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Otii Product Suite

The ultimate solution for mastering battery life of embedded devices and electronics throughout product development and maintenance.

qoitech.com/otii

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Otii Product Suite

A state-of-the-art solution for power profiling, battery life estimation, selection, emulation, and energy harvesting testing for embedded electronics.

The Otii products are designed for every-day power analysis and testing at the developer's bench. They are also scalable for automated power testing and optimization across teams, product lines, and development stages.

One comprehensive product suite. 20+ powerful capabilities designed to bring you and your team closer to optimal battery life of your embedded product.

Otii instruments:

Otii Ace Pro (≤ 25V, 5A)
Otii Arc Pro (≤ 5V, 5A)

Otii instruments come with powerful Otii desktop application for Windows/Ubuntu/macOS.

Otii software toolboxes:

Otii Battery Toolbox
Otii Automation Toolbox

The Otii toolboxes are sharable licenses that evolve Otii Arc/Ace Pro to specialised instruments.

For R&D and FAE teams looking to:

1. Deliver quality by powering, measuring and analysing energy consumption for every HW/FW/SW iteration.
2. Estimate realistic battery life based on device's and battery behaviour for the specific application.
3. Pick the right energy source, profile and emulate batteries for their specific applications.
4. Cut qualification and verification time and cost by evaluating and cycling batteries.
5. Streamline and automate power measurements as part of continuous integration, regression testing or hardware/software benchmark.

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Otii application and use cases

Equip your team with comprehensive yet versatile solution for power and battery life optimization.

APPLICATION AND USE CASE	Otii instrument	Automation Toolbox	Battery Toolbox
Device and firmware power measurements and analysis			
Power and current profiling Measure, analyze and optimize your embedded device's real current and power consumption. High dynamic range, high resolution measurements.	Arc/Ace		
UART logs sync with power measurements Synchronise your debug logs with power measurements to understands what drains the energy. Insights are the first step to optimizing. Iterate measurements for all changes in firmware.	Arc/Ace		
In-line mode/Ampere meter mode measurements Measure the current, voltage, power and energy in-line with power source and your embedded device. Like multimeter but also measuring both current and voltage at the same time.	Ace		
4-wire mode Seperate voltage measurement from the power delivery, also known as Kelvin connection.	Arc/Ace		
Control device via AT Command while power measuring Optimize eDRX and PSM settings of your device by changing the settings in real time while measuring. Improve this further by automate this with a script. Python script available at Qoitech Github.	Arc/Ace		
Battery life calculator Get a quick battery life calculation from your measured power profile. Use battery capacity from datasheet or data from battery profiling.	Arc/Ace		
Logic analyzer Connect DUT digital signals to GPIs, to monitor logic levels, like a logic analyzer. Use the MCU GPIOs as status indicator and view them in Otii desktop appplication.	Arc/Ace		
Subsystem measurement/secondary current channel Examine how each subsystem affects current consumption and voltage levels.	Arc/Ace		
External shunt resistor/Differential measurement Measure current and voltage without using the internal power supply of Otii hardware.	Arc/Ace		
2-channel power supply Use Otii Ace as two power boxes and four multimeters, due to its isolation between main channel and expansion board.	Ace		

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Otii application and use cases

APPLICATION AND USE CASE	Otii instrument	Automation Toolbox	Battery Toolbox
Battery life estimation and battery analysis and testing			
Battery profiling Create discharge profiles of the batteries with specific conditions for the discharge that reflect how your application is behaving. Use these to emulate batteries.	Arc/Ace		■
Battery emulation Use Otii Arc/Ace to act as a battery, following a discharge curve of your specific discharge profile or preset Otii profiles. Emulate battery, get the real capacity value and find the right match for your application.	Arc/Ace		■
Advanced battery life estimation Combine real device power consumption with a battery discharge profile and estimate realistic runtime, within seconds.	Arc/Ace		■
Battery cycling and performance validation Evaluate deteriorating effect of charging and discharging. Profile and cycle battery for aging and create battery profiles at different aging states of the rechargeable batteries	Ace		■
Evaluation of battery passivation Measure and visualize the passivation effects to understand and prevent premature device resets.	Ace		■
Energy harvesting measurements and analysis			
PV cell and energy storage evaluation In-line measurements to evaluate how much current and energy that a solar panel/PV cell is charging the embedded device's energy storage. Make sure that your PV cell generates enough energy to keep your system powered at all use cases.	Ace		
Stress testing of the energy harvester and storage for different applications, protocols, duty cycles Using Otii Ace as the load, emulating your embedded device in different conditions, to evaluate if the energy harvesting system is self-sufficency.	Ace		■

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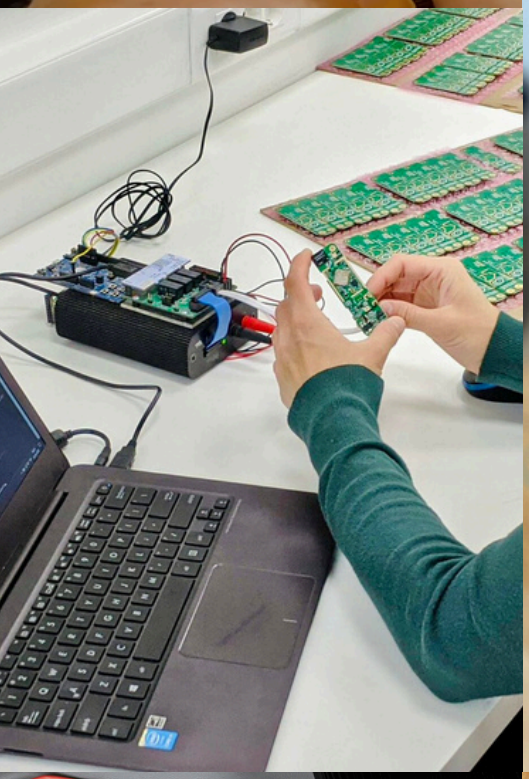
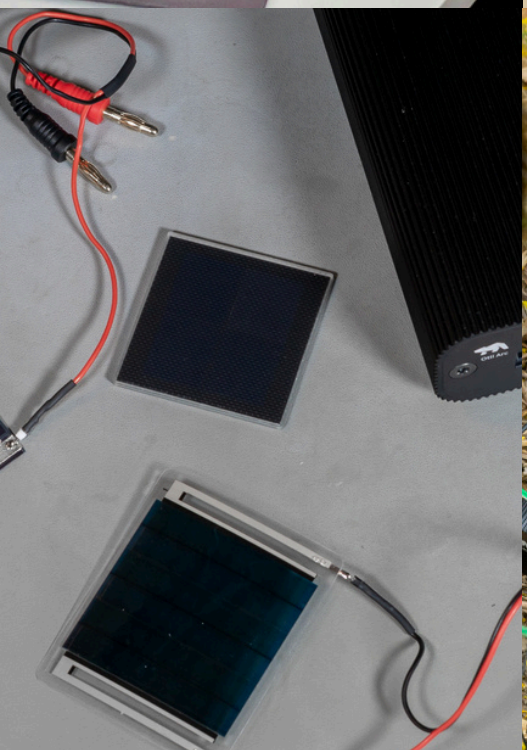
Otii application and use cases

APPLICATION AND USE CASE	Otii instrument	Automation Toolbox	Battery Toolbox
Automated power measurements and testing			
Automation with scripting in Python and C# for regression testing, validation and Continuous Integration (CI) Control your Otii Arc/Ace with the built-in TCP-server from any language or system that supports communication over TCP sockets, using a JSON-based API. Any of the use cases in this and other application areas can be automated.	Arc/Ace	■	
Importing external logs into an Otii 3 project using Python Import an external CSV-based log (from Wireshark, network analyzer etc) into an existing Otii 3 project using the Otii TCP Python API, aligning events with power measurements for precise time correlation.	Arc/Ace	■	
Automated measuring efficiency of a PMIC (DC/DC converter) Check the efficiency of your PMIC (DC/DC converter) with your embedded device as consumer and the efficiency at all loads.	Ace	■	
Automated battery emulation Fast-forward test of the device when battery is discharged. Automatically find real used capacity at cut-off.	Arc/Ace	■	■
Power measurement in functional testing with Raspberry Pi Automate functional testing with Raspberry Pi, streamlining comprehensive testing in development workflows.	Arc/Ace	■	
Using Otii for automated power testing within a Docker environment Use Otii in a Docker instance for your CI implementation.	Arc/Ace	■	

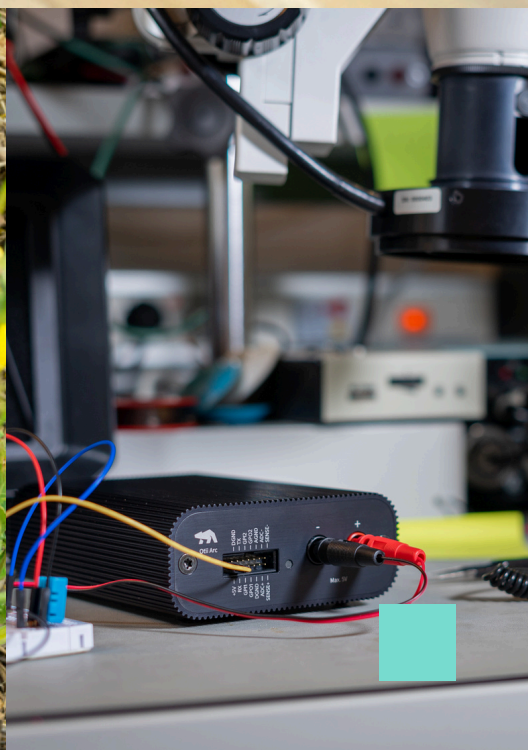

1
2
3
4
5
Panasonic
Energizer




Not connected
General Settings
OC protection:
800m A
Digital voltage:
3.7 V
GPO1
GPO2
5V
Main current:
Auto range
ADC resistor:
1 Ω
Uart
Not connected
Add
Add
0.0 s
5 s
500 n
0.0 A
Main current - Ace
Main power - Ace
1.00 W
0.0 W
GPI 1 - Ace
UART log - Uart
Filter
Log message
Available: 0bytes
WiFi signal strength: 90.0
IP address: 192.168.156.188
Temperature: nan °C
Humidity: 0 %
Publishing to the cloud
Disconnecting...
Disconnected
Turning off wifi...
Entering sleep mode




sensefarm



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Otii instruments

Power analyzer, source measure unit (SMU), power supply, digital multimeter, power debugger - all in one Otii instrument.

The Otii instruments, Otii Ace Pro and Otii Arc Pro can precisely source power and simultaneously measure current and voltage. They can also be a programmable load, sinking with a constant current, power or resistance.

They come in two options - for electronics up to 5V/5A and with a higher sample rate for electronics up to 25V/5A

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	Otii Ace Pro	Otii Arc Pro
Current and voltage measurement	±(0.05% + 25nA) for -5 A to 5 A	±(0.1% + 50nA)
Current measurement resolution	400pA	5nA
Current sink	Max 5A	Max 2.5A
Voltage measurement accuracy	±(0.01% + 1 mV)	±(0.1% + 1.5 mV)
Current ranges	Auto range (only one switch) High current range 24 bit ADC with automatic switching between ranges	
Sample rate	Adjustable sample rate up to 50 ksps for main current and voltage channel. Up to 50 ksps for all other channels (ADC current, ADC voltage, SENSE+, SENSE-)	Sample rate up to 4ksps for main current channel. 1ksps for all other channels (main voltage, ADC current, ADC voltage, SENSE+, SENSE-)
Output voltage	0 - 25V Isolated power supply, ±200 V. Active voltage regulation No burden voltage	0.5 - 5V Active voltage regulation No burden voltage
Output power	Max continuous 30W Peak 50W	Max continuous 12W Peak 25W
Expansion port	Digital IO ADC differential ADC, Singel ended SENSE	
Channels	Main channel ADC channel for subsystems Multiple Arc/Ace can be used in one and the same Otii project in the desktop application	
USB, DC Jack	DC jack input 7-20V, max 5A USB port 4.75-20V, max 3A	DC jack input 7-9V, max 5A USB port 4.75-5.25V, max 3A
Size	10,9cm x 14,4cm x 4,4cm (WxLxH) 450 grams	10,9cm x 14,4cm x 4,4cm (WxLxH) 450 grams
NIST traced calibration	Yes	Yes
Software	Otii desktop application for Windows, Ubuntu, macOS Online and offline license modes Multiple Otii instruments can be simultaneously used in one Otii project (only limited by the computer)	
Software toolboxes	Supports following licenses: Otii Battery Toolbox Otii Automation Toolbox Otii Energy Harvesting (COMING SOON)	Supports following licenses: Otii Battery Toolbox Otii Automation Toolbox
Additional resources	DATASHEET	DATASHEET

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Otii desktop application features

The Otii software is free and works on Windows, Ubuntu and macOS. The software features below require Otii instruments connected to the computer. A limited set of features can be used when only using the Otii desktop application without the Otii hardware, in a so called viewer mode.

FEATURE	Otii Ace Pro	Otii Arc Pro	Otii app only (no HW)
Current, voltage, power measurements	■	■	
Unlimited recordings	■	■	
Unlimited recording time	■	■	
Sync and compare multiple recording	■	■	■
Multiple selections (save, rename, compare)	■	■	■
Sync recordings with UART output	■	■	■
Add unlimited new recordings in existing project	■	■	
Battery life calculator	■	■	■
GPI measurements	■	■	
ADC (sub-system) measurements	■	■	
Customizable monitor	■	■	
Run multiple Otii instruments in one Otii project	■	■	
Offline license mode	■	■	
Customize statistics (ex energy in Joule)	■	■	■
Control device via AT commands in UI	■	■	
Minibar - compact sidebar with quick controls	■	■	
Statistic (Active, Selection, Recording)	■	■	■
Analyze graphs while measuring in the background	■	■	
Save/load project	■	■	■
Offset calibration	■	■	
Unlimited redo/undo functionality	■	■	■
Name, scale, hide and customize recordings	■	■	■
Downsampling	■	■	■
Crop	■	■	■
In-app help	■	■	■
Support for 4-wire measurements	■	■	
Support for in-line measurements	■		
Set sample rate	■		

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Otii Toolboxes

Elevate Otii instruments with additional software toolboxes for scripting capabilities and battery profiling, emulation, testing and validation.

Otii Toolboxes are additional software licenses that can be purchased perpetual or as monthly and yearly subscription. The two avaliable Otii Toolboxes are:

Otii Automation Toolbox

This license elevates the Otii software with scripting capabilities and opens for endless automated use cases.

Otii Battery Toolbox

This license enables capabilities for battery profiling, emulation, and cycling - everything needed to pick the right battery for your project.

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Otii Battery Toolbox

The ultimate solution to find and validate the right, first and second source battery through out the IoT and embedded product lifecycle.

Battery profiling

- Simple set-up: one battery connected at main connectors of one Otii instrument
- Connect as many Otii instruments as the computer allows for multi channel usage
- All connected batteries will be discharged with the same chosen profile
- Otii Arc resp. Ace can sink currents up to 2.5A resp. 5A and source currents up to 5A.
- Create discharge profiles with two levels of discharge: low for sleep mode and high for active mode.
- Discharge the battery with a constant current. The current will not change as the battery voltage drops. This is similar to as if there were a linear regulator as load.
- Discharge the battery with constant power. Voltage is measured and discharge current is calculated to get set power. The discharge current will increase as the battery voltage drops while profiling.
- Discharge the battery by simulating a resistance connected to the battery. The discharge current will decrease as the battery voltage drops during the profiling.

Battery emulation

- ‘Fixed’ emulation to emulate the battery with a constant “Used capacity”. Pick a spot on the discharge curve and emulate in this position (position = how much used capacity is drawn from the battery).
- ‘Follow’ emulation will emulate a discharge over the time of the recording. Position in the discharge curve will then move as per how your device consumes energy.
- Emulate set-ups with battery cells in parallel and/or series – up to 4 batteries for parallel set-up and flexible number for series set-up depending on the Open Circuit Voltage (OCV).
- Automate battery emulation with Otii Automation Toolbox - switch profiles for different state of charge, battery types and temperatures.

Battery life estimation

- Combine a real measurement of your device with a battery discharge profile and get a defensible runtime number, in seconds.
- Create an activity profile from your device measured behaviour and the repeatability of the behaviour.
- Configure a battery from an existing profile, measured or imported. Create a pack in series or parallel.
- Run the estimator. Get the runtime, discharge curve and used capacity. Test “what if” scenarios with ease.
- Use your created discharge profiles with Otii or import collegues’ or manufacturers’.

Battery Validation (Otii Ace Pro only)

- Highly customizable test sequence – option to customize discharge, idle mode and charging, pulse width control, repeated cycles, cut-off voltages
- No limitations on number of cycles
- No limitations on number of batteries to be tested at the same time. Connect as many Otii Ace Pro as the computer allows.

Shareable license

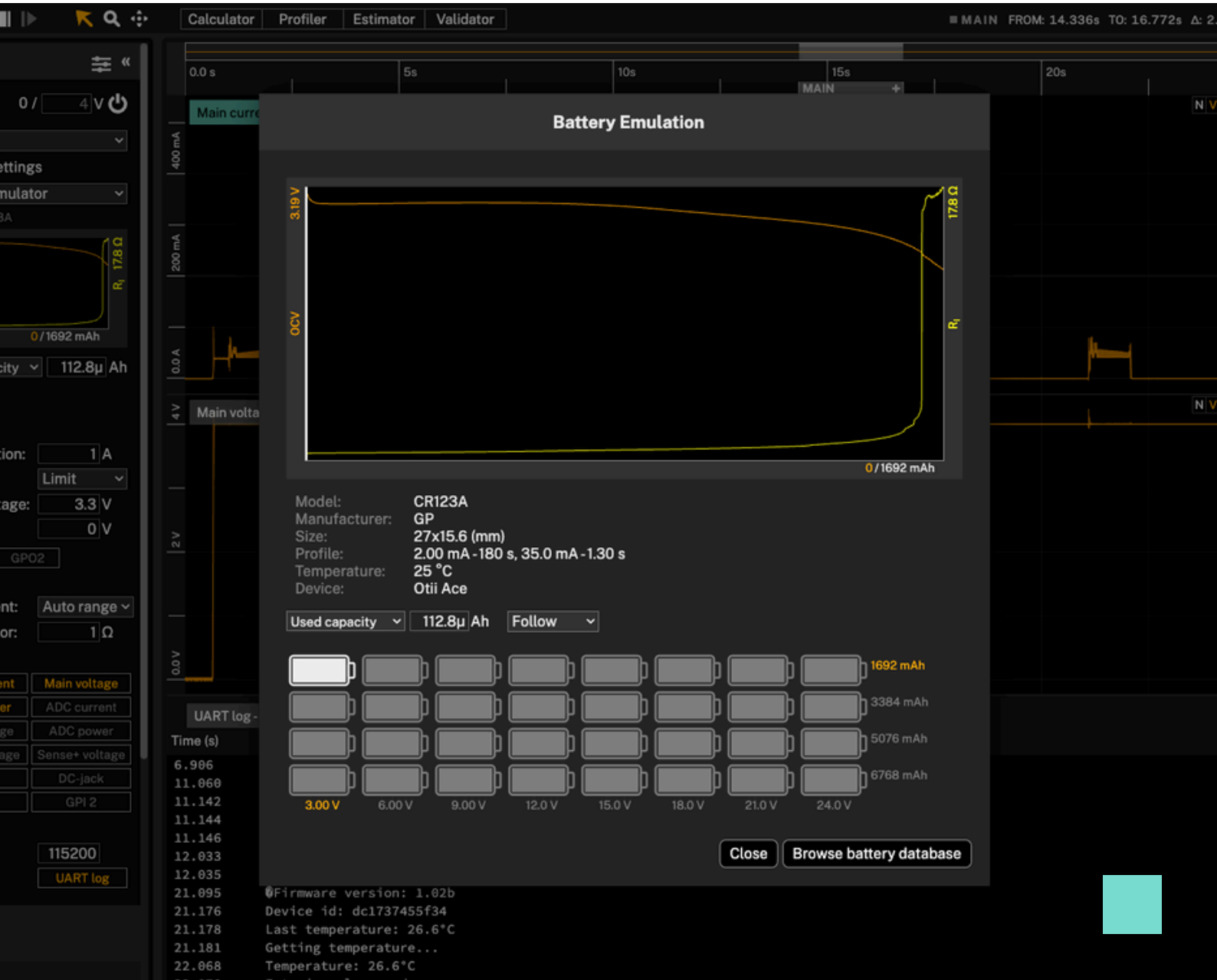
- Otii Battery Toolbox is shareable. The license can be assigned only at one user at the time. The license management is done in Otii User Management.
- The license can also be used in offline mode.

Otii Battery Toolbox

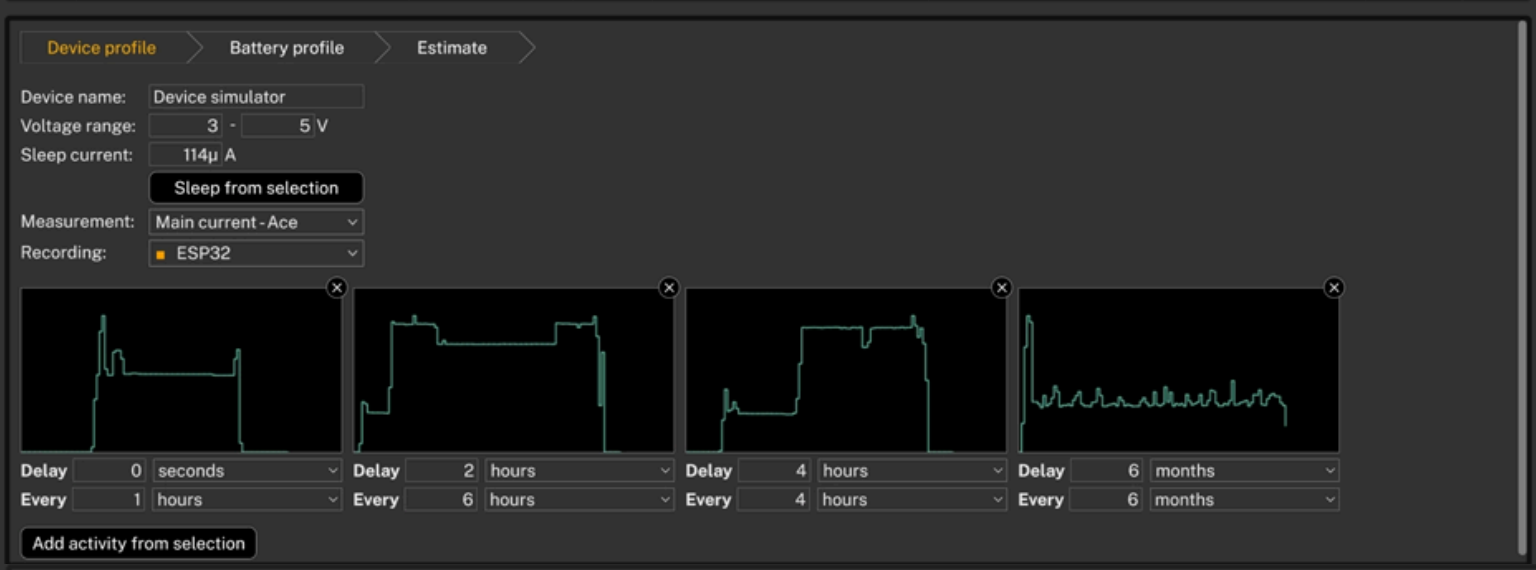
Battery model parameters

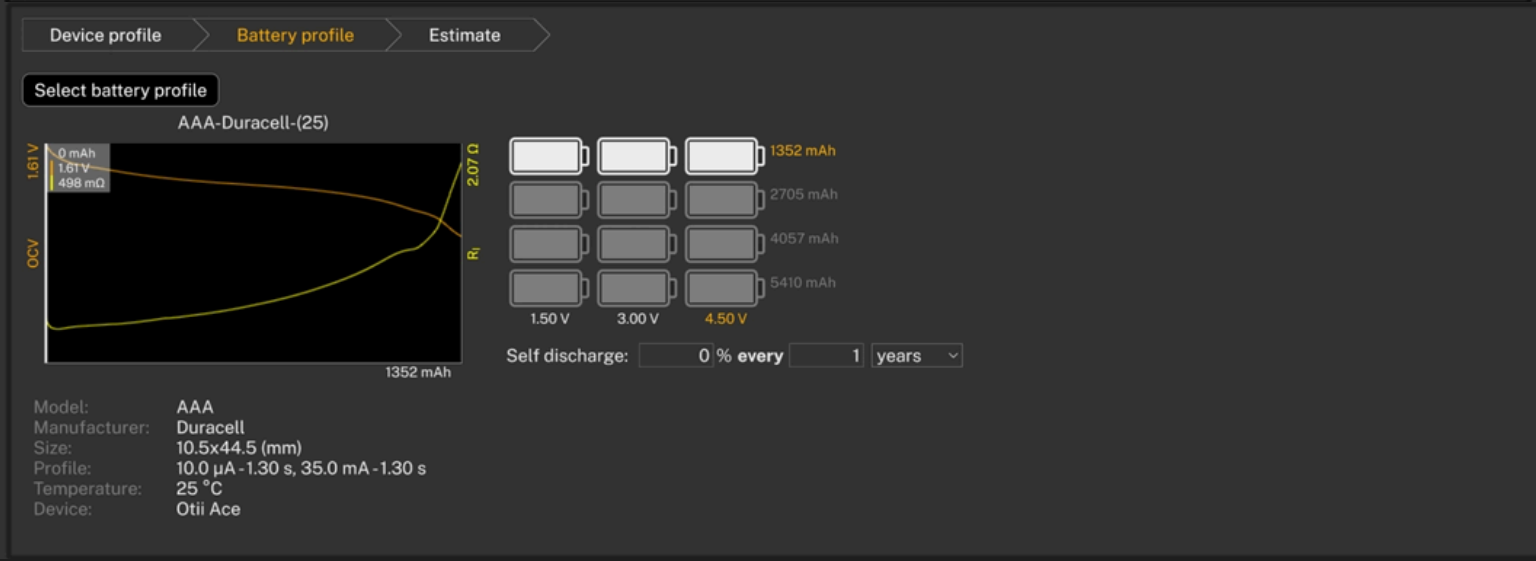
	Otii Ace Pro	Otii Arc Pro
Points in Emulation	as many as no of iterations	as many as no of iterations
ESR Range[1]	up to 5 kohm	up to 5 kohm
ESR Resolution	down to 1 mohm	down to 1 mohm
Voc Range	0V to 25V	0.5V to 5V
Voc Resolution	1 mV	1 mV
Capacity Range	no limit	no limit
Capacity Resolution	1 µAh	1 µAh

[1] Otii Battery Toolbox emulates the total ESR.

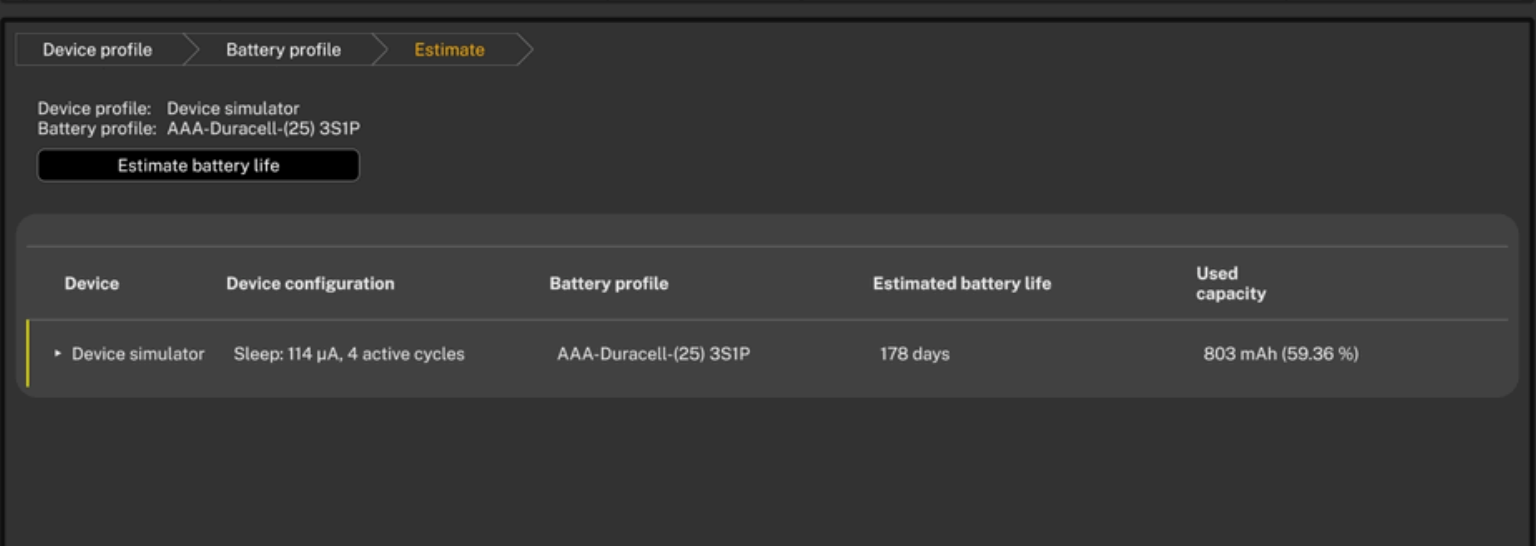



Calculator
Profiler
Estimator
Validator
FOTA FROM: 1m:40.835s TO: 2m:41.080s Δ: 1m:0.245s
0.0 s
20s
40s
1m
1m:20s
1m:40s
2m
2m:20s
2m:40s
Sleep
Active_1
Active_2
Active_3
FOTA
Main current - Ace
400
200 mA
0.0 A


Device profile
Battery profile
Estimate
Device name: Device simulator
Voltage range: 3 - 5 V
Sleep current: 114µ A
Sleep from selection
Measurement: Main current - Ace
Recording: ESP32
Delay 0 seconds
Every 1 hours
Delay 2 hours
Every 6 hours
Delay 4 hours
Every 4 hours
Delay 6 months
Every 6 months
Add activity from selection


Device profile
Battery profile
Estimate
Select battery profile
AAA-Duracell-(25)
1.61 V
0 mAh
1.61 V
498 mΩ
OCV
2.07 Ω
Ri
1352 mAh
1352 mAh
2705 mAh
4057 mAh
5410 mAh
1.50 V
3.00 V
4.50 V
Self discharge: 0 % every 1 years
Model: AAA
Manufacturer: Duracell
Size: 10.5x44.5 (mm)
Profile: 10.0 µA -1.30 s, 35.0 mA -1.30 s
Temperature: 25 °C
Device: Otii Ace


Calculator
Profiler
Estimator
Validator
FOTA FROM: 1m:40.835s TO: 2m:41.080s Δ: 1m:0.245s
0.0 s
23d:3h:33m:20s
46d:7h:6m:40s
69d:10h:40m
92d:14h:13m:20s
115d:17h:46m:40s
138d:21h:20m
162d:53m:20s
FOTA
Main voltage - Device simulator
4.5 V
4 V
3.5 V


Device profile
Battery profile
Estimate
Device profile: Device simulator
Battery profile: AAA-Duracell-(25) 3S1P
Estimate battery life
Device
Device configuration
Battery profile
Estimated battery life
Used capacity
Device simulator
Sleep: 114 µA, 4 active cycles
AAA-Duracell-(25) 3S1P
178 days
803 mAh (59.36 %)

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Otii Automation Toolbox

The key to functional, regression, and benchmark testing. Ideal for continuous integration, tracking energy consumption from prototyping to production.

Scripting in any language using JSON API

- Otii Automation Toolbox makes Otii instruments programmable.
- Control your Otii Arc/Ace with the built-in TCP-server from any language or system that supports communication over TCP sockets, using a JSON-based API.
- Find an example of how to integrate Otii in Jenkins using the Python programming language in the Help section of the Otii application.
- Great for your continuous integration set-up, to keep track of your system's energy consumption throughout the whole development cycle, from prototyping to production.

Scripting statistics API

- The Otii core computational engine is designed to efficiently make calculations of large sets of data.
- The TCP-API is constantly being expanded with methods that will simplify your energy optimization tasks.
- Examples of API additions are recording_get_info that returns information about a recording, and recording_get_statistics that returns the minimum, maximum, average and energy consumed over a specified time range.

Packaged scripting modules available for Python, Matlab, C#, Java

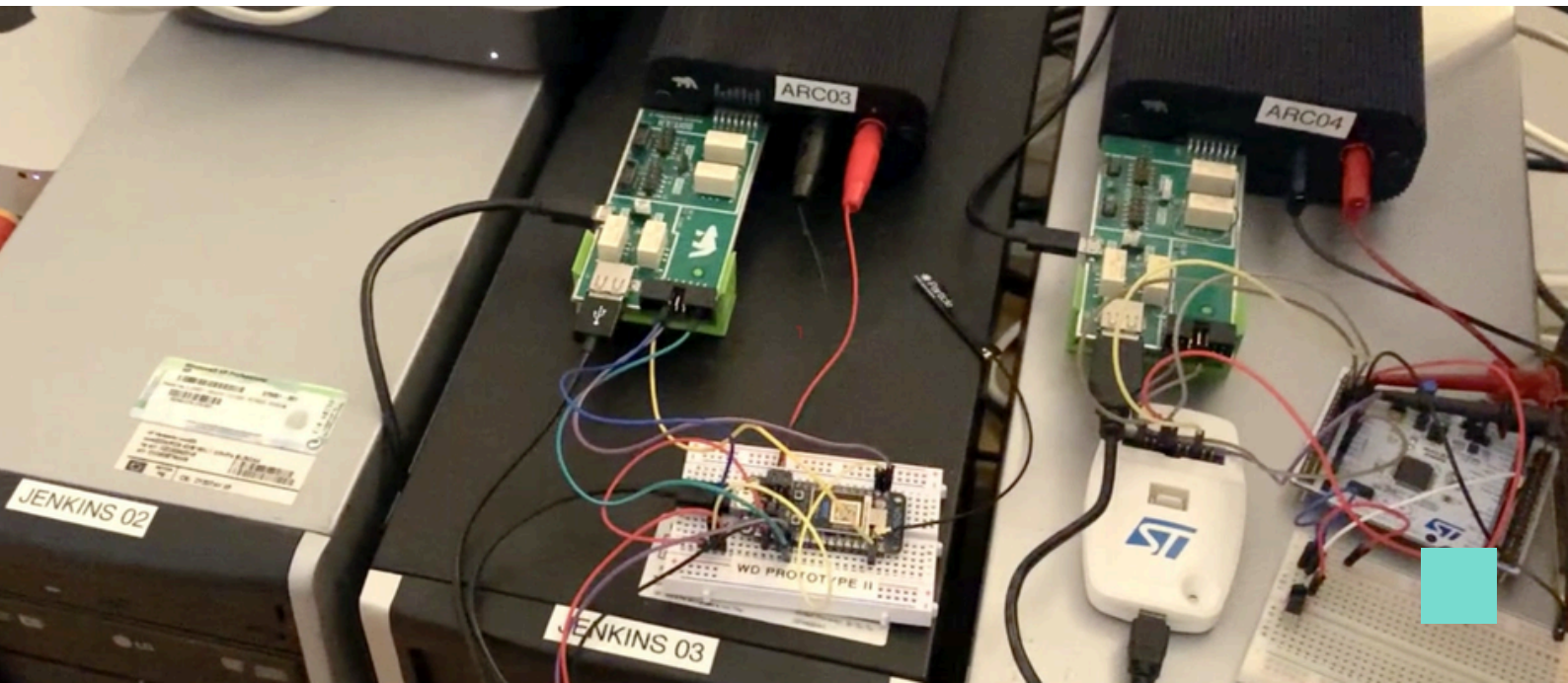
- Write your scripts using the JSON-based API or use our packaged scripting modules available for popular languages like Phyton, Java, C# and Matlab.
- Find the modules on Qoitech GitHub.

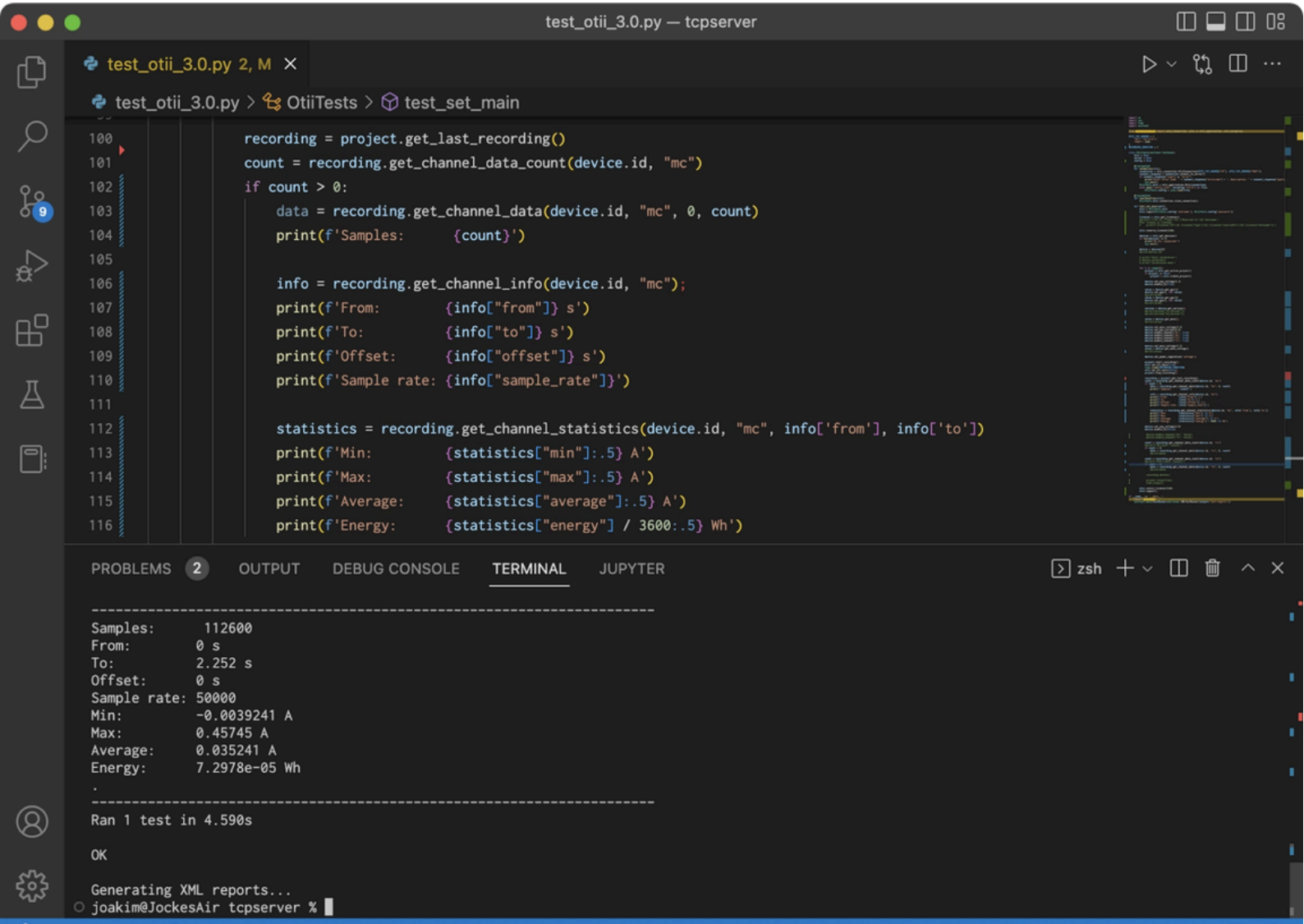
Command line tools

- The toolbox includes a command-line tool, that makes it possible to run test scripts without the UI.
- Run your script in your favorite continuous integration (CI) environment
- Create a test setup in a remote location
- The TCP API includes methods to log in, log out, and handle Otii licenses directly from the script, making it easier to include the script in an automated environment.

Shareable license

- Otii Automation Toolbox is shareable. The license can be assigned only at one user at the time. The license management is done in Otii User Management.
- The license can also be used in offline mode.






```java
try {
    // Remove any open project
    Project project = otii.getActiveProject();
    if (project != null) {
        project.close(true);
        project = null;
    }
    assertNull(project);

    Arc[] arcs = otii.getDevices();
    assertEquals(1, arcs.length);
    Arc arc = arcs[0];

    arc.setMainVoltage(3.0);
    arc.setExpVoltage(3.0);
    arc.setMaxCurrent(0.5);
    arc.setUartBaudrate(115200);
    arc.enableUart(true);
    arc.enableExpPort(true);
```

Java

```matlab
try
    % Configure first available device
    devices = otii.devices();
    assert(~isempty(devices.payload.devices), 'No available devices');
    device = otii.get_device(devices.payload.devices(1));
    device.enable_channel('mc');
    device.enable_channel('mv');

    % Create a new project if needed
    if ~otii.has_project()
        fprintf('Creating new project\n');
        otii.create_project();
    end

    % Save the project
    otii.save_project('Testar.otii', true, true, @(progress) disp(progress));

    % Record for a few seconds
    otii.start_recording();
    otii.set_all_main(true);
    pause(2);
    otii.set_all_main(false);
    otii.stop_recording();

    % Read recorded data
    recordings = otii.list_recordings();
    recording = recordings(2);

    count = otii.get_channel_data_count(device.device_id, recording.recording_id, 'mc');
    data = otii.get_channel_data(device.device_id, recording.recording_id, 'mc', 0, 1000);

    timestamp = 0:0.25:249.75;
    plot(timestamp, data);

    % Save the project
    otii.save_project('Testar.otii', true, true, @(progress) disp(progress));

catch ME
    disp(ME);
end
```

MATLAB

```python
def setup_otii():
    connection = otii_connection.OtiiConnection(OTII_TCP_SERVER["IP"
    connect_response = connection.connect_to_server()
    if connect_response["type"] == "error":
        print("Exit! Error code: " + connect_response["errorcode"]
        sys.exit()
    otii = otii_application.Otii(connection)

    devices = otii.get_devices()
    if len(devices) == 0:
        print("No Arc connected!")
        sys.exit()
    devices = [device for device in devices if device.name == ARC_NA
    if len(devices) != 1:
        print("Expected to find exactly 1 device named {0}, found {1
        sys.exit()
    arc = devices[0]

    arc.set_range("high")
    arc.set_main_voltage(3.3)
    arc.set_exp_voltage(3.3)
    arc.set_max_current(0.5)
    arc.set_adc_resistor(0.2)
    arc.set_uart_baudrate(115200)
    arc.enable_uart(True)
    arc.enable_exp_port(True)
    arc.enable_5v(True) # The switch board is powered by the Otii +5V pin

    return otii, arc
```

Python

Resources

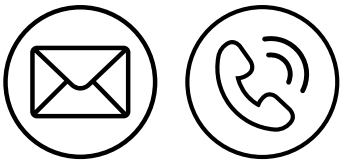
Otii Ace Pro datasheet

Otii Arc Pro datasheet

Otii Battery Toolbox documentation

Otii Automation Toolbox documentation

Otii Product Suite documentation



Contact us

To discuss how Otii Product Suite can best suit your team/s and how to tailor it for optimal utilization and cost efficiency, please contact our sales team at

sales@qoitech.com

SE +46 46 261 50 50

For technical questions and support, please contact us at

support@qoitech.com

We’re here to help!

The Qoitech Team

QOITECH

qoitech.com/otii

Qoitech creates the most effective solutions for energy consumption analysis and optimization, battery life analytics and prediction, and testing of batteries and energy harvesters, applicable across all industries. Founded as subsidiary of Sony, Qoitech is a Swedish company with global reach.