Caterpillar 3500b Engines Application And Installation Guide
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3500B Engines Application and Installation Guide

- Electronics
- Electrical Power Supply
- Electronic Features
- Electronic Attachments

LEBM7301-01 (Supersedes LEBM7301)

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General Information

Introduction

Caterpillar's 3500B marine engines were introduced in mid 1995. Since then, their acceptance by the marine marketplace has exceeded all expectations. This is due to their high power, superior emissions, superb fuel efficiency and long life-before-overhaul. Greater power than their predecessors results in extra productivity. 3500B engines have much better fuel efficiency than their mechanical counterparts…doing the same work for less fuel…or more work for the same fuel. Cleaner engines makes their owners better neighbors as more and more emissions rules come into effect in the first years of the new millennium. But the 3500B also have a wealth of electronic features. This manual is to help both dealer and owner understand and fully utilize those features.

Electronic Features

The 3500B is controlled by a computer rather than a governor. This gives the engine all the capabilities of a computer that can: communicate over a modem…be called on a phone or interfaced with another computer. A service man with a laptop computer can connect to the engine computer – called the engine control module (ECM) - and use the laptop to extract historical data describing how the engine has operated or upload new software which could change the way the engine reacts to its operating conditions.

The 3500B is truly an *intelligent* engine, protecting itself from abuse. It monitors its exhaust temperature, air cleaner restriction, jacket water temperature, altitude, aftercooler water temperature and crankcase pressure, continuously. If one of these critical parameters enters into a dangerous condition, the engine can be set to derate itself a few percent every few seconds to protect from unplanned downtime and repair expenses. Before the advent of the 3500B electronic marine engine, we used a calendar to decide when to perform maintenance. With the electronic features built into the 3500B, we use the standard, full-range, pressure transducers located both upstream and downstream of all their filters to fully utilize the life in filters, but without risking running dirty oil, fuel, or air going through the engines. Electronic 3500B engines have a self-diagnostic capability. The ability to detect unintentional grounds, shorts, and open circuits saves time during diagnosis of any engine problem. The 3500B engines' electronics store records of past performance. This will allow troubleshooters to see if operation contributed to problems.

This manual will lead the reader through the steps to understand the differences and the advantages of computer-control.

Minimum Electrical Requirements for Installation of 3500B Marine Engines

System	Remarks	Reference
Power Supply: 3500B engines must be supplied with a reliable source of direct current electricity, with a minimum of one alternative power source to provide redundancy	The engine's Electronic Control Module (ECM) needs 10 amps of 24 VDC supplied via a dedicated battery set. Interrupting this power will shutoff the engine. Alternative power supplies include, but are not limited to, back-up battery sets, engine driven alternators and battery chargers.	See page 7-11 for details
Data Transmission: If a pilothouse instrument panel (only available on propulsion engines) is desired to monitor the engine, the panel must be connected via wires. The path for the wires must be free of significant electromagnetic interference	The engine's Electronic Control Module (ECM) uses a twisted pair of wires with low capacitance over which to transmit its performance data. Use unshielded Data Link cable (P/N 143-5018) if a Data Link equal to or shorter than 30 meters or 100 feet is required. Use shielded Data Link cable (P/N 123-2376) with a Customer Communications Module, to boost the Data Link signal, in applications demanding between 30 and 457 meters or 100 to 1500 feet of Data Link. The wire path must not contain wires going to radar or radio antennas, generator output leads or battery charger's power conductors.	See page 14-16 for details
Throttle Signal: The engine uses a pulse-width modulated (PWM) electronic signal to control its speed.	Caterpillar offers a throttle signal generator to generate the required, regularly spaced, "square wave" pulses of varying width that the engine uses as a throttle signal in response to the angular movement of a lever. Several Pilot House Control Vendors offer products which also supply the PWM signal.	See page 36 & 64 for details

Electrical Power Requirements

A well-designed power supply to the 3500B engine includes a 24-volt battery set, usually composed of two 12-volt batteries connected in series and capable of continuous supply of ***10 amps to each engine*** to drive its injectors, regardless of whether the engine is equipped with a backup ECM or not. It is important that each engine have its own set of batteries in the manner of the figure 1 sketch. Note that the following sketches are not intended to illustrate all the features or components of a fully operational system. The sketches are to illustrate specific aspects of the installation and are simplified for ease of understanding.

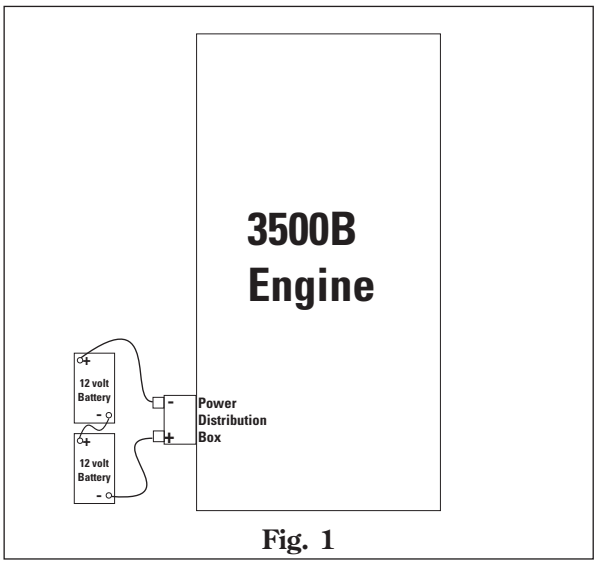


Fig. 1

The engine must also have a redundant or alternative power supply to the engine to protect it from power loss because of a single component failure. The alternative power supply might be, but is not limited to, a second 24-volt battery set, a battery charger, or a separate engine-driven alternator for each engine. If a single battery charger is used to charge the batteries for more than one engine, the lines connecting the positive post of each of the batteries to the positive terminal of the battery charger must include properly oriented diodes. The diodes are to prevent an adequately charged battery discharging through a failed battery charger or a failed battery. The negative terminal of each battery set is to be connected to a single point on the metal hull or to the common ground plate on a non-metallic hull. Under no circumstances should the positive poles of each battery set be connected together. They must remain independent so a failure in any one battery does not drain the other batteries in the system.

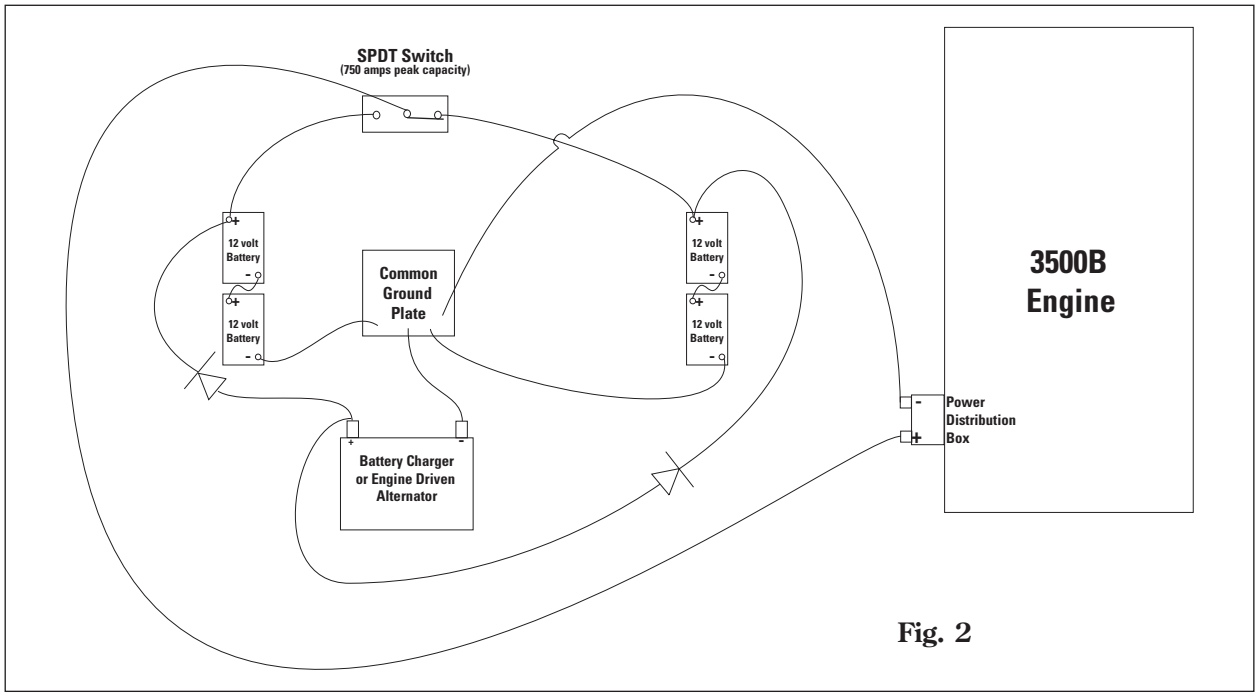
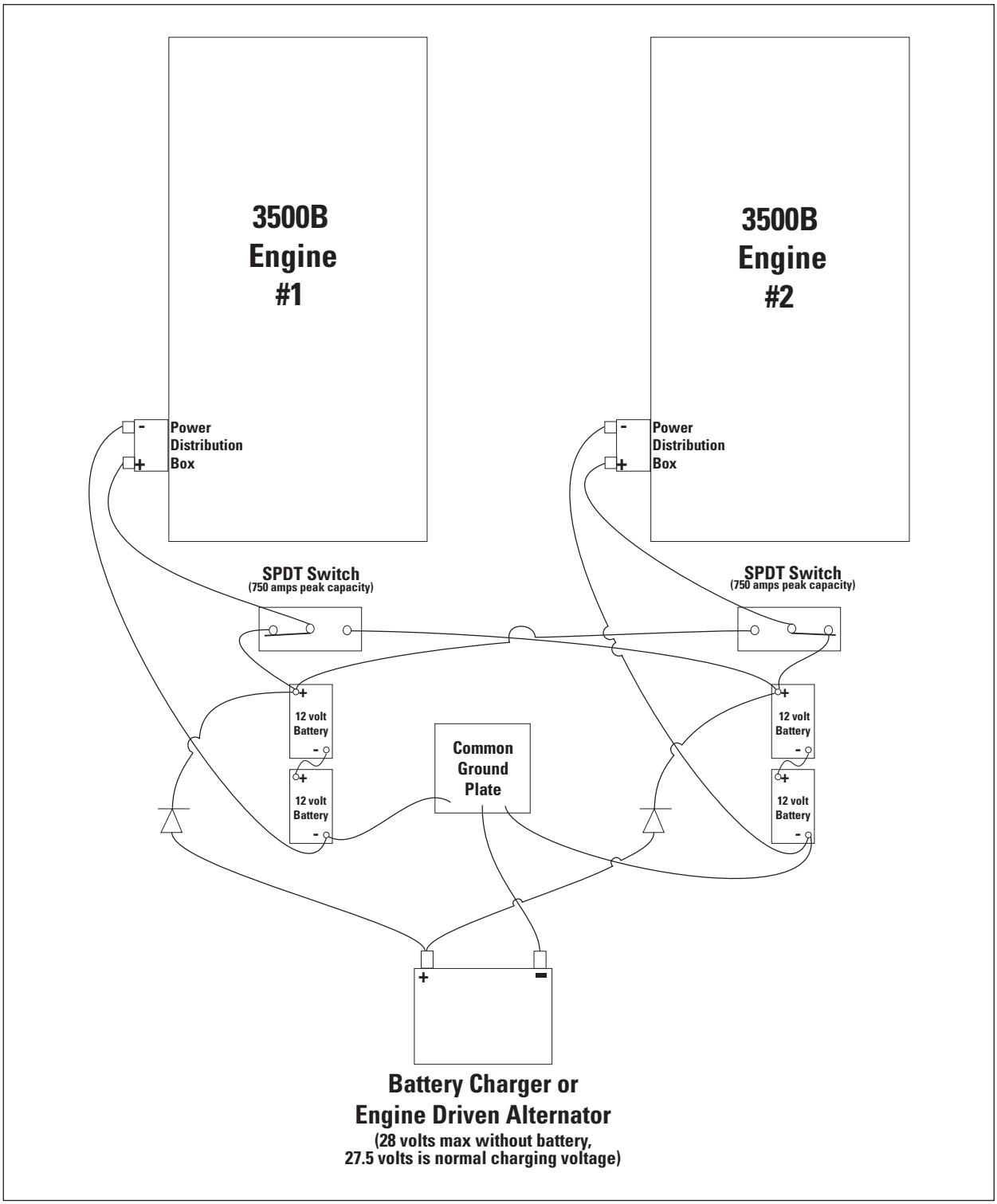


Fig. 2

In the application of multiple engines, it is desirable to be able to operate any engine from any set of batteries or battery charger. The sketch below illustrates the use of redundant batteries. Notice the diodes are required in the application because the battery chargers/alternators are not dedicated to a specific set of batteries.



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Acceptable Voltage Range

The recommended continuous voltage range to provide power to a 3500B marine engine is 20 to 28 volts. The engine's monitoring system will annunciate an alarm condition if the voltage falls below this range. A back-up battery set should be brought on line as soon as the primary system voltage falls outside the recommended range. *Make-before-break* contacts are preferred.

Many battery chargers are capable of dangerously high voltages if operated without a functioning battery to provide an electrical load. Engine operation with ECM voltage above 30 volts will damage the ECM. Engine-driven alternators include a voltage regulator and will not damage the ECM should a battery failure occur. Engine-driven alternators are to be preferred over battery chargers as a redundant power source.

The monitoring system will not function correctly below 18 volts. Engine shutdown will occur if the engine's power supply is interrupted for more than 0.25 seconds. The engine will continue to run to as low as 12 volts. The engine is designed to handle momentary drops in system voltage to as low as 9.6 VDC. However components are not designed to operate in this mode indefinitely and continued operation at this voltage level will result in system damage. A temporary loss of power (as in one or two milliseconds when switching from primary to backup power batteries) will not effect engine operation. The engine will continue to run normally.

Current Requirements

A 3500B engine requires 10 amps of 24-volt direct current power to run. Battery chargers must be capable of providing that plus an additional 2 to 5 amps of power, over the total normal electrical load, to charge batteries, if the batteries are in a discharged state. The ECM requires 80 amps of inrush current for 2 milliseconds to initialize its injector drivers. Any engine power supply must be capable of supplying this requirement: power supplies that include batteries are capable of meeting this requirement.

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