Vehicle Equipment Installation Instructions

Table of Contents

1 About This Manual .................................................................................................................. 3
  1.1 Intended Use ...................................................................................................................... 3
  1.2 Technical Support .............................................................................................................. 3
2 Safety Information .................................................................................................................. 3
  2.1 Label Locations .................................................................................................................. 4
  2.2 Safety Considerations ....................................................................................................... 5
  2.3 FCC and IC Statement ....................................................................................................... 6
3 Description .............................................................................................................................. 6
  3.1 Opticom™ GPS System .................................................................................................... 6
  3.2 Vehicle Equipment ............................................................................................................ 7
  3.3 Parts List .......................................................................................................................... 8
  3.4 Features ........................................................................................................................... 9
  3.5 Specifications .................................................................................................................. 10
4 Installation ............................................................................................................................... 11
  4.1 Model 1050 Radio/GPS antenna installation .................................................................. 12
  4.1.1 Antenna location considerations ............................................................................. 12
  4.1.2 Antenna Installation .................................................................................................. 12
  4.1.3 Model 79XHM, Model 79XTM ................................................................................. 14
  4.2 Radio/GPS Control Unit (RGCU) Installation ................................................................. 15
  4.3 Cable connections ........................................................................................................... 16
5 Wiring Connections .................................................................................................................. 17
  5.1 Power and Ground Connections ...................................................................................... 19
  5.2 Lightbar or Ignition Sense Connection ........................................................................... 19
  5.2.1 Activation Methods and Switch settings .................................................................. 20
    5.2.1.1 Emergency Vehicle Activation methods ......................................................... 21
    5.2.1.2 Transit Vehicle Activation methods ................................................................. 21
    5.2.1.3 Maintenance Vehicle Activation Methods ....................................................... 21
  5.3 Turn Signal Sensing Connections ................................................................................... 22
  5.4 Disable Sense Connection .............................................................................................. 23
  5.5 Low Priority (optional) .................................................................................................... 24
  5.6 Probe Priority (optional) .................................................................................................. 24
  5.7 J1708 Connections (optional) ......................................................................................... 25
  5.8 GPS Output (optional) ..................................................................................................... 26
  5.9 Other connections (optional) ........................................................................................... 27
  5.10 Model 2173 Adapter for using previous generation harness .................................... 27
6 Infrared Emitter connections (optional) ............................................................................... 28
7 Configuration and Checkout ................................................................................................... 30
  7.1 Configuration Setup ......................................................................................................... 31
  7.2 Input Verification .............................................................................................................. 32
    7.2.1 Turn Signal input verification .................................................................................. 32
    7.2.2 Disable Input Verification ...................................................................................... 33
    7.2.3 Probe and Low Priority Input Verification ............................................................. 33
  7.3 Transmit and Receive Verification ................................................................................... 33
    7.3.1 Verifying with two vehicles .................................................................................... 33
    7.3.2 Verifying using an Intersection .............................................................................. 34
8 Communication Ports ............................................................................................................ 35
  8.1 RS-232 Communication Port ........................................................................................... 35
  8.2 USB Port .......................................................................................................................... 35
  8.3 Ethernet Port .................................................................................................................... 36
9 Troubleshooting ..................................................................................................................... 37
10 Maintenance ........................................................................................................................... 38
1 About This 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.

1.1 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*.

1.2 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 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.

*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.
2.1 Label Locations

There are fuse size safety labels, FCC/IC labels 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.

Labels listing the fuse size are included with the installation kit and should be placed by the installer next to the fuse holders. Fuses are ATC-2.

The FCC/IC Label is located on the Radio/GPS Control Unit.

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failure to replace the fuse size as marked may cause property damage. Replace fuse size as marked.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mise en garde</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

Figure 2-1. Vehicle Equipment Fuse Safety Label Location

Figure 2-2. FCC, IC Label Location
2.2 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.

**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.

**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.

**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.

**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.

**Disposal of Device**

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

FCC Statement:
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. This product contains a certified radio transmitter module labeled with FCC ID: VJB-OPTICOMGPS2

Industry Canada Statement:
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.
This product contains an approved radio transmitter module labeled with IC: 7275A-OPTICOM2

A label is located on the equipment with the FCC and IC information. See Figure 2-2 for the location of the label.

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 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, and ID information 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.
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 Control Unit (RGCU) containing a GPS receiver and a 2.4 GHz transceiver. The RGCU also provides an interface point to the vehicle wiring, and an external PC used for configuration and diagnostics. A radio/GPS antenna is also a component of the vehicle equipment.

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

![Figure 3-1. Typical Vehicle Equipment Installation for Priority Vehicle](image)

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Left turn signal sense</td>
<td>7. Fuse</td>
</tr>
<tr>
<td>3. Right turn signal sense</td>
<td>8. Light bar/ignition sense</td>
</tr>
<tr>
<td>5. Radio/GPS control unit</td>
<td>10. Disable switch</td>
</tr>
</tbody>
</table>
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.

5 *Model 2100 Radio/GPS control unit or Model 2101 Radio/GPS control unit
   - Black module with ON/OFF switch and indicators
   - Mounting bracket and screws.

4 Model 2071 Vehicle Interface Harness
   - 25’ Cable with a DB-25 connector and 25’ of un-terminated loose wires

Miscellaneous parts
   - Fuse holder
   - 2 amp fuse
   - Fuse label
   - Butt splice(2)
   - Installation Instructions

* Model 2100 units are factory programmed to high priority.
  Model 2101 units are factory programmed to low priority.

Optional Parts

The following items are not included in the kit but are available separately.
   - Model 2173 Cable adapter (see section 5.10)
   - Antenna Stud extender (see section 4.1.2)
   - Spare parts are also available separately.
3.4 Features

Opticom™ GPS system vehicle equipment has the following features:

- Operates on 10-36 VDC
- Sense inputs 10-36 VDC
- 25-foot interface cable for installation flexibility
- Configurable Disable mode with multiple activation and operational behavior options.
- Configurable remote activation input with multiple activation and operational behavior options.
- Configurable turn signal sense inputs with multiple activation options.
- Diagnostic indicators
- Vehicle identification encoding; selectable at installation
- Capability to control an Opticom™ Infrared emitter through single control module
- Wide operational temperature range: –30°F to +165°F (–34°C to +74°C)
- Meets FCC part 15
- This device complies with European Standard EN 50498: 2010 “Electromagnetic Compatibility (EMC)
- Meets SAE J1455 Section 4.11 Operational Shock Test
- J575 Section 4.2 Vibration Test
- Serial port
- USB Port
- Ethernet port
- RS-485/J1708 serial interfaces
- GPS data output in NMEA format for other onboard uses
- Option to add additional radio for other applications (future)
- Option to add dead reckoning unit (future)
- Available adapter for upgrading from previous generation equipment without rewiring
- Available Windows™1 Configuration and Maintenance Software

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1 Windows is a trademark of Microsoft Corporation.
3.5 Specifications

- Opticom™ model 2100 or 2101 GPS vehicle control unit
  - Length: 7.25 in. (18.4 cm)
  - Width: 5.44 in. (13.8 cm)
  - Height: 1.63 in. (4.1 cm)
  - Weight: 1.2 lb. (0.54 kg)

- Opticom™ model 1050 GPS/radio antenna
  - Length: 15.0 ft. (4.6 m)
  - Diameter: 2.85 in. (7.2 cm)
  - Height: 1.4 in. (3.5 cm)
  - Weight with cables: 0.6 lbs. (0.30 kg)

- Model 2071 Vehicle Interface Harness
  - Length: 25'
  - See table 5-1 for wire sizes

- Environmental
  - Temperature: -30° F to +165° F (-34° C to +74° C)
  - Relative humidity: 5% to 95%

- Electrical
  - Input voltage: 10–36 VDC
  - Sense line inputs 10-36 VDC
  - Current: Less than 2 amps
  - See Infrared emitter manual for emitter electrical specifications
4 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 light bar, 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 light bar.
- Installation on specialty vehicles (such as motorcycles, parking enforcement, utility and special maintenance vehicles) requires particular care and attention to details.
- 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 modify the radio/GPS unit circuitry. There are no user serviceable parts inside.

<table>
<thead>
<tr>
<th>IMPORTANT NOTE</th>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modifying the radio/GPS unit may seriously damage the equipment and void the warranty. <strong>Do not attempt to modify the radio/GPS circuitry in any way.</strong> Modifying the radio and/or antenna in any way may cause the radio to violate FCC/IC requirements.</td>
<td><strong>Vehicle batteries contain sulfuric acid and may contain explosive gases.</strong> 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. <strong>Battery acid may cause skin irritation and eye injury.</strong> Explosive gases may cause severe injury or death.</td>
</tr>
</tbody>
</table>
4.1 Model 1050 Radio/GPS antenna installation

The antenna cables are 15’ long. When choosing a location for the radio/GS antenna and the vehicle control unit, be sure that the cables are long enough to reach the location of the vehicle control unit. Choose other locations/ if necessary.

4.1.1 Antenna location considerations

**WARNING**

The antenna has been approved for mobile applications where the antenna 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.

- 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.

- **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.

- 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.

4.1.2 Antenna Installation

1. Remove interior panels and headliners, as necessary, to provide access for cable routing.
2. Remove the nut and washer from the Radio/GPS antenna.
3. Drill a 5/8 to 3/4-inch hole. See Figure 4-1.
4. Route the cables through the hole and replace the lock washer and nut.
5. Tighten the nut with a 15/16” wrench (a 24 mm wrench may be used if a 15/16’ wrench is not available)
   
   a. **Do not over tighten the nut or the antenna may be damaged. 5 ft/lbs is the recommended torque.**

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

7. 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.

8. **An adapter for thicker roofs is available. Contact GTT Technical Service at 1-800-258-4610 for details.**
Figure 4-1. Mounting Radio/GPS Antenna on Priority Vehicle

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Vehicle radio/GPS antenna</td>
<td>4. Radio and GPS antenna cables</td>
</tr>
<tr>
<td>2. Vehicle mounting surface</td>
<td>5. 5/8 to 3/4-inch mounting hole</td>
</tr>
<tr>
<td>3. Antenna nut</td>
<td>6. Antenna lock washer</td>
</tr>
</tbody>
</table>
4.1.3 Model 79XHM, Model 79XTM

**WARNING**
The antenna has been approved for mobile applications where the antenna 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 20 cm is strictly prohibited.

This section describes the use of the Model 79XHM and the 79XTM multimode emitters. The multimode emitter contains an infrared emitter. The multimode emitter also contains 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 79XXM for details on installation and wiring.
2. See Section 7 for details on wiring the 79XXM emitter to the vehicle control unit.
3. Proceed to 4-3 for details on terminating the antenna cables

Figure 4-2. Model 79XHM, 79XTM multimode emitter
4.2 Radio/GPS Control Unit (RGCU) Installation

This section describes the installation of the Model 2100 or 2101 Radio/GPS Control Unit.

Notes:

- The radio/GPS control unit must not be in the path of airbag deployment.
- Use care when drilling holes to avoid drilling into undesirable locations.
- The location of the radio/GPS control unit must be within the 15’ cable run of the antenna cables.

1. Determine the desired location to mount the radio/GPS 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 4-3.

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

![Control Unit Mounting Bracket Installation](image)

**Figure 4-3. Control Unit Mounting Bracket Installation**

<table>
<thead>
<tr>
<th>1. 10-32 nut (2)</th>
<th>4. Mounting surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Lock washer (2)</td>
<td>5. Mounting bracket</td>
</tr>
<tr>
<td>3. 7/32-inch hole (2)</td>
<td>6. 10-32 x 3/4-inch cap screw (2)</td>
</tr>
</tbody>
</table>
4.3 Cable connections

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

2. Route the cables from the radio/GPS antenna (or 79XXM) through the vehicle to the back of the radio/GPS control unit. See Figure 4-4.

3. Coil up any excess cable.
   a. When coiling excess cable do not create any sharp bends in the cable or the cable may be damaged.

4. Connect the cable labeled GPS to the GPS connector.

5. Connect the cable labeled 2.4 GHz to the 2.4 GHz connector.

6. Tighten the connectors using a 5/16” wrench (an 8 mm wrench may also be used).
   a. Do not over tighten the connectors.

Notes:

- The connectors are keyed and cannot be connected to the wrong connector.
- To avoid damage to the equipment always connect the GPS and Radio connectors before connecting the vehicle interface cable.
- Never operate the equipment with the antenna cables disconnected.

7. Connect the vehicle interface cable to the J2 connector on the radio/GPS control unit.

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

9. Route the wires of the vehicle interface harness to the appropriate connection points. See section 5 for details.

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Figure 4-4. Radio/GPS Control Unit Connections

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Radio/GPS control unit</td>
</tr>
<tr>
<td>2</td>
<td>Infrared emitter terminal strip</td>
</tr>
<tr>
<td>3</td>
<td>Vehicle interface harness</td>
</tr>
<tr>
<td>4</td>
<td>GPS Cable</td>
</tr>
<tr>
<td>5</td>
<td>Radio cable</td>
</tr>
</tbody>
</table>
5 Wiring Connections

This section wiring describes the wiring connections in the vehicle. The connections are made via the Model 2171 vehicle interface harness. Table 5-1 shows the connector pin number, wire color, and function for each wire. The harness contains wires which may not be used in all installations. Some wires are for future applications The wires in bold are typically used in all installations. You may cut off excess and unused wires or leave them at factory length in case the equipment is moved in the future. Figure 5-1 shows the pin view of the J2 connector. Figure 5-2 shows the socket view of the connector on the Model 2171 vehicle interface harness.
<table>
<thead>
<tr>
<th>Pin</th>
<th>Wire Color</th>
<th>Wire Function</th>
<th>Wire Size (AWG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>White/Yellow</td>
<td>J1708+</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Blue</td>
<td>Light Bar Sense or Ignition Switch</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>Brown</td>
<td>Low Priority</td>
<td>20</td>
</tr>
<tr>
<td>4</td>
<td>Gray</td>
<td>Probe Priority</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>Yellow/Blue</td>
<td>Not Used</td>
<td>n/a</td>
</tr>
<tr>
<td>6</td>
<td>White</td>
<td>Disable Sense</td>
<td>20</td>
</tr>
<tr>
<td>7</td>
<td>Green</td>
<td>Right Turn Signal Sense</td>
<td>20</td>
</tr>
<tr>
<td>8</td>
<td>Yellow</td>
<td>Left Turn Signal Sense</td>
<td>20</td>
</tr>
<tr>
<td>9</td>
<td>Black</td>
<td>Ground (DC-)</td>
<td>18</td>
</tr>
<tr>
<td>10</td>
<td>Red</td>
<td>Power Input, (+10-36 VDC)</td>
<td>18</td>
</tr>
<tr>
<td>11</td>
<td>White/Green</td>
<td>Speed Pulse Sense (Future)</td>
<td>20</td>
</tr>
<tr>
<td>12</td>
<td>White/Violet</td>
<td>Reverse Sense (Future)</td>
<td>20</td>
</tr>
<tr>
<td>13</td>
<td>White/Orange</td>
<td>GPS Data-</td>
<td>20</td>
</tr>
<tr>
<td>14</td>
<td>White/Brown</td>
<td>GPS Data+</td>
<td>20</td>
</tr>
<tr>
<td>15</td>
<td>White/Blue</td>
<td>J1708-</td>
<td>20</td>
</tr>
<tr>
<td>16</td>
<td>White/Black</td>
<td>Can Bus Low (Future)</td>
<td>20</td>
</tr>
<tr>
<td>17</td>
<td>Not Used</td>
<td>Not Used</td>
<td>n/a</td>
</tr>
<tr>
<td>18</td>
<td>White/Red</td>
<td>Can Bus High (Future)</td>
<td>20</td>
</tr>
<tr>
<td>19</td>
<td>Not Used</td>
<td>Not Used</td>
<td>n/a</td>
</tr>
<tr>
<td>20</td>
<td>Yellow/Green</td>
<td>Discrete Output 1(Future)</td>
<td>20</td>
</tr>
<tr>
<td>21</td>
<td>Yellow/Black</td>
<td>Discrete Output 2 (Future)</td>
<td>20</td>
</tr>
<tr>
<td>22</td>
<td>Yellow/Red</td>
<td>Discrete Output 3 (Future)</td>
<td>20</td>
</tr>
<tr>
<td>23</td>
<td>Yellow/Brown</td>
<td>Discrete Output 4(Future)</td>
<td>20</td>
</tr>
<tr>
<td>24</td>
<td>Yellow/Orange</td>
<td>Spare Input 1(Future)</td>
<td>20</td>
</tr>
<tr>
<td>25</td>
<td>Yellow/Violet</td>
<td>Spare Input 2 (Future)</td>
<td>20</td>
</tr>
</tbody>
</table>

Table 5-1 Interface Harness Connector Pin Index
5.1 Power and Ground Connections

Notes:

- The system will operate from +10-36 VDC.
- In order for the GPS receiver to maintain an accurate location and for the vehicle equipment to start up quickly, the receiver requires a constant DC power source.
- The connection point should provide DC power even while the vehicle is shut off and the battery master switch is off.
- The included butt splice connectors have larger holes on one end to accommodate the larger wire on the included fuse holder. See steps 2a and 2B.

1. Connect the red wire to DC power source that provides at least 2 amps at all times.
2. Cut the red wire and install the provided fuse holder inline using the provided butt splices.
   a. The end of the butt splice with the red stripe attaches to the red wires.
   b. The other ends of the butt splice attaches to the wires on the fuse holder.
   c. Heat butt splice with a heat gun to seal.
      i. The insulation on the butt splice connector is heat shrinkable and contains a hot melt sealant that flows and seals the splice when heated.
3. Install the fuse rating label on the red wire near the fuse holder. Fuse is ATC-2.
   a. Rock fuse side to side to remove.
4. Connect the black wire to vehicle chassis ground (DC–).

5.2 Lightbar or Ignition Sense Connection

In order for the equipment to power on it is necessary to apply a signal to the blue wire AND depress the ON/OFF switch. There are multiple ways that a signal may be applied to the blue wire. It is also possible to activate the equipment by either applying a signal to the blue wire OR depressing the ON/OFF switch.

Notes:

1. See section 5.2.1 and subsections for
   a. Details on what signal may be applied to the blue wire.
   b. The appropriate switch settings to match how the blue wire was connected to the vehicle.
   c. Recommendations on wiring and switch settings

1. Connect the blue wire as described in either step a or b below.
   a. Connect the blue wire to a point that provides a signal or ground only when the light bar is turned on. This enables the driver to activate the system by turning on the light bar. The ON/OFF switch on the control unit should always be left in the ON position.
   b. Connect the blue wire to a point that provides a signal when the ignition switch is in the RUN position. This enables the driver to activate the system only when the ignition switch is on and the ON/OFF switch on the control unit to the ON position.
5.2.1 Activation Methods and Switch settings

There are three recessed switches on the back of the radio/GPS control unit. These switches are for controlling the function and behavior of the light bar/ignition sense input (Blue wire).

<table>
<thead>
<tr>
<th>Switch</th>
<th>Position</th>
<th>Function/Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>IGNIT</td>
<td>12-36V</td>
<td>System activated by applying vehicle voltage (+10-36 VDC) to the blue wire</td>
</tr>
<tr>
<td></td>
<td>+5V</td>
<td>System activated by applying a logic level (+5V) signal to the blue wire</td>
</tr>
<tr>
<td>IGNIT LVL</td>
<td>12-36V</td>
<td>System activated by applying vehicle voltage (+10-36 VDC) to the blue wire (Use this position for either position of the IGNIT switch)</td>
</tr>
<tr>
<td></td>
<td>GND*</td>
<td>*System activated by applying a ground to the blue wire</td>
</tr>
<tr>
<td>MODE</td>
<td>AND</td>
<td>System activated by pressing the ON/OFF button AND applying a signal to blue wire</td>
</tr>
<tr>
<td></td>
<td>OR</td>
<td>System activated by pressing the ON/OFF button OR applying a signal to blue wire</td>
</tr>
</tbody>
</table>

Table 5-2 Activation switch settings

Figure 5-3 Activation mode switch locations.

Notes:

- Select the switch positions to correspond how the vehicle is wired and how you want the system to activate.
  - If the switch positions do not match the actual wiring connections, the system may not activate as intended.
- The default positions are in bold.
- The default positions will work in most installations.
- Use a small screwdriver or similar tool to change the switch position.
- Set the IGNIT switch to +5V if the light bar/flasher control module is activated by a logic level signal (5V) from an electronic control panel.
- Set the IGNIT LVL switch to GND if the light bar/flasher switch switches ground rather than 12-36 V.
• If the IGNIT LVL switch is set to GND, the blue wire must normally have +10-36 VDC power applied to it. Also set the IGNIT switch to 12-36V.
  o If not the unit will not shut off.

5.2.1.1 Emergency Vehicle Activation methods:

• Code 3 only (Light bar must be on to activate the system)
  o Connect blue wire so a signal is applied when light bar is activated.
  o Leave the MODE switch in the AND position.
  o Leave ON/OFF switch depressed

• Code 2 or Code 3 (System activates with light bar OR manually with light bar off)
  o Connect blue wire so signal is applied when light bar is activated.
  o Set the MODE switch to the OR position
  o Light bar will activate system
    ▪ If light bar activates system, ON/OFF switch will have no effect.
  o ON/OFF switch will activate system
    ▪ If ON/OFF switch activates system, light bar will have no effect.

5.2.1.2 Transit Vehicle Activation methods:

• System activates with ignition.
  o Connect the blue wire to an ignition source.
  o Leave the ON/OFF switch in the ON position.

• System activated via AVL
  o Connect the blue wire to an ignition source.
  o Leave the ON/OFF switch in the ON position.
  o See section 5-7 for additional details on using the J-1708 interface.

• Driver activates the system with ON/OFF switch
  o Connect the blue wire to an ignition source.
  o ON/OFF switch will activate system.

5.2.1.3 Maintenance Vehicle Activation Methods

• Driver activates the system with ON/OFF switch
  o Connect the blue wire to an ignition source.
  o ON/OFF switch will activate system.
5.3 Turn Signal Sensing Connections

The turn signal sensing inputs operate by detecting the vehicle’s turn signal circuits. The turn signal sense wires may be connected to a pulsing turn signal circuit or a steady turn signal circuit. By default the radio/GPS control unit is looking for a pulsing signal on the turn signal circuit. If you will be connecting to a steady (non-pulsing) turn signal circuit, you will need to use the On-site software to change the input mode. See the On-site software help file for more details.

Notes:

- 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 will occur if the emergency flashers are on.
  - This may also occur 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.
3. Set the desired operation mode and input type using the On-site software.
4. See section 8.2 for details on how to verify proper turn signal sense operation.
5. Rewire any connections that do not work properly.
5.4 Disable Sense Connection

It is recommended that the disable sense wire be connected. It is important to provide an automatic method of disabling the vehicle equipment so that emergency vehicle drivers do not need to remember to shut off the equipment when arriving at the scene. If the disable sense is not wired and the driver does not manually shut the Opticom™ equipment off, any in range intersection/s may remain in preemption mode.

On transit vehicles it is recommend that the disable sense be wired to the passenger door to disable the transit signal priority request while passengers are loading and unloading.

1. Connect the white wire to a switch that actuates when the vehicle reaches the scene.
   a. For instance, this could be a door switch, parking brake, air brake, or gear shift.
   b. The switch may provide either +10-36 VDC or a ground when actuated.
   c. This switch may be an existing vehicle switch or you may install your own.

2. Using the On-site software set the Disable Triggering Mode:
   a. Set to “Apply Ground” if the white wire will be grounded when the disable is activated.
   b. Set to “Apply 12 Volts DC” if the white wire will have a voltage applied when the disable is activated.
      i. This voltage may be +10-36 VDC

3. Using the On-site software set the Disable Operating Mode:
   a. Set to Latching if you are connecting the disable sense wire to the door of an emergency vehicle.
   b. Set to non-latching if you are connecting the disable sense wire to a brake switch, gear shift or the door of a transit vehicle.

4. Verify proper operation. See section 8.2 and 8.3 for details.

Notes:

- See the On-site help file for more details
- If the white disable sense wire is not to be used, it is recommended that this wire be connected to Ground.
  o The Disable Triggering Mode should then be set to “Apply 12VDC”.
  o The Disable Operating Mode should then be set to “Non-latching”.

5.5 Low Priority (optional)

When Opticom™ vehicle equipment ships from the factory, the priority level (High or Low) is factory programmed. 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™ intersection equipment where both high and low priority vehicles operate.

When a signal applied is applied to the brown wire, the vehicle equipment will temporarily broadcast that it is in Low priority. **Do not connect the Brown wire if you do not want to use this mode.**

1. Connect the brown wire to one side of a switch (not provided) and connect the other side to either +10-36 VDC or ground.
   a. Install an in-line fuse holder with a 2A, 250V fuse (not provided) if you are using a 10-36 VDC signal.
2. Using the On-site software, select the method used in step 1 (Apply Ground or 12 VDC).
3. When you activate the switch, the vehicle will be a low priority vehicle until the switch is deactivated.
4. Verify proper operation by monitoring the priority level in the vehicles heard screen of the On-site software.

5.6 Probe Priority (optional)

The user has the option of activating the Opticom™ GPS vehicle unit in Probe priority. Probe priority will allow the vehicle to transmit its position information but will not request TSP/preemption.

When a signal applied is applied to the Gray wire, the vehicle equipment will temporarily broadcast that it is in Probe priority. **Do not connect the Gray wire if you do not want to use this mode.**

1. Connect the gray wire to one side of a switch (not provided) and connect the other side to either +10-36 VDC or ground.
   a. Install an in-line fuse holder with a 2A, 250V fuse (not provided) if you are using a 10-36 VDC signal.
2. Using the On-site software, select the method used in step 1 (Apply Ground or 12 VDC).
3. When you activate the switch, the vehicle will be a probe priority vehicle until the switch is deactivated.
4. Verify proper operation by monitoring the priority level in the vehicles heard screen of the On-site software.
5.7 J1708 Connections (optional)

This section describes the necessary connections and configuration to communicate between the Opticom™ GPS system vehicle equipment and other onboard devices such as an Automatic Vehicle Location (AVL). Skip this section if these connections are not to be used.

J1708/J1587 is a communication protocol which allows communications between the Opticom™ GPS vehicle equipment and other onboard devices such as an Automatic Vehicle Location (AVL) system or other master control devices. This connection allows the master control device to control the Opticom™ GPS vehicle equipment. It is also possible to obtain GPS information from the Opticom™ GPS vehicle equipment via this connection.

The document “Vehicle Priority Module J1708/1587 Communication Protocol Specification” provides all of the information needed to allow a programmer to write the commands to communicate with the Opticom™ GPS system vehicle equipment from the master control device. Contact the GTT Technical Service Department to obtain a copy of this document.

Wiring
1. Connect the White/Yellow (J1708 +) wire of the vehicle interface harness to the serial A connection on the J1708 connector on the master control device.

2. Connect the White/Blue (J1708 -) wire of the vehicle interface harness to the serial B connection on the J1708 connector on the master control device.

3. Jumper the black (Ground) wire of the vehicle interface harness to the ground connection on the J1708 connector on your master control device.

4. Jumper the red (Power) wire of the vehicle interface harness to the power connection on the J1708 connector.

Configuration
1. Connect a cable from the radio/GPS control unit to the PC. Open the On-site software and read from device.

2. Go to the General Configuration section and select J1708 Port in the Communications Section.

3. Set the protocol is to “J1708”. The baud rate is fixed at 9600.

4. Press the “Write to Device” Button to apply the changes to the vehicle unit.
5.8 GPS Output (optional)

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. This data is always available even when the equipment is powered down. As long as 10-36 VDC is applied to the red power wire, the data will be available. Skip this section if these connections are not to be used.

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 0183, v2.0 or later format. The Baud rate is fixed at 38400. 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

Notes:
- The baud rate of the data is fixed at 38400 and cannot be changed.
  - The utility “GPS Gate” may be used to create a virtual COM port operating at different baud rates.
  - Download at http://gpsgate.com/products/gpsgate_client
- While your computer is starting up, it is important to not have the GPS serial data cable connected to the computer. The computer will likely interpret this data as input from a mouse. Your computer may behave erratically and possibly try to install a driver for an additional mouse. Wait until the computer is fully started before connecting this cable.

Wiring 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 a jumper from 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.
5.9 Other connections (optional)

No other wiring connections are needed. Some of the wires described in Table 5-1 are for future applications. Do not connect any wires not described in sections 5-1 to 5-8.

5.10 Model 2173 Adapter for using previous generation harness

The Model 2173 adapter is available if you are upgrading from a Model 1020 or 1021 Vehicle Control Unit using a Model 1071 vehicle interface harness to a Model 2100 or 2101 Radio/GPS Control Unit. By using the Model 2173 adapter, you will not need to rewire the vehicle. In this case, you will not need the Model 2171 harness that is included with your new vehicle kit.

1. Plug the 25 pin connector of the 2173 adapter into the J2 connector on the vehicle control unit.
2. Plug the 15 pin connector of the existing Model 1071 harness into the 15 pin connector on the 2173 adapter.

Note:

- The model 2100/2101 with the 2171 vehicle interface harness contains features and connections not included on the previous generation.
  - If any of the new features are needed then the 2173 adapter cannot be used.
    - Either cut off the connector of the 1071 harness and splice to the 2171 harness or replace the 1071 harness with the 2171 harness.
  - The Model 2173 will provide connections for the following signals only. See Table 5-3

<table>
<thead>
<tr>
<th>Wire Color</th>
<th>Wire Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>White/Yellow</td>
<td>J1708+</td>
</tr>
<tr>
<td>Blue</td>
<td>Light Bar Sense or Ignition Switch</td>
</tr>
<tr>
<td>Brown</td>
<td>Low Priority</td>
</tr>
<tr>
<td>Gray</td>
<td>Probe Priority</td>
</tr>
<tr>
<td>White</td>
<td>Disable Sense</td>
</tr>
<tr>
<td>Green</td>
<td>Right Turn Signal Sense</td>
</tr>
<tr>
<td>Yellow</td>
<td>Left Turn Signal Sense</td>
</tr>
<tr>
<td>Black</td>
<td>Ground (DC-)</td>
</tr>
<tr>
<td>Red</td>
<td>Power Input</td>
</tr>
<tr>
<td>White/Orange</td>
<td>GPS Data-</td>
</tr>
<tr>
<td>White/Brown</td>
<td>GPS Data+</td>
</tr>
<tr>
<td>White/Blue</td>
<td>J1708-</td>
</tr>
</tbody>
</table>

Table 5-3 Available connections with Model 2173
6 Infrared Emitter connections (optional)

Skip this section if you are not connecting an infrared emitter.

The radio/GPS control unit contains a 6-pin terminal strip for connecting an Infrared emitter. When connected, the emitter will be able to be switched on and off by the radio/GPS control unit. When the radio/GPS control unit is put into disable mode, any emitter that is connected to it will also be turned off (disabled). The emitter will not be put into disable mode but rather shut off. Therefore the LEDs (794-795 emitters) will not flash at the disable flash rate.

Any model Opticom™ emitter may be connected.

These terminals may also be used to control/switch other devices on the vehicle. Anything connected to these terminals will be switched on and off with the radio/GPS control unit. Contact GTT technical support for details on what may be controlled/switched with these terminals.

Notes:

• See the emitter installation instructions for additional mounting and wiring details.

• Additional power and ground connections must be made via the terminal strip BAT and GND connections.
  o The emitter is not powered through the J2 connections.
  o Supply a sufficient voltage and current to support the model of emitter that you will be connecting. See the emitter installation instructions for more details.

• You must set the J1708/J1587 Serial port to the Emitter Master protocol using the On-site software for this feature to work.

• The connected emitter will turn on and off with the GPS vehicle equipment. If you want to control the infrared emitter independently, either do not use the connections described in this section or install an additional switch in series with the red power wire in step 2.

• If the IR emitter is to be controlled via J1708, do not connect the IR emitter to the 2100/2101. Connect the blue and gray wires directly to the controlling device. Connect power and ground wires directly to the vehicle’s power source.

• The 2100-2101 controls the attached emitter by switching the ground.

• Even though the emitter J1708 connections (Gray and Blue wires) have terminal strip connection points, they are not currently used. You may connect these wires or leave them disconnected.
  o If the emitter is to be controlled via J1708, the emitter’s gray and blue wires should be connected directly to the controlling device.

• If both the 2100/2101 and the emitter are to be controlled via J1708, contact GTT technical support for more details.

1. Mount the emitter per the instructions included with the emitter.
2. Connect a AWG 20 or larger red wire from a 12 VDC power source to the BAT terminal.
3. Insert the fuse holder, fuse and fuse label (Supplied with the emitter) on the 12 VDC power source wire.
4. Connect a AWG 20 or larger black wire from a vehicle ground point to the GND terminal.
5. Crimp a spade lug on the red and blacks wires of the emitter cable that was supplied with the emitter.
6. Connect the red wire to the red terminal.
7. Connect the black wire to the black terminal.
8. Cut off, tape off, or insulate and secure the gray and blue wires.
   a. See note above
9. Leave the green, white and orange wires disconnected. Cut off, tape off, or insulate and secure these wires.

Figure 6-1 Optional Infrared emitter connections
7 Configuration and Checkout

This section describes how to configure check out and verify the installed Opticom™ GPS vehicle. 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.

**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.

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. Turn on the equipment by depressing the ON/OFF button and/or activating the lightbar/ignition.
   
   a. The unit should acquire GPS within a few minutes; however, it may take up to 15 minutes. A green RADIO indicator means that GPS has been acquired. An amber RADIO 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.
   
   b. Also verify GPS reception using the GPS status screen in the Current Activity section of the On-site software.
### Table 7-1. Radio/GPS Control Unit Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Color/State</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ON/OFF</strong></td>
<td>Off</td>
<td>Unit is powered off</td>
</tr>
<tr>
<td><strong>Switch</strong></td>
<td>Steady Green</td>
<td>Unit is powered on</td>
</tr>
<tr>
<td></td>
<td>Flashing Green once</td>
<td>Unit is in Disable mode</td>
</tr>
<tr>
<td></td>
<td>every two seconds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flashing Green two</td>
<td>Unit is in Broken mode</td>
</tr>
<tr>
<td></td>
<td>times per second</td>
<td></td>
</tr>
<tr>
<td><strong>STATUS</strong></td>
<td>Off</td>
<td>Unit powered off or offline</td>
</tr>
<tr>
<td></td>
<td>Steady Green</td>
<td>Unit powered and online</td>
</tr>
<tr>
<td></td>
<td>Flashing Green</td>
<td>Unit is in broken mode</td>
</tr>
<tr>
<td><strong>RADIO</strong></td>
<td>Off</td>
<td>Radio module is not operating</td>
</tr>
<tr>
<td></td>
<td>Flashing Amber</td>
<td>Searching for radio module</td>
</tr>
<tr>
<td></td>
<td>Steady Amber</td>
<td>Radio module connected, but no 3D/WAAS GPS fix, radio is not transmitting or receiving</td>
</tr>
<tr>
<td></td>
<td>Steady Green</td>
<td>GPS receiver has a 3D/WAAS fix</td>
</tr>
<tr>
<td><strong>LINK</strong></td>
<td>Off</td>
<td>No other radios in range</td>
</tr>
<tr>
<td></td>
<td>Steady Green</td>
<td>Actively communicating with another radio</td>
</tr>
<tr>
<td></td>
<td>Amber</td>
<td>Radio has been placed in Transmit test mode</td>
</tr>
<tr>
<td><strong>PRIORITY</strong></td>
<td>Off</td>
<td>Unit is either offline or broadcasting Probe Priority</td>
</tr>
<tr>
<td></td>
<td>Steady Green</td>
<td>Broadcasting High Priority</td>
</tr>
<tr>
<td></td>
<td>Steady Amber</td>
<td>Broadcasting Low Priority</td>
</tr>
<tr>
<td><strong>DISABLE</strong></td>
<td>Off</td>
<td>Unit NOT in Disable mode</td>
</tr>
<tr>
<td></td>
<td>Flashing Amber once</td>
<td>Unit is in Disable mode</td>
</tr>
<tr>
<td></td>
<td>every two seconds</td>
<td></td>
</tr>
</tbody>
</table>

#### 7.1 Configuration Setup

Using the On-site software, configure the vehicle control unit operating parameters and ID information. See the On-site Help files for additional details.
7.2 Input Verification

Click on Diagnostics Link in the On-site software to see the discreet inputs section. This screen will allow you to monitor the state of various discreet inputs. If the discreet inputs are not seen in this screen, it will be necessary to rewire the inputs so that they are detected. Contact technical service if you have difficulty.

7.2.1 Turn Signal input verification

1. Set the appropriate Turn Signal operating Mode using the On-site software.
   a) Set the appropriate Right and Left Turn Signal Triggering Mode (if needed) using the On-site software.

2. Activate the left turn signal.
   a) Verify that the left turn signal indicator flashes as switches between On and Off.
   b) Pump the brakes several times and verify that only the left turn signal indicator flashes as switches between On and Off.

3. Activate the right turn signal.
   a) Verify that the right turn signal indicator flashes as switches between On and Off.
   b) Pump the brakes several times and verify that only the right turn signal indicator flashes as switches between On and Off.

Notes:

- There may be a delay before the turn signal status will be seen by the On-site software.
- 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.
  o 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.
  o Therefore it is recommended that the yellow and green turn signal sense lines be connected only to the front turn signal wires.
- If both signals are being detected when only the left or right signal is activated, it will be necessary to connect the turn signal line to another point.
- Set the proper input mode and state of the turn signal inputs using the On-site software. See the On-site help file for more details.
7.2.2 Disable Input Verification

1. Set the appropriate Disable Operating Mode and Turn Signal Triggering Mode using the On-site software.

2. Activate the disable switch and verify that the disable input changes form Off to On or On to Off.
   - 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.

3. 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.

7.2.3 Probe and Low Priority Input Verification

1. If used, set the appropriate Low and or Probe Priority Triggering mode using the On-site software. Skip this section if these inputs are not being used.

2. If used, activate the Low priority switch.

3. Verify that the Low priority input is detected in the discrete inputs screen.
   - Also confirm that Low is displayed in the priority column in the vehicles heard screen.

4. If used, activate the Probe priority switch.

5. Verify that the Probe priority input is detected in the discrete inputs screen.
   - Also confirm that Probe is displayed in the priority column in the vehicles heard screen.

7.3 Transmit and Receive Verification

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 coverage (Green Radio indicator).

7.3.1 Verifying with two vehicles

A vehicle radio will not transmit unless it hears an intersection. This section describes the procedure for forcing a vehicle unit to transmit for testing purposes.

1. Place the vehicle to be tested in radio range of a known good Opticom™ GPS-equipped vehicle. This vehicle also must have good GPS coverage.

2. Connect to the On-site software Click on the Diagnostics Link.

3. Press the Set Transmit 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. The Link light should be amber.

4. Exit the Diagnostic screen, disconnect the COM cable and connect to your test vehicle.
5. Open the vehicle heard screen and verify that you can hear the vehicle being tested.
6. Place the test vehicle into transmit test mode per step 3.
7. Reconnect to the vehicle being tested and verify that you can hear the test vehicle.
8. The Link indicator on both units should be green.
9. You have now verified that the vehicle being tested is transmitting and receiving.

7.3.2 Verifying using an Intersection

This section describes the procedure for using an Opticom™ GPS radio connected to a phase selector in a nearby intersection for verifying that the vehicle radio is transmitting and receiving.

1. **Activate the vehicle’s disable switch or you may be placed priority requests to the intersection controller.**
2. Connect to the vehicle being tested with the On-site software.
3. Verify that you can hear the nearby intersection in the Intersections Heard section of the Current Activity screen.
   a. The Link light should be green.
4. Exit the Current Activity screen, disconnect the COM cable and connect to the phase selector in the nearby intersection.
5. Verify that you can hear the vehicle being tested in the Vehicles Heard section of the Current Activity screen.
   a. The Link indicator should be green.
8 Communication Ports

Radio/GPS control units have multiple communication ports:
- One RS-232(DB-9) port
- One USB port
- One Ethernet port
- One J1708 port
- One GPS Data output port
- One CAN port (future)

8.1 RS-232 Communication Port

There is one RS-232 communication port. This port called PC is on the front panel. This port uses an industry-standard DB-9 connector. The protocol and baud rate are fixed at 115,200 SCOM (Serial Communications)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DTR (Data Terminal Ready)</td>
</tr>
<tr>
<td>2</td>
<td>TXD (transmit data)</td>
</tr>
<tr>
<td>3</td>
<td>RXD (receive data)</td>
</tr>
<tr>
<td>4</td>
<td>DCD (Data Carrier Detect)</td>
</tr>
<tr>
<td>5</td>
<td>GND (ground)</td>
</tr>
<tr>
<td>6</td>
<td>DTR (Data Terminal Ready)</td>
</tr>
<tr>
<td>7</td>
<td>CTS (Clear to Send)</td>
</tr>
<tr>
<td>8</td>
<td>RTS (Ready to Send)</td>
</tr>
<tr>
<td>9</td>
<td>RI (ring Indicator)</td>
</tr>
</tbody>
</table>

Table 8-1 RS-232 port pin assignments

8.2 USB Port

The USB port on the Radio/GPS Control Unit is a standard mini-AB receptacle. To communicate with the Radio/GPS Control Unit using USB, connect a USB cable from the USB port on the Radio/GPS Control Unit to a USB port on your computer.

- The first time you connect your computer to the Radio/GPS Control Unit using the USB port, your computer will detect a new device called Opticom™.
  - The drivers will be loaded.
  - Once complete, a new serial port will be created on your computer.
- Select that port number in the On-site software to communicate with the Radio/GPS Control Unit.
  - See the On-site software help file for details.
- When you disconnect the USB cable, your computer will no longer see that serial port.
  - But it will reappear when you reconnect the cable.
  - If you plug into a different USB port on your computer, it may install another serial port.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VCC (+5 VDC)</td>
</tr>
<tr>
<td>2</td>
<td>Data -</td>
</tr>
<tr>
<td>3</td>
<td>Data +</td>
</tr>
<tr>
<td>4</td>
<td>ID</td>
</tr>
<tr>
<td>5</td>
<td>Ground</td>
</tr>
</tbody>
</table>

Table 8-2 USB port (mini-A) pin assignments
8.3 Ethernet Port

The default address for the Ethernet port is:

<table>
<thead>
<tr>
<th>IP Address</th>
<th>192.168.0.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCP Port</td>
<td>5000</td>
</tr>
<tr>
<td>UDP Port</td>
<td>6000</td>
</tr>
</tbody>
</table>

Table 8-3 Ethernet Port Default settings

- The address and port numbers in the Radio/GPS Control Unit may be changed using the On-site software. See the On-site help files for details.
  - Record the new address and port numbers so that you can communicate with the Radio/GPS Control Unit.
- Connect a standard Ethernet cable between the Ethernet port on the Radio/GPS Control Unit and the Ethernet network device that you will use to communicate with the Radio/GPS Control Unit.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Data 1+</td>
</tr>
<tr>
<td>2</td>
<td>Data 1 -</td>
</tr>
<tr>
<td>3</td>
<td>Data 2 +</td>
</tr>
<tr>
<td>4</td>
<td>Not used</td>
</tr>
<tr>
<td>5</td>
<td>Not Used</td>
</tr>
<tr>
<td>6</td>
<td>Data 2 -</td>
</tr>
<tr>
<td>7</td>
<td>Signal Common (0V) for data 1</td>
</tr>
<tr>
<td>8</td>
<td>Signal Common (0V) for data 2</td>
</tr>
</tbody>
</table>

Table 8-4 Ethernet port pin assignment

Ethernet indicators

There are two indicator lights on the Ethernet port. The following is the meaning of these indicators:

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Off</th>
<th>Solid</th>
<th>Flashing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow</td>
<td>No Ethernet connection</td>
<td>Ethernet port connected</td>
<td>Active communication</td>
</tr>
<tr>
<td>Green</td>
<td>Speed set to 10Mb/s</td>
<td>Speed set to 100Mb/s</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Table 8-5 Ethernet port indicator meaning
## 9 Troubleshooting

Table 9-1 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>
<thead>
<tr>
<th>Symptom</th>
<th>Possible Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle control unit LEDs will not light.</td>
<td>Wiring incorrect.</td>
<td>Check wiring. Verify that control unit is getting 10-36 VDC.</td>
</tr>
<tr>
<td>Vehicle control unit LEDs will not light.</td>
<td>Remote activation line not active.</td>
<td>Verify that a signal is being applied to blue wire of vehicle interface harness.</td>
</tr>
<tr>
<td>Vehicle control unit LEDs will not light.</td>
<td>Remote activation line not configured correctly</td>
<td>Set switches to match how remote activation line is wired.</td>
</tr>
<tr>
<td>Vehicle control unit LEDs will not light.</td>
<td>Fuse/s blown</td>
<td>Replace fuses with 2A/250V 3AG SLO-BLO.</td>
</tr>
<tr>
<td>Vehicle control unit LEDs will not light.</td>
<td>Vehicle control unit failed.</td>
<td>Return unit to GTT for service.</td>
</tr>
<tr>
<td>GPS will not acquire. (RADIO LED is amber.)</td>
<td>Initial start-up may take up to 5 minutes.</td>
<td>Wait 5 minutes.</td>
</tr>
<tr>
<td>GPS will not acquire. (RADIO LED is amber.)</td>
<td>Radio/GPS unit’s view of sky is obstructed.</td>
<td>Move unit or remove obstructions.</td>
</tr>
<tr>
<td>GPS will not acquire. (RADIO LED is amber.)</td>
<td>Radio/GPS antenna failed.</td>
<td>Return unit to GTT for service.</td>
</tr>
<tr>
<td>GPS will not acquire. (RADIO LED is amber.)</td>
<td>Radio/GPS control unit failed.</td>
<td>Return unit to GTT for service.</td>
</tr>
</tbody>
</table>

Table 9-1. Troubleshooting Symptoms, Possible Causes, and Solutions
### Table 9-1. Troubleshooting Symptoms, Possible Causes, and Solutions (continued)

#### 10 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 and emitter.
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