

# PS-175B

## Heavy Duty Rack Power Supply

**The ideal power source when using high current devices such as video detection cards.**

The PS-175B Rack Power Supply is a rack mounted high efficiency switching power supply that provides regulated 24 VDC power for a Nema TS-1 Detector Rack. The PS-175B meets or exceeds all requirements of the NEMA Standard TS-1 1989 R2005.

Each EDI PS-175B Cabinet Power Supply is put through a rigorous three part Total Quality Assurance program and tested under the extreme environmental conditions experienced on the street. It is this commitment to quality and performance that EDI products are known for, providing years of trouble free operation.

- **PS175B:** 24Vdc @ 3 Amps

### PS-175B OPERATIONAL FEATURES

**Basic Functions:** The PS-175B provides a regulated output rated at 3 Amps over the full -30°F to 165°F (-34°C to +74°C) Nema operating temperature range.

- ☒ 3 Amp Maximum Load Current
- ☒ Full Output Regulation: 24 Vdc +/- 2 Vdc
- ☒ Four DC Output pins are common
- ☒ Input and Output Fused

**Display Indicators:** Separate green LED indicators are provided to display input and output status and fuse integrity.

**Output Protection:** The output is fused for over-current protection and protected against voltage transients by a 1500 Watt suppressor.

**Input Voltage Operating Range:** 89 Vac to 270 Vac at 50 / 60 Hz

**Input / Output Pins:**

Pin	Pin	Function
A	1	DC Ground
B	2	DC Output
C	3	DC Output
L	10	Chassis Ground
M	11	AC Neutral
N	12	AC Line
U	17	DC Output
V	18	DC Output

**Power Switch:** Switches AC power input

**Connector:** Double sided 44-pin with gold contact fingers

**Dimensions:** 4.5 inches High x 2 inches Wide x 6.875 inches Deep excluding handle

### EBERLE DESIGN INC.

3510 East Atlanta Avenue  
Phoenix, AZ 85040 USA  
www.EDITraffic.com

Tel (480) 968-6407  
Fax (602) 437-1998



DEFLECTOMETER



# LMD624T

## DEFLECTOMETER® SERIES

FOUR CHANNEL NEMA TS-2 TYPE D LOOP MONITOR

Built-in DEFLECTOMETER® Technology Provides Users With:

- ☒ Call Strength Indicator for Optimum Sensitivity Programming
- ☒ One step / One vehicle dynamic Sensitivity programming
- ☒ Frequency Meter for immediate analysis of loop frequency, avoiding loop cross-talk problems
- ☒ Push Button Programming

**Why guess when you can know your detector is optimally programmed and performing for all vehicle classes!**

### ENHANCED FEATURES

**DEFLECTOMETER Call Strength Indicator:** The *Call Strength Indicator* provides the technician with a simple one-step method for accurately setting the optimum level of sensitivity that ensures accurate vehicle detection of all vehicles, including motorcycles and high-bed trucks. **NO MORE GUESSING!**

When a medium size vehicle is over the roadway loop, a DEFLECTOMETER Call Strength value of "5" assures that the optimum sensitivity has been achieved. You can adjust the DEFLECTOMETER reading *DYNAMICALLY* without moving the vehicle by using the front panel UP or DOWN sensitivity buttons. **IT DOES NOT GET ANY EASIER THAN THIS!**

**Frequency Meter:** The built-in *Frequency Meter* reports the operating frequency of the loop network. Ensuring that adjacent loops are separated by at least 5 KHz will avoid crosstalk problems and future service calls.

**Delay and Extension Timing:** Delay and Extension Timing is provided for all four channels via PCB mounted DIP switches

**Output CALL Test Mode:** The Output Call Test Mode provides a straight forward way to test that the Controller Unit is receiving an active output from the detector. This eliminates the need for cabinet test switches and associated wiring. A huge time saving feature during system set-up and trouble-shooting.

**Advanced Loop Diagnostics:** The Fault (FLT) indicator displays the type of fault: Short, Open or 25% change of inductance. The Fault Monitor will report and store three types of loop faults; Open Loops, Shorted Loops, and 25% sudden changes in inductance. Each type of fault is indicated by a unique sequence of flashes allowing the user to diagnose loop failures at a glance.

**Delay and Extension Timing:** Delay and Extension timing functions are provided on all four channels.

### STANDARD FEATURES

- ☒ Automatic Tuning
- ☒ Lightning & Surge Protection
- ☒ Four (4) Frequency Levels
- ☒ Fail Safe Output Configuration
- ☒ Separate Color Coded LED indicators
- ☒ Wide Loop Inductance Range: 20 to 2500 micro Henries.

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3510 East Atlanta Avenue  
Phoenix, AZ 85040 USA  
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Tel (480) 988-6407  
Fax (602) 437-1996



# LMD624T DEFLECTOMETER SERIES FOUR CHANNEL INDUCTIVE LOOP VEHICLE DETECTOR SPECIFICATIONS

## General Characteristics

**Controls:** Front panel push buttons allow the user to set the Sensitivity Level, Operational mode, and nominal Frequency independently on each channel. PCB mounted DIP switches allow the user to set the Delay and Extension timers.

## Setting Sensitivity - Front Panel Push Buttons

The DEFLECTOMETER (front panel 7-segment LED) aids in setting the DETECTOR quickly and easily to the most optimum sensitivity level to ensure the trouble-free detection of all vehicles, including motorcycles and high bed vehicles. For typical vehicles (mid-size vehicle / small pick up) utilizing properly installed roadway loops, a Call Strength of 5 displayed on the DEFLECTOMETER during the DETECT output period indicates an optimum sensitivity setting. For high profile vehicles (commercial trucks, 4x4's, etc...), a Call Strength value of 4 will be optimum. For low profile vehicles (sports cars, etc...), a Call Strength value of 6 will be optimum.

## Adjusting sensitivity using the DEFLECTOMETER (recommended):

The DEFLECTOMETER should read zero (0) with no vehicle over the roadway loop. When a typical mid-sized vehicle is completely in the detection zone (DET indicator On), the Call Strength value should be adjusted up or down until the DEFLECTOMETER displays the desired optimum value of 5 (or 4 or 6 as described above).

If a typical vehicle located over the roadway loop causes the Call Strength "7" to be displayed on the DEFLECTOMETER, the sensitivity should be decreased two levels. This can be done by pressing the front panel SENS  $\blacktriangledown$  button two times to achieve the Call Strength value of 5.

If a typical vehicle located over the roadway loop causes the number "2" to be displayed on the DEFLECTOMETER, the sensitivity should be increased three levels. This can be done by pressing the front panel SENS  $\blacktriangle$  button three times to achieve the Call Strength value of 5.

**NOTE: THE DEFLECTOMETER CALL STRENGTH DYNAMICALLY UPDATES AFTER EACH SENSITIVITY LEVEL CHANGE, ALLOWING YOU TO CHANGE SENSITIVITY SETTINGS WHILE A VEHICLE REMAINS IN THE LOOP DETECTION ZONE.**

## Adjusting sensitivity without using the DEFLECTOMETER (manually setting sensitivity):

The DETECTOR offers 9 levels of sensitivity (1 to 9). Level 9 is the highest sensitivity. Sensitivity Level can be manually set to any desired value by pressing the front panel SENS buttons ( $\blacktriangle$  or  $\blacktriangledown$ ) when a vehicle is NOT over the roadway loop (DET indicator Off). The first time a SENS button ( $\blacktriangle$  or  $\blacktriangledown$ ) is pressed, the current Sensitivity Level is displayed on the DEFLECTOMETER for 3 seconds. If either SENS button ( $\blacktriangle$  or  $\blacktriangledown$ ) is pressed again before the 3 second period ends, the Sensitivity Level will increase (SENS  $\blacktriangle$ ) or decrease (SENS  $\blacktriangledown$ ). The new Sensitivity Level value will be displayed on the DEFLECTOMETER display for 3 seconds. The factory default Sensitivity setting is level 6.

Sensitivity	$\Delta L / L$	Sensitivity	$\Delta L / L$
9	0.01%	4	0.32%
8	0.02%	3	0.64%
7	0.04%	2	1.28%
6	0.08%	1	2.56%
5	0.16%	-	-

**Loop Frequency / Loop Frequency Display:** One of four frequency settings may be selected via the front panel FREQ push button to alleviate interference which may occur when loops connected to different detectors are located adjacent to one another. To help prevent or diagnose crosstalk problems, the loop frequency is displayed on the front panel DEFLECTOMETER. The current loop frequency is displayed after pressing the FREQ button to display the current Frequency Level. The frequency is shown in KHz with a "-" symbol displayed both before and after the numeric digits shown on the DEFLECTOMETER.

For example, after pressing the FREQ button once the display sequence might show:

"3"  $\Rightarrow$  "-"  $\Rightarrow$  "2"  $\Rightarrow$  "7"  $\Rightarrow$  "-"

This sequence would indicate Frequency Level "3" and a loop reference frequency of 27 KHz. Detectors on adjacent loops should all be separated by at least 5 KHz.

**Loop Fault Monitoring:** The Detector continuously checks the integrity of the loop. The system is able to detect shorted or open circuit loops, or sudden changes in inductance exceeding 25% of the nominal inductance. If a fault is detected, the OUT and FLT indicators continuously emit a sequence of flashes. Additionally, the DEFLECTOMETER displays the letter "F" indicating a current loop fault. Each type of fault is identified by a unique flash sequence:

Flash Sequence	Fault
1 flash	Open Circuit Loop.
2 flashes	Shorted Circuit Loop.
3 flashes	25% excessive change in inductance.

If the Open or Shorted fault condition self heals, the DET indicator and DEFLECTOMETER will return to normal operation. The FLT indicator will continue to flash with the sequence signifying the type of fault that was last detected. In the case of the excessive inductance change fault, the unit will return to the new inductance after a period of two seconds and continue operation. The fault condition will be indicated by the flash sequence of the FLT indicator.

## Operational Modes

**Presence:** For each channel, a Presence output mode may be selected from the front panel MODE push button. If Presence mode is selected then a choice of short (S) or long (L) can be selected. Short Presence is defined as 30 minutes and Long Presence is defined as 120 minutes.

**Pulse:** For each channel, a Pulse output mode (P) may be selected from the front panel MODE push button. In Pulse mode, a 125 ms  $\pm$  25ms width pulse will be output for each vehicle entering the loop.

**Call:** For each channel, a continuous CALL output (C) may be selected from the front panel MODE push button which will simulate the presence of a vehicle. This mode is used for testing the CALL output of a channel.

**Channel Off:** For each channel, the Channel Off (-) may be selected from the front panel Mode push button. This option turns OFF the channel and disables the oscillator. An additional option allows the Status Output to be turned ON while the channel is OFF.

## Selectable Options:

**Call Delay Timer for Presence & Pulse Modes:** For each channel, a delay time of 1 to 63 seconds may be selected by setting the appropriate PCB mounted DIP switches to the ON position. Call Delay time starts counting down when a vehicle enters the loop detection area. During the Delay time the DET indicator will flash two times per second and the DEFLECTOMETER will display the letter "d". Delay time can be overridden by a True (low) signal at the Timer Control input.

**Call Extension Timer for Presence Mode:** For each channel, an extend time of 0.25 to 15.75 seconds can be set via the EXTEND DIP switches. The numeric sum of the switches in the On position is equal to the Extend time. Two modes are provided:

**Extend Always (default):** Call Extend time starts counting down when the last vehicle clears the loop detection zone. During the Extend time the DET indicator will flash four times per second and the DEFLECTOMETER will display the letter "E". Any vehicle entering the loop detection zone during the Extend time period causes the Extend timer to be reset and the output maintained. The Timer Control input has no effect on this mode.

## Extend on Green (EOG)

Call Extend time starts counting down when the last vehicle clears the loop detection zone if the Timer Control input is True (low). During the Extend time the DET indicator will flash four times per second and the DEFLECTOMETER will display the letter "E". Any vehicle entering the loop detection zone during the Extend time period causes the Extend timer to be reset and the output maintained.

The Extend on Green mode is enabled by a factory installed jumper located at E6 on the pcb. Consult the factory for details.

**Timer Control Inputs:** Timer Control inputs are provided for each channel to modify the operation of the Delay and Extension functions. The application of a True (low) state voltage will inhibit the Delay timing function and/or enable the Extend timing function. Timer Control inputs are primarily provided for downward compatibility.

## Pin Assignment:

PIN	FUNCTIONS	PIN	FUNCTIONS
A	Logic Ground	1	Ch 1 Timer Control Input
B	DC Supply	2	Ch 2 Timer Control Input
C	Ext. Reset	3	Ch 3 Timer Control Input
D	Ch 1 Loop Input	4	Ch 1 Redundant Loop Input
E	Ch 1 Loop Input	5	Ch 1 Redundant Loop Input
F	Ch 1 Output (+)	6	Reserved
H	Ch 1 Output (-)	7	Ch 1 Status Output
J	Ch 2 Loop Input	8	Ch 2 Redundant Loop Input
K	Ch 2 Loop Input	9	Ch 2 Redundant Loop Input
L	Chassis Ground	10	Ch 4 Timer Control Input
M	Reserved	11	Reserved
N	Reserved	12	Reserved
P	Ch 3 Loop Input	13	Ch 3 Redundant Loop Input
R	Ch 3 Loop Input	14	Ch 3 Redundant Loop Input
S	Ch 3 Output (+)	15	Reserved
T	Ch 3 Output (-)	16	Ch 3 Status Output
U	Ch 4 Loop Input	17	Ch 4 Redundant Loop Input
V	Ch 4 Loop Input	18	Ch 4 Redundant Loop Input
W	Ch 2 Output (+)	19	Reserved
X	Ch 2 Output (-)	20	Ch 2 Status Output
Y	Ch 4 Output (+)	21	Reserved
Z	Ch 4 Output (-)	22	Ch 4 Status Output

**DC Supply Voltage:** Minimum.....10.8 Vdc  
Maximum.....28.8 Vdc

**DC Supply Current:** Maximum.....100 mA

**DC Timer Control Inputs:** True (low).....Less than 8 Vdc  
False (high).....Greater than 16 Vdc

**Optical Isolated Outputs:** True (low, 50 mA).....Less than 1.5 Vdc  
Maximum Current.....100 mA

Outputs are fail-safe such that a Detector with no power will provide the True (low) Call state.

**Environmental:** Operating Temperature Range: -30°F to 165°F (-34°C to 74°C)

**Mechanical:** International Card with 44 pin double sided edge connector

Height.....4.5" (114.3mm)  
Width.....2.34" (59.4mm)  
Depth (excluding handle).....6.875" (174.6mm)

## Status Outputs:

Each channel includes a separate output which is used to transmit operational status information to a bus interface unit (BIU). Fault information is transmitted by means of pulse-width modulation. Pulse widths shown are +10ms.

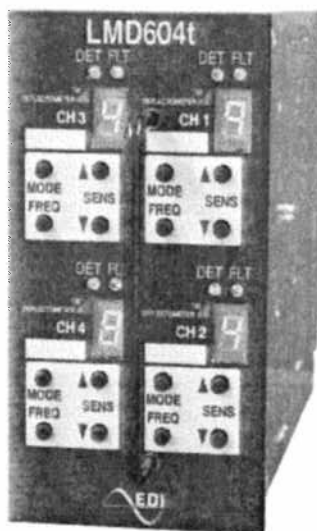
Status	Status Output Condition
Normal operation / No fault.....	Continuous ON (low)
Watchdog fail / Power Supply fail.....	Continuous OFF (high)
Open circuit loop.....	50ms OFF, 50ms ON
Short circuit loop.....	100ms OFF, 50ms ON
25% change in inductance.....	150ms OFF, 50ms ON

DEFLECTOMETER

# LMD604T

## DEFLECTOMETER® SERIES

FOUR CHANNEL NEMA TS-1 LOOP MONITOR



Built-in DEFLECTOMETER® Technology Provides Users With:

- ☒ Call Strength Indicator for Optimum Sensitivity Programming
- ☒ One step / One vehicle dynamic Sensitivity programming
- ☒ Frequency Meter for immediate analysis of loop frequency, avoiding loop cross-talk problems
- ☒ Push Button Programming

*Why guess when you can know your detector is optimally programmed and performing for all vehicle classes!*

### ENHANCED FEATURES

- DEFLECTOMETER Call Strength Indicator:** The *Call Strength Indicator* provides the technician with a simple one-step method for accurately setting the optimum level of sensitivity that ensures accurate vehicle detection of all vehicles, including motorcycles and high-bed trucks. **NO MORE GUESSING!** When a medium size vehicle is over the roadway loop, a DEFLECTOMETER Call Strength value of "5" assures that the optimum sensitivity has been achieved. You can adjust the DEFLECTOMETER reading *DYNAMICALLY* without moving the vehicle by using the front panel UP or DOWN sensitivity buttons. **IT DOES NOT GET ANY EASIER THAN THIS!**
- Frequency Meter:** The built-in *Frequency Meter* reports the operating frequency of the loop network. Ensuring that adjacent loops are separated by at least 5 KHz will avoid crosstalk problems and future service calls.
- Delay and Extension Timing:** Delay and Extension Timing is provided for all four channels via PCB mounted DIP switches
- Output CALL Test Mode:** The Output Call Test Mode provides a straight forward way to test that the Controller Unit is receiving an active output from the detector. This eliminates the need for cabinet test switches and associated wiring. A huge time saving feature during system set-up and trouble-shooting.
- Advanced Loop Diagnostics:** The Fault (FLT) indicator displays the type of fault: Short, Open or 25% change of inductance. The Fault Monitor will report and store three types of loop faults; Open Loops, Shorted Loops, and 25% sudden changes in inductance. Each type of fault is indicated by a unique sequence of flashes allowing the user to diagnose loop failures at a glance.

### STANDARD FEATURES

- ☒ Delay & Extension Timing on All Four Channels
- ☒ Automatic Tuning
- ☒ Lightning & Surge Protection
- ☒ Four (4) Frequency Levels
- ☒ Separate Color Coded LED indicators
- ☒ Wide Loop Inductance Range: 20 to 2500 micro Henries.

EBERLE DESIGN INC.

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Phoenix, AZ 85040 USA  
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Tel (480) 968-6407  
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# LMD604T DEFLECTOMETER® SERIES FOUR CHANNEL INDUCTIVE LOOP VEHICLE DETECTOR SPECIFICATIONS

## General Characteristics

**Controls:** Front panel push buttons allow the user to set the Sensitivity Level, Operational mode, and nominal Frequency independently on each channel. PCB mounted DIP switches allow the user to set the Delay and Extension timers.

## Setting Sensitivity - Front Panel Push Buttons

The DEFLECTOMETER® (front panel 7-segment LED) aids in setting the DETECTOR quickly and easily to the most optimum sensitivity level to ensure the trouble-free detection of all vehicles, including motorcycles and high bed vehicles. For typical vehicles (mid-size vehicle / small pickup) utilizing properly installed roadway loops, a Call Strength of 5 displayed on the DEFLECTOMETER® during the DETECT output period indicates an optimum sensitivity setting. For high profile vehicles (commercial trucks, 4x4's, etc...), a Call Strength value of 4 will be optimum. For low profile vehicles (sports cars, etc...), a Call Strength value of 6 will be optimum.

## Adjusting sensitivity using the DEFLECTOMETER® (recommended):

The DEFLECTOMETER® should read zero (0) with no vehicle over the roadway loop. When a typical mid-sized vehicle is completely in the detection zone (DET indicator On), the Call Strength value should be adjusted up or down until the DEFLECTOMETER® displays the desired optimum value of 5 (or 4 or 6 as described above).

If a typical vehicle located over the roadway loop causes the Call Strength "7" to be displayed on the DEFLECTOMETER®, the sensitivity should be decreased two levels. This can be done by pressing the front panel SENS ⬇ button two times to achieve the Call Strength value of 5.

If a typical vehicle located over the roadway loop causes the number "2" to be displayed on the DEFLECTOMETER®, the sensitivity should be increased three levels. This can be done by pressing the front panel SENS ⬆ button three times to achieve the Call Strength value of 5.

**NOTE: THE DEFLECTOMETER® CALL STRENGTH DYNAMICALLY UPDATES AFTER EACH SENSITIVITY LEVEL CHANGE, ALLOWING YOU TO CHANGE SENSITIVITY SETTINGS WHILE A VEHICLE REMAINS IN THE LOOP DETECTION ZONE.**

## Adjusting sensitivity without using the DEFLECTOMETER® (manually setting sensitivity):

The detector offers 9 levels of sensitivity (1 to 9). Level 9 is the highest sensitivity. Sensitivity Level can be manually set to any desired value by pressing the front panel SENS buttons (⬆ or ⬇) when a vehicle is NOT over the roadway loop (DET indicator Off). The first time a SENS button (⬆ or ⬇) is pressed, the current Sensitivity Level is displayed on the DEFLECTOMETER® for 3 seconds. If either SENS button (⬆ or ⬇) is pressed again before the 3 second period ends, the Sensitivity Level will increase (SENS ⬆) or decrease (SENS ⬇). The new Sensitivity Level value will be displayed on the DEFLECTOMETER® display for 3 seconds. The factory default Sensitivity setting is level 6.

Sensitivity	ΔL / L	Sensitivity	ΔL / L
9	0.01%	4	0.32%
8	0.02%	3	0.64%
7	0.04%	2	1.28%
6	0.08%	1	2.56%
5	0.16%	-	-

**Loop Frequency / Loop Frequency Display:** One of four frequency settings may be selected via the front panel FREQ push button to alleviate interference which may occur when loops connected to different detectors are located adjacent to one another. To help prevent or diagnose crosstalk problems, the loop frequency is displayed on the front panel DEFLECTOMETER®. The current loop frequency is displayed after pressing the FREQ button to display the current Frequency Level. The frequency is shown in KHz with a "-" symbol displayed both before and after the numeric digits shown on the DEFLECTOMETER®.

For example, after pressing the FREQ button once the display sequence might show:

"3" ⇒ "-" ⇒ "2" ⇒ "7" ⇒ "-"

This sequence would indicate Frequency Level "3" and a loop reference frequency of 27 KHz. Detectors on adjacent loops should all be separated by at least 5 KHz.

**Loop Fault Monitoring:** The Detector continuously checks the integrity of the loop. The system is able to detect shorted or open circuit loops, or sudden changes in inductance exceeding 25% of the nominal inductance. If a fault is detected, the OUT and FLT indicators continuously emit a sequence of flashes. Additionally, the DEFLECTOMETER® displays the letter "F" indicating a current loop fault. Each type of fault is identified by a unique flash sequence:

Flash Sequence	Fault
1 flash	Open Circuit Loop.
2 flashes	Shorted Circuit Loop.
3 flashes	25% excessive change in inductance.

If the Open or Shorted fault condition self heals, the DET indicator and DEFLECTOMETER® will return to normal operation. The FLT indicator will continue to flash with the sequence signifying the type of fault that was last detected. In the case of the excessive inductance change fault, the unit will return to the new inductance after a period of two seconds and continue operation. The fault condition will be indicated by the flash sequence of the FLT indicator.

## Operational Modes

**Presence:** For each channel, a Presence output mode may be selected from the front panel MODE push button. If presence mode is selected then a choice of short (S) or long (L) can be selected. Short Presence is defined as 30 minutes and Long Presence is defined as 120 minutes.

**Pulse:** For each channel, a Pulse output mode (P) may be selected from the front panel MODE push button. In Pulse mode, a 125 ms ± 25ms width pulse will be output for each vehicle entering the loop.

**Call:** For each channel, a continuous CALL output (C) may be selected from the front panel MODE push button which will simulate the presence of a vehicle. This mode is used for testing the CALL output of a channel.

**Channel Off:** For each channel, the Channel Off (-) may be selected from the front panel Mode push button. This option turns OFF the channel and disables the oscillator. An additional option allows the Status Output to be turned ON while the channel is OFF.

## Selectable Options:

**Call Delay Timer for Presence & Pulse Modes:** For each channel, a delay time of 1 to 63 seconds may be selected by setting the appropriate PCB mounted DIP switches to the ON position. Call Delay time starts counting down when a vehicle enters the loop detection area. During the Delay time the DET indicator will flash two times per second and the DEFLECTOMETER® will display the letter "d". Delay time can be overridden by a True (low) signal at the Timer Control input.

**Call Extension Timer for Presence Mode:** For each channel, an extend time of 0.25 to 15.75 seconds can be set via the EXTEND DIP switches. The numeric sum of the switches in the On position is equal to the Extend time. Two modes are provided:

**Extend Always (default):** Call Extend time starts counting down when the last vehicle clears the loop detection zone. During the Extend time the DET indicator will flash four times per second and the DEFLECTOMETER® will display the letter "E". Any vehicle entering the loop detection zone during the Extend time period causes the Extend timer to be reset and the output maintained. The Timer Control input has no effect on this mode.

## Extend on Green (EOG)

Call Extend time starts counting down when the last vehicle clears the loop detection zone if the Timer Control input is True (low). During the Extend time the DET indicator will flash four times per second and the DEFLECTOMETER® will display the letter "E". Any vehicle entering the loop detection zone during the Extend time period causes the Extend timer to be reset and the output maintained.

The Extend on Green mode is enabled by a factory installed jumper located at E6 on the pcb. Consult the factory for details.

**Timer Control Inputs:** Timer Control inputs are provided for each channel to modify the operation of the Delay and Extension functions. The application of a True (low) state voltage will inhibit the Delay timing function and/or enable the Extend timing function. Timer Control inputs are primarily provided for downward compatibility.

## Pin Assignment:

PIN	FUNCTIONS	PIN	FUNCTIONS
A	Logic Ground	1	Ch 1 Timer Control Input
B	DC Supply	2	Ch 2 Timer Control Input
C	Ext. Reset	3	Ch 3 Timer Control Input
D	Ch 1 Loop Input	4	Ch 1 Redundant Loop Input
E	Ch 1 Loop Input	5	Ch 1 Redundant Loop Input
F	Ch 1 Output (+)	6	Reserved
H	Ch 1 Output (-)	7	Reserved
J	Ch 2 Loop Input	8	Ch 2 Redundant Loop Input
K	Ch 2 Loop Input	9	Ch 2 Redundant Loop Input
L	Chassis Ground	10	Ch 4 Timer Control Input
M	Reserved	11	Reserved
N	Reserved	12	Reserved
P	Ch 3 Loop Input	13	Ch 3 Redundant Loop Input
R	Ch 3 Loop Input	14	Ch 3 Redundant Loop Input
S	Ch 3 Output (+)	15	Reserved
T	Ch 3 Output (-)	16	Reserved
U	Ch 4 Loop Input	17	Ch 4 Redundant Loop Input
V	Ch 4 Loop Input	18	Ch 4 Redundant Loop Input
W	Ch 2 Output (+)	19	Reserved
X	Ch 2 Output (-)	20	Reserved
Y	Ch 4 Output (+)	21	Reserved
Z	Ch 4 Output (-)	22	Reserved

**DC Supply Voltage:** Minimum.....10.8 Vdc  
Maximum.....28.8 Vdc

**DC Supply Current:** Maximum.....100 mA

**DC Timer Control Inputs:** True (low).....Less than 8 Vdc  
False (high).....Greater than 16 Vdc

**Optical Isolated Outputs:** True (low, 50 mA).....Less than 1.5 Vdc  
Maximum Current.....100 mA

**Environmental:** Operating Temperature Range: -30°F to 165°F (-34°C to 74°C)

**Mechanical:** International Card with 44 pin double sided edge connector

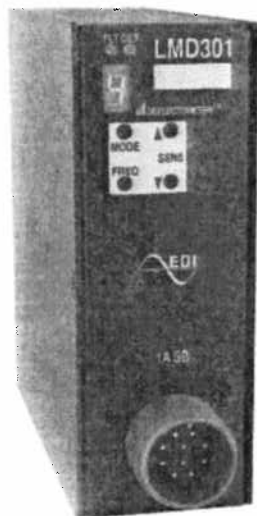
Height.....4.5" (114.3mm)  
Width.....2.34" (59.4mm)  
Depth (excluding handle).....6.875" (174.6mm)

DEFLECTOMETER

# LMD301 Series

## DEFLECTOMETER® SERIES

SINGLE CHANNEL NEMA TS-1 LOOP MONITOR



Built-in DEFLECTOMETER® Technology Provides Users With:

- ☒ Call Strength Indicator for Optimum Sensitivity Programming
- ☒ One step / One vehicle dynamic Sensitivity programming
- ☒ Frequency Meter for immediate analysis of loop frequency, avoiding loop cross-talk problems
- ☒ Push Button Programming

**Why guess when you can know your detector is optimally programmed and performing for all vehicle classes!**

**Model Options:**

- LMD301S Single Channel with Solid State outputs
- LMD301T Single Channel with Delay & Extend timing
- LMD301TS Single Channel with Delay & Extend timing & Solid State outputs

### ENHANCED FEATURES

**DEFLECTOMETER Call Strength Indicator:**

The *Call Strength Indicator* provides the technician with a simple one-step method for accurately setting the optimum level of sensitivity that ensures accurate vehicle detection of all vehicles, including motorcycles and high-bed trucks. **NO MORE GUESSING!**

When a medium size vehicle is over the roadway loop, a DEFLECTOMETER® Call Strength value of "5" assures that the optimum sensitivity has been achieved. You can adjust the DEFLECTOMETER® reading *DYNAMICALLY* without moving the vehicle by using the front panel UP or DOWN sensitivity buttons. **IT DOES NOT GET ANY EASIER THAN THIS!**

**Frequency Meter:**

The built-in *Frequency Meter* reports the operating frequency of the loop network. Ensuring that adjacent loops are separated by at least 5 KHZ will avoid crosstalk problems and future service calls.

**Output CALL Test Mode:**

The Output Call Test Mode provides a straight forward way to test that the Controller Unit is receiving an active output from the detector. This eliminates the need for cabinet test switches and associated wiring. A huge time saving feature during system set-up and trouble-shooting.

**Advanced Loop Diagnostics:**

The Fault (FLT) indicator displays the type of fault: Short, Open or 25% change of inductance. The Fault Monitor will report and store three types of loop faults; Open Loops, Shorted Loops, and 25% sudden changes in inductance. Each type of fault is indicated by a unique sequence of flashes allowing the user to diagnose loop failures at a glance.

**Delay & Extension Timing:**

The LMD301t model provides a programmable Delay time of 1 to 63 seconds, and an Extend time of 0.25 to 15.75 seconds. These parameters are set via the front panel DIP switches.

### STANDARD FEATURES

- ☒ Delay & Extension Timing on LMD301t model
- ☒ Automatic Tuning
- ☒ Lightning & Surge Protection
- ☒ Four Frequency Levels
- ☒ Separate Color-Coded LED indicators
- ☒ Wide Loop Inductance Range: 20 to 2500 microHenries.

#### EBERLE DESIGN INC.

3819 East La Salle Street  
Phoenix, AZ 85040 USA  
www.EDIttraffic.com

Tel (480) 968-6407  
Fax (602) 437-1996



# LMD301 DEFLECTOMETER® SERIES SINGLE CHANNEL INDUCTIVE LOOP VEHICLE DETECTOR SPECIFICATIONS

## General Characteristics

**Controls:** Front panel push buttons allow the user to set the Sensitivity Level, Operational mode, and nominal Frequency independently on each channel. DIP switches allow the user to set the Delay and Extension timers on the LMD301t model.

### Setting Sensitivity - Front Panel Push Buttons

The DEFLECTOMETER® (front panel 7-segment LED) aids in setting the DETECTOR quickly and easily to the most optimum sensitivity level to ensure the trouble-free detection of all vehicles, including motorcycles and high bed vehicles. For typical vehicles (mid-size vehicle / small pick up) utilizing properly installed roadway loops, a Call Strength of 5 displayed on the DEFLECTOMETER® during the DETECT output period indicates an optimum sensitivity setting. For high profile vehicles (commercial trucks, 4x4's, etc...), a Call Strength value of 4 will be optimum. For low profile vehicles (sports cars, etc...), a Call Strength value of 6 will be optimum.

### Adjusting sensitivity using the DEFLECTOMETER® (recommended):

The DEFLECTOMETER® should read zero (0) with no vehicle over the roadway loop. When a typical mid-sized vehicle is completely in the detection zone (DET indicator On), the Call Strength value should be adjusted up or down until the DEFLECTOMETER® displays the desired optimum value of 5 (or 4 or 6 as described above).

If a typical vehicle located over the roadway loop causes the Call Strength "7" to be displayed on the DEFLECTOMETER®, the sensitivity should be decreased two levels. This can be done by pressing the front panel SENS ⬇ button two times to achieve the Call Strength value of 5.

If a typical vehicle located over the roadway loop causes the number "2" to be displayed on the DEFLECTOMETER®, the sensitivity should be increased three levels. This can be done by pressing the front panel SENS ⬆ button three times to achieve the Call Strength value of 5.

**NOTE: THE DEFLECTOMETER® CALL STRENGTH DYNAMICALLY UPDATES AFTER EACH SENSITIVITY LEVEL CHANGE, ALLOWING YOU TO CHANGE SENSITIVITY SETTINGS WHILE A VEHICLE REMAINS IN THE LOOP DETECTION ZONE.**

### Adjusting sensitivity without using the DEFLECTOMETER® (manually setting sensitivity):

The DETECTOR offers 9 levels of sensitivity (1 to 9). Level 9 is the highest sensitivity. Sensitivity Level can be manually set to any desired value by pressing the front panel SENS buttons (⬆ or ⬇) when a vehicle is NOT over the roadway loop (DET indicator Off). The first time a SENS button (⬆ or ⬇) is pressed, the current Sensitivity Level is displayed on the DEFLECTOMETER® for 3 seconds. If either SENS button (⬆ or ⬇) is pressed again before the 3 second period ends, the Sensitivity Level will increase (SENS ⬆) or decrease (SENS ⬇). The new Sensitivity Level value will be displayed on the DEFLECTOMETER® display for 3 seconds. The factory default Sensitivity setting is level 6.

Sensitivity	ΔL / L	Sensitivity	ΔL / L
9	0.01%	4	0.32%
8	0.02%	3	0.64%
7	0.04%	2	1.28%
6	0.08%	1	2.56%
5	0.16%	-	-

**Loop Frequency / Loop Frequency Display:** One of four frequency settings may be selected via the front panel FREQ push button to alleviate interference which may occur when loops connected to different detectors are located adjacent to one another. To help prevent or diagnose crosstalk problems, the loop frequency is displayed on the front panel DEFLECTOMETER®. The current loop frequency is displayed after pressing the FREQ button to display the current Frequency Level. The frequency is shown in KHz with a "-" symbol displayed both before and after the numeric digits shown on the DEFLECTOMETER®.

For example, after pressing the FREQ button once the display sequence might show:

"3" ⇒ "-" ⇒ "27" ⇒ "K" ⇒ "-"

This sequence would indicate Frequency Level "3" and a loop reference frequency of 27 KHz. Detectors on adjacent loops should all be separated by at least 5 KHz.

**Loop Fault Monitoring:** The Detector continuously checks the integrity of the loop. The system is able to detect shorted or open circuit loops, or sudden changes in inductance exceeding 25% of the nominal inductance. If a fault is detected, the OUT and FLT indicators continuously emit a sequence of flashes. Additionally, the DEFLECTOMETER® displays the letter "F" indicating a current loop fault. Each type of fault is identified by a unique flash sequence:

Flash Sequence	Fault
1 flash	Open Circuit Loop.
2 flashes	Shorted Circuit Loop.
3 flashes	25% excessive change in inductance.

If the Open or Shorted fault condition self heals, the DET indicator and DEFLECTOMETER® will return to normal operation. The FLT indicator will continue to flash with the sequence signifying the type of fault that was last detected. In the case of the excessive inductance change fault, the unit will retune to the new inductance after a period of two seconds and continue operation. The fault condition will be indicated by the flash sequence of the FLT indicator.

## Operational Modes

**Presence:** A Presence output mode may be selected from the front panel MODE push button. If presence mode is selected then a choice of short (S) or long (L) can be selected. Short Presence is defined as 30 minutes and Long Presence is defined as 120 minutes.

**Pulse:** A Pulse output mode (P) may be selected from the front panel MODE push button. In Pulse mode, a 125 ms ± 25ms width pulse will be output for each vehicle entering the loop.

**Call:** A continuous CALL output (C) may be selected from the front panel MODE push button which will simulate the presence of a vehicle. This mode is used for testing the CALL output of a channel.

**Channel Off:** The Channel Off (-) may be selected from the front panel Mode push button. This option turns OFF the channel and disables the oscillator.

## LMD301t Selectable Options:

**Call Delay Timer for Presence & Pulse Modes:** A delay time of 1 to 63 seconds can be set via the DELAY DIP switches. The numeric sum of the switches in the On position is equal to the Delay time. Call Delay time starts counting down when a vehicle enters the loop detection area. During the Delay time the DET indicator will flash two times per second and the DEFLECTOMETER® will display the letter "d". Delay time can be overridden by a True (low) signal at the Timer Control input.

**Call Extension Timer for Presence Mode:** An extend time of 0.25 to 15.75 seconds can be set via the EXTEND DIP switches. The numeric sum of the switches in the On position is equal to the Extend time. Two modes are provided:

**Extend Always (default):** Call Extend time starts counting down when the last vehicle clears the loop detection zone. During the Extend time the DET indicator will flash four times per second and the DEFLECTOMETER® will display the letter "E". Any vehicle entering the loop detection zone during the Extend time period causes the Extend timer to be reset and the output maintained. The Timer Control input has no effect on this mode.

### Extend on Green (EOG)

Call Extend time starts counting down when the last vehicle clears the loop detection zone if the Timer Control input is True (low). During the Extend time the DET indicator will flash four times per second and the DEFLECTOMETER® will display the letter "E". Any vehicle entering the loop detection zone during the Extend time period causes the Extend timer to be reset and the output maintained.

The Extend on Green mode is enabled by a factory installed diode on the pcb. Consult the factory for details.

**Timer Control Inputs:** Timer Control inputs are provided for each channel to modify the operation of the Delay and Extension functions. The application of a True (low) state voltage will inhibit the Delay timing function and/or enable the Extend timing function. Timer Control inputs are primarily provided for downward compatibility.

## Pin Assignment:

Pin	Function
A	Neutral (AC-)
B	Ch 1 Output Relay Common (Emitter)
C	Power (AC+)
D	Channel 1 Loop Input
E	Channel 1 Loop Input
F	Ch 1 Output Relay N.O. (Collector)
G	Ch 1 Output Relay N.C.
H	Earth Ground
I	No Connect
J	Ch 1 Timer Control (LMD301t)

N.O. is Normally Open, N.C. is Normally Closed.

Relay Contacts are shown with power applied, loops connected and no vehicle present.

<b>AC Supply Voltage:</b>	Minimum .....89 Vac Maximum .....270 Vcc Frequency ..... 47 to 63 Hz
<b>AC Timer Control Inputs:</b>	True (active) ..... Greater than 70 Vac False (not active) ..... Less than 15 Vac
<b>Optically Isolated Outputs:</b>	True (low, 50 mA) ..... Less than 1.5 Vdc Maximum Current ..... 100 mA
<b>Relay Outputs:</b>	AC Contact Rating ..... 5A @ 120 Vac DC Contact Rating ..... 5A @ 30 Vdc
<b>Environmental:</b>	Operating Temperature Range: -30°F to 165°F (-34°C to 74°C)
<b>Mechanical:</b>	Height ..... 5.5 inches Width ..... 2 inches Depth ..... 5.412 inches



DEFLECTOMETER

# LMD302 Series

## DEFLECTOMETER® SERIES

DUAL CHANNEL NEMA TS-1 LOOP MONITOR



Built-in DEFLECTOMETER Technology Provides Users With:

- ☒ Call Strength Indicator for Optimum Sensitivity Programming
- ☒ One step / One vehicle dynamic Sensitivity programming
- ☒ Frequency Meter for immediate analysis of loop frequency, avoiding loop cross-talk problems
- ☒ Push Button Programming

**Why guess when you can know your detector is optimally programmed and performing for all vehicle classes!**

**Model Options:**

- LMD302S Two Channel with Solid State outputs
- LMD302T Two Channel with Delay & Extend timing
- LMD302TS Two Channel with Delay & Extend timing & Solid State outputs

### ENHANCED FEATURES

**DEFLECTOMETER Call Strength Indicator:**

The *Call Strength Indicator* provides the technician with a simple one-step method for accurately setting the optimum level of sensitivity that ensures accurate vehicle detection of all vehicles, including motorcycles and high-bed trucks. **NO MORE GUESSING!**

When a medium size vehicle is over the roadway loop, a DEFLECTOMETER® Call Strength value of "5" assures that the optimum sensitivity has been achieved. You can adjust the DEFLECTOMETER® reading *DYNAMICALLY* without moving the vehicle by using the front panel UP or DOWN sensitivity buttons. **IT DOES NOT GET ANY EASIER THAN THIS!**

**Frequency Meter:**

The built-in *Frequency Meter* reports the operating frequency of the loop network. Ensuring that adjacent loops are separated by at least 5 KHz will avoid crosstalk problems and future service calls.

**Output CALL Test Mode:**

The Output Call Test Mode provides a straight forward way to test that the Controller Unit is receiving an active output from the detector. This eliminates the need for cabinet test switches and associated wiring. A huge time saving feature during system set-up and trouble-shooting.

**Advanced Loop Diagnostics:**

The Fault (FLT) indicator displays the type of fault: Short, Open or 25% change of inductance. The Fault Monitor will report and store three types of loop faults; Open Loops, Shorted Loops, and 25% sudden changes in inductance. Each type of fault is indicated by a unique sequence of flashes allowing the user to diagnose loop failures at a glance.

**Delay & Extension Timing:**

The LMD302T model provides a programmable Delay time of 1 to 63 seconds, and an Extend time of 0.25 to 15.75 seconds. These parameters are set via the front panel DIP switches.

### STANDARD FEATURES

- ☒ Delay & Extension Timing on LMD302T model
- ☒ Automatic Tuning
- ☒ Lightning & Surge Protection
- ☒ Four Frequency Levels
- ☒ Separate Color-Coded LED indicators
- ☒ Wide Loop Inductance Range: 20 to 2500 microHenries.

EBERLE DESIGN INC.

3510 East Atlanta Avenue  
Phoenix, AZ 85040 USA  
www.EDIttraffic.com

Tel (480) 968-6407  
Fax (602) 437-1996





# LMD302 DEFLECTOMETER® SERIES DUAL CHANNEL INDUCTIVE LOOP VEHICLE DETECTOR SPECIFICATIONS

## General Characteristics

**Controls:** Front panel push buttons allow the user to set the Sensitivity Level, Operational mode, and nominal Frequency independently on each channel. DIP switches allow the user to set the Delay and Extension timers on the LMD302T model.

### Setting Sensitivity - Front Panel Push Buttons

The DEFLECTOMETER® (front panel 7-segment LED) aids in setting the DETECTOR quickly and easily to the most optimum sensitivity level to ensure the trouble-free detection of all vehicles, including motorcycles and high bed vehicles. For typical vehicles (mid-size vehicle / small pick up) utilizing properly installed roadway loops, a Call Strength of 5 displayed on the DEFLECTOMETER® during the DETECT output period indicates an optimum sensitivity setting. For high profile vehicles (commercial trucks, 4x4's, etc...), a Call Strength value of 4 will be optimum. For low profile vehicles (sports cars, etc...), a Call Strength value of 6 will be optimum.

### Adjusting sensitivity using the DEFLECTOMETER® (recommended):

The DEFLECTOMETER® should read zero (0) with no vehicle over the roadway loop. When a typical mid-sized vehicle is completely in the detection zone (DET indicator On), the Call Strength value should be adjusted up or down until the DEFLECTOMETER® displays the desired optimum value of 5 (or 4 or 6 as described above).

If a typical vehicle located over the roadway loop causes the Call Strength "7" to be displayed on the DEFLECTOMETER®, the sensitivity should be decreased two levels. This can be done by pressing the front panel SENS ⬇ button two times to achieve the Call Strength value of 5.

If a typical vehicle located over the roadway loop causes the number "2" to be displayed on the DEFLECTOMETER®, the sensitivity should be increased three levels. This can be done by pressing the front panel SENS ⬆ button three times to achieve the Call Strength value of 5.

**NOTE: THE DEFLECTOMETER® CALL STRENGTH DYNAMICALLY UPDATES AFTER EACH SENSITIVITY LEVEL CHANGE, ALLOWING YOU TO CHANGE SENSITIVITY SETTINGS WHILE A VEHICLE REMAINS IN THE LOOP DETECTION ZONE.**

### Adjusting sensitivity without using the DEFLECTOMETER® (manually setting sensitivity):

The DETECTOR offers 9 levels of sensitivity (1 to 9). Level 9 is the highest sensitivity. Sensitivity Level can be manually set to any desired value by pressing the front panel SENS buttons (⬆ or ⬇) when a vehicle is NOT over the roadway loop (DET indicator Off). The first time a SENS button (⬆ or ⬇) is pressed, the current Sensitivity Level is displayed on the DEFLECTOMETER® for 3 seconds. If either SENS button (⬆ or ⬇) is pressed again before the 3 second period ends, the Sensitivity Level will increase (SENS ⬆) or decrease (SENS ⬇). The new Sensitivity Level value will be displayed on the DEFLECTOMETER® display for 3 seconds. The factory default Sensitivity setting is level 6.

Sensitivity	ΔL / L	Sensitivity	ΔL / L
9	0.01%	4	0.32%
8	0.02%	3	0.64%
7	0.04%	2	1.28%
6	0.08%	1	2.56%
5	0.16%	-	-

**Loop Frequency / Loop Frequency Display:** One of four frequency settings may be selected via the front panel FREQ push button to alleviate interference which may occur when loops connected to different detectors are located adjacent to one another. To help prevent or diagnose crosstalk problems, the loop frequency is displayed on the front panel DEFLECTOMETER®. The current loop frequency is displayed after pressing the FREQ button to display the current Frequency Level. The frequency is shown in KHz with a "K" symbol displayed both before and after the numeric digits shown on the DEFLECTOMETER®.

For example, after pressing the FREQ button once the display sequence might show:

"3" ⇒ "K" ⇒ "27" ⇒ "KHz"

This sequence would indicate Frequency Level "3" and a loop reference frequency of 27 KHz. Detectors on adjacent loops should all be separated by at least 5 KHz.

**Loop Fault Monitoring:** The Detector continuously checks the integrity of the loop. The system is able to detect shorted or open circuit loops, or sudden changes in inductance exceeding 25% of the nominal inductance. If a fault is detected, the OUT and FLT indicators continuously emit a sequence of flashes. Additionally, the DEFLECTOMETER® displays the letter "F" indicating a current loop fault. Each type of fault is identified by a unique flash sequence:

Flash Sequence	Fault
1 flash	Open Circuit Loop.
2 flashes	Shorted Circuit Loop.
3 flashes	25% excessive change in inductance.

If the Open or Shorted fault condition self heals, the DET indicator and DEFLECTOMETER® will return to normal operation. The FLT indicator will continue to flash with the sequence signifying the type of fault that was last detected. In the case of the excessive inductance change fault, the unit will retune to the new inductance after a period of two seconds and continue operation. The fault condition will be indicated by the flash sequence of the FLT indicator.

## Operational Modes

**Presence:** A Presence output mode may be selected from the front panel MODE push button. If presence mode is selected then a choice of short (S) or long (L) can be selected. Short Presence is defined as 30 minutes and Long Presence is defined as 120 minutes.

**Pulse:** A Pulse output mode (P) may be selected from the front panel MODE push button. In Pulse mode, a 125 ms ± 25ms width pulse will be output for each vehicle entering the loop.

**Call:** A continuous CALL output (C) may be selected from the front panel MODE push button which will simulate the presence of a vehicle. This mode is used for testing the CALL output of a channel.

**Channel Off:** The Channel Off (-) may be selected from the front panel Mode push button. This option turns OFF the channel and disables the oscillator.

## LMD302T Selectable Options:

**Call Delay Timer for Presence & Pulse Modes:** A delay time of 1 to 63 seconds can be set via the DELAY DIP switches. The numeric sum of the switches in the On position is equal to the Delay time. Call Delay time starts counting down when a vehicle enters the loop detection area. During the Delay time the DET indicator will flash two times per second and the DEFLECTOMETER® will display the letter "d". Delay time can be overridden by a True (low) signal at the Timer Control input.

**Call Extension Timer for Presence Mode:** An extend time of 0.25 to 15.75 seconds can be set via the EXTEND DIP switches. The numeric sum of the switches in the On position is equal to the Extend time. Two modes are provided:

**Extend Always (default):** Call Extend time starts counting down when the last vehicle clears the loop detection zone. During the Extend time the DET indicator will flash four times per second and the DEFLECTOMETER® will display the letter "E". Any vehicle entering the loop detection zone during the Extend time period causes the Extend timer to be reset and the output maintained. The Timer Control input has no effect on this mode.

### Extend on Green (EOG)

Call Extend time starts counting down when the last vehicle clears the loop detection zone if the Timer Control input is True (low). During the Extend time the DET indicator will flash four times per second and the DEFLECTOMETER® will display the letter "E". Any vehicle entering the loop detection zone during the Extend time period causes the Extend timer to be reset and the output maintained.

The Extend on Green mode is enabled by a factory installed diode on the pcb. Consult the factory for details.

**Timer Control Inputs:** Timer Control inputs are provided for each channel to modify the operation of the Delay and Extension functions. The application of a True (low) state voltage will inhibit the Delay timing function and/or enable the Extend timing function. Timer Control inputs are primarily provided for downward compatibility.

## Pin Assignment:

Pin	Function (Channel 1)	Function (Channel 2)
A	Neutral (AC-)	No Connect
B	Ch 1 Output Relay Common (Emitter)	Ch 2 Output Relay Common (Emitter)
C	Power (AC+)	No Connect
D	Channel 1 Loop Input	Channel 2 Loop Input
E	Channel 1 Loop Input	Channel 2 Loop Input
F	Ch 1 Output Relay N.O. (Collector)	Ch 2 Output Relay N.O. (Collector)
G	Ch 1 Output Relay N.C.	Ch 2 Output Relay N.C.
H	Earth Ground	Earth Ground
I	No Connect	No Connect
J	Ch 1 Timer Control (LMD302T)	Ch 2 Timer Control (LMD302T)

N.O. is Normally Open, N.C. is Normally Closed.

Relay Contacts are shown with power applied, loops connected and no vehicle present.

<b>AC Supply Voltage:</b>	Minimum.....89 Vac Maximum.....270 Vcc Frequency.....47 to 63 Hz
<b>AC Timer Control Inputs:</b>	True (active).....Greater than 70 Vac False (not active).....Less than 15 Vac
<b>Optically Isolated Outputs:</b>	True (low, 50 mA).....Less than 1.5 Vdc Maximum Current.....100 mA
<b>Relay Outputs:</b>	AC Contact Rating.....5A @ 120 Vac DC Contact Rating.....5A @ 30 Vdc
<b>Environmental:</b>	Operating Temperature Range: -30°F to 165°F (-34°C to 74°C)
<b>Mechanical:</b>	Height.....6.4 inches Width.....3.0 inches Depth.....7.3 inches

DEFLECTOMETER



# LMD622t

## DEFLECTOMETER® SERIES

### TWO CHANNEL NEMA TS-2 TYPE C LOOP MONITOR

Built-in DEFLECTOMETER® Technology Provides Users With:

- ☑ Call Strength Indicator for Optimum Sensitivity Programming
- ☑ One step / One vehicle dynamic Sensitivity programming
- ☑ Frequency Meter for immediate analysis of loop frequency, avoiding loop cross-talk problems
- ☑ Push Button Programming

**Why guess when you can know your detector is optimally programmed and performing for all vehicle classes!**

## ENHANCED FEATURES

**DEFLECTOMETER Call Strength Indicator:** The *Call Strength Indicator* provides the technician with a simple one-step method for accurately setting the optimum level of sensitivity that ensures accurate vehicle detection of all vehicles, including motorcycles and high-bed trucks. **NO MORE GUESSING!**

When a medium size vehicle is over the roadway loop, a DEFLECTOMETER Call Strength value of "5" assures that the optimum sensitivity has been achieved. You can adjust the DEFLECTOMETER reading *DYNAMICALLY* without moving the vehicle by using the front panel UP or DOWN sensitivity buttons. **IT DOES NOT GET ANY EASIER THAN THIS!**

**Frequency Meter:** The built-in *Frequency Meter* reports the operating frequency of the loop network. Ensuring that adjacent loops are separated by at least 5 KHz will avoid crosstalk problems and future service calls.

**Output CALL Test Mode:** The Output Call Test Mode provides a straight forward way to test that the Controller Unit is receiving an active output from the detector. This eliminates the need for cabinet test switches and associated wiring. A huge time saving feature during system set-up and trouble-shooting.

**Rugged Handle Assembly:** The rugged handle assembly is made of GE LEXAN, which is a super durable polycarbonate resin. The design of this assembly strengthens and protects the whole PCB assembly much better than conventional face plates. The temperature stability of critical components is improved with the more encompassing enclosure. Quick reference instructions are conveniently attached directly on the side of the unit, eliminating the need for cards.

**Advanced Loop Diagnostics:** The Fault (FLT) indicator displays the type of fault: Short, Open or 25% change of inductance. The Fault Monitor will report and store three types of loop faults; Open Loops, Shorted Loops, and 25% sudden changes in inductance. Each type of fault is indicated by a unique sequence of flashes allowing the user to diagnose loop failures at a glance.

**Delay and Extension Timing:** Delay and Extension timing functions are provided.

## STANDARD FEATURES

- ☑ Delay & Extension Timing
- ☑ Automatic Tuning
- ☑ Lightning & Surge Protection
- ☑ Four (4) Frequency Levels
- ☑ Fail Safe Output Configuration
- ☑ Separate Color-Coded LED indicators
- ☑ Wide Loop Inductance Range: 20 to 2500 microHenries.

U.S. Pat. No. 7,855,893

EBERLE DESIGN INC.

3510 East Atlanta Avenue Tel (480) 968-6407  
Phoenix, AZ 85040 USA Fax (602) 437-1996  
www.EDItraffic.com



# LMD622t DEFLECTOMETER SERIES TWO CHANNEL INDUCTIVE LOOP VEHICLE DETECTOR SPECIFICATIONS

## General Characteristics

**Controls:** Front panel push buttons allow the user to set the Sensitivity Level, Operational mode, and nominal Frequency independently on each channel. PCB mounted DIP switches allow the user to set the Delay and Extension timers.

## Setting Sensitivity - Front Panel Push Buttons

The DEFLECTOMETER (front panel 7-segment LED) aids in setting the DETECTOR quickly and easily to the most optimum sensitivity level to ensure the trouble-free detection of all vehicles, including motorcycles and high bed vehicles. For typical vehicles (mid-size vehicle / small pickup) utilizing properly installed roadway loops, a Call Strength of 5 displayed on the DEFLECTOMETER during the DETECT output period indicates an optimum sensitivity setting. For high profile vehicles (commercial trucks, 4x4's, etc...), a Call Strength value of 4 will be optimum. For low profile vehicles (sports cars, etc...), a Call Strength value of 6 will be optimum.

## Adjusting sensitivity using the DEFLECTOMETER (recommended):

The DEFLECTOMETER should read zero (0) with no vehicle over the roadway loop. When a typical mid-sized vehicle is completely in the detection zone (DET indicator On), the Call Strength value should be adjusted up or down until the DEFLECTOMETER displays the desired optimum value of 5 (or 4 or 6 as described above).

If a typical vehicle located over the roadway loop causes the Call Strength "7" to be displayed on the DEFLECTOMETER, the sensitivity should be decreased two levels. This can be done by pressing the front panel SENS  $\blacklozenge$  button two times to achieve the Call Strength value of 5.

If a typical vehicle located over the roadway loop causes the number "2" to be displayed on the DEFLECTOMETER, the sensitivity should be increased three levels. This can be done by pressing the front panel SENS  $\blacklozenge$  button three times to achieve the Call Strength value of 5.

**NOTE: THE DEFLECTOMETER CALL STRENGTH DYNAMICALLY UPDATES AFTER EACH SENSITIVITY LEVEL CHANGE, ALLOWING YOU TO CHANGE SENSITIVITY SETTINGS WHILE A VEHICLE REMAINS IN THE LOOP DETECTION ZONE.**

## Adjusting sensitivity without using the DEFLECTOMETER (manually setting sensitivity):

The DETECTOR offers 9 levels of sensitivity (1 to 9). Level 9 is the highest sensitivity. Sensitivity Level can be manually set to any desired value by pressing the front panel SENS buttons ( $\blacklozenge$  or  $\blacklozenge$ ) when a vehicle is NOT over the roadway loop (DET indicator Off). The first time a SENS button ( $\blacklozenge$  or  $\blacklozenge$ ) is pressed, the current Sensitivity Level is displayed on the DEFLECTOMETER for 3 seconds. If either SENS button ( $\blacklozenge$  or  $\blacklozenge$ ) is pressed again before the 3 second period ends, the Sensitivity Level will increase (SENS  $\blacklozenge$ ) or decrease (SENS  $\blacklozenge$ ). The new Sensitivity Level value will be displayed on the DEFLECTOMETER display for 3 seconds. The factory default Sensitivity setting is level 6.

Sensitivity	$\Delta L / L$	Sensitivity	$\Delta L / L$
9	0.01%	4	0.32%
8	0.02%	3	0.64%
7	0.04%	2	1.28%
6	0.08%	1	2.56%
5	0.16%	-	-

**Loop Frequency / Loop Frequency Display:** One of four frequency settings may be selected via the front panel FREQ push button to alleviate interference which may occur when loops connected to different detectors are located adjacent to one another. To help prevent or diagnose crosstalk problems, the loop frequency is displayed on the front panel DEFLECTOMETER. The current loop frequency is displayed after pressing the FREQ button to display the current Frequency Level. The frequency is shown in KHz with a "-" symbol displayed both before and after the numeric digits shown on the DEFLECTOMETER.

For example, after pressing the FREQ button once the display sequence might show:

"3"  $\Rightarrow$  "-"  $\Rightarrow$  "2"  $\Rightarrow$  "7"  $\Rightarrow$  "-"

This sequence would indicate Frequency Level "3" and a loop reference frequency of 27 KHz. Detectors on adjacent loops should all be separated by at least 5 KHz.

**Loop Fault Monitoring:** The Detector continuously checks the integrity of the loop. The system is able to detect shorted or open circuit loops, or sudden changes in inductance exceeding 25% of the nominal inductance. If a fault is detected, the OUT and FLT indicators continuously emit a sequence of flashes. Additionally, the DEFLECTOMETER displays the letter "F" indicating a current loop fault. Each type of fault is identified by a unique flash sequence:

Flash Sequence	Fault
1 flash	Open Circuit Loop.
2 flashes	Shorted Circuit Loop.
3 flashes	25% excessive change in inductance.

If the Open or Shorted fault condition self heals, the DET indicator and DEFLECTOMETER will return to normal operation. The FLT indicator will continue to flash with the sequence signifying the type of fault that was last detected. In the case of the excessive inductance change fault, the unit will return to the new inductance after a period of two seconds and continue operation. The fault condition will be indicated by the flash sequence of the FLT indicator.

## Operational Modes

**Presence:** For each channel, a Presence output mode may be selected from the front panel MODE push button. If presence mode is selected then a choice of short (S) or long (L) can be selected. Short Presence is defined as 30 minutes and Long Presence is defined as 120 minutes.

**Pulse:** For each channel, a Pulse output mode (P) may be selected from the front panel MODE push button. In Pulse mode, a 125 ms  $\pm$  25ms width pulse will be output for each vehicle entering the loop.

**Call:** For each channel, a continuous CALL output (C) may be selected from the front panel MODE push button which will simulate the presence of a vehicle. This mode is used for testing the CALL output of a channel.

**Channel Off:** For each channel, the Channel Off (-) may be selected from the front panel Mode push button. This option turns OFF the channel and disables the oscillator. An additional option allows the Status Output to be turned ON while the channel is OFF.

## Selectable Options:

**Call Delay Timer for Presence & Pulse Modes:** For each channel, a delay time of 1 to 63 seconds may be selected by setting the appropriate PCB mounted DIP switches to the ON position. Call Delay time starts counting down when a vehicle enters the loop detection area. During the Delay time the DET indicator will flash two times per second and the DEFLECTOMETER will display the letter "d". Delay time can be overridden by a True (low) signal at the Timer Control input.

**Call Extension Timer for Presence Mode:** For each channel, an extend time of 0.25 to 15.75 seconds can be set via the EXTEND DIP switches. The numeric sum of the switches in the On position is equal to the Extend time. Two modes are provided:

**Extend Always (default):** Call Extend time starts counting down when the last vehicle clears the loop detection zone. During the Extend time the DET indicator will flash four times per second and the DEFLECTOMETER will display the letter "E". Any vehicle entering the loop detection zone during the Extend time period causes the Extend timer to be reset and the output maintained. The Timer Control input has no effect on this mode.

## Extend on Green (EOG)

Call Extend time starts counting down when the last vehicle clears the loop detection zone if the Timer Control input is True (low). During the Extend time the DET indicator will flash four times per second and the DEFLECTOMETER will display the letter "E". Any vehicle entering the loop detection zone during the Extend time period causes the Extend timer to be reset and the output maintained.

The Extend on Green mode is enabled by a factory installed diode located at OPT6 on the pcb. Consult the factory for details.

**Timer Control Inputs:** Timer Control inputs are provided for each channel to modify the operation of the Delay and Extension functions. The application of a True (low) state voltage will inhibit the Delay timing function and/or enable the Extend timing function. Timer Control inputs are primarily provided for downward compatibility.

## Pin Assignment:

PIN	FUNCTIONS	PIN	FUNCTIONS
A	Logic Ground	1	Ch 1 Timer Control Input
B	DC Supply	2	Ch 2 Timer Control Input
C	External Reset	3	No Connection
D	Ch 1 Loop Input	4	Ch 1 Redundant Loop Input
E	Ch 1 Loop Input	5	Ch 1 Redundant Loop Input
F	Ch 1 Output (+)	6	No Connection
H	Ch 1 Output (-)	7	Ch 1 Status Output
J	Ch 2 Loop Input	8	Ch 2 Redundant Loop Input
K	Ch 2 Loop Input	9	Ch 2 Redundant Loop Input
L	Chassis Ground	10	No Connection
M	No Connection	11	No Connection
N	No Connection	12	No Connection
P	No Connection	13	No Connection
R	No Connection	14	No Connection
S	No Connection	15	No Connection
T	No Connection	16	No Connection
U	No Connection	17	No Connection
V	No Connection	18	No Connection
W	Ch 2 Output (+)	19	No Connection
X	Ch 2 Output (-)	20	Ch 2 Status Output
Y	No Connection	21	No Connection
Z	No Connection	22	No Connection

**DC Supply Voltage:** Minimum ..... 10.8 Vdc  
Maximum ..... 28.8 Vdc

**DC Supply Current:** Maximum ..... 100 mA

**DC Timer Control Inputs:** True (low) ..... Less than 8 Vdc  
False (high) ..... Greater than 16 Vdc

**Optically Isolated Outputs:** True (low, 50 mA) ..... Less than 1.5 Vdc  
Maximum Current ..... 100 mA

Outputs are fail-safe such that a Detector with no power will provide the True (low) Call state.

**Relay Outputs:** AC Contact Rating ..... 5A @ 120 Vac  
DC Contact Rating ..... 5A @ 30 Vdc

**Environmental:** Operating Temperature Range: -30°F to 165°F (-34°C to 74°C)

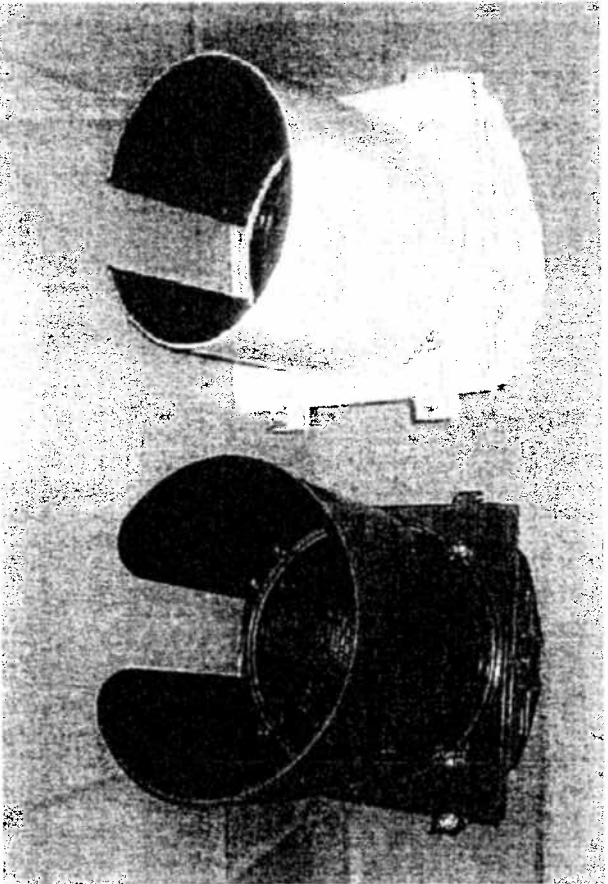
**Mechanical:** International Card 4.500"H (114.30mm) x 6.875"D (174.63mm) x 1.14"W (28.96mm), excluding handle, with 44 pin double sided edge connector.

## Status Outputs:

Each channel includes a separate output which is used to transmit operational status information to a bus interface unit (BIU). Fault information is transmitted by means of pulse-width modulation. Pulse widths shown are  $\pm$ 10ms.

Status	Status Output Condition
Normal operation / No fault	Continuous ON (low)
Watchdog fail / Power Supply fail	Continuous OFF (high)
Open circuit loop	50ms OFF, 50ms ON
Short circuit loop	100ms OFF, 50ms ON
25% change in inductance	150ms OFF, 50ms ON

# CHAPEL HILL MANUFACTURING



TRAFFIC PARTS, INC.

TYPE 1 8"

## OPTIONS/TRAFFIC PARTS, INC.

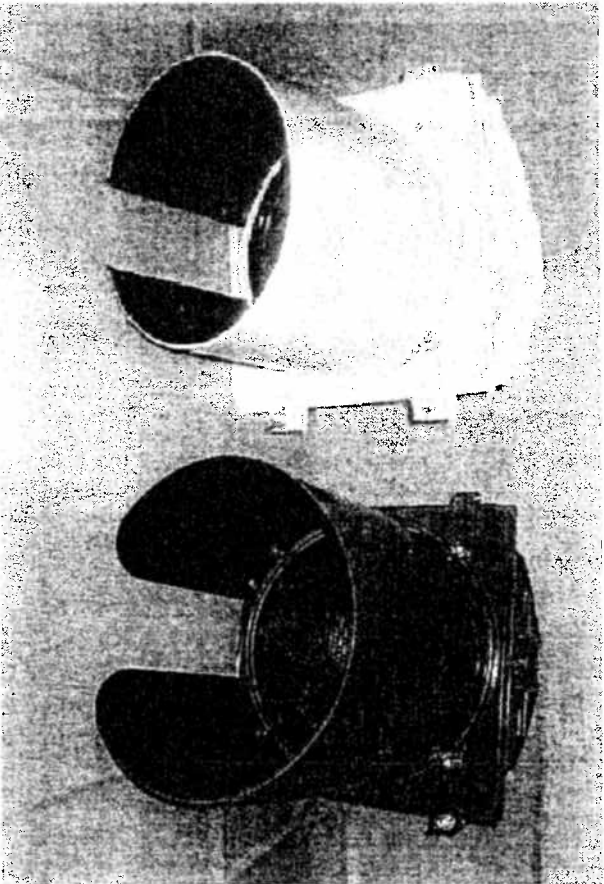
1. **SIZE/TYPE**  
E = 8" VEHICLE T = 12"  
P = 12" PEDESTRAIN L = LANE CONTROL  
C = COMBO 8/12 S = 12" SPEED
2. **MATERIAL**  
P = POLY A = ALUM.  
T = ALUM. TOP/PC BOTTOM  
C = POLY SIGNAL VISOR
3. **COLOR**  
Y = YELLOW B = BLACK F = FLAT BLACK (12")  
G = DARK GREEN L = LIGHT GREEN  
C = YELL BODY/BLK DOOR/BLK VISOR  
D = YELL BODY/BLK DOOR/YELL VISOR  
E = YELL BODY & DOOR/BLACK VISOR  
V = BLK BODY/YELL DOOR/BLK VISOR
- 4-5. **CONFIGURATION** 30-476  
2 DIGIT MPH FOR SPEED INDICATION  
DIGIT CONFIG. CODE ON ADJ. PAGE
6. **TERMINAL BLOCK TYPE**  
5 = 5 POS. 20A 6 = 6 POS. 20 A  
7 = 5 POS. 30A 8 = 6 POS. 30 A  
2 = 2 POS. 20A N = NONE  
T = TEXAS SPEC CONFIG 30,47,56 ONLY
7. **TERMINAL BLOCK LOCATION**  
T = TOP C = CENTER B = BOTTOM  
X = SPECIAL  
VISOR
8. **VISOR**  
T = TUNNEL C = CAP  
F = FULL CIRCLE\*\* N = NO VISOR
9. **LENS**  
N = NONE G = GLASS P = POLY  
M = GLASS W/MOLDED ARROWS (12" ONLY)
10. **LENS GASKETED TYPE**  
E = INCAND/LED RDY/NO GASKET  
B = TXDOT EV C = ITE LED  
G = CLATTRANS/ 2005 ITE STYLE  
J = ITE/HIFLUX INCANDESCENT LOOK  
L = 12" EX. VIEW TXDOT M = HIFLUX TXDOT
11. **ORIENTATION**  
V = VERTICAL H = HORIZONTAL
12. **SUPPORT PLATES**  
1 = ONE TOP 2 = ON BOTTOM  
3 = TWO BOTTOM 4 = ONE TOP & 2 BOT  
X = SPECIAL 5 = TWO FOR EP  
6 = DOGHOUSE (1TOP/BOTTOM OF RED)  
N = NONE
13. **MECHANICAL**  
0 = PLATED TRI-STUD 1 = SS TRI-STUDS  
2 = PLATED SCREWS 3 = SS SCREWS
14. **LED CONFIGURATION**  
0 = NONE A = ALL SECTIONS LED  
N = ALL LED RDY  
J = RED BALL/HAND LED  
K = RED BALL/HAND LED READY  
G = RED, GREEN BALL/ARROW LED  
H = RED, GRN BALL/ARROW LED RDY  
I = BI-MODALS ONLY, LED RDY  
S = STROBE, 12" 1 SECT. B = ALL SECT. (12VDC)

SIG	1	2	3	4	5	6	7	8	9	10	11	12	13	14
OPTION CATEGORY	E	P	Y	3	0	5	L	T	N	E	V	N	O	N

\* 6 POS WILL NOT FIT IN 8" \*

\* WITH LEDTEK R.Y.G. INSTALLED

# CHAPEL HILL MANUFACTURING



TRAFFIC PARTS, INC.

TYPE 1 12"

SLA-  
TR-1(B) 300-CTN-EVN-ON  
W/R, Y, G LED INSTALLED  
VISORS ATTACHED

## OPTIONS/TRAFFIC PARTS, INC.

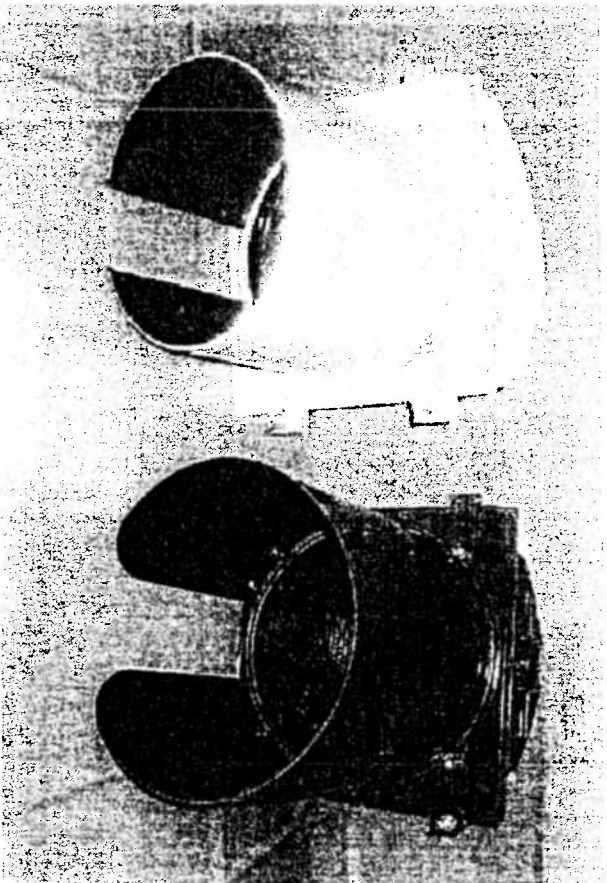
- SIZE/TYPE**  
E = 8" VEHICLE T = 12"  
P = 12" PEDESTRAIN L = LANE CONTROL  
C = COMBO 8/12 S = 12" SPEED
- MATERIAL**  
P = POLY A = ALUM.  
T = ALUM. TOP/PC BOTTOM  
C = POLY SIGNAL VISOR
- COLOR**  
Y = YELLOW B = BLACK F = FLAT BLACK (12")  
G = DARK GREEN L = LIGHT GREEN  
C = YELL BODY/BLK DOOR/BLK VISOR  
D = YELL BODY/BLK DOOR/YELL VISOR  
E = YELL BODY & DOOR/BLACK VISOR  
V = BLK BODY/YELL DOOR/BLK VISOR
- CONFIGURATION**  
2 DIGIT MPH FOR SPEED INDICATION  
DIGIT CONFIG. CODE ON ADJ. PAGE
- TERMINAL BLOCK TYPE**  
5 = 5 POS. 20A 6 = 6 POS. 20 A  
7 = 5 POS. 30A 8 = 6 POS. 30 A  
2 = 2 POS. 20A N = NONE  
T = TEXAS SPEC CONFIG 30,47,56 ONLY
- TERMINAL BLOCK LOCATION**  
T = TOP G = CENTER B = BOTTOM  
X = SPECIAL
- VISOR**  
T = TUNNEL C = CAP  
F = FULL CIRCLE\*\* N = NO VISOR
- LENS**  
N = NONE G = GLASS P = POLY  
M = GLASS W/MOLDED ARROWS (12" ONLY)
- LENS GASKET/LED TYPE**  
E = INCAND/LED RDY NO GASKET  
B = TXDOT E V. C = ITE LED  
G = CLATTRANS/ 2005 ITE STYLE  
J = ITE/HIFLUX INCANDESCENT LOOK  
L = 12" EX. VIEW TXDOT M = HIFLUX TXDOT
- ORIENTATION**  
V = VERTICAL H = HORIZONTAL
- SUPPORT PLATES**  
1 = ONE TOP 2 = ON BOTTOM  
3 = TWO BOTTOM 4 = ONE TOP & 2 BOT  
X = SPECIAL 5 = TWO FOR EP  
6 = DOGHOUSE (1TOP/BOTTOM OF RED)  
N = NONE
- MECHANICAL**  
0 = PLATED TRISTUD 1 = SS TRISTUDS  
2 = PLATED SCREWS 3 = SS SCREWS
- LED CONFIGURATION**  
0 = NONE A = ALL SECTIONS LED  
N = ALL LED RDY  
J = RED BALL/HAND LED  
K = RED BALL/HAND LED READY  
G = RED, GREEN BALL/ARROW LED  
H = RED, GRN BALL/ARROW LED RDY  
I = BI-MODALS ONLY, LED RDY  
S = STROBE, 12" 1 SECT. B = ALL SECT. (12VDC)

SIG	1	2	3	4	5	6	7	8	9	10	11	12	13	14
OPTION CATEGORY	T	P	Y	3	0	6	C	T	N	E	N	M	O	M

\* WITH LEOTEK R,Y,G LED  
INSTALLED

# CHAPEL HILL MANUFACTURING

## OPTIONS/TRAFFIC PARTS, INC.



TRAFFIC PARTS, INC.

TYPE 2 12"

SIG-TM (B) 376 CTN. EVN ON  
W/ RA, YA, GA INSTALLED  
VISORS ATTACHED

1. SIZE/TYPE  
E = 8" VEHICLE T = 12"  
P = 12" PEDESTRAIN L = LANE CONTROL  
C = COMBO 8/12 S = 12" SPEED

2. MATERIAL  
P = POLY A = ALUM.  
T = ALUM. TOP/PC BOTTOM  
C = POLY SIGNAL VISOR

3. COLOR  
Y = YELLOW B = BLACK F = FLAT BLACK (12")  
G = DARK GREEN T = LIGHT GREEN  
C = YELL BODY/BLK DOOR/BLK VISOR  
D = YELL BODY/BLK DOOR/YELL VISOR  
E = YELL BODY & DOOR/BLACK VISOR  
V = BLK BODY/YELL DOOR/BLK VISOR

- 4-5. CONFIGURATION  
2 DIGIT MPH FOR SPEED INDICATION  
DIGIT CONFIG. CODE ON ADJ. PAGE

6. TERMINAL BLOCK TYPE  
5 = 5 POS. 20A 6 = 6 POS. 20A  
7 = 5 POS. 30A 8 = 6 POS. 30A  
T = 2 POS. 20A N = NONE  
T = TEXAS SPEC CONFIG. 30, 47, 56 ONLY

7. TERMINAL BLOCK LOCATION  
T = TOP C = CENTER B = BOTTOM  
X = SPECIAL  
8. VISOR  
T = TUNNEL C = CAP  
F = FULL CIRCLE\*\* N = NO VISOR

9. LENS  
N = NONE G = GLASS P = POLY  
M = GLASS W/MOLDED ARROWS (12" ONLY)

SIG	1	2	3	4	5	6	7	8	9	10	11	12	13	14
OPTION CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12	13	14

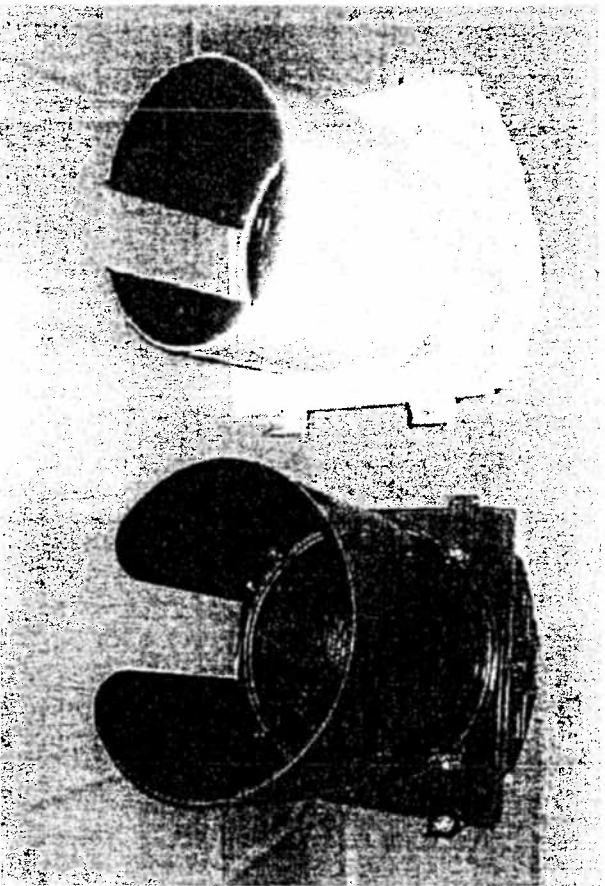
\* WITH LEOTER RA, YA, GA

INSTALLED



# CHAPEL HILL MANUFACTURING

## OPTIONS/TRAFFIC PARTS, INC.



TRAFFIC PARTS, INC.

TYPE 2A FYA

ALL SIG-TRK(B)-46-CIN-OWN-ON  
W(RA,YA,HA,GA) INSTALLED  
VIDEOS ATTACHED

1. SIZE/TYPE  
E = 8" VEHICLE T = 12"  
P = 12" PEDESTRAIN L = LANE CONTROL  
C = COMBO 8/12 S = 12" SPEED
2. MATERIAL  
P = POLY A = ALUM.  
T = ALUM. TOP/PC BOTTOM  
C = POLY SIGNAL VISOR
3. COLOR  
Y = YELLOW B = BLACK P = FLAT BLACK (12")  
G = DARK GREEN L = LIGHT GREEN  
C = YELL BODY/BLK DOOR/BLK VISOR  
D = YELL BODY/BLK DOOR/YELL VISOR  
E = YELL BODY & DOOR/BLACK VISOR  
V = BLK BODY/YELL DOOR/BLK VISOR
- 4-5. CONFIGURATION  
2 DIGIT MPH FOR SPEED INDICATION  
DIGIT CONFIG. CODE ON ADJ. PAGE  
4C = YA, GA  
RA, YA
6. TERMINAL BLOCK TYPE  
5 = 5 POS. 20A 6 = 6 POS. 20A  
7 = 5 POS. 30A 8 = 6 POS. 30A  
2 = 2 POS. 20A N = NONE  
T = TEXAS SPEC CONFIG 30, 47, 56 ONLY
7. TERMINAL BLOCK LOCATION  
T = TOP C = CENTER B = BOTTOM  
X = SPECIAL  
VISOR
8. VISOR  
T = TUNNEL C = CAP  
F = FULL CIRCLE\*\* N = NO VISOR
9. LENS  
N = NONE G = GLASS P = POLY  
M = GLASS W/MOLDED ARROWS (12" ONLY)
10. LENS GASKET/LED TYPE  
E = INCAND/LED RDY. NO GASKET  
B = TXDOT E.V. C = ILE LED  
G = CLATTRANS/ 2005 ITE STYLE  
J = ITE/HIFLUX INCANDESCENT LOOK  
L = 12" EX. VIEW TXDOT M = HIFLUX TXDOT  
N = OMNI-DIRECTIONAL ARROW  
Z = INCAND/LED RDY. W/GASKET
11. ORIENTATION  
V = VERTICAL H = HORIZONTAL
12. SUPPORT PLATES  
1 = ONE TOP 2 = ON BOTTOM  
3 = TWO BOTTOM 4 = ONE TOP & 2 BOT  
X = SPECIAL 5 = TWO FOR EP  
6 = DOGHOUSE (1TOP/BOTTOM OF RED)  
N = NONE
13. MECHANICAL  
0 = PLATED TRI-STUD 1 = SS TRI-STUDS  
2 = PLATED SCREWS 3 = SS SCREWS
14. LED CONFIGURATION  
0 = NONE A = ALL SECTIONS LED  
N = ALL LED RDY  
J = RED BALL/HAND LED  
K = RED BALL/HAND LED READY  
G = RED, GREEN BALL/ARROW LED  
H = RED, GRN BALL/ARROW LED RDY  
I = BI-MODALS ONLY, LED RDY  
S = STROBE, 12" 1 SECT. B = ALL SECT. (12VDC)

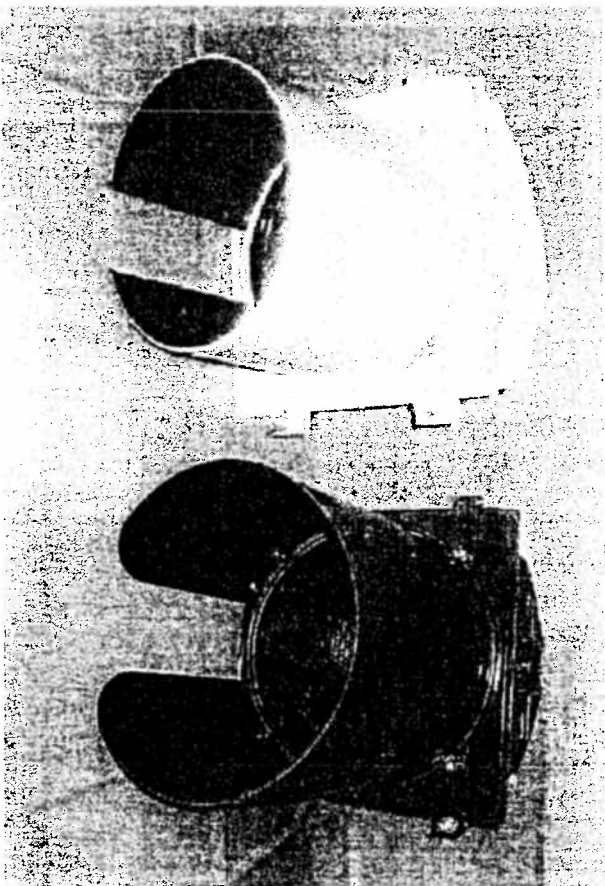
SIG	1	2	3	4	5	6	7	8	9	10	11	12	13	14
OPTION CATEGORY	T	P	Y	4	C	B	C	T	N	E	V	N	O	N

\* WITH LEDTEK RA, YA, YA, GA

INSTALLED



# CHAPEL HILL MANUFACTURING



## OPTIONS/TRAFFIC PARTS, INC.

- SIZE/TYPE**  
E = 8" VEHICLE T = 12"  
P = 12" PEDESTRAIN L = LANE CONTROL  
C = COMBO 8/12 S = 12" SPEED
- MATERIAL**  
P = POLY A = ALUM.  
T = ALUM. TOP/PC BOTTOM  
C = POLY SIGNAL VISOR
- COLOR**  
Y = YELLOW B = BLACK F = FLAT BLACK (12")  
G = DARK GREEN L = LIGHT GREEN  
C = YELL BODY/BLK DOOR/BLK VISOR  
D = YELL BODY/BLK DOOR/YELL VISOR  
E = YELL BODY & DOOR/BLACK VISOR  
V = BLK BODY/YELL DOOR/BLK VISOR
- CONFIGURATION** 41 = R.Y.Y.A.G  
2 DIGIT MPH FOR SPEED INDICATION  
DIGIT CONFIG. CODE ON ADJ. PAGE
- TERMINAL BLOCK TYPE**  
5 = 5 POS. 20A 6 = 6 POS. 20 A  
7 = 5 POS. 30A 8 = 6 POS. 30 A  
2 = 2 POS. 20A N = NONE  
T = TEXAS SPEC CONFIG 30, 47, 56 ONLY
- TERMINAL BLOCK LOCATION**  
T = TOP C = CENTER B = BOTTOM  
X = SPECIAL
- VISOR**  
T = TUNNEL C = CAP  
F = FULL CIRCLE\*\* N = NO VISOR
- LENS**  
N = NONE G = GLASS P = POLY  
M = GLASS W/WOLDED ARROWS (12")  
ONL.Y)
- LENS GASKET/LED TYPE**  
E = INCANDILED RDY. NO GASKET  
B = TXDOT E.V. C = ITE LED  
G = CLATTRANS/ 2005 ITE STYLE  
J = ITE/HIFLUX INCANDESCENT LOOK  
L = 12" EX. VIEW TXDOT M = HIFLUX  
TXDOT
- ORIENTATION**  
N = OMNI-DIRECTIONAL ARROW  
Z = INCANDILED RDY.W/GASKET  
V = VERTICAL H = HORIZONTAL
- SUPPORT PLATES**  
1 = ONE TOP 2 = ON BOTTOM  
3 = TWO BOTTOM 4 = ONE TOP & 2 BOT  
X = SPECIAL 5 = TWO FOR EP  
6 = DOGHOUSE (1TOP/BOTTOM OF RED)  
N = NONE
- MECHANICAL**  
0 = PLATED TRI-STUD 1 = SS TRI-STUDS  
2 = PLATED SCREWS 3 = SS SCREWS
- LED CONFIGURATION**  
0 = NONE A = ALL SECTIONS LED  
N = ALL LED RDY  
J = RED BALL/HAND LED  
K = RED BALL/HAND LED READY  
G = RED GREEN BALL/ARROW LED  
H = RED GRN BALL/ARROW LED RDY  
I = BI-MODALS ONLY, LED RDY  
S = STROBE, 12" 1 SECT. B = ALL SECT.  
(12VDC)

## TRAFFIC PARTS, INC.

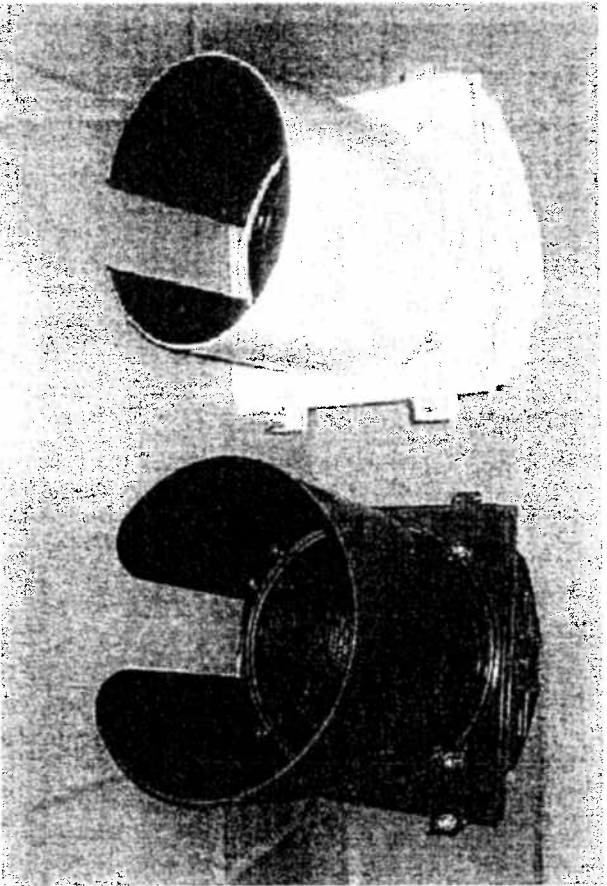
TYPE 3

24-TAY(B)-416-CIN-EVA-ON  
w/ R.Y.Y.A.G LED INSTRUCTIONS  
VISORS ATTACHED

SIG	1	2	3	4	5	6	7	8	9	10	11	12	13	14
T P Y	4	1	6	C	T	N	E	V	N	O	N			
OPTION/ CATEGORY														

\* WITH ROTER R.Y.Y.A.G  
INSTALLED  
INVERTED T

# CHAPEL HILL MANUFACTURING



## OPTIONS/TRAFFIC PARTS, INC.

1. **SIZE/TYPE**  
E = 8" VEHICLE T = 12"  
P = 12" PEDESTRAIN L = LANE CONTROL  
C = COMBO 8/12 S = 12" SPEED
2. **MATERIAL**  
P = POLY A = ALUM.  
T = ALUM. TOP/PC BOTTOM  
C = POLY SIGNAL VISOR
3. **COLOR**  
Y = YELLOW, B = BLACK, F = FLAT BLACK (12")  
G = DARK GREEN, L = LIGHT GREEN  
C = YELL BODY/BLK DOOR/BLK VISOR  
D = YELL BODY/BLK DOOR/YELL VISOR  
E = YELL BODY & DOOR/BLACK VISOR  
V = BLK BODY/YELL DOOR/BLK VISOR
- 4-5. **CONFIGURATION** 31-8 YH YH  
2 DIGIT MPH FOR SPEED INDICATION  
2 DIGIT CONFIG. CODE ON ADJ. PAGE
6. **TERMINAL BLOCK TYPE**  
5 = 5 POS. 20A 6 = 6 POS. 20A  
7 = 5 POS. 30A 8 = 6 POS. 30A  
2 = 2 POS. 20A N = NONE  
T = TEXAS SPEC CONFIG 30, 47, 56 ONLY
7. **TERMINAL BLOCK LOCATION**  
T = TOP C = CENTER B = BOTTOM  
X = SPECIAL
8. **VISOR**  
T = TUNNEL C = CAP  
F = FULL CIRCLE\*\* N = NO VISOR
9. **LENS**  
N = NONE G = GLASS P = POLY  
M = GLASS W/MOLDED ARROWS (12" ONLY)
10. **LENS GASKET/LED TYPE**  
E = INCAND/LED RDY - NO GASKET  
B = TXDOT E.V. C = ITE LED  
G = CLATTRANS/2005 ITE STYLE  
J = ITE/HIFLUX INCANDESCENT LOOK  
L = 12" EX. VIEW TXDOT M = HIFLUX TXDOT
11. **ORIENTATION**  
N = OMNI-DIRECTIONAL ARROW  
Z = INCAND/LED RDY-W/GASKET
12. **SUPPORT PLATES**  
1 = ONE TOP 2 = ON BOTTOM  
3 = TWO BOTTOM 4 = ONE TOP & 2 BOT  
X = SPECIAL 5 = TWO FOR EP  
6 = DOGHOUSE (1TOP/BOTTOM OF RED)  
N = NONE
13. **MECHANICAL**  
0 = PLATED TRI-STUD 1 = SS TRI-STUDS  
2 = PLATED SCREWS 3 = SS SCREWS
14. **LED CONFIGURATION**  
0 = NONE A = ALL SECTIONS LED  
N = ALL LED RDY  
J = RED BALL/HAND LED  
K = RED BALL/HAND LED READY  
G = RED, GREEN BALL/ARROW LED  
H = RED, GRN BALL/ARROW LED RDY  
I = BI-MODALS ONLY, LED RDY  
S = STROBE, 12" 1 SECT. B = ALL SECT. (12VDC)

TRAFFIC PARTS, INC.

TYPE 2B FYH

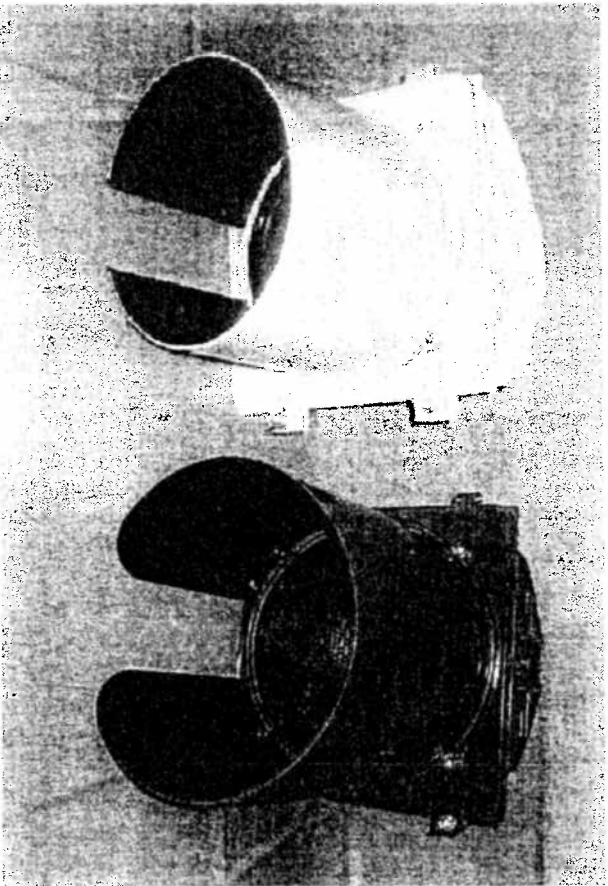
SK-TRM(B) 316 CTN-EVN-ON  
W/ R, YH, YH INSTALLED  
VISORS ATTACHED

SIG	1	2	3	4	5	6	7	8	9	10	11	12	13	14
OPTION CATEGORY	T	P	Y	3	1	6	T	M	E	V	M	O	N	

X WITH LEDTEK R, YH, YH INSTALLED

# CHAPEL HILL MANUFACTURING

## OPTIONS/TRAFFIC PARTS, INC.



1. **SIZE/TYPE**  
E = 8" VEHICLE T = 12"  
P = 12" PEDESTRAIN L = LANE CONTROL  
C = COMBO 8/12 S = 12" SPEED
2. **MATERIAL**  
P = POLY A = ALUM.  
T = ALUM. TOP/PC BOTTOM  
C = POLY SIGNAL VISOR
3. **COLOR**  
Y = YELLOW B = BLACK P = FLAT BLACK (12")  
G = DARK GREEN L = LIGHT GREEN  
C = YELL BODY/BLK DOOR/BLK VISOR  
D = YELL BODY/BLK DOOR/YELL VISOR  
E = YELL BODY & DOOR/BLACK VISOR  
V = BLK BODY/YELL DOOR/BLK VISOR
- 4-5. **CONFIGURATION** 3A = RYA, 6A  
2 DIGIT MPH FOR SPEED INDICATION  
DIGIT CONFIG. CODE ON ADJ. PAGE
6. **TERMINAL BLOCK TYPE**  
5 = 5 POS. 20A 6 = 6 POS. 20 A  
7 = 5 POS. 30A 8 = 6 POS. 30 A  
2 = 2 POS. 20A N = NONE  
T = TEXAS SPEC CONFIG 30, 47, 56 ONLY
7. **TERMINAL BLOCK LOCATION**  
T = TOP C = CENTER B = BOTTOM  
X = SPECIAL
8. **VISOR**  
T = TUNNEL C = CAP  
F = FULL CIRCLE\*\* N = NO VISOR
9. **LENS**  
N = NONE G = GLASS P = POLY  
M = GLASS W/MOLDED ARROWS (12") ONLY
10. **LENS GASKET/LED TYPE**  
E = INCAND/LED RDY. NO GASKET  
B = TXDOT E.V. C = ITE LED  
G = CLATTRANS/ 2005 ITE STYLE  
J = ITE/HIFLUX INCANDESCENT LOOK  
L = 12" EX. VIEW TXDOT M = HIFLUX TXDOT
11. **ORIENTATION**  
N = OMNI-DIRECTIONAL ARROW  
Z = INCAND/LED RDY-W/GASKET
12. **SUPPORT PLATES**  
1 = ONE TOP 2 = ONE BOTTOM  
3 = TWO BOTTOM 4 = ONE TOP & 2 BOT  
X = SPECIAL 5 = TWO FOR EP  
6 = DOGHOUSE (1TOP/BOTTOM OF RED)  
N = NONE
13. **MECHANICAL**  
0 = PLATED TRI-STUD 1 = SS TRI-STUDS  
2 = PLATED SCREWS 3 = SS SCREWS
14. **LED CONFIGURATION**  
0 = NONE A = ALL SECTIONS LED  
N = ALL LED RDY  
J = RED BALL/HAND LED  
K = RED BALL/HAND LED READY  
G = RED, GREEN BALL/ARROW LED  
H = RED, GRN BALL/ARROW LED RDY  
I = BI-MODALS ONLY, LED RDY  
S = STROBE, 12" 1 SECT. B = ALL SECT. (12VDC)

## TRAFFIC PARTS, INC.

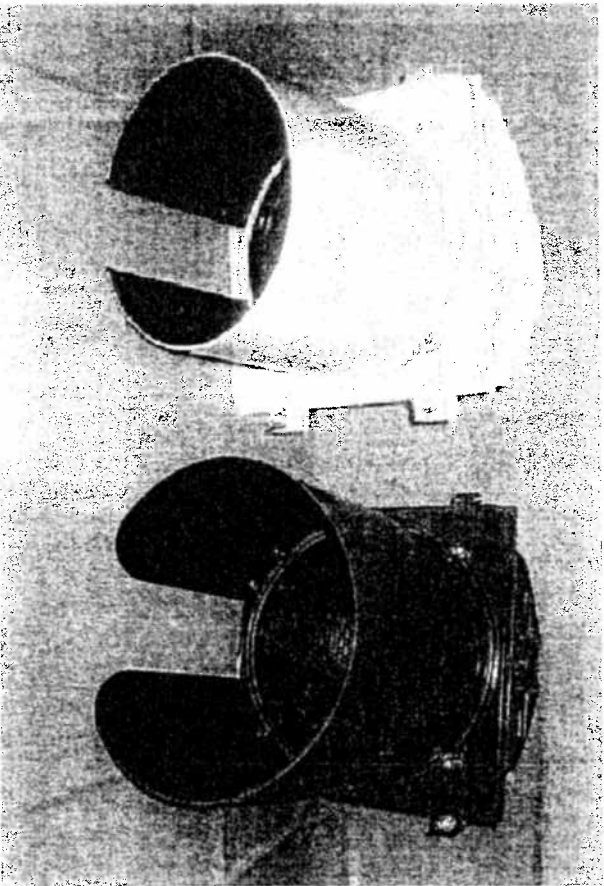
TYPE 4

916-TN(B)-3A6-CTN-EVN ON  
W/ R, YR, GR INSTALLED  
VISORS ATTACHED

SIG	1	2	3	4	5	6	7	8	9	10	11	12	13	14
OPTION CATEGORY	T	P	Y	3	9	6	Q	T	N	E	V	N	O	N

\* WITH LEDS R, YR, GR

# CHAPEL HILL MANUFACTURING



TRAFFIC PARTS, INC.

TYPE H  
614-TM(B)-346-CM-EVN-ON  
W/ R,R,Y LED INSTALLED  
VISORS ATTACHED

## OPTIONS/TRAFFIC PARTS, INC.

1. **SIZE/TYPE**  
E = 8" VEHICLE T = 12"  
P = 12" PEDESTRAIN L = LANE CONTROL  
C = COMBO 8/12 S = 12" SPEED
2. **MATERIAL**  
P = POLY A = ALUM.  
T = ALUM. TOP/PC BOTTOM  
C = POLY SIGNAL VISOR
3. **COLOR**  
Y = YELLOW B = BLACK F = FLAT BLACK (12")  
G = DARK GREEN L = LIGHT GREEN  
C = YELL BODY/BLK DOOR/BLK VISOR  
D = YELL BODY/BLK DOOR/YELL VISOR  
E = YELL BODY & DOOR/BLACK VISOR  
V = BLK BODY/YELL DOOR/BLK VISOR
- 4-5. **CONFIGURATION** 3A R,R,Y  
2 DIGIT MPH FOR SPEED INDICATION  
DIGIT CONFIG. CODE ON ADJ. PAGE
6. **TERMINAL BLOCK TYPE**  
5 = 5 POS. 20A 6 = 6 POS. 20A  
7 = 5 POS. 30A 8 = 6 POS. 30A  
2 = 2 POS. 20A N = NONE  
T = TEXAS SPEC CONFIG 30,47,56 ONLY
7. **TERMINAL BLOCK LOCATION**  
T = TOP C = CENTER B = BOTTOM  
X = SPECIAL
8. **VISOR**  
T = TUNNEL C = CAP  
F = FULL CIRCLE\*\* N = NO VISOR
9. **LENS**  
N = NONE G = GLASS P = POLY  
M = GLASS W/MOLDED ARROWS (12" ONLY)
10. **LENS GASKET/LED TYPE**  
E = INCAND./LED RDY. NO GASKET  
B = TXDOT E.V. C = ITE LED  
G = CLATTRANS/2005 ITE STYLE  
J = ITE/HIFLUX INCANDESCENT LOOK  
L = 12" EX. VIEW TXDOT M = HIFLUX TXDOT  
N = OMNI-DIRECTIONAL ARROW  
Z = INCAND./LED RDY. W/GASKET
11. **ORIENTATION**  
V = VERTICAL H = HORIZONTAL
12. **SUPPORT PLATES**  
1 = ONE TOP 2 = ON BOTTOM  
3 = TWO BOTTOM 4 = ONE TOP & 2 BOT  
X = SPECIAL 5 = TWO FOR EP  
6 = DOGHOUSE (1 TOP/BOTTOM OF RED)  
N = NONE
13. **MECHANICAL**  
0 = PLATED TRISTUD  
2 = PLATED SCREWS 1 = SS TRISTUDS  
3 = SS SCREWS
14. **LED CONFIGURATION**  
0 = NONE A = ALL SECTIONS LED  
N = ALL LED RDY  
J = RED BALL/HAND LED  
K = RED BALL/HAND LED READY  
G = RED, GREEN BALL/ARROW LED  
H = RED, GRN BALL/ARROW LED RDY  
I = BI-MODALS ONLY, LED RDY  
S = STROBE, 12" 1 SECT. B = ALL SECT. (12VDC)

SIG	1	2	3	4	5	6	7	8	9	10	11	12	13	14
OPTION CATEGORY	T	P	Y	3	A	6	C	T	N	E	V	N	O	N

\* WITH LEOTER R,R,Y INSTALLED

# DT Series Extended Life LED 8" and 12" Traffic Signal Module Incandescent Look Ball



## Leading the LED Industry Since 1992

With over 7,000,000 units installed globally

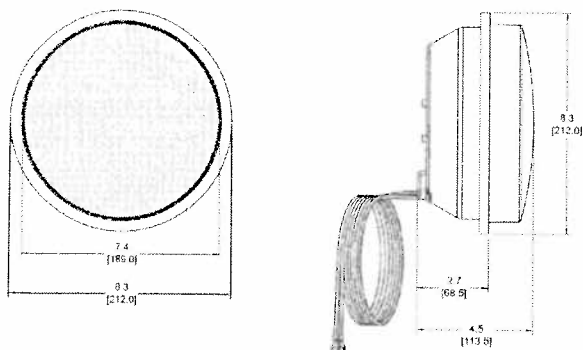
## Superior Performance and Reliability

- Special extended life LEDs (LM-80/TM-21)
- Special purpose-built extended life power supply
- Intertek ETL verified
- Meets and/or exceeds all ITE standards ITE VTCSH LED Circular Signal Supplement dated June 27, 2005
- Patented innovative optical technology
- Wider viewing angle and enhanced uniformity
- Overmolded electrical connectors provide fully-weatherized seal
- Excellent moisture and dust resistance
- Utilizes constant current source to maintain consistent light output
- 15-year limited full performance warranty

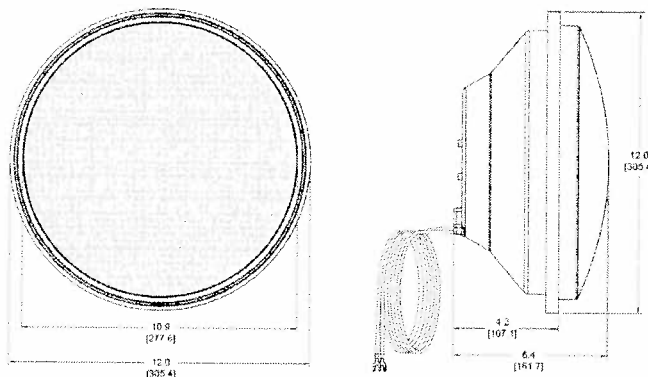


## Mechanical Dimensions [in(mm)]

8 Inch



12 Inch











# DT Series Extended Life LED 8" and 12" Traffic Signal Module Incandescent Look Ball

## Model Specifications and Ordering Options

Operating Temperature: -40°F to 165°F (-40°C to 74°C)	Turn-On/Turn-Off Time: < 75msec
Operating Voltage: 80 - 135Vac	Turn-Off Voltage: > 35Vac
Power Factor: > 0.90	Total Harmonic Distortion (THD): < 20%

	Model Number and Color	Wattage Drawn	Voltage	Dominant Wavelength	Maintained Intensity (cd) Min.	Standard
DT	<b>8 inch ball</b>					
	TSL-08R-DT-A1 	6.1	80-135Vac	626	165	ITE 2005/ETL
	TSL-08Y-DT-A1 	6.1	80-135Vac	589	410	ITE 2005/ETL
	TSL-08G-DT-A1 	6.2	80-135Vac	500	215	ITE 2005/ETL
	<b>12 inch ball</b>					
	TSL-12R-DT-A1 	6.2	80-135Vac	626	365	ITE 2005/ETL
	TSL-12Y-DT-A1 	7.9	80-135Vac	589	910	ITE 2005/ETL
	TSL-12G-DT-A1 	6.1	80-135Vac	500	475	ITE 2005/ETL

### Notes:

1 Tinted lens standard, clear lens optional. When ordering clear lens, please add "-CLR" to model number. Both tinted and clear lens are Intertek ETL Verified.

## Standard Conformance

- FCC Compliant for Electrical Noise
- MIL-STD-810F Moisture Resistant
- MIL-STD-883 Mechanical Vibration
- NEMA TS2 Section 2.1.8, Transient Voltage Protection over 2000V
- IEC 1000-4-5, 3KV, 2 ohm source impedance
- ANSI/IEEE C62.41-2002; IEC 61000-4-12, 6KV, 200A, 100KHz ring wave

## ITE VTCSH Compliance - LED Circular Signal Supplement – June 27, 2005

• Conditioning	ITE 6.4.2	• Luminous Intensity	ITE 6.4.4.1-4
• Mechanical Vibration	ITE 6.4.3.1	• Chromaticity	ITE 6.4.4.6
• Temperature Cycling	ITE 6.4.3.2	• Current Consumption	ITE 6.4.6.1

# DT Series Extended Life 12" Traffic Signal Module Incandescent Look Arrow



## Leading the LED Industry Since 1992

With over 7,000,000 units installed globally

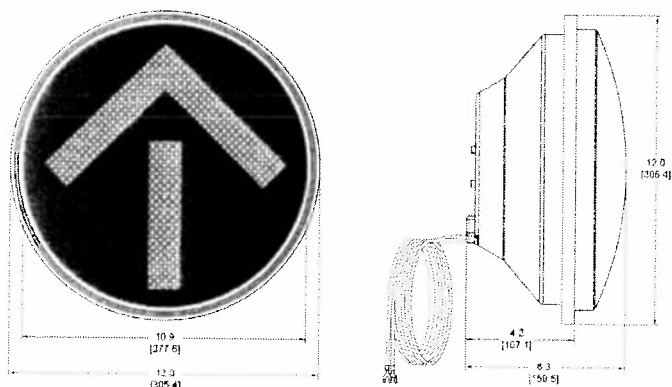
## Superior Performance and Reliability

- Special extended life LEDs (LM-80/TM-21)
- Special purpose-built extended life power supply
- Intertek ETL verified
- Meets and/or exceeds all ITE standards ITE VTCSH LED Arrow Signal Supplement dated July 1, 2007
- Patented innovative optical technology
- Wider viewing angle and enhanced uniformity
- Overmolded electrical connectors provide fully-weatherized seal
- Excellent moisture and dust resistance
- Utilizes constant current source to maintain consistent light output
- 15-year limited full performance warranty



## Mechanical Dimensions [in(mm)]

12 inch








# DT Series Extended Life 12" Traffic Signal Module Incandescent Look Arrow

## Model Specifications and Ordering Options

Operating Temperature: -40°F to 165°F (-40°C to 74°C)	Turn-On/Turn-Off Time: < 75msec
Operating Voltage: 80 - 135Vac	Turn-Off Voltage: > 35Vac
Power Factor: > 0.90	Total Harmonic Distortion (THD): < 20%

	Model Number and Color	Wattage Drawn	Voltage	Dominant Wavelength	Maintained Intensity (cd) Min.	Standard
DT	12 inch arrow					
	TSL-12RA-DT-A1 	6	80-135Vac	626	58.4	ITE 2007/ETL
	TSL-12YA-DT-A1 	10	80-135Vac	589	145.6	ITE 2007/ETL
	TSL-12GA-DT-A1 	6.8	80-135Vac	500	76.0	ITE 2007/ETL

### Notes:

1 Tinted lens standard, clear lens optional. When ordering clear lens, please add "-CLR" to model number. Both tinted and clear lens are Intertek ETL Verified.

## Standard Conformance

- FCC Compliant for Electrical Noise
- MIL-STD-810F Moisture Resistant
- MIL-STD-883 Mechanical Vibration
- NEMA TS2 Section 2.1.8, Transient Voltage Protection over 2000V
- IEC 1000-4-5, 3KV, 2 ohm source impedance
- ANSI/IEEE C62.41-2002; IEC 61000-4-12, 6KV, 200A, 100KHz ring wave

## ITE VTCSH Compliance - LED Arrow Signal Supplement – July 1, 2007

• Conditioning	ITE 6.4.2	• Luminous Intensity	ITE 6.4.4.1-4
• Mechanical Vibration	ITE 6.4.3.1	• Chromaticity	ITE 6.4.4.6
• Temperature Cycling	ITE 6.4.3.2	• Current Consumption	ITE 6.4.6.1

**OPTIONS****TRAFFIC PARTS, INC.**

## BACK PLATES FOR CHAPEL HILL SIGNALS \*\*\*

**1. MATERIAL**

A = AL, Flat, One Piece  
R = AL Flat Riveted  
P = PC Flat One Piece  
S = PC, Flat, Riveted  
V = ABS Vacuum Formed

**4. CONFIGURATION**

1 = 1 Sect. 2 = 2 Sect. 3 = 3 Sect  
4 = 4 Sect. 5 = 5 Sect  
H = 3S Sect Hawk 17" Tri-Stud  
C = 5S Clust, 17" Tristud Doghouse  
E = 5S Clust, 16" EZ Brac Doghouse  
K = 5S Clust, 16" EZ Brac 3SV x 2SV  
F = 5S Clust, 17" Framework Doghouse  
G = 5S Clust, 16.5" Framework, Doghouse

**2. SIGNAL/BORDER**

T = 12", 5" Border  
2 = 12", 8" Border  
P = 12" Plumbizer, 5" Border  
E = 8", 5" Border  
1 = 8", 8" Border  
C = Cluster, 12" Rectangular  
N = Cluster, 12" Notched 5" uniformed Border

**5. REFLECTIVE TAPE**

N = None  
1 = 1" 3M Tape  
2 = 2" 3M Tape  
A = 2" Avery  
3 = 3" 3M (Non-louvered only)

**3. LOUVERS**

N = None  
L = Louvers

**6. MOUNTING SCREWS**

N = None  
P = PC Signals  
1 = PC Signals, SS  
A = Al. Signals

\*\*\* - In most cases the 3 and 4 Section Back Plates will also fit Peek or TCT signals  
Cluster BP are signal Mfg and hardware specific.

BP	V	T	N	3	N	P
OPTION CATAGORY	1	2	3	4	5	6

2" TAPE ADDER \$36.72

**OPTIONS****TRAFFIC PARTS, INC.**

# BACK PLATES FOR CHAPEL HILL SIGNALS \*\*\*

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R = AL Flat Riveted  
P = PC Flat One Piece  
S = PC, Flat, Riveted  
V = ABS Vacuum Formed

**4. CONFIGURATION**

1 = 1 Sect. 2 = 2 Sect. 3 = 3 Sect  
4 = 4 Sect. 5 = 5 Sect  
H = 3S Sect Hawk 17" Tri-Stud  
C = 5S Clust, 17" Tristud Doghouse  
E = 5S Clust, 16" EZ Brac Doughouse  
K = 5S Clust, 16" EZ Brac 3SV x 2SV  
F = 5S Clust, 17" Framework Doghouse  
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N = None  
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**6. MOUNTING SCREWS**

N = None  
P = PC Signals  
1 = PC Signals, SS  
A = Al. Signals

\*\*\* - In most cases the 3 and 4 Section Back Plates will also fit Peek or TCT signals  
Cluster BP are signal Mfg and hardware specific.

BP	V	T	N	4	N	P
OPTION CATAGORY	1	2	3	4	5	6

TYPE  
2A FYA

\* 2" TAPE ADDER \$ 39.15

# OPTIONS

# TRAFFIC PARTS, INC.

## BACK PLATES FOR CHAPEL HILL SIGNALS \*\*\*

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 F = 5S Clust, 17" Framework Doghouse  
 G = 5S Clust, 16.5" Framework, Doghouse

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 1 = 8", 8" Border  
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 N = Cluster, 12" Notched 5" uniformed Border

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 1 = 1" 3M Tape  
 2 = 2" 3M Tape  
 A = 2" Avery  
 3 = 3" 3M (Non-louvered only)

### 3. LOUVERS

N = None  
 L = Louvers

### 6. MOUNTING SCREWS

N = None  
 P = PC Signals  
 1 = PC Signals, SS  
 A = Al. Signals

\*\*\* - In most cases the 3 and 4 Section Back Plates will also fit Peek or TCT signals  
 Cluster BP are signal Mfg and hardware specific.

BP	V	C	N	E	A	
OPTION CATAGORY	1	2	3	4	5	6

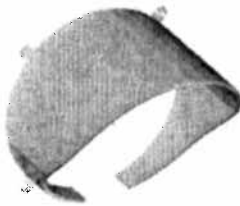
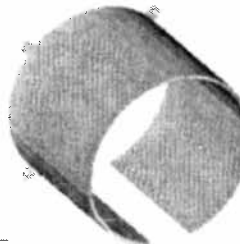
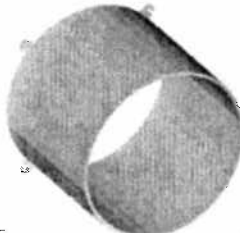


TYPE 1

\* 2" TAPE ADDER

\$49.15

# Replacement Visors (Veh Signals)

Note: Replacement visors below will fit most signal heads, but some brands require special visors; always check with sales department prior to ordering.

Description			12"		8"	
Type		Color	Poly	Alum	Poly	Alum
Cap  (Tabs, for CH)		Yellow	2382	5537	2743	5531
		Black	3806	5538	3801	5532
		Dk Grn	3807	5539	3802	5533
Tunnel  (Tabs, for CH)		Yellow	<del>X</del> 1777	<del>X</del> 5540	2407	5534
		Black	<del>X</del> 2575	<del>X</del> 5541	3803	5535
		Dk Grn	3805	5542	3804	5536
Full Circle  (Tabs)		Yellow	6133	5302	*	*
		Black	7372	5303	*	*
		Dk Grn	*	5098	*	*
Cap  (For Eagle)		Yellow	*	927 (slots)	*	*
		Black	*	4279 (slots)	*	*
		Dk Grn	*	5304 (slots)	*	*
Tunnel  (For Eagle)		Yellow	6298 (tabs)	564 (slots)	*	*
		Black	6299 (tabs)	790 (slots)	*	*
		Dk Grn	6300 (tabs)	792 (slots)	*	*

\*=Special