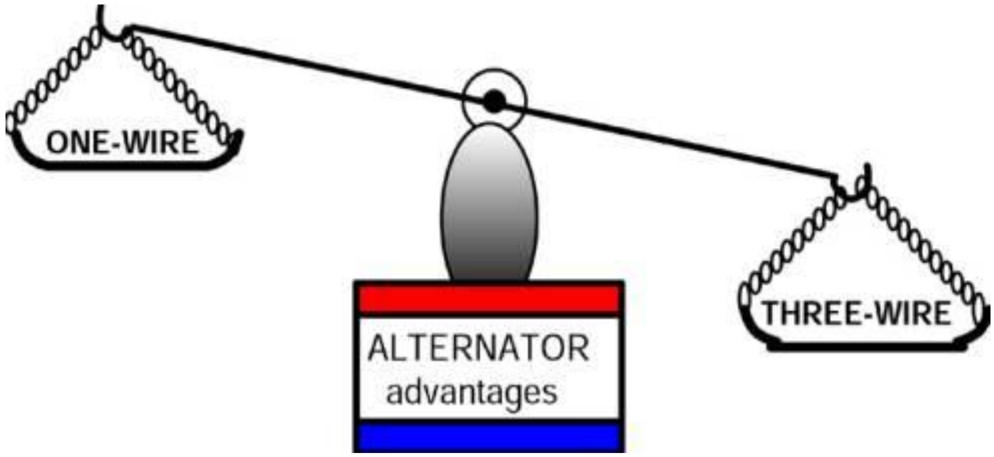
You be the Judge!



For most applications, the advantages of a THREE-WIRE alternator will far *outweigh* the little time saved with a ONE-WIRE installation.

Both types have the voltage regulator in the alternator, but there are important differences between the ONE-WIRE and THREE-WIRE systems.

This is a fairly involved topic, and this feature contains issues that have never before been directed at the High Performance automotive industry. It was posted for the enjoyment of those who enjoy learning how things work.

Anyone who would like to check the performance of an existing system, ONE-WIRE or other, can get out the voltmeter and see how well the system is working. Check voltage at various places. Like with engine running at cruise RPM, headlights ON (high beam), heater fan on medium blower fan speed, measure the voltage at a brake light or dome light fuse. That measurement will indicate voltage from the dash area "main power-up wire," which is a very indicator of overall performance. (The dash area "main power-up" supports ignition, lighting, and accessories.)

Sometimes we think performance is pretty good, but we never know how good performance really could be until we test it or compare it to something better. It's surprising how much stronger HEI system (ignition) is at 14 volts, compared to operating at 11 or 12 volts. And the same is true with the headlights, the strength of electric radiator fans, and other items.

Information in this feature applies to all alternator systems, not just the 10SI and 12SI Delco systems.

The real story STARTS here!

"<u>ONE-WIRE Alternators</u>"

compared to

"THREE-WIRE Alternators"

Just the facts, please…

OPTIONS	THREE-WIRE	ONE-WIRE
Can operate a Warning Light At the dash? (1)	YES	no
Can read "Voltage Sensing" Remote from alternator? (2)	YES	no
Available at nearly all Auto Parts Stores? (3)	YES	no
Less expensive? (4)	YES	no
Least knowledge required for Installation wiring? (5)	no	YES

(1) Even with a VOLT gauge at the dash, it's a good idea to also have an alternator Warning Light. (We can have both.) Warning Lights are easily added at custom dash panels and at dash panels that did not come with an alternator Warning Light. Warning Lights attract attention immediately. With only a gauge at the dash it's easy enough to be in real trouble before an unusual reading is noticed. The best is to use a Warning Light and a gauge.

- ***If the Warning Light comes ON while driving, watch the Water Temp gauge!*** The belt may have tossed or there may be other problems, which have stopped turning the water pump.
- If the ignition is switched ON without the engine running (for service work or for any other reason) the warning light is a good reminder that the ignition is ON.

(2) "Remote Voltage-sensing" is a must for good electrical system performance with most factory-original type wire harness designs. We have explained the Remote Voltage-Sensing function in our Tech Section, where a feature essay is dedicated to this topic. But because knowledge of remote voltage-sensing is important to this comparison, here's a brief explanation.

- The alternator is the source of power used to operate the ignition system, lighting, and other electrical system parts. And the parts will deliver best performance when operating at about 14 volts. The voltage regulator will always attempt to maintain the electrical system voltage at about 14 volts. But the original wire harness will feed power to these parts from a "main junction" in the wiring, which is often far downstream from the alternator. The voltage regulator can maintain 14 volts at the "remote main junction," if we give the regulator opportunity to read "voltage-sensing" from the junction.

- The ONE-WIRE, without REMOTE VOLTAGE-SENSING option, as an "intended up-grade" from a 55Amp externally regulated to a 100Amp ONE-WIRE can result with dim lights, weak ignition, and weak performance in general. (Especially so when a factory-original" type wire harness system is used.) And at M.A.D. we have received many phone calls from people who have experienced the result of such conversions.

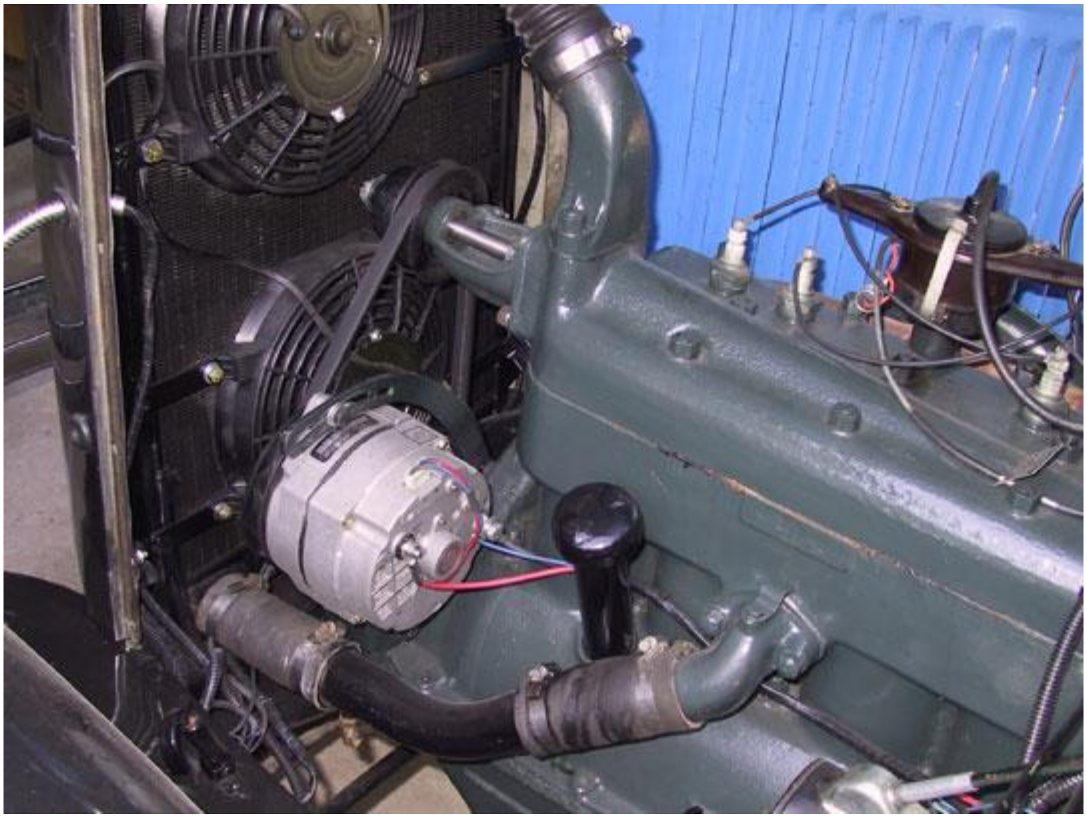
(3) The THREE-WIRE models are the most readily available, because for many years they were factory installed on nearly all makes and models of GM cars and pick-up trucks.

(4) POPULARITY as a replacement service part and also with retrofit up-grades has made the THREE-WIRE 10SI and 12SI models the least expensive alternator/regulator system in the industry.

(5) The ONE-WIRE system was designed and intended for **limited applications**, because not much knowledge is required for installation wiring. This is the only significant advantage of the ONE-WIRE, and ***it is a major advantage that has contributed much enjoyment to the sport of Hot Rodding***. At least, the ONE-WIRE has provided a simple means of charging and maintaining the battery while driving. This is an important area that might have been troublesome for a lot of people, if not for the ONE-WIRE. (And therefore this "tech feature" is in no way an attempt to "bash" the ONE-WIRE alternator system.)

The 12SI Delco alternator is a very good up-grade for many makes and models. We have all seen them used as an up-grade on Chevy and other GM cars. Here's one that has performed very well on a FORD, for many years and lots of miles. At the time of this writing it still serves as a daily driver. Often this alternator has had to work hard, and sometimes for long days. There are four electric radiator fans (all come ON at once), another fan on a transmission oil cooler (foreground), a powerful air conditioning system, a small sound system, electronic ignition, Halogen Headlights on relays, and there are two batteries that must be maintained. It's a stock, DELCO, THREE-WIRE alternator, and was wired using M.A.D.'s part #ALT-1 kit. The system also operates the factory "GEN" warning light at the dash at this '64 FORD.

The FORD (shown in previous photo) is a ’64, which came with a generator, not an alternator. It’s a nice touch to make use of the original Warning Light at the dash, when using a stock dash system. And this GEN light works perfectly with the THREE-WIRE 12SI, wired using M.A.D.’s part # ALT-1 alternator wiring kit. (Shown with Ignition Switch ON, engine stopped.) The THREE-WIRE system will also support the factory “ALT Warning Light” when converting from the externally regulated alternator systems.



For many years the model 10SI and 12SI DELCO alternator has been a favorite for all types of cars, trucks and machinery. Here's a THREE-WIRE 12SI on a '30 Model A FORD, and it still has a Model A engine! (The old Model A generator was not strong enough to support ordinary sealed-beam headlights, the Model A had small light bulbs in a large reflector lamp assembly.) Notice that the old Model A has also been up-graded to electric radiator fans, which save horsepower when cruising (especially when revved up to 45 MPH!) Ha! (The fans are not needed at cruise speed, and it really does save horsepower not to pull a fan on the water pump.)

At the dash of the old Model A, the 15 AMP gauge was removed in favor of a Warning Light, which operates perfectly with the THREE-WIRE model 12SI alternator. (Shown with ignition ON, engine stopped.)

ALTERNATORS

In recent years it seems that the term ONE-WIRE has become a much-used buzzword, and ONE-WIRE is often used by people who do not understand it. Among the GM SI series alternators, there is both the ONE-WIRE type and the THREE-WIRE type. Many people who have called did not know that ***not all* alternators with a built-in voltage regulator are "ONE-WIRE" types**. Many people simply refer to *all* alternators with built-in voltage as ONE-WIRE. (Lumping the THREE-WIRE and the ONE-WIRE, both with built-in voltage regulator, into the same classification; is incorrect and results from lack of being informed.)

With this technical feature we will attempt to discuss, compare, and provide the information needed to decide which system is the best for particular applications. (ONE-WIRE, or THREE-WIRE, both with a built-in voltage regulator.) And we will discuss the advantages and disadvantages of each type when used in different applications.

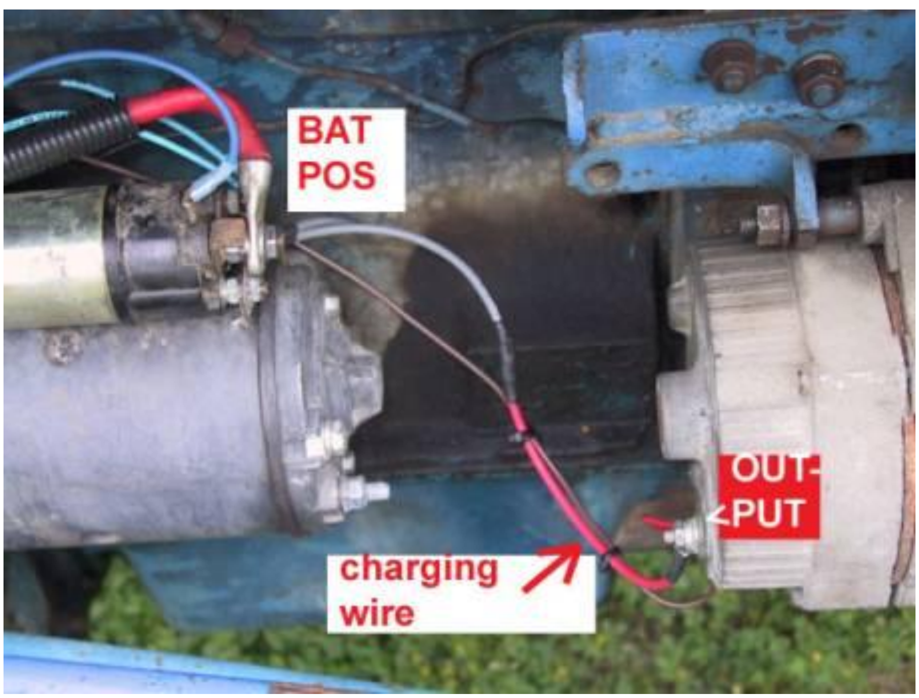
Shown above is the first-generation GM Delco-Remy alternator with built-in voltage regulator. The "ONE-WIRE" alternator shown above only has a heavy gauge wire connected from the output terminal to the battery. The obvious advantage is that not much knowledge is needed to wire it! (The ONE-WIRE alternator shown above is the 10SI model.)

It's logical that Delco-Remy Division of GM would have originally designed the "ONE-WIRE" version of their 10SI alternator. These alternators have been widely used on agricultural and industrial machinery. Considering the number of companies building tractors, forklifts, engines for irrigation pumps, air compressors, and the many other examples of machinery requiring an alternator, it would have been simple to furnish the ONE-WIRE. There's not much to teach about wiring the "ONE-WIRE." And so the "ONE-WIRE" alternator would have avoided a lot of "how-to-wire-it" teaching sessions, which can occur when supplying the THREE-WIRE system. (Trust us, the tech calls can drive a person MAD! And the need for knowledge of proper wiring is why we made the part#ALT-1 kit, which comes with good instructions and all the proper wiring parts.)

If the "ONE-WIRE" would have worked well with the complicated wiring involved for support of all the many accessories on cars, then over the years GM could have saved a fortune in wiring. But GM did not compromise electrical system performance in this area. They did spend more money for engineering and wiring to install the THREE-WIRE alternators, which will deliver best performance. And as we shall see, there really is value to the little extra work required to install the THREE-WIRE system.

The "ONE-WIRE" alternator is best suited for applications that need the alternator only for a battery charger. Okay, so it's a little radical to use an old farm tractor as a model in a site for High Performance cars. Ha! But the tractor example makes a strong point about the ONE-WIRE alternator system.

This tractor is an application that only needs the alternator for battery charging purpose. This simple tractor has **no lights, no electrical accessories, and not even an ignition system** (The engine is a diesel model.)



And the **wire harness** on tractors and most other machinery **is short in length**, with fairly heavy gauge size wire. The ONE-WIRE alternator could satisfy the battery charging needs on this simple old tractor.

It’s important to notice the short-in-length charging wire on the tractor. Significant voltage drop will not occur with the battery charging wire only a few inches in length. And there are no accessories to hook-up downstream from the alternator. The “remote voltage sensing” option available with the THREE-WIRE is not needed with this tractor application.

However… Even the most simple of applications, like **the old tractor, can use the THREE-WIRE type alternator with built-in voltage regulator** (the two wire plug-in plus the “charging wire). Although it must be properly wired, the THREE-WIRE type does work equally well for the tractor application. The added benefit of wiring the tractor for the THREE-WIRE alternator is that replacements will be less expensive and more easily found. (Since the “THREE-WIRE” type was used on many years of all GM cars and trucks, it can be found at about any place where auto parts are sold, and usually for far less money than the special “ONE-WIRE” type.) And a Warning Light on the dash in addition to a gauge will be an option when the THREE-WIRE is installed.

TIPS Notice the debris at the air-intake for cooling, which probably resulted from operating in a dusty, dirty environment. (see arrows) This needs attention, as alternators require adequate cooling. What we should see through those air-intake openings is the rectifier heat sink with aluminum cooling fins. Sometimes plugged air-intake is also a problem when fiberglass hood insulators deteriorate on cars and trucks. That debris will have to be cleaned out of there. The cooling fan at the front of these alternators is an exhaust fan, and it pulls air in through the back of the alternator where the rectifier heat sink is mounted. (That’s why the debris is stuck in the back-of the alternator.)

Cooling is very important to an alternator. Machinery built by man is never 100% efficient. But energy is never lost or destroyed (only converted). Briefly speaking, if an alternator design was only 50% efficient, and 4 horsepower was required to operate the alternator; then we would get 2 horsepower worth of electrical energy from the alternator and 2 horsepower worth of heat energy from the alternator. And of course, as with engines, increasing the output potential will increase the heat output. (Heat is the by-product of efficiency loss.)

When alternator output rating is increased, the cooling capacity of the alternator should also be increased. ***Beware of budget 100 amp alternators built upon the 63 AMP rated, 10SI model case design***, and with only original design rectifiers and fans. The output potential is nearly doubled, and the cooling capacity is reduced since the case will be filled with more windings. And be thankful for good companies like POWERMASTER, who improve the cooling capacity when they increase output potential. (POWERMASTER also gives us the options of both "THREE-WIRE" and "ONE-WIRE" alternators.)

The difference between the ONE-WIRE and THREE-WIRE alternator is the **voltage regulator**. The Delco part # D680 voltage regulator shown above is used in both the 10SI and 12SI THREE-WIRE models. The same model of alternator can be assembled with different types of voltage regulators (for ONE-WIRE or for the THREE-WIRE system). We do have options, and the choice is ours to make.

The voltage regulator for the "ONE-WIRE" alternator is often referred to as "SELF-EXCITING." The "self-exciting" terminology probably comes from the old generator days, when testing the generator output required "exciting" the field winding (which involved powering-up the field winding so that it would make a maximum strength "magnetic field"). And the "self" part of the term comes from the voltage regulator turn ON function without the assistance of a dedicated wire circuit.

How the ONE-WIRE Voltage Regulator Works

The iron core material next to the field winding in the alternator will retain some magnetism after once being magnetized with field winding power-up (during assembly). After the engine has been started, and the alternator is spinning, the existing weak magnetic field from the iron core material will cause the alternator to produce a small amount of current. This small amount of current is used to turn the voltage regulator electronics ON (rather than wiring a special wiring circuit to turn the voltage regulator ON). And of course the faster we spin the alternator, the greater the potential for output. That is why sometimes we have to rev the engine once to kick in the "ONE-WIRE" alternator. (We have to spin the field in the alternator fast enough to make sufficient current to turn ON the "self-exciting" voltage regulator.)

How the THREE-WIRE Voltage Regulator Works

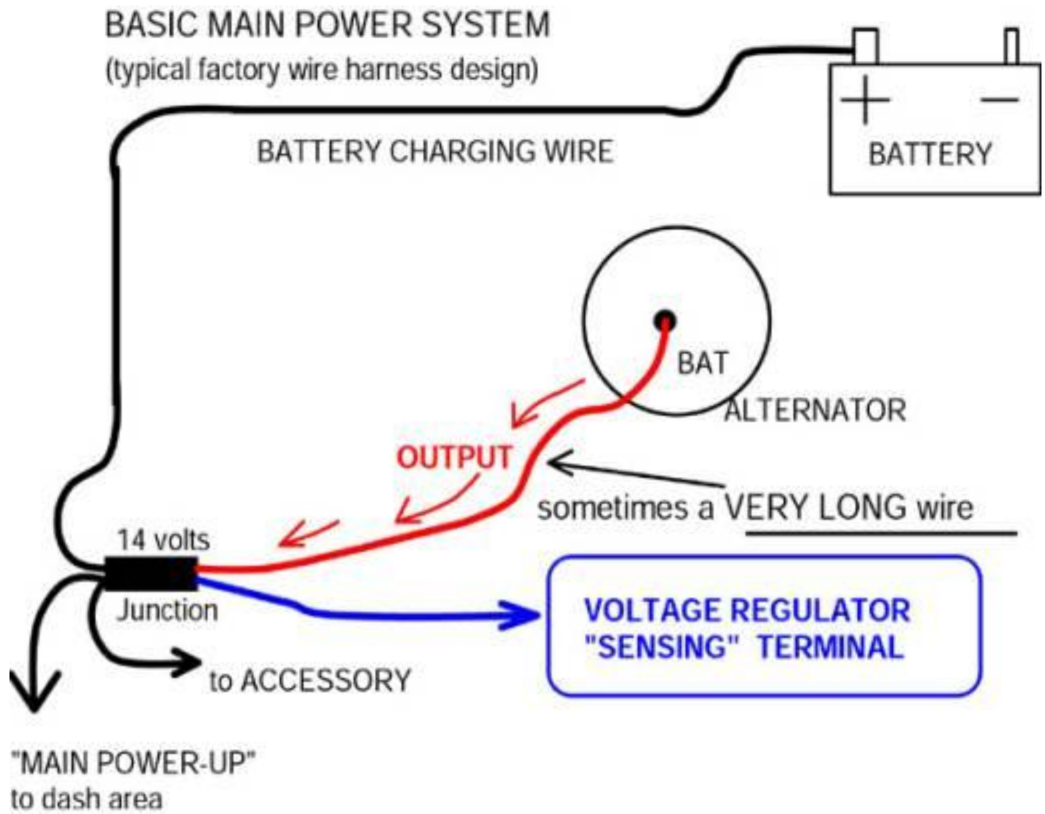
(the Turn ON & Warning Light circuit)

With the "THREE-WIRE" alternator model built for cars and trucks, one of the voltage regulator terminals is wired to an ignition switched OFF/ON source. And the OFF/ON circuit may also be used to operate a warning light at the dash. (The THREE-WIRE type can be wired with or without a warning light at the dash. The warning light is an option–not a requirement.)

REMOTE VOLTAGE SENSING, a THREE-WIRE *advantage*

The other of the two plug-in wires at the SI series alternator is the "voltage-sensing" terminal for the voltage regulator. Through the sensing-wire, the voltage regulator monitors electrical system voltage and makes adjustments to alternator output. The regulator will adjust alternator output as needed to maintain the place where the sensing-wire is routed (at about 14.2 volts). And the sensing-wire can be routed to a place remote from the alternator (downstream).

This "remote voltage-sensing" feature is often a big advantage when running with a factory type wire harness from the Muscle car period (60's and early 70's period cars and trucks). Then the alternator output will be adjusted according to what goes on far downstream from the alternator–at the main power distribution junction, which operates the whole car plus charges the battery!

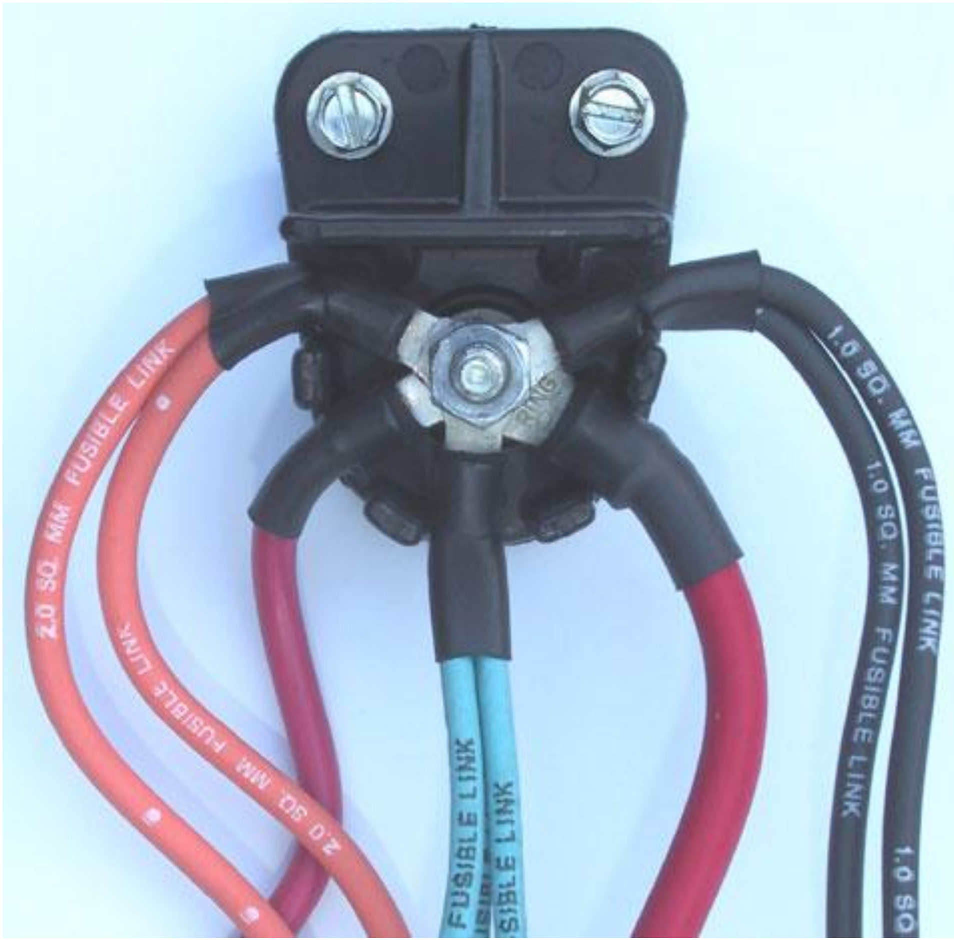


<u>What Happens when the ONE-WIRE cannot do Remote Voltage-Sensing</u>

All voltage regulators for alternator systems will have a "VOLTAGE SENSING" terminal. The voltage regulator for the "ONE-WIRE" system gets the voltage reading from within the alternator, and it will maintain the alternator out-put terminal at about 14.2 volts. Lack of compensation for voltage drop that will occur with a long wire routed to a "MAIN POWER DISTRIBUTION JUNCTION" is the problem with being able to read voltage only at the alternator. In many factory-original wiring systems, ***the entire electrical system will draw power from the main junction***, and the battery will charge from the main junction too. If we have a 2.5 volt drop in the long length of wire between the alternator and the "main junction," and start out at the alternator with 14.2, then we only have 11.7 volts at the main junction. ***Expect dim lights, weak ignition, and slow electric radiator fans with this system being powered by a "ONE-WIRE" alternator.***

Please note that simply disconnecting the original alternator wires, and then installing a heavy cable from the alternator directly to the battery, will only make the alternator effective as a "battery charger." (That happens when running a ONE-WIRE alternator with many factory layouts.) Of course we have to charge the battery, but what about routing power from the alternator to the electrical system? (ignition, lights, and accessories) Power would have to flow from the battery to the junction via the old "charging wire." And often in a factory-original type harness the "charging wire" is even longer than the wire from the alternator to the junction. And so the result of this ONE-WIRE method would be dimmer lights and overall weak electrical system performance; in fact often worse performance than with the original, correctly wired, small alternator that was standard equipment on the old cars.

Okay, all these modern accessories that come with instructions to connect a wire directly to the battery POS, and the instruction to connect a cable from the ONE-WIRE directly to the battery, has resulted with a clutter at the battery area. And thanks to the 100 amp ONE-WIRE alternator (a high rate battery charger indeed), the wires are a corroded, unreliable, mess!



The insulated terminal block, is a sensible method of connecting a few wires together. It has a re-enforced shield above it to shed water, and separators between wires. It's a great little organizer in general. And it will be mounted remote from the battery, where it will stay free of corrosion.

<u>Value of Remote Voltage-Sensing with THREE-WIRE</u>

The well laid-out factory system will have the voltage regulator taking the "VOLTAGE SENSING" sample directly from the "MAIN JUNCTION," through a wire dedicated to this function. And that was true with both the external and the internal voltage regulator systems. And it's the reason that the old external voltage regulator stayed at the driver's side when the alternator got moved to the opposite side, beginning with '69 models (Chevy V-8 engines).

As lighting or any accessories are switched ON, more power is drawn from the main junction, which would lower voltage at the junction. But the voltage regulator will increase alternator output as needed to maintain the 14 volt level at the junction. If we have a 2.5 volt drop in the wire between the alternator and the junction, then the voltage regulator will make the alternator produce 16.5 volts to compensate for the voltage drop with routing of power to the junction.

It's a somewhat "spongy" system, but it does work well and the alternator doesn't know the difference. Expect bright lights, strong ignition, powerful accessories, and a properly charged battery when this system is wired effectively. When running with the factory-original type wire harness, clearly it is an advantage to maintain the "MAIN POWER DISTRIBUTION JUNCTION" at 14 volts.

ELECTRICAL SYSTEM PERFORMANCE

When voltage available to electrical parts drops about 10% below optimum level, the performance of the parts will typically drop by about 30%. If voltage delivered to parts is only a little low, performance can be very weak. (Lights will be dim, electric fans will not move as much air, fuel pumps will be low with fuel pressure delivery, and so on, when these parts operate at low voltage.) ***Most automotive electrical parts are rated at about 14 volts. And the parts will deliver best performance and last the longest when operating at 14 volts.***

A couple of very important considerations

regarding this factory-original type system, which uses a main power distribution junction, and remote voltage sensing.

(1) The system only works properly when the "battery charging wire" connects from the junction to the battery. There will never be a wire connected from the alternator directly to the battery.

By now the thought may have occurred, that a possible installation could include a heavy gauge charging wire from the alternator directly to the battery. And then leave in place the original wire from the alternator to the factory main junction. Route the voltage sensing wire to the junction, in effort to keep the lights and ignition happy. It's true that then voltage regulator would maintain the junction at the 14.2 level. However, the fault in the plan is with the voltage drop that will occur between the alternator and the junction. As was previously discussed, the system will compensate by raising the voltage level at the alternator. The problem would be overcharging the battery through the separate charging wire, as voltage at the back of the alternator could be over 16 volts.

(2) The second important consideration of the typical Muscle Car period factory system is the effect of the long battery charging wire (which routes from the junction to the battery). ***It's a rare occasion when a little resistance in wiring can actually help us, and this is one of those rare occasions.*** A small amount of resistance in the "charging wire" leg of this system will serve as a cushion. The amount of resistance will be much too small to be measured with an ordinary ohmmeter, as accuracy of the ohmmeter will only be good to about a plus or minus 0.2 ohm. But the amount of resistance can be calculated after measuring current flow and voltage drop.

To understand how this "cushion" effect with a small resistance at the charging wire works, we must first have knowledge of how batteries behave when being charged. When recharging a low battery, battery voltage will be low, and current flow (amps) to the battery will be a large amount. As the battery becomes charged, battery voltage increases, and it will accept less charge, so charging current (amps) will decrease. Eventually during charging, battery voltage reaches the level of the voltage setting at the charger, and the battery stops accepting all but a very small amount of current.

(See more about how discharged batteries behave when being charged, in photos and captions, at our "RE-CHARGING LOW BATTERIES" page, in this tech section. And see more about special maintenance battery chargers at our BATTERY CHARGING for MAINTENANCE and STORAGE page in this tech section.)

When working with more than a 60 amp alternator, the actual amount of resistance at the "charging wire," and also the wire from the alternator to the junction, should always calculate to less than 0.1 ohm. The actual amount of resistance will vary with wire length and wire gauge sized used in various models, and the amount of resistance will also change with temperature. (A warm wire conductor will have more resistance than a cool wire conductor.) A new or good condition, factory built harness on a Chevy from the Muscle Car period will have about **0.02 to 0.05 ohm** resistance at the wire from the alternator to the junction, and about the same at the charging wire from the junction to the battery.

RESISTANCE IN THE "CHARGING WIRE" / FULLY CHARGED BATTERY

For our calculations, we will use a 0.05 ohm resistance, which is a middle-of-the-road number, for an average Chevy factory harness. The battery will be charged from the junction in the wire harness, and voltage at the junction will be maintained at 14.2 volts. With the battery in a fully charged condition, it will accept less than 1 amp, from a 14.2 volt source. We will use 1.5 amp for the charge rate, which is a battery approaching fully charged condition. The math formula (from Ohm's Law) can be used to easily calculate the amount of voltage drop that will occur with the small amount of resistance at the "charging wire" between the junction and the battery. The math formula gives us that Voltage (drop) = current flow (amps) X resistance (ohms). With the numbers used for this example, 1.50 amps X 0.05 ohms = 0.075 volt(drop). Rounded off to the nearest $1/100^{th}$ of a volt, that is a 0.08 volt drop. And so, with 14.20 volts at the junction, we have 14.12 volts at the battery, which is fine. (Individual voltage regulator settings will vary more than 0.08 volts.) The small amount of resistance in this wiring system does not have significant effect on charging the battery, when the battery becomes fully charged. Voltage drop is a very small amount, when the current flow is a small amount (through the small amount of resistance at the charging wire).

RESISTANCE IN THE "CHARGING WIRE" / DISCHARGED BATTERY

When charging current is delivered to a discharged battery at a full 14.2 volt level, the battery will accept a large amount of current (amps). And when charging a large capacity battery, if the battery charger or alternator is sufficiently powerful, the amount of current can be a large amount. In that case we can expect the battery to get warm and produce excessive gas (which results with short battery life and a corroded mess at the battery area). The battery charger or alternator will produce a significant amount of heat too, so it will need a good cooling capacity. (With both the battery and the alternator, it's back to that efficiency loss situation where heat is the by-product.

The low battery being charged by the alternator is a situation when the small amount of resistance in the charging wire will help us. Power from the junction will reach the battery at a reduced voltage level; which automatically reduces the charge rate. We could do calculations for this situation, like we did above with demonstration of system performance when the battery is fully charged. However with the discharged battery situation we don't have constants.

Resistance in the charging wire causes voltage drop with current flow to the battery, and the voltage drop reduces current flow. Current flow is also reduced as the battery becomes charged. We begin with a discharged battery that cannot produce full voltage on its own. Then as the battery accepts current it becomes more charged and produces more voltage, and then the battery accepts less current flow. ***In this battery being re-charged situation, the system is not "static," it is a changing and self-adjusting system. The small amount of resistance at the "battery charging wire" makes it is a very gentle and "forgiving system."***

The system is conservative as it helps to prevent battery gassing, battery overheating, and alternator overheating. The small amount of resistance in the "charging wire" does not prevent the battery from reaching a fully charged condition; with a small resistance it will just take a little longer to top off the battery with charge. (And when using a 100 amp alternator, it can be a very good idea to slow down the charging rate!)

And… while all the above is happening, ignition, lighting, and accessories are being powered-up from the main junction, and at a 14 volt level–and 14v regardless of battery condition! (The exact voltage level will be the setting of the voltage regulator, and we assume that the alternator is capable of operating all the accessories plus charge the battery). All aspects, considered the factory layout using a "main junction" and "remote voltage sensing" is an incredibly effective system. Although when the alternator is replaced with a more powerful model, and added accessories draw more power from the system, then the wiring for the system must also be up-graded.

It has never been a good idea to re-charge a low battery with the alternator. But there are those times when we are caught by surprise… It's easy enough to accidentally leave the lights on when far away from home. Or an electric fan run-on function can run the fans longer than the battery can stand. Eventually the time can arise when we need a jump-start, and then we will drive to our destination. And with a high powered alternator in place, these are the times when a system like the factory lay-out with a properly wired THREE-WIRE alternator system could really help us out, by slowing the charge rate. (A low battery should be re-charged with a workshop type charger. The alternator is intended to keep the battery topped off and operate the electrical system.)

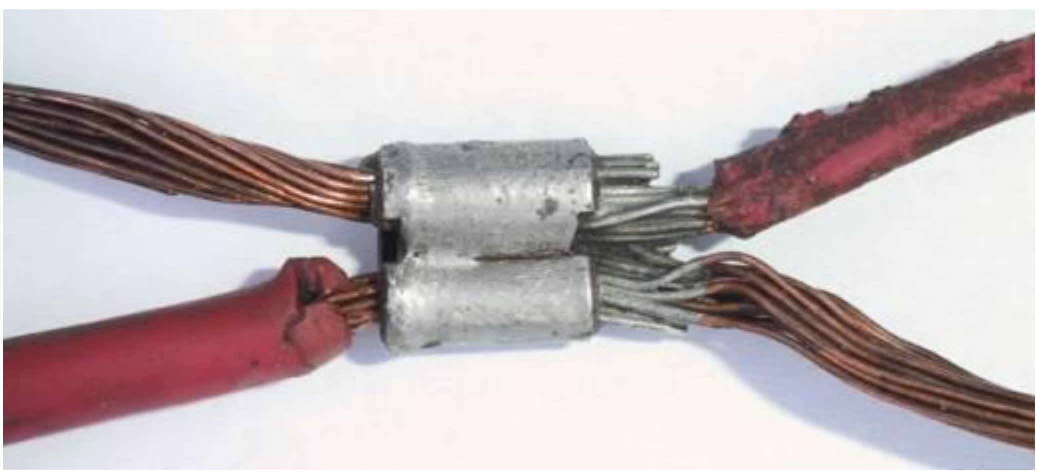
A POSSIBLE PROBLEM with installing a more powerful alternator and using the existing factory wiring is that when those older cars were built, the wire gauge sizes were calibrated for much less powerful alternators than we are using today. And back when those cars were built, we were not operating so many powerful accessories. Nowadays electric radiator fans are a common example of an added accessory that will strain the existing system.

Voltage drop resulting from a small amount of resistance spread out over a long length of wire will behave quite differently than a small amount of resistance at a "bottleneck." With voltage drop, the electrical energy lost is converted to heat. (Again, energy is never lost or destroyed–only converted.) In the case of a short length, under-capacity wire, or in the case of a poor connection, we have resistance at a small area, and this bottleneck effect can result with destruction of the part through "thermal run-away." When we spread the small amount of resistance out over a long length of wire, the voltage drop and heat generated is also spread out over the length of the long wire; and then the heat can be dissipated without overheating the wire. But as with stress limitations of any machinery part, there are limitations with this wiring system too. (A thorough discussion and explanation of “thermal run-away” effect is contained in the “tech is made simple” book, available from M.A.D.

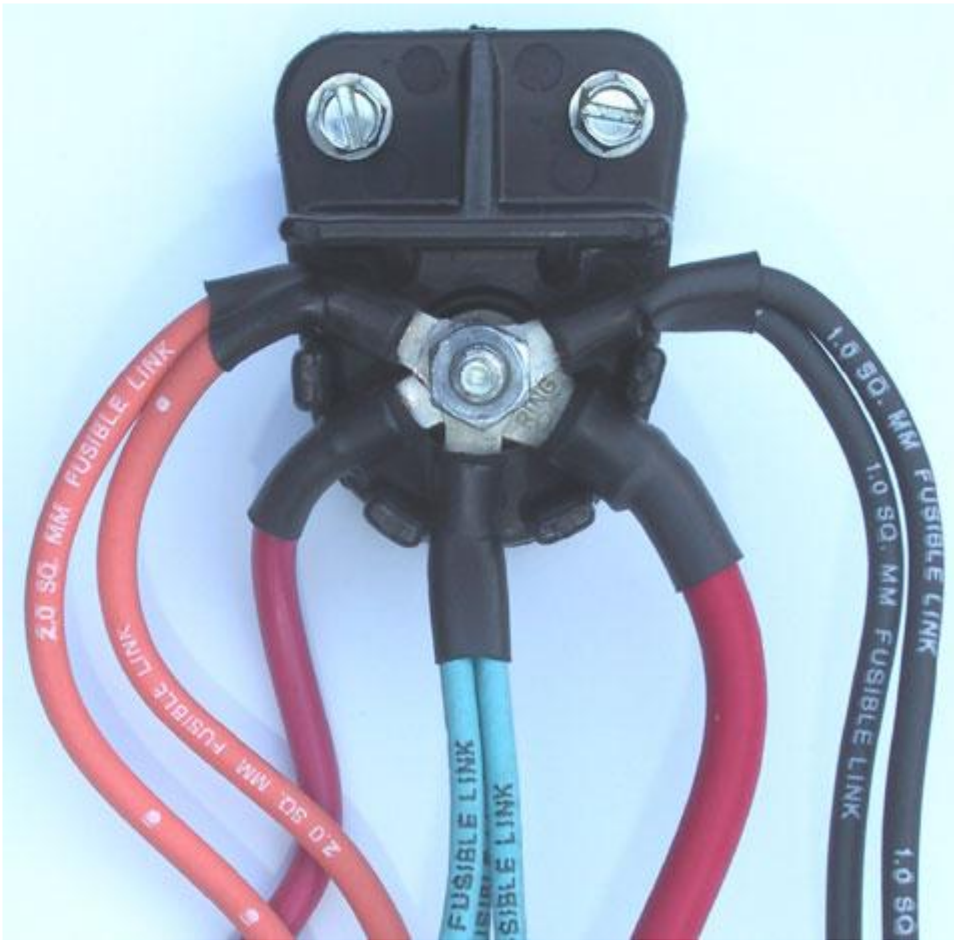
A typical ’65 Chevy was often shipped with only a 37 amp alternator, and the wiring was adequate for that much output. The wire from the output terminal of the alternator was often only 12 gauge, with early alternator systems. The wiring will have to be up-graded on those early cars, when we use more powerful alternators and accessories.

The current capacity of factory systems in various cars from the Muscle Car period will differ considerably. But Chevy is more popular than ever before; we will use Chevy for an example. The ’69 –’71 Chevy with V-8 engine uses a system like the diagram in this feature. The passenger side mounted alternator has a very long wire from the alternator to the main junction. The junction is a “welded splice,” in the loom, at the driver’s side. The wire routing is a very long semi-circle between the alternator and the junction. And the “battery charging wire” is also very long, to get from the junction back to the battery at the passenger side. At least in these years of Chevy cars, the alternator output wire and the battery charging wire are both 10 gauge wires. A 63 amp model 10SI works very well with existing wiring in that system, and the factory built 78 amp 12SI will work well with this system too. But remote voltage sensing from the junction should always be used with up-grades to SI alternators.

When adding electrical accessories with significant current draw, and the SI alternators to this existing Chevy system, it is very important that the accessories are powered from the wiring at the junction–rather than connected directly to the alternator or to the battery. But the factory “welded splice,” hidden in the wire harness is not friendly to work with.



The photo above shows a close-up view of an actual “junction” from a Chevy wire harness. Four red, 10 gauge wires were all connected together, at what we have labeled a “junction” in our system diagram. (The GM engineering department refers to the junction as a “welded splice.” “Buss-bar” would also be correct terminology with this discussion.) This type of junction, hidden in the wire harness, is very reliable, and it was economical to manufacture; but it is not friendly for up-grade work. The “junction” does not lend itself to system modification or adding wires for accessories. The insulated terminal block seen in the photo below is a very friendly to work with “junction,” and it should be used when up-grading this system.



On the "flip side" of our systems comparison, expect that with a 100amp ONE-WIRE alternator, wired directly to the battery, and the same '69-'71 Chevy wiring system, performance of the electrical system parts will be significantly reduced. Wiring from the alternator directly to the battery will charge the battery, but that could be done with a 37 amp alternator too. The performance problem will come from "back-feeding" power through the old charging wire to the junction. Driving with lights and factory accessories switched ON, we can have a 30 to 35 amp current load through that 0.05 ohm resistance at the old charging wire. And then we will have a 1.5 to 1.75 volt drop in the old circuit, which is now feeding power to the junction. This situation would result with the junction delivering power to various parts of the electrical system at only 12.45 to 12.7 volts, which is no better than just running off the battery!

Also, if we ever have the need to recharge a discharged battery while driving, the ONE-WIRE alternator with a heavy cable connected directly to the battery makes for a high rate battery charger system. And as previously discussed, fast charging batteries can be destructive.

IN SUMMARY

We often need more powerful alternators than the old cars came with, because we are often installing items that use more electrical power. But we must do a good job of distributing the electrical power from the alternator to the various parts of the electrical system. And while installing a ONE-WIRE with a heavy cable directly to the battery will keep the battery alive, it does not always do a good job of supporting the electrical system. A powerful ONE-WIRE can also be abusive when re-charging a low battery.

It's obvious that the properly wired THREE-WIRE ALTERNATOR can do a lot more for us than the ONE-WIRE. The comparison is in parallel with thoughts of engine tune-up mechanics. ***There are those*** tune-up mechanics that are perfectly contented to work on slow, no fun or frills, four door models–And never do more than change spark plugs and other parts, and then verify that the engine has no misfires. (Although the engine may still be sluggish, or run a little on the warm side when the spark advance and air-fuel ratio is out of focus.) ***And then other*** tune-up mechanics are most happy when tuning an engine for maximum performance. And they do very well at getting the most from an engine. The distributor spark advance system gets custom re-curved, the carburetor gets custom calibrated, the valves get properly adjusted, and so on. The ONE-WIRE is like the tune-up that keeps the car running, but does not optimize performance. The THREE-WIRE provides the option of getting the best performance from the alternator.

The only disadvantage of the THREE-WIRE alternator compared to the ONE-WIRE alternator is that a little more knowledge will be required to properly wire the THREE-WIRE into a particular system.