6th edition

Designed by ZIVE LAB

Multichannel Electrochemical Workstation ZIVE MP1

Including Internal FRA 10Volts/1Amp

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

WonATech

Electrochemical Workstation ZIVE MP1

System Features

- Versatile, high quality multichannel Potentiostat/Galvanostat/Impedance Analyzer
- Standard 4 channel housing system and optional slave channels are also available
- Fully independent channels with 14 EIS technique capability including multisine EIS technique at affordable price
- Compact design with Smart LCD per channel
- Current Interrupt IR measurement
  IR compensation available(dynamic, positive feedback)
- Wide current ranges(10nA~1A) for various application
  (10nA with gain)
- Independent operation by DSP with FPGA per channel
- Built-in FRA in each channel: Impedance measurements
- High speed data sampling time
  - 2usec or 3usec depending on data point number
- Fast sweep mode(5000V/sec with 10mV data sampling)
- Internal 542,000 data point storage and test running regardless of PC failure
- Channel expansion is available up to 16 channels via USB hub
- Full software packages are included as standard
  - Corrosion test software package(COR)
  - EIS test software package(EIS)
  - Electrochemical analysis software package(EAS)
  - Energy software package(BAT)
- Voltage pulse or current pulse charge/discharge test(GSM,CDMA etc) and sine wave function for ripple simulation in battery test package & pulse plating available(Bipolar pulse capability)
- Free software upgrade

- 4 channel housing system

4ch housing system

Channel expansion = master + slave option

1) Example 1
: 6 channel system
= master(4ch) + slave(2ch)

2) Example 2
: 8 channel system
= master(4ch) + slave(4ch)

- 8 channel housing system

8ch housing system

System

The ZIVE MP1, the outstanding multichannel potentiostat/galvanostat/FRA is the best choice for the complete DC and impedance characterization of corrosion, coatings, sensors and other fundamental electrochemical analysis. And also, its versatile functions make it suited to other application including various energy sources and storage such as fuel cells, batteries, solar cells, and super capacitors.

Each channel is designed under FPGA (Field Programmable Gate Array) and DSP(Digital Signal Processor) control with high speed capability.

• DAC control: Two set of high speed 16bit DAC(50MHz) for offset & scanning
• ADC reading: Two set of 16 bit 500kHz ADC for reading voltage/current and 1 channel 16bit 250kHz ADC for auxiliary data input.
It can provide high frequency EIS, fast pulse techniques and high speed sampling time.

The ZIVE MP1's each channel is equipped with a frequency response analyzer(FRA) and Smart LCD as standard. It also provides high performance impedance measurement over the frequency range 10uHz to 1MHz. The ZRA(zero resistance ammeter) function can measure max. 1Amp in galvanic corrosion technique. The system is supplied with four(4) advanced software packages, which are catagorized by application fields. With this advanced software packages, user can widen ZIVE MP1's flexibility.

Versatility

The ZIVE MP1's system comes with one additional analog input(auxiliary voltage input). Each channel can work on same or different experiment at the same time. This model can interface with ZB series external booster for high current applications. The channels are expandable by adding slave channels up to 16 channels.

Safety

- When communication failure occurs between a PC and ZIVE MP1, the running channels will continue experiments and, at the same time, save the data into ZIVE memory up to 542,000 data point set. When the communication is recovered, ZIVE MP1 will transfer saved data to the PC. User can transfer data set from ZIVE MP1 to PC at any time. This function is highly efficient for long-term experiment and protects experiments from unexpected PC failure.
- Users can define safety condition setting by inputting his/her own safety levels for voltage, and current etc. If the measurement value exceeds the setting value, the system will automatically stop to protect the system and cell.
- If the control value of voltage or current is different from the measured value, the experiment will stop automatically to protect the cell.
- Automatic calibration function is supplied for user calibration.

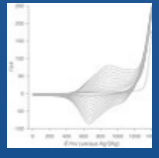
Maintenance

- The system has its own hardware parameters and calibration data.
- Each channel is plug & play type and easy to install or to be removed.

Application

The ZIVE MP1 multichannel 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 MP1 is also suitable for the development of bio-research, electron transfer kinetic studies and electrochemical analysis of compounds at low trace levels, where multichannel DC and impedance analysis is beneficial in providing high throughput of results.

Electrochemical Workstation ZIVE MP1

Corrosion

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

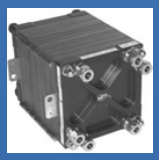
Sensors

The ZIVE MP1 can be used for sensor research using with DNA chips or screen printed electrodes. System's minimum current range is 10nA(with gain) with EIS capability.

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.

Fuel Cells

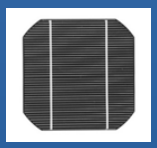


The ZIVE MP1 is ideal for characterizing the fuel cells and anodic/cathodic process mechanism at development and research grade. This system can be directly used for PEMFC, DMFC, and DEFC etc. Automatic current ranging potentiostatic/ galvanostatic IV curve is available.

Super Capacitors

The ZIVE MP1 has fast potentiostat circuit with high speed data acquisition. This function is well applicable to super capacitor testing. Charging/discharging capability is used for this application.

Solar Cells

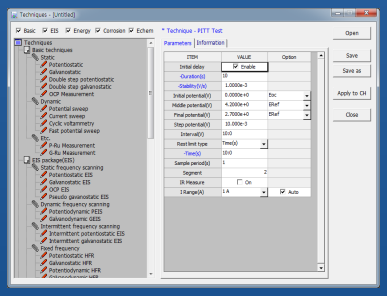


Solar cell development and production requires extensive material and device testing to improve efficiency and match individual cells for panel construction.

Main Software

SM

The Smart Manager (SM) is to control ZIVE MP1 model and it 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.



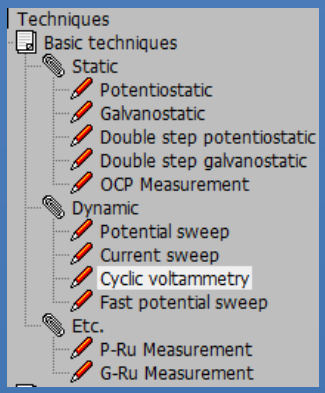
Technique list

Basic Techniques

Basic techniques with standard functions

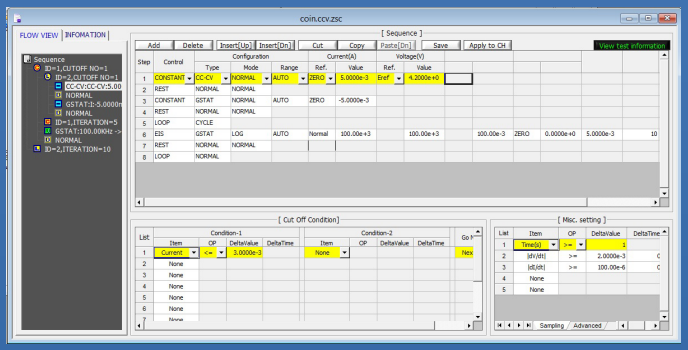
1) Potentiostatic
2) Galvanostatic
3) Double step potentiostatic
4) Double step galvanostatic
5) OCP measurement
6) Potential sweep
7) Current sweep
8) Cyclic voltammetry
9) Fast potential sweep
10) Potentiostatic Ru measurement
11) Galvanostatic Ru measurement

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



Sequence editor

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



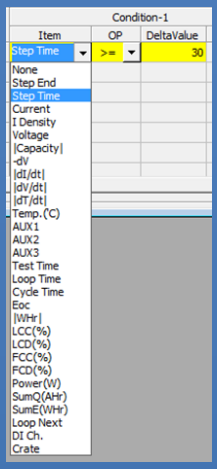
Sequence editor

Control Task Parameters

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

Electrochemical Workstation ZIVE MP1

- 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



Cutoff Condition

Cut-off(Vertex) Condition

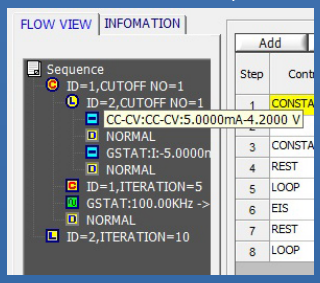
- Time(step, test, loop, cycle)
- Current, current density
- Voltage
- Capacity
- C-rate
- -dV
- |dV/dt|
- |dI/dt|
- Aux1
- Eoc
- etc.

Sampling Condition

- Time, |dI/dt|, |dV/dt|, |dA1/dt|, burst time

Flow View

- User can see the sequence flow at a glance.



Flow view

Batch function

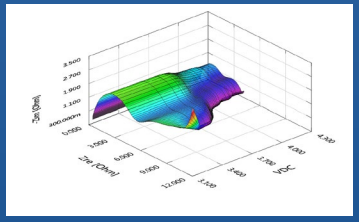
User can design batch file including multiple technique files and/or sequence files. With this batch file, user can experiment several techniques/sequence in series automatically.

Smart Manager Advanced Software Packages

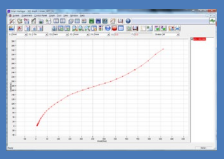
For a wide range of application, advanced software packages for specific experimental techniques are available.

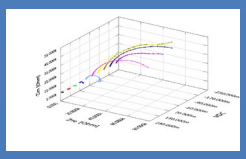
EIS Software Package(EISe)

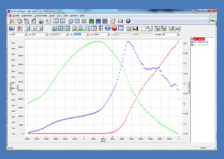
1. Potentiostatic EIS
2. Galvanostatic EIS
3. Pseudo galvanostatic EIS
4. OCP(*1) EIS
5. Potentiodynamic PEIS
6. Galvanodynamic GEIS
7. Potentiodynamic HFR
8. Galvanodynamic HFR
9. Potentiostatic HFR monitor
10. Galvanostatic HFR monitor
11. Multisine potentiostatic EIS
12. Multisine galvanostatic EIS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


Coin Cell Intermittent PEIS
3D Nyquist Plot By ZMAN

(*1) The system measures open circuit potential before each frequency change and applies AC sine wave on this potential.


OCP EIS

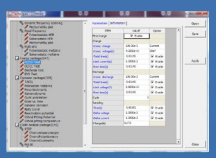
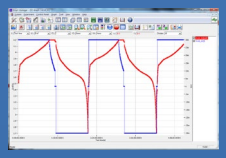

Potentiodynamic PEIS


Rs, Cp & Idc vs Vdc plot

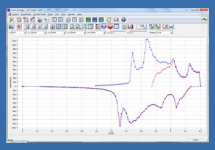
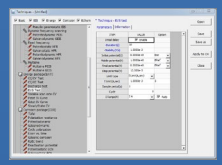
Energy Software Package(BATe)

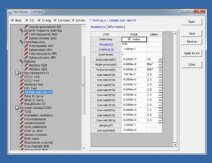
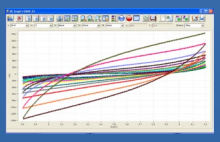
BATe software supports IR measurement.

1. Battery test techniques
   - CC/CV test for cycle life test of lithium battery
   - CC/CC test for cycle life test of NiCd or NiMH battery
   - Discharging test
   - EVS(Electrochemical voltage spectroscopy)
   - Variable scan rate CV
   - Potentiostatic IV curve
   - Galvanostatic IV curve
   - Steadystate CV
   - GITT
   - PITT

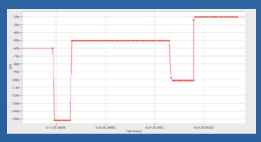


CC/CV test

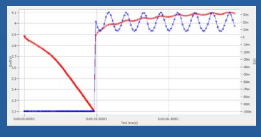

CC/CC test



EVS test



Variable scan rate CV

- Pulse mode is available for GSM & CDMA profile. Pulse shape profile can be measured by user's demand.


Pulse shape profile monitor(micro seconds 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 or GSM and CDMA application.

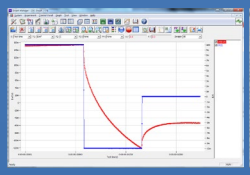
Electrochemical Workstation ZIVE MP1

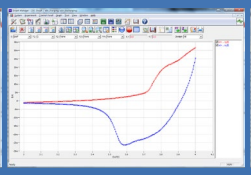
Electrochemical Analysis Software Package(EASe)

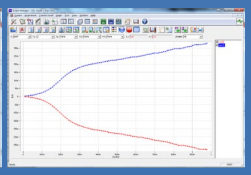
1. Step techniques
   - CA(Chronoamperometry)
   - CC(Chronocoulometry)
   - CP(Chronopotentiometry)

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(Diff. pulse amperometry)
   - NPV(Normal pulsed voltammetry)
   - RNPV(Reverse normal pulse voltammetry)
   - DNPV(Differential normal pulse voltammetry)


50usec sampling

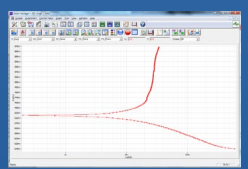

Sampled DC voltammetry

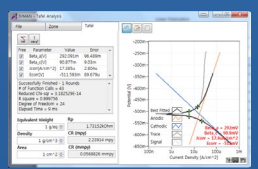

NPV &RNPV overlay

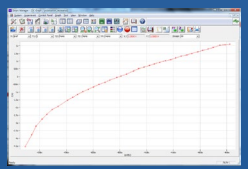
Corrosion Software Package(CORe)

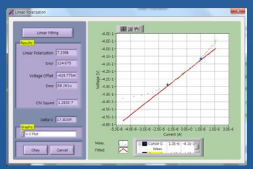
Corrosion technique supports IR compensation.

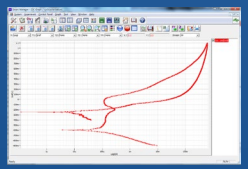
1. Tafel(Tafel experiment)
2. Rp(Polarization resistance)
3. Potentiodynamic
4. Galvanodynamic
5. Cyclic polarization
6. Ecorr vs. time
7. Galvanic corrosion
8. RpEc trend
9. Reactivation potential
10. Critical pitting potential




Tafel experiment




Rp
(Polarization
resistance)

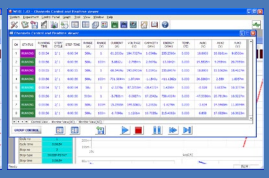

CYPOL(Cyclic polarization resistance)

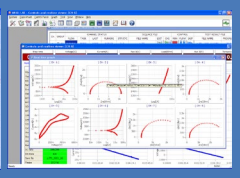
Each software package's upgrade will be provided at free of charge.

Control & Real Time Graph

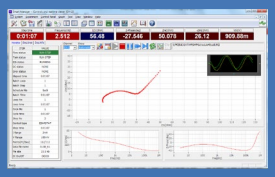
Smart Manager provides 2 kinds of control & data acquisition with real time graph.


Multichannel control panel


Multichannel data monitor
(EIS data/DC data selectable)

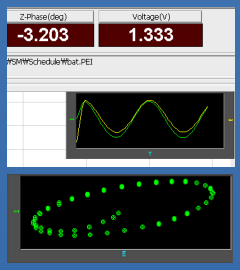

Multichannel
real time graph

User can control and monitor for specific channel in details 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 also defined by user's demand per techniques.

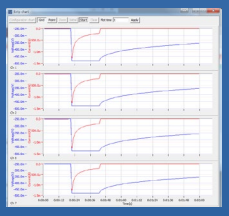


For experiment using sequence file or batch file, user can designate X,Y parameter on three different real time graphs. This graph shows the changes and can monitor and control the channel at the same time.

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.



Strip Chart



Strip chart recorder function provides real graph function independently. You can monitor 2 Y axis data such as voltage, current, auxV, power, and capacity etc. in real time. You can also select channels that need to be monitored and can set maximum data point for strip chart length.

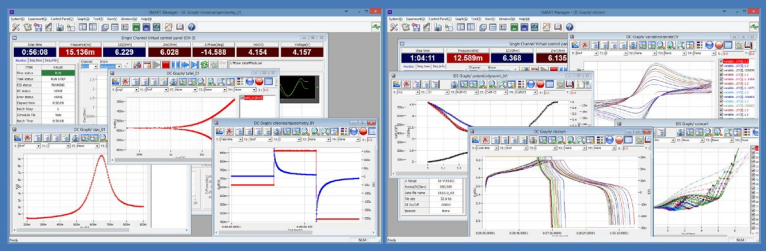
Simple Monitor

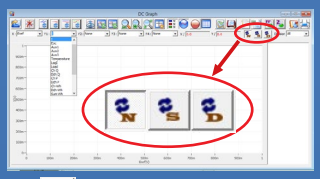
This display window is for monitoring the major data values and channel status for multiple channel operation.

Electrochemical Workstation ZIVE MP1

Graph

Smart Manager's graph function is to simplify the operation. There are 3 kinds of graph per 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 graph format will be changed accordingly.



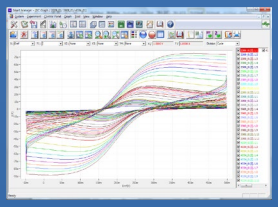


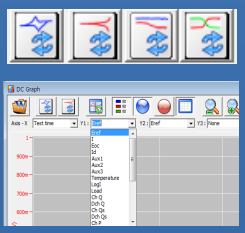
In DC and Cycle graph, whenever you click S or D, the parameters which are related to current such as current, capacity, energy, power, load, etc., are changed into calculated specific value or density value, respectively.

S : value divided by weight D : value divided by active area

1. DC graph

For general data display

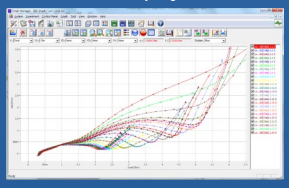


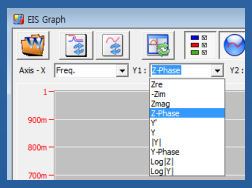


4 Shortcut buttons:
I vs. V, E vs. Logl, V, I vs. time, V vs. Q.
Graph parameters: Time, Eref, I, Eoc, Id, AuxV, Logl, Load, ChQ, DchQ, ChQs, DchQs, Ch P, Dch P, Ch-Wh, Dch-Wh, Sum Wh, Sum Q, Sum |Q|, |Q|, Rp, dQ/dV

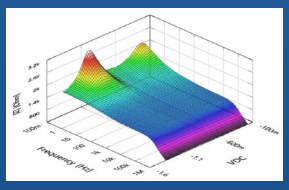
2. EIS graph

For EIS data display





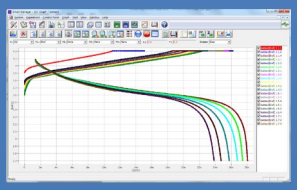
3 Shortcut buttons
Nyquist plot, Bode plot, Cs vs. frequency.
Graph parameters: Frequency, Zre, -Zim, Zmag, Zph, Y', Yimg, Y , |Y|, Yph, LogZ, LogY, Rs(R-C), Cs(R-C), Rp(R|C), Cp(R|C), Rs(R-L), Ls(R-L), Q(R-L), time, Vdc, Idc, Aux(1)

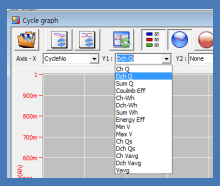


3D Bode Plot by ZMAN
Technique used: Potentiodynamic Impedance Measurement by using a corrosion cell

3. BAT graph

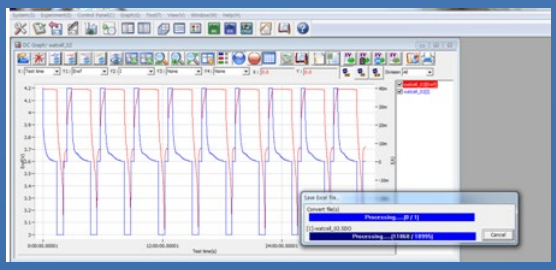
For battery cycle data display





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.

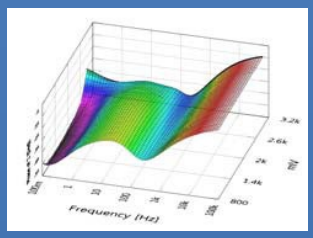
ZMAN™ EIS Data Analysis Software

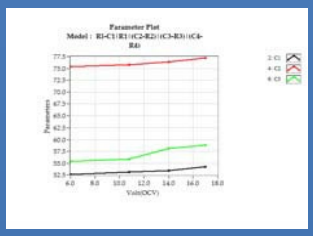
- Model simulation and fitting
- 2D- and 3D-Bode- and Nyquist plots
- Automatic equivalent circuit model search function
- Project concept to handle multiple EIS data analysis
- Parameter plot from fitted elements value
- Compatible with data format from Zahner, Gamry, Ametek etc. (License code is needed.)
- 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

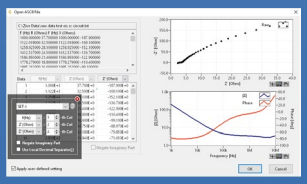
Electrochemical Workstation ZIVE MP1

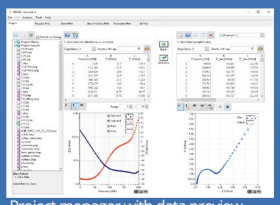
- Empty cell capacitance calculation
- Find file function
- Data replacement by formula function
- Cursor data display
- Model finding result automatic sorting by Chi square value
- R, C R, L R, Q preview & graphic
- ZHIT function
- Mott-Schottky analysis
- Donor density vs. Vfb graph
- C vs. voltage graph

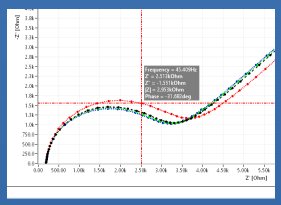
WonATech
ZMAN™ 2.2
Impedance Spectroscopy Analysis & Presentation

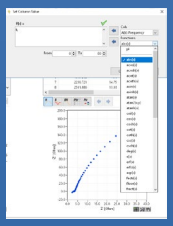

3D Bode plot for series measurement

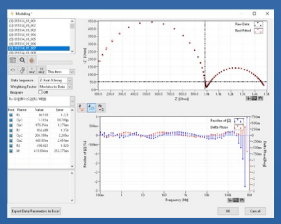

Parameter plot

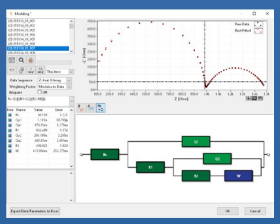

Importing 3rd parties ASCII data file

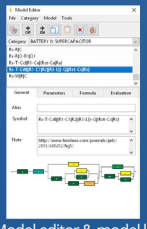

Project manager with data preview

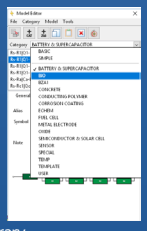

Cursor data display

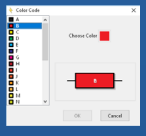

Data replacement by formula function

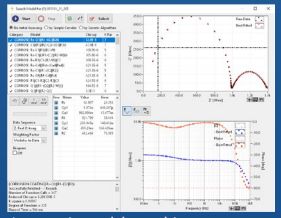

Fitting display

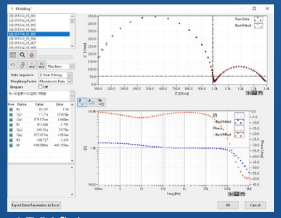


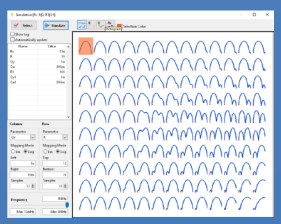

Model editor & model library

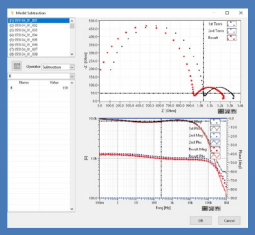


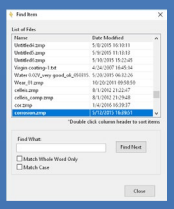


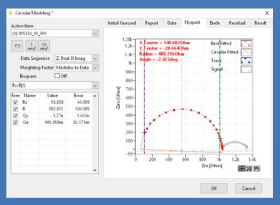

Automatic model searching

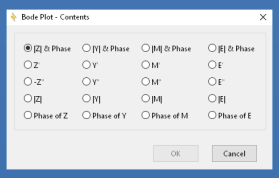

LEVM fitting

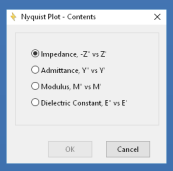

Parameter simulation

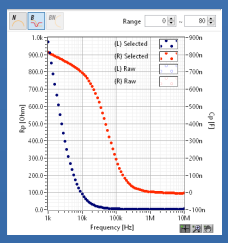

Element add/subtraction

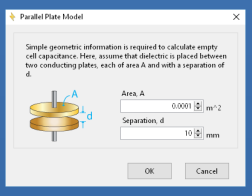

Finding data file menu

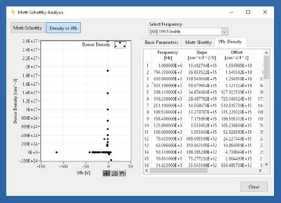

Circular fitting

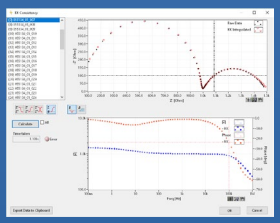

2D Nyquist plot

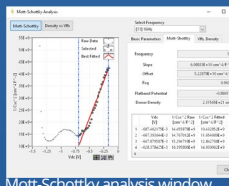

2D Bode plot

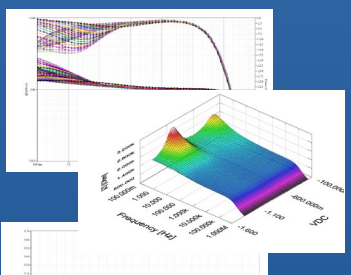

Rp,Cp vs frequency (R|C)

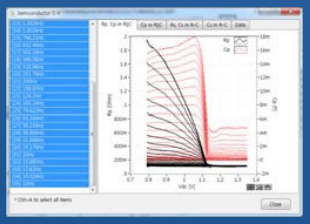

Empty cell capacitance


Donor density vs. Vfb graph and analysis


KK consistency


Mott-Schottky analysis window


Bode & Nyquist overlay & 3D plots

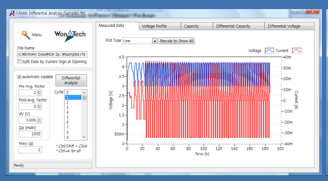

C/R-V graph

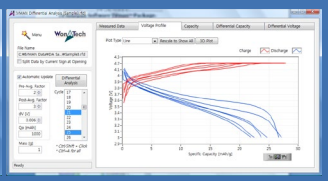
IVMAN™ DC Data Analysis Software

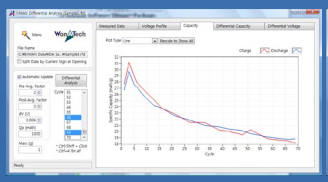
IVMAN™ software package consists of
- IVMAN software
- IVMAN utilities
  - IVMAN differential analysis software
  - IVMAN photo voltaic cell analysis.
  - IVMAN Tafel analysis
  - IVMAN extractor
  - IVMAN peak find module

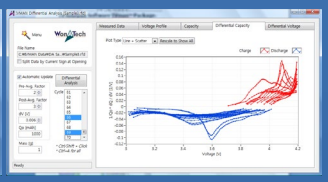
IVMAN DA™ Battery Test Data Analysis Software

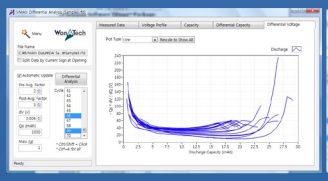
- Battery test data analysis
- Electrochemical voltage spectroscopy (dQ/dV vs. V)
- Voltage vs. Capacity analysis (V vs. Q)
- Cycle graph (Q vs. cycle)
- Differential voltage graph(dV/dQ vs. Q)

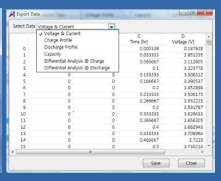

Measured data


V vs. Q

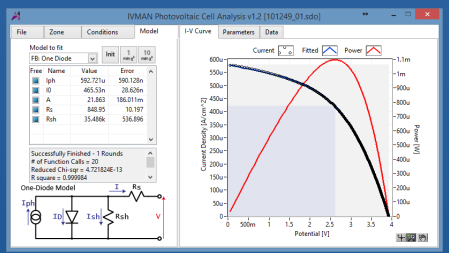

Cycle graph


dQ/dV vs. V


dV/dQ vs. Q


Export ASCII file

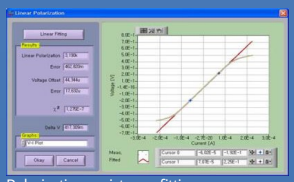
IVMAN™ Photovoltaic Cell Analysis

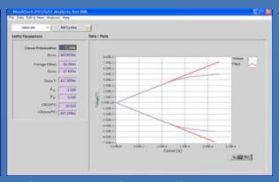


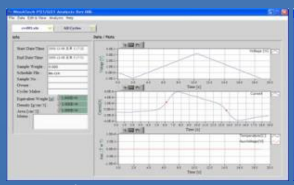
- Automatic analysis of parameters
  : open circuit voltage, open circuit current, max. power, efficiency
  photo induced current, diode quality factor, series resistance, etc.

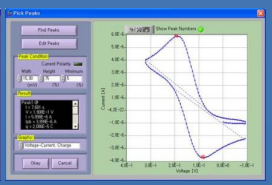
IVMAN™ Main Software

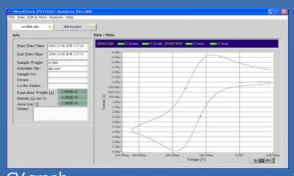
- Ideal for DC corrosion data analysis and electro-analytical data analysis
- Initial guessing function on Tafel analysis
- Polarization resistance fitting
- 3D graph
- Find peak function
- Interpolation, differentiation, integration etc.
- Reporting function

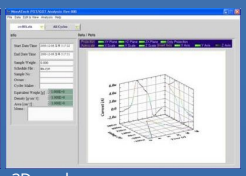

Polarization resistance fitting


Polarization analysis result

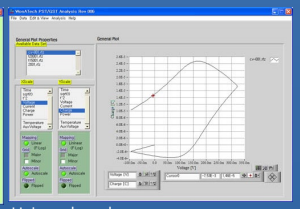

Time graph


Find peak menu


CV graph

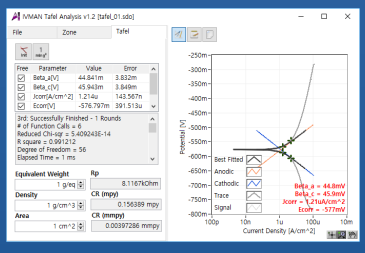

3D graph


Edit data menu


Universal graph

IVMAN TA™ Tafel Analysis

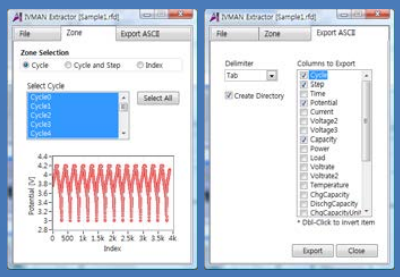
- Simple Tafel calculation



Electrochemical Workstation ZIVE MP1

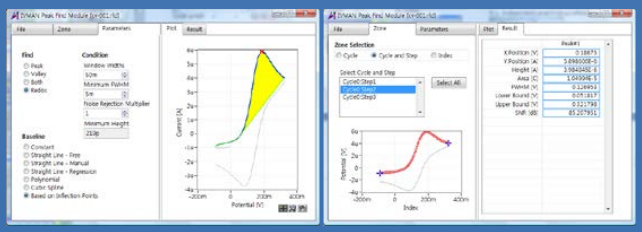
IVMAN EX™ Extractor

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



IVMAN PF™ Peak Find Module

- Independent peak finding software

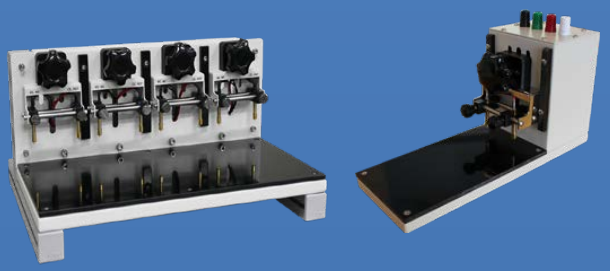


Optional Accessories

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

- Battery Jig & Coin Cell Jig
  - for cylindrical cell or coin cell
  - 4 or 2 contact pin depending on models
  - rack type is available.

- Pouch Cell Jig
  - contact type
    a) pull-down contact type with adjustable contact probe's width
    b) banana connector for cell cable connection
  - 4 contact point type(Kelvin probe)



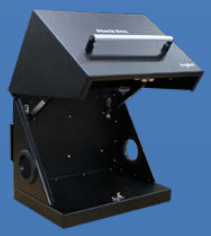
- Coin Cell Holder
  - D-SUB connector type

- Redox Flow Battery Test System
  - for charge/discharge test of a single cell
  - impedance measurement available
  - temperature control and measurement
  - electrolyte flow control with a dual channel peristaltic pump
  - max. 4 channel control with a PC
  - support various safety functions
  - system configuration :
    ZIVE SP5 Electrochemical workstation + RFC1 flow cell controller

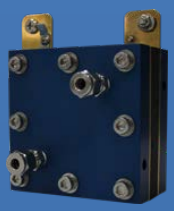
- Flow Cell Controller
  - MFCs and/or liquid pumps control
  - heating and cooling control
  - valve control
    (gas flowing on/off, dry/wet gas selection etc.)
  - rotator control
  - pressure regulator control
  - measurement of temperature, voltage, pressure,humidity etc.

Electrochemical Workstation ZIVE MP1

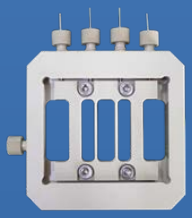
• Black Box
- for photoelectrochemical experiments



• Single Cell Hardware Fixture
- for PEMFC and DMFC
- max. temp. : 120˚C or 180˚C
- active area :
5, 25 cm^2
- MEA is not included.



• Membrane Conductivity Cell
- for 5, 9 and 25cm^2 fuel cell hardware fixture
- material : PEEK(cell body), platinum(wire)
- operating temp. : up to 130˚C

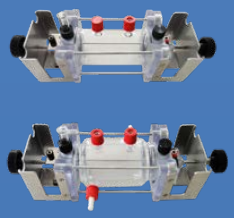


• Through-Plane Conductivity Test Jig
- for through plane conductivity measurement
- 2 probe type

• Universal Electrode Holder
- electrode and glass vial are not included.

• Cell Kit

Corrosion Cell Kit

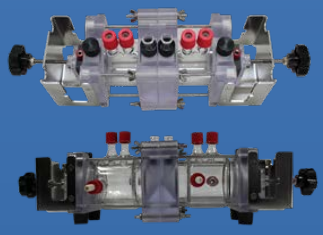


Flat Cell Kit

Plate Test Cell

Plate Test Cell

Photoelectrochemical Cell



Permeation Cell

• Flat Specimen Holder

• Pt Plate Counter Electrode

• Faraday Cage
- size : 300 x 300 x 398mm(WxDxH)

Specification

Main System	
PC communication	USB2.0 high speed
Line voltage	100~240VAC, 50/60Hz
Max. channel no. per unit	4 channels per unit (4ch housing system) 8 channels per unit (8ch housing system)
Channel expansion	16 channel expandable per PC
Max. output power	12Watt per channel
Size 4 channel housing 8 channel housing	 199.4x465.6x315mm (WxDxH) 448x466x208mm (WxDxH)

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
Front panel LED	Busy, Run
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% fs (gain x1)
Max. scan range	±10V vs. ref. E
Current measurement	
Current range	9 ranges(auto/manual setting) 100nA ~ 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% fs (gain x1)

Electrometer	
Max. input voltage	±10V
Input impedance	$2x10^{13}\Omega \mid\mid 4.5pF$
Bandwidth	>22MHz
CMRR	>114dB

EIS(Internal FRA) for System	
Frequency range	10uHz~1MHz
Frequency accuracy	0.01%
Frequency resolution	5000/decade
Amplitude	0.1mV~5Vrms (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 PEIS/GEIS**

Interfaces for System	
Auxiliary port	
Auxiliary voltage input	1 analog input: ±10V
Zero resistance ammeter	100nA~1A ranges
External booster interface	Via booster I/F cable

Smart LCD Display (for 4ch housing system only, per channel)	
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(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.

Designing the Solution for Electrochemistry

Designed by

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