

CRESSALL

**THE COMPACT, MODULAR
WATER COOLED RESISTOR**



**FOR AUTOMOTIVE, TRACTION
AND MARINE SYSTEMS**

ADVANCED TECHNOLOGY FOR MORE EFFICIENT PERFORMANCE

Manufactured from advanced materials the EV2 and EVT use a patented design that encapsulates and totally separates the resistor elements from the coolant providing a light weight, low volume, high power solution for water cooled applications. Their revolutionary modular design mean that they can be simply plugged together to match your power needs.

Typically our EV resistors are 10% of the volume and 15% of the weight of the equivalent conventional convection cooled DBR.

The ceramic material used in the EV2 and EVT has properties that are found individually in many materials but rarely together in the same one.

High thermal conductivity comparable to aluminium, better than most common metals, enabling very high heat transfer at low temperature differences.

High electrical resistivity ($>10^{14} \Omega \cdot \text{cm}$): comparable to most ceramics, enabling construction of high voltage heaters.



APPLICATIONS

- Hybrid & Electric (BEV/FCEV) vehicles
- Winches and cranes
- Cable laying vessels
- Propulsion drives on ships and oil rigs
- Dummy loads
- Discharge resistors



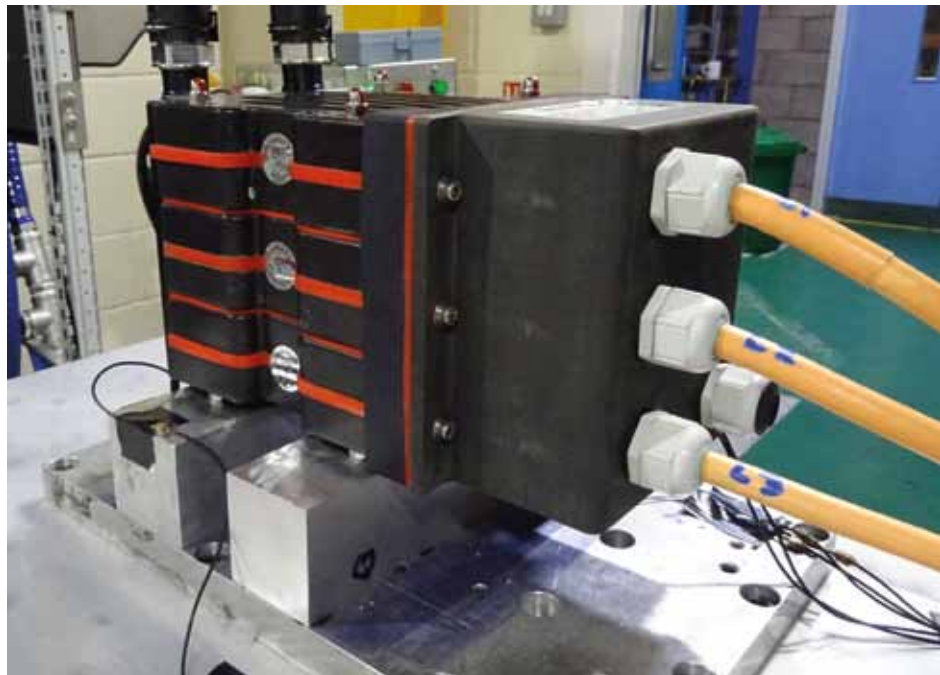


PROVEN STRENGTH AND RELIABILITY

EV2 resistors used to control hoists on board ship. The open back plate assembly holds 2 x 4EV2 assemblies to give a maximum continuous power of 200kW.



Multiple EV2 units assembled to provide a single 400kW water cooled load



Shock and vibration testing with simultaneous power cycling being carried out to current automotive and traction standards.



CRESSALL EV2 EMERGENCY BRAKING

The latest hybrid/electric vehicle developments mean there is an urgent need for a new approach to regenerative braking. Our EV2 resistor provides the higher reliability, mechanical simplicity and low weight demanded. The EV2 is the most cost effective way to ensure any excess energy produced is safely and efficiently recycled within the vehicle itself.

The need for three independent braking systems in hybrid/electric vehicles means that regenerative braking

using the EV2 is the greenest way for these vehicles to dissipate energy.

Units can be combined together to handle from 25kW to 600kW and supplied as individual components, frame mounted assemblies for integration in customer's systems or completely enclosed multi-banked systems that include inlet/outlet manifolds, flow and temperature monitoring.

EMERGENCY BRAKING

The legal requirement of the UN R13 Type IIA Test for three independent braking systems on battery powered vehicles has previously proved almost impossible to meet.

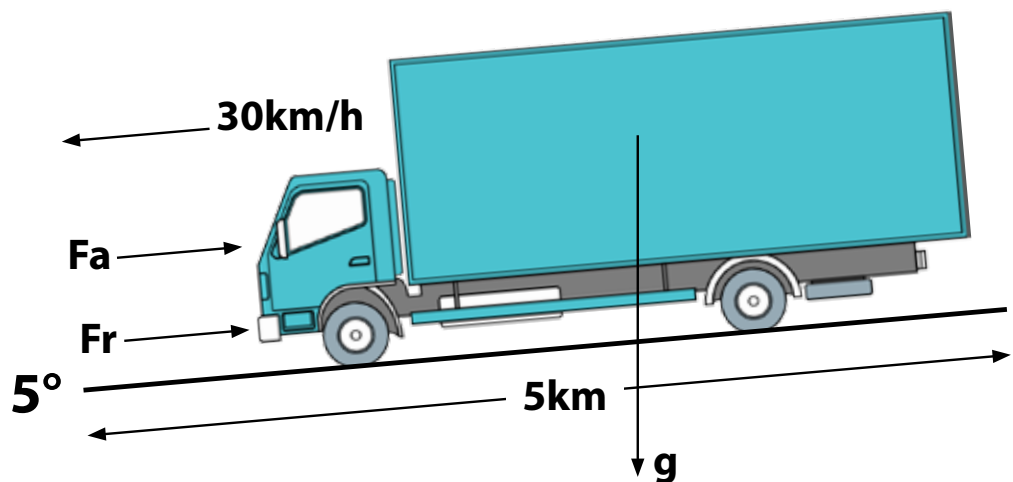
With a fully loaded battery the vehicle's kinetic energy cannot be converted into electricity and stored, meaning no emergency braking is available.

Fitting an EV2 solves this problem by converting excess electricity into hot water within the BEV's own cooling system and doing so instantly. All without the expected weight penalty and simultaneously protecting the vehicle's most expensive component - the battery pack.

THE DOWNHILL TEST FOR A FULLY LOADED 8 TON TRUCK

- g = Gravity Force
- F_a = Air Resistance
- F_r = Rolling Resistance
- Slope = 5°
- 5 km track at constant 30 km/h

To meet the legal requirement, the braking resistor must have the capacity to absorb 34.18MJ of energy. Cressall's solution to this would be 2 x 3EV2, rated for 100kW.



AND HEATING - ALL IN ONE RESISTOR

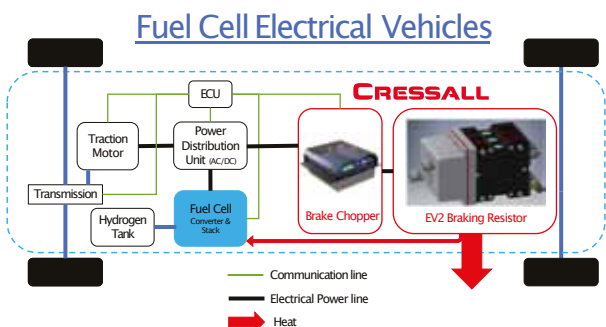
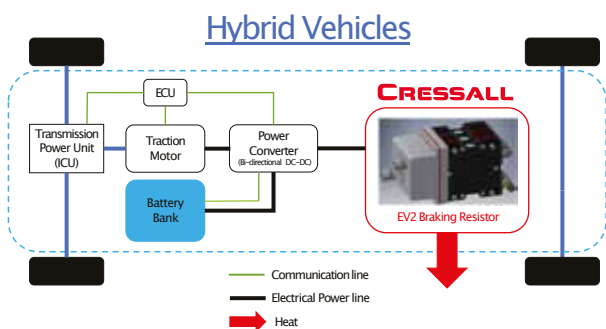
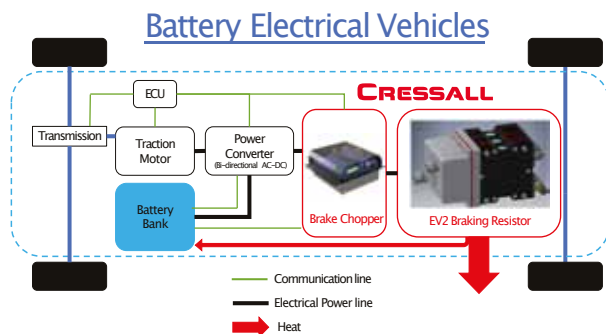
BATTERY AND CABIN HEATING

Low temperatures greatly reduce the power and efficiency of any vehicle's battery pack or fuel cell. During the charging cycle the EV2 ensures the battery is able to operate effectively in colder weather but also makes the vehicle more comfortable for driver and passengers.

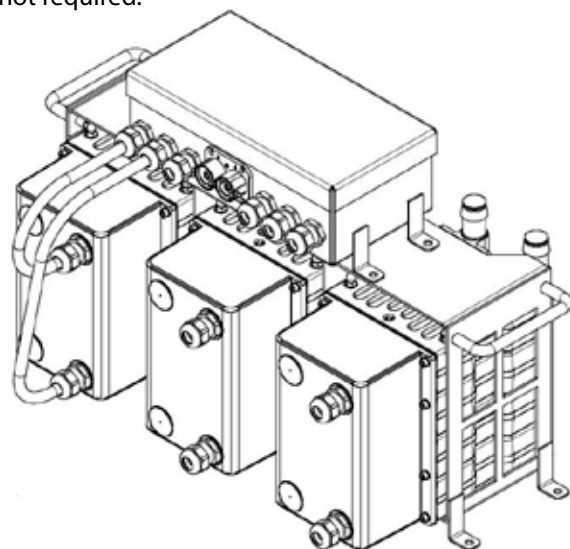
EASY TO INSTALL

The EV2 resistor packs a powerful electric vehicle solution into a small footprint. Their small size, low weight and simple connections make it easy to install in any vehicle without the need for extensive re-engineering of existing components.

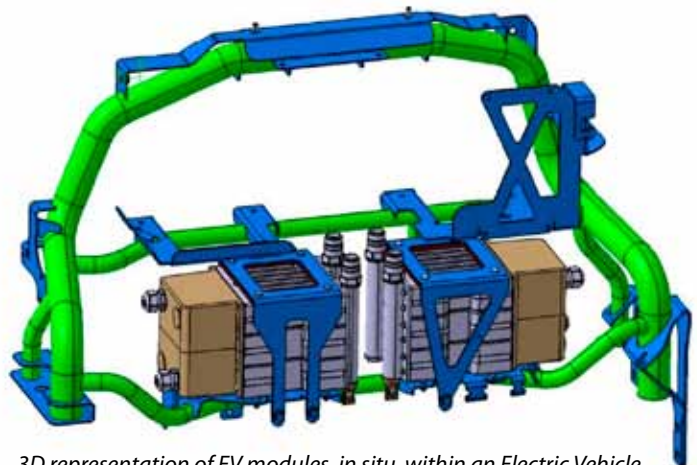
The EV2 can be integrated into the vehicle's existing overall cooling system, so a separate, dedicated circuit is not required.



Managing the transient power from the fuel cell is a concern of many customers. Dissipating this excess power through the EV2 allows for a more consistent acceleration and deceleration characteristic.



An example of a compact housing for 3 EV modules, designed and manufactured by Cressall, to meet a customer defined envelope



3D representation of EV modules, in situ, within an Electric Vehicle.

EV2 & EVT SPECIFICATIONS

Parameter	EV2	EVT
Nominal Power Rating (Water Coolant At 18L/M)	25kW*	10kW*
Overload Ratings Available	Up to 28%	N/A
Resistance (Cold)	1.0Ω to 20Ω***	
Storage Temperature	-40°C to +80°C	
Operational Temperature	-30°C to +50°C	
Ingress Protection	IP67 to BS EN 60529 (with single EV2 terminal cover fitted)	
Electrical Interface	M8 bolted connection	
Insulation Voltage Class	1.5kV**	
Test Voltage	3kV for 60 seconds**	
Insulation Resistance Test	>100MΩ at 1kV	
Shock And Vibration	JLR spec TPJLR.00.047: 50 hours random vibrations, 3axis shock, 4000 x 30	N/A
Coolant Types	De-ionised Water, 20% Glycol, 50% Glycol	
Operating Pressure	1.5 bar to 3 bar max	
Test Pressure	6 bar	
Water Interface	2 x pipe stubs for 25mm hose	
Minimum Coolant Flow Rates	See Tables	
Pre-Filtration Level Required	≤100µm	
Materials:	Body & Terminal Cover: Glass-filled Plastic Terminals: Plated copper • Seals: Silicone Rubber	
Edge Gasket Colour	Red	Black
Registered Patents:	UK 2478547; China ZL 2012 0455472.7; UK, France, Germany, Italy, Netherlands, Spain, Sweden 2 592 633; Japan 6351926; USA 8.643.464; Brazil 10 2012 029181-9; India 1297/KOL/2012; South Korea 10-2012-0128957	
* Maximum possible power per module, dependent on coolant type and flow. ** For higher voltage applications, contact Cressall. *** For lower resistant values, contact Cressall.		

EV2 Power Ratings			
Max. Power (kW) for coolant types:	Min. Flow Rate (l/m)		
	14	16	18
Water	15kW	20kW	25kW
20% Glycol	X	15kW	20kW
50% Glycol	X	X	15kW

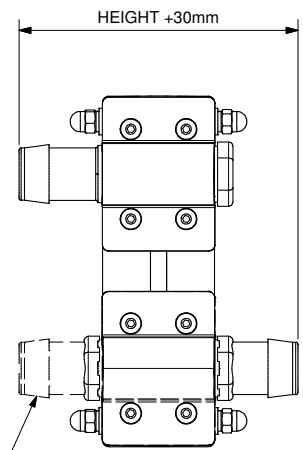
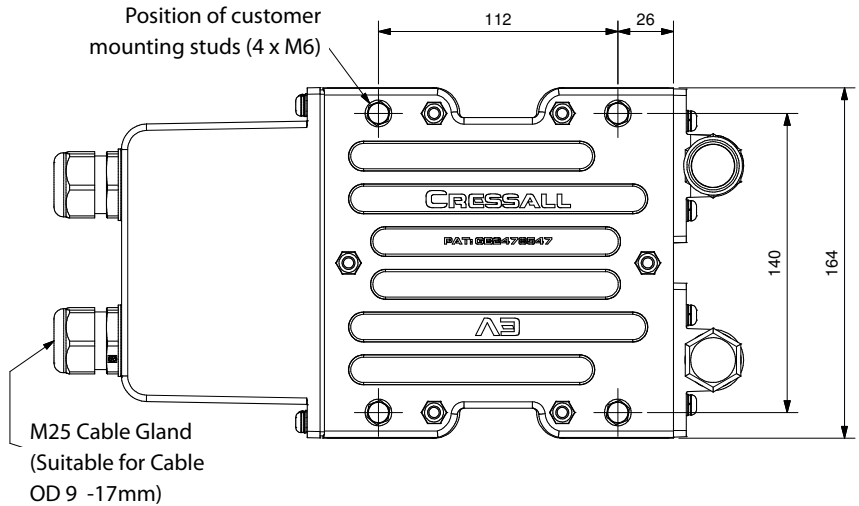
EVT Power Ratings			
Max. Power (kW) for coolant types:	Min. Flow Rate (l/m)		
	14	16	18
Water	6kW	8kW	10kW
20% Glycol	X	6kW	8kW
50% Glycol	X	X	6kW

Module Height (mm)		Module Weight empty (kg)	
		EV2	EVT
1 x EV	100	2.7	2.6
2 x EV	153	5.4	5.2
3 x EV	206	8.0	7.7
4 x EV	259	10.7	10.3
5 x EV	312	13.4	13.0

Mounting Options

Although the EV resistor assemblies can be supplied as individual components, Cressall have the design expertise to offer different mounting solutions to cater for individual customer needs. These can range from open bracket designs (to fit into existing enclosures) to complete custom designed enclosures, fabricated using our in house facilities.

Contact Cressall for further details.

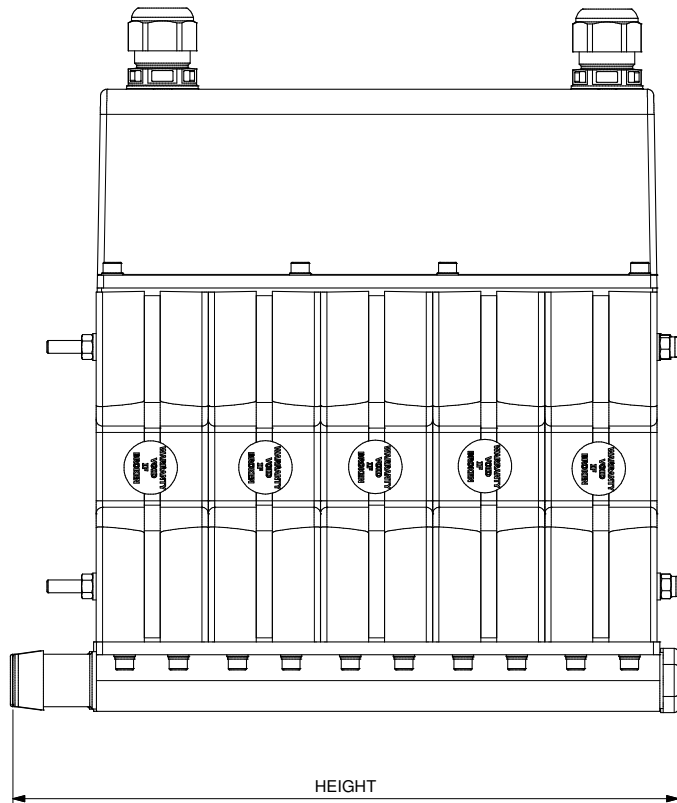
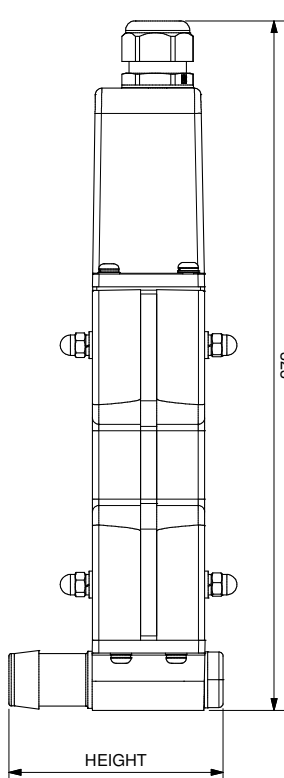


Manifolds orientated up or down to suit customer requirements

AUTOMOTIVE APPLICATIONS

Coolant = Glycol Mix 50%. Coolant Inlet Temperature @ 70°C. Coolant Temperature Rise approx 15°C						
Continuous Braking Power	up to 17 kW	17 - 35 kW	35 - 52 kW	52 - 70 kW	70 - 88 kW	>88kW
Model Type	EV2	2 x EV2	3 x EV2	4 x EV2	5 x EV2	Multiple Units to match the Power Level required
EV2 single module Resistance (HOT)	starting from 0.1Ω up to 12.5Ω					
EV2 single module Resistance (COLD)	starting from 0.1Ω up to 20Ω					
Total Resistance (HOT)	according to the electrical connection (parallel/series) and required value					
Length (with cable box and cable glands)	323mm					According to the designed solution
Width	164mm					
Height	100mm	153mm	206mm	259mm	312mm	
Weight (empty)	2.7kg	5.4kg	8.1kg	10.8kg	13.4kg	
Total Coolant Flow	18 L/min	36 L/min	54 L/min	72 L/min	90 L/min	

Coolant = Deionised Water (60ppm). Coolant Inlet Temperature @ 30°C. Coolant Temperature Rise approx 18°C						
Continuous Braking Power	up to 25 kW	25 - 50 kW	50 - 75 kW	75 - 100 kW	100 - 125 kW	>125kW
Model Type	EV2	2 x EV2	3 x EV2	4 x EV2	5 x EV2	Multiple Units to match the Power Level required
	Same technical details as above					According to the designed solution
Total Coolant Flow	20 L/min	40 L/min	60 L/min	80 L/min	100 L/min	



RECOMMENDED ACCESSORIES FOR EV RESISTORS



1 Flow Meter

- Low pressure drop flow meter
- 0 to 100 l/m input
- Pulsed NPN transistor output
- Supply Voltage: 4.5-24Vdc
- 2 x 1" BSP Male pipe connections

2 Pressure Sensor

- 0 to 5 Bar input
- 4-20mA output
- G1/4 Male threaded connection
- Supply Voltage: 9-32Vdc

3 Filter

- In-line Y-strainer Filter
- Filtration to 100µm
- 2 x 1" BSP Female pipe connection



Temperature Sensor

- -40°C to 275°C temperature input
- PT100 or PT1000 type
- M14 x 1.5mm mounting thread

CRESSALL – POWER RESISTORS DESIGNED AND MANUFACTURED IN THE UK FOR A GLOBAL MARKET

With more than 100 years' experience designing and manufacturing resistors in the UK, Cressall can supply high power resistors for use in:

- Electricity generation, transmission and distribution
- Renewable energy
- Marine and offshore electrical systems
- High power electrical testing
- Rail traction
- Drives and Automation
- Telecoms
- Oil and Gas
- Automotive

Our equipment is used in some of the most demanding locations around the world for applications such as:

- Neutral earthing resistors for MV and HV electrical supplies
- Dynamic braking resistors for braking inverters and motors
- Portable load banks for testing batteries, generators and UPS systems
- High voltage filter resistors for SVC, capacitor damping networks and HVDC applications
- Load banks for load testing diesel generators and large gas turbines
- Pre-insertion resistors for transformers and high voltage networks
- Braking resistors, control resistors and trackside resistors for rail traction
- Liquid cooled resistors



CRESSALL

Evington Valley Road, Leicester, LE5 5LZ, U.K.
 Tel: +44 (0) 116 273 3633 • Fax: +44 (0) 116 273 7911
 email: sales@cressall.com

© Cressall Resistors Ltd, Evington Valley Road, Leicester, LE5 5LZ, United Kingdom.
 Cressall reserve the right to change and improve products and specifications.