NMEA Training Overview

NMEA offers 4 classroom installer training courses

- Basic Marine Electronics Installer (MEI)
- Basic NMEA 2000 Network Installer
- Basic Marine Electronics Installer (MEI)
- Advanced NMEA 2000 Network Installer
MEI Training Overview

- General Knowledge
- Ohms Law
- Grounds
- Batteries & Battery Charging Systems
- DC Wiring
- Coaxial Cables
- Antenna Installations
- Display Installations
- Black Box Installations
- Marine VHF Radio Installations
- Automatic Identification Systems “AIS” Installations
- Radar Installations
- Transducer Installations
- Heading Sensor Installations
- NMEA Data Interfacing
- EMI
Ohm’s Law Examples

A Radar is rated at 60 Watts. What is the current draw when operating at 24V?

\[ I = \frac{P}{E} \] (Current = Power / Voltage)

I(Current in Amps) = \frac{60}{24}

Current is 2.5 Amps
Drilling Solid Fiberglass with Gel Coat

Use Multi Flute Countersink

Countersink through gelcoat

Flat washer

Gelcoat Layer

Self Tapping Screw

Drill Tap Sized Hole

Fiberglass

Fiberglass
VHF Radio: Post Install Checks

1. Check Transmit Power into Dummy Load prior to testing antenna
2. Confirm sufficient radio supply voltage during HI Transmit
3. Test Forward and Reflected Power (25W radio should have $\leq 3W$ reflected)
4. Check receiver by listening for local traffic and distant NOAA weather channels
5. Perform Radio Check. Do not use CH16! (Check local area for automated test services)
6. Confirm that Lat/Lon displayed. (Advise owner on obtaining MMSI #)
7. Confirm all other functions & auxiliary equipment

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Marine Frequency Spectrum

Sat TV
12-26 GHz
KU – KA Band

Vsat
12-26 GHz
KU – KA Band

WiFi
2.4 - 5.9 GHz
L - S Band

FCMW Radar
9 GHz
X Band

X Band Radar
9.4 GHz
X Band

Irridium
1.6 GHz
L Band

Standard “C”
1.5 GHz
L Band

S Band Radar
3 GHz
S Band

GPS
1575 MHz
UHF Band

Cellular
800-2600 MHz
UHF – L Band

Fleet Broadband
1-2 GHz
L Band

Marine VHF
156-162 MHz
VHF Band

AIS
162 MHz
VHF Band

EPIRB / PLB
406 MHz
UHF Band

Navtex
518kHz
LF Band

SSB
2-30 MHz
MF – HF Band

PLB
121 MHz
VHF Band
# Coaxial Connector Selection

<table>
<thead>
<tr>
<th>Connector Type</th>
<th>Maximum Frequency</th>
<th>Impedance</th>
<th>Common Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>UHF (PL-259)</td>
<td>300 MHz</td>
<td>50-Ohm</td>
<td>VHF, SSB, DGPS, Stereo, AIS</td>
</tr>
<tr>
<td>BNC</td>
<td>4.0 GHz</td>
<td>50-Ohm</td>
<td>VHF, SSB, DGPS, Cell, GPS, AIS</td>
</tr>
<tr>
<td>TNC</td>
<td>2.5 GHz</td>
<td>50-Ohm</td>
<td>SSB, DGPS, Cell, GPS, MINI-M</td>
</tr>
<tr>
<td>N</td>
<td>11.0 GHz</td>
<td>50-Ohm</td>
<td>VHF, SSB, DGPS, Cell, GPS, AIS</td>
</tr>
<tr>
<td>F</td>
<td>2.0 GHz</td>
<td>75-Ohm</td>
<td>TV, GPS</td>
</tr>
<tr>
<td>Mini UHF</td>
<td>2.5 GHz</td>
<td>50-Ohm</td>
<td>Cell</td>
</tr>
<tr>
<td>SMA</td>
<td>12.0 GHz</td>
<td>50-Ohm</td>
<td>SAT Phone, Satellite Radio</td>
</tr>
<tr>
<td>SMB</td>
<td>4.0 GHz</td>
<td>50-Ohm</td>
<td>Satellite Radio</td>
</tr>
<tr>
<td>FME</td>
<td>200 MHz</td>
<td>50-Ohm</td>
<td>Satellite Radio</td>
</tr>
</tbody>
</table>
DC Panel Capacity Planning

- Calculate existing spare capacity
  - Load of existing equipment
  - Feed wire gauge and length
  - Available spare breakers or fuses
  - If Watts are given, convert to Amps

\[ P = I \times E \]

\[ I = \frac{P}{E} \]

\[ E = \frac{P}{I} \]

“P” is Power in Watts
“E” is Voltage in volts
“I” is Current in Amps

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NMEA 2000 Overview

- Cables & Connectors
- Cable Specifications
- Building the Network
- Physical Planning & Documentation
- Power Sources & Distribution
- Voltage Drop Calculations
- Finalizing the Network
- Data Messages aka Parameter Group Numbers
- Connecting to Other Data Sources
- Network Setup
- Troubleshooting
- Exam
Introduction:
NMEA 2000® IS....
Backbone and drop line topology – also known as trunk and drop line. Both ends of the backbone are terminated.

Network interfaces provide power for the device transceivers, so the backbone includes a pair for power and ground.
Power Distribution: Middle Power - Battery Example

- Termination Resistors Not shown
# Testing and Troubleshooting: With Network Power ON

<table>
<thead>
<tr>
<th>Pin/Signal</th>
<th>Measurement</th>
<th>Nominal Value</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2) PWR +</td>
<td>Voltage Between PWR + and Pin (3) PWR- (Ground)</td>
<td>12 V to 13.84V</td>
<td>≥ 9.5 V to ≤ 15.75 V</td>
</tr>
<tr>
<td>(RED)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Cable Specifications: Wiring Info.- Light Cable

- **RED+ NET-S (22 AWG)**
- **BLACK – NET-C (22 AWG)**
- **BLUE NET-L Data (24 AWG)**
- **WHITE NET-H Data (24 AWG)**
- **Overall Braid Shield**
- **Alignment Key**
- **Shield / Drain (22 AWG)**
AMEI Training Overview

- Marine Computer Installations
- Data & Ethernet
- Electromagnetic Interference (EMI)
- VHF, DSC, SSB
- Non-Magnetic Heading Sensors
- Antenna Placement / Satellite Communications
- AIS
- Radar
- Autopilots
- Exam
Mounting Considerations: Linear Rudder Reference

- Linear RRUs are used with outboards and I/O type systems. They mount parallel with a linear drive unit.

Rudder Reference Units may not be used on some Autopilots
Radar Installation Considerations

- Two radars require vertical separation
- Located outside vertical beamwidth of any other radar
- Some radars have blanking sectors
- Consider cable length necessary
AIS Equipment Location

- Operation from Normal Watch standing Location
- Pilot Plug
  - NMEA 0183-HS Interface

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Transmit A</td>
</tr>
<tr>
<td>4</td>
<td>Transmit B</td>
</tr>
<tr>
<td>5</td>
<td>Receive A</td>
</tr>
<tr>
<td>6</td>
<td>Receive B</td>
</tr>
<tr>
<td>9</td>
<td>Shield</td>
</tr>
</tbody>
</table>
Typical Satellite System

Above Deck

Below Deck

Interface is dependent on Satellite Dome & System

OR

OR

OR
Non-Magnetic Heading Sensor Installation Considerations

- Multipath

- Refer to manufacturers installation instructions

- Give considerations to equipment locations for serviceability, proper operation & functionality
Basic SSB Components

50 Ohm Coaxial Cable Connections ≤ 2dB Loss at 2 - 30 MHz
Avoiding EMI Problems

Layout & Space Planning
- Identify Potential EMI Radiation Sources
- Identify Potential EMI Conducted Sources
- Avoid Potential Hot Spots
- Avoid bundling RF Transmission cables with data communications cables
Ethernet Connectors (Ez)

- RJ45 Type Connectors
  - Recommend EZ Type
  - Rated IP67 or Higher (IEC 529)

- Durability
  - Use manufacturer recommended cables when possible
  - Strain relief for all cable Connections
Advanced NMEA2000
Class Room Objectives

- NMEA2000 CAN Topology Review
- NMEA2000 CAN Signaling
- NMEA2000 Network Characteristics
- NMEA2000 Device Configuration
- NMEA2000 Diagnostic Tools
- NMEA2000 Network Design
NMEA2000
Network Bridge Example

Installed as a “Drop” Between Networks
NMEA2000 Parameter Groups

Mandatory PGN’s for devices Certified on or after Aug 2016
ALL Devices Must Support a Minimum Group of messages

<table>
<thead>
<tr>
<th>Message Name / Functionality</th>
<th>PGN</th>
<th>TX</th>
<th>RX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address Claim</td>
<td>ISO 060928</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Product Information</td>
<td>NMEA 126996</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Configuration Information</td>
<td>NMEA 126998</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Request/ Group Function</td>
<td>NMEA 126208</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Command Group Function</td>
<td>NMEA 126208</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Acknowledgment Group Function</td>
<td>NMEA 126208</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Acknowledgment</td>
<td>ISO 059392</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Request</td>
<td>ISO 059904</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>TX/RX PGN List Group Function</td>
<td>NMEA 126464</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Heartbeat PGN</td>
<td>NMEA 126993</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Commanded Address</td>
<td>ISO 065240</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Transport Protocol, Data Transfer</td>
<td>ISO 60160</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Transport Protocol</td>
<td>ISO 60416</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
NMEA2000 Diagnostic Tools
N2K Meter by MARETRON

6 Separate CAN Voltage Measurements For Quick Troubleshooting
NMEA2000 “Good” CAN Signaling Scope Example
Note: NET-H (Yellow Trace) Dominant State Positive Going @ 1vdc
Advanced NMEA2000
Hands On Objectives

Confirm Network Devices & Data