Elliott Laboratories Inc.
www.elliottlabs.com
684 West Maude Avenue
Sunnyvale, CA 94086-3518
408-245-7800 Phone
408 245-3499 Fax

Electromagnetic Emissions Test Report and Application for Grant of Equipment Authorization pursuant to FCC Part 15, Subpart C Specifications for an Intentional Radiator on the Nova Engineering, Inc. Model: NovaRoam 900

FCC ID:	OOSNROAM900
GRANTEE:	Nova Engineering, Inc. 5 Circle Freeway Drive Cincinnati, OH 45246-1201
TEST SITE:	Elliott Laboratories, Inc. 684 W. Maude Avenue Sunnyvale, CA 94086
REPORT DATE:	August 26, 1999
FINAL TEST DATE:	August 12 through August 23, 1999
AUTHORIZED SIGNATORY:	David W Bare David W. Bare Principal Engineer

TABLE OF CONTENTS

TABLE OF CONTENTS CONT'

SCOPE

An electromagnetic emissions test has been performed on the Nova Enginnering model NovaRoam 900 pursuant to Subpart C of Part 15 of FCC Rules for intentional radiators. Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in ANSI C63.4-1992 as outlined in Elliott Laboratories test procedures.

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant FCC performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

The test results recorded herein are based on a single type test of the Nova Enginnering model NovaRoam 900 and therefore apply only to the tested sample. The sample was selected and prepared by Barry Carlin of Nova Engineering, Inc.

OBJECTIVE

The primary objective of the manufacturer is compliance with Subpart C of Part 15 of FCC Rules for the radiated and conducted emissions of intentional radiators. Certification of these devices is required as a prerequisite to marketing as defined in Part 2 the FCC Rules.

Certification is a procedure where the manufacturer or a contracted laboratory makes measurements and submits the test data and technical information to the FCC. The FCC issues a grant of equipment authorization upon successful completion of their review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units that are subsequently manufactured.

STATEMENT OF COMPLIANCE

The tested sample of Nova Engineering, Inc. model NovaRoam 900 complied with the requirements of Subpart C of Part 15 of the FCC Rules for low power intentional radiators.

Maintenance of FCC compliance is the responsibility of the manufacturer. Any modification of the product that may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

EMISSION TEST RESULTS

The following emissions tests were performed on the Nova Enginnering model NovaRoam 900. The actual test results are contained in an exhibit of this report.

LIMITS OF CONDUCTED INTERFERENCE VOLTAGE

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.207.

The following measurement was extracted from the data recorded during the conducted emissions scan and represents the highest amplitude emission relative to the specification limit. The actual test data and any correction factors are contained in an exhibit of this report.

120V, 60Hz

Frequency MHz	Level dBuV	Power Lead	FCC Limit	FCC Margin	Detector QP/Ave	Comments
6.050	33.1	Neutral	48.0	-14.9	QP	

LIMITS OF ANTENNA CONDUCTED POWER

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.247.

The highest out-of-band (Un-restricted) emission recorded in any 100 kHz band was 22 dB below the in-band level at 901.7 MHz with the radio set to 909 MHz using 159kbps modulation. The actual test data and any correction factors are contained an exhibit of this report.

LIMITS OF RADIATED INTERFERENCE FIELD STRENGTH

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.247 and 15.209 in the case of emissions falling within the frequency bands specified in Section 15.205.

The following measurement was extracted from the data recorded during the radiated electric field emissions scan and represents the highest amplitude emission relative to the specification limit. The actual test data and any correction factors are contained in an exhibit of this report.

Frequency MHz	Level dBuV/m	Pol v/h	FC Limit	FCC Margin	Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
2763.000	49.6	h	54.0	-4.4	Avg	40	1.4	

LIMITS OF POWER AND BANDWIDTH

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.247.

The maximum power output was 27.0 dBm at 915 MHz using 159 kbps modulation. The minimum 6 dB bandwidth was 1.13 MHz using 101 kbps modulation. The maximum power spectral density was 6.4 dBm using 317 kbps modulation. The actual test data and any correction factors are contained in an exhibit of this report.

MEASUREMENT UNCERTAINTIES

ISO Guide 25 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with NAMAS document NIS 81.

Measurement Type	Frequency Range (MHz)	Calculated Uncertainty (dB)
Conducted Emissions	0.15 to 30	± 2.4
Radiated Emissions	30 to 1000	± 3.2

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Nova Enginnering model NovaRoam 900 is a DSSS Transceiver designed to handle network traffic via RF transmission. The sample was received on August 12,1999 and tested on August 12 through August 23, 1999. The EUT consisted of the following component(s):

Manufacturer/Model/Description	Serial Number
Nova Engineering / NovaRoam 900 / DSSS Transceiver	RF005 Dig005

INPUT POWER

The EUT input is rated at 120/240, 50/60 Hz. The EUT contained the following input power components during emissions testing:

Description	Manufacturer	Model
AC-DC adapter	Ault	328-2012-T0021

PRINTED WIRING BOARDS

The EUT contained the following printed wiring boards during emissions testing:

Manufacturer/Description	Assembly #	Rev.	Serial #	Crystals (MHz)
Nova Engineering / RF	8040-0102	-	-	19.65
Nova Engineering / Digital	8040-0107	-	-	18.432, 20, 40

ENCLOSURE

The body of the EUT enclosure consists of a pair of interlocking pieces. The base is extruded aluminum while the top is steel with a textured black coating. The ends of the enclosure are aluminum caps with plastic bezels that attach to the base via a pair of self-tapping screws. The enclosure measures approximately 10.5 cm wide by 24 cm deep by 3.8 cm high.

EMI SUPPRESSION DEVICES

The EUT contained the following EMI suppression devices during emissions testing:

Description	Manufacturer	Part Number
Shield, Synthesizer	Fotofab	3116-0110
Shield, RF Section	Fotofab	3116-0111
Partition, RF Section	Fotofab	3116-0112
Partition, IF	Fotofab	3116-0113
Gasket, TNC	EIS	3116-0114
Bezel, Nickel Acrylic	Lansing	CQ1B90-N1X2
Common Mode Choke	Pulse Engineering	P0351

SUPPORT EQUIPMENT

The following equipment was used as remote support equipment for emissions testing:

Manufacturer/Model/Description	Serial Number	FCC ID Number
WinBook / XP5 Model ANL-5 / Laptop Computer	GKF20AR3296 104	JRUANL-5
WinBook / XP Model ADP-30DB-1 / AC adapter	X4525020457	None
Megahertz / XJ10BT or XJ10BC / Ethernet PCMCIA adapter	103N18460039	F2M5510011

ANTENAS

The following antennas were used with the EUT for emissions testing:

Description	Manufacturer	Part Number
Omnidirectional 6 dbi	Antenex	FG9026
Yagi 9dBi	Antenex	YB8966
Collinear 5 dBi	Antenex	None

EXTERNAL I/O CABLING

The I/O cabling configuration during emissions testing was as follows:

Cable Description	Length (m)	From Unit/Port	To Unit/Port
LMR 400 Coaxial Cable (For direct measurements)	0.3	EUT/Antenna	Power Meter
RJ45 Cat 5 Unshielded	30	EUT /Ethernet	Laptop/Ethernet
Monitor, DB-9 to 8-pin Circular Mini DIN	30	EUT/Monitor	Laptop/Serial
LMR Coaxial Cable	30	EUT/Antenna	Antenna/input-output
LMR Coaxial Cable	7.6	EUT/Antenna	Antenna/input-output

TEST CONFIGURATION

The laptop computer was configure the EUT via RS232 connection to the EUT's monitor input for configuring operating parameters and then was disconnected for testing. The twisted pair ethernet connection throughout testing was connected to EUT but no traffic was being sent testing was performed in a continuous transmit mode. The radio was programmed to transmit continuously during all testing. In normal operation, the radio operates at a 40% duty cycle thus allowing an 8 dB correction factor for all average measurements.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on August 12 through August 23, 1999 at the Elliott Laboratories Open Area Test Sites #2 and #3 located at 684 West Maude Avenue, Sunnyvale, California. The test site contains separate areas for radiated and conducted emissions testing. Pursuant to section 2.948 of the Rules, construction, calibration, and equipment data has been filed with the Commission.

The FCC recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement with the exception of predictable local TV, radio, and mobile communications traffic. The test site contains separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent FCC requirements.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed in conformance with ANSI C63.4-1992. Measurements are made with the EUT connected to the public power network through nominal standardized RF impedance, which is provided by a line impedance stabilization network, known as a LISN. A LISN is inserted in series with each current-carrying conductor in the EUT power cord.

RADIATED EMISSIONS CONSIDERATIONS

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment. The test site is maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4 guidelines.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz.

INSTRUMENT CONTROL COMPUTER

The receivers utilize either a Rohde and Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers.

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically.

LINE IMPEDANCE STABILIZATION NETWORK (LISN)

Line conducted measurements utilize a fifty microhenry Line Impedance Stabilization Network as the monitoring point. The LISN used also contains a 250 uH CISPR adapter. This network provides for calibrated radio frequency noise measurements by the design of the internal low pass and high pass filters on the EUT and measurement ports, respectively.

POWER METER

A power meter and thermister mount are used for all direct output power measurements from transmitters as they provide a broadband indication of the power output.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

A biconical antenna is used to cover the range from 30 MHz to 300 MHz and a log periodic antenna is utilized from 300 MHz to 1000 MHz. Narrowband tuned dipole antennas are used over the entire 30 to 1000 MHz range for precision measurements of field strength. Above 1000 MHz, a horn antenna is used. The antenna calibration factors are included in site factors programmed into the test receivers.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height.

ANSI C63.4 specifies that the test height above ground for table mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

EUT AND CABLE PLACEMENT

The FCC requires that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4, and the worst case orientation is used for final measurements.

CONDUCTED EMISSIONS

Conducted emissions are measured at the plug end of the power cord supplied with the EUT. Excess power cord length is wrapped in a bundle between 30 and 40 centimeters in length near the center of the cord. Preliminary measurements are made to determine the highest amplitude emission relative to the specification limit for all the modes of operation. Placement of system components and varying of cable positions are performed in each mode. A final peak mode scan is then performed in the position and mode for which the highest emission was noted on all current carrying conductors of the power cord.

RADIATED EMISSIONS

Radiated emissions measurements are performed in two phases as well. A preliminary scan of emissions is conducted in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed from 30 MHz up to the frequency required by the regulation specified on page 1. One or more of these is with the antenna polarized vertically while the one or more of these is with the antenna polarized horizontally. During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit.

A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth which results in the highest emission is then maintained while varying the antenna height from one to four meters. The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain. Emissions which have values close to the specification limit may also be measured with a tuned dipole antenna to determine compliance.

CONDUCTED EMISSIONS FROM ANTENNA PORT

Direct measurements are performed with the antenna port of the EUT connected to either the power meter or spectrum analyzer via a suitable attenuator and/or filter. These are used to ensure that the front end of the measurement instrument is not overloaded by the fundamental transmission.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions are given in units of microvolts, and the limits for radiated emissions are given in units of microvolts per meter at a specified test distance. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

For reference, converting the specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. These limits in both linear and logarithmic form are as follows:

CONDUCTED EMISSIONS SPECIFICATION LIMITS, SECTION 15.207

Frequency Range (MHz)	Limit (uV)	Limit (dBuV)
0.450 to 30.000	250	48

RADIATED EMISSIONS SPECIFICATION LIMITS, SECTION 15.209

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
0.009-0.490	$2400/F_{KHz}$ @ 300m	$67.6-20*\log_{10}(F_{KHz})$ @ 300m
0.490-1.705	$24000/F_{KHz}$ @ 30m	$87.6-20*\log_{10}(F_{KHz})$ @ 30m
1.705 to 30	30 @ 30m	29.5 @ 30m
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r - B = C$$

and

$$C - S = M$$

where:

R_r = Receiver Reading in dBuV

B = Broadband Correction Factor*

C = Corrected Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

* Broadband Level - Per ANSI C63.4, 13 dB may be subtracted from the quasi-peak level if it is determined that the emission is broadband in nature. If the signal level in the average mode is six dB or more below the signal level in the peak mode, the emission is classified as broadband.

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements. A distance factor, when used for electric field measurements, is calculated by using the following formula:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB

D_m = Measurement Distance in meters

D_s = Specification Distance in meters

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

R_r = Receiver Reading in dBuV/m

F_d = Distance Factor in dB

R_c = Corrected Reading in dBuV/m

L_s = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

EXHIBIT 1:Test Equipment Calibration Data

Test Equipment List - SVOATS#3

August 4, 1999

Manufacturer/Description		Model	Asset #	Interval	Last Cal	Cal Due
☒ Elliott Laboratories	300-1000 MHz Log Periodic	EL300.1000	55	12	9/26/98	9/26/99
☒ Elliott Laboratories	Biconical Antenna, 30-300 MHz	EL30.300	773	12	11/3/98	11/3/99
☐ EMCO	D. Ridge Horn Antenna, 1-18GHz	3115	487	12	3/24/99	3/24/2000
☐ EMCO	D. Ridge Horn Antenna, 1-18GHz	3115	786	12	1/15/99	1/15/2000
☐ EMCO	D. Ridge Horn Antenna, 1-18GHz	3115	868	12	9/22/98	9/22/99
☐ Filtek	High Pass Filter	HP12/1000-5BA	955	12	4/17/99	4/17/2000
☐ Filtek	High Pass Filter	HP12/1000-5BA	956	12	4/17/99	4/17/2000
☐ Filtek	High Pass Filter	HP12/1000-5BA	957	12	4/17/99	4/17/2000
☒ Fischer	LISN	FCC-LISN-50/2	810	12	2/2/99	2/2/2000
☐ Fluke Mfg Co	Signal Generator.	6062A	852	N/A		
☐ Hewlett Packard	EMC Receiver /Analyzer	8595EM	780	12	1/4/99	1/4/2000
☐ Hewlett Packard	EMC Recever /Analyzer	8595EM	787	12	11/23/98	11/23/99
☐ Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	263, (F303)	12	5/24/99	5/24/2000
☐ Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	12	11/25/98	11/25/99
☐ Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	12	11/12/98	11/12/99
☐ Hewlett Packard	Power Meter	432A	259, (F304)	12	2/17/99	2/17/2000
☐ Hewlett Packard	Spectrum Analyzer	8563E	284, (F194)	12	1/18/99	1/18/2000
☐ Hewlett Packard	Spectrum Analyzer, 9 KHz-6.5 GHz	8595E-041-103-	Metric. 885	12	5/11/99	5/11/2000
☐ Hewlett Packard	Thermistor Mount	478A	652	12	2/17/99	2/17/2000
☐ Narda West	EMI Filter 2.4 GHz, High Pass	60583 HPF-161	248	12	4/23/99	4/23/2000
☐ Narda West	EMI Filter 5.6 GHz, High Pass	60583 HXF370	247	12	4/29/99	4/29/2000
☐ Narda West	High Pass Filter	HPF 180	821	12	8/10/98	8/10/99
☒ Rohde& Schwarz	Pulse Limiter	ESH3 Z2	812	12	12/8/98	12/8/99
☒ Rohde & Schwarz	Test Receiver, 0.009-30 MHz	ESH3	215, (F197)	12	2/17/99	2/17/2000
☒ Rohde & Schwarz	Test Receiver, 20-1300 MHz	ESVP			1/11/99	1/11/2000

File Number: T33208

Date: 8.12.99

Engr: [signature]

All calibration of equipment is traceable to a national standard of measurement such as NIST.

Test Equipment List - SVOATS#2

August 5, 1999

	Manufacturer/Description		Model	Asset #	Interval	Last Cal	Cal Due
☐	Elliott Laboratories	2 x (Solar 8028 LISN + 6512 Caps)	LISN-5, Support	379	12	6/10/99	6/10/2000
☐	Elliott Laboratories	300-1000 MHz Log Periodic	EL300.1000	297, (F113)	12	11/30/98	11/30/99
☐	Elliott Laboratories	FCC / CISPR LISN	LISN-4, OATS	362	12	6/10/99	6/10/2000
☐	EMCO	Biconical Antenna, 30-300 MHz	3110B	801	12	12/12/98	12/12/99
☐	EMCO	D. Ridge Horn Antenna, 1-18GHz	3115	487	12	3/24/99	3/24/2000
☐	EMCO	D. Ridge Horn Antenna, 1-18GHz	3115	786	12	1/15/99	1/15/2000
☐	EMCO	D. Ridge Horn Antenna, 1-18GHz	3115	868	12	9/22/98	9/22/99
☐	Filtek	High Pass Filter	HP12/1000-5BA	955	12	4/17/99	4/17/2000
☐	Filtek	High Pass Filter	HP12/1000-5BA	956	12	4/17/99	4/17/2000
☐	Filtek	High Pass Filter	HP12/1000-5BA	957	12	4/17/99	4/17/2000
☐	Hewlett Packard	EMC Receiver /Analyzer	8595EM	780	12	1/4/99	1/4/2000
☐	Hewlett Packard	EMC Recever /Analyzer	8595EM	787	12	11/23/98	11/23/99
☐	Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	263, (F303)	12	8/3/99	8/3/2000
☐	Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	12	11/25/98	11/25/99
☐	Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	12	11/12/98	11/12/99
☒	Hewlett Packard	Power Meter	432A	259, (F304)	12	2/17/99	2/17/2000
☒	Hewlett Packard	Spectrum Analyzer	8563E	284, (F194)	12	1/18/99	1/18/2000
☐	Hewlett Packard	Spectrum Analyzer, 9 KHz-6.5 GHz	8595E-041-103-	Metric, 885	12	5/11/99	5/11/2000
☐	Hewlett Packard	Thermistor Mount	478A	652	12	2/17/99	2/17/2000
☐	Narda West	EMI Filter 2.4 GHz, High Pass	60583 HPF-161	248	12	4/23/99	4/23/2000
☐	Narda West	EMI Filter 5.6 GHz, High Pass	60583 HXF370	247	12	4/29/99	4/29/2000
☐	Narda West	High Pass Filter	HPF 180	821	12	8/10/98	8/10/99
☐	Rohde & Schwarz	Pulse Limiter	ESH3Z2	372	12	6/10/99	6/10/2000
☐	Rohde & Schwarz	Test Receiver, 0.009-2000 MHz	ESN	775	12	6/10/99	6/10/2000
☒	Narda	Attenuator DC-12.4GHz	37391	258	12	5/17/99	5/17/00
☒	Narda	Attenuator DC-10.0GHz	774-10	641	12	10/12/98	10/12/99

File Number: T33315

Date: 8/18/99

Engr: Paul Chapman and Pam Galvan

All calibration of equipment is traceable to a national standard of measurement such as NIST.

Test Equipment List - SVOATS#2

August 5, 1999

	Manufacturer/Description		Model	Asset #	Interval	Last Cal	Cal Due
☐	Elliott Laboratories	2 x (Solar 8028 LISN + 6512 Caps)	LISN-5, Support	379	12	6/10/99	6/10/2000
☒	Elliott Laboratories	300-1000 MHz Log Periodic	EL300.1000	297, (F113)	12	11/30/98	11/30/99
☐	Elliott Laboratories	FCC / CISPR LISN	LISN-4, OATS	362	12	6/10/99	6/10/2000
☐	EMCO	Biconical Antenna, 30-300 MHz	3110B	801	12	12/12/98	12/12/99
☐	EMCO	D. Ridge Horn Antenna, 1-18GHz	3115	487	12	3/24/99	3/24/2000
☒	EMCO	D. Ridge Horn Antenna, 1-18GHz	3115	786	12	1/15/99	1/15/2000
☐	EMCO	D. Ridge Horn Antenna, 1-18GHz	3115	868	12	9/22/98	9/22/99
☐	Filtek	High Pass Filter	HP12/1000-5BA	955	12	4/17/99	4/17/2000
☐	Filtek	High Pass Filter	HP12/1000-5BA	956	12	4/17/99	4/17/2000
☐	Filtek	High Pass Filter	HP12/1000-5BA	957	12	4/17/99	4/17/2000
☒	Hewlett Packard	EMC Receiver /Analyzer	8595EM	780	12	1/4/99	1/4/2000
☐	Hewlett Packard	EMC Recever /Analyzer	8595EM	787	12	11/23/98	11/23/99
☐	Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	263, (F303)	12	8/3/99	8/3/2000
☒	Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	12	11/25/98	11/25/99
☐	Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	12	11/12/98	11/12/99
☐	Hewlett Packard	Power Meter	432A	259, (F304)	12	2/17/99	2/17/2000
☒	Hewlett Packard	Spectrum Analyzer	8563E	284, (F194)	12	1/18/99	1/18/2000
☐	Hewlett Packard	Spectrum Analyzer, 9 KHz-6.5 GHz	8595E-041-103-	Metric, 885	12	5/11/99	5/11/2000
☐	Hewlett Packard	Thermistor Mount	478A	652	12	2/17/99	2/17/2000
☒	Narda West	EMI Filter 2.4 GHz, High Pass	60583 HPF-161	~~248~~ 833	12	~~4/23/99~~ 8/10/99	~~4/23/2000~~ 8/10/2000
☐	Narda West	EMI Filter 5.6 GHz, High Pass	60583 HXF370	247	12	4/29/99	4/29/2000
☐	Narda West	High Pass Filter	HPF 180	821	12	8/10/98	8/10/99
☐	Rohde & Schwarz	Pulse Limiter	ESH3Z2	372	12	6/10/99	6/10/2000
☒	Rohde & Schwarz	Test Receiver, 0.009-2000 MHz	ESN	775	12	6/10/99	6/10/2000
☒	Narda	10dB ATTENUATOR	774-10	641	12	10/12/98	10/12/99
☒	Narda	10dB ATTENUATOR	774-10	257	12	5/17/99	5/17/2000
☒	Rohde & Schwarz	Power Meter	NRVD	1071	12	5/4/99	5/4/2000
☒	Rohde & Schwarz	Power Sensing Head		1070	12	4/27/99	4/27/2000

File Number: D33346 D33363/D33365

Date: 8.19-20-21.99

Engr: Jerry Hill

All calibration of equipment is traceable to a national standard of measurement such as NIST.

Test Equipment List - SVOATS#1

August 13, 1999

Manufacturer/Description		Model	Asset #	Interval	Last Cal	Cal Due
☐ EMCO	Biconical Antenna, 30-300 MHz	3110B	363	12	4/19/99	4/19/2000
☐ EMCO	D. Ridge Horn Antenna, 1-18GHz	3115	487	12	3/24/99	3/24/2000
☐ EMCO	D. Ridge Horn Antenna, 1-18GHz	3115	786	12	1/15/99	1/15/2000
☐ EMCO	D. Ridge Horn Antenna, 1-18GHz	3115	868	12	9/22/98	9/22/99
☐ EMCO	Log Periodic Antenna, 0.3-1 GHz	3146A	364	12	6/25/99	6/25/2000
☐ Filtek	High Pass Filter	HP12/1000-5BA	955	12	4/17/99	4/17/2000
☐ Filtek	High Pass Filter	HP12/1000-5BA	956	12	4/17/99	4/17/2000
☐ Filtek	High Pass Filter	HP12/1000-5BA	957	12	4/17/99	4/17/2000
☐ Fischer Custom	LISN, Freq. 0.9 -30 MHz,16 Amp	FCC-LISN-50/2	1079	12	6/11/99	6/11/2000
☐ Hewlett Packard	EMC Receiver /Analyzer	8595EM	780	12	1/4/99	1/4/2000
☐ Hewlett Packard	EMC Recever /Analyzer	8595EM	787	12	11/23/98	11/23/99
☐ Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	263, (F303)	12	8/3/99	8/3/2000
☐ Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	12	11/25/98	11/25/99
☐ Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	12	11/12/98	11/12/99
☐ Hewlett Packard	Power Meter	432A	259, (F304)	12	2/17/99	2/17/2000
☒ Hewlett Packard	Spectrum Analyzer	8563E	284, (F194)	12	1/18/99	1/18/2000
☐ Hewlett Packard	Spectrum Analyzer, 9 KHz-6.5 GHz	8595E-041-103-	Metric, 885	12	5/11/99	5/11/2000
☐ Hewlett Packard	Thermistor Mount	478A	652	12	2/17/99	2/17/2000
☐ Inmet Corporation	20 dB Pad, DC-18 GHz, 50Ω	18N-20	859	12	8/27/98	8/27/99
☐ Narda West	EMI Filter 2.4 GHz, High Pass	60583 HPF-161	248	12	4/23/99	4/23/2000
☐ Narda West	EMI Filter 5.6 GHz, High Pass	60583 HXF370	247	12	4/29/99	4/29/2000
☐ Narda West	High Pass Filter	HPF 180	821	12	8/10/99	8/10/2000
☐ Rohde& Schwarz	Pulse Limiter	ESH3 Z2	811	12	7/10/99	7/10/2000
☐ Rohde & Schwarz	Test Receiver, 0.009-30 MHz	ESH3	274	12	5/27/99	5/27/2000
☐ Rohde &Schwarz	Test Receiver, 20-1300MHz	ESVP	213, (F196)	12	5/27/99	5/27/2000
☐ Solar Electronics	Support Equipment LISN,	8012-50-R-24-B	305, (F111)	12	3/26/99	3/26/2000

File Number: T33399

Date: 8-23 99

Engr: DwB

All calibration of equipment is traceable to a national standard of measurement such as NIST.

EXHIBIT 2:Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T 33208	8 Pages
T 33315	26 Pages
T 33365	16 Pages
T 33399	12 Pages
Processing Gain Measurement	6 Pages

Elliott

EMC Test Log

Client:	Nova Engineering	Date:	08.12.99	Test Engr:	Jerry Hill
Product:	NovaRoam 900	File:	T33208	Proj. Eng:	David Bare
Objective:	Final Qualification	Site:	SVOATS # 3	Contact:	Barry Carlin
Spec:	FCC A,part.15.109(b),15.107(b)	Page:	1 of 4	Approved:	
Revision	1.0				

Ambient Conditions	
Temperature:	23 °C
Humidity:	78 % RH

Test Objective

The objective of this test session is to perform final qualification testing the EUT defined below relative to the specification(s) defined above.

Test Summary

Run #1 - Unmaximized Preliminary Radiated Emissions Scan, 30-1000 MHz

Results: FCC A -11.8 dB QP @ 320.000 MHz Vertical

Run #2 - Maximized Radiated Emissions from Run #1

PASS Results: FCC A -9.7 dB QP @ 360.000 MHz Vertical

Run #3 - Conducted Emissions Scan of EUT, 0.15-30.00 MHz, 120V, 60Hz

PASS Results: FCC B -14.9 dB QP @ 6.050 MHz Neutral

Equipment Under Test (EUT) General Description

The EUT is a DSSS Transceiver which is designed to handle network traffic via RF transmission. Normally, the EUT would be placed on a table top during operation. The EUT was, therefore, placed in this position during emissions testing to simulate the end user environment. The electrical rating of the EUT is 120 V, 60 Hz.

Equipment Under Test (EUT)

Manufacturer/Model/Description	Serial Number	FCC ID Number
Nova Engineering / NovaRoam 900 / DSSS Transceiver	RF005 Dig005	OOSNROAM900

Client:	Nova Engineering	Date:	08.12.99	Test Engr:	Jerry Hill
Product:	NovaRoam 900	File:	T33208	Proj. Eng:	David Bare
Objective:	Final Qualification	Site:	SVOATS # 3	Contact:	Barry Carlin
Spec:	FCC A,part.15.109(b),15.107(b)	Page:	2 of 4	Approved:	
Revision	1.0				

Power Supply and Line Filters

Description	Manufacturer	Model
AC-DC adapter	Ault	328-2012-T0021

Printed Wiring Boards in EUT

Manufacturer/Description	Assembly #	Rev.	Serial Number	Crystals (MHz)
Nova Engineering / RF	8040-0102	-	-	19.65
Nova Engineering / Digital	8040-0107	-	-	18.432, 20, 40

Subassemblies in EUT

Manufacturer/Description	Assembly Number	Rev.	Serial Number
None	-	-	-

EUT Enclosure

The body of the EUT enclosure consists of a pair of interlocking pieces. The base is extruded aluminum while the top is steel with a textured black coating. The ends of the enclosure are aluminum caps with plastic bezels that attach to the base via a pair of self-tapping screws. The enclosure measures approximately 10.5 cm wide by 24 cm deep by 3.8 cm high.

EMI Suppression Devices (filters, gaskets, etc.)

Description	Manufacturer	Part Number
Shield, Synthesizer	Fotofab	3116-0110
Shield, RF Section	Fotofab	3116-0111
Partition, RF Section	Fotofab	3116-0112
Partition, IF	Fotofab	3116-0113
Gasket, TNC	EIS	3116-0114
Bezel, Nickel Acrylic	Lansing	CQ1B90-N1X2
Common Mode Choke	Pulse Engineering	P0351

Client:	Nova Engineering	Date:	08.12.99	Test Engr:	Jerry Hill
Product:	NovaRoam 900	File:	T33208	Proj. Eng:	David Bare
Objective:	Final Qualification	Site:	SVOATS # 3	Contact:	Barry Carlin
Spec:	FCC A,part.15.109(b),15.107(b)	Page:	3 of 4	Approved:	
Revision	1.0				

Modifications

No modifications were made to the EUT in order to comply with the requirements.

Local Support Equipment

Manufacturer/Model/Description	Serial Number	FCC ID Number
None	-	-

Remote Support Equipment

Manufacturer/Model/Description	Serial Number	FCC ID Number
WinBook / XP5 Model ANL-5 / Laptop Computer	GKF20AR3296 104	JRUANL-5
WinBook / XP Model ADP-30DB-1 / AC adapter	X4525020457	None
Megahertz / XJ10BT or XJ10BC / Ethernet PCMCIA adapter	103N18460039	F2M5510011

Antena

Manufacturer/Model/Description	Serial Number	FCC ID Number
Antenex / Yb8966 / Yagi +9 dBd Antenna BLK 9 DB 6 Ele YAGI1	896-970	None

Interface Cabling

Cable Description	Length (m)	From Unit/Port	To Unit/Port
LMR400 Coax	30	EUT / Output	Yagi Antenna
RJ45 Cat 5 unshielded	30	EUT / Output	Laptop / Ethernet port
RJ45 Cat 5 unshielded Monitor cable	30	EUT / Output-input	Laptop / Serial Port

Test Software

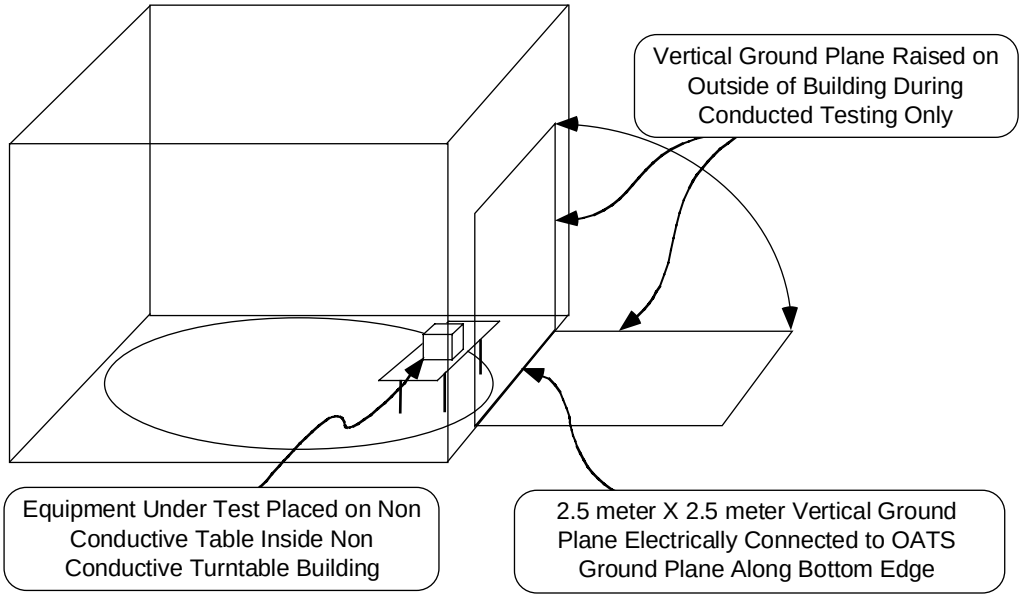
The laptop computer was configured to send a series of test packets to the EUT via the twisted pair ethernet connection throughout testing. The EUT in turn reflected these packets back to the laptop computer. This packet exchange was not relayed to the radio interface for wireless transmission since the EUT was transmitting data continuously to support testing. The laptop was configured to automatically execute this packet transmission as an MS-DOS batch program and therefore this process did not require any intervention.

Client:	Nova Engineering	Date:	08.12.99	Test Engr:	Jerry Hill
Product:	NovaRoam 900	File:	T33208	Proj. Eng:	David Bare
Objective:	Final Qualification	Site:	SVOATS # 3	Contact:	Barry Carlin
Spec:	FCC A,part.15.109(b),15.107(b)	Page:	4 of 4	Approved:	
Revision	1.0				

General Test Conditions

During radiated testing, the EUT was connected to 120V, 60Hz power input. The EUT was located on the turntable for radiated testing and conducted testing. All remote support equipment was located approximately 30 meters from the EUT with all I/O connections running through overhead loops at the turntable and running over the groundplane back to the support equipment.

During conducted emissions testing, the EUT was connected to either 120V, 60Hz power input as noted. A 2.5 meter X 2.5 meter ground plane was raised to a vertical position 40 cm from the EUT as shown below:



Test Data Tables

See attached data

Emissions Test Data

Client:	Nova Engineering	Date:	08.12.99	Test Engr:	Jerry Hill
Product:	NovaRoam900 / +9dBd Yagi / 100' LMR400	File:	T33208	Proj. Engr:	David Bare
Objective	Final Qualification	Site:	SVOATS #3	Contact:	Barry Carlin
Spec:	FCC A, par. 15.109(b), 15.107(b)	Distance:	10m	Approved:	

Ambient Conditions
Temperature: 23 °C
Humidity: 78 % RH

Setup Info: No system setup cable after setting EUT up, since this is a service port cable it was removed after initialization.
All support equipment was remote by 30meters away.
EUT operated from 120V/60Hz.

Run #1: Preliminary radiated emissions, 30-1000 MHz. Sorted by Margin.
Digital Device using RF005 DIG 005 no Ethernet Caps EUT.

Frequency	Level	Pol	FCC A	FCC A	Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
320.000	34.6	v	46.4	-11.8	QP	134.0	1.0	
180.000	31.1	v	43.5	-12.4	QP	13.0	1.0	
360.000	34.0	v	46.4	-12.4	QP	90.0	1.0	
340.000	34.0	v	46.4	-12.4	QP	123.0	1.0	
340.000	33.0	h	46.4	-13.4	QP	123.0	2.8	
320.000	32.7	h	46.4	-13.7	QP	41.0	2.8	
80.000	24.8	v	39.1	-14.3	QP	175.0	1.2	
480.000	32.0	v	46.4	-14.4	QP	233.0	1.0	
360.000	31.3	h	46.4	-15.1	QP	128.0	3.1	
160.000	28.2	h	43.5	-15.3	QP	284.0	4.0	
280.000	31.0	v	46.4	-15.4	QP	220.0	1.0	
640.000	30.8	v	46.4	-15.6	QP	217.0	1.0	
240.000	30.4	h	46.4	-16.0	QP	220.0	4.0	
240.000	30.2	v	46.4	-16.2	QP	110.0	1.0	
80.000	22.9	h	39.1	-16.2	QP	176.0	4.0	
400.000	29.7	h	46.4	-16.7	QP	149.0	3.1	
160.000	26.6	v	43.5	-16.9	QP	309.0	1.0	
280.000	29.2	h	46.4	-17.2	QP	160.0	4.0	
600.000	29.2	v	46.4	-17.2	QP	0.0	1.2	
640.000	28.4	h	46.4	-18.0	QP	24.0	2.8	
120.000	25.4	v	43.5	-18.1	QP	157.0	1.0	
180.000	25.4	h	43.5	-18.1	QP	49.0	3.5	
220.000	28.0	v	46.4	-18.4	QP	192.0	1.0	
400.000	27.0	v	46.4	-19.4	QP	208.0	1.9	
520.000	27.0	v	46.4	-19.4	QP	244.0	1.0	
480.000	26.9	h	46.4	-19.5	QP	186.0	3.3	
800.000	26.5	v	46.4	-19.9	QP	0.0	1.6	
800.000	26.0	h	46.4	-20.4	QP	300.0	2.2	
520.000	25.0	h	46.4	-21.4	QP	0.0	3.3	
600.000	25.0	h	46.4	-21.4	QP	0.0	3.1	
220.000	23.0	h	46.4	-23.4	QP	331.0	3.6	
120.000	19.2	h	43.5	-24.3	QP	0.0	4.0	

Elliott

Emissions Test Data

Client:	Nova Engineering	Date:	08.12.99	Test Engr:	Jerry Hill
Product:	NovaRoam900 / +9dBd Yagi / 100' LMR400	File:	T33208	Proj. Engr:	David Bare
Objective	Final Qualification	Site:	SVOATS #3	Contact:	Barry Carlin
Spec:	FCC A, par. 15.109(b), 15.107(b)	Distance:	10m	Approved:	

Run #2: Maximized readings from run #1. Sorted by Margin.

Digital Device using RF005 DIG 005 no Ethernet Caps EUT.

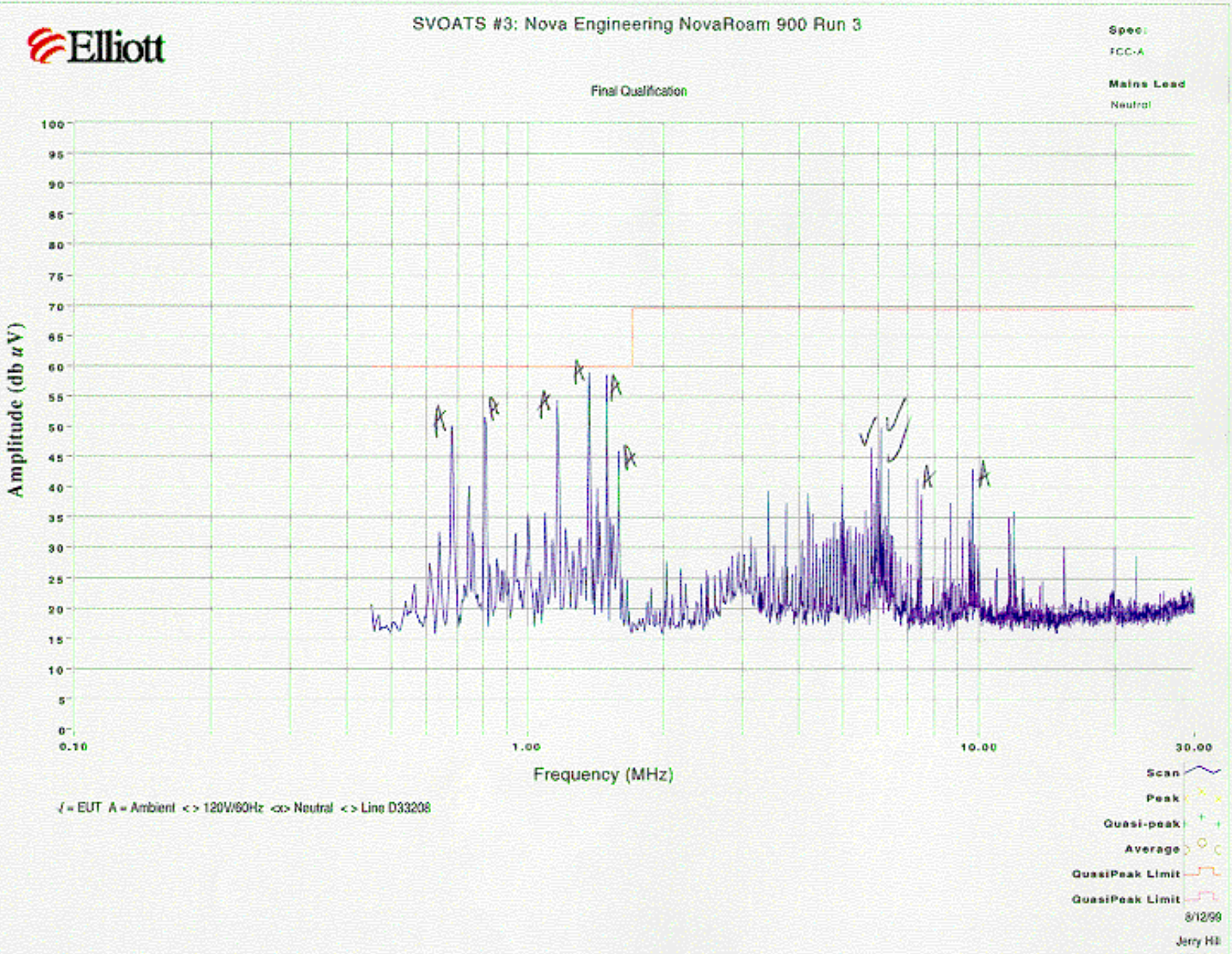
Frequency	Level	Pol	FCC A	FCC A	Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
360.000	36.7	v	46.4	-9.7	QP	96.0	1.0	note 1
340.000	35.0	v	46.4	-11.4	QP	87.0	1.0	note 1
180.000	31.5	v	43.5	-12.0	QP	85.0	1.0	note 1
320.000	33.3	v	46.4	-13.1	QP	134.0	1.0	note 1
340.000	33.5	h	46.4	-12.9	QP	120.0	2.9	note 1
320.000	32.8	h	46.4	-13.6	QP	79.0	3.0	note 1

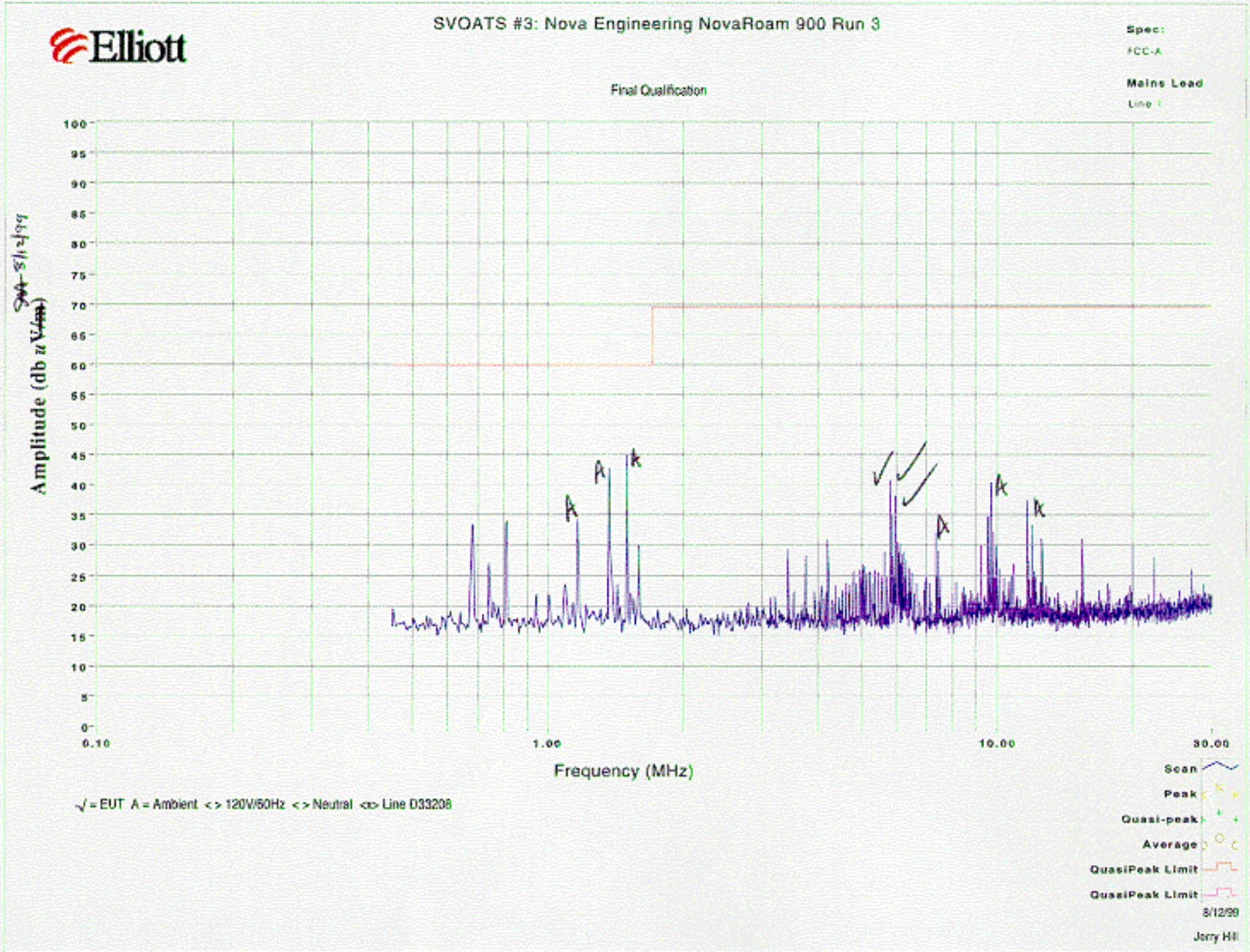
Note 1:	ac adapter cable and RF LMR400 coax was the typical max. items.

Run #3: Conducted Emissions, 120V/60Hz

Digital Device using RF005 DIG 005 no Ethernet Caps EUT.

Frequency	Level	Power	FCC B	FCC B	Detector	Comments
MHz	dBuV	Lead	Limit	Margin	QP/Ave	
6.050	33.1	Neutral	48.0	-14.9	QP	
5.966	32.8	Neutral	48.0	-15.2	QP	
5.798	32.5	Neutral	48.0	-15.5	QP	
5.965	24.7	Line 1	48.0	-23.3	QP	
5.881	24.3	Line 1	48.0	-23.7	QP	
5.797	23.7	Line 1	48.0	-24.3	QP	


Elliott
SVOATS #3: Nova Engineering NovaRoam 900 Run 3
Spec:
FCC-A
Final Qualification
Mains Lead
Neutral
Amplitude (db uV)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0.10
1.00
10.00
30.00
Frequency (MHz)
√ = EUT A = Ambient < > 120V/60Hz <x> Neutral < > Line D33208
Scan
Peak
Quasi-peak
Average
QuasiPeak Limit
QuasiPeak Limit
8/12/99
Jerry Hill


Elliott
SVOATS #3: Nova Engineering NovaRoam 900 Run 3
Spec:
FCC-A
Mains Lead
Line 1
Final Qualification
Amplitude (db uV/m)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0.10
1.00
10.00
30.00
Frequency (MHz)
√ = EUT A = Ambient < > 120V/60Hz < > Neutral <□> Line D33208
Scan
Peak
Quasi-peak
Average
QuasiPeak Limit
QuasiPeak Limit
8/12/99
Jerry Hill

Client:	Nova Engineering	Date:	8/18/99	Test Engr:	Paul Chapman
Product:	NovaRoam 900	File:	T33315	Proj. Eng:	David Bare
Objective:	Final Qualification	Site:	SVOATS #2	Contact:	Barry Carlin
Spec:	FCC Part 15	Page:	1 of 5	Approved:	
Revision	1.0				

Ambient Conditions	
Temperature:	22.2 °C
Humidity:	44 % RH

Test Objective

The objective of this test session is to perform final qualification testing the EUT defined below relative to the specification(s) defined above.

Test Summary

Run #1 - Output Power measured directly from the antenna port

Peak output power was measured at 915 MHz with 21, 42, 101, 159, 317, and 655 kbps modulations; 906 MHz at 42 kbps and at 924 MHz at 42 kbps.

PASS The maximum output power was measured on channel 915 MHz, 159 kbps to be +27.0 dBm (0.5 Watts). See data table 1.

Run #2 - Bandwidth

Minimum 6dB bandwidth was measured at 915 Mhz at modulations of 101 and 317 kbps.

PASS The minimum 6dB bandwidth for the direct sequence radio was measured to be 1130 KHz at the 101 kbps modulation.

Run #3 - Power Spectral Density (Direct Sequence Radios Only)

Power Spectral Density was measured at 915 Mhz with 21, 42, 101, 159, 317, and 655 kbps modulations; 906 MHz at 42 kbps and 924 MHz at 42 kbps.

PASS The maximum PSD was measured to be +6.4 dBm in a 3kHz bandwidth averaged over 1 second, operating at 915 Mhz and 317 kbps.

Client:	Nova Engineering	Date:	8/18/99	Test Engr:	Paul Chapman
Product:	NovaRoam 900	File:	T33315	Proj. Eng:	David Bare
Objective:	Final Qualification	Site:	SVOATS #2	Contact:	Barry Carlin
Spec:	FCC Part 15	Page:	2 of 5	Approved:	
Revision	1.0				

Run #4 - Conducted Spurious Emissions On The Antenna Port, 30 MHz - 10 GHz

Spurious Emissions on the antenna port was measured at 906 and 924 MHz utilizing a 21 kbps modulation.

PASS* The out of band spurious emissions on the antenna port for these two channels were measured to be more than 20dB below the highest in-band signal level.

*Note: Additional frequencies and modulations remain to be tested.

Equipment Under Test (EUT) General Description

The EUT is a spread spectrum radio that uses Direct Sequence spreading code. The EUT is designed for use in industrial applications and operates in the 902-928 MHz ISM frequency band. Normally, the EUT would be placed on a table top during operation. The EUT was, therefore, placed in this position during emissions testing to simulate the end user environment. The electrical rating of the EUT is 120V, 60 Hz.

Equipment Under Test (EUT)

Manufacturer/Model/Description	Serial Number	FCC ID Number
Nova Engineering / NovaRoam 900 / DSSS Transceiver	RF005 Dig005	OOSNROAM900

Power Supply and Line Filters

Description	Manufacturer	Model
AC-DC adapter	Ault	328-2012-T0021

Printed Wiring Boards in EUT

Manufacturer/Description	Assembly #	Rev.	Serial Number	Crystals (MHz)
Nova Engineering/RF	8040-0102	-	-	19.65
Nova Engineering/Digital	8040-0107	-	-	18.432, 20, 40

Client:	Nova Engineering	Date:	8/18/99	Test Engr:	Paul Chapman
Product:	NovaRoam 900	File:	T33315	Proj. Eng:	David Bare
Objective:	Final Qualification	Site:	SVOATS #2	Contact:	Barry Carlin
Spec:	FCC Part 15	Page:	3 of 5	Approved:	
Revision	1.0				

Subassemblies in EUT

Manufacturer/Description	Assembly Number	Rev.	Serial Number
None	-	-	-

EUT Enclosure

The body of the EUT enclosure consists of a pair of interlocking pieces. The base is extruded aluminum while the top is steel with a textured black coating. The ends of the enclosure are aluminum caps with plastic bezels that attach to the base via a pair of self-tapping screws. The enclosure measures approximately 10.5 cm wide by 24 cm deep by 3.8 cm high.

EMI Suppression Devices (filters, gaskets, etc.)

Description	Manufacturer	Part Number
Shield, Synthesizer	Fotofab	3116-0110
Shield, RF Section	Fotofab	3116-0111
Partition, RF Section	Fotofab	3116-0112
Partition, IF	Fotofab	3116-0113
Gasket, TNC	EIS	3116-0114
Bezel, Nickel Acrylic	Lansing	CQ1B90-N1X2
Common Mode Choke	Pulse Engineering	P0351

Modifications

No modifications were made to the EUT in order to comply with the requirements.

Local Support Equipment

Manufacturer/Model/Description	Serial Number	FCC ID Number
None	-	-

Client:	Nova Engineering	Date:	8/18/99	Test Engr:	Paul Chapman
Product:	NovaRoam 900	File:	T33315	Proj. Eng:	David Bare
Objective:	Final Qualification	Site:	SVOATS #2	Contact:	Barry Carlin
Spec:	FCC Part 15	Page:	4 of 5	Approved:	
Revision	1.0				

Remote Support Equipment

Manufacturer/Model/Description	Serial Number	FCC ID Number
WinBook / XP5 Model ANL-5 / Laptop Computer	GKF20AR3296 104	JRUANL-5
WinBook / XP Model ADP-30DB-1 / AC adapter	X4525020457	None
Megahertz / XJ10BT or XJ10BC / Ethernet PCMCIA adapter	None	F2M5510011

Interface Cabling

Cable Description	Length (m)	From Unit/Port	To Unit/Port
RF/LMR 400	0.3	EUT/Antenna	Power Meter/Spectrum Analyzer
RJ45 Cat 5 Unshielded	30	EUT /Ethernet	Laptop/Ethernet
Monitor, DB-9 to 8-pin Circular Mini DIN	30	EUT/Monitor	Laptop/Serial

Test Software

The laptop computer was configured to send a series of test packets to the EUT via the twisted pair ethernet connection throughout testing. The EUT in turn reflected these packets back to the laptop computer. This packet exchange was not relayed to the radio interface for wireless transmission since the EUT was transmitting data continuously to support testing. The laptop computer was configured to automatically execute this packet transmission as an MS-DOS batch program and therefore this process did not require any intervention.

Client:	Nova Engineering	Date:	8/18/99	Test Engr:	Paul Chapman
Product:	NovaRoam 900	File:	T33315	Proj. Eng:	David Bare
Objective:	Final Qualification	Site:	SVOATS #2	Contact:	Barry Carlin
Spec:	FCC Part 15	Page:	5 of 5	Approved:	
Revision	1.0				

Test Data

See data below and attached plots

Run #1 - Output Power measured directly from the antenna port

a. 915 MHz

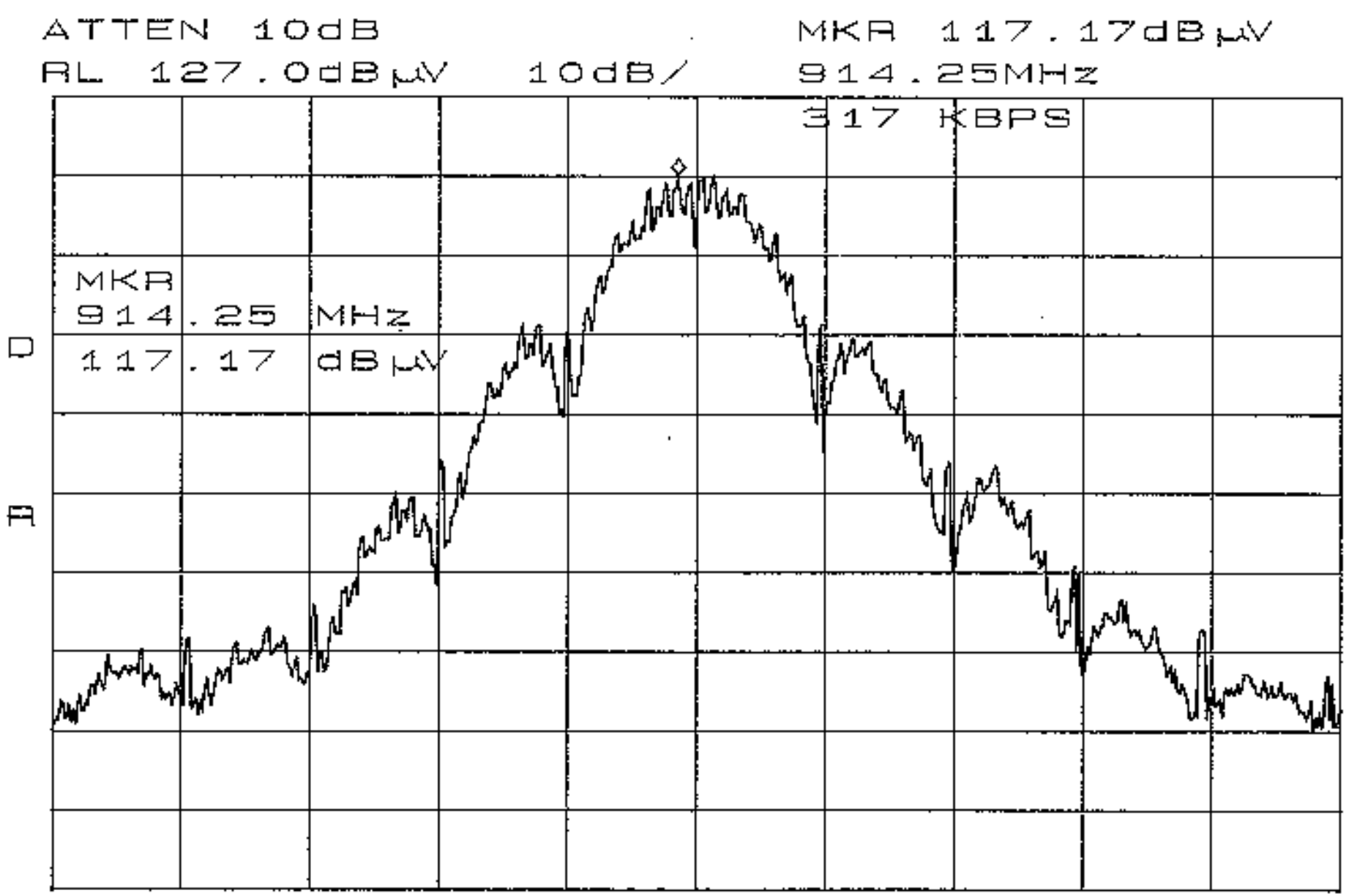
21 kbps	+20.4 dBm
42 kbps	+22.8 dBm
101 kbps	+23.7 dBm
159 kbps	+27.0 dBm
378 kbps	+26.5 dBm
655 kbps	+24.1 dBm

b. 906 MHz

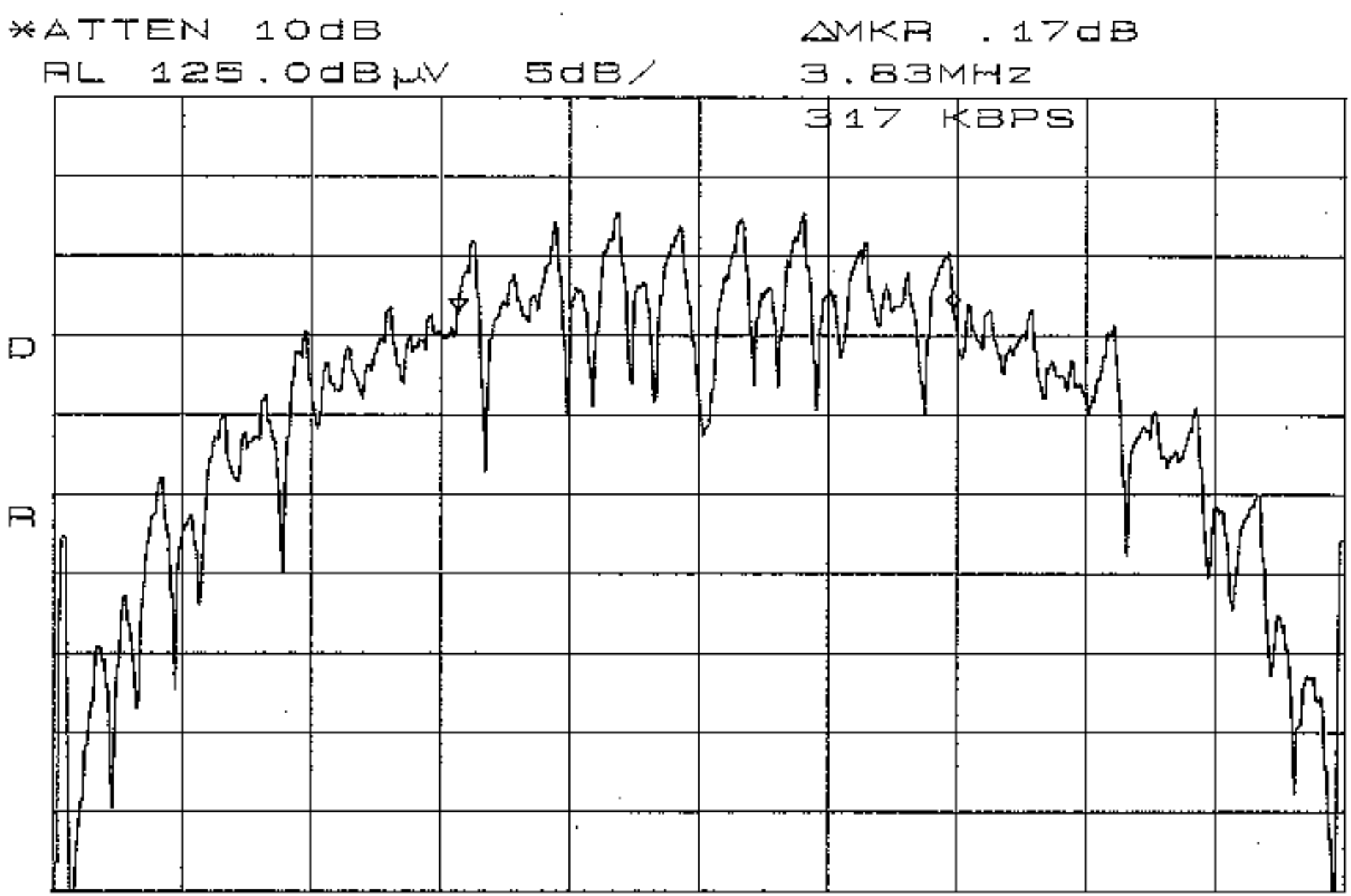
42 kbps	+22.8 dBm

c. 924 MHz

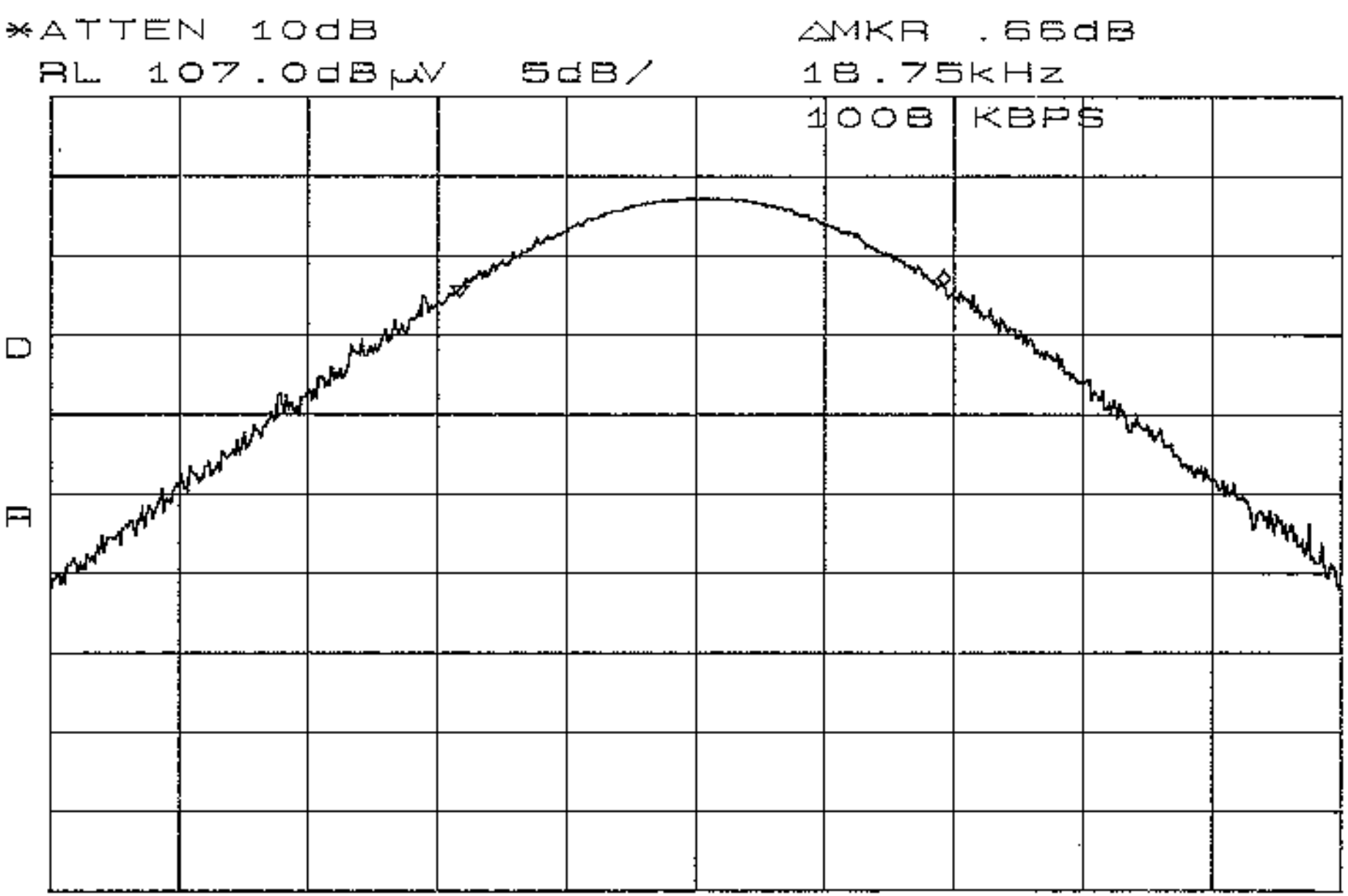
42 kbps	+22.7 dBm



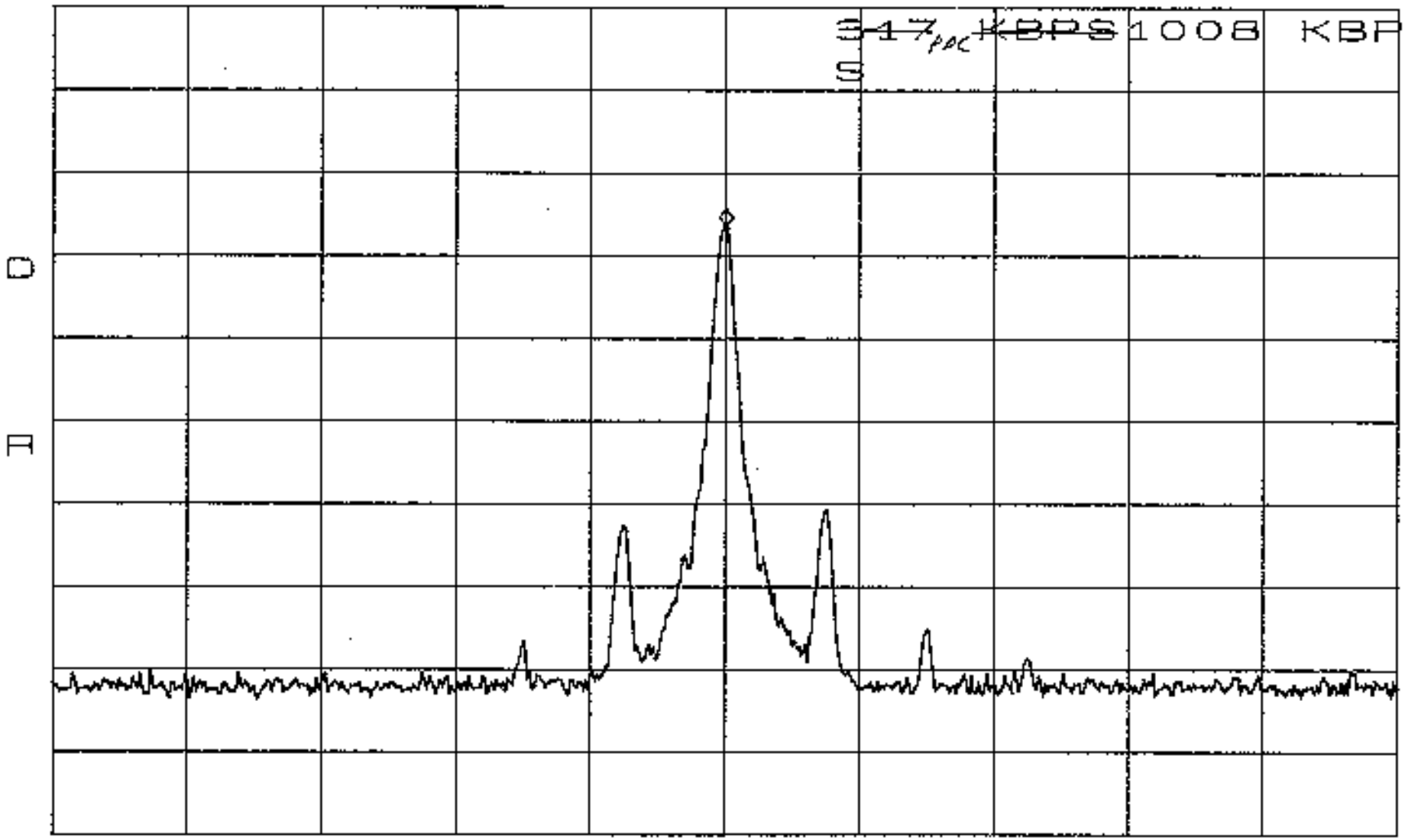
Minimum 6dB BW (915.0 MHz, 317 kbps) SPAN 50 MHz



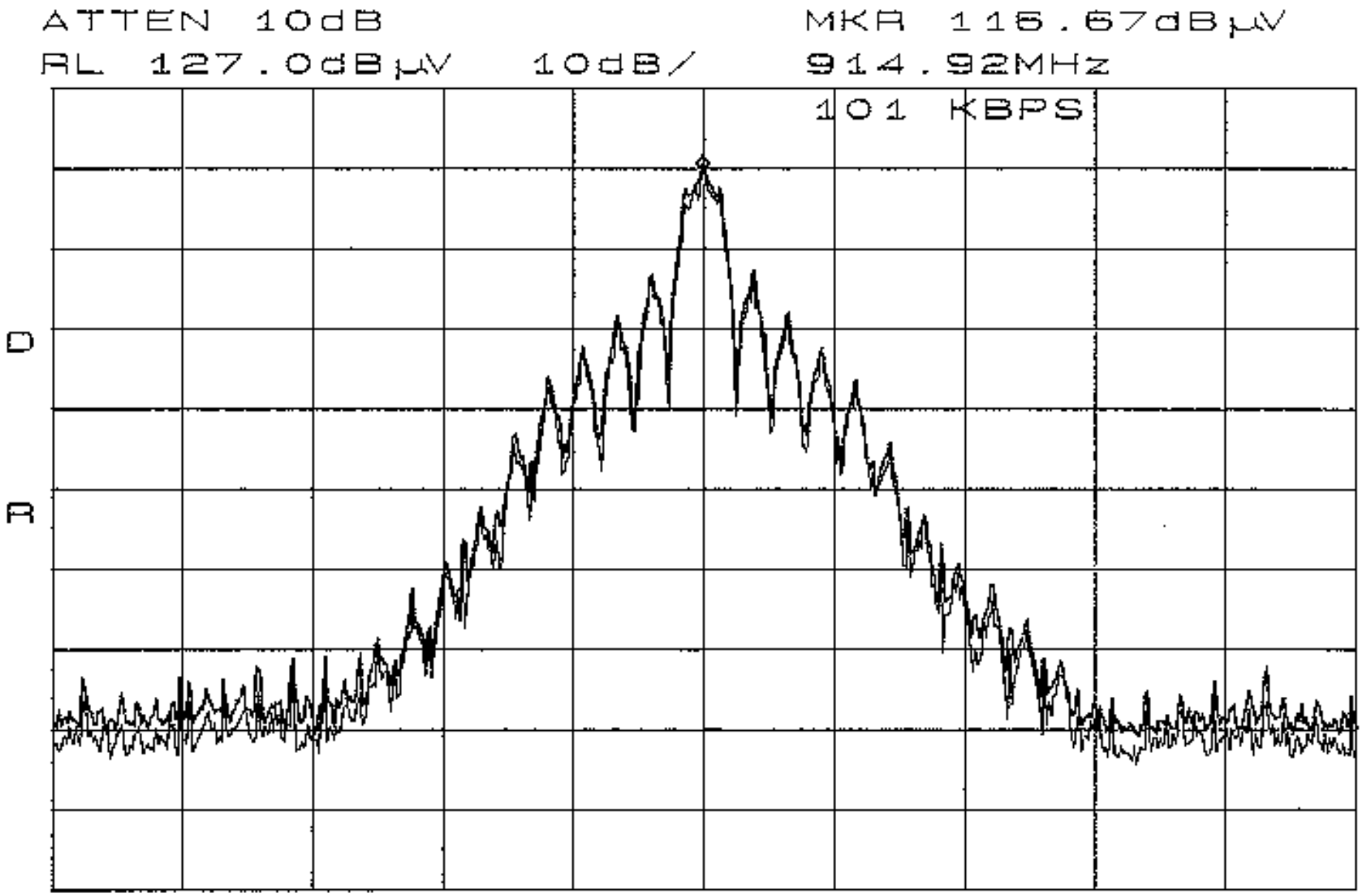
Minimum 6dB BW (915.0 MHz, 317 kbps) SPAN 10 MHz



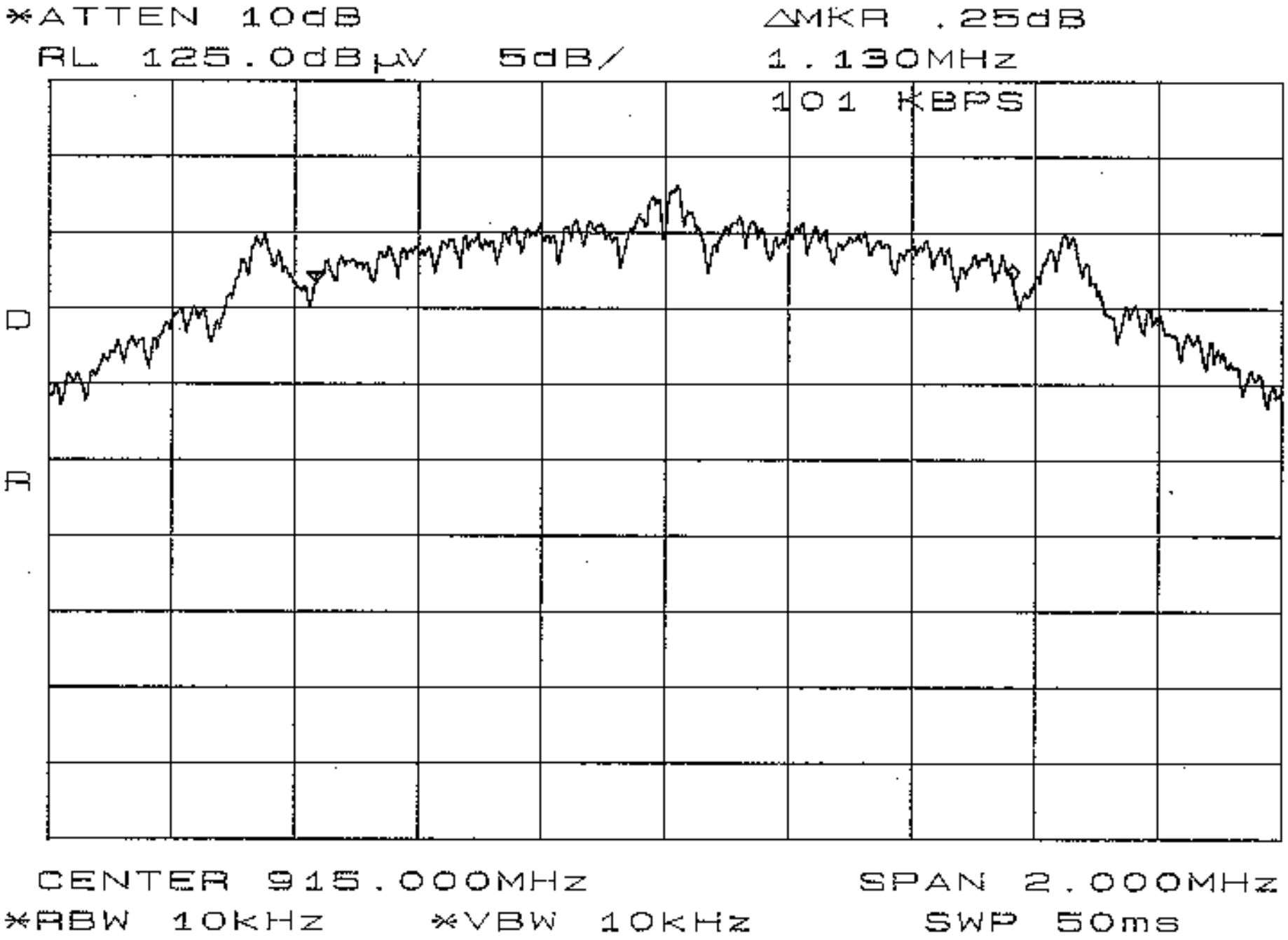
Minimum 6dB BW (915.0MHz, 100B kbps) SPAN 50 kHz



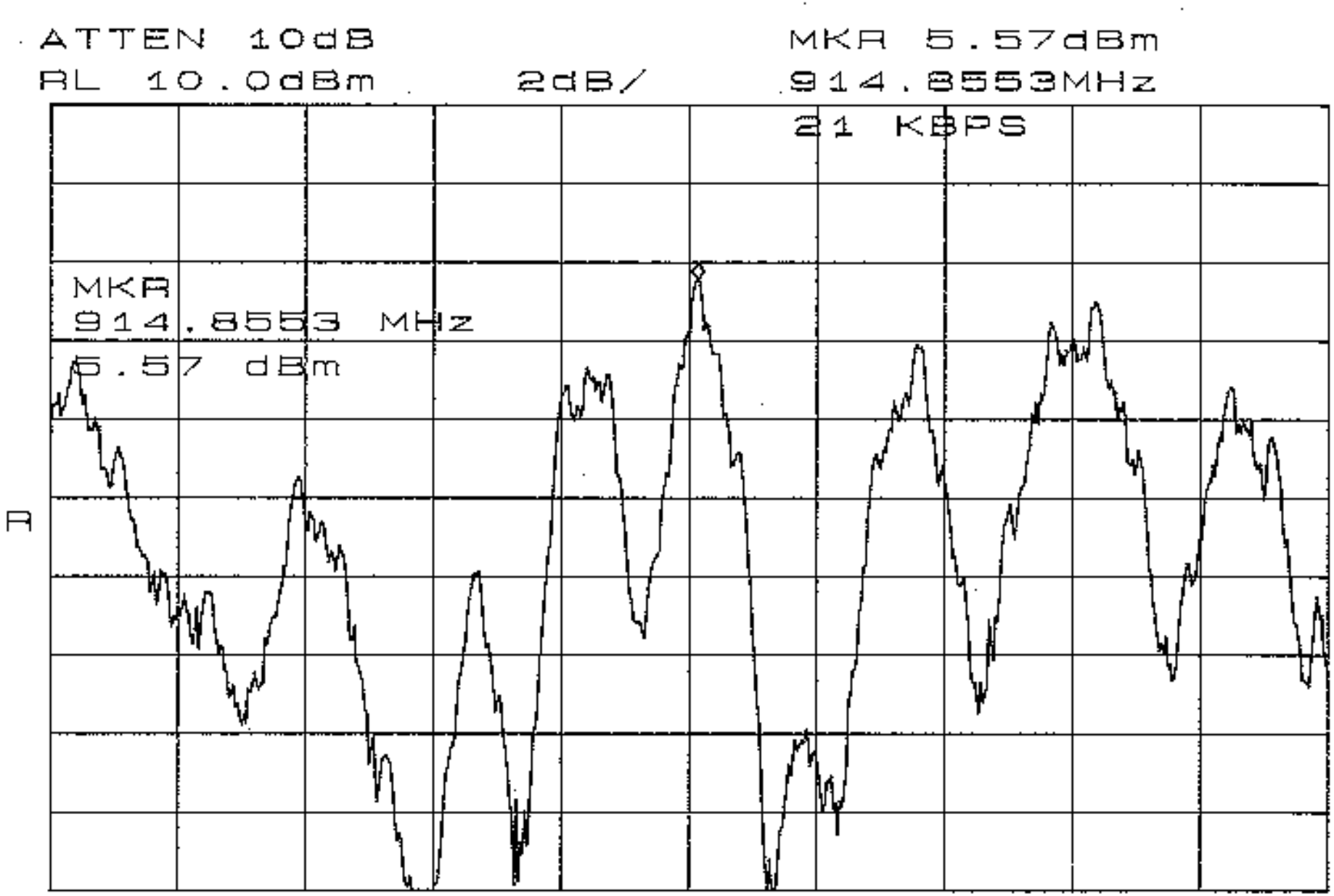
Minimum 6dB BW (915.0 MHz, 1008 kbps) SPAN 2.0 MHz



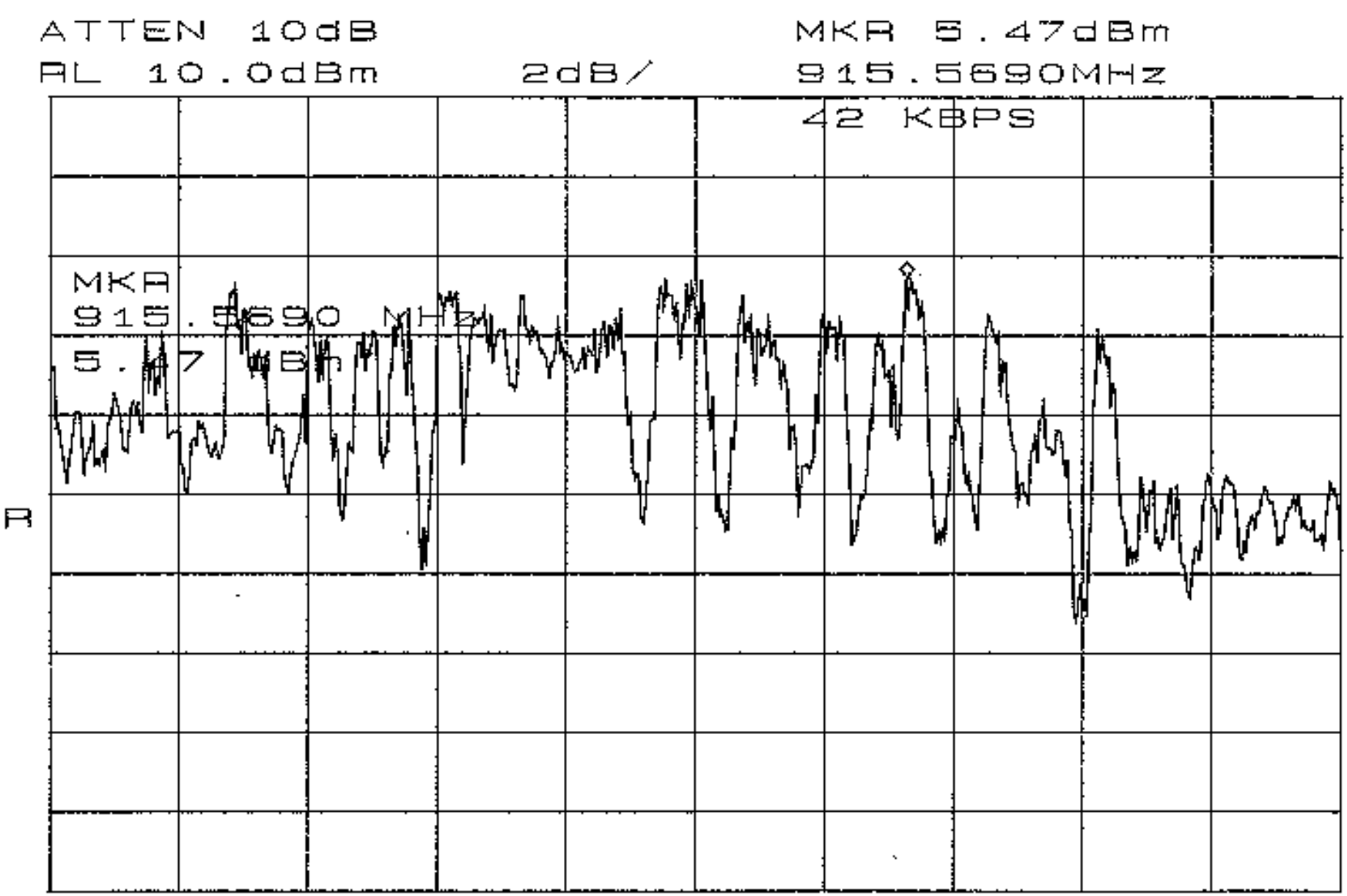
Minimum 6dBBW (915.0 MHz, 101 kbps) SPAN 50 MHz



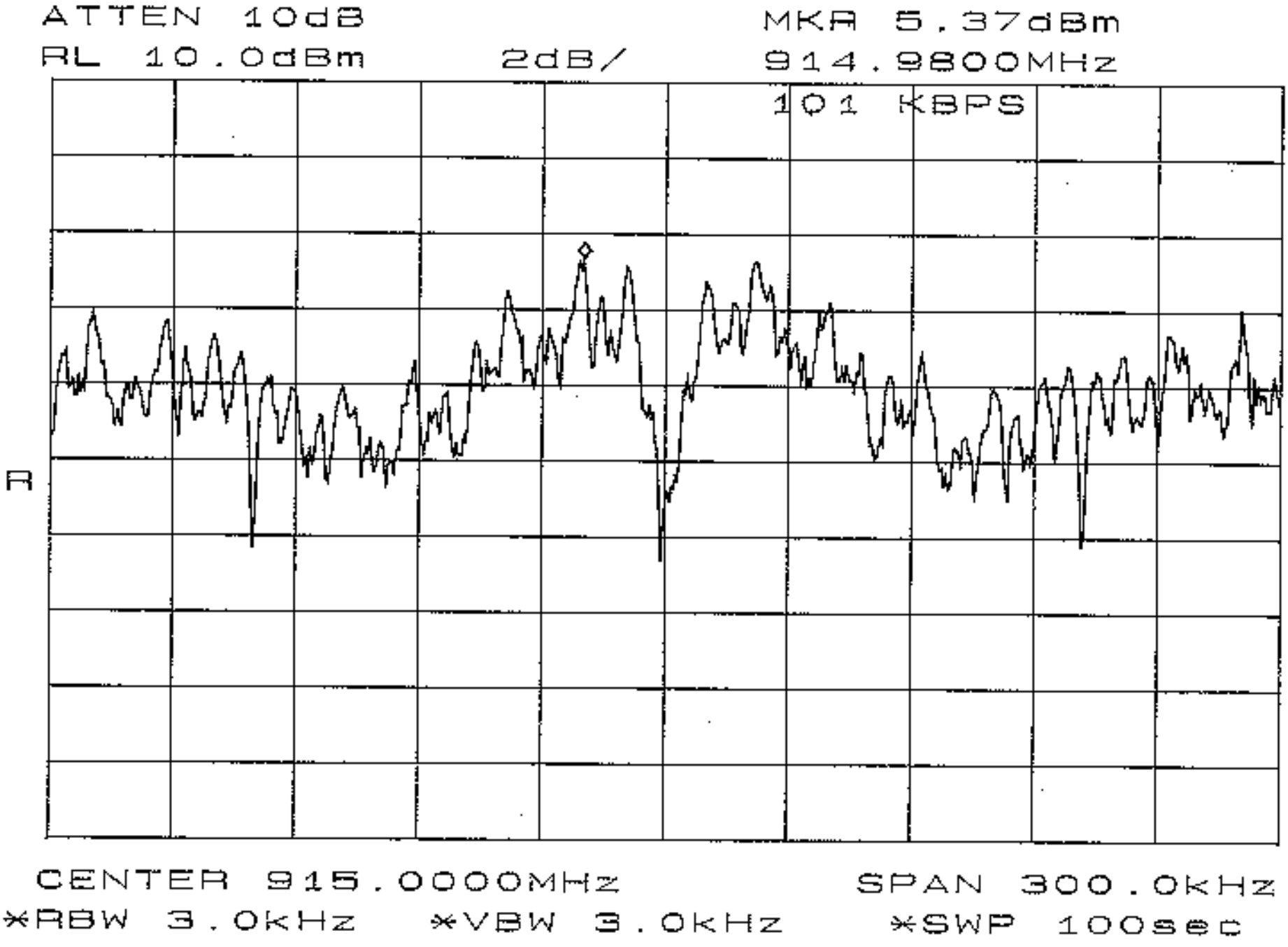
Minimum 6dB BW (915.0 MHz, 101 kbps) SPAN 2 MHz



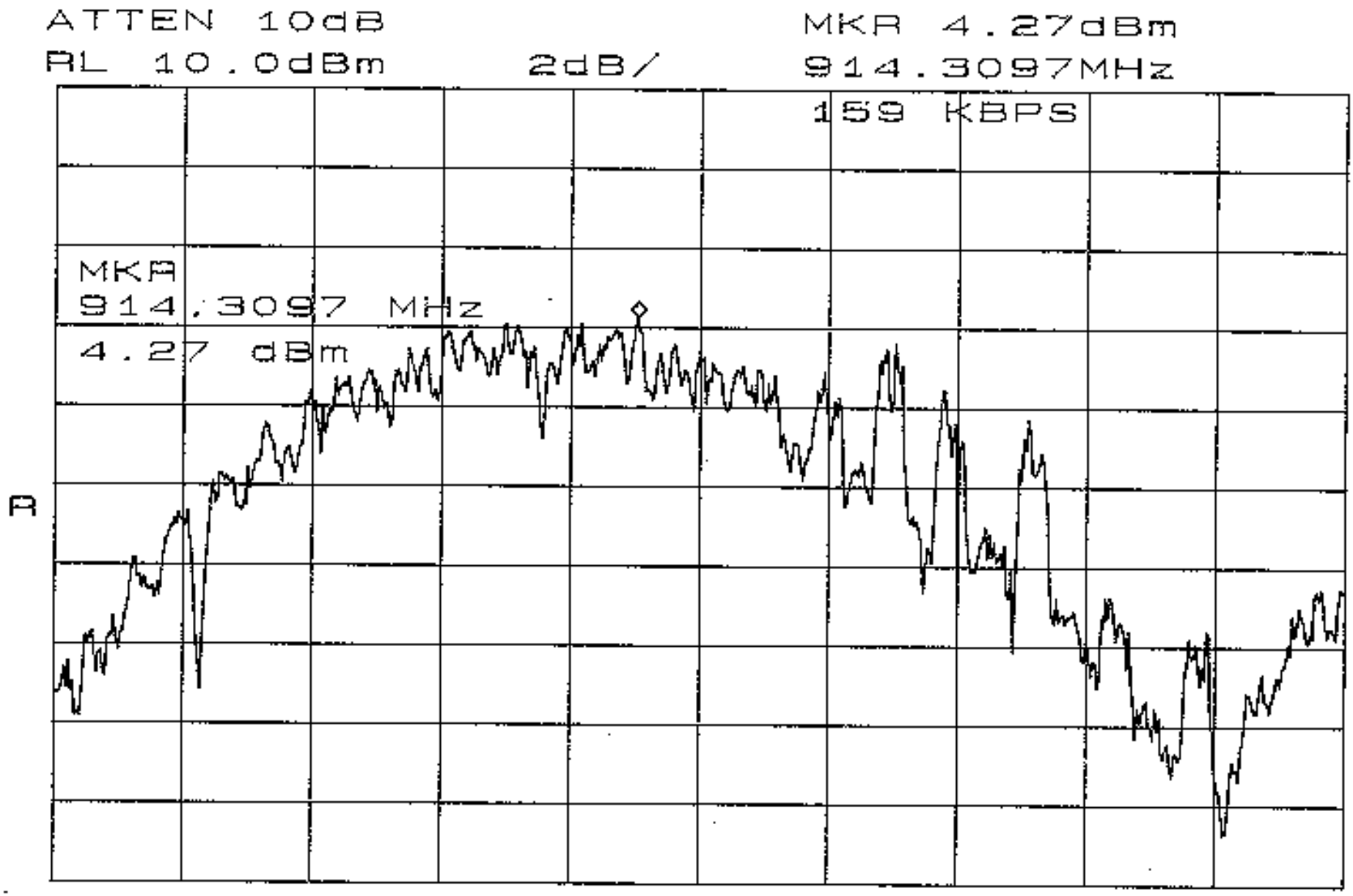
PSD (915MHz, 21 kbps)



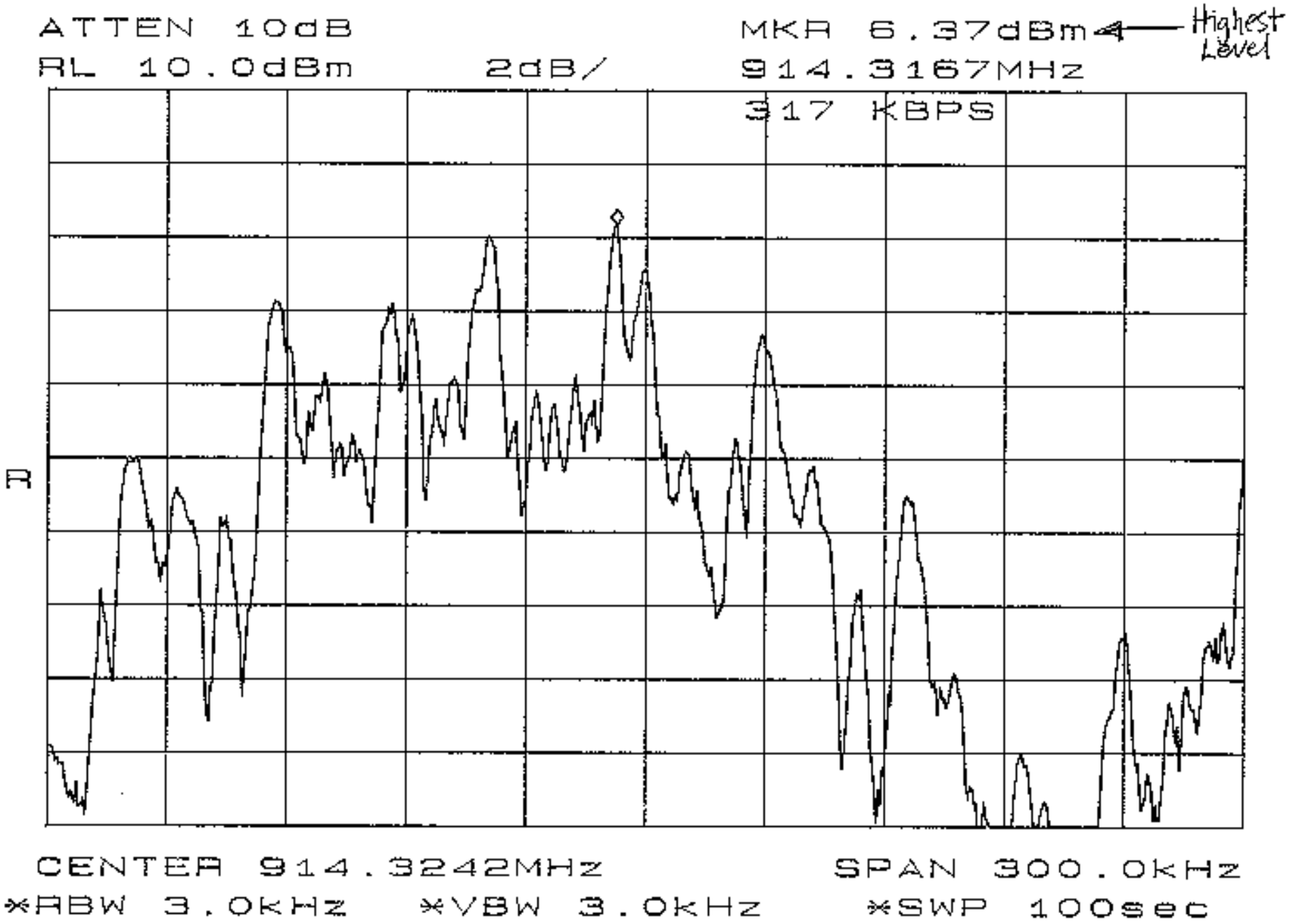
PSD (915MHz, 42 kbps)



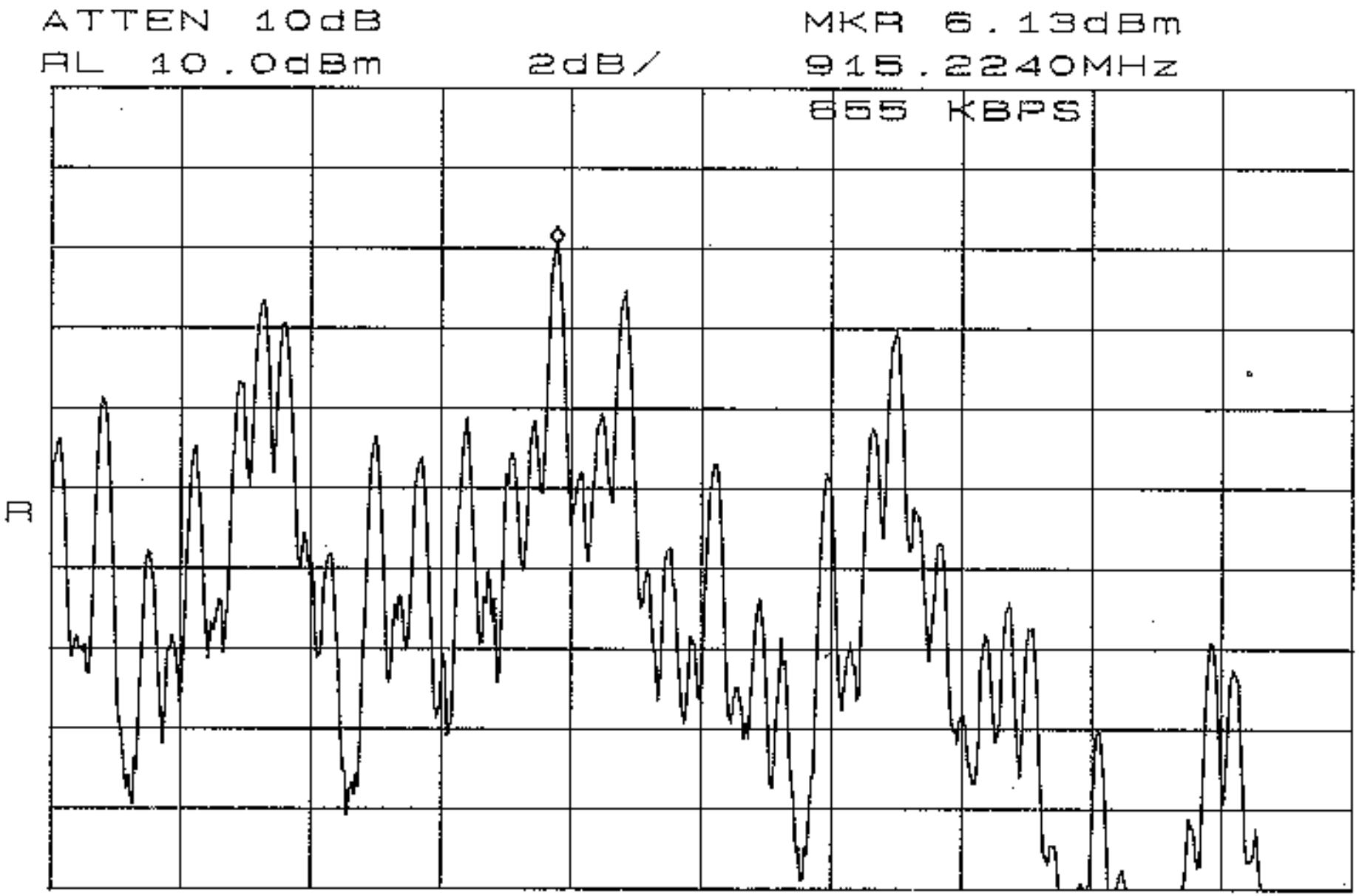
PSD (915 MHz, 101 kbps)



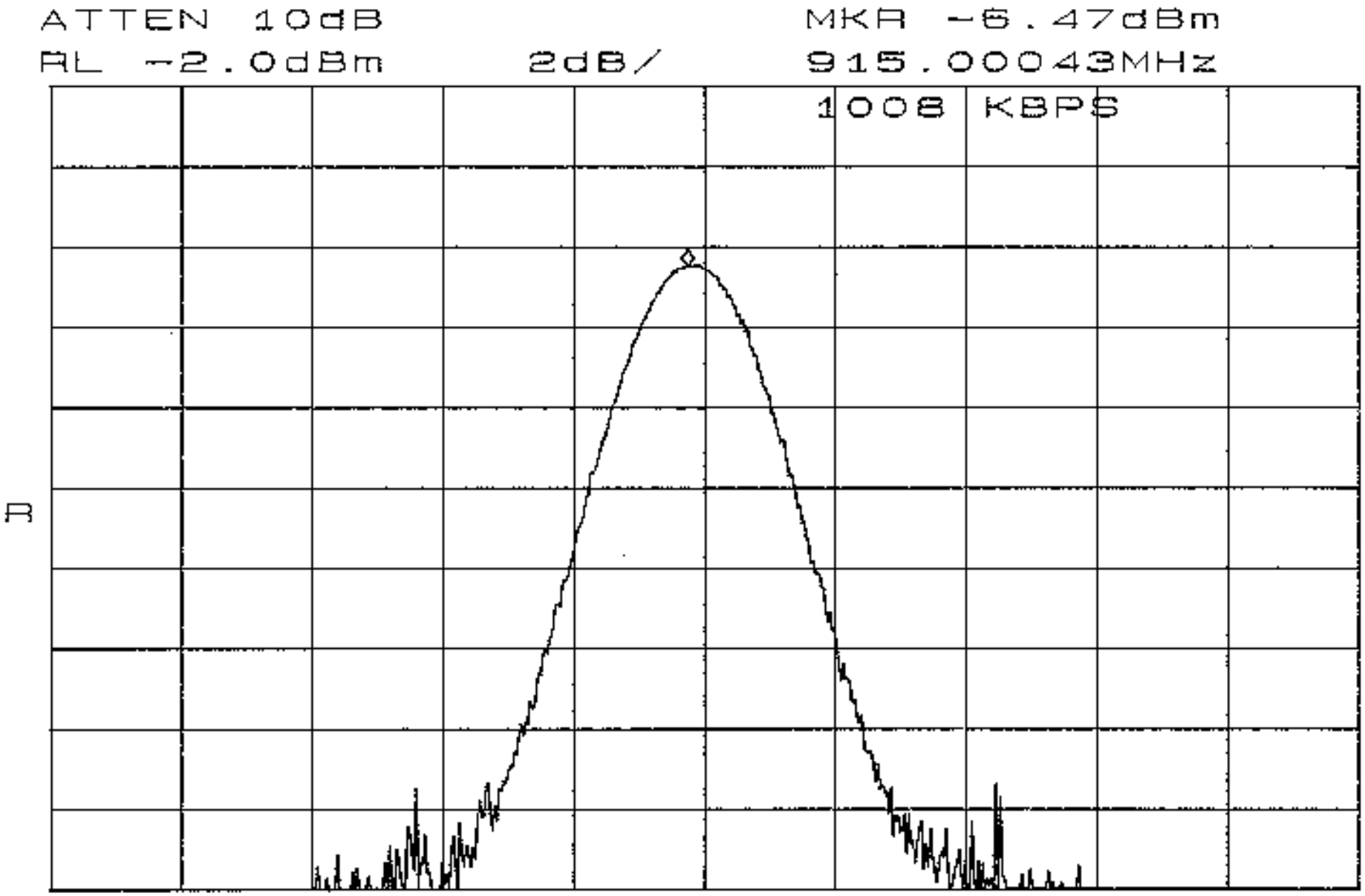
PSD (915MHz, 159 Kbps)



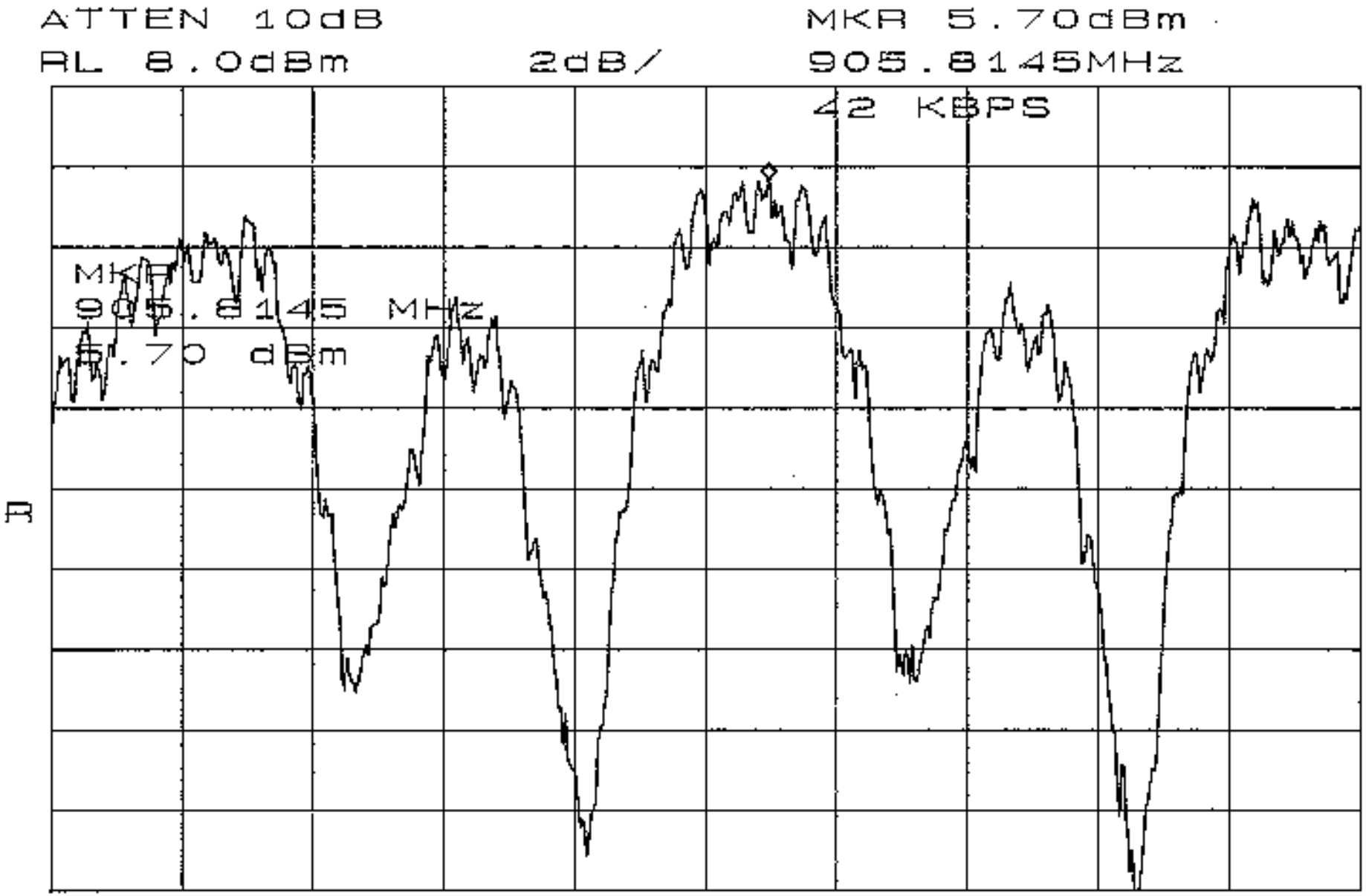
PSD (915 MHz, 317 kbps)



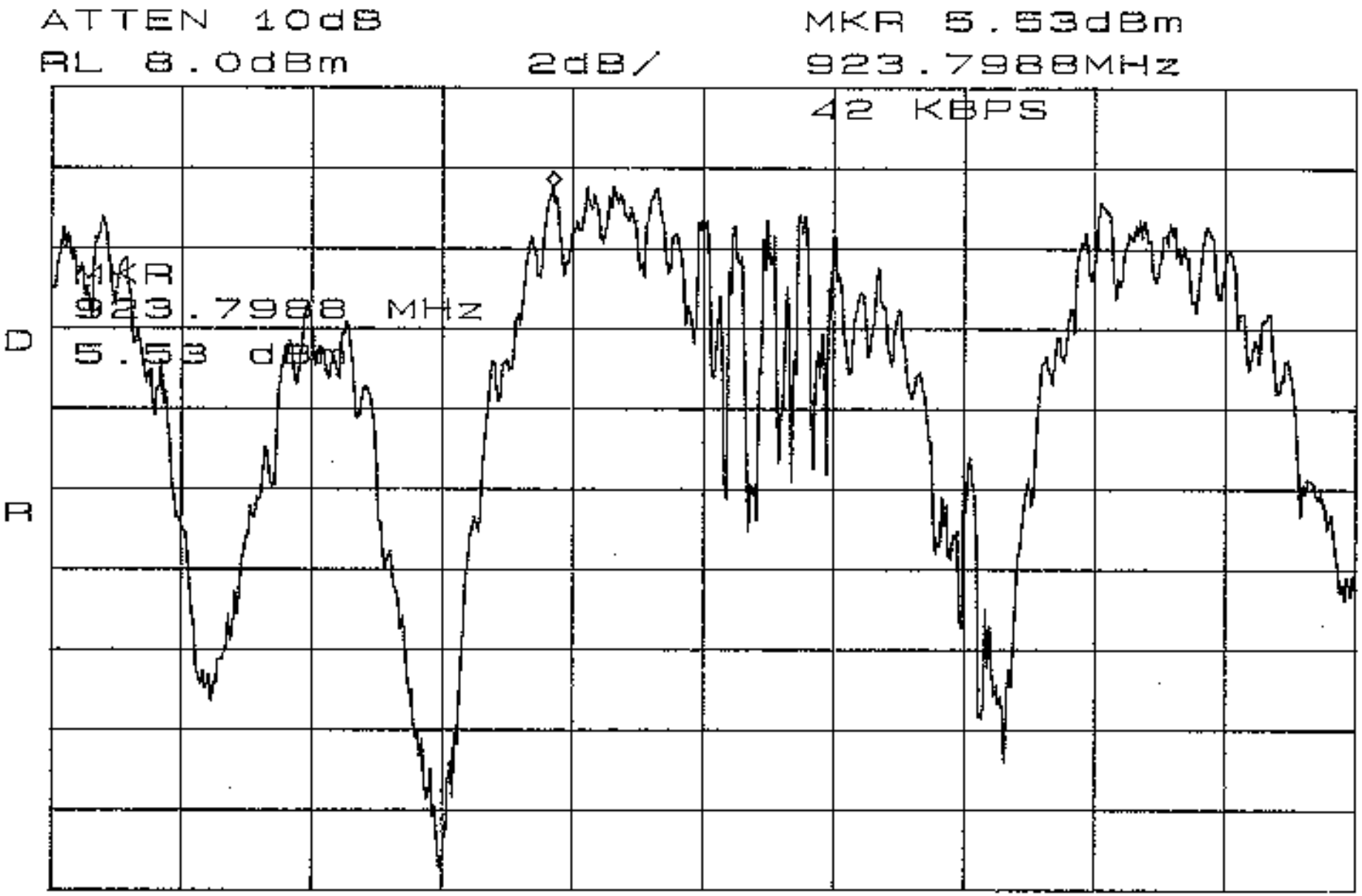
PSD (915 MHz, 655 kbps)



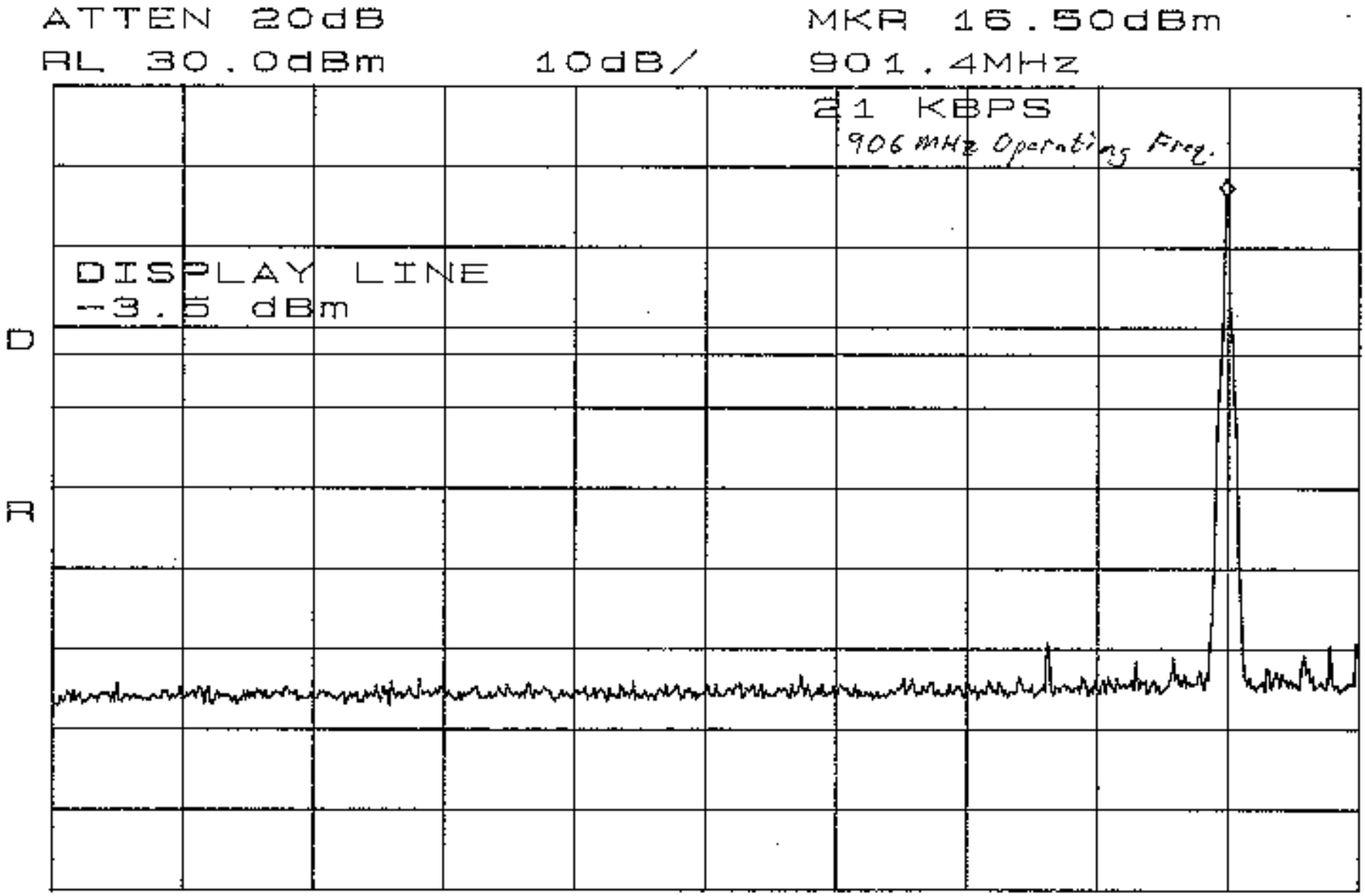
PSD (915MHz, 1008 kbps)



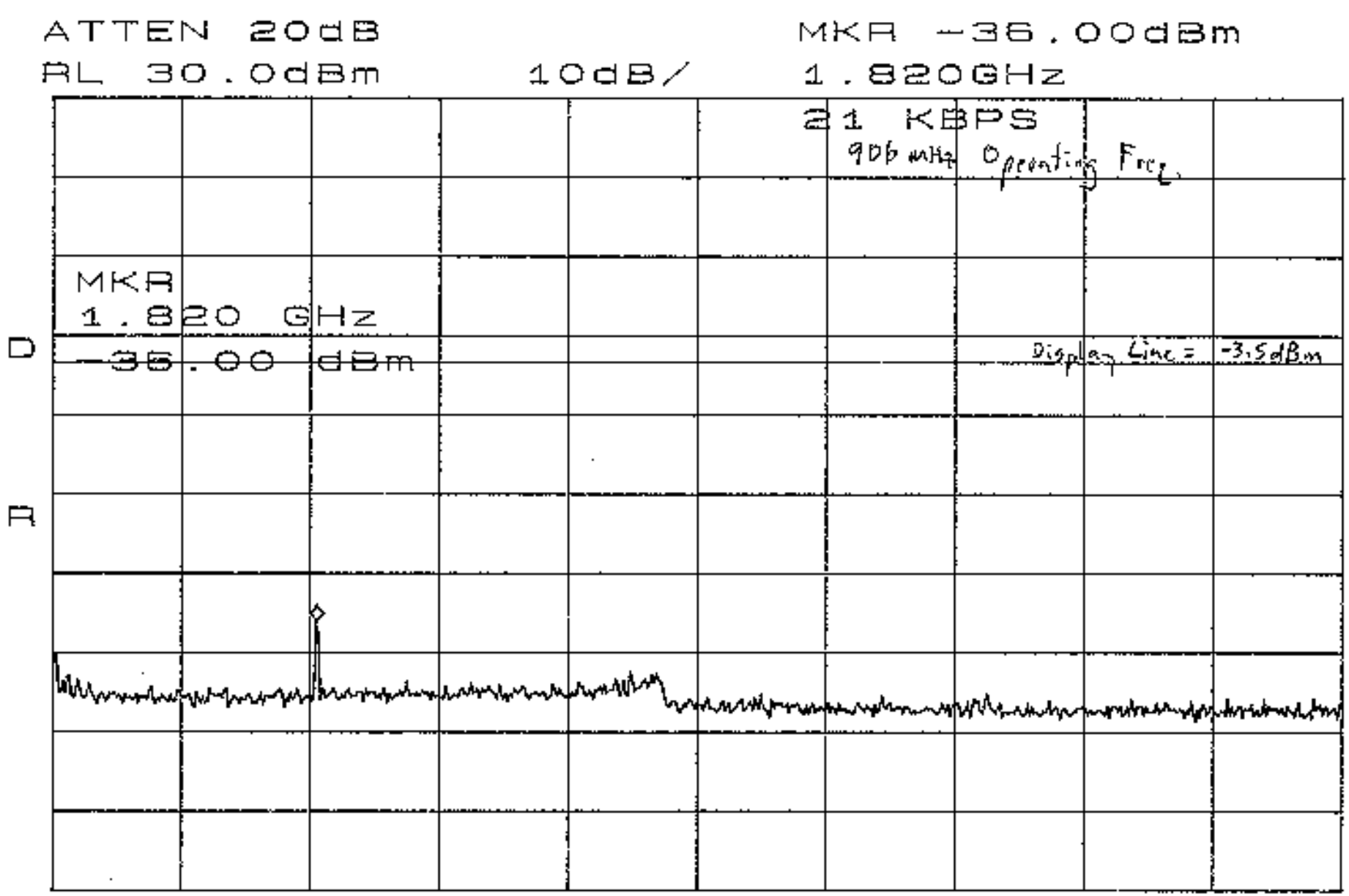
PSD (906.0MHz, 42 kbps)



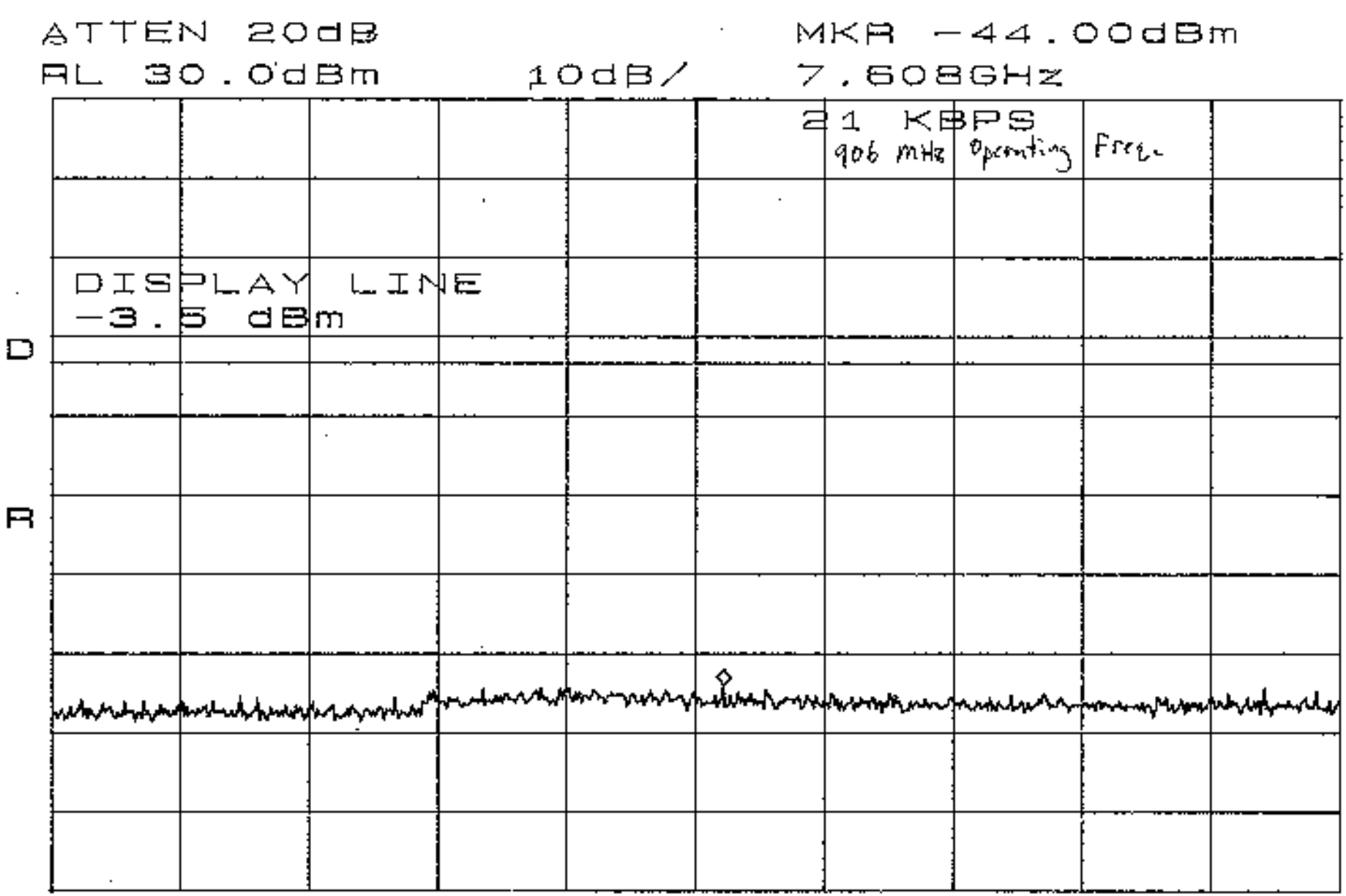
PSD(924.0MHz, 42 kbps)



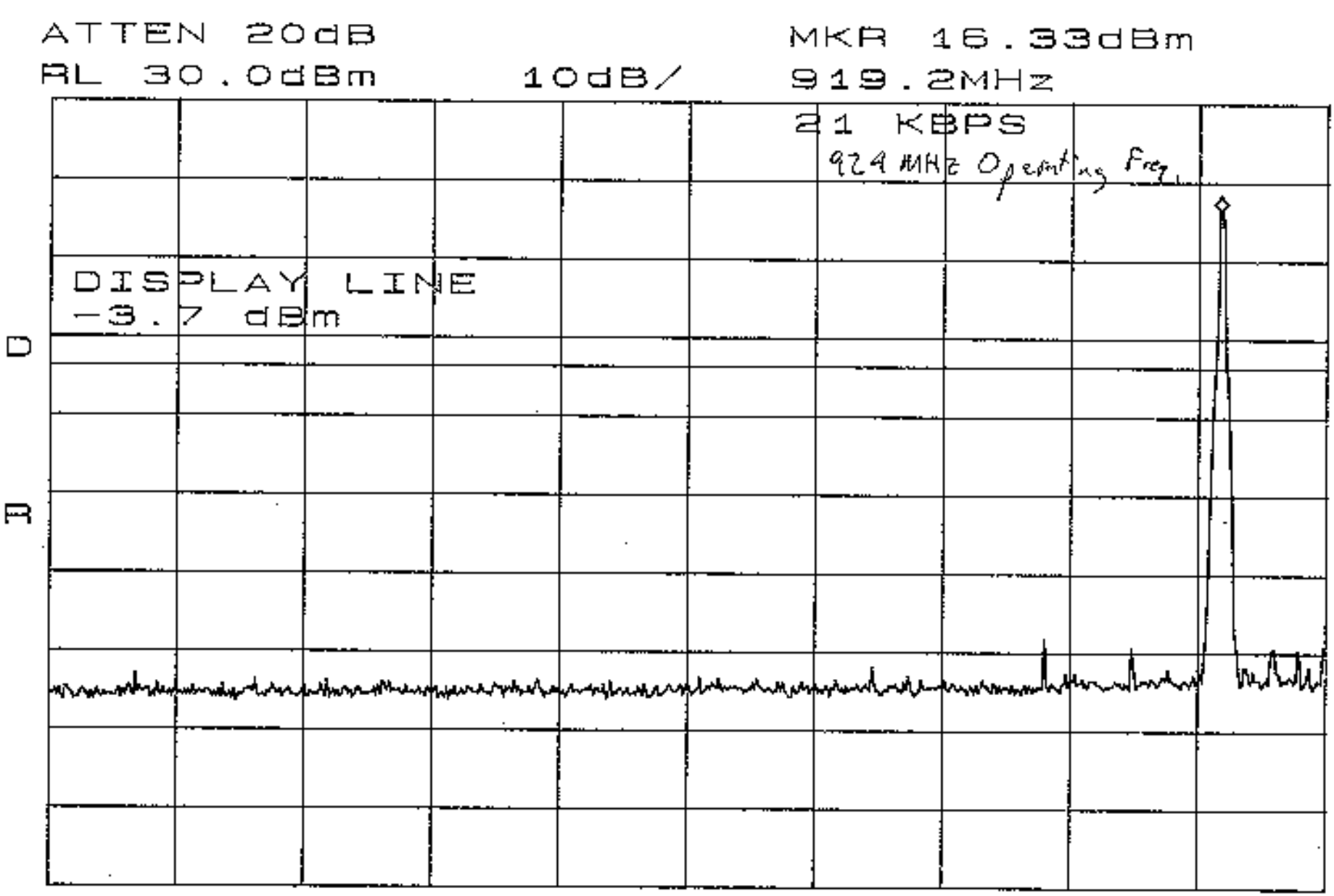
Conducted Spurious Emissions on Antenna Port (906MHz, 21kbps)
one/three



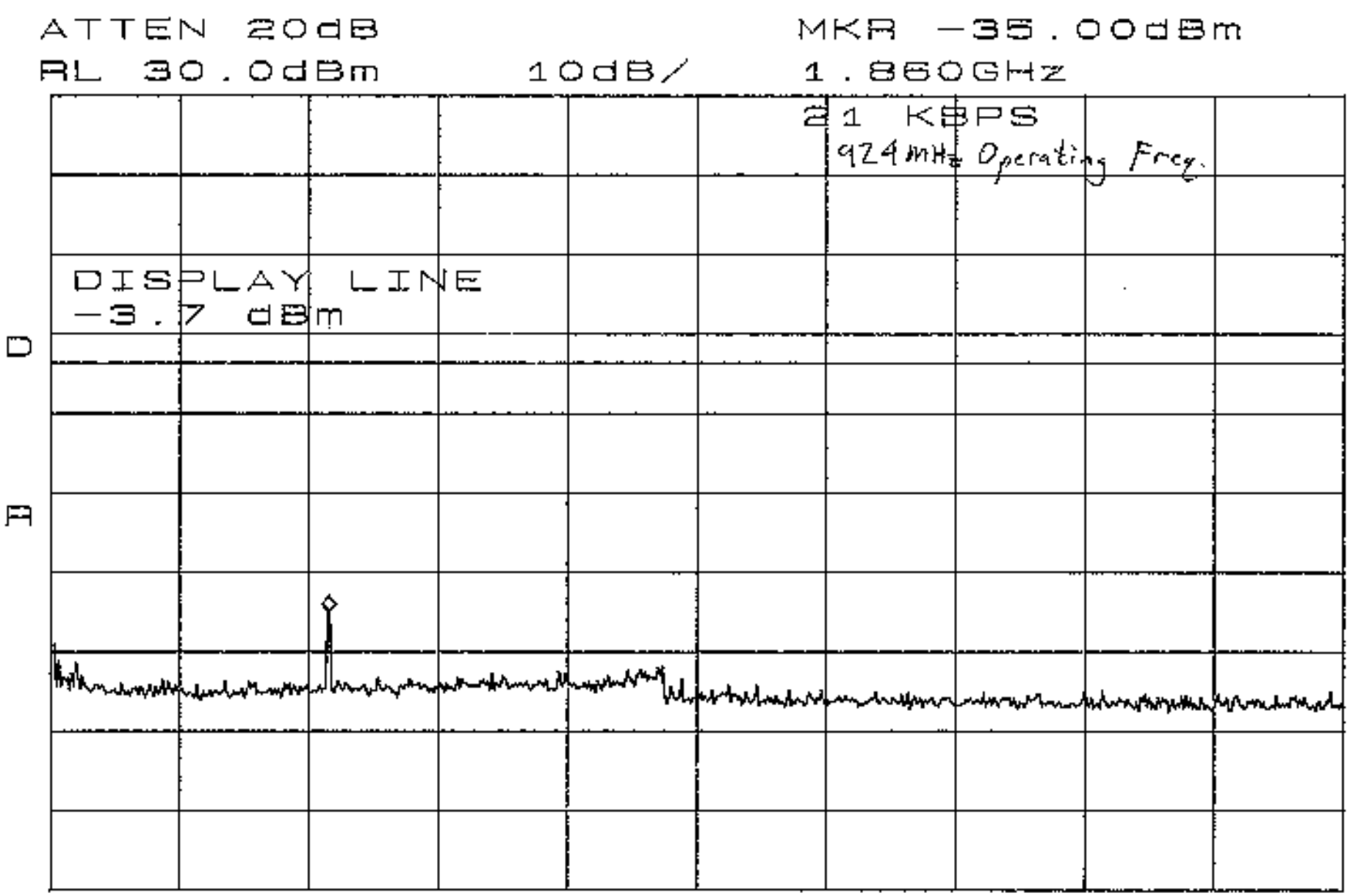
Conducted Spurious Emissions on Antenna Port (906 MHz, 21 Kbps)
two/three



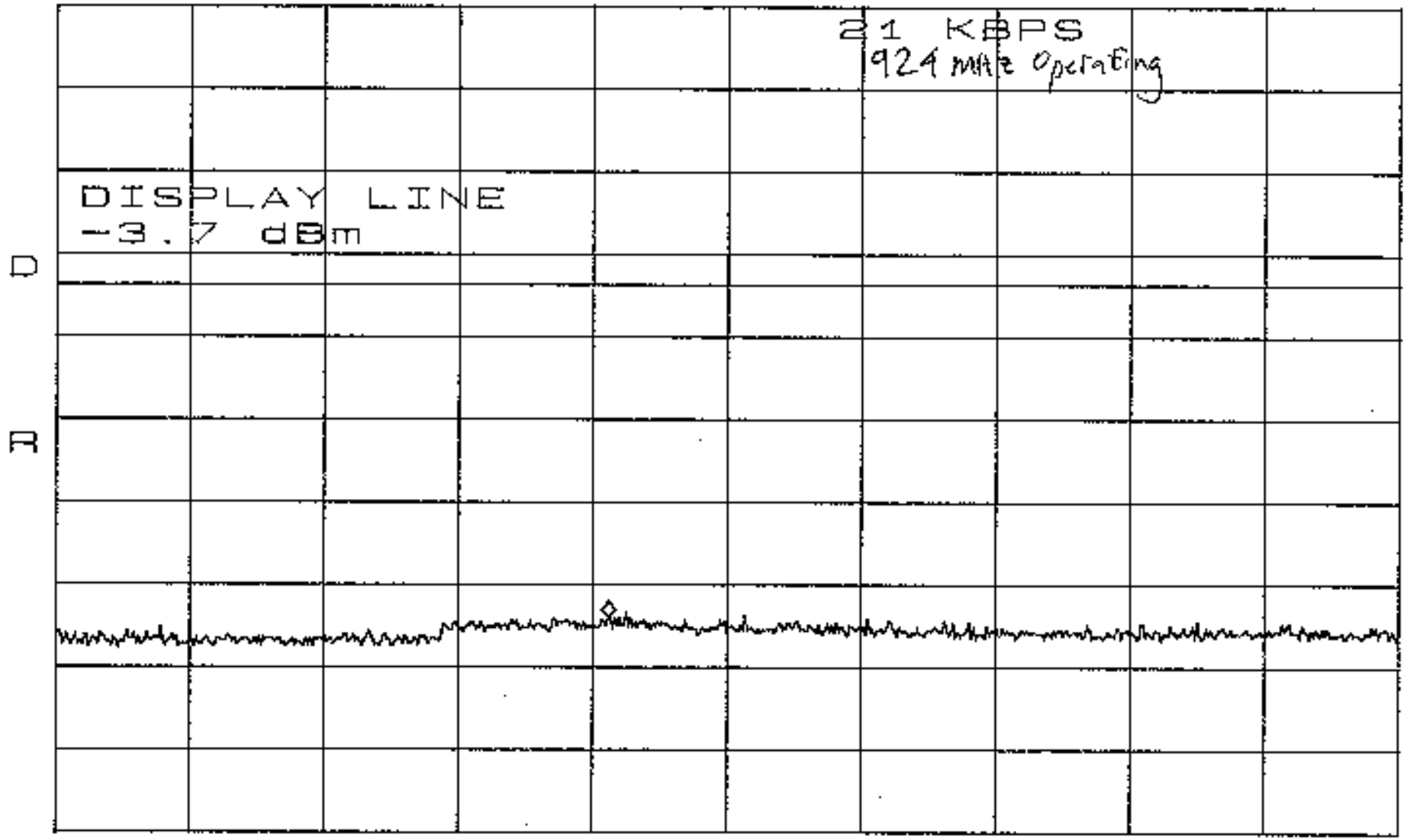
Conducted Spurious Emissions on Antenna Port (906MHz, 21kbps)
three/three



Conducted Spurious Emissions on Antenna Port (924MHz, 21Kbps)
one of three plots



Conducted Spurious Emissions on Antenna Port (924 MHz, 21 Kbps)
two of three plots



Conducted Spurious Emissions on Antenna Port (924 MHz 21 kbps)
three of three plots

Client:	Nova Engineering	Date:	08/19-20-21/99	Test Engr:	Jerry Hill
Product:	NovaRoam 900	File:	T33365	Proj. Eng:	David Bare
Objective:	Final Qualification	Site:	SVOATS #2	Contact:	Barry Carlin
Spec:	FCC Part 15	Page:	1 of 5	Approved:	
Revision	1.0				

Ambient Conditions	
Temperature:	21 °C
Humidity:	68 % RH

Test Objective

The objective of this test session is to perform final qualification testing the EUT defined below relative to the specification(s) defined above using the following antenna configurations:

(a config), +6 dBd Antenex Omnidirectional Antenna with 25' of LMR 400 Coaxial Cable.
(b config), +9 dBd Antenex Yagi 6 element Antenna with 100' of LMR 400 Coaxial Cable.
(c config), +5 dBd Magnetic Mount Loaded Collinear Antenna with 12' of Teflex Coaxial Cable.

Test Summary

Run #1 - (a config) Maximized Spurious Radiated Emissions Intentional Radiator

Spurious Emissions from the EUT were measured with the radio operating at 924 MHz utilizing a 101 kbps modulation.

PASS Results: FCC para. 15.209 -12.7 dB QP @ 960.200 MHz Horizontal

Run #2 - (b config) Maximized Spurious Radiated Emissions Intentional Radiator

Spurious Emissions from the EUT were measured with the radio operating at 921 MHz utilizing a 317 kbps modulation.

PASS Results: FCC para. 15.209 -4.4 dB AVG @ 2763.00 MHz Horizontal

Run #3 - (c config) Maximized Spurious Radiated Emissions Intentional Radiator

Spurious Emissions from the EUT were measured with the radio operating at 921 MHz utilizing a 1008 kbps modulation.

PASS Results: FCC § 15.209 -4.4 dB AVG @ 2763.00 MHz Horizontal

Run #4 - Power Spectral Density (Direct Sequence Radios Only), §15.247(d) at 915 MHz with 1008 kbps modulation:

PASS Results: The maximum PSD was measured to be +6.25 dBm in a 3kHz bandwidth averaged over 1 second.

Run #5- Output Power, § 15.247(b) at the antenna port

Peak output power was measured at 915 MHz with 1008 kbps modulation directly from the antenna port.

PASS The maximum output power was measured to be +25.2 dBm (0.331 Watts).

Run #6 6 dB Bandwidth, See plot. § 15.247(a)

Minimum 6dB Bandwidth was measured at 915 MHz with 1008 kbps modulation.

PASS The minimum 6 Bandwidth was 6.63 MHz.

Run #7 Conducted Spurious Emissions On The Antenna Port, § 15.247(c)

Spurious Emissions on the antenna port were measured at 906 and 924 MHz utilizing a 21, 159, and 1008 kbps modulations, (see attached data plots) .

PASS The out of band spurious emissions on the antenna port for all channels measured were measured to be more than 20dB below the highest in-band signal level at the band edges. Refer to T33315 for measurements from 30 MHz to 10 GHz

Equipment Under Test (EUT) General Description

The EUT is a spread spectrum radio that uses Direct Sequence spreading code. The EUT is designed for use in industrial applications and operates in the 902-928 MHz ISM frequency band. Normally, the EUT would be placed on a tabletop during operation. The EUT was, therefore, placed in this position during testing to simulate the end user environment. The electrical rating of the EUT is 120V, 60 Hz.

Client:	Nova Engineering	Date:	08/19-20-21/99	Test Engr:	Jerry Hill
Product:	NovaRoam 900	File:	T33365	Proj. Eng:	David Bare
Objective:	Final Qualification	Site:	SVOATS #2	Contact:	Barry Carlin
Spec:	FCC Part 15	Page:	3 of 5	Approved:	
Revision	1.0				

Equipment Under Test (EUT)

Manufacturer/Model/Description	Serial Number	FCC ID Number
Nova Engineering / NovaRoam 900 / DSSS Transceiver	RF005 Dig005	OOSNROAM900

Power Supply and Line Filters

Description	Manufacturer	Model
AC adapter	Ault	328-2012-T0021

Printed Wiring Boards in EUT

Manufacturer/Description	Assembly #	Rev.	Serial Number	Crystals (MHz)
Nova Engineering/RF	8040-0102	-	-	19.65
Nova Engineering/Digital	8040-0107	-	-	18.432, 20, 40

Subassemblies in EUT

Manufacturer/Description	Assembly Number	Rev.	Serial Number
None			

EUT Enclosure

The body of the EUT enclosure consists of a pair of interlocking pieces. The base is extruded aluminum while the top is steel with a textured black coating. The ends of the enclosure are aluminum caps with plastic bezels that attach to the base via a pair of self-tapping screws. The enclosure measures approximately 10.5 cm wide by 24 cm deep by 3.8 cm high.

Client:	Nova Engineering	Date:	08/19-20-21/99	Test Engr:	Jerry Hill
Product:	NovaRoam 900	File:	T33365	Proj. Eng:	David Bare
Objective:	Final Qualification	Site:	SVOATS #2	Contact:	Barry Carlin
Spec:	FCC Part 15	Page:	4 of 5	Approved:	
Revision	1.0				

EMI Suppression Devices (filters, gaskets, etc.)

Description	Manufacturer	Part Number
Shield, Synthesizer	Fotofab	3116-0110
Shield, RF Section	Fotofab	3116-0111
Partition, RF Section	Fotofab	3116-0112
Partition, IF	Fotofab	3116-0113
Gasket, TNC	EIS	3116-0114
Bezel, Nickel Acrylic	Lansing	CQ1B90-N1X2
Common Mode Choke	Pulse Engineering	P0351

Modifications

No modifications were made to the EUT in order to comply with the requirements.

Local Support Equipment

Manufacturer/Model/Description	Serial Number	FCC ID Number
(a) Antenex / +6dBd 902-928 Omnidirectional Antenna	128	-
(b) Antenex / +9dBd 896-970 /Blk 6ele Yagi Antenna	121	-
(c) +5dBd Magnetic Mount Base Loaded Collinear Antenna with 3.6m of Teflex Coaxial Cable permanently attached.	-	-

Remote Support Equipment

Manufacturer/Model/Description	Serial Number	FCC ID Number
WinBook / XP5 Model ANL-5 / Laptop Computer	GKF20AR3296 104	JRUANL-5
WinBook / XP Model ADP-30DB-1 / AC adapter	X4525020457	None
Megahertz / XJ10BT or XJ10BC / Ethernet PCMCIA adapter	None	F2M5510011

Client:	Nova Engineering	Date:	08/19-20-21/99	Test Engr:	Jerry Hill
Product:	NovaRoam 900	File:	T33365	Proj. Eng:	David Bare
Objective:	Final Qualification	Site:	SVOATS #2	Contact:	Barry Carlin
Spec:	FCC Part 15	Page:	5 of 5	Approved:	
Revision	1.0				

Interface Cabling

Cable Description	Length (m)	From Unit/Port	To Unit/Port
LMR 400 Coaxial Cable (For direct measurements)	0.3	EUT/Antenna	Power Meter
RJ45 Cat 5 Unshielded	30	EUT /Ethernet	Laptop/Ethernet
Monitor, DB-9 to 8-pin Circular Mini DIN	30	EUT/Monitor	Laptop/Serial
LMR Coaxial Cable	30	EUT/Antenna	Antenna/input-output
LMR Coaxial Cable	7.6	EUT/Antenna	Antenna/input-output

Test Conditions

The laptop computer was configure the EUT via RS232 connection to the EUT's monitor input for configuring operating parameters and then was disconnected for testing. The twisted pair ethernet connection throughout testing was connected to EUT but no traffic was being sent since these measurements were for the transmitter operation only. The radio was programmed to transmit continuously during all testing. In normal operation, the radio operates at a 40% duty cycle thus allowing an 8 dB correction factor for all average measurements.

Test Data

See attached data and plots

Emissions Test Data

Client:	Nova Engineering	Date:	08/19-20-21/1999	Test Engr:	Jerry Hill
Product:	Nova Roam 900	File:	T33346/T33363/T33365	Proj. Engr:	David Bare
Objective	Final Qual	Site:	SVOATS #2	Contact:	Barry Carlin
Spec:	FCC Part 15	Distance:	3 m	Approved:	

Ambient Conditions
Temperature: 21 °C
Humidity: 68 % RH

Config: No network traffic. Cat 5 cable connected. Coax cable coiled and hanging from table. Antenna in center . Serial cable disconnected when not in use. EUT operating on 120V/60Hz.

Antenna A	+6 dBd Omnidirectional Antenna. w/ 25' of LMR400 Coaxial cable.
Antenna B	Antenex (YB8966) Yagi +9dBd 6 element w/100' of LMR400 Coaxial cable.
Antenna C	+5 dBd Mag. Mount Loaded Collinear Antenna with 12' of Teflex Coaxial Cable.

Run #1: Maximized radiated emissions Intentional Radiator, 960MHz. (Ant. A, SS mode 3, Center freq. 924MHz).
Per Paragraph 15.209 3 meters distance. Sorted by Margin.

Frequency	Level	Pol	FCC	FCC	Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
960.200	33.3	h	46.0	-12.7	QP	0	3.8	No emission detected.
960.200	33.2	v	46.0	-12.8	QP	0	1.0	No emission detected.

Harmonics 1-10GHz, Intentional Radiator, in restrictive bands. (Ant. A, SS mode 3, Center freq. 924MHz).
Per Paragraph 15.209 3 meters distance. Duty cycle corrected (Avg only) by using -8dB factor.
Using EL833 High Pass filter >1.6GHz do to preamp saturation. Sorted by Margin.

Frequency	Level	Pol	FCC	FCC	Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
8316.000	41.2	v	54.0	-12.8	Avg	190	1.0	restrictive band duty cycle adjusted
2772.000	40.8	v	54.0	-13.2	Avg	90	1.0	restrictive band duty cycle adjusted
7392.000	38.9	v	54.0	-15.1	Avg	193	1.0	restrictive band duty cycle adjusted
7392.000	35.7	h	54.0	-18.3	Avg	190	1.0	restrictive band duty cycle adjusted
8316.000	55.2	v	74.0	-18.8	Pk	190	1.0	restrictive band
2772.000	54.4	v	74.0	-19.6	Pk	90	1.0	restrictive band
8316.000	34.3	h	54.0	-19.7	Avg	196	1.2	restrictive band duty cycle adjusted
8316.000	53.1	h	74.0	-20.9	Pk	196	1.2	restrictive band
7392.000	52.6	h	74.0	-21.4	Pk	190	1.0	restrictive band
7392.000	52.5	v	74.0	-21.5	Pk	193	1.0	restrictive band
3696.000	32.3	h	54.0	-21.7	Avg	166	2.5	restrictive band duty cycle adjusted
3696.000	31.8	v	54.0	-22.2	Avg	160	1.0	restrictive band duty cycle adjusted
2772.000	31.3	h	54.0	-22.7	Avg	110	1.0	restrictive band duty cycle adjusted
2772.000	48.0	h	74.0	-26.0	Pk	110	1.0	restrictive band
4620.000	27.7	v	54.0	-26.3	Avg	116	1.0	restrictive band duty cycle adjusted
3696.000	47.0	v	74.0	-27.0	Pk	160	1.0	restrictive band
4620.000	26.0	h	54.0	-28.0	Avg	90	2.0	restrictive band duty cycle adjusted
3696.000	45.5	h	74.0	-28.5	Pk	166	2.5	restrictive band
4620.000	45.4	h	74.0	-28.6	Pk	90	2.0	restrictive band
4620.000	44.0	v	74.0	-30.0	Pk	116	1.0	restrictive band

Elliott

Emissions Test Data

Client:	Nova Engineering	Date:	08/19-20-21/1999	Test Engr:	Jerry Hill
Product:	Nova Roam 900	File:	T33346/T33363/T33365	Proj. Engr:	David Bare
Objective	Final Qual	Site:	SVOATS #2	Contact:	Barry Carlin
Spec:	FCC Part 15	Distance:	3 m	Approved:	

Run #2: Maximized radiated emissions, Intentional Radiator, 960MHz. (Ant. B, SS mode 5, Center freq. 921MHz).
Per Paragraph 15.209 3 meters distance. Sorted by Margin.

Frequency	Level	Pol	FCC	FCC	Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
960.200	33.3	h	46.0	-12.7	QP	0	3.8	No emission detected.
960.200	33.2	v	46.0	-12.8	QP	0	1.0	No emission detected.

Harmonics 1-10GHz, Intentional radiator, in restrictive bands. (Ant. B, SS mode 5, Center freq. 921MHz).
Per Paragraph 15.209 3 meters distance. Sorted by Margin.
Using EL833 High Pass filter >1.6GHz do to preamp saturation.

Frequency	Level	Pol	FCC	FCC	Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2763.000	49.6	h	54.0	**-4.4**	Avg	40	1.4	restrictive band duty cycle adjusted
2763.000	44.6	v	54.0	-9.4	Avg	68	1.4	restrictive band duty cycle adjusted
7368.000	43.8	h	54.0	-10.2	Avg	17	1.4	restrictive band duty cycle adjusted
8289.000	40.8	h	54.0	-13.2	Avg	20	1.4	restrictive band duty cycle adjusted
2763.000	60.7	v	74.0	-13.3	Pk	230	1.5	restrictive band
4605.000	40.0	h	54.0	-14.0	Avg	142	1.4	restrictive band duty cycle adjusted
2763.000	55.9	h	74.0	-18.1	Pk	230	1.5	restrictive band
7368.000	34.0	v	54.0	-20.0	Avg	142	1.4	restrictive band duty cycle adjusted
3684.000	34.0	h	54.0	-20.0	Avg	21	1.4	restrictive band duty cycle adjusted
8289.000	32.8	v	54.0	-21.2	Avg	687	1.4	restrictive band duty cycle adjusted
8289.000	52.4	h	74.0	-21.6	Pk	124	1.7	restrictive band
3684.000	31.2	v	54.0	-22.8	Avg	40	1.4	restrictive band duty cycle adjusted
4605.000	28.7	v	54.0	-25.3	Avg	21	1.4	restrictive band duty cycle adjusted
3684.000	47.6	h	74.0	-26.4	Pk	238	1.4	restrictive band
4605.000	45.0	h	74.0	-29.0	Pk	240	1.5	restrictive band
7368.000	44.4	h	74.0	-29.6	Pk	170	1.7	restrictive band
7368.000	42.1	v	74.0	-31.9	Pk	170	1.7	restrictive band
8289.000	41.0	v	74.0	-33.0	Pk	124	1.7	restrictive band
3684.000	39.0	v	74.0	-35.0	Pk	238	1.4	restrictive band
4605.000	36.0	v	74.0	-38.0	Pk	240	1.5	restrictive band

Run #3: Maximized radiated emissions, Intentional Radiator, 960MHz. (Ant. C, SS mode 7, Center freq. 921MHz).
Per Paragraph 15.209 3 meters distance. Sorted by Margin.

Frequency	Level	Pol	FCC	FCC	Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
960.200	33.3	h	46.0	-12.7	QP	0	3.8	No emission detected.
960.200	33.2	v	46.0	-12.8	QP	0	1.0	No emission detected.

Elliott

Emissions Test Data

Client:	Nova Engineering	Date:	08/19-20-21/1999	Test Engr:	Jerry Hill
Product:	Nova Roam 900	File:	T33346/T33363/T33365	Proj. Engr:	David Bare
Objective	Final Qual	Site:	SVOATS #2	Contact:	Barry Carlin
Spec:	FCC Part 15	Distance:	3 m	Approved:	

Harmonics 1-10GHz, Intentional radiator, in restrictive bands. (Ant. C, SS mode 7, Center freq. 921MHz).
Per Paragraph 15.209 3 meters distance. Sorted by Margin.
Using EL833 High Pass filter >1.6GHz do to preamp saturation.

Frequency	Level	Pol	FCC	FCC	Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2763.000	49.6	h	54.0	**-4.4**	Avg	100	1.1	restrictive band duty cycle adjusted
8289.000	47.1	h	54.0	-6.9	Avg	120	1.1	restrictive band duty cycle adjusted
7368.000	45.2	h	54.0	-8.8	Avg	120	1.1	restrictive band duty cycle adjusted
2763.000	42.4	v	54.0	-11.6	Avg	100	1.1	restrictive band duty cycle adjusted
7368.000	37.9	v	54.0	-16.1	Avg	120	1.1	restrictive band duty cycle adjusted
3684.000	37.4	h	54.0	-16.6	Avg	120	1.1	restrictive band duty cycle adjusted
4605.000	37.2	h	54.0	-16.8	Avg	115	1.1	restrictive band duty cycle adjusted
8289.000	35.4	v	54.0	-18.6	Avg	120	1.1	restrictive band duty cycle adjusted
2763.000	53.5	h	74.0	-20.5	Pk	167	1.5	restrictive band
7368.000	52.9	h	74.0	-21.1	Pk	222	1.6	restrictive band
8289.000	48.8	h	74.0	-25.2	Pk	200	1.7	restrictive band
3684.000	28.2	v	54.0	-25.8	Avg	120	1.1	restrictive band duty cycle adjusted
4605.000	27.4	v	54.0	-26.6	Avg	115	1.1	restrictive band duty cycle adjusted
4605.000	47.3	h	74.0	-26.7	Pk	162	1.2	restrictive band
2763.000	45.7	v	74.0	-28.3	Pk	167	1.5	restrictive band
7368.000	41.7	v	74.0	-32.3	Pk	222	1.6	restrictive band
8289.000	39.9	v	74.0	-34.1	Pk	220	1.7	restrictive band
3684.000	39.7	h	74.0	-34.3	Pk	167	1.6	restrictive band
3684.000	37.6	v	74.0	-36.4	Pk	167	1.6	restrictive band
4605.000	35.8	v	74.0	-38.2	Pk	162	1.2	restrictive band

Continuation of testing on 08.21.99 (D33363)

Run #4, Power Spectral Density (Direct Sequence Radios Only), Para. 15.247(d): See plots for data.
Power Spectral Density was measured at 915 MHz with 1008 kbps rate. Measured 6.25dBm.

Run #5, Power, Output Port, Para. 15.247(b)
915 MHz, SS Mode 7, 1008kbps was measured as 25.2 dBm when measured on a Rohde & Schwarz Power Meter NRVD EL#1071.

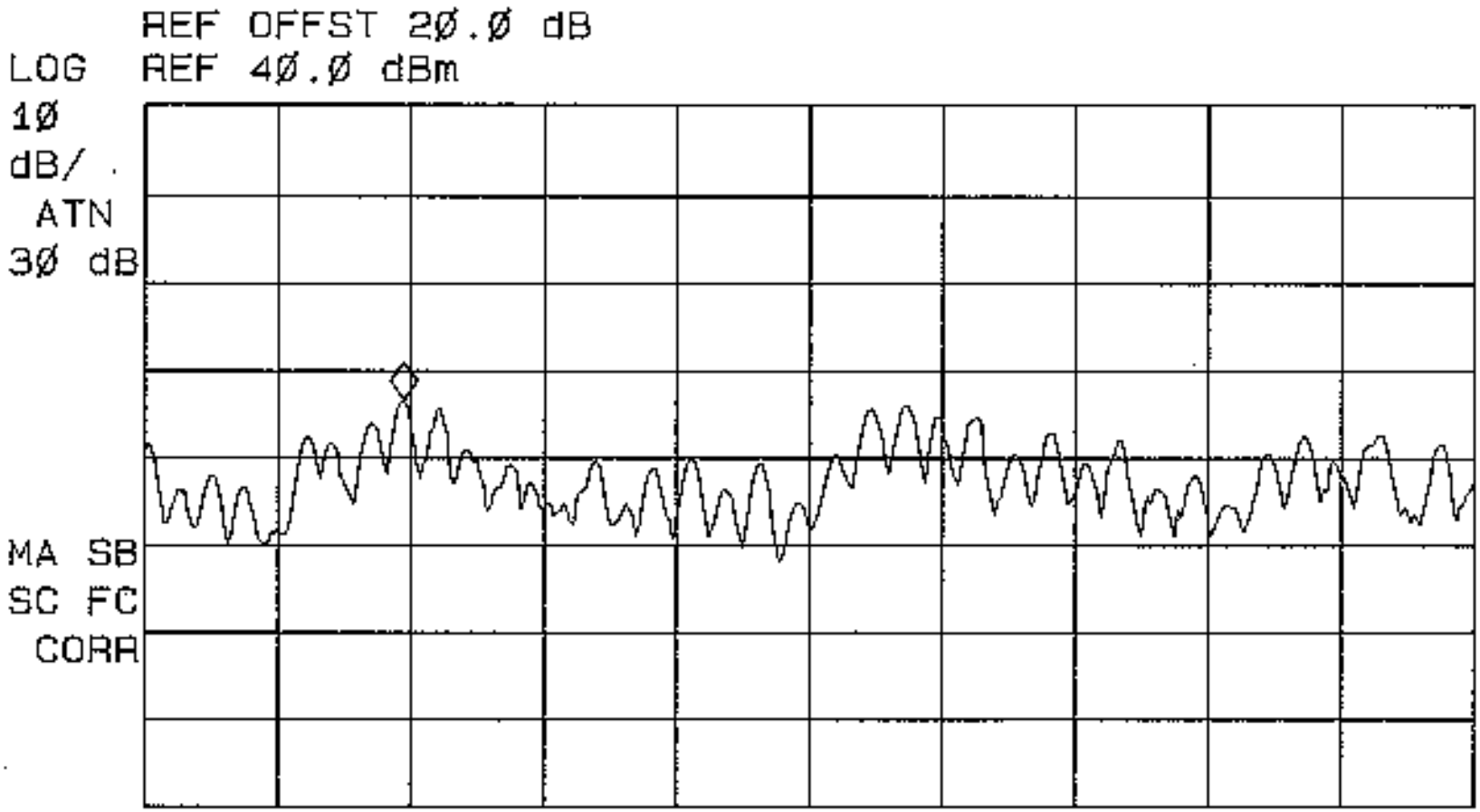
Run #6, 6 dB Bandwidth. See plot.
Minimum 6dB bandwidth was measured at 915 MHz, SS mode # 7, 1008 kbps rate.
The minimum 6dB bandwidth for the direct sequence radio was measured to be 6.63MHz at 1008 kbps rate.

Run #7, Sidelobes Outside ISM Band, para. 15.247(C). See plots.
See Plot's (6 ea.). All measured for 915MHz 21kbps, 159kbps, 1008kbps >20dB down.

NOVA ROAM 900

1008 KBPS
Power Spectral Density 15.247(b)
T33365-4

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 914.9535 MHz
6.25 dBm



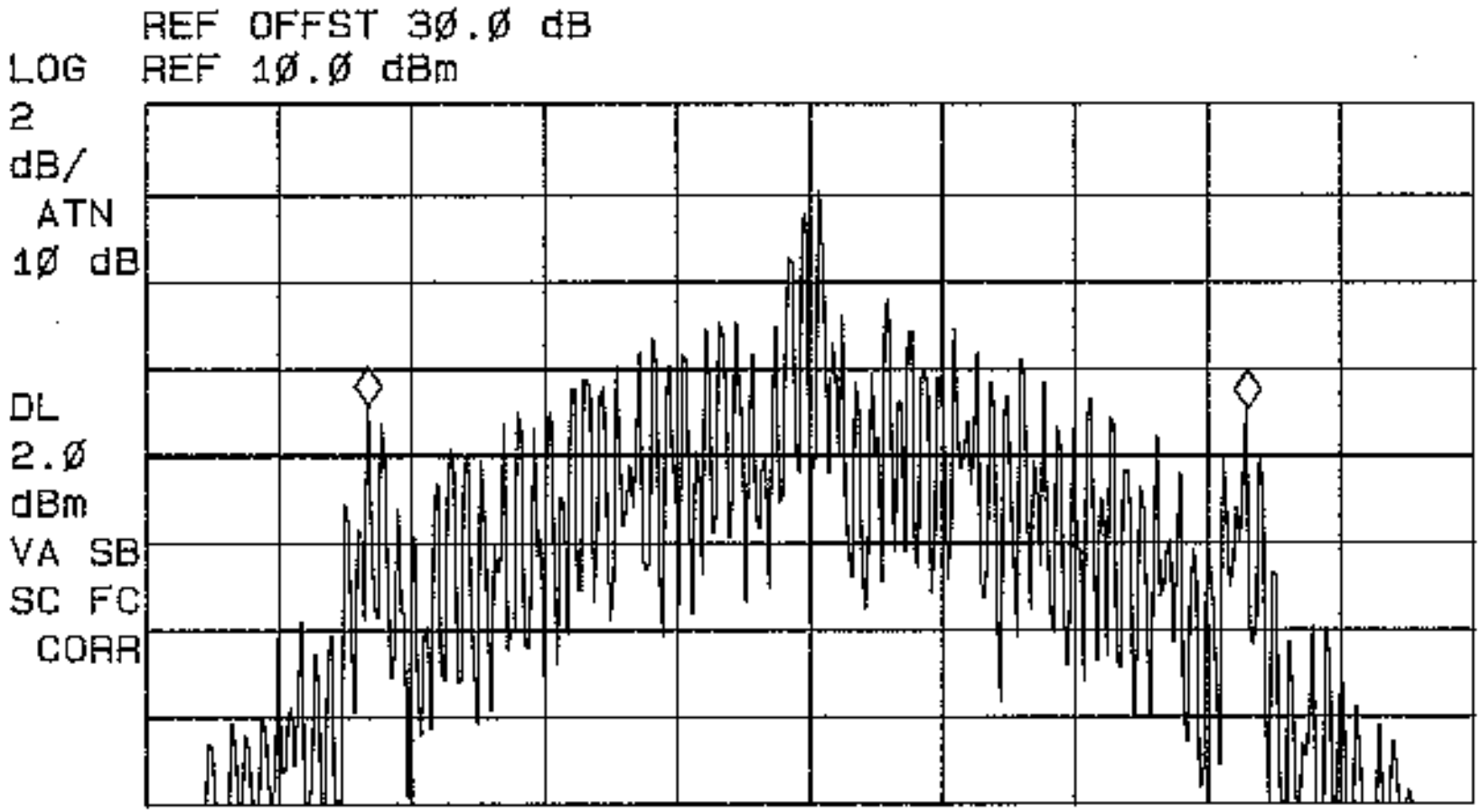
CENTER 915.0450 MHz
#IF BW 3.0 kHz
#AVG BW 10 kHz
SPAN 300.0 kHz
#SWP 100 sec

8/2/99

NOVAROAM 9ØØ

100 KBPS, SS MODE 7, RF CH = 915 MHz

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 6.63 MHz
-.Ø9 dB



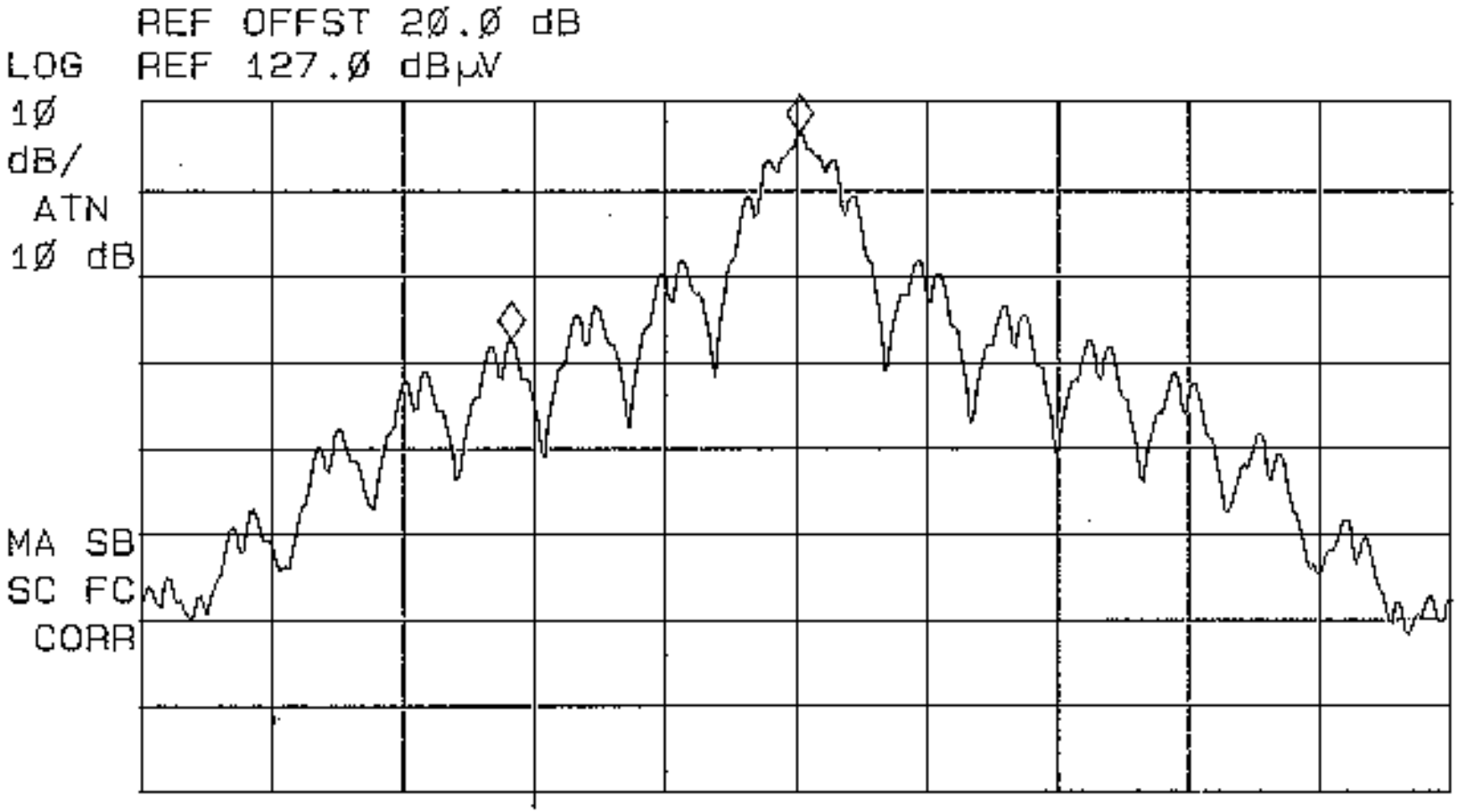
CENTER 915.ØØ MHz
SPAN 1Ø.ØØ MHz
#IF BW 1Ø kHz
AVG BW 1Ø kHz
SWP 3ØØ msec

hp NOVA ROAM 900

21 KBPS 55 mode 1 RF CH = 906 MHz
FP 15.247(c) Sidelobes outside ISM Band

D33365-7a

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR -4.40 MHz
-23.95 dB



CENTER 906.00 MHz
#IF BW 100 kHz #AVG BW 100 kHz
SPAN 20.00 MHz
SWP 20.0 msec

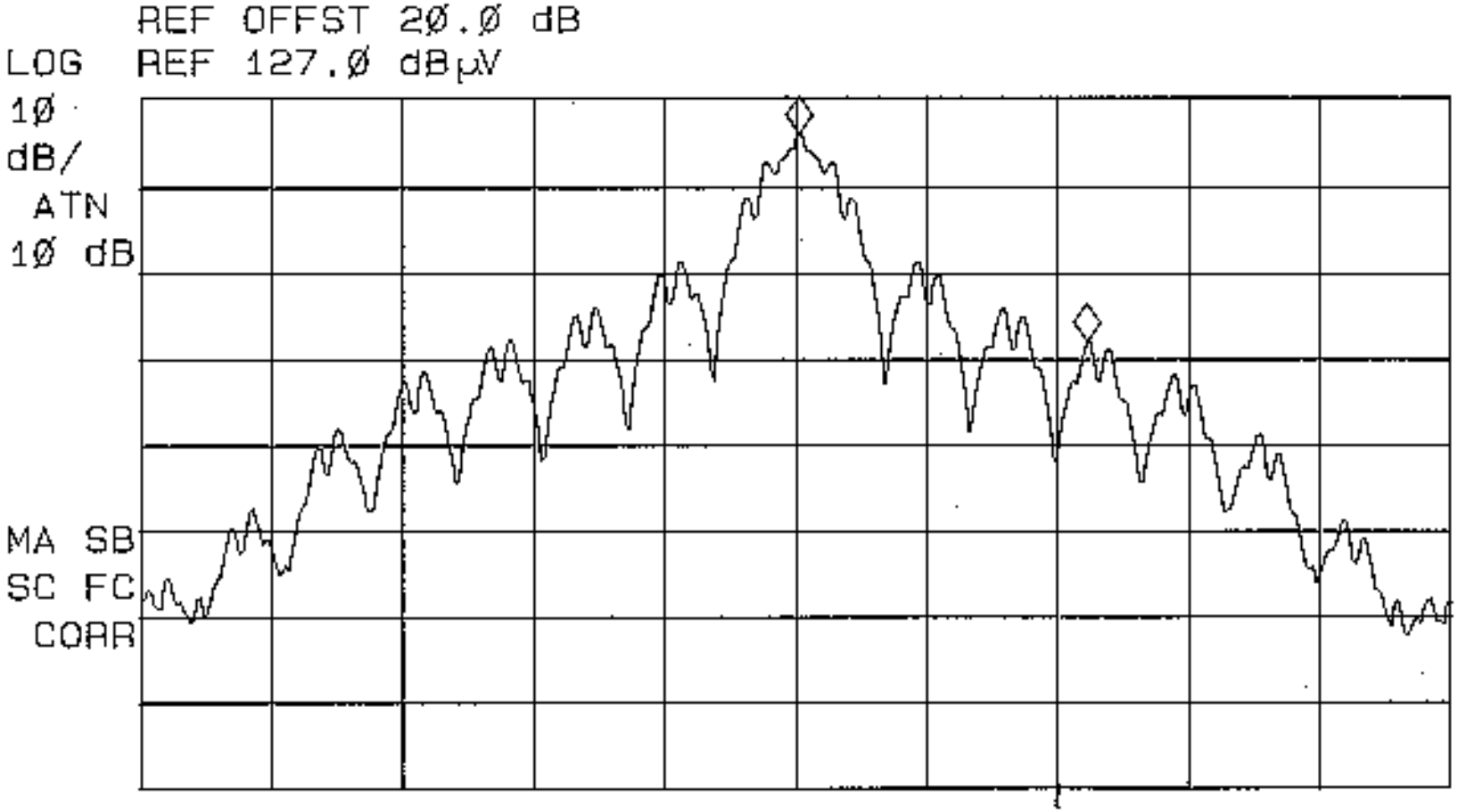
8/21/99

NOVA ROAM 900

21 KBPS SS mode 1, RF CH = 924 MHz
FCC 15.247(c) Sidelobes outside ISM Band

D33365-7b

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 4.40 MHz
-24.06 dB



CENTER 924.00 MHz
SPAN 20.00 MHz
#IF BW 100 kHz
#AVG BW 100 kHz
SWP 20.0 msec

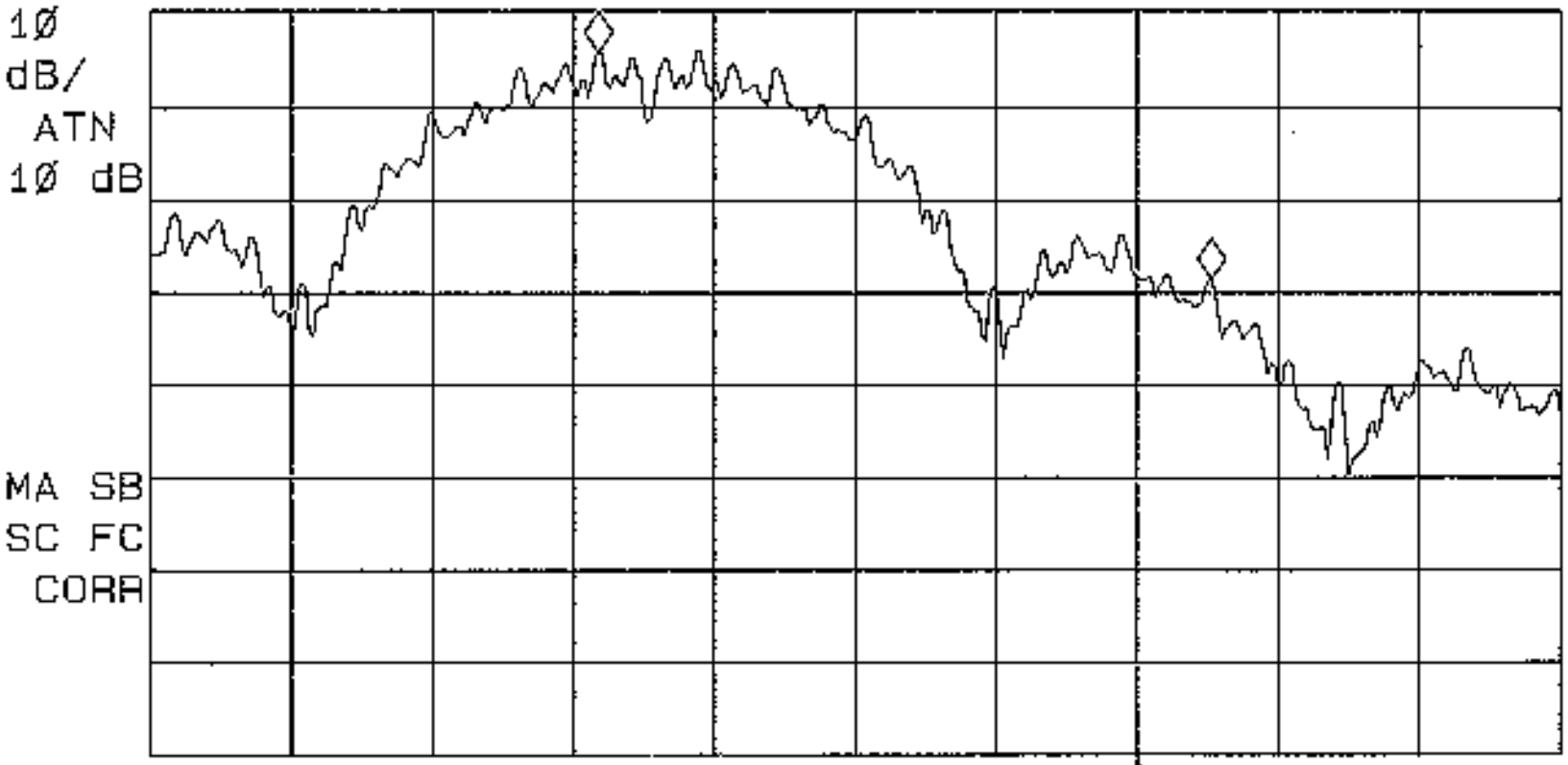
8/2/99

hp NOVA ROAM 900

159 KBPS SS mode 4, RF CH = 921 = 915 MHz
15.247(a) Sidelobes outside ISM Band

D33365-7c

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 8.7Ø MHz
-24.39 dB

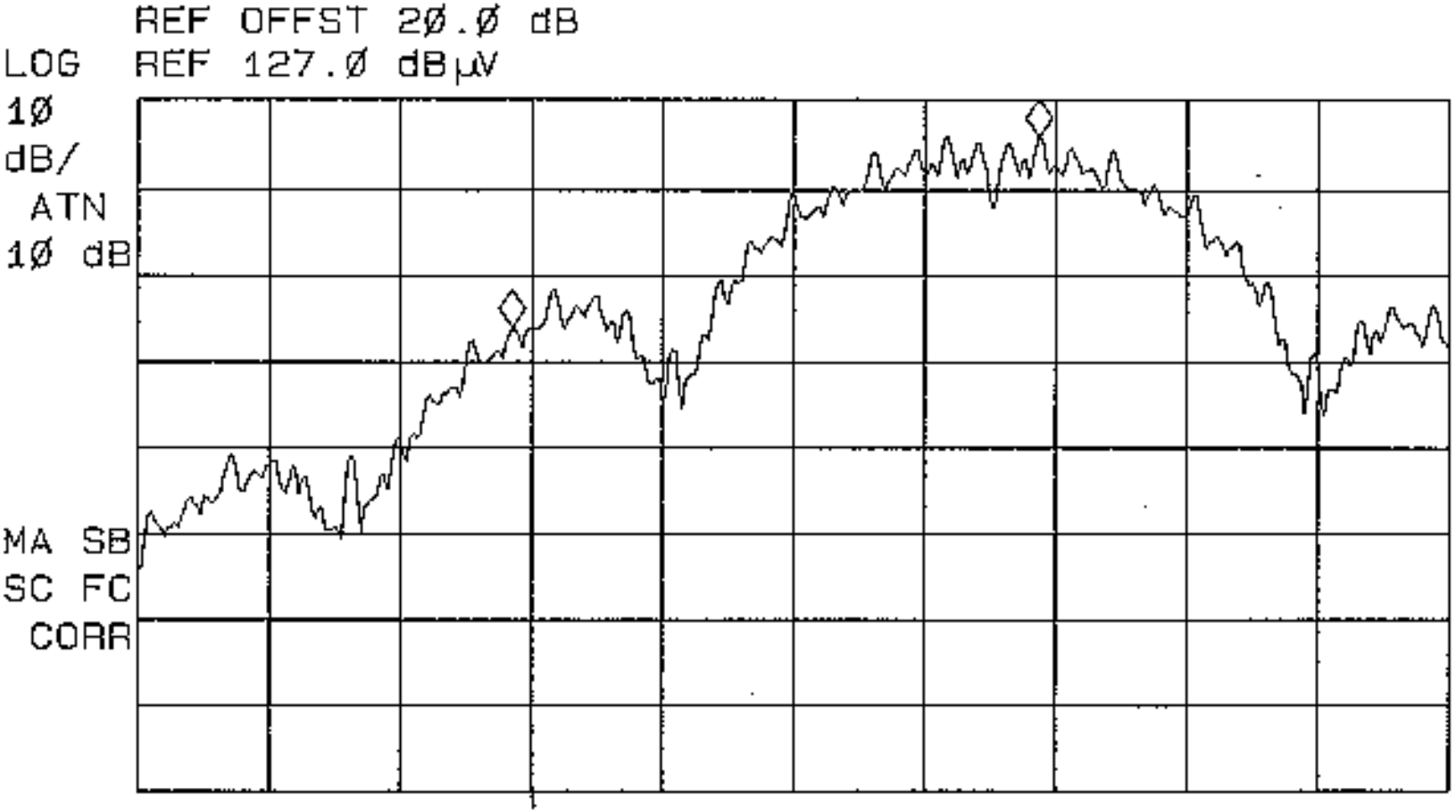


Jerry Hill 8/21/99

hp NOVA ROAM 900

159 KBPS SS mode 4, RF CH = 909 915 MHz
(P 15.247(c)) Sidelobes outside ISM Band
D33365-7d

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR -8.05 MHz
-22.10 dB



CENTER 906.00 MHz
#IF BW 100 kHz #AVG BW 100 kHz
SPAN 20.00 MHz
SWP 20.0 msec

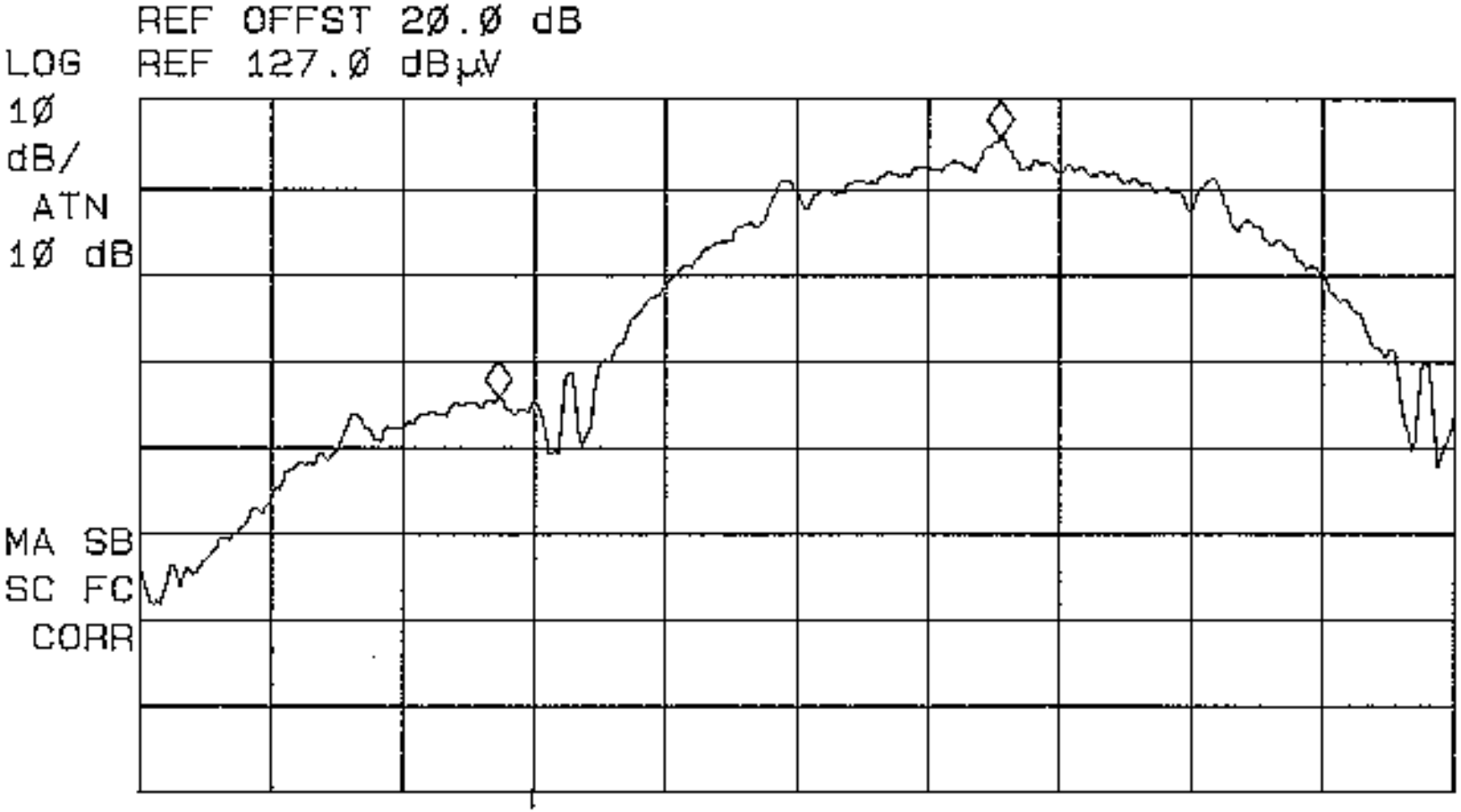
Jerry Hill 8/21/99

hp NOVA ROAM 900

1008 KBPS 55 mode 7, RF CH = 909 915MHz
FCC 15.247(c) Sidebands outside ISM Band

D33365-7e

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR -7.65 MHz
-30.06 dB



CENTER 906.00 MHz
#IF BW 100 kHz
#AVG BW 100 kHz
SPAN 20.00 MHz
SWP 20.0 msec

Jerry Hall 8/21/99

hp NOVA ROAM 900

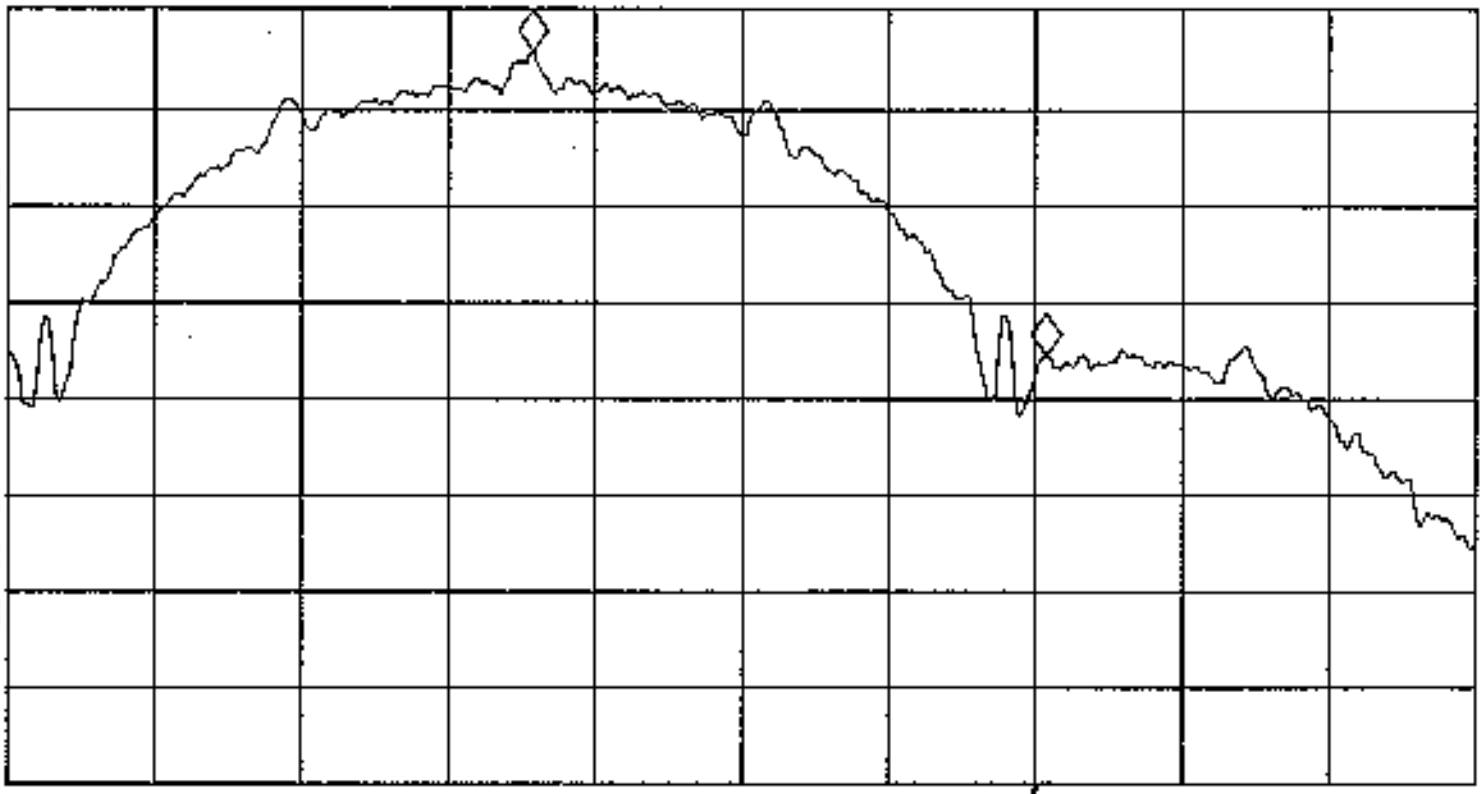
1008 KBPS SS mode 7, RF Ch = 921 mid

FR15.247(c) Sidelobes outside 15M band

D33365-7E

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 7.00 MHz
-31.30 dB

REF OFFST 20.0 dB
LOG REF 127.0 dBµV
10 dB/
ATN 10 dB



MA SB
SC FC
CORR

CENTER 924.00 MHz
928 SPAN 20.00 MHz
#IF BW 100 kHz #AVG BW 100 kHz SWP 20.0 msec

Jerry Hill 8/21/97

Elliott

EMC Test Log

Client:	Nova Engineering	Date:	8-23-99	Test Engr:	David Bare
Product:	NovaRoam 900	File:	T33399	Proj. Eng:	David Bare
Objective:	Final Qualification	Site:	Chamber #2	Contact:	Barry Carlin
Spec:	FCC Part 15	Page:	1 of 3	Approved:	
Revision	1.0				

Ambient Conditions	
Temperature:	20 °C
Humidity:	58 % RH

Test Objective

The objective of this test session is to perform final qualification testing the EUT defined below relative to the specification(s) defined above.

Test Summary

Run #1 Conducted Spurious Emissions On The Antenna Port, § 15.247(c)

Spurious Emissions on the antenna port were measured at 909 and 921 MHz utilizing 159 and 1008 kbps modulations, (see attached data plots) .

PASS The out of band spurious emissions on the antenna port for all channels measured were measured to be more than 20dB below the highest in-band signal level at the band edges

Equipment Under Test (EUT) General Description

The EUT is a spread spectrum radio that uses Direct Sequence spreading code. The EUT is designed for use in industrial applications and operates in the 902-928 MHz ISM frequency band. Normally, the EUT would be placed on a tabletop during operation. The EUT was, therefore, placed in this position during testing to simulate the end user environment. The electrical rating of the EUT is 120V, 60 Hz.

Equipment Under Test (EUT)

Manufacturer/Model/Description	Serial Number	FCC ID Number
Nova Engineering / NovaRoam 900 / DSSS Transceiver	RF005 Dig005	OOSNROAM900

Client:	Nova Engineering	Date:	8-23-99	Test Engr:	David Bare
Product:	NovaRoam 900	File:	T33399	Proj. Eng:	David Bare
Objective:	Final Qualification	Site:	Chamber #2	Contact:	Barry Carlin
Spec:	FCC Part 15	Page:	2 of 3	Approved:	
Revision	1.0				

Power Supply and Line Filters

Description	Manufacturer	Model
AC adapter	Ault	328-2012-T0021

Printed Wiring Boards in EUT

Manufacturer/Description	Assembly #	Rev.	Serial Number	Crystals (MHz)
Nova Engineering/RF	8040-0102	-	-	19.65
Nova Engineering/Digital	8040-0107	-	-	18.432, 20, 40

Subassemblies in EUT

Manufacturer/Description	Assembly Number	Rev.	Serial Number
None	-	-	-

EUT Enclosure

The body of the EUT enclosure consists of a pair of interlocking pieces. The base is extruded aluminum while the top is steel with a textured black coating. The ends of the enclosure are aluminum caps with plastic bezels that attach to the base via a pair of self-tapping screws. The enclosure measures approximately 10.5 cm wide by 24 cm deep by 3.8 cm high.

EMI Suppression Devices (filters, gaskets, etc.)

Description	Manufacturer	Part Number
Shield, Synthesizer	Fotofab	3116-0110
Shield, RF Section	Fotofab	3116-0111
Partition, RF Section	Fotofab	3116-0112
Partition, IF	Fotofab	3116-0113
Gasket, TNC	EIS	3116-0114
Bezel, Nickel Acrylic	Lansing	CQ1B90-N1X2
Common Mode Choke	Pulse Engineering	P0351

Client:	Nova Engineering	Date:	8-23-99	Test Engr:	David Bare
Product:	NovaRoam 900	File:	T33399	Proj. Eng:	David Bare
Objective:	Final Qualification	Site:	Chamber #2	Contact:	Barry Carlin
Spec:	FCC Part 15	Page:	3 of 3	Approved:	
Revision	1.0				

Modifications

No modifications were made to the EUT in order to comply with the requirements.

Local Support Equipment

Manufacturer/Model/Description	Serial Number	FCC ID Number
WinBook / XP5 Model ANL-5 / Laptop Computer	GKF20AR3296 104	JRUANL-5
WinBook / XP Model ADP-30DB-1 / AC adapter	X4525020457	None
Megahertz / XJ10BT or XJ10BC / Ethernet PCMCIA adapter	None	F2M5510011

Remote Support Equipment

Manufacturer/Model/Description	Serial Number	FCC ID Number
None		

Interface Cabling

Cable Description	Length (m)	From Unit/Port	To Unit/Port
LMR 400 Coaxial Cable (For direct measurements)	0.3	EUT/Antenna	Spectrum Analyzer
Monitor, DB-9 to 8-pin Circular Mini DIN	30	EUT/Monitor	Laptop/Serial

Test Conditions

The laptop computer was used to configure the EUT via RS232 connection to the EUT's monitor input for configuring operating parameters. The radio was programmed to transmit continuously during all testing. In normal operation, the radio operates at a 40% duty cycle.

Test Data

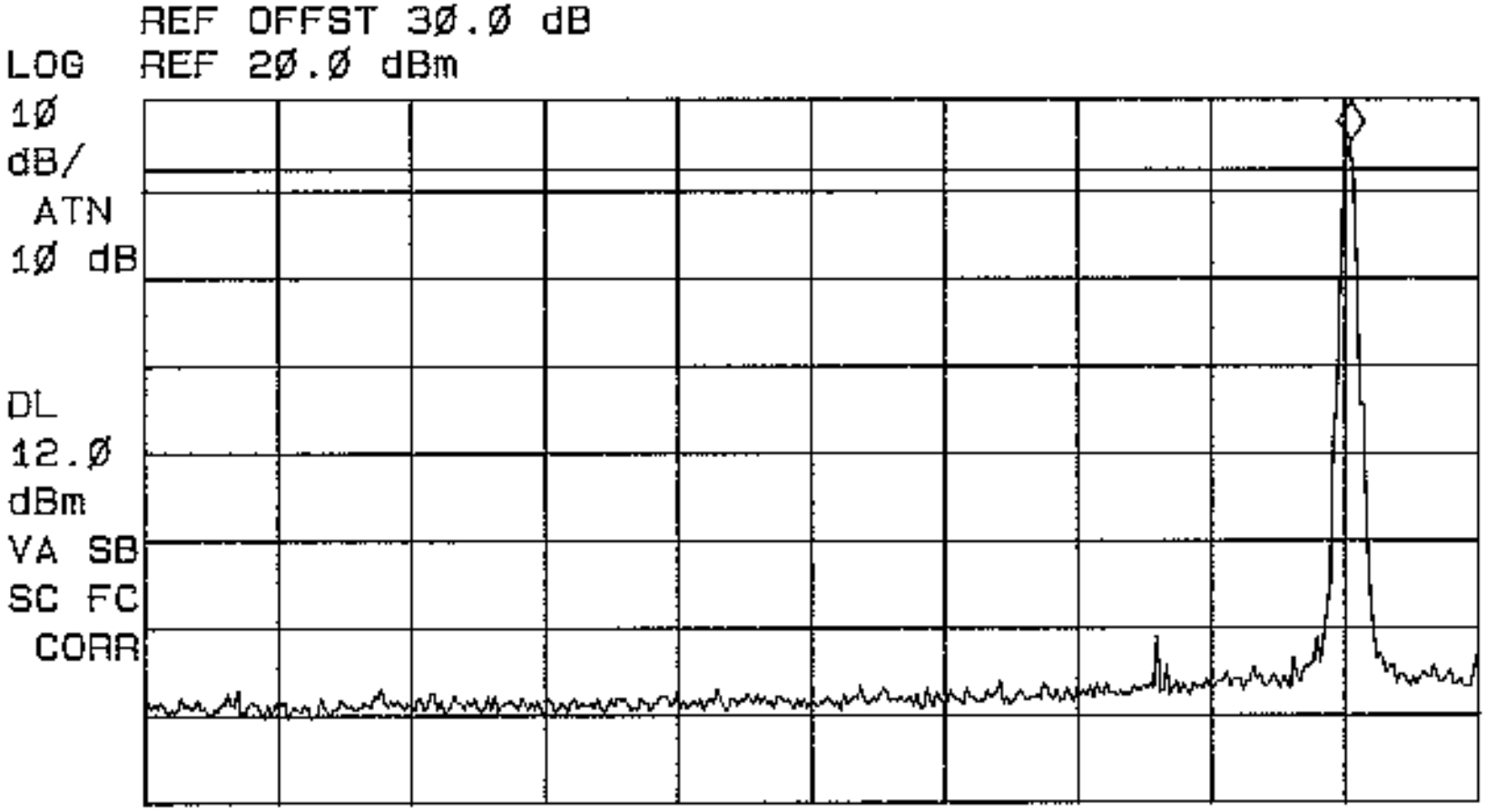
See attached plots (9)

T33399/001

NOVAROAM 900

909 MHz , 1008 Kbps

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 907.9 MHz
15.22 dBm



START 30.0 MHz
#IF BW 100 kHz #AVG BW 100 kHz
STOP 1.0000 GHz
SWP 291 msec

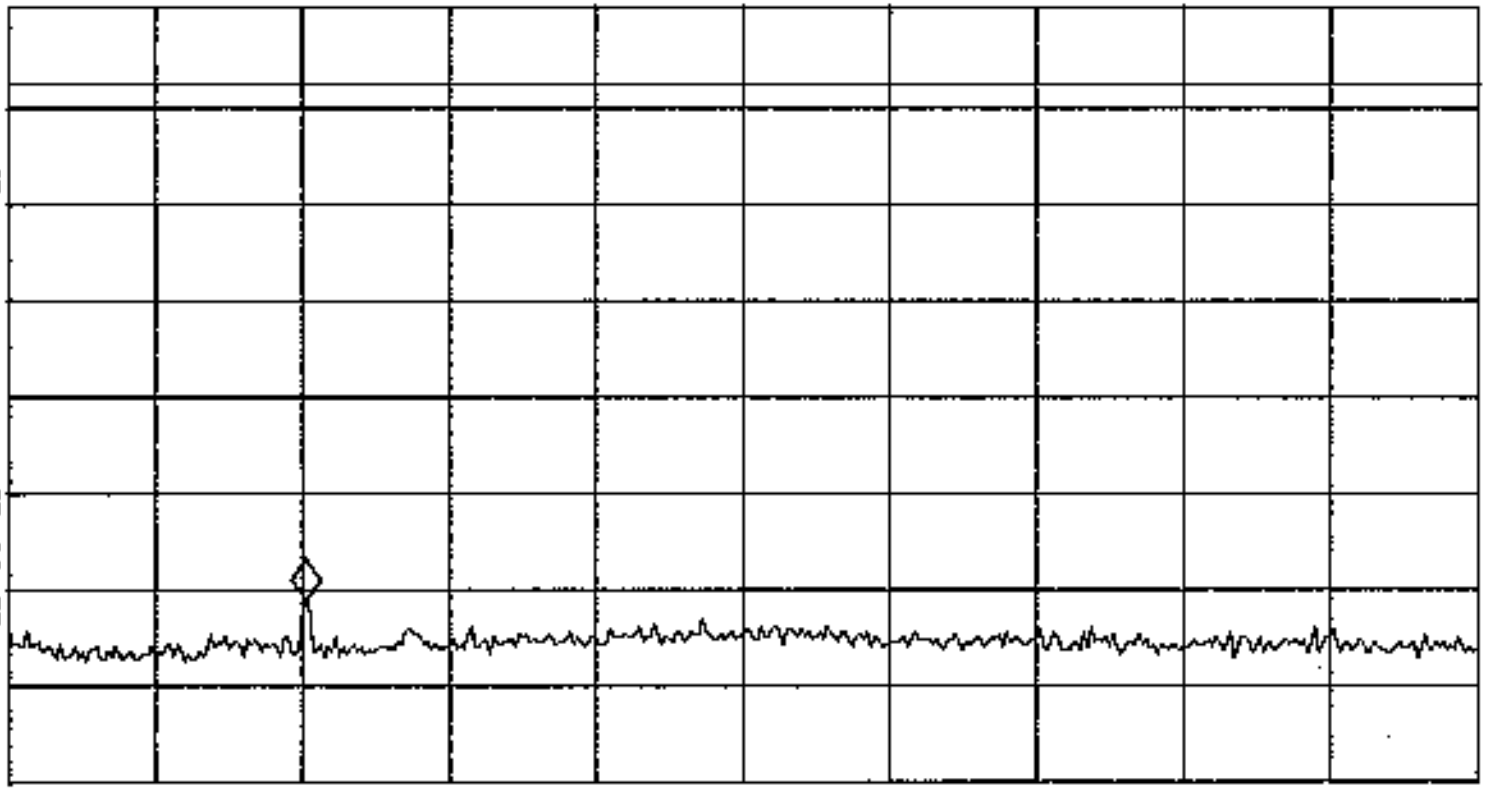
T33599/002

NOVAROAM 900

909 MHz, 1008 kbps

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 1.810 GHz
-41.32 dBm

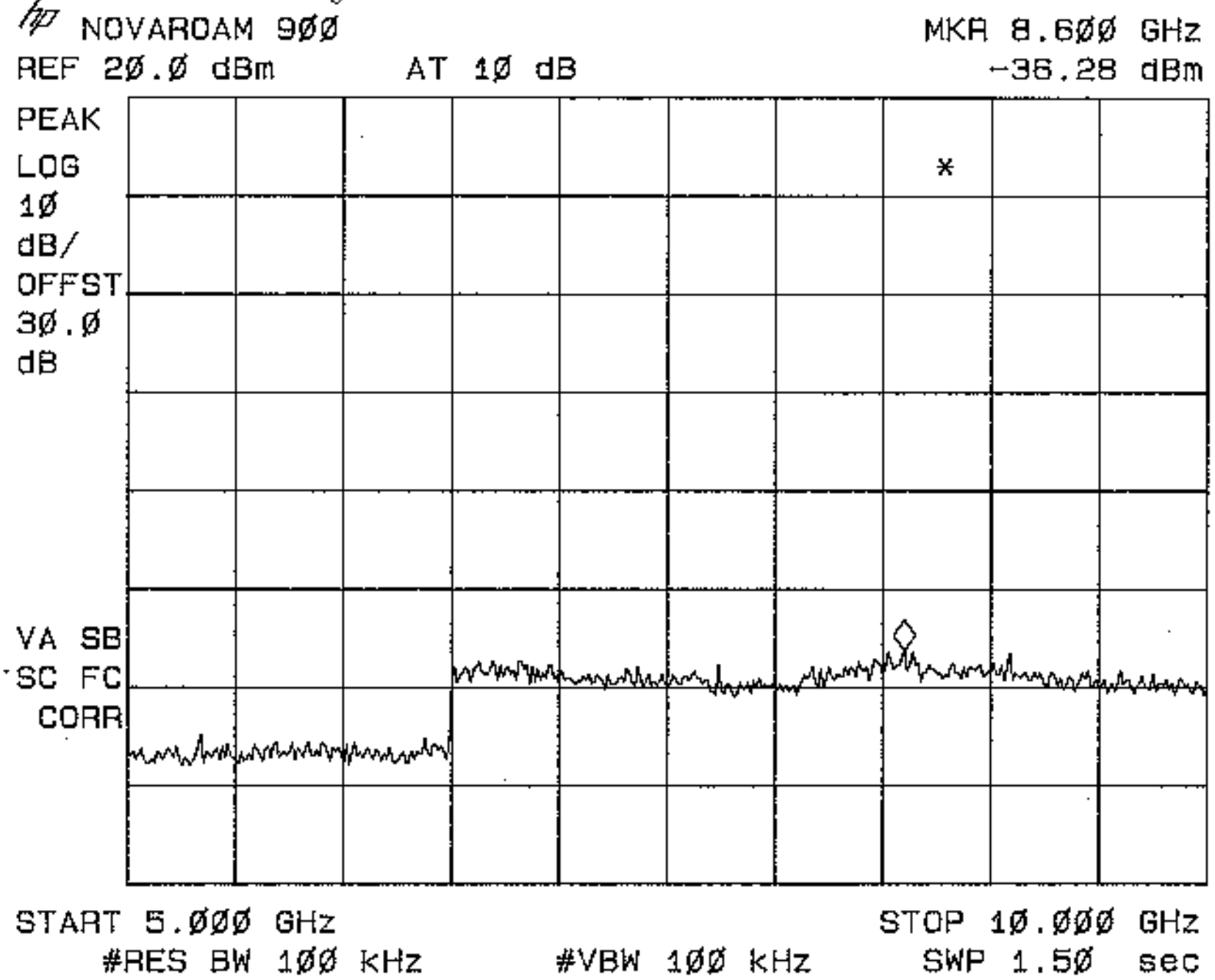
REF OFFST 30.0 dB
LOG REF 20.0 dBm
10 dB/
ATN 10 dB
DL 12.0 dBm
VA SB
SC FC
CORR



START 1.000 GHz
#IF BW 100 kHz
#AVG BW 100 kHz
STOP 5.000 GHz
SWP 1.20 sec

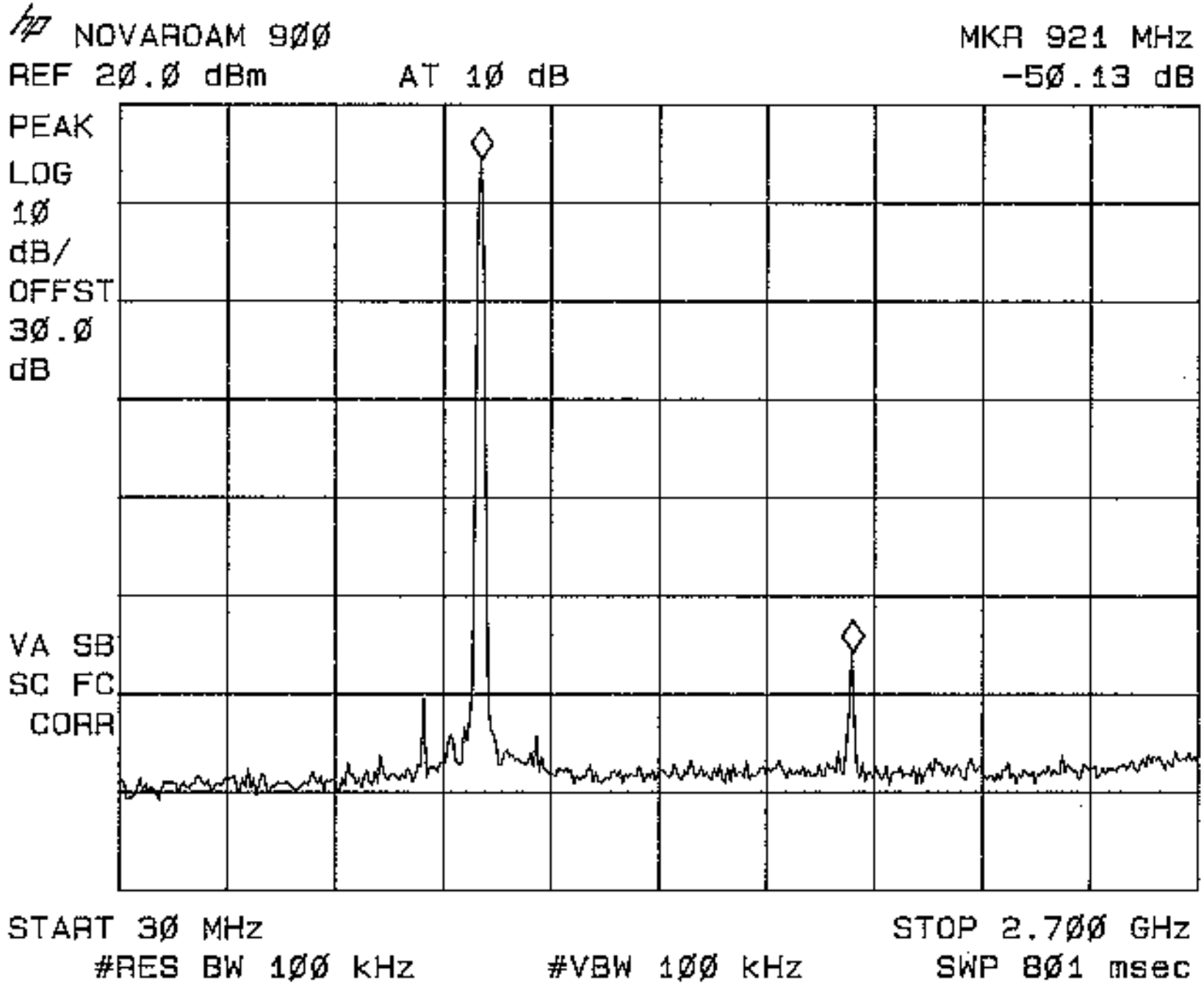
T33399/003

909 MHz, 1008 kbps



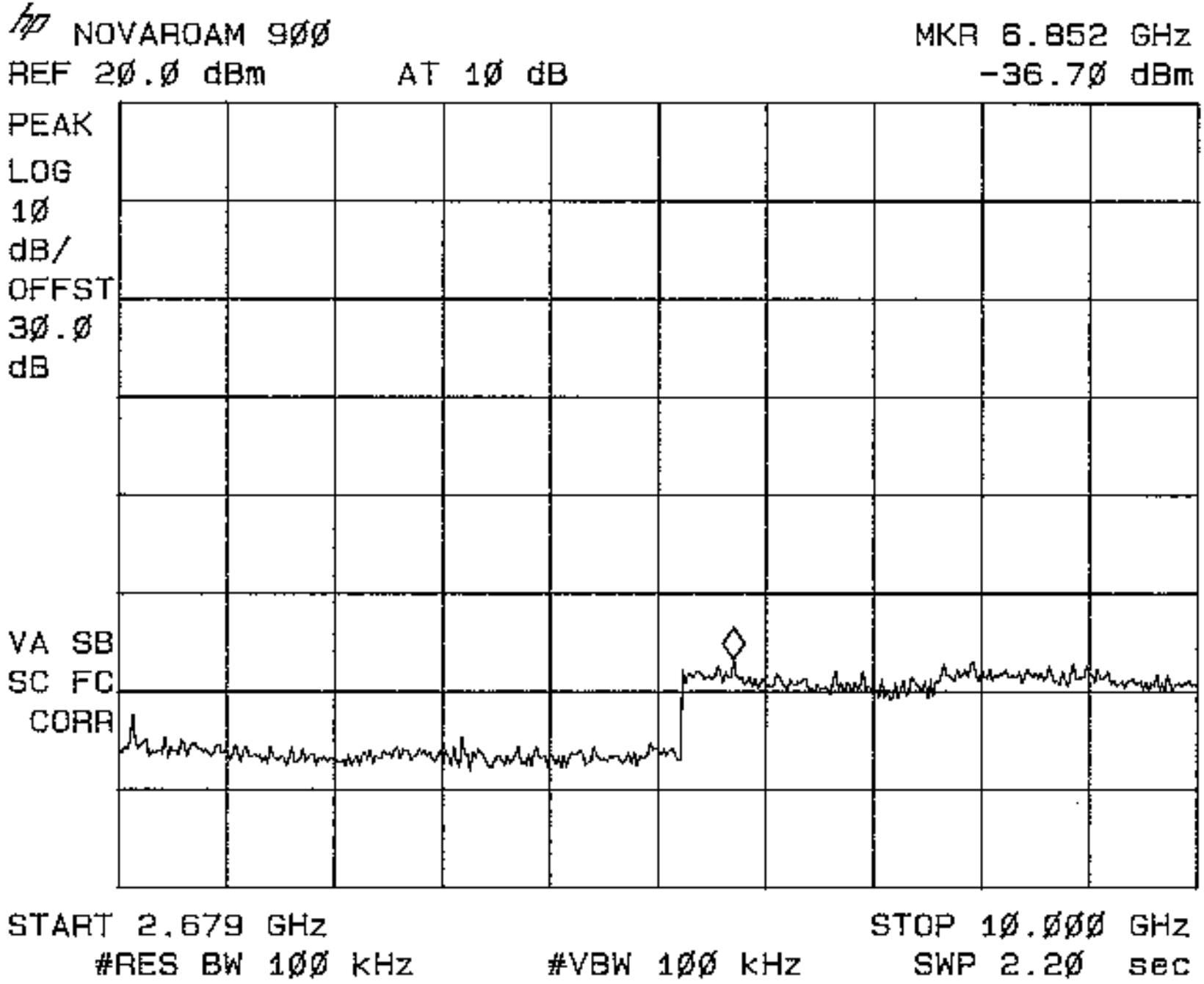
T33399/004

921 MHz, 1008 Kbps



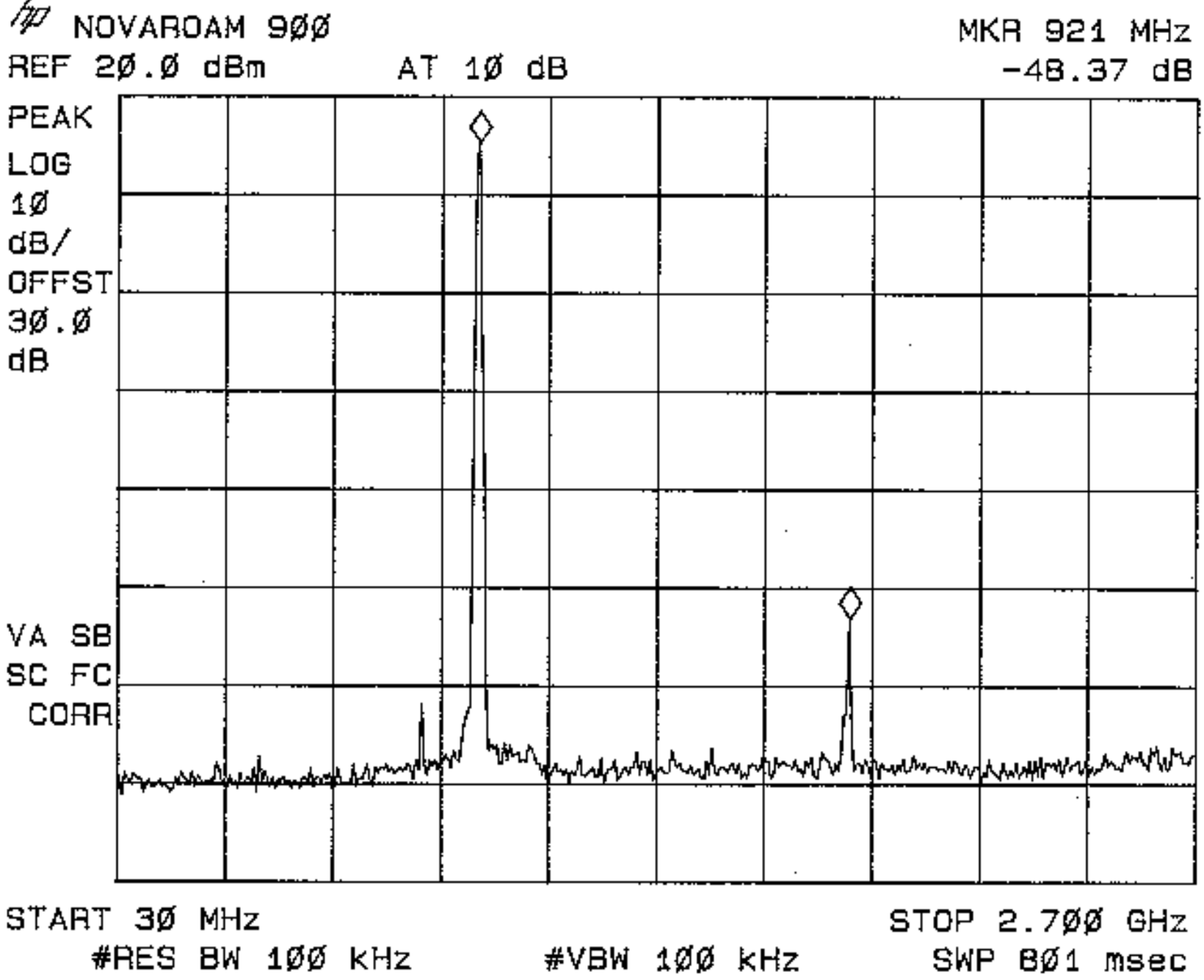
T33399/005

921 MHz, 1008 Kbps



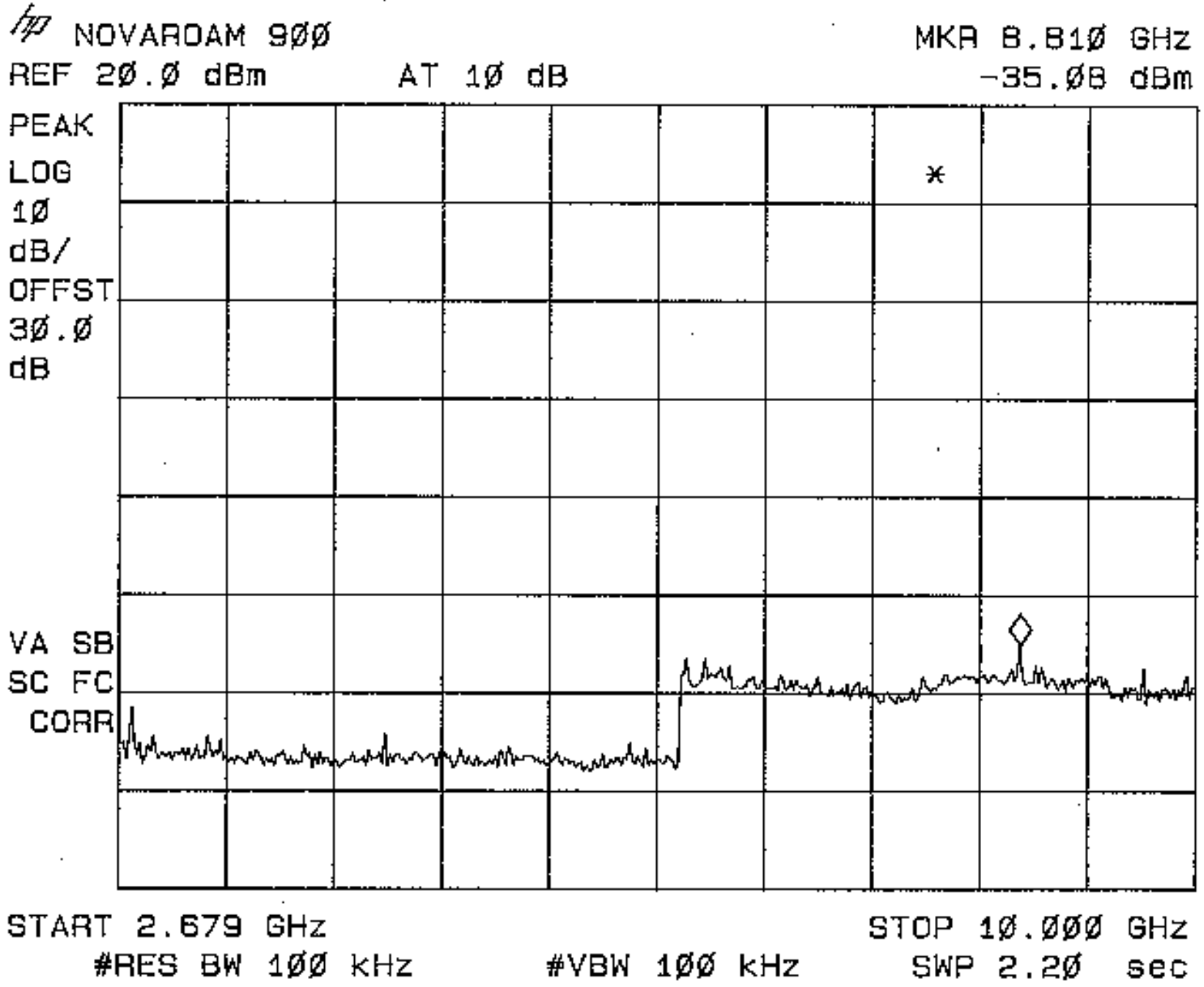
T33399/006

921 MHz, 159 Kbps



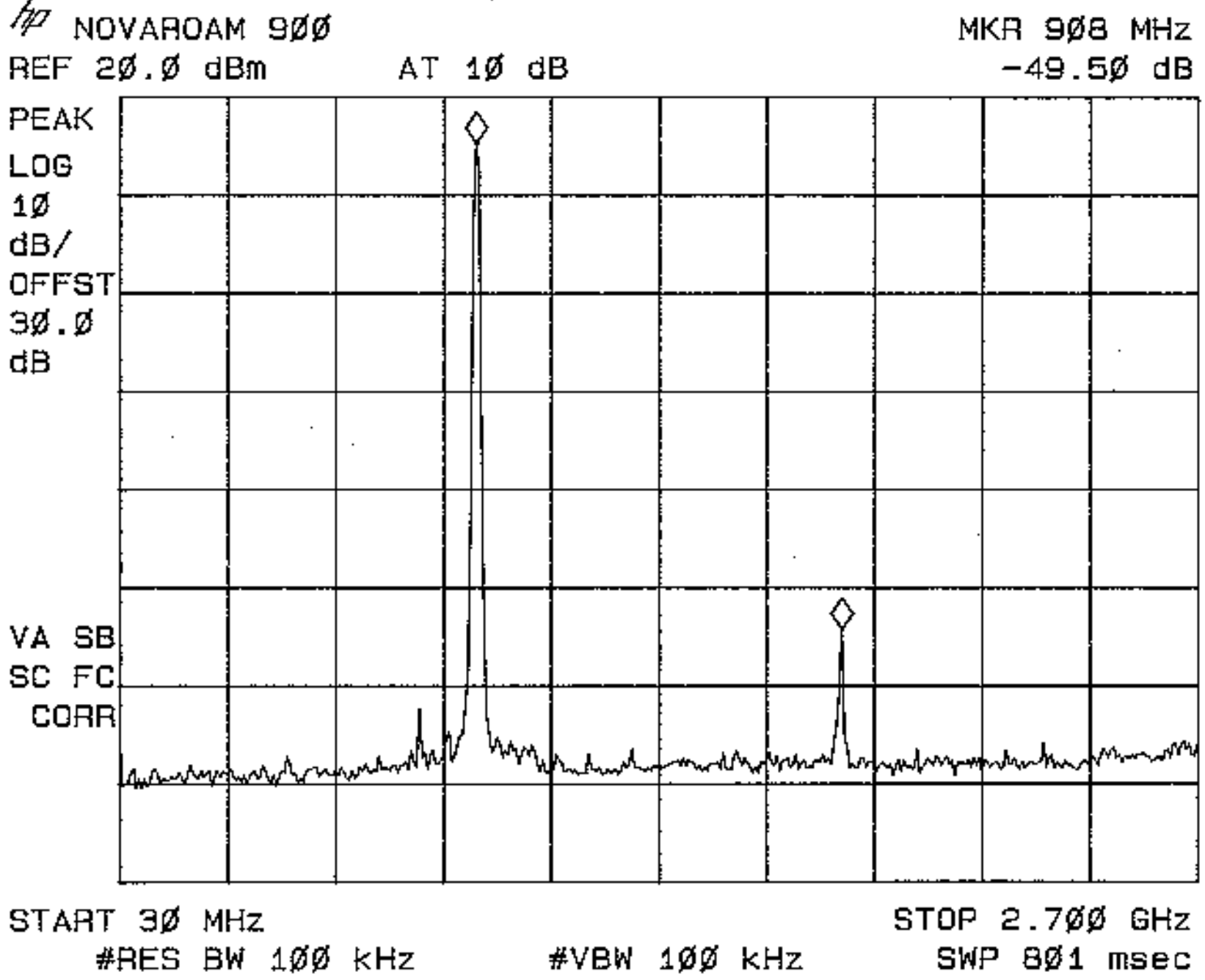
921 MHz, 159 Kbps

733399/007



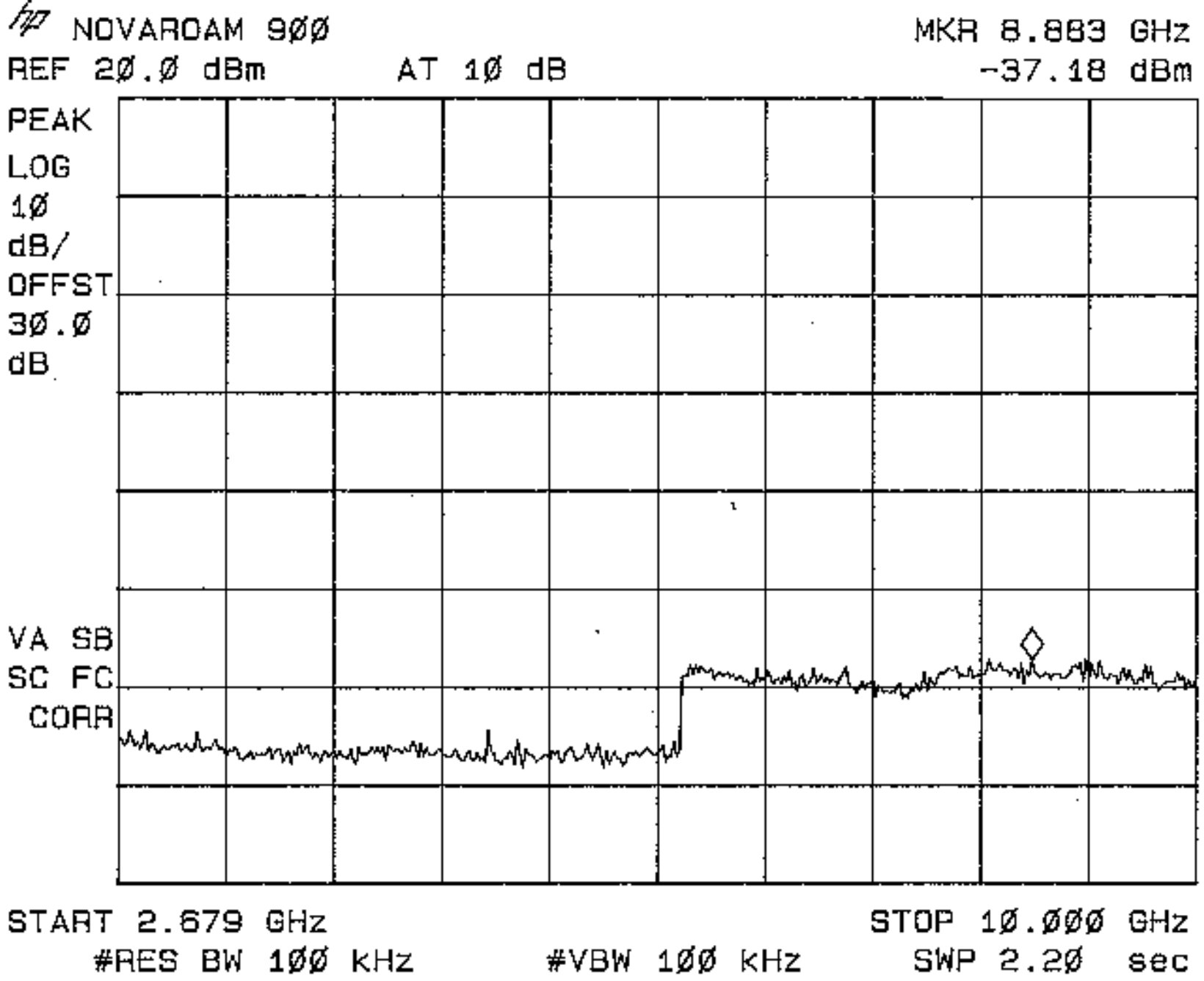
T33399/008

909 MHz, 159 Kbps



T53599/009

909 MHz, 159 Kbps



EUT Processing Gain Measurement

The EUT processing gain was measured by means of the jamming margin method specified in Appendix C of the FCC Report and Order, FCC 97-114, released 10 April 1997. The test configuration is illustrated in the attached diagram. The test method consists of stepping a synthesized signal generator in 50kHz increments across the passband of the EUT. The bandwidth of the passband is 2.7MHz for Mode 3 and 9.6MHz for Modes 6 and 7, which matches the EUT IF filter 3.0dB bandwidth. At each point, the generator level required to produce a bit error rate (BER) of $3x10^{-4}$ is recorded. This BER corresponds to a successful packet transfer rate of 95%, which is defined as the sensitivity level for this transceiver design. The resulting RF power is equal to the jammer level. The RF output power of the transmitting unit is measured at the same location. The jammer to signal ratio (M_j) is then calculated. After M_j values at all jammer frequencies have been measured, the worst 20% of the M_j data points are then discarded. The lowest remaining M_j ratio is used to calculate the EUT processing gain (G_p).

In a practical system, there are always implementation losses (L_{sys}) which degrade performance below that of an optimal theoretical system of the same type. Losses occur due to suboptimal filtering, intersymbol interference, clock recovery jitter, lack of equalization, LO phase noise, and truncation errors in digital processing. The cumulative effect of these factors is known to exceed 2.0dB for the EUT and therefore L_{sys} has been set to this value in the following calculations.

The EUT is capable of implementing either a DQPSK or DPSK waveform. Mode 3 employs DPSK while Modes 6 and 7 utilize DQPSK, as indicated in the EUT Test Plan. The BER (P_e) that can be achieved from a given signal to noise ratio $(S/N)_o$ for ideal non-coherent DQPSK and DPSK receivers are:[1],[2]

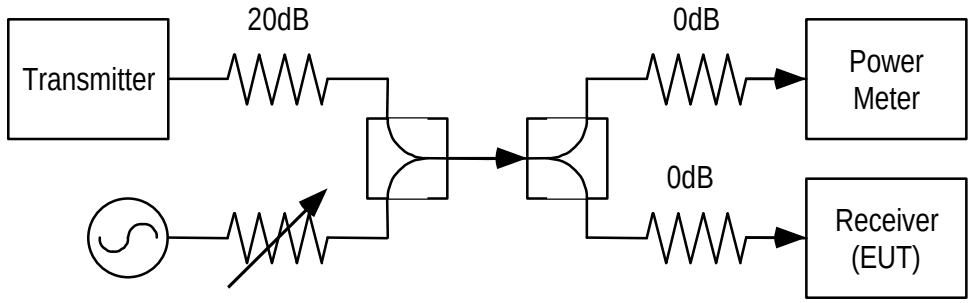
$$P_e = \frac{1}{2} erfc\left[\sqrt{(S/N)_o * (2\sin^2\frac{p}{8})}\right] \text{ for DQPSK} \qquad P_e = \frac{1}{2} e^{-(S/N)_o} \text{ for DPSK}$$

This equation reveals that the lowest values of $(S/N)_o$ that can deliver a BER of $3x10^{-4}$ are 13.0 and 8.7dB for DQPSK and DPSK, respectively. The value of $(S/N)_o$ is therefore set to 8.7dB for Mode 3, DPSK, and 13.0dB for Modes 6 and 7, DQPSK.

The processing gain is related to other parameters quoted above through the equation:[3]

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

The data on the following spreadsheet reveals that the value for M_j corresponds to -0.5, -2.3, and –4.7dB for the EUT when operated in Modes 3, 6, and 7, respectively. This indicates that the resulting processing gains, G_p, are 10.2, 12.7, and 10.3dB. This exceeds the 10.0dB minimum requirement established in §15.247(e) of the FCC regulations by 0.2, 2.7, and 0.3dB for EUT operating Modes 3, 6, and 7, respectively.



Processing Gain Test Setup

[1] Proakis, John G., Digital Communications, (New York: McGraw-Hill, 1983), pp. 171-175.
[2] Ha, Tri T., Digital Satellite Communications, (New York: McGraw-Hill, 1990), p. 421.
[3] Dixon, R., Spread Spectrum Systems, (New York: Wiley, 1984), Chapter 1.

NovaRoam 900 Processing Gain Measurement							
Date: 22 Jul 99							
101kbps BPSK							
Length 13 PN Sequence, Sync Set 2							
Transmit from SN004 at +22dBm/911MHz, Receive at SN001							
System attenation equals 23dB, yielding -1dBm at Receiver							
J/S Ratio at 0dBm from Sig Gen (dB)			-2.8				
Jammer RF Frequency (MHz)	Sig Gen Level at 3E-4 BER (dBm)	Jammer/Signal Ratio (dB)	Worst 20% Jammer/Signal Ratio		Jammer RF Frequency (MHz)	Sig Gen Level at 3E-4 BER (dBm)	Jammer/Signal Ratio (dB)
910.950	0.0	-2.8	*		912.050	4.0	1.2
911.000	0.0	-2.8	*		912.100	4.0	1.2
910.800	1.0	-1.8	*		912.150	4.0	1.2
910.850	1.0	-1.8	*		912.200	4.0	1.2
910.900	1.0	-1.8	*		909.650	5.0	2.2
911.050	1.0	-1.8	*		909.700	5.0	2.2
911.100	1.0	-1.8	*		912.250	5.0	2.2
911.150	1.0	-1.8	*		912.300	6.0	3.2
911.200	1.0	-1.8	*		912.350	6.0	3.2
911.350	1.0	-1.8	*				
911.650	2.2	-0.6	*				
910.650	2.3	-0.5					
910.450	2.4	-0.4					
911.300	2.4	-0.4					
909.900	3.0	0.2					
909.950	3.0	0.2					
910.000	3.0	0.2					
910.050	3.0	0.2					
910.100	3.0	0.2					
910.150	3.0	0.2					
910.200	3.0	0.2					
910.300	3.0	0.2					
910.350	3.0	0.2					
910.400	3.0	0.2					
910.500	3.0	0.2					
910.600	3.0	0.2					
910.700	3.0	0.2					
910.750	3.0	0.2					
911.250	3.0	0.2					
911.400	3.0	0.2					
911.550	3.0	0.2					
911.600	3.0	0.2					
911.700	3.0	0.2					
911.800	3.0	0.2					
911.850	3.0	0.2					
911.900	3.0	0.2					
911.950	3.0	0.2					
909.750	4.0	1.2					
909.800	4.0	1.2					
909.850	4.0	1.2					
910.250	4.0	1.2					
910.550	4.0	1.2					
911.450	4.0	1.2					
911.500	4.0	1.2					
911.750	4.0	1.2					
912.000	4.0	1.2					

NovaRoam 900 Processing Gain Measurement

Date: 22 Jul 99

655kbps QPSK

Length 15 PN Sequence, Sync Set 2

Transmit from SN004 at +22dBm/911MHz, Receive at SN001

System attenation equals 23dB, yielding -1dBm at Receiver

J/S Ratio at 0dBm from Sig Gen (dB) -2.3

Jammer RF Frequency (MHz)	Sig Gen Level at 3E-4 BER (dBm)	Jammer/Signal Ratio (dB)	Worst 20% Jammer/Signal Ratio	Jammer RF Frequency (MHz)	Sig Gen Level at 3E-4 BER (dBm)	Jammer/Signal Ratio (dB)
910.80	-4.0	-6.3	*	908.60	1.0	-1.3
910.85	-4.0	-6.3	*	909.50	1.0	-1.3
911.20	-4.0	-6.3	*	909.55	1.0	-1.3
910.75	-3.0	-5.3	*	909.60	1.0	-1.3
911.15	-3.0	-5.3	*	909.65	1.0	-1.3
911.25	-3.0	-5.3	*	909.70	1.0	-1.3
909.20	-2.0	-4.3	*	909.75	1.0	-1.3
909.25	-2.0	-4.3	*	909.80	1.0	-1.3
909.30	-2.0	-4.3	*	909.95	1.0	-1.3
910.70	-2.0	-4.3	*	910.15	1.0	-1.3
910.90	-2.0	-4.3	*	910.25	1.0	-1.3
911.10	-2.0	-4.3	*	910.35	1.0	-1.3
912.75	-2.0	-4.3	*	910.50	1.0	-1.3
912.80	-2.0	-4.3	*	910.60	1.0	-1.3
909.15	-1.0	-3.3	*	911.35	1.0	-1.3
909.35	-1.0	-3.3	*	911.50	1.0	-1.3
910.40	-1.0	-3.3	*	911.65	1.0	-1.3
910.95	-1.0	-3.3	*	911.70	1.0	-1.3
911.00	-1.0	-3.3	*	911.90	1.0	-1.3
911.05	-1.0	-3.3	*	911.95	1.0	-1.3
911.30	-1.0	-3.3	*	912.10	1.0	-1.3
911.60	-1.0	-3.3	*	912.15	1.0	-1.3
912.50	-1.0	-3.3	*	912.20	1.0	-1.3
912.70	-1.0	-3.3	*	912.30	1.0	-1.3
912.85	-1.0	-3.3	*	912.35	1.0	-1.3
908.65	0.0	-2.3	*	912.60	1.0	-1.3
909.10	0.0	-2.3	*	913.35	1.0	-1.3
909.40	0.0	-2.3	*	913.40	1.0	-1.3
909.45	0.0	-2.3	*	913.45	1.0	-1.3
910.00	0.0	-2.3	*	914.05	1.0	-1.3
910.05	0.0	-2.3	*	914.15	1.0	-1.3
910.10	0.0	-2.3	*	906.80	2.0	-0.3
910.45	0.0	-2.3	*	906.85	2.0	-0.3
911.55	0.0	-2.3	*	906.90	2.0	-0.3
912.00	0.0	-2.3	*	907.25	2.0	-0.3
912.05	0.0	-2.3	*	907.40	2.0	-0.3
912.25	0.0	-2.3	*	907.85	2.0	-0.3
912.40	0.0	-2.3	*	907.90	2.0	-0.3
912.45	0.0	-2.3	*	907.95	2.0	-0.3
912.55	0.0	-2.3		908.05	2.0	-0.3
912.65	0.0	-2.3		908.10	2.0	-0.3
912.90	0.0	-2.3		908.15	2.0	-0.3
913.50	0.0	-2.3		908.20	2.0	-0.3
913.55	0.0	-2.3		908.25	2.0	-0.3
908.50	1.0	-1.3		908.30	2.0	-0.3
908.55	1.0	-1.3		908.40	2.0	-0.3

Jammer RF Frequency (MHz)	Sig Gen Level at 3E-4 BER (dBm)	Jammer/Signal Ratio (dB)	Worst 20% Jammer/Signal Ratio	Jammer RF Frequency (MHz)	Sig Gen Level at 3E-4 BER (dBm)	Jammer/Signal Ratio (dB)
908.45	2.0	-0.3		906.40	3.0	0.7
908.70	2.0	-0.3		906.45	3.0	0.7
908.75	2.0	-0.3		906.50	3.0	0.7
908.80	2.0	-0.3		906.55	3.0	0.7
908.85	2.0	-0.3		906.60	3.0	0.7
908.90	2.0	-0.3		906.65	3.0	0.7
908.95	2.0	-0.3		906.70	3.0	0.7
909.00	2.0	-0.3		906.75	3.0	0.7
909.05	2.0	-0.3		906.95	3.0	0.7
909.85	2.0	-0.3		907.00	3.0	0.7
909.90	2.0	-0.3		907.05	3.0	0.7
910.20	2.0	-0.3		907.10	3.0	0.7
910.30	2.0	-0.3		907.15	3.0	0.7
910.55	2.0	-0.3		907.20	3.0	0.7
910.65	2.0	-0.3		907.30	3.0	0.7
911.40	2.0	-0.3		907.35	3.0	0.7
911.45	2.0	-0.3		907.45	3.0	0.7
911.75	2.0	-0.3		907.50	3.0	0.7
911.80	2.0	-0.3		907.55	3.0	0.7
911.85	2.0	-0.3		907.60	3.0	0.7
912.95	2.0	-0.3		907.65	3.0	0.7
913.00	2.0	-0.3		907.70	3.0	0.7
913.05	2.0	-0.3		907.75	3.0	0.7
913.10	2.0	-0.3		907.80	3.0	0.7
913.15	2.0	-0.3		908.00	3.0	0.7
913.20	2.0	-0.3		908.35	3.0	0.7
913.25	2.0	-0.3		913.65	3.0	0.7
913.30	2.0	-0.3		913.70	3.0	0.7
913.60	2.0	-0.3		913.95	3.0	0.7
913.75	2.0	-0.3		914.00	3.0	0.7
913.80	2.0	-0.3		914.25	3.0	0.7
913.85	2.0	-0.3		914.30	3.0	0.7
913.90	2.0	-0.3		914.35	3.0	0.7
914.10	2.0	-0.3		914.40	3.0	0.7
914.20	2.0	-0.3		914.45	3.0	0.7
914.50	2.0	-0.3		914.80	3.0	0.7
914.55	2.0	-0.3		914.85	3.0	0.7
914.60	2.0	-0.3		914.90	3.0	0.7
914.65	2.0	-0.3		915.40	3.0	0.7
914.70	2.0	-0.3		915.45	3.0	0.7
914.75	2.0	-0.3		915.50	3.0	0.7
914.95	2.0	-0.3		915.55	3.0	0.7
915.00	2.0	-0.3		915.60	3.0	0.7
915.05	2.0	-0.3		906.20	4.0	1.7
915.10	2.0	-0.3		915.65	4.0	1.7
915.15	2.0	-0.3		915.70	4.0	1.7
915.20	2.0	-0.3		915.75	5.0	2.7
915.25	2.0	-0.3		915.80	5.0	2.7
915.30	2.0	-0.3				
915.35	2.0	-0.3				
906.25	3.0	0.7				
906.30	3.0	0.7				
906.35	3.0	0.7				

NovaRoam 900 Processing Gain Measurement

Date: 22 Jul 99

1008kbps QPSK

Length 13 PN Sequence, Sync Set 2

Transmit from SN004 at +22dBm/911MHz, Receive at SN001

System attenation equals 23dB, yielding -1dBm at Receiver

J/S Ratio at 0dBm from Sig Gen (dB) -2.2

Jammer RF Frequency (MHz)	Sig Gen Level at 3E-4 BER (dBm)	Jammer/Signal Ratio (dB)	Worst 20% Jammer/Signal Ratio	Jammer RF Frequency (MHz)	Sig Gen Level at 3E-4 BER (dBm)	Jammer/Signal Ratio (dB)
914.25	-7.0	-9.2	*	909.15	-2.0	-4.2
914.30	-7.0	-9.2	*	909.25	-2.0	-4.2
907.75	-6.0	-8.2	*	909.30	-2.0	-4.2
907.80	-5.0	-7.2	*	909.40	-2.0	-4.2
911.00	-5.0	-7.2	*	909.45	-2.0	-4.2
911.05	-5.0	-7.2	*	909.85	-2.0	-4.2
914.20	-5.0	-7.2	*	910.40	-2.0	-4.2
914.35	-5.0	-7.2	*	910.45	-2.0	-4.2
907.60	-4.0	-6.2	*	910.50	-2.0	-4.2
907.65	-4.0	-6.2	*	910.55	-2.0	-4.2
907.70	-4.0	-6.2	*	910.60	-2.0	-4.2
907.85	-4.0	-6.2	*	910.75	-2.0	-4.2
910.05	-4.0	-6.2	*	911.20	-2.0	-4.2
910.25	-4.0	-6.2	*	911.60	-2.0	-4.2
910.30	-4.0	-6.2	*	911.80	-2.0	-4.2
910.85	-4.0	-6.2	*	912.20	-2.0	-4.2
910.90	-4.0	-6.2	*	912.65	-2.0	-4.2
910.95	-4.0	-6.2	*	912.70	-2.0	-4.2
911.10	-4.0	-6.2	*	912.80	-2.0	-4.2
911.15	-4.0	-6.2	*	912.85	-2.0	-4.2
911.70	-4.0	-6.2	*	912.90	-2.0	-4.2
911.90	-4.0	-6.2	*	913.15	-2.0	-4.2
911.95	-4.0	-6.2	*	913.20	-2.0	-4.2
912.00	-4.0	-6.2	*	913.30	-2.0	-4.2
912.05	-4.0	-6.2	*	913.70	-2.0	-4.2
912.10	-4.0	-6.2	*	913.80	-2.0	-4.2
914.15	-4.0	-6.2	*	914.45	-2.0	-4.2
914.40	-4.0	-6.2	*	908.25	-1.0	-3.2
911.75	-3.5	-5.7	*	908.30	-1.0	-3.2
910.10	-3.2	-5.4	*	908.35	-1.0	-3.2
912.15	-3.1	-5.3	*	908.40	-1.0	-3.2
909.90	-3.0	-5.2	*	908.70	-1.0	-3.2
910.00	-3.0	-5.2	*	908.85	-1.0	-3.2
909.95	-2.9	-5.1	*	908.90	-1.0	-3.2
913.75	-2.9	-5.1	*	909.05	-1.0	-3.2
910.35	-2.8	-5.0	*	909.10	-1.0	-3.2
910.80	-2.8	-5.0	*	909.20	-1.0	-3.2
911.85	-2.8	-5.0	*	909.50	-1.0	-3.2
910.15	-2.6	-4.8	*	909.80	-1.0	-3.2
910.20	-2.5	-4.7		910.65	-1.0	-3.2
911.65	-2.5	-4.7		910.70	-1.0	-3.2
913.25	-2.4	-4.6		911.25	-1.0	-3.2
909.35	-2.3	-4.5		911.40	-1.0	-3.2
907.55	-2.0	-4.2		911.45	-1.0	-3.2
908.75	-2.0	-4.2		911.50	-1.0	-3.2
908.80	-2.0	-4.2		911.55	-1.0	-3.2

Jammer RF Frequency (MHz)	Sig Gen Level at 3E-4 BER (dBm)	Jammer/Signal Ratio (dB)	Worst 20% Jammer/Signal Ratio	Jammer RF Frequency (MHz)	Sig Gen Level at 3E-4 BER (dBm)	Jammer/Signal Ratio (dB)
912.25	-1.0	-3.2		908.00	1.0	-1.2
912.55	-1.0	-3.2		908.10	1.0	-1.2
912.60	-1.0	-3.2		908.15	1.0	-1.2
912.75	-1.0	-3.2		908.50	1.0	-1.2
912.95	-1.0	-3.2		908.55	1.0	-1.2
913.00	-1.0	-3.2		909.70	1.0	-1.2
913.10	-1.0	-3.2		912.30	1.0	-1.2
913.65	-1.0	-3.2		912.40	1.0	-1.2
914.10	-1.0	-3.2		913.50	1.0	-1.2
914.75	-1.0	-3.2		913.55	1.0	-1.2
914.80	-1.0	-3.2		913.90	1.0	-1.2
914.85	-1.0	-3.2		914.05	1.0	-1.2
914.90	-1.0	-3.2		914.50	1.0	-1.2
907.15	0.0	-2.2		915.00	1.0	-1.2
907.20	0.0	-2.2		915.15	1.0	-1.2
907.25	0.0	-2.2		915.20	1.0	-1.2
907.90	0.0	-2.2		915.25	1.0	-1.2
907.95	0.0	-2.2		915.40	1.0	-1.2
908.20	0.0	-2.2		915.45	1.0	-1.2
908.45	0.0	-2.2		906.20	2.0	-0.2
908.60	0.0	-2.2		906.25	2.0	-0.2
908.65	0.0	-2.2		906.30	2.0	-0.2
908.95	0.0	-2.2		906.40	2.0	-0.2
909.00	0.0	-2.2		906.45	2.0	-0.2
909.55	0.0	-2.2		906.50	2.0	-0.2
909.60	0.0	-2.2		906.55	2.0	-0.2
909.65	0.0	-2.2		906.75	2.0	-0.2
909.75	0.0	-2.2		906.80	2.0	-0.2
911.30	0.0	-2.2		906.95	2.0	-0.2
911.35	0.0	-2.2		907.45	2.0	-0.2
912.45	0.0	-2.2		908.05	2.0	-0.2
912.50	0.0	-2.2		912.35	2.0	-0.2
913.05	0.0	-2.2		913.95	2.0	-0.2
913.35	0.0	-2.2		914.00	2.0	-0.2
913.40	0.0	-2.2		914.55	2.0	-0.2
913.45	0.0	-2.2		914.65	2.0	-0.2
913.60	0.0	-2.2		915.05	2.0	-0.2
913.85	0.0	-2.2		915.10	2.0	-0.2
914.70	0.0	-2.2		915.50	2.0	-0.2
914.95	0.0	-2.2		915.55	2.0	-0.2
915.30	0.0	-2.2		915.60	2.0	-0.2
915.35	0.0	-2.2		915.65	2.0	-0.2
906.35	1.0	-1.2		907.35	3.0	0.8
906.60	1.0	-1.2		907.40	3.0	0.8
906.65	1.0	-1.2		914.60	3.0	0.8
906.70	1.0	-1.2		915.70	3.0	0.8
906.85	1.0	-1.2		915.75	3.0	0.8
906.90	1.0	-1.2		915.80	3.0	0.8
907.00	1.0	-1.2				
907.05	1.0	-1.2				
907.10	1.0	-1.2				
907.30	1.0	-1.2				
907.50	1.0	-1.2				

EXHIBIT 3:Radiated Emissions Test Configuration Photographs

APPENDIX 3: Radiated Emissions Test Configuration Photographs

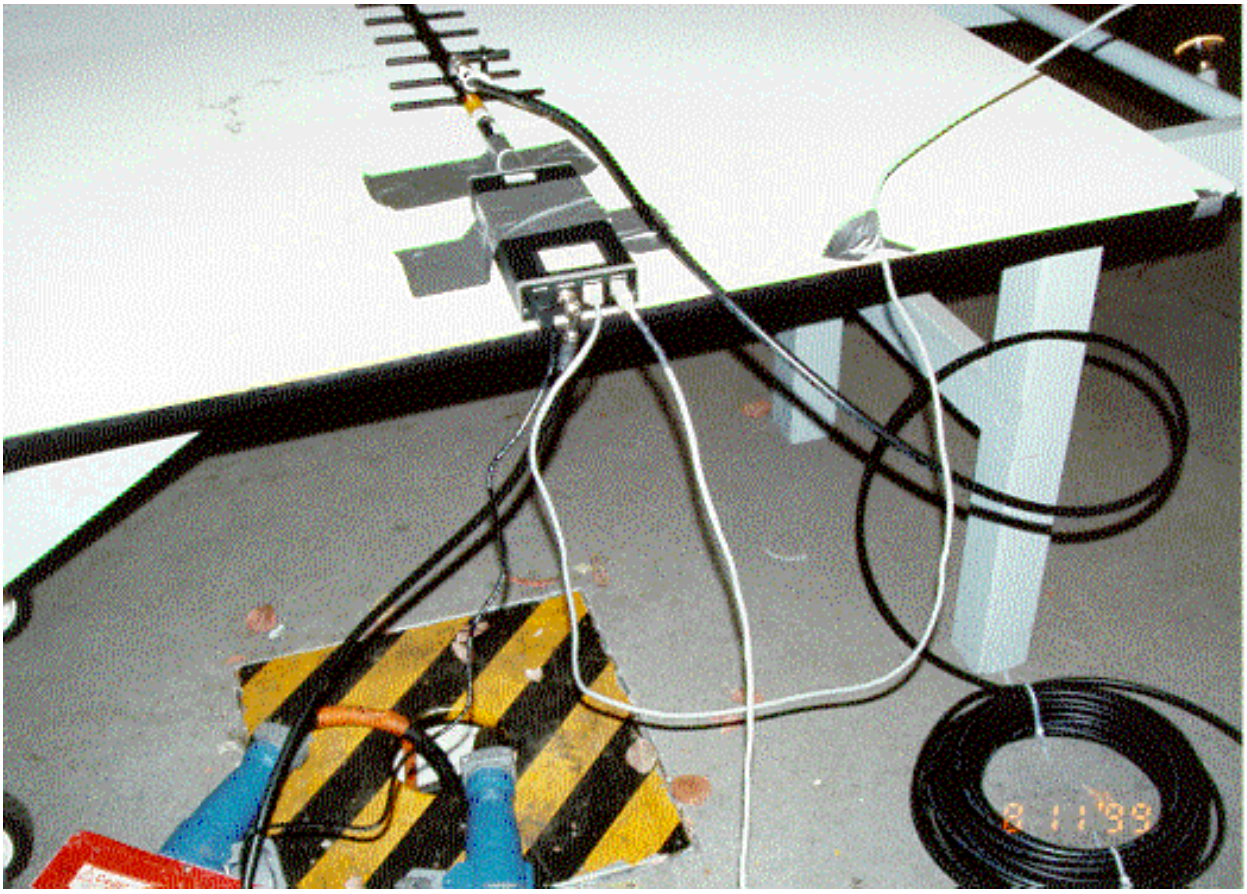


EXHIBIT 4:Conducted Emissions Test Configuration Photographs

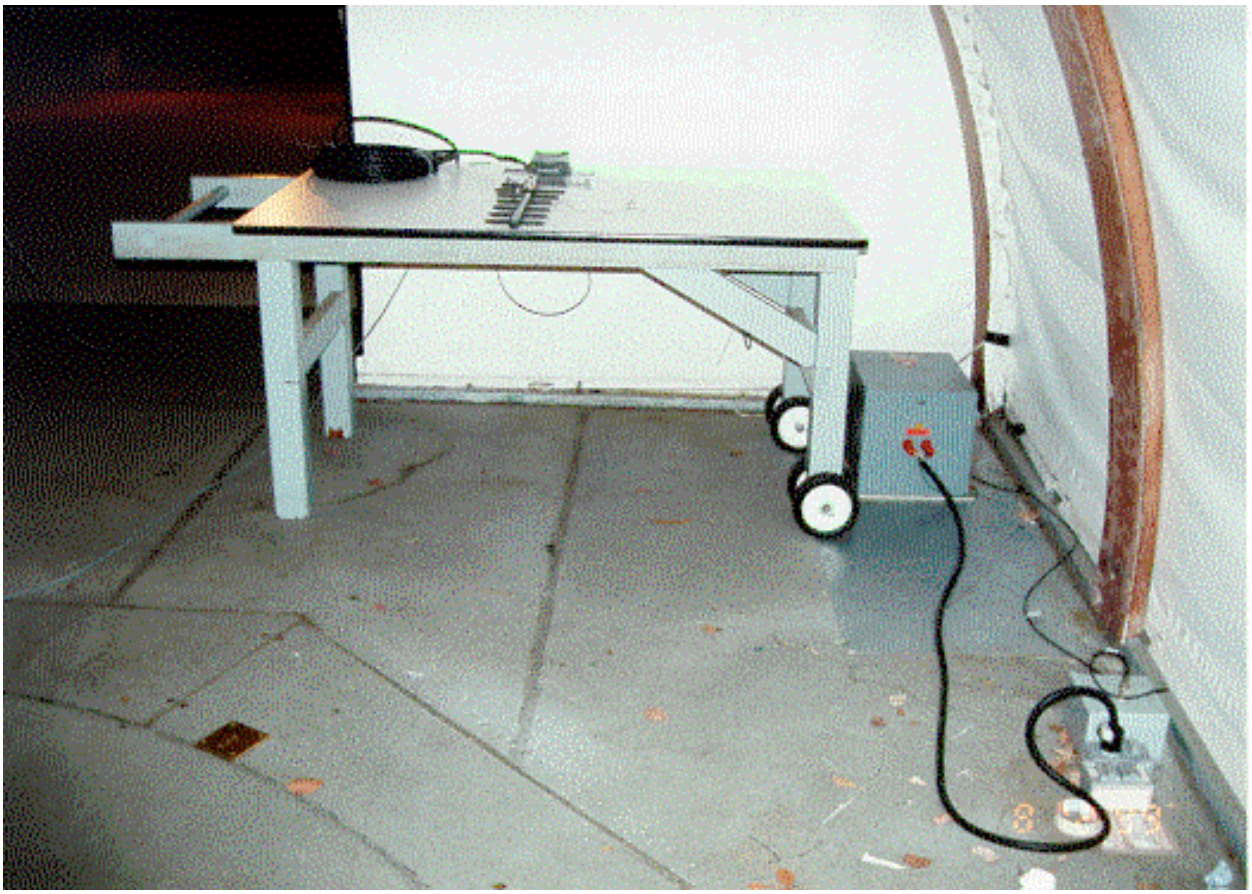


EXHIBIT 4: Conducted Emissions Test Configuration Photographs

EXHIBIT 5:Proposed FCC ID Label & Label Location

2 Pages

EXHIBIT 6:Detailed Photographs of Nova Engineering, Inc. Model NovaRoam 900Construction

10 Pages

EXHIBIT 7: Operator's Manual for Nova Engineering, Inc. Model NovaRoam 900

6 Pages

EXHIBIT 8: Block Diagram of Nova Engineering, Inc. Model NovaRoam 900

1 Page

EXHIBIT 9:Schematic Diagrams for Nova Engineering, Inc. Model NovaRoam 900

19 Pages

EXHIBIT 10:Theory of Operation for Nova Engineering, Inc. Model NovaRoam 900

3 Pages