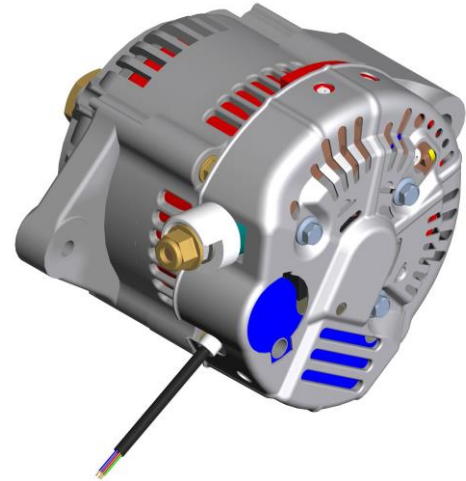


Smart Alternators

Introduction

McLaren Applied Technologies offers the Smart Alternator in either 140 Amp or 180 Amp variants in the same package as the G-Type alternator.

This application note describes the control of the alternator regulator – for installation and application notes of the G-Type alternator range, see the relevant documents available on the McLaren Applied Technologies website. This document should be read in conjunction with the Smart Alternator CAN Matrix, available on request.



The Smart Alternator gives the customer control of the following parameters over the CAN bus:

- Regulation Voltage over 11V to 16V range
- Regulation On/Off control
- Diagnostic frame transmission frequency
- Diagnostic frame single request
- Self-protection configuration

The Smart Alternator will report the following diagnostic information over the CAN bus:

- Battery Voltage
- Internal Regulator Temperature and Error
- Rectifier Temperature, Warning, Error and Sensor Failure
- Alternator RPM measurement
- Over-current warning
- Regulation voltage error
- Over-voltage error
- Mechanical abnormality
- Internal communication error
- Internal voltage error (180 Amp Version Only)
- Ignition status
- Waiting for Configuration

External Connections

CAN Bus	1Mbps, 11-bit message identifiers. See the CAN matrix for more information. The response time of the regulator is typically 60ms, therefore no more than 16 frames should be sent to the regulator per second, or there may be unexpected results.
Ignition	When ON, the regulator will be fully functional. When OFF, the regulation will be disabled and the periodic diagnostic frame transmission will be disabled. The regulator will still respond to the <i>DREQ</i> command. The external lamp will always be off.
Lamp	The lamp is used to indicate certain faults as described below. If the lamp is flashing upon power-up an initialisation fault has occurred and the unit will not regulate or respond over CAN. Please contact McLaren Applied Technologies to arrange a service.
Sense	This connection must be connected to the battery as per a standard G-Type alternator
Battery (B+)	This is through the threaded stud. See the individual design specification for more information.
GND	This is through the body of the alternator. See the individual design specification for more information.

Smart Alternator Configuration

Regulation Voltage

The regulation voltage can be controlled using the *RVS* bits in the message *CAN_OBJECT_VOLTAGE_CONFIGURATION*. It is possible to set the voltage in the range 11V to 16V. The regulation band of the alternator is +150mv / -1000mV.

Regulation On/Off

The regulation can be turned on or off using the *AREN* bit in the message *CAN_OBJECT_VOLTAGE_CONFIGURATION*. Once turned off, the voltage will be solely that provided by the battery. Once turned on, there will be a short ramp time for the voltage to come within the regulation band – during this time; there may be a regulation voltage and/or over-current warning.

Diagnostic Frame Transmission Period

Using the *CAN_OBJECT_DIAG_REQUEST* frame, the period between transmissions can be set by setting the *DPER* bits as follows:

- 0 – Do not transmit periodically
- 1 – 50ms
- 2 – 100ms
- 3 – 200ms
- 4 – 500ms
- 5 – 1s
- 6 – 2s
- 7 – 5s

Note: When sending *DPER*, the value in *SPEN* will also be updated.

When the *FAULT* code changes, a diagnostic frame will be sent within 50ms, regardless of the setting of *DPER*. The periodic transmission will then continue as set in *DPER* from this frame.

Diagnostic Frame Single Request

It is possible to request a single diagnostic frame at any time by sending a '1' in the *SDREQ* field. This is particularly useful when the transmission period is set to longer periods or off.

Note: When sending *SDREQ*, the value in *DPER* and *SPEN* will also be updated.

Self Protection Configuration

The self protection mechanism can be turned on or off by the relevant command in the *SPEN* field. When the self-protection is enabled, the following errors will cause the alternator to switch off the voltage regulation:

- Rectifier Temperature Error
- Rectifier Temperature Sensor Failure
- Regulator Temperature Error

The following error will switch off the extended functionality of a 180 Amp alternator, and will continue to run as a 140 Amp temporarily:

- Internal Voltage Error (180 Amp Version Only)

The over-voltage error will always turn off the regulation, whether self-protection is enabled or disabled.

See the relevant sections below for more information on the individual faults.

Smart Alternator Diagnostics

Battery Voltage

The battery voltage will be reported in the frame *BATV*. Measurement of battery voltage is between 0V (0x000) to 18.3V (0xFF) with a conversion of 4.46886mV/bit.

Note that the unit will switch off at approximately 6V, so in normal use the reported voltage will never be below this value.

Internal Regulator Temperature and Error

The internal regulator temperature will be reported in the frame *REGT*. Measurement of this temperature is between -55°C (0x000) and +149.75°C (0xFF) with a conversion of 0.05°C/bit.

The regulator temperature error flag will be set in the *FAULT* code when the temperature measurement goes above +105°C and will be reset only when the temperature measurement falls below +95°C. This error flag will disable the regulation if self-protection is enabled. The external lamp will be illuminated with this error.

Rectifier Temperature, Warning, Error and Sensor Failure

The rectifier temperature will be reported in the frame *RECT*. Measurement of this temperature is between -50°C (0x000) and +250°C (0xFF) with a conversion of 0.07326°C/bit.

The rectifier temperature warning flag will be set in the *FAULT* code when the temperature measurement goes above +140°C and will be reset only when the temperature measurement falls below +130°C.

The rectifier temperature error flag will be set in the *FAULT* code when the temperature measurement goes above +175°C and will be reset only when the temperature measurement falls below +165°C. This error flag will disable the regulation if self-protection is enabled. The external lamp will be illuminated with this error.

The rectifier temperature sensor failure flag will be set in the *FAULT* code when the measurement is out of range (below -50°C or above +250°C) as this could indicate that a wire has broken or shorted on the sensor. If this is the case, the temperature will report as either -50°C or +250°C. Contact McLaren Applied Technologies for a service if this error is showing, but the temperature is not at the extremes. This error flag will disable the regulation if self-protection is enabled. The external lamp will be illuminated with this error.

Alternator RPM Measurement

The alternator RPM will be reported in the frame *RPM*. Measurement of the RPM is between 1,500RPM (0x000) to 34,267RPM (0xFF) with a conversion of 1RPM/bit.

Note that the absolute maximum rated RPM of the alternator is 18,000RPM and this should not be exceeded.

Over-Current Warning

The regulator monitors the operation of the alternator and will set this warning flag in the *FAULT* code if the PWM on the rotor is at 100% (maximum) and the voltage is below the regulation band as this combination indicates that the alternator is being used beyond its power curve. The external lamp will be illuminated with this error.

Note that the regulation voltage error will illuminate with the current error as it is a part of the determination of this error.

Regulation Voltage Error

The regulation band of the alternator is set to +150mV / -1000mV. If the measured battery voltage is outside of this band, the warning flag in the *FAULT* code will be set. The external lamp will be illuminated with this error.

Smart Alternator Diagnostics

Over-Voltage Error

If the measured battery voltage exceeds 16.25V, the regulator will be disabled and the error flag will be set in the *FAULT* code. This error will remain set until 5 seconds after the voltage has fallen below 16.25V. The external lamp will be illuminated with this error.

Note that this failure mode operation is not able to be turned off with the self-protection configuration.

Mechanical Abnormality

This error is set in the *FAULT* code when the RPM is below approximately 600RPM. When the alternator is not rotating (i.e. ignition on, but engine off) then it can be disregarded, however it can be used to detect mechanical faults, i.e. broken drive belt, if the alternator should be rotating but isn't. The external lamp will be illuminated with this error.

Internal Communication Error

This error is set in the *FAULT* code if there is an internal communication error inside the regulator. If this error persists for more than 3 seconds, the voltage regulation point will be adjusted to 14.3V for safety reasons. If the fault disappears then the voltage will continue to regulate at the voltage set point. The external lamp will be illuminated with this error.

Note that if the voltage set point is changed during the time that this error is set, then once the unit recovers the new set point will be used.

Internal Voltage Error (180 Amp Version Only)

This error is set in the *FAULT* code if there is an internal voltage error inside the regulator. This error flag will disable the additional functionality of the 180 Amp alternator, and reduce the capability to that of a 140A amplifier, for minimum 5 seconds, if self-protection is enabled. If this error does not clear of its own accord, please contact McLaren Applied Technologies to arrange a service. The external lamp will be illuminated with this error.

Ignition Status Flag

The ignition status flag is located in the *FAULT* code, although it is not a fault as such. This flag will be set when the ignition is ON and cleared when the ignition is OFF. This flag indicates ignition status, and therefore could indicate a broken wire, if the ignition is ON and is reported as OFF. When the ignition is off, the lamp will always be off.

Note that when the ignition changes state from ON to OFF, a single *CAN_OBJECT_DIAG* frame will be sent to indicate this. The ECU can then interrogate the regulator using the *DREQ* command.

Waiting for Configuration

When the unit is first powered, this flag will be set and the regulator will regulate to 14.3V. This flag will stay set until a *CAN_OBJECT_VOLTAGE_CONFIGURATION* command is received.