

**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**

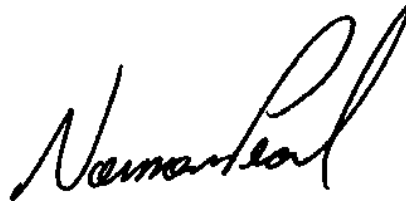
**Dataradio Gemini Modem**

**FCC ID: EOTGPDA  
Trade Name: GEMINI**

October 20, 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 written in a cursive style with a large, prominent initial "N".

---

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 mobile radio modem, which 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 completed unit as Gemini. The EOTGPDA unit certificate has been granted for a 2-level FSK (DGMSK) and a 2<sup>N</sup>-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 with 2 new proposed rates. The change intends to add another 16-FSK modulation scheme with two new bit rates of 32kbps and 28.8kbps along with their emission designators emission of 8K42F1D and 7K92F1D. 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 a beta (prototype) firmware. 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, 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 2.1041 and 2.1049 of Rules Service Co rev.2-165, Mar 15,2003. 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 Oct 12, 2004 and Oct 19, 2004

CONCLUSION

Given the results of the measurements contained herein, the applicant requests to have appended the new emission designator 8K42F1D and 7K92F1D in the list of the Certificate EOTGPDA and to have accepted the use of with a 16-FSK modulation following the Class II Permissive Change, as per FCC part 2.1043(b)(2).



20/10/04

Constantin Pintilei  
R&D Test Engineer, Dataradio Inc.

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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 EOTGPDA has been granted to Dataradio Inc for its Gemini radio modem, which is comprised of the Dataradio COR Ltd. (DRL) Mobile Data Platform (MDP) UHF (403 MHz-512MHz) 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)	<b>7K92F1D</b>
	12.5kHz ch. spacing (7200baud, 16 FSK)	<b>8K42F1D</b>
Previously granted for EOTGPDA	25kHz ch. spacing (16000baud, 16 FSK)	<b>16K4F1D</b>
	25kHz ch. spacing (14400baud, 16 FSK)	<b>16K9F1D</b>
	25kHz ch. spacing (16000baud, 8 FSK)	<b>17K0F1D</b>
	25kHz ch. spacing (14400baud, 8 FSK)	<b>16K4F1D</b>
	12.5kHz ch. spacing (8000baud, 8 FSK)	<b>8K17F1D</b>
	12.5kHz ch. spacing (7200baud, 8 FSK)	<b>9K67F1D</b>
	12.5KHz ch. spacing (9600bps)	<b>8K60F1D</b>
	25KHz ch. spacing (16.0Kbps)	<b>15K3F1D</b>
	25KHz ch. spacing (19.2Kbps)	<b>15K0F1D</b>
	25kHz ch. spacing (12800baud, 4 FSK)	<b>15K6F1D</b>
	25kHz ch. spacing (9600baud, 4 FSK)	<b>16K0F1D</b>
	12.5kHz ch. spacing (8000baud, 4 FSK)	<b>8K17F1D</b>
	12.5kHz ch. spacing (7200baud, 4 FSK)	<b>8K67F1D</b>
	25kHz ch. spacing (16000baud, 4 FSK)	<b>16K8F1D</b>

The change consists of the addition of two new speeds for the 16-level FSK modulations with two new emission designators 7K92F1D and 8K42 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 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-6045-xyz

SERIAL NUMBER ( S ): 0000-prototype Gemini modem  
 6045-11655-134 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 blocked by software)

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

NUMBER OF CHANNELS: 16 Channel Modem

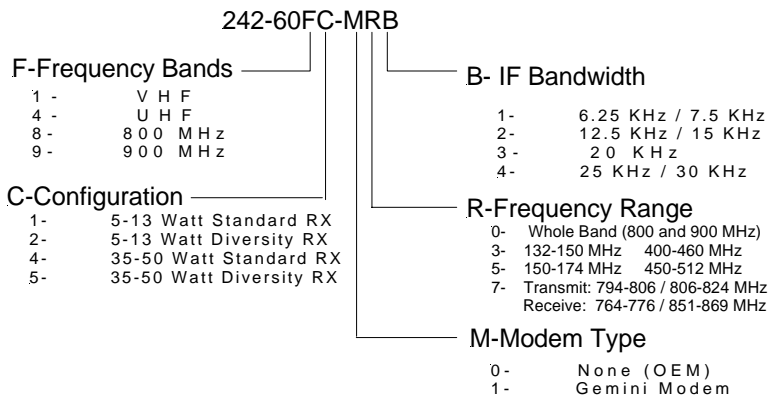
INPUT IMPEDANCE: 50 ohms, Nominal

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

**EQUIPMENT IDENTIFICATION:**

<u>TRADE NAME</u>	<u>DESCRIPTION</u>	<u>DRI PART NUMBER</u>
MDP6000	403-520 MHz XCVR	242-604C-MRB
Gemini GCU III	Modem	255-03434-00x

**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
Spectrum efficiency standard	90.203 (j) (64000 or 57600 bps /25kHz) is larger than 19200 bps required in 25kHz (4*4800 bps/4*6.25kHz)
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 and 90.214
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
Transient Frequency Behavior	90.214



**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 16-level-FSK 12.5kHz ch. spacing (8000baud, 16 FSK) **7K92F1D**  
 12.5kHz ch. spacing (7200baud, 16 FSK) **8K42F1D**

Previously granted for EOTGPDA

25kHz ch. spacing (16000baud, 16 FSK)	<b>16K4F1D</b>
25kHz ch. spacing (14400baud, 16 FSK)	<b>16K9F1D</b>
25kHz ch. spacing (16000baud, 8 FSK)	<b>17K0F1D</b>
25kHz ch. spacing (14400baud, 8 FSK)	<b>16K4F1D</b>
12.5kHz ch. spacing (8000baud, 8 FSK)	<b>8K17F1D</b>
12.5kHz ch. spacing (7200baud, 8 FSK)	<b>9K67F1D</b>
12.5KHz ch. spacing (9600bps)	<b>8K60F1D</b>
25KHz ch. spacing (16.0Kbps)	<b>15K3F1D</b>
25KHz ch. spacing (19.2Kbps)	<b>15K0F1D</b>
25kHz ch. spacing (12800baud, 4 FSK)	<b>15K6F1D</b>
25kHz ch. spacing (9600baud, 4 FSK)	<b>16K0F1D</b>
12.5kHz ch. spacing (8000baud, 4 FSK)	<b>8K17F1D</b>
12.5kHz ch. spacing (7200baud, 4 FSK)	<b>8K67F1D</b>
25kHz ch. spacing (16000baud, 4 FSK)	<b>16K8F1D</b>

**DIGITAL MODULATION TECHNIQUES**

2.1033 (c)(13)

The Gemini DSP modem generates 16-level Squared Root Raised Cosine Frequency Shift Keying. (SRRC16FSK). Both modulation schemes have been granted before with the certificate EOTGPDA. 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 32.0kbps 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	Reference Deviation
32000 b/s	8000bauds	4.0 kHz	± 1.95 kHz
28800 b/s	7200bauds	3.6 KHz	± 2.25 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(c):** 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 test reports have been generated for Class II Permissive Change notification for EOTGPDA, Gemini radio modem.

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 (SRRC16FSK) is not covered by paragraphs (1), (2) or (3) from 2.202(c), the result exceeding the 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 on 1kHz tone	Deviation on random data	Occupied Bandwidth	Authorized Bandwidth	Emission designator
8000 bauds	$\pm 1.95$ kHz	$\pm 2.60$ kHz	7917 Hz	11250 Hz	7K92
7200 bauds	$\pm 2.25$ kHz	$\pm 3.12$ kHz	8417 Hz	11250 Hz	8K42

The measurement theory and set-up explanations follow.

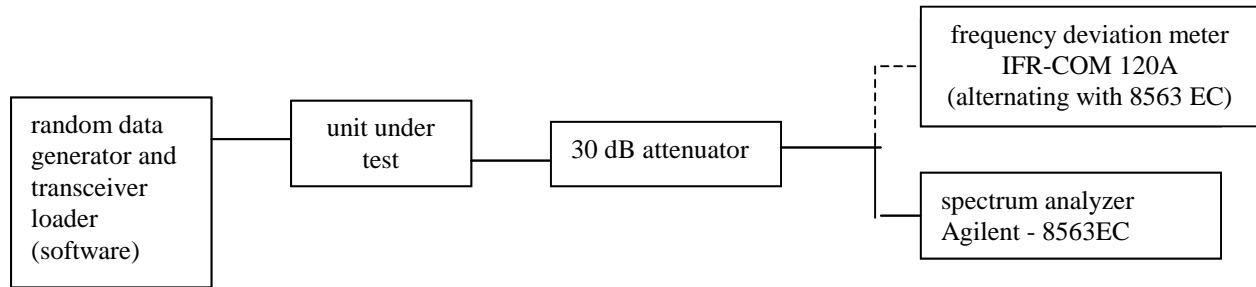
**Occupied Bandwidth Measurement**

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 D, the resulting value was recorded as Occupied Bandwidth.

The measurement set-up is:



To record the deviation level, the 30kHz IF filter option was used on the IFR-COM 120A.

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

Mask compliance data in support of Emission Designator **7K92F1D**

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

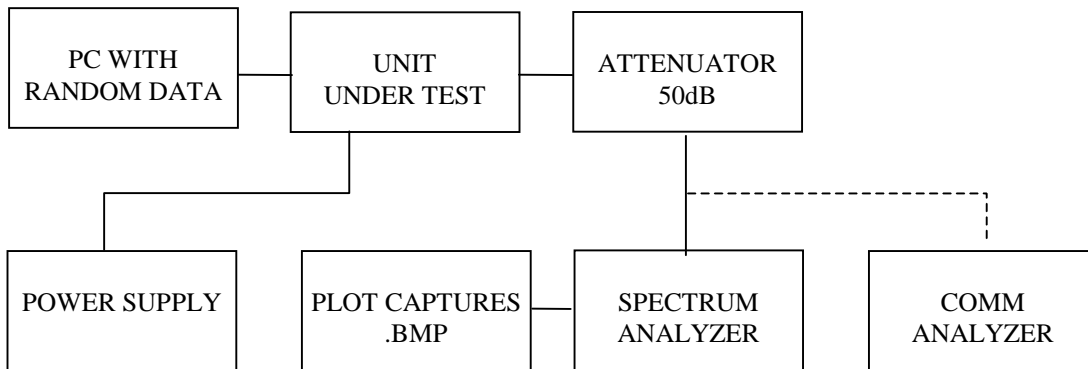
TEST EQUIPMENT: Attenuator, BIRD Model / 50-A-MFN-30 / 30 dB / 50 Watt  
Attenuator, BIRD Model / 5-A-MFN-20 / 20 dB / 5 Watt  
DC Power Source, Model Astron VS 20M  
Communication Analyzer, Model IFR COM120A (deviation meter)  
Spectrum Analyzer, Model Agilent (HP) 8563EC

*Constantin Pintilei*

PERFORMED BY: \_\_\_\_\_  
Constantin Pintilei

DATE: 10/19/04

TEST SET-UP:



NAME OF TEST: Transmitter Occupied Bandwidth (Continued)  
GEMINI Modem at 8000 bauds, 16FSK  
In Support of Emission Designator **7K92F1D**

**MODULATION SOURCE DESCRIPTION:**

TX Data Test Pattern:

The transmit "test data" pattern command produces a 8,388,607 bit pseudo- random pattern. This pattern is generated by the internal DSP software using the polynomial  $X^{23}+X^5+1$  form and a 23-bit shift register. Initial value of the register is 1 (1 hex). The 8,388,607 bit sequence is repeated thereafter as long is necessary to complete the test duration. A sequence lasts 262 seconds at 32 kbps or 290seconds at 28.8kbps.

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

This data flow follows same modulation process as described in the "Digital Modulation Techniques" on page 9. The resulting baseband signal feeds the modulator's input of the transceiver.

For 8000 baud rate /32000 bit rate the deviation is set to 1.950 kHz using a 1kHz tone to control the deviation level.

**NECESSARY BANDWIDTH (Bn) CALCULATION**

See Page 11 for emission designator determination.

The corresponding emission designator prefix for necessary bandwidth = **7K92F1D**

TEST DATA: Refer to the following graphs:

MASK: D, 7K92F1D, 10W

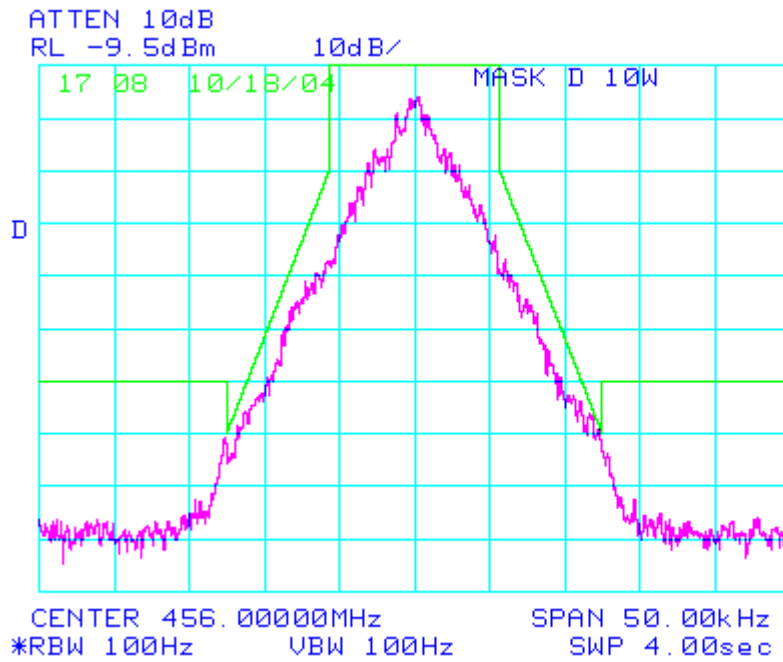
SPECTRUM FOR EMISSION 7K92F1D

OUTPUT POWER: 10 Watts

8000 bauds 16 level FSK

DEVIATION = 1950 Hz

SPAN = 50 kHz



**MASK: D, 7K92F1D, 50W**

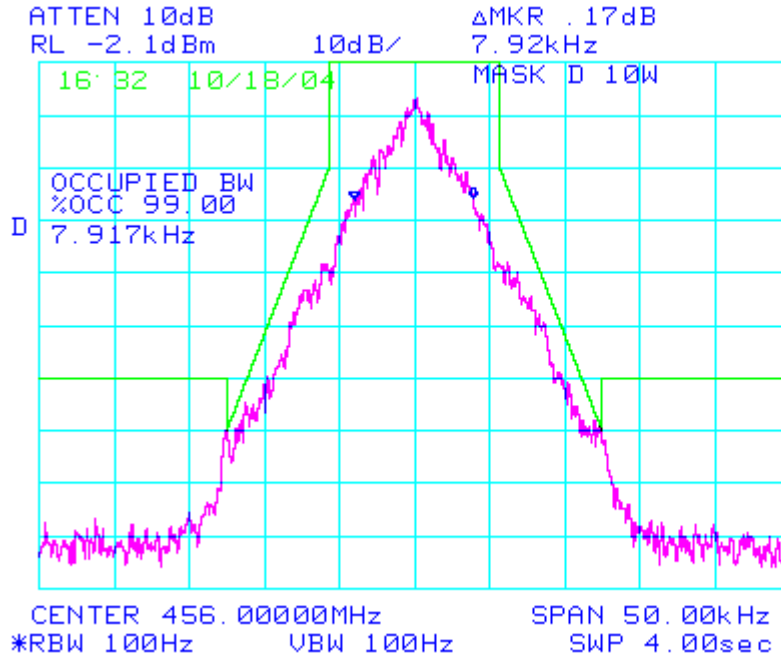
**SPECTRUM FOR EMISSION 7K92F1D**

OUTPUT POWER: 50 Watts

8000 bauds 16 level FSK

DEVIATION = 1950 Hz

SPAN = 50 kHz



Note: For frequencies spaced more than 12.5kHz from the central frequency the mask drawing shoulders should read 67dBc for 50W. The above plot shows shoulders at 60dBc as indicated at the Mask D description on page 12.

NAME OF TEST: Transmitter Occupied Bandwidth  
GEMINI Modem at 7200bauds 16FSK

Mask compliance data in support of Emission Designator **8K42F1D**

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

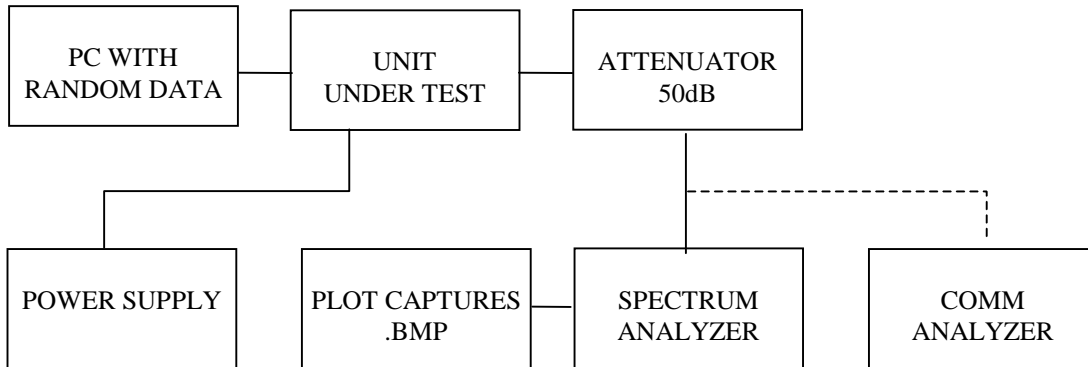
TEST EQUIPMENT: Attenuator, BIRD Model / 50-A-MFN-30 / 30 dB / 50 Watt  
Attenuator, BIRD Model / 5-A-MFN-20 / 20 dB / 5 Watt  
DC Power Source, Model Astron VS 20M  
Communication Analyzer, Model IFR COM120A (deviation meter)  
Spectrum Analyzer, Model Agilent (HP) 8563EC

*Constantin Pintilei*

PERFORMED BY: \_\_\_\_\_  
Constantin Pintilei

DATE: 10/19/04

TEST SET-UP:





NAME OF TEST: Transmitter Occupied Bandwidth (Continued)  
GEMINI Modem at 7200 bauds, 16FSK  
In Support of Emission Designator **8K42F1D**

**MODULATION SOURCE DESCRIPTION:**

TX Data Test Pattern:

The transmit "test data" pattern command produces a 8,388,607 bit pseudo- random pattern. This pattern is generated by the internal DSP software using the polynomial  $X^{23}+X^5+1$  form and a 23-bit shift register. Initial value of the register is 1 (1 hex). The 8,388,607 bit sequence is repeated thereafter as long is necessary to complete the test duration. A sequence lasts 262 seconds at 32 kbps or 290seconds at 28.8kbps.

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

This data flow follows same modulation process as described in the "Digital Modulation Techniques" on page 9. The resulting baseband signal feeds the modulator's input of the transceiver.

For 7200 baud rate /28800 bit rate the deviation is set to 2.250kHz using a 1kHz tone to control the deviation level.

**NECESSARY BANDWIDTH (Bn) CALCULATION**

See Page 11 for emission designator determination.

The corresponding emission designator prefix for necessary bandwidth = **8K42F1D**

TEST DATA: Refer to the following graphs:

MASK: D, 8K42F1D, 10W

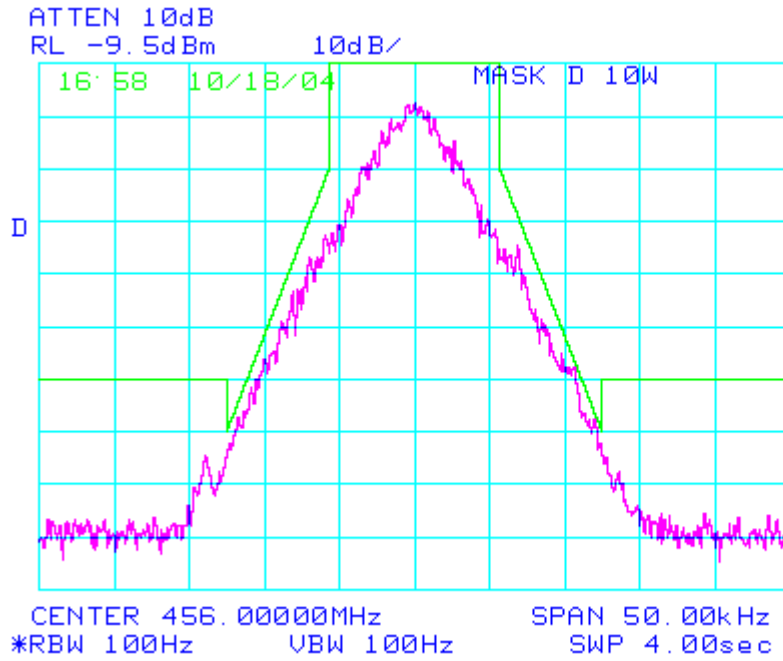
SPECTRUM FOR EMISSION 8K42F1D

OUTPUT POWER: 10 Watts

7200 bauds, 16 level FSK

DEVIATION = 2250 Hz

SPAN = 50 kHz



MASK: D, 8K42F1D, 50W

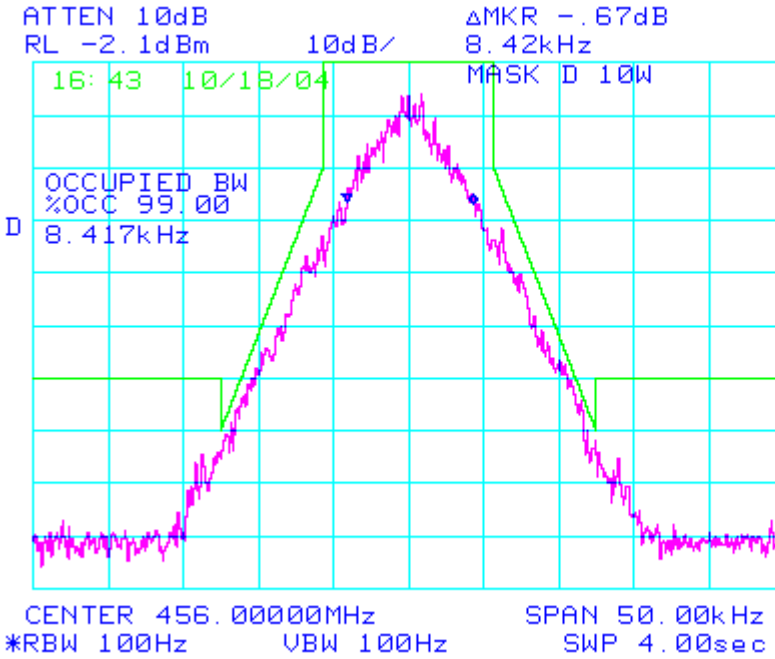
SPECTRUM FOR EMISSION 8K42F1D

OUTPUT POWER: 50 Watts

7200 bauds, 16 level FSK

DEVIATION = 2250 Hz

SPAN = 50 kHz



Note: For frequencies spaced more than 12.5kHz from the central frequency the mask drawing shoulders should read 67dBc for 50W. The above plot shows shoulders at 60dBc as indicated at the Mask D description on page 12.