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MEJ

MARINE ELECTRONICS JOURNAL

March/April 2021
Volume 31, No. 2
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TROLLING MOTORS

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The Official Journal of the National Marine Electronics Association

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NMEA Business

Three NMEA wins during the pandemic

Mark Reedenauer
President & Executive Director

In our small marine electronics industry business is booming. Electronics manufacturers are logging some of the best financial quarters ever. Installers are booking several weeks out. Boat manufacturers are sold out. In other industries, the story is the same. Ordering a new camper is nearly impossible. Hot tubs and pools are back ordered over six months. These are all good problems on the backside of a pandemic.

Major boat shows are still halted due to safety concerns, yet our members' businesses are stronger than ever. Are we starting to see a shift or pullback in advertising because a company simply does not need to advertise, or doesn't need to exhibit at their local boat show? I hope not. As we get further into 2021 and back to a more normal lifestyle, I am hopeful that boat shows and trade shows will happen once again.

Meantime, NMEA's virtual installer trainings have led to three success stories that I will illustrate below:

Trade schools

NMEA has partnered with several trade schools around the world in which we have agreements for licensing the basic MEI installer and basic NMEA 2000® installer curricula. This agreement allows the trade school to utilize the NMEA training material as part of their marine technology program. What takes NMEA a day to train may take a trade school a month to educate. This is done intentionally as the trade school filters sections of the NMEA installer trainings into their curriculum. The end result is a graduating student with his associate degree from the trade school AND their basic MEI or basic NMEA 2000 certificate, making them more marketable in our industry as a new hire.

International training

The pandemic has forced NMEA to shift all training to virtual, which we did not offer in 2019. NMEA cannot travel to every area of the globe to train and educate marine electronics installers. Virtual training has opened up the option for anyone, anywhere to get NMEA installer training. I am proud to report that in 2020 NMEA trained 810 students representing 14 countries. This is up from 2019, where we trained 741 students representing six countries. Virtual training will continue post pandemic and complement our in-person installer training that we hope to open back up this summer.

Inland electronics market

The inland electronics market is another area where NMEA sees a large growth potential for education and training around installing NMEA 2000 networks and simple electronics systems. As the standard approaches 20 years old, it is commonplace now to have a simple network factory-installed at the boatbuilder level. This expansion comes with the challenge of NMEA training the boatbuilder and the installer. In the freshwater market, the installer is not typically working for a marine electronics company but instead for a boat dealer as the engine mechanic, the trolling motor installer, power pole installer, and electronics installer. This is a new breed of tech that we see evolving as the engine, MFD, and ancillary systems become linked together via the NMEA 2000 network. Be on the lookout for more inland electronics awareness from NMEA in the upcoming months.

A big thank you to NMEA manufacturers who have put in place requirements for NMEA training certifications in order for their installers to do warranty work or get install credits. I thank all manufacturer members who have driven this effort, and I encourage others to join the effort for the betterment of the industry.

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Steve's Marine Service
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Phone: (410) 231-3191
Email: steve@stevesmarineservice.com

VICE CHAIRPERSON
Brian Kane
GOST
Ft. Lauderdale, FL
Phone: (954) 868-2714
Email: bkane@gostglobal.com

TREASURER
Richard Baker
Garmin
Glendale AZ
Phone: (714) 642-3517
Email: richard.baker@garmin.com

SECRETARY
Jason Young
Vesper Marine
West Creek, NJ
Phone: (609) 246-5067
Email: jason@vespermarine.com

DIRECTORS
John Barry
Technical Marine Support, Inc.
Pleasant Prairie, WI
Phone: (847) 746-0100
Email: john@technicalmarine.com

Kevin Boughton
Midcoast Marine Electronics
Rockland, ME
Phone: (207) 691-3986
Email: kbofme@gmail.com

Peter Braffitt
Gemeco
Lake City, SC
Phone: 803-693-0777
Email: pbraffitt@gemeco.com

Paul Comyns
Intellian Technologies
Everett, WA
Phone: (949) 727-4498 ext. 1301
Fax: (949) 271-4183
Cell: (425) 879-3823
Email: paul.comyns@intelliantech.com

Sean Hatherley
Navico
Merrimack, NH
Phone: (603) 493-8662
Email: sean.hatherley@navico.com

Brian Swanke
CWR Electronics
Bayville, NJ
Phone: 800-527-3306
Email: brians@cwrdistribution.com

Todd Tally
Atlantic Marine Electronics
New Gretna, NJ
Phone: (609) 296-8826
Email: toddt@atlantic-me.com

Johnny Lindstrom
Omnisense Systems USA
Port Angeles, WA
Phone: (410) 975-9425
Email: jelindstrom@omnisense-systems.com

1ST PAST CHAIRPERSON
Mike Spyros
Electronics Unlimited
Ft. Lauderdale, FL
Phone: (954) 467-2695
Email: m.spyros@comcast.net

NMEA NATIONAL OFFICE
846 Ritchie Highway, L4
Severna Park, MD 21146
Phone: (410) 975-9425
Fax: (410) 975-9450
Email: info@nmea.org

President & Executive Director
Mark Reedenauer
Email: mreedenauer@nmea.org

Director of Standards
Mark Oslund
Email: moslund@nmea.org

Office Manager
Cindy Love
Email: clove@nmea.org

Office Assistant
Laura Chester
Email: lchester@nmea.org

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Publisher
NMEA
846 Ritchie Highway, L4
Severna Park, MD 21146
(410) 975-9425, Fax (410) 975-9450
info@nmea.org www.nmea.org

Editor
James W. Fullilove
617 Pineneedle Lane
Englewood, FL 34223
Mobile (207) 542-9511
jim@mejbiz.com

Design
Kelly Williams
Kelly Designs
37 Lord Road
Hope, ME 04847
(207) 763-4572, kelly@tidewater.net

Advertising Sales Office
Bruce J. Cole
Marine Electronics Journal Inc.
P.O. Box 418
Rockport, ME 04856-0418
(207) 230-0554, Fax: (207) 236-0369
bcole@mcnabbmr.com

Marine Electronics Journal, Inc.
Ken Englert, *President*
maritime@maritimecomm.com
Tim Conroy, *Vice President*
tim@commar.com
Steve Burdett, *Treasurer*
steve@coastmarinemarketing.com
Cindy Ensley, *Secretary*
cindy@ensley.com

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Nauticomp Inc.
8 Callaghan Road
Lindsay, Ontario
Canada K9V 4R4
p: +1.705.328.2992

*ISO 9001:2000
Certified Corporate Offices

Nauticomp International
3886 SW 30th Avenue
Fort Lauderdale, Florida
United States 33312
p: +1.800.267.9491

Nauticomp European Distribution
CA Clase, 2 Mornington Place,
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Cal Marine Electronics Inc.
Stephen Hensley
Pier 40 The Embarcadero, Ste. 14
San Francisco, CA 94107
Phone: 415-291-7550
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MANUFACTURER

Clickahoy by Ship-Ahoy GmbH
Christian Fehr
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8002 Zurich
Phone: 041797557136
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Phone: 207-458-8545
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Micro-Star Intl. Co., Ltd.
Michael Se
No 65, Lide St.
Zhonghe Dist.
New Taipei City, 235 Taiwan
Email: michaelse@msi.com
Website: https://tw.msi.com/

TRADE

BassTech Marine, LLC
Bryan Rennell
8501 Edinburgh Ct.
Montgomery, TX 77316
Phone: 281-380-0796
Email: bryanr@basstechmarine.com

Topside Yacht Management
Michael Colarusso
PO Box 202, East Greenwich, RI 02818
Phone: 401-236-5258
Email: mike@topsidym.com

Marine Solutions Asia Pacific
David Wharton
40 D Royal Langkawi Yacht Club
Jalan Dato Syed Omar Kuah Langkawi
Kuah, Malaysia 07000
Phone: +60143740053
Email: david.w@marineSolutionsAsiaPacific.com

Universite De Toulon
Lucie Blanc
Agence Comptable/Sfact
CS 60584
83041 Toulon Cedex 9 France
Phone: 04 94 14 26 55
Email: lucie.blanc@univ-tln.fr

Shift5
James Correnti
1100 Wilson Blvd., Ste. 2100
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Phone: 267-402-8260
Email: james@shift5.io
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A Better Choice Marine Services
Andrew Namer
5 Macleish Dr., Morganville, NJ 07751
Phone: 732-614-9038
Email: andy@abcmarineservices.com

Safe Harbor Plymouth LLC
David Johnson
14 Union St., Plymouth, MA 02360
Email: djohnson@shmarinas.com
Phone: 508-746-4500
Website: www.shmarinas.com

Kat Marine Electronics
Tim Longo
100 Harbor La., New Rochelle, NY 10805
Phone: 917-838-6698
Email: tim@sneekcity.com

Bayport Marina
Mike Hurley
200 Fifth Ave. South
Bayport, MN 55003
Phone: 651-439-1043
Email: mike@bayportmarina.com
Website: www.bayportmarina.com

Fly Creek Marina
Jeannie Paradise
2212 Harlem Blvd.
Rockford, IL 61103
Phone: 251-928-4868
Email: j.paradise@flycreekmarina.com

Ocean Marine Supplies Ltd.
Nicolas Humphrey
6C Prior Park
St. James, Barbados
Phone: 246-826-2326
Email: oceanmarine@caribsurf.com

Clarke Marine Electrical Services
Ian Clarke
9 King St.
Bristol, RI 02809
Phone: 214-600-4277
Email: ian@clarkemarineelectrical.co

USA Yacht Tech, LLC
Andres Marrero
9405 SW 156 Pl.
Miami, FL 33196
Phone: 786-423-4592
Email: theadsgrp@gmail.com

Extreme Car Audio LLC
Michael Trung
6615 Westbank Expressway
Marrero, LA 70072
Phone: 504-347-8889
Email: eca@extremecaraudiollc.com
Website: https://extremecaraudiollc.com/

BCD Innovations, LLC
Robert Chrzan
1 Kingsport Dr.
Howell, NJ 07731
Phone: 732-735-1350
Email: bcdinnovations@yahoo.com

ASSOCIATE

Gary Passenti
87 Mountainview Dr.
Clifton, NJ 07013
Phone: 973-725-9833
Email: gpassenti@gmail.com

Jamey Conrad
14002 Hillsborough Dr.
Omaha, NE 68164
Phone: 402-350-1239
Email: jamey.conrad@gmail.com

Anderson Sullivan
501 S Flagler Dr., Ste. 500
West Palm Beach, FL 33401
Phone: 561-722-1868
Email: captsully67@gmail.com

Patrick Shipman
15 Down River Rd.
New Canaan, CT 06840
Phone: 203-505-8276
Email: risingtidecharters@hotmail.com

Andre Lekai
911 21st St.
Paso Robles, CA 93446
Phone: 805-440-7106
Email: andre@c3buildingcontractor.com

Erin Heffron
978 South St.
Portsmouth, NH 03801
Email: ejheffron@gmail.com
Phone: 603-502-1860

Ed Nuttall
3287 Library Rd.
Pittsburgh, PA 15234
Phone: 412-377-5738
Email: ed@teamnutztecnology.com

Kevin Scopinich
1 Cedar La.
Hampton Bays, NY 11946
Phone: 631-374-9211
Email: kevin@kevinscopinich.com

Kevin Agee
220 Mill Point Dr.
Hampton, VA 23669
Phone: 757-578-0962
Email: waypointmarineworks@gmail.com

Daniel Sexton
16300 SW Famel Ave.
Indiantown, FL 34956
Phone: 870-807-4075
Email: saltyseth@gmail.com

Daniel Elmo
2500 Alameda Ave. #214
Norfolk, VA 23513
Phone: 973-525-9895
Email: delmo@wrsystems.com

Joshua Ross
2161 Poppy Dr.
Tustin, CA 92780-6821
Phone: 619-564-1400
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Standards Update

From Director of Standards Mark Oslund

Technical committees—what's next?

In the past few months, with volunteer help NMEA has made positive developments in its standards. Committees are engaged with initiatives to improve our standards for the betterment of the boating community. Your industry's volunteer professionals have produced excellent results, which will help our standards play a vital role in vessel inter-networking globally.

While you are reading this article, your NMEA Technical Standards Committee (TSC) members are discussing the next steps to secure the future of your standards and how we can bring maximum benefit to all affected stakeholders. We have initiated regular virtual meetings to make it convenient for members to increase participation and work together. In an effort to take advantage of this momentum, we have decided to hold quarterly TSC meetings instead of the single convention plenary meeting. This increase in meetings will ramp up our capabilities to accelerate standards work and also accommodate our industry's need for an evolving interface and message standard.

NMEA invites anyone who would like to participate in any of our standards or study groups. Please send an email to info@nmea.org to learn more. At the end of this article, we will provide a list of areas where we currently need volunteer experts.

NMEA 0183 update

NMEA and several of our volunteers continue to work with the IEC (International Electrotechnical Commission) to improve message functionality in safety systems for both commercial and recreational equipment markets. NMEA's continued participation with IEC and ISO (International Organization for Standardization) helps our industry serve a larger body of experts when, in particular, national publications need to be aligned with international standards.

NMEA continues to maintain our published 0183 Standard along with a list of 0183 mnemonic manufacturer codes used for talker identification. There are more than 600 NMEA 0183 manufacturer mnemonic codes in our registry.

NMEA continues to play its part in serving an industry-wide audience. We recently had the good fortune to work together with the University of Colorado-Boulder organization, which has contributed new anti-spoofing messages that will improve navigation security for our industry and mobile positioning systems, like the one in your cell phone. The NMEA 0183 Standard continues to be improved in order to meet today's challenges.

NMEA 2000 update

The NMEA 2000® Committee, under the direction of new leadership, is currently approving and reviewing initiatives we wrapped up in 2019-2020. This committee plays a vital role in having NMEA improve device certification for all who benefit from this technology. Aside from certification, NMEA workgroups and committee members actively develop new messages and message applications to serve stakeholders. An increase in our message catalog will provide manufacturers the path to innovating without the burden of messaging and interoperability concerns. By having an application-rich standard, we can help promote vessel integration at the levels that will increase boating adoption for generations to come. I firmly believe that someday we could all have the connected boat experience carried on the backbone of NMEA 2000.

We are looking for experts in the field of HVAC, energy storage systems, and safety automation. If you have an interest in any of the fields mentioned above, please contact NMEA.

To meet our annual publication maintenance cycle, NMEA will reopen existing workgroups that have been silent for some time now. This new initiative should allow members to revisit previous ideas that we may not have foreseen as required years ago. We are now targeting the applications for Power Distribution and Battery Systems, and the list continues to grow.

Publication release

The NMEA 2000 publication of revised documents: Main Document 2.2 (Standard), Appendix A/B (Application Layer and Network Messaging) (Parameter Groups), C (Certification Document), D (Application Notes) are planned for early Q2 2021. *(Continued on page 48)*

RTCM Report

By Mike Trent

Maritime Autonomous Surface Ship Update

As an organization dedicated to improving the safety of life at sea, RTCM continues to monitor the progress of Maritime Autonomous Surface Ship (MASS) technology, related projects and revisions to maritime regulations that will require new radiocommunication and navigation standards. Numerous projects are underway to develop autonomous systems capable of supporting all forms of watercraft, both military and commercial. While artificial intelligence (AI) and machine learning/deep learning (ML/DL) technologies are maturing to support MASS operations, key challenges remain to deploy the technology more broadly, safely, and securely across the shipping industry.

Whether you are a professional mariner, recreational boater, marine electronics OEM, or service organization, you've heard something about the coming of Autonomous Ships. You've likely read about it in *MEJ* or other industry publications. Or you've heard talk about the Navy's "ghost fleet" or the coming of sea drones, sail drones or sea bots. Perhaps you've even seen some form of remote-controlled, autonomous, or unmanned watercraft in operation on your local waters.

But have you been wondering—what technology are we talking about? Why is it happening? When will we see it? And, what if it happens? How will we regulate it? How will we test it? All are reasonable questions that have received a lot of attention by national and international maritime authorities, regulatory bodies, classification societies, masters, mates, marine engineers, and the companies developing the autonomous systems.

In fact, the development of autonomous ships is well underway across the globe. As described in the May/June 2020 *MEJ* article "Autonomous Vessels," the market for autonomous ships spans many vessel types and functions across both the commercial and military sectors. The technology involved includes advanced all-weather, self-tuning perception systems, combined with "big data" from shipboard sensors, control systems, planning tools and external sources, to feed an AI system capable of learning, reasoning, and making decisions on its own.

The goal is to enable this AI or "autonomous" command system to understand the vessel's intended operations, voyage, or mission, and perceive the vessel's current condition, activity, and surrounding environment in order to independently develop situational awareness sufficient to safely operate the vessel as well or better than a skilled operator.

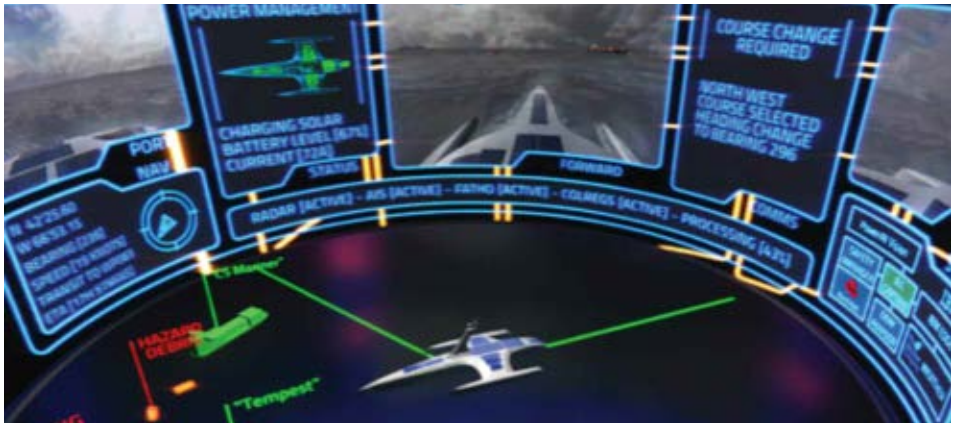
A fully autonomous command system must become the master, mate or pilot aboard a vessel who understands the weather, sea conditions, the status of ownship equipment, course, and speed of ownship, the surrounding navigational hazards, nearby ships, the current ship evolution, the COLREGS, ownship maneuvering characteristics and how to communicate with other vessels and shoreside personnel. A fully autonomous control system will have a lot of learning to do and require significant sea time to accomplish it, then it must be thoroughly tested before earning its license and taking the helm.

Obviously, we're not there yet but successful workboats, ferries, survey vessels and military craft are being delivered today with various levels of autonomy. Developers are taking a stepwise approach building on proven systems for unmanned, remotely operated, or autonomous submersibles and aerial drones combined with technological advances in high-speed edge computing, big data analytics and machine learning to deliver initial MASS capabilities.

Are autonomous ships unmanned? Not necessarily. In practice autonomy has become a general term referring to various levels of automation, decision support or self-governance that may be employed aboard a ship, reducing the need for human intervention. Depending on the vessel type, size, installed equipment, current operations and area of operations, the degree of vessel autonomy exercised will vary. Certain basic definitions pertain.

- "Automation" is the automatic control and operation of an apparatus, process, or system by mechanical or electronic devices that take the place of human labor. *{ABS Advisory on Autonomous Functionality 2020}*
- "Autonomy" is different in that it requires a quality of self-governance and freedom from external control or influence. *{ABS Advisory on Autonomous Functionality}* As in "Autonomous Ship" it means that the ship can operate without human intervention, related to one or more ship functions, for full or limited periods of the ship operations or voyage. *{MSC 102/5/18 Annex, Proposed General MASS Terminology}*

For the purposes of evaluating MASS technology, the impact on maritime regulations historically developed for manned vessels, and to aid in determining suitable conditions for conducting MASS



Courtesy of IBM and ProMare

IBM teamed up with ocean research non-profit ProMare to build the AI Captain as the artificial intelligence engine that will drive the solar-powered Mayflower Autonomous Ship (MAS) on its voyage from Plymouth, England to Plymouth, MA. The University of Plymouth is also a key player in the project. MAS Project Director Brett Phaneuf presented the program at the 2020 RTCM Virtual Annual Assembly and Conference.

trials, the International Maritime Organization (IMO) has defined the four degrees of autonomy listed below.

Degree 1: Ship with automated processes and decision support
Degree 2: Remotely controlled ship with seafarers onboard
Degree 3: Remotely controlled without seafarers onboard
Degree 4: Fully autonomous ship

It is also important to note that the degree of autonomous operation used on a ship may change from time-to-time during a single voyage to suit a particular activity or phase of the voyage.

The driving forces spurring development in the commercial marketplace include reductions in marine accidents due to human error, cost savings due to optimized ship routing and just-in-time arrivals, as well as reductions in CO^2 emissions and truck traffic congestion at major ports. As an example, in 2019 the EU funded the AUTOSHIP project to speed up the transition to a new generation of autonomous ships that will operate on short seas routes and inland waterways. The project is intended to demonstrate the economic and environmental benefits of moving cargo from large ports to small ports over water on "green" vessels versus trucks over land. The use of shorter sea routing and clean hybrid propulsion systems will save time and money while reducing CO^2 emissions and truck traffic congestion in large port areas.

On the military side, the US Navy and their NATO allies have embarked on aggressive programs to develop unmanned surface vessels (USV) to support a variety of warfighting missions including surveillance, intelligence gathering, command and control, anti-submarine warfare and mine countermeasures. As an example, the US Navy's 132-foot trimaran Sea Hunter was launched in 2016 as a prototype unmanned vessel intended for anti-submarine warfare. In February 2019, the Sea Hunter demonstrated its autonomous operations by completing an unmanned round-trip voyage between San Diego and Hawaii.

In the near term, the MASS vessels developed for commercial purposes will be operated and capable of only autonomy degrees 1, 2 and possibly 3. It will take several more years operating the autonomous command system at sea to sufficiently train the system for fully autonomous operation—degree 4. Additionally, there are other challenges that could impede advancing from degrees 1 and 2 today to operating remotely controlled and unmanned—degree 3. These challenges include the need to: provide resilient sources of precision navigation and timing (PNT), ensure robust cybersecurity of the autonomous systems, provide unique identification of autonomous vessels within the Automatic Identification System (AIS), determine how autonomous and unmanned vessels will communicate and interact with manned vessels, and update international and national maritime regulations to accommodate MASS operations.

In a future report, we will review the progress and outcomes of the IMO Working Group tasked to conduct a Regulatory Scoping Exercise to assess the impact of MASS on international regulations. We'll also report on the USCG Request for Information (RFI) posted in the *Federal Register* in August 2020 *{Docket No. USCG-2019-0698}* when more information is available. This RFI sought information regarding opportunities, challenges and regulatory impacts of automated and autonomous commercial vessels operating within the US Maritime Transportation System (MTS). Responses to the RFI were due to the USCG in October 2020.

Brett Phaneuf is Project Director for the Mayflower Autonomous Ship, which he described in a presentation at our 2020 conference. He is also Program Manager for Promare, and the President of the Submergence Group.

According to its website (https://mas400.com) the Mayflower Autonomous Ship (MAS) is a "grass roots initiative led by marine research nonprofit ProMare with support from IBM and a global consortium of partners. Working in tandem with oceanographers and other vessels, MAS provides a flexible, cost-effective and safe option for gathering critical data about the ocean. It can spend long durations at sea, carrying scientific equipment and making its own decisions about how to optimize its route and mission."

IBM has teamed up with Promare to build the AI Captain as the artificial intelligence engine that will drive the MAS autonomously on its voyage from Plymouth, England to Plymouth, MA. The University of Plymouth is also a key player in the project and is working with Promare and IBM on the scientific research mission for the project.

About the author

Michael Trent is the Managing Director of MARITECH USA, a consulting company specializing in product development, project management and marketing of maritime technologies. He is a retired U.S. Navy Captain and a member of the RTCM Board of Directors. His expertise spans commercial and military projects in ship automation, VTS, SAR and maritime surveillance.

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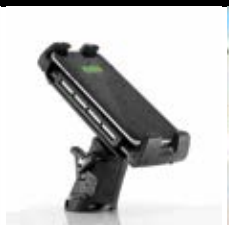
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Industry News

FLIR Systems to be acquired by Teledyne

Teledyne Technologies has agreed to acquire FLIR Systems in an $8 billion deal that includes Raymarine. The agreement is expected to close in mid-2021.

From all accounts, it's business as usual at FLIR and Raymarine as integration details with Teledyne are worked out. Sales and warranty support of Raymarine products will continue as usual, according to an industry source.

In early 2020, FLIR put Raymarine up for sale but then suspended the offering in May due to market uncertainties posed by the emerging pandemic. At the time, FLIR CEO Jim Cannon said FLIR values Raymarine's products but pointed to FLIR's more commercial orientation.

Teledyne provides instrumentation, digital imaging products and software, aerospace and defense electronics and engineered systems. "At the core of both our companies is proprietary sensor technologies," said Teledyne Executive Chairman Robert Mehrabian. "Our business models are also similar: we each provide sensors, cameras and sensor systems to our customers. However, our technologies and products are uniquely complementary with minimal overlap, having imaging sensors based on different semiconductor technologies for different wavelengths."

KVH expands maritime network coverage

KVH has expanded its mini-VSAT Broadband HTS network coverage throughout Hudson Bay and the North Atlantic, including northeastern Canada, the Labrador Sea, Iceland, and Greenland. The expansion represents an addition of nearly 4 million square kilometers of Ku-band coverage to the 272 million square kilometers of global coverage that KVH's HTS network provides. The Hudson Bay coverage is particularly important to commercial fishing fleets, which rely on satellite connectivity for operations and crew welfare.

"This expansion of coverage reflects our continued commitment to providing the maritime industry with a complete end-to-end solution for global connectivity," says Mark Woodhead, KVH's Executive Vice President for Mobile Connectivity. "Today, vessels use connectivity for everything from communications and crew welfare to performance optimization and we see our network as essential to their success."

Assisted Docking ramps up human-machine interface

Volvo Penta has announced what it says is the industry's first fully integrated assisted docking system. Called appropriately Assisted Docking, it "gives the captain better control when docking a boat by automating his or her intentions, compensating for some dynamic variables, such as wind and current, and helping the vessel stay on its intended course."

A press release reports that Assisted Docking integrates an in-house software layer with the company's "GPS-based Dynamic Positioning System and proprietary Inboard Performance Systems (IPS) and includes HMI (human-machine interface) at the helm, electronics via the engine, propulsion systems and sensors, and advanced navigation processing power for a much easier boating experience, even in rough conditions."

In operation, the captain maneuvers the vessel with the joystick, "thereby informing the system which direction it should head in and at what speed. If you move the joystick forward, the system lays out a path straight forward from the boat and the boat starts to follow a straight line with the indicated speed. The boat docking system also takes into account certain external forces (i.e. wind, current) and the EVC system—upgraded with in-house developed software—compensates to ensure the boat follows the thrust, then acts on the drift and moves the boat back to its intended course. The boat docking system keeps this course by constantly fine-tuning the steering angles and thrust."

"Assisted Docking is a hybrid between automated docking and manual docking," says Ida Sparrefors, Director of Autonomous Solutions and New Business Models at Volvo Penta. "Even though, in some ways, it would have been easier to implement full automation, the beauty of this system is that it gives the captain enhanced control. With our team of experts, from software developers to test drivers, we have made it behave intuitively in all situations, so that anyone can feel like a seasoned captain."

Daniel A. Harper

As we went to press we received the tragic news of the death of Daniel A. Harper, founder and CEO of Siren Marine. He was 51 years old.

Dan described himself as both a lifelong, waterborne adventurer and die-hard electronics enthusiast. His mantra was "do what you love." Early on in his career, Harper was a marine professional and captain with experience sailing all over the globe, overseeing luxury fleets and restoring classic sailboats.

He founded Siren Marine in 2011, "kicking off a Connected Boat revolution 10 years in the making," the company said. "With his innovation, creativity and a steady hand on the rudder, Dan led Siren Marine in launching a series of successful marine telematic products and forged partnerships with dozens of top boat brands, transmission manufacturers, engine builders and other OEM industry stakeholders. The work he began a decade ago has forever changed the boating industry.

"Dan often said he was on a mission to make every boat a Connected Boat. To honor his legacy, all of us here at Siren Marine will continue to execute his vision to deliver the modern boating experience and transform the marine industry."

Siren Marine has named Jeffrey Poole as CEO. He has served as COO since April 2020.

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Vesper Marine promotes Jason Young to Global Sales Director

Jason Young is now Global Sales Director for Vesper Marine. "After a period of rapid growth driven by award-winning product innovation, Vesper has promoted Young to continue expansion in vital markets around the world," a press release reports. Young is also a member of the NMEA Board of Directors who serves as Secretary.

"We are excited to announce the appointment of Jason Young to the role of Global Sales Director," said Brady Cox, Vesper Marine CEO. "Anyone who has dealt with Jason knows how passionate he is about the marine electronics industry and that his priority is always for his customers. His extensive product knowledge is a great resource for Vesper customers around the world."

The company said, "Young has established himself as an industry leader with 15 years of experience in marine electronics and technology, in positions including management, sales and service capacities with top marine industry corporations, including expertise in product, brand and channel management."

Young joined Vesper Marine as Vice President of Sales in 2017, overseeing all business operations for North America and managing a team of over 10 national sales representatives. "Over the last three years he has expanded distribution and achieved record growth every year," according to Vesper Marine. "In 2017, Young was also elected to the National Marine Electronics Association Board of Directors. In 2019, he created the NMEA Young Professionals Group to attract and retain the next generation of thought leaders while promoting diversity, inclusion, and encouraging personal and professional growth in the marine electronics industry."

"Our design teams always set out to create something truly remarkable," said Young. "With Cortex, they totally smashed it out of the park. It's incredibly exciting to be part of the team that is fundamentally changing the way boaters communicate."

Mission Critical Electronics makes two key appointments

NMEA member Mission Critical Electronics (MCE) recently announced the appointments of two new key personnel, John Kalbfleisch as General Manager and VP of subsidiary Xantrex, and John Hoeft as MCE Vice President of Operations and IT.

Kalbfleisch is an experienced business leader with a broad set of skills, including P&L management, manufacturing, global supply chain management, executive LEAN leadership, product development, mergers and acquisitions, and business transformation. He has degrees in Mechanical Engineering and Management, as well as an MBA from McMaster University.

"John is a great addition to the MCE team. His broad set of skills and experiences will allow him to effectively support our company and partners," said Dale Tompkins, President of MCE's Vehicle Power Division, which consists of Xantrex, Purkeys and Kussmaul brands.

Hoeft is also a manufacturing veteran who has held senior positions with several companies. Most recently he was VP of Operations for Advance Storage Products, a manufacturer of pallet rack systems.

Scott Breaux joins GOST tech support team

GOST has hired Scott Breaux as a technical support specialist. He is tasked with configuring and troubleshooting tracking and security systems and assisting installers with video surveillance setup.

"Scott has proven himself over decades in the offshore energy and maritime communications markets, and we have had the pleasure to have known him for a long time," said Jay Keenan, GOST President and CEO. "He has a vast breadth of knowledge and experience to draw from and we are confident he will efficiently and professionally help our vessel owners, crew members and professional installing marine electronics dealers to get the most out of their GOST system. We are very excited to welcome him to our team."

Ryan Pannell is Engineering Director for Oceanic Systems

Oceanic Systems (UK) Ltd. has promoted Ryan Pannell to the main Board of Directors as Engineering Director. Pannell joined Oceanic in 2016 as a Development Engineer and quickly progressed to Engineering Manager within Oceanic's Engineering/Research & Development team.

"Ryan's promotion to Engineering Director reflects the huge contribution that he has made since he joined us. He has been instrumental in the growth of the business and is an invaluable asset. His promotion is very well deserved," said Oceanic Systems Managing Director Bruce Coward.

CWR names Mark Dew Director of Outside Sales

CWR Wholesale Distribution has promoted Mark Dew to Director of Outside Sales, where he is tasked with continuing to grow the outside sales team in key markets. Currently, there is outside sales representation in the northeast, New Jersey, Florida, Georgia and South Carolina. CWR hopes to continue to expand the outside sales representation across the entire United States.

CWR said for the past seven years Dew has "excelled with CWR as an experienced Southeast Territory Manager covering Florida, Georgia, and South Carolina. With a demonstrated history of working in the marine industry, Mark brings aboard skills in negotiation, sales, business development, and account management."

Brian Swanke, President of CWR Wholesale Distribution, said, "This is a very exciting time for CWR. We have talked about this expansion for some time and I am happy that we will have Mark on the team to help CWR continue to offer top-notch sales and service to our dealer base."

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NMEA OneNet 101

Committee Chair Nate Karstens describes the basics

Nate Karstens
OneNet Committee Chair

Nate Karstens is a Technical Lead Software Engineer at Garmin International, Inc. who has 13 years of experience in the marine electronics industry. He says he loves writing software and has contributed in many areas, but his passion is embedded systems networking and cybersecurity. Karstens has served as Chair of the OneNet Committee for the past four years. He happily credits his wife of 11 years and their four very energetic children for his inspiration.

With NMEA OneNet Version 1.00 released in November, 2020, we were curious about some basic aspects of the new standard. Karstens kindly answered our questions. We'll dive deeper into aspects of the standard in future issues.

How would you describe NMEA OneNet in 25 words or less?

NMEA OneNet is a networking technology based on Ethernet IPv6 and other internet protocols for distributing marine data on the vessel.

A NMEA press release dated Aug. 1, 2012 told the world about a new standard called NMEA OneNet that was "scheduled to be operational by late 2014." Flash forward to its official launch at the end of 2020. Why such a long delay?

That is a long delay, and we really do appreciate everyone's patience and willingness to give us the time to develop a high-quality standard. The version that would have been available in 2014 was NMEA 2000® running on Ethernet, with a few additional features from internet standards. The committee recognized that this approach was not going to allow the standard to grow as technology evolved. We pivoted and worked to create a platform for distributing data, with NMEA 2000 parameter groups being one type of data supported. The new platform goes beyond purpose-built equipment and uses an architecture that supports PCs and mobile devices. Finally, there was an added emphasis on cybersecurity.

The committee also put the standard through a rigorous quality control process involving dozens of engineers. There were over 450 individual changes to the documents between the beta version and the first published version, and our draft-for-comment elicited 280 comments for the committee to resolve.

What is the current relationship between OneNet and NMEA 2000 in terms of how they will work together or independently to fulfill onboard functions. Do you foresee a time when OneNet will replace NMEA 2000 and/or 0183?

Compatibility with NMEA 2000 was a requirement for OneNet from the very beginning. The OneNet standard contains a specification for a gateway between the two networks. The gateway is designed to make all NMEA 2000 devices appear as if they were really OneNet devices, and all OneNet devices appear as if they were really NMEA 2000 devices. This provides backwards compatibility with existing NMEA 2000 devices, which were developed without any knowledge of OneNet. Similarly, it allowed the OneNet standard to be developed without being constrained by the decisions made for NMEA 2000.

The differences in the underlying network technology mean that both types of networks will have a place on boats for the foreseeable future. NMEA 2000 uses CAN, which features a built-in mechanism for ensuring high-priority messages always take precedent over low-priority messages. This is essential for real-time, safety-critical applications. However, the relatively low bandwidth available on CAN make it unsuitable for high-bandwidth applications, like radar. Ethernet supports high-bandwidth traffic, but it does not support message prioritization.

Time-Sensitive Networking is a technology that adds message prioritization to Ethernet. This may be incorporated into future versions of OneNet and provide an alternative to CAN.

OneNet is now available to be purchased but not paid for until the certification tool is available, which I believe is late 2021 at the earliest. Will this affect the development of OneNet-certified products? Will it have an impact on the widespread adoption of OneNet aboard recreational and commercial vessels?

It is unfortunate that the certification tool is not available. Aside from certification testing, the tool can be used by manufacturers as an aid during product development. It includes a separate test for each requirement, so once the manufacturer implements one section of the standard, they can confirm it works before they move on to the next part. Until the tool is available, the best option for manufacturers is to engage the OneNet community through events like Plug-Fests. Combined with the uncertainty around the tool, some organizations may not be prepared to take that on, and so will wait to develop their product. That does delay adoption of the standard, though I'm still optimistic about the progress that can be made even without the tool.

When NMEA 2000 was released many years ago, the world was introduced to N2K backbones, drop cables, micro and mini components, nodes, terminators and so forth. Please describe the infrastructure of a typical OneNet installation or will it simply operate on existing Ethernet cabling without additional dedicated hardware components?

OneNet network design will be no problem for anyone familiar with Ethernet. Most installations will have at least one switch to connect products to the network, and some switches will be integrated into other products. Larger installations will have multiple switches connected together. OneNet Ethernet cables are required to use one of the approved connectors, so it may be necessary to replace existing cabling and components (depending on the installation environment). As OneNet advances and we start seeing a mix of 1Gbps and 100Mbps devices, it will be important for installers to provide a network backbone as fast as the fastest device on the network (you cannot connect two 1Gbps devices using a 100Mbps link).

All that being said, the first version of the standard does not have a detailed specification on network infrastructure components. Networks with the first version of OneNet can get by with a standard, consumer-grade switch. The problem with these switches is that most only meet the needs of a small home or office environment. In the future, OneNet networks will have a mix of product types and it will take some specialty equipment to get them to coexist on the network. To illustrate, consider a high-bandwidth radar on the same network as a temperature sensor that is only able to process a small amount of traffic. With a standard switch, the link to the temperature sensor will be overwhelmed by traffic from the radar. Networks like this will need switching technology that more intelligently directs these data streams. We plan to define this in the next update to the standard.

Once OneNet is in common use throughout the industry, how is it likely to impact: dealers/installers/service techs (in terms of any additional

skills and training needed); manufacturers (any changes in product design, capabilities or functionality); and end users (benefits to boaters and commercial operators)?

Installers who are unfamiliar with Ethernet will want to educate themselves on basic wiring and network design. The technology can be very complicated and we think there will be a good market for troubleshooting tools that can analyze the network and identify problems.

Manufacturers unfamiliar with Ethernet, TCP/IP, and cybersecurity will have a steeper learning curve. The OneNet Committee was conscious of this and designed OneNet to use industry-standard protocols with lots of documentation and community support. There are many excellent open-source packages that can be used to create a OneNet product. Manufacturers with existing Ethernet-based networks may have to retool those networks to satisfy connector requirements.

In the near future, end users can expect more choice in how networks are designed and the equipment that goes on their boats. As OneNet grows I think we will see a great deal of innovation in how products interoperate with each other, even more so as onboard internet becomes more cost effective.

Maximizing cybersecurity has been a major effort in OneNet's development. Please describe the standard's cybersecurity defenses.

Modern networks include some significant entry points for attackers, such as Wi-Fi and the internet. To protect against this, each OneNet device must prove that it is authorized to communicate with the OneNet network. This requires installers to pair each device to the network. Pairing is a quick process and should be straightforward once everyone understands how it works.

Beneath the surface, the pairing process is really a mechanism for distributing an encryption key to devices on the network. Once devices have this key, they encrypt all network communications using TLS v1.2, DTLS v1.2, and an IPsec protocol adapted to OneNet. The encryption algorithm is 256-bit AES operating in Galois-Counter Mode, so it automatically authenticates all messages. These are industry-standard technologies used to secure financial transactions on the internet, so we can be confident they are highly secure.

OneNet underwent extensive beta testing. Were there any significant modifications made to it as a result?

Beta testing for OneNet was a little disappointing in that the team, as a whole, never developed enough momentum to complete an entire product. Nevertheless, the process was extremely valuable for a number of reasons. First, exposing the standard to people outside the committee revealed a number of assumptions we had made about how the document would be interpreted. This was especially apparent in the Device Architecture section, which explains the various components of a OneNet product and how they fit together. Understanding this section is key to understanding the rest of the document, so we provided more detail and some examples.

The second benefit was that it moved the standard out of the realm of theory and into

(Continued on page 50)

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New tricks for an

The venerable trolling motor enters the electronics age

Trolling motors are more popular than ever, and with competition heating up, innovation and system integration have become the name of the game for manufacturers as well as marine electronics dealers and installers.

Integration with onboard electronics has helped fuel the upsurge in trolling motor sales by boaters across a range of vessel sizes in both fresh and saltwater environments. In the process, CWR Wholesale Distribution's Brian Swanke says, "the level of integration with NMEA 2000 has forced the trolling motor to become a part of the NMEA dealer/installer's business."

BY LENNY RUDOW

Few marine devices scream "high-tech" and "innovative" less than the humble trolling motor in its original form. Minn Kota has been selling electric trolling motors since the 1930s and MotorGuide came out with their pedal-operated steering system during the Kennedy administration. Since then, they've been relegated to the bows of bass boats and the transom of the occasional dinghy. Now with built-in transducers, GPS guidance and wireless controllers, there's no question that trolling motors have come a long way.

If you've had your ear to the ground, you're probably aware that Garmin and Lowrance have thrown their proverbial hats in the ring with the release of the Force and Ghost trolling motors, respectively. Despite being the new kids on the block, these two models are giving traditional manufacturers a run for their money. The Force and Ghost have specs and price points similar to the other freshwater frontrunners—Minn Kota's Ultrex and MotorGuide's Tour Pro. Naturally, competition drives innovation, and to get a leg up on their competitors, manufacturers are packing their motors with new functions and features like better motors, dynamic positioning, built-in transducers, remote controls, and—crucially—integration with electronics systems. These smarter, beefier motors are appealing to anglers well beyond bass fishermen, and manufacturers are beginning to take advantage of mostly heretofore untapped markets.

The Gold Rush

At the 2019 ICAST trade show, Garmin and Lowrance both showcased their first takes on trolling motors. Since then, there has been a rivalry between the Garmin Force, Lowrance Ghost, Minn Kota Ultrex, and MotorGuide Tour Pro—and choosing between them is no small feat. In some ways there are pretty large disparities between them. And it's important to note that at least at this point, Garmin and Lowrance haven't yet pushed into the saltwater market while Minn Kota offers Riptide versions of their models and MotorGuide offers saltwater Xi models for marine use. But in other ways they're quite similar.

All four motors produce north of 100 pounds of thrust, fall in around the $3,000 price range, come in similar shaft lengths, offer 36-volt and 24-volt options, and even have similar warranties. Side note: if you're ever curious about how many different ways there are of marketing dual gas spring lift-assist systems, then look no further than manufacturers' descriptions of these products.

Big boats offer big (and new) potential for the trolling motor industry, particularly on the saltwater side. Power is obviously a

old dog

key component, but the major limiting factor is shaft length.

"We're always adapting to new opportunity and we'll do whatever the market demands," says Bill Carson, Field Marketing Manager for Johnson Outdoors, Minn Kota's parent company. "We came out with the 87-inch shaft to accommodate boats with higher bows, and we can't build them fast enough to keep up with demand. We're definitely looking at making things bigger, making them stronger, looking at new composites for the shafts, getting more thrust, more power. It's also possible to use multiple motors to handle bigger jobs. There are some 35-footers out there with multiple motors, one on the bow and two on the stern. The captain can hold a big boat like that into a strong current by using autopilot with the stern motors and putting the bow into Spot-Lock. That just gives you amazing control."

Spot-Lock is what Minn Kota calls their dynamic positioning feature. The user presses a button, and the trolling motor holds the boat in place via the application of power, steering and GPS. Minn Kota's competitors offer similar dynamic positioning systems, which have become a key set of features that consumers want. Virtual anchoring, autopilot, contour following and route following have come to be expected on high-end trolling motors. So too have periphery interfaces.

For the most part, the only time you have to touch these tech-savvy motors is when they are being lifted or deployed into the water, though you don't have to do that with Minn Kota Ulterra's Auto Stow/Deploy system. And while MotorGuide pioneered foot pedal steering, all four manufacturers now offer versions that have handheld remotes with speed controls and hotkeys. Garmin even has a Wii-like remote that uses "point-and-go gesture steering" to steer the boat based on hand movements. Still, shaft length remains the limiting factor when it comes to equipping saltwater boats with high bows.

"The general rule is that the top of the (propeller) motor housing should be submerged 12 inches," says Kevin Conroy of ComMar Sales, which serves as a bridge between many Johnson Outdoors products and installers and dealers. "Minn Kota recommends anglers whose boats have a bow to waterline distance of 28 to 34 inches select a 54 to 62-inch shaft, while anglers with a bow to waterline distance of 34 to 44 inches select a 72-inch trolling motor. Anything above that would be best suited for an 87-inch length. However, while this is a great place to start, it doesn't take into consideration the next most important factor: what sea conditions you intend to use the motor in."

Unlike the bass fishing venues where electric trolling motors were born, in different saltwater angling environments the conditions can vary radically. "A large center console using Spot-Lock to chunk for tuna will experience very different waves than a bay boat cruising the flats using Follow the Contour while looking for tailing reds," Conroy explains. "Reaching 12 inches below the waterline may be acceptable for freshwater or inshore fisherman, but those fishing in larger waves offshore may want to increase this number to 24 inches as a general rule of thumb."

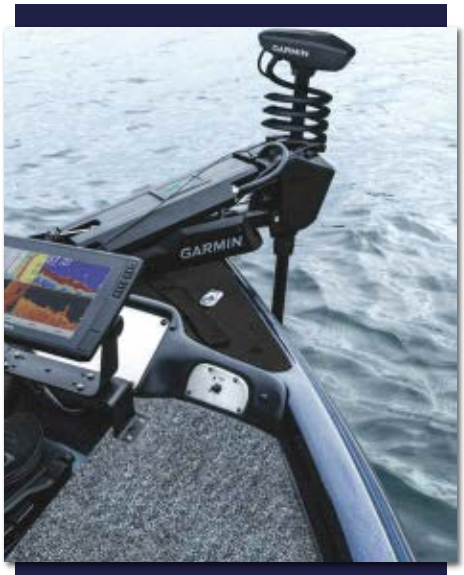
Given the angling emphasis on dynamic positioning and user interfaces, it makes sense that GPS giants like Garmin and Lowrance have started making trolling motors. But neither yet offers shaft lengths exceeding 60 inches and only niche-player Rhodan Marine can match (and exceed, at 96 inches) Minn Kota's long reach. Setting aside this factor, all the potential technology can only come together because of one particular advancement that has become paramount for OEMs and installers—system integration.

Integration is key

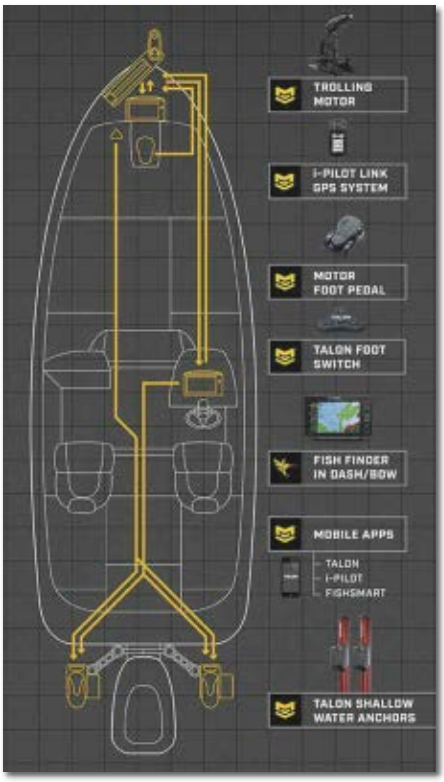
With the drive towards integration depending to an extent on brand, there is some concern that installers and consumers might lose the ability to select components from different OEMs. While Rhodan's motors have long-shaft options and dynamic positioning abilities, they are stand-alone motors as opposed to the Garmin, Lowrance and Minn Kota, which connect to their manufacturers' proprietary GPS/chartplotters, improving the capabilities of dynamic positioning and periphery controls. MotorGuide's system incorporates similar functionality, but allows for greater versatility across brands.

"Chartplotter integration has been a key part of our strategy for years and is something that our consumers expect from us," says Haley Patrone, Associate Marketing Manager for MotorGuide. "Our Xi Series motors connect with Lowrance, Simrad, and Mercury VesselView electronics with an NMEA connection, providing additional control of their trolling motor through their electronics. Our new Tour Pro includes that same compatibility and Tour Series motors enabled with HD+ universal sonar are compatible with all major sonar units. Our goal is to allow anglers to choose the combination of electronics that they prefer, so we intend to be compatible with as many brands as possible."

To a certain degree, the main goal of integrated trolling motors is consolidation of con-



Trolling motors are no longer just for small boats fishing the shallows. Longer shafts, some extending to 8 feet, are tailored for larger boats with higher bows that may fish in rougher waters. The idea is to keep the propeller motor housing submerged in all sea conditions.



Garmin and Lowrance jumped into the market in 2019, introducing their own Force and Ghost trolling motors, joining veteran Minn Kota, a subsidiary of Johnson Outdoors and sister brand of Humminbird. All integrate with their proprietary GPS/chartplotters and dynamic positioning functions. Johnson Outdoors Field Marketing Manager Bill Carson says, "With a boat integrated with our systems, you can press a button and deploy the trolling motor, then hold the boat in place or adjust its position while your anglers cast at a fish. And you can do it all without ever leaving the tower."

trol, giving boaters the ability to lock their position or change course without leaving the helm or putting down their fishing rod. Most of these high-end trolling motors also have built-in transducers, which takes some installation effort out of the equation. The question is, does the convenience outweigh the price? For Johnson Outdoors' Carson, the answer is a resounding yes.

"We're actually fishermen, so we understand the value of being able to integrate all of these parts of the boat, all of these fishing tools," he says. "What it all comes down to is a person being able to focus more on the fishing and less on attending to the boat. In a way, we're optimizing the process. Say you're a captain running a boat fishing for cobia and you're up in a tower. With a boat integrated with our systems, you can press a button and deploy the trolling motor, then hold the boat in place or adjust its position while your anglers cast at a fish. And you can do it all without ever leaving the tower."

These integrated motors have also been met with a warm reception from consumers, according to Brian Swanke, owner of CWR Wholesale Distribution. "I think platform integration is what the customer is looking for in a system today," he says. "They want the screens on the boat to all talk to each other and communicate with the trolling motor. This is what brought Lowrance and Garmin into the market. Folks wanted a complete package from a single vendor."

"Our interest in the market was driven by a growing trend toward integration between navigation displays and trolling motors, giving anglers the ability to use info from their charts to position themselves near fish or fish-holding structure, or to create a route to follow to maximize their time on the water," says Lowrance Executive Vice President Lucas Steward. "We began by working with existing trolling motor companies to create this type of integration and we continue to do so today, but we also saw an opportunity to make a bigger impact by creating a trolling motor from the ground up."

In terms of tech, Minn Kota, MotorGuide, Lowrance and Garmin are all at the high end of the scale. Due to technology sharing among the different brands of Minn Kota's parent company, their systems enjoy an added level of integration in some cases. They have the ability to tie in Cannon Downriggers and display downrigger data and controls, for example, or offer Tallon shallow-water anchor controls, all on the same Humminbird MFD screens the trolling motor can be controlled from.

Motor matters

While modern trolling motors are pretty Space Age, they vary in how they carry out their primary function: moving the boat. In 1934, O.G. Schmidt built the first gear-driven electric trolling motor by strapping a prop to the starter motor from a Ford Model A and selling it under the name Minn Kota. Just as Schmidt's company remains today, so does the technology he pioneered. Model A's are a little more difficult to come by, but the motors Minn Kota currently uses are not as dissimilar as one might think. Brushed DC motors can be found in everything from power drills to golf carts, not to mention MotorGuide and Minn Kota trolling motors. However, Lowrance and Garmin both opted to use brushless DC (BLDC) motors in their new models. But, is brushless better?

The biggest advantage of brushed motors is their price. A 36-volt Ultrex with a 52-inch shaft is around $450 less expensive than a 50-inch Force. That being said, if you factor in optional extras they can be about neck and neck. BLDC motors, on the other hand, have three major benefits: efficiency, longevity and noise. Estimates vary wildly, but in general BLDC motors offer 5% to 40% greater efficiency, which means that more electricity is being converted into mechanical energy than into heat or noise.

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Remotes are handy when you're holding a fishing rod in the other hand and want to move closer to the action. One difference among the brands is brushed vs brushless motors. Minn Kota and MotorGuide rely on brushed engineering while Garmin and Lowrance swear by brushless technology. Brushed motors tend to be less expensive while brushless construction offers other benefits.

The problem with power

As additional power-hungry electronics like trolling motors make their way onto boats, more powerful and efficient batteries are necessary—which creates challenges. For boat builders that involves designing more storage space in often limited real estate to accommodate larger battery banks. For trolling motor manufacturers the problem is that they don't build their own batteries, so they're reliant on what battery OEMs offer. For boaters the choice between traditional lead-acid and lithium-ion batteries isn't always an easy one. While lithium-ion batteries can store about five times more energy per pound than lead-acid, they come at a far higher price.

There may be lessons for the trolling motor market in electric outboard technology, which is pushing integrated power systems in a big way. Torqeedo led the field with the industry's first production models, but today there are several manufacturers building electric outboards with batteries that are shaped more or less like an outboard cowl, which clip into place on top of the shaft for easy removal and charging. Net result? While testing a new ePropulsion Spirit 1.0 Plus 3-h.p. outboard on a small jon boat, we found that the rig quadrupled range and doubled the speed while reducing battery weight by more than half, as compared to clamping on a traditional transom-mounted electric trolling motor and hauling aboard a pair of 12-volt batteries.

kind of like spinning a compass needle by moving a magnet around it. Brushed motors create fluctuating magnetic fields using carbon brushes. On the rotor (the part that spins) there are several little contact plates connected to copper coils. As the rotor rotates, the brushes make and break circuits with different contact plates, momentarily powering up alternating coils that create a magnetic field. As the name implies, BLDC motors don't have brushes. Instead, they switch the magnets on or off using transistors controlled by a motor-driven circuit. Why does that matter? Brushes wear down as they rub against the contact plates, meaning that over time they become less effective until they eventually have to be replaced. While most people have never had to replace the brushes in their trolling motor, they may notice a drop in performance after many years of use. So theoretically, BLDC motors should offer better longevity. But since these motors are so new to the market, only time will tell for sure.

"Brushless motors offer quietness, efficiency and power," says Lowrance's Steward. "No other trolling motor was using it at the time (that Ghost was developed). Brushless technology also eliminated sonar interference, a consistent problem we've dealt with for years. And a brushless motor is 40% more efficient. That's a lot more fishing time regardless of the battery being used. Reducing battery weight and letting anglers run all day on a 24-volt system is a big deal."

Garmin Media Relations Manager Carly Hysell agrees. "Brushless motors are the future of trolling motors and solve some of the power

(Continued on page 50)

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ED'S ELECTRO-TECH TIPS

ALL THINGS ELECTRICAL

Understanding Power Factor

BY ED SHERMAN

It seems every year around the end of haulout season here in the Northeast where I live, I get at least one and sometimes more than one call asking this basic question: "Hey Ed, how come the zincs on my boat are almost completely used up this year and last year they weren't even half consumed?" The question is usually followed up by a series of nearly useless explanations about the boats in the adjacent slips and all their presumed faults that could contribute to this phenomenon.

If I've learned anything in my nearly 50 years of dealing with marine electrical and corrosion issues, when it comes to corrosion it is almost always someone else's fault, at least in the eyes of the boat owner. So, let's make sure that you as technicians can not only explain all of this to your customer, but also have the knowledge to help mitigate some of the problems that do crop up.

Beginning with galvanic corrosion

Let's start out by making sure you understand what galvanic corrosion actually is. The ABYC Corrosion Certification study guide defines galvanic corrosion this way: "The most prevalent corrosion process in the marine industry always involves two or more dissimilar metals submerged in a common electrolyte connected by a metallic (or carbon fiber) path capable of supporting electron flow. "Dissimilar metals" in this case refers to differences in electrical potential (voltage). Galvanic corrosion is one of two types of galvanic processes; the other is simple corrosion."

So, via this definition we have identified four constituents that fall into what we sometimes refer to as the "corrosion quadrangle"—anode, cathode, common electrolyte and conductive path (at right). Note that rather than refer to metal 1 or 2 we refer to anode and cathode. In our definition we refer to dissimilar metals with different voltage potentials. Understand that metals with a more negative potential are going to be considered as anodic and will be the ones corroding and metals with a more positive potential are going to be considered cathodic. This is all based upon the table of nobility found in ABYC Standard E-2. All of these components need to exist for galvanic corrosion to occur. Elimination of any one of the four constituents will stop galvanic corrosion.

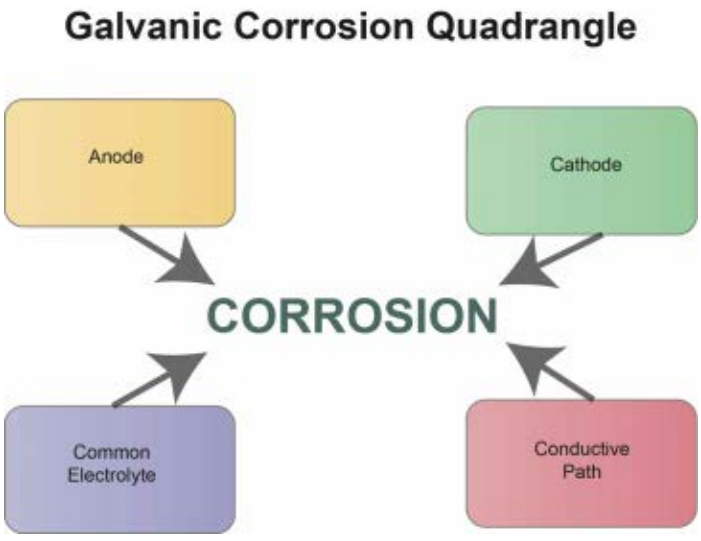
The problem with shore power

One of the problems with shore power systems on the dock is that every point of connection to receive power is interconnected via what we refer to as the grounding system. This is required under electrical codes and should always be the case. Maintaining earth ground continuity throughout a dock wiring system is an important safety concern. The same scenario is also found on a standards-compliant boat.

This whole matter of grounding is worthy of an entirely separate article, but for now just understand that with few exceptions everything electrical, both AC and DC, is ultimately interconnected on board the boat. Additionally, nonelectrical metal items like seacocks and other through-hull hardware may be tied into what we refer to as a bonding system. So, assuming some of these items are located below the boat's waterline, we have metal in a common electrolyte, electrically tied

For small- and mid-size boats, galvanic isolators can be effective at blocking galvanic currents although there are limitations under certain conditions.

For galvanic corrosion to occur, four elements must be present: anode, cathode, common electrolyte and conductive path. Metals with a more negative potential are considered anodic and will be subject to corrosion while metals with a more positive potential are considered cathodic.



together via this bonding/grounding system. Furthermore, these same bits of metal are also connected to metal on other boats sharing the same dock and shore power system and we end up with a large galvanic cell that contains all of the components needed to create the corrosion quadrangle. The net result of this can show up as corroded metal or rapid anode consumption on your customer's boat.

One of the other dirty little secrets we've learned over the years is that this grounding/bonding system, normally described as "non-current carrying," actually does carry low-level current sometimes in the form of AC leakage from certain appliances, in addition to the low-level galvanic current (DC). Any boat that spends much time at the dock and plugged into shorepower needs to protect against this. The potential influences on electrical system performance are numerous and go beyond the scope of this article.

The transformer solution

The most obvious is to never plug in at the dock. This is of course not too practical for most modern boaters. Another solution is to install what is known as an isolation transformer. These transformers are expensive, heavy, take up a fair amount of space and generate quite a bit of heat. It's a great solution on larger boats and they are used quite frequently. In my opinion they are the ultimate solution because they completely eliminate any hardwire connection between the boat and the dock. Magnetic induction within the unit gets the power from the primary to secondary side of the transformer. It not only provides total isolation galvanically but offers other advantages like stopping electrical noise transfer from the dock system to the boat and the ability to step up or down voltage output. All that said, they are just not practical for use on small- to mid-sized boats due to the size and weight issues.

The galvanic isolator

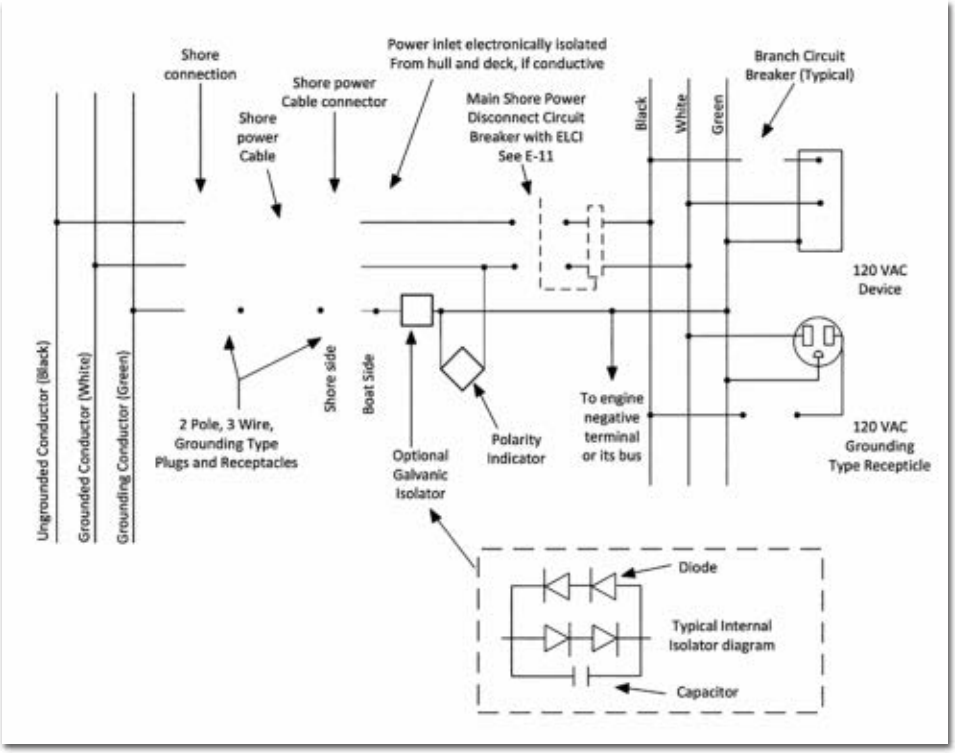
Enter the galvanic isolator, which is a simple electronic device that utilizes some diodes and a capacitor to effectively block galvanic level currents. Therein lies the only major weakness with these devices, in my view. Galvanic level voltages are quite low, less than approximately 1.5 VDC. So, if for example there is a battery level voltage leak into the boat's grounding system, the galvanic isolator will only block about 1.5 volts of it. Although rare, this can and does occasionally happen.

The primary cause is a boat owner that uses their bonding system as a DC negative conductor. The appliance will work fine, but every time the device is running the bonding system, which is ultimately connected to the boat's grounding system, will be conducting 12 volts-plus back to the DC power source. Some of that voltage and current will also attempt to go thought the galvanic isolator (all but 1.5 volts) in search of a pathway back to its source. Symptomatically, this will show up as extreme and rapidly occurring corrosion.

Of course, the other major concern over galvanic isolators is the fact that it is installed in series with the all-important safety wire, the green (or green with a yellow stripe) grounding conductor on board the boat. Any failure of the isolator that causes an open circuit will eliminate the ground fault (read shock hazard) protection on the boat. It was due to this worry among ABYC electrical committee members that led to acceptance of a new generation of isolators with a rating of "failsafe," which essentially means it cannot fail in an open circuit mode. It may fail to block galvanic level currents, but it will not fail in an open-circuit mode. Things known to cause failure are lightning strikes that may enter any dock wiring network.

Often, I get questions regarding the purpose of the capacitor in the isolator. Early units did not use capacitors. The mandate for the capacitor was added after we all learned that the matter of low-level AC current leakage into the grounding system on boats is actually rather common. Certain non-linear AC appliances (devices like modern AC units, and galley appliances) in fact leak low levels of AC current whenever they are running. I'm referring to milliamps here and the amount of allowable leakage is regulated under international electrical standards. This reality is the primary reason that ABYC and international (ISO) electrical standards for boats use a 30-mA trip level for whole boat shock hazard protection.

Understand that the current is cumulative on board depending upon how many appliances are operating at a given moment. It is not uncommon on larger yachts to measure 15 or 20 mA of leakage current. The purpose of the capacitor in a galvanic isolator is to help



This schematic diagram shows wiring for a typical isolator as well as its location in the shore power system. Early galvanic isolators without the now-mandatory capacitors had a fairly high failure rate due to low-level currents damaging the diodes.

protect the diodes from constant exposure to this low-level AC current. The capacitor, installed in parallel to the diode array, offers a conductive pathway for the AC to move on and away from the boat, but effectively blocks DC. Capacitors will conduct AC but totally block DC. Early galvanic isolators without the capacitors had a fairly high failure rate due to these low-level currents damaging the diodes. The drawing on page 33 illustrates the internal wiring for a typical isolator as well as its location in the shore power system.

Isolator installation and things to look for

For experienced electronic equipment installers installation of a galvanic isolator should be an easy task. From a specification perspective you will need to ensure that the unit is rated as "ignition protected" if the boat is gasoline fueled. I'm fairly certain that all of the US manufacturers of galvanic isolators have this rating, but I have seen some European units that did not. One of several standards may be referenced to indicate this rating: SAE-J1171, UL-1500, C-1500 or ISO-8846.

Additionally, these units must be rated to match or exceed the current rating of the shore power system. Here in the US that means 30 amps, 50 amps and possibly 100 amps, although boats with 100-amp service are typically large enough so that the isolation transformer option makes more sense. It will need to be labeled as "fail-safe per ABYC A-28."

A common question is what to do with a boat that has dual shore power inlets? Can you use just one isolator to service both shore power grounds? The way it is worded in the A-28 Standard makes this impractical. From 28.7.1: "In dual shore power cord applications using a single isolator, the current rating of the galvanic isolator shall not be less than the sum of the ratings of the main shore power disconnect circuit breakers as per ABYC E-11." Unless you have a pile of 100 amp-rated galvanic isolators in inventory, you'll need two isolators in this situation. Understand that 100 amp-rated galvanic isolators are difficult to come by in most areas of North America.

Another area of consideration with galvanic isolators is that there is no service to the boat that can bypass the isolator. A classic example is cable TV coaxial cables. Specialized isolators are available to handle that situation. As for metal-hulled boats, all AC power inlets, and cable TV and phone inlets to the boat must be insulated from the hull to minimize the potential for bypassing the galvanic isolator.

As for installation specifics, isolators need to be installed in ventilated, dry, and accessible locations that don't exceed the temperature rating of the unit (minimum 122 degrees F).

Conductors (green wire in, green wire out) shall be supported and clamped to relieve strain within six inches of the isolator case.

"Quick connect" (friction) terminals shall not be used on the AC grounding conductors.

In closing

So, the next time you get a call from a customer questioning a change in anode consumption on their boat (they'll call you because you installed a new VHF last spring), you need to get the following questions answered before jumping to any conclusions.

(Continued on page 50)

TECH TALK

TALES & TIPS FROM THE BILGE

Sleuthing out electromagnetic interference

BY JOHN BARRY
CMET & NMEA Instructor

Electromagnetic Interference or EMI is defined as electromagnetic energy that causes interference. Since electromagnetic energy is the foundation of all that we do, we must distinguish between wanted and unwanted electricity. When unwanted electrical energy interferes with the proper operation of equipment we call it noise or EMI. Problems with EMI are still a factor on many boats. This month we take a closer look at EMI.

Two years ago, a *Notice to Mariners* was issued by the US Coast Guard to warn about light dimmers causing interference in VHF radios. To detect the EMI, this notice recommended setting the VHF on the edge of breaking squelch and then turning on the lights. If squelch broke, this indicates an EMI problem with the lights. This rudimentary method can be done by novices and serves as a good warning. Light dimmers are often the culprit for this type of EMI noise problem which gets worse with more dimming.

A deeper look at noise problems allows for troubleshooting this difficult problem. There are many types of noise and many ways that noise manifests itself on boats. EMI noise has certain characteristics depending on where it comes from. Boats have different characteristics that may improve or worsen the environment for noise to spread. Basically, noise is unavoidable and can be conducted or radiated or both. Decreasing the noise to a level that makes it unharmful is the objective.

Noise varies

The noise that you may get from a failing alternator is quite different from that of an unshielded ethernet wire. EMI is electricity and has the same characteristics as other electricity, like voltage level and frequency. When an alternator fails, it can send 100-volt spikes across the ship's grounding system and cause havoc with electronics. An ethernet wire may emit just one volt of noise, but at a radio frequency. This type of noise is more likely to interfere with other similar frequencies like video or radios. EMI can be elusive.

Start with the source

All the rules of troubleshooting apply here. Be scientific, vary just one variable at a time. Duplicate the problem before you start. Understand how it should work, so you can tell if it does work. Regardless of the situation, we always follow the basics. Identifying the source of EMI is where we start. The process of elimination applies here. Duplicate the problem, then turn things off one by one until the noise disappears. Conversely, turn things on one by one until the problem shows up, which confirms the culprit. This method usually identifies the offending piece.

Once we know the source of the EMI, the next step is to identify how it gets to its victim. It may be radiated directly to the unit, it may be conducted to the unit through its cabling, or it may be radiated to the cabling and subsequently conducted to the unit.

Identifying the mode of transmission is an important step to understanding and resolving noise problems. This is where things get tough. Let's say your VHF radio has a noise problem and you unplug the antenna and the problem disappears. One could assume a bad antenna or poorly made coax connection and be right, but it could also be a wire routing problem with the new dimmer switch and LED lighting in the vicinity of the antenna or its wiring.

Sometimes experience is the only solution to noise problems. From defective batteries to spinning shafts, noise can come from many places. The AMEI (Advanced Marine Electronics Installer) class from the NMEA covers EMI. One thing that helps with noise is a properly installed device. Most products that run on 12VDC have a connection to the positive and negative battery supply plus a connection to RF ground. The RF ground connection is the wing nut on the back the unit or the shield from the unit's power cord. The purpose of this connection is to provide a low impedance path to the water for noise dissipation. If these connections are not made or if the boat lacks an RF ground, it may be impossible to solve certain problems. The NMEA MEI class teaches a whole section on grounds and grounding.

Solutions

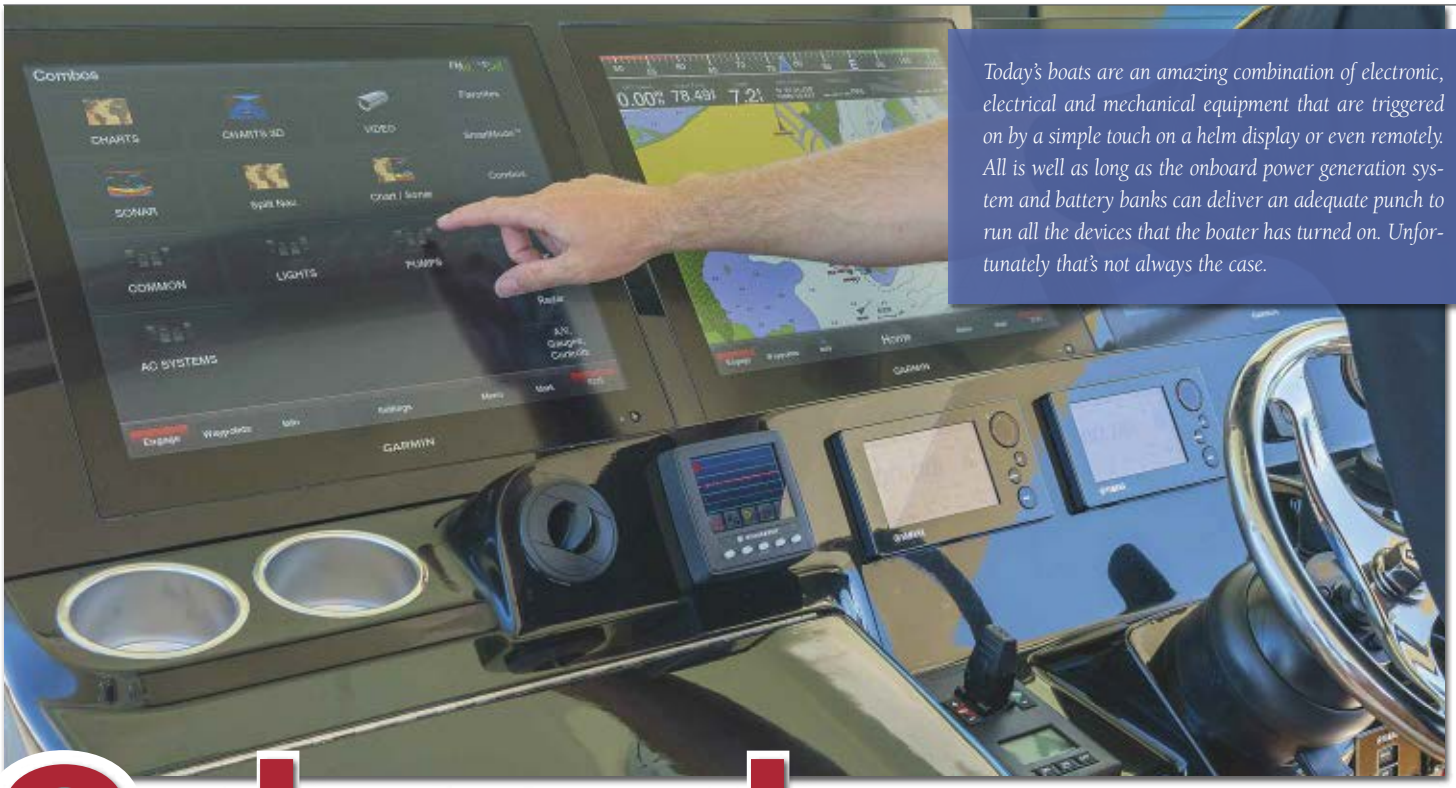
So how do we solve EMI problems? As mentioned above, improving the quality of the installation, ensuring proper grounding is number one. Further mitigation is possible using ferric rings or ferrites. These circular magnets are constructed to change the impedance of the cables going through them, shunting frequencies above a certain level to ground. Placing a ferrite on an antenna line or transducer line would be wrong, since these cables contain our desirable electromagnetic energy. Ferrites on power cables can prevent high-frequency (RF) noise from being conducted into a noise victim.

Ground loops are a common thing. When we ground things, natural loop pathways for electricity are inevitably formed. Not all ground loops are created equal, and sometimes a ground loop can cause noise problems. Ground loops have an impedance and noise has a frequency. If they match, we get gain, and noise can manifest itself. Since grounding and ground loops are beyond the scope of this article, suffice it to say that sometimes removing the RF ground connection may help.

Fishfinders susceptible

Noise manifests itself most obviously in audio devices, causing distortion and buzzing and it shows up in video displays, causing lines or smearing. Fishfinders are particularly susceptible. Noise can also cause intermittent data problems or other seemingly mysterious symptoms. Using a portable AM radio to sniff

(Continued on page 50)



Today's boats are an amazing combination of electronic, electrical and mechanical equipment that are triggered on by a simple touch on a helm display or even remotely. All is well as long as the onboard power generation system and battery banks can deliver an adequate punch to run all the devices that the boater has turned on. Unfortunately that's not always the case.

Onboard Power Puzzle

As boat owners demand ever more power-hungry equipment on their vessels, everyone from boat builders and boat retailers to equipment manufacturers and marine electronics dealers are under the gun to deliver. In this and future issues we'll look at the challenges to supplying adequate power needed to keep electronics and other equipment operating properly as well as how we can educate boaters about the consequences of over-equipping their vessels.

BY ZUZANA PROCHAZKA

Growing energy demands pose challenges

I always tell my charter guests that a boat is a self-sustaining city that must manage its own waste, water and power. I usually get a few nods or maybe just a blank stare and then they're off—taking 20-minute showers, cranking the stereo, leaving the lights and fans on, and opening the fridge for long inspections of what might make a good snack. But it's not just the newbies whose expectations of staying aboard mirror those of life at home. Seasoned boaters are increasingly subject to bouts of "buttonitis,"a unique malady that overcame Jane Jetson from the 1960s TV cartoon show of what life would be like in the future. Our push-button lives feed on power, so our self-sustaining cities are being asked to do more and that leads to hurdles at various points in the value chain.

Adequate onboard power is necessary for marine electronics and electrics and substantially increased needs are popping up everywhere: 16-inch MFDs, 4kW radars, 2kW fishfinders, deep-drop reels, autopilots, underwater lighting, 12-speaker stereos with three amplifiers, air conditioning, desalinators, galley refrigeration, electric winches and heads, powered window screens, spotlights, hatches and doors, joystick controls, and thrusters along with security and geo-fencing systems and a whole lot more. Today, you'll find gyrostabilizers on boats down to 30 feet and heavy hull sides and transoms that lower electrically. TVs in every cabin and satellite communications and entertainment have crept down to mid-sized cruisers that are now being asked to do what was once the realm of superyachts powered by multiple gensets. Even tow boats today are sporting some sort of digital switching system where everything is commanded with touches and swipes on a screen. The result is a power-strained vessel where equipment sometimes works sub-optimally or not at all—and that can be beyond inconvenient, it can be dangerous.

For everything to work properly, boats need more robust and efficient power generation and distri-

bution systems including fuel-efficient generators, high-output alternators, chargers that can manage disparate battery banks, and more dense batteries that can store greater amounts of energy and discharge at a slower rate. Lithium-ion batteries in various chemistries from providers such as Mastervolt and NexGen are becoming more accepted as the technology gets better, safer and more affordable.

New power generation equipment is under development, such as Nigel Calder's 9kW "alternator on steroids" called Integrel (Intelligent Generation of Electricity) that is marketed by Triskel Marine. It's meant to be a sort of genset replacement for boats that don't have the space and owners who don't have the budget for an AC generator. Meanwhile, monitoring specialists like Victron and Simarine are pouring money into R&D and bringing out some interesting products. Victron Energy has just launched their GX networking products that monitor and control battery sensors, chargers, inverters and solar panel controllers for both efficiency and safety.

Of course, there are other considerations in power distribution, including the sizing of components and wiring/cabling for safe voltage and necessary amperage. The days of a simple 12-volt system are going by the wayside as more boats have 24- and even 48-volt systems, like those using Side-Power's series of 48-volt tunnel thrusters. That's not even touching on the much higher voltage systems needed for electric propulsion like Torqeedo's 100kW Deep Blue inboard motor.

Electric propulsion aside, however, adding equipment spec'd by the owner can be tricky. Consideration must be given to galvanic protection, stray current protection, ground fault devices and the possibilities of general overheating and/or a meltdown. Even if a boat doesn't catch on fire, there's always inconvenience such as climate control that isn't working or a fridge full of lukewarm beer.

Many questions

Perhaps the best way to break down the power game is with a few questions and some perspective from the field.

1) Is the problem an engineering one at the boatbuilder level?

Some feel that adaptation and integration of advanced technologies aren't being done well and the answer seems to lie at least in part with realistic engineering at the boatbuilder level. When a boat is designed and built, it's set up with a certain amount of equipment, space and a power system. Then comes the options list, and down the line probably even more equipment will find its way aboard in the form of desired upgrades and retrofits over time. An owner with deep pockets may load up a boat, and then when he keys the VHF mic as the autopilot and radar are running and someone flushes an electric head, things go wrong. One or all systems may go down intermittently because the power structure isn't built to operate all equipment at peak draw simultaneously.

Ed Sherman, retired Vice President/Education at ABYC, notes that, "Most [builders] do not add expansion capability to their electrical systems because it does add cost. I generally recommend design parameters that include a 15-20% expansion capability, because we know the owner will want to add more accessories."

Additions create problems down the line too, especially for older boats. Ed Wiser of Boat Doc Marine Electric & Electronics says, "Boatbuilders consistently use wiring that does not meet ABYC standards, is too small for the expected load, is unprotected and unsecured. Worse yet, the wire is routed in a way that makes doing an upgrade very difficult."

To pile on, the equipment that's on today's boats is often quite sophisticated and can't be installed by your average electrician, especially one that's forced to work quickly in a builder's production line environment. Finally, new boats are packed tight so there's not much extra room. "Space for cable runs and extra batteries is at a premium," says Kevin Sherburne of HWH Electronics.

Whose problem is it? "Well, there's a lot of finger pointing between the boatbuilders, the equipment manufacturers and the service team in the field," adds Sherburne. "Boatbuilders aren't adequately anticipating a client's needs so problems show up in the field and lead to frustrated customers. Each boat should leave the factory only after all systems are turned on, tuned, proven to operate as intended and then tested under load simultaneously. Optionally, customers could be trained with reasonable expectations set to properly monitor and adequately manage limited power resources safely while on the water."

2) What needs to happen at the boatbuilder and equipment manufacturer level to alleviate the problem down the line?

One of the problems in meeting power demands is the limited real estate onboard most recreational boats for current and future equipment. New boats tend to be designed with minimal space to accommodate future power needs. Electrical guru Ed Sherman recommends that builders provide a 15-20% expansion capability in their electrical systems to handle future equipment.

Let's start with new boats. A lot can happen calibration-wise when a boat rolls off the line with equipment from different manufacturers working together. There may be Lifeline AGM batteries with a charger from Scandvik Marine. Add in perhaps Victron's Argo FET charging isolators or an alternator and regulator combination from Balmar. While there is nothing necessarily inappropriate with a more specialized approach, you have a soup of components that some technician down the line will have to ensure are "balanced" to prevent potential problems.

Batteries themselves can be a challenge especially when more juice is needed for add-ons. "In some cases, battery capacity can be expanded by a change in technology from flooded cell lead acid technology to AGM where non-damaging levels of discharge are deeper by about 30% over flooded. That effectively adds some capacity," says Sherman. "Accurate AC and DC load analysis and calculations need to be done to determine how much change is needed."

Is this analysis being done? At some builders, yes. For example, both Sherman and Wiser agree that Scout is a good example of a builder that knows how their boats will be used and has the trained staff to create work-

Battery development is a key to solving the power problem. Sometimes battery capacity can be expanded by going with a different technology, say moving from flooded cell lead acid to AGM. Meantime, lithium-ion systems are getting better, safer and more affordable all the time.

Power generation technology along with monitoring and control systems are also advancing quickly. Triskel Marine's Integrel is described as a genset replacement for boats that don't have the space and owners who don't have the budget for an AC generator.

able solutions. Sherburne names Viking as another good example.

This leads us to training. Not only do builders need to train their own employees to spec and install equipment correctly, they need to offer training downstream for dealers and technicians. But the onus isn't just on boat builders. The same goes for equipment manufacturers building today's advanced chargers, alternators and so forth.

Mitul Chandrani of inverter/charger producer Xantrex says that training videos are a great help. "We have videos that teach both techs and owners step-by-step and screen-by-screen," he says. "It's not a small investment but it makes sense for us because it lowers the call volume to our tech support team and we get fewer returns."

Sherman agrees. "Training and product knowledge are the keys here. There are some solutions out there, but they're not for beginners."

Now for the used boat. About 80% of boats on the water are pre-owned, but owners think they can just add a bank of mismatched batteries and the latest equipment to make their old boat feel new again. The problem is in the infrastructure. Just adding equipment and batteries isn't enough. You have to upgrade the cabling, wiring, switching and sometimes even the user interface to deal with the changes. I tripled the battery capacity on my boat in order to add some conveniences, but the installation and the upgrades to manage all this power left me with sticker shock. In the end, it totaled more than the cost of the components. That's a common experience among owners of older boats.

According to Wiser, "The rule of thumb is, if a boat is more than 10 years old and has had more than two owners, it probably needs significant electrical work."

3) Is this a regulation issue?

The question is, can engineering, education, training and good installs be regulated? "Not really," says Sherman. "Wiring sizes for 'X' amount of amperage are in ABYC regulations. Fuse and circuit breaker ratings based on amperage are also in the regs, but we place no limit on how much gear a builder wants to install."

Wiser adds, "You have to attack the problem through regulation and education."

4) Are there advanced systems (like digital switching) that can be put into place for automatic load shedding?

It would seem that systems which can shut down equipment that's not critical would be ideal. Load shedding is used to extend basic power before a complete shutdown. CZone for example will turn off non-essential circuits, like a water heater, to reduce the load draw and increase use time for critical equipment such as navigation or lighting. Whether through an automated digital switching system or an owner-designated manual system, peak power loads need to be managed. "The technology is certainly available, but sometimes the builders don't want to use it due to cost," says Sherman.

5) Where does the owner come into this scenario?

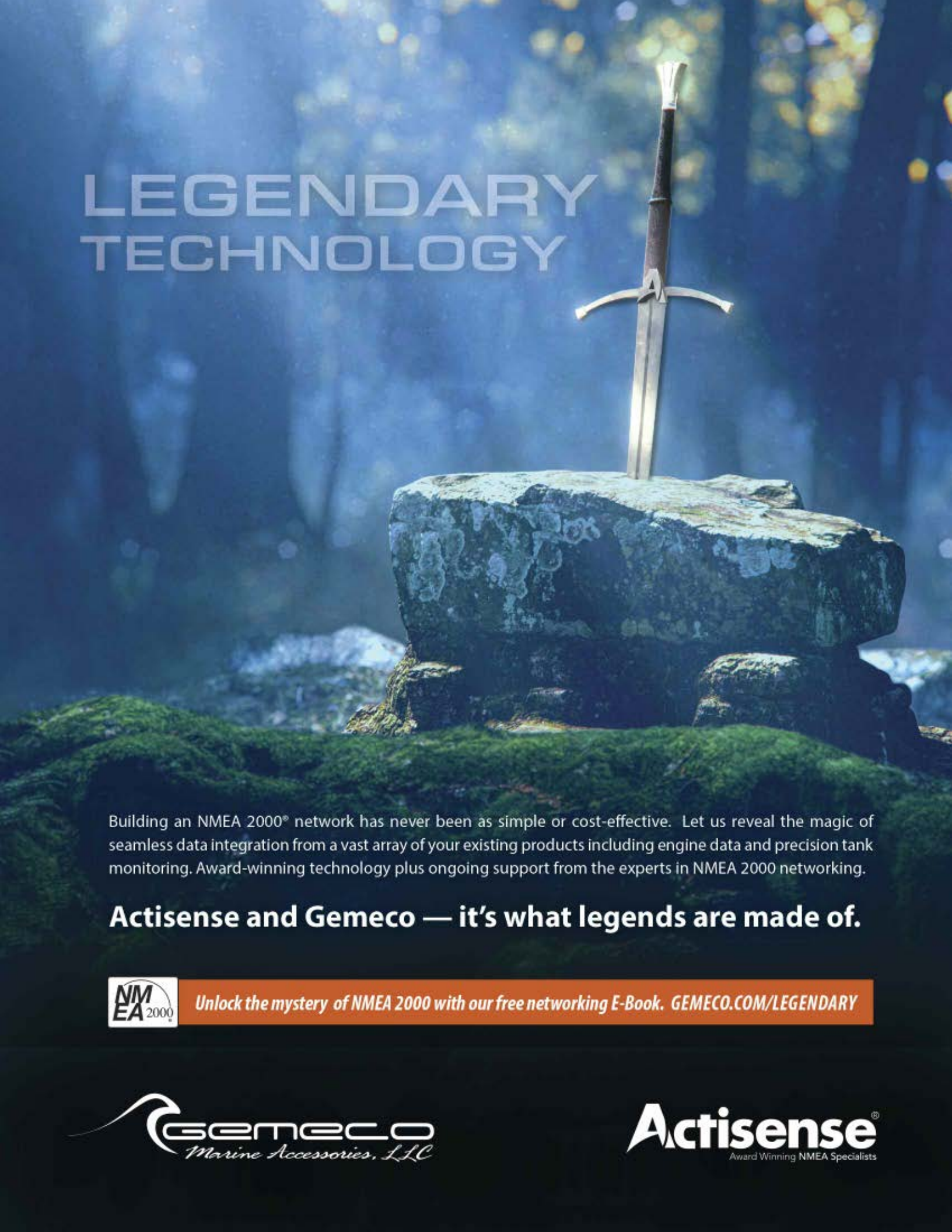
Everyone I spoke with agreed that education is the solution and it's needed from the builder, through the sales and service level, and right down to the owner. Especially today, when boats are flying off the shelves, production is hurried and there's not much time for training at the builder level. Then there's the salesman who assures the prospective owner that he can run every system aboard at peak and all the time. Overly enthusiastic (and often underinformed) salespeople lead to overpromising and underdelivering. "The way boats are being marketed doesn't always reflect reality when it comes to power," says Sherburne.

Finally, there's the owner himself. Many are experts in their professional fields, but they aren't electricians and they just want to come aboard, turn the key and go. However, education about the limitations of their power system isn't at the top of their to-do list.

Wiser notes, "An educated consumer is the best customer and is the easiest to work with. The problem is that many don't want to take the time to get an education. I used to give presentations at West Marine. If I was speaking on maintenance, a couple of people would show up. If I was talking fishing, the room would be packed."

What's the answer?

There are many factors at play and the power puzzle is anything but simple. Do builders need to anticipate and make provisions for what owners will spec upon purchase and down the line? Yes. Do both boatbuilders and equipment manufacturers need to invest in training? Yes. Do dealers and installers need to have more sophisticated electri-



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cians and computer-savvy gurus on staff? Yes. How do you tame the over-zealous salesperson? Who knows? And how do you get increasingly unaware boat owners educated? A double who knows.

The parties I spoke with had differing opinions on whether poor power performance is making boaters leave the industry. Sherman

(Continued on page 48)

Alternators, ratings and real-world output

BY CHRIS WITZGALL, CDI ELECTRONICS/BALMAR PRODUCT MANAGER

If you work in the marine electrical world, it is not long before you have a customer come to you about an alternator upgrade. "Look at this great 400A colussus-maximus alternator! If you install one of these for me, it will charge my 400AH lead acid batteries in an hour!" What follows is a discussion of how that won't actually put 400AH into a battery in one hour.

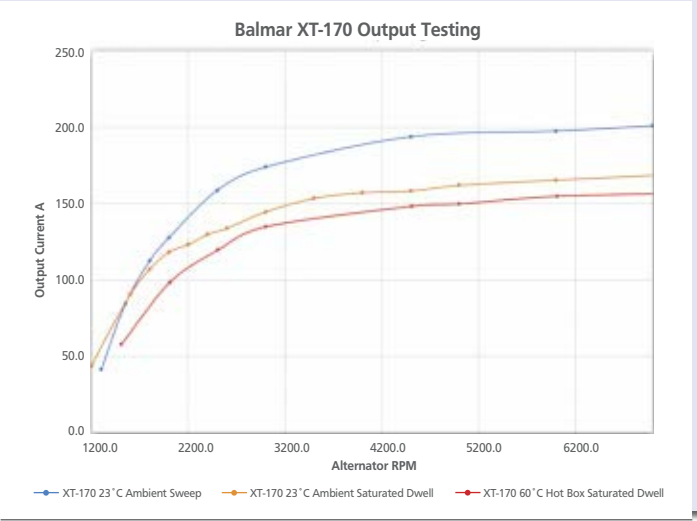
How can you choose an alternator and regulator that will meet their expectations, or reset the expectations with the customer based on the realities of budget, availability and fitment? To have any chance of doing this, you must know the performance of an alternator system in a meaningful way. This starts with two important values: What is the manufacturer's stated output of an alternator, and what can I expect in real world conditions in the actual installation?

Sweep test

Let's start with the rating. Many automotive aftermarket alternators sold into the marine industry are rated by what is known as a sweep test. In this test, an alternator is connected to a test rig, which consists of an electric motor to drive the alternator at precise RPMs, a depleted battery bank, and measuring and control equipment. In a sweep test, the alternator is loaded up to its maximum output and run through the RPM range as quickly as possible. When started, the alternator is at ambient temperature. The test takes less than a minute, so the alternator never heats up fully at any given RPM. The result looks something like the blue line in the graph below. It represents the most optimistic results of any alternator test. An alternator's output drops as they become heat saturated, but this is not reflected in the sweep test.

Dwell test

Enter the saturated dwell test, shown by the orange line in the graph below. It is designed to illustrate the output at stabilized temperatures. Typically, an alternator is first warmed up on the rig, and then run at a predefined set of RPM values—for instance 7000 RPM, then 6500, then 6000, etc. At each step, the temperature is allowed to stabilize, and only then is the output recorded. This test takes an hour or more to complete. While it takes into account the lower output of an alternator as it gets hotter, it does NOT take into account the potential higher ambient temperature of an engine room.



This might be a good place to pause and consider battery charging. When charging, there are always factors that reduce the actual power that will end up in a battery. Of particular note:

1. Engine self-consumption—what the engine uses itself. Newer common rail engines and any with an ECM (electronic control module) will be higher than most older engines. This has become such an issue with Mercedes and their Sprinter vans, for instance, that MB limits the amount of power that can be drawn by aftermarket equipment on the primary alternator to no more than 40 amps! The answer to this issue is often to use a secondary alternator, leaving the primary alternator to service the engine and its start battery, and the secondary to manage the house batteries.
2. Other loads that may be on at the time, such as lights, refrigeration, etc.
3. Batteries cannot absorb all the energy thrown at them, as they have an internal resistance. Additionally there will be losses due to resistance in the circuit.

Hot-box test

OK, back to the tests. To account for the actual (heat-soaked) operating environment, a hot-box test can be performed. This test is designed to simulate a hot engine enclosure to stress test a design, look for failure points, and to document what its performance might be in hot conditions. In the graph, the red line shows a hot-box saturated dwell test at 75 degrees C. This comes closer to what might be seen when actually installed, but it could be higher or lower depending on the ambient temperatures before an engine is started, and how well an installation provides fresh air to the alternator and the engine compartment in general.

Most reputable alternator manufacturers rate their alternators based on the middle-of-the-road ambient dwell test. Be careful to read the fine print surrounding the manufacturer's performance data to be sure that sweep test data is not used to optimistically rate the alternator's performance.

As you can see, there is a significant difference between the three curves and the output at any given RPM. We are often asked if there is some rule of thumb that can be applied to an alternator's rating to determine what its real world continuous output might be. Unfortunately, there are too many variables to do this with a range of derating that make any sense.

A clear conclusion is that any alternator drops in output as it gets hotter. If they get too hot, they fail. But each alternator design will be affected differently. Some tricks that savvy installers make is to oversize the alternator when possible and then use the external regulator ("Max Field %" or "Belt Manager" on Balmar Alternators) to dial back the output to a lower level than maximum. This allows for a cooler running alternator and makes it easier to predict the continuous output of the system. A properly aligned and tensioned belt is essential to avoid any belt-induced excess heat. Finally, a fresh supply of outside air, hopefully as close to the alternator as possible, can have a dramatic effect on both the output and longevity of any alternator.

BUSINESS SENSE

PUMPING UP PROFITABILITY

Automation

Affordable tools to help small businesses

BY STEVE KATZ

As strange as the business environment was in 2020—rough, unpredictable, unprecedented—many marine-related businesses had a busy and profitable year. While it is hard to predict what is in store for 2021, it seems that the marine sector is off to a profitable start.

Let's look at ways to do more than survive but to thrive in 2021. Analysts with Twilio went so far as to declare COVID-19 the "digital accelerant of the decade" and noted that 79% of respondents to a Twilio survey said the pandemic has increased their budgets for digital initiatives.

The high sales volume combined with staffing shortages faced by many businesses combined to create increased backlogs for manufacturing, sales and service companies. While many large organizations may have the resources to get through a time like this, smaller companies, especially those in the marine electronics business, cannot quickly increase the capacity to handle additional work or fill staff vacancies.

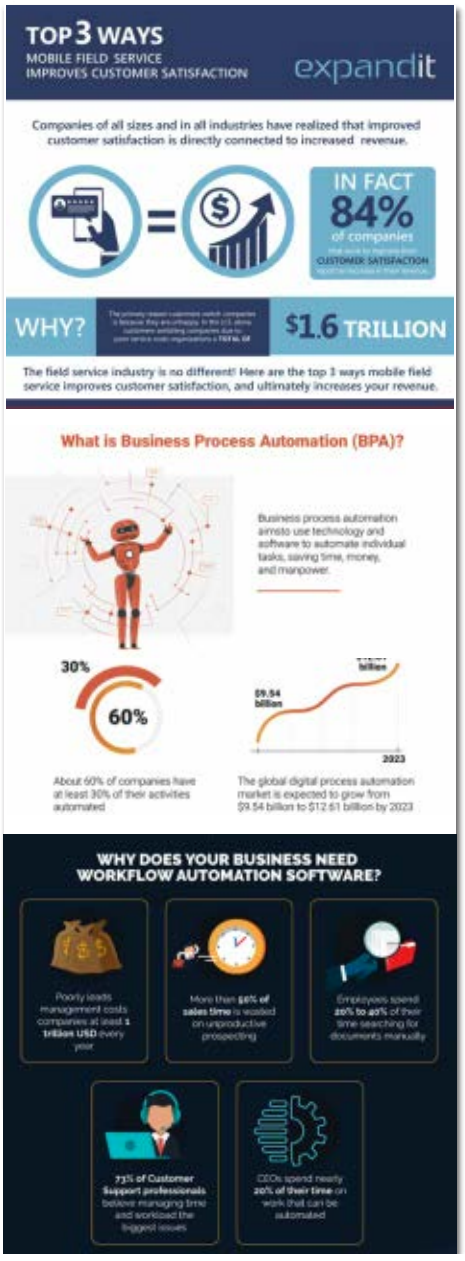
So, what can a small marine business do? The simplest thing is to schedule the work into the future and hope your customers do not mind waiting. Unfortunately, some of those customers may change their mind and not get the work done or may contact another company who can do the work sooner. Progressive businesses have discovered business tools that can help automate a business, freeing up internal resources that can be redirected to assist with throughput and improve efficiencies overall within your business.

Customer service trends and tools to improve operations

Why do we need automation to help with sales and service communications with customers? Customers' expectations and needs are as demanding as ever, and patience is lower than ever. Technology has shortened all business processes and customers expect the same speedy 4.5-minute service at your business that they receive at the fast-food drive through. Modern consumers want easy-to-navigate, honest information during business interactions. They want to engage with your business on their own terms. They want their problems to be solved quickly and completely.

Here are some popular business automation tools that could be useful for a small business in the marine electronics industry:

Email: Quickly replacing the traditional phone call, email is one of the most popular tools both new and long-term customers use to contact your business. It is easy to become



Many affordable automation tools exist to help small businesses become more efficient. They can also facilitate speed of response, which customers expect. Some generic field service software can be configured for marine electronics businesses to assist in areas such as scheduling work, assigning/tracking labor as well as managing parts inventory and distribution.

overwhelmed by trying to constantly keep your inbox clear and quickly responding to requests. A new survey reveals nearly a third of customers expect businesses to respond to emails in one hour or less.

Robo Response is one of many companies that can automate your sales-related email by acting as virtual assistant. It scans incoming emails, sends customized and unique replies in a jiffy without human assistance. This product continues to learn from your customer email conversations over a period of time and acts as an experienced member of your sales team by accumulating this knowledge. Robo Response is a subscription-based service with a free trial and starts at $25/month.

Social media: Among respondents to The Social Habit survey who have ever attempted to contact a brand, product or company through social media for customer support, 32% expect a response within 30 minutes. Further, 42% expect a response within 60 minutes. Is your company prepared to handle social media inquiries within the hour? A few are. Most are not.

Hootsuite is one of many companies that offer social media automation. The Hootsuite products enable social media automation using software tools to handle some of the time-consuming tasks involved in maintaining a professional social media presence. For instance, scheduling posts ahead of time, curating content for republishing, triaging routine customer queries, and producing analytics reports are all examples of social media automation. Hootsuite indicates that not all social media tasks can or should be automated, especially personal replies to direct messages from customers to your business. Hootsuite offers monthly subscription plans that start at $29/month.

Service: While the marine electronics industry is not large enough for the major software providers to offer specific business operation systems, there are many generic field service software systems that can be easily configured to help run a marine electronic business. Our business model is similar to electricians, plumbers, HVAC and other service-based operations. We all have the same common needs such as scheduling customers, assigning and tracking labor, managing parts inventory and distribution.

There are many software solutions that can help or even run the service side of your business. These systems often include job scheduling & dispatch, work order management, inventory, routing, tracking, customer portal and, importantly, invoice and payment. These systems often integrate with other popular software solutions such as accounting systems like QuickBooks, Salesforce and others. Popular software solutions are FieldEZ and Jobber and, of course, Salesforce, one of the largest platforms in the marketplace with numerous tools that can help you tune the service for your needs.

Back office: It's hard to mention software solutions and automation without talking about QuickBooks and FreshBooks and the myriad of third-party tools that can help customize and tune a generic QuickBooks or FreshBooks into a customized solution for the way you work. From employee scheduling, benefits and payroll through time and material tracking to billing and payments,

(Continued on page 48)

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The Covid-19 Emergency Relief

Some existing programs extended, others added

In late December, Congress passed and the President signed into law the long-anticipated additional round of COVID relief, which includes a list of extended and enhanced benefits for employers and employees. The funding is part of the larger Consolidated Appropriations Act of 2021.

BY MARK E. BATTERSBY

The legislation renews the Paycheck Protection Program (PPP) for a second round of forgivable loans while ensuring the deductibility of business expenses paid with them. Other benefits include:

• $166 billion has been allocated for economic impact payments of $600 for individuals making up to $75,000 per year and $1,200 for married couples making up to $150,000 per year, as well as a $600 payment for each dependent child.

- $120 billion provides workers receiving unemployment benefits a $300 per week supplement from Dec. 26 until March 14, 2021. Of interest to self-employed marine electronics personnel, independent contractors and so-called "gig" workers, the bill includes an extension of the Pandemic Unemployment Assistance (PUA) program, from Dec. 31, 2020 until March 14, 2021. Eligible individuals can receive up to 50 weeks of PUA. Payments of retroactive PUA for those who had already exhausted the prior maximum is limited to weeks of unemployment after Dec. 1, 2020.
- The Pandemic Emergency Unemployment Compensation (PUC) program, which provides additional weeks of federally funded unemployment benefits to individuals who have exhausted their regular state benefits, has also been extended.
- $25 billion in emergency rental aid and an extension of the national eviction moratorium through Jan. 1, 2021.

Small business bennies

The wide-sweeping bill contains quite a few provisions that impact employers, both in the private and public sectors, in 2021. Among the most significant provisions are:

- Extension of the Employee Retention Credit (ERC), the fully refundable payroll tax credit for employers paying qualified wages and health plan expenses through June 30, 2021. The ERC for wages paid between Jan. 1, 2021 and June 30, 2021 will be equal to 70% of qualified wages rather than the former 50%. Plus, the ERC cap on qualified wages has been increased from $10,000 of wages per employee per year to $10,000 of wages per employee per calendar quarter.
- Extension of the time allotted for repayment of employee Social Security taxes deferred under the President's memorandum deferring payroll tax through the end of 2021. This applies to payroll taxes on wages paid from Sept. 1 through Dec. 30, 2020. Under the memorandum, employers were required to increase withholding and pay the deferred amount in the first quarter of 2021. The bill has extended the repayment period through Dec. 31, 2021.
- Extension of the refundable Payroll Tax Credit for paid sick and family leave enacted as part of the Families First Coronavirus Response Act (FFCRA) through March 2021. Even though FFCRA paid leave benefits are no longer mandatory, employers can voluntarily continue providing paid leave benefits with the option of claiming the payroll tax credit through March 31, 2021.

The amended FFCRA rules now allow employers to take a payroll tax credit for voluntarily providing emergency paid sick leave and paid extended family medical leave into the first quarter of 2021. Many businesses/employers can now recover the costs of providing required FFCRA leave in 2020 and for "voluntarily" providing emergency leave and family medical emergency leave through March 31, 2021.

- The new bill also allows individuals to use their average daily self-employment income from 2019 rather than 2020 to compute the refundable Payroll Tax Credit.

SBA assistance

The new legislation includes approximately $325 billion in funding for the Small Business Administration (SBA) to help small businesses impacted by the COVID-19 pandemic. Included among these provisions are:

- The three-martini lunch. Designed to help the restaurant industry, the bill temporarily allows a 100% business expense deduction for meals with customers and potential customers (rather than the current 50%) as long as the expense is for food or beverages provided by a restaurant. Effective for expenses incurred after Dec. 31, 2020, the provision expires at the end of 2022.
- IRA withdrawals. Individual Retirement Accounts (IRA) and other retirement plans can now be used for "disaster mitigation." Residents in qualified disaster areas can make a distribution of up to $100,000 from an IRA or other retirement plan without penalty. Amounts withdrawn may be recontributed to the plan without consequences or included in income over a three-year period.

Survival funding

The legislation provides numerous funding opportunities including:

- Over $300 billion for small businesses struggling after nine months of the coronavirus pandemic.
- More than $284 billion has been provided to the SBA for first and second PPP forgivable small business loans, along with $20 billion to provide Economic Injury Disaster Loan (EIDL) grants to small businesses in low-income communities.

The EIDL program, which is designed to provide economic relief to businesses currently experiencing a temporary loss of revenue due to the pandemic, has received a second round of funding. The new law replenished the EIDL Advance Fund, which allows businesses suffering a substantial economic injury to apply for an advance that does not need to be repaid or up to $1,000 per employee, limited to $10,000 total. Also eliminated was the requirement that PPP borrowers deduct the amount of an EIDL advance from their PPP forgiveness amount.

Of course, the big news is the renewal of the Paycheck Protection Program The new law provides $284 billion to reopen and strengthen the PPP for both first-time and second-time borrowers.

As with the original PPP, small businesses can borrow money from private lenders without collateral, personal guarantees or fees. These loans don't have to be repaid to the extent they have been used to cover certain expenses.

Among the features of the restored PPP is a process for businesses to receive a second PPP loan if they have less than 300 employees and can show a 25% reduction in revenue in any 2020 quarter compared with the same quarter in 2019. Sole proprietors, independent contractors and the self-employed are also eligible to apply.

In general, borrowers are eligible for PPP loan forgiveness if they apply at least 60% of the proceeds to payroll. Partial loan forgiveness may be available to those failing to meet this threshold. Borrowers may spend up to 40% on other qualified expenses during the covered periods.

In addition to rent, mortgage interest and utilities, the list of eligible non-payroll expenses has been expanded to include worker protection and facility modification expenditures including PPE (Personal Protection Equipment) and operating costs such as software and cloud computing services.

The maximum loan amount is $2 million for "second draw" loans, down from the $10 million maximum that applied under the original CARES Act. Most borrowers can qualify for a loan of up to two-and-a-half times their average monthly payroll costs. PPP loans that aren't forgiven are subject to an interest rate of 1%.

Beware state rulings

Reversing an earlier ruling by the IRS, business expenses paid with PPP funding would be tax deductible. Beware, however, many states may not go along with allowing these deductions together with loan forgiveness because they would result in an unexpected state tax bill.

Unfortunately, the bill rescinded amounts formerly appropriated under the CARES Act for direct loans by the Treasury

(Continued on page 48)

Innovations

MODULAR VHFS DRIVE UP TO EIGHT HANDSETS

Simrad Yachting has rolled out a pair of premium multi-station black box marine radio systems, the Simrad RS100 and RS100-B. The RS100-B is integrated with a Class-B AIS transceiver and GPS. These systems are expandable and customizable to suit any boat and any on-water communication needs.

The RS100 and RS100-B are modular VHF systems that are expandable up to eight handsets (four wired and four wireless) and four external speakers. The wireless handsets duplicate the radio display and controls on easy-to-read screens viewable under all lighting conditions, even bright sunlight. All primary functions are accessible from the handset with channel scan and favorites, alphanumeric keypad, clear audio, handset station naming and 60-second audio rewind. With inductive charging (cordless charging), users are only a push of a button away from staying in touch.

The RS100-B system features a Class-B AIS receiver and transmitter, allowing users to see and be seen by other vessels with AIS equipment. AIS information can be viewed directly on the radio's screen or via a compatible multifunction display (MFD) as an overlay on a chart or radar screen.

The Class-D DSC-approved radio can make and receive DSC distress signals, including current position, and supports direct calling to other DSC-equipped radios. A dual-channel watch enables monitoring of the current channel and emergency channel 16 (in the US, tri-channel watch monitors the current channel, emergency channel 16, and calling channel 9). A record and replay feature ensures important calls are never missed. The system includes one external speaker with additional outputs for up to four speakers and one optional loudhailer/foghorn.

► **Simrad:** www.simrad-yachting.com

MID-SIZED CHARTPLOTTERS SPORT HIGHER RESOLUTION, MORE POWER

Garmin has introduced its next-generation GPSMAP 7x3, GPSMAP 9x3 and GPSMAP 12x3 mid-sized chartplotters and combination units, which offer a streamlined design, improved display optics and a robust feature set that seamlessly integrates into a Garmin marine system, available with and without built-in sonar.

Designed for a wide range of dash configurations, the GPSMAP x3 series features slimline design borders with edge-to-edge glass displays. The maximized glass design can be bail-, flush- or flat-mounted and offers a reduced footprint. For superior clarity and sunlight readability, the GPSMAP 12x3 and 9x3 models offer high-resolution in-plane switching (IPS) touchscreens that provide consistent, accurate colors that can be seen from all viewing angles, even with polarized sunglasses.

Offering nearly double the processing power of the previous generation, the power found in the GPSMAP x3 series significantly benefits all onboard sensors like sonar, radar, cameras, video and digital switching, and enhances the user experience across the entire network. Fast and responsive, these systems reference 10Hz GNSS (GPS, GLONASS and Galileo) for accurate positioning and smooth speed as well as course over ground (COG) data.

The sonar combo versions (xsv series) offer built-in support for 1kW traditional CHIRP sonar so anglers can see superior target separation up to 1,000 feet below the boat. These new combos also have built-in support for Ultra High-Definition SideVü and ClearVü scanning sonars featuring Garmin's new high-contrast vivid color palettes, making it easier for anglers to distinguish fish from structure. The xsv models also support the Garmin Panoptix all-seeing sonar.

► **Garmin:** www.garmin.com

DIAGNOSTIC TOOL GIVES QUICK CHECK OF NMEA 2000 SYSTEMS

NMEA 2000® networks are based on a robust CANbus architecture, but one bad device, cable or termination can have a detrimental effect on performance. Fault-finding can be time-consuming and tricky, so having a diagnostics device in your toolkit will save time, money and frustration.

Digital Yacht's NAVDoctor is a portable NMEA 2000 network diagnostic tool/tester. It combines the functionality of existing NMEA 2000 display programs and test equipment into a single, cost effective, simple plug-and-play box.

The NAVDoctor is self-powered from the network and creates a local Wi-Fi point for a mobile phone, tablet or PC to connect. Once connected, you simply access functions through the mobile's web browser so there's no complicated software to install. You can view and drill down on devices as well as PGN data on the network. It can even monitor physical characteristics of the network including bus voltages and load and detect frame errors.

► **Digital Yacht:** www.digitalyacht.co.uk

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- Exceptional 5 second surge for motor loads
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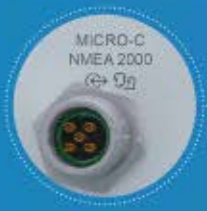
- Meets UL458 and ABYC safety standards

Part # 808-2015 (2000W/100A) and 808-3015 (3000W/150A)

Built-in Micro-C NMEA 2000 connector for easy connection without having to use an adapter.



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*VIA FREEDOM X REMOTE PANEL

MARINE POWER DIVISION

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Onboard power puzzle (Continued from page 40)

and Wiser feel that boaters are either settling or just shrugging it off as "the way it is." Sherburne on the other hand feels the whole industry gets a black eye from such problems. "Fire risks increase, functionality decreases, system fixes and repairs are expensive and customers can be placed in inherent danger."

However, nothing changes during good times. So long as boats are being sold (mostly due to COVID at the moment) then the status quo will hold. If boats start catching fire or experiencing catastrophic failures, that will be another story. Change, it seems, mostly happens under duress and during tough times.

Power promises not kept could be a part of why a large percentage of new entrants leave boating within five years. Actually, most boats are held on average of less than three years and are used only 5-15% of time they're owned.

The one common thread that runs throughout all these questions is much the same as the answer to a happy life—expectation management. If the marine industry wants to attract and retain customers, it must become realistic and build, sell and service products that meet boater expectations. In turn, boaters need to understand they're not at home on their sofa with all conveniences at their fingertips. Anyone who figures out the power dilemma and devises a solution that sticks with all parties will have found the key to (boating) life happiness. **MEJ**

About the author

Zuzana Prochazka is a freelance writer and photographer who contributes regularly to over a dozen sail and power boating magazines and web publications. A USCG 100 Ton Master, Zuzana has cruised, chartered and captained flotillas in many parts of the world and serves as an international presenter on charter destinations and technical topics. She is the Chair of the New Product Awards Committee for the National Marine Manufacturers Association, which judges innovative boats and gear, and Executive Director of Boating Writers International.

Covid-19 Emergency Relief Act

(Continued from page 45)

and emergency lending by the Federal Reserve. That means the end of several lending programs, including the Main Street Loans.

Somewhat more targeted, the new law contains provisions in areas such as:

- The New Markets Tax Credit—for encouraging tax-favored investments in economically depressed areas has been extended for five additional years at 2020 levels.
- The popular Work Opportunity Tax Credit, which has proven successful in helping employers add disadvantaged individuals, has also been extended for five years.

In addition to funding and granting temporary tax credits to help employers cover the cost of payrolls, the new bill provides more exotic benefits for wind and solar projects and creates permanent tax breaks for beer brewers, wine makers and liquor distillers. Many of the benefits for businesses will stick around long after the pandemic is over.

Not so surprisingly, the guidelines and corrections that inevitably follow massive legislation such as this as well as the future changes proposed by lawmakers mean massive confusion. Professional assistance is invaluable for any business owner hoping to reap their share of the tax breaks, unique funding and other benefits. **MEJ**

About the author

Mark Battersby has reported on news and developments within the tax and financial arenas for over 25 years. His articles regularly appear in many publications, including MEJ.

BUSINESS SENSE

(Continued from page 42)

there is a QuickBooks or FreshBooks solution that can streamline and automate back-office systems.

With today's ever-changing business models, social distancing and customer expectations, incorporating tools such as automation, artificial intelligence and other modern methods can allow a business to survive and thrive in the most difficult times. **MEJ**

Standards Update

(Continued from page 12)

NMEA OneNet (1Net) Update

Your NMEA OneNet (1Net) leadership team is engaged in technical meetings to review several ongoing activities that were developed this month. This new standard is moving forward, and the OneNet certification program should be complete by the end of this year. We are beginning to see that OneNet has an exciting niche, attributed to its building blocks. We expect that this standard may help bridge many unique platforms into one. Many main-set industries may utilize 1Net to modernize old/new systems.

For this reason, NMEA is evaluating both a self-test certification tool and a physical validation process. We are building a relationship with New Hampshire University's Interoperability Laboratory (IOL) to help NMEA validate OneNet devices to meet the standard's specified requirements. The IOL laboratory has the ability to test requirements within the OneNet Standard that the software certification tool cannot test for. In addition to validation, the IOL consists of professors and interns in the field of IP technology. NMEA is hopeful we can hold our first OneNet Plug Fest hosted by the University of New Hampshire IOL in 2022.

We need YOU. NMEA is in a constant adaptive role to help evolve interface standards. To do so, we must study our past, present and future. The safety of the boating public is paramount, and the boating public's needs grow, either directly or indirectly. Here at NMEA, your industry volunteers are attempting to ensure both operation and convenience are in reach. The contributor pool is growing, and you can be a part of it.

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NMET

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Become an NMET today!

NMET stands for National Marine Electronics Technician, which is similar to Certified Marine Electronics Technician (CMET), but without the Federal Communications Commission (FCC) requirements. The NMET certification is designed for businesses and individuals who focus on the recreational marine electronics market. The NMET candidate is an advanced installer/troubleshooter who has extensive "experiential knowledge" related to installing, troubleshooting, and repairing marine electronics. The CMET/NMET exam question pool, now nearly 500 in all, has been expanded and modernized by subject matter experts in the areas of radar, sat comm, GPS, Sat TV, autopilots, AIS, video displays, computers, heading devices, Ethernet, MFDs, Wi-Fi, VHF, DSC, SSB, NMEA 0183, NMEA 2000, Electrical Principals, RF Principals, Transducers / Hydroacoustics, and Power Distribution.

For more information go to nmea.org

NMEA OneNet 101 (Continued from page 24)

implementation. We identified several features that sounded good in theory but actually getting it to work would have been impossible.

With the ever-expanding and growing complexity of onboard networks, are you confident that OneNet is up to the challenge of accommodating new operational demands into the future?

Making sure the standard can adapt to future needs was a primary objective for the committee. There are two things that make me confident that OneNet is positioned well in this regard. First, the standard is flexible. We've already discussed how OneNet is not reliant on NMEA 2000 parameter groups. As useful as these are, there are much more manageable ways to represent data, like JSON, that are widely used on the internet today. I would expect these technologies to make their way into OneNet fairly soon.

The second is that OneNet is built on a foundation of industry-standard protocols. As new operational demands arise this will allow us to more easily integrate solutions developed for other industries.

How do you see OneNet growing in the future?

I've already mentioned the absence of a detailed specification for network infrastructure components. That will be needed to support the radar messages already being worked on.

As more manufacturers get involved I expect there to be a lot of new ideas brought to the committee, but I'll touch on two other ways that I anticipate OneNet growing in the near future.

First, I think there will be a demand to better support products connected over Wi-Fi.

The second is a solution to a problem we run into often with NMEA 2000, where a display from one manufacturer cannot configure the sensor from another. OneNet already requires all products to run an HTTP server, so the idea is to build on this by requiring sensors to offer a web page that can be shown on any display and used to securely configure that sensor.

New tricks for an old dog (Continued from page 30)

issues that have troubled customers in the past. Lithium battery technology will also evolve and make batteries more efficient."

The reduction in sonar interference is a big potential advantage of BLDC motors. Because brushed motors make and break circuits multiple times per second, they generate a lot of electrical and electromagnetic noise. When you have a transducer sitting a few inches away from the motor it could pose an issue. That being said, few anglers have qualms with the performance of the Ultrex or Tour Pro's transducers.

So, while Garmin and Lowrance are adamant that BLDC is the future of trolling motors, the jury is still out on just how important the difference is. What can be said for sure is that trolling motors are getting more powerful and being asked to do bigger jobs, especially in the saltwater realm where currents and wind can raise demands quite a bit. And more powerful motors need bigger batteries, which poses a new set of challenges for onboard storage.

There's no doubt that growing capabilities of trolling motors and increasing demands by end users are changing much about the technology and how it is utilized. As CWR's Swanke sees it, installers are going to be the ones to facilitate the shift. "In the past trolling motors went on small bass boats, so the traditional coastal NMEA installing dealers were not involved at all. The trolling motor has evolved so much, and these are being used on saltwater coastal fishing boats all over now, so the marine electronics installer is very involved. Plus, the level of integration with NMEA 2000® has forced the trolling motor to become a part of the NMEA dealer/installer's business." **MEJ**

About the author

Lenny Rudow has been a boating writer for more than 20 years. He writes regularly for several marine publications and websites, including BoatUS, Texas Fish & Game, *and* boats.com. *Lenny owns Marine Editorial Services and FishTalkMag.com based in Edgewater, MD, and is past president and current board member of Boating Writers International.*

ED'S ELECTRO-TECH TIPS (Continued from page 34)

- Was the boat stored in the same slip as last year? Things like conductivity of the water, pH and salinity are factors and will vary due to rain frequency and location.
- Water current is also a factor. More current equals faster anode consumption.
- Did the boat get used more frequently than in previous years? More usage equals more rapid anode consumption.
- Have paint or barrier coated metals been exposed due to grounding or simple wear and tear? More exposed metal will change the amount of anode needed to protect the exposed metal (cathode).
- Are they using the same anode material? The switch is on toward to the use of aluminum anodes vs. zinc and many boaters are not aware of this. If the boat is kept in a brackish water environment and they had been using zinc anodes, they would definitely last longer but they probably weren't providing much protection either. Depending on the actual salinity they may even have developed a passive coating. Aluminum is the best choice of anode material in either salt or brackish water environments.

So, after answering the questions above and ensuring things are in proper order, the solution may be to install yet another piece of electronic equipment, the galvanic isolator. Several well-known manufacturers that I know comply with all of the ABYC requirements are:

Professional Mariner: www.promariner.com
Victron Energy: www.victronenergy.com
Newmar: www.newmarpower.com
Mercury Marine: www.mercurymarine.com

TECH TALK (Cont. from page 35)

for noise can be quite effective. An oscilloscope or spectrum analyzer are great tools to see noise. If you know where the noise is coming from, always mitigate the source as opposed to protecting the victim. Removing the offending unit is a good idea. Following best practices with tight connections and proper grounding and using quality marine grade equipment are the best trick all!

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