Installing, Operating and Maintaining Your


System for Maximum Performance

Including:

- Successful Installation
- Preparing for an Event
- Before Each Session
- After Each Session
- Protecting Your Data

Prepared by:

# Introduction

This booklet is intended for customers of Creative Motorsport Solutions who are installing or using Stack Dash and Data Loggers. Although much of this information can be found in the Stack manuals, this manual is a reflection of our experience in getting the most from racecar data acquisition. *We strongly recommend all users of Stack systems to read the manuals accompanying their system.*

Data acquisition systems are, by design, extremely sensitive equipment capable of capturing information about a racecar in great detail and with extraordinary accuracy and precision. To get the most out of this equipment requires attention to detail during preparation and operation of the racecar.

***Suggestion:*** Make checklists of all work needing to be done, be it routine, between races or at the track. The myriad of detailed information necessary for a successful racing campaign is simply too much to remember. We suggest lists for regular maintenance at the shop and at the track and post-session data (setup information, tire temps & pressures, other vehicle and track data).

# Installation

A well thought-out installation is the cornerstone of a superior performing dash or data acquisition system.

- Bench test the unit first. Connect all sensors (including the lap time beacon and receiver) and apply power from a 12V battery.
  - ◊ If you have a data logger, install the Stack software on your PC and connect to the data port. Use the Real Time Display (F6) to monitor sensor output.
  - ◊ Run a simulated session, using all the sensors (turn steering & throttle sensors, turn LAT-G sensor on each side, heat temp sensors, rapidly but lightly touch wheel speed sensor to a ferrous target). Analyze the data (OK, it's not much) to see if it makes sense.
- Bundle extra wiring. The wire loom/harness will have wires longer than necessary for some sensors, depending on the application. Secure extra wire so that it will not interfere with other wiring or components, either electrically or physically.
- Use *very stiff* brackets, especially for wheel speed sensors. Always shield exposed sensors from stone/debris hits.
  - ◊ Mount the wheel speed sensor on the wheel least likely to spin or lockup.
  - ◊ Also have a stiff target. Mount the wheel speed sensor nominally 0.030" from the target, 0.060" max.
- Ground the system directly to the battery, not the chassis. Ground loops result in poor tachometer operation and intermittent data logging.
- The G-sensor is designed to operate in a ± 5g environment. Dropping the sensor even from a height of six inches onto a hard surface **WILL** damage it!
  - ◊ Mount the G-sensor with 3M Dual Lock fastener. This will help filter out higher frequency noise. Do mount the G-sensor on a rigid part of the car (frame rail, etc.). Also mount the G-sensor out of harms way or shield it to protect from knocks.
- Preferred mounting of the throttle sensor is on the throttle shaft. This gives a better indication of throttle operation without the play of the throttle linkage.
- Steering Angle
  - ◊ If the steering shaft is exposed, use the long O-ring to wrap around the steering shaft 3-4 turns

- ◊ If not, use the smaller o-ring supplied on the pulley to mount directly against the steering shaft. Adhere some fine emery or crocus cloth to the shaft to provide traction to the pulley. Light pressure is all that is needed.

- Lap timer
  - ◊ Mount the receiver in the car at the highest point possible to ensure a clear line of sight to the beacon while in traffic.
  - ◊ Provide for mounting on left and right sides of the car.
  - ◊ Do not mount the sensor behind glass, Lexan, or plexiglass
  - ◊ Direct sunlight can overpower the receiver. Try shrouding the receiver with a black plastic film can or equivalent.
  - ◊ For the beacon use a decent tripod with a ball or pan head at least 5' high to mount the beacon transmitter. A small 12V rechargeable battery will work fine (Radio Shack sells a small, rechargeable 12V lead-acid battery for home alarm systems that works well .).
- Suspension Travel
  - ◊ A digital interface (ST683) is supplied for use with each suspension sensor. This provides anti-aliasing and signal conditioning. Each digital interface should be mounted in a location as free from heat and vibration as possible.

  For the best accuracy mount the sensor parallel to the damper.
  - ◊ Provide for easy disconnection during spring/damper changes (Nylon bolts are good for this – they will break first, saving an expensive sensor).
- Pressure sensors
  - ◊ Vibration will eventually damage a pressure sensor. The preferred mounting is not directly on the engine, but rather mount it to the chassis and connect to the engine with braided hose. Aeroquip fittings and adapters are commonly available for this purpose.
- Protect your system with a fuse or circuit breaker (0.5– 1.0 A). Electrical noise can affect the quality of your data and lead to premature failure of system components.
- Ensure wire loom routing won't interfere with other systems' operation (including the driver!) and won't chafe against other components or chassis members. Also ensure sensors and wiring is removed from sources of electrical interference (ignition, for example).
- Tie-wrap wires snugly, but not too tight. Leave just enough slack to slide wires back and forth.
- Perform a system check at the shop before going to the track for the first time (run car on stands and check all sensors for operation). Familiarize yourself with ALL aspects of the software. Use the demonstration data provided to check out all of the software features. Time at the track is too valuable to spend learning the software or system features.
- Place all buttons and network (download) port within reach when belted in the car.
  - ◊ Button 3 (display layer control) should be on the wheel.
  - ◊ Button 4 (lap marker insert) should be very convenient to the driver (or on the wheel if no lap time beacon is being used).
- Calibrate the wheel sensor
  - ◊ Measure the wheel circumference. Preferred method:
    - Inflate the tire to its normal hot operating pressure.
    - Put a chalk mark on the tire at its lowest point and put a corresponding mark on the floor.
    - Roll the car forward exactly three wheel revolutions.
    - Mark the floor where the chalk mark on the wheel is.
    - Measure the distance on the floor and divide by three.

# Preparing for an Event

Preparation is as important for your data system as for your car. Before leaving the shop for an event perform a full systems check. As work is performed on the car sensors are often moved, affecting the calibration and accuracy of the system. A system check will also refresh the user on the operation of the system.

***Inspect the harness.*** Every connector should be firmly attached and all wires securely fastened to the car.

***Inspect every sensor.*** Check the fitting of each sensor; any unintentional movement will reduce the accuracy of the system and may lead to premature sensor failure.

***Tare each position sensor.*** Most position sensors have a specific operating range. For maximum accuracy these sensors should be reset in their zero position. Steering position sensors are the best example. Using the **Utils, Realtime Display** menu, center the steering wheel and then adjust the steering sensor until the software shows a '0' for the steering channel. The same procedure can be used for other position sensors.

***Charge batteries.*** Ensure the laptime beacon transmitter battery is fully charged. Ditto if the Stack system has its own battery.

A data acquisition system is only as useful as the quality of data it collects. If data is lost, poorly calibrated or mislabeled it becomes useless or even worse – misleading. With the high costs in time and money of putting a racecar on the track a few moments spent ensuring your data is stored in the correct place is a good investment.

***Select a track.*** From within the PC software select the correct track for the event. If this is to be the first outing for this track follow the software manual instructions to setup a new track. Ensure the track length is correct and the tolerance is reasonable (100 ft. is a good starting point). Most track lengths are taken at the middle of the track. Your racing line will differ significantly in length. If your wheel circumference is accurate, adjust the track length accordingly (see After Session section).

***Update the track notes.*** The software maintains some basic information about each track. Take this opportunity to review and update this information. Has the track configuration or distance changed? Has it been resurfaced? These types of changes affect the meaning of the data you collect and should be recorded.

# Beginning of the Day/Session

Check the PC interface with **Realtime Display** option under the **Utils** menu.

- Create a new session (File, Select Session, New). The default name is year, month, and day (ex. 990530). Edit this name to suit; however we recommend keeping the default and adding two characters for driver or car identification.
- Check the track length and tolerance for accuracy. Add information as necessary.
- Ensure whatever may be in memory is downloaded (if it's worth saving) and clear the data logger memory.
- Ensure the power supply (battery) is fully charged. Ditto for the lap timer beacon.
- Check the dash setup for the car and track (i.e. shift light, warning lights, engine warnings, Predictive Lap Timer range…)
- Put the beacon transmitter at trackside. Some tracks have a designated area for transmitters. It's best if all Stack beacons are grouped together. If transmitters span the length of the pits, the lap timer may reset before the end of the pits. Stack does, however, recommend 10 feet minimum between beacons of any brand/type.

# End of Session

Download your session data. Backup original data to an archive **directory.** Clear memory.

Adjust track distance, if necessary, to an approximate average of good laps. Recalculate (Options->Calculate->Standard). Also adjust the lap tolerance if necessary and recalculate. Correct any missing/wrong lap markers.
Missed laps are indicated by a lap time that is a multiple of a typical lap. Many missed laps are an indication of a signal blocked by traffic, low beacon battery level, electrical noise or sunlight interference with the receiver.
If lap times from another source are available, use these as a guide to scale the Stack lap times.
**The sum of the revised lap times must equal the original large lap time.**
***Make Track Map, if necessary.*** If a track map is not already available, make maps of all laps (Options->Calculate->C*X*-MAP-*X*). To calculate all laps, enter zero for the lap to calculate. Select the best map from those calculated.
***Enter session notes.***
Weather - air temperature and barometric pressure, air density, cloudy/bright conditions.
Track conditions - surface conditions, new pavement, oil or oil dry on line.
Review your driving - note crisp downshifts, apexes hit and application of power. Remember that objectivity counts.
Car performance – handling, brake bias, gearing, throttle response, tires (note heat cycles on tires).
***Review the session.***

- Were all the sensors working?
- Does the data make sense?
- Concentrate on the best one or two laps. Compare with previous session data to see where time was gained or lost (Speed Differential, Rolling Lap Time, Lap Time Comparison). Why the differences?
- Track conditions, tires, traffic, chassis adjustments, better driving?
- Compare data with session notes.
- Does time lost correspond to oil on the track or over/under steer caused by tires going off?
- Is later braking sacrificing corner exit speed?

# End of Event

Turn the system off. Retrieve the beacon transmitter and battery from the pits and pack for travel (Ensure battery is charged back at the shop).
Always backup your data after the event – you'll want to use that data for comparison the next time you visit that track.
The original data should always be archived since recalculations may not always give the desired information. Name directories with useful names and try to include the event date.
Ensure the system is ready for traveling. As in pre-race prep, make sure no sensors (ex. wheel speed and suspension motion sensors) will be strained or pulled by tie-downs or items stored in the car.

# Dash Buttons (We recommend labeling your buttons to aid the driver – and the crew!)

| **Switch** | **Normal** | *Setup Mode* | **Laptime Memeory** **(optional)** |
|---|---|---|---|
| 1 | **Peaks** | Decrease value | Previous lap |
| 2 | **Clear** Message /Laptime Mode | Increase value | Next lap |
| 3 | Change **Layer** | Next parameter | Exit |
| 4 | Insert **Lap** marker | Exit | |
| 1 & 2 | Enter Setup Mode | | |
| 1 & 3 | Clear peaks & best laptime | | |
| 1 & 4 | Clear laptime memory | | |

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