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TABLES

EXHIBITS

1.0 Introduction

This report has been prepared on behalf of Gateway Communications, Inc. to support the attached Application for Type Acceptance of a IVDS Transmitter, for use under FCC Part 95, in the Interactive Video Data Service. The Equipment Under Test was the Gateway Communications, Inc. ***DG-100 Transceiver Unit.***

Radio-Noise Emissions tests were performed according to Part 2, Subpart J and 95.851 of the FCC Rules. The measuring equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

Testing was performed at National Certification Laboratory in Ellicott City, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch. FCC acceptance was granted on May 26, 1993.

1.1 Summary

The Gateway Communications, Inc. ***DG-100 Transceiver Unit*** complies with the technical standards for transmitters operating under FCC Rules Part 95.851, in the Interactive Video Data Service.

2.0 Description of Equipment Under Test (EUT)

The EUT Features:

218.0-219.0 MHz Operation

5 Watt Power Rating

Narrowband GMSK Modulation

12.5 KHz Channel Spacing

50 Ohm RF Impedance

4800 BPS Synchronous Data

12 VDC Operation

Mini - UHF Antenna Connector

1. General Description

The DG-100 is a 218 MHz transceiver designed for use in the Interactive Video and Data Service authorized under Part 95. The unit consists of an RF board and a digital/baseband board housed in an aluminum enclosure. External connectors are provided for power, antenna and RS-232 port. The device is intended for 2-way transport of digital data using spectrum efficient GMSK modulation.

2. General Specifications

Tx/Rx range:	218.0125 - 218.9875
Channel spacing:	12.5 KHz
No. of channels:	78 (39A & 39B)
Modulation:	GMSK (BT = .3)
Deviation:	± 3KHz
Data rate:	4800 bps synchronous
Tx power:	10mw to 5 watts (100 steps)
Ant. Connector:	Mini - UHF
Power supply:	12 VDC @ 1.5A

3. Description of Components

A. RF board (see attached schematic)

The receiver is a dual conversion super-heterodyne type. Q2 is the first RF amp. Its input and output are band-limited with passive L-C components. Q3 is the first mixer. The first LO frequency is produced by the VCO (described later) and mixed with the incoming carrier to produce the first IF of 21.4 MHz. This is filtered by FL1 and FL2, amplified by Q4 and applied to U1, the FM IF IC. This IC produces the second IF of 455 KHz by mixing with the second LO of 20.945 MHz (X1). The second IF is then amplified, limited and demodulated via quadrature discriminator. This IC also provides an RSSI output which is used for carrier detection and received signal strength measurement. The recovered audio output of U1 is amplified and level shifted by U8A before routing to the digital/baseband board via J4.

The VCO section consists of two voltage controlled oscillators. In receive mode Q6 is turned on (Q5 is turned off) and oscillates at the first LO frequency (Rx freq. - 21.4 MHz). In transmit mode Q5 is turned on (Q6 is turned off) and oscillates at the transmit frequency. U3 buffers and amplifies both VCO signals. In receive mode D3 is turned on to route the

injection frequency to the mixer. Q7 and Q8 provide VCO Tx/Rx switching. Both VCOs are controlled by a steering voltage from synthesizer IC, U4, via loop filter C57, R38 and C56. U4 is programmed via a three wire serial bus from the digital/baseband board. The reference frequency for U4 is U5, a 14.4 MHz Voltage Controlled Temperature Compensated Crystal Oscillator (VCTCXO). Q9 and associated circuitry is for an alternate reference oscillator which is not currently installed. U4 also provides a lock detect output which is filtered and inverted by Q10.

Modulation for the transmitter originates on the digital/baseband board and is routed via J4 to U8B where it is level shifted and amplified. It is then applied to the VCTCXO and to the Tx VCO, providing two-point modulation. R28 sets the balance between the two modulation points to provide a good eye pattern in the transmit signal with ± 3KHz of deviation.

When the digital/baseband board activates the transmitter it first programs U4 with new serial data. It then makes PTT low which turns on Q11. This removes power from the receiver front end by turning off Q1 and switches the transmit VCO on. The low PTT signal is also applied to the input of switch U6C which is controlled by lock detect. This switch is in series with switch U6A which is controlled by a signal from the digital board, SDA. Both of these switches must be in the proper position for the low PTT signal to be passed to U12, a 5 volt regulator with enable input. This switched 5 volts is applied to U11 (the transmit driver) U13 (the transmit power amplifier bias input) and the antenna switch (D12, D1 and associated components). With this arrangement there is both hardware and software control of transmit inhibit when the VCO is out of lock. When the digital board initiates transmit mode it waits for VCO lock before enabling the transmit chain which eliminates spurious transmissions during the VCO locking process. Transmit power control is provided by integrating and level shifting the PWM output from the digital/baseband board using U14 and associated circuitry. This variable voltage is applied through pass transistor, Q12, to the power control input of the hybrid power amplifier module, U13. A low pass filter follows the power amplifier to reduce transmitter harmonics.

B. Digital/Baseband board (see attached schematic)

This board uses a 386 EX microprocessor (U3) with 16 bit interface to a Flash memory (U5) plus SRAM (U6) and an 8 bit interface to a GMSK baseband IC (U7). It uses various I/O ports to control the radio board via connector P1. A fully implemented RS-232 serial connection is provided via level converter, U2. RS-232 signals are routed through P1 to the RF board which has a DB-9 connector for attachment of subscriber

equipment. J1 provides connections for Flash boot block programming via the 386 JTAG function, as well as TTL Tx and Rx serial data and one general purpose I/O port. Dual OpAmp, U8, buffers the Tx baseband signal from U7 before it is routed to the RF board. It also amplifies the RSSI signal from the receiver and routes it to comparator, U12, which allows the microprocessor to measure up to 8 levels of received signal strength. Clock oscillator, U11, provides reference frequency, 9.8304 MHz, to the microprocessor and baseband IC. The baseband IC (U7) assembles data received from the microprocessor, adds forward error correction and error detection codes, interleaves and scrambles the bit pattern, adds bit and frame sync codewords and converts this into analog GMSK signals for modulating the radio transmitter. C42 and R27 provide further filtering of the signal before routing to the RF board via P1. In receive mode the level shifted and amplified discriminator output from the RF board is routed via P1 to the input of the baseband IC. After error correction and removal of packet overhead the recovered data is supplied to the microprocessor. A readout of the SNR value during receipt of a packet is also provided. The digital/baseband board receives 12VDC from the RF board. Separate 5V regulators are used for the digital (U4) and analog (U1) portions of the board. Hex inverter, U10, is used for reset, interrupt and I/O purposes.

4. Compliance with Part 95

The DG-100 is specifically designed for use in the IVDS spectrum and incorporates features that ensure compliance with the unique requirements of that service. The unit incorporates automatic power control, as required, and this feature further allows setting of the maximum ERP of any unit at installation (e.g. 100 milliwatts for mobiles). In addition, the requirement for control of duty cycle in TV channel 13 areas is met through the timing capabilities of the digital control board and is controlled via software.

3.0 Test Program

Testing was performed on the EUT to demonstrate performance to the following FCC Rule Parts:

95.855 ---------- Power Rating

95.857 ---------- Harmonics & Spurious Levels

95.853 ---------- Frequency Segment/Channel Bandwidth

2.995 ---------- Frequency Stability

The following Section 4.0 of this report provides Testing Configurations and Data.

FCC Part 2.202/95.853 - Calculation of Necessary Bandwidth

$$Bn = 2M + 2DK$$

Where K= 1, M= Max Modulation, D= Peak Freq Deviation

Based on Designer's Specs.: M = 2.4 KHz, D = 3.0 KHz

Therefore: Bn = 4.8 KHz + 6.0 KHz = <u>10.8 KHz</u>

FCC Part 95.857 - Emission Limits

All spurious out-of-band emissions shall be attenuated by:

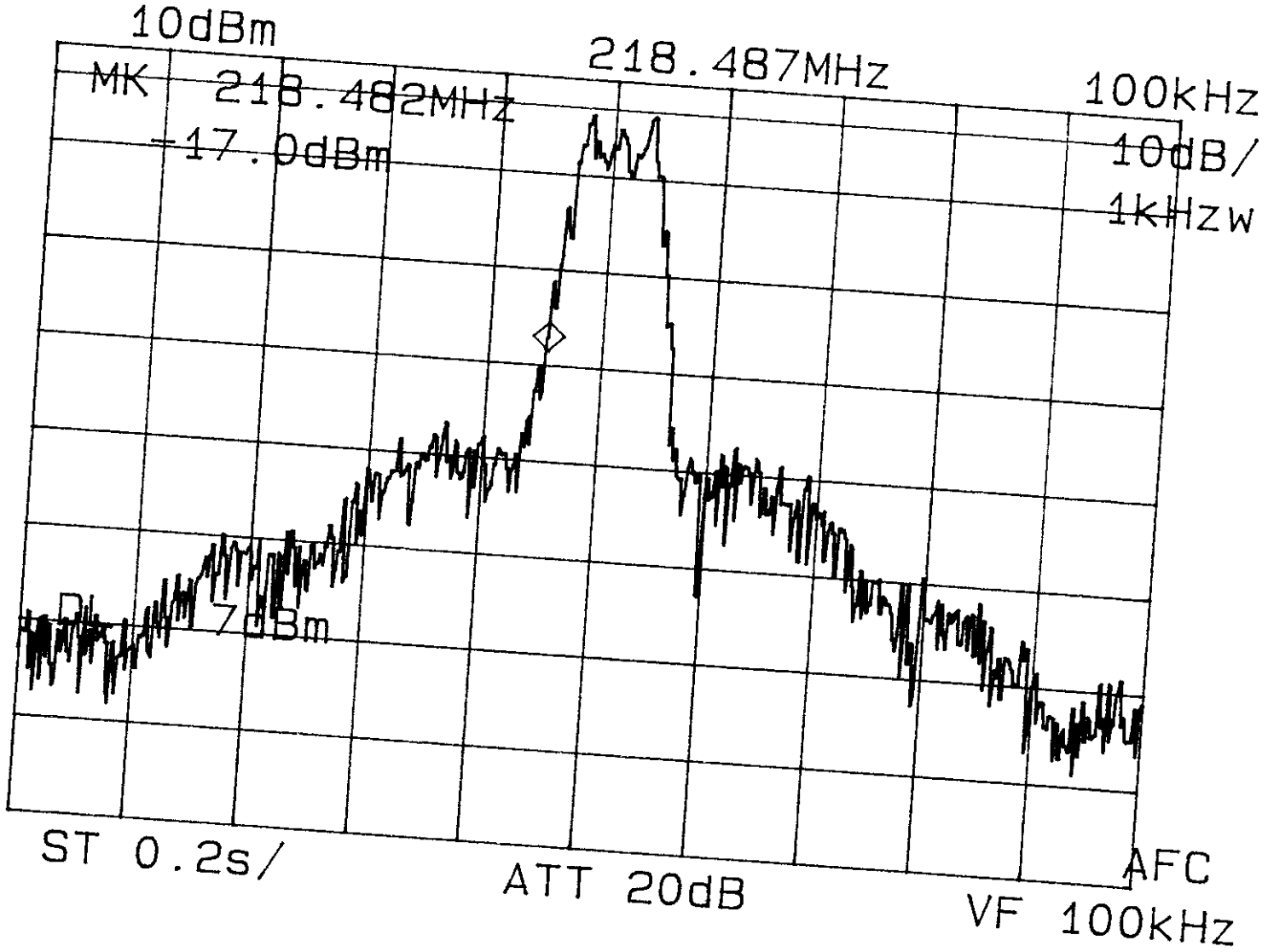
1) 28 dB on any frequency removed from center by more than 250 kHz up to 750 kHz.

2) 35 dB on any frequency removed from center by more than 750 kHz up to 1250 kHz.

3) 43 + 10*Log Power Out on any frequency removed from center by more than 1250 kHz.

23 dB OCCUPIED BANDWIDTH MEASUREMENT = 10 KHZ

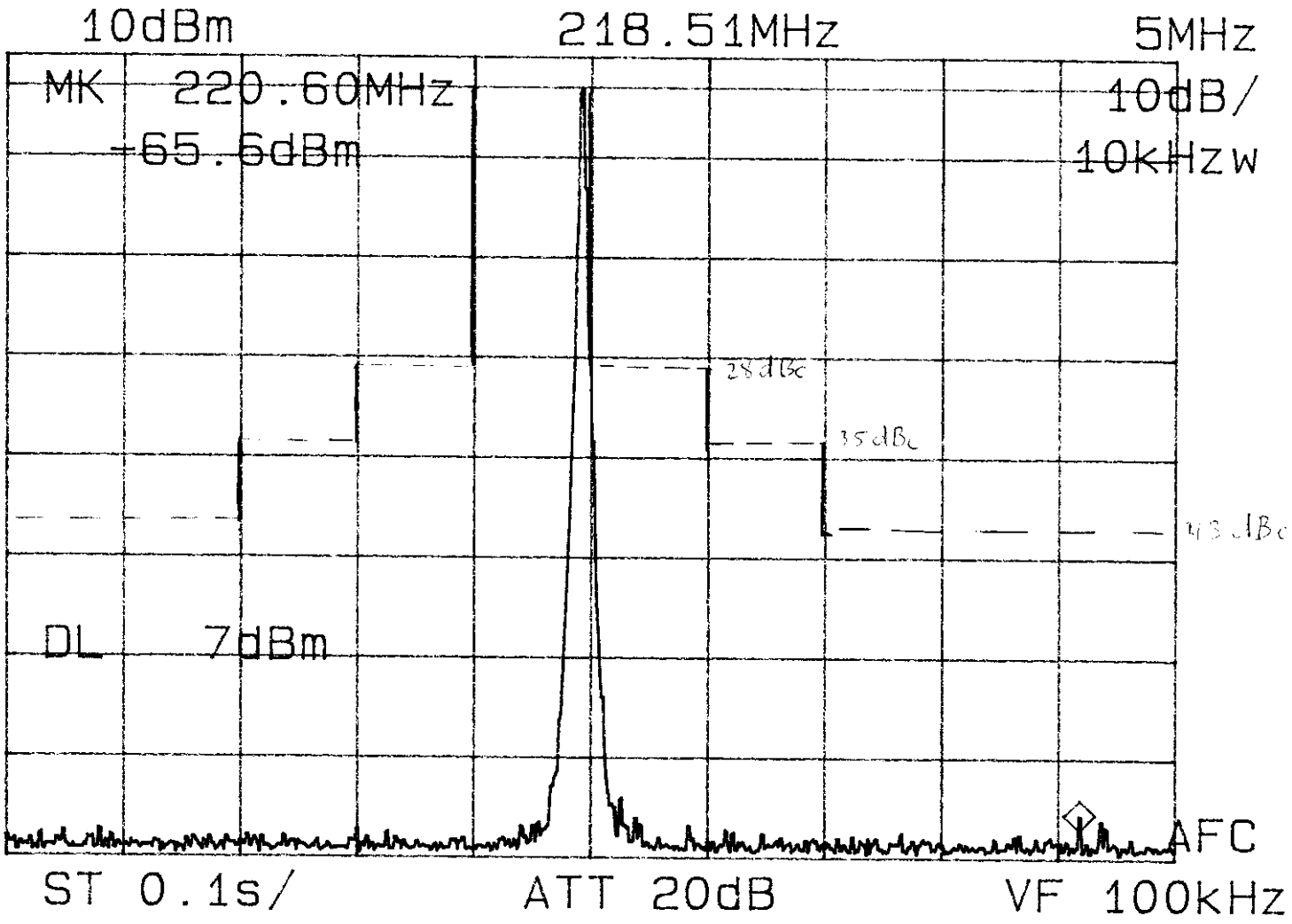
MODULATED **100 KHZ SPAN** **1 KHZ RES. BW**



NOTE: 30 dB EXT. ATTN.

OUT-OF-BAND EMISSIONS MEASUREMENT

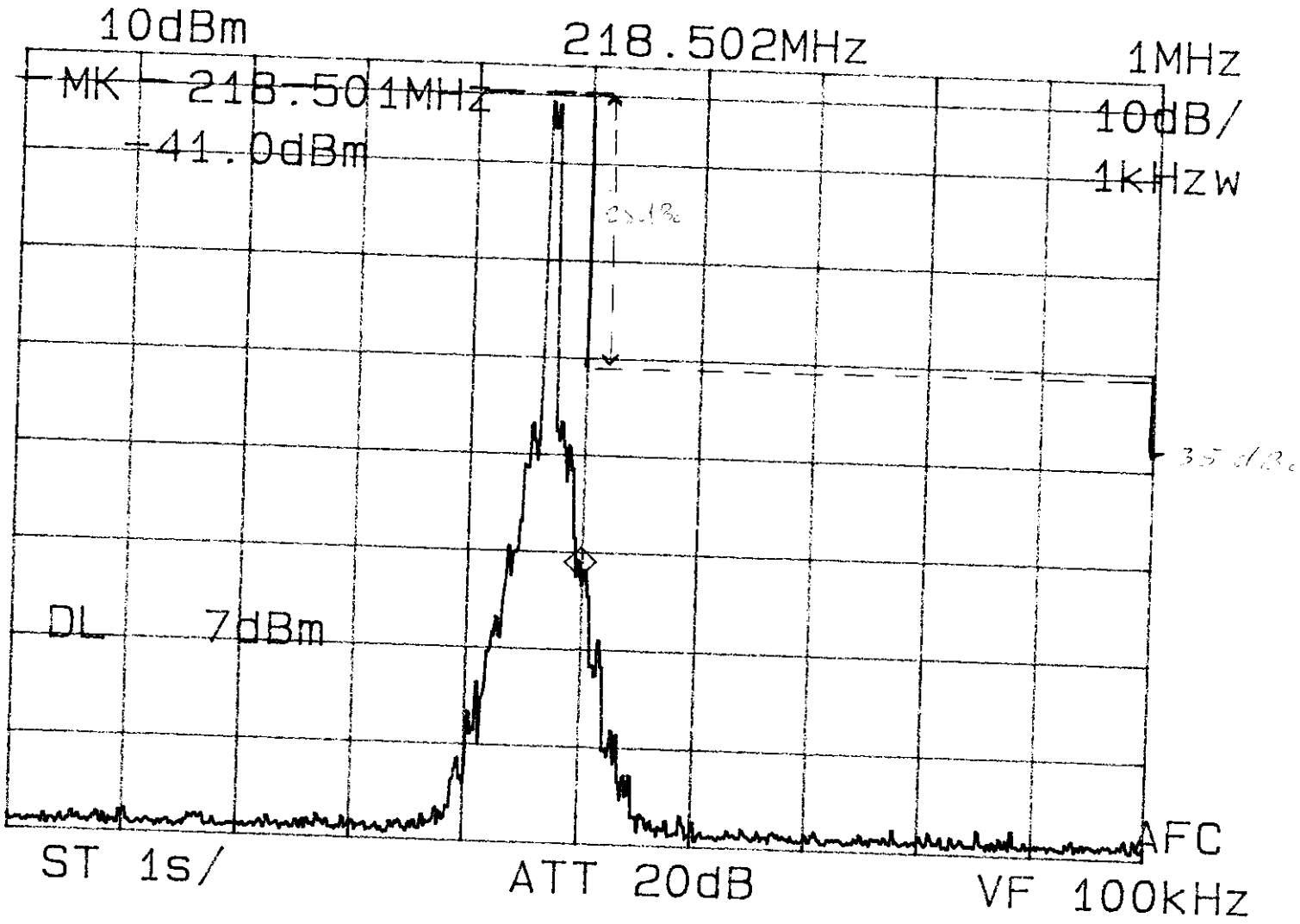
MODULATED **5.0 MHZ SPAN** **10 KHZ RES. BW**



NOTE: 30 dB EXT. ATTN.

OUT-OF-BAND EMISSIONS MEASUREMENT

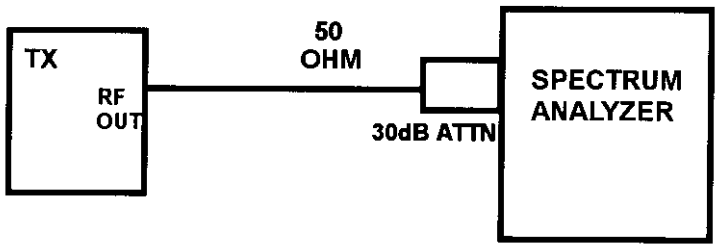
MODULATED **1.0 MHZ SPAN** **1 KHZ RES. BW**



NOTE: 30 dB EXT. ATTN.

FCC Part 95.855 - Power Output Rating

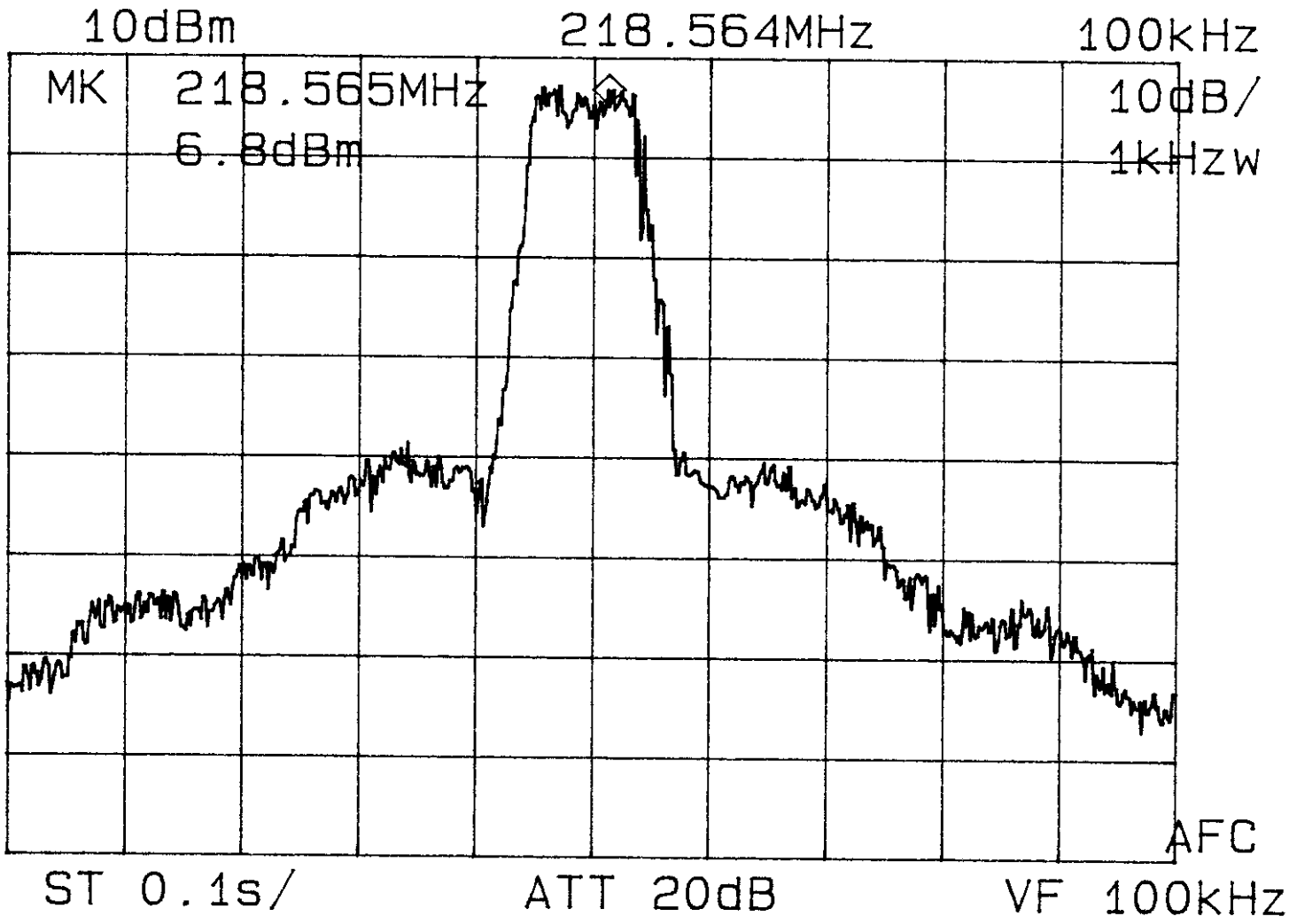
Test Configuration



RF Power Reading = 36.8 dBm

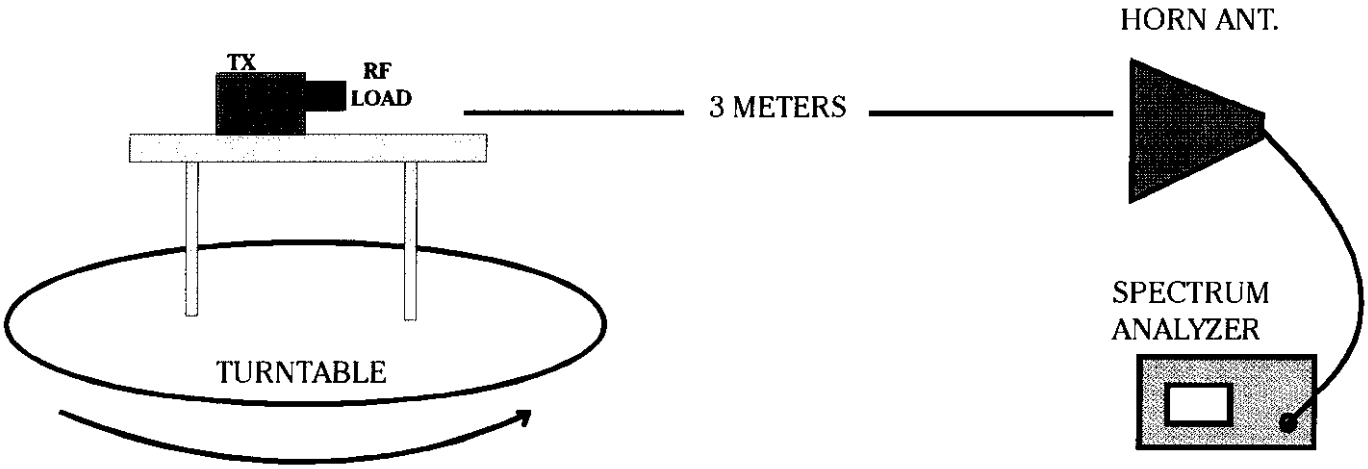
REFERENCE RF POWER OUTPUT WITH 1 KHZ RES. BW

MODULATED **100 KHZ SPAN** **1 KHZ RES. BW**



NOTE: 30 dB EXT. ATTN.

RADIATED EMISSIONS MEASUREMENT



PEAK CARRIER FIELD STRENGTH
CALCULATION FOR HALF-WAVE DIPOLE @ 3 METERS

$$\text{FS (V/m)} = \sqrt{\frac{(49.2 * 5 \text{ WATTS})}{3 \text{ METERS}}} = 5.2 \text{ V/m @ 3 M}$$

$$= 134 \text{ dBuV/m @ 3M}$$

FCC PART 2.993/95.857 - RADIATED SPURIOUS EMISSIONS

Frequency of Carrier = 218.48 MHz
Limit = 43 + 10 (log 5.0 Watts) dB = 50.0 dBc

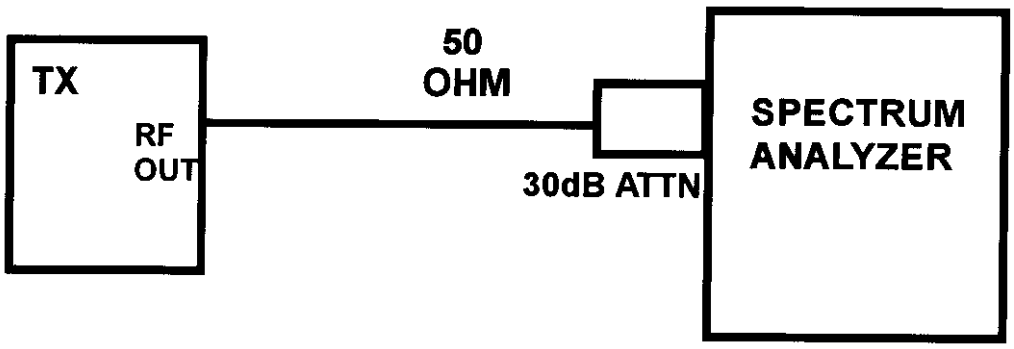
TEST RESULTS

LIMIT: -50.0 dB FROM PEAK CARRIER

COMPONENT	FREQUENCY (MHZ)	RESULT (dB FROM PEAK)
HARMONIC	436.970	- 54
HARMONIC	655.460	- 61
HARMONIC	873.950	- 68
HARMONIC	1092.440	- 70
HARMONIC	1310.920	- 67
HARMONIC	1529.410	- 72
HARMONIC	1747.890	- 71
HARMONIC	1966.380	- 74
HARMONIC	2184.870	- 75

CONDUCTED EMISSIONS MEASUREMENT

TEST CONFIGURATION



FCC PART 2.991/95.857 - CONDUCTED SPURIOUS EMISSIONS

Frequency of Carrier = 218.48 MHz
Limit = 43 + 10 (log 5.0 Watts) dB = 50.0 dBc

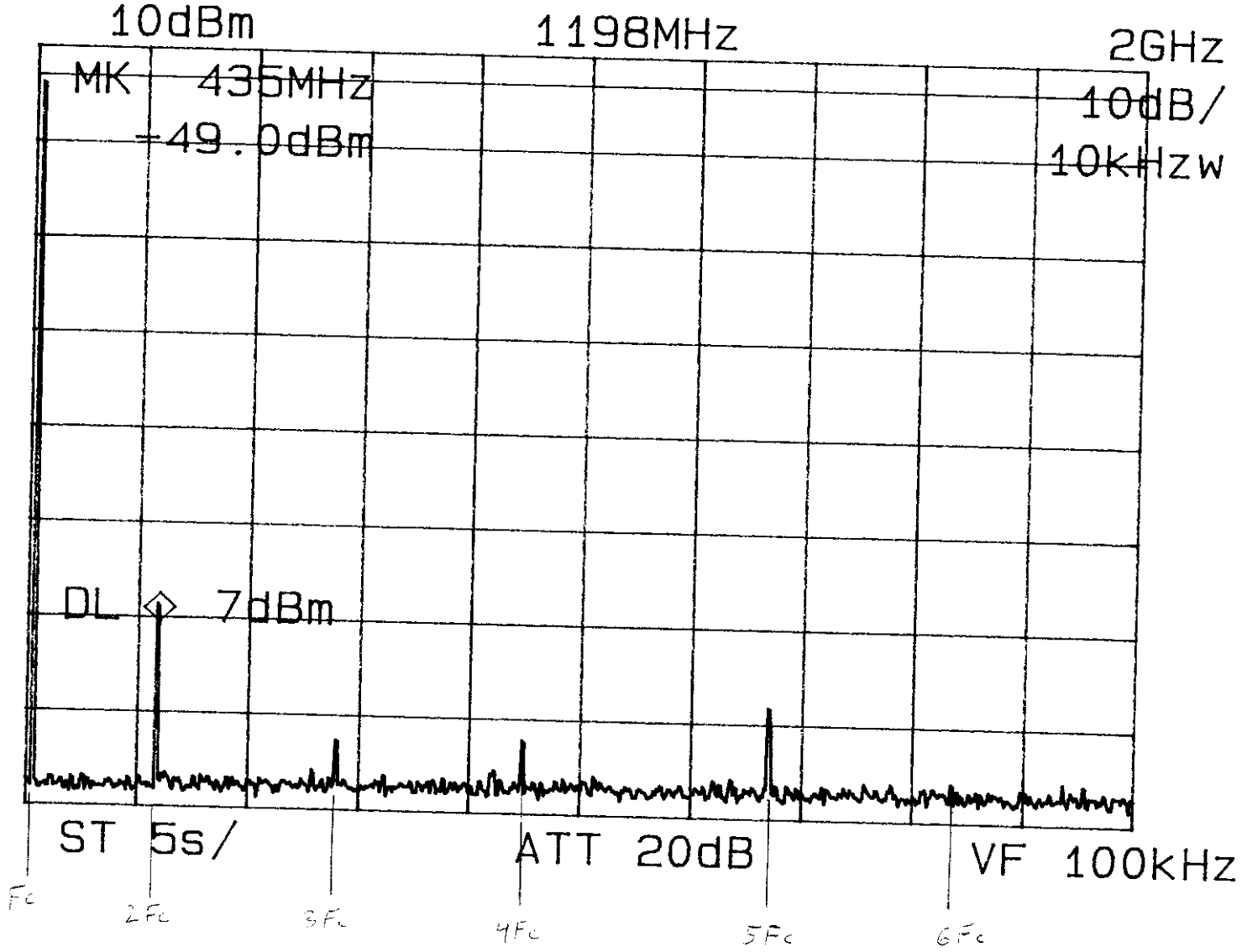
TEST RESULTS

LIMIT: -50.0 dB FROM PEAK CARRIER

COMPONENT	FREQUENCY (MHZ)	RESULT (dB FROM PEAK)
HARMONIC	436.970	- 56
HARMONIC	655.460	- 70
HARMONIC	873.950	- 69
HARMONIC	1092.440	- 64
HARMONIC	1310.920	- 75
HARMONIC	1529.410	- 78
HARMONIC	1747.890	- 78
HARMONIC	1966.380	- 78
HARMONIC	2184.870	- 78

HARMONIC EMISSIONS MEASUREMENT

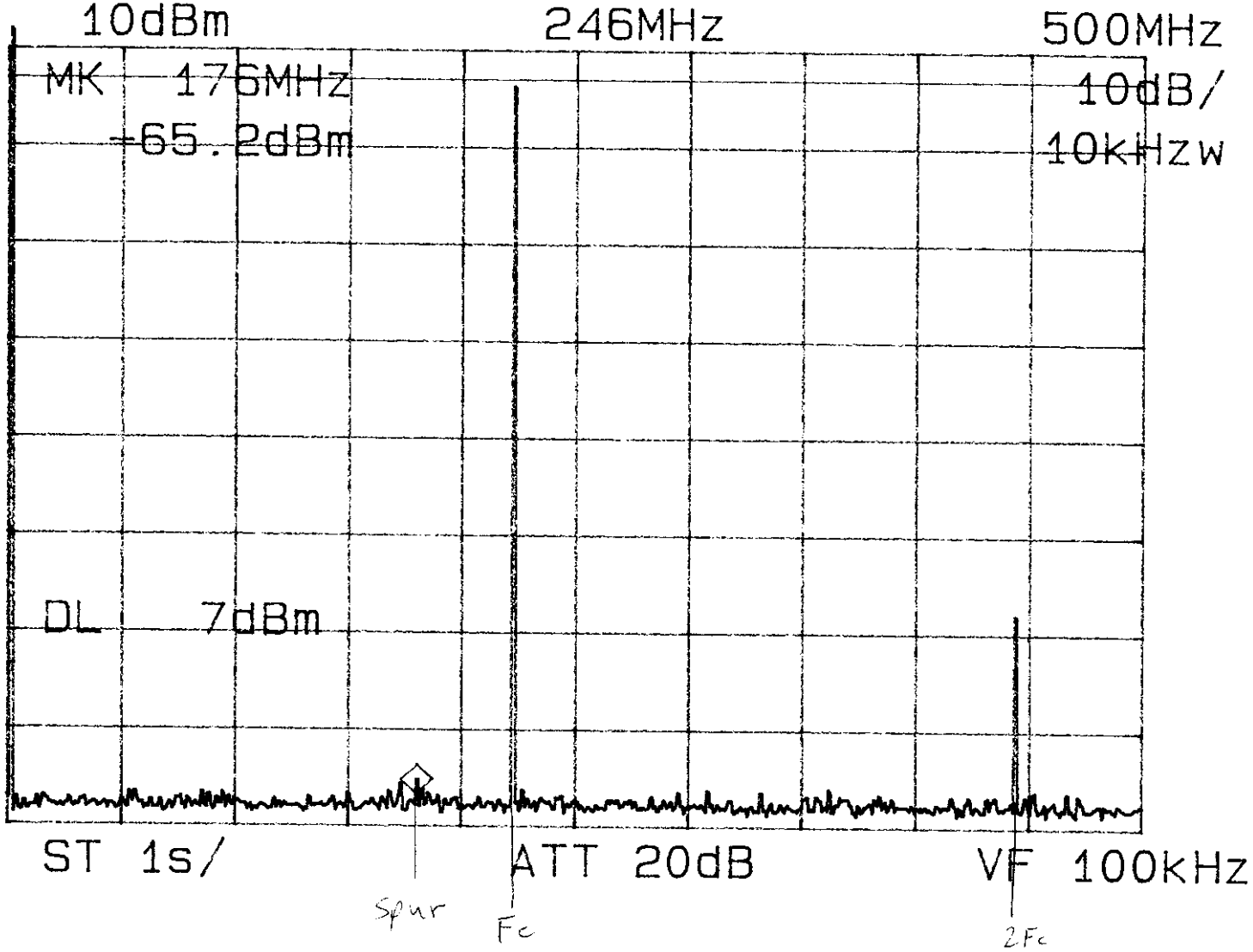
MODULATED **2.0 GHZ SPAN** **10 KHZ RES. BW**



NOTE: 30 dB EXT. ATTN.

SPURIOUS EMISSIONS MEASUREMENT

MODULATED **500 MHZ SPAN** **10 KHZ RES. BW**



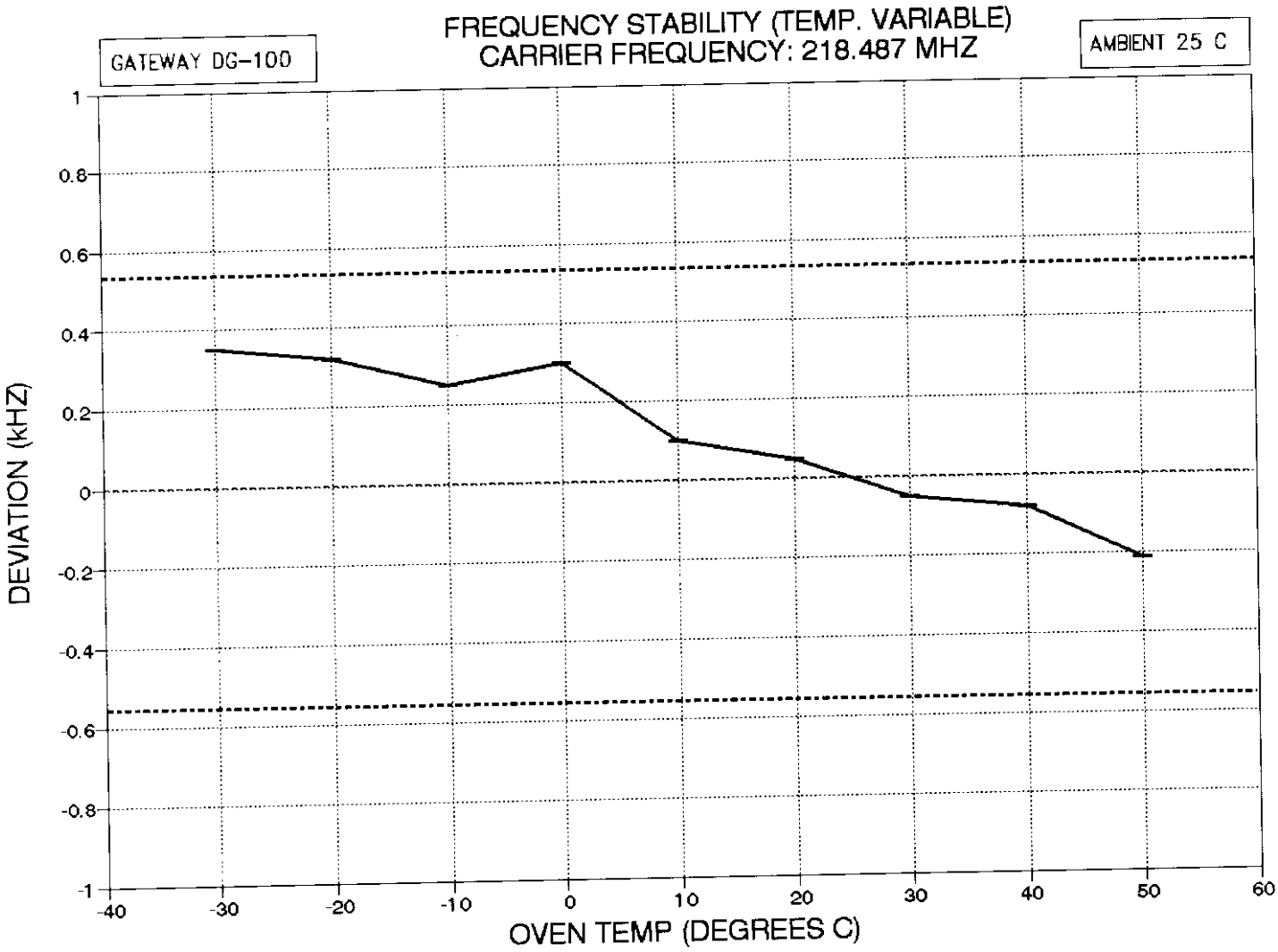
NOTE: 30 dB EXT. ATTN.

FCC PART 2.995 - FREQUENCY STABILITY

The following charts reveal the Frequency Tolerance of the transmitter carrier frequency as a function of Temperature and Supply Voltage. The charts confirm the rated tolerance of 2.5 PPM.

The transmitter was placed in the temperature chamber at 25 degrees C and allowed to stabilize for one hour. The transmitter was keyed on for one minute during which a frequency reading was taken. This was considered to be the reference frequnecy. The temp. was reduced to -30 degrees C and the transmitter allowed to stabilize for one hour. Frequency readings were taken and this procedure repeated in 10 degree increments up to 50 degrees C.

Frequency readings were also taken at + and - 15% of the supply voltage of 12 VDC.


FREQUENCY STABILITY (TEMP. VARIABLE)
CARRIER FREQUENCY: 218.487 MHZ
GATEWAY DG-100
AMBIENT 25 C
DEVIATION (kHZ)
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-40
-30
-20
-10
0
10
20
30
40
50
60
OVEN TEMP (DEGREES C)

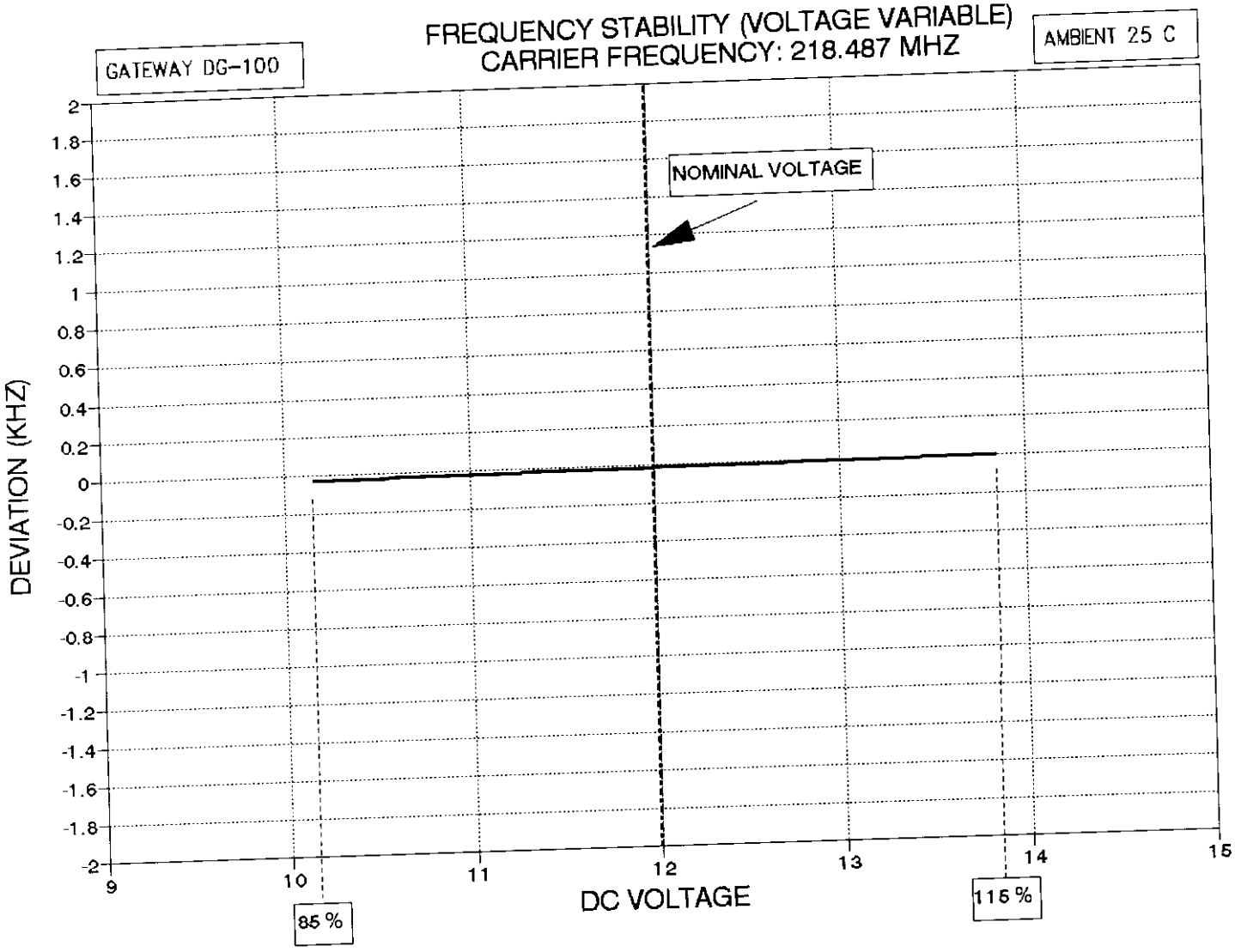

FREQUENCY STABILITY (VOLTAGE VARIABLE)
CARRIER FREQUENCY: 218.487 MHZ
GATEWAY DG-100
AMBIENT 25 C
NOMINAL VOLTAGE
DEVIATION (KHZ)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8
-2
9
10
11
12
13
14
15
DC VOLTAGE
85 %
115 %

Table 1

Measurement Equipment Used

The following equipment is used to perform measurements:

EQUIPMENT	SERIAL NUMBER
EMCO Model 3115 Double Ridgeguide Horn Ant.	3807
EMCO Model 3110 Biconical Antenna	1619
EMCO Model 3146 Log Periodic Antenna	1222
HP 8482B Power Sensor	245-688PS
Advantest Model R4131D Spectrum Analyzer	54378A
HP 437B Power Meter	
Bird 8306-300-N 30dB Attenuator	29198391515
Thermotron S-16 Temperature Chamber	534-84
Decibel DB4303B 100 Watt/50 ohm RF Load	D34512-1

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(410) 461-5548

FCC REPORT OF TYPE ACCEPTANCE

for

Gateway Communications, Inc.
2016 E. Broadway Blvd.
Tucson, AZ 85719

FCC ID: NAUDG100

August 12, 1998