PROPRIETARY-MATERIAL-USE
PUBLIC-INTEREST FINDING

PROGRAMMATIC APPROVAL

PROGRAMMATIC APPROVAL PERIOD: July 1, 2011 – June 30, 2013

FHWA OVERSIGHT: YES ☒ NO ☐

PROPRIETARY MATERIAL:
Global Traffic Technologies, LLC
Canoga™ 702 Non-invasive Microloop™ Sensor

Product Selection

The Traffic Control Systems Division of the Indiana Department of Transportation is seeking approval to create a recurring special provision and ultimately incorporate into the Standard Specifications additional requirements for a common alternative to inductive vehicle detection loops at signalized intersections. The Canoga™ 702 Non-invasive Microloop™ Sensor is a useful alternative to the conventional method in the following situations:

- if the pavement is in poor condition
- if a shorter lane closure is desired for maintaining traffic, as the Canoga™ 702 Non-invasive Microloop™ Sensor is bored underneath the pavement from the side of the road
- if the pavement is due to be resurfaced within the next few years

Product History

The existing requirements for microloop vehicle detectors can be found in Section 805 of the current edition of the INDOT Standard Specifications. The proposed additional requirements would limit the types of Microloop detectors that can be used to just one product. These additional requirements are already being used as unique special provision on a somewhat recurring basis, particularly in the Fort Wayne District. The desired product is also currently listed on INDOT's Approved Materials List for Traffic Signal Control Equipment under the non-counting loop amplifier section. Even though it is listed as a non-counting loop amplifier, it does have vehicle counting capabilities and is the only one of the three that currently has this capability. The ability to count vehicles and communicate this data is important if a vehicle detection device is to be a true alternative to traditional inductive vehicle detection loops.

Project Compatibility.

The product desired would be compatible with many traffic signal installation and traffic signal modernization projects throughout the State. The product would be intended for use at all traffic signal projects when its advantages outweigh its disadvantages.

Product Availability

MICROLOOP DETECTOR

PROGRAMMATIC APPROVAL - APPENDIX

PROGRAMMATIC APPROVAL PERIOD: July 1, 2011 – June 30, 2013

PROPRIETARY MATERIAL:
Global Traffic Technologies, LLC
Canoga™ 702 Non-invasive Microloop™ Sensor

ADDITIONAL PARTS:
The following parts have been added to the programmatic approval for the Canoga™ 702 Non-invasive Microloop™ Sensor, as being necessary for a complete installation of a microloop vehicle detection system.

1. Canoga™ 702 Microloop™ Sensor Carrier
2. Canoga™ 702 Non-invasive Microloop™ Sensor Installation Kit
3. 3M™ Scotchcast™ 3832 Buried Service Wire Splice Installation Kit
4. Canoga™ C922, C924 Vehicle Detectors
5. Canoga™ 3003 Home Run Cable

EFFECTIVE DATE:
The effective date of the programmatic approval for the Canoga™ 702 Non-invasive Microloop™ Sensor is August 11, 2011. The effective date of this Appendix is January 3, 2012.

APPROVED: _____
~~Deputy Commissioner~~, Director
Engineering Services & Design
Support, INDOT

_____
for Division Administrator, FHWA

PREPARED BY:
Date: 1/4/2012
Joseph E. Bruno
Traffic Administration Engineer
INDOT – Traffic Support Division
(317) 234-7949

The product desired is the only product of its type that is currently available. A Google search for "vehicle detection microloop" will turn up only the Canoga™ 702 Non-invasive Microloop™ Sensor within the first 20 relevant search results.

Product Cost

The most recent unit price summaries show an average unit price of $1,203.88 for a Microloop Detector (pay item 805-92512) out of a total of 114 items. Typically, the conventional inductive loops are paid for by the amount of saw cutting and cable installed (to the nearest linear foot). However, when an inductive loop is paid for by the unit, the unit price summaries show an average unit price of $391.00 (pay item 805-01161) out of a total of 11 items. So while the product desired is not cheaper than conventional vehicle detection methods, it is the preferred detection method when the existing pavement is in poor condition (for example on local road approaches) or to minimize lane closures.

Product Alternatives – Summary Table

	Microloop Detectors	Video Detection Systems	Wireless Vehicle Detection Systems	Traditional Inductive Loops
Non-invasive to Pavement	Yes, system bored underneath pavement	Yes, system installed on traffic signal mast arms	No, requires 4 inch pavement cores	No, requires saw cutting for loops
High Accuracy Rate	Yes, meets ITM 934	No, see JTRP Report 2005-30	Yes, meets ITM 934	Yes, meets ITM 934
Minimizes Lane Closure During Installation	Yes, system can be installed with shoulder closure	No, requires short lane close to install camera over lanes	No, requires short lane closure for pavement cores	No, requires moderate lane closure for saw cutting
Capable of Providing Vehicle Counts	Yes, Canoga 702 Microloop	Yes	Yes, Type F Sensor	Yes
Proprietary Item	Yes, Canoga by GTT	No, multiple manufacturers	Yes, VDS 240 by Sensys Networks	No, multiple manufacturers

Maintenance

The product is easier to maintain than inductive loops because they are not as susceptible to being torn by the pavement (because they are bored underneath the pavement) and the sensors can be replaced without cutting the pavement.

PREPARED BY:

Date: 5/2/2011

Joseph E. Bruno
Traffic Administration Engineer
INDOT – Traffic Support Division
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Based upon the above finding, the use of the proprietary material listed is in the public interest and is hereby approved.

APPROVED: David B Hall for Eugene Skolnik ①

Deputy Commissioner, Design, Project Management, & Technical Support, INDOT

Division Administrator, FHWA (if FHWA oversight req'd)

Date: 10 June 2011

Date: Aug 11, 2011

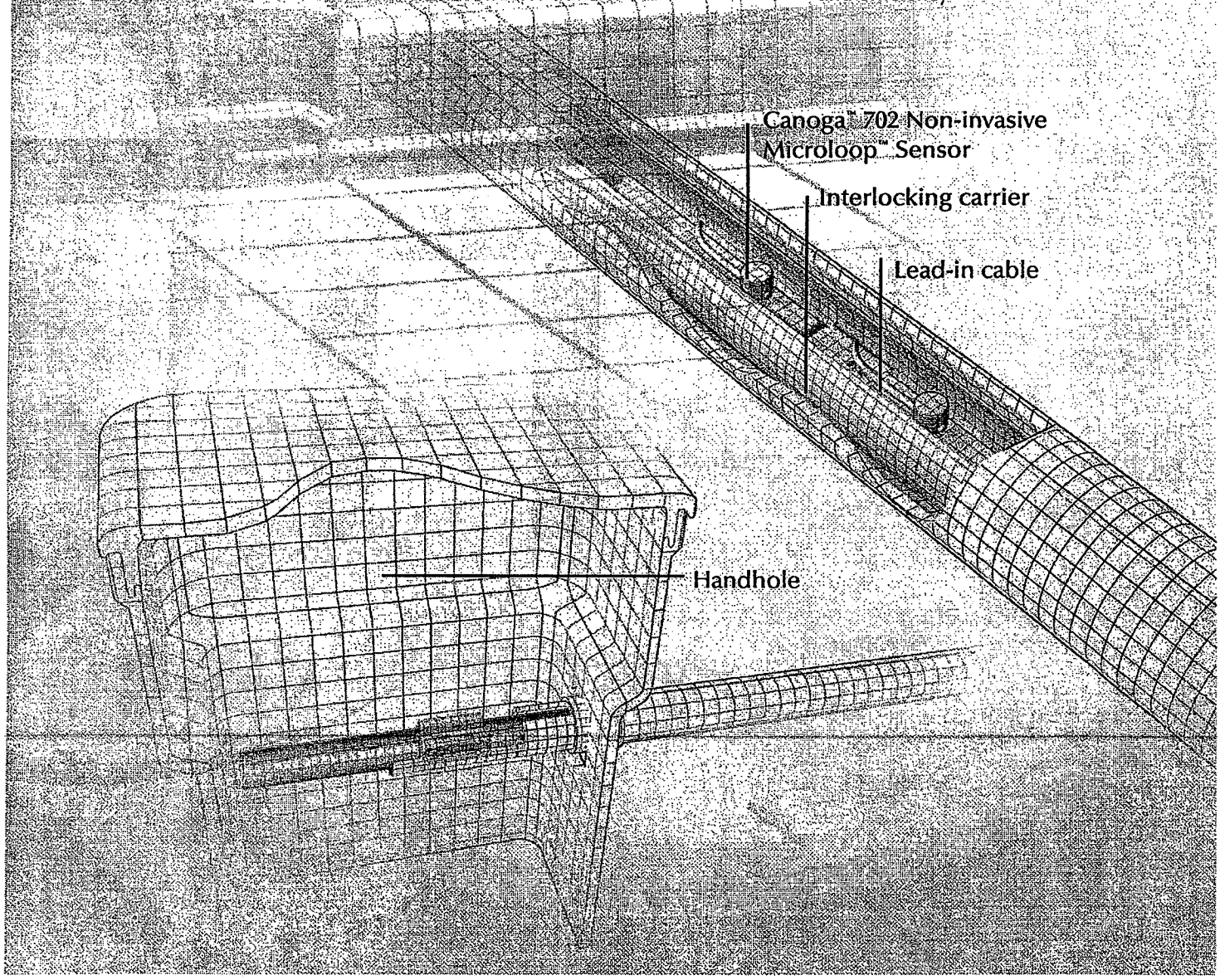
① Approved programmatic use on projects that meet 3 conditions noted under Product Selection

Innovative. Practical. Reliable.

The Canoga traffic sensing system is installed beneath the roadway pavement—the surface is left undisturbed. The Canoga™ 702 Non-invasive Microloop™ Sensor is installed in a protective 3-inch (7.6 cm) conduit located 18–24 inches (45.7–60.9 cm) below the pavement surface.

Canoga 702 Microloop carriers contain pre-set receptacles to firmly hold individual sensors at desired locations. One, two or three sensors are used per lane or per area, depending on the level of accuracy and lane coverage required to sense everything from bicycles to tractor trailers.

Lead-in or home-run cable is used to link Canoga 702 Microloop sensors to the Canoga™ Traffic Monitoring Card. In turn, the Canoga traffic monitoring card provides—in real-time—the traffic flow data you need to manage incidents and optimize traffic safety and efficiency.



The Canoga™ Traffic Sensing System

Accurate, consistent, real-time data is the foundation for effective traffic management and planning. The Canoga traffic sensing system delivers on both counts. This matched component system installs unobtrusively below the road surface: no saw cuts, no weather exposure, no traffic interruptions.

Eight reasons you can count on the Canoga traffic sensing system

1 Consistency.
The Canoga traffic sensing system provides highly reliable measurements (99.5% accuracy of conventional 6 x 6 ft. [1.7 x 1.7 m] loops) under nearly all congestion levels in any weather. The system performs in fog, rain, hail, wind, snow or ice, 24 hours per day, 365 days per year.

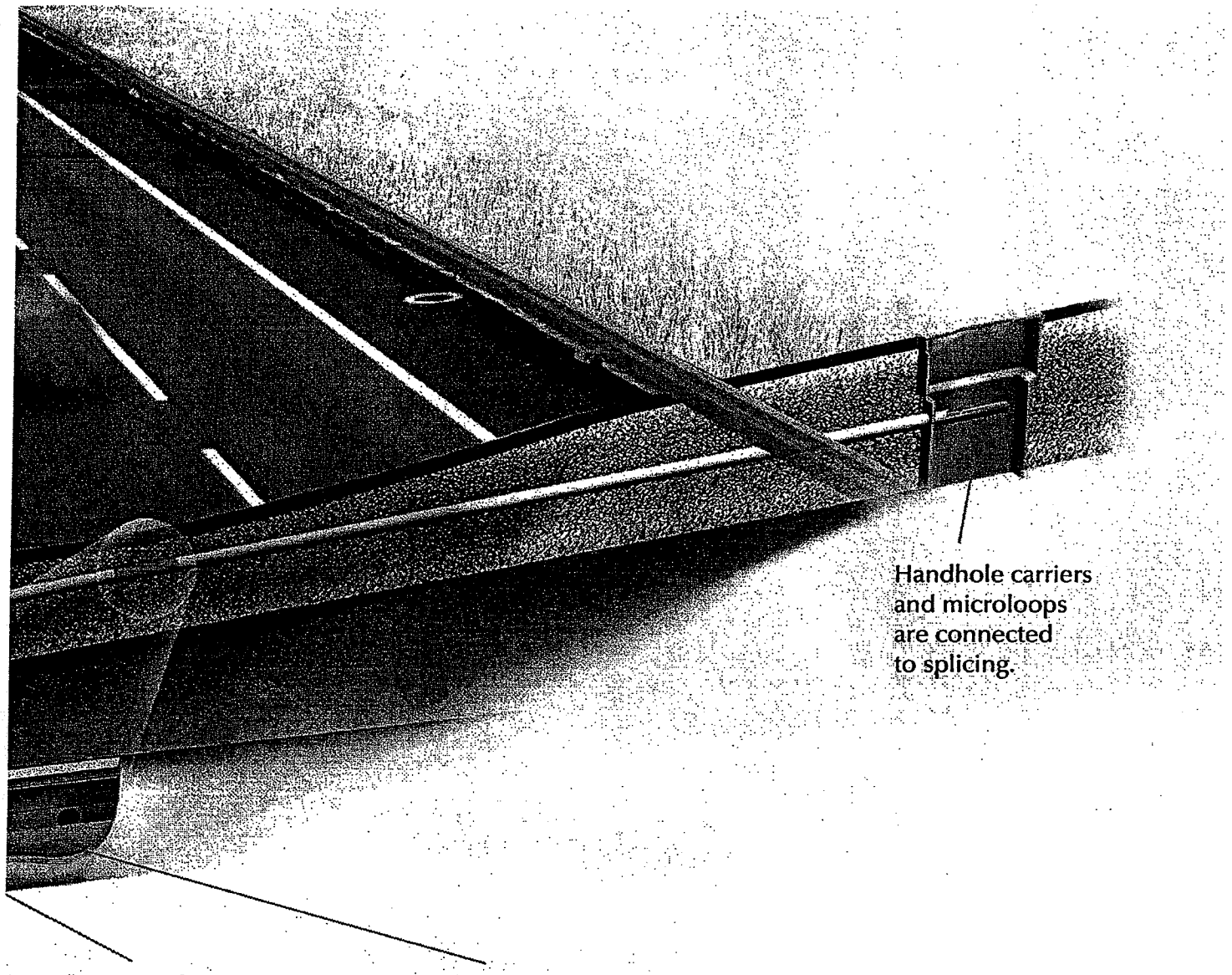
2 Non-intrusive.
The Canoga traffic sensing system is out of sight below the pavement, reducing visual clutter and making it ideal for scenic roadways.

3 Non-invasive.
The Canoga traffic sensing system is contained in a protective conduit that is completely beneath the roadway. It is naturally shielded from weather and wear and is unaffected by pavement failure and milling operations.

4 Low Cost Installation.
Installation costs are especially low in new road construction. Traffic can flow normally and installation crews can work quickly and safely.

5 No Maintenance.
Underground, protected from weather and traffic, the Canoga traffic sensing system operates without service or maintenance. Essentially, you install it and forget it.

6 Low Life Cycle Cost.
Built to last and service-free, the Canoga traffic sensing system offers industry-leading value.



7 **Future Flexibility.**

The Canoga traffic sensing system's scalable design of matched components permits easy modification, reconfiguration and relocation. It can be readily integrated with nearly all traffic management system software.

8 **Real-Time Traffic Data.**

The Canoga traffic sensing system communicates the data you need to manage traffic—count, speed, length, roadway occupancy and vehicle classification data, all available in real time. Field processors such as 170 controllers become unneccessary. Canoga technology includes serial communications to automate roadway information and link to other traffic management products.

Global Traffic Technologies

Canoga™ Traffic Sensing System

Canoga™ 702 Non-invasive Microloop™ Sensors

A Matched Component of the Canoga™ Traffic Sensing System **October 2007**

Description

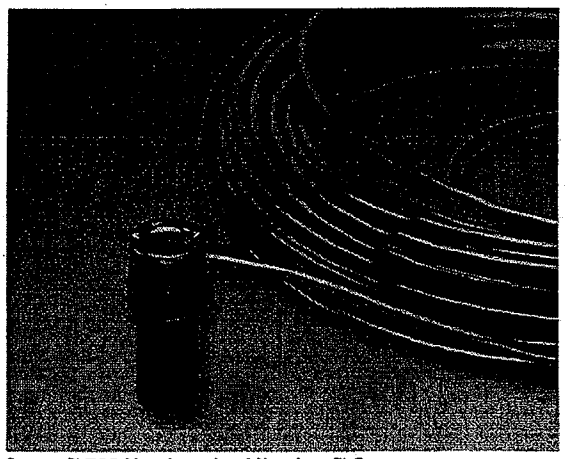
Canoga™ 702 Non-invasive Microloop™ Sensors are a matched component of the Canoga™ Traffic Sensing System. These traffic sensors provide a unique alternative to other vehicle detection systems when connected to a suitably configured Canoga™ Traffic Monitoring Card or a Canoga™ C900 Series Vehicle Detector.

The Canoga 702 Microloop is a transducer that converts changes in the vertical component of the earth's magnetic field to changes in inductance. Vehicles containing vertical components of ferromagnetic material "focus" the earth's field, increasing the magnetic field at the sensor when vehicles move over the sensor. Changes in inductance can be sensed by a Canoga traffic monitoring card or Canoga C900 series vehicle detector suitably configured for the Canoga 702 Microloop.

The Canoga 702 Microloop sensor's small size permits its easy insertion into a 3-inch (7.6 cm) plastic conduit installed 18–24 inches (46–61 cm) below the road surface. Installing the sensors in a conduit leaves the road surface intact, bypasses the effects of poor pavement conditions and inclement weather, and virtually eliminates maintenance and service requirements.

Features

Canoga 702 Microloop offers superior value compared with other vehicle detection technology. It effectively replaces inductive loops for freeway, counting and intersection applications. When connected to Canoga traffic monitoring cards, Canoga 702 Microloop provides accurate, real-time mean speed, count and occupancy data, and vehicle speed and length classification. When performance and life cycle cost are important, Canoga 702 Microloop provides an industry leading advantage.



Canoga™ 702 Non-invasive Microloop™ Sensor

Superior Value

- Lower life cycle costs.
- No maintenance. Underground, protected from weather and traffic, highly durable Canoga 702 Microloop requires no maintenance.
- Lower service costs. Repair is virtually eliminated. Buried sensors and cables are not affected by environmental factors, pavement deterioration or other mechanical stresses. Sensors can be replaced from the roadside without affecting traffic.
- Lower pavement repair and maintenance costs; the road surface is not damaged.
- Better installation and efficiency; traffic lanes are not closed for long periods of time.
- Better road repair efficiency; resurfacing and surface repairs can occur without affecting detection performance.

A Matched Component of the Canoga™ Traffic Sensing System

Flexibility

The Canoga™ 702 Non-invasive Microloop™ Sensors can be easily repositioned or readjusted to improve vehicle sensing accuracy or to reflect changing traffic characteristics in permanent installations or work zones.

Easy to Install

Conventional, horizontal directional drilling techniques or open trenching are used for installation of the conduit.

Small Size

Canoga 702 Microloop sensors fit into specially designed carriers. Carriers can be inserted in less than an hour into a 3-inch (7.6 cm) Schedule 80 conduit installed 18–24 inches (46–61 cm) below the road surface.

Accurate

Canoga 702 Microloop sensors connected to a suitably configured Canoga™ Traffic Monitoring Card or Canoga™ C900 Series Vehicle Detector provide accurate and highly reliable measurements.

- Closely spaced vehicles can be resolved and adjacent lane vehicles rejected.
- Accurate detection is achieved in every lane and under all environmental conditions, unfazed by rain, snow, wind or fog.

Operating Parameters

- **Earth's Vertical Magnetic Field:** 0.2–0.8 oersted.
- **Inductance (Red to Green Wires):** 50–63 microhenries per sensor plus a nominal 16.5 microhenries per 100 feet (30 m) of lead-in cable.
- **DC Resistance (Red to Green Wires):** 1.2–1.8 ohm per sensor plus a nominal 3.04 ohm per 100 feet (30 m) of lead-in cable.
- **Transducer Gain (Sensitivity):** Typically 5.0 nH per millioersted per sensor at 0.4 oersted ambient vertical field intensity.
- **Canoga 702 Microloop Assemblies:** Available in single, double or triple sensor assemblies with standard sensor separations and connected in series to a lead-in cable which may be up to 1,000 feet (305 m) in length.
- **Home-run Cable:** Canoga™ 30003 Home-run Cable is used to connect lead-in cable to the cabinet. The combined length of home-run cable and lead-in cable may be as long as 2,500 feet (762 m).
- **Maximum Number of Sensors per Channel:** Up to three sensors are recommended per channel.
- **Microloop Peak-to-Peak Drive Current with Canoga Traffic Monitoring Cards or Canoga C900 Series Cards:** The cards must provide between 14 and 80 milliAmp$_{p\text{-}p}$.

Installation

Canoga 702 Microloop sensors are designed to be inserted into a 3-inch (7.6 cm) non-ferrous Schedule 80 conduit.

Conduit is installed 21 ± 3 inches (53.3 ± 7.6 cm) below the road surface using horizontal directional drilling or open trenching techniques.

See Canoga 702 Microloop installation instructions for more information.

Wiring

Multiple Canoga 702 Microloop sets can be wired in series to accommodate different applications. Two independent sensor sets can be connected to a single Canoga 30003. For reliable operation, all splices must be soldered, insulated and waterproofed. See Canoga 702 Microloop installation instructions for detailed wiring instructions.

Environmental

- **Temperature:** -30° F to +165° F (-34° C to +74° C).
- **Relative Humidity:** 100% (including submersion in solutions of chemicals typical of roadway runoff).

Physical Characteristics

- **Sensor:** Cylindrical, 2.25 inches (5.7 cm) high, fitting a .8125 inch (2 cm) hole in the carrier.
- **Lead-in Cable:** Polyurethane-jacketed cable with two PVC insulated AWG #22 conductors. Overall diameter 0.19 inches (0.48 cm).
- **Color:** Black sensor body and black jacketed lead-in cable with red and green insulated wires.

Related Products or Accessories

Canoga™ 702 Non-invasive Microloop™ Sensor Carriers hold Canoga 702 Microloop sensors in a fixed, vertical position as they are inserted into the previously installed, 3-inch (7.6 cm) conduit. The carriers' interlocking mechanism maintains the alignment of the sensors within ± 20° from vertical.

— Physical characteristics of the carrier: 12 inches (30.5 cm) long PVC sensor carrier with an outer diameter of 2.6 inches (6.6 cm).

Canoga™ 702 Non-invasive Microloop™ Sensor Installation Kit is required for each conduit

\(one kit per conduit). The kit contains all of the parts necessary to insert and remove the sensors, to label sensor cables and to close off the conduit ends.

— Physical characteristics of the end cap carrier: PVC tubing 13 inches (33 cm) long and 2.6 inches (6.6 cm) in diameter. The end cap carrier is the first piece to be inserted into the conduit. It has an attached rope that permits removal of the installed Canoga 702 Microloop assembly.

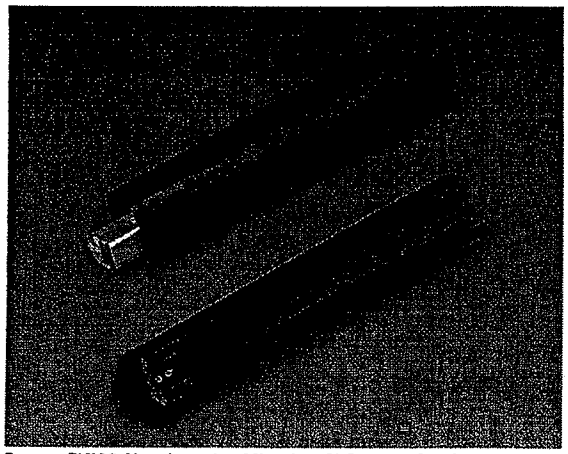
Consult the installation instructions to install the conduit and Canoga 702 Microloop sensors using Canoga 702 Microloop carriers.

3M™ Scotchcast™ 3832 Buried Service Wire Splice Installation Kit is recommended for splicing the lead-in cable with the home-run cable. This wire splice installation kit ensures a reliable connection in the environments encountered by the Canoga 702 Microloop.

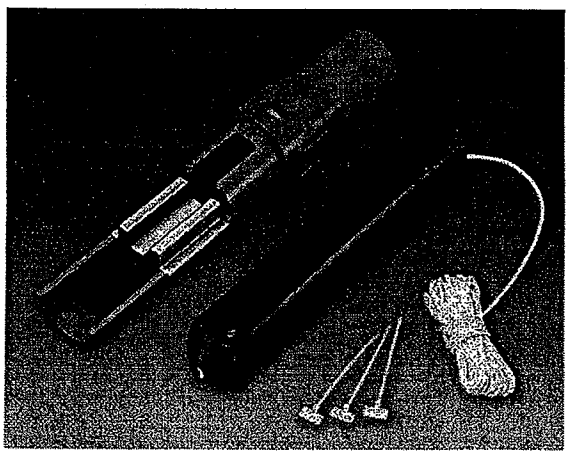
Canoga™ 942 or 944 Traffic Monitoring Card for monitoring vehicle speeds, count and occupancy, and for classification of vehicle speeds and lengths.

Canoga™ C922 or C924 Vehicle Detectors for detection of vehicle presence and for traffic count applications.

Canoga™ 30003 Home-run Cable is recommended for all home-runs, especially those exceeding 500 feet.



Canoga™ 702 Non-invasive Microloop™ Sensor Carriers



Canoga™ 702 Non-invasive Microloop™ Sensor Installation Kit

Important Notice to Purchaser:

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GTT will, at its sole option, repair, replace or refund the purchase price of Canoga™ Traffic Sensing System components or Canoga™ Vehicle Detectors described herein found to be defective in materials or manufacture within seven (7) years from the date of shipment from GTT. This warranty shall not apply to Canoga traffic sensing system components or Canoga vehicle detectors which have been (1) repaired or modified by persons not authorized by GTT; (2) subjected to misuse, neglect or accident; (3) damaged by extreme atmospheric or weather conditions; or (4) subjected to events or use outside the normal or anticipated course.

IN NO EVENT SHALL GTT BE LIABLE FOR ANY INJURY (INCLUDING, WITHOUT LIMITATION, PERSONAL INJURY), DEATH, LOSS, OR DAMAGE (INCLUDING, WITHOUT LIMITATION, PROPERTY DAMAGE), WHETHER DIRECT, INDIRECT, INCIDENTAL, SPECIAL, CONSEQUENTIAL OR OTHERWISE, ARISING OUT OF THE USE OR INABILITY TO USE, REPAIR OR FAILURE TO REPAIR, ANY GTT PRODUCT, REGARDLESS OF THE LEGAL THEORY ASSERTED. THE REMEDIES SET FORTH IN THIS DOCUMENT ARE EXCLUSIVE.

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INDIANA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS MANAGEMENT

PROCEDURE FOR EVALUATING VEHICLE DETECTION PERFORMANCE
ITM No. 934-08P

1.0 SCOPE.

1.1 This test procedure covers the methods that a vehicle detector is evaluated in the field, and is placed, maintained, or removed from an approval list.

1.2 The values stated in either English or acceptable SI metric units are to be regarded separately as standard, as appropriate for a specification with which this ITM is used. Within the text, SI metric units are shown in parenthesis. The values stated in each system may not be exact equivalents; therefore each system shall be used independently of the other, without combining values in any way.

1.3 This ITM may involve hazardous materials, operations, and equipment and may not address all of the safety problems associated with the use of the test method. The user of the ITM is responsible for establishing appropriate safety and health practices and determining the applicability of regulatory limitations prior to use.

2.0 REFERENCES.

2.1 NEMA Standards.

2003 NEMA Standards Publication TS-2 Traffic Signal Controller Assemblies

3.0 TERMINOLOGY. Definitions for terms and abbreviations shall be in accordance with the Department's Standard Specifications, Section 101 and NEMA TS-2 Section 1.

4.0 SIGNIFICANCE AND USE. This ITM is used to evaluate, approve, maintain approval, and remove from the approval listing vehicle detectors which are placed on the Department's List of Approved Traffic Controller Equipment. Each model of vehicle detector will be bench tested and field tested separately.

5.0 APPARATUS.

5.1 A fully functional instrumented intersection, with detector data output logging, and live video overlay capabilities.

6.0 SAMPLING. The manufacturer shall furnish, at no cost to the Department, three randomly selected production-run vehicle detectors for field testing.

7.0 PROCEDURE. The Department will evaluate the performance of individual vehicle detectors upon successful completion of all other requirements specific to the vehicle detector being tested.

8.0 BENCH TESTING. The vehicle detector will be bench tested in accordance with the specific ITM procedures for the detector prior to field testing.

9.0 FIELD TESTING.

9.1 For field testing of detection temporal presence and count accuracy of the vehicle detector, the following procedures will be used:

9.1.1 Vehicle detection is required to satisfy two objectives for efficient actuated signal control as follows:

a) To extend green service to a phase until there is no longer demand or flow rates have reduced to levels for phase termination

b) To call service to a phase when, and only when, there is demand

9.1.2 Both 9.1.1 requirements are required for optimal intersection efficiency; however, there may be conditions where a fully compliant detector may not be deployable. Consequently, separate performance specifications are defined for as follows:

a) Standard Performance Calling/Extension Detector. Standard Performance Calling/Extension Detectors are used to call a phase that is amber or red and to extend a phase that is green. These detectors are compliant with the NEMA performance specification for induction loop detection. The Department requires induction loop amplifiers and other fully compliant vehicle detection technologies to meet this specification.

b) Low Performance Calling/Extension Detector. Low Performance Calling/Extension Detectors may be used to call service to a phase that is red and to inefficiently extend a phase that is green. These low performance detectors are not compliant with NEMA TS2-2005 specification for loop amplifiers. These low performance detectors provide some benefit over non-actuated control in extending phases, but do not provide the efficiency of a Standard Performance Calling/Extension Detector. Low Performance Calling/Extension Detectors do not provide detection to the precision level required by a NEMA controller to efficiently extend and terminate phases, but may be deployed where Standard Performance Calling/Extension Detectors are not feasible. The Department will consider this lowered standard

c) of Calling Detector only where a Standard Performance Calling/Extension Detector cannot be reasonably deployed.

9.1.3 Performance Metrics. Detection units shall be evaluated only when the lateral offset of the center of a vehicle (FHWA Class 1-13) is not more than the distance (o) from the center of the lane (Figure 1 and Table 1) and operating at speeds between 0 and 60 mph. Fundamental traffic flow theory and the NEMA TS2-1998 Sections 2.2.2, 3.5.3.1, 6.5.2.17, and 6.5.2.19 demonstrate the importance of 100 millisecond detection resolution for monitoring traffic flow rates for phase termination. Consequently, the following specifications for extension detectors (Table 1) conform to the requirements of 100ms detection resolution.

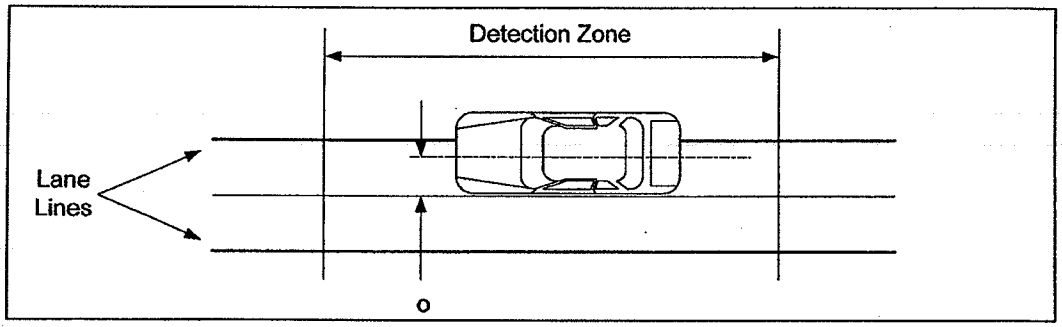


Figure 1: Lateral Detection Zone Boundaries

	Low Performance		Standard Performance	
	During Amber and Red Interval	During Green Interval	During Amber and Red Interval	During Green Interval
Lateral Offset (o)	≤ 3.0 ft	≤ 3.0 ft	≤ 3.0 ft	≤ 3.0 ft
Activation Position, Upstream Tolerance (A_u-A)	≤ 6.0 ft	≤ 6.0 ft	≤ 3.0 ft	≤ 3.0 ft
Activation Position, Downstream Tolerance (A-A_d)	≤ 6.0 ft	≤ 6.0 ft	≤ 3.0 ft	≤ 3.0 ft
Termination Position, Upstream Tolerance (T_u-T)	≤ 6.0 ft	≤ 6.0 ft	≤ 3.0 ft	≤ 3.0 ft
Termination Position, Downstream Tolerance (T-T_d)	≤ 6.0 ft	≤ 6.0 ft	≤ 3.0 ft	≤ 3.0 ft
Response Time, Typical ($R_{85\%}$)	≤ 2 sec	≤ 1 sec	≤ 1 sec	≤ 100 ms
Response Time, Maximum ($R_{100\%}$)	≤ 10 sec	≤ 5 sec	≤ 5sec	≤ 1sec
False Call Duration (F_d)	≤ 5 sec	≤ 5 sec	≤ 500 ms	≤ 500 ms

Table 1: Parameters for Measuring Detector Performance
(Per respective detection zone)

9.1.4 Detection Zone Operation. The Detection Zone is the region defined by an activation and termination location in a single lane. Figure 2 illustrates the upstream activation location (A) and downstream termination location (T) of the detection zone. The subscripted locations in Figure 2 and Table 1 define the spatial tolerance of these activation and termination points.

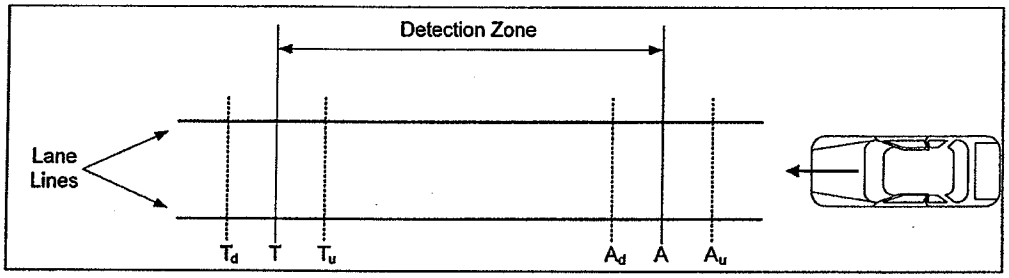


Figure 2: Longitudinal Detection Zone Boundaries

	Low Performance		Standard Performance	
	Performance During Amber and Red Interval	Performance During Green Interval	Performance During Amber and Red Interval	Performance During Green Interval
Number of Missed Calls (N_{mc})	0 /24 h	≤ 10 /24 h	0 /24 h	≤ 10 /24 h
Number of False Calls (N_{fc})	≤ 20 /24 h		≤ 20 /24 h	

Table 2: Acceptance Criteria

a) The detection device shall call and hold a call as long as any portion of any vehicle is between the upstream point (A_d) and downstream point (T_u)

b) Failure to detect a vehicle meeting the spatial and timing tolerances listed in Table 1 shall be considered a missed call. Allowable tolerances for Missed Calls (N_{mc}) defined by these criteria are listed in Table 2. Detection performance outside of these tolerances is grounds for rejection of the device.

c) The detection device shall not place a call when no portion of a vehicle is between the upstream point (A_u) and downstream point (T_d)

d) Indication of the presence of a vehicle when no vehicle meets the spatial and timing criteria listed in Table 1 shall be considered a false call. Allowable tolerances for false calls (N_{fc}) defined by these criteria are listed in Table 2. Detection performance outside of these tolerances is grounds for rejection of the device.

e) Response time at transition points shall be as follows:

1. When transitioning from no-call to call states, the detection device shall indicate a detection no later then ($R_{100\%}$) after the front of a vehicle crosses point (A_d).

2. When transitioning from call to no-call, the detection device shall drop a call no later then ($R_{100\%}$) after the rear of a vehicle crosses point (T_d).

9.1.5 Detector performance specifications shall be as follows:

a) A vehicle detector shall be considered acceptable for a given lane and application (Calling or Calling/Extension) if:

1. The output response time at the transition points is $\leq R_{85\%}$ for 85% of the call/no-call observations

2. The output response time is $\leq R_{100\%}$ for 100.00% of the call/no-call observations in any 24 h period

3. Not more than (N_{fc}) false calls lasting more then (F_d) are produced in any 24 h period

b) Calling/Extension Detector performance standards are required to be met for detection devices installed for all lanes of Department intersection, unless prior written approval is obtained from the Highway Support Section of Operations Support Division to use Calling Detector standards for selected lanes.

c) Environmental conditions shall be as follows:

1. One test period of 24 contiguous hours of operation

2. One test period of 2 contiguous hours of sunny conditions with visible shadows projected a minimum of 6 ft into the adjacent lane(s). Alternatively two different 1 h periods collected at the same sight on at different times is acceptable.

3. One test period of 2 contiguous hours of night time operations with wet pavement and vehicle head lights on. Alternatively two different one hour periods collected at the same sight on at different times is acceptable.

d) Intersection /Approach conditions shall be as follows:

1. The approach shall have a minimum of one left turn lane, two through lanes, and one right or right/through lane.

2. The intersection shall be a in a rural area with no lighting.

3. The left turn movement shall be controlled by a five section protected/permissive head.

9.2 Counting accuracy shall be as follows:

9.2.1 Detectors shall be approved for counting purposes as a separate and independent detection function.

9.2.2 A valid vehicle is defined by the detection zone and vehicle relationships in Table 1.

9.2.3 Counting detectors are required to count valid vehicles with a maximum error rate of ± 10 percent compared to visually ground truth vehicles over a 24 h period and shall not exceed ± 10 percent error for any time interval that includes 50 qualified vehicles.

9.3 When protected/permitted operation is used, detector operations during both the protected and permissive period will be evaluated using the Green Interval Criteria in Table1

10.0 REPORT. A final report will include the notations and findings from the electronic bench test and field testing results and documentation.

11.0 APPROVAL LIST.

11.1 Approval of vehicle detector. The vehicle detector model may be placed on the approval list when the following conditions are met:

11.1.1 The bench and field testing are completed with satisfactory results.

11.1.2 The required documentation is submitted.

11.2 Maintaining Approval.

11.2.1 Once a detection system has been approved; each time any change in the firmware is made the vendor shall provide the Department with the following:

a) Induction Loop Amplifiers. The vendor shall furnish the Department with test results from a calibrated ATSI ALSA-1250 or equivalent loop system analyzer to verify NEMA compliance. The vendor shall notify the Department prior to shipment of amplifiers containing firmware updates.

b) Non Loop Based Systems. The vendor shall furnish the Department with a DVD video recording of the detector operation, demonstrating that the detector continues to meet the original acceptance criteria listed in Table 2, with the detector and phase status of each lane overlaid on the video, and including the following conditions:

1. Environmental Conditions:

a. One clip of 24 contiguous hours of operation.

b. One clip of 2 contiguous hours of sunny conditions with visible shadows projected a minimum of 6 ft into the adjacent lane(s). Alternatively two different 1 h periods collected at the same sight on at different times is acceptable.

c. One clip of 2 contiguous hours of night time operations with wet pavement and vehicle head lights on. Alternatively two different 1 h periods collected at the same sight on at different times is acceptable.

2. Intersection /Approach Conditions:

a. The approach shall have a minimum of 1 left turn lane, 2 through lanes, and 1 right or right/through lane.

b. The intersection shall be a in a rural area with no lighting.

c. The left turn movement shall be controlled by a five section protected/permissive head.

All video on the DVD shall be recorded at vendor recommended maximum setback of detection zones from the video camera. A shop drawing showing camera elevation, detection zone setback, detection zone sizes shall accompany the DVD along with a letter certifying that the DVD was recorded using the new firmware version and has been verified to meet the above standards.

11.2.2 If the manufacturer makes any changes to an approved model to correct a non-NEMA compliancy or other safety issue, the Department shall be notified immediately. The manufacturer shall correct all existing equipment purchased by the Department either directly, by contract, or through agreement prior to the change being incorporated at the manufacturer's production level.

11.2.3 A design change to an approved model shall require a submittal of documented changes. At the discretion of the Department, resubmission of the model for testing and evaluation may be required. Permanent addition or removals of component parts or wires, printed circuit board modifications, or revisions to memory or processor software, are examples of items that are considered to be design changes.

11.3 Removal from Approval List. The vehicle detector will be removed from an approval list for, but not limited to, the following reasons:

11.3.1 Changes in the vehicle detector components or production process that fail testing and/or evaluation

11.3.2 If three consecutive years elapse without furnishing the vehicle detector

11.3.3 Performance of the vehicle detector no longer meets the intended purpose

11.3.4 Recurring similar product failures indicative of a manufactures defect

Global Traffic Technologies

Canoga™ Traffic Sensing System

Canoga™ 702 Non-invasive Microloop™ Sensors

A Matched Component of the Canoga™ Traffic Sensing System **October 2007**

Description

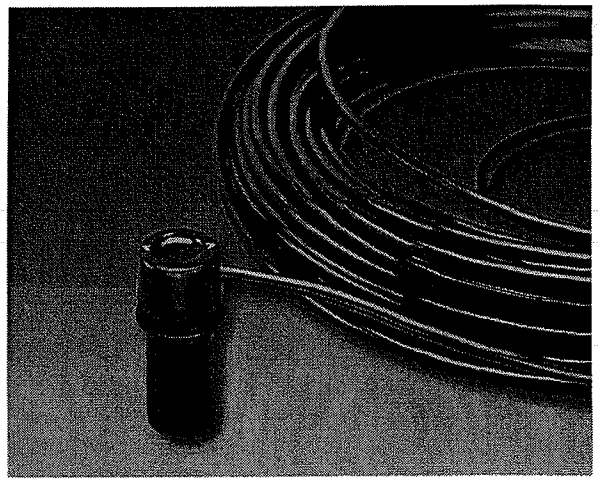
Canoga™ 702 Non-invasive Microloop™ Sensors are a matched component of the Canoga™ Traffic Sensing System. These traffic sensors provide a unique alternative to other vehicle detection systems when connected to a suitably configured Canoga™ Traffic Monitoring Card or a Canoga™ C900 Series Vehicle Detector.

The Canoga 702 Microloop is a transducer that converts changes in the vertical component of the earth's magnetic field to changes in inductance. Vehicles containing vertical components of ferromagnetic material "focus" the earth's field, increasing the magnetic field at the sensor when vehicles move over the sensor. Changes in inductance can be sensed by a Canoga traffic monitoring card or Canoga C900 series vehicle detector suitably configured for the Canoga 702 Microloop.

The Canoga 702 Microloop sensor's small size permits its easy insertion into a 3-inch (7.6 cm) plastic conduit installed 18–24 inches (46–61 cm) below the road surface. Installing the sensors in a conduit leaves the road surface intact, bypasses the effects of poor pavement conditions and inclement weather, and virtually eliminates maintenance and service requirements.

Features

Canoga 702 Microloop offers superior value compared with other vehicle detection technology. It effectively replaces inductive loops for freeway, counting and intersection applications. When connected to Canoga traffic monitoring cards, Canoga 702 Microloop provides accurate, real-time mean speed, count and occupancy data, and vehicle speed and length classification. When performance and life cycle cost are important, Canoga 702 Microloop provides an industry leading advantage.



Canoga™ 702 Non-invasive Microloop™ Sensor

Superior Value

- Lower life cycle costs.
- No maintenance. Underground, protected from weather and traffic, highly durable Canoga 702 Microloop requires no maintenance.
- Lower service costs. Repair is virtually eliminated. Buried sensors and cables are not affected by environmental factors, pavement deterioration or other mechanical stresses. Sensors can be replaced from the roadside without affecting traffic.
- Lower pavement repair and maintenance costs; the road surface is not damaged.
- Better installation and efficiency; traffic lanes are not closed for long periods of time.
- Better road repair efficiency; resurfacing and surface repairs can occur without affecting detection performance.

A Matched Component of the Canoga™ Traffic Sensing System

Flexibility

The Canoga™ 702 Non-invasive Microloop™ Sensors can be easily repositioned or readjusted to improve vehicle sensing accuracy or to reflect changing traffic characteristics in permanent installations or work zones.

Easy to Install

Conventional, horizontal directional drilling techniques or open trenching are used for installation of the conduit.

Small Size

Canoga 702 Microloop sensors fit into specially designed carriers. Carriers can be inserted in less than an hour into a 3-inch (7.6 cm) Schedule 80 conduit installed 18–24 inches (46–61 cm) below the road surface.

Accurate

Canoga 702 Microloop sensors connected to a suitably configured Canoga™ Traffic Monitoring Card or Canoga™ C900 Series Vehicle Detector provide accurate and highly reliable measurements.

- Closely spaced vehicles can be resolved and adjacent lane vehicles rejected.
- Accurate detection is achieved in every lane and under all environmental conditions, unfazed by rain, snow, wind or fog.

Operating Parameters

- **Earth's Vertical Magnetic Field:** 0.2–0.8 oersted.
- **Inductance (Red to Green Wires):** 50–63 microhenries per sensor plus a nominal 16.5 microhenries per 100 feet (30 m) of lead-in cable.
- **DC Resistance (Red to Green Wires):** 1.2–1.8 ohm per sensor plus a nominal 3.04 ohm per 100 feet (30 m) of lead-in cable.
- **Transducer Gain (Sensitivity):** Typically 5.0 nH per millioersted per sensor at 0.4 oersted ambient vertical field intensity.
- **Canoga 702 Microloop Assemblies:** Available in single, double or triple sensor assemblies with standard sensor separations and connected in series to a lead-in cable which may be up to 1,000 feet (305 m) in length.
- **Home-run Cable:** Canoga™ 30003 Home-run Cable is used to connect lead-in cable to the cabinet. The combined length of home-run cable and lead-in cable may be as long as 2,500 feet (762 m).
- **Maximum Number of Sensors per Channel:** Up to three sensors are recommended per channel.
- **Microloop Peak-to-Peak Drive Current with Canoga Traffic Monitoring Cards or Canoga C900 Series Cards:** The cards must provide between 14 and 80 milliAmp$_{p\text{-}p}$.

Installation

Canoga 702 Microloop sensors are designed to be inserted into a 3-inch (7.6 cm) non-ferrous Schedule 80 conduit.

Conduit is installed 21 ± 3 inches (53.3 ± 7.6 cm) below the road surface using horizontal directional drilling or open trenching techniques.

See Canoga 702 Microloop installation instructions for more information.

Wiring

Multiple Canoga 702 Microloop sets can be wired in series to accommodate different applications. Two independent sensor sets can be connected to a single Canoga 30003. For reliable operation, all splices must be soldered, insulated and waterproofed. See Canoga 702 Microloop installation instructions for detailed wiring instructions.

Environmental

- **Temperature:** -30° F to +165° F (-34° C to +74° C).
- **Relative Humidity:** 100% (including submersion in solutions of chemicals typical of roadway runoff).

Physical Characteristics

- **Sensor:** Cylindrical, 2.25 inches (5.7 cm) high, fitting a .8125 inch (2 cm) hole in the carrier.
- **Lead-in Cable:** Polyurethane-jacketed cable with two PVC insulated AWG #22 conductors. Overall diameter 0.19 inches (0.48 cm).
- **Color:** Black sensor body and black jacketed lead-in cable with red and green insulated wires.

Related Products or Accessories

Canoga™ 702 Non-invasive Microloop™ Sensor Carriers hold Canoga 702 Microloop sensors in a fixed, vertical position as they are inserted into the previously installed, 3-inch (7.6 cm) conduit. The carriers' interlocking mechanism maintains the alignment of the sensors within ± 20° from vertical.

— Physical characteristics of the carrier: 12 inches (30.5 cm) long PVC sensor carrier with an outer diameter of 2.6 inches (6.6 cm).

Canoga™ 702 Non-invasive Microloop™ Sensor Installation Kit is required for each conduit

\(one kit per conduit). The kit contains all of the parts necessary to insert and remove the sensors, to label sensor cables and to close off the conduit ends.

— Physical characteristics of the end cap carrier: PVC tubing 13 inches (33 cm) long and 2.6 inches (6.6 cm) in diameter. The end cap carrier is the first piece to be inserted into the conduit. It has an attached rope that permits removal of the installed Canoga 702 Microloop assembly.

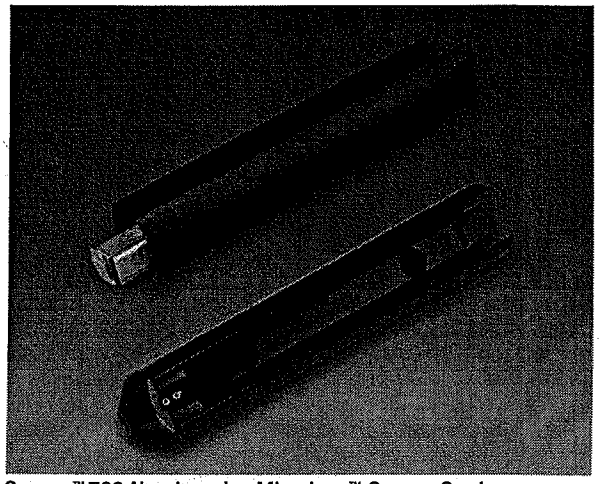
Consult the installation instructions to install the conduit and Canoga 702 Microloop sensors using Canoga 702 Microloop carriers.

3M™ Scotchcast™ 3832 Buried Service Wire Splice Installation Kit is recommended for splicing the lead-in cable with the home-run cable. This wire splice installation kit ensures a reliable connection in the environments encountered by the Canoga 702 Microloop.

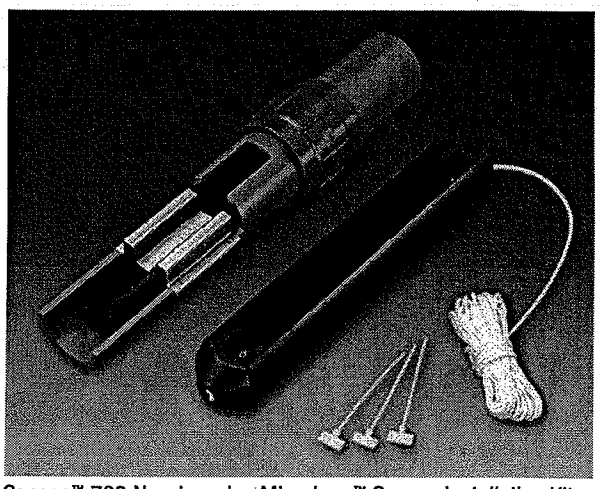
Canoga™ 942 or 944 Traffic Monitoring Card for monitoring vehicle speeds, count and occupancy, and for classification of vehicle speeds and lengths.

Canoga™ C922 or C924 Vehicle Detectors for detection of vehicle presence and for traffic count applications.

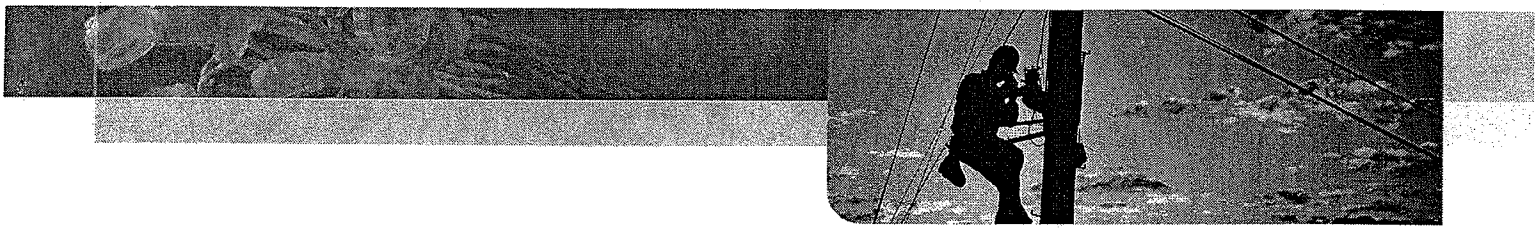
Canoga™ 30003 Home-run Cable is recommended for all home-runs, especially those exceeding 500 feet.



Canoga™ 702 Non-invasive Microloop™ Sensor Carriers



Canoga™ 702 Non-invasive Microloop™ Sensor Installation Kit



3M™ Scotchcast™ Buried Service Wire Splice Encapsulation Kit 3832

For up to 5-pair buried service wires

Instructions

1. Snip end cap ports to fit snug on cables (one port on each end cap for in-line splice, two ports on lower end cap for butt splice, etc.).
2. Slide end cap(s) over cable ends and push down out of the way.
3. For inline splice, place barrel and sleeve over either cable and slide down out of the way.
4. Prepare service wires per Figure 1. Scuff and clean surfaces that will come in contact with compound. Use of 3M™ Scotchcast™ Service Wire Cleaning Kit 4415 is recommended.

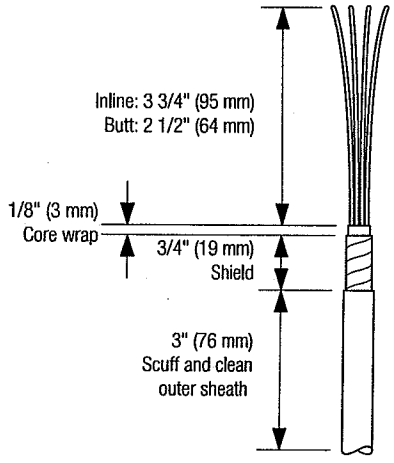


Figure 1

5. Attach split bolt to wire shields per Figure 2. Tighten securely.
6. Splice conductors per Figure 2.

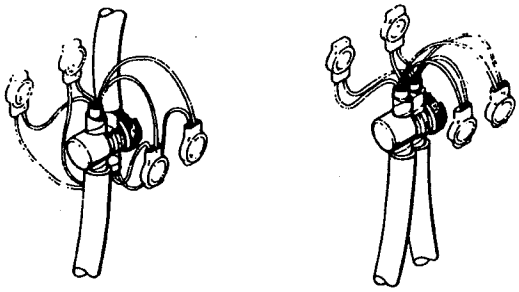


Figure 2

7. Center barrel and sleeve over splice. Slide end caps (lower end cap for butt splice) onto barrel seating them firmly into place.
8. For inline splice, level barrel with opening on top.
9. For butt splice, close barrel opening with sleeve.

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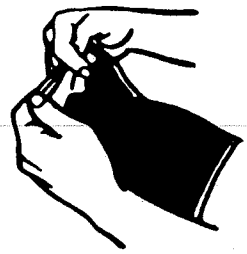
10. Mix Compound: Warm closed mixing bag to 16°C (60°F) or more before mixing. Break center barrier by grasping sides of bag and rolling thumbs through barrier.

Thoroughly mix by squeezing compound back and forth 30 to 40 times. Strip compound from corners while mixing.



11. Snip off corner of closed mixing bag and pour compound into barrel (through opening for inline splice, through upper end for butt splice) until completely full.

12. Close Barrel: By rotating sleeve for inline splice, with upper end cap for butt splice. Note Figure 3.

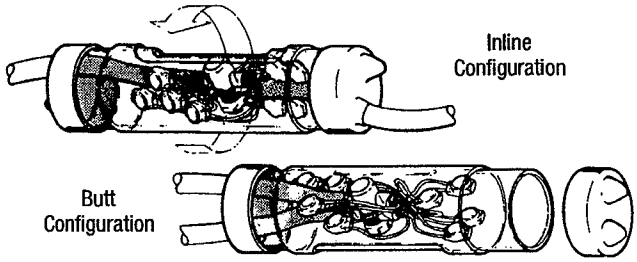


Figure 3

13. Closure may be placed immediately after completion of filling operation.

⚠CAUTION

Vapor and liquid may cause sensitization. Contains isocyanate. May be irritating to the eyes. Avoid skin and eye contact. Avoid repeated and prolonged breathing of vapor. Use only in well ventilated areas.

⚠FIRST AID

Inhalation - provide fresh air. In case of eye contact flush eyes with plenty of water for 10 minutes and get medical attention. If ingested - do not induce vomiting. Get medical attention. Wash with soap and water in case of skin contact.

3M

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Global Traffic Technologies

Canoga™ Traffic Sensing System

Canoga™ C922 and C924 Vehicle Detectors

Matched Components of the Canoga™ Traffic Sensing System **October 2007**

Description

Canoga™ C922 and C924 Vehicle Detectors measure vehicle presence, count and roadway occupancy with industry-leading accuracy and reliability through superior inductive vehicle detection. Canoga C922 is a two-channel vehicle detector and the Canoga C924 is a four-channel vehicle detector. Both are designed to meet U.S. control cabinet rack standards. They are configured using Canoga™ C900 Configuration Software. Through the Canoga C900-CS, users are able to easily change a detector's configuration, view binning data, monitor traffic real-time (including speed and length), and view detector status. Canoga C922 and C924 allow remote access through serial ports on the front of the detector and on the back panel connector.

Operating Characteristics

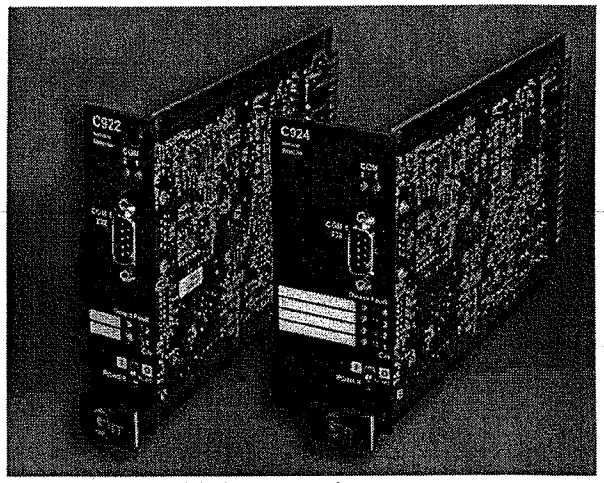
Canoga C922 and C924 have built-in protection against lightning-induced and other transients. User-programmed settings and vehicle detector–gathered data are stored in non-volatile memory.

Communication

Two independent serial ports are available for local and remote communications:

- Front panel TIA232 (RS232) port
- Back panel transmit/receive pin connectors for multi-drop TIA485 (RS485) communication

Canoga C900-CS uses the ports for local or remote configuration of the detector and for disturbance identification, to monitor and retrieve real-time activity, and to access data logging and binning information.



Canoga™ C922 Vehicle Detector and Canoga™ C924 Vehicle Detector

Tuning Range

20 to 2,500 microhenries.

Sensitivity Setting

Sixteen sensitivity settings are available per channel:

- Eight "pulse" mode sensitivities, or
- Seven "presence" mode sensitivities, or
- "Off" mode

Frequency Setting

Four frequency settings per channel.

Matched Components of the Canoga™ Traffic Sensing System

Sensitivity, Threshold and Typical Response Time Values

Sensitivity Level	Threshold in Nanohenries	Typical Loop System Response Time
C	1024	<5 milliseconds
1	512	<6 milliseconds
2	256	<6 milliseconds
3	128	<8 milliseconds
4	64	<12 milliseconds
5	32	<20 milliseconds
6	16	<34 milliseconds
7	8	<64 milliseconds

Remote Reset Input

Input allows an external reset of the detector. When input voltage on pin C is pulled below 6 VDC for ≥ 17 milliseconds, the detector resets all active channels and establishes a new reference for each "On" loop within four seconds.

Power On/Off Switch (Reset Switch)

Allows the unit to be disabled or reset while still in the card rack.

Internal Loop Diagnostics

Records and stores type of loop fault and time of occurrence.

Channel by Channel Programmability

All vehicle detection parameters are programmable separately for each channel. This includes the sensitivity, background adapt rate, recovery method, wash delay time and wash adapt rate.

Status Output

Status output "on" when channel is okay.

Switch Output

Opto-isolated darlington pair switch outputs.

Detect and Fault LED Indicators

Green Detect LED indicators display channel output status and output timing.

- "On" during detection indicates that a vehicle is being detected
- "Flash" indicates that timing is active during delay or extension (with timing option) or direction detection
- Continuous "on" indicates fault condition exists

Red Fault LED indicators display coded messages of current or historical fault status and failure type.

- One long and one short pulse indicates a current open loop
- One long and two short pulses indicate a current shorted loop
- One long and three short pulses indicate current excess inductance change ($\Delta L \geq 25\%$)
- A 5-second long pulse followed by the flash code for a fault indicates historical fault status

Power LED

- Indicates power is applied to the unit

Comm Port Activity LEDs

- Rapidly flashing LED indicates data transmission
- COM 1 LED indicates front port communication
- COM 2 LED indicates rear port communication
- A 1-Hz flash by either LED indicates synchronization faults

Environmental

Temperature: -29° F (-34° C) to +165° F (+74° C)
Humidity: 5% to 95% (non-condensing)
Electrical: 10.8 VDC to 37.8 VDC
≤50 milliamperes/channel at 24 VDC
110 milliamperes/unit typical at 12 VDC
55 milliamperes/unit typical at 24 VDC

Physical Dimensions

Net Weight: (C922) 4.2 oz. (181 g)
(C924) 7.8 oz. (220 g)
Width: (C922) 1.13 in. (2.87 cm)
(C924) 1.91 in. (4.86 cm)
Height PC board: 4.5 in. (11.43 cm)
Face plate: 4.5 in. (11.43 cm)
Depth: 7.1 in. plus .55 in. for handle
(18 cm plus 1.4 cm for handle)

Canoga™ C900 Configuration Software

Canoga™ C900 Configuration Software is a matched component of the Canoga™ Vehicle Detection System. The configuration software can be run on both PCs and handheld devices. It uses communication ports to access Canoga™ C922 and C924 Vehicle Detectors to read and change configuration settings, for disturbance or fault identification and verification, to monitor real-time activity, and to retrieve binned traffic data.

Configuration of Canoga C922 and C924

Canoga C900-CS is used to completely configure Canoga C922 and C924 using the TIA232 serial port. The following parameters can be programmed per channel:

- Sensitivity/mode and operating frequency
- Delay or extend time
- Adapt parameters per channel: background adapt rate, recovery method, wash delay time, wash adapt rate
- Traffic sensor parameters
- Long loop counting parameters
- Directional vehicle detection parameters
- Detect LED, call output, fault LED and status output can be forced "on" or "off"
- Configure channel for traffic count and occupancy data selection

Canoga C900-CS is also used to set all other detector parameters:

- Field modem parameters
- Programmable address and password of detector
- Front and rear communication ports
- Synchronization mode
- Vehicle count period
- State of outputs for fault conditions
- Three types of noise filtering
- Pulse rephase time
- Configure schedule for traffic count and occupancy data collection

Applications

Real-time Activity Monitoring

The real-time activity monitoring application allows a traffic engineer to monitor detector activity in real-time from a remote location. The following parameters can be monitored: loop measurements (loop status, loop inductance, loop frequency, reference frequency), last fault or disturbance (type, time and date of occurrence), last vehicle (inductance change, duration of detection, and time and date of detection) and count (vehicle count, directional count and period remaining).

Traffic Data Binning

Traffic data binning retrieves the binned data collected in the vehicle detector memory. Binned vehicle count and occupancy can be viewed by date and time for each channel. Since overall memory is limited in size, setting the end time to "indefinite" or too far into the future will eventually fill the memory of the detector. In this case, the first data collected will be replaced by new data. If longer binning duration is required, the Canoga™ 848 Memory Module is available as an option to increase the memory size.

The table below illustrates the binning duration depending on the indicated binning interval.

	Binning Interval	Onboard Memory	Memory Module
Two Channel	1 Minute	42 Hours	180 Hours
	15 Minutes	26 Days	112 Days
Four Channel	1 Minute	21 Hours	90 Hours
	15 Minutes	13 Days	56 Days

Real-time Vehicle Logging

Canoga C900-CS receives data from the vehicle detector serial port and displays the information in real-time. Users may select which channel to log and can enter location-specific descriptions. The following parameters are displayed in real-time calculated by Canoga C900-CS: vehicle speed, detection duration, loop duration and vehicle length. The real-time data may be stored in a file on a disk or printed for later analysis.

Directional Vehicle Travel Detection

Canoga C900-CS can configure Canoga C922 and C924 for detection of vehicle travel direction. Two overlapping inductive loops are connected to either channels 1 and 2 (Canoga C922 or C924) or 3 and 4 (Canoga C924 only). The travel direction of a vehicle is identified by the directional vehicle count and the directional call in either the first or second channel of the channel pair, depending on the channel chosen for direction detection.

Long Loop Counting

Canoga C900-CS can be used to remotely retrieve long loop counting information from Canoga C922 and C924.

Canoga™ C922 and C924 Vehicle Detector Options

Canoga™ 848 Memory Module

The Canoga™ 848 Memory Module is an optional accessory for Canoga™ C922 and C924 Vehicle Detectors and expands the memory used for traffic data binning. This module increases the standard available binning memory from 16KB to 64KB.

Canoga™ 832 Communication Module

The Canoga™ 832 Communication Module changes the rear TIA485 port to a TIA232 port. The Canoga 832 module cannot be used when a Canoga 848 module is installed, and vice versa.

Canoga™ C922 AND C924 Vehicle Detector Board Edge Connector Terminations

Pin	Function	C922	C924	Pin	Function	C922	C924
A	Common of +24VDC	•	•	1	Synchronize Conductor 1	•	•
B	+24VDC (+10.8VDC to 38VDC)	•	•	2	Synchronize Conductor 2	•	•
C	RESET External	•	•	3	NC		
D	Channel 1 Loop Input A	•	•	4	Channel 1 Redundant Loop Input A	•	•
E	Channel 1 Loop Input B	•	•	5	Channel 1 Redundant Loop Input B	•	•
F	Channel 1 Switch Output (C)	•	•	6	NC		
H	Channel 1 Switch Output (E)	•	•	7	Channel 1 Disturbance Signal (OC)	•	•
J	Channel 2 Loop Input A	•	•	8	Channel 2 Redundant Loop Input A	•	•
K	Channel 2 Loop Input B	•	•	9	Channel 2 Redundant Loop Input B	•	•
L	PE (Protective Earth)	•	•	10	NC		
M	NC			11	NC		
N	NC			12	NC		
P	Channel 3 Loop Input A		•	13	Channel 3 Redundant Loop Input A		•
R	Channel 3 Loop Input B		•	14	Channel 3 Redundant Loop Input B		•
S	Channel 3 Switch Output (C)		•	15	NC		
T	Channel 3 Switch Output (E)		•	16	Channel 3 Disturbance Signal (OC)		•
U	Channel 4 Loop Input A		•	17	Channel 4 Redundant Loop Input A		•
V	Channel 4 Loop Input B		•	18	Redundant Loop Input B		•
W	Channel 2 Switch Output (C)	•	•	19	EIA-485-A [RS-232 TX (M832 Option)]	•	•
X	Channel 2 Switch Output (E)	•	•	20	Channel 2EIA Disturbance Signal (OC)	•	•
Y	Channel 4 Switch Output (C)		•	21	EIA-485-B [RS-232 RX (M832 Option)]	•	•
Z	Channel 4 Switch Output (E)		•	22	Channel 4 EIA Disturbance Signal (OC)		•
	Shaded means this model has no connection to this pin.						

(E): Emitter of Opto-coupler (C): Collector of Opto-coupler (OC): Open Collector/Open Drain NC = No Connection
Pins 1 through 22 are on the top (component) side and pins A through Z are 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.

Important Notice to Purchaser:

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Global Traffic Technologies

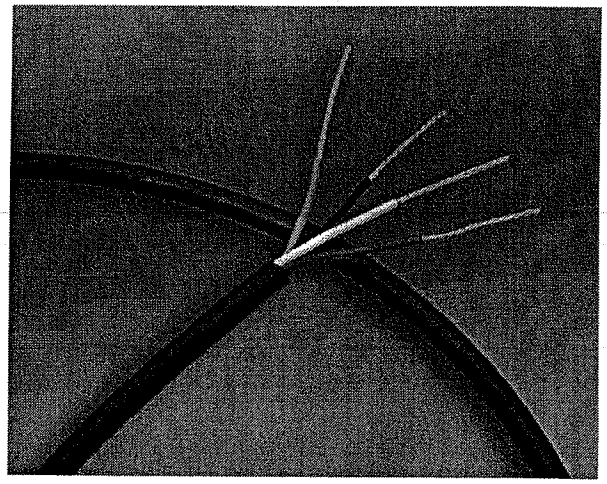
Canoga™ Traffic Sensing System

Canoga™ 30003 Home-run Cable

A Matched Component of the Canoga™ Traffic Sensing System **October 2007**

Description

Canoga™ 30003 Home-run Cable is a small-diameter, shielded, four-conductor, controlled capacitance cable designed for interconnecting Canoga™ 702 Non-invasive Microloop™ Sensors, Canoga™ 701 Microloop™ Sensors or inductive loops to Canoga™ Traffic Monitoring Cards or Canoga™ C900 Series Vehicle Detectors. The cable has four #18 AWG colored-coded conductors. The conductors are spirally laid and enclosed in an aluminized polyester shield, which is located inside a polyethylene jacket. The black, high-density polyethylene jacket provides excellent chemical resistance and mechanical protection, and the interior of the cable is filled with a water-blocking material. Low cable inductance and stable inter-lead capacitance makes long runs possible with little or no sensitivity loss.



Canoga™ 30003 Home-run Cable is less than 1/4-inch (0.6 cm) in diameter and can be used in conduit, direct burial or sawslot installations.

Features and Benefits

- **Small size:** Four-conductor cable of less than 1/4-inch (0.6 cm) diameter. Reduced space requirements for conduit or sawslot installations optimizes installation cost economies.
- **Chemical resistant and waterproof:** UV stable, black, high-density polyethylene jacket rated to exceed 600 volts. Permits direct burial—ideal for advanced detection applications—or conduit installations.
- **Shielded:** Aluminized polyester shield protects against electromagnetic interference.
- **Waterblocked:** Cable interior is filled with a water-blocking material that prevents moisture penetration. Permits direct burial.
- **Stable inter-lead capacitance:** Maximizes performance with vehicle detectors.
- **Low cable inductance:** Long home-run distance—up to 2,500 feet (762 m) from Canoga Microloop sensors to Canoga C900 series detectors. Reduces need for additional cabinets.
- **Four conductors:** Permits connection of two Canoga Microloop sensors per Canoga 30003, reducing number of cables.

Operating Parameters

- **Dialectric:** Withstands voltage strength exceeding 600V per UL 83 section 36.
- **Inductance:** Approximately 23 mH/100 feet (23 mH/30.5 m) for diagonal pairs.
- **Capacitance:**
  Adjacent pairs: 30 pf/foot (30 pf/30.5 cm) with all others disconnected.
  Diagonal pairs: 27 pf/foot (27 pf/30.5 cm) with all others disconnected.
- **High-Density Polyethylene Jacket:** Nominal thickness 0.032 inches (0.81 mm).
- **Four Conductors:** AWG #18 stranded copper with color-coded, polypropylene insulation, twisted six turns/foot (six turns/30.5 cm). Color rotation is black, red, white and green.
- **Waterblocked:** Amorphous interior moisture-penetration barrier prevents hosing, siphoning or capillary absorption of water along cable interstices.
- **Stable Electrical Characteristics:** Suitable for prolonged exposure to temperature in extreme environmental range of -65° F to +176° F (-60° C to +80° C).

Physical

- **Outside Diameter:** Less than 0.25 inches (6.4 mm).
- **Shipping Weight:** Approximately 40 lbs./1,000 feet (19.9 kg/1205 m).

Packaging

- Available in 1,000-foot (305 m) and 2,500-foot (762 m) spools.

Recommended Wiring

Electrical connections should be soldered, insulated and waterproofed. Connection to the shield is generally not necessary. The 3M™ Scotchcast™ 3832 Buried Service Wire Splice Installation Kit is recommended for reliable interconnection to Canoga™ Microloop™ Sensors.

Related Products or Accessories

The Canoga™ 30003 Home-run Cable is a matched component of the Canoga™ Traffic Sensing System that consists of the following components:

- Canoga™ 702 Non-invasive Microloop™ Sensors and installation components
- Canoga™ 701 Microloop™ Sensors
- Canoga™ 30003 Home-run Cable
- Canoga™ Traffic Monitoring Cards
- Canoga™ TMC Configuration Software
- Canoga™ C900 Series Vehicle Detectors
- Canoga™ C900 Configuration Software

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3M

Canoga™
Vehicle Detection System
Non-invasive Microloop Model 702

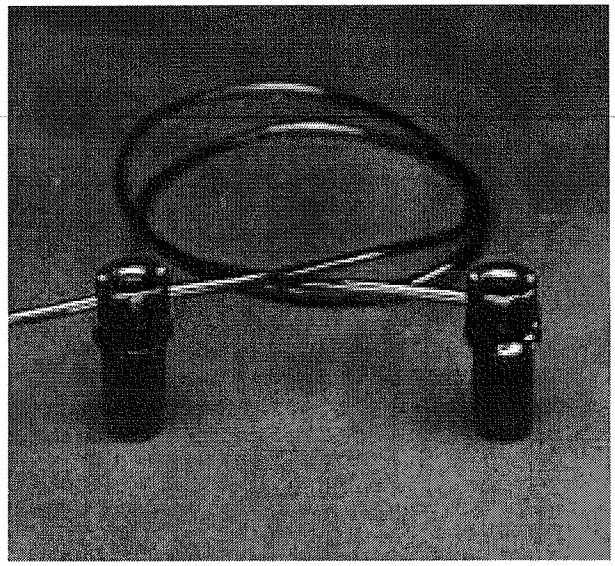
A Canoga™ System Matched Component Product

Description

The 3M™ Canoga™ Non-invasive Microloop Vehicle Detection System consists of the following matched components: Model 702 non-invasive microloop probes and carriers, installation kit, Canoga vehicle detectors, and home-run cables required to install the non-invasive microloop.

The non-invasive microloop probe is a transducer that converts changes in the vertical component of the earth's magnetic field to changes in inductance. Vehicles containing vertical components of ferromagnetic material "focus" the earth's field, increasing the magnetic field at the sensor when the vehicle moves over the sensor. Changes in inductance can be sensed by a Canoga vehicle detector suitably configured for the non-invasive microloop.

The non-invasive microloop probe's small size permits its easy insertion into a three inch plastic conduit installed 18-24 inches below the road surface. Installing the sensors in a conduit leaves the road surface intact, bypasses the effects of poor pavement conditions, and virtually eliminates the maintenance and service requirements of conventional loops.



— Model 702

Features

The non-invasive microloop vehicle detection technology offers superior value compared to other loop-based systems. Replaces 6x6 loops in freeway monitoring and advance detection applications. Provides speed measurements, counting, occupancy and length classification when connected to a Canoga vehicle detector.

A single probe centered under a lane will detect most vehicles. Two or more probes with a three to four foot spacing are recommended to detect small motorcycles and bicycles.

- **Superior Value**
  - — Lower life cycle costs.
  - — Lower loop maintenance costs. Maintenance and repair are virtually eliminated. The buried probes and cables are not affected by environmental factors, pavement deterioration or other mechanical stresses.
  - — Lower pavement repair and maintenance costs; the road surface is not damaged.
  - — Better installation efficiency; traffic lanes are not closed for long periods of time.
  - — Better repair efficiency; resurfacing and surface repairs can occur without affecting detection performance.
- **Flexibility**
  - — Connect up to four (4) probes to the same lead. Easily reposition or readjust probe placement to improve vehicle sensing accuracy or to reflect changing traffic characteristics in permanent installations or work zones.
- **Easy to Use**
  - — Permits conventional, horizontal directional drilling techniques or open trenching for installation.
- **Small Size**
  - — Probes fit into specially designed carriers. Carriers can be inserted in less than an hour into a three-inch Schedule 80 conduit installed 18-24 inches below the road surface.
- **Accurate**
  - — Can resolve closely spaced vehicles and reject adjacent lane vehicles; the unique magneto-inductive operating characteristics improve count accuracy.

Operating Parameters

—Earth's Vertical Magnetic Field . . . 0.2 to 0.8 Oersted.

—Inductance (Red to Green wires) . . . 50-63 microHenries per probe plus a nominal 16.5 microHenries per 100 feet of lead-in cable.

—DC Resistance (Red to Green wires) . . . 1.2 ohms - 1.8 ohms per probe plus a nominal 3.04 ohms per 100 feet of lead-in cable.

—Transducer Gain (Sensitivity) . . . Typically 5.0 nanoHenries per millioersted per probe at 0.4 Oersted ambient vertical field intensity.

—Non-invasive Microloop Assemblies . . . Available in single, double, triple or quadruple probe assemblies with specified probe separations and connected in series to a lead-in cable which may be up to 1000 feet in length.

—Home-run Cable . . . Model 30003 is used to connect the lead-in cable to the cabinet. The combined length of the home-run cable and the lead-in cable may be as long as 2500 feet.

—Maximum Number of Probes per Channel . . . up to four probes are recommended per channel.

—Microloop Peak-to-Peak Drive Current with Canoga vehicle detector . . . The detector must provide between 14 and 80 milliAmp$_{p\text{-}p}$.

Installation

The non-invasive microloop assemblies are designed to be inserted into a three-inch non-ferrous Schedule 80 conduit.

Conduit is installed 21 ±3 inches below the road surface using horizontal directional drilling or open trenching techniques.

(see Installation Instructions for further information)

Wiring

Multiple non-invasive microloop probe sets can be wired in series to accommodate different applications. Two independent probe sets can be connected to a single Model 30003 home-run cable. For reliable operation, all splices must be soldered, insulated and waterproofed. See Model 702 Installation Instructions for detailed wiring instructions.

Environmental

—Temperature Range . . . -30° F to +165° F (-34° C to +74° C).

—Humidity . . . To 100% relative humidity including submersion in chemical solutions typical of roadway runoff.

Physical Characteristics

—Probe . . . Cylindrical shape 2 1/4 inches high, fitting a 13/16 inch hole in the carrier.

—Lead-in Cable . . . Polyurethane-jacketed cable with two PVC insulated AWG #22 conductors and an overall diameter 0.19 inches.

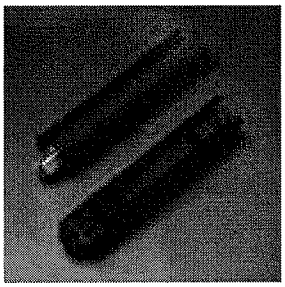
—Color . . . Black probe and black, jacketed lead-in cable with red and green insulated wires.

Related Products

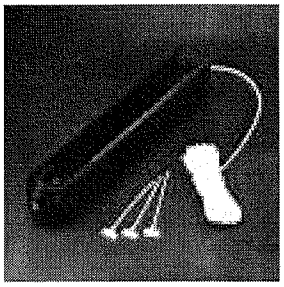
Model 702 Carrier

Model 702 carriers hold the non-invasive microloop probes in a fixed, vertical position as they are inserted into the previously installed, three-inch conduit. The interlocking mechanism of the carriers maintains the alignment of the probes within ±20 degrees from vertical.

—Physical Dimensions of the Carrier . . . 12 inch long PVC probe carrier with an outer diameter of 2.6 inches.



Model 702 Carrier



Model 702 Installation Kit

Model 702 Installation Kit

One installation kit is required for each conduit. The kit contains all the parts necessary to insert and remove the probes, to label probe cables and to close off the conduit ends.

—Physical Dimensions of End Cap Carrier . . . The end cap carrier is PVC tubing 13 inches long and 2.6 inches in diameter. The end cap carrier is the first piece to be inserted into the conduit. It has a rope attached to it that permits removal of the installed non-invasive microloop assembly.

Consult the Installation Instructions to install the conduit and the Model 702 non-invasive microloop probes using the Model 702 carriers.

3M Scotchcast™ 3832 Buried Service Wire Splice Installation Kit

Scotchcast 3832 is recommended for splicing the lead-in cable with the home-run cable. This wire splice installation kit assures a reliable connection in the environments encountered by the non-invasive microloop.

Canoga™ C800 Series Vehicle Detector

Canoga C800 vehicle detectors are recommended. Consult Canoga system product literature for detailed specifications.

Model 30003 Home-run Cable

Home-run cable is recommended for all home runs, especially those exceeding 500 feet.

Important Notice to the Purchaser

THE FOLLOWING IS MADE IN LIEU OF ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING THE IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE:

3M will, at its option, either repair or replace any 3M™ Canoga™ Vehicle Detection System component or components found to be defective in materials or manufacture within five (5) years from date of purchase provided the component has been installed, maintained, and used as instructed. This warranty does not apply to components that have been subjected to misuse, neglect or accident or that have been damaged by extreme atmospheric or weather-related conditions, including chemical corrosion, hail, windstorm, lightning or flooding.

In no event shall 3M be liable for any injury, loss, or damage, whether direct, indirect, incidental or consequential, arising out of the use or inability to use the Canoga system or any component thereof. THE REMEDIES SET FORTH HEREIN ARE EXCLUSIVE.

3M

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