Series 1580 Dynamometer Datasheet

Features List

- **Direct measurements**
  - **Torque (Nm)**
  - **Thrust (kgf)**
  - **Voltage (V) and current (A)**
  - **Rotations per minute (RPM)**
  - **Motor winding resistance (Ohm)**
  - **Accelerometer on PCB (g)**
- **Derived measurements**
  - **Motor efficiency (%)**
  - **Propeller efficiency (g/W)**
- **USB interface**
- **ESC manual control**
- **Three servo control ports**
- **Automatic control**
- **Powerful scripting**
- **Three accessories ports**
- **Three temperature probe ports**
- **Output data to CSV file**
- **Real-time sensor plots**
- **Included calibration hardware**

Application

- **Inrunner and outrunner brushless motor characterization (0-40A)**
- **Propeller characterization**
- **Servo testing and control**
- **Battery endurance testing**
- **Factory tests**

Introduction

This datasheet provides the technical specifications, the mechanical characteristics, the software features and the accessories available for the Series 1580 Dynamometer and Thrust Stand. The Series 1580 is the only dynamometer developed specifically for drone designers with a USB interface and powerful software for automated control and data-logging. Mechanical and electrical efficiency can be obtained directly from the software. Multiple accessories are provided to help UAV developers achieve peak performance. It is the ideal tool for optimizing the performances of drones, robots and radio-controlled vehicles.

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Technical Specification

Table 1: Design specifications of the Series 1580 Dynamometer

Specification	Min.	Max.	Tolerance	Unit
Thrust	-5	5	0.5%∓0.005	kgf
Torque	-1.5	1.5	0.5%∓0.005	Nm
Voltage	0	35	0.5%∓0.05	V
Current	0	40	1%∓0.1	A
Burst Current	0	50		A
Angular speed*	0	190k	1	eRPM
Coil resistance	0.003	240	0.5%∓0.1	Ohm

*Electrical RPM, divide by the number of motor poles to obtain true mechanical RPM.

The tolerances are given as a percentage of the measured value plus a constant. Sampling rate depends on your computer (up to ~50Hz) and is lower for the load measurements (~8Hz). The torque measurement accuracy is valid for tools produced after 2020-01, or for tools using the rigid sheet metal connector between the motor mount and the load cells. The previous design using hinges had 0.5%∓0.01 Nm accuracy.

Your test accuracy depends on your experimental setup. Loose wires and objects in the test area will affect the accuracy due to the ground effect of the propeller.

Software features list

- Real time graphs
- Manual motor control
- Manual servo control (three channels)
- Calibration wizard
- Safety cutoffs based on any measured data
- CSV export
- Firmware update
- Automated test
  - Ramps
  - Steps
  - Measure Kv
  - Measure number of poles
  - And more...
- User scripts with documentation

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Hardware

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

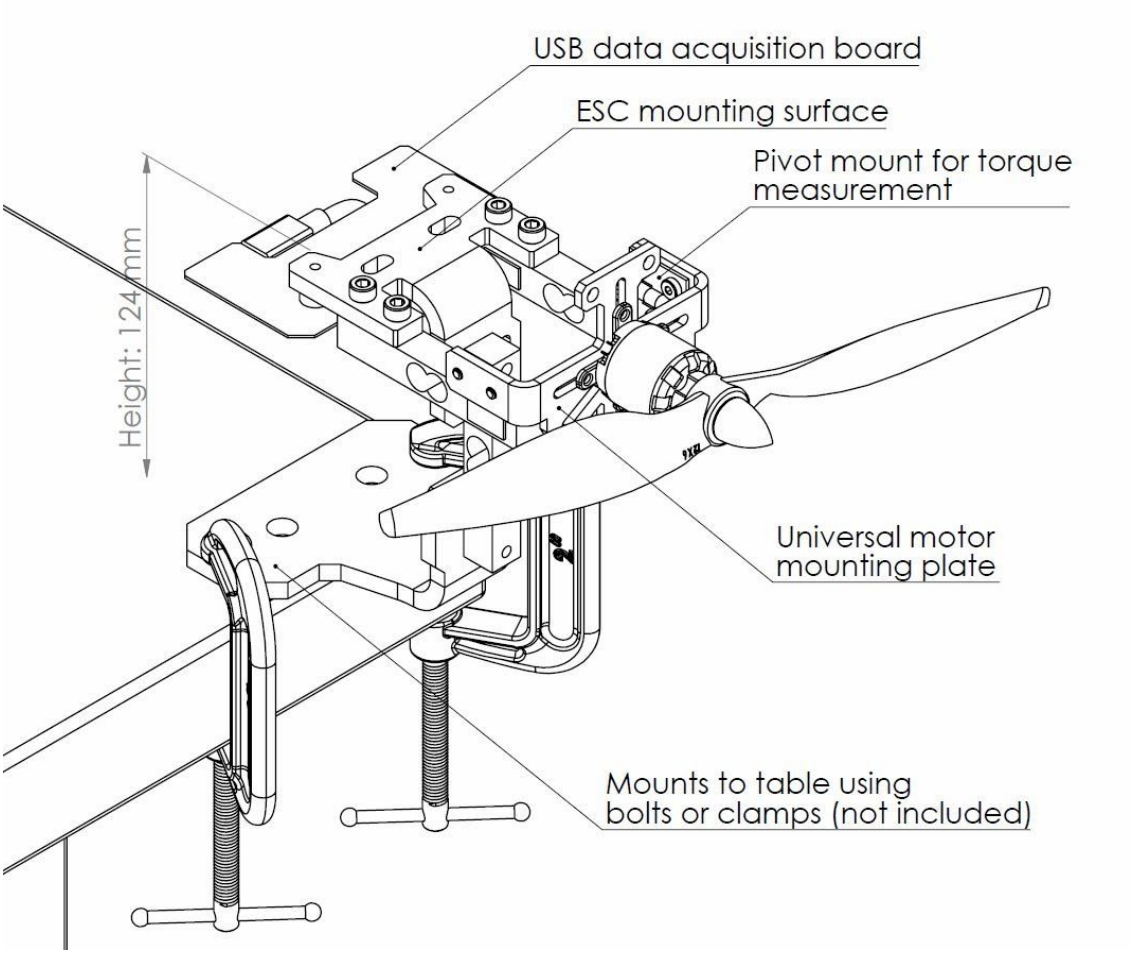

Fig. 1: Hardware overview

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For a given **voltage**, brushless motor **speed** is a function of two variables: the **mechanical load** (in Nm), and the **electrical signal 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 propellers have different size and pitch.

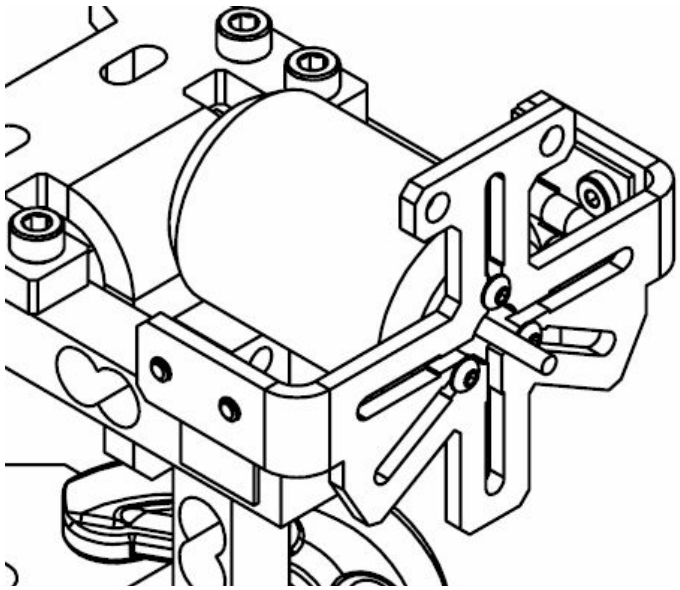

Fig. 2: Mounting shown with 36mm ∅ and 53mm length inrunner motor.

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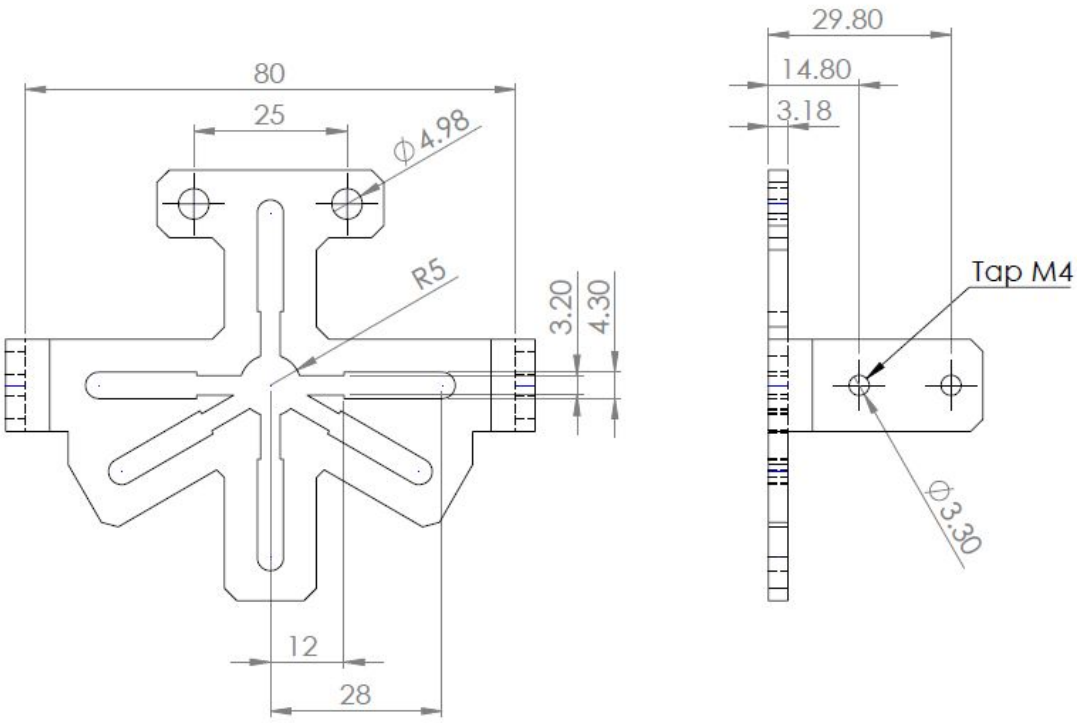

Fig. 3: Motor mounting part dimensions

The test device can accept most inrunner and outrunner brushless motors with M2 to M4 screws and screw spacing of up to 56mm. Inrunner motors can have a maximum length of 55mm and a maximum diameter of 48mm. Figure 2 shows an example of an inrunner mounted on the device.

Use the drawing in Figure 3 to check if you can install your motor on the device. The pattern fits almost all standard motors. Otherwise, you can make a wood adapter, or design your own motor mounting part using the dimensions in the drawing.

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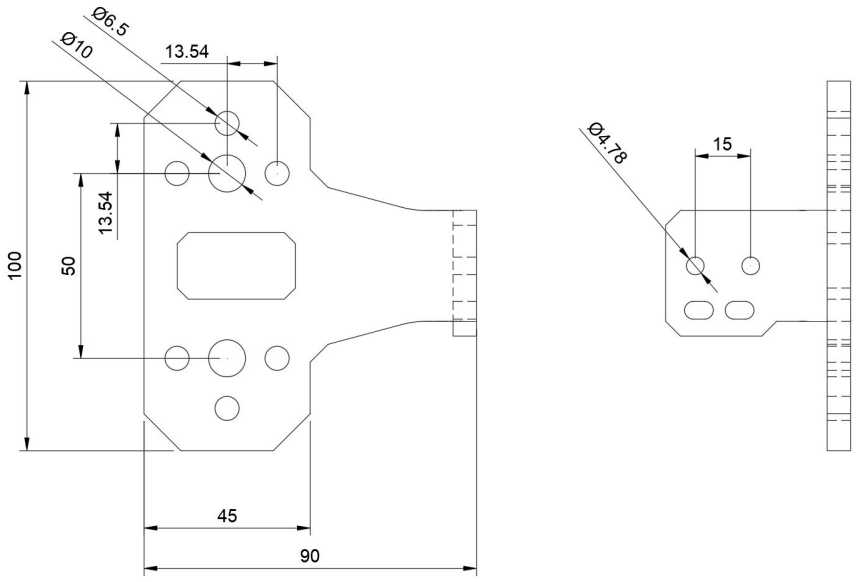

Fig. 4: Lower Mounting Part

As shown in Figure 4, you can mount the tool using M8 or 5/16" bolts spaced 50 mm apart. The Lower Mounting part can also be replaced by your own mount for wind tunnel installation.

Load cell dimensions are shown in Figure 5 and wiring information is shown in Table 2. The load cell can be read with an instrumentation amplifier.

Table 2: Wiring information of the load cell

Wire colour	Wire description
Red	Power input + / 5V
White	Signal 1
green	Signal 2
Black	Power input - / GND

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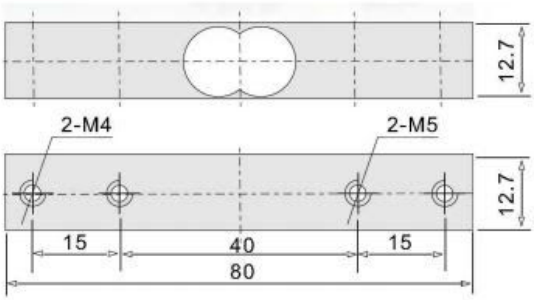

Fig. 5: General dimensions of the load cell

The L-shaped mount has two large ⅜" (M9) clearance holes spaced 50 mm apart.

Calibration

The device is supplied with calibration hardware for both the torque and thrust measurements. Figure 5 shows the device with its included calibration hardware and precision weight. See the instruction in the RCbenchmark GUI for the detailed information of the calibration.

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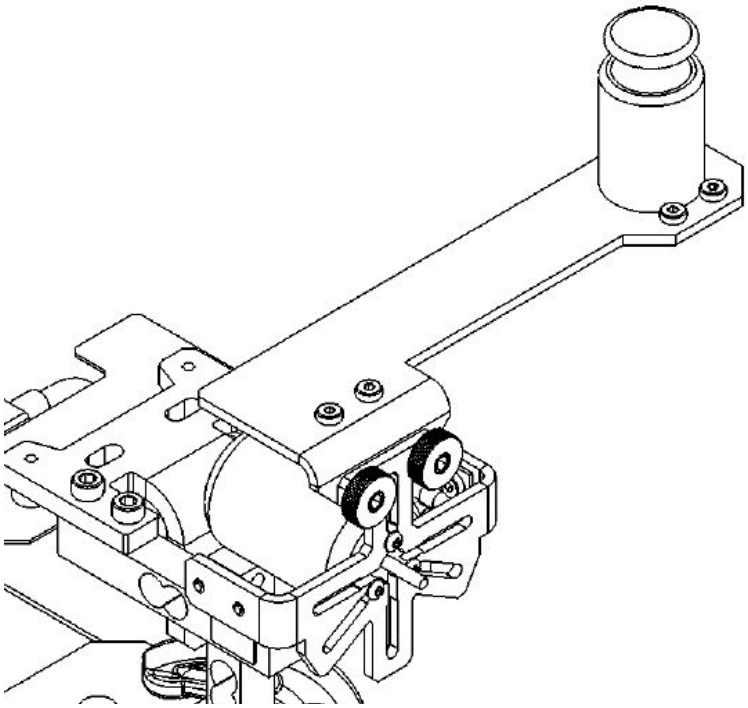

Fig. 5: Calibration Hardware (included)

Circuit Board (PCB)

The Series 1580 circuit board is designed for the Series 1580 Dynamometer, which is only compatible with the RCbenchmark GUI.

The Series 1580 circuit board is able to measure three load cell units, ESC power, RPM of the motor accelerometer and winding resistor on the motor. In the meantime, it provides connectors to control three servo motors and one ESC. It also compatible with three temperature probe, one optical RPM probe(S1 port) and three I2C interface accessories(from RCbenchmark). Please find the accessories information in the **Accessories** section.

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For the 'S1', 'S2', and 'S3' port on the circuit, the pins in the middle do not supply the power. If the user need to use these three connectors to control the servo motor, please use your own power supply.

Figure 6 and figure 7 show layout of the circuit and the dimensions of the PCB is shown in the figure 8.

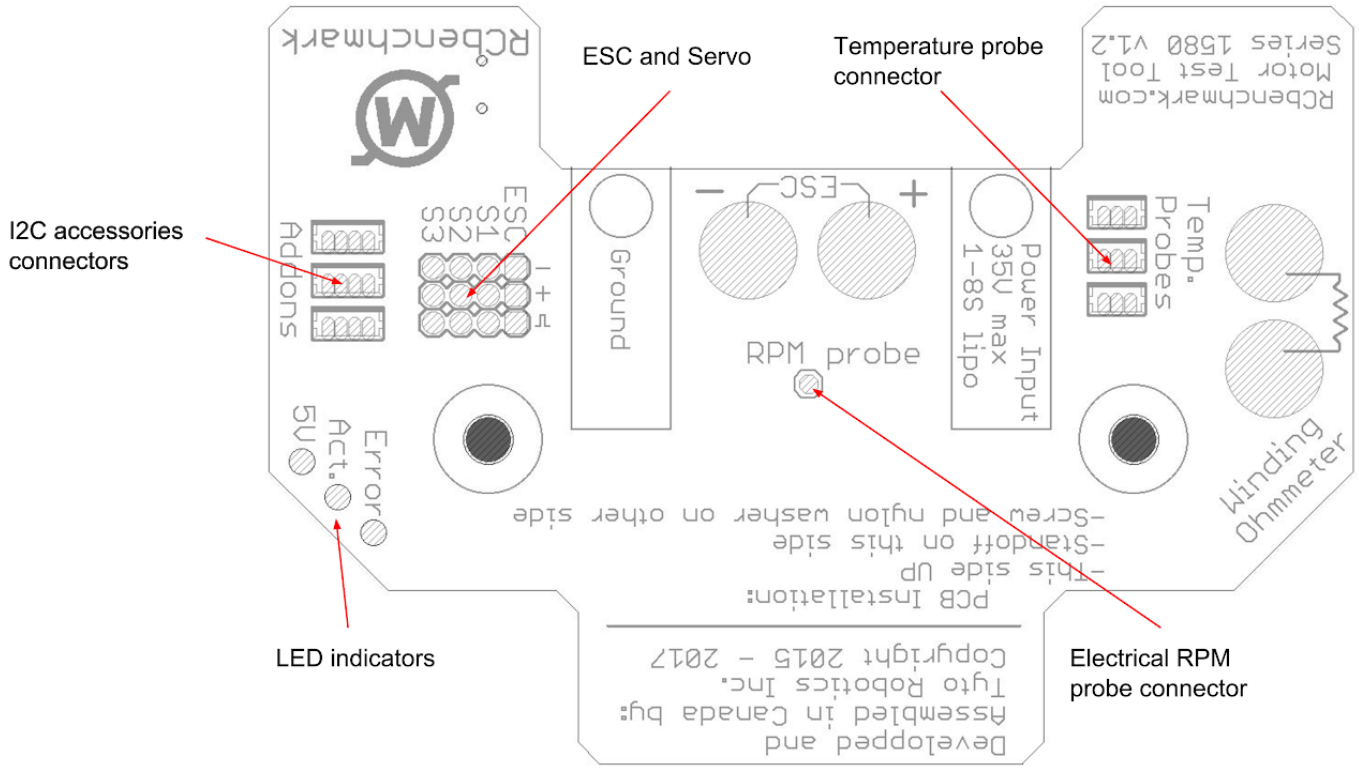


Fig. 6: Top layout

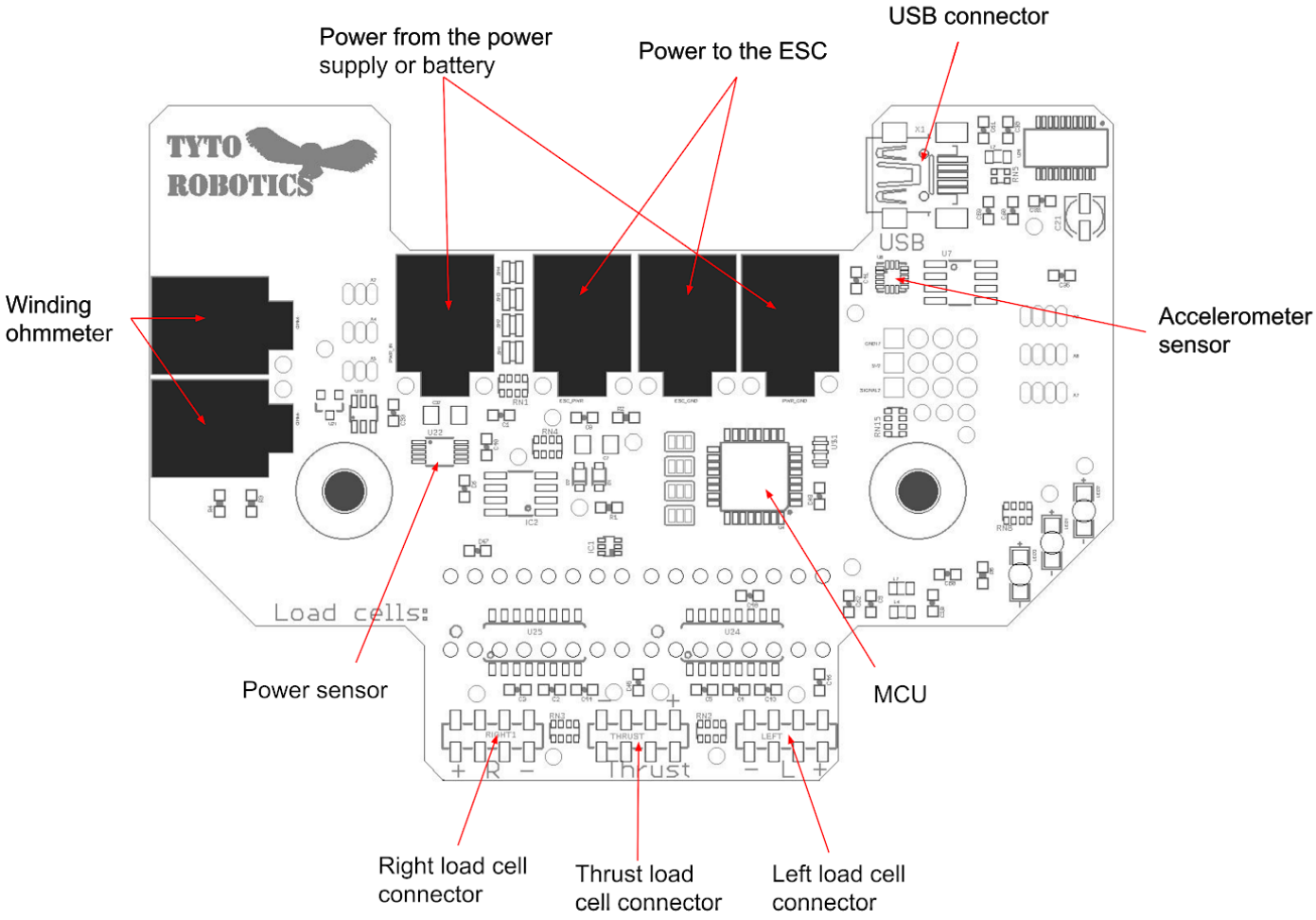
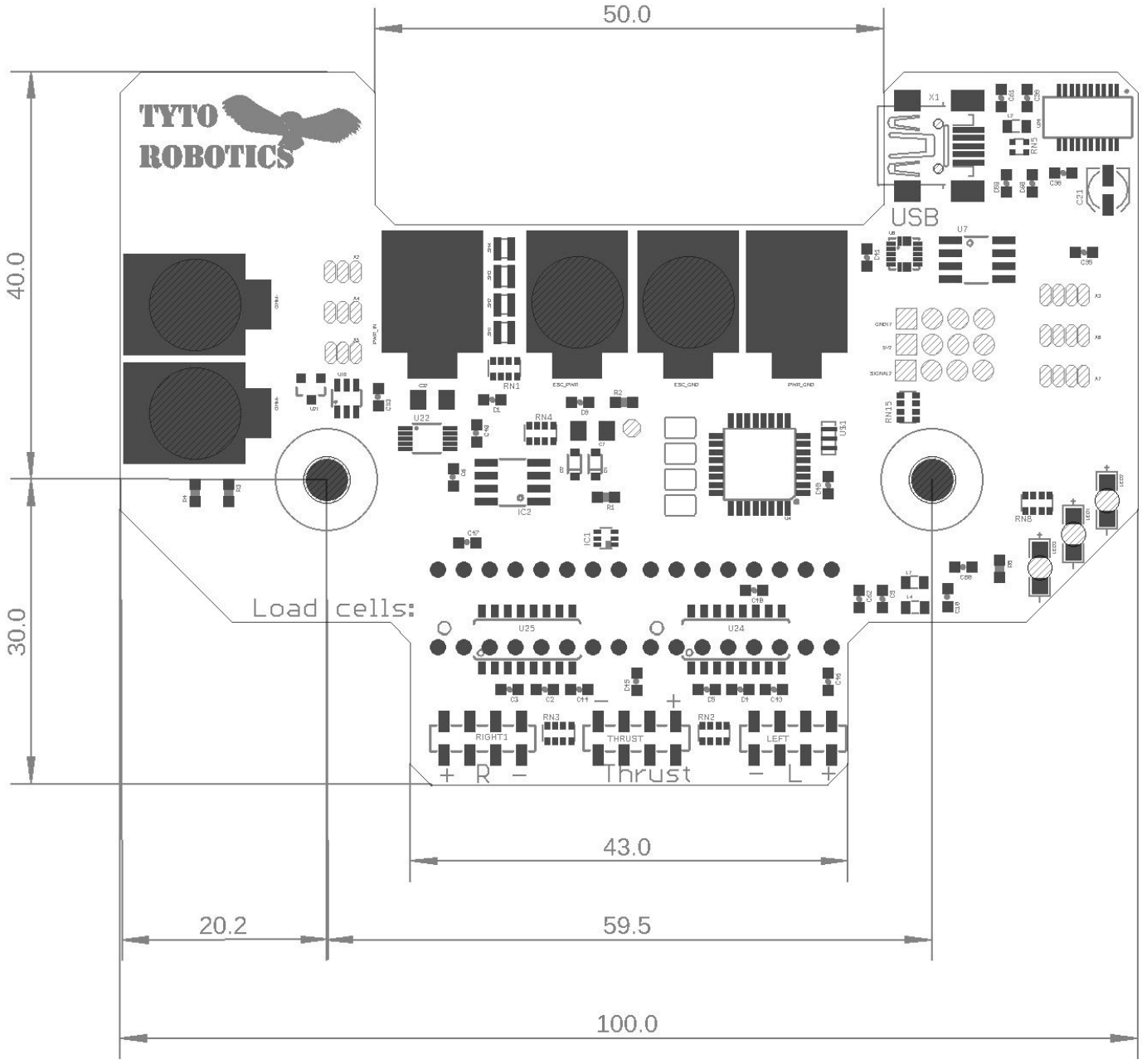


Fig. 7: Bottom layout



*diameter of the mounting holes on the circuit is 4mm.

Fig. 8: Series 1580 circuit board (PCB) dimensions

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Safety

Fast spinning propellers and motors can potentially cause harm to the user. Safety goggles must always be worn when testing and an enclosure must be built around the test area. 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. An enclosure is provided as an optional accessory, see the information in the next section.

Accessories

Serial 1580 dynamometer support optional accessories: an airspeed probe, temperature probes, an optical probe, a no-solder board, and an enclosure. For the purchase information, please visit this website..

1. Airspeed Probe (SKU: P2D2)
   The RCbenchmark airspeed probe is designed to be used with the Series 1580 and 1585. The airspeed probe is using an accessory port on the S1580 and S1585 PCB. It is a precision differential pressure sensor fully integrated with the RCbenchmark software. The sensor is intended to be used with a pitot tube to measure the airspeed in a wind tunnel, or to measure the airspeed behind the propeller. Only one pressure probe can be connected to the Series 1580.

2. Temperature Probe (SKU: 3CF7)
   The temperature probe is based on the DS18B20. Three temperature probe can be connected to the Series 1580 simultaneously. Each probe can be renamed (ESC, Motor, Battery, Ambient, etc....) and each probe can be configured with its own safety cutoff using the RCbenchmark GUI. The temperature data is also part of the generated log files. The software can also be configured to work in Celsius, Fahrenheit, or Kelvin.

3. Optical RPM Probe (SKU: XC9T)
   The optical RPM probe is compatible with RCbenchmark Series 1520, Series 1580 and Series 1585 dynamometers. The electrical RPM probe is embedded on the PCB of all of the dynamometers. However, because of the hardware limit, the electrical RPM probe does not work when the motor is running at low RPM (<500), or when testing a very low KV motor (<700 RPM/Volts). The optical RPM probe provides precise RPM measurement and it is easy to install. The measurement speed of it is from 10 to 30 000 RPM.

4. No-solder Board (SKU: G51J)
   The No-solder board is only compatible with the Series 1580 and 1585 dynamometers, which can save time and improve your work efficiency when testing multiple motors and ESCs. It is a board that can be fixed directly on your Dynamometer allowing the installation of various types of ESCs and motors (inrunners and outrunners) without any soldering. The 3 lug connectors can accommodate bullet connectors of up to 6mm or bare wires.

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5. Series 1520/1580/1585 Enclosure (SKU: PHJY)
   This enclosure is compatible with the Series 1520, the Series 1580 and the Series 1585. The enclosure is an important safety feature, as propellers can break during the test. It can also help to avoid operators from getting too close to the spinning propellers. This product has been tested and proved safe for carbon and plastic propellers no larger than 16" (see product specifications for details). The enclosure comes with an extended lower support to center the propeller in the cage.

6. Custom Load Cell
   2kg, 5kg, 10kg and 20kg load cells are provided as custom load cells. You can experiment with load cells of different rating, but please be aware that doing so will void your warranty, as the tools were designed for a specific load cell. All our thrust measurement tools include the recommended load cells. You will need a replacement load cell if an original load cell is damaged.

7. RC Control Board (SKU# JSDS)
   The RC Control Board is compatible with the Series 1580/1585 dynamometer. It is able to generate different types of the ESC signal to control the ESC (OneShot42/125, DShot150/300/600, Multishot and Standard PWM). For the customers who want to test the system by using more precise and higher speed ESC signal, the RC Control Board is a good option to them. The customers do not need to do extra programming for it. All the control and setup can be done in the RCbenchmark GUI.

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Software

The software allows users to control the motor and up to three servo-motors manually or by using scripts. The interface displays sensor information in textual and graphical form. Users can record all the measurements 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. Firmware update can be done through the GUI. Figure 9 shows the UI of the RCbenchmark GUI. For a detailed RCbenchmark software tutorial, please look here.

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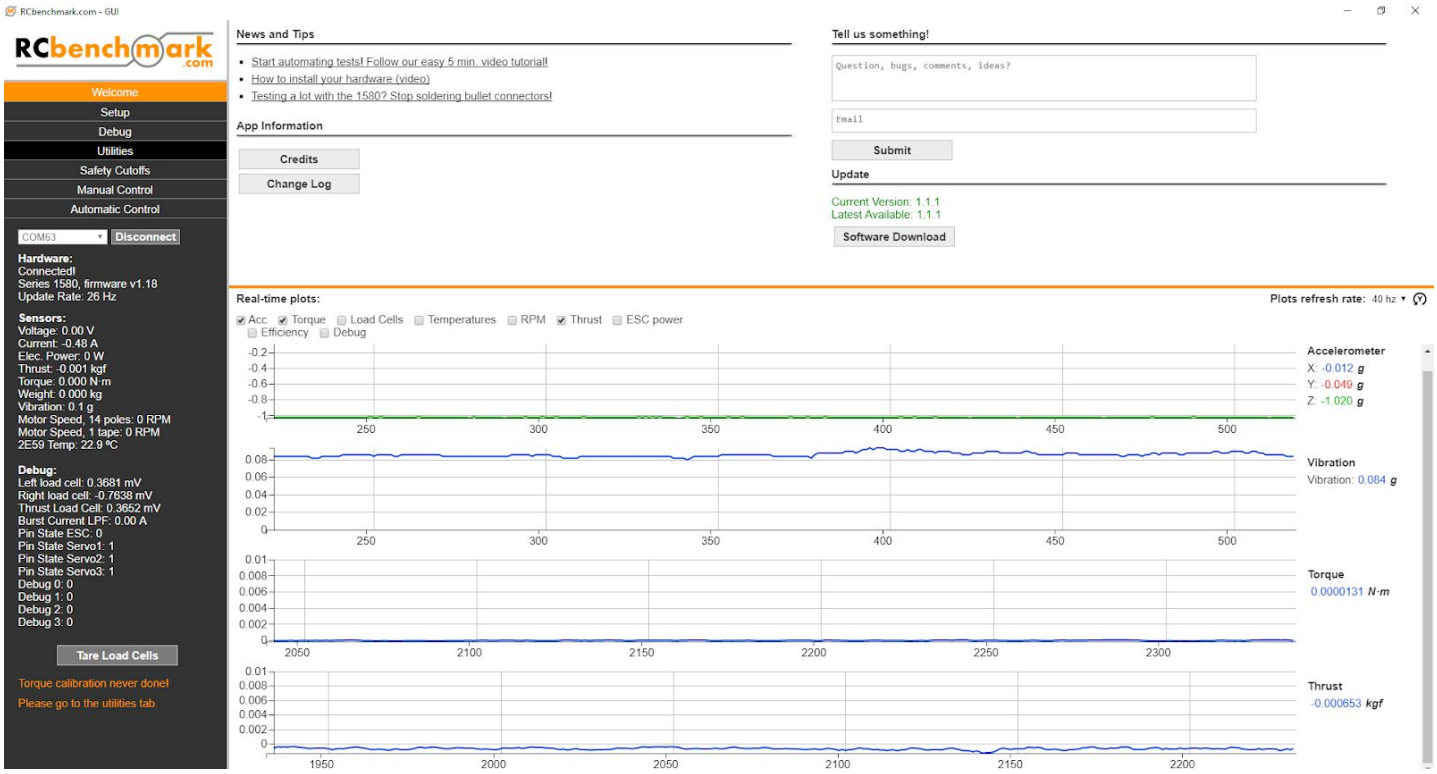

Fig. 9: RCbenchmark GUI

The software runs on Windows, Linux, Mac and Chrome OS. An internet connection is required to download the software. For the latest version:
https://docs.rcbenchmark.com/en/dynamometer/software/dynamometer-software-download.html

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