Application for Certification
For a
Locator and Monitoring Service (LMS)
Roadside Transmitter/Receiver

Raytheon Company
1801 Hughes Drive
P.O. Box 3310
Fullerton, CA 92834 USA

DSRC Reader

Part # 60020-2

FCC ID: PJL60020-2

REPORT # RA054925/10112

This report was prepared in accordance with the requirements of the FCC Rules and Regulations Part 2, Subpart J, 2.1031 through 2.1057, Part 90 and other applicable sections of the rules as indicated herein.

Prepared By:

Fred Gurule

DNB Engineering, Inc.
3535 W. Commonwealth Ave.
Fullerton, CA 92833

16 APRIL 2001

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1.0 ADMINISTRATIVE DATA

1.1 Certifications and Qualifications

I certify that DNB Engineering, Inc conducted the tests performed in order to obtain the technical data presented in this application. Also, based on the results of the enclosed data, I have concluded that the equipment tested meets or exceeds the requirements of the Rules and Regulations governing this application.

DNB Engineering was established in 1979 to provide Electromagnetic Compatibility (EMC) Testing, Consulting and Engineering. We have grown to become the most capable EMC Test Lab in the nation, with three outstanding test facilities. All facilities are equipped with modern automated test equipment and staffed with experienced EMC Test Engineers. Engineering support is a standard feature of each site. We are ready to support and assist you in meeting your compliance requirements.

Our qualifications include:

Quality Assurance MIL-I-45208A	Calibration per MIL-STD-45662A and
A2 LA Accredited	ANSI Z540-1
FCC Listed	DSCC Approved
Quality Assurance EN45000	NARTE Certified (Engineers & Technicians)

European Competent Body Approved and a Competent Authorized Body (CAB)

1.2 Measurement Repeatability Information

The test data presented in this report has been acquired using the guidelines set forth in FCC Part 2.1031 through 2.1057, Part 90. The test results presented in this document are valid only for the equipment identified herein under the test conditions described. Repeatability of these test results will only be achieved with identical measurement conditions. These conditions include: The same test distance, EUT Height, Measurement Site Characteristics, and the same EUT System Components. The system must have the same Interconnecting Cables arranged in identical placement to that in the test set-up, with the system and/or EUT functioning in the identical mode of operation (i.e. software and so on) as on the date of the test. Any deviation from the test conditions and the environment on the date of the test may result in measurement repeatability difficulties. All changes made to the EUT during the course of testing as identified in this test report must be incorporated into the EUT or identical models to ensure compliance with the FCC regulations.

Bryan Broaddus (Para. 1.1)
Manager, Test Dept.
DNB Engineering, Inc.
Tel. (714) 870-7781 FAX (714) 870-5081

2.1033 (C) (1) Application for Certification

Name of Applicant:		Raytheon Company 1801 Hughes Drive P.O. Box 3310 Fullerton, CA 92834 USA
Applicant is:	X	Manufacturer Vendor Licensee Prospective Licensee Other
Description:		DSRC Reader
Part Number:		60020-2
Anticipated Production Quantity:		Multiple Units

2.1033 (C) (2) FCC Identifier

FCC ID: PJL60020-2

2.1033 (C) (3) Installation and Operating Instructions

Please refer to Appendix A

2.1033 (C) (4) Type of Emissions

3M6A1D

2.1033 (C) (5) Frequency Range

918 MHz

2.1033 (C) (6) Operating Power

1 Watt nominal

2.1033 (C) (7) Maximum Power Allowed in Applicable Part(s) of the Rules

RULES PART	MAXIMUM POWER (WATTS)
Part 90.205	30 Watts (ERP)

2.1033 (C) (8) Final RF Amplifier Input Power Characteristics

Input Voltage:	9-18 Vdc
Input Current:	5.0 Adc maximum
Power Output	1 Watt nominal

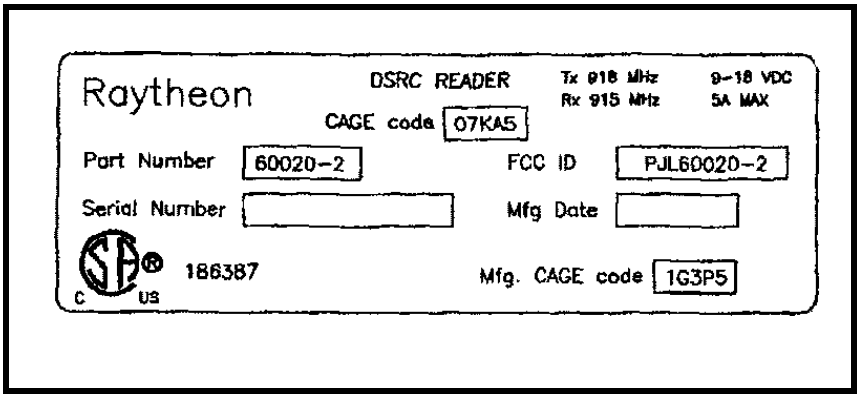
2.1033 (C) (9) Tune Up Procedure

Please refer to Appendix A.

2.1033 (C) (10) Schematic Diagram and Circuit Description

Please refer to Appendix B

2.1033 (C) (11) Equipment Identification Plate



NOTES:
Label will be constructed of 0.02 inch aluminum as shown on the equipment with permanent adhesive.

All information on the label will be etched or stamped. Both methods will exceed the expected lifetime of the equipment.

The label will be large enough to allow all information to be legible.

2.1033 (C) (11) Equipment Photographs

Note: The Main Circuit Board shown in these photos has no components on the reverse side.

Photo 1 Main Circuit Board (Overall View)

Photo 2 Circuit Board (Detail)

Photo 3 Circuit Board (Detail)

Photo 4 External Front and Back View

Photo 1 Main Circuit Board (Overall View)

Photo 2 Circuit Board (Detail)

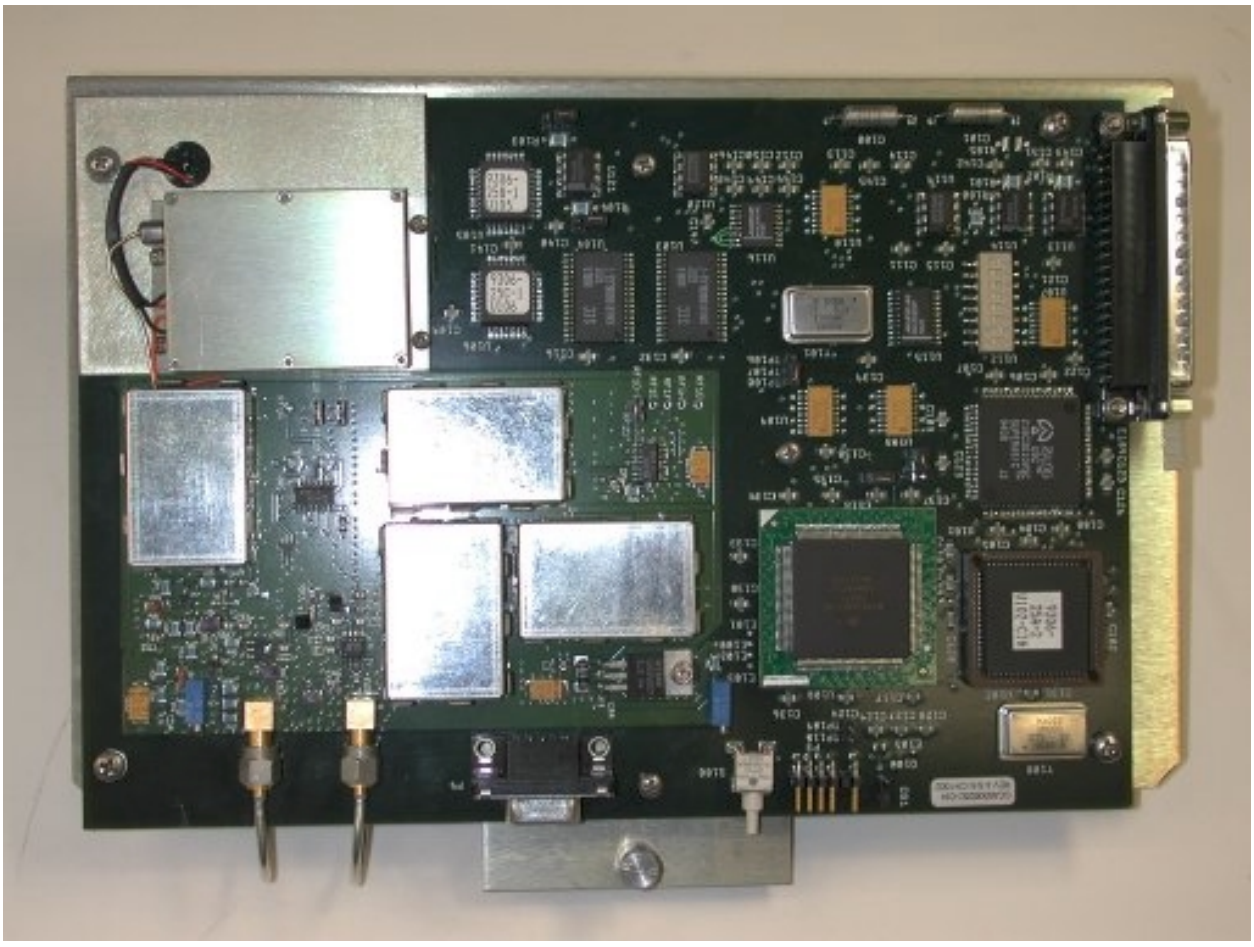


Photo 3 Circuit Board (Detail)

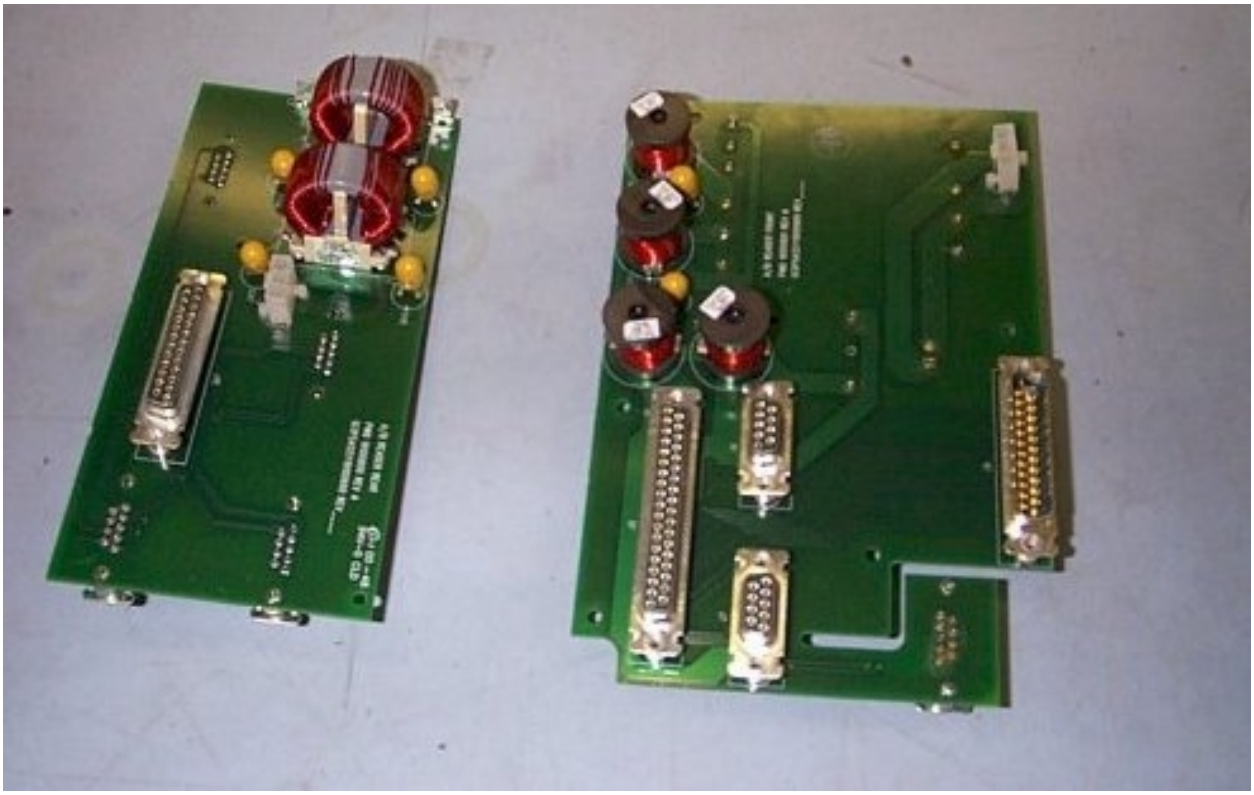


Photo 4 External Front and Back View

2.1033 (C) (13) Digital Modulation Techniques

Manchester, ASK

2.1033 (c) (14) Test Data

Refer to 2.1046 through 2.1057

2.1046 Measurement of RF Power Output

Power was verified to not exceed 30 dBm (1 Watt).

2.1049 Measurement of Occupied Bandwidth

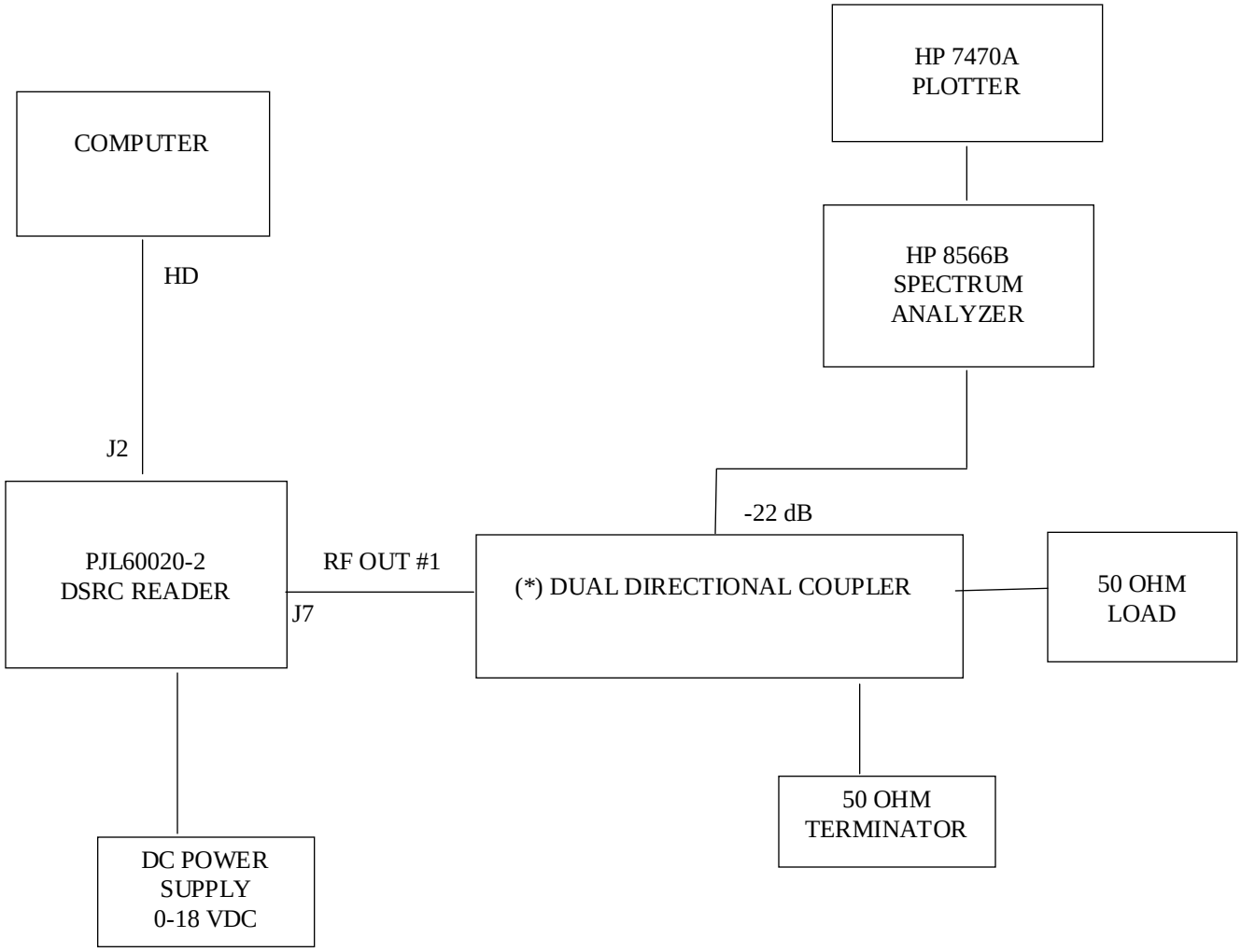
Definition:
Occupied Bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are equal to 0.5 percent of the total mean power radiated by a given emission.

Test Method: Connect the Equipment per FIGURE 1.
Measurements were made with the internal modulator running in the worst case mode.

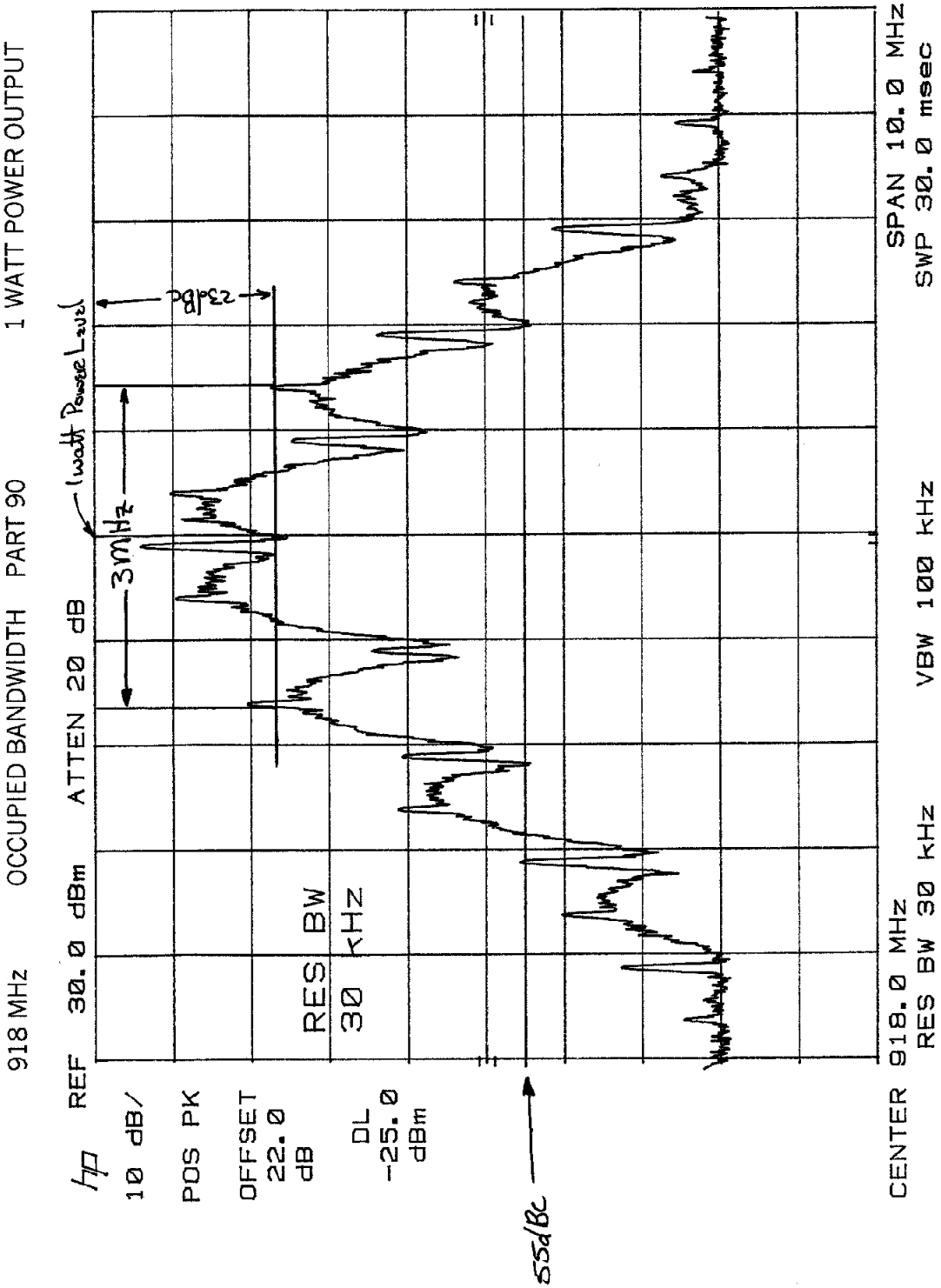
Test Results: See Plots following FIGURE 1.

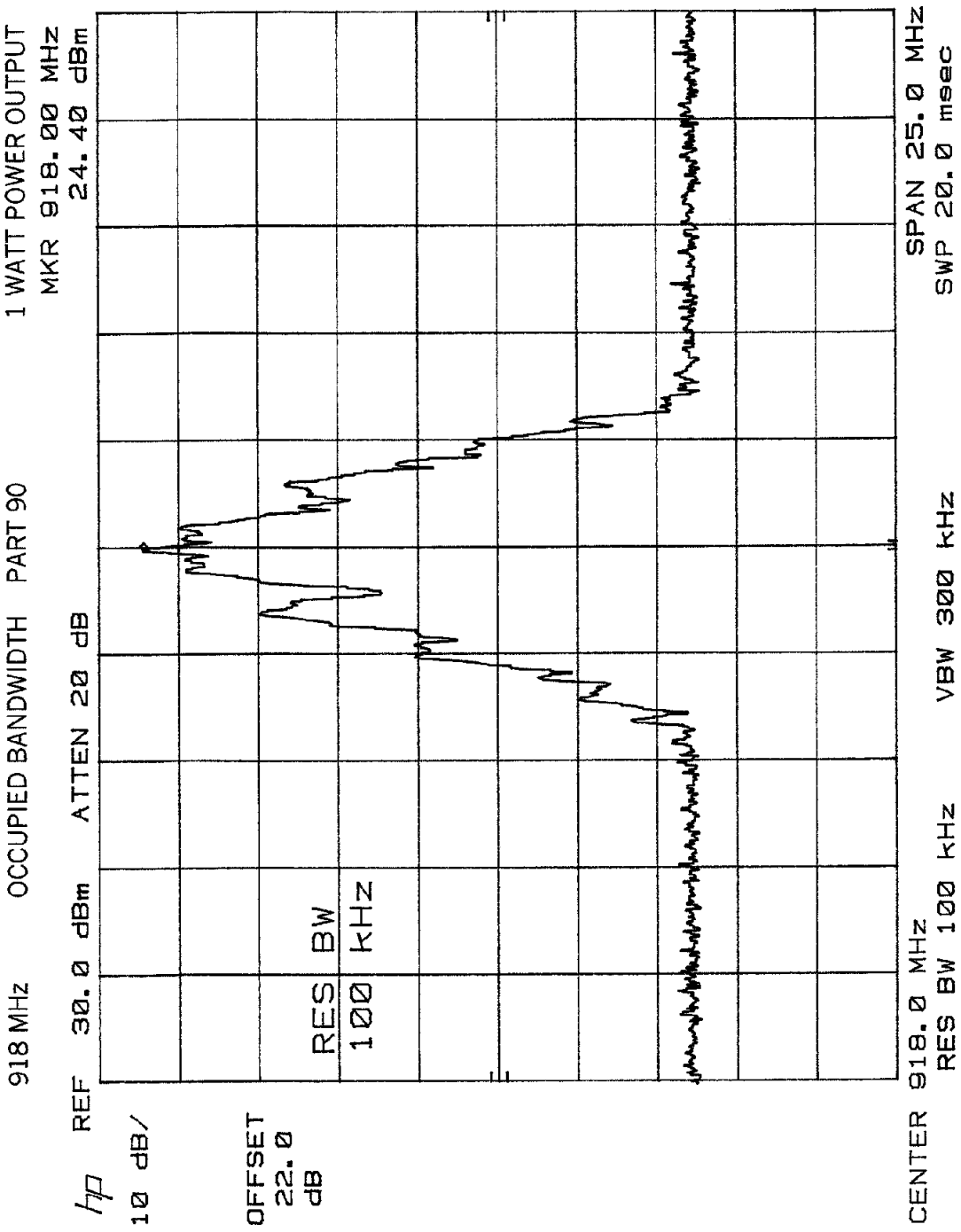
The center frequency of the signal did not shift with modulation. The spectrum bandwidth was well within the limits specified in the FCC regulations.

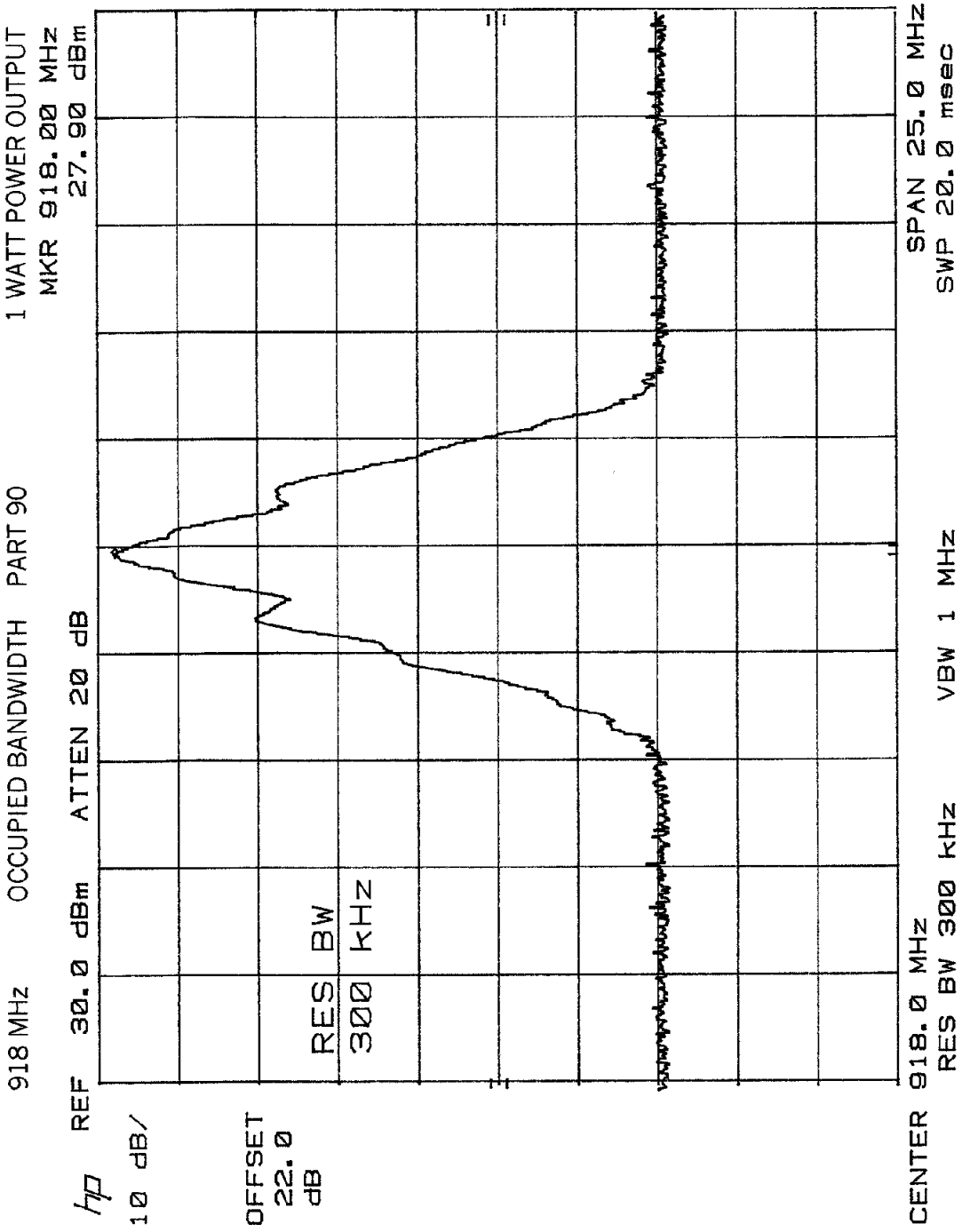
FIGURE 1: Block Diagram
(Occupied Bandwidth tests)

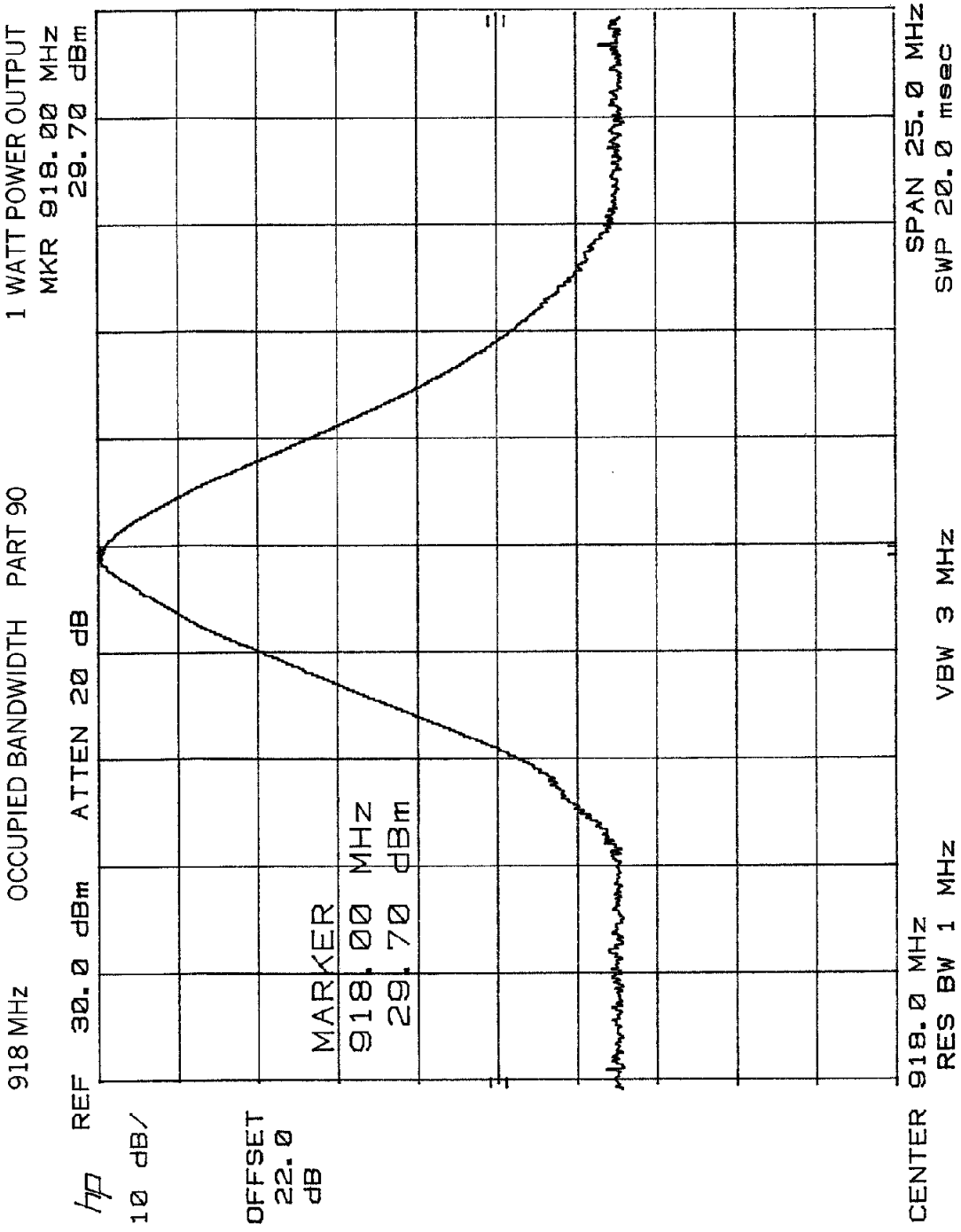


Note: RF Ports #2, #3, #4 were not connected
* HP 778 D (0.1 – 2.0 GHz)
* HP 11691D (2.0 –18 GHz)


1 WATT POWER OUTPUT
OCCUPIED BANDWIDTH PART 90
918 MHz
REF 30.0 dBm
ATTEN 20 dB
10 dB/
POS PK
OFFSET 22.0 dB
RES BW 30 kHz
DL -25.0 dBm
1watt Power Level
3MHz
23dBc
55dBc
CENTER 918.0 MHz
RES BW 30 kHz
VBW 100 kHz
SPAN 10.0 MHz
SWP 30.0 msec


1 WATT POWER OUTPUT
MKR 918.00 MHz
24.40 dBm
918 MHz
OCCUPIED BANDWIDTH PART 90
REF 30.0 dBm
ATTEN 20 dB
10 dB/
OFFSET
22.0
dB
RES BW
100 kHz
CENTER 918.0 MHz
RES BW 100 kHz
VBW 300 kHz
SPAN 25.0 MHz
SWP 20.0 msec


1 WATT POWER OUTPUT
MKR 918.00 MHz
27.90 dBm
OCCUPIED BANDWIDTH PART 90
918 MHz
REF 30.0 dBm
ATTEN 20 dB
10 dB/
OFFSET
22.0
dB
RES BW
300 kHz
CENTER 918.0 MHz
RES BW 300 kHz
VBW 1 MHz
SPAN 25.0 MHz
SWP 20.0 msec


1 WATT POWER OUTPUT
MKR 918.00 MHz
29.70 dBm
918 MHz
OCCUPIED BANDWIDTH PART 90
REF 30.0 dBm
ATTEN 20 dB
10 dB/
OFFSET
22.0
dB
MARKER
918.00 MHz
29.70 dBm
CENTER 918.0 MHz
RES BW 1 MHz
VBW 3 MHz
SPAN 25.0 MHz
SWP 20.0 msec

2.1051 Spurious Emissions at Antenna Terminals

Definition:
Conducted Spurious Emissions are emissions at the antenna terminals on a frequency or frequencies which are outside an occupied band sufficient to ensure transmission of information of required quality for the class of communication desired. The reduction in the level of these spurious emissions will not affect the quality of the information being transmitted.

Conducted Spurious Emissions shall be attenuated below the maximum level of the carrier frequency in accordance with the following formula:

Spurious attenuation in dB = $55 + 10 \log_{10} Po$

Where Po = Output in Watts

$= 55 + 10 \log_{10} (1)$

= 55 dB

Test Method: Per EIA RS 152-B, Paragraph 4.

Connect the equipment as shown in FIGURE 2.

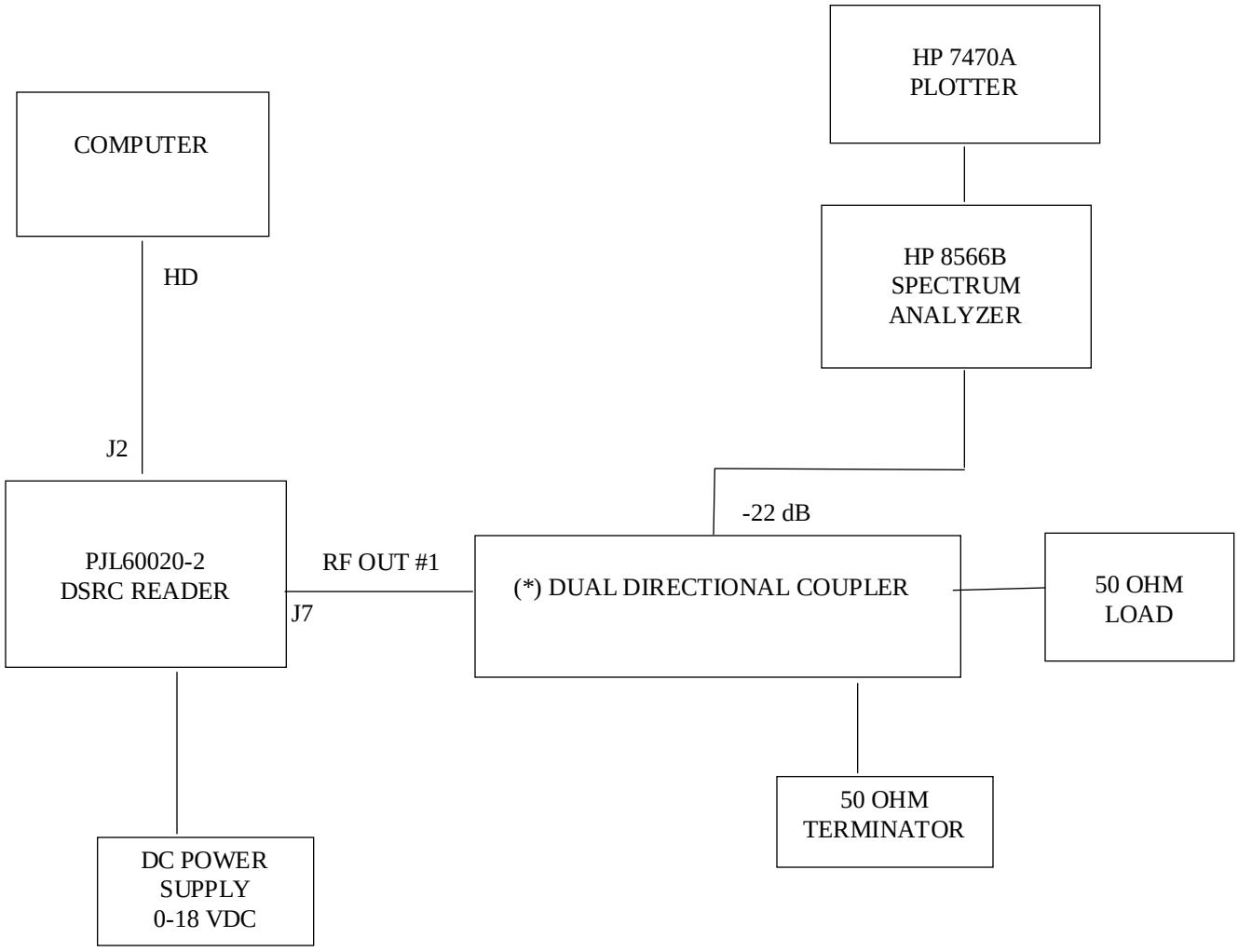
Manchester ASK modulation is produced internal to the device under test.

Scan the frequency spectrum from the lowest radio frequency generated in the equipment through the 10^{th} harmonic of the carrier frequency.

Test Results: See Plots following FIGURE 2.

All spurious emissions at the antenna terminals are below the FCC specifications

FIGURE 2: Block Diagram
(Spurious Emissions tests)



Note: RF Ports #2, #3, #4 were not connected
* HP 778 D (0.1 – 2.0 GHz)
* HP 11691D (2.0 –18 GHz)

TEST EQUIPMENT LOG

Customer: Raytheon Company
EUT: DSCR Reader
Model / Part #: 60020-2
Serial #:

Test Procedure: FCC Part 90
Test Specification: Conducted Emissions
Test Engineer: Fred Gurule
Customer Rep: Ted Gormley

DESCRIPTION	MANUFACTURER	MODEL # / SERIAL #	CAL. DUE
Spectrum Analyzer	HP	8566B / 2407A13212	03/08/01
Directional Coupler	HP	778D	Cal Prior to use
Directional Coupler	HP	11691D	Cal Prior to use
50 ohm load	Electro Impulse Labs	DA-242A/U - 79400097	Reference
Power Supply	Sorensen	DCR40-250	N/A
Plotter	HP	7470A	N/A
50 ohm terminator	Narda	370	Reference

* = Customer Supplied Parts

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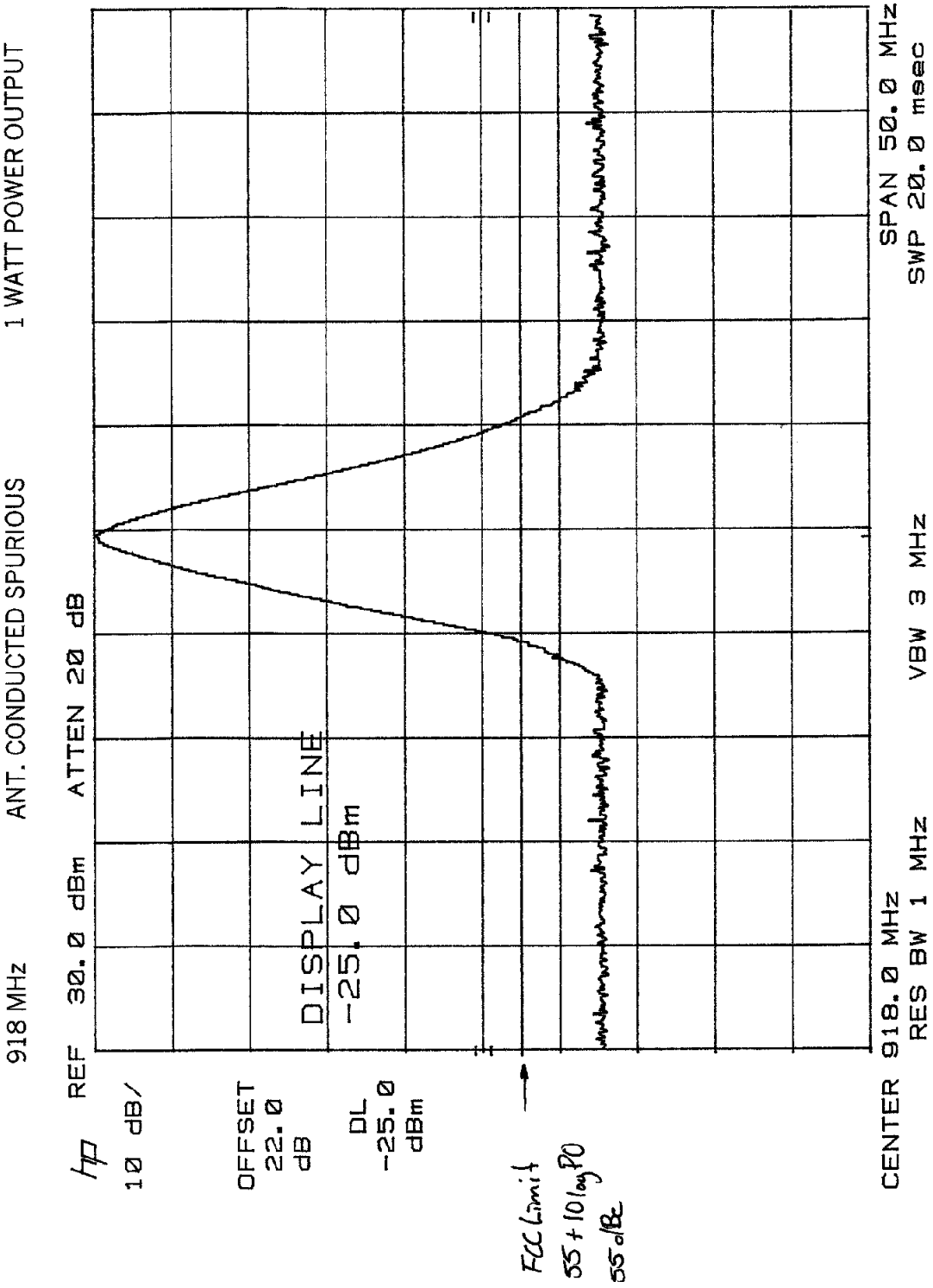
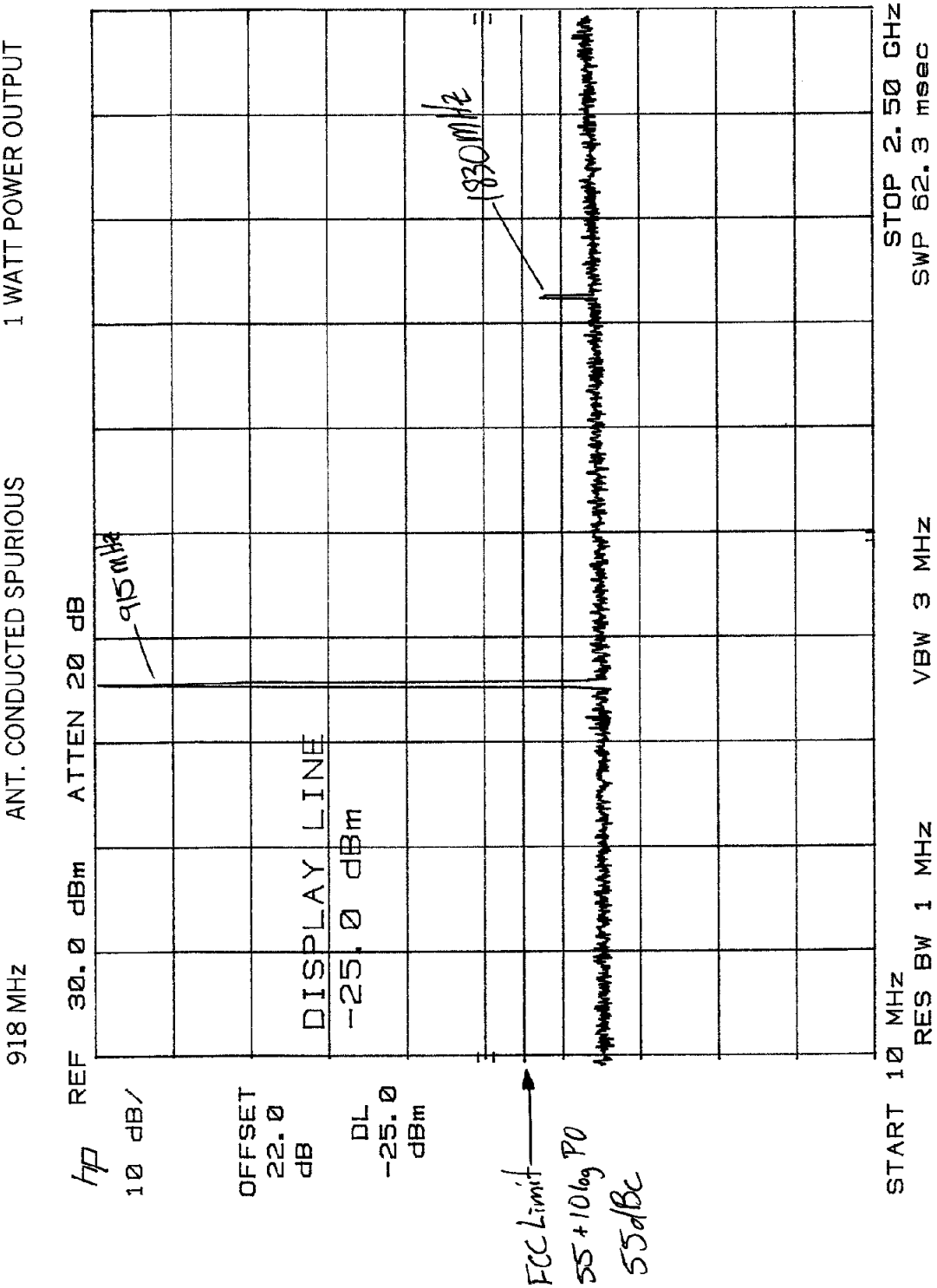
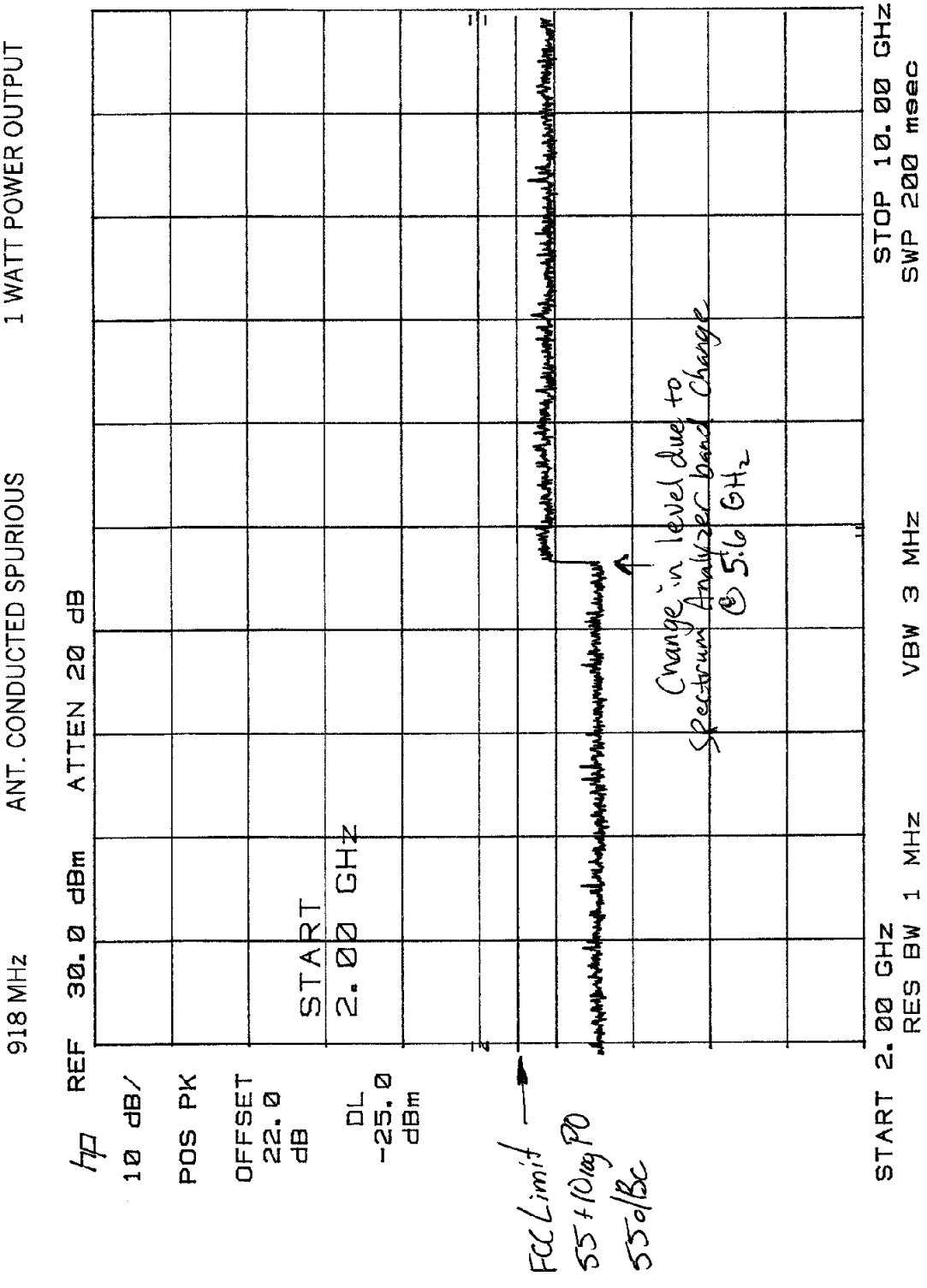

918 MHz
ANT. CONDUCTED SPURIOUS
1 WATT POWER OUTPUT
REF 30.0 dBm
ATTEN 20 dB
10 dB/
OFFSET 22.0 dB
DL -25.0 dBm
DISPLAY LINE -25.0 dBm
FCC Limit 55 + 10 log P0 55 dBc
CENTER 918.0 MHz
RES BW 1 MHz
VBW 3 MHz
SPAN 50.0 MHz
SWP 20.0 msec


918 MHz
ANT. CONDUCTED SPURIOUS
1 WATT POWER OUTPUT
REF 30.0 dBm
ATTEN 20 dB
10 dB/
OFFSET 22.0 dB
DL -25.0 dBm
DISPLAY LINE
-25.0 dBm
915MHz
1830MHz
FCC Limit
55+10log PO
55dBc
START 10 MHz
RES BW 1 MHz
VBW 3 MHz
STOP 2.50 GHz
SWP 62.3 msec


918 MHz
ANT. CONDUCTED SPURIOUS
1 WATT POWER OUTPUT
REF 30.0 dBm
ATTEN 20 dB
10 dB/
POS PK
OFFSET 22.0 dB
DL -25.0 dBm
START 2.00 GHz
FCC Limit
55+10log P0
55o/Bc
Change in level due to Spectrum Analyzer band Change @ 5.6 GHz
START 2.00 GHz
RES BW 1 MHz
VBW 3 MHz
STOP 10.00 GHz
SWP 200 msec

2.1053 Field Strength of Spurious Radiation

Definition:
Emissions from the equipment when connected into a non-radiating load on a frequency or frequencies which are outside an occupied band sufficient to ensure transmission of information of required quality for the class of communication desired. The reduction in the level of these spurious emissions will not affect the quality of the information being transmitted.

Test Method: Per EIA RS 152-B.

Connect the equipment and follow the procedure described in paragraph 2.2.1.1 and paragraph 5.0. Measure the amplitude of each spurious radiated signal through the 10^{th} harmonic. The level in dBuV/m is calculated on the following page. The spurious signals are then measured on the 3 meter range.

$$\text{Spurious attenuation dB} = 10 \log \frac{\text{Po Watts}}{\text{Calc. Spurious power}}$$

Bandwidth and Detector Function: All radiated spurious signals were measured with a Peak detector and a 1 MHz resolution bandwidth.

Test Results: See TABLE on following Page.

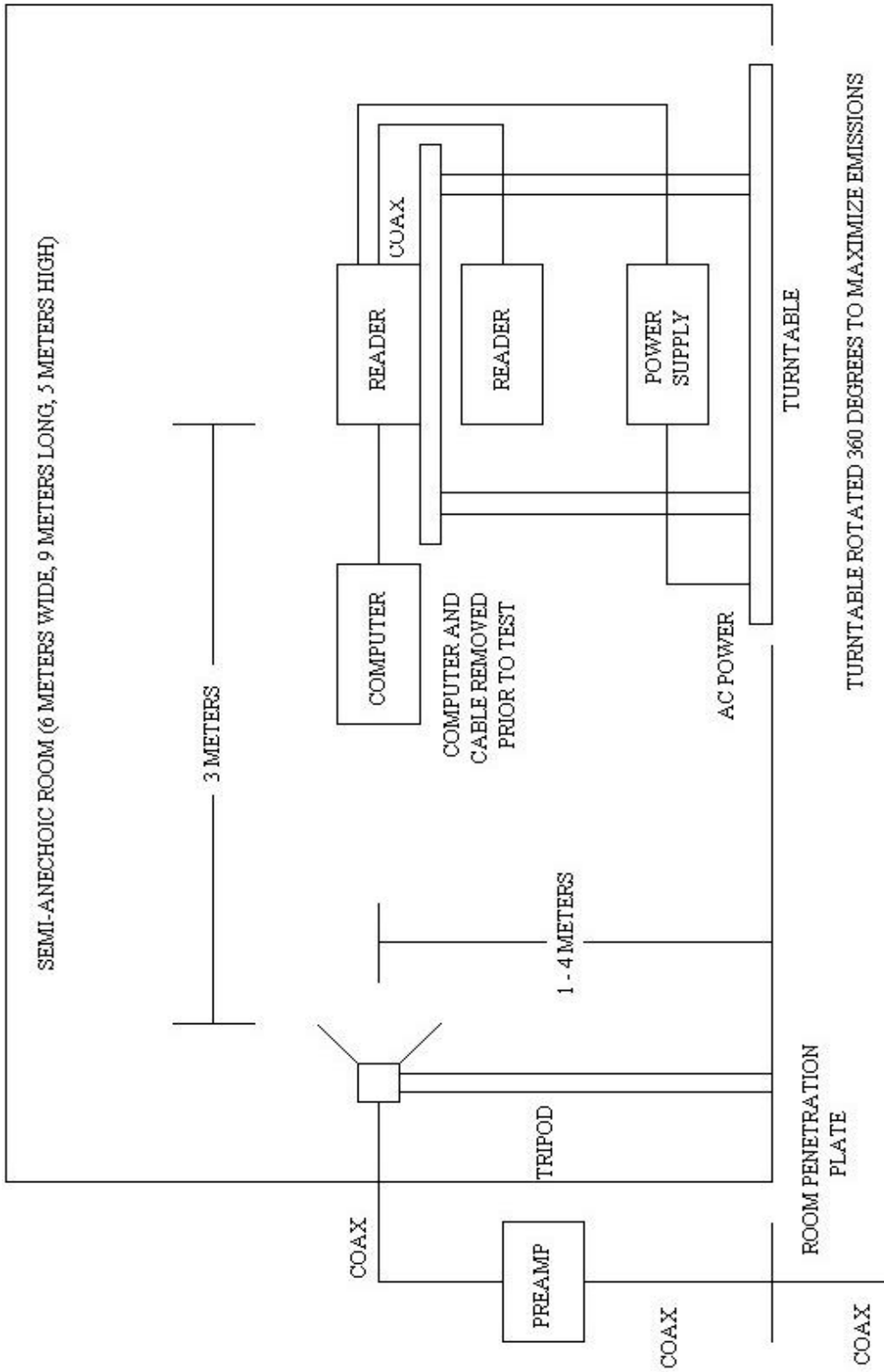
All radiated spurious emissions are below the FCC Specifications.

RF Exposure

The information contained in "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields", OET Bulletin 65; August 1997 is applicable when a radiating antenna is connected to this DSCR Reader.

This product is certified to meet the RF exposure guidelines of OET-65 as a stand-alone RF power device. The RF spurious emissions recorded when the antenna output connector is terminated into a non-radiating 50 ohm load does not exceed the 27.5 V/m limit specified for General Population/Uncontrolled Exposure in OET Bulletin 65.

FIGURE 3: BLOCK DIAGRAM
(Spurious Radiation Tests)



RADIATED SPURIOUS TEST SETUP

TEST EQUIPMENT LOG

Customer: Raytheon Company
EUT: DSCR Reader
Model / Part #: 60020-2
Serial #:

Test Procedure: FCC Part 90
Test Specification: Radiated Spurious
Test Engineer: Fred Gurule
Customer Rep: Ted Gormley

DESCRIPTION	MANUFACTURER	MODEL # / SERIAL #	CAL. DUE DATE
Spec. Analyzer	H.P.	2637A03865	05/25/2001
Hi-Freq. Coaxial	Malik Cable Devices	CA-NPS096NPS	Cal prior to use
DRG Ant.	Electro-Metrics	RGA-60 / 6103	01/12/2002
Pre-Amp	Miteq	12391	01/30/2002
Pre-Amp	Miteq	378064	01/30/2002
Pre-Amp	Miteq	02000400	01/30/2002
Pre-Amp	MCL	ZFL2000	03/17/2001
Power Supply	Sorenson	DCR40-250	N/A

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DNB Engineering, Inc.
SPURIOUS RADIATED SIGNAL MEASUREMENTS
(Ref: Part 2, Subpart J, 2.1053 and 2.1057)

Date	02-27-2001	
Customer	Raytheon	
EUT	A/B Reader	
P/N	60020	
S/N	N/A	
Pass/Fail	PASS	
Operating Mode	AM Modulation	
Test Engineer	Fred Gurule	
Fund. Freq.	918	MHz
Output Power	1	W
Output Impedance	50	ohms
Fund. Field Strength	2.4	V/m
Fund. Field Strength	127.4	dBuV/m
FCC Limit	55.0	dBc

Antenna Polarization	Freq (MHz)	Measured Signal (dBuV)	AF (dB/m)	Cable Loss (dB)	Amp Gain (dB)	Corrected Measurement (dBuV)	Fundamental Field Strength (dBuV/m)	Spurious Below Carrier (dBc)	FCC Limit (dBc)
H	1836	39.7	27.4	2.2	22.0	47.3	127.4	80.1	55.0
H	2754	56.1	28.7	2.5	31.7	55.6	127.4	71.8	55.0
H	3672	61.7	31.0	2.9	31.7	63.9	127.4	63.5	55.0
H	4590	43.7	32.9	3.6	28.1	52.1	127.4	75.3	55.0
H	5508	51.8	34.6	4.4	29.1	61.7	127.4	65.7	55.0
H	6426	52.5	35.3	4.7	29.0	63.5	127.4	63.9	55.0
H	7344	42.3	37.0	5.2	28.8	55.7	127.4	71.7	55.0
H	8262	39.1	37.0	5.4	21.8	59.7	127.4	67.7	55.0
H	9180	38.2	37.8	5.1	21.7	59.4	127.4	68.0	55.0
H/90	1836	41.5	27.4	2.2	22.0	49.1	127.4	78.3	55.0
H/90	2754	54.2	29.4	2.5	31.7	54.4	127.4	73.0	55.0
V/90	3672	50.2	31.4	2.9	31.7	52.8	127.4	74.6	55.0
V/90	4590	45.7	33.7	3.6	28.1	54.9	127.4	72.5	55.0
V/90	5508	55.3	35.0	4.4	29.1	65.6	127.4	61.8	55.0
H/90	6426	48.2	36.0	4.7	29.0	59.9	127.4	67.5	55.0
H/90	7344	42.7	36.8	5.2	28.8	55.9	127.4	71.5	55.0
H/90	8262	38.8	37.3	5.4	21.8	59.7	127.4	67.7	55.0
H/90	9180	38.0	38.0	5.1	21.7	59.4	127.4	68.0	55.0

2.1055 Measurement of Frequency Stability

Not required per 90.213 (a) \13 \ since it is a fixed non-multilateration transmitter with an authorized bandwidth that is more than 40 KHz from the band edge.

2.1057 Frequency Spectrum to be Investigated

The Frequency was searched from the lowest radio frequency generated in the equipment through the 10^{th} harmonic of the carrier frequency.