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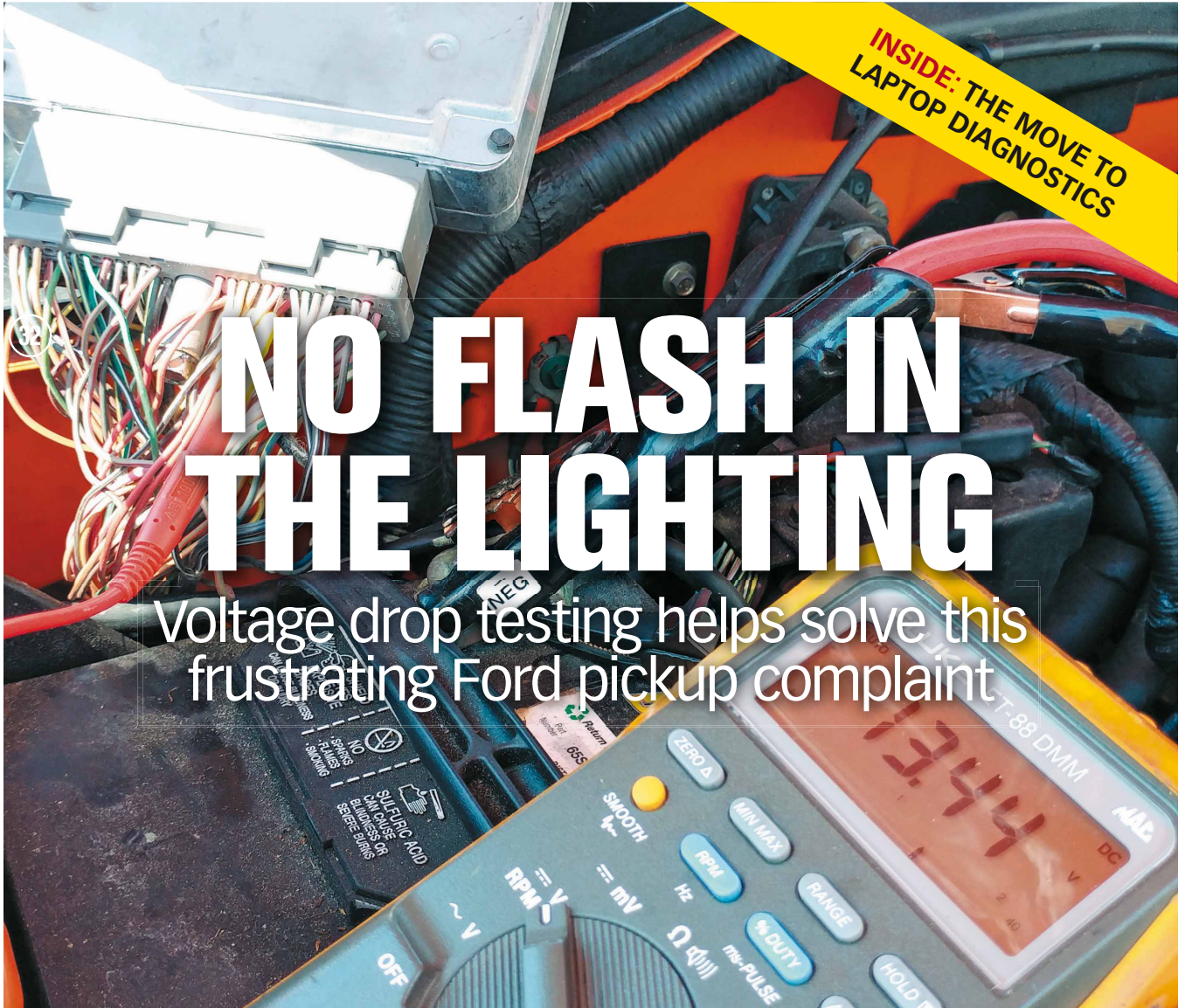
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TRAINING EVENT

BIG EVENT OFFERS ATTENDEES TABLET IN ADDITION TO TRAINING

KRISTA MCNAMARA //
Content Channel Director

➔ In addition to leaving with improved knowledge for industry success, one annual training event is sending you back to your shop with more than just information — you'll be getting a tablet as well.

The 15th Annual TST Tech Training Big Event, scheduled for March 17 at the Westchester Marriott in Tarrytown, NY, is featuring the first electronic handout automotive seminar in the country, which includes with registration an Android tablet loaded with three full-color manuals and a newsletter.

"Since paper manuals had exceeded \$25,000 last year, we thought for a bit more we could save some trees and

time. The TST board and myself are volunteers — no one gets paid — we do it for the betterment of the industry. Now the attendees won't have to lug around a big stack of manuals that they may not use," said G. Jerry Truglia, owner of Automotive Technician Training Services and president of Technicians Service Training (TST). "They can utilize the tablet to review the notes and the presentations and use it to play music and surf the internet after the event. For the vendors, there is a better chance that the attendees will use the tablet and view the sponsor logo and short videos that we have uploaded to the tablets."

The event features a hot breakfast, lunch and snacks throughout the day,

>> **BIG EVENT CONTINUES ON PAGE 6**

BREAKING NEWS

VEHICLE TECHNOLOGY

HOW AUTO BRAKING AFFECTS REPAIRS

ASTECH //
Contributed Article

➔ Automatic braking systems are just one of many Advanced Driver Assistance Systems that help drivers reduce crashes. These systems use sensors and brake controls to help prevent high-speed accidents by reducing the vehicle's speed before an accident happens. If more vehicles are being equipped with automatic braking, what does this mean for repair shops and technicians, and how will repair processes change?

Repair shops and technicians should plan for a future of fewer repairs coming from one obvious source, such as rear-end crashes. The vehicles of the future will require different technology and repair tools. Technicians will need additional skill sets, including diagnostic and vehicle electronics knowledge to perform the required

>> **BRAKE CONTINUES ON PAGE 8**

TRENDING

LEGISLATION TO REPEAL SAFETY INSPECTION PROGRAM INTRODUCED

Missouri Rep. J. Eggleston, R-2, recently introduced House Bill 1444 that, if enacted, would repeal the state's vehicle safety inspection program. ASA opposed the bill.

MOTORAGE.COM/HB1444

NEW OMNICRAFT PARTS INTRODUCED FOR NON-FORD REPAIRS

Omnecraft is adding spark plugs and TPMS sensors to its lineup, providing owners of non-Ford vehicles access to quality parts at a competitive price, backed by Ford.

MOTORAGE.COM/NONFORD

PROGRAM GIVES INSIGHT INTO INDUSTRY, ASSOCIATION

The Next Step program from the Young Auto Care Network and the Auto Care Association offers future leaders the opportunity to become involved in the industry.

MOTORAGE.COM/NEXTSTEP

AUTONOMOUS VEHICLE SALES TO SURPASS 33 MILLION IN 2040

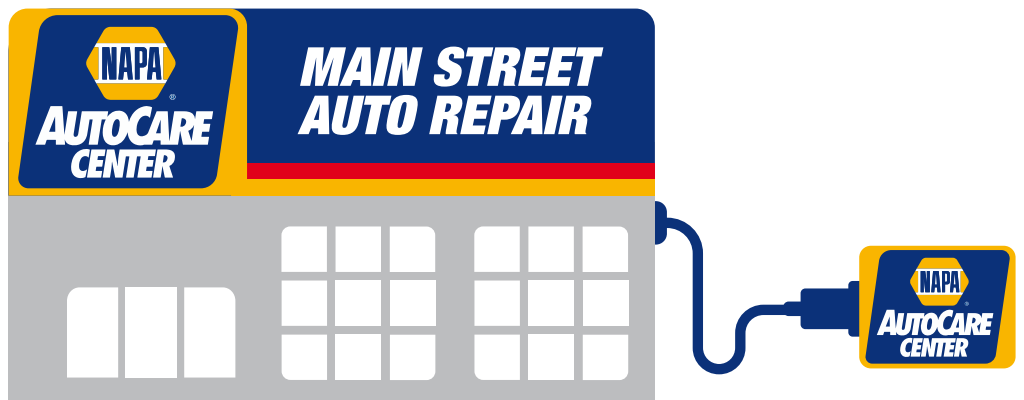
More than 33 million autonomous vehicles will be sold globally in 2040, a substantial increase from the 51,000 units forecast for the first year of significant volume in 2021.

MOTORAGE.COM/2040SALE

STANDARD MOTOR PRODUCTS ANNOUNCES CHALLENGE WINNER

Standard Motor Products announced the winner of its Standard Tech Star Challenge: Matthew Cranford of Zubalon, NC. He will record three videos with the company.

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>> **BIG EVENT CONTINUED FROM PAGE 4**

along with a keynote speaker and three training seminars featuring Jim Moritz of Snap-on, Edwin Hazzard with Southeast Mobile, Bernie Thompson with ATS and keynote speaker Chris Chesney of the Carquest Technical Institute.

Moritz will lead “The Power in Overlooked Fundamentals” and will review using accessories with your scope and meter to simplify diagnostic challenges, working with pressure probes, low and high amps probes, using ShopStream Connect to tame unruly data, high load circuit tests, why an ohmmeter is not enough, quick and easy electronic compression testing, misleading and sympathetic codes and cause and effect and misfire diagnostics made easy.

“Keeping Your Diagnostics Simple” will be lead by Hazzard, who will provide you with the keys to make your

diagnosis simple by gathering as much information as possible. When you ask questions and write information down, along with following some other simple steps in this seminar, you will be able to perform your diagnostic routine easily.

Thompson will teach “Understanding Control Areas Network (CAN).” Communication has been essential from the beginning of history. In the modern vehicle, communications are vital in order to control the onboard systems within the vehicle. The first electrical data communications was Morse code, where on-off signals were timed to provide information that would be sent on a wire. This basic idea of on (high)-off (low) signals is still the main way onboard vehicle communications send and receive communications. This class will cover how the CAN works, how to diagnose the CAN system and how to properly repair bus

problems. With many real-world case studies, you will learn how to quickly diagnose this advanced communication system where it counts — in your service bays.

“With today’s vehicle being so complex, if a technician does not stay up to date, they will evaporate. TST provides five to six training events per year, along with webcasts and special *Motor Age*/TST webcasts that provide needed information to help technicians and shop owners stay current and learn a few good things along the way,” Truglia said. “Also, besides the instructors providing information, there is a big benefit to being involved in our training event, as networking with other shop owners has always been a big help to our attendees. Last year we had attendees from 19 different states and two countries; techs

>> CONTINUES ON PAGE 8

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>> BIG EVENT CONTINUED FROM PAGE 6

and owners drove and flew from all over to be at the event.”

The event is put on with the help and support of sponsors including *Motor Age*, ATTS, Automotive Test Solutions, Autologic, Neutronics, Drew Tech, Flo-Dynamics, CPS, GTC (General Technologies Corp), LAUNCH, NAPA, Mitchell 1, Identifix, iATN, ATEQ TPMS Tools, along with at least 20 others.

Now in its 15th year, the Big Event has evolved over the years, and Truglia looks to continue developing the event further in the future. “Our roots are linked to the Society of Automotive Engineering (SAE) technicians group, Service Technician Society (STS), where I was a board member and the last president of the group before SAE decided to shut it down. Since I had a large following of students from teaching all over the country, I was able to get technicians

and shop owners to join STS from states as far away as Alaska, Hawaii, Florida and Maine,” Truglia said.

He continued to grow STS chapters — with help from technicians including Pierre Respaut, John Anello, Basil Stratos and Rich Peterson — in New York, New Jersey, Maine and Connecticut.

“TST is still providing training to techs and shop owners under the TST banner in these states at least five times a year besides the Big Event. TST also provides help to technicians with almost 300 videos on our TST seminars YouTube channel. Our Big training event started with only 100 or so attendees and has grown to over 460 last year,” Truglia said.

Registration for the event is now open until March 7.

You can register online at www.TST-seminars.org, or send checks to TST at 11 Lupi Plaza, Mahopac, NY 10541.

>> BRAKE CONTINUED FROM PAGE 4

repairs. The complexity of vehicle technology is changing rapidly.

Currently, automatic braking is a standard feature on approximately 10 percent of all new vehicles, and is available as an option on another 50 percent. However, most U.S. automakers have voluntarily committed to have automatic braking systems on all of their vehicles by 2018, four years ahead of the self-imposed deadline from the auto industry to have automatic braking systems in vehicles by 2022.

Automatic braking systems often use sensors to identify objects that the vehicle is approaching. Most Advanced Driver Assistance Systems use sensors. These sensors, located primarily in the front bumper and windshield, include radar, camera, infrared and ultrasonic varieties. Checking the automatic braking system, and all related sensors, is critical after a crash. A vehicle should

not be released from the repair facility if there was damage to any of the systems or sensors until these parts are replaced and re-calibrated to ensure that the entire system is back on the network and working properly.

Using a scanning tool to perform both pre-repair and post-repair diagnostic tests will assist the repair technician in identifying any Diagnostic Trouble Codes (DTC) before the repair process is started and after the repairs have been completed. With modern vehicles having so many sensors, identifying every issue before repairs begin is more important than ever.

After the vehicle is repaired and everything has been recalibrated, a post-scan should be performed as well. A vehicle is not completely repaired until all of the DTCs are cleared and verified as repaired. A completion scan can determine if all repairs to each damaged sensor and other parts have been successfully completed.

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Train staff to improve, or train them to leave you

A shop owner's commitment to training is vital for employee progression, retention

There are a lot of factors that go into finding and keeping the right talent. Today, let's listen to ATI Coach John Leslie explain just one of the hot topics that keeps coming up: training.

So, what exactly is the purpose of an employee training program? Do we throw them an employee handbook and put the signature page in the middle of it to see if they have read it or not? Too often there is no real focus or plan for what you are trying to train this person for. We show them where to put their box, which bay is theirs, the equipment they'll need and so on. I'm confused. What is our commitment to training? The purpose of proper employee training is to help an employee gain sufficient knowledge and skill to be efficient in his or her job and to increase their ability to make more money.

Create your on-boarding process

As shop owners, we must develop a proper on-boarding and training process. The shop owner's commitment to staff training is a significant factor in employee progression and retention. Think

of it as the Sticky Factor.


We must leverage internal and external training opportunities. By doing this we can create loyal and growing employees. Develop a lifelong learner. Someone who is engaged. Employee development is expensive but it equals the shop's growth and performance. Evolve and perform better than your competitors by keeping employees skilled and current. Analyze skill gaps, find out what an employee's motivational factor is and encourage critical thinking. You will also have to measure an employee's learning objectives. You need to have a checklist of skills needed and as the new tech masters those skills, someone signs off on the checklist. Imagine the positive feedback for the new employee as more and more skills are checked off. Very few shops do this but the ones that do produce a totally different product. This will increase company profit, reduce turnover and develop deeper talent succession pipelines.

Develop standard operating procedures

The implementation and consistency

of a shop's training SOPs is a recurring issue in the industry. To overcome this problem, create and stick to your company's mission statement, encourage interconnection between staff, develop strategic plans to realize your mission and set specific goals and timetables for success. Make the mission statement a living, breathing document. I know a shop owner who has just that. He asks every client he sees if the shop lived up to its mission. The input he receives is second to none and has helped him focus on what his clients expect. This in turn influences how he drills down into his employee training program.

Test your existing people

If you are not sure if you need a training program, or if you are not sure how effective your program is, have your staff take the test to see where your problems might be. It is an eye-opening experience to see what your people really think. Also included is an Onboarding Checklist that you can use for all new hires, regardless of position. Simply go to www.ationline-training.com/2018-02 for a limited time and download everything you need to hold on to your people longer! 

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Chris "Chubby" Frederick, CEO



CHRIS "CHUBBY"

FREDERICK is the CEO and founder of the Automotive Training Institute. ATI's 115 associates train and coach more than 1,400 shop owners every week

across North America to drive profits and dreams home to their families. This month's article was written with the help of Coach John Leslie. chubby@autotraining.net

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HOW TO BUILD A STRONG ONLINE BRAND

Four areas to focus on when planning your shop's digital strategy

TODD WESTERLUND //
Contributing Editor

You've probably heard a lot about how important it is to build a strong online brand. While that's certainly true, I understand how difficult it is for shop owners, who have their hands full just running their businesses, to navigate the world of digital communications. Establishing a solid online presence takes time, so before I launch into a lot of tips about how to improve your social media

activity or improve your website, I'd like to take a step back.

Before you start developing an online marketing plan, consider two questions: what is your brand and who are your customers? The answers to those two questions will guide all of your online activity and will help you build more effective digital communication strategies. The most successful businesses have a great sense of who they are and who they serve.

So, consider your own shop. How does it look? How does it feel when you

walk in the door? What sets you apart from the shop next door? What is your culture? All of those characteristics form your brand, and you need to convey those unique characteristics through your digital platforms. For example, let's say your shop not only offers loaner cars, but loaner bikes as well. Photos of those loaner bikes belong in one of the rotating banners on your website as well as on your social media channels.

Now, think about who you serve. Do a lot of busy moms visit your shop? Are you in a college town and naturally

mobbed by Millennials? Or maybe you're located close to a downtown area and get lots of professionals who stop by on their way to work. While you might have one or two demographics that stand out, most shops serve a mix of customers and a mix of generations. Multi-generational marketing can be tricky, but it's worth tailoring your messages to meet the preferences of the various groups you serve and to keep traditional marketing methods in mind.

Now that you have a better handle of who you are and who you want to reach, let's take a look at the strategies you can use to build a stronger relationship with your audiences.

Prioritize SEO

Search Engine Optimization may still be a foreign term for some shop owners, but many have realized the importance of increasing the online visibility of their websites. After all, the majority of your customers are going to find you after conducting an online search. The way I look at it is if you build a clear and concise website, then you've done most of what Google wants, and you should see traffic result from your efforts. As an example, reflect back on those questions you had to ponder to narrow down your brand. Let's say your niche is servicing Subarus and you're located in Salt Lake City. To maximize the chances of someone clicking on your site, you should build landing pages that list the various services you provide for all the various Subaru models you fix. That way, if someone does a Google search on Subaru oil change or Subaru transmission repair, your site should come up.

You can also use Google AdWords campaigns to supplement your efforts and target certain key terms that you believe your potential customers might be searching. If you take that route, you'll likely need help from a marketing company. Before hiring help, make sure

the company knows the auto repair industry and can provide analytics about performance, so you can easily evaluate the success of your campaigns and determine if they are worth the money.

Use consistent design

Companies that are effective marketers are typically very good at ensuring that consumers can recognize their brand wherever it may appear. If you get an email from Starbucks, chances are it's going to have the same color scheme, font style and imagery as the company's website and social media channels. You need to do the same with your brand, so your customers can easily identify your shop and what you stand for. Your website should serve as a visual representation of your physical shop. Use images that highlight the characteristics that distinguish you from the competition – whether that's a high-tech waiting room or expert technicians. Think about who your target customer is and be sure to include features that will appeal to them. If your key demographic is young professionals, give them the ability to make appointments online with a click of a button. Make sure you duplicate your website's look, feel and features in all of your online materials, so potential customers can become more and more familiar with your brand and form an allegiance with your shop.

Embrace technology

Three quarters of Americans now own a smartphone. If you're not taking advantage of the technology that so many of your customers and potential customers have at their fingertips, you're missing a huge opportunity to raise awareness of your services and build loyalty. For example, we just added a digital inspection tool to our platform that allows shops to be more transparent with consumers about the repair process. Technicians can use the tool to take pictures

of the vehicle and point arrows to show damaged areas. Once the inspection is done, the shop can easily email the photos and explanations to a customer who can then decide how to proceed. Eventually, shop owners will be able to send the inspection via text. And speaking of text, don't be afraid to use texting to communicate with your Millennial customers, who prefer digital messages to phone calls. I'd never suggest sending them marketing offers via text, but it's a great way to provide updates on repairs or reminders for appointments.

Commit to social media

If you want to stay front of mind, social media is a great tool. Facebook is an especially powerful platform to reach Generation X customers, as two-thirds of that generation is active on that channel. YouTube, on the other hand, appeals to Millennials, with more than half of 18 to 34-year-olds visiting the platform at least once a day. However, building a following from these generations requires a commitment. Don't just open an account and post once a month. Posting three times a week is what we consider the bare minimum to keep an account active, but communicating daily with a mix of discounts, community posts, information about your employees and funny happenings in the shop is the way to cultivate viewers and engagement.

There's no doubt that building an online brand takes work. But if you focus your digital marketing efforts on promoting what makes your shop special and craft messages that will compel your target audiences, you'll increase your likelihood of success. **TZ**



TODD WESTERLUND

is the CEO of Kukui Corporation. He also spent 15 years as an ASE Certified Smog Technician and two years with a dealership.



Be strategic to ensure continued business success

AARON STOKES // Contributing Editor

Like it or not, the internet has dramatically changed the way consumers make purchasing decisions. Even word of mouth has gone digital, with potential customers asking for business referrals through Facebook and NextDoor or visiting Yelp to scan reviews. As a result, having a strong online presence is no longer optional, but essential.

A 2015 consumer behavior survey conducted by the marketing firm Yodle found that 77 percent of automotive repair shop customers use the Internet to find or research a business. That's two percentage points higher than the number of customers who use the Internet to search for other types of service businesses, which means that building a solid

online brand is especially vital for repair shop owners.

The trick to maximizing your online marketing efforts is to be strategic in your approach. Simply being active in a variety of platforms isn't enough to distinguish yourself from the competition. These days, consumers are looking for authenticity. It's also important to remember that digital marketing should augment, rather than replace more traditional marketing methods. After all, some of your customers will respond to your social media posts, but others might be more compelled by a newsletter with car care tips that you send directly to their house.

Here's a look at the tools we use to build brand awareness and trust online. Remember that the key to success with any marketing effort — whether online-

based or more conventional in nature — is consistency.

Websites

Let's face it, unless you're the only shop around in a one-stoplight town, you're going to need a website. Now don't panic if your site doesn't have a plethora of bells and whistles. Just make sure your site is fairly modern because if it looks like it was created in 2001, potential customers will assume your shop is outdated, too. Here are some other tips to help you use your site to attract customers and build credibility.

- Make it user friendly. You only have one chance to make a good first impression, and if your site is hard to navigate, consumers will wonder if their customer experience will be poor as well. Make sure your contact information is

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not only displayed prominently on your home page but on other sub-pages as well, so customers can reach out easily. Organization is also key. Make sure that what the customer needs to see is located right up front, whether that's a call to action or a benefit of your shop that you want to promote. Having a button on your home page that customers can click on to make an appointment right online is also useful.

- **Make it personal.** The site should reflect the personality of the shop and the owner. To that end, all of the photos on the site are either of me or my employees, not stock photos. I want potential customers to feel comfortable about doing business with me and my employees before they even walk in the door. I also include photos of my shop on my site so people can get a sense of what to expect when they visit.

- **Make it mobile friendly.** Most people are using smart phones to search for services instead of their desktops, so your site needs to look and feel the same way on a phone as it does on a computer. The other issue is that Google gives preference to sites that are mobile friendly, so if your site isn't, it won't show up as high in the search rankings. Remember that your site's ease of use and look is a reflection of your business overall. In the Yodle survey, 67 percent of auto repair shop customers said they wanted service centers to improve their websites over the next year.

Social media

Social media is a great vehicle for developing a stronger relationship with your customers and cultivating loyalty. We focus our efforts on Facebook, but if your demographic is younger, Instagram or Twitter might be a better fit. Instead of using Facebook to simply push sales, our approach is about establishing social credibility. We want our followers to get to know me and my staff better through our posts. We want to be relatable, so

customers understand that this is a family-owned business run by caring people who live in their community. If you looked at 10 of our posts, two might be promoting an oil change special or some other offer, while the other eight will be about what's happening in the shop or in my life. We might post a photo of a beautiful classic car and say something about what a treat it is to work on those types of automobiles, which shows how passionate we are about our work. Videos are also a good way to endear yourself to the customer. I once posted a photo of my daughter learning to drive a stick shift (and stalling out several times), which got a great response from followers.

Whatever you do, don't be tempted to "farm out" your social media to an outside marketing firm. It might seem like an efficient way to still stay active and connected, but customers can tell when your posts feel pre-programmed. We did hire our social media out for awhile, and it was a disaster because we ended up with posts that were completely irrelevant to the message we were trying to communicate. At the end of the day, nobody knows who you are better than you and your team.

Online reviews

If you're not asking your customers for reviews, you're missing out on a big opportunity. Three-quarters of the consumers surveyed by Yodle said that having reviews is expected and gives a local business a competitive advantage. Yet, less than one in ten consumers in the survey had been asked to write a review of a local business. Even more surprising? The majority, a whopping 89 percent, said they would be willing to provide a review if their experience was positive.

We have a sign at the front desk at each of our shops that encourages reviews, and we also use software that automatically generates a text or email request for a review after a customer vis-

its. Our staff is trained to ask for reviews and to head off problems before they turn into online complaints.

If you have good reviews, share them on your website, on social media and in your other marketing campaigns. Google reviews often carry more weight these days, so you might consider featuring a link to your Google reviews on your website.

Email

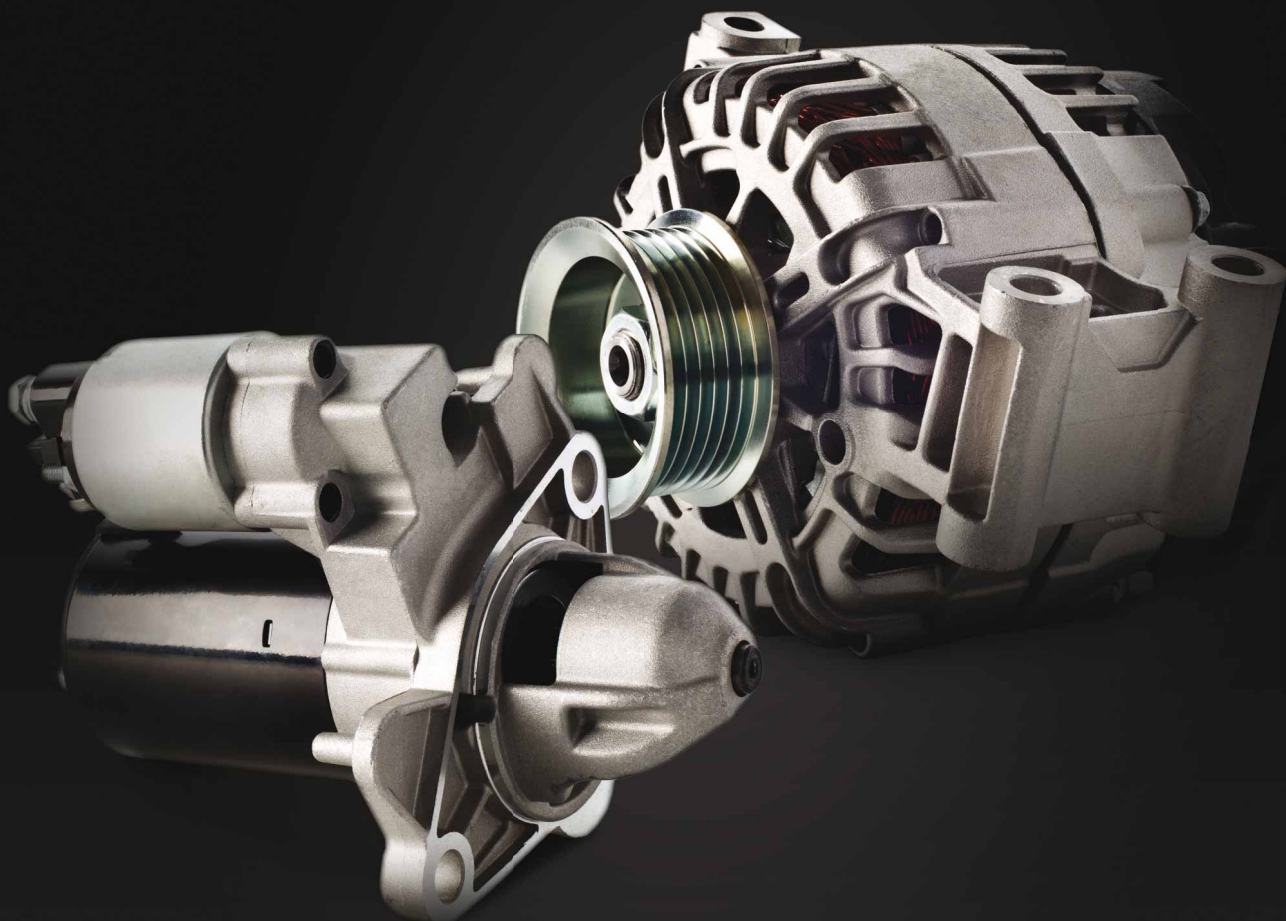
Shop owners often turn to email campaigns because they are a relatively inexpensive option. However, in my recent experience, email hasn't proven effective for either driving sales or building trust. The problem is that in many cases, your emails are getting filtered out before they even reach your customer. And even when it lands in a customer's inbox, they are often viewed simply as spam and deleted immediately. I spend my marketing dollars instead on a printed newsletter that features car maintenance tips, recipes and coupons for service. I know that piece will be better read and accomplishes my goal of making me, as a business owner, more relatable. If you still want to use email, I suggest doing special offers just once a quarter, to avoid inundating customers and potentially losing them from your subscription list.

No matter what method you use, it's important to remember that building trust with consumers takes time. If you're genuine and consistent with your efforts, you should make headway and position yourself as front of mind the next time a customer needs a repair or service. **TM**



AARON STOKES grew his business from a one-car garage to a six-shop operation that includes a car rental agency. He is the founder of Shop

Fix Academy, an innovative management coaching and training company offering AMi-accredited programs. He also hosts a weekly radio show on auto repair. aaron@shopfixacademy.com



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Use self-discipline to drive your shop to the next level

Don't let the negative impact of weaker shops drive your business down

This particular article is addressed to all the progressive independent shops in the country.

Over the past five years, many independents throughout the country have refocused their efforts to become better business people and entered the mission to move their business to the next level. These shops are to be congratulated; the industry should offer a huge thank you for their efforts.

The encouragement to you now is “don't stop here.” As a progressive shop owner/manager, you have a larger responsibility to yourself, your team and the industry than you may think.

Consider the following: Traditionally independent shop owners attend courses sponsored by their supplier or WD and leave the course semi-focused in that they understood the message, but were fuzzy on how to implement their new knowledge into their particular outlet. These shop owners represent about 80 percent of the participants attending these courses.

The most progressive shop owners represent the remaining 20 percent of these participants. The top 20 percent take the information, review and study it to fully understand the details and then apply it to their particular shop, understanding the proper time frame to expect results. More importantly, they remain focused to see their mission to the end. They learned to change only two things at a time, as they now realize many changes — such as five or six at once — will cause an implosion in the business as the staff tries to grasp what is going on.

The remainder of the industry gets lost in the forest, working “in” the business and not “on” it. They end up confronting their biggest nemesis in their business — namely, a total lack of self-discipline to execute.

Consider that it is this lack of self-discipline that people throughout our industry fail to recognize as the root cause of why an independent shop owner/manager does not move



TOP SHOPS WITHIN OUR COUNTRY LEAD THE INDUSTRY IN HOW BUSINESS SHOULD BE AND MUST BE DONE TO SUSTAIN AND SUCCEED IN THE FUTURE.

their business to the next level or become the very best they could be.

The question must arise to the most progressive shop owners: “Well, how does this affect me?”

It affects you very dramatically, and it shows up on your bottom line, called net profit.

The weaker shops within our industry keep dragging down the overall image the consumer has of us. Consider the image projected of our industry on past investigative-type TV programs aired where set-up ghost cars were taken to various shops across the country. This format is unfair, and we all acknowledge that; however, it leaves one heck of a perception in the consumers' mind, and it is not good!

It is time the strong independents became more prominent in the consumers' mind. It is time the stronger independents became more prominent to their peers, perhaps challenging them — through leading by example — to come up to the next level. Why? Because the good in our industry are great, and because when the independents are focussed, they are the best and that is the image the consumer must come to see.

Top shops within our country lead the industry in how business should be, and must be done today to sustain and succeed in our future.

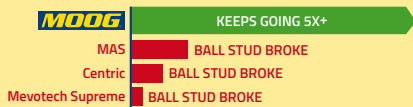
These types of shops must challenge the entire industry to join them. Ladies and gentlemen, our industry must embrace these owners and move to their level with them. Don't ignore them saying there isn't enough of them; let's all work together and bring as many shops to this level as possible. Our independent future depends on it. **ZZ**

BOB GREENWOOD, AMAM, is president and CEO of Automotive Aftermarket E-Learning Centre Ltd. (AAEC), which provides business management resources for the automotive aftermarket. Bob has more than 36 years of business management experience and is one of 150 worldwide AMi-approved instructors. greenwood@aaec.ca

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¹The results shown are based on independent testing conducted by B83 Testing & Engineering, Inc. on ball joints for a 2007 Toyota Camry, 2013 Ford F-150 and 2007 Chevrolet Silverado. Testing was performed on a Multi-Axial Durability Suspension Simulator to simulate ball joint service life on a vehicle.

²IMR Research Study 2015



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Haus of opportunity

Shop owner fills a void by bringing a bit of European expertise to the South

ROBERT BRAVENDER // Contributing Editor

➔ Somewhere along the line, someone familiar with Schneider Autohaus was asked to name one thing unique about this Florence, Ala. facility. Their answer: survivor. “I guess I am,” laughs Jim Schneider — although he has no idea who may have said this.

As the Germanic spelling of ‘house’ indicates, Schneider specializes in European luxury cars, particularly German and Scandinavian. “I’ve been in the business for over 40 years and I’ve worked on basically all models,” he notes, “but I’ve always had an interest in the European models to where I’ve owned a few and had training on them.”

Schneider began his career as a technician in southern California, and at one point co-owned a repair shop. “It was a very busy shop, and I just got tired of it,” he relates. “I was getting older, and I wanted to get out of southern California. Then a body shop owner a few doors from me told me he was selling his business and moving to Florence.”

Moving that far east hadn’t occurred to Schneider, so he began doing research on the Alabama town. “It was just what I wanted,” he enthuses, “kind of in the city, kind of in the country, with a beautiful historic downtown as well as the University of North Alabama.”

Florence is located on the Tennessee River across from Muscle Shoals, renowned for its recording studios and their contribution to the American music scene. “I quickly realized that I should go for it,” Schneider concluded. “And I love it here; I love the people and the customers — it’s why I’m successful at all.”

Schneider moved to Alabama in 2007 with no solid plan. “I didn’t come here rich,” he confides, “I still had to pay a mortgage — but I thought I’d try something different.” And after about a year in the area he realized there were no local services for European makes.

“You’d have to drive like 70 miles away or further to get service on certain vehicles, and there are lots of them here,” Schneider noted. “So I opened the shop in October 2009, and it’s been progressively successful every year. I do run across challenges that a lot of shops are facing these days, and they seem to compound every time you turn around, but that’s what still makes it exciting for me.

“You don’t open a shop just for belts and hoses and oil changes,” Schneider observes. “Those are important things,



SCHNEIDER AUTOHAUS

Florence, Ala. // www.schneiderautohausllc.com



Jim Schneider
Owner

9
Years in business

5
No. of employees

6,000
Total square footage of shop

1
No. of shops

6
No. of bays

but my opinion is if you’re going to be in this business, you’ve got to go all the way. You’ve got to make investments in the kind of equipment you need to do diagnostics, flashing and programming of all the systems and training — right now I’m acquiring information on courses for hybrid vehicles. There’re a lot of them out there, and they’re getting old. When I think about the last 40 years and how much technology has changed my job, I’m just glad it was baby steps all the way, because it would just be daunting otherwise.”

Finding key members of his workforce “was a hidden challenge,” Schneider admits. “I was able to make ends meet by myself — barely — but I got to a point where I had to hire some help; I was overwhelmed with the diagnostic end of these high-tech vehicles. I’m not saying there’s no talent here — they’re

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probably happily working someplace already. So I actively searched across the country on websites like ACT, Auto Staffing and Indeed. I finally got people to relocate here; one came in from Las Vegas. But when you want someone to relocate, it's got to be for good money."


However, there were some challenges that were truly daunting. About four years after renting his first building, an old facility built in 1947, Schneider realized he was running out of room and began looking for a larger space. Around this time his agent came by to renew his insurance and suggested Schneider underwrite his business as well. On a whim, he did. "Then six months later the place caught on fire due to an electrical problem, destroying everything I'd collected for 35 years."

Fortunately, Schneider had insurance, "because I would have just gone home," he states. "It took care of my income while the shop was out of business, it took care of my guys' income, plus I was able to get them back into tools. The fire took place in early September and by October we had moved into [our current] place.

"A fire like that is a terrible thing," he notes. "I'd never had a loss like that; it was a mental thing for at least a few months. I still go to my toolbox looking for a tool I had — no, I lost that in the fire. Fortunately, the shop doesn't depend on me as far as doing that kind of work."

The year before that, in July 2012, Schneider had to get one of his legs amputated below the knee due to an injury, which was compounded by diabetes. "I saw guys and gals coming back from the war with limbs blown off, and they were walking around with their prosthetics and getting over it," Schneider observed.

"I couldn't get around without a walker or crutches, so I told my doctor to just cut it off. It was cut off on a Wednesday morning, I was home Friday night, and was back in the shop Monday morning. I could have stayed at home in a chair with an aching stump and been worried about my shop, but I went to work. I had things to do.

"I guess I wake up every morning with a sense of desperation to get things done," says Schneider. "I'm not freaking out over things, but I guess I wouldn't have it any other way. I've always been kind of aggressive in trying to get things done the right way, and bringing everybody with me who wants to come." 



ROBERT BRAVENDER graduated from the University of Memphis with a bachelor's degree in film and video production. He has edited magazines and produced shows for numerous channels, including "Motorhead Garage" with longtime how-to guys Sam Memmolo and Dave Bowman. rbravender@comcast.net



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Your industry is changing: Are you prepared to survive?

YOU MUST RESEARCH VEHICLE CHANGES AND BE READY TO SERVICE THEM

CHRIS CHESNEY // Contributing Editor

Over the last 20 years, the automotive industry has changed in ways that will cause shops to close or threaten the way we currently do business. There are so many changes occurring today that will have a significant impact to your livelihood unless you grab the opportunity to separate your business from the rest.

Let's look at the evidence that deserves our attention. First, there's the tidal wave of technology being installed on today's new vehicles. Mass-produced hybrid vehicle technology is now 20 years old. The first Prius was released in Japan in 1997 and in the U.S. in 2000. For many years, I've stated that hybrid vehicle technology is a transition technology meant to learn our way to Fuel Cell Vehicles while providing time to build the infrastructure for FCVs or Battery Electric Vehicles (BEV). Well, that transition process is happening and is providing tremendous opportunity for you to grow and transition your team's technical skills.

On the other end of the technology spectrum is the Internal Combustion Engine (ICE). Innovation within ICE is still an important element of the transition strat-

egy for all OEMs. You may have heard the news that the OEMs are preparing to stop building ICE-powered vehicles in the next 10 years. In that time, however, they will continue to enhance ICE technologies to support the transition and those vehicles — millions of which will be in your bays seeking service for many years to come.

Look at the 2019 Infiniti QX50 SUV powered by a revolutionary variable compression turbocharged 2.0L 4-cylinder engine that promises to cure many of the issues with GDI, such as LSPI (low speed pre ignition) and carbon contamination while increasing fuel economy and retaining tremendous power output. Your shop needs to be ready. Simply learning on the job isn't good enough anymore; with the complexity of new technologies, many shops are going to struggle to solve things in time. You and your team must become a researcher of change and learn about these technologies before they arrive in your shop.

The world we live in is changing, with disruptors impacting industries of all kinds. Think about the ride share industry. For many of us, attending AAPEX every year meant taking a taxi to various meetings and events. Now, that's the more difficult way to get around. Disruptive innovation is staring industries in the face. The aftermarket needs to be prepared.

Large investors are making buys at both ends of the supply chain, consolidating ownership of manufacturing, repair facilities and distribution channels. And of course, there is always the potential for

a group like Amazon to dive into the parts industry more than it already has. Experience tells me there will be some significant disruption that changes the way we operate in the near future. The key to this for your businesses is awareness. Be ready for your team and your customers.

There is huge opportunity here. Consider what these disruptors are providing to the consumer. In almost every case, the change is greater convenience. Uber gives you control over your transportation. Amazon saves you a trip to the store and the ability to comparison shop without the hassle. If time is the commodity disruptors are creating for their customers, how is your business adapting to that trend?

Many of you are already doing this and don't even realize it. I see examples everywhere, such as creating reserved parking spots for your customers with appointments, providing rental or loaner vehicles, and having shuttle services and workstations in your waiting area. The challenge is to differentiate yourself from everyone else.

Most important, innovation doesn't happen without someone taking the first step. Take the time to sit down with your team and discuss ways to disrupt the norm. Convenience and innovation — it's what your customers want! **ZZ**

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CHRIS CHESNEY is the Senior Director of Customer Training for Carquest Technical Institute (CTI) and Advance Professional. chris.chesney@carquest.com



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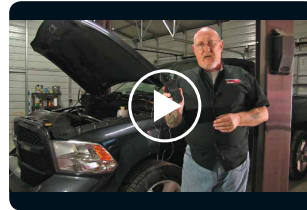
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MOTORAGE.COM/SeatHeater



How to build a strong culture

MOTORAGE.COM/StrongCulture



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MECHANICAL MOMENT

SERVICE REPAIR PROBLEMS AND SOLUTIONS THAT JUST MIGHT BENEFIT YOUR SHOP TECHNICIANS

DODGE SPRINTER WON'T SHUT OFF — AND SHOWS NUMEROUS DTCS

VEHICLE: 2007 Dodge Sprinter 2500, V6-3.0L DSL Turbo, VIN 45, Automatic Transmission

MILEAGE: 169,995

PROBLEM: The engine stays running with the key off. The malfunction indicator light is on with 38 DTCs present: U0002, U0100, U0103, U110B, U0114, U0121, U140A, U140B, U140C, U140D, U140F, U0141, U150A, U0155, U0164, U0401, U0404, U0414, U0415, U0423, U0424, U0431, U1118, U1119, U1400, U1401, U1402, U1404, U1405, U1406, U1407, U1408, U1409, U1410, U1505, U1507, U1508, U1509

DETAILS: After retrieving the DTCs, the technician checked power to the ignition fuses. He found that there was battery voltage on many of them, even with the ignition switch turned off. Next, he pulled

one fuse at a time to determine if there was a “short-to-power” issue coming from another circuit. When he pulled the #8 or #24 fuse, the other fuses lost power.

After reviewing the schematic, he found that the only thing the two fuses had in common was connector C103, located next to the PCM. He inspected the connector and found both sides of the connector to be corroded and melted.

CONFIRMED REPAIR: After replacing connector C103, the engine could then be shut down when the key was turned off. All DTCs were cleared and did not come back. Problem fixed!

This tech tip and others comes from ALLDATA Tech-Assist, a diagnostic hotline of ASE-Certified Master Technicians.

Learn more at ALLDATA.com.

TRAINING EVENTS

FEBRUARY 14-17

MACS 2018 Training Event and Trade Show
Caribe Royal
Orlando, Florida

FEBRUARY 17

ATI Repair Shop Mastery
Hotel to be determined
Riverside, California

MARCH 1-4

2018 VISION Hi-Tech Training & Expo
Overland Park Convention Center
Overland Park, Kansas

MARCH 10

ATI: Eight Essential Skills for Shop Success
Hotel to be determined
Annapolis, Maryland

MARCH 17

TST 2018 15th Annual Big Event
Westchester Marriott
Tarrytown, New York

MAY 2-6

ASA Annual Meeting and Conference
Walt Disney World Swan and Dolphin
Orlando, Florida

JULY 23-26

2018 ASE Instructor Conference
Embassy Suites
Frisco, Texas

AUGUST 8-10

NACE Automechanika 2018
Georgia World Congress Center
Atlanta, Georgia



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IF YOU DON'T KNOW WHAT YOU SHOULD SEE ON A VOLTMETER — BEFORE YOU HOOK IT UP TO THE CIRCUIT — THERE'S NO POINT IN TAKING THE METER OUT OF YOUR TOOLBOX

JEFF MINTER // Contributing Editor

All too often it seems technicians begin diagnostics without a clear plan of attack. That often results in them randomly scrolling through data on a scan tool without really knowing what they are looking for or connecting a volt meter (or worse, a test light) to circuits without knowing what they should see if it's operating correctly. This article will focus on the importance of having a solid electrical diagnostic strategy that includes the use of wiring diagrams and service information. I'm a firm believer

that most electrical problems, even the seemingly complex ones, can be solved by any technician who has a solid understanding of how to diagnose a relay circuit as long as they also know how to leverage the available service information and diagrams.

This article will include information on:

- Diagnostic tools needed for electrical diagnosis
- Resources available to help with electrical diagnosis
- Overview of building a diagnostic strategy
- Using electrical diagrams to speed up diagnosis

- Using wiring diagrams to assist with check engine light diagnostics

Tooling

When thinking about electrical diagnostics, a few tools typically come to mind immediately. Most of the time the first two tools that people will mention are test lights and voltmeters. There are actually many different tools that fall under what most people simply group as test lights and the differences can be pretty important depending on what circuits are being tested. The three most common types I've seen referred to as "test lights" are incandescent, LED and

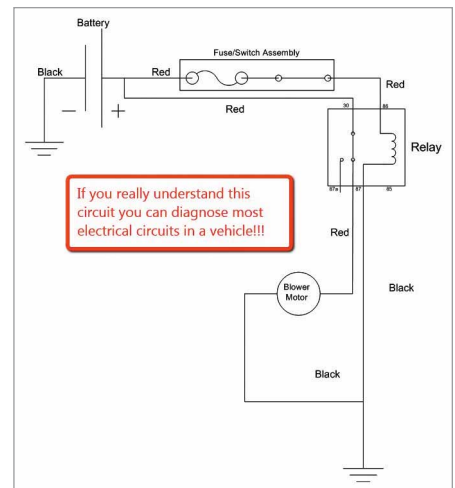
logic probes. Some very old commercially available incandescent test lights (or a homemade one) may actually draw enough current to damage computerized circuits, though newer ones typically draw less than 10mA to help prevent that. Of course, that low current draw makes the test light very limited in its ability to provide diagnostic information. In essence, all three of the types of test lights listed above aren't good for much more than identifying if a pin/wire is connected to a ground or to a power source. So, while many technicians tend to grab this tool first, I hope this article will help convince you that a voltmeter is a much better (and faster) choice.

The digital voltmeter (DVOM) is by far the tool that should be used most often during electrical diagnostics. DVOMs have evolved over the years and are currently available with a wide range of options. With the increased number of hybrid and electric vehicles, it's important to be sure the meter is rated appropriately. The general recommendation related to the safety for use on hybrid and electric vehicles is to ensure the meter is rated at a minimum of a Category III 1000V and also to be sure the rating of the leads being used are at or above the rating of the meter. You don't have to spend a fortune to get a good quality DVOM. Entry-level meters with all of the basic functions needed can be found for as little as \$50, mid-level meters with higher quality leads, etc. will run close to \$150, while a very high-end commercial-quality meter will run in the range of \$250+. Personally, I've had a PDI Meter (Precision Diagnostics Instruments) DVOM in my toolbox since I was in tech school (nearly 20 years ago now) and it has operated flawlessly. Over the years I did add a Fluke 233 with remote display for those instances when I wanted to measure a reading without using super long test leads. Since then other models have come on the market with Bluetooth

capability that allows you to use a phone as your remote display (such as the FLIR DM91 or Fluke 3000 FC). Regardless of which brand or model of meter you purchase, the most important thing is to become familiar with its settings, capabilities and use.

Resources

Once you have your basic diagnostic tools in hand, you'll need to know what to do with them. In addition to understanding the basics of electricity, you'll need access to reliable service information. For most electrical-related diagnostics there are three main items you will need access to. First, and most important, are wiring diagrams. These come in a variety of formats today depending on the age and manufacturer of the vehicle, as well as the information source you are using. Many of the service information providers utilize the OEM diagrams and package them for you to purchase; others may actually re-draw the diagrams so all diagrams appear in a similar format regardless of the OEM. Either way, you absolutely must have access to diagrams. The second thing you should have access to are the OEM diagnostic flow charts. While I typically refer to these flow charts as a tool for those who don't understand how a system operates, they do at times contain specifications related to normal resistance, normal voltage ranges, etc. that aren't found anywhere else in the service information. Lastly, if you are dealing with an electrical diagnosis that involves a trouble code, you'll need access to the code set parameters. If you aren't familiar with code set parameters, these are the basic set of rules that determine when a code sets (voltage drops below "x" for "x" number of seconds, etc.). Understanding code set parameters will help you understand what "normal" operation is for a circuit.



RELAY CIRCUIT TESTING represents the skills needed for virtually all 12V system testing.

Strategy

Once you have your diagnostic tool(s) and have access to service information, you'll need a diagnostic strategy. I define a diagnostic strategy as a series of steps used to locate the source of the problem. A diagnostic strategy involves:

- Gathering information
- Duplicating the problem
- Defining when the problem occurs
- Checking for diagnostic trouble codes
- Researching information related to the problem
- Performing a thorough visual inspection
- Performing pin-pointed diagnostics
- Confirming the diagnosis before repair
- Verification of the repair

Information gathering should come from the primary driver of the vehicle. You must ensure you are getting as much information as possible about when the problem started, any conditions that make the problem worse or better, any additional complaints, and any history related to other recent repairs.

Once you have as much information as possible, you need to duplicate the problem. If a problem can't be duplicated, a repair should not be attempted. The bottom line is if you can't duplicate

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a problem, there is no way to accurately diagnose it or validate the repair when it is completed. Once you are able to duplicate the problem, you should define when the problem occurs. For instance, if the complaint is a blown fuse, make a note of what has to occur for the fuse to blow, as that information will help you in determining the root cause of the problem.

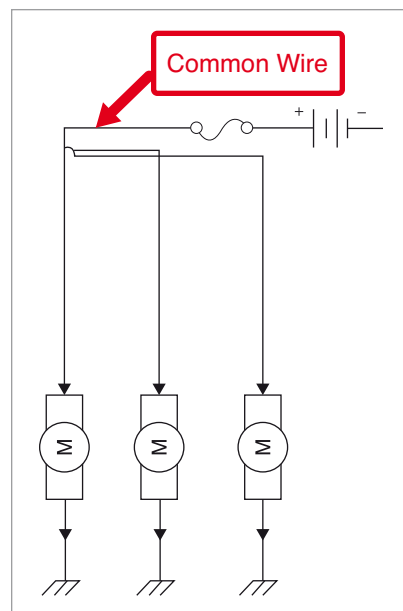
The next steps will be to check for diagnostic trouble codes and research the problem. This should involve checking for any related Technical Service Bulletins (TSBs) based on codes and/or symptoms, reviewing wiring diagrams, etc. Of these, the absolute most important for electrical diagnostics is reviewing the wiring diagrams for the affected components/circuits. Since you've already identified which component(s) aren't working, the diagrams should be

used to identify:

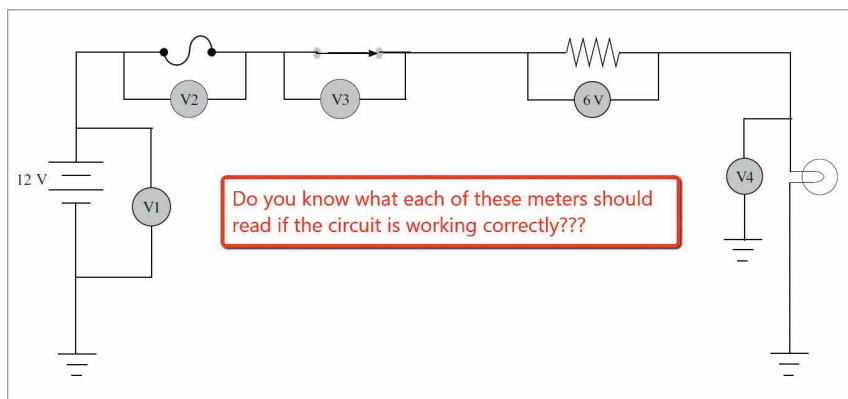
- Power source
- Ground source
- Commonalities if more than one component or system are affected
- Fuses
- Connectors
- Ground locations

Electrical fault tips

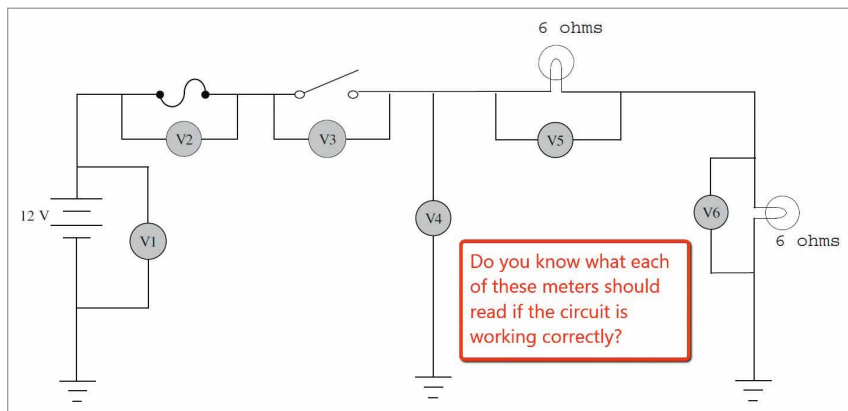
If you would like more information on the basics of reading electrical diagrams, there are many very good articles available on MotorAge.com. Once you understand how to read those diagrams, the next question becomes how to use them to speed up the diagnostic process. When looking at the diagram, you have to be sure not to get tunnel vision. In other words, make sure you remember the component(s) you are testing



IF ONLY ONE of the motors is not working the common wire cannot be at fault.



IF 6V ARE USED by (dropped across) the resistor, do you know what each of the other meters should read?



IF TWO LOADS with a similar resistance are wired in series, do you know what each of the meters should read?

don't operate in a vacuum; they are likely connected in one or more ways to other components on the vehicle. I like to start at the component itself and then work outwards. I typically follow the positive-side wiring on the diagram and find a junction point, connector or splice where there may be additional components supplied from the same voltage source. If you find any common positive-side wiring like that, it's as simple as activating those components that share the wiring to see if they work or not. If they do work, then you know the problem is not further back in the circuit. If they don't work, then you know the problem must be further back in the circuit. This type of electrical diagram analysis isn't meant to replace pinpoint testing but rather to reduce the time spent doing that testing. A very simplified example would be: Wire "A" supplies wires "B," "C" and "D." A component connected to wire "C" is inoperative but those connected to wires "B" and "D" still work. Given that fact, there is no reason to test wire "A" because a failure in that wire would have resulted in failure of all connected components. In essence, you

validated the integrity of wire “A” by using the diagram and the other components that also receive power from wire “A.” This type of diagram-based pre-testing work can significantly speed up your diagnosis.



HOW DO YOU KNOW what voltage each wire should have without a diagram?

Once you’ve narrowed down the parts of the circuit that will need to be tested as much as possible, the next step is to perform a thorough visual inspection. This doesn’t mean disassembling the entire vehicle, opening up all of the wire looms, etc. but you should perform an inspection on parts of the circuit that are readily accessible. Things you should be looking for include signs of physical damage, corrosion, previous wiring repairs and improper routing. Previous repairs should be inspected closely, as it’s not uncommon for a poor-quality wiring repair to fail again.

Of course, once you’ve narrowed down the parts of the circuit you need to test, you’ll need to know what the normal readings should be at each point you’ll be testing. This may seem simple to identify which wires should have battery voltage and which ones should have ground, but remember to take into account the effects of switches, etc. Also remember it’s best to test the circuit without disturbing it, if at all possible. Any time you disconnect connectors for testing purposes you run the risk of covering up or temporarily fixing the problem you are chasing.

Even after you’ve performed your testing and are fairly confident you’ve found the root cause of your electrical problem, you still aren’t quite done with your diagnostics. The last step in your diagnostics should be to attempt to bypass the problem area and confirm correct circuit operation, which accomplishes two things. First, it lets you verify your diagnosis before beginning a permanent repair. Second, it allows you to actuate the rest of the circuit to ensure there aren’t any other problems present that are being hidden by the failure you’ve already found.

Once you’ve identified the failure and repaired it, you should do a final verification of the circuit. It’s important to not only see if a component works, but you should also verify the integrity of the wiring to/from the component. That testing is best done using a voltage drop test on both the positive and negative side of the circuit while the component is operating. If the voltage-drop tests pass, you can feel confident in your repair and not have to worry about a potential comeback due to an underlying problem that was missed.

DTC applications

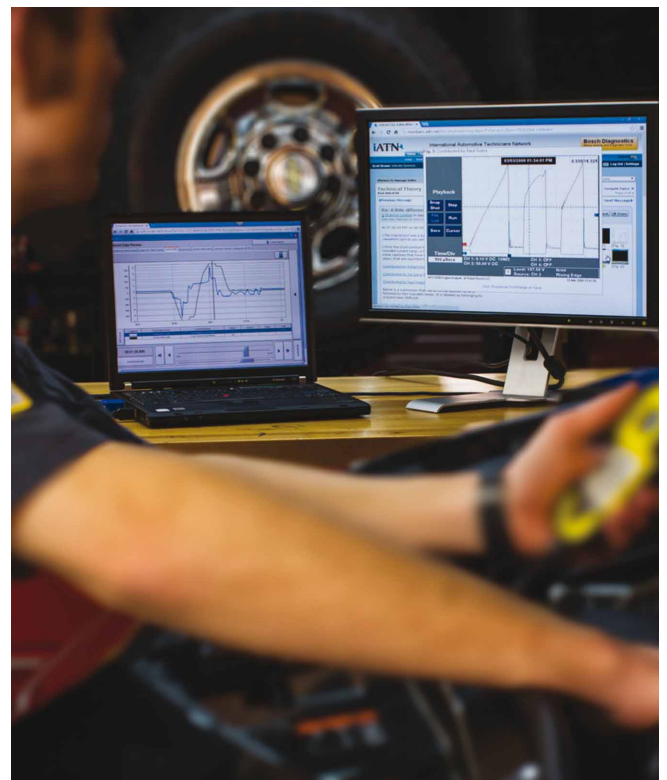
This same process can also be used to help speed up the diagnosis of check engine light problems related to things like actuators or sensors. It’s a similar process where you can use a wiring diagram to check for electrical commonalities in the components. If, for instance, you had a code for a single fuel injector circuit, you could use the wiring diagram to verify which parts of that circuit are potentially shared with other injectors that are still working. Any parts of the circuit that are shared with other components that are still working don’t need to be tested.

In the grand scheme of things, if you can explain and test the electrical integrity of a simple relay circuit, you can test virtually any 12V circuit. The electrical tests on other components/circuits follow the same exact principles, but you do need to effectively interpret wiring diagrams to know what “normal” is for each test being performed. *ZZ*



JEFF MINTER is currently serving as the service director for a group of dealerships in the heavy-duty vehicle industry. He is an ASE certified Master/L1/L3/F1 technician with OEM training from numerous manufacturers.

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NO FLASH IN THE LIGHTNING

VOLTAGE DROP TESTING HELPS SOLVE THIS FRUSTRATING FORD PICKUP COMPLAINT

JAIME LAZARUS // Contributing Editor

I heard the familiar rumbles off in the distance. It was summertime in central Florida. I was near the middle of an area that's called "the lightning belt" — an imaginary line that can be drawn between Tampa and Jacksonville. It's called this because it is said to have more lightning strikes per year than any other place in the Northern hemisphere. The weatherman said there was a good chance for a thunderstorm that day — and this time it appeared he was correct. The sounds continued to get louder as the storm got closer. Having lived in Florida nearly all of my life, I paid little attention, as this is an almost everyday occurrence.

The Pontiac Fiero's engine had been disassembled earlier in the day and the car was left outside to accommodate the service bay for other work while we waited for the delivery of the parts needed to reassemble it. With the approaching storm's arrival sure to beat the parts driver's, I pushed the car inside the bay just enough to where any rain that might blow in wouldn't cause damage to the exposed components. The wind started picking up, and since it was close to the garage door opening, I started protecting the car's engine compartment with plastic sheeting when...

I woke up on the garage floor beside the car! I could see the undercarriage as well as the tools on the other side. I

couldn't move. There was a loud ringing in my right ear. I took a deep breath and could smell something had burned, but couldn't place what it might have been. It wasn't like plastic or wood, just an unfamiliar smell of something that burned. I felt tingling all along my right side, including the right half of my tongue! Finally, I could move my right arm (was lying on my left side) and in a few minutes was able to sit upright. I gave a quick visual inventory of my extremities; all were intact, then looked around, still quite dazed, but had the wherewithal to know what just happened. I had been struck by lightning!

I'm thankful it wasn't a direct hit. In fact I'm sure if it had been, I wouldn't be sharing this with you today. Judging from the damage the strike caused, I'm certain it would have killed me. Every phone wire, phone jack and telephone in the building was destroyed. The TV was no good anymore. The submersible well pump on the property, hanging on over 60 feet of pipe, was destroyed as was the pump at a neighbor's home some 200 yards away! I have since forgotten what else was affected in that one-second-long event, but I'm sure you get the point.

A different kind of lightning

Can you imagine what my initial reaction was when years later I received a call from an owner desperate to get his Ford Lightning running? I had a



THIS TRUCK'S NAMEPLATE might stir emotions in some people.

flashback to that fateful summer day momentarily, but regained my composure quickly enough that it went unnoticed. His truck had stopped running unexpectedly and would not restart. My notes of our initial conversation include, "Owner has a Ford Lightning; the Powertrain Control Module (PCM) has failed (per Ford dealer's findings). The truck shut off, would not restart and has Passive Anti-Theft System (PATS) Diagnostic Trouble Codes (DTCs). He has another PCM he bought from Ford that needs to be flashed, but Ford was unable to perform the task."

As a mobile technician, I come across all kinds of unusual scenarios that aren't commonly seen in the stationary repair shops. "The engine quit running while being driven," the owner said when I arrived at the location to where the dealership had towed the vehicle, and "it has been to a dealership for analysis. The PCM was condemned and must be programmed to the vehicle." He wasn't sure why they couldn't

do it, or pretended this very well, and handed me the “new” PCM and the box from where it had been removed.

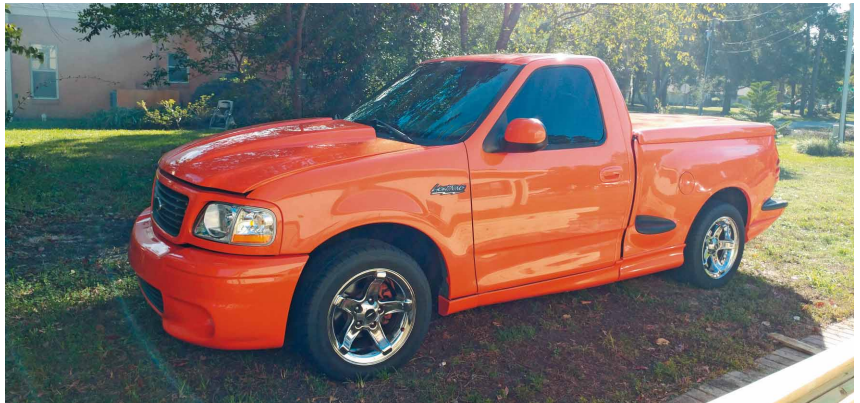
Without elaborating unnecessarily about all the details, I learned one of the reasons why Ford wasn’t able to complete the repairs on it. There was a “problem” with the Vehicle Identification Number (VIN). I learned the truck’s cab had been replaced, but the original VIN had not been transferred to the replacement. Therefore, the VIN displayed on the door label and viewed through the windshield (1FTRF07263KB98749) really didn’t belong to the rest of the vehicle — so the dealership probably refused to perform any more repairs once this fact was acknowledged by the owner. This VIN is for a 2003 Ford F-150! I was reconsidering the reasons why I chose to be a mobile tech at this point!

During my visual inspection, I also noticed the odometer was displaying only dashes. Performing the vehicle network test using the Ford IDS resulted in eight DTCs stored in the three modules that reported — but showed no communication with the PCM or the IC (Instrument Cluster). I informed the owner that it is impossible to program a module that cannot communicate on the network. I also educated him about how programming a module does not “allow” it to talk on a network (as he had thought). Then I began my own testing.

Where to go?

There are several tests published for when one or more modules are unable to communicate with a scanner. I reviewed them to refresh my memory of procedures that should be followed, and hoped they gave me some insight as to what might make it impossible to access those modules with the scan tool.

In most cases, there are redundant steps to follow, which could waste a lot of time, that if one reads through the



NOT MY TRUCK and not the original color.

whole test before beginning to work on the vehicle, one could skip those and still not misdiagnose the problem. For example, why check the power at the fuses and then again at the module if the fuses are “good?” It would be safe to assume that the fuses are “good” if proper voltage is read at the module if voltage were tested there first. Of course, if the voltage supplied to the module wasn’t what it should be, one could then work towards the battery, look at what voltage was read at the fuse, at the battery connections to the fuse block, at the ignition switch, etc.

I thought now would be a good time to take a quick look at the communication networks and the PCM wiring diagrams. If you’re reliant on one service information provider, then you might get a bit frustrated if you are the one trying to look for the correct network communication wiring diagram for this truck. I have a few providers, precisely for when I run into information that doesn’t match the vehicle I’m working on. That’s exactly what happened when I went to use my first choice.

It’s instinctive to just look for a “Pickup” or “F-150,” since “Lightning” wasn’t one of the choices available at the time I was entering the vehicle information. I saw two choices for a 2004 Ford, but the “Pickup F-150” choice showed me an incorrect diagram (and I went back thinking I erred when



THE PCM IS MOUNTED inside the vehicle, on the right-side kick panel above and outboard of the blower motor.

building the vehicle). The second time I made the other choice, “Pickup Heritage F-150.” What would you have done if your information provider’s data is incorrect? What would you do if neither choice matched the vehicle? Add the complication of possibly having the wrong wiring in the vehicle because the truck cab was replaced and now you’ve got a REAL mess!

I chose an alternate source of service information — the OEM’s site — to com-

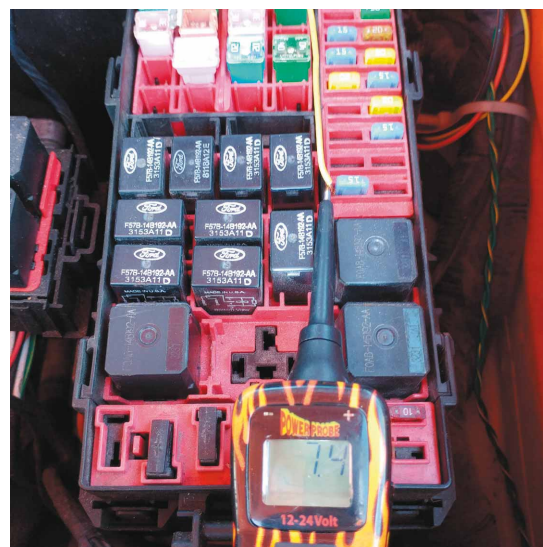
pare with my aftermarket information. Ford's Professional Technician Society (PTS) site, also known as Ford's Installer Support, showed the same wiring diagrams as Mitchell's (Shopkey). I knew my choice was correct when I saw "Heritage F-150" is what Ford's service information indicated this vehicle is — after I identified it by the VIN on their website. It would have saved me time to look there first in this case.

Once I had accurate-for-the-vehicle service information, I was able to perform circuit testing. It is nearly impossible to do so without an accurate wiring diagram! The easiest test to perform verified the integrity of the Standard Corporate Protocol (SCP) network wiring by using conti-

nunity. Continuity to both SCP wires was verified between the PCM connector and the Data Link Connector (DLC) under the dash by back-probing both while the ignition key was off. Neither wire was shorted to the other, nor was either shorted to voltage or to ground, and both showed continuity between the connectors. This meant the communication network to the PCM was intact.

My next test was to verify the integrity of the PCM's grounds. With the connector removed from the module, I applied battery voltage to the three ground terminals through a back-probe attached to each wire, one at a time. I used a Power Probe 3 only because it was already attached to the battery. The method I used caused the circuit breaker to "trip" in my tool, which indicated the circuits were able to withstand a substantial load and didn't display any voltage drop conditions.

It is a quick, easy and conclusive test for ground circuit integrity. Be aware — one must exercise extreme caution when performing tests this way! Please

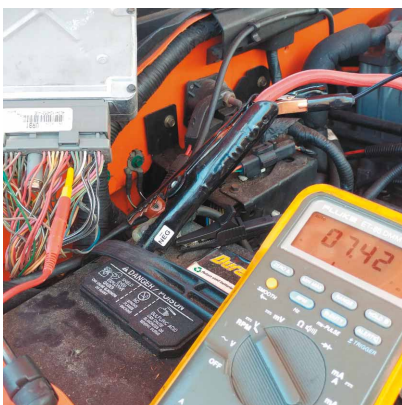


POWER PROBE 3 VOLT METER DISPLAYING circuit #361 source voltage at the battery junction block (UHFB) while touching the unprofessionally-installed wire sharing the fuse socket.

make sure, before you push the switch on your tool, that there are absolutely no electrical devices attached to the circuit or between the output of your tool and the battery (or batteries). If you aren't sure, then do NOT apply voltage to the circuit to which you are attached! In fact, I recommend people install safety devices to their tools to prevent the accidental introduction of battery voltage into a circuit being tested.

Grounds good, on to power

After verifying the grounds were good, I needed to measure the battery-supplied and ignition switch-supplied voltages at the PCM connector. I reconnected the PCM electrically and tested for adequate terminal voltages by back-probing the appropriate terminals. It was during this test when less than 8 Volts DC was measured on the "VPWR" circuit, #361 (PCM Pins 71 & 97). Suspecting the possibility that the dealership technician condemned the PCM because an internal fault was causing such a voltage drop on these circuits, I disconnected it and measured the voltage again. It was identical!



DVOM BACK PROBING PCM connector circuit #361 showing 7.41 VDC (not the 12 VDC it should have).

Screenshot of the Ford Technical Resource Center website showing vehicle information for a 2004 F-150 Heritage. The page includes sections for Vehicle Information, General Warranty Information, Outstanding Field Service Actions, and Extended Coverages.

Vehicle Specific Information 3FTRF7364C23030		USA: EN: US	20-NOVEMBER-2017 15:24:44 EST: EDCA505HA Login Time: 29-NOVEMBER-2017 3:24:12 PM
VEHICLE INFORMATION			
VEHICLE DESCRIPTION 2004 F150	VERSION/SERIES: 190 SERIES	DRIVE TYPE: 2 WH, LH REAR DRIVE	PAINT COLOR: Sonic Blue
ENGINE 4.0L Gas V6 SOHC SFI	AXLE RATIO: 3.79 Ratio	AXLE CODE: B6	WHEEL SIZE: B&X HF 6-SPRKE ALUM CHROMED
TRANSMISSION: 4 SP Auto Trans 5A&O 4R150 HD	TIRE: FORWARD: R1 PERF 23W	RETAIL SALES TYPE: R	
GENERAL WARRANTY INFORMATION			
FINANCING BY: 31 PERI LPH LC: 22-JANUARY-2004	BUILD DATE: 26-OCTOBER-2003	RELEASE DATE: 26-OCTOBER-2003	
SALE M/CAGC: 00014			
OUTSTANDING FIELD SERVICE ACTIONS			
8250: GREEN CONTROL SYSTEM MODIFICATION			
11521: FUEL TANK STRAP INSPECTION AND REPAIR			
EXTENDED COVERAGES			
3759: EXPIRED	STANDARD DEDUCTIBLE: 100 USD	EXPIRATION DATE: 22-JANUARY-2010	OWNER NAME: DISTANCE: 69000
11000: EXPIRED	CONTRACT SOLD BY: USA 01029		OPTIONS: \$100 DED. RENTAL: 28 UP TO 16 DAYS
3892: EXPIRED	STANDARD DEDUCTIBLE: 0 USD	EXPIRATION DATE: 22-JANUARY-2005	TOWING: 0 USD
	CONTRACT SOLD BY: USA 01229		ESR CONTRACT START DATE: 22-JANUARY-2004

FORD'S PTS SITE properly identifies the vehicle based on the VIN (including the original color and powertrain options).



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#partsmatter

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This meant the voltage supply from the ignition switch was insufficient. A look again at the wiring diagrams showed these two circuits were supplied voltage by just one fuse. I removed the Battery Junction Box (underhood fuse block) cover. A visual inspection of the fuse in the circuit revealed a yellow-colored wire was forced into one socket that the fuse's "leg" was meant for, in addition to the fuse! My Power Probe volt meter indicated a "good" supply on one leg, yet only 8 VDC on the other.

Even after removing the non-factory-installed additional component (yellow wire) from where it was forcibly inserted, the voltage readings didn't change! The fuse was damaged; the loop between the two fuse legs was barely touching one of the legs! Whether it broke from being wedged into place or due to vibration, the fuse was producing a voltage drop — so much so that the PCM wasn't getting enough to wake up when the key was turned on. I replaced fuse #18 and found the odometer was now properly displaying numbers instead of all dashes. I was now able to communicate with both the IC and the PCM.

I successfully performed all PCM self-tests and cleared all CMDTCs throughout the vehicle, verifying the PCM wasn't faulty. At the owner's re-



VOLTAGE DROP STILL evident through the fuse after yellow wire has been removed from the fuse socket.

quest, I installed and programmed the replacement PCM (since he said it wasn't returnable anyway). I called this job done.

There are times when I see guidelines or advice printed by a manufacturer about a purchasing choice, which warns of inferior products that may adversely affect the operation or longevity of something the manufacturer produces. For instance, we all (should) know not to use inferior oils in an engine designed for use with a specific product. Doing so may cause problems that could be catastrophic.

Another example, certainly one by now we are all aware of, is the GM service alert (#07-08-45-002) where "concerns" were published about how well

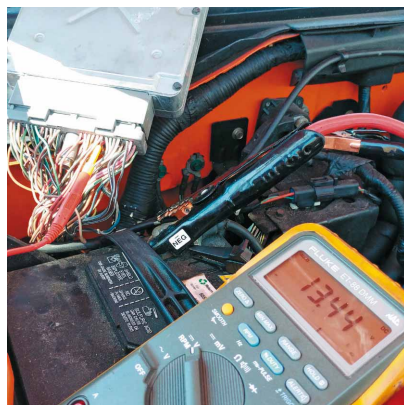
certain aftermarket blade-type fuses performed in certain applications. The TSB described in detail why GM was concerned and placed emphasis on why, in the name of safety mostly, shops and dealerships should inspect their inventories for faulty items and immediately remove them so no technician would install them in a customer's vehicle. I don't know if the fuse producing the voltage drop was one GM mentioned or not.

There are also times when I see guidelines or advice distributed by experts in their field(s). I heed the warnings of weather experts now when they warn of severe thunderstorms approaching — ever since that fateful summer day when a lightning strike nearly took my life. The only lightning I'll mess with now is made by Ford!

P.S. — Can a voltage drop test be done with a test light? Think about that when you're checking fuses from now on! **TLZ**



DAMAGED FUSE — loop broken from the "leg."



DVOM INDICATING proper voltage at PCM connector circuit #361.



JAIME LAZARUS

has regularly presented technical seminars since 1985. He recently taught instructors at the North American Council of Automotive Teachers conference and the

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THE MOVE TO LAPTOP DIAGNOSTICS

ARE PC-BASED SCAN TOOLS OVERTAKING HANDHELDS? WHAT YOU NEED TO KNOW ABOUT GROWING TRENDS IN DIAGNOSTIC TOOLING.

ERIC ZIEGLER // Contributing Editor

How many times have you heard a customer come in the shop and ask if you “have that computer that you hook up to my car that tells you everything that’s wrong with it?” Over the past 20 years or so I have heard this phrase or something like it, more times than I can recall. It started back when vehicles started to incorporate the ALDL (OBD I) or DLC (OBD II) test port inside the vehicle that we plugged a scanner of some sort into. While a scanner was technically a computer, its processor, RAM and internal storage was limited at best. Nowadays it has come full circle. I find myself daily with a laptop in one hand and scan tool interface in the other. So I ask you, “Do you have a computer, laptop or tablet that you plug into a vehicle to aid in its diagnosis?” If your answer was no, I would be curious as to why not.

In this article we will examine the shift by the OEMs and scan tool manufacturers away from the traditional handheld scanners of the past to a laptop or tablet-based systems. Don’t get me wrong, I still use handheld scanners like the DRB III or Snap-on Solus Ultra from time to time. Handheld OE tools like the GM Tech II in years past were almost surgically attached to my hand; nowadays, I find myself still using a virtual Tech II by utilizing GM’s Tech2Win



MANY OF US GREW UP ON the handheld scan tool like the venerable Tech2 or DRB III, or an aftermarket one like the Snap-on “brick.”

software and a MDI interface.

GM

Tech2Win has almost all the functionality of its predecessor, less Tech II remote programming. Moreover, the boot time is much faster, the screen size is much bigger and the ability to make screenshots and archiving data is much easier. The only downside is that you have to have a current subscription to use it. You must have either a three-day, short-term subscription, an add-on to the TDS programming package or the Global A vehicle laptop-based diagnostic software Global

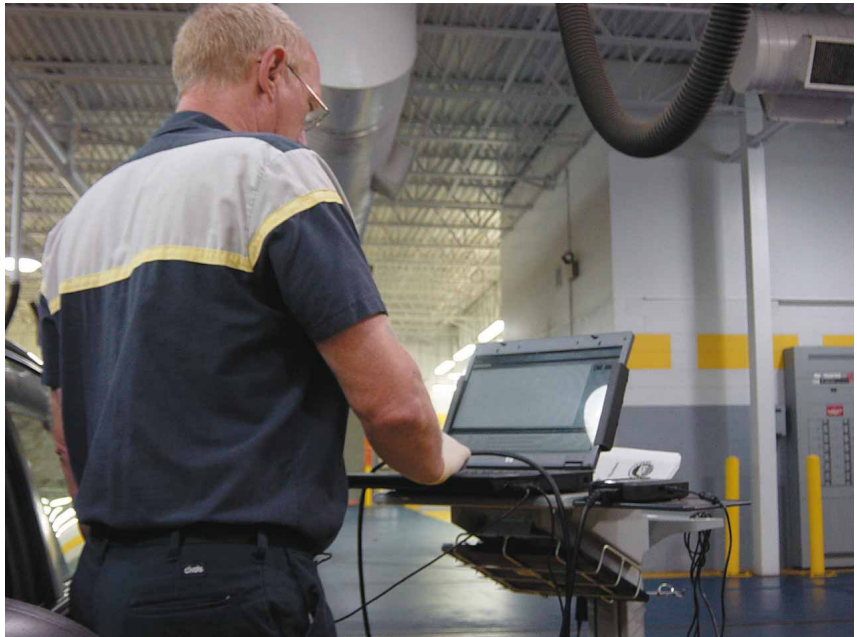
Diagnostic System II (GDS II). Tech2Win has a 29-day subscription timer that counts down and will lock you out if you do not renew. The Modular Diagnostic Interface (MDI) 1 or 2 can be used as an interface as well as any Drew Tech J2534 device including the inexpensive USB-style Mongoose GM Pro interface.

The Tech2Win laptop setup with an MDI 1 or MDI 2 or approved J-2534 device eliminates the need for the requisite CANdi module for the handheld unit. It can be installed on more than one laptop and is touchscreen compatible on Windows-based touchscreen

laptops and tablets. It shares all the same functionality as the handheld Tech 2, such as DTC reading and clearing, reading data, recording snapshots, bidirectional control, as well as all the special functions like misfire graphic, injector balance and EVAP service bay tests. It's only shortcoming, if there is one, is that it doesn't have the ability to do Tech2 remote-style programming where the information is inhaled into the Tech2 and then exhaled into the vehicle for module programming. I see this to be a moot point considering the Tech2 remote programming ended about the time CAN vehicles emerged on the scene circa 2007 or 2008 and for the fact that you can SPS flash (SPS subscription required) much faster with the laptop setup. All the information regarding purchasing a subscription, step-by-step instruction on software installation and how to update the Tech2Win software are available at www.acdelcotechconnect.com.

Toyota

Another very powerful and relatively inexpensive laptop-based OE scan tool that has made some major changes and become more affordable than ever is the Toyota Techstream Lite. Toyota switched from a handheld platform based on the Vetronix MTS3100 platform to join the laptop ranks with the introduction of Techstream. The original Techstream came with a Panasonic Toughbook, carbon fiber cradle and Denso VIM or Vehicle Interface Module that was very expensive, with a cost north of \$10K when it was introduced. This was cost prohibitive to small shops and large shops requiring multiple units. Toyota wanted to come up with a way to put an OE scan tool in each tech's hands for under \$1,000. They partnered up with Drew Technologies to design a low-cost interface to use with Toyota's Techstream software. The result was



LAPTOP OR PC-BASED SCAN TOOLS are becoming the norm, and offer a variety of added benefits to the tech including point-of-need access to service information and diagnostic resources.



LAPTOPS ALSO ALLOW TECHS to expand their diagnostic arsenal with add-ons like the DSO shown.

Techstream Lite. This was the origin of the Drew Technologies USB-style Mongoose MFC interface, which was a low-cost ISO 9141 interface (< \$500) that could work with a Windows-based laptop with a USB port. Toyota of-

fers the Techstream Lite package with Mongoose and a year's subscription that includes scan tool updates, flash files, service information and Identifix Direct Hit for Toyota, Lexus and Scion vehicles for an extremely reasonable

price. If you already have a Toyota validated J-2534 compliant device, one can have an OE factory scan tool with OE service information and flash files for a reasonable price. Information regarding Techstream Lite can be found at <https://techinfo.toyota.com>.

Techstream has many useful features, such as Health Check, which will query every module on the vehicle, check for DTCs, as well as freeze-frame data, info codes and all the module calibration numbers once the vehicle has been identified and communication started. In addition, in some instances, it will record stamps of the failures and when the scan tool has access to the internet, it will check for any calibration updates available. It can even record the tire pressure readings via TPMS. The Health Check results are conveniently displayed on one screen, color coding the modules that have DTCs stored. The Health Check data can be archived for later viewing. Moreover, a detailed diagnostic report can be printed and shared with the customer or generated for pre-/post-scanning records on collision vehicles.

Techstream Lite has all the other features one would expect, like scan data monitoring and recording snapshots. It harnesses the power of a laptop processor and graphs well. Subsequently, it has bi-directional control of actuators and has the ability to run several special functions such as Toyota's 11-step evaporative emissions diagnostic test, which can be graphed making short work of interpreting the data from the test.

Aftermarket moves to PC

It's not only the OEMs that have embraced utilizing the power of a laptop and using a USB-style interface. Tools like the Ross-Tech VCDS (former known as Vag-Com) have been doing this since the early 2000s. Around May of 2009 Vag-Com simply changed names and is

now known as Ross-Tech VCDS (Vag Com Diagnostic System). This is, in my opinion, is possibly the biggest bang for the buck in laptop-based scan tools. The scan tool platform runs on Windows-based laptops. It is for VW/Audi/Skoda/Seat vehicles only and lacks immobilizer and programming capabilities. But what it does it does extremely well. The price of this tool is comparable to a quality of a ½" drive socket set in some cases. Moreover, it is the only scan tool I have ever purchased that did not charge me for updates. That's correct — updates for the Ross-Tech VCDS are free!

The VW VAS 5051/5052 was the tablet-based OE tool during the time Vag-Com introduced. Simply put, the VAS5051/5052 is extremely slow and complicated to run unless one was a trained VW tech or had access to factory publications detailing the numbering of module addresses, measuring blocks and basic settings functions. Vag-Com was a game changer in the fact that they labeled the modules along

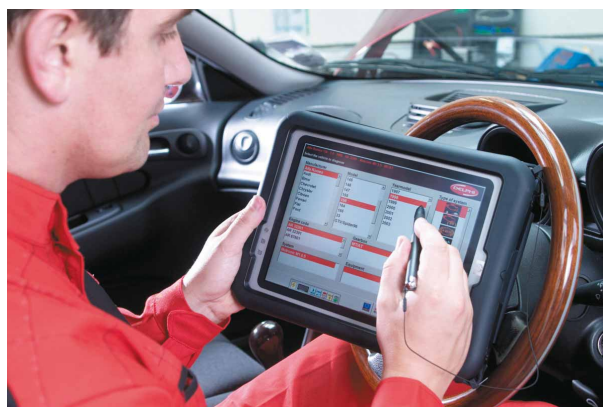


PHOTO: DELPHI

TABLETS ARE AN INCREASINGLY POPULAR handheld platform, allowing touchscreen convenience and intuitive navigation.

with their addresses and listed the data blocks in Measuring Blocks to help in identifying the data PID for the module that you were monitoring. VCDS (Vag-Com) also did something extremely helpful, which was to do an auto scan based upon the vehicle's VIN that generated a "log file" that displayed all of the vehicle's modules by their address and listing the module's coding, any DTCs stored and freeze-frame information with time stamps in most cases. This auto scan process was much faster than the factory tool, especially if you added in the boot time, largely because VCDS queried the suggested modules by VIN code rather than checking every possibility. However, CAN-equipped vehicles



THE VCDS OFFERS most of the OEM features at a much lower cost and is easy to learn how to operate.

run the scans much faster than their non-CAN counterparts. This log file could be archived for later use, as well as printed for documentation for pre-/post-scans or showing the customer.

VCDS also can perform adaptations, reset Service Reminder Indexes (SRI), check TDI pump timing, graph scan data and force readiness monitors to run. Perhaps the greatest feature of VCDS is its ability to code modules and their slaves' offline. Coding is essential when a module has been replaced to unlock the software inside of it for the appropriate vehicle options. It isn't programming — in the VW/Audi world it is SVM or Software Version Management — but it is an essential configuration/setup of a replaced module. The VCDS log file can be saved — including the coding data — and it can be referenced later. This is helpful when a scan has been performed and saved and later a module was replaced with the old module is no longer present to extract the coding from. Furthermore, VCDS has a unique feature known as coding helper, which will suggest or give the options of the module's coding choices and the configurations they represent. In addition, the Ross-Tech Wiki is a web-based information site that is extremely helpful in all facets of VCDS operations, but it really comes in handy when trying to figure out the appropriate coding for a module that has been changed and the previous coding or correct coding is not known.

The Ross-Tech VCDS- NET Pro[®] is now available in the wireless WIFI interface, which shares all the same functionality as its predecessor and will now work on non-PC platforms. According to Ross-Tech, it is compatible on devices with Microsoft Windows' versions from XP through the current Windows 10, Apple iPad[®], iPhone[®], most Android[®] phones and tablets, Blackberry Z10[®], Q10[®] Micro-

soft Surface[®] and Windows Phone[®] and Kindle Fire[®]. The same interface will also work hardwired with a USB cable. It acts as a dongle when plugged into the DLC.

The activation of the full VCDS or new VCDS mobile software is built into the interface. There are customer loyalty incentives that allow past VCDS owners to upgrade to the VCDS-Net Pro via a trade in. Ross-Tech also offers an annual support package, which is extremely reasonable. I have owned their products since the early 2000s, as well as the VW/Audi factory tools, and regularly grab my VCDS for quick scans and function that do not require online functionality or Guided Fault Finding (GFF), which VCDS does not have. All things considered, this is a very affordable, powerful, intuitive and well supported diagnostic scan tool. Further information regarding Ross Tech VCDS can be found at www.ross-tech.com.

Capability beyond the scan

Up to this point we have examined laptop-based scan tools; however, the move to technicians having laptops in the service bay can also incorporate access to service information, pay sites like www.iATN.net, invoicing software, digital vehicle inspection (DVI) and other power tools such as a PicoScope[®] lab scope.

Think of the time saved by having your service information (SI) or wiring diagrams right at your fingertips via a laptop or a tablet as the tech works on a vehicle. Traditionally, shops that I worked at had SI on a desktop computer, usually the invoicing computer in the front office. If not, there was a separate desktop setup in the shop



THE NEWER MONGOOSE PRO, coupled with the Toyota software, provides techs with the Toyota factory tool at an affordable price.

that all the techs shared. Wiring diagrams and test plans were printed out and carried to the vehicle. If someone else was using the desktop, it created a roadblock. Nowadays with each tech having their own laptop and wireless access to the internet, techs can access the information they need right at the vehicle. Many systems allow the techs to look at the vehicle's service history and share invoice information such as VIN, odometer reading and plate number and put services and parts direct to the RO. DVI allows the you to incorporate photos in the inspections and to email or text them to the vehicle's owner. These are all tremendous time savers and increase efficiency.

So the question remains, have you or your shop integrated this not-so-new technology? If not, what is keeping you from making the leap? Change can be scary for some folks. But if you think about it, our industry has always been in a state of technological flux. We live in interesting times where time equals money. Harnessing the power of laptop-based diagnostic tools and systems is just another way that we can increase our efficiency and productivity. **ZZ**

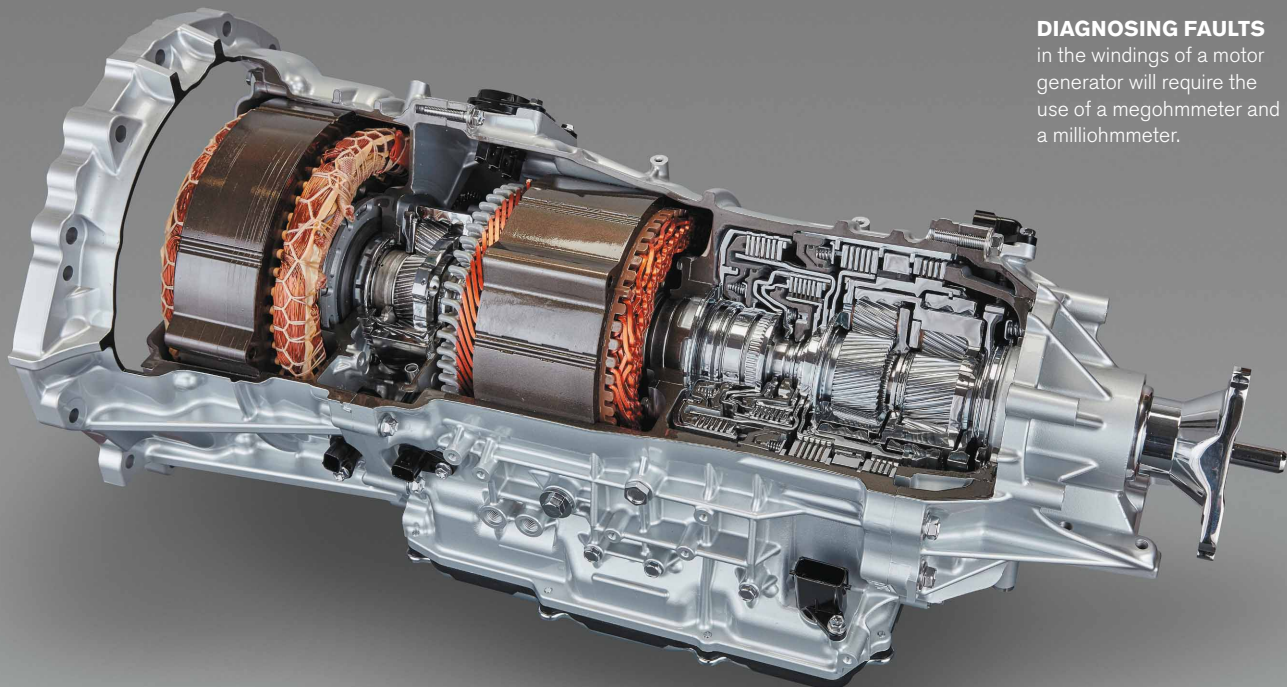


ERIC ZIEGLER is an ASE Certified Master Tech who specializes in module programming, drivability, electrical and network systems diagnostics. He owns and operates EZ Diagnostic

Solutions Inc. and is a trainer for Automotive Seminars and The Driveability Guys.

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DIAGNOSING FAULTS
in the windings of a motor generator will require the use of a megohmmeter and a milliohmmeter.



MEGOHMS AND MILLIOHMS

A LOOK AT ONE OF THE NEWEST DIAGNOSTIC TOOLS FOR HYBRID REPAIR — THE MILLIOHMMETER

DAVE MACHOLZ // Contributing Editor

The digital multimeter (DMM) has been around for quite some time and is an invaluable tool for performing a variety of tests including available voltage, voltage drop, resistance, diode tests and more. With advancements in

hybrid and electric vehicle technology, new testing equipment may now be required to perform advanced tests outside of the capabilities of the traditional DMM. The megohmmeter and milliohmmeter are two of the tools that you are most likely to see when diagnosing faults within the windings of motor generator units and the high-resistance,

high-voltage wiring that carry the current for the motor generators. New tooling brings us to a familiar crossroad of the questioning of our diagnostic strategies and whether or not the hybrid repair business is one in which we want to venture. We will look at the ins and outs of this new tooling and help build a case for intelligent diagnostics.

PHOTO: FLUKE



THE FLUKE 1587 is a popular megohmmeter for hybrid insulation testing.

Before we dive into specific tooling, it may be helpful to refresh our knowledge of the units of measurement for resistance. The base unit of measurement is the Ohm, named for Georg Ohm, a German scientist who discovered and named the principle of resistance. Units of measure smaller than an ohm include milliohms and micro-ohms. Units of measure larger than the ohm are the kilohm, the megohm and the gigohm. A megohm is equivalent to 1,000,000 ohms while the base unit ohm is equivalent to 1,000 milliohms.

The megohmmeter

The megohmmeter, often known as an insulation meter, functions in a very similar fashion to the resistance or diode check feature on your traditional DMM. These features utilize a current that is sent through the leads to determine a voltage drop, which is then displayed as a unit of resistance measured in Ohms. We have been taught that using the resistance function on the DMM does not give us an accurate indication of a circuit's integrity due to the fact that we are not testing the circuit dynamically. However, that notion is misleading. We are testing dynamically but the meter does not produce enough voltage or current to truly load the circuit. This is why voltage drop testing a live circuit is so effective because the current within the live circuit is providing the "dynamic" portion of the test. The DMM is simply reading the results. The lack of voltage and current is the reason

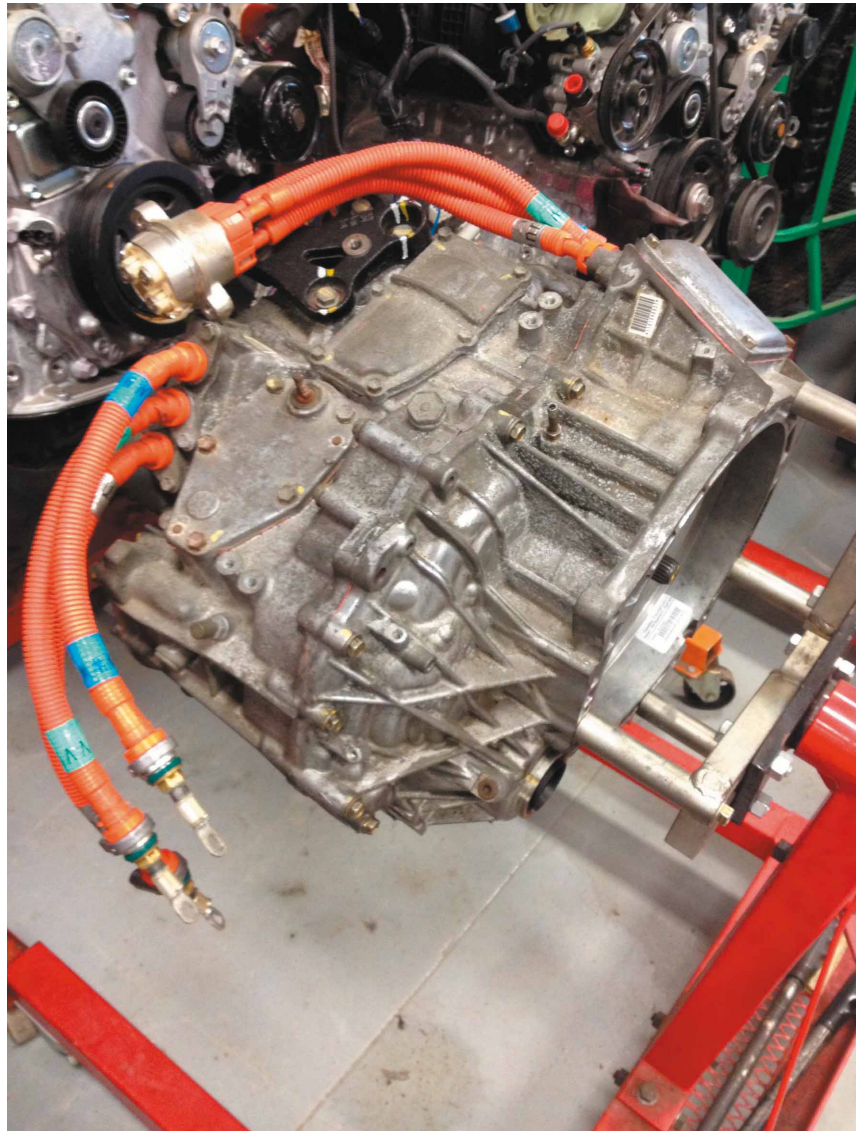


PHOTO: DAVE MACHOLZ

DIAGNOSING WITH A MEG OR MILLIOHMMETER requires the component or harness to be isolated from the HV circuit.

that there are two different settings for resistance measurements and diodes to begin with. The resistance function utilizes approximately 2-3 volts and relatively low current. This amount of current is not enough to properly forward bias a diode while yielding an accurate voltage drop measurement. In plain English, when using the Ohms function to check a diode your resistance measurement will most likely be inaccurate. You will be able to see that the diode passes current in one direction and blocks it in the reverse polar-

ity, but the actual voltage drop reading displayed on the meter would be wrong. The diode test function provides enough voltage and current to forward bias the diode and will yield an accurate voltage drop measurement. When it comes to testing the windings of an electric motor such as those found in hybrid electric, electric and fuel cell vehicles, the DMM simply does not have the ability to reach the voltage or current required to "dynamically" test the windings. Additionally, using a voltage drop test for this type of circuit is dangerous and should be

avoided at all costs. The megohmmeter allows the user to test these high voltage components in an isolated environment while the high voltage system within the vehicle is disconnected. Think of these tests as you would a pressure test of a hydraulic circuit. If you were to pressure test a hydraulic circuit, you would most likely pressurize the system in excess of the typical system pressure in order to determine if there are leaks in the system. The insulation of high voltage systems is very similar to that of a hydraulic system and insulation of the wire is very much like the hose or pipe that carries the hydraulic pressure. If the pressure compromises the insulation, a faulty reading will be displayed on the meter. For the sake of your safety, do not attempt to test these circuits while the high voltage system is operational. Follow manufacturer instructions and perform your testing accordingly.

Megohmmeters are readily available through the name brand electrical testing companies you are already familiar with and can be purchased for between \$500-\$700. Whether or not this investment may prove to be worthwhile might depend on how committed you are to hybrid repair as well as the frequency of these types of repairs that

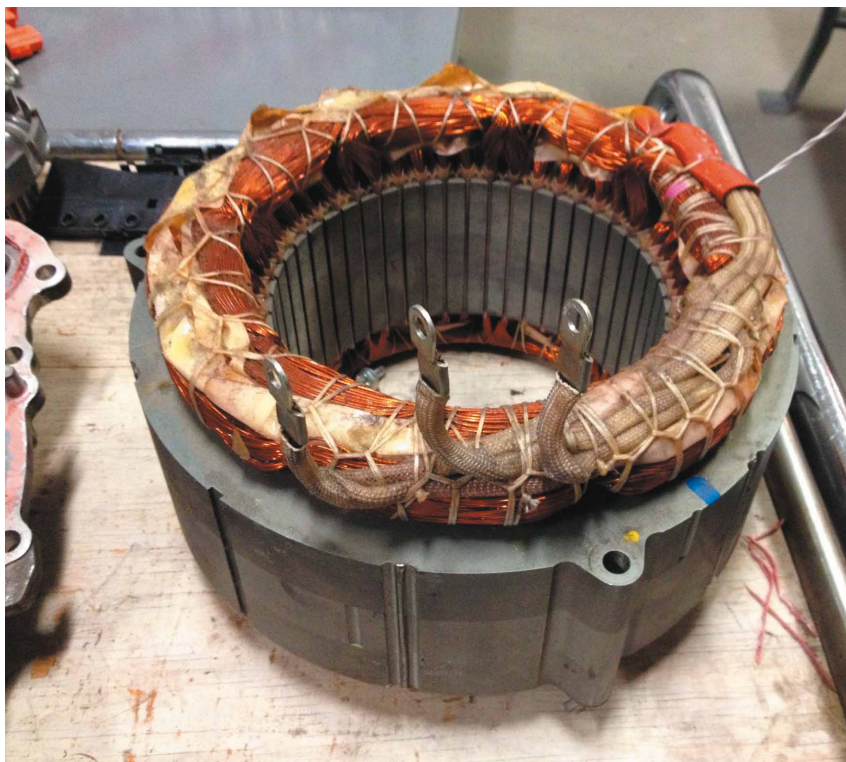


PHOTO: DAVE MACHOLZ

DIAGNOSING WINDINGS within the MG units may require the use of a megohmmeter and a milliohmeter.

you might see in your shop.

Reality check

Last year I received a call from an acquaintance who does a fairly significant amount of diagnostic work. He called with the complaint of a P0A7F diag-

nostic trouble code with an information code of 555 on a late-model Toyota Prius. This particular code had the technician concerned due to the fact that the diagnostic flow chart for this code within Toyota's service information was more than 150 steps long and

included the use of a megohmmeter, which he did not own. Additionally, following the flow chart indicated that there was a problem in one of three major areas: the hybrid transaxle, the inverter assembly or the high voltage ECU. None of these yielded themselves to a silver-bullet fix or the ability to substitute a known good part. The call was one of those we have all made at some point looking for a workaround for a diagnostic process that included tooling we just don't have.

TOYOTA PROVIDES QUICK TRAINING GUIDES for megohmmeter and milliohmeter usage with a TIS subscription.

HINT:

- *1: The HV control ECU may be suspected as a main cause of the malfunction.
- *2: The power module intelligent transistor set may be suspected as a main cause of the malfunction.
- *3: The hybrid vehicle transaxle assembly may be suspected as a main cause of the malfunction. In this case, the vehicle may not drive smoothly.

MONITOR DESCRIPTION

If over-amperage flows through the boost converter due to an internal short, the boost converter transmits a boost converter fail signal to the HV control ECU. Upon receiving this signal, the HV control ECU illuminates the MIL and sets a DTC.

MONITOR STRATEGY

TOYOTA PROVIDES HINTS AND TSBS for complex hybrid faults, which often bypass the need for advanced tooling.

One of the amazing things about Toyota as a company is their commitment to “Kaizen” processes or “constant improvement” as it translates. This has led Toyota to build updates into their service information in the form of service hints, which appear in TIS documents in green font and usually proceed service and diagnostic procedures. In the case of the P0A7F, Toyota indicated a hint that pointed the technician toward the hybrid inverter assembly. Surely it couldn't be that simple, could it? In this case it was. The choice then became whether to buy a new inverter or replace the Intelligent Power Module within the inverter. Both were prohibitively expensive. This led to a call to a local salvage yard and the acquisition of a complete inverter unit for \$250. A few days later I received a call back that this car was fixed and returned to its happy owner.

Diagnostics are never quite as easy as that example, but this story points to a larger reality. The person who wrote that hint most likely used a megohmmeter to get to his diagnosis, but the techs that followed were able to bypass those steps. Toyota had their fair share of issues with inverters, and technical service bulletins and service updates were readily available to point technicians in the right direction. While every diagnostic scenario is unique, the frequency in which you will use the

megohmmeter may help make up your mind as to whether or not it's a part of your tool set. For the hybrid specialty shops, it may be a no-brainer, but for the typical shop performing hybrid maintenance and repair work, the answer may not be so cut and dry.

The milliohmmeter


While many are still adjusting to the concept of megohmmeter usage, certain DTCs relating to the motor generator units will now require testing with a milliohmmeter. The milliohmmeter specified by Toyota is the Hioki RM3548, which retails for about \$1,200. Much in the way that the DMM was limited in its ability to test high resistance values, the DMM also cannot measure very small resistance values to verify good connections. The milliohmmeter offers the ability to measure resistance between phases of the motor generator units when dealing with trouble codes relating to the MG units.

The main difference between the megohmmeter and the milliohmmeter is that the milliohmmeter is designed to read a very small amount of resistance. In order to get a precise reading, the milliohmmeter utilizes a 4-wire resistance measurement in which two of the wires pass the current through the circuit while the other two wires make the delta (difference between two points) voltage measurement. The milliohm-

meter further depicts the deficiencies of a traditional DMM for resistance measurement.

Temperature of the windings is also critical to the test procedure. You may recall that as temperature goes up, resistance goes up. When you are dealing in milliohms, the temperature becomes incredibly important. Toyota, for example, uses the temperature of 20 degrees Celsius throughout their service information. If you were to take a measurement of a motor generator unit that was not at that ambient temperature, the readings may mislead you and lead to a bad diagnostic outcome. A formula will need to be utilized to adjust for the actual tested ambient temperature. Toyota suggests that you store both the meter and MG unit in the same area before testing. Additionally, Hioki specifies an operating heat range of 32-104 degrees F with a relative humidity of less than 80 percent.

Additional resources

Toyota's factory service information subscription is one of the least expensive in the industry. To access Toyota's information, visit www.techinfo.toyota.com. Within the TIS system you will find a tab titled “QTG” (Quick Training Guides). Toyota provides a quick training guide on the usage of megohmmeters as well as milliohmmeters to use as a reference for testing. These are fantastic resources for first-time users. It's well worth the cost of a 2-day subscription (about \$15). 



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L1 technician and holds a New York State teaching certification in vehicle repair.

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WHAT MAKES YOU WANT TO LEARN?

YOU HEAR US HARPING ON THE NEED FOR CONTINUED TRAINING ALL THE TIME. BUT WHAT IS IT THAT MOTIVATES YOU TO LEARN?

PETE MEIER // Technical Editor

The last shop I worked for full-time was a national chain that specialized in reconditioning used cars for sale. Internally, we had two distinct “teams” — one was a group of techs who inspected and repaired the incoming stock and the other was made up of techs who took care of our retail and warranty customers. I was on the latter.

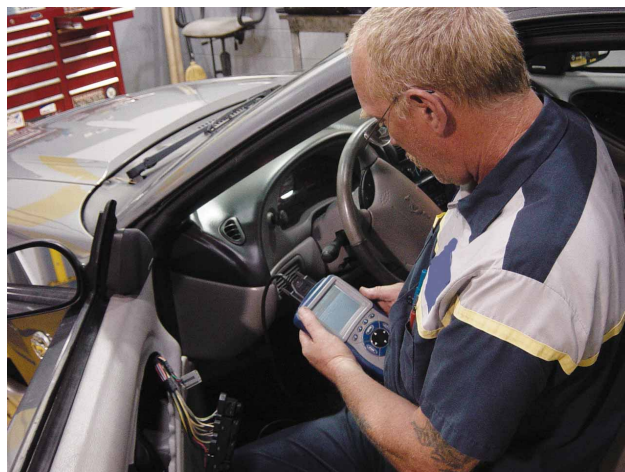
The company, at that time, held annual contests for its technicians. Techs competed against one another first on a state level with the winners going head to head in a regional competition. Those winners, in turn, competed for top honors at a national event. I participated in the contest that first year and was successful in earning a slot at that national contest. And I was very optimistic about my chances at winning there, too.

I blew away the written part of the contest and aced every skill station I was assigned. It was all going to come down to the hands-on troubleshooting challenge. The judges had bugged several GM trucks in order to generate a DTC and turn on the vehicle’s MIL lamp. We would be judged on our speed in coming to a successful diagnostic solution.

Watching it slip away

I don’t recall the DTC — I think it was a P0101 (MAF sensor circuit range/performance problem). What I do remember is that it was more than likely a circuit issue and I should be able to nail it down pretty quickly using a technique I had recently read about. Something called “voltage drop” testing.

At first, I did what many still do today. I unplugged the connector and measured power to the sensor. At the time, I didn’t realize or understand that I was only measuring OCV (Open Circuit Voltage) and wasn’t really testing the circuit’s actual ability to provide full voltage in the working circuit. I then moved my leads to the ground side with the connector plugged back in. The meter was trying to tell me that I had



RELYING ON SKILLS learned in days past will only take you so far when dealing with more modern systems.

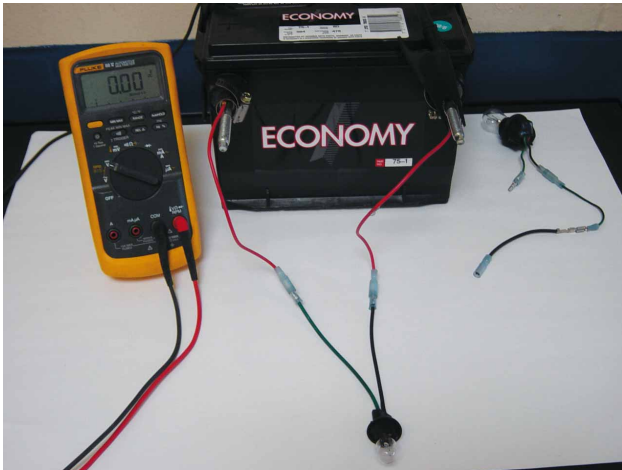
located a problem on the ground path, but I wasn’t seeing it. My test procedure was correct but I didn’t understand the concept of how voltage drop worked in a “live” circuit. All I could remember thinking was, “How can I be measuring voltage when my leads are attached to a ground point on both ends?” I questioned my lead placement, my interpretation of the wiring diagram and even began wondering if the meter I had been provided with was working properly. My judges could see my building frustration and tried to provide me with little clues, to no avail. I was lost — pure and simple.

And it cost me the competition. And that ticked me off.

I wasn’t angry because I lost. I was angry at myself because I had tried a testing method I was sure I understood and failed. (OK, maybe I was also a little angry that I lost.)

What are you going to do now?

That anger fueled a strong desire to really learn what I thought I had already learned. I went back to the source I had first found and reread everything I could find on voltage drop testing.



IT MAY NOT LOOK LIKE A FANCY LEARNING AID, but it was all I needed to finally make sense of voltage drops.

Then I went out to the shop and built a simple circuit with a battery, some wire and a couple of light bulbs.

First, I wired just one bulb to the battery. Then I took my meter and measured voltage on the positive side with the bulb lit, and then moved my meter lead to the ground side. Keep in mind that I'm using the positive meter lead to take the measurements while leaving my meter's negative lead grounded to the negative battery terminal.

I read near battery voltage on the first measurement but this was no longer OCV that I was reading. This was now a loaded circuit and the voltage first had to pass through any other sources of resistance in that circuit before it made it to the bulb. And that's when the first "bulb" went off in my head! The reading was slightly less at the bulb connection because of the resistances encountered along the way: the point of connection at the battery and the point of connection between the wire I was using and the existing bit of wire from the bulb's original harness I had the bulb plugged into.

The ground side read a few tenths of a volt and the second "bulb" went off. The 12 volts (and change) that I had measured earlier had been consumed by the bulb, the largest source of resistance in my circuit. The few tenths remaining were there to overcome the remaining resistances in the circuit as it returned to the battery: the bulb-to-wire connection and the wire-to-battery negative connection, as well as the wire itself.

OK, OK — I think we're starting to understand now. But the "bug" the judges had used in the contest was the addition of a small resistor on the ground side of the MAF sensor. I had to duplicate that "bug" and see what would happen to the meter readings.

Adding a thief

I wired a second bulb to my test circuit, placing it in series on

the first bulb's ground side. When I bridged the connection back to the battery, it was easy to see the effects of the added resistance. The second bulb glowed dimly but the first bulb was nearly non-existent. Time to take the measurements again.

I didn't expect to see a change on the positive side of the first bulb, and I didn't. Next, I moved on to the second measurement on the ground side of bulb #1 — and I got a reading of over 7 volts. You would think that I would know by now why I was reading voltage, but in my mind, I was still thinking like I had at the contest and was trying to understand how I could measure voltage on a ground! It was an internal block, caused by all of my preconceived notions and experiences on how a ground should act.

I then moved my meter lead down to the "positive" side of the second bulb. I measured the same 7 volts here. Perhaps it was the placement of the meter lead in relation to the load that finally started the third, and final, "bulb" to go off in my head. I had read 12 volts and change on the positive side of bulb #1 and understood that was the bulb's source voltage. Now, I only had 7 volts source voltage. What happened to the other 5 volts?

Of course! It was consumed by the first bulb! Then the electrical rule that all source voltage will be consumed proportionately by all the resistances in the circuit began to

FAG

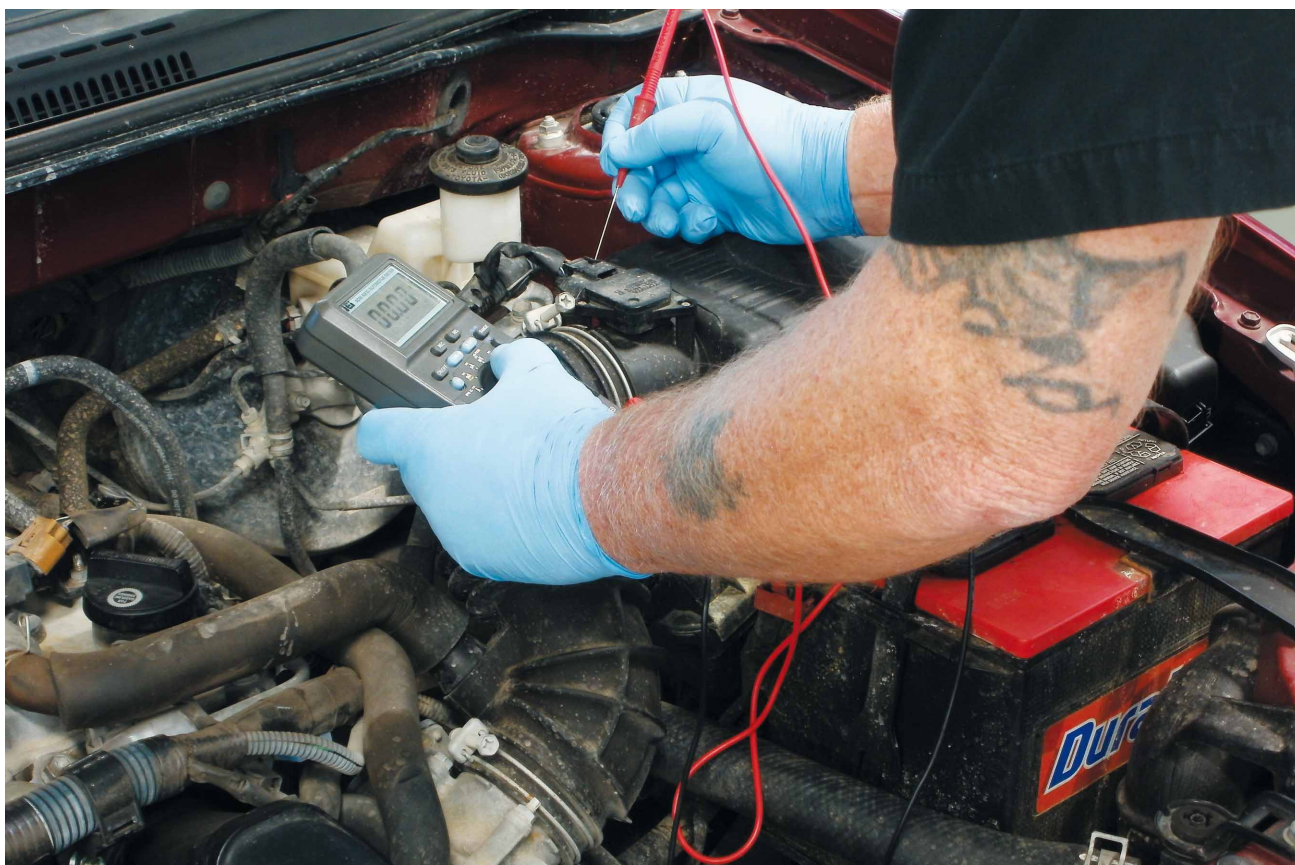
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I SOMETIMES TAKE A MOMENT to interpret my meter, but I'm more comfortable with it now than I was at the competition.

resonate in my mind. Here it was, in living proof! Moving my lead to the ground side of bulb #2, I measured the same few tenths that I had in my initial experiment. As the rule said, the (now) two major sources of resistance in the circuit consumed the majority of the source voltage I started with.

So when I measured 7 volts on the ground side of the first bulb, the meter was telling me that there had to be a source of resistance yet to come. The concept of using voltage drop as a testing method finally made sense!

And it was so simple!

I admit, I am not fluent in electrical testing and still have to stop and think about my meter readings from time to time. But I also know that this illuminating moment changed my entire outlook on how I approach electrical issues, and I've solved many

more of them, and solved them faster, than I would have without this testing method in my arsenal.

The true moral of the story

My objective for writing this month's article was not to share the story of how I lost a competition, or to teach you voltage drop testing. I wanted to challenge you to ask yourself, "What does it take before I'm willing to invest the time to learn?"

It is easy to become complacent. If we can make a living and support our families on the skill sets we already have, why train on new systems or processes? And it is an unfortunate, but true, reality that way too many of us are that complacent.

I invested the time and energy to learn voltage drop testing because I was angry with myself for thinking I knew something I really didn't. Ego was definitely involved. But that investment

in time and action has paid off in more ways than one. Becoming more proficient absolutely increased my earning potential and the surety of my diagnosis prevented me from wasting valuable time or making an incorrect repair that would ultimately result in a comeback.

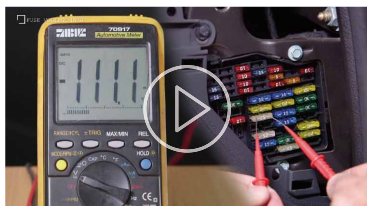
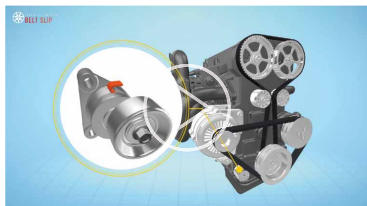
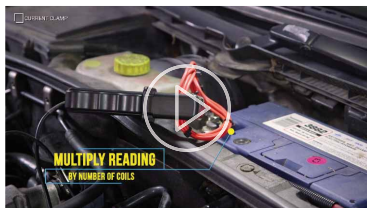
And that, my friends, is what should have motivated me to learn — the desire to grow and maintain my professional skill sets in an ever-increasingly complex field. I hope that's what motivates you. **TM**



PETE MEIER is an ASE certified Master Technician and sponsoring member of iATN. He has over 35 years practical experience as a technician and educator, covering a wide variety of makes and models. His primary goal is to bring working techs the information they need.

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SESAME STREET DIAGNOSTICS

A VISUAL INSPECTION MAY HELP YOU TO UNCOVER WHEN 'ONE OF THESE THINGS IS NOT LIKE THE OTHER'

JOHN ANELLO // Contributing Editor

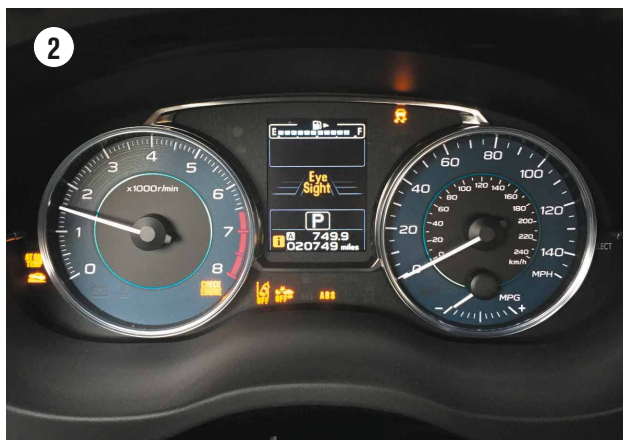
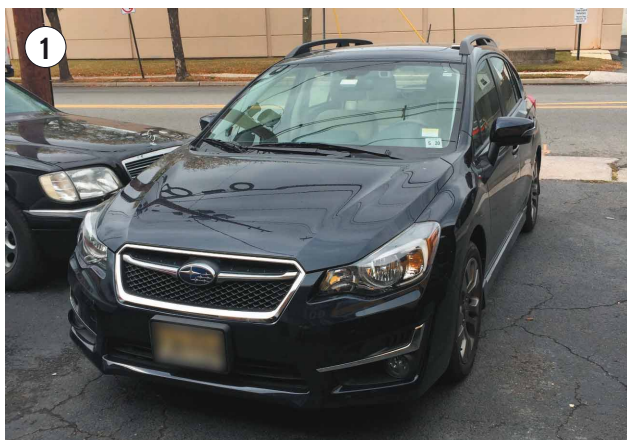
I was called to a shop with a complaint of an ABS light on. The vehicle was a 2017 Subaru Impreza with a 2.0L engine (Figure 1). It was involved in an extensive front-end collision and experienced severe damage to the right front suspension. The shop had replaced a lot of suspension parts including a right front wheel speed sensor. They cleared all onboard control modules of error codes in memory after all the repairs were completed, but the ABS codes still remained in memory.

When I arrived at the shop, I noticed that the vehicle had multiple warning lights illuminated on the instrument dash panel (Figure 2). There was a light for the antilock brakes, stability control, collision avoidance, lane keep safe and the Eye Sight control systems. It is hard to imagine that all of these operating systems were experiencing problems at the same time. They all shared the same network, so it was possible that one problem could be resonating a fault in one controller that had an adverse effect on the operation of the other controllers within the network. Many of these controllers today share input sensors among each other on a CAN bus network rather than wiring one sensor input to various controllers.

Time to dive in

It is always best to go into every controller and record codes stored as “current” or “past” codes and then do an overview to see if these codes all point to one area of concern. If there is a problem in one controller that is on a shared network, you can almost be guaranteed that other controllers will record complaint codes redirecting your attention to the specific controller having an issue. Do not get in the habit of doing a vehicle scan of all controllers at once because you may not be guaranteed to pull ALL codes from every control module. Some scan tools may pull “present” codes but may not pull “past” codes, which could defeat the purpose of putting together a complete game plan of attack. It is vital to compile as much information as needed to narrow down the suspect in your diagnostic routine.

In this particular case, I performed a quick vehicle scan to get a basic overview of what was going, knowing that, if needed, I would have to go to individual modules for a deeper dig. The engine and transmission modules on the network were pointing fingers towards the ABS control module for a fault in vehicle speed error by setting a code P0500. The ABS module stored codes C0022 for front right ABS sensor signal fault and a code C1424 for ECM abnormal (Figure 3). The right



Fault	1	Engine Control System	3
DTC code	DTC status	DTC content	
P0500	Past faults	Vehicle Speed Sensor	
Fault	1	Transmission Control System	
DTC code	DTC status	DTC content	
P0500	Past faults	Vehicle Speed Sensor	
Fault	2	ABS/VDC System	
DTC code	DTC status	DTC content	
C1424	(Current)	ECM abnormal	
C0022	(Old)	Front Right ABS Sensor Signal	
Fault	5	Tire pressure monitor	
DTC code	DTC status	DTC content	
C2021	Past faults	Tire 1 air pressure decrease	
C2022	Past faults	Tire 2 air pressure decrease	
C2023	Past faults	Tire 3 air pressure decrease	
C2024	Past faults	Tire 4 air pressure decrease	

Live data				4
No.	Name	Value	Unit	
1	FR Wheel Speed	0.00	mph	
2	FL Wheel Speed	9.94	mph	
3	RR Wheel Speed	9.94	mph	
4	RL Wheel Speed	9.94	mph	
5	Longitudinal G Sensor (CAN)	0	m/s ²	
6	Steer Angle Sensor Op	36.0	deg	
7	Yaw Rate Sensor Output	2.71	deg/s	
8	Master Cylinder Pressure Sensor	0	bar	
9	FL Wheel Cylinder Pressure Sensor	0.3	bar	
10	FR Wheel Cylinder Pressure Sensor		bar	
11	Fr Rr G sensor Output		m/s ²	
12	Lateral G sensor Output		m/s ²	
13	ABS_CM Power Voltage		V	
14	M. Relay monitor Voltage		V	

front wheel speed sensor had some kind of operational issues. At this point I had to verify the problem and decide whether it was a mechanical issue or an electrical issue.

Most ABS systems will perform a static and dynamic test of the operating system to alert the driver of any issues. On startup there will be an integrity check just like there would be in the engine management system for component tests. This could require either one or even two to three key cycles, so I simply cleared all the codes and turned off the ignition switch for one minute. I then proceeded to start the vehicle and let it run for one minute. I did this three times to insure a three-cycle event, and the warning lights did not come on at all. This is a quick procedure that can be done from the driver seat and holds great value to limit a lot of wasted time by guaranteeing that your problem is not electrical but more mechanical. Understand that the ABS module is sending reference voltage/reference ground into all of the ABS Wheel Speed sensors and checking all solenoid/relay/lamp circuits for a driver threshold status while it validates the system during key-on operation. If there were any electrical issues, a light would have been on. Now it was time to go ahead with a dynamic test.

Narrowing down the possibilities

I went to the ABS data PIDs and selected the front and rear Wheel Speed sensors and proceeded to drive the vehicle about 10 MPH (Figure 4). The right front wheel did not show

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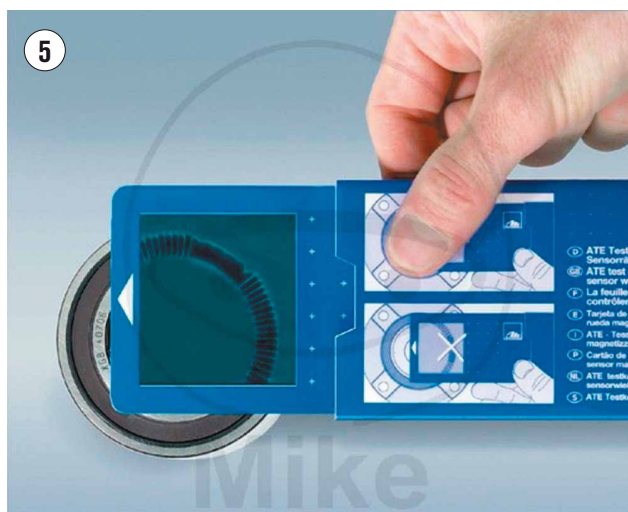

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any wheel speed signal at all, and as I continued to drive, the warning lights all came back on. This was definitely a mechanical condition. The culprits on my list as I was driving back to the shop were that the ABS sensor was not seated in the mounting hole properly, the tone ring was bad or the sensing device within the new sensor was bad.

The Magnetic Resistive type sensor looks similar to a mag-



netic sensor, but its circuitry is different. This sensor also uses two wires, but it is dependent on a reference supply voltage and a reference ground feed to the sensing device that will in turn act on the reference voltage line to toggle it and produce a digital signal. The sensor itself will need to be triggered by magnetic bar segments and the air gap between the sensing device and magnets is crucial for proper operation. This type of sensor is more dependable because it can actually measure vehicle creep because its amplitude is not dependent on vehicle speed and it is less susceptible to electrical interference.

The front hub bearing has a seal on each side of the bearing. Only one side of the bearing has segmented magnets imbedded into the seal along its circumference for the ABS wheel speed sensor to read. It is not uncommon for any shop to put this bearing in backwards because it can be installed in either direction. The segmented magnetic ring side must face the sensor. There is an installation tool (ATE #760130) that you can purchase off of Amazon to ensure proper installation that houses a very fine metal powder in an enclosed plastic film that when placed over the proper side of the bearing will show the magnetic segments (Figure 5). My guess was that the bearing could be in backwards.



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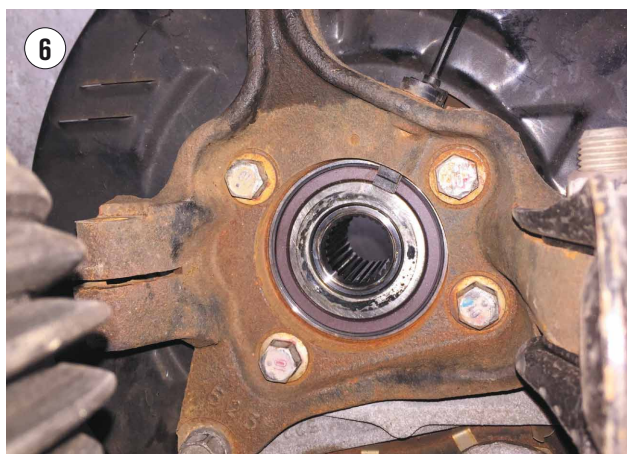
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I had the shop pull apart the right front suspension so I could take a close look at the repairs. This was a point where I had to perform “Sesame Street” tactics that I learned many years ago when I was but a six-year-old kid watching my favorite show and singing “One of these things was not like the other.” It is so vital to perform visual inspections as part of your diagnostic routine. I had one vehicle a few months back where a shop installed a used spindle on a vehicle and the wheel speed sensor hole was offset by a half inch because it was the wrong year spindle for the car. At this point, I had to keep an open mind and play outside the sandbox.

When I started to inspect the right-side hub bearing, I could see it was installed properly with the magnetic ring facing toward the sensor (Figure 6) and everything seemed fine.



At this point I was scratching my head and decided to take the other side apart to start comparing side to side measurements. As I was looking closely I sat there in awe with what I discovered. If you looked at the Wheel Speed sensor hole on the left side of the vehicle, the hub bearing was protruding three-fourths into the sensor hole diameter (Figure 7). The right-side bearing was only about one-fourth into the hole diameter (Figure 8). I could not believe what I was seeing, and I never knew this could even happen.

After taking out the new

hub assembly and comparing it to the old hub assembly, you could see that the inner part of the new hub bearing was shorter in length (Figure 9). This goes back to the old saying that the parts guy can be your best friend or your worst enemy. It's so hard to believe that a parts guy could hand you a wrong part and at the same time an installer does not take the time to match a part up. We are in such a rush in today's automotive world that we just don't take the time to check everything in our routine repairs. There are no longer guarantees that you are getting a correct part or even a working part. It just ends up putting you down a different path of “denial diagnostics” that can ruin your day and create many unwanted hours of wasted time and not to mention your loss in confidence in your work. My only hope is that this story hits home with many of you techs out there and that you keep on the watch to ensure this doesn't happen to you. **ZZ**



JOHN ANELLO owns Auto Tech on Wheels in northern New Jersey, which is a mobile diagnostic service for 1,700 shops, providing technical assistance and remote programming. He is also a nationally known trainer.
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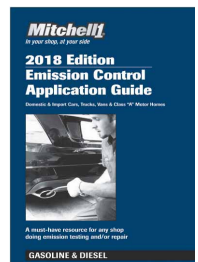
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CHECKING POWER AND GROUNDS

ARE YOU PROPERLY TESTING THE POWER SUPPLY AND GROUNDS TO THAT COMPONENT YOU DECLARED DEAD?

PETE MEIER // Technical Editor

“Hey, Pete! Got a minute?” the tech over in the next bay asked. “I replaced the blower motor in this car, and it still runs slow.”

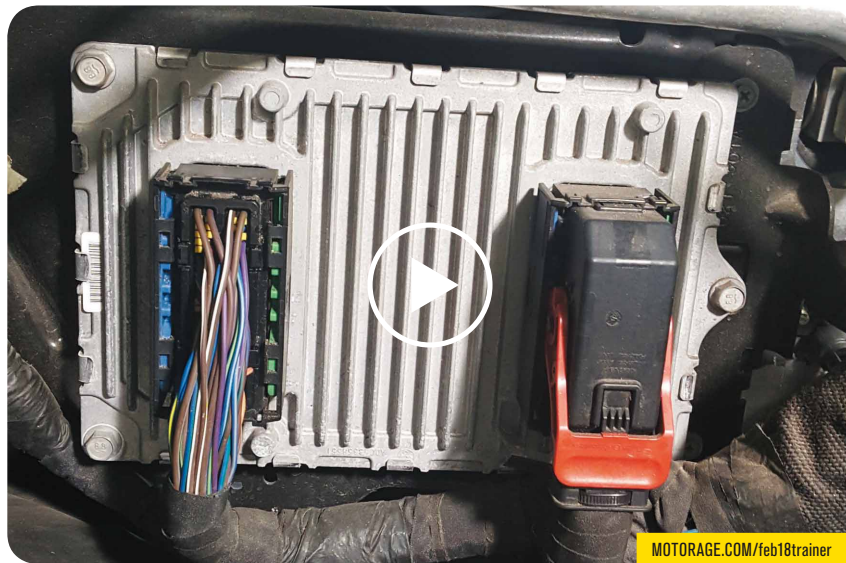
“Did you check the power and ground to the blower?” I asked.

“Yeah, my test light lights up when I stick it in the end of the connector so power’s good. And the ground side ohms out OK.”

This is just an example of the help requests I got when I still worked full-time as a technician.

Before I even went over to help, I had a good idea of what I would find. Would you?

The “tests” that my technician friend had performed were static tests and really proved nothing other than that there was some path linking the connector back to the battery. The voltage he measured was, of course, OCV (Open Circuit Voltage) and told him nothing about the circuit’s ability to provide power to the component under load. The ground side resistance test only proved that at least one strand of wire was linking his test point to ground but, again, no verifica-



tion that the circuit would hold up to the blower motor’s demands. Sure enough, testing for power using the voltage drop testing method at the blower motor with the blower motor running found the problem. There was only 9.2 volts there. Backtracking, we found the firewall harness connector burnt, creating the extra resistance in the circuit that was robbing the blower motor of its full share.

Testing components like a blower motor with the voltage drop method is

pretty straightforward. But what about testing the power and ground circuits that feed a control module? Often there are more than one, and before we can condemn a module (typically an expensive repair option) we need to make sure that they are all healthy.

In this edition of The Trainer, I’ll show you ways to test common components and control modules so you’ll know with confidence where the TRUE problem lies. **TL**



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