



CERTIFICATION TEST REPORT
FOR THE
27.145 MHZ TRANSMITTER, FMT-301
FCC PART 15 SUBPART C
COMPLIANCE

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PREPARED FOR:

Elsema Pty Ltd
Unit 3, 10 Hume Road
Smithshield 2164 Australia

P.O. No: G197
W.O. No: 68667

Report No: FC99-008

DOCUMENTATION CONTROL:

Tracy Phillips
Documentation Control Supervisor
CKC Laboratories, Inc.

PREPARED BY:

Joyce Walker
CKC Laboratories, Inc.
5473A Clouds Rest
Mariposa, CA 95338

Date of test: July 1 & December 15, 1998

APPROVED BY:

Dennis Ward

Dennis Ward
Director of Laboratories
CKC Laboratories, Inc.

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TABLE OF CONTENTS

Administrative Information	3
Summary Of Results	4
Equipment Under Test (EUT) Description	4
Measurement Uncertainty	4
Peripheral Devices	4
Report Of Measurements	5
Table 1: Highest Radiated Emission Levels - 15.227(a)	5
Table 2: Six Highest Radiated Emission Levels - 15.227(b)	6
Table A : List Of Test Equipment.....	7
EUT Setup.....	8
Test Instrumentation And Analyzer Settings	8
Table B : Analyzer Bandwidth Settings Per Frequency Range	8
Spectrum Analyzer Detector Functions	9
Peak.....	9
Quasi-Peak	9
Average	9
Test Methods.....	10
Radiated Emissions Testing	10
Frequency Stability	11
Occupied Bandwidth.....	11
Sample Calculations.....	12
Appendix A : Information About The Equipment Under Test	13
I/O Ports	14
Crystal Oscillators.....	14
Printed Circuit Boards.....	14
Required EUT Changes To Comply	14
Photograph Showing Radiated Emissions	15
Photograph Showing Radiated Emissions	16
Appendix B : Measurement Data Sheets	17

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ADMINISTRATIVE INFORMATION

DATE OF TEST: July 1 & December 15, 1998

PURPOSE OF TEST: To demonstrate the compliance of the 27.145 MHz Transmitter, FMT-301, with the requirements for Part 15, Subpart C devices.

MANUFACTURER: South Pacific Electronics Ltd.
P.O. Box 9417
Nadi Airport
Fiji Islands

REPRESENTATIVE: Hermann Roesch

TEST LOCATION: CKC Laboratories, Inc.
5473A Clouds Rest
Mariposa, CA 95338

TEST PERSONNEL: Dustin Oaks & Skip Doyle

TEST METHOD: ANSI C63.4 1992

FREQUENCY RANGE TESTED: 25MHz - 1000 MHz

EQUIPMENT UNDER TEST: 27.145 MHz Transmitter
Manuf: Elsema
Model: FMT-301
Serial: 0003
FCC ID:

SUMMARY OF RESULTS

The Elsema Pty Ltd 27.145 MHz Transmitter, FMT-301, was tested in accordance with ANSI C63.4 1992 for compliance with Part 15, Subpart C.

As received, the above equipment was found to be fully compliant with the limits of Part 15, Subpart C. The results in this report apply only to the items tested, as identified herein.

EQUIPMENT UNDER TEST (EUT) DESCRIPTION

Singe Channel 27MHz Hand Held Remote Control Digital Transmitter.

MEASUREMENT UNCERTAINTY

Associated with data in this report is a ± 4 dB measurement uncertainty.

PERIPHERAL DEVICES

The EUT was not tested with peripheral devices.

REPORT OF MEASUREMENTS

The following Tables 1 and 2 report the highest worst case emissions levels during the tests performed on the 27.145 MHz Transmitter, FMT-301. The data sheets from which these tables were compiled are contained in Appendix B.

Table 1: Highest Radiated Emission Levels - 15.227(a)

FREQUENCY MHz	METER READING dB μ V	CORRECTION FACTORS				CORRECTED READING dB μ V/m	SPEC LIMIT dB μ V/m	MARGIN dB	NOTES
		Ant dB	Amp dB	Cable dB	Dist dB				
27.144	77.1	16.5	-27.3	1.0		67.3	80.0	-12.7	H
27.152	86.1	16.5	-27.3	1.0		76.3	80.0	-3.7	VQ
27.225	86.5	16.4	-27.3	1.0		76.6	80.0	-3.4	V

Test Method: ANSI C63.4 1992
Spec Limit : FCC 15.227(a)
Test Distance: 3 Meters

NOTES: H = Horizontal Polarization
V = Vertical Polarization
N = No Polarization
D = Dipole Reading
Q = Quasi Peak Reading
A = Average Reading

COMMENTS: EUT operating on fresh 9V battery. EUT is in continuously transmitting modulated signal at 27.145MHz. Frequency Range maximized at fundamental frequency of 27.145MHz IAW FCC. Limits are IAW FCC pt 15.227(a).

Table 2: Six Highest Radiated Emission Levels - 15.227(b)

FREQUENCY MHz	METER READING dB μ V	CORRECTION FACTORS				CORRECTED READING dB μ V/m	SPEC LIMIT dB μ V/m	MARGIN dB	NOTES
		Ant dB	Amp dB	Cable dB	Dist dB				
434.412	45.3	18.4	-27.6	4.3		40.4	46.0	-5.6	HQ
461.508	43.9	18.8	-27.8	4.4		39.3	46.0	-6.7	H
732.975	39.3	21.4	-27.7	5.5		38.5	46.0	-7.5	V
760.125	38.5	21.7	-27.7	5.5		38.0	46.0	-8.0	V
787.268	38.7	22.1	-27.8	5.7		38.7	46.0	-7.3	V
950.129	35.1	24.1	-27.2	6.3		38.3	46.0	-7.7	VQ

Test Method: ANSI C63.4 1992
Spec Limit : FCC 277 (b)
Test Distance: 3 Meters

NOTES: H = Horizontal Polarization
V = Vertical Polarization
N = No Polarization
D = Dipole Reading
Q = Quasi Peak Reading
A = Average Reading

COMMENTS: EUT operating on fresh 9V battery. EUT is in continuously transmitting modulated signal at 27.2MHz. Frequency Range scanned from 25MHz to 1GHz IAW FCC. Limits are IAW FCC pt 15.227(b).

TABLE A

LIST OF TEST EQUIPMENT

1. Spectrum Analyzer, Hewlett Packard, Model No. 8566B, S/N 2209A01404. Calibration date: June 12, 1998. Calibration due date: June 12, 1999.
2. Preamp, Hewlett Packard, Model No. 8449B, S/N 3008A00301. Calibration date: October 15, 1998. Calibration due date: October 15, 1999.
3. Biconical Antenna, A & H Systems, Model No. SAS-200/542, S/N 156. Calibration date: June 9, 1998. Calibration due date: June 9, 1999.
4. Log Periodic Antenna, A & H Systems, Model No. SAS-200/512, S/N 154. Calibration date: June 9, 1998. Calibration due date: June 9, 1999.
5. Magnetic Loop Antenna, EMCO, Model No. 6502, S/N 1074. Calibration date: May 11, 1998. Calibration due date: May 11, 1999.
6. Site B (Barn) Calibration date: June 18, 1998. Site B (Barn) Calibration due date: June 18 1999.
7. Test software, EMI Test 2.91.

EUT SETUP

The equipment under test (EUT) was setup in a manner that represented its normal use. Any special conditions required for the EUT to operate normally are identified in the comments that accompany Tables 1 and 2 for radiated emissions.

During radiated emissions testing, the EUT was mounted on a nonconductive, rotating table 80 cm above the conductive grid. The nonconductive table dimensions were 1 meter by 1.5 meters. This configuration is typical for radiated emissions testing of table top devices.

TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed in Table A were used to collect the radiated emissions data for the 27.145 MHz Transmitter, FMT-301. For radiated measurements below 300 MHz, the biconical antenna was used. For frequencies from 300 to 1000 MHz, the log periodic antenna was used. For frequencies below 30 MHz the magnetic loop antenna was used. All antennas were located at a distance of 3 meters from the edge of the EUT.

The HP spectrum analyzer was used for all measurements. Table B shows the analyzer bandwidth settings that were used in designated frequency bands. During radiated testing, the measurements were made with 0 dB of attenuation, a reference level of 97 dBμV, and a vertical scale of 10 dB per division.

TABLE B : ANALYZER BANDWIDTH SETTINGS PER FREQUENCY RANGE

TEST	BEGINNING FREQUENCY	ENDING FREQUENCY	BANDWIDTH SETTING
RADIATED EMISSIONS	25 MHz	1000 MHz	120 kHz

SPECTRUM ANALYZER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in Tables 1 and 2 indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "Peak" mode. Whenever a "Quasi-Peak" or "Average" reading is listed as one of the six highest readings, this is indicated as a "Q" or an "A" in Table 1 or Table 2. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data for the 27.145 MHz Transmitter, FMT-301.

Peak

In this mode, the Spectrum Analyzer or test engineer recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature of the analyzer called "peak hold," the analyzer had the ability to measure transients or low duty cycle transient emission peak levels. In this mode the analyzer made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

Quasi-Peak

When the true peak values exceeded or were within 2 dB of the specification limit, quasi-peak measurements were taken using the HP Quasi-Peak Adapter for the HP Spectrum Analyzer. The detailed procedure for making quasi peak measurements contained in the HP Quasi-Peak Adapter manual were followed.

Average

When the frequencies exceed 1 GHz, average measurements may be made using the spectrum analyzer. To make these measurements, the test engineer reduces the video bandwidth on the analyzer until the modulation of the signal is filtered out. At this point the analyzer is set into the linear mode and the scan time is reduced.

TEST METHODS

The radiated emissions data of the 27.145 MHz Transmitter, FMT-301, was taken with the HP Spectrum Analyzer. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the "Sample Calculations". The corrected data was then compared to the FCC Part 15, Subpart C emissions limits to determine compliance.

Preliminary and final measurements were taken in order to better ensure that all emissions from the EUT were found and maximized.

Radiated Emissions Testing

During the preliminary radiated scan, the EUT was powered up and operating in its defined FCC test mode. For frequencies below 30 MHz the magnetic loop antenna was used. The frequency range of 30 MHz - 88 MHz was then scanned with the biconical antenna located about 1.5 meter above the ground plane in the vertical configuration. During this scan, the turntable was rotated and all peaks, which were at or near the limit, were recorded. The frequency range of 100 - 300 MHz was scanned with the biconical antenna in the same manner, and the peaks recorded. Lastly, a scan of the FM band from 88 - 110 MHz was made, using a reduced resolution bandwidth and a reduced frequency span. The biconical antenna was changed to the horizontal polarity and the above steps were repeated. After changing to the log periodic antenna in the horizontal configuration, the frequency range of 300 - 1000 MHz was scanned. The log periodic antenna was changed to the vertical polarity and the frequency range of 300 - 1000 MHz was again scanned. Care was taken to ensure that no frequencies were missed within the FM and TV bands. An analysis was performed to determine if the signals that were at or near the limit were caused by an ambient transmission. If unable to determine by analysis, the equipment was powered down to make the final determination if the EUT was the source of the emission.

A thorough scan of all frequencies was manually made using a small frequency span, rotating the turntable as needed. Comparison with the previously recorded measurements was then made.

Using the peak readings from both scans as a guide, the test engineer then maximized the readings with respect to the table rotation, and antenna height. Photographs showing the final worst case configuration of the EUT are contained in Appendix A.

FCC Part 15.31(e) - Frequency Stability Measurements

In accordance with Part 15.31(e), since the unit was battery operated, a fresh battery was inserted.

FCC Part 15.215- Occupied Bandwidth Measurements

In accordance with Part 15.215(c), the fundamental frequency was kept within the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

Frequency Range of Transmitter: 27 MHz

In accordance with Part 15.247(a), the field strength of the emissions within the 26.96-27.28 MHz band did not exceed 10,000 microvolts/meter at 3 meters. The emission limit it was based on is the measurement instrumentation employing an average detector. The provisions in 15.35 for limiting peak emissions apply.

SAMPLE CALCULATIONS

The basic spectrum analyzer reading was converted using correction factors as shown in the six highest emissions readings in Tables 1 and 2. For radiated emissions in dB μ V/m, the spectrum analyzer reading in dB μ V was corrected by using the following formula:

$$\begin{aligned}
 & \text{Meter reading (dB}\mu\text{V)} \\
 & + \text{Antenna Factor (dB)} \\
 & + \text{Cable Loss (dB)} \\
 & - \text{Distance Correction (dB)} \\
 & - \text{Pre-amplifier Gain (dB)} \\
 \\
 & = \text{Corrected Reading (dB}\mu\text{V/m)}
 \end{aligned}$$

This reading was then compared to the applicable specification limit to determine compliance. A typical data sheet will display the following in column format:

#	Freq MHz	Rdng dB μ V	Barn	Pream	Bicon	Log 1	Dist	Corr dB μ V/m	Spec	Margin dB	Polar
---	----------	-----------------	------	-------	-------	-------	------	-------------------	------	-----------	-------

means reading number

Freq MHz is the frequency in MHz of the obtained reading.

Rdng dB μ V is the reading obtained on the spectrum analyzer in dB μ V.

Pream is short for the preamplifier factor or gain in dB.

Bicon is the biconical antenna factor in dB.

Log 1 is the log periodic antenna factor in dB.

Barn is the cable loss in dB of the coaxial cable on the OATS.

Dist is the distance factor (in dB). It is used when testing at a different test distance than the one stated in the spec.

Corr dB μ V/m is the corrected reading which is now in dB μ V/m (field strength).

Spec is the specification limit (dB) stated in the agency's regulations.

Margin dB is the closeness to the specified limit in dB; + is over and - is under the limit.

Polar is the Polarity of the antenna with respect to earth.

APPENDIX A
INFORMATION ABOUT THE EQUIPMENT UNDER TEST

INFORMATION ABOUT THE EQUIPMENT UNDER TEST

Test Software/Firmware: N/A
 CRT was displaying: N/A
 Power Supply Manufacturer: N/A
 Power Supply Part Number: N/A
 AC Line Filter Manufacturer: N/A
 AC Line Filter Part Number: N/A

Line voltage used during testing: N/A

I/O PORTS

Type	#
N/A	

CRYSTAL OSCILLATORS

Type	Freq In MHz
Custom made CMOS Chip 30ppm Fundamental Crystal	27.145

PRINTED CIRCUIT BOARDS

Function	Model & Rev	Clocks, MHz	Layers	Location
Transmitter main board	Elsema B31B	N/A	2	N/A

REQUIRED EUT CHANGES TO COMPLY:

None.

APPENDIX B
MEASUREMENT DATA SHEETS

Test Location: CKC Laboratories, Inc. • 5473A Clouds Rest Rd, Barn • Mariposa, CA 95338 • (800)-500-4EMC

Customer: **Elsema** Date: Dec-15-98
 Specification: **FCC 15.227(a)** Time: 11:34
 Test Type: **Radiated Scan** Sequence#: 1
 Equipment: **Transmitter**
 Manufacturer: **Elsema** Tested By: Skip Doyle
 Model: **FMT-301**
 S/N:

Equipment Under Test (* = EUT):

Function	Manufacturer	Model #	S/N
Transmitter	Elsema	FMT-301	

Support Devices:

Function	Manufacturer	Model #	S/N
None			

Test Conditions / Notes:

EUT operating on fresh 9V battery. EUT is in continuously transmitting modulated signal at 27.145MHz. Frequency Range maximized at fundamental freq. of 27.145MHz IAW FCC. Limits are IAW FCC pt 15.227(a).

Measurement Data:

Sorted by Margin

Test Distance: 3 Meters

#	Freq MHz	Rdng dB μ V	Pream			Bicon			Barn			Dist dB	Corr dB μ V/m	Spec dB μ V/m	Margin dB	Polar
			dB	dB	dB	dB	dB	dB	dB	dB	dB					
1	27.225	86.5	-27.3	+16.4				+1.0	+0.0	76.6	80.0	-3.4	Vert			
2	27.152	86.1	-27.3	+16.5				+1.0	+0.0	76.3	80.0	-3.7	Vert			
3	27.144	77.1	-27.3	+16.5				+1.0	+0.0	67.3	80.0	-12.7	Horiz			

Test Location: CKC Laboratories, Inc. • 5473A Clouds Rest Rd, Barn • Mariposa, CA 95338 • (800)-500-4EMC

Customer: **Elsema** Date: Dec-15-98
 Specification: **FCC 15.227(b) / 15.209** Time: 12:29
 Test Type: **Maximized Emissions** Sequence#: 2
 Equipment: **Transmitter**
 Manufacturer: Elsema Tested By: Skip Doyle
 Model: FMT-301
 S/N:

Equipment Under Test (* = EUT):

Function	Manufacturer	Model #	S/N
Transmitter	Elsema	FMT-301	

Support Devices:

Function	Manufacturer	Model #	S/N
None			

Test Conditions / Notes:

EUT operating on fresh 9V battery. EUT is in continuously transmitting modulated signal at 27.2MHz. Frequency Range scanned from 25MHz to 1GHz IAW FCC. Limits are IAW FCC pt 15.227(b).

Measurement Data:

Sorted by Margin

Test Distance: 3 Meters

#	Freq MHz	Rdng dBµV	Location				Dist dB	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar
			Pream dB	Bicon dB	Log 1 dB	Barn dB					
1	434.412	45.3	-27.6	+0.0	+18.4	+4.3	+0.0	40.4	46.0	-5.6	Horiz
Quasi Peak											
^	434.413	46.5	-27.6	+0.0	+18.4	+4.3	+0.0	41.6	46.0	-4.4	Horiz
3	461.508	43.9	-27.8	+0.0	+18.8	+4.4	+0.0	39.3	46.0	-6.7	Horiz
4	787.268	38.7	-27.8	+0.0	+22.1	+5.7	+0.0	38.7	46.0	-7.3	Vert
5	732.975	39.3	-27.7	+0.0	+21.4	+5.5	+0.0	38.5	46.0	-7.5	Vert
6	950.129	35.1	-27.2	+0.0	+24.1	+6.3	+0.0	38.3	46.0	-7.7	Vert
Quasi Peak											
^	950.126	37.5	-27.2	+0.0	+24.1	+6.3	+0.0	40.7	46.0	-5.3	Vert
8	760.125	38.5	-27.7	+0.0	+21.7	+5.5	+0.0	38.0	46.0	-8.0	Vert
9	407.236	42.4	-27.3	+0.0	+18.0	+4.0	+0.0	37.1	46.0	-8.9	Horiz
10	678.684	38.5	-27.8	+0.0	+20.7	+5.3	+0.0	36.7	46.0	-9.3	Vert
11	380.111	39.0	-27.1	+0.0	+18.7	+3.8	+0.0	34.4	46.0	-11.6	Vert

12	407.234	39.6	-27.3	+0.0	+18.0	+4.0	+0.0	34.3	46.0	-11.7	Vert
13	542.988	37.7	-27.7	+0.0	+19.5	+4.6	+0.0	34.1	46.0	-11.9	Horiz
14	352.944	37.3	-26.9	+0.0	+19.9	+3.6	+0.0	33.9	46.0	-12.1	Vert
15	434.410	38.6	-27.6	+0.0	+18.4	+4.3	+0.0	33.7	46.0	-12.3	Vert
16	461.519	37.9	-27.8	+0.0	+18.8	+4.4	+0.0	33.3	46.0	-12.7	Vert
17	597.267	35.7	-27.9	+0.0	+19.7	+4.9	+0.0	32.4	46.0	-13.6	Vert
18	570.104	34.8	-27.8	+0.0	+19.6	+4.7	+0.0	31.3	46.0	-14.7	Vert
19	81.515	38.1	-27.1	+8.0	+0.0	+1.6	+0.0	20.6	40.0	-19.4	Vert
20	108.646	34.7	-27.1	+12.8	+0.0	+1.9	+0.0	22.3	43.5	-21.2	Vert
21	81.473	33.6	-27.1	+8.0	+0.0	+1.6	+0.0	16.1	40.0	-23.9	Horiz
22	135.761	30.5	-27.1	+13.7	+0.0	+2.1	+0.0	19.2	43.5	-24.3	Vert

PHOTOGRAPH SHOWING RADIATED EMISSIONS



Radiated Emissions - Front View

NOTES:

PHOTOGRAPH SHOWING RADIATED EMISSIONS



Radiated Emissions - Back View

NOTES: