

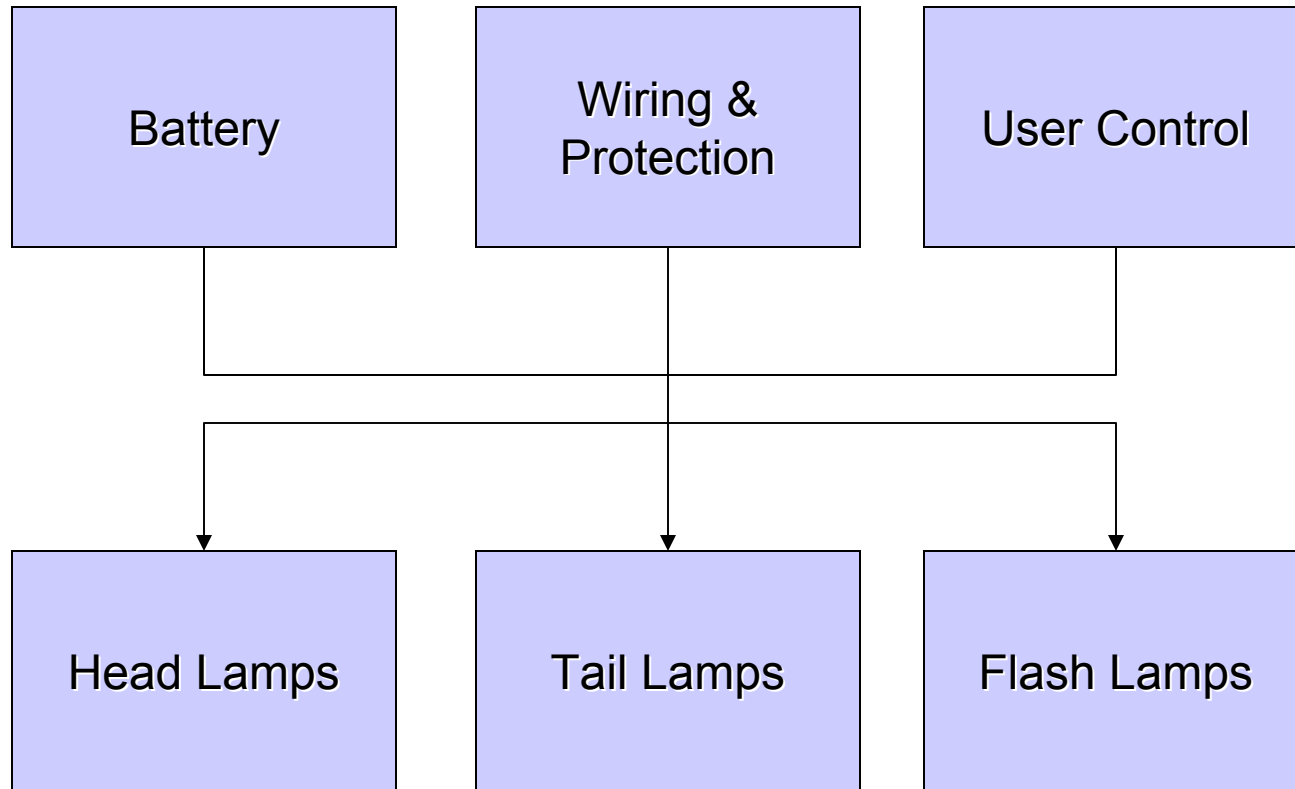
# Automotive System Design Examples

Ansoft Corporation  
Pittsburgh, PA

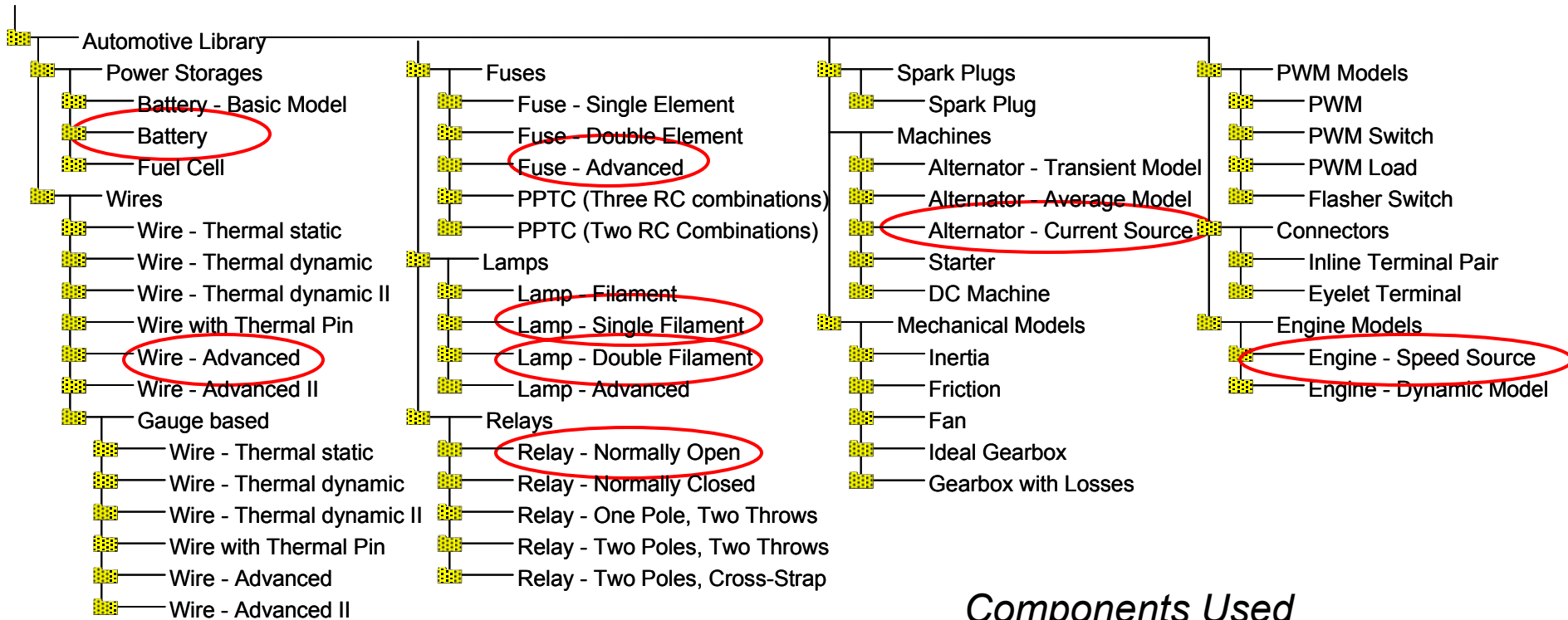
# Exterior Lighting System

- ▶ Automotive system design models
- ▶ Animated Symbols
- ▶ Real-time Displays
- ▶ Variables (temperature)
- ▶ User derived messages in output
- ▶ State Machines

# Exterior Lighting System

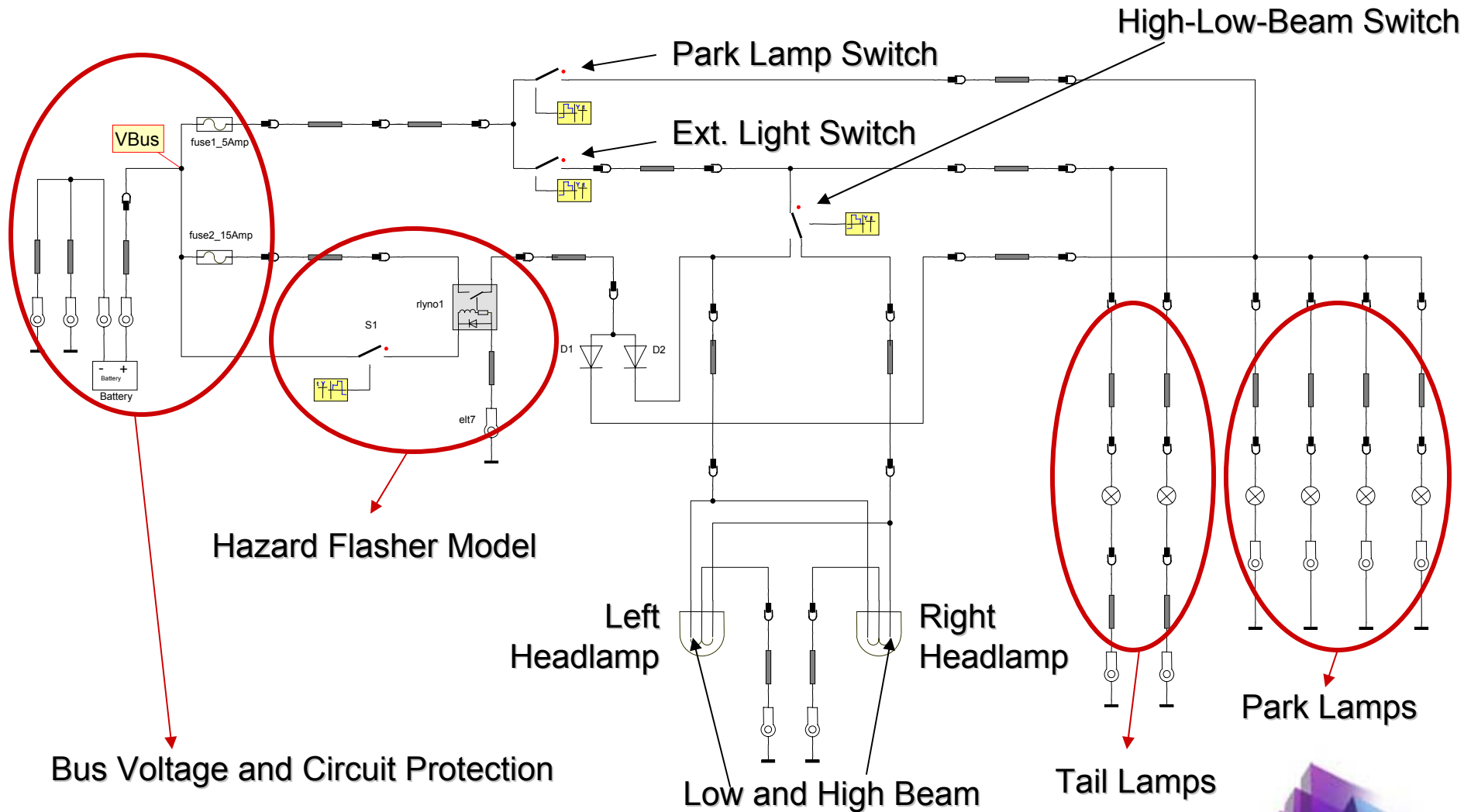


# Automotive Library

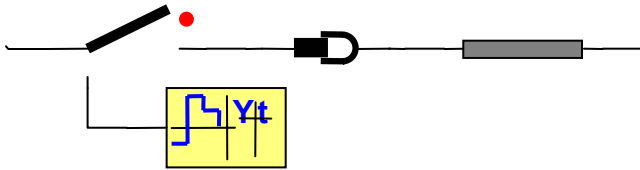


*Components Used*

# Model Structure



# Switch Control



LightSwitch

Properties - LightSwitch

Characteristic | Output / Display | Library

Name: LightSwitch  Show Name

Parameters

Interpolation: Without

Delay [s]: 0

Period [s]: 100

Phase [deg]: 0

Angular Dimension: deg

Periodical: No

File Reference

Data Pairs

No.	x-axis : t[s]	y-axis : Y
1	0	0
2	30	1
3	60	0
4	100	0

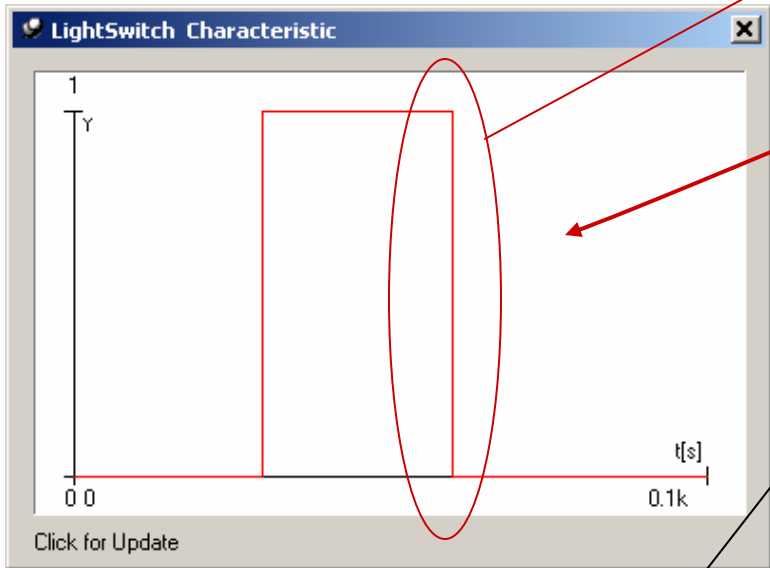
File Name: LightSwitch.mdx

Show

Default Outputs

Value

OK Cancel Apply Help



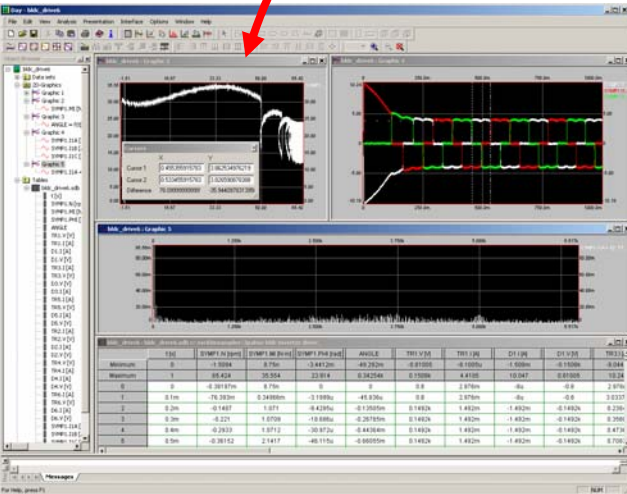
Enter Data Manually and save...

... or read measurement data from file

# Where To Get Data?



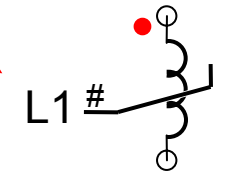
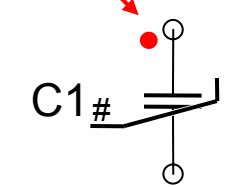
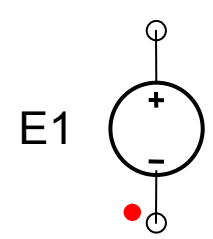
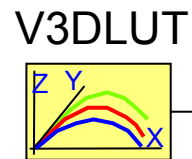
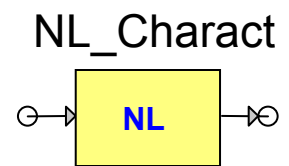
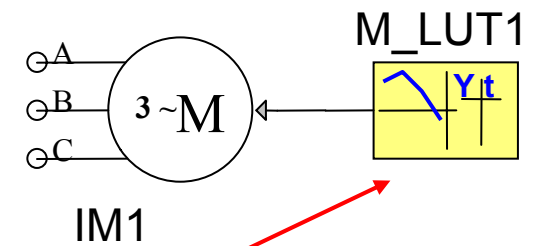
Data Acquisition



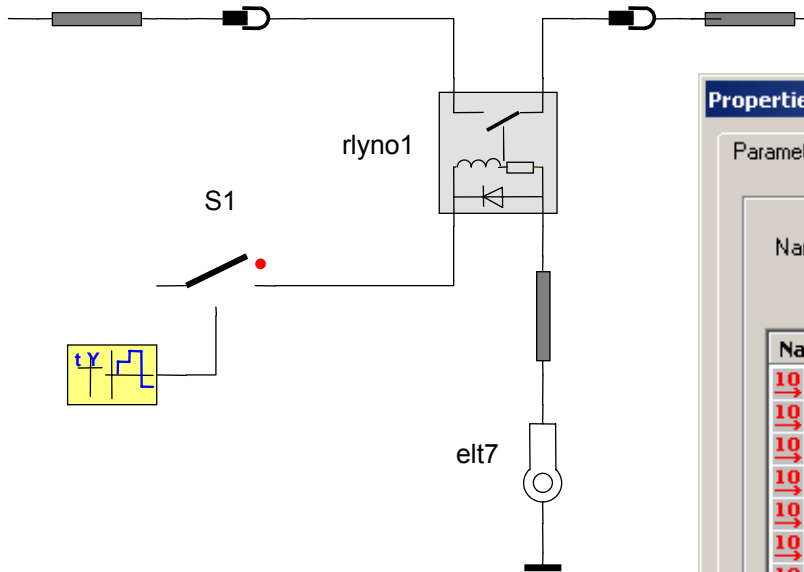
Data Processing

- Characteristics
- Stimuli
- Loads

2D, 3D, multi dimensional lookup table



# Hazard Flasher



Properties - rlyno1

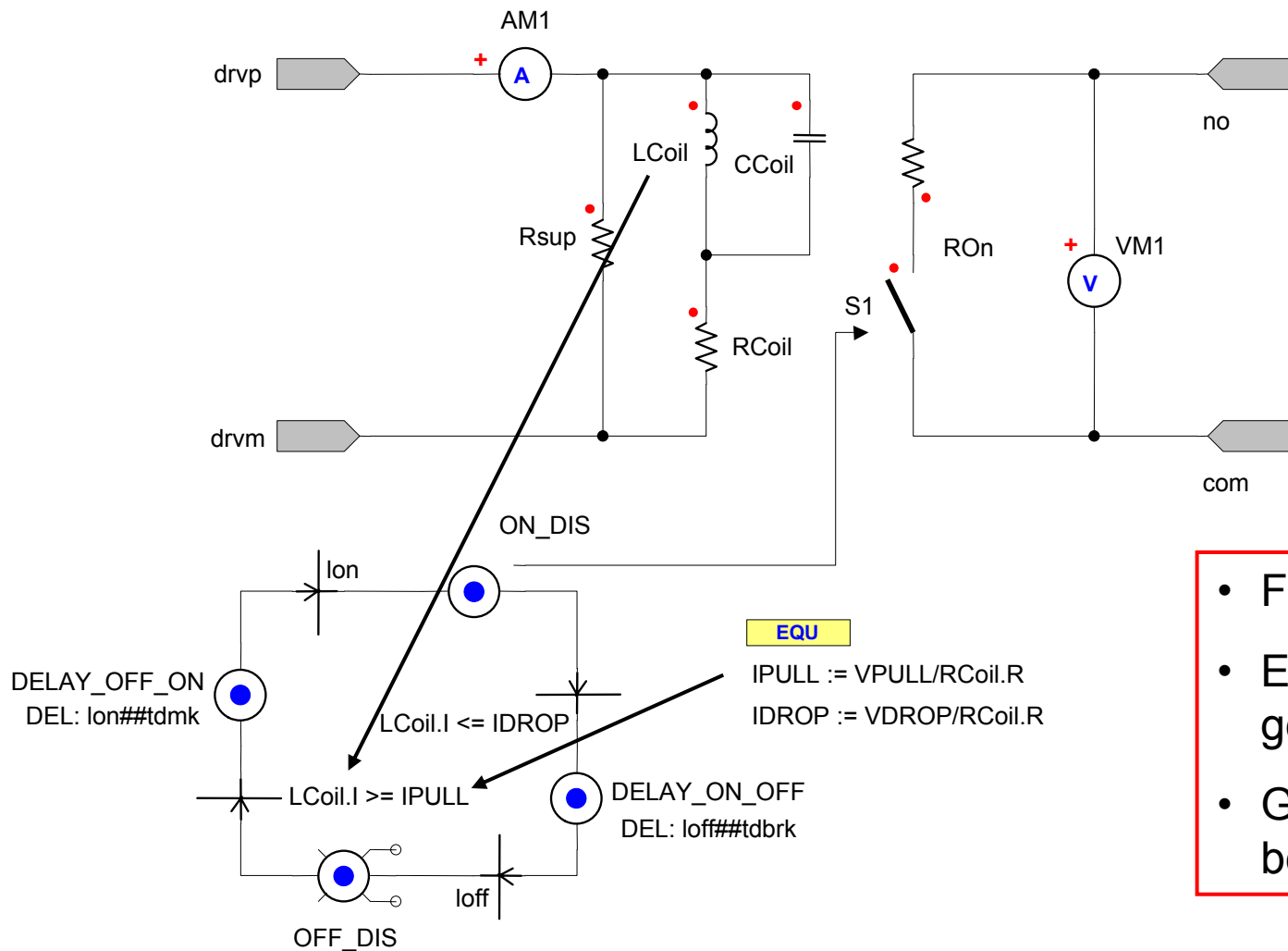
Parameters Output / Display Library

Name   show

Name	Value	Unit	Description
<u>10</u> lcoil	0.5	H	Coil Inductance
<u>10</u> rcoil	5	Ohm	Coil Resistance
<u>10</u> vpull	12	V	Resistor Voltage for Switching On
<u>10</u> vdrop	2	V	Resistor Voltage for Switching Off
<u>10</u> ron	5m	Ohm	On-Resistance (Load Side)
<u>10</u> roff	10Meg	Ohm	Off-Resistance (Load Side)
<u>10</u> tdmk	0.2	s	Delay Off-On
<u>10</u> tdbrk	3m	s	Delay On-Off
<u>10</u> enable_ramp	1		Selection Transition Type

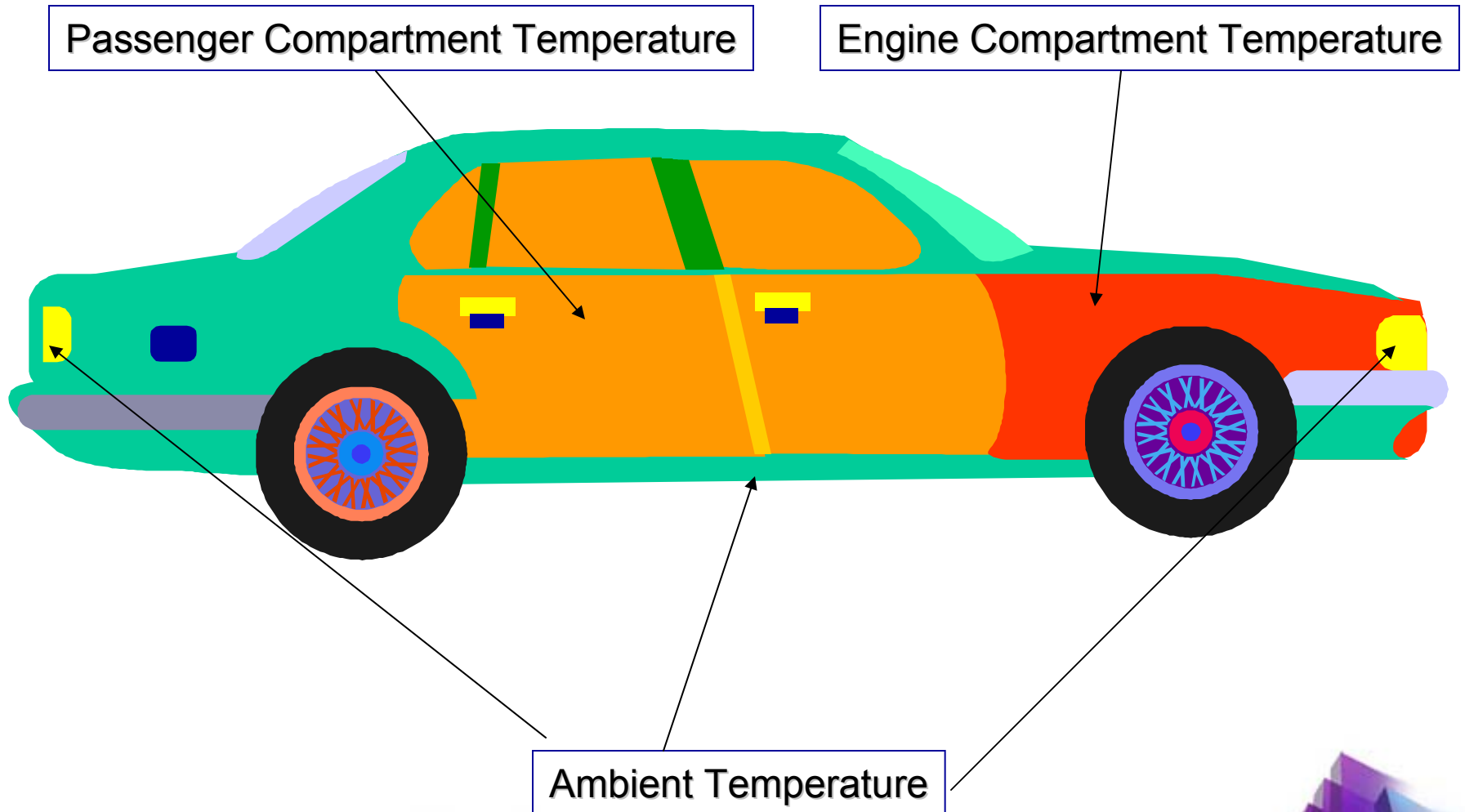
OK Cancel Apply Help

# Behavioral Relay Model

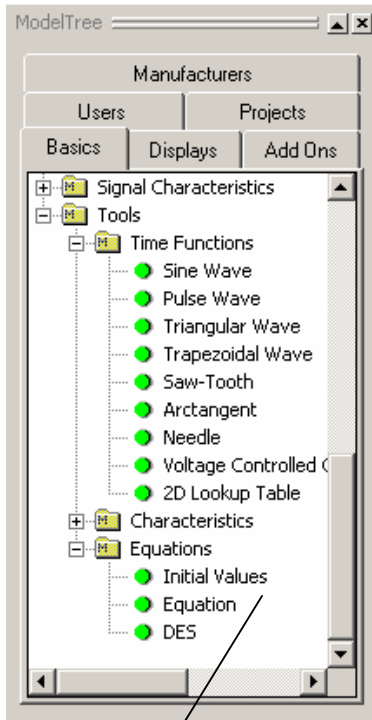


- Fast!
- Easy model generation
- Good numerical behavior

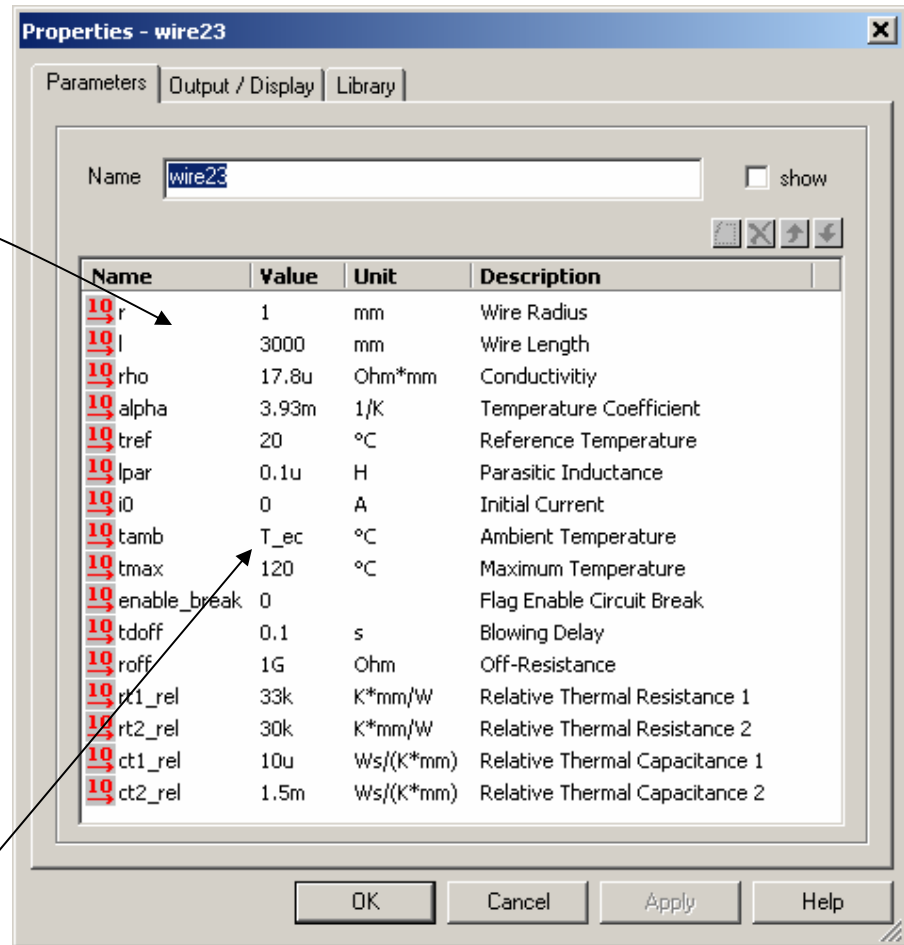
# Temperature Zones



# Initial Temperature Definition



Advanced  
SIMPLORER  
Wire  
Model



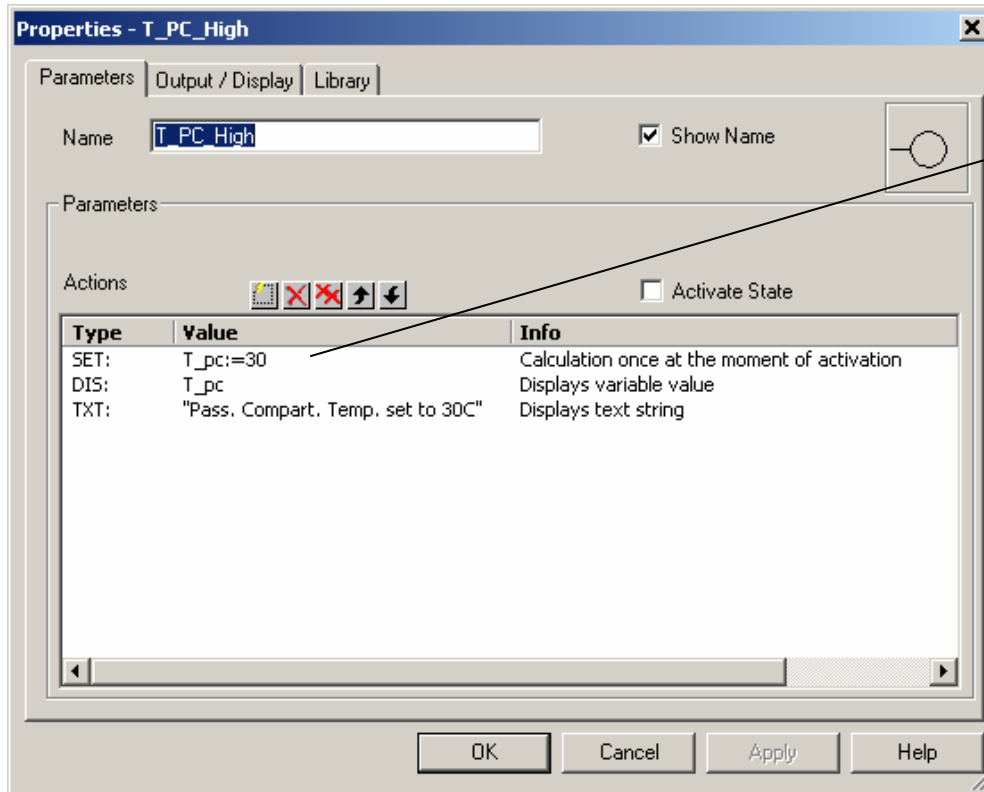
**ICA:** Init\_Temps

$T_a := 23$  Ambient Temperature (local)

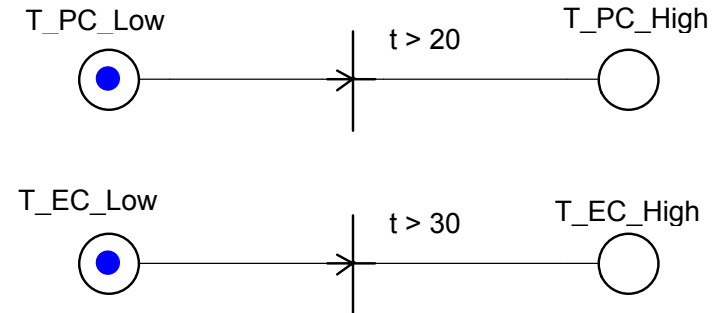
$T_{pc} := 20$  Passenger Compartment Temperature

$T_{ec} := 40$  Engine Compartment Temperature

# Temperature Modification

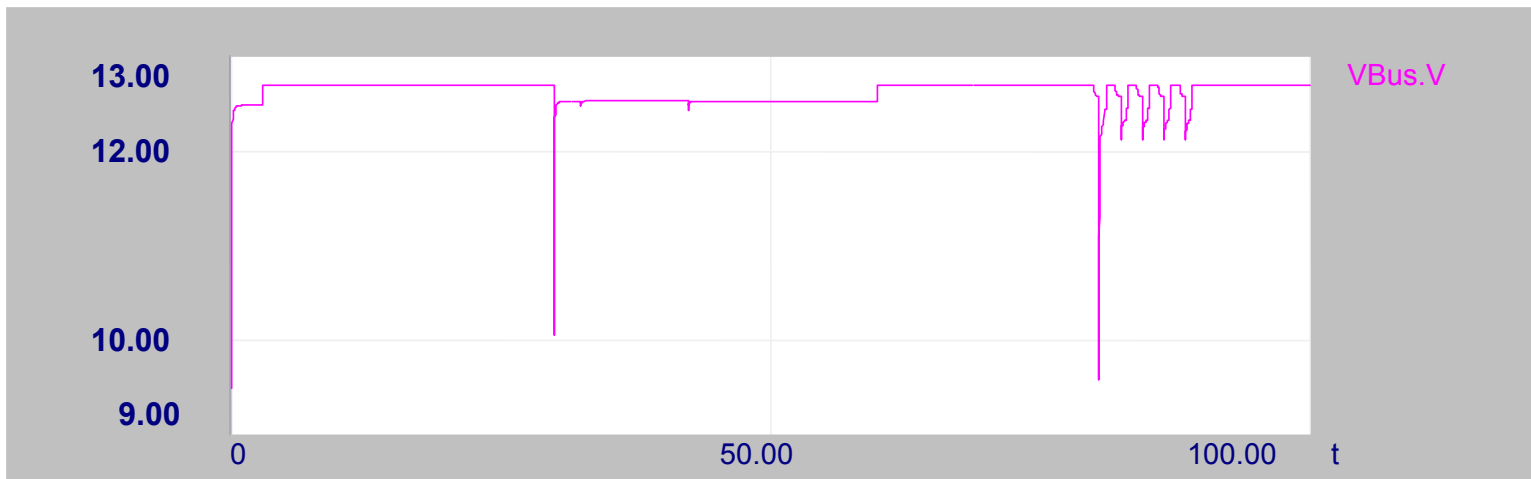
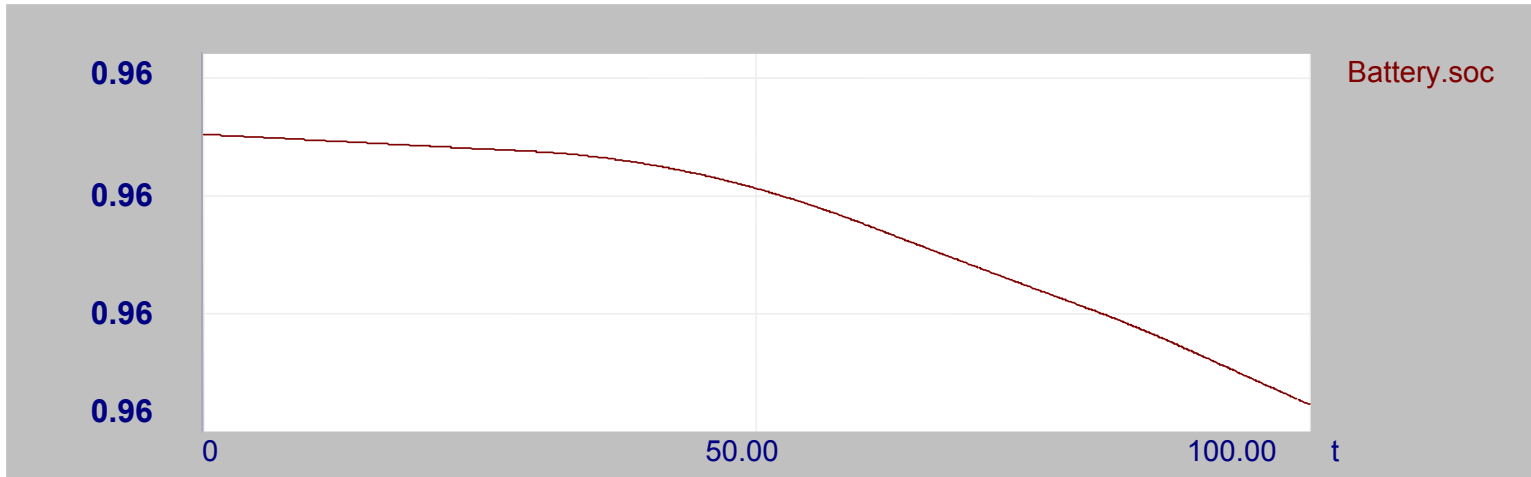


Set Passenger  
Compartment  
Temperature to 30C

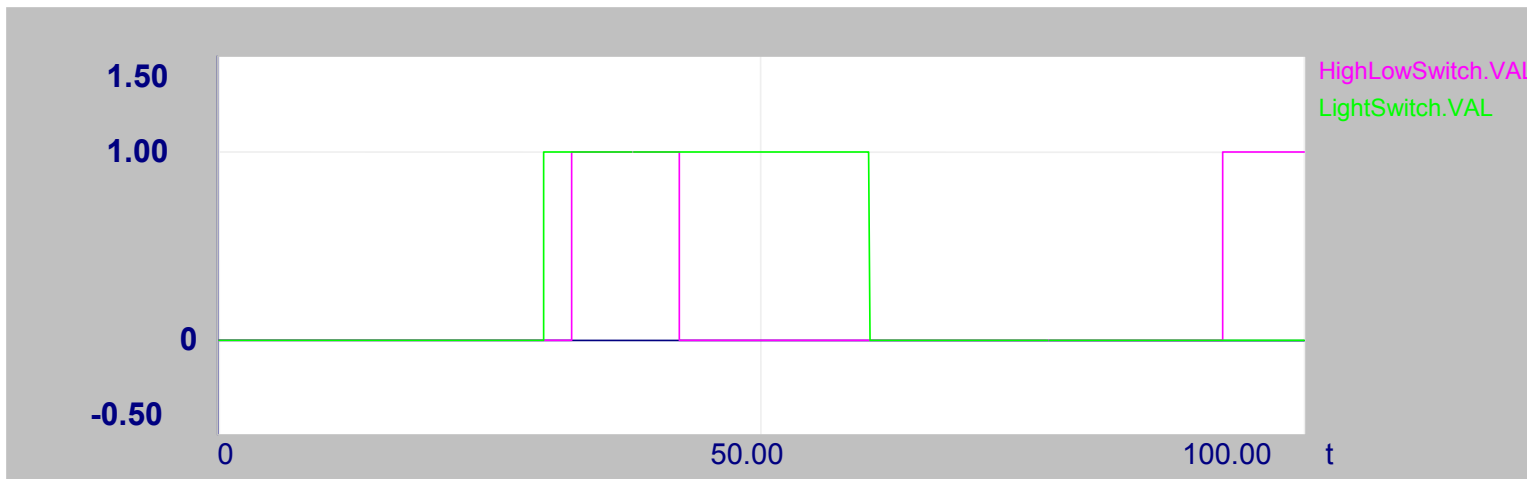
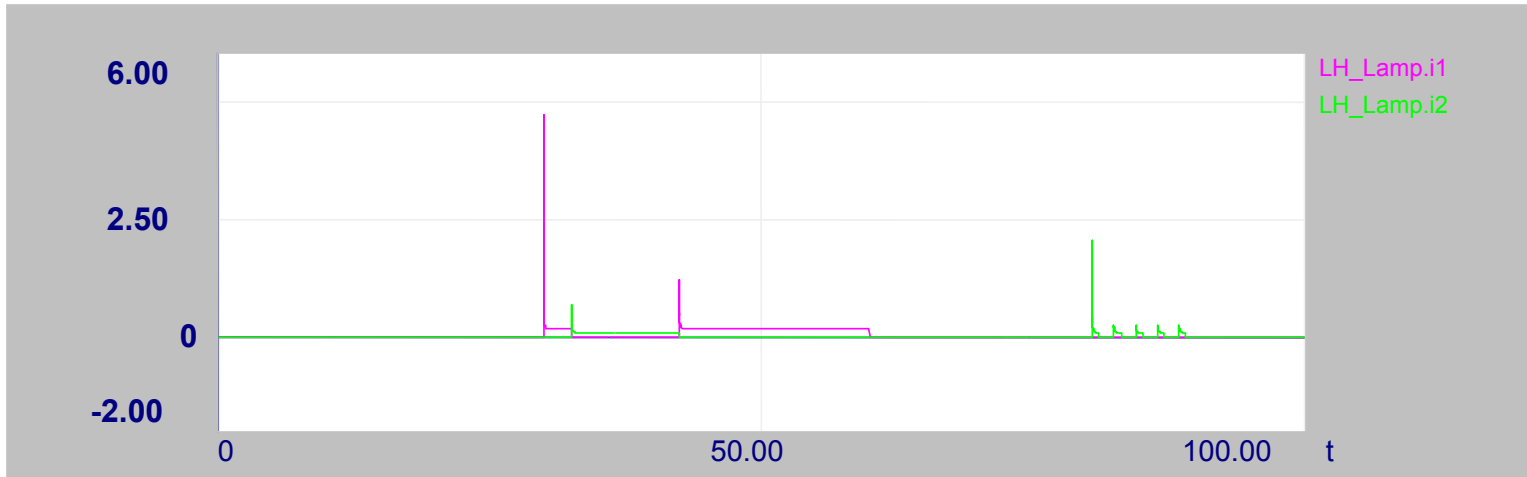


Any Quantity or  
parameter can be  
modified by a state  
machine while the  
simulation is running

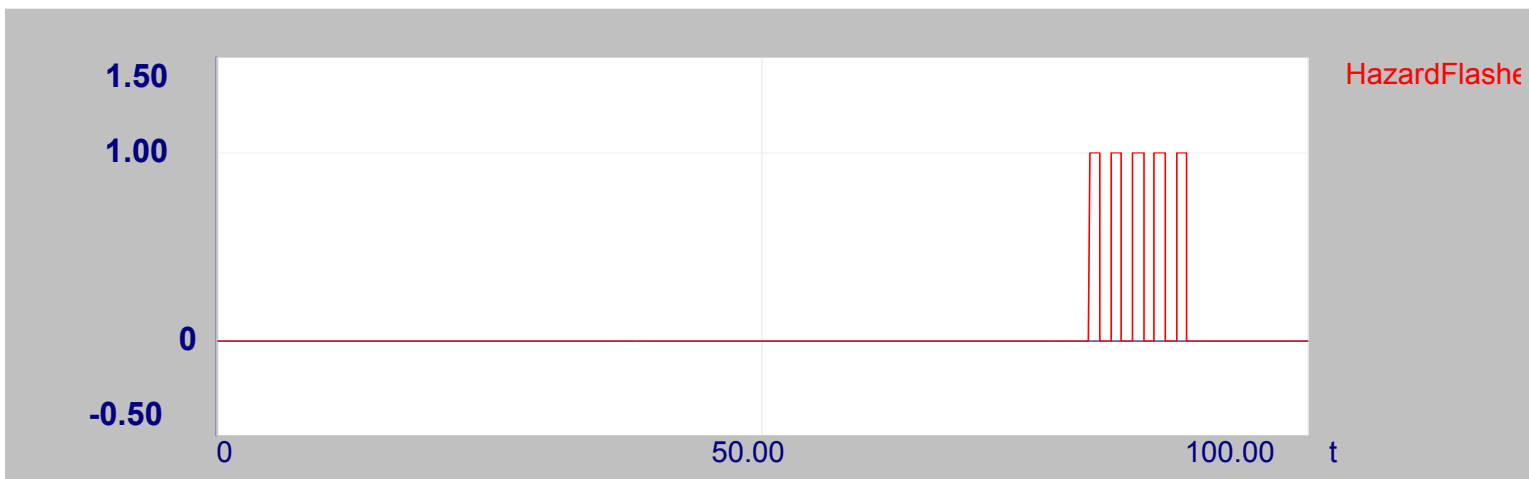
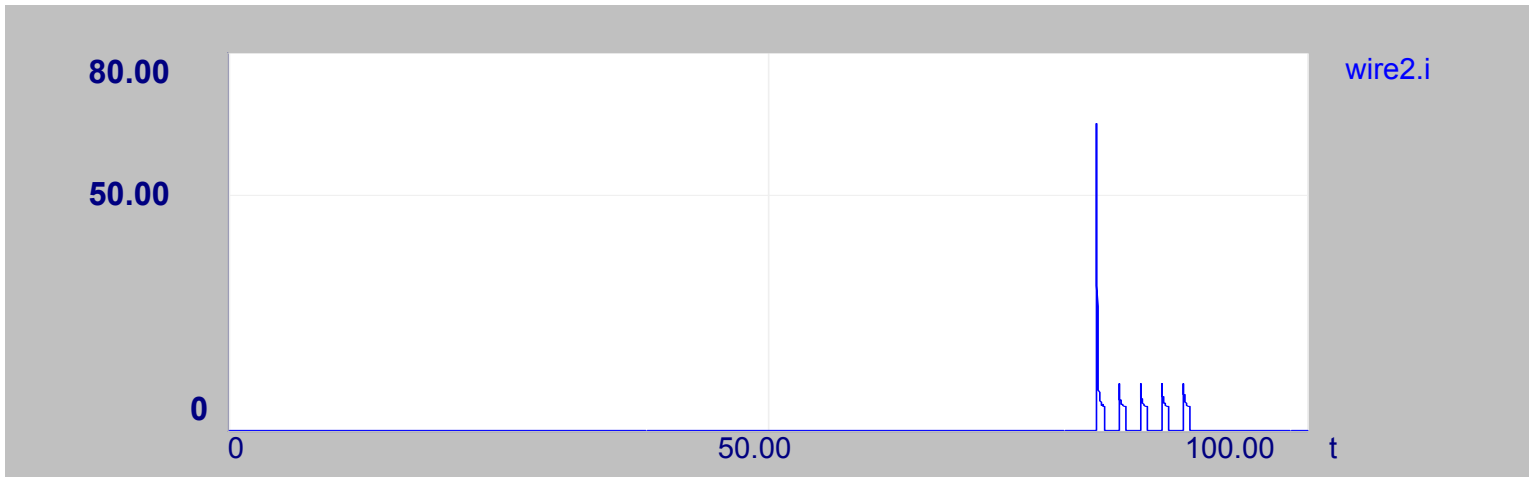
# Simulation Results



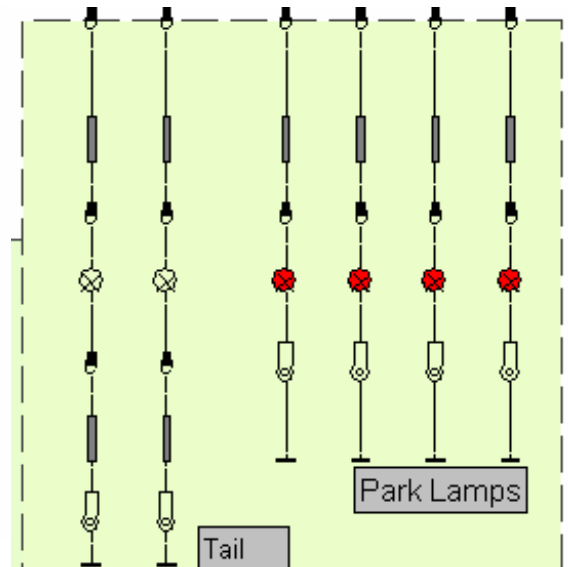
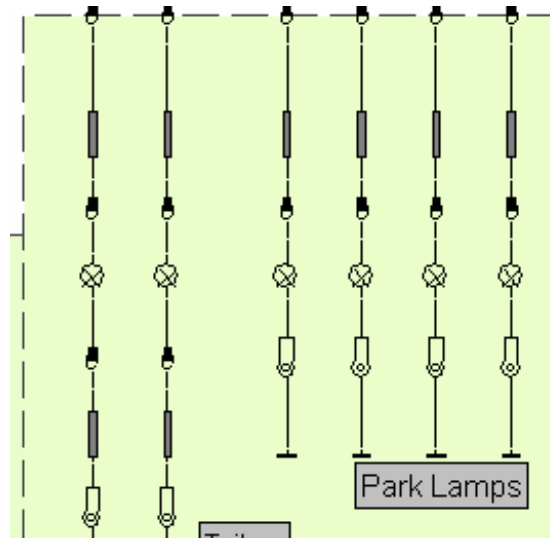
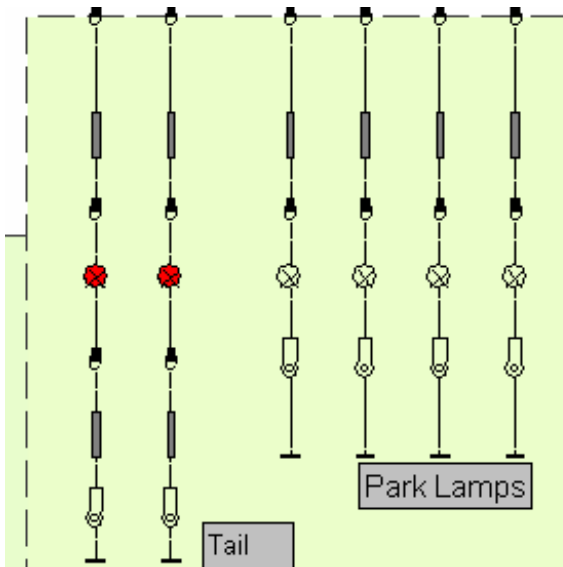
# Simulation Results



# Simulation Results



# Animated Symbols



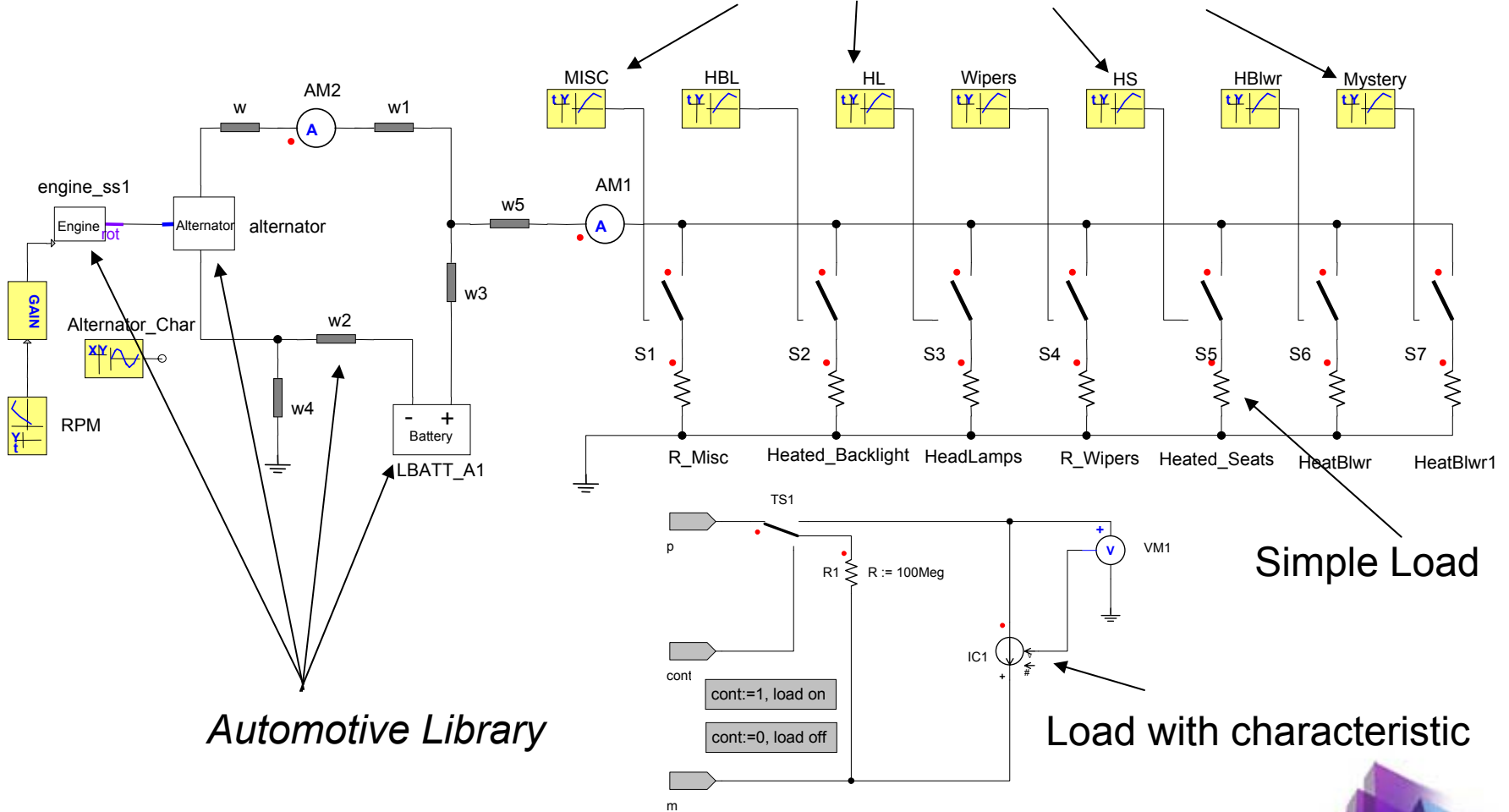
Park Lamp Switch ON  
Hazard Flasher OFF

Park Lamp Switch OFF  
Hazard Flasher OFF

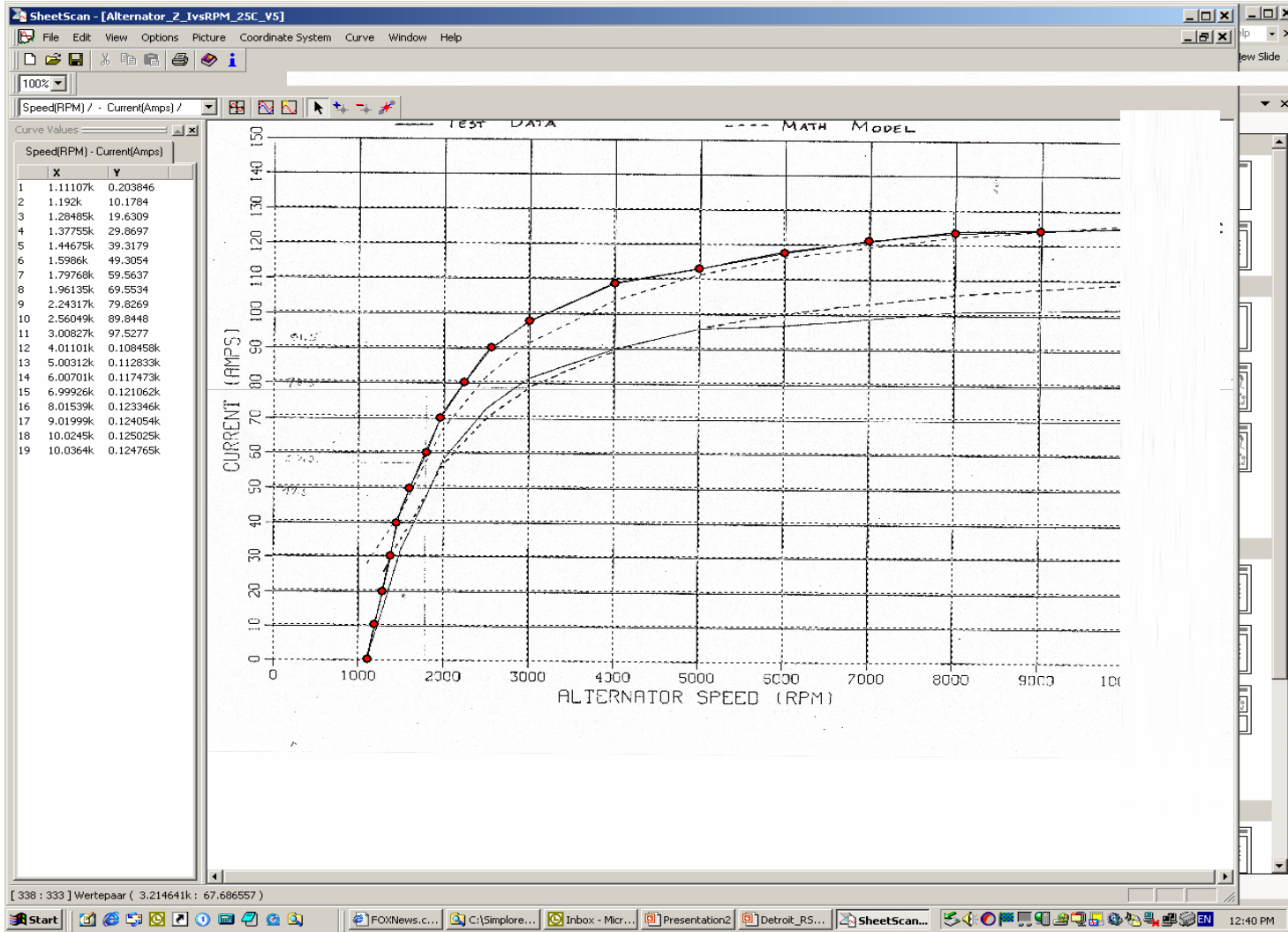
Park Lamp Switch ON  
Hazard Flasher ON

# EPA23 Drive Cycle

## Load Profile Description Using Lookup Tables



# SIMPLORER Sheet-Scan

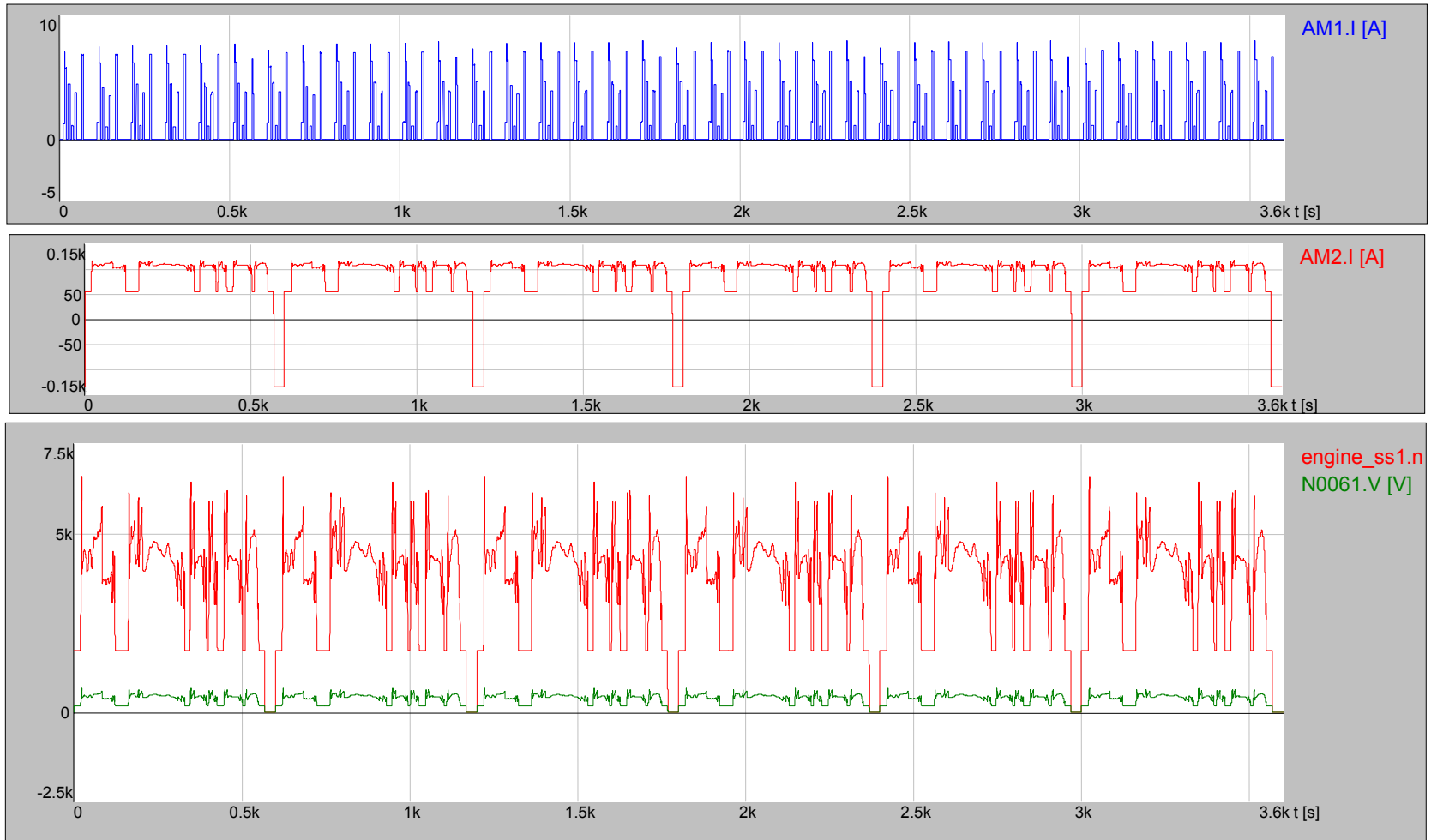


# Sheet-Scan Generated MS/Excel File

Speed(RPM)	Current(Amps)
1111.07	0.203348136
1606.921667	49.7342546
2102.773333	74.70896336
2598.625	90.49902608
3094.476667	98.46739404
3590.328333	103.8722102
4086.18	108.789193
4582.031667	110.9760761
5077.883333	113.1787723
5573.735	115.4705355
6069.586667	117.6994333
6565.438333	119.4930878
7061.29	121.20174
7557.141667	122.3158945
8052.993333	123.3720833
8548.845	123.7217884
9044.696667	124.0779392
9540.548333	124.5570288
10036.4	124.7650305

Speed(Rad/Sec)	Current(Amps)
116.3509783	; 0.203348136 ;
168.2764434	; 49.7342546 ;
220.2019085	; 74.70896336 ;
272.1273736	; 90.49902608 ;
324.0528388	; 98.46739404 ;
375.9783039	; 103.8722102 ;
427.903769	; 108.789193 ;
479.8292341	; 110.9760761 ;
531.7546992	; 113.1787723 ;
583.6801643	; 115.4705355 ;
635.6056294	; 117.6994333 ;
687.5310945	; 119.4930878 ;
739.4565596	; 121.20174 ;
791.3820247	; 122.3158945 ;
843.3074898	; 123.3720833 ;
895.232955	; 123.7217884 ;
947.1584201	; 124.0779392 ;
999.0838852	; 124.5570288 ;
1051.00935	; 124.7650305 ;

# Drive Cycle Results



# Conclusion

- ▶ Automotive Library
  - ▶ Multiple Accuracy Levels
  - ▶ Comprehensive Set of Components
  - ▶ Including first level battery & fuel cell model
- ▶ State Machines
  - ▶ Easy to use for system modification and observation
- ▶ External Data
  - ▶ Sheet-Scan – easy data acquisition
  - ▶ Flexible external data interface