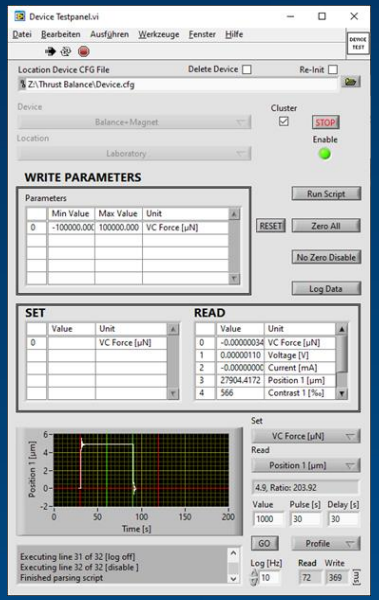
LabView DAQ Software

LabView Software

- ✓ Data acquisition with NI, LabJack and Others
- ✓ Closed-loop or Open-loop balance operation
- ✓ Operate multiple devices and thrusters
- ✓ Automated calibration
- ✓ Dedicated script language



About us

Our development team with expertise plasma physics and aerospace engineering has many years of experience in the development and operation of electric propulsion systems and thrust balances. Ranging from electrothermal-, electrostatic-, electromagnetic thrusters to photonic force measurements with steady-state lasers in solar-sail applications. Situated in the laboratories of the Institute of Aerospace Engineering at Technische Universität Dresden in Germany, we are dedicated to the continual enhancements of our thrust balances in space-like environments.

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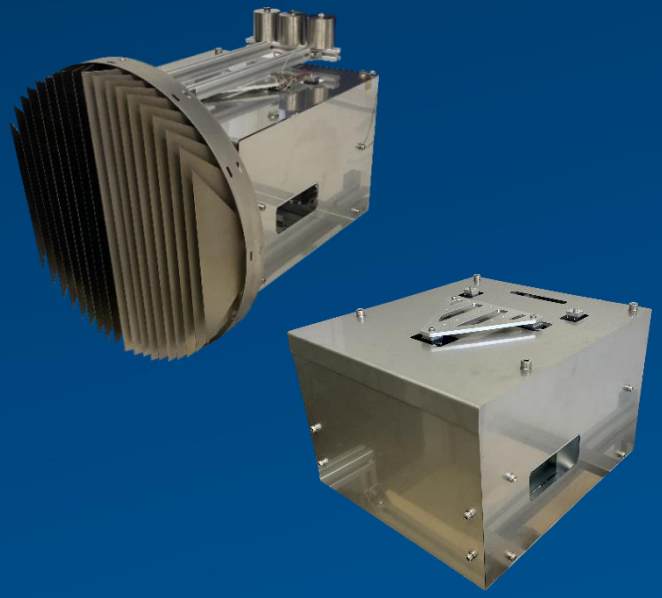
GWT Gesellschaft für Wissens- und Technologietransfer

TECHNISCHE UNIVERSITÄT DRESDEN



Compact Thrust Balance (CTB)

Direct and Indirect High-Resolution Thrust Measurements of Space Propulsion Systems

Institute of Aerospace Engineering

Compact Thrust Balance

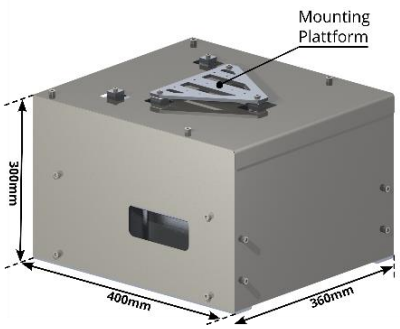
Thorough characterizations of electric propulsion systems regarding thrust and operating parameters are essential to verify their abilities in space applications. We provide innovative thrust balances for this exact purpose and more!

With **up to 10 kg EP-system-mass** our balances achieve **nanonewton thrust resolution**.

The CTB is our most compact thrust balance with excellent integration, operation and resolution. Our best features and enhancements, gained from years of thrust balance development and operation, combined in a compact plug- and play design.

CTB Features

- ✓ Plasma shielding
- ✓ Minimum drift
- ✓ Compact design
- ✓ Micro- and nanonewton thrust resolution
- ✓ 50 mN measurement range (can be adopted)
- ✓ Up to 10 kg thruster mass
- ✓ Variable thruster position
- ✓ Propellant feedthroughs
- ✓ Built-in calibrator
- ✓ Software for balance operation, logging & DAQ
- ✓ Variety of optional upgrades
  - Nanonewton thrust resolution
  - Different mounting positions
  - High-Voltage (5kV) feedthrough
  - Remote balance fixation



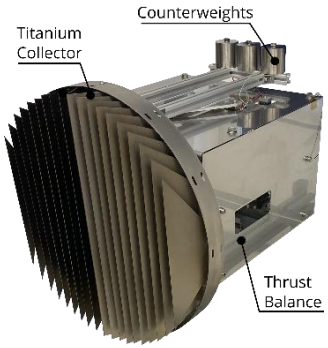
Reference Customer: ESA Propulsion Laboratory

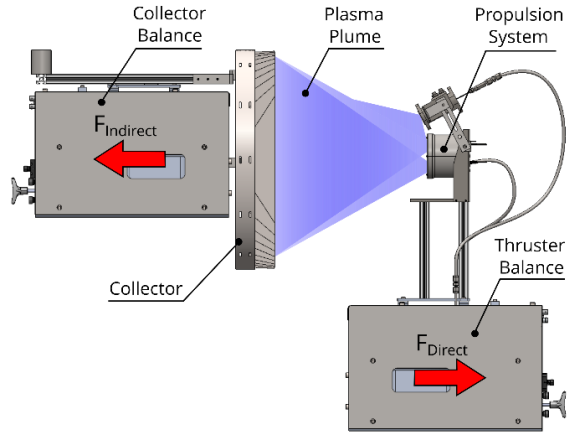
Specifications	Compact Thrust Balance (*CTB*)	Resolution Upgrade (*CTB+*)
Dimensions (LxWxH)	(0.4x0.36x0.3)m³	(0.4x0.36x0.5)m³
Net weight	15 kg	20 kg
Maximum load	10 kg	5 kg
Resolution (Load=2.5kg)	Sub-µN	nN
Measurement range	50 mN	10 mN
Average response time	3s (load dependent)	10s (load dependent
Number of electric lines (examples)	12 (2 A/500 V)	5x10 kV/6x0.5 kV
Thermocouple wires	6 (example)	3 (example)
Propellant supplies	0-2	0-2

Our balances operate in a wide measurement range with micronewton or even nanonewton resolution. With this level of accuracy, they are not even confined to conventional EP-systems, they can characterize photon-based propulsion systems and solar sail materials, as proven in previous projects [1 - 2].

Collector Balance

In case the propulsion system or electrical components require liquid cooling or complex matching networks in radiofrequency applications, for example, we offer a solution as well – an indirect measurement with a collector. Instead of a thruster, the CTB is operated with a titanium collector mounted to its front. The plasma plume of a thruster and its non-charged particles impact on the collector to measure thrust indirectly. This way, we utilize the high-resolution of the CTB without interfering with the propulsion system's electrical- and thermal interfaces. We demonstrated this novel non-invasive measurement method with a 400 W-class Hall-effect thruster [3].





Exemplary References:

[1] M. Tajmar, O. Neunzig & M. Weikert: *High-accuracy thrust measurements of the EMDrive and elimination of false-positive effects*. CEAS Space Journal 14, 31–44 (2022). https://doi.org/10.1007/s12567-021-00385-1

[2] O. Neunzig, M. Weikert & M. Tajmar: *Thrust measurements and evaluation of asymmetric infrared laser resonators for space propulsion*. CEAS Space Journal 14, 45–62 (2022). https://doi.org/10.1007/s12567-021-00366-4

[3] O. Neunzig & M. Tajmar: *Verification of a Novel Collector-Thrust Measurement using a Low-Power Hall-Effect* Thruster. Space Propulsion Conference, Glasgow, Scotland, 20-23 May (2024), SP2024_318