

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

**for the**

**Mobile Data Platform Transceiver (800 MHz MDP)**

**With the**

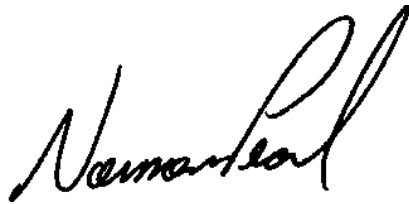
**Dataradio Gemini Modem**

**FCC ID: EOTGPDB  
Trade Name: GEMINI/PD**

March 8, 2002

**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.

A handwritten signature in black ink, appearing to read "Norman Pearl". The signature is fluid and cursive, with the first name "Norman" and last name "Pearl" clearly distinguishable.

---

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 EOTGPDB.

The certification EOTGPDB 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) 800 MHz Transceiver with the Dataradio Inc Gemini Modem. Dataradio Inc does the final assembly and markets the Gemini/PD unit. The EOTGPDB certificate has been granted for a 2-level FSK (DGMSK) and a 4-level FSK (xRC4FSK) types of modulation scheme together with associated maximum deviation levels at various rates. The deviation levels proposed for 19.2 and 25.6 kbps xRC4FSK are going to allow this speeds to be used in the more restrictive 821-824 MHz band (Mask 90.210H). 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 EOTGPDB which deviation changed to fit the new restriction. The transceiver operates on frequencies ranging from 806.000 MHz to 824.000 MHz. The frequency tolerance of the transceiver is .00015% or 1.5 parts per million as granted in EOTGPDB.

PROPOSED CONDITIONS

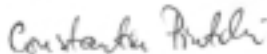
It is proposed to accept the request for the GEMINI/PD, 806-824 MHz Transceiver/Modem/GPS for operation in the band of frequencies previously outlined. The applicant anticipates marketing the device for use in wireless transmission of data.

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 2.1041 and 2.1049 of Rules Service Co rev.2-158, Mar 15,2001. 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 Mar 7, 2002 and Mar 8, 2002

CONCLUSION

Given the results of the measurements contained herein, the applicant requests to have appended two new emission designators 10K2F1D and 11K5F1D accepted to the list of the Certificate EOTGPDB following the Class II Permissive Change, as per FCC part 2.1043(b)(2), in order to market the 19.2 and 25.6kbps RC4FSK in 821-824MHz frequency band .



03/13/02

Constantin Pintilei, Eng  
R&D Test Engineer, Dataradio Inc.

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## 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: Professional Engineer since 2001  
8 Years experience in radio frequency measurements.

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

The certification EOTGPDB 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) 800 MHz Transceiver with the Dataradio Inc Gemini Modem. Dataradio Inc does the final assembly and markets the Gemini/PD unit. The certificate, comprising its several Class II permissive changes already underwent, has been granted for a 2-level FSK, DGMSK – Differential Gaussian Minimum Shift Keying, with three emission designators 8K60, 15K0 , 15K3F1D and 4-level FSK, xRC4FSK –Squared Root Raised Cosine 4-level Frequency Shift Keying, with four emission designators 10K0,11K0, 15K6 and 16K0 F1D.

The change consists of the usage of 19.2 and 25.6 kbps speeds (4FSK) with a smaller deviation in the 821-824 MHz band. The smaller deviation permits signaling at the same baud rates already approved with mask G while fitting the requirements of Mask H. The receiver side was improved to upgrade the signal-to -noise (data sensitivity) performance. Only the deviation setting parameter of the operating firmware is being changed to produce smaller deviation. 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.

The resulting occupied bandwidths are 10.170 and 11.500 kHz. The 11K5F1D and 10K2F1D emission designators are suggested to be appended to the emission designator list. Following the FCC part 2.1043(b)(2) rule, in order to market the proposed change we must obtain the acknowledgment of the Commission that the change is acceptable. Therefore a Class II Permissive Change request from the certificate granted on 12/04/2001 has been considered.

The characteristics affected are :  
Occupied bandwidth and mask compliance requirement - part 2.1049,90.210(h)

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 appended service-related information for 4 level FSK modulation is provided as appendix of the report.

**GENERAL INFORMATION ABOUT THE GRANTEE AND CERTIFICATED EQUIPMENT -2.1043 (b)(2)**  
 (as per Rule 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-6085-xyz

SERIAL NUMBER ( S ): 101-3322-002 Gemini modem firmware v3.15.(beta3), DSP v4.10  
 6085- 12013 - 104 production MDP transceiver

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

FREQUENCY RANGE: 806.000 MHz - 824.000 MHz  
 (806-821/851-866 and 821-824/866-869 MHz Bands)

MAXIMUM POWER RATING: 40.00 Watts (5-40 watts variable).

NUMBER OF CHANNELS: 16 Channel Modem

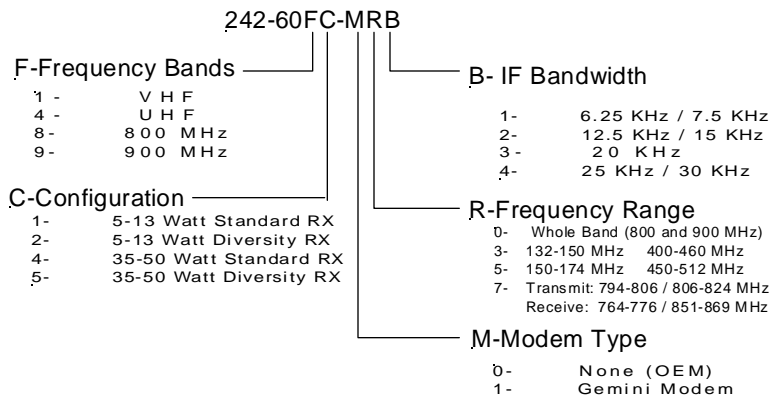
INPUT IMPEDANCE: 50 ohms, Nominal

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

## EQUIPMENT IDENTIFICATION:

<u>TRADE NAME</u>	<u>DESCRIPTION</u>	<u>DRI PART NUMBER</u>
MDP6000	806-824/851-869MHz XCVR	242-608C-MRB
Gemini	Modem	050-03322-00x

**DRL Part Number System for MDP:**



**DATA AND CHARACTERISTICS NOT AFFECTED BY THE CHANGE - Rule Part Number: 2.1033 (c).(4),(8),(9),(10),(11),(12),(13),(15),(16)**

Type Of Emission:	2.1033 (c).(4)
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)
Digital modulation techniques	2.1033 (c).(13)
Data addressing Rule Part Number	2.1033 (c).(15),(16): this unit is not designed for the mentioned purposes
MPE limits compliance	2.1091
Test results not affected by the change	2.1033(c).(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)**

**INSTRUCTION BOOK**

2.1033 (c) (3)

Annex A . The attached Installation Guide for the GEMINI/PD Transceiver/Modem/GPS is a preliminary version.

**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(h):** Other types of equipment: this equipment is not provided with hardware audio low-pass filters, the filtering is entirely result of DSP firmware.

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	Raised Cosine filter's 3dB cut-off frequency	Deviation
25600 b/s	12800bauds	6.4 kHz	± 2.15 kHz
19200 b/s	9600bauds	4.8 kHz	± 2.25 kHz

The following test report have been generated for Class II Permissive Change notification for EOTGPDB, Gemini/PD radio modem. Gemini/PD is comprised of the Dataradio COR Ltd. (DRL) Mobile Data Platform (MDP) 800 MHz Transceiver with the Dataradio Inc Gemini Modem. Dataradio Inc does the final assembly and markets the Gemini/PD unit

The measurements were conducted following the procedures set forth in the TIA/EIA-603 revA 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 Raised Cosine  $\alpha=0.4$  DSP implemented low-pass filter to an FM transceiver. The necessary bandwidth calculation for this type of modulation (RC4FSK) is not covered by paragraphs (1), (2) or (3) from 2.202(c), the result exceeding the real 99% 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	Authorised Bandwidth	Proposed Emission Designator
25600 bauds	$\pm 2.10$ KHz	11500 Hz	20000Hz	11K5F1D
19200 bauds	$\pm 2.20$ KHz	10170 Hz	20000Hz	10K2F1D

The measurement theory and set-up explanations follow.

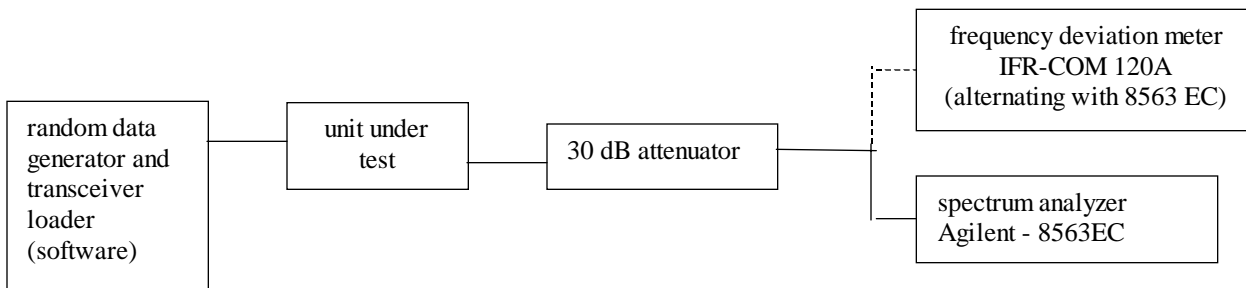
#### Occupied Bandwidth Measurement

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 the *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 G, the resulting value was recorded as Occupied Bandwidth.

The measurement set-up is:



NAME OF TEST: Transmitter Occupied Bandwidth  
GEMINI Modem at 25600 bps, 12800bauds 4FSK

### Mask compliance data in support of Emission Designator **11K5F1D**

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

MINIMUM STANDARD: Mask H  
Sidebands and Spurious [Rule 90.210 (h)]  
Authorized Bandwidth = 20 kHz [Rule 90.209(b) (5)]  
Fo to 4.0 kHz Attenuation = 0 dB  
>4.0 kHz to 8.5 kHz Attenuation=  $107 \cdot \log(f_d / 4)$  dB  
>8.5 kHz to 15 kHz Attenuation=  $40.5 \cdot \log(f_d / 1.16)$  dB  
>15 kHz to 25kHz Attenuation =  $116 \cdot \log(f_d / 6.1)$  dB  
>25kHz  $43 + 10 \cdot \log(P)$  dB  
**Corner Points:**  
Fo to 4.0 kHz Attenuation = 0 dB  
>4.0 kHz to 8.5 kHz Attenuation= 0 dB to 35 dB  
>8.5 kHz to 15 kHz Attenuation = 35 dB to 45 dB  
>15 kHz to 25 kHz Attenuation =45 dB to 71 dB  
>25 kHz Attenuation =53dB (10W-generic)  
The limits would read 59dB for 40W and 50dB for 5W output.

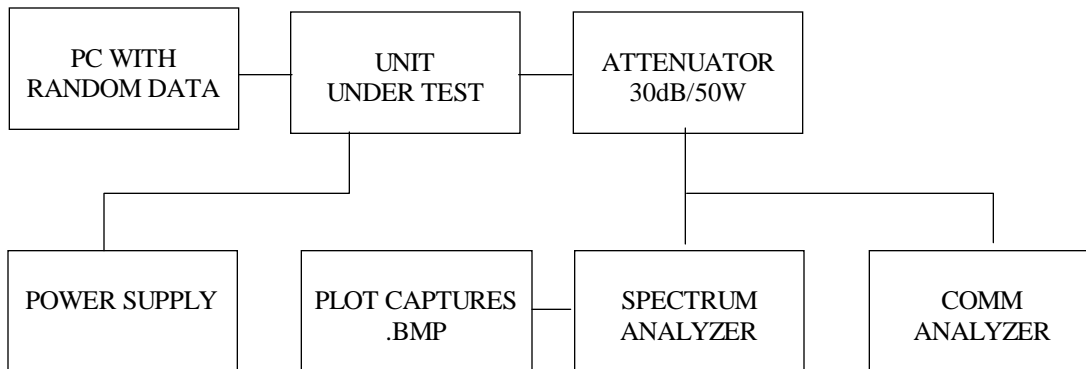
TEST RESULTS: Meets minimum standard (see data on the following pages)

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: Constantin Pintilei DATE: 03/08/02

### TEST SET-UP:



NAME OF TEST: Transmitter Occupied Bandwidth (Continued)  
 GEMINI Modem at 25600 bps, 12800bauds 4FSK

**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 11111111110 (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 4 FSK RC  $\alpha=0.4$  pulse shaping .

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 25.6 kbps references in the Installation Guide correspond to a transmitter baud rate of 12800 baud. That digital signal is digitally filtered (Squared Root Raised Cosine pulse shaping with  $\alpha=0.4$ ) 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.

For 25600 bit rate the deviation is set to 2.150kHz using a 1kHz tone to control the deviation level.

**NECESSARY BANDWIDTH (Bn) COMPLIANCE**

See Page 14 for Occupied Bandwidth data. 11500Hz < 20000Hz , Authorized Bandwidth

TEST DATA: Refer to the following graphs:

MASK: H, 40W

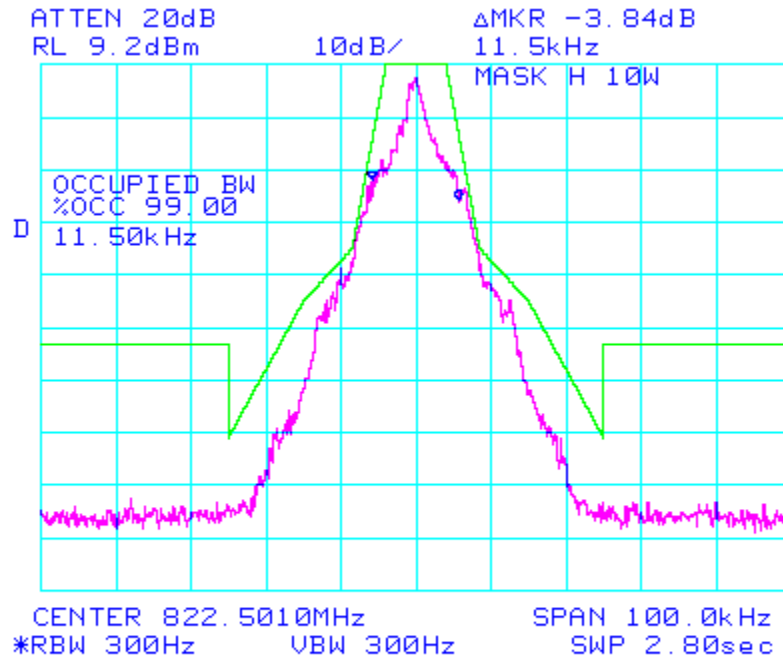
SPECTRUM FOR EMISSION **11K5F1D**

OUTPUT POWER: 40 Watts

25600bps=12800 bauds 4 level FSK

PEAK DEVIATION = 2150 Hz

SPAN = 100 kHz



MASK: H, 5W

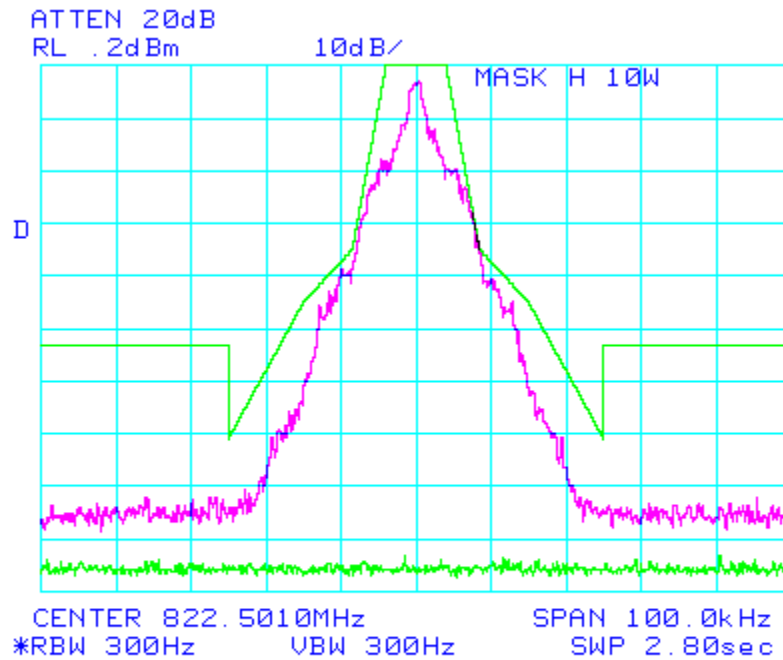
SPECTRUM FOR EMISSION **11K5F1D**

OUTPUT POWER: 5 Watts

12800 bauds 4 level FSK

PEAK DEVIATION = 2150 Hz

SPAN = 100 kHz



NAME OF TEST: Transmitter Occupied Bandwidth  
GEMINI Modem at 19200 bps, 9600bauds 4FSK

### Mask compliance data in support of Emission Designator **10K2F1D**

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

MINIMUM STANDARD: Mask H  
Sidebands and Spurious [Rule 90.210 (h)]  
Authorized Bandwidth = 20 kHz [Rule 90.209(b) (5)]  
Fo to 4.0 kHz Attenuation = 0 dB  
>4.0 kHz to 8.5 kHz Attenuation=  $107 \cdot \log(f_d / 4)$  dB  
>8.5 kHz to 15 kHz Attenuation=  $40.5 \cdot \log(f_d / 1.16)$  dB  
>15 kHz to 25kHz Attenuation =  $116 \cdot \log(f_d / 6.1)$  dB  
>25kHz  $43 + 10 \cdot \log(P)$  dB  
**Corner Points:**  
Fo to 4.0 kHz Attenuation = 0 dB  
>4.0 kHz to 8.5 kHz Attenuation= 0 dB to 35 dB  
>8.5 kHz to 15 kHz Attenuation = 35 dB to 45 dB  
>15 kHz to 25 kHz Attenuation =45 dB to 71 dB  
>25 kHz Attenuation =53dB (10W –generic limit)  
The limits would read 59dB for 40W and 50dB for 5W output.

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

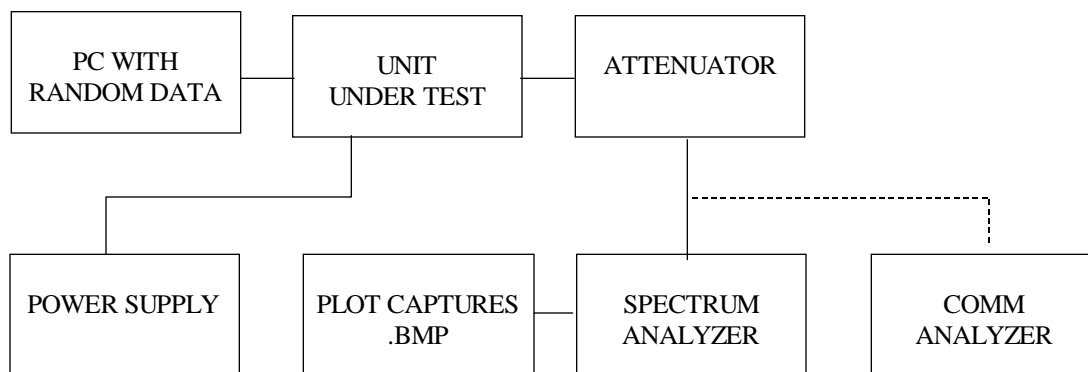
PERFORMED BY:

*Constantin Pintilei*

Constantin Pintilei

DATE: 03/08/02

TEST SET-UP:





NAME OF TEST: Transmitter Occupied Bandwidth (Continued)  
GEMINI Modem at 19200 bps, 9600bauds 4FSK

#### **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 4 FSK SRRC pulse shaping .

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 19.2 kbps references in the Installation Guide correspond to a transmitter baud rate of 9600 baud. That digital signal is digitally filtered ( Raised Cosine pulse shaping with  $\alpha=0.4$ ) 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.

For 9600 baud rate the deviation is set to 2.25kHz.

#### **NECESSARY BANDWIDTH (Bn) CALCULATION**

See Page 17 for occupied bandwidth data. The corresponding emission designator prefix for necessary bandwidth = **10K2F1D**

TEST DATA: Refer to the following graphs:

MASK: H,40W

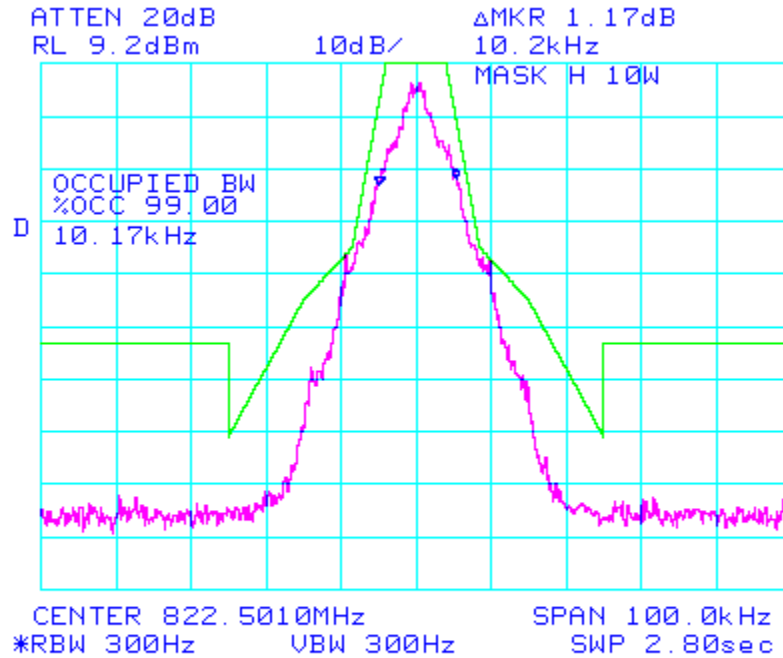
OUTPUT POWER: 40 Watts

19200 bps /9600 bauds 4 level FSK

Digital filters RC 0.4

PEAK DEVIATION = 2250 Hz

SPAN = 100 kHz



MASK: H, 5W

OUTPUT POWER: 5 Watts

19200 bps /9600 bauds 4 level FSK

Digital filter RC 0.4

PEAK DEVIATION = 2250 Hz

SPAN = 100 kHz

