

EMC EMISSION - TEST REPORTTest Report No. **B023001** Issue Date September 11, 2000Model / Serial No. DGR09 / 902-1164Product Type Transceiver ModuleClient Freewave TechnologiesManufacturer Freewave TechnologiesLicense holder Freewave TechnologiesAddress 1880 Flatiron Court, Suite FBoulder, CO 80301

Test Criteria Applied FCC Part 15 15.247C

Test Start Date: 10 July 2000Test End Date: 18 August 2000Test Result **PASS** **FAIL**Test Report Project No. BC1G023001Total Pages including
Appendices 52
Reviewed By : Felix J. Chavez
Reviewed By : Robert Cresswell

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EMISSIONS TEST REGULATIONS :

The tests were performed according to following regulations :

- - Federal Communication Commission part 15
- - Federal Communication Commission part 15, Subpart C
- - Class A
- - 15.209
- - Class B
- - 15.247

All tests performed according to ANSI C63.4.

Emission Test Results:

Conducted emissions 450 kHz - 30 MHz

Test Result - PASS - FAIL - Not Applicable

Passing Margin 3.5 dB at 1.785 MHz

Remarks: Conducted emissions test was performed on HP model E3620A DC power supply.

Radiated emissions (electric field) 30 MHz - 5000 MHz (Unintentional Radiator)

Test Result - PASS - FAIL - Not Applicable

Passing Margin 3.1 dB at 1864.84 MHz

Remarks: _____

Radiated emissions (electric field) 906 MHz - 9278.6 MHz (Intentional Radiator)

Test Result - PASS - FAIL - Not Applicable

Passing Margin 12.1 dB at 3608.1 MHz

Remarks: _____

Fundamental and Spurious Emissions

GENERAL REMARKS:

Modifications required to pass: None

Test Specification Deviations: Additions to or Exclusions from: None

Test Equipment Used

Equipment Report

Project Number: B0230
Company Name: Freewave

Project Date: 10-Jul-2000 to 18-Aug-2000

Equip ID	Manufacturer	Model Number	Serial Number	Description	Date	Calibration Interval	Due	Cal Code
Test Performed C		Conducted Emissions						
8004	RHODE & SCHWARZ	ESH3	872318/036	Low Frequency Receiver (9 kHz - 30 MHz)	13-Sep-1999	12	12-Sep-2000	G
8183	EMCO	3825/2	9202-1946	LISN				G
8258	POLARAD	ESH3-Z2	357.881J.32	Transient Limiter				Y
8308	EMCO	3825/2	9202-1945	LISN				G
Test Performed R		Radiated Emissions						
7514	A.H.SYSTEMS	SAS-200/512	104	Log Periodic Antenna (200-1500 MHz)	28-Jul-1999	13	27-Aug-2000	G
7575	MINI-CIRCUITS LAB	ZHL-1042j	D0122299-6	Pre Amplifier				B
7603	MINI-CIRCUITS LAB	ZHL-1042J	D012600-16	Amplifier				B
8051	HEWLETT PACKARD	85662A	2112A02220	Display Section	13-Jun-2000	12	13-Jun-2001	G
8052	HEWLETT PACKARD	8566B	2115A00853	Spectrum Analyzer	13-Jun-2000	12	13-Jun-2001	G
8207	AVANTEK	AWT-18037	1002	RF Pre-Amplifier (8-18 GHz)	02-Dec-1999	12	01-Dec-2000	G
8208	AVANTEK	AFT97-8434	1007	RF Pre-Amplifier (4-8 GHz)	02-Dec-1999	12	01-Dec-2000	G
8213	HEWLETT PACKARD	8566B	2410A00154	Spectrum Analyzer (dc-22 GHz)	12-May-2000	12	12-May-2001	G
8214	HEWLETT PACKARD	85662A	2403A08749	Display Section	12-May-2000	12	12-May-2001	G
8215	HEWLETT PACKARD	85650A	2043A00256	Quasi Peak Adapter	17-Jun-2000	12	17-Jun-2001	G
8219	HEWLETT PACKARD	8445B	2034A03223	Pre-Selector	15-Jun-2000	12	15-Jun-2001	G
8225	EMCO	3108	7059203-2457	Biconical Dipole Antenna	28-Jul-1999	13	27-Aug-2000	G
8264	EMCO	3115	9205-3886	Horn Antenna	20-May-2000	12	20-May-2001	G
8303	AH SYSTEMS	SAS-200/510	705	Log Periodic Antenna (300-1800 MHz)	30-Jul-1999	13	29-Aug-2000	Y
8345	HEWLETT-PACKARD	85650A	2811A01300	Q.P Adapter	23-Nov-1999	12	22-Nov-2000	G

Cal Code Legend: G=Out Source, Y=No Cal required, R=Out of Service, B=In-House Verification Required

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Appendix A

Transmitter Data Sheets

15.247 SPREAD SPECTRUM INTENTIONAL RADIATOR DATA

Date: 10-Jul-00
EUT: DGR09 w/10 dB Yagi Antenna
Customer: Aleksey Pozhidaev

Measured @
 Low Freq.: 902.05 MHz
 Mid Freq: 914.95 MHz
 High Freq: 927.86 MHz

Tx Mode: Radiated Measurements

Calculated Averaging Factor: -24.8 dB (20*Log(duty cycle))
Max Averaging Factor Allowed: -20 dB
Averaging Factor Applied: -20 dB
Fundamental Field Strength: 131 dBuV/m

Range	Specification	Peak Measurement dBuV/m @ MHz	Average Measurement dBuV/m @ MHz	Delta dB
2nd harmonic (1804-1855.8 MHz)	20 dB down	65.9	45.9	-19.9
3rd harmonic (2706-2783.6 MHz)	54 dBuV/m	59	39.0	-20.0
4th harmonic (3608-3711.5 MHz)	54 dBuV/m	61.9	41.9	-20.0
5th harmonic (4510-4639.3 MHz)	54 dBuV/m	48.7	28.7	-20.0
6th harmonic (5412-5567.2 MHz)	54 dBuV/m	48.2	28.2	-20.0
7th harmonic (6314-6495.1 MHz)	20 dB down	No emissions found above the receiver's noise floor		
8th harmonic (7216-7422.9 MHz)	54 dBuV/m	to 10th harmonic.		
9th harmonic (8118-8350.8 MHz)	54 dBuV/m			
10th harmonic (9020-9278.6 MHz)	54 dBuV/m			

Minimum Passing Margin: -12.1 dB

15.247 SPREAD SPECTRUM INTENTIONAL RADIATOR DATA

Date: 10-Jul-00 **Measured @**
EUT: DGR09 w/5 dB Omni Directional Antenna Low Freq.: 902.06 MHz
Customer: Aleksey Pozhidaev Mid Freq: 914.96 MHz
 High Freq: 927.85 MHz

Tx Mode: Radiated Measurements

Calculated Averaging Factor: -24.8 dB (20*Log(duty cycle))
Max Averaging Factor Allowed: -20 dB
Averaging Factor Applied: -20 dB
Fundamental Field Strength: 127.8 dBuV/m

Range	Specification	Peak Measurement dBuV/m @ MHz	Average Measurement dBuV/m @ MHz	Delta dB
2nd harmonic (1804-1855.7 MHz)	20 dB down	59	1855.6	1855.6 -48.8
3rd harmonic (2706-2783.6 MHz)	54 dBuV/m	60.1	2706.1	2706.1 -13.9
4th harmonic (3608-3711.4 MHz)	54 dBuV/m	59.8	3608.1	3608.1 -14.2
5th harmonic (4510-4639.3 MHz)	54 dBuV/m	55.1	4639.2	4639.2 -18.9
6th harmonic (5412-5567.1 MHz)	54 dBuV/m	59.5	5566.8	5566.8 -14.5
7th harmonic (6314-6495 MHz)	20 dB down	56.3	6314.4	6314.4 -51.5
8th harmonic (7216-7422.8 MHz)	54 dBuV/m	No emissions found above the receiver's noise floor		
9th harmonic (8118-8350.7 MHz)	54 dBuV/m	to 10th harmonic.		
10th harmonic (9020-9278.5 MHz)	54 dBuV/m			

Minimum Passing Margin: -13.9 dB

Appendix B

Detailed Test Data Sheets

Radiated Electromagnetic Emissions



Test Report #: B0230 Run 02 Test Area: Pinewood Site 1 (3m)
 Test Method: N/A Test Date: 10-Jul-2000
 EUT Model #: DGR09 EUT Power: 12VDC
 EUT Serial #: 902-1164 Temperature: _____ °C
 Manufacturer: Freewave Technologies Relative Humidity: _____ %
 EUT Description: Transceiver module Air Pressure: _____ kPa
 Notes: _____ Page: 1 of 4
10 dB Yagi antenna

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB) (dBm) (dB)	FINAL (dBuV)	POL / HGT / AZ (m) (DEG)	DELTA1 (dB) N/A	DELTA2 (dB) N/A
902.06	105.6 Pk	2.0 / 22.7 / 0.0	130.3	H / 1.0 / 0.0	N/A	N/A
914.95	105.0 Pk	2.0 / 22.8 / 0.0	129.8	H / 1.0 / 0.0	N/A	N/A
927.86	101.4 Pk	2.0 / 23.4 / 0.0	126.8	H / 1.0 / 0.0	N/A	N/A
927.86	101.8 Pk	2.0 / 23.4 / 0.0	127.2	V / 1.0 / 0.0	N/A	N/A
914.96	104.9 Pk	2.0 / 22.8 / 0.0	129.7	V / 1.0 / 0.0	N/A	N/A
902.05	106.3 Pk	2.0 / 22.7 / 0.0	131.0	V / 1.0 / 0.0	N/A	N/A
1803.88	59.1 Pk	2.8 / 27.7 / 28.9	60.7	V / 1.0 / 0.0	N/A	N/A
2705.99	50.5 Pk	3.6 / 31.6 / 29.3	56.3	V / 1.4 / 334.0	N/A	N/A
3608.05	53.5 Pk	4.1 / 33.5 / 29.2	61.9	V / 1.2 / 45.0	N/A	N/A
3659.70	52.9 Pk	4.1 / 33.6 / 29.2	61.4	V / 1.2 / 45.0	N/A	N/A
2744.75	48.1 Pk	3.6 / 31.7 / 29.3	54.0	V / 1.2 / 334.0	N/A	N/A
1829.80	57.2 Pk	2.8 / 27.8 / 29.0	58.9	V / 1.0 / 0.0	N/A	N/A
1855.65	54.1 Pk	2.9 / 27.9 / 29.0	55.8	V / 1.0 / 0.0	N/A	N/A
2783.45	49.0 Pk	3.6 / 31.8 / 29.3	55.1	V / 1.3 / 330.0	N/A	N/A
3711.34	50.1 Pk	4.2 / 33.7 / 29.2	58.8	V / 1.2 / 43.0	N/A	N/A
1855.70	64.2 Pk	2.9 / 27.9 / 29.0	65.9	H / 1.1 / 199.0	N/A	N/A
2783.50	52.9 Pk	3.6 / 31.8 / 29.3	59.0	H / 1.1 / 205.0	N/A	N/A
3711.32	48.5 Pk	4.2 / 33.7 / 29.2	57.1	H / 1.1 / 328.0	N/A	N/A
1829.84	56.8 Pk	2.8 / 27.8 / 29.0	58.5	H / 1.2 / 233.0	N/A	N/A
2744.79	46.9 Pk	3.6 / 31.7 / 29.3	52.9	H / 1.2 / 200.0	N/A	N/A
3659.75	51.1 Pk	4.1 / 33.6 / 29.2	59.6	H / 1.2 / 45.0	N/A	N/A

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Radiated Electromagnetic Emissions



Test Report #: B0230 Run 02 Test Area: Pinewood Site 1 (3m)
 Test Method: N/A Test Date: 10-Jul-2000
 EUT Model #: DGR09 EUT Power: 12VDC
 EUT Serial #: 902-1164 Temperature: _____ °C
 Manufacturer: Freewave Technologies Relative Humidity: _____ %
 EUT Description: Transceiver module Air Pressure: _____ kPa
 Notes: _____ Page: 2 of 4
10 dB Yagi antenna

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB) (dB/m) (dB)	FINAL (dBuV)	POL / HGT / AZ (m) (DEG)	DELTA1 (dB) N/A	DELTA2 (dB) N/A
1803.88	62.4 Pk	2.8 / 27.7 / 28.9	64.0	H / 1.1 / 147.0	N/A	N/A
2705.97	51.1 Pk	3.6 / 31.6 / 29.3	56.9	H / 1.1 / 190.0	N/A	N/A
3608.24	53.1 Pk	4.1 / 33.5 / 29.2	61.5	H / 1.1 / 77.0	N/A	N/A
No emissions found above the receiver's noise floor to 10th harmonic.						
4510.22	49.0 Pk	4.7 / 33.3 / 40.9	46.0	H / 1.1 / 0.0	N/A	N/A
5412.29	46.2 Pk	5.2 / 36.7 / 40.8	47.3	H / 1.1 / 0.0	N/A	N/A
No emissions found above the receiver's noise floor to 10th harmonic.						
4574.74	46.8 Pk	4.8 / 33.6 / 41.0	44.2	H / 1.1 / 0.0	N/A	N/A
5489.69	46.8 Pk	5.2 / 36.9 / 40.7	48.2	H / 1.1 / 0.0	N/A	N/A
No emissions found above the receiver's noise floor to 10th harmonic.						
4639.29	47.0 Pk	4.9 / 34.0 / 41.0	44.8	H / 1.1 / 0.0	N/A	N/A
5567.15	45.2 Pk	5.2 / 37.0 / 40.7	46.8	H / 1.1 / 0.0	N/A	N/A
No emissions found above the receiver's noise floor to 10th harmonic.						
4639.24	51.0 Pk	4.9 / 34.0 / 41.0	48.7	V / 1.1 / 134.0	N/A	N/A
5567.13	43.8 Pk	5.2 / 37.0 / 40.7	45.3	V / 1.1 / 0.0	N/A	N/A
No emissions found above the receiver's noise floor to 10th harmonic.						
4574.75	49.3 Pk	4.8 / 33.6 / 41.0	46.7	V / 1.1 / 134.0	N/A	N/A
5489.69	45.2 Pk	5.2 / 36.9 / 40.7	46.6	V / 1.1 / 0.0	N/A	N/A
No emissions found above the receiver's noise floor to 10th harmonic.						

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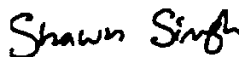
Radiated Electromagnetic Emissions



Test Report #: B0230 Run 02 Test Area: Pinewood Site 1 (3m)
 Test Method: N/A Test Date: 10-Jul-2000
 EUT Model #: DGR09 EUT Power: 12VDC
 EUT Serial #: 902-1164 Temperature: _____ °C
 Manufacturer: Freewave Technologies Relative Humidity: _____ %
 EUT Description: Transceiver module Air Pressure: _____ kPa
 Notes: _____ Page: 3 of 4
10 dB Yagi antenna

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB) (dB\m) (dB)	FINAL (dBuV)	POL / HGT / AZ (m) (DEG)	DELTA1 (dB) N/A	DELTA2 (dB) N/A
4510.29	49.7 Pk	4.7 / 33.3 / 40.9	46.8	V / 1.1 / 0.0	N/A	N/A
5412.35	45.1 Pk	5.2 / 36.7 / 40.8	46.1	V / 1.1 / 0.0	N/A	N/A
No emissions found above the receiver's noise floor to 10th harmonic.						

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Radiated Electromagnetic Emissions



Test Report #: B0230 Run 02 Test Area: Pinewood Site 1 (3m)
 Test Method: N/A Test Date: 10-Jul-2000
 EUT Model #: DGR09 EUT Power: 12VDC
 EUT Serial #: 902-1164 Temperature: _____ °C
 Manufacturer: Freewave Technologies Relative Humidity: _____ %
 EUT Description: Transceiver module Air Pressure: _____ kPa
 Notes: Hopping Mode Page: 4 of 4
10 dB Yagi antenna

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB) (dBm) (dB)	FINAL (dBuV)	POL / HGT / AZ (m) (DEG)	DELTA1 (dB) N/A	DELTA2 (dB) N/A
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***** MEASUREMENT SUMMARY *****						
902.05	106.3 Pk	2.0 / 22.7 / 0.0	131.0	V / 1.0 / 0.0	N/A	N/A
914.95	105.0 Pk	2.0 / 22.8 / 0.0	129.8	H / 1.0 / 0.0	N/A	N/A
927.86	101.8 Pk	2.0 / 23.4 / 0.0	127.2	V / 1.0 / 0.0	N/A	N/A
1803.88	62.4 Pk	2.8 / 27.7 / 28.9	64.0	H / 1.1 / 147.0	N/A	N/A
1829.80	57.2 Pk	2.8 / 27.8 / 29.0	58.9	V / 1.0 / 0.0	N/A	N/A
1855.70	64.2 Pk	2.9 / 27.9 / 29.0	65.9	H / 1.1 / 199.0	N/A	N/A
2705.97	51.1 Pk	3.6 / 31.6 / 29.3	56.9	H / 1.1 / 190.0	N/A	N/A
2744.75	48.1 Pk	3.6 / 31.7 / 29.3	54.0	V / 1.2 / 334.0	N/A	N/A
2783.50	52.9 Pk	3.6 / 31.8 / 29.3	59.0	H / 1.1 / 205.0	N/A	N/A
3608.05	53.5 Pk	4.1 / 33.5 / 29.2	61.9	V / 1.2 / 45.0	N/A	N/A
3659.70	52.9 Pk	4.1 / 33.6 / 29.2	61.4	V / 1.2 / 45.0	N/A	N/A
3711.34	50.1 Pk	4.2 / 33.7 / 29.2	58.8	V / 1.2 / 43.0	N/A	N/A
4510.29	49.7 Pk	4.7 / 33.3 / 40.9	46.8	V / 1.1 / 0.0	N/A	N/A
4574.75	49.3 Pk	4.8 / 33.6 / 41.0	46.7	V / 1.1 / 134.0	N/A	N/A
4639.24	51.0 Pk	4.9 / 34.0 / 41.0	48.7	V / 1.1 / 134.0	N/A	N/A
5412.29	46.2 Pk	5.2 / 36.7 / 40.8	47.3	H / 1.1 / 0.0	N/A	N/A
5489.69	46.8 Pk	5.2 / 36.9 / 40.7	48.2	H / 1.1 / 0.0	N/A	N/A
5567.15	45.2 Pk	5.2 / 37.0 / 40.7	46.8	H / 1.1 / 0.0	N/A	N/A

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Radiated Electromagnetic Emissions



Test Report #: **B0230 Run 04** Test Area: Pinewood Site 1 (3m)
 Test Method: N/A Test Date: 11-Jul-2000
 EUT Model #: DGR09 EUT Power: 12VDC
 EUT Serial #: 902-1164 Temperature: _____ °C
 Manufacturer: Freewave Technologies Relative Humidity: _____ %
 EUT Description: Transceiver module Air Pressure: _____ kPa
 Notes: Hopping Mode Page: 1 of 4
5 dB Omni Directional Antenna

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB) (dB/m) (dB)	FINAL (dBuV)	POL / HGT / AZ (m) (DEG)	DELTA1 (dB) N/A	DELTA2 (dB) N/A
902.06	102.3 Pk	2.0 / 22.7 / 0.0	127.0	V / 1.0 / 0.0	N/A	N/A
Antenna height 1.3 meters for above reading.						
914.96	103.0 Pk	2.0 / 22.8 / 0.0	127.8	V / 1.0 / 1.4	N/A	N/A
927.79	101.6 Pk	2.0 / 23.4 / 0.0	127.0	V / 1.0 / 1.4	N/A	N/A
927.85	91.7 Pk	2.0 / 23.4 / 0.0	117.1	H / 1.0 / 323.0	N/A	N/A
Antenna height 1.4 meters for above reading.						
914.96	93.8 Pk	2.0 / 22.8 / 0.0	118.6	H / 1.3 / 323.0	N/A	N/A
902.03	92.5 Pk	2.0 / 22.7 / 0.0	117.2	H / 1.3 / 323.0	N/A	N/A
1804.02	48.1 Pk	2.8 / 27.7 / 28.9	49.7	V / 1.2 / 0.0	N/A	N/A
2706.05	50.0 Pk	3.6 / 31.6 / 29.3	55.7	V / 1.2 / 0.0	N/A	N/A
3608.08	50.2 Pk	4.1 / 33.5 / 29.2	58.6	V / 1.2 / 0.0	N/A	N/A
1829.92	53.5 Pk	2.8 / 27.8 / 29.0	55.1	V / 1.2 / 0.0	N/A	N/A
2744.85	50.4 Pk	3.6 / 31.7 / 29.3	56.4	V / 1.2 / 292.0	N/A	N/A
3659.81	50.9 Pk	4.1 / 33.6 / 29.2	59.4	V / 1.2 / 82.0	N/A	N/A
1855.56	54.3 Pk	2.9 / 27.9 / 29.0	56.0	V / 1.2 / 296.0	N/A	N/A
2783.35	47.6 Pk	3.6 / 31.8 / 29.3	53.8	V / 1.2 / 20.0	N/A	N/A
3711.28	46.7 Pk	4.2 / 33.7 / 29.2	55.3	V / 1.2 / 124.0	N/A	N/A
1855.63	57.3 Pk	2.9 / 27.9 / 29.0	59.0	H / 1.1 / 0.0	N/A	N/A
2783.42	45.2 Pk	3.6 / 31.8 / 29.3	51.4	H / 1.1 / 350.0	N/A	N/A
3711.21	48.3 Pk	4.2 / 33.7 / 29.2	56.9	H / 1.1 / 45.0	N/A	N/A
1829.78	55.6 Pk	2.8 / 27.8 / 29.0	57.2	H / 1.1 / 0.0	N/A	N/A
2744.74	47.0 Pk	3.6 / 31.7 / 29.3	52.9	H / 1.1 / 31.0	N/A	N/A
3659.70	50.8 Pk	4.1 / 33.6 / 29.2	59.3	H / 1.1 / 47.0	N/A	N/A

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File No. BC1G023001, Page B6 of B16

Radiated Electromagnetic Emissions



Test Report #: B0230 Run 04 Test Area: Pinewood Site 1 (3m)
 Test Method: N/A Test Date: 11-Jul-2000
 EUT Model #: DGR09 EUT Power: 12VDC
 EUT Serial #: 902-1164 Temperature: _____ °C
 Manufacturer: Freewave Technologies Relative Humidity: _____ %
 EUT Description: Transceiver module Air Pressure: _____ kPa
 Notes: Hopping Mode Page: 2 of 4
5 dB Omni Directional Antenna

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB) (dBm) (dB)	FINAL (dBuV)	POL / HGT / AZ (m) (DEG)	DELTA1 (dB) N/A	DELTA2 (dB) N/A
1804.04	56.8 Pk	2.8 / 27.7 / 28.9	58.3	H / 1.4 / 22.0	N/A	N/A
2706.06	54.4 Pk	3.6 / 31.6 / 29.3	60.1	H / 1.4 / 350.0	N/A	N/A
3608.14	51.4 Pk	4.1 / 33.5 / 29.2	59.8	H / 1.4 / 33.0	N/A	N/A
4510.22	54.1 Pk	4.7 / 33.3 / 40.9	51.2	H / 1.1 / 0.0	N/A	N/A
5412.30	54.6 Pk	5.2 / 36.7 / 40.8	55.7	H / 1.1 / 0.0	N/A	N/A
6314.38	54.6 Pk	5.4 / 36.7 / 40.5	56.3	H / 1.1 / 0.0	N/A	N/A
No emissions found above the noise floor to 10th harmonic.						
4574.79	56.6 Pk	4.8 / 33.6 / 41.0	54.1	H / 1.1 / 305.0	N/A	N/A
5489.66	56.1 Pk	5.2 / 36.9 / 40.7	57.5	H / 1.1 / 305.0	N/A	N/A
6404.63	53.2 Pk	5.5 / 36.6 / 40.5	54.8	H / 1.1 / 312.0	N/A	N/A
No emissions found above the noise floor to 10th harmonic.						
4639.15	54.5 Pk	4.9 / 34.0 / 41.0	52.3	H / 1.1 / 312.0	N/A	N/A
5566.84	58.0 Pk	5.2 / 37.0 / 40.7	59.5	H / 1.1 / 312.0	N/A	N/A
6495.00	52.4 Pk	5.5 / 36.4 / 40.5	53.8	H / 1.1 / 312.0	N/A	N/A
No emissions found above the noise floor to 10th harmonic.						
4639.23	57.4 Pk	4.9 / 34.0 / 41.0	55.1	V / 1.1 / 0.0	N/A	N/A
5567.02	54.9 Pk	5.2 / 37.0 / 40.7	56.4	V / 1.1 / 70.0	N/A	N/A
6494.81	51.1 Pk	5.5 / 36.4 / 40.5	52.5	V / 1.1 / 70.0	N/A	N/A
No emissions found above the noise floor to 10th harmonic.						
4574.80	54.4 Pk	4.8 / 33.6 / 41.0	51.8	V / 1.1 / 0.0	N/A	N/A
5489.76	55.2 Pk	5.2 / 36.9 / 40.7	56.6	V / 1.1 / 80.0	N/A	N/A
6404.72	52.5 Pk	5.5 / 36.6 / 40.5	54.1	V / 1.1 / 90.0	N/A	N/A
No emissions found above the noise floor to 10th harmonic.						

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Radiated Electromagnetic Emissions



Test Report #:	B0230 Run 04	Test Area:	Pinewood Site 1 (3m)		
Test Method:	N/A	Test Date:	11-Jul-2000	Temperature:	_____ °C
EUT Model #:	DGR09	EUT Power:	12VDC	Relative Humidity:	_____ %
EUT Serial #:	902-1164			Air Pressure:	_____ kPa
Manufacturer:	Freewave Technologies				
EUT Description:	Transceiver module				
Notes:	Hopping Mode			Page:	3 of 4
	5 dB Omni Directional Antenna				

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB) (dB\m) (dB)	FINAL (dBuV)	POL / HGT / AZ (m) (DEG)	DELTA1 (dB) N/A	DELTA2 (dB) N/A
4510.33	56.2 Pk	4.7 / 33.3 / 40.9	53.3	V / 1.1 / 90.0	N/A	N/A
5412.41	54.5 Pk	5.2 / 36.7 / 40.8	55.6	V / 1.1 / 90.0	N/A	N/A
6314.53	52.5 Pk	5.4 / 36.7 / 40.5	54.2	V / 1.1 / 90.0	N/A	N/A
No emissions found above the noise floor to 10th harmonic.						

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Radiated Electromagnetic Emissions



Test Report #:	B0230 Run 04	Test Area:	Pinewood Site 1 (3m)		
Test Method:	N/A	Test Date:	11-Jul-2000		
EUT Model #:	DGR09	EUT Power:	12VDC		
EUT Serial #:	902-1164			Temperature:	_____ °C
Manufacturer:	Freewave Technologies			Relative Humidity:	_____ %
EUT Description:	Transceiver module			Air Pressure:	_____ kPa
Notes:	Hopping Mode			Page:	4 of 4
	5 dB Omni Directional Antenna				

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB) (dB/m) (dB)	FINAL (dBuV)	POL / HGT / AZ (m) (DEG)	DELTA1 (dB) N/A	DELTA2 (dB) N/A
---------------	-----------------	--	-----------------	-----------------------------	--------------------	--------------------

***** MEASUREMENT SUMMARY *****						
902.06	102.3 Pk	2.0 / 22.7 / 0.0	127.0	V / 1.0 / 0.0	N/A	N/A
914.96	103.0 Pk	2.0 / 22.8 / 0.0	127.8	V / 1.0 / 1.4	N/A	N/A
927.79	101.6 Pk	2.0 / 23.4 / 0.0	127.0	V / 1.0 / 1.4	N/A	N/A
927.85	91.7 Pk	2.0 / 23.4 / 0.0	117.1	H / 1.0 / 323.0	N/A	N/A
1804.04	56.8 Pk	2.8 / 27.7 / 28.9	58.3	H / 1.4 / 22.0	N/A	N/A
1829.78	55.6 Pk	2.8 / 27.8 / 29.0	57.2	H / 1.1 / 0.0	N/A	N/A
1855.63	57.3 Pk	2.9 / 27.9 / 29.0	59.0	H / 1.1 / 0.0	N/A	N/A
2706.06	54.4 Pk	3.6 / 31.6 / 29.3	60.1	H / 1.4 / 350.0	N/A	N/A
2744.85	50.4 Pk	3.6 / 31.7 / 29.3	56.4	V / 1.2 / 292.0	N/A	N/A
2783.35	47.6 Pk	3.6 / 31.8 / 29.3	53.8	V / 1.2 / 20.0	N/A	N/A
3608.14	51.4 Pk	4.1 / 33.5 / 29.2	59.8	H / 1.4 / 33.0	N/A	N/A
3659.81	50.9 Pk	4.1 / 33.6 / 29.2	59.4	V / 1.2 / 82.0	N/A	N/A
3711.21	48.3 Pk	4.2 / 33.7 / 29.2	56.9	H / 1.1 / 45.0	N/A	N/A
4510.33	56.2 Pk	4.7 / 33.3 / 40.9	53.3	V / 1.1 / 90.0	N/A	N/A
4574.79	56.6 Pk	4.8 / 33.6 / 41.0	54.1	H / 1.1 / 305.0	N/A	N/A
4639.23	57.4 Pk	4.9 / 34.0 / 41.0	55.1	V / 1.1 / 0.0	N/A	N/A
5412.30	54.6 Pk	5.2 / 36.7 / 40.8	55.7	H / 1.1 / 0.0	N/A	N/A
5489.66	56.1 Pk	5.2 / 36.9 / 40.7	57.5	H / 1.1 / 305.0	N/A	N/A
5566.84	58.0 Pk	5.2 / 37.0 / 40.7	59.5	H / 1.1 / 312.0	N/A	N/A
6314.38	54.6 Pk	5.4 / 36.7 / 40.5	56.3	H / 1.1 / 0.0	N/A	N/A
6404.63	53.2 Pk	5.5 / 36.6 / 40.5	54.8	H / 1.1 / 312.0	N/A	N/A
6495.00	52.4 Pk	5.5 / 36.4 / 40.5	53.8	H / 1.1 / 312.0	N/A	N/A

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Radiated Electromagnetic Emissions



Test Report #: B0230 Run 6 Test Area: Pinewood Site 2 (3m)
 Test Method: FCC Part 15 Test Date: 18-Jul-2000
 EUT Model #: DGR09 EUT Power: 11 VDC
 EUT Serial #: 902-1164
 Manufacturer: FreeWave

Temperature: 22 °C
 Relative Humidity: 40 %
 Air Pressure: 80.5 kPa

Notes: with 10 dB Yagi, 85cm unshielded 10 wire data/power
cable, terminated the micro strips on the board and
raised the height of the RF section shield

Page: 1 of 2

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB)	FINAL (dBuV/m)	POL / HGT / AZ (m) (DEG)	DELTA1 FCC B (< 1GHz)	DELTA2 N/A
932.48	41.5 Qp	6.1 / 22.5 / 28.8	41.2	V / 1.2 / 10.0	-4.8	N/A
moved cables						
932.48	41.6 Qp	6.1 / 22.5 / 28.8	41.4	V / 1.2 / 10.0	-4.6	N/A
945.38	38.6 Qp	6.2 / 22.5 / 28.8	38.4	V / 2.0 / 105.0	-7.6	N/A
958.29	36.2 Qp	6.3 / 22.5 / 28.8	36.2	V / 2.0 / 105.0	-9.8	N/A
958.29	38.8 Qp	6.3 / 22.5 / 28.8	38.8	H / 1.0 / 155.0	-7.2	N/A
945.38	38.6 Qp	6.2 / 22.5 / 28.8	38.4	H / 1.0 / 340.0	-7.6	N/A
moved cables						
945.38	38.9 Qp	6.2 / 22.5 / 28.8	38.7	H / 1.0 / 340.0	-7.3	N/A
moved cables						
932.48	42.9 Qp	6.1 / 22.5 / 28.8	42.6	H / 1.0 / 340.0	-3.4	N/A
end of test up to 1 GHz						

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Radiated Electromagnetic Emissions



Test Report #: B0230 Run 6 Test Area: Pinewood Site 2 (3m)
 Test Method: FCC Part 15 Test Date: 18-Jul-2000
 EUT Model #: DGR09 EUT Power: 11 VDC
 EUT Serial #: 902-1164 Temperature: 22 °C
 Manufacturer: FreeWave Relative Humidity: 40 %
 EUT Description: _____ Air Pressure: 80.5 kPa
 Notes: with 10 dB Yagi, 85cm unshielded 10 wire data/power Page: 2 of 2
cable, terminated the micro strips on the board and
raised the height of the RF section shield

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB)	FINAL (dBuV/m)	POL / HGT / AZ (m) (DEG)	DELTA1 FCC B (< 1GHz)	DELTA2 N/A
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***** MEASUREMENT SUMMARY *****						
932.48	42.9 Qp	6.1 / 22.5 / 28.8	42.6	H / 1.0 / 340.0	-3.4	N/A
958.29	38.8 Qp	6.3 / 22.5 / 28.8	38.8	H / 1.0 / 155.0	-7.2	N/A
945.38	38.9 Qp	6.2 / 22.5 / 28.8	38.7	H / 1.0 / 340.0	-7.3	N/A

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Radiated Electromagnetic Emissions



Test Report #: B0230 Run 7 Test Area: Pinewood Site 2 (3m)
 Test Method: FCC Part 15 Test Date: 18-Aug-2000
 EUT Model #: DGR09 EUT Power: 11 VDC
 EUT Serial #: 902-1164 Temperature: 22 °C
 Manufacturer: FreeWave Relative Humidity: 40 %
 EUT Description: _____ Air Pressure: 80.5 kPa
 Notes: with 10 dB Yagi, 85cm unshielded 10 wire data/power Page: 1 of 3
cable, terminated the micro strips on the board and
raised the height of the RF section shield

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB)	FINAL (dBuV/m)	POL / HGT / AZ (m) (DEG)	DELTA1 FCC B (> 1GHz)	DELTA2 N/A
Low						
1864.84	48.1 Av	3.2 / 27.9 / 29.4	49.8	H / 1.0 / 90.0	-4.2	N/A
2797.29	41.6 Av	3.7 / 31.9 / 29.5	47.7	H / 1.2 / 0.0	-6.3	N/A
3729.72	40.9 Av	4.3 / 33.7 / 29.3	49.6	H / 1.4 / 36.0	-4.4	N/A
Med						
3781.32	36.8 Av	4.3 / 33.8 / 29.3	45.6	H / 1.4 / 40.0	-8.4	N/A
2835.99	39.3 Av	3.8 / 32.0 / 29.4	45.6	H / 1.6 / 20.0	-8.4	N/A
High						
2874.70	34.8 Av	3.8 / 32.1 / 29.4	41.3	H / 1.7 / 20.0	-12.7	N/A
3832.93	36.8 Av	4.3 / 33.9 / 29.3	45.7	H / 1.7 / 45.0	-8.3	N/A
2874.70	33.9 Av	3.8 / 32.1 / 29.4	40.4	V / 1.0 / 180.0	-13.6	N/A
Med						
2835.99	35.2 Av	3.8 / 32.0 / 29.4	41.5	V / 1.0 / 110.0	-12.5	N/A
Low						
1864.84	49.2 Av	3.2 / 27.9 / 29.4	50.9	V / 1.0 / 90.0	-3.1	N/A
2797.29	40.0 Av	3.7 / 31.9 / 29.5	46.1	V / 1.0 / 90.0	-7.9	N/A
Low						
4662.14	37.6 Av	4.8 / 34.1 / 40.0	36.5	V / 1.1 / 90.0	-17.5	N/A
Med						
4726.65	38.7 Av	4.8 / 34.4 / 40.0	38.0	V / 1.1 / 70.0	-16.0	N/A
High						

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Radiated Electromagnetic Emissions



Test Report #: B0230 Run 7 Test Area: Pinewood Site 2 (3m)
 Test Method: FCC Part 15 Test Date: 18-Aug-2000
 EUT Model #: DGR09 EUT Power: 11 VDC
 EUT Serial #: 902-1164
 Manufacturer: FreeWave

Temperature: 22 °C
 Relative Humidity: 40 %
 Air Pressure: 80.5 kPa

Notes: with 10 dB Yagi, 85cm unshielded 10 wire data/power
cable, terminated the micro strips on the board and
raised the height of the RF section shield

Page: 2 of 3

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB)	FINAL (dBuV/m)	POL / HGT / AZ (m) (DEG)	DELTA1 FCC B (> 1GHz)	DELTA2 N/A
4791.17	39.6 Av	4.9 / 34.8 / 40.0	39.3	V / 1.1 / 60.0	-14.7	N/A
4791.17	39.4 Av	4.9 / 34.8 / 40.0	39.1	H / 1.2 / 80.0	-14.9	N/A
Med						
4726.65	35.8 Av	4.8 / 34.4 / 40.0	35.1	H / 1.2 / 70.0	-18.9	N/A
Low						
4662.15	37.2 Av	4.8 / 34.1 / 40.0	36.1	H / 1.2 / 110.0	-17.9	N/A
EUT in normal operating mode.						
The following were maximized						
1890.67	28.2 Av	3.2 / 28.0 / 29.5	29.9	V / 1.0 / 117.0	-24.1	N/A
1916.48	27.9 Av	3.2 / 28.1 / 29.5	29.7	V / 1.0 / 161.0	-24.3	N/A
3729.72	24.9 Av	4.3 / 33.7 / 29.3	33.6	V / 1.0 / 93.0	-20.4	N/A
3832.93	25.3 Av	4.3 / 33.9 / 29.3	34.2	V / 1.0 / 300.0	-19.8	N/A
The following were maximized in horizontal polarization						
1890.67	27.5 Av	3.2 / 28.0 / 29.5	29.3	H / 1.4 / 346.0	-24.7	N/A
1916.48	27.4 Av	3.2 / 28.1 / 29.5	29.3	H / 1.5 / 238.0	-24.7	N/A
The following were maximized in vertical polarization.						
3781.32	24.4 Av	4.3 / 33.8 / 29.3	33.2	V / 1.0 / 350.0	-20.8	N/A
3781.32	24.4 Av	4.3 / 33.8 / 29.3	33.2	V / 1.0 / 350.0	-20.8	N/A
1864.84	27.9 Av	3.2 / 27.9 / 29.4	29.6	V / 1.0 / 354.0	-24.4	N/A

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Radiated Electromagnetic Emissions




Test Report #: B0230 Run 7 Test Area: Pinewood Site 2 (3m)
 Test Method: FCC Part 15 Test Date: 18-Aug-2000
 EUT Model #: DGR09 EUT Power: 11 VDC
 EUT Serial #: 902-1164 Temperature: 22 °C
 Manufacturer: FreeWave Relative Humidity: 40 %
 EUT Description: _____ Air Pressure: 80.5 kPa
 Notes: with 10 dB Yagi, 85cm unshielded 10 wire data/power Page: 3 of 3
cable, terminated the micro strips on the board and
raised the height of the RF section shield

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB)	FINAL (dBuV/m)	POL / HGT / AZ (m) (DEG)	DELTA1 FCC B (> 1GHz)	DELTA2 N/A
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***** MEASUREMENT SUMMARY *****						
2797.29	41.6 Av	3.7 / 31.9 / 29.5	47.7	H / 1.2 / 0.0	-6.3	N/A
2835.99	39.3 Av	3.8 / 32.0 / 29.4	45.6	H / 1.6 / 20.0	-8.4	N/A
2874.70	34.8 Av	3.8 / 32.1 / 29.4	41.3	H / 1.7 / 20.0	-12.7	N/A
4791.17	39.6 Av	4.9 / 34.8 / 40.0	39.3	V / 1.1 / 60.0	-14.7	N/A
4726.65	38.7 Av	4.8 / 34.4 / 40.0	38.0	V / 1.1 / 70.0	-16.0	N/A
4662.14	37.6 Av	4.8 / 34.1 / 40.0	36.5	V / 1.1 / 90.0	-17.5	N/A
3832.93	25.3 Av	4.3 / 33.9 / 29.3	34.2	V / 1.0 / 300.0	-19.8	N/A
3729.72	24.9 Av	4.3 / 33.7 / 29.3	33.6	V / 1.0 / 93.0	-20.4	N/A
3781.32	24.4 Av	4.3 / 33.8 / 29.3	33.2	V / 1.0 / 350.0	-20.8	N/A
1890.67	28.2 Av	3.2 / 28.0 / 29.5	29.9	V / 1.0 / 117.0	-24.1	N/A
1916.48	27.9 Av	3.2 / 28.1 / 29.5	29.7	V / 1.0 / 161.0	-24.3	N/A
1864.84	27.9 Av	3.2 / 27.9 / 29.4	29.6	V / 1.0 / 354.0	-24.4	N/A

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Conducted Electromagnetic Emissions



Test Report #: B0230 Run 1 Test Area: Screen Room
 Test Method: FCC Class B Test Date: 09-Aug-2000
 EUT Model #: DGR09 EUT Power: 120 VAC / 60 HZ
 EUT Serial #: 902-1164
 Manufacturer: Freewave Technologies
 EUT Description: Transceiver Module
 Notes: Conducted Emissions test was performed on HP model F3620A DC power supply.

Temperature: _____ °C
 Relative Humidity: _____ %
 Air Pressure: _____ kPa
 Page: 1 of 2

Level Key	
PK – Peak	Nb – Narrow Band
Qp – QuasiPeak	Bb – Broad Band
Av - Average	

FREQ (MHz)	LEVEL (dBuV)	CABLE / LISN / ATTEN (dB)	FINAL (dBuV)	TEST POINT	DELTA1 (dB) FCC B	DELTA2 (dB) N/A
QP - Neutral Measurements						
1.60	34.5 Qp	0.0 / 0.0 / 0.0	34.5	Neutral	-13.5	N/A
1.72	41.0 Qp	0.0 / 0.0 / 0.0	41.0	Neutral	-7.0	N/A
1.78	44.5 Qp	0.0 / 0.0 / 0.0	44.5	Neutral	-3.5	N/A
1.93	39.0 Qp	0.0 / 0.0 / 0.0	39.0	Neutral	-9.0	N/A
2.00	39.0 Qp	0.0 / 0.0 / 0.0	39.0	Neutral	-9.0	N/A
15.22	34.0 Qp	0.0 / 0.0 / 0.0	34.0	Neutral	-14.0	N/A
QP - Line Measurements						
1.60	35.0 Qp	0.0 / 0.0 / 0.0	35.0	Line 1	-13.0	N/A
1.72	40.2 Qp	0.0 / 0.0 / 0.0	40.2	Line 1	-7.8	N/A
1.78	44.3 Qp	0.0 / 0.0 / 0.0	44.3	Line 1	-3.7	N/A
1.93	39.1 Qp	0.0 / 0.0 / 0.0	39.1	Line 1	-8.9	N/A
2.00	39.0 Qp	0.0 / 0.0 / 0.0	39.0	Line 1	-9.0	N/A
15.22	34.0 Qp	0.0 / 0.0 / 0.0	34.0	Line 1	-14.0	N/A

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Conducted Electromagnetic Emissions




Test Report #: B0230 Run 1 Test Area: Screen Room
 Test Method: FCC Class B Test Date: 09-Aug-2000
 EUT Model #: DGR09 EUT Power: 120 VAC / 60 HZ
 EUT Serial #: 902-1164
 Manufacturer: Freewave Technologies
 EUT Description: Transceiver Module
 Notes: Conducted Emissions test was performed on HP model F3620A DC power supply.

Temperature: _____ °C
 Relative Humidity: _____ %
 Air Pressure: _____ kPa
 Page: 2 of 2

Level Key	
Pk – Peak	Nb – Narrow Band
Qp – QuasiPeak	Bb – Broad Band
Av - Average	

FREQ (MHz)	LEVEL (dBuV)	CABLE / LISN / ATTEN (dB)	FINAL (dBuV)	TEST POINT	DELTA1 (dB) FCC B	DELTA2 (dB) N/A
***** Measurement Summary *****						
1.78	44.5 Qp	0.0 / 0.0 / 0.0	44.5	Neutral	-3.5	N/A
1.78	44.3 Qp	0.0 / 0.0 / 0.0	44.3	Line 1	-3.7	N/A
1.72	41.0 Qp	0.0 / 0.0 / 0.0	41.0	Neutral	-7.0	N/A
1.93	39.1 Qp	0.0 / 0.0 / 0.0	39.1	Line 1	-8.9	N/A
2.00	39.0 Qp	0.0 / 0.0 / 0.0	39.0	Line 1	-9.0	N/A
1.60	35.0 Qp	0.0 / 0.0 / 0.0	35.0	Line 1	-13.0	N/A
15.22	34.0 Qp	0.0 / 0.0 / 0.0	34.0	Line 1	-14.0	N/A

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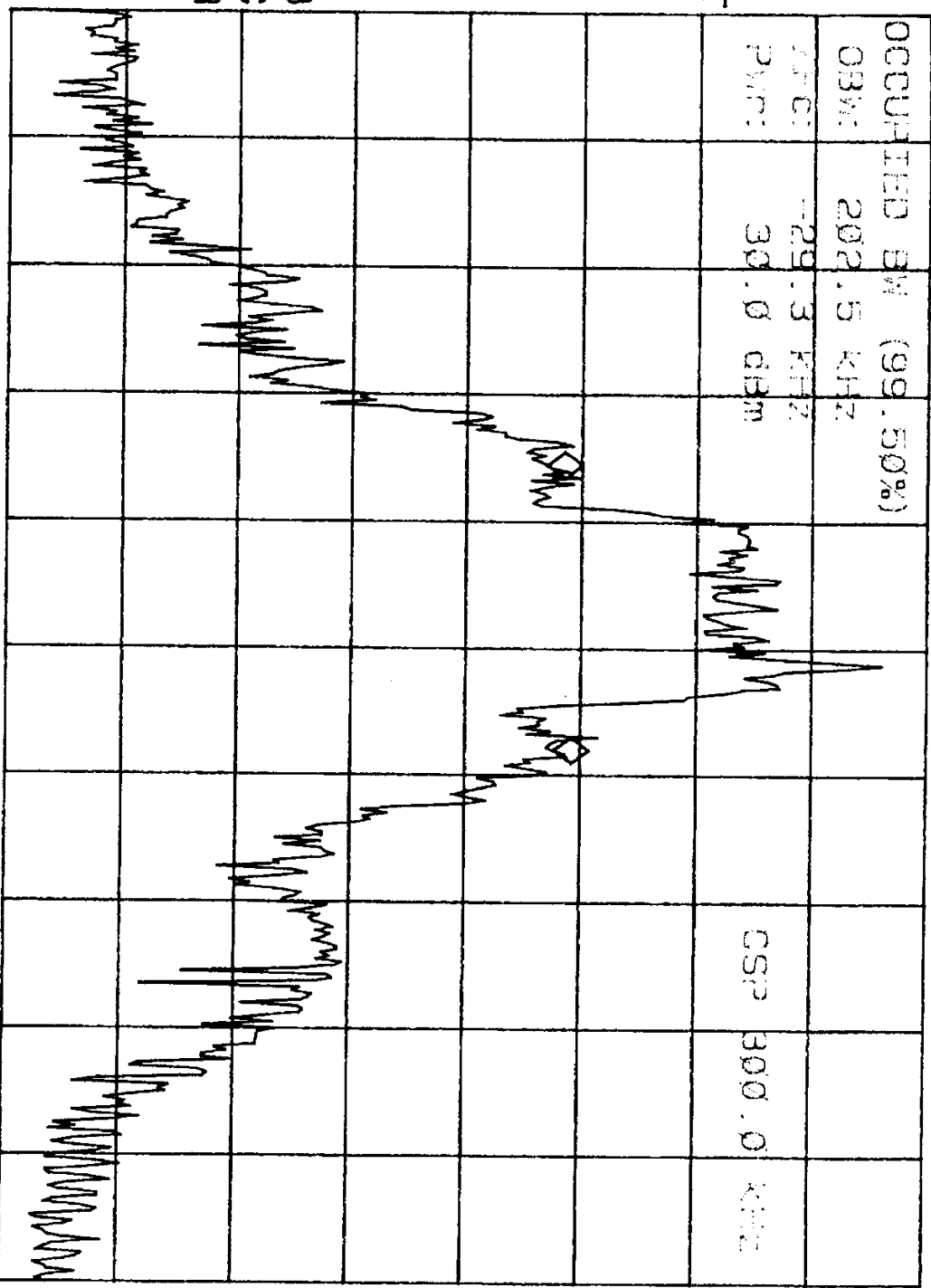
Appendix C

Plot of Occupied Bandwidth of a Single Channel with Modulation

14: 41: 00 NOV 14, 2000

REF 28.3 dBm AT 40 dB

SMP L
LOG
10
dB/
OFFST
-1.7
dB



VA SB
SC FC
CORR

CENTER 902.0450 MHz
#RES BW 3.0 KHz

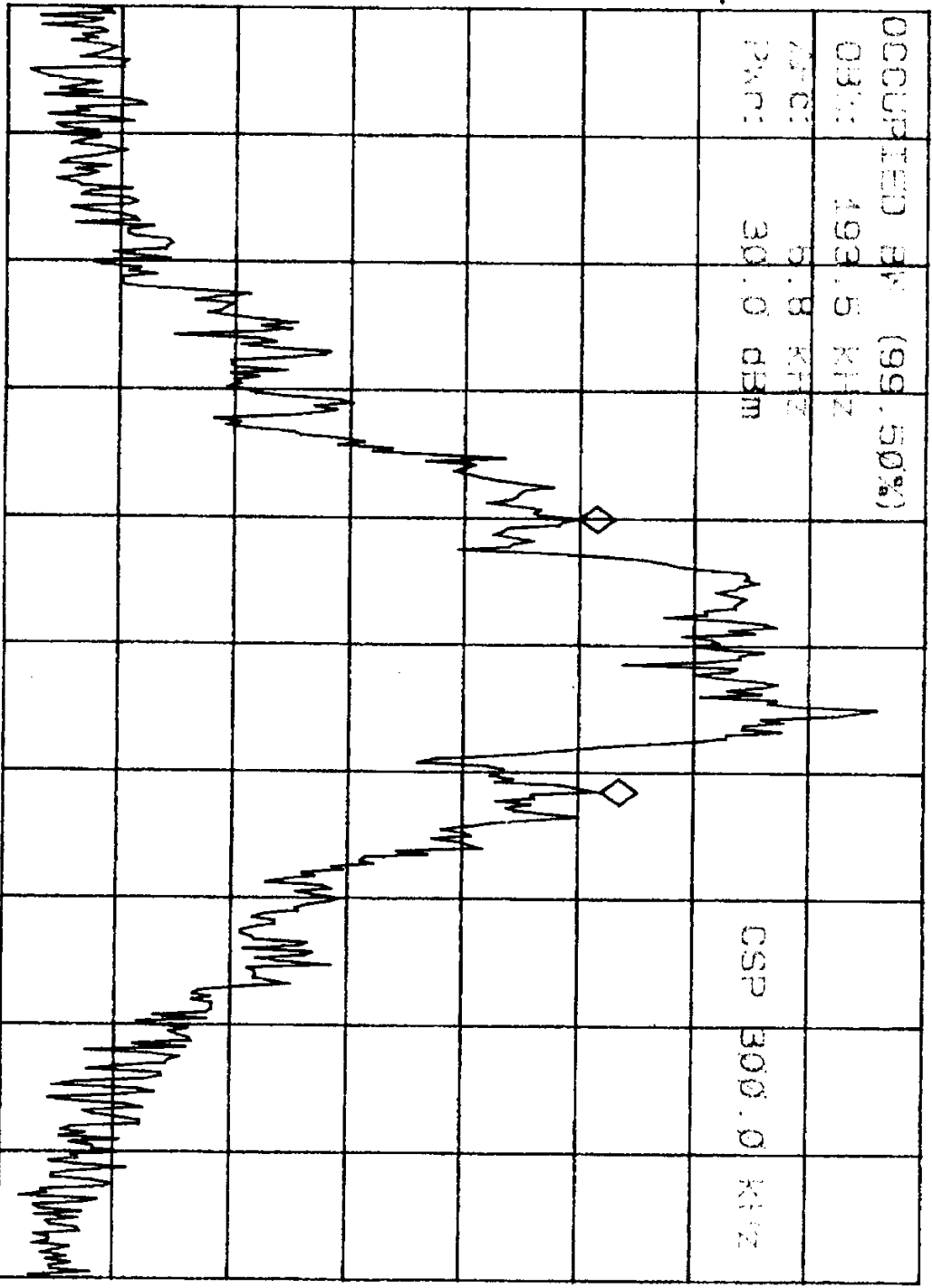
#VBW 30 KHz

SPAN 900.0 KHz
SWP 300 msec

15: 17: 24 NOV 14, 2000
 /

REF 28.3 DBM AT 40 DB

SMPL LOG 10 DB/ OFFST -1.7 DB



VA SB
 SC FC
 CORR

CENTER 914.9135 MHZ
 #RES BW 3.0 KHZ

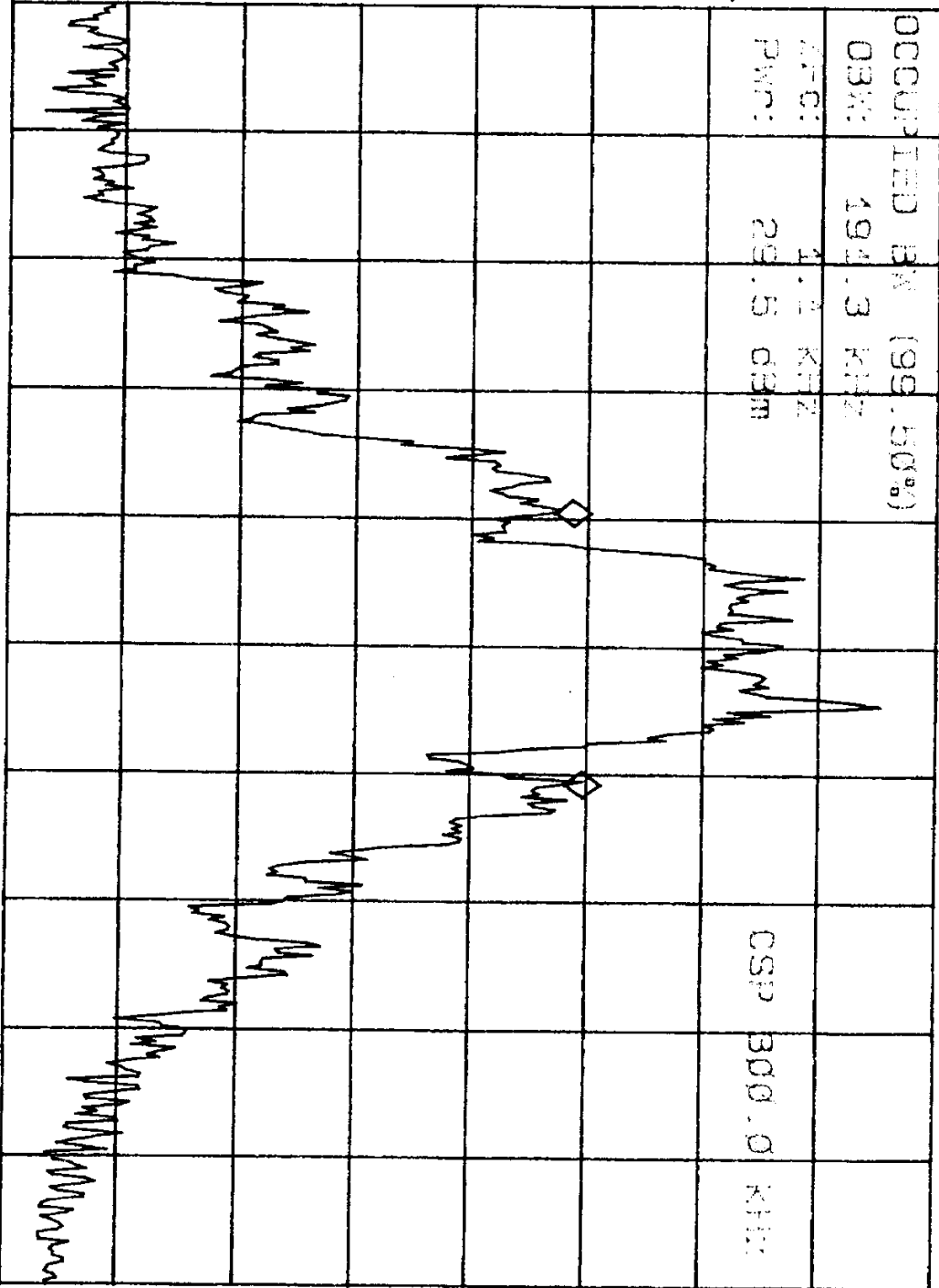
#VBW 30 KHZ

SPAN 900.0 KHZ
 SWP 300 msec

15: 24: 26 NOV 14, 2000

REF 28.3 dBm AT 40 dB

SMP L
LOG
10
DB/
OFFST
-1.7
DB



VA SB
SC FC
CORR

CENTER 927.8208 MHz
#RES BW 3.0 KHz

#VBW 30 KHz

SPAN 900.0 KHz
SMP 300 msec

Appendix D

Plot of Nominal Channel Band Occupancy

November 13, 2000

Federal Communications Commission
Equipment Authorization Division
7435 Oakland Mills Road
Columbia, MD 21046

**Frequency channels occupancy time in 20 seconds period
calculations/measurements.**

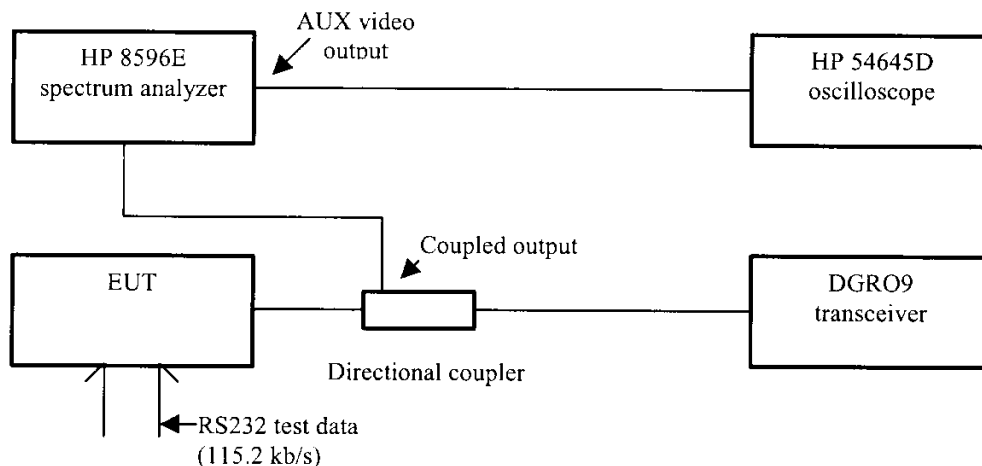
To whom it may concern,

FreeWave Technologies is submitting a low power output 902-928 MHz frequency hopping spread spectrum transceiver (FCC ID KNY-1931852313419, model number DGRO9). This transceiver's frequency channel occupancy time is programmable and depends on MinPacketSize and MaxPacketSize settings on the radio (for more information about this settings, please, refer to page 28 of the User Manual).

In general, MinPacketSize and MaxPacketSize settings define the number of bytes to be allocated in a time domain for transceiver's transmission. Bigger MinPacketSize, MaxPacketSize settings leads to more bytes of data DGRO9 transceiver (EUT) will be able to transmit in one packet (on one frequency channel). That is why the EUT will occupy a single frequency channel for the longest time in the case if three conditions will be met:

- MinPacketSize will be set to "9" and the MaxPacketSize will be set to "9",
- EUT is programmed to be a Point-to-Point master,
- EUT is communicating with another DGRO9 series transceiver,
- and when the radio is sending continuous stream of RS232 data at the maximum data rate (115.2 kb/s).

To measure the frequency channel occupancy time following equipment setup was used:



The EUT was setup to communicate with another DGRO9 transceiver at the fixed frequency mode. Random RS232 data was sent to the EUT to simulate the worst case scenario described above.

Spectrum analyzer was setup to demodulate EUT's signal while oscilloscope was used for time measurements.

The test includes two steps:

1. Measure frequency channel occupancy time when the radio is in a fixed frequency mode.

The EUT was setup to stay on a fixed frequency (914.9182 MHz). In other words, every time the EUT would under normal circumstances hop to a different frequency, it was hopping to the same frequency channel. By doing this, single frequency channel occupancy time was measured.

The oscilloscope's screen snapshot for this configuration is given on Figure 1 (for time measurement accuracy oscilloscope was setup to show at least 20 periods – 23 is an actual number). The Figure 2 shows settings on the spectrum analyzer used for these measurements. From the Figure 1 follows that the EUT will stay on each frequency channel for no longer than

$$T1 = 482 \text{ msec} / 23 \text{ periods} = 20.9565 \text{ msec.}$$

2. Calculate frequency channel occupancy time for 20 seconds period when the radio is in a hopping mode.

The EUT uses frequency hop pattern, which consists 112 frequency channels. Each frequency channel within the hopping pattern is used just once. So, the hop pattern duration is

$$\text{Hop Pattern Duration [T2]} = T1 * \text{Number Of Frequency Channels In The Hop Pattern}$$

In our case this time will be

$$T2 = 20.9565 \text{ msec} * 112 = 2347.128 \text{ msec} \sim 2.347 \text{ sec.}$$

The EUT will repeat the hopping pattern within 20 seconds period of time:

Hop Pattern Will Be Repeated $[N] = 20 \text{ seconds} / T2$

or

$N = 20 \text{ seconds} / 2.347 \text{ seconds} = 8.5215 \text{ times.}$

In other words, each frequency channel will be used by the EUT no more than 9 times within 20 seconds period of time in the worst case scenario. Figure 3 shows spectrum analyzer's screen snapshot then the sweep time was set to 20 seconds. As you can see, the 914.918 MHz frequency appeared on output of the EUT 8 times within 20 seconds period of time. So, the total time the EUT will occupy a single frequency channel in the worst case will be

*Single Frequency Occupation Time for 20 seconds period = $T1 * 9 = 188.6085 \text{ msec.}$*

Sincerely,

A handwritten signature in black ink, appearing to read 'Aleksey Pozhidaev', with a long horizontal flourish extending to the right.

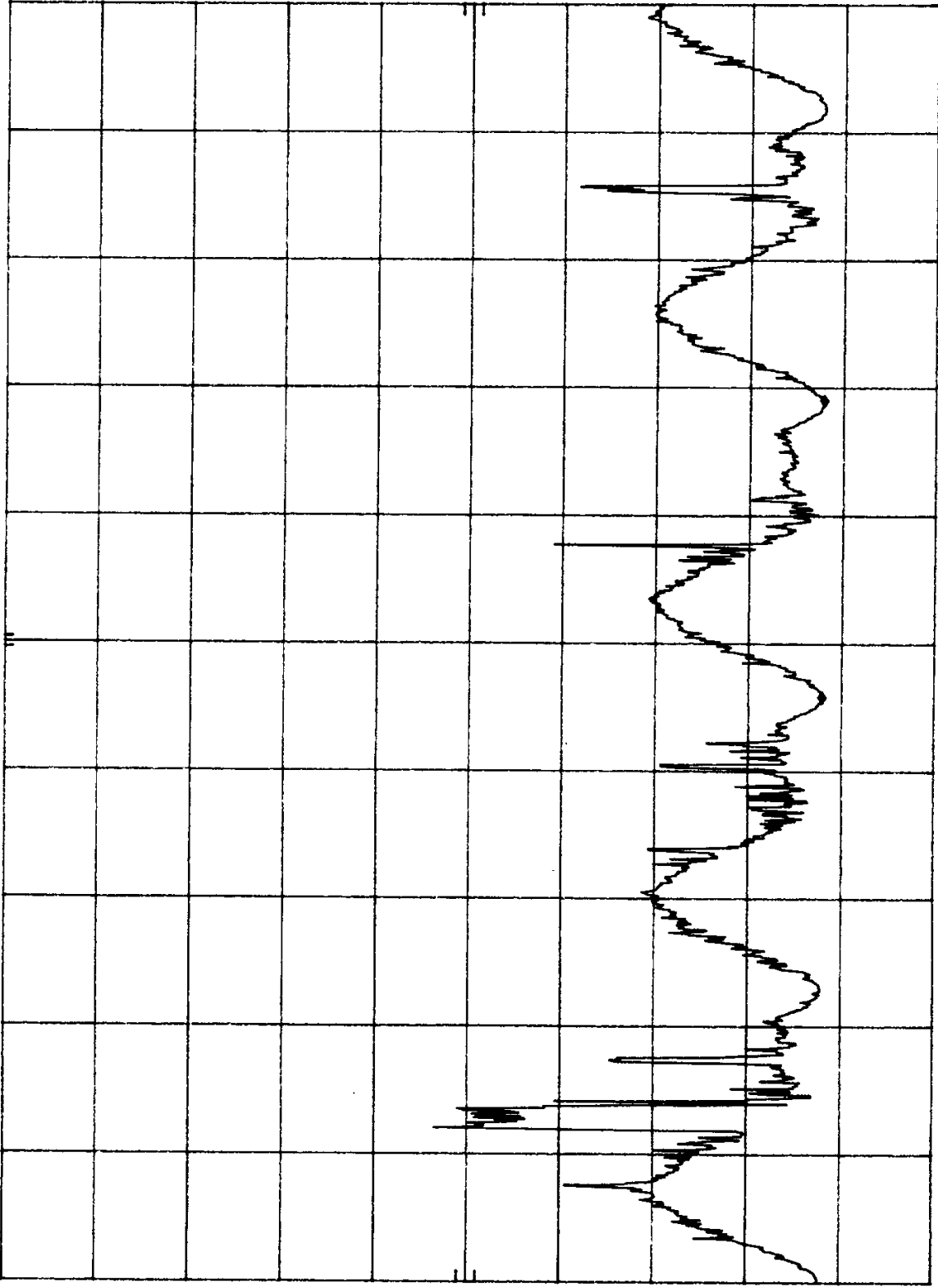
Aleksey Pozhidaev
Engineer

Appendix E

Plot of Channel Spacing



HE2 BM 30 KHZ VBM 100 KHZ 2MB 50.0 msec
CENTER 212.00 KHZ 2BAM 1.00 KHZ



dB
0.2
OFFSET

10 dB

PH

HE2 140.0 QBWA V1TEN 20 QB
FBEMVALE DGR00

0.00 QB
WKB Δ 535 KHZ

Appendix F

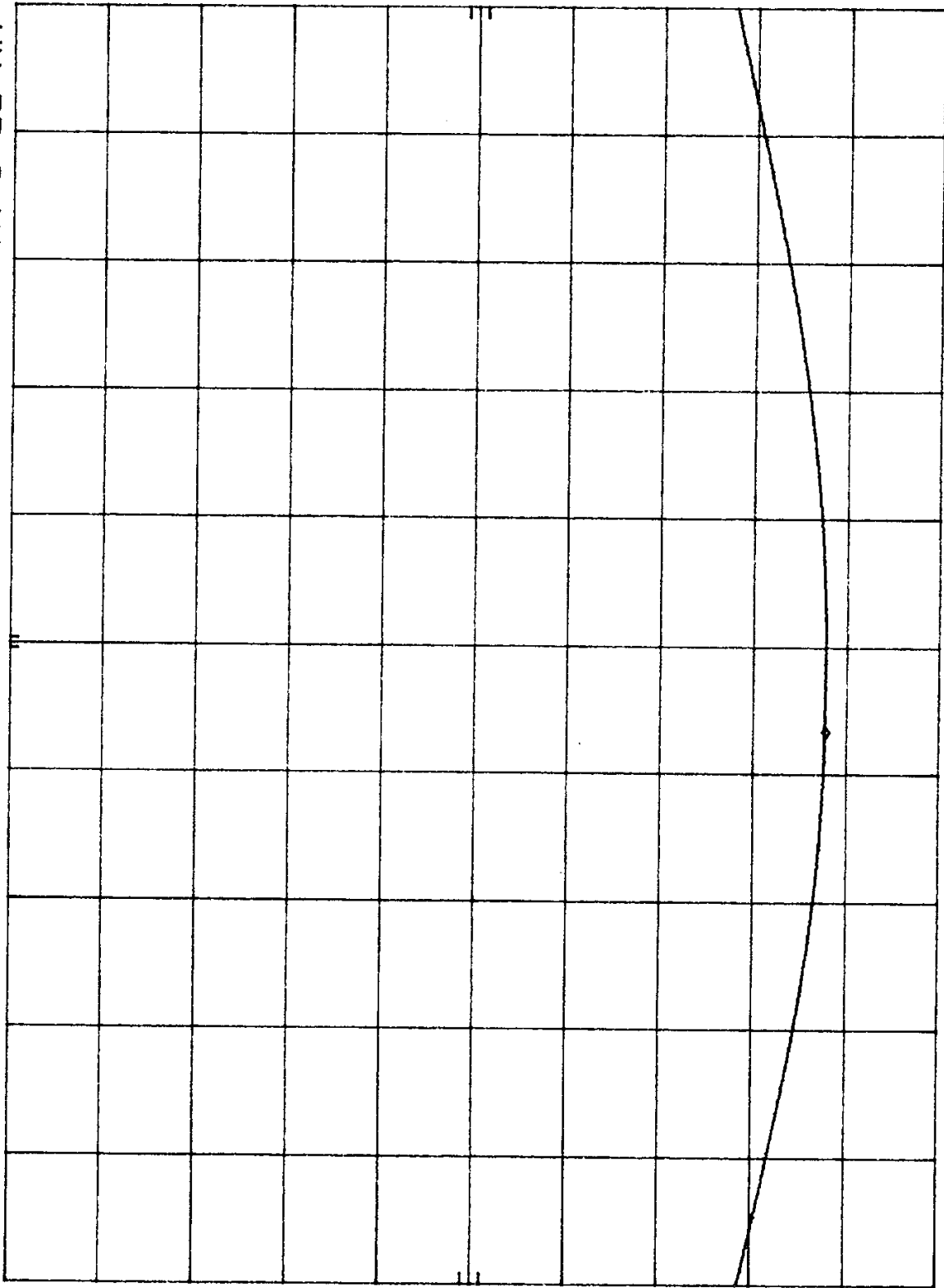
Plot of Power Output

Output Power = 26.8 dBm + 3 dBm (cable loss) = 29.8 dBm = 955 mW

REF 30.0 dBm
LREEMVALE DEARB

ABM 7 MHz

2Mb 50.0 msec
SPAN 5.00 MHz

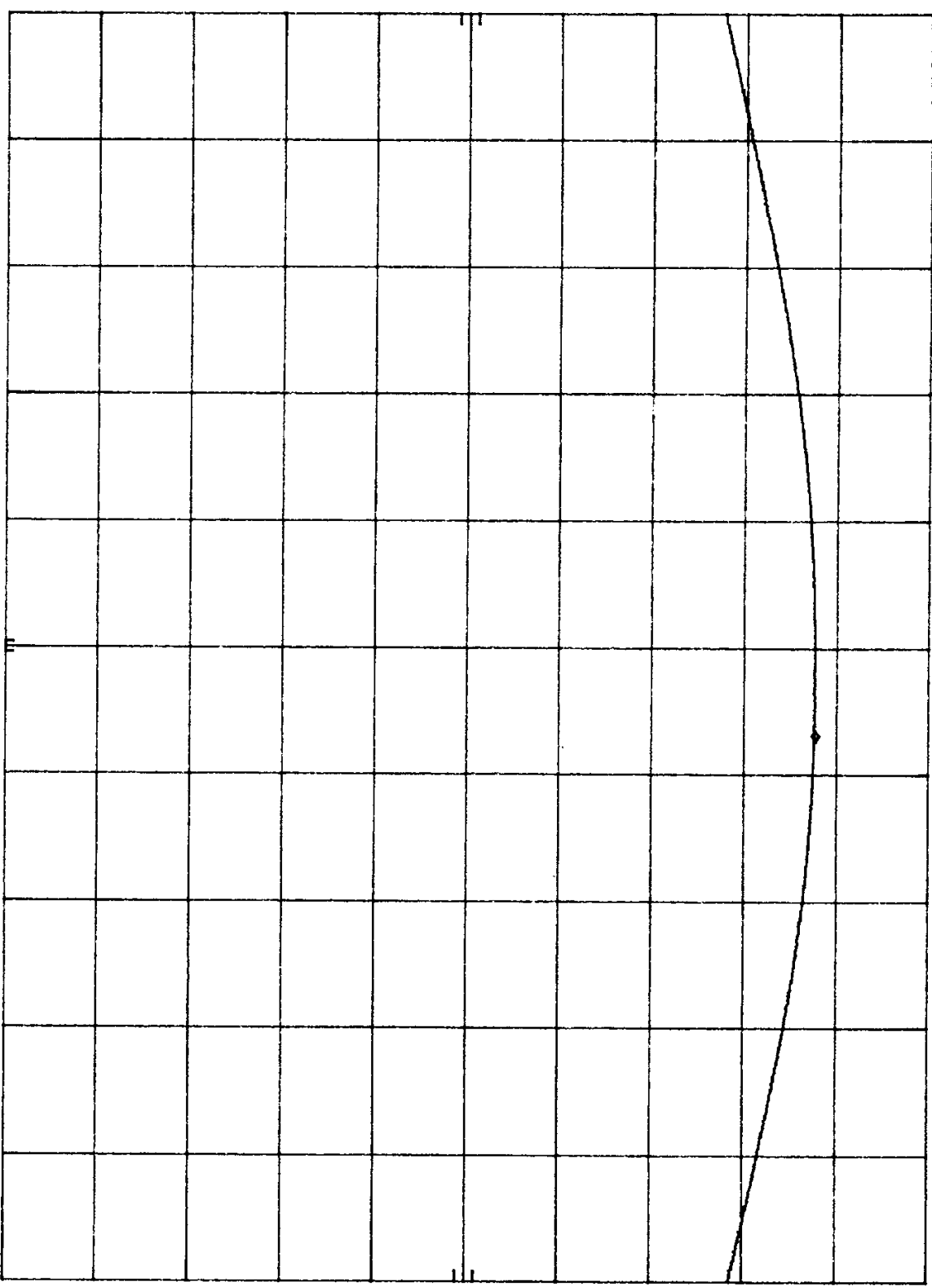


REF 30.0 dBm
LREEMVALE DEARB

ABM 7 MHz

2Mb 50.0 msec
SPAN 5.00 MHz

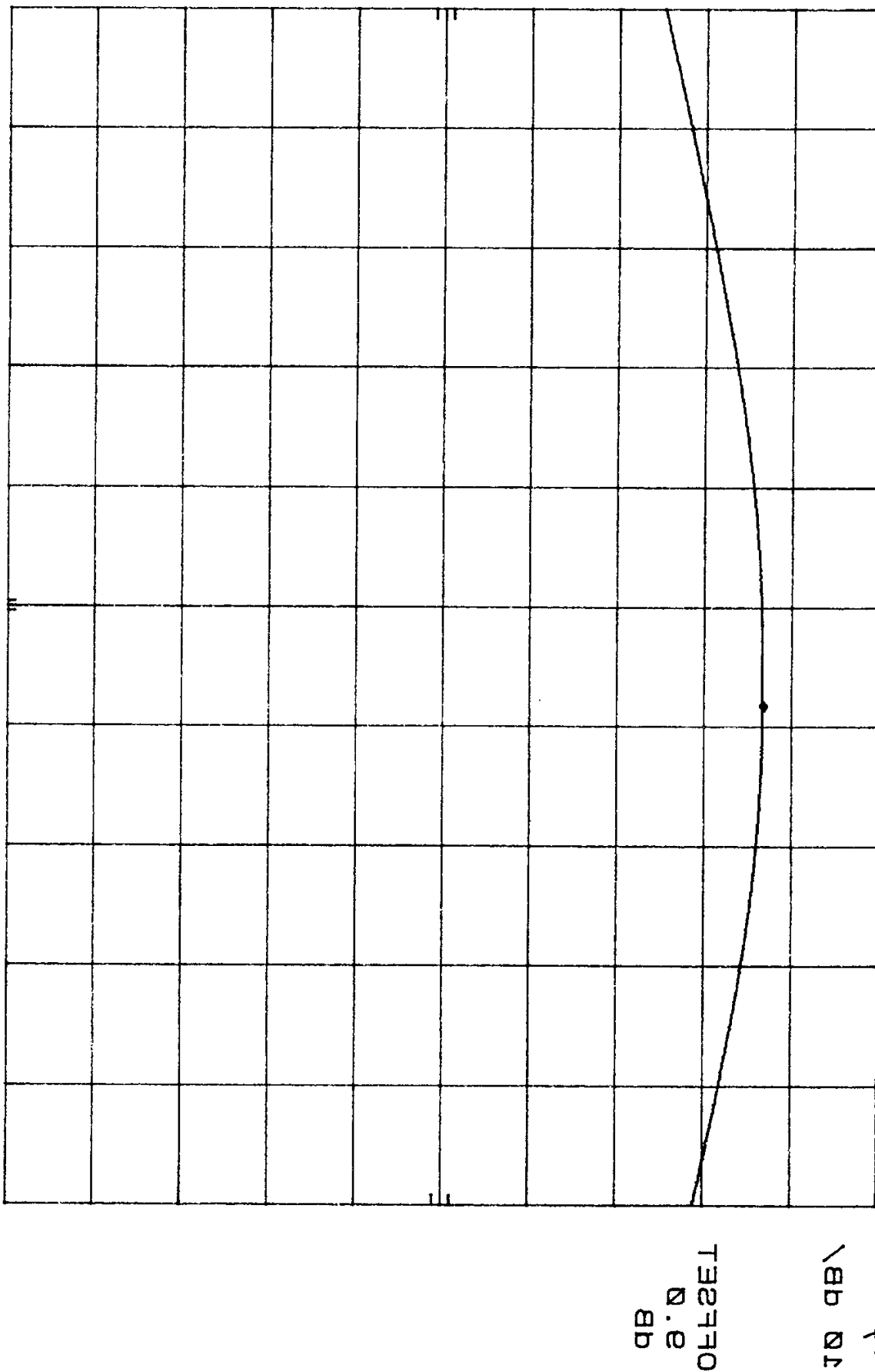
Output Power = 26.7 dBm + 3 dBm (cable loss) = 29.7 dBm
 2Mb 50.0 usec
 2bAN 5.00 MHz



50.00 dBW
 50.00 dBW
 50.00 dBW
 50.00 dBW
 50.00 dBW
 50.00 dBW
 50.00 dBW
 50.00 dBW
 50.00 dBW
 50.00 dBW

dB
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0

Output Power = 25.8 dBm \pm 3 dB (cable loss) = 28.8 dBm \pm 3 dB
 Center 5.0 MHz

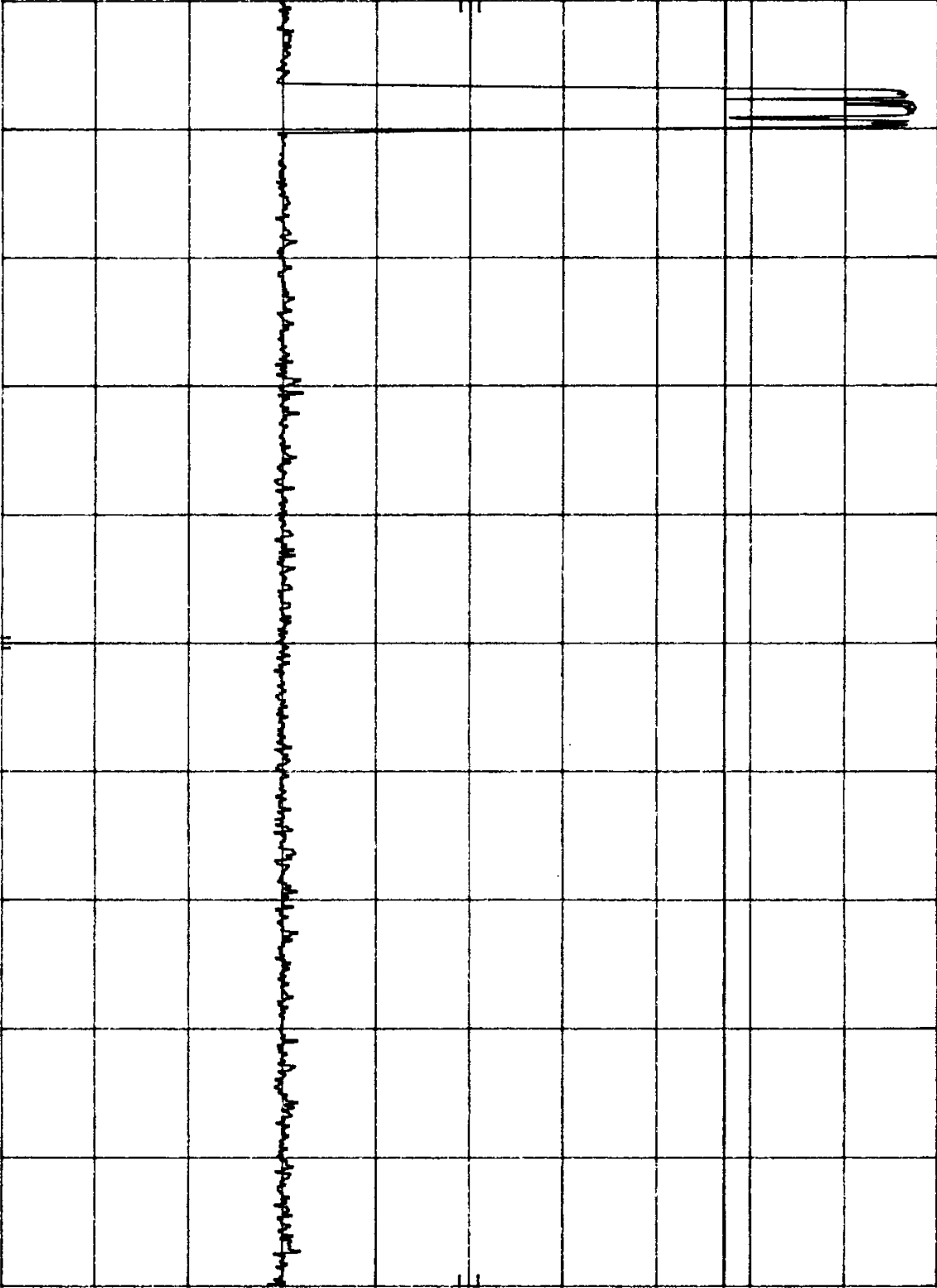


52.80 dBm
 MKB 25.145 MHz

Appendix G

Plot of Out of Bands

START 30 MHz RES BM ↑ MHz VBM ↑ MHz 2MB 54.3 msec STOP ↑ 000 GHz



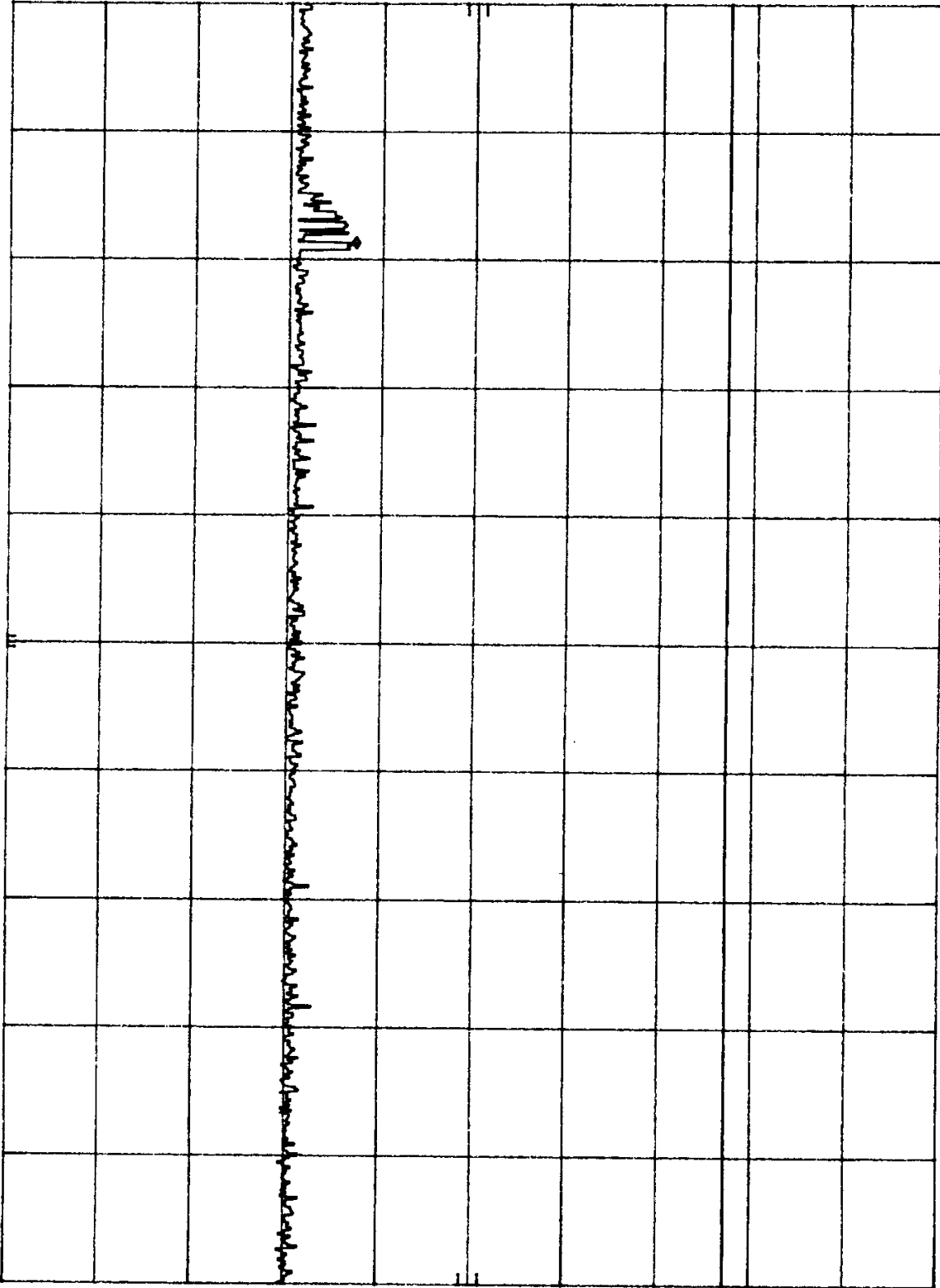
qbw
e.s
df

qb
0.0
offset

↑ 0 qb \

RES 50.0 qbw VLEN 30 qb SE.50 qbw
 FBEEWAVE DCR00 WKH 0↑.e MHz

START 1.00 GHz RES BM 1 MHz VBM 1 MHz 2MB 52.0 wac STOP 5.00 GHz



qbw
e.s
df

qb
2.0
offset

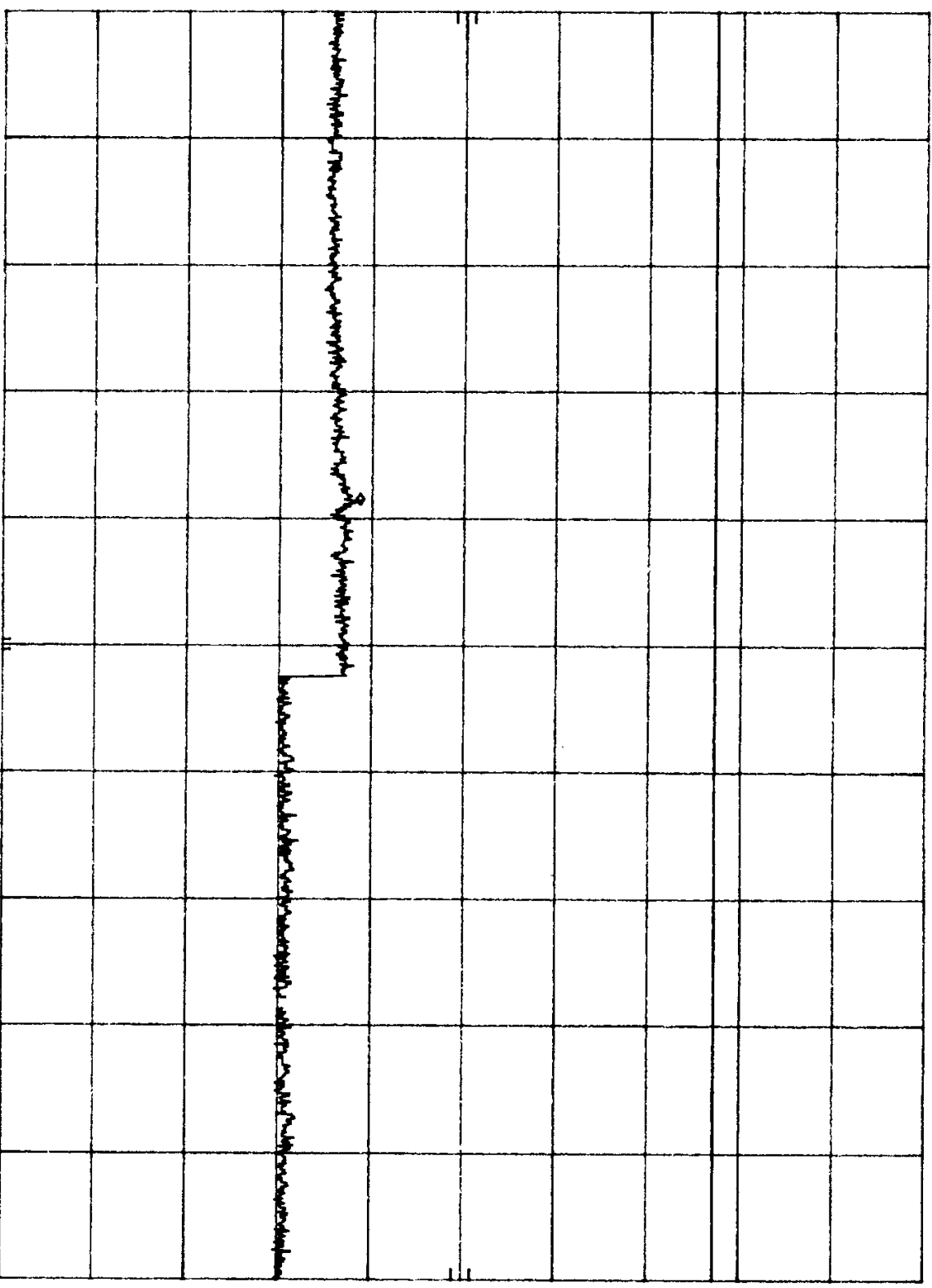
10 qb\

14

RES 52.0 qbw V1LEN 30 qb
FREEMOVE DCB00

-33.20 qbw
WKH 1.875 GHz

START 5.00 CHZ RES BM ↑ MHZ VBM ↑ MHZ 2MB 500 msec STOP 10.00 CHZ



qbw
e.s
dl
qb
0.0
OFFSET

↑ 10 qb \

RES 50.0 qbw VLEN 30 qb -35.30 qbw
FREEMOVE DCR00 MKR 0.015 CHZ

Appendix H

Test Plan and Constructional Data Form

Form

EMC Test Plan and Constructional Data Form

PLEASE COMPLETE THIS DOCUMENT IN FULL, ENTERING N/A IF THE FIELD IS NOT APPLICABLE.

Applicant -- NOTE: This information will be input into your test report as shown below. Press the F1 key at any time to get HELP for the current field selected.

Company: FreeWave Technologies, Inc.
Address: 1880 S. Flatiron Court, Suite F
Boulder, CO 80301
Contact: Aleksey Pozhidaev Position: Engineer
Phone: (303) 444-3862 Fax: (303) 786-9948
E-mail Address: alexp@freewave.com

General Equipment Description -- NOTE: This information will be input into your test report as shown below.

EUT Description: frequency hopping spread spectrum transceiver module, 902-928 MHz band, 1 W
EUT Name: wireless data transceiver
Model No.: DGRO9 Serial No.: 902-1164
Product Options:
Configurations to be tested: DGRO9 with 10 dB Yagi antenna, DGRO9 with 5 dB omnidirectional antenna

Test Objective

- EMC Directive 89/336/EEC (EMC)
Machinery Directive 89/392/EEC (EMC)
Medical Device Directive 93/42/EEC (EMC)
Vehicle Directive 72/245/EEC (EMC)
FDA Reviewers Guidance for Premarket Notification Submissions (EMC)
FCC: Class A B Part 15
VCCI: Class A B
BCIQ: Class A B
Canada: Class A B
Australia: Class A B
Other:

TÜV Product Service Certification Requested

- Attestation of Conformity (AoC)
Certificate of Conformity (CoC)
International EMC Mark (IEM)
Compliance Document
Protection Class (N/A for vehicles)
Class I Class II Class III
(Press F1 when field is selected to show additional information on Protection Class.)

Form

EMC Test Plan and Constructional Data Form

Attendance

Test will be: Attended by the customer Unattended by the customer

Failure - Complete this section if testing will not be attended by the customer.

If a failure occurs, TUV Product Service should:

- Call contact listed above, if not available then stop testing. (After hrs phone): _____
- Continue testing to complete test series.
- Continue testing to define corrective action.
- Stop testing.

EUT Specifications and Requirements

Length: 5.040" Width: 2.435" Height: 0.612" Weight: 90 g

Power Requirements

Regulations require testing to be performed at typical power ratings in the countries of intended use. (i.e., European power is typically 230 VAC 50 Hz or 400 VAC 50 Hz, single and three phase, respectively)

Voltage: 12 VDC (If battery powered, make sure battery life is sufficient to complete testing.)

of Phases: _____

Current (Amps/phase(max)): 1 A max Current (Amps/phase(nominal)): 250 mA

Other _____

Other Special Requirements

Typical Installation and/or Operating Environment

(ie. Hospital, Small Business, Industrial/Factory, etc.)

Typical installations are remote monitoring and data gathering, Internet access, and differential GPS.

EUT Power Cable

- Permanent OR Removable Length (in meters): _____
- Shielded OR Unshielded
- Not Applicable

Form

EMC Test Plan and Constructional Data Form

EUT Interface Ports and Cables												
Interface			Shielding									
Type	Analog	Digital	Qty	Yes	No	Type	Termination	Connector Type	Port Termination	Length (in meters)	Removable	Permanent
EXAMPLE: RS232	<input type="checkbox"/>	<input checked="" type="checkbox"/>	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Foil over braid	Coaxial	Metallized 9-pin D-Sub	Characteristic Impedance	6	<input checked="" type="checkbox"/>	<input type="checkbox"/>
power and RS232 data port	<input type="checkbox"/>	<input checked="" type="checkbox"/>	1	<input type="checkbox"/>	<input checked="" type="checkbox"/>			10 pin Header, Surface mount, Locking Ramp			<input type="checkbox"/>	<input checked="" type="checkbox"/>
antenna port	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Coaxial cable		reverse SMA	Characteristic impedance	6	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>
Not Applicable	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>

Form

EMC Test Plan and Constructional Data Form

EUT Software.

Revision Level: version 5.63

Description: supports Point-to-Point, Point-to-Multipoint, TDMA and Peer-to-Peer network protocols

EUT Operating Modes to be Tested -- list the operating modes to be used during test. It is recommended the equipment be tested while operating in a typical operation mode. FCC testing of personal computers and/or peripherals requires that a simple program generate a complete line of upper case H's. Provide a general description of all software, firmware, and PLD algorithms used in the equipment. List all code modules as described above, with the revision level used during testing. Consult with your TÜV Product Service Representative if additional assistance is required.

1. Test mode 1 - single frequency (low, mid and high), 100 % receiver duty cycle - for the unintentional radiated emissions test.
2. Test mode 2 - single frequency (low, mid and high), receiver is off, transmitter is on with the duty cycle 20.4 % - for the intentional radiated emissions test.
- 3.

EUT System Components -- List and describe all components which are part of the EUT. For FCC testing a minimum configuration is required. (ie. Mouse, Printer, Monitor, External Disk Drive, Motherboard, etc.)

Description	Model #	Serial #	FCC ID #
"FreeWave Technologies" radio transceiver module	DGRO9	902-1164	KNY-19318523-13419
data and power cable	buit for the test purposes only		
"Larsen" 10 db Yagi antenna	YA0006		
"Antennex" 5 dB omnidirectional antenna	EB8965C		
"Denver Beta" antenna coaxial cable	ASC0202RN		

Form

EMC Test Plan and Constructional Data Form

Support Equipment -- List and describe all support equipment which is not part of the EUT. (i.e. peripherals, simulators, etc)			
<i>Description</i>	<i>Model #</i>	<i>Serial #</i>	<i>FCC ID #</i>
"Hewlett Packard" linear power supply	E3620A	KR75307041	
"Dell" laptop computer	P133ST	7YF1K7	E2KXPE2KXPT

Oscillator Frequencies			
<i>Frequency</i>	<i>Derived Frequency</i>	<i>Component # / Location</i>	<i>Description of Use</i>
14.7456 MHz		U5, Y1, R52, R48, C54, C85	main crystal oscillator
902-928 MHz and 932-958 MHz		Q10, Q11, Y2, U3, U22	local oscillator (Tx and Rx frequencies)

Power Supply			
<i>Manufacturer</i>	<i>Model #</i>	<i>Serial #</i>	<i>Type</i>
Hewlett Pacckard	E3628	KR75307041	<input type="checkbox"/> Switched-mode: (Frequency) _____ <input checked="" type="checkbox"/> Linear <input type="checkbox"/> Other: _____
			<input type="checkbox"/> Switched-mode: (Frequency) _____ <input type="checkbox"/> Linear <input type="checkbox"/> Other: _____

Power Line Filters		
<i>Manufacturer</i>	<i>Model #</i>	<i>Location in EUT</i>

Form

EMC Test Plan and Constructional Data Form

Critical EMI Components (Capacitors, ferrites, etc.)				
Description	Manufacturer	Part # or Value	Qty	Component # / Location

EMC Critical Detail -- Describe other EMC Design details used to reduce high frequency noise.

(PLEASE INSERT "ELECTRONIC SIGNATURE" BELOW IF POSSIBLE)

Authorization Signatures

Aleksey Pozhidaev

7/03/00

Customer authorization to perform tests
according to this test plan.

Date

Test Plan/CDF Prepared By (please print)



Date

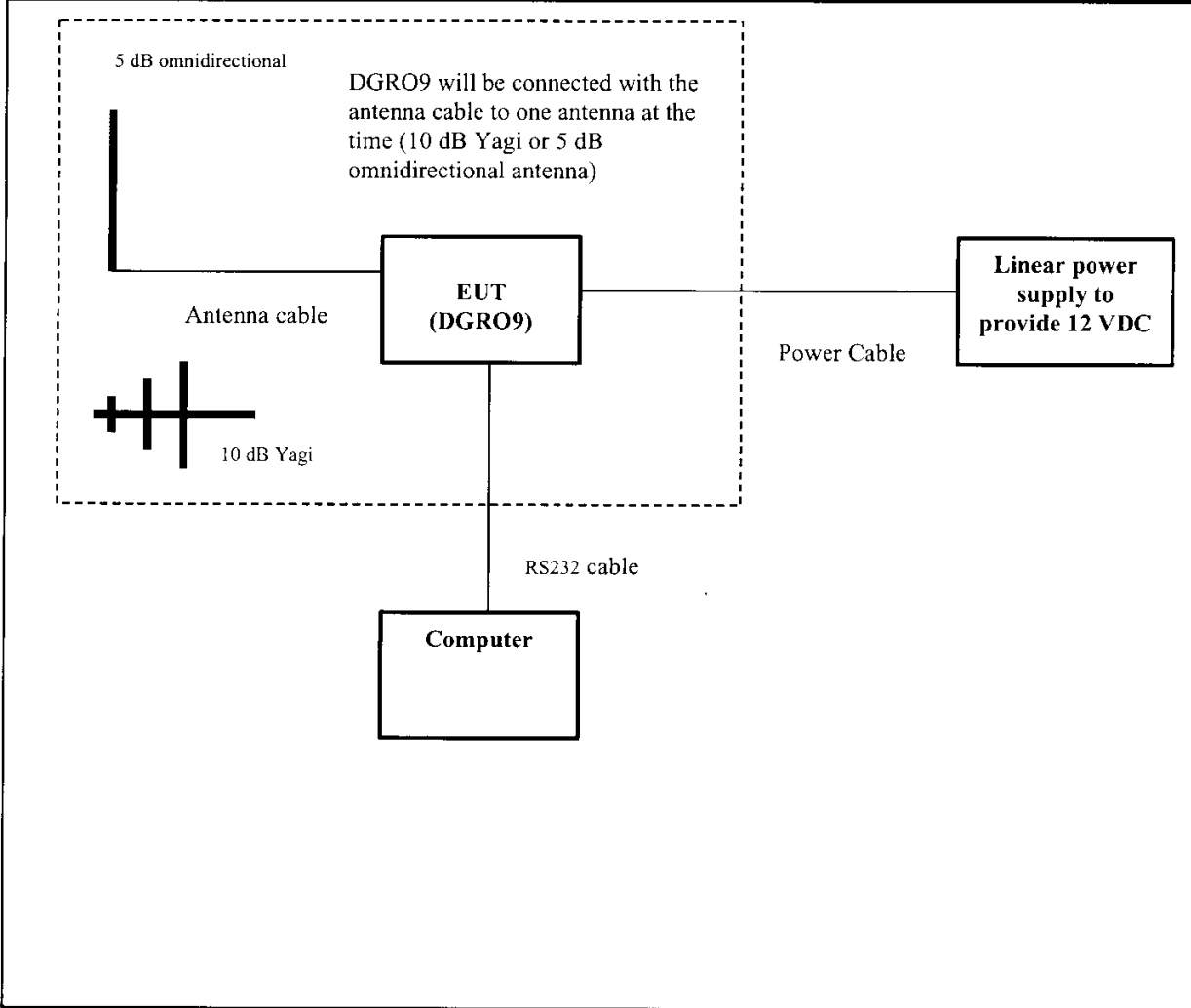
Sept. 05, 2000

Reviewed by TÜV Product Service Associate

Date

EMC Block Diagram Form

System Configuration Block Diagram -- Provide a line drawing identifying the EUT, simulators, support equipment, I/O cables, power cables, and any other pertinent components to be used during testing. Use a dashed line to separate the equipment in the testing field versus equipment outside testing field.



Authorization Signatures

Customer authorization to perform tests according to this test plan.

_____ Date

Aleksey Pozhidaev

7/03/00

Test Plan Prepared By (please print)

_____ Date

J. J. [Signature]

Sept. 05, 2000

Reviewed by TÜV Product Service Associate

_____ Date

FCC Emissions Test Plan Details

(ATTACHMENT)



If testing levels other than those desired, then indicate the requested test levels under Engineering Justifications / Test Deviations.

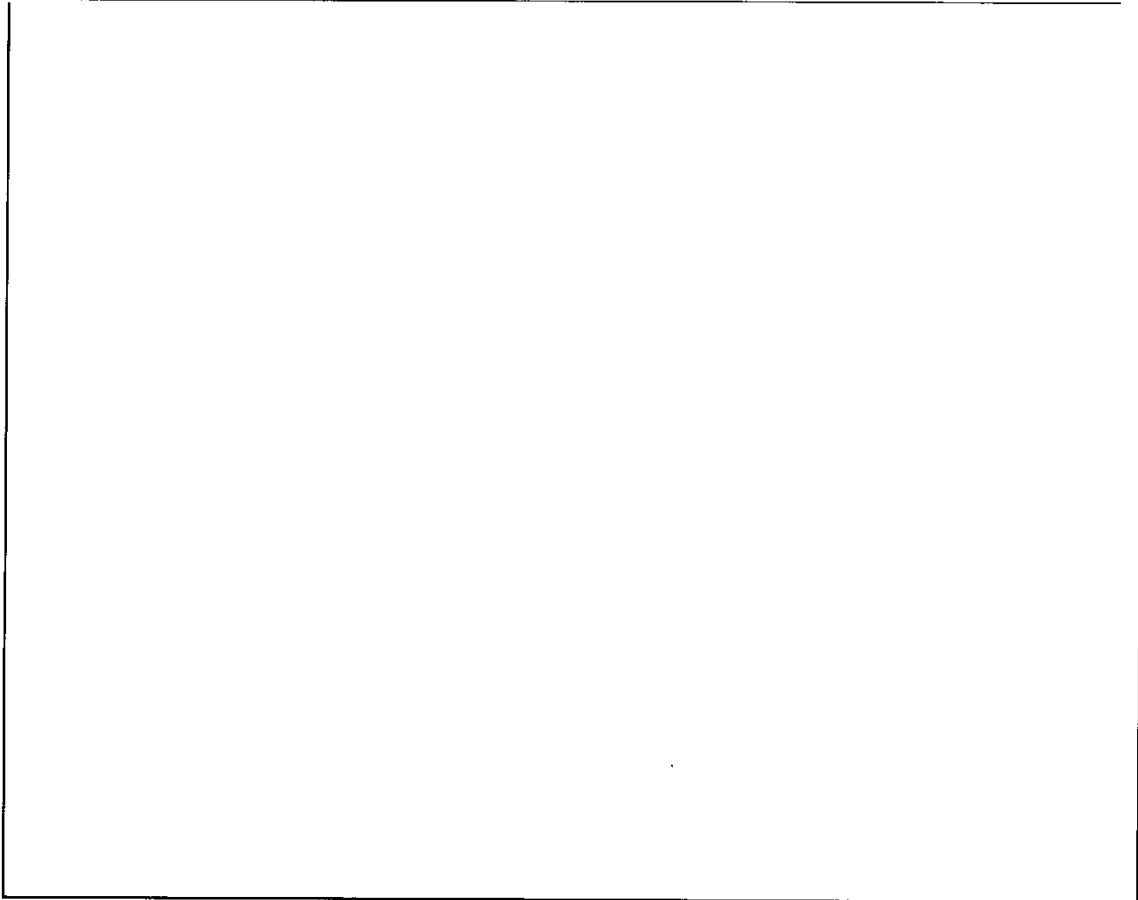
Standards to be Applied		
<input type="checkbox"/>	CISPR 22	
	<input type="checkbox"/> Class A	
	<input type="checkbox"/> Class B	
<input checked="" type="checkbox"/>	FCC Part <u>15</u>	(list) Class <u>B</u> (list)
<input type="checkbox"/>	Other _____	(list)

Description	Basic Document	Requirement
Radiated & Conducted Emissions	ANSI 63.4	Reference Basic Document or Applicable Standard

Engineering Justifications / Test Deviations
<p>1. The FreeWave Technologies will provide the DGRO9 radio transceiver module for installation in a combination with a set of different antennas (complete list of antenna model numbers and antenna manufactures provided in the User Manual). All of these antennas can be divided into two general types - omnidirectional and directional. After prescanning all of the antennas in the "TUV product service" company's EMC measurements laboratory, was found that two antennas shall be considered as a worst case from the intentional radiation levels stand point - 10 dB Yagi and 5 dB omnidirectional antennas and one antenna shall be considered as a worst case from the unintentional radioation levels stand point - 10 dB Yagi. So, all of the intentional measurements shall be done using 10 dB Yagi and 5 dB omnidirectional antennas and all of the unintentional measurements shall be done using 10 dB Yagi antenna.</p>

UEMC0911.DOC, Revision 2.0
Author: F.Chavez
Revised: 26 September 1999

**FCC Emissions
Test Plan Details**
(ATTACHMENT)



UEMC0911.DOC, Revision 2.0
Author: F.Chavez
Revised: 26 September 1999

Appendix I

Measurement of Protocol

MEASUREMENT PROTOCOL FOR FCC

GENERAL INFORMATION

Measurement Uncertainty

The test system for conducted emissions is defined as the LISN, tuned receiver or spectrum analyzer, and coaxial cable. The test system for radiated emissions is defined as the antenna, the pre-amplifier, the spectrum analyzer and the coaxial cable. These test systems have a measurement uncertainty of ± 4.5 dB. The equipment comprising the test systems are calibrated on an annual basis.

Justification

The Equipment Under Test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral into its characteristic impedance or left unterminated. When appropriate, the cables are manually manipulated with respect to each other to obtain maximum emissions from the unit.

CONDUCTED EMISSIONS

The final level, expressed in dB μ V, is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the FCC limit.

To convert between dB μ V and μ V, the following conversions apply:

$$\text{dB}\mu\text{V} = 20(\log \mu\text{V})$$

$$\mu\text{V} = \text{Inverse log}(\text{dB}\mu\text{V}/20)$$

RADIATED EMISSIONS

The final level, expressed in dB μ V/m, is arrived at by taking the reading from the spectrum analyzer (Level dB μ V) and adding the antenna correction factor and cable loss factor (Factor dB) to it. This result then has the FCC limit subtracted from it to provide the Delta which gives the tabular data as shown in the data sheets in Attachment B. The amplifier gain is automatically accounted for by using an analyzer offset.

Example:

Frequency (MHz)	Level (dB μ V)	+	Factor & Cable (dB)	=	Final (dB μ V/m)	-	FCC B Limit (dB μ V/m)	=	Delta FCC B (dB)
32.21	13.9	+	16.3	=	30.2	-	40.0	=	-9.8

DETAILS OF TEST PROCEDURES

General Standard Information

The test methods used comply with ANSI C63.4-1992 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

Conducted Emissions

Conducted emissions on the 60 Hz power interface of the EUT are measured in the frequency range of 450 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection, and a Line Impedance Stabilization Network (LISN), with 50 Ω /50 μ H (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimeters above the floor and is positioned 40 centimeters from the vertical ground plane (wall) of the screen room. In some cases, a pre-scan using a spectrum analyzer is initially performed on the units comprising the system under test to locate the highest emissions. If the minimum passing margin appears to be less than 20 dB with a peak mode measurement, the emissions are re-measured using a tuned receiver or spectrum analyzer with quasi-peak and average detection and recorded on the data sheets.

Radiated Emissions

Radiated emissions from the EUT are measured in the frequency range of 30 to 9278.6 MHz using a spectrum analyzer and appropriate broadband linearly polarized antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection and measurements above 1000 MHz are made with a 1 MHz/6 dB bandwidth and peak detection. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimeters above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. Interface cables that are closer than 40 centimeters to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimeters from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna is positioned 3 meters horizontally from the EUT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters, measurement scans are made with both horizontal and vertical antenna polarizations and the EUT are rotated 360 degrees. Intentional radiators are rotated through three orthogonal axes to determine the attitude that maximizes the emissions.

15: 56: 34 NOV 14, 2000

HP

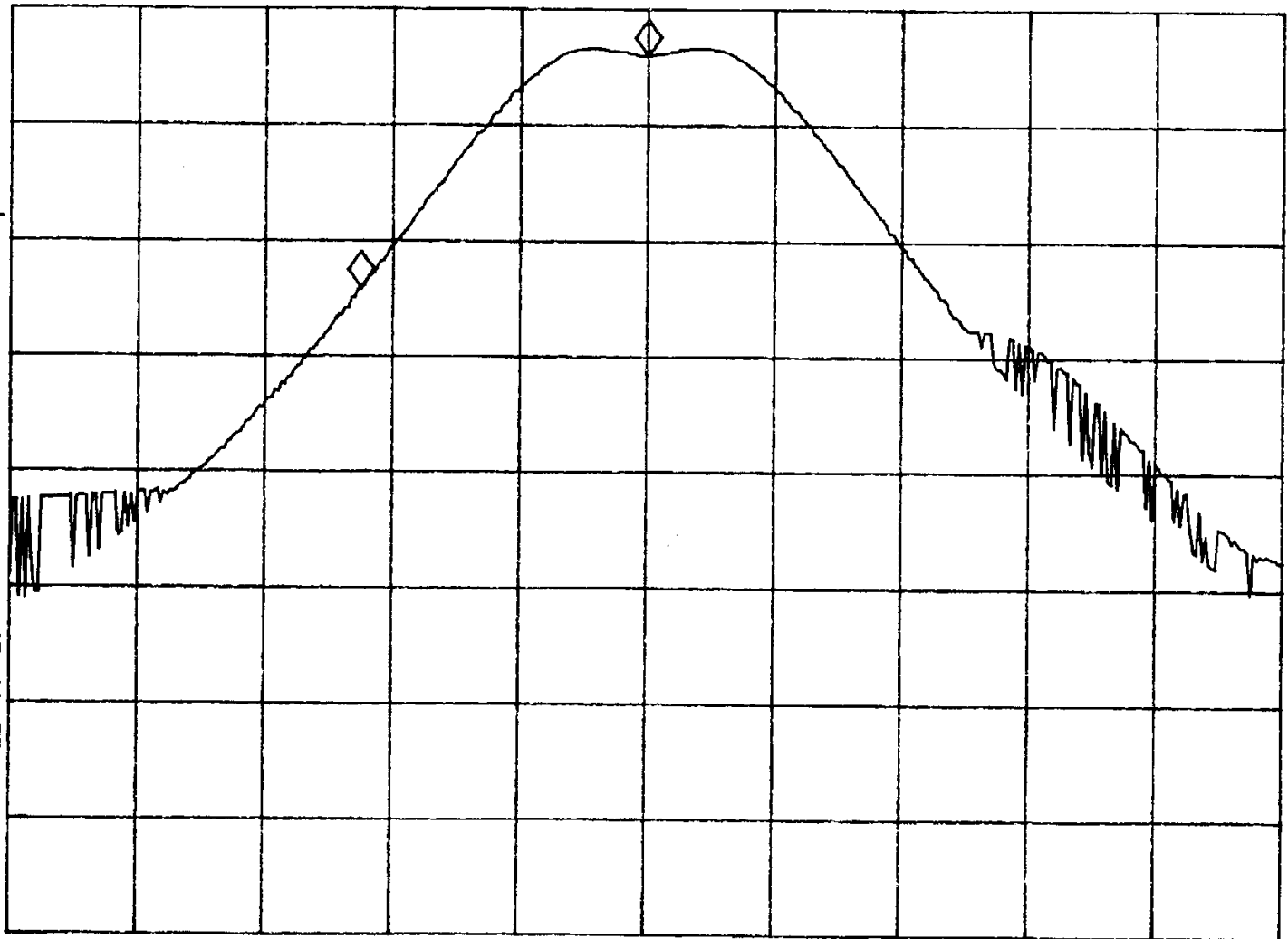
REF 28.3 dBm

AT 40 dB

MKR Δ -225 kHz

-20.08 dB

PEAK
LOG
10
dB/
OFFST
-1.7
dB



VA SB
SC FC
CORR

CENTER 902.016 MHz

#RES BW 100 kHz

VBW 100 kHz

SPAN 1.000 MHz

SWP 20.0 msec

16: 25: 38 NOV 14, 2000

hp

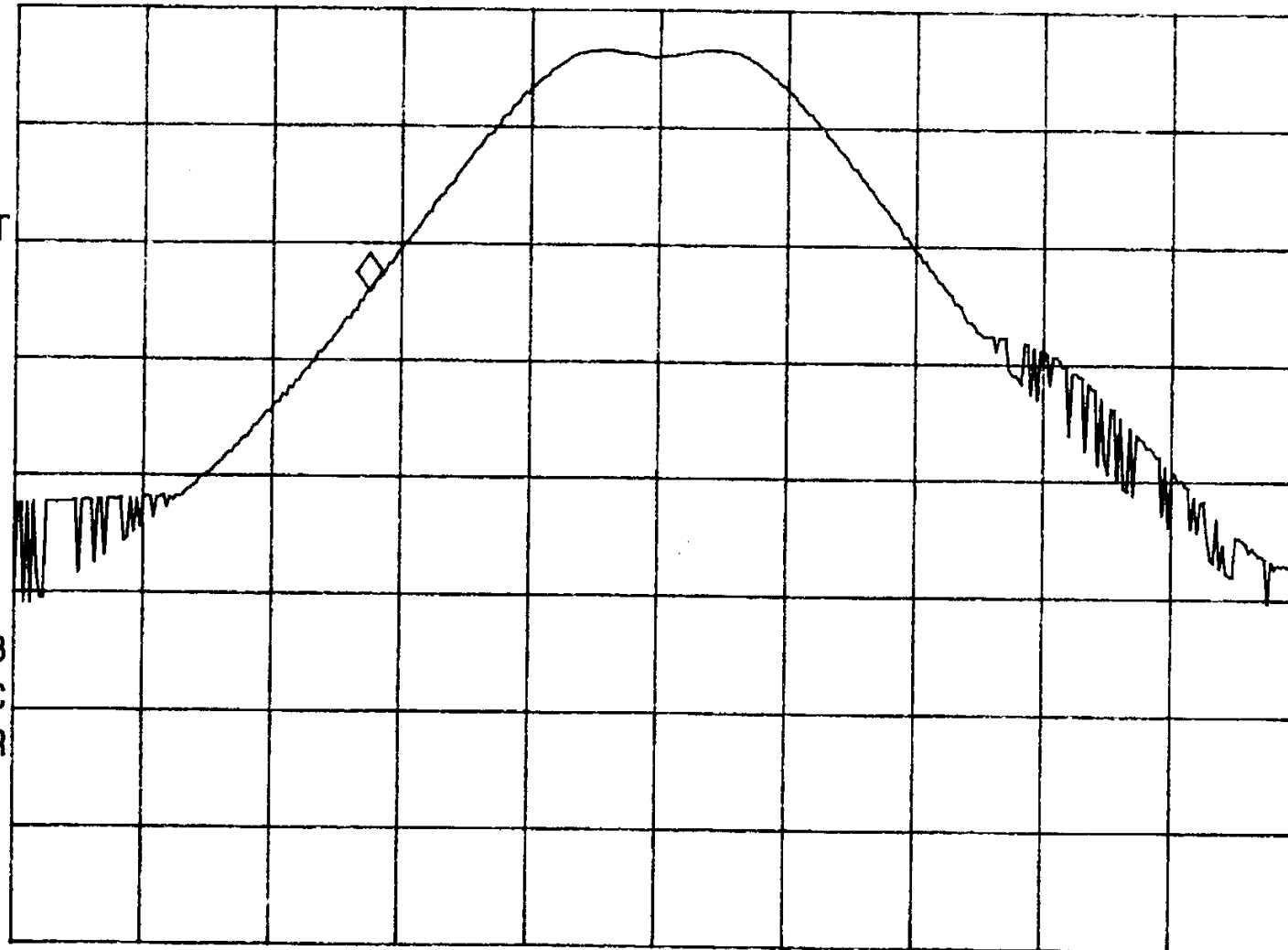
MKR 901.791 MHz

REF 28.3 dBm

AT 40 dB

4.20 dBm

PEAK
LOG
10
dB/
OFFST
-1.7
dB



VA SB
SC FC
CORR

CENTER 902.016 MHz

#RES BW 100 KHz

VBW 100 KHz

SPAN 1.000 MHz

SWP 20.0 msec

15: 42: 08 NOV 14, 2000
hp

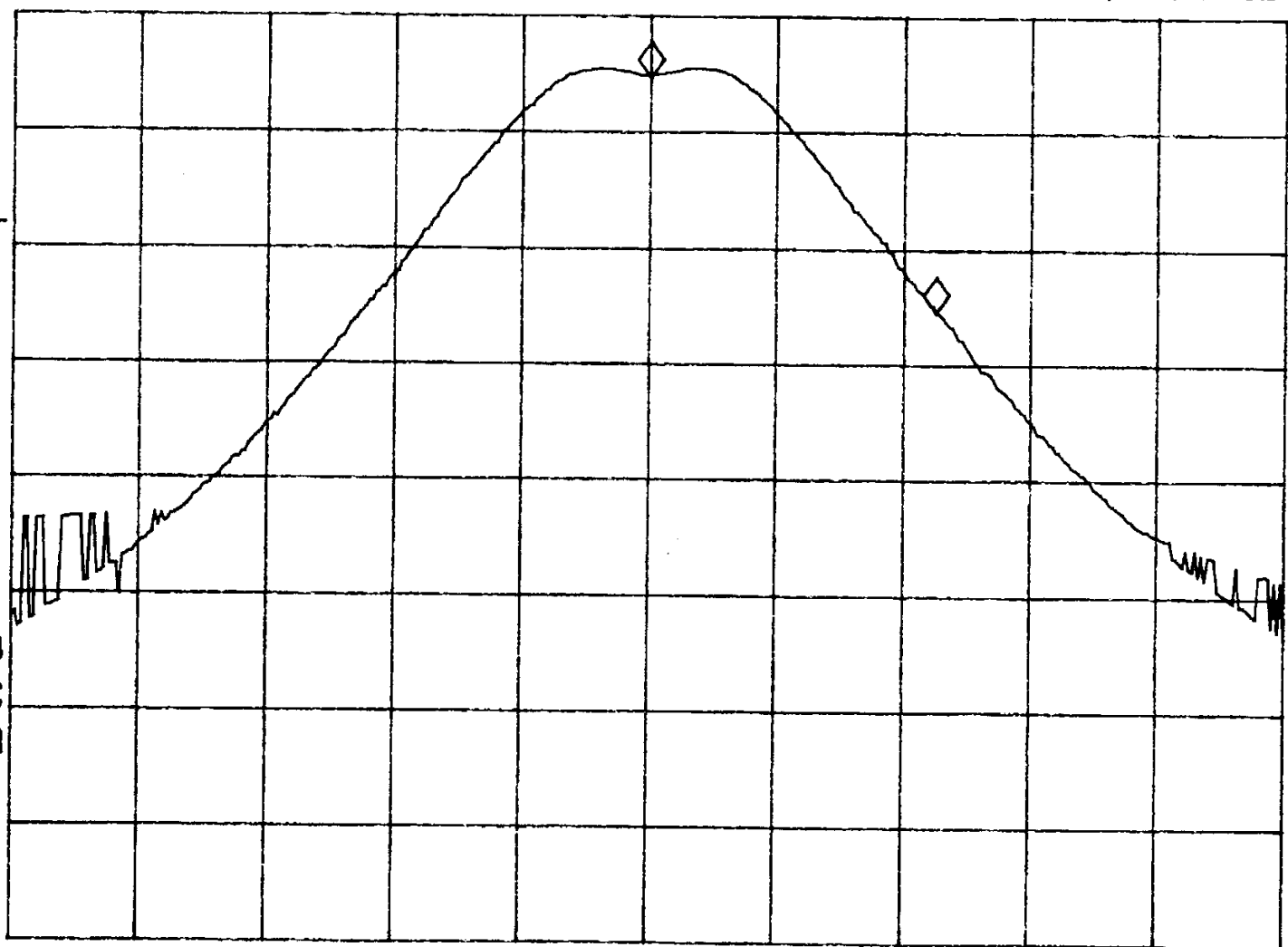
REF 28.3 dBm

AT 40 dB

MKR Δ 225 KHZ
-20.12 dB

PEAK
LOG
10
dB/
OFFST
-1.7
dB

VA SB
SC FC
CORR



CENTER 927.821 MHz

#RES BW 100 KHZ

VBW 100 KHZ

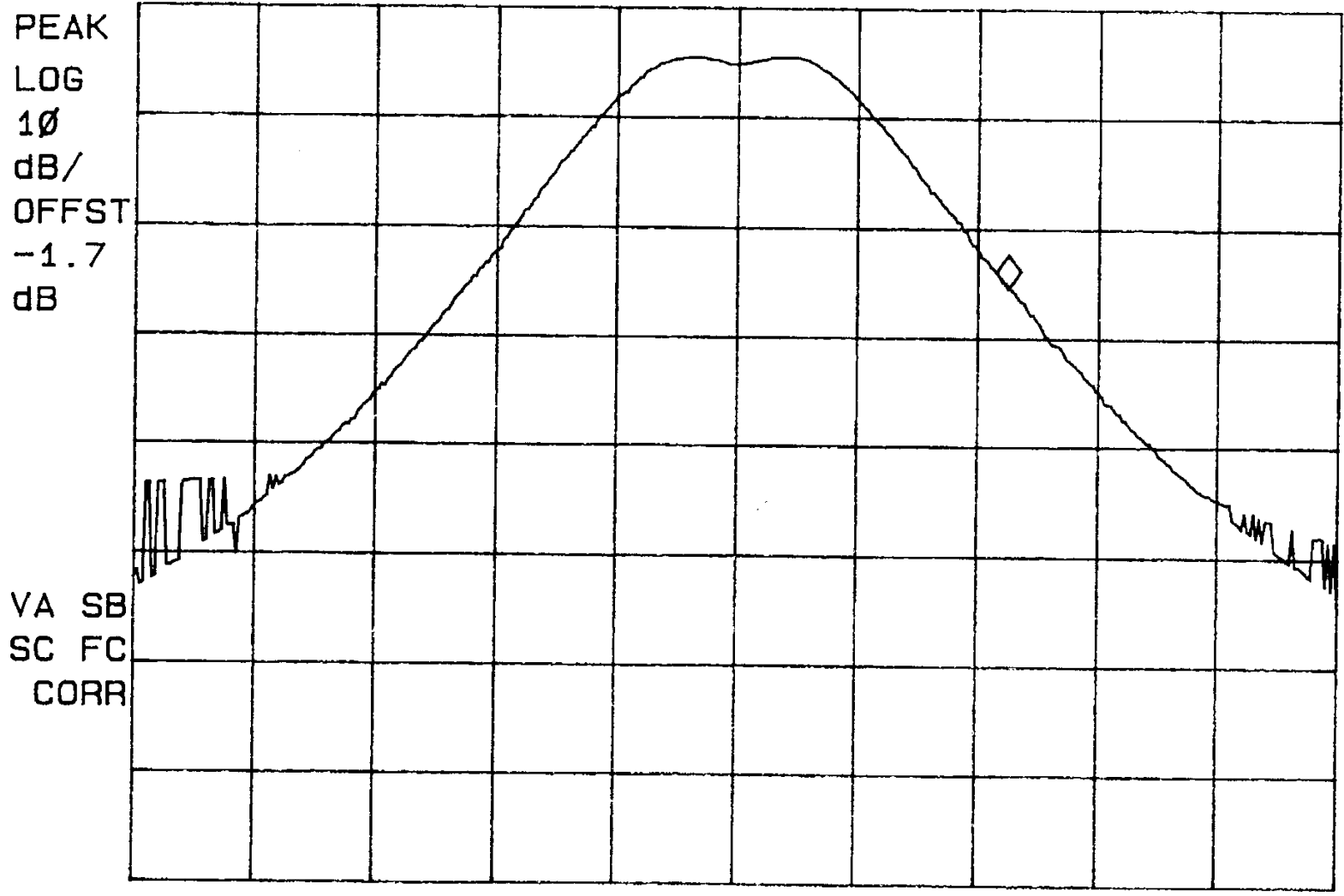
SPAN 1.000 MHz

SWP 20.0 msec

15:46:51 NOV 14, 2000
hp

MKR 928.046 MHz
2.81 dBm

REF 28.3 dBm AT 40 dB



CENTER 927.821 MHz SPAN 1.000 MHz
#RES BW 100 KHz VBW 100 KHz SWP 20.0 msec

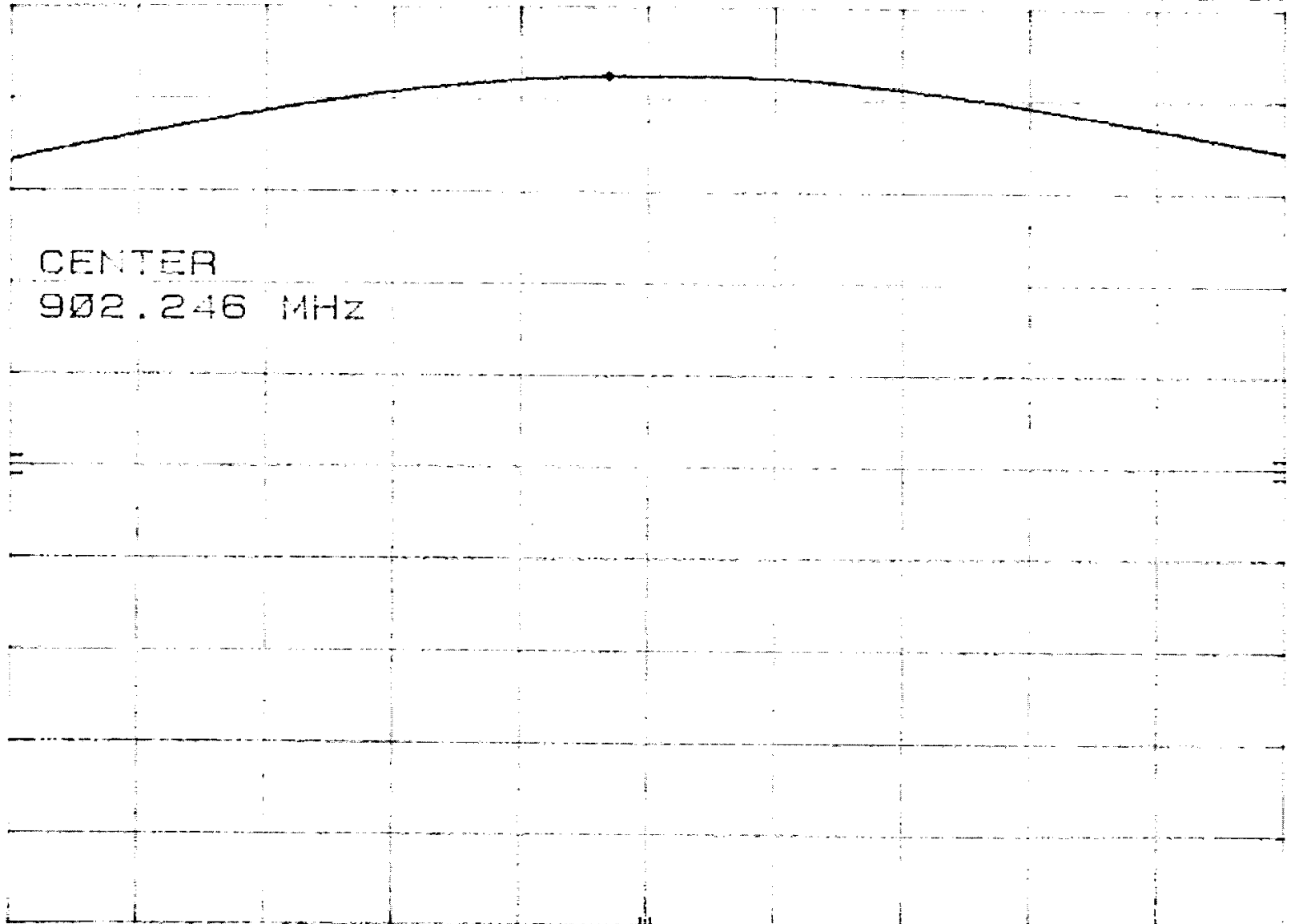
LMR 400 100ft
REF 30.0 dBm

ATTEN 20 dB

MKR 902.182 MHz
22.60 dBm

hp
10 dB/

OFFSET
20.0
dB



CENTER 902.246 MHz
RES BW 1 MHz

VBW 300 kHz

SPAN 2.000 MHz
SWP 20 msec

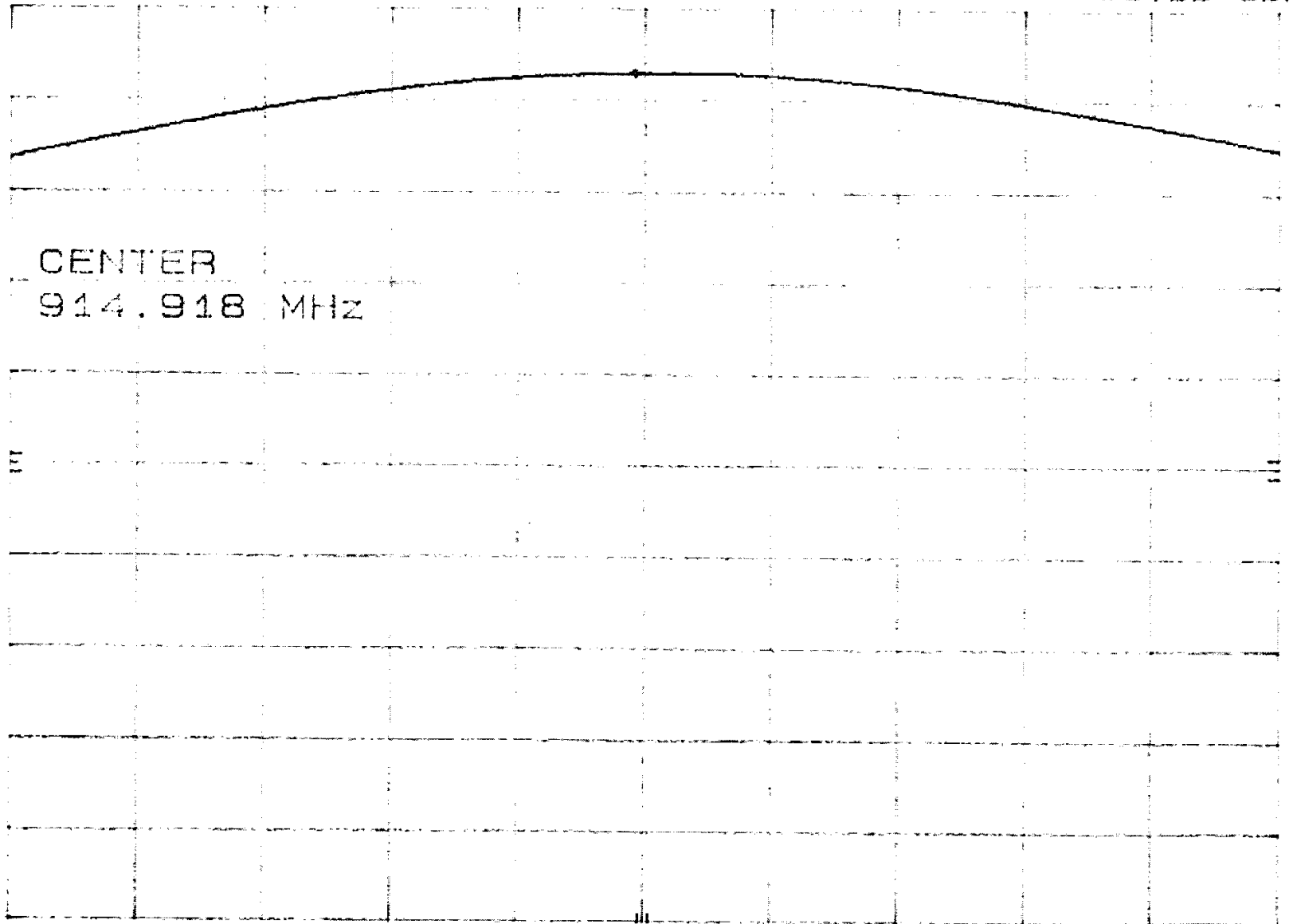
LMR 400 100ft
REF 30.0 dBm

ATTEN 20 dB

MKR 914.900 MHz
23.00 dBm

hp
10 dB/

OFFSET
20.0
dB



CENTER
914.918 MHz

CENTER 914.918 MHz
RES BW 1 MHz

VBW 300 kHz

SPAN 2.000 MHz
SWP 20 msec

LMR 400 100ft

MKR 927.811 MHz

hp

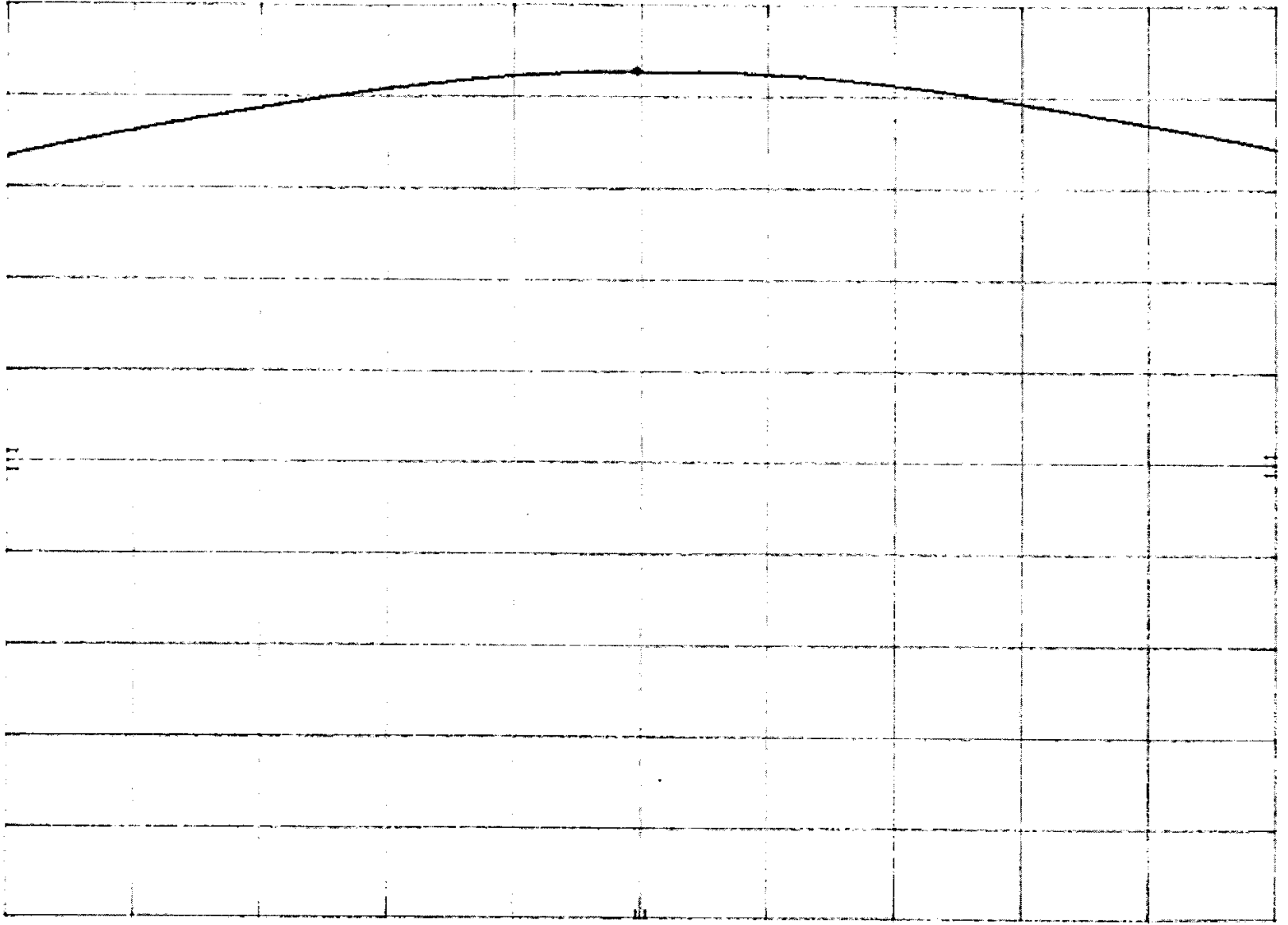
REF 30.0 dBm

ATTEN 20 dB

22.80 dBm

10 dB/

OFFSET
20.0
dB



CENTER 927.821 MHz

RES BW 1 MHz

VBW 300 KHz

SPAN 2.000 MHz

SWP 20 msec

LMR 240 50ft

MKR 902.246 MHz

hp

REF 30.0 dBm

ATTEN 20 dB

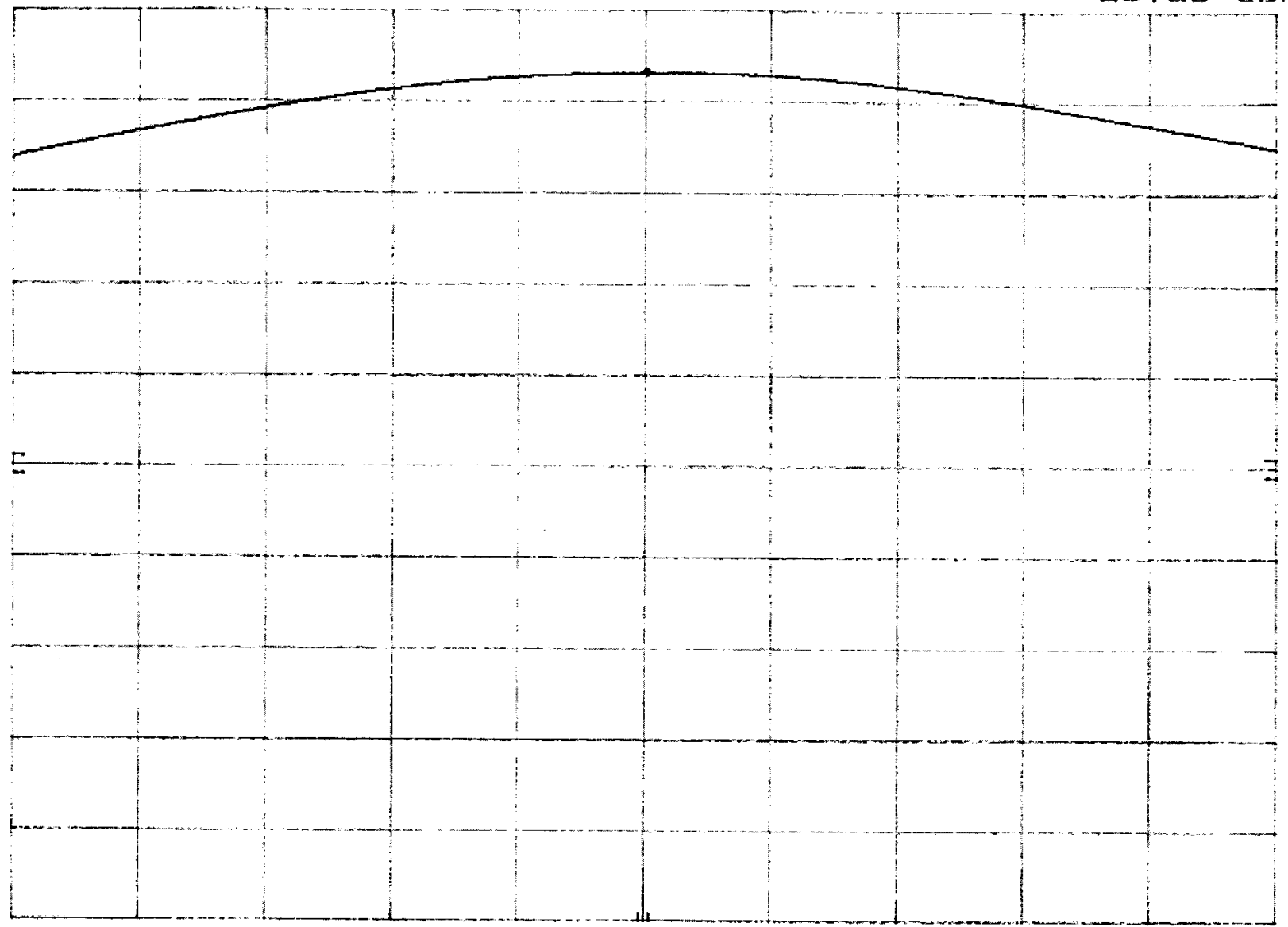
23.20 dBm

10 dB/

OFFSET

20.0

dB



CENTER 902.246 MHz

RES BW 1 MHz

VBW 300 kHz

SPAN 2.000 MHz

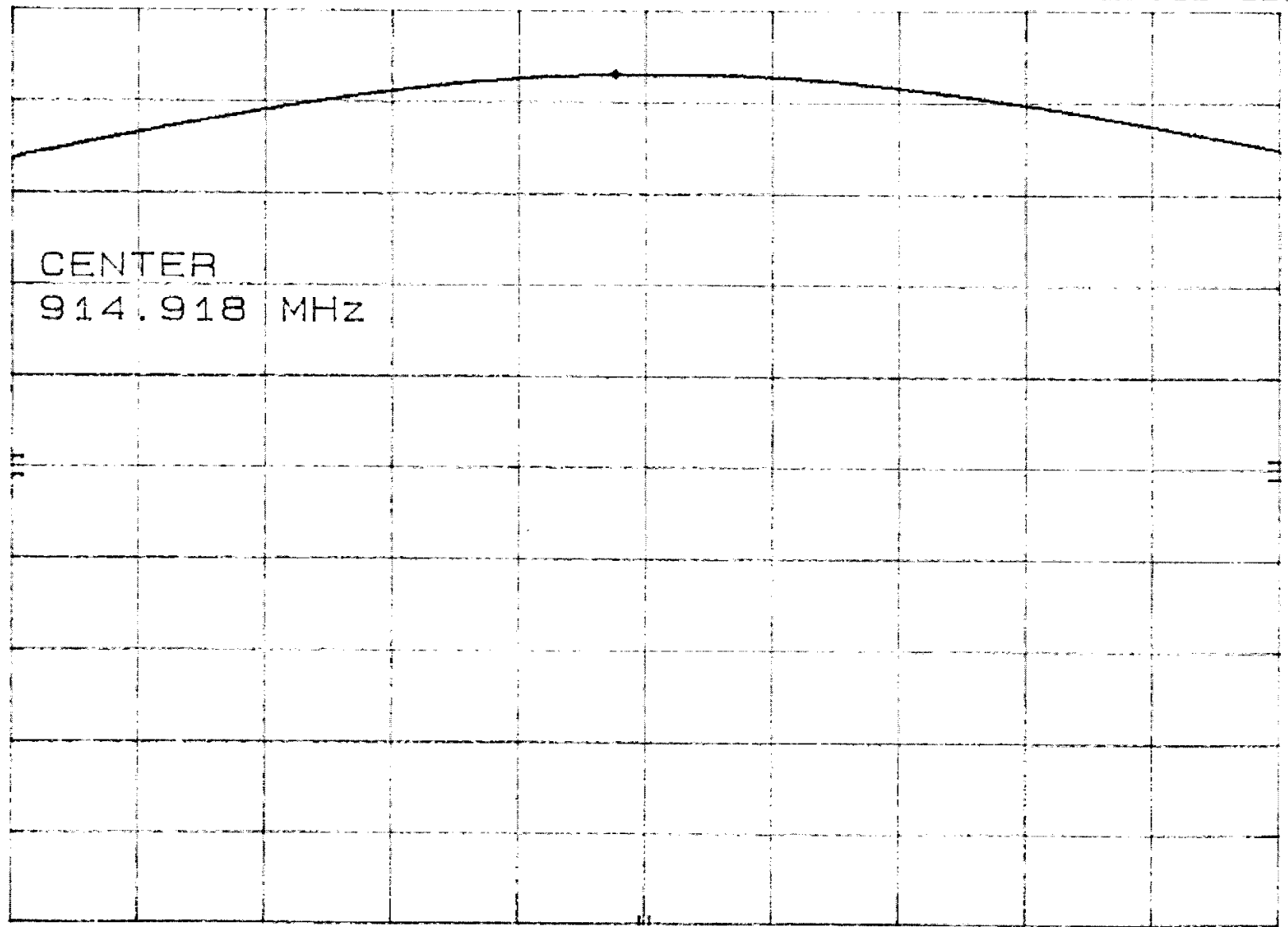
SWP 20 msec

LMR 240 50ft
REF 30.0 dBm

ATTEN 20 dB

MKR 914.868 MHz
23.10 dBm

hp
10 dB/
OFFSET
20.0
dB



CENTER 914.918 MHz
RES BW 1 MHz

VBW 300 kHz

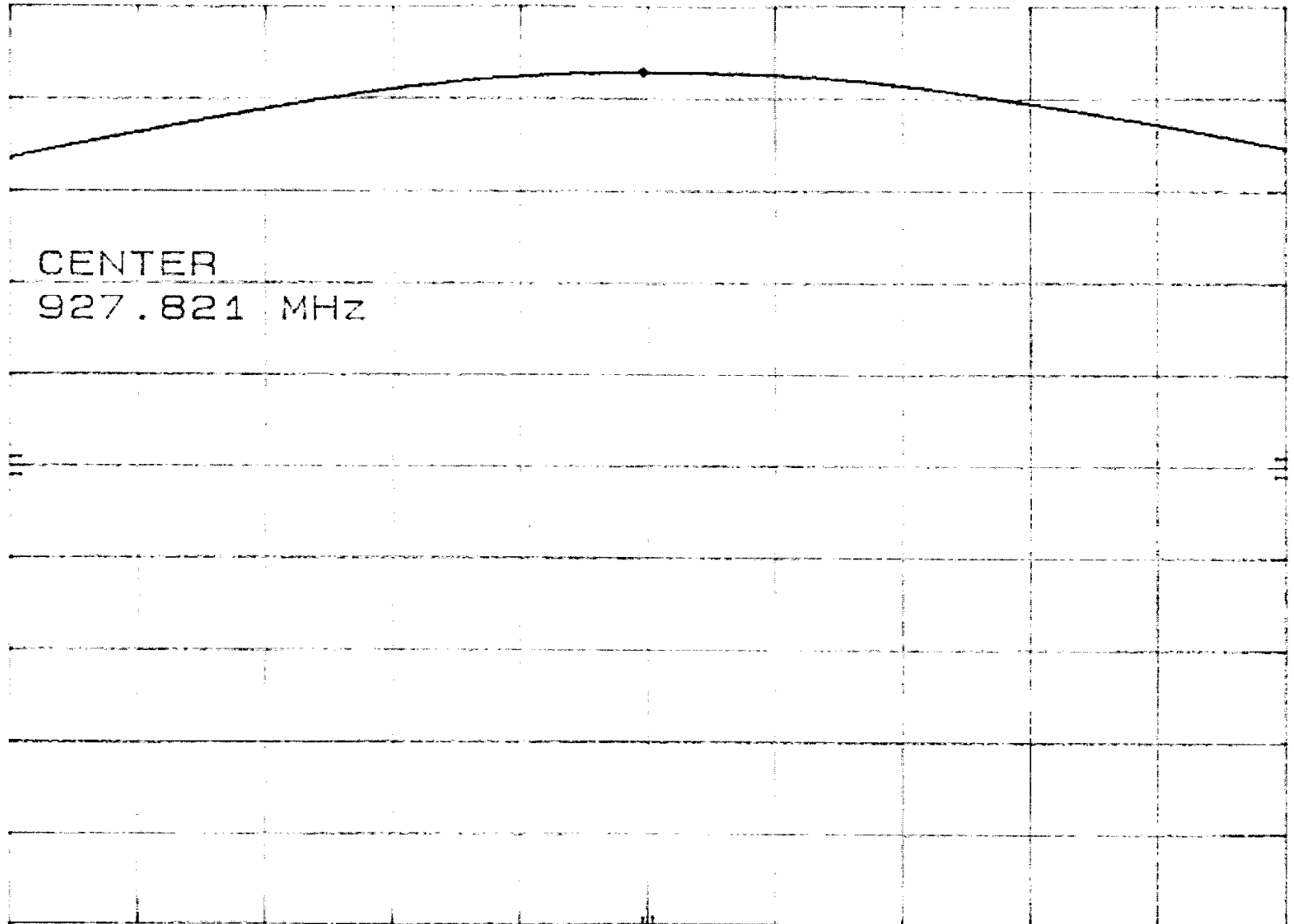
SPAN 2.000 MHz
SWP 20 msec

LMA 240 50ft
REF 30.0 dBm

ATTEN 20 dB

MKR 927.811 MHz
22.90 dBm

hp
10 dB/
OFFSET
20.0
dB



CENTER 927.821 MHz
RES BW 1 MHz

VBW 300 kHz

SPAN 2.000 MHz
SWP 20 msec

November 29, 2000

Federal Communications Commission
Equipment Authorization Division
7435 Oakland Mills Road
Columbia, MD 21046

To whom it may concern,

For modules, which will have the external 10 dB Yagi antenna, we will use a special reverse polarity SMA type connector supplied by Amphenol (Amphenol part number #615X-1279-200, the drawing is attached).

Additionally, the 10 dB Yagi antennas will be supplied by FreeWave Technologies in a combination with a coaxial 50 Ohms cable permanently and securely connected to the antenna with Conap High Strength Epoxy and Sealant. The length of the cable will be chosen to provide at least 4 dB insertion loss in 902-928 MHz frequency band.

We believe the above additions to our module will fulfill requirements of Sections 15.203 and 15.204(c) as well as requirement of Public Notice DA 00-1407 for a "unique" antenna coupler and therefor do not need to meet requirements for professional installation.

Sincerely,

A handwritten signature in black ink, appearing to read 'Aleksey Pozhidaev', with a horizontal line underneath.

Aleksey Pozhidaev
Engineer