

OPERATION MANUAL



GPS-101 GLOBAL POSITIONING SIMULATOR



1002-1000-200
Ver 1.00



OPERATION MANUAL
GPS-101

GPS-101 GLOBAL POSITIONING SIMULATOR

OPERATION MANUAL

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OPERATION MANUAL GPS-101

SAFETY FIRST: TO ALL OPERATIONS & SERVICE PERSONNEL

REFER ALL SERVICING OF UNIT TO QUALIFIED TECHNICAL PERSONNEL.

SAFETY IDENTIFICATION IN TECHNICAL MANUAL

The following terms are used throughout this manual to draw attention to possible safety hazards, which may exist when operating or servicing this equipment.

CAUTION: THIS TERM IDENTIFIES CONDITIONS WHICH CAN RESULT IN EQUIPMENT OR PROPERTY DAMAGE.

WARNING: THIS TERM IDENTIFIES CONDITIONS OR ACTIVITIES WHICH, IF IGNORED, CAN RESULT IN PERSONAL INJURY OR DEATH.

POWER SUPPLY

This device is intended for operation from an external power source providing no more than 120 VAC (North American)/240 VAC (European) at a frequency of 50 to 400 Hz. Power supply specifications are provided within the manual.

EQUIPMENT GROUNDING PRECAUTION

Improper grounding of equipment can result in electrical shock.

USE OF PROBES

Check the maximum voltage, current and power ratings of any connector on the equipment in the product specifications prior to connecting it with a probe from a terminal device. Be sure the terminal device performs within these specifications prior to using it for measurement, to prevent electrical shock or damage to the equipment.

POWER CORDS

Power cords are supplied specifically for use with this product. The power cord must not be frayed, broken nor expose bare wiring when operating this equipment.

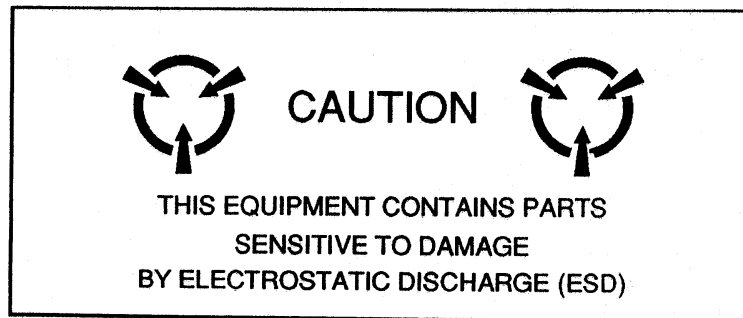
USE RECOMMENDED FUSES ONLY

Use only fuses specifically recommended for the equipment at the specified current and voltage ratings.

CASE, COVER OR PANEL REMOVAL

Removing protective covers, casings or panels from this product exposes the operator to electrical hazards which can result in electrical shock or equipment damage. Do not operate this equipment with the case, cover or panels removed.

CAUTION: INTEGRATED CIRCUITS AND SOLID STATE DEVICES ARE SUSCEPTIBLE TO DAMAGE BY ELECTROSTATIC DISCHARGES RECEIVED FROM IMPROPER HANDLING, THE USE OF UNGROUNDED TOOLS, AND IMPROPER STORAGE AND PACKAGING. PROPER ESD PRECAUTIONS MUST BE UTILIZED AS REQUIRED.



CAUTION: THE USE OF SIGNAL GENERATORS FOR MAINTENANCE AND OTHER ACTIVITIES CAN BE A SOURCE OF ELECTROMAGNETIC INTERFERENCE (EMI) TO COMMUNICATION RECEIVERS, WHICH CAN CAUSE DISRUPTION AND INTERFERENCE TO COMMUNICATION SERVICE OUT TO A DISTANCE OF SEVERAL MILES. USERS OF THIS EQUIPMENT SHOULD SCRUTINIZE ANY OPERATION WHICH RESULTS IN RADIATION OF A SIGNAL (DIRECTLY OR INDIRECTLY) AND SHOULD TAKE NECESSARY PRECAUTIONS TO AVOID POTENTIAL COMMUNICATION INTERFERENCE PROBLEMS.



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CHAPTER ONE
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SECTION 1 - DESCRIPTION

1. GENERAL DESCRIPTION AND CAPABILITIES

1.1 GENERAL

The GPS-101 Global Positioning Simulator provides for installation and functional bench testing of global positioning system (GPS) receivers.

The GPS-101 simulates one of many specific global positioning satellites. Selected specific satellite vehicle (SV) signals transmitted with selected navigation (NAV) data test patterns are used to verify the operational integrity of GPS receivers.

1.2 SYSTEM OPERATION

Most GPS receivers operate by receiving the coarse acquisition (C/A) encoded signals on the L1 (1575.42 MHz) channel. The receiver uses the C/A encoded signal to calculate the distance from each specific satellite.

The combined 50 Hz NAV data and C/A encoded satellite signals contain satellite position and information accuracy. The full navigation message contains 25 data frames, each having 1500 bits of information and includes an almanac for the receiver data base. The full navigation message takes about 12.5 minutes to transmit.

The almanac data base in the GPS receiver maintains position information on all the satellites for any given time. From the last acquired position and using the almanac data base, the GPS receiver selects three (two dimensional positioning) or four (three dimensional positioning) of the best satellites known to be in view at the current time. After the receiver starts tracking the three or four selected satellites, position is calculated using the received information.

1.3 FUNCTIONAL CAPABILITIES

The GPS-101 has the following functional capabilities:

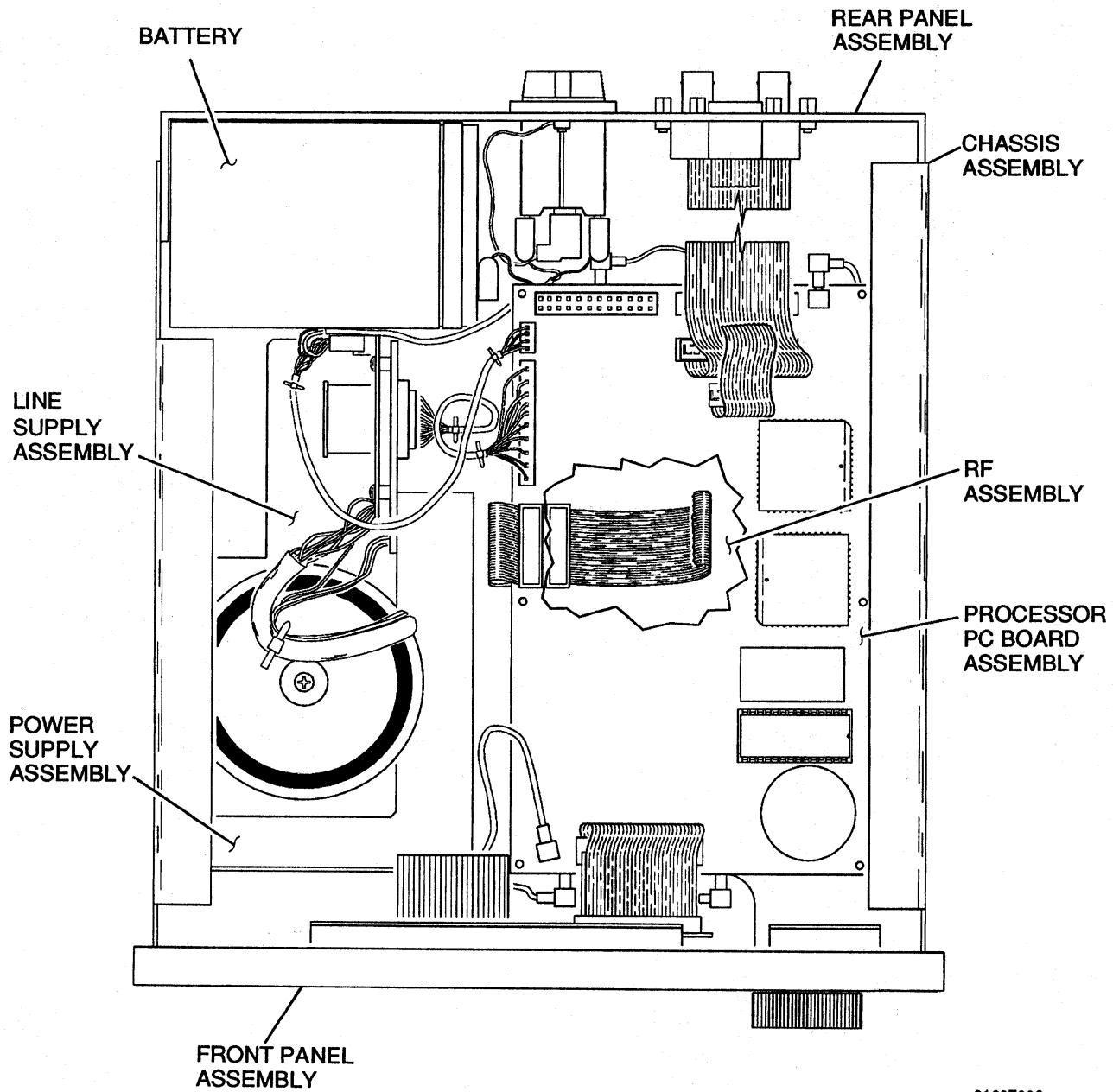
- Generates GPS signals on the L1 channel (1575.42 MHz) frequency.
- Provides adjustable RF output level from -85 to -145 dBm in 1 dB steps (to verify system and/or receiver sensitivity).
- Offsets Doppler frequency as selected (no shift, -4 or +4 kHz).
- Simulates one of 32 global positioning satellites or one of five ground stations by transmitting the selected phase modulated C/A code (Gold Code) signal identifying the particular satellite or ground station.
- Provides selectable preset 50 Hz NAV data test patterns.
- Allows uploading and downloading of almanac data. Refer to Appendix B.
- Provides adjustable date and time. (The GPS-101 has the current date and time [UTC] loaded initially at the factory.)
- Operates on battery power for approximately six hours.

1.4 MECHANICAL DESCRIPTION

The GPS-101 mechanical description is shown in 1-1-1, Figure 1.



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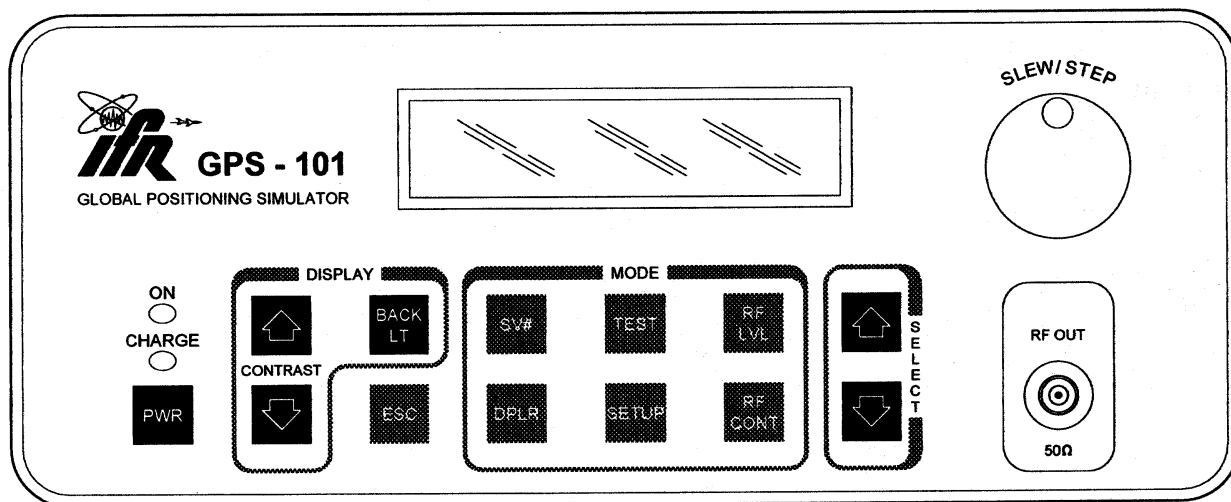
01007009

GPS-101 Composite
Figure 1



2. CONTROLS, CONNECTORS AND INDICATORS

2.1 FRONT PANEL



01007001

GPS-101 Front Panel
Figure 2

LCD

Displays the various screens used for setups, simulation tests, selftests and calibrations.

SLEW/STEP Control

Performs edits of the selected data field. Also selects top level (root) Setup Menu screen from any other root Setup Menu screen.

ON Indicator

Two color LED illuminates to indicate power is On (green-normal operation, red-low battery).

CHARGE Indicator

Two color LED illuminates to indicate internal battery is charging (green-≥80% charged battery, red-charging low battery).

PWR Key

Controls power to GPS-101 Satellite Simulator.

↑ or ↓ CONTRAST Key

Controls the contrast for the LCD.

BACK LT Key

Toggles the LCD backlight On or Off.

ESC Key

- Escapes from any Setup Submenu to corresponding root Setup Menu.
- Escapes from any root Setup Menu to Main Menu screen and positions cursor to RF Level field.

SV# Key

Enters Main Menu screen and moves cursor to the Satellite Vehicle (SV) field.

DPLR Key

Enters Main Menu screen and moves cursor to the Doppler Offset (DPLR) field.

TEST Key

Enters Main Menu screen and moves cursor to the Test (T) field.

SETUP Key

Enters last accessed Setup Menu screen from Main Menu Screen. Continued pressing selects root Setup Menu screen.



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RF LVL Key

Enters Main Menu screen and moves cursor to the RF Level field.

RF CONT Key

Enters Main Menu screen and moves cursor to the RF Control field.

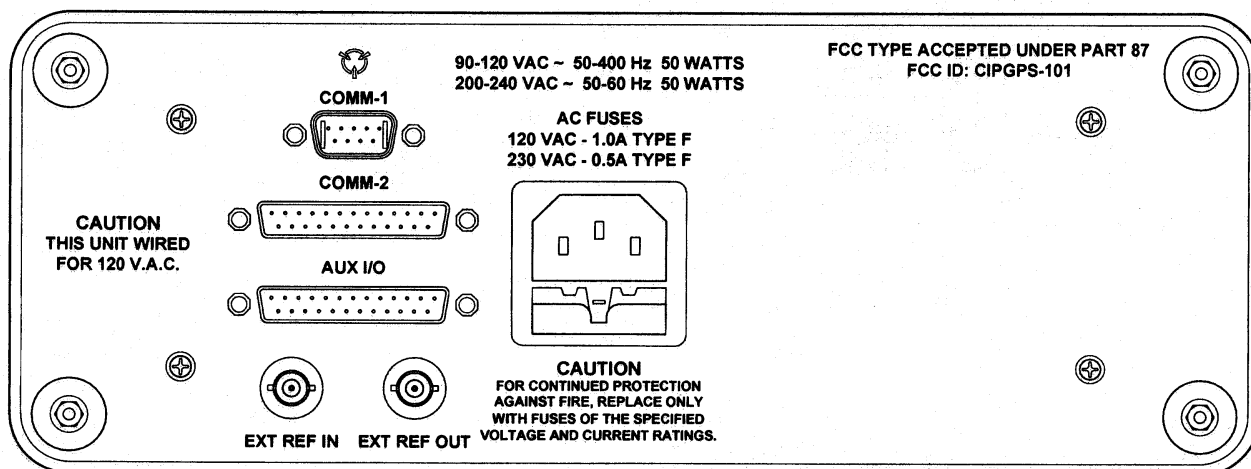
↑ or ↓ SELECT Key

Enters the Setup Menu fields (submenu screens) under the current root Setup Menu. Also edits currently selected data field in Main Menu screen.

RF OUT Connector

Transmits the simulated satellite signal.

2.2 REAR PANEL



01007002

GPS-101 Rear Panel
Figure 3

COMM-1 Connector

Provides serial channel for uploading and downloading of satellite almanac information. Refer to Appendix B.

COMM-2 Connector

Provides for communication with GPS receiver under test.

AUX I/O Connector

Provides input for external modulation.

EXT REF IN Connector

Provides input for an alternate external 10.00 MHz time base.

EXT REF OUT Connector

Provides the 10.00 MHz internal system clock.

AC INPUT Connector

Receives ac power for operation and/or charging the internal battery.

AC FUSE Housing

Contains two ac line fuses. Refer to 1.3 in 1-2-1.



SECTION 2 - OPERATION

1. INSTALLATION

1.1 POWER

The GPS-101 is powered by an internal battery. The battery charging circuit enables the operator to recharge the battery anytime the unit is connected to ac power. The GPS-101 can operate continuously on ac power for servicing and/or bench tests.

The internal battery is equipped to power the GPS-101 for six to eight continuous hours of use. When the battery needs recharging, the ON Indicator illuminates red.

The GPS-101 conserves battery power with the Battery Saver function. The Battery Saver function shuts off the GPS-101 after 15 minutes without key or control activity when operating on battery power.

Battery Saver Function:

STEP	PROCEDURE
------	-----------

- | | |
|----|--|
| 1. | Press PWR Key to activate GPS-101 (ON Indicator illuminates). |
| 2. | Press SETUP Key. Continue pressing SETUP Key, as needed, to display System Setup Menu. |

Setup: System

- | | |
|----|--|
| 3. | Press ↓ SELECT Key to enter Battery Saver Submenu field. |
|----|--|

**Setup: System
Battsaver: Yes**

- | | |
|----|---|
| 4. | Turn SLEW/STEP Control to select Yes to activate Battery Saver function or No to deactivate Battery Saver function. |
|----|---|

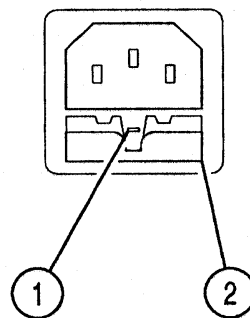
1.2 SAFETY PRECAUTIONS

Two important safety precautions must be observed during installation and operation. IFR SYSTEMS, INC., assumes no liability for failure of customer to comply with any of the safety precautions outlined in this manual:

- Do not attempt to operate the GPS-101 without reading and complying with instructions contained in this manual.
- Connect the three-prong plug on the supplied ac power cable to a properly grounded three-prong wall receptacle.

WARNING: DUE TO POTENTIAL SAFETY HAZARDS, USE OF THREE-PRONG TO TWO-PRONG ADAPTOR PLUG(S) IS NOT RECOMMENDED.

1.3 FUSE REPLACEMENT (Figure 1)



01007003

Fuse Replacement
Figure 1

STEP	PROCEDURE
------	-----------

- | | |
|----|---|
| 1. | Remove ac power from GPS-101. |
| 2. | Push down tab (1) and pull out AC FUSE Housing (2). |
| 3. | Replace fuses according to Line Supply Voltage Select Switch setting and operating voltage, 1.0 A Fast (120 VAC) or 0.5 A Fast (230 VAC). |
| 4. | Insert AC FUSE Housing (2) into Rear Panel until tab (1) locks into place. |



1.4 BATTERY CHARGING

The battery charger operates whenever ac power is applied to the Test Set. When charging, the battery reaches a full charge in approximately half the discharge time (≈ 4 hours from a full discharge). The CHARGE Indicator illuminates red when operating in maximum charge mode (battery at $< 80\%$). The CHARGE Indicator illuminates green when operating in trickle charge mode (battery at $\geq 80\%$).

The battery should be charged every three months (minimum) or disconnected for long term inactive storage periods of more than six months. Refer to 1.2 in 1-5-1.

Charging Battery:

STEP	PROCEDURE
1.	Verify GPS-101 is Off.
2.	Connect supplied ac power cable to AC INPUT Connector. (CHARGE Indicator illuminates.)
3.	Allow four to six hours for full battery charge or until CHARGE Indicator illuminates green.

NOTE: The GPS-101 can be used while charging the battery.

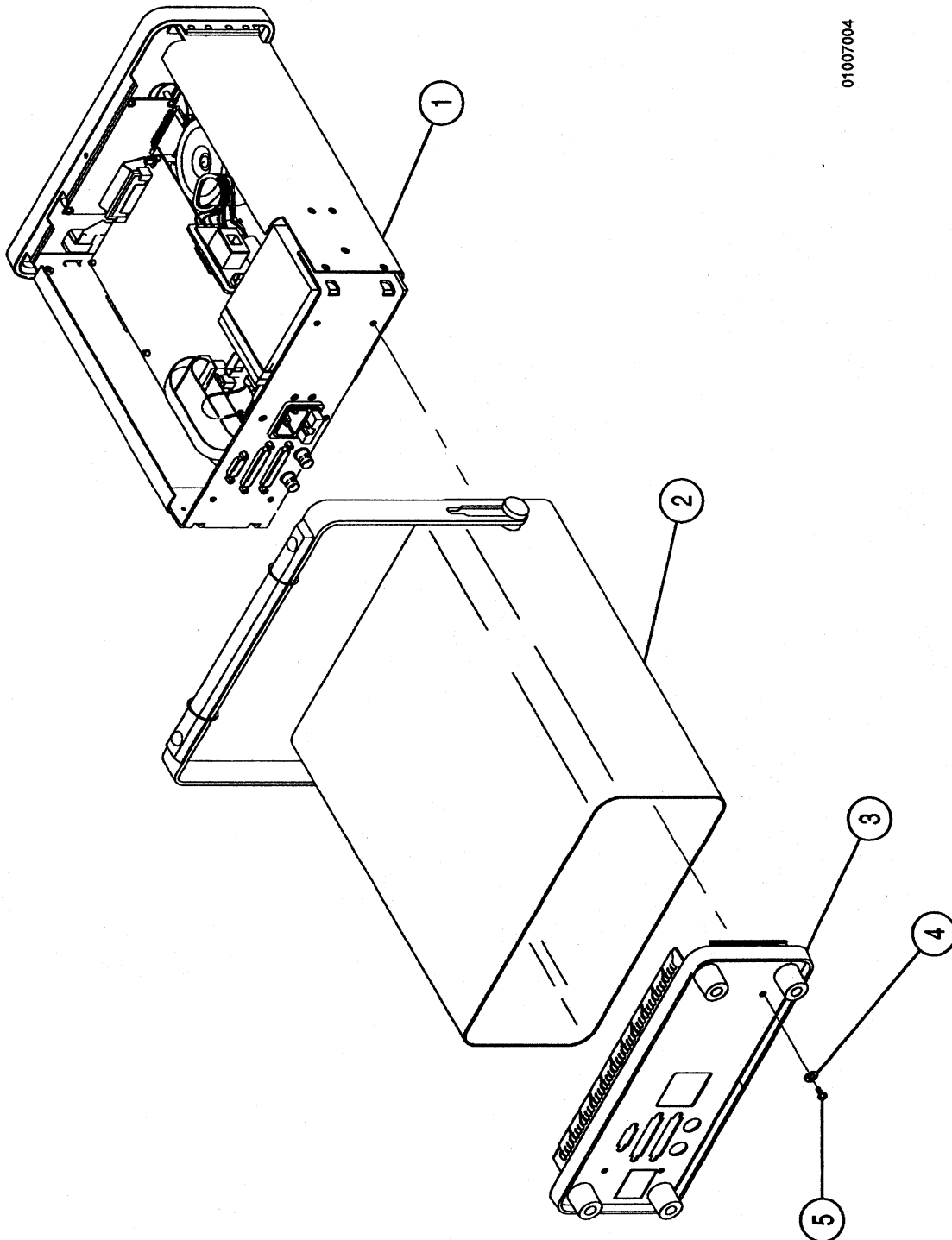
1.5 SETTING LINE SUPPLY VOLTAGE SELECT SWITCH

The Line Supply Voltage Select Switch is set according to the sticker on the Rear Panel Assembly. The Line Supply Voltage Select Switch must be changed before connecting the GPS-101 to a different power source.

STEP	PROCEDURE
1.	Verify GPS-101 is Off and disconnected from ac power.
2.	Refer to 1-2-1, Figure 2. Remove four screws (5), four washers (4) and Rear Panel Assembly (3).
3.	Refer to 1-2-1, Figure 2. Slide Case Assembly (2) towards rear and remove from Chassis Assembly (1).
4.	Refer to 1-2-1, Figure 3. Set Line Supply Voltage Select Switch (9) to 115 for 90 to 120 VAC power source or 230 for 180 to 240 VAC power source.
5.	Reassemble GPS-101 in reverse order of Steps 2 and 3.
6.	Replace fuses as needed according to 1.3 in 1-2-1.
7.	Refer to 1-1-2, Figure 3 and Add or remove sticker on Rear Panel as required.



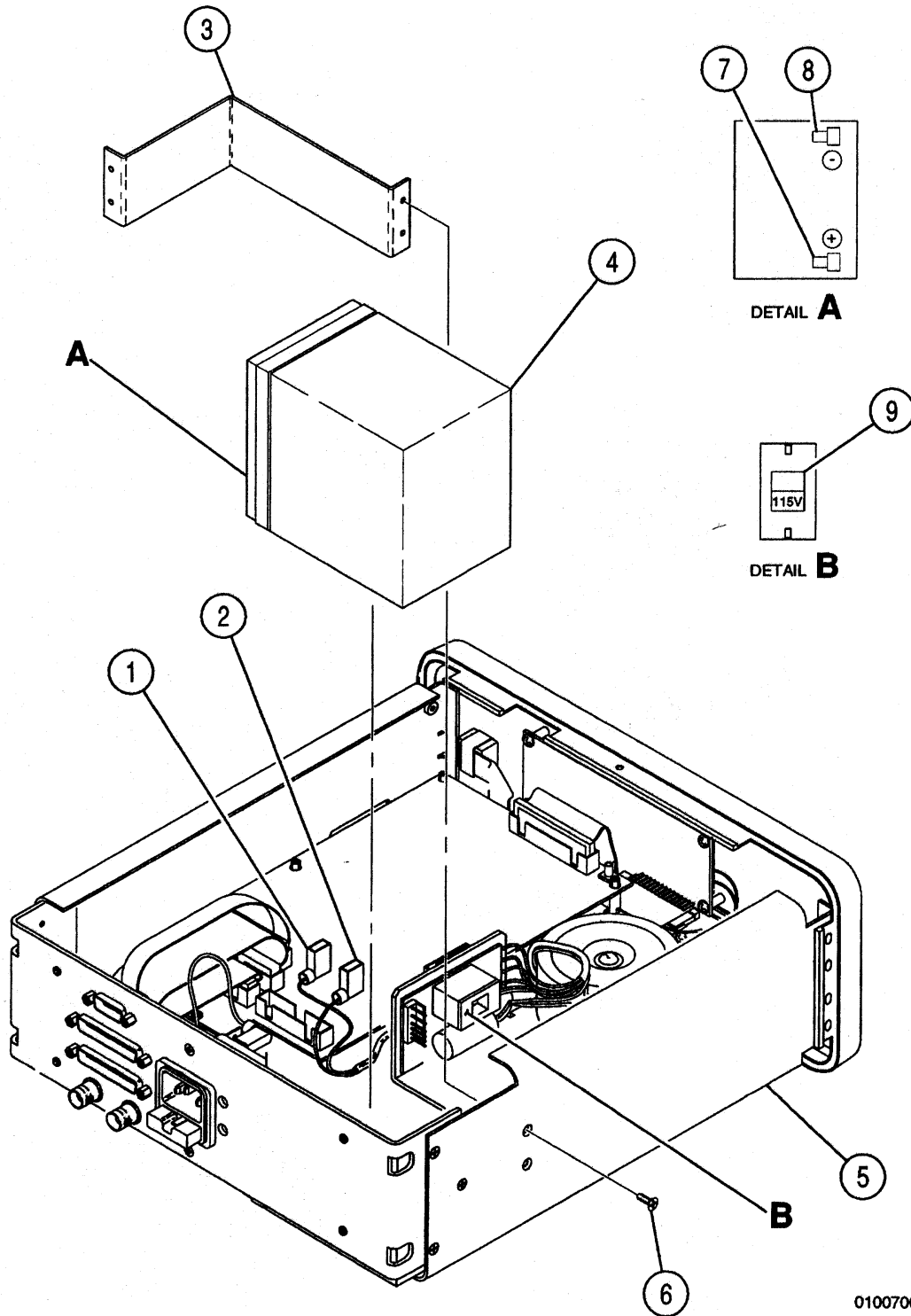
01007004



Case Removal
Figure 2



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01007005

Battery Removal
Figure 3



1.6 BATTERY REMOVAL

Only a defective battery should be removed and replaced. A defective battery does not accept a charge.

Removing Battery:

- | STEP | PROCEDURE |
|------|--|
| 1. | Verify GPS-101 is Off and disconnected from ac power. |
| 2. | Refer to 1-2-1, Figure 2. Remove four screws (5), four washers (4) and Rear Panel Assembly (3). |
| 3. | Refer to 1-2-1, Figure 2. Slide Case Assembly (2) towards rear and remove from Chassis Assembly (1). |
| 4. | Refer to 1-2-1, Figure 3. Disconnect black cable (2) from negative (-) battery terminal (8). |
| 5. | Refer to 1-2-1, Figure 3. Remove four screws (6) from bracket (3). |
| 6. | Refer to 1-2-1, Figure 3. Carefully lift battery (4) and bracket (3) from Chassis Assembly (5). |
| 7. | Refer to 1-2-1, Figure 3. Disconnect red cable (1) from positive (+) battery terminal (7). |
| 8. | Discard old battery. |
| 9. | Install new battery in reverse order of Steps 2 through 7. |

1.7 DISPLAY CONTROL

Because of varying preferences and environmental considerations, the GPS-101 provides back light and contrast controls for the LCD:

- Press BACK LT Key to set LCD back light On or Off. (Off increases battery run time.)
- Press ↑ CONTRAST Key to decrease contrast (makes characters lighter on display).
- Press ↓ CONTRAST Key to increase contrast (makes characters darker on display).

1.8 MENU SETTINGS

The GPS-101 saves current settings for all data fields, except date and time, when powered down. Date and time fields are continually updated by the internal real time clock (RTC) and changes are only saved by the user. Refer to 1.10 in 1-2-1. On power up, the GPS-101 restores the saved settings for all Menu fields. The GPS-101 also returns to the last screen used before the previous power down.

1.9 ALMANAC WARNING

The GPS-101 displays alternating warning screens when the internal almanac might be out of date:

**WARNING: Almanac
May Be Expired**

**Contact IFR at
1-800-835-2350**

CAUTION: USING THE GPS-101 WITH AN OUTDATED ALMANAC MAY CAUSE THE GPS RECEIVER TO FAIL MOMENTARILY IN LOCATING SATELLITES OR SHOW SYMPTOMS OF PRODUCT FAILURE.

Refer to Appendix B when the almanac warning appears.



1.10 SETTING DATE AND TIME

The GPS-101 provides two different times and dates, real time and current session time. When received from the factory, the GPS-101 has the current Coordinated Universal Date and Time (UTC) loaded as the internal real time clock (RTC) reference. Upon power up, the internal real time clock (RTC) accurately updates the current date and time from the RTC reference. Some GPS receivers may require local time or other time zones for testing. The user can adjust the current session time without changing the RTC reference.

Date Function:

NOTE: Steps 1 through 8 provide date settings for current session only. Steps 9 and 10 store date settings as new RTC reference.

STEP	PROCEDURE
------	-----------

- | | |
|----|--|
| 1. | Press PWR Key to activate GPS-101 (ON Indicator illuminates). |
| 2. | Press SETUP Key. Continue pressing SETUP Key, as needed, to display Date Setup Menu. |

Setup: Date

- | | |
|----|--|
| 3. | Press ↓ SELECT Key to enter Month Submenu field. |
|----|--|

Setup: Date
Mar 3 1995 FRI

- | | |
|----|---|
| 4. | Use SLEW/STEP Control to set month (Jan to Dec). |
| 5. | Press ↓ SELECT Key to enter Date Submenu field. |
| 6. | Turn SLEW/STEP Control to set date (1 to 28, 29, 30 or 31; depending on month). |
| 7. | Press ↓ SELECT Key to enter Year Submenu field. |
| 8. | Turn SLEW/STEP Control to set year (1980 to 2050). (The weekday automatically adjusts to new settings.) |

STEP	PROCEDURE
------	-----------

- | | |
|----|---|
| 9. | Press ↓ SELECT Key to enter Date Set Submenu field. |
|----|---|

Setup: Date
Set: Use Spinner

- | | |
|-----|---|
| 10. | Turn SLEW/STEP Control (Spinner) to save current date settings. |
|-----|---|



Time Function:

NOTE: Steps 1 through 8 provide time settings for current session only. Steps 9 and 10 store time settings as new RTC reference.

STEP	PROCEDURE
------	-----------

- | | |
|----|--|
| 1. | Press PWR Key to activate GPS-101 (ON Indicator illuminates). |
| 2. | Press SETUP Key. Continue pressing SETUP Key, as needed, to display Time Setup Menu. |

Setup: Time

- | | |
|----|---|
| 3. | Press ↓ SELECT Key to enter Hour Submenu field. |
|----|---|

**Setup: Time
11:06:37 (UTC)**

- | | |
|----|---|
| 4. | Use SLEW/STEP Control to set hour (00 to 23). |
| 5. | Press ↓ SELECT Key to enter Minute Submenu field. |
| 6. | Turn SLEW/STEP Control to set minute (00 to 59). |
| 7. | Press ↓ SELECT Key to enter Second Submenu field. |
| 8. | Turn SLEW/STEP Control to set second (00 to 59). |
| 9. | Press ↓ SELECT Key to enter Time Set Submenu field. |

**Setup: Time
Set: Use Spinner**

- | | |
|-----|--|
| 10. | Turn SLEW/STEP Control (Spinner) to store current time settings as new internal RTC reference. |
|-----|--|

1.11 OPERATION INTERFACE

There are no special connections or requirements to interface the GPS-101 with the GPS receiver to be tested.

NOTE: The GPS receiver is also referred to as the Unit Under Test (UUT).

Direct Connection (Figure 4):

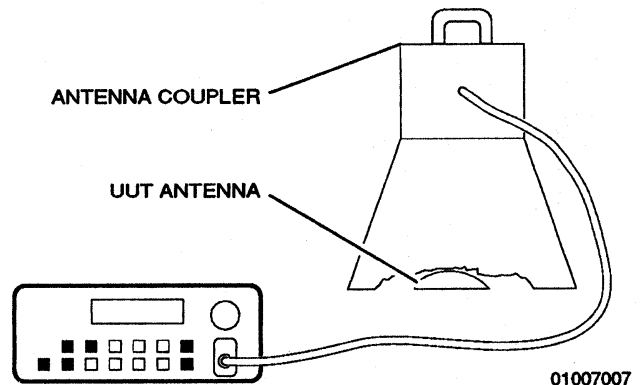
- Use RF cable to connect RF OUT Connector to UUT Receive Connector.
- Conduct GPS Receiver Test Operation according to 1-2-2.



Direct Connect Testing
Figure 4

Antenna Coupler Connection (Figure 5):

- Use RF cable to connect RF OUT Connector to Antenna Coupler Connector.
- Cover UUT Antenna with Antenna Coupler.



Antenna Testing
Figure 5



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2. MAIN MENU (GPS RECEIVER TEST OPERATION)

NOTE: Some GPS receivers enter a search mode if multiple satellites are not acquired and may drop a single satellite signal after a short period of time.

STEP	PROCEDURE
1.	If needed, set GPS-101 date and time according to 1.10 in 1-2-1.
2.	Connect GPS-101 to GPS Receiver according to 1.11 in 1-2-1.
3.	Press PWR Key to activate GPS-101. (ON indicator illuminates.)
4.	Press SV# Key to edit Satellite Vehicle (SV) field.

SV13* T1 -100dBm DPLR0 RFOFF

(* indicates unhealthy SV or no almanac data is available.)

5. Use SLEW/STEP Control or ↑ or ↓ SELECT Key to select SV (1-32) or ground station to simulate (33-37).
6. Press TEST Key to edit Test (T) field.

SV02 T1 -100dBm DPLR0 RFOFF
--

7. Use SLEW/STEP Control or ↑ or ↓ SELECT Key to select 50 Hz NAV data test pattern (1-9). Set to:
- **T1** for NAV Data with almanac and current Time/Date.
 - **T2** for fixed test pattern. Refer to Appendix B.
 - **T3** 110011001100... test pattern.

T4 through **T9** are not used at this time and no NAV Data is transmitted when selected (C/A Code only).

8. Press RF LVL Key to edit RFLevel field.

SV02 T1 -125dBm DPLR0 RFOFF
--

STEP	PROCEDURE
------	-----------

9. Use SLEW/STEP Control or ↑ or ↓ SELECT Key to set output level (-145 to -85 dBm). (Typical level setting for initial lock-on is **-120dBm** for direct connection or **-105dBm** using Antenna Coupler.)

For actual RF level into UUT, calculate cable loss (≈4 dB) for direct connection. When using Antenna Coupler, calculate antenna gain, cable loss and coupling loss (≈20 dB).

NOTE: Setting too high an output level may cause erroneous receiver indications due to signal saturation.

10. Press DPLR Key to edit Doppler Offset (DPLR) field.

SV02 T1 -125dBm DPLR+ RFOFF
--

11. Use SLEW/STEP Control or ↑ or ↓ SELECT Key to set Doppler Offset. Set to:

- **DPLR0** for no offset (normal).
- **DPLR+** for +4 kHz Doppler shift (simulates satellite moving towards receiver).
- **DPLR-** for -4 kHz Doppler shift (simulates satellite moving away from receiver).

12. Press RF CONT Key to edit RF Control field.

SV02 T1 -125dBm DPLR+ RFON



STEP	PROCEDURE
------	-----------

- | | |
|-----|---|
| 13. | Use SLEW/STEP Control or ↑ or ↓
SELECT Key to select signal. Set to: <ul style="list-style-type: none">● RFOFF to disable output through
RF OUT Connector.● RFON for 1575.42 MHz CW
modulated with Gold Code and
selected 50 Hz NAV test data
pattern (normal operation).● RFEXT for external BPSK
modulation through AUX I/O
Connector. Refer to 3.3 in 1-2-3.● RFCW for 1575.42 MHz CW.● RFSQR for 1575.42 MHz CW
modulated with 511.5 kHz square
wave. |
| 14. | Verify GPS Receiver operation. |



3. EXTERNAL INPUT OPERATION

3.1 COMM-1 CONNECTOR

The COMM-1 Connector provides for the uploading of almanac data. Refer to Appendix B. Operating parameters for the COMM-1 Connector are set in the Comm-1 Setup Submenus.

STEP	PROCEDURE
------	-----------

- | | |
|----|--|
| 1. | Press PWR Key to activate GPS-101 (ON Indicator illuminates). |
| 2. | Press SETUP Key. Continue pressing SETUP Key, as needed, to display Comm-1 Setup Menu. |

Setup: Comm-1

- | | |
|----|--|
| 3. | Press ↓ SELECT Key to enter Baud Rate Submenu field. |
|----|--|

Setup: Comm-1 Baud Rate: 9600
--

- | | |
|----|--|
| 4. | Turn SLEW/STEP Control to select desired baud rate in bps (110, 150, 300, 600, 1200, 2400, 4800, 9600 or 19200). |
| 5. | Press ↓ SELECT Key to enter Parity Submenu field. |

Setup: Comm-1 Parity: None

- | | |
|----|--|
| 6. | Turn SLEW/STEP Control to select desired parity mode (None, Even, Odd, Mark or Space). |
| 7. | Press ↓ SELECT Key to enter Data Bits Submenu field. |

Setup: Comm-1 Data Bits: 8

- | | |
|----|---|
| 8. | Turn SLEW/STEP Control to select desired data bits per byte (7 or 8). |
|----|---|

STEP	PROCEDURE
------	-----------

- | | |
|----|--|
| 9. | Press ↓ SELECT Key to enter Stop Bits Submenu field. |
|----|--|

Setup: Comm-1 Stop Bits: 1

- | | |
|-----|---|
| 10. | Turn SLEW/STEP Control to select desired stop bits per byte (1 or 2). |
| 11. | Press ↓ SELECT Key to enter Handshake Submenu field. |

Setup: Comm-1 Handshake: RTS

- | | |
|-----|--|
| 12. | Turn SLEW/STEP Control to select desired communications handshake mode (None, RTS [hardware] or Xon [software]). |
|-----|--|



3.2 COMM-2 CONNECTOR

The COMM-2 Connector is not used at this time. Parameters for the COMM-2 Connector are set in the Comm-2 Setup Submenus.

STEP	PROCEDURE
------	-----------

- | | |
|----|--|
| 1. | Press PWR Key to activate GPS-101 (ON Indicator illuminates). |
| 2. | Press SETUP Key. Continue pressing SETUP Key, as needed, to display Comm-2 Setup Menu. |

Setup: Comm-2

- | | |
|----|--|
| 3. | Press ↓ SELECT Key to enter Baud Rate Submenu field. |
|----|--|

Setup: Comm-2
Baud Rate: 9600

- | | |
|----|--|
| 4. | Turn SLEW/STEP Control to select desired baud rate in bps (110, 150, 300, 600, 1200, 2400, 4800, 9600 or 19200). |
| 5. | Press ↓ SELECT Key to enter Parity Submenu field. |

Setup: Comm-2
Parity: None

- | | |
|----|--|
| 6. | Turn SLEW/STEP Control to select desired parity mode (None, Even, Odd, Mark or Space). |
| 7. | Press ↓ SELECT Key to enter Data Bits Submenu field. |

Setup: Comm-2
Data Bits: 8

- | | |
|----|---|
| 8. | Turn SLEW/STEP Control to select desired data bits per byte (7 or 8). |
|----|---|

STEP	PROCEDURE
------	-----------

- | | |
|----|--|
| 9. | Press ↓ SELECT Key to enter Stop Bits Submenu field. |
|----|--|

Setup: Comm-2
Stop Bits: 1

- | | |
|-----|---|
| 10. | Turn SLEW/STEP Control to select desired stop bits per byte (1 or 2). |
| 11. | Press ↓ SELECT Key to enter Handshake Submenu field. |

Setup: Comm-2
Handshake: RTS

- | | |
|-----|--|
| 12. | Turn SLEW/STEP Control to select desired communications handshake mode (None, Xon [software] or RTS [hardware]). |
| 13. | Press ↓ SELECT Key to enter Level Submenu field. |

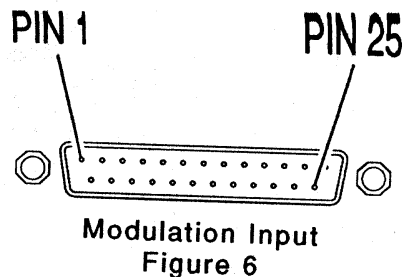
Setup: Comm-2
Level: RS-232

- | | |
|-----|--|
| 14. | Turn SLEW/STEP Control to select desired voltage levels and I/O pins (RS-232 or RS-422). |
|-----|--|

3.2 AUX I/O CONNECTOR

The AUX I/O Connector is used for BPSK modulation input when the RF Control field is set to **RFEXT**. Refer to 1-2-2. Refer to 1-2-3, Figure 6 and set external modulation (TTL level signals) through AUX I/O Connector as follows:

- Apply BPSK modulation to Pin 1.
- Apply common ground to Pin 25.



01007008



4. INFORMATION SCREENS

4.1 VERSION

STEP	PROCEDURE
------	-----------

1. Press PWR Key to activate GPS-101 (ON Indicator illuminates).
2. Press SETUP Key. Continue pressing SETUP Key to display Version Setup Menu.

Setup: Version

3. Press ↓ SELECT Key to display Version Number Screen.

Setup: Version 01.00

4. Press ↓ SELECT Key to display Version Date (of compilation) Screen.

Setup: Version Mar 20 1995

5. Press ↓ SELECT Key to display Version Time (of compilation) Screen.

Setup: Version 08:56:20
--

4.2 DATE OF ALMANAC UPLOAD

STEP	PROCEDURE
------	-----------

1. Press PWR Key to activate GPS-101 (ON Indicator illuminates).
2. Press SETUP Key. Continue pressing SETUP Key to display System Setup Menu.

Setup: System

3. Press ↓ SELECT Key twice to display Almanac Date Screen.

Setup: System Alm: Apr 7 95
--

(The GPS-101 displays the date of the last almanac upload.)



4.3 DATE OF CALIBRATION

- | STEP | PROCEDURE |
|------|--|
| 1. | Press PWR Key to activate GPS-101 (ON Indicator illuminates). |
| 2. | Press SETUP Key. Continue pressing SETUP Key to display System Setup Menu. |

Setup: System

3. Press ↓ SELECT Key three times to display Calibration Date Screen.

Setup: System
Cal: May 15 95

(The GPS-101 displays the date of the last calibration.)

4.4 ELAPSED TIME

- | STEP | PROCEDURE |
|------|--|
| 1. | Press PWR Key to activate GPS-101 (ON Indicator illuminates). |
| 2. | Press SETUP Key. Continue pressing SETUP Key to display System Setup Menu. |

Setup: System

3. Press ↓ SELECT Key four times to display Elapsed Time Screen.

Setup: System
ElapHrs: 282.4

(The GPS-101 displays total unit run time [ac and battery] in tenths of hours.)



5. PERFORMANCE EVALUATION

The GPS-101 is equipped with a Selftest for quick performance evaluation. Selftest checks memory (RAM and ROM), internal communication channels, logic cell array (LCA), display and internal clock for operational capability. The GPS-101 also performs an abbreviated Selftest on power up. Selftest provides Pass/Fail indications for the complete set of tests (Summary) and each test performed.

STEP	PROCEDURE
------	-----------

- | | |
|----|--|
| 1. | Press PWR Key to activate GPS-101 (ON Indicator illuminates). |
| 2. | Press SETUP Key. Continue pressing SETUP Key to display Selftest Setup Menu. |

Setup: Selftest

- | | |
|----|--|
| 3. | Press ↓ SELECT Key to enter Summary Selftest Screen. |
|----|--|

Setup: Selftest ALL PASS

(The GPS-101 displays results of last Selftest.)

- | | |
|----|--|
| 4. | Press ↓ SELECT Key to enter Rom Selftest Screen. |
|----|--|

Setup: Selftest Rom: Pass

(The GPS-101 displays results of last Rom Selftest.)

- | | |
|----|--|
| 5. | Press ↓ SELECT Key to enter Ram Selftest Screen. |
|----|--|

Setup: Selftest Ram: Pass

(The GPS-101 displays results of last Ram Selftest.)

STEP	PROCEDURE
------	-----------

- | | |
|----|--|
| 6. | Press ↓ SELECT Key to enter NVRam Selftest Screen. |
|----|--|

Setup: Selftest NVRam: Pass
--

(The GPS-101 displays results of last NVRam Selftest.)

- | | |
|----|--|
| 7. | Press ↓ SELECT Key to enter Comm1 Selftest Screen. |
|----|--|

Setup: Selftest Comm1: Pass
--

(The GPS-101 displays results of last COMM-1 Connector Selftest.)

- | | |
|----|--|
| 8. | Press ↓ SELECT Key to enter Comm2 Selftest Screen. |
|----|--|

Setup: Selftest Comm2: Pass
--

(The GPS-101 displays results of last COMM-2 Connector Selftest.)

- | | |
|----|--|
| 9. | Press ↓ SELECT Key to enter LCD Selftest Screen. |
|----|--|

Setup: Selftest LCD: Pass

(The GPS-101 displays results of last Liquid Crystal Display Selftest.)

- | | |
|-----|--|
| 10. | Press ↓ SELECT Key to enter RTC Selftest Screen. |
|-----|--|

Setup: Selftest RTC: Pass

(The GPS-101 displays results of last Real Time Clock Selftest.)



STEP PROCEDURE

11. Press ↓ SELECT Key to enter LCA Selftest Screen.

Setup: Selftest
LCA: Pass

(The GPS-101 displays results of last Logic Cell Array Selftest.)

12. Press ↓ SELECT Key to enter Selftest Start Screen.

Setup: Selftest
Spinner to Start

13. Turn SLEW/STEP Control (Spinner) to initiate Selftest.

(Selftest cycles through all of the tests and automatically displays the Summary Selftest Screen when finished.)

14. Repeat Steps 4 through 11 to view current Selftest results.
15. If any failure exists, refer to GPS-101 Maintenance Manual or contact IFR Customer Service Department.

CONTACT: IFR Systems, Inc.
Customer Service

Telephone: 800-835-2350
FAX: 316-524-2623



SECTION 3- SPECIFICATIONS

1. GPS-101 SPECIFICATIONS

GENERATOR

Frequency:	1575.42 MHz
Accuracy:	Same as Timebase
Doppler Offset (selectable):	+3.936 or -3.935 kHz
Accuracy:	Same as Timebase
Channels:	Single SV simulation (selectable 1 to 37)
Phase Modulation:	BPSK
PRN Code (C/A code):	C/A code=1.023 MHz, 1023 bit gold code
NAV Data (test pattern):	50 Hz
Output:	RF OUT Connector
Level:	-145 to -85 dBm
Steps:	1 dB
Accuracy (into 50 Ω):	± 2 dB
Spurious:	<-40 dBc over the 20 MHz bandwidth
External Modulation:	
Input:	AUX I/O Connector (Pins 1 and 25)
Level:	TTL

TIMEBASE

Standard:	
Frequency:	10 MHz (See Note.)
Uncertainty:	± 1 ppm
Temperature Stability:	± 1 ppm
Aging Rate:	± 1 ppm/yr, ± 5 ppm/10 yr
Option:	
Frequency:	10 MHz (See Note.)
Uncertainty:	± 0.1 ppm
Temperature Stability:	± 0.1 ppm
Aging Rate:	± 0.1 ppm/yr

NOTE: Internal Timebase frequency is a function of timebase calibration, aging rate, temperature stability and uncertainty.



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External Reference:

Input:	EXT REF IN Connector
Frequency:	10.0 MHz
Level:	0.25 to 6.0 V _{p,p}
Impedance:	150 Ω nominal
Output:	EXT REF OUT Connector
Frequency:	10.0 MHz nominal
Level:	1 V _{p,p} nominal into 50 Ω

ANTENNA COUPLER

Coupling:	-20 dB typical at 1575.42 MHz (assumes 4.77 dB patch antenna gain and 4 dB cable)
Isolation:	>25 dB at 1575.42 MHz (30 dB typical)

POWER

ac Requirements:

Input:	AC INPUT Connector
Voltage Range:	90 to 120 VAC (50 to 400 Hz) or 200 to 240 VAC (50 to 60 Hz)
Power Consumption:	<50 W, <40 W typical

Battery:

Operation Time:	≥2 Hours, 6 Hours typical
Full Charge Time:	
Unit Operating:	≤8 Hours at 115 VAC, 60 Hz
Unit Not Operating:	≤6 Hours at 115 VAC, 60 Hz

ENVIRONMENT

Operating Temperature:	0° to 50° C
Storage Temperature:	-20° to +70° C
Humidity:	95% (±5%) non-condensing at +10° to +30° C
Shock:	MIL-T-28800D, Type 3, Class 5, Style C Sections 3.7.5.1, 4.5.5.4.1
Vibration:	MIL-T-28800D, Type 3, Class 5, Style C Sections 3.7.4.1, 4.5.5.3.1
Bench Handling:	MIL-T-28800D, Type 3, Class 5, Style C Sections 3.7.5.3, 4.5.5.4.3



SECTION 4 - SHIPPING

1. SHIPPING TEST SETS

1.1 INFORMATION

IFR Test Sets returned to factory for calibration, service or repair must be repackaged and shipped according to the following conditions:

Authorization

Do not return any products to factory without first receiving authorization from IFR Customer Service Department.

CONTACT: IFR Systems, Inc.
Customer Service

Telephone: 800-835-2350
FAX: 316-524-2623

Tagging Test Sets

All Test Sets must be tagged with:

- Identification and address of owner.
- Nature of service or repair required.
- Model Number.
- Serial Number.

Shipping Containers

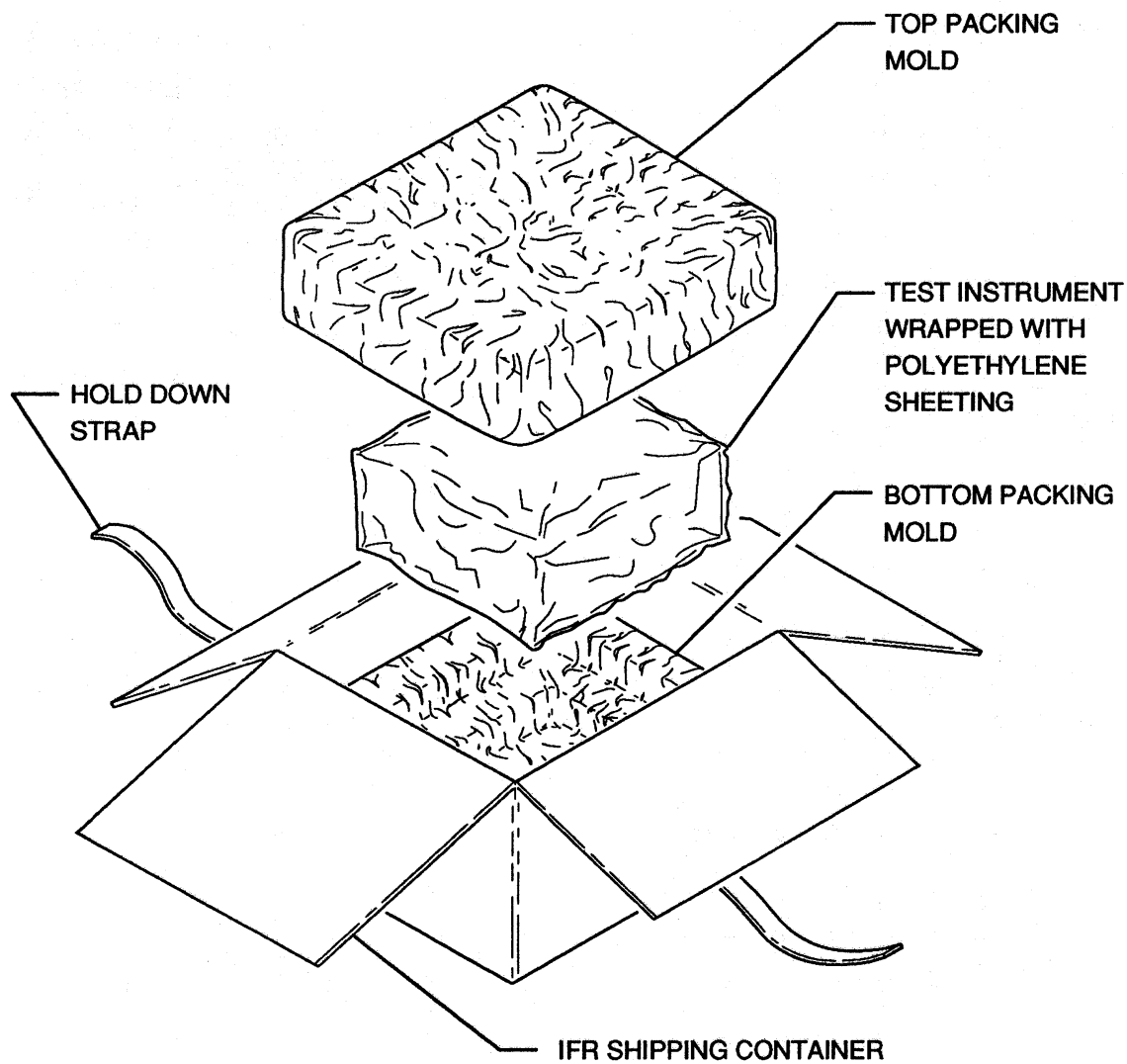
Test Sets must be repackaged in original shipping containers using IFR packing molds. If original shipping containers and materials are not available, contact IFR Customer Service for shipping instructions.

Freight Costs

All freight costs on non-warranty shipments are assumed by the customer. (See "Warranty Packet" for freight charge policy on warranty claims.)

1.2 REPACKING PROCEDURE

- Make sure bottom packing mold is seated on floor of shipping container.
- Carefully wrap Test Set with polyethylene sheeting to protect finish.
- Place Test Set into shipping container, making sure Test Set is securely seated in bottom packing mold.
- Place top packing mold over top of Test Set and press down until mold rests solidly in bottom packing mold.
- Close shipping container lids and seal with shipping tape or an industrial stapler. Tie all sides of container with break resistant rope, twine or equivalent.



Repacking Procedure
Figure 1



SECTION 5 - STORAGE

1. STORING TEST SETS

1.1 STORING PROCEDURE

Perform the following storage precautions whenever the Test Set is stored for extended periods:

- Disconnect Test Set from any electrical power source. If being stored for more than six months, disconnect battery according to 1.2 in 1-5-1.
- Disconnect and store ac power cable and other accessories in Lid Assembly.
- Cover Test Set to prevent dust and debris from covering and entering Test Set.

1.2 DISCONNECTING BATTERY

STEP	PROCEDURE
1.	Verify GPS-101 is Off and not connected to ac power.
2.	Refer to 1-2-1, Figure 2. Remove four screws (5), four washers (4) and Rear Panel Assembly (3).
3.	Refer to 1-2-1, Figure 2. Slide Case Assembly (2) towards rear and remove from Chassis Assembly (1).
4.	Refer to 1-2-1, Figure 3. Disconnect black cable (2) from negative (-) battery terminal (8).
5.	Refer to 1-2-1, Figure 3. Secure black cable (2) away from negative (-) battery terminal (8).
6.	Reassemble in reverse order of Steps 2 and 3.



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APPENDIX A - I/O CONNECTORS AND PIN-OUT TABLES

1. I/O CONNECTORS

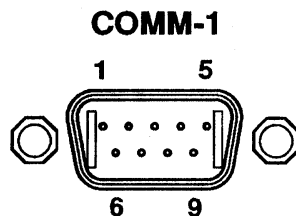
CONNECTOR	DESIGNATOR	TYPE	IN/OUT	SIGNAL
AC INPUT	10A1A8A1	3-Prong Plug	IN	ac Line Power
AUX I/O	10A1A8W1J1	25-Pin, D-Sub, Male	IN	See Pin-Out (Appendix A, Table 3).
COMM-1	10A1A8W3J1	9-Pin, D-Sub, Male	IN/OUT	See Pin-Out (Appendix A, Table 2).
COMM-2	10A1A8W2J1	25-Pin, D-Sub, Male		See Pin-Out (Appendix A, Table 4).
EXT REF IN	10A1A8J1	BNC	IN	10 MHz Clock
EXT REF OUT	10A1A8J2	BNC	OUT	10 MHz Clock
RF OUT	10A1A1J8	TNC Female	OUT	RF

I/O Connectors
Table 1

2. COMM-1 CONNECTOR PIN-OUT

PIN NUMBER	SIGNAL
1	DCD
2	TX
3	RX
4	DSR
5	GND
6	DTR
7	CTS
8	RTS
9	$\overline{\text{RI}}$

Pin-Out for COMM-1 Connector
Table 2



01018003

COMM-1 Connector
Figure 1



3. AUX I/O CONNECTOR PIN-OUT

PIN NUMBER	SIGNAL
1	EXT MOD
2	EXT NAV IN
3	N_EN AUX
4	EXT IN3
5	EXT IN4
6	EXT IN5
7	EXT IN6
8	EXT IN7
9	STRAP 10
10	
11	
12	
13	
14	EXT C/A OUT
15	EXT DATA OUT
16	G⓪
17	EXT OUT1
18	END
19	50 Hz
20	1 kHz
21	1.023 MHz
22	STRAP 11
23	
24	
25	GND

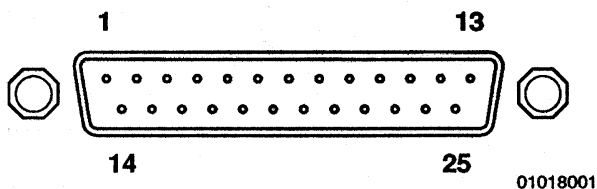
Pin-Out for AUX I/O Connector
Table 3

4. COMM-2 CONNECTOR PIN-OUT

PIN NUMBER	SIGNAL
1	
2	TX1 (232)
3	RX1 (232)
4	RTS1 (232)
5	CTS1 (232)
6	
7	GND
8	
9	
10	
11	
12	RX1_T (422)
13	RX1_C (422)
14	RTS1_T (422)
15	RTS1_C (422)
16	CTS1_T (422)
17	CTS1_C (422)
18	
19	
20	
21	
22	
23	
24	TX1_T (422)
25	TX1_C (422)

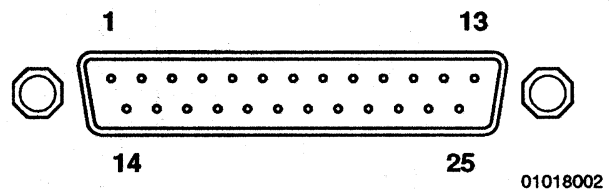
Pin-Out for COMM-2 Connector
Table 4

AUX I/O



AUX I/O Connector
Figure 2

COMM-2



COMM-2 Connector
Figure 3



APPENDIX B - NAV DATA AND ALMANAC INFORMATION

1. INFORMATION

1.1 NAV DATA

The 50 Hz NAV data is divided into 25 frames of 1500 bits. Each frame contains five 300-bit subframes. Each subframe contains ten 30-bit words. The GPS-101 transmits one subframe every six seconds and a full frame every 30 seconds. Transmission of the complete 25 NAV data frames requires 12.5 minutes (25x30 sec).

The first three subframes of each frame are generic and contain the same basic information for the selected satellite. The first three subframes contain the following information:

- Preamble indicates the start of a subframe and aids the receiver in synchronizing with the satellite data stream.
- Time of week (TOW) provides a time offset from midnight Saturday/Sunday in six second increments.
- GPS week indicates current week relative to January 5/6, 1980.
- Health indicates the operational status of the selected satellite. Satellites that are damaged, off course or out of synchronization are flagged as unhealthy. Unhealthy satellites must not be used by GPS receivers.

(The GPS-101 indicates an unhealthy satellite by displaying * in the SV field in the Main Menu screen.)

- Subframe ID provides additional verification of receiver synchronization with the satellite data stream.
- Accuracy alerts inform the receiver of possible satellite induced errors.
- Ephemeris provides short term information to determine with fair accuracy, the selected satellite position.

- Issue of Data Clock (IODC)/Issue of Data Ephemeris (IODE) changes to notify receiver Ephemeris data has been updated.

- Clock correction fields compensate for satellite timing errors.

The last two subframes, specific to each frame, contain parts of the almanac data. Some information is similar to the first three subframes except it usually applies to other satellites. The last two subframes contain:

- Preamble.
- TOW.
- GPS week.
- SV Identification indicates the particular satellite the following information applies to. The SV Identification field may also contain codes indicating the subframe contains reserved messages or data applying to several satellites.
- Health.
- Subframe ID.
- Accuracy alerts.
- Almanac contains reduced precision subsets of satellite Ephemeris information for all satellites in the constellation. Almanac data allows the receiver to determine the location of any satellite, resulting in reduced acquisition time.
- Ionospheric and UTC information data allows the receiver to compensate for atmospheric conditions and timing discrepancies caused by earth deceleration.



1.2 TEST PATTERNS

The GPS-101 currently contains three test patterns, selected in the Main Menu. Refer to 1-2-2.

The first test pattern (**T1**) contains a full set of 25 NAV data frames using the currently loaded almanac and Time/Date. The same NAV data (except date/time fields) is repeated every 12.5 minutes. The first test pattern should be used most often to test commercial GPS receivers.

The second test pattern (**T2**) transmits diagnostic (dummy) NAV data captured Thursday, November 3, 1994 at 02:10:36 UTC. The fixed sequence of 1500 bits (one frame) repeats, including same date/time fields, every 30 seconds. The dummy almanac data provided has coding to tell receivers not to update, but to maintain current almanac data. This pattern provides enough information to test GPS receiver operation. Unfortunately, many receivers incorrectly interpret dummy almanac data and overwrite the receiver almanac anyway, destroying the current almanac.

CAUTION: USING THE SECOND GPS-101 TEST PATTERN (**T2**) MAY DESTROY CURRENT RECEIVER ALMANAC CAUSING THE GPS RECEIVER TO FAIL MOMENTARILY IN LOCATING SATELLITES OR SHOW SYMPTOMS OF PRODUCT FAILURE.

If the current receiver almanac is destroyed, conduct test using the first test pattern (for ≥ 13 minutes) to reload current almanac.

The third test pattern (**T3**) repeats a fixed sequence of two ones and two zeros:

11001100110011001100110011001100...

The third test pattern is not intended to convey information, but to aid in alignment of the GPS receiver circuits.

Other test patterns (**T4-T9**) transmit NAV data consisting only of binary zeros.



2. PROCEDURES

The GPS-101 almanac requires periodic updating (every 30 days recommended). A new almanac, when available, should be uploaded into the GPS-101. If the currently loaded almanac is old, the GPS-101 displays alternating warning screens. Refer to 1.9 in 1-1-1.

CAUTION: USING THE GPS-101 WITH AN OUTDATED ALMANAC MAY CAUSE THE GPS RECEIVER TO FAIL MOMENTARILY IN LOCATING SATELLITES OR SHOW SYMPTOMS OF PRODUCT FAILURE.

Almanac updates can be obtained from the U.S. Coast Guard. Refer to 2.1 in Appendix B. For customer convenience, IFR Systems, Inc. offers a subscriber service to send an updated almanac every month for the GPS-101. Refer to Section 3 in Appendix B.

Refer to 2.2 in Appendix B for uploading the new almanac into the GPS-101. If the currently loaded almanac is desired for customer use, refer to 2.3 in Appendix B for downloading the current almanac.

2.1 OBTAINING DATA FROM COAST GUARD

STEP	PROCEDURE
1.	Use PC and modem to connect to U.S. Coast Guard NAVIGATION INFORMATION SERVICE BULLETIN BOARD. <i>WWW.NAVCEN.USCG.MIL</i> <i>Dial 703-313-5940. (GPS)</i>
2.	Select GPS Subsystem.
3.	Select Almanac Menu.
4.	Select "Yuma" Format.
5.	Note name of file.
6.	Select Y (Yes) to display or download file.
7.	Select download option. If compatible with current customer setup, select ZMODEM (>2400 bps modem). If not, select applicable YMODEM, XMODEM option or ASCII.
8.	After download of file, exit out to root level.
9.	Select Y (Yes) to terminate connection.

*WWW.NAVCEN.USCG.
MIL*

*(GPS)
YUMA FORMAT
ALMANACS*



2.2 UPLOADING ALMANAC DATA

STEP PROCEDURE

1. Connect Host System Comm Connector to COMM-1 Connector according to Appendix B, Figure 1 for 9-Pin operation or Appendix B, Figure 2 for 25-Pin operation.

2. Set COMM-1 Connector operating parameters according to 3.1 in 1-2-3.

- Set operating parameters to match user equipment and interface settings.
- Set Handshake to **RTS** for direct upload or **Xon** for modem operation.

3. Send following almanac data operation commands:

ALMAnac:CLEar

to clear GPS-101 of old almanac data.

ALMAnac:SET

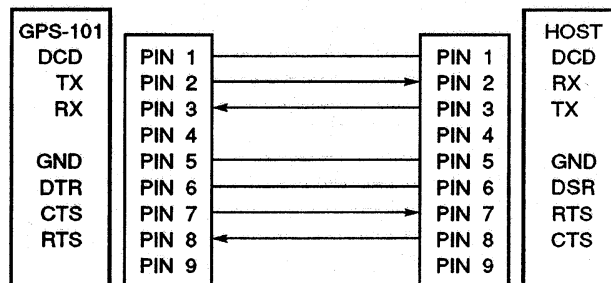
and follow directions on PC monitor screen to upload almanac file (ASCII text) into GPS-101.

NOTE: Short forms of commands are shown in upper case. Long forms include lower case letters. Commands themselves are not case sensitive.

4. If desired, send following almanac data status query:

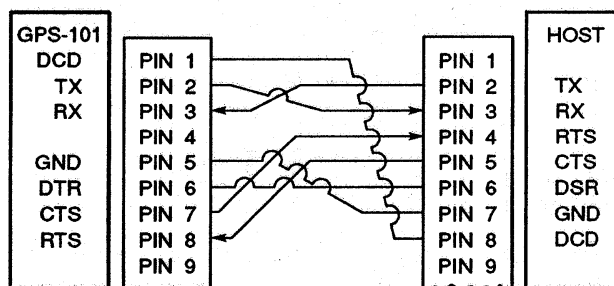
ALMAnac:STATus?

to return current GPS-101 almanac status. Refer to Appendix B, Table 1 for possible responses.



01003001

GPS-101 to Host System (9-Pin)
Figure 1



01003002

GPS-101 to Host System (25-Pin)
Figure 2

NOTE: A PC, using Terminal Emulation Software, or an RS-232 Terminal can be used as the Host System.

RESPONSE	STATUS
0	Almanac present, usable and recent.
1	Almanac not present or not usable.
2	Almanac present, but old.
3	No almanac data array present.

Almanac Status
Table 1



2.3 DOWNLOADING ALMANAC DATA

STEP	PROCEDURE
------	-----------

1. Connect Host System Comm Connector to COMM-1 Connector according to Appendix B, Figure 1 for 9-Pin operation or Appendix B, Figure 2 for 25-Pin operation.
2. Set COMM-1 Connector operating parameters according to 3.1 in 1-2-3.
 - Set operating parameters to match user equipment and interface settings.
 - Set Handshake to **RTS** for direct download or **Xon** for modem operation.
 - Setup PC communication software to record (log) received data.
3. Send following almanac data operation command:

ALMANac:GET?

to receive current almanac (ASCII text) from GPS-101.

NOTE: Short forms of the command are shown in upper case. Long forms include lower case letters. The command itself is not case sensitive.

1	R	
2	B	- R
3	0	
4	B) 0
5	W	
6	R	
7	B	- Y
8	R	
9	B	- G



3. SUBSCRIBER SERVICE

IFR Systems, Inc. provides a subscriber service (for a fee) to send an updated almanac for the GPS-101 every month. Each almanac file is sent on a 3.5 inch (≈ 8.9 cm) data disk. To subscribe to the IFR Almanac Update Service, please perform the following:

- Fill out the attached form.
- Fold on the dotted lines and seal with tape.
- Add regular postage stamp.
- Mail to the Customer Service department at IFR Systems, Inc.

If there are any questions, please contact IFR Systems, Inc. Customer Service at:

1-800-835-2350.

300 YR

IFR SYSTEMS, INC.
ALMANAC UPDATE SERVICE

FOR THE

GPS-101

COMPANY NAME: _____

CONTACT: _____

SHIPPING ADDRESS: _____

TELEPHONE NUMBER: _____

FAX NUMBER: _____

PLACE
STAMP
HERE

ATTEN: CUSTOMER SERVICE
IFR SYSTEMS, Inc.
10200 West York Street
Wichita, KS 67215

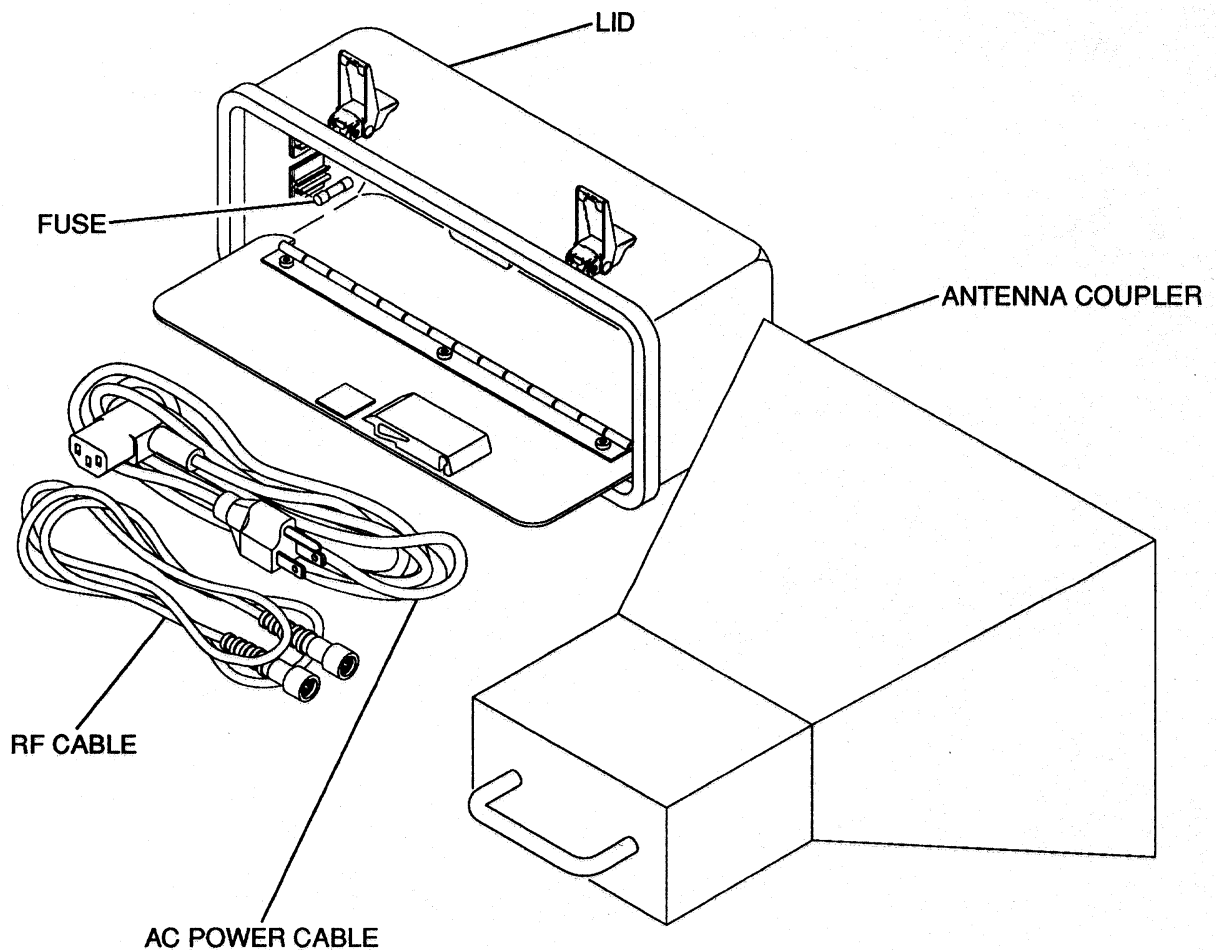


APPENDIX C - AUXILIARY EQUIPMENT

The GPS-101 stores the following equipment in the Lid:

- Two spare fuses (1.0 A, Fast for 120 VAC operation or 0.5 A, Fast, 250 V for 230 VAC operation).
- The ac power cable connects an external ac power source to the AC INPUT Connector.
- The RF cable (TNC to BNC coaxial cable) connects the RF OUT Connector to the GPS Receiver Input Connector or the Antenna Coupler Connector.

The Antenna Coupler (Horn Assembly) allows the GPS-101 to transmit through the GPS Receiver Antenna.



01007010

Auxiliary Equipment
Figure 1



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APPENDIX D - METRIC/BRITISH IMPERIAL CONVERSION TABLE WITH NAUTICAL DISTANCE CONVERSIONS

TO CONVERT:	INTO:	MULTIPLY BY:	TO CONVERT:	INTO:	MULTIPLY BY:
cm	feet	0.03281	meters	feet	3.281
cm	inches	0.3937	meters	inches	39.37
feet	cm	30.48	m/sec	ft/sec	3.281
feet	meters	0.3048	m/sec	km/hr	3.6
ft/sec	km/hr	1.097	m/sec	miles/hr	2.237
ft/sec	knots	0.5921	miles	feet	5280
ft/sec	miles/hr	0.6818	miles	km	1.609
ft/sec ²	cm/sec ²	30.48	miles	meters	1609
ft/sec ²	m/sec ²	0.3048	miles	nmi	0.8684
grams	ounces	0.03527	miles/hr	ft/sec	1.467
inches	cm	2.54	miles/hr	km/hr	1.609
kg	pounds	2.205	miles/hr	knots	0.8684
kg/cm ²	psi	0.0703	nmi	feet	6080.27
km	feet	3281	nmi	km	1.8532
km	miles	0.6214	nmi	meters	1853.2
km	nmi	0.5396	nmi	miles	1.1516
km/hr	ft/sec	0.9113	ounces	grams	28.34953
km/hr	knots	0.5396	pounds	kg	0.4536
km/hr	miles/hr	0.6214	psi	kg/cm ²	0.0703
knots	ft/sec	1.689	100 ft	km	3.048
knots	km/hr	1.8532	100 ft	miles	1.894
knots	miles/hr	1.1516	100 ft	nmi	1.645



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APPENDIX E - ABBREVIATIONS

A		E	
A	Amperes	EC	European Community
AC	Alternating Current	EEC	European Economic Council
ac	Alternating Current	ELAP	Elapsed
Alm	Almanac	EMC	Electromagnetic Compatibility
Apr	April	EMI	Electromagnetic Interference
ASCII	American National Standard Code for Information Interchange	ESD	Electrostatic Discharge
Aug	August	EXT	External
AUX	Auxiliary		
B		F	
Batt	Battery	FAX	Facsimile
bps	Bits per Second	FCC	Federal Communications Commission
BPSK	Bi-Phase Shift Keying	Feb	February
C		Ft	Foot/Feet
C	Celsius or Centigrade		
CAL	Calibration	G	
C/A	Coarse Acquisition	GHz	Gigahertz (10 ⁹ Hertz)
cm	Centimeter (10 ⁻² Meters)	GND	Ground
Comm	Communication	GNSS	Global Navigation System Satellite
CSA	Canadian Standards Association	GPS	Global Positioning System
CTS	Clear to Send		
CW	Continuous Wave	H	
D		HDOP	Horizontal DOP
DCD	Data Carrier Detect	hr	Hour
dB	Decibel	Hrs	Hours
dBc	Decibels above carrier	Hz	Hertz
dBm	Decibels above one milliwatt		
Dec	December	I	
DOP	Dilution of Precision	ID	Identification
DPLR	Doppler	I/O	Input/Output
DSR	Data Set Ready	IODC	Issue of Data Clock
DTR	Data Terminal Ready	IODE	Issue of Data Ephemeris
		J	
		Jan	January
		Jul	July
		Jun	June
		K	
		Kg	Kilogram (10 ³ Grams)
		KHz	Kilohertz (10 ³ Hertz)
		Km	Kilometers (10 ³ Meters)



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L		S	
lbs	Pounds	sec	second
LCA	Logic Cell Array	Sep	September
LCD	Liquid Crystal Display	SQR	Square
LT	Light	SV	Satellite Vehicle
M		T	
m	Meter	TDOP	Time DOP
Mar	March	TOW	Time of Week
MHz	Megahertz (10^6 Hertz)	TTL	Transistor-Transistor Logic
mA	Milliamp (10^{-3} Amperes)	TX	Transmit
μ A	Microamp (10^{-6} Amperes)		
N		U	
NAV	Navigation	UERE	User Equivalent Range Error
nmi	Nautical Miles	UL	Underwriter Laboratories
Nov	November	U.S.	United States
NVRAM	Non Volatile RAM	U.S.A.	United States of America
O		UTC	Coordinated Universal Time
Oct	October	UUT	Unit Under Test
Ω	Ohm		
GND	Ground		
GNSS	Global Navigation System Satellite	V	Volt
GPS	Global Positioning System	VAC	Volts, Alternating Current
P		VDOP	Vertical DOP
PC	Personal Computer	V_{P-P}	Volts, Peak to Peak
PDOP	Position DOP (combined HDOP and VDOP)		
ppm	Parts per Million	W	Watt
PR	Pseudorandom Range		
PRN	Pseudorandom Noise		
psi	Pounds per Square Inch	yr	Year
PSK	Phase Shift Keying		
PWR	Power		
R			
RAM	Random Access Memory		
RF	Radio Frequency		
RFI	Radio Frequency Interference		
RI	Ring Indicator		
ROM	Read Only Memory		
RTC	Real Time Clock		
RTS	Request to Sent		
RX	Receive		



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ac power cable
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