Multichannel Electrochemical Measurement System

# HZ-Pro Series

- Electrode materials research
- Electrochemical analysis
- Surface processing research
- Corrosion protection research
- Metal materials research
- Catalyst research


HZ-Pro S12


HZ-Pro S4


HZ-Pro S2A

MEIDEN HOKUTO

Introducing HZ-Pro, a modular, multichannel electrochemical measurement system engineered to support a wide range of measurements, from basic electrochemical measurements to corrosion tests, battery tests, and analytical tests.


## Features

- Capable of mounting a maximum of 12 potentiostat boards and booster boards (when using a 12-slot chassis)
- Offers an impedance measurement range up to 10MHz*1
- Allows parallel connection of optional 5A booster boards (max. 55A)
- Performs simultaneous measurement of reference electrode, working electrode, and counter electrode potentials (simultaneous measurement of EIS)
- Supports external communication using digital input/output or PC communication functions (HoPath)
- Delivers automated temperature control with a thermostatic chamber (thermostatic chamber linkage function)

### Main unit

Lineup of 2/4/12-slot models

### Potentiostat board

Max. output of 12V, 500mA
Supports external communication using digital input/output


### FRA

Provides EIS measurement (1MHz/10MHz*1) with an additional license

### CPU board

Connects to a computer via 100BaseT Ethernet

### Booster board

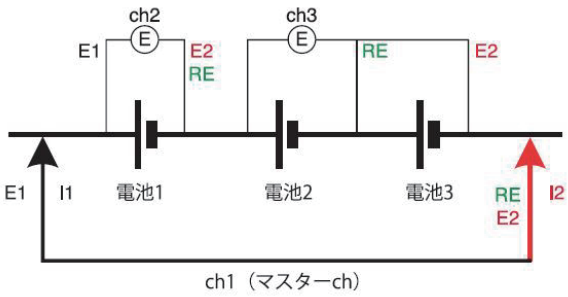
Max. output of 10V, 5A
Delivers up to 55A by connecting multiple boards

*1 Requires a separately available potentiostat board with 10MHz FRA capability and a dedicated cell cable

# High-usability application software supports users with ample features

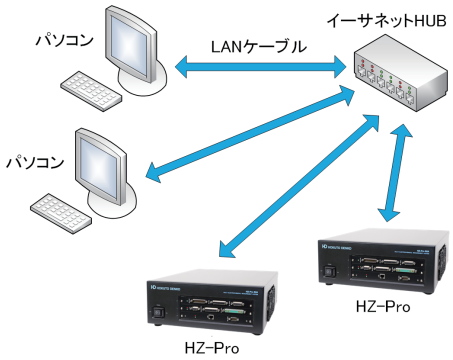
## Features

- Comprehensive coverage of measurement methods used in the electrochemistry, corrosion, and battery fields (p.10)
- Convenient electric quantity control (SOC, DOD, C-rate)
- Greater measurement flexibility (system configuration, additional conditions)
- Thorough safety features (power outage recovery, simplified measurements, etc.)
- “Channel Group function,” a powerful tool in the battery field
- User support features (language switching, automatic text saving, etc.)




Control of electrical current and voltage as the master channel
Measurement of voltage by other channels

Channel Group function



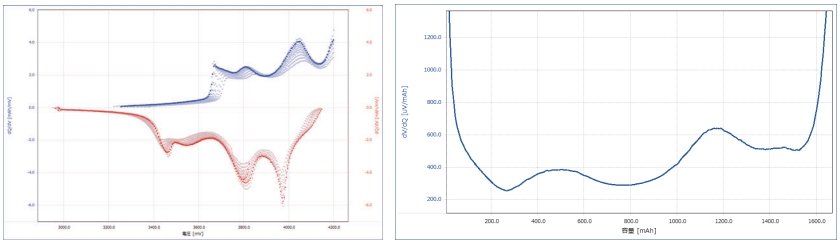

Control of multiple HZ-Pro units
by multiple users

HZ-Pro system configuration

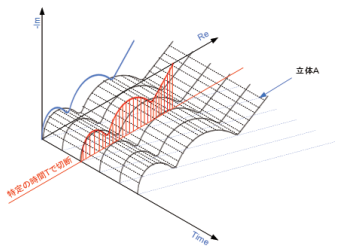
# Data analysis supported by simple operations

## Features

- Various waveform processing functions (moving average, DC removal, etc.)
- Comprehensive range of analyses, including dV series and pause extraction series (GITT)
- Analysis methods defined by JIS, including internal resistance calculation
- Data search from sample information
- In-situ AC impedance analysis function (EIS software)
- Outputs in ZView format files



dQ/dV and dV/dQ curves (LiB 18650)



In-situ AC impedance analysis function

# HZ-Pro Product Lineup

## HZ-Pro chassis

HZ-Pro comes in three types of chassis with varying slot capacities to choose from to meet various applications and expansion needs. An optional external booster is also available.


2-slot chassis


4-slot chassis

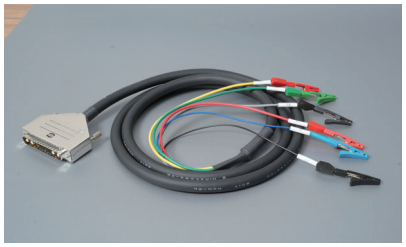

12-slot chassis

Optional external booster

## Potentiostat boards and cell cables

The number of measurement channels can be expanded by adding potentiostat boards. The potentiostat board can be given FRA functionality (1MHz/10MHz*1) with an additional license.

Potentiostat board (1MHz)



Cell cable (1MHz)

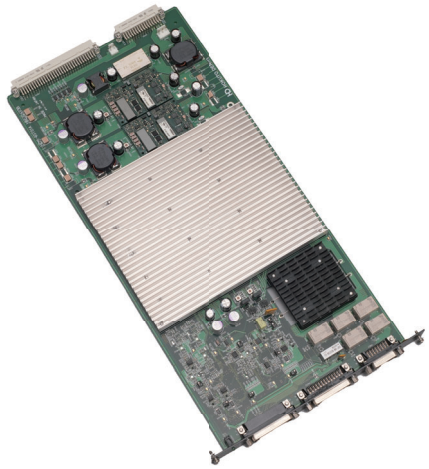
Potentiostat board (10MHz*1)

Cell cable (10MHz*1)

*1 Requires a separately available potentiostat board with 10MHz FRA capability and a dedicated cell cable.

## Booster board

The system's specifications can be expanded by adding booster boards. Booster boards can be connected in parallel, up to a maximum current of 55A.



Current booster board / Voltage booster board

## External system linkage function

The system can be linked to external devices via external analog and digital input/output.

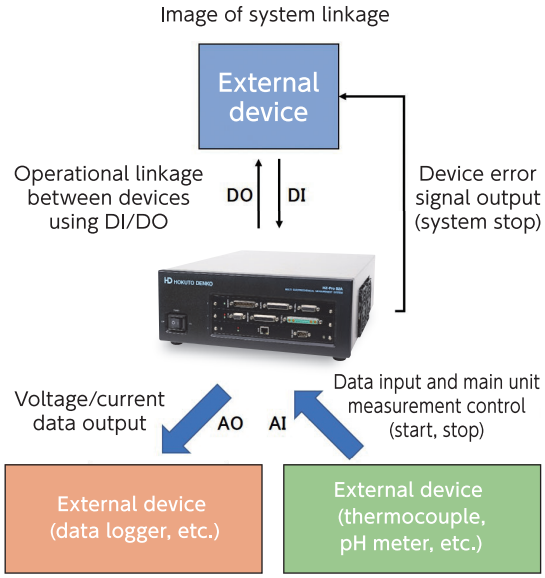



Image of external system linkage

# Technical Note

## FRA*1 capable of measuring up to 10MHz for all-solid-state batteries

The potentiostat capable of electrochemical impedance measurement can measure impedance from 10 μHz to 10 MHz, the highest frequency range in the industry.

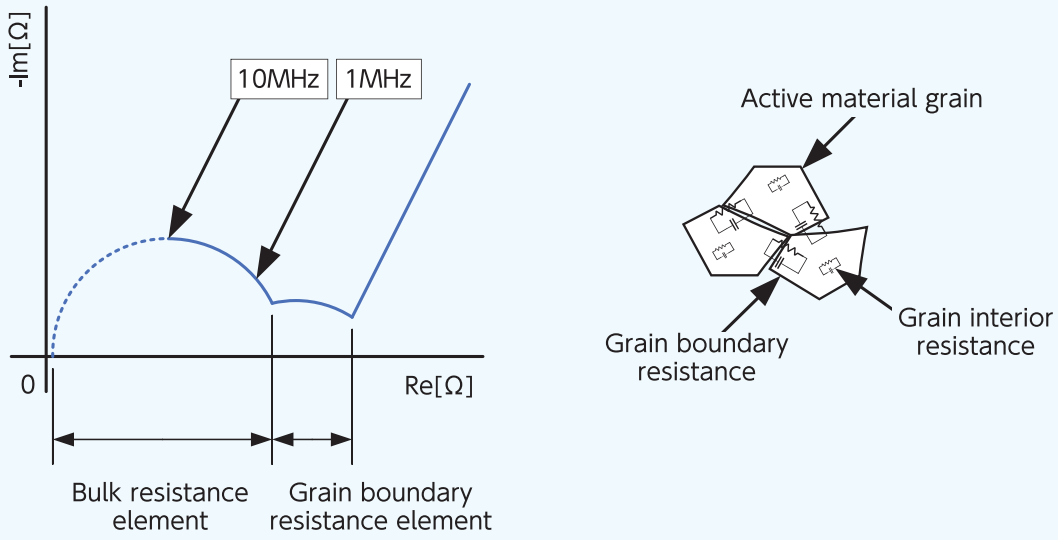



Image of an all-solid-state battery electrode and a Nyquist plot example

*1 Requires a separately available potentiostat board with 10MHz FRA capability and a dedicated cell cable.

# Hoktnet Station

## Features

- Supports everything from creating measurement conditions to analysis and management
- Provides high usability
- Supports users with ample features
- Easy language switching operation (supports Japanese and English)

## Software configuration

### Hoktnet Client

Performs everything from creating measurement conditions to providing measurement control and generating measurement data.

### Hoktnet Analyzer

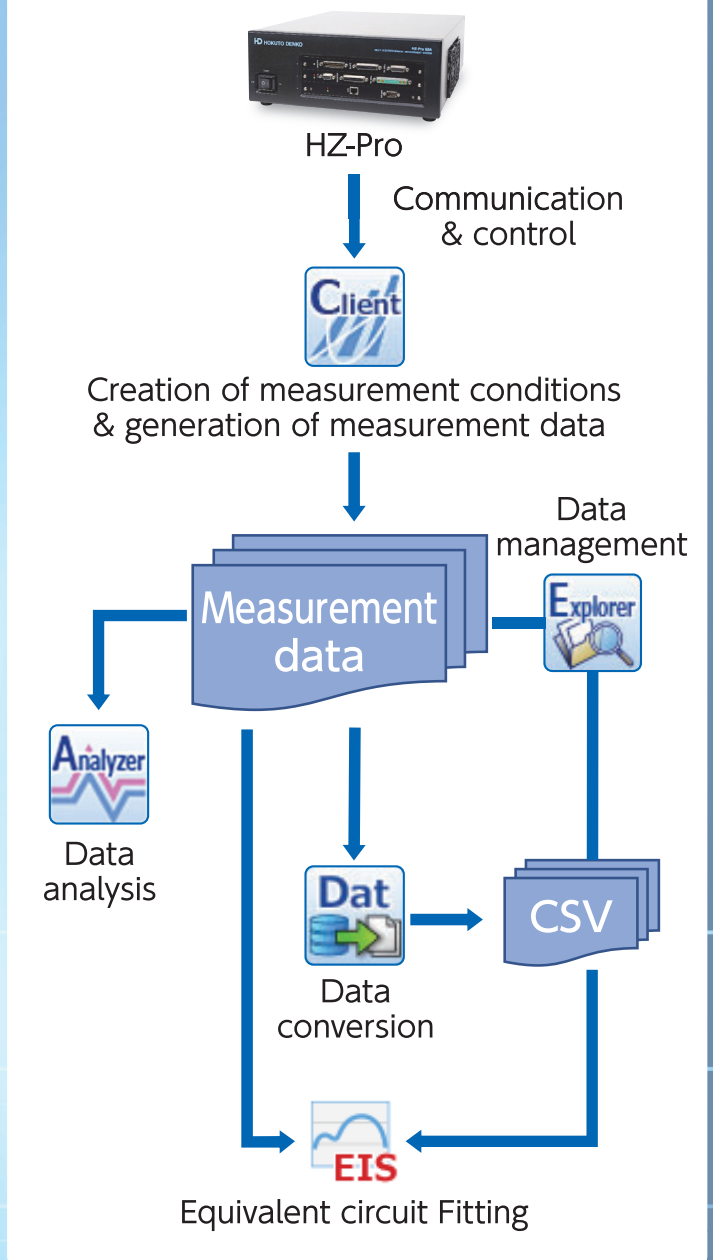
Displays measurement data in graph form and performs data analysis.

### Hoktnet Dat

Converts measurement data into CSV files.

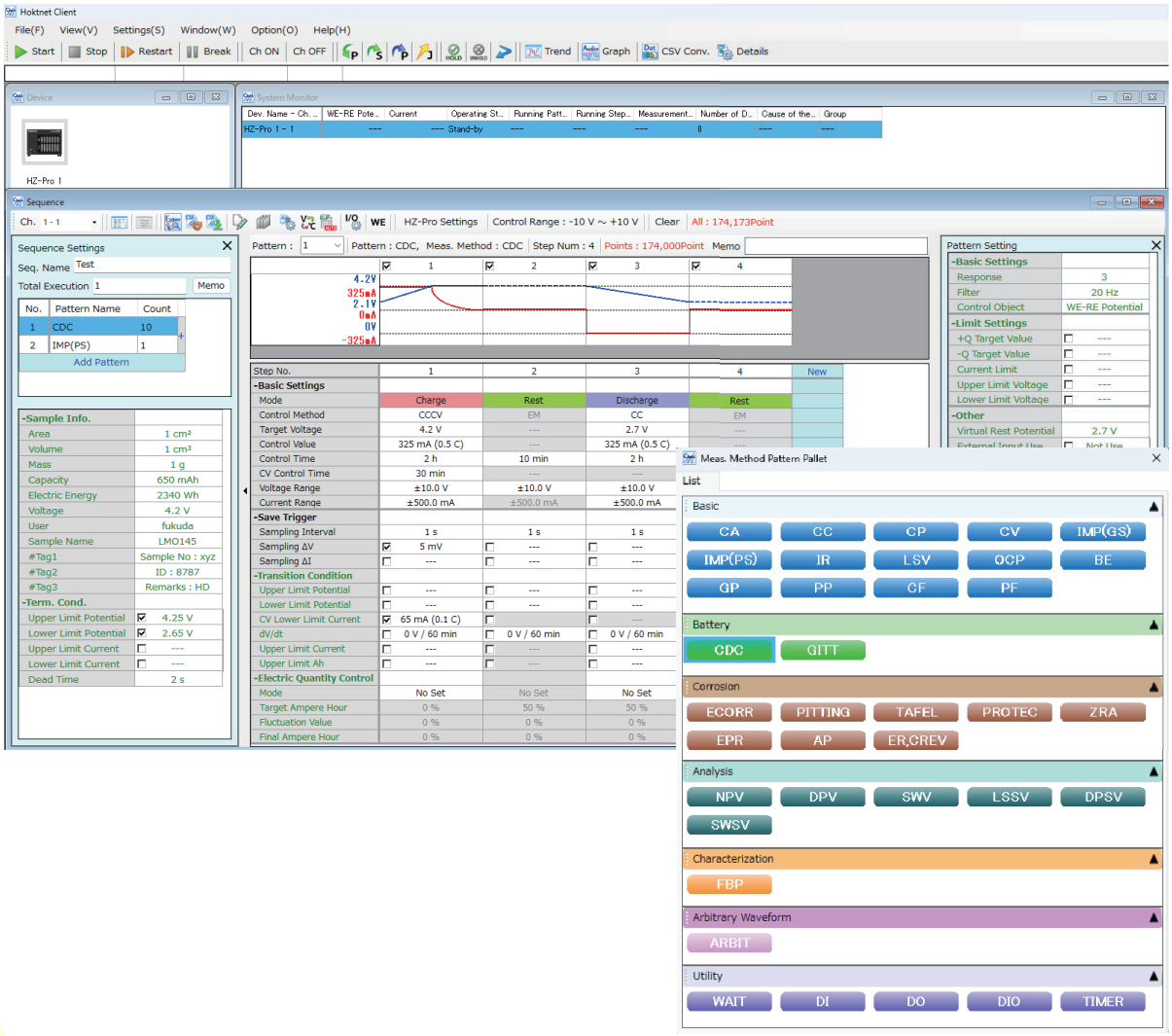
### Hoktnet Explorer

Collectively manages measurement conditions, measurement data, and CSV files.



# Hoktnet Client

Allows flexible arrangements of measurement conditions with intuitive operation. Schematic diagrams visualize control waveforms, and a host of support features allow for detailed settings and customer-specific operating conditions.




# Hoktnet Dat

Converts measurement data into CSV files. The CSV file can be saved in a number of save formats, including Time Series, Cycle Series, Step Series, ZView Series, and EIS Series.

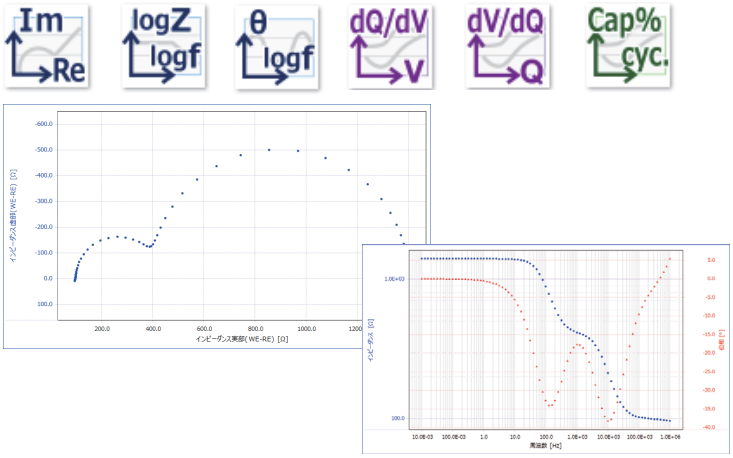
# Hoktnet Explorer

Collectively manages measurement conditions, measurement data, and CSV files. Desired files are found quickly by using advanced filtering and search functions, and past measurement data can be referenced from measurement histories. Important measurement data can also be organized together using the filing function.

# Hoktnet Analyzer

## Plot type

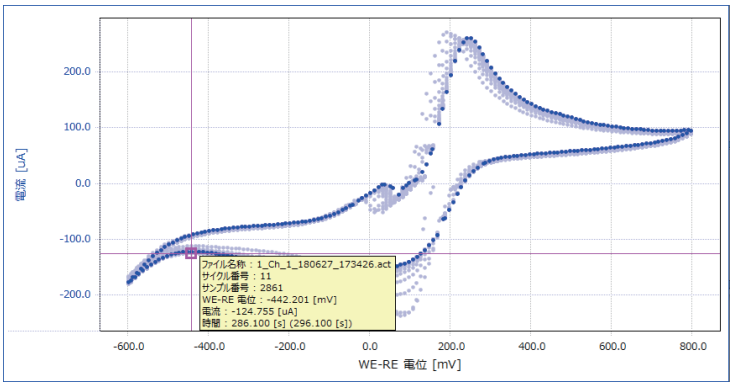
The data display can be switched with one click. Original plots can be created and registered among the measurement patterns.




## Bookmark

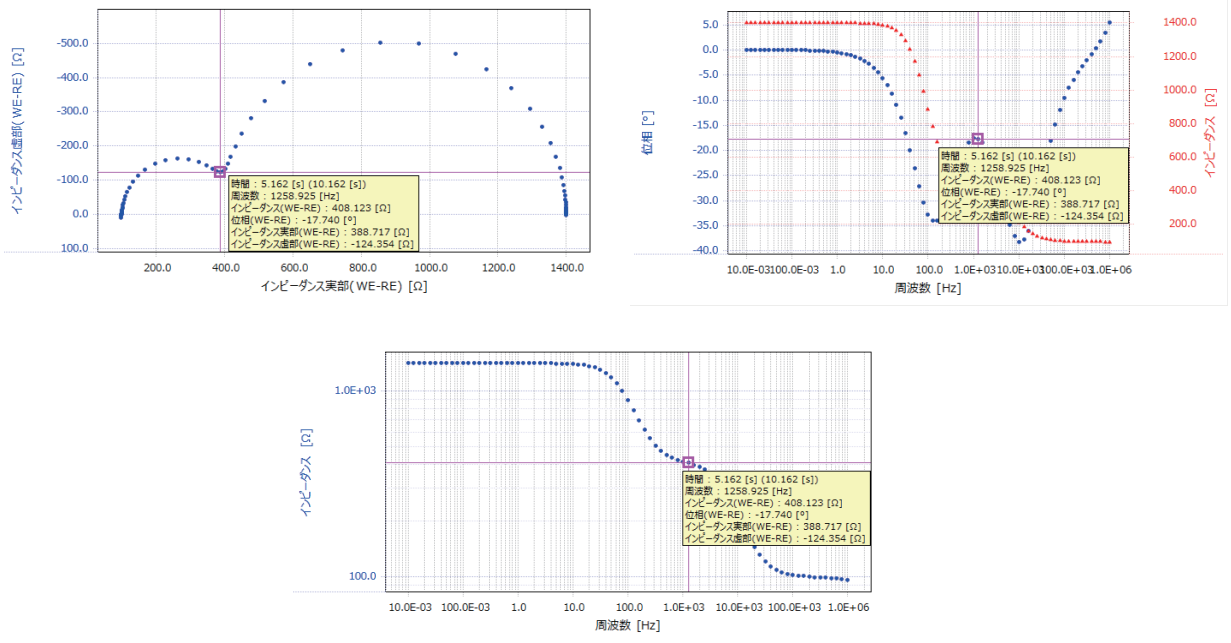
Point data is displayed with labels. By customizing the labels, information that cannot be displayed in 2D can be verified easily.

The labels can be registered in the point data.



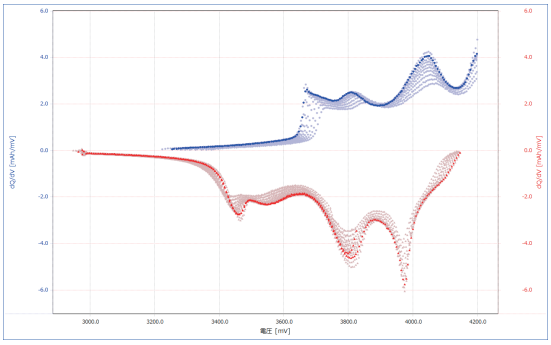

## Multiple graphs

A multiple number of graphs (max. 9 graphs) can be displayed simultaneously. The linkage of point data allows easy data comparisons.

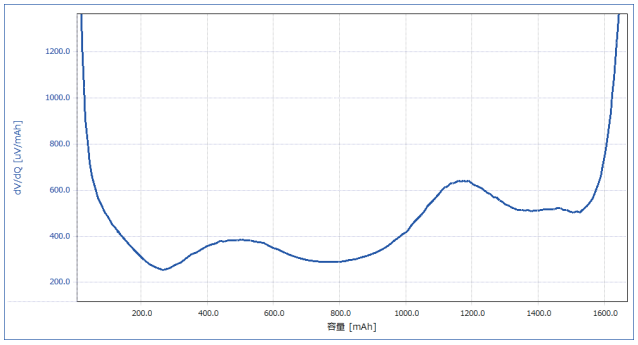


## Data series

Compatible with various data series, including dV series.



dQ/dV curves (LiB 18650)



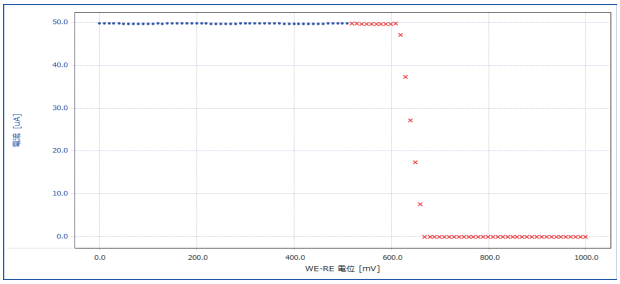
dV/dQ curve (LiB 18650)

## Analysis function

Supports parameter designated analysis to intuitive analysis based on graph manipulation. Field-specific analyses can be easily executed.

## Sample making

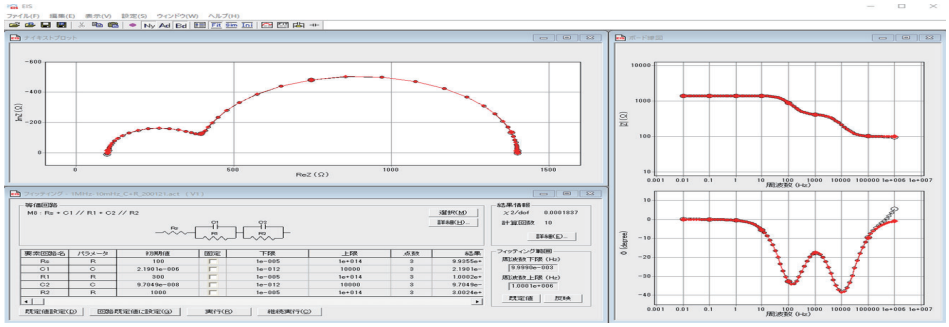
Displays out-of-range data as sample information in a graph for easy identification of abnormal data.




# EIS

## Equivalent circuit and fitting

An equivalent circuit can be created and the value of each element determined with a simple operation.



# HZ-Pro Product Specifications

## Base unit

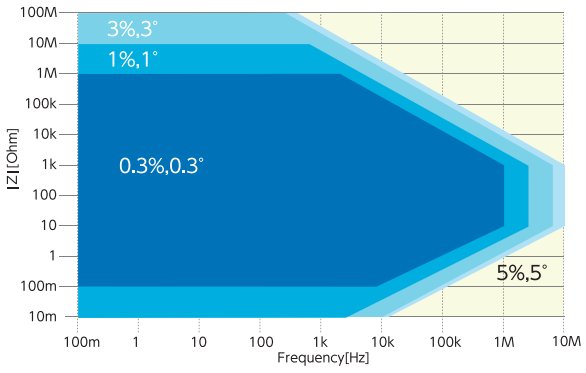
| Item | Specification | | |
|---|---|---|---|
| Model | HZ-ProS2A | HZ-ProS4 | HZ-ProS12 |
| No. of channel slots | 2 | 4 | 12 |
| External dimensions*1 W x H x D (mm) | 370 x 150 x 480 | 256 x 350 x 500 | 440 x 350 x 500 |
| Max. power consumption | 250VA | 600VA | 1700VA |
| Weight*2 | < 5.8kg | < 9.5kg | < 14.3kg |
| Power supply | Φ1 AC100V～240V ±10% 50/60Hz | | |

*1 Does not include protruding parts *2 When no board is mounted

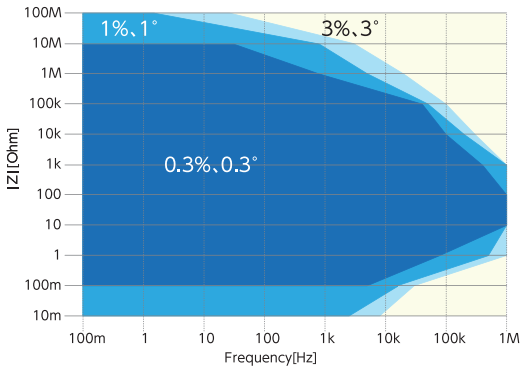
## PGS board

| Item | Specification | |
|---|---|---|
| Model | HZA-PGS111 | HZA-PGS101A |
| Max. output voltage | ±12V | |
| Max. output current | ±500mA | |
| Control voltage | ±10V | |
| Min. control voltage resolution | 160nV | |
| Current control resolution | 0.004% of the range | |
| Voltage control accuracy | ±0.03% of the setting ±1mV | |
| Current control accuracy | 500mA～5μA range: ±0.03% of the setting ±0.08% of the range<br>500nA range: ±0.03% of the setting ±0.1% of the range<br>50nA range: ±0.03% of the setting ±0.16% of the range | |
| Voltage control response speed*3 | 2μS | |
| Voltage detection range | ±10V、±2.5V、AUTO | |
| Voltage detection accuracy | ±0.03% of the reading ±1mV | |
| Input bias current | < 10pA | |
| Input impedance | > 1TΩ | |
| Current detection range | ±500mA～±50nA (8 ranges), AUTO | |
| Current detection accuracy | 500mA～5μA range: ±0.03% of the reading ±0.08% of the range<br>500nA range: ±0.03% or the reading ±0.1% of the range<br>50nA range: ±0.03% of the reading ±0.16% of the range | |
| Impedance (optional) Measurement frequency range | 10μHz～10MHz | 10μHz～ 1MHz |
| AUX | External analog control input, trigger IO × 2, analog input × 2, analog record output (V, I), stop input, hardware error output | |
| Weight | < 0.7kg | |

*3 At no load




HZA-PGS111 impedance accuracy map

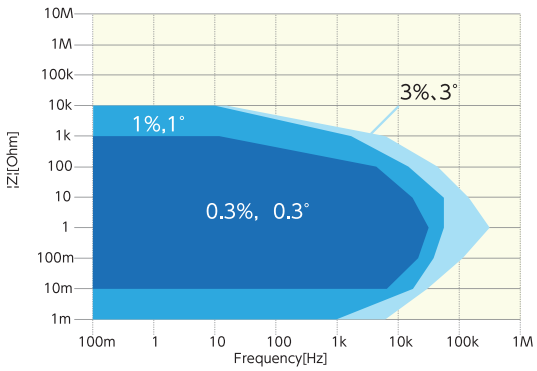



HZA-PGS101A impedance accuracy map

## Booster

| Item | Specification | | | |
|---|---|---|---|---|
| Model | HZA1005 | HZA5001 | HZAP0312 | HZAP0612 |
| Max. output voltage | ±10V | ±50V | ±3V | -0.1V～+6V |
| Max output current | ±5A | ±1A | ±100A | |
| Current range | ±5A*1、±500mA | ±1A*1、±100mA | ±100A、±10A、±1A | |
| Current control accuracy | ±0.2% of the range | ±0.3%±500pA of the range | ±0.3% of the range | |
| Current detection accuracy | ±0.2% of the range | ±0.3%±500pA of the range | ±0.3% of the range | |
| Current control response speed | ≒300μs*2 | <50μs(No lord) | ≒600μs*3 | |
| External dimensions*4 W x H x D (mm) | Inserted in the base unit | Inserted In the base unit | 440 x 350 x 500 | |
| Max. power consumption | 130VA per board | 115VA per board | 1800VA | |
| Weight | <1.2kg | <1.2kg | <30kg | |
| Power supply | Supplied from the base unit | Supplied from the base unit | Φ1 AC 200V～240V±10% 50/60Hz | |

*1 Range x Number of parallels = Actual current range *2 At a control value of 5A and load of 100mΩ *3 At a control value of 100A and load of 1mΩ *4 Excluding protruding parts




HZAP0312 and 0612 impedance accuracy map

## Measurement method

| Item | Measurement method |
|---|---|
| Basic measurement | OCP (OCV), CA, CC, CP, CV, LSV, BE, IR, Electrochemical impedance spectroscopy<br>Potential pulse, current pulse, potential function*4, current function*4 |
| Charge/discharge measurement | CC mode, CCCV mode, CP mode, CCCP mode, GITT, CR mode (discharge only) |
| Corrosion measurement | REST potential, pitting potential, TAFEL, protective potential, zero shunt ammeter, reactivation rate, anodic polarization, crevice erosion repassivation potential |
| Analysis | NPV、DPV、SWV、LSSV*5、DPSV*5、SWSV*5 |
| Other | Flat band potential, arbitrary waveform*6 |

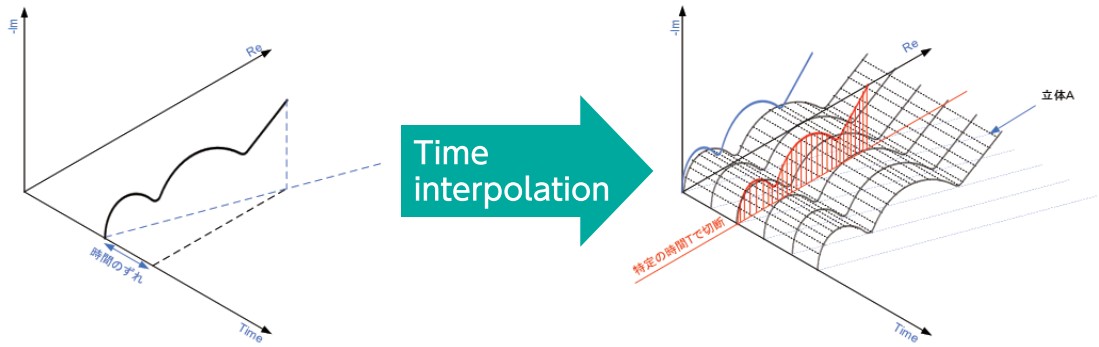
*4 Step and sweep measurements can be combined. *5 Stripping voltammetry *6 Potential and current control can be mixed. However, this accompanies a certain amount of step switching time.

## Analysis function

| Item | Analysis method |
|---|---|
| Point data | Arbitrary points, coordinate specification, open circuit potential, measurement start potential, solution resistance |
| Battery & capacitor | DC internal resistance, short-circuit current (lead-acid battery), capacitor capacitance (linear approximation, power conversion), intersection internal resistance |
| CV analysis | Peak recognition, coulomb value, E1/2 |
| Waveform analysis | Maximum/minimum value, average value, integration, length measurement, half-wave potential |
| Corrosion analysis | Pitting potential, reactivation rate |
| Physical properties evaluation | Flat band potential |
| Other functions | Auxiliary line drawing (between two points, linear approximation, horizontal line, vertical line, bisector), waveform processing (moving average, DC removal, difference, translation), data dump, bookmarks, user-defined plot types, zoom display, etc. |

# Technical Note

## In-situ AC impedance analysis function



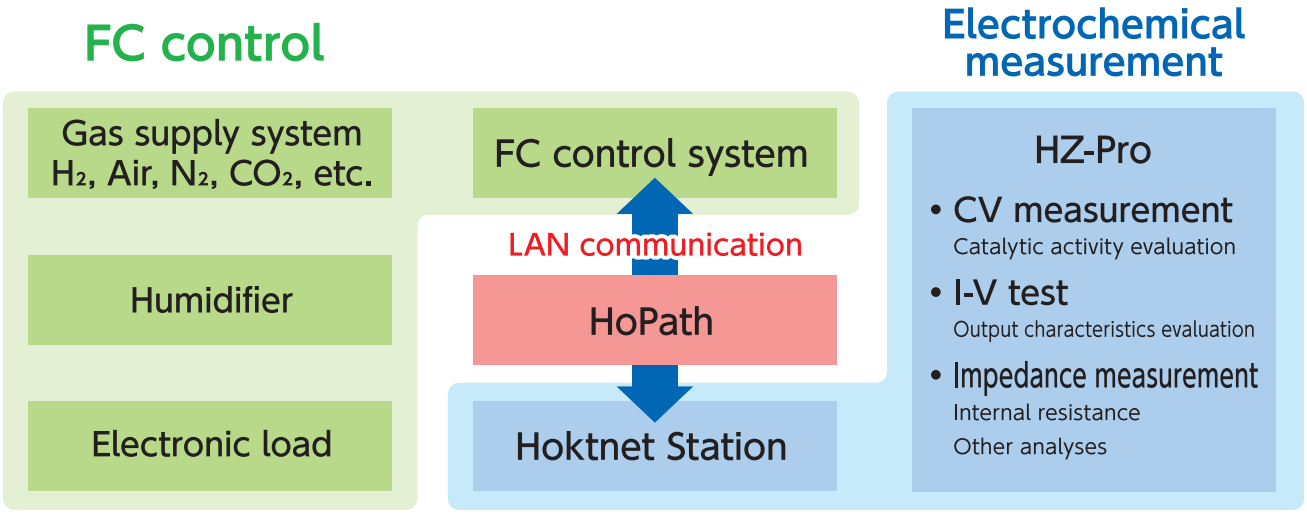

In electrochemical impedance spectroscopy, measuring low-frequency ranges can take time, potentially altering the sample's state during measurement. The in-situ AC impedance analysis function performs instantaneous characterization by time-interpolating multiple continuous data.

## Using HoPath*1 to control HZ-Pro via a custom system *1

Customers can control HZ-Pro from their own system. By setting the start and stop of measurements at any desired timing, a custom system incorporating the HZ-Pro can be realized.

*1 Optional feature

### System configuration example (fuel cell evaluation system)

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■Specifications are subject to change due to improvements in functions and performance.

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