

Designed by ZIVE LAB



20V compliance Portable Electrochemical Workstation ZIVE PP3

For Field Application
Including Internal FRA
10Volts/1Amp

*For
Corrosion
Material Testing
High compliance application*

Portable Electrochemical Workstation ZIVE PP3

The **ZIVE PP3**, a portable Potentiostat/Galvanostat/FRA, is for an electrochemical test requiring high compliance voltage such as DC corrosion measurement, EIS test under low conductivity environment etc. and is suitable for outdoor use. The system is housed in a 5 meter water-proofed industrial plastic case. A multichannel system can be configured using multiple **ZIVE PP3** units and an external PC. The internal potentiostat/galvanostat circuit is floating type to enable users to do a pipe corrosion measurement. External battery pack is not available in this model. This model use AC/DC adapter power only. The **ZIVE PP3** comes with a slim and light tablet computer as standard and you can also use your own laptop computer.

The system is designed under FPGA and DSP control with high speed capability.

DAC Control

: Two sets of high speed 16bit DAC(50MHz) for offset & scanning

ADC Reading

: Two sets of 16 bit 500kHz ADC for reading voltage/current and 16bit 250kHz ADCs for auxiliary data input. This can provide high frequency EIS, fast pulse techniques and high speed sampling time.

The **ZIVE PP3** is a perfect choice for the complete DC and impedance characterization of low conductive electrochemical applications. The system is equipped with a frequency response analyzer(FRA) for system as standard and it provides high performance impedance measurements over the frequency range 10uHz to 1MHz.

The ZRA(zero resistance ammeter) function can measure max. 1Amp in galvanic corrosion technique. Four(4) advanced software packages, which are categorized by application field, are provided with the system as standard. Consequently, it widens **ZIVE PP3's** flexibility.

Features

- Portable high quality Potentiostat/Galvanostat/Impedance Analyzer
- Light weight and compact size with full functions
- Supplied in a 5 meter waterproof housing case
- Wide current ranges(1nA~1A: 1nA with gain) for various applications
- Built-in FRA : enables EIS tests by using software
- 14 EIS techniques capability including multisine
- Capable of multitude of applications
 - Corrosion, general electrochemistry requiring high compliance voltage etc.
- Current interrupt IR measurement
 - IR compensation(dynamic, positive feedback)
- Bipolar pulse capability and auxiliary voltage measurement available
- Voltage pulse or current pulse charge/discharge test(GSM,CDMA etc.), sine wave function for ripple simulation in battery test package & pulse plating available
- High speed data sampling time
 - 2usec or 3usec depending on data point number
- Fast sweep mode(5000V/sec with 10mV data sampling)
- 3 measurement/control voltage ranges & 10 measurement/control current ranges
- Internal 542,000 data point storage & continuing experiment regardless of PC failure.
- Full software package included as standard
 - Corrosion test software package (COR)
 - EIS test software package (EIS)
 - Electrochemical analysis software package (EAS)
 - Energy software package (BAT)
- Multichannel configuration available
- Free software upgrade

• Main body Connectors



Safety and Maintenance

1. Even though the communication failure occurs between PC and **ZIVE PP3**, 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.

Application

A portable electrochemical workstation, **ZIVE PP3**, is ideal for field application. You can use this system for corrosion/coating evaluation, sensor test, electrode material, membrane, etc.

■ Corrosion



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

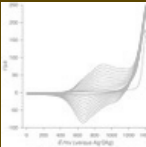
Portable Electrochemical Workstation ZIVE PP3

Sensors



The ZIVE PP3 can be used for sensor research using with DNA chips or screen printed electrodes. System's minimum current range is 2nA(with gain). Cyclic voltammetry, Chronoamperometry and EIS measurement can be used for this application.

General Electrochemistry

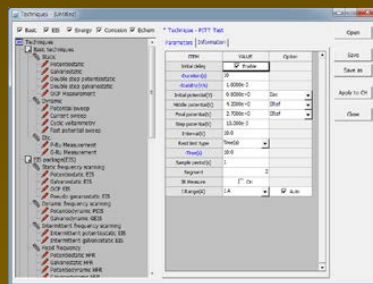


The ZIVE PP3 is also suitable for research and development of electrochemical reaction under low conductive environment.

Main Software SM

The Smart Manager (SM) is to control ZIVE PP3 model and it provides user defined sequential test by using sequence file, technique menu and batch file. The batch file allows the users to do a serial test by combining sequence files and/or technique files.

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

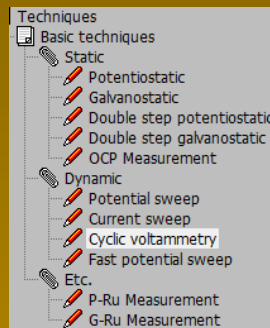


Technique list

Basic Techniques

Basic techniques with standard functions

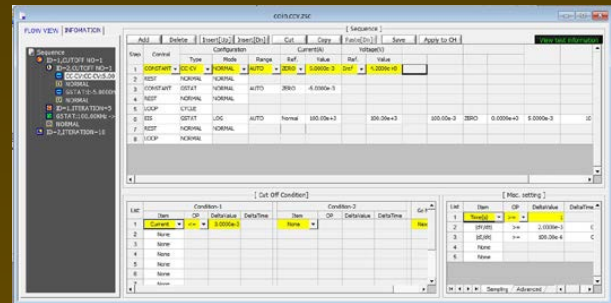
- 1) Potentiostatic
- 2) Galvanostatic
- 3) Double step potentiostatic
- 4) Double step galvanostatic
- 5) OCP measurement
- 6) Potential sweep
- 7) Current sweep
- 8) Cyclic voltammetry
- 9) Fast potential sweep
- 10) Potentiostatic Ru measurement
- 11) Galvanostatic Ru measurement



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

Sequence editor

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

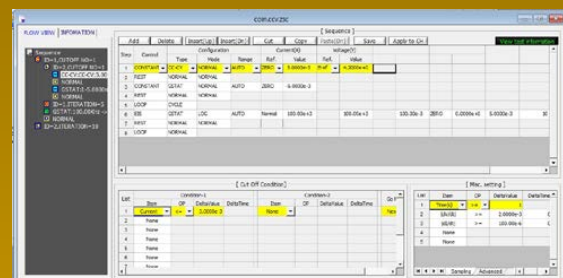


Sequence editor

Control Task Parameters

Control Mode		
constant	GSTAT	constant current control
	Crate	constant Crate control
	PSTAT	constant voltage control
	POWER	constant power control
	LOAD	constant load control
	CC-CV	constant current constant voltage control
	Crate-CV	Crate constant voltage control
	CP-CV	constant power constant voltage control
	CL-CV	constant load constant voltage control
	Id	Id control
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
	MisineG	galvanostatic multisine EIS
	MisineP	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

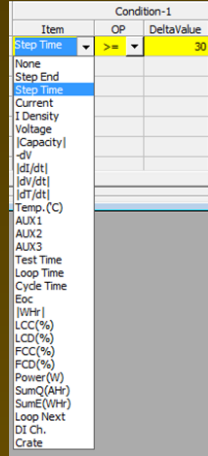
- Constant potential, current, C-rate, power, load, OCP
- Sweep potential, current
- Fast sweep potential, current
- Staircase potential, current
- CC-CV, CP-CV, CL-CV, Crate-CV control
- Id, Is control
- EIS control
- Pulse or sinewave control
- Rest(voltage monitoring only)
- Loop(cycle) control



Sequence editor

• Cut-off(Vertex) Condition

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



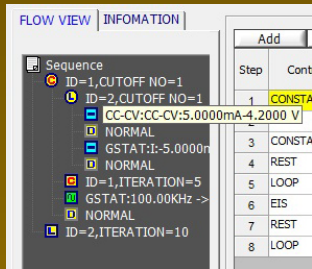
Cutoff Condition

• Sampling Condition

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

• Flow View

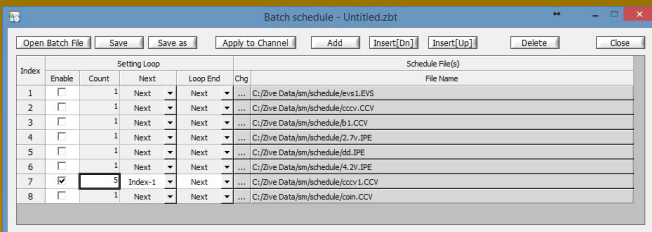
- This displays sequence flow at a glance.



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.

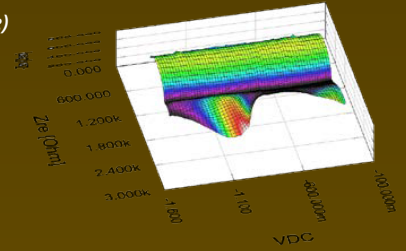


Advanced Software Packages

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

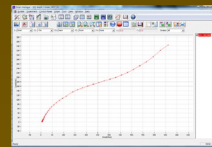
■ EIS Software Package(EISE)

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

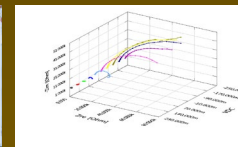


Corrosion PEIS
3D Nyquist plot by ZMAN

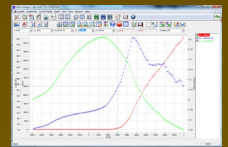
(*)1) The system measures open circuit potential before for each frequency change and apply AC sine wave on this potential.



OCP EIS



Potentiodynamic PEIS

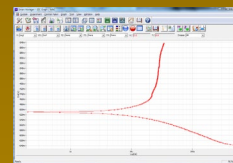


Rs, Cp & Idc vs Vdc plot

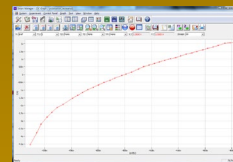
■ Corrosion Software Package(CORE)

Corrosion technique supports IR compensation.

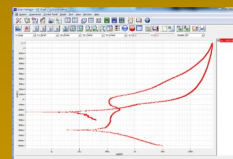
1. Tafel(Tafel experiment)
2. Rp(Polarization resistance)
3. Potentiodynamic
4. Galvanodynamic
5. Cyclic polarization
6. Ecorr vs. time
7. Galvanic corrosion
8. RpEc trend
9. Reactivation potential
10. Critical pitting potential



Tafel experiment



Rp
(Polarization
resistance)



CYPOL(Cyclic polarization resistance)

■ Electrochemical Analysis Software Package(EASe)

1. Step techniques

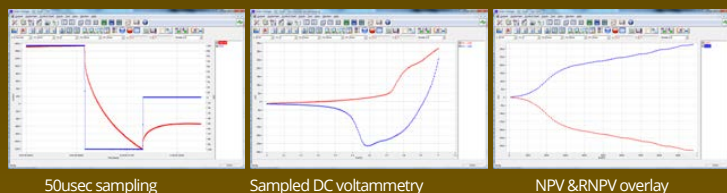
- CA(Chronoamperometry)
- CC(Chronocoulometry)
- CP(Chronopotentiometry)

2. Sweep techniques

- LSV(Linear sweep voltammetry)
- SDV(Sampled DC voltammetry)
- Fast CV
- Fast LSV

3. Pulsed techniques

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

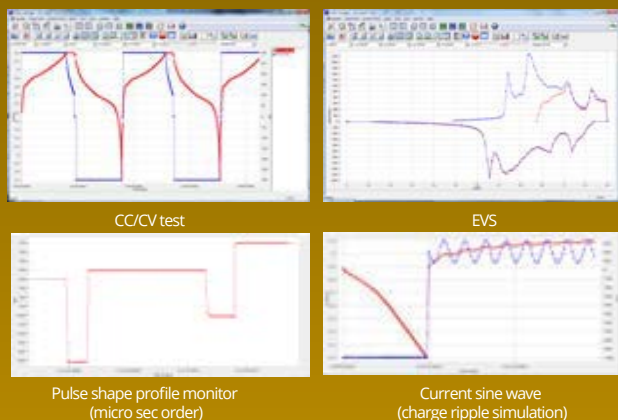


■ Battery Software Package(BATe)

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



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.

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

Control & Real Time Graph

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



Multichannel real time graph

User can control and monitor in this control panel and he/she can monitor data in VOI (Value Of Interest) window and channel status in one window. Real time graph's X Y axis format will be changed per technique automatically. It can be defined by user's demand per technique. For

experiment using sequence file or batch file, user can designate X,Y axis parameter on three different real time graph.

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

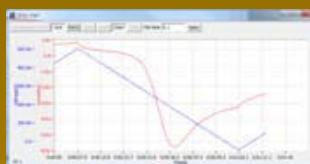


Single channel control panel



Multichannel real time graph

Strip Chart

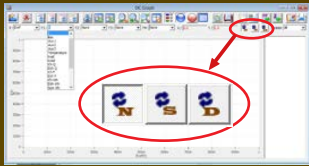
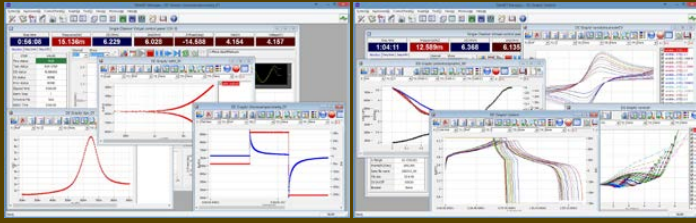




Strip chart recorder function allows you to monitor DC curve in real time. You can monitor 2 Y axis data such as voltage, current, auxV, power, capacity etc. in real time

Graph

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

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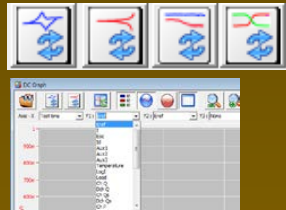
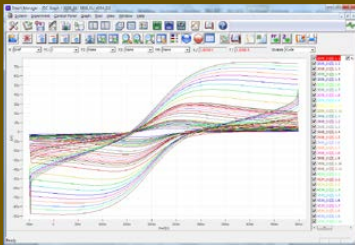
In DC and Cycle graph, whenever you click  or , the parameters which are related to current such as current, capacity, energy, power, load, etc., are changed into calculated specific value or density value, respectively.

 : value divided by weight

 : value divided by active area

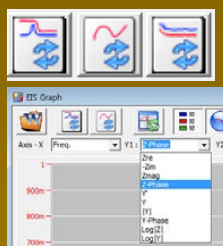
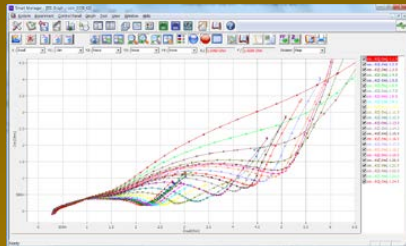
1) DC Graph

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



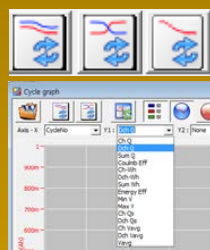
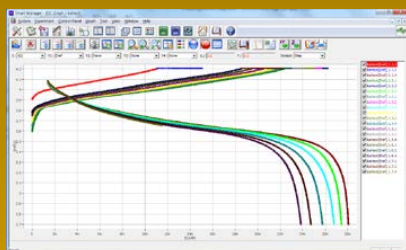
2) EIS Graph

- 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)

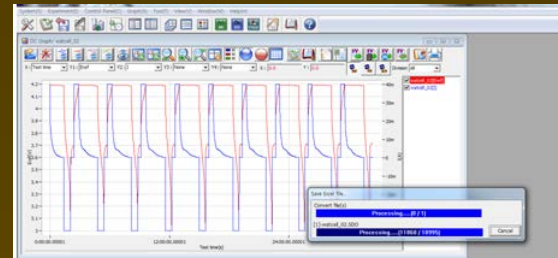


3) BAT Graph

- 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

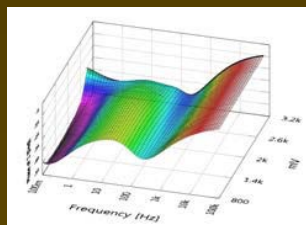
ZIVE data file can be used for analysis by using external IVMAN™ software for DC analysis, IVMAN DA™ software for battery data analysis, IVMAN PA™ software for photo-voltaic cell data analysis and ZMAN™ software for EIS data analysis without license.

ZMAN™ EIS Data Analysis Software

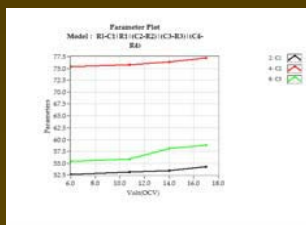
- Model simulation and fitting
- 2D- and 3D-Bode- and Nyquist plots
- Automatic equivalent circuit model search function
- Project concept to handle multiple EIS data analysis
- Parameter plot from fitted elements value
- Compatible with data format from Zahner, Gamry, Ametek etc. (License code is needed.)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



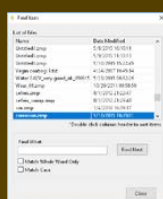
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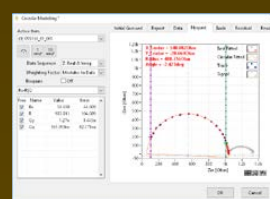
3D Bode plot for series measurement



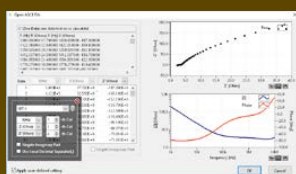
Parameter plot



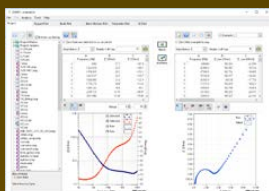
Finding data file menu



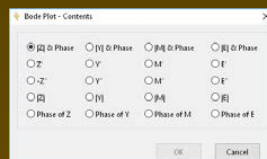
Circular fitting



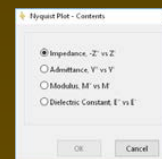
Importing 3rd parties ASCII data file



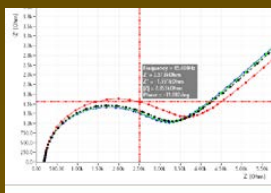
Project manager with data preview



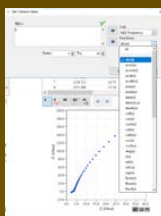
2D Nyquist plot



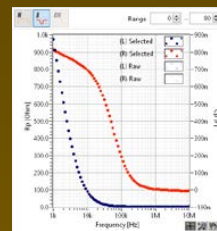
2D Bode plot



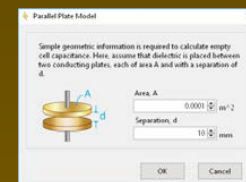
Cursor data display



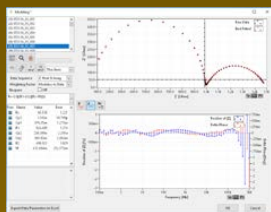
Data replacement by formula function



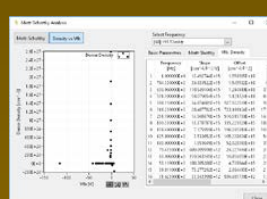
Rp,Cp vs frequency (R) (C)



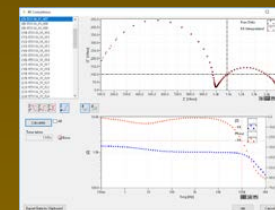
Empty cell capacitance



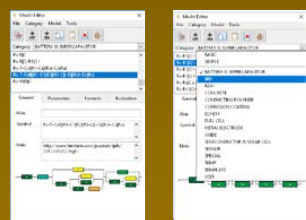
Fitting display



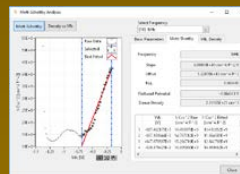
Donor density vs. Vfb graph and analysis



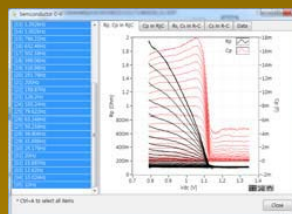
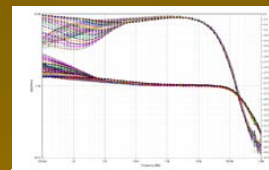
KK consistency



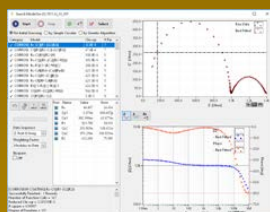
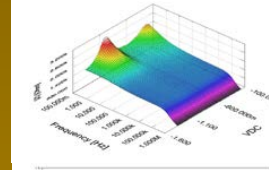
Model editor & model library



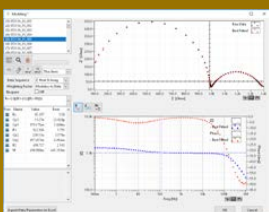
Mott-Schottky analysis window



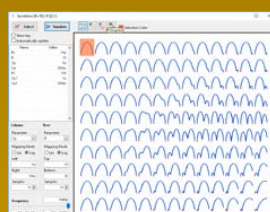
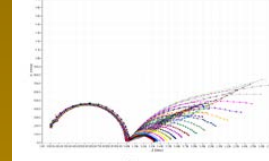
C/R-V graph



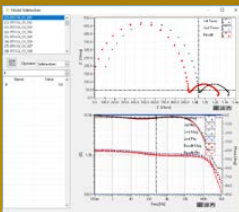
Automatic model searching



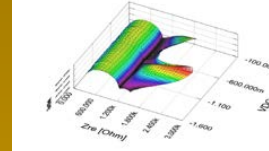
LEVM fitting



Parameter simulation



Element add/subtraction



Bode & Nyquist overlay & 3D plots

IVMAN™ DC Data Analysis Software



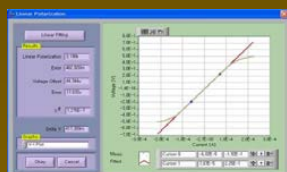
IVMAN™ software package consists of

- 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

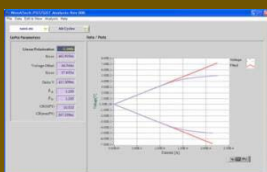


IVMAN™ Main Software

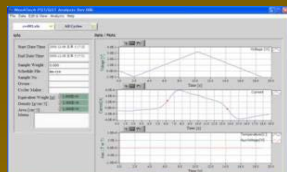
- Ideal for DC corrosion data analysis and electro-analytical data analysis
- Initial guessing function on Tafel analysis
- Polarization resistance fitting
- 3D graph
- Find peak function
- Interpolation, differentiation, integration etc.
- Reporting function



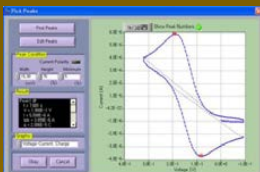
Polarization resistance fitting



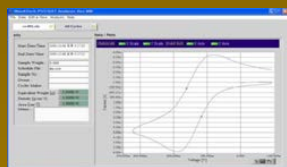
Polarization analysis result



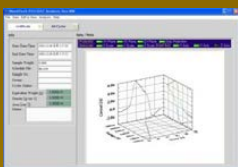
Time graph



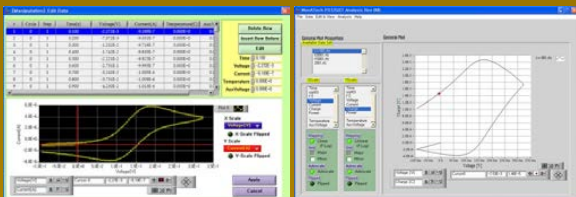
Find peak menu



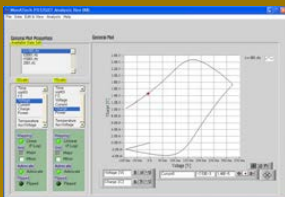
CV graph



3D graph



Edit data menu

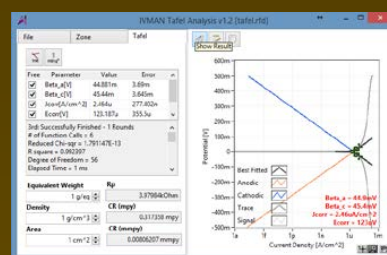


Universal graph



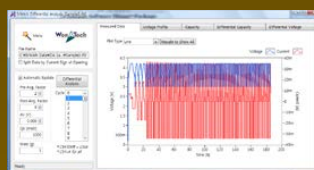
IVMAN TA™ Tafel Analysis

- Simple Tafel calculation

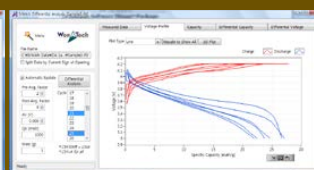


IVMAN DA™ Battery Test Data Analysis Software

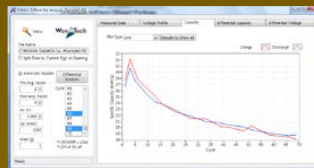
- Battery test data analysis
- Electrochemical voltage spectroscopy (dQ/dV vs. V)
- Voltage vs. Capacity analysis (V vs. Q)
- Cycle graph (Q vs. cycle)
- Differential voltage graph (dV/dQ vs. Q)



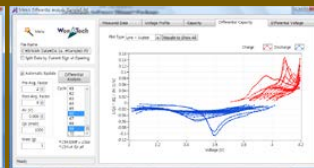
Measured data



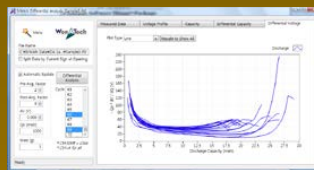
V vs. Q



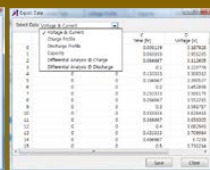
Cycle graph



dQ/dV vs. V



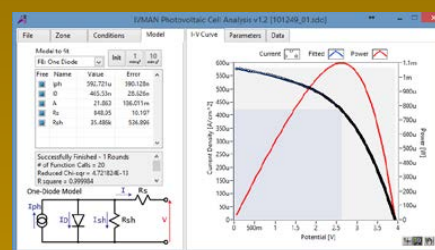
dV/dQ vs. Q



Export ASCII file



IVMAN™ Photovoltaic Cell Analysis

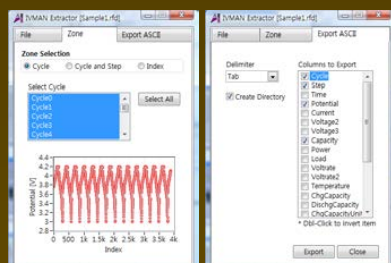


- Automatic analysis of parameters
 - open circuit voltage, open circuit current, max. power, efficiency photo induced current, diode quality factor, series resistance, etc.

Portable Electrochemical Workstation ZIVE PP3

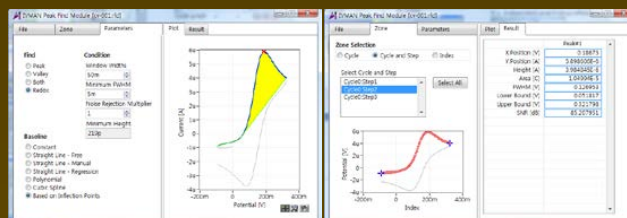
IVMAN EX™ Extractor

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



IVMAN PF™ Peak Find Module

- Independent peak finding software



Optional Accessories

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



H-Type Cell



Corrosion Cell Kit



Flat Cell Kit



Permission Cell Kit



Plate Test Cell

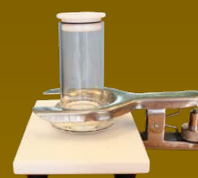


Plate Test Cell



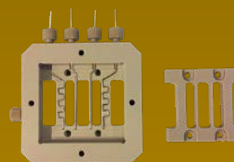
Universal electrode holder



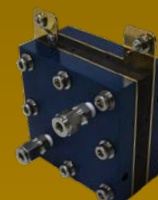
Black Box for photo-electrochemistry



Faradaic cage



membrane conductivity cell



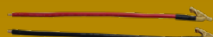
Single Cell Hardware Fixture



Flat specimen holder



Through-Plane Conductivity Test Jig



Copper Alligator electrode holder



Pt plug electrode

Specification

Main System	
PC communication	USB2.0 high speed
Line voltage	100~240VAC, 50/60Hz
Max. output power	40Watt
Size	408.5x302.8x166mm(WxDxH)
LED indicator	Run, Comm

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
Internal data memory	542,000 points
LCD display	DC & EIS mode automatically

Power Amplifier(CE)	
Power	20Watt(20V@1A)
Compliance voltage	±20V
Max. current	±1A
Control speed selection	4ea
Bandwidth	1MHz
Slew rate	8V/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	10 ranges(auto/manual setting) 10nA~1A 1nA with gain
Current resolution	16 bit 30uA, 3uA, 300nA, 30nA, 3nA, 300pA, 30pA, 3pA, 300fA, 30fA
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
Current accuracy	±0.03% f.s.(gain x1)>100nA
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 ¹³ Ω 4.5pF
Bandwidth	>22MHz
CMRR	>114dB

EIS Measurement for System	
Frequency range	10uHz~1MHz
Frequency accuracy	<0.01%
Frequency resolution	5000/decade
Amplitude	0.5mV~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	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

Software	
Max. step per experiment	1000
Shutdown safety limits	Voltage, current, temperature, etc.
Max. sampling rate	2usec or 3usec depending on data point number
Min. sampling time	Unlimited
Sampling condition	Time, dv/dt, dl/dt, temperature, 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
Thermocouple	K-type, 1.5 meter long(option)
Auxiliary cable	Option
Misc. cable	Option
Impedance analysis S/W	ZMAN™ software
DC data analysis S/W	IVMAN™ software package

The specifications are subject to change without notice.
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