TEST REPORT

Equipment Tested:

Utility Meter Transceiver
Model 45ES-1
Serial Number 10013073

Itron Test Facility
2401 North State Street
Waseca, Minnesota 56093

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TABLE OF CONTENTS

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1. TEST SUMMARY

Test Report No.:	W980505
Company:	Itron, Inc.
Requester:	Klaus Bender
Phone:	(509) 891-3323
Test Date(s):	May 1, 2, 4, 5 & 12, 1998
Equipment Under Test:	Utility Meter Transceiver
General Test Summary:	The 45ES-1 ERT® transmitter was tested for compliance to FCC Part 15.249 requirements for an intentional radiator. The receiver was tested for compliance to FCC Part 15.109.
Original Grant or Permissive Change:	Original Grant
Certification Status:	The 45ES-1 ERT transmitter has been verified as being compliant with the FCC Part 15.249 requirements for an intentional radiator. The receiver has been verified as being compliant with the FCC Part 15.109 requirements for receivers.
Modifications Necessary for Compliance:	None. See Section 2. For EUT description.

Tested By: Robert A. Sleen

Report Written By: Robert A. Sleen

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2. PRODUCT DESCRIPTION AND TEST OBJECTIVE

The EUT is a utility meter transceiver used in conjunction with a host meter to measure electrical consumption. The EUT transmits consumption data if the receiver detects a wake-up tone See Sections 6 and 7 for test set-up description. The 45ES-1 ERT® has a 948 - 960 MHz receiver. The actual fundamental receiver frequency is set at the time of manufacture. The unit also has a frequency-hopping transmitter that operates over a maximum 4 MHz bandwidth in the 910-920 MHz band (the actual fundamental frequency is set at the time of manufacture). The objective of this test is to determine if the EUT transmitter meets the radiated emission levels established by FCC Part 15.249 for intentional radiators and to determine if the EUT receiver meets the radiated emission levels established by FCC Part 15.109 for unintentional radiators. The EUT was tested at an antenna to EUT distance of 3 meters according to ANSI C63.4-1992.

3. TEST FACILITY

The tests were performed at the test facility of Itron, Inc. located at 2401 North State Street, Waseca, Minnesota 56093. This site is fully described in a document submitted to the FCC and accepted in a letter dated June 12, 1996 (Ref.: 31040/SIT 1300F2).

4. EUT SUPPORT EQUIPMENT USED:

Test Equipment	Model	Manufacturer	Serial. No.	Radiated or Conducted EMI	Cal. Due
RF Signal Generator	8656A	Hewlett Packard	2341A05541	R & C	N/A
Function Generator	171	Wavetek	M6230187	R & C	N/A
Double Ridged Guide Antenna	3115	EMCO	9508-4550	R & C	N/A

5. EUT SYSTEM DESCRIPTION:

The EUT was physically configured similar to a typical user configuration. Where appropriate, the cable was moved to obtain maximum emissions. The EUT was placed in the center of the test table 80 cm above the ground plane. The EUT cable was bundled and positioned per ANSI C63.4-1992.
There were no associated components or accessories on the table during the radiated emissions tests.

6. OPERATING MODE OF EUT, SOFTWARE/FIRMWARE ETC. :

The EUT was operationally configured to a special test mode. This special test mode causes the ERT® to transmit consecutive messages, thus allowing peaks of transmitter radiation to be more easily found as antenna heights and turntable azimuth are varied.

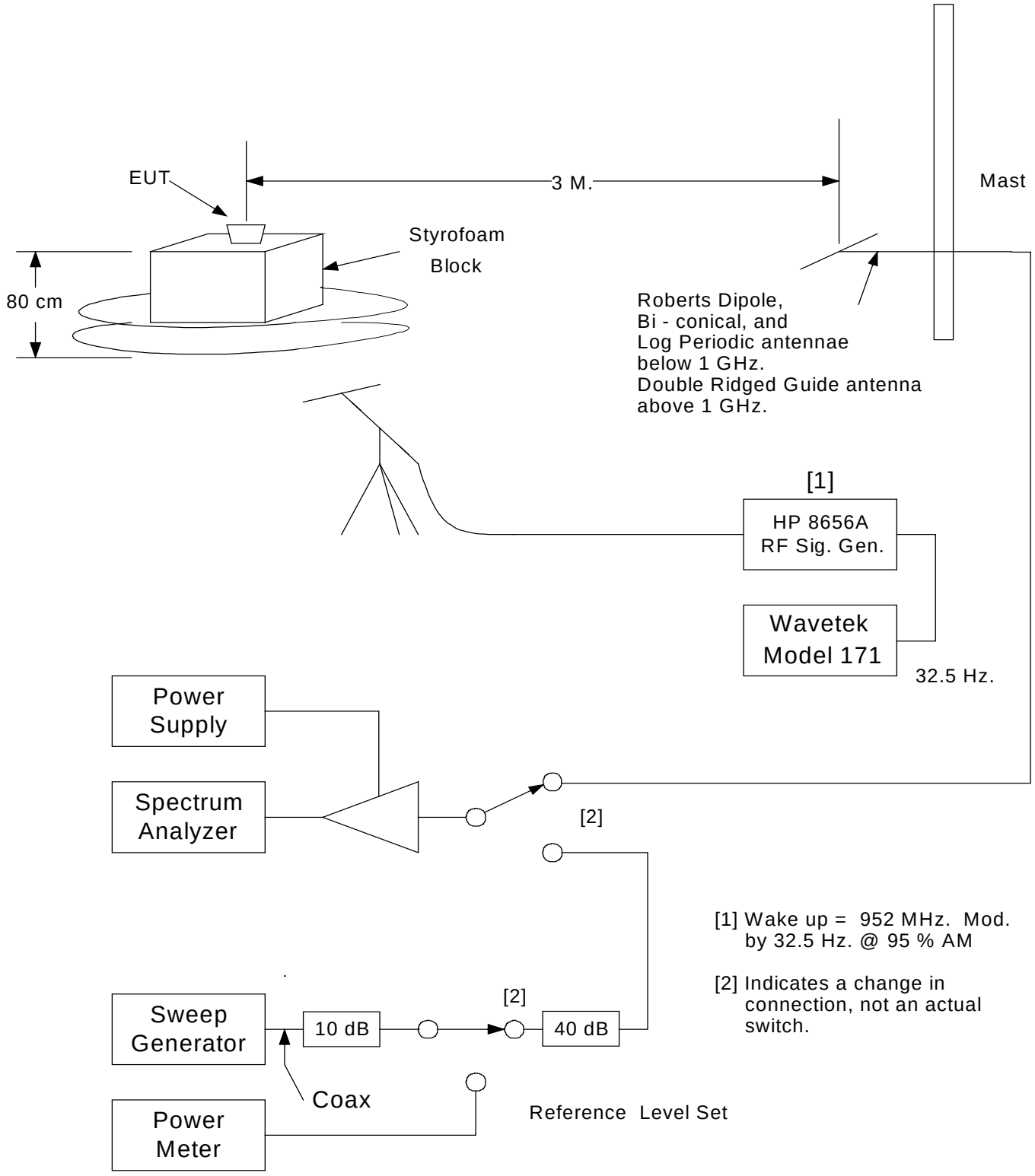
The hopping bandwidth of the transmitter is around 2.0 to 4.0 MHz including manufacturing and component variability.

See Attachment B for message detail.

The receiver was under normal operation (a 0.2 usec. wide on-time pulse occurring at a 512 HZ rate).

See the test set-up diagram in Section 7 and the photos in Attachment G.

7. TEST SET-UP DIAGRAM:



8. TEST AND MEASUREMENT EQUIPMENT DETAIL:

Test Equipment	Model	Manufacturer	Serial Number	Radiated or Conducted EMI	Cal Due
Spectrum Analyzer Display Section	141T	Hewlett-Packard	1337A-08156	R	01/99
RF Section	8555A	Hewlett-Packard	1429A04027	R	01/99
IF Section	8552A	Hewlett-Packard	1410A06719	R	01/99
Spectrum Analyzer	8593E	Hewlett-Packard	3543A02032	R	04/99
LISN	3825-2	EMCO	9605-2535	R & C	03/99
Sweep Generator	8350B	Hewlett-Packard	2722A08843	R & C	05/98
RF Plug-In	83592A	Hewlett-Packard	2252A00787	R & C	05/98
Power Meter	437B	Hewlett-Packard	3125U16900	R & C	03/99
Power Meter Sensor	8481D	Hewlett-Packard	331BA11513	R & C	03/99
Amplifier < 5 GHz	ZHL - 1042J	Mini-Circuits	H110894-008	R	N/A
Amplifier > 5 GHz	JCA010-415	JCA	103	R	N/A
Power Supply	6201B	Hewlett-Packard	1145A03611	R	12/98
Antenna - Dipole	Roberts	Compliance Design	19570	R	12/98
Antenna - Double Ridged Guide	3115	EMCO	9205-3878	R	03/99
Antenna - Log periodic	3108	EMCO	9203-2455	R	03/99
Antenna - Bi-conical	3146	EMCO	9203-3358	R	03/99

9. AMBIENT CONDITIONS DURING TEST:

Date	Temp (°F)	Humidity (% RH)
05/01/98	64	62
05/01/98	79	31
05/01/98	78	29
05/01/98	77	29
05/02/98	57	49
05/02/98	59	46
05/04/98	78	33
05/05/98	57	56
05/05/98	61	60
05/12/98	66	75

10. DISTRIBUTION LIST: Klaus Bender
Emmy Nickolson
Archive

11. REFERENCES: ANSI C63.4-1992

12. DESCRIPTION OF TEST PROCEDURE

12.1 Radiated Emissions (Transmitter and Receiver)

These tests measure the transmitter radiated emissions and the receiver radiated emissions using a spectrum analyzer and receiving antenna. During testing the EUT was placed on a non-conducting support, 80 cm above the ground plane. The RF spectrum was scanned from 30 MHz to 1000 MHz using the Bi-conical, Log Periodic and Dipole antennae. A Double Ridged Guide antenna was used from 1 GHz to the product's tenth harmonic of the transmitter (9.143 GHz) and 5 GHz on the receiver. The EUT cable was moved to determine configuration with highest emission. Levels below 1 GHz were measured with the spectrum analyzer resolution bandwidth at 120 kHz and levels at or above 1 GHz were measured with the spectrum analyzer resolution bandwidth at 1 MHz for the transmitter and 1 MHz for the receiver. The receiver harmonics were also checked with the spectrum analyzer at the following settings: Resolution Bandwidth = 1 MHz; Video Bandwidth = 10 Hz and Span = 0 Hz. The emissions were measured with vertical and horizontal antenna polarizations. The antenna height was varied from 1-4 meters and the EUT was rotated from 0-360°. Maximum emissions were recorded. The antenna to EUT test distance was 3 meters horizontally. An analog spectrum analyzer was used as an aid in locating the maximum radiation emission as the EUT orientation and antenna position were varied. The level was determined on the HP8593E by means of signal substitution. Testing was performed according to the procedures in ANSI C63.4-1992.

12.2 CONDUCTED EMISSIONS

This test determines the power line conducted emission using a LISN (Line Impedance Stabilization Network) and a spectrum analyzer. The EUT was placed on a non-conducting tabletop 80 cm above the conductive ground plane of the test site. The LISN was grounded to the conductive ground plane by means of a copper strap. A 9 kHz resolution bandwidth was used during the conducted emissions testing. The response due to the ambient electromagnetic conditions (without the EUT being energized) was plotted and the frequencies involved were determined. This was done in order to differentiate between the responses caused by ambient electromagnetic signals and the true EUT generated conducted emissions. The outputs of both ports of the LISN were plotted.

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13. RESULTS

13.1 Radiated Emissions (Transmitter and Receiver)

Final emission levels are expressed in dBuV/m. This level is determined by converting the reading from the spectrum analyzer or power meter to dBuV and adding the antenna correction factor (dB) and cable loss (dB) to it. The amplifier gain is accounted for when the spectrum analyzer display is calibrated. Antenna and cable loss factors are included in the tabular results contained in Attachment A. All levels below 1 GHz are quasi-peak with the exception of the transmitter fundamental. The transmitter fundamental is expressed in peak level as it is below the quasi-peak limit. Transmitter final levels of frequencies above 1 GHz are peak average with a 13 dB relaxation allowed for duty cycle.

Refer to Attachment B for duty cycle calculation.
Refer to Attachment F for pulse desensitization of the spectrum analyzer calculations.

13.1.1 Transmitter Radiated Emissions

RULE: **Part 15.249:** Emission of RF Energy - Transmitter

STANDARD: **Part 15.33 (a)(1)** Frequency range of the radiated measurements:

Tenth harmonic of the highest fundamental frequency.

Part 15.249

Field Strength of Fundamental Frequency: 50,000 uV/m (94 dBuV/m)
Field Strength of Harmonic Radiation: 500 uV/m (54 dBuV/m)

Field Strength of Spurious Radiation:

Part 15.249(c):
Emissions radiated outside the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiation limits in 15.209, whichever is the lesser attenuation.

Part 15.209
Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency of Emission (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

TEST RESULTS: The EUT transmitter radiated emissions met the requirements established by FCC Part 15.249 for intentional radiators. The EUT was tested from 30 MHz to the transmitter's 10th harmonic (9.143 GHz). No EUT transmitter emissions other than the fundamental at 914.3 MHz were detected in the range from 30 MHz to 1 GHz.

The transmitter fundamental (914.3 MHz) was measured to be 93.2 dBuV/m peak. This is 0.8 dB below the quasi-peak limits established by Part 15.249. The worst case harmonic radiated emission was determined to be 65.4 dBuV/m peak. The limit established by Part 15.249 and Part 15.35 (b) is 67 dBuV/m (conversion of instantaneous peak power to average power allows an additional 13 dB relaxation). The result is a margin of 1.6 dB.

In compliance with FCC Part 15.35 (b), conversion of instantaneous peak power to average power is addressed in Attachment B.

TEST DATA: Refer to Attachment A for detailed test results

13.1.2 Bandwidth of Emission

RULE: **Part 15.231 (c) Bandwidth of Emission**

STANDARD: **Part 15.231 (c), Part 15.31 (m)**

Width of emission shall be no wider than 0.5% of the center frequency.

914.3 MHz * 0.005 = 4.7755 MHz

TEST RESULTS: Meets standard. The occupied bandwidth of the transmitted signal was determined to be 410 kHz. Refer to Attachment C for Part 15.231(c); Bandwidth Plot.

TEST DATA: Refer to Attachment D for Part 15.31 (m); Measurement of Relative Field Intensity at the High and Low Frequencies of the EUT.

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13.1.3 Receiver Radiated Emissions

RULE: **Part 15.109: Radiated Emission Limits**

STANDARD: **Part 15.33 (b)(1)**
The upper frequency of measurement range: 5000 MHz.

Part 15.109 (a)
The field strength of radiated emissions from unintentional radiators at a distance of three meters shall not exceed the following values:

Frequency of Emission (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

TEST RESULTS: The EUT receiver radiated emissions met the levels established by FCC Part 15.109 (a) requirements for receivers.
The EUT was tested from 30 MHz to 5000 MHz.

The receiver fundamental (951.1 MHz) was determined to be 41.7 dBuV/m quasi-peak. The limit established by Part 15.109 (a) is 46 dBuV/m. No EUT receiver emissions other than the fundamental at 951.1 MHz were detected in the range from 30 MHz to 1 GHz.

There were no receiver harmonics detected.

Duty cycle calculation for Pulsed RF per FCC Part 15.35 (b) is addressed in Attachment B.

TEST DATA: Refer to Attachment A for detailed test results

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13.2 Conducted Emissions

RULE:	**Part 15.107 (a), Part 15.207 (a)**
STANDARD:	**Part 15.107 (a), Part 15.207 (a)** For equipment that is connected to the public utility power line, the frequencies in the band 450 kHz to 30 MHz as measured between each power line and ground at the power terminal shall not exceed 250 microvolts (48 dBuV).
TEST RESULTS::	When the EUT active results were compared with the ambient response results, there were no detectable conducted signals produced by the EUT.
TEST DATA:	Refer to Attachment E for FCC Part 15.107; Power line Conducted Emissions Plots

Results contained in this report apply to test sample only

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ATTACHMENT A

EUT: Encoder/Receiver/Transmitter
Model : 45ES-1
Serial No.: 10013073

FCC Part 15.249
Radiated Emissions-Transmitter
Test Dates: May 1 & 2, 1998
Engineer: Robert A. Sleen

Freq. MHz	Ant. Pos.	Level dBm	[1]	Level dBuV	Ant. Factor dB	Cable Loss dB	[2] [3] **Corrected Level dBuV/m**	Limit dBuV/m	Duty Cycle Factor dB	[4] Final Limit dBuV/m	Margin dB
914.26	V	**-47.6**	P	**59.4**	28.9	3.8	**92.2**	94		94	1.8
914.26	H	**-46.5**	P	**60.5**	28.9	3.8	**93.2**	94		94	0.8
1828.5	V	**-75.8**	P	**31.2**	28.1	6.1	**65.4**	54	-13	67	1.6
1828.5	H	**-81.5**	P	**25.5**	28.1	6.1	**59.7**	54	-13	67	7.3
2742.8	V	**-85.1**	P	**21.9**	30.7	3.1	**55.7**	54	-13	67	11.3
2742.8	H	**-85.1**	P	**21.9**	30.7	3.1	**55.7**	54	-13	67	11.3
3657.0	V	**-85.5**	P	**21.5**	32.9	3.6	**58.0**	54	-13	67	9.0
3657.0	H	**-86.4**	P	**20.6**	32.9	3.6	**57.1**	54	-13	67	9.9
4571.3	V	**-83.6**	P	**23.4**	34.5	4.1	**62.0**	54	-13	67	5.0
4571.3	H	**-84.4**	P	**22.6**	34.5	4.1	**61.2**	54	-13	67	5.8
5485.6	V	**-93.3**	P	**13.7**	36.0	5.0	**54.8**	54	-13	67	12.2
5485.6	H	**-93.0**	P	**14.0**	36.0	5.0	**55.0**	54	-13	67	12.0
6399.8	V	-95.9	NF	11.1	36.9	5.4	*53.5*	54	-13	67	*13.6*
6399.8	H	-95.8	NF	11.2	36.9	5.4	*53.5*	54	-13	67	*13.5*
7314.1	V	-95.5	NF	11.6	38.0	6.2	*55.7*	54	-13	67	*11.3*
7314.1	H	-95.6	NF	11.4	38.0	6.2	*55.6*	54	-13	67	*11.4*
8228.3	V	-95.6	NF	11.4	38.8	6.0	*56.2*	54	-13	67	*10.8*
8228.3	H	-96.1	NF	11.0	38.8	6.0	*55.8*	54	-13	67	*11.3*
9142.6	V	-95.2	NF	11.8	39.8	7.0	*58.5*	54	-13	67	*8.5*
9142.6	H	-95.7	NF	11.3	39.8	7.0	*58.1*	54	-13	67	*9.0*

Notes:
[1] QP = Quasi-peak, P = Peak, NF = Noise Floor of the Spectrum Analyzer
[2] The Spectrum Analyzer settings are as follows:
Fundamental - Resolution Bandwidth = 120 kHz; Video Bandwidth = 300 kHz; Span = 10 MHZ.
Harmonics - Resolution Bandwidth = 1 MHz; Video Bandwidth = 3 MHz; Span = 50 MHZ.
[3] "Corrected Level" numbers in bold are RF signal levels.
"Corrected Level" numbers in italics are noise floor and as such indicate that there is no RF signal at that level. The "Antenna Correction Factor" and the "Cable Loss" have been factored in with the noise floor levels in order to demonstrate what the "Corrected Level" of an RF signal at the noise floor level would have been equal to.
[4] The "Final Limit", in the case of the harmonics, represents 13 dB above the average limit in FCC Part 15.249 Refer to Attachment B (Part 15.35 (b)).

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ATTACHMENT A cont.

EUT: Encoder/Receiver/Transmitter
Model : 45ES-1
Serial No.: 10013073

FCC Part 15.109
Radiated Emissions-Receiver
Test Dates: May 12, 1998
Engineer: Robert A. Sleen

Freq. MHz	Ant. Pos.	Level dBm	[1]	Level dBuV	Ant. Factor dB	Cable Loss dB	[2] **Final Level dBuV/m**	[3] Limit dBuV/m	Margin dB
951.1	V		QP	**9.8**	30.2	1.7	**41.7**	46	**4.3**
951.1	H		QP	**6.8**	30.2	1.7	**38.7**	46	**7.3**
1902.2	V	-96.0	NF	11.0	28.4	2.5	*41.9*	74	
1902.2	H	-96.1	NF	10.9	28.4	2.5	*41.8*	74	
2853.3	V	-96.0	NF	11.0	31.1	3.1	*45.2*	74	
2853.3	H	-96.1	NF	10.9	31.1	3.1	*45.1*	74	
3804.4	V	-95.8	NF	11.2	33.0	3.8	*48.0*	74	
3804.4	H	-97.0	NF	10.1	33.0	3.8	*46.8*	74	
4755.5	V	-98.9	NF	8.1	34.9	4.5	*47.5*	74	
4755.5	H	-98.1	NF	8.9	34.9	4.5	*48.3*	74	

Notes:
[1] QP = Quasi-peak, P = Peak, NF = Noise Floor of the Spectrum Analyzer
[2] The Spectrum Analyzer settings are as follows:
Fundamental - Resolution Bandwidth = 120 kHz; Video Bandwidth = 300 kHz; Span = 10 MHZ.
Harmonics - Resolution Bandwidth = 1 MHz; Video Bandwidth = 3 MHz; Span = 50 MHZ.
[3] "Final Level" numbers in bold are RF signal levels.
"Final Level" numbers in italics are noise floor and as such indicate that there is no RF signal at that level.
The "Antenna Correction Factor" and the "Cable Loss" have been factored in with the noise floor levels in order to demonstrate what the "Final Level" of an RF signal at the noise floor level would have been equal to. Refer to Attachment F
The "Final Limit", in the case of the harmonics, represents 20 dB above the average limit in FCC Part 15.109. Refer to Attachment B (Part 15.35 (b)).
PDSA (Pulse Desensitization of the Spectrum Analyzer) has not been factored in as the level measured represents the noise floor not a harmonic. PDSA of the harmonics at a Resolution Bandwidth of 1MHz would be 10.5 dB. - See Attachment F.

ATTACHMENT A cont.

EUT:	Encoder/Receiver/Transmitter	**FCC Part 15.109**	
Model :	45ES-1	**Radiated Emissions-Receiver**	
Serial No.:	10013073	**Test Dates:**	May 4, 1998
		Engineer:	Robert A. Sleen

Freq. MHz	Ant. Pos.	Level dBm	[1]	Level dBuV	Ant. Factor dB	Cable Loss dB	[3] Final Level dBuV/m	Limit dBuV/m
1902.2	V	-110.0	NF	-3.0	28.4	2.5	*27.9*	54
1902.2	H	-109.8	NF	-2.8	28.4	2.5	*28.1*	54
2853.3	V	-109.8	NF	-2.8	31.1	3.1	*31.4*	54
2853.3	H	-109.3	NF	-2.3	31.1	3.1	*31.9*	54
3804.4	V	-110.7	NF	-3.7	33.0	3.8	*33.1*	54
3804.4	H	-110.7	NF	-3.7	33.0	3.8	*33.1*	54
4755.5	V	-111.9	NF	-4.9	34.9	4.5	*34.5*	54
4755.5	H	-111.9	NF	-4.9	34.9	4.5	*34.5*	54

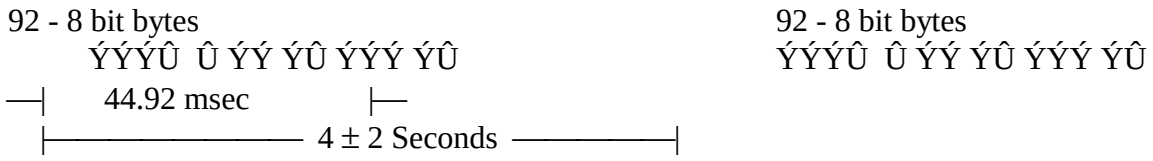
NOTES:
[1] QP = Quasi-peak, P = Peak, NF = Noise Floor of the Spectrum Analyzer
[2] The Spectrum Analyzer settings are as follows:
Resolution Bandwidth = 1 MHz; Video Bandwidth = 10 Hz; Span = 0 HZ.
[3] "Final Level" numbers in bold are RF signal levels.
"Final Level" numbers in italics are noise floor and as such indicate that there is no RF signal at that level. The "Antenna Correction Factor" and the "Cable Loss" have been factored in with the noise floor levels in order to demonstrate what the "Final Level" of an RF signal at the noise floor level would have been equal to.

ATTACHMENT B

Conversion from Instantaneous Peak Power to Average Power
45ES-1 ERT®

The ERT Unit Transmits a Manchester Encoded Message in a two to six second period. Each of the messages are 92 bytes (736 bits) long. Each message is broadcast on a different frequency within the Transmit Band.

Zooming in on a message length;



Bit rate is: 16.384 Kbits/Second.
Message Period is: 736/16.384 Kbits / sec = 44.92 msec

During the transmission of messages, the Transmit Duty Cycle can be computed.

% Duty Cycle Transmit = (736 bits) (1/16.384 Kbits/Sec) (.5) (100%) / (100 msec)

% Duty Cycle Transmit =22.46 %

Note: The .5 factor is a result of Manchester Encoded Data.

Expressing the correction factor for Duty Cycle in dB:

dB Duty Cycle Transmit = 20 Log (Duty Cycle)
dB Duty Cycle Transmit = 20 Log (.2246)
dB Duty Cycle Transmit = -12.97 dB

During the receive mode, the Receive Duty Cycle can be computed.

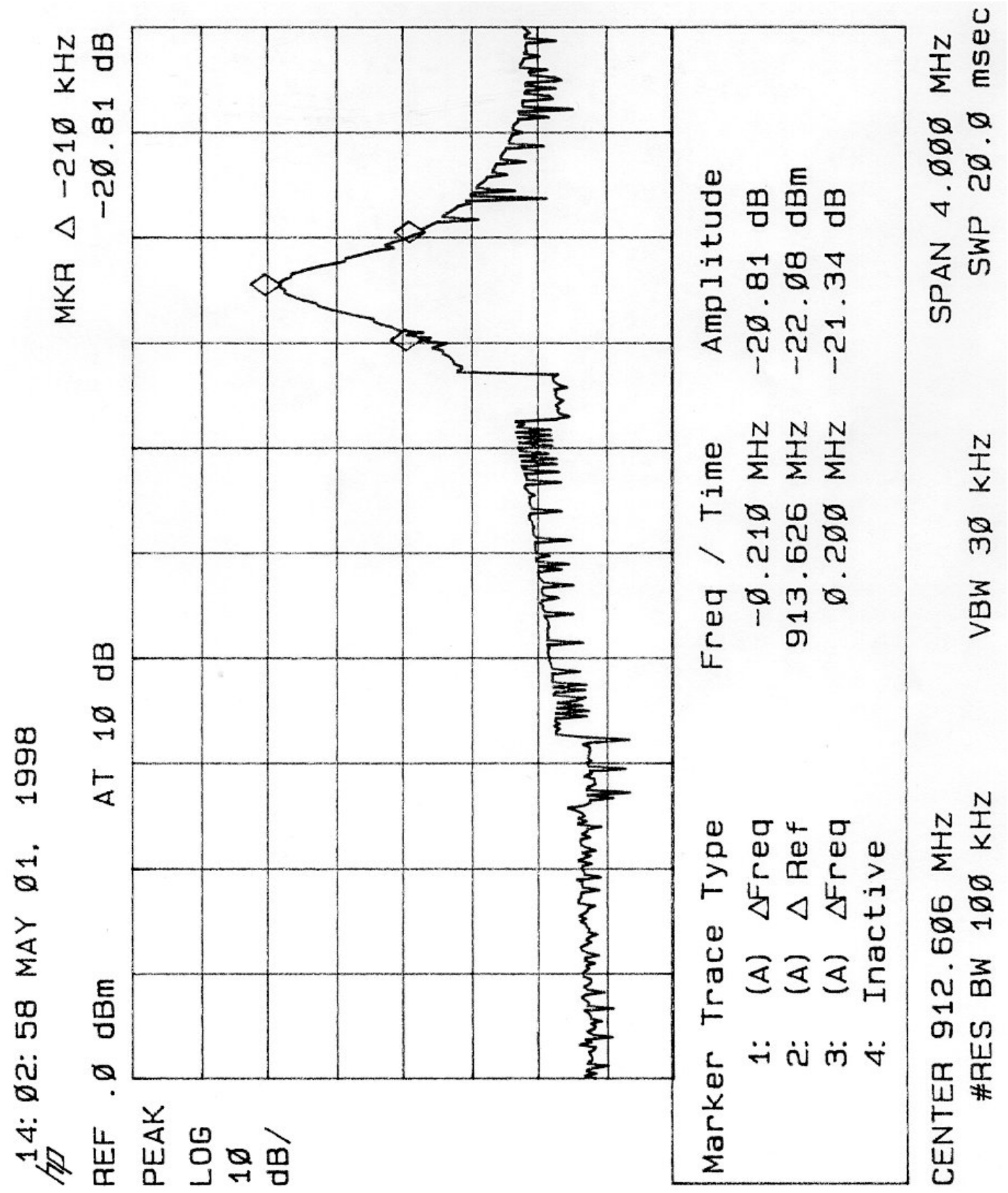
% Duty Cycle Receive = (0.2 μsec.) (512 Hz) (100 %)
% Duty Cycle Receive = .01024 %

Expressing the correction factor for Duty Cycle in dB:

dB Duty Cycle Receive = 20 Log ($10.24 * 10^{-5}$)
dB Duty Cycle Receive = - 79.8 dB

ATTACHMENT C

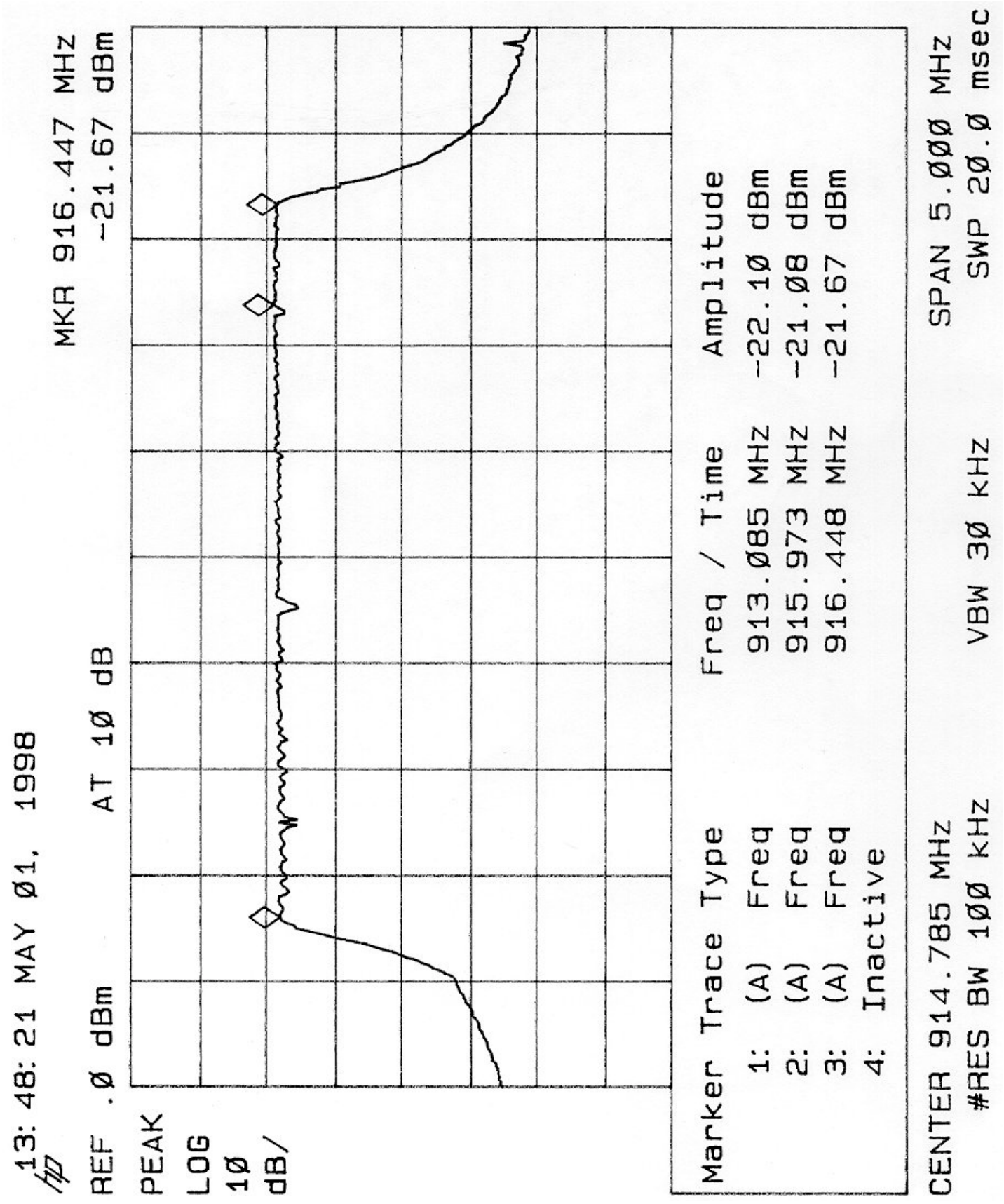
Part 15.231(c) Bandwidth Plot


14: Ø2: 58 MAY Ø1, 1998
MKR Δ -21Ø kHz
-2Ø.81 dB
REF .Ø dBm
AT 1Ø dB
PEAK
LOG
1Ø
dB/
Marker Trace Type
Freq / Time
Amplitude
1: (A) ΔFreq
-Ø.21Ø MHz
-2Ø.81 dB
2: (A) Δ Ref
913.626 MHz
-22.Ø8 dBm
3: (A) ΔFreq
Ø.2ØØ MHz
-21.34 dB
4: Inactive
CENTER 912.6Ø6 MHz
SPAN 4.ØØØ MHz
#RES BW 1ØØ kHz
VBW 3Ø kHz
SWP 2Ø.Ø msec

ATTACHMENT D

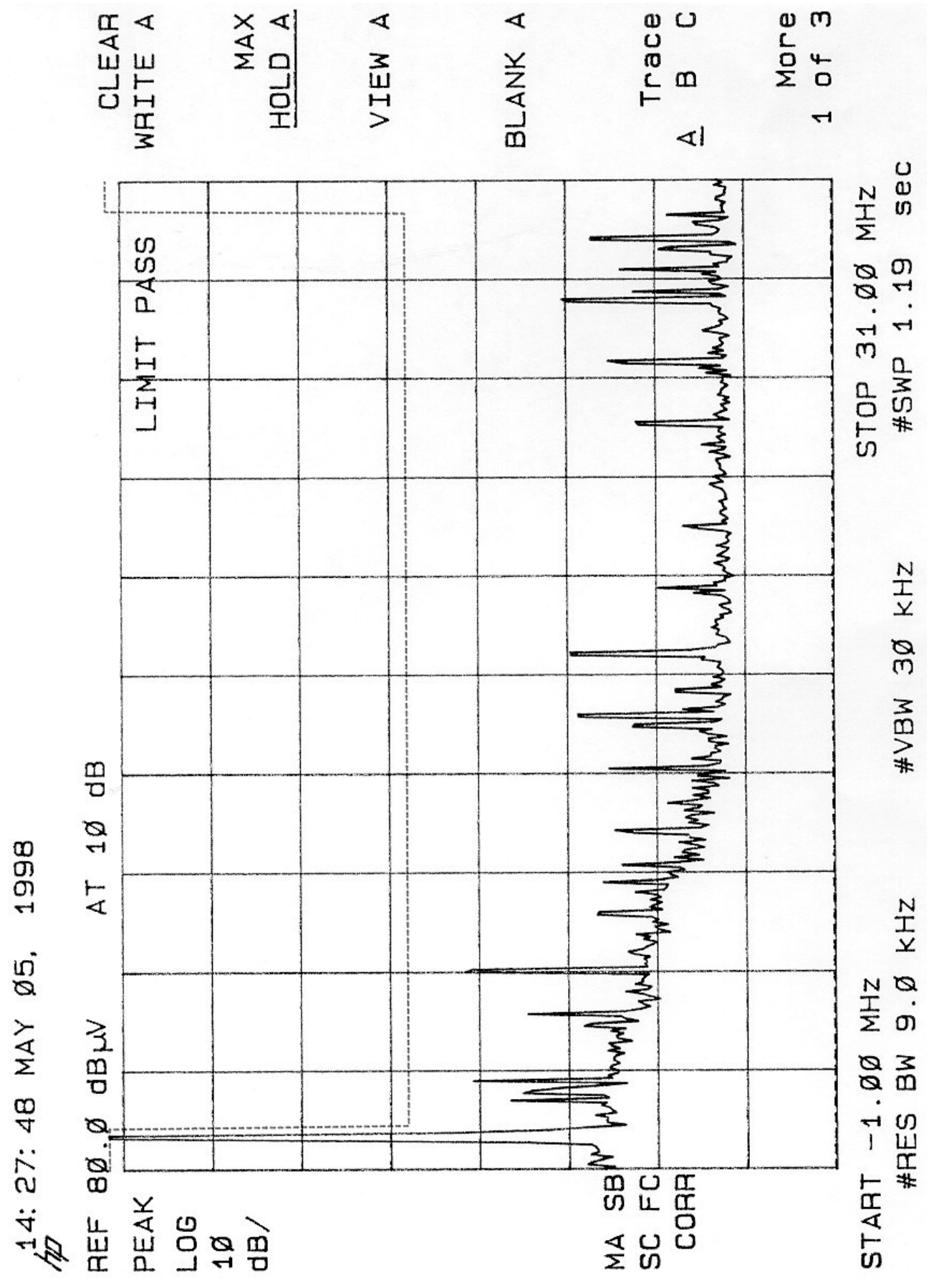
Part 15.31(m)

Measurement of Relative Field Intensity at the High and Low Frequencies of the EUT.


13: 48: 21 MAY Ø1, 1998
MKR 916.447 MHz
-21.67 dBm
REF .Ø dBm
AT 1Ø dB
PEAK
LOG
1Ø
dB/
Marker Trace Type Freq / Time Amplitude
1: (A) Freq 913.Ø85 MHz -22.1Ø dBm
2: (A) Freq 915.973 MHz -21.Ø8 dBm
3: (A) Freq 916.448 MHz -21.67 dBm
4: Inactive
CENTER 914.785 MHz
SPAN 5.ØØØ MHz
#RES BW 1ØØ kHz
VBW 3Ø kHz
SWP 2Ø.Ø msec

ATTACHMENT E

Part 15.107 Power Line Conducted Emissions Plots


14: 27: 48 MAY 05, 1998
REF 80.0 dBµV
AT 10 dB
PEAK
LOG
10
dB/
LIMIT PASS
CLEAR
WRITE A
MAX
HOLD A
VIEW A
BLANK A
Trace
A B C
More
1 of 3
MA SB
SC FC
CORR
START -1.00 MHz
#RES BW 9.0 kHz
#VBW 30 kHz
STOP 31.00 MHz
#SWP 1.19 sec

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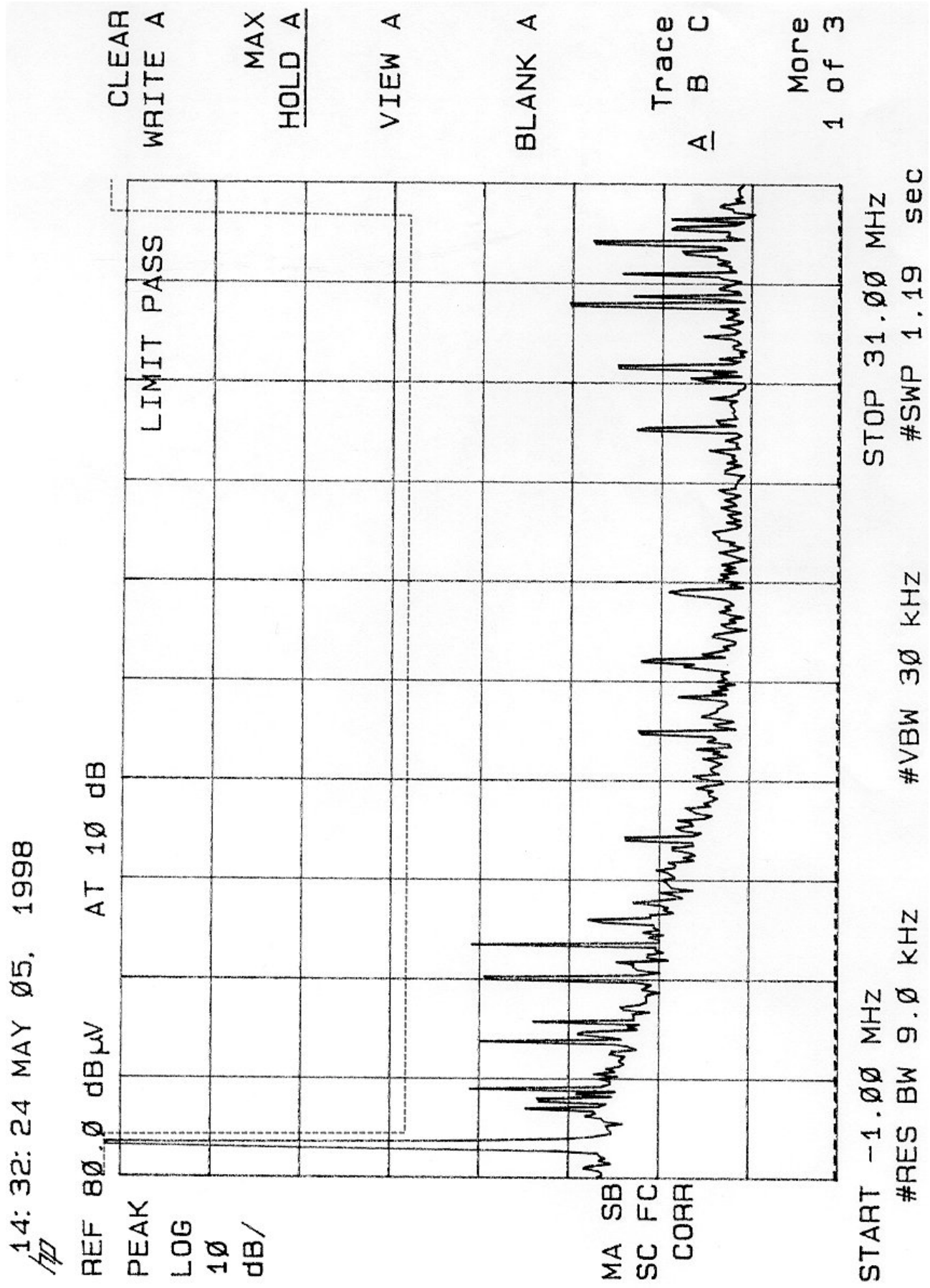
14: 32: 24 MAY 05, 1998
REF 80.0 dBµV
AT 10 dB
PEAK
LOG
10
dB/
LIMIT PASS
CLEAR
WRITE A
MAX
HOLD A
VIEW A
BLANK A
Trace
A B C
More
1 of 3
MA SB
SC FC
CORR
START -1.00 MHz
#RES BW 9.0 kHz
#VBW 30 kHz
STOP 31.00 MHz
#SWP 1.19 sec

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ATTACHMENT F

Pulse Desensitization of the Spectrum Analyzer

Pulse Desensitization of the Spectrum Analyzer is the rise time delay inherently imposed by the resolution bandwidth setting of the spectrum analyzer. The resulting attenuation of narrow pulse signals necessitates that a compensating factor be applied to the levels on the spectrum analyzer when peak levels are being measured.

This does not apply to Quasi-peak measurements.

Reference: Application Note 150-2 "Spectrum Analysis of Pulsed RF", Hewlett Packard, November 1971

Example:

PDSA = 20 log (Pulse width x 1.5 x Spectrum Analyzer Resolution Bandwidth)
PDSA = 20 log (.15 x 10^{-6} x 1.5 x 1 x 10^{6})
PDSA = -12.96 dB

Pulse Desensitization of the Spectrum Analyzer

RF Pulse Width (nsec.)	Spectrum Analyzer Resolution Bandwidth			
	100 kHz	300 kHz	1 MHz	3 MHz
	Desensitization			
	(dB)	(dB)	(dB)	(dB)
500	-22.5	-13.0	-2.5	
450	-23.4	-13.9	-3.4	
400	-24.4	-14.9	-4.4	
350	-25.6	-16.1	-5.6	
300	-26.9	-17.4	-6.9	
250	-28.5	-19.0	-8.5	
225	-29.4	-19.9	-9.4	
200	-30.5	-20.9	-10.5	-0.9
175	-31.6	-22.1	-11.6	-2.1
150	-33.0	-23.4	-13.0	-3.4
125	-34.5	-25.0	-14.5	-5.0
100	-36.5	-26.9	-16.5	-6.9
75	-39.0	-29.4	-19.0	-9.4
50	-42.5	-33.0	-22.5	-13.0

ATTACHMENT G

Photographs (Test Setup)