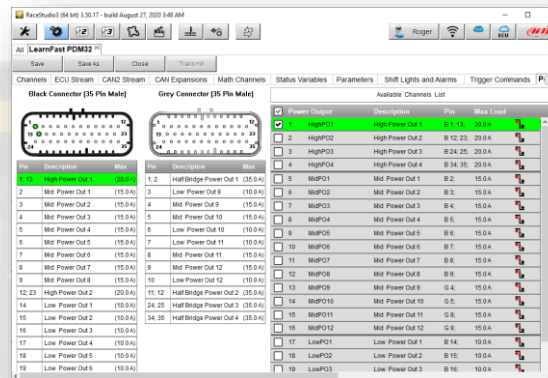




Co-Host
Fabrizio Rizzi
 AiM Sportline - Italy

Webinar Series

Bringing Data Support and Training to You

Introducing The AiM Sports PDM
More Than a Power Distribution Module

2020 Webinar #51

September 22nd, 2020

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1.800.718.9090

Fabrizio Rizzi

AiM Sportline – Italy

Hardware Team Manager

fabrizio.rizzi@aim-sportline.com



- Currently is the Head of Hardware Development for AiM Sportline in Italy. He has worked for AiM Sportline since 2014
- Career started in 1999 as a firmware developer for microcontrollers. A couple of years later he also started hardware development of the board where the microcontrollers were mounted



PDM vs. Relay-Fuse Box

Main Advantages:

- Wiring harness and connection is simpler and cleaner
- Reduction of weight
- Easier to check and find a wiring harness malfunction
- Useful during vehicle function development, easier to change strategies
- No hardware change required for adding or removing output channels (only load wire)
- Useful to analyze power data logged
- User can implement many strategies to optimize power consumption

Additional Features:

- Current monitoring and recording
- Predictive warning/alarm state
- Dynamic management
- Easier to change rules for activating and/or deactivating outputs
- Many strategies can be implemented. Difficult to do this with standard relay-fuse box
- User selectable current trip value. Easy to change. Auto restart. No fuse to change or restore. Auto retries are configurable

High Side Out

Measures and laps

Measures Laps User Profiles

Per Lap Color Sort Channels

Tests Loaded:

MATHS_Andrew_MuleHT8_VIR_VA_Warm-up

4 02:11.308

Measures:

GPS_Speed [mph] 123.4

RearDiffCk [%] 0.07

ECU_Rpm [rpm] 7062

ECU_Pedal_Pos [%] 99.500

ECU_Water [%] 100

Oil_Temp [F] 9.63

ECU_Lambda [A/F] 14.50

ECU_Spark [deg] 5.50

ECU_Intake [deg] 6.6

External_Voltage [V] 13.0

GearRatio 3.51

LambdaFilter 1.51

Spark_AdvFiltered [deg] 23.50

OverRev 0.00

RevFilter 2.2

ECU_SpeedChdFilt [km/h] 123.4

AFR [A/F] 13.51

AFR_Filt 1.51

AvgRearWheelSpeed [mph] 121.52

RPS_Diff [%] 100.50

ECU_SpeedChdFilt [km/h] 123.4

GPS_Lateral [g] 0.02

GPS_Long [g] 0.02

GPS_Slope [deg] 0.02

InlineAcc [g] 0.02

LateralAcc [g] -0.17

VerticalAcc [g] 0.02

PitchRate [deg/s] -0.6

RollRate [deg/s] 0.8

YawRate [deg/s] -0.2

GPS_PosAccuracy [m] 0.940

GPS_Neat [m] 15

GPS_Gyro [deg/s] -0.9

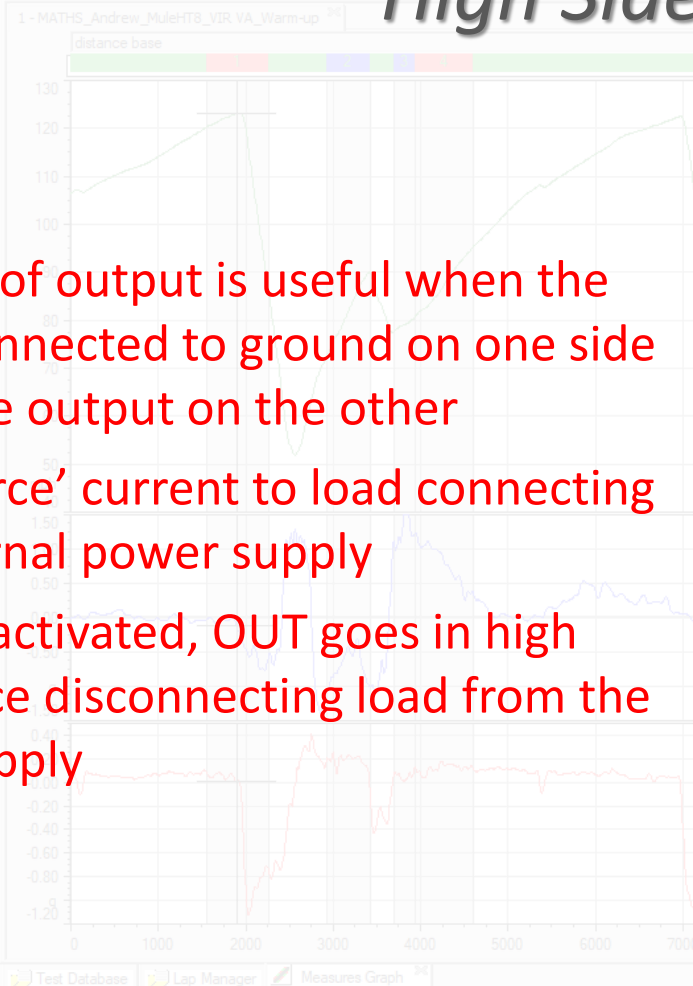
GPS_Heading [deg] -23.8

GPS_Altitude [m] 142.96

GPS_SpdAccuracy [m] 0.157

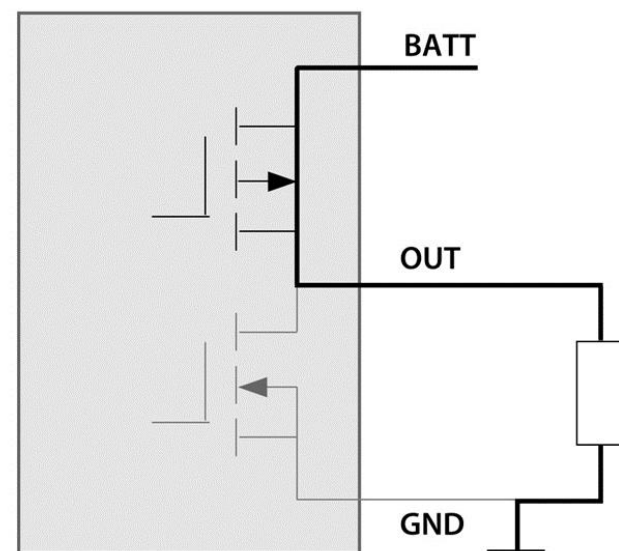
GPS_Speed [mph] 123.4

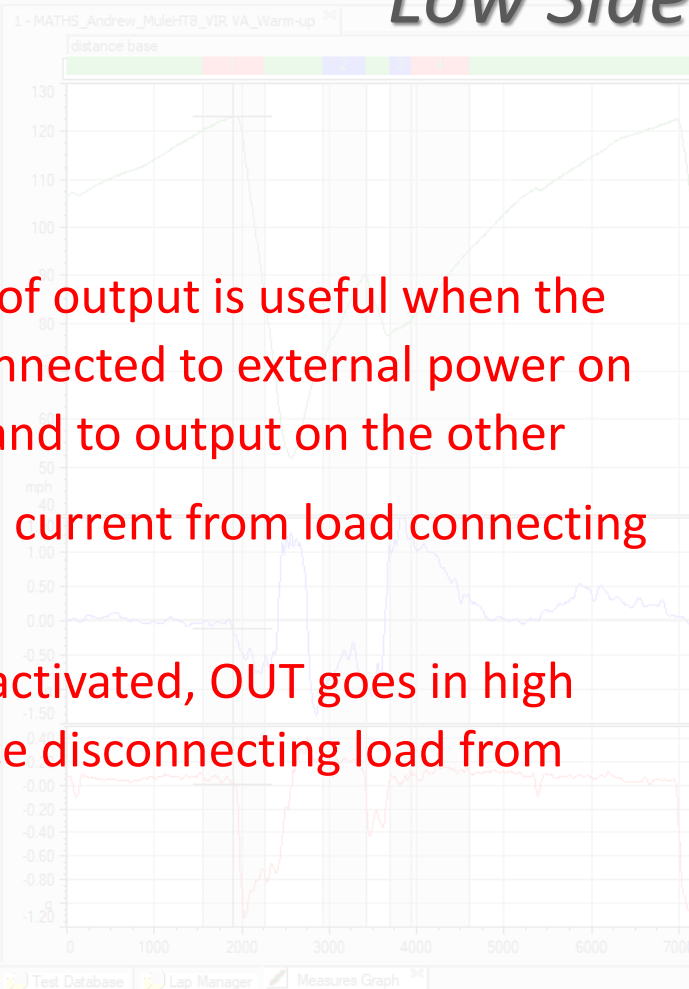
GPS_Speed [km/h] 197.8



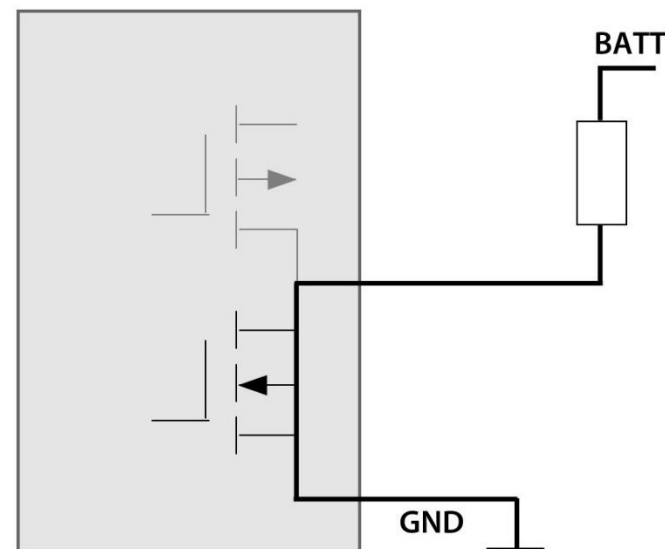
- This type of output is useful when the load is connected to ground on one side and to the output on the other
- 'OUT source' current to load connecting it to external power supply
- When deactivated, OUT goes in high impedance disconnecting load from the power supply

HIGH SIDE





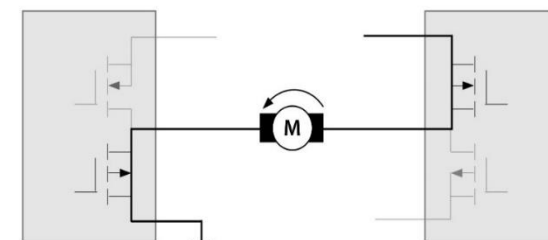
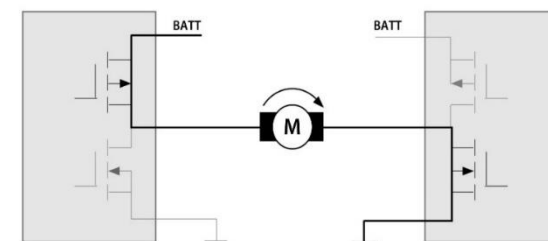
- This type of output is useful when the load is connected to external power on one side and to output on the other
- OUT sinks current from load connecting it to GND
- When deactivated, OUT goes in high impedance disconnecting load from GND



Full Bridge Configuration

- This configuration requires 2 half bridges to work. The load is connected between the outputs
- Selecting which OUT is active high or low, we can reverse voltage across the load
- Due to this functionality, if we connect a motor between the OUTs, we can manage the rotation in both directions
- Another useful condition in this configuration is the brake. Pulling LOW both output PDM could brake motor in specific position
- Using Pulse Width Modulation (PWM) we can also manage the speed of the motor

FULL BRIDGE



More Than A PDM

Power Module

- This powers different electronic devices in the vehicle such as: solenoids, pumps, fans, lights, and electronic devices such as the ECU

Dash Controller

- The dash, in installations with the PDM32, becomes a very simple and inexpensive device connected to the PDM through a 1.5 GHz LVDS cable

Automatic Lap Timer

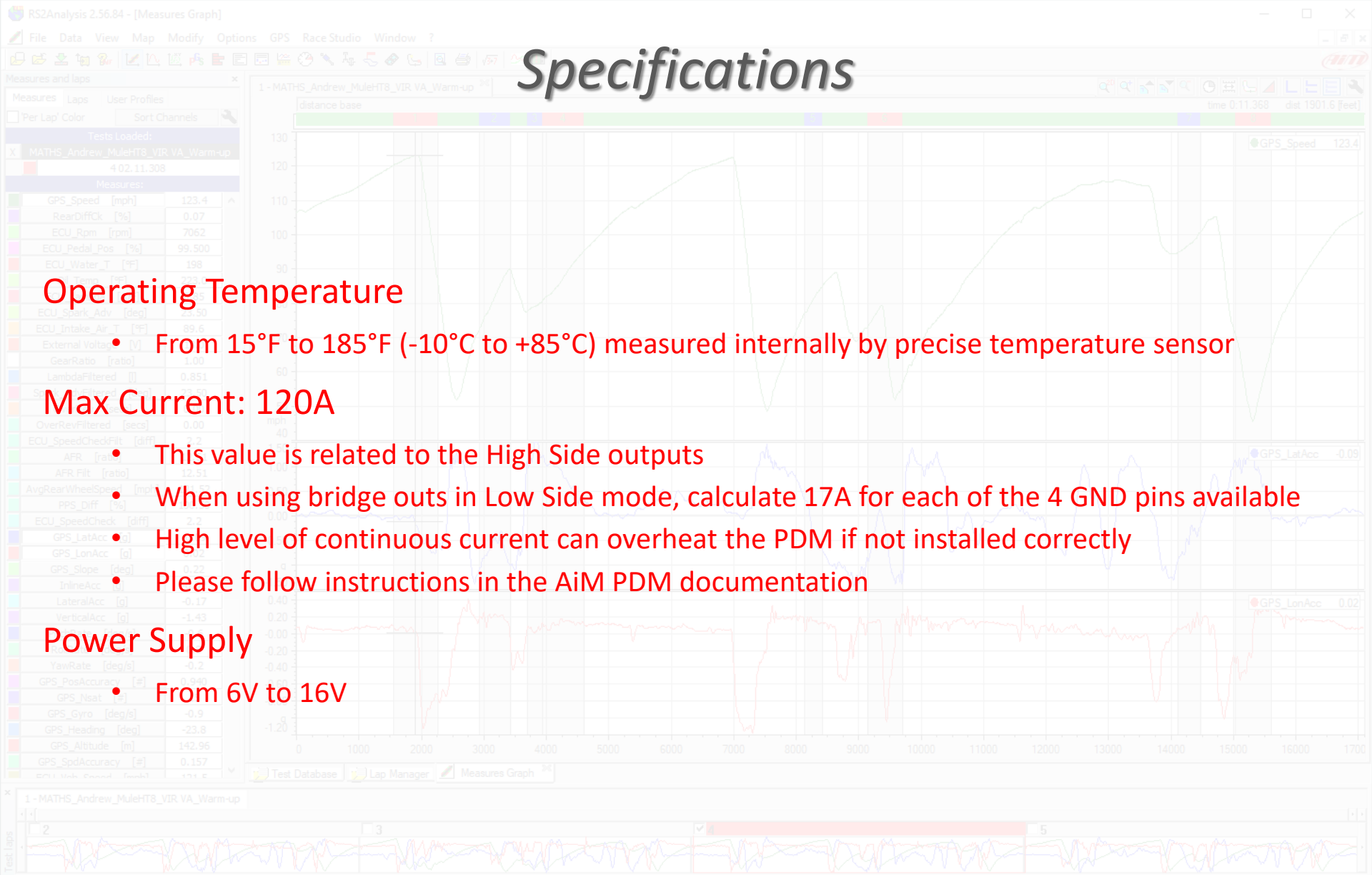
- Thanks to the high precision AiM GPS Module and a huge database of thousands of tracks all around the world, the lap times are automatically calculated and shown in the display and recorded for future data analysis

Datalogger

- The PDM32 has a huge 4GB memory, that records not only all the data coming from the sensors but also data from; the ECU, Expansions, and all the Power Output current consumption
- All of this is correlated with the position on the track, with the map of the track and, eventually, with the SmartyCam video

Features

234.5 x 94.6 x 49.5 mm



+12V out

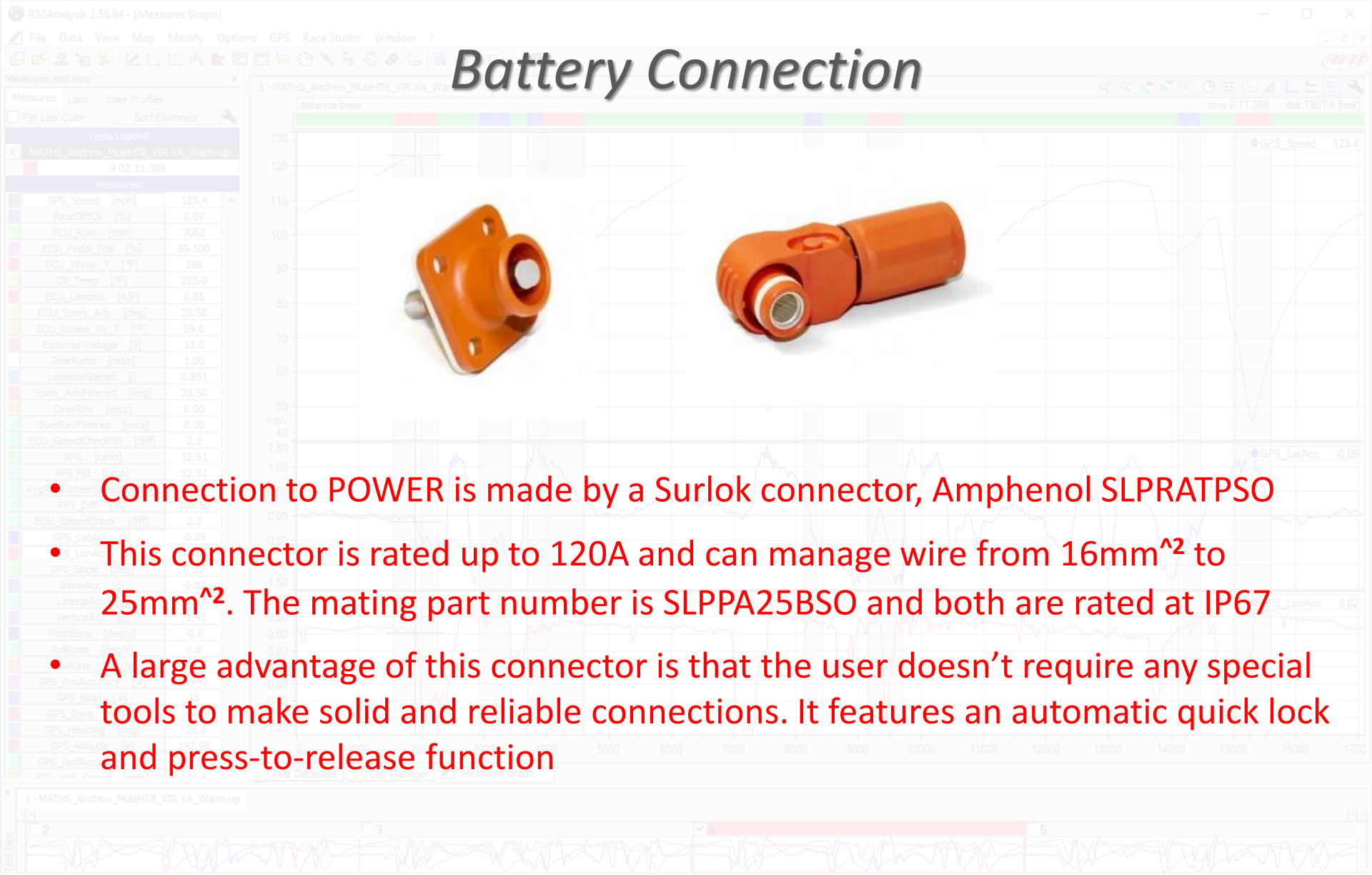
- Internally generated for sensor supply with short circuit protection
- Up to 500mA current available

- Internally regulated with 350mA current available to power external sensors
- Protected from short circuit

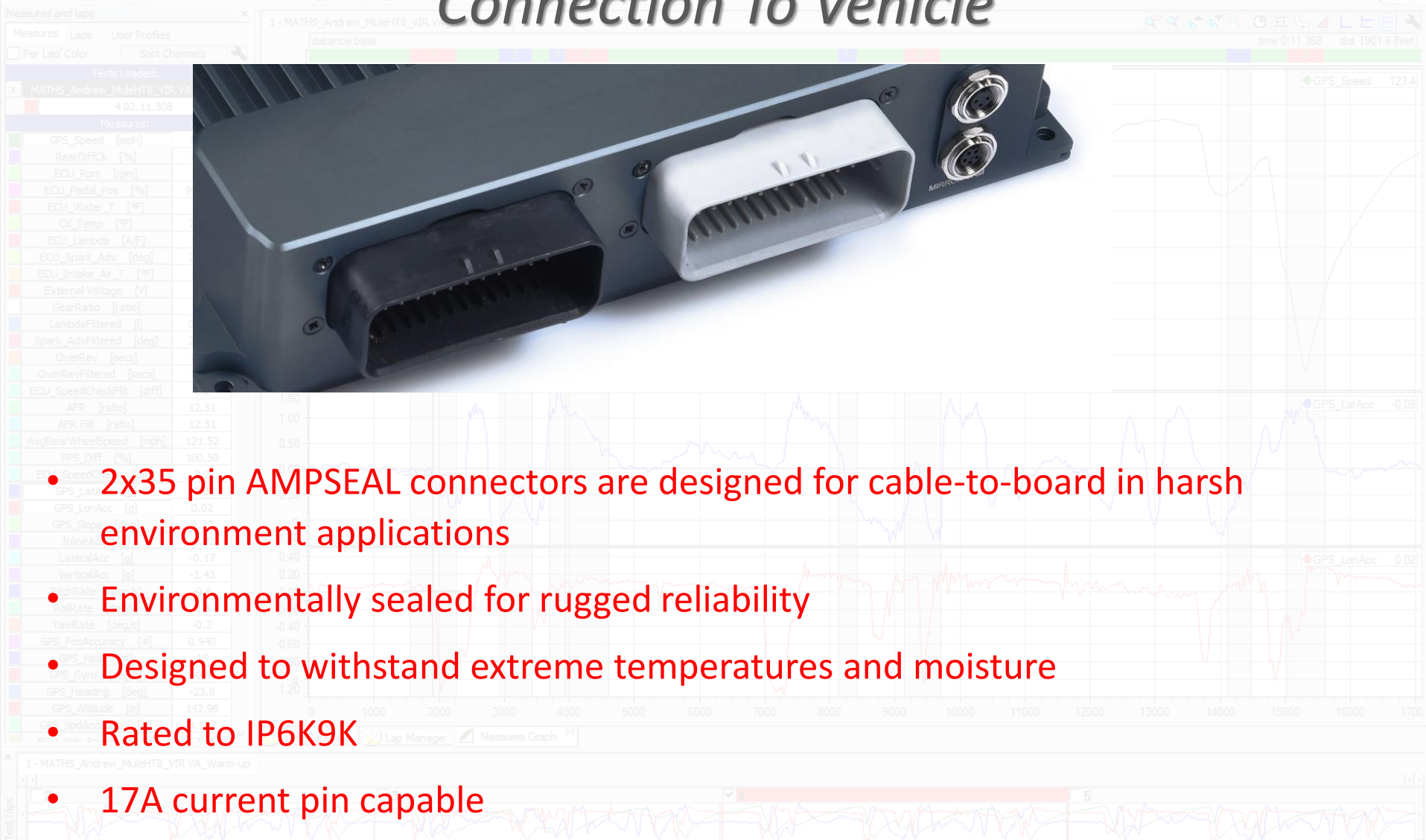
All inputs are protected from high voltage burst and surge

OUTPUTS H1-H4 have internal freewheeling diodes to manage high voltage spikes produced by very high inductive loads

H1 also has a series diode to directly control an engine starter motor



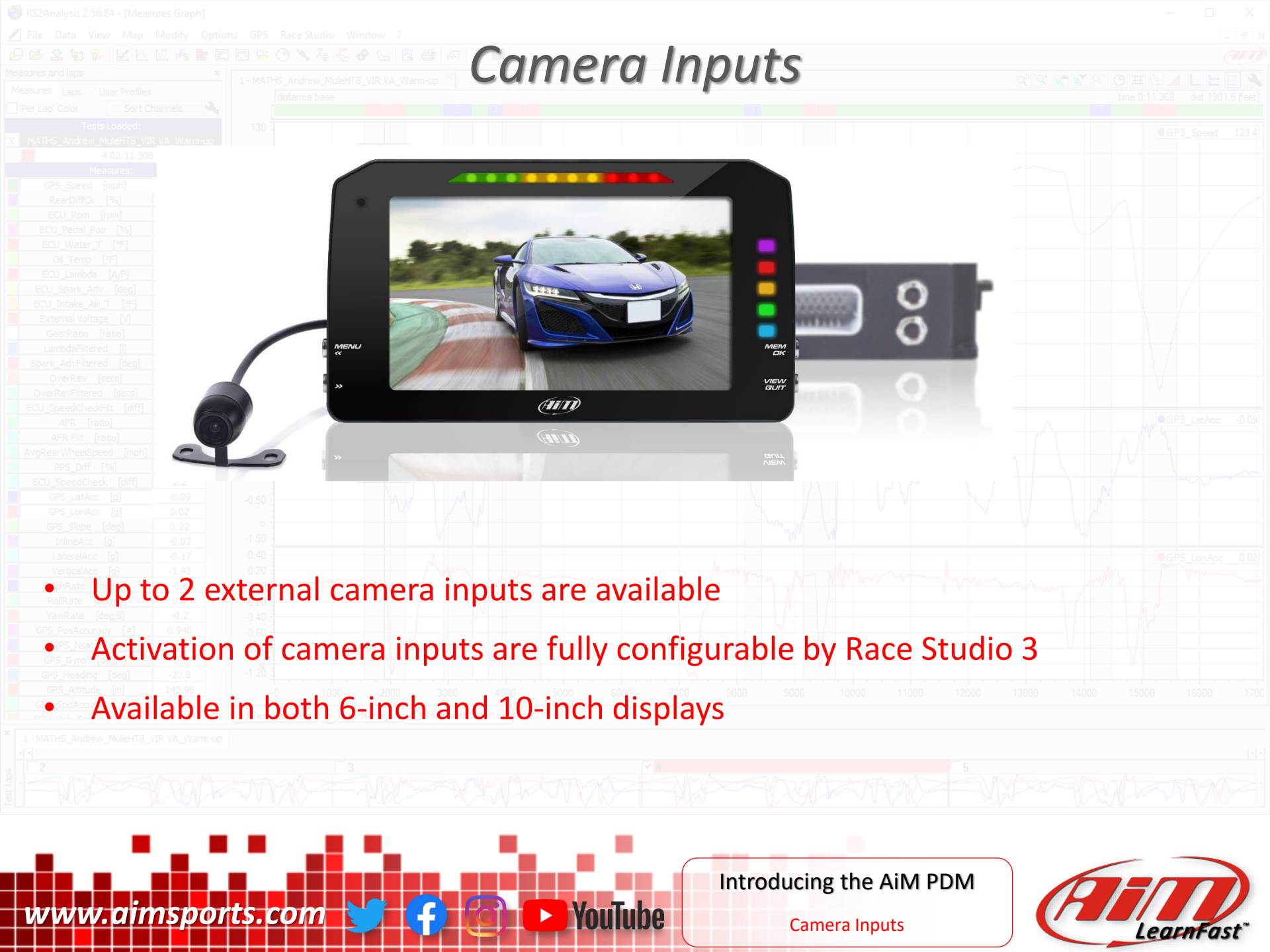
Connection To Vehicle



Remote Display Connection



- The AiM PDM has a highspeed link used for the remote display. This is done by an AiM 1.5GHz LVDS cable
- This cable transmits the TFT information and LED status to the remote display
- The PDM receives light sensor data and push button status from the display
- This same cable powers the remote display, making a simple and reliable connection
- Rosenberger connectors allow high immunity noise levels and IP67 class connection



Camera Inputs

- Up to 2 external camera inputs are available
- Activation of camera inputs are fully configurable by Race Studio 3
- Available in both 6-inch and 10-inch displays

Remote Keypads



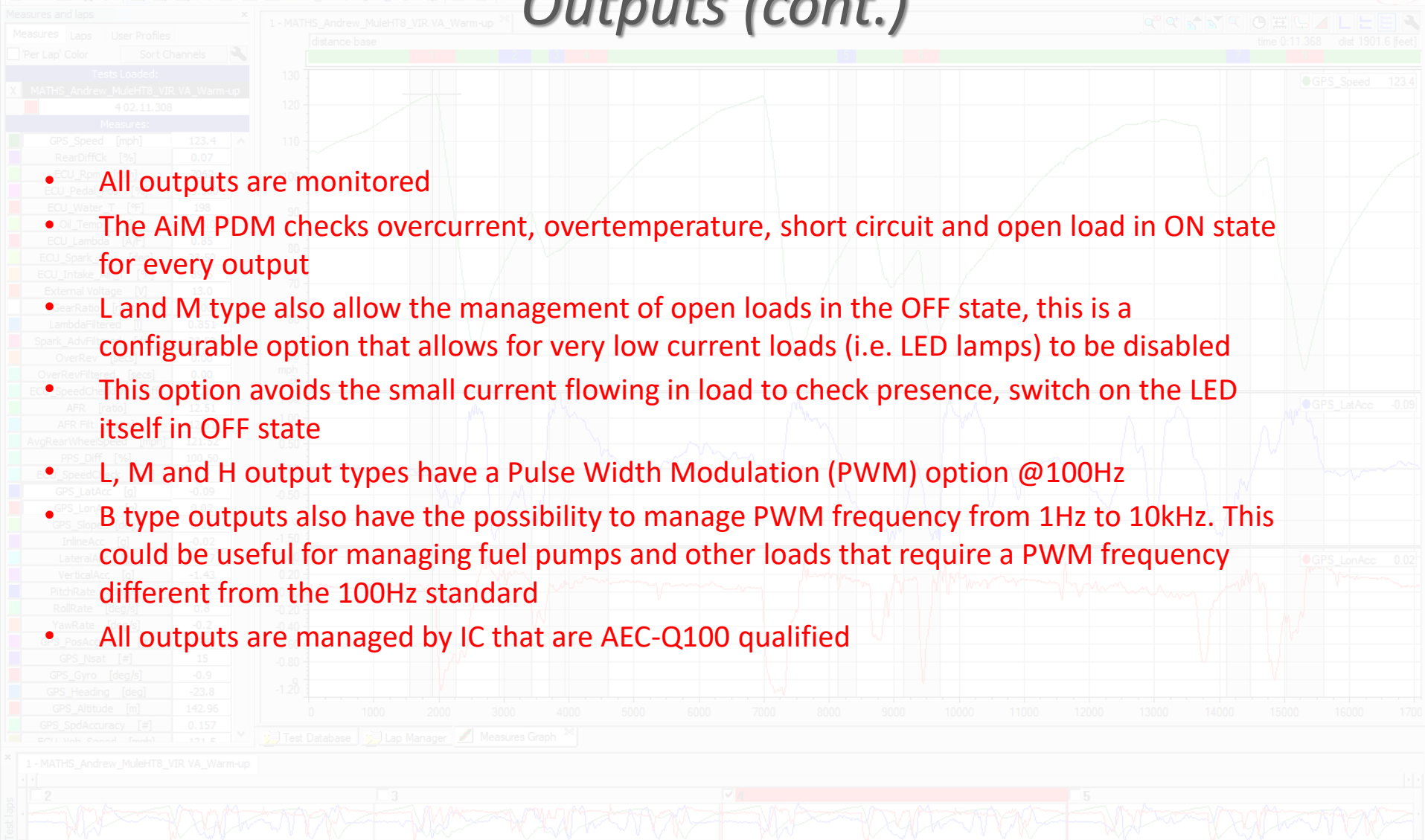
- Useful to add additional User Inputs
- Flexible management
- Users can build CAN protocols to manage different keypads

Outputs

The AiM PDM has 4 Output Types

- L1-L12 are High Side output type and can manage up to 10A of continuous current and up to 35A of Inrush current
- M1-M12 are High Side capable to source up to 15A of continuous current and up to 80A of Inrush current
- H1-H4 are High Side sourcing of up to 20A continuous current and up to 100A of Inrush current
 - H1 also has a series diode to prevent reverse current from load. For example, this output can be used to directly drive a starter motor
 - All H type outputs have internal freewheeling diodes that allow high inductive load connections, i.e. solenoids
- B1-B4 are Half Bridge outputs. They can manage up to 35A of continuous current and up to 100A Inrush current.
 - This means that these outputs can be used in two different ways: HIGH SIDE or LOW SIDE
 - During High Side mode, they switch external battery voltage to load sourcing current
 - In Low Side mode, they close load to ground sinking current from load itself
 - They also could be combined to have a Full Bridge output. In this situation, when one output function as High Side, the complementary works as Low Side. Swapping them we can reverse the current flowing into load. An example of this application could be managing a windshield wiper motor

Outputs (cont.)



- All outputs are monitored
- The AiM PDM checks overcurrent, overtemperature, short circuit and open load in ON state for every output
- L and M type also allow the management of open loads in the OFF state, this is a configurable option that allows for very low current loads (i.e. LED lamps) to be disabled
- This option avoids the small current flowing in load to check presence, switch on the LED itself in OFF state
- L, M and H output types have a Pulse Width Modulation (PWM) option @100Hz
- B type outputs also have the possibility to manage PWM frequency from 1Hz to 10kHz. This could be useful for managing fuel pumps and other loads that require a PWM frequency different from the 100Hz standard
- All outputs are managed by IC that are AEC-Q100 qualified

Configuration Of Outputs

RS2Analysis 2.56.84 - [Measures Graph]

File Data View Map Modify Options GPS RaceStudio Window ?

Measures and Laps

Measures: GPS_Speed [mph] 123.4

Tests Loaded: MATHS_Andrew_MuleHT8_VIR_VA_Warm-up 4 02.11.308

Name: MidPO6

Settings

☐ Soft Start in a time of 1 sec

☐ Soft Stop in a time of 1 sec

PWM based on frequency of 100 Hz

Maximum Value of Requested Load (up to 15.0 A) 15 A

Over Current Latch-Off Time 0.5 sec

Number of Retries 1

Retry Delay 0.5 sec

Minimum Current 0 A

Check Open Load in Off State ☐

← Same condition for activation and deactivation →

RollRate [deg/s] 0.8

YawRate [deg/s] -0.2

GPS_PosAccuracy [m] 0.940

GPS_Neat [m] 15

GPS_Gyro [deg/s] -0.9

GPS_Heading [deg] -23.8

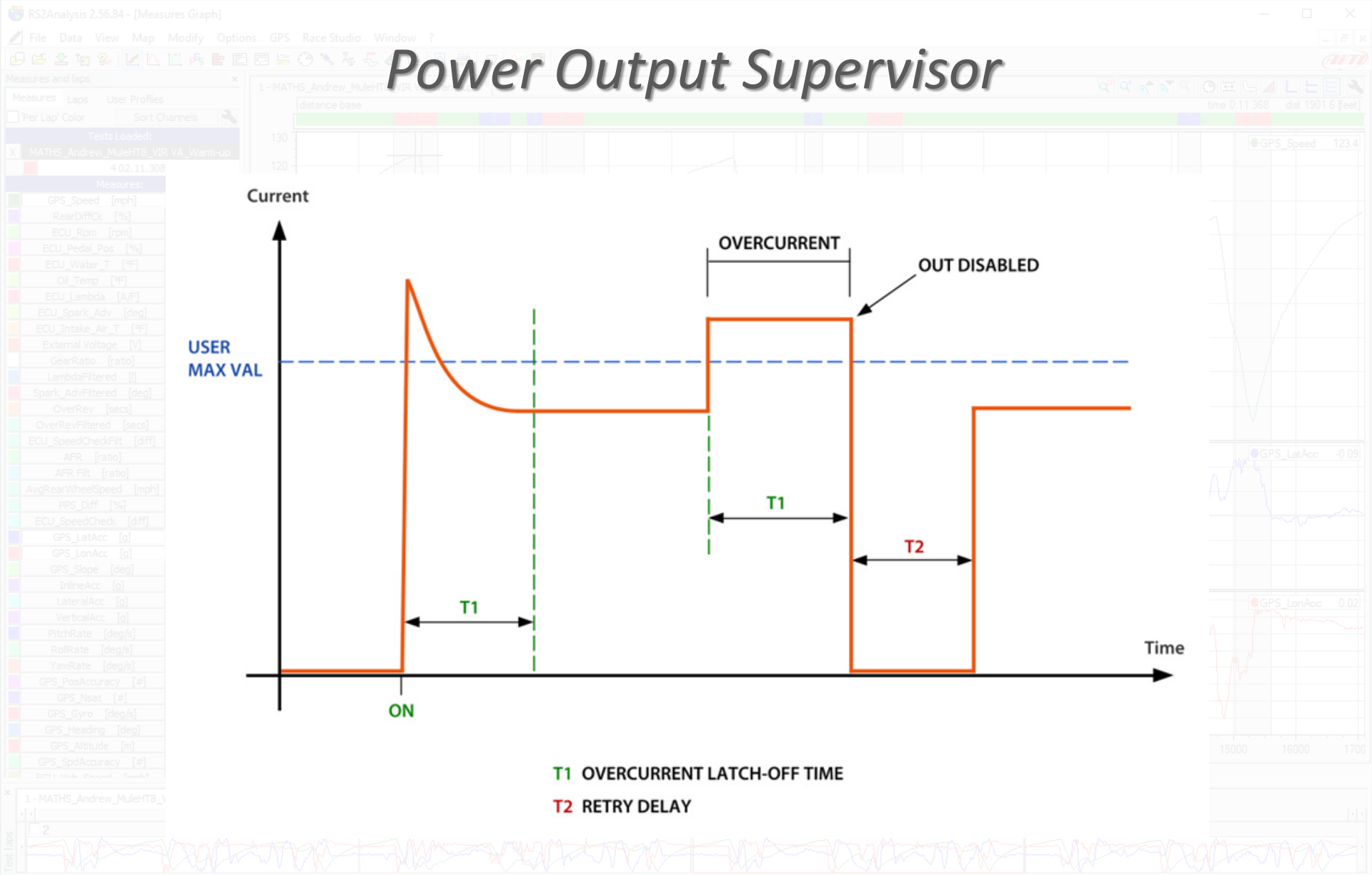
GPS_Altitude [m] 142.96

GPS_SpdAccuracy [m] 0.157

Test Database Lap Manager Measures Graph

1 - MATHS_Andrew_MuleHT8_VIR_VA_Warm-up

2 3 4 5



Configuration Of Inputs

AiM PDM's have 12 Input Channels with these specifications

- CH_IN1 to CH_IN8 are Fully Configurable

- Analog

- Analog with internal pullup 2K enabled

- Digital

- Digital with pull-down or

- Digital with pull-up

- CH_IN9 to CH_IN12 are Digital Only

- Pull-up Enabled

- Pull-down Enabled

- CH_IN11 and CH_IN12 can switch on the PDM without IGN signal, when specified input levels are High. Examples are:

- Radiator fans ON when other outputs and display are OFF

- Hazard function

- Only side lights ON, etc...

- All inputs, when used as digital, can also be monostable, bistable or multistable

Configuration Of Inputs (cont.)

Measures and laps
Measures Laps User Profiles
Per Lap Color Sort Channels

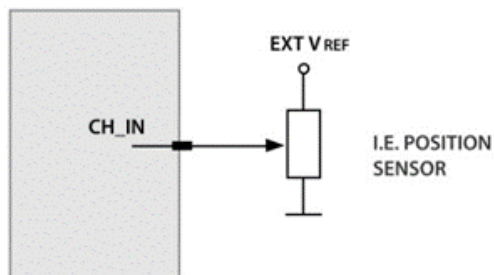
Tests Loaded:
MATHS_Andrew_MuleHT8_VIR
4 02:11.308

Measures:

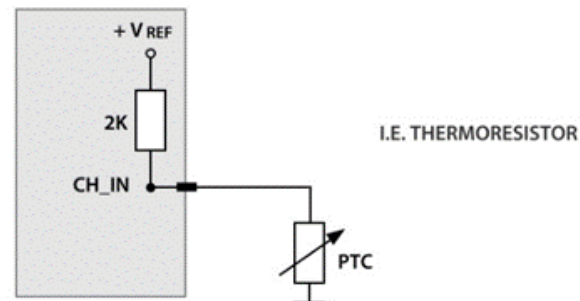
- GPS_Speed [mph]
- RearDiffCk [%]
- ECU_Rpm [rpm]
- ECU_Pedal_Pos [%]
- ECU_Water_T [°F]
- Oil_Temp [°F]
- ECU_Lambda [A/F]
- ECU_Spark_Adv [deg]
- ECU_Intake_Air_T [°F]
- External Voltage [V]
- GearRatio [ratio]
- LambdaFiltered []
- Spark_AdvFiltered [deg]
- OverRev [secs]
- OverRevFiltered [secs]
- ECU_SpeedCheckFilt [diff]
- AFR [ratio]
- AFR_Filt [ratio]
- AvgRearWheelSpeed [mph]
- RPS_Diff [%]
- ECU_SpeedCheck [diff]
- GPS_LatAcc [g]
- GPS_LonAcc [g]
- GPS_Slope [deg]
- InlineAcc [g]
- LateralAcc [g]
- VerticalAcc [g]
- PitchRate [deg/s]
- RollRate [deg/s]
- YawRate [deg/s]
- GPS_PosAccuracy [#]
- GPS_Neat [#]
- GPS_Gyro [deg/s]
- GPS_Heading [deg]
- GPS_Altitude [m]
- GPS_SpdAccuracy [#]
- GPS_Steer [deg]

1 - MATHS_Andrew_MuleHT8_VI
2

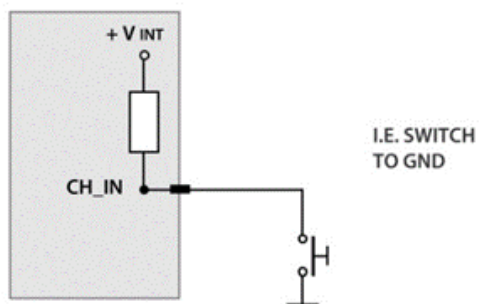
ANALOG



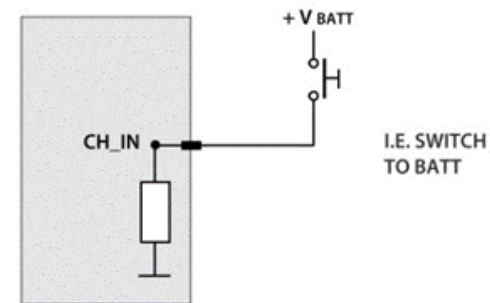
ANALOG WITH PULL UP 2K

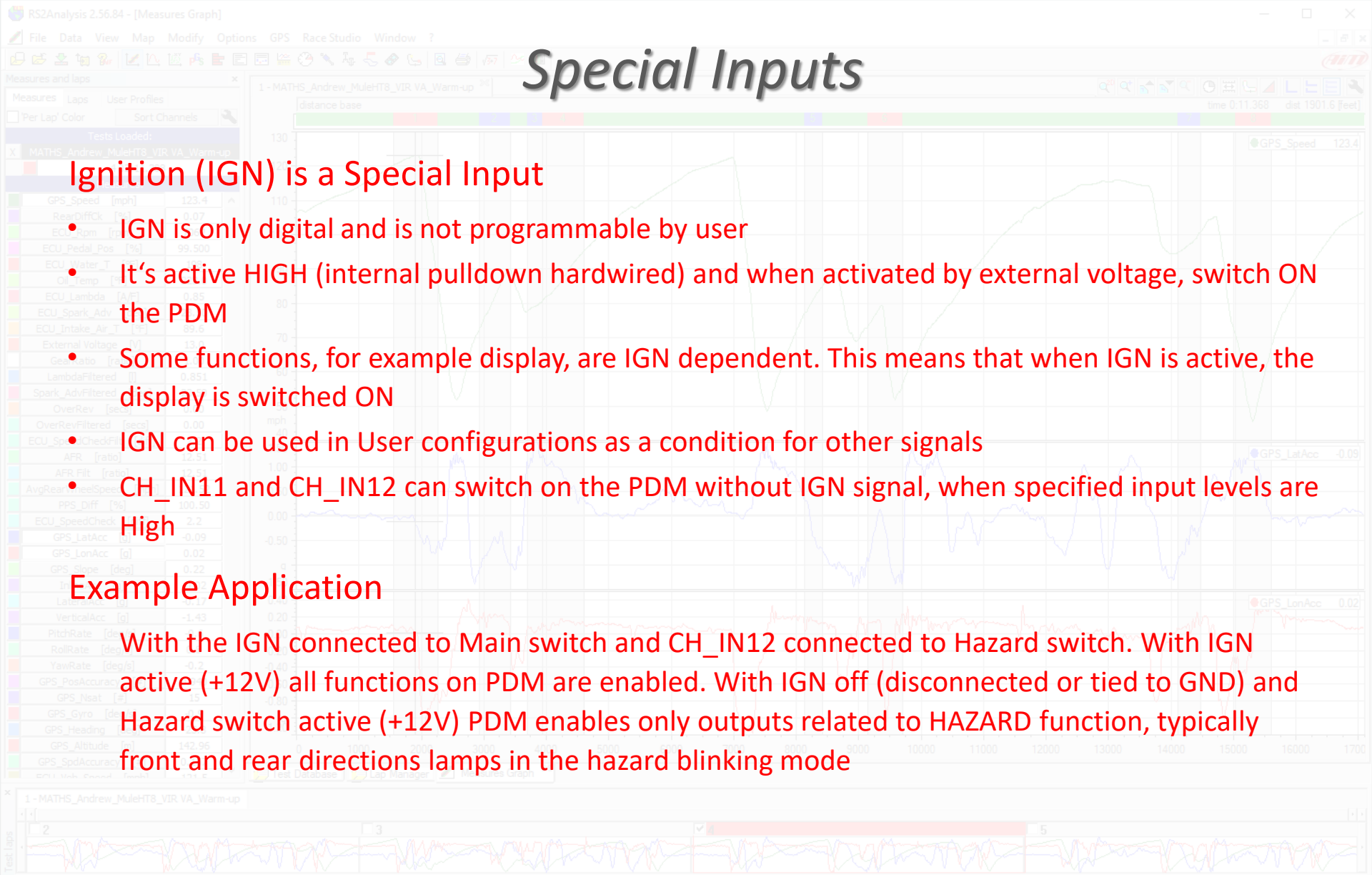


DIGITAL PULL UP



DIGITAL PULL DOWN





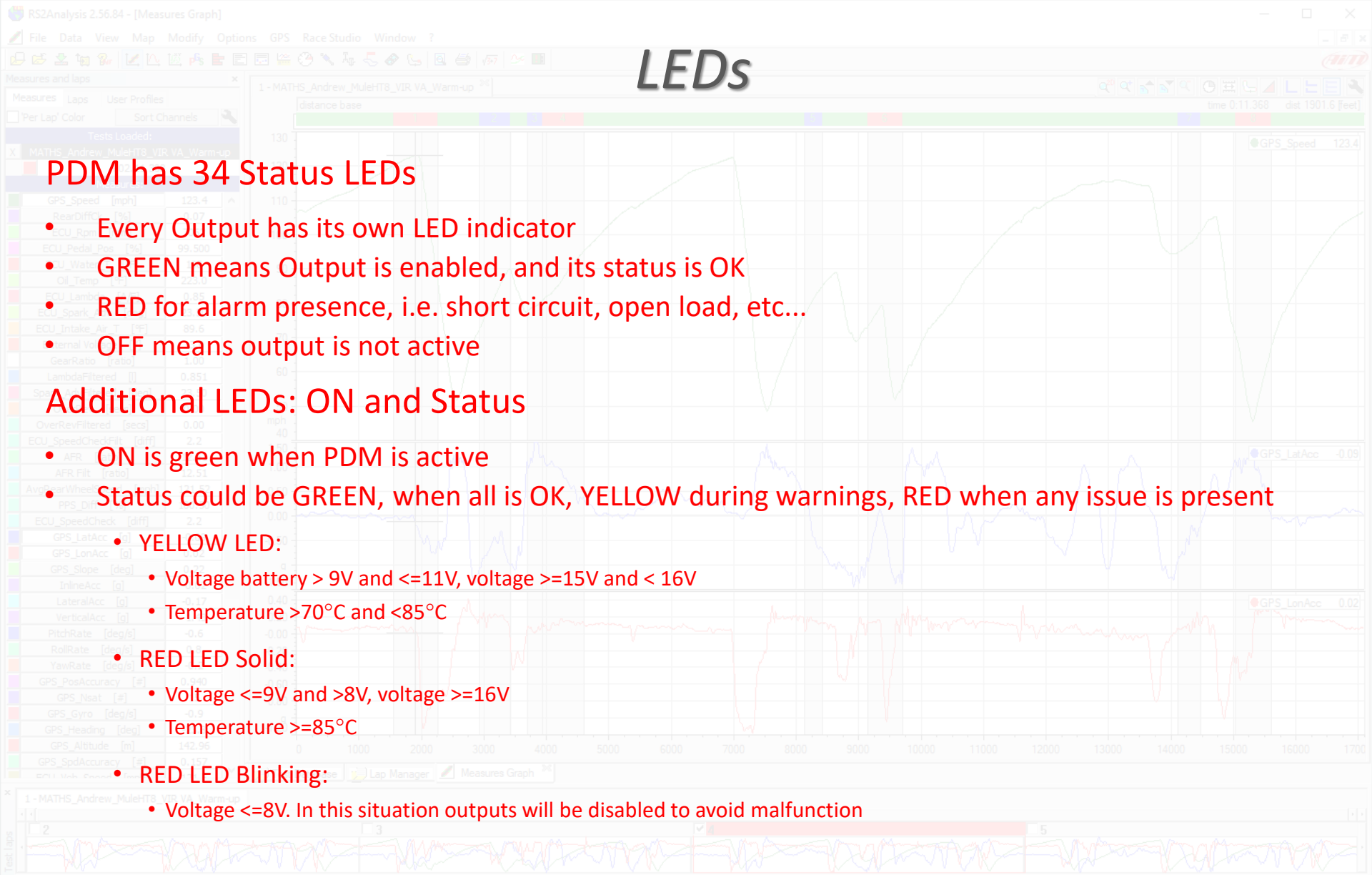
Special Inputs

Ignition (IGN) is a Special Input

- IGN is only digital and is not programmable by user
- It's active HIGH (internal pulldown hardwired) and when activated by external voltage, switch ON the PDM
- Some functions, for example display, are IGN dependent. This means that when IGN is active, the display is switched ON
- IGN can be used in User configurations as a condition for other signals
- CH_IN11 and CH_IN12 can switch on the PDM without IGN signal, when specified input levels are High

Example Application

With the IGN connected to Main switch and CH_IN12 connected to Hazard switch. With IGN active (+12V) all functions on PDM are enabled. With IGN off (disconnected or tied to GND) and Hazard switch active (+12V) PDM enables only outputs related to HAZARD function, typically front and rear directions lamps in the hazard blinking mode



LEDs

PDM has 34 Status LEDs

- Every Output has its own LED indicator
- GREEN means Output is enabled, and its status is OK
- RED for alarm presence, i.e. short circuit, open load, etc...
- OFF means output is not active

Additional LEDs: ON and Status

- ON is green when PDM is active
- Status could be GREEN, when all is OK, YELLOW during warnings, RED when any issue is present
- YELLOW LED:
 - Voltage battery > 9V and <=11V, voltage >=15V and < 16V
 - Temperature >70°C and <85°C
- RED LED Solid:
 - Voltage <=9V and >8V, voltage >=16V
 - Temperature >=85°C
- RED LED Blinking:
 - Voltage <=8V. In this situation outputs will be disabled to avoid malfunction

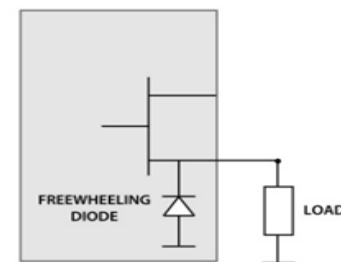
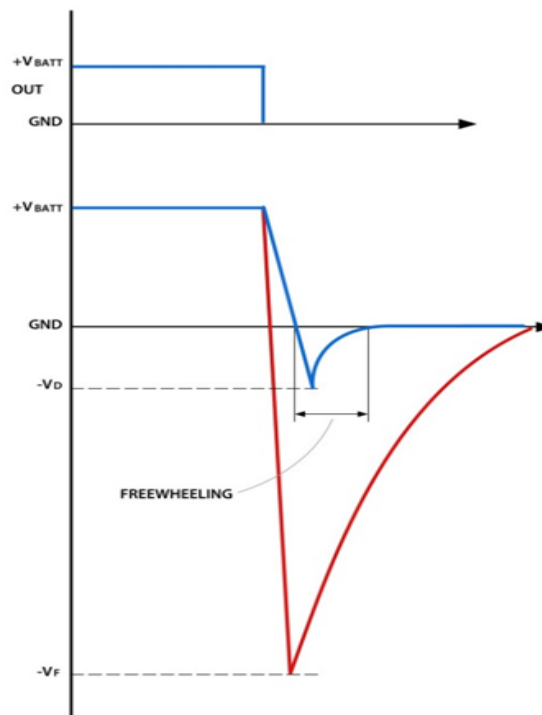
Protection Diodes Inside the PDM

Outputs H1-H4 have internal freewheeling diodes to manage high voltage spikes produced by very high inductive loads.

Outputs HB1-HB4 are fully capable of managing voltage spikes.

As indicated in the picture, voltage levels are clamped to very low values. This action protects the Power MOSFET inside the PDM to avoid complete output destruction.

Typical inductive loads are; big relays, solenoid valves, starter solenoid, big fans, etc...



Protection Diodes Inside the PDM

Output H1 has an internal series diode, useful for disconnecting auto polarizing loads and can manage directly a Starter Solenoid. This can also be used as standard High Side Output

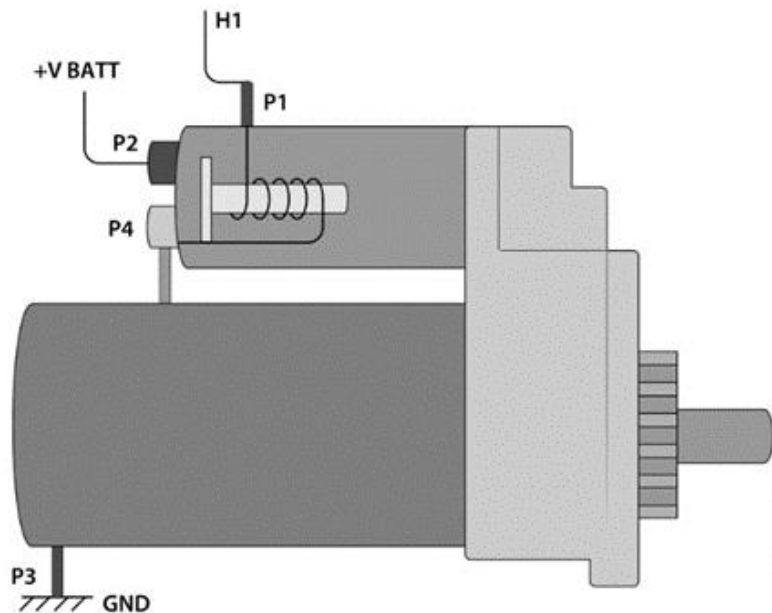
During starter activation, current flows from the PDM out to P1 of Starter.

From P1 current goes to GND through internal auxiliary solenoid to P4 and then through Main solenoid to P3.

During this phase, internal auxiliary solenoid closes the Main switch of starter, connecting P2 to P4. The Starter motor now is activated, and its rotation starts the vehicle Engine.

When the Engine is running, the PDM output must be disabled. The Internal diode block reverses current that would normally flow from P4 (shorted to P2) to P1 and finally to PDM out.

Without this internal series diode, the reverse current would flow into PDM out and keep Starter Motor Engaged.





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- **I Have Downloaded my Data, Now What - Part 2*
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- Export Tests
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RS2Analysis 2.56.84 - [Measures Graph]

File Data View Map Modify Options GPS RaceStudio Window ?

Measures and Laps

Measures Laps User Profiles

Per Lap Color Sort Channels

Tests Loaded:

MATHS_Andrew_MuleHT8_VIR_VA_Warm-up

130

4 02:11.3

Measures:

GPS_Speed [km/h]		
RearDiffCk [rpm]	7062	100
ECU_Rpm [rpm]	99.500	
ECU_Pedal_Pos [%]		
ECU_Water_T [°F]		
Oil_Temp [°F]	0.85	
ECU_Lambda [A/F]		
ECU_Spark_Adv [deg]		
ECU_Intake_Air_T [°F]		
External_Voltage [V]	13.0	
GearRatio [ratio]	1.00	
LambdaFiltered [I]	0.851	60
Spark_AdvFiltered [deg]	23.50	

1 - MATHS_Andrew_MuleHT8_VIR_VA_Warm-up

distance base

time 0:11.368 dist 1301.6 feet

123.4

Customer Support

AiM Sports technical support staff regularly attend races and other events

Call us at 1-800-718-9090 and Look for us at a track near you!



A black and white photograph of a white AiM Rumble van parked next to a large black banner that reads 'RUMBLE' in a stylized font. The van has the AiM logo on its side.



A photograph of a technician wearing a black AiM vest with 'Racing Data Power' written on it, working on the front of a blue car. The car has an AiM logo and a 'Precision' sticker.



A photograph of an AiM booth at a race track. A man in a black shirt and shorts stands under a red AiM canopy tent. A white AiM van and a motorcycle are also visible.

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 YouTube

Customer Support

At an Event Near You!



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LearnFast™

Next Webinar

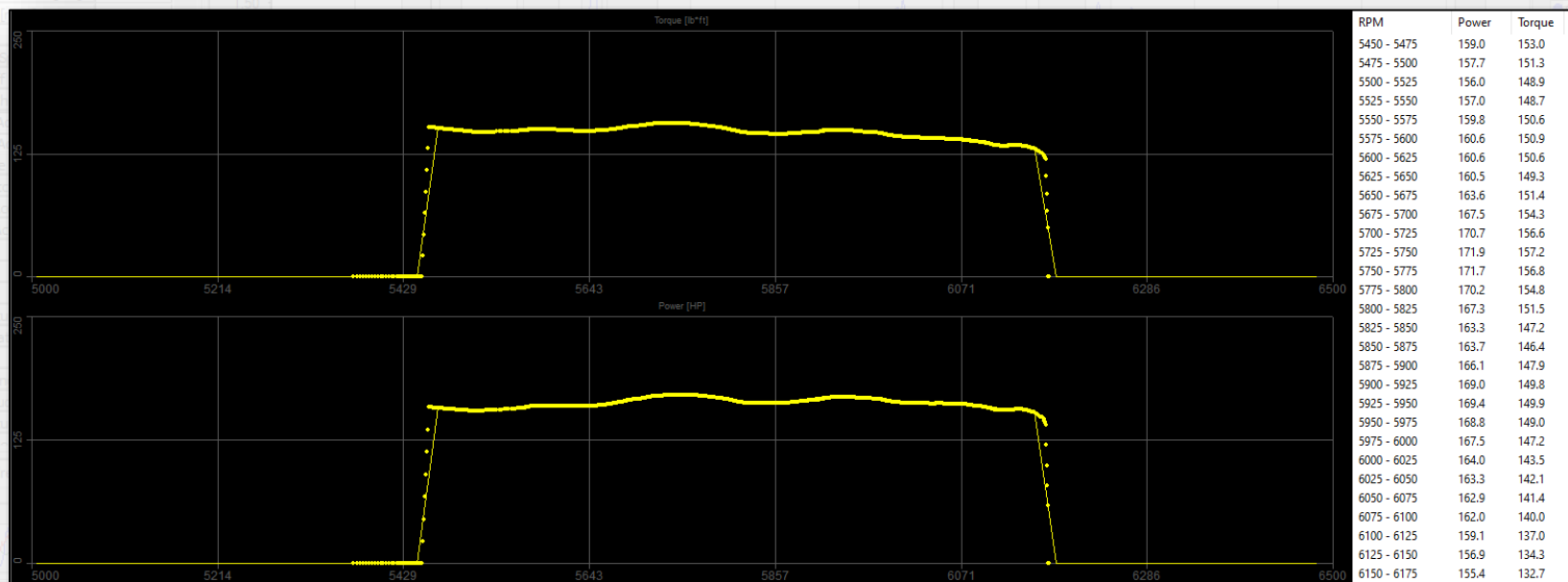
Thursday Sept 24th, 2020

10:00am Pac / 1:00pm East



Host
Roger Caddell

Engine RPM Analysis HP/TQ Calculation in Race Studio 2 Analysis



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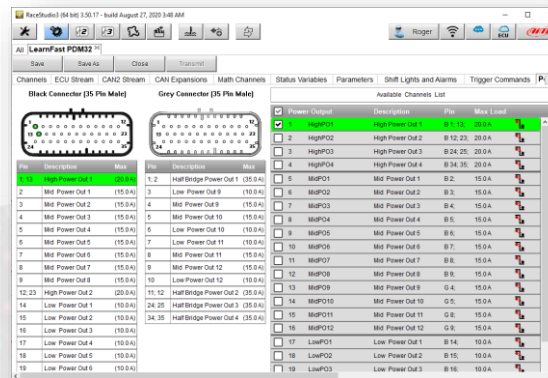


YouTube

Next Webinar Topic

Engine RPM Analysis





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