



ATSPM TRAIN-THE- TRAINER

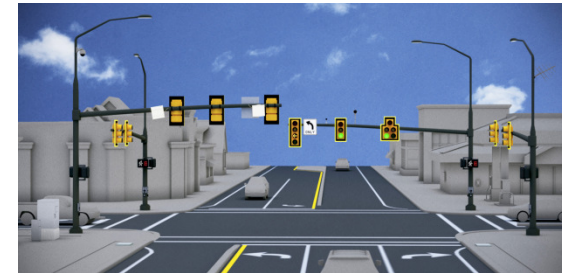
Mark Taylor, P.E., PTOE

Traffic Signal Operations Engineer

Utah Department of Transportation

Brief Utah Update

- 2019 Traffic Signals in the State of Utah
 - 1194 owned and operated by UDOT (59%)
 - 825 owned and operated by cities /counties (41%)



- All cities share same ITS communications
 - 94% of UDOT signals connected
 - 79% of non-UDOT signals connected



- All cities in Utah & UDOT share same ATMS



The logo for ATSPM features a thick orange horizontal bar at the top. Below it, the letters 'A', 'S', 'P', and 'M' are rendered in a large, bold, blue sans-serif font. The letter 'T' is represented by a vertical orange bar that extends from the top orange bar down to the baseline of the other letters. Below the letters, the full name 'Automated Traffic Signal Performance Measures' is written in a smaller, blue, sans-serif font.

ATSPM

Automated Traffic Signal Performance Measures

Started Development November 2012.

Estimate 6,000 hours of UDOT development
November 2012 to January 2017.

Old UDOT ATSPM Website (Version 1-3)



Signal Performance Metrics



Charts Reports Log Action Taken Links FAQ

->Signal Metrics

Selected Signal
 No Signal Selected

Signals
Region:
Metric Type:
Filter:

Signal List

Map

Metric Settings

Metric Type

- Purdue Phase Termination
- Split Monitor
- Pedestrian Delay
- Preemption Details
- Turning Movement Counts
- Purdue Coordination Diagram
- Approach Volume
- Approach Delay
- Arrivals On Red
- Approach Speed
- Yellow and Red Actuations
- Purdue Split Failure

Time Y Axis Maximum:
Volume Y Axis Maximum:
Volume Bin Size:
Dot Size:
 Show Plan Statistics
 Show Volumes
[Export Data](#)
 Upload Current Data

Dates
Start Date:
End Date:

Sun	Mon	Tue	Wed	Thu	Fri	Sat
31	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	1	2	3
4	5	6	7	8	9	10

UDOT's New ATSPM Website (Version 4)

<http://udottraffic.utah.gov/ATSPM>



Measures Reports Log Action Taken Links FAQ Admin About

Hello defaultadmin@spm.gov! Log off

Signal

Signal Selection

Signal ID

7220 Foothill Drive @ 1300 South

Signal List

Signal Map

Region: --Select Region--

Metric Type: --Select a Metric--

Chart Selection

Metrics List

- Purdue Phase Termination
- Split Monitor
- Pedestrian Delay
- Preemption Details
- Turning Movement Counts
- Purdue Coordination Diagram
- Approach Volume
- Approach Delay
- Arrivals On Red
- Approach Speed
- Yellow and Red Actuations
- Purdue Split Failure

Phase Termination Options

Y-axis Max

Auto

Consecutive Count

1

Show Plans

Show Ped Activity

Date Selection

Start Date: 12/07/2016 12:00 AM

End Date: 12/07/2016 11:59 PM

Reset Date

Create Chart

Automated Traffic Signal Performance Measures Ver 4.0

1749 (87%) Utah's traffic signals

ATSPM Basic Concept

Hi Def Data Logger
included in controller
firmware

Hi Def logs retrieved
every 10-60 minutes
from controller to server

Website to display
SPM's



(Or...Retrieve data logs
from controller manually
using Raspberry Pi)

A Central Signal System is NOT used or Needed!

Why Model what you can Measure?

System Requirements



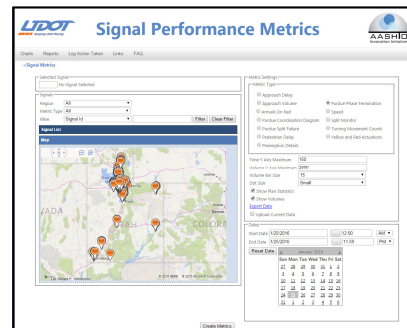
Communications



High-resolution Controller

- 1) Get .dat Files
- 2) Translate Files
.dat → .csv
- 3) Store in Database

Server



Software



Detection (optional)

System Requirements



High-resolution Controller with built in data logger using Indiana Enumerations

- Econolite Cobalt: Any Version
- Econolite ASC3 NEMA: V. 2.50+
- Econolite 2070 with 1C CPU Module: V. 32.50+
- Intelight Maxtime: V. 1.7.0+
- Peek ATC Greenwave 03.05.0528+
- Trafficware 980ATC V. 76.10+
- McCain ATC eX NEMA: V. ?
- Siemens M50 Linux & M60 ATC
 - ECOM V. 3.52+
 - NTCIP V. 4.53+

2070's don't work without 1C CPU



Data Logger records to the 1/10 second resolution

Objective: Vendor Neutrality



Controller Enumerations

Active Phase Events:

- 0 Phase On
- 1 Phase Begin Green
- 2 Phase Check
- 3 Phase Min Complete
- 4 Phase Gap Out
- 5 Phase Max Out
- 6 Phase Force Off
- 7 Phase Green Termination
- 8 Phase Begin Yellow Clearance
- 9 Phase End Yellow Clearance
- 10 Phase Begin Red Clearance
- 11 Phase End Red Clearance

Preemption Events:

- 101 Preempt Advance Warning Input
- 102 Preempt (Call) Input On
- 103 Preempt Gate Down Input Received
- 104 Preempt (Call) Input Off
- 105 Preempt Entry Started

Detector Events:

- 81 Detector Off
- 82 Detector On
- 83 Detector Restored
- 84 Detector Fault- Other
- 85 Detector Fault- Watchdog Fault
- 86 Detector Fault- Open Loop Fault

11-2012

Indiana Traffic Signal Hi Resolution Data Logger Enumerations

James R. Sturdevant
INDOT, jsturdevant@indot.in.gov

Timothy Overman
INDOT

Eric Raamot
Econolite Group Inc.

Ray Deer
Peek Traffic Corporation

Dave Miller
Siemens Industry, Inc.

See next page for additional authors

<http://docs.lib.purdue.edu/jtrpdata/3/>

Controller Enumerations

Active Phase Events:

- 0 Phase On
- 1 Phase
- 2 Phase
- 3 Phase
- 4 Phase
- 5 Phase
- 6 Phase
- 7 Phase
- 8 Phase
- 9 Phase
- 10 Phase
- 11 Phase

Preemption Event

- 101 Preemp
- 102 Preemp
- 103 Preemp
- 104 Preemp
- 105 Preemp

Detector Events:

- 81 Detector Off

Purdue University
Purdue e-Pubs

JTRP Data Papers

11-2012

Indiana Traffic Signal Hi Resolution Data Logger Enumerations

James R. Sturdevant
INDOT, jsturdevant@indot.in.gov

Timothy Overman
INDOT

Eric Raamot
Econolite Group Inc.

Ray Deer
Peek Traffic Corporation

Dave Miller
Siemens Industry, Inc.

See next page for additional authors

<http://docs.lib.purdue.edu/jtrpdata/3/>

<http://docs.lib.purdue.edu/jtrpdata/3/>

High-resolution Data

	Timestamp	Event Code	Event Parameter
Detector 5 ON	6/27/2013 1:29:51.1	10	8
	6/27/2013 1:29:51.1	82	5
	6/27/2013 1:29:52.2	1	2
	6/27/2013 1:29:52.2	1	6
	6/27/2013 1:29:52.3	82	2
	6/27/2013 1:29:52.8	82	4
	6/27/2013 1:29:52.9	81	4
	6/27/2013 1:29:53.3	81	6
	6/27/2013 1:29:54.5	81	2
	6/27/2013 1:30:02.2	8	2
	6/27/2013 1:30:02.2	8	6
	6/27/2013 1:30:02.2	33	2
	6/27/2013 1:30:02.2	33	6
	6/27/2013 1:30:02.2	32	2
6/27/2013 1:30:02.2	32	6	
6/27/2013 1:30:06.1	10	2	
6/27/2013 1:30:06.1	10	6	
Phase 8 GREEN	6/27/2013 1:30:08.1	1	8
Detector 5 OFF	6/27/2013 1:30:13.1	32	8
	6/27/2013 1:30:15.8	81	5
	6/27/2013 1:30:18.5	82	6
	6/27/2013 1:30:27.5	81	6
	6/27/2013 1:30:30.4	8	8

Objective: Vendor Neutrality



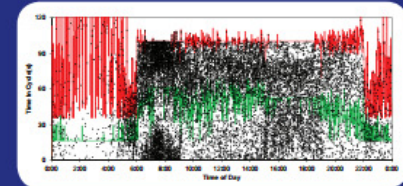


PURDUE
UNIVERSITY



PERFORMANCE MEASURES FOR TRAFFIC SIGNAL SYSTEMS

An Outcome-Oriented Approach



*Christopher M. Day, Darcy M. Bullock, Howell Li, Stephen M. Remias, Alexander M. Hainen,
Richard S. Freije, Amanda L. Stevens, James R. Sturdevant, and Thomas M. Brennan*



PURDUE
UNIVERSITY



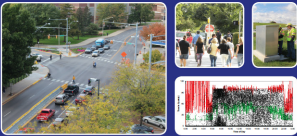
POOLED FUND STUDY

INDIANAPOLIS


NOVEMBER 12, 2014

PERFORMANCE MEASURES FOR
TRAFFIC SIGNAL SYSTEMS

An Outcome-Oriented Approach



Christopher M. Gray, Cheryl M. Aubock, Howell Li, Stephen M. Dennis, Alexander M. Hahnert,
Richard S. Fraga, Amanda L. Stevens, James R. Shubert, and Thomas M. Brown



Salt Lake ATSPM Workshop Participants – Jan 2016

-  20 State & Federal Agencies
-  25 Public Agencies
-  5 Universities
-  35 Private Sector Locations



170 Representatives from 85 Different Organizations, 28 States, DC, & Canada

Search

Enter search terms:

in this collection ▾

[Advanced Search](#)

Notify me via email or [RSS](#)

Browse

[Collections](#)
[Disciplines](#)
[Authors](#)

Links for Authors

[Policies and Help Documentation](#)



PRESENTATIONS FROM JANUARY 26-27, 2016



2016

Tuesday, January 26th

Traffic Signal Performance Measures Workshop

Darcy Bullock, *Purdue University*

TSM&O in Florida

Raj Ponnaluri, *Florida Department of Transportation*

Automated Traffic Signal Performance Measures, AASHTO Innovation Initiative 2013 Focus Technology

Rob Clayton, *Utah Department of Transportation*

Lessons Learned from ASCT and Systems Engineering

Eddie Curtis, *Federal Highway Administration*

Transportation Pooled Fund Program Recap

Jim Sturdevant, *Indiana Department of Transportation*
Richard Denney, *Federal Highway Administration*

Public/Private Partnerships: Expanding the Reach of Traffic Signals

Lynne Yocom, *Utah Department of Transportation*

<http://docs.lib.purdue.edu/atspmw>

ite
Institute of Transportation Engineers

ITE 3-part Webinar
April, May, June 2014

BOOKSTORE EMPLOYMENT CENTER TECHNICAL INFORMATION

ABOUT ITE JOIN ITE TODAY! COUNCILS

Automated Traffic Signal Performance Measures

ITE Journal, August 2016

Implementation of **Automated Traffic Signal Performance Measures**

BY CHRISTOPHER M. DAY, PH.D., MARK TAYLOR, P.E., PTOE,
JAMIE MACKEY, P.E., PTOE, ROB CLAYTON, P.E., PTOE,
SHITAL K. PATEL, P.E., GANG XIE, P.E., HOWELL LI,
JAMES R. STURDEVANT, P.E., AND DARCY BULLOCK, P.E.



Helping Traffic Engineers Manage Data to Make Better Decisions

Automated Traffic Signal Performance Measures

DARCY BULLOCK, P.E., ROB CLAYTON, P.E., PTOE, JAMIE MACKEY, P.E.,
JAMES R. STURDEVANT, P.E., PTOE, AMANDA STEVENS, P.E., JIM STURDEVANT, P.E.,
MARK TAYLOR, P.E., PTOE

Improved signal operations with smooth and equitable traffic flow are goals for most traffic engineers; however the limited snapshot-view retiming methods that involve manual data collection, traffic signal modeling, and field fine-tuning are resource intensive and unresponsive to changes in traffic patterns. The National Transportation Operations Coalition's 2012 National Traffic Signal Report Card has led agencies to focus on these activities and develop methodologies to examine all the components of traffic signal operations.¹ These data-driven program management plans provide objective methods for identifying shortcomings and encourages coordination with neighboring jurisdictions. In addition, agencies need tools to prioritize activities when resources are constrained.

Public Records (GRAMA) – What Do We Do?

- We give them raw records of what they are asking for – what we have - if we have it.
 - This may include the entire signal database for the intersection being requested.
 - We will define direction with phase number since this is not in the database.
 - This may include the the raw hi def data logs (CSV format).
 - We give them a link to the Purdue website that defines the enumerations.
 - They have no idea what to do with the raw data.
- We DO NOT create new records or refer them to ATSPM website.
- We DO NOT interpret or explain any of the data, even if they call or visit us. We do not help them sue us.

Sample – No headers, no contact info

This is in response to the request for the timing sequence for the traffic signal at ADDRESS on DATE & TIME. Provided is the database from the traffic signal controller that was in use on the above referenced date.

Also provided are the high resolution data logs from the signal controller from TIME AND DATE TO TIME AND DATE. In interpreting these logs, please reference *Indiana Traffic Signal Hi Resolution Data Logger Enumerations*, published by Purdue University, November 2012, available at (<http://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=1002&context=jtrpdata>). These logs are generated automatically and have not been checked for completeness.

In the provided database from the traffic signal controller, the phase numbers reference these movements (PLEASE SELECT OR MODIFY THE DESCRIPTION BELOW):

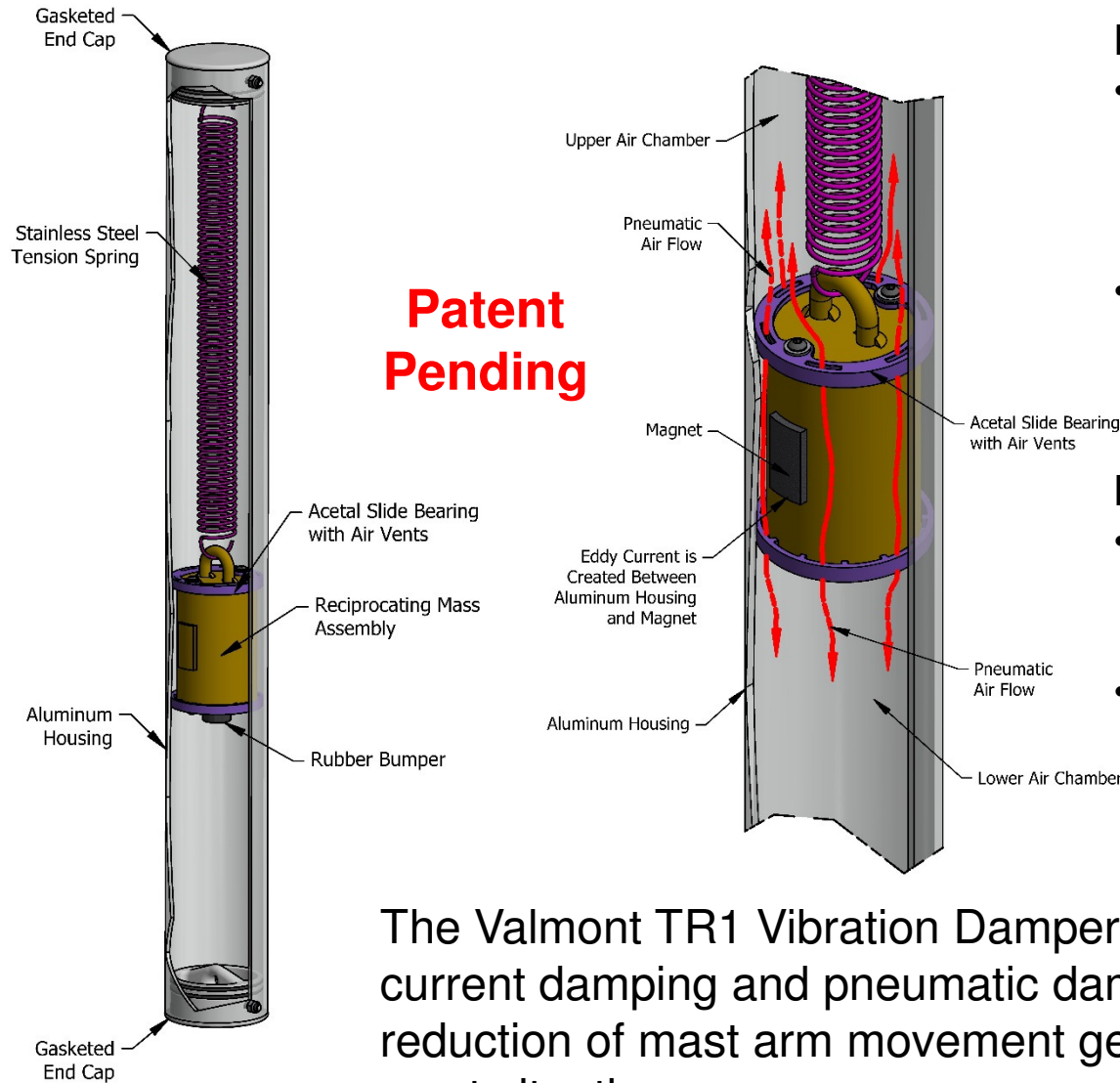
- Phase 1: Eastbound to northbound left
- Phase 2: Westbound thru
- Phase 3: Southbound to eastbound left
- Phase 4: Northbound thru
- Phase 5: Westbound to southbound left
- Phase 6: Eastbound thru
- Phase 7: Northbound to westbound left
- Phase 8: Southbound thru

MITIGATOR TR1 TRAFFIC DAMPER UDOT

LTCS Engineering
01-19-2017

Carl Macchietto, P.E.

TR1 Damper Technology (Eddy Current + Pneumatic)



Eddy Current:

- Eddy currents are circular electric currents induced within conductors by the movement of a magnet next to the conductive material.
- These circular currents are opposite the direction of movement creating a resistance and thus damping.

Pneumatic:

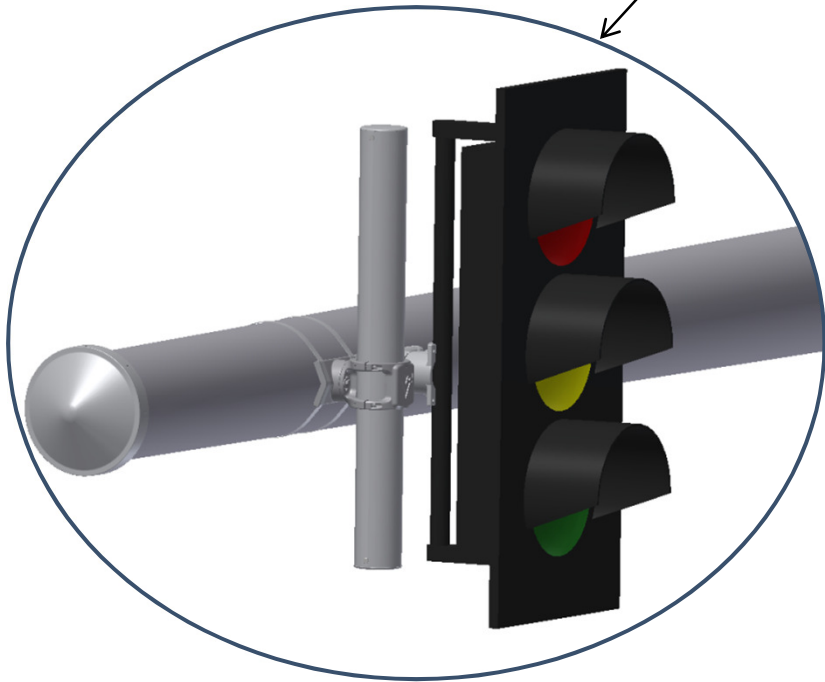
- Pneumatic Damping occurs as steel weight translates up and down within a sealed chamber.
- The exchange of air from the upper air chamber to the lower air chamber creates this resistance.

The Valmont TR1 Vibration Damper has both eddy current damping and pneumatic damping resulting in a reduction of mast arm movement generally over 90% in most situations.

Mitigator TR1 Vibration Damper

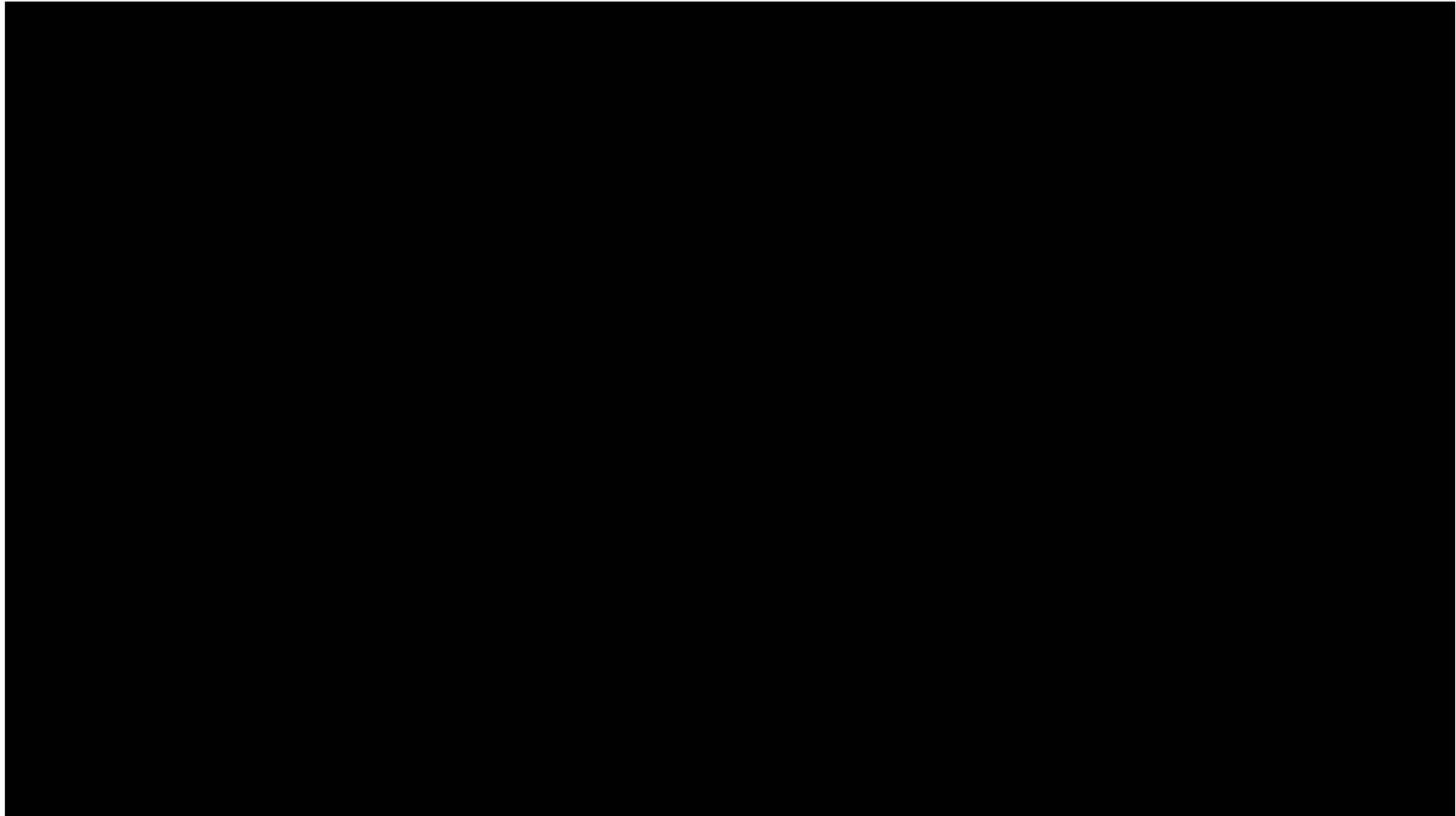


Damper Hidden Behind Traffic Signal
Total Weight = 34.7 lbs.
Dimensions = 4.5" diameter x 43" long



Mitigator TR-1 Damper Field Tests with Utah DOT

SR-36 & Bates Canyon Road – P4 Free Vibration Tests



ABOUT Tab – ATSPM website



Measures Reports Log Action Taken Links FAQ Admin **About**

Signal

Signal Selection

Signal ID

Signal ID

Press Enter to select signal

Signal List

Signal Map

ABOUT Tab Information – What's New & Up Next

What's New

Version 4.0

- Mobile Friendly
- ADA Compliant
- Enhanced Security
- Link Pivot Redone
- Easier Installation
- Conversion to use Entity Framework
- Conversion to MVC with Bootstrap
- New About Page
- New Logo

What's Next

UDOT is continually improving and updating the software. Currently we are working on the following features:

- Read-Only signal configuration option
- Modify Preemption Metric so it is more readable
- Modify Purdue Split Failure to accommodate permissive left turns
- Modify Yellow and Red Actuations to accommodate permissive left turns
- Comprehensive GDOT documentation

Currently Being Worked On (part 1)

- Add a read-only signal configuration table & route setup that is viewable and accessible by all.
- Modify preemption metric so it is more readable.
- Modify Purdue Split Failure to accommodate permissive left turns.
- Modify Yellow & Red actuations to accommodate permissive left turns.
- Add detector type & accuracy information to configuration tool and charts.

Currently Being Worked On (part 2)

- Add summary table to Turning Movement Counts (like approach volumes).
- Standardize chart headers
- Fix calendar so it displays entire weeks, including possibly last few days of the last month and/or first few days of the next month.
- Add additional text to the FAQ's.
- Route configuration – add some text at the top explaining how to add phase/directions.
- Security – Provide a table showing users and roles. Also, to allow a user to be deleted from system.

What's Up Next – Mid Future (??)

- Bring back Executive Reports
- Vegas Metrics
 - Defining phase direction
 - Time-Space Diagram
- Purdue Link Pivot – high-level analysis tracker & alert
- Cycle-by-Cycle metric (bicycle crash example)
- Daily Alert enhancements
- QC check of all metrics

UDOT Asset Management Tiers (2015 & Prior)

- Asset Management Tiers range from 1 to 3
- Tier 1 assets:
 - Highest value combined with highest risk of negative financial impact for poor management.
 - Very important to UDOT.
 - Receive separate funding source.
 - Targets and measures are set and tracked.

Tier 1 Assets
Pavement
Bridges

Tier 2 Assets
ATMS / Signal Devices
Pipe Culverts
Signs
Barriers & Walls
Rumble Strips
Pavement Markings

Tier 3 Assets
Cattle Guards
Interstate Lighting
Fences
Curb & Gutter
Rest Areas

UDOT Asset Management Tiers (2016 & Future)

- Asset Management Tiers range from 1 to 3
- Tier 1 assets:
 - Highest value combined with highest risk of negative financial impact for poor management.
 - Very important to UDOT.
 - Receive separate funding source.
 - Targets and measures are set and tracked.

Tier 1 Assets
Pavement
Bridges
ATMS / Signal Devices



Tier 2 Assets
Pipe Culverts
Signs
Barriers & Walls
Rumble Strips
Pavement Markings

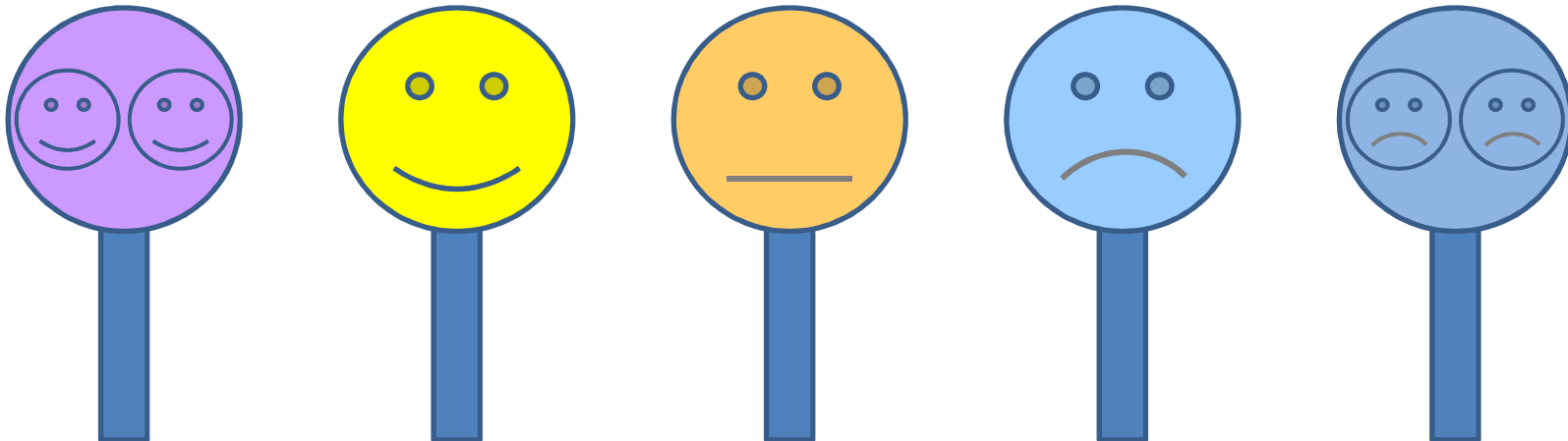
Tier 3 Assets
Cattle Guards
Interstate Lighting
Fences
Curb & Gutter
Rest Areas

UDOT Signal Timing Focus Group (July 2014)

- *How do you feel about UDOT?*



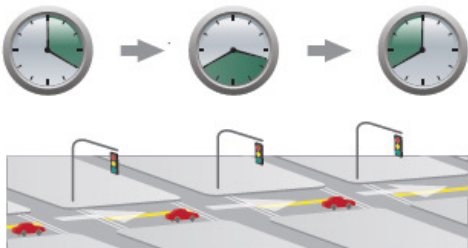
- *How do traffic signals make you feel?*



Focus Group Key Findings (July 2014)



UDOT is perceived positively, with innovation as the primary driver of positive impressions.



Drivers believe traffic signal synchronization is improving.



Drivers feel UDOT should be open about its accomplishments in a way that protects its credibility.

60 S Commercial – Love green lights? So do UDOT traffic engineers



<http://udot.utah.gov/greenlights>

udottraffic.utah.gov/ATSPM

Mark Taylor
marktaylor@utah.gov

Jamie Mackey
jamiemackey@utah.gov

