



Elliott Laboratories Inc.
www.elliottlabs.com

684 West Maude Avenue
Sunnyvale, CA 94086-3518

408-245-7800 Phone
408-245-3499 Fax

May 25, 2001

American TCB
6731 Whittier Avenue
McLean, VA 22101

Gentlemen:

The enclosed documents constitute a formal submittal and application for a Grant of Equipment Authorization pursuant to Subpart C of Part 15 of FCC Rules (CFR 47) regarding intentional radiators. Data within this report demonstrates that the equipment tested complies with the FCC limits for intentional radiators.

Elliott Laboratories, as duly authorized agent prepared this submittal. A copy of the letter of our appointment as agent is enclosed.

If there are any questions or if further information is needed, please contact Elliott Laboratories for assistance.

A handwritten signature in black ink that reads "David W. Bare".

Sincerely,
David W. Bare
Chief Technical Officer

DWB/pjp

Enclosures: Agent Authorization Letter
 Emissions Test Report with Exhibits

***Electromagnetic Emissions Test Report
and
Application for Grant of Equipment Authorization
pursuant to
FCC Part 15, Subpart C Specifications for an
Intentional Radiator on the
Schlumberger - RMS Div.
Model: kV MFMM***

FCC ID: F9CCMM1303

GRANTEE: Schlumberger - RMS Div.
125 Shoreway Road
San Carlos, CA 94070

TEST SITE: Elliott Laboratories, Inc.
684 W. Maude Avenue
Sunnyvale, CA 94086

REPORT DATE: May 25, 2001

FINAL TEST DATE: May 7 and May 14, 2001



AUTHORIZED SIGNATORY: _____

David W. Bare
Chief Technical Officer

This report shall not be reproduced, except in its entirety, without the written approval of Elliott Laboratories, Inc.

TABLE OF CONTENTS

COVER PAGE.....	1
TABLE OF CONTENTS	3
SCOPE.....	5
OBJECTIVE.....	5
STATEMENT OF COMPLIANCE.....	5
EMISSION TEST RESULTS	6
LIMITS OF CONDUCTED INTERFERENCE VOLTAGE.....	6
LIMITS OF ANTENNA CONDUCTED POWER.....	6
LIMITS OF RADIATED INTERFERENCE FIELD STRENGTH.....	7
LIMITS OF POWER AND BANDWIDTH	7
MEASUREMENT UNCERTAINTIES	8
EQUIPMENT UNDER TEST (EUT) DETAILS	8
GENERAL.....	8
OTHER EUT DETAILS	8
ENCLOSURE	8
MODIFICATIONS.....	8
THE EUT DID NOT REQUIRE MODIFICATIONS DURING TESTING IN ORDER TO COMPLY WITH SPECIFICATIONS.....	8
SUPPORT EQUIPMENT.....	9
EUT INTERFACE PORTS	9
TEST SOFTWARE.....	9
ANTENNA SYSTEM	9
TEST SITE.....	10
GENERAL INFORMATION.....	10
CONDUCTED EMISSIONS CONSIDERATIONS.....	10
RADIATED EMISSIONS CONSIDERATIONS	10
MEASUREMENT INSTRUMENTATION.....	11
INSTRUMENT CONTROL COMPUTER.....	11
LINE IMPEDANCE STABILIZATION NETWORK (LISN).....	11
POWER METER	12
FILTERS/ATTENUATORS.....	12
ANTENNAS.....	12
ANTENNA MAST AND EQUIPMENT TURNTABLE.....	12
INSTRUMENT CALIBRATION.....	12
TEST PROCEDURES	13
EUT AND CABLE PLACEMENT	13
CONDUCTED EMISSIONS.....	13
RADIATED EMISSIONS	14
CONDUCTED EMISSIONS FROM ANTENNA PORT	14
SPECIFICATION LIMITS AND SAMPLE CALCULATIONS	15
CONDUCTED EMISSIONS SPECIFICATION LIMITS, SECTION 15.207.....	15
RADIATED EMISSIONS SPECIFICATION LIMITS, SECTION 15.209	15
SAMPLE CALCULATIONS - CONDUCTED EMISSIONS.....	16
SAMPLE CALCULATIONS - RADIATED EMISSIONS	17

TABLE OF CONTENTS (Continued)

EXHIBIT 1: Test Equipment Calibration Data	1
EXHIBIT 2: Test Data Log Sheets.....	2
EXHIBIT 3: Radiated Emissions Test Configuration Photographs.....	3
EXHIBIT 4: Conducted Emissions Test Configuration Photographs.....	4
EXHIBIT 5: Proposed FCC ID Label & Label Location.....	5
EXHIBIT 6: Detailed Photographs.....	6
EXHIBIT 7: Operator's Manual	7
EXHIBIT 8: Block Diagram.....	8
EXHIBIT 9: Schematic Diagrams.....	9
EXHIBIT 10: Theory of Operation.....	10

SCOPE

An electromagnetic emissions test has been performed on the Schlumberger - RMS Div. model kV MFMM pursuant to Subpart C of Part 15 of FCC Rules for intentional radiators. Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in ANSI C63.4-1992 as outlined in Elliott Laboratories test procedures.

The intentional radiator above has been 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.

The test results recorded herein are based on a single type test of the Schlumberger - RMS Div. model kV MFMM and therefore apply only to the tested sample. The sample was selected and prepared by Doug Gronberg of Schlumberger - RMS Div.

OBJECTIVE

The primary objective of the manufacturer is compliance with Subpart C of Part 15 of FCC Rules for the radiated and conducted emissions of intentional radiators. Certification of these devices is required as a prerequisite to marketing as defined in Part 2 the FCC Rules.

Certification is a procedure where the manufacturer or a contracted laboratory makes measurements and submits the test data and technical information to the FCC. The FCC issues a grant of equipment authorization 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.

The kV MFMM was tested in both OOK and CCSK modulation modes to determine compliance with the requirements.

STATEMENT OF COMPLIANCE

The tested sample of Schlumberger - RMS Div. model kV MFMM complied with the requirements of Subpart C of Part 15 of the FCC Rules for low power intentional radiators.

Maintenance of FCC compliance is the responsibility of the manufacturer. Any modification of the product resulting 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 Schlumberger - RMS Div. model kV MFMM. The actual test results are contained in an exhibit of this report.

LIMITS OF CONDUCTED INTERFERENCE VOLTAGE

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.207.

The following measurement was extracted from the data recorded during the conducted emissions scan and represents the highest amplitude emission relative to the specification limit. The actual test data and any correction factors are contained in an exhibit of this report.

120V, 60Hz, OOK modulation

Frequency MHz	Level dBuV	Power Lead	FCC 15.207		Detector QP/Ave	Comments
			Limit	Margin		
20.2690	25.7	Neutral	48.0	-22.3	QP	-

120V, 60Hz, CCSK modulation

Frequency MHz	Level dBuV	Power Lead	FCC 15.207		Detector QP/Ave	Comments
			Limit	Margin		
19.6794	27.4	Line	48.0	-20.6	QP	

LIMITS OF ANTENNA CONDUCTED POWER

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.247.

The highest out-of-band (Un-restricted) emission recorded in any 100 kHz band was 45 dB below the in-band level at 458 MHz using OOK modulation. The actual test data and any correction factors are contained an exhibit of this report.

LIMITS OF RADIATED INTERFERENCE FIELD STRENGTH

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.247 and 15.209 in the case of emissions falling within the frequency bands specified in Section 15.205.

The following measurement was extracted from the data recorded during the radiated electric field emissions scan and represents the highest amplitude emission relative to the specification limit. The actual test data and any correction factors are contained in an exhibit of this report.

CCSK modulation

Frequency MHz	Level dBuV/m	Pol v/h	FCC Limit	15.247 Margin	Detector Pk/QP/Av g	Azimuth degrees	Height meters	Comments
3670.320	66.0	v	74.0	-8.0	Pk	99	1.0	

OOK modulation

Frequency MHz	Level dBuV/m	Pol v/h	FCC Limit	15.247 Margin	Detector Pk/QP/Av g	Azimuth degrees	Height meters	Comments
3670.320	66.5	v	74.0	-7.5	Pk	100	1.0	

LIMITS OF POWER AND BANDWIDTH

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.247.

The maximum power output was 23.1 dBm at 917.355 MHz using OOK modulation. The maximum power output was 22.6 dBm at 917.655 MHz using CCSK modulation. The minimum 6 dB bandwidth was 1.390 Megahertz at 917.58 MHz using OOK. The minimum 6 dB bandwidth was 1.385 Megahertz at 917.58 MHz using CCSK modulation. The maximum power spectral density was 3.0 dBm at 917.355 MHz using OOK modulation. The maximum power spectral density was 4.0 dBm at 917.409 MHz using CCSK modulation. The actual test data and any correction factors are contained in an exhibit of this report.

MEASUREMENT UNCERTAINTIES

ISO Guide 25 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with NAMAS document NIS 81.

Measurement Type	Frequency Range (MHz)	Calculated Uncertainty (dB)
Conducted Emissions	0.15 to 30	± 2.4
Radiated Emissions	30 to 1000	± 3.2

EQUIPMENT UNDER TEST (EUT) DETAILS**GENERAL**

The Schlumberger - RMS Div. model kV MFMM is a direct sequence spread spectrum transmitter designed to work with electric power meter to enable continual monitoring of power usage. Normally, the EUT would be pole mounted during operation. The EUT was treated as table-top equipment during testing to simulate the end user environment. The electrical rating of the EUT is 120V, 60 Hz. The sample was received on May 7, 2001 and tested on May 7 and May 14, 2001. The EUT consisted of the following component(s):

Manufacturer	Model	Description	Serial Number	FCC ID
Schlumberger	KV MFMM	DSSS Transmitter	143	

OTHER EUT DETAILS

The EUT consists of the transmitter and the power meter. The meter is manufactured by GE.

ENCLOSURE

The EUT does not have an enclosure as it will be installed inside a utility meter.

MODIFICATIONS

The EUT did not require modifications during testing in order to comply with specifications.

SUPPORT EQUIPMENT

The following equipment was used as local support equipment for emissions testing:

Manufacturer	Model	Description	Serial Number	FCC ID
GE	kV	Watt-Hr. meter	37076930	-
Schlumberger (Note 1)	none	20cm coax SMA to SSMB adaptor	none	none

Note 1: Used during antenna port conducted Runs. 1.4dB loss at 917MHz

No remote support equipment was used during emissions testing.

EUT INTERFACE PORTS

The I/O cabling configuration during emissions testing was as follows:

EUT Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length (m)
Power in	AC Mains	Power cord	Unshielded	2

TEST SOFTWARE

The EUT was set to continuously pulse transmissions at one-second intervals at full power. Normally, the EUT would only transmit an average of once every 5 minutes.

ANTENNA SYSTEM

The antenna system used consists of an external flexible dipole antenna mounted on the outside of the meter housing, but inside of the clear plastic meter cover. The antenna is a custom part and is Schlumberger part number 19-0122 and connects to the EUT via an SSMB connector. This product is installed and operated by trained Schlumberger personnel, thereby meeting the requirements of part 15 of the FCC rules.

TEST SITE**GENERAL INFORMATION**

Final test measurements were taken on May 7 and May 14, 2001 at the Elliott Laboratories Open Area Test Site #3 located at 684 West Maude Avenue, Sunnyvale, California. The test site contains separate areas for radiated and conducted emissions testing. Pursuant to section 2.948 of the Rules, construction, calibration, and equipment data has been filed with the Commission.

The FCC recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement with the exception of predictable local TV, radio, and mobile communications traffic. The test site contains separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent FCC requirements.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed in conformance with ANSI C63.4-1992. Measurements are made with the EUT connected to the public power network through a nominal, standardized RF impedance, which is provided by a line impedance stabilization network, known as a LISN. A LISN is inserted in series with each current-carrying conductor in the EUT power cord.

RADIATED EMISSIONS CONSIDERATIONS

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment. The test site is maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4 guidelines.

MEASUREMENT INSTRUMENTATION**RECEIVER SYSTEM**

An EMI receiver as specified in CISPR 16-1 is used for emissions measurements. The receivers used can measure 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 CISPR 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. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz.

INSTRUMENT CONTROL COMPUTER

The receivers utilize either a Rohde and Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers.

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically.

LINE IMPEDANCE STABILIZATION NETWORK (LISN)

Line conducted measurements utilize a fifty microhenry Line Impedance Stabilization Network as the monitoring point. The LISN used also contains a 250 uH CISPR adapter. This network provides for calibrated radio frequency noise measurements by the design of the internal low pass and high pass filters on the EUT and measurement ports, respectively.

POWER METER

A power meter and thermister mount are used for all direct 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 LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude 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 entire 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.

ANSI C63.4 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 exhibit of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES**EUT AND CABLE PLACEMENT**

The FCC requires that 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.

CONDUCTED EMISSIONS

Conducted emissions are measured at the plug end of the power cord supplied with the EUT. Excess power cord length is wrapped in a bundle between 30 and 40 centimeters in length near the center of the cord. Preliminary measurements are made to determine the highest amplitude emission relative to the specification limit for all the modes of operation. Placement of system components and varying of cable positions are performed in each mode. A final peak mode scan is then performed in the position and mode for which the highest emission was noted on all current carrying conductors of the power cord.

RADIATED EMISSIONS

Radiated emissions measurements are performed in two phases as well. 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 30 MHz 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 is 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.

CONDUCTED EMISSIONS FROM ANTENNA PORT

Direct measurements 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 by the fundamental transmission.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions are given in units of microvolts, and the limits for radiated emissions are given in units of microvolts per meter at a specified test distance. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

For reference, converting the specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. These limits in both linear and logarithmic form are as follows:

CONDUCTED EMISSIONS SPECIFICATION LIMITS, SECTION 15.207

Frequency Range (MHz)	Limit (uV)	Limit (dBuV)
0.450 to 30.000	250	48

RADIATED EMISSIONS SPECIFICATION LIMITS, SECTION 15.209

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
0.009-0.490	$2400/F_{\text{KHz}} @ 300\text{m}$	$67.6-20*\log_{10}(F_{\text{KHz}}) @ 300\text{m}$
0.490-1.705	$24000/F_{\text{KHz}} @ 30\text{m}$	$87.6-20*\log_{10}(F_{\text{KHz}}) @ 30\text{m}$
1.705 to 30	$30 @ 30\text{m}$	$29.5 @ 30\text{m}$
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r - B = C$$

and

$$C - S = M$$

where:

R_r = Receiver Reading in dBuV

B = Broadband Correction Factor*

C = Corrected Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

* Broadband Level - Per ANSI C63.4, 13 dB may be subtracted from the quasi-peak level if it is determined that the emission is broadband in nature. If the signal level in the average mode is six dB or more below the signal level in the peak mode, the emission is classified as broadband.

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements. A distance factor, when used for electric field measurements, is calculated by using the following formula:

$$F_d = 20 * \text{LOG}_{10} (D_m/D_s)$$

where:

$$F_d = \text{Distance Factor in dB}$$

$$D_m = \text{Measurement Distance in meters}$$

$$D_s = \text{Specification Distance in meters}$$

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_C = R_R + F_d$$

and

$$M = R_C - L_S$$

where:

$$R_R = \text{Receiver Reading in dBuV/m}$$

$$F_d = \text{Distance Factor in dB}$$

$$R_C = \text{Corrected Reading in dBuV/m}$$

$$L_S = \text{Specification Limit in dBuV/m}$$

$$M = \text{Margin in dB Relative to Spec}$$

EXHIBIT 1: Test Equipment Calibration Data

EXHIBIT 2: Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T43286 36 Pages
Processing Gain 4 Pages
Maximum Permissible 2 Pages
Exposure
CCSK vs. OOK Modulation 2 Pages

EXHIBIT 3: Radiated Emissions Test Configuration Photographs

2 Pages

EXHIBIT 4: Conducted Emissions Test Configuration Photographs

2 Pages

EXHIBIT 5: Proposed FCC ID Label & Label Location

2 Pages

**EXHIBIT 6: Detailed Photographs
of Schlumberger - RMS Div. Model kV MFMM Construction**

5 Pages

**EXHIBIT 7: Operator's Manual
of Schlumberger - RMS Div. Model kV MFMM**

1 Page

**EXHIBIT 8: Block Diagram
of Schlumberger - RMS Div. Model kV MFMM**

1 Page

**EXHIBIT 9: Schematic Diagrams
for Schlumberger - RMS Div. Model kV MFMM**

5 Pages

**EXHIBIT 10: Theory of Operation
for Schlumberger - RMS Div. Model kV MFMM**

4 Pages