EZMETROLOGY

EnergyPod | Datasheet

TELD012 v5

Contents

1. Introduction

EnergyPod is the latest-generation measurement device for fast and highly accurate characterization of door systems and closing efforts. The unique combination of sensitive inertial and 3D force sensors enables unseen versatility in inspection capabilities in a compact gauge.

EnergyPod's smart operation and smart technology provide a measurement gauge that is both powerful and easy to use.

EnergyPod can be used on all types of doors to characterize not only minimum closing energy but also closing speed, hinge inclination, friction, opening speed and, for analysis, full raw movement data.

2. Smart Features

2.1 EnergyPod Features

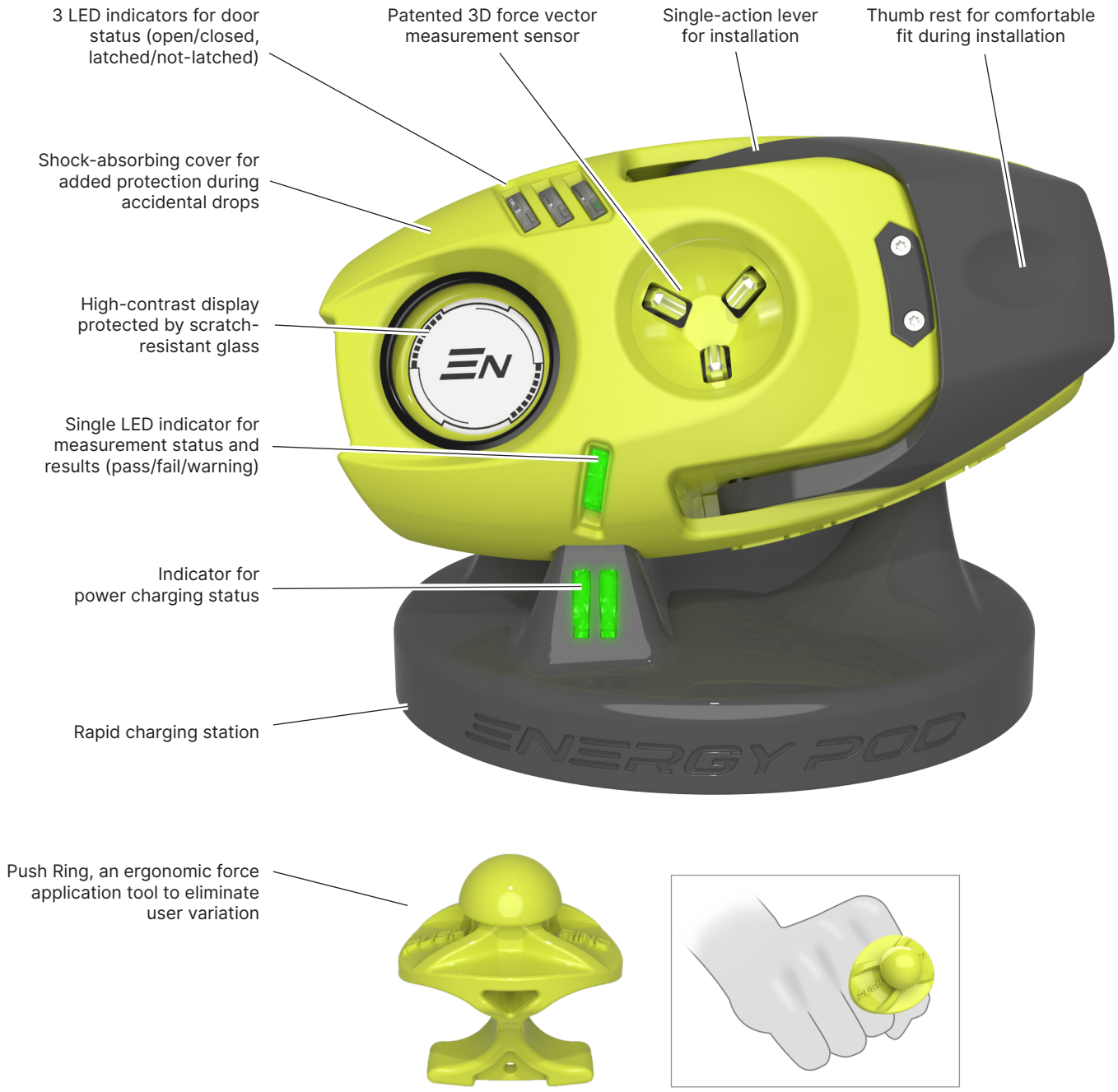


Figure 1. Key features illustrated for EnergyPod measurement device

2.2 EZ Operation

EnergyPod integrates several features to provide a gauge which is both intelligent and easy to use:

Rapid Mounting: Single-lever operated suction cup enables the device to be mounted in the blink of an eye to any type of smooth surface—glass, metals, and plastics. The same suction cup lever also allows for a quick-release feature for easy dismounting.

Robust Installation: EnergyPod can be mounted in any orientation and any location to determine the accurate door movement and characteristics.

Smart Movement Detection: The smart movement detection algorithm keeps track of the location, movements, and measurements in progress. This allows the device to manage the session, guide operators, complete the measurement, and validate all requirements.

Real-time LED feedback: Four multi-color LEDs instantly communicate the measurement state of the device. The smart positioning algorithm indicates device status: open, moving, closed, mounted stable - ready, latched, and not-latched. Additional lights show measurement pass/fail, charging/powered, and mounted/dismounted states.

Automatic Latch Detection: A specific collection of characteristics is used by the device to determine if a door is latched or not-latched during a measurement cycle. This intelligence eliminates the need for constant feedback from the user on the state of the door after closing.

Finished Condition: The device will provide feedback to the user and indicate when sufficient data has been collected for a complete, valid measurement.

2.3 Advanced Technology

EnergyPod is a new generation, handheld instrument that integrates the latest available technology to provide fast, lightweight, and highly accurate measurements of door systems.

3D Inertial Sensor: An industrial inertial sensor (3D gyroscope and 3D accelerometer) registers the movement when mounted to a moving door. The multi-axis sensing provides the benefits of mounting the device in any position and orientation on the surface during measurements of door closing efforts.

3D Force Sensor: A setup of multi-directional force sensors measures the amplitude and direction of force application, extracting only the essential component of actual force application in the direction of the movement.

Dual-Core Real-Time Processing: A powerful on-board processor chip enables button-free operation. Intelligent algorithms will determine if the device has been mounted on a door and start the measurement automatically without any further user interaction. The device will automatically determine if the door has been latched or not-latched.

Li-Ion Battery: Energy-dense and lightweight for long-lasting mobile operation with a fast-charging docking station.

2.4 Compatible Door Types

EnergyPod can be used on all door types.

The basic model has movement functionality for all classic hinged doors. The optional Universal Hinge Module enables measurements on any hinge orientation such as liftgates, tailgates, trunks, frunk, falcon, swan and more.

3. Measurement Performance

3.1 Metrics

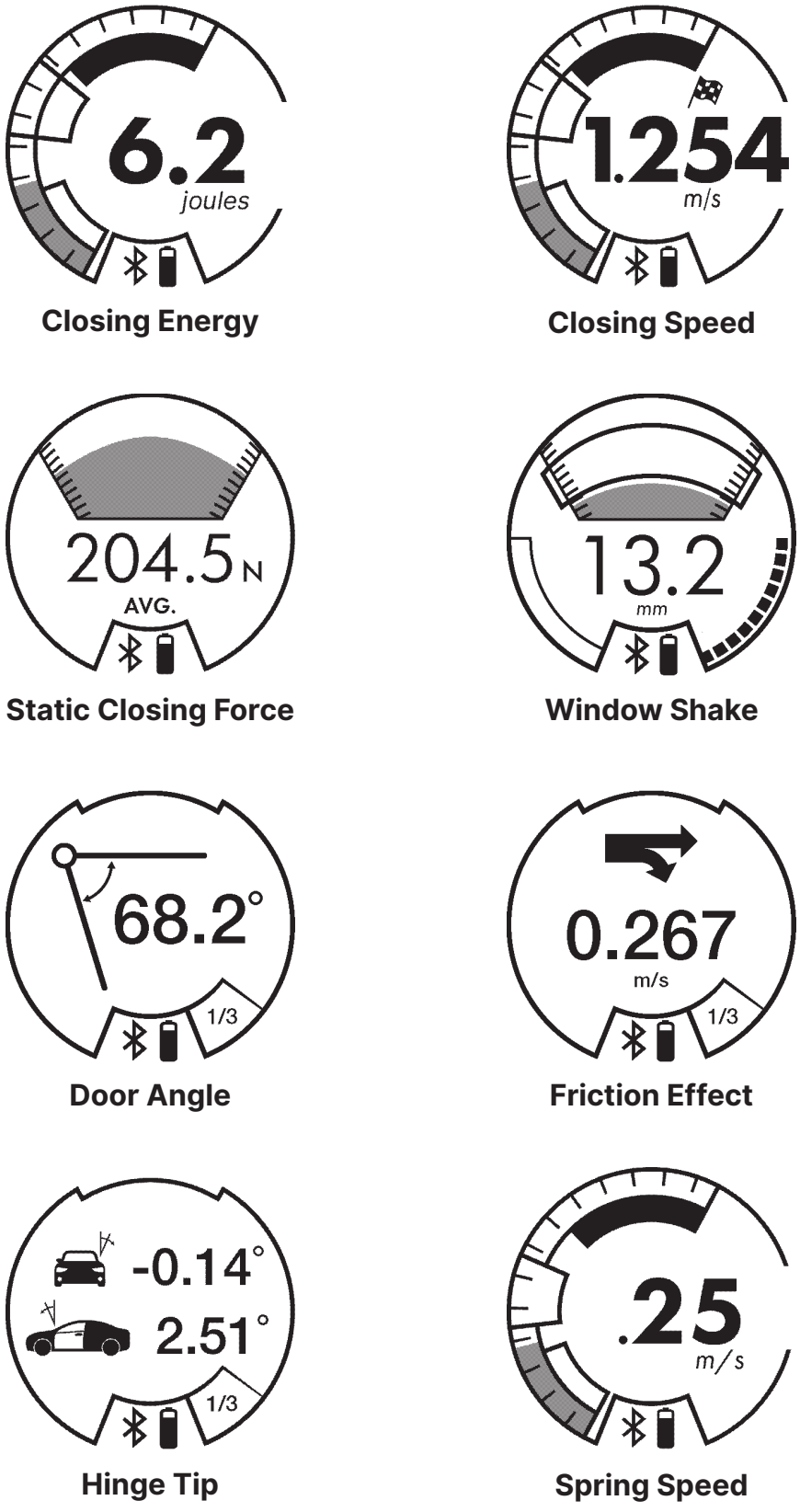


Figure 2. EnergyPod device screens in use for single measurement values

EnergyPod has optional modules to extract specific metrics from the measured movement:

Closing Energy: Required input energy from the user to move the door and latch the door. This can be performed from any start position of the door. This metric is available in any version of EnergyPod.

Closing Speed: Speed of a door at a specific point along its trajectory. Includes methods to determine minimum closing speed using both latched and not-latched trials. This metric is available in any version of EnergyPod.

Static Closing Force: The amount of force required to fully latch the door with a semi-static push action on the door. Available in the Latch Analysis Module.

Window Shake: Amplitude of window vibration while unlatching or opening. Typically used on frameless doors. Available in the Frameless Window Module.

Door Angle: Angle of door travel. Typically used to measure detent angles of the door system. Available in the Trajectory Module.

Friction: Loss of kinetic energy during travel. Available in the Trajectory Module.

Hinge Tip: Orientation of the hinge axis with respect to gravity. Available in the Trajectory Module.

Spring: The maximum speed of a door or hood during unlatching. Available in the Latch Analysis Module.

3.2 Process Efficiency

EnergyPod has built-in methods to perform measurements for application-driven objectives. The selection will minimize the measurement time, all while meeting specific criteria to obtain the desired result. The device will show a large Finished Flag on the display to indicate the completion of the measurement to the operator.

All modes are available for any of the metrics that EnergyPod technology can measure.

EZ Mode: Instant measurements with low-setup requirements—no need for tolerances. The individual measurements are shown on the display.

Go/No-Go Mode: A mode focused on the shortest possible cycle time. As soon as the measurement data confirms the door is in or out of tolerance, the measurement is flagged as completed. The user is shown the Finished Flag to indicate a successfully completed measurement. This configuration is ideal for pass/fail applications.

True Value Mode: The most accurate and traceable method for measuring absolute minimum closing energy and a variety of other metrics. Only when all criteria, such as Gap value or number of samples, are reached, will the measurement be flagged as completed.

3.3 Performance Enhancement Functions

Multiple features enable button-free operation and reduce any variation in the measurement due to user or door variation.

Smart Tolerances and Settings: Result value and attempt limits to quickly end a measurement session and immediately determine pass/fail status.

Gap Mode: Measurement mode that requires a high not-latched measurement and a low latched measurement. As soon as the values are within defined range of each other (Gap Tolerance), the system will end the measurement automatically. The result is the average between the highest not-latched and lowest latched measurement.

Multi-Gap Mode: Average multiple Gap measurements and statistically reduce the variation of the samples, reducing variation between a team of operators as well as for a single operator over the duration of a shift.

Minimum Number of Samples: Within one session, the system can require multiple acquisitions to reduce user variation to a minimum by establishing minimum sample size.

Uncertainty: A "gray zone" can be defined so that if the final measurement is close to the tolerance, an additional measurement is requested to decrease the uncertainty band and avoid false positives and false negatives.

Button-Free Latched/Not-Latched: EnergyPod will automatically determine if the door was latched or not-latched after a closing movement without any required interaction or button operation from the user. The standard detection algorithm can work in most cases. For a few special cases, a built-in teaching mode can determine the optimal settings for any given door.

Latch Profile: Based on a one-time sampling procedure, the device algorithm will teach itself how to recognize differences between latched and not-latched cases. This setting is saved in a Profile and can be recalled at any point in time.

Extended Speed Range: For certain applications, the gauge's maximum speed of 2.2 m/s can be expanded to measure speeds up to 8.2 m/s.

Extended Force Range: For certain applications, the gauge's maximum force of 225 N can be expanded to measure forces up to 450 N.

3.4 Accuracy, Resolution, and Range

Parameter	Range	Resolution	Accuracy
Speed (Standard Range)	0.010 to 2.2 m/s	0.001 m/s	< 1.5%
Speed (Extended Range)	0.010 to 8.2 m/s	0.001 m/s	< 1.5%
Force (Standard Range)	0 to 225 N	1 N	< 2%
Force (Extended Range)	0 to 450 N	1 N	< 2%
Vibration	± 160 m/s²	0.05 m/s²	< 1.5 %
Door Angle	0 to 90°	0.1°	< 0.8 %

4. Software and Data Logging

4.1 Data Logging Software

EnergyPod's wireless capabilities, in combination with software applications, provide a reliable platform for inspection requirements from product sampling to 100% inline inspection to door system analysis.

These additional software products are available from EZMetrology to extend the capabilities of EnergyPod:

Data Logging Module *(#10606):* Enables data logging to CSV files using MyPod software. This logging can be used to record continuous raw data to reconstruct the full trajectory and force interaction. The device can also be configured to log only the key metric values to file. The details of the file content are shown in section 4.5-4.6 of this document.

IOManager *(#10453, #10454, #10921):* Software solution for recording EnergyPod sensor data. This will show speed as a function of time or acceleration. The software incorporates many signal processing options to assist in extracting the right data or characteristics such as speed in function of door angle, force in function of angle, or speed in function of force. This platform can be simultaneously coupled with additional EZMetrology Pod technologies to include a variety of other metrics (for example, pressure or force). This is a popular solution for engineering or analysis.

PLS - Production Line Solution *(#10430):* Ideal for repetitive measurements with the least amount of user interaction. The application itself does not require any user interaction as the inspection process is fully automated. The software will be initiated by scanning an ID, such as the VIN, which is used to determine the vehicle type, model and associated door profiles. When the inspection routine is complete, a report on the vehicle is made which can be saved and displayed locally, in a remote database or as a cloud report.

4.2 MyPod: Pod Management Software

Configuration software to set up the device with preferred settings such as profiles, units, and tolerances.

4.2.1 Personalization
Settings that allow the user to configure the device according to specific habits and conventions. This includes units, connections, logging, etc.

4.2.2 Profiles
Programmable user profiles can quickly adapt the device to a specific door or use case. The profile contains information on measurement mode, settings, and use case. A profile can be recalled and activated with one click.

A collection of Profiles can be produced to support an entire inventory of vehicles. Typical settings include:

- Tolerances
- Measurement Metrics
- Operation Mode
- Door Radius

4.2.3 Verification
In combination with the SpeedBay and ForceBay verification tools, MyPod can confirm the performance of the EnergyPod device at any chosen time interval.

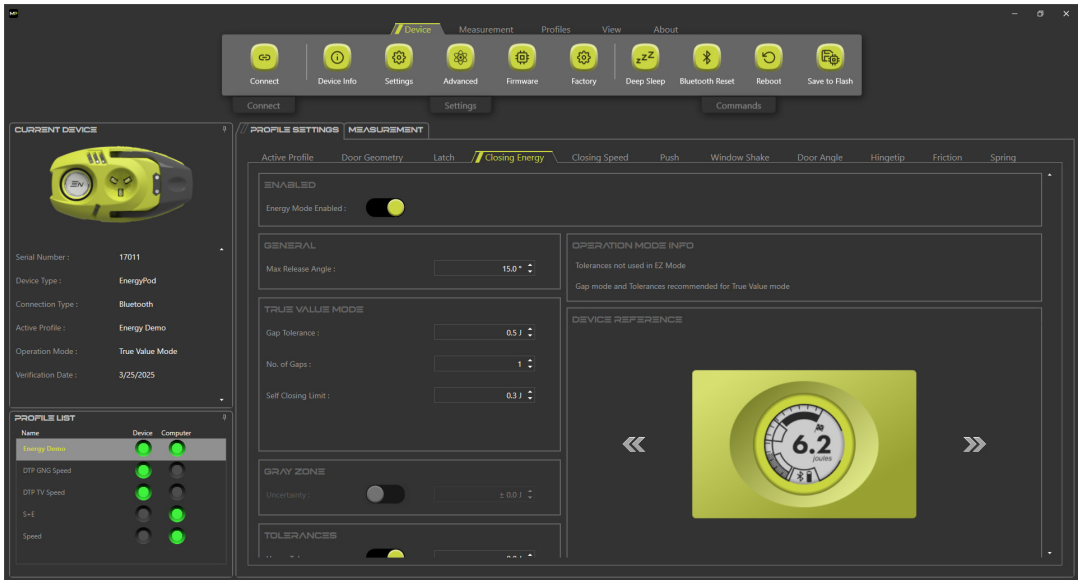


Figure 3. MyPod software screen for device setup

4.3 Computer Requirements

Minimum Hardware Requirements	
Operating System	Windows 10
CPU	Intel® i5 Core or equivalent
Memory	8 GB RAM
Storage	SSD with 2.5 GB available for MyPod Software install and use
USB 2.0 Ports	2
Connectivity	Bluetooth® (onboard / USB Dongle *#20100*)

4.4 Storage & Export

Parameter	Value
Onboard Non-Volatile Memory	32 GB
Discrete Data	Approx. 160M samples
Sensor Data	Approx. 50K Recordings
Export Format	CSV

4.5 Discrete Data

```
Date and Time,Vehicle Identification Number,Door Location,Profile Name,Closing Speed,Units, Door Radius,
Evaluation, Latched/Not Latched
11/29/2023 15:22,123456,RightRear,DEMO,1.019,m/s,1000,Pass, Latched
11/29/2023 15:22,123456,RightRear,DEMO,1.133,m/s,1000,Pass, Latched
```

Figure 4. Closing Speed measurement example with CSV output

```
Date and Time,Vehicle Identification Number,Door Location,Profile Name,Current X Value,Current Y Value,
Average X Value, Average Y Value,Angle Units,Evaluation, Latched/Not Latched
11/29/2023 3:31,5T54R2,LeftFront,DEMO,-3.2,-2,-3.2,-2,Degrees,Fail, Latched
11/29/2023 3:31,5T54R2,LeftFront,DEMO,-3.3,-1.9,-3.3,-1.9,Degrees,Fail, Latched
```

Figure 5. Hinge Tip measurement example with CSV output

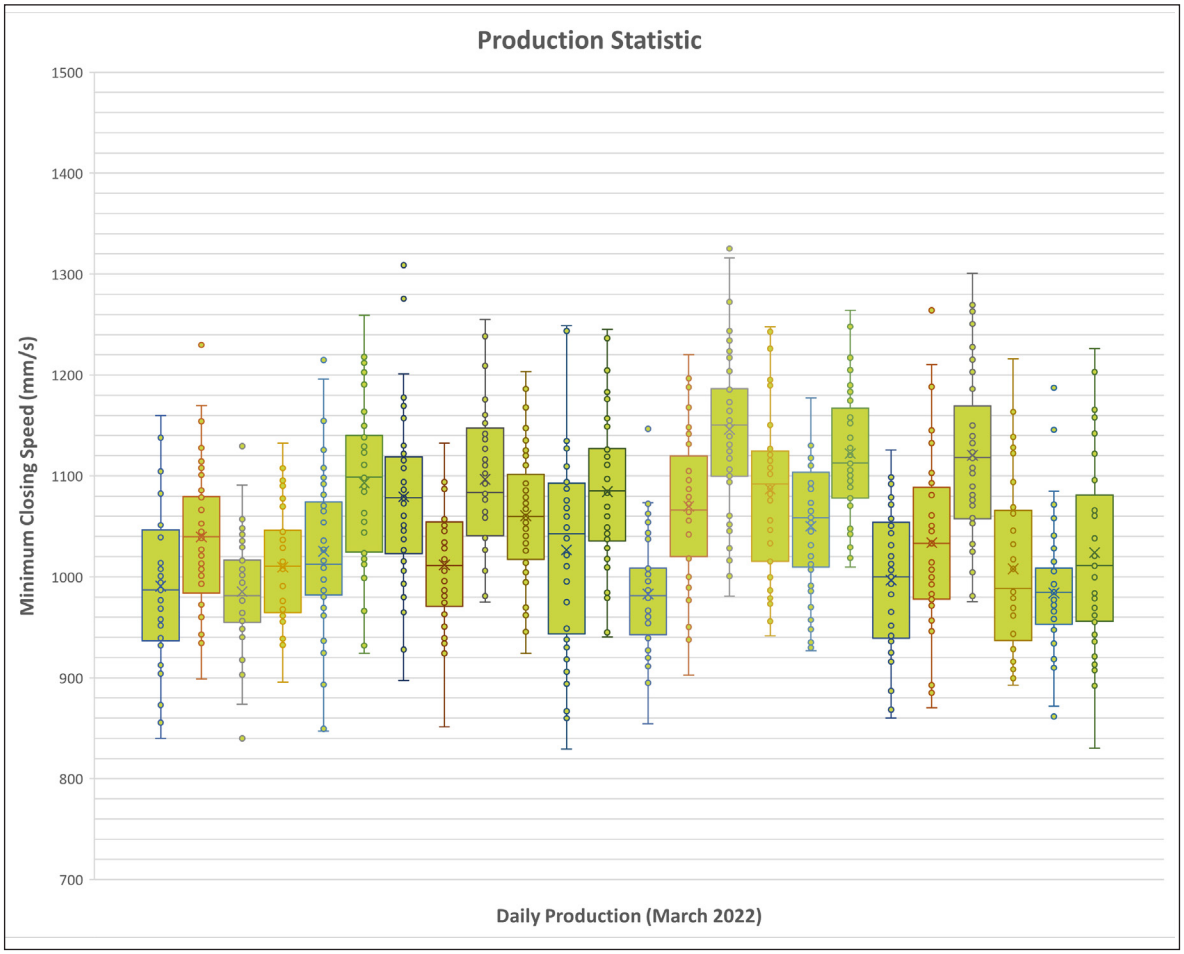


Figure 6. Example of Box and Whisker plot with discrete data export and Microsoft® Excel

4.6 Sensor Data

```
Time,GyroX, GyroY, GyroZ, AccelX, AccelY, AccelZ, Force 1, Force 2, Force 3
0.0000, 0.03051,-0.06109,-0.12203,-0.02197,-0.99552,-0.00244,10.213,17.354,12.345
0.0025,-0.18305, 0.00762,-0.15254,-0.02343,-0.99796, 0.00097,12.435,18.644,13.193
0.0050,-0.11444,-0.03051, 0.16782,-0.02148,-0.99259,-0.00097,15.756,20.723,15.891
0.0075,-0.13736,-0.09154, 0.23648,-0.02392,-0.99356,-0.00634,18.593,22.156,17.045
```

Figure 7. Manually recorded hinged door trajectory example and CSV output

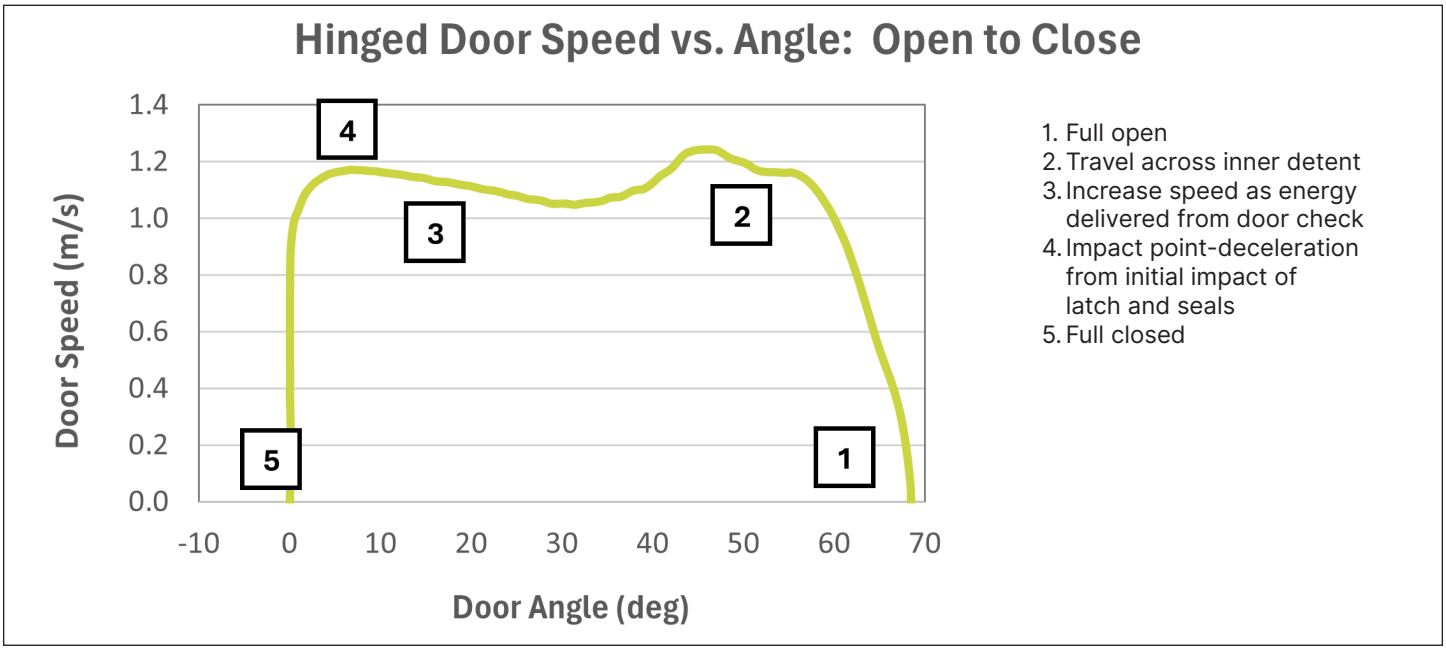


Figure 8. Trend Chart of Hinged Door Closing Speed vs. Angle from export of data into Microsoft® Excel

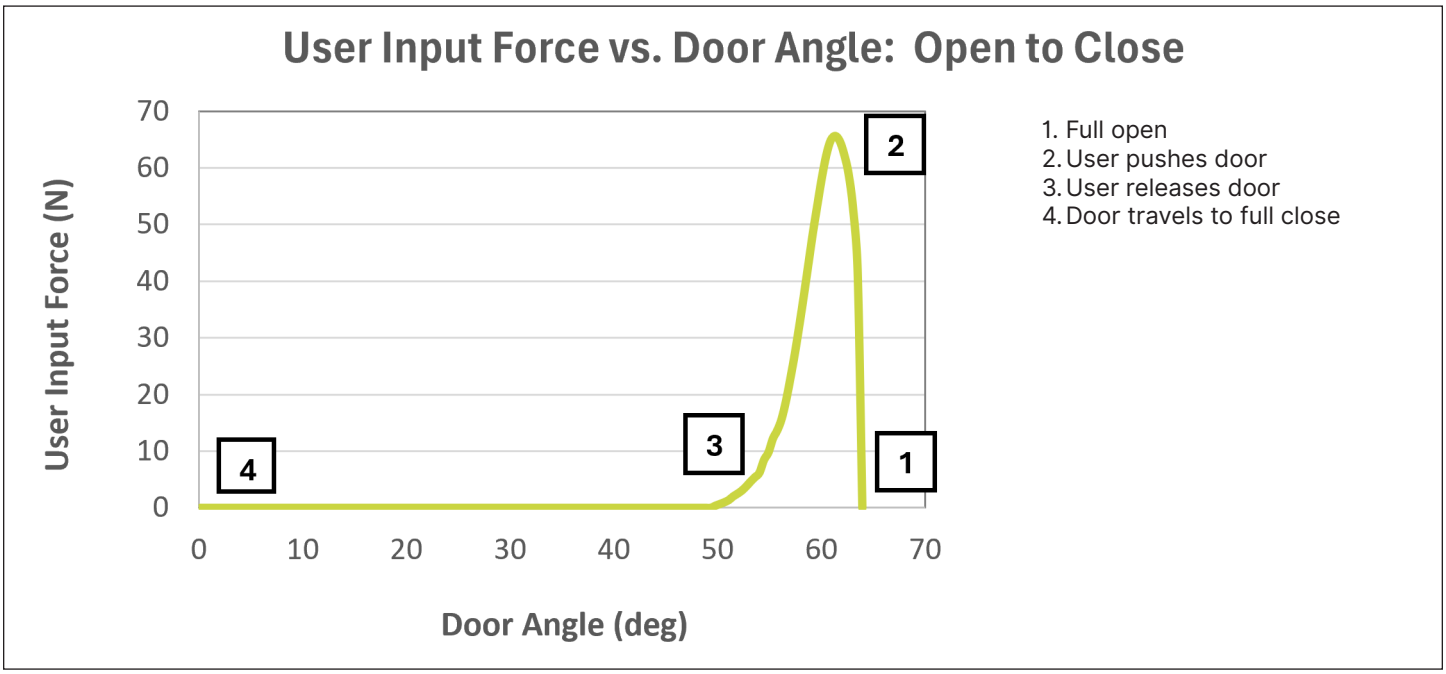


Figure 9. Trend Chart of User Input Force vs. Door Angle from export of data into Microsoft® Excel

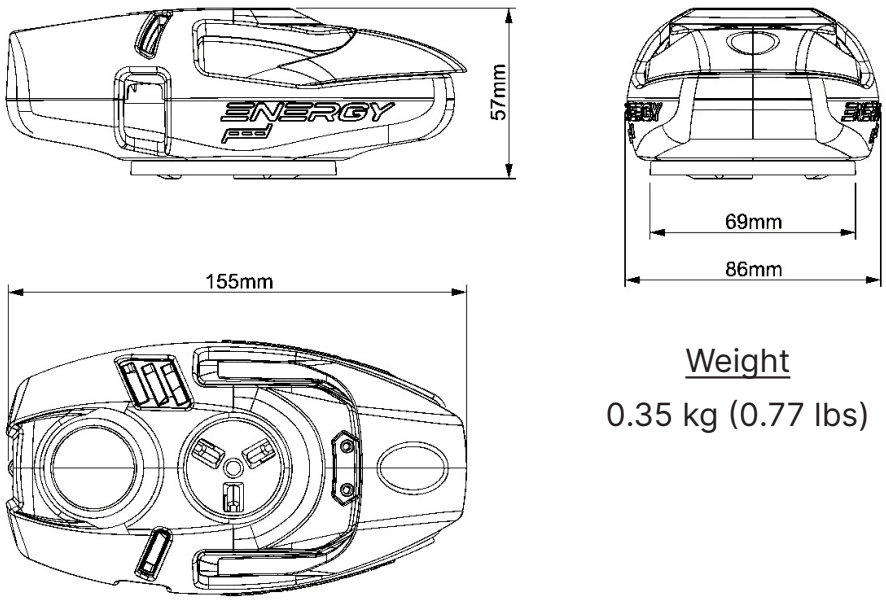
4.7 Recording Sampling Rate

Data Sampling Rate[1] (Hz)	Max. Recording Time (s)
25	88
50	44
100	22
200	11
400	5
800	2
1600	1

[1] *Configuration of sampling rate available in Manual Recording; default value is 400 Hz*

5. General Specifications

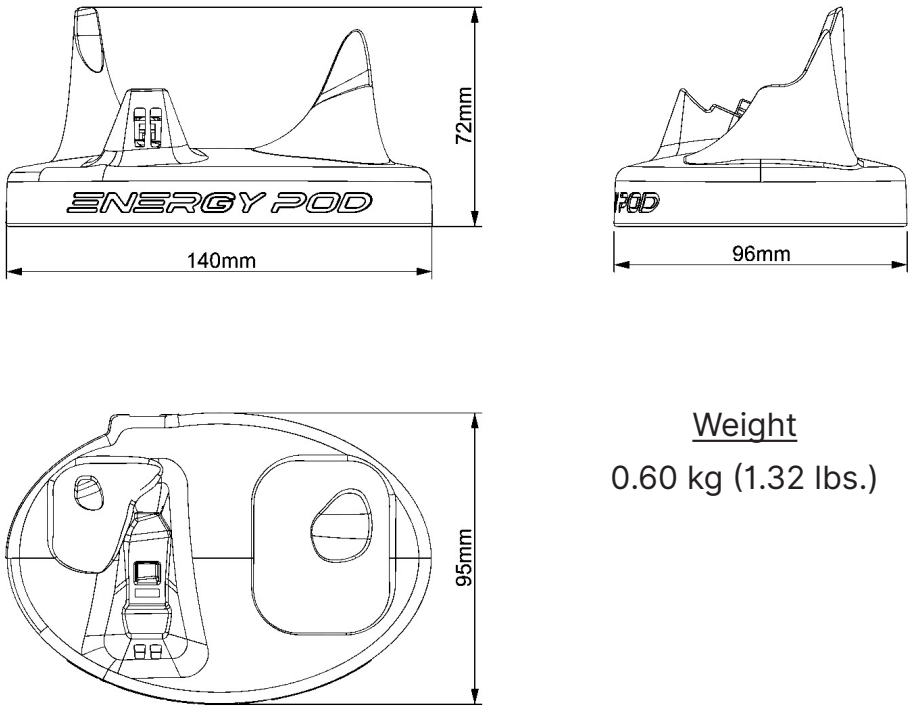
5.1 Dimensions and Weight



Weight

0.35 kg (0.77 lbs)

Figure 10. EnergyPod height, width, length, and weight



Weight

0.60 kg (1.32 lbs.)

Figure 11. Power Station height, width, length, and weight

5.2 Power Specifications

Parameter		Value
Batteries		2 independent Li-Ion, rechargeable
Voltage		3.7 V
Current Capacity		650 mAh
Power Capacity		2.5 Wh
Operation on Single Full Charge (normal use)		8 hours
Power Station Fast Charging	Requirements	110 - 210 VAC to 5 VDC, 6W
	0 to 40%	1 hour
	0 to 100%	< 3 hours

5.3 Connectivity

Parameter		Description
Bluetooth	Version	v4.2 + BR/EDR
	Transmit Power	Max. +3 dBm (limited by firmware)
	Receiver Sensitivity	-88 dBm (min); -89 dBm (typical); -90 dBm (max)
	Range	10 meters, line of sight
	Transmitter/Receiver	Integrated chip antenna or U. FL connector
Wi-Fi		802.11 b/g/n
USB-C		v3.1 Gen 2

5.4 EMC & Certification

Wireless Certifying Organization	Certificate/Identifier Number
Bluetooth Launch Studio	D051055
Canada ISED (RSS-247 Issue 2)	B20070614
China CMIIT	2020DP2713
Europe CE (EMC Directive 2014/53/EU)	B2004079
FCC (Part 15c)	2AC7Z-ESP32WROOM32E
Japan MIC	217-204070
Korea KCC	R-C-es5-ESP32WROOM32E
Taiwan NCC	CCAK21Y10020T0
Wi-Fi Alliance Interoperability	WFA97858

5.5 Environmental & Operational Sensitivity

Parameter	Value
Orientation Sensitivity[1]	0.50%
Placement Sensitivity[2]	0.46%
Operating Temperature (Continuous Operation)	0 to 49°C
Temperature Measurement Sensitivity - Speed (Force)	0.12% (0.36%) per 10°C
Storage Temperature	-20°C to +60°C

[1] Average measurement variation for EnergyPod mounted on car door and rotated between 0 and 360°
[2] Average measurement variation for EnergyPod mounted on car door for matrix of 2 different radii from hinge and 3 different vertical positions along metal + window door assembly

5.6 Reliability

Parameter		Value
Drop Resistance		1.8 m (6 ft)
Glass Screen Shatter Resistance		> 300 N
Suction Cup System[1]	Holding Force	120 N
	Holding Time	3 hours
	Durability	> 100,000 cycles

[1] Suction cup replacement kit available

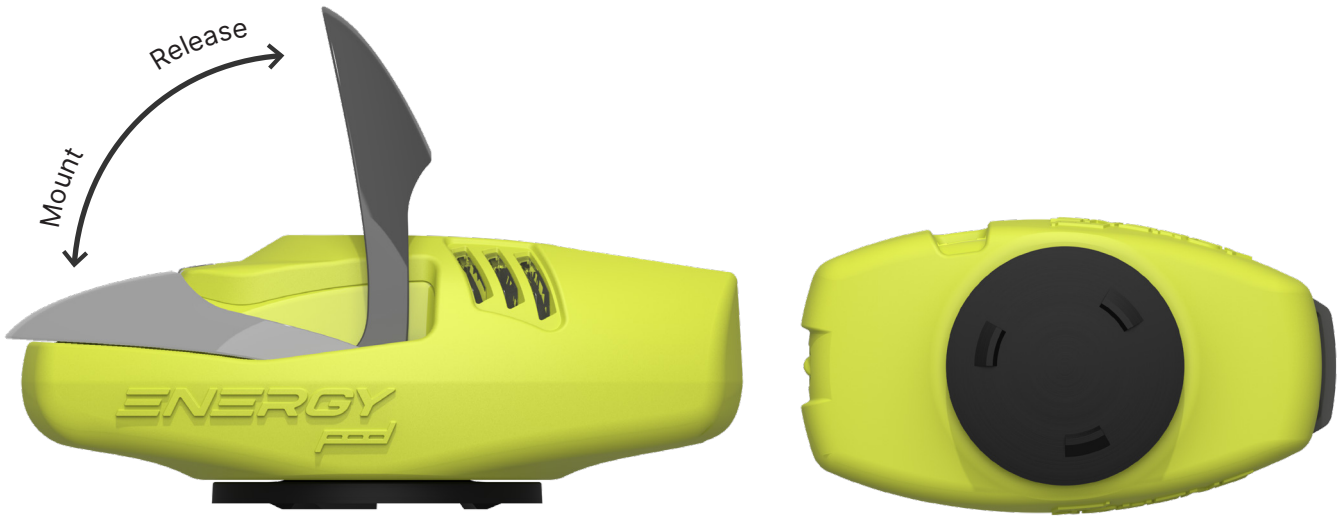


Figure 12. Single-action lever to mount and release EnergyPod with patented suction cup

5.7 Parts and Materials

Figure 13. Exploded view of EnergyPod

	Component	Material
1	**Protective Cover**	Silicone (40 Shore A)
2	**Housing**	ABS
3	**Display Screen Transparent Cover**	Mineral Glass
4	**Retainer Ring**	Anodized Aluminum
5	**Suction Cup Lever**	Nylon
6	**Suction Cup**	Polyurethane
7	**Power Station Cover**	ABS

6. Purchase and Service

6.1 Kit Content

EnergyPod

- Base, Flex, & Pro models

Power Station

USB A to C

- 1 m / 3 ft

Push Ring with wrist strap

Rugged Transport Case with Custom Foam Insert

- Height x Width x Length: 30 x 25 x 12 cm
- Weight: 2.32 kg

MyPod Software

- MyPod program and installer provided on device SD card

Wall Mount Adapter

- 110-240VAC to 5VDC 6W

Type A (NEMA 1-15 U.S. 2 pin)	North America
Type C (CEE 7/16 Europlug)	Europe
Type G (BS 1363 UK)	United Kingdom
Type I (Australian AS/NZS 3112)	Australia

Figure 14. EnergyPod kit with accessories

6.2 Optional Modules

The basic functionality can be enhanced with modules to widen applications or to satisfy requirements:

Universal Hinge Module *(#10607)*
The Universal Hinge Orientation Module extends the capability of EnergyPod to measure characteristics of Non-Vertical Hinge Door systems such as tailgates, liftgates, trunks, hoods and butterfly doors.

Trajectory Module *(#10609)*
The Trajectory Analysis Module expands the capacity of EnergyPod to characterize hinges and door checks. This extension enables the user to measure:

- X and Y Hinge inclination with respect to gravity
- Open Angle for hinged doors
- Friction effect of hinges and rollers

Latch Analysis Module *(#10611)*
The Latch Analysis Module expands the capability of EnergyPod with functions to characterize events related to latching. This extension enables the user to measure:

- Spring or Opening Speed during the unlatching event
- Static Closing Force

Data Logging Module *(#10606)*
The Data Logging Module expands the data storage and export capabilities for EnergyPod. The file can be saved directly to a computer via a Bluetooth or Wi-Fi connection, or, when no computer is available, to the onboard 16GB memory card. This extension enables the user to log:

- Measurement values from the built-in algorithms into a universal text file format (CSV)
- Raw sensor data collected during a Manual Recording in a text file format to analyze any aspects of opening or closing movements

Extended Speed Range Module *(#10875)*
Increase the maximum speed measurement capacity from the standard 2.2 m/s to 8.2 m/s.

Extended Force Range Module *(#10876)*
Increase the maximum force measurement capacity from the standard 225 N to 450 N.

Streaming Module *(#10877)*
The Streaming Module enables the device to transmit sensor values at high speed and in real time to IOManager software. This data stream can be used in combination with other sensors and allows for advanced processing, graphing, and reporting. The IOManager software (not included) will manage all incoming streams and save them accordingly in its database.

Frameless Window Analysis Module *(#10610)*
The Frameless Window Analysis Module enhances the capability of EnergyPod to characterize frameless window behavior. This extension enables the user to measure:

- Window Vibration (in mm) when opening the door

6.3 Popular Bundles

6.3.1 EnergyPod Base *(#31501)*
EnergyPod Base includes the following modules:
- Measurements: Minimum Closing Energy and Minimum Closing Speed
- Works for vertical hinged doors

EnergyPod Base can measure speeds up to 2.2 m/s and forces up to 220 N.

6.3.2 EnergyPod Flex *(#31500)*
EnergyPod Flex includes the following modules:
- Measurements: Minimum Closing Energy and Minimum Closing Speed
- Universal Hinge: Works for any hinge orientation
- Data Logging: Save data to gauge or computer in universal text file format
- Streaming: Stream raw data to IOManager (software not included)

EnergyPod Flex can measure speeds up to 2.2 m/s and forces up to 220 N.

6.3.3 EnergyPod Pro *(#31502)*
EnergyPod Pro includes the following modules:
- Measurements: Minimum Closing Energy and Minimum Closing Speed
- Trajectory Analysis: Door Angle, Hinge Tip and Friction Measurement
- Latch Analysis: Spring or Opening Speed and Static Closing Force
- Extended Force Range: Measure up to 450 N
- Universal Hinge: Works for any hinge orientation
- Data Logging: Save data to gauge or computer in universal text file format
- Streaming Module: Stream raw data to IOManager (software not included)

EnergyPod Pro can measure speeds up to 2.2 m/s and forces up to 450 N.

6.4 Calibration Service

6.4.1 Factory *(#45012)*
All devices are initially calibrated at EZMetrology's Calibration Lab. The individual device serial numbers, procedures, and necessary information for traceability are listed in the calibration documents for each device. It is recommended to return the devices to EZMetrology for recalibration after one year.

6.4.2 Remote Calibration Subscription *(#45017)*
An annual per-device subscription to enable the assigned EnergyPod to process, execute, and perform calibration using the SpeedBay and ForceBay tools.
This capability requires:
- Access to a calibrated SpeedBay and ForceBay (not included).
- A qualified operator that is registered with EZMetrology for calibration procedures. A specialized certification class is available for operators.

6.5 Verification Tools

EnergyPod technology is based on speed and force measurements. In order to validate a device, it is mandatory to validate each individual sensor technology component. Therefore, two independent verification tools are used to validate each sensor.

6.5.1 SpeedBay *(#31300)*
A convenient tool for onsite verification that can be used by customers at any time to ensure the speed sensor performance is within tolerances.

6.5.2 ForceBay *(#31301)*
A convenient tool for onsite verification that can be used by customers at any time to ensure the force sensor performance is within tolerances.

6.6 Replacement Kits

EnergyPod Suction System Replacement Kit
#31506

EnergyPod Protective Cover Kit
#31507

EnergyPod Push Rings (x10)
#31508

6.7 Training

Online and on-site training options for EnergyPod are available from our technical experts. All training classes are adapted to suit the number of participants and the objective of the envisioned use cases in the customer's environment.

6.8 Support, Protect and Care *(#45405)*

All EnergyPod devices are covered by our 1-year Support, Protect and Care Program. The program covers access to software updates, technical support, and warranty coverage for any device malfunction. Details of the coverage and exceptions can be found in the respective Support, Protect and Care policy. The program can be extended after the initial coverage period ends.

6.9 Other Pods

Visit our website below for information regarding additional products in the EZMetrology Pod family:

SpeedPod
#31000, #31001, #31002

PressurePod
#31100, #31101

ForcePod
#31200, #31201

SensorPod
#31400

6.10 Order & Contact Information

Telephone: +1 248 861 2600
Email: info@ezmetrology.com
Website: www.ezmetrology.com

References: TELC003 Wireless Certificate, TELC001 Certificate of Conformity, TELD006 VARTA Li Polymer Battery SDS