Flameproof Diesel Machinery Electrical System DCBR User Manual

(Firmware V1.33 + V1.86)

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1 OVERVIEW

1.1 Scope of this document

This document outlines the installation, operation, maintenance and testing of the Mining Repairs Model MR110 alternator when fitted with electronic protection / regulator type DCBR with firmware V1.33 or V1.86 or later. The manual is also generally applicable to earlier releases of firmware.

1.2 Description

The MR110 alternator is a self-excited three phase multi-pole alternator with integral rectification and regulation in a certified flameproof housing.

The alternator is rated at 13.0V DC and 26A at an ambient temperature not exceeding 40 deg C. The maximum rated speed is 7000 RPM.

1.3 Applications

The MR110 alternator with DCBR controller module is designed for use on mobile diesel plant operating in Group I zone classifications as typically used by the underground coal mining industry.

1.4 Retrofit

The DCBR module system is factory fitted to MR110 alternator and replaces the older style regulators.

The DCBR module can be retrofitted in the factory to older MR110 alternators.

1.5 Certification

The MR110 with DCBR controller is certified Ex d I 150 deg C IP65 under

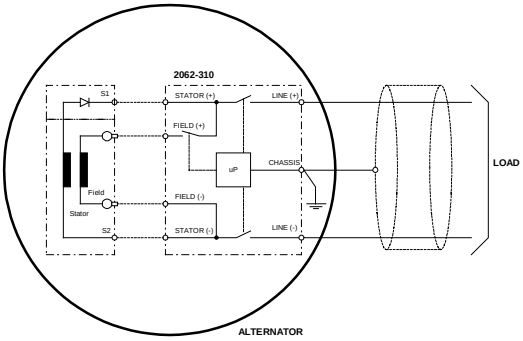
- IECEx TSA 06.0041X
- MDA Ex d 2477
- QMD 92 7116X

1.6 Integrated flameproof package

The MR110 when fitted with the DCBR module is a single flameproof component that embodies the functions of a

- Self excited alternator
- Circuit interrupter
- Protection relay
- Datalogger

The protection features include



- Instantaneous overcurrent
- Timed overcurrent
- Insulation impedance (+ve and –ve power rails to chassis)
- Overvoltage

The protection settings are factory set and not accessible to the user.

The protection system is entirely solid state

and free from selection switches, potentiometers or mechanical relays.

1.7 Integrated test features

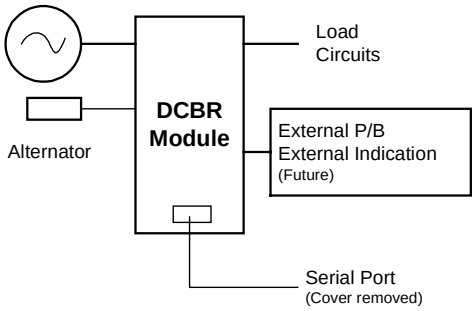
The DCBR module has an integral test feature that confirms correct chassis protection operation. This feature utilises a primary test technique to ensure the test has high credibility. No simulation is involved.

A successful test temporarily disconnects the supply and only re-establishes supply if the test sequence is successful. A failed test will prevent re-supply of the load circuits.

The test may be conducted at any time by activation of the test button on the DCBR module. This is accessible by removal of the end cover on the MR110 alternator.

A remote test button will be available as an option under future upgrades of the alternator enclosure.

The test switch is only active if the alternator is running and excited.



Removal of the cover must be performed by an authorised person. The test must only be conducted in a safe environmental zone where the risk of igniting an explosive gas and / or dust mixtures has been assessed.

1.8 Reset

The DCBR controller has protection functions which latch out the main circuit interrupter. Latched protection trips must be manually reset. The reset switch is accessible by removal of the end plate on the MR110 alternator.

A remote reset button will be available as an option under future upgrades of the alternator enclosure.

The reset switch is only active if the alternator is running and energised. Operating the reset switch without the alternator being excited will not initiate a reset.

The reset switch may only be operated by an authorised person. The reset must be conducted in a safe environmental zone where the risk of igniting an explosive gas and / or dust mixtures has been assessed.

1.9 Regulation and compensation

The DCBR also regulates the voltage output of the alternator to a preset value which is factory set.

The regulator has a load compensation feature which increases output voltage in proportion to the load current to compensate for voltage drop in the supply circuits.

1.10 Benefits

The DCBR system as fitted to the MR110 alternator is primarily designed to enhance the safe operation of flameproof electrical systems on mobile diesel machinery.

The DCBR system minimises the risk that cable faults on flameproof electrical systems could provide ignition potential by providing an additional layer of electrical protection interruption and isolation to existing mechanical protection techniques.

The DCBR complies with the legislative requirements of the "Recognised" Standards"

The DCBR system is a replacement solution that does not add additional components to the vehicle. The DCBR module can be retrofitted to any MR110 alternator.

The DCBR event log enables the record of usage to be examined.

The DCBR chassis test facility makes verification of circuit integrity a simple process.

The excellent transient performance is compatible with third party electronic systems including gas detection systems.

The load compensation feature is friendly to third party electronic systems.

The susceptibility to vibration is minimised by use of solid state components throughout.

Protection settings cannot be tampered with or incorrectly set since these are factory set.

A protection operation is latched in persistent memory to ensure that even if the power is cycled, the protection operation is strictly enforced.

2 INSTALLATION

2.1 Mounting locations

The MR110 alternator with DCBR module is designed for a maximum ambient temperature of 40 deg C. Consideration should be given to the installation location to choose a mounting site that avoids higher ambient temperatures.

Locate or shield the alternator from sources of direct heat. Ensure the alternator is well ventilated and air flow is not restricted.

2.2 Direction of rotation

The direction or rotation is not critical and rotation in either direction is acceptable. The polarity of the output terminals is not determined by direction of rotation.

2.3 Wiring standards

This alternator is fitted with chassis fault protection which operates *instantaneously*. The chassis fault protection is sensitive to both persistent and intermittent chassis faults.

Failure to properly insulate the load conductors from chassis will result in protection operation and isolation of the alternator supply until the fault is removed and the alternator protection is reset.

A static megger test of the wiring may indicate sound insulation. However in operational use the insulation integrity may be compromised by vibration and temperature. A static megger test is NOT conclusive evidence of sound insulation integrity.

Tape earth screens and cable connectors.

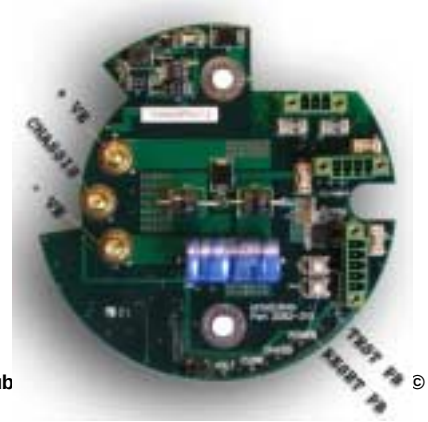
Restrain / locate conductors so that their insulation integrity is retained under service conditions including the effects from vibration and temperature.

2.4 Power terminals

Connect the load to the "+" and "-" terminals. Connect the cable screens to the "chassis" terminals and ensure that the alternator housing is bonded to the vehicle chassis.

Power terminals are M5 studs.

The chassis terminal is internally connected to the chassis of the alternator inside of the flameproof enclosure.



Recommended terminal arrangement.

High current alternator terminals must be securely made. The use of tooth lock washers in combination with brass flat washers is recommended

Do not over tighten. Any movement of the terminal stud on the PCB will result in damage to the current paths.

2.5 Field winding terminals

Observe correct polarity when connecting the field windings.

2.6 Competent Installation

The DCBR system must be installed in accordance with flameproof principles by technicians meeting the competency requirements of the industry.

2.7 Cable Glands

The MR110 alternator is presently designed with a single M20 cable gland entry for connection of load circuits using 1.5mm2 Type 2S cables.

Under future modifications, the MR110 will be available with additional gland entires.

2.8 Serial port terminals

Subject to the build, the DCBR module is provided with a serial port for manufacturing and service purposes. The serial port is provided as a multi-pole connector.

2.9 Stator mounting washers

The use of toothlock washers to mount the DCBR module is PROHIBITED, due to the damage they potentially cause to the high current terminals.

Tooth lock washers PROHIBITED for this terminal.

3 TESTING

3.1 When to test?

Test the chassis protection before operational use via the test pushbutton.

Test regularly in accordance with standard operating procedures

3.2 Chassis Test

The DCBR is fitted with an automatic test feature, which is activated by pressing the TEST pushbutton momentarily.

The test can only be conducted if the alternator is running in a fully excited state.

The test pushbutton is internal to the alternator and can be accessed by removal of the alternator cover.

Operation of the test switch at any time will initiate a test sequence which applies a low impedance across the output terminals within the DCBR of less than the threshold value.

While the test is in progress the lighting system will be momentarily interrupted to indicate that the test command is in progress.

A successful test sequence will result in closure of the interrupter and automatic resumption of supply.

A failed test sequence will result in operation and latching of the interrupter in the open state.

With the alternator running, conduct the chassis test by activating the TEST pushbutton. The supply will be lost for about 5 sec and then restored to confirm correct operation of the DCBR chassis protection features. Failure to restore supply indicates a failure of the DCBR which should be immediately returned for repair or service.

A failed test means that the DCBR has a defect and it should be replaced.

An alternator which fails the chassis protection tests MUST NOT be used in service.

The chassis test confirms the correct operation of the chassis protection and thereby confirms that chassis faults do not exist on the vehicle wiring.

The test facility does not increment the fault event log. Externally simulated faults will however increment the event log. The event log can only be reset in the factory.

3.3 Megger Test *(caution!)*

The high voltage produced by a megger, inappropriately applied, may damage

circuits and / or cause maloperation of the protection functions.

The use of a high voltage megger to test insulation integrity when the alternator is connected is expressly PROHIBITED and will void warranty.

If the circuit must be meggered then isolate the electronics by disconnecting both line conductors at the alternator terminals.

A static megger test of the wiring may indicate sound insulation. However in operational use the insulation integrity may be compromised by vibration and temperature. A static megger test is NOT conclusive evidence of sound insulation integrity.

3.4 Reset

The reset pushbutton is used to reset latched protection.

3.5 Other earths

The DCBR is designed for DC source power systems that are floating and unbonded to the chassis. The existence of other impedances between the power rails and the chassis may be detected and interpreted as an earth fault.

If for instance, the 0V DC rail is connected to the chassis, this would be interpreted as an earth fault – ie a low earth impedance.

4 OPERATION

4.1 Closing the interrupter

The DCBR closes the interrupter to connect supply after excitation conditions have been attained.

The DCBR system does not make an assessment of the load circuit before closing the interrupter. If a fault condition exists the interrupter will be close and open according to the nature of the fault and the protection settings.

The DCBR has an automatic re-close feature to allow very cold lamps to be warmed and allow the alternator to get away. With standard factory settings and recommended load, this feature would rarely be invoked.

4.2 Opening the interrupter

In the event of a protection operation occurring the DCBR will interrupt the flow of current to remove supply from the load circuits.

The interrupter may be either latched or unlatched depending on the protection features set in the factory. A latched interrupter will not be cancelled by cycling power.

4.3 Timed overcurrent protection

The DCBR continuously monitors the current flow. If the current exceeds a threshold value for a threshold duration the interrupter will latch open after a set delay period.

The DCBR has an automatic re-close attempt following detection of timed overcurrent. If the re-close also results in an overcurrent condition, a latched trip will occur.

The time delay to operate is factory set.

After an overcurrent trip “CURR” LED on the front of the indicator panel will flash and remains in this state for as long as the alternator is excited and until the protection latch is cancelled by a reset operation.

The protected cable zone for overcurrent faults is limited to the load side of the interrupter.

4.4 Instantaneous overcurrent protection

The general performance is similar to the delayed overcurrent settings, except that the protection operates at a higher threshold current and operates without programmed delay.

If the current exceeds the instantaneous threshold, the interrupter will immediately open.

After an instantaneous overcurrent trip the “CURR” LED on the front of the indicator panel will be continuously illuminated and will remain in this state as long as the alternator is excited and until the protection latch is cancelled by a reset operation.

The protected cable zone for overcurrent faults is limited to the load side of the interrupter.

4.5 Chassis protection

If the resistance to chassis of either of the power rails falls below the threshold value, the interrupter will immediately latch open.

The chassis protection is equally sensitive to both persistent and transient faults

A static megger test of the wiring may indicate sound insulation. However in operational use the insulation integrity may be compromised by vibration and temperature. A static megger test is NOT conclusive evidence of sound insulation integrity.

The protected cable zone is both on the load side and the source side of the interrupters, which includes the alternator windings. The cable zone does not include the test / reset circuits (though these have intrinsic protection through low voltages and low currents)

The interrupter is prevented from restoring supply after clearing a chassis fault by the latching feature.

After a chassis fault the “CHASS” LED on the front of the indicator panel will flash and remain in this state for as long as the alternator is excited and until the protection latch is cancelled by a reset operation.

If the fault condition remains when the reset switch is operated, the protection will immediately open the interrupter again.

4.6 Overvoltage protection

The DCBR continuously monitors the output voltage and latches out the supply if overvoltage conditions are sustained for longer than the set delay period.

After an overvoltage fault operation the “VOLT” LED on the front of the indicator panel will be continuously illuminated and remain in this state for as long as the alternator is excited and until the protection latch is cancelled by a reset operation.

4.7 Undervoltage protection

The DCBR continuously monitors the output voltage and latches out the supply if low voltage conditions arise which are characteristic of a short circuit.

The DCBR is able to distinguish between undervoltage caused by a stalled engine and undervoltage caused by a short circuit.

After an undervoltage fault operation the “VOLT” LED on the front of the indicator panel will flash and remain in this state for as long as the alternator is excited.

Undervoltage operation is in general, evidence of a short circuit fault. It can be reset by stopping and restarting the alternator or by pressing the RESET pushbutton.

4.8 Reset command

The reset switch is accessible by removal of the end cover. The reset switch is the only mechanism to unlatch the interrupter following a protection trip.

The DCBR is a protection device that must only be reset by authorised personnel following investigation of the root cause of the fault.

The reset can only be conducted if the alternator is running in a fully excited state.

Subject to the build, the test / reset (unlatch) buttons are brought to a multi-pole connector for externalisation.

Under future modifications, the MR110 will be available with externalised test and reset pushbuttons.

The reset contact needs to be held momentarily for the command to be recognised.

4.9 LED indicators

An LED indicator panel is visible following removal of the end cover. The panel provides the following annunciation –

LED	**LED state**		
	Continuous	*Flashing*	*Off*
PWR	Power ON	-	Power OFF
CHASS	-	Chassis trip	-
CURR	Instantaneous overcurrent trip	Timed overcurrent trip	-
VOLT	Overvoltage trip	Short circuit trip (close in to alternator)	-

On power up all LED’s may be observed to flash momentarily. This is normal operation.

An internal fault with the DCBR may be evident as a condition where all lights flash alternately. If the “fairy lights” condition is

apparent, the DCBR is faulty and must not be used.

If all LED's are observed to flash in unison, this indicates that the alternator is beyond its recommended service interval and should be returned for overhaul.

4.10 Diagnostic Flow Chart

A diagnostic flow chart is appended to this manual to assist with the analysis and interpretation of the LED panel.

5 SPECIFICATION

5.1 MR110 + DCBR

The DCBR is specifically designed to suit the self-excited flameproof MR110 alternator.

5.2 Typical loads

The load should be substantially resistive in nature as typified by halogen lighting systems. Depending upon the cable arrangements the load may have an inductive component.

The DCBR is suited to electronic components because of its ability to tightly manage output voltages under regulation and switching operation. Electronic components should be designed with diode protected front end low pass filters.

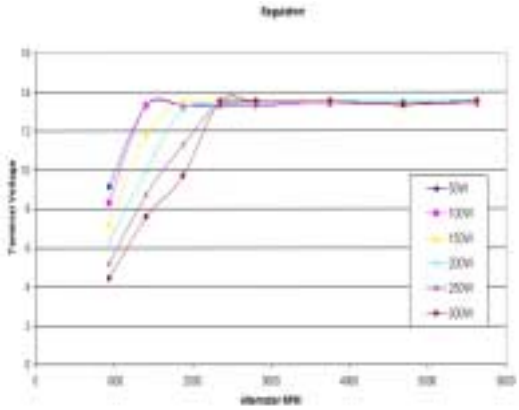
5.3 Interrupter states

In the open state, the interrupter may be modelled by a high impedance series connection.

In the closed state, the interrupter may be modelled by a low series resistance connection.

5.4 Regulation

The DCBR provides loop controlled regulation of the output voltage. The loop parameters are factory set.



5.5 Load Compensation

The DCBR performs load compensation and raises the output voltage in proportion to the load current. The load compensation curve is factory preset.

5.6 Output ripple

The alternator output is unsmoothed with a ripple waveform that varies with load and alternator RPM.

5.7 Output transients

The DCB is exceptional in its management of transient voltages. In normal operation transient voltages do not arise in excess of the intrinsic ripple.

Under switching duty the DCBR cleanly interrupts load current without the generation of transient voltages (unlike relay switched loads, where contact arcing gives rise to transient voltages.)

During a close operation, the DCBR loop controller manages the output voltage and keeps overshoot within the intrinsic ripple limits.

5.8 Test / reset circuits

The test / rest circuits are driven by low voltage (5V DC) and a high impedance source.

5.9 Ratings

The DCBR is factory preset. The standard factory settings are as follows.

Parameter	Value
Rated voltage	13.0V rms
Load compensation	5% curve
Voltage at 200W	~13.3 V rms
Max voltage transient	15V peak
Max continuous trip current	26 A
Timed overcurrent trip delay	0.3 sec
Instantaneous trip current	55 A
Overvoltage trip	16.0 V
Overvoltage trip delay	1.0 sec
Chassis fault impedance (+ve to chassis)	~500 ohms
Chassis fault impedance (-ve to chassis)	~500 ohms
Chassis fault delay to trip	Instantaneous
Un-latching method	Manual reset
Service interval	2000 hours
Excitation commencement speed	<2200 RPM
Excitation dropout speed	~800 RPM

6 ENHANCED FEATURES

6.1 Event Log

The DCBR records

Run hours
Trip events

The event log is only accessible via optional hardware and software.

6.2 External Pushbuttons

The RESET and TEST pushbuttons will be externally accessible via optional hardware and that will fit to future releases of the MR110 enclosure.

6.3 External LED Panel

The led indicator panel will be externally accessible via optional hardware under future releases of the MR110 enclosure.

6.4 External Communications Port

The communications port enables read only access to operating parameters and event logs. The port is accessible for testing purposes via optional hardware and software.

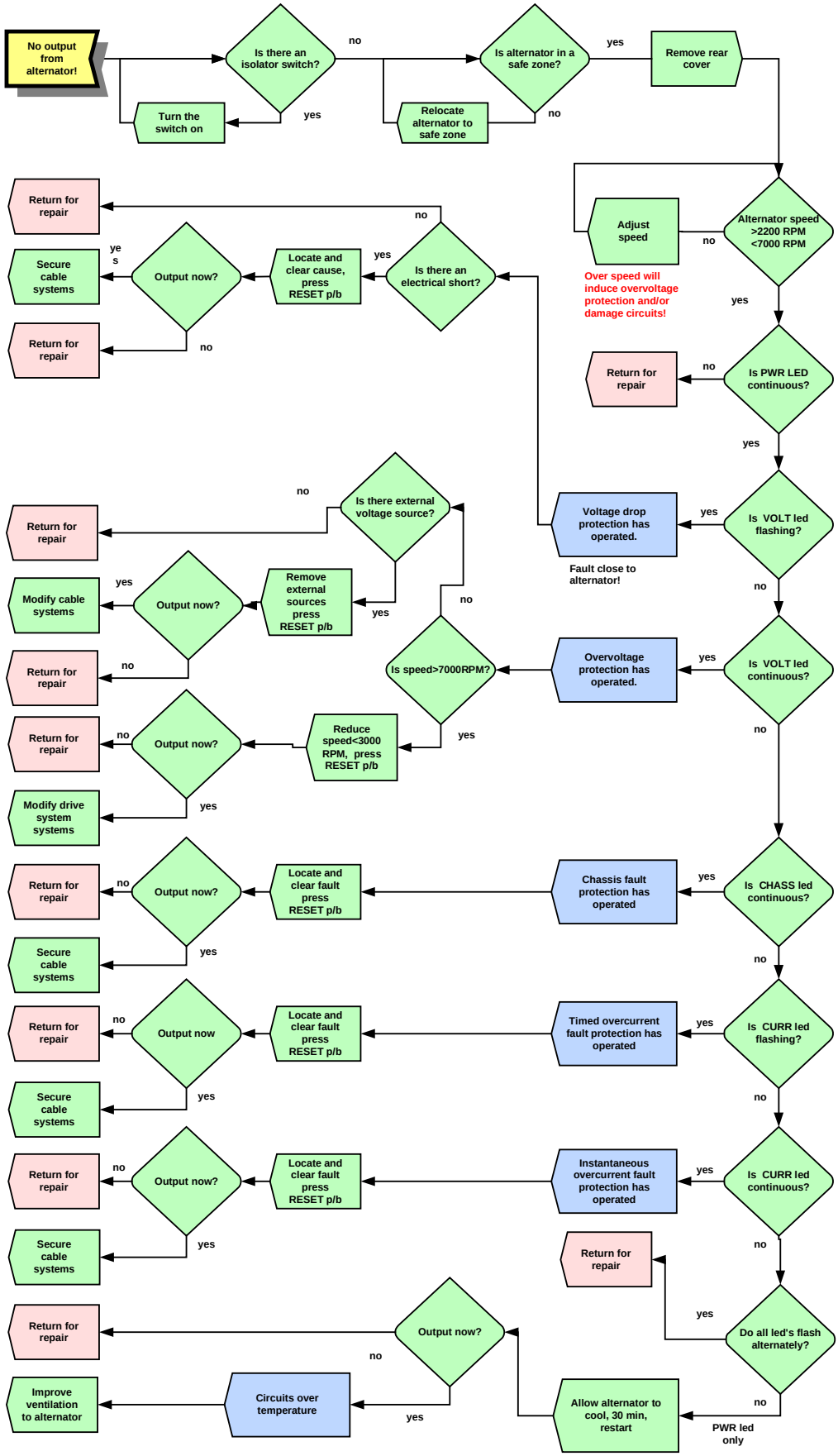


Figure 1 - Fault Diagnostic Flowchart

7 REFERENCE PUBLICATIONS

Reference	Title
Publication DCBR-009	DCBR instrument panel
Publication DCBR-010	DCBR handheld remote
Publication DCBR-014	MR110 Series Test Bench User Manual
Publication DCBR-018	Alternator Test Procedures (with DCBR fitted)

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