STANDALONE GUIDE AND ELECTRONICS PACKAGES

Rev. 07JULY2022

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Engine Control Packages Offered and Tested

For all engine platforms assume we do not have factory sensor curves, so temp and pressure sensors must be acquired from us if you wish to run one of these engines

- Duramax
  - LBZ through L5P can be controlled with no modification
  - The LB7 and LLY must have a tone wheel from an LBZ installed to be operational. It must be a 60-2 trigger wheel. We do not have factory sensor curves, so temp and pressure sensors must be acquired from us if you wish to run one of these engines.
  - LML must use M141 ECU
- Cummins
  - 5.9 and 6.7 Cummins common rail engines
  - 2003-2007 5.9L and 2007-Current 6.7
- Ford Scorpion
  - All 2011-Current Powerstroke engines
  - Must use M141 ECU
- Volkswagen TDI
  - All 2.0 TDI engines from 2009-2014 that are similar to the CJAA platform
  - US based engines use M141 ECU (Piezo)

Factory Transmission Support Offered

If it is not on this list, we do not support it yet

***Neither of these packages are fully tested or on road proven with lots of miles for mass consumption, we are not to be held liable for issued with hardware when using either of these packages. ***

- **2020 L5P with 10 Speed Allison**
  This package utilizes a MoTeC ECU in conjunction with a factory transmission controller. This package has been made to be functional, but we are still finding bugs with the control side of things, so we are not offering it yet to the public. Once the package is complete and tested, we will have something to release. Check back toward the end of 2022

- **Allison 6 Speed Control**
  This is a very basic package that utilizes a MoTeC ECU and factory A50 transmission controller. The transmission is still tuned through the factory TCM with EFI Live or similar (We do not provide EFI Live tuning) once the CAN bus is connected to the MoTeC ECU and the bus is functional, the TCM is provided with the correct information to make shifts happen. There is currently no fuel cut for shifts, no manual shift control, no speed sensors readings through the bus, it is very basic and functional. We plan to refine this package to include features like that. Check back toward the end of 2022.

Future Planned Engine and Transmission Support

Utilizing a MoTeC ECU and factory transmission controller, a 6-speed package for a 2017 Ford 6.7 Powerstroke is currently in development, but there is no ETA on when it may be released. It could be 6 months, and it could be 2 years from now.

Utilizing a MoTeC ECU and HTG integration with the 8 Speed behind an ECO Diesel is in the plans to develop. No ETA on this project is yet projected.

Things We Do

- ✔ Remote standalone calibration and setup support
- ✔ On-site and remote calibration and setup support
- ✔ Engine dyno service for Cummins and Duramax
- ✔ Custom wiring harness builds only for our standalone ECUs
- ✔ Fuel System Characterization and flow testing

Things We Do NOT Do

- ✖ Fabrication
- ✖ Factory ECU tuning
- ✖ Factory ECU custom wiring
- ✖ Mounting sensors or devices
- ✖ Drilling holes for harness fasteners
- ✖ Cutting holes for Harness Bulkheads
- ✖ Chassis Dyno in House
- ✖ Hub Dyno in House
- ✖ Mechanic work of any kind
  - ✖ Including but not limited to:
  - ✖ Changing injectors
  - ✖ Changing high pressure fuel pumps
  - ✖ Running hoses
  - ✖ Fixing leaks
  - ✖ Changing Oil
  - ✖ Bleeding brakes
    - ✖ If you expect us to do a first fire, the vehicle needs to have functional brakes
- ✖ Provide free wiring harness guidance
  - ✖ The pinouts for almost all devices we sell are readily available online, or we can send the documentation and give a basic run down, but if you don't have any wiring experience, we would not recommend taking it on yourself. Wiring support would be $150/hour and is not prioritized on the schedule
- ✖ Prepare engines for the engine dyno
  - ✖ Engines must already be assembled with sensors in place if we are to engine dyno it
  - ✖ Engine dyno date rate is charge for any work we are expected to do to prepare it

Process for Creating a Standalone Package

1. Skim this entire packet
    a. It looks long, but many sections can be quickly skimmed, particularly the packages offered as it is repetitive
    b. **Questions asked that can be easily answered in this guide are liable to not get a timely response**
2. What is the application of the ECU? Truck pulling, drag racing, street rod, ect…?
3. Decide what ECU to use M141 or M142
    a. Reference “What ECU to use”
4. Decide if you need a PMU
    a. Reference “When do I need a PMU”
5. If you don’t need a PMU
    a. Do you need solid state relays for nitrous solenoids?
    b. Do you need a keypad for driver inputs?
6. Check the “Packages to build or buy from” section to see if one of them fits your needs. If not continue to step 7 to compile your own sensor list.
7. Compile a sensor list to be able to place an order
    a. Go through the entire “Race Vehicle Planning Guide” and select the things on the vehicle that you want to monitor
    b. Select everything you will need to control with the ECU or PMU
    c. Select all the driver inputs you want from the driver input list
        i. Buttons
        ii. Keypads
        iii. Rotary switches
        iv. Etc….
    d. Be sure to look at “General ECU information” to make sure there are enough inputs and outputs to control and monitor your selection. If not, expander modules are an option
8. Create a hardware order
    a. Select the sensor for each item you want to monitor that fits your application based on the description and sensor option listed for each item.
    b. Count the amount of each sensor and device you want to purchase, like you are making a grocery list
    c. Send the order with quantities and part numbers to sales@ssdiesel.com
    d. **It is only at the point you receive an order confirmation that your order is official and hardware can be held for you**
9. Once the hardware is received
    a. Mount all the hardware in the vehicle, every sensor and device
10. If the vehicle is coming to S&S for a custom harness
    a. Every device, sensor, actuator, driver input, must be mounted. Anything with a wire going to it must be in place so that a wire can be ran to it for the harness.
    b. If bulkheads are included in you harness package, you will need to make sure provisions are made in the firewall for them. We do not do fabrication or hole drilling on vehicles.
        i. One large bulkhead for all sensor wires
        ii. One small bulkhead for all injector wires
        iii. One additional small bulkhead required for nitrous wires passing through firewall
    c. See the Custom Wiring Section for more details

Things to Know When Buying a Standalone ECU

- One hour of support is included for first fire to work on rail pressure and idle control
  - Anything over the allotted hour will cost $150/hr for troubleshooting, setup, and tuning of any kind that becomes required.
- Fuel system must be fully mapped
  - Pump flow curve must be obtained in liters/hour
    - S&S can test your pumps to provide this information
  - Injector linearization table must be obtained
    - S&S can test your injectors to provide this information
    - This table associates a rail pressure and injector duration to a fuel mass, since the ECU operates in terms of fuel mass
    - Linearization table test points should include 25 MPa to the maximum rail pressure you plan to run, ideally 20 to 25 MPa higher than maximum rail pressure.
    - It should include fuel mass or volume greater than what you plan to run.
- If S&S is not doing the entire harness, but S&S is to do the device setup
  - Clear documentation of how all devices were wired must be provided
  - Clear documentation of what sensors are used for each sensor input
  - Clear documentation for the scaling of any sensors that were not provided by S&S must be supplied
  - Support charge of $150/hour will be charged for setup
- Support is not always available on weekends or after normal business hours
  - If you do not test your vehicle except when you are at major events, supporting you will not be a priority or emergency. Do everyone a favor and test your vehicle outside of big events. Qualifying rounds are not testing rounds.
  - S&S employees have lives outside of work and are not always able to answer all phone calls, texts, and emails immediately. Leave a message and they will get back as soon as possible.
  - If you have an event that you know you need support for, we must know in advance and we will do our best to be available.
  - There are videos available on the SSfueled or S&S MoTeC Support YouTube channel and notes in the S&S Workbook to try to help work through basic questions. Sometimes if you have a question on the table you are working on click “F1” on your keyboard to bring up the “Help”.
  - Time required for calls, texts, and emails related to support will be recorded and added up at the end of each month
  - Support will be billed monthly at $150 per hour in 15-minute increments with 15 minutes being the minimum for a text/call/email/datalog review/revision.
- Factory engine sensors
  - The only factory sensors we use on the platforms we support are:
    - Fuel rail pressure Sensor (Often times upgrades are recommended or required)
    - Camshaft position sensor
    - Crankshaft position sensor
  - We do not keep scaling on hand for the various factory pressure and temperature sensors on stock engines. We recommend using our known sensor packages.

What ECU to Use

M141 ECU for Piezo injectors: LML Duramax, 6.7 Ford, USA based TDI

M142 ECU for Solenoid injectors: 5.9 and 6.7 Cummins, All Duramax besides LML

Due to supply issues with the M142 ECU: The M141 ECU has been approved for use on solenoid injectors for diesel truck pulling, drag racing, and other short duration events. With piezo injectors operating at a higher voltage, the electronics have higher resistance which will cause heat to build up faster compared to the M142 ECU in the same conditions. With this in mind, special consideration should be taken to not mount the ECU on something that may be excessively warm and internal ECU temperature should be monitored if using the M141 on solenoid injectors for long durations at high RPM and/or pulse width.

General ECU Information

- The M141 and M142 ECU have the same pinout
- Refer to M1 ECU Hardware PDF for more detailed information
- Refer to M142 or M141 PDF Datasheet for more information
- ECU Inputs
  - 17 Analog Voltage input pins
    - Measure from 0 to 6.098 volts
    - Used for 0-5v sensors
  - 6 Analog Temperature input pins
    - Internal 1K Ohm Pull up resistor to 5v
    - Measure from 0 to 6.098 volts (Used for 0-5v sensors)
    - Thermistor style sensors wired here
  - 2 “Narrow Lambda” input pins
    - Can be used as Analog Voltage inputs
  - 4 Knock sensor input pins
    - Can be used as high-speed Analog Voltage inputs
  - 4 Fixed Digital input pins
    - Internal 4.7K Ohm pull up resistor to 3.3 volt
  - 12 Universal Digital Input pins
    - Measures -10.668v to 11.472v
    - Switchable internal 3.3K Ohm via diode to 5v
    - Used for speed sensor inputs
    - Crankshaft Speed must go on Udig 1
- ECU Outputs
  - 8 Direct Injector Inductive Output Pins
    - Used for Solenoid injectors on M142 or M141 ECUs
  - 8 Direct Injector Piezo Output Pins
    - Used for Piezo injectors on M141 ECUs

- 20v to 180v capable

- 14 Low Side Outputs
  - Low Side Injector outputs or Low Side Ignition outputs
  - Maximum of 3.5 amps
  - Used to control relays or low current solenoids
- 10 Half Bridge Outputs
  - Low side max of 12 amps
  - High side max of 9 amps
  - Used to control high pressure fuel pumps

- Communications
  - Ethernet
    - All calibration and datalog retrieval is through this
  - 3 CAN Busses
    - Adjustable baud rate
    - CAN messages are hard coded into base firmware, not adjustable within ECU parameters without custom software
    - RS232 for GPS

When to Include a PMU

PMU is a Power Management Unit or PDM which is Power Distribution Module. They have to do with managing power throughout a vehicle. They can act as a “fuse box” with calibratable “fuses” you can set the maximum amperage for a circuit and a resetting strategy to try turning on again if an over-current event occurs. The PMU 16 can act as a solid-state relay box to PWM high current solenoids. They also have the capability of some more flexible CAN input/output, allowing the use of many different keypads to control everything from lights to water pumps and ECU driver input adjustments.

- ECU Master PMU 16 has the following outputs:
  - 10x 25-amp outputs
  - 6x 15-amp outputs
- Up to continuous 150-amp total
- You can combine up to 3 outputs for a maximum of 75 amps continuous on one circuit, you can mix and match the 15-amp outputs with a 25-amp if you only need 40 amps on a circuit instead of two 25-amp outputs to make 50.
- PWM capability for nitrous solenoids
- To run 4 nitrous solenoids without a PMU that would require 4 solid state relays over $100 each, plus the extra control wiring and the work to put them in. You can gain a lot more functionality by saving money on solid state relays and purchasing a PMU instead
- Use in tandem with a CAN keypad
- Must use USB to CAN to communicate and configure

Main Electronic Devices

- MoTeC M141 ECU - $5,800.00
  - Ordering PN: ECU-M141-PKG
  - Includes our custom diesel software
  - Included Level 2 Datalogging
  - Used for Piezo Injector applications
  - Used for some solenoid injector applications
  - See “What ECU to use” for more information
  - See “General ECU Information”
  - Datasheet and Hardware Data

- MoTeC M142 ECU - $5,800.00
  - Ordering PN: ECU-M142-PKG
  - Includes our custom diesel software
  - Included Level 2 Datalogging
  - Used for Solenoid Injector applications
  - See “What ECU to use” for more information
  - See “General ECU Information”
  - Datasheet and Hardware Data

- ECU Master PMU 16 - $1,385.00
  - Ordering PN: PMU16
  - Used to manage and distribute electrical power throughout the vehicle and devices
  - Used to directly control nitrous solenoids
  - Product Information Link
  - USB to CAN Needed for Configuration - $155
  - USB to CAN Datasheet

- MoTeC C127 Display – $2,780.00
  - Ordering PN: DSPLY-C127
  - Used only as a display in most cases as the ECU does the data logging
  - Has I/O capability - $400 – See datasheet
  - Has logging capability - $530 – See datasheet

Pressure Sensors

- -14.7 vacuum to 15 PSI - $165
  - Ordering PN: SENS-PRES-15DTM
  - -3 Male JIC/AN connection
  - Must be remote mounted on a hose to promote vibration isolation
  - Used for measuring crankcase pressure
  - Scale 0.5V = -14.7 PSI and 4.5V = 15 PSI

- 0 to 300 PSI - $165
  - Ordering PN: SENS-PRES-300DTM
  - 1/8-27 NPT male connection
  - Remote mounting is recommended for vibration isolation, solid mounting to engine or transmission will likely prematurely fail the sensor
  - Scale 0.5V = 0 PSI and 4.5V = 300 PSI

- 0 to 500 PSI - $165
  - Ordering PN: SENS-PRES-500DTM
  - 1/8-27 NPT male connection
  - Remote mounting is recommended for vibration isolation, solid mounting to engine or transmission will likely prematurely fail the sensor
  - Scale 0.5V = 0 PSI and 4.5V = 500 PSI

- 0 to 2000 PSI - $165
  - Ordering PN: SENS-PRES-2000DTM
  - 1/8-27 NPT male connection
  - Remote mounting is recommended for vibration isolation, solid mounting to engine or transmission will likely prematurely fail the sensor
  - Scale 0.5V = 0 PSI and 4.5V = 2000 PSI

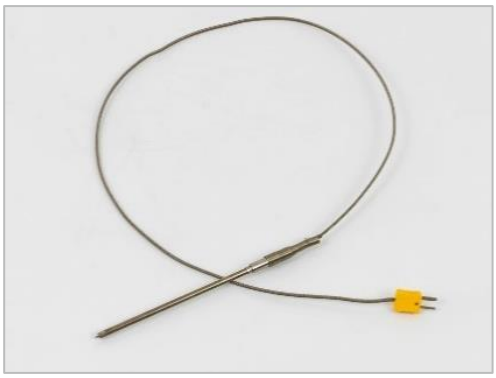
Temperature Sensors and Devices

- Stainless Body Liquid Temp Sensor with Lead - $78.95
  - Ordering PN: SENS-TMP-STLS
  - Good for up to 400°
  - 1/8-27 NPT
  - Datasheet

- Brass Body Liquid Temp Sensor - $55.00
  - Ordering PN: SENS-TMP-LQ-BRS
  - Good for up to 300°
  - 1/8-27 NPT
  - Datasheet

- Brass Body Air Temp Sensor - $55.00
  - Ordering PN: SENS-TMP-AIR-BRS
  - Good for up to 300°
  - Exposed element design for fast response
  - Do not use for intake air temp on non-intercooled engines
  - 1/8-27 NPT
  - Datasheet

- Open Tip Thermocouple $70.00
  - Ordering PN: SENS-EGT-OPEN
  - Brass ferrules are automatically sent (stainless available)
  - Ferrules are 1/8-27 male NPT
  - Used to measure hot air over 300°F (compressor outlet temp)
  - If used in exhaust, premature failure can occur
  - Probes can be bent by hand, yet line bender is recommended



- Closed Tip Thermocouple - $70.00
  - Ordering PN: SENS-EGT-CLOSED
  - Brass ferrules are automatically sent (stainless available)
  - Ferrules are 1/8-27 male NPT
  - Used to measure exhaust gas temperatures
  - Probes can be bent by hand, yet line bender is recommended
  - If they are put into the exhaust flow too far, they will bend over inside from the flow and heat

- Infrared Temperature Sensor - $170.00
  - Ordering PN: SENS-TMP-IR-200
  - Good for up to 392°F
  - Contactless measurement designed for distances of 1.2" to 5.9" away
  - Very small body
  - Used for Tire or Track surface temperature

- Surface Temperature Sensor - $30
  - Ordering PN: SENS-TMP-SURF
  - 0.145" eyelet for a machine screw
  - Measures the temperature of whatever it is bolted to
  - Used to measure things like bearing pack temperature on a screw blower
  - 2 Position DTM connector to be fitted

- 8 Channel EGT Module - $529.00
  - Ordering PN: SENS-TC8
  - Use with any K-Type thermocouple probes
  - Communicates via CAN
  - Autosport connector not included

- Single Channel EGT to Analog converter - $150.00
  - Ordering PN: SENS-THK-1250
  - Used when only one or two probes are needed in the system
  - Converts the K-Type output to a 0-5v analog output

Chassis Sensors

- Davis Technologies VPS Accelerometer - $836.00
  - Ordering PN: SENS-ACC-VPS
  - Used as an accelerometer in most race vehicles
  - Outputs CAN messages and 0-5v analog voltage signals
  - Comes with mounting hardware
  - Setup screen and harness not included

- Bosch MM5.10 Accelerometer - $699.00
  - Ordering PN: SENS-ACC-MM5.10
  - No mounting provisions included
  - Outputs CAN messages with acceleration and yaw rates
  - Datasheet

- Davis Technologies Driveshaft Speed Sensor - $175.00
  - Ordering PN: SENS-SPD-DAV-001
  - Used in conjunction with steel or ferrous material tone rings, so it can pick up on bolt heads or gear teeth
  - Tone rings from Davis Technologies available (http://moretraction.com/product/32t-drive-shaft-rpm-ring/)
  - 32 teeth for great resolution
  - ID measurements available: 1.000", 1.375", 1.500", 1.625", 1.750", 1.812", 1.875", 2.000", 2.113", 2.125", 2.187", 2.250", 2.375", 2.500"

- Linear Position Sensor - $293.00 to $411.50

  - Ordering PN: SENS-LPS-(insert travel in mm here)
  - Used to measure suspension position on race vehicles
  - Used to create custom throttle pedals in race applications
  - From 2” to 8” in 1” increments available (except 7”) and 13.75” (actual measurements in mm)
  - For 2” Travel 7.8” overall compressed and 9.8” overall extended use “SENS-LPS-50”
  - For 3” Travel 8.8” overall compressed and 11.8” overall extended use “SENS-LPS-175”
  - For 4” Travel 9.8” overall compressed and 13.8” overall extended use “SENS-LPS-100”
  - For 5” Travel 10.75” overall compressed and 15.75” overall extended use “SENS-LPS-125”
  - For 6” Travel 11.75 overall compressed and 17.75” overall extended use “SENS-LPS-150”
  - For 8” Travel 13.3” overall compressed and 21.3” overall extended use “SENS-LPS-200”
  - For 13.75” Travel 18.6” overall compressed and 32.5” overall extended use “SENS-LPS-350”
  - Datasheet

- Ground Speed Radar Sensor Drag Racing 300 MPH - $2107

  - Ordering PN: SENS-SPD-300MPH and SENS-SPD-BRKT-300MPH **Price Includes Bracket**
  - Mounting backet must be purchased with sensor
  - Used for drag racing applications up to 300 MPH to get a true ground speed reading

- GPS - $195.00

  - Ordering PN: SENS-GPS-L10
  - Used to get speed readings in truck or tractor pulling
  - Needs to be mounted to have view of the sky for satellite signal
  - Magnetic base
  - Not fast enough for measuring acceleration for drag racing, but can be used to confirm all other speed sensors are reading correctly during coast down
  - Datasheet

Driver Input Devices

- CAN Keypads MoTeC or ECU Master - $574 to $589
  - Ordering PN: KEYPAD-8 OR KEYPAD-15
  - MoTeC Keypads work directly with the ECU and are able to control things like Ignition, or they can also toggle through settings for fuel limiters or other adjustable ECU features like a rotary trim switch.
  - All keypads are compatible the ECU Master PMU to control functions through the PMU to the ECU
  - ECU master keypads available upon request, more information after field testing occurs
  - Datasheet

- Rotary Trim Switch 4 position - $109.00
  - Ordering PN: RTY-4POS
  - 4 position rotary switch for adjusting things like fuel limitations, bump time, AFR targets, anything that has adjustability via driver switches
  - Datasheet

- Rotary Trim Switch 12 position - $145
  - Ordering PN: RTY-12POS
  - 4 position rotary switch for adjusting things like fuel limitations, bump time, AFR targets, anything that has adjustability via driver switches
  - Datasheet

Other

- ECU Master Lambda to CAN - $259
  - Ordering PN: SENS-LTC-ECUMASTER
  - Lambda to CAN connects to the Bosch O2 sensor to control it and relay air fuel or lambda data back to the ECU
  - Manual

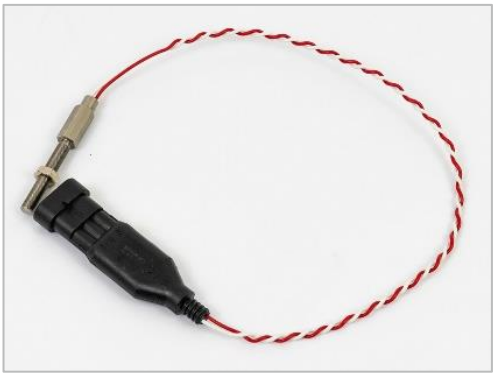
- Bosch Oxygen Sensor - $80.00
  - Ordering PN: SENS-LSU4.9
  - Used with Lambda to CAN
  - Special sensor used in OEM diesel applications

- Solid State Relay - $120.00
  - Ordering PN: RLY-SS-100
  - Used when the ECU must control something that draws more than 10 amps and vehicle does not have a PMU or PDM
  - Tested to have the best control with a nice square wave
  - Many relays on the market will not accurately control a nitrous solenoid in PWM conditions
  - 100 amp maximum current, 40 amp continuous maximum without heatsink

- Current Sensor - $63.95
  - Ordering PN: SENS-CRNT-5AMP
  - -5 amp to +5 amp current sensor
  - Used for closed loop current control for high pressure fuel pumps or electronic relief valves
  - Feedback is analog 0V to 5V
  - Scale 0.5V = -5 Amp and 4.5V = +5 Amp
  - Datasheet

- Borg/Garrett Turbo Speed Sensor – $170.00
  - Ordering PN: SENS-SPD-BORG-TRBO
  - Borg/Garrett style with plastic body and Oring is becoming the most popular

- M6 threaded body Precision Turbo - $389.00
  - Ordering PN: SENS-SPD-M6-TRBO
  - M6x1 threaded body with a jam nut, usually used on precisions



- Milspec Wiring M141/M142 Flying Lead - $1,440.00
  - Ordering PN: HNS-M142-FLY
  - Fully Populated ECU connectors
  - 10 feet of wire
  - Different color wire for almost all I/O to make it easy to work with
  - Documentation included

- 3 Port MAC Valve - $60.00
  - Ordering PN: MAC-3PORT
  - 3 Ports 1/8-27 NPT
  - One-way control for things like air shifter, parachutes, and simple open OR closed wastegate control

- 4 Port MAC Valve - $70.00
  - Ordering PN: MAC-4PORT
  - 4 Ports 1/8-27 NPT
  - Two-way control for open AND close wastegate control

Custom Wiring for Standalone ECU

- We only offer custom wiring for MoTeC ECUs that we sell.

- For pricing estimates, please see the packages section and try and line up your sensor package with a similar offered package, and use the harness cost range associated with it. Minimum harness price is $3200 for a very bare bones setup and maximum not capped at, but could reach $10k-$11k for complex harnesses with lots of pieces and terminations.

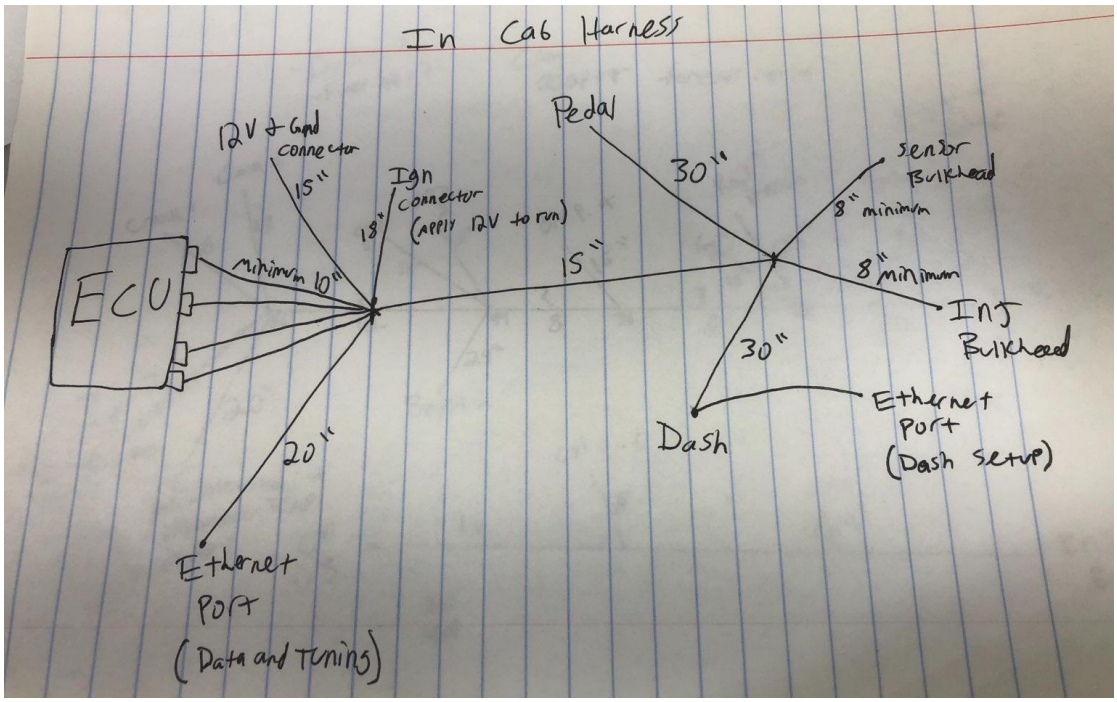
- **COMPLETE:** Custom wiring for a race vehicle can be a large undertaking, so after every piece of hardware is installed, along with provisions for bulkheads and passthroughs, the vehicle would be dropped off at the S&S Diesel Motorsport facility in Southern Indiana. Here we will conduct a harness layout to be manufactured in house or outsourced with partnering companies to manufacture the one-off harness for us. The lead time on this can be up to a few months, as each harness can take up to 3 weeks to build, since we also have to handle support for customers like you, the schedule can fill up quickly.

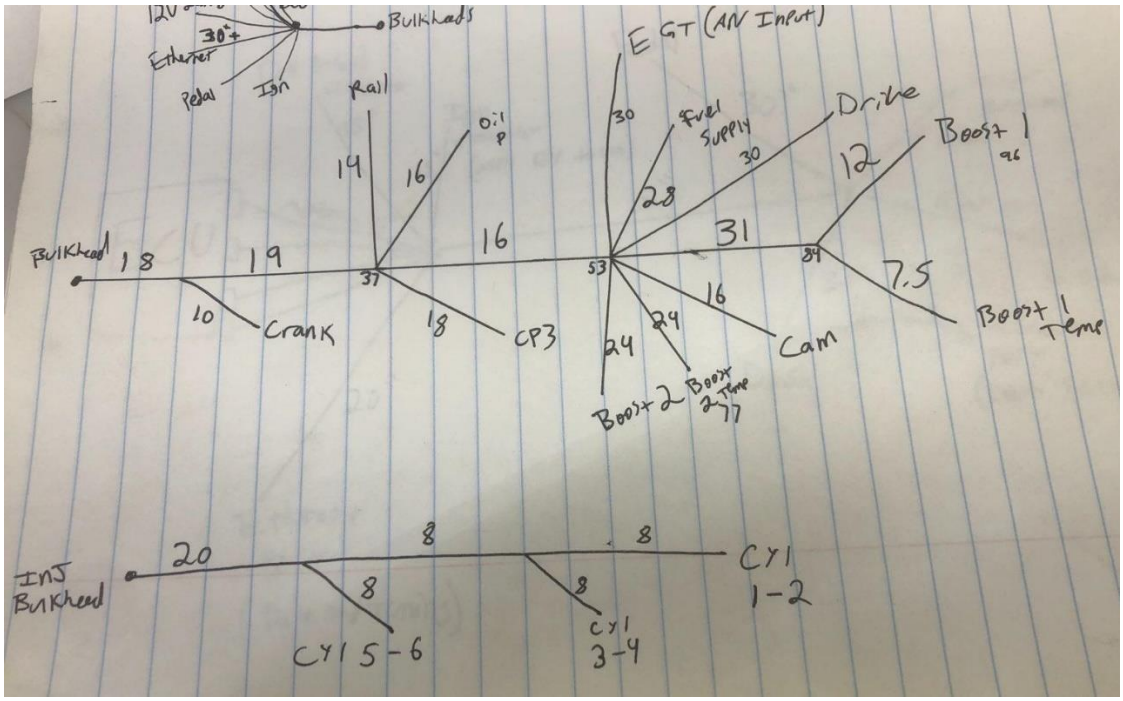
- **FROM LAYOUT:** If dropping the vehicle off at S&S Diesel Motorsport is not an option, we can work off a layout you provide to us. This is not recommended for pro level drag racing cars or other complex harnesses. Making a proper layout can be difficult if you have never handled or built something similar to what you expect the finished product to be. Mainly understanding how booting and supporting of joints take place. Please see the Customer Provided Layout Guidance Section for more details.

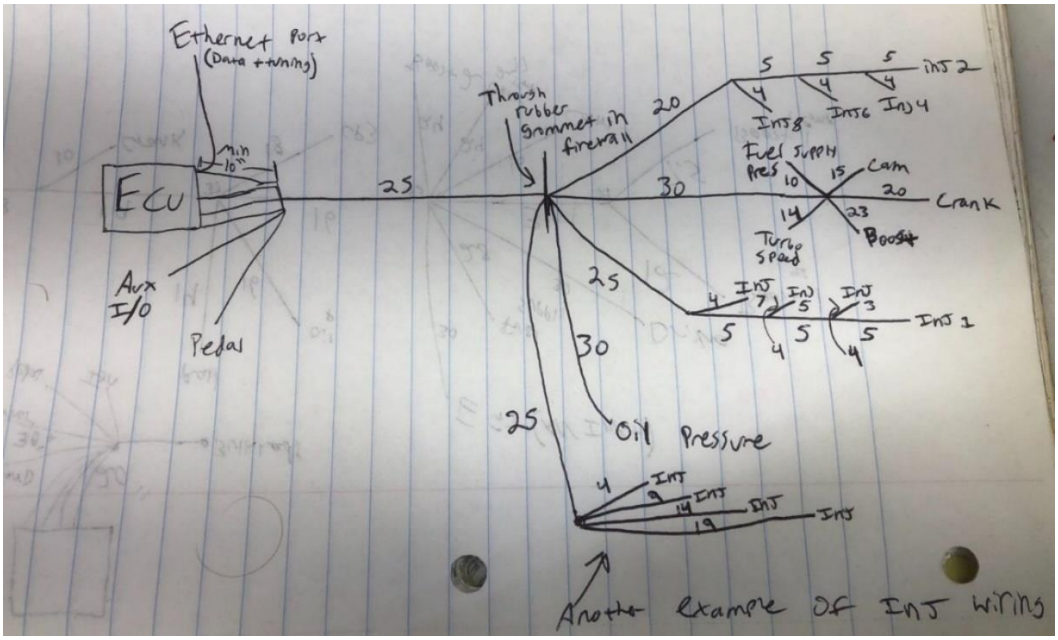
- **DIY:** If you want to do the wiring yourself, we have a file containing all the hardware documentation and some excel files that we use internally to help with harness builds. We would highly recommend you start with a flying lead harness which can be purchased from us. If we do not have one in stock, lead time can be up to 3-5 weeks. The flying lead harness contains 4 fully populated ECU connectors with 10’ of length on each and the documentation to go with it. Telling what color wire is pinned where. When doing your own wiring, we will not hesitate to charge our normal support rate of $150/hr when trouble shooting. It is also expected that you provide us with clear documentation if we are expected to set the ECU up for you. If we ask, what analog input is oil pressure on, you should be able to answer quickly based on your documentation with “Analog voltage Input 4” for example, so we can get through the setup quickly and efficiently.

Customer Provided Layout Guidance

Pictured below are 2 example layouts. One that would incorporate an interior harness with an injector bulkhead and sensor bulkhead, and the other that is one harness from the ECU. While yes, it is a quick draft for display purposes, this is enough data to build a harness off of. Assuming all connections are straight booted and using our sensors. The biggest thing is every line is a section of harness and every section needs a length, and every end point needs a label as to what is there. Be sure to read all of the tips following the example.







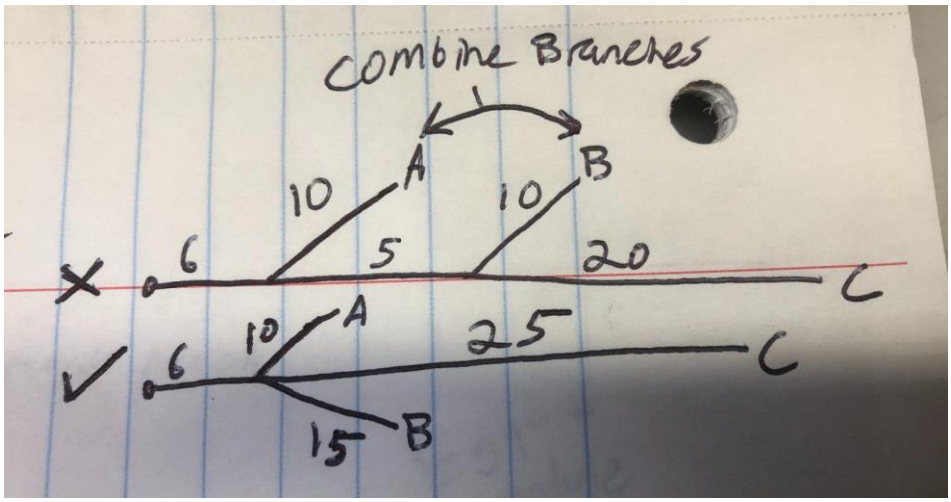
Layout Building Tips and Requirements

Keep in mind that large bundles of wires and even small bundles don't have an infinitely small bend radius. This needs to be kept in mind. Also considering the actual length of the connector itself for when the wire actually starts to be able to bend, since the connectors are rigid, you don't want to start the bend right off the connector, oftentimes you must give a 0.75"-1.0" straight length to account for the connector when you make a layout. The adhesive lined heat shrinks, or boots can be formed to a 90° bend. This must be indicated somehow on the layout drawing, if this is not indicated, straight boot or straight heat shrink will be assumed. Reference photos below for bend radius accountability

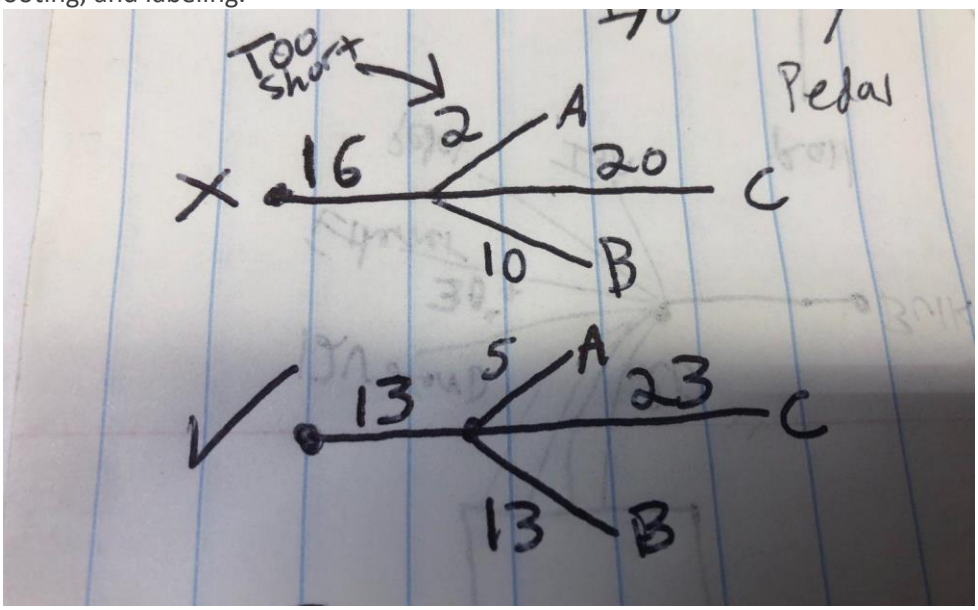
Figure 1 How it is thought to be

Figure 2 How it is

- The no bulkhead option is basically the same as how it would be with bulkheads. The difference being with bulkheads the injector bundle and main sensor bundle is split up with ~8” leading up to it to allow for separating and ease of mounting on the firewall. And then they completely separate after the firewall bulkheads.
- The 4 bundles from the ECU have a minimum of **10 inches** because they all need to converge for things that are shared between each connector and it just needs some length to do so (Can be shorter if absolutely necessary depending on the situation)
- Consider how the branch points are done from the main bundle. Don’t put 2 branch points right next to each other, just combine them unless there is a real purpose to have 2 branches really close to each other. See example below.



- Don’t make a branch less than 5 inches, if that happens, just move the joint up on the harness (see example). If for some real reason it needs to be short, it can be done, but it leaves some to be desired in flexibility, booting, and labeling.



- The example photos for the full layout just have random lengths, the best way to make a layout is to take ethernet cable or rope and actually “build” the harness with zip ties and rope, then lay it out on a bench, draw it up, and put measurements to it.

- If factory sensors or sensors that are not provided by us are being used, pinouts, scaling, and connector housing kits (housing, terminals, seals, lockers…) must be provided or a source for them. If you have a pigtail, a Deutsch connector adapter can be made, but we will not splice it into the harness. The following factory connections are exceptions that we keep in stock: Dmax and Cummins Crank and Cam, most Dmax oil pressure sensor connectors, DRV, Metering unit (FCA), Rail pressure Sensors, Wagler hand throttle sensor, Dmax and both style Cummins injector connectors, most Davis technologies connectors, a large variety of Deutsch DTM, DT, and DTP. Along with all sensors we provide.

- If a PMU is in the system, it is recommended to have us do the harness in house. If a PDM of PMU is added, the system will be more complex to integrate since it will be going to more devices in/out of the main harness. But add it in as you would any device on a layout.

Packages to Buy or Build From

The following pages contain information on different packages for racing or truck pulling to give you a great base package to build from, or a package to order.

It first shows the devices and sensors included and the “Sensor List Selection” shows you where they would be used on the car just as you would find from the “Race Vehicle Planning Guide”. EX: The package includes 3x 500 psi sensors, it’ll explain where they are normally used.

Also see the sections with the sensors we offer to see what you can add to your package

Package Prices listed are subject to change if item prices change

Just get me running package $6829.00 plus harness cost $3.2k-$5k

****Not recommended for any competition use****

This package is designed around a vehicle that only needs the engine to run and is not interested in chassis controls, nitrous controls, or large amounts of pressure and temperature data. No display is included, so this could pair with a vehicle that already has a nice display or maybe a Dakota digital dash gauge cluster. You would have to provide the ECU with switched 12V or ground for an ignition signal, along with a pedal input.

Devices and Sensor Included:

- M1 ECU with S&S Software and Level 2 Logging
- Single THK-1250 EGT K-Type to Analog Converter 1x K-Type EGT probe
- Lambda to CAN and Oxygen Sensor (SENS-LTC-ECUMASTER and SENS-LSU4.9)
- 1x Air temp sensor (SENS-TMP-AIR-BRS)
- 1x liquid temp sensors (SENS-TMP-LQ-BRS)
- 3x 300 PSI Sensors (SENS-PRES-300DTM)

**** If non-intercooled****

You will have to use an open tip K-Type EGT probe for inlet manifold temp instead of the air temp sensor

Sensor List selection

From "Required"

- ☐ Crankshaft Position Sensor
  - ○ Customer Provided
- ☐ Camshaft Position Sensor
  - ○ Customer Provided
- ☐ Pedal Position
  - ○ Customer Provided
- ☐ Engine Coolant Temperature
  - ○ Single "SENS-TMP-LQ-BRS" good for up to 300°F
- ☐ Inlet Air Temperature (manifold)
  - ○ Intercooled application up to 300°F use "SENS-TMP-AIR-BRS"
  - ○ **If non-intercooled an open tip K-Type EGT probe must be used for inlet manifold temperature
- ☐ Inlet Manifold Pressure
  - ○ Use "SENS-PRES-300DTM"
- ☐ Fuel Supply Pressure
  - ○ Use "SENS-PRES-300DTM"
- ☐ Fuel Rail Pressure
  - ○ Customer provided
  - ○ Options offered by S&S

- [ ] Engine Oil Pressure
  - ○ Use “SENS-PRES-300DTM”
- [ ] Exhaust Lambda
  - ○ ECU Master Lambda to CAN
  - ○ Bosch O2 Sensor

From “Temperatures”

- [ ] Exhaust Temp in the collector
  - ○ Single EGT probe “SENS-EGT-CLOSED” paired with “SENS-THK-1250” for a single K-Type

Just Wanna Race Package $10,559 plus harness cost $3.2k-$8k

Package designed with budget in mind for a vehicle that has basic sensors on board to run the engine, a display, and control up to 3 nitrous solenoids, without the use of a PMU. Generally, might be used if you have an air shifted transmission with only 1 pressure to monitor on it. Or something that is controlled with a PCS. Something that has a switch panel already and all lights are controlled by another device.

Devices and Sensor Included:

- M1 ECU with S&S Software and Level 2 Logging
- C127 Display
- Single THK-1250 EGT K-Type to Analog Converter 1x K-Type EGT probe
- Lambda to CAN and Oxygen Sensor (SENS-LTC-ECUMASTER and SENS-LSU4.9)
- 1x Driveshaft Speed sensor (SENS-SPD-DAV-001)
  - You will need to purchase or provide a tone ring as well
- 1x Air temp sensor (SENS-TMP-AIR-BRS)
- 2 liquid temp sensors (SENS-TMP-LQ-BRS)
- 4x 300 PSI Sensors (SENS-PRES-300DTM)
- 1x 500 PSI Sensor (SENS-PRES-500DTM)
- 1x 2000 PSI Sensor (SENS-PRES-2000DTM)
- 3x Solid State Relays for Nitrous Solenoids

**** If non-intercooled****

You will have to use an open tip K-Type EGT probe for inlet manifold temp instead of the air temp sensor

Sensor List selection

From "Required"

- ☐ Crankshaft Position Sensor
  - ○ Customer Provided
- ☐ Camshaft Position Sensor
  - ○ Customer Provided
- ☐ Pedal Position
  - ○ Customer Provided
- ☐ Engine Coolant Temperature
  - ○ Single "SENS-TMP-LQ-BRS" good for up to 300°F
- ☐ Inlet Air Temperature (manifold)
  - ○ Intercooled application up to 300°F use "SENS-TMP-AIR-BRS"
  - ○ **If non-intercooled an open tip K-Type EGT probe must be used for inlet manifold temperature
- ☐ Inlet Manifold Pressure
  - ○ Use "SENS-PRES-300DTM"
- ☐ Fuel Supply Pressure
  - ○ Use "SENS-PRES-300DTM"

- [ ] Fuel Rail Pressure
  - ○ Customer provided
  - ○ Options offered by S&S
- [ ] Engine Oil Pressure
  - ○ Use “SENS-PRES-300DTM”
- [ ] Exhaust Lambda
  - ○ ECU Master Lambda to CAN
  - ○ Bosch O2 Sensor

From “Temperatures”

- [ ] Exhaust Temp in the collector
  - ○ Single EGT probe “SENS-EGT-CLOSED” paired with “SENS-THK-1250” for a single K-Type

From “Pressures”

- [ ] Transmission Line Pressure
  - ○ Use “SENS-PRES-500DTM”
- [ ] Engine Crankcase Pressure
  - ○ Use “SENS-PRES-15DTM”
- [ ] Nitrous Bottle Pressure
  - ○ Use “SENS-PRES-2000DTM”
- [ ] Turbocharger Turbine inlet Pressure (Drive Pressure)
  - ○ Use “SENS-PRES-300DTM”

From Speeds

- [ ] Driveshaft Speed
  - ○ “SENS-SPD-DAV-001” Speed sensor

From Actuators

- [ ] High pressure Fuel Pumps
  - ○ How Many_____
- [ ] Shifter Actuation (air shifter)
- [ ] Transmission Brake
  - ○ Customer provided
- [ ] Transmission Dump
  - ○ Customer provided
- [ ] Transmission Converter Lock-Up
  - ○ Customer provided
- [ ] Line Lock
  - ○ Customer Provided
- [ ] Nitrous solenoids
  - ○ Customer Provided
- [ ] Relays for Nitrous solenoids
  - ○ Solid States needed since no PMU is used “RLY-SS-100”

From Driver Inputs

- [ ] Transmission Brake Button
  - ○ Customer Provided
- [ ] Transmission Brake Bump Button
  - ○ Customer Provided
- [ ] Race Mode switch
  - ○ Customer Provided

Basic Pro Drag Racing Package $14,752 plus harness cost $5k-$10k

Package designed around a racer using a TH400, with an intercooled engine, using the PMU to control and protect nitrous solenoids, lights, and other electronic devices.

Devices and Sensor Included:

- M1 ECU with S&S Software and Level 3 Logging
- C127 Display
- PMU 16
- Davis Technologies VPS accelerometer
- 8 Position MoTeC Keypad
- 8 Channel EGT Module and 8x K-Type EGT probes
- Lambda to CAN and Oxygen Sensor (SENS-LTC-ECUMASTER and SENS-LSU4.9)
- 1x Driveshaft Speed sensor (SENS-SPD-DAV-001)
  - You will need to purchase or provide a tone ring as well
- 1x Air temp sensor (SENS-TMP-AIR-BRS)
- 2 liquid temp sensors (SENS-TMP-LQ-BRS)
- 1x -14.7 to 15 PSI Sensor (SENS-PRES-15DTM)
- 4x 300 PSI Sensors (SENS-PRES-300DTM)
- 3x 500 PSI Sensors (SENS-PRES-5000DTM)
- 1x 2000 PSI Sensor (SENS-PRES-2000DTM)

**** If non-intercooled****

You will have to use an open tip K-Type EGT probe for inlet manifold temp instead of the air temp sensor

Sensor List selection

From "Required"

- ☐ Crankshaft Position Sensor
  - ○ Customer Provided
- ☐ Camshaft Position Sensor
  - ○ Customer Provided
- ☐ Pedal Position
  - ○ Customer Provided
- ☐ Engine Coolant or Oil temp or Both
  - ○ Single "SENS-TMP-LQ-BRS" good for up to 300°F
- ☐ Inlet Air Temperature (manifold)
  - ○ Intercooled application up to 300°F use "SENS-TMP-AIR-BRS"
  - ○ **If non-intercooled an open tip K-Type EGT probe must be used for inlet manifold temperature
- ☐ Inlet Manifold Pressure
  - ○ Use "SENS-PRES-300DTM"

- [ ] Fuel Supply Pressure
  - ○ Use “SENS-PRES-300DTM”
- [ ] Fuel Rail Pressure
  - ○ Customer provided
  - ○ Options offered by S&S
- [ ] Engine Oil Pressure
  - ○ Use “SENS-PRES-300DTM”
- [ ] Exhaust Lambda
  - ○ ECU Master Lambda to CAN
  - ○ Bosch O2 Sensor

From “Temperatures”

- [ ] Transmission Pan Temp
  - ○ Single “SENS-TMP-LQ-BRS” good for up to 300°F
- [ ] Exhaust Temp at each cylinder
  - ○ Use of “SENS-TC8-EGT” for up to 8 K-Type thermocouples

From “Pressures”

- [ ] Transmission Converter Pressure
  - ○ Use “SENS-PRES-500DTM”
- [ ] Transmission Line Pressure
  - ○ Use “SENS-PRES-500DTM”
- [ ] Transmission Lock up Pressure
  - ○ Use “SENS-PRES-500DTM”
- [ ] Engine Crankcase Pressure
  - ○ Use “SENS-PRES-15DTM”
- [ ] Nitrous Bottle Pressure
  - ○ Use “SENS-PRES-2000DTM”
- [ ] Turbocharger Turbine inlet Pressure (Drive Pressure)
  - ○ Use “SENS-PRES-300DTM”

From Chassis

- [ ] G-Force Accelerometer
  - ○ Davis Technologies VPS “SENS-ACC-VPS”

From Speeds

- [ ] Driveshaft Speed
  - ○ “SENS-SPD-DAV-001” Speed sensor

From Actuators

- [ ] High pressure Fuel Pumps
  - ○ How Many_____
- [ ] Shifter Actuation (air shifter)
- [ ] Transmission Brake
  - ○ Customer provided

- [ ] Transmission Dump
  - ○ Customer provided
- [ ] Transmission Converter Lock-Up
  - ○ Customer provided
- [ ] Line Lock
  - ○ Customer Provided
- [ ] Nitrous solenoids
  - ○ Customer Provided

From Driver Inputs

- [ ] Transmission Brake Button
  - ○ Customer Provided
- [ ] Transmission Brake Bump Button
  - ○ Customer Provided
- [ ] Race Mode switch
  - ○ On keypad
- [ ] CAN Keypad 8 button

Deluxe Pro Drag Racing Package $17,869.00 plus harness cost $7k-$11k

This packages almost maxes out the I/O capabilities of the ECU. It has an excess amount of sensor and data to make informed decisions from every single pass you make on the track. It is designed for an intercooled Pro Mod Level race car with nitrous solenoids and controlling lights. On this level some customization to the sensor package may be needed to be able to utilize all of the device I/O effectively.

Devices and Sensor Included:

- M1 ECU with S&S Software and Level 3 Logging
- C127 Display
- PMU 16
- GPS
- Davis Technologies VPS accelerometer
- 8 Position MoTeC Keypad (15 position may be requested for additional $20)
- 8 Channel EGT Module and 8x K-Type EGT probes
- Single THK-1250 EGT K-Type to Analog Converter 1x K-Type EGT probe
- Lambda to CAN and Oxygen Sensor (SENS-LTC-ECUMASTER and SENS-LSU4.9)
- 1x Driveshaft Speed sensor (SENS-SPD-DAV-001)
  - You will need to purchase or provide a tone ring as well
- 2x Air temp sensor (SENS-TMP-AIR-BRS)
- 2 liquid temp sensors (SENS-TMP-LQ-BRS)
- 1x -14.7 to 15 PSI Sensor (SENS-PRES-15DTM)
- 5x 300 PSI Sensors (SENS-PRES-300DTM)
- 3x 500 PSI Sensors (SENS-PRES-5000DTM)
- 3x 2000 PSI Sensor (SENS-PRES-2000DTM)
- 1x Borg/Garrett Turbo Speed Sensor
- 3x Rotary Trim Switches
- 3x 3 port Mac Valves
- 1x 4 port Mac Valve
- 2x infrared Temperature Sensors
- 4x Suspension Position Sensors
  - 2x 8 inch travel
  - 2x 6 inch travel

**** If non-intercooled****

You will have to use an open tip K-Type EGT probe for inlet manifold temp instead of the air temp sensor

From “Required”

- [ ] Crankshaft Position Sensor
  - ( ) Customer Provided

- [ ] Camshaft Position Sensor
  - ○ Customer Provided
- [ ] Pedal Position
  - ○ Customer Provided
- [ ] Oil temp
  - ○ Single “SENS-TMP-LQ-BRS” good for up to 300°F
- [ ] Inlet Air Temperature (manifold)
  - ○ Intercooled application up to 300°F use “SENS-TMP-AIR-BRS”
  - ○ **If non-intercooled an open tip K-Type EGT probe must be used for inlet manifold temperature
- [ ] Inlet Manifold Pressure
  - ○ Use “SENS-PRES-300DTM”
- [ ] Fuel Supply Pressure
  - ○ Use “SENS-PRES-300DTM”
- [ ] Fuel Rail Pressure
  - ○ Customer provided
  - ○ Options offered by S&S
- [ ] Engine Oil Pressure
  - ○ Use “SENS-PRES-300DTM”
- [ ] Exhaust Lambda
  - ○ ECU Master Lambda to CAN
  - ○ Bosch O2 Sensor

From “Temperatures”

- [ ] Transmission Pan Temp
  - ○ Good for up to 300° use “SENS-TMP-LQ-BRS”
- [ ] Ambient Air Temp
  - ○ Use “SENS-TMP-AIR-BRS”
- [ ] Ambient Track Temperature
  - ○ Use an infrared temp sensor for contactless measurement “SENS-TMP-IR-200”
- [ ] Vehicle Tire Temperature
  - ○ Use an infrared temp sensor for contactless measurement “SENS-TMP-IR-200”
- [ ] Turbocharger Compressor Outlet Temperature
  - ○ “SENS-EGT-OPEN” paired with “SENS-THK-1250” for a single K-Type
- [ ] Wastegate Temperature
  - ○ Temperature Sensor in the wastegate dump tube to read if the wastegate is open or not
  - ○ Use “SENS-EGT-CLOSED” paired with either of the following “SENS-THK-1250” for a single K-Type or “SENS-TC8-EGT” for up to 8 K-Type thermocouples

From “Pressures”

- [ ] Transmission Converter Pressure
  - ○ Can be up to 250 PSI, use “SENS-PRES-500DTM”
- [ ] Transmission Line Pressure

- Use “SENS-PRES-500DTM”

- [ ] Transmission Lock up Pressure
  - Use “SENS-PRES-500DTM”
- [ ] Engine Crankcase Pressure
  - Required to be remote mounted to reduce vibration with -3 hose
  - Use “SENS-PRES-15DTM”
- [ ] Nitrous Bottle Pressure
  - Usually after main bottle is open, before main system valve
  - This allows you to not have a sensor in every bottle and the ECU will control bottle pressure based on this value
  - Use “SENS-PRES-2000DTM”
- [ ] Regulated Nitrous Pressure
  - This is the pressure that might be used for an air shifter, parachutes, or wastegates
  - Use “SENS-PRES-300DTM”
- [ ] Turbocharger Turbine Inlet Pressure (Drive Pressure)
  - Helpful to utilize the turbocharger inputs when compound turbos are used
  - Use “SENS-PRES-300DTM”
- [ ] Nitrous Kit Pressure
  - This would be the pressure between the solenoid and jet/nozzle
  - Use “SENS-PRES-2000DTM”
- [ ] Water Injection Pressure
  - Use “SENS-PRES-2000DTM”

From Chassis

- [ ] G-Force Accelerometer
  - Extremely valuable tool for drag racing
  - Davis Technologies VPS use “SENS-ACC-VPS”
- [ ] Suspension Position
  - From 2” to 8” in 1” increments available (except 7”) and 13.75” (actual measurements in mm)
  - For 2” Travel 7.8” overall compressed and 9.8” overall extended use “SENS-LPS-50”
  - For 3” Travel 8.8” overall compressed and 11.8” overall extended use “SENS-LPS-175”
  - For 4” Travel 9.8” overall compressed and 13.8” overall extended use “SENS-LPS-100”
  - For 5” Travel 10.75” overall compressed and 15.75” overall extended use “SENS-LPS-125”
  - For 6” Travel 11.75 overall compressed and 17.75” overall extended use “SENS-LPS-150”
  - For 8” Travel 13.3” overall compressed and 21.3” overall extended use “SENS-LPS-200”
  - For 13.75” Travel 18.6” overall compressed and 32.5” overall extended use “SENS-LPS-350”

From Speeds

- [ ] Driveshaft Speed
  - Use a “SENS-SPD-DAV-001” Speed sensor
  - Tone rings from Davis Technologies available (http://moretraction.com/product/32t-drive-shaft-rpm-ring/DAV-001)
  - 32 teeth for great resolution

- ID measurements available: 1.000", 1.375", 1.500", 1.625", 1.750", 1.812", 1.875", 2.000", 2.113", 2.125", 2.187", 2.250", 2.375", 2.500"

- [ ] Individual wheels speeds
  - Front Wheel Speed
  - Use a “SENS-SPD-DAV-001” Speed sensor
- [ ] Transmission Input shaft speed (to monitor converter slip)
  - Customer Provided
- [ ] Turbo Speed
  - Borg/Garret Type bolt in plastic sensor use “SENS-SPD-BORG-TRBO”

From Actuators

- [ ] High pressure Fuel Pumps
  - How many_____
- [ ] Boost control Solenoids
  - 4 Port MAC Valve for two-way wastegate open and close control “MAC-4PORT”
- [ ] Shifter Actuation (Electronic or air)
  - Air solenoid control “MAC-3PORT”
- [ ] Parachute Charge
  - Air solenoid control “MAC-3PORT”
- [ ] Parachute deploy
  - Air solenoid control “MAC-3PORT”
- [ ] Transmission Brake
  - Customer Provided
- [ ] Transmission EZ stage
  - Rossler Internal Dump
  - Customer Provided
- [ ] Transmission Dump
  - Customer Provided
- [ ] Transmission Converter Lock Up
  - Customer Provided
- [ ] Transmission Converter Soft Lock
  - Customer Provided
- [ ] Line Lock
  - Customer Provided
- [ ] DRV (electronic high-pressure fuel relief valve)
  - Some systems have this as part of the factory fuel rail
- [ ] Nitrous solenoids
  - Customer provided

From PMU Input/Output (All customer provided):

- [ ] Nitrous Solenoids
- [ ] Nitrous Bottle Heater

- [ ] Headlights
- [ ] Taillights
- [ ] Brake Lights
- [ ] Reverse Lights
- [ ] Interior Lights
- [ ] Starter Solenoid
- [ ] Intercooler Water Pump

From Driver Inputs:

**Some of these can be combined into the same button if you use a “Race Mode Switch” For example: When not in race mode, the left button can be a line lock button, when in race mode that button can now be your bump button so plan to have 2 to 3 steering wheel buttons and an 8 or 15 button keypad

- [ ] Transmission Brake Button
  - ○ Customer Provided
    OR
  - ○ CAN Keypad
- [ ] Line lock Button
  - ○ Customer Provided
    OR
  - ○ CAN Keypad
- [ ] Transmission Brake Bump Button
  - ○ Customer Provided
    OR
  - ○ CAN Keypad
- [ ] Screen Brightness
  - ○ Customer Provided
    OR
  - ○ CAN Keypad
- [ ] Screen Page Switch
  - ○ Customer Provided
    OR
  - ○ CAN Keypad
- [ ] Race Mode switch
  - ○ Generally, on a keypad or toggle switch
  - ○ Will “arm” everything necessary to make a pass and change rev limits
- [ ] Rotary trim switches
  - ○ On the fly switching of
    - Fuel mass limits
    - Air fuel ratio trim targets
    - Transmission Brake Bump Time
    - Driveshaft Speed target curve

- [ ] Brake Pressure Switch
  - To control brake lights
  - Customer Provided
- [ ] Neutral Safety Starter Lockout
- [ ] CAN Keypad 8 or 15 button
  - Keypad works in conjunction with the ECU alone or with the PMU
  - For 8 button use “KEYPAD-8” and for 15 button use “KEYPAD-15”

Basic Pulling Package $9585.00 Plus Harness Cost $3.2-$5K

This package is designed to be simple yet effective for truck pulling. Switch 12v or Ground will need to be provided on a toggle switch for ignition. This is the only package that does not include a lambda or air fuel ratio monitoring device since most pulling trucks are fixed fueling. If you will be needing support or plan to be changing turbos often along with fueling, it would be recommended to add back to the package at $339.

Devices and Sensor Included:

- M1 ECU with S&S Software and Level 2 Logging
- C127 Display
- GPS
- Single THK-1250 EGT K-Type to Analog Converter 1x K-Type EGT probe
- 1x Air temp sensor (SENS-TMP-AIR-BRS)
- 1x liquid temp sensor (SENS-TMP-LQ-BRS)
- 4x 300 PSI Sensors (SENS-PRES-300DTM)

**** If non-intercooled****

You will have to use an open tip K-Type EGT probe for inlet manifold temp instead of the air temp sensor

Sensor List selection

From "Required"

- ☐ Crankshaft Position Sensor
  - ○ Customer Provided
- ☐ Camshaft Position Sensor
  - ○ Customer Provided
- ☐ Pedal Position
  - ○ Customer Provided
- ☐ Engine Coolant or Oil temp
  - ○ Single "SENS-TMP-LQ-BRS" good for up to 300°F
- ☐ Inlet Air Temperature (manifold)
  - ○ Intercooled application up to 300°F use "SENS-TMP-AIR-BRS"
  - ○ **If non-intercooled an open tip K-Type EGT probe must be used for inlet manifold temperature
- ☐ Inlet Manifold Pressure
  - ○ Use "SENS-PRES-300DTM"
- ☐ Fuel Supply Pressure
  - ○ Use "SENS-PRES-300DTM"
- ☐ Fuel Rail Pressure
  - ○ Customer provided

- ○ Options offered by S&S
- ☐ Engine Oil Pressure
  - ○ Use “SENS-PRES-300DTM”

From “Temperatures”

- ☐ Exhaust Temp in the collector
  - ○ Single EGT probe “SENS-EGT-CLOSED” paired with “SENS-THK-1250” for a single K-Type

From “Pressures”

- ☐ Turbocharger Turbine inlet Pressure (Drive Pressure)
  - ○ Use “SENS-PRES-300DTM”

From Chassis

- ☐ GPS
  - ○ Global positioning for a speed or position reference
  - ○ Use “SENS-GPS-L10”

From Actuators

- ☐ High pressure Fuel Pumps
  - ○ How Many_____

Deluxe Truck Puller Package $12,382 plus harness cost $5k-$8k

Package designed around a pulling truck to include a display, exhaust gas temperatures, wheel speed vs actual speed, and air system sensors so the owner can stay informed about turbo and intercooler performance. Consider adding turbo shaft speed to the package

Devices and Sensor Included:

- M1 ECU with S&S Software and Level 2 Logging
- C127 Display
- GPS
- 8 Position MoTeC Keypad
- 8 Channel EGT Module and 8x K-Type EGT probes
- Lambda to CAN and Oxygen Sensor (SENS-LTC-ECUMASTER and SENS-LSU4.9)
- 1x Driveshaft Speed sensor (SENS-SPD-DAV-001)
  - You will need to purchase or provide a tone ring for the sensor to pick up on
- 1x Air temp sensor (SENS-TMP-AIR-BRS)
- 1x liquid temp sensor (SENS-TMP-LQ-BRS)
- 1x -14.7 to 15 PSI Sensor (SENS-PRES-15DTM)
- 5x 300 PSI Sensors (SENS-PRES-300DTM)
- 2x Suspension Travel Sensors

****For 8-cylinder engines****

Add single THK-1250 EGT K-Type to Analog Converter and 1x K-Type EGT probe (adds $220 to package cost)

**** If non-intercooled****

You will have to use an open tip K-Type EGT probe for inlet manifold temp instead of the air temp sensor

Sensor List selection

From "Required"

- [ ] Crankshaft Position Sensor
  - ( ) Customer Provided
- [ ] Camshaft Position Sensor
  - ( ) Customer Provided
- [ ] Pedal Position
  - ( ) Customer Provided
- [ ] Engine Coolant or Oil temp
  - ( ) Single "SENS-TMP-LQ-BRS" good for up to 300°F
- [ ] Inlet Air Temperature (manifold)

- Intercooled application up to 300°F use “SENS-TMP-AIR-BRS”
- **If non-intercooled an open tip K-Type EGT probe must be used for inlet manifold temperature

- [ ] Inlet Manifold Pressure
  - Use “SENS-PRES-300DTM”
- [ ] Fuel Supply Pressure
  - Use “SENS-PRES-300DTM”
- [ ] Fuel Rail Pressure
  - Customer provided
  - Options offered by S&S
- [ ] Engine Oil Pressure
  - Use “SENS-PRES-300DTM”
- [ ] Exhaust Lambda
  - ECU Master Lambda to CAN
  - Bosch O2 Sensor

From “Temperatures”

- [ ] Exhaust Temp at each cylinder
  - Use of “SENS-TC8-EGT” for up to 8 K-Type thermocouples
- [ ] Turbocharger Compressor Outlet Temperature (Pre-Intercooler temperature)
  - Helpful to utilize the turbocharger inputs when compound turbos are used
  - Use “SENS-EGT-OPEN” paired with “SENS-TC8-EGT” and with 8-cylinder engine it is paired with “SENS-THK-1250” for a single K-Type

From “Pressures”

- [ ] Engine Crankcase Pressure
  - Use “SENS-PRES-15DTM”
- [ ] Turbocharger Compressor Outlet Pressure (Pre-Intercooler Pressure)
  - Use “SENS-PRES-300DTM”
- [ ] Turbocharger Turbine inlet Pressure (Drive Pressure)
  - Use “SENS-PRES-300DTM”

From Chassis

- [ ] GPS
  - Global positioning for a speed or position reference
  - Use “SENS-GPS-L10”
- [ ] Suspension Position
  - From 2” to 8” in 1” increments available (except 7”) and 13.75” (actual measurements in mm)
  - For 2” Travel 7.8” overall compressed and 9.8” overall extended use “SENS-LPS-50”
  - For 3” Travel 8.8” overall compressed and 11.8” overall extended use “SENS-LPS-175”
  - For 4” Travel 9.8” overall compressed and 13.8” overall extended use “SENS-LPS-100”
  - For 5” Travel 10.75” overall compressed and 15.75” overall extended use “SENS-LPS-125”

- For 6” Travel 11.75 overall compressed and 17.75” overall extended use “SENS-LPS-150”
- For 8” Travel 13.3” overall compressed and 21.3” overall extended use “SENS-LPS-200”
- For 13.75” Travel 18.6” overall compressed and 32.5” overall extended use “SENS-LPS-350”

From Speeds

- [ ] Driveshaft Speed
  - “SENS-SPD-DAV-001” Speed sensor

From Actuators

- [ ] High pressure Fuel Pumps
  - How Many_____

From Driver Inputs

- [ ] CAN Keypad 8 Button

Race Vehicle Planning Guide

The race vehicle planning guide is to help us know the full scope of the project and where every wire might travel to in the vehicle. To properly spec an electronics system, every single input from the driver, engine, and chassis must be known. Equally important is to know what the electronics systems outputs are expected to control for the engine, chassis, or driver.

Everything listed below is to help cover all the bases to ensure all sensors and devices are planned and accounted for, that is why "Customer provided" items are included. This also gives us a good idea of the full scope of the project, so we know what the expectation of our system is. In order to better help with your project, as many details as possible must be known.

Can be used as a checklist as you go through it

This first section of sensors is required as a bare minimum to run an engine and get support

- [ ] Crankshaft Position Sensor
  - Customer Provided
- [ ] Camshaft Position Sensor
  - Customer Provided
- [ ] Pedal Position
  - Generally, customer provided
  - Most factory pedals work with no issues
  - Here is a good factory option https://www.rockauto.com/en/moreinfo.php?pk=4710438&cc=3441722&pt=5061&jsn=964
  - See "Suspension travel" sensors and select a size if you want to rig your own pedal up using a linear potentiometer
  - Rotary position sensors also available "SENS-RTY-90"
- [ ] Engine Coolant or Oil temp or Both
  - Good for up to 400° use "SENS-TMP-STLS"
    - OR
  - Good for up to 300° use "SENS-TMP-LQ-BRS"
- [ ] Inlet Air Temperature (manifold)
  - Intercooled application up to 300°F use "SENS-TMP-AIR-BRS"
  - Non-intercooled applications over 300°F use "SENS-EGT-OPEN" paired with either of the following "SENS-THK-1250" for a single K-Type or "SENS-TC8-EGT" for up to 8 K-Type thermocouples
- [ ] Inlet Manifold Pressure

- Use our 300 PSI pressure sensor “SENS-PRES-300DTM”

- [ ] Fuel Supply Pressure (Fuel Primary Pressure)
  - Use our 300 PSI pressure sensor “SENS-PRES-300DTM”
- [ ] Fuel Rail Pressure (Fuel Primary Pressure Direct Bank 1)
  - Sensor must be rated at least 20 MPa over commanded pressure.
  - You will never lose enough resolution to cause an issue with a high range sensor, so we always recommend a 2700 bar sensor “SENS-RDS-2700”
  - If you do not want to or cannot change connectors to use the 2700 bar, the 2400 bar works in most applications “SENS-RDS-2400”
- [ ] Engine Oil Pressure
  - Use our 300 PSI pressure sensor “SENS-PRES-300DTM”
- [ ] Exhaust Lambda
  - ****REQUIRED for any remote tuning support****
  - Use Bosch O_2 sensor “SENS-LSU4.9”
  - The sensor we provide is made specifically for use on production diesel engines
  - Use in conjunction with “SENS-LTC” OR “SENS-LTC-ECUMASTER”

Temperatures:

- [ ] Transmission Pan Temp
  - Good for up to 400° use “SENS-TMP-STLS”
    OR
  - Good for up to 300° use “SENS-TMP-LQ-BRS”
- [ ] Transmission Inlet Temp
  - Good for up to 400° use “SENS-TMP-STLS”
    OR
  - Good for up to 300° use “SENS-TMP-LQ-BRS”
- [ ] Transmission Outlet Temp
  - Good for up to 400° use “SENS-TMP-STLS”
    OR
  - Good for up to 300° use “SENS-TMP-LQ-BRS”
- [ ] Exhaust Temp at each cylinder
  - Use “SENS-EGT-CLOSED” paired with either of the following “SENS-THK-1250” for a single K-Type or “SENS-TC8-EGT” for up to 8 K-Type thermocouples
- [ ] Exhaust Temp in the collector
  - Use “SENS-EGT-CLOSED” paired with either of the following “SENS-THK-1250” for a single K-Type or “SENS-TC8-EGT” for up to 8 K-Type thermocouples
- [ ] Wastegate Temperature
  - This is reference to the temperature in the dump tube to use as an indicator if the wastegate is open
  - Use “SENS-EGT-CLOSED” paired with either of the following “SENS-THK-1250” for a single K-Type or “SENS-TC8-EGT” for up to 8 K-Type thermocouples
- [ ] Ambient Air Temp
  - Not required to run the engine

- Could place at inlet of turbo so you can see exactly what is entering your turbo from the atmosphere
- Use “SENS-TMP-AIR-BRS”

- [ ] Ambient Track Temperature
  - Use an infrared temp sensor for contactless measurement “SENS-TMP-IR-200”
- [ ] Vehicle Tire Temperature
  - Use an infrared temp sensor for contactless measurement “SENS-TMP-IR-200”
- [ ] Differential Temperature
  - Good for up to 400° use “SENS-TMP-STLS”
    OR
  - Good for up to 300° use “SENS-TMP-LQ-BRS”
- [ ] Fuel Temperature
  - For the most part this is not ever needed, but if you suspect you want it, use the sensors below.
  - Good for up to 400° use “SENS-TMP-STLS”
    OR
  - Good for up to 300° use “SENS-TMP-LQ-BRS”
- [ ] Turbocharger Turbine Inlet Temperature
  - Helpful to utilize the turbocharger inputs when compound turbos are used
  - Use “SENS-EGT-CLOSED” paired with either of the following “SENS-THK-1250” for a single K-Type or “SENS-TC8-EGT” for up to 8 K-Type thermocouples
- [ ] Turbocharger Turbine Outlet Temperature
  - Helpful to utilize the turbocharger inputs when compound turbos are used
  - Use “SENS-EGT-CLOSED” paired with either of the following “SENS-THK-1250” for a single K-Type or “SENS-TC8-EGT” for up to 8 K-Type thermocouples
- [ ] Turbocharger Compressor Inlet Temperature
  - Helpful to utilize the turbocharger inputs when compound turbos are used
  - Use “SENS-EGT-OPEN” paired with either of the following “SENS-THK-1250” for a single K-Type or “SENS-TC8-EGT” for up to 8 K-Type thermocouples
- [ ] Turbocharger Compressor Outlet Temperature
  - Helpful to utilize the turbocharger inputs when compound turbos are used
  - Use “SENS-EGT-OPEN” paired with either of the following “SENS-THK-1250” for a single K-Type or “SENS-TC8-EGT” for up to 8 K-Type thermocouples
- [ ] Surface Temperature Sensor with 0.145” hole
  - This can be mounted on anything with a machine screw to monitor temp
  - Currently used to monitor blower bearing temperature
  - Use this part number “SENS-TMP-SURF”
- [ ] Wastegate Temperature
  - Temperature Sensor in the wastegate dump tube to read if the wastegate is open or not
  - Use “SENS-EGT-CLOSED” paired with either of the following “SENS-THK-1250” for a single K-Type or “SENS-TC8-EGT” for up to 8 K-Type thermocouples

Pressures:

The goal with pressure sensors is to have the pressure they are measuring right about in the middle of their range, or at least a decent buffer from maxing the top range out. If oil pressure can get up to 150 psi, you want to use a 300 PSI sensor, if Transmission Converter Pressure can get up to 250 PSI, you want to use a 500 PSI sensor

All pressure sensors are recommended to be mounted on a small hose to reduce vibration to them using something like this https://www.hammertechracecars.com/product-page/8

- [ ] Transmission Converter Pressure
  - Can be up to 250 PSI, use “SENS-PRES-500DTM”
- [ ] Transmission Stator Pressure
  - Use “SENS-PRES-500DTM”
- [ ] Transmission Line Pressure
  - Use “SENS-PRES-500DTM”
- [ ] Transmission Lock up Pressure
  - Use “SENS-PRES-500DTM”
- [ ] Engine Oil Pressure
  - Use “SENS-PRES-300DTM”
- [ ] Engine Crankcase Pressure
  - Required to be remote mounted to reduce vibration with -3 hose
  - Use “SENS-PRES-15DTM”
- [ ] Nitrous Bottle Pressure
  - Usually after main bottle is open, before main system valve
  - This allows you to not have a sensor in every bottle and the ECU will control bottle pressure based on this value
  - Use “SENS-PRES-2000DTM”
- [ ] Nitrous Line pressure
  - Pressure after main system valve is open, and bottle valves are open
  - Use “SENS-PRES-2000DTM”
- [ ] Nitrous Kit Pressure
  - This would be the pressure between the solenoid and jet/nozzle
  - Use “SENS-PRES-2000DTM”
- [ ] Regulated Nitrous Pressure
  - This is the pressure that might be used for an air shifter, parachutes, or wastegates
  - Use “SENS-PRES-300DTM”
- [ ] Brake Pressure
  - Use “SENS-PRES-2000DTM”
- [ ] Clutch Pressure
  - Use “SENS-PRES-2000DTM”
- [ ] Coolant Pressure

- Use “SENS-PRES-300DTM”

- [ ] Exhaust Pressure
  - This would be a low-pressure measurement **after** the turbocharger discharge
  - Use “SENS-PRES-15DTM”
- [ ] Steering Pressure
  - Power Steering fluid pressure
  - Use “SENS-PRES-2000DTM”
- [ ] Water Injection Pressure
  - Use “SENS-PRES-2000DTM”
- [ ] Turbocharger Compressor Outlet Pressure
  - Helpful to utilize the turbocharger inputs when compound turbos are used
  - Use “SENS-PRES-300DTM”
- [ ] Turbocharger Compressor inlet Pressure
  - ` Helpful to utilize the turbocharger inputs when compound turbos are used
  - Use “SENS-PRES-300DTM”
- [ ] Turbocharger Turbine Outlet Pressure
  - Helpful to utilize the turbocharger inputs when compound turbos are used
  - Use “SENS-PRES-300DTM”
- [ ] Turbocharger Turbine Inlet Pressure (Drive Pressure)
  - Helpful to utilize the turbocharger inputs when compound turbos are used
  - Use “SENS-PRES-300DTM”

Chassis:

- [ ] G-Force Accelerometer
  - Extremely valuable tool for drag racing
  - For a Bosch MM5.10 unit use “SENS-ACC-MM5.10”
  - For a Davis Technologies VPS use “SENS-ACC-VPS”
- [ ] Wheelie Bar Pressure
  - Use “SENS-PRES-2000DTM”
  - Used in conjunction with a wheelie bar load cell that has a pressure port
- [ ] Suspension Position
  - From 2” to 8” in 1” increments available (except 7”) and 13.75” (actual measurements in mm)
  - For 2” Travel 7.8” overall compressed and 9.8” overall extended use “SENS-LPS-50”
  - For 3” Travel 8.8” overall compressed and 11.8” overall extended use “SENS-LPS-175”
  - For 4” Travel 9.8” overall compressed and 13.8” overall extended use “SENS-LPS-100”
  - For 5” Travel 10.75” overall compressed and 15.75” overall extended use “SENS-LPS-125”
  - For 6” Travel 11.75 overall compressed and 17.75” overall extended use “SENS-LPS-150”
  - For 8” Travel 13.3” overall compressed and 21.3” overall extended use “SENS-LPS-200”
  - For 13.75” Travel 18.6” overall compressed and 32.5” overall extended use “SENS-LPS-350”
- [ ] GPS
  - Global positioning for a speed or position reference

- Use “SENS-GPS-L10”

Speeds:

- Driveshaft Speed
  - Use a “SENS-SPD-DAV-001” Speed sensor
  - Tone rings from Davis Technologies available (http://moretraction.com/product/32t-drive-shaft-rpm-ring/DAV-001)
  - 32 teeth for great resolution
  - ID measurements available: 1.000", 1.375", 1.500", 1.625", 1.750", 1.812", 1.875", 2.000", 2.113", 2.125", 2.187", 2.250", 2.375", 2.500"
- Individual wheels speeds
  - Use a “SENS-SPD-DAV-001” Speed sensor
- Transmission Input shaft speed (to monitor converter slip)
  - Usually used on most Rossler Transmissions is a “M MHALL 437 V2”
- Turbo Speed
  - Borg/Garret Type bolt in plastic sensor use “SENS-SPD-BORG-TRBO”
  - Threaded Body M6 type sensor use “SENS-SPD-M6-TRBO”
- Ground Speed
  - For Truck and Tractor Pulling up to 44 MPH use “SENS-SPD-44MPH”
    - GPS can also be used “GPS-L10”
  - For Drag Racing up to 300 MPH use “SENS-SPD-300MPH”

Actuators:

(most of these are generally already on the vehicle)

- High pressure Fuel Pumps
  - How many_____
- Boost control Solenoids
  - 4 Port MAC Valve for two-way wastegate open and close control “MAC-4PORT”
  - 3 Port Mac Valve for air shifter or one-way wastegate control open or closed “MAC-3PORT”
- Shifter Actuation (Electronic or air)
  - Air solenoid control “MAC-3PORT”
- Parachute Charge
  - Air solenoid control “MAC-3PORT”
- Parachute deploy
  - Air solenoid control “MAC-3PORT”
- Transmission Brake
  - Customer Provided
- Transmission EZ stage
  - Rossler Internal Dump
  - Customer Provided
- Transmission Dump
  - Customer Provided

- [ ] Transmission Converter Lock Up
  - ○ Customer Provided
- [ ] Transmission Converter Soft Lock
  - ○ Customer Provided
- [ ] Line Lock
  - ○ Customer Provided
- [ ] DRV (electronic high-pressure fuel relief valve)
  - ○ Some systems have this as part of the factory fuel rail
- [ ] Relays for Nitrous solenoids
  - ○ Solid States only needed if a PMU is not present in the system
  - ○ If needed use "RLY-SS-100"
- [ ] Nitrous solenoids
  - ○ Customer provided
- [ ] Nitrous Bottle Heater Relay
  - ○ Use "RLY-MECH-120" for a 120 amp mechanical relay to control bottle heaters

PMU Input/Output:

(All customer provided)

- [ ] Nitrous Solenoids
- [ ] Bottle Heater
- [ ] Headlights
- [ ] Taillights
- [ ] Brake Lights
- [ ] Reverse Lights
- [ ] Interior Lights
- [ ] Starter Solenoid
- [ ] Intercooler Water Pump

Driver Inputs:

Some of these can be combined into the same button if you use a "Race Mode Switch" For example: When not in race mode, the left button can be a line lock button, when in race mode that button can now be your bump button

- [ ] Transmission Brake Button
  - ○ Customer Provided
    OR
  - ○ CAN Keypad
- [ ] Line lock Button
  - ○ Customer Provided
    OR

- CAN Keypad

- [ ] Transmission Brake Bump Button
  - Customer Provided
    OR
  - CAN Keypad
- [ ] Screen Brightness
  - Customer Provided
    OR
  - CAN Keypad
- [ ] Screen Page Switch
  - Customer Provided
    OR
  - CAN Keypad
- [ ] Race Mode switch
  - Generally, on a keypad or toggle switch
  - Will “arm” everything necessary to make a pass and change rev limits
- [ ] Rotary trim switches
  - On the fly switching of
    - Fuel mass limits
    - Air fuel ratio trim targets
    - Transmission Brake Bump Time
    - Driveshaft Speed target curve
- [ ] Brake Pressure Switch
  - To control brake lights
  - Customer Provided
- [ ] Neutral Safety Starter Lockout
- [ ] Lights on or off
  - Interior
  - Tail Lights
  - Reverse
  - Brake Lights
  - Headlights
- [ ] CAN Keypad 8 or 15 button
  - Keypad works in conjunction with the ECU alone or with the PMU
  - For 8 button use “KEYPAD-8” and for 15 button use “KEYPAD-15”