

Product Catalog

WBRS20 5V2A Battery Test System



The **WBRs20** is a Max. 2Ampere@-5V to +5V single cell test system in 1800mm height rack (128 channels with PC mount per rack) or 1100mm height rack (128 channels configuration). This can be configured up to 128 channels with battery interface software.

The **WBRs20** provides independent control over each channel, user can test multiple samples simultaneously and independently. The powerful battery interface software can give various plots for users to analyze test results easily.

The **WBRs20** is designed with 4 probe type true potentiostat/galvanostat circuit and various switching conditions and multiple condition parameters can be input. Pre-defined techniques for battery test allow user to test their battery so easily even if he/she is a novice for battery testing. And it also can easily create test conditions using the schedule editor.

The **WBRs20** is suitable for battery testing and analysis and provides techniques such as EVS and variable scanning speed CV as well as charging and discharging test.

Features

● Potentiostat/Galvanostat Circuit

- No switching time (charging to discharging, discharging to charging)
- Analog feedback control to keep constant voltage & current
- Capable of testing anode materials, cathode materials, and complete cells, including half-cell experiments

● High Precision

- 16bit ADC, DAC: High resolution of 0.0015% f.s. (control and data storage)
- Voltage accuracy: $\pm 0.02\%$ f.s.
- Current accuracy: $\pm 0.02\%$ f.s.
- 4 current ranges
- MOSFET type linear power supply circuit
- Digital coulometer is included: capability to calculate real-time capacity at hardware sampling rate and store it in memory

● Safety

- Unique "Fail check" function
: To protect the system and cell itself, the experiment will stop automatically when the measured value is different from control value due to battery failure or wrong cell connection, etc.
e.g. Control value: 500mA, Measured value: 300mA
The experiment will stop automatically.
- System safety parameter
: If the measured value is over system specification or user defined safety limit condition, the experiment stops automatically.
: User defined safety condition setting
User can input safety level depending on chemical properties of reactants in test cell.
- Automatic cell connection check
: Before experiment, if the cell voltage value is over than standby voltage range, program gives the warning message for the operator to check the cell connection.
- If operator presses stop button by mistake, a confirmation message box will appear.
- To prevent over current, a poly-switch is located in each channel.
- Watchdog function:
Experiments stop of the channel connected to the board when error occurs in the CPU operation of the SIF board.

- Even if a PC failure/communication failure happens, the system will work without data loss and will store the data by max. 290,000 data points per control board.
- If the main program is down by unstable operating system, the independent server program keeps the experiment (control & data acquisition) without dead time.

● Maintenance & System Expansion

- Channel expansion: Max. 128 channels in one WBRs20 rack is available.
- Automatic data backup function
- Hard disk space check function
- While one or more channels is working, the calibration for the other channels in rest mode is available.
- Software specialized for battery testing (Battery Interface Software)
- Easy calibration software
- Stable TCP/IP communication
- Automatic firmware upgrade

Options

● Auxiliary voltage & temperature measurement

- Auxiliary voltage monitoring
- Temperature measurement monitoring

● Various Battery jig

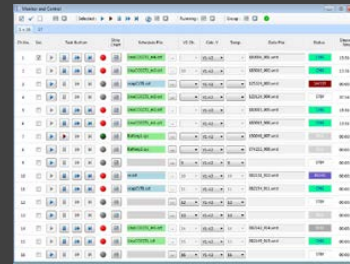
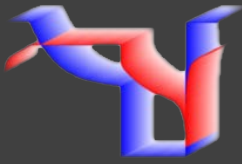
- Coincell jig
- Cylindrical Battery jig
- Pouch cell jig

Specifications

Control voltage range	$\pm 5V$
Control current range	4 ranges 2A, 200mA, 20mA, 2mA
Input impedance	1Tohm
Cell connection	4 probe type, alligator clip cables
Max. channel No.	128
Min. channel No.	16
Voltage accuracy	$\pm 0.02\%$ f.s.
Current accuracy	$\pm 0.02\%$ f.s.
Voltage Control/Measurement	
Full scale ranges	$\pm 5V$
Resolution (16 bits)	0.15mV
Current Control/Measurement	
Full scale ranges	Max. 2A@ $\pm 5V$
Resolution	16 bit (0.0015% f.s)
Communication	TCP/IP
Sampling time	50msec
Safety	Emergency button integrated
Size	W724xD690xH1300mm (standard 128-channel rack) W724xD690xH1800mm (PC rack)

All specifications are subject to change without notice.

Software (Battery Interface)



Multichannel control panel



Single channel control/monitor panel

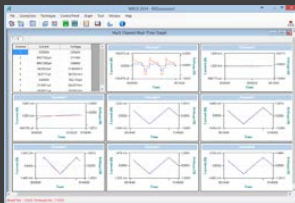
- 32bit/64bit OS
- TCP/IP communication
- Max. 200 step conditions can be made
- Max. 10 cut-off conditions can be input for each step
- Max. 290,000 data points can be stored on the communication board
- Single/multichannel control panel
- Various types of real time graphs and axis adjustment functionality
- Data backup function
- WYSIWYG graphics
- User friendly software

Virtual Control Panel

- BCO (Button click operation): The user can perform any task with just a button click, no menu selection required.



- By selecting the combo box, users can easily change the charge/discharge condition file for the channel.
- Experiment condition files for multiple channels can be changed simultaneously.
- Real-time dual-channel (V&I) strip chart display for selected channels or all running channels.



Multichannel real time graph



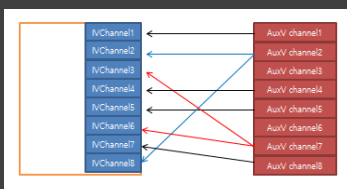
Single channel real time graph

- Display channel status on the status bar
- Various task functions: run, stop, hold, moving step, etc.



Jump step function

- Assign temperature and Auxiliary voltage channel on virtual control panel.



- Single channel & multichannel control/monitor panel

- VOI(Value of Interest) bar is located in upper side of control/monitor window.

The first value on the far left represents the elapsed time since the experiment started. Other parameter values can be selected or hidden selectable control types: voltage, current, auxiliary voltage, temperature, load, power, capacity and energy.

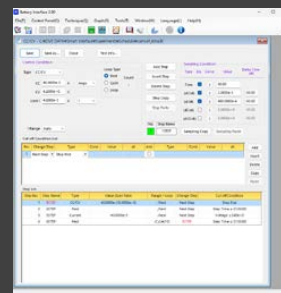
Elapsed Time	Voltage(V)	Current(A)	Power(W)	Auxiliary(V)	Temperature(°C)
00:00:50	1.5m	0.000	0.000	181.3m	0.0

Voltage control

Step Time	Voltage(V)	Current(A)	Power(W)	Auxiliary(V)	Temperature(°C)
00:00:20	3.887	-50.0m	-194.4m	237.4m	0.0

Current control

Schedule Editor



- One stop test condition creation/modification
- Multiple input parameters available
- Create schedules with a max of 200 steps
- Control parameters
 - Constant voltage, LastV
 - Constant current, LastI
 - Constant power
 - Constant load
 - C-rate
 - Voltage scanning, current scanning
 - Conditioning potential
 - Conditioning current
 - Rest
 - LastVscan
 - CstepV(Staircase Voltage Sweep)
 - CstepI(Staircase Current Sweep)
 - CC/CV, CL/CV, CP/CV, C-rate/CV
 - Id, Is control
- Step flow is defined by next step, loop and cycle
- Selection of cut-off conditions and values
 - step time, voltage, current, dV/dt, dI/dt, cycle time, loop time, capacity, dV, Whr, Ahr, temperature, Aux voltage, dT/dt, Eoc, stepend

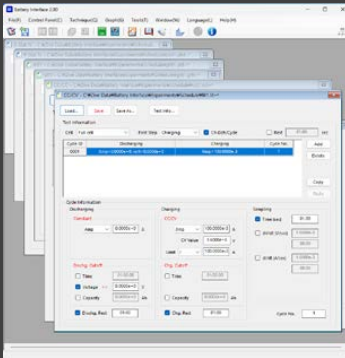
Cut off Condition List

No.	Change Step	Type	Cond.	Value	dt
1	Next Step	Step End			
	Step List	Step No.	Step Name	Value (Scan Rate)	
		1	1ST Step	Auxiliary Voltage	40.0000e-3 (0.0000e+0)
		2	2ST Step	Temperature	
		3	3ST Step	Loop Time	-40.0000e-3
		4	4ST Step	Eoc Voltage	
			Step End		
			C Rate		
			AB5(i)		
			Cycle/Loop		
			FCC		
			FCD		
			LCC		
			LCD		
			Specific I		

Cut-off condition

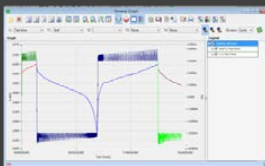
- Data sampling condition by each step
 - time, dV/dt, dI/dt, dT/dt, dV2/dt
- And/Or logic for cut-off condition settings

Menu Selection (Pre-defined techniques)

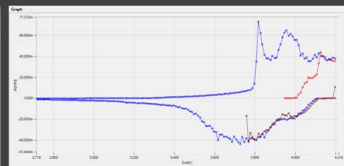


Techniques

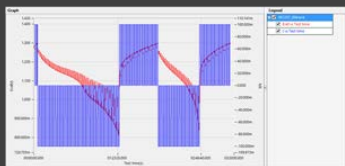
- CC/CV (Lithium battery) test
- CC/CC (NiCd(NiMH) battery) test
- Steady state CV
- Pstat IV curve
- Gstat IV curve
- EVS (Electrochemical voltage spectroscopy) test
- GITT (Galvanostatic intermittent titration technique) test
- PITT (Potentiostatic intermittent titration technique) test
- Discharge test
- Variable scan rate CV test



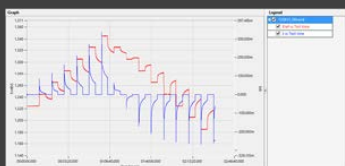
EVS test raw data



EVS graph format (dQ/dV vs. V)



GITT test



PITT test raw data

Real time data monitor



- Real time display: time, voltage, current, channel status
- Channel status displayed by color: charging, discharging, standby, idle, calibration

Grouping

- Classification/grouping channels by user's purpose
- Each group can be named based on user name, chemistries, etc
- Group monitoring available
- Group control



Detailed Data Monitor

- Display test data: status, running time, step number, cycle number, step time, current range, current, voltage, capacity, power, energy, Aux V, Calc V, temp, cycle file name, data file name, and file size.
- Monitor type selection: All channels, running channels only, and grouped channels.
- Display active status only for running channels

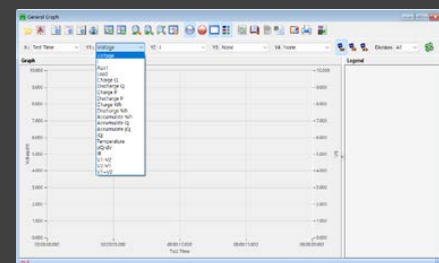
Channel Monitoring

Item / Ch.	1	2	3	4	5	6	7	8
Status	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00
Step / Cycle	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1
Step Time	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00
Current Range	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0
Current (A)	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0
Voltage (V)	3.8188e+0	3.7895e+0	3.7895e+0	3.7895e+0	3.7895e+0	3.7895e+0	3.7895e+0	3.7895e+0
Capacity (Ah)	1.9423e+0	1.9423e+0	1.9423e+0	1.9423e+0	1.9423e+0	1.9423e+0	1.9423e+0	1.9423e+0
Power (Watt)	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0
Energy (Whatt)	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0
Run (h)	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0
Calc V	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0	0.0000e+0
Temp (C)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Channel Name	CVT4	CVT4	CVT4	CVT4	CVT4	CVT4	CVT4	CVT4
File Name	20201010_001	20201010_001	20201010_001	20201010_001	20201010_001	20201010_001	20201010_001	20201010_001
File Size	822 Kbytes	771 Kbytes	810 Kbytes	4 Mbytes	10465 Kbytes	10465 Kbytes	10465 Kbytes	10465 Kbytes

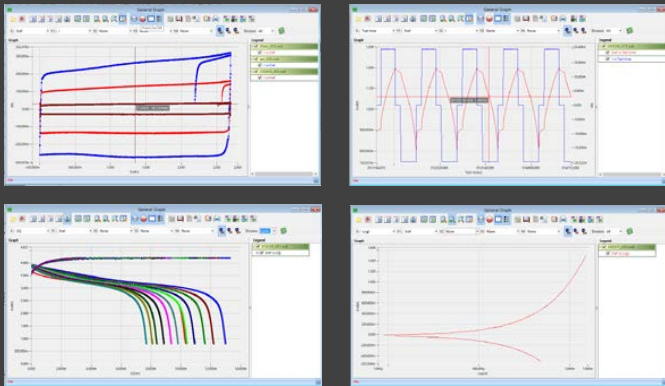
Graphics

- Multiple graph format
 - General graph
 - Cycle graph

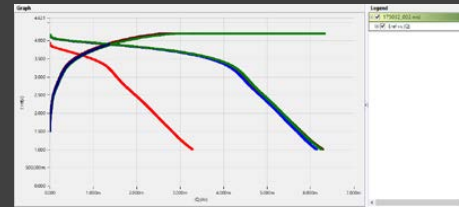
General graph format



Battery Test System WBRs20

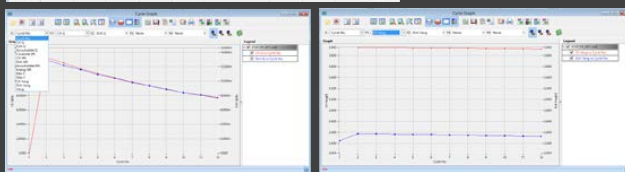
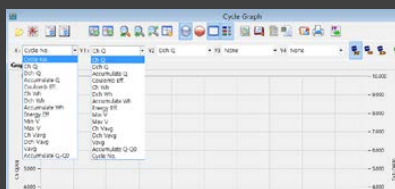


- Parameter change without reloading the data file
- Data On/Off settings: Data can be shown or hidden by selecting or deselecting it.
- Rest step data hidden function
- Advanced graph settings



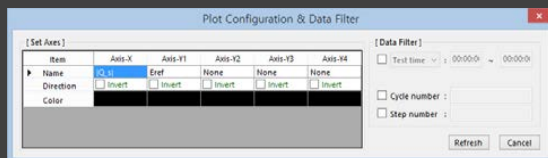
Voltage vs. |capacity| graph

- Cycle graph format

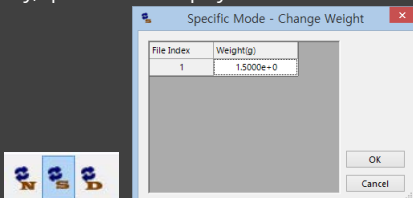


- General graph functions

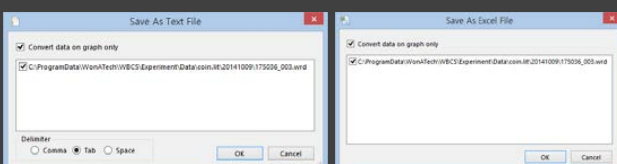
- Various axis variable settings
- Graph overlay : max. 20 data
- Universal graph : Combinations of X, Y1, Y2, Y3, Y4 axis parameters
- Automatically update the plot of running channels by pressing the 'reload' button
- Automatic/manual scale and polarity selection for each axis



- Cross-hair pointer by mouse click/arrow key displays coordinate values on graph
- Mouse zooming
- Density, specific value display

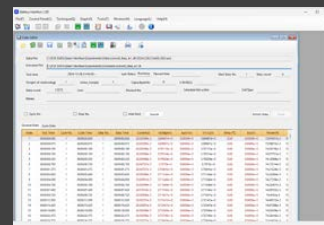


- Graphic data can be copied to the clipboard for use in other application software
- Grid on/off and dot/line selection
- Only the data on the graph can be converted to an ASCII file or an Excel file.



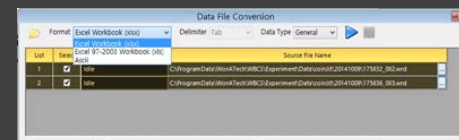
- Tools

- Data Editor
 - General data report
 - Cycle data report

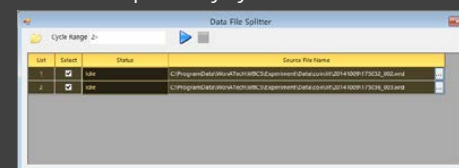


- * Data editing
- * Data filtering

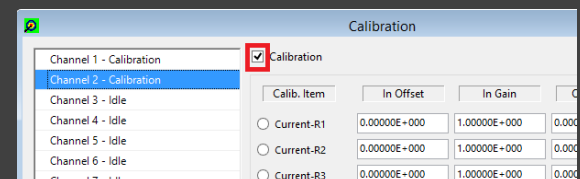
- Data Conversion
 - Convert data to ASCII or Excel file format



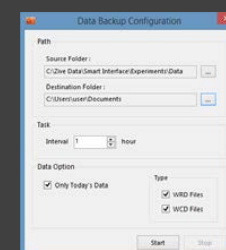
- Data file splitter by cycle number



- Calibration
 - User can calibrate channel(s) while other channels are running.



- Data backup



Independent Data Analysis Software



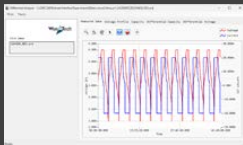
The data format obtained using BI and SI can be analyzed with independent data analysis software, and the following analysis tools are available for free.

- IVMAN differential analysis (battery analysis) software
- IVMAN photovoltaic cell analysis
- IVMAN peak find module

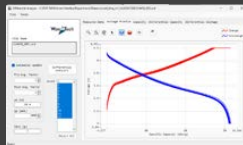


IVMAN DA™ Battery Test Data Analysis Software

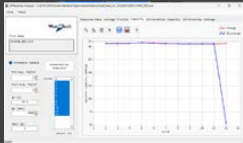
- Battery test data analysis
- Electrochemical voltage spectroscopy (dQ/dV vs. V)
- Voltage vs. capacity analysis (V vs. Q)
- Cycle graph (Q vs. cycle)
- Differential voltage graph (dV/dQ vs. Q)



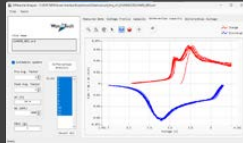
Measured data



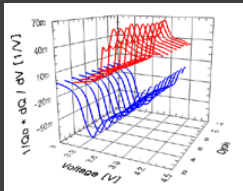
V vs. Q



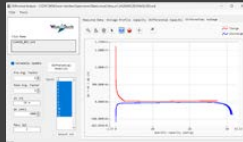
Cycle graph



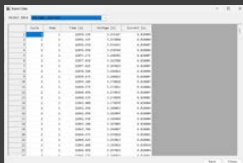
dQ/dV vs. V



3D graph



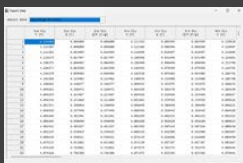
dV/dQ vs. Q



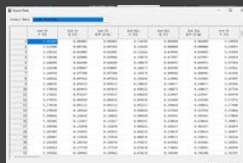
V/I vs. T



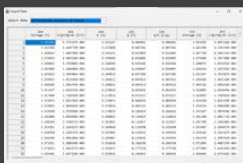
Charging profile



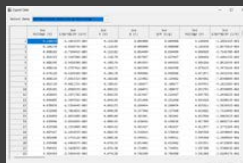
Discharging profile



Cycle profile



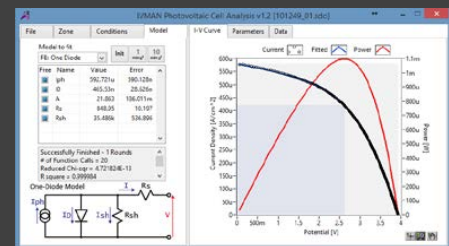
Charging EVS



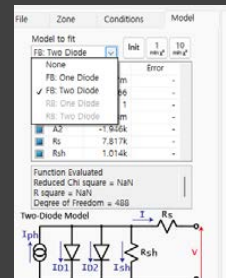
Discharging EVS



IVMAN™ photovoltaic cell analysis



• V vs. I graph



• Model selection and fitting

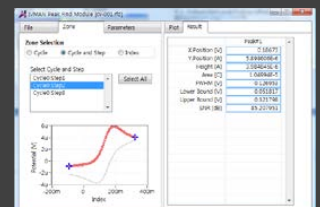
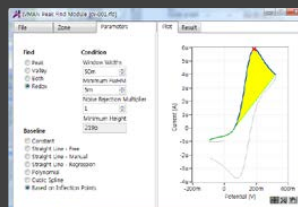
Conditions	Auto-Fitted	User
Area (cm²)	1000	
Temperature (K)	300	
Open circuit voltage (V)	1.722049	1.48337
Short circuit current (A/cm²)	8.31168	7.07138
Voltage @ max power (V)	1.520191	1.470111
Current @ max power (A/cm²)	3.000087	2.500084
Max power (mW/cm²)	3.000172	2.500084
Efficiency (%)	2.522887	2.500084
Photo-induced current (A/cm²)	8.31168	7.07138
Diode quality factor	22.913597013	10.15362354
Series resistance (ohm)	1013.507867	1013.507867
Shunt resistance (ohm)		

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



Peak Find Module

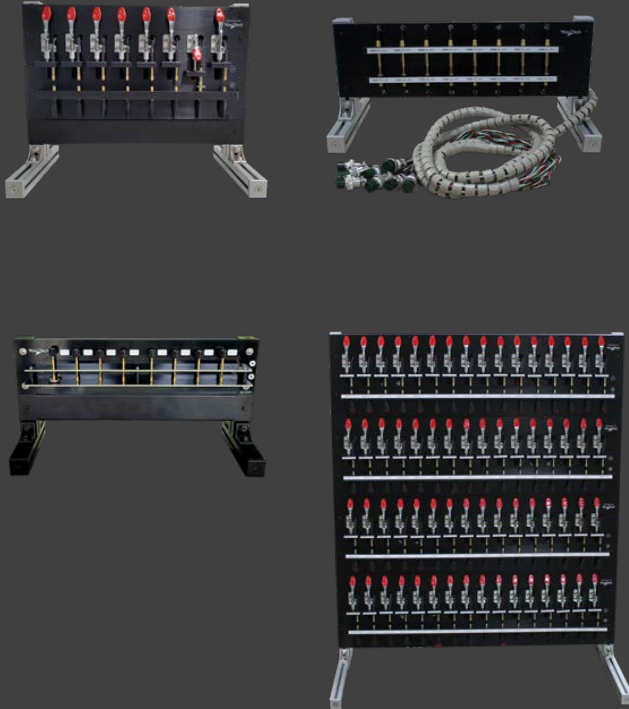
- Independent peak finding software



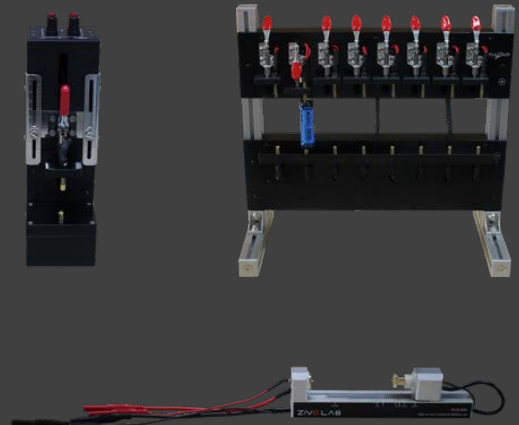
WBR20 Battery Test System

Jigs

● Coin Cell Jig



● Cylindrical Battery Jig



● Pouch Cell Jig

- 4 pin lever type

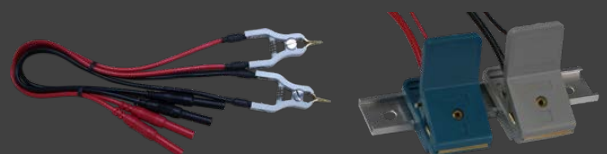


● Clamp Cable Jig

- Two 2-contact clip type (4 contact)

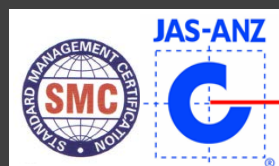


● Clamp Cable





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ISO 9000 & ISO 14000 Qualified

