FCC Certification Test Report

FCC Certification Test Report for Demarc Technologies Group, LLC QGK-DT100

October 8, 2002

Prepared for:

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Prepared By:

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FCC Certification Test Report
for the
Demarc Technologies Group, LLC
DT-ZM-100MW-WC 2.4 GHz DSSS
QGK-DT100

WLL JOB# 7165

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President

Abstract

This report has been prepared on behalf of Demarc Technologies Group, LLC to support the attached Application for Equipment Authorization. The test report and application are submitted for a Spread Spectrum Transceiver under Part 15.247 of the FCC Rules and Regulations. This Federal Communication Commission (FCC) Certification Test Report documents the test configuration and test results for a Demarc Technologies Group, LLC DT-ZM-100MW-WC 2.4 GHz DSSS.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

The Demarc Technologies Group, LLC DT-ZM-100MW-WC 2.4 GHz DSSS complies with the limits for a Spread Spectrum Transceiver device under Part 15.247 of the FCC Rules and Regulations.

Table of Contents

List of Tables

List of Figures

1 Introduction

1.1 Compliance Statement

The Demarc Technologies Group, LLC DT-ZM-100MW-WC Spread Spectrum System complies with the limits for a Spread Spectrum Transceiver device under Part 15.247 of the FCC Rules and Regulations.

1.2 Test Scope

Tests for radiated and conducted emissions were performed. All measurements were performed according to the 1992 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	Demarc Technologies Group, LLC 40 Fairview Road Frenchtown, NJ 08825
Quotation Number:	60022

1.4 Test Dates

Testing was performed from June 27, 2002 to June 28, 2002.

1.5 Test and Support Personnel

Washington Laboratories, LTD	James Ritter
Customer	Tony Morella

1.6 Abbreviations

A	Ampere
Ac	alternating current
AM	Amplitude Modulation
Amps	Amperes
b/s	bits per second
BW	Bandwidth
CE	Conducted Emission
cm	centimeter
CW	Continuous Wave
dB	decibel
dc	direct current
EMI	Electromagnetic Interference
EUT	Equipment Under Test
FM	Frequency Modulation
G	giga - prefix for 10^9 multiplier
Hz	Hertz
IF	Intermediate Frequency
k	kilo - prefix for 10^3 multiplier
M	Mega - prefix for 10^6 multiplier
m	Meter
μ	micro - prefix for 10^{-6} multiplier
NB	Narrowband
LISN	Line Impedance Stabilization Network
RE	Radiated Emissions
RF	Radio Frequency
rms	root-mean-square
SN	Serial Number
S/A	Spectrum Analyzer
V	Volt

2 Equipment Under Test

2.1 EUT Identification & Description

The Demarc Technologies Group, LLC DT-ZM-100MW-WC 2.4 GHz DSSS is a wireless LAN card that is based on the Senao PC LAN Card (FCC ID: NI3-25CD-PLUS). The original device was Certified by AmericanTCB on April 26, 2002.

The EUT is powered by host equipment; a unique connector has been installed in place of the patch antenna from the Certified Card to allow the connection of two different antennas to increase the gain and range of the device. The device is provided with a unique (reverse MMCX) connector so that only the approved antennas may be used with the device.

The EUT is designed to be a modular unit that will be used with various types of units.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	Demarc Technologies Group, LLC
FCC ID Number	QGK-DT100
EUT Name:	Reliawave 100
Model:	DT-ZM-100MW-WC
FCC Rule Parts:	§15.247
Frequency Range:	2412.67 MHz - 2462.5 MHz
Maximum Output Power:	20.3dBm (107mW) @2412 MHz
Modulation:	Direct Sequence Spread Spectrum
Occupied Bandwidth:	6.47MHz
Keying:	Automatic
Type of Information:	Data
Number of Channels:	11
Antenna Type	Two types: Omnidirectional Antenna – SPG17E-450 17.8dbi Plate Antenna – SPFPG18 18dbi
Frequency Tolerance:	N/A
Emission Type(s):	N/A
Interface Cables:	See Section 2.2
Power Source & Voltage:	120VAC via support PC

2.2 Test Configuration

The EUT was configured with a support notebook PC (Dell Model PPM0027V for radiated testing and HP Pavilion Model 6645C for conducted testing). An extender card was used for the interface to the PC during testing. The extender card was used so that the EUT was fully exposed during the test thus allowing use in different devices.

The following antennas were used during testing:

- 45° Sector Panel Antenna – SPG17E-450, 17.8dbi
- Directional Panel Antenna – SPFPG18, 18dbi

These antennas represent the highest gain for each type of antenna used. The Omni directional antennas listed in the manual are the panel antennas with no deflection plate attached.

The EUT firmware/software was set up for a data sequence provided by the CPRISM test appliance software (Version 3.0.22).

The following cables were used on the DT-ZM-100MW-WC during testing:

Port/Cable Description	Shielding	Length	Connected (from/to)
P/N: DTRPMMCX-NM-PIG	Yes	0.3 meters	PCMIA RCV Port to 50Ω terminator
P/N: DTRPMMCX-NM-PIG	Yes	0.3 meters	PCMIA RCV Port to Antenna

2.3 Testing Algorithm

The DT-ZM-100MW-WC 2.4 GHz DSSS was operated continuously by powering the notebook PC, which used client-supplied software (MODES.CPRISM TEST APLIANCE VER 3.0.22) to set control channels.

2.4 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

2.5 Measurements

2.5.1 References

FCC97114 Report & Order, Appendix C: Guidance on Measurements for Direct Sequence Spread Spectrum Systems

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

Land Mobile FM or PM Communications Equipment Measurement and Performance Standards (ANSI/TIA/EIA-603-93)

2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. The measurement uncertainty of the data contained herein is ±2.3 dB.

For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is ± dB. This has been calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

Total Uncertainty = $(A^2 + B^2 + C^2)^{1/2}/(n-1)$

where:

A = Antenna calibration uncertainty, in dB = 2 dB

B = Spectrum Analyzer uncertainty, in dB = 1 dB

C = Site uncertainty, in dB = 4 dB

n = number of factors in uncertainty calculation = 3

Thus, total uncertainty = $0.5\ (2^2 + 1^2 + 4^2)^{1/2}$ = ±2.3 dB.

3 Test Equipment

Table 2 shows a list of the test equipment used for measurements along with the calibration information.

Table 2. Test Equipment List

Manufacturer & Model	Description	Serial Number	Property Number	Calibration Due Date
A.H. Systems SAS-200/518	Log Periodic Antenna	117	00001	3/1/03
Antenna Research Associates DRG-118/A	Horn Antenna	1010	00004	10/20/02
Antenna Research Associates LPB-2520	Biconilog Antenna Site 2	1044	00007	6/19/03
Hewlett Packard 8449B	Pre-Amplifier	3008A00729	00066	1/31/03
Hewlett Packard 8564E	Spectrum Analyzer	3643A00657	00067	4/18/03
Hewlett Packard 85650A	Q.P. Adapter (Site 2)	2811A01283	00068	7/5/03
Hewlett Packard 85685A	RF Preselector (Site 2)	3221A01395	00071	5/17/03
Hewlett Packard 8568B	Spectrum Analyzer (Site 2)	2928A04750	00072	7/3/03
Solar Electronics 8012-50-R-24-BNC	LISN	8379493	00124	8/15/02

4 Test Results

4.1 RF Power Output

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer (HP8564E). The method of measurement chosen was one that has been an acceptable test procedure per the FCC. The following describes the test procedure used.

Using the spectrum analyzers Band Power Measurement Function over the appropriate emission bandwidth (6dB bandwidth + 2MHz) gives the peak output reading. The following table lists the conducted power measurements.

Table 3. RF Power Output

Frequency	Level	Limit	Pass/Fail
Channel 1 2412 MHz	20.3 dBm	30dBm	Pass
Channel 6 2437.6 MHz	19.6 dBm	30dBm	Pass
Channel 11 2462.6 MHz	19.9 dBm	30dBm	Pass

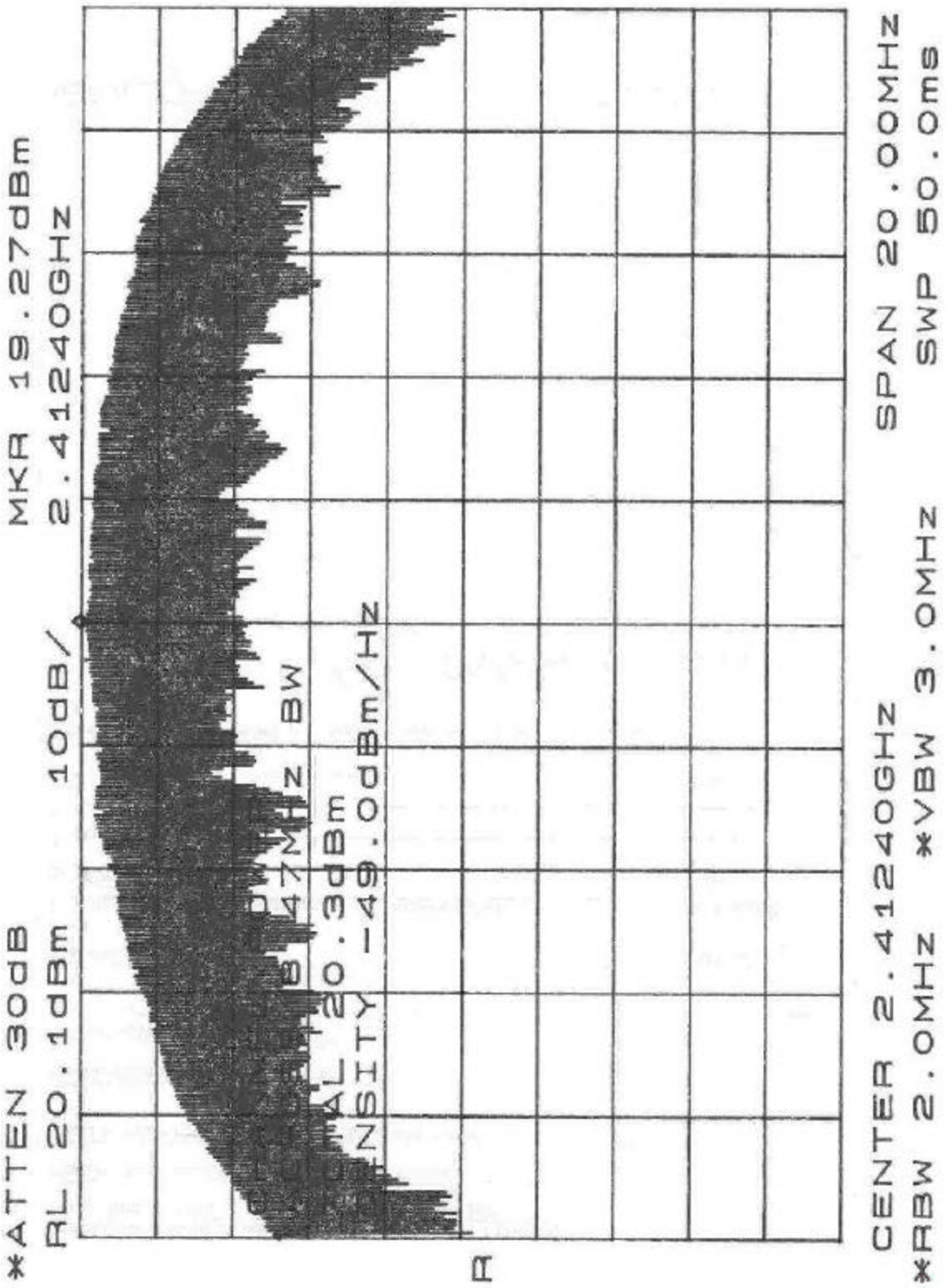

Figure 1: Conducted Output Power, Channel 1

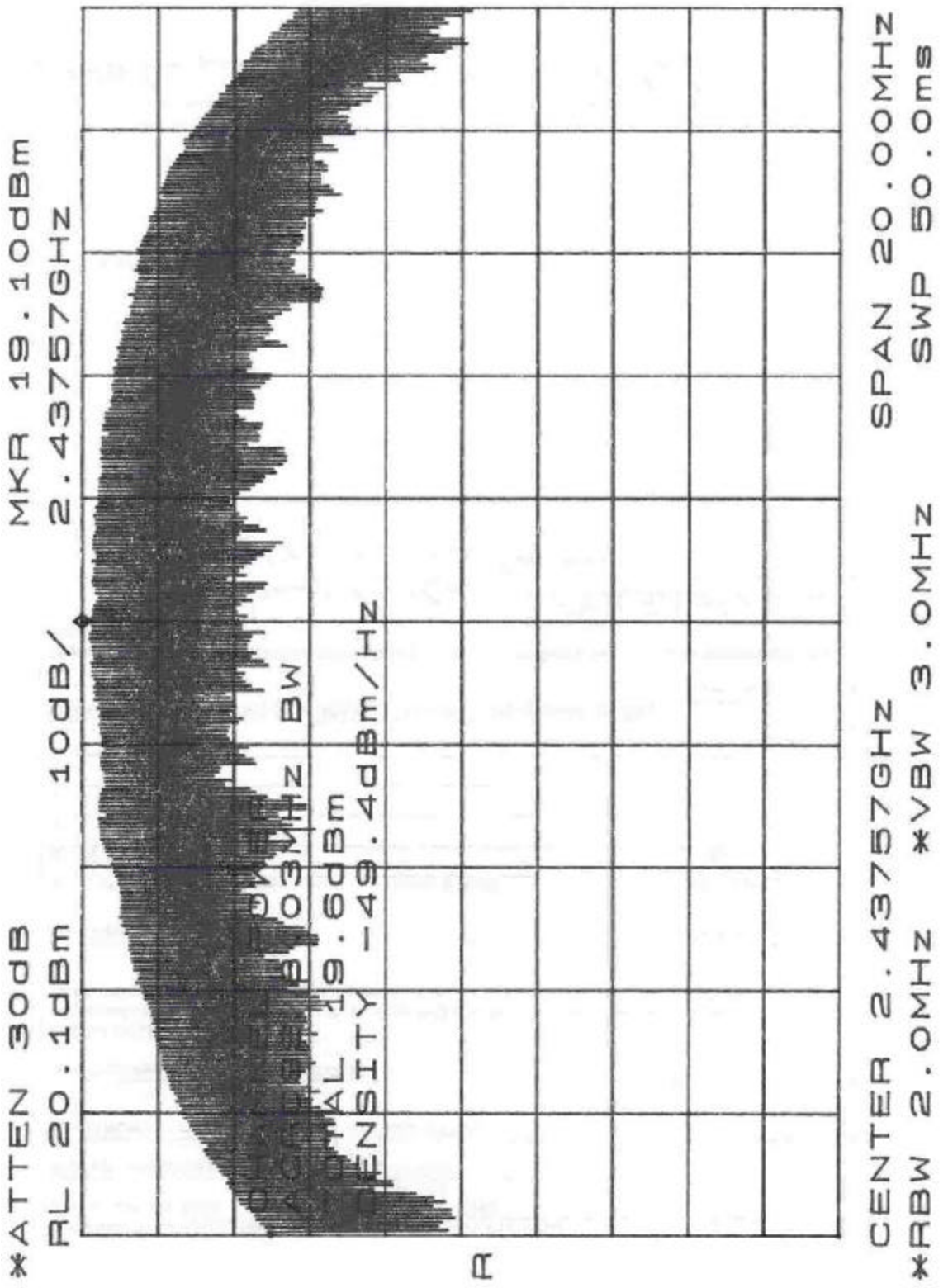

Figure 2: Conducted Output Power, Channel 6

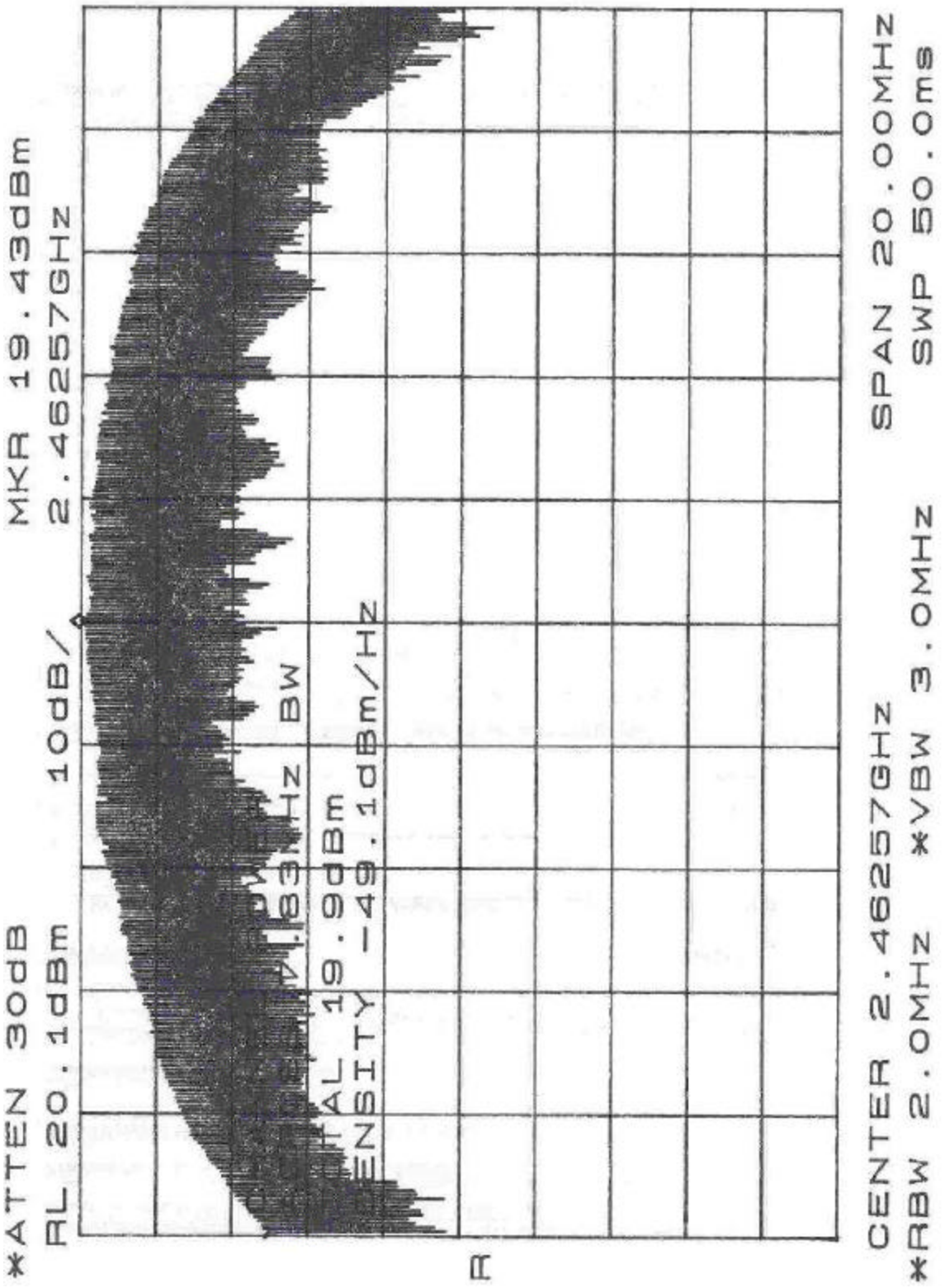

Figure 3: Conducted Output Power, Channel 11

4.2 Power Spectral Density

For DSSS devices, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band.

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer. The analyzer offset was adjusted to compensate for the attenuator and other losses in the system.

The carrier was modulated internally via firmware that provided loop-back data to the rear-panel T1 connectors.

Table 4. Power Spectral Density

Frequency	Level	Limit	Pass/Fail
Channel 1 2412 MHz	-5.5 dBm	8 dBm	Pass
Channel 6 2437.8 MHz	-6.2 dBm	8 dBm	Pass
Channel 11 2462.4 MHz	-4.5 dBm	8 dBm	Pass

4.3 Occupied Bandwidth

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer.

For Direct Sequence Spread Spectrum Systems, FCC Part 15.247 requires that the minimum 6 dB bandwidth be at least 500 kHz.

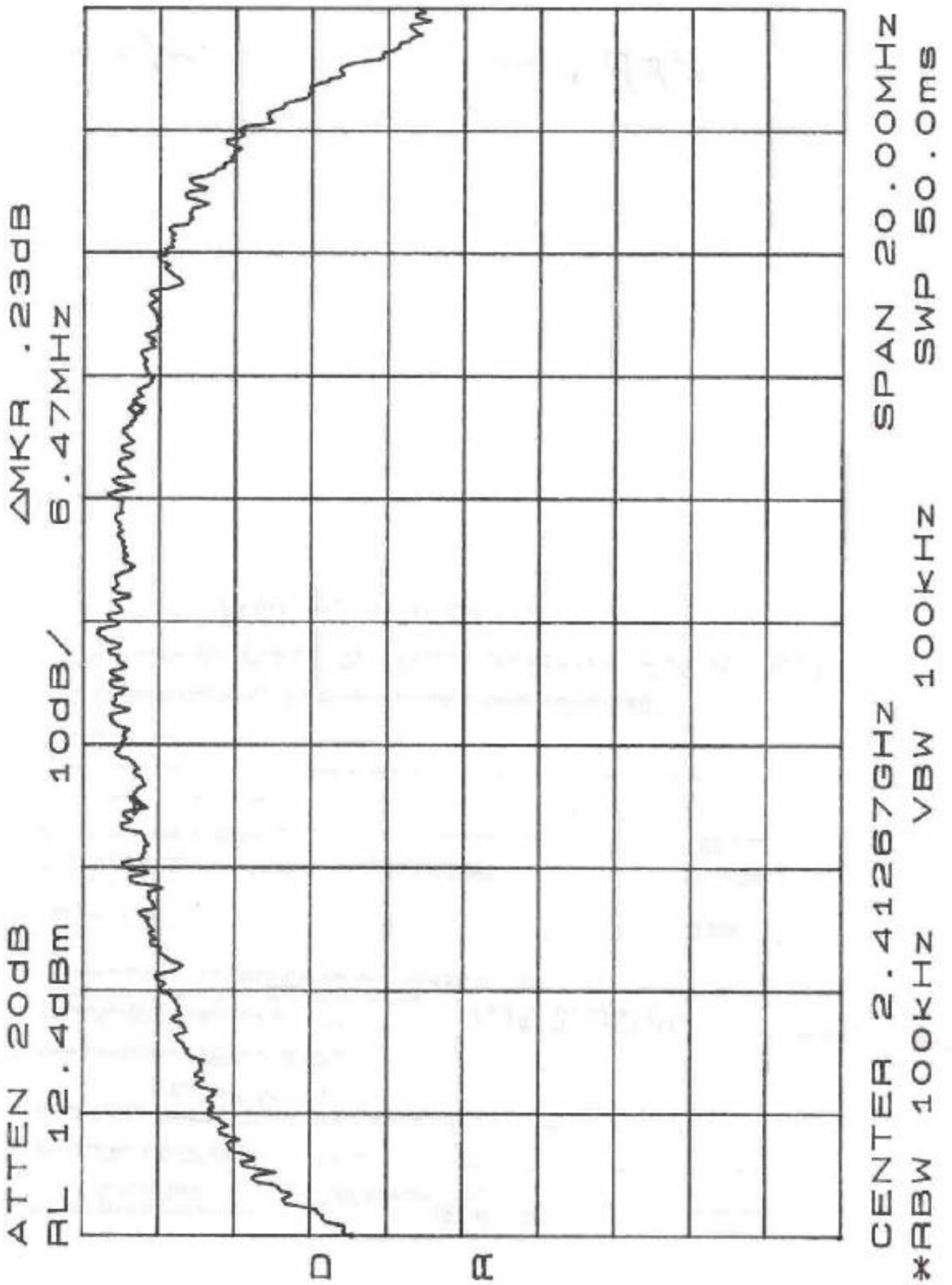

Figure 4. Occupied Bandwidth Channel 1

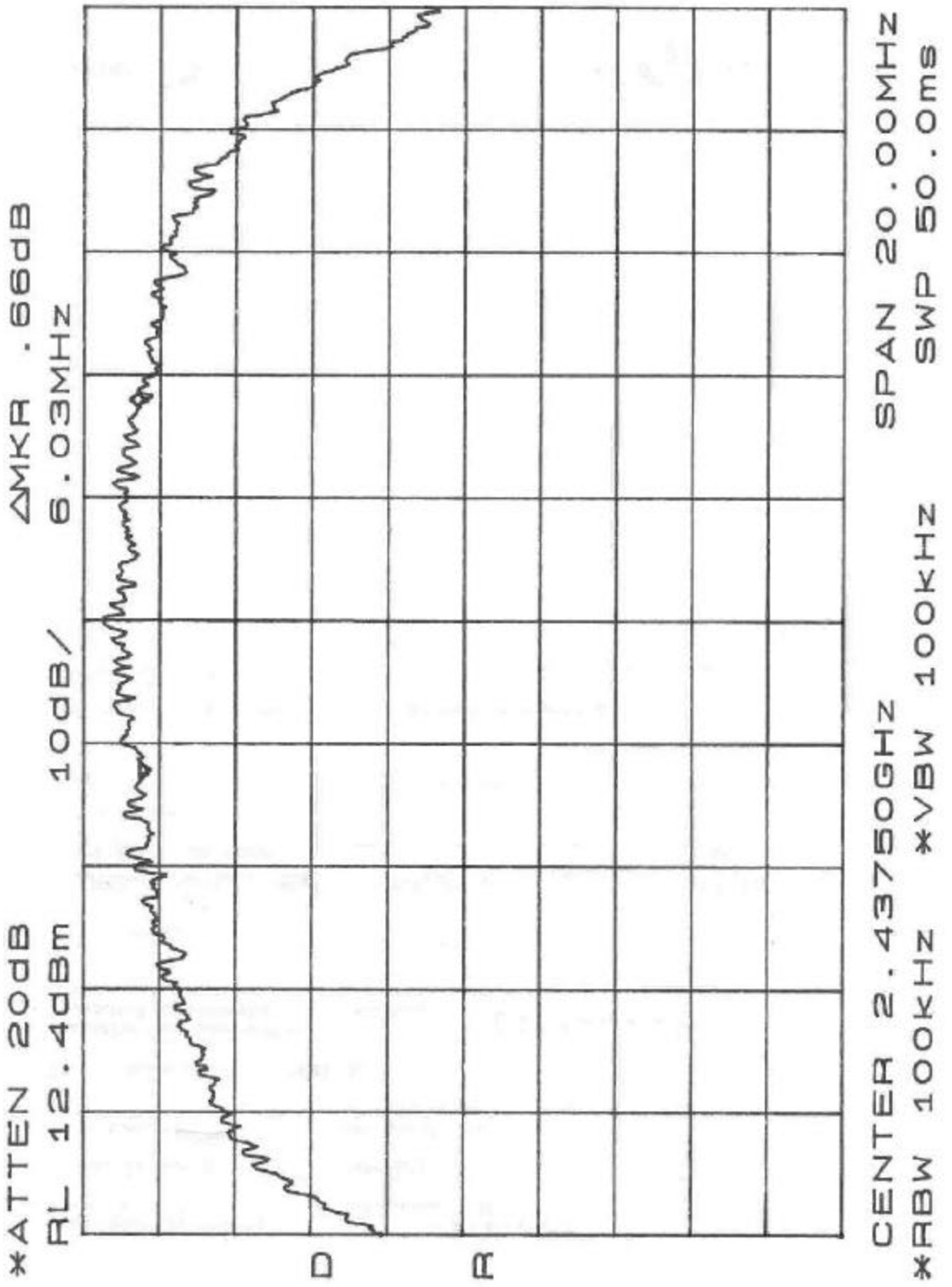

Figure 5. Occupied Bandwidth Channel 6

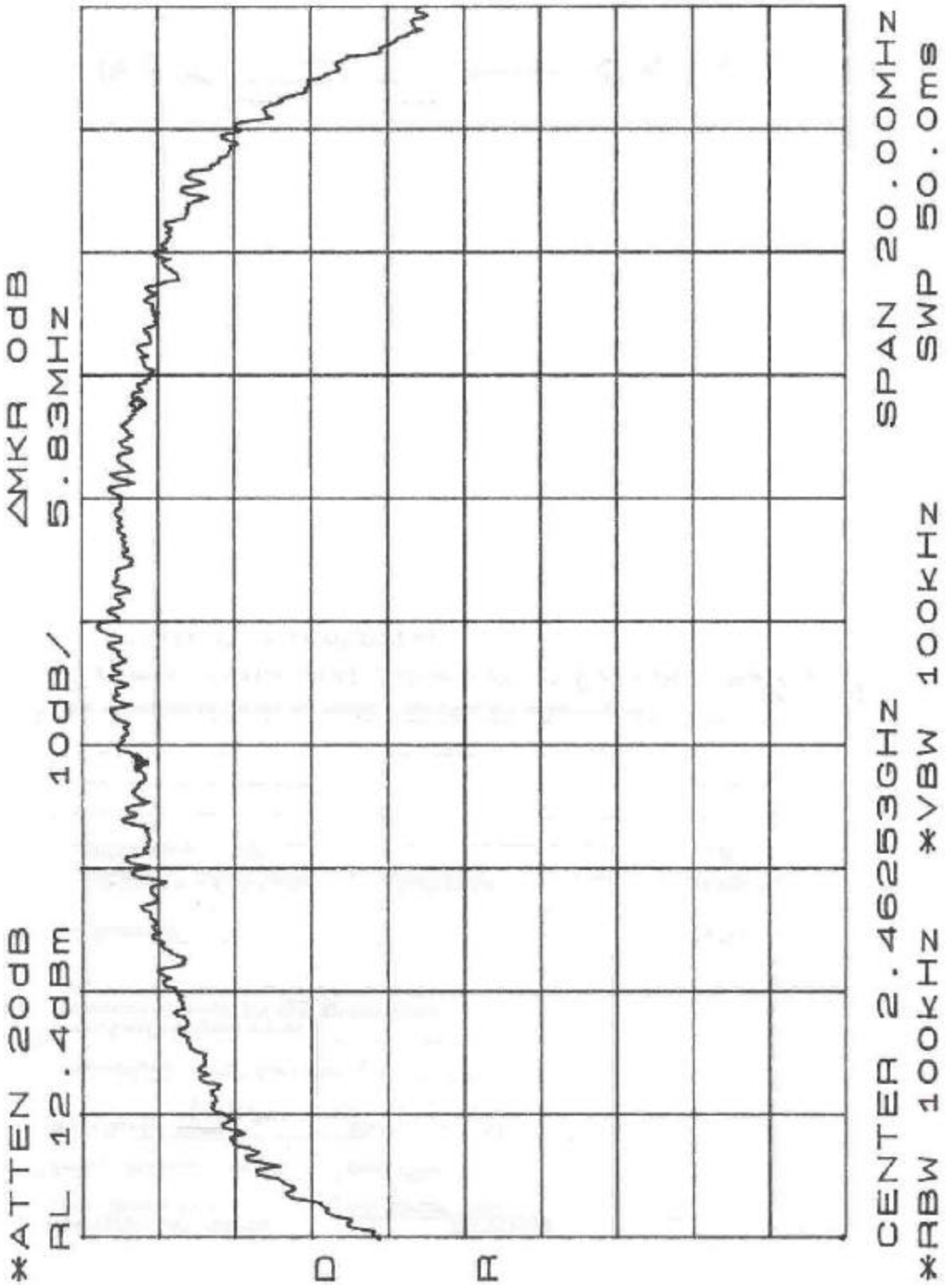

Figure 6. Occupied Bandwidth Channel 11

Table 5 provides a summary of the Occupied Bandwidth Results.

Table 5. Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
Channel 1 2412 MHz	6.47 MHz	> 500 kHz	Pass
Channel 6 2437.5 MHz	6.03 MHz	> 500 kHz	Pass
Channel 11 2462.5 MHz	5.83 MHz	> 500 kHz	Pass

4.4 Spurious Emissions at Antenna Terminals (FCC Part §15.247(b))

In any 100 kHz band outside the frequency band in which the system is operating, the RF power shall be at least 20dB below that in the 100 kHz bandwidth that contain the highest level of the desired power.

See the plots of conducted emissions plots below.

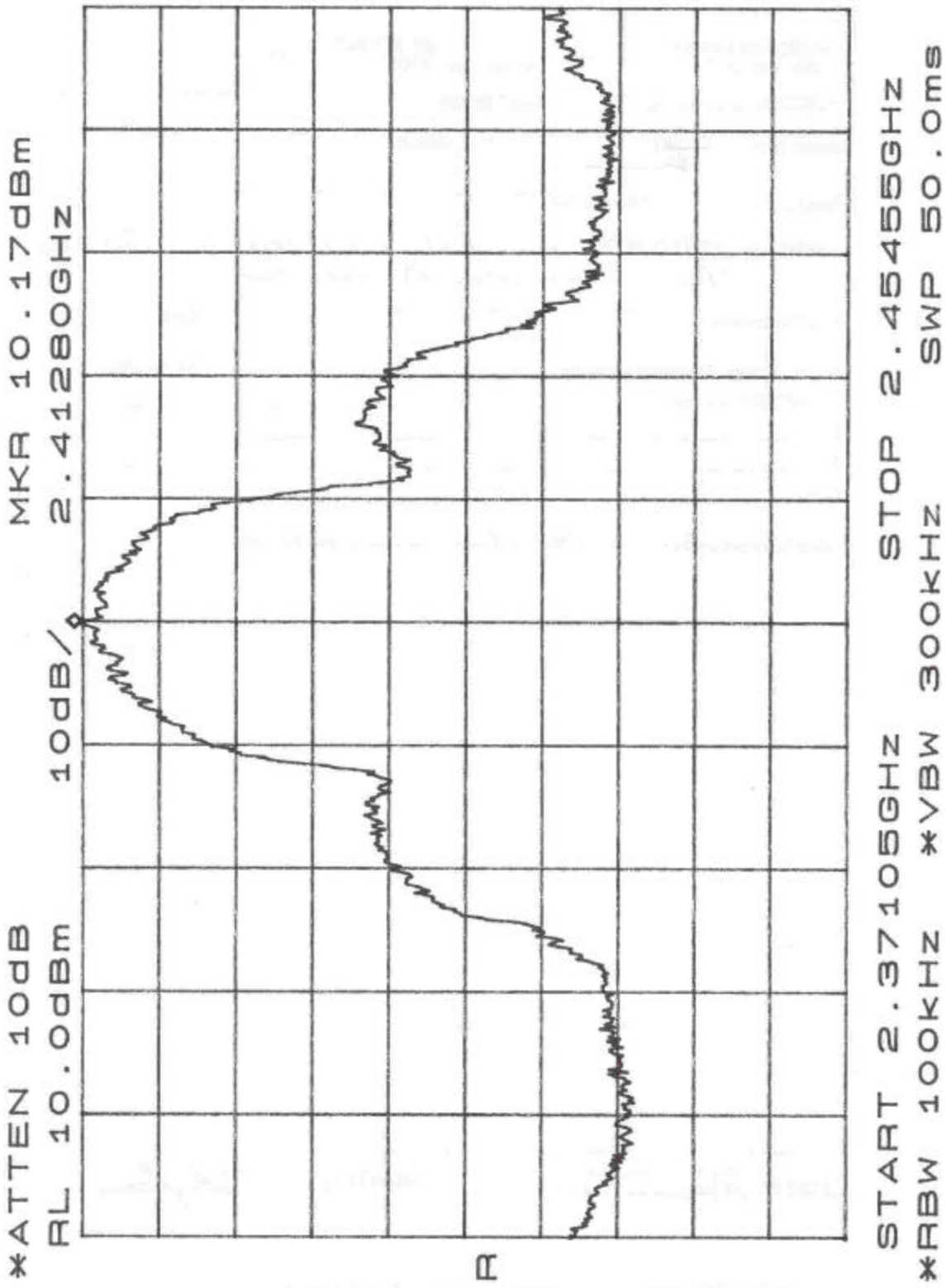

Figure 7. Spurious Emissions Data- Channel 1, Fundamental

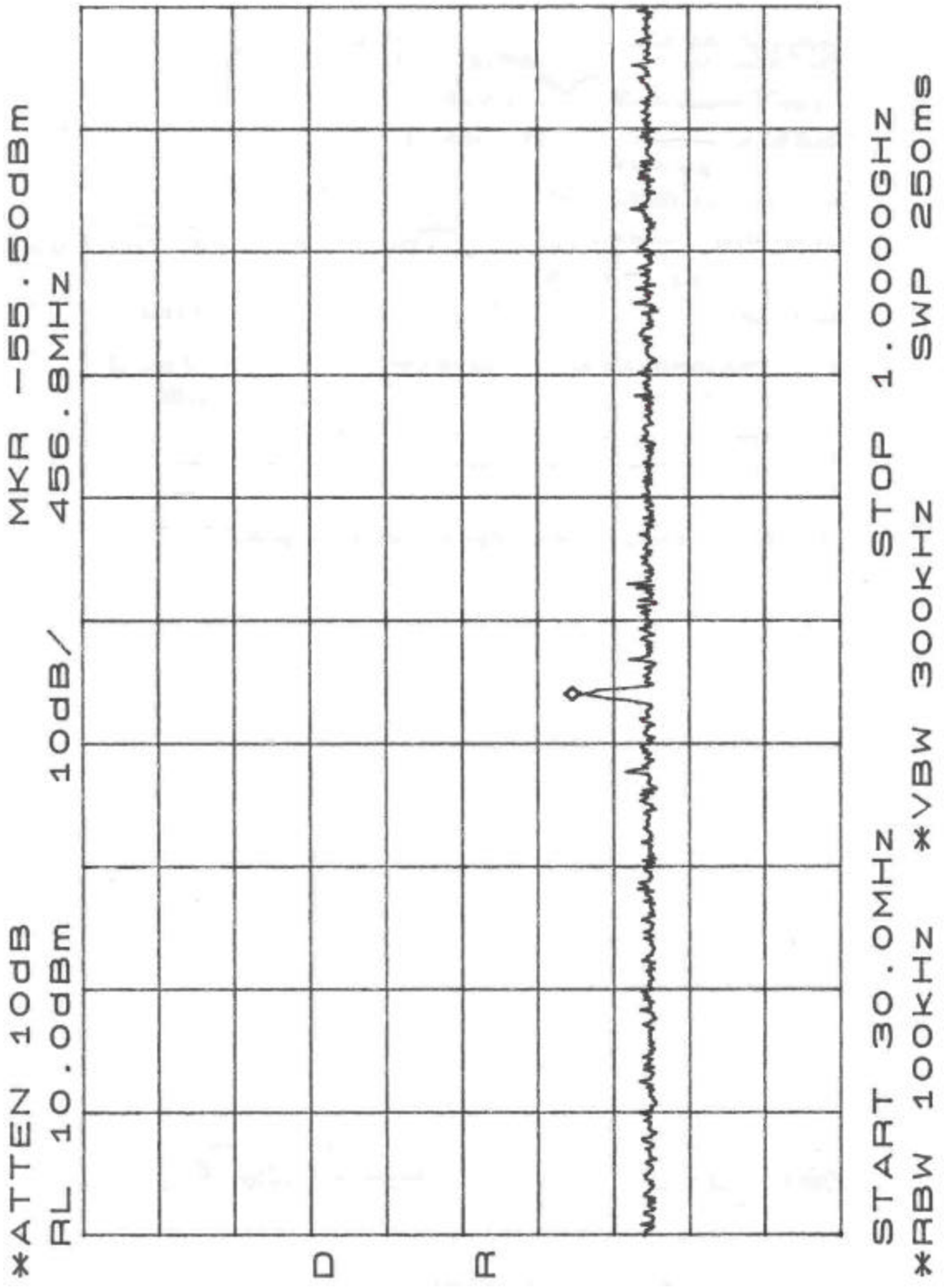

Figure 8. Spurious Emissions Data- Channel 1, 30MHz - 1GHz

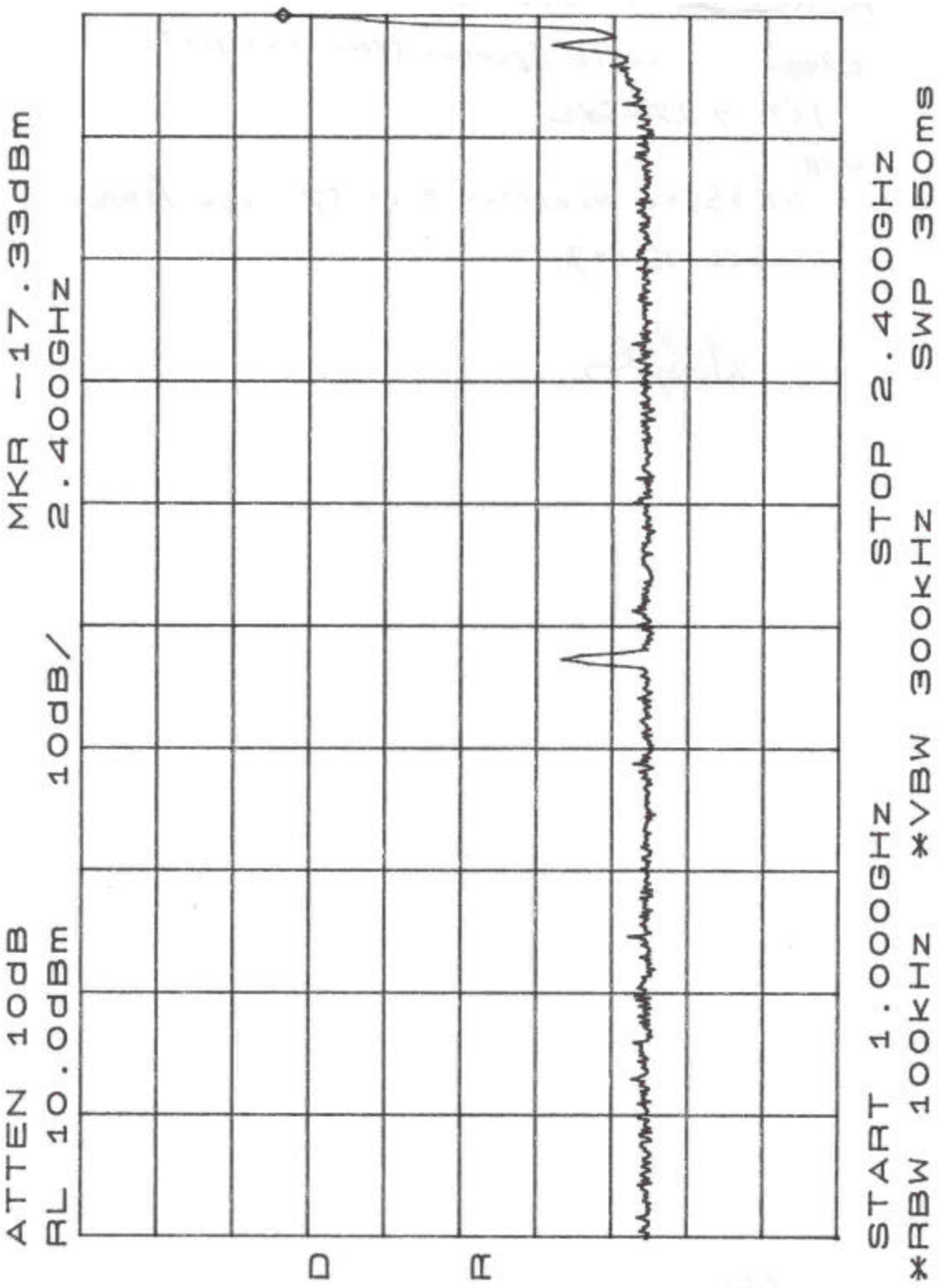

Figure 9. Spurious Emissions Data- Channel 1, 1GHz – 2.4 GHz

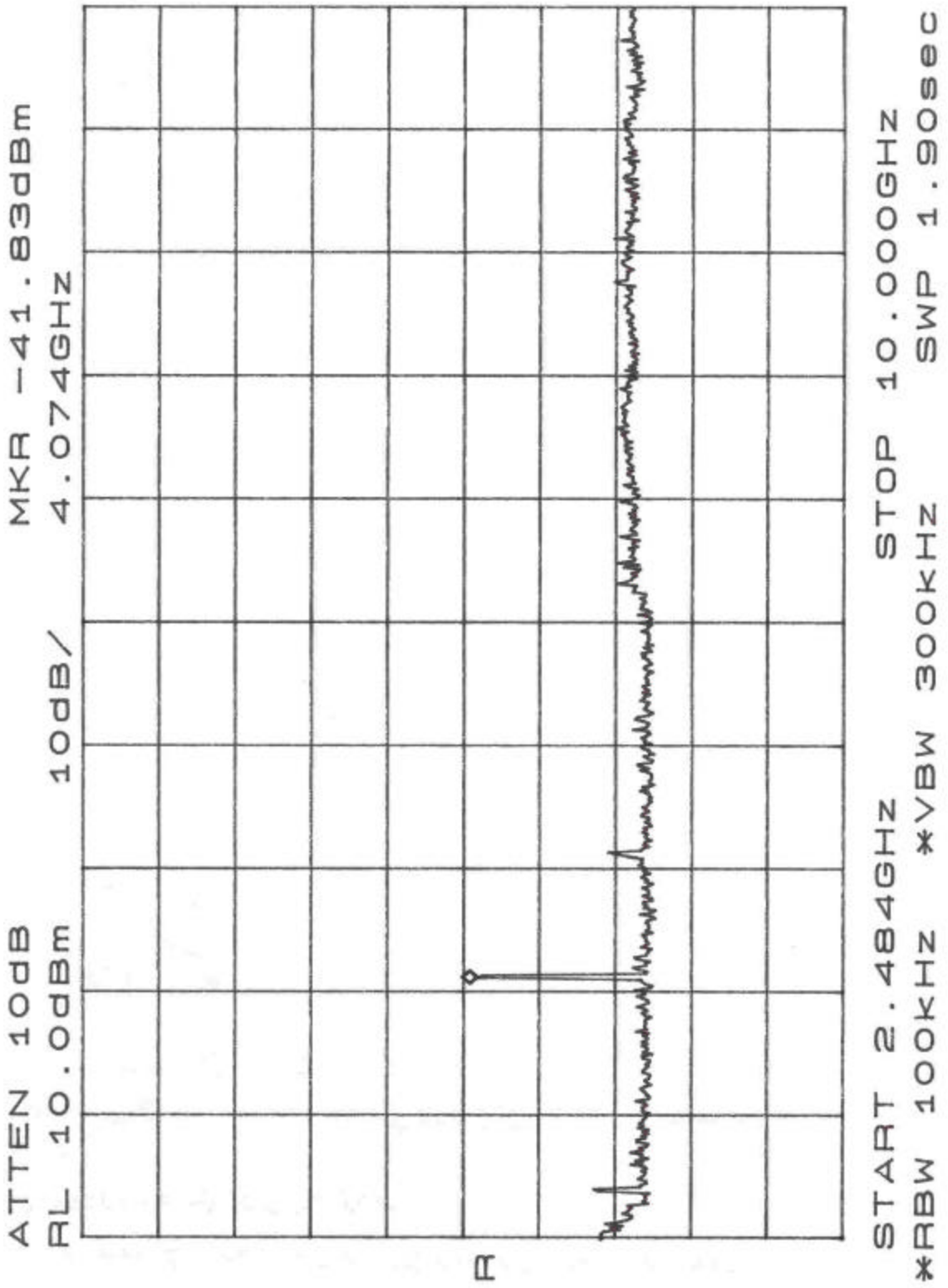

Figure 10. Spurious Emissions Data- Channel 1, 2.4835GHz – 10GHz

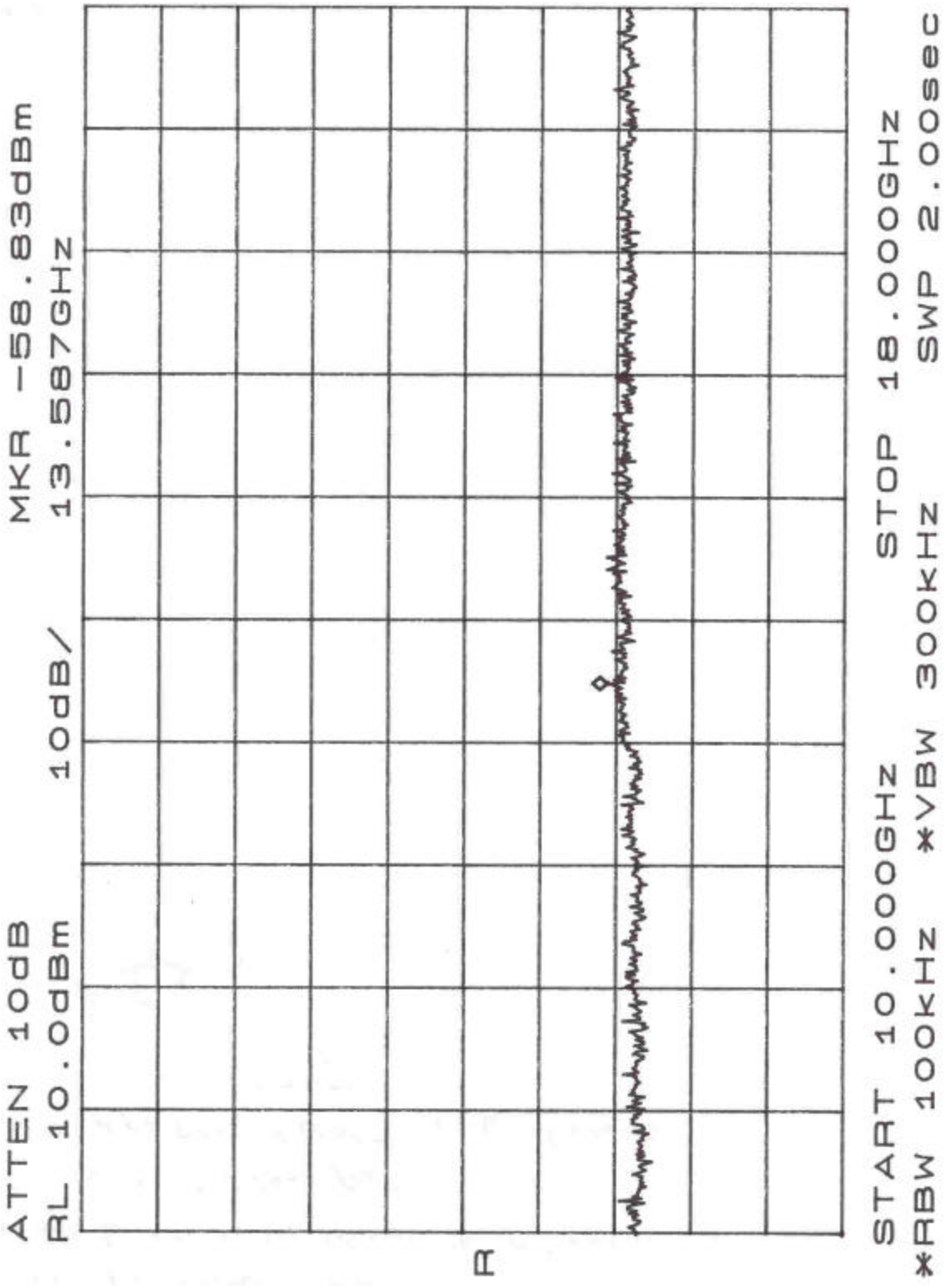

Figure 11. Spurious Emissions Data- Channel 1, 10GHz – 18GHz