

END-OF-LINE CONTROL SOFTWARE

EXTENSIVE FUNCTIONALITY DUE TO SEPARATE PROCESS CONTROLLER:

- More flexibility to create customized profiles
- The option to create customer-specific characteristics and signal shapes such as rectangular pulse profiles or sine waves
- Evaluation of the measured data with regard to internal resistance, impedance and relaxation voltage after discharge
- Ability to run multiple profiles in a sequence, e.g. starts with AC impedance followed by constant current and 2nd AC impedance for comparison
- Provision of all recorded data at PLC level for pick-up by higher-level SCADA systems to include automation & traceability

THE MAIN SCREEN PANEL

Substantial information of the production batch

Relevant batch information, test data and test results per battery line by line

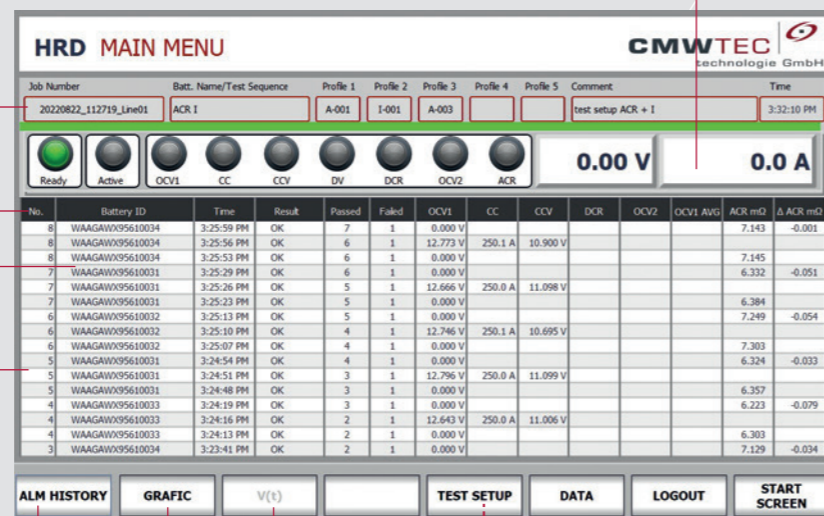
Battery ID is the key to all battery data

Self-generating battery counter per batch

Table view of the last 15 batteries on the main panel

Self-explaining softkeys to navigate through the extensive software functions

Big display showing discharge current and terminal voltage of the battery in process



Graphical display instead of table view

Displays voltage curve vs. time of the discharge process

THE TEST SET UP EDITOR

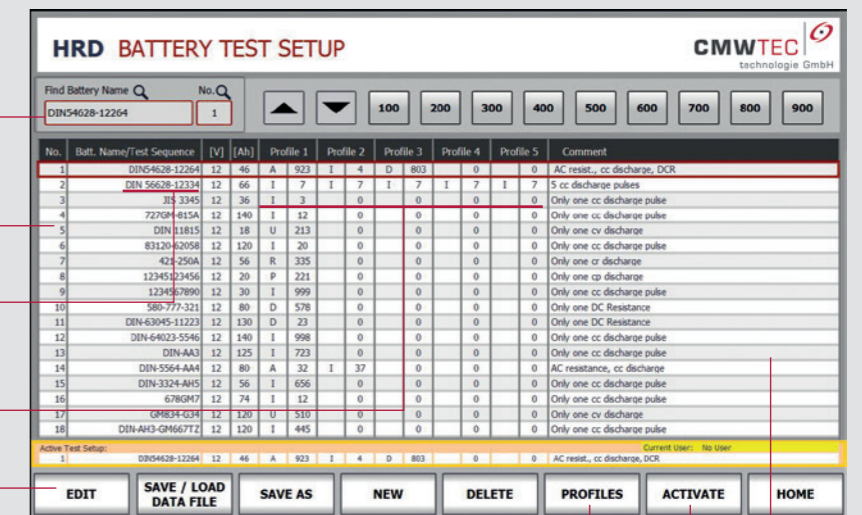
Search criteria can be battery type or battery number

Self-generating battery number

Battery type set up

Up to 5 test profiles in a sequence

Edit the test set up



Create the test profiles

Activate the selected profile

Space for comments

THE PROFILE EDITOR

To improve significantly the reliability of test results the HRD software offers supplemental evaluation criteria beyond just constant current discharge. The latest research results are obtained using a variety of methods for measuring internal resistance:

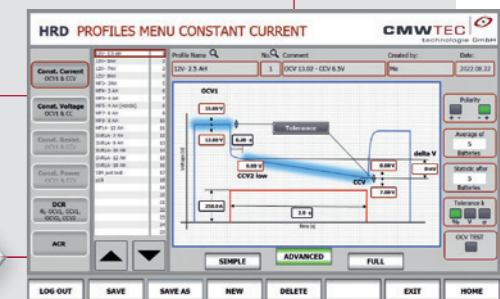
CCVmin evaluation measures the voltage drop from OCV to CCVmin of the load jump, before the chemical reaction or „charge transfer“ takes place.

The **two-tier DC load** method is applying two sequential discharge loads of different currents and time durations and calculates the DC resistance DCR.

The **AC impedance** test is another common method. A 1kHz signal excites the battery and Ohm's law calculates the AC impedance. The internal impedance of a cell determines its current carrying capability.

Delta_V measurement begins after passing the initial voltage drop when the voltage recovers and is in a relatively stable state. The acid is now diffusing into the pores of the active mass and there is a smooth electrochemical conversion of lead respective lead oxide. Delta_V measures the gradient of this process.

When removing the load after discharge, the voltage of a healthy battery gradually recovers and rises towards the nominal voltage. Differences in the affinity of metals in the electrodes produce this voltage potential. A parasitic load or high self discharge prevents voltage recovery. The second **OCV** (OCV2) correlates to irregularities affecting the recovery process.

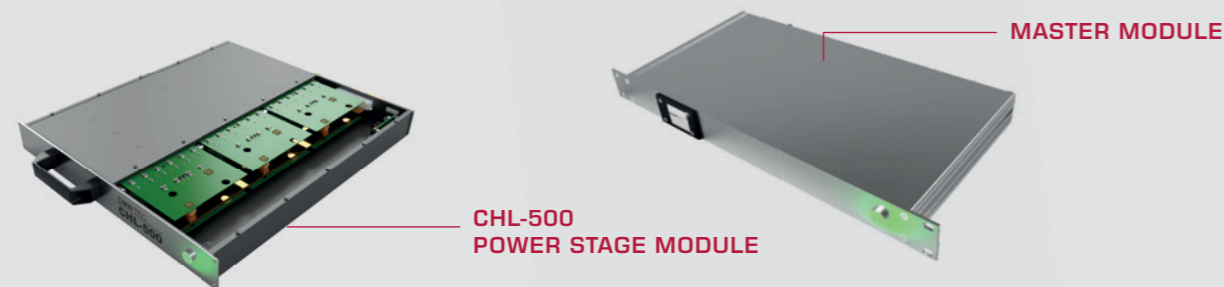


EOL HIGH CURRENT E-LOAD POWER STAGE MODULE

Designed for high current load tests in a production line for testing of automotive batteries.
Each device consists of a rack housing a control unit and multiple power stage modules up to 6 in one rack.



Application shows different E-Load systems from 1000A – 3000A in a stainless steel rack.



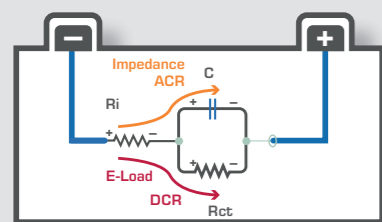
THE ADVANTAGES

- Robust stainless steel rack
- Space saving design without bulky electronic E-Load cabinet
- Fail safe operation to eliminate production downtime
- Free access to relevant components
- Water cooled, suited to operate in heavy duty environment

WITH ADVANCE FUNCTION FOR CURRENT BATTERY TESTING REQUIREMENTS

DCR -> ohmic + polarization Rct resistance
ACR -> ohmic resistance
Rct -> DCR – ACR

These two test procedures DCR & ACR provide the maximum investigation possibility of battery performance during very limited test time in the production line.



| ACR mOhm | DCR mOhm | Rct mohm |
|----------|----------|----------|
| 4,656 | 6,633 | 1,978 |
| 4,014 | 5,808 | 1,794 |
| 3,630 | 5,240 | 1,610 |
| 4,778 | 6,680 | 1,902 |

DCR is included in E-Load by default
ACR is available on request

Transfer quality tests from the lab to your production. This is possible with the QTS High Current Process Controller Software and the CMWTEC High Current E-Load modules. You can configure the test parameters as you wish and combine different quality tests without the need for additional test machines.

HIGH CURRENT E-LOAD

The high current E-Load CHL500 provides four characteristics: constant current; constant voltage; [constant power and constant resistance on request]. Each of the tests can have different profile settings and can be combined with DC resistance (DCR) and AC impedance (ACR) profiles (option). At the end of the test, a comparison of the different test criteria within one test sequence is made on a basis of statistically determined comparison data and test results. These results are rated either ACCEPTED or FAILED. The average value and the standard deviation for the open circuit voltage and the high current voltage are calculated on a basis of test results of all batteries with the result ACCEPTED. These calculated statistical values allow a better evaluation of the whole batch. The CMWTEC High current E-Load will be controlled by the EOL Control Software® which is an integrated part of the PLC.

TECHNOLOGY POWER STAGE MODULE [CHL500]

- Linear close-loop current control avoiding high frequency noise or ripple currents
- Water cooled power resistor and power electronics
- Power electronics based on MOSFET-technology
- Current control organized in multiple transistor layers per power stage of 500A
- Integrated automatic polarity switch with low voltage drop

CMWTEC HIGH-RATE E-LOAD SYSTEM

Available from 500A to 3000A 6-12V, with integrated polarity switch
Consisting of the following components:

- CMW High-Rate E-Load Module CHL500 [1-6 depending on application]
- CMW High-Rate E-Load Master control unit for Ethernet connection to QTS Software.
- CMW High-Rate Rack
- CMW High-Rate Water cooling Unit
- CMW High Current Process Controller

TECHNICAL SPECIFICATION POWER STAGE MODULES

Discharge current range [depend on application] : 10A - 3000A
Nominal discharge voltage range : $\pm 6 - 12$ VDC
Duty cycle : 60% [6 sec ON / 4 sec. OFF]
Rated power max [depend on full rating] : 3000W – 18.000W [5000W – 30.000W x 60% duty cycle]
Short time power : 6000W – 36.000W I max. time 500 mSec.
Resolution of current reading : 10 mA
Resolution of voltage reading : 1 mV
Accuracy of current reading : $\pm 0.15\%$ of full scale

TECHNICAL SPECIFICATION CONTROL UNIT MASTER

Communication: Ethernet [external], CAN [internal]
Voltage measurement: ± 15 VDC on source terminal
Resolution of Voltage reading: 16 bit
Accuracy of voltage reading: ± 6 mV $\pm 0.02\%$ fs [fs=30V]

TECHNICAL SPECIFICATION ENVIRONMENT

Ambient temperature: 10°C to 40°C [50°F to 104°F]
up to 50°C [122°F] with derating indicated in data sheet
Protection: IP20