Thermal Management | Off-Highway

HEATING AND COOLING SOLUTIONS FOR OFF-HIGHWAY MACHINERY

Today. Tomorrow. Together.

Grayson

READY FOR THE THERMAL CHALLENGES FACING THE OFF-HIGHWAY SECTOR

Off-highway machines operate in some of the toughest conditions on the planet, from open stone quarries in artic cold to underground mines in extreme heat. And as these platforms transition to electric and hybrid drivetrains, thermal management is becoming more critical and more complex.

We understand the challenges engineers at off-highway OEMs face: balancing cooling performance with energy efficiency, designing systems that can handle intensive duty cycles in extreme conditions, and integrating thermal solutions into confined architectures.

Whether you're electrifying next-gen machines or upgrading ICE platforms, we partner with OEMs and tier 1s to design and supply systems that are engineered to conquer harsh climates and taxing duty cycles.

WE ARE GRAYSON

5 Facilities
across Europe and USA

370+ Employees
located across the world

VCA Approved
includes compliance to UNECE 155 & UNECE 156

Extensive Portfolio
tested and validated standard solutions

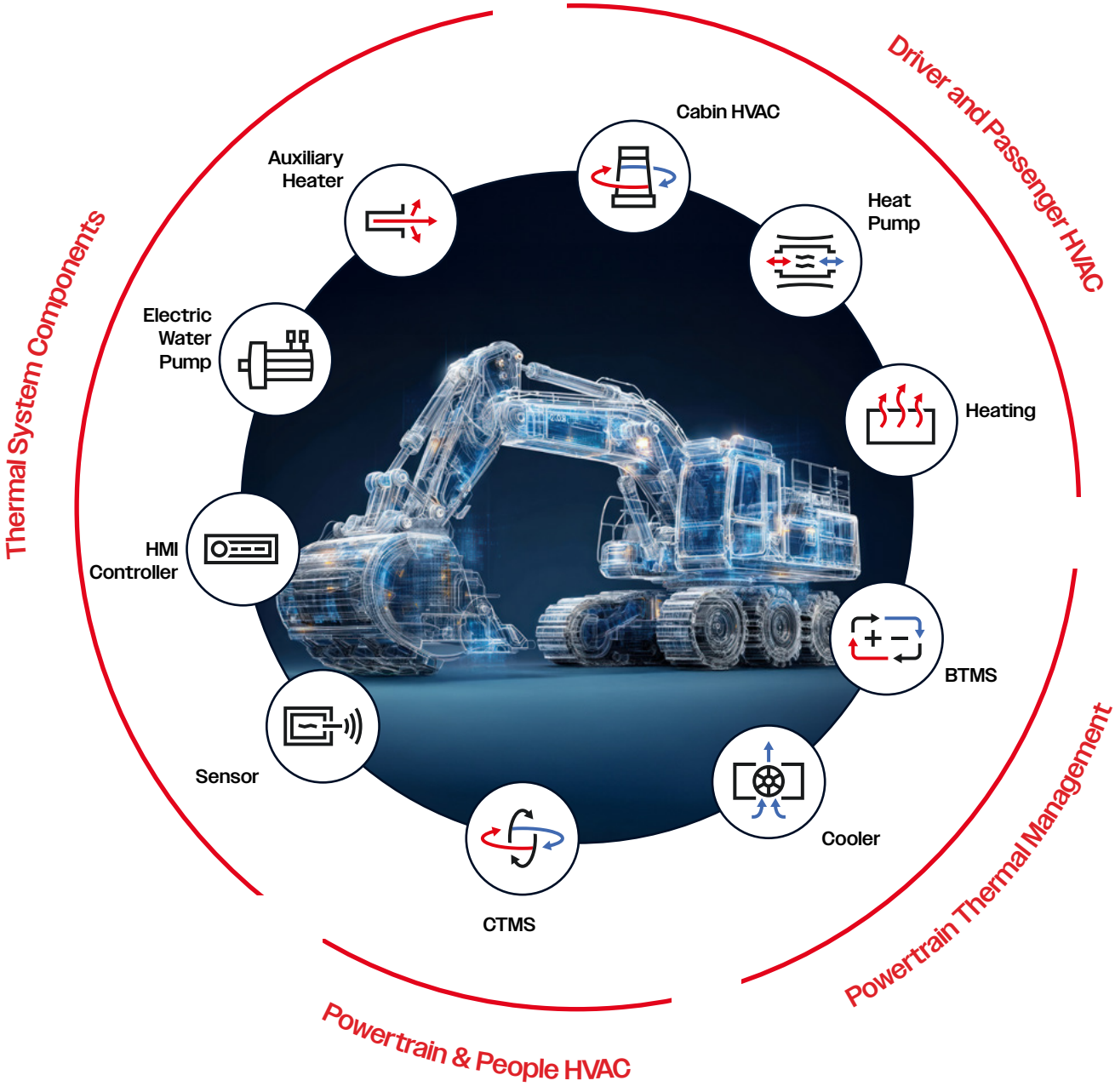
48 Years
heritage in engineering and manufacturing

Assured Quality
Certified to ISO 9001, ISO 14001, ISO/IEC 27001

UK & USA Manufacturing
high-quality production and Buy-America compliance

Build to Specification
fully bespoke systems built to exact requirements

OUR PRODUCT PORTFOLIO



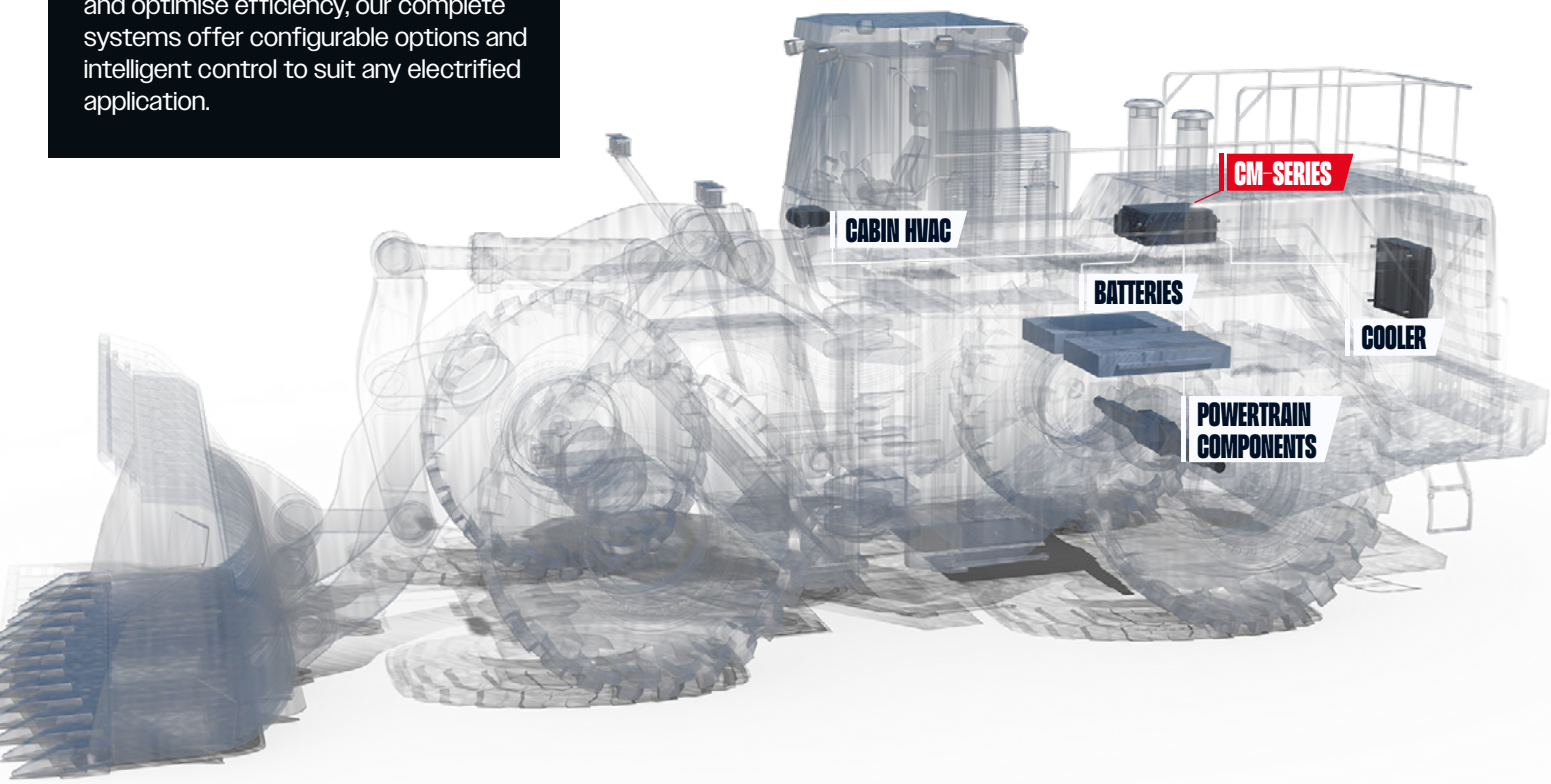
TOTAL THERMAL MANAGEMENT

Tomorrow's vehicles demand smarter thermal solutions. Grayson's total thermal management offering combines proven standard products with tailored system design to deliver efficiency, reliability, and comfort across every application. From pumps and heaters to fully integrated CTMS platforms, discover the full Grayson range of thermal management systems and components at **www.graysonts.com**.

POWERTRAIN & PEOPLE HVAC

Grayson's Powertrain and People HVAC solutions of complete thermal management solutions deliver integrated, multi-functional thermal management unifying HVAC, battery thermal management and power electronics cooling.

Designed to reduce system complexity and optimise efficiency, our complete systems offer configurable options and intelligent control to suit any electrified application.



Complete Thermal Management System (CTMS)

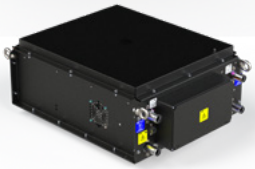
Grayson's CTMS range intelligently manages the thermal demands of multiple systems from a single, easy-to-integrate module. Engineered for electrified platforms, CTMS reduces system complexity while optimising efficiency, performance and comfort across an entire application's thermal architecture.

CM-SERIES

The all-in-one, chassis-mounted module integrating battery, power electronics and cabin HVAC into a single intelligent module. Using advanced reversible heat pump technology and smart heat recovery, the series delivers optimised thermal performance, efficiency and simplified vehicle integration for electrified platforms.

FUNCTIONS

- Battery Active Cooling
- Battery Passive Cooling
- Powertrain Cooling
- Cabin Air Conditioning
- Battery Heating
- Cabin Heating
- Heat Recovery
- Cabin Dehumidification
- Cold-Start Pre-Heating



		CM1	CM2
Dimensions (L x W x H)	mm	780 x 600 x 300	780 x 486 x 300
Weight	kg	64	45
Cooling Performance*	kW	10	
Heating Performance**	kW	12	
Operating Temperature	˚C	-20 to +45	
High Voltage Range	V DC	450 – 860	
Low Voltage Range	V DC	18 – 32	
Control		CAN J1939	
Refrigerant		R134a / R1234yf	
Water Pumps		Integrated	Externally Mounted
PTC Heater		Integrated	Externally Mounted

at 40°C ambient. 10kW split between active battery cooling and cabin air conditioning.

**at -25°C ambient*

LEARN MORE ABOUT THE CM-SERIES CTMS

POWERTRAIN THERMAL MANAGEMENT

Grayson's Powertrain Thermal Management solutions protect batteries, traction systems and combustion engines from heat-related performance loss.

Explore our portfolio of proven cooling modules and battery thermal management systems engineered to deliver stable temperatures, longer component life and reliable operation across demanding duty cycles and environments.

Cooler

Grayson's Cooler range features robust air-to-liquid cooling modules designed to reject heat from coolant circuits using ambient air. Engineered for reliability and efficiency, these passive cooling solutions support effective thermal control of power electronics, traction motors, combustion engines and fuel cells.

CE-SERIES

The CE-series of **combustion engine coolers** supports electric, hydraulic and mechanical fan technologies, delivering efficient cooling for gasoline, diesel, HVO and biodiesel-powered machines.

- Variety of standard sizes to meet packaging requirements
- 4, 5 and 6-fan configurations as standard
- 24V DC or 3x400V AC brushless fans
- Up to 40,000 hours fan life
- Reverse fan function to clear debris
- Optional integrated CAN controller
- Plug-and-play system

FC-SERIES

The FC-series of **hydrogen fuel cell coolers** is engineered for high heat rejection and continuous duty, delivering scalable, efficient cooling for fuel cell stacks across mobility and stationary power platforms.

- Variety of standard sizes to meet packaging requirements
- 2, 3, 6 and 9-fan configurations available
- AC and DC-powered options
- De-ionised water compatibility
- Waste heat recovery options
- Optional integrated CAN controller
- Plug-and-play system

PE-SERIES

The PE-series of **power electronic and electric motor coolers** features scalable fan configurations, high-voltage options and smart control integration, delivering proven passive cooling.

- Variety of standard sizes to meet packaging requirements
- 1, 2, 3, 4 and 6-fan configurations available
- AC and DC-powered fan options
- High voltage (up to 800V DC) available
- Optional header tanks
- Optional integrated CAN controller
- Plug-and-play system

DISCOVER THE ENTIRE COOLER RANGE

Battery Thermal Management System (BTMS)

Precise, reliable heating and cooling to protect lithium-ion batteries across mobile and stationary power applications. Designed for performance, efficiency and long service life, our BTMS solutions support optimal battery operation in challenging environments.

M-SERIES

Lghtweight and powerful **mobile battery thermal management systems** delivering efficient liquid and cooling for high-voltage, space-constrained applications. Fully tested, validated and homologated solutions trusted by OEMs worldwide.

M1

Dimensions (L x W x H)	mm	750 x 604 x 438
Weight	kg	55
Cooling Performance*	kW	5.8
Heating Performance	kW	3.6
Operating Temperature	˚C	-35 to +45
High Voltage Range	V DC	420 – 860
Low Voltage Range	V DC	18 – 32
Control		CAN J1939
Refrigerant		R134a (R407C optional)

*at 40°C ambient, 25°C coolant

- Battery Active Cooling
- Battery Passive Cooling
- Battery Heating
- Cold-Start Pre-Heating

M2

Dimensions (L x W x H)	mm	1341 x 554 x 436.5
Weight	kg	74
Cooling Performance*	kW	11.5
Heating Performance	kW	3.6
Operating Temperature	˚C	-35 to +45
High Voltage Range	V DC	420 – 750
Low Voltage Range	V DC	18 – 32
Control		CAN J1939
Refrigerant		R134a (R407C optional)

*at 40°C ambient, 25°C coolant

- Battery Active Cooling
- Battery Passive Cooling
- Battery Heating
- Cold-Start Pre-Heating

M5

Dimensions (L x W x H)	mm	1025 x 471 x 575
Weight	kg	119
Cooling Performance*	kW	8.5
Heating Performance	kW	10
Operating Temperature	˚C	-35 to +45
High Voltage Range	V DC	575 – 800
Low Voltage Range	V DC	18 – 32
Control		CAN J1939
Refrigerant		R134a (R407C optional)

*at 40°C ambient, 25°C coolant

- Battery Active Cooling
- Battery Passive Cooling
- Battery Heating
- Cold-Start Pre-Heating

S-SERIES

The high-capacity battery thermal management series for **stationary power applications**. Designed for continuous-duty operation, the S-series delivers stable, liquid-cooled battery heating and cooling in a low-profile, AC-powered format.

SI		
Dimensions (L x W x H)	**mm**	1319 x 556 x 392
Weight	**kg**	92
Cooling Performance*	**kW**	12
Heating Performance	**kW**	5
Operating Temperature	**˚C**	-35 to +45
High Voltage Range	**V AC**	400
Low Voltage Range	**V DC**	18 – 32
Control		CAN J1939
Refrigerant		R407C

**at 40°C ambient, 25°C coolant*

- Battery Active Cooling
- Battery Passive Cooling
- Battery Heating
- Cold-Start Pre-Heating

DISCOVER THE ENTIRE BTMS RANGE

CASE STUDY: BEMO RAIL

Bemo Rail required a compact, durable battery thermal management solution for a next-generation hybrid shunter operating in harsh industrial environments, with temperature demands from -10°C to 40°C.

Grayson delivered the BTMS S1-400V AC—a proven, plug-and play system providing up to 14 kW cooling and 5 kW heating. Fully integrated via CAN, the system dynamically controls battery temperatures to optimise performance and lifespan.

The result is a reliable, high-performance thermal solution validated through rigorous testing and now supporting one of the most compact hybrid locomotives in its class.

Click or scan QR code to explore the full case study.

DRIVER & PASSENGER HVAC

Grayson's Driver and Passenger HVAC solutions deliver heating, cooling and demisting solutions for heavy vehicles and machinery.

From cabin HVAC for vital air conditioning in demanding environments to effective heating in the coldest conditions, our portfolio supports comfort, safety and visibility while helping OEMs manage energy use, integration and performance needs.

Heat Pump

Efficient heating and cooling for driver and passenger environments in electric and hybrid vehicles. The Grayson Heat Pump range uses advanced heat pump technology, reducing energy consumption while maintaining reliable cabin climate comfort across wide ambient conditions.

DH-SERIES

Driver cabin heat pumps with reversible heat pump technology. The DH-series delivers efficient heating, air conditioning and windscreen demist/defrost from a compact, plug-and-play system.

DH3

Dimensions (L x W x H)	mm	1184 x 264 x 544
Weight	kg	70
Heating Performance*	kW	5
Cooling Performance**	kW	3
Operating Temperature	˚C	-10 to +35
High Voltage Range	V DC	400 - 900
Low Voltage Range	V DC	18 – 32
Control		CAN J1939
Refrigerant		R407C

** at -10°C ambient. 3.6kW PTC Auxiliary Heater option available*

*** at 35°C ambient*

- Cabin Air Conditioning
- Cabin Heating
- Cabin Dehumidification

LH-SERIES

The LH-series of liquid heat pumps generate ultra-efficient hot water for effective cabin heating, delivering high heating output with low energy consumption. The series provides a proven alternative to conventional electric water heaters.

LH1

Dimensions (L x W x H)	mm	750 x 604 x 448
Weight	kg	60
Operating Temperature*	˚C	-20 to +45
Heating Performance**	kW	12
Auxiliary Heating Capacity	kW	3.6 - 5
High Voltage Range	V DC	420 - 750
Low Voltage Range	V DC	18 – 32
Control		CAN J1939
Refrigerant		R407C

** -5°C with heat pump / -20°C with assisted PTC*

*** at 0°C ambient, 45°C coolant, 40 l/min coolant flow*

- Cabin Heating

DISCOVER THE ENTIRE HEAT PUMP RANGE

Cabin HVAC

Grayson's Cabin HVAC range delivers dependable heating, cooling and demisting solutions for operator cabins in demanding conditions. The range supports electric, hybrid and combustion platforms, ensuring clear visibility, thermal comfort and reliable performance across diverse environments.

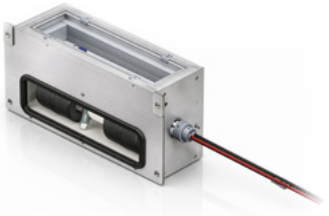
DM-SERIES

Compact cabin demisters designed to deliver fast, reliable windscreen clearing in demanding operating conditions. Available in electric, coolant-fed and combined heat-and-cool variants, the DM-series supports operator safety and visibility.

DM1

Heating Type		Air PTC Heating
Dimensions (L x W x H)	mm	435 x 148.5 x 300
Weight	kg	6.8
Heating Performance*	kW	1.25
Maximum Airflow	m³/h	727
Blower Speeds		2
Supply Voltage	V DC	24

at 0 static pressure



- Cabin Dehumidification

DM2

Heating Type		Coolant
Dimensions (L x W x H)	mm	525 x 220 x 440
Weight	kg	8.85
Heating Performance	kW	7
Coolant Requirements		Min. flow 12 l/min; Min. temp 75°C; Max pressure 2 bar
Blower Speeds		1
Supply Voltage	V DC	24

- Cabin Heating
- Cabin Dehumidification

DM3

Heating Type		Coolant
Dimensions (W x L x D)	mm	579 x 440 x 220
Weight	kg	14.2
Heating Performance	kW	12
Cooling Performance	kW	4
Coolant Requirements		Min. flow 12 l/min; Min. temp 35°C; Max pressure 1.5 bar
Blower Speeds		1
Supply Voltage	V DC	24

at 0°C air, 80°C coolant

- Cabin Air Conditioning
- Cabin Heating
- Cabin Dehumidification

DISCOVER THE ENTIRE CABIN HVAC RANGE

Heating

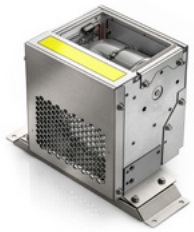
Grayson's Heating range delivers dependable driver cabin heating designed to keep operators comfortable in cold environments. The range supports electric, hybrid and conventional platforms, providing targeted or high-output heating to maintain comfort, safety and operational performance.

CH-SERIES

Compact, all-electric **PTC cabin heaters** for off-highway applications. Designed for fast, localised heat delivery, the CH-series provides efficient, self-regulating air heating for hybrid and fully electric vehicles operating in cold climates.

CH1

Heating Type		Air PTC Heating
Dimensions (L x W x H)	**mm**	369 x 188.5 x 249.5
Weight	**kg**	4
Heating Performance*	**kW**	1.4
Maximum Airflow	**m³/h**	260
Blower Speeds		2
Supply Voltage	**V DC**	20 - 32



Cabin Dehumidification

CH2

Heating Type		Air PTC Heating
Dimensions (L x W x H)	**mm**	217 × 194 × 241
Weight	**kg**	3.4
Heating Performance*	**kW**	1.4
Maximum Airflow	**m³/h**	260
Blower Speeds		2
Supply Voltage	**V DC**	20 - 32

Cabin Heating

DISCOVER THE ENTIRE HEATING RANGE

BESPOKE BUILDS FOR YOUR SPEC

Be it a tested, validated and homologated catalogue product or bespoke system specific for your application, Grayson's in-house design, testing, engineering, manufacturing and aftersales support means we can deliver the right solution to meet your needs.

Contact our team of thermal management experts to discuss your requirements and find the right solution today.

THERMAL SYSTEM COMPONENTS

Grayson's Thermal System Components portfolio provides the critical building blocks for robust thermal management systems.

Designed for demanding duty cycles, these components support accurate control, reliable circulation and system-level performance across machine and stationary power platforms.

Auxiliary Heater

Grayson's Auxiliary Heater range delivers fast, reliable electric water heating for off-highway applications. Designed to provide instant thermal support in cold conditions, the range enables efficient cabin heating, battery preconditioning and coolant temperature control across demanding duty cycles.

EW-SERIES

Electric water heaters designed to deliver rapid, reliable auxiliary heating. The EW-series provides instant, high-capacity heat for cabins, batteries and coolant circuits in cold conditions, covering a wide voltage and power range.

EW3

Dimensions (L x W x H)	mm	200 x 173 x 126
Weight	kg	2.9
Heating Performance*	kW	7
Operating Temperature	˚C	-40 to +105
Coolant Temperature	˚C	-40 to +90
Voltage Range	V DC	700 - 900
Control		CAN J1939
Coolant Outlet Size	mm	Ø 20 O.D.
IP Rating		IP67 & IP6K9K, IP68

at 800V DC, 0°C coolant temperature, 10 L/min flow rate

Self-regulating PTC technology

EW4

Dimensions (L x W x H)	mm	229 x 255 x 110
Weight	kg	5
Heating Performance*	kW	10
Operating Temperature	˚C	-40 to +105
Coolant Temperature	˚C	-40 to +90
Voltage Range	V DC	550 - 900
Control		CAN J1939
Coolant Outlet Size	mm	Ø 25 O.D.
IP Rating		IP67 & IP6K9K

at 800V DC, 60°C coolant temperature, 12 L/min flow rate

Self-regulating PTC technology

EW5

Dimensions (L x W x H)	mm	175.5 x 140 x 123
Weight	kg	1.7
Heating Performance*	kW	5
Operating Temperature	˚C	-40 to +105
Coolant Temperature	˚C	-40 to +90
Voltage Range	V DC	250 - 450
Control		CAN J1939
Coolant Outlet Size	mm	Ø 20 O.D.
IP Rating		IP67 & IP6K9K

Self-regulating PTC technology

DISCOVER THE ENTIRE AUXILIARY HEATER RANGE

Electric Water Pump

Grayson's Electric Water Pump range delivers precise, reliable coolant circulation for heavy machinery and stationary power. Designed to maintain stable flow and pressure across circuits, the range supports effective heat transfer in battery, power electronics, HVAC and integrated thermal systems.

MD-SERIES

The MD-series of **magnetic drive electric water pumps** circulates coolant (water ethylene glycol) for precise heating or cooling, delivering stable flow across a wide pressure range.

MD1

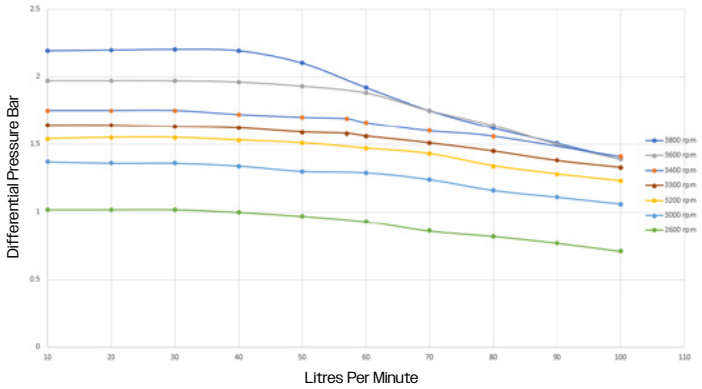
MD2

		MD1	MD2
Dimensions (L x W x H)	**mm**	230 x 141.5 x 162	248 x 154.5 x 168
Weight	**kg**	4.1	5.1
Flow Rate	**l/min**	0 - 100	
Pressure	**bar**	0 to 2.0 (2.2 maximum)	
Ambient Temperature	**˚C**	-40 to +95	
Coolant Temperature*	**˚C**	-40 to +75	-40 to +85
Coolant Outlet Size	**mm**	Ø 20 O.D.	
Control		CAN / PWM / Standalone	
Operating Voltage Range	**V DC**	18 - 32	
Power Rating	**W**	400	530
Current Range	**A**	3 to 17 (self-regulating at 20)	3 to 22 (self-regulating at 23)

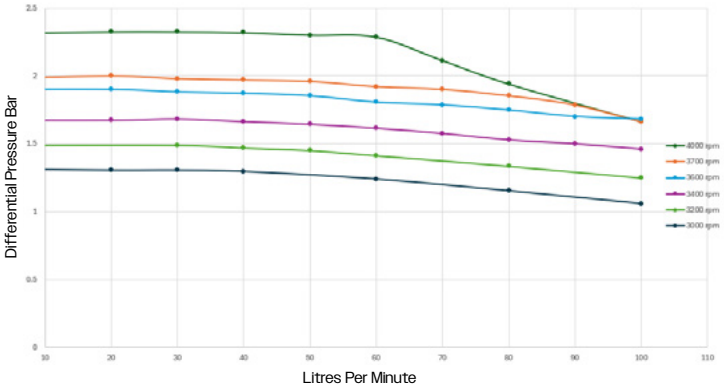
** coolant limiting*

Pressure and Flow Curves

MD1



MD2



CP-SERIES

Canned motor electric water pumps providing sealed, reliable coolant circulation. The CP-series delivers stable flow and pressure with low maintenance and is compatible with de-ionised water, making it ideal for hydrogen fuel cell applications.

CP2

Dimensions (L x W x H)	mm	198.6 x 90 x 162
Flow Rate	l/min	0 - 100
Pressure	bar	1.6 rated (2.5 maximum)
Weight	kg	3
Voltage Range	V DC	400 - 800
Ambient Range	˚C	-40 to +105
Coolant Temperature	˚C	-40 to +85
Coolant Outlet Size	mm	Ø 25 O.D.
Control		PWM / Standalone

CP3

Dimensions (L x W x H)	mm	216.4 x 171 x 190
Flow Rate	l/min	0 - 300
Pressure	bar	2.0 rated (2.8 maximum)
Weight	kg	5.7
Voltage Range	V DC	400 - 800
Ambient Range	˚C	-40 to +105
Coolant Temperature	˚C	-40 to +85
Coolant Outlet Size	mm	Ø 64 O.D.
Control		PWM / Standalone

DISCOVER THE ENTIRE ELECTRIC WATER PUMP RANGE

CASE STUDY: APPLIED EV

Applied EV is redefining industrial and last-mile mobility with the Blanc Robot, its autonomous, configurable electric platform.

To manage its complex battery and powertrain thermal loads, Applied EV turned to Grayson. Our Chassis-Mounted CTMS delivered a compact, integrated module capable of intelligently controlling multiple thermal circuits.

HMI Controller

Grayson's HMI Controller range provides stylish, intuitive interfaces for controlling vehicle heating, cooling and defrost systems. Designed for CAN-based architectures, these controllers enable clear operator use, configurable behaviour and dependable operation in demanding off-highway environments.

CA-SERIES

Intuitive driver control of heating, defrost and air conditioning systems.
The CA-series delivers an easy-to-use operator interfaces and stylish design that seamlessly integrates into off-highway applications.

CA2

Function		Cabin Climate Control
Dimensions (L x W x H)	**mm**	31 x 188 x 60
Operating Voltage	**V DC**	12 / 24
Operating Temperature	**˚C**	-40 to +85
IP Rating		IP54 (front, IEC 60529)
Control		CAN
Output Short Circuit Protection		Protected
Polarity Reverse Protection		Protected

DISCOVER THE ENTIRE HMI CONTROLLER RANGE

Sensor

Grayson's Sensor offering supports accurate monitoring of key thermal and cabin conditions, providing the data needed to control heating, cooling and ventilation systems effectively. The range helps OEMs optimise comfort, ventilation, energy usage and system protection across varied operating conditions.

TC-SERIES

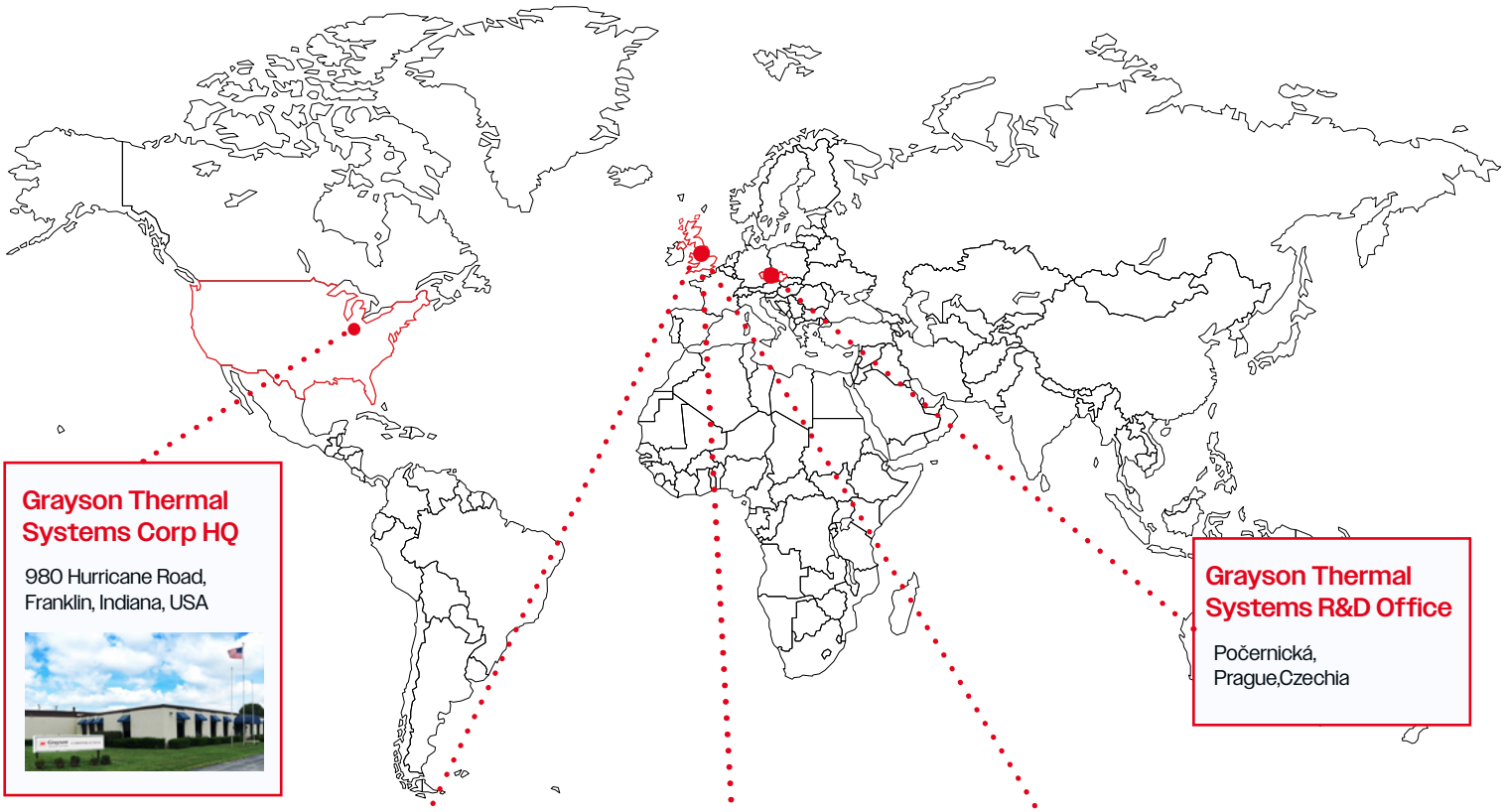
Combined **temperature and CO_2 sensors** for continuous cabin condition monitoring. By providing real-time environmental data, the TC-series enables intelligent HVAC control, optimised ventilation and, operator comfort and safety.

TC1

Function		Temperature and CO_2 Monitoring
Dimensions (L x W x H)	**mm**	80 x 65 x 38.5
Operating Voltage	**V DC**	24
Operating Temperature	**˚C**	1.25
Control		CAN

DISCOVER THE ENTIRE SENSOR RANGE

GLOBAL REACH, LOCAL TOUCH



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Grayson Fabrication Centre

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Grayson UK Aftermarket Centre

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SOURCE TO SERVICE

Complete end-to-end support for off-highway OEMs and tier 1s.

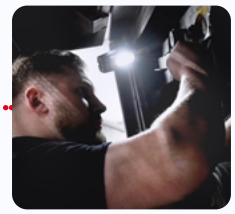
1/ Concept Design

2/ Research & Development

3/ Installation Support

4/ End-to-end Manufacturing

5/ Quality Assurance



6/ Aftermarket Support

Grayson Thermal Systems is a global engineering and manufacturing group specialising in advanced thermal management solutions for heavy-duty machinery and stationary power applications.

With nearly 50 years of expertise, we design, manufacture, and support systems that keep people and industries moving — **today, tomorrow, together.**

Discover more at **www.graysonts.com** and contact our team to discuss your requirements.

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