

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

for the

Mobile Data Platform Transceiver (800 MHz MDP)

With the

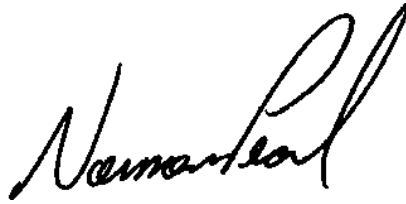
Data Radio Gemini Modem

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

April 25, 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.

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 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 10K0 and 11K0F1D. 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 with beta-level firmware used to create the modulation scheme. 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.2-154, 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 EOTGPDB to add the two new emission designators 10K0F1D and 11K0F1D to the existent list.



04/24/01

Constantin Pintilei
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: 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 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 10K0 and 11K0F1D. This modulation permits signaling at a reduced baud rate while fitting the requirements of Mask H 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(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 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): BBB-prototype 4-level FSK Gemini modem
 6085- 10460 - 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

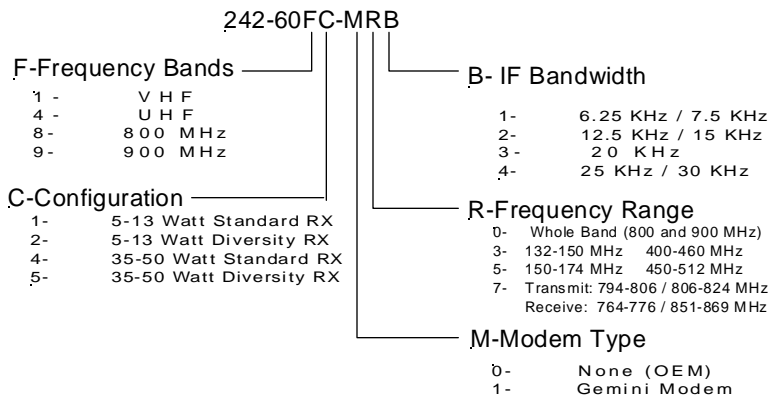
INPUT IMPEDANCE: 50 ohms, Nominal

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).(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
MPE limits compliance	2.1091
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 ch. sp. (8000baud, 4 FSK) **10K0F1D**
 12.5kHz ch. sp. (7200baud, 4 FSK) **11K0F1D**

Previously granted for EOTGPDB 12.5KHz ch. sp. (9600bps) **8K60F1D**
 25KHz ch. sp. (16.0Kbps) **15K3F1D**
 25KHz ch. sp. (19.2Kbps) **15K0F1D**
 25kHz ch. sp. (12800baud, 4 FSK) **15K6F1D**
 25kHz ch. sp. (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 EOTGPDB. 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 $\alpha=0.4$) 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.

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	± 2.48 kHz
14400 b/s	7200bauds	3.6 KHz	± 2.80 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 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

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 $\alpha=0.4$ 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	± 2.48 KHz	10000 Hz	10K0
7200 bauds	± 2.80 KHz	11000 Hz	11K0

The measurement theory and set-up explanations follow.

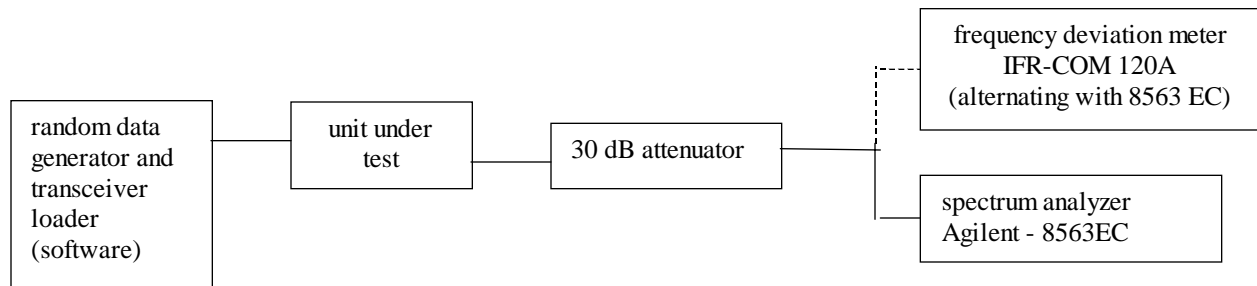
Occupied Bandwidth Measurement

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 H, the resulting value 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 **10K0F1D**

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)

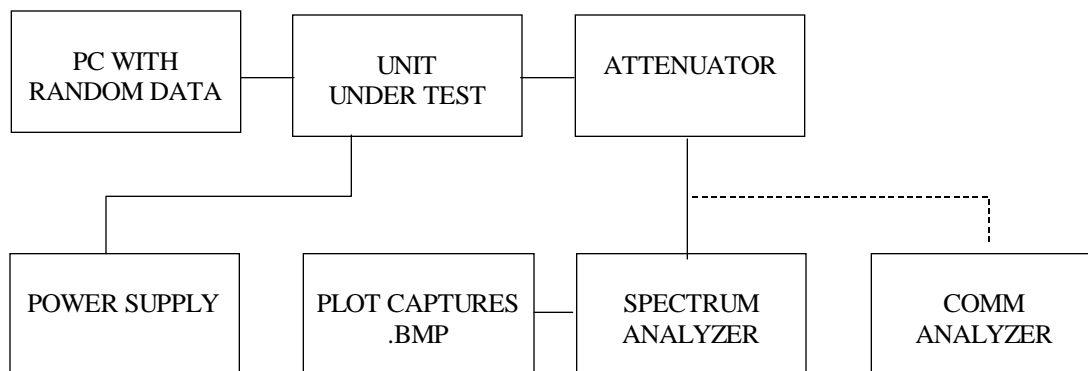
TEST RESULTS: Meets minimum standard (see data on the following pages)

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

Constantin Pintilei

PERFORMED BY: _____ DATE: 04/24/01
Constantin Pintilei

TEST SET-UP:



NAME OF TEST: Transmitter Occupied Bandwidth (Continued)
GEMINI Modem at 8000 bauds, 4FSK
In Support of Emission Designator **10K0F1D**

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 SRRC pulse shaping .

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 2.48kHz.

NECESSARY BANDWIDTH (Bn) CALCULATION

See Page 11 for emission designator determination.

The corresponding emission designator prefix for necessary bandwidth = **10K0F1D**

TEST DATA: Refer to the following graphs:

MASK: H, 10K0F1D, 40W

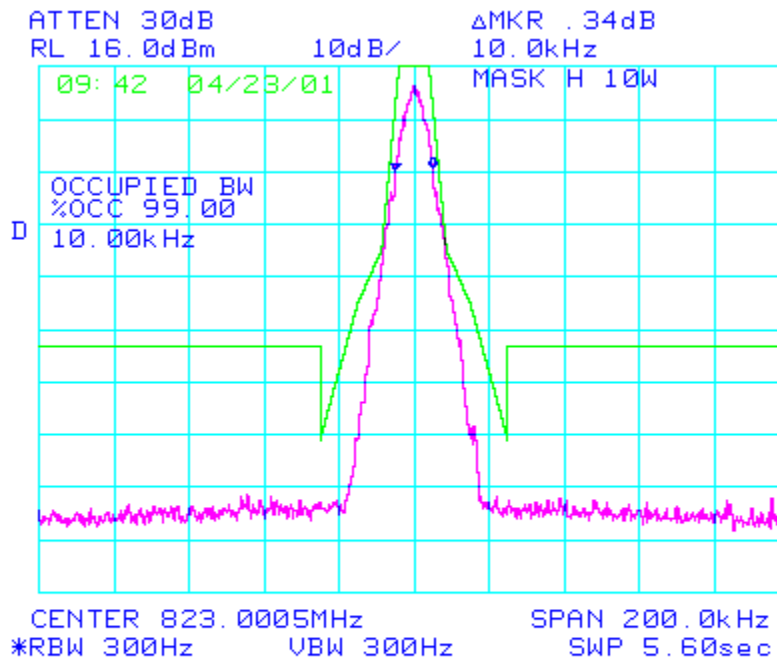
SPECTRUM FOR EMISSION **10K0F1D**

OUTPUT POWER: 40 Watts

8000 bauds 4 level FSK

PEAK DEVIATION = 2480 Hz

SPAN = 200 kHz



Note: For frequencies spaced more than 25kHz from the central frequency the attenuation should read 59dBc at 40W.
The plot above reads 53dBc as indicated in the description of the set-up.

MASK: H, 10K0F1D, 5W

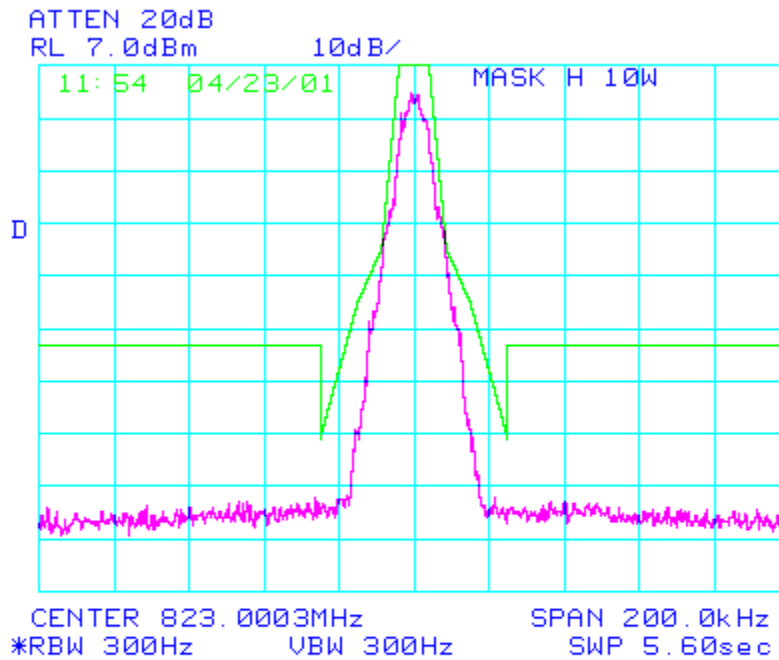
SPECTRUM FOR EMISSION **10K0F1D**

OUTPUT POWER: 5 Watts

8000 bauds 4 level FSK

PEAK DEVIATION = 2480 Hz

SPAN = 200 kHz



Note: For frequencies spaced more than 25kHz from the central frequency the attenuation should read 50dBc at 5W.
The plot above reads 53dBc 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 **11K0F1D**

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)

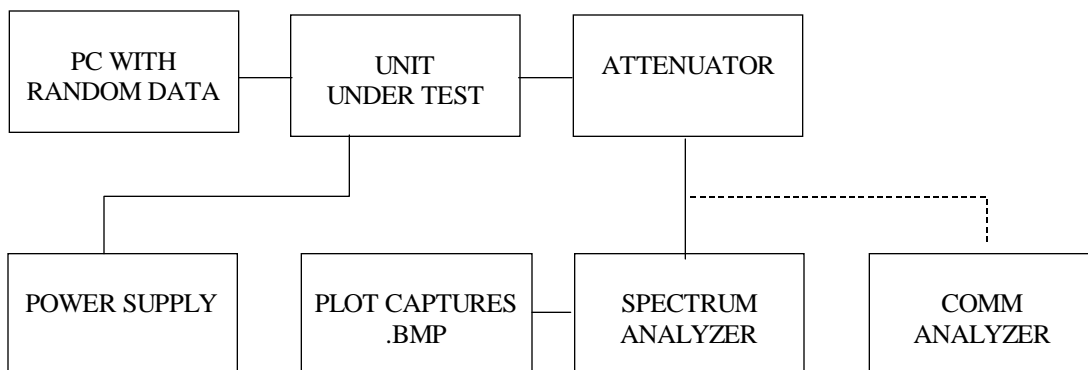
TEST RESULTS: Meets minimum standard (see data on the following pages)

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

Constantin Pintilei

PERFORMED BY: _____ DATE: 04/24/01
Constantin Pintilei

TEST SET-UP:



NAME OF TEST: Transmitter Occupied Bandwidth (Continued)
 GEMINI Modem at 7200 bauds 4FSK
 In Support of Emission Designator **11K0F1D**

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 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 feed the modulator's input of the transceiver.

For 7200 baud rate the deviation is set to 2.80 kHz.

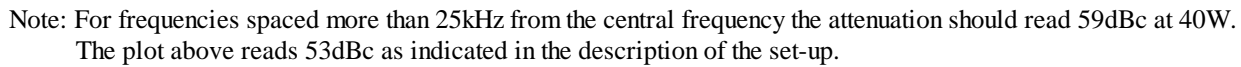
NECESSARY BANDWIDTH (Bn) CALCULATION

See Page 11 for emission designator determination.

The corresponding emission designator prefix for necessary bandwidth = **11K0F1D**

TEST DATA: Refer to the following graphs:

SPAN = 200 kHz



MASK: H, 11K0F1D, 5W

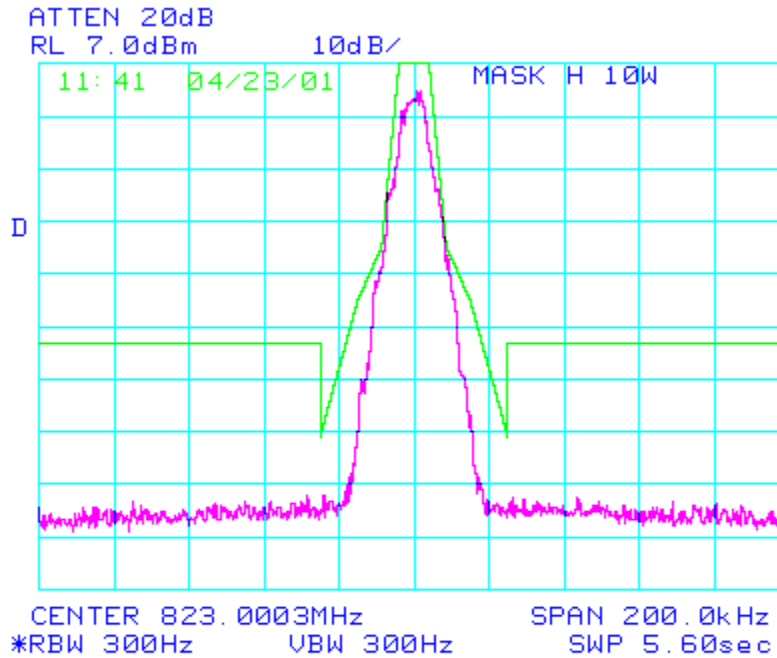
SPECTRUM FOR EMISSION 11K0F1D

OUTPUT POWER: 5 Watts

7200 bauds, 4 level FSK

PEAK DEVIATION = 2800 Hz

SPAN = 200 kHz



Note: For frequencies spaced more than 25kHz from the central frequency the attenuation should read 50dBc at 5W.
The plot above reads 53dBc as indicated in the description of the set-up.