EXTERNAL WIRING DIAGRAM

The Controller has 3 main connections:

AC Power Input:	110-240VAC 50-60Hz with a current draw of less than 1A						
Computer Comunicat	ions: RS232 Serial D-9 connector for Serial or Serial to USB connection						
Dynamometer Wiring consisting of the following connections:							
RPM Dyno	This connects to a speed pickup (Hall Effect or Variable Reluctance type)						
Ground	All signals must share a common ground, and should connect to computer chassis						
RPM Engine	Input from Speed Clamp (Coil, Injector, Tack or Spark signal)						
5V	Output for Hall effect Sensors, Remote or Other Sensors						
12V	Output for powering AFR Meters						
A1	Analog Channel 1 Input, 0-5V						
A2	Analog Channel 2 Input, 0-5V						
A3	Analog Channel 3 Input, 0-5V						
A4	Analog Channel 4 Input, 0-5V						
TTL	Throttle Output (used for controlling various peripherals like fans)						



HALL EFFECT SPEED PICKUP (3-Wire):



VARIABLE RELUCTANCE SPEED PICKUP (2-Wire):

					-	-
Power Switch	RPM GI Dyno	ID RI En	M <u>5V 12</u> Y <u>A1</u> gine OUT	A2 A3 A4 INPUTS	TPS OUT	
ENGINE SPEED CLAMP: Clamp on low-voltage lead to Spark Coil, or Injector. Clamping the Spark						

High Voltage line may give "noisy"

readings unless Wire is Secured Tightly within clamp. Use Foam or similar to prevent motion of Spark Wire.

SOFTWARE

EZ pull Dynamometer program is designed to be a simple interface for dynamometer testing and tuning of all types of vehicles. It works with our Motorcycle, Automotive and Heavy Duty Vehicle chassis dynamometers, allowing various ways to control the load, as well as collecting and displaying data from the dyno and vehicle.

An on-line tutorial covering this software is available at "ezDyno Monitor Tutorial": https://www.youtube.com/watch?v=iylz2doeOK8

Dyno pulls are "Wide Open Throttle" acceleration tests used to measure power, torque and usually the Air/Fuel Ratio of your engine during hard acceleration. The pull should last for 10 to 20 seconds to get best results. This can be done with no load (an inertia only pull), 2-point loading (has a start rpm and load and stop rpm and load), or acceleration loading (uses start rpm and load, then adjusts load to achieve constant acceleration).

SETTING UP CONTROLLER TO PERFORM PULLS:

"Tare" load cell reading (or double click on the TARE button to automatically TARE) Select Gear, and spin up roller Click **"RATIO"** and set gear ratio (if using Calculated Engine RPM) Return engine to idle Click **ENGINE/DYNO** button to select RPM reference

Set desired **START** and **STOP** RPMs



PERFORMING PULLS:

Select Vehicle ID (license plate number or other) and File Destination Slowly open throttle to wide open at the start speed "Instantaneous" graph will automatically show up if the Instant Pull Graph box is ticked Hold throttle Wide Open following instructions in the notification window When at redline, or instructed to close throttle, reduce throttle To view results and compare/print click on the GRAF button There are several AUTOMATIC options used when performing pulls:

LOAD: Not used for Inertia pulls

SAVE: When this is ON the file will automatically be saved with the given vehicle ID and run number GRAF: When this is ON the large graf will automatically be opened at the end of the pull. INSTAGRAF: When this is on an "instantaneous" graf will show up during pulls/.

These options are turned on/off by clicking the button. They are ON when the button is GREEN.

GRAF: Graphic Results Display

To view the large "Pull" graf, click on the GRAF button.

Click on file name buttons to load existing files, and select X and Y axis parameters from the **SETUP** menu.



Saving the Data

You can save the graf the JPG button (prints it to a file), **REPORT** (sends it to an Excell spread sheet) or the **PRINT** button (prints to a printer).

Graf setup parameters (what data to plot, 1 or 2 graphs, grid size and etc) can be accessed by hitting the **SETUP** button.

CALIBRATIONS

To properly calculate the vehicles power the calibrations must be set to the correct values. Most problems with power calculations are related to incorrect calibration values. The dynamometer Roller Diameter and Inertia are the most critical. Next is the Friction, however if the inertia is properly set, the friction can be automatically calibrated. You can also set up the calibration for practically any sensor connected to the Analog Inputs, and many other parameters of interest.

Dynamometer Calibrations can be accessed by hitting the Calibration button.

NOTE: Friction can be calibrated only once the Inertia is correctly set.

To calibrate friction:

Tare the load cell

Spin up the dyno to a high speed (typical speed encountered during testing) Click on the AUTO friction button (and OK on the confirmation box) Clutch the vehicle (or place in neutral) and allow the roller/wheel so spin freely to a stop The new friction parameters will be presented in a confirmation box.

TYPICAL CALIBRATION NUMBERS Quad: 0 Nm/rpm² FRICTION Offset: 4Nm Factor: 0.002 Nm/rpm Dyno Inertia: 1.3 Max RPM: 8000 Roller Diameter: 0.165m Max Torque: 250Nm Gear Ratio: 3 (varies depending on what gear used on vehicle) Engine Inertia: 0 Dynamometer and Vehicle Calibration Title Mccd-100 with Inertia Dynamometer Calibrations (critical for proper power calculation) 0.1 Dyno Type MCCD-100i Roller Diam (m) Dynamometer Inertia (kg m²) 1.9 **Friction Calibrations** Max RPM 6000 Equiv Engine In Frict, Offset (Nm) 184,187 0.001 l orque (Nm) 500 Engine Inertia Factor (Nm/rpm) 0.017233 Auto 25 Gear Ratio Quad (Nm/rpm²) -1.5254791 Delta T: 0.060 Screen Refresh: .1 **Controller Calibrations Access** You can change Cal Enable Controller Cals Speed Pulses per Rev and PID and Alamr Limits Remote Control Settings: Remote lets you push a button to: Enable/Dissable Load Remote Control Settings Remote on Analog Channel: 3 Enable/Dissable Break, and Save and Close Graf Braking Controls: Breaking Load: Low Speed Cutoff: Breaking can be ramped down or continous Using a constant, or the 2-Point Stop load% and continue to 0 rpm, or the start speed Braking also used when BRAKE is activated Ramp Down Breaking Calibrations C Load: 10 % Use Stop Load % 🔽 Cutoff at Start RPM RPM1 - Dyno ▼ VALUE: 0 Channel Name, Scaling, Filtering, Gage Tcks and Decimal Points Units Offset Fac rpmD 0 1 Min Name Factor Max Filter Major Tix Minor Tix Decimal **Channel Settings** 4500 0 0 Roller RPM 5 5 n0 Filter: 0 No Filter, 0.99 = Heavy Filter Cancel Displayed value = Measured x Factor + Offset Set Calibrations

Each "Channel" has a label, units and linear calibrations (offset and factor). For scaling purposes there is a minimum and maximum value that can be changed, and a filter value for smoothing out the fluctuations. Filter value of 0 gives no filtering, 0.5 is slight filtering, and 0.9 is heavy filtering. Major and Minor number of ticks on the dial gages can be set, and the number of digits to be displayed (for example F2 or N2 for 2 digits to the right of the decimal point).

Common Analog Channel Calibrations

DEVICE NAME	<u>UNITS</u>	<u>OFFSET</u>	<u>FACTOR</u> (U/V)			
INNOVATE Motorsport AFR Meter	AFR	7.35	3.01			
AEM AFR	AFR	7.3125	2.375			
Focus Thermistor	°C	-27.6	135 (approximate)			

To change the controllers internal calibrations, you can click the **Controller Cals** button.

PPR are the "pulses per rev" of the dyno, or RPM2

Torque Averaging of 50% is normal. Use ~80 for greater averaging of displayed number (on controller) Torque Decimal places can be set (0, 1, 2, 3 or 4)

PPR1	44	PPR2	11	1) Mount Calibration Arm and	2) Place Calibration Weight, En	ter Torque, click "SET"
RPM1 Max	5000	RPM1 Alarm	5000	Calibration	EXAMPLE Torq = 0.51m x 20kg x 1.5 x 9.81m/s ²	Radius
Torque Avg	50	Torg Cal	5000	Arm	= 150 Nm	
Torque Alarm	10000	Torq Decimal	3			Cal Weight
	Speed Co	ntrol Mode Paramete	ers	Load		•
Kp	204	Fp	150	Dynamometer Cell		/ 泡
Кі	5	Fi	400	Calibrati	ion Torque:	T
Kd	20	Fd	10	(Nm) (meters) (kg) (Dyno/Input) (m/s ²)	
	Torque Co	ontrol Mode Paramet	ers	Case Patie: Duns Snood Unput Shaft Snood	Dyn	• EXAMPLE
Kp	20	Fp	500	(normally 1 for Engine Dynos)	(Roller)	Dyno spins 1.5 x faster so Gear Ratio = 1.5
Ki	5	Fi	1000	Gear Ratio = Dyno Speed / Roller Speed		
Kd	0	Fd	100			
Posdloadk	dode Parametere	Torque	Calibration	3) Remove Cal Weight and repeat step	p 1 to check calibration	
Kfrict	100	TARE -0.1	Nm (Read)	Max Signal Voltage	\sim	\
Kareo	7000	SET	Nm (Target)		Speed	1 to 2V
Kmass	25	Put on Cal Arm, T.	ARE, Load Cal		Sensor	
		Unload, TARE an	d Reload to check.	Upper Trigger		+
Speed Si	gnal Upper/Lower	Trigger Voltage	Levels (DC5.5)	1 /	1 1	0.1 to 0.5V
Upper 0	39 RPM1	0.39	RPM2	Lower Trigger		
Lower 0.	0	0.00	0	Min Signal Voltage	~ 0.5V	
			-			_
To keep the	calibrations you can 5 m permanently you mu	END them to the co ust BURN them to fla	introller. ish in the controller.	Speed Trigger Levels should	be set within the sensors output	ut voltage.
REMEMBER	i: Incorrect cals can c	Burn Durns	ehave unexpectedly.	Leave margin, especially bet	ween the Upper Threshold and	the Max voltage.
	14		E XII	Set levels and confirm speed	I reading at high and low speed	s before burning.
PID Tun	ning:		Not U	sed for Inertial Dynos		
-	0			1		

- Road Load Tuning: Not Used for Inertial Dynos
- Torque Calibration: Not Used for Inertial Dynos

Speed Signal Trigger Levels: Normally this will by 0.5 for the lower level and 1.0 for the upper level Upper and Lower levels can be adjusted to give best RPM stability If a trigger level is too high or low, the RPM will be 0 even with a signal Spin the rollers or run the engine with speed clamp to view RPM numbers

SEND the parameters to the controller to test out.

BURN them to the controller when you are happy with the results.

ENGINE TUNING WITH THE "TUNE BUDDY" SCREEN:

To get the "Tune Buddy" tuning assist screen, click the TUNE button on the main screen. You will then have a second window open that has 3 grids, each with the same coordinates, usually X = Engine RPM, Y = Throttle (or MAP) and Z (the displayed item) is Air/Fuel ratio:

Tune Buddy																	
ł	Configure	RI	RPM 2,880				Tuning Assist Screen										
		Target Measured Correction %															
r	Load			1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000		
	28		5	0.40	0.14	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	Set Target To: 12.5	-	10	0.00	0.00	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			15	0.00	0.00	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
i.	And Easter 1	- 1	20	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
;	Acc. Factor	-11	25	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Target	12.50
	Correction: AFR or % Fuel:		30	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
1	I % Fuel		35	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Current	5.00
	Zero Corrections		40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Correction	0.28
ŧ.	Export Map	1	45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		,
i.	Import Map	1	50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Abort	Close

TARGET: This is the target AFR. It can be set by entering a number in the upper left box and hitting "Set Target To" button. If you want different target values in different cells, you can Export, edit and then Import the map.

MEASURED: This is the actual measured average AFR for each cell. The averaging exponent is labeled as the Acc. Factor (accumulation factor)

Correction %: This is the relative change required in the fueling map of the engines ECU (Electronic Control Unit)

As you change the operating condition the light blue highlighting indicates what cell you are operating in. You can observe the Measured and Correction values change while you run.

The Current cell value, Target value and Correction value for the current cell are displayed on the right side. Corrections can be reset by hitting the "Zero Corrections" button.

You can edit the Tune display configuration with the Configure button:

💦 Tuneing Configu	ration	
Tuning Assist Scree	n	
X-Axis Title RPM	Y-Axis Title Load	Z-Axis Title AFR
Source	Source	Source
RPM1	C Throttle	
C RPM2	• Load	
C Analog 1	C Analog 1	C Analog 1
C Analog 2	C Analog 2	C Analog 2
C Analog 3	C Analog 3	Analog 3
C Analog 4	C Analog 4	C Analog 4
X-Bins 12	X-Bin Step 100	00
Y-Bins 10	Y-Bin Step 5	
	Abort	Close

You can select the variable for the X axis, Y axis and Z, as well as the number of bins in the X and Y directions, and their step size. These parameters are saved in the Tune Configuration file.

REMOTE

A remote is available which has 3 to 5 buttons. This is connected to any one of the Analog inputs. The Remote functions need to be turned ON via the Calibrations Remote section:

Remote Control Settings:

Remote on Analog Channel: 3

Remote lets you push a button to: Enable/Dissable Load Enable/Dissable Break, and Save and Close Graf

The first button puts the dyno in BREAKING mode, applying a load specified in the Breaking section of the Calibrations. BREAKING mode can be toggled ON/OFF with this button.

The second button is the LOAD button. The Load can be toggled ON/OFF using this button.

The Third button is the CONTINUE button. This is used to SAVE files when the Save file dialog box is open, or to EXIT the Graf when it is open. This allows you to continue testing without having to click the mouse.

For more information contact: www.FocusAppliedTechnologies.com