DESCRIPTION OF CIRCUITRY

RULE PART NUMBER: 2.983 (d)(10)

THEORY OF OPERATION

1.0 PURPOSE

This report has been prepared to support the application for FCC Type Acceptance PER CODE OF FEDERAL REGULATIONS, TITLE 47, PARTS 2, 90 AND 101 for the transmitter subsystem of the JDT Model 242-3492-XYZ Transceiver. The report presents necessary information concerning electrical circuit description, measured performance and physical construction and configuration.

2.0 DL-3492 TRANSCEIVER

2.1 GENERAL

The main subassemblies of this transceiver include the RF board, and Modem board. The RF board provides frequency modulation and demodulation of the radio frequency signal. The main components of the RF board include the Frequency Synthesizer/VCO, dual conversion superheterodyne receiver, RF exciter/power amplifier, and a Temperature compensated crystal oscillator as a frequency reference. The main components of the modem board include the microprocessor, the transmit audio processing circuitry, and receive audio processing circuitry. A block diagram of the transceiver is located at the end of this section.

2.2 TRANSCEIVER CIRCUIT DESCRIPTION

The transmitter produces a nominal RF output power output of 5W at 13.3V DC. Frequency modulation of the transmit signal occurs in the synthesizer. Transmit audio processing circuitry is contained in the modem board.

DRIVER (Q500)

The VCO RF output signal is applied to R846, R847 and R848 that form a resistive splitter for the receive first local oscillator and the transmitter. The VCO signal is then applied to a 50 ohm pad formed by R500, R501, and R502. The RF signal is applied to Q500 which provides amplification and additional isolation between the VCO and transmitter. Biasing for this stage is provided by R503 and L500, C505 provides RF decoupling. The RF signal is then applied to the power amplifier module Q500.

FINAL (U510)

The RF signal from Q500 is applied to the input port of the RF power amplifier module, U510, which provides 5 watts (nominal) at the antenna connector J501. U510 operates on an input voltage from 10-16Vdc.

POWER CONTROL (U130C)

Power control is provided by U520, U130, Q520 and a stripline directional coupler. The power is adjust by Power Set Control R525 which provides a reference voltage to U130C. U130C drives Q520 and PA module U510. The stripline directional coupler is connected to a forward RF peak detector formed by R535, CR520, C531 and U520A. The other end of the stripline directional coupler is connected to a reverse RF peak detector formed by R593, CR592, C593 and U520B.

If the power output of U510 decreases due to temperature variations, etc., the forward peak detector voltage decreases. The detector voltage drop is buffered by U520A and applied to inverting amplifier U130C which increases the forward bias on Q520. The increased bias voltage on Q520 increases the power output level of U510. If the power output of U510 increases, the forward peak detector voltage increases and U130C decreases the forward bias on Q520. The decreased bias voltage on Q520 decreases the output power of U510. The output of CR520 and CR592 are applied to U520. If the output of either buffer increases, the increase is applied to the inverting input of U130C. The output of U130C then decreases and Q520 decreases the input voltage to U510 to lower the power. The control voltage is isolated from RF by ferrite bead EP513 and C513 decouples RF. The forward/reverse power voltages from U520A/B are also applied to U913/U912 for outputs on J201.

LOW PASS FILTER

The low-pass filter consists of L540, C541, L541, C542, L542, C543, and C544. The filter attenuates spurious frequencies occurring above the transmit frequency band. The transmit signal is then fed through the antenna switch to antenna jack J501.

ANTENNA SWITCH (CR540, CR541)

The antenna switching circuit switches the antenna to the receiver in the receive mode and the transmitter in the transmit mode. In the transmit mode, +9V is applied to L543 and current flows through diode CR540, L544, diode CR541 and R540. When a diode is forward biased, it presents a low impedance to the RF signal; conversely, when it is reverse biased (or not conducting), it presents a high impedance. Therefore, when CR540 is forward biased, the transmit signal has a low-impedance path to the antenna through coupling capacitor C546. L544, and C552 form a discrete quarter- wave line. When CR540 is forward biased, this quarter-wave line is effectively AC grounded on one end by C552. When a quarter-wave line is grounded on one end, the other end presents a high impedance to the quarter-wave frequency. This blocks the transmit signal from the receiver. C545 and C551 matches the antenna to 50 ohms in transmit and receive.

TRANSMITTER KEY-UP CONTROL

Q130, Q131, and Q132 act as switches which turn on with the RX_EN line. When the line goes low the Q130 is turned of which turns Q131 on turning Q132 on. This applies 13.3V to U130 before the TX_EN line goes high. U130A/B provides the key-up and key-down conditioning circuit. C116 and R117 provide a ramp up and ramp down of the 9.0TX during key-up and key-down which reduces load pull of the VCO during key-up. The conditioning provides a stable 5.5V output by balancing the 5.5V reference with the 5.5V regulated supply. The output on U130B, pin 7 is applied to comparator U130D, pin 12, the non-inverting input. The output of U130D, pin 14 is applied to the base of current source Q135. The output of Q135 is on the emitter and is applied back to the inverting input of comparator U130D, pin 13. A decrease or increase at U130D, pin 13 causes a correction by U130D to stabilize the 9V transmit output. R140/141 establish the reference voltage on U130D, pin 13. C143 and C144 provide RF decoupling and C145 stabilizes the output. The 9V transmit voltage is then distributed to the circuits.

2.3 POWER SUPPLIES

REGULATED +9.6V

The RF enable signal applied on J201, pin 5 and to the base of Q110 turning the transistor on. This causes the collector to go low and applies a low to the control line of U111, pin 1 and R110 is a pull up resistor.

The 13.3V from J201, pin 2 is on U111, pin 6 to produce a +9.6V reference output on U111, pin 4. C120 stabilizes the voltage and C122 provides RF decoupling.

REGULATED +5.5V

The RF enable signal applied on J201, pin 5 and to the base of Q110 turning the transistor on . This causes the collector to go low and applies a low to the control line of U110, pin 1. C904 decouples RF and R131 is a pull up resistor. The 13.3V from J201, pin 2 is on U110, pin 6 to produce a +5.5V regulated output on U110, pin 4. C119 stabilizes the voltage and C115 provides is a bypass capacitor for U110.

2.4 SYNTHESIZER

The synthesizer output signal is produced by the VCO (voltage controlled oscillator). The VCO frequency is controlled by a DC voltage produced by the phase detector in U800. The phase detector senses the phase and frequency of the two input signals and causes the VCO control voltage to increase or decrease if they are not the same. The VCO is then "locked" on frequency.

Programming of the synthesizer provides the data necessary for the internal prescaler and counters. One input signal is the reference frequency. This frequency is produced by the 17.5 MHz reference oscillator (TCXO). The other input signal is the VCO frequency. a block diagram of synthesizer IC is shown at the end of this section.

VOLTAGE-CONTROLLED OSCILLATOR

Oscillator (Q820)

The VCO is formed by Q820, several capacitors and varactor diodes, and ceramic resonator L826. It oscillates at the transmit frequency in transmit mode and first injection frequency in the receive mode Biasing of Q820 is provided by R823, R824 and R825. An AC voltage divider formed by C844, C845 initiates and maintains oscillation and also matches Q820 to the tank circuit ceramic resonator. L826 is grounded at one end to provide shunt inductance to the tank circuit.

Frequency control

The VCO frequency is controlled in part by DC voltage across varactor diode CR824. As voltage across a reverse-biased varactor diode increases, its capacitance decreases, Therefore, the vco frequency increases as the control voltage increases. The control line is isolated from tank circuit RF by choke L825. The amount of frequency change produced by CR824 is controlled by series capacitor C836. The VCO frequency is modulated using a similar method. The transmit audio/data signal from J201, pin 6 is applied across varactor diode CR823 which varies the VCO frequency at an audio rate. Series capacitors C824/C825 set the amount of deviation produced. R821 provides a DC ground on the anodes of CR8222/CR823, and isolation is provided by R820 and C826.The DC voltage across CR823 provides compensation to keep modulation relatively flat over the entire bandwidth of the VCO. This compensation is required because modulation increases as the VCO frequency increases. CR823 also balances the modulation signals applied to the VCO and TCXO.

FREQUENCY MODULATION

Both the VCO and reference oscillator (TCXO) are modulated in order to achieve the required frequency response. If only the VCO was modulated, the phase detector in U800 would sense the frequency change and increase or decrease the VCO control voltage to counteract the change (especially at the lower audio frequencies). If only the reference oscillator frequency is modulated, the VCO frequency would not change fast enough (especially at the higher audio frequencies). Modulating both VCO and reference oscillators produces a flat audio response. Potentiometer R827 sets the VCO modulation sensitivity so that it is equal to the reference oscillator modulation sensitivity.

CASCADE AMPLIFIERS (Q821/Q822)

The output signal on the collector of Q820 is coupled by L861/C864 to buffer amplifier Q821/Q822. This is a shared-bias amplifier which provides amplification and also isolation between the VCO and the stages which follow. The signal is direct coupled from the collector of Q822 to the base of Q821. The resistors in this circuit provide biasing and stabilization.

AMPLIFIER (Q823)

Amplifier Q823 provides amplification and isolation between the VCO and receiver, and transmitter. C851/C861/L832 provides matching between the amplifiers. Bias for Q823 is provided by R840/R842/R843. Inductor L833 and capacitor C863 provide impedance matching on the output.

SUPPLY FILTER (Q845)

Q845 on the RF board is a capacitance multiplier to provide filtering of the 9.6V supply to the VCO. R945 provides transistor bias and C842 provides the capacitance that is multiplied. If a noise pulse or other voltage change appears on the collector, the base voltage does not change significantly because of C845.

VCO BAND SELECT AND T/R FREQUENCY SHIFT (U840)

The VCO must be capable of producing frequencies from 840 to 960 MHz to produce the required receive injection and transmit frequencies. If this large of a shift was achieved by varying the VCO control voltage, the VCO gain would be undesirably high. Therefore, capacitance is switched in and out of the tank circuit to provide a coarse shift in frequency.

The 928 to 960 MHz band is divided into two segments , 928 to 944 MHz and 944 to 960 MHz. The band selection controlled by the shift register U840 and digital transistors Q843, and Q844 and pin diode CR820 on the vco board.

A frequency shift of 87.85 MHz is required to go from transmit to receive mode and visa versa. Transmit-to-Receive frequency shift is accomplished by programming the shift register U840 which drives the digital transistors Q841 and Q842. In transmit mode, Q841and Q842 forward bias pin diode CR821 which switches in an inductive transmission line in parallel with the vco resonator causing the vco frequency to increase. In receive mode, Q841, Q842 reverse bias CR821 which switches out the inductive transmission line and lowers the vco frequency for the mixer injection.

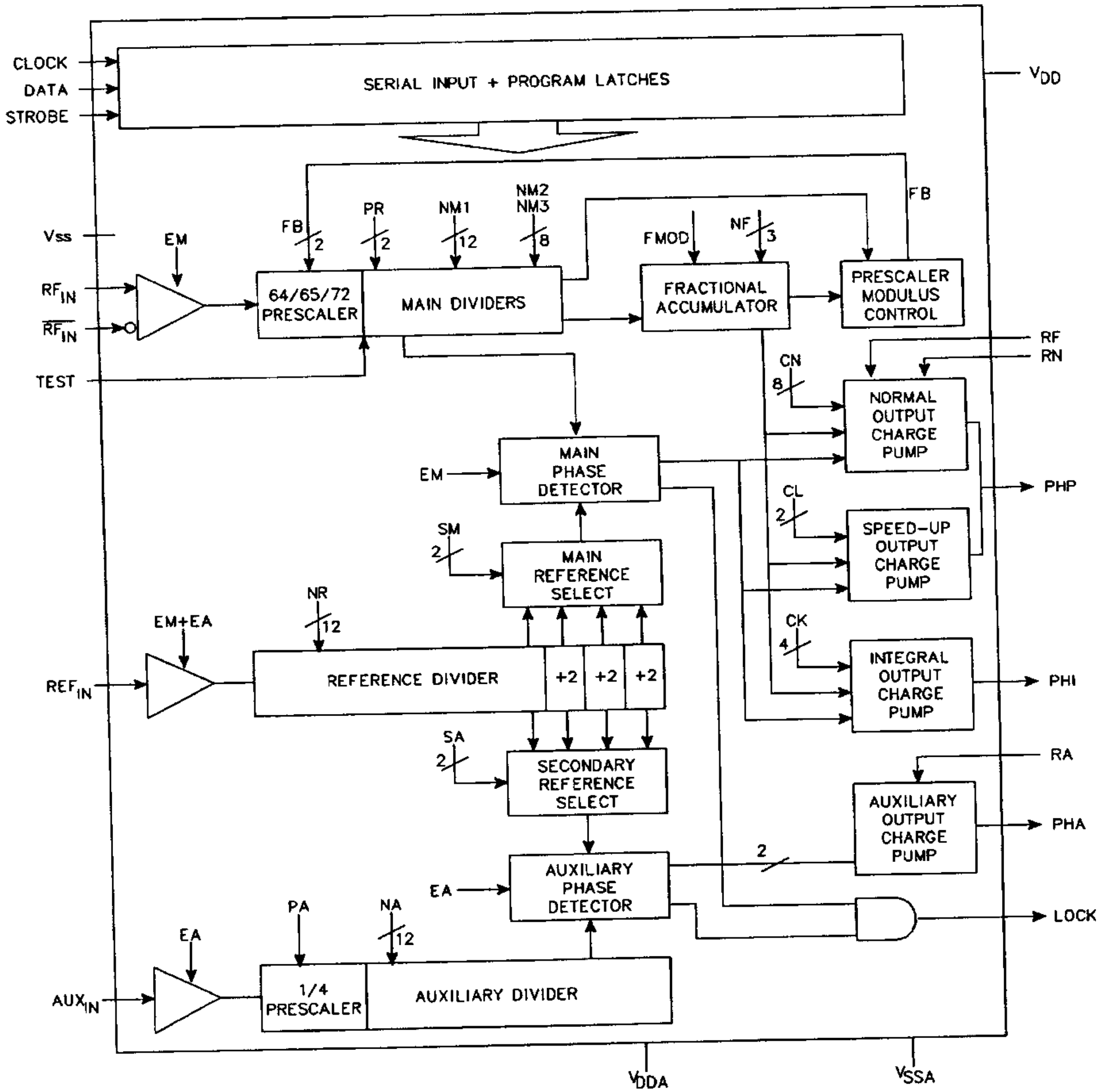
SYNTHESIZER INTEGRATED CIRCUIT (U800)

Synthesizer chip U800 is shown in Figure 4-2. This device contains the following circuits: R (reference), Fractional-N, NM1 and NM2; phase and lock detectors, prescaler and counter programming circuitry.
Frequencies are selected by programming the R, Fractional-N, NM1 and NM2 in U800 to divide by a certain number. These counters are programmed by Modem board or a user supplied programming circuit. The counter divide numbers are chosen so that when the VCO is oscillating on the correct frequency, the VCO-derived input to the phase detector is the same frequency as the reference oscillator-derived

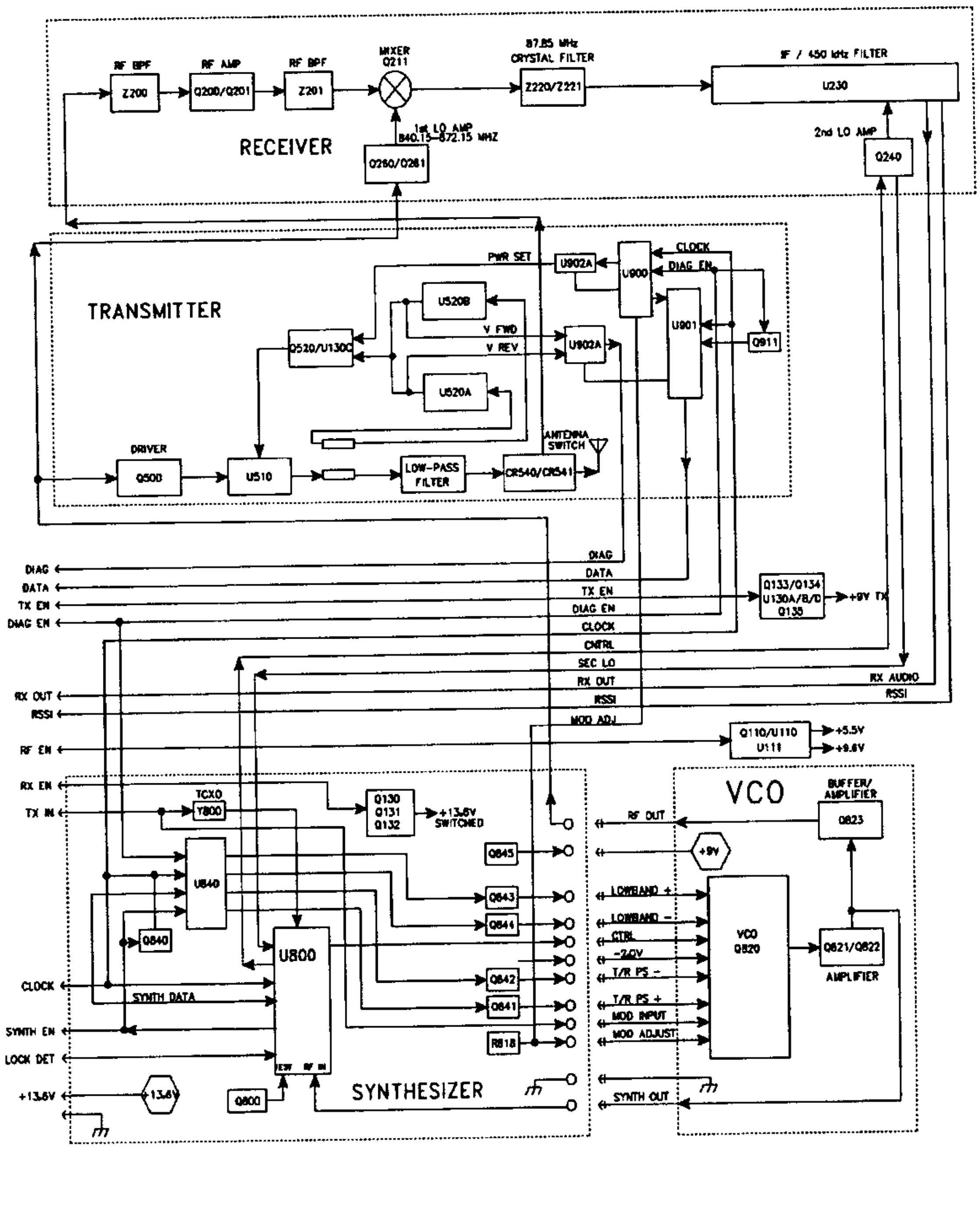
frequency. The VCO frequency is divided by the internal prescaler and the main divider to produce the input to the phase detector.

LOCK DETECT

When the synthesizer is locked on frequency, the SYNTH LOCK output of U800, pin 18 (J201, pin 7) is a high voltage. Then when the synthesizer is unlocked, the output is a low voltage. Lock is defined as a phase difference of less than 1 cycle of the TCXO.



DL-3492 SYNTHESIZER INTEGRATED CIRCUIT (U800)



DL-3492 TRANSCEIVER BLOCK DIAGRAM

3.0 DL-3286 MODEM

3.1 GENERAL

The Modem board, Part No. 023-3286-330, is a plug-in circuit board. The three main functions of the modem board include, loading the synthesizer, providing the baseband modulating signal for the transmitter and demodulating receive audio signals. The modem board is programmed by a personal computer and software. The modem board connects to the radio through 14-pin connector J100. Programming channels and other operating parameters is provided through DB9 connector. A block diagram of the modem is shown at the end of this section.

3.2 TRANSMIT DATA

Transmit Data from the RS-232 port is level-shifted to TTL levels by U216. The MX919B modem, U210 takes the digital data stream and modulates the analog baseband signal using a 4 Level Root Raised Cosine FSK modulation scheme, which is then filtered by U502 then applied to MOD_IN (pin 6) of J100.

The MX919B modem IC is a custom MX-COM 4-level FSK packet data modem operating from 4800 bps to 19.2 kbps. The modem IC adds forward error correction (FEC) and data correction (CRC) information. After adding symbol and frame synchronization codewords, the data packet is converted into filtered 4-level analog signals for modulation the radio. Potentiometer R508 sets the transmit deviation.

3.2 RECEIVE DATA

Received signals are filtered by band-pass filter U402-3 and the gain is adjusted with R410 to set the correct analog levels for the modem IC. The detected audio is fed to the input of the modem IC and also to a symbol synchronization band-pass filter U402-1. From U402-1 the audio passes through a peak detector and amplifier U402-4, then to the processor where a symbol sync pattern is searched for. Once this symbol sync pattern is found the processor enables the Modem to start accepting the data from low-pass filter U402-3. The modem IC takes the analog signals, removes the overhead bits, and performs the error correcting.

3.3 SYNTHESIZER PROGRAMMING

The processor loads the synthesizer on power up, wake up, or receive or transmit transitions. The synthesizer load is sent on the SPI bus with RF_SYNTH_ENABLE, pin 8 of J100, asserted. The radio synthesizer generates a lock detect signal to show when it is on frequency. This signal enters the loader on pin 7 of J100 where it is buffered by U300. If the synthesizer is out of lock the processor will remove the TX enable (if present) and reload the synthesizer until lock is again regained. Eight channel frequency select is provided DIP switches 1, 2, and 3 of S1.

3.4 POWER SUPPLIES

Voltage Regulator U800 provides 8 volt V_SRC for the 3474 Module. Ferrite bead EP 800 is placed when the regulator is in use. To bypass the regulator when an externally-regulated 8 volt supply is used, or when the 3412/3422/3492 RF modules which operate on 12.5 v are being used, EP 800 is removed and EP 700 is placed instead. U604 provides 5.5 V for the receiver 5.5REG and analog modem circuitry, while U602 provides 5V for the CPU and other digital logic.

MOSFET Q806 controls the rise and fall time of RF_TX_EN to eliminate keying transients with the DL3474. This KEY UP CIRCUITRY is only placed on the (-002) boards for use with the 3474.

3.5 MISCELLANEOUS FUNCTIONS

An error condition, when the logic voltage regulator goes out of regulation, resets the processor. U606 is a temperature sensor used by the firmware to compensate for variations in RSSI.

The RF module's RSSI_OUT, J100 pin 12, is read by an analog input on the CPU, which implements a squelch threshold in software. Various internal voltages (F_B+, analog VCC, RX5V, TX5V, SWB+) are read and the diagnostics can be displayed using the available software.

Switch S102 puts the CPU in programming mode in which the CPU accepts new boot code from the software.

NAME OF TEST: Transmitter Rated Power Output

RULE PART NUMBER: 2.983 (d)(5), 2.985 (a)

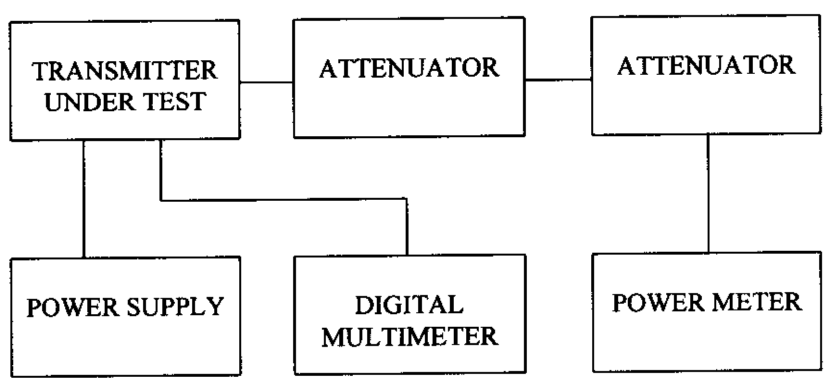
TEST RESULTS: See results below

TEST CONDITIONS: Standard Test Conditions, 25 C

TEST EQUIPMENT:
Attenuator, BIRD Model / 9715 / 50-A-MFN-06 / 6 dB / 50 Watt
Attenuator, BIRD Model / 9716 / 25-A-MFN-20 / 20 dB / 25 Watt
Digital Voltmeter, Fluke Model 8012A
DC Power Source, Model HP6284A
Power Meter, Model HP436A

PERFORMED BY: Allen Frederick DATE: 4/14/98
Allen Frederick

TEST SET-UP:



TEST RESULTS:

Frequency (MHz)	DC Voltage at Final (Vdc)	DC Current into Final (Adc)	DC Power into Final (W)	RF Power Output (W)
944.000	13.3	1.61	21.4	5.0

NAME OF TEST: Transmitter Occupied Bandwidth
DL-3286 Modem at 9600 bps (4800 BAUD)
In Support of Emission Designator 16K0F1D

RULE PART NUMBER: 2.201, 2.202, 2.989 (h), 90.209 (b)(5), 90.210 (b)

MINIMUM STANDARD: Mask B
Sidebands and Spurious [Rule 90.210 (b), P = 5 Watts]
Authorized Bandwidth = 20 KHz [Rule 90.209(b) (5)]
From Fo to 50% of Authorized BW Removed from Fo, down 0 dB.
From 50% to 100% removed, at least 25 dB.
From 100% to 250% removed, at least 35 dB.
Greater than 250% remove, at least 43 + $10\log_{10}(P)$ dB.

Fo to 10 KHz Attenuation = 0 dB
10 KHz to 20 KHz, Attenuation = 25 dB minimum
20 KHz to 50 KHz, Attenuation = 35 dB minimum
> 50 KHz, Attenuation = 50 dB minimum (5 watts)
> 50 KHz, Attenuation = 43 dB minimum (1 watt)

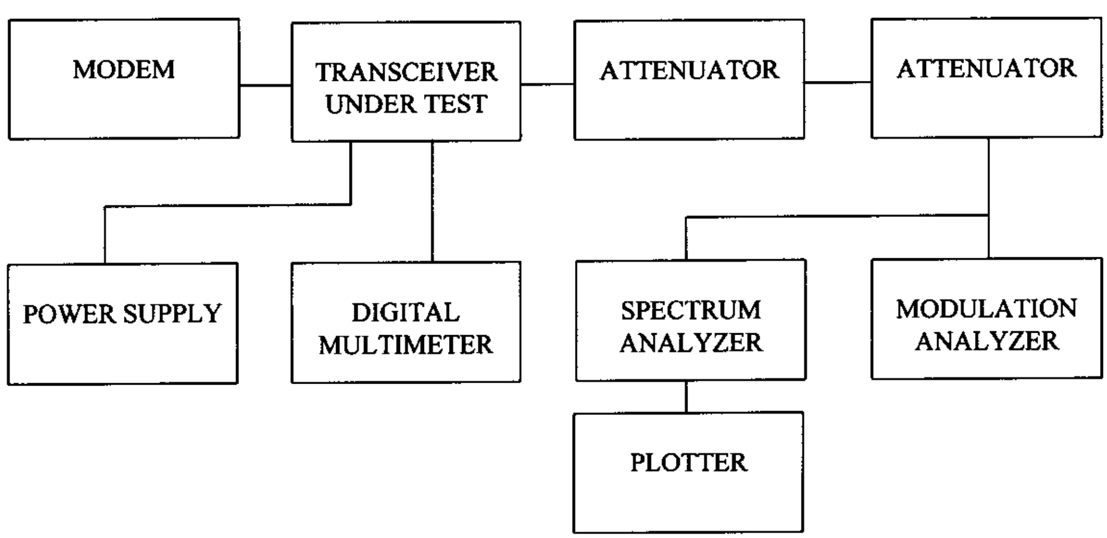
TEST RESULTS: Meets minimum standard (see data on the following pages)

TEST CONDITIONS: Standard Test Conditions, 25 C

TEST EQUIPMENT: Attenuator, BIRD Model / 9715 / 50-A-MFN-06 / 6 dB / 50 Watt
Attenuator, BIRD Model / 9716 / 25-A-MFN-20 / 20 dB / 25 Watt
Digital Voltmeter, Fluke Model 8012A
DC Power Source, Model HP6284A
Modulation Analyzer, Model HP8901A
Spectrum Analyzer, Model HP8563E
Plotter, HP7470A

PERFORMED BY: [signature] DATE: 5/15/98
Allen Frederick

TEST SET-UP:



NAME OF TEST: Transmitter Occupied Bandwidth (Continued)
DL-3286 Modem at 4800 BAUD (9600 bps)
In Support of Emission Designator 16K0F1D

MODULATION SOURCE DESCRIPTION:

The DL-3286 modem was used as the modulating source for this test configuration.
The deviation was set to +/- 5.6 KHz . A random test pattern was generated by the modem. The baud rate was set to 4800 Symbols/sec which corresponds to a bit rate of 9600bps. In this mode, the highest resulting modulating frequency is 2400 Hz.

The modem uses a random number generator to produce random binary numbers from 0-255 decimal to be used as random data to modulate the transceiver. A Symbol Synchronization Code, Frame Synchronization and Header Block is added to the beginning of the frame. (see figure below) From the time the modem keys the transmitter there is a 3 mS delay before the Symbol Synchronization Code begins.

Transmit Frame Structure

Symbol Synchronization 1.2 KHz SineWave Tone 25 mS	Frame Synch. 5 mS	Header Block 14 mS	Data including FEC

Transmit Data from the RS-232 port is level-shifted to TTL levels by U216. The MX919B modem, U210 takes the digital data stream and modulates the analog baseband signal using a 4 Level Root Raised Cosine FSK modulation scheme, which is then filtered by U502. The modem IC adds forward error correction (FEC) and data correction (CRC) information. After adding Symbol Synchronization Code, Frame Synchronization and A Header Block, the data packet is converted into filtered 4-level analog signals for modulating the radio.

NECESSARY BANDWIDTH (Bn) CALCULATION

Bn = 2M + 2DK

M= 2400 Hz. This is the highest modulating frequency corresponding to 4800 baud (9600bps).

D = 5600 Hz. This is the maximum deviation.

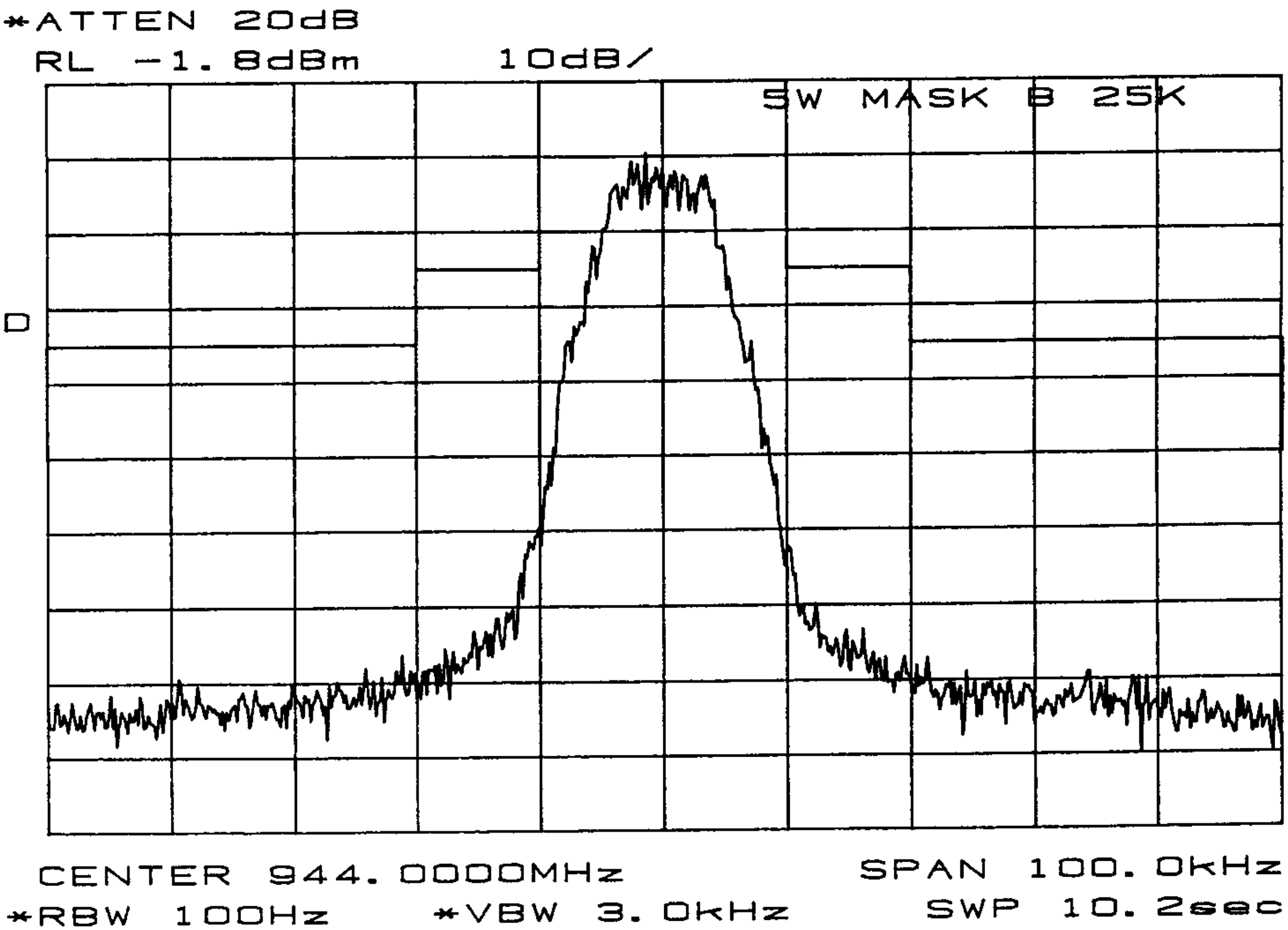
K = 1.0

Bn = 2(2400) + 2(5600)(1.0) = 16,000 Hz.

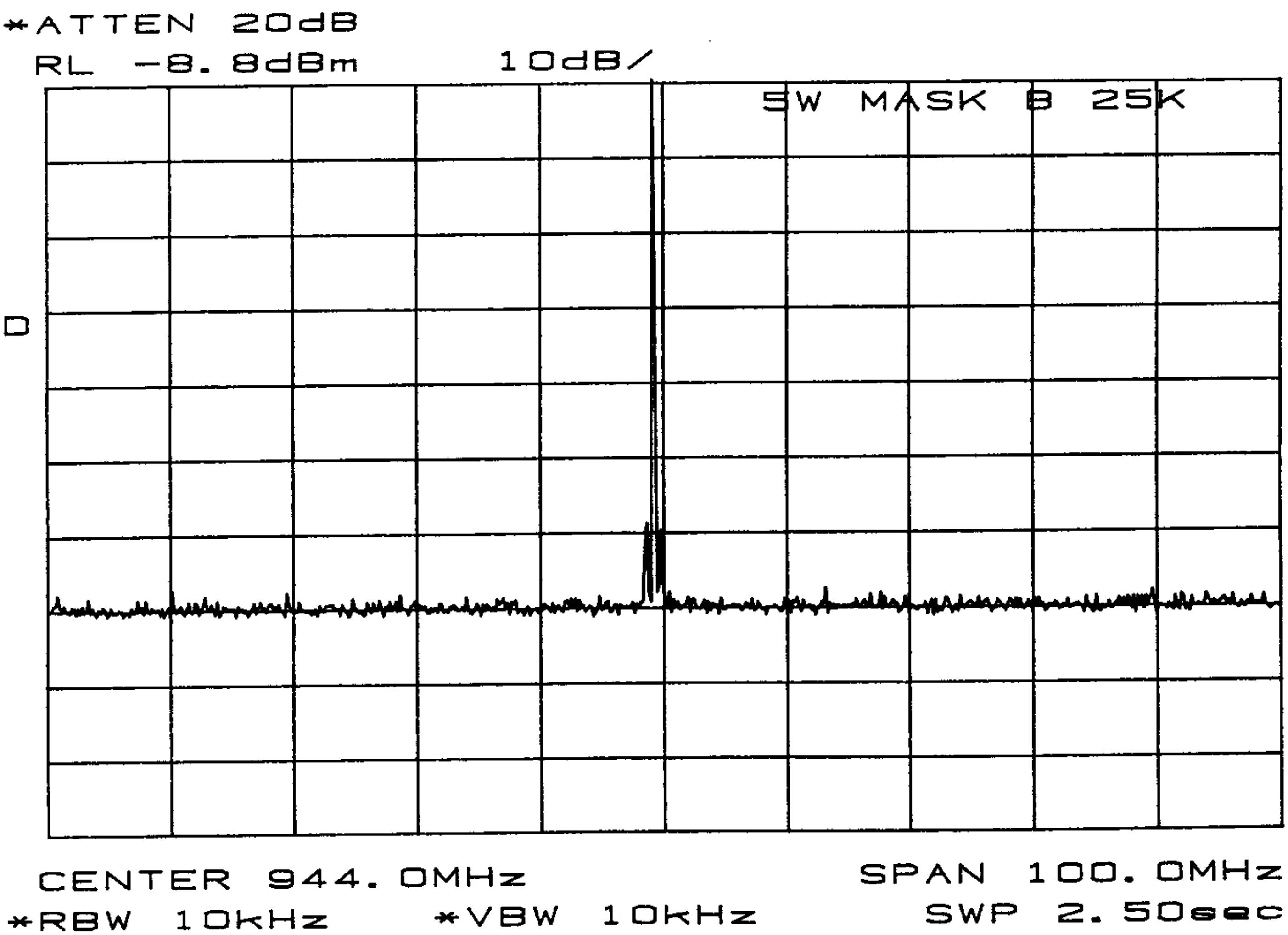
The corresponding emission designator prefix for necessary bandwidth = **16K0.**

TEST DATA: Refer to following graphs:

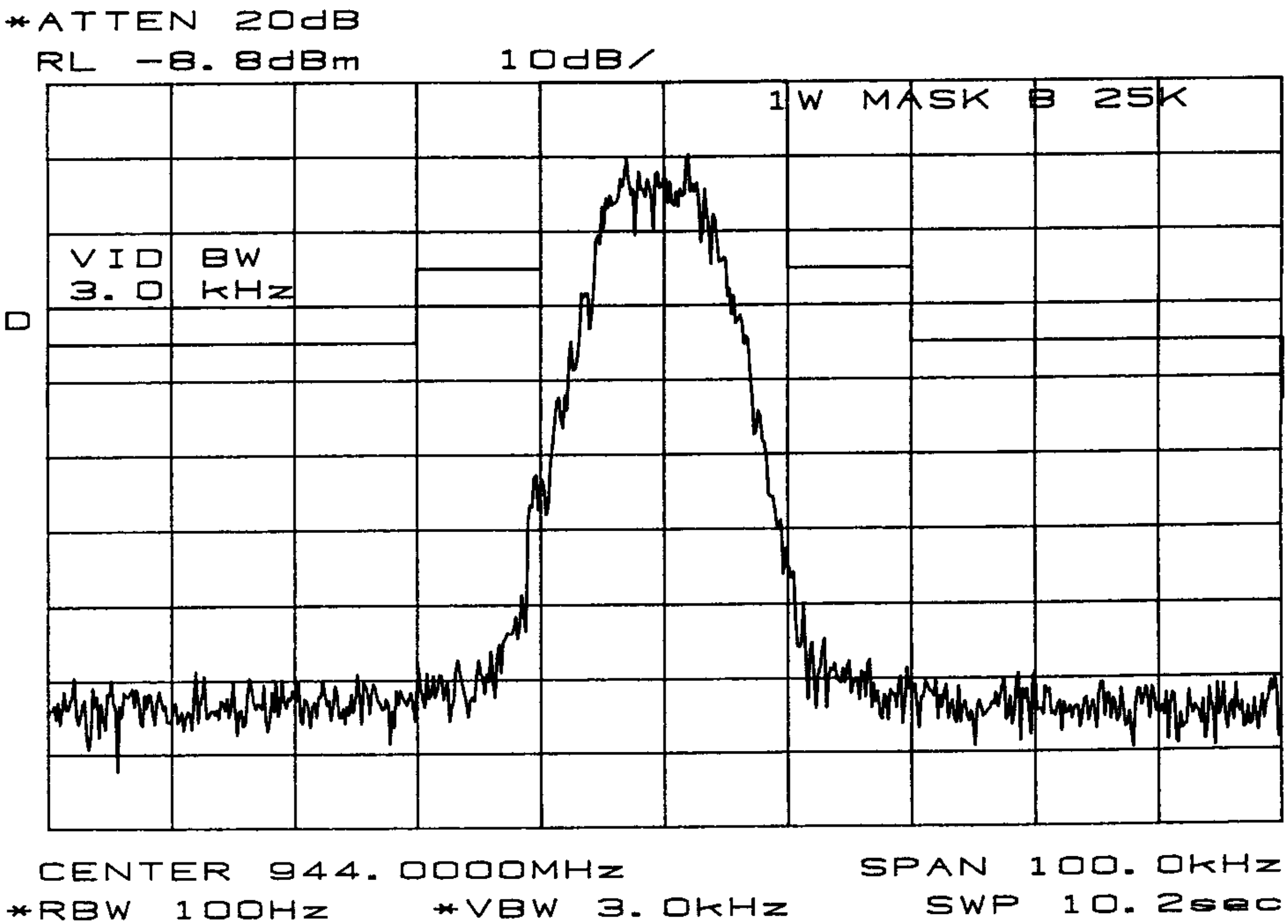
GRAPH: MASK B
SPECTRUM FOR EMISSION 16K0F1D
OUTPUT POWER: 5 Watts
4800 BAUD (9600 bps)
PEAK DEVIATION = 5600 Hz
SPAN = ± 50 KHz



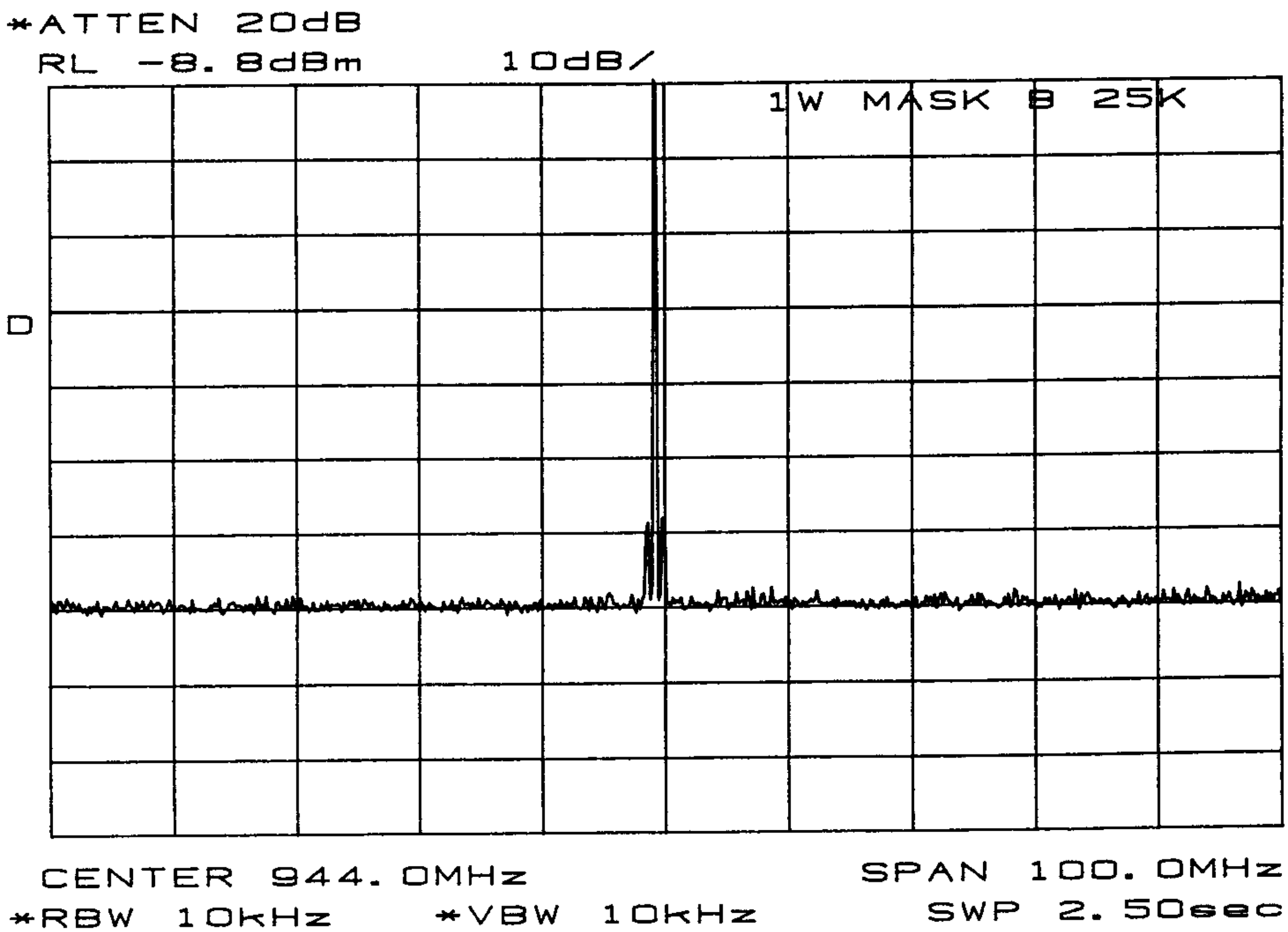
GRAPH: MASK B
SPECTRUM FOR EMISSION 16K0F1D
OUTPUT POWER: 5 Watts
4800 BAUD (9600 bps)
PEAK DEVIATION = 5600 Hz
SPAN = ± 50 MHZ



GRAPH: MASK B
SPECTRUM FOR EMISSION 16K0F1D
OUTPUT POWER: 1 Watts
4800 BAUD (9600 bps)
PEAK DEVIATION = 5600 Hz
SPAN = ± 50 KHz



GRAPH: MASK B
SPECTRUM FOR EMISSION 16K0F1D
OUTPUT POWER: 1 Watts
4800 BAUD (9600 bps)
PEAK DEVIATION = 5600 Hz
SPAN = ± 50 MHz



NAME OF TEST: Transmitter Occupied Bandwidth
DL-3286 Modem at 9600 bps (4800 BAUD)
In Support of Emission Designator 13K0F1D

RULE PART NUMBER: 2.201, 2.202, 2.989 (h), 90.209 (b)(5), 90.210 (d)

MINIMUM STANDARD: Mask D
Sidebands and Spurious [Rule 90.210 (d), P = 5 Watts]
Authorized Bandwidth = 11.25 KHz [Rule 90.209(b) (5)]
From Fo to 5.625 KHz, down 0 dB. Greater than 5.625 KHz to 12.5 KHz, down 7.27(f_d-2.88kHz) dB. Greater than 12.5 KHz, at least 50+10$\log_{10}$(P) or 70 dB, whichever is the lesser of the attenuation.

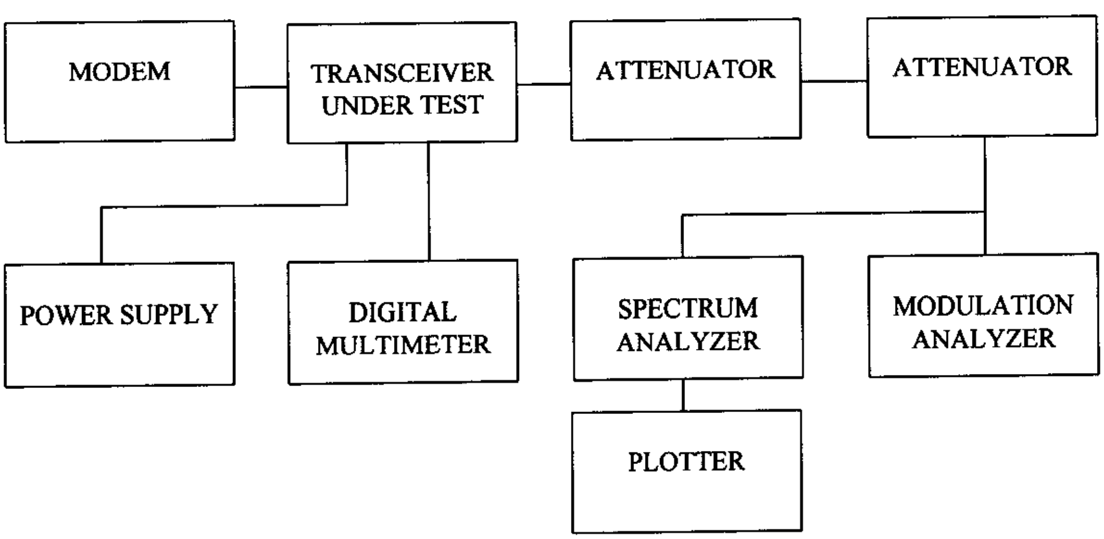
Attenuation = 0 dB at Fo to 5.625 KHz
Attenuation = 20 dB at 5.625 KHz and 70 dB at 12.5 KHz
Attenuation = 57 dB at > 12.5 KHz

TEST RESULTS: Meets minimum standard (see data on the following pages)

TEST CONDITIONS: Standard Test Conditions, 25 C

TEST EQUIPMENT: Attenuator, BIRD Model / 9715 / 50-A-MFN-06 / 6 dB / 50 Watt
Attenuator, BIRD Model / 9716 / 25-A-MFN-20 / 20 dB / 25 Watt
Digital Voltmeter, Fluke Model 8012A
DC Power Source, Model HP6284A
Modulation Analyzer, Model HP8901A
Spectrum Analyzer, Model HP8563E
Plotter, HP7470A

PERFORMED BY: Allen Frederick DATE: 5/15/98



NAME OF TEST: Transmitter Occupied Bandwidth (Continued)
DL-3286 Modem at 4800 BAUD (9600 bps)
In Support of Emission Designator 13K0F1D

MODULATION SOURCE DESCRIPTION:

The DL-3286 modem was used as the modulating source for this test configuration.
The deviation was set to +/- 4.1 KHz . A random test pattern was generated by the modem. The baud rate was set to 4800 Symbols/sec which corresponds to a bit rate of 9600bps. In this mode, the highest resulting modulating frequency is 2400 Hz.

The modem uses a random number generator to produce random binary numbers from 0-255 decimal to be used as random data to modulate the transceiver. A Symbol Synchronization Code, Frame Synchronization and Header Block is added to the beginning of the frame. (see figure below) From the time the modem keys the transmitter there is a 3 mS delay before the Symbol Synchronization Code begins.

Transmit Frame Structure

Symbol Synchronization 1.2 KHz SineWave Tone 25 mS	Frame Synch. 5 mS	Header Block 14 mS	Data including FEC

Transmit Data from the RS-232 port is level-shifted to TTL levels by U216. The MX919B modem, U210 takes the digital data stream and modulates the analog baseband signal using a 4 Level Root Raised Cosine FSK modulation scheme, which is then filtered by U502. The modem IC adds forward error correction (FEC) and data correction (CRC) information. After adding Symbol Synchronization Code, Frame Synchronization and A Header Block, the data packet is converted into filtered 4-level analog signals for modulating the radio.

NECESSARY BANDWIDTH (Bn) CALCULATION

Bn = 2M + 2DK

M= 2400 Hz. This is the highest modulating frequency corresponding to 4800 baud (9600bps).

D = 4100 Hz. This is the maximum deviation.

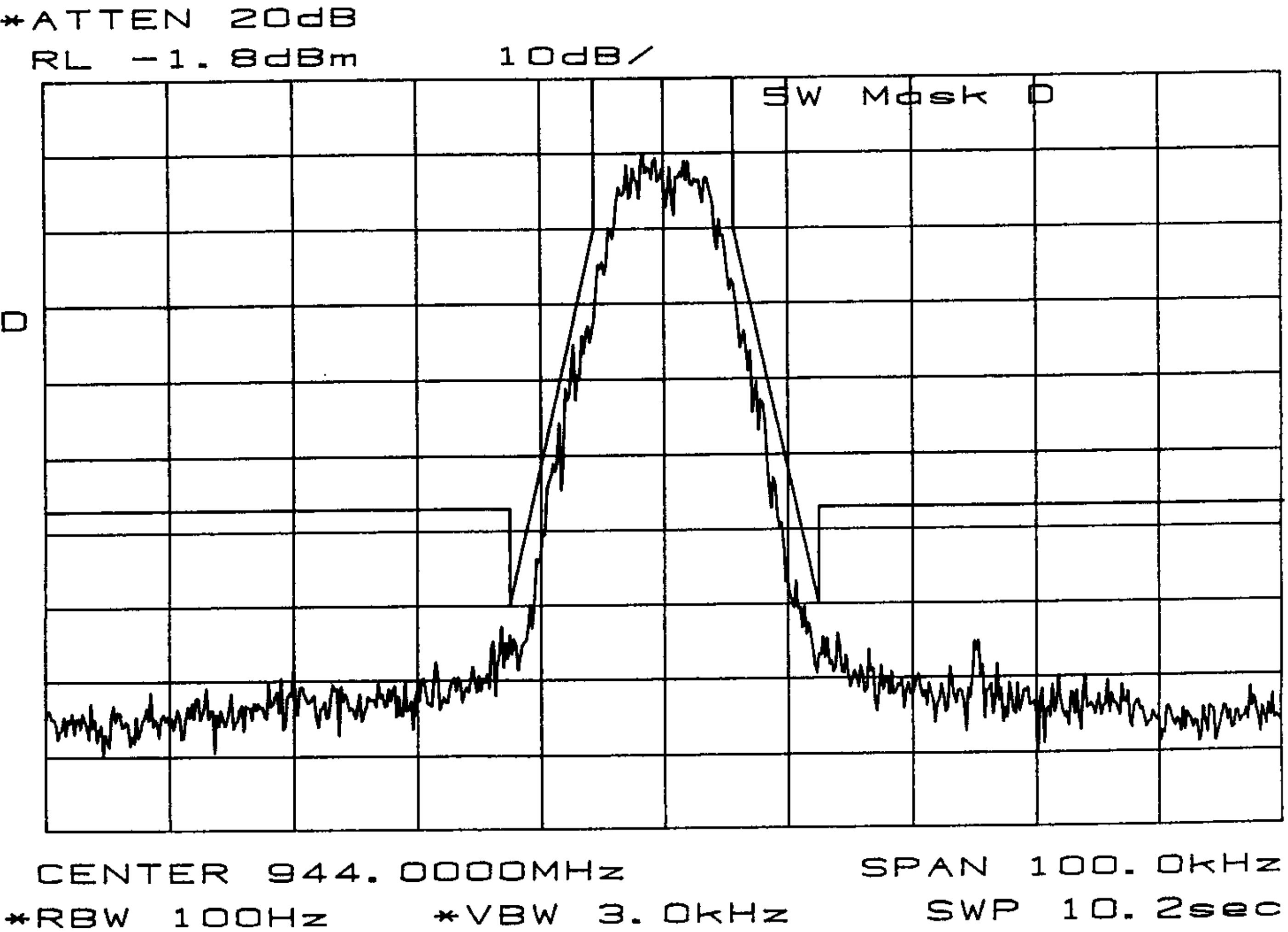
K = 1.0

Bn = 2(2400) + 2(4100)(1.0) = 13,000 Hz.

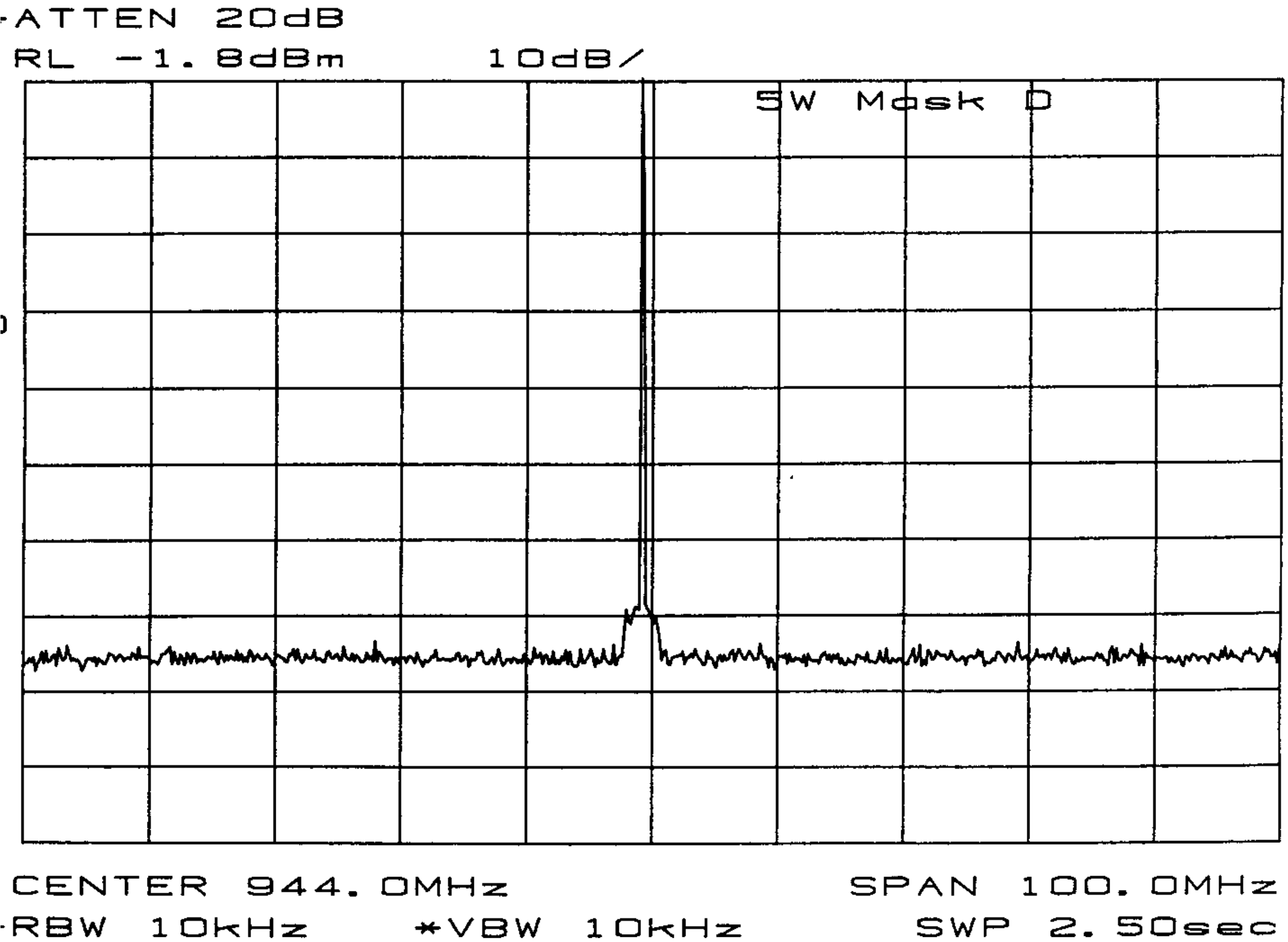
The corresponding emission designator prefix for necessary bandwidth = **13K0.**

TEST DATA: Refer to following graphs:

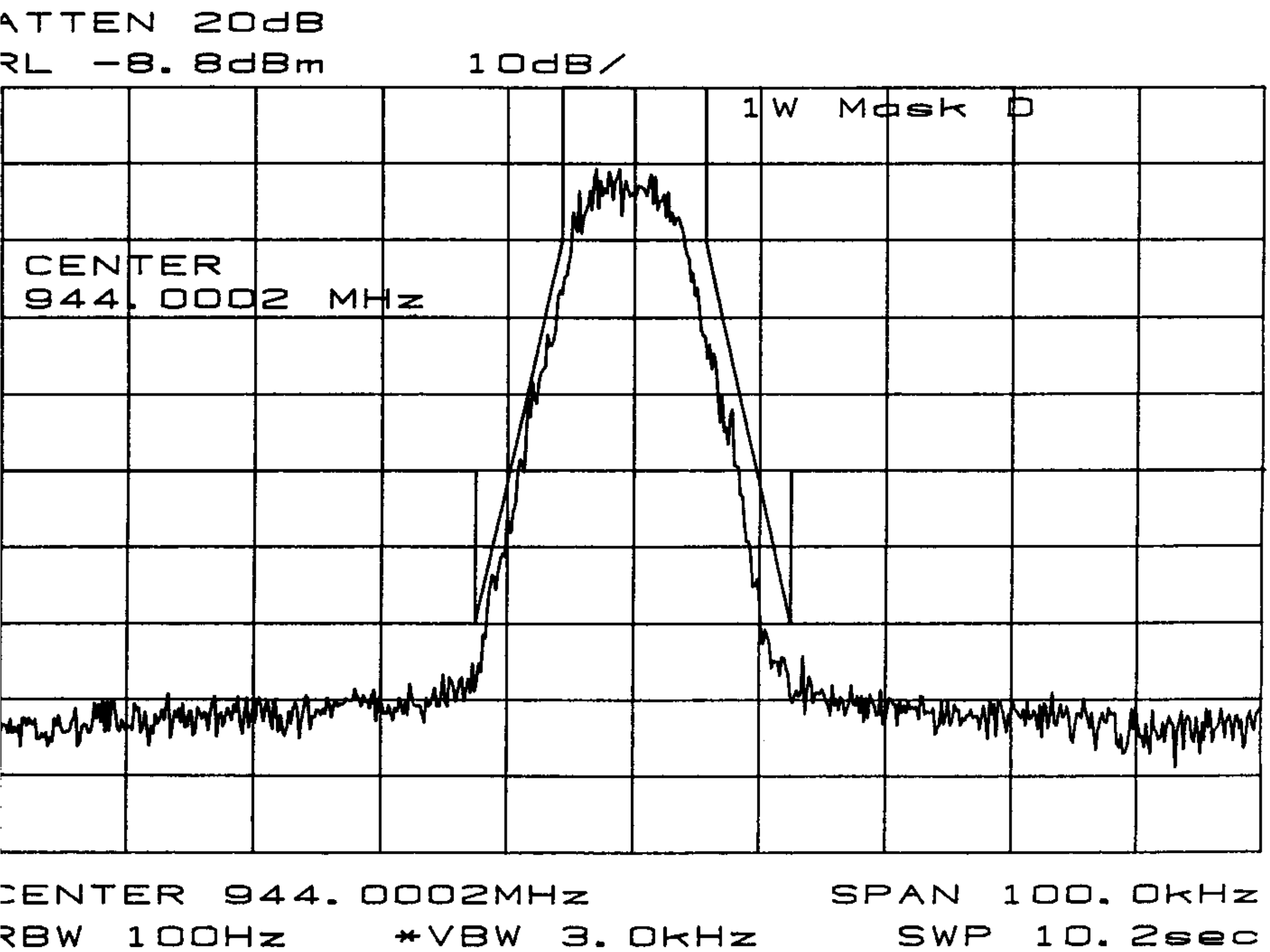
GRAPH: MASK D
SPECTRUM FOR EMISSION 13K0F1D
OUTPUT POWER: 5 Watts
4800 BAUD (9600 bps)
PEAK DEVIATION = 4100 Hz
SPAN = ± 50 KHz



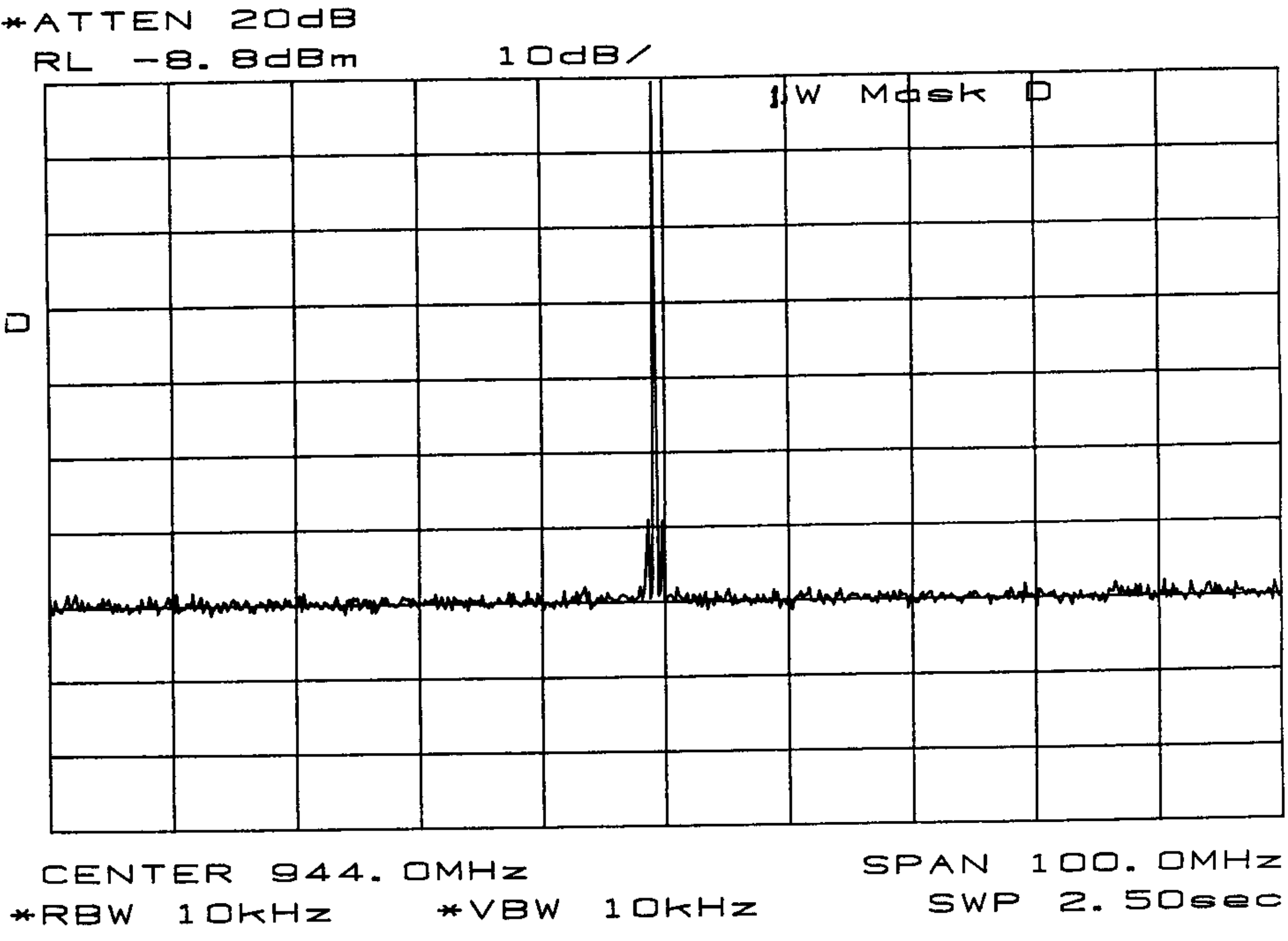
GRAPH: MASK D
SPECTRUM FOR EMISSION 13K0F1D
OUTPUT POWER: 5 Watts
4800 BAUD (9600 bps)
PEAK DEVIATION = 4100 Hz
SPAN = ± 50 MHz



GRAPH: MASK D
SPECTRUM FOR EMISSION 13K0F1D
OUTPUT POWER: 1 Watts
4800 BAUD (9600 bps)
PEAK DEVIATION = 4100 Hz
SPAN = ± 50 KHz



GRAPH: MASK D
SPECTRUM FOR EMISSION 13K0F1D
OUTPUT POWER: 1 Watts
4800 BAUD (9600 bps)
PEAK DEVIATION = 4100 Hz
SPAN = ± 50 MHz



NAME OF TEST: Transmitter Occupied Bandwidth
DL-3286 Modem at 9600 bps (4800 BAUD)
In Support of Emission Designator 13K0F1D

RULE PART NUMBER: 2.201, 2.202, 2.989 (h), 101.111(a)(5)

MINIMUM STANDARD: Mask 101.111(a)(5)
Sidebands and Spurious [Rule 101.111(a)(5), P = 5 Watts]
Authorized Bandwidth = 12.5 KHz [Rule 101.109]
From Fo to 2.5 KHz, down 0 dB.
Greater than 2.5 KHz to 6.25 KHz, down 53 $\log_{10}$(fd/2.5)
Greater than 6.25 KHz to 9.5 KHz, down 103 $\log_{10}$(fd/3.9)
Greater then 9.5 to 15 KHz, 157 $\log_{10}$(fd/5.3)
Greater then 15 KHz,, 50+10 $\log_{10}$(P) or 70 dB

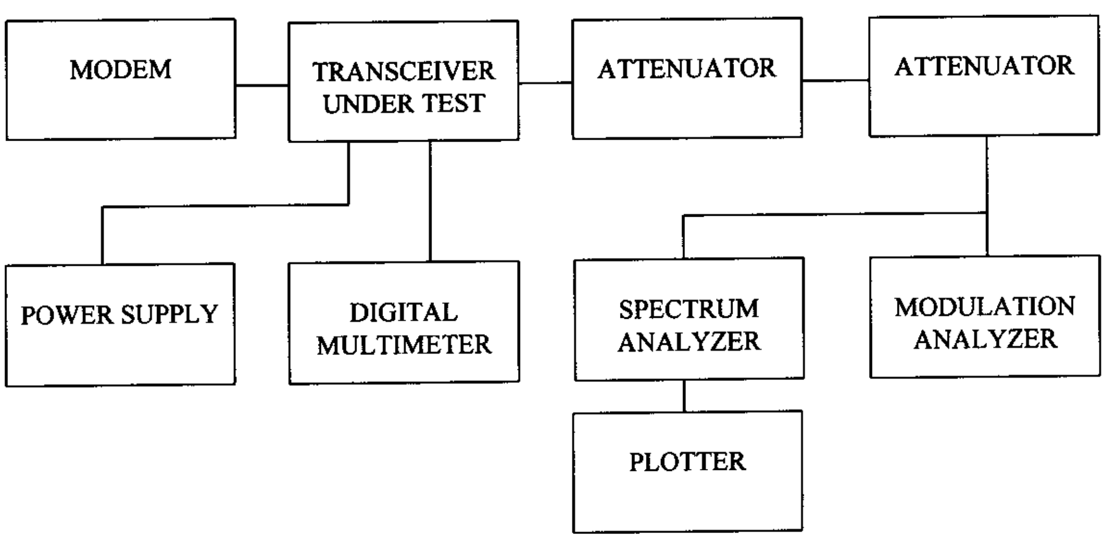
Attenuation = 0 dB at Fo to 2.5 KHz
Attenuation = 21.1dB at 6.25 KHz
Attenuation = 39.8 dB at 9.5 KHz
Attenuation = 70.9 dB at 15 KHz
Attenuation = 57 dB at > 15 KHz

TEST RESULTS: Meets minimum standard (see data on the following pages)

TEST CONDITIONS: Standard Test Conditions, 25 C

TEST EQUIPMENT: Attenuator, BIRD Model / 9715 / 50-A-MFN-06 / 6 dB / 50 Watt
Attenuator, BIRD Model / 9716 / 25-A-MFN-20 / 20 dB / 25 Watt
Digital Voltmeter, Fluke Model 8012A
DC Power Source, Model HP6284A
Modulation Analyzer, Model HP8901A
Spectrum Analyzer, Model HP8563E
Plotter, HP7470A

PERFORMED BY: Allen Frederick DATE: 5/15/98
Allen Frederick



NAME OF TEST: Transmitter Occupied Bandwidth (Continued)
DL-3286 Modem at 4800 BAUD (9600 bps)
In Support of Emission Designator 13K0F1D

MODULATION SOURCE DESCRIPTION:

The DL-3286 modem was used as the modulating source for this test configuration.
The deviation was set to +/- 4.1 KHz . A random test pattern was generated by the modem. The baud rate was set to 4800 Symbols/sec which corresponds to a bit rate of 9600bps. In this mode, the highest resulting modulating frequency is 2400 Hz.

The modem uses a random number generator to produce random binary numbers from 0-255 decimal to be used as random data to modulate the transceiver. A Symbol Synchronization Code, Frame Synchronization and Header Block is added to the beginning of the frame. (see figure below) From the time the modem keys the transmitter there is a 3 mS delay before the Symbol Synchronization Code begins.

Transmit Frame Structure

Symbol Synchronization 1.2 KHz SineWave Tone 25 mS	Frame Synch. 5 mS	Header Block 14 mS	Data including FEC

Transmit Data from the RS-232 port is level-shifted to TTL levels by U216. The MX919B modem, U210 takes the digital data stream and modulates the analog baseband signal using a 4 Level Root Raised Cosine FSK modulation scheme, which is then filtered by U502. The modem IC adds forward error correction (FEC) and data correction (CRC) information. After adding Symbol Synchronization Code, Frame Synchronization and A Header Block, the data packet is converted into filtered 4-level analog signals for modulating the radio.

NECESSARY BANDWIDTH (Bn) CALCULATION

Bn = 2M + 2DK

M= 2400 Hz. This is the highest modulating frequency corresponding to 4800 baud (9600bps).

D = 4100 Hz. This is the maximum deviation.

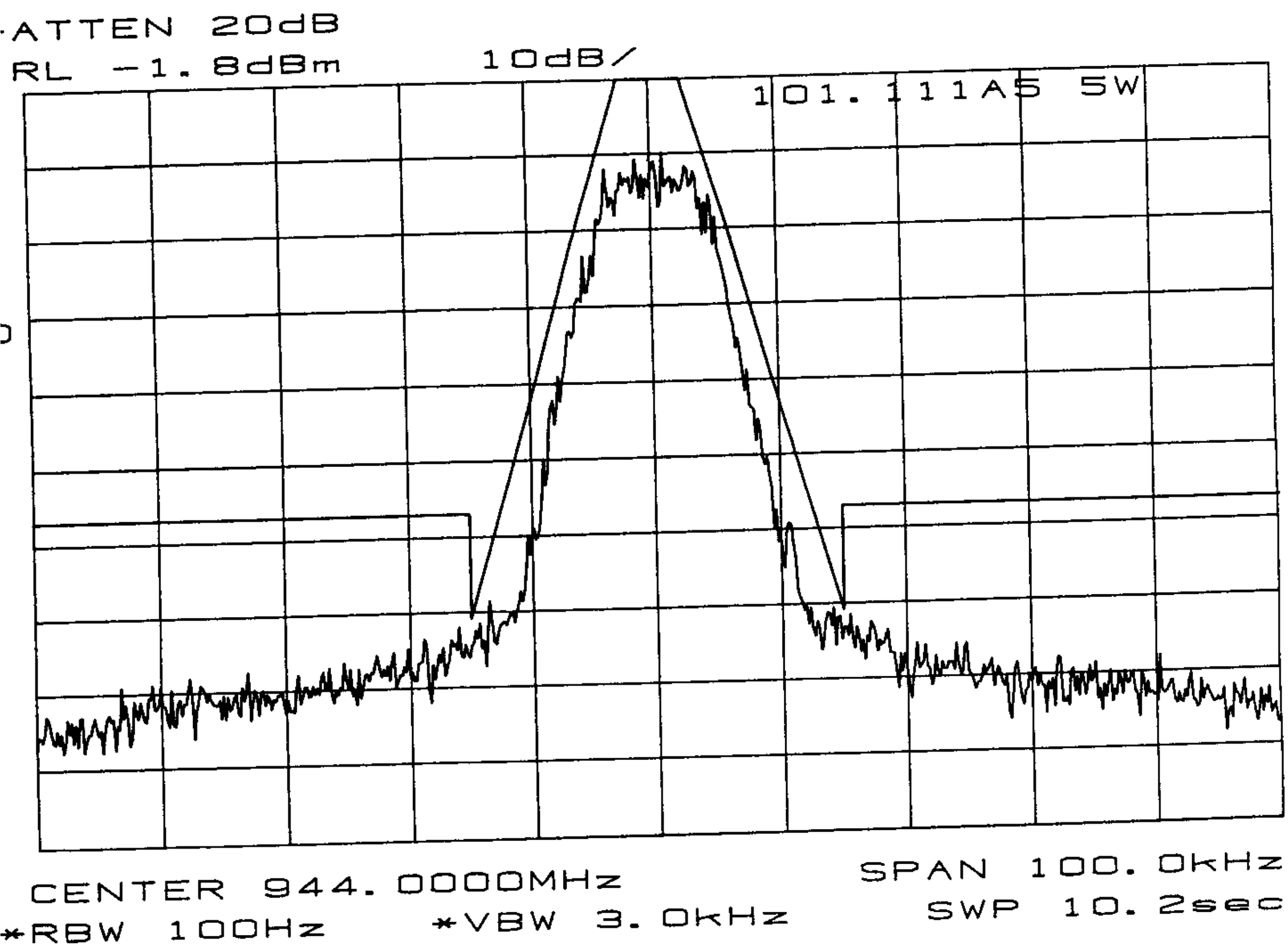
K = 1.0

Bn = 2(2400) + 2(4100)(1.0) = 13,000 Hz.

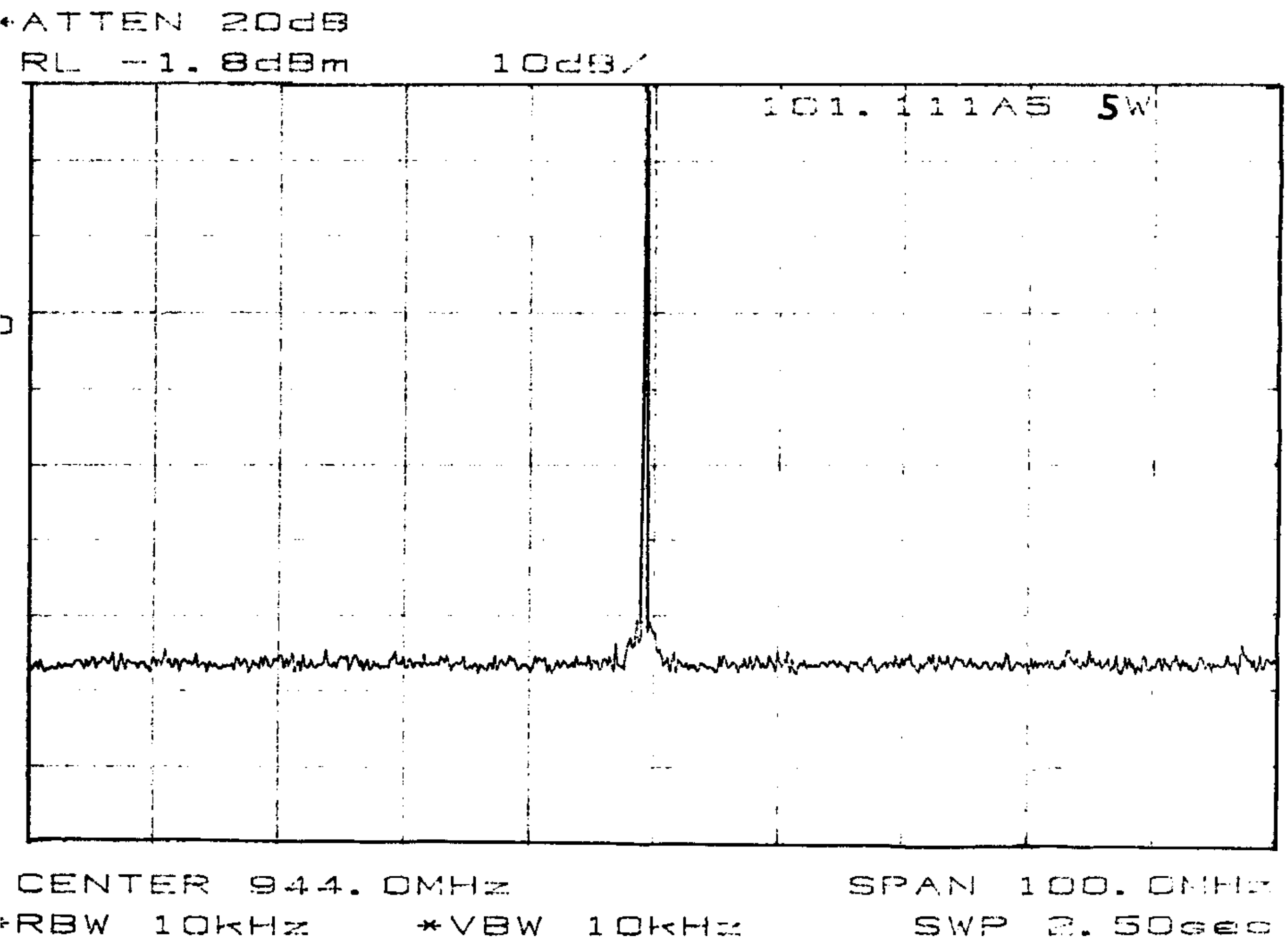
The corresponding emission designator prefix for necessary bandwidth = **13K0.**

TEST DATA: Refer to following graphs:

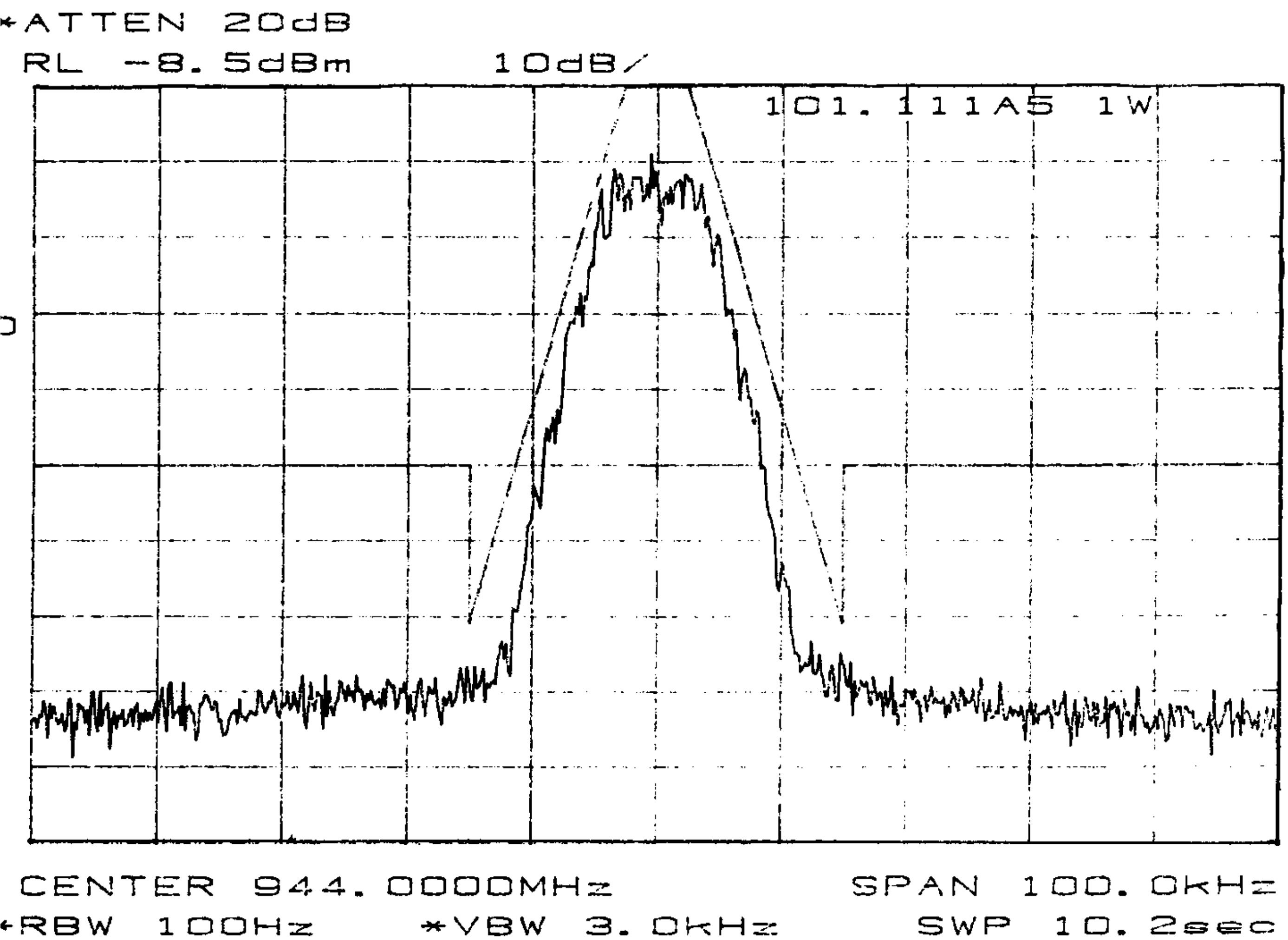
GRAPH: MASK 101.111(a)(5)
SPECTRUM FOR EMISSION 13K0F1D
OUTPUT POWER: 5 Watts
4800 BAUD (9600 bps)
PEAK DEVIATION = 4100 Hz
SPAN = ± 50 KHz



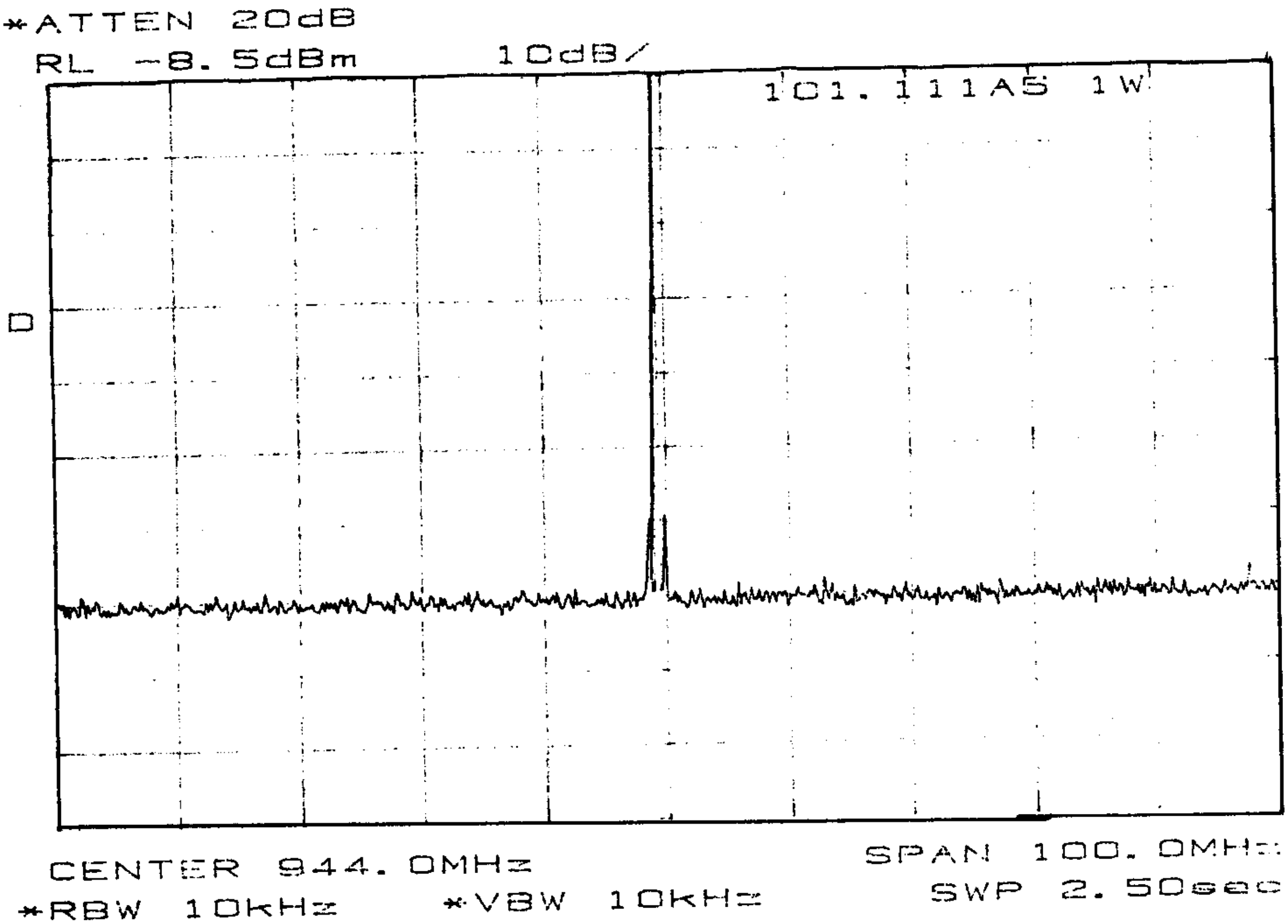
GRAPH: MASK 101.111(a)(5)
SPECTRUM FOR EMISSION 13K0F1D
OUTPUT POWER: 5 Watts
4800 BAUD (9600 bps)
PEAK DEVIATION = 4100 Hz
SPAN = ± 50 MHz



GRAPH: MASK 101.111(a)(5)
SPECTRUM FOR EMISSION 13K0F1D
OUTPUT POWER: 1 Watts
4800 BAUD (9600 bps)
PEAK DEVIATION = 4100 Hz
SPAN = ± 50 KHz

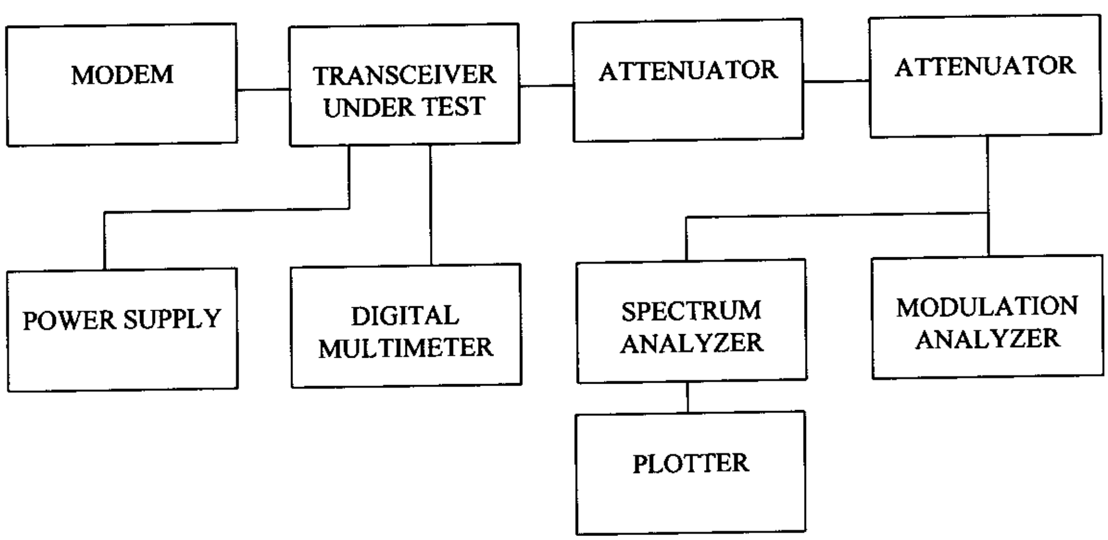


GRAPH: MASK 101.111(a)(5)
SPECTRUM FOR EMISSION 13K0F1D
OUTPUT POWER: 1 Watts
4800 BAUD (9600 bps)
PEAK DEVIATION = 4100 Hz
SPAN = ± 50 MHz



NAME OF TEST:	Transmitter Occupied Bandwidth DL-3286 Modem at 9600 bps (4800 BAUD) In Support of Emission Designator 16K0F1D
RULE PART NUMBER:	2.201, 2.202, 2.989 (h), 101.111(a)(6)
MINIMUM STANDARD:	Mask 101.111(a)(6) Sidebands and Spurious [Rule 101.111(a)(6), P = 5 Watts] Authorized Bandwidth = 25 KHz [Rule 101.109] From Fo to 5.0 KHz, down 0 dB. From 5 KHz to 10 KHz, 83 $\log_{10}$ (fd / 5) Greater than 10 KHz to 250% auth BW, down 116 $\log_{10}$ (fd/6.1) or 50+ 10 $\log_{10}$ (P) or 70 dB, whichever is lesser attenuation. Greater then 250% auth BW, 43+10$\log_{10}$(P) or 80 dB. Attenuation = 0 dB at Fo to 5 KHz Attenuation = 25 dB at 10 KHz Attenuation = 57 dB at 18.91 KHz (50 dB at 1W) Attenuation = 50 dB at > 62.5 KHz (43 dB at 1W)
TEST RESULTS:	Meets minimum standard (see data on the following pages)
TEST CONDITIONS:	Standard Test Conditions, 25 C
TEST EQUIPMENT:	Attenuator, BIRD Model / 9715 / 50-A-MFN-06 / 6 dB / 50 Watt Attenuator, BIRD Model / 9716 / 25-A-MFN-20 / 20 dB / 25 Watt Digital Voltmeter, Fluke Model 8012A DC Power Source, Model HP6284A Modulation Analyzer, Model HP8901A Spectrum Analyzer, Model HP8563E Plotter, HP7470A
PERFORMED BY:	Allen Frederick (signature) Allen Frederick

DATE: 5/15/98



NAME OF TEST: Transmitter Occupied Bandwidth (Continued)
DL-3286 Modem at 4800 BAUD (9600 bps)
In Support of Emission Designator 16K0F1D

MODULATION SOURCE DESCRIPTION:

The DL-3286 modem was used as the modulating source for this test configuration.
The deviation was set to +/- 5.6 KHz . A random test pattern was generated by the modem. The baud rate was set to 4800 Symbols/sec which corresponds to a bit rate of 9600bps. In this mode, the highest resulting modulating frequency is 2400 Hz.

The modem uses a random number generator to produce random binary numbers from 0-255 decimal to be used as random data to modulate the transceiver. A Symbol Synchronization Code, Frame Synchronization and Header Block is added to the beginning of the frame. (see figure below) From the time the modem keys the transmitter there is a 3 mS delay before the Symbol Synchronization Code begins.

Transmit Frame Structure

Symbol Synchronization 1.2 KHz SineWave Tone 25 mS	Frame Synch. 5 mS	Header Block 14 mS	Data including FEC

Transmit Data from the RS-232 port is level-shifted to TTL levels by U216. The MX919B modem, U210 takes the digital data stream and modulates the analog baseband signal using a 4 Level Root Raised Cosine FSK modulation scheme, which is then filtered by U502. The modem IC adds forward error correction (FEC) and data correction (CRC) information. After adding Symbol Synchronization Code, Frame Synchronization and A Header Block, the data packet is converted into filtered 4-level analog signals for modulating the radio.

NECESSARY BANDWIDTH (Bn) CALCULATION

$Bn = 2M + 2DK$

M= 2400 Hz. This is the highest modulating frequency corresponding to 4800 baud (9600bps).

D = 5600 Hz. This is the maximum deviation.

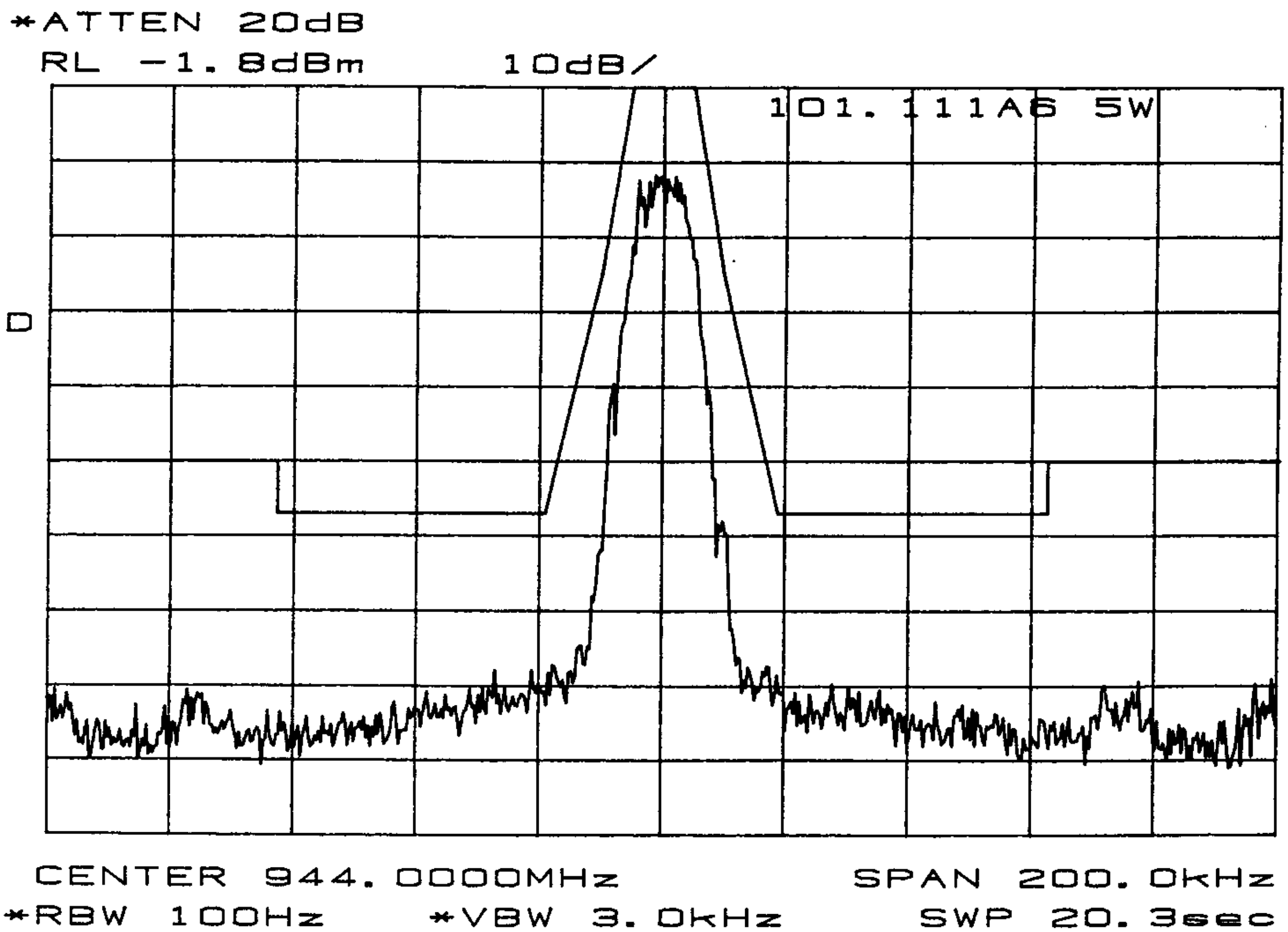
K = 1.0

$Bn = 2(2400) + 2(5600)(1.0) = 16,000$ Hz.

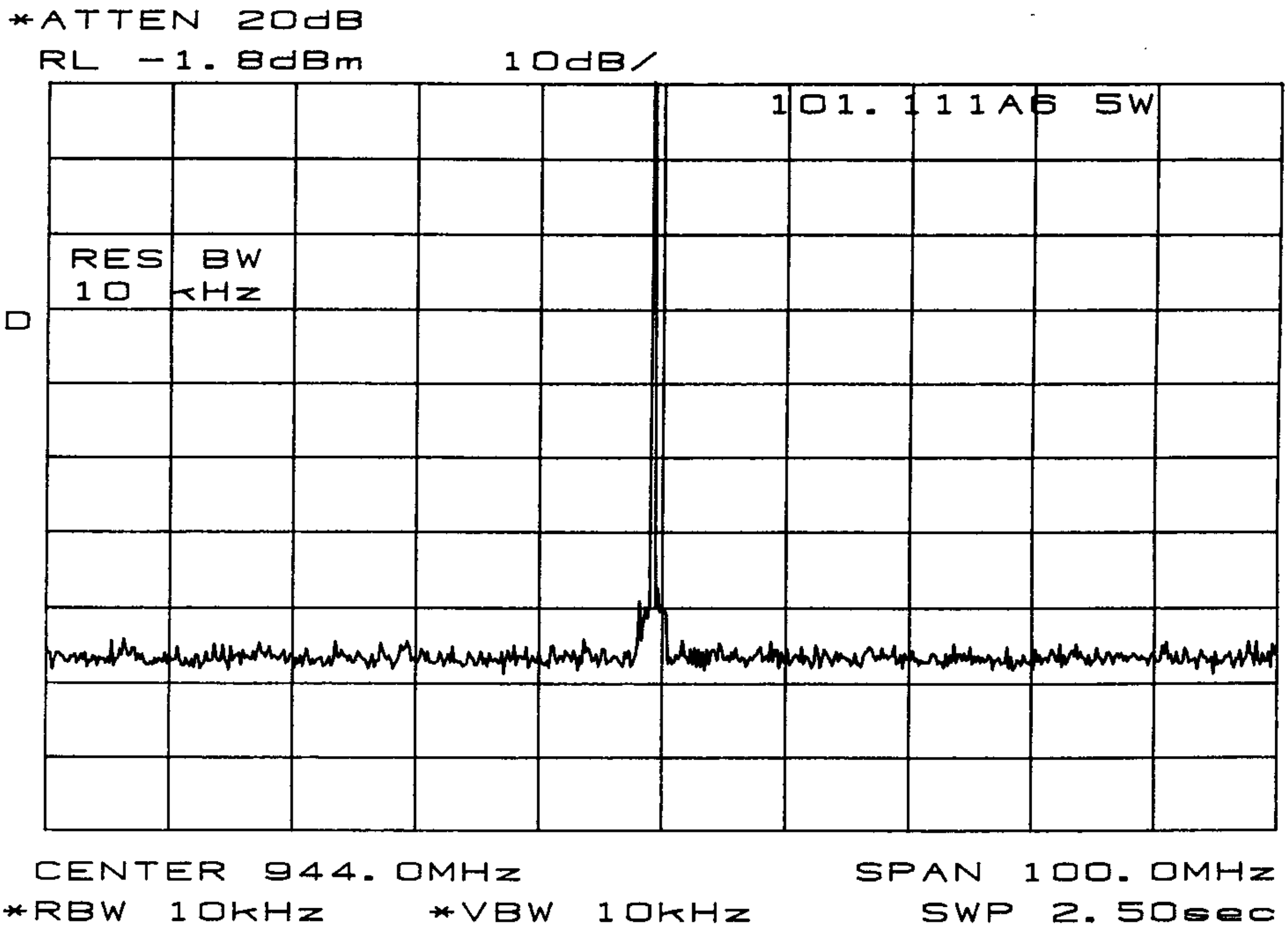
The corresponding emission designator prefix for necessary bandwidth = **16K0.**

TEST DATA: Refer to following graphs:

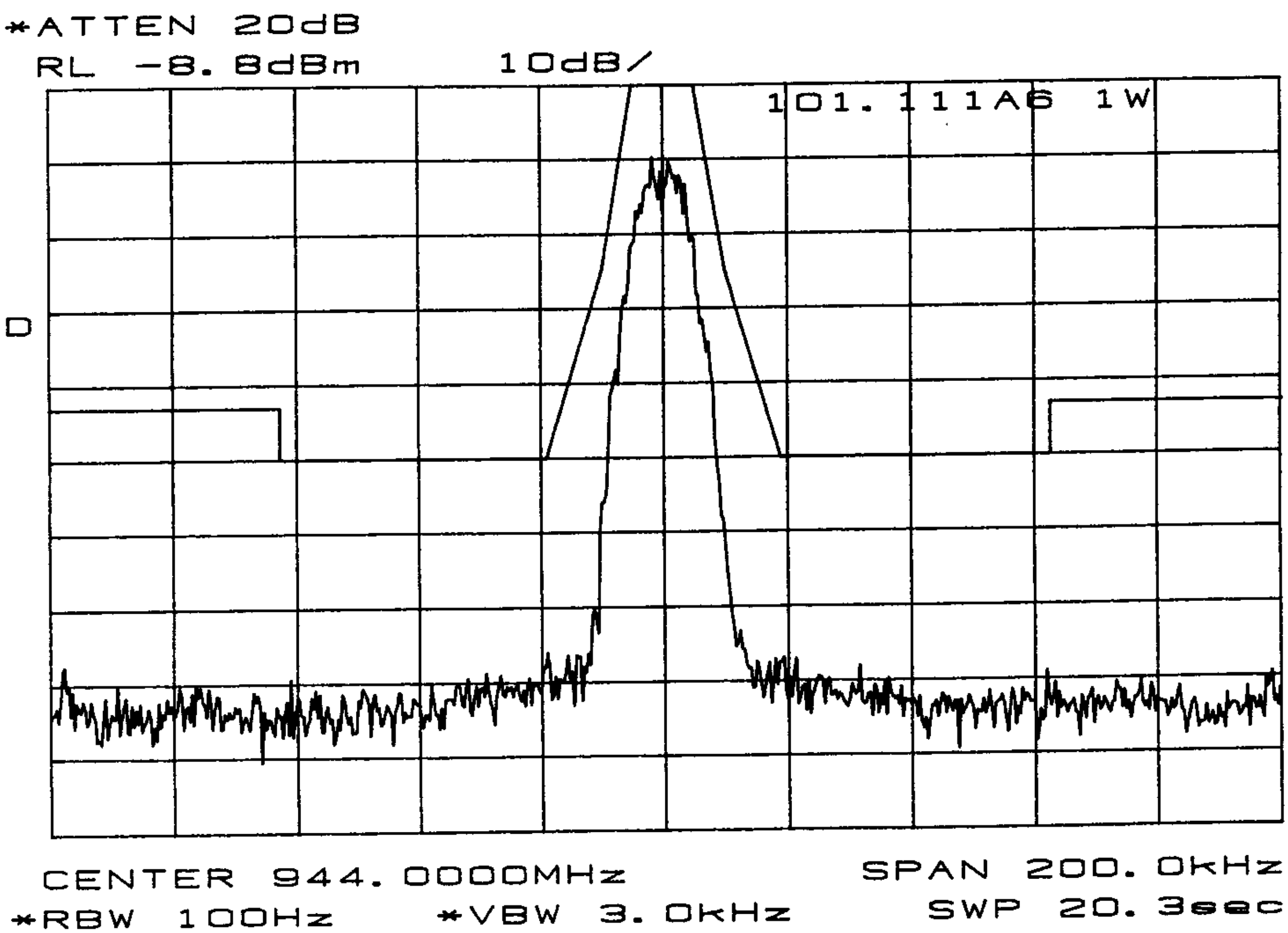
GRAPH: 101.111(a)(6)
SPECTRUM FOR EMISSION 16K0F1D
OUTPUT POWER: 5 Watts
4800 BAUD (9600 bps)
PEAK DEVIATION = 5600 Hz
SPAN = ± 100 KHz



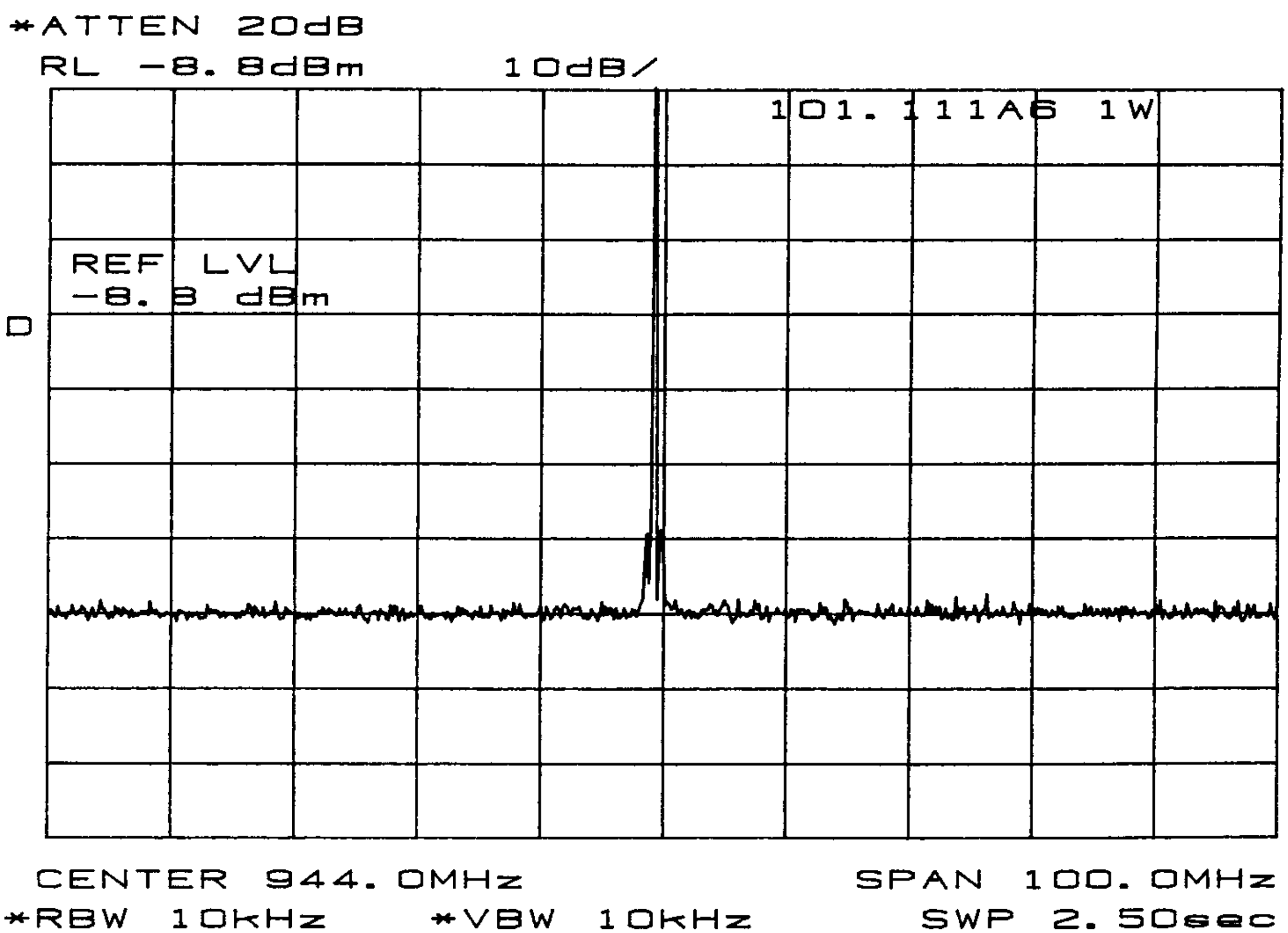
GRAPH: 101.111(a)(6)
SPECTRUM FOR EMISSION 16K0F1D
OUTPUT POWER: 5 Watts
4800 BAUD (9600 bps)
PEAK DEVIATION = 5600 Hz
SPAN = ± 50 MHz



GRAPH: 101.111(a)(6)
SPECTRUM FOR EMISSION 16K0F1D
OUTPUT POWER: 1 Watts
4800 BAUD (9600 bps)
PEAK DEVIATION = 5600 Hz
SPAN = ± 100 KHz



GRAPH: 101.111(a)(6)
SPECTRUM FOR EMISSION 16K0F1D
OUTPUT POWER: 1 Watts
4800 BAUD (9600 bps)
PEAK DEVIATION = 5600 Hz
SPAN = ± 50 MHz



NAME OF TEST: Transmitter Spurious and Harmonic Outputs

RULE PART NUMBER: 2.991, 90.210 (d)(3)

MINIMUM STANDARD: For 5 Watt; $50+10Log_{10}(5 \text{ Watts}) = -57$ dBc
or -70 dBc whichever is the lesser attenuation.

TEST RESULTS: Meets minimum standard (see data on the following page)

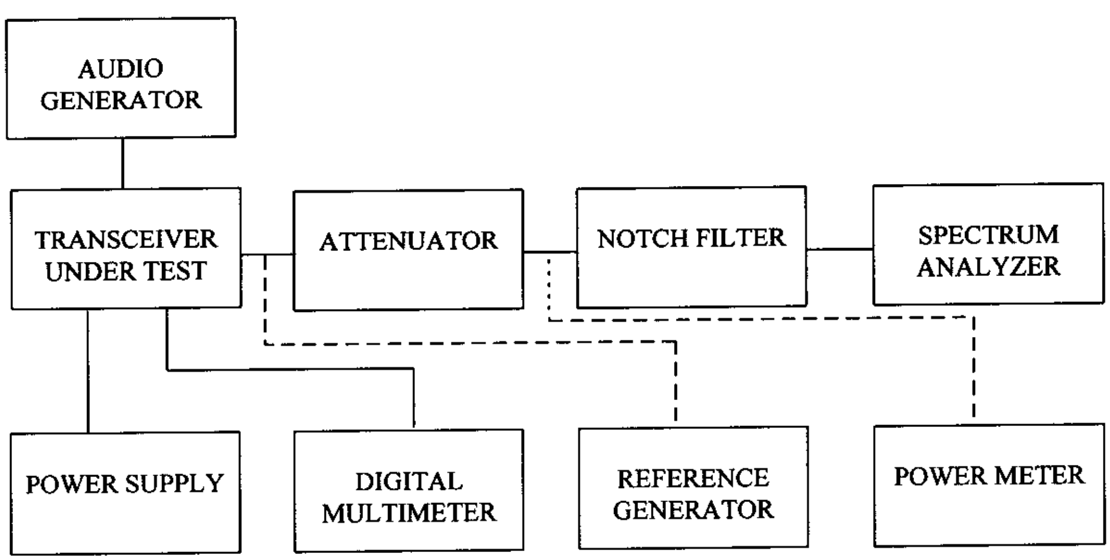
TEST CONDITIONS: Standard Test Conditions, 25 C
RF voltage measured at antenna terminals

TEST PROCEDURE: TIA/EIA - 603, 2.2.13

TEST EQUIPMENT:
Attenuator, BIRD Model / 9715 / 50-A-MFN-06 / 6 dB / 50 Watt
Attenuator, BIRD Model / 9716 / 25-A-MFN-20 / 20 dB / 25 Watt
Digital Voltmeter, Fluke Model 8012A
DC Power Source, Model HP6284A
Modulation Analyzer, Model HP8901A
Spectrum Analyzer, Model HP8563E
Plotter, HP7470A
Reference Generator, Model HP83732B
Power Meter, Model HP436A
Audio Generator, Model HP8903B

PERFORMED BY: Allen Frederick Date:4/27/98

TEST SET-UP:



NAME OF TEST: Transmitter Spurious and Harmonic Outputs (Continued)

MEASUREMENT PROCEDURE:

1. The transmitter carrier output frequency is 928.000, 944.000 and 960.000 MHz. The reference oscillator frequency is 17.5000 MHz.

2. After carrier reference was established on spectrum analyzer, the notch filter was adjusted to null the carrier Fc to extend the range of the spectrum analyzer for harmonic measurements.

3. At each spurious frequency, Generator substitution was used to establish the true spurious level.

4. The spectrum was scanned to the 10th harmonic.

TEST DATA:

F_o = 928.000 MHz

5 Watts = 37dBm Transmitter Spurious and Harmonics

Frequency (MHz)	Relation	Level (dBm)	Level Relative To Carrier (dBc)
1856	2 Fo	-47	-84
2784	3 Fo	-44	-81
3712	4 Fo	-53	-90
4640	5 Fo	-51	-88
5568	6 Fo	-55	-92
6496	7 Fo	-61	-98
7424	8 Fo	-53	-90
8352	9 Fo	-57	-94
9280	10 Fo	-60	-97

F_o = 944.000 MHz

5 Watts = 37dBm Transmitter Spurious and Harmonics

Frequency (MHz)	Relation	Level (dBm)	Level Relative To Carrier (dBc)
1888	2 Fo	-57	-94
2832	3 Fo	-46	-83
3776	4 Fo	-50	-87
4720	5 Fo	-48	-85
5664	6 Fo	-63	-100
6608	7 Fo	-64	-101
7552	8 Fo	-64	-101
8496	9 Fo	-60	-97
9440	10 Fo	-61	-98

NAME OF TEST: Transmitter Spurious and Harmonic Outputs (Continued)

F_o = 960.000 MHz

5 Watts = 37dBm Transmitter Spurious and Harmonics

Frequency (MHz)	Relation	Level (dBm)	Level Relative To Carrier (dBc)
1920	2 Fo	-48	-85
2880	3 Fo	-55	-92
3840	4 Fo	-64	-101
4800	5 Fo	-51	-88
5760	6 Fo	-59	-96
6720	7 Fo	-66	-103
7680	8 Fo	-65	-102
8640	9 Fo	-60	-97
9600	10 Fo	-65	-102

F_o = 928.000 MHz

1 Watts = 30 dBm Transmitter Spurious and Harmonics

Frequency (MHz)	Relation	Level (dBm)	Level Relative To Carrier (dBc)
1856	2 Fo	-48	-78
2784	3 Fo	-48	-78
3712	4 Fo	-48	-78
4640	5 Fo	-83	-113
5568	6 Fo	-45	-75
6496	7 Fo	-59	-89
7424	8 Fo	-59	-89
8352	9 Fo	-62	-92
9280	10 Fo	-63	-93

NAME OF TEST: Transmitter Spurious and Harmonic Outputs (Continued)

F_o = 944.000 MHz

1 Watts = 30 dBm Transmitter Spurious and Harmonics

Frequency (MHz)	Relation	Level (dBm)	Level Relative To Carrier (dBc)
1888	2 Fo	-51	-81
2832	3 Fo	-61	-91
3776	4 Fo	-38	-68
4720	5 Fo	-56	-86
5664	6 Fo	-62	-92
6608	7 Fo	-70	-100
7552	8 Fo	-67	-97
8496	9 Fo	-60	-90
9440	10 Fo	< -80	< -110

F_o = 960.000 MHz

1 Watts = 30 dBm Transmitter Spurious and Harmonics

Frequency (MHz)	Relation	Level (dBm)	Level Relative To Carrier (dBc)
1920	2 Fo	-55	-85
2880	3 Fo	-56	-86
3840	4 Fo	-52	-82
4800	5 Fo	-54	-84
5760	6 Fo	-61	-91
6720	7 Fo	-77	-107
7680	8 Fo	-63	-93
8640	9 Fo	< -70	< -100
9600	10 Fo	< -70	< -100

NAME OF TEST: Field Strength of Spurious Radiation

RULE PART NUMBER: 2.993, 90.210 (d)(3)

MINIMUM STANDARD: For 5 Watts; $50+10\text{Log}_{10}(5) = -57$ dBc

TEST RESULTS: Meets minimum standard (see data on the following page)

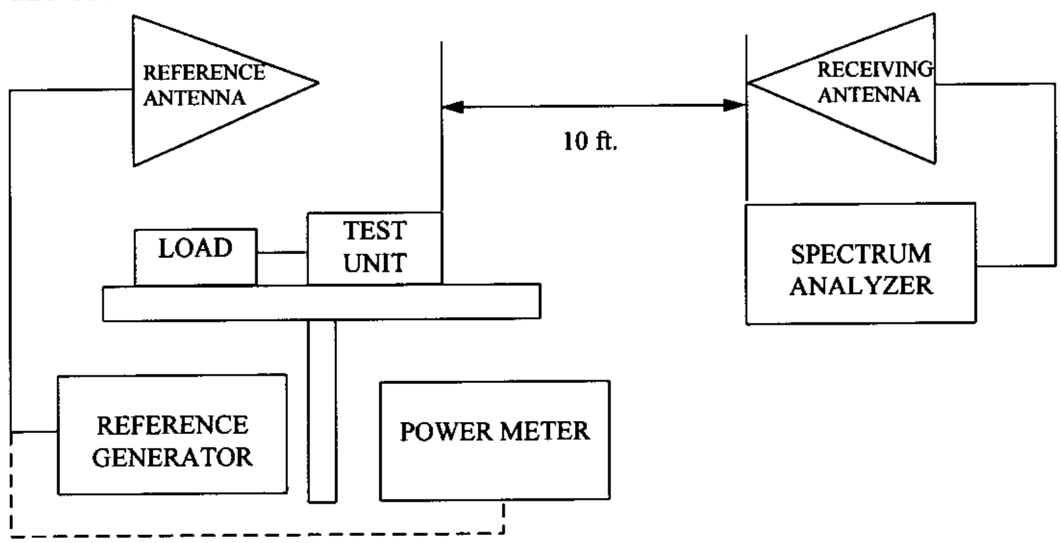
TEST CONDITIONS: Standard Test Conditions, 25 C

TEST PROCEDURE: TIA/EIA - 603, 2.2.12

TEST EQUIPMENT:
Log Spiral Antenna, Model 93491-2
Log Periodic Antenna, Model LPA-112
Reference Generator, Model HP83732A
Load, Lucas Weinschel 58-30-43
Spectrum Analyzer, Model HP8563E
Power Meter, Model HP436A
Power Supply, Model HP-6284A

MEASUREMENT PROCEDURE: Radiated spurious attenuation was measured according to TIA/EIA Standard 603 Section 2.2.12

TEST SET-UP:



PERFORMED BY: Allen Frederick DATE: 4/30/98

NAME OF TEST: Spurious Radiation Attenuation (Continued)

Freqency: 928 MHz
Power: 5 Watts
37.0 dBm

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Antenna Gain (dBd)	Circular Polarization Correction (dB)	Spurious Attenuation dBc
1856	H	-64.5	-27.1	1.20	3.0	-65.9
	V	-70.0	-30.6	1.20	3.0	-69.4
2784	H	-72.0	-29.3	1.20	3.0	-68.1
	V	-68.2	-27.0	1.20	3.0	-65.8
3712	H	-65.3	-27.3	1.20	3.0	-66.1
	V	-64.0	-24.3	1.20	3.0	-63.1
4640	H	-76.0	-35.0	1.20	3.0	-73.8
	V	-75.9	-35.4	1.20	3.0	-74.2
5568	H	-79.0	-33.7	1.20	3.0	-72.5
	V	-84.6	-36.6	1.20	3.0	-75.4
6496	H	-90.0	-47.4	1.20	3.0	-86.2
	V	-91.0	-45.6	1.20	3.0	-84.4
7424	H	-110.0	-69.2	1.10	3.0	-108.1
	V	-111.0	-64.5	1.10	3.0	-103.4
8352	H	-120.0	-75.3	0.50	3.0	-114.8
	V	-121.0	-77.2	0.50	3.0	-116.7
9280	H	-121.0	-78.5	0.50	3.0	-118.0
	V	-123.0	-83.0	0.50	3.0	-122.5

Freqency: 944 MHz
Power: 5 Watts
37.0 dBm

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Antenna Gain (dBd)	Circular Polarization Correction (dB)	Spurious Attenuation dBc
1888	H	-74.0	-37.5	1.20	3.0	-76.3
	V	-76.0	-39.0	1.20	3.0	-77.8
2832	H	-82.0	-36.8	1.20	3.0	-75.6
	V	-65.0	-23.6	1.20	3.0	-62.4
3776	H	-68.3	-29.2	1.20	3.0	-68.0
	V	-68.0	-28.0	1.20	3.0	-66.8
4720	H	-85.9	-45.9	1.20	3.0	-84.7
	V	-80.0	-41.0	1.20	3.0	-79.8
5664	H	-86.3	-41.2	1.20	3.0	-80.0
	V	-85.0	-35.0	1.20	3.0	-73.8
6608	H	-94.0	-50.3	1.20	3.0	-89.1
	V	-90.2	-46.5	1.20	3.0	-85.3
7552	H	-113.0	-61.0	1.10	3.0	-99.9
	V	-101.0	-52.7	1.10	3.0	-91.6
8496	H	-111.0	-70.2	0.50	3.0	-109.7
	V	-110.0	-60.0	0.50	3.0	-99.5
9440	H	-123.0	-79.5	0.50	3.0	-119.0
	V	-120.0	-69.1	0.50	3.0	-108.6

NAME OF TEST: Spurious Radiation Attenuation (Continued)

Freqency: 960 MHz
Power: 5 Watts
37.0 dBm

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Antenna Gain (dBd)	Circular Polarization Correction (dB)	Spurious Attenuation dBc
1920	H	-67.5	-33.0	1.20	3.0	-71.8
	V	-70.0	-33.6	1.20	3.0	-72.4
2880	H	-71.0	-29.8	1.20	3.0	-68.6
	V	-65.1	-25.0	1.20	3.0	-63.8
3840	H	-67.0	-25.8	1.20	3.0	-64.6
	V	-66.0	-26.1	1.20	3.0	-64.9
4800	H	-76.0	-37.0	1.20	3.0	-75.8
	V	-76.2	-36.5	1.20	3.0	-75.3
5760	H	-90.0	-40.0	1.20	3.0	-78.8
	V	-92.5	-38.0	1.20	3.0	-76.8
6720	H	-104.0	-57.0	1.20	3.0	-95.8
	V	-100.0	-52.8	1.20	3.0	-91.6
7680	H	-106.0	-56.2	1.10	3.0	-95.1
	V	-107.0	-55.5	1.10	3.0	-94.4
8640	H	-110.0	-73.6	0.50	3.0	-113.1
	V	-113.0	-76.5	0.50	3.0	-116.0
9600	H	-110.0	-77.0	0.50	3.0	-116.5
	V	-111.0	-79.5	0.50	3.0	-119.0

CALCULATIONS FOR FIELD STRENGTH OF SPURIOUS RADIATION TESTS:

Since the reference antenna used above 1 GHz has gain that differed from a dipole, the generator output was corrected for antenna gain at each spurious frequency. The power was measured directly at the reference antenna and therefore requires no coaxial cable loss correction. An additional correction was made for the 3 dB polarization loss in the reference path.

EXAMPLE:

At 1856 MHz, 5 Watts and horizontal polarization.

R - Reference Generator (dBm) -27.1

A - Antenna Gain (dB) +1.2

P - Polarization Correction Factor (dB) 3.0

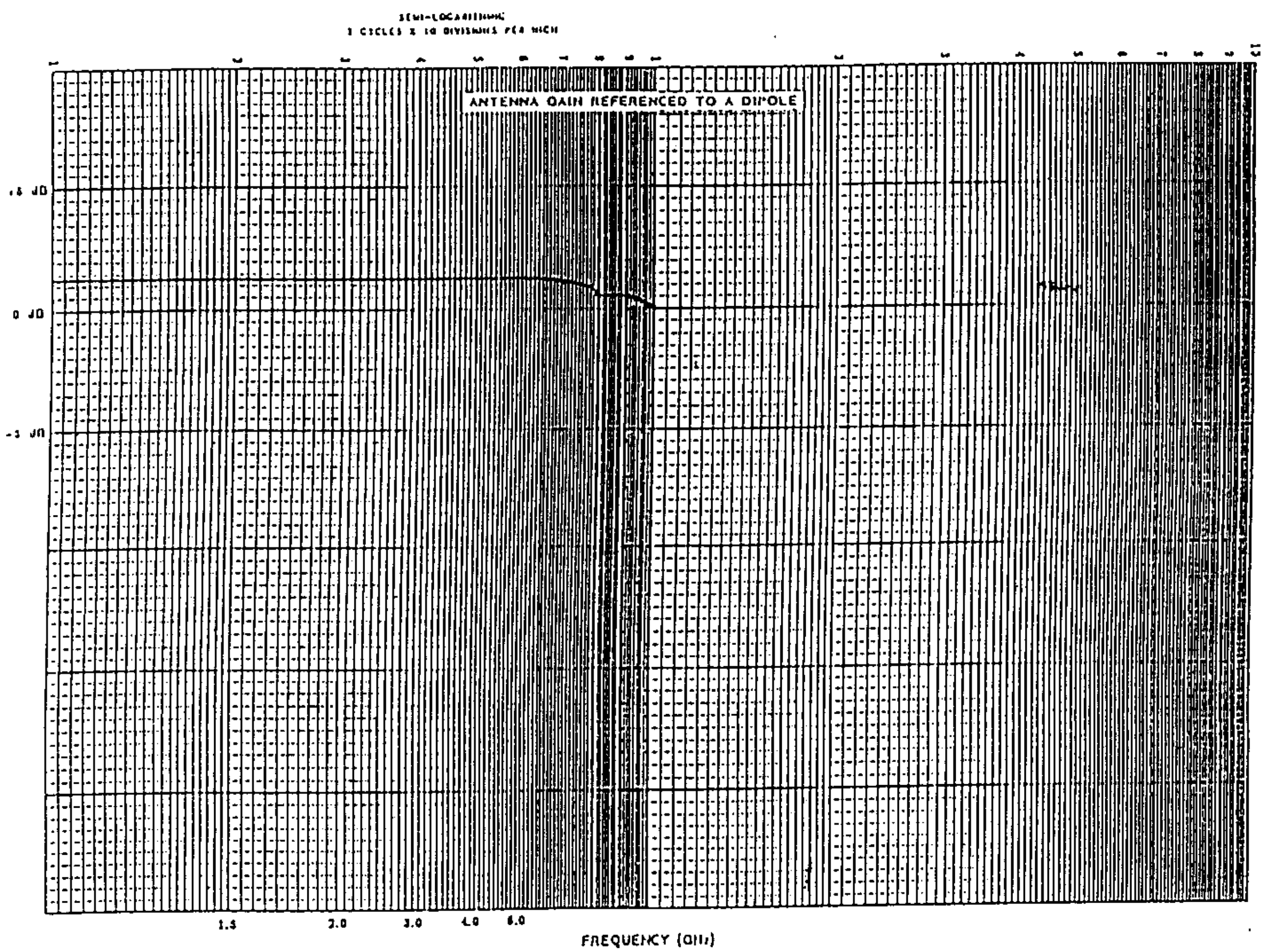
R' - Corrected Reference (dBm)

R' = R + A - P = -43.16 + 1.2 - 3.0 = -28.9 dBm

Po - Radiated Carrier Power (dBm)

5 Watts = 37 dBm

Radiated Spurious Emission (dBc) = Po - R' = -28.9 - (+37) = -65.9 dBc



ANTENNA GAIN GRAPH

NAME OF TEST: Frequency Stability with Variation in Ambient Temperature

RULE PART NUMBER: 2.995 (a)(1), 90.213 (a) (7)

MINIMUM STANDARD: Shall not exceed ± 0.000150% from test frequency, or 1.50 ppm

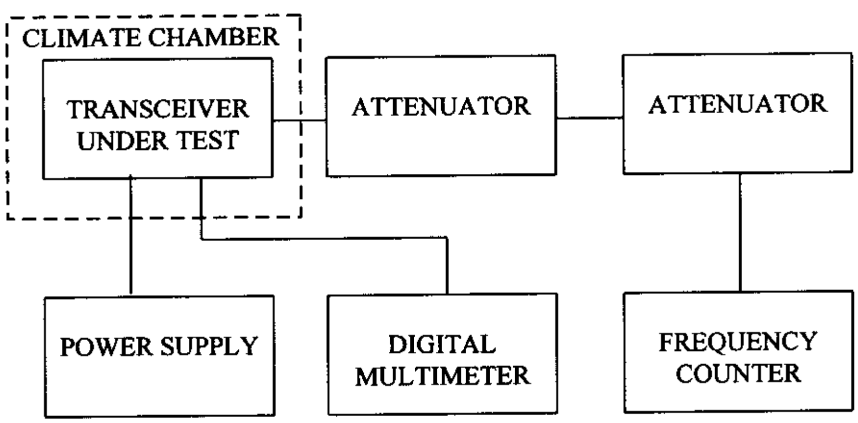
TEST RESULTS: Meets minimum standard, see data on following page

TEST CONDITIONS: Standard Test Conditions, 25 C

TEST EQUIPMENT:
Attenuator, BIRD Model / 9715 / 50-A-MFN-06 / 6 dB / 50 Watt
Attenuator, BIRD Model / 9716 / 25-A-MFN-20 / 20 dB / 25 Watt
Frequency Counter, Fluke Model 1920A
Digital Voltmeter, Fluke Model 8012A
DC Power Source, Model HP6284A
Climate Chamber, TempGard III, Tenney Jr.

PERFORMED BY: [signature] DATE: 4/13/98
Allen Frederick

TEST SET-UP:



(Test data on next page)

NAME OF TEST: Frequency Stability with Variation in Ambient Temperature (Continued)

Frequency Reference Set at 25° C: 944000112 Hz
Tolerance Requirement: 1.5 ppm
Highest Variation (ppm): 0.534 ppm

TEMP ° C	FREQUENCY MHz	FREQ DELTA Hz	ppm from assigned frequency
-30	944000525	413	0.437
-20	944000605	493	0.522
-10	944000616	504	0.534
0	944000223	111	0.118
10	944000040	-72	0.076
20	944000133	21	0.022
25	**944000112**	**0**	**0.000**
30	944000274	162	0.172
40	944000320	208	0.220
50	944000389	277	0.293
60	944000495	383	0.406

NAME OF TEST: Frequency Stability with Variation in Supply Voltage

RULE PART NUMBER: 2.995 (d)

MINIMUM STANDARD: Shall not exceed ± 0.000150% from test frequency, 1.50 ppm for ±15% change in supply voltage

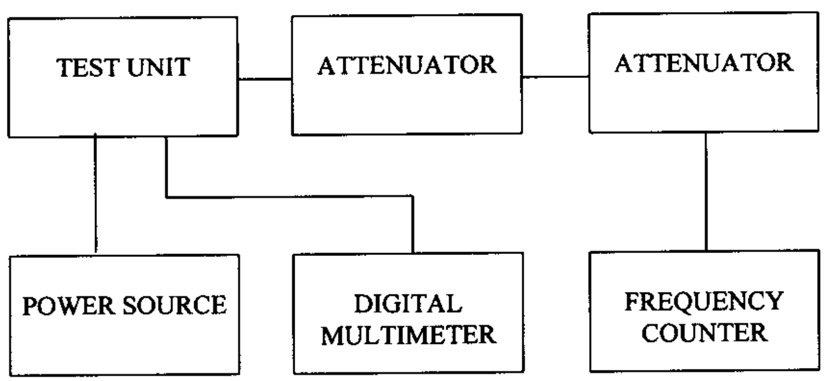
TEST RESULTS: Meets minimum standard, see data on following page

TEST CONDITIONS: Standard Test Conditions, 25 C

TEST EQUIPMENT:
Attenuator, BIRD Model / 9715 / 50-A-MFN-06 / 6 dB / 50 Watt
Attenuator, BIRD Model / 9716 / 25-A-MFN-20 / 20 dB / 25 Watt
Frequency Counter, Fluke Model 1920A
Digital Voltmeter, Fluke Model 8012A
DC Power Source, Model HP6284A

PERFORMED BY: Allen Frederick DATE: 4/13/98

TEST SET-UP:



TEST SET-UP

(Test data on next page)

NAME OF TEST: Frequency Stability with Variation in Supply Voltage (Continued)

MEASUREMENTS TAKEN:

1.5 ppm Reference Oscillator

Frequency Reference Set at 25° C: 944000112 Hz
Tolerance Requirement: 0.00015 %
Highest Variation (%): 0.00000003 %
Highest Variation (ppm): 0.025 ppm

SUPPLY VDC	FREQUENCY MHz	DELTA FREQ % of assigned f	SPEC LIMIT % of assigned f	ppm from assigned frequency
10	944000089	0.00000002	0.00015	0.024
13	**944000112**	0.00000000	0.00015	0.000
16	944000088	0.00000003	0.00015	0.025

NAME OF TEST: Transient Frequency Behavior

RULE PART NUMBER: 90.214

TEST CONDITIONS: Transient tests were conducted with the DL-3286 modem modulating the transmitter at 9600 bps (4800 baud), 4.1 KHz deviation

MINIMUM STANDARD: **12.5 KHz channel** (used worst case numbers from 928 to 960 MHz)

TIME INTERVAL	MAXIMUM FREQUENCY DIFFERENCE (KHz)	TIME (mS)
T1	+/- 12.5	10
T2	+/- 6.25	25
T3	+/- 12.5	10

TEST RESULTS: Meets minimum standards, see data on following pages

TEST CONDITIONS: RF Power Level = 5 Watts
Standard Test Conditions, 25 C

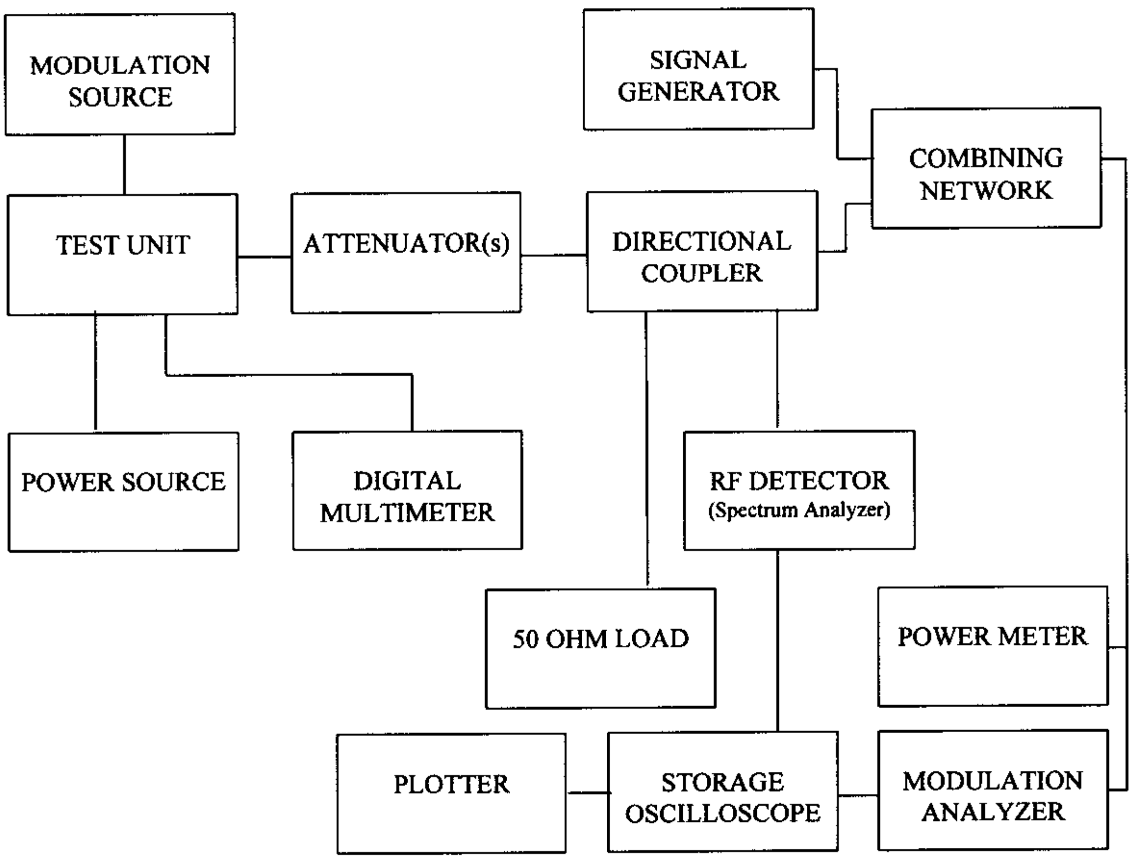
TEST PROCEDURE: TIA/EIA - 603, 2.2.19

TEST EQUIPMENT:
Attenuator, BIRD Model / 9716 / 25-A-MFN-20 / 20 dB / 25 Watt
Digital Voltmeter, Fluke Model 8012A
DC Power Source, Model HP6284A
Modulation Analyzer, Model HP8901A
RF Detector (Spectrum Analyzer), Model HP8563E
Plotter, Model HP2671G
Reference Generator, Fluke Model 6071A
Power Meter, Model HP436A
Power Combiner, Model MCL ZFSC-4-1
Oscilloscope, Model HP54503A
Directional Coupler, Model HP778D

PERFORMED BY: Allen Frederick (signature) Date: 4/28/98
Allen Frederick

NAME OF TEST: Transient Frequency Behavior (Continued)

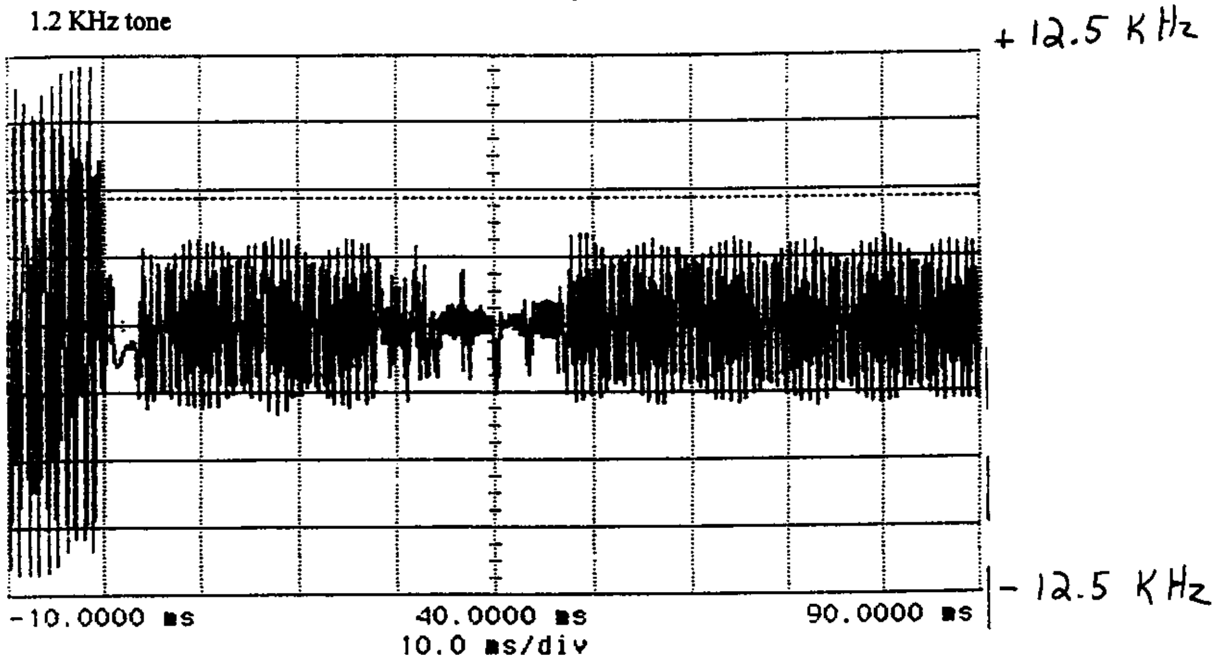
TEST SET-UP:



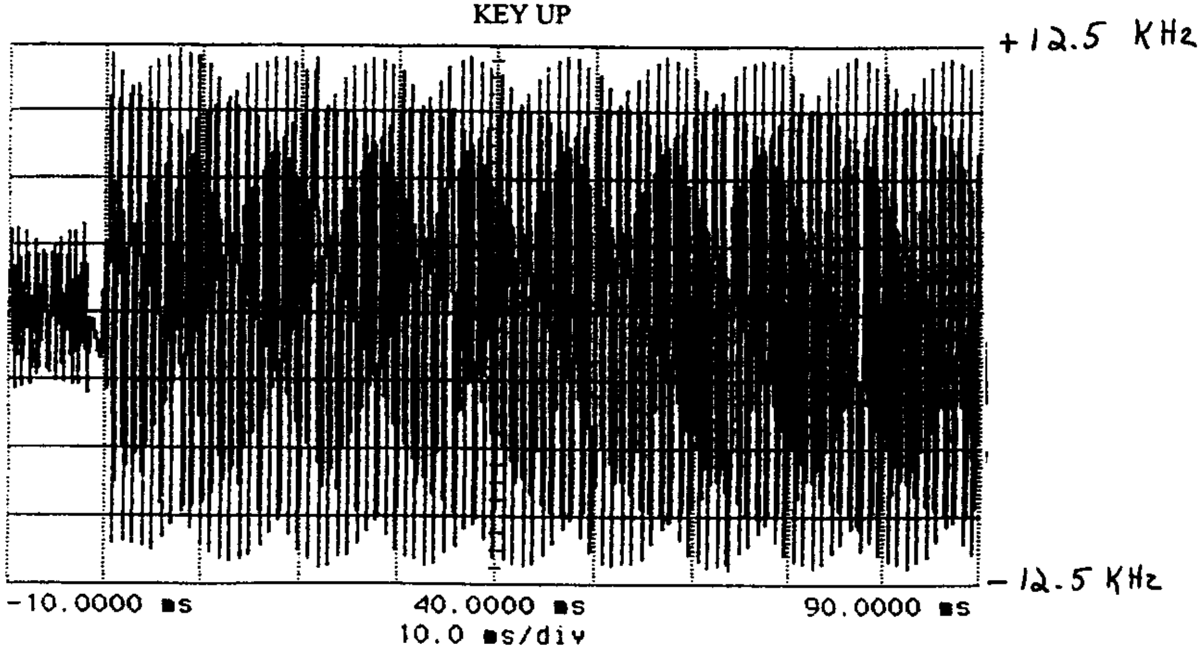
TRANSIENT FREQUENCY RESPONSE
TRANSCEIVER MODULATED BY DL-3286 MODEM, 1.2 KHz TONE , 4.1 KHz DEVIATION

The DL 3286 Modem was used to modulate the DL 3492 for this test, modulation format is shown below. The modem delays 3 mS from the time the transmitter is enabled until the 1.2 KHz tone is sent.

1.2 KHz tone	25 mS
Frame Synchronization Bit Pattern	5 mS
Header	14 mS
1.2 KHz tone	

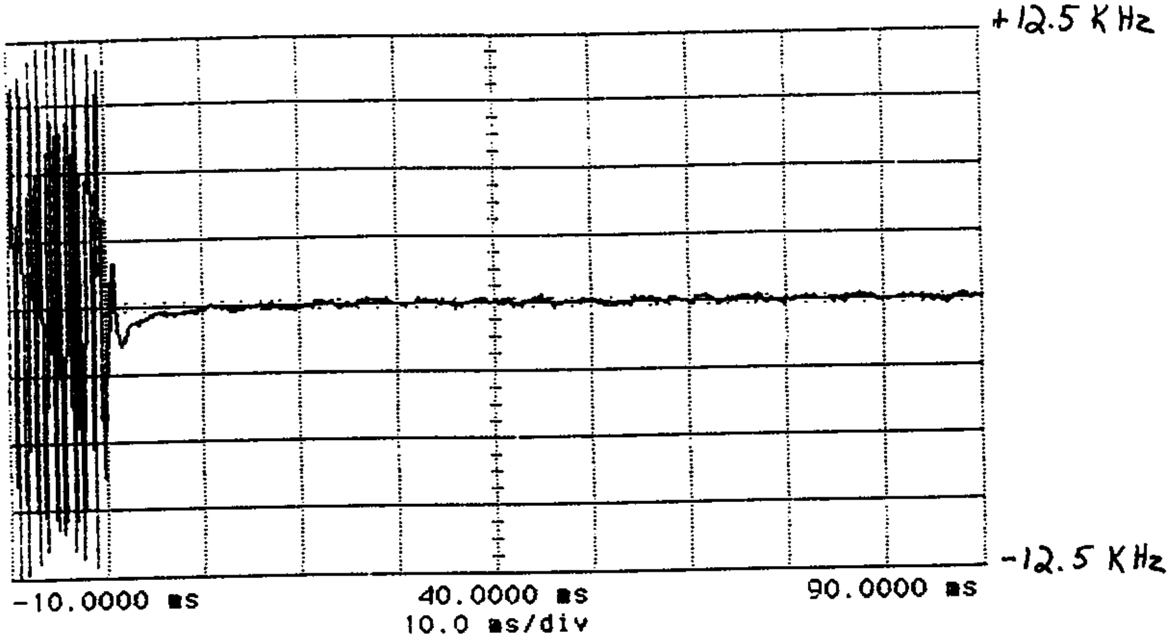


KEY UP

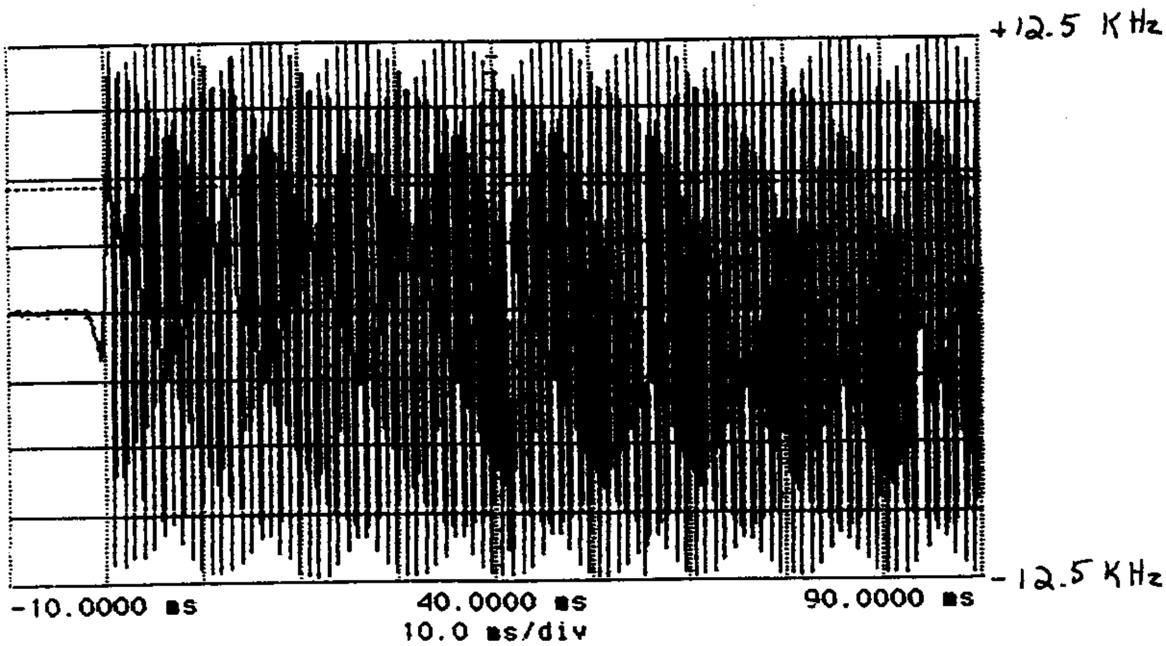


KEY DOWN

TRANSIENT FREQUENCY RESPONSE
TRANSCEIVER UNMODULATED



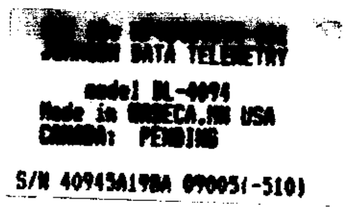
KEY UP



KEY DOWN

FCC LABEL:

RULE PART NUMBER: 2.983 (f)



PHOTOGRAPHS:

RULE PART NUMBER: 2.983 (g)

SEE ATTACHMENTS

MANUAL: The DL-3492 manual contains the schematic for the 3492 Transceiver and 3492 VCO.
SCHEMATIC: DL-3286 TELEMETRY MODEM

SEE ATTACHMENTS