Elliott

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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 WaveSpan Corporation Model: Stratum 100

FCC ID:	NGP7020010
GRANTEE:	WaveSpan Corporation 500 North Bernardo Avenue Mountain View, CA 94043
TEST SITE:	Elliott Laboratories, Inc. 684 W. Maude Avenue Sunnyvale, CA 94086
REPORT DATE:	March 25, 1999
FINAL TEST DATE:	March 3, 1999, March 15, 1999 and March 18, 1999
AUTHORIZED SIGNATORY:	Mark Briggs Mark Briggs Manager, EMC Consulting Staff

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SCOPE

An electromagnetic emissions test has been performed on the WaveSpan Wireless Radio System model Stratum 100 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 WaveSpan model Stratum 100 and therefore apply only to the tested sample. The sample was selected and prepared by Roger Eline of WaveSpan Corporation.

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 which are subsequently manufactured.

STATEMENT OF COMPLIANCE

The tested sample of WaveSpan model Stratum 100 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 which 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 WaveSpan model Stratum 100. 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 15.209.

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 IDU powering ODU B

Frequency MHz	Level dBuV	Power Lead	FCC B Limit	FCC B Margin	Detector QP/Ave	Comments
0.4515	31.2	Line	48.0	-16.8	QP	

120V, 60Hz IDU powering ODU A

Frequency MHz	Level dBuV	Power Lead	FCC B Limit	FCC B Margin	Detector QP/Ave	Comments
0.4513	29.1	Neutral	48.0	-18.9	QP	

LIMITS OF ANTENNA CONDUCTED SPURIOUS EMISSIONS

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.407 (b)(3)

ODU A

The output power level of all spurious emissions in a 1MHz bannd conducted from the EUT antenna port were below the limit.

ODU B

The output power level of all spurious emissions in a 1MHz bannd conducted from the EUT antenna port were below the limit.

LIMITS OF POWER AND BANDWIDTH

The EUTs tested complied with the limits detailed in FCC Rules Part 15 Section 15.407(a). The actual test data and any correction factors are contained in an exhibit of this report.

ODU A

The maximum power output was -0.9 dBm.
The peak power spectral density was -9.0 dBm/MHz.
The 26 dB bandwidth was 73.22 MHz.
The ratio of peak excursion of modulation envelope to the peak transmit power was -9.0dB.

ODU B

The maximum power output was -3.5 dBm.
The peak power spectral density was -9.3 dBm/MHz.
The 26 dB bandwidth was 76 MHz.
The ratio of peak excursion of modulation envelope to the peak transmit power was -5.8dB.

LIMITS OF RADIATED INTERFERENCE FIELD STRENGTH

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.407 (b)(5) for emissions from 30 - 1000 MHz and with the limits detailed in 15.407(b)(6) in the case of emissions falling within the frequency bands specified in Section 15.205 above 1 GHz.

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.

30-1000 MHz ODU A

Frequency MHz	Level dBuV/m	Pol v/h	FCC B Limit	FCC B Margin	Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
48.320	31.5	v	40.0	-8.5	QP	71	1.7	

30-1000 MHz ODU B

Frequency MHz	Level dBuV/m	Pol v/h	FCC B Limit	FCC B Margin	Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
64.885	26.7	v	40.0	-13.3	QP	310	1.0	

1.0-26.5 GHz ODU A

Frequency MHz	Level dBuV/m	Pol v/h	FCC B Limit	FCC B Margin	Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
5184.000	50.4	v	54.0	-3.6	Avg			

1.0-26.5 GHz ODU B

Frequency MHz	Level dBuV/m	Pol v/h	FCC B Limit	FCC B Margin	Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
1065.000	45.7	v	54.0	-8.3	Avg	0	1.0	

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

COMPLIANCE EXPLANATION

When the measurement uncertainties (see above section) associated with the emission test methods and equipment used are taken into consideration there are four possible results as detailed below:

Complied
All measurements recorded were below the specification limit by a margin greater than the measurement uncertainty.

Probably Complied
One or more measurements recorded were below the specification limit by a margin less than the measurement uncertainty. It is not possible to determine that the unit complied with a 95% confidence level from the results. There is a high probability that the product tested does comply.

Probably Did Not Comply
One or more measurements recorded were above the specification limit by a margin less than the measurement uncertainty. It is not possible to determine that the unit failed to comply with a 95% confidence level from the results. There is a high probability that the product tested does not comply.

Did Not Comply
One or more measurements recorded exceeded the specification limit by a margin greater than the measurement uncertainty.

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The WaveSpan model Stratum 100 is a wireless radio system which is designed to use the UNII band. The complete system is comprised of an Indoor Unit (IDU) and Outdoor Unit (ODU). The IDU has a LAN interface (MII or UTP) DSX-1 interfaces and an optical data interface to the ODU and a DC output to provide power to the ODU. The IDU would typically to table top equipment. The ODU contains the radio circuitry and 28dBi antenna. It comes in two configurations. ODU A and ODU B. The ODU A transmits in the 5.25-5.35 GHz band and the ODU B transmit in the 5.725-5.825 GHz band. The sample was received on March 3, 1999 and tested on March 3, 1999, March 15, 1999 and March 18, 1999. The EUT consisted of the following component(s):

Manufacturer/Model/Description	Serial Number	FCC ID Number
Wavespan / Stratum 100 ODU A & B / UNII Radio	None	NGP7020010

INPUT POWER

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

Description	Manufacturer	Model
None	-	-

The ODU receives 48VDC, 1 Amp from the IDU unit.

PRINTED WIRING BOARDS

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

ODU A

Manufacturer/Description	Assembly #	Rev.	Serial #	Crystals (MHz)
Wavespan / ODU Radio A	500055701	X5	5001A	120.0
Wavespan / Tuner Assembly	500056301	X8	None	10.0
Wavespan / ODU Control Board	500056101	15	None	32.424

ODU B

Manufacturer/Description	Assembly #	Rev.	Serial #	Crystals (MHz)
Wavespan / ODU Radio B	500055801	X4	4002B	120.0
Wavespan / Tuner Assembly	500056301	X8	None	10.0
Wavespan / ODU Control Board	500056101	15	None	32.424

SUBASSEMBLIES

The EUT contained the following subassembly modules during emissions testing:

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

ENCLOSURE

The EUT enclosure is primarily constructed of fabricated sheet steel. It measures approximately 31 cm wide by 40 cm deep by 5 cm high.

EMI SUPPRESSION DEVICES

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

Description	Manufacturer	Part Number
Feedthru Filter	Corry Micronics, Inc.	FTF3-15
RF Gasket	Vanguard Products, Corp.	12125-03-075-PSA
RF Gasket	Vanguard Products, Corp.	14125-05-050-ORA-NPS

MODIFICATIONS

Metal shield covering the LED and the AIMING BNC. Shielded the DC connections to the ODU panel. Feed through filters attached.

SUPPORT EQUIPMENT

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

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

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

Manufacturer/Model/Description	Serial Number	FCC ID Number
Wavespan / Stratum 100 IDU / Indoor Unit	10004	None

EXTERNAL I/O CABLING

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

ODU A Tested 3/15/99

Cable Description	Length (m)	From Unit/Port	To Unit/Port
Fiber Optic	30	IDU Data	ODU data
Shielded	30	IDU dc Power out	ODU dc power in

ODU A Tested 3/18/99

Cable Description	Length (m)	From Unit/Port	To Unit/Port
Duplex fiber (x1)	30	Data I/O port	IDU
Shielded multicore (x1)	30	Power port	IDU

ODU B

Cable Description	Length (m)	From Unit/Port	To Unit/Port
Duplex fiber	30	Data I/O port	IDU
Shielded multicore	30	Power port	IDU

TEST SOFTWARE

The remote IDU contained test software running during testing which continuously exercised the EUT by sending and recieving information.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on March 3, 1999, March 15, 1999 and March 18, 1999 at the Elliott Laboratories Open Area Test Site #1 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 a 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 measurments 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 which are 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#1

January 19, 1999

	Manufacturer/Description		Model	Asset #	Interval	Last Cal	Cal Due
☒	Elliott Laboratories	FCC / CISPR LISN	LISN-3, OATS	304	12	6/24/98	6/24/99
☒	EMCO	Biconical Antenna, 30-300 MHz	31100	363	12	4/8/98	4/8/99
☐	EMCO	D. Ridge Horn Antenna, 1-18GHz	3115	487	12	6/18/98	6/18/99
☒	EMCO	D. Ridge Horn Antenna, 1-18GHz	3115	368	12	9/22/98	9/22/99
☒	EMCO	Log Periodic Antenna, 0.3-1 GHz	3146A	364	12	4/8/98	4/8/99
☒	~~Hewlett Packard~~ ML	EMC Receiver /Analyzer	8595EM	780	12	1/4/99	1/4/2000
☒	~~Hewlett Packard~~ ML	EMC Receiver /Analyzer	8595EM	787	12	11/23/98	11/23/99
☐	Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	263, (F303)	12	6/8/98	6/8/99
☐	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	3/10/98	3/10/99
☒	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	5/11/98	5/11/99
☒	Hewlett Packard	Thermistor Mount	478A	652	12	3/10/98	3/10/99
☐	Narda West	High Pass Filter	HPF 180	821	12	8/10/98	8/10/99
☐	Narda-West	EMI Filter 2.4 GHz, High Pass	60583 HPF-161	248	12	4/27/98	4/27/99
☐	Narda-West	EMI Filter 5.6 GHz, High Pass	60583 HXF370	247	12	4/27/98	4/27/99
☒	Rohde & Schwarz	10 dB Pad / Pulse Limiter	ESH3Z2	372	12	6/22/98	6/22/99
☒	Rohde& Schwarz	Receiver 20 MHz - 1.3 GHz	ESVP		6	1/18/99	7/18/99
☒	Rohde& Schwarz	Receiver 9KHz - 30 MHz	ESH3		6	1/18/99	7/18/99
☒	Hewlett Packard	Analyzer 30Hz - 40GHz	8565E	N/A	12	3-2-99	3-2-00
☒	EMCO	Horn Antenna, 18-40GHz	3116	N/A (Telegy 55875)	12	-	6-5-97

File Number: T30696

Date: 3-3-99

Engr: AA

Test Equipment List - SVOATS#3

March 8, 1999

	Manufacturer/Description		Model	Asset #	Interval	Last Cal	Cal Due
☒	Elliott Laboratories	300-1000 MHz Log Periodic	EL300.1000	55, (F130)	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	6/18/98	6/18/99
☒	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	Horn Antenna 18 - 40 GHz	3116	Telogy 55875		6/5/98	6/5/99
☒	Fischer	LISN	FCC-LISN-50/2	810	12	2/2/99	2/2/2000
☐	Hewlett Packard	EMC Receiver /Analyzer	8595EM	780	12	1/4/99	1/4/2000
☐	Hewlett Packard	EMC Receiver /Analyzer	8595EM	787	12	11/23/98	11/23/99
☒	Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	263, (F303)	12	6/8/98	6/8/99
☐	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	5/11/98	5/11/99
☐	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	4/27/98	4/27/99
☐	Narda-West	EMI Filter 5.6 GHz, High Pass	60583 HXF370	247	12	4/27/98	4/27/99
☒	Rohde& Schwarz	Pulse Limiter	ESH3Z2	812	12	12/8/98	12/8/99
☒	Rohde & Schwarz	Test Receiver, 0.009-30 MHz	ESH3	274	12	4/8/98	4/8/99
☒	Rohde &Schwarz	Test Receiver, 20-1300MHz	ESVP	213, (F196)	12	10/4/98	10/4/99

File Number: T30809

Date: 3-15-99

Engr: Conrad Chu

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

Test Equipment List - SVOATS#1

March 8, 1999

	Manufacturer/Description		Model	Asset #	Interval	Last Cal	Cal Due
☐	Elliott Laboratories	FCC / CISPR LISN	LISN-3, OATS	304	12	6/24/98	6/24/99
☐	EMCO	Biconical Antenna, 30-300 MHz	3110B	363	12	4/8/98	4/8/99
☐	EMCO	D. Ridge Horn Antenna, 1-18GHz	3115	487	12	6/18/98	6/18/99
☐	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	Horn Antenna 18 - 40 GHz	3116	Telogy 55875		6/5/98	6/5/99
☐	EMCO	Log Periodic Antenna, 0.3-1 GHz	3146A	364	12	4/8/98	4/8/99
☐	Hewlett Packard	EMC Receiver /Analyzer	8595EM	780	12	1/4/99	1/4/2000
☐	Hewlett Packard	EMC Receiver /Analyzer	8595EM	787	12	11/23/98	11/23/99
☐	Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	263, (F303)	12	6/8/98	6/8/99
☐	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-041-100-	Metric, 885	12	5/11/98	5/11/99
☒	Hewlett Packard	Thermistor Mount	478A	652	12	2/17/99	2/17/2000
☐	Narda West	High Pass Filter	HPF 180	821	12	8/10/98	8/10/99
☐	Narda-West	EMI Filter 2.4 GHz, High Pass	60583 HPF-161	248	12	4/27/98	4/27/99
☐	Narda-West	EMI Filter 5.6 GHz, High Pass	60583 HXF370	247	12	4/27/98	4/27/99
☐	Rohde & Schwarz	10 dB Pad / Pulse Limiter	ESH3Z2	372	12	6/22/98	6/22/99
☐	Rohde& Schwarz	Receiver 20 MHz - 1.3 GHz	ESVP	IR, 046	6	1/18/99	7/18/99
☐	Rohde& Schwarz	Receiver 9KHz - 30 MHz	ESH3	IR, 024	6	1/18/99	7/18/99
☒	HP	Analyzer 30Hz - 50GHz	8565E		12	3-2-97	3-2-00

File Number: T30880

Date: 3-18-99

Engr: CC

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

Contained in file: R31010 Testsdata.pdf

T30606 20 Pages
T30809 9 Pages
T30880 16 Pages

Ambient Conditions	
Temperature:	20 °C
Humidity:	59 %

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 - Radiated Emissions, 1000 - 26500 MHz

PASS Results: 15.407(b)(6) -8.3 dB Ave @10650.000 MHz Vertical

Run #2a - 26 dB bandwidth Measurement

Results: 76.00 MHz

Run #2b - Power measurement

PASS PSD: 15.407(a)(3) -9.3 dBm/MHz
Power 15.407(a)(3) -3.5 dBm

Run #2c - Out of band spurious emissions (direct measurements). Refer to plots.

PASS Results: 15.407(b)(3) -0.6 dB Peak @ 5.715 GHz Direct

Run #2d - Ratio of Peak Excursion of Modulation Envelope vs. Peak Transmit Power, 15.407 (a) (6)

PASS Results: Ratio was -5.8 dB

Run #3 - Unmaximized Preliminary Radiated Emissions Scan, 30-1000 MHz.

Results: 15.407(b)(5) -17.5 dB QP @ 81.06 MHz Vertical

Run #4 - Maximized Radiated Emissions from Run #1

PASS Results: 15.407(b)(5) -13.3 dB QP @ 64.885MHz Vertical

Run #5 - Conducted Emissions Scan of EUT, 0.15-30.00 MHz, 120V, 60Hz (IDU)

PASS Results: 15.209 -16.8 dB QP @ 0.4515 MHz Line

Equipment Under Test (EUT) General Description

The EUT is the Outdoor unit (ODU) for a UNII radio system. The ODU would normally mounted on the mast or wall-mounted. The EUT was, therefore, placed on the table top during emissions testing to simulate the end user environment.

Equipment Under Test (EUT)

Manufacturer/Model/Description	Serial Number	FCC ID Number
Wavespan / Stratum 100 ODU B / UNII Radio	None	NGP7020010

Power Supply and Line Filters

The ODU receives 48VDC, 1 Amp from the IDU unit.

Printed Wiring Boards in EUT

Manufacturer/Description	Assembly #	Rev.	Serial Number	Crystals (MHz)
Wavespan / ODU Radio B	500055801	X4	4002B	120.0
Wavespan / Tuner Assembly	500056301	X8	None	10.0
Wavespan / ODU Control Board	500056101	15	None	32.424

Subassemblies in EUT

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

EUT Enclosure(s)

The EUT enclosure is primarily constructed of fabricated sheet steel. It measures approximately 31 cm wide by 40 cm deep by 5 cm high.

EMI Suppression Devices (filters, gaskets, etc.)

Description	Manufacturer	Part Number
Feedthru Filter	Corry Micronics, Inc.	FTF3-15
RF Gasket	Vanguard Products, Corp.	12125-03-075-PSA
RF Gasket	Vanguard Products, Corp.	14125-05-050-ORA-NPS

Modifications

The following modifications were made to the EUT in order to comply with the requirements:

Metal shield covering the LED and the AIMING BNC. Shielded the DC connections to the ODU panel. Feed through filters attached.

Local Support Equipment

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

Remote Support Equipment

Manufacturer/Model/Description	Serial Number	FCC ID Number
Wavespan / Stratum 100 IDU / Indoor Unit	10004	None

Interface Cabling

Cable Description	Length (m)	From Unit/Port	To Unit/Port
Duplex fiber	30	Data I/O port	IDU
Shielded multicore	30	Power port	IDU

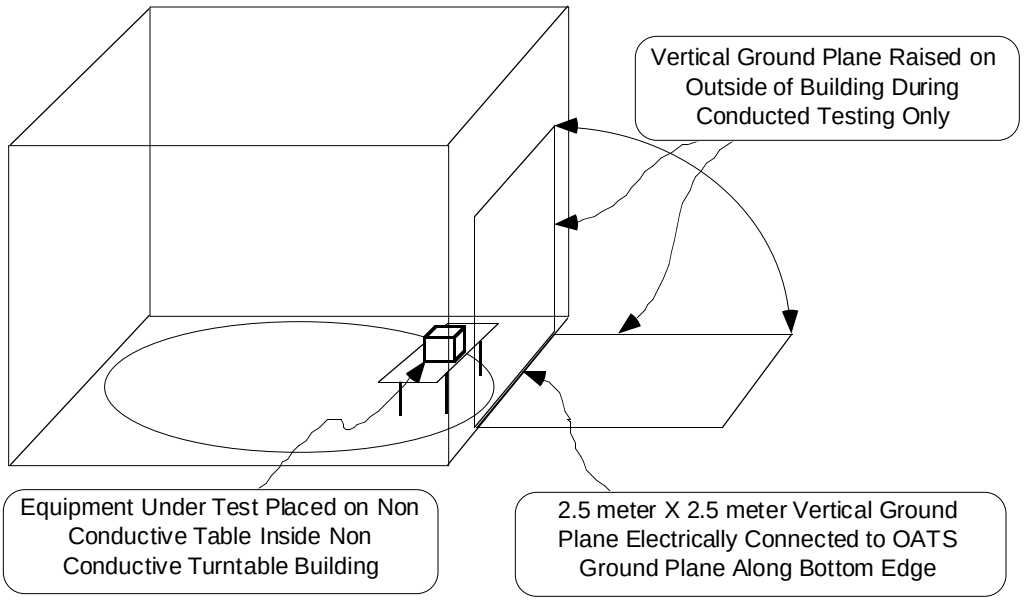
Test Software

The remote IDU contained test software running during testing which continuously exercised the EUT by sending and recieving information.

General Test Conditions

During radiated testing, the EUT was connected to the remote power supply. 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 on top of the groundplane.

During conducted emissions testing, the the IDU unit was tested and the EUT was connected to the IDU. 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

Elliott — Emissions Test Data

Client:	Wavespan Corporation	Date:	3/3/99	Test Engr:	Anil Allamaneni
Product:	Stratum 100 ODU B	File:	D30606	Proj. Engr:	Mark Briggs
Objective	Final Qualification.	Site:	SVOATS # 1	Contact:	Roger Eline
Spec:	FCC B	Distance:	3 m	Approved:	

Ambient Conditions
Temperature: 20 °C
Humidity: 59 %

Run # 1 : Radiated scan from 1 - 26 GHz.
Unit modified form digital device and conducted emissions testing 2/25/99 - refer to test log.

Frequency	Level	Pol	FCC B	FCC B	Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
10650.00	45.7	v	54.0	-8.3	Avg	0	1.0	
10650.00	41.8	h	54.0	-12.2	Avg	0	1.0	
1800.00	31.6	h	54.0	-22.4	Avg	60	1.0	
1800.00	31.4	v	54.0	-22.6	Avg	45	1.0	
6280.00	30.1	v	54.0	-23.9	Avg	180	1.0	
6280.00	29.6	h	54.0	-24.4	Avg	195	1.0	
10650.00	48.9	v	74.0	-25.1	Pk	0	1.0	
10650.00	43.9	h	74.0	-30.1	Pk	0	1.0	
1800.00	34.5	h	74.0	-39.5	Pk	60	1.0	
6280.00	34.0	h	74.0	-40.0	Pk	195	1.0	
1800.00	33.9	v	74.0	-40.1	Pk	45	1.0	
6280.00	33.8	v	74.0	-40.2	Pk	180	1.0	
6244.00	49.6	h			Avg	0	1.0	Not in restricted band, EIRP < -27dBm.
6244.00	52.7	h			Pk	0	1.0	Not in restricted band, EIRP < -27dBm.
6244.00	58.2	v			Avg	0	1.0	Not in restricted band, EIRP < -27dBm.
6244.00	60.1	v			Pk	0	1.0	Not in restricted band, EIRP < -27dBm.
5764.00	100.7	v			Avg	0	1.1	Fundamental
5764.00	111.2	v			Pk	0	1.1	Fundamental
5764.00	83.4	h			Avg	0	1.4	Fundamental
5764.00	91.8	h			Pk	0	1.4	Fundamental
5800.00	100.4	v			Avg	0	1.1	Fundamental
5800.00	110.3	v			Pk	0	1.1	Fundamental
5800.00	81.2	h			Avg	0	1.4	Fundamental
5800.00	89.5	h			Pk	0	1.4	Fundamental

Elliott — Emissions Test Data

Client:	Wavespan Corporation	Date:	3/3/99	Test Engr:	Anil Allamaneni
Product:	Stratum 100 ODU B	File:	D30606	Proj. Engr:	Mark Briggs
Objective	Final Qualification.	Site:	SVOATS # 1	Contact:	Roger Eline
Spec:	FCC B	Distance:	3 m	Approved:	

Run #2: Antenna Conducted Measurements per 15.407

26dB bandwidth:
Measured to be 76 MHz (refer to plot).

Output Power:
Measured to be -3.5dBm (0.446 mW) using power meter.
Maximum permitted is 0.316 Watt (25dBm) for a bandwidth of 76 MHz after correcting for antenna gain.
System antenna gain is 28dBi, therefore maximum permitted output power is reduced by 5dB from 1Watt to 0.316 Watts..

Power Spectral density:
Measured to be -9.3 dBm Peak (RBW=VBW=1MHz), -22.2 dBm Average (RBW = 1MHz, VBW=10Hz). Refer to plots.
Maximum permitted is 12 dBm (given antenna gain is 28dBi).
Maximum deviation between Peak and avergae is

Out-Of Band Spurious Emissions
The highest out of band emissions are listed below - refer to plots:

Frequency Range of Plot	Highest spurious emission (dBm)	EIRP (dBm)*	Limit (EIRP) (dBm)	
30 MHz - 1GHz	-66.7	-38.7	-27	
1GHz - 5.715 GHz	-55.6	-27.6	-27	Peak reading
1GHz - 5.715 GHz	-59.0	-31.0	-27	Average reading
5.715 - 5.725 GHz	-52.8	-24.8	-17	
5.825 - 5.835 GHz	-53.5	-25.5	-17	
5.835 - 10 GHz	-56.8	-28.8	-27	Peak reading
10 - 20 GHz	-62.1	-34.1	-27	Peak reading
20 - 26.5 GHz	-60.3	-32.3	-27	Peak reading

Notes:
Note 1: Emisson at 5.71005 GHz measured with RBW = 1MHz, VBW = 30Hz (i.e. average reading).

* Assumes system antenna gain is flat acorss frequency range and is 28dBi.

Run # 3: Initial radiated scan from Run # 2 in D30507.
ODU B

Frequency	Level	Pol	FCC B	FCC B	Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
81.060	22.5	v	40.0	-17.5	QP	195	1.0	
32.424	21.6	v	40.0	-18.4	QP	169	1.0	
129.697	24.5	h	43.5	-19.0	QP	230	2.6	
129.696	23.7	v	43.5	-19.8	QP	177	1.0	
453.936	24.6	v	46.0	-21.4	QP	25	1.0	
64.885	17.9	v	40.0	-22.1	QP	26	1.0	
259.393	22.2	v	46.0	-23.8	QP	220	3.2	
64.849	16.0	h	40.0	-24.0	QP	340	3.5	
453.936	22.0	h	46.0	-24.0	QP	230	2.3	
113.485	18.6	h	43.5	-24.9	QP	125	3.3	
162.120	18.2	v	43.5	-25.3	QP	20	1.0	
259.392	20.0	h	46.0	-26.0	QP	265	4.0	
162.001	16.8	h	43.5	-26.7	QP	280	3.1	
145.908	12.8	v	43.5	-30.7	QP	180	1.0	

Elliott — Emissions Test Data

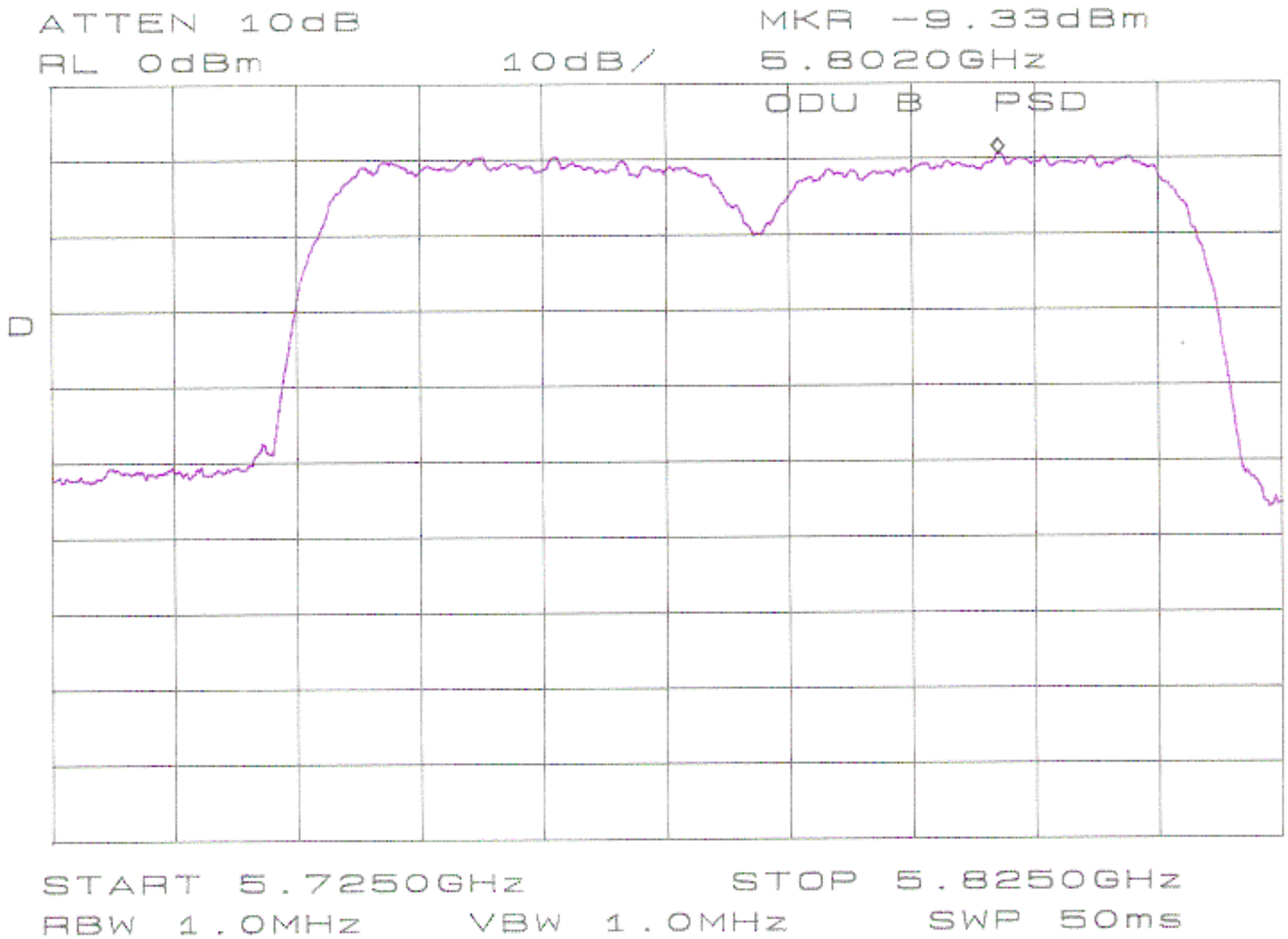
Client:	Wavespan Corporation	Date:	3/3/99	Test Engr:	Anil Allamaneni
Product:	Stratum 100 ODU B	File:	D30606	Proj. Engr:	Mark Briggs
Objective	Final Qualification.	Site:	SVOATS # 1	Contact:	Roger Eline
Spec:	FCC B	Distance:	3 m	Approved:	

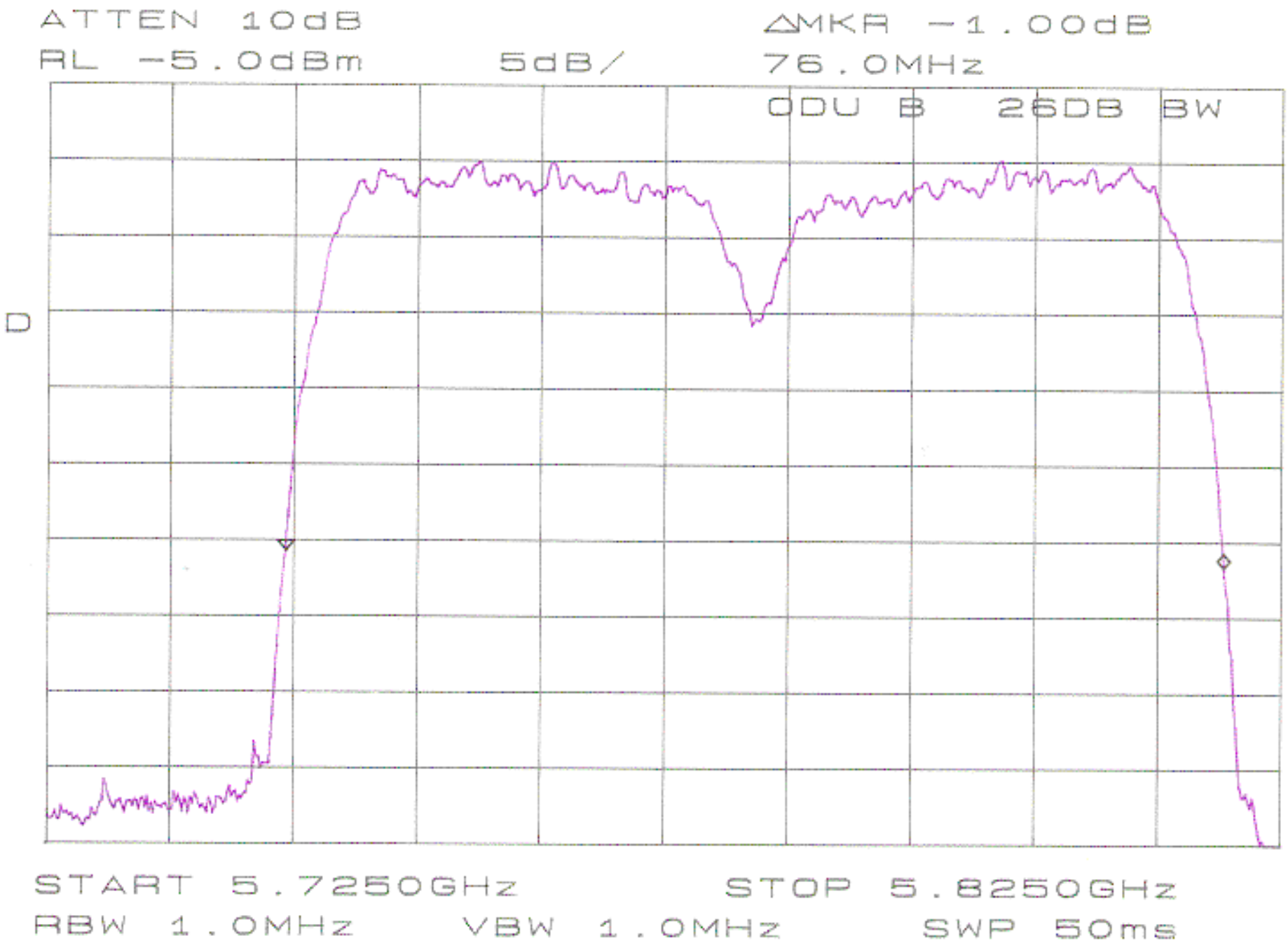
Run # 4: Maximized readings from Run #3 in D30507.

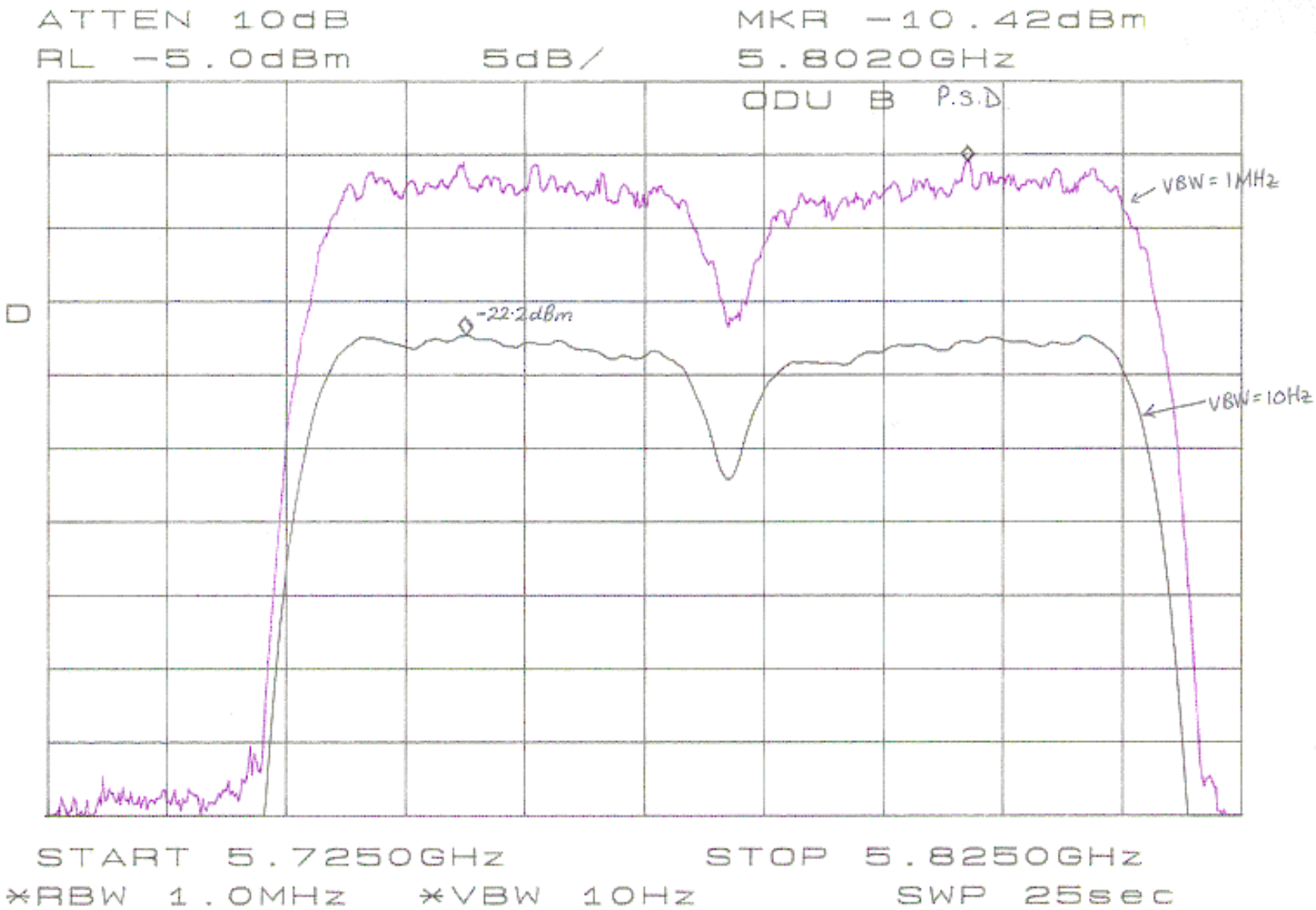
Frequency	Level	Pol	FCC B	FCC B	Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
64.885	26.7	v	40.0	-13.3	QP	310	1.0	
129.696	29.3	v	43.5	-14.2	QP	350	1.0	
129.697	29.0	h	43.5	-14.5	QP	320	1.7	
81.060	23.0	v	40.0	-17.0	QP	195	1.0	
32.424	21.6	v	40.0	-18.4	QP	169	1.0	
453.936	24.6	v	46.0	-21.4	QP	25	1.0	

Run #5 : Conducted Emissions, 120V/60Hz, .45 - 30 MHz.

Frequency	Level	Power	FCC B	FCC B	Detector	Comments
MHz	dBuV	Lead	Limit	Margin	QP/Ave	
0.4515	31.2	Line	48.0	-16.8	QP	
0.4515	31.2	Neutral	48.0	-16.8	QP	
18.0076	29.6	Line	48.0	-18.4	QP	
24.2230	24.6	Neutral	48.0	-23.4	QP	
7.5749	22.8	Line	48.0	-25.2	QP	
7.5749	21.7	Neutral	48.0	-26.3	QP	

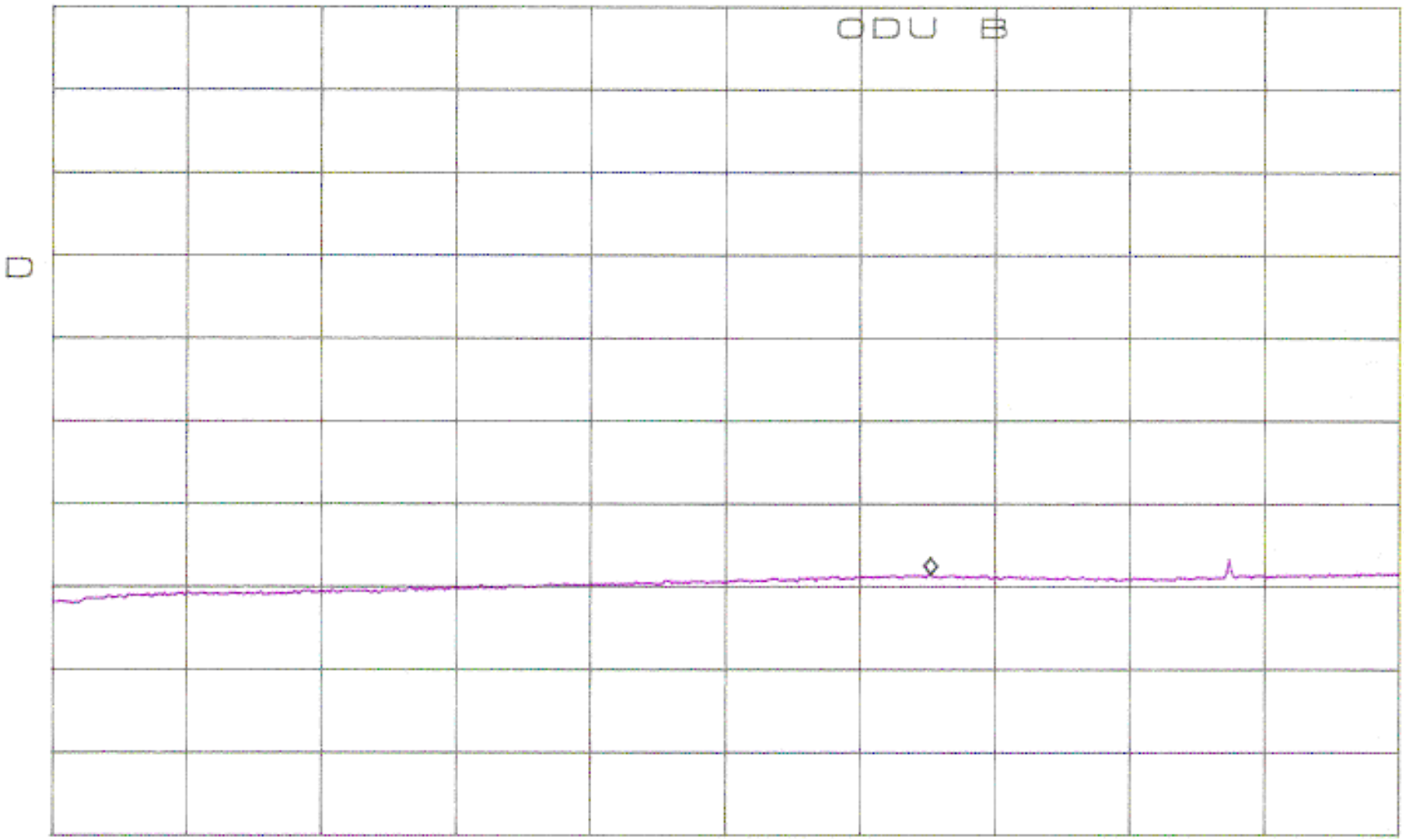

ATTEN 10dB
MKR -9.33dBm
RL 0dBm
10dB/
5.8020GHz
ODU B PSD
D
START 5.7250GHz
STOP 5.8250GHz
RBW 1.0MHz
VBW 1.0MHz
SWP 50ms


ATTEN 10dB
RL -5.0dBm
5dB/
ΔMKR -1.00dB
76.0MHz
ODU B 26DB BW
D
START 5.7250GHz
STOP 5.8250GHz
RBW 1.0MHz
VBW 1.0MHz
SWP 50ms


ATTEN 10dB
RL -5.0dBm
5dB/
MKR -10.42dBm
5.8020GHz
ODU B P.S.D
VBW = 1MHz
-22.2dBm
VBW = 10Hz
D
START 5.7250GHz
STOP 5.8250GHz
*RBW 1.0MHz
*VBW 10Hz
SWP 25sec

ATTEN 10dB
RL -45.0dBm 5dB/

MKR -79.25dBm
662.1MHz

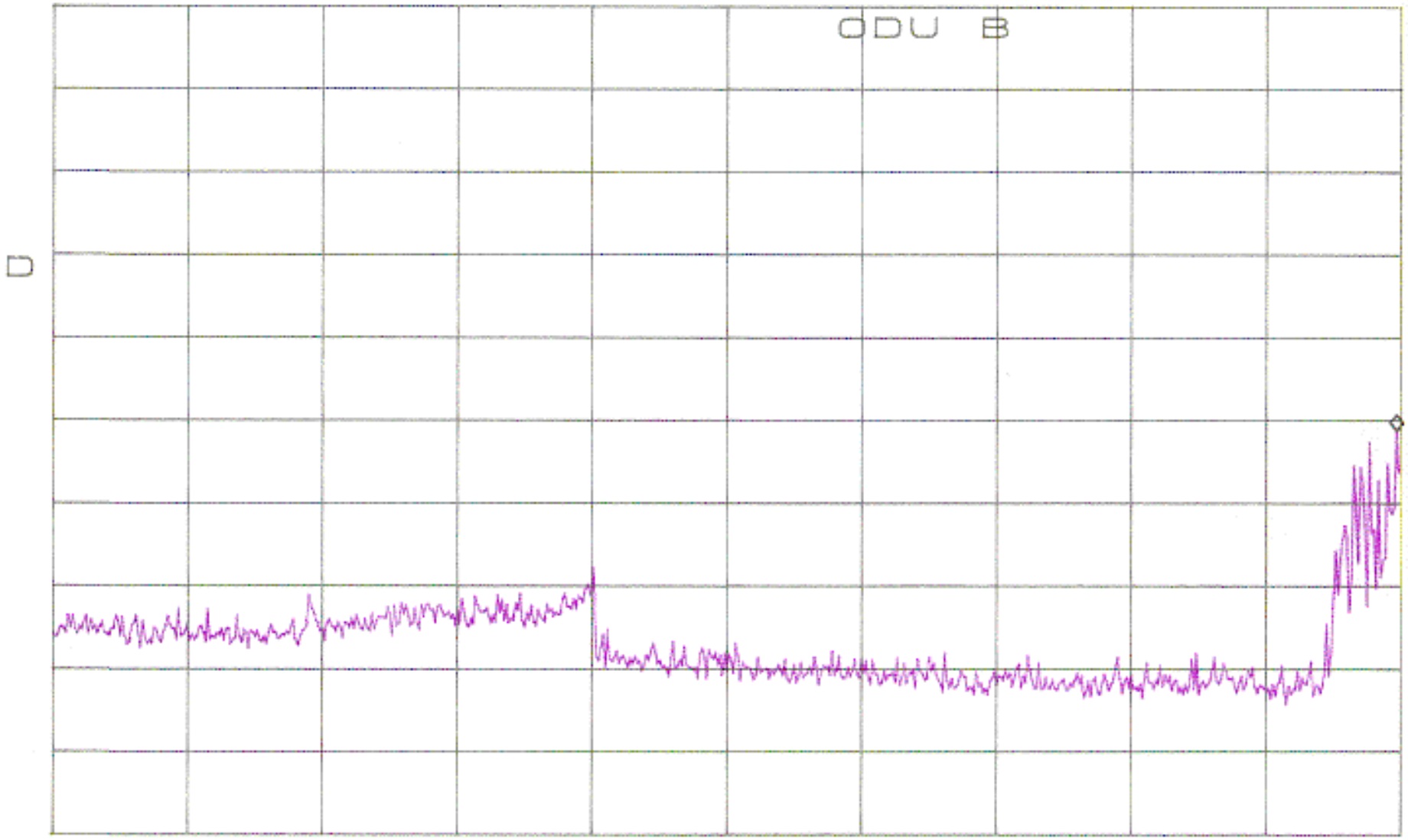


START 30.0MHz STOP 1.0000GHz
*RBW 1.0MHz *VBW 300Hz SWP 8.1sec

ATTEN 10dB MKR -55.58dBm

RL -30.0dBm 5dB/ 5.699GHz

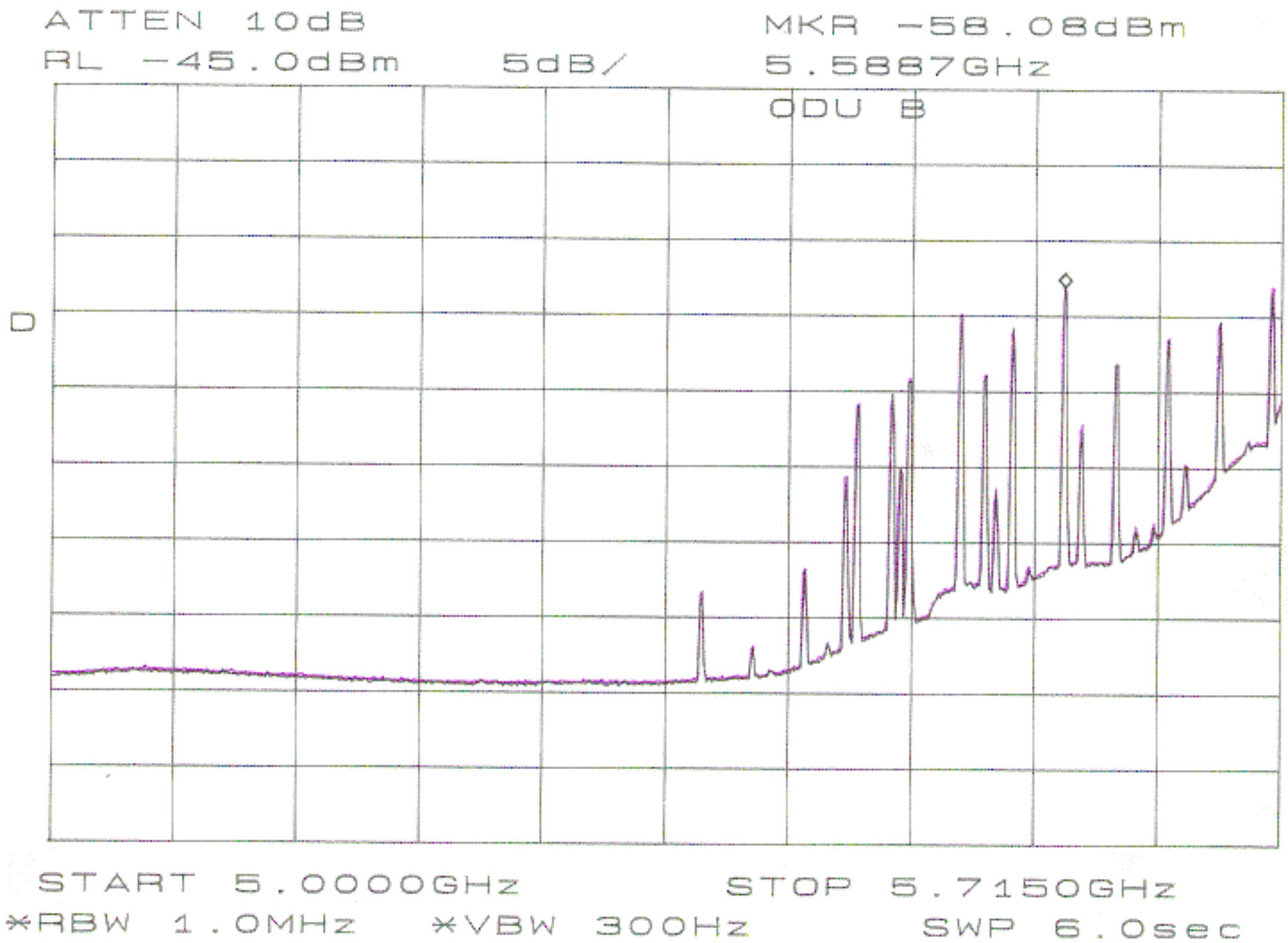
ODU B

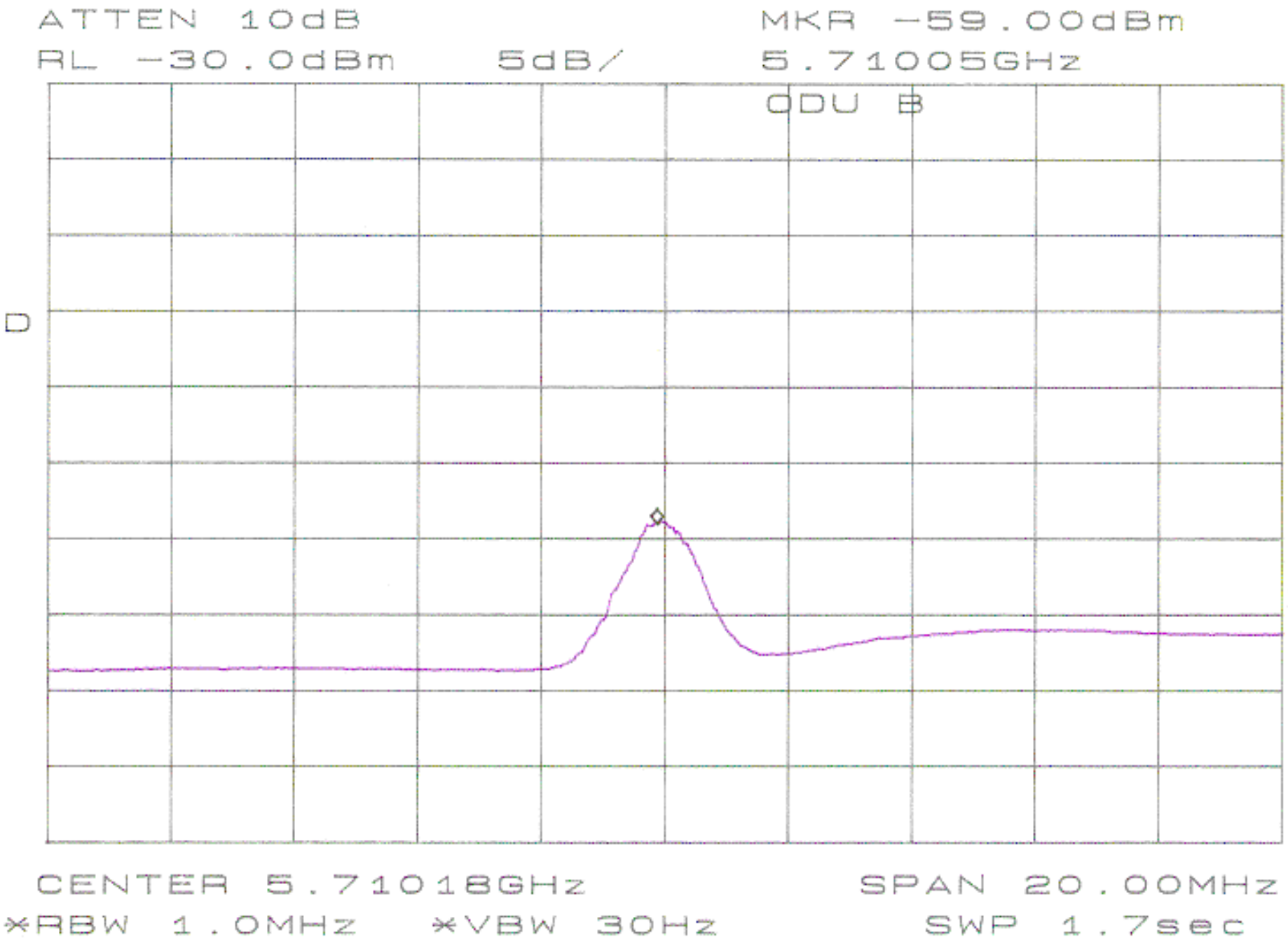


START 1.000GHz STOP 5.715GHz

*RBW 1.0MHz VBW 1.0MHz SWP 95ms

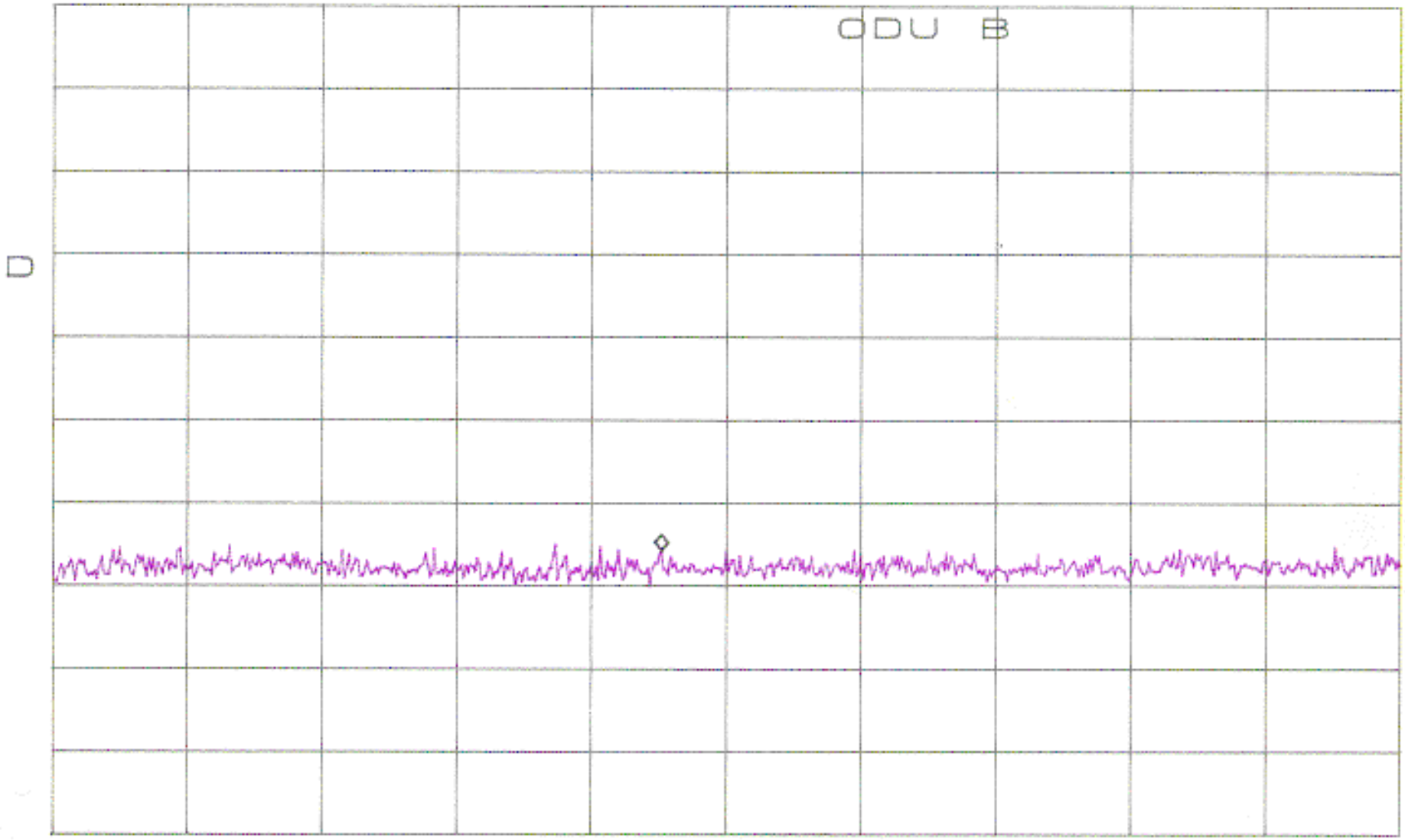
REFER TO ZOOM PLOT SHOWING AVERAGE READING


ATTEN 10dB
RL -45.0dBm
5dB/
MKR -58.08dBm
5.5887GHz
ODU B
D
START 5.0000GHz
STOP 5.7150GHz
*RBW 1.0MHz
*VBW 300Hz
SWP 6.0sec

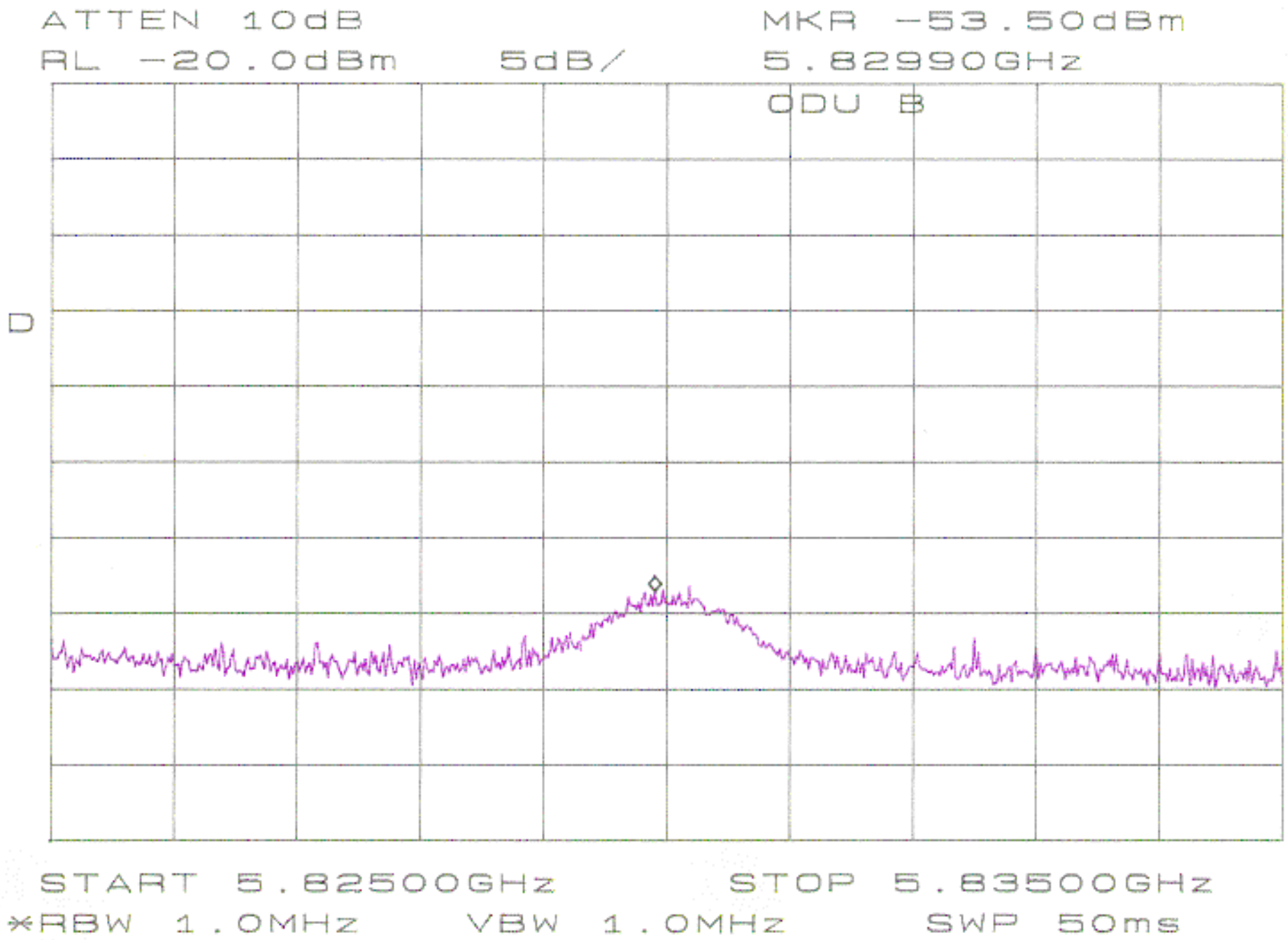

ATTEN 10dB
MKR -59.00dBm
RL -30.0dBm
5dB/
5.71005GHz
ODU B
D
CENTER 5.71018GHz
SPAN 20.00MHz
*RBW 1.0MHz
*VBW 30Hz
SWP 1.7sec

ATTEN 10dB
RL -20.0dBm 5dB/

MKR -52.83dBm
5.71952GHz
ODU B



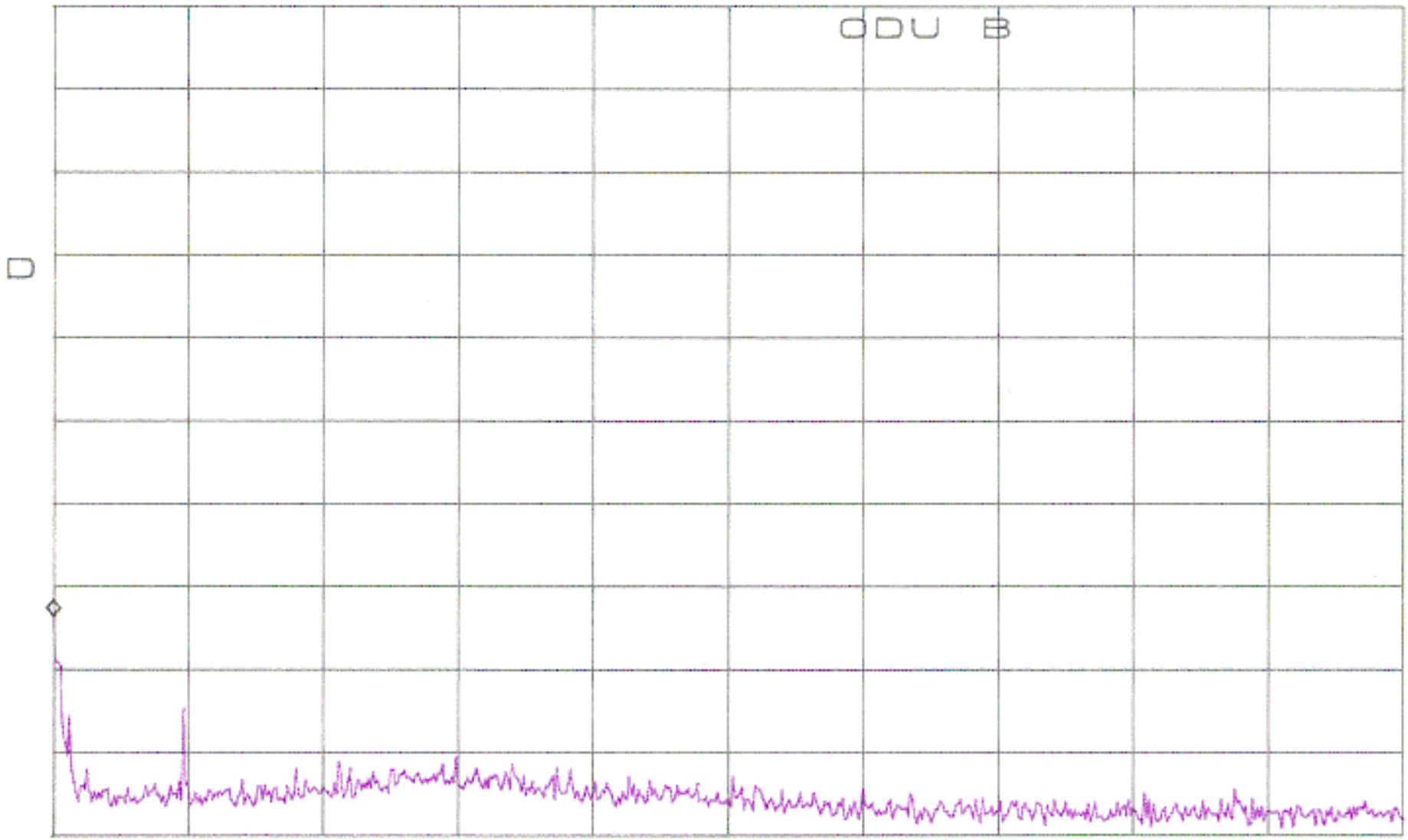
START 5.71500GHz STOP 5.72500GHz
*RBW 1.0MHz VBW 1.0MHz SWP 50ms


ATTEN 10dB
MKR -53.50dBm
RL -20.0dBm
5dB/
5.82990GHz
ODU B
D
START 5.82500GHz
STOP 5.83500GHz
*RBW 1.0MHz
VBW 1.0MHz
SWP 50ms

ATTEN 10dB MKR −56.75dBm

RL −20.0dBm 5dB/ 5.835GHz

ODU B



START 5.835GHz STOP 10.000GHz

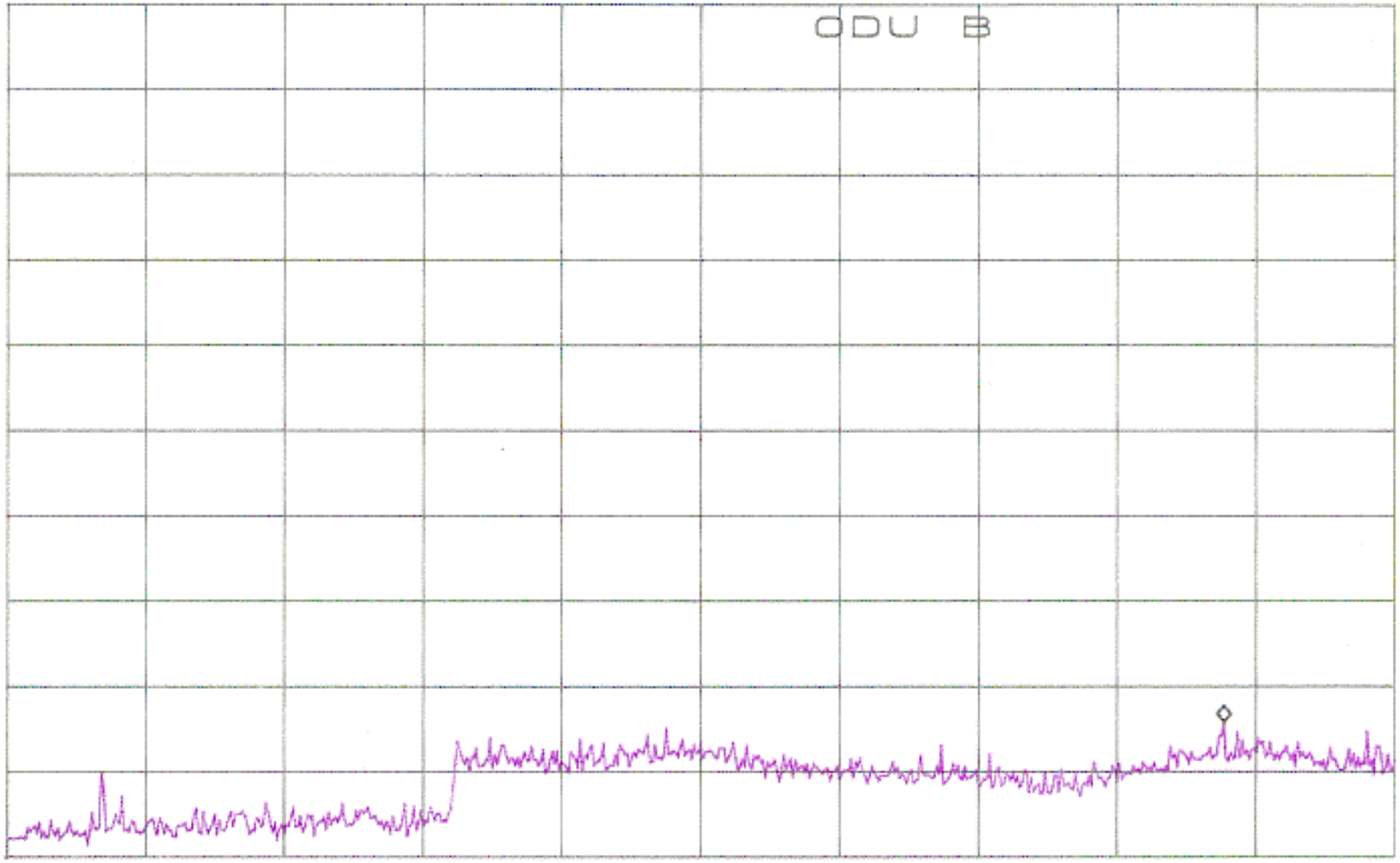
*RBW 1.0MHz VBW 1.0MHz SWP 84ms

ATTEN 10dB MKR -62.08dBm

RL -20.0dBm 5dB/ 18.77GHz

ODU B

D

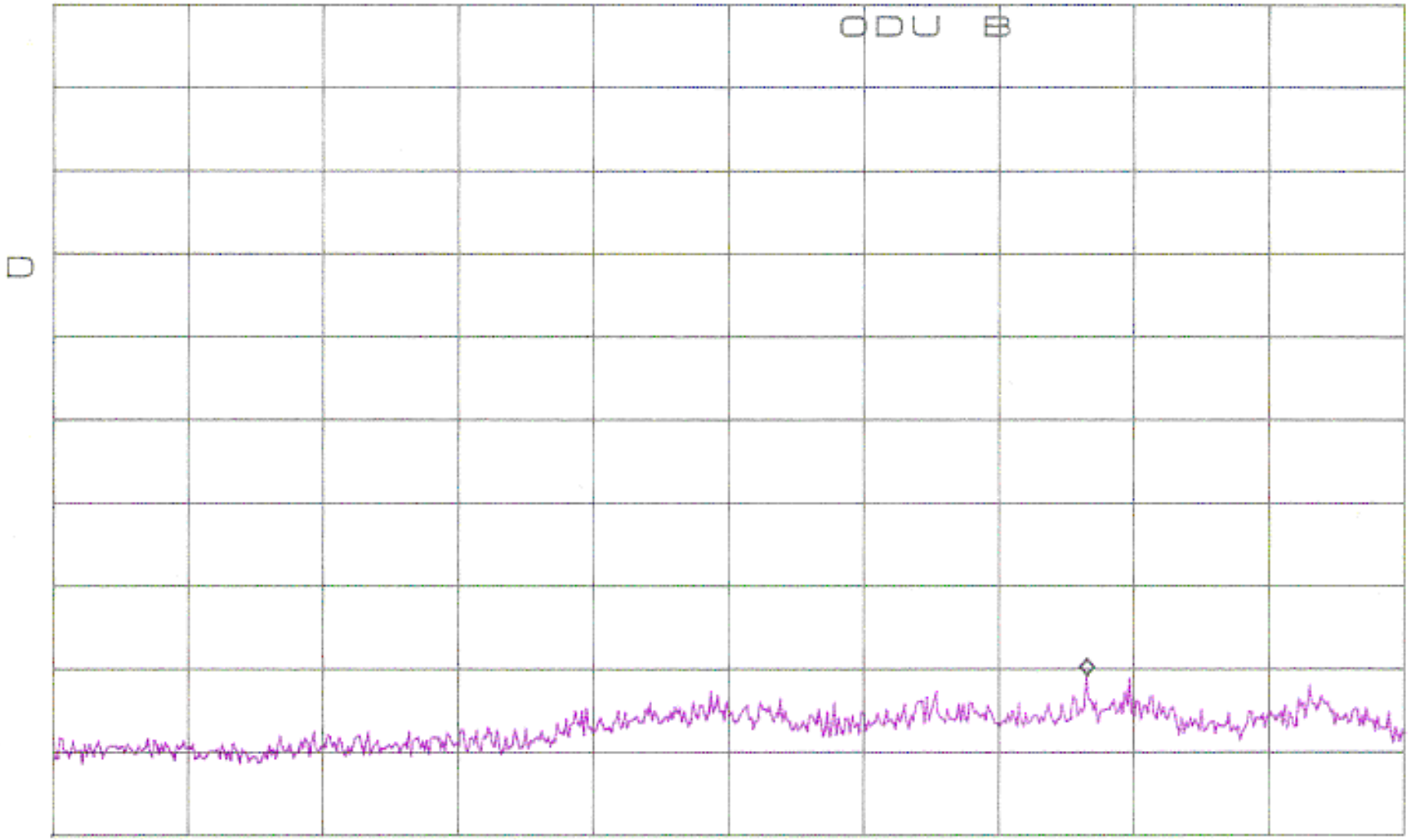


START 10.00GHz STOP 20.00GHz

*RBW 1.0MHz VBW 1.0MHz SWP 200ms

ATTEN 10dB
RL -20.0dBm 5dB/

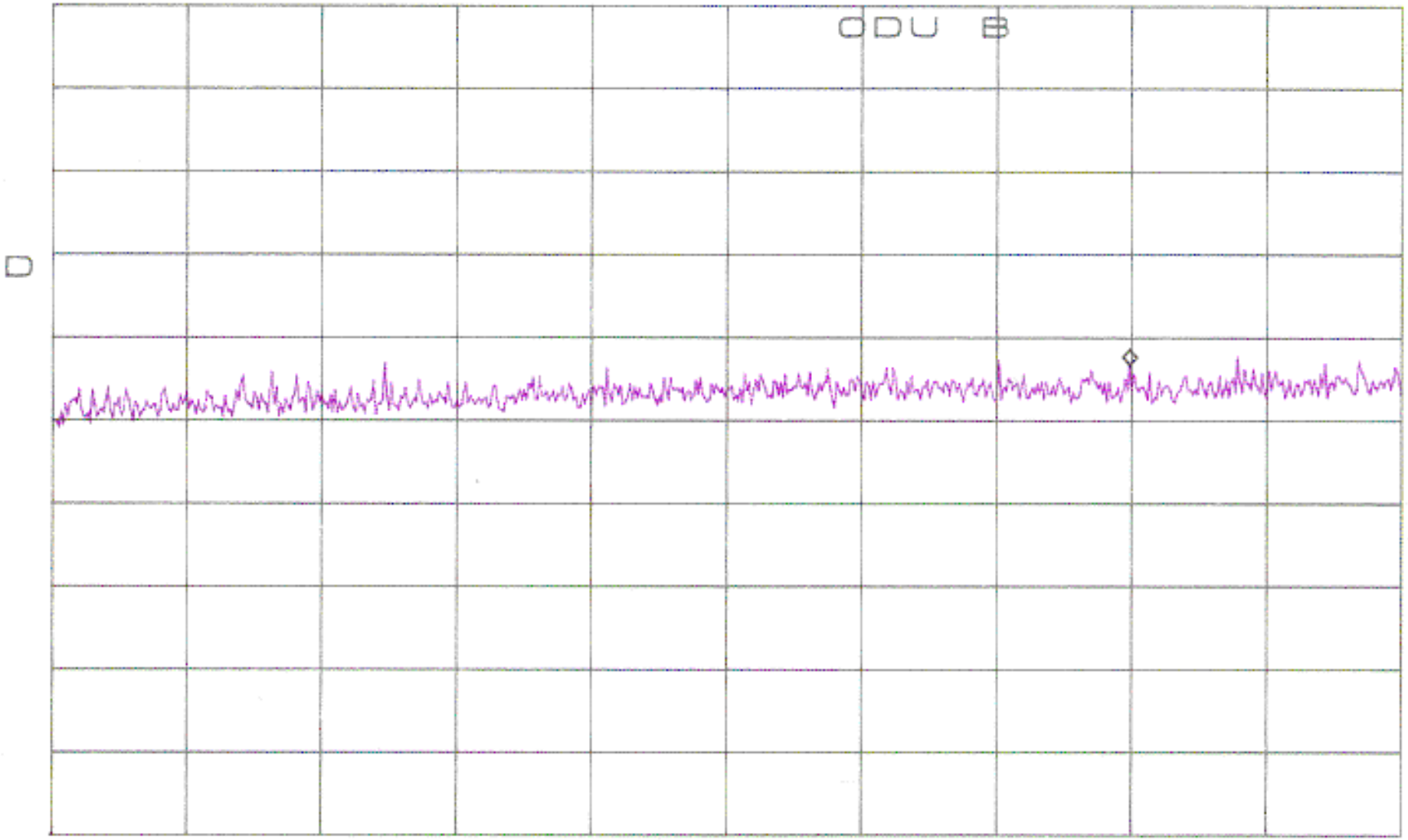
MKR -60.33dBm
24.973GHz
ODU B



START 20.000GHz STOP 26.500GHz
*RBW 1.0MHz VBW 1.0MHz SWP 130ms

ATTEN 10dB
RL −45.0dBm 5dB/

MKR −66.67dBm
804.4MHz
ODU B



START 30.0MHz STOP 1.0000GHz
*RBW 1.0MHz *VBW 1.0MHz SWP 50ms

Ambient Conditions	
Temperature:	7.2 °C
Humidity:	92 %

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 - Maximized Radiated Emissions, 1.0-26.5 GHz

PASS Results: 15.407(a)(2) -3.6 dB Avg @ 5184.000 MHz Vertical

Run #2 - Unmaximized Preliminary Radiated Emissions Scan, 30-1000 MHz

Results: 15.407(b)(5) -10.0 dB QP @ 48.320 MHz Vertical

Run #3 - Maximized Radiated Emissions from Run #2

PASS Results: 15.407(b)(5) -8.5 dB QP @ 48.320 MHz Vertical

Run #4- Conducted Emissions, 0.45 - 30 MHz

PASS Results: 15.209 -18.9 dB QP @ 0.4513 MHz Neutral

Conducted emissions measured on the IDU which supplies the ODU with dc power. During this test the IDU and ODU were co-located on the table. For the radiated emissions test the IDU was tretaed as remote suport equipment and located 10m from the EUT.

Equipment Under Test (EUT) General Description

The EUT is a transceiver which is designed to transmit and receive 100 MB/s Ethernet data from point to point. Normally, the EUT would be mounting on the outside of a building during operation and connected to an Indoor Unit (IDU) located within the building. The EUT was treated as tabletop equipment during emissions testing to simulate the end user environment. The electrical rating of the IDU is 120 V/60 Hz. The ODU takes dc power from the IDU.

Equipment Under Test (EUT)

Manufacturer/Model/Description	Serial Number	FCC ID Number
Wavespan / Stratum 100 ODU A / UNII Radio	None	NGP7020010

Power Supply and Line Filters

The ODU receives 48VDC, 1 Amp from the IDU unit.

Printed Wiring Boards in EUT

Manufacturer/Description	Assembly #	Rev.	Serial Number	Crystals (MHz)
Wavespan / ODU Radio A	500055701	X5	5001A	120.0
Wavespan / Tuner Assembly	500056301	X8	None	10.0
Wavespan / ODU Control Board	500056101	15	None	32.424

Subassemblies in EUT

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

EUT Enclosure(s)

The EUT enclosure is primarily constructed of fabricated sheet steel. It measures approximately 31 cm wide by 40 cm deep by 5 cm high.

EMI Suppression Devices (filters, gaskets, etc.)

Description	Manufacturer	Part Number
Feedthru Filter	Corry Micronics, Inc.	FTF3-15
RF Gasket	Vanguard Products, Corp.	12125-03-075-PSA
RF Gasket	Vanguard Products, Corp.	14125-05-050-ORA-NPS

Modifications

The following modifications were made to the EUT in order to comply with the requirements:

Metal shield covering the LED and the AIMING BNC. Shielded the DC connections to the ODU panel. Feed through filters attached.

Elliott

EMC Test Log

Client:	Wavespan Corporation	Date:	3/15/99	Test Engr:	Conrad Chu
Product:	Stratum 100 ODU A	File:	T30809	Proj. Eng:	Mark Briggs
Objective:	Final Qualification	Site:	SVOATS #3	Contact:	Roger Eline
Spec:	FCCB	Page:	3 of 5	Approved:	
Revision	1.0				

Local Support Equipment

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

Remote Support Equipment

Manufacturer/Model/Description	Serial Number	FCC ID Number
Wavespan IDU	10004	None

Interface Cabling

Cable Description	Length (m)	From Unit/Port	To Unit/Port
Fiber Optic	30	IDU Data	ODU data
Shielded	30	IDU dc Power out	ODU dc power in

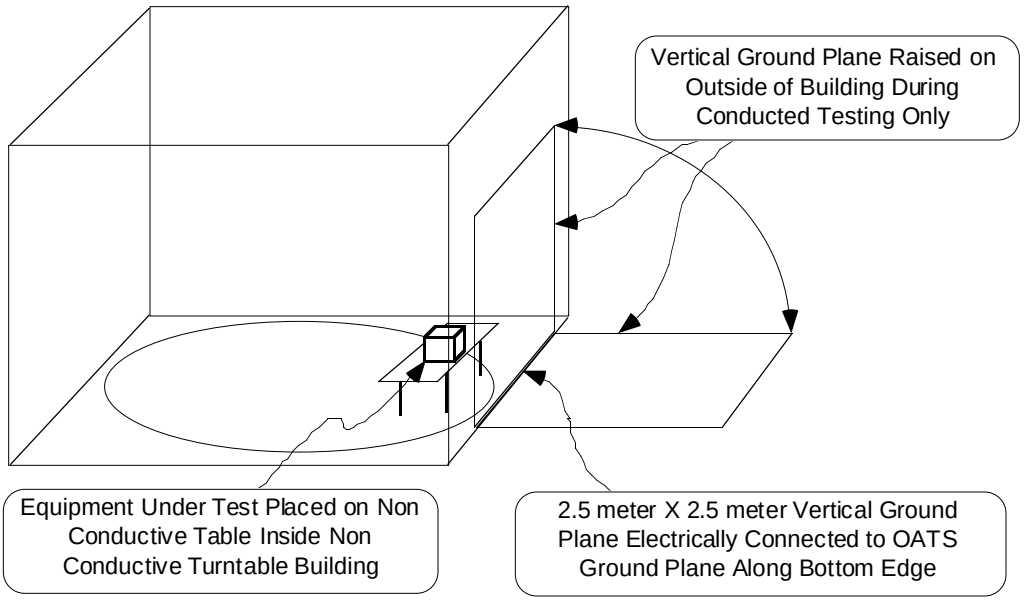
Test Software

The IDU was tarnsferring to the ODU at 100 Mb/s. The ODU transmitted the data.

General Test Conditions

During radiated testing, the remote IDU was connected to 120V, 60Hz power input. This powered the EUT via the shielded cable. The EUT was located on the turntable for radiated testingand the remote support equipment was located approximately 10 meters from the EUT with all I/O connections running on top of the groundplane.

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



For conducted testing the IDU was located on the table alongside the EUT.

Test Data Tables

See attached data for radiated emissions runs 1 - 3.

Run #4- Conducted Emissions, 0.45 - 30 MHz

Frequency MHz	Level dBuV	Power Lead	FCC B Limit	FCC B Margin	Detector Function	Comments
0.4513	29.1	Neutral	48.0	-18.9	QP	
0.4523	28.7	Line 1	48.0	-19.3	QP	
5.2234	20.5	Neutral	48.0	-27.5	QP	
5.2229	20.5	Line 1	48.0	-27.5	QP	
24.2234	18.3	Neutral	48.0	-29.7	QP	
24.2359	18.3	Line 1	48.0	-29.7	QP	

Note: Conducted emission measured on the IDU which supplies the ODU with dc power. During this test the IDU and ODU were co-located on the table. For the radiated emissions test the IDU was tretaed as remote suport equipment and located 10m from the EUT.

Elliott — Emissions Test Data

Client:	Wavespan Corporation	Date:	3/15/99	Test Engr:	Conrad Chu
Product:	Stratum 100 ODU A	File:	D30809	Proj. Engr:	Mark Briggs
Objective	Final Qualification	Site:	SVOATS #3	Contact:	Roger Eline
Spec:	FCCB	Distance:	3 m	Approved:	

Ambient Conditions
Temperature: 7.2 °C
Humidity: 92 %

Run #1: Maximized readings, 1.0-26.5 GHz
Measurements made at 3m per FCC requirements.
Checked local oscillators and their harmonics (2395 MHz, 2412 MHz, 2150 MHz).
Checked in all restricted bands as defined in the FCC handbook.
Checked harmonics of the main 5261.5 MHz (approximate) transmission frequency.

Frequency	Level	Pol	FCC B	FCC B	Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5184.000	50.4	V	54.0	-3.6	Avg			
5361.700	49.9	V	54.0	-4.1	Avg			
9648.000	47.2	V	54.0	-6.8	Avg			
5424.000	46.9	V	54.0	-7.1	Avg			
5394.000	46.4	V	54.0	-7.6	Avg			
4790.000	46.1	V	54.0	-7.9	Pk			
9648.000	44.5	H	54.0	-9.5	Avg			
10750.000	44.0	H	54.0	-10.0	Avg			
9580.000	43.4	H	54.0	-10.6	Avg			
10750.000	43.3	V	54.0	-10.7	Avg			
9580.000	43.0	V	54.0	-11.0	Avg			
5361.700	61.7	V	74.0	-12.3	Pk			
4824.000	39.2	V	54.0	-14.8	Avg			
5184.000	58.8	V	74.0	-15.2	Pk			
7185.000	38.7	V	54.0	-15.3	Avg			
6450.000	38.2	V	54.0	-15.8	Avg			
5424.000	36.1	H	54.0	-17.9	Avg			
5394.000	56.0	V	74.0	-18.0	Pk			
9648.000	55.6	V	74.0	-18.4	Pk			
10750.000	55.4	H	74.0	-18.6	Pk			
9648.000	55.0	H	74.0	-19.0	Pk			
10750.000	54.6	V	74.0	-19.4	Pk			
5424.000	54.5	V	74.0	-19.5	Pk			
9580.000	54.2	V	74.0	-19.8	Pk			
9580.000	53.1	H	74.0	-20.9	Pk			
7185.000	50.4	V	74.0	-23.6	Pk			
2412.000	30.1	V	54.0	-23.9	Avg			
6450.000	49.4	V	74.0	-24.6	Pk			
5184.000	29.1	H	54.0	-24.9	Avg			
4824.000	47.9	V	74.0	-26.1	Pk			
5424.000	47.8	H	74.0	-26.2	Pk			
5184.000	47.6	H	74.0	-26.4	Pk			
2412.000	42.5	V	74.0	-31.5	Pk			
5261.500	111.2	V	N/A	N/A	Pk			Note 1
5292.500	109.8	V	N/A	N/A	Pk			Note 1
5214.000	68.9	V	N/A	N/A	Pk			Note 2
5214.000	54.2	V	N/A	N/A	Avg			Note 2

Note 1:	Measured level of transmit frequency emission to verify proper operation of EUT.
Note 2:	Emission falls outside of restricted bands. To be measured in anenna conducted emissions measurements.

Elliott — Emissions Test Data

Client:	Wavespan Corporation	Date:	3/15/99	Test Engr:	Conrad Chu
Product:	Stratum 100 ODU A	File:	D30809	Proj. Engr:	Mark Briggs
Objective	Final Qualification	Site:	SVOATS #3	Contact:	Roger Eline
Spec:	FCCB	Distance:	3 m	Approved:	

Run #2: Initial radiated scan, 30-1000 MHz

Measurements made at 3m per FCC requirements.

Frequency	Level	Pol	FCCB	FCCB	Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
48.320	30.0	V	40.0	-10.0	QP	86	1.1	
44.812	25.0	V	40.0	-15.0	QP	9	1.9	
218.250	30.3	H	46.0	-15.7	QP	45	1.4	
218.250	26.7	V	46.0	-19.3	QP	9	2.0	
265.300	21.4	V	46.0	-24.6	QP	78	1.0	
213.010	16.8	H	43.5	-26.7	QP	112	1.6	
261.000	16.4	V	46.0	-29.6	QP	155	1.0	

Run #3: Maximized readings from run #2

Measurements made at 3m per FCC requirements.

Frequency	Level	Pol	FCCB	FCCB	Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
48.320	31.5	V	40.0	-8.5	QP	71	1.7	
44.812	26.6	V	40.0	-13.4	QP	52	1.0	
218.250	32.6	V	46.0	-13.4	QP	240	2.7	
218.250	31.9	H	46.0	-14.1	QP	231	2.6	
265.300	21.4	V	46.0	-24.6	QP	78	1.0	
213.010	16.8	H	43.5	-26.7	QP	112	1.6	

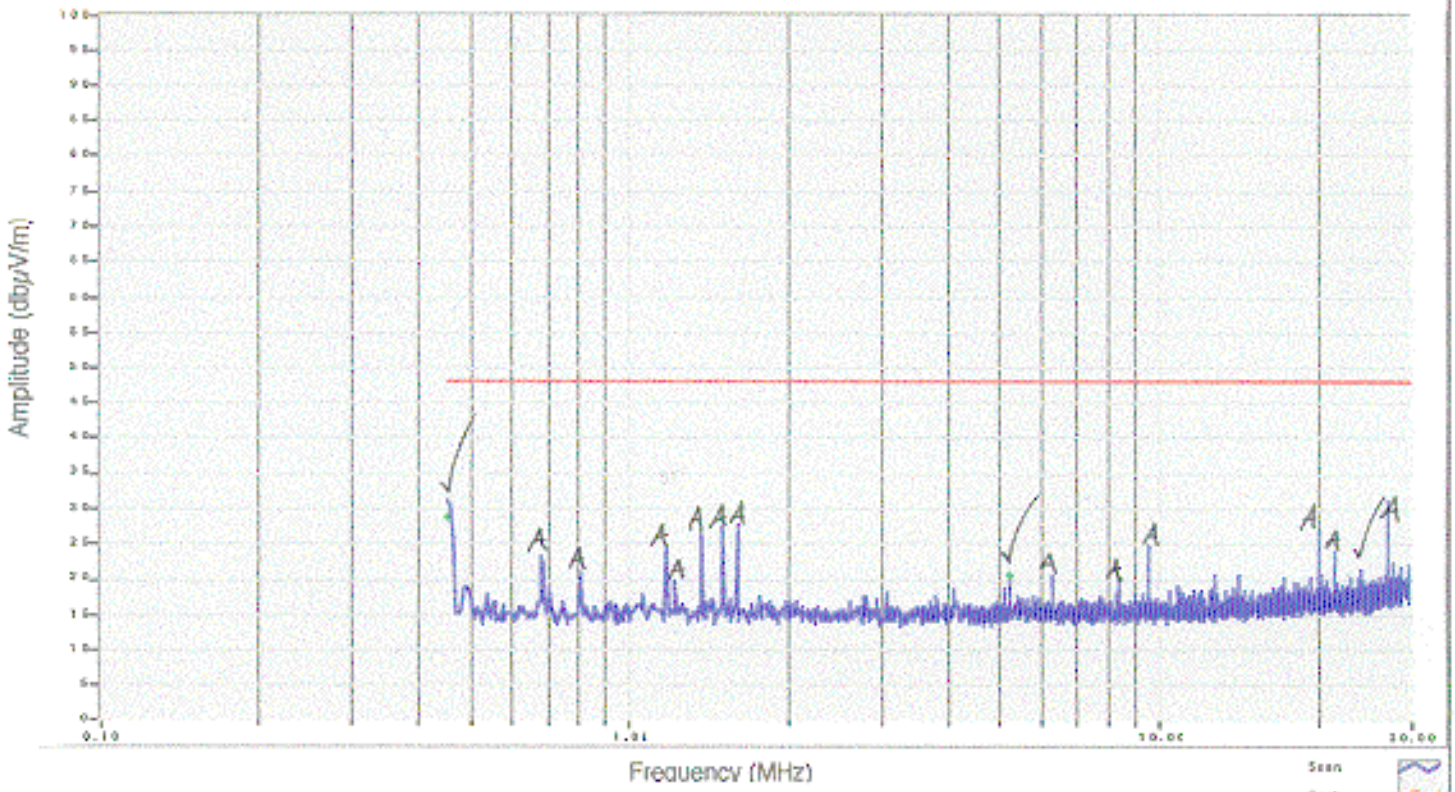
Elliott

SV #3: Wavespan ODU A Run 4

120V/60Hz

Spec: FCC B

Mains Lead Line 1



Scan
Peak
Quasi-peak
Average
Quasi Peak L
Limit 2

3/15/00

Mr. C. Chu

A: Ambient

C.C

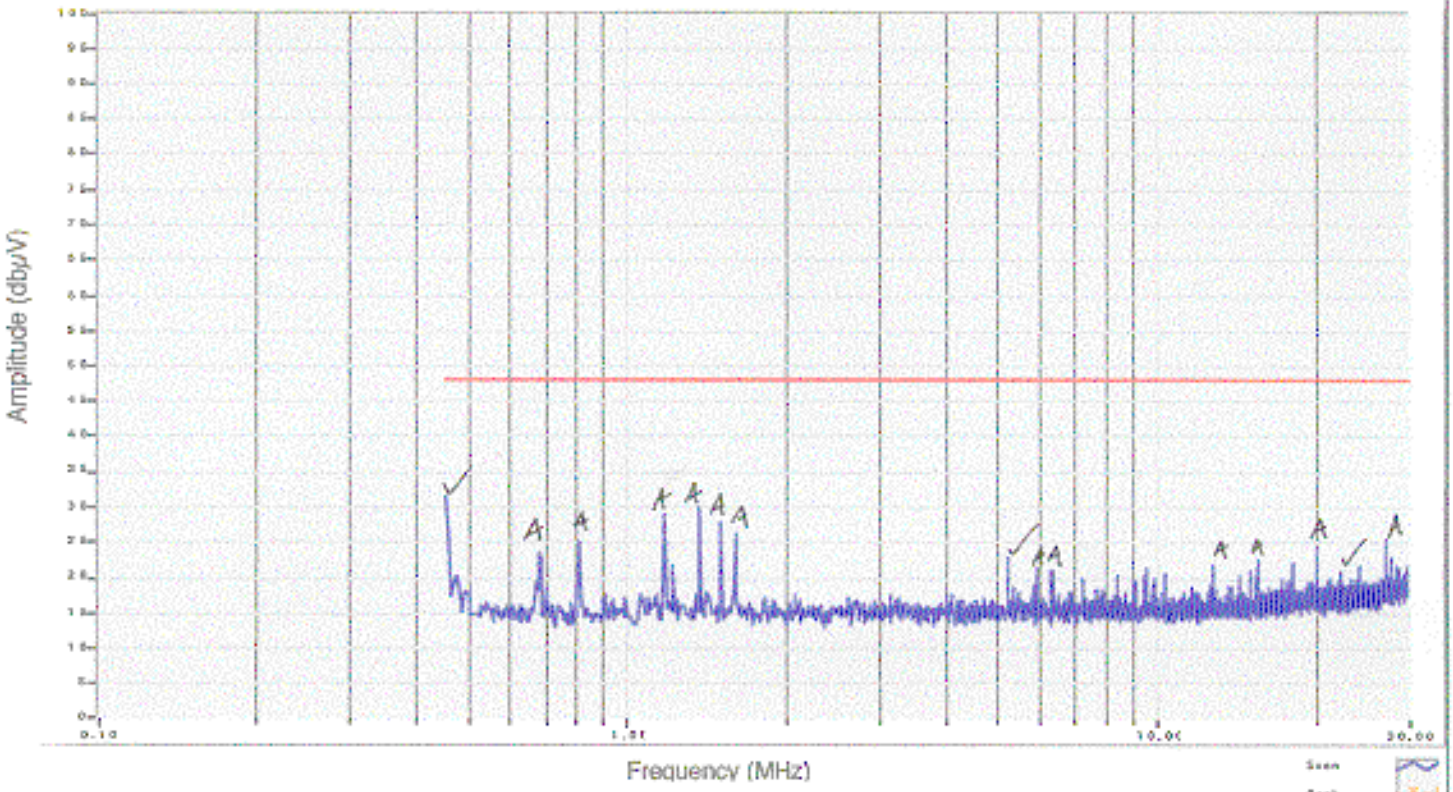
Elliott

SV #3: Wavespan ODU A Run 4

120V/60Hz

Spec: FCC

Mains Lead Neutral



Seen
Peak
Quasi-peak
Average
QuasiPeak L
Limit 2

3/15/00

Mr. C. Chu

A: ambient

MRB.

Ambient Conditions
Temperature: 21.0 °C
Humidity: 40 %

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 #1a - Maximized Radiated Emissions, 26.0 - 40.0 GHz

PASS Results: No emissions from the EUT were found in this frequency range.

Run #2a - 26 dB Bandwidth Measurement, 15.407 (a) (2)

Results: 26 dB Bandwidth was 73.22 MHz

Run #2b - Peak Transmit Power for the Band 5.25-5.35 GHz, 15.407 (a) (2)

PASS Results: Peak Transmit Power was -0.9 dBm Peak

Notes: Shall not exceed the lesser of 250 mW (24 dBm) or 11 dBm + 10logB, where B is the 26-dB emission bandwidth in MHz.
11 dBm + 10log(73.22) = 29.65 dBm.
The lesser of 24 dBm and 29.65 dBm is 24 dBm.

Run #2c - Peak Power Spectral Density, 15.407 (a) (2)

PASS Results: Maximum Power Spectral Density was -9.0 dBm Peak

Notes: Shall not exceed 11 dBm in any 1-MHz band.

Run #2d - Ratio of Peak Excursion of Modulation Envelope vs. Peak Transmit Power, 15.407 (a) (6)

PASS Results: Ratio was -8.1 dB

Notes: Shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.
Peak Excursion of Modulation Envelope was -9.0 dBm
Peak Transmit Power was -0.9 dBm

Run #3 Undesirable Emissions Outside of the 5.15-5.35 GHz band, Chapter 15.407 (b) (2)

PASS There were no emissions that exceeded an EIRP of -27dBm/MHz

Equipment Under Test (EUT) General Description

The EUT is the Outdoor unit (ODU) for a UNII radio system. The ODU would normally mounted on the mast or wall-mounted. The EUT was, therefore, placed ion the table top during emissions testing to simulate the end user environment.

Equipment Under Test (EUT)

Manufacturer/Model/Description	Serial Number	FCC ID Number
Wavespan / Stratum 100 ODU A / UNII Radio	None	NGP7020010

Power Supply and Line Filters

The ODU receives 48VDC, 1 Amp from the IDU unit.

Printed Wiring Boards in EUT

Manufacturer/Description	Assembly #	Rev.	Serial Number	Crystals (MHz)
Wavespan / ODU Radio A	500055701	X5	5001A	120.0
Wavespan / Tuner Assembly	500056301	X8	None	10.0
Wavespan / ODU Control Board	500056101	15	None	32.424

Subassemblies in EUT

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

EUT Enclosure(s)

The EUT enclosure is primarily constructed of fabricated sheet steel. It measures approximately 31 cm wide by 40 cm deep by 5 cm high.

EMI Suppression Devices (filters, gaskets, etc.)

Description	Manufacturer	Part Number
Feedthru Filter	Corry Micronics, Inc.	FTF3-15
RF Gasket	Vanguard Products, Corp.	12125-03-075-PSA
RF Gasket	Vanguard Products, Corp.	14125-05-050-ORA-NPS

Modifications

The following modifications were made to the EUT in order to comply with the requirements:

Metal shield covering the LED and the AIMING BNC. Shielded the DC connections to the ODU panel. Feed through filters attached.

Local Support Equipment

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

Remote Support Equipment

Manufacturer/Model/Description	Serial Number	FCC ID Number
Wavespan / Stratum 100 IDU / Indoor Unit	10004	None

Interface Cabling

Cable Description	Length (m)	From Unit/Port	To Unit/Port
Duplex Fiber (x1)	30.0	Data I/O Port	IDU
Shielded Multicore (x1)	30.0	Power Port	IDU

Test Software

The remote IDU contained test software running during testing which continuously exercised the EUT by sending and recieving information.

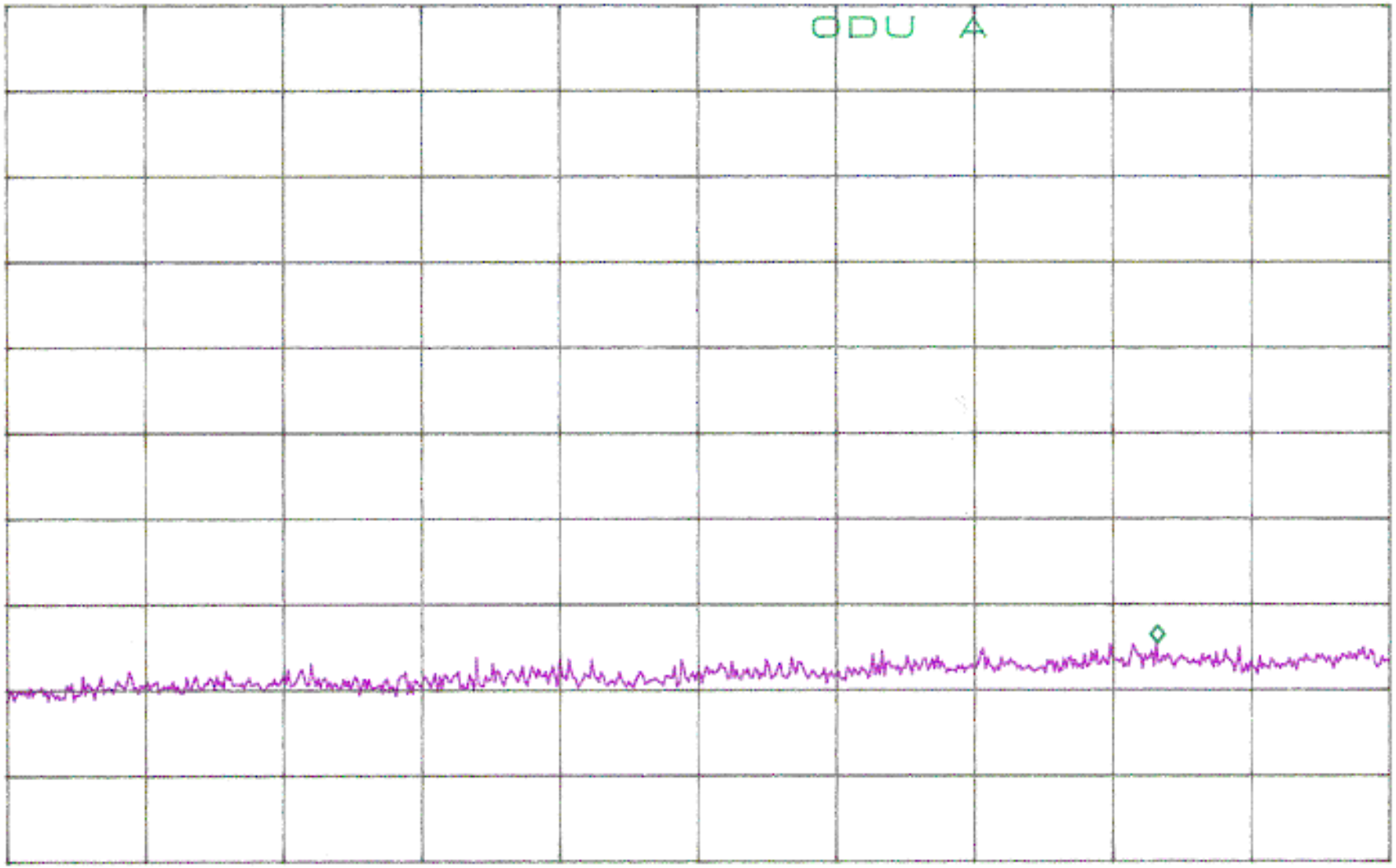
General Test Conditions

During radiated testing, the EUT was connected to 120V, 60Hz power input. The EUT and all local support equipment were located on the turntable for radiated testing and conducted testing.

Test Data Tables

See attached plots

*ATTEN 0dB MKR -62.25dBm
RL -25.0dBm 5dB/ 836.7MHz
ODU A



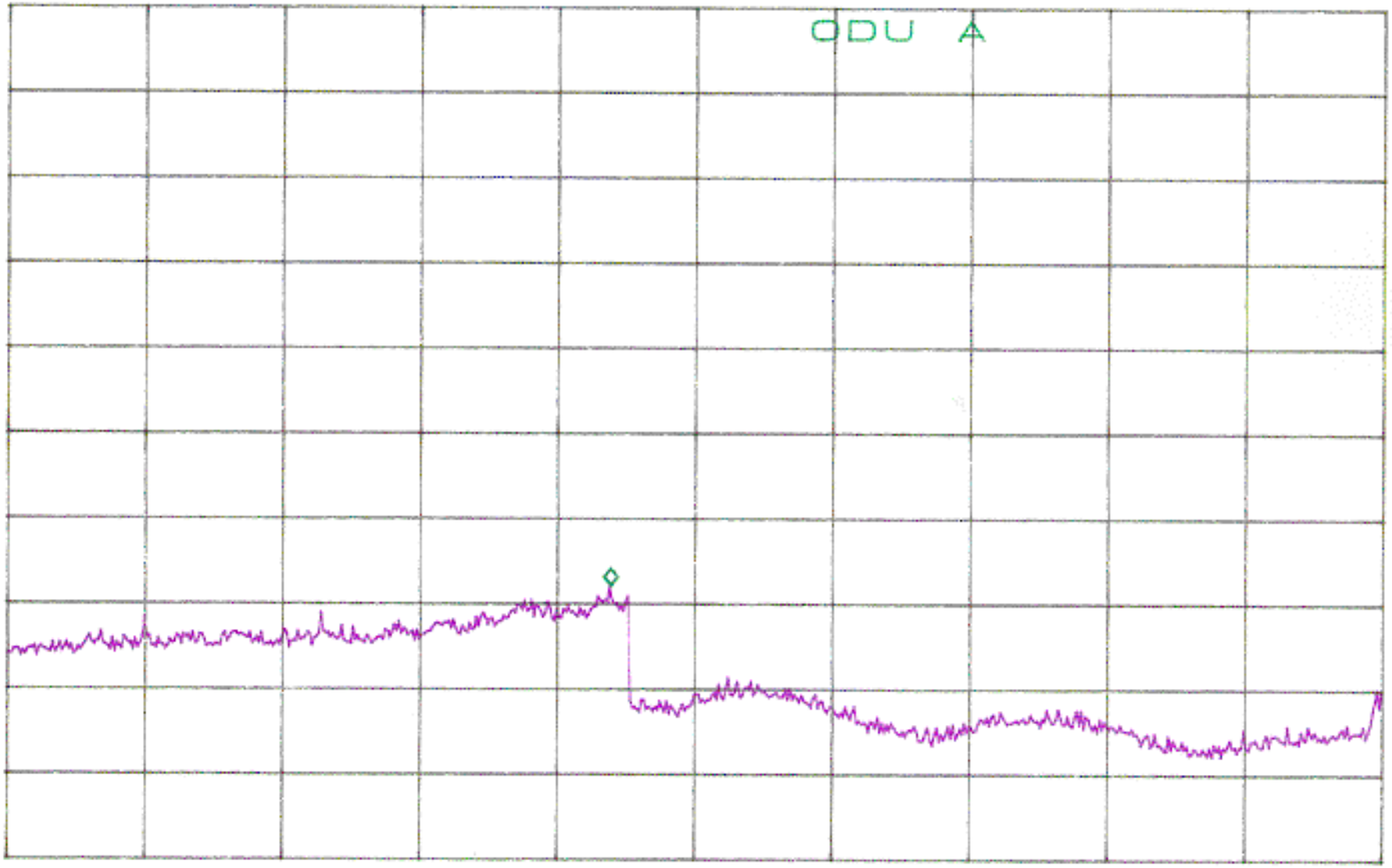
START 30.0MHz STOP 1.0000GHz
*RBW 1.0MHz *VBW 1.0MHz SWP 50.0ms

T30880
Run 3

C.

*ATTEN 0dB
RL -25.0dBm 5dB/

MKR -58.92dBm
2.841GHz
ODU A

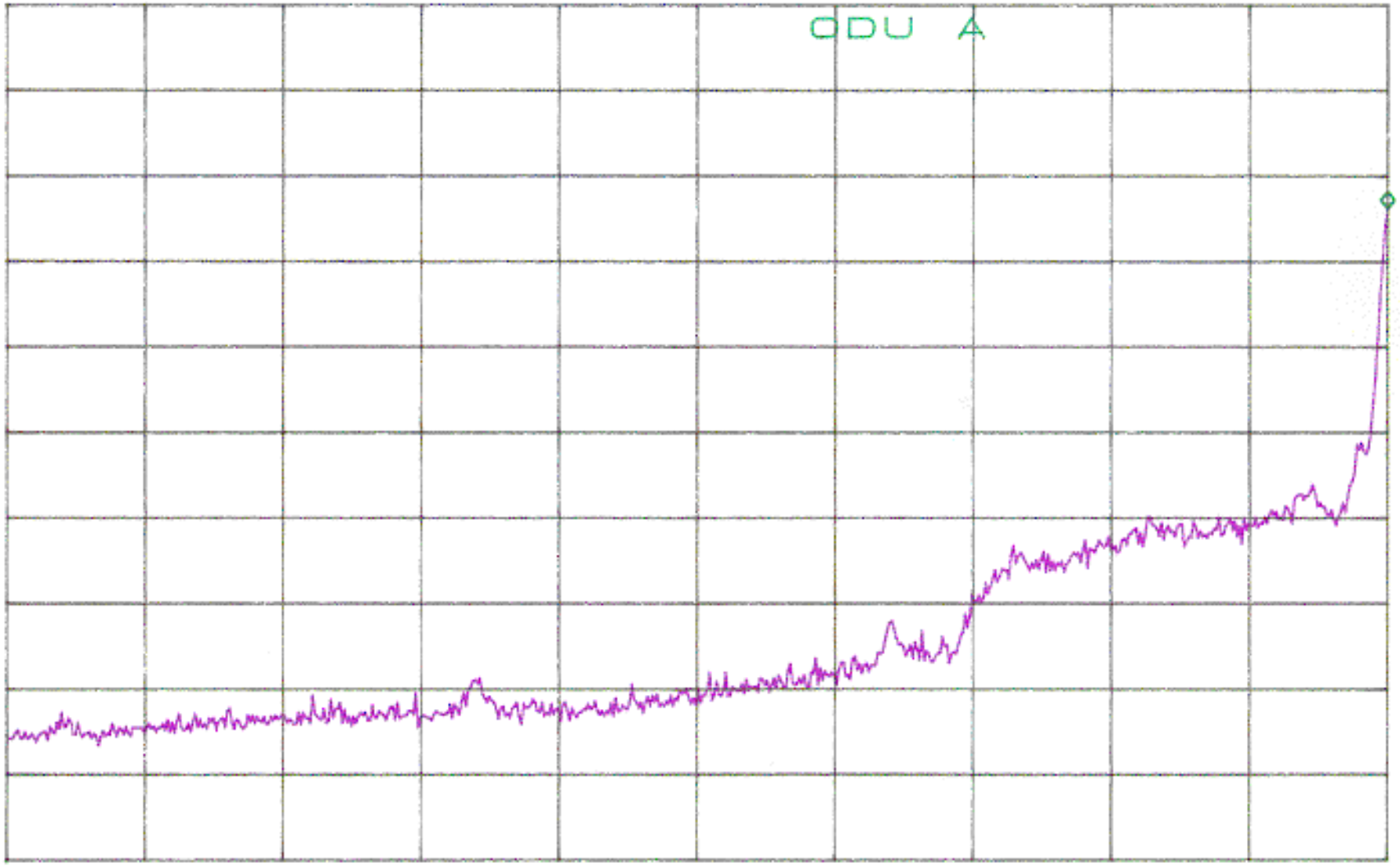


START 1.000GHz STOP 5.200GHz
RBW 1.0MHz *VBW 1.0MHz SWP 84.0ms

T30880 Run 3 C.C

*ATTEN 0dB
RL -25.0dBm 5dB/

MKR -36.83dBm
5.2500GHz
ODU A



START 5.1500GHz STOP 5.2500GHz
*RBW 1.0MHz *VBW 1.0MHz SWP 50.0ms

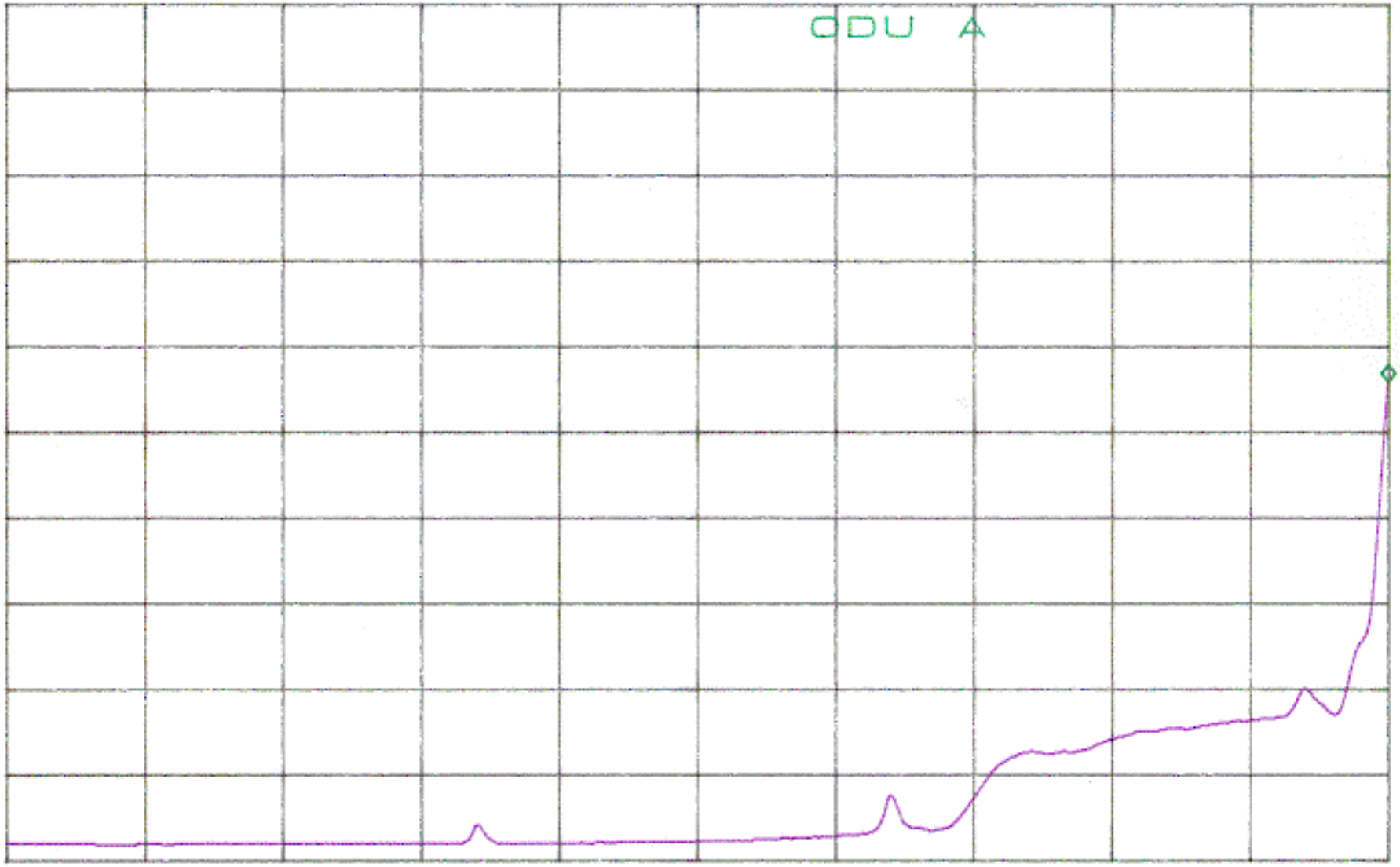
T30880 Run 3 C. Ch

*ATTEN 0dB MKR -47.00dBm

RL -25.0dBm 5dB/ 5.2500GHz

ODU A

D



START 5.1500GHz STOP 5.2500GHz

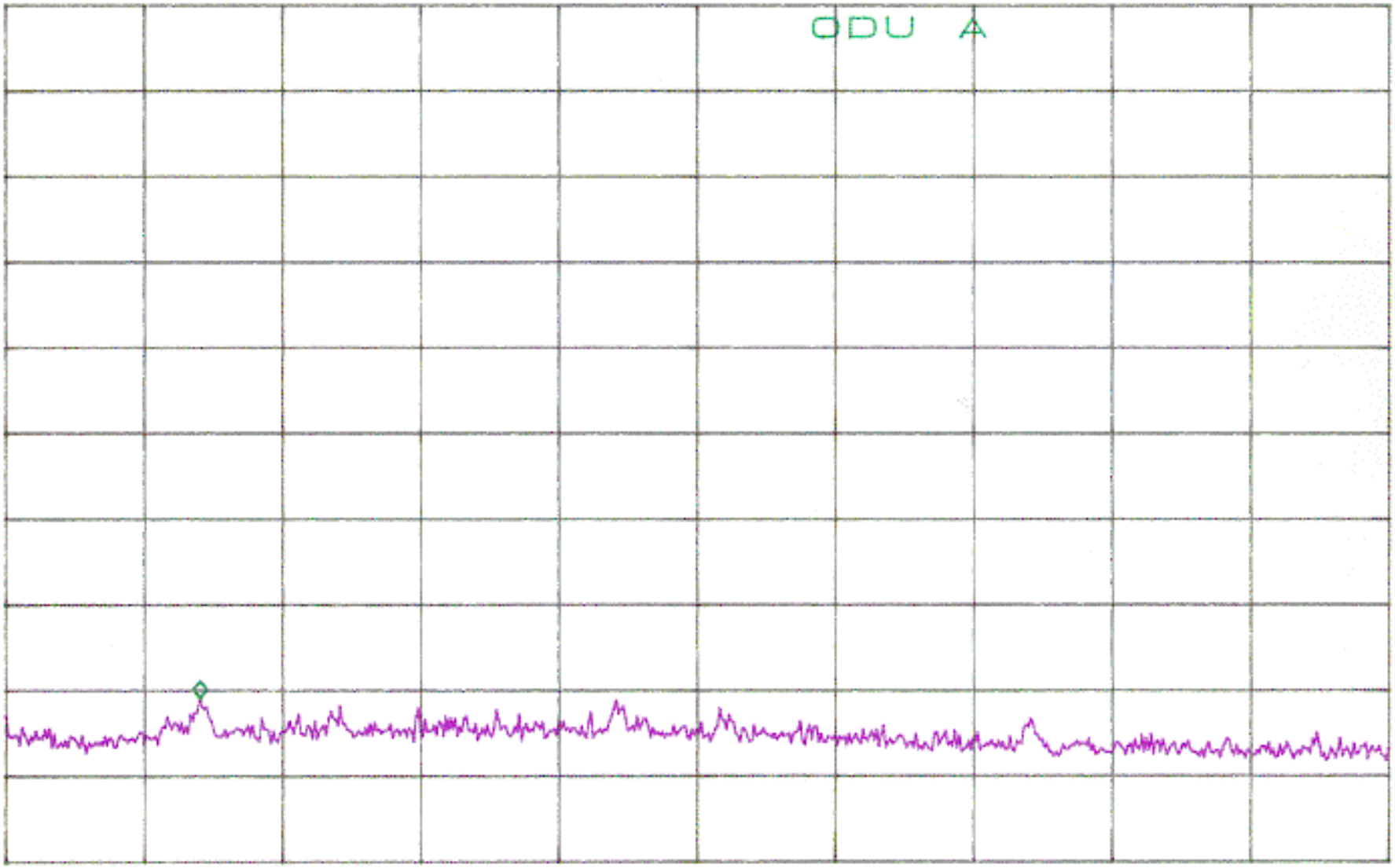
*RBW 1.0MHz *VBW 10Hz SWP 25.0sec

T30880 Run3 C.

*ATTEN 0dB MKR -65.42dBm

RL -25.0dBm 5dB/ 5.3640GHz

ODU A



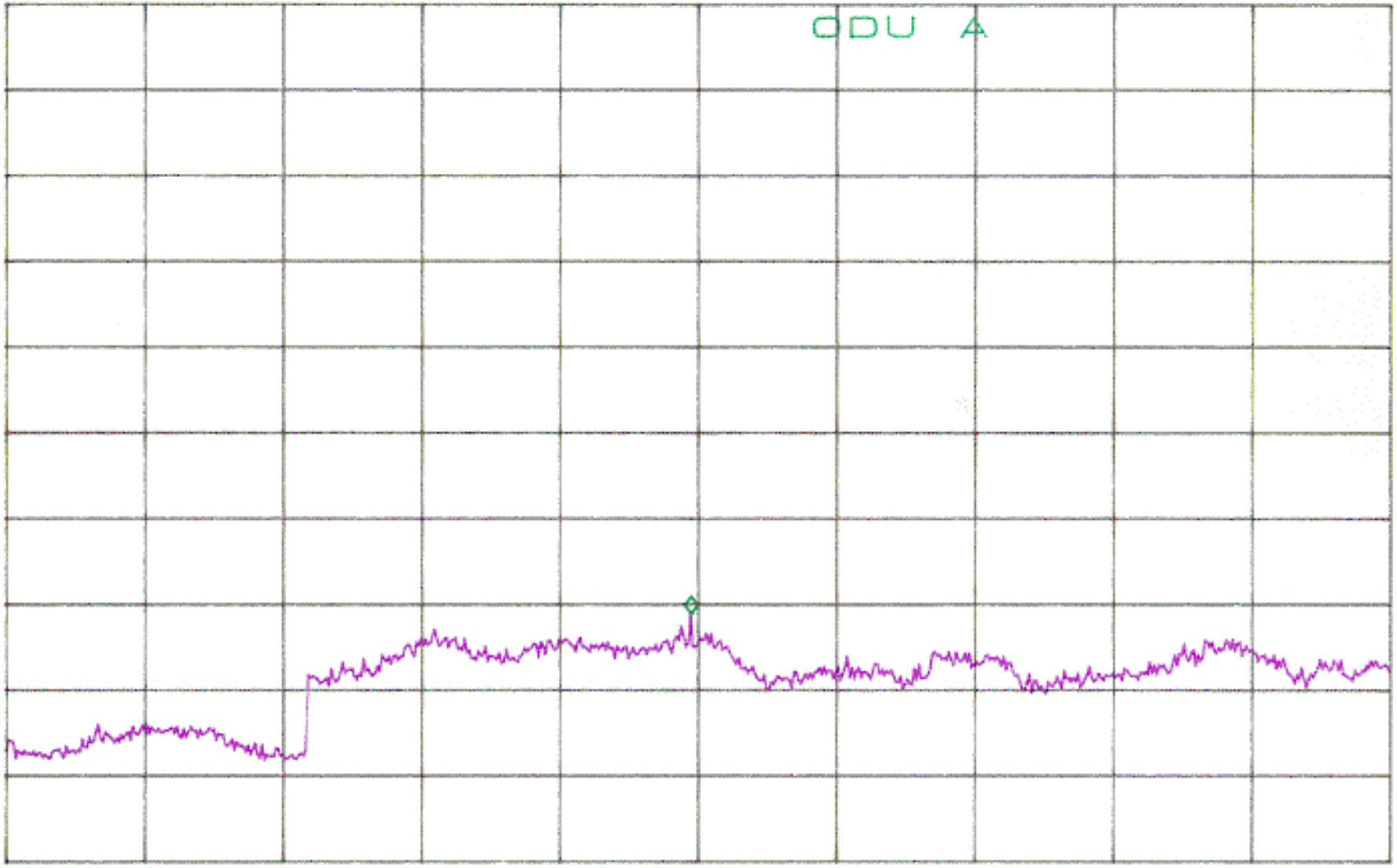
START 5.3500GHz STOP 5.4500GHz

*RBW 1.0MHz *VBW 1.0MHz SWP 50.0ms

T30880 Run 3 C.C

*ATTEN 0dB
RL -25.0dBm 5dB/

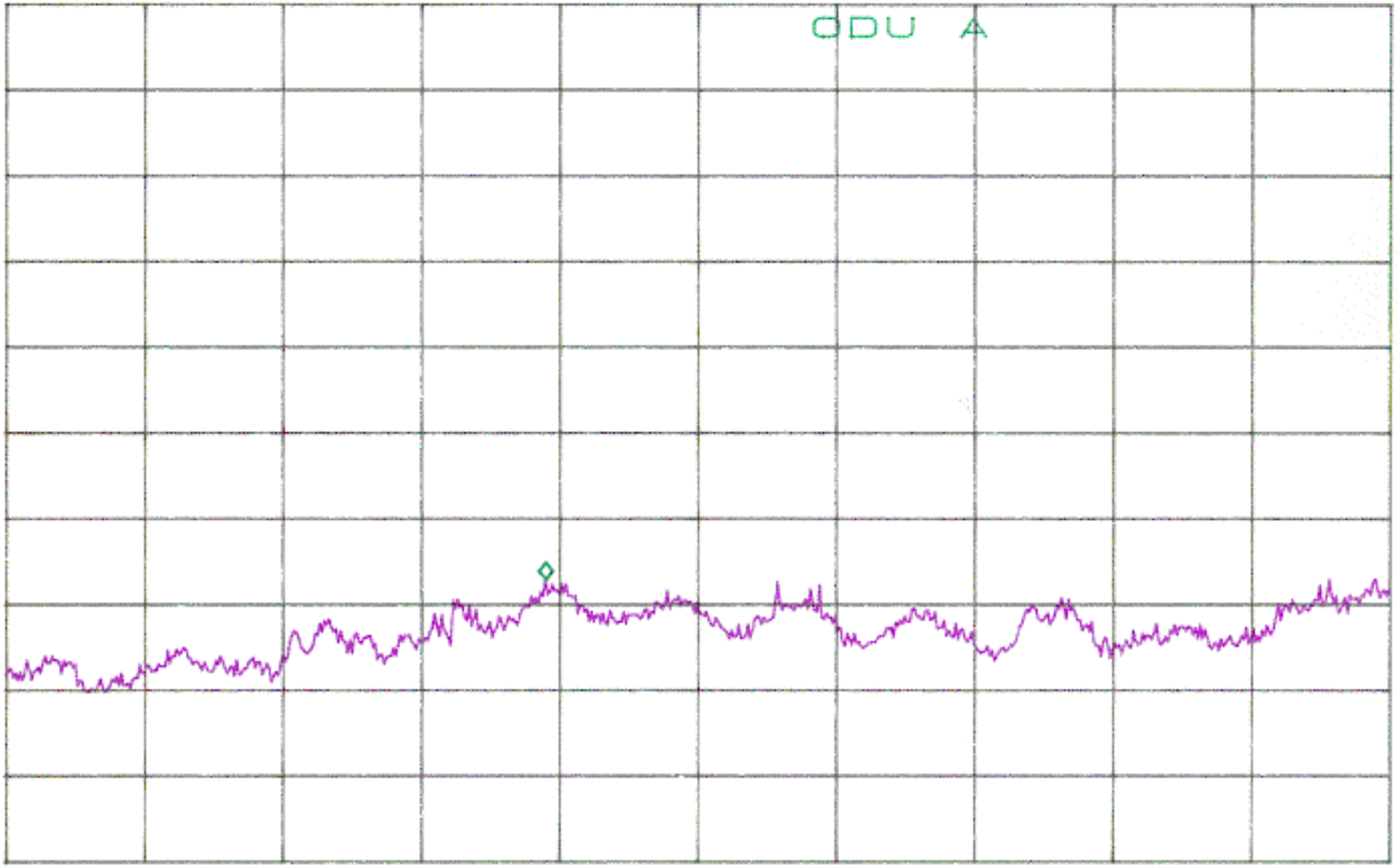
MKR -60.50dBm
7.702GHz
ODU A



START 5.450GHz STOP 10.000GHz
*RBW 1.0MHz *VBW 1.0MHz SWP 91.0ms

T30880 Run3 C.C

*ATTEN 0dB MKR -58.50dBm
RL -25.0dBm 5dB/ 13.90GHz
ODU A



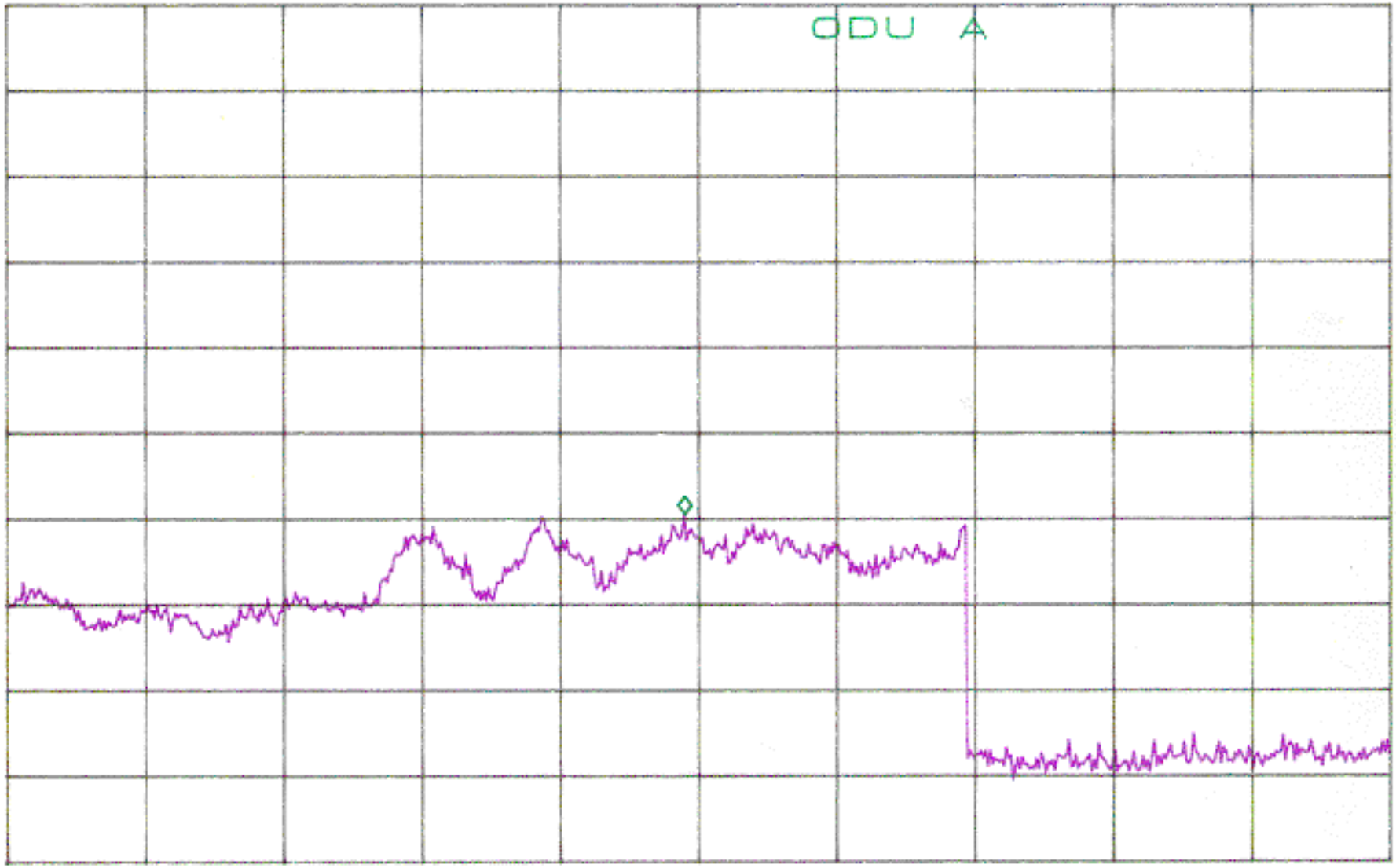
START 10.00GHz STOP 20.00GHz
*RBW 1.0MHz *VBW 1.0MHz SWP 200ms

T30880 Run 3 C.C.

*ATTEN 0dB MKR -54.67dBm

RL -25.0dBm 5dB/ 24.90GHz

ODU A



START 20.00GHz STOP 30.00GHz

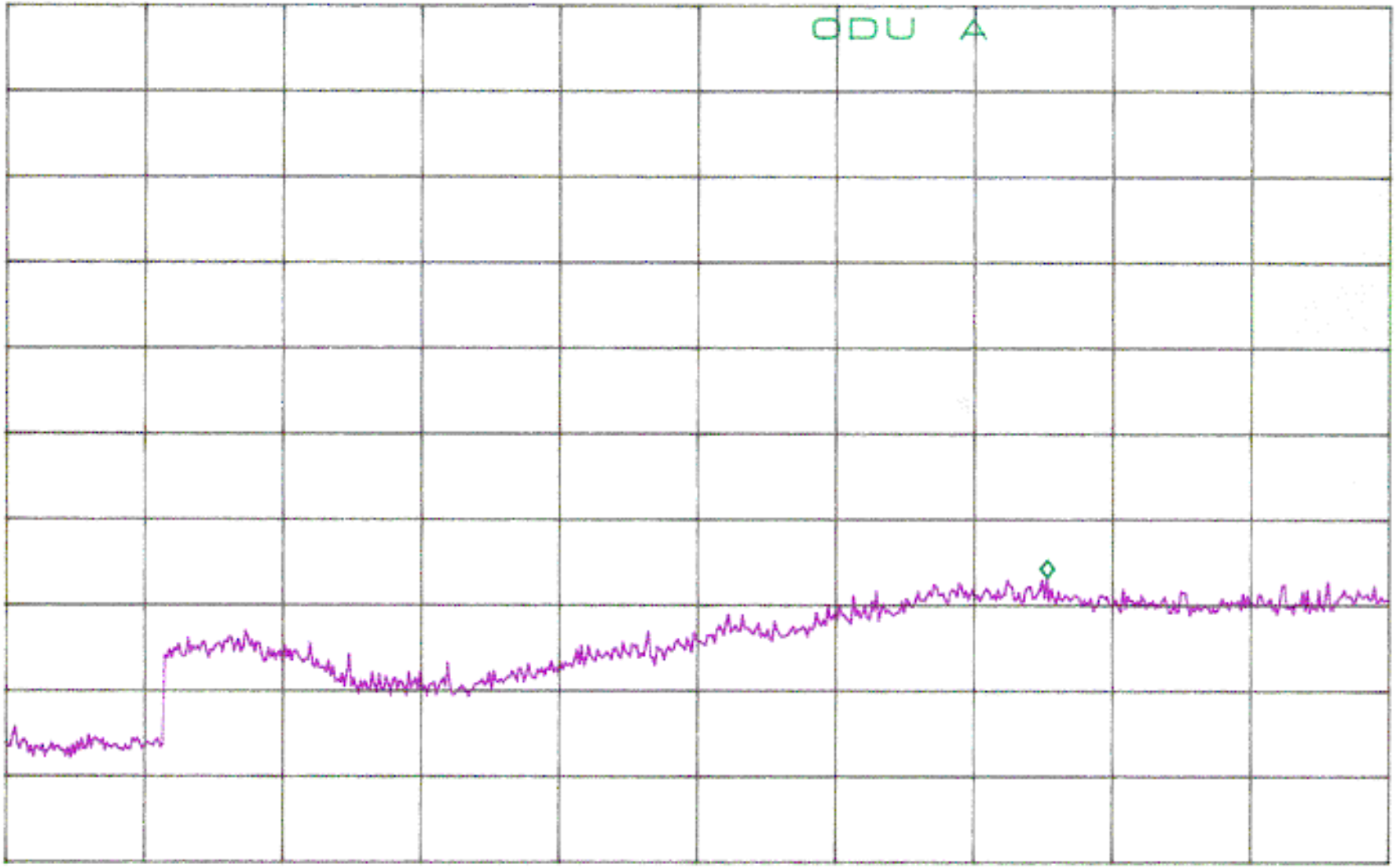
*RBW 1.0MHz *VBW 1.0MHz SWP 200ms

T30880 Run3

C.C

*ATTEN 0dB
RL -25.0dBm 5dB/

MKR -58.33dBm
37.53GHz
ODU A

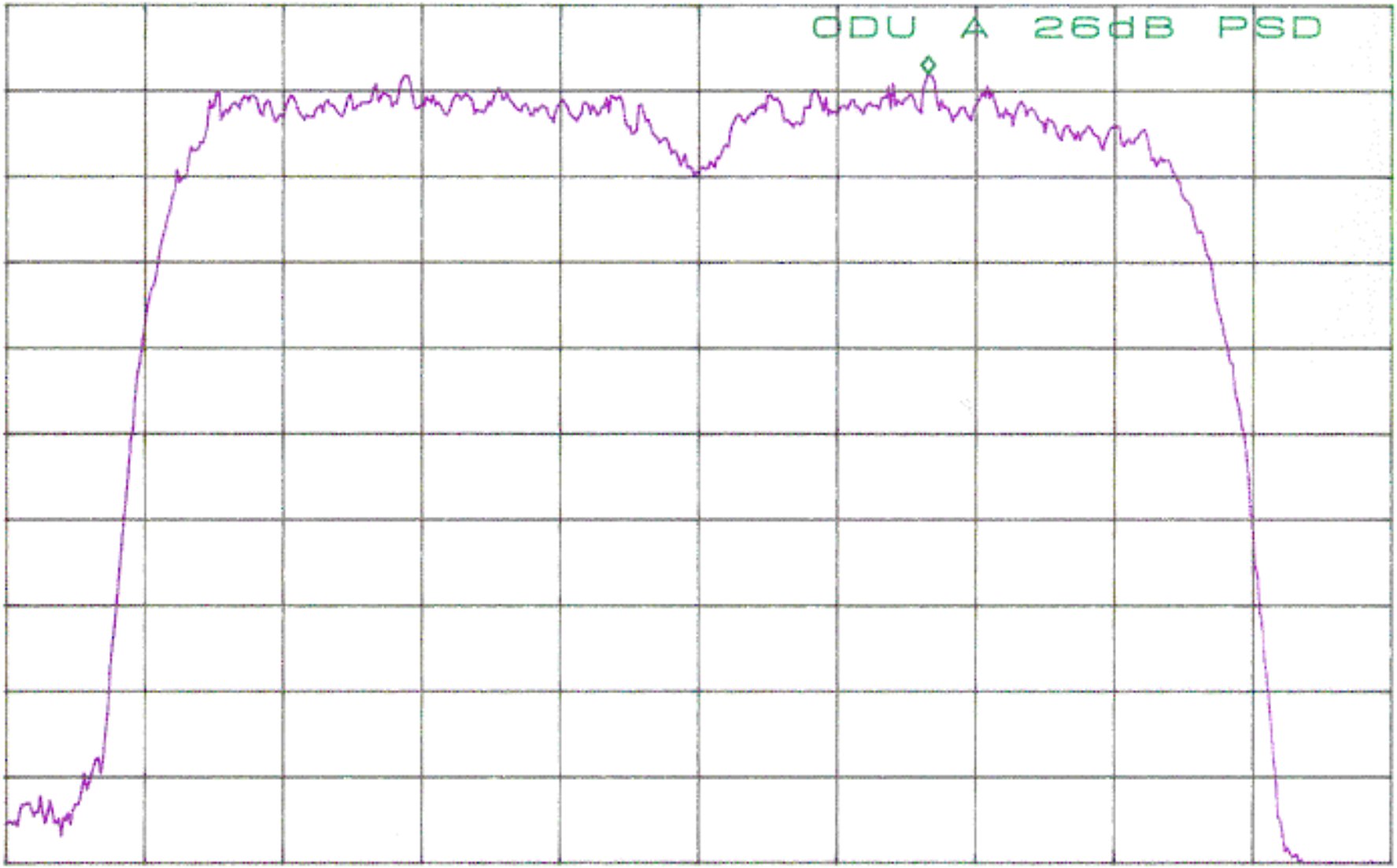


START 30.00GHz STOP 40.00GHz
*RBW 1.0MHz *VBW 1.0MHz SWP 200ms

T30880 Run 3 C.C

ATTEN 10dB MKR -9.00dBm

RL -5.0dBm 5dB/



CENTER 5.28762 GHz C.C. SPAN 89.84 MHz C.C.

RBW 1.0MHz *VBW 1.0MHz SWP 50.0ms

T30880 Run 2c C.C.

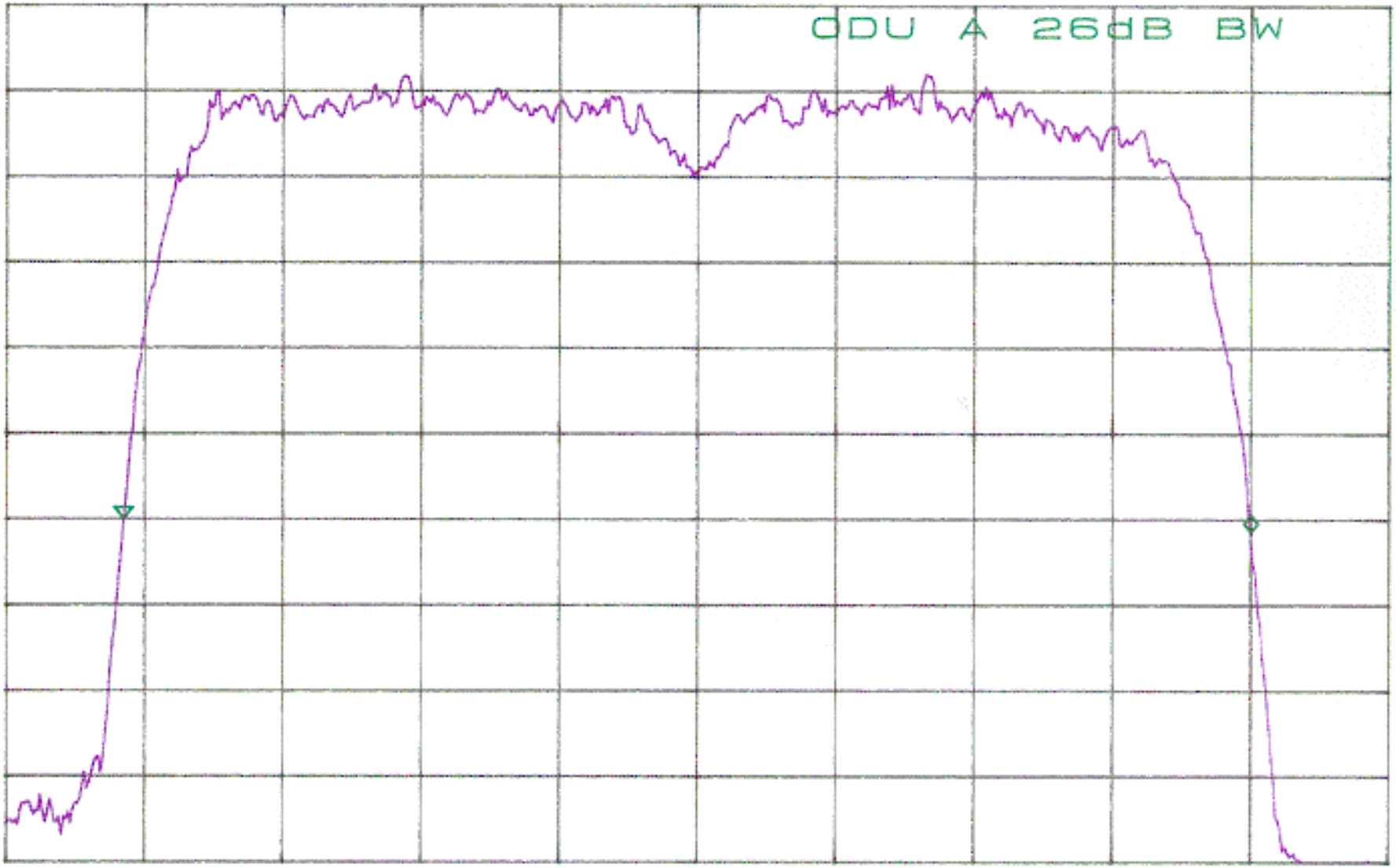
ATTEN 10dB

RL -5.0dBm 5dB/

ΔMKR -.75dB

73.22MHz

ODU A 26dB BW



CENTER 5.28762GHz

SPAN 89.84MHz

RBW 1.0MHz *VBW 1.0MHz

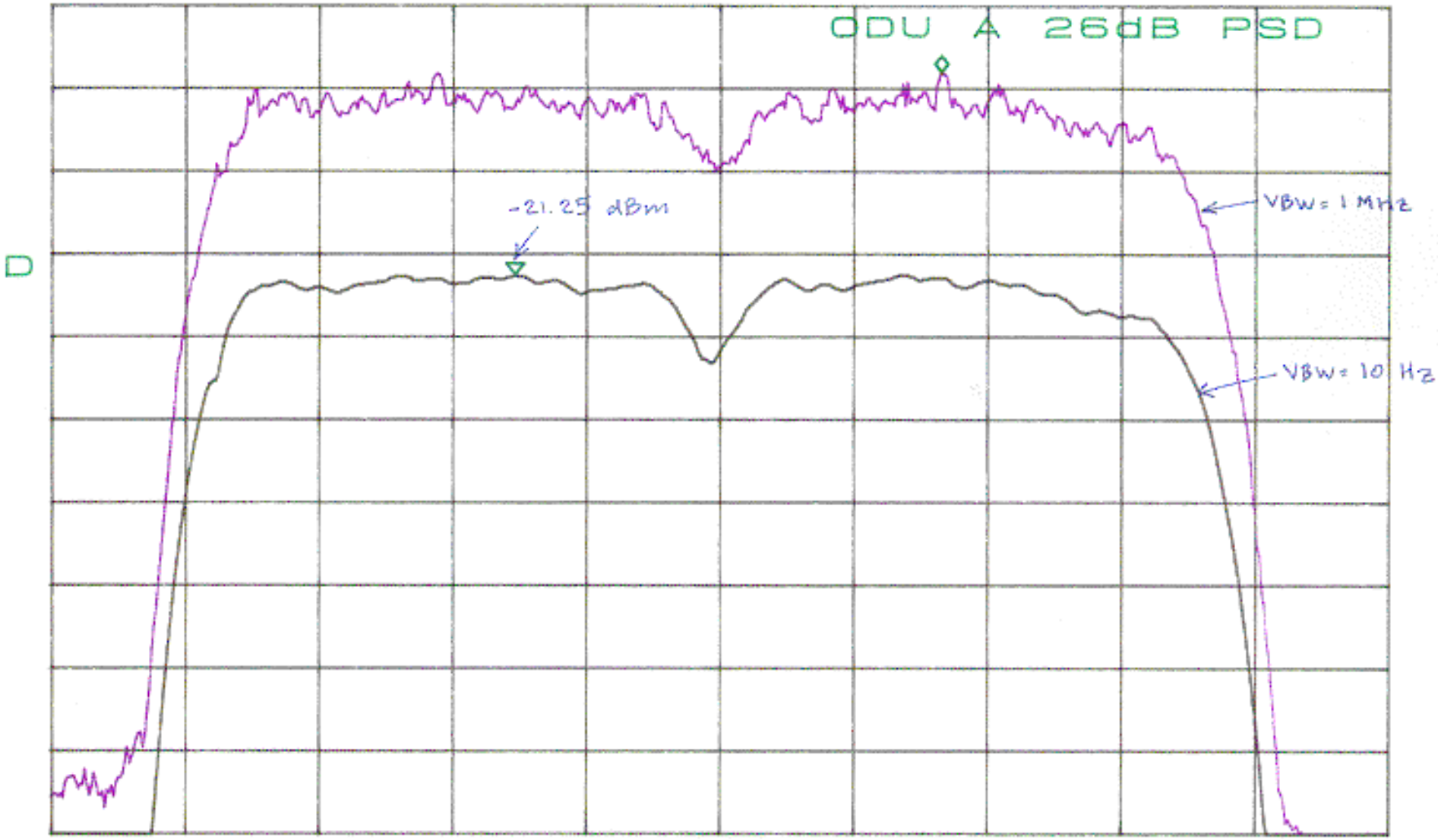
SWP 50.0ms

Run 2A
T30880

ATTEN 10dB

RL −5.0dBm 5dB/

ΔMKR 12.25dB



CENTER

RBW 1.0MHz *VBW 10Hz

SPAN

SWP 23.0sec

Run 2d

T30880

CC

EXHIBIT 3: Radiated Emissions Test Configuration Photographs

EXHIBIT 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

Contained in file: R31010 Label.pdf

2 Pages

EXHIBIT 6:Detailed Photographs of WaveSpan Model Stratum 100 Construction

Contained in file: R31010 DetailPhoto.pdf

13 Photos

EXHIBIT 7:Operator's Manual for WaveSpan Model Stratum 100

Contained in file: R31010 UserManual.pdf

67 Pages

EXHIBIT 8:Block Diagram of WaveSpan Model Stratum 100

Contained in file: R31010 Block.pdf
This Exhibit is to be held confidential.

2 Pages

EXHIBIT 9:Schematic Diagrams for WaveSpan Model Stratum 100

Contained in file: R31010 Schem.pdf
This Exhibit is to be held confidential.

56 Pages

EXHIBIT 10:Theory of Operation for WaveSpan Model Stratum 100

Contained in file: R31010 Theory.pdf
This Exhibit is to be held confidential.

25 Pages