

DV POWER SOLUTIONS FOR BATTERY MAINTENANCE

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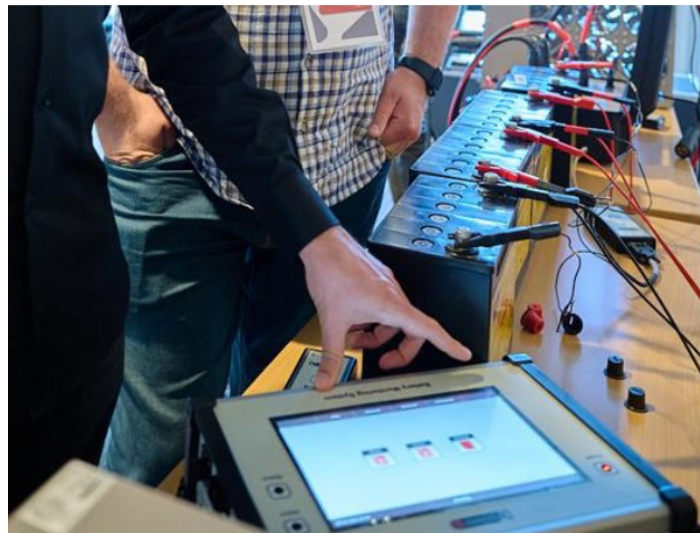


Agenda

- DV Power – company profile
- Test methods and relevant standards for battery maintenance
- Battery capacity tester
- Battery internal resistance tester
- Battery monitoring systems
- DV Power portable units (up to 1350 V) for battery recycling, second-life assessment, electric vehicle battery pack testing, pre-shipment discharge, etc.

About DV Power

IBEKO Power AB with the headquarters in Stockholm, Sweden was founded in **2000** by the group of engineers with an extensive experience in the power electronics technology area.



DV Power Products

Battery Test
Equipment



Transformer
Test
Equipment



Circuit
Breaker Test
Equipment



Motor /
Generator Test
Equipment



Electrical
Safety Test
Equipment



Battery Test Equipment

Existing product line

- Battery Load Units (capacity/discharge testers) – **BLU/BXL series**
- Battery Voltage Recorders – **BVR series**
- Battery Voltage Supervisors – **BVS series**
- Universal Battery Chargers – **BAC series**
- Battery resistance testers – **IBAR series**
- Online battery monitoring – **MB100 series**



Distributors Map



- Headquarters: **Stockholm, Sweden**
- Branch office: **Orlando, FL, USA**
- Distributors and representatives: **90**
- Countries: **70**

UK & Ireland Representative

DRALLIM INDUSTRIES LTD.

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Representing DV Power in
the UK and RoI

DV Power Products

Why DV Power?

- Products used in more than **110** countries worldwide
- Robust design for field use
- Simple and easy to operate
- Wide product line
- **Free-of-charge** DV-Win software
- Warranty period: **3 + 1 year**
- Customer support 24/7



Standards for battery maintenance

Vented Lead Acid batteries (VLA)

- IEEE 450
- IEC 60896-11

Valve-regulated Lead Acid (VRLA)

- IEEE 1188
- IEC 60896 – 21

Nickel-Cadmium

- IEEE 1106 – 2015

Lithium

- Not published yet

Standards for battery maintenance

Vented Lead Acid batteries (VLA) - IEEE 450

Measurement	Monthly	Quarterly	Annually
Battery (String) Voltage	✓		
Charger Voltage & Current	✓		
Ambient temperature	✓		
Visual Inspection	✓		
Electrolyte Levels	✓		
Pilot Cell Voltage, Temperature , Specific gravity	✓		
Cell Temperature		✓ (10%)	
Cell Internal Ohmic			User Option
Connection Resistance			✓
Capacity Test Intervals			25 % of expected service life

Standards for battery maintenance

Valve-regulated Lead Acid (VRLA) – IEEE 1188

Measurement	Monthly	Quarterly	Annually
Battery (String) Voltage	✓		
Charger Current	✓		
Ambient temperature	✓		
Visual Inspection	✓		
Electrolyte Levels			
All Cell Voltages		✓	
Cell Temperature		✓ (10%)	
Cell Internal Ohmic		✓	
Connection Resistance			✓
Capacity Test Intervals			25 % of expected service life or every 2 years

Standards for battery maintenance

Nickel-Cadmium – IEEE 1106

Measurement	Quarterly	Semi-annually	Annually
Visual Inspection	✓	✓	✓
Charger Output Current	✓	✓	✓
Charger Output Voltage	✓	✓	✓
String (Float) Voltage	✓	✓	✓
All Cell Voltages		✓	
Cell Temperature		✓ (10%)	
Cell Internal Ohmic	N/A	N/A	N/A
Connection Resistance			✓
Capacity Test Intervals			25 % of expected service life

DV Power Solutions for Battery Testing

- Battery Capacity Testers (0 – 1350 V DC)
- Battery Internal Resistance Testers
- Cell Voltage Monitoring during Capacity Test
- Battery Chargers
- Discharging Batteries Before Transport (Li-ion)
- Second-Life assessment or Recycling
- Electric vehicle battery pack testing, etc.

Capacity Testers

BLU-T Series

0,9 – 70,5 V DC
Up to 350 A



BLU-A Series

5,55 – 300 V DC
Up to 240 A



BLU-C Series

3.0 – 800 V DC
Up to 300 A



BLU-D Series

0 – 1350 V DC
Up to 100 A
with integrated ZVD



Battery Capacity Test

- The most important parameter for condition assessment
- The only 100%-reliable method to test your battery (*slow, but safe*).
- The key test according to IEEE standards.
 - Acceptance test
 - Periodically
 - If we suspect there is a problem

-> HOW?

Battery Capacity Test

- Fully charged battery (up to float or maximum voltage)
- Connect battery to „dummy load” (simulating real battery load)
- Test parameters settings
 - Current / power / resistance
 - Time
 - Limits (end voltage, capacity, and time)

-> After 10h (usually), the result is ...

Battery Capacity Test

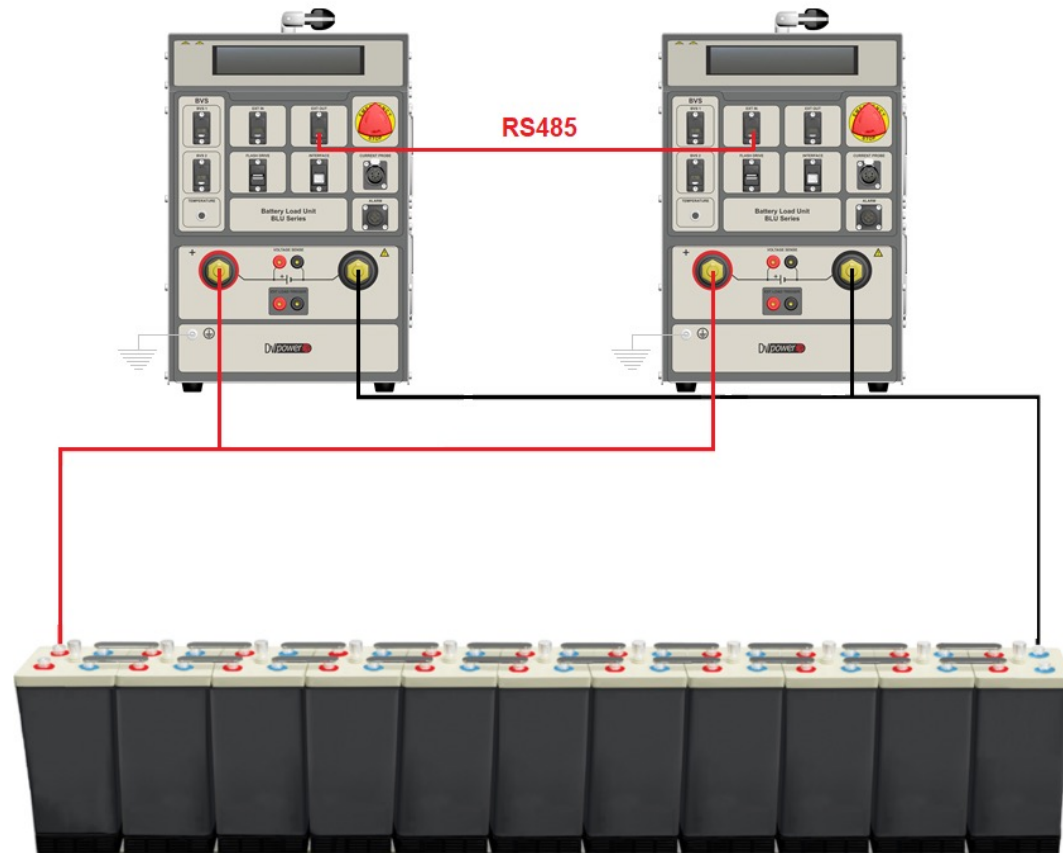
- The result is a number: $C = I \times t$ (Ah)
- Example:
 - Manufacturer: $C_{10} = 1\ 200$ Ah
 - Measured: $C_{M10} = 1\ 134$ Ah (94,5%) **good?**
- Yes, because 80% limit not breached (960 Ah)
- 94,5% Ah capacity is still there

PRODUCT RANGE

	Type	Positive Plates		Number of Poles	Nom. capacity (Ah at 20°C)			
		Number	Number		C10 (Ah) 1.80 Vpc	C5 (Ah) 1.75 Vpc	C3 (Ah) 1.75 Vpc	C1 (Ah) 1.75 Vpc
Cells	2V 4 OPzV 200 ¹	4	50	2	224	202	179	124
	2V 5 OPzV 250 ¹	5	50	2	280	253	224	155
	2V 6 OPzV 300 ¹	6	50	2	336	303	268	185
	2V 5 OPzV 350 ¹	5	70	2	405	365	320	212
	2V 6 OPzV 420 ¹	6	70	2	486	438	384	252
	2V 7 OPzV 490 ¹	7	70	2	567	512	447	292
	2V 6 OPzV 600 ¹	6	100	2	690	623	539	330
	2V 8 OPzV 800 ¹	8	100	4	920	831	720	445
	2V 10 OPzV 1000 ¹	10	100	4	1150	1039	899	554
	2V 12 OPzV 1200 ¹	12	100	4	1380	1247	1076	657
	2V 12 OPzV 1500 ¹	12	125	4	1620	1470	1275	784
	2V 16 OPzV 2000 ¹	16	125	6	2160	1960	1701	1049
2V 20 OPzV 2500 ¹	20	125	8	2700	2452	2130	1322	
2V 24 OPzV 3000 ¹	24	125	8	3240	2940	2544	1552	
Blocks	6V 4 OPzV 200 ²	4	50	2	206	190	169	117
	6V 5 OPzV 250 ²	5	50	2	257	237	211	146
	6V 6 OPzV 300 ²	6	50	2	309	285	253	173
	12V 1 OPzV 50 ²	1	50	2	51	47	42	30
	12V 2 OPzV 100 ²	2	50	2	102	94	84	59
	12V 3 OPzV 150 ²	3	50	2	153	141	126	88

¹ According to DIN 40 742 ² According to DIN 40 744 *includes i

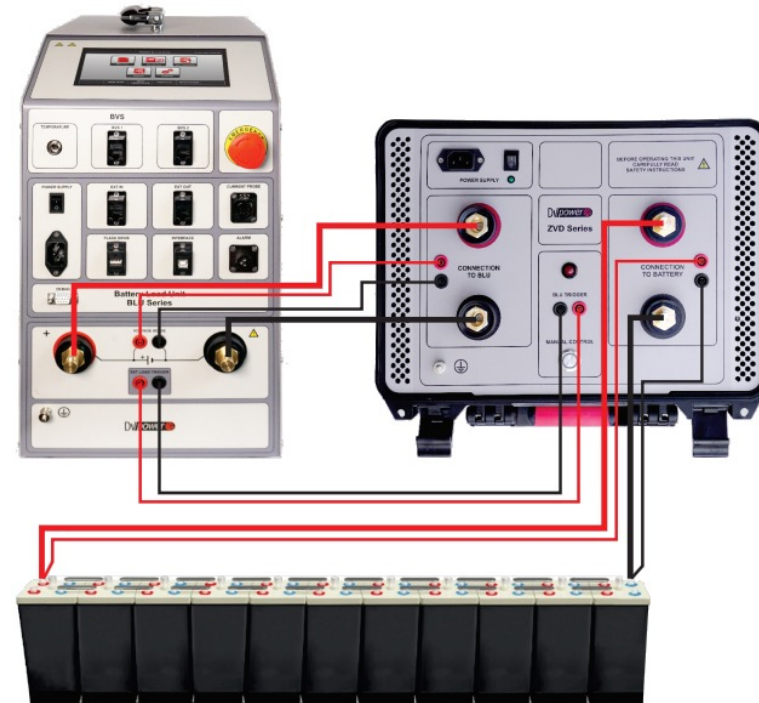
Battery Capacity Test – parallel operation



Solutions for Recycling

BLU + ZVD System

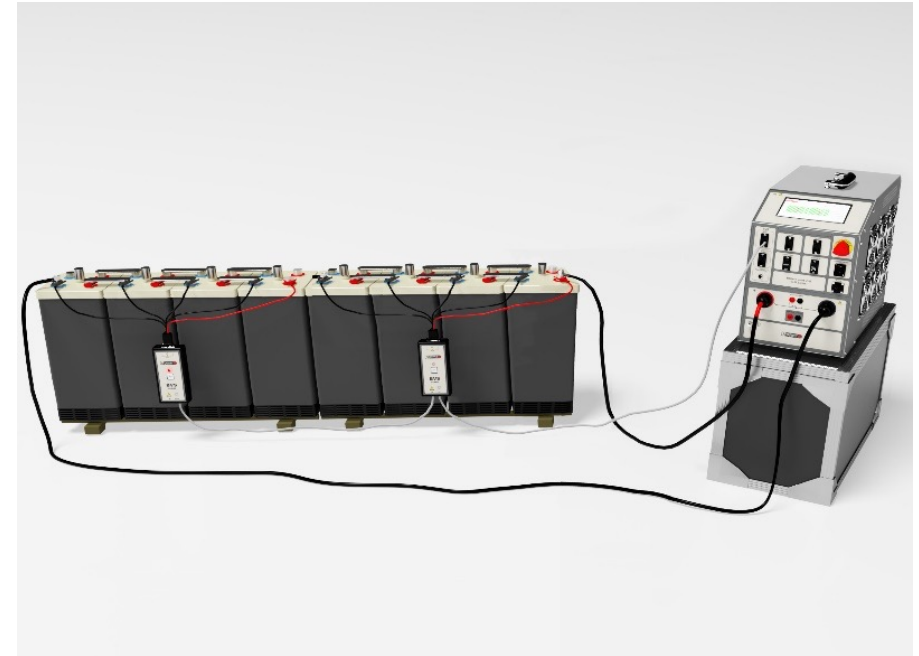
- Controlled constant current discharge down to 0 V (up to 60 A)
- 2-step process:
 - Discharge down to 0 V
 - Battery Short-circuited (ZVD)



Battery Voltage Supervisor

BVS-4

- **Consists of CVM-4 modules:**
 - 1 module monitors 4 cells
 - Less cables
 - Less time for connection
 - Reduced complexity
- **CVM-4 monitors:**
 - Cell voltage
 - Cell temperature (optionally)



MANUAL CELL VOLTAGE MEASUREMENT

Battery Voltage Recorder BVR



- Support tool for battery capacity test
- Record, view and analyze cell float voltages
- Enables simultaneous string voltage and current measurement to analyze discharge test process
- Upload and view DMA35 Hydrometer Data
- Easy transfer of measured data to DV-B Win software

Battery Monitoring System

MB 100

Battery Monitoring System – coming soon!

- Designed for 24/7 real time monitoring of battery systems for various applications
- Monitors and logs battery cell and string parameters, as well as alarm conditions
- String voltage & current, and ambient temperature measurement
- Use settable limits and acquisition intervals
- Logging of cell/battery parameters with data/time stamps
- Alarm conditions logging and alarm email alerts
- Export data for further analysis



Battery Internal Resistance Tester - IBAR

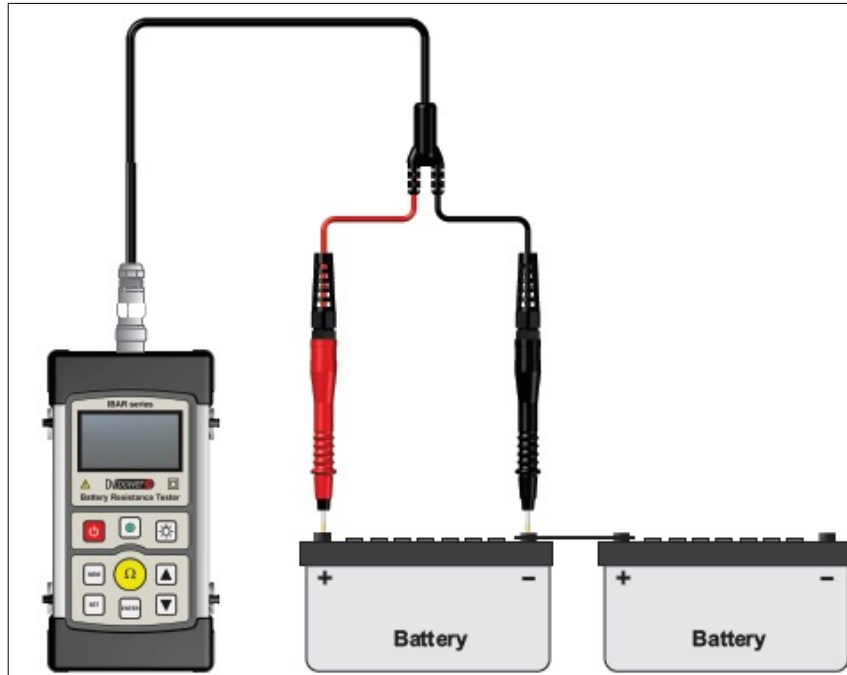
- Handheld device (less than 1 kg)
- Injection of 1 kHz AC
- Test current: 1,5 mA – 150 mA
- Measured parameters:
 - Internal cell resistance/ intercell connection resistance**
 - Cell voltage**



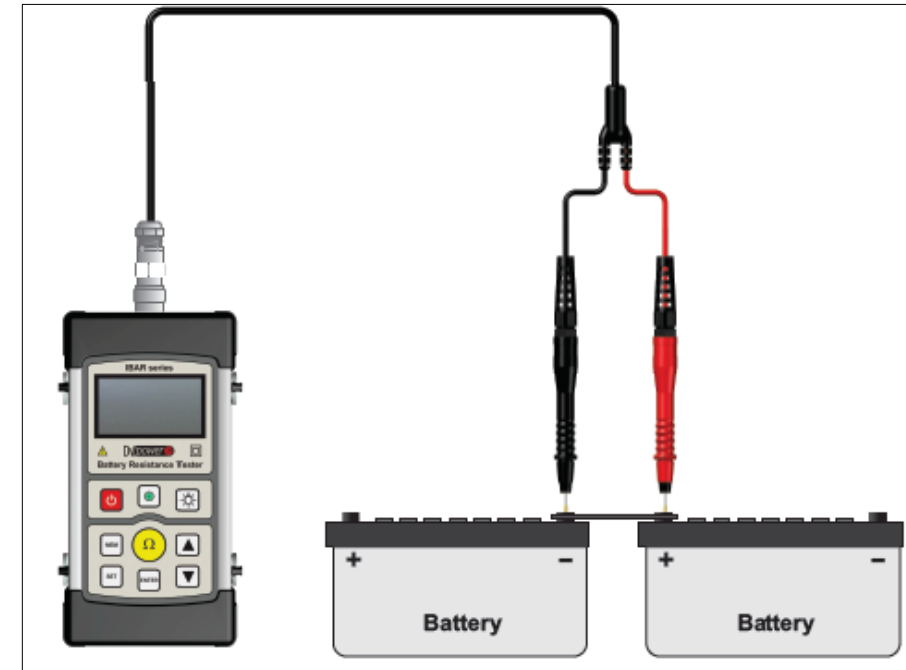
Battery Internal Resistance Tester – IBAR

Connection to Test object

1. Cell resistance and cell voltage measurement







2. Intercell connection resistance measurement



Internal Ohmic Measurement – Evaluation Criteria

Cell Acceptance Criteria—Deviation From the Nominal Value or Adjusted Average

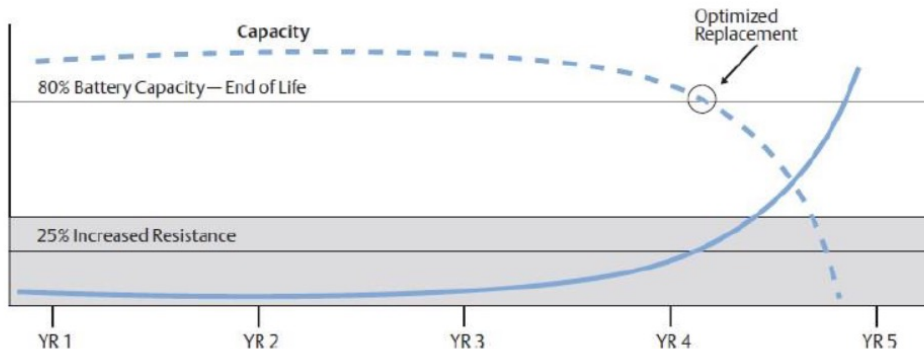
Type of Measurement	 <u>Green</u> Good Range	 <u>Yellow</u> Watch	 <u>Red</u> Probable Low Capacity	 <u>Danger</u> Probable Dead Cell
Conductance	0–15%	15–25%	25–40%	>40%
Impedance	0–20%	20–40%	40–80%	>80%
Resistance	0–20%	20–40%	40–80%	>80%

Source: W. Johnson, Stationary Battery Monitoring by Internal Ohmic Measurements, EPRI, Palo Alto, CA: 2002. 1002925.

- Based on experience (applicable to VLA and VRLA)
- Proceed to capacity test to check condition!

Correlation Between Internal Resistance and Battery Capacity

Relation between Battery Internal Resistance and Battery Capacity



- Inversely proportional correlation between battery capacity and resistance – VLA and VRLA batteries

- A change in impedance / conductance / resistance of more than 25% could indicate a bad battery / cell

Universal Battery Charger

BAC series

- Lightweight – only 10 kg
- Battery Voltage range:
 - **BAC25A:** 10 – 300 V (up to 25 A)
 - **BAC50L:** 1 – 60 V (up to 50 A)
- Controllable charging process (IU and UU modes available)
- Temperature compensation charging
- Overvoltage alarms to prevent excessive charge



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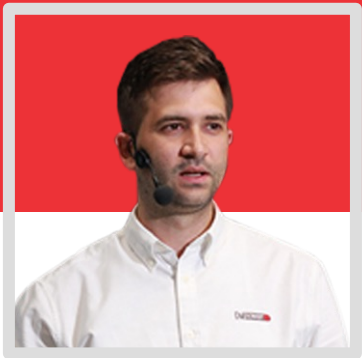
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- How-to videos
 - Instruction videos
 - Device application
 - Device specifications
 - Testing procedures



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- Latest news
 - Events
 - Webinars announcements
 - Application notes



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Thank you

Questions?

You can contact me at vedran@dv-power.com and visit at stand C33!

