



FOCUS APPLIED TECHNOLOGIES DYNAMOMETER SYSTEM DESKTOP DYNO MODEL DTD1 CONTROLLER MODEL DC5

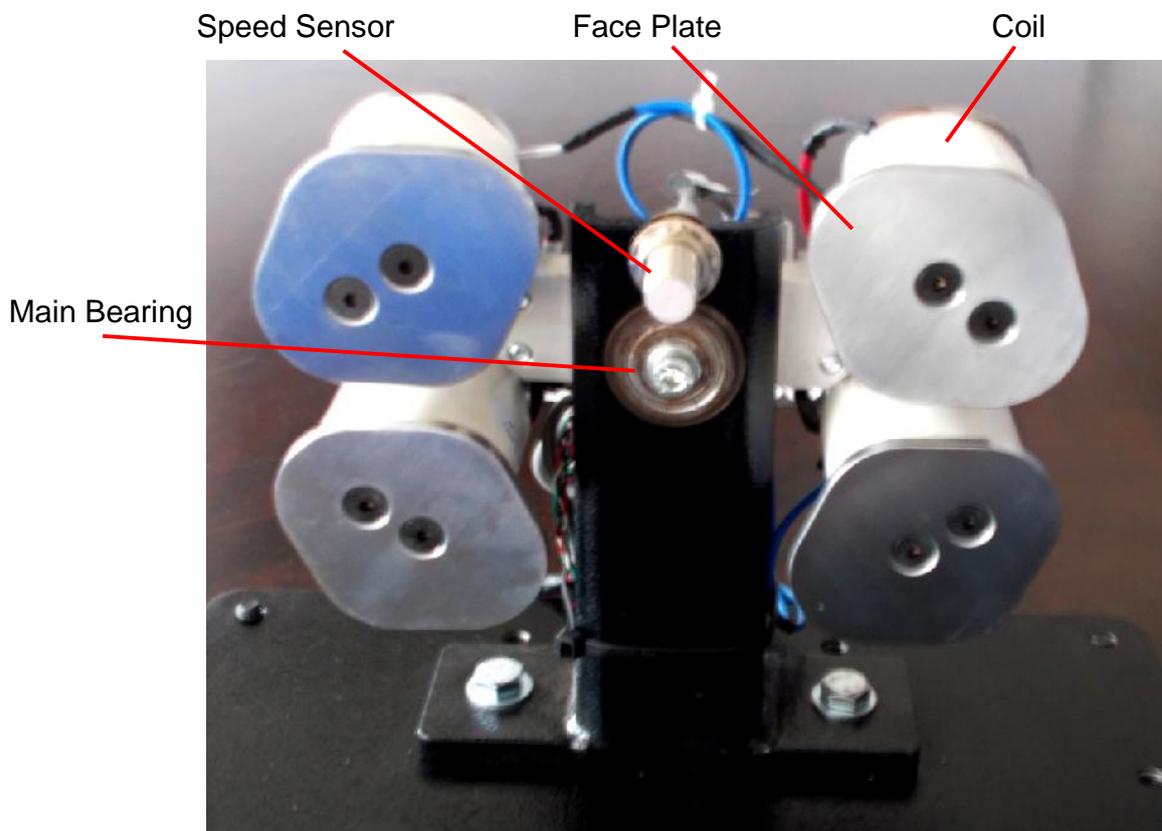
Manual Rev. 1-0715

2kW EDDY CURRENT DYNAMOMETER
WITH CONTROLLER

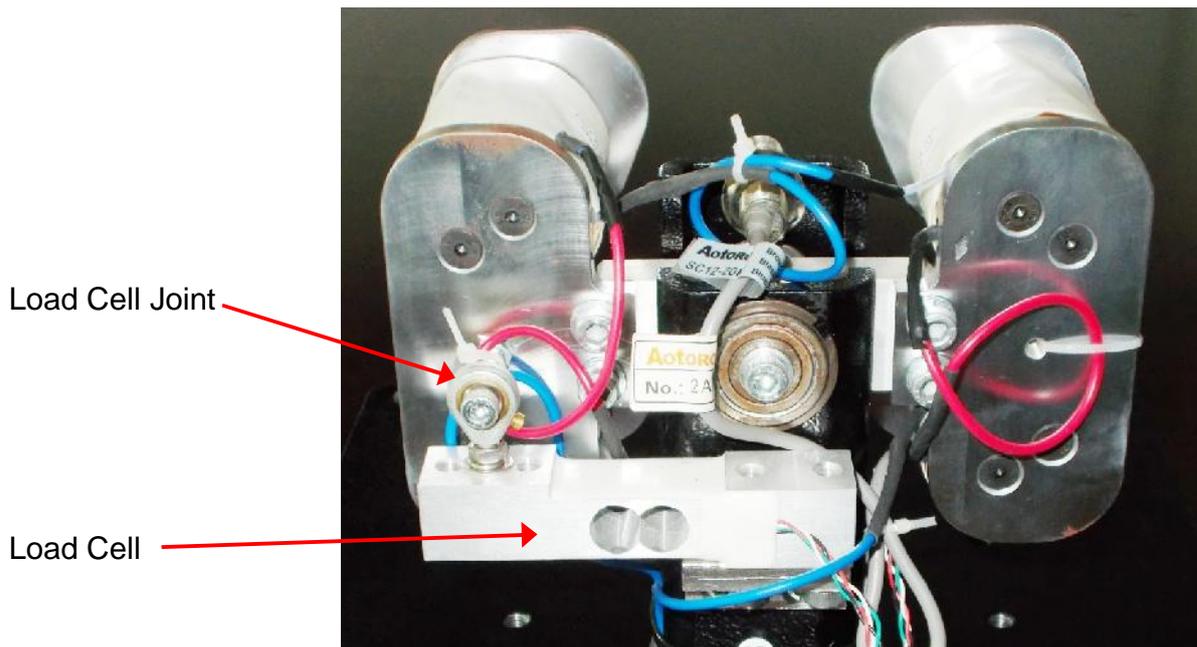


FOCUS APPLIED TECHNOLOGIES SDN. BHD.
#34 Jalan Jawi Indah
Sungai Jawi 14200
PENANG, MALAYSIA
www.FocusAppliedTechnologies.com

DYNAMOMETER FACE VIEW



DYNAMOMETER BACK VIEW



INTERNAL COMBUSTION ENGINE

This shows the Internal Combustion Engine (ICE) mounted on the DeskTop Dyno



FEATURES

Dynamometer

The dynamometer is an eddy current dynamometer especially designed for easy replacement of the prime mover, including an Internal Combustion Engine, AC or DC motor. Power from the engine or motor rotates the Eddy Disk in front of the dynamometers coils. The dynamometers axial magnetic field is controlled by the dynamometer current. More current gives a stronger stator magnetic field, inducing more eddy current in the rotating disk. The resulting magnetic field produced in the disk opposes the direction of motion, creating drag on the disk, and a torque on the dynamometer which is measured by a load cell. Power from the prim mover is dissipated as heat in the spinning disk.

Dynamometer Controller

This dynamometer controller allows the user to control the dynamometer in several different modes: Manual, Speed, Torque, Road Load (RPM²) and Computer (remote) mode. Which of these modes to use depends on the specifics of your testing. For simple loading of a vehicle (ie. adding or reducing the load) the easiest mode is the Manual Control mode. For constant speed operation (Torque will vary) use the Speed Control mode. Road Load mode is commonly used to simulate the aerodynamic load a vehicle when operated on the road. Note that inertia/mass is not matched unless the eddy disk has the same inertial as the target vehicle, however vehicle mass effects can be simulated in the Road Load mode. Computer control mode is used for automated testing, often in conjunction with the throttle control, which can also be operated remotely from the computer.

Computer Communications

A computer can be connected to the dynamometer controller for logging data from the Dynamometer Controller, Fuel Scale and Data Acquisition systems via Serial Ports. If serial ports are unavailable then a USB-Serial Port converter may be used. Serial port communications are via RS232: 9600 baud, No parity, 1 Stop bit. The cable should be a "straight through" cable connecting pins 2, 3, and 5 at both ends. In Verbose mode the controller automatically sends data out in the format shown below at approximately 4Hz. During power on the controller sends out a "Power On" message with the firmware code. Data can be logged from various serial communications programs including Hyperterminal. Various controller parameters can be modified from the computer interface, and data can be logged by the computer as well. In Verbose mode the controller will automatically output data to the serial port every 250ms. When the control is NOT in Verbose mode sending the character "A" will cause the controller to respond with the data.

In general the computer data is output in the following format:

ZSSSS1_SSSS2_TT.TTT_LLL_Mode_SP_TTL_Alarm_A1_A2_A3_A4 [CR]

Where:

S is speed in RPM (S1 is rpm1, displayed on the front panel, S2 is rpm2 which is not displayed on the front panel)

T is torque in Nm

L is load in %

Mode is the mode:

NM for front panel Manual mode, CM for Computer Manual

NS for front panel Speed mode, CS for Computer Speed

NT for front panel Torque mode, CT for Computer Torque

NR for front panel Road Load mode, CR for Computer Road Load

SP is the set point

TTL is the throttle position (0-1023 is 0 to Wide Open)

Alarm is 0 for no alarm, and 1 for alarm

A1 .. A4 is the Analog input in 0-1024 (ie. 10 bit) 5V resolution.

The separator between the fields is a space character

For example:

Z2510 6500 12.345 20 NS 2500 53 0 123 345 678 1023

Speed is 2510 RPM

Speed 2 is 6500 rpm

Torque is 12.345Nm

Load is 20%

Mode is Front Panel, Speed Mode

Set Point is 2500

Throttle is 53

No Alarm state present

Analog Input 1 is 0.601V (ie. $5 \cdot 123 / 1023$)

Analog Input 2 is 1.686V

Analog Input 3 is 3.314V

Analog Input 4 is 5.00V

Data Acquisition System

This dynamometer controller includes a basic Data Acquisition System (DAQ). This system is for reading signals from various sensors commonly used in engine testing such as Thermocouples, Pressure Sensors, Voltages and etc. Several channels are available for the use, and are logged along with the standard controller data (eg. Speed, Torque, %Load, Control Mode, Alarm Status). All of these sensors can be read by the computer data logging software for display and recording.

NOTE: Analog input voltages are limited to 0 to 5V. If measuring voltage above 5V you must use a voltage divider to reduce the voltage to below 5V max.

Fuel Scale

Some test systems are equipped with a fuel scale. This digital gravimetric fuel scale measures fuel weight as it is consumed by the engine under test. The data is fed to the computer via serial (RS-232) communications link, allowing seamless integration with our dynamometer and DAQ systems. The weight of fuel is measured as a function of time allowing direct measurements of fuel consumption, and calculation of Break Specific Fuel Consumption (BSFC), and Fuel Mass Flow rate, for calculation of actual Air Fuel Ratio (AFR) when combined with an air flow sensor.

Dynamometer Operating Range

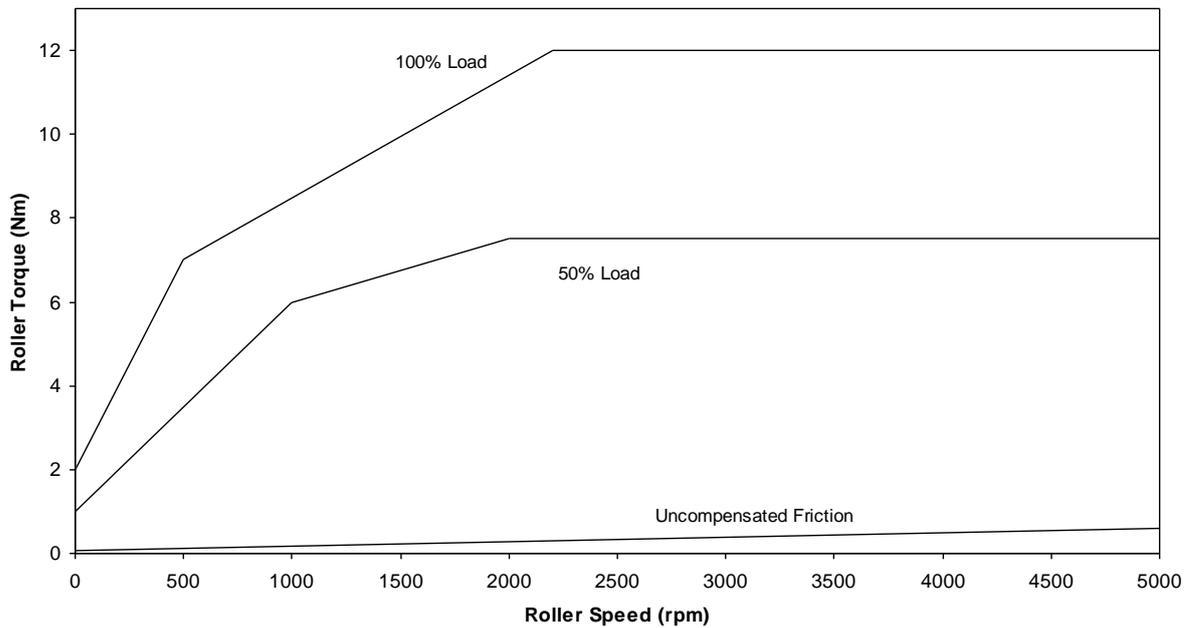
The dynamometer is designed to operate at over 10,000 rpm, however the prime mover's speed should be limited to 10,000 rpm max. One advantage of having the prime mover drive the eddy disk directly, is that all dynamometer friction is eliminated. There is a slight "wind load" on the disk, which can be compensated for using the following Torque Friction Correction equation is used:

$$\text{Compensated Torque} = \text{Measured Torque} + 1 \text{ Nm } (0.08 + \text{RPM}/9600)$$

For example if you are measuring 6Nm of torque at 3000rpm, the compensated torque is 6Nm plus 1Nm x (0.08+3000/9600) or about 6.4Nm total. If the DynoParameters file is set up correctly, the Torque displayed on the computer will be correct.

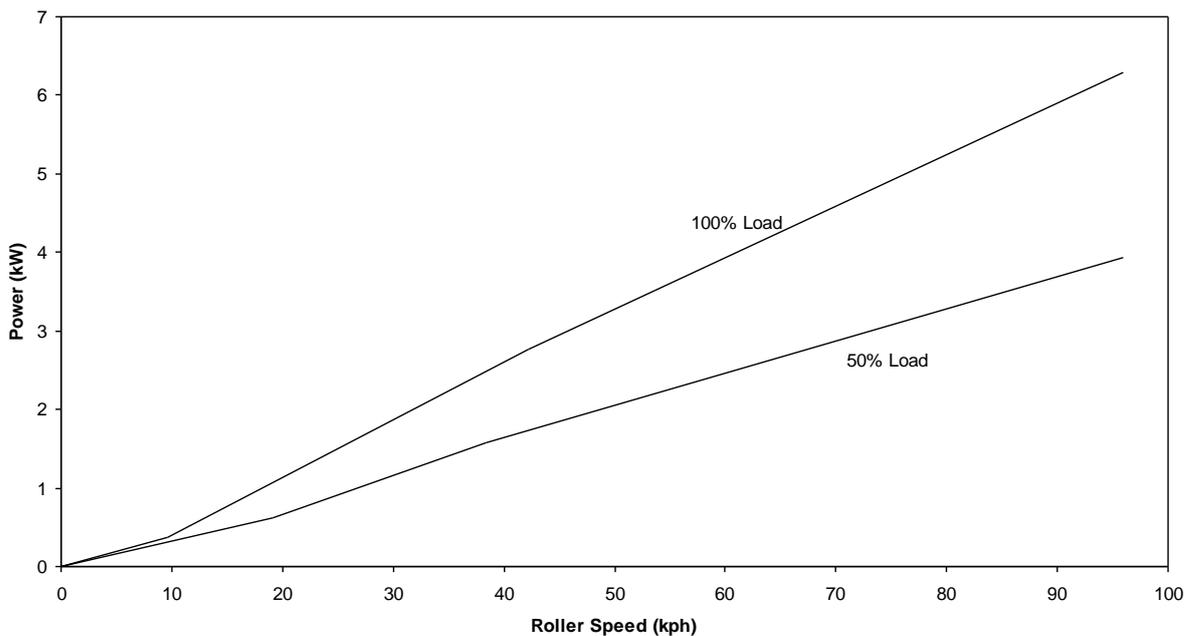
The maximum torque rating of the dynamometer is approximately 12Nm. This gives a maximum mechanical power of approximately 6kW at 5000rpm. Tire losses on the roller are approximately 10%, giving a maximum wheel torque of over 6.5kW. The area of safe operation is shown below.

NOTE: Dynamometer friction is compensated for in the "Total Torque" number on the dynamometer logging display.



Torque is limited by the available voltage from the dyno at low speeds. At higher speeds, the torque is relatively constant as the dynamometer operates in a current (torque) limited mode. The roller speed should be limited to 5000rpm to avoid damage to the dynamometer. The lower limit of torque is the total friction. The safe area of operation is anywhere between the frictional curve and the 100% load line. For reference a 50% load line has been given.

The maximum power curve is given below. The dynamometer can extract power in excess of 6kW at 95 kph.



DYNAMOMETER STARTUP PROCEDURE

This controller is equipped with several safety features to avoid damage to the dynamometer and engine. These must be correctly wired to insure safe operation. This section describes their setup and use.

Dynamometer Startup Procedure

1. VMI: Visually inspect all components of the dynamometer system, engine and fueling system for make sure there are no missing or broken components, leaks or loose items which may cause damage.
2. Turn Computer ON
3. Turn Dynamometer Current to the OFF position
4. Switch the Mode selector switch to MANUAL mode
5. Set the Set Point Adjust to 0%
6. Turn the Dynamometer Controller and Power Unit ON
7. TARE the load cell (this may be repeated after unit has warmed up for best results)
8. Set the Throttle Set Point to IDLE

Fuel Scale Startup Procedure

1. Switch ON the Fuel Scale
2. Zero the Fuel Scale Load
3. Load the Fuel tank with fuel
4. Place the fuel tank on the scale
5. Confirm that the scale is not overloaded

Engine Startup Procedure

1. Check the Engine Oil and fuel levels
2. Check the Engine Mounting and Eddy Disk Clamp to insure that it is securely mounted to the dynamometer
3. Pump the fuel bulb (at base of carburetor)
4. Power on the exhaust system
5. Place Throttle to the START position (IDLE)
6. Make sure the Dyno current is switched OFF
7. Start the engine by pulling the starter cord (use choke if necessary, but close choke once engine starts)

Engine Testing Procedure

1. Set the Engine's Throttle to Idle and start engine
2. Set Dyno load to 0% in Manual mode, and Switch Dyno Current ON
3. Switch Controller to appropriate Mode
4. Adjust Set Point to desired set point
5. Open Throttle to Desired Operating Condition
6. Commence Measurements, adjusting either Set Point of Throttle as required

Shut Down Procedure

1. Reduce Throttle to Idle
2. Save all data on the computer
3. Place Dynamometer in Manual Mode
4. Reduce Dynamometer load to 0%
5. Switch Dyno Current OFF
6. Allow the engine some time to cool at IDLE if hot
7. Once the engine has cooled Continue:
8. Shut OFF the Engine Ignition (hit the KILL button)
9. Turn OFF Exhaust fan
10. Stop the Computer Data Acquisition Program
11. Shut OFF The Fuel Scale
12. Shut OFF The Dynamometer and Power Supply

DYNAMOMETER CONTROLLER

Modes of Control

This dynamometer controller allows the user to control the dynamometer in several different modes: Manual, Speed, Torque, Road (RPM²) and Computer Control mode. Which of these modes to use depends on the specifics of your engine testing. For simple loading of an engine (ie. adding or reducing the load) the easiest mode is the Manual Control mode. For constant speed operation (Torque will vary) use the Speed Control mode. For automated testing, use the COMputer controlled mode, which also allows control of the Throttle setting. In all operating modes the **TARE** key zeros out the torque reading, and **Alarm Reset** resets the alarm state, assuming the cause of the alarm condition has been cleared.

Manual Control

In Manual Control mode the Set Point Adjust knob directly controls the current going to the dynamometer. For a given speed, the load will be directly proportional to the knob setting: 0% load at one end, 100% load at the other end.

The most common engine testing is done using manual mode control. For a torque/power curve of the engine, the engine can be started and throttled up to “redline” (ie. the maximum rated speed). Dyno load is increased as the throttle is opened to keep the engine just at redline speed. Once the throttle is fully open, the torque and speed are recorded. Subsequently the load is increased in small steps, causing the engine speed to decrease. At each new speed the torque and speed are again recorded. Repeating this in steps of 500 rpm allows the wide open throttle (WOT) torque curve to be determined.

NOTE: Engines operating at Wide Open Throttle can generate a lot of heat. Make sure you supply the engine or motor with sufficient cooling air.

Speed Control

In Speed control mode the Set Point Adjust knob sets the desired speed. If the engine is operating above the set speed, the controller will increase the current to the dynamometer, increasing the load on the engine, and slowing it down to the set speed. If the engine is incapable of reaching the set speed at a given throttle, the engine will operate at a speed below the set point, and the dynamometer will be completely unloaded. For best results the PID gains must be carefully adjusted.

Torque Control

In Torque control mode the Set Point Adjust knob sets the desired Torque. If the dyno is operating below the set torque, the controller will increase the current to the dynamometer, increasing the load on the engine, and slowing it down, while the torque increases to the set point. If the engine is incapable of reaching the set torque at a given throttle, the dynamometer will continue to add load until the engine stalls, the clutch slips, or maximum load is attained. If the dyno torque is above the set point, then the load will be reduced, dropping the torque, and increasing the speed.

Road Load Control

In Road Load control mode the load is varied as a function of speed to mimic aerodynamic loading of a vehicle. Load is increased proportional to the square of the speed, with no load at zero speed. In this mode the set point adjustment knob controls the proportionality constant. A larger constant is used for physically larger vehicles, while a smaller constant is used for smaller, or more aerodynamic vehicles. A good way to calibrate the constant is to operate the vehicle at a known throttle/speed combination. If the vehicle speed is higher than the desired operating point the constant can be increased, and if the speed is lower, the constant should be decreased. This calibration should be performed in the mid-point of the desired test speed range. Once the constant is established for a given vehicle, it should always be re-used for that particular model.

Computer Control

In Computer control mode the operating control mode and set point and throttle position are received from the computer via the serial port. The command sequence to be sent from the computer is as follows:

CSSSSS

Where:

C is a character indicating the control mode:

M for Manual

S for Speed

T for Torque

R for Road Load

SSSSS is the appropriate set point



RPM	TORQUE	%LOAD
03423	+899.91	>800
COM		

For Example here are several valid mode/setpoint commands:

M0128	Manually Sets Load to 100*128/1024 or 25%
S12250	Sets Speed control mode to 12250 rpm
T01234	Set Torque control mode to 12.34Nm
R0512	Set Road Load with factor of 50% (512/1023)

NOTE: the controller needs to receive the correct number of digits, so “preceding” zeros must be sent. M and R modes require 4 digits (0000-1023) and S and T modes require 5 (00000-65350).

For throttle Position control send the following sequence:

PXXXX

Where XXXX is the desired load (0 to 1023)

For Example the following sequence sets the throttle output voltage to 50% (ie. 2.5V):
T0512

NOTE: the controller needs to receive the correct number of digits, so “preceding” zeros must be sent. For P mode 4 digits are required (0000-1023).

Internal Strain Gage Amplifier

This dynamometer controller features an internal strain gage amplifier. This amplifier can be connected to any standard Wheatstone bridge configuration 4-wire strain gage load cell. The amplifier may be bypassed if the load cell does not require further amplification.

Internal Dynamometer Power Supply

This dynamometer controller features an internal power supply providing DC current to the dynamometer coils. Make sure not to exceed the power supply ratings. In general the dynamometer coil resistance should be more than 10 ohms. When operating loads requiring more power, it will be necessary to provide an external power switching device (ie. transistor), which may be triggered from the controller’s dynamometer output by running it through an appropriate voltage divider.

Serial Port Data Logging

Along with the controller a “serial port data logging” program is also supplied. This program communicates from any PC via the serial port directly to the dynamometer controller and can display and record the mode specific set point (ie. set speed or torque), dynamometer speed, torque, and dynamometer load (duty cycle). It may require the installation of Agilent VEE driver software, which can be downloaded for free from the appropriate Agilent website. The simple serial port communications protocol can also be reproduced in user defined programs for customization.

The Dynamometer controller can be set up to “broadcast” its data automatically by turning the “Verbose” mode ON. This can be done from the front panel menu in

manual mode. When verbose mode is OFF the controller will only send out data in response to a received character "A". This is done on some systems to help synchronize data acquisition. Make sure not to issue the A command to the controller more than once every 250ms.

Controller Setup

From the main menu you can access the setup menus using the **right** or **left** arrow keys. Different menus are available for the different modes, as selected by the mode switch. To adjust any of the parameters use the **Up** and **Down** arrow keys. To permanently save changes you make to the configuration use the Up arrow to change the **Save Config?** Value to **YES** then hit the **right** arrow key to exit the menu.

In Manual mode you can select the over speed and torque limits, and the "Pulses Pre Revolution" for the RPM1 and RPM2 speed signals. If a target wheel has 30 teeth, then the appropriate PPR would be 30. Finally in Manual mode you can set the appropriate position for the decimal in the torque display.

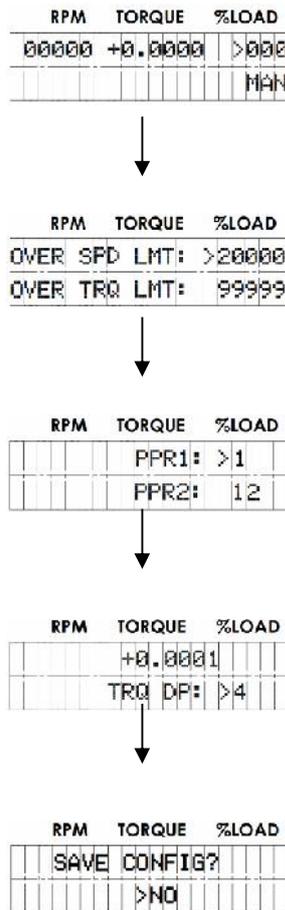
In Speed mode you can adjust the Speed Maximum Set Point, and the Proportional, Integral and Differential gain values for the Speed PID Control. For extended PID resolution denominator factors for P, I and D are also provided. If you want finer resolution, and lower gain on a given factor, increase the appropriate factor.

In Torque mode you again have a the Torque Maximum Set Point and the Proportional, Integral and Differential gain values for the Torque PID Control. For extended PID resolution denominator factors for P, I and D are also provided. If you want finer resolution, and lower gain on a given factor, increase the appropriate factor.

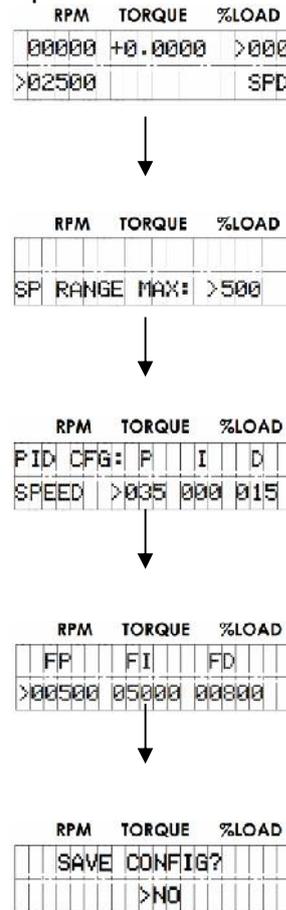
Controller Configuration Menu Map

Set the Mode Select Switch to get access to the various menus. Use the **Right/Left** arrows to page through the menu. Use the **Up/Down** arrow keys to change the individual values. To save the configuration use the **Up** arrow key to change **NO** to **YES** at the **Save Config?** screen.

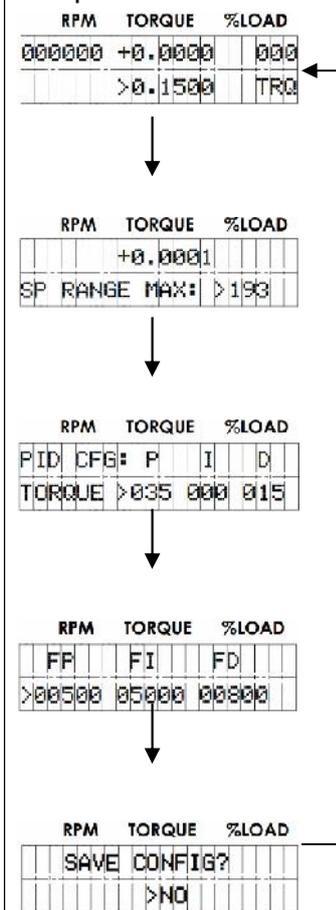
Manual Mode



Speed Mode



Torque Mode



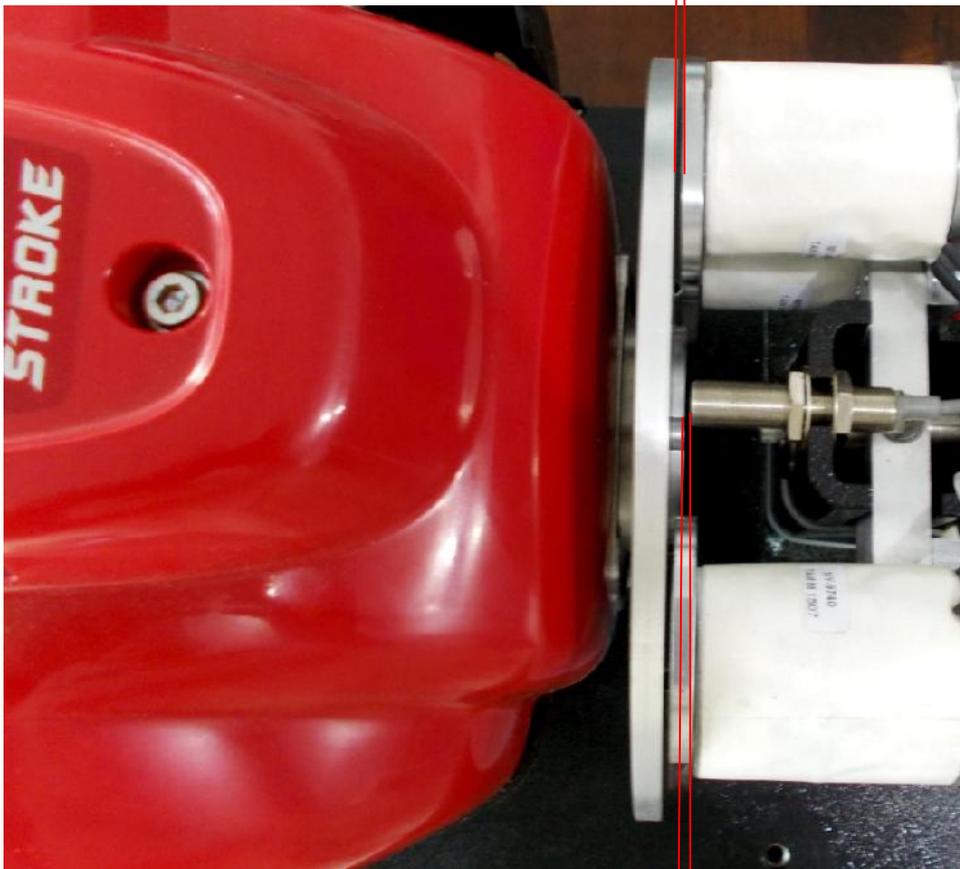
CALIBRATION AND ADJUSTMENTS

Speed Calibration and Adjustment

Speed is determined from the frequency of teeth passing the speed pickup. As such the only calibration required is setting the proper number of teeth on the speed target wheel. The standard speed target wheel has 4 teeth and is mounted on the Dynamometer (as shown below), thus the controller should be set up for **4 pulses per revolution (PPR)** to give the appropriate disk speed. This can be set from the front panel by hitting the right arrow in Speed mode, and following the prompts on the screen.

To properly read the teeth it is important that the speed pickup be clean, and in close proximity to the disk clamp target wheel. The gap between the speed pickup tip and the target wheel should be approximately 2mm. The acceptable range is 1mm to 3mm. Additionally the Eddy Disk should be close to the Dynamometers Face Plates to insure good flux transfer. The recommended gap is 3mm.

Disk Gap: 3 to 4mm



Speed Sensor Gap: 1mm to 3mm

First adjust the Disk to Face Plate gap by loosening the Engine Mounting Block bolts, and moving the engine to give an even gap distance right and left. If the gap is not consistent top to bottom the engine may be shimmed by inserting a thin metal shim below the mounting blocks as required. Once the disk has a uniform gap of approximately 3mm, tighten the engine mounting bolts down and confirm the proper gap.

Finally, to adjust the sensor gap, or adjust the height of the sensor, loosen the large nuts securing the sensor to the holding bracket, adjust the gap and height, and re-tighten the nuts. Do not over tighten as this can destroy the sensor.

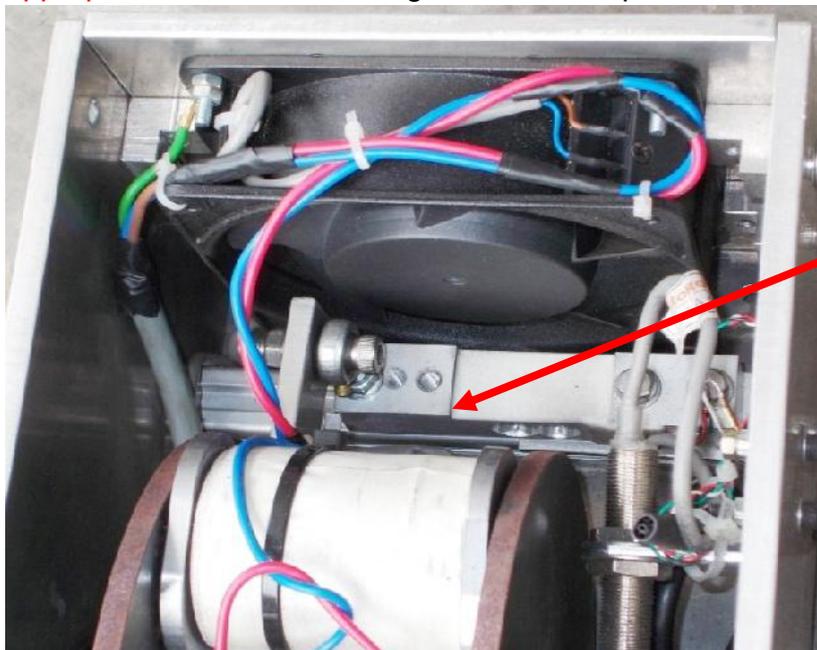
Torque Calibration

A calibration weight is provided with the dynamometer. This needs to be screwed into the load cell as shown below to calibrate the system. First remove the top cover, and power on the dynamometer controller. Load the dynamometer by pushing down lightly on the load cell, and release. Zero the torque reading by hitting the **TARE** button. The standard weight provided weighs 1.2kg, and the radius of the mounting hole is 0.10m from the center of rotation of the dynamometer. The torque resulting from a mass M is:

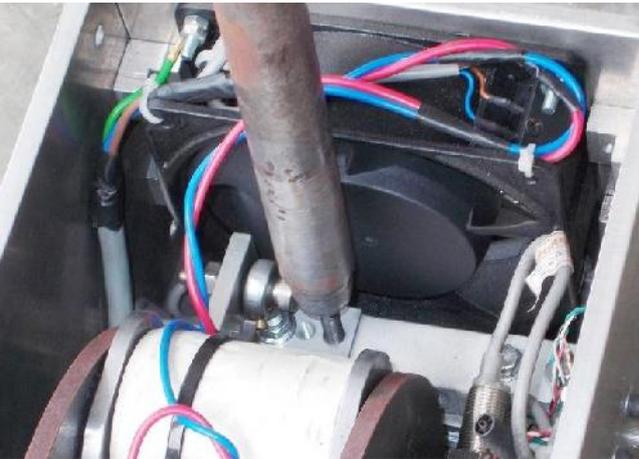
$$\text{Torque} = 1.2 \times 9.81 \times 0.10 \times 2$$

Where: M is the weight of the mass in kg
9.81 is standard gravitational acceleration
0.10 is the radius of the weights in meters
2 is the gearing ratio to the main roller

For the 1.2kg mass this should give a reading of **2.35Nm**. If the front panel torque reading is different from this amount, then the calibration factor must be adjusted. To do this put the mode selector switch in TORQUE mode and go to the front panel menu by hitting the right arrow, and adjust the torque calibration factor up or down as appropriate. Remove the weight, re-zero torque and recheck calibration when finished.



Screw Calibration Weight in to this hole



Calibration Weight:



This shows the calibration weight properly mounted:

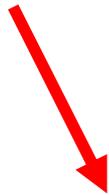
MAINTAINENCE GUIDE

This dynamometer is designed to require relatively little maintenance once properly setup, however there still are a few items that require periodic checking and maintenance. The Dynamometer mounting bolts should be checked, and re-torqued in necessary annually, and the unit may also require cleaning to remove any debris which has accumulated inside the dynamometer housing. Also check the wires for cracking, looseness and chafing, and repair at required.

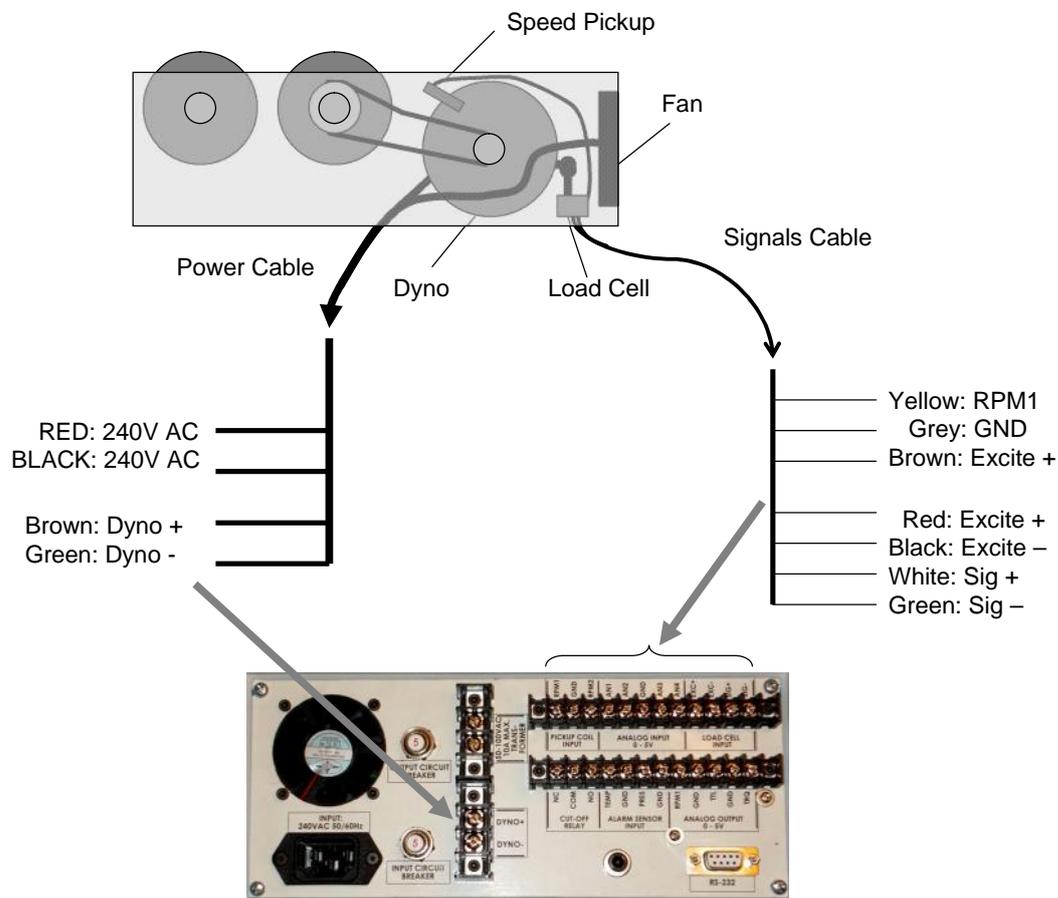
Engine Maintenance

As the engine is used....

To.



EXTERNAL WIRING DIAGRAM



The Controller should be is powered from a clean AC line power source.

The Dynamometer +/- power lines are connected to the “Dyno In” lines on the dynamometer with power cables (10A capable). Insure appropriate gage wires are used.

WARNING: Both the Dyno +/- control lines may have high voltages on them and can cause shocks if handled improperly! Always use appropriate cautions when using/installing the dynamometer.

The speed pickup is connected to the appropriate inputs via a shielded co-axial cable. This signal is polar and should be switch from about 0V to 5V DC when the Eddy Disk Clamp is rotated in front of the sensor.

The load cell amplifier is connected to the appropriate connections on the dyno controller, typically: RED = Excite+, BLACK = Excite -, WHITE= Sig+, GREEN = SIG-

Serial port communications are via RS232: 9600 baud, No parity, 1 Stop bit. The cable should be a “straight through” cable connecting pins 2, 3, and 5 at both ends. The data

from the controller will be decimal coded ASCII number for the speed, torque and other data separated by a space and terminated by a linefeed/carriage return. The controller will send data 4 times a second in Verbose mode, or respond to a "A" character ping.

DYNO MONITOR PROGRAM

The Dyno Monitor program requires Agilent Instruments IO drivers to operate. These are provided with the disk accompanying the dynamometer controller, and can be downloaded directly from the Agilent website. Once installed, the runtime dyno monitor program (DynoMonG5-1.VXE or similar) can be run from the command line, or from a shortcut icon.

The program will load various calibration parameters from the file:
C:\Fosuc\DynoCal.CSV

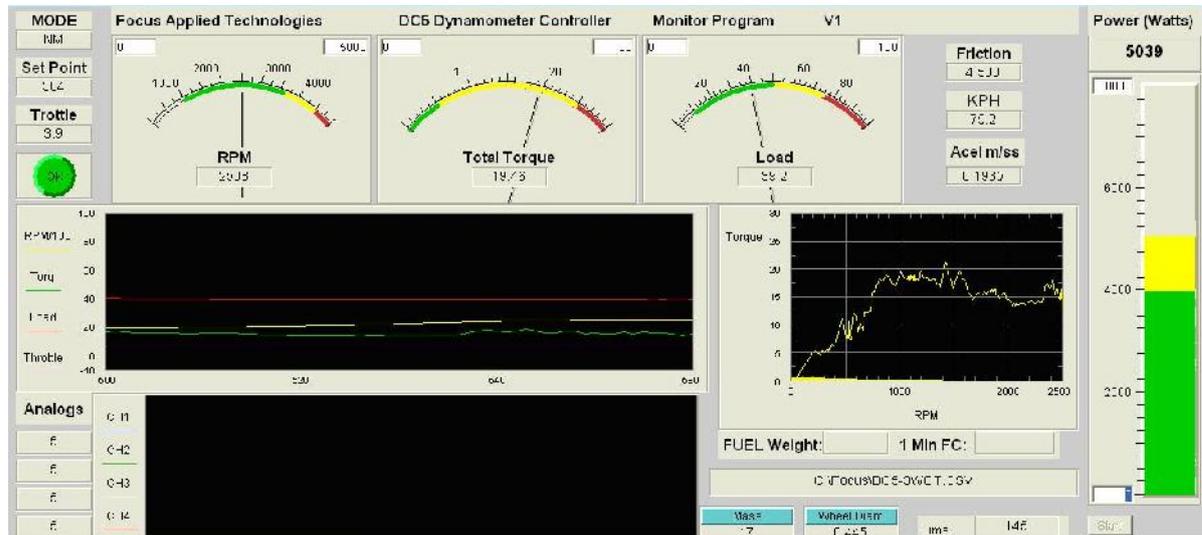
This file is easy to edit in Excel or any text editing program and contains the parameters listed below. Not all parameters are used with every version of Dyno Controller, but the parameters file contains all the standard information, and is saved as a "Comma Separated Variables" file.

	A	B	C
1	Focus Applied Technologies Dynamometer Calibration File	Kerdea	
2	Version	Chassis-BCD	
3	Mass	190	
4	Diam	0.444999993	
5	PPR	30	
6	RPM/V	250	
7	MPS/V	20	
8	Trq Offset	0	
9	Trq Fact	1	
10	Frict Ofs	1	
11	Frict Fact	0.001	
12	Last Cal	63489753474	
13			
14			
15			

The program will then prompt you for a data file in which it will save all the dynamometer parameters during operation. You will then be prompted for the serial port for communications to the Dynamometer controller, and the Fuel Scale. If one of these is not present enter a zero for the port.

In operation the various dyno parameters are displayed, and/or graphed, as shown below. In general the displayed values should agree with toes on the front panel of the dyno controller, with variations diminished via exponential averaging. Note that the

displayed Total Torque is the measured torque plus friction and in the case of inertial dynos plus the torque due to acceleration.



In general the display is self explanatory. The various meters can be re-scaled by changing the range limit numbers in the upper corners of the meters. The graphs can be cleared or rescaled by right clicking on the graph, and following prompts. Analog input channels voltage values are displayed and graphed in the lower logging graph.

If a fuel scale is present, the actual current fuel weight is displayed, along with a one minute fuel consumption average, which is updated every 60 seconds.

In the event of a communications failure the following message may appear:



If this appears it means that the software was unable to communicate with the dynamometer controller through the designated port. This is generally the result of one of the following:

- 1) The dyno controller is not powered on, or not connected
- 2) The Serial Communications Port is incorrect for the connection
- 3) USB – Serial port converters are often subject to Electro-Magnetic Interference which can cause them to become inoperable. This can be remedied by disconnecting and then reconnecting the offending USB converter.

In the event of an “Alarm” situation, the ignition relay will be powered off, and throttle command will go to zero, while the “Alarm” button will show ALARM in red. Clear the offending alarm (temperature, pressure, over speed or over torque) and reset the alarm from the keypad to clear the alarm state, and continue testing. NOTE:

Dynamometer power IS NOT released in an alarm state. This is done intentionally to prevent runaway of the dynamometer.

Data File

The data is continuously saved to the designated file as follows:
 Time in seconds, Main Roller speed in rpm, Torque in Nm, % dynamometer load, Throttle position, Controller mode (described above in Computer Communications section), Set point (mode dependent), Friction in Nm (a function of speed), Acceleration in M/s², and the analog input voltages 1, 2, 3, and 4 respectively.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Focus Applied Technologies Dynamometer Data Log												
2	File Opened: 63475828548.14												
3	Time	RPM	Torq(Nm)	%Load	Throttle	Mode	SetPt	Frict(Nm)	Accell(m/s:	Ch1	Ch2	Ch3	Ch4
4	5.296997	0	0	1.9	3.9	NM	19	2	0	5	5	5	5
5	5.563004	0	0	5.8	3.9	NM	57	2	0	5	5	5	5
6	6	0	0	8	3.9	NM	79	2	0	5	5	5	5
7	6.046997	0	0	10.7	3.9	NM	105	2	0	5	5	5	5
8	6.296997	0	0	16.8	3.9	NM	165	2	0	5	5	5	5
9	6.563004	0	0	19.8	3.9	NM	194	2	0	5	5	5	5
10	7.030998	0	0	23.4	3.9	NM	229	2	0	5	5	5	5
11	7.046997	382	0	29.8	3.9	NM	292	2.764	0	5	5	5	5
12	7.313004	882	13.58009	30	3.9	NM	294	3.382	3.590241	5	5	5	5
13	7.75	1286.5	27.34808	34.4	3.9	NM	337	3.691	7.230161	5	5	5	5
14	7.844002	1383.75	27.87659	37.3	3.9	NM	365	3.481	7.369884	5	5	5	5
15	8.046997	1073.875	80.82412	39.4	3.9	NM	386	2.764	21.36791	5	5	5	5
16	8.313004	729.9375	45.56084	44.2	3.9	NM	433	2.386	12.04517	5	5	5	5
17	8.765999	461.4688	19.66562	45.7	3.9	NM	447	2.193	5.199107	5	5	5	5
18	8.844002	278.7344	7.956489	48.4	3.9	NM	474	2.096	2.1035	5	5	5	5
19	9.046997	163.3672	-50.1613	52.9	3.9	NM	518	2.048	-13.2614	5	5	5	5
20	9.485001	93.68359	-39.2142	53.2	3.9	NM	521	2.024	-10.3673	5	5	5	5
21	9.546997	52.8418	-29.9272	56.9	3.9	NM	557	2.012	-7.91201	5	5	5	5
22	9.780998	29.4209	-22.4064	58.2	3.9	NM	569	2.006	-5.92371	5	5	5	5
23	10.047	16.21045	-16.1734	61.2	3.9	NM	599	2.003	-4.27585	5	5	5	5
24	10.5	8.605225	-13.9794	64.4	3.9	NM	630	2.001	-3.69582	5	5	5	5
25	10.547	4.302612	-10.0916	66.1	3.9	NM	647	2	-2.66798	5	5	5	5
26	10.781	2.151306	-7.2269	70.3	3.9	NM	688	2	-1.91061	5	5	5	5

This data can then be graphed and analyzed further.

Alternative Data Logging

An alternative option for data logging is via any serial communications program, such as Hyperterminal or RealTerm. Simply connect to the dynamometer controller, insure that the controller has Verbose mode ON, and save the resulting data to a text file. This text file can then be loaded into a spreadsheet such as Excel and the various columns can be converted to data as mentioned above in the Computer Communications section above.

SAFETY PRECAUTIONS

The Focus Applied Technologies DeskTop Dynamometer is designed to be an inherently safe machine via the use of heavy duty mountings and base plate, disk guard, electrical fault protection, and ignition cutoff system. However as with any power equipment improper use can result in a hazardous situation.

With this in mind here are several tips to help keep the users safe:

- Always maintain the engine/motor, disk and wires in good condition.
- Always make sure the test engine or motor is firmly secured to the dyno
- NEVER TOUCH on a moving disk!
- Avoid loose items including cloths, cables, belts and loose small times which might fall into the gap between the disk and the dynamometer.
- The controller contains dangerous voltages and currents. Never operate the dynamometer with the controller opened. .
- Disconnect all power to the dynamometer and auxiliary components before opening or servicing.
- Insure proper ventilation whenever operating a combustion engine.

NEVER allow personnel to access the inside of the dynamometer while in operation. Fingers and articles of clothing can be pulled into the moving rollers and/or belts potentially maiming the user.

ELECTRICAL HAZARDS

This equipment is powered by potentially dangerous AC and DC voltages, and normal precautions pertaining to electrical appliances apply. Do not operate the equipment if there is water present in, on, or around the equipment. Make sure all electrical wiring is properly installed and grounded, and has a fast-acting Ground Fault Interrupter in the circuit.

The power from the dynamometer to the dump load is to be considered a **HAZARDOUS VOLTAGE**, which may be as high as 400VAC. It is imperative that the dump load and wiring be routed in such a way as to prevent the possibility of contact with any conductive object or personnel. Additionally the dump load may become **VERY HOT** in operation. Make sure it is mounted away from any flammable objects, or anything that could be damaged by elevated temperatures.

MECHANICAL HAZARDS

This equipment may be operating at high speeds, and rotating equipment is always a potential hazard. Keep hands, hair and cloths clear of the rotating shafts (especially the speed target wheel). Inattention may allow a loose article of clothing (ie. a shirt sleeve, neck tie, or head scarf) to become entangled in the rotating shaft, potentially injuring **OR KILLING** the person.

Equipment featuring a spinning disk can be dangerous if imbalanced, or loose. Although the shaft selected may be operating within the designed specifications, it could possibly become damaged, or fail, resulting in an outward explosion of the disk, throwing heavy components outward at high speed. Insure the disk guard is in place during operation. **ALWAYS STAY WELL AWAY FROM THE DISK AREA WHEN IN OPERATION!**

FIRE HAZARDS

As always, when operating engines high temperatures, sparks and fuel are present. Take all necessary precautions and **always** have a fire extinguisher on hand.

TROUBLE SHOOTING GUIDE

If you encounter problems with the dynamometer, there are some simple tests and checks you can perform to help you track down the source of the problem. A dynamometer and controller is a complex system, and very often problems are related to improper external wiring or usage of the controller. The following simple tests should help you diagnose what is wrong with the system and correct it.

DYNAMOMETER POWER TEST

To check the dynamometers loading capability first mount a disk (preferable from the AC or DC motor) in close proximity to the coils. Apply power to the Dynamometer Coils. This can be done by directly running power in (ie. connecting to a 12V battery) or by placing the dynamometer controller in manual mode and setting it to 20% load. The shaft of the dynamometer should have significant resistance to rotation. Remove the power from the dynamometer coil and the shaft should spin freely. If applying power to the dynamometer coils does not result in a loaded shaft than either the dyno coil lines are open circuited, or the dyno is not supplying power to them. Check the resistance across both lines. The Dyno Coils should have a resistance of between 10 and 100 ohms. The dynamometers stator (the wires going to the Dump Load) lines should have a resistance below 20 ohms when disconnected from the dump load. The Dump Load should have a resistance of between 10 and 20 ohms. If any of these are out of specification the dynamometer will not be able to apply the appropriate load to the shaft.

DYNAMOMETER CONTROLLER POWER TEST

Apply a load to the Dynamometer Coil Output: a 500 ohm, 10W power resistor can be used to simulate the coil load. In Manual Mode you should be able to see a signal on the Dynamometer Coil Output lines. At low load the DC voltage across the load should be low, and should go up to over 50V at full load. This can be measured with either a volt meter, or on an oscilloscope. On the oscilloscope you should be able to see wave forms something like that in the Sample Signal section of this manual. If you get this DC voltage, then the power supply, power switching transistor and controller are all working properly. If you do not, try resetting the circuit breakers, checking wire connections and trying again.

SPEED SIGNAL TEST

The speed signal must have sufficient amplitude to trigger the speed sensing circuitry. Typically this will require a zero-to-peak amplitude of at least 1V. For accurate speed measurements, the signal should not have any noise exceeding this threshold. With the dynamometer spinning the speed pickup signal can be viewed on an oscilloscope.

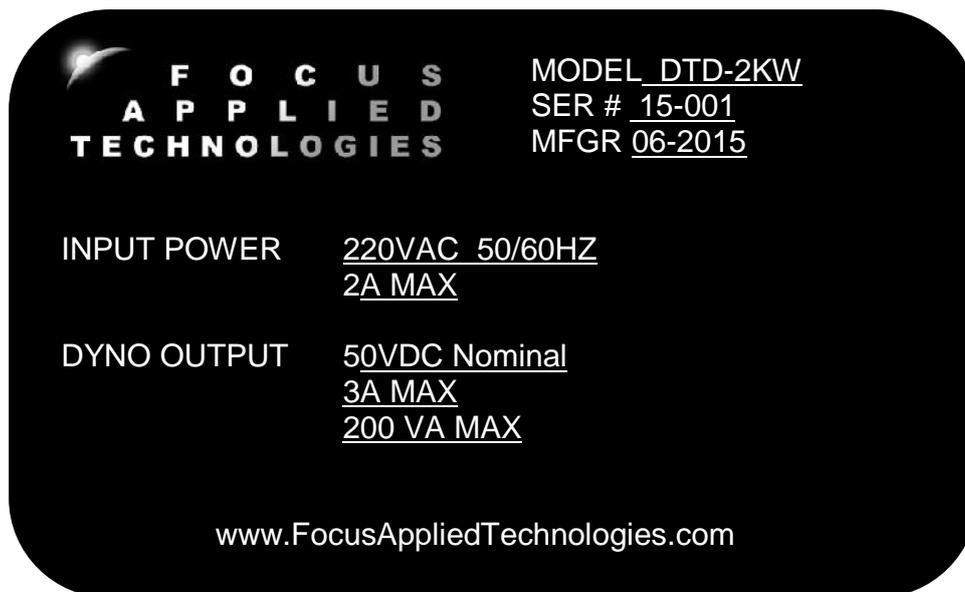
The signal should look like one of those in the Sample Speed Signals section. The actual speed is calculated from period of n transitions, where n is the number of pulses per revolution. On the oscilloscope trace you should confirm that all n of the transitions exceed the threshold level, and none of the noise spikes do.

LOAD CELL TEST

The load cell and amplifier can easily be tested together by observing the voltage (amplifier output which should be fed into Torque Input terminals on the back of the controller) while changing the load on the load cell. Unloaded the amplifier should have a small DC voltage (the “zero voltage”). As load is applied this voltage should increase linearly proportional to the applied load. If the voltage *decreases* when applying load in the nominal loading direction, reverse the **Sig +** and **Sig –** lines on the amplifier; this will cause the voltage to increase with applied load. When the load is removed the voltage should decrease back to the initial “zero voltage”. If the assembly does not behave as indicated, it is likely that there is a problem with the load cell wiring, and you should proceed to the following “Load Cell Trouble Shooting” section.

CONTACT INFORMATION

As there are so many factors outside of our direct control, Focus Applied Technologies does not assume any liability for accidents caused by the use of this equipment. Use of this equipment is at the users own risk. If any problems or accidents occur, we wish to be informed so that we may improve our products, and fix any issues they may have. Please send us any feed back you have regarding the use of this equipment.



For further information on this or other products please contact us via the following:

Web site: www.FocusAppliedTechnologies.com

Email: Sales@FocusAppliedTechnologies.com

Post: FOCUS APPLIED TECHNOLOGIES SDN. BHD.
 #34 Jalan Jawi Indah
 Sungai Jawi 14200
 PENANG, MALAYSIA