Canoga™ Traffic Sensing System
C900 Series Vehicle Detector
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1 About This Manual

1.1 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
Contains important information about safety messages and safety precautions.

Section 3. Regulatory Requirements Conformance
Contains information about testing the traffic monitoring cards for conformance to regulatory requirements.

Section 4. Hardware Installation
Describes the steps involved to install the C922E and C924E vehicle detectors, into European style vehicle detector racks and to install the C922 and C924 into NEMA, 170 and 2070 style detector racks.

Section 5. Software Installation
Describes system requirements and step-by-step procedures for installing C900 Configuration Software.

Section 6. Quick Setup
Describes the minimum items that must be covered to start up a new vehicle detector.

Section 7. Vehicle Detector Setup and Configuration – Recommended Steps
Describes, in a step-by-step manner, how to set the operating parameters for the C922, C924, C922E and C924E vehicle detectors. It also describes how to check that the desired operation is being obtained.

Section 8. Historical Data Retrieval, Examination, Saving, Exporting, Printing
Describes how to retrieve, examine, save, export and print historical traffic data stored in the detector.

Section 9. Troubleshooting
Describes how to eliminate crosstalk between channels and provides the diagnostic codes displayed by the front panel LED indicators when faults occur.

Section 10. Product Description and Specification

1.2 Purpose of Manual
This manual provides the installation and setup information required to successfully install C922, C924, C922E and C924E vehicle detectors. In addition to installation instructions, this manual contains information useful for retrieving and saving traffic data stored in the vehicle detectors, and for troubleshooting and maintaining systems containing C922, C924, C922E and C924E vehicle detectors.

1.3 Manual Audience
This manual is written for GTT certified traffic system installers and maintenance technicians.

1.4 Model Numbers
The Canoga C922E and C922 vehicle detectors have two-channels (single channel pair) and the Canoga C924E and C924 vehicle detectors have four-channels (two channel pairs). All vehicle detectors are components of a matched component system.

Models with an E suffix are vehicle detectors designed for European requirements. Their size is that of a Euro card (3U) and they have a 48 contact DIN 41612 Type F connector (male contacts, female body).

Models with no E suffix are vehicle detectors for NEMA/170/2070/ATC specification compatible racks. They are STD size cards with a 44 contact card-edge connector, contacts spaced on 0.156 inch (3.96 mm) centers.

The switch outputs (channel call/vehicle detected outputs) on all models are optically isolated Darlington pair outputs. This also applies to the Collective Disturbance (Unit Fault Status) output on the E suffix units.
1.5 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.

<table>
<thead>
<tr>
<th>Element</th>
<th>Convention</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acronyms</td>
<td>Uppercase</td>
<td>LED</td>
</tr>
<tr>
<td>Abbreviations</td>
<td>Lowercase</td>
<td>ms (milliseconds)</td>
</tr>
<tr>
<td></td>
<td>...Except where standard usage is uppercase</td>
<td>Mb (megabits)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MB (megabytes)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>dB (decibel)</td>
</tr>
<tr>
<td>Model Names</td>
<td>First or formal reference: initial caps</td>
<td>C924E &amp; C922 Vehicle Detector, detector, or card</td>
</tr>
<tr>
<td></td>
<td>Subsequent use or informal reference: initial caps for Model, lowercase for remainder</td>
<td>C924E &amp; C922 Vehicle Detector, detector, or card</td>
</tr>
</tbody>
</table>
2 Safety

We include important safety information and warnings to help you understand and avoid potential harm to yourself, and possible damage to the equipment, during the installation of the Canoga C922, C924, C922E and C924E vehicle detectors. Although we have included potential hazards that 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 and observe all safety information and instructions in this manual before installing the system 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 Canoga™ Traffic Sensing System, including vehicle detector(s), used with C900 Configuration Software (C900-CS) is intended to provide traffic measurement and vehicle detection information for use in Intelligent Transportation Systems and Advanced Traffic Management Systems.

The Canoga Traffic Sensing System consists of the C922E, C924E, C922 and/or C924 vehicle detectors, the C900-CS configuration software and the GTT 701 or 702 Microloops™. The vehicle detectors may also be connected to standard inductive loops.

2.2 Technical Support

If you have any questions about the system, its use, or operation, please call the GTT Technical Service Department at 1-800-258-4610 or +1 (651) 789-7333 (Worldwide Technical Service).

2.3 Safety Messages

We include safety messages in this manual to help protect your safety and the safety of others. This section contains important information to help you recognize and understand these safety messages. Please read these messages before proceeding with the installation.

2.4 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 the safety alert symbol (⚠️); one of three signal words: DANGER, WARNING, or CAUTION; plus a safety message.

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

⚠️ DANGER

The safety message is in this box.

DANGER means you and/or someone else WILL be KILLED or SERIOUSLY HURT if you do not follow these instructions.

⚠️ WARNING

The safety message is in this box.

WARNING means you and/or someone else MAY be KILLED or SERIOUSLY HURT if you do not follow these instructions.

⚠️ CAUTION

The safety message is in this box.

CAUTION means you and/or someone else MAY be HURT or property damage may result if you do not follow these instructions.

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.
2.5 Safety Messages Contained in This Manual

The following safety messages appear in this manual:

**WARNING**
Improper use of vehicle detectors may cause improper operation of the traffic control system, which may result in personal injury. To avoid improper use of the C922, C924, C922E and C924E vehicle detectors, installation must be done only by qualified professionals who are trained to operate and maintain traffic control systems, and who are familiar with this equipment. Improper operation of the traffic control system may result in unsafe driver action.

**WARNING**
Plugging a vehicle detector into the wrong connector may cause improper operation of the traffic control system, which may result in personal injury. To avoid this problem, be sure to plug the vehicle detector into a 48-contact connector (C922E or C924E) intended for vehicle detectors or into a 22/44-contact connector (C922 or C924) intended for vehicle detectors. Improper operation of the traffic control system may result in unsafe driver action.

**WARNING**
Improper wiring of the card rack connector may cause incorrect operation of the vehicle detector and affect the traffic control system, which may result in personal injury. To avoid this problem, verify that the card rack connectors and wiring are appropriate. Improper operation of the traffic control system may result in unsafe driver action.

---

2.6 Safety Considerations

Please consider the following safety issues before beginning the installation.

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 Work Zone Traffic Control

Proper control of vehicle traffic is important during many procedures. When necessary, we recommend that you have people trained in manual traffic control, such as police officers, assist you.

When you install devices that require you to position vehicles, equipment, or people in or near the roadway it is important that you use appropriate work zone traffic control techniques, equipment, and procedures. Sometimes you may have to work on or near the roadway and these same techniques, equipment, and procedures should be used for your protection.

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

2.6.3 Electric Shock

The possibility of electrical shock exists when installing Canoga™ C922, C924, C922E and C924E vehicle detectors if they are not installed properly. Follow proper work procedures and read and understand the safety messages in this manual.

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 off before beginning any procedure. 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 procedures are recommended for the job, ask your supervisor or foreman.

2.7 Disposal of Device

Please dispose of the device in accordance with all local government laws and regulations.
3 Regulatory Requirements Conformance


The detectors have also been certified to conform to the electromagnetic compatibility requirements of European Standard EN 50293: 2000: “Electromagnetic Compatibility – Road Traffic Signal Systems – Product Standard”.

4 Hardware Installation

This section describes how to check and install card rack wiring, how to install accessory modules on the Canoga C922, C924, C922E and C924E vehicle detectors, and how to install those vehicle detectors.

4.1 Pre-Installation

Check the card rack or input file connector to be sure that it is a properly wired 48-contact DIN connector (E units) or a properly wired 44 contact card-edge connector (non-E units).

The connectors must be fully wired, including wired for channel synchronization and serial communication, to fully take advantage of the advanced features of vehicle detectors. See Table 4-1 and Table 4-2 for card rack connector pin assignments for the non-E and E versions, respectively.

Table 4-1 shows the pin assignments viewed from the front of the card rack (looking into the slot). Pins z2 to z32 are on the left side of the connector, pins b2 to b32 are in the middle of the connector, and pins d2 to d32 are on the right side of the connector.

In Table 4-2, the numbered contacts are on the “component side” or left side of the board, and the lettered contacts are on the “circuit side” or right of the board.

You will need card rack mounting tools, hardware as required, and connection wire that meets applicable electrical codes and any standards established at the installation site.

Refer to Subsection 10.2 Vehicle Detector Specifications for vehicle detector power requirements.

4.2 Card Rack Wiring

1. If the card rack is not pre-wired or you replaced a connector in the card rack, install the wiring. Use Table 4-1 and/or Table 4-2 to determine the required connections.

   Make all connections to the pins on the rear of the card rack connector into which the vehicle detectors will plug. Any of the inputs or outputs not used in your application can be left unconnected except in configurations where vehicle detector synchronization is used. In this case, a short must be placed across the sensor inputs for unused channels.

   WARNING

   Improper wiring of the card rack connector may cause incorrect operation of the vehicle detector and affect the traffic control system, which may result in personal injury. To avoid this problem, verify that the card rack connectors and wiring are appropriate. Improper operation of the traffic control system may result in unsafe driver action.

2. If the card rack is pre-wired, verify that the wiring is compatible with Table 4-1 or Table 4-2.

   WARNING

   Improper wiring of the card rack connector may cause incorrect operation of the vehicle detector and affect the traffic control system, which may result in personal injury. To avoid this problem, be sure to plug the vehicle detector into a 48-contact connector (C922E or C924E) intended for vehicle detectors or into a 22/44-contact connector (C922 or C924) intended for vehicle detectors. Improper operation of the traffic control system may result in unsafe driver action.

4.2.1 Switch/Call Outputs

The structure of the channel switch/call outputs is shown in Figure 4-1. Channel Switch/Call Output Structure. The + terminal of each output must be connected to the more positive of the two load terminals.

Connect the outputs only to load configurations that meet the requirements stated in Section 10.2 Vehicle Detector Specifications.

You will need card rack mounting tools, hardware as required, and connection wire that meets applicable electrical codes and any standards established at the installation site.

Figure 4-1. Switch/Call Output Structure
4.2.2 Disturbance/Status Outputs

The structure of the channel disturbance/status outputs in C922E and C924E units is shown in Figure 4-2. C922E/924E Channel Disturbance/Status Output Structure. The + terminal of each output must be connected to the more positive of the two load terminals. 32d is the internal DC supply common conductor of the vehicle detector.

Connect the outputs only to load configurations that meet the requirements stated in Section 10.2 Vehicle Detector Specifications.

The structure of the channel disturbance/status outputs in C922 and C924 units is shown in Figure 4-3. C922/C924 Channel Disturbance/Status Output. The + terminal of each output must be connected to the more positive of the two load terminals. 32d is the internal DC supply common conductor of the vehicle detector.

Connect the outputs only to load configurations that meet the requirements stated in Section 10.2 Vehicle Detector Specifications.

4.2.3 Optional Synchronized Vehicle Detector Rack Wiring

To use the Synchronization feature of the C922E, C924E C922 and C924 vehicle detectors, the card rack connectors that receive vehicle detectors must be wired as follows:

For C922E and C924E:
1. All 6B pins (Synchr. Conduct. 1) must be bussed on the card rack.
2. All 26B pins (Synchr. Conduct. 2) must be bussed on the card rack.
3. All 32d pins (0 VDC reference) must be bussed on the card rack.

For C922 and C924:
1. All number 1 contacts (Synchr. Conduct. 1) must be bussed on the card rack.
2. All number 2 contacts (Synchr. Conduct. 2) must be bussed on the card rack.
3. All A contacts (0 VDC reference) must be bussed on the card rack.

See Table 4-1. C922E and C924E Card Rack Connector Pin Assignments and Table 4-2. C922 and C924 Vehicle detector Card-Edge Connector Contact Assignments for card rack connector pin assignments.
CAUTION

The edge connector contacts on C922 and C924 units that have the SYNC I/O lines, pin 1 and pin 2, are specified as GREEN input lines on NEMA vehicle detectors. **If the inputs to any load switches are connected to edge connector pins 1 and 2, remove those connections.** Failure to do so may interfere with load switch control and cause a controller cabinet conflict monitor or malfunction management unit to place the intersection into flash.

4.2.4 Rear Connector Communication Port Wiring

To use the rear communication port on C922, C924, C922E and C924E vehicle detectors, the card rack connectors that receive vehicle detectors must be wired as follows. These points must then be connected to the appropriate pins of a connector going to a device communication port.

**For C922E and C924E models:**
1. All 2b pins (TIA-485-A or TIA-232 TX output) must be bussed on the card rack.
2. All 4b pins (TIA-485-B or TIA-232 RX input) must be bussed on the card rack.
3. All 32d pins (0 VDC reference) must be bussed on the card rack.

**For C922 and C924 models:**
1. All number 19 contacts (TIA-485-A or TIA-232 TX output) must be bussed on the card rack.
2. All number 21 contacts (TIA-485-B or TIA-232 RX input) must be bussed on the card rack.
3. All A contacts (0 VDC reference) must be bussed on the card rack.

4.2.5 Remote Reset Wiring

A remote reset input is available on vehicle detector rear connector. Remote Reset is activated by a LOW on these slot terminals:

1. C922E and C924E units – 28d (+) to 32d(-)
2. C922 and C924 units – 3(+) to A(-)

WARNING

When you reset the vehicle detector, all vehicles currently over the sensors will be tuned out and possibly left undetected. This may cause improper operation of the traffic control system, which may result in personal injury. Improper operation of the traffic control system may result in unsafe driver action. **To avoid this problem, take the appropriate steps to prevent vehicles from being left undetected at an intersection or other traffic control point when you reset the vehicle detector.**

4.3 Communication Connections

The Canoga C922, C924, C922E and C924E vehicle detectors each contain a front panel TIA-232 port connector and are configured as Data Terminal Equipment (DTE) devices. [A PC is a DTE device; a modem is a DCE (Data Communication Equipment) device.] Two independent communication channels are supported. On the front panel, a 9-pin D subminiature (pin contacts, female shell as prescribed for DTE devices) provides full-duplex TIA-232 communication with TX and RX signals supported. An RTS signal is present with signal levels that are TRUE when the vehicle detector is transmitting and high impedance when it is listening. The CTS signal is terminated with a receiver circuit, but is functionally ignored.

The standard rear communication port is TIA-485 and is terminated at the card rack connector. This is a two-wire, half-duplex interface.
To ensure proper TIA-485 transmission line loading, place a jumper across JP5 on one vehicle detector card in the rack.

With the installation of an optional 832 communication module, the rear communication port becomes full-duplex TIA-232 supporting only TX and RX signals.

Both communication ports can be programmed for baud rates of 1200, 2400, 4800, 9600 (default), 19,200 and 38,400. Communication uses 8 bits, no parity, and 1 stop bit.

For more information on rear communication port wiring, see Table 4-1. C922E and C924E Card Rack Connector Pin Assignments and Table 4-2. C922 and C924 Vehicle detector Card-Edge Connector Contact Assignments.

4.3.1 Cable – Front Port to PC (9-Pin DSUB sockets both ends)

To connect a PC to the front panel TIA-232 port, you may use a GTT C900 Communication Cable or a null modem cable that conforms to the connections shown in Figure 4-5. Null Modem Cable Schematic.

4.3.2 Cable – Front Port to Modem (9-Pin DSUB pins)

To connect a modem to the front panel TIA-232 port, you may use a standard serial communication 9-Pin DSUB extension cable. If the modem requires a 25-Pin DSUB, use a standard Male 9-Pin DSUB to Male 25-Pin DSUB converter.

4.3.3 Cable – Rear C92xE TIA-485 Half Duplex Port to PC or Modem

The rear TIA-485 communication port on a C922E and/or a C924E may be connected to a modem or PC using the cabling shown in Figure 4-6. Cable – Rear C92xE TIA-485 Port to Modem or PC. The most common means of connection to a TIA-485 port is via a terminal block. The modem or PC must be configurable for half duplex. Another option is to use a full duplex to half-duplex converter in between the vehicle detector(s) and the modem or PC.

4.3.4 Cable – Rear C92x TIA-485 Half Duplex Port to PC or Modem

The rear TIA-485 communication port on a C922 and/or a C924 may be connected to a modem or PC using the cabling shown in Figure 4-7. Cable – Rear C92x TIA Half Duplex Port to PC or Modem. The most common means of connection to an TIA-485 port is via a terminal block. The modem or PC must be configurable for half duplex. Another option is to use a full duplex to half-duplex converter in between the vehicle detector(s) and the modem or PC.
4.3.5 Cable – C92xE Rear TIA-232 Port to PC

The rear TIA-232 communication port, obtained by installing an 832 communication module on a C922E and/or a C924E, may be connected to a PC using the cabling shown in Figure 4-8. Cable – Rear C92xE TIA-232 Port to PC. The cable goes from the bussed port wires on the rear of the rack to a 9-pin DSUB with socket contacts.

4.3.6 Cable – C92xE Rear TIA-232 Port to Modem

The rear TIA-232 communication port, obtained by installing an 832 communication module on a C922E and/or a C924E, may be connected to a modem using the cabling shown in Figure 4-9. Cable – Rear C92xE TIA-232 Port to Modem. The cable goes from the bussed port wires on the rear of the rack to a 9-pin DSUB with pin contacts.

4.3.7 Cable – C92x Rear TIA-232 Port to PC

The rear TIA-232 communication port, obtained by installing an 832 communication module on a C922 and/or a C924, may be connected to a PC using the cabling shown in Figure 4-10. Cable – Rear C92x TIA-232 Port to PC. The cable goes from the bussed port wires on the rear of the rack to a 9-pin DSUB with socket contacts.

4.3.8 Cable – C92x Rear TIA-232 Port to Modem

The rear TIA-232 communication port, obtained by installing an 832 communication module on a C922 and/or a C924, may be connected to a modem using the cabling shown in Figure 4-11. Cable – Rear C92x TIA-232 Port to Modem. The cable goes from the bussed port wires on the rear of the rack to a 9-pin DSUB with pin contacts.
Table 4-1. C922E and C924E Card Rack Connector Pin Assignments

<table>
<thead>
<tr>
<th>Pin</th>
<th>z</th>
<th>b</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Loop 1</td>
<td>TIA-485 (A+)/TIA-232 (TX)</td>
<td>Loop 2</td>
</tr>
<tr>
<td>4</td>
<td>Loop 3</td>
<td>TIA-485 (B+)/TIA-232 (RX)</td>
<td>Loop 4</td>
</tr>
<tr>
<td>6</td>
<td>Loop 1</td>
<td>Synchr. Conduct. 1</td>
<td>Loop 2</td>
</tr>
<tr>
<td>8</td>
<td>Loop 3</td>
<td>NC</td>
<td>Loop 4</td>
</tr>
<tr>
<td>10</td>
<td>CH1 Switch/Call Output (E)</td>
<td>NC</td>
<td>CH2 Switch/Call Output (E)</td>
</tr>
<tr>
<td>12</td>
<td>CH3 Switch/Call Output (E)</td>
<td>NC</td>
<td>CH4 Switch/Call Output (E)</td>
</tr>
<tr>
<td>14</td>
<td>CH1 Switch/Call Output (C)</td>
<td>NC</td>
<td>CH2 Switch/Call Output (C)</td>
</tr>
<tr>
<td>16</td>
<td>CH3 Switch/Call Output (C)</td>
<td>NC</td>
<td>CH4 Switch/Call Output (C)</td>
</tr>
<tr>
<td>18</td>
<td>CH1 Disturb. Sign. ext. (OC)</td>
<td>NC</td>
<td>CH2 Disturb. Sign. ext. (OC)</td>
</tr>
<tr>
<td>20</td>
<td>CH3 Disturb. Sign. ext. (OC)</td>
<td>NC</td>
<td>CH4 Disturb. Sign. ext. (OC)</td>
</tr>
<tr>
<td>22</td>
<td>12 to 24 V AC/DC A</td>
<td>12 to 24 V AC/DC A</td>
<td>12 to 24 V AC/DC A</td>
</tr>
<tr>
<td>24</td>
<td>NC</td>
<td>NC</td>
<td>NC</td>
</tr>
<tr>
<td>26</td>
<td>NC</td>
<td>Synchr. Conduct. 2</td>
<td>NC</td>
</tr>
<tr>
<td>28</td>
<td>Coll. Disturb. Signal (C)</td>
<td>Coll. Disturb. Signal (E)</td>
<td>RESET external (active ON=LOW)</td>
</tr>
<tr>
<td>30</td>
<td>12 to 24 V AC/DC B</td>
<td>12 to 24 V AC/DC B</td>
<td>12 to 24 V AC/DC B</td>
</tr>
<tr>
<td>32</td>
<td>NC</td>
<td>PE (Protective Earth)</td>
<td>0 VDC</td>
</tr>
</tbody>
</table>

**Shaded contacts not connected on C922E units**

**Key**
- E: Emitter of opto-coupler
- C: Collector of opto-coupler
- OC: Open Collector/Open Drain
- NC: No Connection
Table 4-2. C922 and C924 Vehicle detector Card-Edge Connector Contact Assignments

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
<th>C922</th>
<th>C924</th>
<th>Pin</th>
<th>Function</th>
<th>C922</th>
<th>C924</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Common of +VDC (0 VDC)</td>
<td>⚫</td>
<td>⚫</td>
<td>1</td>
<td>Synchronize Conductor 1</td>
<td>⚫</td>
<td>⚫</td>
</tr>
<tr>
<td>B</td>
<td>+VDC (+10.8VDC to 38VDC)</td>
<td>⚫</td>
<td>⚫</td>
<td>2</td>
<td>Synchronize Conductor 2</td>
<td>⚫</td>
<td>⚫</td>
</tr>
<tr>
<td>C</td>
<td>RESET External</td>
<td>⚫</td>
<td>⚫</td>
<td>3</td>
<td>No Connection</td>
<td>⚫</td>
<td>⚫</td>
</tr>
<tr>
<td>D</td>
<td>Channel 1 Loop Input A</td>
<td>⚫</td>
<td>⚫</td>
<td>4</td>
<td>Channel 1 Redundant Loop Input A</td>
<td>⚫</td>
<td>⚫</td>
</tr>
<tr>
<td>E</td>
<td>Channel 1 Loop Input B</td>
<td>⚫</td>
<td>⚫</td>
<td>5</td>
<td>Channel 1 Redundant Loop Input B</td>
<td>⚫</td>
<td>⚫</td>
</tr>
<tr>
<td>F</td>
<td>Channel 1 Switch/Call Output (C)</td>
<td>⚫</td>
<td>⚫</td>
<td>6</td>
<td>No Connection</td>
<td>⚫</td>
<td>⚫</td>
</tr>
<tr>
<td>G</td>
<td>Channel 1 Switch/Call Output (E)</td>
<td>⚫</td>
<td>⚫</td>
<td>7</td>
<td>Channel 1 Disturbance Signal (OC)</td>
<td>⚫</td>
<td>⚫</td>
</tr>
<tr>
<td>H</td>
<td>Channel 2 Loop Input A</td>
<td>⚫</td>
<td>⚫</td>
<td>8</td>
<td>Channel 2 Redundant Loop Input A</td>
<td>⚫</td>
<td>⚫</td>
</tr>
<tr>
<td>I</td>
<td>Channel 2 Loop Input B</td>
<td>⚫</td>
<td>⚫</td>
<td>9</td>
<td>Channel 2 Redundant Loop Input B</td>
<td>⚫</td>
<td>⚫</td>
</tr>
<tr>
<td>J</td>
<td>Channel 3 Loop Input A</td>
<td>⚫</td>
<td>⚫</td>
<td>10</td>
<td>No Connection</td>
<td>⚫</td>
<td>⚫</td>
</tr>
<tr>
<td>K</td>
<td>Channel 3 Loop Input B</td>
<td>⚫</td>
<td>⚫</td>
<td>11</td>
<td>No Connection</td>
<td>⚫</td>
<td>⚫</td>
</tr>
<tr>
<td>L</td>
<td>PE (Protective Earth)</td>
<td>⚫</td>
<td>⚫</td>
<td>12</td>
<td>No Connection</td>
<td>⚫</td>
<td>⚫</td>
</tr>
<tr>
<td>M</td>
<td>No Connection</td>
<td>⚫</td>
<td>⚫</td>
<td>13</td>
<td>Channel 3 Redundant Loop Input A</td>
<td>⚫</td>
<td>⚫</td>
</tr>
<tr>
<td>N</td>
<td>No Connection</td>
<td>⚫</td>
<td>⚫</td>
<td>14</td>
<td>Channel 3 Redundant Loop Input B</td>
<td>⚫</td>
<td>⚫</td>
</tr>
<tr>
<td>O</td>
<td>No Connection</td>
<td>⚫</td>
<td>⚫</td>
<td>15</td>
<td>No Connection</td>
<td>⚫</td>
<td>⚫</td>
</tr>
<tr>
<td>P</td>
<td>Channel 3 Loop Input A</td>
<td>⚫</td>
<td>⚫</td>
<td>16</td>
<td>Channel 3 Disturbance Signal (OC)</td>
<td>⚫</td>
<td>⚫</td>
</tr>
<tr>
<td>Q</td>
<td>Channel 4 Loop Input A</td>
<td>⚫</td>
<td>⚫</td>
<td>17</td>
<td>Channel 4 Redundant Loop Input A</td>
<td>⚫</td>
<td>⚫</td>
</tr>
<tr>
<td>R</td>
<td>Channel 4 Loop Input B</td>
<td>⚫</td>
<td>⚫</td>
<td>18</td>
<td>Channel 4 Redundant Loop Input B</td>
<td>⚫</td>
<td>⚫</td>
</tr>
<tr>
<td>S</td>
<td>Channel 2 Switch/Call Output (C)</td>
<td>⚫</td>
<td>⚫</td>
<td>19</td>
<td>TIA-485 (A-) or TIA-232 (TX) with M832 Option</td>
<td>⚫</td>
<td>⚫</td>
</tr>
<tr>
<td>T</td>
<td>Channel 2 Switch/Call Output (E)</td>
<td>⚫</td>
<td>⚫</td>
<td>20</td>
<td>Channel 2 Disturbance Signal (OC)</td>
<td>⚫</td>
<td>⚫</td>
</tr>
<tr>
<td>U</td>
<td>Channel 4 Switch/Call Output (C)</td>
<td>⚫</td>
<td>⚫</td>
<td>21</td>
<td>TIA-485 (B+) or TIA-232 RX with M832 Option</td>
<td>⚫</td>
<td>⚫</td>
</tr>
<tr>
<td>V</td>
<td>Channel 4 Switch/Call Output (E)</td>
<td>⚫</td>
<td>⚫</td>
<td>22</td>
<td>Channel 4 Disturbance Signal (OC)</td>
<td>⚫</td>
<td>⚫</td>
</tr>
</tbody>
</table>

Shading means this model has no connection to this pin.

Pin 1 through 22 is on the top (component) side and pin A through Z is on the back (solder side).
Polarization keys are located at three positions: Between B/2 and C/3, Between M/11 and N/12, Between E/5 and F/6.

4.4 Accessory Module Installation

If you are installing either the optional 832 Communication Module or the optional 848 Memory Module, perform the following steps:

1. Remove the two jumpers from the 5-pin connector on the vehicle detector (see Figure 4-12).
2. Plug the optional accessory module into the vehicle detector board (see Figure 4-12). Be sure the pins on the accessory module match the pin configuration on the vehicle detector board. Also, use care when inserting or removing the module to avoid bending or breaking the pins.
3. Secure the accessory module to the vehicle detector by installing the screw as shown in Figure 4-12.
4. When using the 832 communication module (TIA-232) to communicate with more than one C922, C924, C922E and/or C924E vehicle detector in a rack, remove jumpers JP1 and JP2 on all modules except one. The JP1/JP2 jumpers must be installed on only one vehicle detector to enable pull-down resistors on the transmit and receive lines.

4.5 Install TIA-485 Transmission Line Load

When the rear TIA-485 communication ports are parallel connected to multiple vehicle detector cards, place a jumper across JP5 on one vehicle detector card in the rack to ensure proper TIA-485 transmission line loading.

4.6 Vehicle Detector Installation

1. Plug the vehicle detector into an appropriately wired connector in the card rack or input file.
2. Setup and configure the vehicle detector for your application. See Section 5 Software Installation and Section 7 Vehicle Detector Setup and Configuration – Recommended Steps.
Figure 4-12. Accessory Module Installation
5 Software Installation

Canoga™ C900 Configuration Software (C900-CS) is a configuration, diagnostic, and data collection tool intended for use with the C922, C924, C922E and C924E vehicle detectors. C900-CS is an applet that runs under ITS Link, which is the program used to launch the GTT configuration software.

5.1 System Requirements

Minimum System Requirements

- Windows® XP or later Windows Operating Systems
- Microsoft® Internet Explorer 6.0 or greater
- XML libraries
- CD-ROM drive for installation

Recommended System Requirements

- Intel® Pentium® II 266 MHz or faster compatible processor
- 30 MB disk space minimum
- 64 MB RAM minimum

Optional Communication Accessories

- Windows-compatible printer
- Modem and Internet access
- Local area network (file sharing)

5.2 Installing Configuration Software

You must be running Windows XP or later operating system to install ITS Link and C900 configuration software.

NOTE

Close all programs and turn off virus protection software to prevent installation conflicts. Certain virus protection software may view installation files as a potential virus and can slow system performance considerably.

You must be logged in as an Administrator to install ITS Link and C900-CS.

Installation normally starts automatically when you insert the ITS Link CD into your CD-ROM drive. If installation does not start automatically, you can install the software using the following procedure:

1. Insert the GTT ITS Link CD into your CD-ROM drive.
2. From the Start menu, choose Run.
3. In the Run dialog, type d:\setup, where d is the letter assigned to your CD-ROM drive.
4. Click OK, and follow the instructions on your screen.

The Setup program guides you through the installation process.

5.3 Technical Support

If you encounter problems while installing C900 Configuration Software, call Technical Support at 1-800-258-4610 or +1 (651) 789-7333 (Worldwide Technical Service). For help with technical issues, see the GTT Website, which you can access by pointing your Web browser to http://www.GTT.com.
6 Quick Setup

The vehicle detector units leave the factory with settings that will typically provide good operation with typical loops. However, it is always a good idea to go through all of the steps in Section 7 Vehicle Detector Setup and Configuration – Recommended Steps. If a Microloop is the sensor, it will be necessary to use the C900-CS to change the sensor type to Microloop and to make any other settings changes that may be needed.

The factory settings and the hardware default settings are shown in Table 6-1.

C922/C924/C922E/C924E Settings.

Please examine the Table of Contents and go to the appropriate subsection in Section 7 Vehicle Detector Setup and Configuration – Recommended Steps or in Section 10 Product Description and Specifications for detailed directions on making settings adjustments or for clarifying any operation issues.

STARTUP:

1. Plug the vehicle detector unit into the desired slot.
2. Turn the power switch to ON.
3. Verify that when a vehicle is over each sensor that the vehicle is detected on the proper channel.
4. If desired, use the C900-CS to check operational details.
<table>
<thead>
<tr>
<th>#</th>
<th>Setting</th>
<th>Channel 1</th>
<th>Channel 2</th>
<th>Channel 3</th>
<th>Channel 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Now</td>
<td>Fac</td>
<td>Def</td>
<td>Now</td>
</tr>
<tr>
<td>1</td>
<td>Sensor Type</td>
<td>Lp</td>
<td>Lp</td>
<td></td>
<td>Lp</td>
</tr>
<tr>
<td>2</td>
<td>Sensitivity</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Sensitivity Mode</td>
<td>Pres</td>
<td>Pres</td>
<td>Pres</td>
<td>Pres</td>
</tr>
<tr>
<td>4</td>
<td>Frequency</td>
<td>H</td>
<td>MH</td>
<td>MH</td>
<td>ML</td>
</tr>
<tr>
<td>5</td>
<td>Threshold Multiplier</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Slope Timer</td>
<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>7</td>
<td>Slope Divisor</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>Bridge Time</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>10</td>
<td>Delay Timing</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>11</td>
<td>Extension Timing</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>13</td>
<td>Directional Detection Call Duration</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>Background Adapt (Loop only)</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>15</td>
<td>Recovery Mode (Loop Only)</td>
<td>Fast</td>
<td>Nor.</td>
<td>Fast</td>
<td>Nor.</td>
</tr>
<tr>
<td>16</td>
<td>Background Adapt (Microloop)</td>
<td>1/64</td>
<td>1/64</td>
<td>1/64</td>
<td>1/64</td>
</tr>
<tr>
<td>17</td>
<td>Wash Delay Time</td>
<td>600</td>
<td>240</td>
<td>600</td>
<td>240</td>
</tr>
<tr>
<td>18</td>
<td>Wash Adapt Rate</td>
<td>Ins.</td>
<td>0.5</td>
<td>Ins.</td>
<td>0.5</td>
</tr>
<tr>
<td>19</td>
<td>Loop Description</td>
<td>Blank</td>
<td>X</td>
<td>Blank</td>
<td>X</td>
</tr>
<tr>
<td>20</td>
<td>Loop Type</td>
<td>Unk.</td>
<td>X</td>
<td>Unk.</td>
<td>X</td>
</tr>
<tr>
<td>21</td>
<td>Field Length</td>
<td>8.0</td>
<td>X</td>
<td>8.0</td>
<td>X</td>
</tr>
</tbody>
</table>

Lp = Loop; Fac = Factory; Def = Hardware Default; Pres = Presence; En. = Enabled; Dis. = Disabled; Nor. = Normal; X = Don’t Care; Unk = Unknown; Ins. = Instant
<table>
<thead>
<tr>
<th>#</th>
<th>Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>Status Outputs Enabled</td>
<td>Current: Enabled; Factory: Enabled; Hardware Default: Enabled</td>
</tr>
<tr>
<td>24</td>
<td>Open Loop (CALL during Open)</td>
<td>Current: Enabled; Factory: Enabled; Hardware Default: Enabled</td>
</tr>
<tr>
<td>25</td>
<td>Sorted Loop (CALL during Short)</td>
<td>Current: Enabled; Factory: Enabled; Hardware Default: Enabled</td>
</tr>
<tr>
<td>26</td>
<td>&gt;25% delta L (CALL after and for duration of large change – Channel reset attempted 15 seconds into fault)</td>
<td>Current: Enabled; Factory: Enabled; Hardware Default: Enabled</td>
</tr>
<tr>
<td>27</td>
<td>Pulse Duration (Pulse mode)</td>
<td>Current: 118; Factory: 118; Hardware Default: 118</td>
</tr>
<tr>
<td>28</td>
<td>Pulse Rephase Time (only for Sensor Type = Loop and Sens. Mode = Pulse)</td>
<td>Current: 1.9; Factory: 1.9; Hardware Default: 1.9</td>
</tr>
<tr>
<td>29</td>
<td>Vehicle Count Period</td>
<td>Current: Continuous; Factory: Continuous; Hardware Default: Continuous</td>
</tr>
<tr>
<td>30</td>
<td>Synchronization Mode</td>
<td>Current: No Sync; Factory: No Sync; Hardware Default: No Sync</td>
</tr>
<tr>
<td>31</td>
<td>Password</td>
<td>Current: None; Factory: None; Hardware Default: None</td>
</tr>
<tr>
<td>32</td>
<td>Field Modem Command String</td>
<td>Current: None; Factory: None; Hardware Default: None</td>
</tr>
<tr>
<td>33</td>
<td>Field Modem Transmit Delay</td>
<td>Current: 0; Factory: 0; Hardware Default: 0</td>
</tr>
<tr>
<td>34</td>
<td>Front Port Baud Rate</td>
<td>Current: 9600; Factory: 9600; Hardware Default: 9600</td>
</tr>
<tr>
<td>35</td>
<td>Rear Port Baud Rate</td>
<td>Current: 9600; Factory: 9600; Hardware Default: 9600</td>
</tr>
<tr>
<td>36</td>
<td>Rear Serial Port Mode</td>
<td>Current: Auto Detect; Factory: Auto Detect; Hardware Default: Auto Detect</td>
</tr>
<tr>
<td>37</td>
<td>Programmable Address</td>
<td>Current: 255 (Wildcard); Factory: 255 (Wildcard); Hardware Default: 255 (Wildcard)</td>
</tr>
<tr>
<td>38</td>
<td>Power Line Filter</td>
<td>Current: 60 Hz; Factory: Disabled; Hardware Default: Disabled</td>
</tr>
<tr>
<td>39</td>
<td>Oversampling</td>
<td>Current: X2; Factory: X2; Hardware Default: X2</td>
</tr>
<tr>
<td>40</td>
<td>Overscan</td>
<td>Current: Disabled; Factory: Disabled; Hardware Default: Disabled</td>
</tr>
<tr>
<td>41</td>
<td>Speed Trap 1 Lead</td>
<td>Current: Loop 1; Factory: X; Hardware Default: X</td>
</tr>
<tr>
<td>42</td>
<td>Speed Trap 1 Lag</td>
<td>Current: Loop 2; Factory: X; Hardware Default: X</td>
</tr>
<tr>
<td>43</td>
<td>Speed Trap 1 Distance</td>
<td>Current: 16; Factory: X; Hardware Default: X</td>
</tr>
<tr>
<td>44</td>
<td>Speed Trap 1 Distance (C92xE)</td>
<td>Current: 7.2; Factory: X; Hardware Default: X</td>
</tr>
<tr>
<td>45</td>
<td>Speed Trap 2 Lead</td>
<td>Current: Loop 3; Factory: X; Hardware Default: X</td>
</tr>
<tr>
<td>46</td>
<td>Speed Trap 2 Lag</td>
<td>Current: Loop 4; Factory: X; Hardware Default: X</td>
</tr>
<tr>
<td>47</td>
<td>Speed Trap 2 Distance</td>
<td>Current: 16; Factory: X; Hardware Default: X</td>
</tr>
<tr>
<td>48</td>
<td>Speed Trap 2 Distance (C92xE)</td>
<td>Current: 7.2; Factory: X; Hardware Default: X</td>
</tr>
<tr>
<td>49</td>
<td>Binning Schedule Start Date</td>
<td>Current: X; Factory: X; Hardware Default: X</td>
</tr>
<tr>
<td>50</td>
<td>Binning Schedule Start Time</td>
<td>Current: Immediate; Factory: Immediate; Hardware Default: Immediate</td>
</tr>
<tr>
<td>51</td>
<td>Binning Schedule End Time</td>
<td>Current: X; Factory: X; Hardware Default: X</td>
</tr>
<tr>
<td>52</td>
<td>Binning Interval (minutes)</td>
<td>Current: 15; Factory: 15; Hardware Default: 2</td>
</tr>
</tbody>
</table>
Vehicle Detector Setup and Configuration – Recommended Steps

This section describes the setup and configuration procedures for the Canoga™ C922, C924, C922E and C924E vehicle detectors.

It is recommended that the following steps be followed in setting up a new Traffic Sensing System Installation.

7.1 Check card connector and wiring

Check that the card connector is the correct type and is properly wired. See Table 4-1. C922E and C924E Card Rack Connector Pin Assignments and Table 4-2. C922 and C924 Vehicle detector Card-Edge Connector Contact Assignments.

NOTE
Also see, as may be required to reference specific subjects, Section 4 Hardware Installation and subsections of Section 10 Product Description and Specifications

7.2 Insert vehicle detector card

Insert the vehicle detector into the desired card rack slot. The unit may be inserted or removed with the power switch in the OFF position or in the ON position.

7.3 Turn the power switch ON

If the power switch is OFF, move the power switch to the ON position. The green LED power indicator should light up.

7.4 Check start-up sequencing

The vehicle detector card should go through its startup sequence – all indicators ON for less than one second and then all green detect LEDs on for a total of about 4 seconds. After this, normal operation starts.

7.5 Check fault indicators

All fault indicators should be OFF. If any sensor has a fault - Open, Shorted, or >25% dL – find the incorrect or defective connection and fix it.

7.6 Check that Call matches vehicle presence

Check that the detect/call LED comes ON when a vehicle drives over the sensor. If the detect LED turns ON, but not when a vehicle is over the sensor, the channel is probably connected to the wrong sensor. Correct any sensor hookup wiring as may be required.

7.7 Check speed trap detect sequence

If the real-time vehicle logging configuration has speed traps for measuring vehicle speeds and lengths, check to be certain the detect LEDs light in the correct order.

7.8 Check 0 VDC to Protective Earth voltage

Using a voltmeter or oscilloscope, measure the AC and DC voltage from Protective Earth (Earth Ground) to 0 VDC (vehicle detector VDC common). There must be essentially no voltage between these terminals. If a voltage exists, eliminate the cause of the problem (generally some type of cabinet wiring error). When a PC is connected to utilize the C900-CS for completing setup, the PC will likely create a short between Protective Earth and 0 VDC. If a voltage source exists between Protective Earth and 0 VDC, the PC may be damaged.

7.9 Connect PC and start C900-CS

Connect a PC on which ITS Link and C900-CS have been installed to the vehicle detector with a Female DB-9-to-Female DB-9 null modem cable. Start ITS Link using the shortcut in the Start menu.

7.10 Read Settings from C920 Series Unit

Select C900-CS by clicking on it and then click on Read from Device. Always do a Read from Device immediately preceding making any settings changes! This will prevent you from making unwanted settings changes.
If this is the first time you are communicating to a unit, be certain the communication link is connected to only one unit. This is because the factory default address of the card is 255 (FFh). 255 is also the Wildcard Address, e.g. all units will answer to this address. Using the wildcard address to read settings when the computer is connected to multiple units will be unsuccessful because each unit will be trying to send data at the same time. However, the equipment will not be damaged.

When the Read from Device screen appears, set the address to that of the unit you wish to communicate with. If this is the first communication to a unit, or you don’t know the unit address, check the Wildcard Address box. Again, anytime wildcard address is used, be certain there is only one unit attached to the communication link.

Click on OK to start a Read from Device operation.

The reading operation cannot be cancelled. If there is a communication problem, the system will eventually timeout. Correct any problem before reattempting to read settings. The most frequent problems are that the wrong COM port was selected or that the wrong baud rate was used.

To check which communication port is in use, click on Setup -> Setup ITS Link...

Now click on the Communication tab. The highlighted port is the port currently selected. Adjust port selection as required.

Select Setup -> Properties to check the baud rate the PC is using.
Now click on the communication tab. Set the PC communication port baud rate to the same baud rate as the vehicle detector. If the baud rate at the vehicle detector is unknown, it is recommended that they be tried in the following order: 9600, 38400, 19200, 1200, 2400, 4800. Note that the software default baud rate is 9600 baud. The vehicle detector baud rate, as shipped from the factory, is also 9600 baud.

7.11 Make initial settings – Sensitivity and Sensor Type

Setup and configuration procedures are accomplished using C900 configuration software.

Start configuring the vehicle detector by double-clicking on the Settings icon.

The Settings window will appear on your screen. Click on the Channel tab.

Set the Sensitivity Mode to 3/Presence, as a general starting point.

Next set the sensor type. Click on the Long Loop/Microloop tab.

If your vehicle detector is connected to a loop, click the radio button beside Default for each channel connected to a loop. For every vehicle detector channel connected to a Microloop, click on the radio button by Microloop.

For vehicle detector channels set to Microloop, you must set the Threshold Multiplier, Slope Timer, and Slope Divisor. You may make an initial setting for the Threshold Multiplier, Slope Timer, and Slope Divisor by accepting the values given by the Suggest button. Set channel Sensitivity prior to clicking on the Suggest button. The suggest values are tailored for
channels connected to single-probe Microloop sensors which have a typical magnitude response to automobile presence, e.g. 400 to 600 nanohenries. As a general rule, the Threshold Multiplier must be doubled when the channel is attached to a dual-probe or triple-probe Microloops. The settings for Threshold Multiplier and Slope Divisor are dependent on the Channel sensitivity setting. Thus this step must be done every time the channel sensitivity is changed.

If the sensor type is a Microloop, press Suggest and accept the settings. Then set Bridge Time to what you feel is the “typical minimum” time gap (time from when detection drops on the leading vehicle to when detection starts for the trailing vehicle) between vehicles.

Complete these settings for each channel. Wait to click on Apply until after all initial settings changes have been selected.

**NOTE**

A channel configured for optimal performance for an inductive loop will generally not perform as desired when connected to a Microloop. However, if the procedures for Microloop Mode setup are followed, proper operation is expected when an inductive loop is attached to a channel configured for Microloop operation.

**7.12 Set Synchronization as Desired**

Using this feature helps eliminate crosstalk between adjacent loops that are attached to separate vehicle detectors where rewiring loop inputs into the same vehicle detector is not an option. For example, loop 1 of vehicle detector A could safely be adjacent to loops 2, 3, or 4 of a different vehicle detector within the same synchronization group.

Set all units to No Sync or set one unit to Sync Leader and the others units to Sync Follower.

When Sync is used, all 4-channel units will have Channel 1 ON at the same time, next all units will have Channel 2 ON at the same time, etc. The Scan Time for each unit will be equal to the sum of the longest channel ON times for each vehicle detector unit being synchronized.

When 2-channel units are mixed with 4-channel units, channel 1 on the 2-channel units will be ON during the channel 1 time and the channel 3 time on the 4-channel units. Similarly, channel 2 on the 2-channels units will be ON when channel 2 and channel 4 on the 4-channels units is ON.

**NOTE**

It is mandatory that each channel on every vehicle detector to be synchronized be connected to an inductive sensor or that the card channel input terminals be shorted. This applies even for channels that are turned OFF.

When SYNC is programmed, to guarantee that all units are measuring the same channel at the same time, the **SYNC lines operate as follows**:

SYNC 1: Leader unit pulls this line HIGH (+5 VDC) while it is taking a measurement on Channel 1. All followers start a Channel 1 measurement when this line goes HIGH.

SYNC 2: Each unit pulls this line HIGH (to +5 VDC) while it is taking a measurement on any channel. No unit may proceed to taking a measurement on the next channel until SYNC 2 goes LOW (to 0 VDC).
7.13 Set the Noise Immunity Parameters

When doing speed measurement, the most accurate results, as a general rule, are obtained when:

Power Line Filter = Disabled
Oversampling = X1
Overscan = Disabled

If no measurements other than traffic volume are of interest, start with the default settings:

Power Line Filter = Enabled
Oversampling = X2
Overscan = Disabled

Click on Apply, if any settings changes were made, to send those changes to the vehicle detector. After the Write to Device operation completes, click on OK to leave Settings.

7.14 Check sensor inductance, Loop Frequency and Reference Frequency

Check that the sensor inductance is approximately correct (expected sensor inductance plus the inductance of the lead-in and home-run cable (about 23 microhenries per 100 feet (30 meters)). If there is a discrepancy, determine the cause of it and whether or not it represents a potential problem.

Look at the Loop Freq. and the Ref. Freq. They should go to the same value between vehicles. Due to environmental adapt processing and the fact that Loop Freq. and Ref. Freq. are not retrieved at the same time, they may separate by about 1 Hz on occasion. A greater frequency difference that 1 Hz generally means that there is noise in the system (small frequency difference that comes and goes) or that there is a bad electrical connection (large frequency difference) somewhere in the sensor hookup system.

If the frequency difference is large (greater than 1 to 2 Hz), try a channel reset when no vehicle is over the sensor. Do this by leaving the Real-Time Activity Monitoring screen, (select Stop then Close), and by double clicking next on the Reset icon. The screen below indicates that a reset (re-initialization) of Channel 3 has been selected.
Click on **Apply** and then return to the Real-Time Activity Monitoring screen to recheck the Loop Freq. and the Ref. Freq. If the problem recurs, correct the physical connection problem prior to proceeding.

### 7.15 Do Final Setting of Sensitivity and Microloop Mode parameters

Close the Settings window and open the Real Time Activity Monitoring window.

Monitor the Delta-L (inductance change) line for the inductance change caused by a typical automobile. This value will be a key used to select your final Sensitivity setting.

**For loops**, a good guideline is to set Sensitivity to 1/16 to 1/32 of the inductance change caused by a typical auto (compact, midsize, etc.) to ensure the accurate detection of all licensed vehicles. It has generally been found that trucks will be counted as multiple vehicles if sensitivity is set at or less sensitive than (delta L caused by typical auto)/(8).

For Microloops, it is recommended that Sensitivity be set to 1/8 to 1/16 of the inductance change caused by a typical automobile. It has been found that a few autos and most motorcycles will be missed when sensitivity is set equal to or less sensitive than (delta L caused by typical auto)/(4).

Also see Figure 7-1 Typical Sensitivity Settings for suggested sensitivity settings for various sensor configurations.

Single Microloop probes are recommended for general motorway use. A single probe Microloop near the center of the traffic lane will detect all in-lane autos and trucks plus motorcycles traveling near lane center. The single probe Microloop may miss autos centered on the lane division stripe. If this is a problem, dual probe Microloop sensors are recommended. They will also detect motorcycles traveling in the tire track areas of the lane. If nearly all motorcycles must be detected or the width of a 1.8 meter X 1.8 meter loop must be duplicated, use of triple probe Microloop sensors is recommended.

The recommended sensitivity setting rules may need to be modified to achieve acceptable signal-to-noise levels, e.g. eliminate all “false calls”. If vehicles it is desired to detect will be missed when noise dictated settings are used, the user must decide whether to accept the compromised performance, e.g. some false calls or some missed vehicles, or to physically change the installation, e.g. move the sensors to a better location.
Table 7-1. Sensitivity Setting Values

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Detect Threshold</th>
<th>Desirability</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>1024 nH</td>
<td>Rarely Appropriate</td>
</tr>
<tr>
<td>1</td>
<td>512 nH</td>
<td>Seldom Appropriate</td>
</tr>
<tr>
<td>2</td>
<td>256 nH</td>
<td>Appropriate</td>
</tr>
<tr>
<td>3</td>
<td>128 nH</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>64 nH</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>32 nH</td>
<td>Unusual Situations Only</td>
</tr>
<tr>
<td>6</td>
<td>16 nH</td>
<td>Unusual Situations Only</td>
</tr>
<tr>
<td>7</td>
<td>8 nH</td>
<td>Not Recommended</td>
</tr>
</tbody>
</table>

Whenever the sensitivity is changed on channels attached to Microloops, the Threshold Multiplier and Slope divisor for those channels must also be changed. The values offered by the Suggest button are valid only for “typical single probe installations”. Set these parameters as follows:

**Threshold Multiplier:** $\Delta L$ of typical auto/(2*Sensitivity in nanohenries) < setting < $\Delta L$ of typical auto/Sensitivity in nanohenries

**Slope Timer:** = 0.15 sec.

**Slope Divisor:** = Sensitivity in nanohenries/32  
*(use a divisor of 64 if channel noise peak-to-peak is greater ½ sensitivity threshold)*

**Bridge Time:** = minimum typical gap between vehicles (time between vehicles, typically 0.3 sec. to 0.5 sec. are common values)

$(\text{Threshold Multiplier}) \times (\text{Sensitivity Threshold})$ represents a definition of signal magnitude caused by auto presence. $(3) \times (\text{Slope Timer})$ is set to less than typical minimum vehicle gap. $(\text{Sensitivity Threshold})/(\text{Slope Divisor})$ represents a definition of signal size that is greater than noise when no vehicle is present.

Complete the operation of setting the Sensitivity and Microloop mode parameters by clicking the Apply button when no vehicles are over the Microloop sensors or loops attached to the vehicle detector. Clicking OK will **not** send the settings to the vehicle detector. OK will only close the Settings window.

Figure 7-1. Typical Sensitivity Settings

The sensitivity settings shown in Figure 7-1 are recommended initial settings. When you test a new system, check the sensor response to vehicles on each channel and adjust the Sensitivity setting to provide reliable detection and consistent occupancy determination. Use the lowest sensitivity that will detect vehicles of interest in the center of the loop or centered between Microloop probes.
7.16 Verify Counting Accuracy

Compare counts shown in the Real-Time Activity Monitoring screen to visual counts. The counts should match. Also, when a lane contains "speed traps", the count on the lead sensor should match the count on the lag sensor for the percentage of the vehicles that are not switching lanes at the speed trap.

7.17 Timing settings for Delay and Extension

To set Delay time and/or Extension time, click on the Timing tab.

When Extension timing is greater than 0.00 seconds, the switch (call) output will remain ON for Extension time after the vehicle is no longer detected. If another vehicle is detected before extension timing expires, the call output will remain ON until extension time after the last vehicle.

7.18 Long-Loop Counting

Use the following procedure to configure and tune counting of vehicles traveling over long loops using C900-CS. It is important to note that long-loop count is provided via a serial connection or can be stored as binned traffic data.

NOTE

This procedure assumes that sensitivity has been set using the recommended procedures and that noise has been reduced to a low level.

1. From within C900-CS, double-click on the Settings icon.
2. Select the Long Loop/Microloop tab and check the Long Loop Counting radio button to enable counting of vehicles on channels that have been connected to a long loop.
3. Set the Threshold Multiplier, Slope Timer, and Slope Divisor values for the channel by accepting the values provided by clicking on the Suggest button.
NOTE

The suggested values are appropriate only for typical 2-turn long rectangular loops or typical 2-4-2 long Quadrupole loops.

The Threshold Multiplier and Slope Divisor are dependent on the Sensitivity setting selected. You must repeat this step every time a Sensitivity setting change is made.

4. Verify the accuracy of the long loop count by comparing visual counts to detector counts that are displayed in the Real-Time Vehicle Monitoring window. If the values do not match, recheck the response of the loops to a typical auto and modify your Sensitivity setting and/or Long Loop/Microloop settings. Increase Threshold Multiplier if overcounting is occurring. Decrease Threshold Multiplier if undercounting is occurring.

It is recommended that you request and follow the procedures detailed in Technical Bulletin TM-2003-10 Long-Loop Counting Setup Procedures for C800 Series Vehicle Detectors when using the long-loop counting function. This technical bulletin can be obtained from GTT technical service by contacting them at the address and/or phone number listed on the back page of this document.

7.19 Speed Trap Configuration

Use the following procedure to configure and tune speed traps using C900 configuration software. It is important to note that speed and length data are computed by C900-CS and not by the vehicle detector.

NOTE

In order to configure an accurate speed trap that collects both vehicle speed and length, ensure that sensitivity has been set as recommended, that noise sources have been minimized or eliminated, and that scan time is the shortest it can be and still provide reliable vehicle detection.

1. From within C900-CS, double-click on the Real Time Vehicle Logging icon.

2. Select the Log Setup tab and enter loop descriptions of attached loops in the Loop Description field. This does not affect unit operation. It is for your convenience in remembering what sensor the channel is attached to and the function of that sensor.

3. Select the loop type using the Loop Type drop down box. If your loop type cannot be found, select Other as your loop type. After selecting a loop type, you should see the suggested Field Length for the selected loop type. Suggested field lengths are modifiable parameters and can be changed at any time to
help calibrate length calculations. Sensor field length is the distance from the point where a vehicle is first detected to the point where that vehicle is no longer detected.

4. Assign detector channels to the leading and lagging loops of each speed trap being set up.

5. Assign the distance value from leading to lagging loops. This measurement should be from the leading edge of the leading loop to the leading edge of the lagging loop of the speed trap.

7.20 Calibrate Speed and Length

Speed measurement is calibrated by changing the Leading edge distance for a channel pair. In most cases the correct calibration factor is the exact physical center-to-center spacing between the sensors. In some cases this may be difficult to measure. In some cases the sensor response to vehicles may be significantly different in magnitude for one or more of many possible reasons. In these cases the sensor spacing may be adjusted to give the correct speed measurement.

Common methods used to calibrate the speed measurement for a channel pair include:

a. Measuring vehicle speed with a laser gun or other precision device and comparing it to the C900-CS calculated speed. Vehicle length is estimated via observation of the vehicle type.

b. Selecting a test vehicle. Equip it with a portable GPS unit that has a speed display. Measure the length of the vehicle. Drive the vehicle over the speed trap and compare the GPS speed when the vehicle is at the speed trap to the C900-CS calculated speed.

c. The same as “b” except the reference speed is the vehicle speedometer.

The C900-CS calculated speed is observed using the Real-Time Vehicle Logging screen. Select the Log View tab and press Start.

Once this tab has been selected, check the enable box for the channels to be viewed (disable the channels you do not wish to view) during real-time sampling of the speed trap. Channels with cleared check boxes will not be displayed.

Compare the speed calculated by C900-CS to the actual vehicle speed.

Speed is now calibrated by adjusting the setting for the distance between sensors (Leading Edge Distance from) by using the actual vehicle speed and the measured vehicle speed, e.g. increasing the length increases the measured speed and decreasing the length decreases the measured speed. Use this formula to calculate the correct spacing:

\[ L_{space\text{ new}} = L_{space\text{ old}} \times \frac{\text{Speed}_{\text{actual}}}{\text{Speed}_{\text{meas}}} \]

where:

\( \text{Speed}_{\text{meas}} \) = the vehicle speed as measured by the traffic monitoring card

\( \text{Speed}_{\text{actual}} \) = the actual vehicle speed
Instructions

Lspace\textsubscript{old} = the sensor spacing setting in use when Speed\textsubscript{meas} was calculated

Lspace\textsubscript{new} = the new (corrected) loop spacing setting.

Adjust the loop spacing to the new value in the following screen.

Speed should now be calibrated. This may be verified by repeating laser gun speed measurements or having the test vehicle travel over the speed trap multiple times.

Vehicle length measurement is calibrated by adjusting the effective detection length (Field Length) of the sensor. Increasing the Field Length reduces the measured vehicle length by the amount of the Field Length increase. Similarly, decreasing the Field Length increases the measured vehicle length by the amount of the Field Length decrease. The same screens are used as for calibrating speed. Use this formula to adjust the Field Length:

\[ FldLth\textsubscript{new} = FldLth\textsubscript{old} + VehLth\textsubscript{meas} - VehLth\textsubscript{actual} \]

Where:

VehLth\textsubscript{meas} = the vehicle length as measured by the traffic monitoring card

VehLth\textsubscript{actual} = the actual vehicle length

FldLth\textsubscript{old} = the Field Length setting in use when VehLth\textsubscript{meas} was calculated

FldLth\textsubscript{new} = the new, correct Field Length setting

Enter the corrected Field Length. Vehicle length measurement should now be calibrated. Recheck vehicle lengths for several vehicles to ensure the correct lengths are being calculated.

Click on OK to save the settings.

7.21 Configure Historical Binning

The total time period over which data can be stored is determined by the total EEPROM memory on the vehicle detector and the number of channels that are selected for binning. For instance, for a unit having only the basic EEPROM memory, the following screen shows stored data will cover the last 330 hours and 15 minutes when the binning interval is 15 minutes.

To configure historical binning, double-click on the Traffic Data Binning icon in C900-CS to open the Traffic Data Binning window. Click on the Properties button.

NOTE

When using Microloops, automobile measured lengths can vary from about 50% of actual length (for autos carrying high power speaker magnets) to the actual length ±predicted measurement tolerance (determined by scan time and vehicle speed).
In the Binning Channel Setup section, enable the channels for which historical binning data is desired by clicking on the channels’ corresponding check boxes. Time-stamped vehicle count and lane occupancy will be will be recorded and saved for the selected channels.

In the Binning Schedule section, set the Binning Schedule Interval, Binning Schedule Start Date and Time and the Binning Schedule End Date and Time.

First set the Binning Schedule Interval in minutes. Unless one desires data for only a specific period of time, the Binning Schedule End Date and Time is usually set to Indefinite (when memory fills up, the oldest entry will be overwritten by the newest entry). Indefinite is the default setting.

Binning is synchronized to a clock reference by setting the PC time to the same time as the clock reference. Binning is then started at a time that will synchronize all units. For the example of Binning Period of 15 minutes, one could achieve synchronization by starting at 6:15 PM, 6:30 PM, 6:45 PM etc.

Click on OK to save the settings.

7.22 Communication Settings

The Communications tab is reached by double-clicking on the Settings icon. This tab allows setting of:

a. Field Modem Options Command String – if the modem you are using requires a setup string of AT commands, those commands may be entered here. The commands will be sent out shortly after a traffic card reset and once every 24 hours thereafter. Put a setting in only one of the units attached to the modem.

b. Field Modem Options Transmit Delay – some RF modems require a delay between the time they send data to a vehicle detector and the time they are ready to begin receiving data from a vehicle detector. The required delay may be set here.

c. Font Baud Rate – 9600 baud is the default rate.

d. Rear Baud Rate – 9600 baud is the default rate.

e. Rear Serial Port Mode – usually is left in Auto Detect mode. If the rear port should be in TIA-232 (RS-232) mode and it is in TIA-485 (RS-485) mode, use this to force the rear port into TIA-232 mode.

f. Programmable Address for this card – 128 through 255. 255 is the Wild Card address, the factory default address. It is recommended that each card on a given communication link be assigned a unique address.
7.23 Noise Immunity Settings

The following screen shows the Noise Immunity settings typically used for occupancy detection and vehicle counting.

7.23.1 Setting Power Line Filter

The Power Line Filter may be enabled when the interference magnetic field generated by current in the mains/power line cannot be handled by other means. When enabled, the measurement time on each channel is one cycle of the mains. This creates very long scan times and very coarse granularity in vehicle speed and vehicle length measurement for high-speed vehicles.

Scan time when the Power Line Filter is disabled is equal to about 1 millisecond per channel plus the channel measurement time.

7.23.2 Setting Oversampling

The setting of Oversampling = X1 allows the shortest scan times and highest accuracy for vehicle speed and length measurements. It provides a signal-to-noise ratio that is good for low noise operating conditions.

Setting Oversampling = X2 doubles the channel measurement time and thus doubles the signal-to-noise ratio. This results in a significant increase in scan time. Setting Oversampling = X4 again doubles the channel measurement time and signal-to-noise ratio.

7.23.3 Setting Overscan

Overscan may be used to eliminate false detects when peak-to-peak noise is less than sensitivity threshold. Setting Overscan = 1 Scan means that a vehicle must be detected on two successive scans - one extra measurement or scan – before it is recognized as present. To keep recognition and dropout times symmetrical, Setting Overscan = 1 also requires that a vehicle go undetected for two scans in a row before that vehicle is recognized as having departed. When noise is very high, enabling Overscan will cause a vehicle call to lock once a vehicle is recognized as being present.

Similarly, Setting Overscan = 2 Scans requires a vehicle to be present for three successive measurements prior to being recognized and to have departed for three successive measurements/scans prior to being recognized as having departed.

7.24 Channel Adapt Settings

Click on the Adapt tab to reach the Channel Adaptation Parameters. Except for changing Wash Delay Time and Wash Adapt Rate to implement Maximum Presence timing, it is rare that any of these settings need to be changed from the default settings.

7.24.1 Setting Fast Recovery for Pulse Mode

Pulse mode was originally created to assist in traffic counting when an intersection advance traffic detection loop was placed across multiple lanes. It was also used to obtain reasonable estimates of traffic volume over long loops used at stop bars. For long loops, two channels were generally connected to the same loop. One channel was operated in Presence mode and was
used to control intersection timing. The second channel was operated in Pulse mode and was used to count vehicles.

When the sensor is a loop, Pulse mode has two characteristics – the channel switch/call output turns ON for Pulse time when a vehicle arrives at the sensor and, if that vehicle remains over the sensor for more than Pulse Rephase Time, the channel is reinitialized and the detection is cancelled. The next vehicle passing over the sensor will then be detected. For Pulse mode to accomplish consistent detection, the detection reference frequency must be corrected instantly and must follow the decrease in loop frequency that occurs when a vehicle leaves the vicinity of a loop. **Thus for every channel that uses Pulse mode, Fast Recovery Mode must be selected.**

There is one negative aspect associated with using Fast Recovery. Lightning is likely to cause false frequency decreases. Fast Recovery will cause the Reference Frequency to track these false frequency decreases. Then, immediately after the lighting, the channel will have a stuck call. The duration of this call may be limited by setting Max. Presence (see Section 7.25 Setting “Max Presence”.)

When the channel sensor is a Microloop, Pulse mode has only one characteristic - the channel switch/call output turns ON for Pulse time when a vehicle arrives at the sensor. A setting of Fast Recovery is ignored by a channel that has a setting of Microloop.

When the channel sensor is an inductive loop, it is advantageous to use Fast Recovery where there are frequent mains power failures. When power returns it is likely a vehicle will be over the loop. Fast Recovery will immediately correct the Reference Frequency as the channel frequency decreases when the vehicle leaves.

**7.24.2 Setting Pulse Rephase Time**

When Pulse mode is selected on a channel attached to a loop, Pulse Rephase Time controls how long the call will be held prior to channel reinitialization.

**7.24.3 Setting Inductive Loop Background Adapt Rate**

Background Adapt Rate and Recovery Method settings under Adaptation Parameters apply only if the channel sensor is a loop. Background Adapt Rate controls how fast the Reference Frequency is moved towards the Loop Frequency when the channel is not detecting a vehicle. Unless you have a good reason for doing so, do not change the setting from the default of 0.5 sensitivity threshold per second.

**7.24.4 Setting Wash Delay Time**

The default Wash Delay Time setting of 240 seconds/4 minutes has been found useful for most traffic detection situations. In effect, it represents the minimum time that vehicles such as bicycles will be detected if they stop over the sensor.

**7.24.5 Setting Wash Adapt Rate**

The default Wash Adapt Rate, the rate at which the channel Reference Frequency is moved towards the channel Loop Frequency during vehicle detection, is 0.5 nanohenry per second. Except for where Max Presence is being set, it would be unusual to have a situation where this would need to be changed. The magnitude of the sensor inductance change caused by a vehicle divided by the Wash Adapt Rate determines the approximate time a detection will be held when a vehicle stops over a sensor.
7.24.6 Setting Microloop Background Adapt Rate

The default background Adapt Rate for channels having Microloops is 1/64 sensitivity threshold per second. It is unlikely you will need to change this.

7.25 Setting “Max Presence”

The Max Presence function sets the maximum duration of a single vehicle detection. Max Presence is not a specific setting. It is functionally implemented by specific selections of Wash Delay Time, Wash Adapt Rate and, for Inductive Loop sensors, Recovery Method.

For example, set Max Presence to 5 minutes by setting Wash Delay Time to 300 seconds, Wash Adapt to Instantaneous and Fast Recovery (for loops only) to Enabled. When the sensor is a Loop, Fast Recovery is needed to rapidly regain sensitivity after a vehicle is “washed out”. For channels having a Microloop, one vehicle passing over the Microloop will cause the reference frequency to be corrected. The following gives expanded information on setting Max Presence.

Wash Delay Time: Set this equal to the maximum number of seconds for which you desire to have a vehicle place a call.

Wash Adapt Rate: Set this equal to Instantaneous.

Recovery Method: Set this equal to Fast.

The operation of a channel configured in this manner is described below:

1. Vehicle enters sensing area and stops.
2. After Wash Delay Time, the call is cleared and the channel reference frequency is set equal to the current channel frequency.
3. Vehicle leaves and Fast Recovery causes the reference frequency to track the decrease in channel frequency. The reference frequency is corrected by the next vehicle on channels having a Microloop.

7.26 Setting Directional Detection Parameters

A channel pair may be used to detect vehicles traveling only a pre-selected direction. It is recommended that overlapping loops or closely spaced Microloops be used to maximize the reliability of directional detection.

It is frequently asked if it is possible to combine speed measurement applications with the directional detection application. While it is technically possible to combine vehicle speed and length measurement with directional detection, vehicle speed and length measurement accuracy will suffer significantly. Because the ratio of vehicle travel time between loops to scan time is not large when closely spaced loops are used, closely spaced loops are poorly suited for vehicle speed and vehicle length measurement.

Sensors must be close enough so that a vehicle traveling the desired direction cause the following detection sequence:

1. Vehicle not detected by either lead or lag sensor
2. Vehicle detected by lead sensor only
3. Vehicle detected by both the lead sensor and the lag sensor
4. Vehicle detected by the lag sensor only
5. Vehicle not detected by either sensor

Use the Suggest button to calculate the Directional Timeout that you want to set. This determines the slowest vehicle speed for which a vehicle will be detected as traveling the selected direction.
The Call Duration setting determines how long the switch/call output for the channel having Directional Detection enabled will be ON after a vehicle traveling in the proper direction is detected. Note that vehicle presence cannot control the channel output as the detection sequence requires that the vehicle must have left the area of the lag sensor prior to final direction determination.

Click on Apply to save any settings changes made.

### 7.27 Setting Disturbance/Status Output Operation and Duration of Output Pulse in Pulse Mode

Click on the Output tab to make settings related to Output Pulse Duration when a channel is in Pulse mode and to make settings related to Disturbance/Status output operation.

Enable or Disable the Disturbance/Status Outputs as desired. When units are used in a NEMA TS 2 cabinet, the Disturbance/Status outputs must be enabled or the controller will believe the units’ channels are not operating.

If equipment is attached to the channel switch/call outputs, you must determine what the output should do when the sensor channel has a problem. Checking, under “Call Output Fail-Safe Enable for” the box beside each type of sensor failure – Open Loop, Shorted Loop, >25% Inductance Change - will cause the switch/call output for that channel to be ON during the time its channel senses one of the checked types of sensor failures. If a box is unchecked, the channel output will be OFF during that sensor failure.

Intersection systems generally want the output to be ON during a sensor failure to ensure that traffic movement is served. If the C920 series unit is used in some type of traffic monitoring system, those systems usually do not want an output to stay ON during a sensor failure, as this indicates stalled traffic.
Click on Apply to send any settings changes to the vehicle detector.

7.28 Setting a Password

Whenever the communication link to the Microloop has any potential to be accessed by an unauthorized user, it is wise to assign a password. When this is done, before any settings can be changed, the password will be requested by and must be provided to the C900-CS.

The unit is unlocked for making settings changes for one hour after entering the password using the Grant Access (“!” command) or for five minutes after power is turned ON. An unknown password may be canceled by setting a new password during the five minutes after power is turned ON.

To set a password, select the General tab.

Next click on the Change Password button. Enter the desired password as directed. Passwords are case sensitive. Press Apply to send the new password to the vehicle detector. If a previous password had been set and it is more than five minutes after power-up or more than 60 minutes since the last time the old password was entered, the C900-CS will request the old password prior to setting the new password.

7.29 Verify Settings

Do a Read from Device. Go through all the settings tabs on each of the icons with settings – Settings, Properties… tab under Traffic Data Binning, Log Setup tab under Real-Time Vehicle Logging – and check to ensure you have actually entered all the settings you desired to make.

If you have a printer available, it is very handy to first do a File -> Print Preview and then print out all the settings.
7.30 Save Settings Using Print Preview

Once it has been confirmed that all settings are correct, it is strongly recommended that you make a record of the settings by using File -> Print Preview. Select the diskette from the Print Preview screen to save the settings file.

7.31 Save Real-Time Activity Monitoring screen

It is recommended that a copy of the Real-Time Activity Monitoring screen also be saved as a record of the operating conditions that existed at the time the unit was set up.

Double-click on the Real-Time Activity Monitoring icon. Press Start. After allowing data to be gathered, press Stop. Then click on Save and save the file.

A saved file is easy to view by opening it with a spreadsheet program.

7.32 Recheck Operation And Examine Data At A Future Date

It is recommended that data be retrieved from the unit and examined to ensure that it reflects the expected traffic pattern. For example, the Real-Time Activity Monitoring screen can be used to verify that the volumes on lead and lag channels are about equal.
8 Historical Data Retrieval, Examination, Saving, Exporting, Printing

Historical Traffic Data Binning data may be read from the units using the C900-CS or read directly using the ~ and 5 commands or the 5 and 6 commands as described in the communication protocol. [Serial Communication Protocol Canoga™ Vehicle Detection System TM-2003-8 may be obtained by request from GTT Technical Service as listed on the back page of this document.] The data is displayed with the newest data as row 1. The data can be saved to a file, exported to a *.csv file (tab delimited) for easy import into other programs or printed.

8.1 Retrieving Traffic Data Binning Data

To read Traffic Data Binning stored in a C920 series unit, double-click on the Traffic Data Binning icon.

After the Traffic Data Binning screen starts, click on Read from Device. The screen appears as shown below after all historical data is read from the C920 series unit.

The approximate time of power failures can be determined. When there has been a power failure, there will be one or more missing bins. The figure below shows that one bin was missed – the one for 2:21:59 PM on 12/10/2004. The data will also indirectly indicate when a channel fault occurred. The bin beginning at 2:28:59 shows zero count and zero occupancy. This means that the loop is open or shorted. No counts or detection times are accumulated while a channel has a fault condition.

8.2 Examining Traffic Data Binning Data

The Traffic Data Binning data is displayed with the newest bin at the top line. The date and time the bin started are shown along with the count and occupancy for each channel checked under the Properties tab to have its traffic data recorded.
When the binning data shows a count of 0 and an occupancy of 99.2%, the channel has a constant call. An occupancy of 99.2% means an occupancy of 99.2% to 100%. An occupancy value of 100% is reserved to indicate that this bin tells how many bins were skipped due to a power failure.

8.3 Saving Traffic Data Binning Data

Click on Save… to save the binning log to a file. Browse to a directory of your choice, name the file and the click on Save. You may specify which suffix type is issued by typing in the suffix when you are naming the file. The data is actually stored in XML format, regardless of whether the suffix is *.log or *.xml.

8.4 Examining Previously Saved Traffic Data Binning Data

A previously stored file may be examined by clicking on Open… Browse to the directory where the file you wish to view is stored, select the file and then click on Open.

8.5 Exporting Traffic Data Binning Data

The Traffic Data Binning data may be saved in a tab delimited text file by going to File | Export. Browse to the directory where you desire to save the file. Then type the desired file name. Typing in the *.csv suffix is optional. Click on Save to save the file.
To import the data into Microsoft Excel, start up Excel. Please follow the described procedure rather than doing a File|Open operation. The described operation will guarantee that there is an opportunity to specify that tab is the delimiting character. Then go to the New File button and open a new worksheet.

Now go to Data -> Get External Data -> Import Text File...

Browse to the directory where the *.csv file you wish to bring into Excel is, set Files of type to All Files (*.*), select the file and click on Import.

When this screen appears, click on Next.

Check Tab in the Delimiters area. Then click on Finish.
Instructions

Now choose where to put the data. It is assumed that you desire the data to be inserted into the Existing worksheet. Then click on OK.

The data is now inserted into Excel. You may now perform any operations on the data that Excel can perform.

Printing Traffic Data Binning Data

To print a Traffic Binning Data file from the C900-CS, click on Print. The file will now be printed to the currently selected Windows printer.

The File | Print Preview shows what the printed report will look like.
9 Troubleshooting

If you encounter problems while installing your traffic sensing system, call Technical Support at 1-800-258-4610 or +1 (651) 789-7333 (Worldwide Technical Service) or call your local dealer. As another informational resource, see the Global Traffic Technologies Website, which you can access by pointing your Web browser to http://www.GTT.com.

9.1 Crosstalk Elimination

Crosstalk is when a detection channel on one vehicle detector generates a noise signal on a channel of another vehicle detector. Generally the interfering channels on both units are noisy. The most common sources of crosstalk are:

a. Loop sensors attached to different vehicle detector units are placed side-by-side in adjacent lanes.

b. A Microloop is placed near a loop sensor, and the loop sensor is attached to a different vehicle detector than the Microloop sensor is attached to.

c. Intra-cabinet wiring does not use a twisted pair for the wires going to each sensor.

d. The rack holding the vehicle detector units has a poor backplane layout.

To minimize crosstalk between channels, C922E, C924E, C922 and C922 vehicle detectors use a single sensor oscillator and scan their input channels sequentially. Because there is an active signal on only one channel at a time, the probability of crosstalk is eliminated for all sensors on that vehicle detector.

**NOTE**

To minimize crosstalk in systems with multiple vehicle detectors, connect adjacent loops or loops sharing the same lead-in cable to the same vehicle detector.

A less effective method than that explained in the previous NOTE, is to change the frequencies on the cross-talking channels to obtain the greatest possible frequency separation. It is recommended that the sensor with the largest inductance have its channel frequency set to Low and that the channel with the smallest inductance have its channel frequency set to high. It would be very unusual to have a crosstalk problem between channels that have their frequencies separated by 10 kilohertz or more. Frequency separation of >3 kilohertz is usually required.

An excellent method to eliminate crosstalk between channels on different vehicle detector units is to use the Synchronization feature of the vehicle detector. When vehicle detectors are synchronized, each unit has channel 1 on at the same time, and then each unit has channel 2 on at the same time, etc. Side-by-side sensors attached to different units will not crosstalk as long as those sensors are connected to different numbered vehicle detector channels.

9.2 Detecting and Controlling or Eliminating Sensing Channel Noise

The most common source of noise is crosstalk. That was discussed in Section 9.1. Other common noise sources are:

a. Magnetic fields created by power line currents

b. Adjacent lane vehicular traffic

c. Poor power supply connection

d. Noise generated by other equipment in the cabinet

e. Nearby high power radio transmitters

Poor power supply connections can create intermittent and strange results. At any one moment, the results may mimic any and all other types of problems. Inconsistency is a characteristic of this problem. If a poor power supply connection is found, fix the connection and the problems it creates will disappear.
It can be quite difficult to determine the source of noise problems created by other equipment in the cabinet. To eliminate problems from noise generated by other cabinet equipment, it is usually necessary to make some type of physical changes in the cabinet interior or cabinet wiring. This subject is beyond the scope of this document.

Although this situation is relatively rare, it may be necessary to relocate sensors that are too close to a high power radio transmitter.

9.3 Low Sensor Response to Vehicles

A typical automobile will cause an inductance change in Microloop of 400 to 700 nanohenries Microloop probe. When the signal size is \( \frac{1}{2} \) this number or less, one of these items is virtually always the cause:

9.3.1 Microloop

a. Microloop is rotated more than 30 degrees from vertical.

b. Microloop is much deeper than the specified depth.

c. The ambient magnetic field at the Microloop is less than 200 milligauss or greater than 1.2 gauss.

d. The lateral lane position of the Microloop is incorrect (in this case adjacent lane vehicle created detects are also likely).

See Microloop installation instructions for further details. Eliminating the cause of the problem will correct the situation.

9.3.2 Loop

A typical automobile will cause an inductance change in a loop of 3000 to 6000 nanohenries. When the signal size is \( \frac{1}{2} \) this number or less, one of these items is virtually always the cause:

a. Loop has one less turn than specified.

b. Loop is in roadbed versus in the pavement.

c. There is a lot of steel immediately below the loop.

d. There is a rebar grid above the loop.

It is rare that any of these conditions may be remedied. Increase sensitivity by one level for each “power of 2” that the signal is lower than expected.

If the response to a typical auto is about 12,000 nanohenries, decrease sensitivity one level, e.g. use 2 or 3 versus 3 or 4. High sensitivity means there is one or more extra turn(s) on the loop.

9.4 Diagnostic Codes

The C922E, C924E, C922 and C922 vehicle detectors have LED indicators on the front panel that display fault conditions. Table 8-1 lists the diagnostic codes that the LED indicators display when a fault occurs. There is one red Fault LED and one green Detect LED for each input channel.
### Figure 9-1. Diagnostic Codes

<table>
<thead>
<tr>
<th>Diagnostic Codes</th>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel 1 and 2 red Fault LEDs repetitively cycle ON then OFF in sequence.</td>
<td>Settings stored in EEPROM (programmable memory) are corrupt.</td>
<td>Reset the vehicle detector using power switch or C900-CS. The error should clear in about 5 seconds. All settings will return to hardware defaults.</td>
</tr>
<tr>
<td>A red Fault LED repetitively cycles ON for one long pulse (6 sec.) and one short pulse (.25 sec.).</td>
<td>Historical open loop.</td>
<td>Use C900-CS to check the Date/Time when the most recent fault was recorded. If desired, reset the vehicle detector to clear the fault indication.</td>
</tr>
<tr>
<td>A red Fault LED repetitively cycles ON for one long pulse (6 sec.) and two short pulses (.25 sec.).</td>
<td>Historical shorted loop.</td>
<td>Use C900-CS to check the Date/Time when the most recent fault was recorded. If desired, reset the vehicle detector to clear the fault indication.</td>
</tr>
<tr>
<td>A red Fault LED repetitively cycles ON for one long pulse (6 sec.) and three short pulses (.25 sec.).</td>
<td>Historical inductance change greater than 25%.</td>
<td>Use C900-CS to check the Date/Time when the most recent fault was recorded. If desired, reset the vehicle detector to clear the fault indication.</td>
</tr>
<tr>
<td>A red Fault LED repetitively cycles ON for one long pulse (1 sec.) and one short pulse (.25 sec.). Detect LED constantly ON.</td>
<td>Open loop.</td>
<td>Correct the problem with the loop. If no loop is connected to the vehicle detector channel, turn the channel off and place a short across the loop terminals.</td>
</tr>
<tr>
<td>A red Fault LED repetitively cycles ON for one long pulse (1 sec.) and two short pulses (.25 sec.). Detect LED constantly ON.</td>
<td>Shorted loop.</td>
<td>Correct the problem with the loop.</td>
</tr>
<tr>
<td>A red Fault LED repetitively cycles ON for one long pulse (1 sec.) and three short pulses (.25 sec.). Detect LED constantly ON.</td>
<td>Inductance change greater than 25%.</td>
<td>Correct the problem with the loop. This problem is frequently caused by changing of resistances in channel sensor connections. (Check the loop connections. Make sure all connections are secure.) It is common for this sensor “failure” condition to be induced during lightning storms.</td>
</tr>
<tr>
<td>Green Detect LED constantly ON.</td>
<td>External reset is active (tied to ground). Also, there is currently a loop fault.</td>
<td>Correct the situation causing the remote reset input to be continuously active. Correct the loop problem.</td>
</tr>
<tr>
<td>Diagnostic Codes</td>
<td>Problem</td>
<td>Solution</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>COM1 green LED 1 Hz pulse.</td>
<td>Fault indicated for SYNC1. Leader of a synchronization group cannot drive the synchronization circuit.</td>
<td>Check all wiring for shorted wires on the synchronization Synchr. Conduct. 1 (6b) bus. See Table 4-1. C922E and C924E Card Rack Connector Pin Assignments and Table 4-2. C922 and C924 Vehicle detector Card-Edge Connector Contact Assignments for card rack connector pin assignments. Ensure that only one vehicle detector has been set to Leader in the synchronization group.</td>
</tr>
<tr>
<td>COM1 green LED flashing at 1 Hz rate.</td>
<td>Fault indicated for SYNC1. Follower in the synchronization group is not syncing to the Leader.</td>
<td>Ensure that one vehicle detector in the synchronization group has been set to Leader through C900-CS. Check all wiring and fix any shorted wires on the synchronization bus. See Table 4-1 and Table 4-2 for card rack connector pin assignments.</td>
</tr>
<tr>
<td>COM2 green LED flashing at 1 Hz rate.</td>
<td>Fault indicated for SYNC2. There is an open loop on a vehicle detector within the synchronization group.</td>
<td>Verify that all Synchr. Conduct. 2 pins on the vehicle detector rack have been bussed together properly. See Table 4-1 and Table 4-2 for card rack connector pin assignments. Ensure that all open loop inputs have been shorted at the vehicle detector rack, including loops on channels turned off. Vehicle detectors with open loops will display this error either by red Fault LEDs on the vehicle detector front panel or through C900-CS.</td>
</tr>
</tbody>
</table>
10 Product Description and Specifications

The C922E and C924E vehicle detectors consist of single printed circuit modules that plug into a standard 3U card rack. They are high-performance two and four channel digital vehicle detectors.

The vehicle detectors are compatible with the 701 and 702 Non-invasive Microloops and conventional wire-wound loop designs.

**WARNING**

Improper use of vehicle detectors may cause improper operation of the traffic control system, which may result in personal injury. To avoid improper use of C922, C924, C922E and C924E units, installation must be done only by qualified professionals who are trained to operate and maintain traffic control systems, and who are familiar with this equipment. Improper operation of the traffic control system may result in unsafe driver action.

The C922 and C924 vehicle detectors consist of single printed circuit modules that plug into a standard NEMA/170/2070 card rack and have the same functional capabilities as the E series.
10.1 Companion Products

Each Canoga™ C922, C924, C922E, and C924E vehicle detector is one component of the Canoga Traffic Sensing System matched-component system. Each of the other components described on this page is an integral part of this matched-component system. The Canoga Traffic Sensing System consists of the following GTT products:

- Canoga™ C922E Vehicle detector
- Canoga™ C924E Vehicle detector
- Canoga™ C922 Vehicle detector
- C924 Vehicle detector
- ITS Link with Canoga™ C900-CS Configuration Software
- Canoga™ C900 Handheld Programming device
- Canoga™ C900 Serial Communication Cable
- Canoga™ 702 Non-invasive Microloop™
- Canoga™ 701 Microloop™
- 832 Communication Module
- Canoga™ 848 Memory Module
- Canoga™ 30003 Home-run Cable

**Canoga™ 702 Non-invasive Microloop™**

The Canoga 702 Non-invasive Microloop is a magneto-inductive transducer (changes magnetic field intensity into an inductor value). It is installed in 3-inch diameter horizontal conduit about 21 inches underneath the road surface. Vehicle induced changes in the earth’s magnetic field are sensed by the vehicle detector. For detailed information about 702 Non-Invasive Microloop, refer to Canoga™ 702 Non-Invasive Microloop™ Installation Instructions.

**Canoga™ 701 Microloop™**

The Canoga 701 Microloop is a magneto-inductive transducer (changes magnetic field intensity into an inductor value). It is installed in a 2.54 centimeter (1-inch) diameter vertical conduit that is inserted in a hole drilled through the pavement, the bottom of the sensor being about 53 centimeters (21 inches) underneath the road surface. Vehicle induced changes in the earth’s magnetic field are sensed by the vehicle detector. For detailed information about the Canoga 701 Microloop, refer to Canoga™ 701 Microloop Installation Manual.

**832 Communication Module**

The optional 832 communication module is a plug-in communication board that changes the rear card connector communication port of the Canoga C922, C924, C922E and C924E vehicle detectors from an independent, half-duplex party line TIA-485 port to a second independent, full-duplex party line TIA-232 communication link.

**Canoga™ 848 Memory Module**

The optional Canoga 848 memory module is a plug-in non-volatile (EEPROM) memory board. When installed on a Canoga C922E, C924E, C922 or C924 vehicle detector, the memory module expands the unit’s onboard EEPROM memory from 16K to 64K. The module plugs directly into the vehicle detector’s main board.

On any single vehicle detector only the 832 communication module or the 848 memory module may be used.
**Canoga™ 30003 Home-run Cable**

The Canoga 30003 Home-run Cable has four #18 AWG polypropylene insulated color-coded conductors that are spirally laid in an aluminized polyester shield within a durable high-density polyethylene jacket. The cable is filled with a water block to prevent moisture intrusion. The jacket is UV stabilized and the cable is rated for 600 volts.

The cable has two pairs – a Black/White pair and a Red/Green pair. Two sensors may be connected to the cable – one on the BLK/WHT pair and one on the RED/GRN pair. Sensors connected to the same cable must be connected to the same card to prevent crosstalk. The length of lead-in cable plus home-run cable may be a total of 720 meters (2500 feet) from the sensor to the card.

It is recommended that the shield be left open and not terminated to Safety Earth or any other point.

**10.2 Vehicle Detector Specifications**

**Electrical**

**Input Voltage:** 10.8 to 37.8 VDC.

**Current:** 2-channel: <200 mA (<110 mA typ @ 10.8 VDC, <60 mA typ @ 24 VDC)

4-channel: <200 mA (<120 mA typ @ 10.8 VDC, <70 mA typ @ 24 VDC)

**Lightning Resistance:** Gas tube surge arrestors on transformer isolated loop inputs.

**Power Loss Protection:** All settings are stored in non-volatile memory.

**System Connections:**

**C922 and C924** - a 22 position, 44 contact gold over nickel-plated card-edge connector with contacts on 0.156 inch centers. For pin assignments, refer to Table 4-2. **C922 and C924 Vehicle detector Card-Edge Connector Contact Assignments** in Subsection 4.2 Card Rack Wiring.

**C922E and C924E** - DIN 41612 Type F. 48-pin connector (male contacts, female body) with gold-plated contacts that mates with a 48-socket connector. For pin assignments, refer to Table 4-2.

**Dimensions**

**C922 & C924 – STD card:** 7 inches long by 4.5 inches high (17.78 cm long by 11.43 cm high).

**C922 Front Panel:** 1.05 inches wide by 4.5 inches high (2.67 cm wide by 11.43 cm high).

**C924 Front Panel:** 2.1 inches wide by 4.5 inches high (5.33 cm wide by 11.43 cm high).

**C922E & C924E - Eurocard (3U):** 160 mm long x 100 mm high (174 mm normal length including connector block).

**C922E & C924E Front Panel:** 3U x 5HP (128.4 mm high x 25.1 mm wide) with DIN specification pull handle.

**Handle:** Adds 0.55 inch (1.4 cm) to length for all models.

**Weight**

**C922:** approximately 173 grams (6.1 oz.)

**C924:** approximately 220 grams (7.8 oz.)

**C922E:** approximately 181 grams (6.4 oz.)

**C924E:** approximately 215 grams (7.6 oz.)

**Operational Environment**

**Temperature:** –34° to +74°C [-29° to +165°F]

**Humidity:** 5% to 95% (non-condensing)

**Outputs**

**Channel Switch/Call Output – ON while vehicle is detected:** opto-coupler [V\_OFF = 40 VDC max, V\_ON = 1.4 VDC max at I = 50 mA max, V\_ON = 1.0 VDC typ @ I = 10 mA]

**Disturbance/Status Output – For C922 and C924 ON when OK (also meets NEMA requirements during channel disturbance) and for C922E and C924E - ON during channel disturbance:** open collector/drain [V\_OFF = 40 VDC max, V\_ON = 0.5 VDC max at I = 20 mA max, V\_ON = 0.15 VDC typ @ I = 10 mA]

**Common Fault Output – For C922E and C924E only - ON when any channel has a disturbance:** opto-coupler [V\_OFF = 40 VDC max, V\_ON = 1.4 VDC max at I = 50 mA max, V\_ON = 1.0 VDC typ @ I = 10 mA] (No indicator)
**Tuning**

Each channel of the C922, C924, C922E and C924E vehicle detectors automatically tunes to any combination of Microloop/loop and lead-in within the tuning range upon application of power or when a reset is received. An inductive loop and a Microloop may be connected in series with their channel configured for Microloop. Inductive loops will operate correctly on channels configured for Microloop.

**Tuning Range**

20 to 2500 microhenries with a Q factor greater than 2.5.

**Sensitivity Type**

$\Delta L = \frac{\Delta L}{\sqrt{L}}$ where $L = [L_{\text{sensor}} + L_{\text{internal}}]$ and $L_{\text{internal}} = 150 \mu H$

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Detect Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>1024 nH</td>
</tr>
<tr>
<td>1</td>
<td>512 nH</td>
</tr>
<tr>
<td>2</td>
<td>256 nH</td>
</tr>
<tr>
<td>3</td>
<td>128 nH</td>
</tr>
<tr>
<td>4</td>
<td>64 nH</td>
</tr>
<tr>
<td>5</td>
<td>32 nH</td>
</tr>
<tr>
<td>6</td>
<td>16 nH</td>
</tr>
<tr>
<td>7</td>
<td>8 nH</td>
</tr>
<tr>
<td>X</td>
<td>Channel Off</td>
</tr>
</tbody>
</table>

**Frequency per Channel**

Each channel of the C922, C924, C922E and C924E vehicle detectors has four frequency settings:

- High ($\approx 43.4$ KHz @ 100 $\mu$H sensor)
- Medium High ($\approx 35.7$ KHz @ 100 $\mu$H sensor)
- Medium Low ($\approx 34.5$ KHz @ 100 $\mu$H sensor)
- Low ($\approx 33.1$ KHz @ 100 $\mu$H sensor)

**Power Switch**

The front panel of each vehicle detector includes a Power/Reset switch that turns the unit off/on and resets it. See Figure 4-1.

**Communication Ports**

Rear communication port: half duplex TIA-485

Front communication port: DTE (like a PC) configured, full duplex TIA-232 via 9-Pin DSUB (pins, female shell)

Baud rates: 1200, 2400, 4800, 9600 (default), 19200, 38400 using 8 data bits, no parity bit, 1 stop bit.
Front Panel LED Indicators

The front panel of the C924E and C924 vehicle detector is equipped with wide-angle LEDs indicating the unit's current operating status and condition. The front panel of the C922E and C922 vehicle detector is the same, except there are no Channel 3 and Channel 4 LED indicators. All models of vehicle detectors have the following LED indicators:

- **Power Indicator**
  The green Power LED lights when power is applied to the unit.

- **Channel of Detection Indicators**
  There are two wide-angle LED indicators for each channel of detection. The green Channel Detect LEDs indicate vehicle detection and Delay or Extension time. The red Channel Fault LEDs provide diagnostic codes to identify loop system faults. See Subsection 9.4 Diagnostic Codes for a list of diagnostic codes displayed when a fault occurs.

  When Extension/Delay timing is enabled, the green Channel Detect LEDs visually distinguish between periods of Delay and Extension timing. During Delay periods, the green Channel Detect LED flashes at 4 Hz. This indicates that a vehicle has entered the detection zone, but the vehicle detector output is temporarily inhibited. During Extension periods, the green Channel Detect LED flashes at 16 Hz. This indicates that all vehicles have left the loop system, but the output is temporarily being held in the Detect state.

  If neither Delay nor Extension timing is enabled, the green Channel Detect LEDs light when a vehicle is detected and remain on until the detection zone is cleared.

  When you use C900-CS to change the vehicle detector channels to do directional detection, the green Channel Detect LEDs light when vehicle presence is detected and flash at 16 Hz to indicate a call output is activated following detection of a vehicle traveling in the direction to be detected. See the C900-CS On-Line Help for more information on directional detection.

- **Serial Communication Indicators**
  There is one green LED for the front serial port (COM1) and another green LED for the rear serial port (COM2). These LEDs flash when the corresponding serial port is actively passing data. These LEDs also indicate synchronization faults when flashing at a 1 Hz rate:

  **COM 1**: SYNC 1 is missing at follower unit or SYNC 1 is stuck at the leader unit

  **COM 2**: SYNC 2 is stuck or SYNC operation is set and an open loop exists

10.3 Serial Communication

The C922, C924, C922E and C924E Vehicle Detectors each contain two independent communication ports, Front and Rear.

The front panel serial communication port is TIA-232 full duplex. This port is configured as a Data Terminal Equipment (DTE) device port. (Note: A PC is a DTE device; a modem is a DCE, Data Communication Equipment device.). The port is accessed via a 9-pin D subminiature (DSUB) connector (pin contacts, female shell). See
Subsection 4.3.1 Cable – Front Port to PC (9-Pin DSUB sockets both ends) and Subsection 4.3.2 Cable – Front Port to Modem (9-Pin DSUB pins) for connection details.

The rear communication port is TIA-485 and is available through the card rack connector. This is a two-wire, half-duplex interface. See Subsection 4.3.3

Cable – Rear C92xCE TIA-485 Half Duplex Port to PC or Modem for connection details.

With the installation of an optional the 832 communication module, the rear communication port becomes full-duplex TIA-232 (only TX, RX, DC Common available). See Subsection 4.3.4 Cable – Rear C92xCE TIA-485 Half Duplex Port to PC or Modem for connection details.

Both communication ports can be programmed for baud rates of 1200, 2400, 4800, 9600 (default), 19200 and 38400. Communication uses 8 bits, no parity, and 1 stop bit.

10.4 Remote Reset

A remote reset input is available on the vehicle detector rear connector. When the remote reset input is forced to a voltage below 6 volts for a period greater than 17 milliseconds, the vehicle detector will reset and establish a new Reference Frequency for each loop (channel) that is turned on.

10.5 Sensor Type

Vehicle detectors work with Canoga™ 701 Microloop™ sensors, with Canoga™ 702 Non-Invasive Microloop™ sensors and with standard inductive loops. Each channel must be programmed for the type of sensor attached to it (Inductive Loop or Microloop).

When Microloop is selected as the sensor type, the parameters of Threshold Multiplier, Slope Timer, Slope Divisor and Bridge Time must also be set. A Suggest function is provided in the C900-CS for doing initial settings of these parameters. See Subsection 7.15 Do Final Setting of Sensitivity and Microloop Mode parameters for detailed instructions on setting these parameters.
10.6 Sensitivity Operating Modes

Canoga™ C922, C924, C922E and C924E vehicle detectors have two modes of operation that are set as part of the sensitivity setting process: Presence mode and Pulse mode. You can modify these two modes by adding Delay or Extension timing intervals to create a total of five operating modes.

- Presence
- Presence with Delay
- Presence with Extension
- Presence with Delay and Extension
- Pulse

These modes can be set independently for each channel.

In Presence mode, without Delay or Extension, the detect output duration corresponds to the period of vehicle presence over the detection zone.

In Presence-with-Delay mode, the output/indication is inhibited for a Delay interval after vehicle detection.

In Presence-with-Extension mode, the output/indication continues for an Extension interval after the vehicle leaves the detection zone.

In Presence-with-Delay-and-Extension mode, the output/indication is both delayed and extended as described above.

In Pulse mode, each vehicle produces an output pulse of approximately 118 milliseconds. If the vehicle remains over the detection zone, further detection is inhibited for a 1.9-second (default setting) rephase delay. After the pulse rephase delay expires, full sensitivity returns immediately regardless of continued presence of the vehicle. **Fast Recovery mode must be used for each loop sensor channel in Pulse mode.**

When the sensor is a Microloop, selecting Pulse mode causes each vehicle, at the time it is detected, to produce a switch/call output pulse with ON time of Pulse (approximately 118 milliseconds). There is no rephase for pulse mode when the sensor is a Microloop.

10.7 Environmental Adaptation

The C922E, C924E, C922 and C924 vehicle detectors have adaptation parameters that can be uniquely configured for each channel of detection. The following parameters can be set per channel:

- **Background Adapt Rate** (inductive loop channels) – the rate at which Reference Frequency is moved towards Loop Frequency when no vehicle is detected.

- **Recovery Method** (inductive loop channels) – the rate (Normal or Fast) at which reference frequency recovers from conditions under which it became erroneously set to a frequency higher than the “no vehicle present” Loop Frequency (e.g. due to a momentary power failure or reset while a vehicle is over the loop).

- **Wash Delay Time** (inductive loop and Microloop channels) – the amount of time delay before the vehicle detector begins to slowly adapt to (wash out) the effects of a vehicle “stalled” over the sensor (Reference Frequency is slowly moved to the new Loop Frequency).

- **Wash Adapt Rate** (inductive loop and Microloop channels) – the rate at which the Reference Frequency is moved toward the Loop Frequency when a vehicle is “stalled” over the sensor.

- **Microloop Adapt Rate** (Microloop channels) – the rate at which Reference Frequency moves toward Loop Frequency when Loop Frequency is lower than [(Reference Frequency) + (Sensitivity Threshold)].

10.8 Max Presence Configuration

When desired, the vehicle detector channels can be configured for “Max Presence” operation by adjusting Wash Delay Time, Wash Adapt Rate, and Recovery Method parameters. Max Presence, when implemented, specifies the maximum duration of a single vehicle detection.

See Section 7.25 Setting “Max Presence” for further details.
10.9 Synchronization

Synchronization can be used to eliminate crosstalk between inductive sensors (inductive loop-to-inductive loop or inductive loop-to-Microloop sensor) located adjacent to each other and attached to different vehicle detectors installed within the same card rack.

Using this feature helps eliminate crosstalk where rewiring adjacent loops to sensor inputs on the same vehicle detector is not an option.

See Section 7.12 Set Synchronization as Desired for additional details.

10.10 Real-Time Vehicle Speed and Length Measurement Calculated by C900-CS

The C900 configuration software will measure the speed and length of each vehicle when a lead loop and a lag loop are specified in the Configure settings for Speed Trap #1 or Configure settings for Speed Trap #2 and the Leading Edge Distance is specified in the Log Setup tab in the Real-Time Vehicle Logging screen. The results will be saved on the computer while data is being taken. To retain a permanent record of the results, a Save must be done to a desired file name after stopping the logging of vehicle speeds and lengths.

Speed is calibrated by adjusting the setting for the distance between sensors (Leading Edge distance), e.g. increasing the length increases the measured speed and decreasing the length decreases the measured speed. Use this formula to calculate the correct spacing:

\[ L_{space_{new}} = L_{space_{old}} \times \frac{Speed_{actual}}{Speed_{meas}} \]

where \( Speed_{meas} \) is the vehicle speed as measured by the vehicle detector, \( Speed_{actual} \) is the actual vehicle speed, \( L_{space_{old}} \) is the sensor spacing setting in use when \( Speed_{meas} \) was calculated and \( L_{space_{new}} \) will be the new loop spacing setting. The new setting should now give calculated speeds equal to actual vehicle lengths. Please keep these principles in mind:

a. With loops calibrated to correctly measure auto lengths, vehicles that are higher above the road than autos, trucks for example, will be measured shorter than they actually are.

10.11 Historical Traffic Data Binning

The Canoga C922, C924, C922E and C924E vehicle detectors have the ability to store (place a check by each channel for which binning is desired under the Properties tab of the Traffic Data Binning screen) time-stamped vehicle count and lane occupancy data during user defined time intervals (Binning Schedule Interval). The user may specify the Start Date and Time.

Once the vehicle detector has collected the traffic data and placed it into time-stamped bins, the data can be downloaded and viewed using the C900 configuration software. The data may be saved in a Microsoft® Access database or Excel worksheet. Once there, the data may be converted to other formats as the user desires.

The C900-CS also provides means for selective viewing and sorting of the collected data.

10.11.1 Real-time Clock Operation

The vehicle detector has a real-time clock with 24-hour plus power back-up. This will prevent losing data when working with the Historical Traffic Data binning feature.

The vehicle detectors use a relative time reference. This relative time reference is the count of ticks (50 millisecond time periods) that is maintained as Current Time. To attach an absolute time to data, the system reading data from the vehicle detector must first read Current Time and then equate that number of ticks to the absolute time of the data reading system clock. The number of ticks difference from the data reading system clock to the number of ticks at which a vehicle detector event occurred provides the means for the data reading system to assign an absolute date and time to an event such as bin interval start time.
The vehicle detector real-time clock functions as a reference for the card’s relative time keeping clock. The relative time keeping clock counts ticks (50 millisecond time periods) derived from a divider of the 32 Megahertz microcomputer system clock. At each power-up, the real-time clock is read and the number of ticks from midnight on 1/1/2000 to the current real-time clock setting is calculated and placed in Current Time. Current Time is a 32 bit counter which counts to a maximum of 4,294,967,295 ticks of 50 milliseconds duration. After 2485 days, 12 hours, 19 minutes and 24.8 seconds without a power failure to the real-time clock, (about 6 years and 9.7 months), this counter will roll over to zero. If Historical Traffic Data is read during the bin interval immediately after rollover, there will be an apparent time discontinuity that the system reading the data must handle.

The real-time clock is not affected by unit resets or temporary loss of power with duration of 24 hours or less. If power loss (power to vehicle detector is removed) is greater than 24 hours (until super capacitor is discharged), the real-time clock setting reverts to midnight on January 1, 2000. NOTE: Under ideal situations, it may take weeks for the real-time clock to deplete the super capacitor after traffic monitoring card power is removed.

The described method of assigning an absolute time to tick-stamped events using data reading system clock rather than the vehicle detector clock can cause event times to vary slightly between any two successive reads of Historical Traffic Data. For instance, if there is any drift between the detector clock and the data reading system clock between successive reads, tick stamped events will be assigned a slightly different absolute time at the second read as compared to the first read.

To avoid event time discrepancies, the data reading system may reference all relative times to the vehicle detector real-time clock rather than referencing relative times to the data reading system clock. Use the following procedure to accomplish this.

Prior to starting historical traffic data binning, set the vehicle detector real-time clock to the data reading system date and time by using the q5 command. It is preferred that the data reading system clock be synchronized to NIST time. (This and all other unit commands are detailed in the Canoga Series C400/C800/C900E/C900/940E/940 Serial Communication Protocol. It may be requested from GTT at the address or telephone number shown on the back cover of this document.) Then turn power to the card OFF and then ON. This will update Current Time. From this point on, the data reading system can read Current Time using the 5 command and then read the traffic monitoring card real-time clock using the q4 command. The data reading system can then equate, with a small time error magnitude of the time between command replies, Current Time to the absolute time in the card’s real-time clock.

The data reading system can use the q4 and q5 commands to keep real-time clocks closely synchronized. Current time will be “revised” only when there is loss of power to the traffic monitoring card unit.

10.12 Delay and Extension

Canoga C922, C924, C922E and C924E vehicle detectors have Delay and Extension timing functions.

Delay timing inhibits the detector output for a period of time after detection. You can select the Delay Time in 1-second increments up to 31 seconds.

Extension timing extends the detector output for a period of time after the detection is over. You can select the Extension Time in 0.25-second increments up to 7.75 seconds.

10.13 Sensitivity and Mode Selection

Select the lowest sensitivity setting that will reliably detect all vehicles of interest in the weakest area of the sensing zone. For example, the center of a loop when loops are used, or the vehicle near lane division strip when Microloop sensors are used. Lower sensitivity settings present less exposure to environmental noise, allow faster response, and reduce susceptibility to adjacent lane vehicle detection.

For either type of sensor, it is very rare that sensitivity setting other than 2 (256 nanohenries), 3 (128 nanohenries) or 4 (64 nanohenries) is appropriate. A good initial setting is sensitivity 3.
**Presence** mode (output ON while vehicle is being sensed) is recommended for general detection applications. **Pulse** mode (output ON for Pulse **Duration** at the start of vehicle detection and, for loop sensor channels, channel is reinitialized if vehicle is continuously detected for Pulse **Rephase Time** or longer) is generally only used when a loop covers more than one lane, e.g. it is desired that a vehicle stalled in one lane will not prevent vehicles from being detected in the other lane(s). When binning is enabled, count and occupancy will be stored regardless of whether channel is in Presence mode or Pulse mode.

### 10.14 Recovery Method

This setting applies only to channels that have a Loop as the Sensor Type. Select either Normal or Fast Recovery using the C900 configuration software. The recovery method chosen applies only when a vehicle is not being detected. The recovery method may be selected independently for each channel.

When Normal is selected, the vehicle detector adapts (moves Reference Frequency towards Loop Frequency when they are not equal) at the Background Adapt Rate. The default adapt rate setting is 0.50 sensitivity threshold every second. A threshold is the amount of inductance change required to detect a vehicle at the current sensitivity setting. See Table 7-1. Sensitivity Setting Values.

When Fast Recovery is selected, the vehicle detector adapts instantly to large changes (more than one threshold) of apparent inductance in the non-call (non-detect) direction, e.g. Loop Frequency decreases to a value less than (Reference Frequency - Sensitivity Threshold).

**Fast Recovery** may be desirable for Presence-type detection in detection areas that remain occupied for hours at a time. This option is **required for each channel set to Pulse mode**. It is **strongly recommended for a channel configured for Max Presence**. Similarly, it is normally recommended that Max Presence be configured for channels placed in the Fast Recovery mode. Fast Recovery mode is also **recommended for locations that have frequent power failures**.

The disadvantage of Fast Recovery is that large noise events, particularly lightning storms, can cause the detection frequency reference to be set at a frequency lower than the sensor drive frequency (loop frequency) when no vehicle is present. This can result in a call locked in for hours or up until Max Presence time. See Subsection 10.8 Max Presence Configuration.
Long-Loop Counting

The Long-Loop Counting feature allows you to collect count and presence data from long loops. A presence output is provided through the output pins of the detector while the vehicle count data is provided via the front or rear serial ports of the vehicle detector. A long loop can be defined as an inductive loop longer than a standard 1.8 x 1.8 meter (6 foot by 6 foot) loop. This type of loop configuration occurs primarily at intersections.

10.16 Loop and Home-Run Wiring

In selected situations multiple types of cable can be used successfully for home-run. However, the Canoga 30003 home-run cable is designed specifically for this purpose. The cable contains two pairs of 18 AWG, copper stranded, polypropylene insulated wires encased in a water-blocked cable with a metallized polyester shield covered by a UV resistant high-density polyethylene jacket. The wires are parallel wrapped at 6 turns per 0.3 meter (1 foot). The cable is rated for 600 V.

Because of the high degree of decoupling inherent in the vehicle detector’s sequential scanning detection method, this cable can be used to connect two channels of the same vehicle detector to two different loops. Its stability also allows reliable operation with lead-in lengths up to 762 meters (2500 feet).

One sensor must be connected to the RED-GRN pair and the other sensor to the BLK-WHT pair.

10.17 Direction Detection

Direction detection provides users of the vehicle detectors the ability to determine the direction a vehicle is traveling and count only the vehicles traveling in the specified direction. For directional detection the vehicle sensors should be configured as two Microloop sensors spaced 0.9 meter (or 3 feet) apart or be configured as overlapping inductive loops with the sensors connected to either channels 1 and 2 or to channels 3 and 4. Close or overlapping sensors ensure accurate detection of a vehicle’s travel direction.

10.18 Real Time Activity Monitoring

Channel measurement data includes:
- Loop (channel) frequency
- Reference frequency for each channel
- Loop (sensor) inductance
- Maximum vehicle induced ∆L (inductance change)
- Detection duration
- Detection time and date

Channel activity data includes:
- Type of last loop system fault and time of occurrence of that fault
- Switch/call output status
- Sync inputs - status of each input
- Vehicle count
- Directional detection count
- Time remaining in channel count period (always set to Continuous)
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