Series 1780 dynamometer and thrust stand datasheet

Typical use

- Inrunner and outrunner brushless motor characterization (0-100A)
- Propeller characterization (max 40”)
- Servo testing and control
- Battery endurance testing
- Factory testing

Features list

- Direct measurements
  - Torque
  - Thrust
  - Voltage
  - Current
  - Optical RPM
  - Temperature (three ports for each load measurement unit)
- Derived measurements
  - Motor efficiency (%)
  - Propeller efficiency (g/W)
  - Coaxial global performance (when ordering coax version)
- USB interface
- ESC manual control
- Self-configurable setup
- Load cell overload alarm and cutoff
- Automatic tests and recording
- Coaxial (two motors inline) measurement
- Adjustable axial distance between two motors in a coaxial setup
- Galvanic isolation
- Output data to CSV files
- Real-time sensor plots
- Powerful scripting
- Support for temperature probes
- External cutoff switch and buzzer
- Factory calibrated

Technical specifications

Table 1: Design specifications of the Series 1780 Single Motor version.

Specification	Min.	Max.	Tolerance	Unit
Thrust	-25	25	0.5%	kgf
Torque	-12	12	0.5%	Nm
Voltage	0	60	0.5%	V
Current	0	100	1%	A
Angular speed*	0	190k	-	RPM

*Optical RPM.

Sampling rate depends on your computer (50Hz+).

Due to the vibration isolators, expect hysteresis of a maximum of 100 g in thrust after full range testing. Tare the load sensor (from the software) before running a test.

info@rcbenchmark.com

Table 2: Design specifications of the Series 1780 Coaxial versions.

Specification	Min.	Max.	Tolerance	Unit
Thrust side A*	-25	25	0.5%	kgf
Thrust side B	-25	25	0.5%	kgf
Torque side A	-12	12	0.5%	Nm
Torque side B	-12	12	0.5%	Nm
Voltage side A	0	60	0.5%	V
Voltage side B	0	60	0.5%	V
Current side A	0	100	1%	A
Current side B	0	100	1%	A
Angular speed**	0	190k	-	RPM

* Each side represents one motor and one propeller, the system can acquisite data for both A and B sides in order to calculate a global performance.
** Optical RPM included.

The load, power and optical RPM measurement units from side A and side B share the same design parameters. Thus, for the Series 1780 coaxial, users can expect a maximum total thrust of 50kgf (110lbf) for the overall system.

Software features list

- Real time graphs
- Manual motor control
- Manual servo control
- Safety cutoffs based on any measured data
- Data recording to CSV file
- Automated tests
  - Ramps
  - Steps
  - Measure number of poles
  - And more with our scripting engine...
- User scripts with documentation

info@rcbenchmark.com

Hardware

The RCbenchmark dynamometer 1780 is designed to greatly reduce the time required for characterizing and testing high power brushless motors and large propellers, while obtaining precise and accurate results. Figure 1 shows an overview of the important components of the tool.

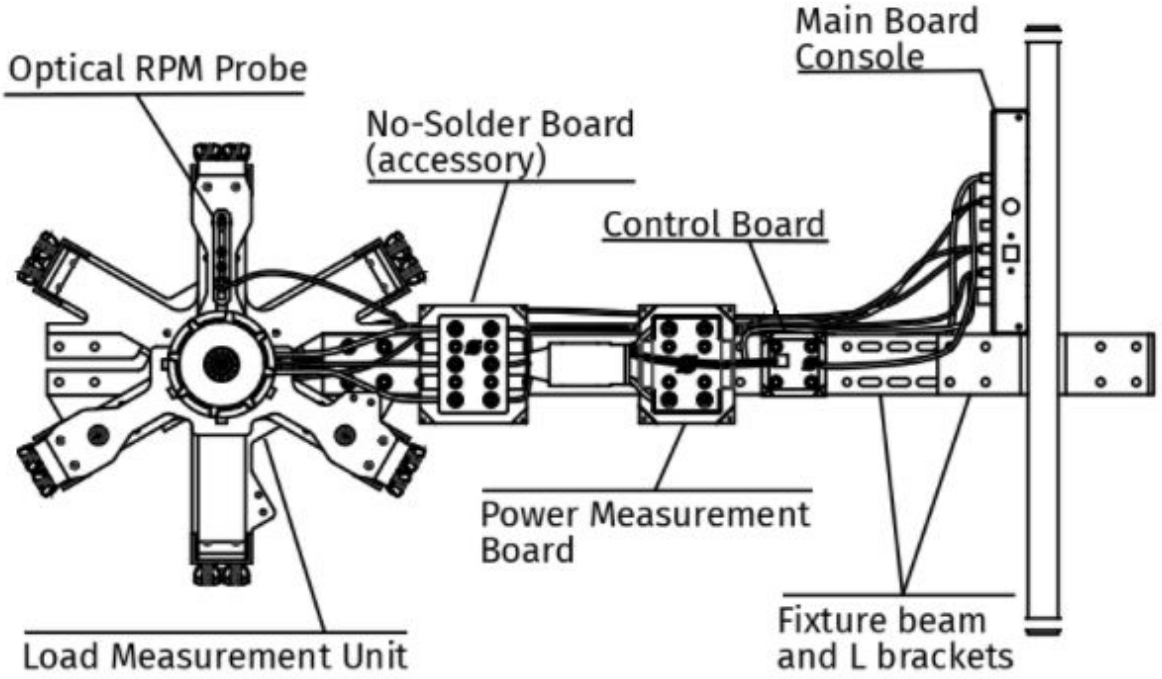


Fig. 1: Hardware overview

For a given voltage, brushless motor speed is a function of two variables: the mechanical load (in Nm), and the input (which can be measured in duty cycle or percentage of the maximum command sent to the ESC).The motors are characterized by changing the input from the software and by changing the load with multiple propellers. The load changes as the propellers have different size and pitch.

info@rcbenchmark.com

Configurations

The Series 1780 is designed to be modular. Those modules can be replaced or reconfigured to adapt to different testing needs. Currently, the Series 1780 supports three different testing configurations: single motor, back-to-back coaxial and face-to-face coaxial:

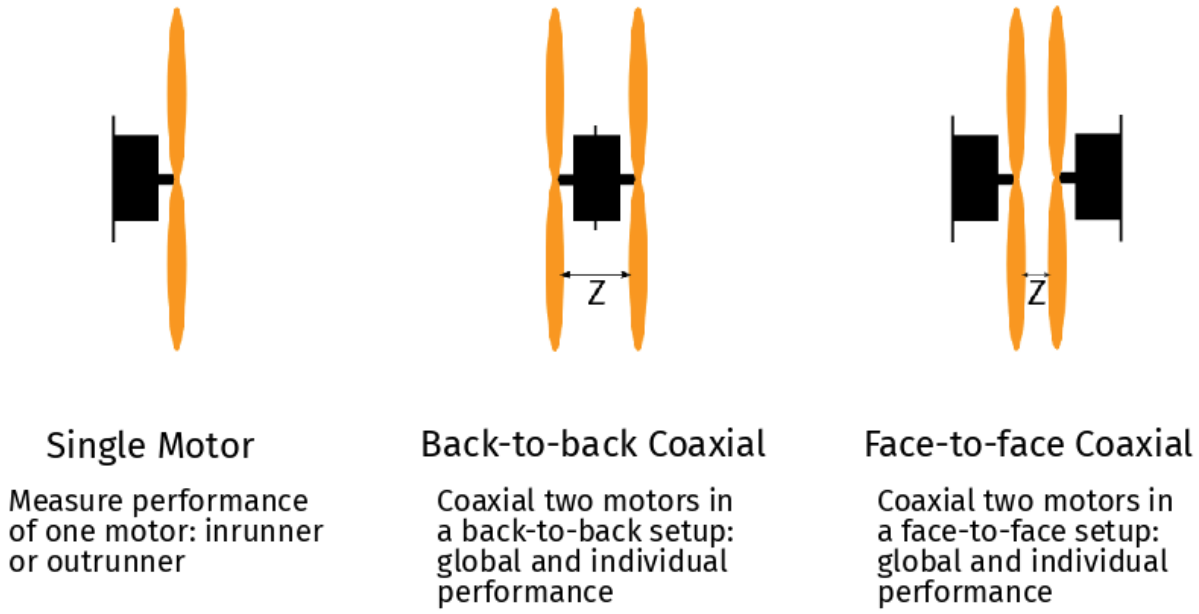


Fig. 2: Available configurations

All three configurations share mostly the same hardwares, except that the back-to-back coaxial requires a special load measurement unit. Additionally, both coaxial setups use a different data acquisition board with extra connectors that allows to control and process data for both motors.

The power measurement board, the control board, the optical RPM probe, the motor mounts and the fixtures are universal to all the configurations. It is possible to switch from one configuration to another by obtaining extra components or by upgrading the Series 1780 load measurement unit. Please contact the RCbenchmark technical support team for more details.

All RCbenchmark Series 1780 dynamometers are calibrated before product's shipment. Upon reception of the product, you may mount the unit onto the test bench and start testing right away.

info@rcbenchmark.com

Mountings and Assemblies

The load measurement unit is pre-assembled and calibrated before its shipment. Users will need to fix the unit to their testing bench inside a safety cage, and finish assembling the unit with the motor mount, the optical RPM probe and other electrical components as shown in Fig.1. Detail instructions are provided.

We recommend to attach the load measurement unit to the two included fixture beams. Eight holes for M6 bolts on the load measurement unit are reserved for mounting. The fixture beams are drilled with holes matching the mounting holes on the load measurement unit.

The load measurement unit and mounting plate can be connected by either a spacer kit or a DoF-Z Kit. The spacer kit contains six 15.88mm length spacers that provide a fixed distance connection with the high structural strength. The DoF-Z kit includes several parts with slots which make the distance between the load measurement unit and the motor mount adjustable (range: 150mm for single motor, 300mm for coaxial).

For customers who intend to test inrunner motors, it is mandatory to purchase the DoF-Z Kit separately.

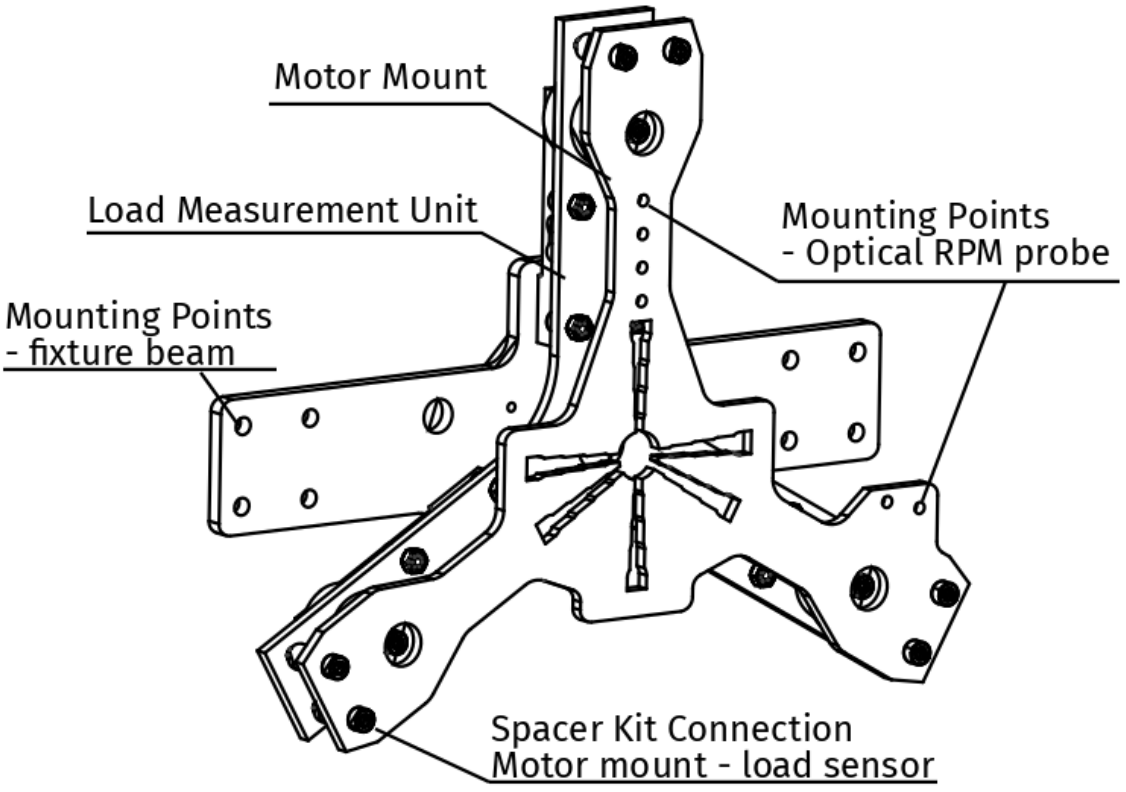


Fig. 3: Mountings on Single Motor unit

info@rcbenchmark.com

Compatible Motors

The motor mount of the Dynamometer Series 1780 is compatible with most of the brushless motors for UAVs on the market. It contains three major features:

Six holes for M5 bolts connect the motor mount to the load measurement unit with either the Spacer Kit or the DoF-Z Kit. Details and specifications of these connections have been introduced in page 5.

Optical RPM probes can be mounted on either the front or the back side on the motor mount, depending on whether an inrunner or an outrunner motor is tested. Use two holes to fix the optical probe on the motor mount and keep a reasonable distance (1 to 2mm) between the probe and the rotor. All fasteners and spacers are included in the package.

The motor can be mounted directly on the motor plate with M3, M4, M5, M6 or M8 screws. The screws go through slots. There are slots at 0, 90, 120, 180, 240, 270 degree in order to adapt to multiple motor geometries. For inrunner motor testing, there is also a center hole of ϕ18 that allows a rotating shaft through the plate.

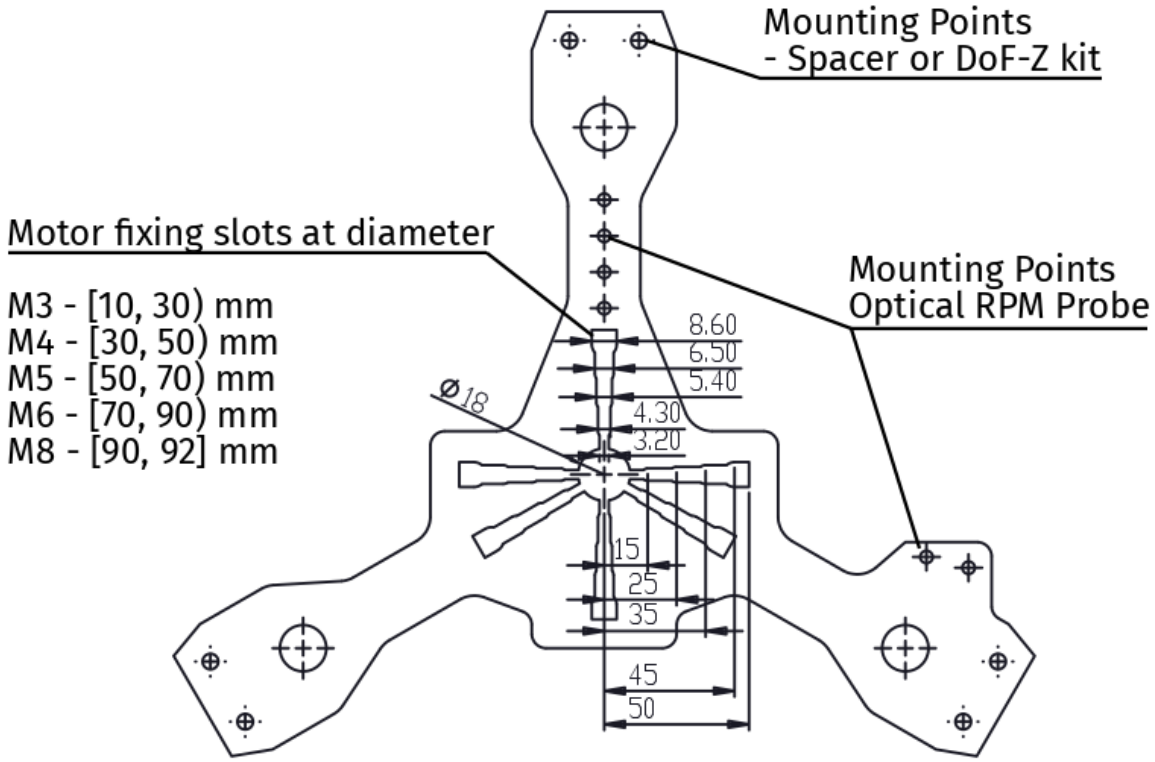


Fig. 4: Motor mount features

If you are planning to test motors out of the specification of this motor mount, we offer a service to build a specialized motor mount at a reasonable fee. Please contact us with the dimensions and motor specifications. You can also machine your own mounting plate.

info@rcbenchmark.com

Safety

Fast spinning propellers and motors can cause harm to the user. Safety goggles must always be worn when testing. The software has automatic cutoffs based on the specifications of the device. These cutoffs can be further limited by the user to, for example, prevent a propeller from spinning too fast or a motor from using too much current.

The Series 1780 should be placed in a separated room. During the tests, no operator must be allowed to enter this room. Additionally, it is important to reinforce the walls, or build a safety cage alongside the propellers' spinning surface. These reinforced structures will protect the operator in case that any moving components were broken apart by accident.

It is highly recommend to use the proper fasteners provided in the package. As the Series 1780 supports measurements up to 25kgf of thrust for a single motor version and up to a total of 50kgf of thrust in a coaxial setup, it is critical to follow the instructions about how to arrange and tighten those fasteners in the user manual.

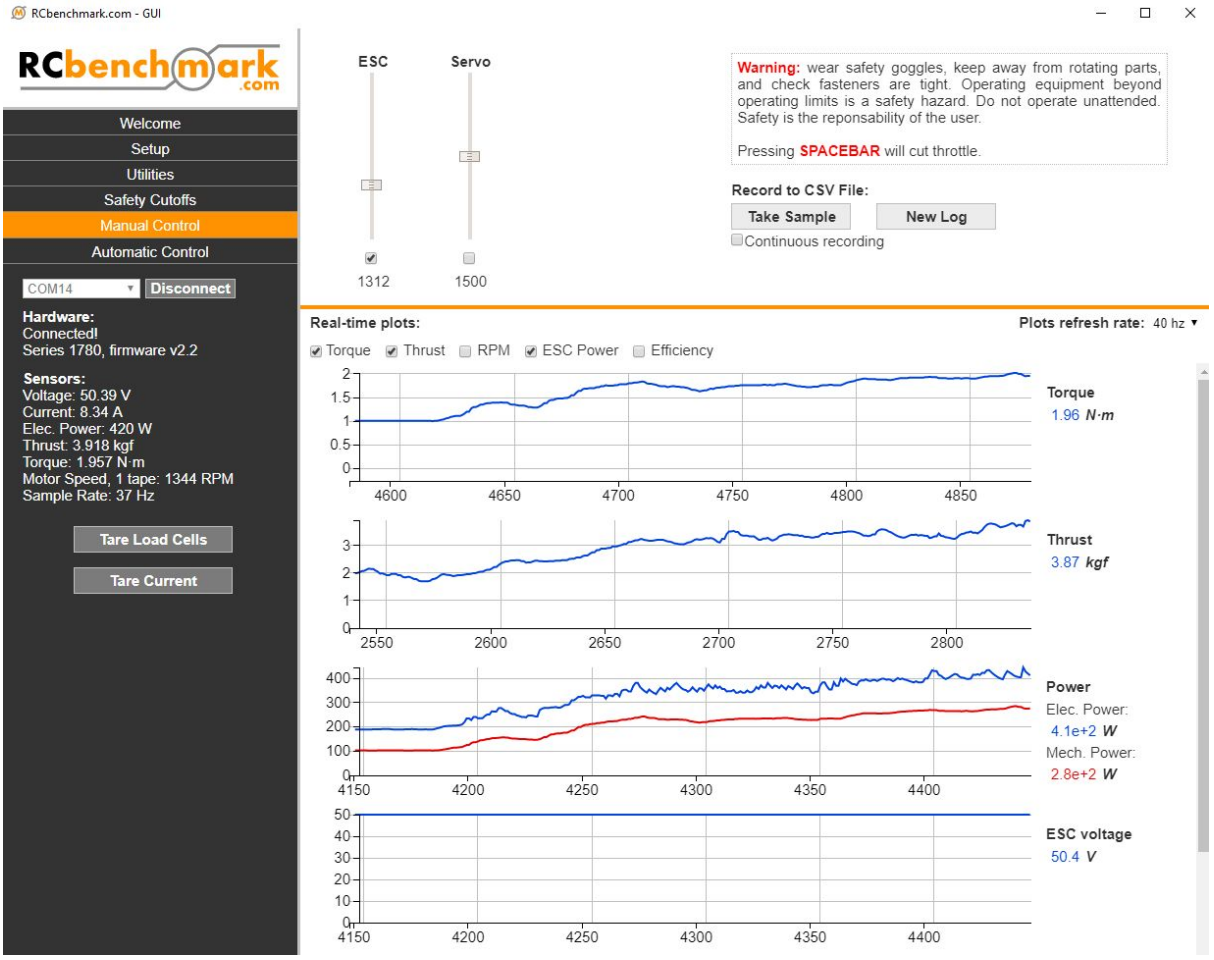
Always check that the screws are fully tightened before running any tests. Also check the room to remove any metal chips or anything hard and loose on the floor before the test. Operations related to the electrical system must be accomplished by qualified personnel only. Cut the power before connecting or disconnecting the components.

Please read the product's safety instructions to obtain complete information.

info@rcbenchmark.com

Software

The software allows the user to control one or two motors simultaneously. It displays the sensor information in text and graphical form. The user can record all of the measured data with a single click, or record continuously. The output is a CSV file, which can be easily opened with spreadsheet software or many other software packages.



Deployment and custom use

The software is open source. It is an app that runs on Windows, Linux, and Mac. The firmware is written in C and the GUI is written in Javascript, which should be very simple to learn for users with C/C++ experience.

info@rcbenchmark.com