

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

for the

Mobile Data Platform Transceiver (800 MHz MDP)

With the

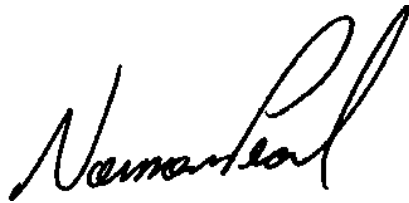
Dataradio Gemini Modem

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

September 7, 2004

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 a large, stylized "P" at the end.

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 mobile radio modem, which 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 completed unit as Gemini/PD or GeminiG3. The EOTGPDB certificate has been granted for a 2-level FSK (DGMSK) and a 2^N-level FSK (xRC4/8/16FSK) types of modulation scheme together with associated maximum deviation levels at various rates. The change consists of the addition of a 16-level FSK modulation scheme with 2 new proposed rates. 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 a beta (prototype) firmware. 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, 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.2-163, Sep15, 2002. 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 Nov, 20 and Dec 2, 2002

CONCLUSION

Given the results of the measurements contained herein, the applicant requests to have appended the new emission designator 10K5F1D in the list of the Certificate EOTGPDB and to have accepted the use of 11K0F1D with a 16-FSK modulation following the Class II Permissive Change, as per FCC part 2.1043(b)(2).



09/02/04

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
27 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
10 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 radio modem, which is comprised of the Dataradio COR Ltd. (DRL) Mobile Data Platform (MDP) 800 (806 MHz-824MHz) Transceiver with the Dataradio Inc Gemini GCU Modem. Dataradio Inc does the final assembly and markets the finished product. The original certificate has been granted for a 2, 4 8 and 16-level FSK type of modulation scheme with several emission designators as follow:

Proposed for Class II Permissive Change	12.5kHz CH SPACING (8000baud, 16 FSK)	10K5F1D
	12.5kHz CH SPACING (7200baud, 16 FSK)	11K0F1D
Previously granted for EOTGPDB	25kHz CH SPACING (16000baud, 16 FSK)	14K4F1D
	25kHz CH SPACING (14400baud, 16 FSK)	14K1F1D
	25kHz CH SPACING (16000baud, 8 FSK)	14K7F1D
	25kHz CH SPACING (14400baud, 8 FSK)	14K7F1D
	12.5kHz CH SPACING (8000baud, 8 FSK)	11K0F1D
	12.5kHz CH SPACING (9600baud, 8 FSK)	11K2F1D
	25kHz CH SPACING (16000baud, 4 FSK)	15K6F1D
	25kHz CH SPACING (12800baud, 4 FSK)	15K6F1D
	12.5kHz CH SPACING (12800baud, 4 FSK)	11K5F1D
	25kHz CH SPACING (9600baud, 4 FSK)	16K0F1D
	12.5kHz CH SPACING (9600baud, 4 FSK)	10K2F1D
	12.5kHz CH SPACING (8000baud, 4 FSK)	10K0F1D
	12.5kHz CH SPACING (7200baud, 4 FSK)	11K0F1D
	12.5KHz CH SPACING (9600bps)	8K60F1D
	25KHz CH SPACING (16.0Kbps)	15K3F1D
	25KHz CH SPACING (19.2Kbps)	15K0F1D

The change consists of the addition of two new speeds for the 16-level FSK modulations with two new emission designators 10K5F1D and 11K0F1D. This modulation permits signaling at a reduced baud rate when fitting the requirements of mask H with improved signal-to-noise (data sensitivity) performance. Only the modulation source is being changed to produce 16-level FSK modulator signal. There are no hardware changes involved in the radio circuitry. Also there are no changes in those modules of the MDP firmware which controls 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(c)

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 16-level FSK modulation rates 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
 PART NUMBER: GPDD-6085-xyz

SERIAL NUMBER (S): 0000-prototype Gemini modem
 6085- 13110 -154 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 (10-40 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:

TRADE NAME

MDP6000

Gemini

DESCRIPTION

806-824/851-869MHz XCVR

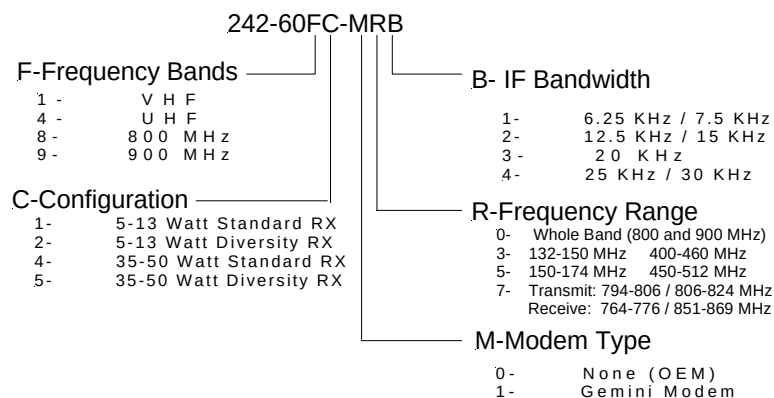
Modem

DRI PART NUMBER

242-608C-MRB

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)

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)(4)(13)(14)**INSTRUCTION BOOK**

2.1033 (c) (3)

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

TYPE OF EMISSION:

2.1033(c)(4)

For Class II Permissive Change 8levelFSK 12.5kHz ch spacing (7200baud, 16 FSK) **11K0F1D**
 12.5kHz ch spacing (8000baud, 16 FSK) **10K5F1D**

Previously granted for EOTGPDB 25kHz ch spacing (16000baud, 16 FSK) **14K4F1D**
 25kHz ch spacing (14400baud, 16 FSK) **14K1F1D**
 25kHz ch spacing (16000baud, 8 FSK) **14K7F1D**
 25kHz ch spacing (14400baud, 8 FSK) **14K7F1D**
 12.5kHz ch spacing (9600baud, 8 FSK) **11K2F1D**
 12.5kHz ch spacing (8000baud, 8 FSK) **11K0F1D**
 12.5KHz ch spacing (9.6kbps DGMSK) **8K60F1D**
 25KHz ch spacing (16.0kbps DGMSK) **15K3F1D**
 25KHz ch spacing (19.2kbps DGMSK) **15K0F1D**
 25kHz ch spacing (12800baud, 4 FSK) **15K6F1D**
 12.5kHz ch spacing (12800baud,4 FSK)**11K5F1D**
 25kHz ch spacing (9600baud, 4 FSK) **16K0F1D**
 12.5kHz ch spacing (9600baud,4 FSK) **10K2F1D**
 12.5kHz ch spacing (8000baud, 4 FSK) **10K0F1D**
 12.5kHz ch spacing (7200baud, 4 FSK) **11K0F1D**
 25kHz ch spacing (16000baud, 4 FSK) **15K6F1D**

DIGITAL MODULATION TECHNIQUES

2.1033 (c)(13) and Part 2.1047 (d), 90.209 (b) 90.210(h)

The Gemini DSP modem generates 16-level Squared Root Raised Cosine Frequency Shift Keying. (SRRC16FSK). Both modulations schemes have been granted before with the certificate EOTGPDB. This measurement concerns only the new symbol rates that use 16-level SRRC (squared root raised cosine) modulation, the description of which follows. Meantime, the modulation scheme SRRC16FSK remains the same.

The 16-level signaling transmits four information bits per symbol (baud) which yields a bit rate four times higher than the on-air baud rate, hence the 28.8 or 32.0 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 SRRC16FSK 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 generated with a reference tone of 1000Hz 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
32000 b/s	8000bauds	4.0 kHz	± 3.23 kHz
28800 b/s	7200bauds	3.6 kHz	± 3.29 kHz

TEST DATA 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,(h)

are provided in next section of this Engineering Report

The following test reports have been generated for Class II Permissive Change notification for EOTGPDB, Gemini radio modem.

The measurements were conducted following the procedures set forth in the TIA/EIA-603 revB 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 (xRC4FSK) 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 1kHz tone	Deviation random data	Occupied Bandwidth	Authorized Bandwidth	Proposed Emission Designator
28800 b/s	± 3.29 kHz	± 4.39 kHz	10963 Hz	20000Hz	11K0F1D
32000 b/s	± 3.23 kHz	± 4.14 kHz	10431 Hz	20000Hz	10K5F1D

The measurement theory and set-up explanations follow.

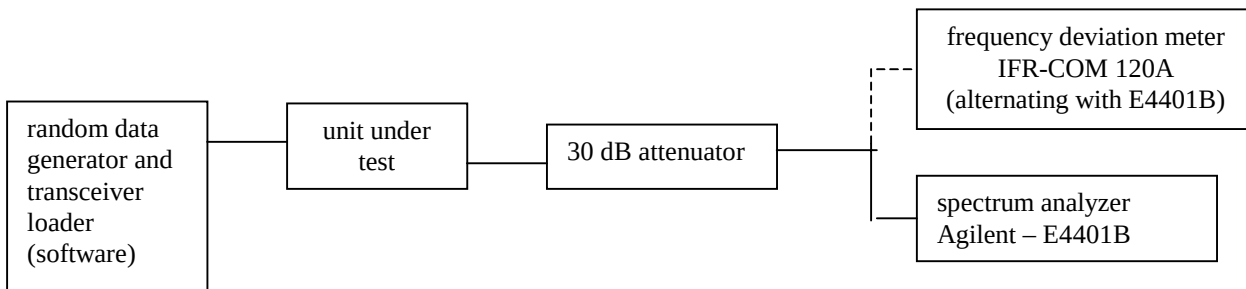
Occupied Bandwidth Measurement

The Occupied Bandwidth measurement option of the instrument (E4401B 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 28800 bps, 7200bauds 16FSK

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-generic)
The limits would read 59dB for 40W and 50dB for 5W output.

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

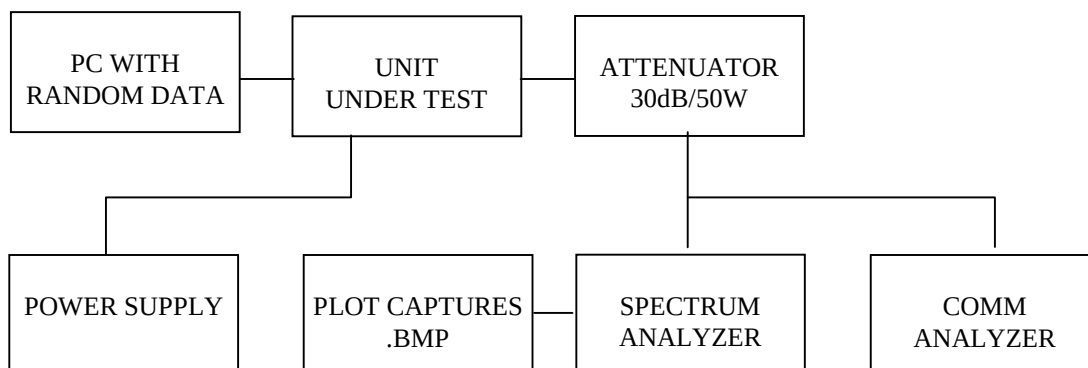
TEST CONDITIONS: Standard Test Conditions, 25 C

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 HP E4401

Constantin Pintilei

PERFORMED BY: _____ DATE: 09/01/04
Constantin Pintilei

TEST SET-UP:



NAME OF TEST: Transmitter Occupied Bandwidth (Continued)
GEMINI Modem at 28800 bps, 9600bauds 8FSK

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. This pattern is applied to the DSP processor data input for encoding and 16 SRFSK RC $\alpha=0.4$ pulse shaping .

The 8-level signaling transmits three information bits per symbol (baud) which yields a bit rate of three times the on-air baud rate, hence the 28.8 kbps references in the Installation Guide correspond to a transmitter baud rate of 7200 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 SRRC16FSK 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 28800 bit rate the deviation is set to 3.29kHz using a 1kHz tone to control the deviation level.

NECESSARY BANDWIDTH (Bn) COMPLIANCE

See Page 11 for Occupied Bandwidth data. 11000Hz < 20000Hz , Authorized Bandwidth

TEST DATA: Refer to the following graphs:

MASK: H, 40W

SPECTRUM FOR EMISSION 11K0F1D

OUTPUT POWER: 40 Watts

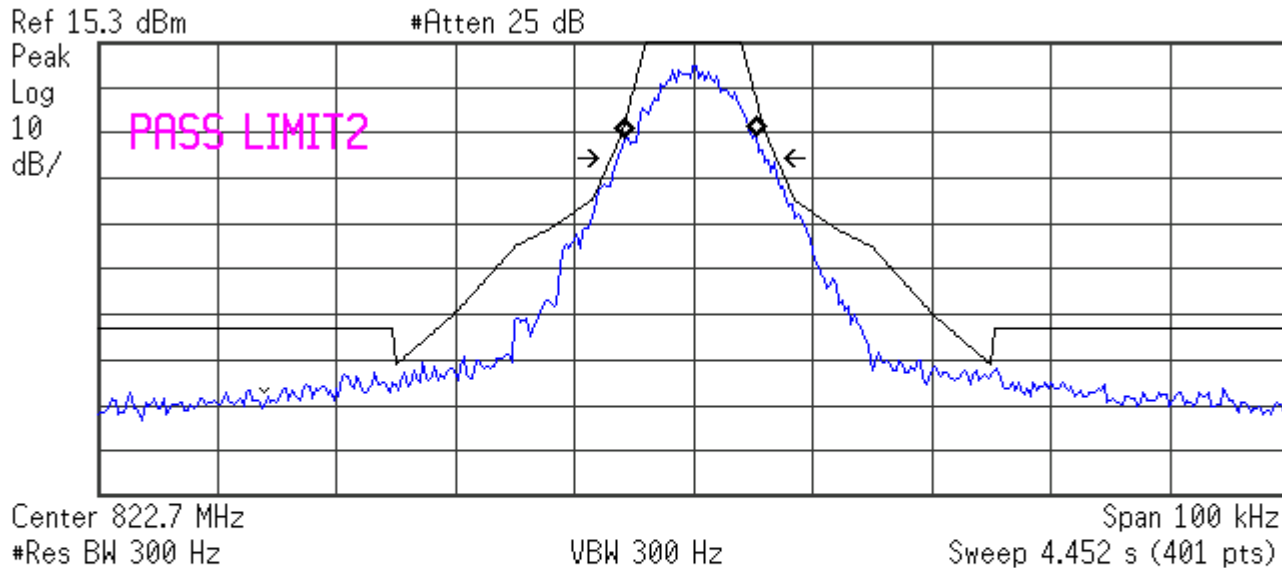
28800bps=7200 bauds 16 level FSK

DEVIATION = 3290 Hz

SPAN = 100 kHz

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Occupied Bandwidth
10.9379 kHz

Occ BW % Pwr 99.00 %

Transmit Freq Error -168.820 Hz
x dB Bandwidth 12.271 kHz

MASK: H, 10W

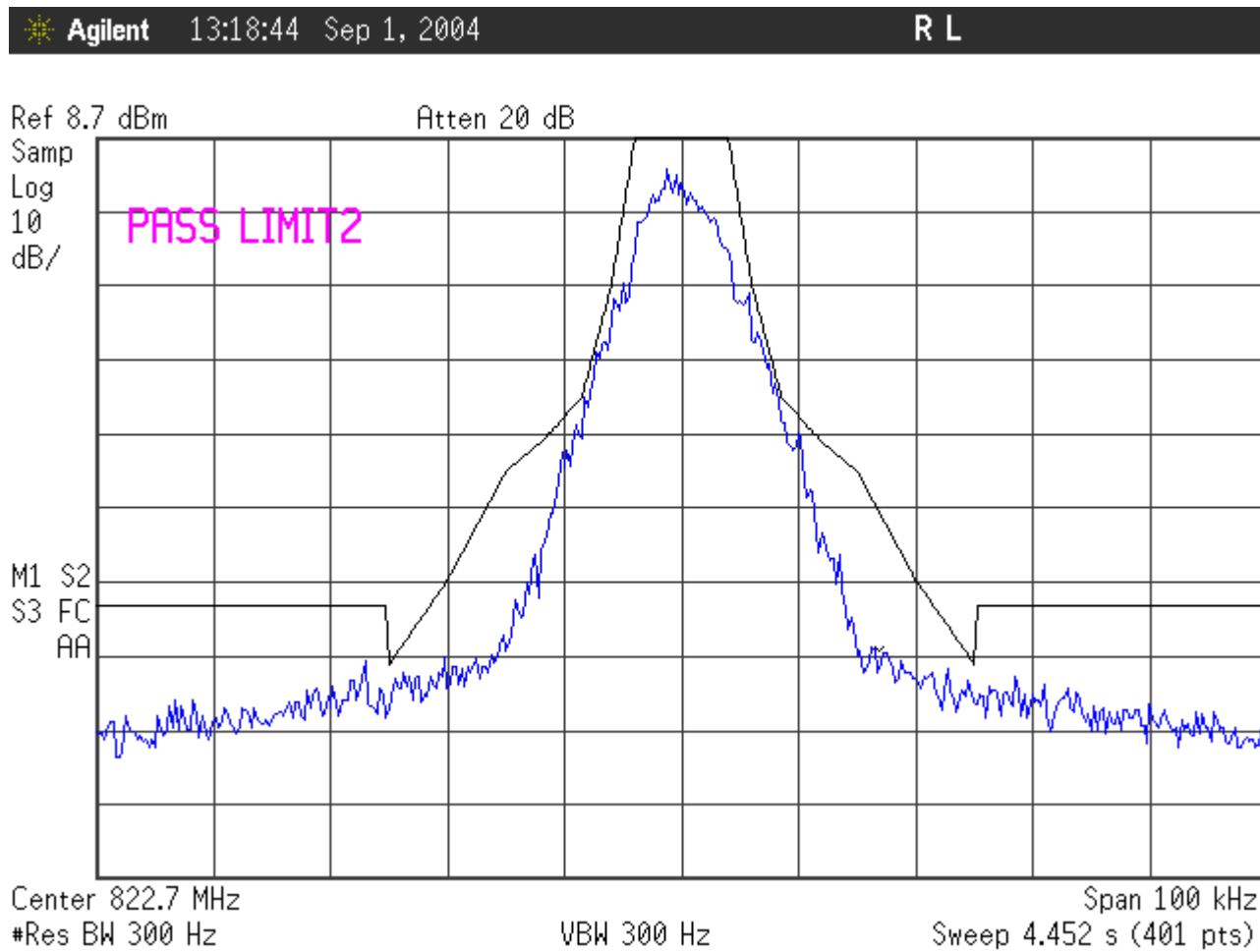
SPECTRUM FOR EMISSION **11K0F1D**

OUTPUT POWER: 10 Watts

7200 bauds 16 level FSK

DEVIATION = 3290 Hz

SPAN = 100 kHz



NAME OF TEST: Transmitter Occupied Bandwidth
GEMINI Modem at 32000 bps, 8000bauds 16FSK

Mask compliance data in support of Emission Designator **10K5F1D**

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.

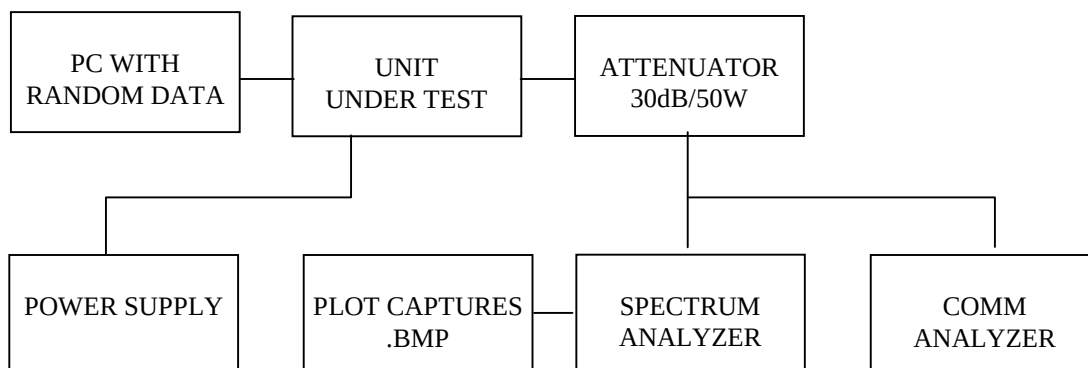
TEST RESULTS: Meets minimum standard (see data on the following pages)

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 HP E4401

Constantin Pintilei

PERFORMED BY: _____ DATE: 09/01/04
Constantin Pintilei

TEST SET-UP:



NAME OF TEST: Transmitter Occupied Bandwidth (Continued)
GEMINI Modem at 32000 bps, 8000bauds 16FSK

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 . This pattern is applied to the DSP processor data input for encoding and 16 FSK SRRC $\alpha=0.4$ pulse shaping .

The 16-level signaling transmits three information bits per symbol (baud) which yields a bit rate of three times the on-air baud rate, hence the 32.0 kbps references in the Installation Guide correspond to a transmitter baud rate of 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 SRRC16FSK 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 32000 bit rate the deviation is set to 3.23 kHz using a 1kHz tone to control the deviation level.

NECESSARY BANDWIDTH (Bn) COMPLIANCE

See Page 11 for Occupied Bandwidth data. $10500\text{Hz} < 20000\text{Hz}$, Authorized Bandwidth

TEST DATA: Refer to the following graphs:

MASK: H, 40W

SPECTRUM FOR EMISSION **10K5F1D**

OUTPUT POWER: 40 Watts

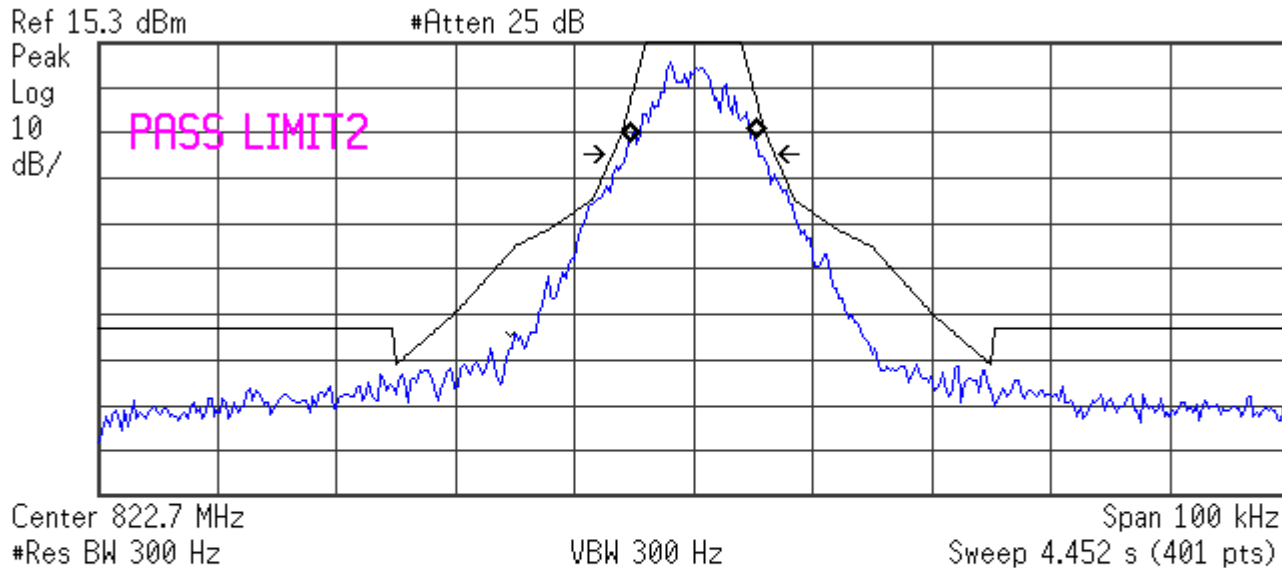
32000bps=8000 bauds 16 level FSK

DEVIATION = 3230 Hz

SPAN = 100 kHz

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Occupied Bandwidth
10.4103 kHz

Occ BW % Pwr 99.00 %

Transmit Freq Error -56.093 Hz
x dB Bandwidth 11.120 kHz

MASK: H, 10W

SPECTRUM FOR EMISSION **10K5F1D**

OUTPUT POWER: 10 Watts

8000 bauds 16 level FSK

DEVIATION = 3230 Hz

SPAN = 100 kHz

