



Certelecom Laboratories Inc.

Safety - EMI - Telecom - ISO Guide 25

ENGINEERING TEST REPORT

ON:
THE PANASONIC CANADA INC.
"2.4 GHz SPREAD SPECTRUM CORDLESS TELEPHONE"

IN ACCORDANCE WITH:
FCC PART 15, SUBPART B
RADIO RECEIVERS

PROJECT NO.: 8R00161

TESTED FOR:

PANASONIC CANADA INC.
5770 AMBLER DRIVE
MISSISSAUGA, ONTARIO
L4W 2T3

TESTED BY:

CERTELECOM LABORATORIES INC.
3325 RIVER ROAD, R.R. 5
OTTAWA, ONTARIO K1V 1H2

MAY 1998

This document contains 22 pages including this one.

Certelecom Laboratories Inc. authorizes the above named company to reproduce this report provided it is reproduced in its entirety and for use by the company's employees only.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Certelecom Laboratories Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

This report applies only to the items tested.



1	Panasonic Spread Spectrum Cordless Telephone System, Model KX-TG210 Series	1
2	Base Unit: FCC ID: ACJ96NKX-TG210	
3	Handset Unit: FCC ID: ACJ96NKX-TG210 B	
4	FCC Reg No: ACJJP-25503-W1-E	

Certelec Laboratories Inc.

Safety - EMI - Telecom - ISO Guide 25

ENGINEERING TEST REPORT

ON:

THE PANASONIC CANADA INC.

"2.4 GHz SPREAD SPECTRUM CORDLESS TELEPHONE HANDSET"

IN ACCORDANCE WITH:

FCC PART 15, SUBPART C

DIRECT SEQUENCE TRANSMITTERS

902 - 928 MHz

PROJECT NO.: 8R00161.1

TESTED FOR:

PANASONIC CANADA INC.

5770 AMBLER DRIVE

MISSISSAUGA, ONTARIO

L4W 2T3

TESTED BY:

CERTELECOM LABORATORIES INC.

3325 RIVER ROAD, R.R. 5

OTTAWA, ONTARIO K1V 1H2

MAY 1998

This document contains 54 pages including this one.

Certelec Laboratories Inc. authorizes the above named company to reproduce this report provided it is reproduced in its entirety and for use by the company's employees only.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Certelec Laboratories Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

This report applies only to the items tested.



Panasonic Model KX-TG210 Series
900 MHz / 2.4 GHz Spread Spectrum Cordless Telephone System
FCC ID: ACJ96NKX-TG210

Certelec Laboratories Inc.

Safety - EMI - Telecom - ISO Guide 25

ENGINEERING TEST REPORT

ON:

THE PANASONIC CANADA INC.

"2.4 GHz SPREAD SPECTRUM CORDLESS TELEPHONE HANDSET"

IN ACCORDANCE WITH:

FCC PART 15, SUBPART C

DIRECT SEQUENCE TRANSMITTERS

902 - 928 MHz

PROJECT NO.: 8R00161.1

TESTED FOR:

PANASONIC CANADA INC.

5770 AMBLER DRIVE

MISSISSAUGA, ONTARIO

L4W 2T3

TESTED BY:

CERTELECOM LABORATORIES INC.

3325 RIVER ROAD, R.R. 5

OTTAWA, ONTARIO K1V 1H2

MAY 1998

This document contains 54 pages including this one.

Certelec Laboratories Inc. authorizes the above named company to reproduce this report provided it is reproduced in its entirety and for use by the company's employees only.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Certelec Laboratories Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

This report applies only to the items tested.

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

EQUIPMENT DESCRIPTION:

MODEL NO.: KX-TG210

SERIAL NO.: None

GENERAL:

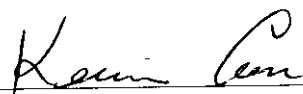
These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, Subpart C Paragraph 15.247 for Direct Sequence Spread Spectrum devices.

ABSTRACT:

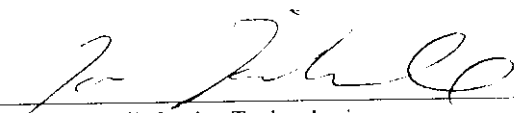
Based on the data contained in this report, the E.U.T. complies with the standards set forth in FCC Part 15.247 for direct sequence transmitters.

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE. - None

TESTED BY: 
Kevin Carr, Technologist

DATE: 02 June 1998

APPROVED BY: 
Tom Tidwell, Senior Technologist

DATE: 02 June 1998

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

SUMMARY OF TEST DATA

NAME OF TEST	PARA. NO.	SPEC.	MEAS.	RESULT
Powerline Conducted Emissions	15.207(a)	48 dB μ V	20 dB μ V	Complies
Occupied Bandwidth	15.247(a)(2)	≥ 500 kHz	1.41 MHz	Complies
Peak Power Output	15.247(b)	1 watt	4.88 mW	Complies
Spurious Emissions (Band Edge Antenna Radiated)	15.247(c)	-20 dBc	Plot	Complies
Spurious Emissions (Radiated)	15.247(c)	Table 15.209(a)	Chart	Complies
Transmitter Power Density	15.247(d)	$\leq +8$ dBm	-12.4 dBm	Complies
Processing Gain	15.247(e)	≥ 10 dB	Cust. Data	Complies

FOOTNOTES FOR N/A'S:

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

GENERAL EQUIPMENT SPECIFICATION

TRANSMITTER

Power Input:	Battery
Frequency Range:	909.64 MHz to 920.80 MHz (HANDSET UNIT)
Tunable Bands:	None
Necessary Bandwidth:	500 kHz
6 dB Bandwidth:	1.41 kHz
Type of Modulation:	Direct Sequence Spread Spectrum
Emission Designator:	F1D
RF Power Output (rated):	Normal Mode: 0.0025W (3.98 dBm) High Mode: 0.1W (20 dBm)
Duty Cycle:	Continuous
Channel Spacing:	360 kHz
Operator Selection of Operating Frequency:	Key Pad

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

GENERAL EQUIPMENT SPECIFICATION

RECEIVER

Frequency Range:	2402.08 MHz to 2481.44 MHz
Tunable Bands:	1
Bandwidth:	500 kHz
Type of modulation:	Direct Sequence Spread Spectrum
Operator Selection of Operating Frequency:	Key Panel

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

NAME OF TEST: Powerline Conducted Emissions

15.207(a)

TESTED BY: Kevin Carr

DATE: April 17, 1998

TEST RESULTS: Complies. See attached graph.

MEASUREMENT DATA: See attached graph.

Phase

Apr 11 17. 1998

8r00161_2 10dB Limiter used

REF 90.0 dBμV ATTN 10 dB

hp

10 dB/

DL
38.0
dBμV

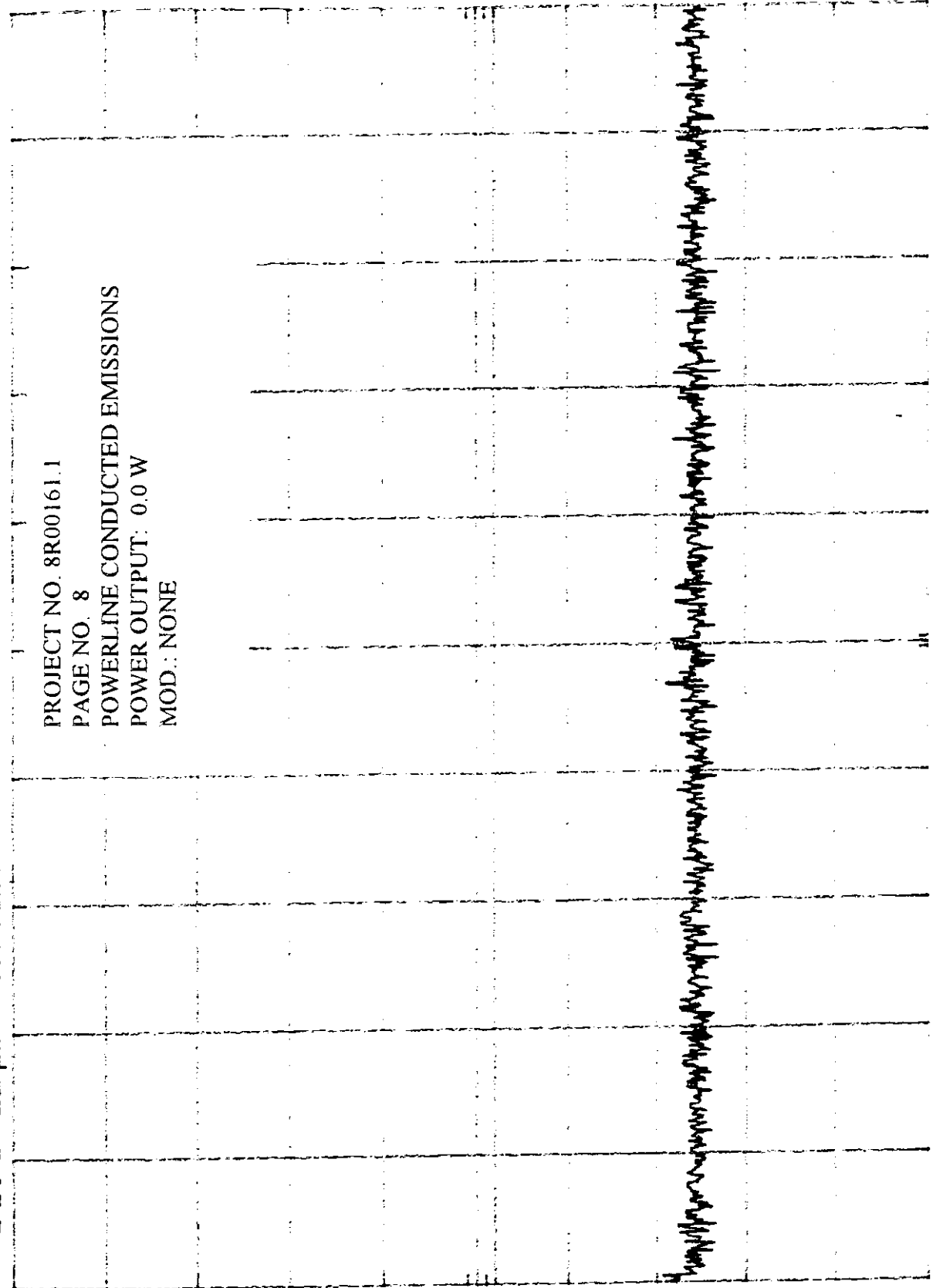
PROJECT NO. 8R00161.1

PAGE NO. 8

POWERLINE CONDUCTED EMISSIONS

POWER OUTPUT: 0.0 W

MOD.: NONE



START 450 kHz

RES BW 10 kHz

VBW 30 kHz

STOP 30.0 MHz

SWP 887 msec

Neutral

April 17, 1998

8r00161_2 10dB Limiter used

REF 90.0 dBμV, ATTN 10 dB

HP

10 dB/

DL
38.0
dBμV

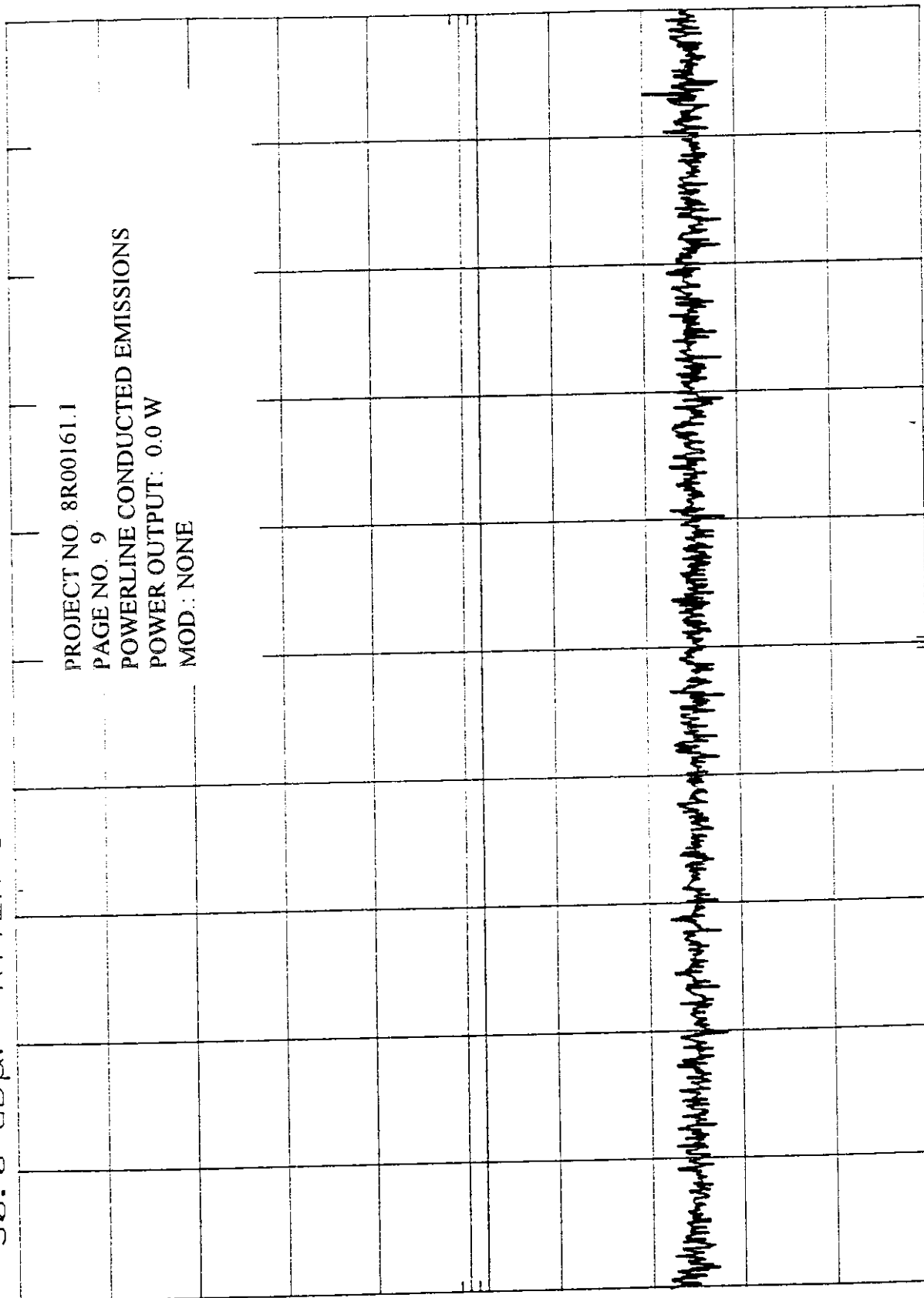
PROJECT NO. 8R00161.1

PAGE NO. 9

POWERLINE CONDUCTED EMISSIONS

POWER OUTPUT: 0.0 W

MOD: NONE



START 450 kHz

RES BW 10 kHz

VBW 30 kHz

STOP 30.0 MHz

SWP 887 msec

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

NAME OF TEST: Occupied Bandwidth

PARA. NO.: 15.247(a)(2)

TESTED BY: Kevin Carr

DATE: April 24, 1998

TEST RESULTS: Complies. The 6 dB bandwidth is 1.41 MHz. See attached graph.

MEASUREMENT DATA: See attached graph.

ATTEN 10dB

RL -39.6dBm

MKR - .03dB

2dB

1.410MHz

CHANNEL POWER
ACROSS 1.41MHz BW

TOTAL 34.2dBm

DENSITY -95.7dBm/Hz

PROJECT NO. 8R00161.1
PAGE NO. 11
OCCUPIED BANDWIDTH
POWER OUTPUT 89.8dBuV/m@3m
MOD: FID
CH. 1, Horz. Rad. Em.

CENTER 909.643MHz

SPAN 2.000MHz

*RBW 100kHz

VBW 100kHz

SWP 50.0ms

*ATTEN 10dB

MKR 0dB

RL -37.0dBm

2dB

1.400MHz

CHANNEL POWER
ACROSS 1.40MHz BW

TOTAL 31.4dBm

DENSITY -92.9dBm/Hz

PROJECT NO. 8R00161.1

PAGE NO. 12

OCCUPIED BANDWIDTH

POWER OUTPUT: 98.6dBuV/m@3m

MOD.: FID

CH. 1, Vert. Rad. Em.

CENTER 909.620MHz

SPAN 2.000MHz

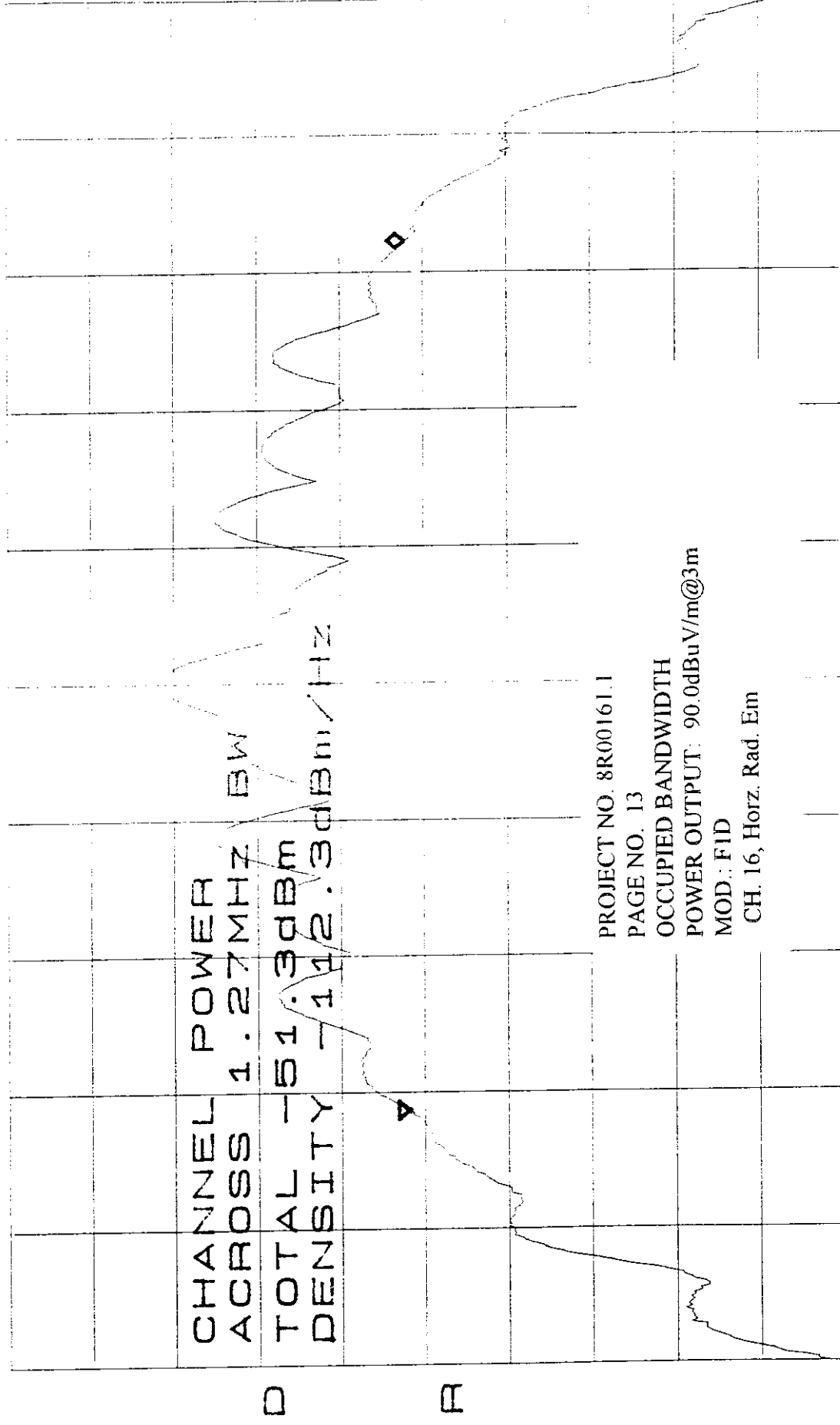
*RBW 100kHz

VBW 100kHz

SWP 50.0ms

*ATTEN 10DB
PL -55.2dbm

NY 100-106114-106115



CENTER 915.033MHZ
*RBW 100KHZ VBW

SPAN 2.000MHZ
SWP 50.0ms

ATTEN 10dB
RL -37.0dBm

2dB

MKR .13dB
1.270MHz

CHANNEL POWER
ACROSS 1.27MHz BW
TOTAL -33.1dBm
DENSITY -94.1dBm/Hz

PROJECT NO. 8R00161.1
PAGE NO. 16
OCCUPIED BANDWIDTH
POWER OUTPUT: 90.0dBuV/m@3m
MOD.: FID
CH. 32, Vert. Rad. Em.

CENTER 920.807MHz
*RBW 100kHz

SPAN 2.000MHz
SWP 50.0ms

*ATTEN 10dB

RL -37.0dBm

2dB

MKR -.06dB

1.270MHz

CHANNEL POWER
ACROSS 1.27MHz BW
TOTAL -32.0dBm
DENSITY -93.0dBm/Hz

PROJECT NO. 8R00161.1

PAGE NO. 15

OCCUPIED BANDWIDTH

POWER OUTPUT: 97.6dBuV/m@3m

MOD: FID

CH. 32, Horiz. Rad. Em.

CENTER 920.802MHz

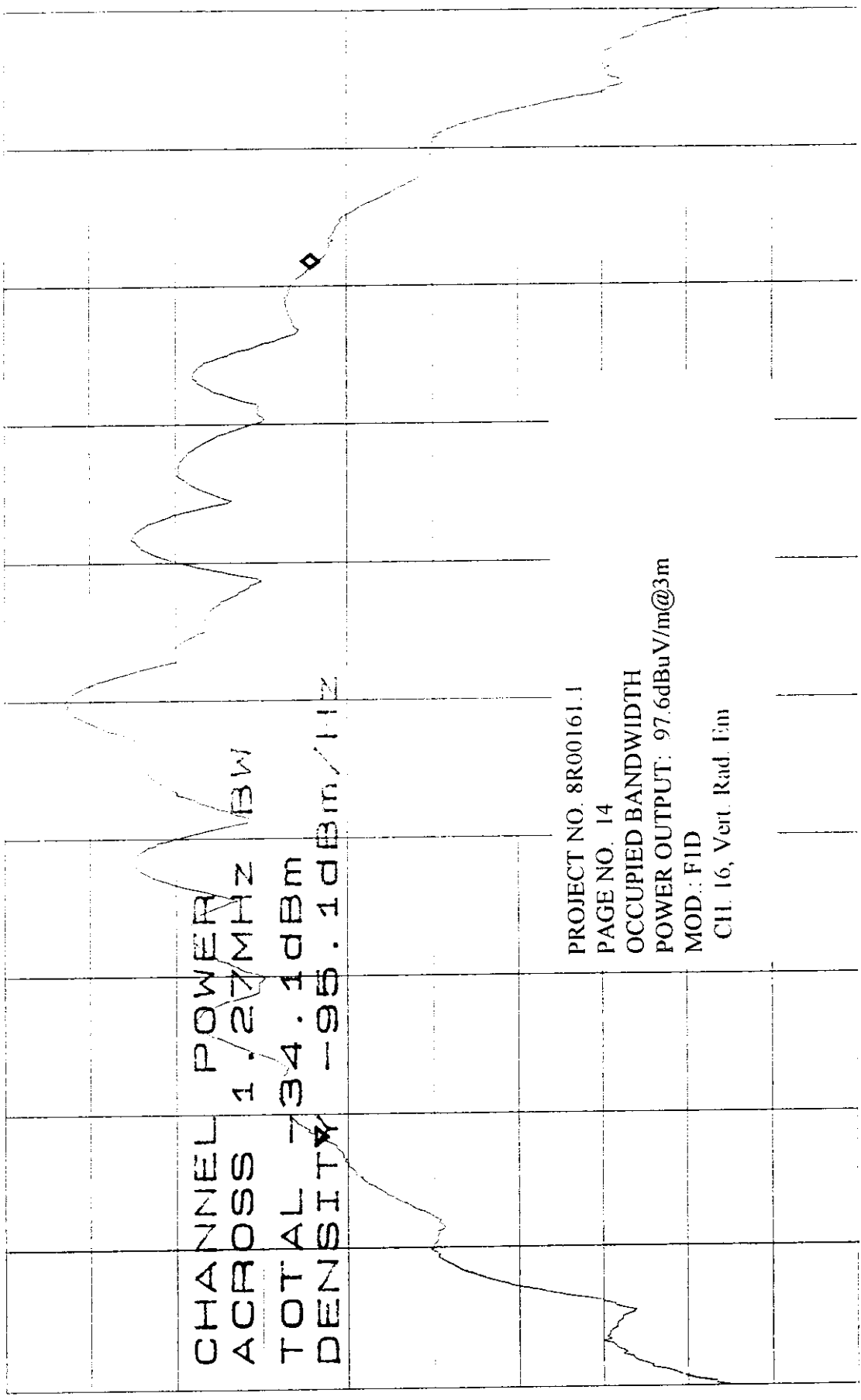
SPAN 2.000MHz

*RBW 100kHz

VBW 100kHz

SWP 50.0ms

ATTEN 10dB , MKR . 17dB
 RL -40.1dBm 2dB 1.270MHz



CHANNEL POWER
 ACROSS 1.27MHz BW
 TOTAL -34.1dBm
 DENSITY -95.1dBm/Hz

PROJECT NO. 8R00161.1
 PAGE NO. 14
 OCCUPIED BANDWIDTH
 POWER OUTPUT: 97.6dBuV/m@3m
 MOD.: FID
 CH. 16, Vert. Rad. Em

CENTER 915.040MHz SPAN 2.000MHz
 *RBW 100kHz VBW 100kHz SWP 50.0ms

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

NAME OF TEST: Peak Power Output

PARA. NO.: 15.247(b)

TESTED BY: Kevin Carr

DATE: May 19, 1998

TEST RESULTS: Complies. The maximum peak power
output of the transmitter is 0.00217 watts.

MEASUREMENT DATA:

Detachable antenna? ☐ yes ☒ no

If yes, state the type of non-standard connector used at the antenna port:

Directional Gain of antenna: _____ dBi or 1 Numeric(dBi/10)

Peak Power Output: 0.00217 watts

Field Strength: 98.6 dB μ V/m @ 3m or 0.0851 V/m @ 3m.

$$\text{Log}^{-1} \left(\frac{98.6 \text{ dB}\mu\text{V}}{20} \right) = 85.1 \text{ mV}$$

$$\text{EIRPs} \left(\frac{85.1 \text{ mV}}{30} \right)^2 \times 9 = 2.17 \text{ mW}$$

$$10 \text{ Log } 2.17 \text{ mW} = 3.36 \text{ dBm}$$

Test Data - Radiated Emissions (PEAK)

Page 18 of 41

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

NAME OF TEST: Band Edge (Antenna Radiated)

PARA. NO.: 15.247(c)

TESTED BY: Kevin Carr

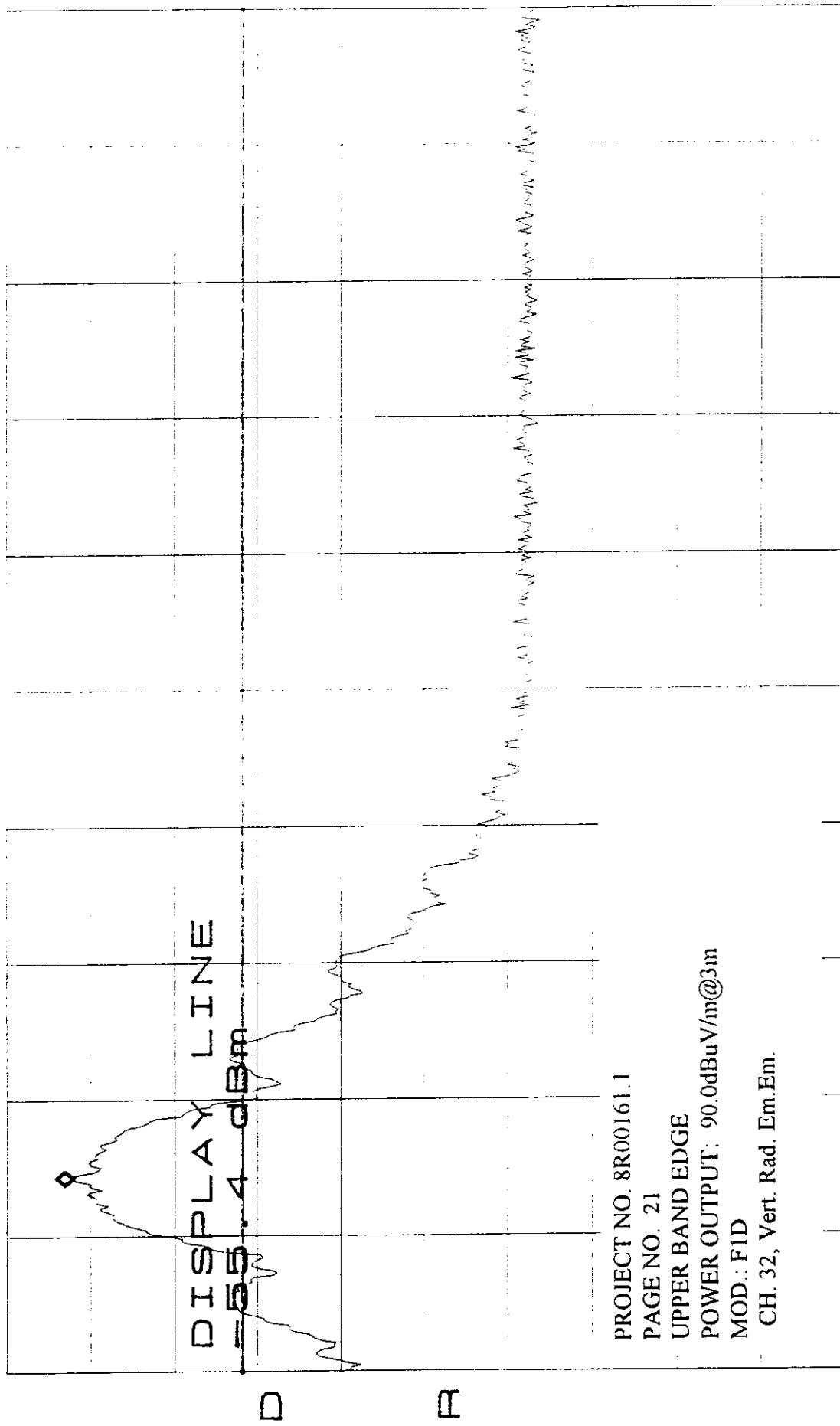
DATE: April 24, 1998

TEST RESULTS: Complies. The worst-case emission level is 30 dBc at 893.60 MHz. This is 10.2 dB below the specification limit.

MEASUREMENT DATA: See attached graphs.

For the worst case radiated emission the difference in antenna factors between 908 MHz and 893 MHz is +0.2 dB

*ATTEN 10dB , MKR -35.03dBm
RL -27.2dBm 920.87MHz



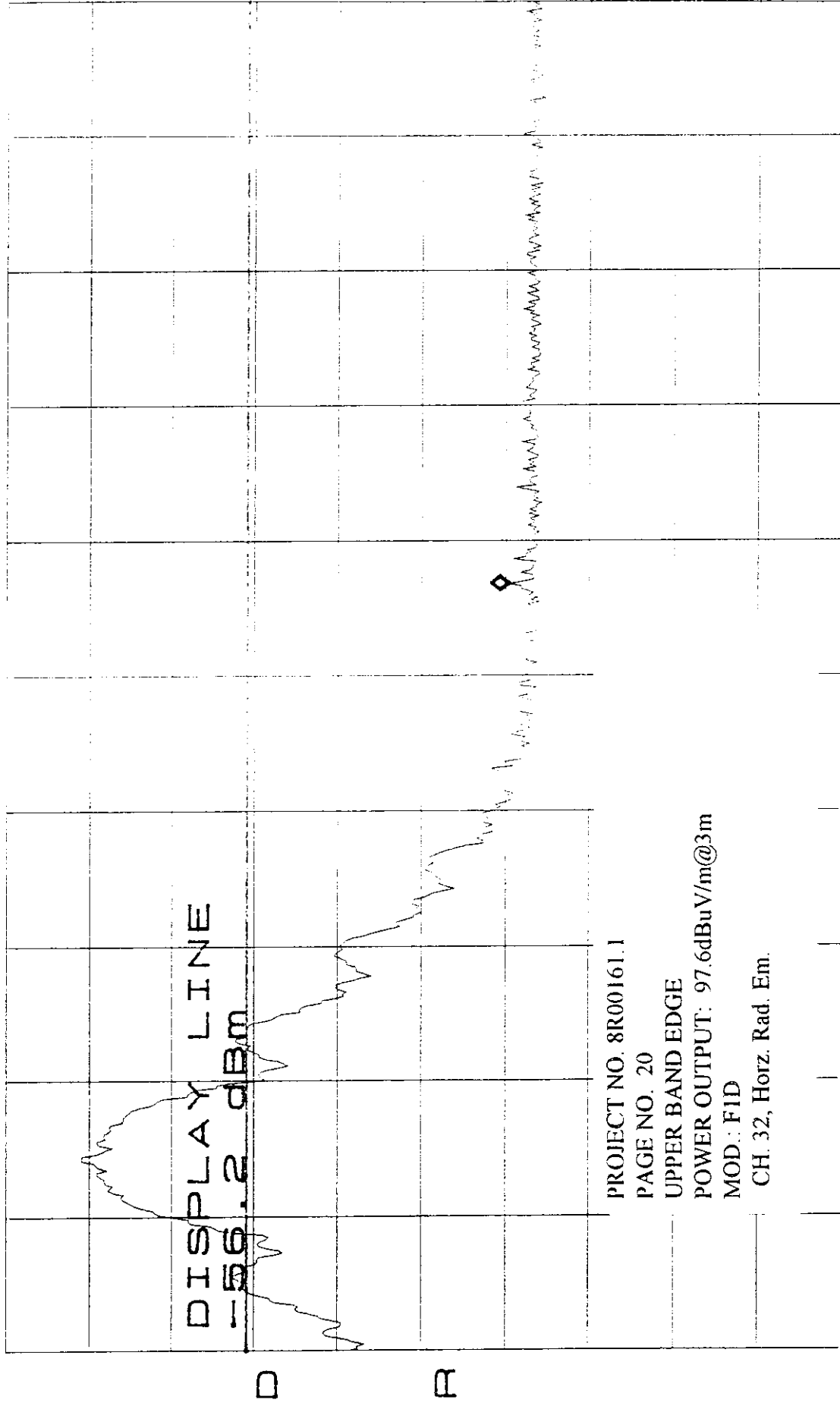
*ATTEN 10dB

RL -27.2dBm

10dB

MKR -87.37dBm

928.37MHz



CENTER 928.00MHz

SPAN 20.00MHz

*RBW 100kHz

*VIEW 300kHz

SWP 50.0ms

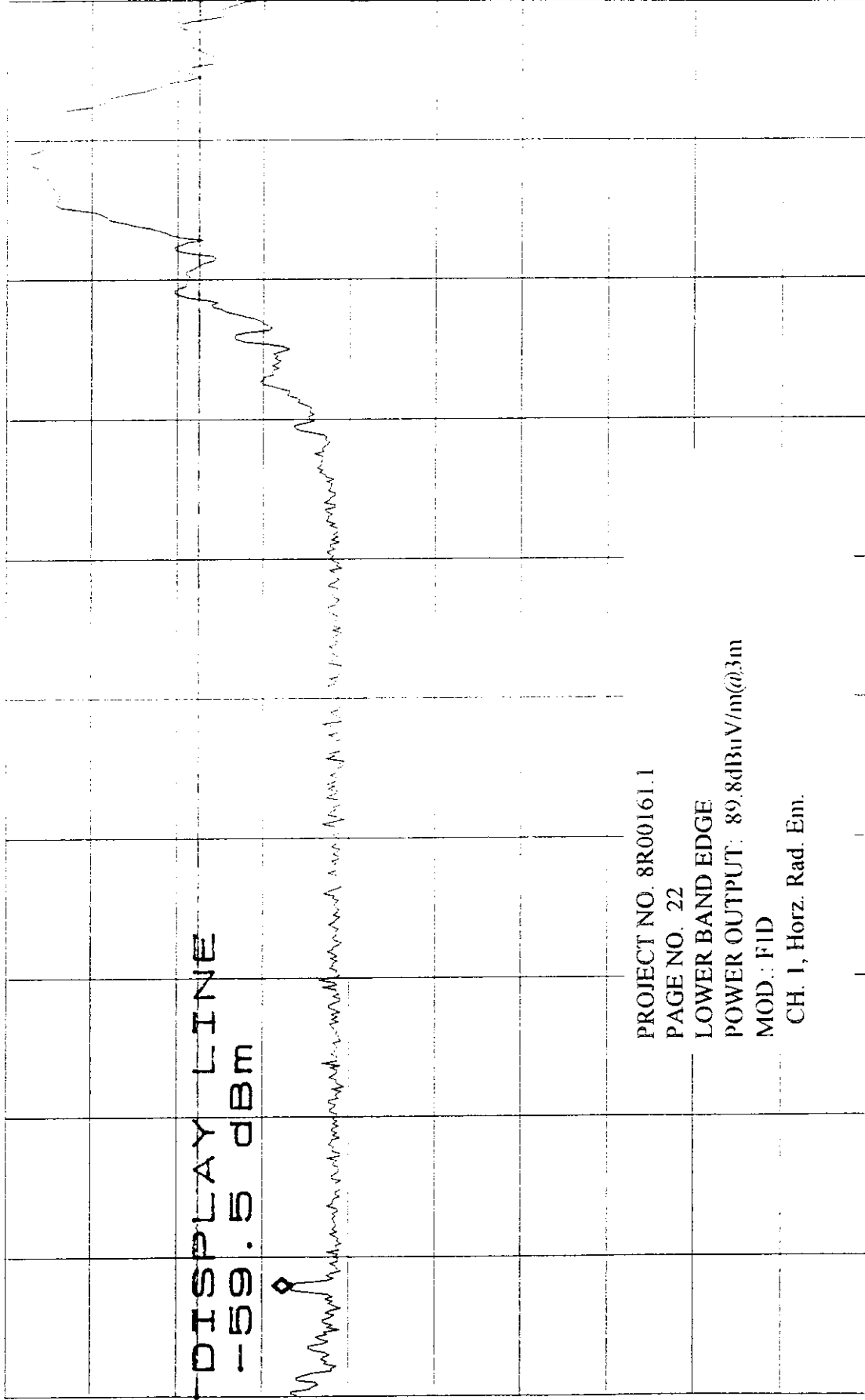
*ATTEN 10dB ,

RL -37.0dBm

10dB/

MKR -70.33dBm

893.60MHz



DISPLAY LINE

-59.5 dBm

PROJECT NO. 8R00161.1

PAGE NO. 22

LOWER BAND EDGE

POWER OUTPUT: 89.8dBuV/m(0.3m

MOD.: FID

CH. 1, Horz. Rad. Em.

CENTER 902.00MHz

SPAN 20.00MHz

*RBW 100kHz

*VBW 300kHz

SWP 50.0ms

*ATTEN 10dB ,

RL -37.0dBm

10dB/

MKR -71.83dBm

892.47MHz

DISPLAY LINE

-59.5 dBm

D

◆

PROJECT NO. 8R00161.1
PAGE NO. 23
LOWER BAND EDGE
POWER OUTPUT: 98.6dBuV/m@3m
MOD: FID
CH. 1, Vert. Rad. Em.

CENTER 902.00MHz

SPAN 20.00MHz

*RBW 100kHz

*VBW 300kHz

SWP 50.0ms

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

NAME OF TEST: Spurious Emissions (Radiated)	PARA. NO.: 15.247(c)
TESTED BY: Kevin Carr	DATE: May 19, 1998

TEST RESULTS: Complies. The worst-case emission level is 41.3 dB μ V/m @ 3m at 2745 MHz. This is 12.7dB below the specification limit.

MEASUREMENT DATA: See attached table.

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

Test Data - Radiated Emissions(AVERAGE)

[illegible]

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

Test Data - Radiated Emissions(AVERAGE)

[illegible]

Test Data - Radiated Emissions (AVERAGE)

Page 27 of 41

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

Test Data - Radiated Emissions(PEAK)

[illegible]

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

Test Data - Radiated Emissions(PEAK)

[illegible]

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

Test Data - Radiated Emissions (PEAK)

[illegible]

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

NAME OF TEST: Transmitter Power Density	PARA. NO.: 15.247(d)
TESTED BY: Kevin Carr	DATE: April 23, 1998

TEST RESULTS: Complies.

MEASUREMENT DATA: See attached graphs.

WORST CASE: 909.64 MHz

ANTENNA FACTOR: 30.0 dB

$$\text{Log}^{-1}\left(\frac{52.8\text{dB}\mu V + 30\text{dB}}{20}\right) = 13803.8\mu V$$

$$\text{EIRPs} \left(\frac{13803.8 \times 10^{-6}}{30}\right)^2 \times 9 = 5.72 \times 10^{-5} W$$

$$10 \text{ Log } 5.72 \times 10^{-5} W = -42.4 \text{ dB}$$

$$= -12.4 \text{ dBm}$$

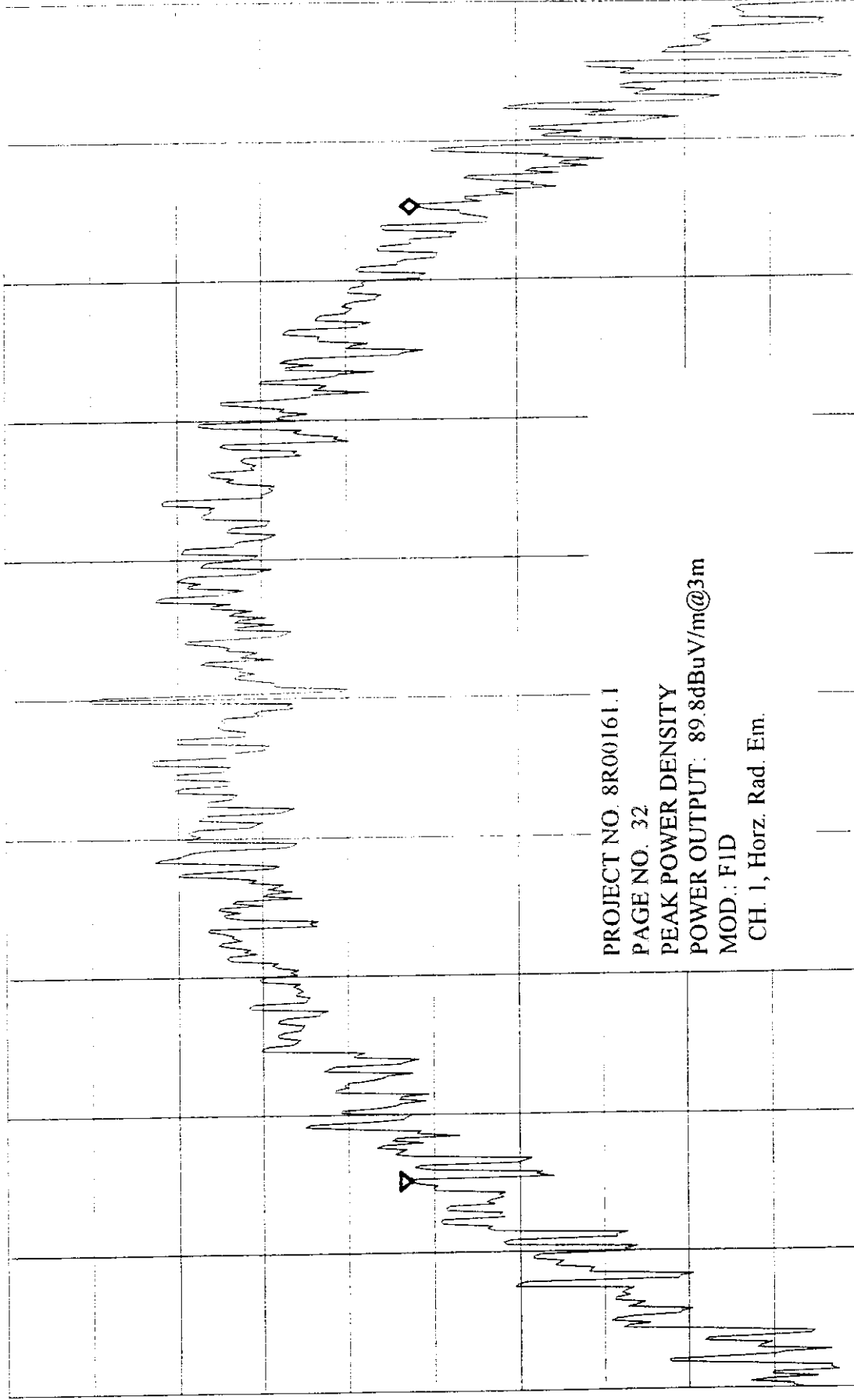
*ATTEN 10dB

MKR - .23dB

RL 52.0dB V

1.403MHz

2dB



CENTER 909.643MHz

SPAN 2.000MHz

*RBW 3.0kHz

*VIEW 10kHz

*SWP 667sec

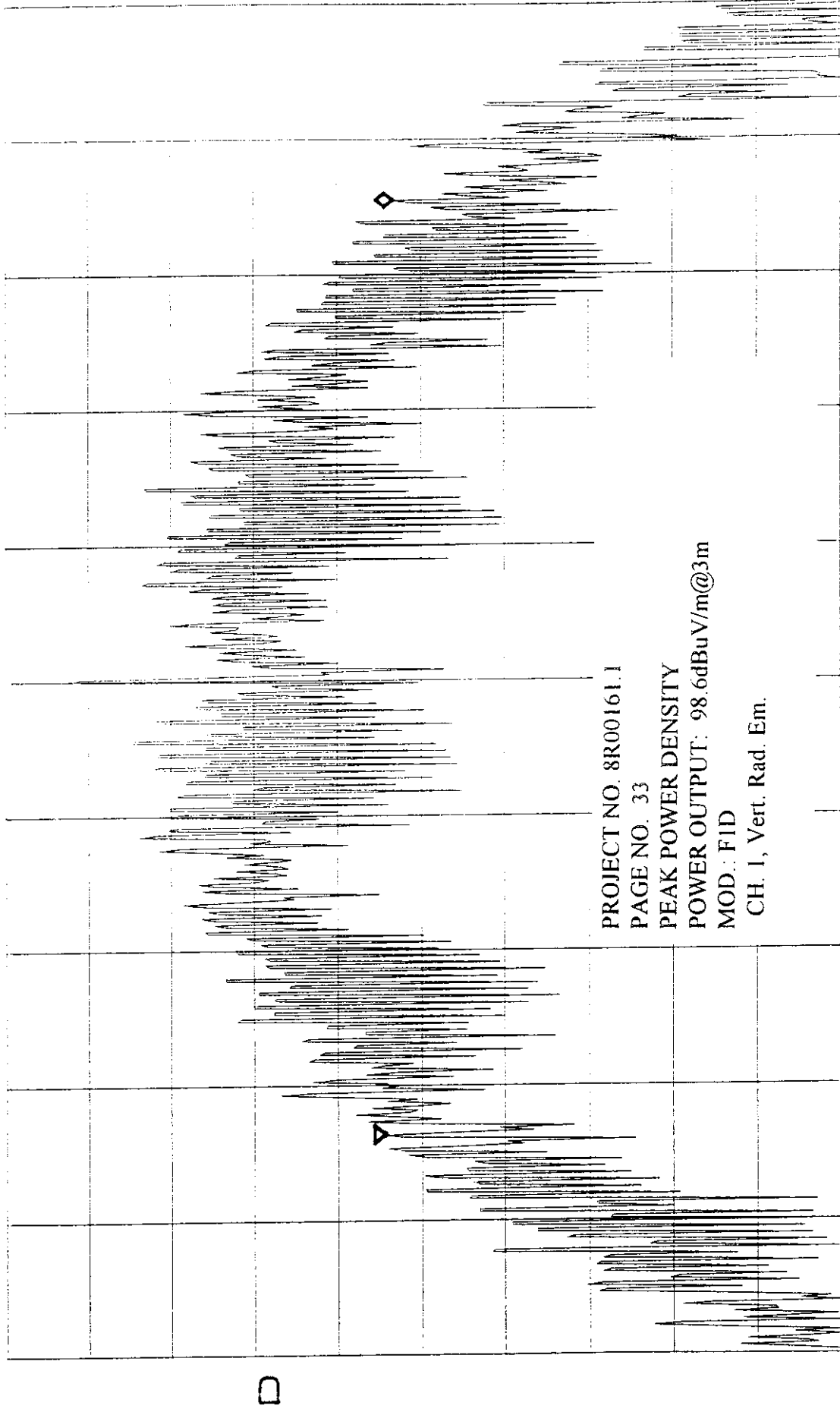
*ATTEN 10dB

RL 54.5dB V

2dB/

MKR -.20dB

1.383MHz



CENTER 909.640MHz

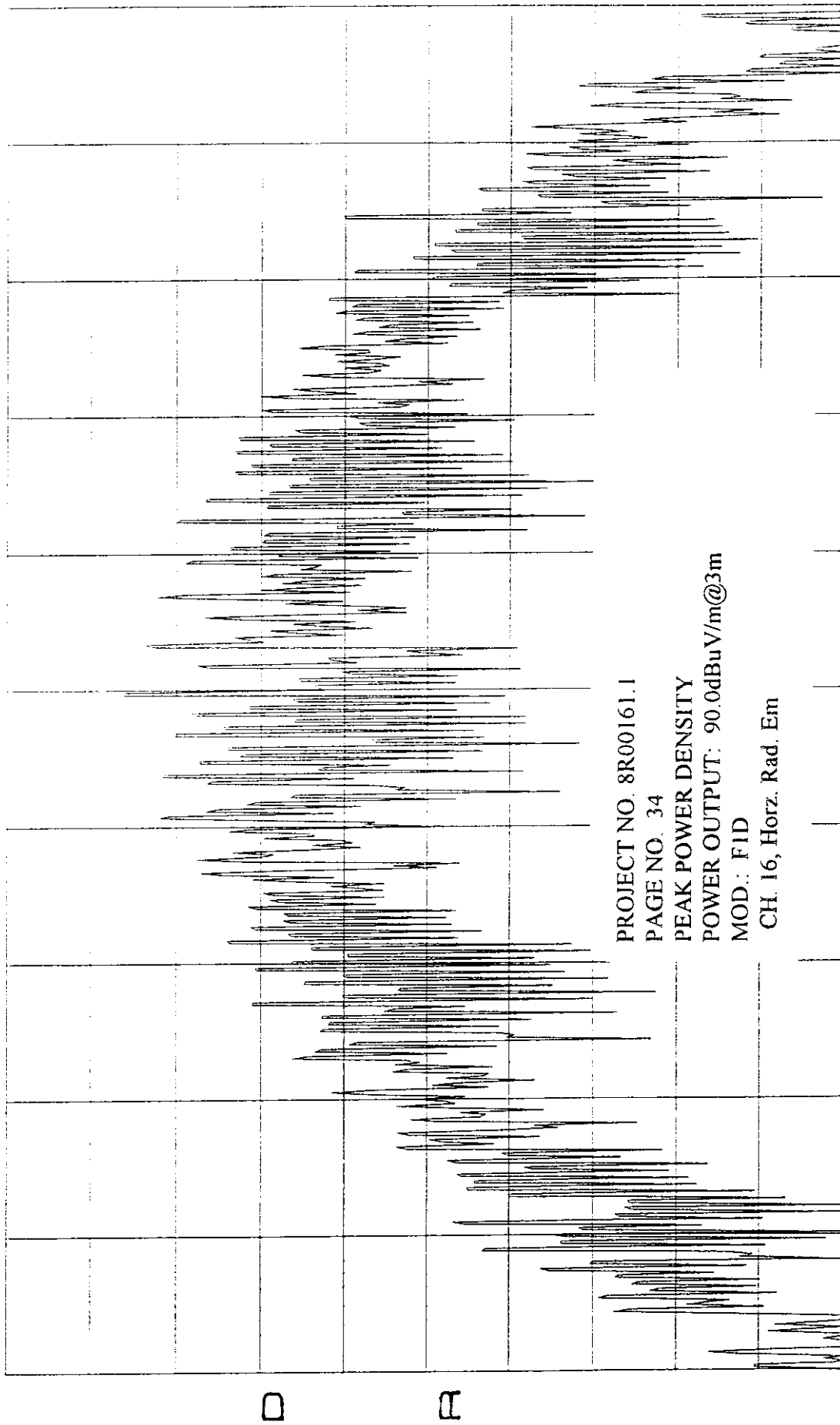
SPAN 2.000MHz

*RBW 3.0kHz

*VBW 10kHz

*SWP 667sec

*ATTEN 0dB
RL 36.6dB V 2dB/

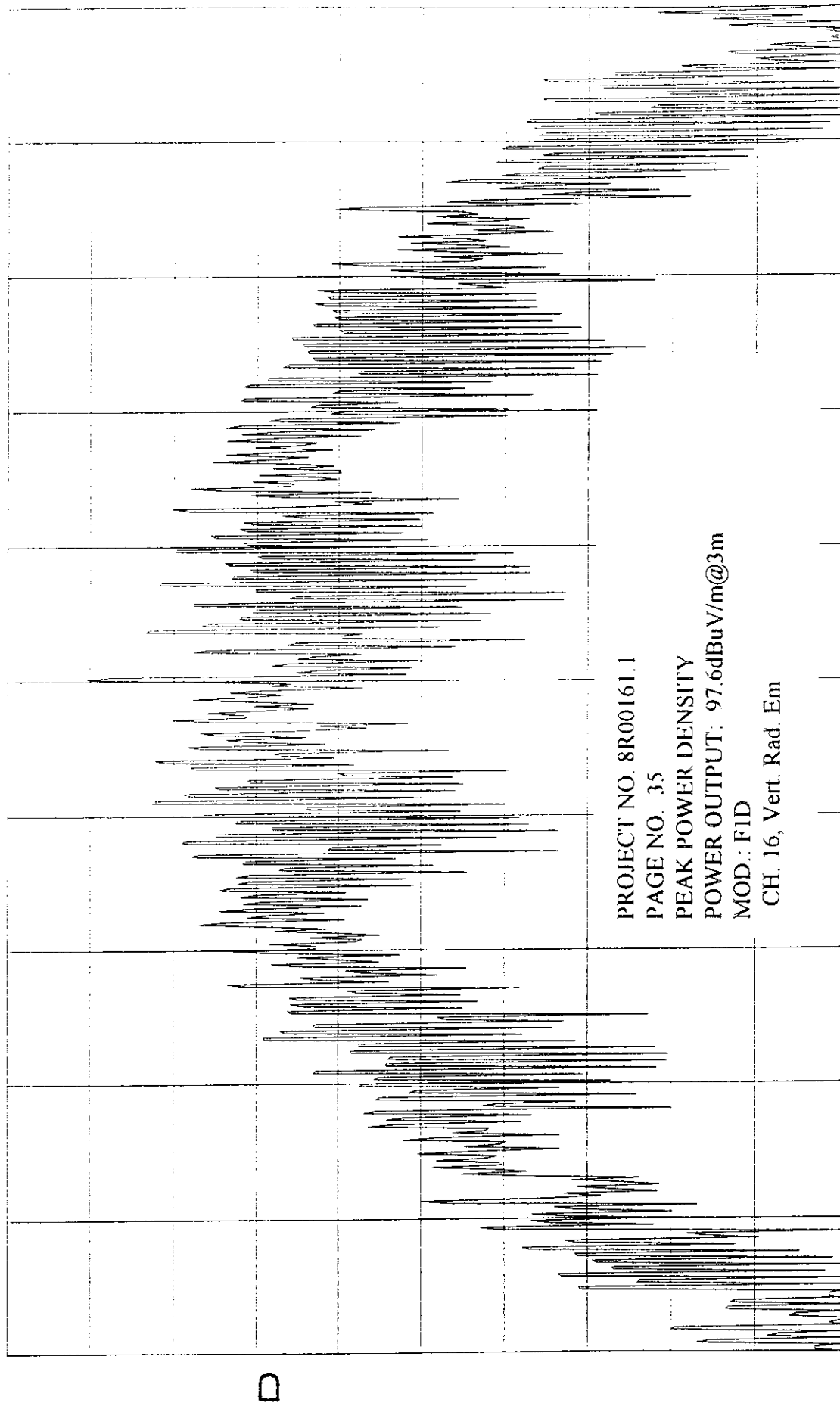


PROJECT NO. 8R00161.1
PAGE NO. 34
PEAK POWER DENSITY
POWER OUTPUT: 90.0dBuV/m@3m
MOD.: FID
CH. 16, Horiz. Rad. Em

CENTER 915.047MHZ
*RBW 3.0KHZ *VBW 10KHZ
SPAN 2.000MHZ *SWP 667sec

ATTEN 10dB

RL 52.5dB V 2dB



CENTER 915.040MHZ

*RBW 3.0KHZ

*VBW 10KHZ

SPAN 2.000MHZ

*SWP 667sec

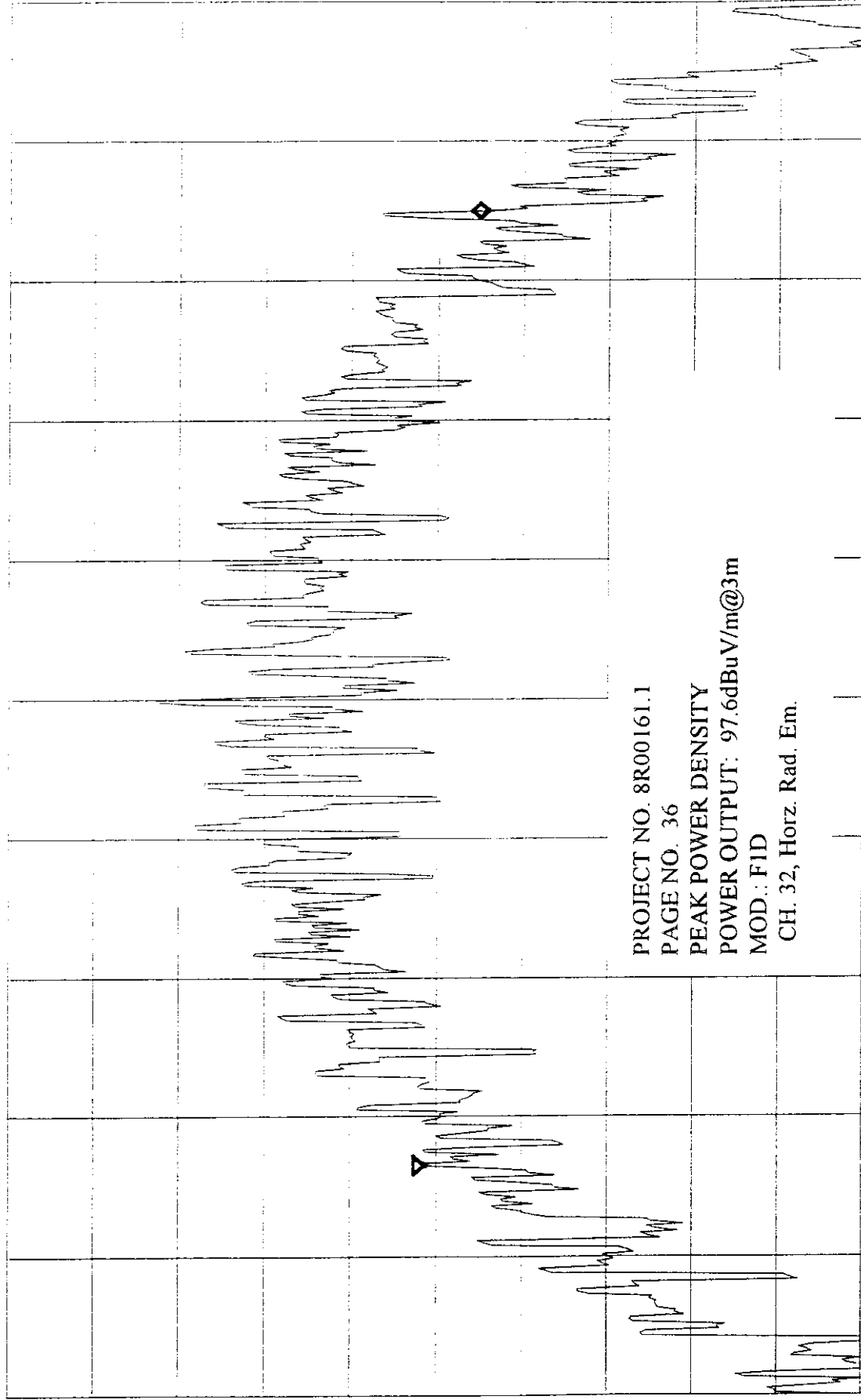
ATTEN 10dB ,

RL 53.6dB V

2dB/

MKR -1.44dB

1.370MHz



CENTER 920.807MHz

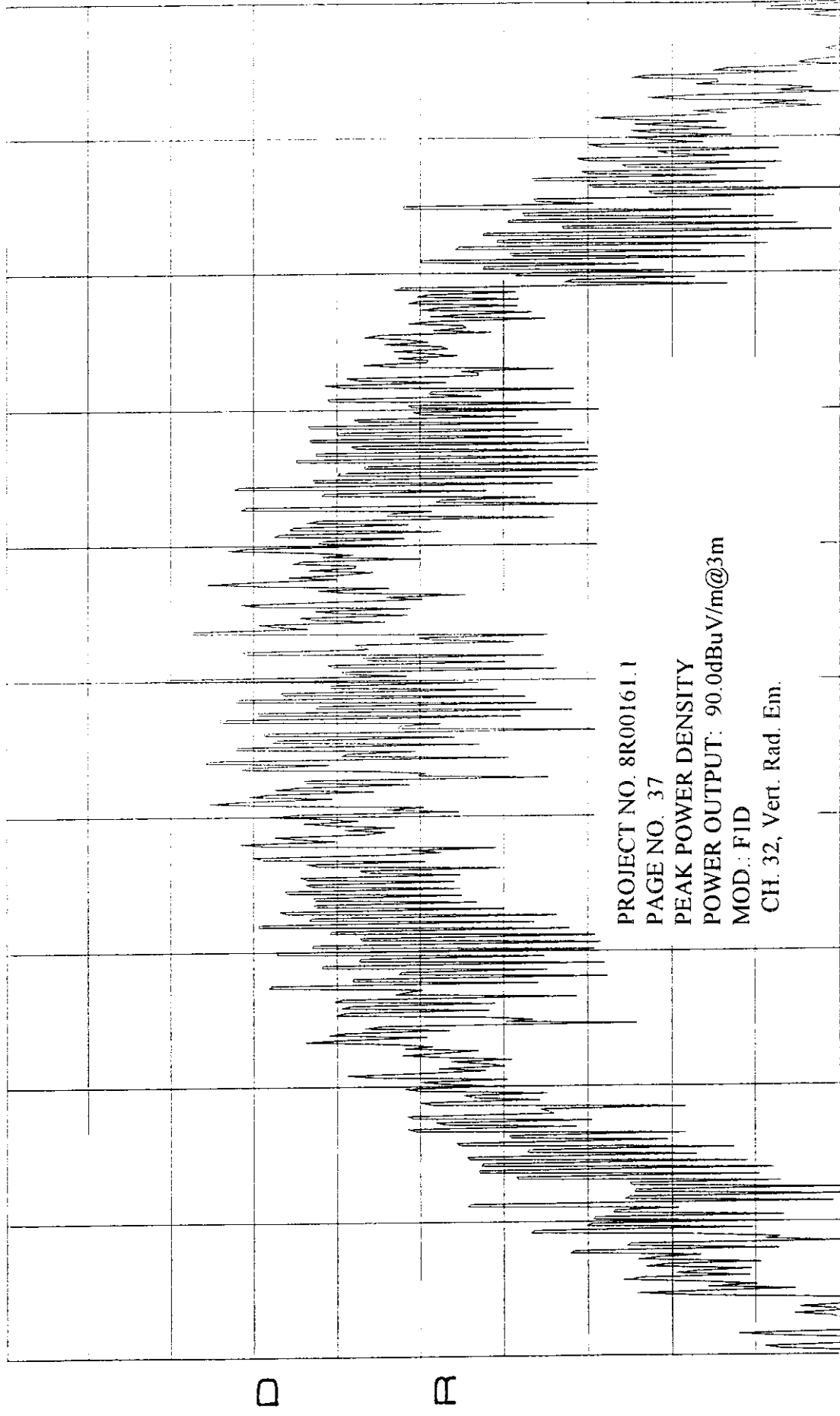
SPAN 2.000MHz

*RBW 3.0kHz

*VIEW 10kHz

*SWP 667sec

*ATTEN 0dB
RL 55.4dB V 2dB/



CENTER 920.800MHZ

SPAN 2.000MHZ

*RBW 3.0KHZ

*VBW 10KHZ

*SWP 667sec

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

NAME OF TEST: Processing Gain

PARA. NO.: 15.247(e)

TESTED BY: Panasonic Supplier Data

DATE: May 7, 1998

TEST RESULTS: Complies. The processing gain of the system is 14.2 dB.

MEASUREMENT DATA: See attached data.

BER:

S/N_{out} :

J/S ratio:

3/6
87 35

KX-TG210B Process Gain

Kyushu Matsushita Electric Co., Ltd
Forth Division Engineering Department
H.Hamada

	Portable Unit	Base Unit
Δf (kHz)	D/U Ratio(dB)	D/U Ratio(dB)
1200	26.2	28.0
1150	22.2	27.0
1100	22.2	25.4
1050	22.5	23.6
1000	18.7	21.9
950	16.7	21.2
900	18.1	18.9
850	15.0	18.0
800	12.6	17.1
750	14.1	14.3
700	13.9	13.6
650	10.7	13.0
600	10.9	11.5
550	12.1	10.0
500	10.4	11.3
450	10.0	11.2
400		10.1
350		
300	9.9	
250		
200		
150	10.4	
100		
50		
0		
-50	9.2	12.3
-100	12.8	12.0
-150		
-200	9.0	10.6
-250	9.3	11.6
-300	10.0	
-350		10.5
-400	12.0	11.2
-450	11.0	12.9
-500	11.5	11.6
-550	10.9	11.6
-600	16.5	13.4
-650	14.0	14.0
-700	13.0	14.9
-750	16.8	16.5
-800	16.8	18.6
-850	20.0	21.5
-900	21.3	24.2
-950	21.5	25.7
-1000	25.5	25.7
-1050	24.4	26.0
-1100	26.6	26.6
-1150	31.3	26.9
-1200	28.0	27.4

D/U Ratio = (Desire Signal) / (Undesired Signal) Ratio

channel : 1ch

worst 20% points
These points are excluded.

OMj Jamming Margin

Mj(U/S ratio)	
Portable	9.2dB
Base	10.1dB

*Mj level is worst value after exclude worst 20% point

OProcess Gain

$$G_p = (S/N)_o + M_j + L_{sys}$$

$$(S/N)_o = 3.0\text{dB}$$

$$L_{sys} = 2.0\text{dB}$$

Mj: compare above table.

Gp (Process Gain)	
Portable	14.2dB (=9.2+3+2)
Base	15.1dB (=10.1+3+2)

OMeasurement Equipment

Signal Generator

HEWLETT PACKERD ESG-D3000A

Audio Analyzer

HEWLETT PACKERD 8903B

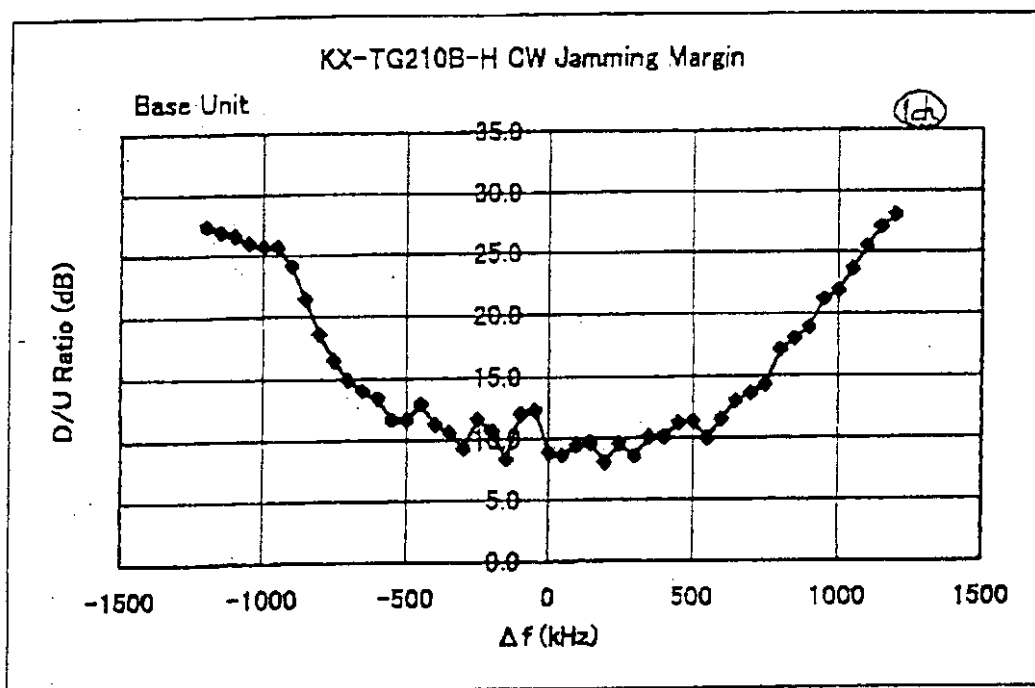
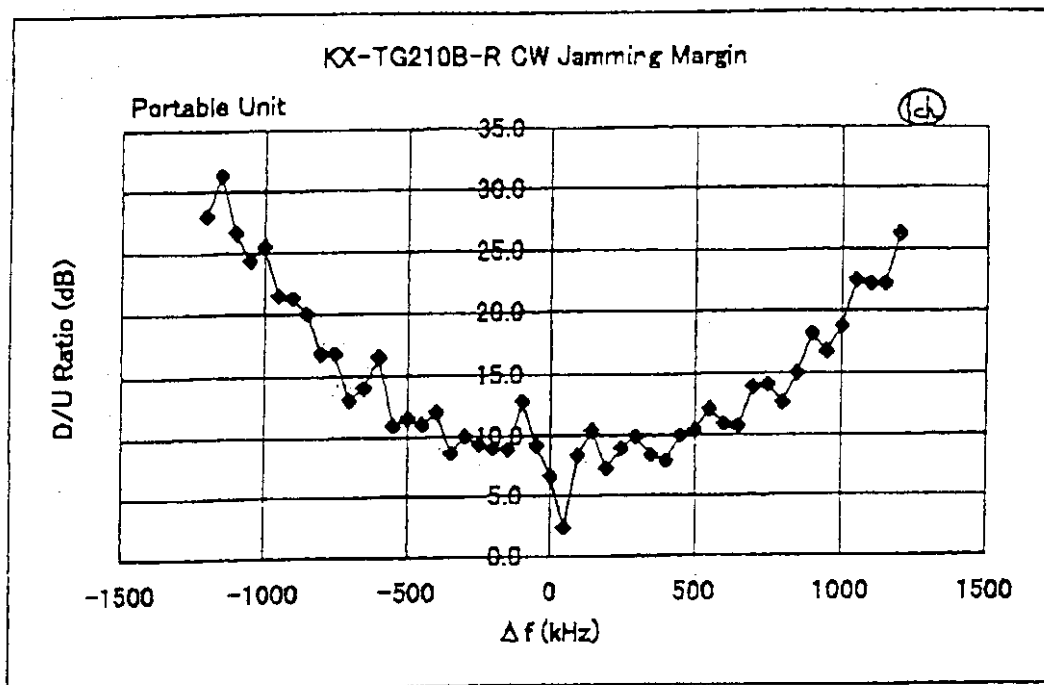
Four port junction Pad

Anritsu MA1812A

50 ohm terminator

HEWLETT PACKERD 908A

4/6
pg 36



Project No.: 8R00161.1
Processing Gain
Page No.: 40 of 41

2/6
pg 37

KK-TG210 Process gain

$$G_p = (C/N)_0 + M_j + L_{sys}$$

G_p = KK-TG210 Process Gain

$(S/N)_0$ = S/N ratio for keeping 12dB SINAD

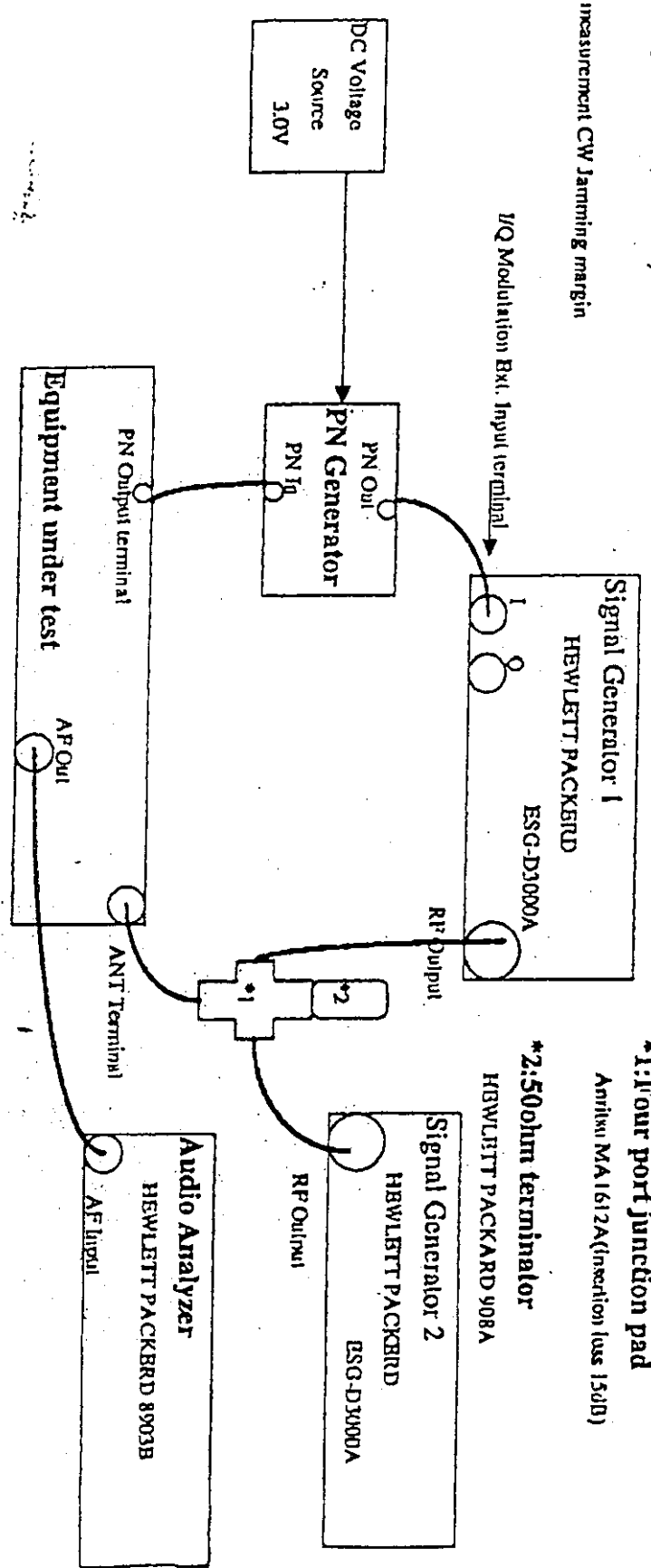
The Base band signals of this model are analog.

$(S/N)_0$ is 3dB on this system.

M_j = 1/S ratio (CW Jamming margin method)

L_{sys} = system loss (≤ 2.0 dB)

1. Method of measurement CW Jamming margin



*1: Four port junction pad

Anritsu MA1612A (insertion loss 1.5dB)

*2: 50 ohm terminator

HEWLETT PACKARD 908A

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

ANNEX A

TEST METHODOLOGIES

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

NAME OF TEST: Powerline Conducted Emissions	15.207(a)
---	-----------

TEST CONDITIONS: Standard Temperature and Humidity
 Standard Test Voltage

MINIMUM STANDARD: The R.F. that is conducted back onto the AC power line on any
 frequency within the band 0.45 to 30 MHz shall not exceed 250 μ V
 (48 dB μ V) across 50 ohms.

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 15.247(a)(2)
----------------------------------	-------------------------

TEST CONDITIONS: Standard Temperature and Humidity
 Standard Test Voltage

MINIMUM STANDARD: The minimum bandwidth shall be at least 500 kHz.

METHOD OF MEASUREMENT:

The spectrum analyzer is set as follows:

RBW: 100 kHz

VBW: 100 kHz

Span: >RBW

LOG dB/div.: 2 dB

Sweep: Auto

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

NAME OF TEST: Peak Power Output

PARA. NO.: 15.247(b)

TEST CONDITIONS: Standard Temperature and Humidity
Standard Test Voltage

MINIMUM STANDARD: The maximum peak power output shall not exceed 1 watt.
If transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

DIRECT MEASUREMENT METHOD FOR DETACHABLE ANTENNAS:

If the antenna is detachable, a peak power meter is used to measure the power output with the transmitter operating into a 50 ohm load.

CALCULATION OF EIRP FOR INTEGRAL ANTENNA:

If the antenna is not detachable from the circuit then the Peak Power Output is derived from the peak radiated field strength of the fundamental emission by using the plane wave relation $GP/4\pi R^2 = E^2/120\pi$ and proceeding as follows:

$$P = \frac{E^2 R^2}{30G} = \frac{E^2 3^2}{30G}$$

where.

P = the equivalent isotropic radiated power in watts

E = the maximum measured field strength in V/m

R = the measurement range (3 meters)

G = the numeric gain of the transmit antenna in relation to an isotropic radiator

The RBW of the spectrum analyzer shall be set to a value greater than the measured 6 dB occupied bandwidth of the E.U.T.

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

NAME OF TEST: Spurious Emissions at Antenna Terminals PARA. NO.: 15.247(c)

TEST CONDITIONS: Standard Temperature and Humidity
Standard Test Voltage

MINIMUM STANDARD: In any 100kHz bandwidth outside the 902 - 928 MHz bands emissions shall be at least 20 dB below the fundamental emission or shall not exceed the following field strength limits. Emissions falling in the restricted bands of 15.205 shall not exceed the following field strength limits:

Frequency (MHz)	Field Strength ($\mu\text{V/m @ 3m}$)	Field Strength (dB @ 3m)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

THE SPECTRUM WAS SEARCHED TO THE 10th HARMONIC

METHOD OF MEASUREMENT:

30 MHz - 10th harmonic plot

RBW: 100 kHz

VBW: 300 kHz

Sweep: Auto

Display line: -20 dBc

Lower Band Edge

RBW: At least 1% of span div.

VBW: >RBW

Span: As necessary to display any spurious at band edge.

Sweep: Auto

Center Frequency: 902 MHz

Marker: Peak of fundamental emission

Marker Δ : Peak of highest spurious level below 902 MHzUpper Band Edge

RBW: At least 1% of span div.

VBW: >RBW

Span: As necessary to display any spurious at band edge.

Sweep: Auto

Center Frequency: 928 MHz

Marker: Peak of fundamental emission

Marker Δ : Peak of highest spurious level above 928 MHz

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

NAME OF TEST: Radiated Spurious Emissions

PARA. NO.: 15.247(c)

TEST CONDITIONS: Standard Temperature and Humidity
Standard Test Voltage

MINIMUM STANDARD: In any 100kHz bandwidth outside the 902 - 928 MHz bands emissions shall be at least 20 dB below the fundamental emission or shall not exceed the following field strength limits. **Emissions falling in the restricted bands of 15.205 shall not exceed the following field strength limits:**

Frequency (MHz)	Field Strength ($\mu\text{V/m @ 3m}$)	Field Strength (dB @ 3m)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

THE SPECTRUM WAS SEARCHED TO THE 10th HARMONIC15.205 Restricted Bands

MHz	MHz	MHz	GHz
0.09-0.11	16.42-16.423	399.9-410	4.5-5.25
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.125-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2655-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41	1718		

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

NAME OF TEST: Transmitter Power Density

PARA. NO.: 15.247(d)

TEST CONDITIONS: Standard Temperature and Humidity
Standard Test VoltageMINIMUM STANDARD: The transmitted power density averaged over any 1 second interval shall not be greater than -8 dBm in any 3 kHz bandwidth.METHOD OF MEASUREMENT:
The spectrum analyzer is set as follows:

RBW: 3 kHz

VBW: >3 kHzSpan: $\Rightarrow$ measured 6 dB bandwidthSweep: $\text{Span(kHz)}/3$ (i.e. for a span of 1.5 MHz the sweep rate is $1500/3 = 500$ sec.

LOG dB/div.: 2 dB

NOTE: For devices with spectrum line spacing ≤ 3 kHz, the RBW of the analyzer is reduced until the spectral lines are resolved. The measurement data is normalized to 3 kHz by summing the power of all the individual spectral lines within a 3 kHz band in linear power units.

FOR DEVICES WITH INTEGRAL ANTENNA:

For devices with non-detachable antennas, the received field strength is peaked and the spectrum analyzer is set as above. The peak emission level is then measured and converted to a field strength by adding the appropriate antenna factor and cable loss. This field strength is then converted to an equivalent isotropic radiated power using the same method as described for Peak Power output.

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

NAME OF TEST: Processing Gain

PARA. NO.: 15.247(e)

TEST CONDITIONS: Standard Temperature and Humidity
Standard Test Voltage

MINIMUM STANDARD: The processing gain shall be at least 10 dB.

METHOD OF MEASUREMENT:

The CW jamming margin method was used to determine the processing gain. A CW signal generator is stepped across the passband of the receiver in 50 kHz increments. At each point the signal generator level required to obtain the recommended bit error rate is recorded. The jammer to signal ratio (J/S) is then calculated. The worst 20% of the J/S points is discarded. The lowest remaining J/S ratio is used to calculate the processing gain.

CALCULATION OF PROCESSING GAIN:

The processing gain was determined by measuring the jamming margin of the E.U.T. and using the following formula:

$$\text{Jamming Margin} = G_p - (S/N)_{\text{out}} - L_{\text{sys}}$$

For a receiver using non-coherent detection the value $(S/N)_{\text{out}}$ is calculated using the formula:

$P_e = (1/2)\text{EXP}\{-E/2N_o\}$ where P_e is the probability of error (minimum Bit Error Rate required for proper operation).

E/N_o is $(S/N)_{\text{out}}$

For example, for a bit error rate of 10^{-4} a S/N ratio of 12.3 dB is required.

L_{sys} (system losses) is assumed to be 2 dB.

$$\text{Therefore } G_p = M_j + (S/N)_{\text{out}} + L_{\text{sys}}$$

Measurement performed at 915 MHz.

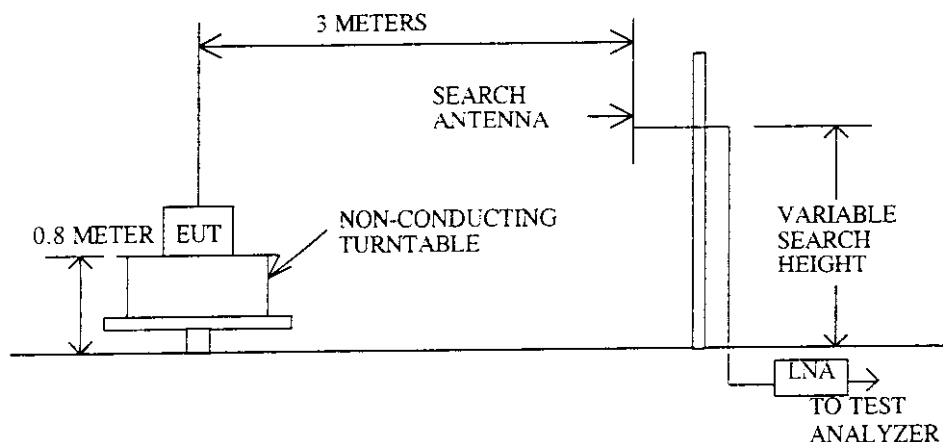
EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

ANNEX B

BLOCK DIAGRAMS

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

TEST SITE FOR RADIATED EMISSIONS



Below 1 GHz

Peak detector.

RBW = 100 kHz

Above 1 GHz for Peak emission levels

Peak detector

RBW = 1 MHz

VBW = >RBW

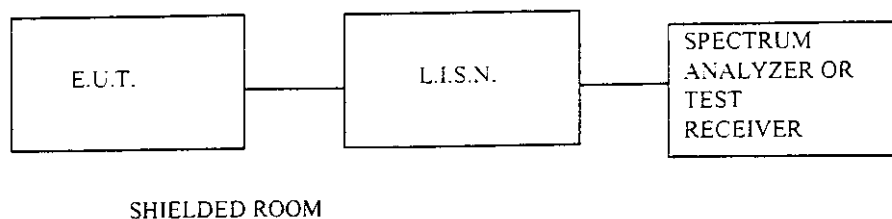
Above 1 GHz for Average emission levels

Peak detector

RBW = 1 MHz

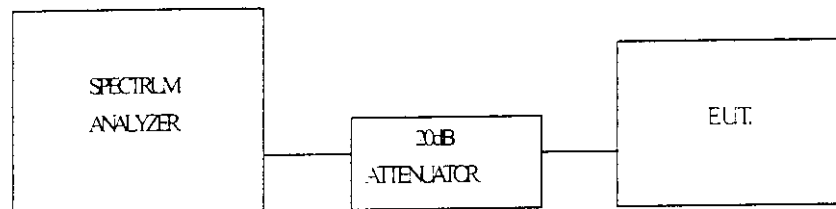
VBW = 10 Hz

CONDUCTED EMISSIONS



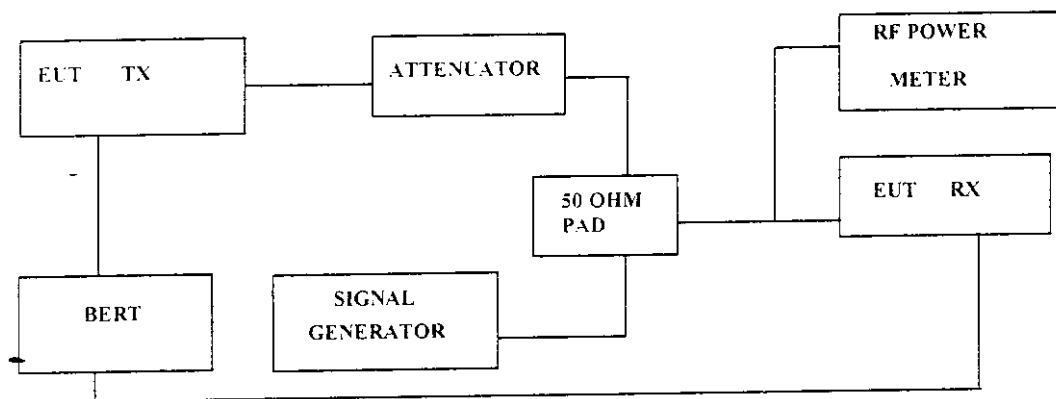
EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

TRANSMITTER POWER DENSITY & PEAK POWER AT ANTENNA TERMINALS



If the E.U.T. has an integral (non-detachable) antenna, the above test is performed as a radiated measurement and the result is reported as EIRP.

PROCESSING GAIN



NOTE: This is a typical setup. The setup may vary slightly since many devices have BER test functions built into the device.

KTL - Certelecom Laboratories Inc.

FCC PART 15, SUBPART C
DIRECT SEQUENCE TRANSMITTERS
PROJECT NO.: 8R00161.1
ANNEX C

EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset

ANNEX C

TEST EQUIPMENT LIST

*EQUIPMENT: 2.4 GHz Spread Spectrum Cordless Telephone Handset***RADIO TEST EQUIPMENT LIST**

CAL CYCLE	EQUIPMENT	MANUFACTURER	MODEL	SERIAL	LAST CAL.	NEXT CAL.	
	Plotter	Hewlett Packard	7470A	2308A30807	NCR	NCR	
1 Year	Spectrum Analyzer-2	Hewlett Packard	8566B	1950A00400	Oct. 3/97	Oct. 3/98	
1 Year	Spectrum Analyzer Display-2	Hewlett Packard	85662A	1950A01177	Oct. 3/97	Oct. 3/98	
1 Year	Quasi Peak Adaptor-2	Hewlett Packard	85650A	2251A00620	Aug. 19/97	Aug. 19/98	
1 Year	Attenuator	Narda	765-20	9510	July 23/97	July 23/98	
1 Year	LISN(peripheral)	Tegam	95300-50	T-109014/15	July 25/97	July 25/98	
1 Year	Receiver	Rohde & Schwarz	ESVS-30	843710/002	Oct. 21/97	Oct. 21/98	
2 Year	Horn Antenna	EMCO #2	3115	4336	Oct. 30/97	Oct. 30/99	
1 Year	Log Periodic Antenna	EMCO	LPA-25	1141	July 10/97	July 10/98	
1 Year	Biconical (1) Antenna	EMCO	3109	9204-2708	July 11/97	July 11/98	
1 Year	Plotter	Hewlett Packard	7550A	FA001129	NCR	NCR	
1 Year	Spectrum Analyzer	Hewlett Packard	8565E	3804A00881	Feb. 27/98	Feb. 27/99	

NA: Not Applicable

NCR: No Cal Required