Engineering Exhibit in Support of
Class II Permissive Change Request
FCC Form 731

for the

Mobile Data Platform Transceiver (UHF (403 MHz-512MHz) MDP)
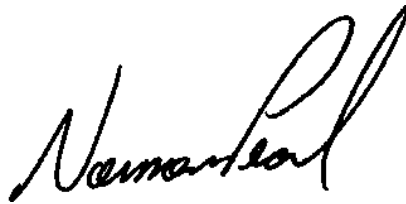
With the

Data Radio Gemini Modem

FCC ID: EOTGPDA
Trade Name: GEMINI/PD

April 26, 2001

AFFIDAVIT

The technical data included in this report has been accumulated through tests that were performed by me or by engineers under my direction. To the best of my knowledge, all of the data is true and correct.

_____

Norman D Pearl
Vice-president Engineering, Dataradio Inc.

Dataradio Inc.
Montreal, Canada

ENGINEERING STATEMENT
OF CONSTANTIN PINTILEI

The application consisting of the attached engineering exhibit and associated FCC form 731 has been prepared in support of a request for a Class II Permissive Change for EOTGPDA.

The certification EOTGPDA has been granted to Dataradio Inc for its Gemini/PD radio modem. Gemini/PD is comprised of the Dataradio COR Ltd. (DRL) Mobile Data Platform (MDP) UHF (403 MHz-512MHz) Transceiver with the Dataradio Inc Gemini Modem. Dataradio Inc does the final assembly and markets the Gemini/PD unit. The original certificate has been granted for a 2-level FSK type of modulation scheme (DGMSK) with three emission designators 8K60, 15K0 , 15K3F1D and 4-level FSK with two emission designators 15K6 and 16K0 F1D. The change intends to add to the 4-FSK emission designator list two new values 8K17 and 8K67F1D. This change involves the firmware only, with no change whatsoever occurring in the hardware.

EXISTING CONDITIONS

The unit utilized for these occupied bandwidth and mask-compliance measurements was a prototype built from production EOTGPDA with beta-level firmware used to create the modulation scheme. The transceiver operates on frequencies ranging from 403.000 MHz to 512.000 MHz. The frequency tolerance of the transceiver is .00015% or 1.5 parts per million as granted in EOTGPDA.

PROPOSED CONDITIONS

It is proposed to accept the request for the GEMINI/PD, 403-512 MHz Transceiver/Modem/GPS for operation in the band of frequencies previously outlined. The applicant anticipates marketing the device for use in wireless transmission of data.

PERFORMANCE MEASUREMENTS

All measurements for Occupied Bandwidth and mask compliance as per 2.1043 (b)(2) were conducted in accordance with the Rules and Regulations Section 2.1041and 2.1049 of Rules Service Co rev.2-154, Mar 15,2000. Equipment performance measurements were made in the engineering laboratory located at 5500 Royalmount ave, Montreal, Canada. All measurements were made and recorded by myself or under my direction. The performance measurements were made between Apr 12, 2001 and Apr 23,2001

CONCLUSION

Given the results of the measurements contained herein, the applicant requests to be applied a Class II Permissive Change for the Certificate EOTGPDA to add the two new emission designators 8K17F1D and 8K67F1D to the existent list.

_____04/24/01

Constantin Pintilei
R&D Test Engineer, Dataradio Inc.

TABLE OF CONTENTS

ANNEXES:

Annex A: Instruction Manual

QUALIFICATIONS OF ENGINEERING PERSONNEL

NAME: **Norman Pearl**

TITLE: Vice-president Engineering

TECHNICAL EDUCATION: Bachelor of Engineering (Electrical)
                                              (1979) McGill University, Montreal, Canada.

TECHNICAL EXPERIENCE: Professional engineer since 1979
                                               25 Years experience in radio communications

NAME: **Constantin Pintilei**

TITLE: R&D Test Engineer

TECHNICAL EDUCATION: Bachelor of Science Degree in Radiotechnique Electronic Engineering
                                              (1993) Technical University of Iasi, Romania.

TECHNICAL EXPERIENCE: 8 Years experience in radio frequency measurements.

CLASS II PERMISSIVE CHANGE INFORMATION REQUESTED BY GRANTEE - Rule part 2.1043 (b)(2)

The certification EOTGPDA has been granted to Dataradio Inc for its Gemini/PD radio modem. Gemini/PD is comprised of the Dataradio COR Ltd. (DRL) Mobile Data Platform (MDP) UHF (403 MHz-512MHz) Transceiver with the Dataradio Inc Gemini Modem. Dataradio Inc does the final assembly and markets the Gemini/PD unit. The original certificate has been granted for a 2-level FSK type of modulation scheme (DGMSK) with three emission designators 8K60, 15K0 , 15K3F1D and 4-level FSK with two emission designators 15K6 and 16K0 F1D

  The change consists of the addition of two new speeds for the 4-level FSK modulations with two new emission designators 8K17 and 8K67 F1D. This modulation permits signaling at a reduced baud rate when fitting the requirements of mask D with improved signal-to -noise (data sensitivity) performance. Only the operating firmware is being changed to produce both 2-level and 4 level FSK modulator signal. There are no hardware changes involved in either the radio or the modem/controller circuits. Also there are no changes in those modules of the firmware that control the transceiver. Therefore a Class II Permissive Change request has been considered.

  The characteristics affected are :
Digital Modulation Techniques   - part 2.1033.(c)(13)
Type of emission and Emission designators list   - part 2.1033 (c)(4),90.209
Occupied bandwidth and mask compliance requirement - part 2.1049,90.210(d)
They are entirely documented with the current report.

  Because this change is implemented in the operating firmware only, there are no change whatsoever occurring in schematics, part list, mechanical assembly, shape, label or any other hardware related issues. A preliminary version of the manual that contains service-related information for 4 level FSK modulations is provided as appendix of the report.

GENERAL INFORMATION ABOUT THE GRANTEE AND CERTIFICATED EQUIPMENT -2.1043 (b)(2)
  (as perRule Part Number: 2.1033 (c).(1),(2),(5),(6),(7))

APPLICANT/GRANTEE   Dataradio Inc.,
                                     5500 Royalmount Ave, suite 200,
                                     Town of Mount Royal, Quebec, Canada, H4P 1H7

MANUFACTURER: Dataradio COR Ltd., Waseca, MN 56093 (MDP Transceiver)
                                     DATARADIO Inc., Town of Mount Royal, Quebec, Canada, H4P 1H7
                                           (Gemini- final assembly)

MODEL NUMBER: GEMINI/PD
PART NUMBER: GPDD-6045-xyz

SERIAL NUMBER (S):   JEANC-prototype 4-level FSK Gemini modem
                                     6045- 10153 -132 production MDP transceiver

FCC ID NUMBER: EOTGPDA
FCC RULES AND REGS: FCC Part (s) 90

FREQUENCY RANGE: 403.000 MHz - 512.000 MHz (406-406.1 MHz software blocked)

MAXIMUM POWER RATING: 50.00 Watts (10-50 watts variable).

NUMBER OF CHANNELS: 16 Channel Modem

INPUT IMPEDANCE: 50 ohms, Nominal

VOLTAGE REQUIREMENTS: 10.9-16.3VDC (13.6 VDC Nominal)

EQUIPMENT IDENTIFICATION:

TRADE NAME	DESCRIPTION	DRI PART NUMBER
MDP6000	403-520 XCVR	242-604C-MRB
Gemini	Modem	050-03322-00x

DRL Part Number System for MDP:

242-60FC-MRB

F-Frequency Bands
1 -   V H F
4 -   U H F
8 -   800 MHz
9 -   900 MHz

C-Configuration
1-   5-13 Watt Standard RX
2-   5-13 Watt Diversity RX
4-   35-50 Watt Standard RX
5-   35-50 Watt Diversity RX

B- IF Bandwidth
1-   6.25 KHz / 7.5 KHz
2-   12.5 KHz / 15 KHz
3-   20 KHz
4-   25 KHz / 30 KHz

R-Frequency Range
0-   Whole Band (800 and 900 MHz)
3-   132-150 MHz   400-460 MHz
5-   150-174 MHz   450-512 MHz
7-   Transmit: 794-806 / 806-824 MHz
        Receive: 764-776 / 851-869 MHz

M-Modem Type
0-   None (OEM)
1-   Gemini Modem

DATA AND CHARACTERISTICS NOT AFFECTED BY THE CHANGE - Rule Part Number: 2.1033 (c).(8),(9),(10),(11),(12) ,(15),(16)

DC Voltages And Currents Into Final Amplifier   2.1033(C).(8)

Transmitter Tune Up Procedure   2.1033 C (9)

Description Of Circuitry   2.1033 (C)(10)

Schematics   2.1033 (C)(10)

Transistor, Diode, And IC Functions   2.1033 C (10)

FCC Label   2.1033 C (11)

Photographs   2.1033 C (12)

Data addressing Rule Part Number   2.1033(c) 15, 16: this unit is not designed for the mentioned purposes

Spectrum efficiency standard   90.203 (j) (16000 or 14400 bps /12.5kHz)>
                                                              (2*4800 bps/2*6.25kHz)

Test results not affected by the change   2.1033C 14, 2.1041

Test data according to:
        Part 2: 2.1046, 2.1051, 2.1053, and 2.1055
        Part 90, Subpart I: 90.213.
    as follow:
        Transmitter Rated Power Output   2.1046
        Transmitter Spurious And Harmonic Outputs   2.1051
        Field Strength Of Spurious Radiation   2.1053
        Frequency Stability and Frequency Tolerance 2.1055,90.213

DATA AND CHARACTERISTICS AFFECTED BY THE CHANGE - Rule Part Number: 2.1033(c) (3)(4)(13)(14)

INSTRUCTION BOOK   2.1033 (c) (3)
Annex A . The attached Installation Guide for the GEMINI/PD Transceiver/Modem/GPS is a preliminary version.

TYPE OF EMISSION: 2.1033(c)(4)

For Class II Permissive Change 4levelFSK   12.5kHz BW (8000baud, 4 FSK) **8K17F1D**
                                                                    12.5kHz BW (7200baud, 4 FSK) **8K67F1D**

Previously granted for EOTGPDA   12.5KHz BW (9600bps)   **8K60F1D**
                                                                    25KHz BW (16.0Kbps)   **15K3F1D**
                                                                    25KHz BW (19.2Kbps)   **15K0F1D**
                                                                    25kHz BW (12800baud, 4 FSK) **15K6F1D**
                                                                    25kHz BW (9600baud, 4 FSK) **16K0F1D**

DIGITAL MODULATION TECHNIQUES   2.1033(c).(13)

The Gemini/PD modem generates 2 level Differential Gaussian Frequency Shift Keying (DGFSK) and 4 level Squared Root Raised Cosine Frequency Shift Keying. (SRRC 4FSK). Both modulations schemes have been granted with the certificate EOTGPDA. This measurement concerns only the new symbol rates that use 4-level SRRC (squared root raised cosine) modulation, their description follows. Meantime, the modulation scheme SRRC 4FSK remains the same.

The 4-level signaling transmits two information bits per symbol (baud) which yields a bit rate of twice the on-air baud rate, hence the 14.4 or 16 kbps references in the Installation Guide correspond to a transmitter baud rate of 7200 or 8000 baud. That digital signal is digitally filtered (Squared Root Raised Cosine pulse shaping with α=0.4) by the DSP then fed to the CODEC for digital to analogue conversion as explained in previous submissions. This SRRC4FSK wave shape applied to the FM modulator will then produce a compact RF spectrum, when using proper frequency deviation, to fit inside the restrictive masks inherent to the intended channel bandwidth.

   The transmitter deviation level and digital filter cutoff frequency (which is based on the raised cosine filter equation) are set according to the bit rate selected and channel bandwidth as follows:

Bit rate	Baud rate	Square Root Raised Cosine filter's 3dB cut-off frequency	Deviation
16000 b/s	8000bauds	4.0 kHz	± 1.95 kHz
14400 b/s	7200bauds	3.6 KHz	± 2.35 kHz

TEST DATA   **2.1033 (c)(14)**
Next section.

TEST DATA Section   Rule Part Number: 2.1033 (c)(14)

All applicable test data according to:
        -Part 2: 2.1043 (b)(2) ,2.1049
        -Part 90, Subpart I: 90.209 and 90.210
are provided in next section of this Engineering Report

Modulation Characteristic Part 2.1047 (d), 90.209 (b) 90.210(g): Other types of equipment: this equipment is not
    provided with hardware audio low-pass filters, the filtering is entirely result of DSP firmware.

The following reports have been generated for Class II Permissive Change request for EOTGPDA ,Gemini/PD radio
modem. Gemini/PD is comprised of the Dataradio COR Ltd. (DRL) Mobile Data Platform (MDP) UHF (403-512 MHz)
Transceiver with the Dataradio Inc Gemini Modem. Dataradio Inc does the final assembly and markets the Gemini/PD
unit

  Unless otherwise noted, all of the measurements were conducted following the procedures set forth in the TIA/EIA-
603 standards.

NAME OF TEST:
Transmitter Occupied Bandwidth

RULE PART NUMBER: 2.201, 2.202, 2.1033 c (14), 2.1049 (h), 2.1041

Emission Designator Determination

Necessary Bandwidth Measurement (90.209.(b))

This radiomodem uses digital modulation signals, passing through a Squared Root Raised Cosine α=0.4 DSP implemented low-pass filter to an FM transceiver. The necessary bandwidth calculation for this type of modulation (SRRC4FSK) is not covered by paragraphs (1), (2) or (3) from 2.202(c), the result exceeding by far the real necessary bandwidth obtained through simulations or measurement.

 Therefore, the approach outlined in (2.202(c)(4)) is applicable in this case.

The results of 99% Occupied Bandwidth measurement are:

Baud rate	Deviation	Occupied Bandwidth	Emission designator
8000 bauds	± 1.95 kHz	8166 Hz	8K17
7200 bauds	± 2.35 kHz	8666 Hz	8K67

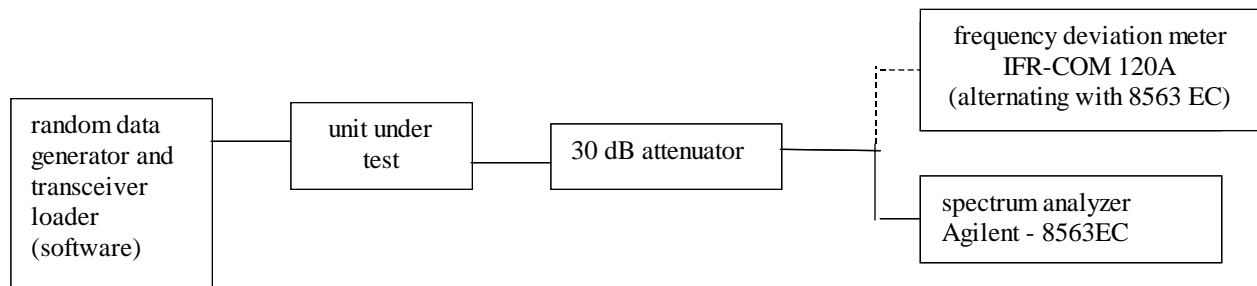The measurement theory and set-up explanations follow.

Occupied Bandwidth Measurement
      The Occupied Bandwidth measurement option of the instrument (8563EC spectrum analyzer from Agilent) calculates and provides the values used above for the emission designator.
      The percentage setting of the measurement has been set to 99% following the definition of *Occupied Bandwidth* "the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission" (FCC 2.202)
      The measurement has been performed during the tests for compliance with mask D, the value occurred was recorded as Occupied Bandwidth.

      The measurement set-up is:

NAME OF TEST: Transmitter Occupied Bandwidth
           GEMINI Modem at 8000bauds 4FSK

Mask compliance data in support of Emission Designator 8K17F1D

RULE PART NUMBER: 2.201, 2.202, 2.1033 c (14), 2.1049 (h), 2.1041, 90.209 (b)(5), 90.210 (d)

MINIMUM STANDARD:	Mask D
	Sidebands and Spurious [Rule 90.210 (d)]
	Authorized Bandwidth = 11.25 kHz [Rule 90.209(b) (5)]

Fo to 5.625 kHz	Attenuation = 0 dB
>5.625 kHz to 12.5 kHz	Attenuation= $7.27(f_d - 2.88kHz)$ dB
>12.5 kHz	Lesser of [50 + 10*log(P)] dB or 70dB

Corner Points:

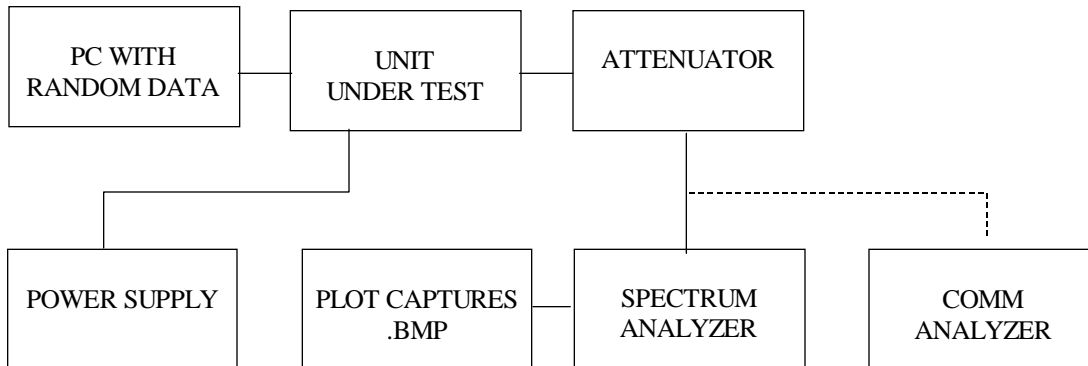|	
Fo to 5.625 kHz	Attenuation = 0 dB
>5.625 kHz to 12.5 kHz	Attenuation= 20 dB to 70 dB
>12.5 kHz	Attenuation =60dB (10W)

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

TEST CONDITIONS: Standard Test Conditions, 25 C
TEST EQUIPMENT: Attenuator, BIRD Model / 50-A-MFN-30 / 30 dB / 50 Watt
           DC Power Source, Model Astron VS 20M
           Communication Analyzer, Model IFR COM120A (deviation meter)
           Spectrum Analyzer, Model Agilent (HP) 8563EC

PERFORMED BY: _____   DATE: 04/23/01
             Constantin Pintilei

TEST SET-UP:

```
┌──────────────┐   ┌──────────────┐   ┌──────────────┐
│   PC WITH    │───│    UNIT      │───│  ATTENUATOR  │
│ RANDOM DATA  │   │ UNDER TEST   │   │              │
└──────────────┘   └──────────────┘   └──────────────┘
                          │                  │
       ┌──────────────┐   │   ┌──────────────┐   ┌──────────────┐
       │    POWER     │   │   │ PLOT CAPTURES│   │  SPECTRUM    │   │  COMM        │
       │   SUPPLY     │   │   │    .BMP      │───│  ANALYZER    │   │  ANALYZER    │
       └──────────────┘       └──────────────┘   └──────────────┘   └──────────────┘
```

NAME OF TEST: Transmitter Occupied Bandwidth (Continued)
           GEMINI Modem at 8000 bauds, 4FSK
           In Support of Emission Designator 8K17F1D

MODULATION SOURCE DESCRIPTION:

TX Data Test Pattern:

The transmit "test data" pattern command produces a 2047 bit pseudo-random pattern. This pattern is generated by the internal software using the polynomial $X^{11}+X^9+1$ form and a 12-bit shift register. Initial value of the register is 111111111110 (FFE hex). The 2047 bit sequence is repeated thereafter as long is necessary to complete the test duration (55 sec). This pattern is applied to the DSP processor data input for encoding and pulse shaping as described above.

This data follows same modulation process as described in Digital Modulation Techniques (page 9) and the resulting base band signal feeds the modulator's input of the transceiver.
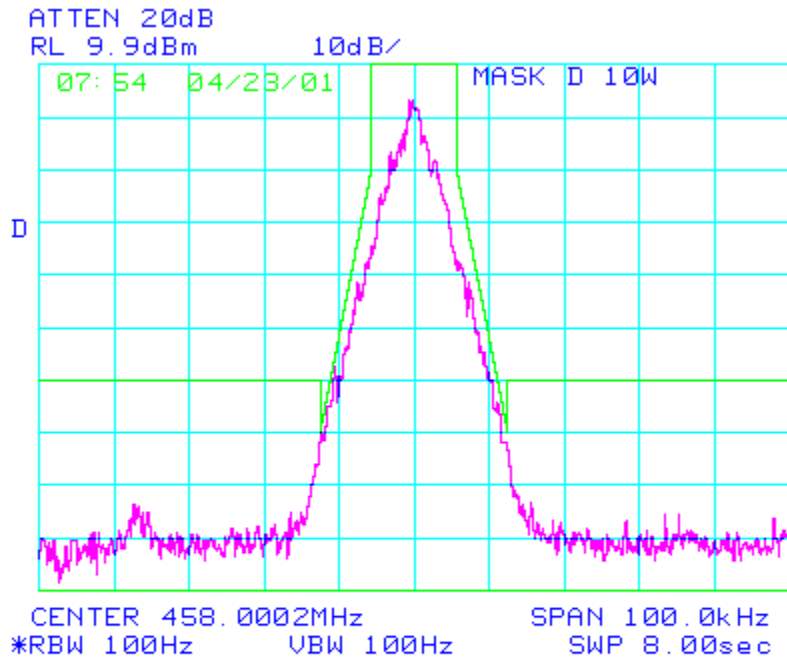
For 8000 baud rate the deviation is set to 1.95kHz.

NECESSARY BANDWIDTH (Bn) CALCULATION

See Page 11 for emission designator determination.

The corresponding emission designator prefix for necessary bandwidth = **8K17F1D**
TEST DATA: Refer to the following graphs:

MASK: D , 8K17F1D, 10W

SPECTRUM FOR EMISSION **8K17F1D**
OUTPUT POWER: 10 Watts
8000 bauds 4 level FSK
PEAK DEVIATION = 1950 Hz
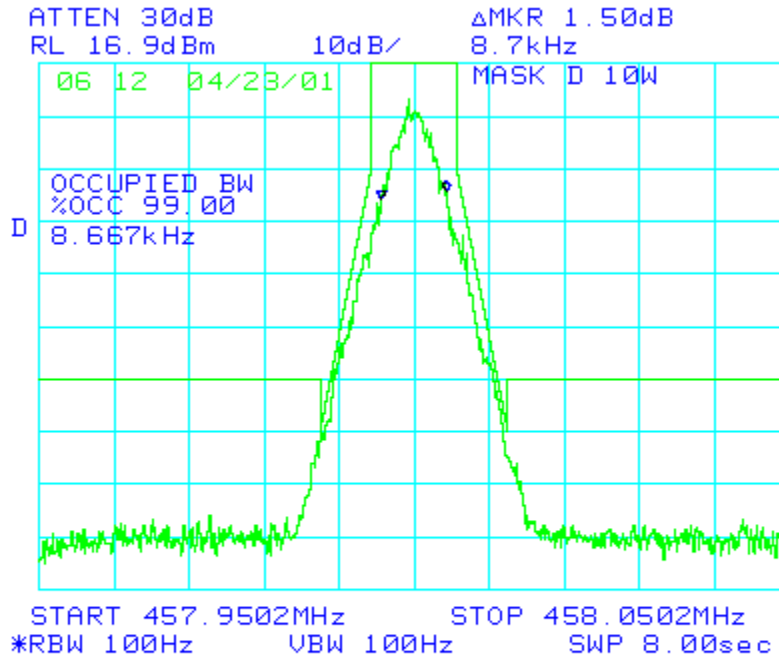SPAN = 100 kHz

MASK: D, 8K17F1D, 50W

SPECTRUM FOR EMISSION **8K17F1D**
OUTPUT POWER: 50 Watts
8000 bauds 4 level FSK
PEAK DEVIATION = 1950 Hz
SPAN = 100 kHz

Note: For frequencies spaced more than 12.5kHz from the central frequency the attenuation should read 67dBc at 50W.
The plot above reads 60dBc as indicated in the description of the set-up.

NAME OF TEST: Transmitter Occupied Bandwidth
                              GEMINI Modem at 7200bauds 4FSK

Mask compliance data in support of Emission Designator **8K67F1D**

RULE PART NUMBER: 2.201, 2.202, 2.1033 c (14), 2.1049 (h), 2.1041, 90.209 (b)(5), 90.210 (d)

MINIMUM STANDARD: Mask D
                             Sidebands and Spurious [Rule 90.210 (d)]
                             Authorized Bandwidth = 11.25 kHz [Rule 90.209(b) (5)]

Fo to 5.625 kHz	Attenuation = 0 dB
>5.625 kHz to 12.5 kHz	Attenuation= $7.27(f_d$ -2.88kHz) dB
>12.5 kHz	Lesser of [50 + 10*log(P)] dB or 70dB

Corner Points:

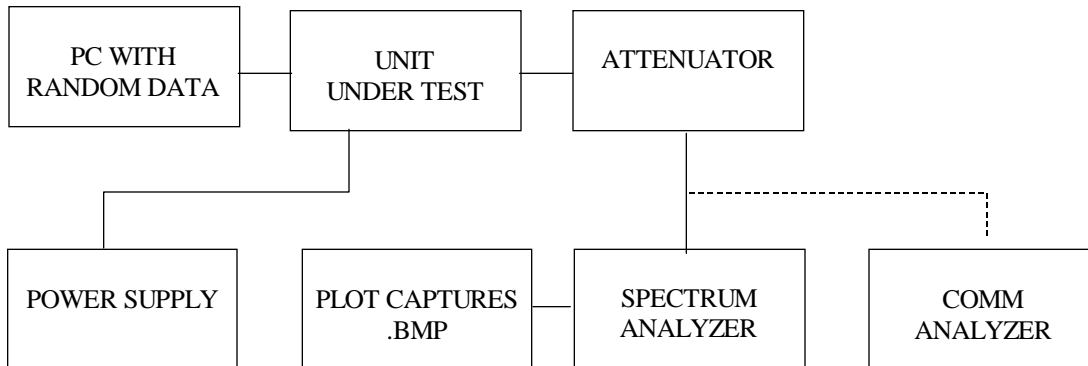|	
Fo to 5.625 kHz	Attenuation = 0 dB
>5.625 kHz to 12.5 kHz	Attenuation= 20 dB to 70 dB
>12.5 kHz	Attenuation =60dB (10W)

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

TEST CONDITIONS: Standard Test Conditions, 25 C
TEST EQUIPMENT: Attenuator, BIRD Model / 50-A-MFN-30 / 30 dB / 50 Watt
                           DC Power Source, Model Astron VS 20M
                           Communication Analyzer, Model IFR COM120A (deviation meter)
                           Spectrum Analyzer, Model Agilent (HP) 8563EC

PERFORMED BY: _____   DATE: 04/23/01
                              Constantin Pintilei

TEST SET-UP:

```
┌──────────────┐   ┌──────────────┐   ┌──────────────┐
│   PC WITH    │───│    UNIT      │───│  ATTENUATOR  │
│ RANDOM DATA  │   │ UNDER TEST   │   │              │
└──────────────┘   └──────────────┘   └──────────────┘
                          │                  │
┌──────────────┐   ┌──────────────┐   ┌──────────────┐   ┌──────────────┐
│ POWER SUPPLY │   │PLOT CAPTURES │───│  SPECTRUM    │   │     COMM     │
│              │   │    .BMP      │   │  ANALYZER    │   │   ANALYZER   │
└──────────────┘   └──────────────┘   └──────────────┘   └──────────────┘
```

NAME OF TEST: Transmitter Occupied Bandwidth (Continued)

GEMINI Modem at 8000 bauds, 4FSK
In Support of Emission Designator **8K17F1D**

MODULATION SOURCE DESCRIPTION:

TX Data Test Pattern:

The transmit "test data" pattern command produces a 2047 bit pseudo-random pattern. This pattern is generated by the internal software using the polynomial $X^{11}+X^9+1$ form and a 12-bit shift register. Initial value of the register is 111111111110 (FFE hex). The 2047 bit sequence is repeated thereafter as long is necessary to complete the test duration (55 sec). This pattern is applied to the DSP processor data input for encoding and pulse shaping as described above.

This data follows same modulation process as described in Digital Modulation Techniques (page 9) and the resulting base band signal feeds the modulator's input of the transceiver.

For 7200 baud rate the deviation is set to 2.35kHz.

NECESSARY BANDWIDTH (Bn) CALCULATION

See Page 11 for emission designator determination.

The corresponding emission designator prefix for necessary bandwidth = **8K67F1D**
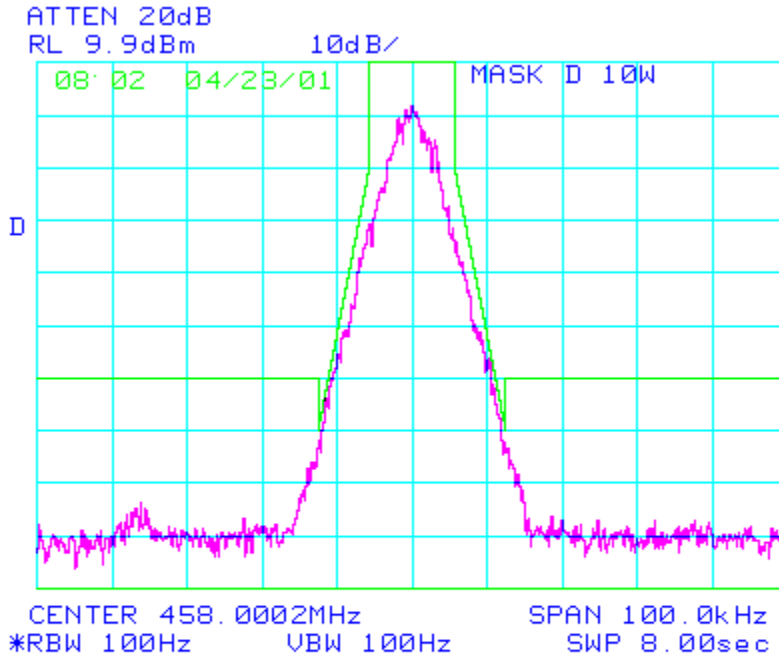TEST DATA: Refer to the following graphs:

MASK: D, 8K67F1D, 10W

SPECTRUM FOR EMISSION **8K67F1D**
OUTPUT POWER: 10 Watts
 7200 bauds, 4 level FSK
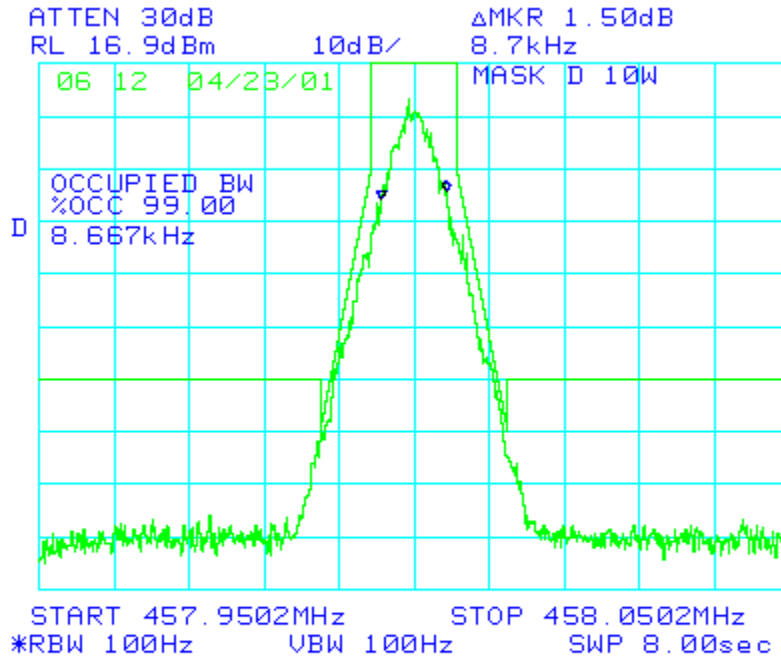PEAK DEVIATION = 2350 Hz
SPAN = 100 kHz

MASK: D , 8K67F1D, 50W

SPECTRUM FOR EMISSION **8K67F1D**
OUTPUT POWER: 50 Watts
7200 bauds, 4 level FSK
PEAK DEVIATION = 2350 Hz
SPAN = 100 kHz

```
ATTEN 30dB              ΔMKR 1.50dB
RL 16.9dBm     10dB/    8.7kHz
  06 12  04/23/01       MASK D 10W

  OCCUPIED BW
  %OCC 99.00
D 8.667kHz




  START 457.9502MHz    STOP 458.0502MHz
 *RBW 100Hz    VBW 100Hz    SWP 8.00sec
```

Note: For frequencies spaced more than 12.5kHz from the central frequency the attenuation should read 67dBc at 50W.
The plot above reads 60dBc as indicated in the description of the set-up.