

Development Kit Setup and Operation Guide For The “Jupiter” GPS Receiver

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Introduction

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The Rockwell Zodiac™ Development Kit is designed to facilitate evaluation of Rockwell's "Jupiter" Global Positioning System (GPS) receiver engine based on the Zodiac chip set. The receiver can be used in both static and mobile operations for evaluation purposes.

The Development Kit implements the receiver control operation and input/output (I/O) functions of the GPS receiver using an IBM-AT compatible personal computer (PC), a serial port, external antenna, and power supply. The GPS receiver is contained in a housing with I/O connectors, status LEDs, and configuration DIP switches as shown in Figure 1.

This document explains how to configure the Development Kit and the receiver, and how to set up the test equipment.

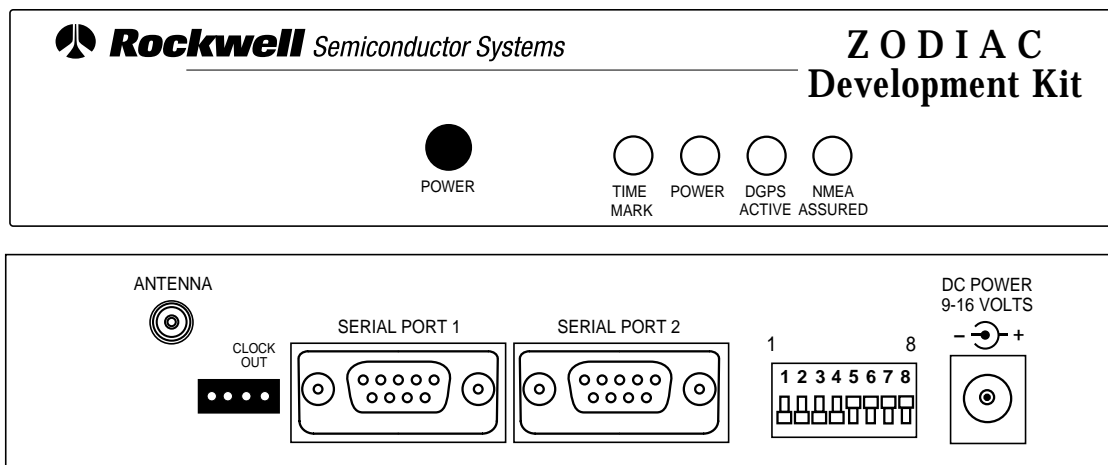


Figure 1. Front (top) and Rear (below) Panels of the Development Kit.

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LABMON, the GPS monitor and controller software, is provided with the Development Kit to communicate with the receiver. This software runs on the PC and allows the user to control the receiver and to display the receiver output message data. Externally supplied Radio Technical Commission for Maritime Services (RTCM SC-104) data can also be logged using a second PC serial port if desired. The LABMON software source code is included to provide a reference for similar Original Equipment Manufacturer (OEM) code implementations.

Details on how to use LABMON are found in a companion document, *LABMON Operation Guide For The "Jupiter" GPS Receiver*. Further information about GPS and the Zodiac family of GPS receivers is provided in the *Zodiac GPS Receiver Family Designer's Guide*.

The Development Kit contains the following items as depicted in Figure 2:

1. "Jupiter" receiver, power supply, voltage regulators, and RS-232 drivers in housing.
2. Active patch antenna with male SMA connector.
3. Two RS-232 cables with female DB-9 connectors at both ends.
4. 120V AC, 60 Hz/12 VDC power adapter.
5. 12 VDC automotive power adapter.
6. *Zodiac GPS Receiver Family Designer's Guide*.
7. *LABMON Operation Guide for the "Jupiter" GPS Receiver*.
8. *Development Kit Setup and Operation Guide For The "Jupiter" GPS Receiver* (this document).
9. Zodiac LABMON software on a 3.5-inch diskette.

Equipment Supplied

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The following OEM supplied equipment is also required, as a minimum, to test the "Jupiter" GPS receiver:

1. IBM-AT compatible PC processor with at least one available serial port, a 3.5-inch diskette drive, at least 640 KB RAM and DOS version 3.0 or greater.
A laptop or portable PC is highly recommended since it allows the receiver to be easily evaluated in an outdoor environment where GPS signals are more accessible.
2. Color monitor with VGA or EGA, or monochrome monitor with VGA (no monochrome with EGA).
3. RTCM data source (required only if the differential capability is being tested).
4. Cabling to connect the RTCM data source to the second PC serial port and the receiver's Auxiliary port for simultaneous RTCM SC-104 data collection and DGPS operation. A ribbon cable with three connectors is recommended.

Equipment Needed

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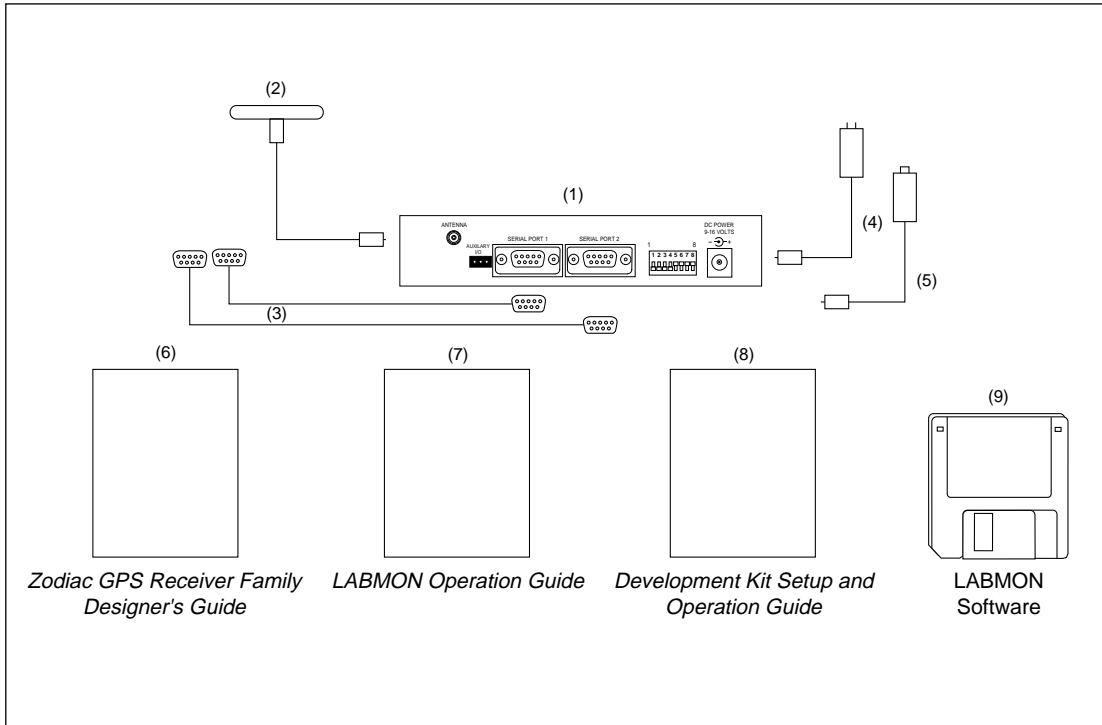


Figure 2. Development Kit Components

Description

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The Development Kit features dual RS-232 level serial data I/O ports, selectable bias voltages for active GPS antennas, port configurations, message protocols, and flexible internal “Keep-Alive” back-up power modes for both the Static Random-Access Memory (SRAM) and the low power time source.

The kit also includes the necessary circuitry to convert the receiver’s Complimentary Metal Oxide Semiconductor (CMOS) level output to RS-232 level, serial data I/O. The two serial data ports are RS-232, 9-pin D-Subminiature connectors. The first, or “host” serial port, is used to send and receive both binary and National Marine Electronics Association (NMEA-0183) initialization and configuration data messages. The second, or “auxiliary,” I/O port is dedicated to the reception of RTCM SC-104 Differential GPS (DGPS) correction messages. No data is output from the receiver through the auxiliary port.

An auxiliary output connector on the Development Kit allows the OEM processor to access the 1 pulse-per-second (1 PPS) time mark and 10 KHz time mark signals. The signals available at the auxiliary test connector are buffered CMOS level outputs driven by a 74LS04 CMOS inverting buffer device.

A number of test pins on the Development Kit board provide access to I/O signal lines. These test pins are located before the RS-232 drivers and timing reference signal buffers to allow examination of these signals at CMOS levels.

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The kit also includes the necessary circuitry to regulate the DC power input and to provide the necessary supply voltages to the receiver.

The Development Kit board contains jumper blocks which allow the OEM to insert a current measuring device inline with the primary and Real-Time Clock (RTC) power lines to the receiver to monitor power usage under various conditions. To isolate the receiver from the Development Kit, an electronic bus switch is used. This switch is controlled externally by a DIP switch on the kit. The bus switch also provides control over the bus voltage level. A jumper block is provided to select the interface voltage level to be used.

DC power for the Development Kit is provided by either an AC/DC converter or automobile adapter. The AC/DC converter operates from a nominal 120 VAC @ 60 Hz input and provides a 12 VDC @ 500 mA out. For mobile operation, an automotive adapter intended for use in 12V vehicles is provided. Four front panel LEDs provide the Development Kit's basic status indicators. A momentary pushbutton switch is provided on the Development Kit board to generate a master reset signal to the receiver.

Ribbon cables are provided to interface between the Development Kit and the customer's PC, and between the Development Kit and a DGPS receiver. These cables are terminated at both ends with female connectors to match the male connectors on the Development Kit and the PC.

A magnetic mount, active antenna is supplied with the kit. An 8-foot long RF cable (RG-316) is provided for the antenna with the proper connector already terminated. The nominal measured attenuation of the cable with

connector is approximately 3 dB. The supplied active antenna should be biased at +5 VDC, but a different active antenna with a bias of either +5 or +12 VDC may be used. Switches located on the back panel of the Development Kit are used to select the proper bias.

▲ CAUTION: *Make certain the antenna power switches are properly set before connecting the antenna. An antenna designed for +5 VDC operation will be damaged if connected to a +12 VDC source.*

A pushbutton ON/OFF power switch is provided to control primary power to the “Jupiter” board. A pushbutton reset switch is also provided on the Development Kit circuit board to generate a receiver system hardware reset. This reset switch is not accessible unless the cover is removed from the Development Kit.

The “Jupiter” receiver engine contains an onboard Super Capacitor (Supercap) which provides backup power to the SRAM and RTC devices for at least an hour after power has been removed from the board. This feature provides the receiver with a “hot start” capability by maintaining last position, current time, and satellite ephemeris data in SRAM.

There is also a provision to supply an external backup voltage to the RTC by properly configuring a jumper block and a configuration DIP switch. When the jumper block and DIP switch settings are made, the current time is maintained whenever the Supercap has been discharged. This feature provides the “Jupiter” with a “warm start” capability by maintaining clock time when the set has been powered down for longer than an hour and the contents in SRAM are no longer valid. This

external backup power is maintained to the RTC unless it is disabled using the DIP switches, by removing the appropriate jumper on the kit, or by removing +12 VDC power to the kit.

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Configuring The Development Kit

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▲ **CAUTION:** *If the Development Kit cover is removed during configuration, proper Electrostatic Discharge (ESD) precautions should be observed when handling the unit to prevent possible damage to circuits. **Failure to observe these precautions may result in permanent damage to the unit.***

The Development Kit should be correctly configured before it is connected to the PC and powered up.

The “Jupiter” board is configured using a bank of eight dip switches, three jumper blocks, and a single, two-position jumper switch block. The relative position of each configuration device on the “Jupiter” board, as well as the auxiliary I/O connector, is shown in Figure 3.

The primary configuration switches, located on the rear of the Development Kit, are illustrated in Figure 4. They are shown in their normal default positions.

▲ **CAUTION:** *The antenna bias may be set to either 0, +5, or +12 VDC for an active antenna. The switches must be set correctly to avoid possible damage to the unit. The active antenna supplied with the Development Kit must be set to +5 VDC only. If a passive antenna is used, be sure to set the antenna bias to 0 volts VDC. Remember to set the Development Kit’s power switch to OFF or remove power from the unit before changing these switches.*

Switch 1 is reserved and should be set to the OFF position.

Switch 2 is used to select the receiver’s output message protocol. If switch 2 is set to the ON position, the receiver’s output message format will be set to NMEA-

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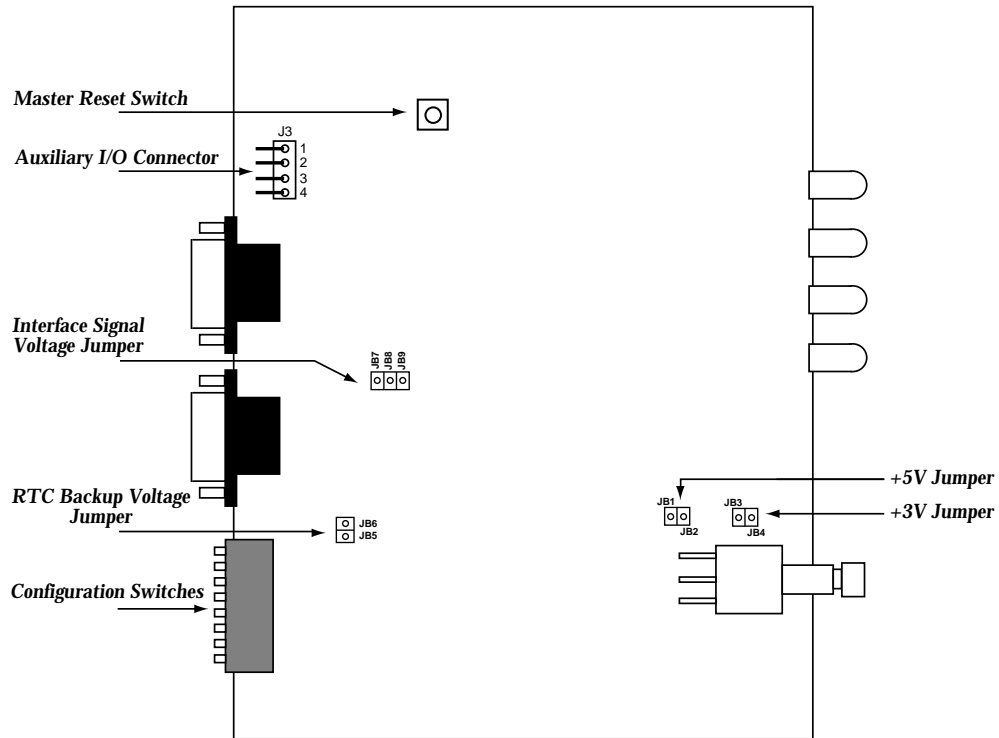


Figure 3. "Jupiter" Board with Location of Configuration Devices

	Switch/Function:	ON:	OFF:
	1 Reserved	N/A	N/A
	2 Host Port Protocol	NMEA Assured	Rockwell Binary or NMEA depending on Switch 3
ON	3 EEPROM Enable/Disable	EEPROM Disable	EEPROM Enabled
	4 Reserved	N/A	N/A
OFF	5 I/O Control	Enable I/O signals	Disable I/O signals
	6 RTC Control	RTC Backup Power Enabled	RTC Backup Power Removed
	7 Preamp Voltage Select	Apply +5 VDC to Active Antenna	Apply +12 VDC to Active Antenna
	8 Preamp Power Enable	Preamp Power On for Active Antenna	Preamp Power Off For Passive Antenna

Figure 4. Development Kit Configuration Switches

0183 with Host port settings of 4800 bps, no parity, 8 data bits, and 1 stop bit. If switch 2 is set to the OFF position, the receiver's output message format and communication parameters are determined by the configuration of switch 3 as follows:

- If switch 3 is ON when switch 2 is OFF, ROM defaults are used and the receiver will output Rockwell binary format messages with Host port settings of 9600 bps, no parity, 8 data bits, and 1 stop bit.
- If switch 3 is OFF when switch 2 is off, the receiver's output protocol, communication parameters, and initialization parameters will be determined from data stored in SRAM or EEPROM (whichever is valid). That is, the receiver recalls the settings from its last operating session.

Switch 3 is used to enable or disable the Electrically Erasable Programmable Read-Only Memory (EEPROM). When switch 3 is ON, EEPROM is disabled and ROM defaults such as message format, host port communication settings, and receiver default message set are used. When switch 3 is off, user-configurable settings stored in EEPROM are used. This switch should normally be OFF to use data such as clock parameters, last position, and receiver configuration from EEPROM.

NOTE: *Be advised that if the Development Kit is operated with switch 3 in the ON position (EEPROM disabled), then each power cycle or reset of the receiver may result in a longer Time-To-First-Fix (TTFF). This is because the receiver will use the default initialization parameters stored in ROM rather than more current initialization parameters that may be available in SRAM or EEPROM.*

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Switch 3 must be in the **Off** position for the receiver to output the results of a commanded Built-In Test (BIT).

Switch 4 is reserved and should be set to the OFF position.

Switch 5 is used to control the I/O signals to the receiver. Set switch 5 ON to enable and OFF to completely disable the receiver's I/O signals.

Switch 6 is used to control whether the Development Kit will supply RTC backup power when the receiver has been switched off. Set switch 6 ON to supply RTC backup power and OFF to remove RTC backup power. When switch 6 is ON, RTC back-up power is supplied to the receiver as long as the Development Kit is receiving +12 VDC power from the supplied AC/DC adapter or car adapter.

The "Jupiter" board's Supercap will continue to supply backup power to the RTC until it is sufficiently discharged regardless of the switch 6 setting.

Switch 7 is used to select the voltage applied to an active antenna when switch 8 is in the ON position. Set switch 7 to ON to apply +5 VDC and to OFF to apply +12 VDC (only +5 VDC should be applied when the active antenna supplied with the Development Kit is used).

Switch 8 is used to select between an active and a passive antenna. Set switch 8 to OFF for a passive antenna and to ON for an active antenna. The ON setting allows DC voltage (selected by switch 7) to be applied to the center conductor of the RF cable.

A jumper block on the Development Kit, with pins labeled **JB5** and **JB6**, may be used to disable the backup power to the RTC from the kit. Remove the jumper to disable the backup power; leave the jumper in place to supply voltage to the RTC even when primary power has been removed from the receiver.

To supply the RTC backup voltage from an external source, remove the jumper and connect the voltage source to pin **JB6**. Consult the *Zodiac GPS Receiver Family Designer's Guide* for more information on the power requirements.

Two additional jumper blocks are provided to enable +3.3 VDC or +5 VDC primary power. To enable the +5 VDC primary power to the receiver interface connector, the jumper should be in place over the pins labeled **JB1** and **JB2** on the circuit board.

To supply the primary voltage from an external source, remove the jumper from pins **JB1** and **JB2** and connect the voltage source to pin **JB2**. Consult the *Zodiac GPS Receiver Family Designer's Guide* for more information on the power requirements.

A switch jumper block is provided to select either +3.3 VDC or +5 VDC for the receiver's I/O interface. The three-pin jumper block is labeled **JB7**, **JB8**, and **JB9** on the circuit board. When the +5 VDC "Jupiter" board is operated with the Development Kit, the jumper should be over pins labeled **JB7** and **JB8**.

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There is a 4-pin AUX I/O connector on the Development Kit as shown in Figure 5. This connector is a Molex 70553 series right-angle pin header. The connector provides access to the buffered 10 KHz UTC signal and the one pulse-per-second timing signal. These may be used by the OEM's processor for synchronization.

The pin assignments are as follows:

1. K10. Buffered 10 KHz UTC output frequency reference signal. This is a synchronous 10 KHz output clock with a 50 ± 5 percent duty cycle.
2. TM (inverted version of TM_F Pulse). This is a 1 pulse-per-second (1 PPS) CMOS output signal buffered through a 74LS04 device.
3. No connect.
4. GROUND.

For further information on the characteristics of these signals, consult the *Zodiac GPS Receiver Family Designer's Guide*.

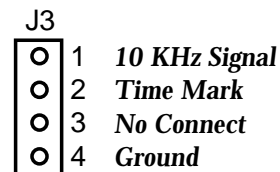


Figure 5. Auxiliary I/O Connector

▲ **CAUTION:** *Do not connect an antenna and apply power to the Development Kit before reviewing this entire section and checking the antenna bias switch settings. The settings must be correct before power is applied to the receiver.*

When connected, a passive antenna provides a low resistance path. Therefore, an abnormally high current will occur in the supply circuits of the “Jupiter” board if the switches are set for an active type. Although the preamp power supply internal to the Development Kit is current-limited to 65 milliamps, this feature will only prevent damage to the receiver, itself, but not necessarily to the Development Kit or antenna.

Failure to observe these precautions may result in permanent damage to the unit and/or the antenna.

Since GPS is a line of sight system, the antenna can only receive signals from visible satellites. Therefore, a location for the test equipment should be selected so that the GPS antenna is placed where the view of the sky is least obstructed for optimal reception of the satellite signals.

Note: *GPS signals are severely attenuated or totally obscured by the roofs or walls of wood, metal, brick, or stucco buildings. The signals are also attenuated by coated glass found in many office structures. The Development Kit should be taken outside or to the roof of a building to effectively evaluate receiver performance. With stationary evaluations, care should also be taken to keep the antenna away from the side of a building since*

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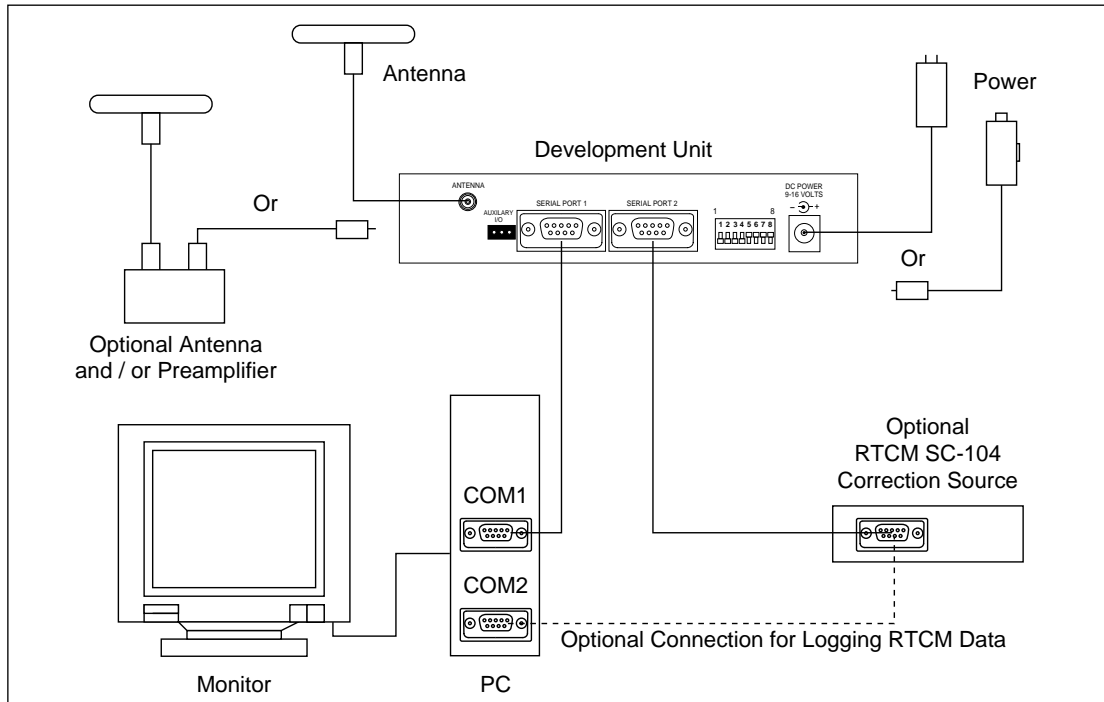


Figure 6. Development Kit Test Equipment Setup

GPS signals can reflect off of metal or coated glass. These reflections have a longer path than direct signals and can cause multi-path errors.

The Development Kit, PC, and the RTCM SC-104 differential correction source are connected as shown in Figure 6. If RTCM SC-104 data needs to be logged at the same time it is sent to the receiver, the OEM must supply a cable with three connectors to connect the RTCM correction source to the Development Kit's Auxiliary port and to an unused serial port on the PC. In this case, data is only logged when LABMON is invoked with filenames as command line arguments as described in the companion document, *LABMON Operation Guide For The "Jupiter" GPS Receiver*.

Logging and subsequent review of RTCM correction data often proves useful to resolve performance or compatibility issues. A utility program, RTCMCHK, is contained on the LABMON disk included with the Development Kit. This software tool checks the integrity of RTCM SC-104 data sources.

Normally, the Development Kit should be set up as shown in Figure 6 with only the RTCM correction source connected to the receiver. If the RTCM cable is not connected to the receiver's Auxiliary port, DGPS operation will not be possible.

Note that the Development Kit may be connected to either the COM1, COM2, COM3, or COM4 serial ports and the RTCM differential correction data source connected either directly to the receiver's Auxiliary I/O port, to one of the remaining serial ports of the PC, or to both using an OEM-supplied three-connector serial cable.

To operate the "Jupiter" receiver, press the pushbutton on/off switch on the front panel of the Development Kit once. When power is applied to the receiver, the POWER LED illuminates and the TIME MARK LED flashes at a 1 Hz rate to indicate the receiver is operating.

When the NMEA protocol for the Host port is selected, the NMEA ASSURED LED illuminates. When data is received by the Auxiliary port, the DGPS ACTIVE LED illuminates. The DGPS ACTIVE LED does not indicate the integrity of the RTCM SC-104 data or the receiver mode.

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Press the pushbutton switch again to remove primary DC power from the receiver. Back-up power will be maintained to the receiver's SRAM and RTC by the "Jupiter's" on-board Supercap for about one hour. The POWER LED on the Development Kit should indicate off before changing the configuration switch settings. The receiver operating settings will not change after re-configuration until the receiver is restarted by pressing the front panel pushbutton on/off switch.

The following acronyms and abbreviations, together with their meanings, are used in this document.

CMOS	Complimentary Metal Oxide Semiconductor
DB-9	9-Pin D-Subminiature Connector
DB-25	25-Pin D-Subminiature Connector
DGPS	Differential Global Positioning System
DOS	Disk Operating System
EEPROM	Electrically Erasable Programmable Read-Only Memory
ESD	Electrostatic Discharge
GPS	Global Positioning System
Hz	Hertz
I/O	Input/Output
LED	Light Emitting Diode
NMEA	National Marine Electronics Association
OEM	Original Equipment Manufacturer
PC	Personal Computer
PPS	Pulse Per Second
ROM	Read-Only Memory
RTC	Real-Time Clock
RTCM	Radio Technical Commission for Maritime Services
SRAM	Static Random Access Memory
TTFB	Time-To-First-Fix
UTC	Universal Time Coordinated

Appendix A: Acronym and Abbreviation List



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