ERA EXCHANGE

YOUR GUIDE TO ELECTRICAL REBUILDING

September 2019 $12.95

AUTO ELECTRIC CORNER
Motor-Generators and “L” Terminals

HOW TO REPAIR LOOSE MAGNETS

EAST ORLANDO REMANUFACTURE
Full Service Auto Electric Shop Thrives

COMMON SENSE | Algorithms: From Self Driving Cars to Running Our World

Electrical Rebuilder's ERA FOUNDED 2001 ASSOCIATION

A WORD FROM THE PRESIDENT
The Date Has Been Set!



The ERA Trade Show Committee held our first meeting for next year's show on the evening of August 8. We have settled upon the weekend of Thursday, March 26 thru Sunday, March 29 to hold our 2020 ERA Expo. The committee has contracted with the Holiday Inn Cincinnati Airport at 1717 Airport Exchange Blvd. in Erlanger, Kentucky to provide the venue, which includes a negotiated room price of less than $100.00 per night lodging. That will include a complimentary breakfast each morning of your weekend stay.

Committee members Mike and Michele Schroeder along with Mohammad Samii visited multiple locations in the greater Cincinnati area the weekend before our meeting. They found that this facility can meet our needs without breaking the bank of the association and its membership. Based upon the discussions held at our meeting, this facility is a carbon copy of the one in Dearborn, Michigan that hosted the 2017 ERA Trade Show. The layout of the two hotels is nearly identical.

The ERA's Technical Advisor, Mohammad Samii is already hard at work with setting up the seminar topics and procuring presenters for this upcoming event. The Trade Show Committee is looking into providing some type of fun entertainment activity for the Saturday evening conclusion of the ERA Expo. As always, the Sunday morning Annual ERA Board of Directors Meeting will take place at the facility along with our annual election of officers. By the way, this meeting is open to all members and I encourage more to attend. I want you to see and understand how your dues are being spent. I would like to receive more input from our membership.

With a large percentage of our association's membership on the upper east coast, I am hoping to see a large turnout of new faces and some others who have missed the last few shows that were held further to the west or south. I encourage all members, especially those who have never taken advantage of this great and affordable opportunity, to come out to learn, visit and socialize with your fellow members and peers of our industry. Save the date: March 26 – 29, 2020 in Cincinnati, Ohio.

Ken Plourde

ABOUT THE COVER

Johnson Controls small engine armature.

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CONTENTS

2 A WORD FROM THE PRESIDENT
2 NEW ERA MEMBERS
3 INDUSTRY NEWS
4 AUTO ELECTRIC CORNER — Motor-Generators and "L" Terminals
8 COMMON SENSE — Algorithms: From Self Driving Cars to Running Our World
9 HOW TO REPAIR LOOSE MAGNETS
12 EAST ORLANDO REMANUFACTURE Full Service Auto Electric Shop Thrives
15 CLASSIFIED ADS

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INDUSTRY NEWS
& ANNOUNCEMENTS

2020 ERA Expo – Cincinnati, Ohio

The date for the next ERA Expo in Cincinnati, Ohio is now set. It is March 26-29, 2020. Mark that date on your calendar now.

The host hotel will be the Holiday Inn Cincinnati Airport, which is minutes from the airport in Kentucky and about 30 minutes from downtown Cincinnati. This hotel provides free shuttle service to and from the airport and free breakfast for all guests.

The guest rooms, all seminars and the Expo itself will be held under one roof. ERA Expo 2020 is still early in the planning stages Further details will be forthcoming in the next few months.

If you have any suggestions for seminar topics, please share them with the ERA's Technical Advisor, Mohammad Samii by phone or email. His contact information can be found at the bottom line of his column, Auto Electric Corner, on page 7 of this issue.





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AUTO ELECTRIC CORNER — Motor-Generators and "L" Terminals



BY MOHAMMAD SAMII

Motor-Generators

Most rebuilders first experience with a dual function unit that worked like a starter AND a generator was Delco 110196X and similar series units that were mainly used on small utility and garden tractors such as Cub Cadets and such. There are still some of those around which by now a rebuilding requires a new armature and a set of field coils. However at times they are owned by people who are not inclined to spend the money needed to fix them.

Perhaps the next generation of Motor-Generators (or starter/generators) was the Bosch units which were later replaced by Hitachi GSB-107 series units (*see Figure 1*) used mainly in Harley-Davidson or Club-Car golf carts and such utility vehicles. They have the ability to be reversible, meaning to turn either clockwise or counter-clockwise depending on how the connections are made and the path of the current flow. Some earlier carts did not have a reverse gear in their rudimentary transmission, but their two-stroke engines were able to start and run in reverse if they cranked in that direction, thus the reason for the reversible Motor-Generators…! But they charge only when going forward.



Figure 1 – A typical Motor-Generator, wired for CCW operation.

In their basic design, motor-generators are simply a "Series" motor consisting of an armature and two sets of field coils. Unlike a typical starter motor or generator that is either series or series-parallel with connections fixed, this type of motor-generator has provisions for external connection. So simply by re-arranging the external connections between the field and armature, the direction of current in the motor's field can be changed, causing it to turn in the reverse direction when needed (*see Figure 2*).

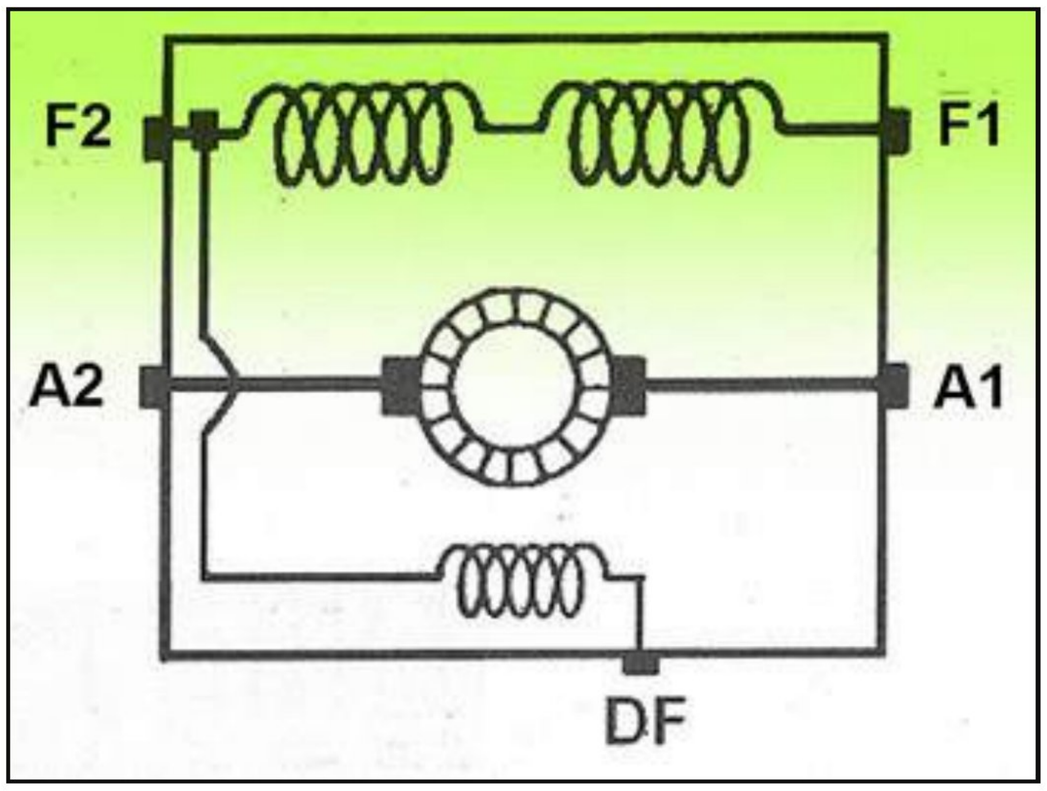


Figure 2 – Coils and armature arrangement of a typical motor-generator.

As you see in our diagram, the two ends of the motor's field coil are marked as **F1** and **F2**, and the armature's ends are **A1** and **A2**. There is also another field coil inside that has much smaller wires and is for the generator field, its post is marked **DF**. Some of the units that come in for rebuilding have their external jumpers in place that determines their rotation. These units only motor and charge in that particular direction that they are already wired for.

As for unit brought in with no wires attached, and you need to test to see if it will motor in both directions, then the procedure is simply to make the connections which are stated below while using our diagram, Figure 2, as a reference:

Motor Testing (One Direction…CW)

1- Connect battery Positive to "**F-2**"
2- Connect Battery Negative to "**A-2**"
3- Use heavy jumper from "**A-1**" to "**F-1**"
4- Apply power

Motor Testing (Opposite Direction…CCW)

1- Connect battery **P**ositive to "**F-2**"
2- Connect battery **N**egative to "**A-1**"
3- Use heavy jumper from "**F-1**" and "**A-2**"
4- Apply power

Generator Testing

1- Connect battery **P**ositive to "**A-1**"
2- Connect battery **N**egative" to "**A-2**"
3- Jumper between "**A-1**" and "**F-1**"
4- Connect "**DF**" to "**A-2**" (Full-fielded A-Circuit), Motor the generator, note the direction of rotation.
5- Using "**DF**", run it as an "**A-circuit**" generator in the direction determined above.

A note about checking for *"Generator"* function: make sure the unit has gained sufficient speed before applying power to the terminals as they draw very

heavily before gaining enough speed to charge.

Interesting to know that the above instructions came in part from *"tech corner"*, a back-page column of an Ace Electric monthly yellow flyer named "The Bullets" that were published from the late 70's on through most of the 80's! That was when the company had been purchased by Echlin who later acquired Mega. On the back page of this flyer dated December of 1988, they listed their combined (Ace-Mega) distribution centers. I counted 32 locations across the country. Ahh yes…the Good ol' days…!

The market for the Motor-Generator has expanded within the last 10 or 15 years and many other brands are now showing up for repair or replacements. It is not unusual to see them made by companies such as Advance Motors & Drives, Valeo, Mando, Iskra/Mahle, and also some private label manufacturers (*see Figure 3*), where servicing them (rebuild or replace) can provide a good sale.

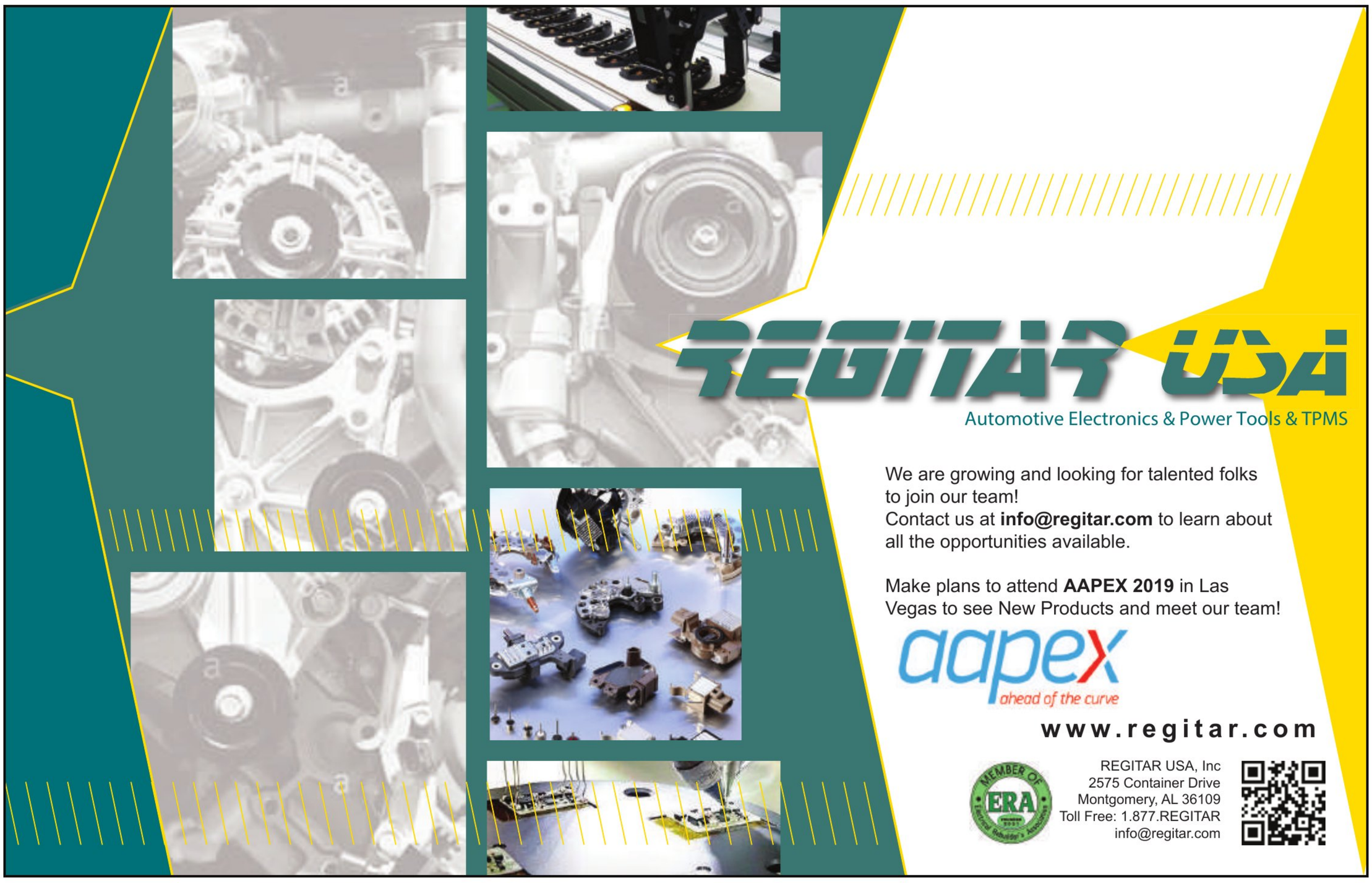


Figure 3 – A more expensive unit by Advanced Motor & Drives for a Club Car application.

"L" terminal discussion

In response to a past column regarding similar Honda alternators with different regulator plug codes for the Honda Odyssey with or without VCM (July 2019), a question arose that I decided to explain it in this column for more members to see, rather than only on the website's Forums where fewer members will get to read it.

After reading that column, our good friend and fellow ERA member Blair Rosson (Automotive Supplies Group NZ Ltd. New Zealand) asked about an issue with 104210-3290 alternator, Lester 13980 (*see Figure 4*). He stated that using an aftermarket regulator causes the warning light to stay on while the charging rate and voltage remains normal. The vehicle in question was a Honda Torneo which does not exist in US, but is similar to an Accord. Such vehicles made for Asian/Pacific market, will have some differences. This one used a regulator with a 296 plug code (*see Figure 5*). How different these are compared to ones made for US market is anyone's guess.



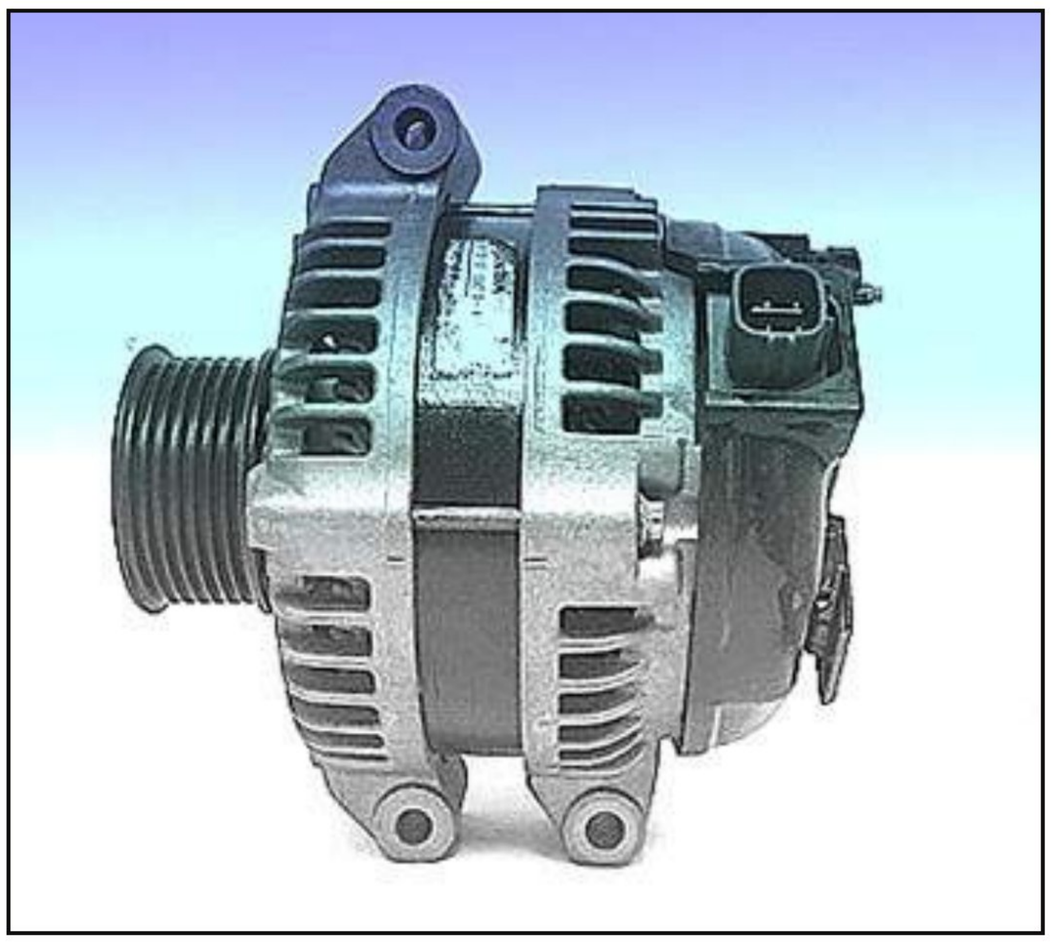


Figure 4 – 13980, a popular Honda alternator.

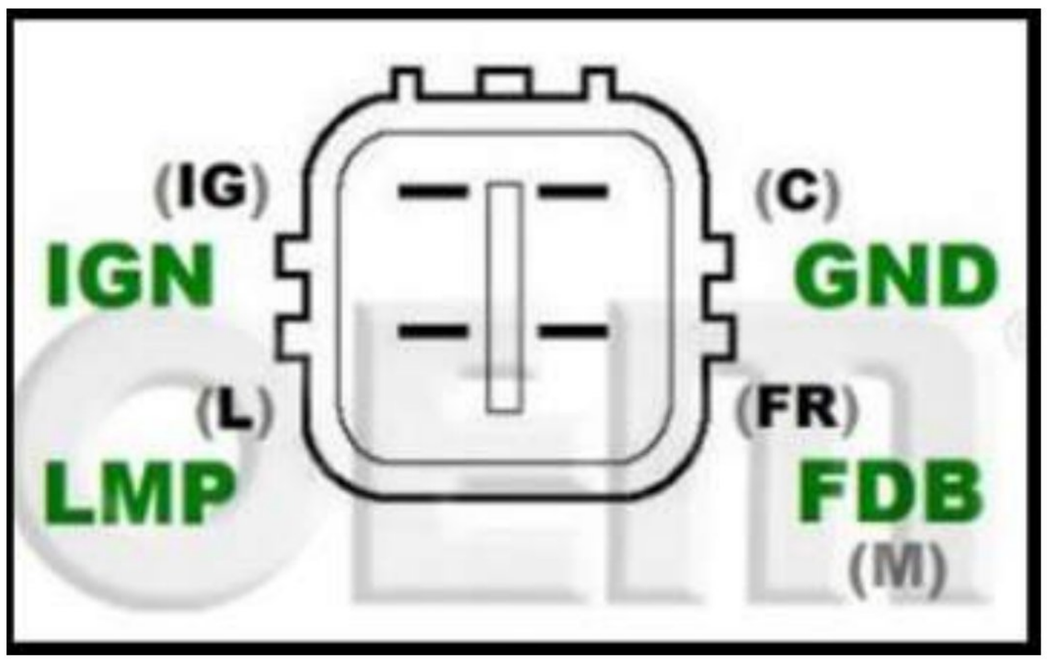


Figure 5 – Plug Code 296 (picture courtesy of Apptrak and the ERA website).

Since we do not have specific information about the vehicle in question, there is no way to know what exactly the culprit is, but I share with you what differences I have seen between the aftermarket and OE regulators and how it relates to warning light operation.

In simpler times, an alternator warning light worked on a sort of *Voltage Equalization* principle. Meaning the ignition switch fed a +B through the warning light to the "L" terminal of the alternator. Initially this voltage would be pulled down by the regulator (thus turning on the warning light), then as soon as the alternator started charging properly, the "L" terminal voltage would go high, equalize with the input to the light, and the light would turn off due to equal voltage at the both end of its filament.

The same principle still applies on the later style regulators, but in a different way. It must be noted that there is no longer any direct connection (hard wire) between the "L" terminal of newer alternators and the warning light on the cluster - their relationship is indirect. In these newer indirect systems, the PCM/ECM applies a voltage, usually a 5V reference voltage with key on, up to the regulator's "L" terminal. This voltage is pulled down initially, but when the alternator start charging, this voltage bounces back to the level (5V) that it had received. PCM looks at this *dip and bounce,* and considers it as normal operation. It may also be programmed to look at the system voltage to see if it is within the expected normal range, and perhaps confirm the FR signal as a sort of verification that the regulator is switching. If all of these fall within the range that PCM is programmed to see, then an appropriate signal is put on the vehicle communication data bus that the alternator is operating normally, and the message is conveyed to all of the modules in the vehicle (*see Figure 6*).

Once the instrument cluster sees and decodes the message, it will turn the warning light off. So as I mentioned before, there is no direct connection between the regulator and the light on the dash.



Now comes the question of the compatibility and the signal being in the proper range. We have seen some aftermarket regulators that were used for the old style warning lights were offered and used in application that the lights were PCM driven. Meaning once the alternator started charging, the "L" terminal voltage would go up to near charging voltage (14V). For a PCM that is programmed to see a 5V (or10V, as in 2000-2005 GM trucks of pre-RVC days) at the "L" terminal, this anomaly can be considered as a *fault*. PCM might ignore it a few times but the cumulative count goes up and when certain numbers are reached, it turns it into a hard fault code, and then PCM turns the warning light on.

I have measured, documented and captured this on some regulators, but I have not have done the same with the above 13980 alternator and have not made any comparison between its OE regulator and aftermarket versions as the process is very labor intensive. But I can tell you with a reasonable amount of certainty that the issue almost always lies on the "L" terminal characteristics and mainly the "L" terminal's impedance.

Sometimes a warning light issue can be addressed with a new PCM program or *reflash*. There were certain Toyota's a few years back that check engine light (or MIL…malfunction indicator light) would come on, indicating out of range O2 sensors. Changing the sensors would not cure the problem, but the company (Toyota) issued new updated programs that once installed, would turn the MIL off. It basically made the proverbial *window* a little larger to allow a slightly bigger signal to pass through without any difficulty. Same has happened on other vehicles (some Fords come to mind) with light-staying-on problems that a reflash took care of it. But reflash is not a cure-all thing, first it must be published by the manufacturer as they deem necessary. And second, one must have an alternator with electronics that generate signals within the acceptable range.

As for our friend Blair's problem, since we really do not know what sort of vehicle he has and whether access to a new OE updated program is available to him or not, it is very hard to say how the problem can be addressed. Best is if another such vehicle could be found, some measurements taken between vehicles equipped with OE and aftermarket regulator to detect any differences. Of course, access to an identical vehicle in New Zealand's market maybe something easier said than done.

Well, that's all for this issue. Until I see you again, keep up the good work.

You can contact Mohammad Samii by phone by calling the ERA Tech Help Line at 636-584-8324 or by email at: sammyselectric@sbcglobal.net.

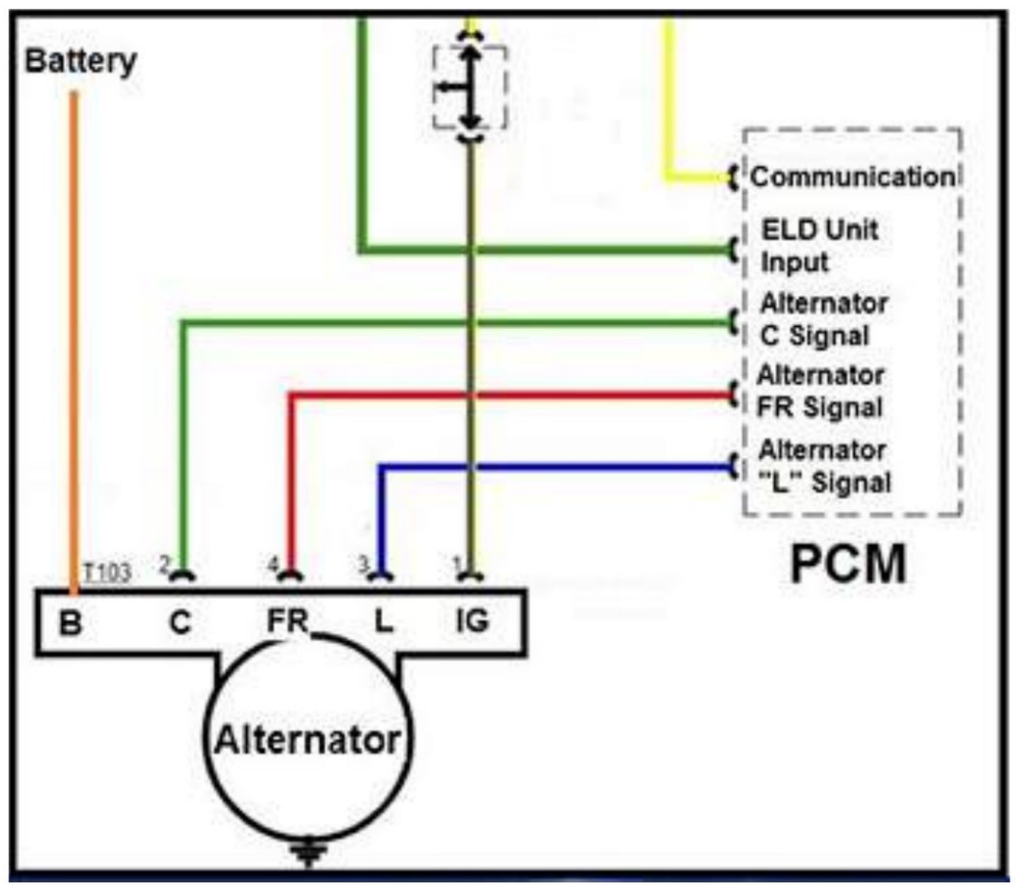


Figure 6 – A typical Honda charging system schematic (Partial).

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COMMON SENSE — Algorithms: From Self Driving Cars to Running Our World



BY BOB THOMAS

About 50 years ago, I took a college course titled *Cybernetics and Society*. It was a five-hour elective offered to help students improve a low grade point average, or to put it more bluntly, keep them from flunking out.

The subject matter was about where computers were being used in the then current world and how they might be used in the future. To insure all students had a chance to get an A, extra credit projects were offered by the instructor.

One such project was to write an essay on how computers might be used in the future. I have always been intrigued by how things worked, specifically anything mechanical. So naturally, I used what I already knew about cars to get extra credit points.

My essay was a proposal that computers would someday drive cars on our highways. I proposed that photoelectric cells would be used to keep the vehicle in the middle of a dedicated lane for automated use. The driver would activate a computer operated throttle control system to maintain the legal speed. I envisioned that radar would supplement that by monitoring for obstacles and maintaining a safe distance from vehicles ahead. The technology was there to do this, even then.

Of course the cost to build a dedicated lane would have been horrendous, as would the cost to modify a vehicle to use it. But those details were immaterial for the purposes of the essay. It brought praise from the instructor and I got the A. Sometimes we just get lucky.

The idea of using computers to drive cars faded away over the decades until Google began to experiment with self-driving cars. A publicity stunt, I thought at then But now it seems we are on the cusp of them being common place.

What caused me to recall my essay recently was an article by Andrew Smith that was printed in *The Guardian* about algorithms. I had heard the word, but did not know precisely what they were.

An algorithm is what some might consider a simple computer program that can learn, based on the results of all previous calculations. The algorithms that are being used today by Amazon, Facebook and such are evolving as you read these words. They were and still are being created as simple computer programs with a set of rules to follow as they methodically figure things out.

They operate by making trial and error decisions the same way that humans learn from birth. However an algorithm can recall the results of every single one of its previous decisions, billions of them, at the speed of light. In other words, algorithms learn from their own experience. And they do that much faster, and with more precision than we ever could. They even create new algorithms to increase their own speed and accuracy.

Algorithms are how Google and Amazon know what you are looking for online, even when you yourself are not so sure. The more that you use them the better they get to know you. That can be helpful if you are looking for a product that you found two years ago, but cannot remember where. But it is not too difficult to imagination scenarios where all of that accumulated knowledge could be used in ways that might not be for your benefit.

Smith's article titled Consequences of Unpredictable Code, begins with a detailed description of the immediate events leading up to an accident by a self-driving driving car in March of 2018. The incident illustrates not only the speed and power of algorithms, but also the failings of those who create and use them.

He wrote, *"That night, a new moon added almost no light to a poorly lit four-lane road in Tempe, Arizona, as a specially adapted Uber Volvo XC90 detected an object ahead. The SUV had been driving autonomously, with no input from its human backup driver, for 19 minutes. An array of radar and light-emitting lidar sensors allowed onboard algorithms to calculate that, given their host vehicle's steady speed of 43mph, the object was six seconds away – assuming it remained stationary. But objects in roads seldom remain stationary, so more algorithms crawled a database of recognizable mechanical and biological entities, searching for a fit from which this one's likely behavior could be inferred.*

"At first the computer drew a blank; seconds later, it decided it was dealing with another car, expecting it to drive away and require no special action. Only at the last second was a clear identification found – a woman with a bike, shopping bags hanging confusingly from handlebars, doubtless assuming the Volvo would route around her as any ordinary vehicle would. Barred from taking evasive action on its own, the computer abruptly handed control back to its human master, but the master wasn't paying attention."

A woman on a bicycle was killed that night by an algorithm driving a Volvo and an inattentive human backup driver. The algorithm's creators place blame for the death on the victim and the backup driver. It is undeniable that humans make mistakes. They argue that their algorithm was only following a set of rules.

But in reality, the author explains, some algorithms are changing their own rules, or to put it more bluntly, they are no longer under the control of their human creators. While they may be becoming more accurate and faster in their decision making as they evolve, they are also becoming unpredictable.

For example, nearly all of Wall Street trading is being done today by algorithms – not just the record keeping, but the actual trading stocks and bonds. The wild fluctuations in markets over the last few years are attributed to algorithms baiting the others into making mistakes as each firm's algorithm is trying to outwit the others. While their creators can go in and make some changes to code, they no longer control them. The full article can be found online at *The Guardian's* website.

If you use Facebook or shop online, it is well worth your reading.

You can reach Bob Thomas by email at: ere.bobt@gmail.com, or by phone at: 904-673-7301.

HOW TO REPAIR LOOSE MAGNETS



BY BOB THOMAS

Over the years I have been asked a number of times about the best way to re-attach a loose permanent magnet in a starter or DC motor. While this is not a common every-day problem, it does happen, and when the magnet is undamaged, it can most certainly be glued back into place.

However there are several mistakes that can be made if you let yourself get in too much of a hurry. To help you avoid those pit falls, I'll try to present the procedure in a step by step format.

1 – First, you must appraise the condition of the loose magnet and the field case. If more than one magnet has come loose, make sure that you know where they both go. If a magnet is broken a repair should not be attempted. The face of each magnet is either a north or south pole. If you try to glue pieces back together they will repel one another, making it nearly impossible to hold them together tight enough and long enough for the glue to cure.

2 – Clean the old glue out of the case and off the magnet if any is stuck to it. This is essential for two reasons. A clean surface insures a good bond. And adding more glue over the old will decrease the airgap and may cause the armature to rub. You only get one chance to glue it back together. From experience, the glue usually comes loose from the magnet, so most of the removal will be in the case. I used a small wire wheel on a die grinder on this project (*see Figure 1*).



Figure 1 – Small wire wheel cleaning case.

3 – Once you are satisfied that the old glue has been removed, clean the surfaces to remove any leftover oils or residue. A little bit of carburetor or brake cleaner will do that nicely (*see Figure 2*). Then dry it off with a clean cloth or paper towel. You are ready for the glue (*see Figure 3*).

4 – Before you mix your epoxy, make sure that you have a plan to hold the magnet tightly in place while the glue dries. Experiment with it first to get it adjusted properly.

5 – Choose a glue that will bond well to steel and that has the right consistency when mixed. By consistency I mean not too thick when mixed. You want the glue to be thin enough that it does not take up too much space behind the magnet. I



HOW TO REPAIR LOOSE MAGNETS



Figure 2 – Carburetor cleaner to remove glue residue.

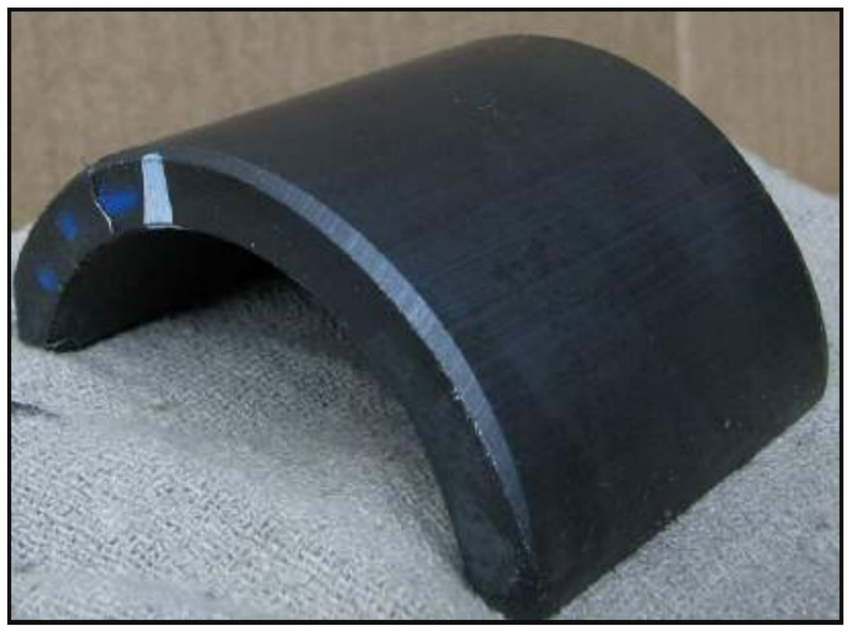


Figure 3 – Magnet must be super clean.

have found that Loctite's Marine Epoxy (*see Figure 4*) works extremely well for this application. It mixes thin and has a working time that is long enough for you to take your time in positioning the magnet. Yet it is fully cured in just two hours.

6 – After mixing thoroughly, apply a thin coat to the back side of the magnet only (*see Figure 5*). Then carefully position the magnet in the case and apply pressure with your hand to squeeze out any excess glue. If you find that you have applied



Figure 4 – Loctite Marine Epoxy – my personal favorite.



too much, this is your last chance to wipe it clean. The magnet must be centered properly to align exactly opposite of the adjacent magnet or magnets (if there are more than two).

7 – Use a small piece of wood between the magnet and the clamp to prevent accidentally applying too much pressure which can easily crack a ceramic magnet (*see Figure 6*).

8 – After it has had ample time to cure, you can remove the clamp and re-assemble the starter (*see Figure 7*).



Figure 5 – Place a thin coat of glue on the magnet only.



Figure 6 – Position the magnet carefully and clamp it.



Figure 7 – Finished Briggs & Stratton starter.



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EAST ORLANDO REMANUFACTURE
Full Service Auto Electric Shop Thrives



BY BOB THOMAS

On the eastern edge of Orlando, Florida just outside the city limits proper and far away from the attractions that bring so many tourists to the city, there sits a family owned and operated automotive electrical shop that is thriving in a business that many believe has already seen its "better days". But don't tell that to the owner, Dario Aguilar. He is a firm believer that better days are still ahead.

His story began when his family immigrated to the United States from Ecuador in 1996 to settle in New York. He was 15-years-old at the time and was thrust into high school where he quickly learned to speak English out of necessity. His uncle co-owned an auto electrical remanufacturing business in Brooklyn and offered his nephew a part time job after school. Aguilar was eager to learn and soon discovered that he enjoyed the challenges and satisfaction that comes from rebuilding alternators and starters.

When is uncle decided to retire and move to Florida in 2000 due health concerns, he sold his nephew the business. So at the age of 19, just out of high school, Aguilar found himself the proud owner of his own auto electric business. But just one year later, tragedy struck when a parts cleaner caught fire and the building and business was burned to the ground.

"We lost everything," Aguilar recounted. "There was insurance, but I discovered too late that it only covered the building, which my uncle still owned. Everything that I owned was gone overnight." It was a hard life lesson and a major setback for such a young man.

His father had been earning a living driving trucks and suggested that his son should try that for a while at least, to see if he liked it. "I drove trucks like my father from 2003 to 2010," he said. "The money was good but being on the road most of time, I just missed being home." During that time, his family and his home had moved to the Orlando area near where is uncle had settled.

Driving trucks gave Aguilar plenty of time to think. He thought about how much he loved working on alternators and starters. He thought about the success that he had for that one year in Brooklyn. He also thought about owning his own business again.

"In 2011 I started East Orlando Remanufacture in 1,200 square feet of space that I rented in a building that was shared with an auto repair shop," he explained. "We moved to our current location and larger building five years ago."

The shop is well organized, neat and spotlessly clean (*see Figure 1*). "My mom is responsible for that," he confessed. "She manages our office and keeps everything well organized and clean." His mom, Mary Aguilar just smiled when he said that.

"Most of our customers are in the general auto repair business. We try to stock enough finished inventory to quickly deliver whatever they need. We deliver to all of our commercial customers within a 10 to 15 mile radius." Their delivery vehicle advertises the business as it travels through the densely populated Greater Orlando area. (*see Figure 2*)



Figure 1 – The front counter of EOR greets customers through an open bay door, thanks to central Florida's year round mild weather.



Figure 2 – Their delivery car advertises the business while delivering units to commercial customers.

He recently had his own boxes printed in color to further enhance the professional look of their finished products (*see Figure 3*). A bar code label using his own unit numbers is applied to each box when the unit goes in. "We used to invoice by Lester number but everyone Googles part numbers today. If you search the web by a Lester number you will find many choices and it's likely you'll find lower prices somewhere, which will cause the customer to feel like they paid too much. To limit that, all of our invoices today use only our own part numbers."

"We buy some units," he said, "but we try to remanufacture as many as we can." There are four work stations in the rebuilding area (*see Figure 4*). A large core inventory can be called upon when the unit the customer needs is not on the shelf.

"We try to focus hard on providing good customer service. In addition to on car electrical, we also work on AC systems." Their service bay is in the rear of the building, right next to the rebuilding shop. There is a customer waiting area near the front counter.

Following the ERA Show in Montgomery, Aguilar set up a relationship with International Winding and now works on DC

motors of all sizes too. "We try to fill the needs of our customers, no matter what they may be."

The EOR employees are cross trained to work different jobs as needed. They include his son Derek, his brother Eric and his mom Mary Aguilar. Joseph Guerrero and José Cheng round out the team (*see Figure 5*). Everyone is bi-lingual which is important in an area with a large population that only speaks one language.



Figure 3 – Personalized custom boxes give EOR's alternators and starters a professional look.



Figure 4 – One of four work stations in the rebuilding area.



Figure 5 – The EOR Team (left to right): Dario Aguilar, Mary Aguilar, Joseph Guerrero, José Cheng, Derek Aguilar and Eric Aguilar.

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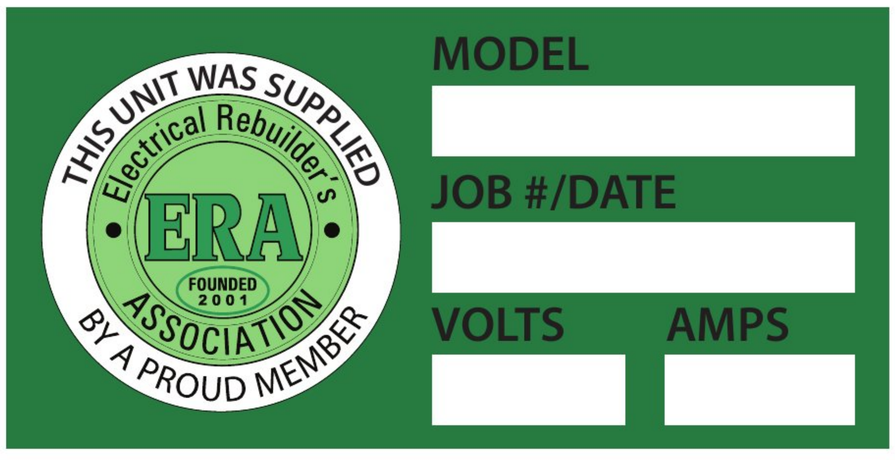
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