

Adding a 12 Volt DC Charging Circuit

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Northeast Forest Fire Supervisors
in Cooperation with
Michigan's Forest Fire Experiment Station

U.S. Military vehicles operate with 24 volt DC electrical systems. Fire departments converting excess military vehicles to fire fighting equipment generally need 12 volt DC to power many of their accessories. REC Project #2, *Wiring Conversion on Military Vehicles*, highlighted several ways to provide 12 volt power. This Newsnote provides an updated look at one of REC Project #2's alternatives, installing an additional and separate 12 volt electrical system.

In many cases it is not practical to change the vehicle's 24 volt system over to 12 volt. The procedure discussed here allows all of the major components of the 24 volt system to stay intact. The engine starter, the ignition system, generator, regulator and the two 12 volt batteries connected in series continue to function as original equipment. The vehicle's 24 volt lighting system may be transferred to the 12 volt system or left alone on a 24 volt system.

Any additional 12 volt loads such as lights (including head, tail, stop, turn, clearance, emergency beacon), two-way radios, electric rewind hose reels, electric pump engine starters can be connected to the separate 12 volt system. The separate 12 volt system components include a 12 volt alternator with a regulator and a 12 volt storage battery.

The major considerations for installing a separate 12 volt system include:

- Finding a space to mount the alternator. The alternator will be driven by a belt. It is desirable to have the alternator drive sheave installed directly on the end of the engine crank shaft. Drive sheaves can be installed on existing alternators, generators, fan or water pump shafts, but this imposes an additional load on the drive belts and bearings of these components that was not originally intended. This may reduce the life of the belts and bearings.

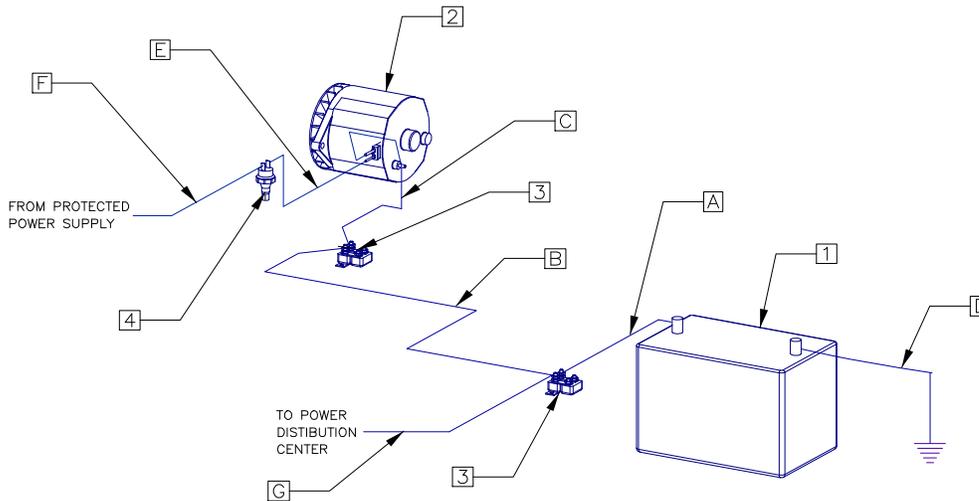
Often an extra sheave is not available and one must be specially machined to fit the crank shaft or drive components shaft.

Normally, automotive alternators have a drive ratio of about 2:1. This means that the alternator RPM is twice as great as the engine RPM. Make sure that you determine the correct drive ratios. For example, if a drive sheave is connected to the existing 24 volt generator shaft which already runs twice as fast as the engine, a 1:1 ratio would be correct.

- Determine the mounting bracket for the 12 volt alternator. It is important to establish good mounting points for the 12 volt alternator mounting bracket. REC has mounting bracket designs for some military vehicles. Make sure your bracket is attached to the engine block or a component attached to the block and that the belt alignment between the drive and driven pulleys is square.
- Completing the 12 volt circuit. An alternator needs an outside source of current to excite its' magnetic field before it can produce current. We suggest connecting a wire from the power distribution panel (fuse or circuit breaker) to the alternator activation terminal.
- Avoiding battery drain. A switch is needed to disconnect the alternator field activation wire to prevent battery drain. You want the 12 volt electrical circuit to be closed only when the engine is operating. This can be done in a number of ways. The preferred method is using an oil pressure switch to close the field activation wire part of the circuit. This is automatic and will close the circuit only when the engine is running. Other alternatives are use the ignition activated circuit or a manual control in which the operator switches on a toggle switch at startup and turns it off in shutdown. While simple to install, the manual toggle switch operation will result in battery drain or other problems if the procedure is forgotten.

The one page diagram on the next page of this report shows a complete 12 volt DC charging circuit and provides additional details.

12 Volt DC Charging Circuit



Item	Description	Capacity	Note
A	Charging wire (alternator end)	Cross sectional area sufficient to handle full alternator output.	This section of wire is unprotected unless a fusible link type wire is used. If standard wire is used this section should be kept as short as possible.
B	Charging wire	Cross sectional area sufficient to handle full alternator output.	
C	Charging wire (battery end)	Cross sectional area sufficient to handle full alternator output.	This section of wire is unprotected unless a fusible link type wire is used. If standard wire is used this section should be kept as short as possible.
D	Ground wire	Cross sectional area sufficient to handle the sum of all the loads that may be used at one time.	
E	Alternator Field activation wire	This is a low amperage load usually less than 2 amps. The wire should be sized to handle a load equivalent to the circuits fuse.	If this wire has power and the engine/alternator is not running there will be a small drain on the battery.
F	Power supply for alternator field activation wire	This is a low amperage load usually less than 2 amps. The wire should be sized to handle a load equivalent to the circuits fuse.	In order to install a separate 12VDC system, a power distribution (fuse/circuit breaker) panel should be installed. All accessory circuits including this circuit should be connected to the protected side of this panel. All accessory circuit wiring should be sized to handle an electric load at least 125% of the capacity of the fuse/circuit breaker protecting the circuit (NFPA 1906).
G	Power supply to vehicle accessories	Size equal to the rating of the circuit breaker/fuse in the charging wire circuit. (Item #3)	This wire can be used to power accessories that have an individual electrical demand less than the output of the alternator. If an accessory has a load requirement higher than the alternator output it should be connected directly to the battery with proper short circuit protection.
1	Battery; 12 Volt	Size dependent on electrical component demands.	
2	Alternator; 12 Volt	Size dependent on electrical component demands.	
3	Circuit breaker/Fuse	Size equal to the rating of the alternator.	A circuit breaker or fuse may be used. Two are required because with the engine running there are two power sources, one at each end of the charging wire circuit.
4	Oil pressure switch	Sized to handle a load equivalent to the circuits fuse.	The requirement of this switch is to disconnect the alternator field activation wire to prevent battery drain. This can be done in a number of ways: 1) engine oil pressure switch(Normally Open non-grounded), 2) use an ignition activated circuit, 3) toggle switch turned on by operator at start up and off at shut down, etc.