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AUTO ELECTRIC CORNER

Denso Alternator, Auxiliary Relay, Generator Regulator Swap, Damaged Starter

An Introduction to 48V Starter Generators

Electrical Rebuilder's ERA FOUNDED 2001 ASSOCIATION

A WORD FROM THE EXECUTIVE DIRECTOR
Almost Showtime!



By the time most of you read this magazine the 2024 ERA Tradeshow in St Louis, MO will only be weeks away. Thanks to a good many of you for registering early to come to the show, I know this takes your time away from your shop and it costs a lot of money to make the trip and to register for the show. If you're still "on the fence" about coming we will still take your registration!

This event means many different things to all you attendees. To suppliers, it's their opportunity to showcase their new products to all rebuilders and to put a face to the voice on the other end of the phone when you are placing your orders. This year we will have the largest number of new supplier exhibitors we have had in quite a number of years, without giving up their identity some of them sell equipment and some are parts suppliers. We are sure to enjoy meeting them and learning about their products!

If you are a "new to the business" rebuilder, I promise you will go home with your head swimming from all that you will have learned at the seminars and exhibits and all the new contacts you will have made, all of which will make your life easier in your business back home.

For us "seasoned veteran rebuilders" it is more of a "family reunion" getting to see each other that we only do once a year at this show. Those of us attending still enjoy attending all the events, we still like to learn new techniques and see new products and equipment.

As for Michele and me, it is the "Grand Finale", the culmination of another year of hard work putting together what we strive to be another "over the top" tradeshow. We can only hope that we have incorporated "something for everyone" in the show schedule!

In closing, I would like to share a few phrases in case I would not be able to express them to each of you personally at the show! **Hello! How have you been? It's great to see you again! I'm pleased to meet you! How is business? I hope you enjoy the event! Thank you for coming! I hope to see you next year at the show! If I can help you in any way just call me! Be safe! Stay healthy! God Bless!**

Mike Schroeder

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ABOUT THE COVER

Burned Rectifier Diode
Photo Credit: Mohammad Samii

ERA EXCHANGE

Volume 41 Number 4

March 2024

Published monthly by the
Electrical Rebuilder's Association
PO Box 906
Union, MO 63084
Phone 636-584-7400
office@electricalrebuilders.org

EDITORIAL ASSISTANT / Bob Thomas

DESIGN & PRODUCTION / Stephanie Schroeder

CONTRIBUTING WRITERS / Mike Schroeder, Mohammad Samii, Ryder Keller

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8:00 AM	Load buses and depart to St. Louis Arch Tour
9:00 AM	Arrive at Arch & begin tour
12:00 PM	Load buses and depart back to hotel
12:30 PM	Buffet Luncheon
2:00-3:30 PM	***Rebuilding and Testing Newer Units*** with Mohammad Samii, ERA Tech Advisor
3:45-5:30 PM	***Latest Info in Battery Technology*** with Dan DenBleyker of Deka Battery

Friday, April 5

8:00 AM -8:45 AM	ERA annual meeting
9:00-11:30 AM	Show Expo
11:30-12:30 PM	Buffet Luncheon; Kenny Wallace Guest Speaker
12:30-1:00 PM	Autographs, Meet & Greet with Kenny Wallace
1:00-6:00 PM	Show Expo

Saturday, April 6

8:30-10:00 AM	***Late Model Unit and Regulator Testing*** with Mohammad Samii, ERA Tech Advisor
10:15-12:00 PM	***Determining Part and Unit Failures*** with Larry Hagemeister of Hagemeister Enterprises, Inc
12:00-1:00 PM	Buffet Luncheon & ERA Award Presentation
1:00-3:00 PM	***Testing for "Hard to Find Vehicle Parasitic Battery Drains"*** with Dan Marinucci of Communique'
3:15-5:00 PM	**Roundtable Discussion**

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AUTO ELECTRIC CORNER — Denso Alternator, Auxiliary Relay, Generator Regulator Swap, Damaged Starter



BY MOHAMMAD SAMII

An effective way of preventing warranty returns is to investigate the reason why the unit failed and take steps in preventing of it happening again. This might require changes in your rebuilding methods, use of different or better quality parts or more extensive final testing. Any effort to accomplish this goal may take a little more time or slightly be more costly, but the results that is providing a better quality product will pay off at the end.

In this issue I will point out to a couple of such ideas that has been a routine in my business:

Denso SC Alternators

For the automotive side of my business that is still very strong, the Denso SC (Hairpin) alternators are the majority of the light alternators I rebuild. They can be for varied application such as Toyota's, Honda's. Ford's, Hyundai, or GM applications that all are using this type (Hairpin) in great numbers. These alternators that are usually off of very high mileage vehicles need slip-ring, bearings, and brushes, and in most cases the rectifiers which I invariably replace for the sake of reliability and mostly for the long labor hours involved for R&R, depending on the application. By doing so I believe I reduce the chances of failure, returns and hefty labor claims. (*Figure-1*)



On the units that the rectifier assembly is already burned and needs be replaced, I have noticed there is a connection between extensive or fully worn brushes and the rectifier failure. That means on the last period of alternator operation, they were intermittent, either not charging properly or suddenly made a better slip-ring to rotor connection which caused a surge in output to compensate for low battery. That is this sudden surge that affects the rectifier, and if does not ruin it it, it possibly can weaken it, resulting in an impending failure. (*Figure-2*)

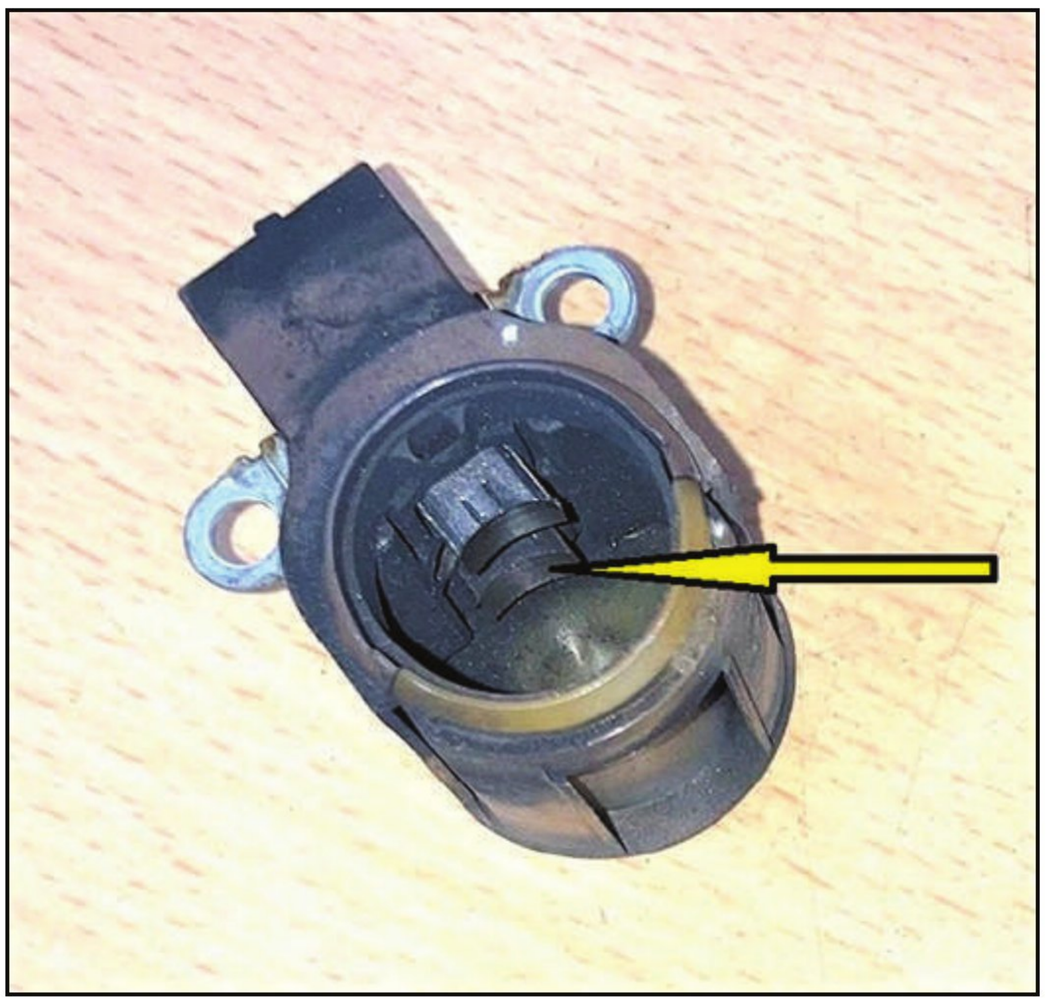

Figure 1 – Worn Denso Brushes

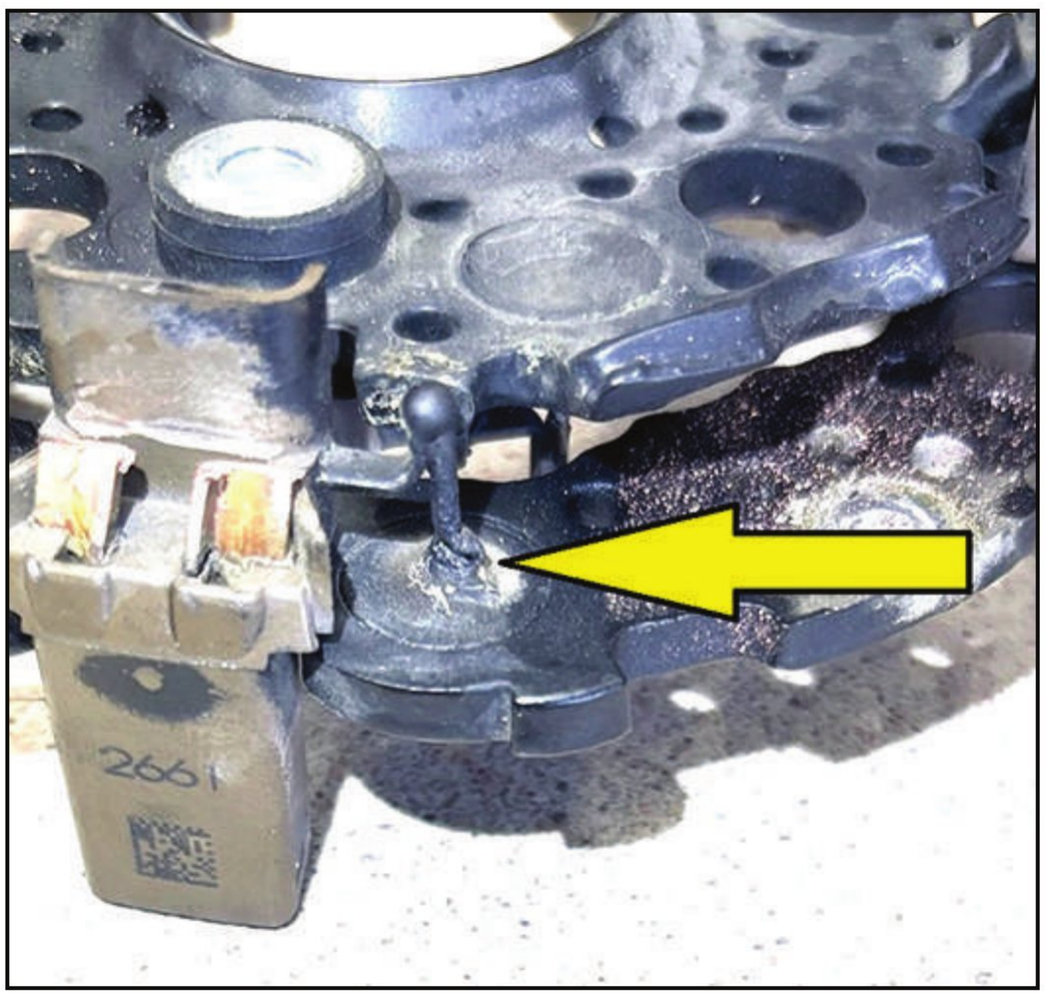

Figure 2 – Burned Rectifier Diode

The surge in output is not just my opinion. Back in the 90's when Ford IAR rectifiers and their plugs were subject of overheating, burning, and at times catching on fire, there was a meeting between Ford engineers and a panel of rebuilders in Ford Headquarters in Dearborn, Michigan to address this issue. The event was organized by the efforts of APRA of the time when electrical rebuilders were the majority of its membership. In that meeting Ford engineers related the IAR's plug and rectifier failure to intermittent surge of output where the brushless were running low, or the charging rate was high due to discharged batteries. They were of the opinion that a sudden output surge could damage the rectifier and ruin the output plug, which indeed was poorly designed to begin with, and that was the reason for the design of the 3-G alternators that replaced the IAR.

Of course Denso alternators do not have a plug issue but I have seen this scenario repeatedly that alternator with severely worn out brushes or deteriorated slip-rings also have a blown rectifier. In my opinion, a rectifier replacement, even if it has not failed yet must be seriously considered in most such units, especially the ones with a very time-consuming R&R time.

Denso starter

We had this Denso 228000-0951 (18400) starter (*Figure-3*) that came in for rebuilding because of intermittent operation that just clicked at times and did not crank the engine unless jump started with a slight tapping with a hammer simultaneously…! Due to age and condition of the starter I offered either rebuilding it or to go with a new aftermarket exchange. The customer decided to have his own rebuilt.



Figure 3 – Denso/Kubota Starter



So the rebuilding process that required new contacts and plunger disc, brushes and reconditioning the clutch which requires dismantling, cleaning and lubrication got started. Just about the time when it was all getting done and the unit being assembled, the customer called, changed his mind, and decided to have a new one.

This particular starter is used on a variety of small tractors and machinery equipped with Kubota engines. We have noticed in many occasions where changing the worn contact did not fully address the clicking issue. The reason is a worn ignition switch with poor or worn contacts. The resulting voltage drop does not allow sufficient current to pull the plunger in. At times a jump start helps to add a little power to the system to get the starter to crank. It is difficult to confirm the cause of clicking is to a worn ignition switch or worn solenoid contacts when the wear is not quite sufficient to confirm what is causing the clicking.

To cover this, I usually add an auxiliary Bosch type ISO relay to the starter and instruct the owner to but his solenoid wire on the right spot on the added relay (*Figure-4*). This of course is in cases such as the above that the owner was simply a Lawn and Garden contractor and not a professional technician for a shop or dealership, who are able to change an ignition switch if needed.

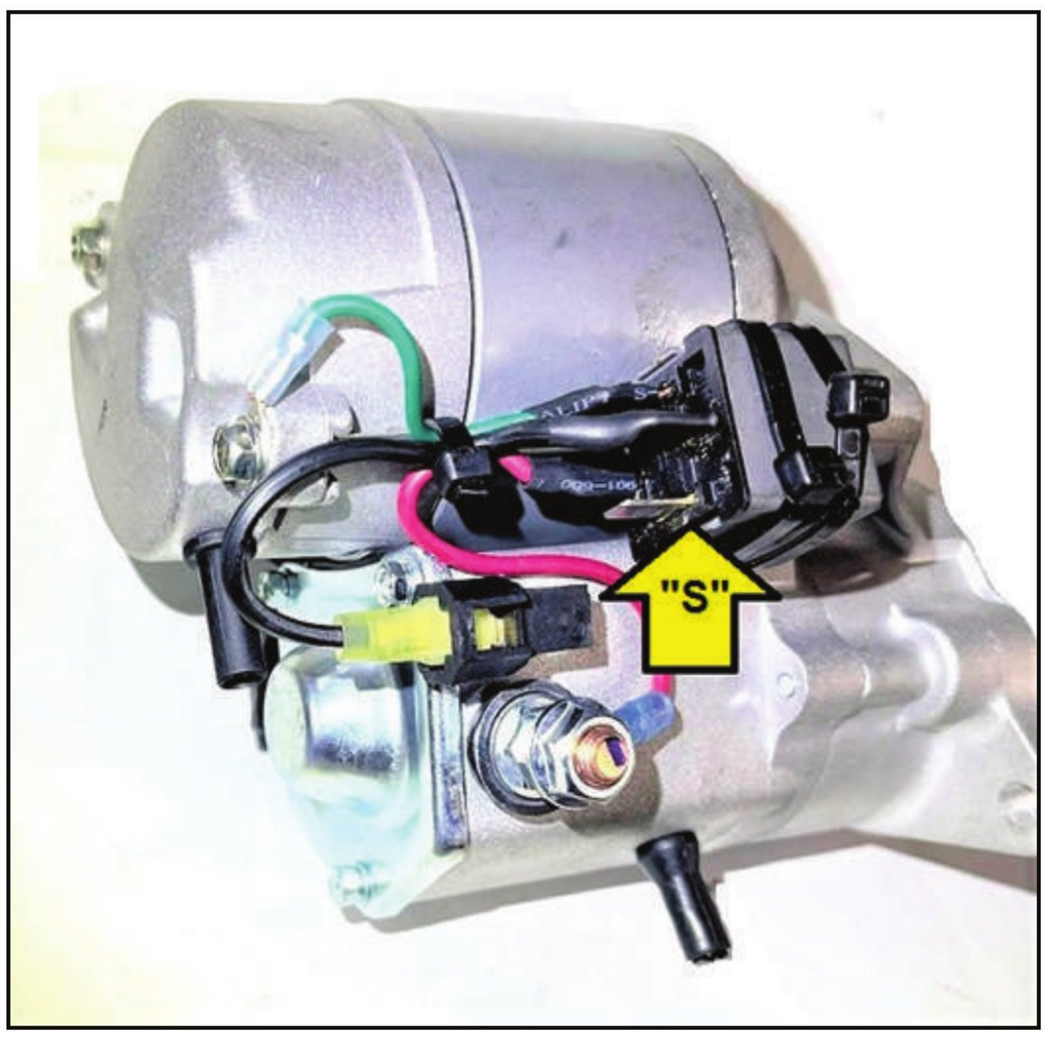

Figure 4 – Installed Auxiliary Relay

What is required is to add 3 wires to the relay's #30, #85, and #87 post and connect them to battery, ground and the "S" post of the starter respectively. (*Figure-5*)

A 20-Amp Bosch or similar relay suffices for this modification. It can be secured in place with a couple of tie-wraps as shown with a dab of epoxy to hold it in place solidly. As simple as it looks, it prevents a lot complaints and comebacks down the road, saving time and headaches. The auxiliary relay does not strain a worn ignition switch, so the cranking will be accomplished, but of course when it completely fails, a replacement ignition switch would obviously become necessary.

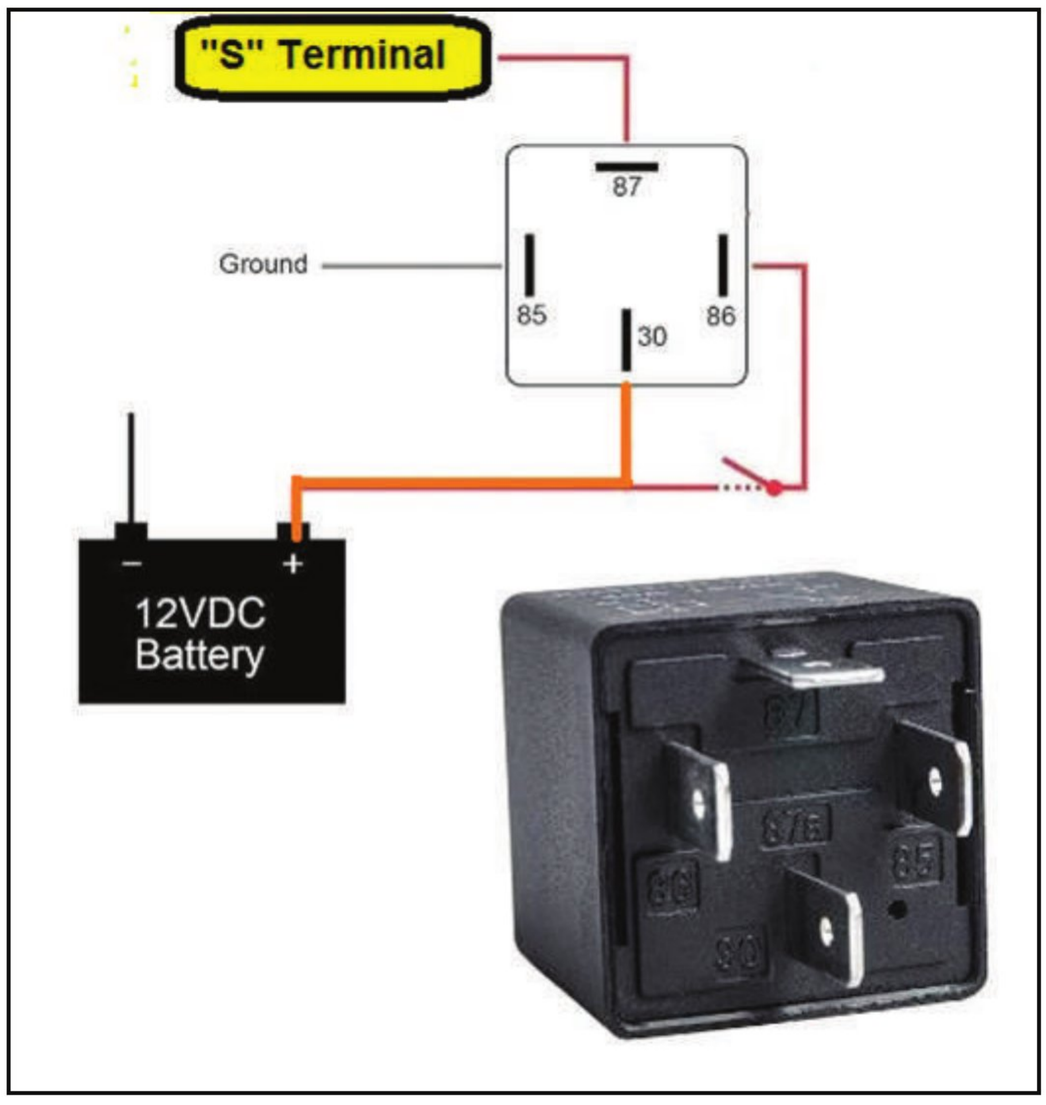

Figure 5 – Auxiliary Relay Details

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Mechanical regulators

We had this Delco 1101691 starter-generator rebuilt for someone who was restoring an old riding mower of sort, perhaps a Cub Cadet. Upon delivery I mentioned this unit would not work unless paired to a suitable regulator and there would be no warranty unless I check it out. He responded he has purchased a new one and is sure there would not be any problem. The old regulator was long gone.

He was back a few days later with the starter-generator and his new regulator (*Figure-6*), claiming they did not work and requested they be checked together. I wired them up and run them on the test bench, and they worked fine. My make-shift test light went off when RPM was turned up, the battery voltage came up, and he test bench showed a few amps which is about all that starter-generator can do.

I was drawing him a basic schematic so he could check and follow his wiring when it dawned on me most those Cub Cadets had a regulator with a ground post on the back, just like his new regulator but his had a "GEN" terminal on the back and not a Ground. A comparison between the two can be seen in *Figure-7*. For the sake of clarification, it be like a comparison between a J&N 231-12004 (Regitar RVR216) and a 231-12014 (Regitar RVR1419).

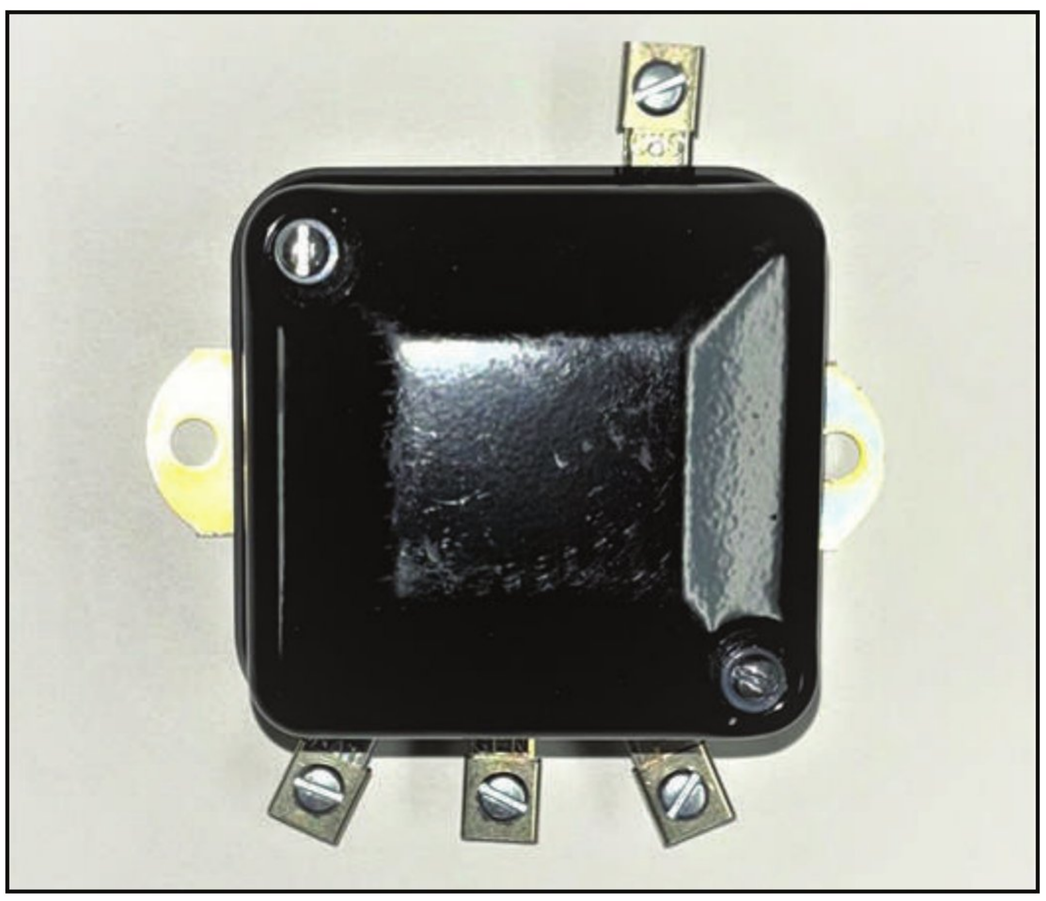

Figure 6 – Generator Regulator

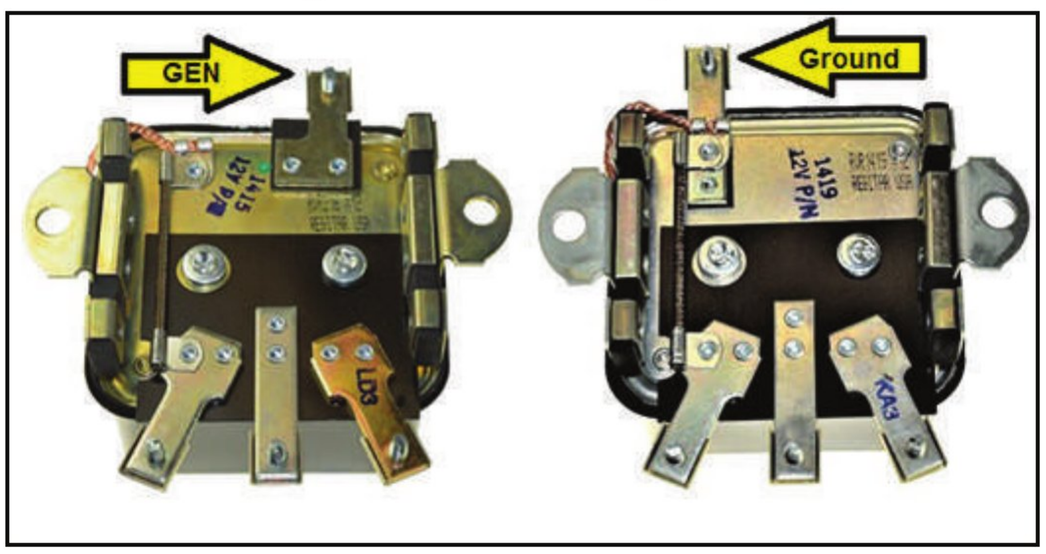

Figure 7 – Regulator Comparison

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Obviously those two are not interchangeable and later on that proved to be the problem with my customer. I sold him my last remaining US-made RVR1419 which was sitting on the shelf for at least 4-5 years at today's going prices! He called a day later and announced now his machine charges and he can go on to the next step of his restoration project.

Damaged starter

My good customer from across the street called and asked for a 16444 (S114-975C) starter for a 2019 Nissan Kicks vehicle. I did not have that starter and the record showed we never had it and never had a call for it. These vehicles (Nissan Kicks) are rare and not many of them are around. I offered them that I may be able to repair it after I see and inspect it. An emphatic NO was their answer. I was informed that I would NOT be able to repair it…!

The reason was that the vehicle's engine had seized right after a mini internal explosion that threw a connecting rod through the side of the motor, opening a large hole as shown in *Figure-8*. The area of impact was right beside the starter. The field case was impacted heavily and opened up, thus any repair was totally impossible. (*Figure-9*)

A quick search through our supplier showed no results. The only option was some used ones on EBay and salvage yards which were days away. Our customer opted to buy one from the dealer for a price of well over $400 which seemed to be their only available option within their time-frame. Given the low number of these vehicles

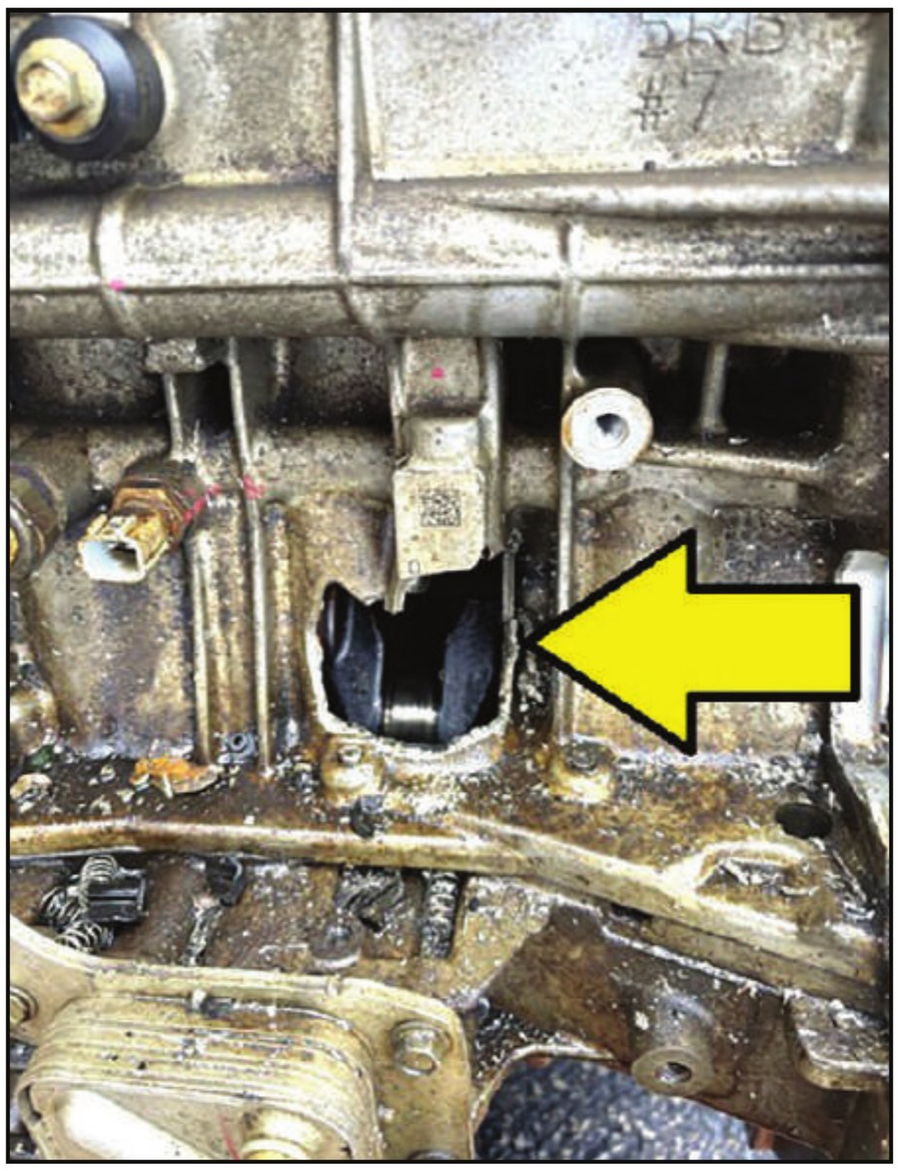

Figure 8 – Damaged Engine Block

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around, I am not willing to buy a used one as a core and try to rebuild it for my stock. So we lost the sale on this one, but we know that you cannot win them all…!

Well, by the time you read this it will be a week or so before the 2024 ERA Show in St. Louis. Your support is necessary to keep the ERA going and be successful. I am hoping to see many of you during the show. Meantime, keep up the good work and remain healthy.

You can contact Mohammad Samii by email at: sammyselectric@sbcglobal.net, or by calling the ERA Tech Help Line at 217-398-3864.

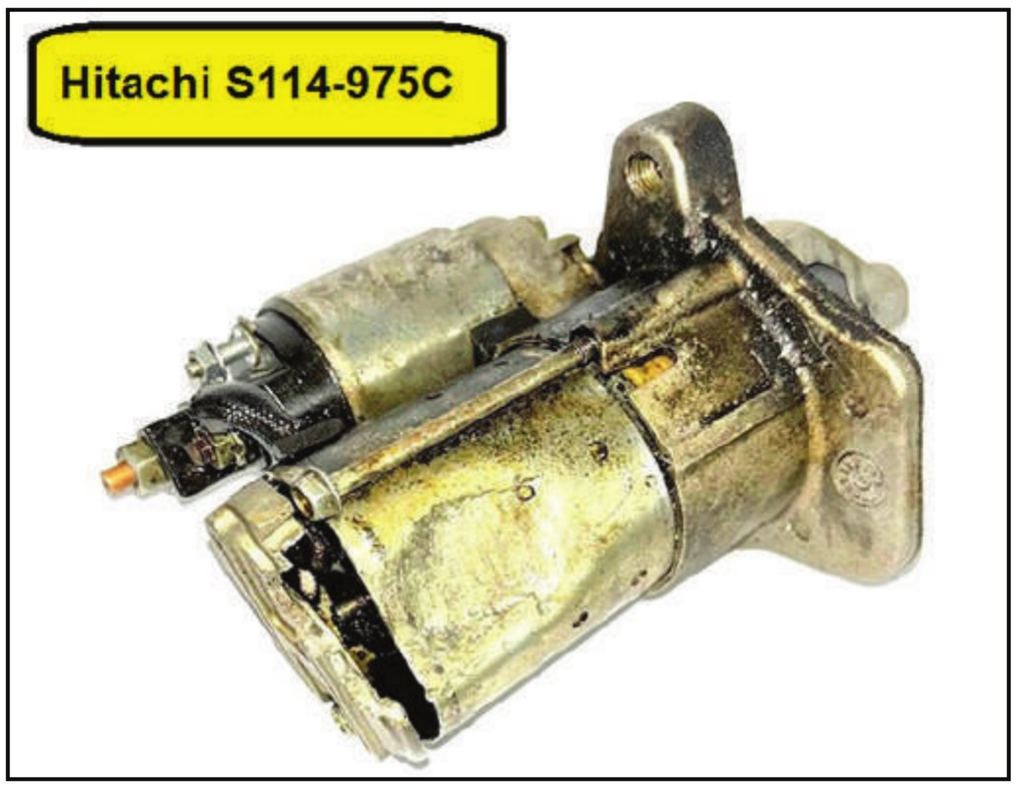
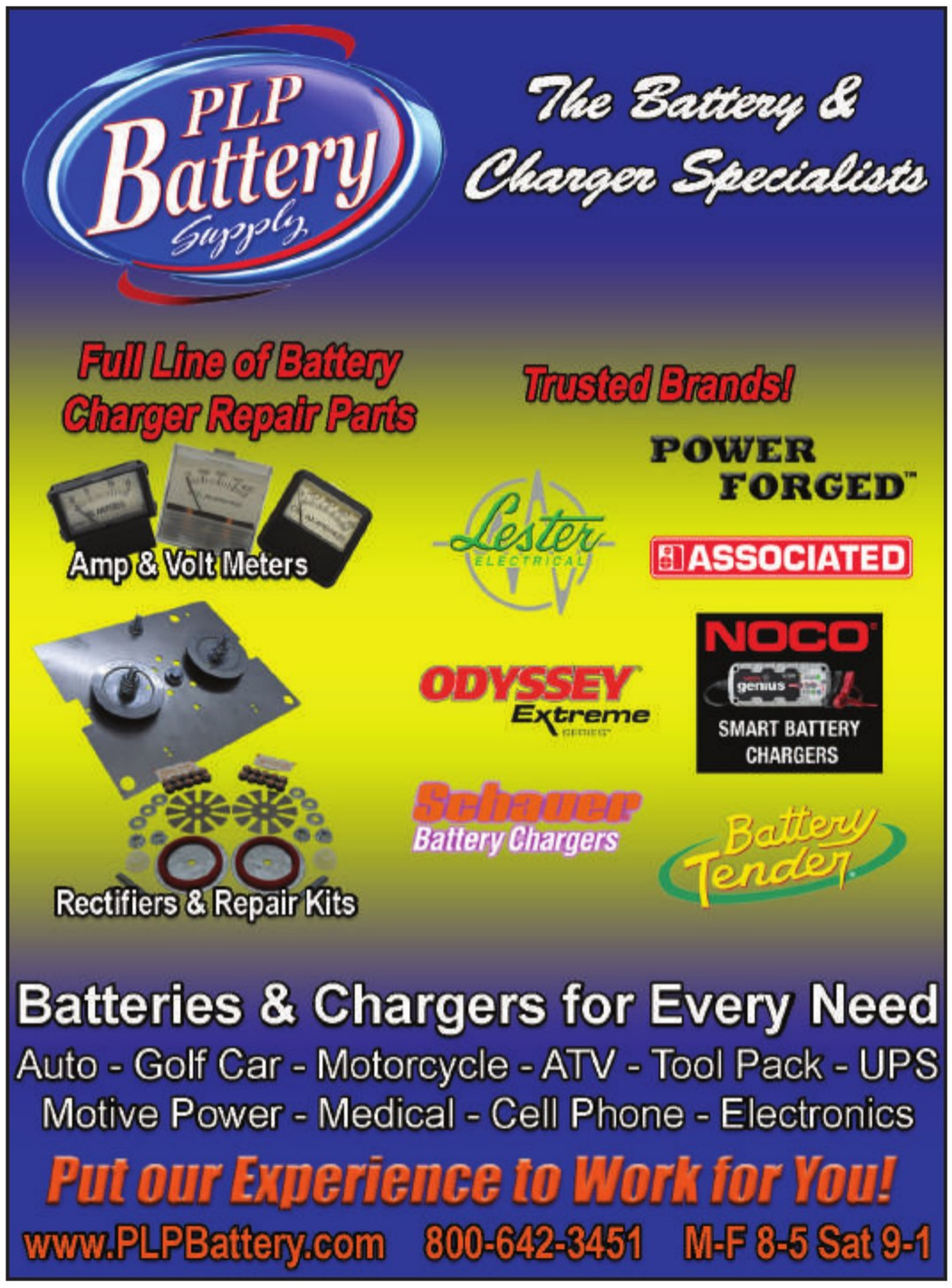


Figure 9 – Damaged 16444 Starter





An Introduction to 48V Starter Generators

BY RYDER KELLER

Recently I was contacted by 2 different customers, within a week of each other, inquiring about how to test an alternator off a 2017 Audi Q8. It started me investigating this market of alternators especially since at last year's ERA technical conference it was strongly mentioned 48V alternators are coming.

Here's what I know so far 48V BSG (belt-driven starter generator) have been on automobiles since 2012 on various General Motors, Dodge, BMW and Audi vehicles and likely other's as well. They are being made by some familiar names, Valeo & Denso, and new names, Continental & Nexteer. It is projected that the demand for mild hybrid, and particularly 48V, is expected to increase about 8% per year according to 1 study I read. Due to the increased emissions standards mandated by the federal government auto manufacturers are working towards meeting those through production of plug in electric and mild hybrid vehicles.

Since most of the vehicle communications and computer controls are developed and first brought to market in Europe, Jimco chose to partner with MSG Equipment in Ukraine about a year ago due to their advancements and knowledge in vehicle electronics and communications. We now have available one of their alternator/ starter/ starter-generator test benches capable of testing the 48V Audi starter generator that uses CAN bus communication. Below is a case study done by MSG for this alternator, it's failure modes and possible repairs.

Recently there's been a noticeable increase in client inquiries regarding repairs of the Continental starter-generator, specifically the model with the OEM number 4N0903028. This unit is a crucial component in the Mild-Hybrid systems of various Audi vehicles, including the A6, A6 allroad, A8, Q7, Q8, and S8 models. Given the cost of this unit, $1,150 on Ebay, the widespread nature of the issue, and the challenges associated with procuring these units in Ukraine, we, the specialists of Master Service, have undertaken the task of resolving this problem.

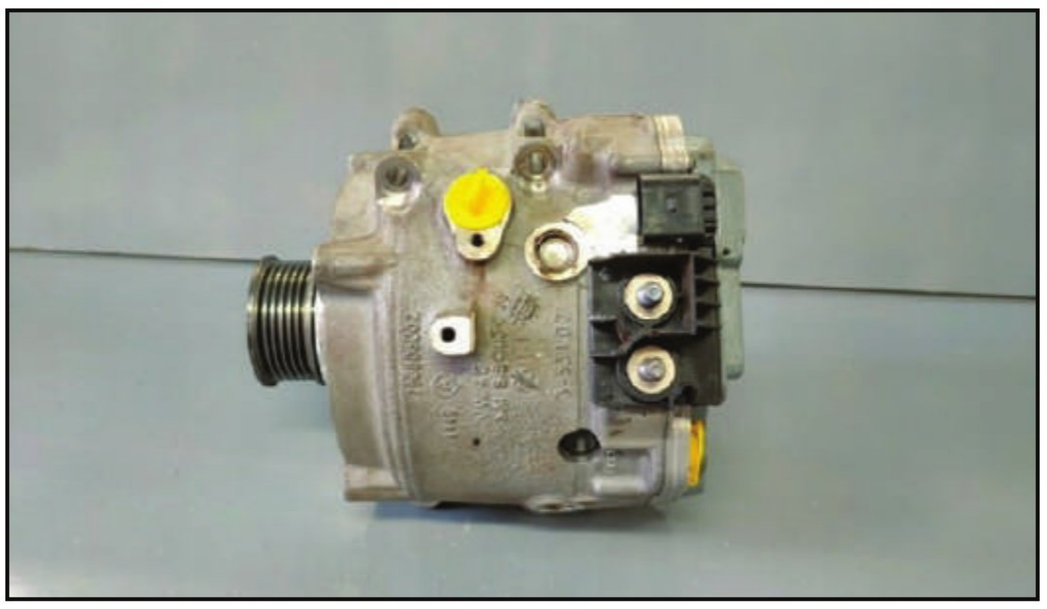


Figure 1



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AN INTRODUCTION TO 48V STARTER GENERATORS

The Mild-Hybrid technology, integral to these Audi models, represents a significant advance in automotive engineering. It's a system that combines a regular internal combustion engine with a starter-generator. The starter-generator assists the engine in specific driving conditions, and during braking, it recovers energy back into the battery, thereby reducing fuel consumption and emissions. Additionally, in certain conditions, the starter-generator can smoothly restart the internal combustion engine when the Start-Stop system is in operation.

In the pictures below, the starter-alternator works like alternator (left) and starter (right).

The Continental starter-generator installed in these Audi vehicles is not just any ordinary alternator. Unlike traditional alternators, it operates in conjunction with a 48V lithium-ion battery, communicates by CAN bus and can be diagnosed by scan tool on the vehicle. This starter-generator is water-cooled, it also controls the cooling liquid pump of the starter-generator using Pulse Width Modulation (PWM) signals. Its main feature is an integrated inverter within the same housing as the electric machine, eliminating the need for external cables. The inverter (mosfets & control circuit board) converts DC from the battery to AC for motor operation to crank the engine and works similar to a rectifier during generator operation.

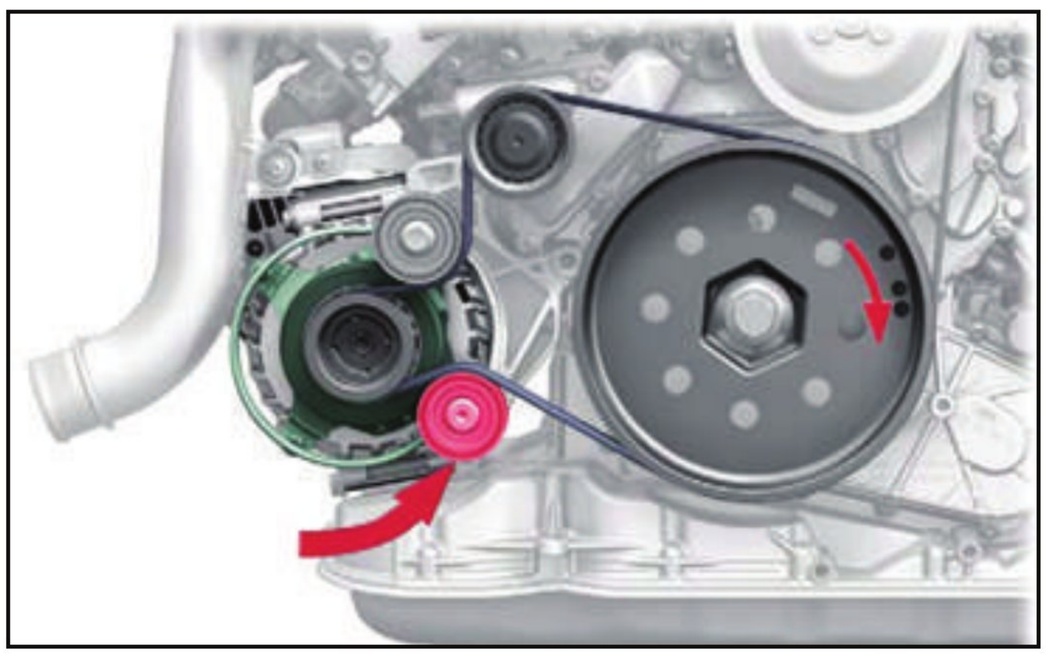

Figure 2

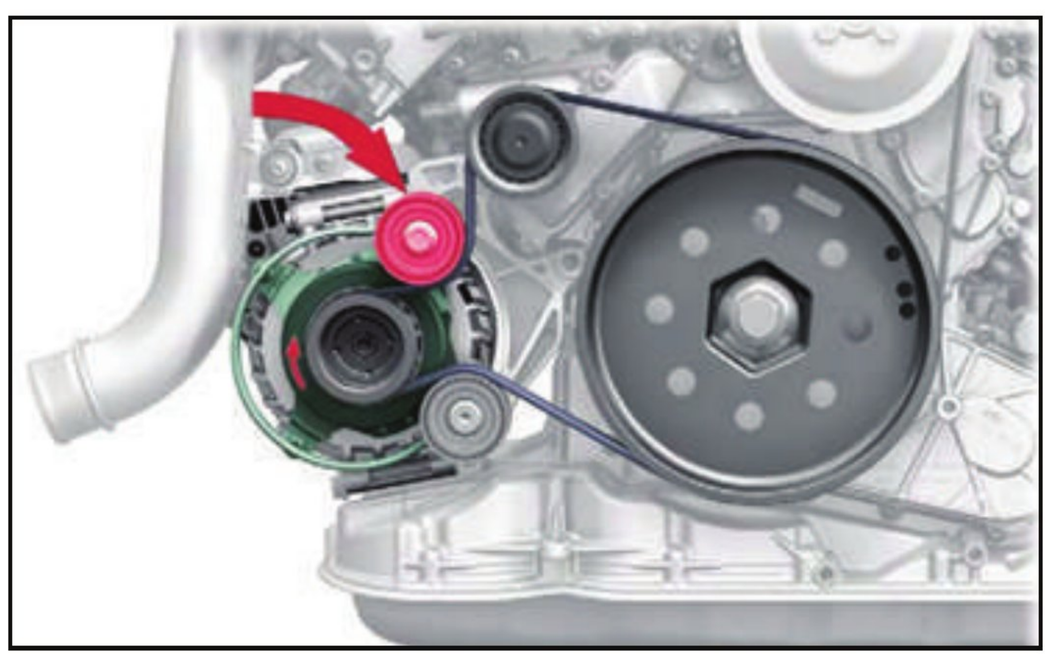

Figure 3



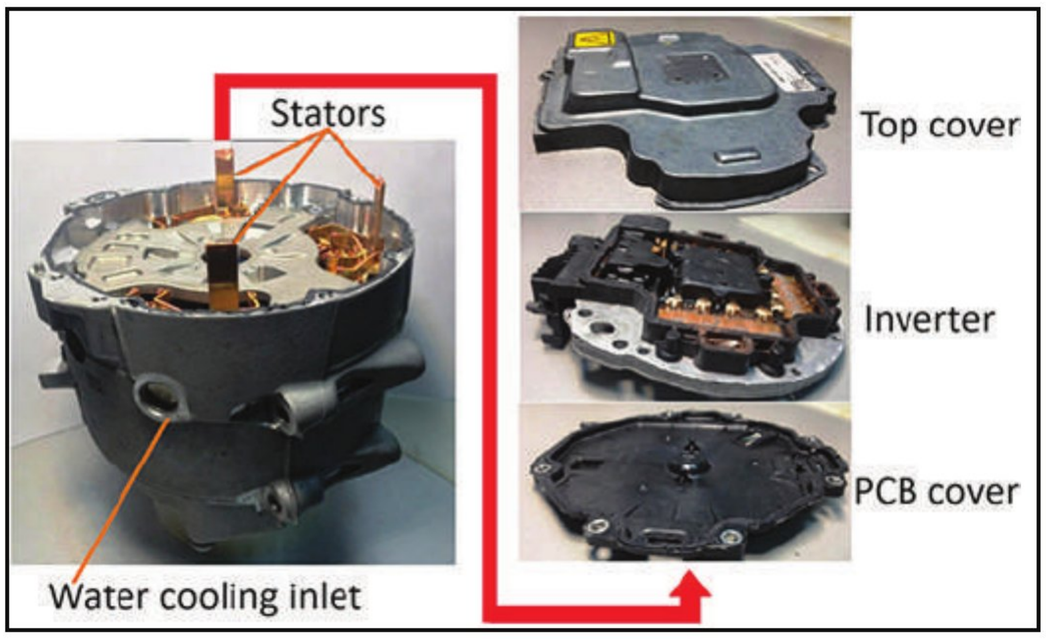

Figure 4

The main issue with this unit lies in its inverter. The symptoms of the problem typically manifest as dashboard warnings such as "Electrical System: Malfunction!" or "Start-Stop System: Malfunction!". Additionally, these issues can lead to a complete discharge of the 48V lithium battery, further complicating its repair and maintenance.

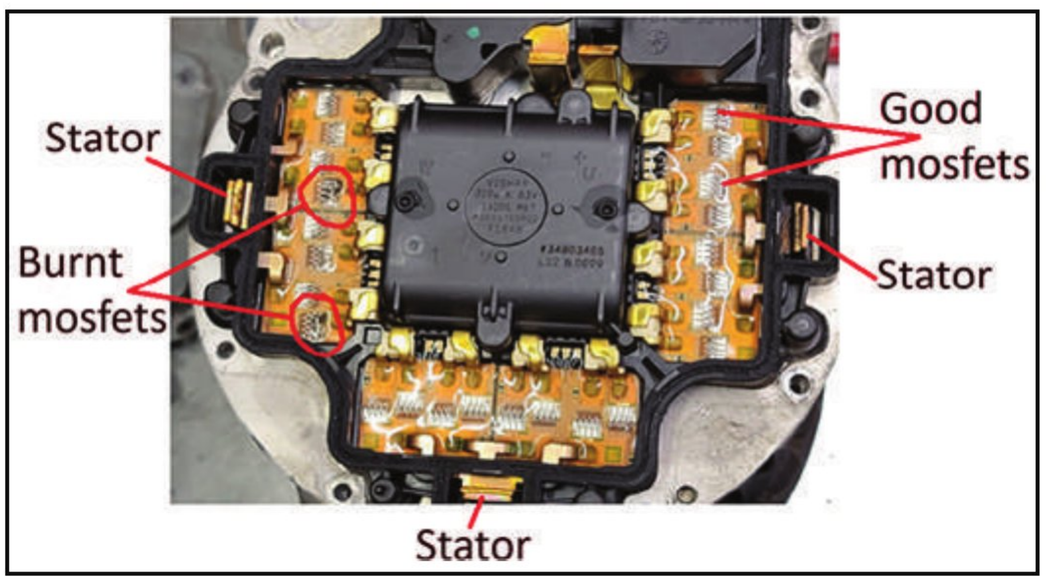

Figure 5

Upon removing the top cover of the generator, we immediately observe the power section of the inverter, which comprises three modules, each with 8 mosfets (4 low-side and 4 high-side, connected in parallel). Typically, visual inspection can reveal damage to one or more mosfets in any of these modules. A mosfet can be loosely related to a diode in that it's primary use is to control conductivity, or how many amps can flow over a period of time, between its source and drain terminals based on timing of a voltage applied to its gate terminal. A mosfet is the most common type of transistor today.

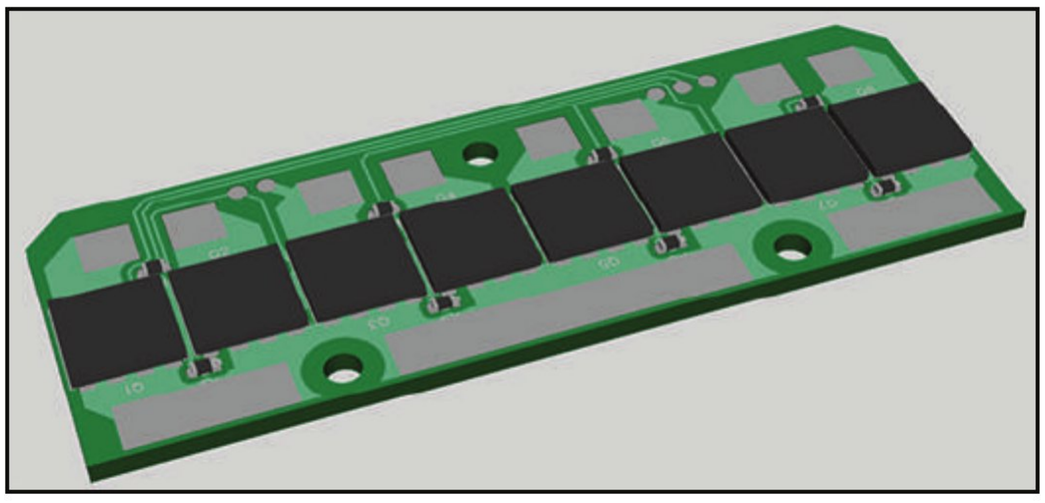

Figure 6

To repair such a unit, we have developed our own aluminum-based printed circuit board based with discrete mosfets NTMTSC1D5N08MC. Initially, it did not function as intended; the transistors began to overheat, prompting us to investigate potential issues within the driver circuit.



Figure 7

Have you seen this ERA label?

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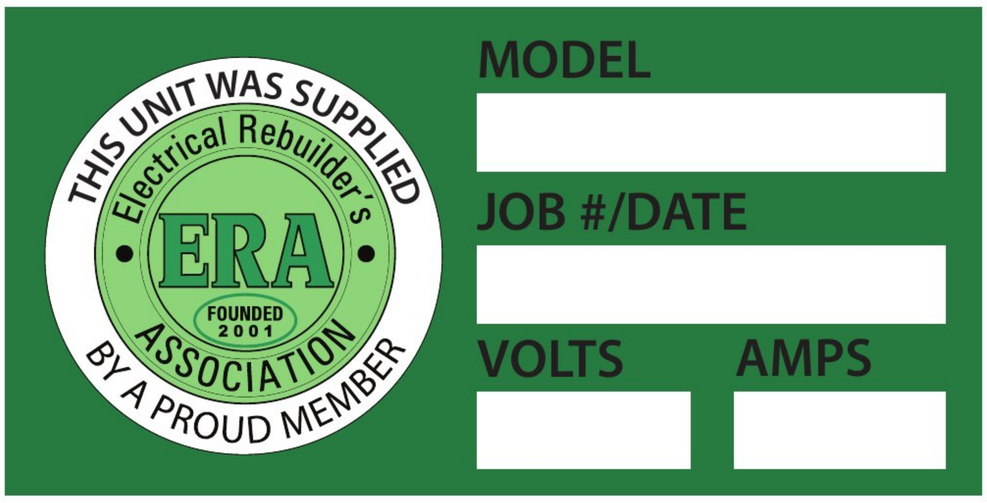

The driver circuit controls the switching on and off of the mosfets, and we identified the problem in its associated components. We found that one of the transistors was short-circuited. After replacing this part, we started to make tests.

To test this starter-generator, we utilized our MS005-48V test bench, MS005, which allows for the diagnosis of this unit under loads of up to 60A @48V in both starter and generator modes. It's important to note that high currents, when tested without the water cooling system connected, can pose safety risks to the generator. The primary goal of these tests was to compare the heating of the modules, as the heat dissipation of our module raised doubts about the success of the entire project.

After analyzing the data obtained from the thermal imaging camera, we discovered that the temperature of our module exceeded that of the others by no more than 5 degrees Celsius. This was noteworthy, especially considering that the original modules were coated with a protective layer that dissipated heat. Currently, several generators repaired by us have been installed in vehicles and are being operated in a test mode under the supervision of our specialists."

Thank you to Master Service and MSG Equipment for making this information available to us. I offer it to you the rebuilder as an introduction to advanced vehicle electronics and how we will have a future in testing, repairing and serving our customer's needs and perhaps making a little more money doing it.



Figure 8



Figure 9

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