

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

**for the**

**Mobile Data Platform Transceiver (700/800MHz triple IF MDP)**

**With the**

**Dataradio Gemini Modem**

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

Jan 10, 2008

Dataradio Inc.  
Montreal, Quebec, Canada

**ENGINEERING STATEMENT**  
OF Constantin Pintilei

This 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 certificate 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) Transceiver and the Dataradio Inc Gemini Control Unit (GCU) Modem. Dataradio Inc does final assembly and markets the finished Gemini product. In 2007 the EOTGPDB certificate was granted for both 700MHz and 800MHz bands, namely the 806-824 MHz Tx paired with 851-869MHz Rx and 794-806MHz Tx paired with 764-776MHz Rx bands. In the 700MHz band operation was limited to wideband 50kHz channels because the frequency stability did not conform to the requirements for narrowband channels and the unit lacked narrowband interoperability capability..

This application documents the upgrade of the frequency stability of the unit using an base-station-driven AFC mechanism. The upgraded base station sends frequency error information via the network protocol to the mobile unit, where the radio firmware handles the frequency offset correction. There is no change whatsoever occurring in the frequency determining circuitry, which already met the non-AFC stability requirements. Also, a functional mode implementing the interoperability technical standards required by 90.528 was added for the nationwide narrowband interoperability channels.

EXISTING CONDITIONS

The unit utilized for these RF measurements was a production sample loaded with upgraded firmware

PROPOSED CONDITIONS

It is proposed to accept the request for the GEMINI. Gemini will be a Transceiver/Modem/GPS device for operation in the band of frequencies allowed by Part 90 subpart R. The applicant anticipates marketing the device for use in wireless data transmission for Public Safety services or other eligible users.

AFFIDAVIT

All measurements for Occupied Bandwidth and Emission Limitations 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.2-172, Mar 15,2005. Equipment performance measurements were made in the R&D laboratory of Dataradio Inc. All measurements were made and recorded by myself or under my direction. The performance measurements were made between Dec 1-Dec 21, 2007. To the best of my knowledge, all of the data is true and correct.

CONCLUSION

Based on the data contained herein, the applicant requests a Class II Permissive Change for the certificate EOTGPDB in order to enable operation on 25KHz and 12.5 KHz narrowband channels in the 700MHz band.



01/10/2008

Constantin Pintilei, PE  
Dataradio Inc

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### **QUALIFICATIONS OF ENGINEERING PERSONNEL**

|                       |                                                                                                                     |
|-----------------------|---------------------------------------------------------------------------------------------------------------------|
| NAME:                 | <b>Constantin Pintilei</b>                                                                                          |
| TITLE:                | R&D Test Engineer                                                                                                   |
| TECHNICAL EDUCATION:  | Bachelor of Science Degree in Radiotechnique Electronic Engineering<br>(1993) Technical University of Iasi, Romania |
| TECHNICAL EXPERIENCE: | Professional engineer since 2001<br>12 Years experience in radio frequency measurements.                            |

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

The certificate EOTGPDB has been granted to Dataradio Inc for its Gemini radio modem which is comprised of a Mobile Data Platform (MDP) Transceiver manufactured by Dataradio COR Ltd. (Waseca, MN), and a Gemini Control Unit (GCU) Modem manufactured by Dataradio Inc (Montreal, Canada). Dataradio Inc does final assembly and markets the finished Gemini product.

The proposed change of the transceiver intends to add network-based Automatic Frequency Control mechanisms in the unit to improve the frequency stability to meet the requirements for narrowband channels in the 700MHz band. This will extend the functionality of the Gemini radio modem in the 700MHz band from the wideband 50kHz channels only to all three 50kHz wideband, 25kHz narrowband and 12.5 kHz narrowband channels, whose requirements are covered by Subpart R of the Part 90 of the FCC rules.

The AFC mechanism relies on the receiver of the basestation to assess the frequency error of the unit, relative to the reference of the basestation. Since the basestation for the narrowband channels must have 0.1ppm frequency stability, the frequency offset detection mechanism in the basestation can track the frequency error of the mobile to the absolute frequency error of 0.2 ppm (double of the base). Therefore the mobile unit can be locked to be within 0.4ppm frequency error required by 90.539(c). Then the offset information is passed back to the mobile unit through the network protocol and the firmware of the mobile unit changes the DC offset of the outgoing modulating signal to compensate for the frequency error.

Since 90.547 requires that narrowband mobile units be capable of operation on nationwide interoperability channels, a functional mode complying with the interoperability technical standards specified in 90.548 is incorporated for use on the 12.5kHz data interoperability channels specified in §90.531(b)(1)(i).

Therefore, considering the requirements of the rule parts 2.1043, 90.549 and 90.203, a Class II Permissive Change request has been considered to address the extension of the functional range to include the narrowband channels of Subpart R from Part 90.

The characteristics affected by this change concern:

- Frequency stability measurements with the AFC enabled according to 90.539
- Emission limitations test data for the modulation scheme in the 700MHz band, according to 90.543

They are entirely documented through two test reports attached to the submission.

**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 modem and final assembly)

MODEL NUMBER: GEMINI

PART NUMBER: GPG3-6085-xyz

FCC ID NUMBER: EOTGPDB

FCC RULES AND REGS: FCC Part ( s ) 90 subparts I, R and S

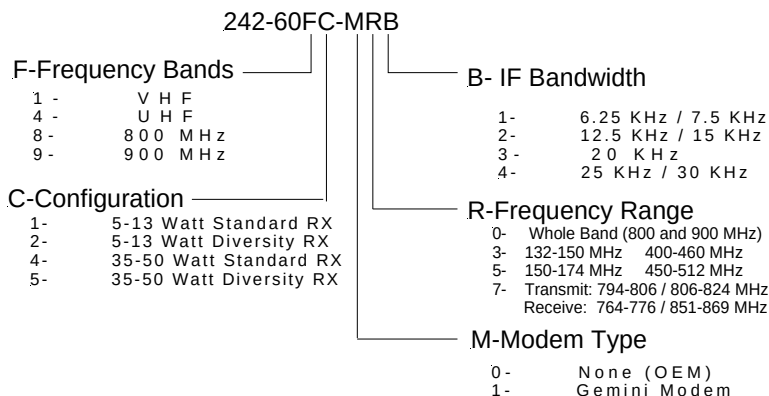
FREQUENCY RANGE: 794.000 MHz - 824.000 MHz Tx with 2 Rx bands 764-776MHz and  
851-869MHz. (794-806/764-776 MHz, 806-809/851-854 MHz and  
809-824/854-869 MHz Bands)

MAXIMUM POWER RATING: 40.00 Watts (10-40 watts variable). For the 700MHz band maximum  
power is set at 30W by internal firmware (10-30W variable)

NUMBER OF CHANNELS: 32 Channel Modem

INPUT IMPEDANCE: 50 ohms, Nominal

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

**EQUIPMENT IDENTIFICATION:****TRADE NAME**MDP6000  
Gemini GCU III**DESCRIPTION**700/800 dual band XCVR  
Modem**DRI PART NUMBER**242-608C-MR0 (new IF code 0)  
255-03434-00x**DRL Part Number System for MDP:**

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

|                                                       |                                                                            |
|-------------------------------------------------------|----------------------------------------------------------------------------|
| Instruction book                                      | 2.1033 (c) (3)                                                             |
| 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)                                                            |
| 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 2:2.1047,2.1049 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 – for                                                        |
| Output RF Power                                       | 2.1046, 90.541(b)                                                          |

**DATA AND CHARACTERISTICS AFFECTED BY THE CHANGE - Rule Part Number:2.1033(c) (8)(9)(10)****Changes of characteristics supported by descriptions, relating to Subpart R – narrowband channels:****Band plan****90.531**

This is a Mobile unit; 794-806MHz transmit band paired with 764-776MHz receive band, 30MHz channel pairing is supported. In narrowband allocations it works on 25.0 kHz and 12.5kHz –size channels.

**Digital Modulation Techniques****2.1033.(c) (13), 90.535 (a)**

The proposed change does not change modulation techniques in terms of pulse shape (Squared Root Raised Cosine) or modulation techniques (16FSK or 8FSK) as they were already certified. Lower deviation down to 1.3kHz for 32kbps data rate was required on 12.5kHz channels in order to fit ACCP requirements. The initial deviation used for NPSPAC channels in 800MHz band was 3.2 kHz.

Overall the digital modulations proposed in 700 MHz narrowband channels are:

| Bit rate  | levels FSK | Symbol rate | Pulse shape and modulation type                            | Acronyms/ factor / 3dB cutoff frequency | Ref Deviation | Occupied Bandwidth |
|-----------|------------|-------------|------------------------------------------------------------|-----------------------------------------|---------------|--------------------|
| 64 kb/s   | 16         | 16000 baud  | Squared Root Raised Cosine 16 Level Frequency Shift Keying | SRRC16FSK $\alpha=0.4$ 8000Hz           | $\pm 2.7$ kHz | 16004Hz            |
| 43.2 kb/s | 8          | 14400 baud  | Squared Root Raised Cosine 8 Level Frequency Shift Keying  | SRRC8FSK $\alpha=0.4$ 7200Hz            | $\pm 3.2$ kHz | 14483Hz            |
| 32 kb/s   | 16         | 8000 baud   | Squared Root Raised Cosine 16 Level Frequency Shift Keying | SRRC16FSK $\alpha=0.4$ 4000Hz           | $\pm 1.3$ kHz | 7075Hz             |

**Spectrum Efficiency Standard****90.535 (c)**

In the proposed new range the unit employs only digital modulation as per 90.535 (a). The narrowband modulation is designed for a channel size of 25 kHz or 12.5kHz as per 90.531(c) with a spectrum efficiency of 64kbps/25kHz or 32kbps/12.5kHz. This equates to 16kbps/6.25kHz, which is better than 4.8kbps/6.25kHz required by 90.535(c)

**Frequency Stability****90.539(e)**

The unlocked frequency stability for 700MHz band in 25kHz and 12.5kHz narrowband channels without the AFC enabled is 1.5ppm. The unit already achieved better than 1.25 ppm for wideband channels, as shown in former submissions. Current measurements confirm that the frequency stability without AFC is better than 0.5ppm, as shown in the Test Report 7/2007

When AFC is enabled, the frequency stability must be better than 0.4ppm. The measurements show it to be better than 0.1ppm. Test data is also available in the aforementioned test report.

**Emission designator according to the Modulation Characteristic 2.1047 (d), 90.209 (b), 90.543 (e)**

Emission designator according to 90.209(b) is 28K0F1D. A plot capture is provided in the test report.

| Bit rate  | Channel size | Emission Designator | Reference Deviation | Occupied Bandwidth |
|-----------|--------------|---------------------|---------------------|--------------------|
| 64 kb/s   | 25kHz        | 16K0F1D             | $\pm 2.7$ kHz       | 16004Hz            |
| 43.2 kb/s | 25kHz        | 14K4F1D             | $\pm 3.2$ kHz       | 14483Hz            |
| 32 kb/s   | 12.5kHz      | 7K10F1D             | $\pm 1.3$ kHz       | 7075Hz             |

**Narrowband Interoperability channel capability requirement 90.547, 90.548.**

A functional mode complying with the standards specified in 90.548 is incorporated for use on the 12.5kHz data interoperability channel pairs 279-280/1239-1240 and 921-922/1881-1882.



**SUBPART R REQUIREMENTS THAT DO NOT APPLY TO THIS CERTIFICATION:**

90.523,90.525,90.527,90.529,90.533,90.537,90.545, 90.551,90.553.

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

All applicable test data as shown above are provided in two attachments of this Engineering Report

Test data supported by test reports relating to Subpart R – narrowband channels refers to:

|                                 |                             |
|---------------------------------|-----------------------------|
| Emission Limitations (ACP, OBW) | as per rules 2.1046, 90.543 |
| Frequency Stability             | as per rules 2.1055, 90.539 |

The reports attached have been generated to confirm the compliance with the standards for the Gemini/PD radio modem. The Gemini unit is comprised of the Dataradio COR Ltd. (DRL) Mobile Data Platform (MDP) UHF (794-824 MHz Tx / 764-776 and 851-869MHz Rx) Transceiver with the Dataradio Inc Gemini G3 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.

|                                                                                          |                |
|------------------------------------------------------------------------------------------|----------------|
| Test Report 7/2007 doc # 156-9000-899 – Frequency Stability over voltage and temperature | 2.1055, 90.539 |
| Test Report 8/2007 doc # 156-9000-898 – Emission Limitations (ACP, OBW)                  | 2.1046, 90.543 |

The two reports are part of the current application.