

# Multichannel/Multi Working Electrodes Electrochemical Workstation ZIVE MP2F (4CH housing)

Including Internal FRA  
10Volts/1Amp



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

The **ZIVE MP2F**, the outstanding multichannel Potentiostat/Galvanostat/FRA, is developed for special applications in which more than one working electrode is used in a single electrochemical cell. The multiple working electrodes share counter electrode and the reference electrode. And the ZIVE MP2F can be also used for separated multiple cells with a working, reference and counter electrode. The system is the best choice for the complete DC and impedance characterization of corrosion, coating, sensor and other fundamental electrochemical analysis. And also, its versatile functions make it suitable 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 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 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.

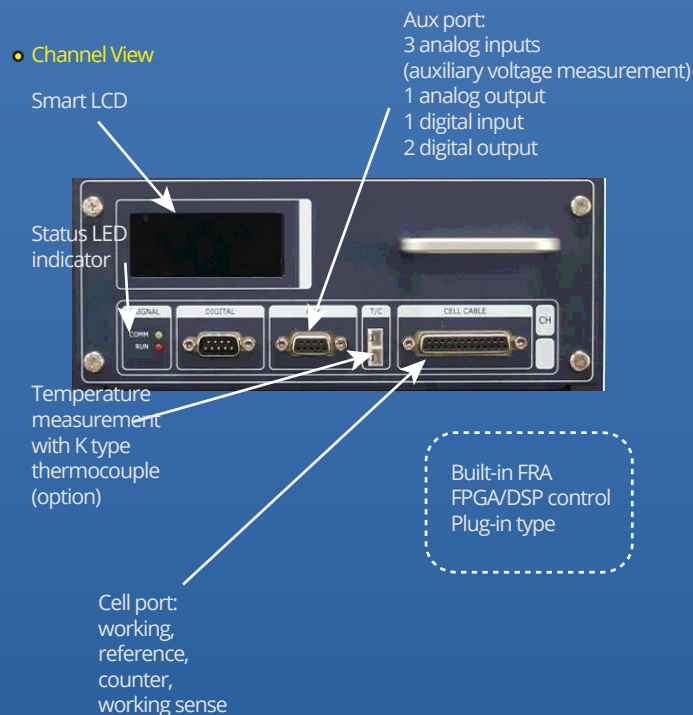
Each channel of **ZIVE MP2F** is equipped with a Frequency Response Analyzer(FRA) as standard and it provides high performance impedance measurements over the frequency range 10uHz to 1MHz. The ZRA(zero resistance ammeter) function can measure max. 1Amp in galvanic corrosion technique. The system is supplied with four(4) advanced software packages, which are categorized by application fields. With this advanced software packages, user can widen **ZIVE MP2F**'s flexibility.

## System Features

- Versatile, high quality multichannel Potentiostat/Galvanostat/Impedance Analyzer
- Standard 4 channel housing system
- 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

## Hardware Features

- $\pm 10V@1A$  control range per channel
- Wide current ranges(1A to 1nA) for various applications  
(1nA with gain)
- High speed potentiostat circuit
- Independent operation by FPGA with DSP
- Built-in FRA per channel for impedance measurement
- Temperature measurement as standard
- Simultaneous 3 auxiliary voltage measurements
- 1 auxiliary analog output
- 2 digital outputs & 1 digital inputs
- External booster(ZB series) interface



## Versatility

The **ZIVE MP2F**'s system comes with additional three analog inputs (auxiliary voltage input) and 1 analog output along with 2 digital outputs and 1 digital input, and one temperature input for K type thermocouple. It will help users expand the usage of the instrument.

For example,

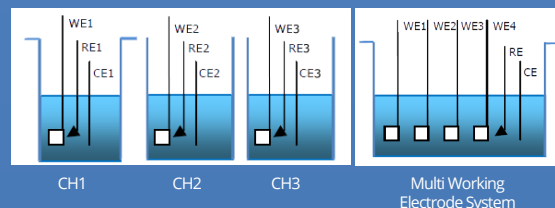
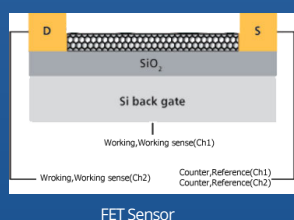
1. User can measure the voltage between working and reference electrode and, by using 2 additional analog inputs (auxiliary voltage input), user can also measure the voltage between reference and counter electrode and working and counter electrode as well.
2. With analog output, the system can control rotating speed of the rotator, MFC flow rate etc. by  $\pm 10V$  full scale.
3. User can control on/off of max. 2 devices by DO etc.

## Safety and Maintenance

1. Even though the communication failure occurs between PC and **ZIVE MP2F**, 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 4 channel system can be expanded upto 16 channel system by using an USB hub.

## Application

The **ZIVE MP2F** multichannel electrochemical workstation is ideal for bi-potentiostat application or multi working electrode application. And it can be also used 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.



### Sensors



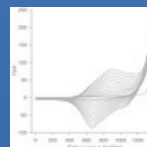
The **ZIVE MP2F** can be used for sensor research using with DNA chips or screen printed electrodes. System's minimum current range is 1nA (with gain). Cyclic voltammetry, Chronoamperometry and EIS measurement can be used for this application.

### 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 MP2F** 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.

### 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 MP2F** 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 MP2F** 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

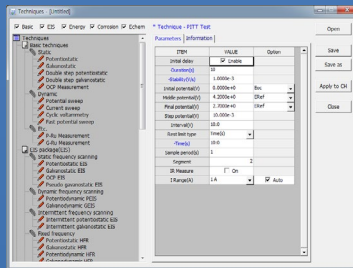


Solar cell development and production requires extensive material and device testing to improve efficiency and match individual cells for panel construction. The **ZIVE MP2F** is the best solution for photovoltaic cell characterization. With system's AI, AO, DI, and DO, the system can monitor other device's signal and also control them.

## Main Software SM

The Smart Manager (SM) is to control **ZIVE MP2F** 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.



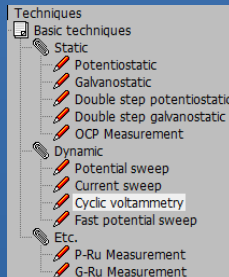
Technique list  
(some techniques require a license to use)

## Basic Techniques

### Basic techniques with standard functions

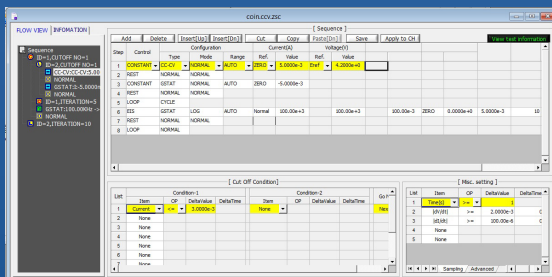
- 1) Potentiostatic
- 2) Galvanostatic
- 3) Double step potentiostatic
- 4) Double step galvanostatic
- 5) OCP measurement
- 6) Potential sweep
- 7) Current sweep
- 8) Cyclic voltammetry
- 9) Fast potential sweep
- 10) Potentiostatic Ru measurement
- 11) Galvanostatic Ru measurement

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
	M sineG	galvanostatic multisine EIS
	M sineP	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.

Condition-1		
Item	OP	DeltaValue
Step Time	>=	30
None		
Step End		
Step Time		
Current		
I Density		
Voltage		
[Capacity]		
-dV		
dV/dt		
dI/dt		
dT/dt		
Temp.(C)		
AUX1		
AUX2		
AUX3		
Test Time		
Loop Time		
Cycle Time		
Eoc		
[W/hr]		
LCC(%)		
LCD(%)		
FCD(%)		
Power(W)		
SumQ(AHr)		
SumE(VHr)		
Loop Next		
DI Ch.		
Crate		

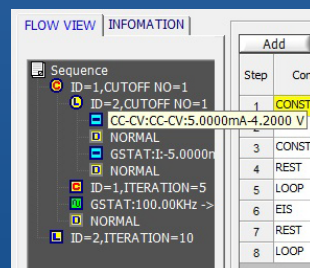
Cutoff Condition

### Sampling Condition

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

### Flow View

- This displays sequence flow at a glance.



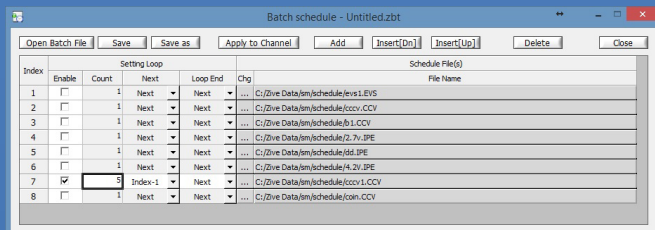
Flow view



# Electrochemical Workstation ZIVE MP2F

## ■ 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.

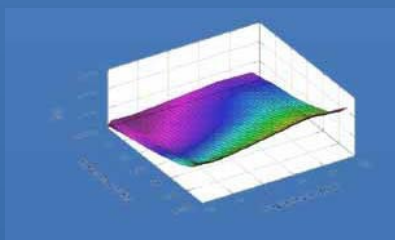


## Smart Manager Advanced Software Package

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

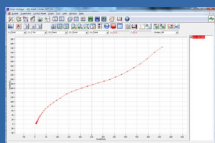
### ■ EIS Software Package(EIS)

1. Potentiostatic EIS
2. Galvanostatic EIS
3. Pseudo galvanostatic EIS
4. OCP (\*)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

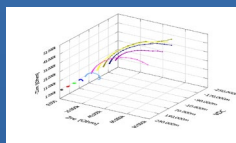


Coin cell Intermittent PEIS  
3D Nyquist plot by ZMAN

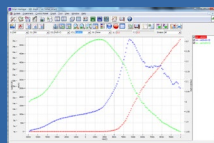
(\*)1 The system measures open circuit potential before each frequency change and applies AC sine wave on this potential.



OCP EIS



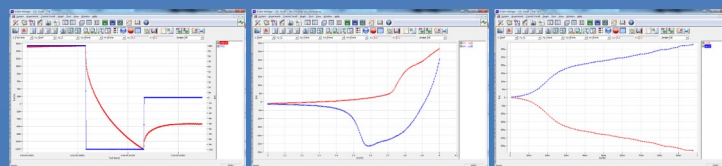
Potentiodynamic PEIS



Rs, Cp & Idc vs Vdc plot

### ■ 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

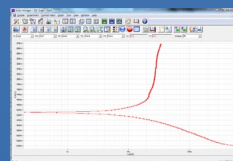
Sampled DC voltammetry

NPV & RNPV overlay

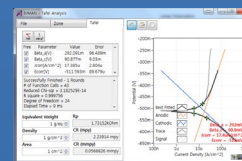
### ■ Corrosion Software Package(COR)

Corrosion technique supports IR compensation.

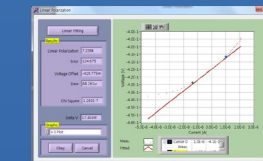
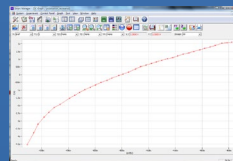
1. Tafel(Tafel experiment)
2. Rp(Polarization resistance)
3. Potentiodynamic
4. Galvanodynamic
5. Cyclic polarization
6. Ecorr vs. time
7. Galvanic corrosion
8. RpEc trend
9. Reactivation potential
10. Critical pitting potential



Tafel experiment



Rp  
(Polarization resistance)



CYPOL(Cyclic polarization resistance)

### ■ Battery Software Package(BAT)

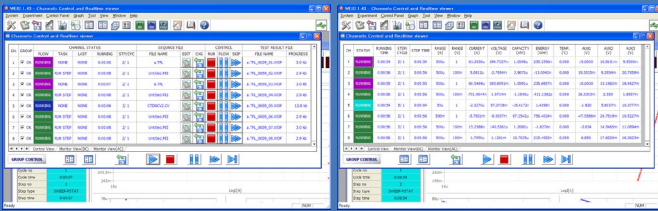
BAT software supports IR measurement.

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
  - PITT(Potentiostatic intermittent titration technique) test
  - GITT(Galvanostatic intermittent titration technique) test
  - Pulse mode is available for GSM & CDMA profile. Pulse shape profile can be measured by user's demand.

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

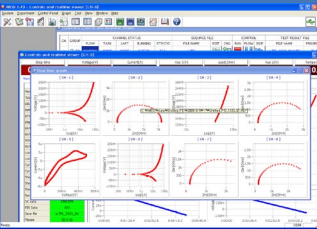
## Control & Real Time Graph

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



Multichannel Control Panel

Multichannel Data Monitor  
(EIS data/DC data selectable)

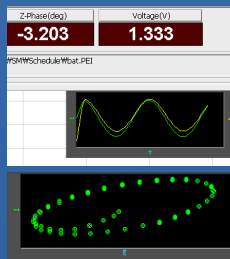
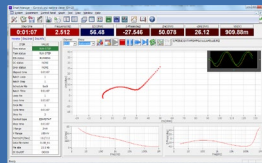


Multichannel Real Time Graph

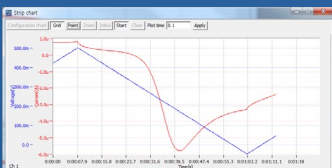
User can control and monitor for specific channel in details and he/she can monitor data in VOI(value of interest) window and channel status in one window. Real time graph's X,Y axis format will be changed per technique automatically. It can be defined by user's demand per technique.

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

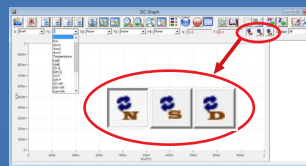
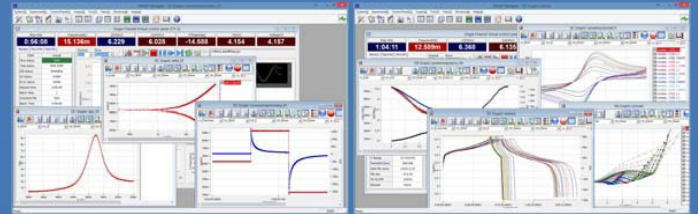


This display window is for monitor the major data values and channel status for multiple channel operation.

## 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.



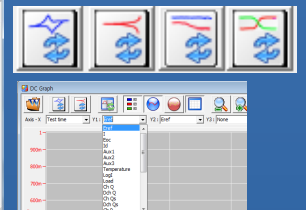
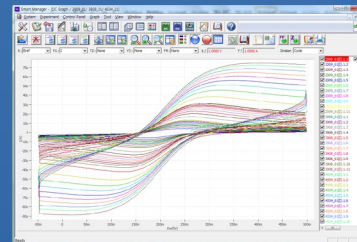
: value divided by weight

In DC and Cycle graph, whenever you click or , 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.

: value divided by active area

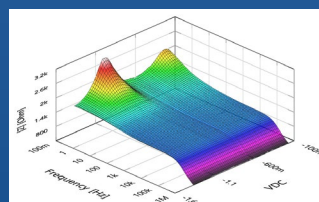
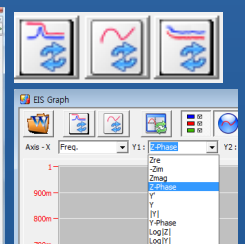
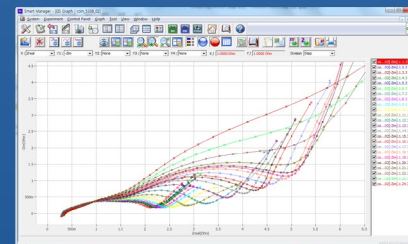
### 1) DC Graph

- For general data display
- 4 shortcut buttons: I vs. V, E vs. LogV, V 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

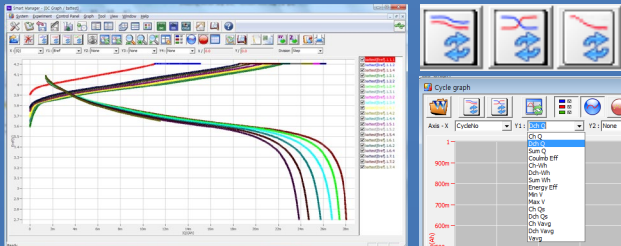
- For EIS data display
- 3 shortcut buttons: Nyquist plot, Bode plot, Cs vs. frequency
- Graph parameters: Frequency, Zre, -Zim, Zmag, Zph, Y, Yimg, Y, |Y|, Yph, LogZ, LogY, Rs(R-C), Cs(R-C), Rp(R|C), Cp(R|C), Rs(R-L), Ls(R-L), Q(R-L), time, Vdc, Idc, temp, Aux(1,2,3)



3D Bode plot by ZMAN  
Technique used: Potentiodynamic  
impedance measurement  
by using a corrosion cell

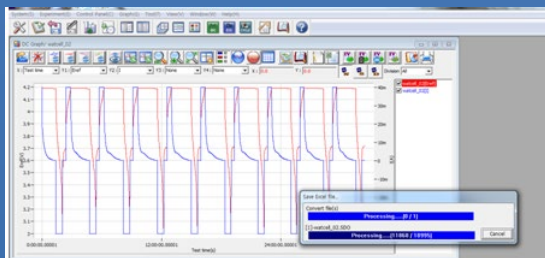
## 3) BAT Graph

- 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

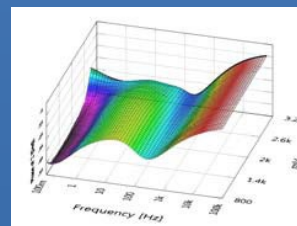


- Free for ZIVE's data format(\*.seo, \*.wis) analysis (No license code required.)
- Circle fitting
- Data editing available (insert, delete, edit)
- Add/subtract element parameters
- Add/subtract model parameters
- Impedance, Z in polar, admittance, Y in Polar, modulus, M in polar, dielectric constant, 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

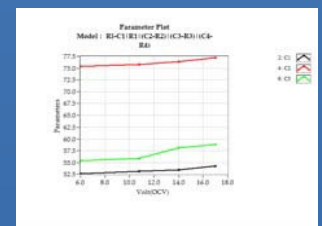
## Data Export to ASCII & Excel File



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



3D Bode plot for series measurement



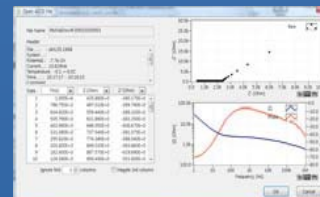
Parameter plot

## 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

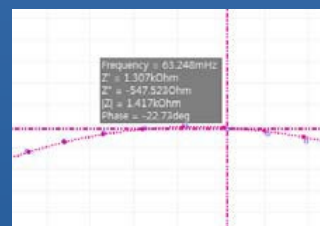
- Model simulation and fitting
- 2D- and 3D-Bode- and Nyquist plots
- Automatic equivalent circuit model search function
- Project concept to handle multiple EIS data analysis
- Parameter plot from fitted elements value
- Compatible with data format from Zahner, Gamry, Ametek etc. (License code is needed.)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



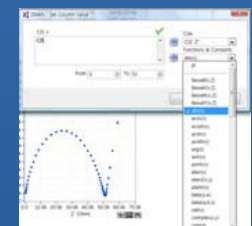
Importing 3rd parties ASCII data file



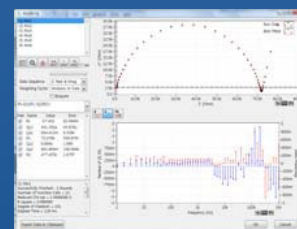
Project manager with data preview



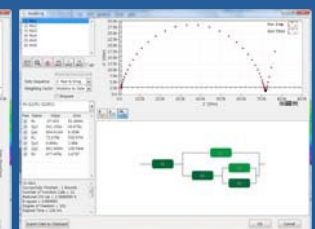
Cursor data display



Data replacement by formula function

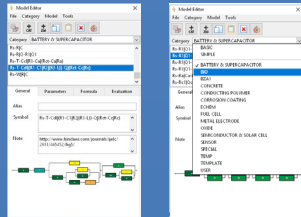


Fitting display

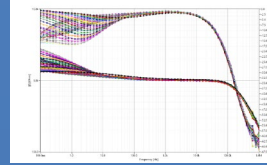
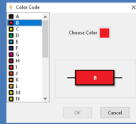




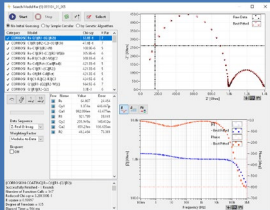
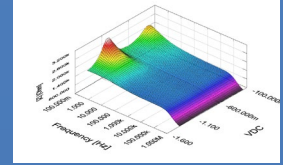
# Electrochemical Workstation ZIVE MP2F



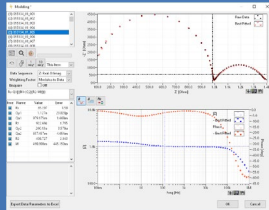
Model editor & model library



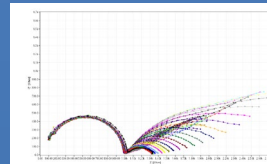
Bode overlay & 3D plots



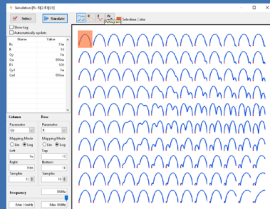
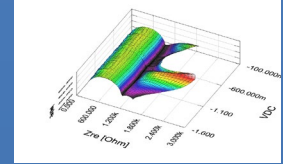
Automatic model searching



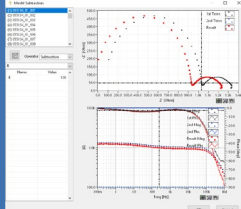
LEVM fitting



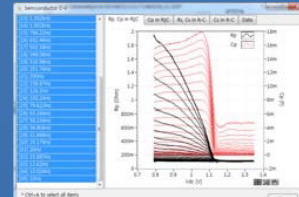
Nyquist overlay & 3D plots



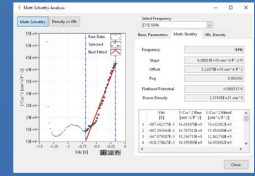
Parameter simulation



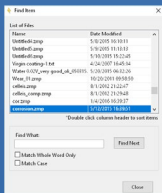
Element add/subtraction



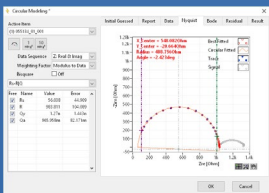
C/R-V graph



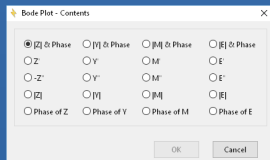
Mott-Schottky analysis window



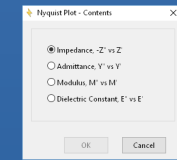
Finding data file menu



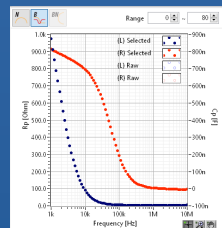
Circular fitting



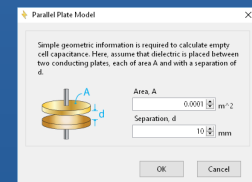
2D Nyquist plot



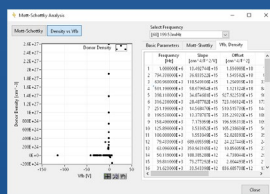
2D Bode plot



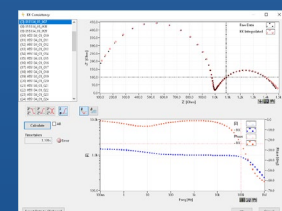
Rp,Cp vs frequency (R|C)



Empty cell capacitance

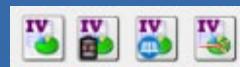


Donor density vs. Vfb graph and analysis



KK consistency

## 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

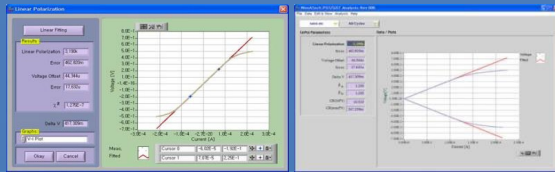


**IVMAN™ Main Software**

- 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

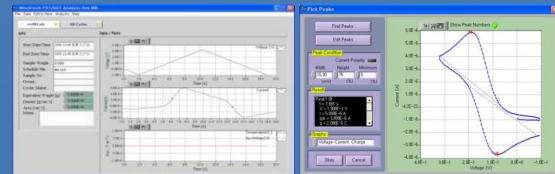


# Electrochemical Workstation ZIVE MP2F



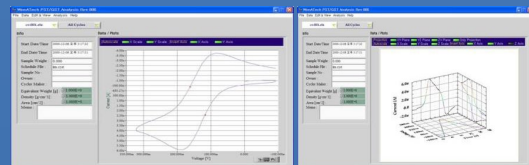
Polarization resistance fitting

Polarization analysis result



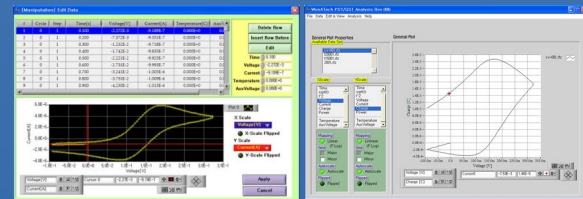
Time graph

Find peak menu



CV graph

3D graph



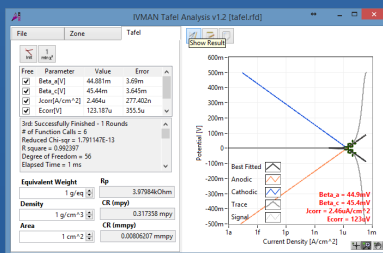
Edit data menu

Universal graph



## IVMAN TA™ Tafel Analysis

- Simple Tafel calculation

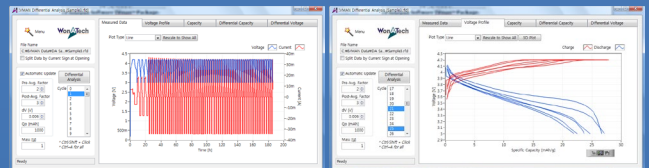


- Automatic analysis of parameters
  - open circuit voltage, open circuit current, max. power, efficiency
  - photo induced current, diode quality factor, series resistance, etc.



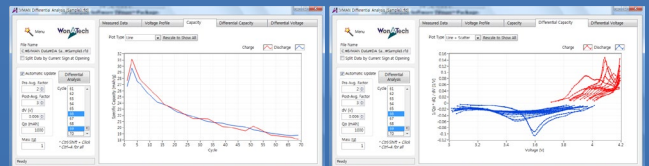
## IVMAN DA™ Battery Test Data Analysis Software

- 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)



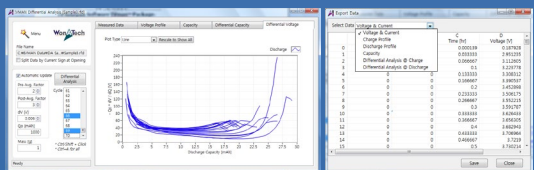
Measured data

V vs. Q



Cycle graph

dQ/dV vs. V

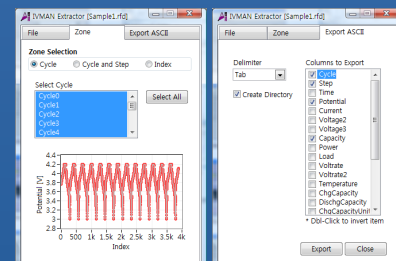


dV/dQ vs. Q

Export ASCII file

## IVMAN EX™ Extractor

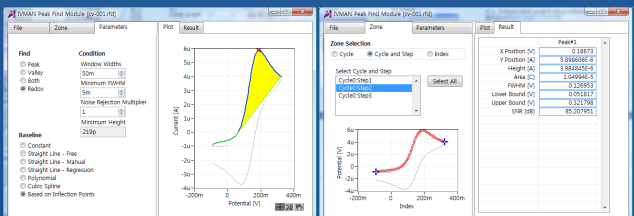
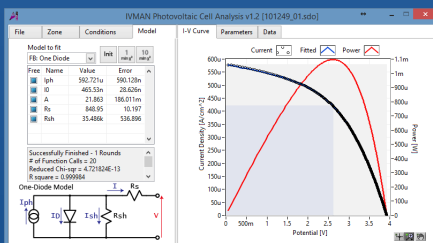
- Extracting data by cycle number or step
- Exporting ASCII file



## IVMAN™ Photovoltaic Cell Analysis

## IVMAN PF™ Peak Find Module

- Independent peak finding software



## Optional Accessories

### • Faraday Cage

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



• Cell Kit

### • Universal Electrode Holder

- electrode and glass vial are not included.



Corrosion Cell Kit



Flat Cell Kit



Plate Test Cell

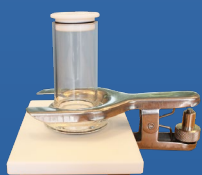


Plate Test Cell



H-Type Cell

### • Power Booster

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



### • Accessories for Battery/Con Cell

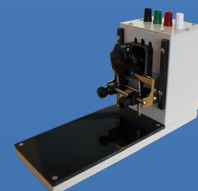
- battery/coin cell jig
- pouch cell jig



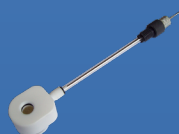
Coin Cell Jig



Pouch Cell Jig



### • Flat Specimen Holder



### • Pt Plate Electrode



### • Photo Echem Cell Kit



PCELL1

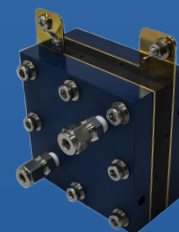
### • Through-Plane Conductivity Test Jig

- for through plane conductivity measurement
- 2 probe type



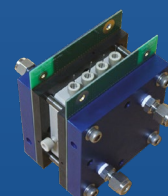
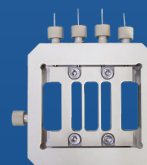
### • Single Cell Hardware Fixture

- for PEMFC and DMFC
- max. temp. : 120°C or 180°C
- active area : 5, 9, 25, 50, 100cm<sup>2</sup>
- MEA is not included.



### • Membrane Conductivity Cell

- for 5, 9 and 25cm<sup>2</sup> fuel cell hardware fixture
- material : PEEK(cell body), platinum(wire)
- operating temp. : up to 130°C



MCC with fuel cell hardware fixture

## 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)
Channel expansion	16 channel expandable per PC
Max. output power	12Watt per channel
Size 4 channel housing	242.6x440.5x304mm (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	8ea
Bandwidth	2MHz
Slew rate	10V/usec

Potentiostat Mode (voltage control)	
Voltage control	
Control voltage range	±10V, ±1V, ±100mV
Voltage resolution	16 bit per each range
Voltage accuracy	±0.02% f.s(gain x1)
Max. scan range	±10V vs. ref. E
Current measurement	
Current range	10ranges(auto/manual setting) 1nA ~ 1A 1nA with gain
Current resolution	16 bit 30uA, 3uA, 300nA, 30nA, 3nA, 300pA, 30pA, 3pA 300fA, (30fA with gain)
Current accuracy	±0.03% 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 with gain)
Current accuracy	±0.03% f.s.(gain x1) >100nA f.s.
Voltage measurement	
Voltage range	10V, 1V, 100mV
Voltage resolution	16 bit 0.3mV, 30uV, 3uV
Voltage accuracy	±0.02% f.s(gain x1)

Electrometer	
Max. input voltage	±10V
Input impedance	2x10 <sup>13</sup> Ω     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	<b>Static EIS:</b> Potentiostatic, Galvanostatic, Pseudogalvanostatic, OCP <b>Dynamic EIS:</b> Potentiodynamic, Galvanodynamic <b>Fixed frequency impedance:</b> Potentiostatic, Galvanostatic, Potentiodynamic, Galvanodynamic <b>Multisine EIS:</b> Potentiostatic, Galvanostatic <b>Intermittent PEIS/GEIS</b>

Interfaces for System	
Auxiliary port	
Digital output	3(open collector)
Digital input	1(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

Peripheral communication	I2C to control external devices
Temp. measurement	1 K-type thermocouple input
Zero Resistance Ammeter	10nA ~ 1A ranges

Smart LCD Display 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, dl/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.  
Windows is a registered trade mark of Microsoft Corporation.

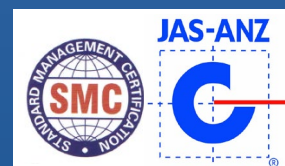
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**ZIVE LAB**  
www.zivelab.com



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