Global Traffic Technologies

Installation Manual	June 2011

Opticom™ GPS System

Vehicle Equipment

Table of Contents

1 About This Manual

1.1 Purpose of Manual

This manual provides step-by-step instructions for installing the Global Traffic Technologies Opticom™ GPS System* vehicle equipment. It is intended for use by installers, maintenance personnel, and others who are responsible for the installation and maintenance of the system.

1.2 Manual Conventions

The conventions listed in Table 1-1 help to make this manual easier to use by presenting a uniform approach to the descriptions, phrases, and nomenclature.

1.3 Related Publications

Opticom™ GPS System Intersection Equipment Installation Instructions.

Opticom™ GPS System Operation Manual.

1.4 Manual Organization

This manual is divided into eight sections.

Section 1. About This Manual
Contains information about the organization and content of this manual.

Section 2. Safety Information
Contains important information about the safety messages, safety labels, safety precautions, and procedures for installation of this device.

Section 3. Description
Briefly describes the vehicle equipment and related system components.

Section 4. Features
Describes important features and characteristics of the vehicle equipment.

Section 5. Installation
Contains step-by-step installation instructions.

Section 6. Checkout
Contains information on how to check out and test the installed system.

Section 7. Troubleshooting
Contains problem solutions to troubleshoot the installed system.

Section 8. Maintenance
Contains information and recommendations to ensure reliable system operation.

Table 1-1. Manual Conventions

Element	Convention	Example
Names	First or formal reference: initial caps	Opticom™ GPS System Vehicle Radio/GPS Unit
	Subsequent use or informal reference: lowercase	radio/GPS unit
Feature names	Initial caps	the Disable feature
Switch position	Uppercase	the OFF position

*The method of using the components of the Opticom™ GPS system may be covered by one or more of US Patent Numbers 5539398, 5926113, 5986575, 6243026.

2 Safety Information

We provide important safety information and warnings to assist you in understanding and avoiding potential harm to yourself, and possible damage to equipment, during the installation of Opticom™ GPS System equipment. Although we have included many potential hazards you may encounter during the installation of this equipment, we cannot predict all of the possible hazards and this list should not be a substitute for your judgment and experience.

Please read, understand, and follow all safety information contained in these instructions before installing the system equipment. Save this installation manual and keep it near the equipment.

If you are unsure about any part of this installation or of the potential hazards discussed, please contact your supervisor immediately.

2.1 Intended Use

The system is intended to assist authorized priority vehicles through signalized intersections by providing temporary right-of-way through vehicle operator interface to the system and through the use of common traffic controller functions. GTT has not evaluated this product for use in any other application.

2.2 Technical Support

If you have questions about the system, its use, or operation, please contact your dealer or call the GTT Technical Service department at 1-800-258-4610.

2.3 Safety Messages and Safety Labels

We include safety messages and safety labels in this manual to help you protect your safety and the safety of others. This section contains important information to help you recognize and understand these safety messages.

Please read all messages before proceeding with the installation.

2.3.1 Safety Message Format

Safety messages are designed to alert you to potential hazards that can cause personal injury to you or others. They can also indicate the possibility of property damage.

Each safety message box contains a safety alert symbol (⚠); one of three signal words: WARNING, CAUTION, or IMPORTANT NOTE; and a safety message.

The signal words and symbols, and their meanings, are shown below:

⚠ **WARNING**
The safety message is in this box.

WARNING indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury.

⚠ CAUTION
The safety message is in this box.

CAUTION indicates a potentially hazardous situation, which, if not avoided, may result in minor or moderate injury.

▢ IMPORTANT NOTE
The safety message is in this box.

IMPORTANT NOTE indicates a potentially hazardous situation, which, if not avoided, may result in property damage.

In addition to the symbols and words explained above, each safety message identifies the hazard, describes what you can and should do to avoid the risk of exposure to the hazard, and tells the probable consequences of not avoiding the hazard.

2.3.2 Safety Label Format

We include safety labels on the devices to help you protect your safety and the safety of others. Safety labels are designed to alert you to potential hazards associated with a piece of equipment that can cause personal injury to you or others. They can also indicate the possibility of property damage.

Please read all safety labels.

Each safety label contains a safety alert symbol (⚠), one of two signal words: WARNING or CAUTION, a pictorial showing the nature of the hazard, and a safety message.

The signal words and symbols, and their meanings, are shown below:
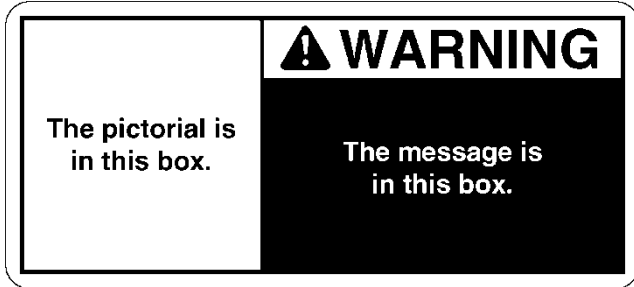
Opticom-243A

WARNING indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury.
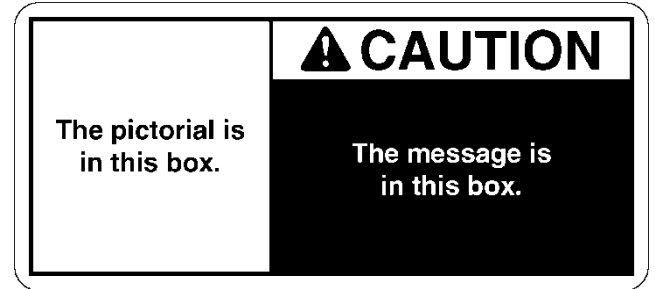
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CAUTION indicates a potentially hazardous situation, which, if not avoided, may result in minor or moderate injury.

We consider safety labels to be an important part of all devices and they should be replaced immediately if they become hard to read.

If any of the safety labels are missing or cannot be read, please contact your dealer or the GTT Repair department for a replacement.

2.4 Safety Messages Contained in this Manual

The following safety messages appear in this manual:

⚠ WARNING

This equipment has been approved for mobile applications where the equipment should be used at distances greater than 20 cm from the human body (with the exception of hands, wrists, feet and ankles). Operation at distances less than 20cm is strictly prohibited.

⚠ AVERTISSEMENT

Cet équipement a été approuvé pour les applications mobiles où l'équipement devrait être utilisé aux distances plus grandes que 20 cm du corps humain (avec l'exception de mains, les poignets, les pieds et les chevilles). L'opération aux distances moins que 20 cm est strictement interdit.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Note: Cet équipement a été testé et trouvé conforme aux limites pour un numérique de classe A, conformément à la partie 15 des règles FCC. Ces limites sont conçues pour fournir une protection raisonnable contre les interférences nuisibles lorsque l'équipement est utilisé dans un environnement commercial. Cet équipement génère, utilise et peut émettre des fréquences radio et, s'il n'est pas installé et utilisé conformément aux instructions, peut causer des interférences nuisibles aux communications radio. L'opération de cet équipement dans une zone résidentielle est susceptible de provoquer des interférences nuisibles, auquel cas l'utilisateur devra corriger ces interférences à ses propres frais.

NOTICE

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A conforme à la norme NMB-003 du Canada.

⚠ IMPORTANT NOTE

Modifying the radio/GPS unit may seriously damage the equipment and void the warranty. **Do not attempt to modify the radio/GPS circuitry in any way.** Modifying the radio and/or antenna in any way may cause the radio to violate FCC/IC requirements.

☐ REMARQUE IMPORTANTE

La modification du système radio/GPS risque d'endommager sérieusement le matériel et d'annuler la garantie. **Ne pas tenter de modifier les circuits du système radio/GPS de quelque façon que ce soit.** En modifiant le système radio et/ou l'antenne de quelque façon que ce soit, la radio risque de ne plus répondre aux exigences de la FCC/IC.

⚠ WARNING

Vehicle batteries contain sulfuric acid and may contain explosive gases. **Keep sparks, flames, and cigarettes away. Wear eye protection. Disconnect the negative cable first to prevent shorting the positive terminal to the chassis when removing the positive cable.** Battery acid may cause skin irritation and eye injury. Explosive gases may cause severe injury or death.

⚠ Avertissement

Les batteries du véhicule contiennent de l'acide sulfurique. Elles risquent également de contenir des gaz explosifs. **Il faut donc les conserver à l'écart des étincelles, des flammes et des cigarettes. Porter des lunettes de protection. Lors du retrait du câble positif, débrancher d'abord le câble négatif pour empêcher la borne positive de court-circuiter le châssis.** L'acide de la batterie risque d'irriter la peau et de causer des blessures aux yeux. Les gaz explosifs risquent de causer des blessures graves ou la mort.

⚠ WARNING

A completed installation that is not tested may result in improper system operation, which may result in accidents and/or injuries. **To avoid this problem, test the system to verify proper operation.** Improper system operation may result in unsafe driver action.

⚠ Avertissement

Une fois terminée, il faut tester l'installation sinon, le système risque de ne pas fonctionner adéquatement et, par conséquent, de causer des accidents et/ou des blessures. **Pour éviter ce problème, tester le système pour s'assurer qu'il fonctionne adéquatement.** Un fonctionnement inadéquat peut occasionner chez les conducteurs une conduite dangereuse.

☐ CAUTION

Failure to replace the fuse size as marked may cause property damage. Replace fuse size as marked.

⚠ Mise en garde

Le fait de remplacer le fusible avec un fusible d'un autre calibre risque de causer des dommages matériels. Remplacer le fusible avec un fusible de même calibre.

2.5 Label Locations

There is one safety label, one FCC label and one IC label on the Opticom™ GPS System vehicle equipment. If a label is missing or cannot be read, please contact your dealer or the GTT Repair department for a replacement. See Figures 2-1 and 2-2 for label locations.

Il ya une étiquette de sécurité, une étiquette de la FCC et une étiquette IC sur l'équipement Opticom ™ GPS Système de véhicule. Si une étiquette est manquante ou ne peut pas être lue, s'il vous plaît contacter votre revendeur ou le département de service de GTT pour un remplacement. Voir les figures 2-1 et 2-2 pour les emplacements des étiquettes.

☐ **CAUTION**

Failure to replace the fuse size as marked may cause property damage. Replace fuse size as marked.

⚠ **Mise en garde**

Le fait de remplacer le fusible avec un fusible d'un autre calibre risque de causer des dommages matériels. Remplacer le fusible avec un fusible de même calibre.
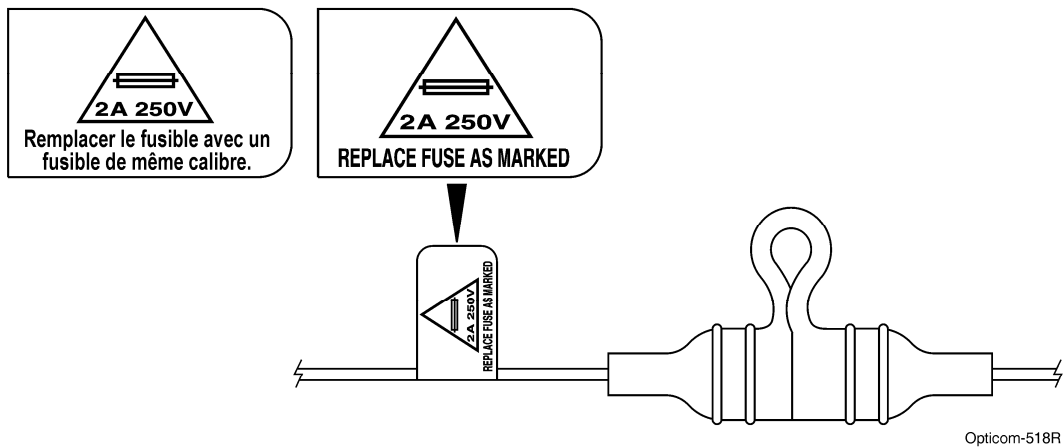

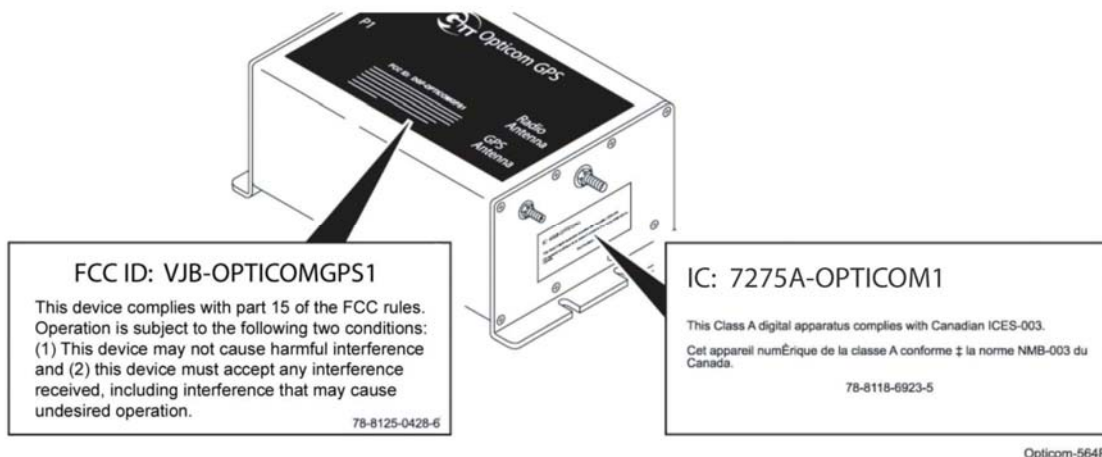**Figure 2-1. Vehicle Equipment Fuse Safety Label Location**

Figure 2-2. FCC, IC Label Location

2.6 Safety Considerations

Please consider the following safety issues before beginning the installation of the Opticom™ GPS System vehicle equipment.

Although we have compiled this list of common safety considerations, it should not be considered as complete. It is not intended to take the place of your good judgment, training, and experience.

2.6.1 Personal Safety Equipment and Clothing

Personal safety equipment and clothing including high visibility vests, hard hats, gloves, electrical shock or electrocution protection clothing and equipment, safety shoes, safety glasses, face shields, goggles, and hearing protection devices are just some of the items available to you.

Choose the right equipment for the job. If you are unsure of which safety equipment is recommended or appropriate for the job, ask your supervisor or foreman.

2.6.2 Electric Shock

As a trained installer of electrical equipment you are aware of the dangers associated with installation of electrical devices. Always be sure that the power to the equipment, and all associated equipment, is turned off and the vehicle battery is disconnected. Use the equipment, techniques, and procedures that you learned during your training or apprenticeship or other electrical industry recognized safety procedures.

If you are unsure of which techniques, procedures, and protective equipment are recommended or appropriate for the job, ask your supervisor or foreman.

2.6.3 Explosion

Common automotive-type batteries produce an explosive gas under some conditions. This gas may easily be ignited by a spark or flame as you work on the vehicle. To reduce the risk of explosion, disconnect the battery, work in a well ventilated area, avoid the use of devices that create sparks or use open flames, and use the appropriate personal safety equipment and clothing.

If you are unsure of which techniques, procedures, and protective equipment are recommended or appropriate for the job, ask your supervisor or foreman.

2.6.4 Chemical Burns

Common automotive-type batteries contain strong acid that can cause personal injury if you come in contact with the acid. To reduce exposure to the risk of chemical burns, wear appropriate protective clothing and handle the battery with care.

If you are unsure of which techniques, procedures, and protective equipment are recommended or appropriate for the job, ask your supervisor or foreman.

2.7 Disposal of Device

Please dispose of the device in accordance with all local, state, and federal laws and regulations.

2.8 FCC Statement

This equipment has been tested and found to comply within the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interferences when the equipment is operated in a commercial environment. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. If operation of this equipment in a residential area causes harmful interference, the user is required to correct the interference at their own expense. See Figure 2-2.

3 Description

This section provides a general description of the Opticom™ GPS system and a detailed description of the vehicle equipment.

3.1 Opticom™ GPS System

The Opticom GPS system assists authorized priority vehicles through signalized intersections by providing temporary right-of-way through the use of common traffic controller functions.

The Opticom GPS system consists of the following matched components:

Vehicle Equipment —

- Radio/GPS unit containing a GPS receiver and a 2.4 GHz transceiver
- Radio/GPS antenna
- Control unit

Intersection Equipment —

- Radio/GPS unit containing a GPS receiver with antenna and a 2.4 GHz transceiver with antenna
- Or Radio/GPS unit containing a GPS receiver and a 2.4 GHz spread spectrum transceiver with a separate Radio/GPS antenna
- Phase Selector
- Card Rack/Input File
- Auxiliary Interface Panel
- Auxiliary Harness

The vehicle equipment is mounted on the priority vehicle. Its GPS receiver acquires position information from the constellation of GPS satellites. This information is used to compute the location, speed, and heading of the vehicle. This information, along with a priority request and the state of the vehicle's turn signal, is broadcast using the 2.4 GHz transceiver.

The intersection equipment receives the radio transmission from the vehicle equipment. The intersection equipment then compares the information being received from the vehicle to the parameters stored in the intersection equipment's memory. If the vehicle is heading toward the intersection in a predefined approach corridor, is requesting preemption and has met all other programmed parameters, the corresponding phase selector output is activated. This output is connected to the traffic controller preemption input. When activated, the controller cycles to grant a green light to the requesting vehicle or holds the green allowing the vehicle to pass through the intersection.

The card rack/input file provides the power and logic wiring for the phase selector, which plugs directly into a slot in the unit.

The auxiliary interface panel provides additional connections for monitoring green phases and also provides additional priority control outputs.

The green sense harness can be used to provide additional connections for monitoring green phases when the auxiliary interface panel is not required.

3.2 Vehicle Equipment

The Opticom™ GPS System vehicle equipment is intended for use on priority vehicles. The vehicle equipment consists of a radio/GPS unit containing a GPS receiver and a 2.4 GHz transceiver, a radio/GPS antenna, as well as a control unit, which also provides an interface point between the radio/GPS unit, the vehicle wiring, and an external PC used for configuration and diagnostics.

This manual describes how to install the vehicle equipment.

Please be aware of the following operational characteristics of this equipment.

Appropriate agency ID, vehicle class, and vehicle ID numbers are determined at the time of installation and are programmed by the user via configuration software.

The Disable feature uses an additional switch (customer supplied) that connects to battery negative or positive when actuated.

Figure 3-1 shows a typical vehicle equipment installation for a priority vehicle.
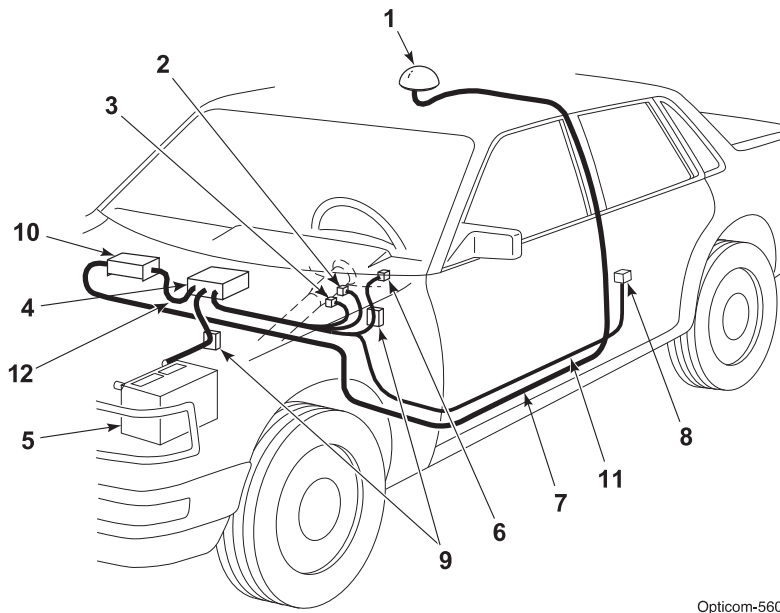
Opticom-560R

Figure 3-1. Typical Vehicle Equipment Installation for Priority Vehicle

1. Radio/GPS antenna (Model 1050)	7. Radio/GPS antenna cable
2. Left turn signal sense	8. Disable switch
3. Right turn signal sense	9. Fuses
4. Model 1020-1021 Vehicle control unit (VCU)	10. Model 1012 Radio/GPS unit
5. Battery	11. Vehicle interface harness (Model 1071)
6. Light bar sense	12. Control Unit cable assembly (Model 1072)

3.3   Parts List

The following is a list of components in the vehicle kit. See Figure 3-1 for more details.

1   Model 1050 Radio/GPS antenna

- White 3" diameter dome with two 15' cables.

4   Model 1020 or 1021 Vehicle Control Unit (VCU

- Black module with ON/OFF switch and indicators

- Mounting bracket and screws.

10   Model 1012 Radio/GPS unit

- Aluminum module with mounting screws

11 Model 1071 Vehicle Interface Harness

- 15' Cable with a DB-15 connector and 15' of un-terminated loose wires

12 Model 1072 control unit cable assembly

- 20' Cable with a DB-15 connector and a black cable

Miscellaneous parts

- Two fuse holders
- Two 2 amp fuses
- Two fuse labels
- Two Grommets
- Installation Instructions

4   Features

Opticom™ GPS system vehicle equipment has the following features:

- Vehicle identification encoding; selectable at installation

- User-selectable Disable mode; Latching or Non-Latching modes

- Diagnostic indicators

- Millions of vehicle identification codes

- Agency ID capability

- Wide operational temperature range: –30°F to +165°F (–34°C to +74°C)

- Meets FCC part 15 Class A specifications

- Additional GPS output in NMEA format for other onboard uses

- R5485/J1708 serial interfaces

- 15 & 20-foot cables for installation flexibility

- Available Windows™[*] Configuration and Maintenance Software

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[*] Windows is a trademark of Microsoft Corporation.

5 Installation

This section describes the installation of the Opticom™ GPS System vehicle equipment.

Please read and fully understand the following paragraphs before starting the installation.

- Before cutting or drilling any openings in the vehicle or lightbar, draw a diagram showing placement, measurements, and dimensions. Use the diagram to avoid drilling or cutting holes in undesirable locations.

- Always follow the vehicle manufacturer's recommendations for modification, alteration, and installation or connection of accessories or equipment to the vehicle and lightbar.

- Installation on specialty vehicles (such as motorcycles, parking enforcement, utility and special maintenance vehicles) requires particular care and attention to details.

- Do not mount the radio/GPS antenna within 18 inches of any other radio antenna. Follow the installation instructions to avoid possible radio frequency interference problems.

- **The radio/GPS unit is not watertight; therefore it should be mounted inside the passenger compartment or some other protected area of the vehicle.**

- **Never operate the equipment with the antenna cables disconnected or the equipment may be damaged.**

- The radio/GPS antenna should be mounted level and as high on the vehicle as possible. The radio/GPS antenna should have an unobstructed view of at least 50% of the sky.

- The radio/GPS antenna must not be obstructed by light bars, speakers, antennas, or other devices especially towards the front of the vehicle.

- Wires that are routed under carpets or mats should be run between the pad and the carpet. This will minimize abrasion and heat damage from catalytic converters.

- Protect cables with armor or sheathing when they are routed around sharp corners and edges. Avoid routing cables through potential pinch points. Clamp or tie all cables in place. Route and secure cables well away from moving parts.

- Do not paint the radio/GPS antenna cover. Metals or metal oxides in the paint may interfere with GPS reception and/or radio reception and transmission.

- Do not modify the radio/GPS unit circuitry. There are no user serviceable parts inside.

☐ **IMPORTANT NOTE**
Modifying the radio/GPS unit may seriously damage the equipment and void the warranty. **Do not attempt to modify the radio/GPS circuitry in any way.** Modifying the radio and/or antenna in any way may cause the radio to violate FCC/IC requirements.

☐ **REMARQUE IMPORTANTE**
La modification du système radio/GPS risque d'endommager sérieusement le matériel et d'annuler la garantie. **Ne pas tenter de modifier les circuits du système radio/GPS de quelque façon que ce soit.** En modifiant le système radio et/ou l'antenne de quelque façon que ce soit, la radio risque de ne plus répondre aux exigences de la FCC/IC.

5.1   Vehicle Radio/GPS Unit Installation

This subsection describes how to install the vehicle radio/GPS unit.

1. Disconnect the battery before beginning the installation. Disconnect the negative battery cable first, then the positive battery cable.

2. Remove interior panels and headliners, as necessary, to provide access for cable routing.

3. Determine an appropriate location in a protected area inside of the vehicle or trunk.

4. Using the provided screws, attach the Radio/GPS unit to the mounting location.

5. The provided screws are self drilling/tapping screws.

Note: The radio/GPS unit is not watertight; therefore it should be mounted inside the passenger compartment or some other protected area of the vehicle.

⚠ **WARNING**

Vehicle batteries contain sulfuric acid and may contain explosive gases. **Keep sparks, flames, and cigarettes away. Wear eye protection. Disconnect the negative cable first to prevent shorting the positive terminal to the chassis when removing the positive cable.** Battery acid may cause skin irritation and eye injury. Explosive gases may cause severe injury or death.

⚠ **Avertissement**

Les batteries du véhicule contiennent de l'acide sulfurique. Elles risquent également de contenir des gaz explosifs. **Il faut donc les conserver à l'écart des étincelles, des flammes et des cigarettes. Porter des lunettes de protection. Lors du retrait du câble positif, débrancher d'abord le câble négatif pour empêcher la borne positive de court-circuiter le châssis.** L'acide de la batterie risque d'irriter la peau et de causer des blessures aux yeux. Les gaz explosifs risquent de causer des blessures graves ou la mort.
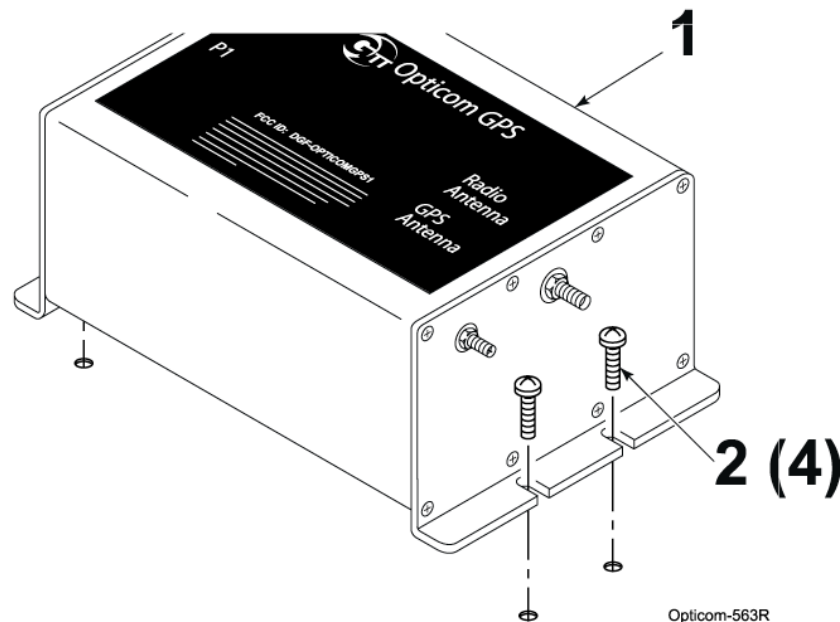

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Figure 5-1. Mounting Radio/GPS Unit on Priority Vehicle

1. Vehicle radio/GPS unit	2. Mounting screws (4)

5.2 Model 1050 Radio/GPS antenna installation

1. Remove the nut and washer from the Radio/GPS antenna.

2. Drill a 5/8 to 3/4-inch hole. See Figure 5-2.

3. Route the cables through the hole. And replace the lock washer and nut.

4. Tighten the nut with a15/16" wrench (a 24 mm wrench may be used if a 15/16' wrench is not available)

Note: Do not over tighten the nut or the antenna may be damaged. 5 ft/lbs is the recommended torque.

5. Apply silicone RTV (not provided) around the antenna if the roof curvature prevents a good seal with the antenna's built-in gasket.

6. If necessary alternate mounting brackets are available for mounting on vehicle mirrors, vertical posts and trunk lids. These brackets are available from Mobile Mark Communications Antennas (www.mobilemark.com, 1-800-648-2800). The part numbers are SM-MM (mirror mount) and SM-TM (trunk lid mount). When using these mounts, GTT recommends that the bottom of the antenna where the cables exit be sealed with RTV. Also care should be taken to protect the cables where they enter into the vehicle.

7. An adapter for thicker roofs is available. Contact GTT Technical Service at 1-800-258-4610 for details.

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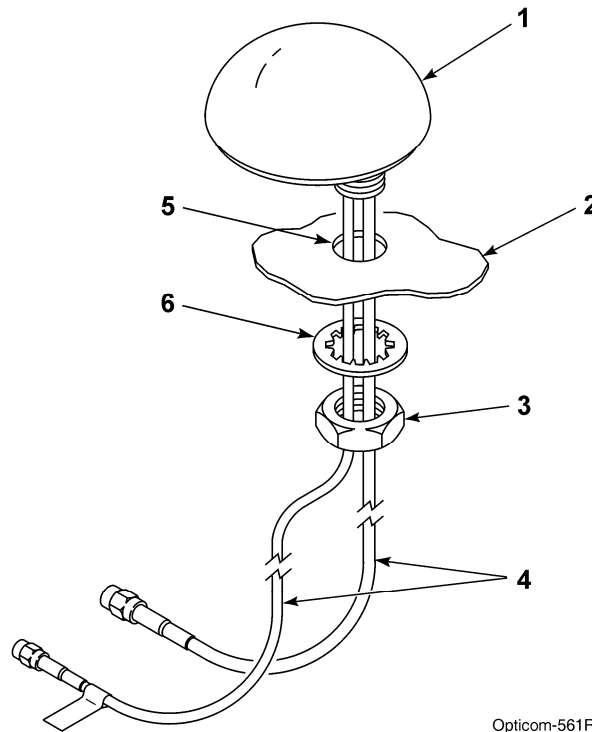
Figure 5-2. Mounting Radio/GPS Antenna on Priority Vehicle

1. Vehicle radio/GPS antenna	4. Radio and GPS antenna cables
2. Vehicle mounting surface	5. 5/8 to 3/4-inch mounting hole
3. Antenna nut	6. Antenna lock washer

5.3   Model 794HM, Model 794TM

This section describes the use of the Model 794HM and the 794TM multimode emitters. The multimode emitter contains an infrared LED emitter. The multimode emitters also contain radio and GPS antennas that perform the same function as the Model 1050 radio/GPS antenna described in section 5.2.

1. Refer to the manual that was included with the Model 794HM or 794TM for details on installation.
2. Proceed to section 5.4.

Cable Entrance Grommet

Antenna Cable

After grommet insertion, apply sealant to grommet, cable and vehicle

Tape Wrap End
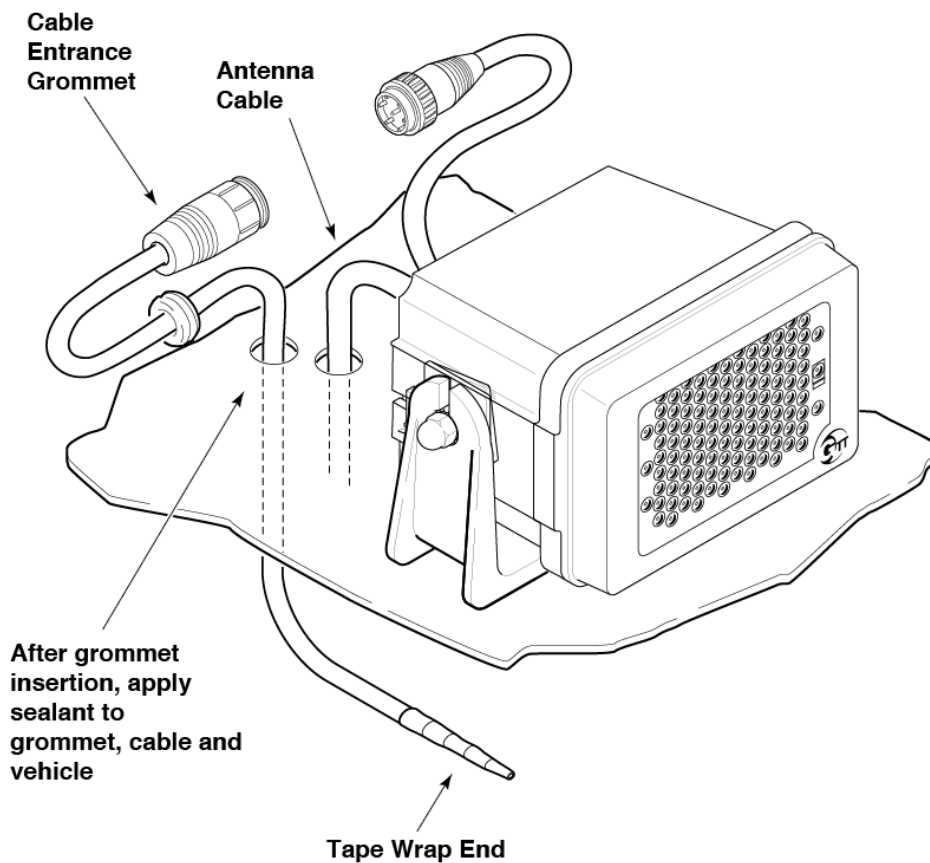
Opticom 794283M

Figure 5-3. Model 794HM, 794TM multimode emitter

5.4 Radio/GPS Unit Cable Terminations

1. Route the cables from the radio/GPS antenna through the vehicle to the radio/GPS unit location.

2. Coil up any excess cable.

Note: When coiling excess cable do not create any sharp bends in the cable or the cable may be damaged.

3. Connect the cable labeled GPS to the GPS connector on the radio/GPS unit. Connect the other cable to the Radio connector. Tighten the connectors using a 5/16" wrench (an 8 mm wrench may also be used).

Note: The connectors are keyed and cannot be connected to the wrong connector.

Note: To avoid damage to the equipment always connect the GPS and Radio connectors before connecting the radio/GPS cable. Never operate the equipment with the antenna cables disconnected.

Also be sure that the end of the radio/GPS cable that connects to the Vehicle control unit is plugged in AFTER the 15-pin connector is plugged into the radio/GPS unit.

4. Plug the 15 pin connector of the radio/GPS cable (black cable) into the P1 connector of the radio/GPS unit and tighten the screws.

5. Route the cable to the location where the Vehicle Control unit will be installed.

Table 5-1. Radio/GPS Cable Connector Pin Index

Pin	Wire Color	Function
1	Yellow	Radio transmit (+)
2	Yellow Black	Radio transmit (–)
4	Blue	Radio receive (+)
5	Blue White	Radio receive (–)
7	Orange	Radio clock (+)
8	Orange Green	Radio clock (–)
9	Brown	GPS power
11	Brown White	Common
12	Violet White	Common
13	Bare	Shield drain wire
15	Violet	Radio power
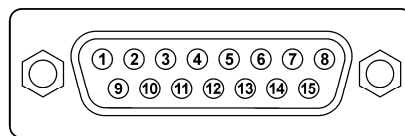
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Figure 5-4. Radio/GPS Cable Connector Pin Configuration
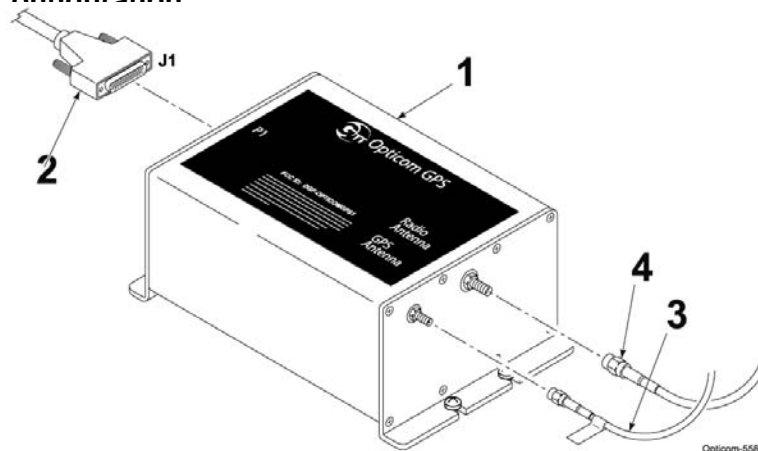
Opticom-558R

Figure 5-5. Radio/GPS Cable Installation

| 1. Vehicle radio/GPS unit | 3. GPS antenna cable |

2. Radio/GPS cable assembly	4. Radio antenna cable

5.5 Vehicle Control Unit Installation

This subsection describes the installation of the Opticom™ GPS System Vehicle Control Unit. It also describes connecting the radio/GPS cable from the radio/GPS unit to the control unit and connecting the vehicle interface harness to the control unit.

Please read and fully understand the following precautionary paragraphs before installing the control unit.

- Installations may include a customer-supplied disable switch in addition to the control unit. The Disable feature disables the priority request when the disable switch closes to battery negative or positive. This feature typically uses an existing switch that indicates the presence of conditions deemed appropriate to disable the priority request, such as opening the vehicle operator's door.

- The control unit must not be in the path of airbag deployment.

- Use care when drilling holes to avoid drilling into undesirable locations.

1. Determine the desired location to mount the vehicle control unit. Mark and drill two 7/32-inch holes, using the control unit mounting bracket as a template.

2. Insert the two 10-32 x 3/4-inch cap screws through the holes in the mounting bracket and mounting surface. See Figure 5-6.

3. Use the two lock washers and 10-32 nuts to secure the bracket to the vehicle.
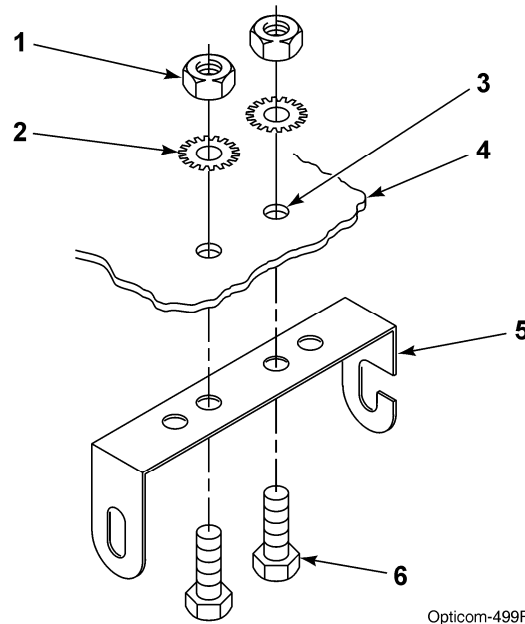
Opticom-499R

Figure 5-6. Control Unit Mounting Bracket Installation

1. 10-32 nut (2)	4. Mounting surface
2. Lock washer (2)	5. Mounting bracket
3. 7/32-inch hole (2)	6. 10-32 x 3/4-inch cap screw (2)

4. Cut the Radio/GPS cable (black cable) to the proper length.

5. Strip approximately 3 inches of the outer jacket from the end of the cable. Be careful not to cut the wires inside.

6. Strip 1/4 inch of insulation from each wire.

   Note: It is very important not to strip too much insulation, which may lead to short circuits; or too little insulation, which may prevent the wire from making good contact.

7. Place each wire into the appropriate terminal in the 10-pin terminal block located on the back of the control unit and tighten the screw to secure the wire. The label on the terminal block shows the color for each wire. Table 5-2 also shows the terminal block pin number, wire color, and function for each wire. See Figure 5-7.

   The terminal block may be removed from the control unit to allow easier connections.

8. Cut the bare wire off even with the edge of the outer jacket of the cable.

9. Plug the vehicle interface harness into the 15-pin connector on the back of the control unit and tighten the screws. See Figure 5-7.

Note: Be sure that the end of the radio/GPS cable that connects to the Vehicle control unit is plugged in AFTER the 15-pin connector is plugged into the radio/GPS unit.

Table 5-2. Control Unit Terminal Block Pin Index

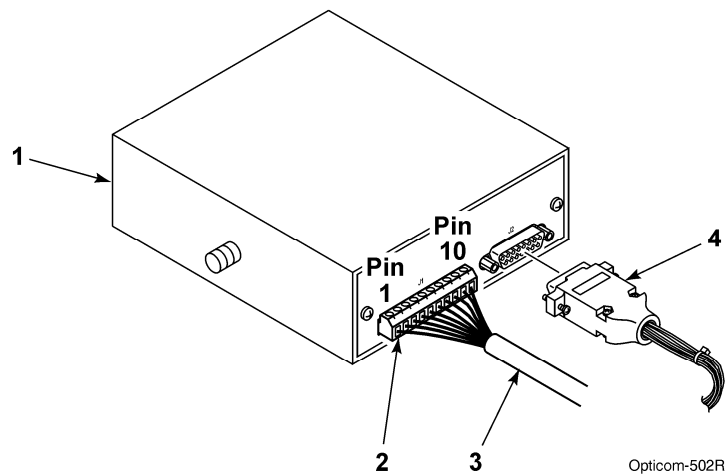| Pin	Wire Color	Function
1	Yellow	Radio transmit (+)
2	Yellow Black	Radio transmit (–)
3	Blue	Radio receive (+)
4	Blue White	Radio receive (–)
5	Orange	Radio clock (+)
6	Orange Green	Radio clock (–)
7	Brown	GPS power
8	Brown White	Common
9	Violet	Radio power
10	Violet White	Common

Figure 5-7. Vehicle Control Unit Wiring

1. Vehicle control unit	3. Radio/GPS cable

2. 10-pin terminal block	4. Vehicle interface harness

10. Place the control unit into the mounting
bracket. Use the two 1/4-inch acorn nuts
and lock washers to secure the control unit
to the bracket. See Figure 5-8.
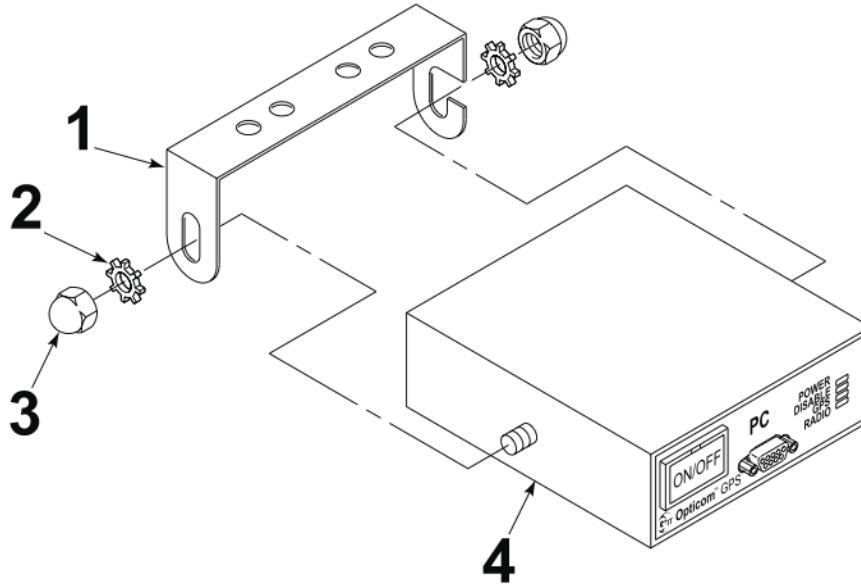
Opticom-500R

Figure 5-8. Vehicle Control Unit Installation

1. Mounting bracket	3. Acorn nut (2)
2. Lock washer (2)	4. Vehicle control unit

11. Route the wires of the vehicle interface
harness to the appropriate connection points.
Table 5-3 shows the connector socket pin
number, wire color, and function for each
wire. Figure 5-9 shows the socket view of
the harness connector. All wires may not be
used in all installations.

Opticom-501R

Figure 5-9. Interface Harness Connector Pin Configuration

Table 5-3. Interface Harness Connector Pin Index

Pin	Wire Color	Function
1	White/Yellow	J1708 (+)
2	Blue	Lightbar sense or Ignition switch
3	Brown	Low priority
4	Gray	Probe/GPS always out input
6	White	Disable sense
7	Green	Right turn sense
8	Yellow	Left turn sense
9	Black	Ground
10	Red	+12 VDC
13	White/Orange	GPS TXD (-)
14	White/Brown	GPS TXD (+)

15	White/Blue	J1708 (-)

5.5.1 Turn Signal Sensing Connections

The turn signal sensing circuit operates by detecting the change of state or flashing of the vehicle's turn signal circuits. **If the turn signal sense circuit detects both the left and the right signal sense lines changing or flashing, the vehicle equipment will transmit that it is going straight.**
This can be verified by monitoring the turn signal inputs with the View Inputs Sensing screen or vehicles heard screen in ITS Explorer.

1. Activate the left turn signal.

2. Press the brake pedal.

3. If you see the right (opposite) turn signal sense change from active to inactive or vice-versa. You will need to find another place to connect to the vehicles turn signals.

Note: there is a 3 second delay before the turn signal status will register. Press the brake pedal several times and hold it for at least 3 seconds.

This occurs because; in some vehicles the brake light bulb is shared with the turn signals. If this is the case, applying the brakes while either turn signal is on will cause the turn signal sensing circuit to think that both inputs are active and cause the vehicle to transmit that it is going straight.
Therefore it is recommended that the yellow and green turn signal sense lines be connected only to the front turn signal wires.

1. Connect the yellow wire from the harness to the vehicle's front left turn signal line.

2. Connect the green wire from the harness to the vehicle's front right turn signal line.

5.5.2 Additional Vehicle Connections

1. Connect the white wire to a switch that actuates when the driver reaches the scene and steps out of the vehicle. For instance, this could be a door switch. The switch may provide either +12 VDC or a ground. You will need this information to set the Operating mode (see Section 6.1, Configuration Setup and Checkout).

Note: If the white disable line is not to be used it is recommended that this wire be connected to Ground. The disable mode should then be set to Ground -> 12VDC and non-latching.

2. Connect the blue wire to one of the provided fuse holders. Connect the other end of the fuse holder as described in either step a or b below.
   Do not install the fuse yet.

a. Connect the fuse holder to a point that provides +12 VDC only when the lightbar is turned on. This enables the driver to activate the system when the lightbar is on by pushing the ON/OFF switch on the control unit to the ON position.

b. Connect the fuse holder to a point that provides +12 VDC when the ignition switch is in the RUN position. This enables the driver to activate the system when the ignition switch is on by pushing the ON/OFF switch on the control unit to the ON position.

3. Install the fuse rating label on the blue wire near the fuse holder.

4. Connect the red wire to the provided fuse holder. Connect the other end of the fuse holder to a +12 VDC power source that provides at least 2 amps at all times. In order for the GPS receiver to maintain an accurate location, the receiver requires a constant +12 VDC power source.

GTT recommends using a direct connection to the battery. If this is not possible, use a terminal block with a direct connection to the battery.
Do not install the fuse yet.

5. Install the fuse rating label on the red wire near the fuse holder.

6. Connect the black wire to vehicle chassis ground (DC–). Again, it is recommended that this connection be made directly to the battery or to a terminal block with a direct connection to the battery.

7. Verify that the control unit on/off switch is set to the OFF position.

8. Inspect all connections and verify that the wiring is complete and accurate as described in this installation manual.

9. Install the fuses (2A, 250V) in the fuse holders.

10. Connect the vehicle's positive battery cable, then connect the negative battery cable.

5.5.3 Low Priority

When Opticom™ GPS vehicle equipment ships from the factory, the priority level (High or Low) is preset. The user cannot change this priority level. However, a high priority vehicle may be set to temporarily be a low priority vehicle. This feature is useful for traffic department maintenance vehicles that maintain Opticom GPS intersection equipment where both high and low priority vehicles operate.

Low Priority Connections:

The vehicle interface harness contains a brown wire that when connected to +12 VDC will cause the vehicle unit to temporarily broadcast that it is a low priority vehicle (see Table 5-3).

1. Connect the brown wire to one side of a switch (not provided) and connect the other side to +12 VDC.

2. Install an in-line fuse holder with a 2A, 250V fuse (not provided).

3. When you activate the switch, the vehicle will be a low priority vehicle until the switch is deactivated.

Do not connect the Brown wire if you do not want to use the mode described above.

This action may be observed using the Vehicles Heard section of ITS Explorer. Refer to the GPS Vehicle Configuration section of the *Opticom™ GPS System Operation Manual.*

5.5.4 Probe Priority/GPS always out

The user has the option of activating the Opticom GPS vehicle unit in a mode that will allow the vehicle to transmit its position information and output GPS data via a com port without requesting TSP/preemption. This is done by connecting the gray wire to +12VDC.

When +12 VDC is applied to the Gray wire, the vehicle equipment will broadcast that it is in Probe priority (will not request TSP/preempt).

Then one of the communication ports may be configured to output GPS data in the NMEA format. This data may be sent to other onboard devices or computers to display the vehicles current position speed and heading.

Notes:

1. See the Technical Bulletin "Vehicle Connections and Configuration to obtain GPS serial data for other Devices" or section 9 of this document for details on how to make these connections.

Do not connect the Gray wire if you do not want to use the mode described above.

6   Checkout

This section describes how to check out and test the installed Opticom™ GPS System.

6.1   Configuration Setup and Checkout

Using the Vehicle Configuration window of the ITS Explorer application, configure the vehicle control unit with the following parameters: (See the on-line Help files and the Operation Manual for additional information.)

Using the General Configuration window, set the following parameters:

Configuration

- Vehicle Name
  Up to 40 alphanumeric characters

- Agency ID
  1 – 254

- Vehicle Class
  1 – 15

- Vehicle ID
  1 – 9999

Operating Mode

- Disable Mode
  Latching or Non-Latching

- Disable Trigger method
  +12 VDC to Ground
  Ground to +12 VDC

- GPS Receiver Power Options
  Always On
  Standby

6.2   Input Verification

1. Open the Vehicle Configuration window in ITS Explorer.

2. Using the Diagnostic Activity window, open the View Inputs Sensing window and activate the left turn signal followed by the right turn signal. Verify that the vehicle equipment detects each input. You may also use the vehicles heard window.

   If both signals are being detected when only the left or right signal is activated, it may be necessary to connect the turn signal line to another point.

3. Activate the disable switch and verify that the vehicle equipment detects this action. Also observe the DISABLE indicator and the

ON/OFF switch indicator. Both indicators will be flashing green when the disable switch is activated. See Table 6-1.

4. Verify that Disable mode activation is correct.

   If Latching Disable mode is used, the vehicle control unit stays in Disable mode after the disable switch is returned to its normal state. Turning the vehicle control unit off for a few seconds and then back on removes the Disable mode.

   If Non-Latching Disable mode is used, the vehicle control unit removes the Disable mode as soon as the disable switch is returned to its normal state.

Table 6-1.   Vehicle Control Unit Indicators

Indicator	Color or Condition	Meaning
POWER	Green	Power applied to unit
ON/OFF Switch	Green	Power applied to unit
	Flashing Green	Vehicle in Disable mode
DISABLE	Off	Vehicle NOT in Disable mode
	Amber	Vehicle is transmitting "Probe" mode
	Flashing Green	Vehicle in Disable mode
GPS	Amber	Not receiving GPS, radio not transmitting
	Green	GPS has good 3D fix
RADIO	Amber	No communication between radio/GPS unit and vehicle control unit
	Green	Good communication between radio/GPS unit and vehicle control unit

6.3 Performance Tests

⚠ WARNING

A completed installation that is not tested may result in improper system operation, which may result in accidents and/or injuries. **To avoid this problem, test the system to verify proper operation.** Improper system operation may result in unsafe driver action.

⚠ Avertissement

Une fois terminée, il faut tester l'installation sinon, le système risque de ne pas fonctionner adéquatement et, par conséquent, de causer des accidents et/ou des blessures. **Pour éviter ce problème, tester le système pour s'assurer qu'il fonctionne adéquatement.** Un fonctionnement inadéquat peut occasionner chez les conducteurs une conduite dangereuse.

These installation instructions are the result of tests performed in our laboratory and we believe these tests to be accurate and complete. However, each installation involves variables that cannot be controlled or predicted. These variables may affect the operational characteristics of the system.

To ensure proper system operation, GTT strongly recommends that, when the system is turned on, the installer functionally tests the system using the following procedure.

1. Place the Opticom GPS-equipped vehicle in an area with GPS coverage. This is either outdoors, away from nearby buildings and overhanging trees, or inside of a garage that has adequate GPS coverage.

2. Verify that the vehicle equipment acquires GPS.

   Turn the vehicle control unit on by pressing the ON/OFF switch. The unit should acquire GPS within a few minutes; however, it may take up to 15 minutes. A green GPS indicator means that GPS has been acquired. An amber GPS indicator means that GPS has not been acquired. If GPS has not been acquired within 15 minutes, turn the control unit off and wait another 15 minutes. Then turn it back on. If the unit still has not acquired GPS, verify that your location has a good view of the sky. If you are unable to acquire GPS, contact GTT Technical Service or your dealer.

3. Verify that the vehicle radio/GPS unit is transmitting information properly. The vehicle radio/GPS unit will not operate if the system has not acquired GPS. Therefore, this check cannot be completed unless you have GPS.

   Place the vehicle to be tested in close proximity of another known good Opticom GPS-equipped vehicle or intersection. This vehicle or intersection also must have good GPS coverage.

If a vehicle is used, its radio must be placed in Transmit mode because vehicle radios will not transmit unless they hear an intersection radio. Open the View Inputs Sensing window and select the Transmit Test tab. Press the Test Mode button. The vehicle radio will now transmit even if it does not hear an intersection radio. The vehicle radio will stay in this mode until the next power cycle.

Note: If an intersection is used for this test, activate the vehicle's disable switch or you will be placing priority requests to the intersection controller. Therefore, it is recommended that another Opticom GPS-equipped vehicle be used for testing.

Open the Vehicles & Intersections Heard window under the Real Time Activity section in ITS Explorer. This window is duplicated in both the Vehicle and Intersection modules of ITS Explorer. Verify that you are receiving the correct following parameters from the vehicle under test.

- Agency ID
- Class ID
- Vehicle ID
- Priority

You should also receive the following information from the vehicle under test. You will not be able to verify the values, but you need to verify that the information is being transmitted. Examples:

- Latitude and Longitude
- Heading and Velocity
- Fix Type
- Position Dilution
- Horizontal Dilution
- Satellites

Activate the left turn signal, the right turn signal, the disable switch and verify that the correct information is being transmitted. This verifies that the vehicle under test is set up correctly and is transmitting all required information.

4.   Verify that the vehicle radio/GPS unit is receiving information properly.

Connect the computer running ITS Explorer to the vehicle under test and repeat the above procedure looking for the data being transmitted from your known good vehicle or intersection equipment. This verifies that the vehicle under test is receiving all required information.

7 Troubleshooting

Table 7-1 shows the symptoms of the Opticom™ GPS System Vehicle Equipment installation problems. The table also shows the possible causes of those problems and suggests solutions to correct them.

Table 7-2 shows the expected voltages at various wiring terminals.

Table 7-1. Troubleshooting Symptoms, Possible Causes, and Solutions

Symptom	Possible Cause	Solution
Vehicle control unit POWER LED will not light.	Wiring incorrect.	Check wiring. Verify that control unit is getting 12 VDC.
	Remote activation line not active.	Verify that 12 VDC is being applied to blue wire of vehicle interface harness.
	Fuse/s blown	Replace fuses with 2A/250V 3AG SLO-BLO.
	Vehicle control unit failed.	Return unit to GTT for service.
Times in log are incorrect.	Time localization not set, or set incorrectly.	Set correct time zone for your area.
GPS will not acquire. (GPS LED is amber.)	Initial start-up may take up to 15 minutes.	Wait 15 minutes.
	Radio/GPS unit's view of sky is obstructed.	Move unit or remove obstructions.
	RF interference.	Turn off vehicle control unit for 15 minutes, then try again.
	Incorrect wiring.	Check wiring at both ends of radio/GPS cable.
	Radio/GPS cable connector (terminal block) plugged in backwards.	Plug in terminal block correctly.
	Radio/GPS unit failed.	Return unit to GTT for service.
	Radio/GPS antenna failed.	Return unit to GTT for service.
	Vehicle control unit failed.	Return unit to GTT for service.
	No power to GPS receiver.	Check voltage between brown (+) and brown/white (–) wires at both ends. It should be about 8.3 VDC.

Table 7-1. Troubleshooting Symptoms, Possible Causes, and Solutions (continued)

Symptom	Possible Cause	Solution
RADIO LED is amber.	Incorrect wiring.	Check wiring at both ends of radio/GPS cable.
	Radio/GPS cable connector (terminal block) plugged in backwards.	Plug in terminal block correctly.
	Radio/GPS cable damaged or poor terminations.	Replace cable, redo terminations.
	Radio/GPS unit failed.	Return unit to GTT for service.
	Vehicle control unit failed.	Return unit to GTT for service.
	No power to radio.	Check voltage between violet (+) and violet/white (–) wires. It should be about 9.0 VDC.
Unable to communicate with vehicle control unit.	Communication cable not connected.	Check cable connection at vehicle control unit and at computer.
	Baud rate/serial port incorrect.	Using ITS Explorer, change baud rate/serial port under Environment options.
Intersection Name not Heard listed instead of intersection name.	Name not heard yet.	Press Get Intersections Heard button again. Cycle power on vehicle control unit.
	Name not assigned in intersection.	Assign an intersection name.
Intersection alternates displaying and dropping the left turn arrow when approaching vehicle has left turn signal activated.	Vehicle brake light bulb shared with turn signal indication. Emergency flashers are active. Controller or phase selector not programmed correctly.	Reconnect vehicle turn signal sense lines to front turn signal wires. Turn of emergency flashers Reprogram controller or phase selector.
Vehicle does not enter disable mode when activated	Incorrect disable trigger mode has been set	Verify that you have set the unit to reflect how the disable line is wired 12 VDC to Ground or Ground to 12 VDC
Intersection does not display left turn arrow when approaching vehicle has the left turn signal activated.	Vehicle brake light bulb shared with turn signal indication. Emergency flashers are active. Controller or phase selector not programmed correctly.	Reconnect vehicle turn signal sense lines to front turn signal wires. Turn off emergency flashers Reprogram controller or phase selector.

Table 7-2. Expected Voltages

Location/Terminal	Expected Voltage	Notes
Red to Black wires on harness	12 VDC	Check fuse.
Blue wire on harness	12 VDC	Must have 12 VDC to activate system, check fuse.
Brown to Brown/White	Approximately 7.15 VDC	GPS power source, check for at least 5 seconds.
Violet to Violet/White	Approximately 7.75 VDC	Radio receiver power source, check for at least 5 seconds.

8 Maintenance

Opticom™ GPS system components are designed for reliable operation. Inspect the components at regular intervals to ensure proper system operation.

GTT recommends the following:

- Each intersection system and vehicle system should be inspected and tested at least every 12 months to ensure it functions to your specifications and requirements.

- Intersection systems should be tested with known good vehicle systems.

- Vehicle systems should be tested with known good intersection systems.

- You should develop a test plan that fits your department's operations and meets the needs of your system.

- You should keep accurate and up-to-date records of system performance and test results.

Note: When washing the vehicle, avoid pointing a high-pressure washer at the radio/GPS antenna.

9   GPS Output Function

The Opticom™ GPS system utilizes information from the constellation of GPS satellites. This data may also be used by other devices that are installed in an Opticom GPS equipped vehicle This section provides details on the format of the GPS data as well as details on how to connect to the Opticom GPS equipped vehicle to obtain this data.

Caution Notes

The Global Positioning System (GPS) is operated by the United States government, which is solely responsible for its accuracy and maintenance. The system is subject to changes which could affect the accuracy and performance of all GPS equipment. Although the Opticom GPS system uses a precise GPS receiver, any navigation system can be misused or misinterpreted and therefore become unsafe. It is the user's responsibility to use this position information prudently. This information is intended to be used only as a navigational aid and must not be used for any purpose requiring precise measurement of direction, distance, location or topography. Use this product at your own risk. To reduce the risk, carefully compare indications from the GPS to all available navigation sources including the information from any other NAVAIDS, visual sightings, maps etc. For safety, always resolve any discrepancies before continuing navigation.

Format and data available

The Opticom GPS system will output serial GPS data in the NMEA 1083, v2.0 or later format. The following messages are provided:

GGA   Global Positioning System Fix Data
GSA   GPS DOP and active satellites
GSV   Satellites in view
RMC   Recommended Minimum Navigation Information

Vehicle Connections and Configurations

This section describes the necessary connections and configuration to obtain the available GPS data from Opticom GPS vehicle equipment.

Connections

1. Connect the White/Orange (GPS TXD -) wire of the Vehicle interface harness to pin 2 on a DB-9 or DB-25 connector.

2. Connect the black (Ground) wire of the Vehicle interface harness to pin 5 on a DB-9 or DB-25 connector.

3. Connect the DB-9 or DB-25 connector to the device that will receive the GPS data.

Configuration

1. Open ITS Explorer and go the Vehicle Configuration section.

2. Go to the General Configuration section and select GPS Port from the Communications Section.

3. Verify that the protocol is set to "GPS Receiver NMEA Messages"

4. The sentences that are available will depend on the baud rate that you select in the communication section of ITS Explorer.

    a. 1200 Baud RMC only

    b. 2400 Baud RMC, GGA and GSA

    c. 4800 Baud and higher RMC, GGA, GSA, GSV

5. Press the "Write to Device" Button to apply the changes to the vehicle unit.

Notes:

1. The GPS data is only available when the vehicle unit is fully powered and requesting preemption/TSP. If you also need to have GPS data available when not in preemption /TSP mode See the Technical Bulletin "Vehicle Connections and Configuration to obtain GPS serial data for other Devices" for details on how to make these connections.

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Since the availability of a GPS signal is out of GTT's control and is required for Opticom™ GPS system operations, GTT does not warrant against Opticom™ GPS system failures due to the unavailability of the GPS signal for any reason.

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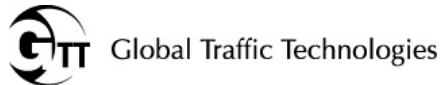
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