Compact Type
Electrochemical Workstation
ZIVE SP1

Including Internal FRA
10Volts/1Amp
Full Software Package Included

For
Corrosion
Material Testing
Sensor/BioElectrochemistry
Battery/Fuel Cell
Super Capacitor/Solar Cell

WonATech

The ZIVE SP1 is an outstanding Potentiostat/Galvanostat/FRA offered at affordable price. This powerful model is a perfect choice for the complete DC and impedance characterization of various electrochemical applications.

The ZIVE SP1 is equipped with a frequency response analyzer(FRA) for system as standard and it provides high performance impedance measurements over the frequency range 10uHz to 1MHz. The ZRA(zero resistance ammeter) function can measure max. 1 Amp in galvanic corrosion technique. Four(4) advanced software packages, which are catagorized by application field, are provided with the system as standard. Consequently, it widens ZIVE SP1's flexibility.

Features

- Economical high quality Potentiostat/Galvanostat/Impedance Analyzer
- Compact size with full functions
- Smart LCD display
- Wide current ranges(10nA~1A) for various applications
- Built-in FRA : enables EIS tests by using software
- 14 EIS techniques capability including multisine
- Capable of multitude of applications
  - Corrosion, general electrochemistry, sensor, battery, fuel cell, supercapacitor, solar cell, etc.
- Current interrupt IR measurement
  IR compensation(dynamic, positive feedback)
- Bipolar pulse capability
- Voltage pulse or current pulse charge/discharge test(GSM,CDMA etc.), sine wave function for ripple simulation in battery test package & pulse plating available
- High speed data sampling time
  - 2usec or 3usec depending on data point number
- Fast sweep mode(5000V/sec with 10mV data sampling)
- 3 measurement/control voltage ranges & 9 measurement/control current ranges
- Internal 542,000 data point storage & continuing experiment regardless of PC failure.
- Full software package included as standard
  - Corrosion test software package (CORe)
  - EIS test software package (EISe)
  - Electrochemical analysis software package (EASe)
  - Energy software package (BATe)
- Multichannel configuration available
- Free software upgrade


ZIVE SP1 front view

DC Mode

EIS Mode

ZIVE SP1 rear view

Application

The ZIVE SP1 electrochemical workstation is ideal for fundamental research in electrochemistry, development and quality assurance of new sensors, corrosion/coatings, electrode material, membrane, conducting polymer, evaluation power device research such as battery materials, fuel cells, super capacitors and solar cells.

General Electrochemistry
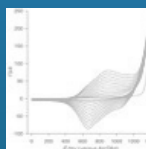
The ZIVE SP1 is also suitable for the development of bio-research, electron transfer kinetic studies or electrochemical analysis of compounds.

Batteries

The system is very well adapted for researches on the cycling behavior of battery. It supports EVS(electrochemical voltage spectroscopy)/ GITT/PITT test. Fast pulse capability for GSM, CDMA test is included in battery test software package. Pulse profile measurement function to check pulse shape is available.   For ripple simulation test, sine wave charging/discharging is available.

Solar Cells
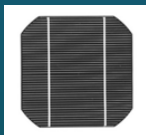
Solar cell development and production require extensive material and device testing to improve efficiency and match individual cells for panel construction. The ZIVE SP1 is the best solution for photovoltaic cell characterization.

Corrosion

The system is suitable for measuring low corrosion rates and EIS test to evaluate corrosion. ZRA function is supplied for galvanic corrosion measurement.

Sensors

The ZIVE SP1 can be used for sensor research using with DNA chips or screen printed electrodes. System's minimum current range is 10nA(with gain).
Cyclic voltammetry, Chronoamperometry and EIS measurement can be used for this application.

Super Capacitors

The ZIVE SP1 has fast potentiostat circuit with high speed data acquisition. This function is well applicable to super capacitors testing. Charging/discharging capability is used for this application

■ Fuel Cells

The ZIVE SP1 is ideal for characterizing the fuel cells and anodic/cathodic process mechanism at development and research grade. This system can be directly used for PEMFC, DMFC, and DEFC etc. Automatic current ranging potentiostatic/galvanostatic IV curve is available.

Smart Manager(SM) Software

The Smart Manager(SM) provides user defined sequential test by using sequence file, technique menu and batch file. The batch file allows the users to do a serial test by combining sequence files and/or technique files.

The SM software is easy to use and supports various electrochemical experiments including functions of system control, schedule file editor, real time graph, analysis graph, user calibration, and data file treatment etc.

Each software package's upgrade will be provided at free of charge.

Basic Techniques

■ Basic Technique with Standard Functions

1) Potentiostatic
2) Galvanostatic
3) Double step potentiostatic
4) Double step galvanostatic
5) OCP measurement
6) Potential sweep
7) Current sweep
8) Cyclic voltammetry
9) Fast potential sweep
10) Potentiostatic Ru measurement
11) Galvanostatic Ru measurement
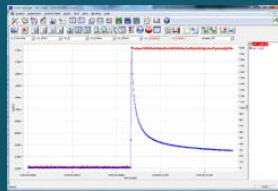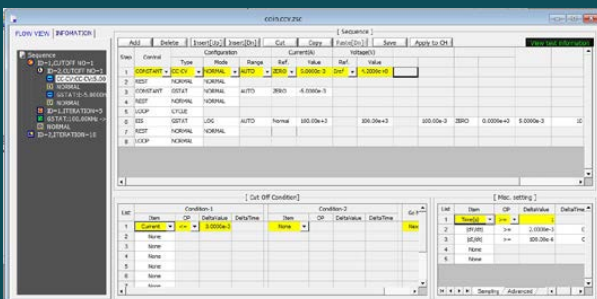

50 usec data sampling
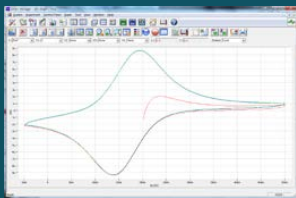
DC graph
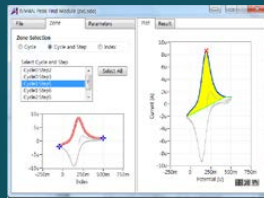
Peak find module

The above functions can be used sequentially by step control function.

■ Sequence Editor

User can design his/her own experiment procedure by using TASK sequential routine editor.

1) Control Task Parameter

Control Mode		
constant	GSTAT	constant current control
	Crate	constant Crate control
	PSTAT	constant voltage control
	POWER	constant power control
	LOAD	constant load control
	CC-CV	constant current constant voltage control
	Crate-CV	Crate constant voltage control
	CP-CV	constant power constant voltage control
	CL-CV	constant load constant voltage control
	Id	Id control
	Is	Is control
	OCP	OCP control
Step	GSTAT	current step control
	PSTAT	potential step control
Sweep	GSTAT	current sweep control
	FAST-G	fast current sweep control
	PSTAT	potential sweep control
	FAST-P	fast potential sweep control
EIS	GSTAT	galvanostatic EIS
	PSTAT	potentiostatic EIS
	OCP	OCP EIS
	PSUEDO	pseudo galvanostatic EIS
	HFR G	galvanostatic HFR
	HFR P	potentiostatic HFR
	MsineG	galvanostatic multisine EIS
	MsineP	potentiostatic multisine EIS
Rest		rest control
ZRA		ZRA control
Loop		loop control
Pulse	Vpulse	voltage pulse control
	Ipulse	current pulse control
	GSINE	current sine wave control
	PSINE	potential sine wave control

- Constant potential, current, C-rate, power, load, OCP
- Sweep potential, current
- Fast sweep potential, current
- Staircase potential, current
- CC-CV, CP-CV, CL-CV, Crate-CV control
- Id, Is control
- EIS control
- Pulse or sinewave control
- Rest(voltage monitoring only)
- Loop(cycle) control

2) Cut-off(Vertex) condition
- Time(step, test, loop, cycle)
- Current, current density
- Voltage
- Capacity
- C-rate
- -dV
- |dV/dt|
- |dI/dt|
- Aux1
- Eoc
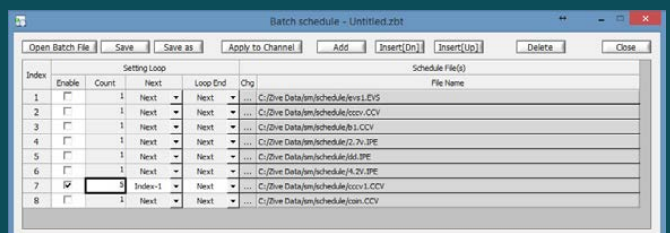- etc.

Cutoff Condition

3) Sampling Condition
- time, |dI/dt|, |dV/dt|, |dA1/dt|, burst time

4) Flow View
This displays sequence flow at a glance.

■ Batch Function

User can design batch file including multiple technique files and/or sequence files. With this batch file, user can experiment several techniques/sequence in series automatically.

Advanced Software Packages

For a wide range of application, following software packages are provided as standard.

■ EIS Software Package (EISe)

1) Potentiostatic EIS
2) Galvanostatic EIS
3) Pseudo galvanostatic EIS
4) OCP(*1) EIS
5) Potentiodynamic PEIS
6) Galvanodynamic GEIS
7) Potentiodynamic HFR
8) Galvanodynamic HFR
9) Potentiostatic HFR monitor
10) Galvanostatic HFR monitor
11) Multisine potentiostatic EIS
12) Multisine galvanostatic EIS
13) Intermittent potentiostatic EIS
14) Intermittent galvanostatic EIS

(*1) The system measures open circuit potential before each frequency change and applies AC sine wave on this potential.
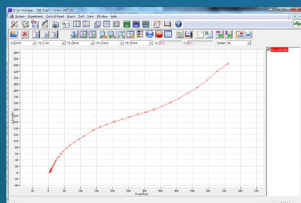
OCV EIS
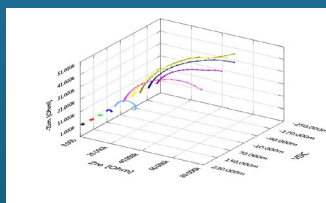
Potentiodynamic PEIS
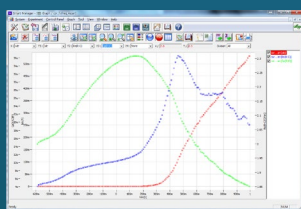
Rs, Cp & Idc vs Vdc plot
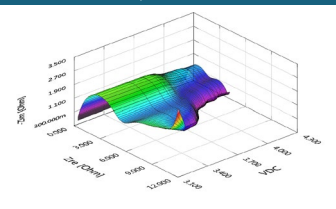
Coin Cell Intermittent PEIS
3D Nyquist Plot By ZMAN

■ Energy Software Package (BATe)

BATe software supports IR measurement.
1) Battery Test Technique
   • CC/CV test for cycle life test of lithium battery
   • CC/CC test for cycle life test of NiCd & NiMH battery
   • Discharging test
   • EVS (Electrochemical voltage spectroscopy)
   • Variable scan rate CV
   • Potentiostatic IV curve
   • Galvanostatic IV curve
   • Steady state CV
   • GITT
   • PITT
   • Pulse mode is available for GSM & CDMA profile.
   Pulse shape profile can be measured by user's demand.
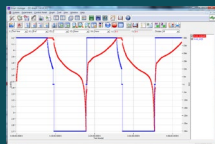
CC/CV test
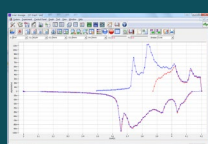
EVS

Pulse shape profile monitor
(micro sec order)

Current sine wave
(charge ripple simulation)

2) Control Mode
   • Charge: CC, CC-CV, pulse, sine wave
   • Discharge: CC, CP, CR, pulse, sine wave

3) Cutoff Condition
   • Time, voltage, current, power, auxV etc.

Various battery charge/discharge test is available including pulse discharge for GSM, CDMA application.

### ■ Electrochemical Analysis Software Package (EASe)

1) Step Techniques
   • CA (Chronoamperometry)
   • CC (Chronocoulometry)
   • CP (Chronopotentiometry)
2) Sweep Techniques
   • LSV (Linear Sweep Voltammetry)
   • SDV (Sampled DC Voltammetry)
   • Fast CV
   • Fast LSV
3) Pulsed Techniques
   • DPV (Differential Pulse Voltammetry)
   • SWV (Square Wave Voltammetry)
   • DPA (Differential Pulse Amperometry)
   • NPV (Normal Pulsed Voltammetry)
   • RNPV (Reverse Normal Pulse Voltammetry)
   • DNPV (Differential Normal Pulse Voltammetry)
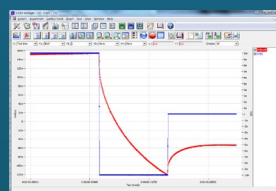
50 usec sampling
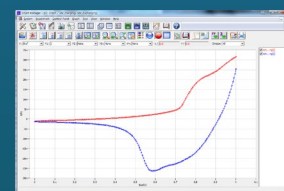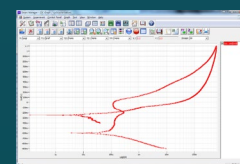

sdv_charging/sdv_discharging
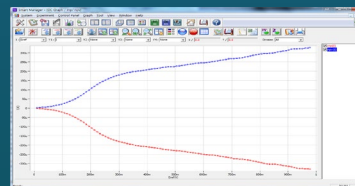
NPV & RNPV overlay

■ Corrosion Software Package (CORe)
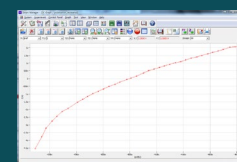
Corrosion technique supports IR compensation.

1. Tafel(Tafel experiment)
2. Rp(Polarization resistance)
3. Potentiodynamic
4. Galvanodynamic
5. Cyclic polarization
6. Ecorr vs. time
7. Galvanic corrosion
8. RpEc trend
9. Reactivation potential
10. Critical pitting potential

Cyclic polarization resistance
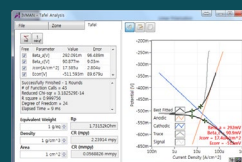
Tafel plot

Polarization resistance

Control & Real Time Graph

Smart Manager Program provides virtual control panel for control & data acquisition with real time graph.
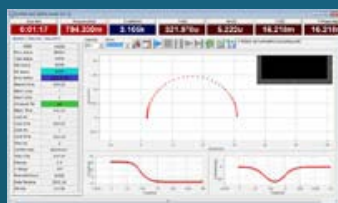

Multichannel real time graph

User can control and monitor in this control panel and he/she can monitor data in VOI (Value Of Interest) window and channel status in one window. Real time graph's X Y axis format will be changed per technique automatically. It can be defined by user's demand per technique. For experiment using sequence file or batch file, user can designate X,Y axis parameter on three different real time graph.

Each real time graph format can be also selected. Real time graph and VOI will be changed depending on DC test or impedance test automatically. Virtual control panel always displays the graph for recent test result. For impedance measurement, wave monitor will be displayed on real time graph to check wave's quality. This monitor can be switched to Lissajous (I vs. E) plot.

Single channel control panel

Multichannel real time graph

Strip Chart
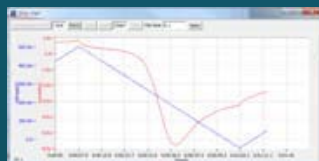
Strip chart recorder function allows you to monitor DC curve in real time. You can monitor 2 Y axis data such as voltage, current, auxV, power, capacity etc. in real time

Graph

Smart Manager's graph function is to simplify the operation. There are 3 kinds of graph per each experiment. You can change X, Y1, Y2, Y3, Y4 axis parameter as you want. Each graph provides shortcut buttons. When you click these buttons, the format of the graph will be changed accordingly.
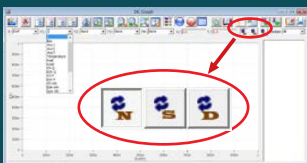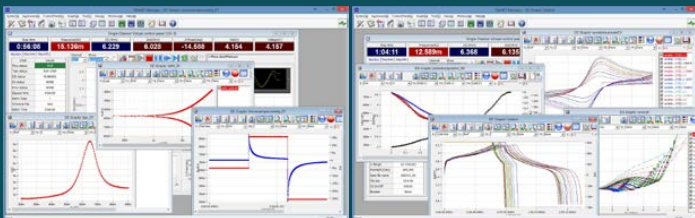

In DC and Cycle graph, whenever you click ![s] or ![d] the parameters which are related to current such as current, capacity, energy, power, load, etc., are changed into calculated specific value or density value, respectively.

![s] : value divided by weight   ![d] : value divided by active area

1) DC Graph
  • For general data display
  • 4 shortcut buttons: I vs. V, E vs. LogI, V, I vs. time, V vs. Q
  • Graph parameters: Time, Eref, I, Eoc, Id, Aux1, LogI, Load, ChQ, DchQ, ChQs, DchQs, Ch P, Dch P, Ch-Wh, Dch-Wh, Sum Wh, Sum Q, Sum |Q|, |Q|, Rp, dQ/dV
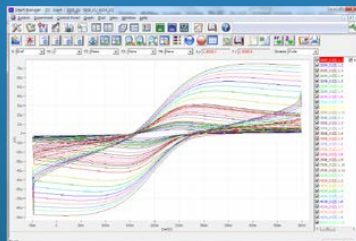

2) EIS Graph
  • For EIS data display
  • 3 shortcut buttons: Nyquist plot , Bode plot, Cs vs. frequency
  • Graph parameters: Frequency, Zre, -Zim, Zmag, Zph, Y', Yimg, Y, |Y|, Yph, LogZ, LogY, Rs(R-C), Cs(R-C), Rp(R|C), Cp(R|C), Rs(R-L), Ls(R-L), Q(R-L), time, Vdc, Idc, Aux1
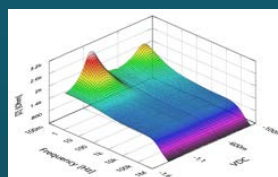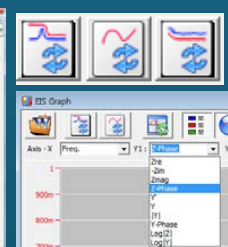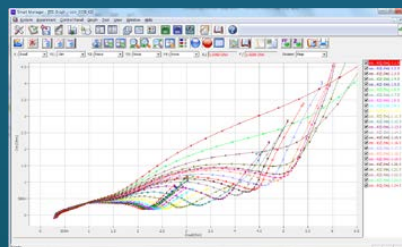

3D Bode Plot by ZMAN
Technique used: Potentiodynamic Impedance Measurement By Using A Corrosion Cell

3) BAT Graph
  • For battery cycle data display
  • 3 shortcut buttons: cycle capacity, cycle average, Log(cycle No) vs. depth of discharge plot.
  • Graph parameters: cycle number, Ch Q, Dch Q, Sum Q, Coulomb Eff, Ch-Wh, Dch-Wh, Sum Wh, Energy Eff, MinV, MaxV, ChQs, DchQ, ChVavg, DchVavg, Vavg
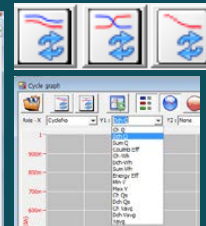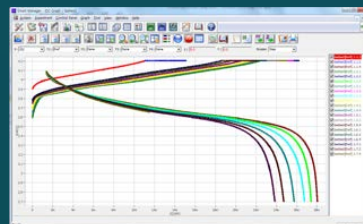
■ *Data Export to ASCII & Excel File*
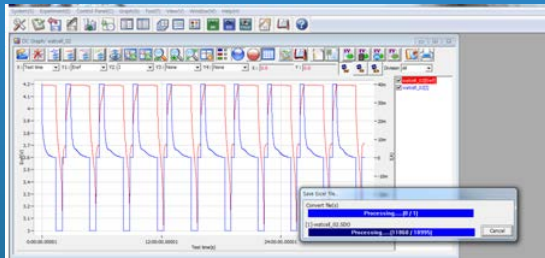
Selectable between 'Convert data on graph only' and 'Convert selected file(s)'

Data Analysis Software

ZIVE data file can be used for analysis by using external IVMAN™ software for DC analysis, IVMAN DA™ software for battery data analysis, IVMAN PA™ software for photo-voltaic cell data analysis and ZMAN™ software for EIS data analysis without license.

ZMAN™ EIS Data Analysis Software

• Model simulation and fitting
• 2D- and 3D-Bode- and Nyquist plots
• Automatic equivalent circuit model search function
• Project concept to handle multiple EIS data analysis
• Parameter plot from fitted elements value
• Compatible with data format from Zahner, Gamry, Ametek etc.
   (License code is needed.)
• Various weighting algorithm
• Model library and user model
• KK plot
• Batch fitting for project data
• Impedance parameter simulation
• Interpolate bad data
• Black-Nichols plot
• 3D graph setting option
• Improved model editor
• Application model library for automatic searching
• Parameter simulation of model
• Genetic algorithm option for initial guessing
• Automatic initial guessing
• Trace movie function on fitting
• Free for ZIVE's data format(*.seo, *.wis) analysis
   (No license code required.)
• Circle fitting
• Data editing available (insert, delete, edit)
• Add/subtract element parameters
• Add/subtract model parameters
• Impedance, Z in polar, admittance, Y in Polar, modulus, M in polar,
   dielectric constant, E in polar. data display
• Empty cell capacitance calculation
• Find file function
• Data replacement by formula function
• Cursor data display
• Model finding result automatic sorting by Chi square value
• R, C R, L R, Q preview & graphic
• ZHIT function
• Mott-Schottky analysis
• Donor density vs. Vfb graph
• C vs. voltage graph

WonATech
ZMAN™ 2.2
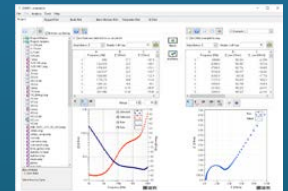Impedance
Spectroscopy
Analysis & Presentation
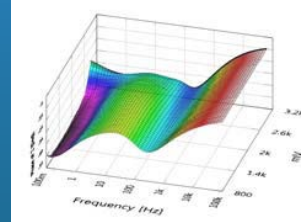
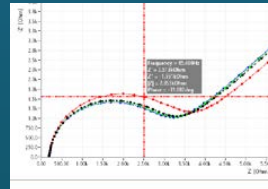3D Bode plot for series measurement
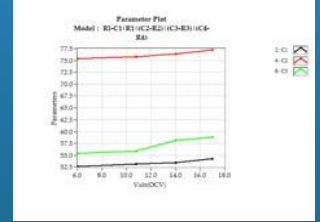
Parameter plot
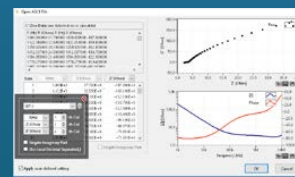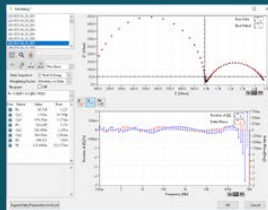

Importing 3rd parties ASCII data file

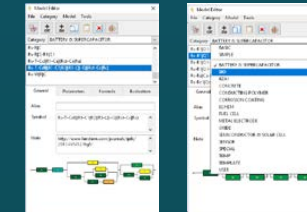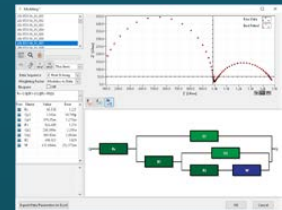Project manager with data preview

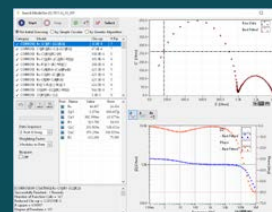
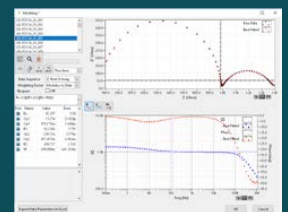Cursor data display

Data replacement by formula function

Fitting display

Model editor & model library
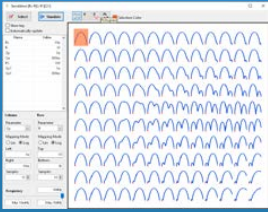

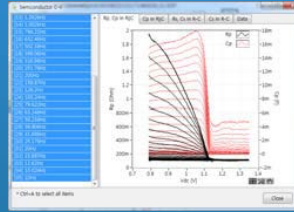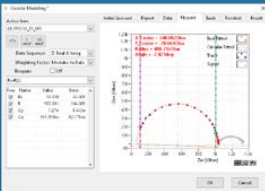Automatic model searching

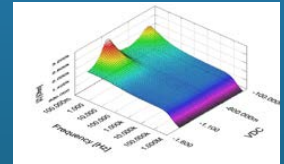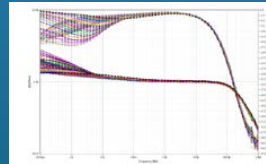LEVM fitting

Parameter simulation
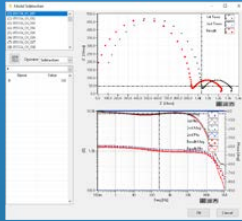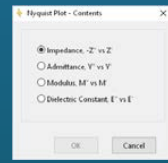

Element add/subtraction

C/R-V graph

Finding data file menu
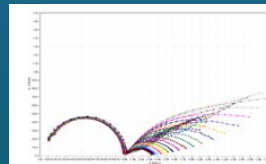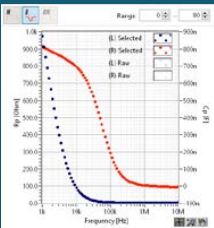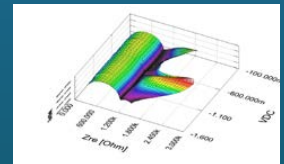

Circular fitting

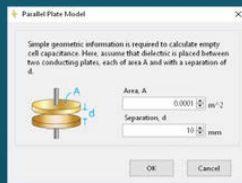

2D Nyquist plot

2D Bode plot

Bode & Nyquist overlay & 3D plots

Rp,Cp vs frequency (R | C)

Empty cell capacitance

IVMAN™ DC Data Analysis Software

IVMAN™ software package consists of
• IVMAN software
• IVMAN utilities
  - IVMAN differential analysis software
  - IVMAN photo voltaic cell analysis.
  - IVMAN Tafel analysis
  - IVMAN extractor
  - IVMAN peak find module
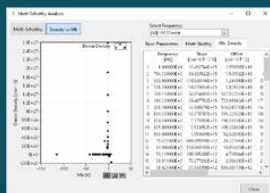
Donor density vs. Vfb graph and analysis

KK consistency

IVMAN DA™ Battery Test Data Analysis Software

• Battery test data analysis
• Electrochemical voltage spectroscopy (dQ/dV vs. V)
• Voltage vs. Capacity analysis (V vs. Q)
• Cycle graph (Q vs. cycle)
• Differential voltage graph(dV/dQ vs. Q)
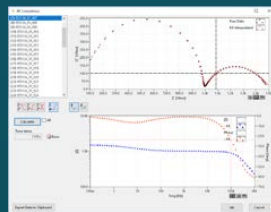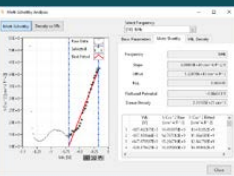
Mott-Schottky analysis window

Measured data

V vs. Q
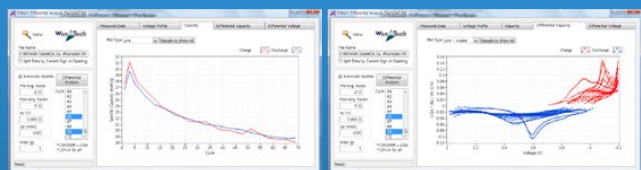
Cycle graph

dQ/dV vs. V
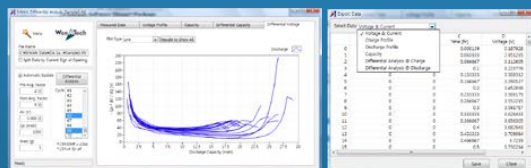
dV/dQ vs. Q

Export ASCII file
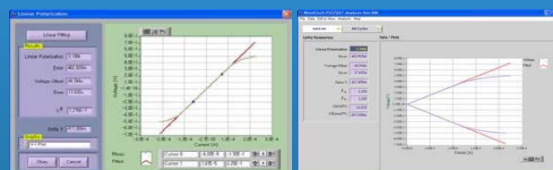
Polarization resistance fitting

Polarization analysis result
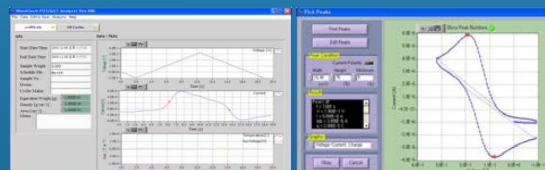
Time graph

Find peak menu
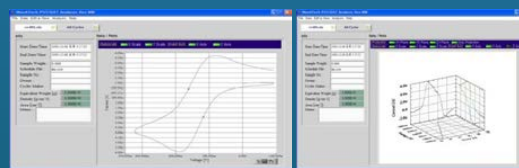
CV graph

3D graph
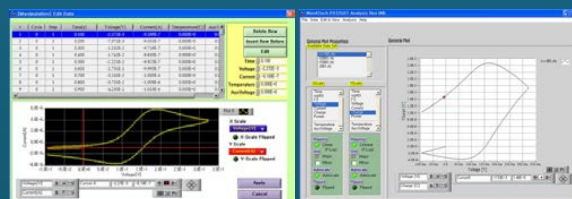
Edit data menu

Universal graph

IVMAN™ Photovoltaic Cell Analysis
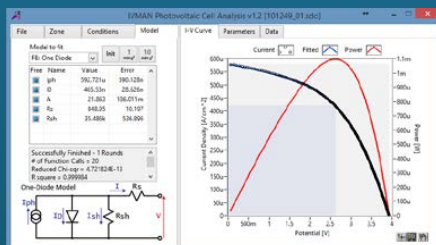
• Automatic analysis of parameters
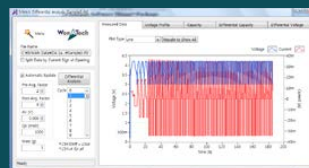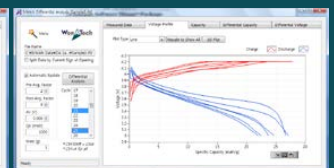 : open circuit voltage, open circuit current, max. power, efficiency
   photo induced current, diode quality factor, series resistance, etc.

IVMAN EX™ Extractor

• Extracting data by cycle number or step
• Exporting ASCII file

IVMAN TA™ Tafel Analysis

• Simple Tafel calculation
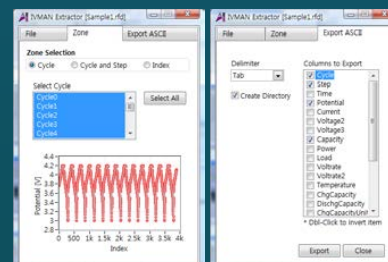
IVMAN PF™ Peak Find Module

• Independent peak finding software
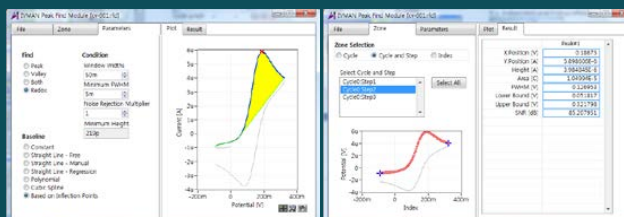
IVMAN™ Main Software

• Ideal for DC corrosion data analysis and electro-analytical
  data analysis
• Initial guessing function on Tafel analysis
• Polarization resistance fitting
• 3D graph
• Find peak function
• Interpolation, differentiation, integration etc.
• Reporting function

Optional Accessories

- Power Booster
  - for high voltage/high current application
  - modular type design
  - EIS capability
  - sine wave simulation available

- Battery Jig & Pouch Jig
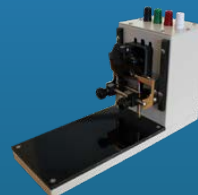
Corrosion Cell Kit

Flat Cell Kit

Permission Cell Kit

Plate Test Cell

Plate Test Cell

Universal electrode holder

Black Box for photo-electrochemistry

Faradaic cage

Flat specimen holder

Through-Plane Conductivity Test Jig

Copper Alligator electrode holder

Pt plag electrode
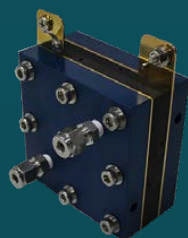
- Single Cell Hardware Fixture
  - for PEMFC and DMFC
  - max. temp. : 120°C or 180°C
  - active area : 5, 25 cm²
  - MEA is not included.
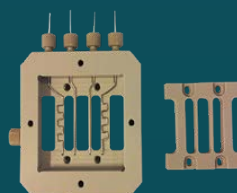
membrane conductivity cell

Specification

Main System

PC communication	USB2.0 high speed
Line voltage	100~240VAC, 50/60Hz, 1Amp
Power adapter	24V 2.5Amp
Size/weight	160x329.4x83.3mm(WxDxH) / 2.5Kg
Max. output power	12Watt

System

Cell cable	1 meter shielded type(standard) working, reference, counter, working sense, Auxiliary V
Control DAC	DSP with FPGA 2x16bit DAC(50MHz) for bias & scan
Data acquisition ADC	2x16bit ADCs(500kHz) for voltage, current 1x16bit ADCs(250kHz) for auxiliary reading
Calibration	Automatic
Filter selection	4ea(5Hz, 1kHz, 500kHz, 5MHz)
Scan rate	0~200V/sec in common mode 0~5000V/sec in fast mode
Max. channel No.	8 channels via USB connection
Internal data memory	542,000 points

Power Amplifier(CE)

Power	12Watt (12V@1A)
Compliance voltage	±12V
Max. current	±1A
Control speed selection	4ea
Bandwidth	2MHz
Slew rate	10V/usec

Potentiostat Mode (voltage control)

|	
Voltage control	
Control voltage range	±10V, ±1V, ±100mV
Voltage resolution	16 bit per each range
Voltage accuracy	±0.02% f.s(gain x1)
Max. scan range	±10V vs. ref. E
Current measurement	
Current range	9 ranges(auto/manual setting) 10nA ~ 1A 10nA with gain
Current resolution	16 bit 30uA,3uA,300nA,30nA,3nA,300pA,30pA,3pA (300fA with gain)
Current accuracy	±0.05% f.s.(gain x1)>100nA

Galvanostat Mode (current control)

Current control	
Control current range	max. ±1A ± full scale depending on selected range
Current resolution	16 bit 30uA,3uA,300nA,30nA,3nA,300pA,30pA,,3pA (300fA with gain)
Current accuracy	±0.05% f.s.(gain x1)>100nA f.s.
Voltage measurement	
Voltage range	10V, 1V, 100mV
Voltage resolution	16 bit 0.3mV, 30uV, 3uV
Voltage accuracy	±0.02% f.s(gain x1)

Electrometer

Max. input voltage	±10V
Input impedance	$2 \times 10^{13}\Omega | | 4.5pF$
Bandwidth	>22MHz
CMRR	>114dB

EIS(Internal FRA) for System

Frequency range	10uHz~1MHz
Frequency accuracy	0.01%
Frequency interval setting (Point / Decade)	Max. 1000/decade (<43mHz) Max. 5000/decade (>43mHz)
Amplitude	0.1mV~5V rms (Potentiostatic) 0.1~70% f.s. (Galvanostatic)

Mode	**Static EIS:**
	   Potentiostatic, Galvanostatic,
	   Pseudogalvanostatic, OCP
	Dynamic EIS:
	   Potentiodynamic, Galvanodynamic
	Fixed frequency impedance:
	   Potentiostatic, Galvanostatic,
	   Potentiodynamic, Galvanodynamic
	Multisine EIS:
	   Potentiostatic, Galvanostatic
	Intermittent EIS:
	   Potentiostatic, Galvanostatic
	Real time EIS:
	   Potentiostatic, Galvanostatic

Interfaces for System

Auxiliary voltage input	1 analog input: ±10V
Zero resistance ammeter	100nA~1A ranges
Auxiliary port	
I2C communication	I2C to control external devices
Digital output	3 (open collector)
Digital input	1 (photo coupler)

Smart LCD Display

DC mode	Control value, E value, I value E range, I range
EIS mode	Frequency, Magnitude, Phase E range, I range
Operation status	Mode: PST, GST, ZRA, EIS, CC,CV,CP,CR Status: Cell On, Run, Error

Software

Max. step per experiment	1000
Shutdown safety limits	Voltage, current, power, AuxV etc.
Max. sampling rate	2usec or 3usec depending on data point number
Min. sampling time	Unlimited
Sampling condition	Time, dv/dt, dI/dt, etc.

PC Requirement

Operating system	Windows 7/8/10/11(32bit/64bit OS)
PC specification	Pentium4, RAM 1GB or higher
Display	1600x900 high color or higher
USB	High speed 2.0

General

Dummy cell	One external dummy cell included
Impedance analysis S/W	ZMAN™ software
DC data analysis S/W	IVMAN™ software package

The specifications are subject to change without notice.
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Designed by

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