The instantaneous frequency deviation resulting from the supervisory audio tones must be +/-2 kHz.

(3) The instantaneous frequency deviation resulting from the signaling tone must be +/-8 kHz.

(4) The instantaneous frequency deviation resulting from wideband data signals must be +/-8 kHz.

(c) Deviation limitation circuitry. Cellular transmitters must be equipped with circuitry that automatically prevents modulation levels for voice transmissions from exceeding the limits specified in this section.

Requirements:

The FM deviation resulting from the main modulating signal shall not exceed +/- 12 kHz peak frequency deviation.

The FM deviation resulting from the SAT shall be maintained within +/- 10% of the +/- 2 kHz peak frequency deviation.

The FM deviation resulting from the signaling tone shall be maintained within +/- 10% of the +/- 8 kHz peak frequency deviation.

Equipment:

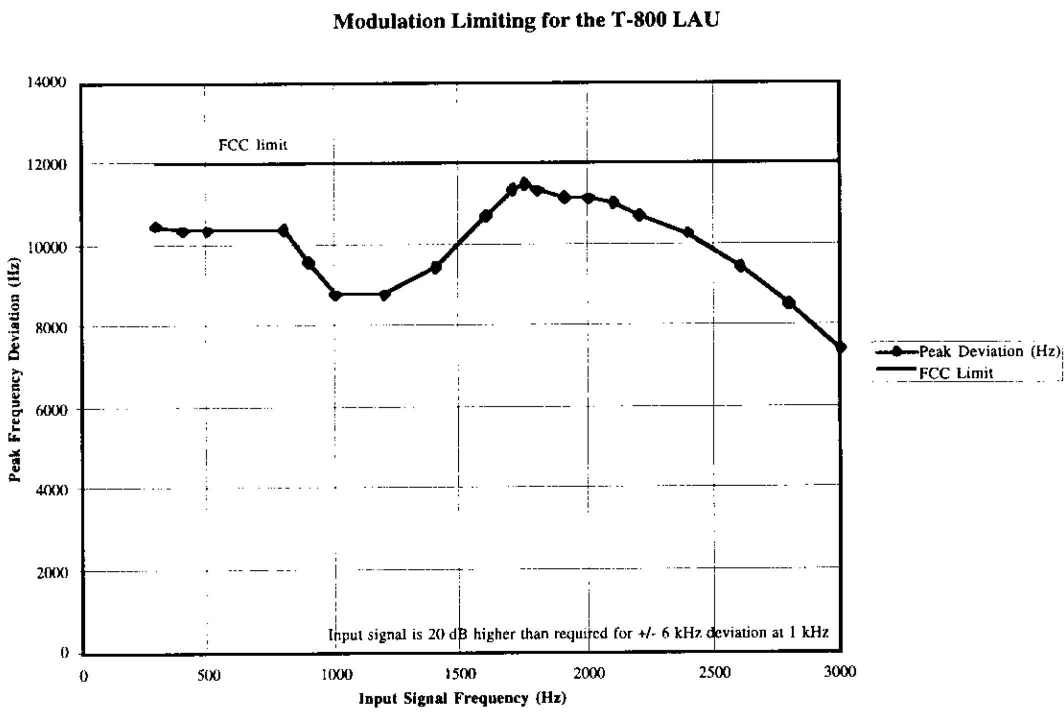
800 MHz Proximity-T LAU

Measurements:

The audio frequency signal generator was used to inject the input signal in the audio port of the T800 (RJ-11 port). The antenna port of the T800 was connected to the Digital Mobile Radio Transmitter Tester where the peak frequency deviation was measured. A 1 kHz sine wave was injected in the T800 and the level was set to produce 50% of the rated deviation (+/- 6 kHz peak deviation). This input level was taken as the reference. The input sine wave was then varied by 20 dB in 1 dB steps and the peak frequency deviation was measured at each step. The peak hold detector on the mobile tester was used for all measurements. The transmitter was operated under the standard test conditions with the compressor enabled.

Frequency deviation produced by the SAT and signalling tones were recorded after instructing the LAU to transmit a SAT and a signalling tone. The T800 is not capable of generating a pseudo-random wideband data signal, therefore, the wideband data test was not performed.

Figure 4: Deviation Limiting vs. Frequency

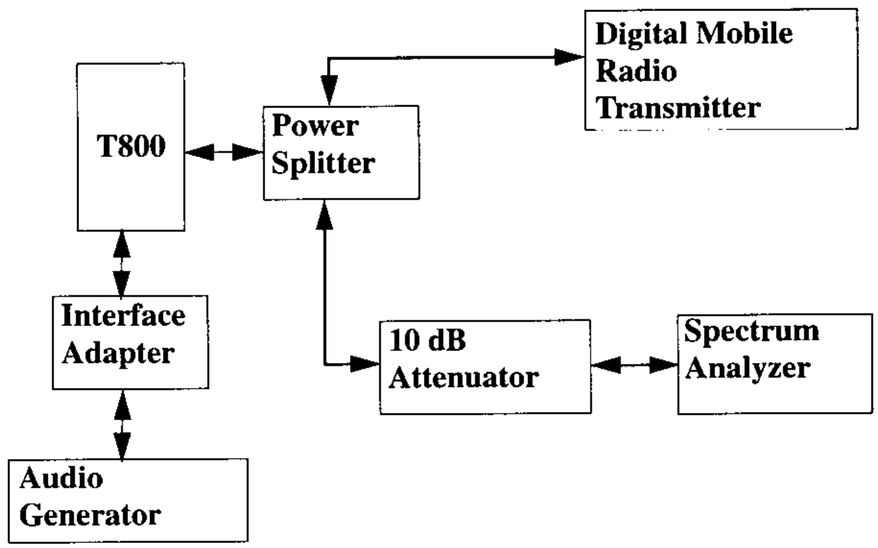


The T800 is not capable of generating a pseudo-random wideband data signal, therefore, the wideband data test was not performed.

Digital Mode

The transmitter was operated under standard test conditions. The antenna port of the T800 was connected through a power splitter to both the RF communications test set and the spectrum analyzer. Modulation was first disabled to establish carrier power. Then the RF communications test set was set to transmit pseudo random bits in the data fields and the T800 was set to echo this data back to the RF communications test set.

Test Setup:



Results:

Conforms.

The occupied bandwidth in digital mode is shown in Tables 2 and Figures 5, 6, and 7.

The occupied bandwidth in analog mode is shown in Figures 8, 9, and 10 for Voice and SAT. Figures 11, 12, and 13 show the results for SAT and as signalling tone.

Figure 5: Occupied Bandwidth for Channel 991 (Digital)

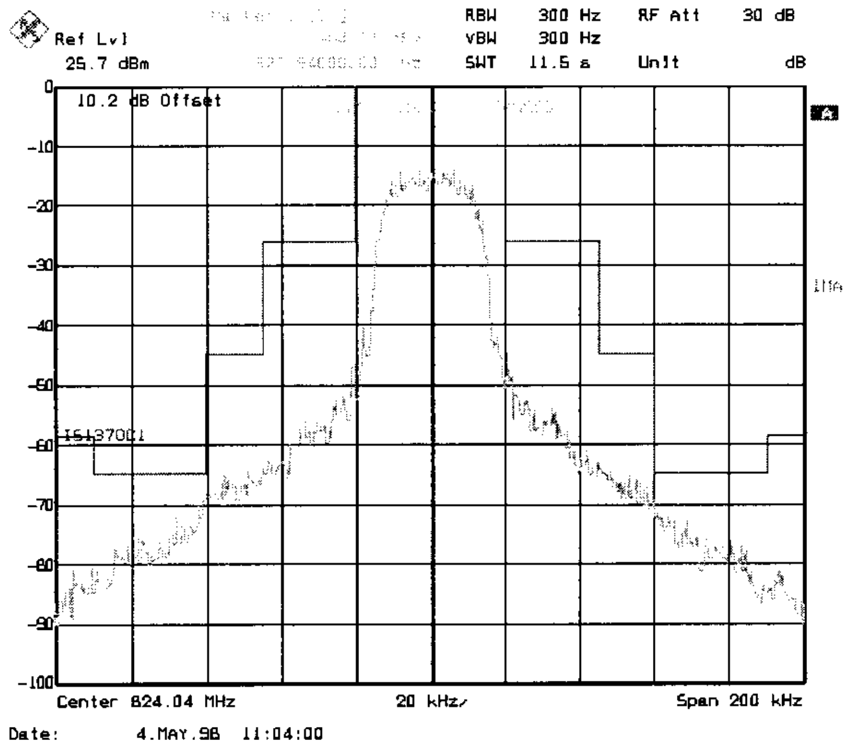


Figure 7: Occupied Bandwidth for Channel 799 (Digital)

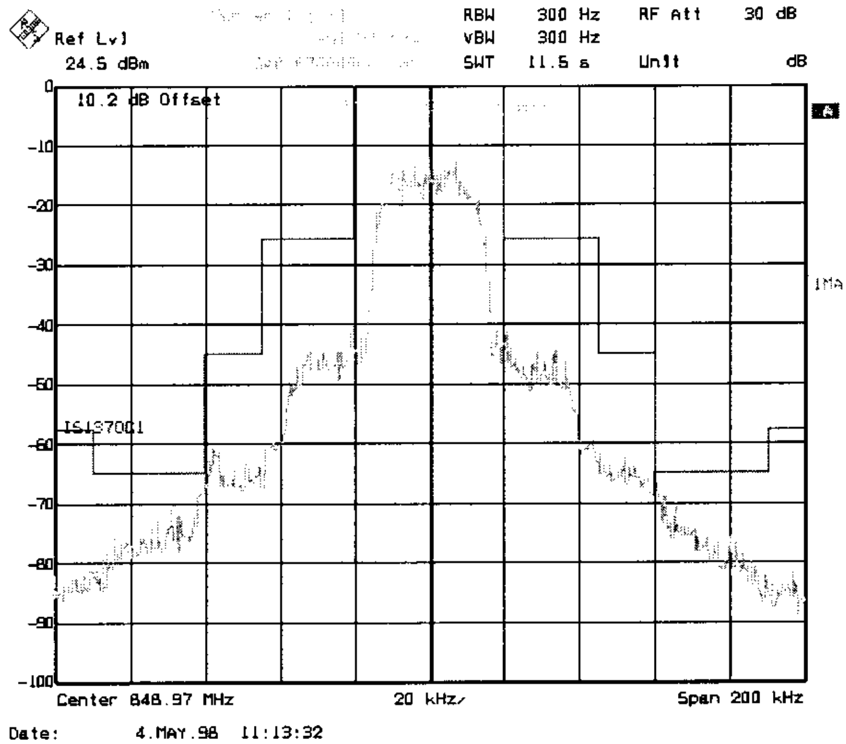


Figure 9: Occupied Bandwidth (Analog) with Voice Modulation and SAT on Channel 383

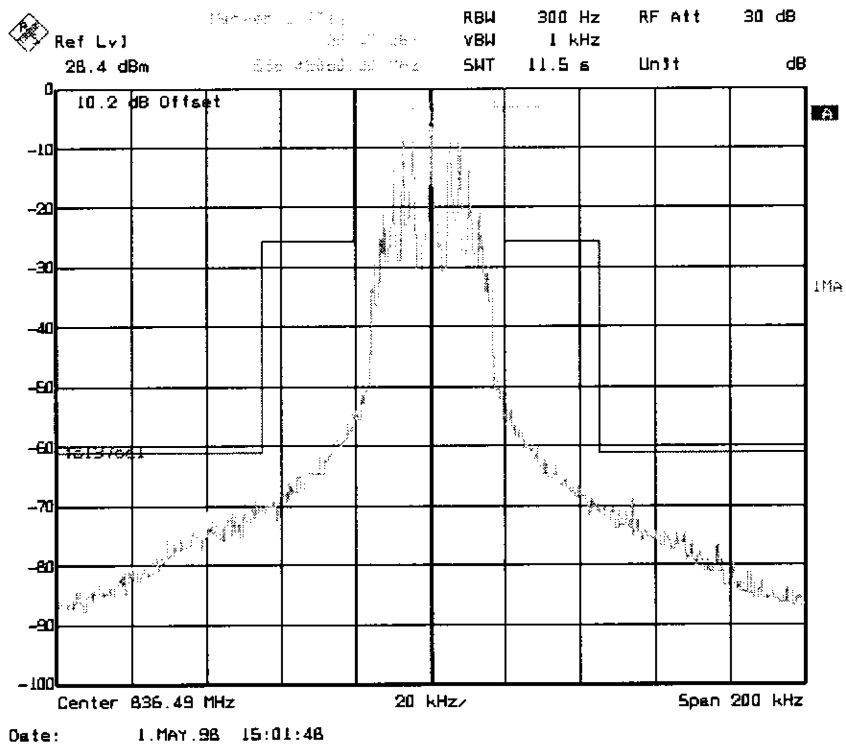


Figure 11: Occupied Bandwidth (Analog) with SAT and a signalling tone on Channel 991

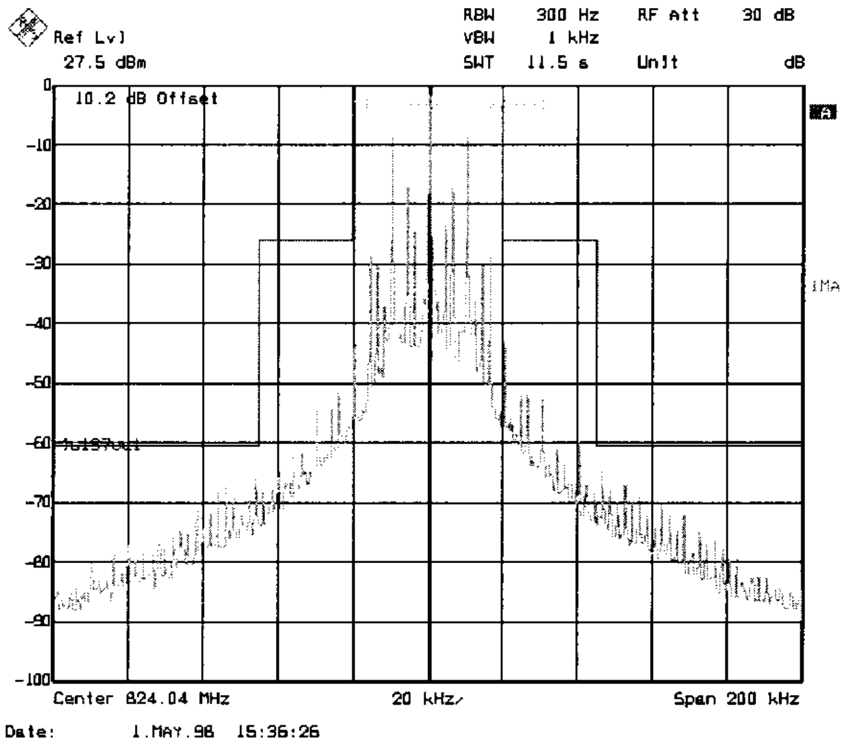
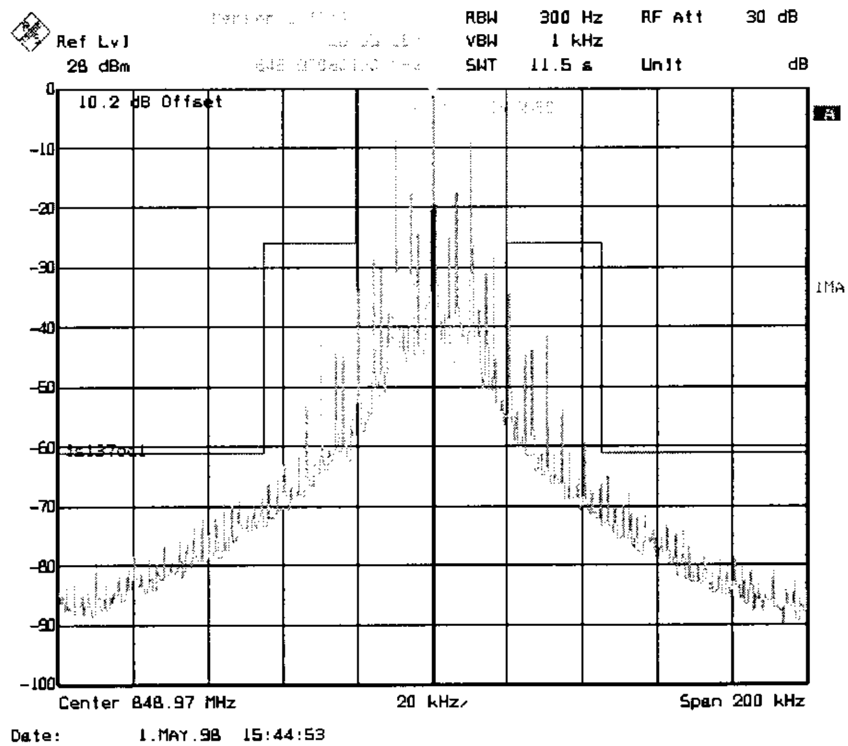


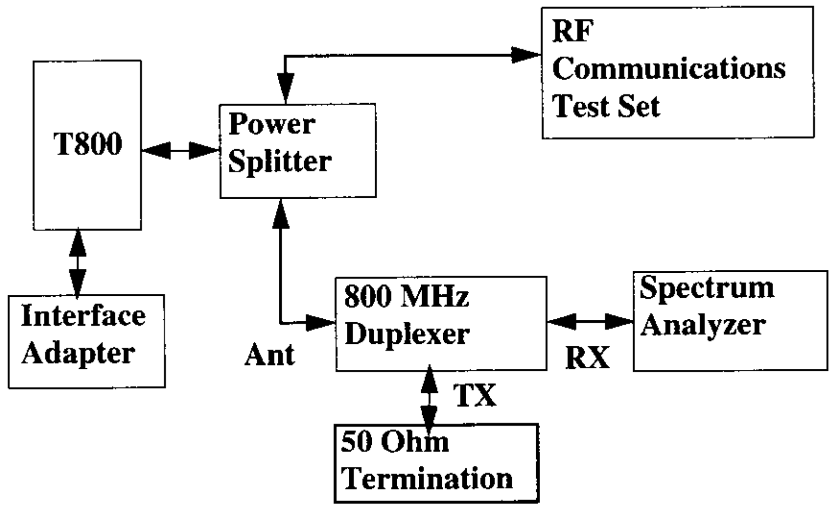
Figure 13: Occupied Bandwidth (Analog) with SAT and a signalling tone on Channel 799



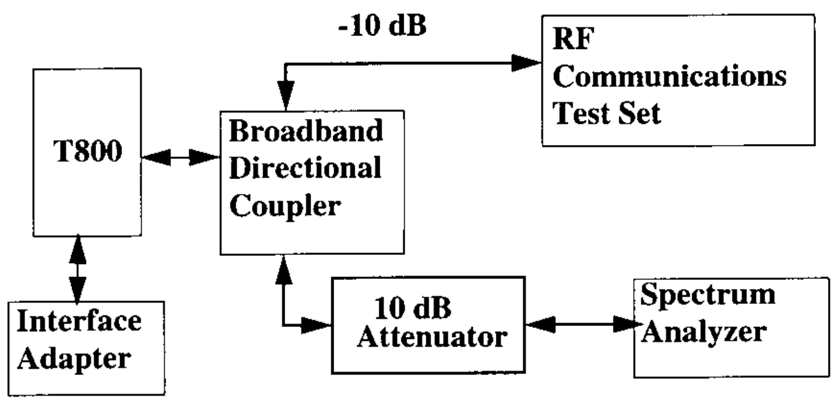
Test Setup:

The diagram below shows the test setup used to measure the emissions in the mobile receive band

Test setup to measure emissions in the mobile Receive band



Test setup to measure emissions from 100 kHz to10 GHz



4.7 Spurious Emissions at Antenna Terminals (Analog Mode)

Standard:

Spurious Emissions at Antenna Terminals (FCC Sec. 2.991 & 22.917)

Conducted spurious emissions shall be attenuated below the level of emissions of the carrier frequency by at least 43 + 10[log(mean output power in watts)]. The mean power level of any emissions within the mobile receive band between 869 and 894 MHz, measured using a 30 kHz bandwidth, shall not exceed -80 dBm.

Conducted Emissions limit:

43 + 10 log(mean output power in watts) = 43 + 10 log (0.631W) = 41 dB

Equipment:

800 MHz Proximity-T LAU

Measurements:

The transmitter's compressor was disabled and was modulated with combined voice and SAT. The voice signal was simulated by a 2500 Hz sine wave 16 dB greater than that required to produce +/- 6 kHz peak frequency deviation at 1000 Hz. The LAU was instructed to generate a 6000 Hz SAT tone at +/- 2 kHz peak frequency deviation.

At 2.5 GHz high pass filter was added in front of the spectrum analyzer for the measurement of frequencies higher than 2.5 GHz

Results:

Receiver emissions

Conforms.

The test was performed on channel 383. Table 4 identifies the frequencies where the emission are within 20 dB of the limit.

Table 4: Transmitter Spurious Emissions (analog)

Frequency (MHz)	Emission Level (dBm)	Limit
875.373	-85.2	-80 dBm
879.692	-93.2	-80 dBm

Transmitter emissions

Conforms.

The test was performed on channel 383. There were no emissions within 20 dB of the -13 dBm limit.

Requirements:

The frequency stability shall be better than +/- 2.5 ppm over a temperature range of -30 to +50 degrees C.

Show that the frequency has stabilized within +/- 2.5 ppm after 10 minutes at -30 deg. C, 0 deg. C, and 30 deg. C.

The frequency stability shall be better than +/- 2.5 ppm over a voltage range of 85 to 115 percent of the nominal voltage.

AC Operation with the Robust power Supply (Ault Inc. BBU06200)

Nominal = 120 VAC, lower = 102 VAC, upper = 138 VAC

Battery Operation with the Robust power Supply (Ault Inc. BBU06200)

Nominal = 6.5 V, lower = 5.5 V, upper = 7.5 V

Measurements:

The transmitter was operated on channel 383 (mid-band). For the temperature test, the T800 was placed in an environmental chamber. The chamber was stabilized to 20 C and the RF carrier frequency was measured using a Modulation Domain Analyzer and a Rubidium Frequency Reference. The chamber was then set to temperatures ranging from -30 to 50 C in 10 C steps. At each temperature, 60 minutes was given for the temperature to stabilize. The T800 transmitter was enabled (without audio or SAT) and the frequency of the RF carrier was measured.

The AC power supply test was performed by varying the AC supply from 102 to 138 VAC in 3 VAC steps. The power supply voltage was measured with the DVM at the terminals of the Variac.

For the battery supply test, the battery voltage to the T800 was varied from 5.5 V to 7.5 V in 0.2 V steps. The power supply voltage was measured with the DVM at the terminals of the power supply. A short cable (approximately 10 inches) was used to connect the power supply to the T800, so the cable loss could be neglected.

Table 6 shows the time required for the frequency to stabilize within +/- 2.5 ppm at -30 deg. C, 0 deg. C, and 30 deg. C.

Table 6: Transmitted frequency vs. Time at -30, 0 & 30 deg. C

Time after power up (min)	-30 deg. C Frequency Offset (ppm)	0 deg. C Frequency Offset (ppm)	30 deg. C Frequency Offset (ppm)	Limit (ppm)
1	0.055	-0.70	0.23	+/- 2.5
2	0.19	-0.23	0.25	+/- 2.5
3	0.25	-0.26	0.26	+/- 2.5
4	0.29	-0.26	0.26	+/- 2.5
5	0.30	-0.27	0.27	+/- 2.5
6	0.32	-0.28	0.28	+/- 2.5
7	0.34	-0.29	0.28	+/- 2.5
8	0.35	-0.31	0.28	+/- 2.5
9	0.36	-0.31	0.28	+/- 2.5
10	0.37	-0.31	0.29	+/- 2.5
11	0.38	-0.32	0.29	+/- 2.5
12	0.38	-0.32	0.29	+/- 2.5
13	0.38	-0.32	0.29	+/- 2.5

Table 8 shows the frequency stability as a function of the battery voltage.

Table 8: Transmitted frequency vs. Battery voltage

Battery voltage (V)	Center Frequency (MHz)	Frequency Offset (ppm)	Limit (ppm)
5.5	836.490165	0.20	+/- 2.5
5.6	836.490167	0.20	+/- 2.5
5.8	836.490168	0.20	+/- 2.5
6.0	836.490168	0.20	+/- 2.5
6.2	836.490168	0.20	+/- 2.5
6.4	836.490169	0.20	+/- 2.5
6.6	836.490170	0.20	+/- 2.5
6.8	836.490171	0.20	+/- 2.5
7.0	836.490172	0.21	+/- 2.5
7.2	836.490173	0.21	+/- 2.5
7.4	836.490174	0.21	+/- 2.5
7.6	836.490175	0.21	+/- 2.5
7.8	836.490176	0.21	+/- 2.5

Table:9 Clock Frequencies.

Fundamental Frequencies (Crystal/VCXO) (MHz)
0.1215
0.450
1.944
2.048
4.860
14.40
38.88
82.23
82.71
741.30-766.26
952.17-977.13

5.1.3 System Cables

The terminal Power Supply Unit (PSU) was connected to a switchable AC mains outlet. The DC cable from the PSU to the terminal was suspended from the backplane of the table as much as the length of the cable would permit.

The extension set was connected to the terminal voice port via a 4-wire telephony cable approximately 8m in length. The cable was draped on a wooden brace positioned above the terminal.

5.2 General Test Conditions

5.2.1 Test Sites

NORTEL maintains two test sites in the vicinity of Ottawa. A radiated emissions Open Area Test Site is located at 1500 Peter Robinson Road, Almonte, Ontario, Canada. An indoor test facility is located at 1 Brewer Hunt Way, Kanata, Ontario, Canada. Both sites are AUSTEL and NVLAP approved.

Radiated emission tests were performed at the Open Area Test Site (1500 Peter Robinson Road, Almonte, Ontario, Canada).

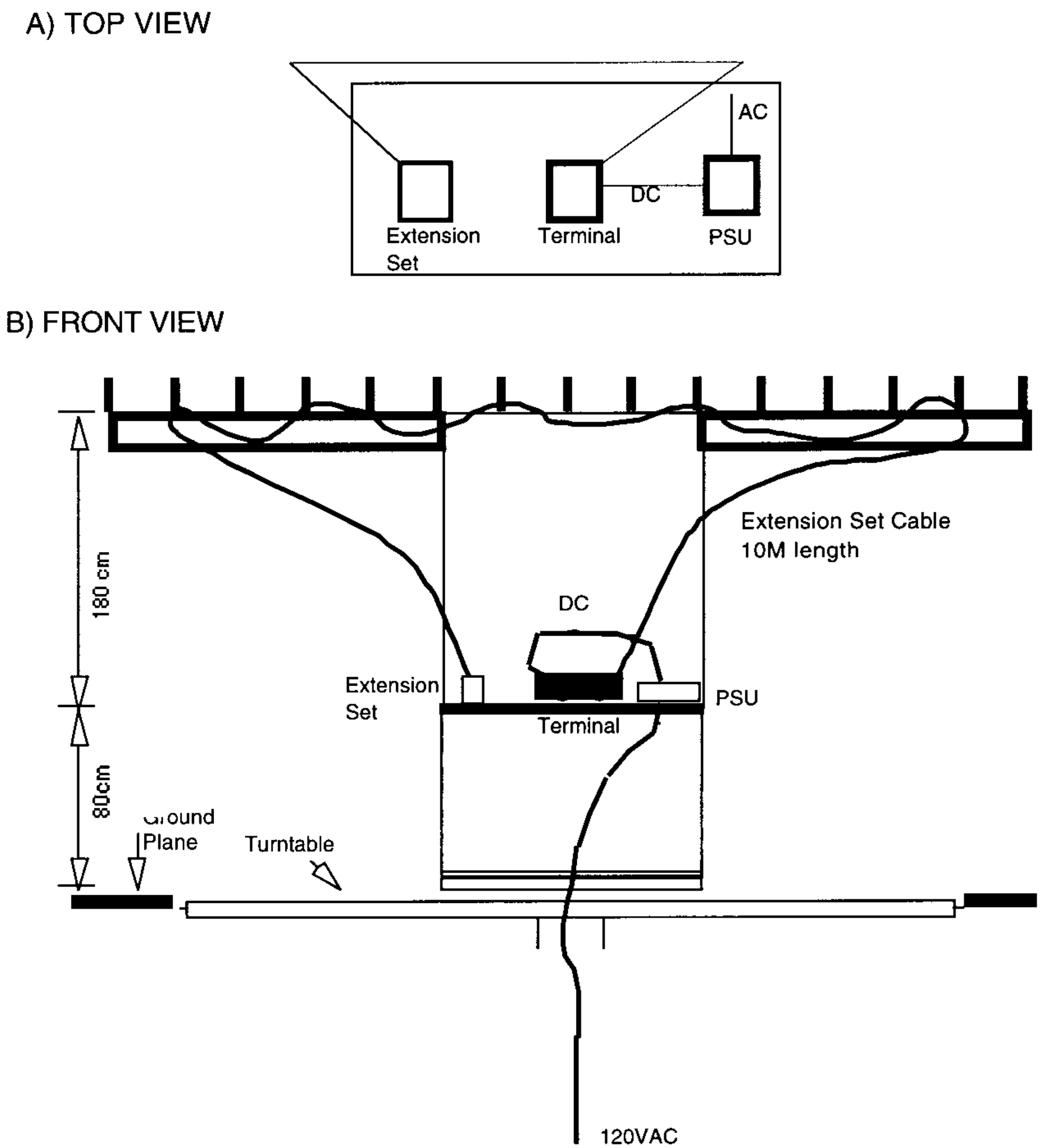


Figure 1: Test Setup For Radiated Emissions at Open Field Site

Table 10: FCC Part 22 / RSS 128 Radiated Emissions

Mode/ Channel	Frequency GHz	Level Measured dBμV	Calculated E-Field dBμV/m	E-Field Limit dBμV/m	Margin dB
AMPS Channel 1	1.65	40.9	32.5	84.4	51.9
AMPS Channel 1	2.475	44.2	40.7	84.4	43.7
AMPS Channel 1	3.3	59.6	61.0	84.4	23.4
AMPS Channel 1	4.125	43.2	46.1	84.4	38.3
AMPS Channel 1	4.95	39.4	44.7	84.4	39.7
AMPS Channel 1	5.775	33.9 (nf)	41.7	84.4	42.7(nf)
AMPS Channel 1	6.6	-39.2(nf)	47.7	84.4	36.7(nf)
AMPS Channel 1	7.425	39.2(nf)	52.0	84.4	32.4(nf)
AMPS Channel 1	8.25	39.7(nf)	53.2	84.4	31.2(nf)
AMPS Channel 1	9.075	38.8(nf)	52.5	84.4	31.9(nf)

nf = noise floor

5.4.2 About the Results

None of the measurements were within 20 dB of the -13 dBm limit. The emission with the highest level was found to be the 4th harmonic of Channel 1 (3300 MHz) in the AMPS mode. The margin on this frequency was 23.4 dB. The results shown in Table 12 illustrate the emission levels observed in this configuration.

5.6 Test Equipment List

Table 11: Test Equipment List for Radiated Emissions Test

MANUFACTURE/TYPE	MODEL NO.	SERIAL NO.	CAL. DUE
HP QUASI-PEAK DETECTOR	85650A	2043A00313	2 JAN 99
HP SPECTRUM ANALYZER	85660B	3014A07256	30 MAR 99
HP SPECTRUM ANALYZER DISPLAY	85662A	3026A20026	30 MAR 99
HP RF PRESELECTOR	85685A	3010A01085	30 MAR 99
HP PLOTTER	7440A	2539A07222	-
A/H TURNTABLE CONTROLLER	MCG300	147	-
CHASE BILOG ANTENNA	CBL 6111	1011	30 DEC 98
EMCO ANTENNA TOWER		1070-6	-
MAST CONTROLLER	EMCO 1090		-
COMPUTER - Macintosh	QUADRA 700	L0056942	-
HP SPECTRUM ANALYZER	8593E	3308A00587	23 MAY 98
EMCO HORN ANTENNA	3115	9104-3683	1 DEC 98
PRE-AMPLIFIER		A-4	28 JUL 98
CABLE		97H0370	27 AUG 98
CABLE		97F0846	7 OCT 98
CABLE		97H0371	28 AUG 98
CABLE		97H0368	28 AUG 98
HP POWER SUPPLY	6284A	1149A01833	18 AUG 98

Exhibit C

Radiation Exposure Attestation

1.0 Attestation of Compliance

2.0 Radiation Exposure measurement results

Nortel Technology
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Tel 613 763-2211

May 12, 1998

NORTEL
NORTHERN TELECOM

Federal Communications Commission
Authorization and Evaluation Division
Equipment Authorization Branch
7435 Oakland Mills Road
Columbia, Maryland, 21046

re: Proximity T-800 LAU (FCC ID: AB6NTGF75BA)

To whom it may concern,

The Radiation Exposure Level of the Proximity T-800 LAU has been investigated and found to comply with the requirements found in FCC Part 1 Section 1.1310.

The evaluation data is being kept on file at,

Nortel
Product Integrity Labs
21 Richardson Side Road
Kanata, Ontario
Canada
K2K 2C1

Sincerely,

Denis Lalonde
Radio Compliance Engineer

Test Results

Table 12 shows the results for RF Hazards measurements.

Table 12: Test Results for RF Hazards

Measurement Method	Frequency (MHz)	Distance (m)	Measured E Field (dBμV/m)	Limit (dBμV/m)
Broadband Probe 1.5m high		0	149.5	153.2
Broadband Probe 1.0m high		0.5	134.0	153.2
Broadband Probe 0.5m high		1.0	134.0	153.2
Dipole Antenna	836.49	0.2	141.9	153.2
	836.49	0.3	139.1	153.2
	836.49	0.5	136.7	153.2
	836.49	1	132.6	153.2
	836.49	1.5	129.8	153.2
	836.49	2	128.1	153.2
	836.49	2.5	123.7	153.2
	836.49	3	120.3	153.2

As shown in Table 12, the field strength is below the allowed limit set by FCC Part1 Sec. 1.1310.

The broadband probe measurements were performed at 3 location in order to calculate the full body average exposure. The measurements simulate the exposure at the height of the head, the waist, and the knee for a person who is touching the LAU with its head.

Full Body Average Exposure = (30 V/m + 5 V/m + 5 V/m) / 3

= 13.3 V/m (142.5 dBμV/m)

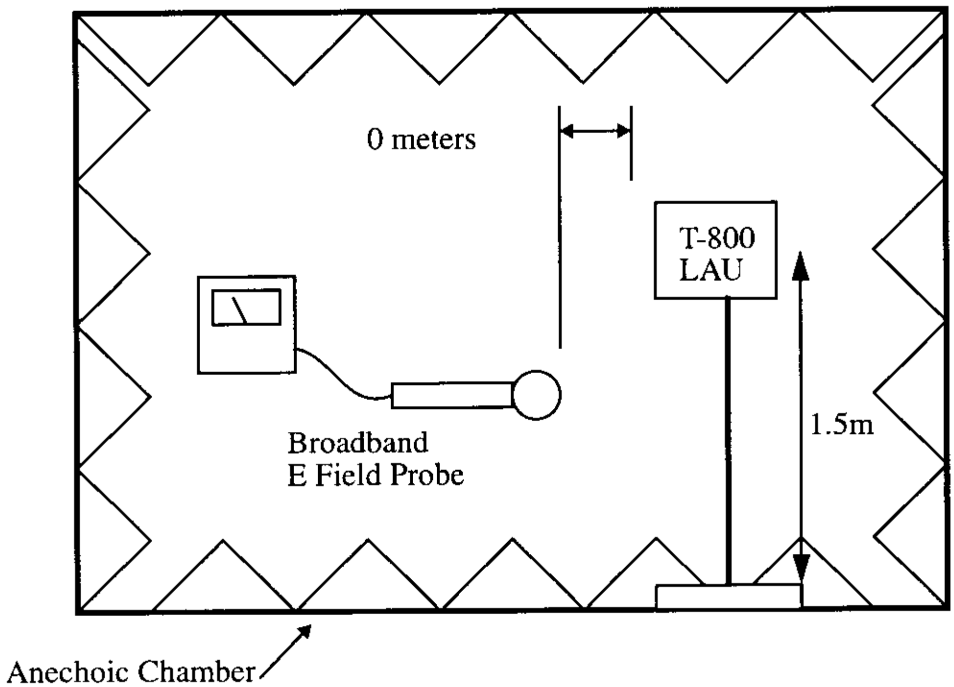
The T-800 LAU complies with the requirement. A safety margin of 10.7 dB was obtained for the 45.5 V/m limit

Test Procedure

Broadband E Field Probe

The equipment was configured as shown in Figure 2.

Figure 2: Test Configuration using Broadband E Field Probe



The LAU was configured to transmit at maximum power in AMPS mode (channel 383) and was equipped with its standard antenna (Duck Centurion, model CXR-821-TN).

The hand held probe was positioned around the entire transceiver and the maximum E Field level was recorded.

Dipole Antenna

The equipment was configured as shown in Figure 3.

Exhibit D

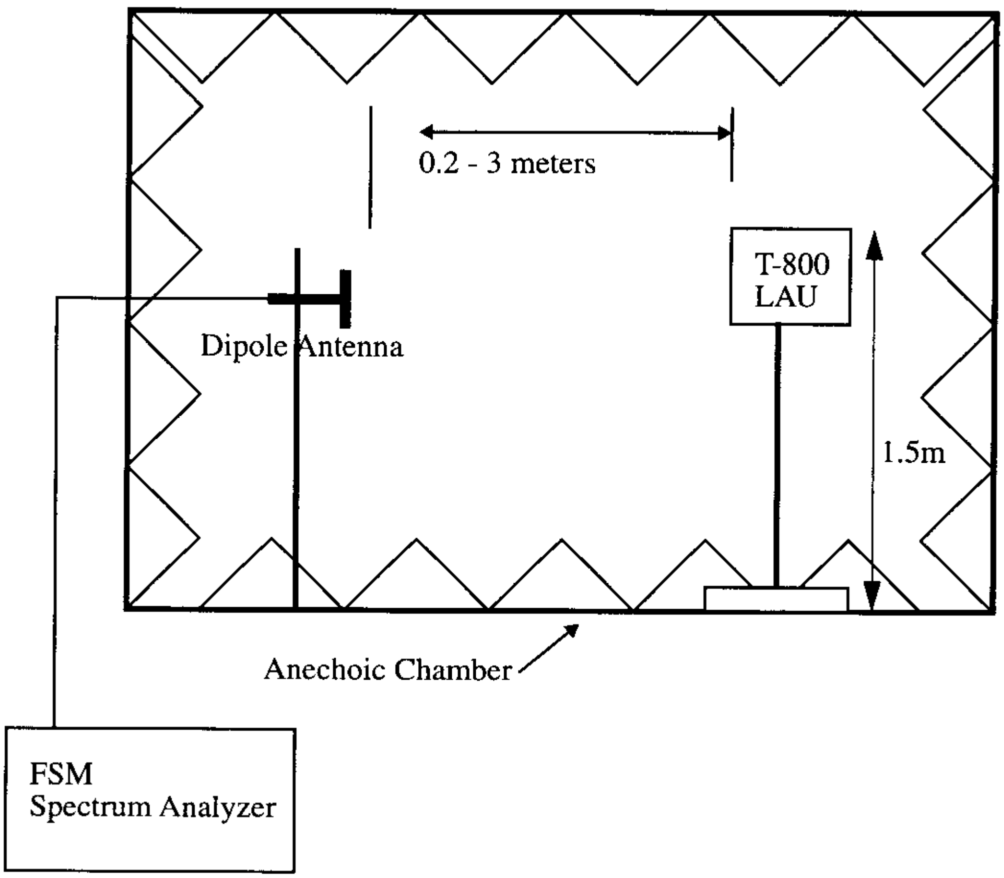
Technical Description

Exhibit E

Circuit Schematics

1.0 800 MHzLine Access Unit (19 pages)

Figure 3: Test Configuration using Dipole Antenna



The LAU was configured to transmit at maximum power in AMPS mode (channel 383) and was equipped with its standard antenna (Duck Centurion, model CXR-821-TN).

Measurements were made at distances from the T-800 LAU of 0.2 to 3 m. The dipole antenna was connected to the spectrum analyzer to measure the field strength. The position of the transceiver which produced the highest level was located and the maximum field strength was recorded.

6.0 Radiation Exposure Evaluation

Standard

Radiation Exposure Evaluation: Mobile Devices FCC Sec. 1091

c) Mobile devices that operate in the Cellular Radiotelephone Service under Part 22 Subpart H are subject to routine environmental evaluation for RF exposure prior to equipment authorization.

Applications for equipment authorization of mobile and unlicensed transmitting devices subject to routine environmental evaluation must contain a statement confirming compliance with the limits specified in paragraph (d) of this section as part of their application.

(d) The limits to be used for evaluation are specified in § 1.1310 of this chapter. All unlicensed personal communications service (PCS) devices and unlicensed NII devices shall be subject to the limits for general population/uncontrolled exposure.

Limits for General Population/Uncontrolled Exposure (freq: 300 - 1500 MHz)

MPE = freq.(MHz)/1500 mW/cm^2

= 824 / 1500

= 0.549 mW/cm^2

Limit

$$PowerDensity\left(\frac{W}{m^2}\right) = \frac{EField\left(\frac{V}{m}\right)^2}{\eta}$$

$$EField\left(\frac{V}{m}\right) = \sqrt{PowerDensity\left(\frac{W}{m^2}\right) \bullet \eta}$$

$$EField\left(\frac{V}{m}\right) = \sqrt{5.49\left(\frac{W}{m^2}\right) \bullet 377\Omega}$$

Therefore,

E Field = 45.5V/m = 153.2 dBμV/m

All measurements < 1 GHz were performed with a Quasi-peak detector.

All measurements > 1 GHz were performed with a peak detector.

5.5 Mathematical Calculations of Compliance Limit and Margin

FCC Part 22 states that harmonics must be suppressed 43 + 10 log P below the transmitter power level in order to comply.

Calculation of Part 22 Limit @ 3m (dBm)

To determine the field strength for compliance at 3 meters, the following calculations were used:

Fundamental Power: 10 log (Pt/0.001) = 10 log (0.631 Watts/0.001) = 28.0 dBm

Suppression: 43 + 10 log (Pt) = 43 + 10 log (0.631 Watts) = 41.0 dB

Therefore limit = 28.0 - 41.0 = **-13 dBm**

Calculation of Part 22 Limit @ 3m (dBμV/m)

To determine the field-strength limit at 3 meters, we use the gain of a half-wave dipole antenna:

E_{limit} = (1/R) * SQRT(30 * Pt * Gt)

where Gt = 1.65 for an half-wave dipole antenna, R = 3 meters, Pt = -13 dBm ~ 50.1 μW

E_{limit} = (1/3) * SQRT(30 * 50.1μW * 1.65)

E_{limit} = 0.0166 V/m

E_{limit} = 20 log (0.0166V) = -35.6 dBV = 84.4 dBμV/m = E-Field Limit @ 3 meters

Calculation of Field Strength @ 3m (dBμV/m)

To calculate the E-field measured by the horn antenna, the following calculations were used:

Data sample: AMPS Channel 1, 3.3 GHz, Measured value = 59.6 dBμV

Antenna factor @ 3.3 GHz = 31.4 dB

Cable Loss @ 3.3 GHz = 10.0 dB

Pre-Amplifier Gain @ 3.3 GHz = 40.0 dB

Field strength measured (dBμV/m) = dBμV + Antenna Factor (dB) + Cable Loss (dB) - Pre-Amp Gain (dB)

= 59.6 dBμV + 31.4 dBm + 10.0 dB - 40 dB

= 61.0 dBμV/m

Therefore, the margin for this example is 84.4 - 61.0 = 23.4 dB.

5.3 Radiated Emissions Measurements

5.3.1 Test Procedure

Test equipment & site verification is performed prior to the installation of test sample as an ISO9000 procedure. The test system uses a broadband antenna positioned at 3 or 10 meters from the test sample. For this test, measurements were performed at 3 meters from the test sample. The test sample is rotated in azimuth over 360 degrees and antenna varied from 1 to 4 meters by increments of no less than 10 degrees and 50 cm, respectively. The azimuth, height and measured signal levels of the maximum emissions for all frequencies of the system clock harmonics are recorded. Cables are placed on the cross-arm to maximize emissions during the test. These procedures apply to both horizontal and vertical polarization of the search antenna. Final measurements are taken with tuned dipole antennae up to 1 GHz and a double ridged horn for above 1 GHz. All measurements are done by an automated program called AEMS, which is NORTEL proprietary software being developed for automated Open Field Tests.

The bandwidth used on the spectrum analyzer is 100 kHz unless otherwise noted. For broadband scans, the detector mode is video averaging of three scans. For measurements at discrete frequencies the detector mode is always quasi-peak except above 1 GHz where 1 MHz resolution bandwidth and average detection (video bandwidth of 100 Hz) are used. The frequency range investigated is 30 to 10000 MHz.

5.3.2 Measurement Instrumentation

The measurement instrumentation conforms to American National Standard Specification for Electromagnetic Interference and Field Strength Instrumentation 100 Hz - 22 GHz, ANSI C63.4 (1992) and CISPR publication 16.

Calibration of the measurement instrumentation is maintained in accordance with the supplier's recommendations, or as necessary to ensure its accuracy.

5.4 Test Results

5.4.1 Radiated Emission Results

Conforms

As specified in FCC Part 22, paragraphs 22.917 (b) (2) and 22.917 (d) (e) measurement of the transmit harmonics of the terminal were carried out for both AMPS and TDMA mode on various channels.

5.2.2 Test Configuration

The test configuration consisted of a T-800 LAU terminal wall mounted with the PSU and an extension set. The DC power cable was suspended from the table backplane behind the terminal and the extension set cable was draped over the arms of the cable trough for a worst case scenario. To simulate operation, the terminal was put into a mode whereby it transmitted a TDMA or AMPS signal at full power into a 50W dummy load attached to the antenna port.

5.0 Field Strength of Spurious and Harmonic Radiation

Standard:

Field Strength of Spurious and Harmonic Radiation FCC Sec.2.993

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of 2.989, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g., a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antennas.

(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:

(1) Those in which the spurious emission are required to be 60 dB or more below the mean power of the transmitter.

(2) All equipment operating on frequencies higher than 25 MHz.

(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.

(4) Other types of equipment as required, when deemed necessary by the Commission.

5.1 Description of Equipment Under Test

5.1.1 Equipment Under Test (EUT)

The EUT is a Proximity-T-800 LAU. It is a dual-mode terminal capable of transmitting analog (AMPS) or digital (TDMA) cellular traffic. Through a RJ-11 connector, the unit provides a single line telephone interface to a suscriber provided telephone set.

5.1.2 System Clocks

The following table lists the clock sources (e.g. discrete crystals and VCXOs) used in the configurations under test

Table 7 shows the frequency stability as a function of the AC voltage.

Table 7: Transmitted frequency vs. AC input

AC voltage (VAC)	Center Frequency (MHz)	Frequency Offset (ppm)	Limit (ppm)
102	836.490111	0.13	+/- 2.5
105	836.490111	0.13	+/- 2.5
108	836.490112	0.13	+/- 2.5
111	836.490112	0.13	+/- 2.5
114	836.490116	0.14	+/- 2.5
117	836.490115	0.14	+/- 2.5
120	836.490115	0.14	+/- 2.5
123	836.490116	0.14	+/- 2.5
126	836.490116	0.14	+/- 2.5
129	836.490117	0.14	+/- 2.5
132	836.490114	0.14	+/- 2.5
135	836.490113	0.14	+/- 2.5
138	836.490113	0.14	+/- 2.5

Results:

Conforms.

Table 5 shows the frequency stability as a function of temperature:

Table 5: Transmitted frequency vs. Temperature

Temperature (deg. C)	Center Frequency (MHz)	Frequency Offset (ppm)	Limit (ppm)
-30	836.490315	0.38	+/- 2.5
-20	836.490127	0.15	+/- 2.5
-10	836.489938	-0.074	+/- 2.5
0	836.489729	-0.32	+/- 2.5
10	836.490066	0.079	+/- 2.5
20	836.490170	0.02	+/- 2.5
30	836.490241	0.29	+/- 2.5
40	836.490309	0.37	+/- 2.5
50	836.489907	-0.11	+/- 2.5

4.8 Frequency Stability

Standard:

Frequency Stability Requirements (FCC Sec. 2.995)

(a) The frequency stability shall be measured with variation of ambient temperature as follows:

(1) From -30 °to +50 °centigrade for all equipment except that specified in subparagraphs (2) and (3) of this paragraph.

(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10 °centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

(c) In addition to all other requirements of this section, the following information is required for equipment incorporating heater type crystal oscillators to be used in mobile stations,...

(1) Measurement data showing variation in transmitter output frequency from a cold start and the elapsed time necessary for the frequency to stabilize within the applicable tolerance.

(2) Beginning at each temperature level specified in paragraph (c)(1) of this section, the frequency shall be measured within one minute after application of primary power to the transmitter and at intervals of no more than one minute thereafter until ten minutes have elapsed or until sufficient measurements are obtained to indicate clearly that the frequency has stabilized within the applicable tolerance, whichever time period is greater.

(d) The frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

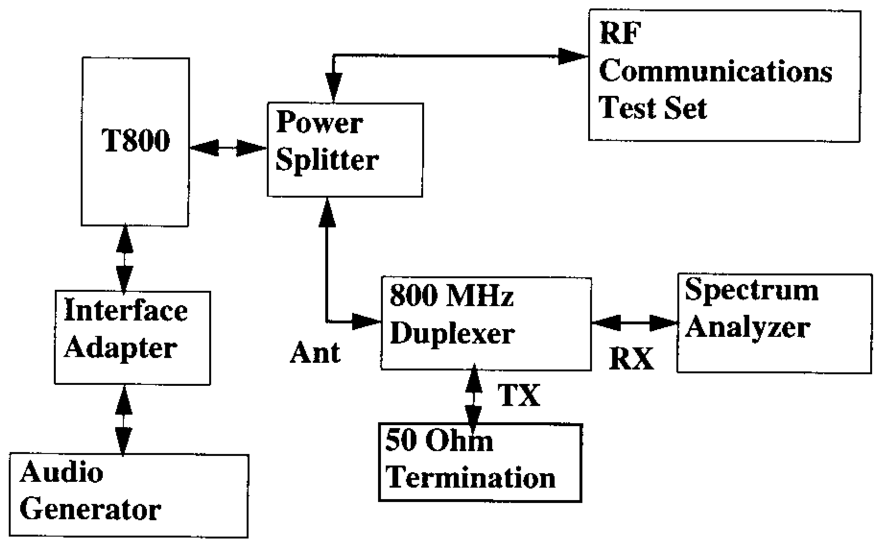
(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

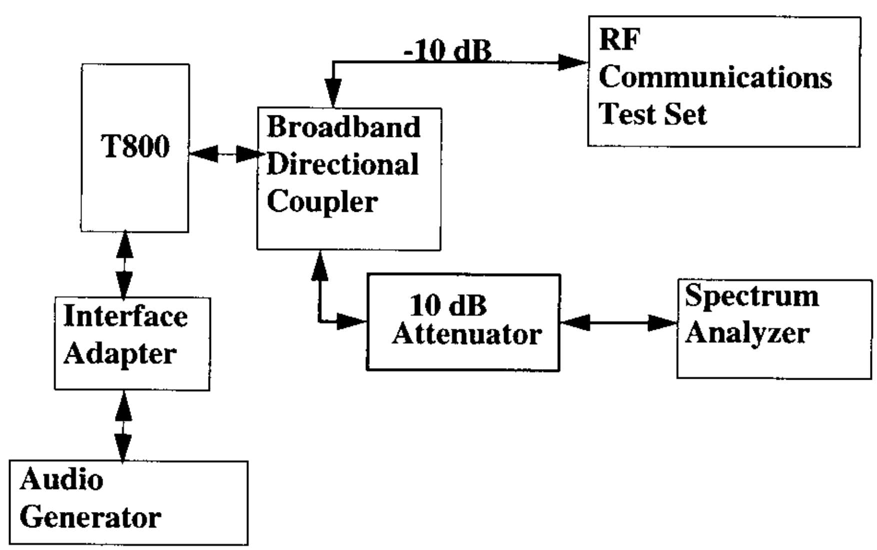
Test Setup:

The diagram below shows the test setup used to measure the emissions in the mobile receive band

Test setup to measure emissions in the mobile Receive band



Test setup to measure emissions from 100 kHz to 10 GHz



Results:

Receiver emissions

Conforms.

The test was performed on channel 383. There were no emissions within 20 dB of the -80 dBm limit.

Transmitter emissions

Conforms.

The test was performed on channel 383. Table 3 identifies the frequencies where the emission are within 20 dB of the limit

Table 3: Transmitter Spurious Emissions (digital)

Frequency (MHz)	Emission Level (dBm)	Limit
827.127	-33.4	-17 dBm (-45 dBc)
845.946	-34.7	-17 dBm (-45 dBc)

4.6 Spurious Emissions at Antenna Terminals (Digital Mode)

Standard:

Spurious Emissions at Antenna Terminals (FCC Sec 2.991 & 22.917)

The peak power level of conducted spurious emissions shall not exceed -13 dBm. The Peak power level of any emissions within the mobile transmit band of 824 and 849 MHz, measured using a 30 kHz bandwidth centered 120 kHz or more from the carrier frequency, shall not exceed 45 dB below the mean carrier output power or -13 dBm, whichever is the lower power. The peak power level of any emissions within the mobile receive band between 869 and 894 MHz, measured using a 30 kHz bandwidth, shall not exceed -80 dBm.

Equipment:

800 MHz Proximity-T LAU

Measurements:

The transmitter was operated under the standard test conditions. The LAU was set to transmit pseudo-random data bits. The harmonic and spurious emissions were measured from 100 kHz to 10 GHz. A 30 kHz resolution bandwidth was used with peak hold.

At 2.5 GHz high pass filter was added in front of the spectrum analyzer for the measurement of frequencies higher than 2.5 GHz

Figure 12: Occupied Bandwidth (Analog) with SAT and a signalling tone on Channel 383

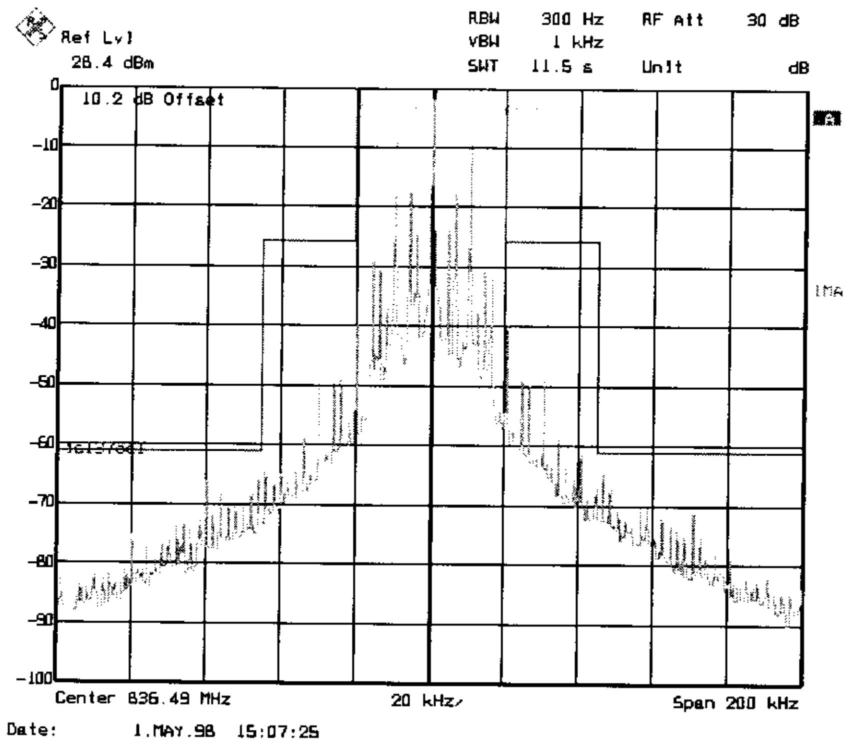


Figure 10: Occupied Bandwidth (Analog) with Voice Modulation and SAT on Channel 799

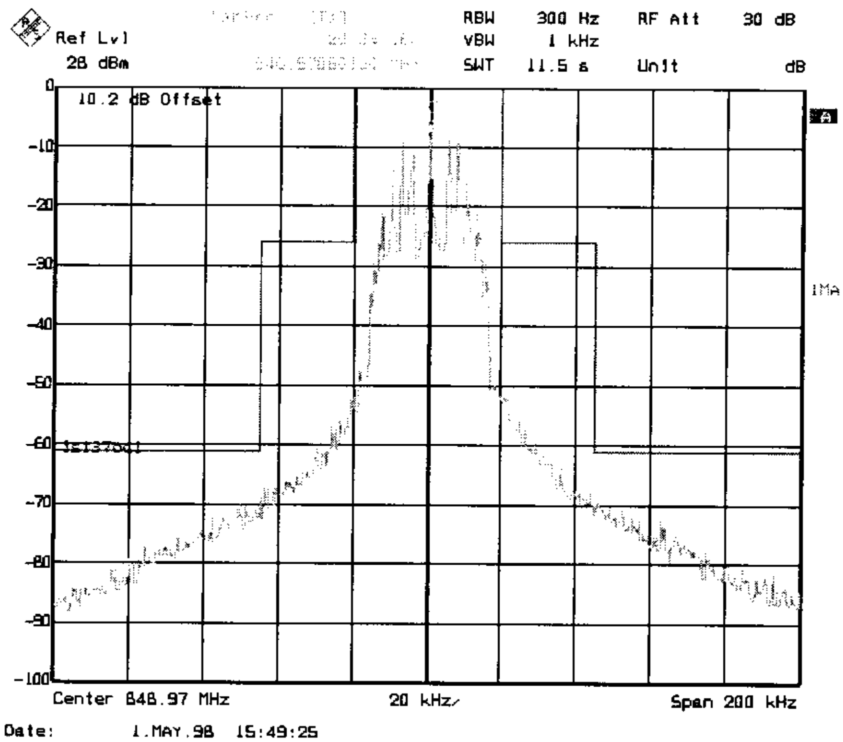


Figure 8: Occupied Bandwidth (Analog) with Voice Modulation and SAT on Channel 991

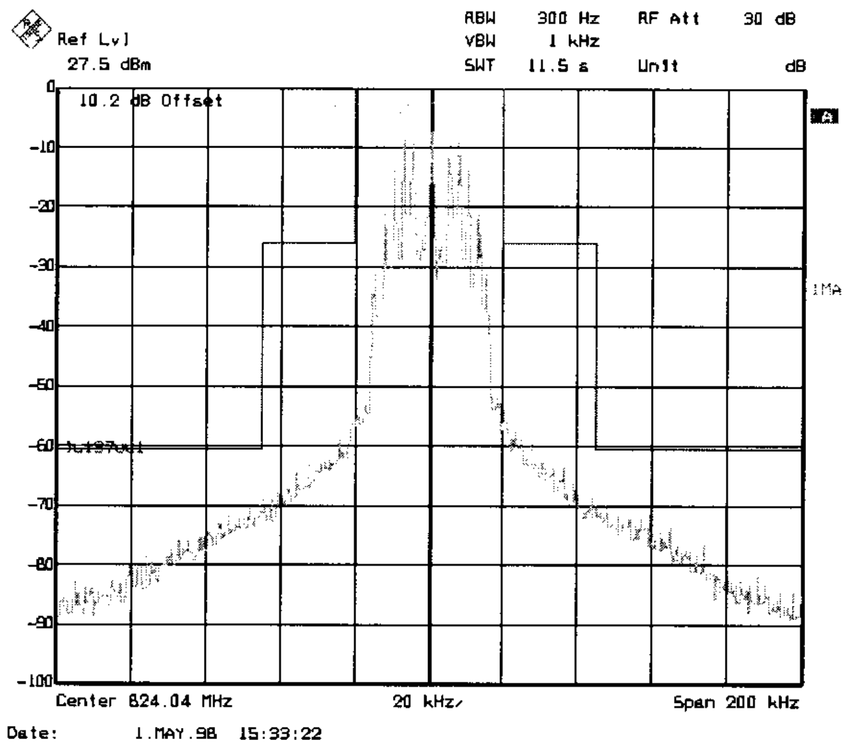


Figure 6: Occupied Bandwidth for Channel 383 (Digital)

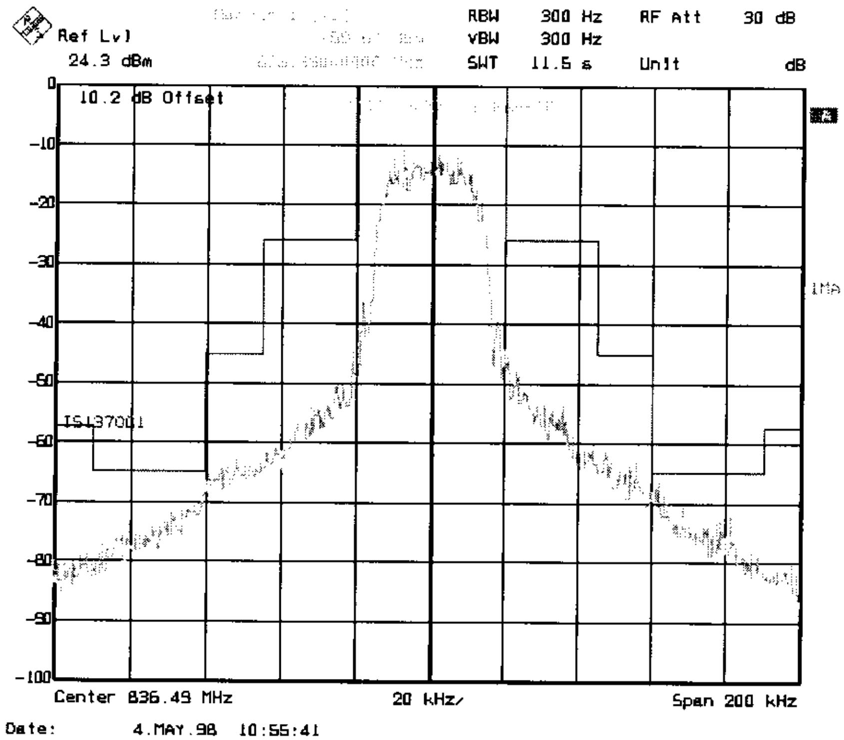


Table 2: Occupied Bandwidth (digital)

Center frequency offset (kHz)	Channel 991 Power (dBc)	Channel 383 Power (dBc)	Channel 799 Power (dBc)	Limit (dBc)
-90	-61.0	-64.3	-59.9	-45
-60	-48.5	-49.9	-48.0	-45
-30	-32.0	-31.4	-27.8	-26
30	-31.5	-30.0	-27.8	-26
60	-47.5	-49.5	-47.6	-45
90	-59.3	-64.2	-59.3	-45

4.5 Occupied Bandwidth

Standard:

Occupied Bandwidth Requirements (FCC Sec. 2.989 & 22.917)

The mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with section 22.917 of the FCC rules as follows:

(b) F3E and F3D emission mask for use with audio filter. For F3E and F3D emissions, the mean power of emissions must be attenuated below the mean output power of the unmodulated carrier wave (P) as follows:

(1) On any frequency removed from the carrier by more than 20 kHz but no more than 45 kHz: at least 26dB.

(2) On any frequency removed from the carrier by more than 45 kHz, up to the first multiple of the carrier frequency: at least 60 dB or 43 + 10 log P dB, whichever is the lesser attenuation.

(d) F1D emission mask. For F1D emissions, the mean power of emissions must be attenuated below the mean output power of the unmodulated carrier wave (P) as follows:

(1) On any frequency removed from the carrier by more than 20 kHz but no more than 45 kHz: at least 26dB.

(2) On any frequency removed from the carrier by more than 45kHz but no more than 90 kHz: at least 45 dB.

(2) On any frequency removed from the carrier by more than 90 kHz, up to the first multiple of the carrier frequency: at least 60 dB or 43 + 10 log P dB, whichever is the lesser attenuation.

Equipment:

800 MHz Proximity-T LAU

Measurements:

Analog Mode

The transmitter was operated under the standard test conditions with the compressor disabled.

The modulated transmitter output was sampled on an RF spectrum analyzer. For audio and SAT modulation the analyzer bandwidth was set to 300 Hz for emissions less than or equal to 45 kHz from the carrier. The same resolution bandwidth was used for emissions greater than 45 kHz from the carrier. The attenuation requirement for frequencies removed from the carrier by more than 45 kHz, up to the first multiple of the carrier frequency was increased by 20 dB since the required analyzer bandwidth is 300 Hz.

For voice modulation, a 2500 Hz tone was applied at a level 16 dB greater than that required to produce 50 percent of the maximum transmitter deviation (+/- 6 kHz). For combined voice and SAT modulation the same audio level was applied and the transmission of the +/ - 2 kHz peak deviation SAT signal was enabled. For combined SAT and signalling tone transmission, both SAT and signalling tone (+/- 8 kHz) were enabled on the LAU.

Results:

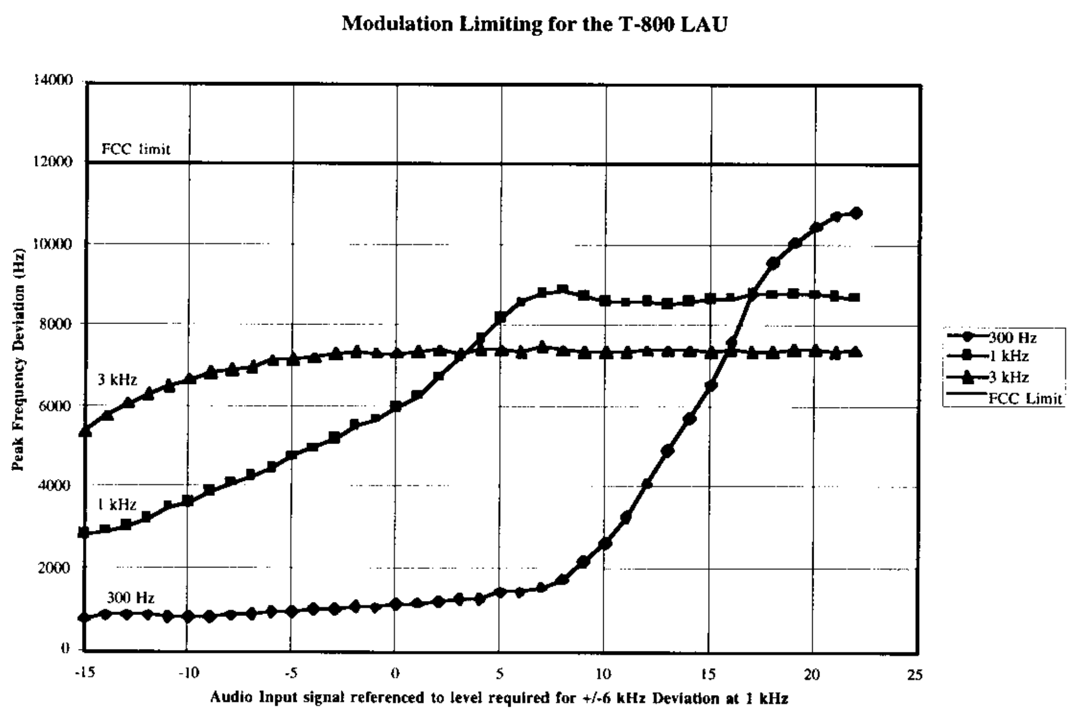
Conforms.

Figure 3 and Figure 4 summarizes the measurement results for audio modulated signals.

The measured frequency deviation when a SAT was transmitted was between 1910 and 2080 Hz. This is within the +/-10% (+/- 200 Hz) requirement.

The measured frequency deviation when a signalling tone is transmitted was between 7855 and 7900 Hz. This is within the +/-10% (+/- 800 Hz) requirement.

Figure 3: Deviation Limiting



Results:

Conforms.

The audio filter response is shown in Figure 2.

Figure 2: Audio Filter Characteristics

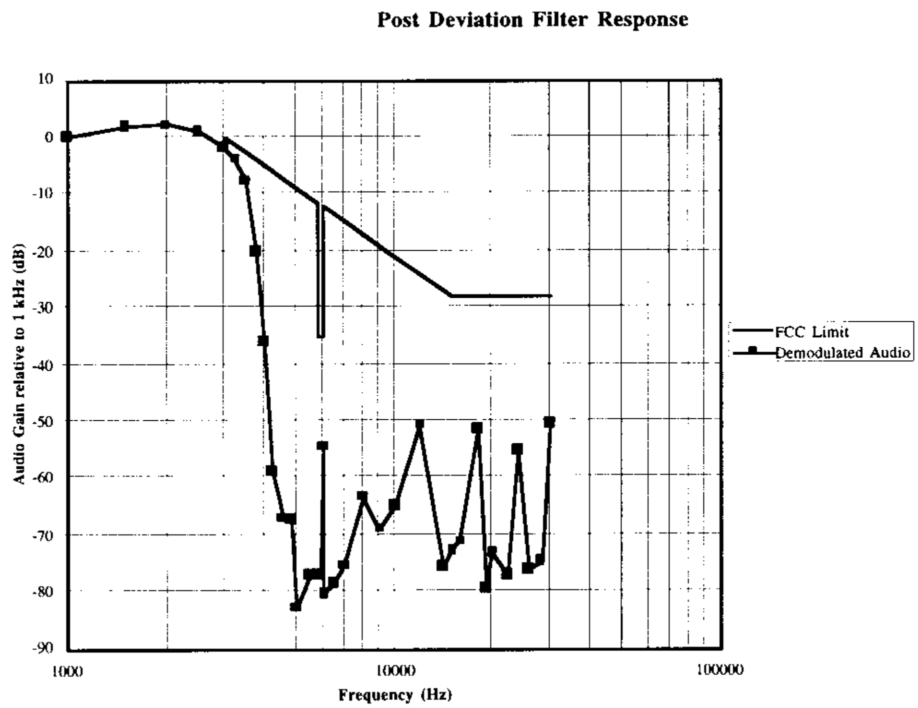
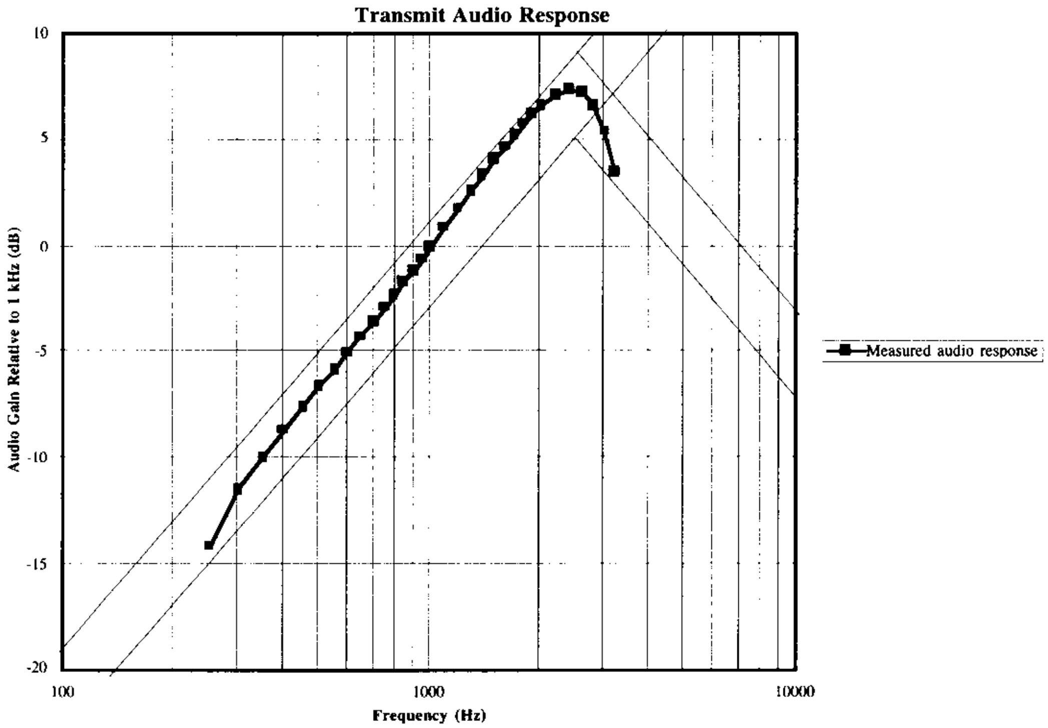
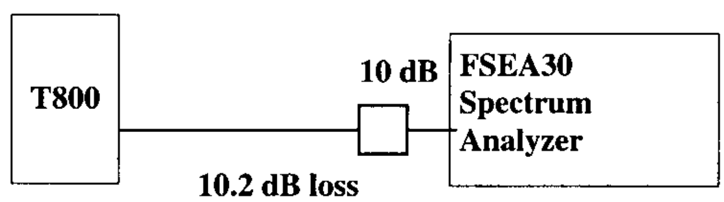


Figure 1: Audio Frequency Response



Test Setup:

ANALOG AND DIGITAL MODE



Results:

Conforms.

The maximum RF power output is 28.0 dBm.

	Analog Mode	Digital Mode
Channel	**Max.RF Power (dBm)**	**Max. RF Power (dBm)**
991 (low end of band)	27.9	28.0
383 (middle of band)	28.0	28.0
799 (top of band)	28.0	28.0

3.21 Test Equipment List

Table 1: Test Equipment

Description	Manufacturer	Model	Serial Number	Cal Due Date
Spectrum Analyzer	Rhode & Schwarz	FSEA30	845394/003	29/12/98
Spectrum Analyzer	Rhode & Schwarz	FSM	827831/016 & 828260/005	6/08/98
Digital Mobile Radio Transmitter Tester	Wavetek	3600D	6098002	21/05/98
Audio Frequency Signal Generator	Hewlett-Packard	HP4935A	2115A00839	3/02/99
Modulation Domain Analyzer	Hewlett-Packard	53310A	3121A01217	6/04/99
Dynamic Signal Generator	Hewlett-Packard	35670A	3340A00772	15/09/98
Rubidium Frequency Reference	UCT	2008	A1014	26/11/98
Digital Volt Meter	Fluke	87 series	57710270	18/07/98
AC Source	Variac	W5M3TA	911121-2	23/12/98
DC Power Supply	Hewlett-Packard	HP6285A	1147A00709	7/10/99
Environmental Chamber	Sexton-Espec	WC-PT-H-14-2-2	15100	29/04/98

3.9 Final RF amplifying device power consumption

The DC voltage applied to the final stage in the Transmit Power Amplifier is 5.0V +/-0.25V. The quiescent DC current into the PA module when the PA module is powered ON is 120 mA +/-20mA.

The PA module is biased Class-AB, so the current draw increases with increasing RF power output. At +28 dBm RF output power at the connector, the typical current draw is 520 mA.

3.10 Function of each active circuit device

See the Technical Description in Exhibit D and Exhibit E for a listing of devices incorporated in the Proximity T-800 LAU.

3.11 Complete circuit diagrams

Exhibit E contains schematics of devices incorporated in the Proximity T-800 LAU.

3.12 User and Maintenance Manual

See Exhibit F.

3.13 Tune-up procedure

The tune-up tests will be performed as part of the factory testing on the product. This includes power output levels, spurious emissions, modulation deviation and occupied bandwidth. These are no user adjustments that will have any affect on these settings. No tune-up testing is required in the field.

3.14 Circuit description for frequency determining and stabilizing

See the Technical Description in Exhibit D.

3.15 Circuit description for suppression of spurious radiation

Spurious radiation is suppressed through filtering in the RF transmit section. A RF SAW filter and a band-pass ceramic filter are present in the tx chain in order to suppress out of band spurious emissions. A duplexer is always included in the transmit path.

3.16 Circuit description for limiting modulation

Modulation deviation limiting is performed in a DSP by a firmware implementation of a hard clipper. There is a post deviation limiter filter, implemented as a digital FIR filter, that serves to prevent the harmonics generated by the limiting operation from reaching the modulator.