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

**for the**

## Mobile Data Platform Transceiver (900MHz MDP)

**With the**

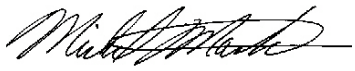
## Data Radio Gemini Modem

## FCC ID: EOTGPD9
## Trade Name: GEMINI

January 6, 2006

**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.



Michel Martin
Director, Research and Development, Dataradio Inc.

Dataradio Cor.
Waseca, MN

**ENGINEERING STATEMENT**
OF CHRIS LUDEWIG

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 EOTGPD9.

The certification EOTGPD9 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) 900MHz Transceiver with the Dataradio Inc Gemini Modem. Dataradio Inc does the final assembly and markets the Gemini unit. The EOTGPD9 certificate has been granted for several bit rates at 2, 4, and 8-level FSK type of modulation scheme with a total of 16 emission designators. The change intends to document the replacement of a RF power transistor (active component) and its incumbent behavioral emissions of spurious, and to add a 16-level FSK modulation scheme. The change involves **only** the power output final stage (power transistor & its biasing passive circuit), with no change to the maximum power rating of the MDP transceiver.
A new modem board to generate the proposed modulation scheme is also presented in this report along with a notification about a Class I permissive change.

## EXISTING CONDITIONS

The unit utilized for these measurements were from pre-production units. The transceiver is designed to operate on frequencies ranging from 896.000 MHz to 901.000 MHz. The frequency tolerance of the transceiver is .0001% or 1.0 parts per million.

## PROPOSED CONDITIONS

It is proposed to accept the request for the GEMINI, 896-901 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 spurious related data, 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.2-172, Mar 15,2005. Equipment performance measurements were made in the R&D laboratory of Dataradio Inc located at 5500 Royalmount Ave., Montreal, Canada and on the FCC certified Open Area Test Site of Dataradio COR located at 299 Johnson Avenue in Waseca, Minnesota. All measurements were made and recorded under my direction. The performance measurements were made between Oct 25 and Dec 12, 2005

## CONCLUSION

Given the results of the measurements contained herein, the applicant requests to be applied a Class II Permissive Change for the Certificate EOTGPD9 to accept the replacement of the obsolete RF power transistor and to add the emission designators of 10K9F1D and 10K3F1D.

_____ 12/12/2005
Chris Ludewig,
Dataradio COR. LTD

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## QUALIFICATIONS OF ENGINEERING PERSONNEL

| | |
|---|---|
| NAME: | **Chris Ludewig** |
| TITLE: | Director of Engineering (Dataradio COR Ltd.) |
| TECHNICAL EDUCATION: | Bachelor of Science in Electrical and Electronic Engineering (1984) From North Dakota State University |
| TECHNICAL EXPERIENCE: | 22 years experience in design of portable and mobile radio equipment |

| | |
|---|---|
| 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<br>12 Years experience in radio frequency measurements. |

| | |
|---|---|
| NAME: | **Daniel Hanson** |
| TITLE: | Electrical Engineer I |
| TECHNICAL EDUCATION: | Bachelor of Science Degree in Electrical Engineering (2005) from Minnesota State University, Mankato |
| TECHNICAL EXPERIENCE: | 1 years experience in RF design. |

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

The certification EOTGPD9 has been granted to Dataradio Inc for its Gemini radio modem. Gemini is comprised of the Dataradio COR Ltd. (DRL) Mobile Data Platform (MDP) 900 MHz Transceiver with the Dataradio Inc Gemini GCUIII Modem. Dataradio Inc does the final assembly and markets the Gemini unit.

The change consists of replacing the obsolete final transistors (Motorola MRF847) with a new device (Mitsubishi RD45HMF-1). The board layout did have to be modified for this change, but only to accommodate a slightly different transistor package, and to add some modifications to the biasing circuit. Matching component values and placement shifted a little as well but there are no changes regarding the functionality of the transmitter or of the frequency-related characteristics of the unit. Dataradio is also going to be adding a cavity shield over the whole PA cavity to improve overall shielding.

The change also consists in the addition of two new emission designators to the current emission designator list of the certificate shown below:

- 8K75 and 10K2F1D for 8kbps and 9.6 kbps DGMSK digital modulation
- 11K8, 10K7 and 9K92F1D for respectively 14.4, 16.0 and 19.2 kbps 4-FSK SRRC digital modulation
- 11K8, 11K4 and 10K2F1D for respectively 21.6, 24.0 and 28.8 kbps 8-FSK SRRC digital modulation

The current Class II permissive change request then asks for following two new 16-FSK modulations along with their emission designators: 10K9 and 10K3F1D for respectively 28.8, 32.0 kbps 16-FSK SRRC digital modulations.

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. All modulator source signal-related issues as per 2.1033 (c) (4) and (13) are explained below on page 9.

Following characteristic values are confirmed within the limits through the tests:

DC Voltages And Currents Into Final Amplifier - part 2.1033 (c).(8)
Transmitter Spurious And Harmonic Outputs - part 2.1051
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(j)

There are no changes to the basic frequency determining and stabilizing circuitry (including clock or data rates), frequency multiplication stages, basic modulator circuit and the maximum power rating is preserved at 27W, as accepted at the certification. The new speeds involve the code of the DSP-driven modulation source only, with no change occurring elsewhere in the circuitry. Therefore a Class II Permissive Change request has been considered.

They are entirely documented with the current report.

The modulation source consisting of a GCU modem board was redesigned and it has been considered to classify under a Class I Permissive Change. Although 2.1043 b.1 allows it without notification, details of this change are presented below.

**DETAILS ABOUT CLASS I PERMISSIVE CHANGE INFORMATION - Rule part 2.1043 (a) and (b)(1)**

As per 2.1043 (a) there are allowed variations in electrical or mechanical construction of the EOTGPD9.

In order to maximize the benefits of higher air transmission rates, the modem board (Gemini GCU) of the unit was redesigned (new Gemini controller unit GCU 3) to add a USB port and a RJ45 Ethernet port along with two RS232 serial ports. The former modem offered three RS232 serial ports. Minor mechanical changes on the front plate of the unit were done to accommodate the change and the corresponding front plate external picture is attached as appendix of the report.

A preliminary version of the manual that contains installation and service-related information for 16 level FSK modulations 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.,<br>5500 Royalmount Ave, suite 200,<br>Town of Mount Royal, Quebec, Canada, H4P 1H7 |
| MANUFACTURER: | Dataradio COR Ltd., Waseca, MN 56093 (MDP Transceiver)<br>DATARADIO Inc., Town of Mount Royal, Quebec, Canada, H4P 1H7<br>(Gemini modem and final assembly) |
| MODEL NUMBER: | GEMINI |
| PART NUMBER: | GPDE-6095-11200 |
| SERIAL NUMBER : | Pre-Production unit #3 comprised of |
| SERIAL NUMBER ( S ): | 255-03434-00x Gemini GCU III modem s/n 3<br>242-6095- 00005- 102 MDP transceiver sn A446 |
| FCC ID NUMBER: | EOTGPD9 |
| FCC RULES AND REGS: | FCC Part (s) 90, 90.603(a),(b) |
| FREQUENCY RANGE: | 896.000 MHz - 901.000 MHz (896-901 Tx/935-941 Rx MHz Bands) |
| MAXIMUM POWER RATING: | 27 Watts, (25 Watts Nominal 10-27 watts adjustable). |
| 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 | 806-824/851-869MHz XCVR | 242-608C-MRB |
| Gemini | Modem | GPmm1 |

**DRL** Part Number System for MDP:

242-60FC-MRB

F-Frequency Bands
- 1- VHF
- 4- UHF
- 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

**DRI** Part Number System for modem “mm”

DD – GCU modem “/PD” board 255-03322-00x
DE – GCU2modem “/PD+” board 255- 03332- 00x ,
G3 – GCU 3 modem “G3” board 255-03434-00x

**DATA AND CHARACTERISTICS NOT AFFECTED BY THE CHANGE - Rule Part Number: 2.1033 (c). (3),(4),(11),(12),(13),(14),(15),(16)**

| | |
|---|---|
| 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 |
| Spectrum efficiency standard | 90.203 (j) |
| MPE limits compliance | 2.1091 |
| Test results not affected by the change | 2.1033(c) 14, 2.1041 |

Test data according to:

Part 2: 2.1046,2.1047,2.1049 and 2.1055

Part 90, Subpart I: 90.209, 90.210, 90.213 and 90.214

as follow:

| | |
|---|---|
| Occupied Bandwidth and Emission designator | 2.1047,2.1049, 90.209, 90.210 |
| Frequency Stability and Frequency Tolerance | 2.1055,90.213 |

Note. Although the power rating as per 2.1046 does not change, transmitter rated power output was tested to show the new DC currents into the part.

DATA AND CHARACTERISTICS AFFECTED BY THE CHANGE - Rule Part Number:2.1033(c) (8)(9)(10)

| | |
|---|---|
| Instruction book | 2.1033 (c) (3) |
| Type of emission: | 2.1033(c) (4) |
| Modulation Characteristic Part | 2.1047 (d), 90.209 (b), 90.603(a,b). |
| DC Voltages And Currents Into Final Amplifier documented in the test report, see below | 2.1033(C).(8) |

On the 4 occurrences below, there are only changes related to the proper denomination of the part. The change consists in the replacement of an obsolete RF transistor (Motorola MRF847) by a functionally identical one (Mitsubishi RD45HMF1). Therefore, except for documentation changes concerning the denomination of the part and its related biasing circuitry, all made of passive components, and slight PCB changes to accommodate the new footprint of the part, there are no other changes.

| | |
|---|---|
| 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) |

**Test data according to**:

Part 2: 2.1046, 2.105, 2.10531 and 2.1057

as follow:

| | |
|---|---|
| Transmitter Rated Power Output | 2.1046 |
| Transmitter's spurious emissions at antenna terminals | 2.1051 |
| Field strength of spurious radiation of the transmitter | 2.1053 |
| Modulation characteristics, Compliance with mask J | 2.1047 and 90, Subpart I: 90.209 and 90.210 (j) |

Note: Although the power ratings do not change, transmitter rated power output was tested to show the new DC currents into the part.

**TEST DATA 2.1033 (c)(14)**

All applicable test data as shown above are provided in next section of this Engineering Report

The following reports have been generated for Class II Permissive Change request for EOTGPD9, Gemini radio modem. Gemini is comprised of the Dataradio COR Ltd. (DRL) Mobile Data Platform (MDP) 900MHz Transceiver with the Dataradio Inc Gemini GCU Modem. Dataradio Inc does the final assembly and markets the Gemini 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 Rated Power Output**

NAME OF TEST: Transmitter Rated Power Output

RULE PART NUMBER: 2.1033 c (6) (7) and 2.1046 (a)

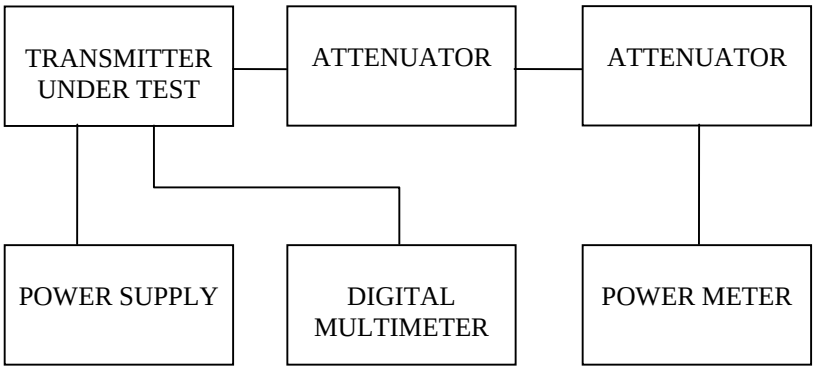
TEST RESULTS: See results below

TEST CONDITIONS: Standard Test Conditions, 25 C

TEST EQUIPMENT: Attenuator, BIRD Model / 50-A-MFN-20 / 20 dB / 50 Watt
Attenuator, BIRD Model / 10-A-MFN-10 / 10 dB / 10 Watt
Digital Voltmeter, Fluke Model 8012A
ower Meter, Model HP437B
Power Meter, HP 436A

PERFORMED BY: _____ DATE: 10/26/05
Daniel Hanson

TEST SET-UP:




TEST RESULTS:

| Frequency (MHz) | DC Voltage at Final (VDC) | DC Current into Final (ADC) | DC Power into Final (W) | RF Power Output (W) |
|---|---|---|---|---|
| 899 | 13.58 | 5.95 | 80.80 | 27 |
| 899 | 13.58 | 5.70 | 77.41 | 25 |
| 899 | 13.58 | 3.65 | 49.57 | 10 |

NAME OF TEST:
**Transmitter Spurious and Harmonic Outputs -conducted**

MINIMUM STANDARD: For 27 Watt:
$50+10Log_{10}$ (27 Watts) = 64.3 dBc
or 70 dBc whichever is the lesser attenuation.

For 10 Watt:
$50+10Log_{10}$ (10 Watts) = 60 dBc
or 70 dBc whichever is the lesser attenuation.

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

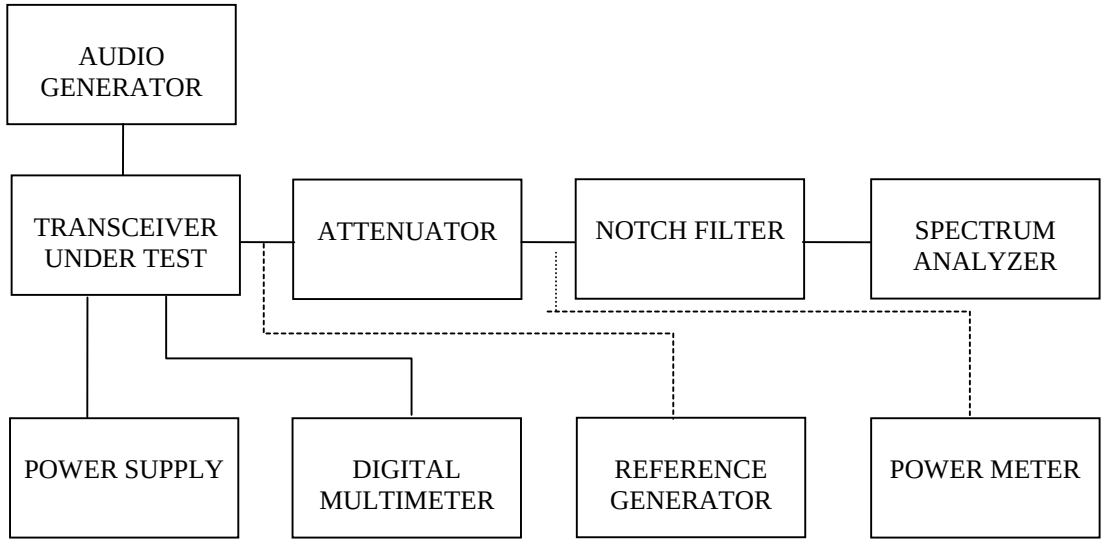
TEST CONDITIONS: Standard Test Conditions, 25 C
RF voltage measured at antenna terminals

TEST PROCEDURE: TIA/EIA - 603, 2.2.13

TEST EQUIPMENT: Attenuator, BIRD Model / 50-A-MFN-20 / 20 dB / 50 Watt
Attenuator, BIRD Model / 10-A-MFN-10 / 10 dB / 10 Watt
Digital Voltmeter, Fluke Model 8012A
DC Power Source, Model HP6024A
Spectrum Analyzer, Model HP8563E
Reference Generator, Model Agilent E8257D
Power Meter, Model HP437B
Audio Generator, Model HP8903B

PERFORMED BY: _____ Date: 10/26/05
Daniel Hanson

TEST SETUP:



NAME OF TEST: Transmitter Spurious and Harmonic Outputs
(Continued)

MEASUREMENT PROCEDURE:

1. The transmitter carrier output frequency is 899 MHz. The reference oscillator frequency is 17.5000 MHz.

2. After carrier reference was established on spectrum analyzer, the notch filter was adjusted to null the carrier Fc to extend the range of the spectrum analyzer for harmonic measurements.

3. At each spurious frequency, Generator substitution was used to establish the true spurious level.

4. The spectrum was scanned to the 10th harmonic.

TEST DATA: See following page.

NAME OF TEST: Transmitter Spurious and Harmonic Outputs (Continued)

Frequency: 899 MHz
Power: **27** Watts
44.3 dBm

Minimum Spec: 64.3 dBc
Worst Case: 72.3 dBc

| Spurious Frequency (MHz) | Spurious Level (dBm) | Substitution Generator (dBm) | Spurious Attenuation dBc | Gen Level amp = 0dBm (dBm) | Actual Spurious Lvl (dBm) |
|---|---|---|---|---|---|
| 1798 | -53.2 | -46.3 | -90.7 | -6.8 | -46.3 |
| 2697 | -67.7 | -60.3 | -104.7 | -7.3 | -60.3 |
| 3596 | -64.2 | -53.3 | -97.7 | -10.8 | -53.3 |
| 4495 | -64.7 | -51.7 | -96.0 | -13.0 | -51.7 |
| 5394 | -50.5 | -39.8 | -84.1 | -10.7 | -39.8 |
| 6293 | -37.8 | -28.0 | **-72.3** | -9.8 | -28.0 |
| 7192 | -46.0 | -31.3 | -75.6 | -14.7 | -31.3 |
| 8091 | -65.7 | -49.2 | -93.5 | -16.5 | -49.2 |
| 8990 | -74.8 | -48.8 | -93.1 | -26.0 | -48.8 |

Frequency: 899 MHz
Power: **10** Watts
40.0 dBm

Minimum Spec: 60.0 dBc
Worst Case: 85.2 dBc

| Spurious Frequency (MHz) | Spurious Level (dBm) | Substitution Generator (dBm) | Spurious Attenuation dBc | Gen Level amp = 0dBm (dBm) | Actual Spurious Lvl (dBm) |
|---|---|---|---|---|---|
| 1798 | -65.7 | -58.8 | -103.2 | -6.8 | -58.8 |
| 2697 | -70.8 | -63.5 | -107.8 | -7.3 | -63.5 |
| 3596 | -67.3 | -56.5 | -100.8 | -10.8 | -56.5 |
| 4495 | -64.8 | -51.8 | -96.1 | -13.0 | -51.8 |
| 5394 | -54.3 | -43.7 | -88.0 | -10.7 | -43.7 |
| 6293 | -50.7 | -40.9 | **-85.2** | -9.8 | -40.9 |
| 7192 | -56.8 | -42.2 | -86.5 | -14.7 | -42.2 |
| 8091 | -73.0 | -56.5 | -100.8 | -16.5 | -56.5 |
| 8990 | -74.8 | -48.8 | -93.1 | -26.0 | -48.8 |

NAME OF TEST:
**Field Strength of Spurious Radiation**

RULE PART NUMBER: 2.1033 c (14), 2.1041, 2.1053, 90.210 (d)(3)

MINIMUM STANDARD: For 27 Watts: $50+10\text{Log}_{10}(27) = 64.3$ dBc
For 10 Watts: $50+10\text{Log}_{10}(10) = 60$ dBc

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

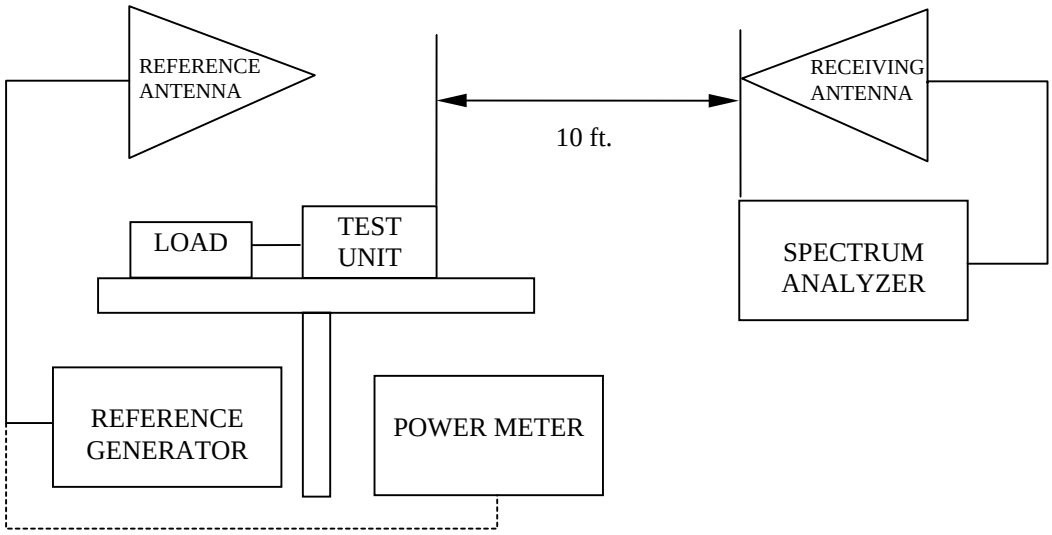
TEST CONDITIONS: Standard Test Conditions, 25 C

TEST PROCEDURE: TIA/EIA - 603, 2.2.12

TEST EQUIPMENT: Log Periodic Antenna, AIL TECH Model 9461
Horn Antenna, Model EMCO 3115
Reference Generator, Model Agilent E8257D
Attenuator, BIRD Model / 50-A-MFN-20 / 20 dB / 50 Watt
Attenuator, BIRD Model / 10-A-MFN-10 / 10 dB / 10 Watt
Spectrum Analyzer, Model HP8563E
Power Meter, Model HP437B
Power Supply, Model HP-6024A

MEASUREMENT PROCEDURE: Radiated spurious attenuation was measured according to TIA/EIA Standard 603 Section 2.2.12

TEST SET-UP:




PERFORMED BY: _____ Date: 10/26/05
Daniel Hanson

NAME OF TEST: SpuriousSpurious Radiation Attenuation (Continued)

Frequency: 899 MHz
Power: 27 Watts
44.3 dBm

Spec = -64.3 dBc
Highest Spur = -71.3 dBc

| Spurious Frequency (MHz) | Polarization (Horz/Vert) | Spurious Level (dBm) | Substitution Generator (dBm) | Cable Loss (dB) | Antenna Gain (dBd) | Spurious Attenuation dBc | Gen Level amp = 0dBm (dBm) |
|---|---|---|---|---|---|---|---|
| 1798 | H | -66.8 | -27.2 | 3.50 | 3.71 | **-71.3** | -39.7 |
| | V | -69.8 | -31.8 | 3.50 | 3.71 | -75.9 | -38.0 |
| 2697 | H | -69.7 | -27.0 | 4.67 | 4.22 | -71.8 | -42.7 |
| | V | -73.7 | -27.5 | 4.67 | 4.22 | -72.3 | -46.2 |
| 3596 | H | -76.2 | -29.5 | 5.67 | 4.17 | -75.3 | -46.7 |
| | V | -77.7 | -29.7 | 5.67 | 4.17 | -75.5 | -48.0 |
| 4495 | H | -90.7 | -37.8 | 7.00 | 4.04 | -85.1 | -52.8 |
| | V | -89.2 | -36.7 | 7.00 | 4.04 | -83.9 | -52.5 |
| 5394 | H | -92.0 | -36.8 | 8.00 | 3.97 | -85.2 | -55.2 |
| | V | -89.2 | -33.7 | 8.00 | 3.97 | -82.0 | -55.5 |
| 6293 | H | -95.2 | -35.5 | 9.00 | 3.98 | -84.8 | -59.7 |
| | V | -89.8 | -29.8 | 9.00 | 3.98 | -79.2 | -60.0 |
| 7192 | H | -95.0 | -32.0 | 10.50 | 3.59 | -83.2 | -63.0 |
| | V | -93.5 | -30.2 | 10.50 | 3.59 | -81.4 | -63.3 |
| 8091 | H | -96.8 | -30.2 | 11.83 | 4.04 | -82.3 | -66.7 |
| | V | -96.5 | -29.2 | 11.83 | 4.04 | -81.3 | -67.3 |
| 8990 | H | -96.0 | -22.8 | 13.50 | 3.51 | -77.1 | -73.2 |
| | V | -95.8 | -24.3 | 13.50 | 3.51 | -78.6 | -71.5 |

Frequency: 899 MHz
Power: 10 Watts
40.0 dBm

Spec = -60.0 dBc
Highest Spur = -73.1 dBc

| Spurious Frequency (MHz) | Polarization (Horz/Vert) | Spurious Level (dBm) | Substitution Generator (dBm) | Cable Loss (dB) | Antenna Gain (dBd) | Spurious Attenuation dBc |
|---|---|---|---|---|---|---|
| 1798 | H | -70.5 | -30.8 | 3.50 | 1.20 | **-73.1** |
| | V | -71.8 | -33.8 | 3.50 | 1.20 | -76.1 |
| 2697 | H | -76.2 | -33.5 | 4.67 | 1.20 | -77.0 |
| | V | -78.2 | -32.0 | 4.67 | 1.20 | -75.5 |
| 3596 | H | -84.0 | -37.3 | 5.67 | 1.20 | -81.8 |
| | V | -82.2 | -34.2 | 5.67 | 1.20 | -78.6 |
| 4495 | H | -87.3 | -34.5 | 7.00 | 1.20 | -80.3 |
| | V | -93.5 | -41.0 | 7.00 | 1.20 | -86.8 |
| 5394 | H | -97.0 | -41.8 | 8.00 | 1.20 | -88.6 |
| | V | -92.7 | -37.2 | 8.00 | 1.20 | -84.0 |
| 6293 | H | -100.3 | -40.6 | 9.00 | 1.20 | -88.4 |
| | V | -99.5 | -39.5 | 9.00 | 1.20 | -87.3 |
| 7192 | H | -101.1 | -38.1 | 10.50 | 1.20 | -87.4 |
| | V | -100.2 | -36.9 | 10.50 | 1.20 | -86.2 |
| 8091 | H | -101.3 | -34.6 | 11.83 | 1.20 | -85.3 |
| | V | -100.0 | -32.7 | 11.83 | 1.20 | -83.3 |
| 8990 | H | -101.8 | -28.6 | 13.50 | 1.20 | -80.9 |
| | V | -101.5 | -30.0 | 13.50 | 1.20 | -82.3 |

CALCULATIONS FOR FIELD STRENGTH OF SPURIOUS RADIATION TESTS:

The transmitter carrier frequency was set to 899.000 MHz. The reference oscillator frequency of all of the transceivers is 17.50 MHz. The output of the transceivers was searched from 17.50 MHz to the tenth harmonic of the carrier frequencies. The tests were conducted with the transceiver/modem/GPS inside of the enclosure.

Because the antennas used for the measurements recorded above 1 GHz were not flat in gain and differed from a dipole, the generator output was corrected for gain at each spurious frequency. The cable loss in the measurements is the loss in the cable between the signal generator and the substitution antenna.

EXAMPLE:

At 1798 MHz (899 MHz tuned), 27 Watts and horizontal polarization.

| | |
|---|---|
| r = Substitution Gen - Cable Loss | -27.2 - 3.50 = -30.7 |
| R = Reference Generator (dBm) | -30.7 |
| A = Antenna Gain (dBd) | 3.71 |
| R' (Corrected Reference (dBm)) = R + A => | -30.7 + 3.71 = -26.99 dBm |
| Po = Radiated Carrier Power (dBm) | 27 Watts = 44.3 dBm |
| Radiated Spurious Emission (dBc) = Po - R' => | 44.3 - (-26.99) = **71.29 dBc** |

NAME OF TEST:
**Transmitter Occupied Bandwidth**
RULE PART NUMBER: 2.201, 2.202, 2.1033 c (14), 2.1047 (d), 2.1049 (h), 2.1041

**Modulation description (2.1047)** :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 |
|---|---|---|---|
| 28800 b/s | 7200bauds | 3.6 kHz | ± 3.18 kHz |
| 32000 b/s | 8000bauds | 4.0 kHz | ± 3.14 kHz |

**Emission Designator Determination and 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 | Raised Cosine filter's 3dB cut-off frequency | Bit rate | Deviation | Occupied Bandwidth | Authorized Bandwidth | Proposed Emission Designator |
|---|---|---|---|---|---|---|
| 7200bauds | 3.6 kHz | 28800 b/s | ± 3.18 kHz | 10880.5 Hz | 13600Hz | 10K9F1D |
| 8000bauds | 4.0 kHz | 32000 b/s | ± 3.14 kHz | 10298.1 Hz | 13600Hz | 10K2F1D |

The measurement theory and set-up explanations follow.

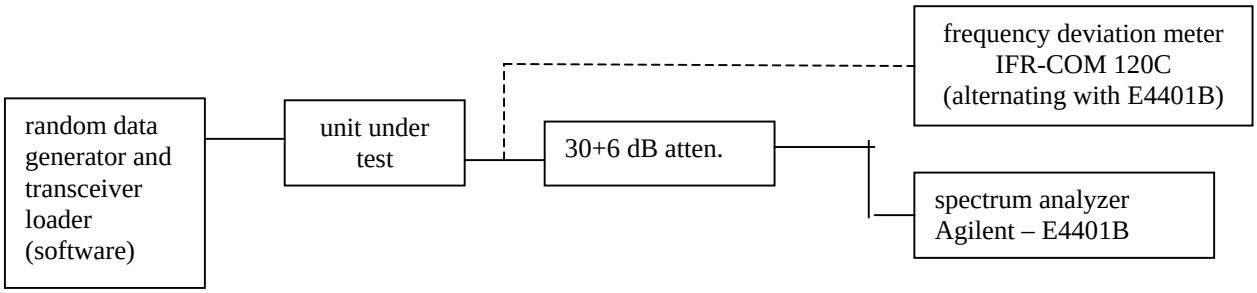
**Occupied Bandwidth Measurement**

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 J, the resulting value was recorded as Occupied Bandwidth.

The measurement set-up is:



**Transmitter Occupied Bandwidth for 28800 bps 16FSK, In Support of Emission Designator 10K9F1D**

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

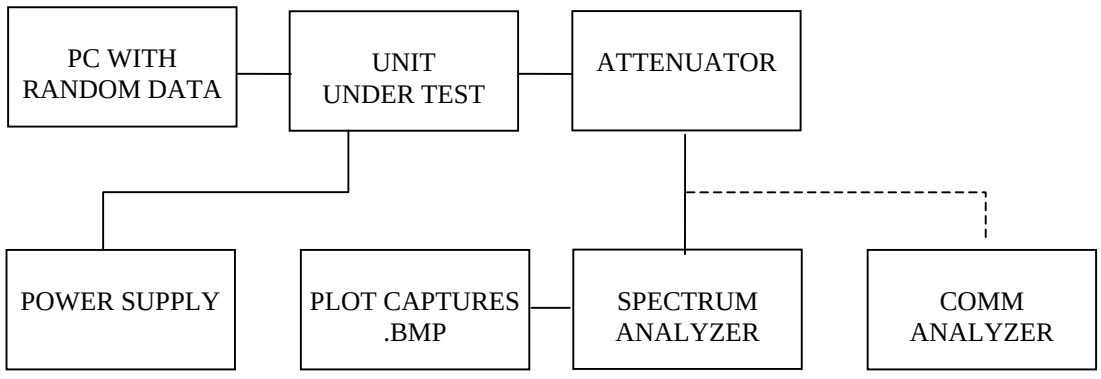
MINIMUM STANDARD: Mask J
Sidebands and Spurious [Rule 90.210 (j)]
Authorized Bandwidth = 13.6 kHz [Rule 90.209(b) (5)]

| | |
|---|---|
| Fo to 2.5 kHz | Attenuation = 0 dB |
| >2.5 kHz to 6.25 kHz | Attenuation= 53*log($f_d$ KHz /2.5) dB |
| >6.25 kHz to 9.5kHz | Attenuation = 103 log ($f_d$/3.9)dB |
| >9.5kHz | lesser of 50 + 10*log(P) or 157 log ($f_d$/5.3) or 70dB |
| **Corner Points:** | |
| $f_0$ to 2.5 kHz | Attenuation = 0 dB |
| >2.5 kHz to 3.8 kHz | Attenuation= 0 dB to 10 dB |
| >3.8 kHz to 6.25 KHz | Attenuation = 10 dB to 21 dB |
| >6.25 kHz to 7.6 KHz | Attenuation = 21 dB to 30 dB |
| >7.6 kHz to 9.5 KHz | Attenuation = 30 dB to 40 dB |
| >9.5 kHz to 11.2 KHz | Attenuation = 40 dB to51 dB |
| >11.2 kHz to 13.8kHz | Attenuation = 51 dB to65 dB |
| >13.8kHz | Attenuation = minimum 65 dB (30W) |

UNIT UNDER TEST Prototype#3
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, Pasternak Model PE7015-6 / 6 dB / 10 Watt
DC Power Supply , Astron Model VS-20M
IFR COM-120B , IF filter set to 30kHz - for deviation meter
Spectrum Analyzer, Model E4401B
HP Benchlink -software for plot captures.

PERFORMED BY: Constantin Pintilei, DATE:12/12/2005
Constantin Pintilei

TEST SET-UP:



NAME OF TEST: Transmitter Occupied Bandwidth (Continued)
GEMINI Modem at 28800 bps
In Support of Emission Designator **10K9F1D**

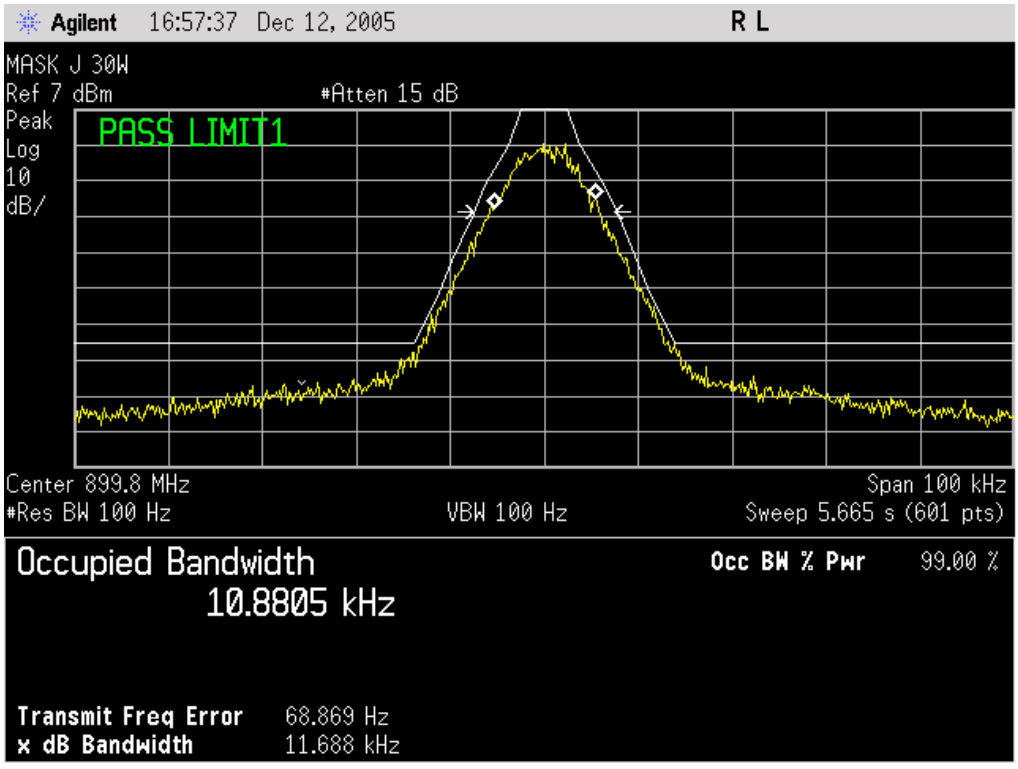
TX Data Test Pattern:

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.

NECESSARY BANDWIDTH (Bn) measurement

See page 17 for emission designator determination.
The corresponding emission designator prefix for necessary bandwidth = **10K9**
The corresponding deviation for 28800 Bps is 3.18KHz
TEST DATA: Refer to the following graph:

MASK: J
SPECTRUM FOR EMISSION **10K9F1D**
OUTPUT POWER: 27 Watts
Speed: 28800 bps 16 FSK
DATA PEAK DEVIATION = 4350 Hz
SPAN = 100 kHz



**Transmitter Occupied Bandwidth for 32000 bps 16 FSK, In Support of Emission Designator 10K3F1D**

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

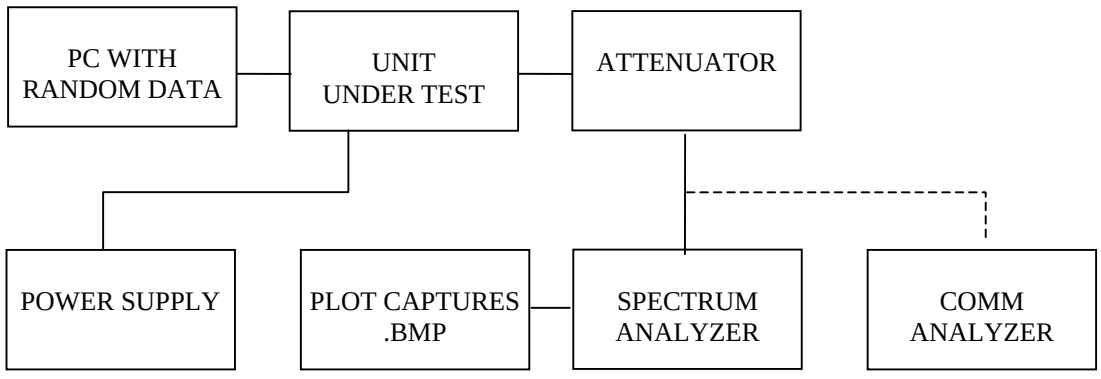
MINIMUM STANDARD: Mask J
Sidebands and Spurious [Rule 90.210 (j)]
Authorized Bandwidth = 13.6 kHz [Rule 90.209(b) (5)]

| | |
|---|---|
| Fo to 2.5 kHz | Attenuation = 0 dB |
| >2.5 kHz to 6.25 kHz | Attenuation= 53*log($f_d$ KHz /2.5) dB |
| >6.25 kHz to 9.5kHz | Attenuation = 103 log ($f_d$/3.9)dB |
| >9.5kHz | lesser of 50 + 10*log(P) or 157 log ($f_d$/5.3) or 70dB |
| **Corner Points:** | |
| $f_0$ to 2.5 kHz | Attenuation = 0 dB |
| >2.5 kHz to 3.8 kHz | Attenuation= 0 dB to 10 dB |
| >3.8 kHz to 6.25 KHz | Attenuation = 10 dB to 21 dB |
| >6.25 kHz to 7.6 KHz | Attenuation = 21 dB to 30 dB |
| >7.6 kHz to 9.5 KHz | Attenuation = 30 dB to 40 dB |
| >9.5 kHz to 11.2 KHz | Attenuation = 40 dB to51 dB |
| >11.2 kHz to 13.8kHz | Attenuation = 51 dB to65 dB |
| >13.8kHz | Attenuation = minimum 65 dB (30W) |

UNIT UNDER TEST Prototype#3
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, Pasternak Model PE7015-6 / 6 dB / 10 Watt
DC Power Supply , Astron Model VS-20M
IFR COM-120B , IF filter set to 30kHz - for deviation meter
Spectrum Analyzer, Model E4401B
HP Benchlink -software for plot captures.

PERFORMED BY: Constantin Pintilei, DATE:12/12/2005
Constantin Pintilei

TEST SET-UP:



NAME OF TEST: Transmitter Occupied Bandwidth (Continued)
GEMINI Modem at 32000 bps
In Support of Emission Designator **10K3F1D**

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.

NECESSARY BANDWIDTH (Bn) measurement

See page 17 for emission designator determination.
The corresponding emission designator prefix for necessary bandwidth = **10K3**
The corresponding deviation for 32000 bps is 3.14 kHz
TEST DATA: Refer to the following graphs:

MASK: J
SPECTRUM FOR EMISSION **10K3F1D**
OUTPUT POWER: 27 Watts
Speed: 32000 bps 16 FSK
DATA PEAK DEVIATION = 4130 Hz
SPAN = 100 kHz