# Relay User Guide

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---

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- (List of notices and specifications)
Relay User Guide

Notice

General Notices

The following notices apply to the Relay.

WARNING!: Changes or modifications to this equipment not expressly approved by Ag Leader could result in violation of FCC, Industry Canada and CE Marking rules and void the user's authority to operate this equipment.

WARNING!: Relay products are available in several different radio configurations. Regulations for legal operation of these radio devices vary by country and the applicable local frequency management authorities. They may operate either on license free channels or on channels where the operation requires a license. Radio transceiver modules shall only to be operated at frequencies allocated by local authorities, and without exceeding the given maximum allowed output power ratings.

WARNING!: Relay equipment should be installed under the guidance of experienced, qualified professionals to ensure that applicable licensing considerations are properly addressed, and that operation of the installed system configuration, (including selected antennas), will be compliant with local regulatory and safety requirements. It remains the installer's responsibility to ensure that an installation operates within EIRP emission limits, and that appropriate separation distances for personal safety are maintained.

WARNING!: Users of UHF 400 MHz radio transceiver modules in North America should be aware, that due to the allocation of the frequency band 406.0 – 406.1 MHz for government use only, the use of radio transceiver module on this frequency band without a proper permit is strictly forbidden.

Export Restrictions

Relay UHF radio variants may be subject to control by the Export Administration Regulations (EAR) and/or the International Traffic in Arms Regulations (ITAR). Export, re-export, or transfer of these products without required authorization from the U.S. Department of Commerce, Bureau of Industry and Security, or the U.S. Department of State, Directorate of Defense Trade Controls, as applicable, is prohibited. Any party exporting, re-exporting, or transferring these products is responsible for obtaining all necessary U.S. government authorizations required to ensure compliance with these and other applicable U.S. laws. Consult with your legal counsel for further guidance.

WARNING!: Changes or modifications to this equipment not expressly approved by Ag Leader could result in violation of FCC, Industry Canada and CE Marking rules and void the user's authority to operate this equipment.

FCC Notices

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

The Relay has been tested and found to comply with the emission limits for a Class B digital device, pursuant to part 15 of the FCC Rules. The Class B limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Re-orient or relocate the Relay
- Increase the separation between the equipment and the Relay
• Connect the equipment to an outlet on a circuit different from that to which the Relay is connected
• Consult the dealer or an experienced radio/TV technician for help

WARNING!: Changes or modifications not expressly approved by the party responsible for compliance could void
the user’s authority to operate the equipment.

CAUTION!: In order to maintain compliance as a Class “B” digital device, shielded cables should be used for the RS-
232 serial data ports (Belden 1036A or equivalent) and twisted pair cable should be used for the CAN port (shielded
twisted pair will improve CAN performance in electrically harsh environments). I/O signals should be referred to
signal ground (connector pin 5) and not power ground (connector pin 9). If I/O signals route to different areas of the
vehicle, dedicated signal grounds for I/O should be spliced into a common connection to connector pin 5 at a point
close to the receiver.

Industry Canada

Relay Class B digital apparatus complies with Canadian ICES-003.

Relay appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

Under Industry Canada regulation, Relay radio transmitters may only operate using an antenna of a type and maximum (or
less) gain approved for the transmitter by Industry Canada. To reduce the potential radio interference to other users, the
antenna type and gain should be chosen so that the equivalent isotropically Radiated Power (RP) is not more than
necessary for successful communication.

CE

The enclosures carry the CE mark.

"Hereby, Ag Leader declares that this Relay is in compliance with the essential requirements and other relevant provisions

A-Tick Marking

The HSPA model of the Relay carries the A-Tick compliance mark.

Safety

WARNING!: Switch OFF your Relay when around gasoline or diesel-fuel pumps and before filling your vehicle with
fuel. Respect restrictions on the use of radio equipment in fuel depots, chemical plants or where blasting operations
are in progress.

WARNING!: There may be a hazard associated with the operation of your Relay close to inadequately protected
personal medical devices such as hearing aids and pacemakers. Consult the manufacturers of the medical device
to determine if it is adequately protected.

WARNING!: Operation of your Relay close to other electronic equipment may also cause interference if the
equipment is inadequately protected. Observe any warning signs and manufacturers’ recommendations.

WARNING!: RF Exposure

Maximum permissible antenna gains and minimum permissible separation distances between antennas and all
persons will vary by radio variant, and must be addressed on a radio specific basis to ensure compliance with FCC,
IC, and other applicable RF exposure compliance requirements. Devices must not be co-located or operating in
conjunction with any other antenna of transmitter. Refer to the radio specific notices for additional guidance.

WEEE Notice

If you purchased your Relay in Europe, please return it to your dealer or supplier at the end of its life. The objectives of the
European Community’s environment policy are, in particular, to preserve, protect and improve the quality of the
environment, protect human health and utilize natural resources prudently and rationally. Sustainable development advocates the reduction of wasteful consumption of natural resources and the prevention of pollution. Waste electrical and electronic equipment (WEEE) is a regulated area. Where the generation of waste cannot be avoided, it should be reused or recovered for its material or energy.

WEEE products may be recognized by their wheeled bin label ().

**REACH**

Ag Leader strives to comply with the EU Directive EC 1907/2006 on chemicals and their safe use as per the Registration, Evaluation, Authorization and Restriction of Chemical substances (REACH) for its products, including the GPS 7500 receiver. Since REACH SVHC lists are updated occasionally, please contact Ag Leader Customer Support if you require further information.

⚠️ WARNING!: Cables may contain DEHP (CAS Number 117-81-7) in concentrations above 0.1% w/w.

**RoHS**

The SMART family are compliant with the European Union (EU) Restriction of Hazardous Substances (RoHS) Directive 2011/65/EU.


**UHF Radios**

**400 MHz Radios**

400 MHz UHF Relays variants contain a radio transceiver module with the following modular approvals:

- FCC ID: MRBSATEL-TA23
- IC ID: 2422A-SATELTA23

The radio transceiver module has been designed to operate on 403-473 MHz, the exact use of which differs from one region and/or country to another. The user of a radio transceiver module must take care that the said device is not operated without the permission of the local authorities on frequencies other than those specifically reserved and intended for use without a specific permit.

The radio transceiver is allowed to be used in the following countries, either on license free channels or on channels where the operation requires a license. More detailed information is available at the local frequency management authority.

- Countries: AT, BE, BG, CA, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MT, NL, NO, PL, PT, RU, RO, SE, SI, SK, US

⚠️ WARNING!: Restricted Use

Users of UHF 400 MHz radio transceiver modules in North America should be aware, that due to the allocation of the frequency band 406.0 – 406.1 MHz for government use only, the use of radio transceiver module on this frequency band without a proper permit is strictly forbidden.

⚠️ WARNING!: RF Exposure

To comply with FCC and IC RF exposure compliance requirements, maximum antenna gain is 14 dBi and separation distance of at least 1 meter must be maintained between the antenna of this device and all persons, (when Relay 400 MHz is used in a transmitter/base station configuration). Professional installation is required, and radio power must be adjusted by the installer, based on the antenna system gain, so as not to exceed FCC prescribed output power limits. This device must not be located or operating in conjunction with any other antenna or transmitter. Installers shall ensure that the device is not configured as a transmitter/base station when installed on a rover, and personal separation distances of only 20 cm may be expected.
**900 MHz Radios**

900 MHz UHF Relays variants contain a radio transceiver module with the following module approvals:

- FCC ID: KNYAMM0921TT
- IC ID: 2329B-AMM0921TT

**WARNING!: RF Exposure**

Antennas used with the RELAY UHF 900 MHz variant must have the following characteristics to remain in compliance with FCC requirements and regulations; Antenna gain does not exceed 12 dBi for Yagi antennas and 8.15 dBi for Omni antennas, and, Overall system Equivalent Isotropically Radiated Power (EIRP) does not exceed 36 dBm. Professional installation is required, and radio power must be adjusted by the installer, based on the antenna system gain, so as not to exceed FCC prescribed output power limits. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 23 cm from all persons and must not be collocated or operating in conjunction with any other antenna or transmitter.

**Customer Support**

**Contact Information**

Use one of the following methods to contact Ag Leader Support:

- ph: (515) 232-5363
- fax: (515) 232-3595
- e-mail: support@agleader.com

**Service**

There are no user-serviceable parts inside the receiver. Contact the manufacturer for a Return Material Authorization (RMA).

- ph: (515) 232-5363
- fax: (515) 232-3595
- e-mail: support@agleader.com

**Conventions Used In This Manual**

**Cautions and Warnings**

The operators manual uses the following text formatting schemes to call attention to information related to simplifying system operation and proper operating practices to prevent accidental data loss. If in doubt about the results of performing an action or deleting an item from the system, back up all system files to the USB external drive prior to proceeding with the action.

- NOTE!: Provides informative tips to assist with system setup, calibration, and operation.
- CAUTION!: Indicates specific settings, calibrations, and procedures that must be followed for proper system performance and operation.
- WARNING!: Indicates specific instructions to avoid accidental loss of data and system configurations settings.

**Cross-references and Web Links**

Throughout this manual, numerous cross-references are provided to other pages or sections. These cross-references are always shown in blue, italic text; and list the title and page number as in the following example: Refer to “Conventions Used In This Manual” on page 4. If you are viewing this manual in PDF format, you can click on this blue text and go directly to the link.
Relay

Viewing this Manual Online

This operators manual can be viewed online at Ag Leader's Web site. To view and/or print the Operators Manual online, you will need the Adobe Acrobat or Adobe Reader. The Adobe Reader software comes pre-installed on most personal computers. If Adobe Reader is not installed on your computer the program is available for download at no charge. A link to the Adobe download site is located at the Ag Leader Web site.

Product Registration

Contact your Ag Leader dealer for technical support.

When registering your Ag Leader Technology products by one of the following methods, you can elect to receive notice of any new product updates or features.

Register by mail:

Ag Leader Technology
2202 South Riverside Dr.
Ames, IA 50010

Register by Fax: 515-232-3595

Register at the Ag Leader Web site at http://www.agleader.com

Overview

The device is an RTK rover radio module for GPS 7500 antennas. The Relay attaches to the GPS 7500 to create a single unit for easy system integration. The RELAY provides the GPS 7500 with radio connectivity to support RTK corrections.

When the RELAY and GPS 7500 are connected, the optional GPS 7500 interface cable is connected to the RELAY and is used to deliver pass-through power, RS-232 ports, CAN Bus and ground speed output from the GPS 7500.

The GPS 7500 COM3 RS-232 port is not available when the RELAY is connected.

Features

The main features are:

- Satel UHF 400 MHz or 900 MHz radio options to support RTK corrections
- Can be mounted to a vehicle using integrated magnets
- Water and dust tight enclosure
- Integrated NMO radio antenna mount

The TNC to NMO cable is installed in the factory. It can be removed to install and optional external antenna.

Connector Overview

The RELAY uses the same cable for power and communication as the GPS 7500. Use the Ampseal connector at the front of RELAY to connect to the GPS 7500.
RTK Radio Mount

The RELAY internal 400 MHz or 900 MHz radio can be used to receive RTK corrections from a compatible base station. An external antenna must be connected to the back of the RELAY.
**Relay Connectors**

<table>
<thead>
<tr>
<th>Connector</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS 7500 Antenna Port</td>
<td>14-pin Ampseal connector</td>
</tr>
<tr>
<td></td>
<td>Connects to the 14-pin connector on the receiver.</td>
</tr>
<tr>
<td>COM and Power Port</td>
<td>14-pin Ampseal connector</td>
</tr>
<tr>
<td></td>
<td>Connects to the cable that provides power for the Relay and receiver.</td>
</tr>
<tr>
<td>Radio Antenna Port</td>
<td>Connects the radio and cell modem in the Relay to the external radio antenna.</td>
</tr>
</tbody>
</table>

**Installation and Setup**

**Relay Setup**

Complete the following steps to connect and power the Relay.

1. Connect the receiver to the Relay.
2. Mount the Relay on a secure, stable structure with an unobstructed view of the sky from horizon to horizon.
3. Connect the interface cable to the COM and Power port on the back of the Relay.
4. Connect the Relay to the external antenna.
5. Connect the display GPS cable to the display GPS serial port. The power LED on the Relay glows red when the Relay is properly powered.
Simplified Relay Setup

NOTE: Minimum conductor size for all signal wiring is 0.5 mm/20 AWG. Minimum conductor size for power wiring.
is 1.25 mm/16 AWG. For user fabricated cables, all wire insulation sizes in the Tyco 14-pin connector must conform to the manufacturer’s recommendations for insulation diameter range (or watertight seal integrity will be compromised).

**Attach and Connect RELAY to GPS 7500**

NovAtel’s RELAY rover radio module attaches to the GPS 7500 to create a single unit for easy system integration.

Before attaching the RELAY to the GPS 7500, make note of the SSID and password (passkey) found on the label on the “connector” back side of the GPS 7500.
1. Ensure cable connection for the Ampseal interface is complete.

2. Tilt the RELAY unit slightly up and slide onto the GPS 7500 unit in the locations marked by the four arrows.

3. Hand fasten the M4 screws (x4). Bit required: M2.5 Hex, torque = 10 to 12 in-lb. Failure to properly install the four screws may cause damage.
Once complete, flip the combined GPS 7500/RELAY over. The optional NovAtel interface cable or the vehicle’s cable attached to the navigation system can be used to connect to the RELAY and power the combined units.

To prevent damage or cable fatigue, ensure any loose cables are secured.

**Connect the RELAY to the Radio Antenna Mount**

To receive UHF radio signals, the RELAY must be connected to a radio antenna. The NMO to TNC Adapter cable comes factory installed. To use an optional external antenna, the cable can be removed. Use the information below to disconnect or reconnect the cable if required later.

**A.** Separate the NMO to TNC Adapter cable.

**B.** From below, slide the now separated NMO end of adapter cable into the slot at the bottom of the RELAY.

**C.** Push the NMO end of the adapter cable up and through the hole in the RELAY.

**D.** Ensure the white washer is in place before attaching the separated part of the NMO cable onto the top of the protruding end of the adapter cable. Hand turn to tighten.

**E.** Connect the TNC end of the cable to the GPS 7500. Hand turn to tighten.

**F.** Attach UHF Radio 400 MHz or 900 MHz antenna as required.
Power Up the RELAY

Once internal connections between the GPS 7500 and RELAY are complete and the two modules tightly attached, connect the GPS 7500 Ampseal interface cable to the back of the RELAY. Apply power and check the front LED on the RELAY for status.

To prevent damage or cable fatigue, ensure any loose cables are secured.

Configuration

The RELAY must be connected to the GPS 7500 and powered up before it can be configured.

To configure the RELAY:

1. The GPS 7500 must be configured to communicate with the RELAY.
2. The GPS 7500 must detect the radio.
3. The radio in the RELAY can be configured or queried.

Connect Power

Power is connected to the Relay through the COM and Power port on the back of the Relay. This power connection provides power to both the Relay and the receiver.

Power Supply Requirements

The Relay requires +9 to +36 VDC input power. The power supply connected to the Relay must be capable of providing enough power for both the Relay and the receiver.

⚠️ WARNING!: The power source must be protected by a 10 A Fast Blow Fuse or damage to wiring may result (not covered by warranty).

Status Indicator

The RELAY has a single LED to indicate the radio status. The LED is located above the radio icon on the back of the RELAY.

<table>
<thead>
<tr>
<th>LED Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid Green</td>
<td>Power On - Ready - No data transmitting to GPS 7500</td>
</tr>
<tr>
<td>Flashing Green</td>
<td>Data is being transmitted between RELAY and GPS 7500</td>
</tr>
<tr>
<td>Solid Red</td>
<td>The radio has encountered an error</td>
</tr>
</tbody>
</table>
## Relay Radio Specification

**Wi-Fi Radio (only on available UHF radio models)**

<table>
<thead>
<tr>
<th>Standards</th>
<th>802.11 b/g/n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Band</td>
<td>2.4 GHz</td>
</tr>
</tbody>
</table>

**CDMA Cellular Radio**

<table>
<thead>
<tr>
<th>Frequency Band</th>
<th>800/1900 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Interface</td>
<td>S-95A/B and CDMA2000</td>
</tr>
<tr>
<td>Data Support</td>
<td>1xRTT</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>CDMA 1x: -108 dBm (typical)</td>
</tr>
</tbody>
</table>

**HPSA Cellular Radio**

<table>
<thead>
<tr>
<th>Frequency Band</th>
<th>850 to 1900 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depending by frequency band(s) provided by the network operator. Use the most suitable antenna for the band(s).</td>
<td></td>
</tr>
<tr>
<td>Bandwidth</td>
<td>70 MHz in GSM850, 80 MHz in GSM900, 170 MHz in DCS and 140 MHz PCS band</td>
</tr>
<tr>
<td>VSWR</td>
<td>Maximum &lt;= 10:1</td>
</tr>
<tr>
<td></td>
<td>Recommended &lt;= 2:1</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>-107 dBm (typical)</td>
</tr>
<tr>
<td>Output Power</td>
<td>Class 4 (2 W) @ 850/900 MHz</td>
</tr>
<tr>
<td></td>
<td>Class 1 (1 W) @ 1800/1900 MHz</td>
</tr>
</tbody>
</table>

**400 MHz Radio**

<table>
<thead>
<tr>
<th>Frequency Band</th>
<th>403 to 473 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmit Power</td>
<td>1 W</td>
</tr>
<tr>
<td>Data Bandwidth</td>
<td>12.5 or 25 kHz</td>
</tr>
<tr>
<td>Receive Sensitivity</td>
<td>-113 dBm @ 25 kHz</td>
</tr>
<tr>
<td>Compatibility</td>
<td>Satelline 3AS, PacCrest (4FSK, GMSK and FST), TrimTalk 450s (P and T)</td>
</tr>
</tbody>
</table>

**900 MHz Radio**

<table>
<thead>
<tr>
<th>Frequency Band</th>
<th>902 to 928 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmit Power</td>
<td>1 W</td>
</tr>
<tr>
<td>Receive Sensitivity</td>
<td>-108 dBm</td>
</tr>
<tr>
<td>Compatibility</td>
<td>Freewave MM2-T</td>
</tr>
</tbody>
</table>
## Physical and Electrical Specifications

### Physical Description

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>186.5 L mm x 199.5 W mm x 76.4 H mm</td>
</tr>
<tr>
<td>Weight</td>
<td>&lt;850 grams</td>
</tr>
<tr>
<td>Status LED</td>
<td>Daylight viewable</td>
</tr>
</tbody>
</table>

### Connector Description

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Connector</td>
<td>14-pin Tyco Ampseal</td>
</tr>
<tr>
<td>External Radio Antenna Cable</td>
<td>TNC female jack, 50 Ω nominal</td>
</tr>
<tr>
<td>Optional Ethernet Cable</td>
<td>M12D (M) to (F)</td>
</tr>
</tbody>
</table>

### Mounting Specifications

- 4 x M4 screw insert to GPS 7500
- Integrated magnetic mount
- Screw mount plate 3-M4

### Interface Ports Description

<table>
<thead>
<tr>
<th>Port Description</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS-232 dedicated ports</td>
<td>2</td>
</tr>
<tr>
<td>CAN Bus NMEA 2000</td>
<td>1</td>
</tr>
<tr>
<td>Ground speed output</td>
<td>1</td>
</tr>
<tr>
<td>Optional Ethernet</td>
<td>1</td>
</tr>
</tbody>
</table>

### Electrical Description

- Input Voltage Range: +7 to +30 VDC
- Power Consumption: 2 W typical

### 400 MHz Radio Model Description

- Frequency Band (receive only): 403 to 473 MHz
- Rx Sensitivity:
  - -112 dBm @ 25 kHz
  - -116 dBm @ 12.5 kHz

### 900 MHz Radio Model Description

- Frequency Band (receive only): 902 to 928 MHz
- Rx Sensitivity: -108 dBm
Mechanical Specifications

GPS 7500 Attachment Locations (X4)

M4x0.7 Blind Threaded Insert (x3)

Dimensions are in millimeters. Internal thread length (i.e. distance from bottom surface) = 9.2 mm.
Torque = 11 in-lb but could be 10-12.
Environmental Specifications

<table>
<thead>
<tr>
<th>Environmental Specifications</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Temperature</td>
<td>-40°C to +70°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-45°C to +80°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>MIL-STD-810G(CH1), Method 507.6</td>
</tr>
<tr>
<td>Immersion</td>
<td>MIL-STD-810G(CH1), Method 512.6</td>
</tr>
<tr>
<td>Ingress Protection Rating</td>
<td>P67, IP69</td>
</tr>
<tr>
<td>Shock</td>
<td>MIL-STD-810G(CH1), Method 516.7</td>
</tr>
<tr>
<td>Solar Radiation</td>
<td>MIL-STD-810G(CH1), 505.6</td>
</tr>
<tr>
<td>Salt Fog</td>
<td>MIL-STD-810G(CH1), 509.6</td>
</tr>
<tr>
<td>Sand and Dust</td>
<td>MIL-STD-810G, 510.6</td>
</tr>
<tr>
<td>Vibration</td>
<td>MIL-STD-810G, Method 514.7</td>
</tr>
<tr>
<td>UV Protection</td>
<td>MIL-STD-810G, 505.6</td>
</tr>
<tr>
<td>I/O Protection</td>
<td>ISO 7637 and ISO 15003</td>
</tr>
<tr>
<td>Compliance</td>
<td>FCC, ISED, CE Mark, E-Mark</td>
</tr>
</tbody>
</table>

Connector Pin Outs

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Pin Function (Black Ampseal, Male)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>COM1 TXD Passthrough</td>
</tr>
<tr>
<td>2</td>
<td>COM1 RXD Passthrough</td>
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<td>6</td>
<td>CAN+ Passthrough</td>
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<td>7</td>
<td>CAN- Passthrough</td>
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<td>PWR-</td>
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Relay

The following are lists of the replacement parts available for the Ag Leader Relay. Should assistance be required or you need to order additional components, contact Ag Leader Support.

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<th>Part Description</th>
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<td>GPS 7500 User Manual</td>
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