Elliott Laboratories Inc.
www.elliottlabs.com
684 West Maude Avenue
Sunnyvale, CA 94086-3518
408-245-7800 Phone
408-245-3499 Fax

Electromagnetic Emissions Test Report
In Accordance With
FCC Part 22 Subpart H
on the
Cellular Module
Model: CMM 7700 and 8700

GRANTEE:	Standard Communications Corp. 1111 Knox St. Torrance, CA 90502
TEST SITE:	Elliott Laboratories, Inc. 684 W. Maude Ave Sunnyvale, CA 94086
REPORT DATE:	January 4, 2001
FINAL TEST DATE:	January 2, 2001

AUTHORIZED SIGNATORY: _____

David Bare

TABLE OF CONTENTS

FCC CERTIFICATION INFORMATION

The following information is in accordance with FCC Rules, 47CFR Part2, Subpart J, Section 2.1033(C).

2.1033(c)(1) Applicant: Standard Communication Corp.
1111 Knox St.
Torrance, CA 90502

2.1033(c)(2) FCC ID: **APV09001**

Technical Description

The CMM 7700 and CMM 8700 Cellular Radio Modules are OEM radio modules for use in embedded wireless data and other applications. They are part of a series of modules providing solutions for customers with limited levels of RF expertise. They provide a flexible turnkey module solution that can be used to implement all of the functionality of a Wideband cellular telephone into a variety of imbedded applications.

The CMM 7700 and 8700 are a fully functional Wideband cellular telephone module with a 3W (Class I) of maximum output power. The difference between the CMM 7800 and 8700 is the protocol embedded in the units.

2.1033(c)(3) Instructions/Installation Manual

Please refer to Exhibit 7: User Manual, Theory of Operation, and Tune-up procedure.

2.1033(c)(4) Type of emissions

Wideband: 36K0F1D

2.1033(c)(5) Frequency Range

Transmitter: 824.01 – 848.97 MHz
Receiver: 869.01 – 893.97 MHz

2.1033(c)(6) Range of Operation Power

CMM 7700

Level 0: 3 W
Level 1: 1.6 W
Level 2: 630 mW
Level 3: 250 mW
Level 4: 100 mW
Level 5: 40 mW
Level 6: 16 mW
Level 7: 6 mW

CMM 8700

Level 0: 3 W
Level 1: 1.6 W
Level 2: 630 mW
Level 3: 250 mW
Level 4: 100 mW
Level 5: 40 mW
Level 6: 16 mW
Level 7: 6 mW

2.1033(c)(7) Maximum Power Rating

Section 22.913: limited to 7 Watts ERP

2.1033(c)(8) Applied voltage and currents into the final transistor elements

CMM 7700 and CMM 8700: 12Vdc, Current 100 mA

2.1033(c)(9) Tune-up Procedure

The tune-up procedure is located on pg. 20 of the Theory of Operations and in the Specification manual. Refer to Exhibit 7: User Manual, Theory of Operation, and Tune-up Procedure.

2.1033(c)(10) Schematic Diagram of the Transmitter

Refer to Exhibit 6. The schematic diagram

2.1033(c)(10) Means for Frequency Stabilization

TCXO (QL03), main VCO (QP01). For more information refer to Exhibit 7: Theory of Operation page 5.

2.1033(c)(10) Means for Suppression of Spurious radiation

A bandpass filter (FT01) is located before the final power amplifier stage to eliminate harmonic and spurious signals.

2.1033(c)(10) Means for Limiting Modulation

The signal is passed trough a Soft limit circuit, BPF, LPF, Compressor circuit, Pre-emphasis circuit, and Hard limit circuit. For more information refer to Exhibit 7: Theory of Operation page 10.

2.1033(c)(10) Means for Limiting Power

Power Detector (QT04), Radio interface IC (QL01), APC circuit (QT05). For more information refer to Exhibit 7: Theory of Operation page 14.

2.1033(c)(11) Photographs or Drawing of the Equipment Identification Plate or Label

Refer to Exhibit 4

2.1033(c)(12) Photographs of equipment

Refer to Exhibit 5

2.1033(c)(13) Equipment Employing Digital Modulation

N/A

2.1033(c)(14) Data taken per Section 2.1046 to 2.1057

Refer to Exhibit 2

Section 22.919: Electronic Serial Number

The EUT meets the requirements of part 22.919 as follows:

?? The ESN Serial number is used by factory for trace control.
?? A Unique ESN Serial number is programmed at the factory for each Radio.
?? The Unique ESN Serial number programmed in the Radio is not removable part.
?? The ESN is stored by Multiplication by a polynomial
?? The ESN is spread over various non-sequential memory.
?? Customers do not have access to change the ESN value.

SCOPE

FCC Part 22 Subpart H testing was performed for the equipment mentioned in this report. The equipment was tested using Sections 2.1046 to 2.1057. TIA-603 was used as a test procedure guideline to perform the required test.

The intentional radiator above was tested in a simulated typical installation to demonstrate compliance with the relevant FCC performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

OBJECTIVE

The primary objective of the manufacturer is compliance with FCC part 22 Subpart H. Certification of these devices is required as a prerequisite to marketing as defined in Section 2.1033.

Certification is a procedure where the manufacturer or a contracted laboratory makes measurements and submits the test data and technical information to FCC. FCC issues a grant of equipment authorization and a certification number upon successful completion of their review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product that may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

EMISSION TEST RESULTS

The following emissions tests were performed on the Standard Communication model CMM 7700. Only the CMM 7700 was tested, since both devices operated at the same output power, both have the same component layout, and the only difference is the protocol commands. The actual test results are contained in an exhibit of this report.

SECTION 2.1046: RF OUTPUT POWER

The EUT tested complied with the limits detailed in Section 22.213(a) with the EUT set to transmit continuously at maximum power. Refer to Setup Photo# 3 in Exhibit 3 and the test data in Exhibit 2: Test Measurement Data for full details.

SECTION 2.1047: MODULATION CHARACTERISTICS

The EUT was configured to transmit using its intended modulation. The modulation characteristic complies with Section 22.915(b)(4).

SECTION 2.1049: OCCUPIED BANDWIDTH

The EUT complied with the emissions masks defined for wideband data in 22.917 (b)(1), 22.917 (b)(2), 22.917 (d)(3) and 22.917(d) with the transmitter set to continuously transmit data at maximum output power and using the 300 Hz resolution and video bandwidths detailed in Section 22.917(h)(2)(i).

Full test configuration and data information can be found in Setup Photo# 3 of Exhibit 3 and in Exhibit 2: Test Measurement Data.

SECTION 2.1051: SPURIOUS EMISSION AT ANTENNA TERMINAL.

The Out-of-Band emissions from 1MHz to the 10^{th} harmonic of the fundamental were tested per Section 22.917(e) using the 30kHz resolution and video bandwidth instrumentation settings per 22.917(h)(2)(ii).

Mobile emissions in the base frequency band were also measured per Section 22.917(f) with the transmitter operating at full power on 849 MHz.

The EUT complies with all requirements. Further information can be found in Setup Photo# 3 in Exhibit 3 and Exhibit 2: Test Measurement Data.

SECTION 2.1053: FIELD STRENGTH OF SPURIOUS RADIATION.

Only the CMM 7700 was tested, since both the devices operated at the same output power, both have the same component layout, and the only difference is the protocol commands. The following measurements were extracted from the data recorded during the radiated electric field emissions scan and represent the highest amplitude peaks relative to the specification limit. The measurement complies with Section 22.917(e). The actual test data is contained in the exhibits of this report.

Maximized Radiated Spurious Emissions

Frequency	Level	Pol	FCC 22.917(e)		Detector	Azimuth	Height	Comments
MHz	dB?V/m	V/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1669.87	79.4	V	84.4	-5.0	Pk	329	1.1	

SECTION 2.1055: FREQUENCY STABILITY

The EUT tested complies with Section 22.355. The frequency of the transmitter varied by 467 Hz over the temperature range of –30 to +50 degrees Celsius.

For voltage stability, the EUT's is battery operated using a +12V dc variable power supply. The battery end point was determined to be at **4.7Vdc**, this will be stated in the manufacturers manual. The frequency of the transmitter varied by 0 Hz.

The test data is contained in Exhibit 2: Test Measurement Data

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on January 2, 2001 at the Elliott Laboratories Open Area Test Site #2 located at 684 West Maude Avenue, Sunnyvale, California. Pursuant to section 2.948 of the FCC Rules, construction, calibration, and equipment data has been filed with the Commission.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing are performed in conformance with Section 2 of FCC Rules. Measurements are made with the EUT connected to a spectrum analyzer through an attenuator to prevent overloading the analyzer.

RADIATED EMISSIONS CONSIDERATIONS

Radiated measurements are performed in an open field environment. The test site is maintained free of conductive objects within the CISPR 16-1 defined elliptical area.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1 is used for radiated emissions measurements. The receivers are capable of measuring over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the particular detector used during measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. If average measurements above 1000MHz are performed, the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz is used.

For direct measurements from the antenna port of the equipment under test, spectrum analyzers are used with resolution and average bandwidths set in accordance with the test procedures and test requirements referenced in this report.

INSTRUMENT CONTROL COMPUTER

A personal computer is utilized to record the receiver measurements of the field strength at the antenna, which is then compared directly with the appropriate specification limit. The receiver is programmed with appropriate factors to convert the received voltage into filed strength at the antenna. Results are printed in a graphic and/or tabular format, as appropriate.

The test receiver also provides a visual display of the signal being measured.

POWER METER

A power meter and thermister mount may be used for output power measurements from transmitters as they provide a broadband indication of the power output.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or EUT and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transmitters and transient events.

ANTENNAS

A biconical antenna is used to cover the range from 30 MHz to 300 MHz and a log periodic antenna is utilized from 300 MHz to 1000 MHz. Narrowband tuned dipole antennas are used over the 30 to 1000 MHz range for precision measurements of field strength. Above 1000 MHz, a horn antenna is used. The antenna calibration factors are included in site factors programmed into the test receivers

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor drive to vary the antenna height.

The requirements of ANSI C63.4 were used for configuration of the equipment turntable. It specifies that the test height above ground for table-mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An appendix of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

Section 2.1047, 2.1049, and 2.1051: CONDUCTED EMISSIONS AT THE ANTENNA PORT

Direct measurements for output power, modulation characterization and frequency stability are performed with the antenna port of the EUT connected to either the power meter or spectrum analyzer via a suitable attenuator and/or filter. These are used to ensure that the front end of the measurement instrument is not overloaded or for input protection by the fundamental transmission. The EUT was set at the middle of the frequency band and operating at maximum output power.

Section 2.1046: RF OUTPUT POWER

The EUT is configured to operate in the middle of the EUT frequency range at full power. A spectrum analyzer with resolution and video bandwidths of 30 kHz are used to measure the fundamental output power.

Section 2.1055: FREQUENCY STABILITY

The EUT is placed inside a temperature chamber with all support and test equipment located outside of the chamber. The spectrum analyzer is configured to give a 6-digit display for the marker-frequency function. The spectrum analyzer's built-in frequency counter is used to measure the maximum deviation of the fundamental frequency at each temperature.

For battery-powered devices the voltage battery end-point is determined by reducing the dc voltage until the unit ceases to function.

EUT AND CABLE PLACEMENT

The FCC requires that for Radiated Emissions interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4, and the worst-case orientation is used for final measurements.

The EUT was set on the turntable and the search antenna position 3 meters away. The output antenna terminal was terminated with a 50-ohm terminator. The EUT was set at the middle of the frequency band and set at maximum output power.

Radiated emissions measurements are performed in two phases. A preliminary scan of emissions is conducted in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed from the lowest frequency generated in the device up to the frequency required by the regulation specified on page 1. One or more of these is with the antenna polarized vertically while the one or more of these are with the antenna polarized horizontally. During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit.

A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth that results in the highest emission is then maintained while varying the antenna height from one to four meters. The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain. Emissions that have values close to the specification limit may also be measured with a tuned dipole antenna to determine compliance.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

FREQUENCY STABILITY REQUIREMENTS, SECTION 22.917(e)

Frequency Range Stability
821 – 869 MHz: 2.5 ppm over the temperature range –30 to +50 degrees Celsius

RADIATED EMISSIONS SPECIFICATION LIMITS, SECTION 22.917(e)

The limits for radiated emissions are based on the power of the transmitter at the operating frequency. Data is measured in the logarithmic form of decibels relative to one milliwatt (dBm) or one microvolt/meter (dBuV/m,). The field strength of the emissions from the EUT is measured on a test site with a receiver.

For an operating power range of 3 watts the radiated emissions limit for spurious signals outside of the assigned frequency block is $43+10\text{Log}_{10}$(mean output power in watts) dB below the measured amplitude at the operating power.

CALCULATIONS – EFFECTIVE RADIATED POWER

$$E(V/m) = \frac{\sqrt{30 * P * G}}{d}$$

E= Field Strength in V/m
P= Power in Watts
G= Gain of antenna in numeric gain (Assume 1.64 for ERP)
d= distance in meters

$$E(V/m) = \frac{\sqrt{30 * 3 \text{ watts} * 1.64 \text{ dB}}}{3 \text{ meters}}$$

20 * log (4.049 V/m * 1,000,000) = 132.14 dBuV/m @ 3 meters

Section 22.917(e): Request an attenuation of 43 + 10 log (3) or 47.8 dB for all emissions outside the assigned block, the limit for spurious and harmonic emissions is:

132.1 dBuV/m – 47.8 dB = 84.3 dBuV/m @ 3 meter.

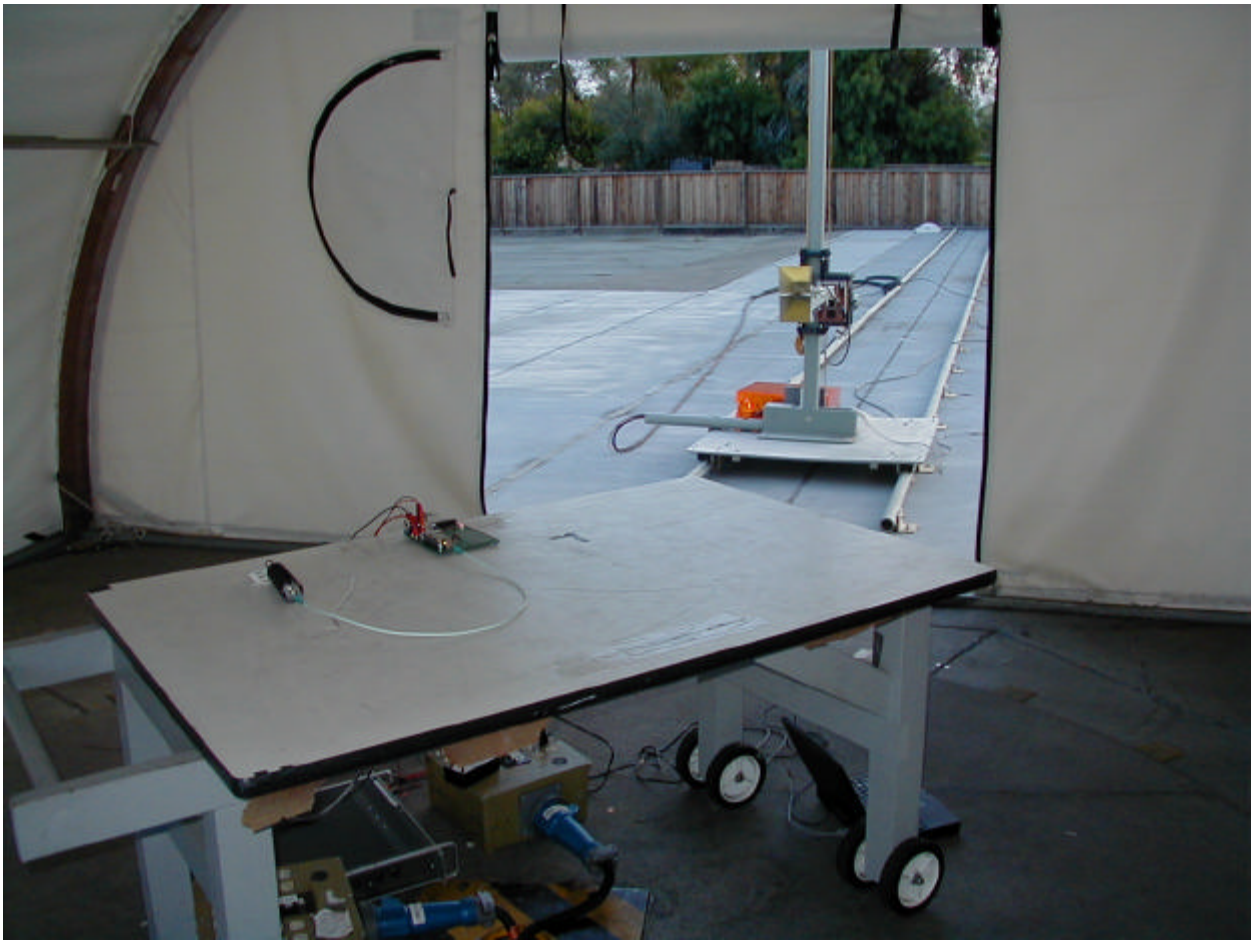
EXHIBIT 1: Test Equipment Calibration Data

EXHIBIT 2: Test Measurement Data

The following data includes conducted and radiated emission measurements of the Standard Communication, model CMM 7700 and CMM 8700.

18 Pages

EXHIBIT 3: Photographs of Test Configuration



Setup Photo# 1

Setup Photo# 2

Setup Photo# 3

EXHIBIT 4: FCC ID Label and Location

1 page

EXHIBIT 5: Internal and External Photos

EXHIBIT 6: Schematics, Block Diagram, and Parts list

EXHIBIT 7: User Manual, Theory of Operation, and Tune-Up procedure