USING THE FACTORY "AMP" GAUGE WITH THE "NEW SYSTEM"

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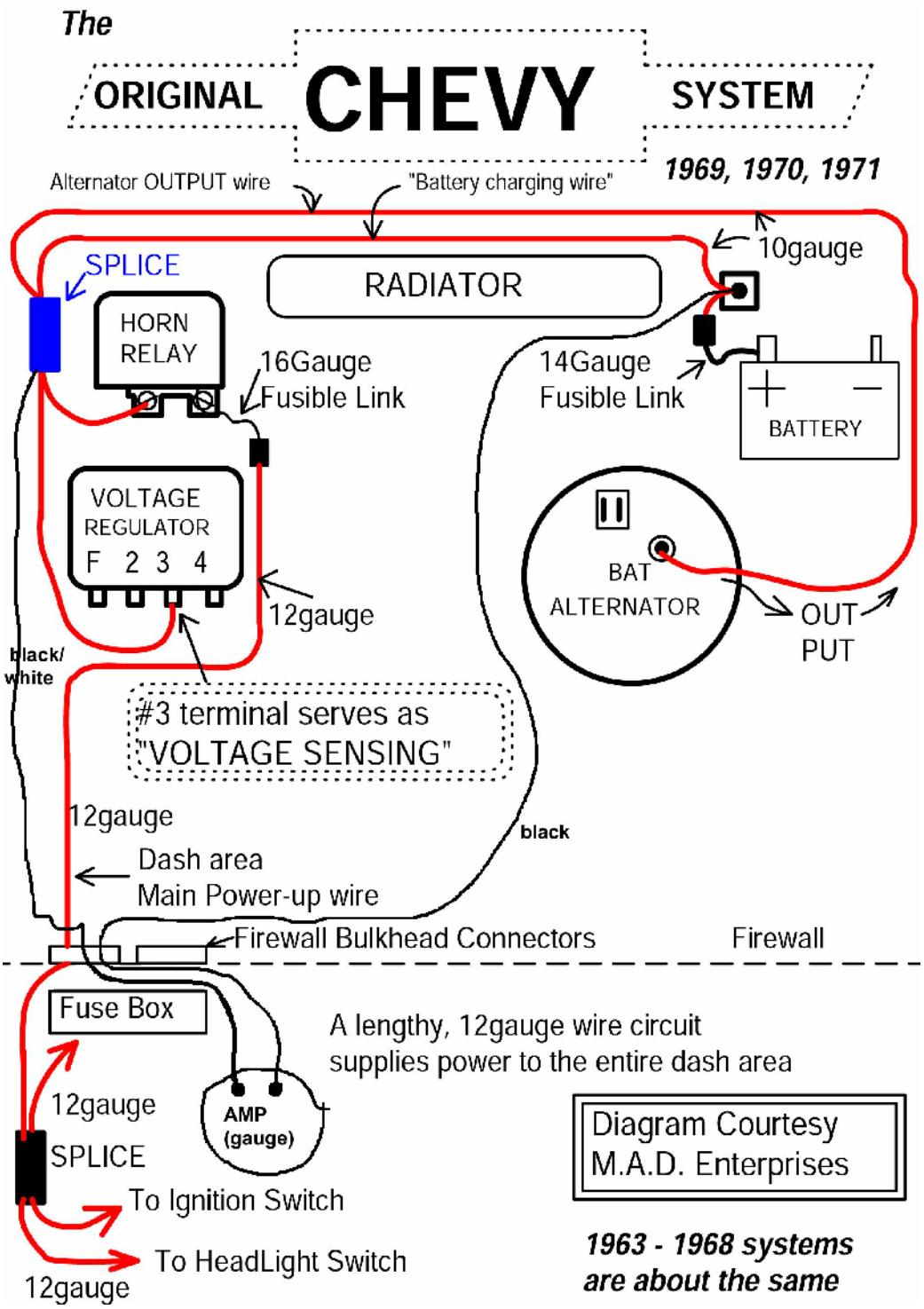
Beginning in '63, with most models of GM cars and trucks, the factory "AMP gauge" at the dash was an "**external-shunt type gauge**." These external-shunt gauges are entirely different than the "full-flow" type gauges, which were used in previous models. Also regarding AMP gauges for dash instruments, nearly all aftermarket amp gauges are the older "full-flow" type. In this discussion, "aftermarket amp gauges" is intended to include those available from AutoMeter, VDO, most Stewart Warner, and also most amp gauges by other companies. (Another major change with the '63 Chevy was the factory-installed alternator—previous years had a "generator.")



Please note that in the diagram of the "original CHEVY system," the color code for the AMP gauge wires are; black with white stripe where the AMP gauge wire connects to the main SPLICE at the driver's side front area, and black without a stripe at the passenger side (battery area). The colors of the AMP gauge wires were the same for all years and models of Chevy using this system. The black/white and also the black AMP gauge wires are about 16gauge size.

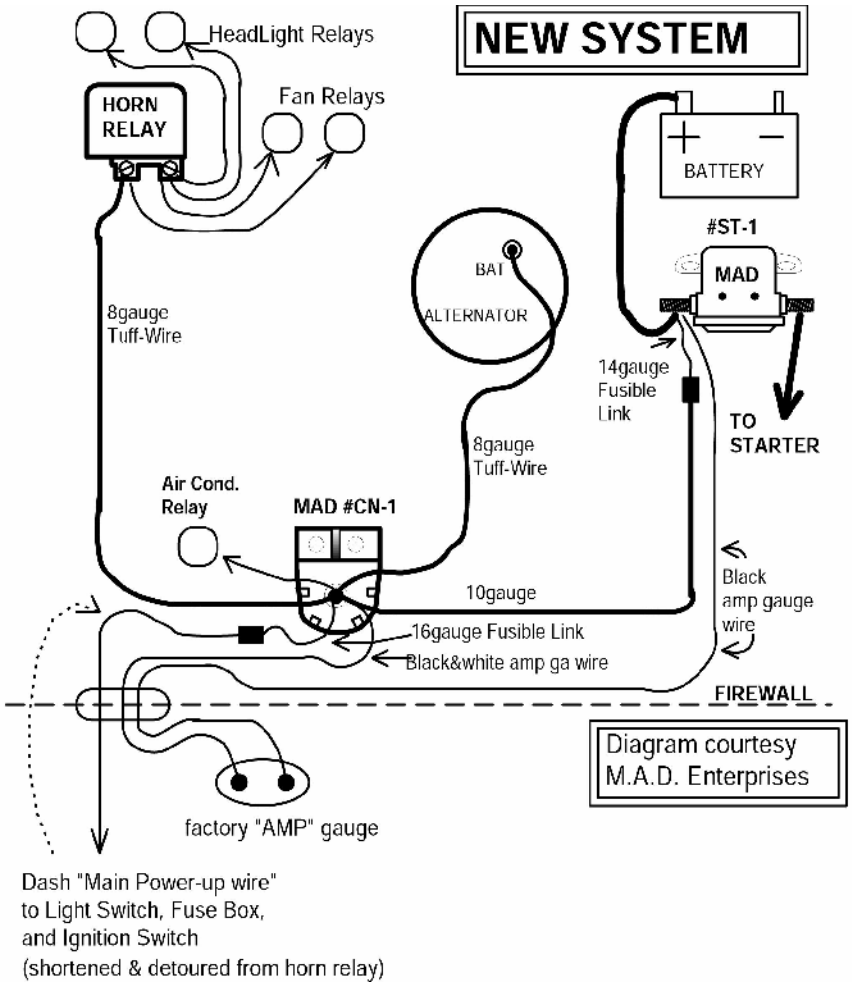
With the factory external-shunt type gauges, only a very small amount of current will flow through the gauge and also through the wires to the gauge. In fact, one way to distinguish these external-shunt type gauges from the full-flow gauges is to look at the diameter of the wires connected to the gauge. The factory external-shunt type gauges have only small diameter wires (typically 16gauge). In the later years of these factory external-shunt amp gauges, the AMP gauge wires plugged into a printed-circuit connector, and then the printed-circuit completed the wiring circuit to the gauge.

The full-flow type of AMP gauge will have thick-in-diameter wires (typically 10gauge) connected to the gauge. Therefore, thick wires connected directly at the back of the AMP gauge will serve as a visual indication that it's an older type "full-flow" amp gauge.

The antiquated "full-flow" type of AMP gauge at the dash had to handle all of the current used to charge the battery. Also, the side of the AMP gauge wiring from the ALTERNATOR (or generator) side of the gauge was typically used for the dash area main power-up circuit. (For a diagram and more information on these systems, please see www.madeletrical.com, go to our **Electrical Tech section**, and open the file titled "By-passing the original full-flow AMP gauges...") ***We DO NOT recommend the old fashioned "full-flow" AMP gauges for use with powerful alternators and modern electrical systems.***

The factory external-shunt type gauges can work perfectly with modern electrical systems and powerful alternators. But the wiring for the alternator, and the under-hood wiring for the "main power distribution" system, and also the "battery charging wire," must all be designed correctly for use with these factory gauges.

It happens that factory external-shunt type AMP gauges can work perfectly with our NEW SYSTEM layout. (Please see the text below this NEW SYSTEM drawing.)



AMP GAUGE FUNCTION & DISPLAY

First of all, the key to understanding the "factory AMP gauge" shown in this diagram is with knowledge of what information a dash installed AMP gauge is intended to display. An AMP gauge at the dash **DOES NOT** measure alternator output; **the AMP gauge at the dash is intended to display the battery charge rate.**

A **discharged battery** will accept a high charge rate; in other words it will accept a large amount of current flow (and the AMP is the measure of current flow). A **fully charged battery** will accept very little current flow (AMPS). Therefore when we first start the engine, especially after the car has been parked for a few days, the AMP gauge should show a high charge rate for a few seconds, and then taper off, and eventually settle down at nearly zero AMPS. A high charge rate for a long period of time would indicate that our battery was significantly discharged.

And so the dash installed AMP gauge should only measure current flow through the "battery charging wire," but not measure the amount of current being consumed by lighting and other accessories. (This AMP gauge display function applies to all AMP gauge at-the-dash systems, not just the factory external shunt type gauge.)

IMPORTANT...

With the "external-shunt-type" factory AMP gauge, nearly all the amount of battery charging current flowed through the 10 gauge battery charging wire under the hood. Only a very small amount of current by-passed this 10 gauge battery charging wire and detoured through the lengthy, small gauge wires, and gauge at the dash. The gauge itself and also the wiring for the gauge is small and fragile; the gauge circuit was not intended to handle heavy current loads. (It's why the GM trucks that used this type of gauge had 4 amp in-line fuses, under the hood, at each leg of the AMP gauge wiring.)

Please notice that in the NEW SYSTEM diagram, the factory AMP gauge is also connected in "parallel" with the 10 gauge battery charging wire —the circuit design is the same with the factory system and the NEW SYSTEM, only with the parts in different locations.

FACTORY AMP GAUGE OPERATION

A very important feature of this "external-shunt-type" factory AMP gauge system is the amount of resistance in the 10 gauge battery charging wire under the hood. The amount of resistance at the 10 gauge charging wire will cause a specific amount of voltage drop across this charging wire, and the amount of voltage drop that occurs will depend upon the amount of current flow through the wire. The function of this gauge relies upon voltage-drop that will occur in this charging wire; and the amount of voltage drop will change with the amount of current flow to through the wire to the battery. This we know from the simple formula that is handed down by Ohm's Law, and formula is written below.

AMPS X OHMS = Voltage (drop) (the Ohm is the unit of measure for resistance)

Consider the amount of voltage drop that would occur with a maximum battery charge rate. Given the typical length of the 10 gauge copper battery charging wire, we can estimate that it will have a resistance of about 0.007 ohm. With a powerful model of battery that had become discharged (accidentally left the lights ON, or other problem); we could expect the battery to accept about 45 amps maximum re-charge rate. (With the voltage being limited to about 14.2 volts by the regulator, the battery would accept about 45 amps.) To calculate the amount of voltage-drop we can plug these resistance and current flow amounts into the simple formula from Ohm's law.

45 AMPS X 0.007 OHMS = 0.315 VOLTS (drop)

Above we calculated the amount of voltage drop that would occur in the length of 10 gauge battery charging wire under the hood (during maximum battery re-charging). The gauge at the dash would recognize this **three-tenths volt-drop** and display the charge rate as 45 amps.

Below, let's take a look at the amount of voltage drop that will occur in the 10 gauge battery charging wire when the battery is fully charged, and will no longer accept a large amount of current when with the voltage regulated to about 14.2 volts.

2 AMPS X 0.007 OHMS = 0.014 VOLTS (drop)

With the battery fully charged, we only see about a **one-hundredth volt drop** in the 10 gauge battery charging wire, and the gauge at the dash will display a barely noticeable battery charging rate in AMPS (The gauge reading may in fact look like zero, as these gauges are not very precise.)

FACTORY AMP GAUGE "CALIBRATION & ACCURACY"

In the discussion of the gauge operation above, we can see that both the amount of current flow (AMPS) and the amount of resistance (OHMS) are factors that change the resulting voltage drop. Obviously, if we change the numbers with either one of these factors, we will change the resulting amount of voltage drop, which in turn will change the display of "AMPS" on the gauge at the dash.

The current flow (AMPS) is the measurement that we attempt to monitor with the gauge at the dash —we want to see the amount current that the battery is absorbing during charging from the on-board alternator system. The other factor in the formula, which is the resistance (OHMS), we can easily adjust by changing the length of the10 gauge battery charging wire used in the system.

To maintain the original calibration of the gauge system, we must fairly closely maintain the length of the 10 gauge battery charging wire. Fortunately, with the NEW SYSTEM layout, the approximate routing shown in our diagram will closely duplicate the original length of the 10 gauge battery charging wire. The mounting placement of the #ST-1 starter solenoid and the #CN-1 terminal block, and the routing of the 10 gauge charging wire, will all affect the length of the battery charging wire.

If we mount the terminal block in the area at the driver's-side of the firewall, and also mount the new #ST-1 starter solenoid near the battery, and follow the routing shown in the diagram, the original length of the 10 gauge charging wire will be approximately preserved.

SOME NOTES ABOUT CHANGING THE CALIBRATION OF THE FACTORY AMP GAUGE...

The 10 gauge AWG battery charging wire will have about 0.0011ohm or resistance **per foot**. (The precise amount will change with temperature, the resistance increases with heat, but this figure is a close measurement with the wire at 70 degrees F. By the time a significant length of the original battery charging wire was warmed-up by radiator heat, the battery would no longer be accepting maximum charge rate, and so the original gauge system probably worked fairly well under most conditions.)

What is important to recognize is that...

If we shorten the length of the 10 gauge battery charging wire, we will reduce the total resistance at the length of the charging wire, which will reduce the resulting amount of voltage drop, which in turn will reduce the amount of current flow displayed by the gauge at the dash.

Or... if we significantly lengthen the 10 gauge battery charging wire we will increase the total amount of resistance at the wire, which will increase the resulting voltage drop at the length of wire, which in turn will cause the gauge at the dash to display a greater amount of AMPS flowing to the battery.

IN SUMMARY

The gauge at the dash will be more sensitive if the 10 gauge battery charging wire is a long length of wire. The gauge at the dash will be less sensitive if the 10 gauge battery charging wire is a shorter (than original) length of wire. If we were pleased with the calibration of the gauge at the dash with the original wiring under the hood, then we should duplicate the length of battery charging wire when installing the NEW SYSTEM layout.

To get the wire length exact we would need to measure the length of the original 10 gauge battery charging wire (take the wire harness apart, and remove the wire, which is a good idea anyway since it will no longer be used).

PLEASE INSTALL IN-LINE FUSES, UNDER THE HOOD, IN BOTH OF THE AMP GAUGE WIRES (5 AMP maximum capacity fuses)

Since only a very small amount of current should ever flow through this fragile AMP gauge circuit, and because an interrupt (open circuit) in the battery charging wire would result with severe overload potential to the gauge circuit, all cars and trucks that will use this system should have small current rated in-line fuses installed under the hood. The fuses that were factory-installed in the trucks were rated at 4 amps, which is about right for this circuit. And ***certainly anyone who is using these factory AMP gauges should install 5amp rated in-line fuses under the hood; and please install fuses at both ends of the circuit***. (Install the in-line fuses at the black/white white at the driver's side front area, and also in the black wire at the passenger side front area.)

Chevy cars, 1967 and newer, that used this type of factory AMP gauge of the "external-shunt-type" design, had 20 gauge Fusible Link wires installed under the hood, at both of the AMP gauge wires. The 20 gauge Fusible Link wires were too strong for the fragile gauge circuits, and a problem with the red 10 gauge battery charging wire under the hood often resulted with damage to the gauge, or damage to the wiring, or in the later years, where "printed circuits" were used for the dash gauges, the printed circuit typically burned before the 20 gauge Fusible Link wires burned-out and disconnected from power. **With all applications that will use this factory-type, external-shunt AMP gauge at the dash, 5 amp in-line fuses should be installed to replace the 20 gauge Fusible Link wires under the hood.**

Not to be a "wise guy," but...

Even when the original AMP gauge at the dash is functioning and calibrated perfectly, the information that we get from the AMP gauge display is still not as useful as what we could see with a VOLT gauge at the dash.

For an interesting comparison of VOLT & AMP gauges see www.autometer.com, look in the FAQ section, "VOLT vs AMP gauges."