

**Gemini / PD**  
**Mobile Radio Modem**  
**Service Manual**  
**version 0.03**

**PRELIMINARY**

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## *What's New in Version 0.02*

GPS Diagnostics procedure

History

Version 0.1: First preliminary version

Version 0.2:

- Unit specification revised
- Typo correction

## Definitions

The following terms are used throughout this document.

<b><u>Item</u></b>	<b><u>Definition</u></b>
<b>DCE</b>	Data Communications Equipment. This designation defines the direction (input or output) of the various RS-232C interface signals. Modems are always wired as DCE. See also DTE.
<b>DTE</b>	Data Terminal Equipment. This designation defines the direction (input or output) of the various RS-232C interface signals. Most user equipment, as well as PCs, are wired as DTE. See also DCE.
<b>GCU</b>	Gemini Control Unit board
<b>Gemini/PD</b>	High specs mobile radio modem. PD = Parallel decode
<b>HDX</b>	Half Duplex. A unit which uses separate transmit and receive frequencies, but which may not transmit and receive simultaneously.
<b>RS-232</b>	Industry-standard interface for low speed data transfer (EIA-RS-232E).
<b>RSS</b>	Radio Service Software. This software allows configuration and testing of the Gemini/PD.
<b>Simplex</b>	A unit which uses the same frequency for transmit and receive.

# 1. PRODUCT OVERVIEW

This document provides the information required for the operation and maintenance of the DATARADIO Gemini/PD mobile radio-modem.

## 1.1 Intended Audience

This document is designed for use by engineering design, installation, and maintenance personnel.

## 1.2 General Description

Gemini/PD is a mobile radio-modem aimed at the public safety and public utility markets to meet demand for high speed and high throughput. It integrates all the necessary hardware for data-only vehicular installations up to but not including the laptop PC and its application software. Example of applications are:

1. Database inquiry systems.  
Small number of brief messages, (usually from the mobile station) with fairly long responses.
2. Computer-aided dispatch (CAD).  
Large number of messages, (usually from the base station) with very brief responses.
3. Automatic Vehicle Location (AVL).  
Using a GPS receiver, determines position, speed and direction of fleet members.

The Gemini/PD is made-up of a main transceiver and a auxiliary receiver for Parallel Decode (PD), a 40 Watt power amplifier, a Gemini Control Unit (GCU) with DSP driven modem and an integrated OEM GPS receiver.

Features:

- Rugged water-proof die-cast aluminum chassis.
- Data speeds of 9600 to 19200 b/s (9600 b/s maximum in half channels)
- 3 available user ports using standard RS-232 interface
- Built-in 16-channel synthesized radio transceiver.
- Power output of 10W to 40W (software controlled).
- Half duplex or simplex operation.

## 1.3 Configuration

Operating characteristics of the Gemini/PD are configured by Dataradio System Engineering for communication protocols and network settings.

A *Radio Service Software (RSS)* is provided for radio/modem maintenance, adjustments and frequency programming. The RSS is MSDOS based and will run on any 486 or higher PC (2 Megabytes memory required).

**WARNING:** The frequency band 406 to 406.1 MHz is reserved for use by distress beacons and cannot not be programmed into the unit.

## 1.4 Factory Technical Support

The Technical Support departments of DATARADIO provide customer assistance on technical problems and serve as an interface with factory repair facilities. They can be reached in the following ways:

DATARADIO Inc.  
5500 Royalmount Ave, suite 200  
Town of Mount Royal  
Quebec, Canada H4P 1H7

Technical support hours: Monday to Friday  
9:00 AM to 5:00 PM, Eastern Time

phone: +1 514 737-0020  
fax: +1 514 737-7883

or

DATARADIO Corp.  
6160 Peachtree Dunwoody RD., suite C-200  
Atlanta, Georgia 30328

Technical support hours: Monday to Friday  
9:00 AM to 5:00 PM, Eastern Time

phone: 1 770 392-0002  
fax: 1 770 392-9199

or

Email address: [support@dataradio.com](mailto:support@dataradio.com)

## 1.5 Product Warranty

Warranty information may be obtained by contacting your sales representative.

## 1.6 Replacement Parts

This product is normally not field serviceable, except by the replacement of complete units. Specialized equipment and training is required to repair the GCU board and radio modules.

Contact Technical Support for service information before returning equipment. A Technical Support representative may sug-

gest a solution eliminating the need to return equipment.

### 1.6.1 Factory Repair

When returning equipment for repair, you must request an RMA (Returned Material Authorization) number. The Tech Support representative will ask you several questions to clearly identify the problem. Please give the representative the name of a contact person who is familiar with the problem, should questions arise during servicing of the unit.

Customers are responsible for shipping charges for returned units. Units in warranty will be repaired free of charge unless there is evidence of abuse or damage beyond the terms of the warranty. Units out of warranty will be subject to service charges. Information about these charges is available from Technical Support.

## 2. Operation

### 2.1 Front & Rear Panels

The front panel includes:

- One mini-UHF type female antenna connector for the auxiliary receiver
- One SMA type female connector for the GPS receiver
- Two LED indicators
- Three DE-9F RS232 ports

The rear panel includes:

- One mini-UHF type female antenna connector for the main transceiver
- One 3-pin pigtailed power connector with ignition sense

### 2.1.1 LED Indicators

The Gemini/PD has two LED indicators:

LED's name	Indicates	Description
PWR	red	DC Power is applied
RX/TX	red	Unit transmit
	green	Unit receive
	flashing red/green	Radio is unlocked

## 2.2 DTE Port Interface

For all three ports:

DE-9 F pin #	Function
1	DCD – from Gemini/PD, normally asserted
2	RXD – data from Gemini/PD
3	TXD – data to Gemini/PD
4	DTR – to Gemini/PD, handshaking
5	Ground
6	DSR – from Gemini/PD, tied to VCC through current limiting resistor
7	RTS - to Gemini/PD, handshaking
8	CTS – from Gemini/PD, handshaking
9	AUX auxiliary input to Gemini/PD, “panic line” input (port 3): It may be activated by dry contact pull-up to the port’s DSR output. It may also tolerate user pull-up to external +12 VDC (car battery), but an isolated dry contact is preferred due to the risk of noise related false alarms caused by the vehicle’s electrical system.

We recommend the use of a shielded 9-wire cable with all pins connected. These ports can be used for unit configuration, maintenance & adjustment as well to connect user applications.

### 2.2.1 RS-232 Interface Signal Levels

In the descriptions of data signals, the following conventions are used:

Table 1 - RS-232 Signal Levels

Term	Alternates	Signal level
ON	asserted, spacing	+3 to +15 V
OFF	dropped, marking	-3 to -15 V

## 3. Adjustments and Maintenance

### 1.1 Overview

This chapter outlines the basic adjustment procedures required upon initial installation and thereafter at prescribed maintenance intervals. Units are delivered from the factory properly aligned and tested on the frequencies specified at time of order. Adjustment beyond that described in this chapter is not required unless radio modules have been tampered with or repaired. In such cases we recommend complete factory re-alignment as special test jigs are required.

### 3.1 Intended Audience

This chapter is intended for use by installation and maintenance personnel.

### 3.2 Equipment Required

The adjustments described below require the following equipment:

- 13.6 VDC (nominal), 20A regulated power supply.
- Radio service monitor (IFR or equivalent).
- Cable with mini-UHF male connector to connect Gemini/PD to the service monitor.
- Gemini Radio Service Software,
- A 486 PC (or better) to run the RSS.
- Normal radio shop tools.

### 3.3 Maintenance Intervals

The adjustments described below should be done at annual intervals or whenever a deterioration in performance indicates that adjustment may be required.

## 3.4 Tests & Adjustments

### 3.4.1 Preliminary Verification

Before performing any adjustment, verify the performance of the unit as shown in the Table 1.

**Important note:** *Before proceeding make sure that the service monitor has been calibrated recently and has warmed up for at least the time specified by its manufacturer.*

*Some reported frequency and deviation problems have actually been erroneous indications from service monitors that have not adequately warmed up. This is particularly likely when field service is done during winter months.*

### 3.4.2 Basic Tests & adjustments

Recommended Tests:

1. TX power output
2. Carrier frequency error
3. Frequency deviation

Note: Only if a loss in system performance has been detected, RX SINAD and RX audio distortion should be verified.

Adjustments:

1. Transmitter power output
2. Frequency error
3. Transmitter deviation

### 3.4.3 Tests & adjustments Procedure

**Refer to the RSS help file for details & parameter information.**

1. Connect the Gemini/PD main antenna connector (or the auxiliary receiver) to the TX/RX input of the service monitor using a suitable length of 50 ohm cable.
2. Connect the Gemini/PD to a suitable power supply and adjust the supply voltage to 13.6 volts.
3. Using a suitable 9 conductor straight RS-232 cable, connect the Gemini port 1 to the RS-232 port of a PC and run the Gemini RSS program.
4. Press *GET* to get the configuration of the unit.
5. Refer to “*Tests and Adjustments*” table.



Table 1: Tests and Adjustments Full & Half Channel Units

STEP	ACTION	EXPECTED RESULTS at 25°C	MEASURE WITH	IF NOT?
1	<b>Output Power</b> Press <i>PTT Channel x</i>	<b>UHF:</b> 40 watts <sup>1</sup> +10%, -20%	Service monitor set to read power	Check the RSS maximum power output setting: must be set to 255 (means 40W). User can however reduced it down to 10 Watts. Refer to factory tech support.
2	<b>Frequency Error</b> Press <i>PTT Channel x</i>	±300 Hz	Service monitor set to read frequency error	Adjust using the RSS <i>Freq Warp</i> setting (fine tuning adjust)  (Typical adjust range is ±1.5KHz) If found outside limits, user is to call factory technical support.
3	<b>Deviation</b> Press <i>PTT Channel x</i> Carrier will be modulated with a 1 KHz tone.	For any bit rate speeds selected: Full channel unit ±4.0 kHz +5%, -10% Half channel unit ±2.5 kHz +5%, -10%	Service monitor set to read deviation	Using RSS, adjust TX deviation.
4	Set the service monitor to generate a -80 dBm signal on the selected receive frequency. The signal should be modulated with a 1.0 kHz tone. Open the top cover to access the radio (see 3.4.4)  <i>To be performed only if a loss in system performance has been detected</i>			
5	<b>12 dB SINAD</b> <ul style="list-style-type: none"> <li>For Full channel unit, set deviation to ±3 kHz.</li> <li>For Half channel unit, set deviation to ±1.5 KHz</li> <li>Set service monitor IF filter to mid (15-30 kHz), no audio filter.</li> </ul>	Measure taken at J400 pin 21 (RX1) and at pin 23 (RX2)  ≤ 0.5 μV <sup>2</sup>	Service monitor set for SINAD. Connect to radio connector J400 pin 21 (RX1) or pin 23 (RX2).	Refer to factory technical support.
6	<b>Distortion</b> Use same settings as per 12 dB SINAD	< 3%	Same as per Step 5	Refer to factory technical support.

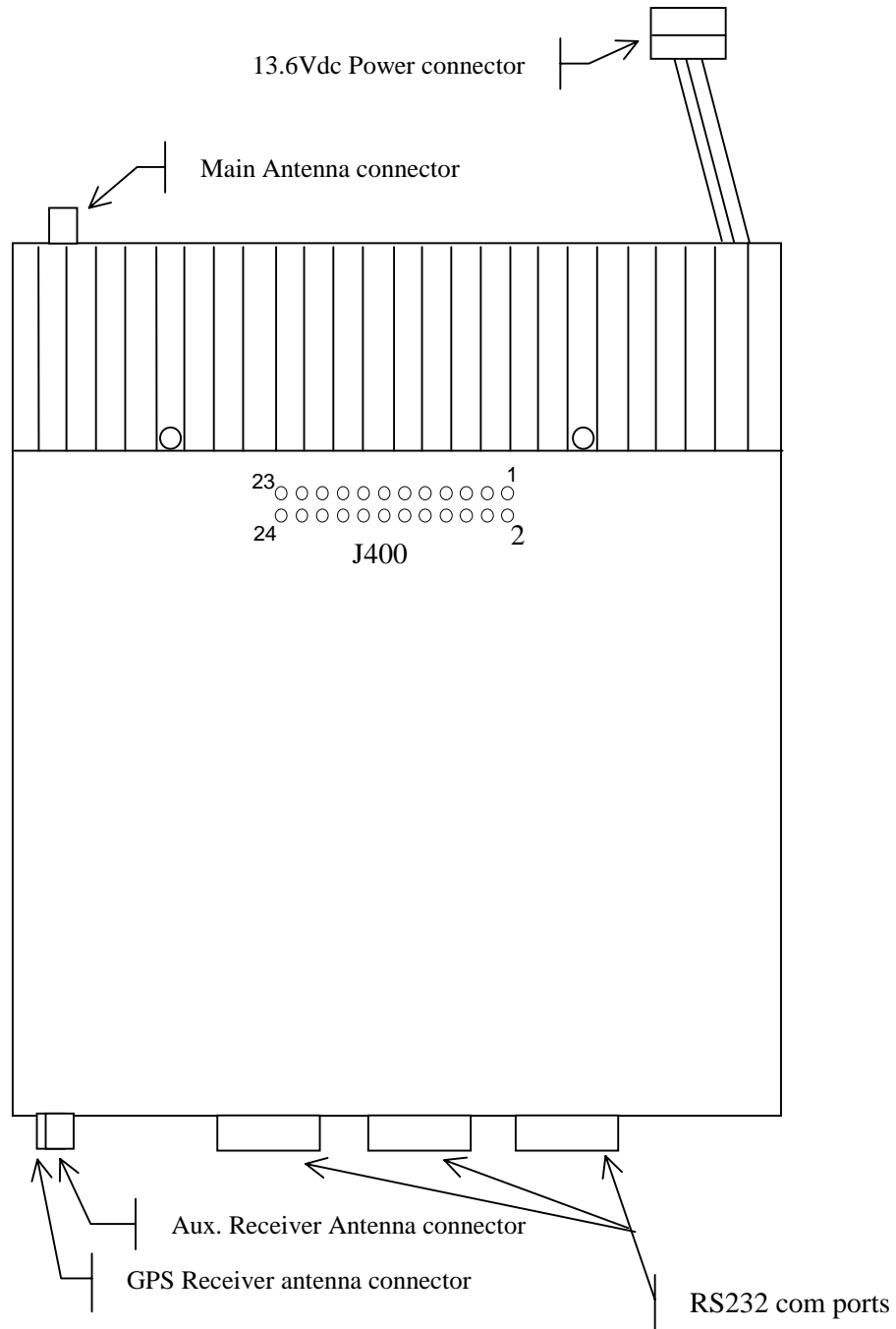
1 (unless you have set a lower value). Note that readings less than 40 watts may be due to losses in cables used for testing. Check also your wattmeter frequency calibration curve. Do not be too ready to condemn the transmitter.

2 If a psophometrically weighted filter is available on the service monitor, use 0.35 μV.

### 3.4.4 Opening the Unit

1. Remove the two Philips screw from the unit top cover.
2. Remove the top cover by lifting it from the rear.
3. Slide the cover out of the case.

Figure 1 Gemini/PD Top view (cover removed)



### 3.4.5 GPS Diagnostics Procedure

#### OVERVIEW

The detection of the POSition message shows a GPS CONNECTED LED. After about three minutes, detection of the one Pulse Per Second (PPS) should flash the POSITION ACQUIRED indicator, this means that the GPS has a position solution.

If the GPS has a good view of the sky and still has not generated any position solution within three minutes (it may take up to 10 minutes or more if the sky view is partially blocked.) the following trouble-shooting procedures should be undertaken to isolate the fault:

- 1) Disconnect the GPS antenna cable connector from the Gemini radio and check for + 5 VDC on the center pin of the GPS antenna connector on the radio using a DVM. If the voltage is present, do not reconnect the cable and proceed to step 2.
- 2) With the DVM, measure resistance between the shell and the center conductor of the GPS cable, resistance should be between 100 and 300 Ohms, if it measures open or short circuit the GPS antenna is either a passive antenna which is the WRONG type, or a defective active antenna, replace with a known good active antenna.
- 3) Connect the new antenna to Gemini and wait about three minutes for the POSITION ACQUIRED indicator to start flashing on Gemini, if not, the Gemini radio or its GPS receiver is defective.

## 4. Specifications

### GENERAL

	UHF
Frequency	400 - 512 MHz <sup>1</sup>
Channel spacing	12.5, 20 or 25 kHz
Frequency Control	Digital Synthesizer / uController
Frequency Stability	1.5 ppm
Operating temperature	-30°C to +60°C (25°C nominal) @ 95% non-cond. RH
Modes of Operation	Simplex or Half Duplex
Number of channels	16 internally stored
Supply voltage	13.6Vdc nominal (negative ground) 10.9 – 16.3 VDC
Circuit Protection	15 Amp fuse external 2 & 4 Amp fuse internal
RX Current at 13.6 VDC	< 550 mA Standby (with auxiliary receiver)
TX Current at 13.6 VDC	< 15 A
TX/RX separation	5 MHz typical
Nominal Dimensions	7.050" D x 6.000" W x 2.0000" H
Weight:	< 3.5 lbs.
RF input/output Impedance	50 ohms nominal
RF connector	Main TX/RX: mini-UHF female Auxiliary RX: mini-UHF female GPS RX: SMA female
Interface connector	3x DE-9F D-subminiature

### RECEIVER

	UHF
Sensitivity (12 dB SINAD)	< 0.35 $\mu$ V *
Selectivity (25KHz)	75 dB typical 70 dB minimum
Selectivity (12.5)	65 dB typical 60 dB minimum
Intermodulation	75 dB typical 70 dB minimum
Spurious rejection	75 dB typical 70 dB minimum
FM hum & noise	-45 dB typical *
Conducted spurious	< -57 dBm

\* psophometrically weighted filter

<sup>1</sup> **WARNING:** The frequency band 406 to 406.1 MHz is reserved for use by distress beacons and should not be programmed into the unit.

**TRANSMITTER**

	UHF
Power output	10-40 watts
Duty cycle	20% @ full power, 30 seconds maximum transmit time
Conducted Spurious	-75 dBc (-38 dBm @ 10 W) typical
Frequency stability	1.5 ppm
FM hum and noise	-45 dB max (25 kHz)
Attack time	< 10 ms

**MODEM OPERATION**

Interface	EIA RS-232C		
Operation	Simplex/half duplex		
Data rates	4800 b/s	9600 b/s	19200 b/s
Modulation type	DRCMSK	DRCMSK	DRCMSK
Packet Error Rate (for < 1% error)	better than -110 dBm at 9600 b/s half channel better than -115 dBm at 9600 b/s full channel better than -112 dBm at 16000 b/s full channel better than -109 dBm at 19200 b/s full channel		
Protocol	Dataradio Proprietary		

**DISPLAY and CONTROLS**

2 status LEDs	RX/TX, PWR
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**FCC / IC  
CERTIFICATIONS**

	FCC	IC (DOC)
VHF		
UHF		
900 MHz		

