Designed by ZIVE LAB

High Compliance Voltage Multichannel Electrochemical Workstation

ZIVE MP5HC

Including Internal FRA/ZRA Compliance Voltage of 40V

For
Corrosion
Low conductivity experiments
Material Testing

WonATech

Electrochemical Workstation ZIVE MP5HC

The ZIVE MP5HC, the multichannle potentiostate/galvanostat/FRA with a compliance voltage of 40V, is the best choice for the complete DC and impedance characterization of coatings and corrosion research. Also, its versatile functions make it suited to other applications including battery, fuel cell, solar cell, and other fundamental electrochemical analysis.

Each channel is designed under FPGA and DSP control with high speed capability.

DAC Control
: Two sets of high speed 16bit DAC(50MHz) for offset & scanning & one set of 16bit DAC(1MHz) for auxiliary analog output control.

ADC Reading
: Two sets of 16 bit 500kHz ADC for reading voltage/current and 4 channel 16bit 250kHz ADCs for auxiliary data input such as temperature, auxiliary voltage etc. It provides high frequency EIS, fast pulse techniques and high speed sampling time.

Each channel of ZIVE MP5HC is equipped with a Frequency Response Analyzer(FRA) 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. 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 MP5HC's flexibility.

System Features

- Versatile high quality multichannel potentiostat/galvanostat/impedance analyzer with a compliance voltage of 40V
- 8 fully independent channels with 14 EIS techniques capability including multisine
- Multichannel FRA function to control an external electronic load or 3rd party potentiostat/galvanostat is available as standard
- Current interrupt IR measurement
  IR compensation available(dynamic, positive feedback)
- Voltage pulse or current pulse charge/discharge test(GSM,CDMA etc.), sine wave function for ripple simulation in battery test package and pulse plating available
- High speed data sampling time
  - 50usec/sample in burst mode
  - 2usec or 3usec/sample depending on data point number in fast mode
  - 1msec/sample in normal mode
- Fast sweep mode(5000V/sec with 10mV data sampling)
- 3 measurement/control voltage ranges &
  10 measurement/control current ranges
- Internal 542,000 data point storage and continuing experiment regardless of PC failure
- 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)
- Channel expandable up to 32 channels
- Free software upgrade

Hardware Features

- ±10V@1Amp control range per channel
- Wide current ranges(1A to 100pA) for various applications (100pA with gain)
- Min. number of channels : 2 channels
- Independent operation by FPGA with DSP
- Built-in FRA per channel for impedance measurement
- Bipolar pulse capability
- K-type thermocouple input for temperature measurement as standard
- Simultaneous 3 auxiliary voltage measurements
- 1 auxiliary analog output
- 3 digital outputs & 2 digital inputs
- External booster(ZB series) interface for high current application
- External multiplexer(MUX series) interface for a sequential measurements on multiple electrochemical cells

Front View

Channel View

Status LED indicator

Aux port:
3 analog inputs
(auxiliary voltage measurement)
1 analog output
2 digital input
3 digital output

Temperature measurement with K type thermocouple (option)

Built-in FRA
FPGA/DSP control
Plug-in type

Cell port 1: working, counter

Cell port 2: reference. working sense

Misc port:
I2C com port for external device control
FRA port
1 sig generator output
1 voltage input
1 current input

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Versatility

The ZIVE MP5HC's system comes with additional three analog inputs (auxiliary voltage input) and 1 analog output along with 3 digital outputs and 2 digital inputs, and one temperature input for K type thermocouple. It will help user expand the usage of the instrument.

For example,

1. User can measure the voltage between working and reference electrode and, by using 2 additional analog inputs(auxiliary voltage input), user can also measure the voltage between reference and counter electrode and working and counter electrode as well.
2. With analog output, the system can control rotating speed of the rotator, MFC flow rate etc. by ±10V full scale.
3. User can control on/off of an external device by 3 DO(digital ouput) signal and 2 DI(digital input) signal from an external device can be used for cutoff condition.
4. This system can interface with an external booster(ZB series).

Safety and Maintenance

1. Even though the communication failure occurs between PC and ZIVE MP5HC, the system continues its experiment on channel and saves the data into ZIVE memory up to 542,000 data point set. After the communication is restored, ZIVE will transfer saved data to PC automatically or user can transfer data when he/she wants. This function will be highly efficient for long time experiment.
2. User can define a safety condition setting by inputting his/her own safety levels for voltage, current, temperature etc. If the measurement value exceeds this setting value, the system will automatically stop to protect the system and cell.
3. If the control value of voltage or current is different from measured value, the experiment will stop automatically to protect the cell.
4. Automatic calibration function is available for user calibration.
5. The system has its own hardware parameters and calibration data.
6. The channels feature plug-n-play setup for easy installation and removal.
7. The system is controlled from a PC via USB.
8. An 8 channel system can be expanded to a 16ch-, a 24ch-system etc. by using an USB hub.

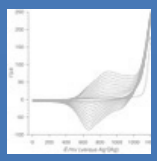
Application

The ZIVE MP5HC multichannel electrochemical workstation is ideal for corrosion research for developing a new corrosion inhibitor and coating technologies. Also, high compliance voltage allows for the growth of thin film electrodes and nanodeposition. This system can be also used for evaluation power device research such as battery material, fuel cell, supercapacitor, and solar cell.

Corrosion

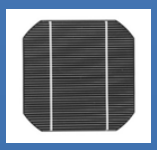
The system is suitable for measuring low corrosion rates* and EIS test to evaluate corrosion.
The ZRA function is supplied for galvanic corrosion measurement.

General Electrochemistry



The ZIVE MP5HC 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.

Solar Cells



Solar cell development and production requires extensive material and device testing to improve efficiency and match individual cells for panel construction. The ZIVE MP5HC is the best solution for photovoltaic cell characterization. With system's AI, AO, DI, and DO, the system can monitor other device's signal and also control them.

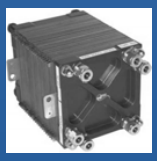
Sensors

The ZIVE MP5HC can be used for sensor research using with DNA chips or screen printed electrodes. System's minimum current range is 100pA(with gain).
Cyclic voltammetry, Chronoamperometry and EIS measurement can be used for this application.

Batteries

The system is very well adapted for researches on the cycling behavior of battery. It provides various control modes for battery cycling. It can support 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 MP5HC 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. The FRA can control an external electronic load for EIS measurement of fuel cell. I-V curve measurements in a full range of available current(autorange option is active during the I-V scan in order to ensure measurement with continuously high resolution).

Super Capacitors

The ZIVE MP5HC has fast potentiostat circuit with high speed data acquisition(50usec/point, burst mode). This function is well applicable to super capacitor testing. Charging/discharging capability is used for this application.

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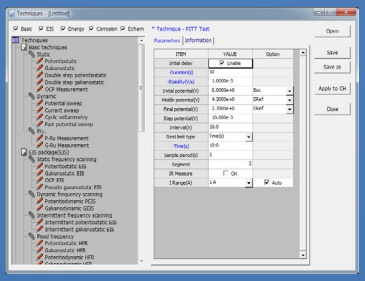
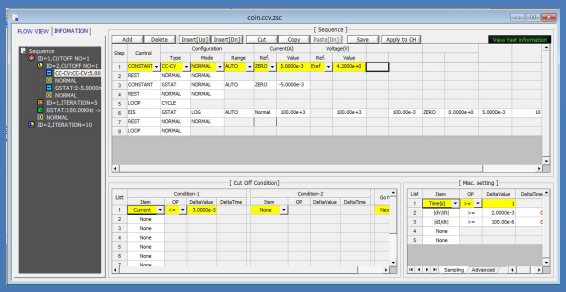
Main Software SM

The Smart Manager (SM) is to control ZIVE MP5HC 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

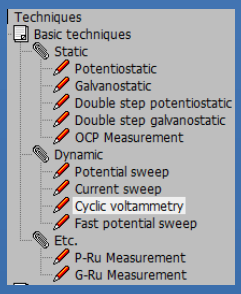


Sequence editor

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.

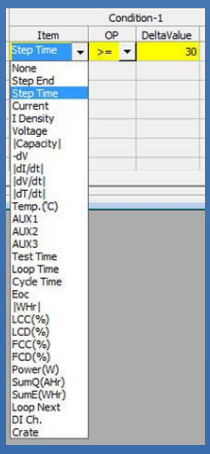
Control Task Parameters

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

- 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

Cut-off(Vertex) Condition

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



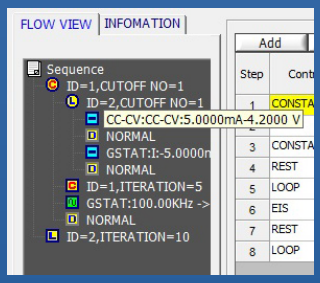
Cutoff condition

Sampling Condition

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

Flow View

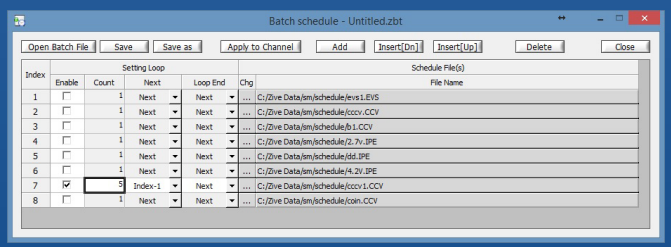
- User can see the sequence flow at a glance.



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.



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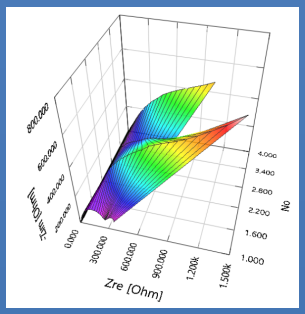
Smart Manager Advanced Software Package

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

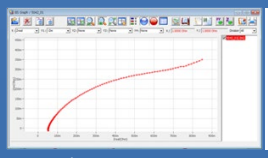
EIS Software Package(EIS)

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

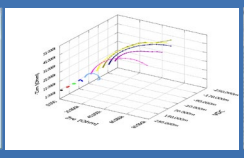


Potentiostatic EIS data of metal sample soaked in NaCl solution over time, 3D Nyquist plot by ZMAN

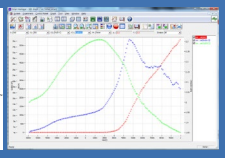
(*1) The system measures open circuit potential before each frequency change and applies AC sine wave on this potential.



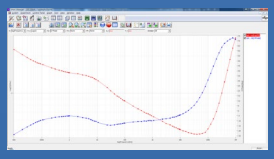
Galvanostatic EIS



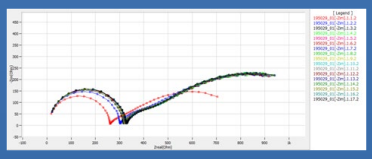
Potentiodynamic PEIS



Rs, Cp & Idc vs Vdc plot



Coin cell multisine EIS data

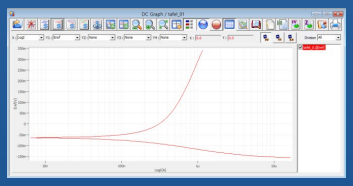


Intermittent Poteniostatic EIS

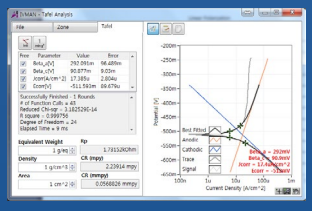
Corrosion Software Package(COR)

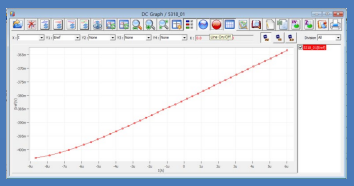
Corrosion technique supports IR compensation.

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

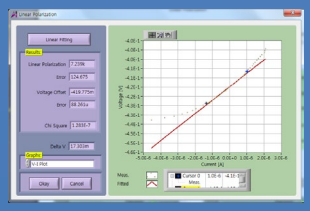


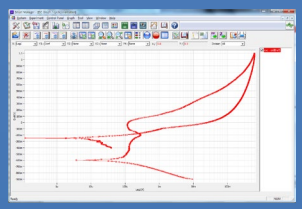
Tafel plot



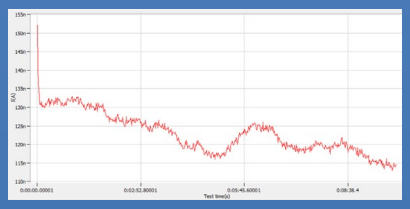


Linear Polarization Resistance

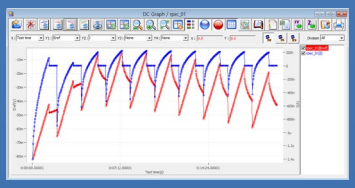




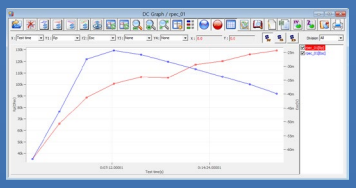
Cyclic polarization resistance



Galvanic Corrosion Test



Monitoring Ecorr & measuring polarization resistance periodically



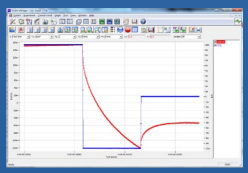
Intermittent poteniostatic EIS

Electrochemical Analysis Software Package(EAS)

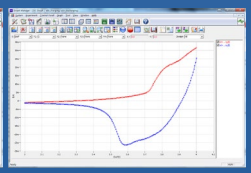
1. Step techniques
   - CA(Chronoamperometry)
   - CC(Chronocoulometry)
   - CP(Chronopotentiometry)

2. Sweep techniques
   - LSV(Linear sweep voltammetry)
   - SDV(Sampled DC voltammetry)
   - Fast CV
   - Fast LSV

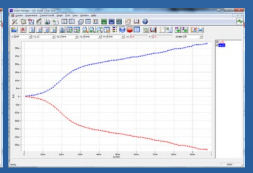
3. Pulsed techniques
   - DPV(Differential pulse voltammetry)
   - SWV(Square wave voltammetry)
   - DPA(Diff. pulse amperometry)
   - NPV(Normal pulsed voltammetry)
   - RNPV(Reverse normal pulse voltammetry)
   - DNPV(Differential normal pulse voltammetry)



50usec sampling



Sampled DC voltammetry



NPV &RNPV overlay

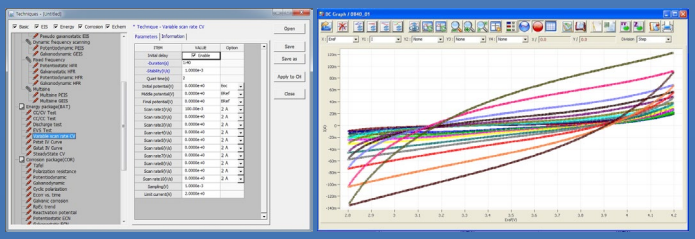
Battery Software Package(BAT)

BAT software supports IR measurement.

1. Battery test techniques

Electrochemical Workstation ZIVE MP5HC

- 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(Galvanostatic intermittent titration technique) test
- PITT(Potentiostatic intermittent titration technique) test



Variable scan rate CV

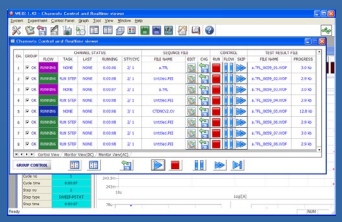
2. Control mode
   - Charge: CC, CC-CV, pulse, sine wave
   - Discharge: CC, CP, CR, pulse, sine wave

3. Cutoff condition
   - time, voltage, current, power, temperature, auxV etc.

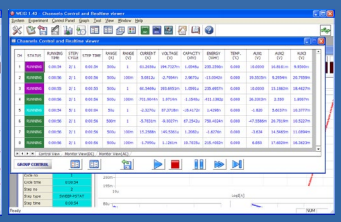
Various battery charge/discharge test is available including pulse discharge for GSM and CDMA application.

Control & Real Time Graph

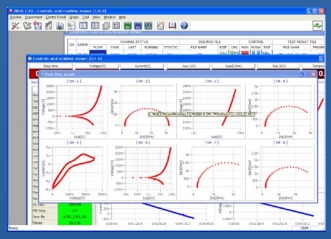
Smart Manager provides 2 kinds of control & data acquisition with real time graph.



Multichannel Control Panel

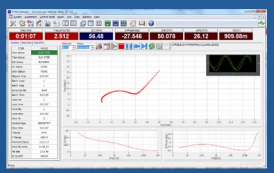


Multichannel Data Monitor
(EIS data/DC data selectable)



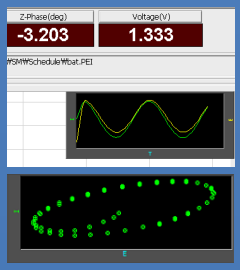
Multichannel Real Time Graph

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 defined by user's demand per technique.

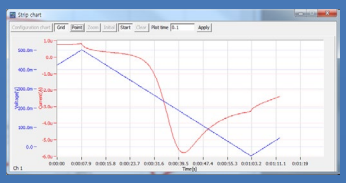


For experiment using sequence file or batch file, user can designate X,Y parameter on three different real time graph. The real time graph's format can be also selected. The channel number which you control can be changed in this window. Even if you control the channel in this mode, you can also monitor and control the same channel in this control panel at same time.

The real time graph and VOI will be changed depending on DC test or impedance test automatically. The 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



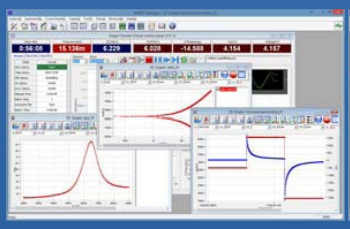
Strip chart recorder function provides real graph function independently. You can monitor 2 Y axis data such as voltage, current, AuxV1,2,3, temperature, power, capacity etc. in real time and can select channel(s) which you want to monitor. You can also set max. data point for showing strip chart length.

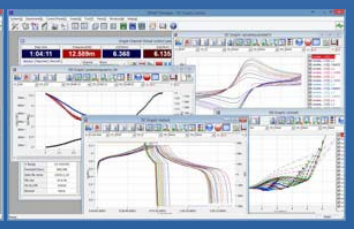
Simple Monitor

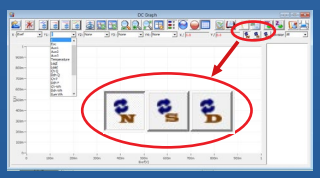
This display window is for monitor the major data values and channel status for multiple channel operation.

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.





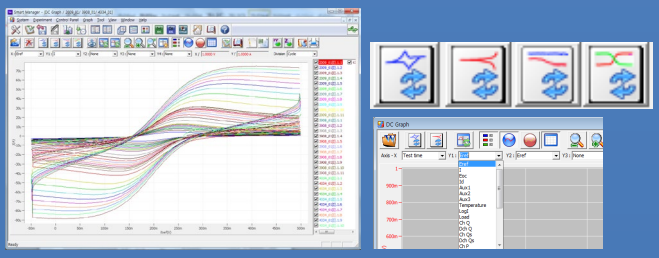


In DC and Cycle graph, whenever you click S or D the parameters which are related to current such as current, capacity, energy, power, load, etc., are changed into calculated specific value or density value, respectively.

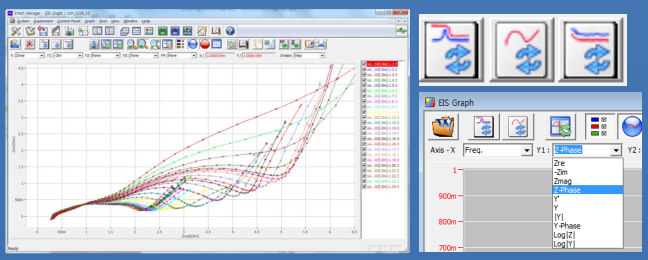
S : value divided by weight

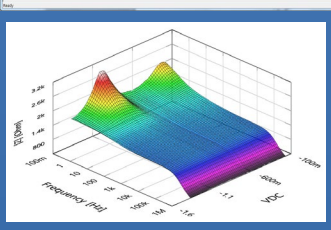
D : value divided by active area

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, Aux2, Aux3, temp, LogI, Load, ChQ, DchQ, ChQs, DchQs, Ch P, Dch P, Ch-Wh, Dch-Wh, Sum Wh, Sum Q, Sum |Q|, |Q|, Rp, dQ/dV



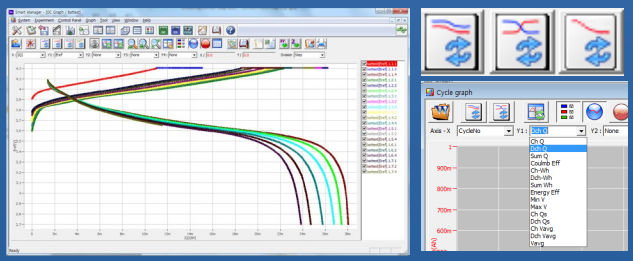
2) EIS Graph
- For EIS data display
- 3 shortcut buttons: Nyquist plot , Bode plot, Cs vs. frequency
- Graph parameters: Frequency, Zre, -Zim, Zmag, Zph, Y', Yimg, Y, |Y|, Yph, LogZ, LogY, Rs(R-C), Cs(R-C), Rp(R|C), Cp(R|C), Rs(R-L), Ls(R-L), Q(R-L), time, Vdc, Idc, temp, Aux(1,2,3)



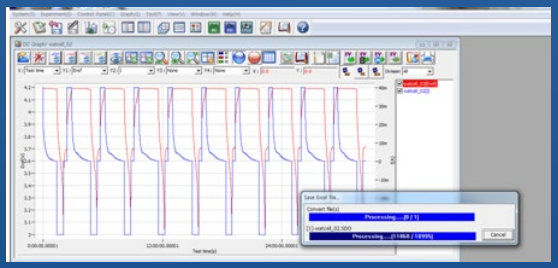


3D Bode Plot by ZMAN
Technique used: Potentiodynamic Impedance Measurement
By Using A Corrosion Cell

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*



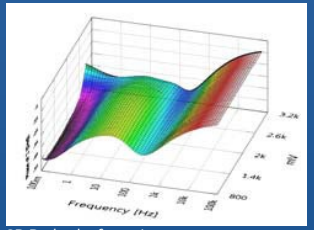
Selectable between 'Convert data on graph only' and 'Convert selected file(s)'

Data Analysis Software

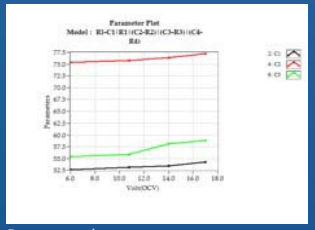
ZIVE data file can be used for analysis by using external IVMAN™ software for DC analysis, IVMAN DA™ software for battery data analysis, IVMAN PA™ software for photo-voltaic cell data analysis and ZMAN™ software for EIS data analysis without license.

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

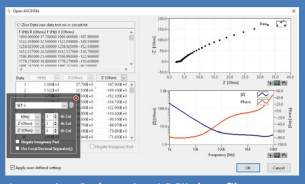


3D Bode plot for series measurement

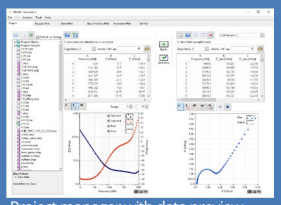


Parameter plot

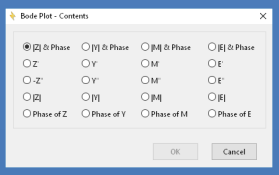
Electrochemical Workstation ZIVE MP5HC



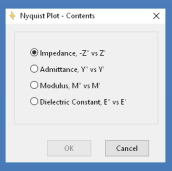
Importing 3rd parties ASCII data file



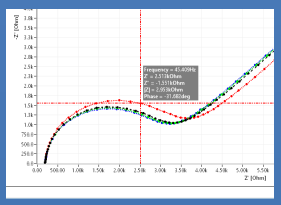
Project manager with data preview



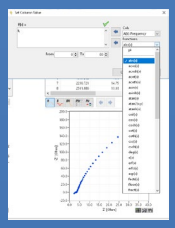
2D Nyquist plot



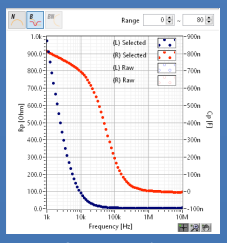
2D Bode plot



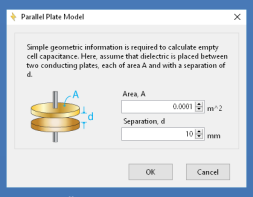
Cursor data display



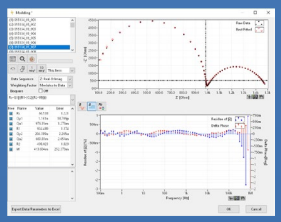
Data replacement by formula function

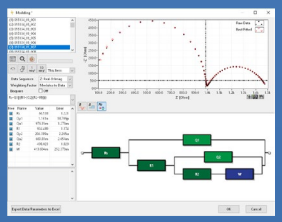


Rp,Cp vs frequency (R|C)

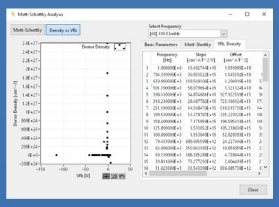


Empty cell capacitance

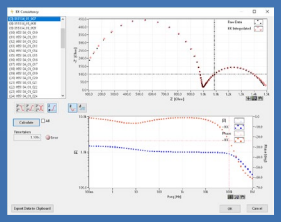




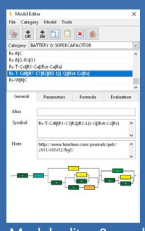
Fitting display

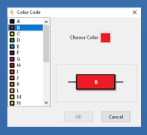


Donor density vs. Vfb graph and analysis

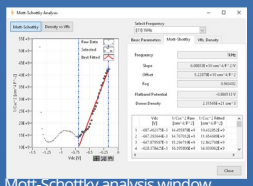


KK consistency

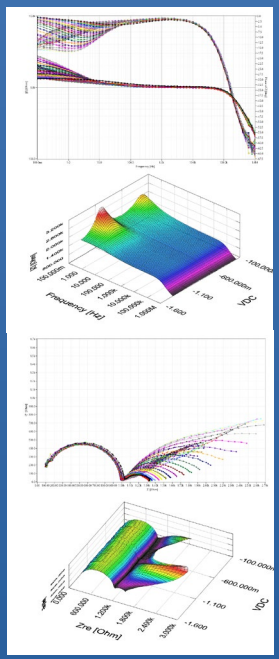


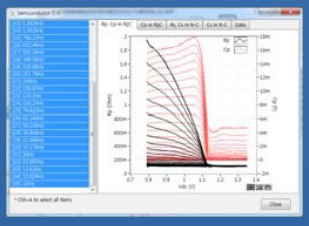


Model editor & model library

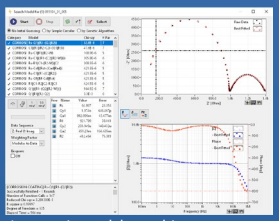


Mott-Schottky analysis window

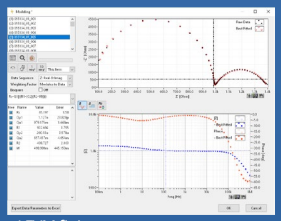




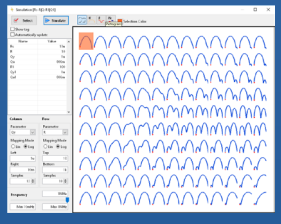
C/R-V graph



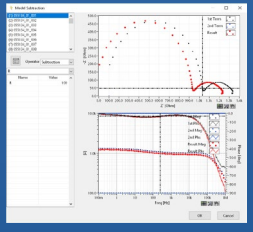
Automatic model searching



LEVM fitting



Parameter simulation

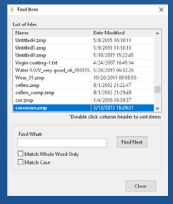


Element add/subtraction

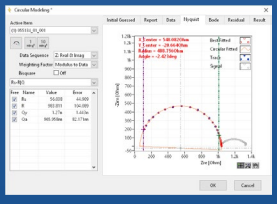
Bode & Nyquist overlay & 3D plots

IVMAN™ DC Data Analysis Software

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



Finding data file menu

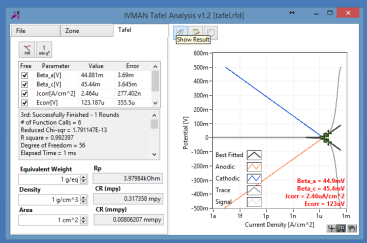


Circular fitting

Electrochemical Workstation ZIVE MP5HC

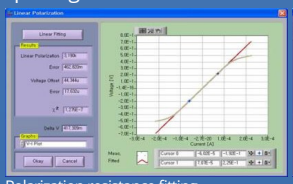
IVMAN TA™ Tafel Analysis

- Simple Tafel calculation

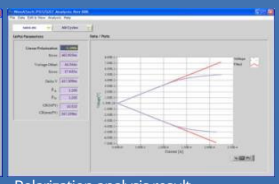


IVMAN™ Main Software

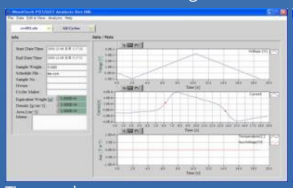
- Ideal for DC corrosion data analysis and electro-analytical data analysis
- Initial guessing function on Tafel analysis
- Polarization resistance fitting
- 3D graph
- Find peak function
- Interpolation, differentiation, integration etc.
- Reporting function



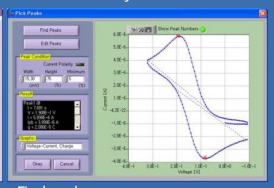
Polarization resistance fitting



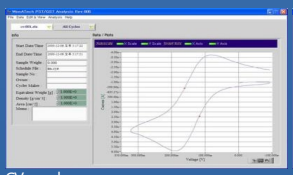
Polarization analysis result



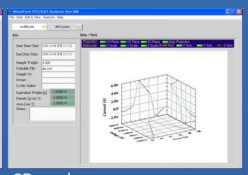
Time graph



Find peak menu

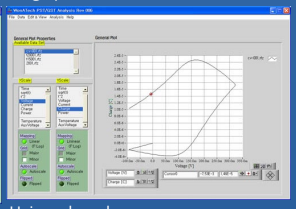


CV graph



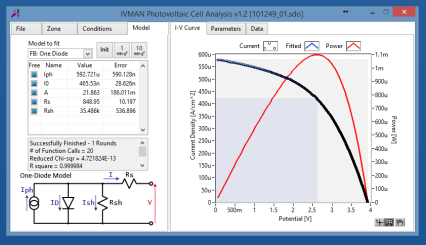
3D graph

Edit data menu



Universal graph

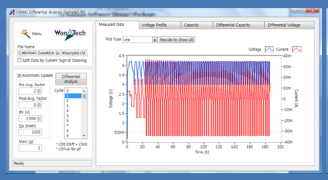
IVMAN™ Photovoltaic Cell Analysis



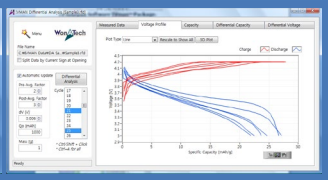
- Automatic analysis of parameters
  -open circuit voltage, open circuit current, max. power, efficiency
  photo induced current, diode quality factor, series resistance, etc.

IVMAN DA™ Battery Test Data Analysis Software

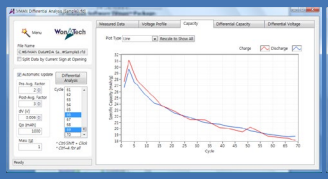
- Battery test data analysis
- Electrochemical voltage spectroscopy (dQ/dV vs. V)
- Voltage vs. Capacity analysis (V vs. Q)
- Cycle graph (Q vs. cycle)
- Differential voltage graph(dV/dQ vs. Q)



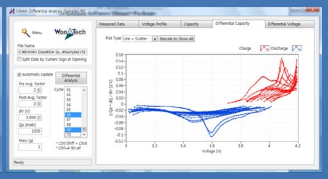
Measured data



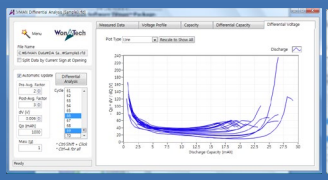
V vs. Q



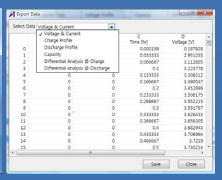
Cycle graph



dQ/dV vs. V



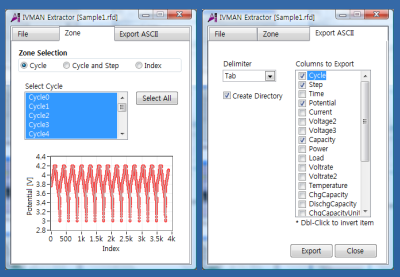
dV/dQ vs. Q



Export ASCII file

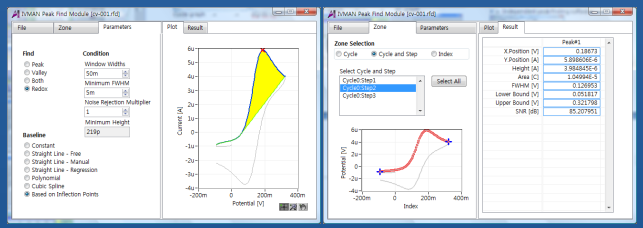
IVMAN EX™ Extractor

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



IVMAN PF™ Peak Find Module

- Independent peak finding software



Optional Accessories

• Multiplexer

- It allows sequential measurements on complete electrochemical cells, up to 8 cells per unit.

• Power Booster

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

• Universal Electrode Holder

- electrode and glass vial are not included.

• Faraday Cage

- size : 300 x 300 x 398mm(WxDxH)

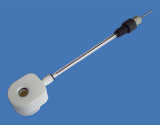
• Through-Plane Conductivity Test Jig

- for through plane conductivity measurement
- 2 probe type

• Cell Kit



Corrosion Cell Kit


Flat Cell Kit

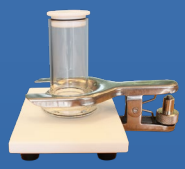



Plate Test Cell

Photoelectrochemical Cell


Permeation Cell

Specification

Main System	
PC communication	USB2.0 high speed
Line voltage	100~240VAC, 50/60Hz
Max. channel number	8 independent channels per unit
Max. channel	32 channels(4 units) expandable per PC
Size/weight	464.5x285.5x519.5mm(WxHxD)/29kg(8ch)

System	
Cell cable	1 meter shielded type(standard) working, reference, counter, working sense
Control DAC	DSP with FPGA 2x16bit DAC(50MHz) for bias & scan 1X16bit DAC(1MHz) for analog output
Data acquisition ADC	2x16bit ADCs(500kHz) for voltage, current 4x16bit ADCs(250kHz) for auxiliary voltage and temperature reading
Calibration	Automatic
Filter selection	4ea(5Hz, 1kHz, 500kHz, 5MHz)
Scan rate	0~200V/sec in common mode 0~5000V/sec in fast mode
LED indicator	Busy, Run
Max. output power	40Watt per channel
Internal data memory	542,000 points

Power Amplifier(CE)	
Power	40Watt (40V@1A)
Compliance voltage	±40V
Max. current	±1A
Control speed selection	8ea
Bandwidth	1MHz
Slew rate	10V/usec

Potentiostat Mode (voltage control)	
Voltage control	
Control voltage range	±10V, ±1V, ±100mV
Voltage resolution	0.0015% f.s.(0.3mV,30uV,3uV)
Voltage accuracy	±1mV ±0.05% of setting
Max. scan range	±10V vs. ref. E
Current measurement	
Current range	11 ranges(auto/manual setting) 1nA~1A 100pA with gain
Current resolution	16 bit 30uA, 3uA, 300nA, 30nA, 3nA, 300pA, 30pA, 3pA, 300fA, 30fA, 3fA
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, 30fA, 3fA
Current accuracy	±0.05% f.s.(gain x1) >100nA
Voltage measurement	
Voltage range	±10V, ±1V, ±100mV
Voltage resolution	16 bit 0.3mV, 30uV, 3uV
Voltage accuracy	±1mV ±0.05% of reading

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

EIS(Internal FRA) for System	
Frequency range	10uHz~1MHz
Frequency accuracy	100ppm(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	
Digital output	3(open collector)
Digital input	2(photo coupler)
Auxiliary voltage inputs	3 analog inputs: ±10V For measurement of WE vs. CE CE vs. RE or other signal
Analog output	1 analog output: ±10V For stirrer, MFC, RDE, etc.
Misc. port	
Sig generator output	1 analog output for FRA output or waveform generation output
Peripheral communication	I2C to control external devices
Temp. measurement	1 K-type thermocouple input
Zero Resistance Ammeter	1nA ~ 1A ranges

Software	
Max. step per experiment	1000
Shutdown safety limits	Voltage, current, temperature, etc.
Max. sampling rate	20kHz(50usec) in burst mode 500kHz(2usec) in fast sweep mode
Min. sampling time	Unlimited
Sampling condition	Time, dV/dt, dI/dt, temperature, etc.

PC Requirement	
Operating system	WindowsXP SP3/7/8/10(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
Thermocouple	K-type, 1.5 meter long(option)
Auxiliary cable	Option
Misc. cable	Option

The specifications are subject to change without notice.

Designing the Solution for Electrochemistry

Designed by

ZIVE LAB

www.zivelab.com

WonATech

WonATech Co., Ltd.
7, Neunganmal 1-gil, Seocho-gu,
Seoul, 06801, Korea
Phone: +82-2-578-6516
Fax: +82-576-2635
e-mail) sales@wonatech.com
website: www.wonatech.com

Local Distributor

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