
# COMBUSTION ANALYSIS DISCUSSION 2025

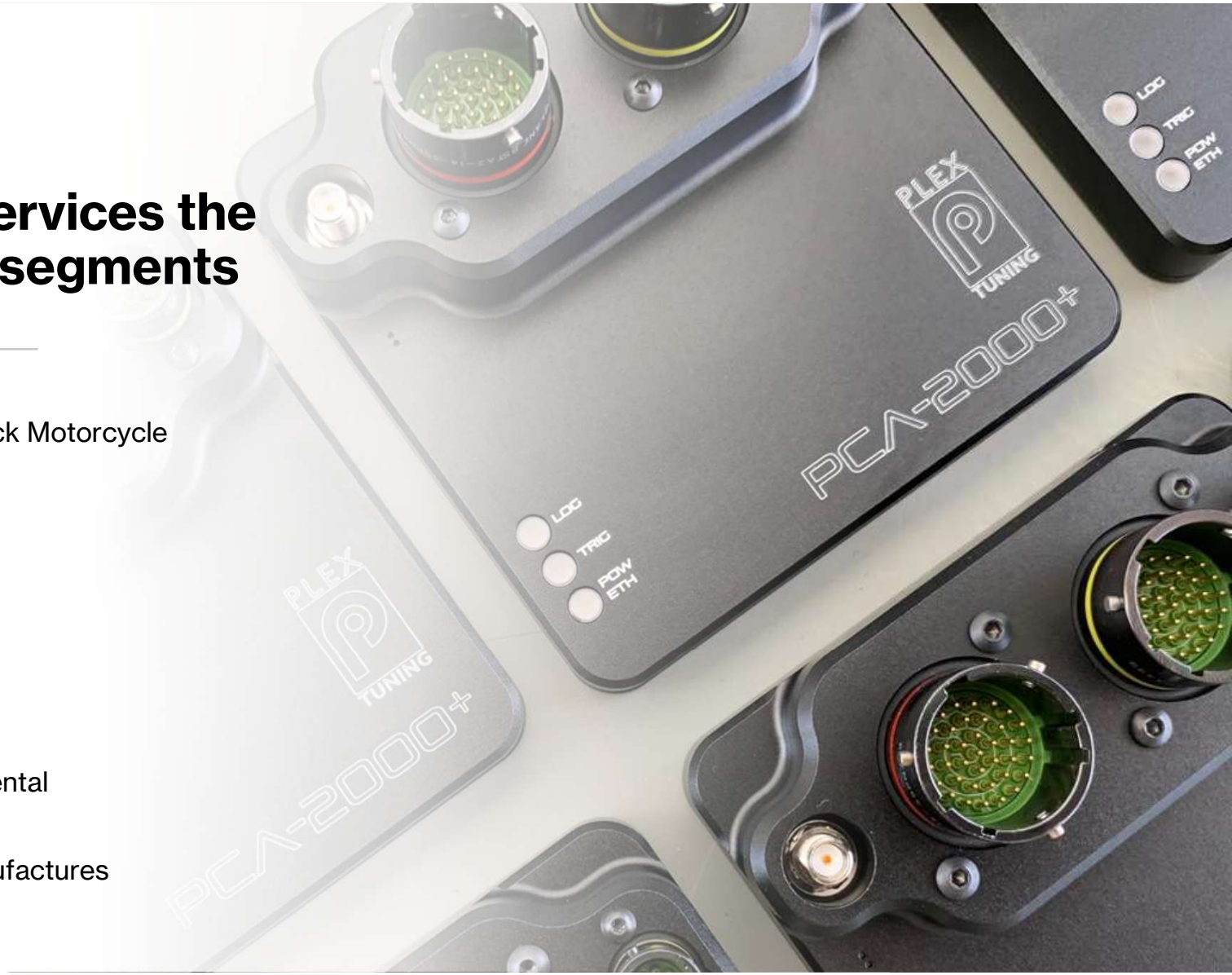
DC INC

BIG STUFF
TOTAL POWER MANAGEMENT

Mooresville, NC 10/11/2025

# DC Inc. proudly services the following market segments

- Nascar / Xfinity
- NHRA Pro Stock Car / Pro Stock Motorcycle
- Pro Mod (forced induction)
- Tractor Pulling / Diesel
- Super Dirt Series
- Power Sports
- Novel Engine Designs
- Alternative Fuel
- 2 Stroke Market
- Methane Recovery / Environmental
- Drone / Military
- Aftermarket Performance Manufactures
- Power Generation / Genset

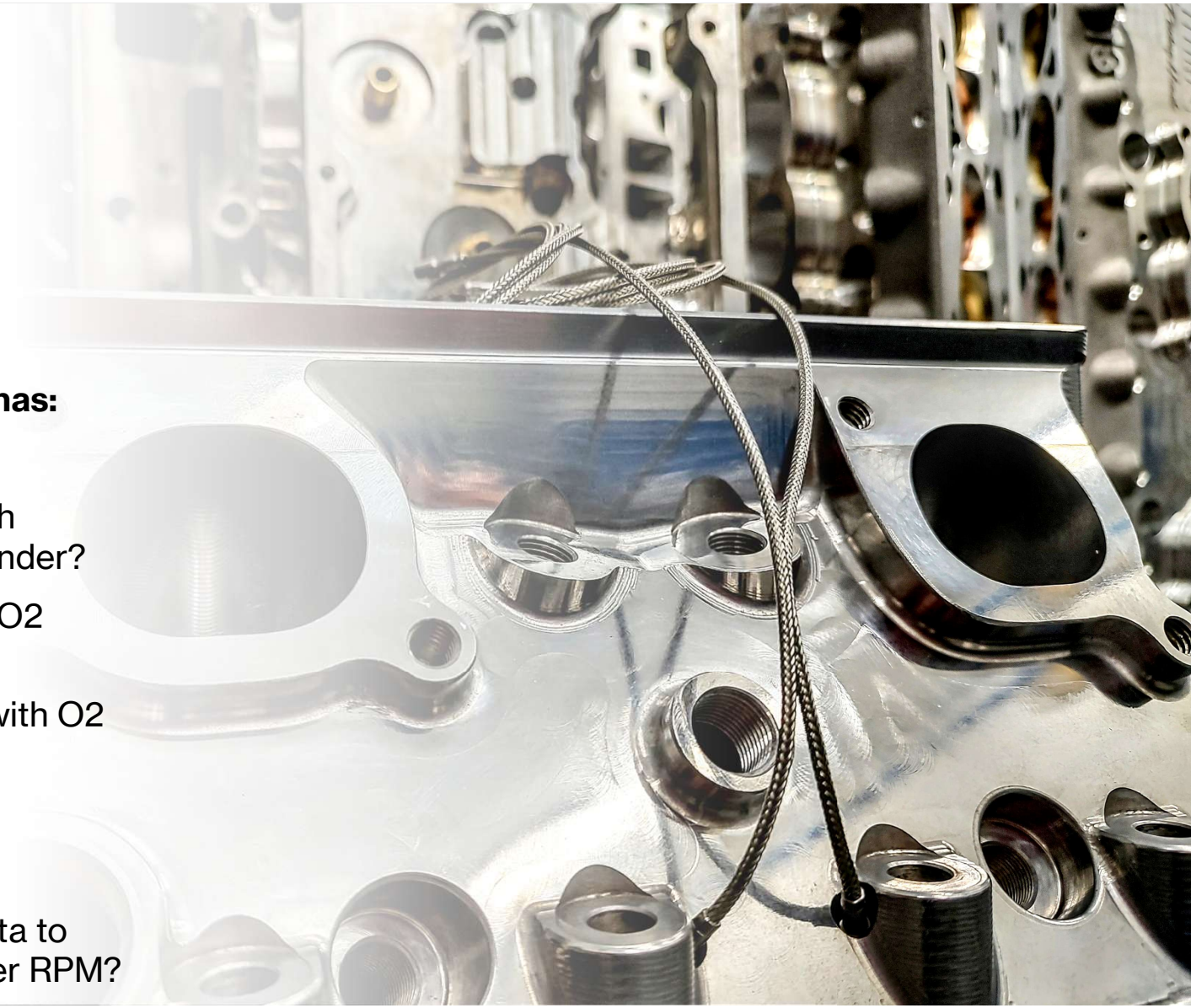


# Why data ? .... **Time is money** ....

- **Save Time**
- **Development Direction**
- **Increase Durability**
- **Increase Power**
- **Prioritize / Focus**
- **Minimize Waste**
- **Reduce Cost**
- **Time to Market**

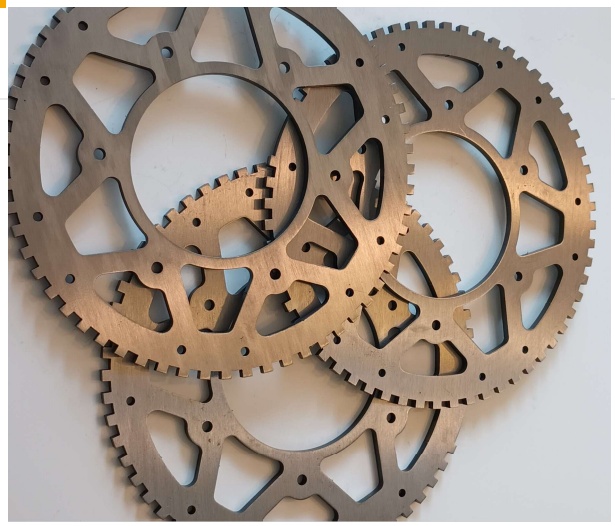
# Group Discussion....

- **By a show of hands who here has:**
- Tuned a carburetor ?
- Tuned a carburetors fueling with multiple carbs or jetting per cylinder?
- Tuned EFI fueling with a global O2 sensor ?
- Tuned EFI fueling per cylinder with O2 per cylinder ?
- Swept global ignition timing ?
- Tuned ignition per cylinder ?
- Who has used a combustion data to calibrate ignition per cylinder per RPM?



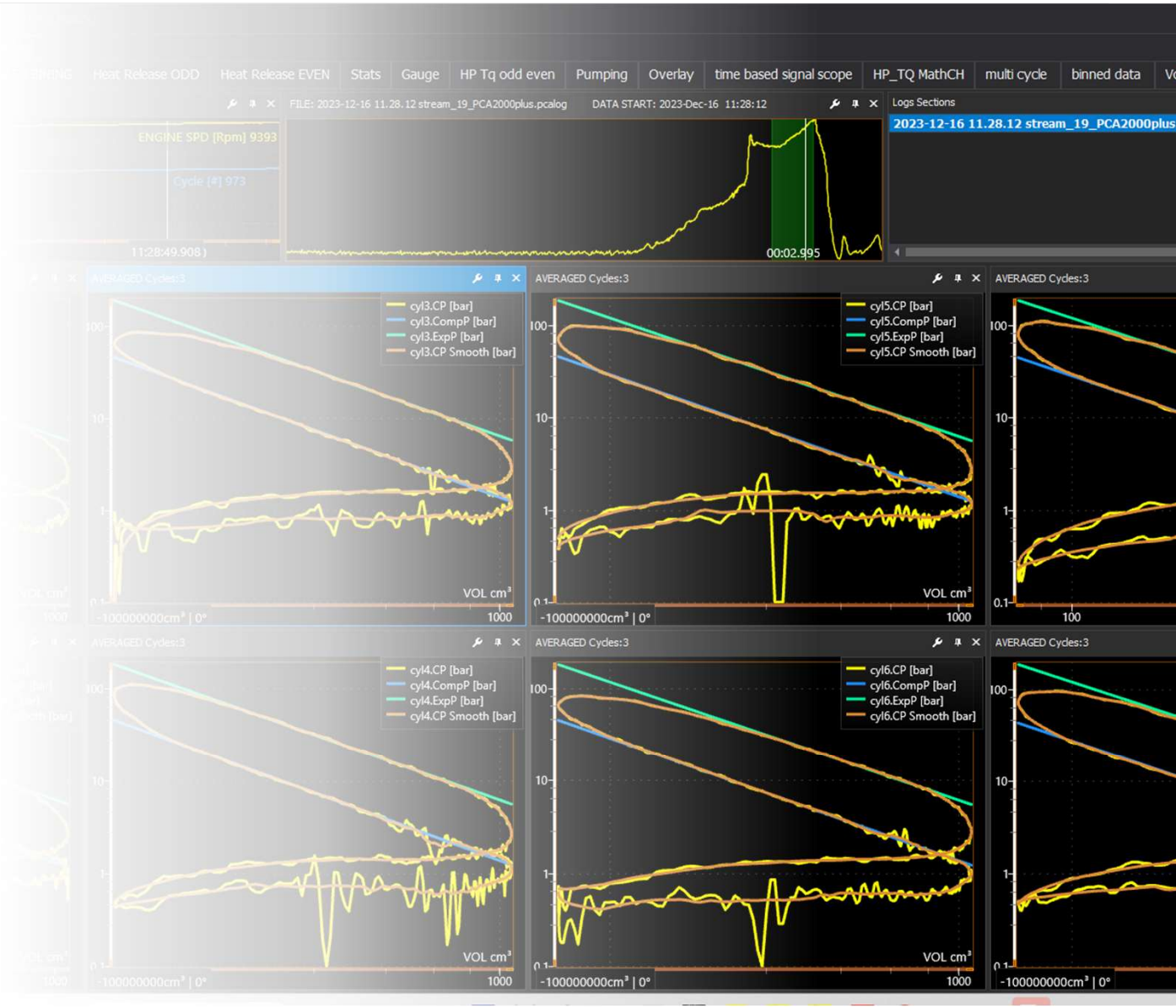
# Equipment Required for Data Collection

**Crank Angle Detection, Combustion System, Charge Amplification, Wiring, Piezoelectric Sensor, Software**



# What can we do with the data collected ?

- Ignition timing / tuning work
- A/B testing comparisons
- Camshaft design optimizations
- Exhaust design work
- Data quality checks
- Engine health / inspection
- Knock detection
- Power per cylinder
- Total observed engine power
- Information for manufacturing
- Dyno Validation



Form drill: 7 inches overall length
1. Passage port .120 diameter into chamber .420 drill length
2. Seating face and tap diameter .177 diameter for M5x.5 (.400 long)
3. Clearance hole for installation tooling .295 diameter (7.3mm) approx. 4 inches of flute
4. All machining tooling and sensor installation tools are available from **DC Inc**.

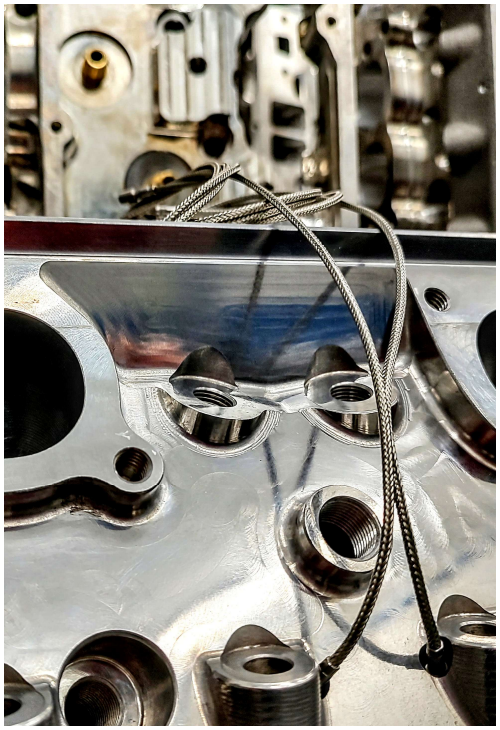
M5x .5 sensor threads, flat face seal for sensor. Reaming tool ensures quality face contact after machining completed or for reconditioning used sealing surfaces.

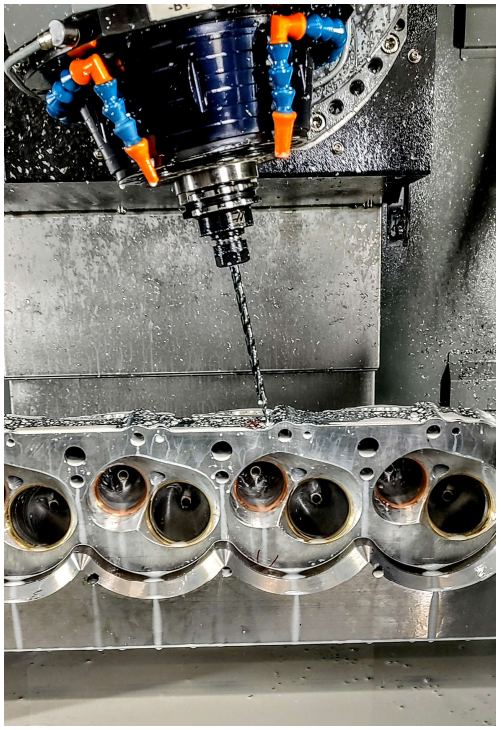
# Machining for Combustion Sensors

**Sensor location is critical to data quality and overall success of combustion measurements**

Sensor depth vs passage length .080-.120

Manual or CNC milling machine process





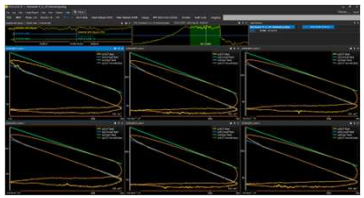
# Sensor Installation

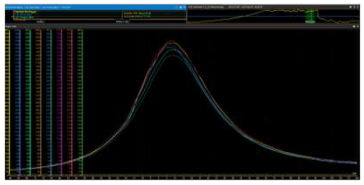
KISTLER
measure. analyze. innovate.

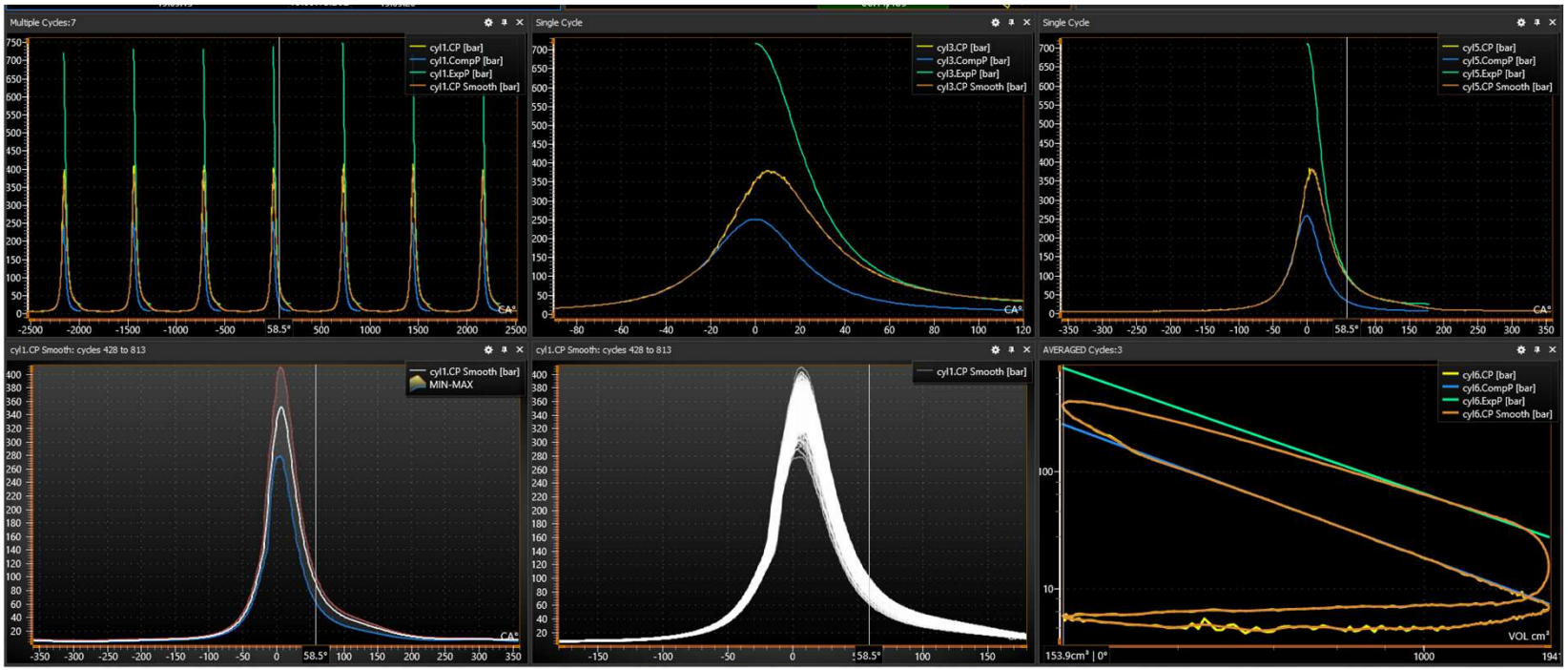
- Cutaway shows sensor machining
- Seating face for sensor with passageway
- Install tool for sensors
- 1.5-2 NM of TQ  (13-17 in-lbs)

**Multiple ways to view collected data**
angle, volume, log PV, multi cycle, avg, defined cycles, zoomed data fit ranges (*user defined selections in software*)

**ALL THE SAME DATA PRESENTED IN DIFFERENT FORMATS**

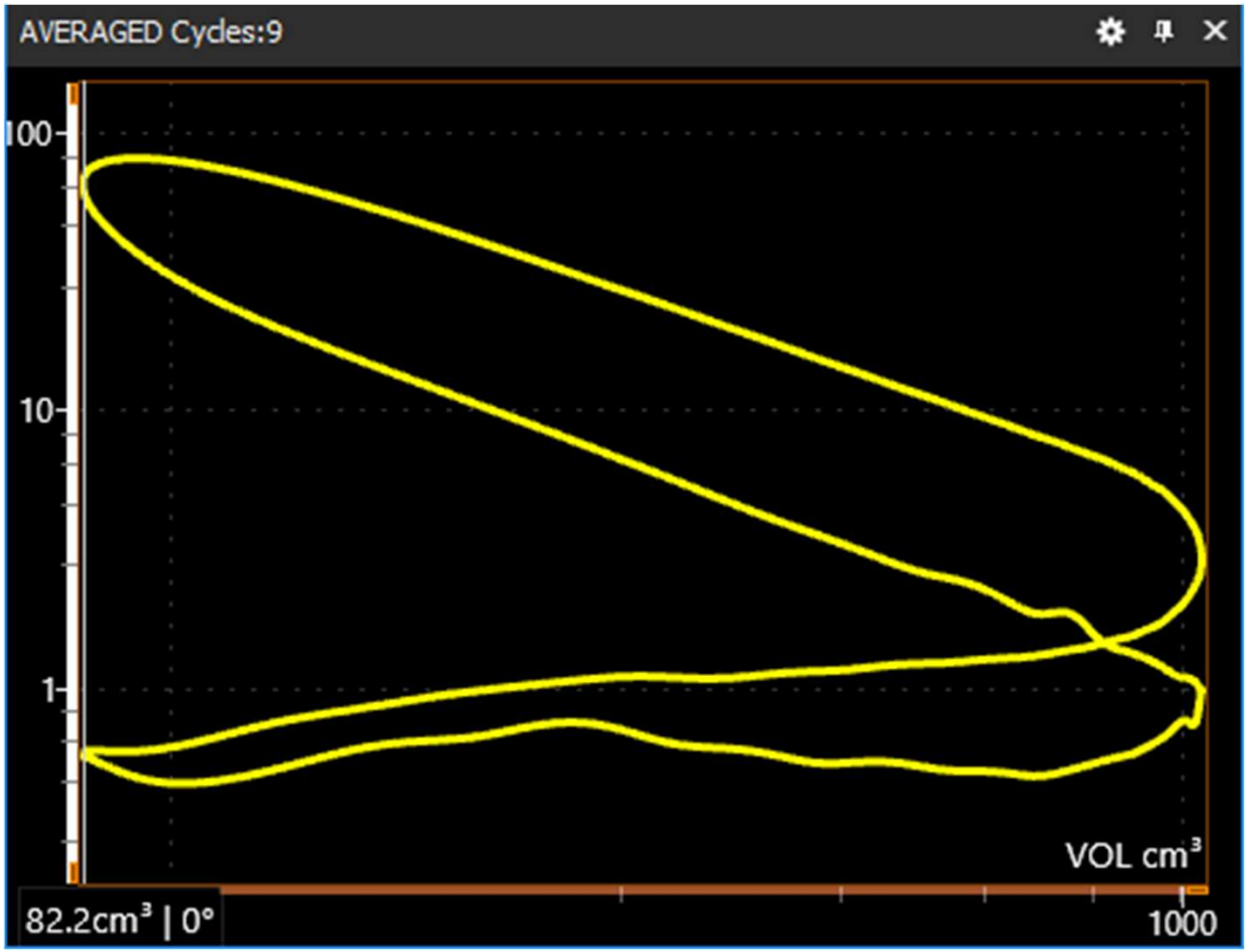






# Log PV
# Pressure / Volume

- LOG SCALING
- TDC two times
- BDC two times
- Y Axis Pressure
- X Axis Total swept volume of the cylinder
- **Key Events Viewed:**
- Overlap
- IVO,EVC,IVC, EVO
- Cylinder filling
- Compression rise
- Start of ignition
- Peak pressure
- Expansion stroke
- Blowdown event
- Exhaust pumping work



# Log PV
# Pressure / Volume

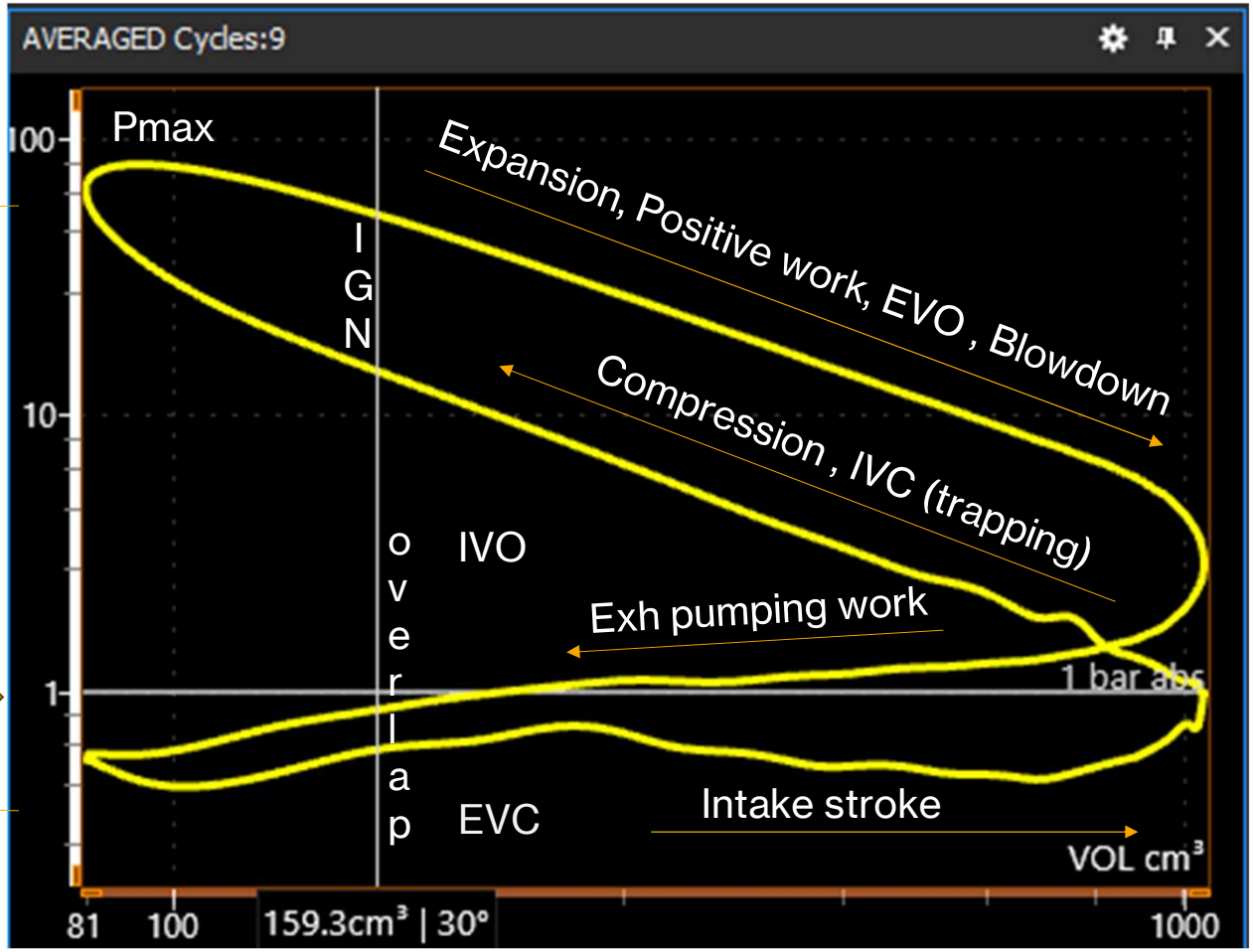
- 4 stroke TDC two times ( 2 stoke once)
- 4 stroke BDC two times ( 2 stoke once)
- Total swept volume of the cylinder
- Patm (1 bar)
- **Overlap,** flush cylinder, critical time to get to Patm and pressure balance to begin cylinder filling
- **IVO**, exhaust draws intake in at overlap
- **EVC ,** Cylinder filling, charge the cylinder vs volume change
- **IVC,** trapping (valves are closed)
- Compression rise, change in volume
- **Start of IGN**, SOC,
- Peak pressure, MAX after TDC
- Expansion stroke torque 3 to 1 payback
- **EVO**
- Blowdown event, free work
- Exhaust pumping work, negative work

LOG

1 bar

TDC

BDC



# What is CA 50 ? ( MFB )

**CA50 is also known as MFB50 Mass Fraction Burned (term used often in Europe)**

- C represents Crank
- A represents Angle
- 50 is the 50 % of the burn
- The convergence of Heat Transfer Losses

Combustion Time Loss align near **7*** ATDC

- Optimum CA 50 generally occurs

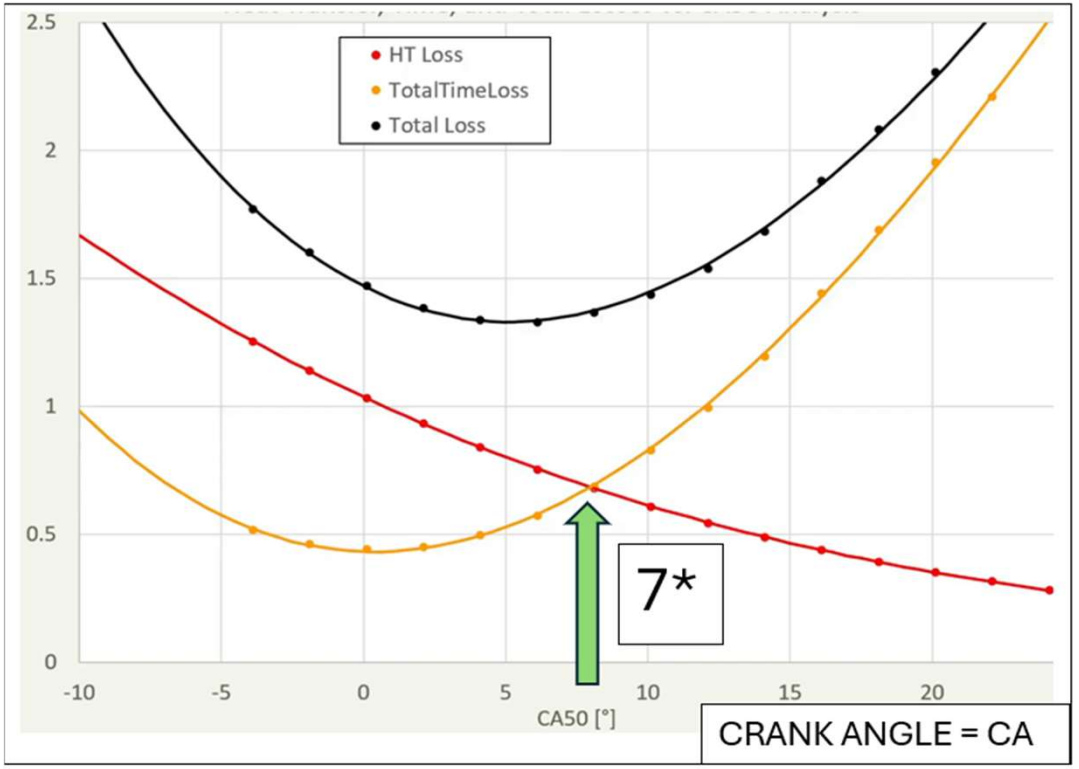
***near* 7*** ATDC in most **NA** engines

- CA10 and CA 90 are metrics used to look at

Beginning and End of combustion (burn duration)

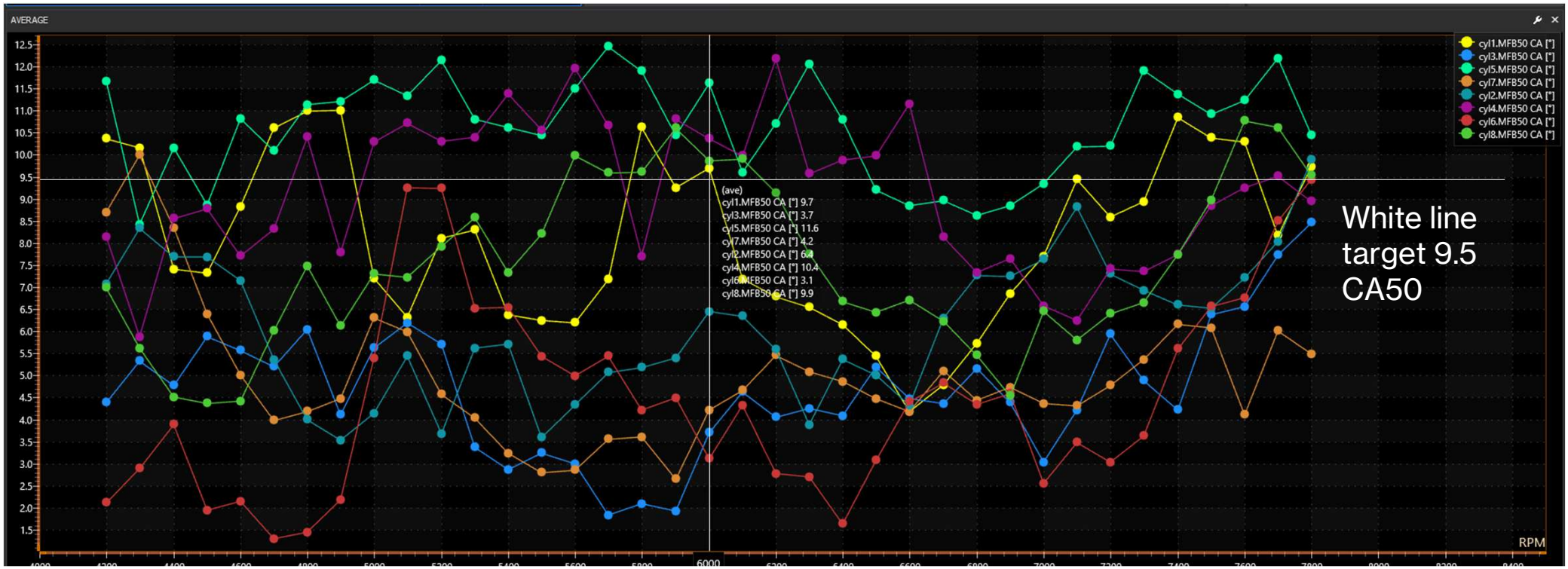
- **FORCED INDUCTION** engines are generally

tuned below optimum CA50 in trade for mechanical durability of the components with high Pmax

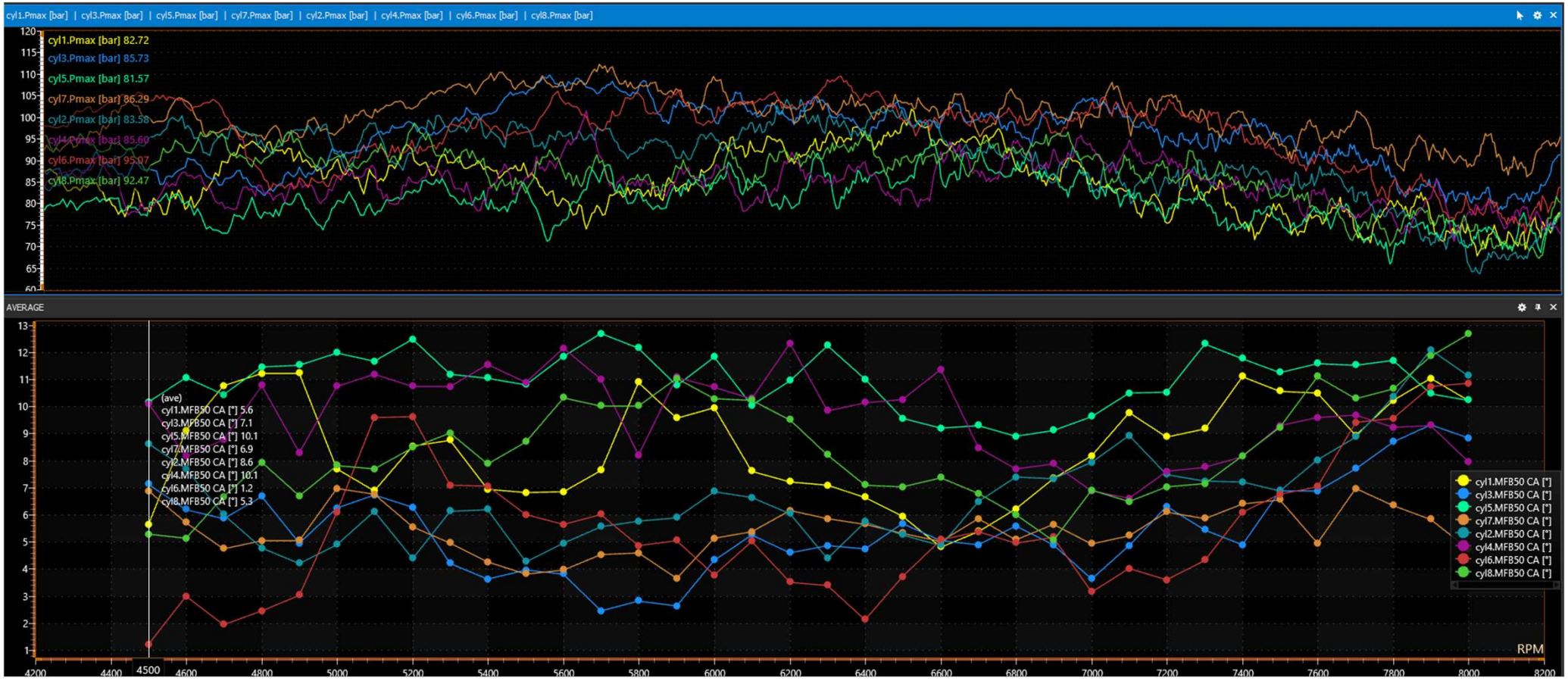


# CA50 spread with 33 degrees base timing 12 degrees of timing spread between min and max across 8 cylinders through RPM range

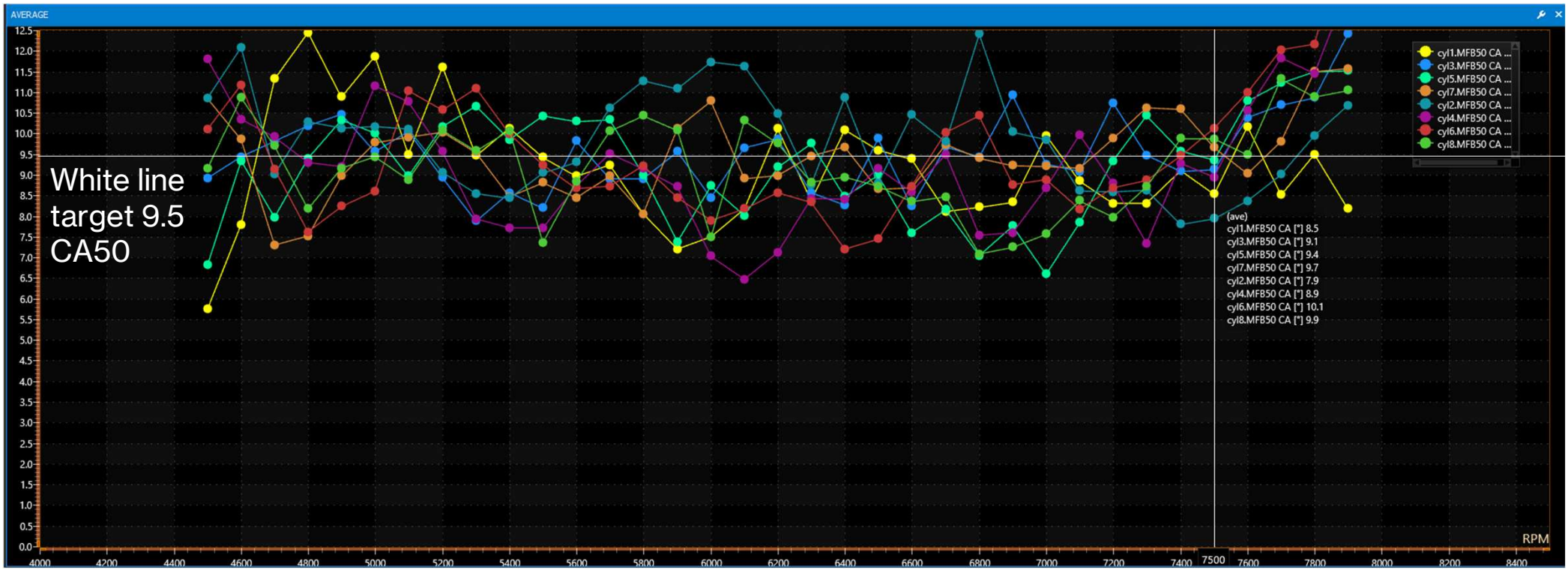
# Y axis CA50 12.5 to 1.5  X axis RPM @100 rpm per dot **BINNING DATA**



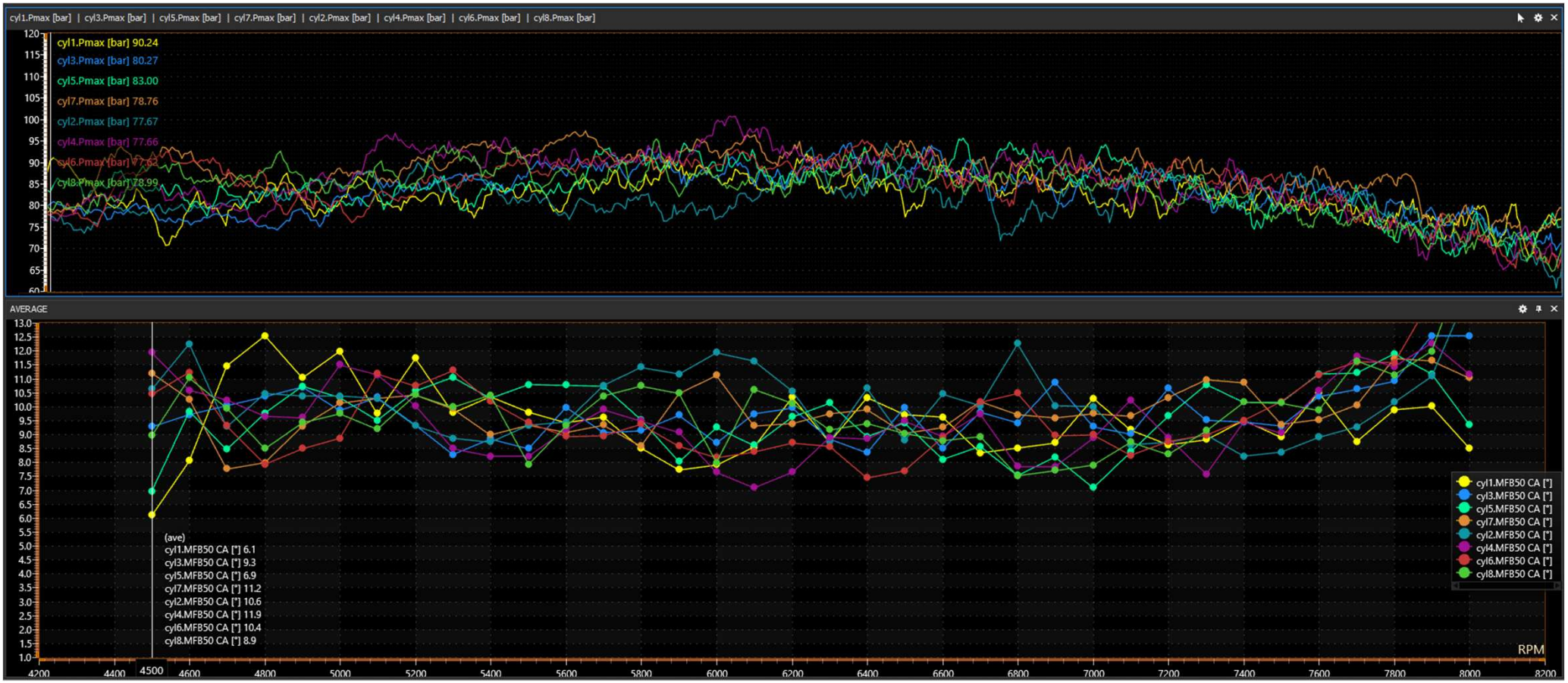
# Over and under timed cylinders Pmax follows the burn rate. Over timed high Pmax under timed low Pmax showcased. Unbalanced power output  70 – 110 bar spread.



# CA50 spread with ignition control per cylinder per RPM 4 degrees of timing spread between min and max across 8 cylinders through RPM range



# Lower Pmax / balanced per cylinder grouping of all 8



**Through customer and industry feedback Plex is continuously adding functionality, features and updates to improve the device and software for all registered users.**

**Plex offers users the option to add features on-line through the license / paid updates to existing hardware.**

**Other device manufactures require yearly license fees to stay active and up to date on software.**

## 2025 Plex Upgrade Options:

- Real time CAN communication
- .1 deg (tenth) resolution option
- Spark timing function

## 2025 Improvements to V2 software:

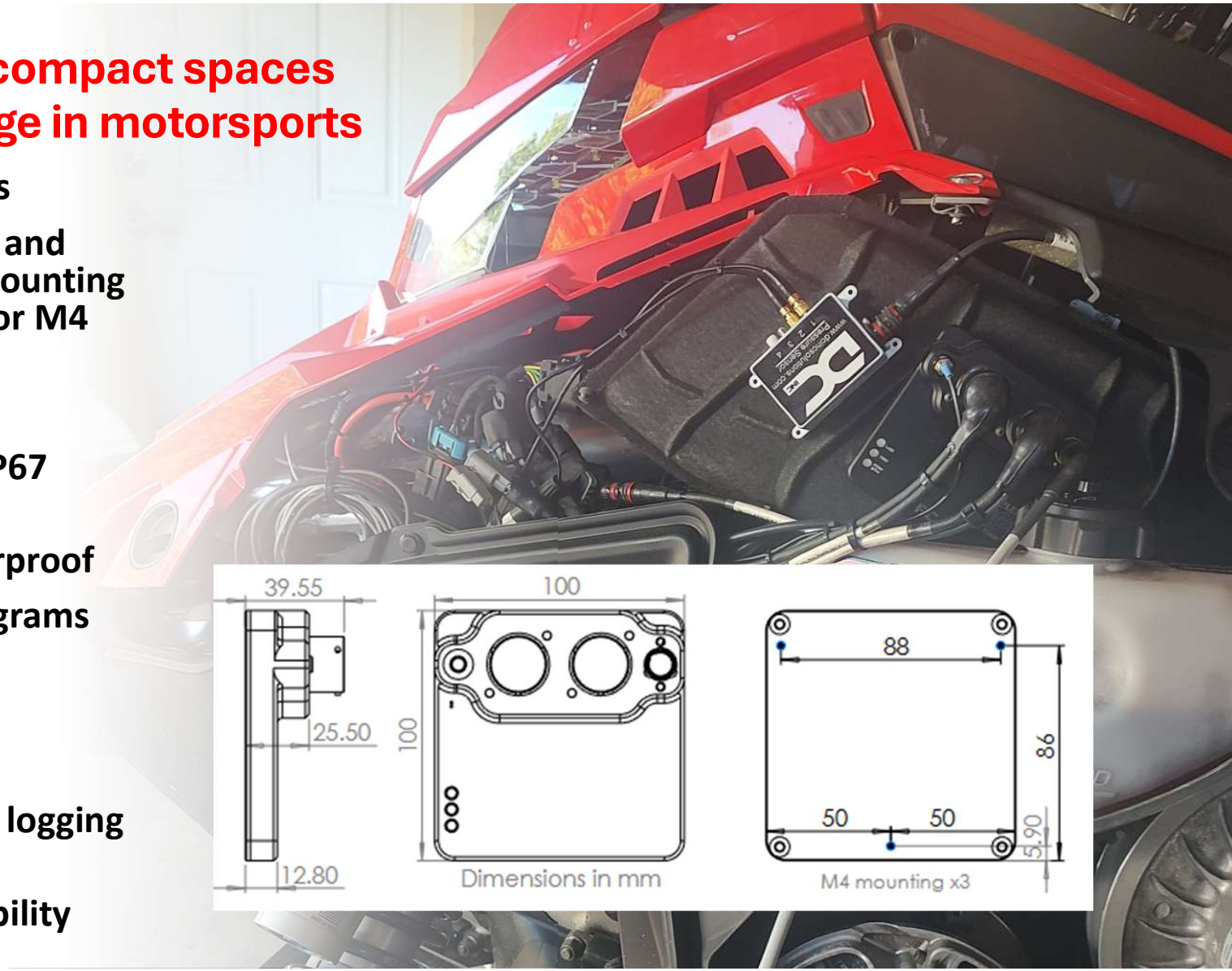
- Expanded options for logging steady state testing
- Crank speed decoding updates for V2 software
- Pegging options user defined
- Updated data filtering user defined options
- Intergraded Barro sensor
- Updates to IMU and GPS functions

## Plex Uses Beyond Combustion:

- Dyno data bi-directional through CANBUS
- High speed data: On track / In vehicle (mobility)
- Data export options
- Custom CANBUS Integrations
- Emissions calibration & scientific validation
- Other HS data IE intake pressure and exhaust pressure data in crank domain
- Custom user created math channels
- Plex valve train module replaces Spintron 2004 software

# Device mounting in compact spaces for mobility advantage in motorsports

- PCA 2000 Plus 4x4 inches
- 250 Grams -Light weight and compact enables easy mounting with adhesive products or M4 screws
- Billet case
- Weatherproof / PCA is IP67 sealed
- DC Inc. wiring is weatherproof
- Amplifier 2x3 inches 85 grams
- IMU motion and force
- GPS positioning
- Logging to device during mobility (no need for PC logging has auto trigger start)
- Price point vs risk in mobility



# DC Inc. Full Harness / Kit

**Full Harness Features**

- Power Supply with DTM
- 16 High Speed Inputs
- 8 Low Speed Analog Inputs
- 2 CANBUS Inputs
- Dual VR/ MAG
- Dual Hall
- 8 Digital Inputs
- 4 Thermocouples

**Leads Provided with Purchase**

- Choice of MAG or Hall flying lead
- 8 High speed inputs (amps)
- 1 CANBUS flying lead
- Power Flying lead with DTM
- Additional leads upon request for purchase

**Harness manufacturing includes:**

- Autosport Connectors
- DR25 wrap
- Mil spec wire
- Labeled
- Sealed
- Potted

# DC Inc. Mini Harness / Kit

**Mini Harnes Features**

- Power supply with DTM
- 8 High speed inputs
- 2 CANBUS inputs
- Dual VR/ MAG

**Leads Provided with Purchase**

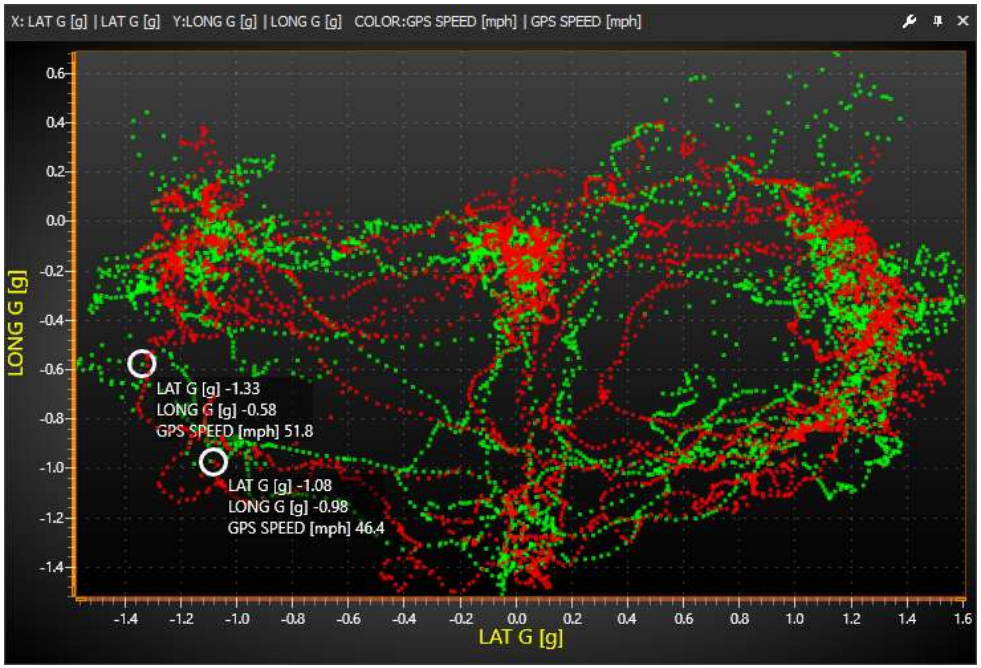
- Mag flying lead
- 8 High speed inputs
- 1 CANBUS flying lead
- Power flying lead with DTM

**Manufacturing**

- Autosport connectors
- Gold plated contacts
- DR25 wrap
- Mil spec wire
- Sealed & Potted
- Labeled connections

**On track using Plex's built in IMU and GPS antenna mobility data plotting. Provides ability to overlay any combustion or CAN data vs on track position, force or speed.**

## G forces IMU data




## GPS / speed force