

# Alternators

## Application Note

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## Alternators

McLaren Electronics offers a selection of alternators to meet varying needs. The F, G and K-series have wound rotors with internal intelligent rectifier/regulator units. For the most demanding motorsport applications, where size and weight must be cut to a minimum, we can supply permanent magnet alternators with separate switched mode rectifier/regulator units.

All models offer excellent power outputs for their size and weight, up to a massive 200 amps in the K-series.

### Wound Rotor Alternators

Wound rotor alternators are available in three sizes: F, G and K. These are based on state of the art production units and have specially wound stators to achieve a high current output. High current diodes are used in the rectifier to match the current output. The ignition circuit may be isolated, while the alternator is being driven, to reduce the load on the engine.

To make the alternator suitable for the high vibration levels encountered in the motor sport environment, they have the following features:

- Brush springs are stiffer than standard
- Extra flexible wire is used to connect the stator to the rectifier
- The stator is pegged to the body
- All screws are locked.

The battery terminal is designed for easy disassembly and re-assembly to facilitate engine strip downs. High quality bearings are used to enable the alternators to run at high speeds (up to 18,000 rpm).

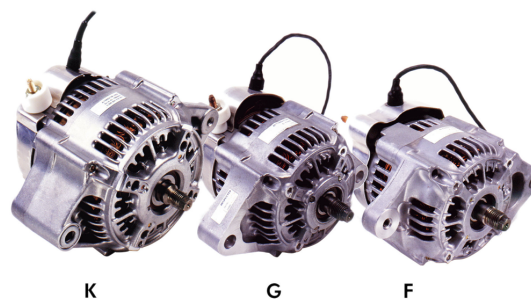
Cooling is assisted by two fans fitted to the rotor spindle inside the alternator body, one at the front and one at the rear. The airflow is sufficient to keep even the highest output models operating reliably at ambient temperatures up to 90°C. The standard mounting method is intended for a belt drive, but the F, G and K alternators may be driven directly, if required.

All alternators are tested to ensure that they produce the specified output and a test report is supplied with each one.

### Comparison of Wound Rotor Alternators

The following table ranks the alternators by their output current capacity. The relationship between operating speed and output is shown in detail in the Product Summaries.

There is some overlap between the ranges. The F-series is the smallest. The G and K-series offer anti clockwise as well as clockwise rotation and have a sense terminal for direct connection to the battery which can improve voltage stability.



Comparison of Wound Rotor Alternators			
Series	F-Type	G-Type	K-Type
Available Ranges of Maximum Current Output (A)			200
			165
		140 <sup>1</sup>	
		120 <sup>1</sup>	

			110
	90	100	
	60		
	40	55	
<b>Body Diameter (mm)</b>	99	105	126
<b>Overall Length (mm)</b>	143	144	161
<b>Max weight (kg)</b>	2.8	3.1	4.9
Note 1: High output variant			

### Design Variants

Wound rotor alternators are available in several variants which affect the output power, the mounting arrangements and the connection arrangements.

Standard alternators can be modified to suit special requirements. Examples of modifications we have made in the past include:

- Accurately bored mounting holes
- High accuracy machining of mounting flanges
- Alternative locations of cable entries
- Alternative connectors

If our standard designs or their variants do not meet your needs, we can design an alternator to suit. Please contact our technical consultancy service who are ready to discuss your requirements.

### Permanent Magnet Alternators

The advantages of the permanent magnet design over the wound type are:

- Smaller size and lower weight for a given output power
- High operating speeds
- Low inertia
- No brushes
- High operating temperature

Permanent magnet alternators are most suitable in situations where weight and overall dimensions must be minimised (e.g. motorcycles and single seat racing cars). Permanent magnet alternators can tolerate high ambient temperatures and vibration, allowing them to be directly mounted to racing engines. Drive is direct, usually via a gear, taking advantage of their small size, and high temperature resistance. Permanent magnet alternators can be supplied for belt drives, if required.



Permanent magnet alternators require a separately mounted, electronic, switched-mode regulator/rectifier unit. This has the advantage that the regulator may be placed in a cooler location in the vehicle.

Even the most efficient permanent magnet alternators generate some heat. Permanent magnet alternators are typically located where there is limited natural airflow, in which case it may be necessary to pipe air to the alternator. This may be, for example, a low pressure bleed from the air-box. Alternatively an open structure may be used which takes full advantage of the available airflow.

McLaren Electronics permanent magnet alternators are the result of an extensive development programme, during which the magnetic and electrical circuits were optimised to operate with a "Buck" regulator – the DC2 or DC3. When used together, the alternator and regulator provide high current, at stable voltage, over a wide range of rotation speeds, from a very small and lightweight package.

### **Voltage Regulators**

Alternators with permanent magnet rotors need a different kind of regulator to that fitted on a wound rotor alternator. In a wound rotor alternator, the output voltage depends on the magnetic field strength of the rotor. This is controlled by the excitation voltage supplied to the rotor by the regulator. With a permanent magnet rotor the field strength is fixed so this method cannot be used. The alternator has a three-phase output in which the voltage and frequency depend on the speed of rotation.

McLaren Electronics have developed regulators which maintain the required voltage by drawing power from the alternator, as and when required, rather than dumping excess energy as heat. This system is more efficient than those using shunt or series pass circuits, so the package can be smaller and it is more likely that forced air cooling will not be required.

The 30A DC2 and the 22A DC3 regulators are optimised for use with McLaren Electronics permanent magnet alternator. Both use "Buck" circuitry which stores and regenerates some of the energy which would otherwise be lost during switching.

The output may be set, at the factory, to any voltage between 13 and 15V DC. A signal line is provided to switch off the regulator remotely, for example, to reduce load on the engine. All the cabling from the voltage regulator to the alternator and to the vehicle electrical system is via a single, integral, military specification connector.

Although McLaren Electronics regulators are very efficient, they do generate some heat and, in some circumstances a flow of cooling air may be required. The case is used as a heat sink and has small fins to increase its ability to lose heat. Ideally, air flow should be along the fins. For optimum performance, the temperature of the case should be monitored and no permitted to exceed the temperature stated in the Product Specification. An internal temperature sensor is provided for this purpose. Temperature can be reduced by improving the cooling, or by reducing the electrical load.

The input to the regulator from the alternator must not be allowed to exceed 200V p-p or the regulator may be damaged. If there is no electrical load on the alternator/regulator, e.g. during engine tests, the voltage may rise to unacceptable levels at high operating speeds. To prevent this, a dummy load should be fitted.

Please contact our technical consultancy service for advice on installing and using our regulators.