

Date: 28 April 1998

EMC Test Report

from

ITL (Product Testing) Ltd.

for

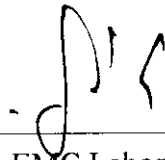
Aptel, Ltd.

1 HaOmanut St., Kiriat Nordau
Netanya 42160
Israel

Equipment under test:

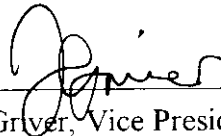
Radio Telemetry Transmitter

Prepared by:



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ITL (Product Testing) Ltd.

Approved by:



Jon Griver, Vice President, Operations
ITL (Product Testing) Ltd.

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This report relates only to item(s) tested.

Measurement/Technical Report for

Aptel, Ltd.

Equipment under test:

Radio Telemetry Transmitter

FCC ID: NL3

28 April 1998

This report concerns: Original Grant x Class II change

Class B verification Class A verification Class I change

Equipment type: Radio Telemetry Transmitter

Request Issue of Grant:

 x Immediately upon completion of review

Limits used:

CISPR 22 Part 15 x

Measurement procedure used is ANSI C63.4-1992.

Application for Certification

prepared by:

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Applicant for this device:

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Shimon Zigdon
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Attachment A: User Manual

1 General Information

1.1 Product Description

The device is a one-way messaging (burst) radio transmitter. It transmits 1 Watt Direct Conversion, Direct Sequence Spread Spectrum through a 0dBi printed dipole antenna. The transmitter frequency band is 903.8 - 926.2 Mhz and channel spacing is 400 kHz, i.e. it has 58 channels. The transmitter local oscillator is synthesized using a crystal oscillator reference of 15 MHz. The modulation technique is SPSP Direct Sequence BPSK with a chip rate of 1 Mchip/sec. The PN codes are 255 maximal length sequences.

1.2 Tested System Details

The FCC IDs for all equipment, plus description of all cables used in the tested system are:

<u>Model No.</u>	<u>Serial No.</u>	<u>FCC ID</u>	<u>Description</u>	<u>Cable Description</u>
AP-WM	540	NL3 AP-WM	(EUT) Radio Telemetry Transmitter	1.5 m Non-shielded 4 cables
Dialog	Not designated	None	Mechanical Water Meter	None
Dialog	Not designated	None	Mechanical Water Meter	None
Dialog	Not designated	None	Mechanical Water Meter	None
Dialog	Not designated	None	Mechanical Water Meter	None

1.3 Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4:1992. Radiated testing was performed at an antenna to EUT distance of 3 meters.

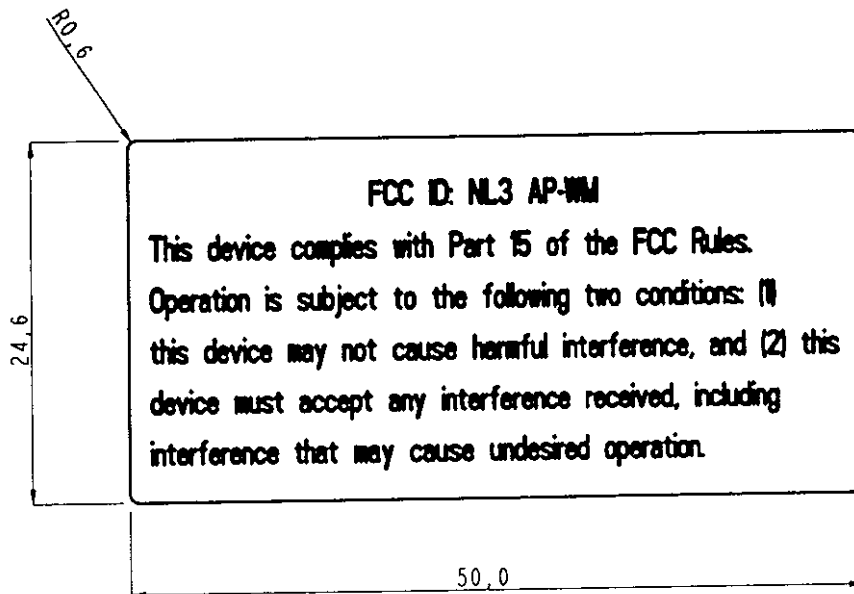
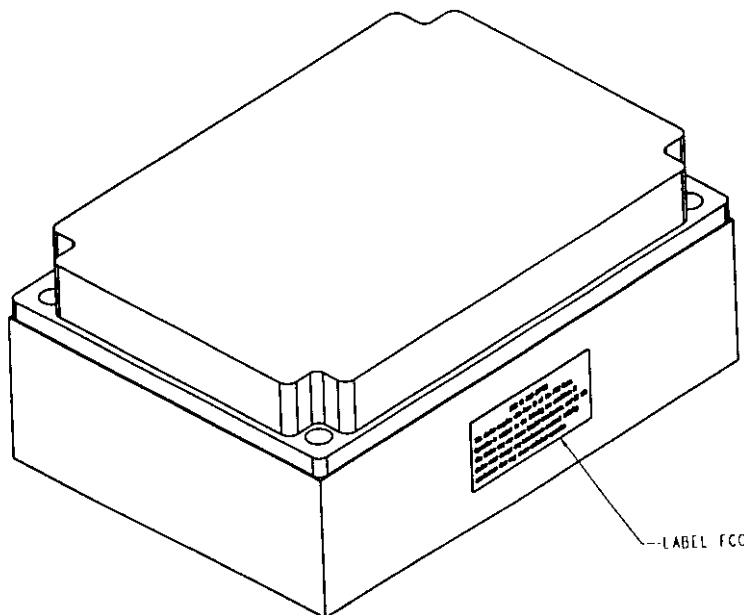
1.4 Test Facility

The open area test site and conducted measurement facility used to collect the data is located at Kfar Bin Nun, Israel. This site has been fully described in reports dated April 10, 1995 and May 8, 1995, submitted to your office, and accepted in a letter dated May 23, 1995 (31040/SIT 1300F2).

The tests that are described in sections 8, 11, 12, and 13 were performed at Aptel's plant.

2

Product Labeling

*Figure 2.1 FCC ID Label**Figure 2.2 Location of Label on EUT*

3 System Test Configuration

3.1 Justification

The E.U.T. was configured to a frequent periodic transmission mode. In this mode, all the sources of emissions were active. The E.U.T. output power is not programmable, and therefore it was tested when transmitting full 1 watt peak output power. The E.U.T. configuration enabled investigation of emissions in power down, operating (housekeeping) and transmit modes.

3.2 EUT Exercise Software

The E.U.T. exercise program used in the testing procedures was the product's standard micro-controller operational firmware. The program was configured to operate the E.U.T. in 3 typical operational modes at the same time:

- ♦ only the I/O interface is under normal operating condition. The rest of the transmitter is in a sleep mode
- ♦ house keeping mode in which the micro-controller wakes up in order to scan the external inputs.
- ♦ periodic transmission, in which the main micro-controller wakes the transmit section up periodically in order to transmit a typical status message.

3.3 Special Accessories

No special accessories were needed to achieve compliance.

3.4 Equipment Modifications

Initially, the E.U.T. failed to meet the requirements of Band Edge Spectrum [In Accordance With Section 15.247(c)]. The manufacturer modified the software controlling the synthesizer and power amplifier. Before the modification, the turning "On" and "Off" of both modules was done without delay between them, which caused the transmission of undesirable spectral components. After the modification, during the turning "On" procedure, the synthesizer is first operated and stabilized for 2 msec., and then the power amplifier is also turned "On". During the turning "Off" procedure, the power amplifier is first turned "Off", and then, after 10 msec., the synthesizer is turned "Off".

3.5 Configuration of Tested System

The configuration of the tested system is described in Figure 3.1.

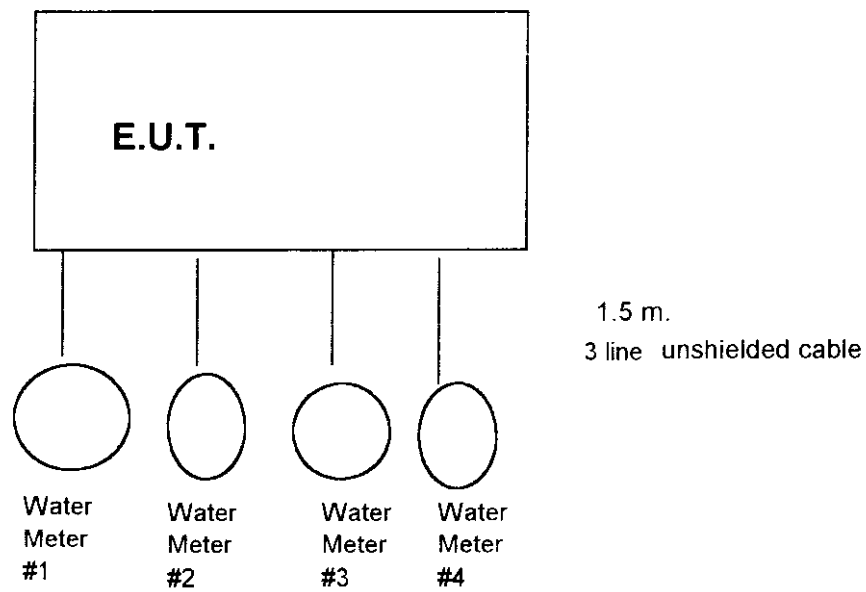
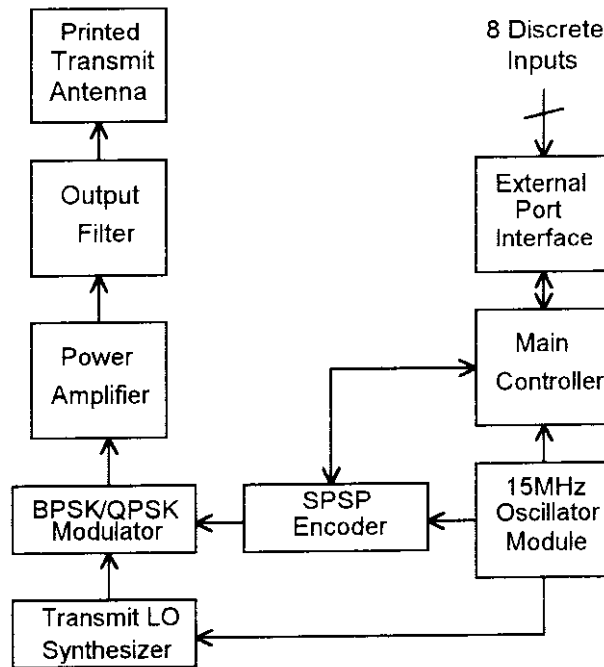


Figure 3.1 Configuration of Tested System

4 Block Diagram

4.1 Schematic Block/Connection Diagram



4.2 Theory of Operation

The E.U.T. transmits Uplink messages to the Base Stations by means of Spread Spectrum technology on ISM frequencies. It also receives input from and conveys messages to the application. The unit's operation is supervised and controlled by a microcontroller.

Components

- ♦ IO (input/output) modules.
- ♦ Transmitter module which includes the following components:
 - Microcontroller
 - ASIC (Application Specific Integrated Circuit)
 - Transmitter
 - External memory

6 Radiated Emission Data

6.1 Radiated Emission 30-1000 MHz, Below 1 GHz

The E.U.T. operation mode and test set-up are as described in Section 3.

A preliminary measurement to characterise the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The effect of varying the position of the cables was investigated to find the configuration that produces maximum emission. The configuration tested is shown in Figure 3.1.

The frequency range 30-1000 MHz was scanned, and the list of the highest emissions was verified and updated accordingly.

The emissions were measured using a computerised EMI receiver complying to CISPR 16 requirements. The specification limits and applicable correction factors are loaded to the receiver via a 3.5" floppy disk.

The readings were maximised by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarisation.

Verification of the E.U.T emissions was based on the following methods:

Turning the E.U.T on and off.

Using a frequency span less than 10 MHz.

Observation of the signal level during turntable rotation. Background noise is not affected by the rotation of the E.U.T.

Field strength at the fundamental transmission frequencies was not measured.

6.2 Measured Data

JUDGEMENT: Passed by 6.6 dB.

The EUT met the requirements of the specification. The worst cases were:

for 903.8 MHz, 11.1 dB @ 610.00 MHz frequency, vertical polarization

for 915 MHz, 6.6 dB @ 900.00 MHz frequency, vertical polarization

for 926.2 MHz, 8.6 dB @ 850.00 MHz frequency, vertical polarization.

The details of the highest emissions are given in Figures 6.1 to 6.24.

TEST PERSONNEL:

Tester Signature: _____

DATE: _____

Typed/Printed Name: _____ I. Raz _____

Radiated Emission

E.U.T Description: Radio Telemetry Transmitter

Type: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Horizontal Detectors: Quasi-peak

Remarks: Antenna at 3 meters distance, Frequency range: 30 MHz to 300 MHz.

Operating Frequency: 903.8 MHz

Freq (MHz)	QP Amp (dB μ V/m)	Specification (dB μ V/m)	Margin (dB μ V/m)	Correction Factor (dB)	
				Ant	Cable
30	25.5	40.0	-14.5	12.1	1.1
45	22.5	40.0	-17.6	10.8	1.3
60	23.2	40.0	-16.8	10.4	1.6
120	22.8	43.5	-20.7	9.7	2.4
150	26.0	43.5	-17.5	12.7	2.7
210	29.7	43.5	-13.8	15.8	3.1
225	30.6	46.0	-15.4	16.3	3.3

Figure 6.1 Radiated Emission. Antenna Polarisation: Horizontal.

Detectors: Quasi-peak

Note: Margin refers to the test results obtained minus specified requirement; thus a negative result indicates that the product passes the test, and a positive number indicates failure.

Radiated Emission

E.U.T Description: Radio Telemetry Transmitter

Type: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Horizontal Detectors: Quasi-peak

Remarks: Antenna at 3 meters distance, Frequency range: 30 MHz to 300 MHz.

Operating Frequency: 903.8 MHz

08:11:59 APR 23, 1998

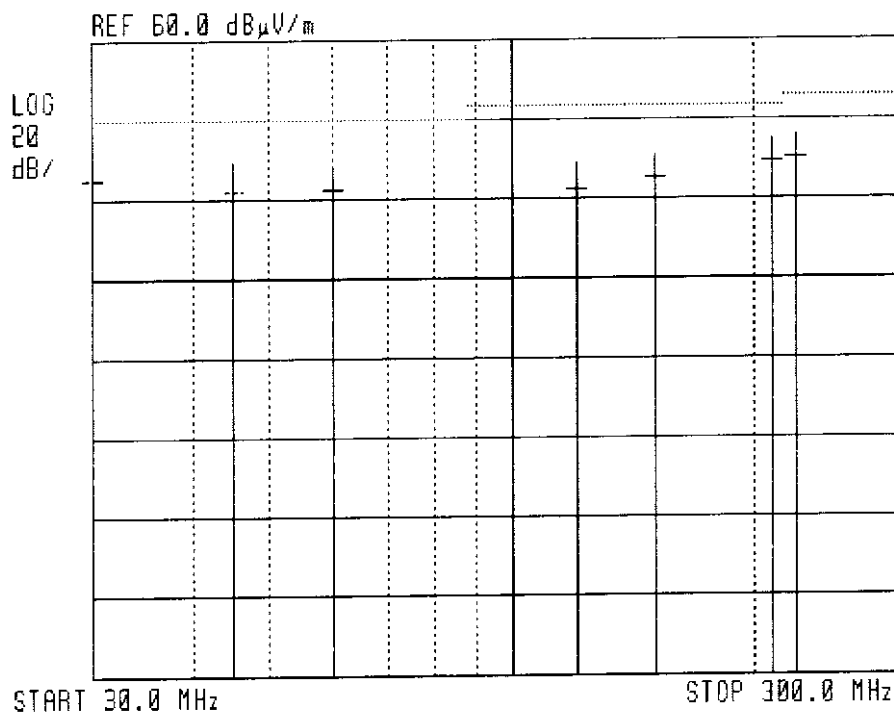


Figure 6.2 Radiated Emission. Antenna Polarisation: Horizontal.

Detectors: Quasi-peak

Note:

1. Horizontal axis shows logarithmic frequency scale.
2. The vertical axis shows amplitude (in dB $\mu V m$).
3. Peak detection is designated by the top of each vertical line.
4. Quasi-peak detection is designated by the first dash mark (from the top) of each vertical line.
5. Average detection is designated by the second dash mark (from the top) of each vertical line.

Radiated Emission

E.U.T Description: Radio Telemetry Transmitter

Type: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Horizontal Detectors: Quasi-peak

Remarks: Antenna at 3 meters distance, Frequency range: 300 MHz to 1 GHz.

Operating Frequency: 903.8 MHz

Freq (MHz)	QP Amp (dB μ V/m)	Specification (dB μ V/m)	Margin (dB μ V/m)	Correction Factor (dB)	
				Ant	Cable
330	27.8	46.0	-18.2	12.4	4.1
405	31.4	46.0	-14.6	14.3	4.6
610	34.9	46.0	-11.1	17.5	5.6
850	30.6	46.0	-15.4	20.0	7.0
965	32.0	54.0	-22.0	22.0	7.6
970	32.2	54.0	-21.8	22.1	7.6

Figure 6.3 Radiated Emission. Antenna Polarisation: Horizontal.

Detectors: Quasi-peak

Note: Margin refers to the test results obtained minus specified requirement; thus a negative result indicates that the product passes the test, and a positive number indicates failure.

Radiated Emission

E.U.T Description: Radio Telemetry Transmitter

Type: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Horizontal Detectors: Quasi-peak

Remarks: Antenna at 3 meters distance, Frequency range: 300 MHz to 1 GHz.

Operating Frequency: 903.8 MHz

20:35:39 APR 22, 1998

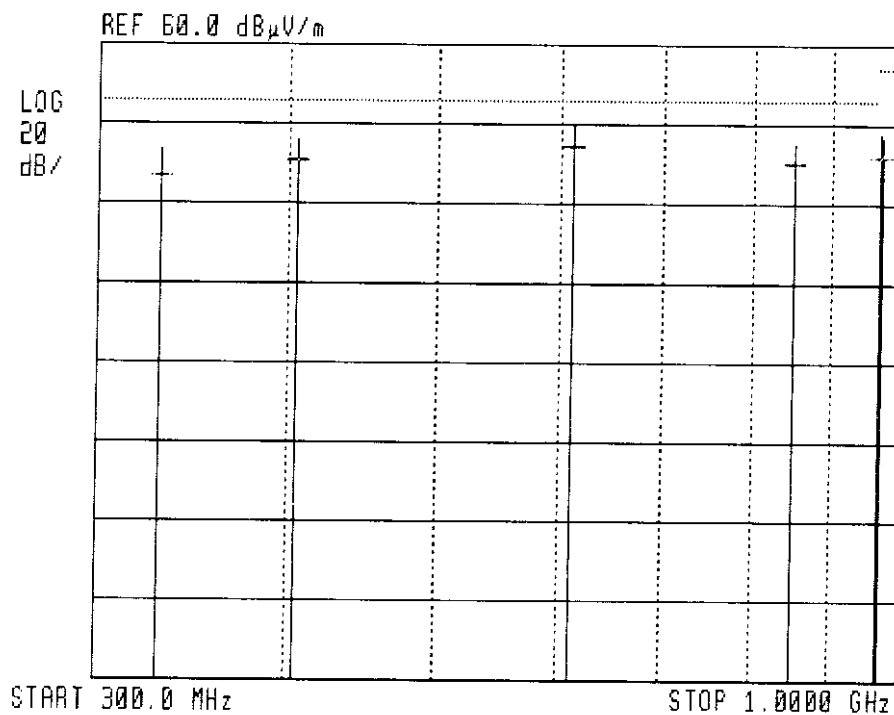


Figure 6.4 Radiated Emission. Antenna Polarisation: Horizontal.

Detectors: Quasi-peak

Note:

1. Horizontal axis shows logarithmic frequency scale.
2. The vertical axis shows amplitude (in dB μ V m).
3. Peak detection is designated by the top of each vertical line.
4. Quasi-peak detection is designated by the first dash mark (from the top) of each vertical line.
5. Average detection is designated by the second dash mark (from the top) of each vertical line.

Radiated Emission

E.U.T Description: Radio Telemetry Transmitter

Type: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Vertical Detectors: Quasi-peak

Remarks: Antenna at 3 meters distance, Frequency range: 30 MHz to 300 MHz.

Operating Frequency: 903.8 MHz

Freq (MHz)	QP Amp (dB μ V/m)	Specification (dB μ V/m)	Margin (dB μ V/m)	Correction Factor (dB)	
				Ant	Cable
30	24.8	40.0	-15.2	12.1	1.1
45	22.7	40.0	-17.3	10.8	1.3
60	24.4	40.0	-15.6	10.4	1.6
120	23.1	43.5	-20.4	9.7	2.4
150	27.8	43.5	-15.7	12.7	2.7
210	29.8	43.5	-13.7	15.8	3.1
225	33.3	46.0	-12.7	16.3	3.3

Figure 6.5 Radiated Emission. Antenna Polarisation: Vertical.

Detectors: Quasi-peak

Note: Margin refers to the test results obtained minus specified requirement; thus a negative result indicates that the product passes the test, and a positive number indicates failure.

Radiated Emission

E.U.T Description: Radio Telemetry Transmitter

Type: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Vertical

Detectors: Quasi-peak

Remarks: Antenna at 3 meters distance, Frequency range: 30 MHz to 300 MHz.

Operating Frequency: 903.8 MHz

07:53:34 APR 23, 1998

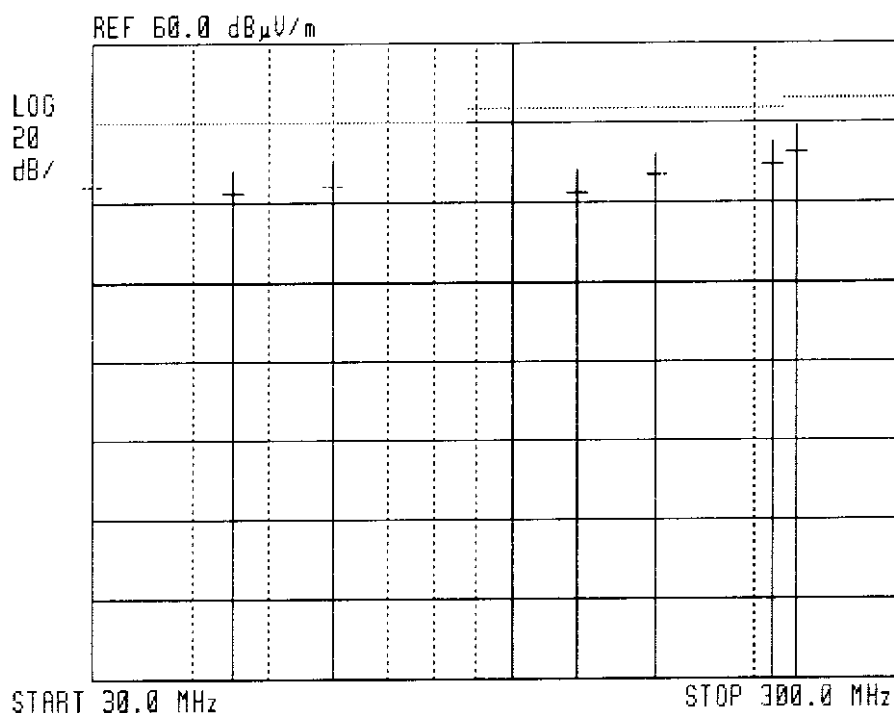


Figure 6.6 Radiated Emission. Antenna Polarisation: Vertical.

Detectors: Quasi-peak

Note:

1. Horizontal axis shows logarithmic frequency scale.
2. The vertical axis shows amplitude (in dB μ V m).
3. Peak detection is designated by the top of each vertical line.
4. Quasi-peak detection is designated by the first dash mark (from the top) of each vertical line.
5. Average detection is designated by the second dash mark (from the top) of each vertical line.

Radiated Emission

E.U.T Description: Radio Telemetry Transmitter

Type: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Vertical Detectors: Quasi-peak

Remarks: Antenna at 3 meters distance, Frequency range: 300 MHz to 1 GHz.

Operating Frequency: 903.8 MHz

Freq (MHz)	QP Amp (dB μ V/m)	Specification (dB μ V/m)	Margin (dB μ V/m)	Correction Factor (dB)	
				Ant	Cable
330	27.9	46.0	-18.1	12.4	4.1
405	23.5	46.0	-22.5	14.3	4.6
610	24.8	46.0	-21.2	17.5	5.6
850	31.2	46.0	-14.8	20.0	7.0
965	31.7	54.0	-22.3	22.0	7.6
970	32.2	54.0	-21.8	22.1	7.6

Figure 6.7 Radiated Emission. Antenna Polarisation: Vertical.

Detectors: Quasi-peak

Note: Margin refers to the test results obtained minus specified requirement; thus a negative result indicates that the product passes the test, and a positive number indicates failure.

Radiated Emission

E.U.T Description: Radio Telemetry Transmitter

Type: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Vertical Detectors: Quasi-peak

Remarks: Antenna at 3 meters distance, Frequency range: 300 MHz to 1 GHz.

Operating Frequency: 903.8 MHz

 20:25:42 APR 22, 1998

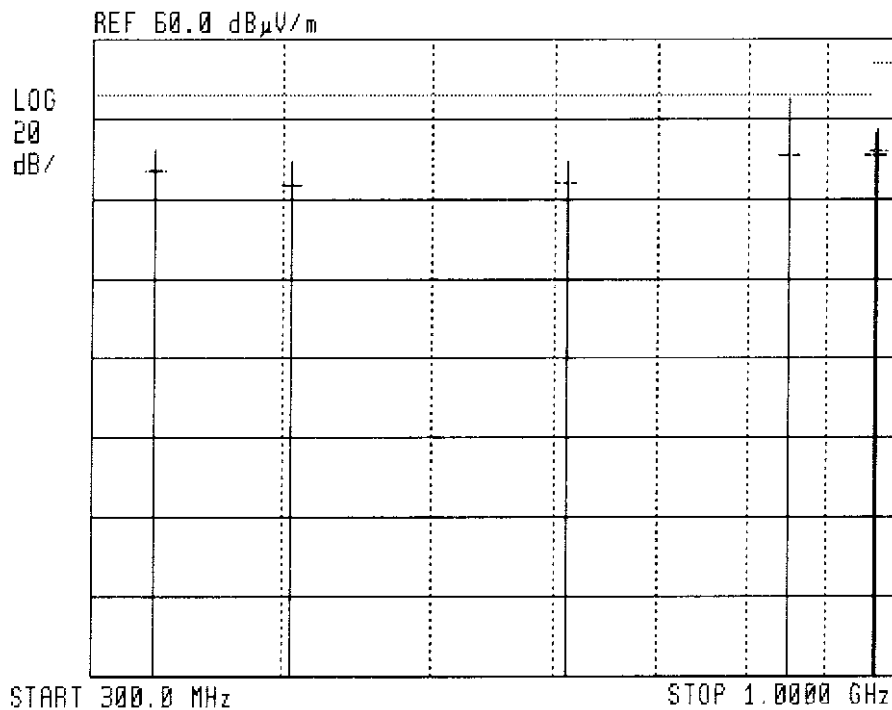


Figure 6.8 Radiated Emission. Antenna Polarisation: Vertical.

Detectors: Quasi-peak

Note:

1. Horizontal axis shows logarithmic frequency scale.
2. The vertical axis shows amplitude (in dB μ V/m).
3. Peak detection is designated by the top of each vertical line.
4. Quasi-peak detection is designated by the first dash mark (from the top) of each vertical line.
5. Average detection is designated by the second dash mark (from the top) of each vertical line.

Radiated Emission

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Horizontal Detectors: Quasi-peak

Remarks: Antenna at 3 meters distance, Frequency range: 30 MHz to 300 MHz.

Operating Frequency: 915 MHz

Freq (MHz)	QP Amp (dB μ V/m)	Specification (dB μ V/m)	Margin (dB μ V/m)	Correction Factor (dB)	
				Ant	Cable
30.01	26.6	40.0	-13.4	14.8	1.1
60.00	22.6	40.0	-17.4	9.1	1.6
120.01	24.9	43.5	-18.6	11.5	2.4
150.01	26.3	43.5	-17.2	12.6	2.7
210.01	29.5	43.5	-14.1	15.3	3.1
225.01	30.5	46.0	-15.4	16.0	3.3

Figure 6.9 Radiated Emission. Antenna Polarisation: Horizontal.

Detectors: Quasi-peak

Note: Margin refers to the test results obtained minus specified requirement; thus a negative result indicates that the product passes the test, and a positive number indicates failure.

Radiated Emission

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Horizontal Detectors: Quasi-peak

Remarks: Antenna at 3 meters distance, Frequency range: 30 MHz to 300 MHz.

Operating Frequency: 915 MHz

11:30:58 APR 12, 1998

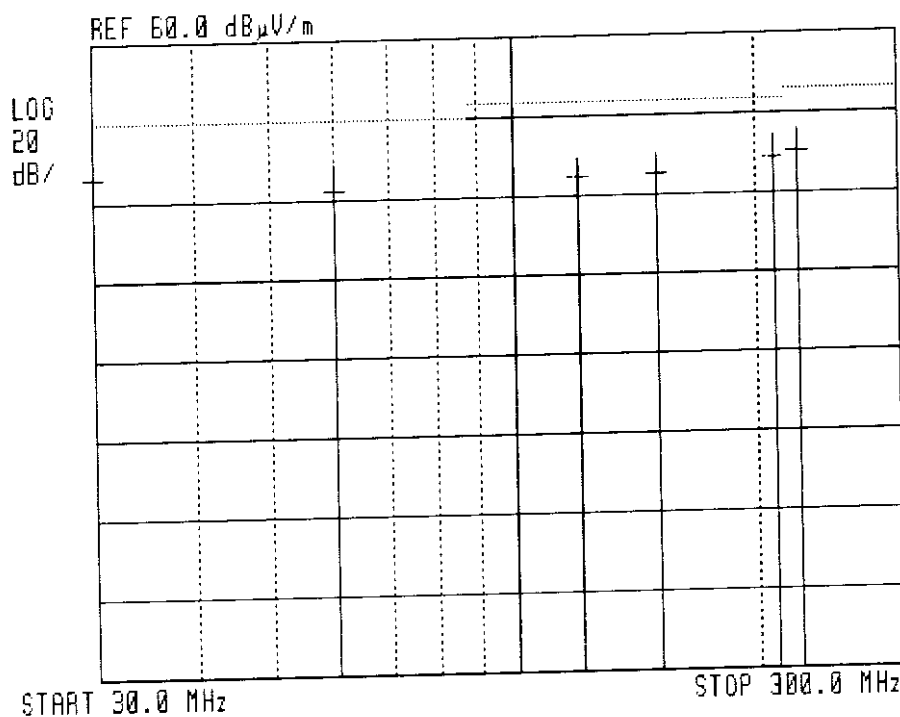


Figure 6.10 Radiated Emission. Antenna Polarisation: Horizontal.

Detectors: Quasi-peak

Note:

1. Horizontal axis shows logarithmic frequency scale.
2. The vertical axis shows amplitude (in dB μ V/m).
3. Peak detection is designated by the top of each vertical line.
4. Quasi-peak detection is designated by the first dash mark (from the top) of each vertical line.
5. Average detection is designated by the second dash mark (from the top) of each vertical line.

Radiated Emission

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Horizontal Detectors: Quasi-peak

Remarks: Antenna at 3 meters distance, Frequency range: 300 MHz to 1 GHz.

Operating Frequency: 915 MHz

Freq (MHz)	QP Amp (dB μ V/m)	Specification (dB μ V/m)	Margin (dB μ V/m)	Correction Factor (dB)	
				Ant	Cable
405	24.4	46.0	-21.6	14.3	4.6
610	25.3	46.0	-20.7	17.5	5.6
850	36.5	46.0	-9.5	20.0	7.0
900	39.4	46.0	-6.6	20.8	7.4
965	34.3	54.0	-19.8	22.0	7.6
975	35.1	54.0	-18.9	22.1	7.7

Figure 6.11 Radiated Emission. Antenna Polarisation: Horizontal.

Detectors: Quasi-peak

Note: Margin refers to the test results obtained minus specified requirement; thus a negative result indicates that the product passes the test, and a positive number indicates failure.

Radiated Emission

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Horizontal Detectors: Quasi-peak

Remarks: Antenna at 3 meters distance, Frequency range: 300 MHz to 1 GHz.

Operating Frequency: 915 MHz

20:03:41 APR 15, 1998

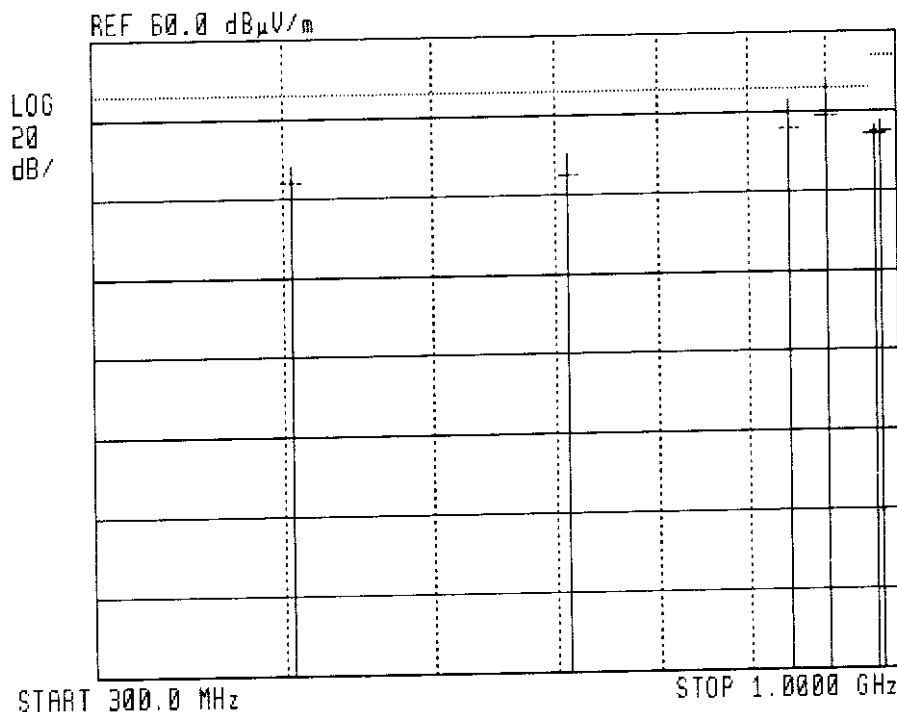


Figure 6.12 Radiated Emission. Antenna Polarisation: Horizontal.

Detectors: Quasi-peak

Note:

1. Horizontal axis shows logarithmic frequency scale.
2. The vertical axis shows amplitude (in dB $\mu V m$).
3. Peak detection is designated by the top of each vertical line.
4. Quasi-peak detection is designated by the first dash mark (from the top) of each vertical line.
5. Average detection is designated by the second dash mark (from the top) of each vertical line.

Radiated Emission

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Vertical Detectors: Quasi-peak

Remarks: Antenna at 3 meters distance, Frequency range: 30 MHz to 300 MHz.

Operating Frequency: 915 MHz

Freq (MHz)	QP Amp (dB μ V/m)	Specification (dB μ V/m)	Margin (dB μ V/m)	Correction Factor (dB)	
				Ant	Cable
30.01	27.5	40.0	-12.5	14.8	1.1
60.01	21.8	40.0	-18.2	9.1	1.6
150.01	26.3	43.5	-17.2	12.6	2.7
195.01	28.4	43.5	-15.1	14.4	3.0
210.01	29.1	43.5	-14.4	15.3	3.1
225.01	31.8	46.0	-15.4	16.0	3.3

Figure 6.13 Radiated Emission. Antenna Polarisation: Vertical.

Detectors: Quasi-peak

Note: Margin refers to the test results obtained minus specified requirement; thus a negative result indicates that the product passes the test, and a positive number indicates failure.

Radiated Emission

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Vertical Detectors: Quasi-peak

Remarks: Antenna at 3 meters distance, Frequency range: 30 MHz to 300 MHz.

Operating Frequency: 915 MHz

11:49:43 APR 12, 1998

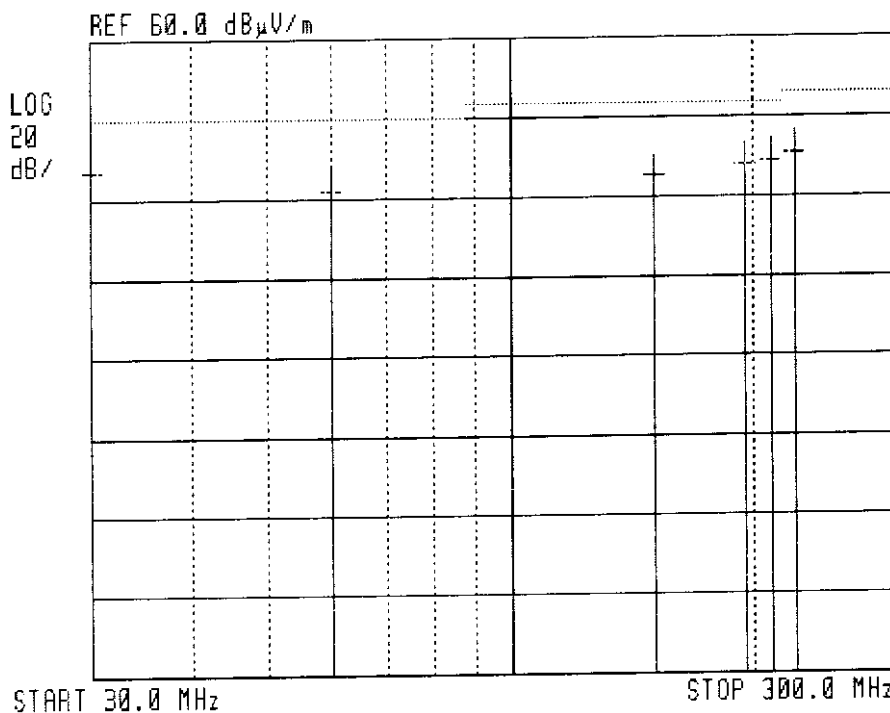


Figure 6. 14 Radiated Emission. Antenna Polarisation: Vertical.

Detectors: Quasi-peak

Note:

1. Horizontal axis shows logarithmic frequency scale.
2. The vertical axis shows amplitude (in dB μ V m).
3. Peak detection is designated by the top of each vertical line.
4. Quasi-peak detection is designated by the first dash mark (from the top) of each vertical line.
5. Average detection is designated by the second dash mark (from the top) of each vertical line.

Radiated Emission

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Vertical Detectors: Quasi-peak

Remarks: Antenna at 3 meters distance, Frequency range: 300 MHz to 1 GHz.

Operating Frequency: 915 MHz

Freq (MHz)	QP Amp (dB μ V/m)	Specification (dB μ V/m)	Margin (dB μ V/m)	Correction Factor (dB)	
				Ant	Cable
405	24.4	46.0	-21.6	14.3	4.6
610	24.9	46.0	-21.1	17.5	5.6
850	30.9	46.0	-15.1	20.0	7.0
900	33.1	46.0	-12.9	20.8	7.4
965	32.0	54.0	-22.0	22.0	7.6
975	32.3	54.0	-21.8	22.1	7.7

Figure 6.15 Radiated Emission. Antenna Polarisation: Vertical.

Detectors: Quasi-peak

Note: Margin refers to the test results obtained minus specified requirement; thus a negative result indicates that the product passes the test, and a positive number indicates failure.

Radiated Emission

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Vertical Detectors: Quasi-peak

Remarks: Antenna at 3 meters distance, Frequency range: 300 MHz to 1 GHz.

Operating Frequency: 915 MHz

20:18:53 APR 15, 1998

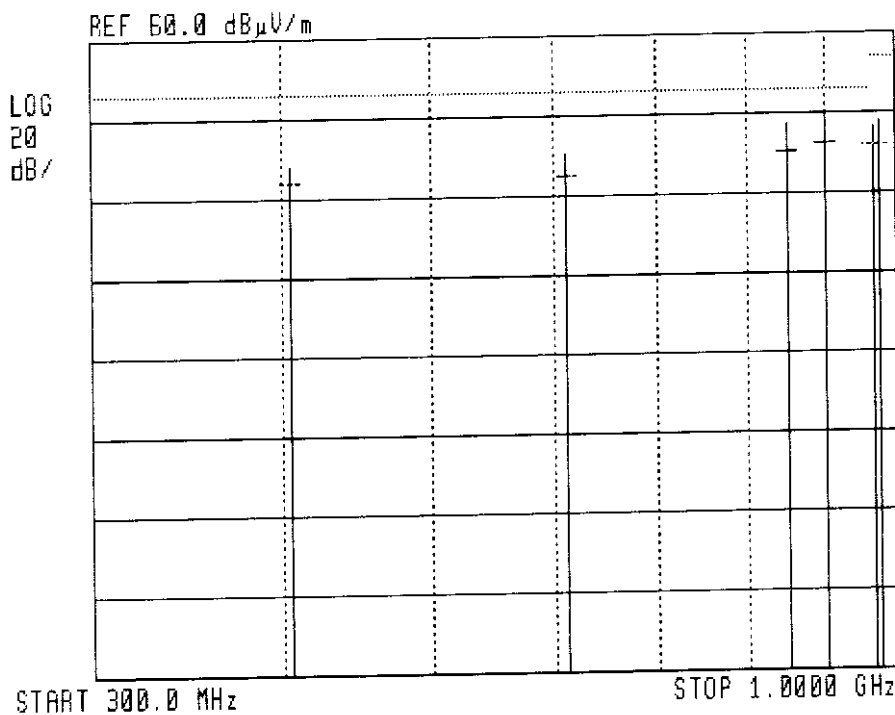


Figure 6.16 Radiated Emission. Antenna Polarisation: Vertical.

Detectors: Quasi-peak

Note:

1. Horizontal axis shows logarithmic frequency scale.
2. The vertical axis shows amplitude (in dB μ V/m).
3. Peak detection is designated by the top of each vertical line.
4. Quasi-peak detection is designated by the first dash mark (from the top) of each vertical line.
5. Average detection is designated by the second dash mark (from the top) of each vertical line.

Radiated Emission

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Horizontal Detectors: Quasi-peak

Remarks: Antenna at 3 meters distance, Frequency range: 30 MHz to 300 MHz.

Operating Frequency: 926.2 MHz

Freq (MHz)	QP Amp (dB μ V/m)	Specification (dB μ V/m)	Margin (dB μ V/m)	Correction Factor (dB)	
				Ant	Cable
45.06	22.9	40.0	-17.2	10.8	1.3
60.00	23.1	40.0	-16.9	10.4	1.6
120.00	23.1	43.5	-20.4	9.7	2.4
150.02	26.1	43.5	-17.4	12.7	2.7
195.00	29.2	43.5	-14.3	15.4	2.9
210.09	29.9	43.5	-13.6	15.8	3.1
225.02	30.9	46.0	-15.1	16.3	3.3

Figure 6.17 Radiated Emission. Antenna Polarisation: Horizontal.

Detectors: Quasi-peak

Note: Margin refers to the test results obtained minus specified requirement; thus a negative result indicates that the product passes the test, and a positive number indicates failure.

Radiated Emission

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Horizontal Detectors: Quasi-peak

Remarks: Antenna at 3 meters distance, Frequency range: 30 MHz to 300 MHz.

Operating Frequency: 926.2 MHz

18:57:59 APR 22, 1998

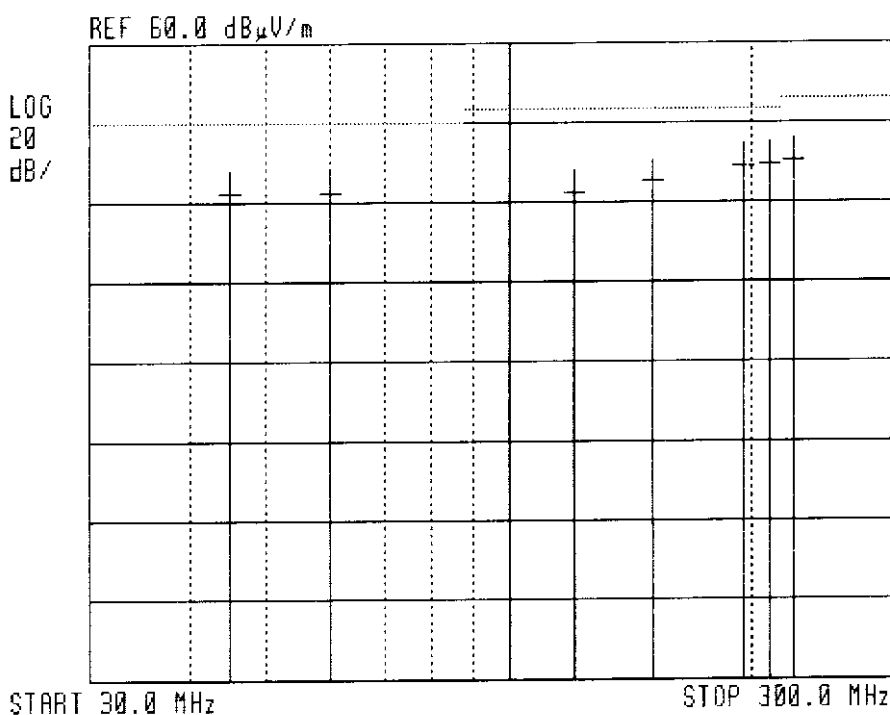


Figure 6.18 Radiated Emission. Antenna Polarisation: Horizontal.

Detectors: Quasi-peak

Note:

1. Horizontal axis shows logarithmic frequency scale.
2. The vertical axis shows amplitude (in dB μ V/m).
3. Peak detection is designated by the top of each vertical line.
4. Quasi-peak detection is designated by the first dash mark (from the top) of each vertical line.
5. Average detection is designated by the second dash mark (from the top) of each vertical line.

Radiated Emission

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Horizontal Detectors: Quasi-peak

Remarks: Antenna at 3 meters distance, Frequency range: 300 MHz to 1 GHz.

Operating Frequency: 926.2 MHz

Freq (MHz)	QP Amp (dB μ V/m)	Specification (dB μ V/m)	Margin (dB μ V/m)	Correction Factor (dB)	
				Ant	Cable
405	24.8	46.0	-21.2	14.3	4.6
610	25.1	46.0	-20.9	17.5	5.6
850	30.5	46.0	-15.5	20.0	7.0
900	31.0	46.0	-15.0	20.8	7.4
965	32.4	54.0	-21.6	22.0	7.6
970	32.2	54.0	-21.8	22.1	7.6

Figure 6.19 Radiated Emission. Antenna Polarisation: Horizontal.

Detectors: Quasi-peak

Note: Margin refers to the test results obtained minus specified requirement; thus a negative result indicates that the product passes the test, and a positive number indicates failure.

Radiated Emission

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Horizontal Detectors: Quasi-peak

Remarks: Antenna at 3 meters distance, Frequency range: 300 MHz to 1 GHz.

Operating Frequency: 926.2 MHz

19:27:52 APR 22, 1998

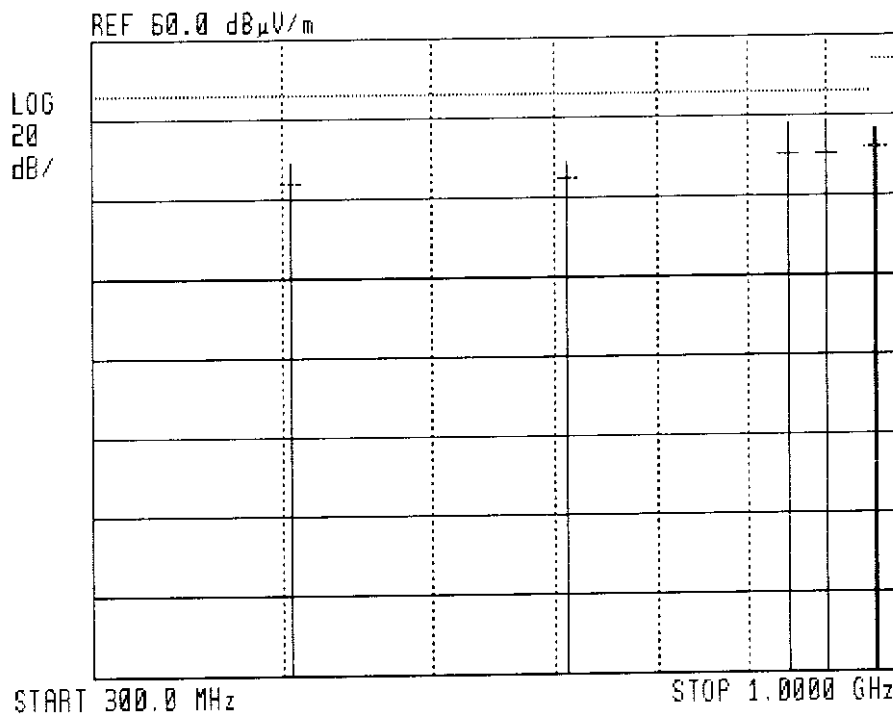


Figure 6.20 Radiated Emission. Antenna Polarisation: Horizontal.

Detectors: Quasi-peak

Note:

1. Horizontal axis shows logarithmic frequency scale.
2. The vertical axis shows amplitude (in dB μ V m).
3. Peak detection is designated by the top of each vertical line.
4. Quasi-peak detection is designated by the first dash mark (from the top) of each vertical line.
5. Average detection is designated by the second dash mark (from the top) of each vertical line.

Radiated Emission

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Vertical Detectors: Quasi-peak

Remarks: Antenna at 3 meters distance, Frequency range: 30 MHz to 300 MHz.

Operating Frequency: 926.2 MHz

Freq (MHz)	QP Amp (dB μ V/m)	Specification (dB μ V/m)	Margin (dB μ V/m)	Correction Factor (dB)	
				Ant	Cable
45.06	23.1	40.0	-16.9	10.8	1.3
60.00	23.4	40.0	-16.6	10.4	1.6
150.02	26.5	43.5	-17.0	12.7	2.7
194.91	29.3	43.5	-14.2	15.4	2.8
210.09	29.9	43.5	-13.7	15.8	3.1
225.02	32.9	46.0	-13.1	16.3	3.3

Figure 6.21 Radiated Emission. Antenna Polarisation: Vertical.

Detectors: Quasi-peak

Note: Margin refers to the test results obtained minus specified requirement; thus a negative result indicates that the product passes the test, and a positive number indicates failure.

Radiated Emission

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Vertical Detectors: Quasi-peak

Remarks: Antenna at 3 meters distance, Frequency range: 30 MHz to 300 MHz.

Operating Frequency: 926.2 MHz

18:32:13 APR 22, 1998

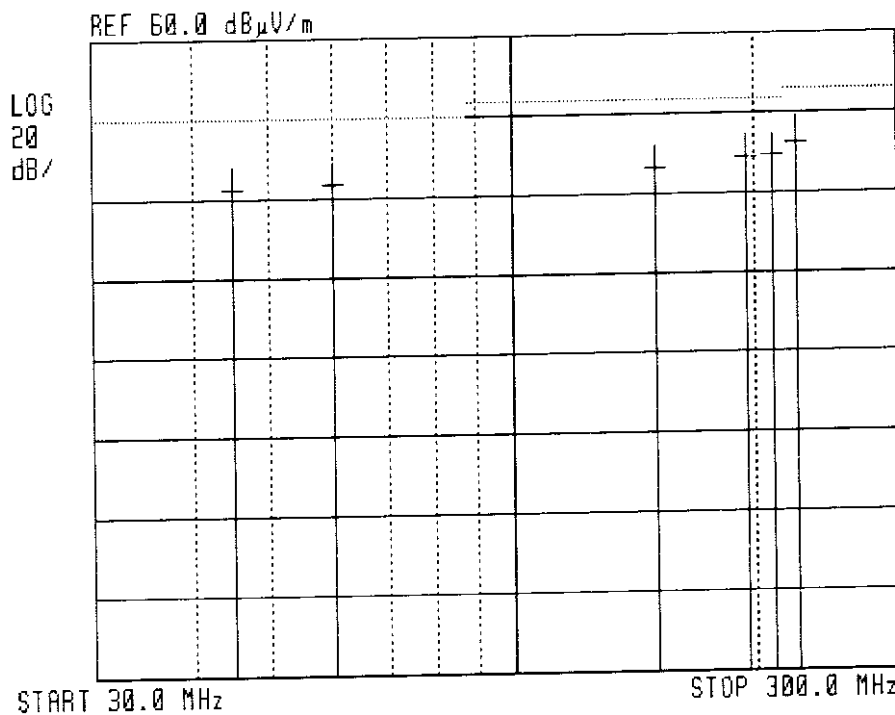


Figure 6.22 Radiated Emission. Antenna Polarisation: Vertical.

Detectors: Quasi-peak

Note:

1. Horizontal axis shows logarithmic frequency scale.
2. The vertical axis shows amplitude (in dB $\mu V/m$).
3. Peak detection is designated by the top of each vertical line.
4. Quasi-peak detection is designated by the first dash mark (from the top) of each vertical line.
5. Average detection is designated by the second dash mark (from the top) of each vertical line.

Radiated Emission

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Vertical Detectors: Quasi-peak

Remarks: Antenna at 3 meters distance, Frequency range: 300 MHz to 1 GHz.

Operating Frequency: 926.2 MHz

Freq (MHz)	QP Amp (dB μ V/m)	Specification (dB μ V/m)	Margin (dB μ V/m)	Correction Factor (dB)	
				Ant	Cable
405	25.0	46.0	-21.0	14.3	4.6
610	25.1	46.0	-20.9	17.5	5.6
850	37.4	46.0	-8.6	20.0	7.0
900	31.9	46.0	-14.1	20.8	7.4
965	31.6	54.0	-22.4	22.0	7.6
970	31.8	54.0	-22.2	22.1	7.6

Figure 6.23 Radiated Emission. Antenna Polarisation: Vertical.

Detectors: Quasi-peak

Note: Margin refers to the test results obtained minus specified requirement; thus a negative result indicates that the product passes the test, and a positive number indicates failure.

Radiated Emission

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Vertical Detectors: Quasi-peak

Remarks: Antenna at 3 meters distance, Frequency range: 300 MHz to 1 GHz.

Operating Frequency: 926.2 MHz

19:47:48 APR 22, 1998

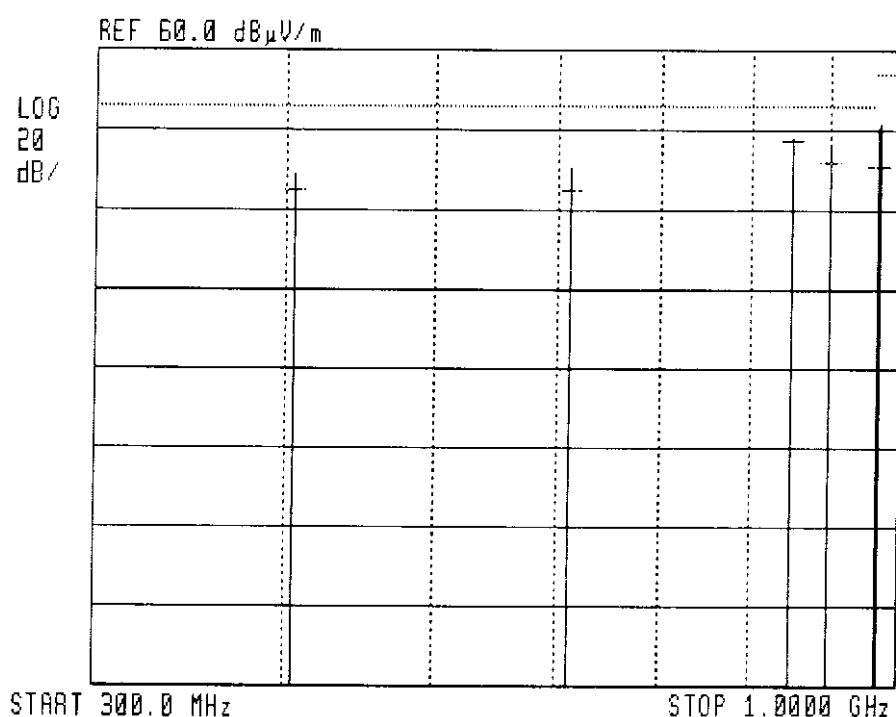


Figure 6.24 Radiated Emission. Antenna Polarisation: Vertical.

Detectors: Quasi-peak

Note:

1. Horizontal axis shows logarithmic frequency scale.
2. The vertical axis shows amplitude (in dB μ V m).
3. Peak detection is designated by the top of each vertical line.
4. Quasi-peak detection is designated by the first dash mark (from the top) of each vertical line.
5. Average detection is designated by the second dash mark (from the top) of each vertical line.

6.3 Test Instrumentation Used, Radiated Measurement Below 1 GHz

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Cal.	Period
Receiver	HP	85420E/85422E	3427A00103/34	Oct. 20, 1997	1 year
Antenna - Biconical HP	ARA	BCH-2030/A	1019	April 2, 1998	1 year
Antenna - Log Periodic	ARA	LPD-2010/A	1037	March 12, 1998	1 year
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A
Printer	HP	ThinkJet2225	2738508357.0	N/A	N/A

6.4 Field Strength Calculation

In the frequency range below 2-9GHz, the field strength is calculated directly by the EMI Receiver software, and a "Correction Factors" data disk, using the following equation:

$$[\text{dB}\mu\text{v/m}] \text{ FS} = \text{RA} + \text{AF} + \text{CF}$$

FS: Field Strength [dB μ v/m]
 RA: Receiver Amplitude [dB μ v]
 AF: Receiving Antenna Correction Factor [dB/m]
 CF: Cable Attenuation Factor [dB]

No external preamplifiers are used.

In the frequency range above 2-9GHz, the field strength is manually calculated using the following equation:

$$[\text{dB}\mu\text{v/m}] \text{ FS} = \text{RA} + \text{AF} + \text{CF} + \text{HPF} - \text{PRAF}$$

HPF: High Pass Filter Attenuation Factor
 PRAF: Preamplifier Gain Factor

7

Radiated Emission in Restricted Bands Above 1 GHz

7.1 Radiated Emission Above 1 GHz

The E.U.T operation mode and test set-up are as described in Section 3.

A preliminary measurement to characterise the E.U.T was performed inside the shielded room, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The effect of varying the position of the cables was investigated to find the configuration that produces maximum emission. The configuration tested is shown in Figure 3.1.

In the frequency range 1-2.9 GHz, a computerised EMI receiver complying to CISPR 16 requirements was used. The test distance was 3 meters.

In the frequency range 2.9-9.26 GHz, a spectrum analyzer including a 1GHz high pass filter and low noise amplifier was used. The test distance was 1.5 meters. During peak measurements, the I.F. bandwidth was 100 kHz, and video bandwidth 300 kHz. During average measurements, the I.F. bandwidth was 100 kHz, and video bandwidth was 3 kHz.

The readings were maximised by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarisation.

Verification of the E.U.T emissions was based on the following methods: turning the E.U.T on and off; using a frequency span less than 10 MHz; observation of the signal level during turntable rotation. (Background noise is not affected by the rotation of the E.U.T.)

7.2 Test Data

JUDGEMENT: Passed by 0.9 db

The EUT met the requirements of the specification. The worst cases were:

- for 903.8 MHz, 1.0 dB @ 2711.4 MHz frequency, vertical polarization
- for 915 MHz, 0.9 dB @ 2745.0 MHz frequency, horizontal polarization
- for 926.2 MHz, 0.9 dB @ 4631.0 MHz frequency, horizontal polarization.

The details of the highest emissions are given in Figures 7.1 to 7.6.

TEST PERSONNEL:

Tester Signature:

L Barry

DATE:

5.11.98

Typed/Printed Name:

L. Barry

Radiated Emission in Restricted Bands Above 1 GHz

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Horizontal

Detectors: Peak

Remarks:

Antenna at 3 meters distance for frequencies between 1 and 2.9 GHz

Antenna at 1.5 meters distance for frequencies between 2.9 GHz and 9.038 GHz

Frequency range: 1 GHz to 9.038 GHz

Operating Frequency: 903.8 MHz

Freq (MHz)	Peak Read (dBμV)	Peak Final Result (dBμV/m)	Specification (dB μV/m)	Margin (dB μV/m)	Correction Factor (dB)		
					Ant	Cable	Gain
2711.4	N/A	51*	54.0	-3.0	31.9	3.6	N/A
3615.0	35.6	50.9	60.0	-9.1	34.0	4.4	+23.1
4519.0	40.0	57.6	60.0	-2.4	36.1	4.9	+23.4
5422.0	36.5	55.0	60.0	-5.0	36.8	5.3	-23.6
8134.0	30.8	51.6	60.0	-8.4	40.1	7.5	-26.8
9038.0	24.0	47.7	60.0	-12.3	41.5	9.2	-27

Figure 7.1 Radiated Emission. Antenna Polarisation: Horizontal. Detectors: Peak

Note: Margin refers to the test results obtained minus specified requirement; thus a negative result indicates that the product passes the test, and a positive number indicates failure.

*This result was measured using an average detector.

The final result using average detection was 3 dB below the specification

Radiated Emission in Restricted Bands Above 1 GHz

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Vertical Detectors: Peak

Remarks:

Antenna at 3 meters distance for frequencies between 1 and 2.9 GHz

Antenna at 1.5 meters distance for frequencies between 2.9 GHz and 9.038 GHz

Frequency range: 1 GHz to 9.042 GHz.

Operating Frequency: 903.8 MHz

Freq (MHz)	Peak Read (dB μ V)	Peak Final Result (dB μ V/m)	Specification (dB μ V/m)	Margin (dB μ V/m)	Correction Factor (dB)		
					Ant	Cable	Gain
2711.4	N/A	53*	54.0	-1.0	31.9	3.6	N/A
3615.0	35.6	50.9	60.0	-9.1	34.0	4.4	+23.1
4519.0	40.0	57.6	60.0	-2.4	36.1	4.9	+23.4
5422.0	36.5	55.0	60.0	-5.0	36.8	5.3	-23.6
8134.0	30.8	51.6	60.0	-8.4	40.1	7.5	-26.8
9038.0	24.0	47.7	60.0	-12.3	41.5	9.2	-27

Figure 7.2 Radiated Emission. Antenna Polarisation: Vertical. Detectors: Peak

Note: Margin refers to the test results obtained minus specified requirement; thus a negative result indicates that the product passes the test, and a positive number indicates failure.

**This result was measured using an average detector.*

The final result using average detection was 1 dB below the specification.

Radiated Emission in Restricted Bands Above 1 GHz

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Horizontal

Detectors: Peak

Remarks:

Antenna at 3 meters distance for frequencies between 1 and 2.9 GHz

Antenna at 1.5 meters distance for frequencies between 2.9 GHz and 9.15 GHz

Frequency range: 1 GHz to 9.15 GHz.

Operating Frequency: 915 MHz

Freq (MHz)	Peak Read (dBμV)	Peak Final Result (dBμV/m)	Specification (dB μV/m)	Margin (dB μV/m)	Correction Factor (dB)		
					Ant	Cable	Gain
2745.0	N/A	53.1*	54.0	-0.9	32.0	15.9	N/A
3660.0	39.0	54.3	60.0	-5.7	34.0	4.4	23.1
4575.0	41.0	58.6	60.0	-1.4	36.1	4.9	23.4
7320.0	33.0	51.7	60.0	-8.3	39.2	6.2	26.7
8235.0	27.0	47.8	60.0	-12.2	40.1	7.5	26.8
9150.0	23.0	46.9	60.0	-13.1	41.6	9.3	27.0

Figure 7.3 Radiated Emission. Antenna Polarisation: Horizontal. Detectors: Peak

Note: Margin refers to the test results obtained minus specified requirement; thus a negative result indicates that the product passes the test, and a positive number indicates failure.

**This result was measured using an average detector.*

The final result using average detection was 0.9 dB below the specification

Radiated Emission in Restricted Bands Above 1 GHz

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Vertical

Detectors: Peak

Remarks:

Antenna at 3 meters distance for frequencies between 1 and 2.9 GHz

Antenna at 1.5 meters distance for frequencies between 2.9 GHz and 9.15 GHz

Frequency range: 1 GHz to 9.15 GHz.

Operating Frequency: 915 MHz

Freq (MHz)	Peak Read (dB μ V)	Peak Final Result (dB μ V/m)	Specification (dB μ V/m)	Margin (dB μ V/m)	Correction Factor (dB)		
					Ant	Cable	Gain
2745.0	N/A	52.1*	54.0	-1.9	32.0	15.9	N/A
3660.0	41.0	56.3	60.0	-3.7	34.0	4.4	23.1
4575.0	39.0	56.6	60.0	-3.4	36.1	4.9	23.4
7320.0	31.7	50.4	60.0	-9.6	39.2	6.2	26.7
8235.0	29.0	49.8	60.0	-10.2	40.1	7.5	26.8
9150.0	24.0	47.9	60.0	-12.1	41.6	9.3	27.0

Figure 7.4 Radiated Emission. Antenna Polarisation: Vertical. Detectors: Peak

Note: Margin refers to the test results obtained minus specified requirement; thus a negative result indicates that the product passes the test, and a positive number indicates failure.

**This result was measured using an average detector.*

The final result using average detection was 1.9 dB below the specification

Radiated Emission in Restricted Bands Above 1 GHz

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Horizontal

Detectors: Peak

Remarks:

Antenna at 3 meters distance for frequencies between 1 and 2.9 GHz

Antenna at 1.5 meters distance for frequencies between 2.9 GHz and 9.262 GHz

Frequency range: 1 GHz to 9.262 GHz.

Operating Frequency: 926.2 MHz

Freq (MHz)	Peak Read (dBμV)	Peak Final Result (dB μV/m)	Specification (dB μV/m)	Margin (dB μV/m)	Correction Factor (dB)		
					Ant	Cable	Gain
2778.6	N/A	51.8*	54.0	-2.2	32.0	3.4	22.6
3704.8	40.8	57.0	60.0	-3.0	35.0	4.4	23.2
4631.0	40.3	59.1	60.0	-0.9	36.1	5.3	22.6
7409.6	30.5	51.2	60.0	-8.8	39.4	8.1	26.8
8335.8	29.0	47.25	60.0	-12.8	40.2	9.85	26.8

Figure 7.5 Radiated Emission. Antenna Polarisation: Horizontal. Detectors: Peak

Note: Margin refers to the test results obtained minus specified requirement; thus a negative result indicates that the product passes the test, and a positive number indicates failure.

**This result was measured using an average detector.*

The final result using average detection was 2.2 dB below the specification

Radiated Emission in Restricted Bands Above 1 GHz

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Antenna Polarisation: Vertical

Detectors: Peak

Remarks:

Antenna at 3 meters distance for frequencies between 1 and 2.9 GHz

Antenna at 1.5 meters distance for frequencies between 2.9 GHz and 9.262 GHz

Frequency range: 1 GHz to 9.262 GHz.

Operating Frequency: 926.2 MHz

Freq (MHz)	Peak Read (dB μ V)	Peak Final Result (dB μ V/m)	Specification (dB μ V/m)	Margin (dB μ V/m)	Correction Factor (dB)		
					Ant	Cable	Gain
2778.6	N/A	51.8*	54.0	-2.2	32.0	3.4	22.6
3704.8	38.8	55.0	60.0	-5.0	35.0	4.4	23.2
4631.0	36.0	54.8	60.0	-5.2	36.1	5.3	22.6
7409.6	31.0	51.7	60.0	-8.3	39.4	8.1	26.8
8335.8	28.0	51.25	60.0	-8.75	40.2	9.85	26.8

Figure 7.6 Radiated Emission. Antenna Polarisation: Vertical. Detectors: Peak

Note: Margin refers to the test results obtained minus specified requirement; thus a negative result indicates that the product passes the test, and a positive number indicates failure.

**This result was measured using an average detector.*

The final result using average detection was 2.2 dB below the specification

7.3 Test Instrumentation Used, Radiated Measurement Above 1 GHz

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Cal..	Period
Spectrum Analyzer	HP	8563E	3745A08184	Dec. 29, 1997	1 year
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A
Printer	HP	ThinkJet2225	2738508357	N/A	N/A
Antenna - Log Periodic	A.H. System	SA5-200/511	253	March 30, 1998	1 year
Low Noise Amplifier	AVANTEC	SFT87-1051 Two in Series	8736J775	April 5, 1998	1 year
Low Noise Amplifier	AVANTEC	SFT87-1052	1) 8735J197 2) 8735J188	April 5, 1998	1 year

7.4 Field Strength Calculation

In the frequency range below 2-9GHz, the field strength is calculated directly by the EMI Receiver software, and a "Correction Factors" data disk, using the following equation:

$$[\text{dB}\mu\text{v/m}] \text{ FS} = \text{RA} + \text{AF} + \text{CF}$$

FS: Field Strength [dB μ v/m]
RA: Receiver Amplitude [dB μ v]
AF: Receiving Antenna Correction Factor [dB/m]
CF: Cable Attenuation Factor [dB]

No external preamplifiers are used.

In the frequency range above 2-9GHz, the field strength is manually calculated using the following equation:

$$[\text{dB}\mu\text{v/m}] \text{ FS} = \text{RA} + \text{AF} + \text{CF} + \text{HPF} - \text{PRAF}$$

HPF: High Pass Filter Attenuation Factor
PRAF: Preamplifier Gain Factor

8 Maximum Transmitted Peak Power Output

8.1 Test Procedure

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through a 30 dB attenuator. Special attention was taken to prevent the R.F. overloading of the EMI receiver/spectrum analyzer input. The Spectrum Analyzer was set to 2 MHz I.F. bandwidth; and the peak power level was measured at the selected operation frequencies.

8.2 Measured Data

JUDGEMENT: Passed by 1 dB.

TEST PERSONNEL:

Tester Signature: _____

For / NK

DATE: _____

11/5/98

Typed/Printed Name: _____ S. Zigdon _____

Maximum Transmitted Peak Power Output

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Operation Frequencies	Reading	Final Result	Specification	Margin	Atten*
(MHz)	(dBm)	(dBm)	(dBm)	(dB)	(dB)
903.8	-2.3	28.7	30.0	-1.3	31.0
915.0	-2.0	29.0	30.0	-1.0	31.0
926.2	-2.0	29.0	30.0	-1.0	31.0

Figure 8.1 Maximum Peak Power Output

*30 dB attenuator + cable loss

8.3 Test Equipment Used, Maximum Transmitted Peak Power Output

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Cal.	Period
Spectrum Analyzer	HP	8563E	3745A08184	Dec. 29, 1997	1 year
Cable	Huber Suhner	RG142	Non	April 1, 1998	1 year
30 dB Attenuator	Mini Circuits	SAT-30	Non	April 1, 1998	1 year

9 Peak Power Output Out of 902-928 MHz Band

9.1 Test Procedure

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through a 20dB attenuator. The EMI receiver was set to 100 kHz I.F. bandwidth. The frequency range 10 kHz to 9.26 GHz was scanned, and the level of the spectral components out of the 902-928 MHz band were measured at the selected operation frequencies.

9.2 Measured Data

JUDGEMENT: Passed by 34 dB.

TEST PERSONNEL:

Tester Signature: _____

DATE: _____

Typed/Printed Name: _____

I. Raz

Peak Power Output Out of 902-928 MHz Band

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Operation Frequencies	Final Result	Specification	Margin	Atten
(MHz)	(dBc)	(dBc)	(dB)	(dB)
903.8	54.0	20.0	-34.0	20.0
915.0	55.0	20.0	-35.0	20.0
926.2	55.0	20.0	-35.0	20.0

Figure 9.1 Peak Power Output Out of 902-928 MHz Band

9.3 Test Equipment Used, Peak Power Output

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Cal.	Period
Spectrum Analyzer	HP	8563E	3745A08184	Dec. 29, 1997	1 year
Cable	Huber Suhner	RG142	Non	April 1, 1998 (Aptel)	1 year
20 dB Attenuator	Mini Circuit	SAT-20	Non	April 1, 1998 (Aptel)	1 year

10 6dB Minimum Bandwidth

10.1 Test Procedure

The E.U.T. was set to the applicable test frequency. The E.U.T. antenna terminal was connected to a spectrum analyzer through a 20db attenuator.

The spectrum analyzer was set to a 2MHz span and 100kHz I.F. bandwidth. The spectrum bandwidth of the E.U.T.'s at the points of 6dB below maximum peak power were measured and recorded.

10.2 Measured Data

JUDGEMENT: Passed by 0.5 MHz.

TEST PERSONNEL:

Tester Signature: _____

DATE: _____

Typed/Printed Name: _____ I. Raz

6dB Minimum Bandwidth

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: (para.15.247-a2)

Operation Frequencies	Reading	Specification	Margin
(MHz)	(MHz)	(MHz)	(MHz)
903.8	1.03	0.5	0.53
915.0	1.02	0.5	0.52
926.2	1.16	0.5	0.66

Figure 10.1 6dB Minimum Bandwidth

10.3- Test Equipment Used, 6dB Minimum Bandwidth

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Cal.	Period
Spectrum Analyzer	HP	8591E	34141U01226	May 28, 1997	1 year
Printer	Hewlett Packard	Thinkjet 2225	1001	N/A	N/A
20 dB Attenuator	Minicircuits	SAT-20	Not designated	April 1, 1998	1 year

11**Band Edge Spectrum****[In Accordance With Section 15.247(c)]****11.1 Test Procedure**

Enclosed are spectrum analyzer plots for the lowest operation frequency (903.8 MHz) and the highest operation frequency (926.2 MHz) in which the E.U.T. is planned to be used.

The E.U.T. antenna terminal was connected to the spectrum analyzer through a 20 dB attenuator. The spectrum analyzer was set to 100 KHz I.F. bandwidth. The power levels at 902 MHz and 926 MHz were measured and compared to the transmission power levels at 903.8 MHz and 926.2 MHz.

11.2 Measured Data

JUDGEMENT: Passed by 10.5 MHz.

Note: Initially, the E.U.T. failed to meet the requirements of this specification. The manufacturer made corrective actions by changing the software controlling the synthesizer and power amplifier. Before the corrective action, the turning "On" and "Off" of both modules was done without delay between them, which caused the transmission of undesirable spectral components. After the corrective action, during the turning "On" procedure, the synthesizer is first operated and stabilized for 2 msec., and then the power amplifier is also turned "On". During the turning "Off" procedure, the power amplifier is first turned "Off", and then, after 10 msec., the synthesizer is turned "Off".

TEST PERSONNEL:

Tester Signature: _____

DATE: _____

Typed/Printed Name: _____

S. Zigdon

Band Edge Spectrum

E.U.T. Operating Frequency (MHz)	Band Edge Frequency (MHz)	Spectrum Level (dBc)	Requirement (dBc)	Margin (dB)
903.8	902.0	30.5	20.0	-10.5
926.2	928.0	31.16	20.0	-11.16

Figure 11.1

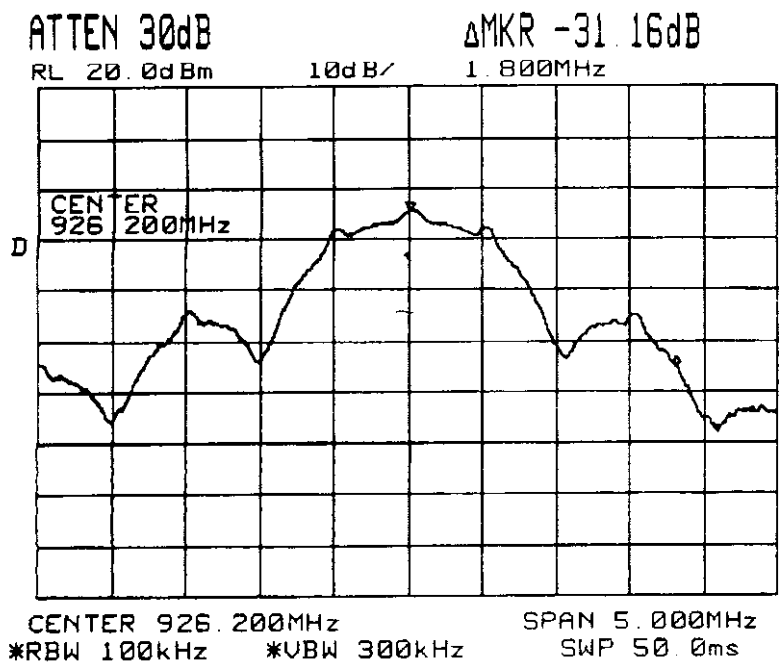


Figure 11.2

Band Edge Spectrum

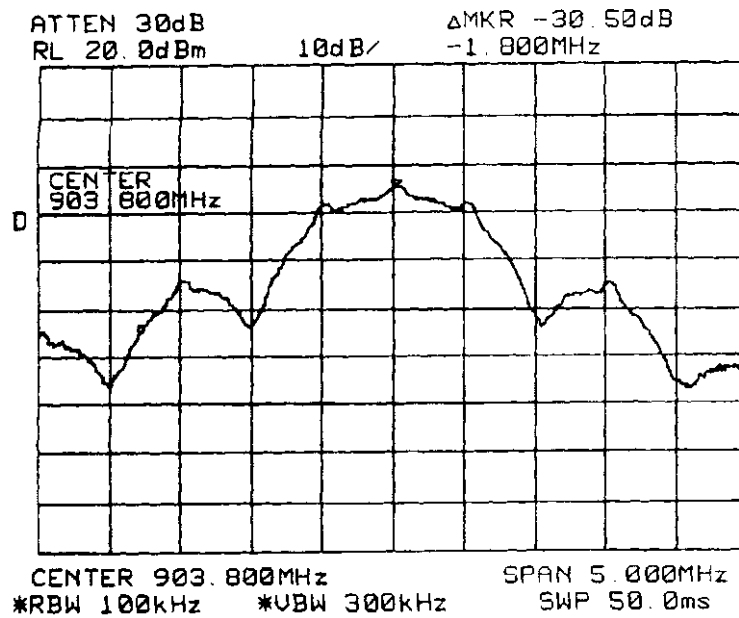


Figure 11.3

12 Transmitted Power Density

[In Accordance With Section 15.247(d)]

12.1 Test Procedure

The spectrum peaks were located at each of the 3 operation frequencies. The spectrum analyzer was set to RBW of 3 KHz, VBW of 10 KHz, and a sweep time of 1 second for each 3 KHz "window".

12.2 Test Results

The E.U.T. met the specifications of this requirement.

See Table 12.1 for details.

TEST PERSONNEL:

Tester Signature: _____

DATE: 11/5/98

Typed/Printed Name: S. Zigdon

Transmitted Power Density

E.U.T Description: Radio Telemetry Transmitter

TYPE: AP-WM

Serial number: 540

Specification: F.C.C. Part 15, Subpart C: CLASS B

Operating Frequency (MHz)	Reading (dBm)	Attenuator* (dB)	Final Result (dBm)	Specification (dBm)	Margin (dB)
903.8	-12.8	20.3	+7.5	8.0	-0.5
915.0	-12.7	20.3	+7.6	8.0	-0.4
926.2	-12.8	20.3	+7.5	8.0	-0.5

* 20 dB attenuator + cable loss

Table 12.1 Power Density

12.3 Test Instrumentation used, Transmitted Power Density

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Cal.	Period
Spectrum Analyzer	HP	8594E	3323A00602	Sept. 14, 1997	1 year
Cable	Huber Suhner	RG142	Non	April 1, 1998 (Aptel)	1 year
20 dB Attenuator	Mini Circuit	SAT-20	Non	April 1, 1998 (Aptel)	1 year

13

Processing Gain

[In Accordance with Section 15.247(e)]

13.1 Test Procedure

The processing gain was measured according to the guidelines in Section 15.247(e). The transmitter was enclosed in a small RF chamber and was configured to transmit periodically typical length burst messages. The jammer was simulated by HP8647A signal generator. The composed signal (transmitter and jammer) was fed to the SPSP receiver and the demodulated data was fed to a PC with decoding and analyzing program. Instead of pointing out a required BER, the criteria that was used is 80% success rate in detecting and decoding burst messages (error free decoded messages). This criteria, which is related to probability of detection rather than to "Required BER", is more suitable in measuring the performance in our system because of its burst nature. By simulation we can show that for a criteria of 80% success rate, the required (S/N) is 16dB. This number does not take into account any implementation losses and it is purely theoretical. The test consists of stepping the signal generator in 50kHz increments across the passband. The measurement was taken in 3 different frequencies-near the low edge of the band in 903.8 MHz, in the middle of the band in 915hz and near the high edge of the band in 926.2 MHz. The measurement was taken when system was configured to work with 255 PN maximal length codes.

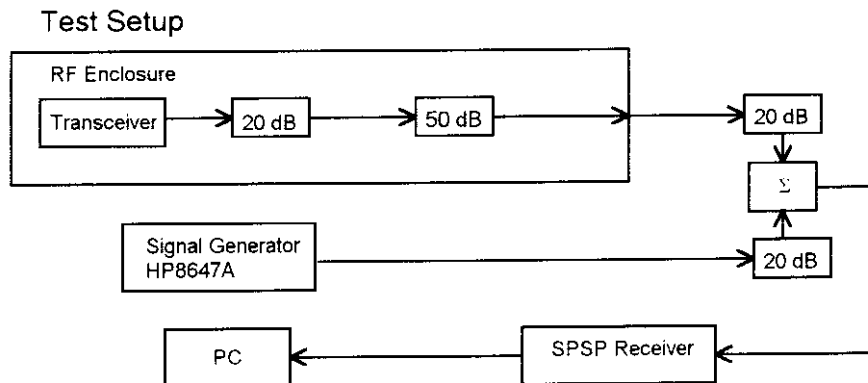


Figure 13.1

TEST PERSONNEL:

Tester Signature:

FOR JMK

DATE:

11/5/98

Typed/Printed Name:

S. Zigdon

Processing Gain

13.2 Measured Data

PN Code Length=255

F0=903.8Mhz

ΔF (Mhz)	J/S (dB)
0	6.5
0.5	6.5
0.1	6.0
0.15	Discard
0.2	6.3
0.25	6.3
0.3	6.4
0.35	6.7
0.4	6.6
0.45	6.6
0.5	6.9
0.55	7.2
0.6	8.0
-0.5	6.6
-0.1	5.7
-0.15	5.7
-0.2	Discard
-0.25	6.1
-0.3	6.2
-0.35	6.5
-0.4	7.0
-0.45	7.1
-0.5	8.1
-0.55	8.5
-0.6	9.3

Processing Gain = $16 + 5.7 = 21.7$

Figure 13.2

Processing Gain

PN Code Length=255

F0=915Mhz

ΔF (Mhz)	J/S (dB)
0	6.2
0.5	5.8
0.1	5.8
0.15	Discard
0.2	6.2
0.25	6.1
0.3	6.0
0.35	6.1
0.4	6.2
0.45	6.3
0.5	6.8
0.55	7.1
0.6	7.7
-0.5	5.6
-0.1	5.7
-0.15	6.2
-0.2	Discard
-0.25	6.5
-0.3	6.0
-0.35	6.3
-0.4	6.7
-0.45	7.1
-0.5	7.3
-0.55	8.5
-0.6	9.4

Processing Gain = $16 + 5.6 = 21.6$

Figure 13.3

Processing Gain

PN Code Length=255

F0=926.2Mhz

ΔF (Mhz)	J/S (dB)
0	7.0
0.5	6.5
0.1	6.2
0.15	Discard
0.2	6.0
0.25	6.0
0.3	6.1
0.35	6.3
0.4	6.5
0.45	6.6
0.5	6.9
0.55	7.2
0.6	8.2
-0.5	6.6
-0.1	6.8
-0.15	6.9
-0.2	Discard
-0.25	6.5
-0.3	6.1
-0.35	7.4
-0.4	7.1
-0.45	7.2
-0.5	8.2
-0.55	8.9
-0.6	10.1

Processing Gain = 16 + 6 = 22

Figure 13.4

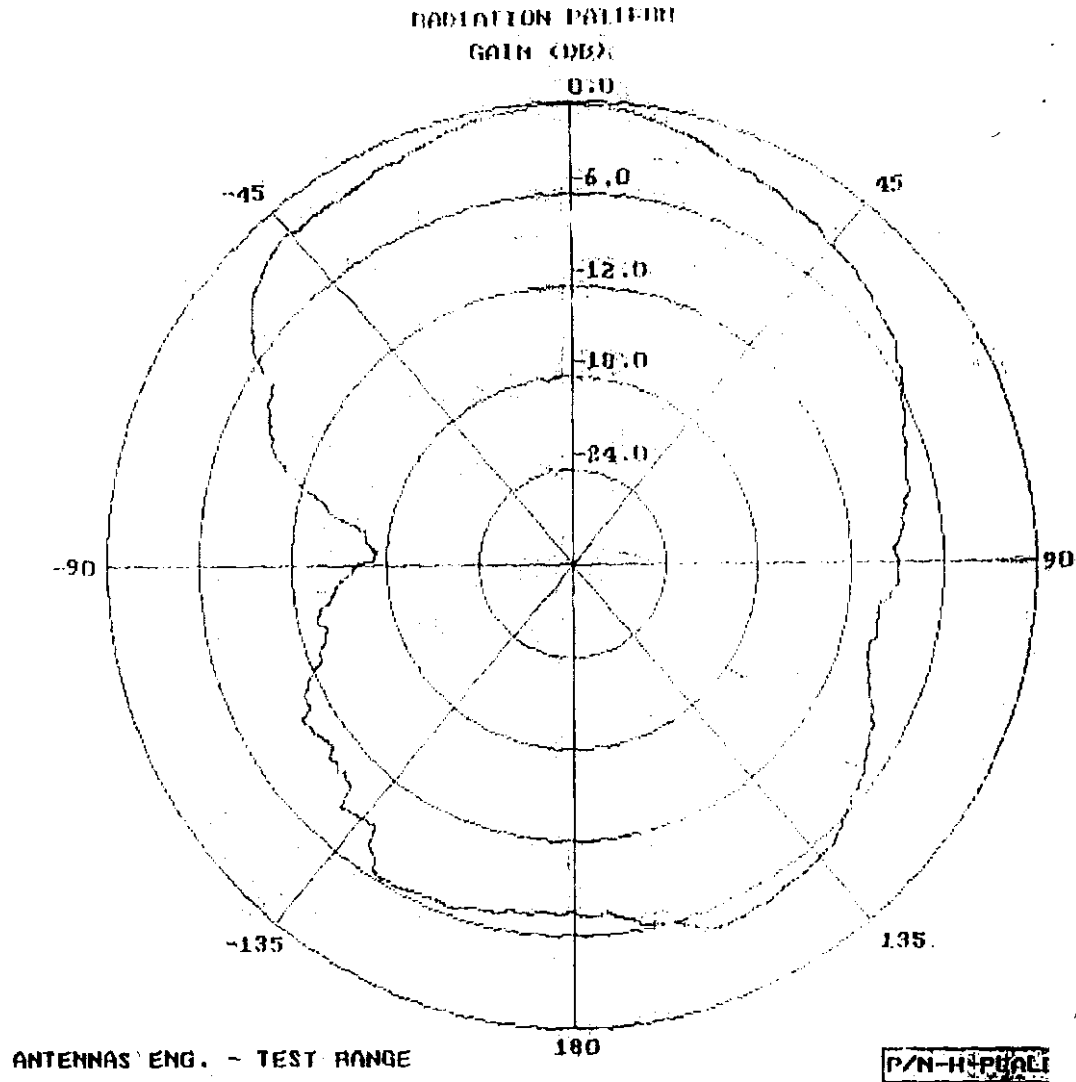
13.3 Test Instrumentation used, Power Gain

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Cal.	Period
Receiver	Aptel	AP-Bx	Non	April 1, 1998 (Aptel)	N/A
Power Splitter	Mini Circuit	ZPSC-2-5	961605	April 1, 1998 (Aptel)	1 year
PC	Toshiba	Satellite 1910	11450545	Non	Non
Variable Att.	Alan	50V100 SMA	90210	April 1, 1998 (Aptel)	1 year
Signal Generator	HP	8647A	3349A02115	April 1, 1998 (Aptel)	1 year
Cable	Huber Suhner	RG142	Non	April 1, 1998 (Aptel)	N/A
20 dB Attenuator	Mini Circuits	SAT-20	Non	April 1, 1998 (Aptel)	1 year

14

Antenna Gain

The gain of the antenna provided with the E.U.T. is zero dBi. Additional details of the antenna radiation characteristics are in the enclosed pattern sheet.



OPERATING FREQUENCY (MHz)	POL. V/H	READING (dB μ v)	CABLE LOSS (dB)	ANT. FACTOR (dB)	RESULT (dB μ v/ m)	SPEC (dB μ v/ m)	MARGIN (dB)
903.8	V	14.3	12.9	32	59.2	74	-14.8
903.8	H	12.1	12.9	32	57.0	74	-17.0
915.0	V	15.4	13.0	32	60.4	74	-13.6
915.0	H	12.8	13.0	32	57.8	74	-15.2
926.2	V	20.6	13.2	32	65.8	74	-9.2
926.2	H	14.8	13.2	32	60.0	74	-14.0

TABLE 2 - PEAK RESULTS FOR
3rd HARMONIC

OPERATING FREQUENCY (MHz)	POL. V/H	READING (dB μ V)	CABLE LOSS (dB)	ANT. FACTOR (dB)	RESULT (dB μ V/ m)	SPEC (dB μ V/ m)	MARGIN (dB)
903.8	V	2.7	12.9	32	47.6	54	-6.4
903.8	H	0.6	12.9	32	45.5	54	-9.5
915.0	V	5.4	13.0	32	50.4	54	-3.6
915.0	H	1.5	13.0	32	46.5	54	-8.5
926.2	V	8.6	13.2	32	53.8	54	-0.2
926.2	H	3.1	13.2	32	48.3	54	-5.7

TABLE 1 - AVERAGE RESULTS FOR
3rd HARMONIC

Tx: 903.8 MHz
 VERTICAL pol.

519

07:49:58 AUG 04, 1998

MARKER
 1.0500 sec
 14.27 dBμV

ACTV DET: PEAK
 MEAS DET: PEAK QP AVG
 MKR 1.0500 sec
 14.27 dBμV

Last Hrd
 Key Menu

SPAN

MARKER
 NORMAL

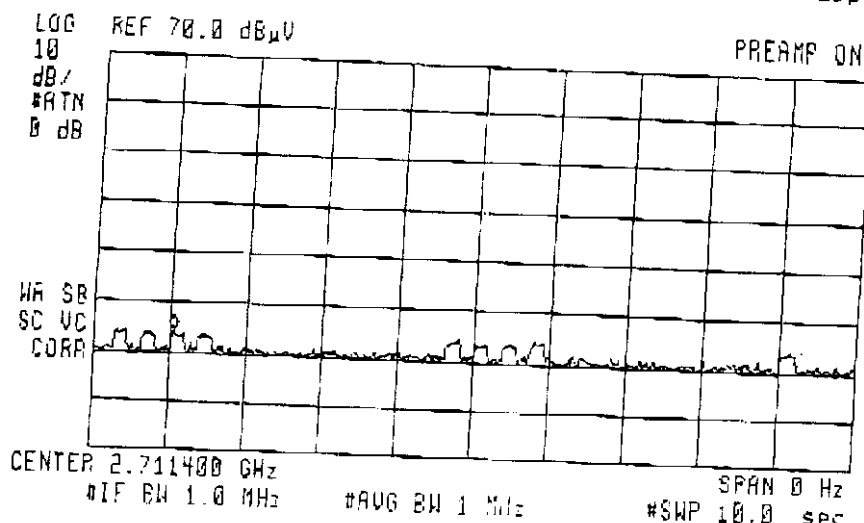
MARKER

MARKER
 AMPTD

SELECT
 1 2 3 4

MARKER 1
 ON OFF

More
 1 of 2



PEAK
 RESULT

07:53:39 AUG 04, 1998

MARKER
 1.1500 sec
 2.73 dBμV

ACTV DET: PEAK
 MEAS DET: PEAK QP AVG
 MKR 1.1500 sec
 2.73 dBμV

Last Hrd
 Key Menu

SPAN

MARKER
 NORMAL

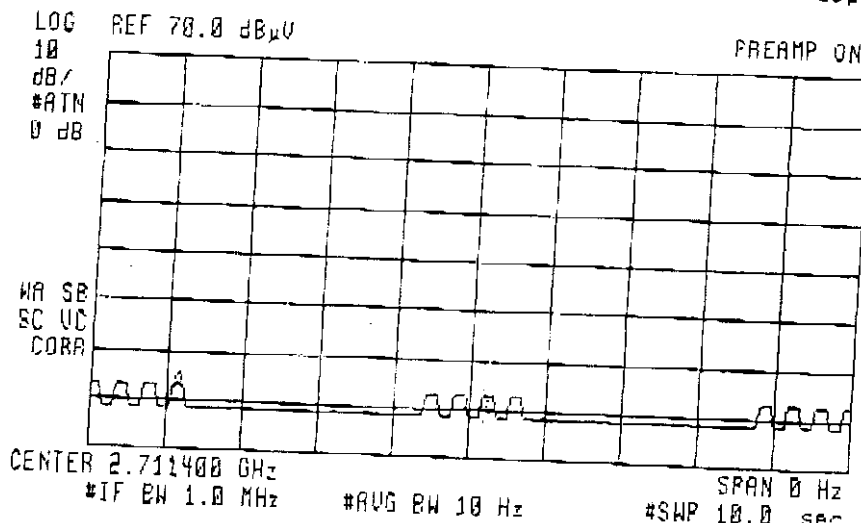
MARKER

MARKER
 AMPTD

SELECT
 1 2 3 4

MARKER 1
 ON OFF

More
 1 of 2



AVERAGE
 RESULT

TX: 903.8 MHz
HORIZ. POL.

4/9

00:06:24 AUG 04, 1998

MARKER
5.4500 sec
12.11 dBμV

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 5.4500 sec
12.11 dBμV

Last Hrd
Key Menu

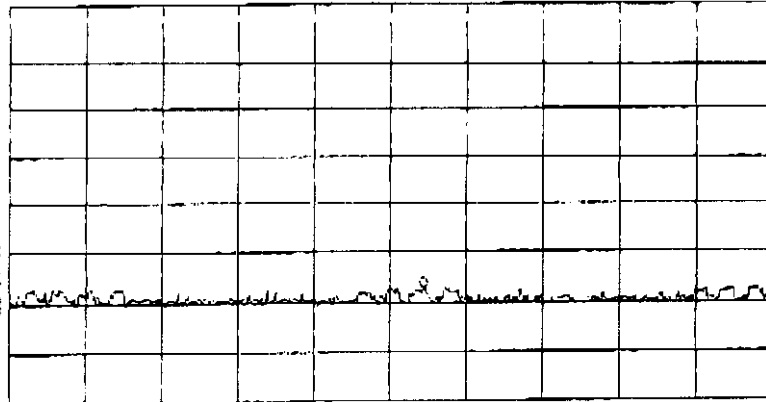
SPAN

LOG REF 70.0 dBμV

PREAMP ON

10
dB/
#ATN
0 dB

WA SB
SC FS
CORR



CENTER 2.711400 GHz

#IF BW 1.0 MHz

#AUG BW 1 MHz

SPAN 0 Hz
#SWP 10.0 sec

MARKER
NORMAL

MARKER
Δ

MARKER
AMPTD

SELECT
1 2 3 4

MARKER 1
ON OFF

More
1 of 2

PEAK
RESULT

00:07:53 AUG 04, 1998

MARKER
6.1750 sec
.63 dBμV

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 6.1750 sec
.63 dBμV

Last Hrd
Key Menu

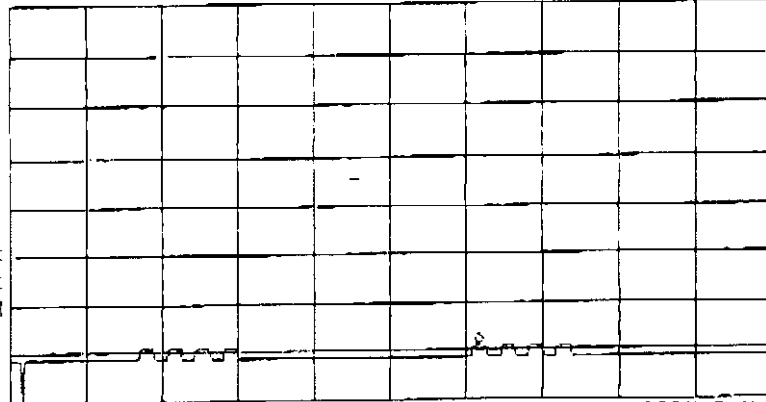
SPAN

LOG REF 70.0 dBμV

PREAMP ON

10
dB/
#ATN
0 dB

WA SB
SC FS
CORR



CENTER 2.711400 GHz

#IF BW 1.0 MHz

#AUG BW 10 Hz

SPAN 0 Hz
#SWP 10.0 sec

MARKER
NORMAL

MARKER
Δ

MARKER
AMPTD

SELECT
1 2 3 4

MARKER 1
ON OFF

More
1 of 2

AVERAGE
RESULT

TX: 915 MHz
VERTICAL POL.

7/9

08:19:44 AUG 04, 1998

MARKER
5.2250 sec
15.45 dBμV

ACTU DET: PEAK
MEAS DET: PEAK QP AVG
MKR 5.2250 sec
15.45 dBμV

Last Hrd
Key Menu

SPAN

LOG REF 70.0 dBμV

PREAMP ON

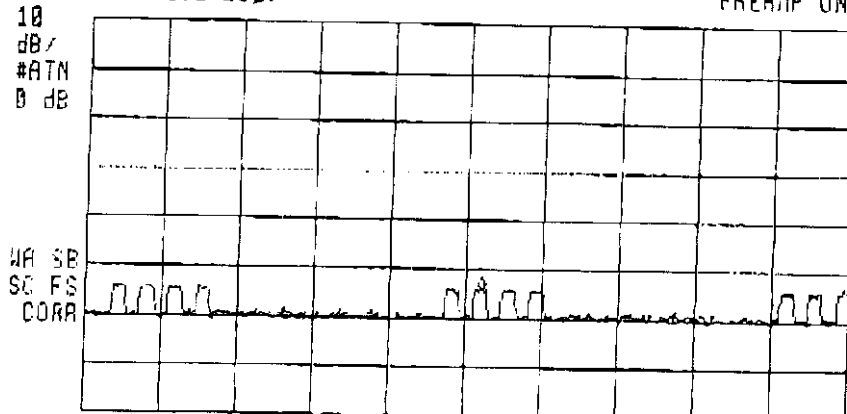
MARKER
NORMAL

MARKER

MARKER
AMPTD

SELECT
1 2 3 4

MARKER 1
ON OFF



CENTER 2.745000 GHz

SPAN 0 Hz

#IF BW 1.0 MHz

#AVG BW 1 MHz

#SWP 10.0 sec

More
1 of 2

PEAK
RESULT

08:21:28 AUG 04, 1998

MARKER
5.2250 sec
5.40 dBμV

ACTU DET: PEAK
MEAS DET: PEAK QP AVG
MKR 5.2250 sec
5.40 dBμV

Last Hrd
Key Menu

SPAN

LOG REF 70.0 dBμV

PREAMP ON

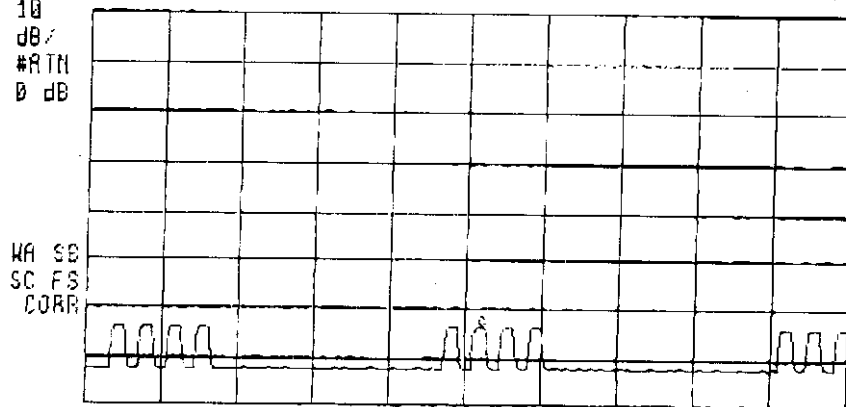
MARKER
NORMAL

MARKER

MARKER
AMPTD

SELECT
1 2 3 4

MARKER 1
ON OFF



CENTER 2.745000 GHz

SPAN 0 Hz

#IF BW 1.0 MHz

#AVG BW 10 Hz

#SWP 10.0 sec

More
1 of 2

AVERAGE
RESULT

TX: 915 MHz

6/9

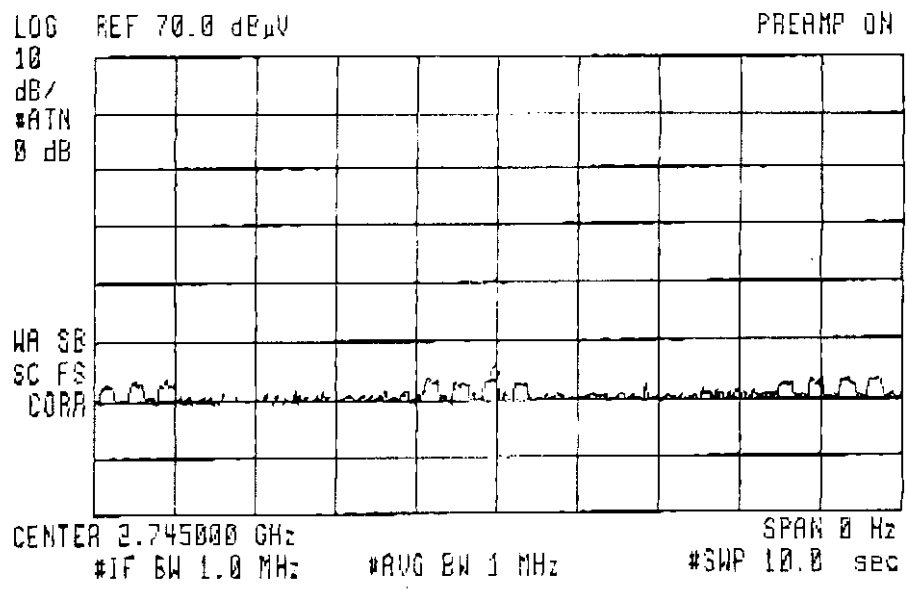
1X. 375 MHz
 Horiz. pos

08:26:42 AUG 04, 1998

MARKER
 4.9750 sec
 12.84 dBμV

ACTV DET: PEAK
 MEAS DET: PEAK QF AVG
 MKR 4.9750 sec
 12.84 dBμV

Last Hrd
 Key Menu
 SPAN



MARKER NORMAL
 MARKER
 MARKER AMPTD
 SELECT 1 2 3 4
 MARKER 1 ON OFF
 More 1 of 2

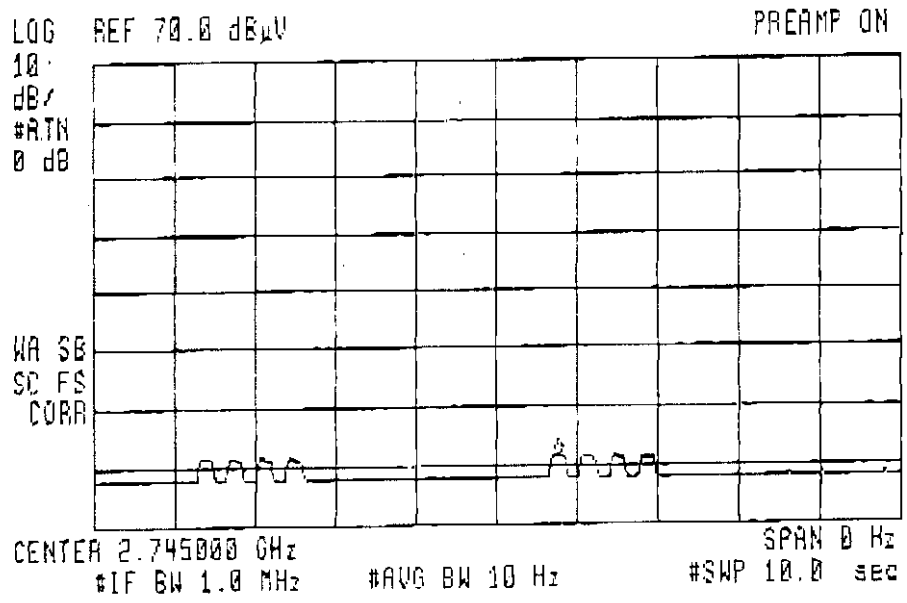
PEAK
 RESULT

08:28:09 AUG 04, 1998

MARKER
 5.7750 sec
 1.51 dBμV

ACTV DET: PEAK
 MEAS DET: PEAK QF AVG
 MKR 5.7750 sec
 1.51 dBμV

Last Hrd
 Key Menu
 SPAN



MARKER NORMAL
 MARKER
 MARKER AMPTD
 SELECT 1 2 3 4
 MARKER 1 ON OFF
 More 1 of 2

AVERAGE
 RESULT

TX: 926.2 MHz
VERTICAL pol.

9/9

00:47:23 AUG 04, 1998

MARKER
3.4750 sec
20.59 dBμV

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 3.4750 sec
20.59 dBμV

Last Hrd
Key Menu

SPAN

LOG REF 02.0 dBμV

10
dB/
#ATN
0 dB

WA SB
SC FS
CORR

CENTER 2.778600 GHz
#IF BW 1.0 MHz

#AVG BW 1 MHz

SPAN 0 Hz
#SWP 10.0 sec

MARKER
NORMAL

MARKER

MARKER
AMPTD

SELECT
1 2 3 4

MARKER 1
ON OFF

More
1 of 2

PEAK
RESULT

00:49:09 AUG 04, 1998

MARKER
4.0000 sec
8.64 dBμV

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 4.0000 sec
8.64 dBμV

Last Hrd
Key Menu

SPAN

LOG REF 02.0 dBμV

10
dB/
#ATN
0 dB

WA SB
SC FS
CORR

CENTER 2.778600 GHz
#IF BW 1.0 MHz

#AVG BW 10 Hz

SPAN 0 Hz
#SWP 10.0 sec

MARKER
NORMAL

MARKER

MARKER
AMPTD

SELECT
1 2 3 4

MARKER 1
ON OFF

More
1 of 2

AVERAGE
RESULT

Tx: 926.2 MHz
 Horiz. pol.

8/9

08:36:54 AUG 04, 1998

MARKER
 4.8750 sec
 14.85 dBμV

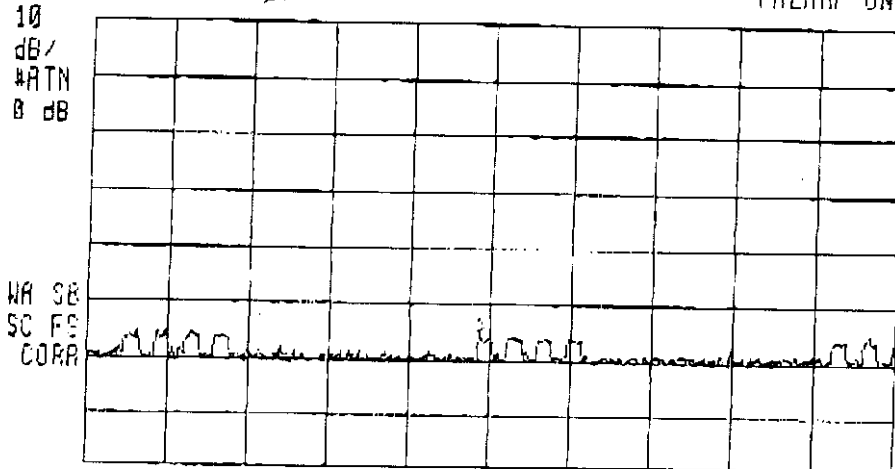
ACTV DET: PEAK
 MEAS DET: PEAK QP AVG
 MKR 4.8750 sec
 14.85 dBμV

Last Hrd
 Key Menu
 SPAN

LOG REF 70.0 dBμV

PREAMP ON

MARKER
 NORMAL



MARKER

MARKER
 AMPTD

SELECT
 1 2 3 4

MARKER 1
 ON OFF

More
 1 of 2

PEAK
 RESULT

08:38:16 AUG 04, 1998

MARKER
 4.7750 sec
 3.13 dBμV

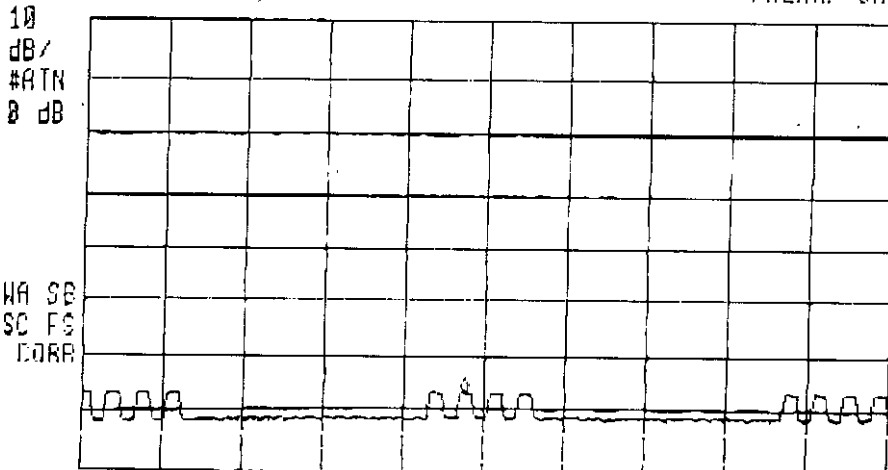
ACTV DET: PEAK
 MEAS DET: PEAK QP AVG
 MKR 4.7750 sec
 3.13 dBμV

Last Hrd
 Key Menu
 SPAN

LOG REF 70.0 dBμV

PREAMP ON

MARKER
 NORMAL



MARKER

MARKER
 AMPTD

SELECT
 1 2 3 4

MARKER 1
 ON OFF

More
 1 of 2

AVERAGE
 RESULT

Attachment B
Peak Radiated Emission, Third Harmonics

- (1) The peak values are calculated from the average levels as follows:
 (a) The transmitter signal in time domain is as shown in Figure 1.
 (b) Based on the equal areas concept, we use the equation $4(E_{p}t_p) = E_{AV} \cdot T$

E_{AV} - Field Peak level (mv/m)

t_p - Pulse Duration (0.16 sec)

T - Duration of Transmission cycle (4.74sec)

E_{av} - Measured Average level (mv/m)

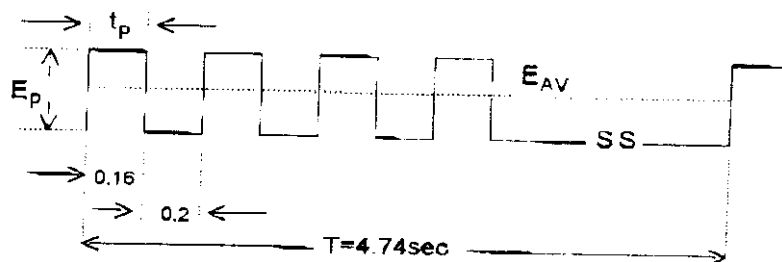


Figure 1 - Transmitter Signal During Testing

For Operational Frequency of 903.8MHz:

Horizontal Polarization:

$$E_{AV} = 51 \text{ dB}\mu\text{v/m} = 0.35 \text{ mv/m}$$

$$E_p = \frac{0.35 \times 4.74}{0.64} = 2.59 \text{ mv/m}$$

$$E_p (\text{dB}\mu\text{v/m}) = 20 \log 2.75 \times 10^3 = 68.3 \text{ dB}\mu\text{v/m}$$

Vertical Polarization:

$$E_{AV} = 53 \text{ dB}\mu\text{v/m} = 0.44 \text{ mv/m}$$

$$E_p = \frac{0.44 \times 4.74}{0.64} = 3.26 \text{ mv/m}$$

$$E_p (\text{dB}\mu\text{v/m}) = 20 \log 3.26 \times 10^3 = 70.3 \text{ dB}\mu\text{v/m}$$

For Operational Frequency of 915MHz:

Horizontal Polarization:

$$E_{AV} = 51.3 \text{ dB}\mu\text{v/m} = 0.45 \text{ mv/m}$$

$$E_p = \frac{0.45 \times 4.74}{0.64} = 3.3 \text{ mv/m}$$

$$E_p (\text{dB}\mu\text{v/m}) = 20 \log 3.3 \times 10^3 = 70.3 \text{ dB}\mu\text{v/m}$$

Vertical Polarization:

$$E_{AV} = 52.1 \text{ dB}\mu\text{v/m} = 0.4 \text{ mv/m}$$

$$E_p = \frac{0.4 \times 4.74}{0.64} = 3 \text{ mv/m}$$

$$E_p (\text{dB}\mu\text{v/m}) = 20 \log 3 = 69.5 \text{ dB}\mu\text{v/m}$$

Attachment B (continued)

For Operational Frequency of 926.2MHz:

Horizontal Polarization:

$$E_{AV} = 51.8 \text{ dB}\mu\text{v/m} = 0.39 \text{ mv/m}$$

$$E_p = \frac{0.39 \times 4.74}{0.64} = 2.9 \text{ mv/m}$$

$$E_p (\text{dB}\mu\text{v/m}) = 20 \log 2.9 \times 10^3 = 69.2 \text{ dB}\mu\text{v/m}$$

Vertical Polarization:

$$E_{AV} = 51.8 \text{ dB } \mu\text{v/m} = 0.39 \text{ mv/m}$$

$$E_p = \frac{0.39 \times 4.74}{0.64} = 2.9 \text{ mv/m}$$

$$E_p (\text{dB}\mu\text{v/m}) = 20 \log 2.9 \times 10^3 = 69.2 \text{ dB}\mu\text{v/m}$$

Attachment DR.F. Safety

Please be advised that the E.U.T. is not a portable or mobile device. It is installed in fixed locations for application of transmitting data of water consumption to central data collection offices. The distance between the E.U.T. and the general population is at least several meters.

Calculation of Maximum Permissible Exposure (MPE)

(a) FCC limits at 915MHz

$$S = \frac{f}{300} = \frac{915}{1500} = 3.05 \frac{mw}{cm^2}$$

Using Table B, page 29 of Supplement c, (Edition 97-01) to OET Bulletin 65 (Edition 97-01) limit for general population/uncontrolled exposure.

The above value is an average over 30 minutes.

(b) The power density produced by the E.U.T. is

$$S = \frac{P_t G_t}{4\pi R^2}$$

P_t - Transmitted Power 1000mw (Peak)

G_t - Antenna Gain, 1(0dB)

R - Distance from Transmitter using 100cm worst case

(c) The peak power density is:

$$S_p = \frac{10^3 \times 1}{4\pi(100)^2} = 7.96 \frac{mw}{cm^2}$$

(d) The duty cycle of transmission in actual use is 4 x 160 msec pulses per 24 hours.

The average power over 30 minutes is:

$$P_{AV} = \frac{1000.64}{30 \times 60} = 0.35mw$$

(e) The averaged power density (over 30 minutes) of the E.U.T. is:

$$S_{AV} = \frac{0.35 \times 1}{4\pi(100)^2} = 2.8 \times 10^{-6} \frac{mw}{cm^2}$$

(f) This is significantly below the FCC limit.