ERA EXCHANGE

YOUR GUIDE TO ELECTRICAL REBUILDING

December 2016 $12.95

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Stator and Rotor Combinations

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2017 Trade Show Registration!
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PLAIN TALK | ARE WE BECOMING THE MAYTAG REPAIRMAN?

A WORD FROM THE PRESIDENT
April 2017 Expo in Dearborn

The ERA trade show committee has been busy working on the final details for our April 2017 Expo in Dearborn Michigan. Having been involved in this process has really impressed me by the amount of effort that goes into putting on a bigger and better event than last year.

A tour of the Ford Rouge River plant on Friday morning promises to be interesting and a must see. The technical seminars focus on providing us with information that you can use in your own shop on a day to day basis to make your business more profitable.

You will get to meet rebuilders and vendors from all over the country to discuss industry trends, discover new products, new sources, new tools and new ideas. As for me, it is the one time a year that I get to meet with and have one on one conversations with suppliers that I do business with throughout the year.

If I am a supplier, this interaction with current and potential customers is something that has been lost over the years. Other than attending a trade show, I have not seen a sales rep in several years. I realize that marketing strategies have changed, but the exchange of ideas, needs and concerns between customer and supplier are key for a profitable relationship for both.

Our show will not be all business. We have scheduled social events for Friday afternoon before the show opens and Saturday at lunch time. After our annual breakfast and ERA meeting Sunday morning the Expo will finish up with a technical seminar from the highly knowledgeable and talented presenter Mohammad Samii, of Sammy's Auto Electric Service.

I believe that industries do not die, but they do change. I am still rebuilding and selling auto electrical products and services. The products, markets, suppliers and technology have made dramatic changes over the last thirty years that I have been in business. The ERA has played a major role in helping me keep up with these changes.

"Industries do not die, but they do change. The products, markets, suppliers and technology have all evolved dramatically over the past thirty years. The ERA can help you to keep up with that change.."

Whether you are new to this business or have been around for a while, my advice to anyone that might ask, is to be an ERA member, attend the annual trade show, use the valuable resources on our web site and participate on the website's Forums. Maybe you want to get more involved in the ERA? Please stop by the ERA booth and we can show you how. Mark your calendar now! April 07-09, 2017.

Mike Dietrich

NEW ERA MEMBERS

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Yakima, Washington

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Brooklyn, New York

ABOUT THE COVER

160 amp Denso Segment Conductor stator with epoxy covered spot welds that connect segments into coils.

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Rebuilding is Recycling!

PLAIN TALK — ARE WE BECOMING THE MAYTAG REPAIRMAN?

BY ROB BUKSAR

Recently the days have been jam-packed with all sorts of excitement. Of course, that depends if you're paying attention. The presidential campaign has been a cascade of circus acts, one right after the other! By the time this is published, aside from some unforeseen craziness, we should have a new commander-in-chief. Hopefully, whoever that is will be a little more nationalistic and a little less global. While the news cycle is totally captivated by the campaign, the sun rises and sets. Time and circumstances continue to unfold regardless of who's being groped or emails are being revealed.

In our little world of rebuilding, the *proliferation* of new offshore replacement units continues to flood the marketplace. Of course, this puts tons of pressure on those of us who still endeavor to fix and rebuild for a living!

I hear countless commentaries debating the sense of rebuilding or just replacing with new. In many cases, there isn't a whole lot of choice. Nobody has tooled up or cataloged replacement components for many late model units. As far as the older stuff is concerned, many of those units are falling off the grid due to the lack of activity. Whoever still has any older components on their shelves will probably not restock once they are sold. A lot of it has already been scraped to open up space for faster moving products. Remember that old Maytag repairman commercial? He was lonely and never called because Maytag maintained that their products never broke down.

Our industry has become lonely and called upon less often because vehicles are made much better. Starting and charging technology has improved also. The electrical rebuilder is rapidly being circumvented for other options. *First,* as the old timers leave the market place, the younger group seldom considers getting anything fixed. They replace with new and swipe a credit card. *Second,* like shoemakers, there are no where near as many electrical rebuilding shops around as there used to be, similar to the Cheshire cat, who continued to disappear until all that was left was his smile. When even that vanished, he was gone. In other words, "out of sight, out of mind". The less seen, the less thought about. *Third,* for those sticking around still making money, good for you and God Bless. For those who would like to stay in, I suspect new income avenues are necessary and probably a new business model might be in order. By the way, I chat with a bunch of you who are not comfortable with the "computer internet stuff". Many sadly don't' know how to take and send a cell phone text picture. Not being able to fumble around with the current technology is like taking the wheels off your pickup and trying to move it! Further, without a web site, the lion's share of potential customers won't even know you exist! Enough said.

"Not being able to fumble around with the current technology is like taking the wheels off your pickup and trying to move it!"

Back in the day, most American businesses dealt through levels of distribution which were seldom crossed. There is some of that still around but it seems to be found in very specialized industries only. For most things to include our products, our market resembles a big flea market or neighborhood garage sale. Whoever shows up with the money can buy regardless of who it is. A vendor selling his customer's customer was taboo in earlier days Now it's not. I know we hate it when our vendors sell direct to our customers but frankly, what are they supposed to do in order to survive?

There used to be a moral and economic quandary over this, but times and circumstances have changed the game. Walmart opened the door and ushered in a new economic model. The trade agreements, globalization and the internet furthered the change and like it or not, brought us into the "brave new world"! Now we're in an economic feeding **frenzy** where pricing for commodities like food, fuel and energy fluctuate hourly.

So what does this all have to do with the price of putty? Simply this. You can no longer sit there waiting for the phone to ring like you used to. It just might not because someone has already beaten you to the sale! Your suppliers, who have helped you grow and prosper, are still your suppliers, but they have also become a serious competitor! You hate it, it stinks but if your supplier intends to stay in business, he has no choice. The market is cut so thin, for lots of reasons, you only buy a fraction of what you formerly did and your vendor can't survive off of that. He has no choice but to retrieve that revenue wherever he can to stay alive, as you do!

When we totally dropped our guard and opened our shores to commercial one-sided trade, our wonderful orderly market was turned into a feeding frenzy flea market. The outcome of this was totally foreseeable. The big fish continues to either eat or destroy the smaller ones leaving just Mr. Big to survive.

This isn't about gloom and doom. Neither am I running for arch bishop. I didn't create this mess; I'm actually somewhat of a victim of it. This much I know. **Either you or someone in your organization needs to become very proactive about finding sales and markets that you can get into.** I would like to think the whole idea is to stay in business. If you have a love affair with rebuilding only, you might have a problem!

Stop, look and listen to what's commercially going on around you. There are very few "one-trick ponies" out there dedicated to doing or selling just one thing or line of products. I know it's difficult but there is safety and prosperity in diversity. The more markets you're in the better off you will be!

Don't resign yourself to becoming the Maytag repairman while watching your business turn into a hobby. None of us can turn back the clock but it's not too late to wind it up again!

God Bless our little industry.

Rob Buksar can be reached at International Winding, Inc
800-323-7521

DENSO SC ALTERNATORS PART 2
Stator and Rotor Combinations

BY BOB THOMAS

In the last issue, I explained the stator innovations that make the Denso SC alternator unique, primarily the rectangular wire segments used in place of round wire (*see Figure 1*). They insure a maximum slot fill that results in a highly efficient stator that was not previously possible. The rectangular segments are welded on the drive end side of the stator in pairs to create relatively short coils (*see Figure 2*). Those coils can then be connected in multiple arrangements. Using this method gives Denso the freedom to create a variety of coil configurations, some of them quite unique as you will see.

Each coil arrangement is designed to achieve a specific output curve for the applications in which it is used. Substituting stators or rotors based on physical dimensions can cause a mismatch that will affect the output curve, overall performance or possibly even reliability. We will examine both components in detail. I will point out what makes each one different and how you can tell them apart.

STATORS

There are five different physical stator sizes known as of date. Their outside diameters are 110.8 mm, 120.0 mm, 122 .0 mm, 128.5 mm and 138.5 mm. Amperage ratings vary from 80 to 225 amps. Most SC stators are delta or wye configured. But some of the coil arrangements are unconventional to say the least and fail to fit neatly into either category.

So far as I know today, Denso has not rectified the wye connections on any SC alternators, which was a common practice in the past to gain additional output. Because of that, the SC stators all look very much alike, usually having six leads connecting to the rectifier. However, some of the lower amperage stators only have three leads. Also note that many of the alternators using the three smallest sizes look like early style alternators with enclosed stators and metal rear covers. If you run into one, it will look similar to the earlier internal fan Denso alternators until you remove the metal back cover. In this article, we will concentrate on the two largest sized stators, used on alternators with the familiar plastic back cover.

By far, most SC alternators that rebuilders are encountering today are those higher amperage units using stators that are 128.5 mm OD or 138.5 mm OD. There are both wye and delta versions of each size. While they look very similar it is possible to easily identify them. It will help if you have a copy of Metro Auto Industrial's Denso Hair Pin Alternators component parts catalog. You can get one by giving them a call at **800-263-8761** or you can download a copy from Metro's website as a PDF file at **www.metroautoinc.com**. It can be printed or simply saved to a computer for easy access. You will find it on their catalog download page. Note: *If you should happen to have an older copy of that catalog, you may notice that the two 128.5 mm stator photos are reversed as well as the description of leads and connections.* Do not let that confuse you. The current catalog should be correct when you read this.

To get started, lets look at the two 128.5 mm stators. One is delta (*see Figure 3*) and the other is wye (*see Figure 4*). At first glance it would appear that they could interchange with one

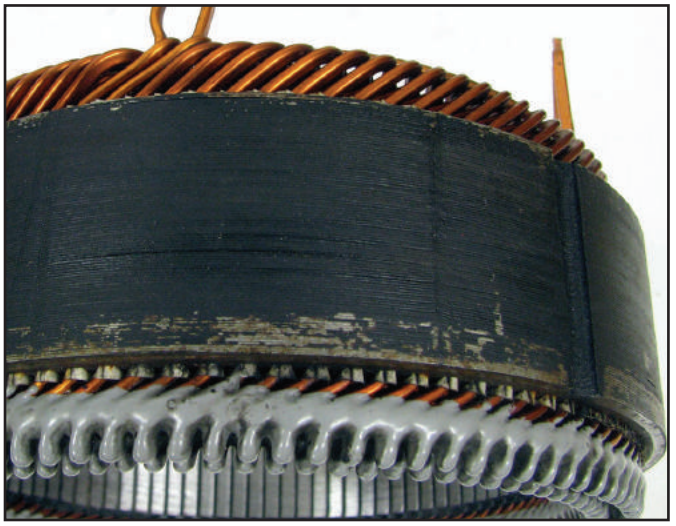

Figure 1 – The square wire conductor and spot welded wire connections identifies a Denso SC stator.

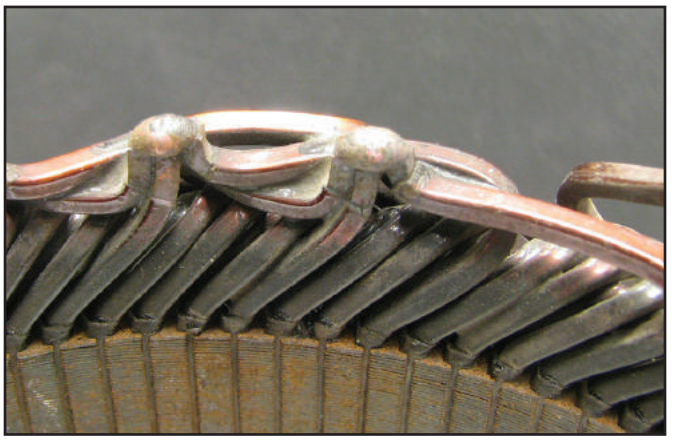

Figure 2 – The coils in a Denso SC stator can be spot welded into a variety of configurations – some unique and never used before.

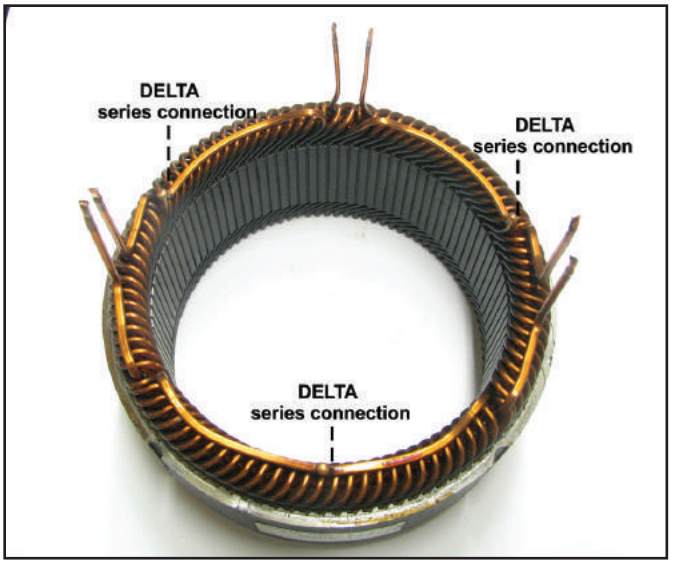

Figure 3 – The delta configured 128.5 mm Denso SC stator can be differentiated by its three spot welded coil connections.

another. They share the same physical dimensions. Both of these stators have have six coils of the same size wire and nearly identical resistance – one-thousandths of an ohm difference (see Figures 5 and 6). However, the individual coils in these stators are connected very, very differently.

The delta stator's diagram (*see Figure 7*) shows six coils, with a pair connected in series to form each of the three phases. You can clearly see the three spot welds in the diagram and the photo. The close up photo shows two coil ends spot welded (*see Figure 8*), indicating a series connection. This stator was used in alternators that were rated between 100 and 130 amps.

The wye stator diagram (*see Figures 9*), also shows six coils, but they are arranged very differently. Here we have two independent sets of windings within one lamination that operate in parallel of one another. Each utilizes three of the coils and is isolated from the other by its own set of diodes. This stator was used in alternators that are rated between 130 and

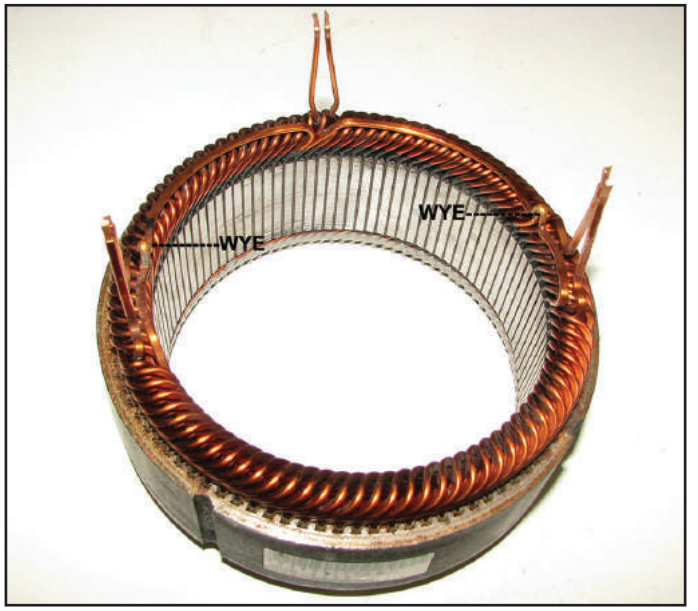

Figure 4 – The wye configured 128.5 mm Denso SC stator can be differentiated by its two spot welded connections.

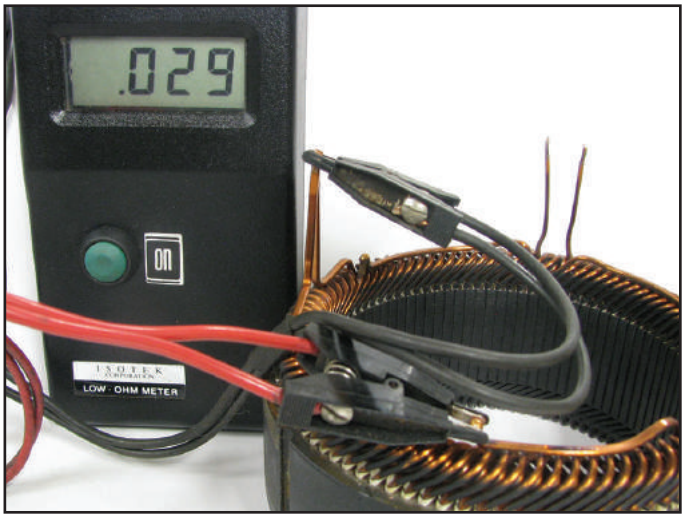

Figure 5 – Reading the resistance of one coil in the delta stator, between a lead and the spot weld, we get .029 ohm.

Figure 6 – Reading the resistance of one coil in the wye stator, between a lead and the wye spot weld, we get .028 ohm.

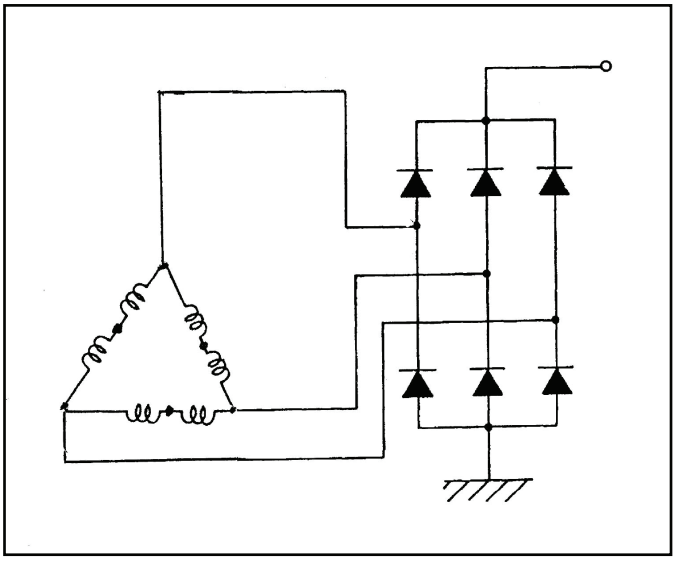

Figure 7 – The delta stator diagram shows that two wire segment coils are connected in series in each phase.

Figure 8 – Here you can see that the delta stator's series connection between two coils.

160 amps. The two wye connections are labeled in the photo and can be seen in the diagram. In the close up photo of a spot weld from this stator (*see Figure 10*), you can see that three leads are being connected, indicating a wye connection.

You may be wondering why there is so much difference in the rated outputs if the square wire segment coils are nearly identical. The higher output rating of the wye stator is a result of two factors. First, you have two wye stators working in parallel within one lamination stack. In a way, that is somewhat similar to having two alternators sharing a single rotor. The second reason has to do with the rotor itself. While the rotors used with the two stators look identical, there is a big difference between them that will be explained later.

But before we move on to rotors, there is another unique stator configuration that Denso has used in the 138.5 mm OD, 220 and 225 amp alternators, common on Ford trucks and special applications requiring high amperage. This stator has proven to be a difficult component to reclaim, with failures being very common. Several large rebuilders have confirmed that the majority of cores that they encounter have burned stators (*see Figure 11*), similar to the one in our photo.

As you can see, this stator has six lead wires and six spot welds connecting coils. On close examination, you can see that each spot weld connects three coil leads (*see Figure 12*). Previously, we referred to this type of spot weld as a wye connection, but how can we have six wye connections in one stator with just six lead wires? Denso has employed a coil arrangement in this stator that is completely different from anything that I have ever seen before.

First of all, there are two identical sets of three-phase windings. They are delta configuration, but with a wye twist (*see Figure 13*). Or you might call this a wye stator with a delta stator being used to form the wye connection. It is innovative. As you can see in the diagram, Denso has placed an extra coil at each corner of the delta, in series with the delta's output. The points at which the series coils are spot welded to the delta corners look very much like the wye connection shown earlier. The result is a stator with very good low speed output and excellent high speed output.

As bad as our sample stator looked, it was not shorted to ground or internally, although it had been severely overheated. If you look closely at the epoxied spot welds on the drive end

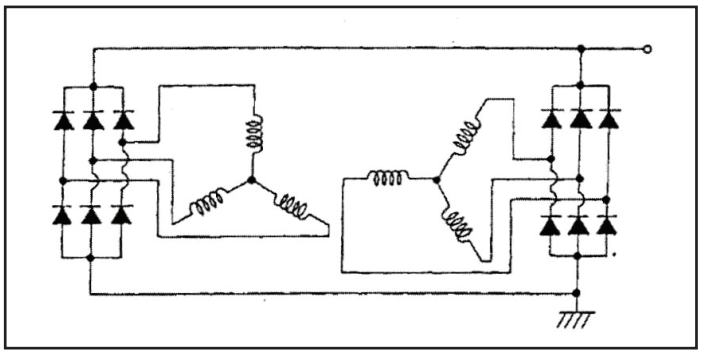

Figure 9 – The wye stator diagram shows both sets of windings connected to a 12 diode rectifier.

Figure 10 – Here you can see that the wye stator's connections join three coils, one for each phase.

Figure 11 – This 138.5 mm 225 amp stator has obvious signs of overheating. Also notice that it has six spot welds with six lead wires.

Figure 12 – Here you can see that each spot weld connects three coil ends.

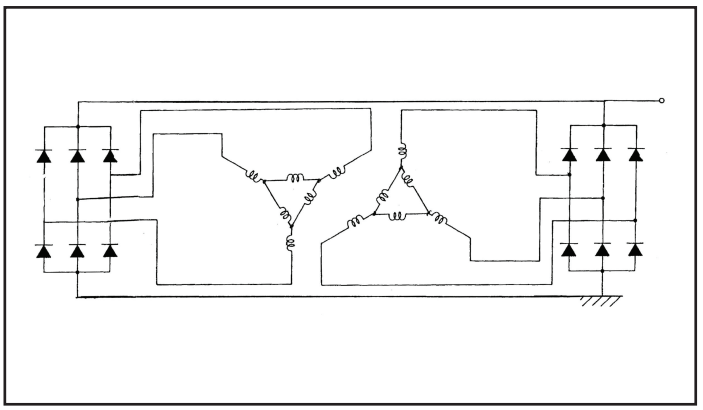

Figure 13 – The diagram for this stator shows that we have two sets of windings, each have a delta arrangement in the center with a series coil connected to each corner of the delta to form the lead.

Figure 14 – A hot spot pattern is clearly visible in our burned stator sample.

Figure 15 – The pattern suggests that one or two coils were heated to greatly higher temperatures.

side (*see Figure 14*), you can see a pattern in the hot spots (*see Figure 15*). This is a sign that the heat was concentrated on just one or two coils. Testing the rectifier that was removed from this stator exposed the reason for the hot spots. The burned phases led directly to the few functional diodes that were left in the rectifier, indicating that the open diodes placed all the load on the coils attached to the functioning diodes.

The rectifiers seem to be the weak link in SC series alternators, especially the higher amperage units. It appears that the high stator failure rate on this stator occurs after some diodes have failed. This alternator is capable of producing high amperage, even at idle, when the fan is less efficient at cooling.

ROTORS

The disparity between Denso SC rotors is less obvious to the eye (*see Figure 14*). The two rotors in the photo came from the same alternators as the first two stators that we looked at. Their physical dimensions are identical. Visibly, the only difference that you can see is the color of the bearing seal, which is probably coincidental. Even the coils look the same.

However, amperage draw or resistance testing shows a huge difference (*see photos 15 and 16*), a 3.1 amp difference in amperage - or 1.69 ohms compared to 2.54 ohms. Unsurprisingly, the higher resistance and lower amperage rotor was in the 100 amp alternator while the higher amperage rotor came out of a 160 amp alternator. Will they interchange? Obviously not, without causing potential problems for your customer and yourself. It is very important that you match rotors and stators when rebuilding these alternators.

There is one more rotor detail that you must be aware of besides the difference in the coils. That is the alternator's direction of rotation. While the vast majority are clockwise rotation, at least two SC alternators exist that turn counter-clockwise. Those rotors have the same dimensions the our sample rotors. Those unit numbers are 104210-4140 and 421000-0810, Lester 11109 and 11584 respectively. The application for the 11109 is 2004-2007 Chevrolet Cobalt and Saturn Ion. The 11584 was used on 2012-2014 Jeep Wranglers with 3.6L engine. Both the cooling fins and the pulley jam nut threads are CCW. If you have trouble getting a nut loose, check the threads and fan, which is visible through the DE.

Many different rectifiers have been designed to date for Denso SC alternators, some only used in a single application for a few model years. Because there are so many and they appear to cause the most failures, covering these rectifiers now would require more space than we have in this issue. Next month – look for Denso SC Rectifiers to learn more.

Special thanks to Mike Dietrich of Action Alternators & Starters Inc in West Bountiful, UT and Henry Lee at Metro Auto Industrial Inc in Pomona, CA for their generous help in making this article possible.

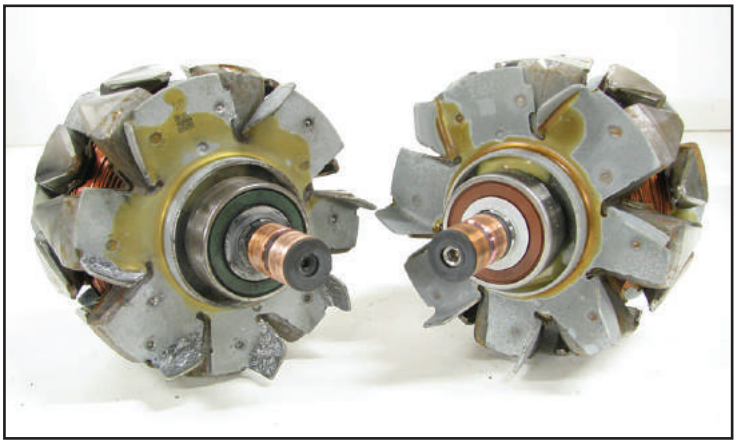

Figure 16 – The rotors that pair with our two 128.5 mm stators appear to be identical, indicating that they could be interchanged.

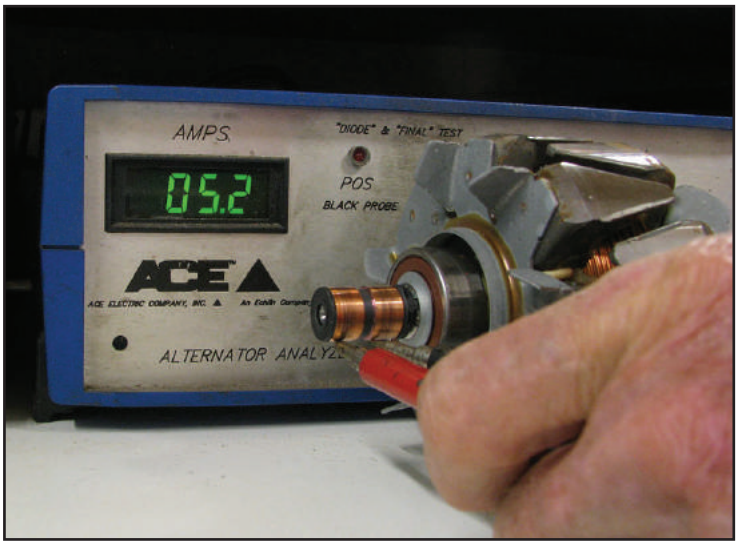

Figure 17 – Testing amperage draw here on the delta stator's rotor, we get a reading of 5.2 amps.

Figure 18 – Testing amperage draw on the wye stator's rotor, we get a reading of 7.3 amps which is significantly higher.

TESTING REGULATOR VSAT

BY GENE KAISER

All voltage regulators control charging rate by rapidly turning the rotor's field current on and off while adjusting the length of the "on" time to meet changing electrical loads. The control circuits in today's regulators have become sophisticated electronically, but a single component usually handles the actual switching of field current. It is commonly called the power transistor (*see Figures 1 and 2*).

As with diodes, there is a certain loss of voltage as the current crosses the junction of a transistor. This lost electrical energy, known as **saturation voltage** or **Vsat**, becomes thermal energy, which generates heat within the transistor. It is the reason that power transistors on very early electronic regulators required significant heat sinking for cooling (*see Figure 3*). Transistors, like diodes can be weakened or damaged by excessive heat. As a regulator ages and the transistor degrades over time, its Vsat will increase. It is the best indicator of the condition and expected life of a voltage regulator – new or used.

Power transistors have evolved considerably since electronic regulators first appeared in the 1960's. Those early regulators employed a single bi-polar transistor or a Darlington Pair to power and switch field current. A bi-polar transistor is a three-terminal semi-conductor that uses a low current input on one lead to switch a much higher current across the other two leads. A Darlington Pair is two transistors integrated into a single component. The first one is switched by the control circuit's low current. The emitter of the first is connected to the base of the second. This allows two levels of amplification and thus the ability to switch higher current. Darlington Pairs became common as the demand for higher amperage alternators increased in the 1970's.

How it works: A regulator's control circuit supplies a small amount of current to the base. That current passes through the junction to the emitter. As it does, a much higher current from the collector also passes through the junction to the emitter side. When there is no current on the base, the high current from the collector is blocked. Total current through the junction is the sum of both although the base current is normally minimal.

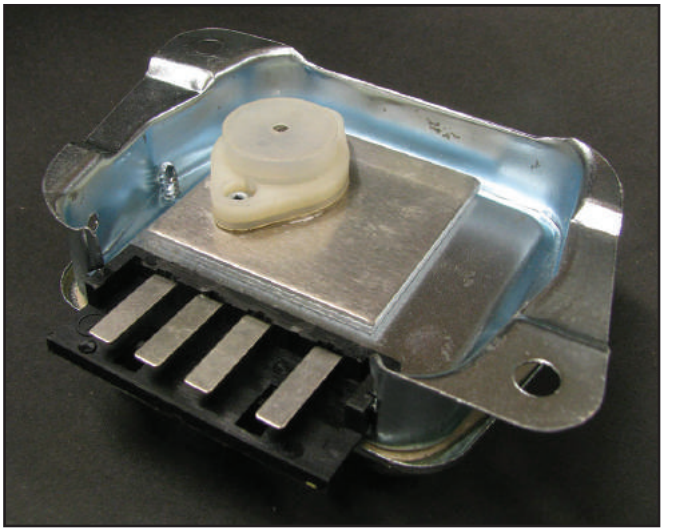

Figure 1 – This Ford regulator uses a large 30 amp bi-polar transistor mounted on a heat sink.

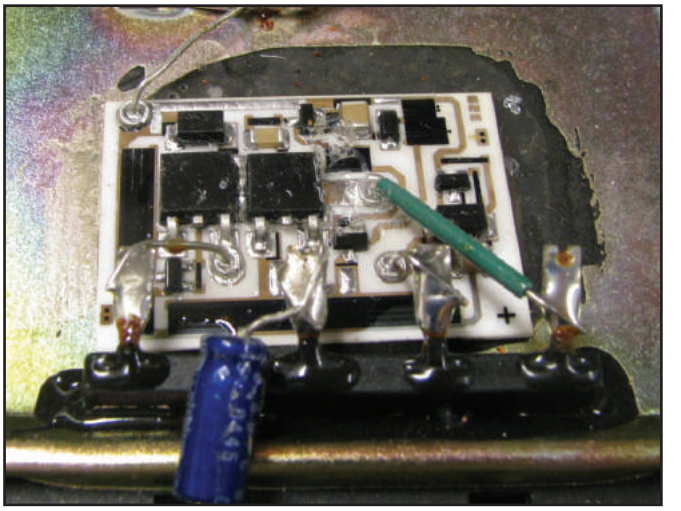

Figure 2 – This regulator employs two field effect transistors in parallel.

For example, we could use 1 mA (milliamp) applied to the base to control 1000 mA or one full amp between the collector to the emitter. Transistors amplify the low current and voltage from the control circuit to supply the power required for the rotor But there are limits to the degree of amplification and control circuits must function on low voltage and very little amperage.

In the 1990's, most regulator manufacturers began using field effect transistors (FETs) and later metal-oxide semi-conductor FETs (MOSFETs) as power transistors. These devices accomplish the same task but in a much more efficient manner. For example, a MOSFET (*see Figure 4*) today can switch 30 amps or more with 1 mA input from the control circuit. They also have a lower Vsat, so they generate less heat.

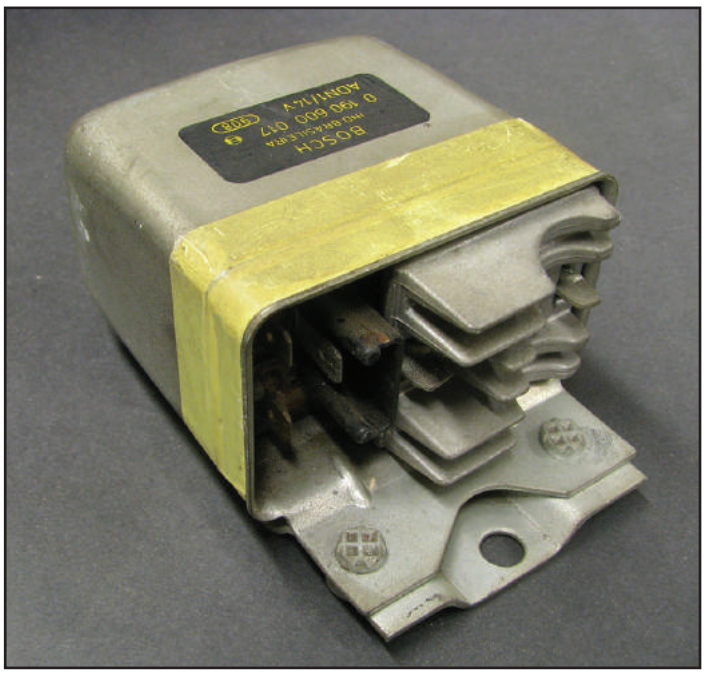

Figure 3 – This Bosch electronic regulator was cutting edge technology 50 years ago. The size of its heat sink is telling of early transistor efficiency.

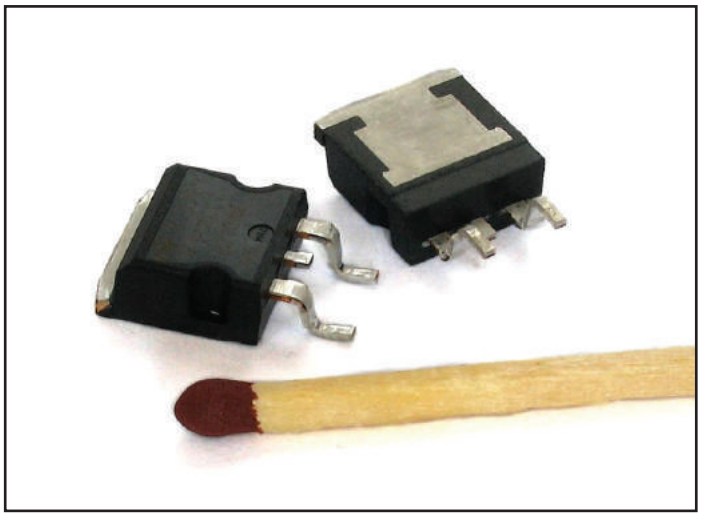

Figure 4 – These are 30 amp MOSFETs.

TESTING REGULATOR VSAT

Testing Vsat: Many rebuilders choose to simply replace all regulators with new product to avoid potential warranty returns. Others may base reclaim decisions on cosmetics and functionality testing – operating the used regulator on a tester or as part of the alternator on a test bench. Sometimes you find yourself in a position where you have no choice but re-use a regulator, assuming it functions properly. Yet we have all experienced warranties caused by a regulator's failure. Most of those could probably have been avoided by testing Vsat.

To do that you need a constant current DC power supply to simulate a full-fielded rotor's amperage across the regulator's power transistor. The cost of a lab quality adjustable power supply is beyond the resources of a small shop. But today, thanks to a growing interest in electronics and Internet shopping, there are many less expensive options available that will allow you to accurately measure the Vsat of nearly any voltage regulator you may encounter. The one that we used for our photos can supply up to 10 amps and was purchased online for $65.

There are three steps to measuring Vsat:

• First, you must activate the regulator's control circuit without connecting anything to the field terminal. You can do this with your regulator tester if you have one or with a test lead for the alternator and any 12v DC power source. Once the regulator is energized, the control circuit should apply low current to the power transistor's base and activate it for testing.

• Second, adjust your constant current power supply to a setting that roughly matches the rotor. We used 7 amps here to test a 22-SI regulator (*see Figure 5*). Then connect those leads to the regulator's field terminal and the controlled source on the regulator, which is ground here because it is A-circuit. Be sure that you observe correct polarity for the field connection! In the case of B circuit regulators, connect the positive lead to the field terminal and the negative lead to regulator B+. Do not become concerned about creating a short circuit with the regulator tester's B+ and ground connections – so long as the tester's field lead is not used.

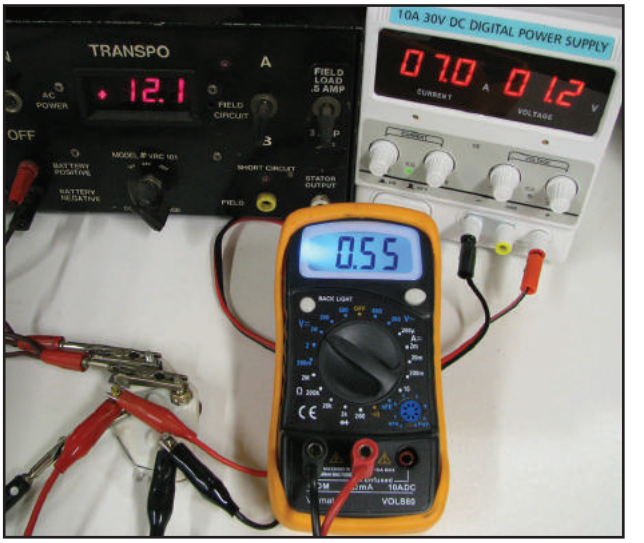

Figure 5 – The regulator tester activates the 22-SI regulator's power transistor. The power supply passes 7 amps of current across the transistor's junction. The DVM measures Vsat.

TESTING REGULATOR VSAT

• Third, connect an accurate voltmeter to the regulator in parallel with the power supply. The voltage reading will be the regulator's Vsat.

We also tested a used Denso SC regulator (*see Figures 6 and 7*) that had been functioning perfectly but the core it was removed from showed obvious signs of having been overheated . Transistors are temperature sensitive and Vsat will increase as the regulator warms itself up, but that could take too long to make the test practical. A simple way to warm it up quickly is a heat gun or hair dryer. Just be careful that you do not apply too much heat. A temperature of 100 C or 210 F is safe. We monitored the regulator's temperature using an infrared thermometer and suggest you do the same. In our testing, a heat gun on low setting warmed it to that temperature in just a few seconds. You can see the dramatic increase in Vsat in the second photo.

Then we tested a new regulator of the same part number to get a comparison between a new power transistor and the questionable used one (*see Figures 8 and 9*). As you can see, there was a significant difference.

What are good numbers? It depends upon the type of power transistor that you are testing. If the regulator is from a 1970's or 80's unit, it is a bi-polar or Darlington Pair and anything below 1.5 volts would be acceptable. But after 1990, it should be no higher than 1.2 volts heated up. For late model applications, expect Vsats below 1 volt, heated up. Testing a new regulator always provides a good baseline, assuming that you have the opportunity to do that. You may want to keep records of those you do test for future reference.

If the field terminal is externally accessible, it is possible to measure Vsat with it operating on the alternator using only a voltmeter. I'll explain that in detail in a later issue.

Gene Kaiser is Quality Control and Technical Manager for Regitar-USA in Montgomery, AL.

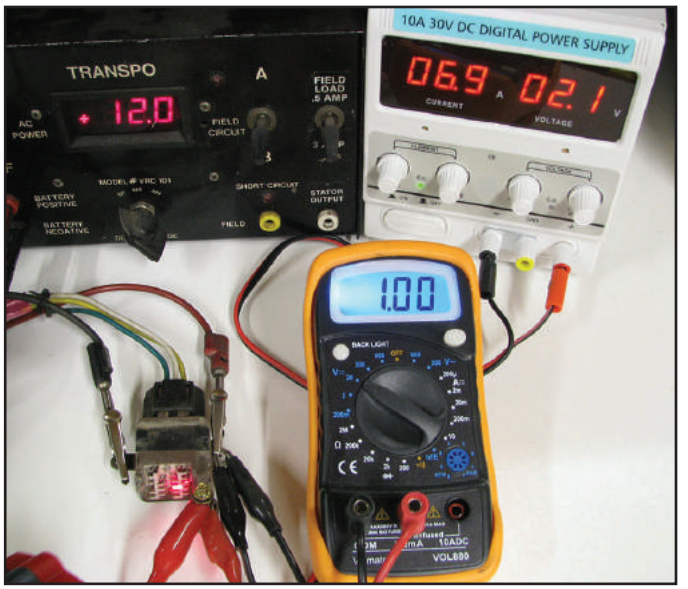

Figure 6 – Here we test a used Denso regulator, again using 7 amps. Vsat seems high at 1v.

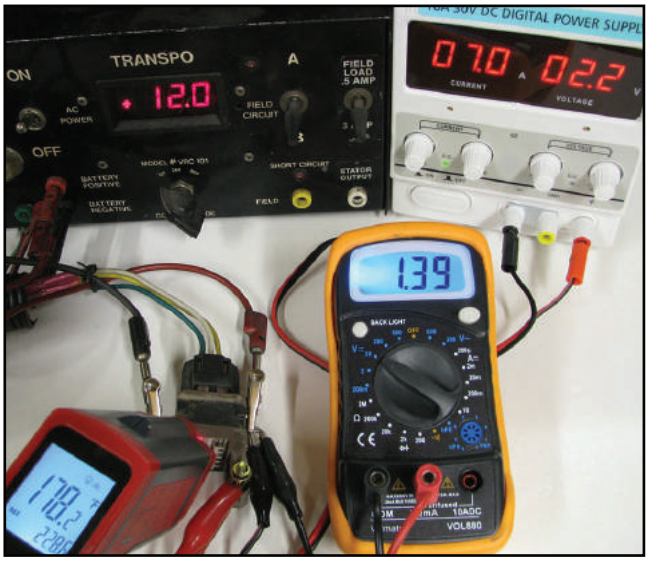

Figure 7 – After heating the regulator to 178 F, the Vsat increased to 1.39v.

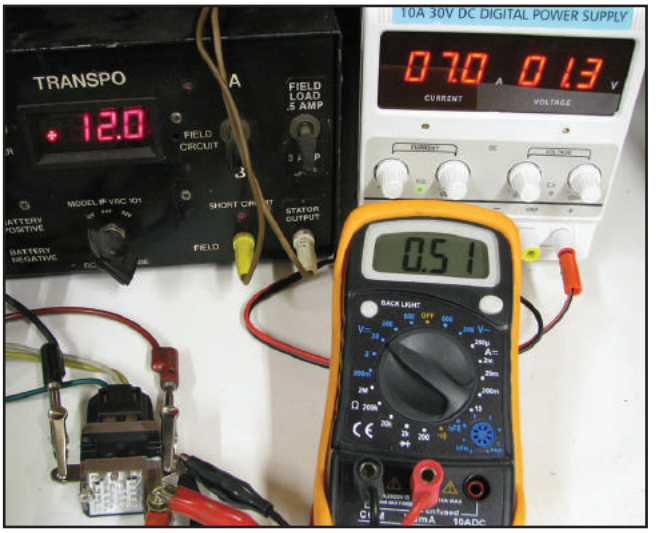

Figure 8 – Here we tested a new Denso regulator for a comparison. Vsat is 0.51v.

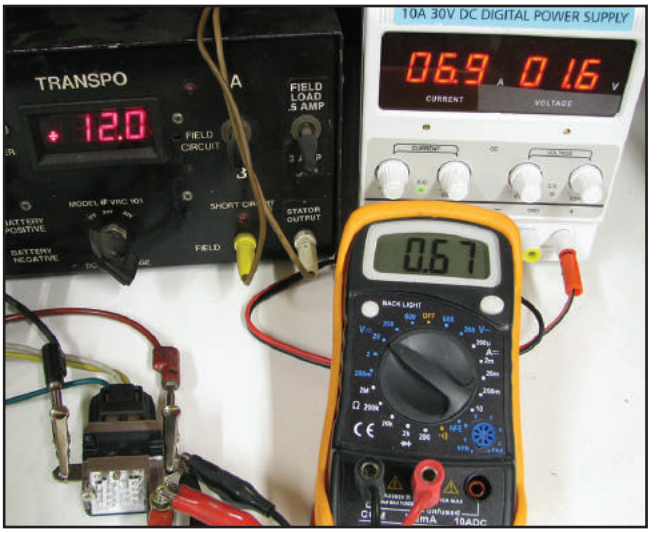

Figure 9 – After heating the regulator the new Vsat is acceptable at 0.67v.

WANTED

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Mark this date now! April 7-9, 2017

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8:30
Load Bus at Hotel
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9:00 – 11:30
Ford Tour

11:30 – 12:00
Return to Hotel

12:00 – 1:00
Hot Lunch Buffet

1:00 – 2:30
Seminar: Tim Weyandt
— with Allegiant Power —
AGM Batteries Explained

2:30 – 4:00
Seminar: Bill Bowman
— retired from Delco Remy —
Alternator Electronics

4:00 – 5:00
Reception with Cash Bar

5:00 – 8:00
Exposition Open

SATURDAY, APRIL 8

8:00 – 10:15
Seminar: Dan Marinucci
— with Communique' —
Vital On-Vehicle Tests That Minimize Starter/Alternator Returns

10:30 - 11:30
Roundtable

11:30 – 1:00
Hot Lunch Buffet

1:00 – 5:00
Exposition Open

SUNDAY, APRIL 9

7:00 – 8:45
ERA Breakfast
&
Annual Board of Directors Meeting

9:00 – 11:30
Seminar: Mohammad Samii
— with Sammy's Auto Electic —
Newer Starter and Alternator, Testing, Rebuilding and Case-Studies

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More details will be announced later. Mark your calendar now.

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Cancellation Policy: Cancellations are subject to a 15% processing fee. NO REFUNDS will be made after March 1st.

TOTAL ⇨

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Do you ever need help testing an alternator? Call the ERA Tech Help Line and talk to a true expert on that topic, Scott Scharrer at JIMCO. Scott can help you find the answers you need to other rebuilding related problems too. No question is too difficult. Scott has a team of experienced rebuilders to back him up.

"I believe I'll be able to help any caller." he explained when he took over the job. "I rely on other ERA members who know more than I do about some subjects." The ERA's Tech Help Line has always been a team effort. The same group of industry veterans are at Scott's disposal.

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