About NMEA 2000® Cables and Connectors

The NMEA 2000® standard goes beyond defining message content and includes requirements for the cabling used to interconnect electronic components (referred to as the physical interface). The following catalog pages contain the NMEA 2000® approved network interconnect components used to build an operational network.

About Micro, Mid and Mini Cable Systems

There are three types of NMEA 2000® cabling systems, Micro, Mid and Mini. The Micro/Mid cable system is generally used for smaller networks requiring less power (i.e., less than 4 amps per network leg) while the Mini cable system is used for larger networks (i.e., more than 4 amps but less than 8 amps per leg).

Micro/Mid NMEA 2000® Network Example
(Up to 4 amps per leg)
**Maretron NMEA 2000® Cable Features**

- Simple trunk and drop line topology interconnects all NMEA 2000® equipment
- Drop line topology allows powered component removal or re-connection while rest of network remains operational
- Cable includes power and ground for powering equipment drawing less than 1 amp/device
- Connectors include keys and keyways for simple error free connections
- Screw thread connectors reduce chances of accidental disconnects of essential equipment
- Waterproof connection system prevents corroded intermittent connections and continues to operate even while submerged in the bilge
- Three independent cable shields (power pair, signal pair, and overall cable) protects system from external noise sources such as high power radio transmitters and radar units
- Nickel plated brass connector ends ideally suited to harsh marine environment
- Phosphor bronze contact base material with gold over nickel plate for reliable connections
- Overmolded cable connector ends provide strain relief
- Simple easy to use diagnostic components enable trained and untrained personnel to diagnose and troubleshoot network installations
Micro bulk cable is primarily used as drop cable, but it can also be used at the trunk line depending on network power requirements. Bulk cable with field-attachable connectors allows for maximum flexibility as cables can be made on the job to exact lengths.

- Meets and exceeds NMEA 2000® specifications for the highest reliability
- Trunk or drop cable for use with Micro connectors
- Used with field-attachable connectors to build exact length cables at the job site

Field-attachable connectors allow you to make field connections to bulk cable (see diagram). The color-coded screw terminals match the individual wire colors found within the bulk cable for error-free field installation.

- Color-coded screw terminals make for error-free field installation
- Rugged housing material designed to withstand harsh marine environments

Like the straight Micro/Mid Field-attachable Connectors, the 90° field attachable connectors allow you to make field connections to bulk cable. The 90° connectors are particularly well suited for tight spaces like the back of displays where there is limited space for a straight connector.

- Useful in tight spaces or where sharp corners need to be made
- Waterproof rated to IP67
Micro Bulk Cable

**Specifications**

- **OVERALL**
  - Outer Jacket Mat/Color: PVC/Gray
  - Insulation Material: PE (data wires), SRPVC (power wires)
  - Construction:
  - 4x22 AWG, 22 AWG Drain
  - FOIL (overall), FOIL (power pair), FOIL (data pair)

- **POWER PAIR**
  - Wire: 2x22 AWG
  - Resistance/Conductor: 18.1 Ohms/1000ft
  - Max Amperage: 6 Amps
  - Color Code: Red/Black

- **DATA PAIR**
  - Wire: 2x22 (AWG)
  - Characteristic Impedance: 120 Ohms ± 10%
  - Capacitance: 11.33pF/ft ± 10%
  - Color Code: White/Blue

- **APPROVALS**
  - UL: PLTC 75°C Sunlight Resistant E90625, AWM 80°C 300V
  - CSA: CMX-OUTDOOR-CMG LS4185 75°C, AWM II/B 80°C 300V FT4
  - NMEA: NMEA 2000® Approved
  - IEC: IEC-61162-3

- **ENVIRONMENTAL**
  - Protection Class: IEC IP67
  - Temperature Range: -40°C TO 85°C (-40°F to 185°F)

- **APPROVALS**
  - NMEA: NMEA 2000® Approved
  - IEC: IEC-61162-3

**Products**

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>CG1</td>
<td>Micro Bulk Cable (Per Meter)</td>
</tr>
<tr>
<td>CG1-100</td>
<td>Micro Bulk Cable (Per 100 Meter Spool-Gray)</td>
</tr>
</tbody>
</table>

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Micro/Mid Field-Attachable Connectors (Straight)

**Specifications**

- **MECHANICAL**
  - Housing Mat/Plating: Nylon/Black
  - Contact Mat/Plating: Brass/Optaloy
  - Coupling Nut Mat/Plating: Brass/Nickel
  - Maximum Wire Size: 18 AWG

- **CABLE GRIP RANGE**
  - 6-8mm

- **electrical**
  - Rated Current: 4.0 Amps
  - Rated Voltage: 30 V AC/ 36 V DC

- **environmental**
  - Protection Class: IEC IP67
  - Temperature Range: -40°C TO 85°C (-40°F to 185°F)

- **APPROVALS**
  - NMEA: NMEA 2000® Approved
  - IEC: IEC-61162-3

**Products**

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<tr>
<td>FA-CF-ST</td>
<td>Micro/Mid Field Attachable Connector (Straight Female)</td>
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<tr>
<td>FA-CM-ST</td>
<td>Micro/Mid Field Attachable Connector (Straight Male)</td>
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Micro/Mid Field-Attachable Connectors (90°)

**Specifications**

- **MECHANICAL**
  - Housing Mat/Plating: Nylon/Black
  - Contact Mat/Plating: Brass/Optaloy
  - Coupling Nut Mat/Plating: Brass/Nickel
  - Maximum Wire Size: 18 AWG

- **CABLE GRIP RANGE**
  - 6-8mm

- **electrical**
  - Rated Current: 4.0 Amps
  - Rated Voltage: 30 V AC/ 36 V DC

- **environmental**
  - Protection Class: IEC IP67
  - Temperature Range: -40°C TO 85°C (-40°F to 185°F)

- **APPROVALS**
  - NMEA: NMEA 2000® Approved
  - IEC: IEC-61162-3

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<td>Micro/Mid Field Attachable Connector (90° Female)</td>
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<tr>
<td>FA-CM-90</td>
<td>Micro/Mid Field Attachable Connector (90° Male)</td>
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Micro Double-Ended Cordsets

Double-ended cordsets are used for trunk or drop lines and make for a secure connection and simple timesaving installation. The connectors are keyed for error-free connection and they are waterproof for continued operation even while submerged in the bilge.

- Rugged, IP68 rated connectors for continued connection integrity in marine environments
- Various cable lengths to match installation requirements

Micro Tee

A Tee is used to tap into the trunk line for adding a drop connection. The standard tee is also available with a cap for a protected diagnostic connection. Tees can be mated with all other devices on the network of the same connector style.

- Gold contacts for greatest reliability
- Keyed connectors for error-free connections

Micro/Mid Powertap Tee

A Powertap Tee is connected to a network backbone just like any Tee but rather than connecting a device their purpose is to provide “bus” power. Maretron Powertap Tee uniquely provides two power inputs permitting doubled power provision for devices.

- Yellow cable indicates power and can’t be confused with gray network cable
- Two cable lengths to match installation requirements
### Specifications

**MECHANICAL**
- Contact Carrier Mat/Color: Thermoplastic PUR/Blue-Gray
- Molded Body Mat/Color: Thermoplastic PUR/Blue-Gray
- Contact Mat/Plating: Brass/Gold
- Coupling Nut Mat/Plating: Brass/Nickel
- Connector Outside Diameter: 0.59”

**ELECTRICAL**
- Current Rating: 4.0 Amps
- Voltage Rating: 250 V

**ENVIRONMENTAL**
- Protection Class: IEC IP67, NEMA 1,3,4,6
- Operating Temperature: -40°C to 80°C (-40°F to 176°F)

**APPROVALS**
- NMEA: NMEA 2000® Approved
- IEC: IEC 61162-3

### Products

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<td>Micro Double-Ended Cordset - M to F - 0.5M (gray)</td>
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<td>CM-CG1-CF-10.0</td>
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### Micro Double-Ended Cordsets

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<td>CM-CF-CC</td>
<td>Micro Tee</td>
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<tr>
<td>CF-SPWR05-CF</td>
<td>Micro/Mid Powertap Tee - FM (left)/5 Meter 4 Wire Power drop (bottom)/FM (right)</td>
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Two termination resistors are required on every NMEA 2000 network, one on each end of the trunk line. Normally, a male termination is used since male pins tend to point back to the power source. In cases where the gender is reversed, a female terminator may be required. The inline terminator is used where the network is terminated at a product, for example a GPS or weather station at the top of a mast.

- Screw terminal connector for positive connections
- Termination resistors are used to terminate both ends of the trunk line

The Bulkhead Feed-Thru allows ease of installation through panels or bulkheads and establishes future connection points in a network installation. The bulkhead feed-thru also maintains the integrity of watertight bulkheads by providing a waterproof seal and connection.

- Features rugged keyways for positive alignment of connections
- Waterproof rated to IP67

Multiport boxes allow several drop cables to be consolidated and connected back to the trunk, which eliminates the need to have numerous tees connected near a single point. Multiport boxes connect back to the trunk through a double-ended cordset and Tee.

- Ideal for consolidating many connections; for example behind dashboards
- Requires the purchase of an additional double-ended cordset for connection back to the trunk
Specifications

**MECHANICAL**
- Molded Body Mat/Color: Thermoplastic PUR/Blue-Gray – TR-CM, TR-CF
- Contact Carrier Mat/Color: Thermoplastic PUR/Black – IT-CM-CF
- Contact Mat/Plating: Brass/Gold
- Housing Mat/Plating: Brass/Nickel
- Gasket Material: Nitrile (Buna N)
- Accommodates Wall (thick): .40” (1.0 mm) to .875” (22.2 mm)

**ELECTRICAL**
- Rated Voltage: 10-30 V DC
- Internal Resistor: 120 Ohms (1/2 W)

**ENVIRONMENTAL**
- Protection Class: IEC IP68, NEMA 1,3,4,6P
- Operating Temperature: -30°C to 80°C (-22°F to 176°F)

**APPROVALS**
- NMEA: NMEA 2000® APPROVED
- IEC: IEC 61162-3

Products

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<td>TR-CM</td>
<td>Micro Termination Resistor (Male)</td>
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<tr>
<td>TR-CF</td>
<td>Micro Termination Resistor (Female)</td>
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<tr>
<td>IT-CM-CF</td>
<td>Micro Inline Terminator</td>
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</table>

Specifications

**MECHANICAL**
- Contact Carrier Mat/Color: PA 6 (Nylon)/Blue-Gray
- Contact Mat/Plating: Brass/Gold
- Housing Mat/Plating: Brass/Nickel
- Gasket Material: Nitrile (Buna N)
- Accommodates Wall (thick): .40” (1.0 mm) to .875” (22.2 mm)

**ELECTRICAL**
- Voltage Rating: 250 V
- Max Amperage: 4.0 Amps
- Number of Conductors: 5x22 AWG

**ENVIRONMENTAL**
- Protection Class: IEC IP67, NEMA 1,3,4,6
- Temperature Range: -40°C to 105°C (-40°F to 221°F)

**APPROVALS**
- NMEA: NMEA 2000® APPROVED
- IEC: IEC 61162-3

Products

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<td>BHF-CM-CF</td>
<td>Micro Bulkhead Feed-Thru</td>
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</table>

Specifications

**MECHANICAL**
- Housing Mat/Color: Nylon/Blue-Gray
- Receptacle Mat/Plating: Brass/Nickel
- Contact Carrier Mat/Color: Nylon/Black
- Contact Mat/Plating: Brass/Gold

**ELECTRICAL**
- Operating Voltage: 250 V
- Operating Current: 4.0 Amps

**ENVIRONMENTAL**
- Protection Class: IP67 – when receptacles are covered
- Operating Temperature: -30°C to 80°C (-22°F to 176°F)

**APPROVALS**
- NMEA: NMEA 2000® Approved
- IEC: IEC 61162-3

Products

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<tr>
<td>CM-CF-4</td>
<td>Multiport Box (Micro-Mid Male Homerun / Micro-Mid Female Drops)</td>
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</table>
Mid Bulk Cable (Gray/Blue)

Mid bulk cable is primarily used as drop cable, but it can also be used at the trunk line depending on network power requirements. Bulk cable with field-attachable connectors allows for maximum flexibility as cables can be made on the job to exact lengths.

- Meets and exceeds NMEA 2000® specifications for the highest reliability
- Used with field-attachable connectors to build exact length cables at the job site
- Optimized for voltage drop sensitive networks (long runs) because power pair wires have half the resistance of Micro cable

Mid Double-Ended Cordsets (Gray)

Double-ended cordsets are used for trunk or drop lines and make for a secure connection and simple timesaving installation. The connectors are keyed for error-free connection and are waterproof for continued operation even while submerged in the bilge.

- Rugged, IP68 rated connectors for continued connection integrity in marine environments
- Various cable lengths to match installation requirements
- Optimized for voltage drop sensitive networks (long runs) because power pair wires have half the resistance of Micro cable

Mid Double-Ended Cordsets (Blue)

Double-ended cordsets are used for trunk or drop lines and make for a secure connection and simple timesaving installation. The connectors are keyed for error-free connection and are waterproof for continued operation even while submerged in the bilge.

- Rugged, IP68 rated connectors for continued connection integrity in marine environments
- Various cable lengths to match installation requirements
- Optimized for voltage drop sensitive networks (long runs) because power pair wires have half the resistance of Micro cable
Mini Bulk Cable (Gray/Blue)

Mini bulk cable is primarily used as trunk cable, but it can also be used as drop lines. Bulk cable with field-attachable connectors allows for maximum flexibility as cables can be made on the job to exact lengths.

- Meets and exceeds NMEA 2000® specifications for the highest reliability
- Trunk or drop cable for use with Mini connectors
- Used with field-attachable connectors to build exact length cables at the job site

Mini Field-Attachable Connector (Male/Female)

Field-attachable connectors allow you to make field connections to bulk cable. The color-coded screw terminals match the individual wire colors found within the bulk cables for error-free field installation.

- Color-coded screw terminators make for error-free field installation
- Rugged housing material designed to withstand harsh marine environments

Mini Double-Ended Cordset (Gray)

Double-ended cordsets are used for trunk or drop lines and make for a secure connection and simple timesaving installation. The connectors are keyed for error-free connection and are waterproof for continued operation even while submerged in the bilge.

- Rugged, IP68 rated connectors for continued connection integrity in marine environment
- Various cable lengths to match installation requirements
**Mini Bulk Cable (Gray/Blue)**

**Specifications**

**Mechanical**
- Housing Material: Glass Filled Nylon/Black
- Contact Material: Brass/Gold
- Anodized Aluminum
- Coupling Nut Material: Brass/Nickel

**Electrical**
- Current Rating: 9.0 Amps
- Voltage Rating: 300 V

**Environmental**
- Protection Class: IEC IP67
- Temperature Range: -40°C to 85°C (-40°F to 185°F)

**Approvals**
- NMEA: NMEA 2000® Approved
- IEC: IEC-61162-3

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<td>NG1</td>
<td>Mini Bulk Cable (Per Meter-Gray)</td>
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<tr>
<td>NG1-100</td>
<td>Mini Bulk Cable (Per 100 Meter Spool-Gray)</td>
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<tr>
<td>NB1</td>
<td>Mini Bulk Cable (Per Meter-Blue)</td>
</tr>
<tr>
<td>NB1-100</td>
<td>Mini Bulk Cable (Per 100 Meter Spool-Blue)</td>
</tr>
</tbody>
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**Mini Field-Attachable Connector (Male/Female)**

**Specifications**

**Mechanical**
- Housing Material: Thermoplastic PUR/Blue-Gray
- Molded Head Material: Thermoplastic PUR/Blue-Gray
- Contact Material: Brass/Gold
- Coupling Nut Material: Brass/Nickel

**Electrical**
- Current Rating: 9.0 Amps
- Voltage Rating: 300 V

**Environmental**
- Protection Class: IEC IP68, NEMA 1,3,4,6P
- Temperature Range: -40°C to 80°C (-40°F to 176°F)

**Approvals**
- NMEA: NMEA 2000® Approved
- IEC: IEC-61162-3

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<td>FA-NF-ST</td>
<td>Mini Field Attachable Connector (Female)</td>
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<tr>
<td>FA-NM-ST</td>
<td>Mini Field Attachable Connector (Male)</td>
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**Mini Double-Ended Cordset (Gray)**

**Specifications**

**Mechanical**
- Contact Carrier Material: Thermoplastic PUR/Blue-Gray
- Molded Head Material: Thermoplastic PUR/Blue-Gray
- Contact Material: Brass/Gold
- Coupling Nut Material: Brass/Nickel
- Connector Outside Diameter: 1.06" (4mm)

**Electrical**
- Current Rating: 9.0 Amps
- Voltage Rating: 300 V

**Cable**
- Outer Jacket Material: PVC/Gray
- Insulation Material: PE (data), PVC (power)
- Number of Conductors: Power 2x15 AWG, 2x18 AWG, 18 AWG Drain Wire
- Shielding (3 Levels): Foil (overall), Foil (power pair), Foil (data pair)

**Environmental**
- Protection Class: IEC IP68, NEMA 1,3,4,6P
- Temperature Range: -40°C to 80°C (-40°F to 176°F)

**Approvals**
- NMEA: NMEA 2000® Approved
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<td>Mini Double-Ended Cordset - M to F - 10M (gray)</td>
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</table>
A Powertap is connected to a network backbone just like any Tee but rather than connecting a device, its purpose is to provide “bus” power. Typically a Powertap is placed as central as possible between total devices on backbone. Maretron Powertap uniquely provides two power inputs permitting doubled power provision for devices.

- Connects power supply to NMEA 2000® Trunk Line in convenient plug/play fashion
- Replaceable fuses to protect bus and connected components from excessive current

A Tee is used to tap into the trunk line for adding a drop connection. Two Mini Tees are available: 1) a Mini Tee with Mini connectors for the trunk and drop lines, and 2) a Mini/Micro Tee with Mini connectors for the trunk lines and a Micro connector for the drop line.

- Gold Contacts for greatest reliability
- Keyed connectors for error-free connections

Double-ended cordsets are used for trunk or drop lines and make for a secure connection and simple timesaving installation. The connectors are keyed for error-free connection and are waterproof for continued operation even while submerged in the bilge.

- Rugged, IP67 rated connectors for continued connection integrity in marine environment
- Various cable lengths to match installation requirements
Mini Double-Ended Cordset (Blue)

Specifications

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<td>Contact Carrier Mat/Color:</td>
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<td>Mini Double-Ended Cordset - M to F - 6M (blue)</td>
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<td>Mini Double-Ended Cordset - M to F - 7M (blue)</td>
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<td>NM-NB1-NF-09.0</td>
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<td>NM-NB1-NF-10.0</td>
<td>Mini Double-Ended Cordset - M to F - 10M (blue)</td>
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Mini Double-Ended Cordset (Blue)

Mini Tees

Specifications

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<thead>
<tr>
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<tbody>
<tr>
<td>Contact Carrier Mat/Color:</td>
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<td>Molded Body Mat/Color:</td>
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<td>Coupling Nut Mat/Plating:</td>
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<td>Conductor Insulation Material:</td>
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<td>Temperature Range:</td>
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<th>APPROVALS</th>
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<td>IEC:</td>
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Products

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<tr>
<td>NM-NF-NF</td>
<td>Mini Tee</td>
</tr>
<tr>
<td>NM-CF-NF</td>
<td>Mini/Micro Tee</td>
</tr>
</tbody>
</table>

Mini Powertap / Mini Power Cord

Specifications

<table>
<thead>
<tr>
<th>MECHANICAL</th>
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</thead>
<tbody>
<tr>
<td>Contact Carrier Mat/Color:</td>
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<td>Protection Circuit:</td>
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Products

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<tr>
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<th>DESCRIPTION</th>
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<tr>
<td>NF-NM4P-NF</td>
<td>Mini Powertap - Female-Female with Fuses</td>
</tr>
<tr>
<td>NM4P-01</td>
<td>Mini Power Cord - Female to Pigtail - 1 Meter</td>
</tr>
<tr>
<td>NM4P-05</td>
<td>Mini Power Cord - Female to Pigtail - 5 Meter</td>
</tr>
</tbody>
</table>
Mini Termination Resistor (Male/Female)

Termination Resistors are required on a NMEA 2000® network and are placed at each end of a network trunk cable. Like the double-ended cordsets, the termination resistors are waterproof and continue to function even while submerged in the bilge.

- Diagnostic versions indicate correct polarity at a glance to ensure power connections have been made properly
- Screw connector for positive connection
- Termination resistors are used to terminate both ends of the trunk line

Mini 90° Male to Female Connector

The Mini Elbow is used in spots where it is impossible to bend a cordset around tight corners. The elbow easily connects to a tee or double-ended cordsets making 90 [degree] turns practical at the end or anywhere along the line.

- Mounting hole for secure fastening of cabling system
- Waterproof seals for reliable connections
- Nickel plated brass ideally suited for harsh marine environment

Mini Male to Micro Female Reducer

The reducer is used to change from a Mini cable to Micro or Mid cable. For example, one end of the network might be terminated at the top of the mast but it may not be desirable to run a Mini trunk cable up the mast. In this case, you can switch over to Micro or Mid cable at the base of the mast using the reducer and continue up the mast with Micro or Mid cable.

- Corrosion resistant Nickle plated Brass
- Weatherproof to IP67
- Reduces Mini Backbone to Micro/ Mid Cable
### Specifications

**Mechanical**
- Molded Body Mat/Color: Thermoplastic PUR/Blue-Gray – TR-NM, TR-NF
- Thermoplastic PUR/Clear – TRL-NM, TRL-NF

**Contact Carrier Mat/Color:**
- Contact Mat/Plating: Brass/Gold – TR-NM, TRL-NM
- Coupling Nut Mat/Plating: Brass/Nickel

**Electrical**
- Rated Voltage: 300 V DC
- Internal Resistor: 120 Ohms (1/2 W)
- Voltage Monitoring: (Bus Power)
  - Green: Correct Polarity
  - Red: Reversed Polarity – TRL-NM, TRL-NF

**Environmental**
- Protection Class: IEC IP67, NEMA 1,3,4,6 P
- Temperature Rating: -40°C to 80°C (-40°F to 176°F)

**Approvals**
- NMEA 2000® Approved
- IEC 61162-3

### Products

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<td>TR-NM</td>
<td>Mini Termination Resistor (Male)</td>
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<tr>
<td>TR-NF</td>
<td>Mini Termination Resistor (Female)</td>
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<tr>
<td>TRL-NM</td>
<td>Mini Termination Resistor with LED (Male)</td>
</tr>
<tr>
<td>TRL-NF</td>
<td>Mini Termination Resistor with LED (Female)</td>
</tr>
</tbody>
</table>

---

### Specifications

**Mechanical**
- Molded Body Mat/Color: Thermoplastic PUR/Blue-Gray – TR-NM, TR-NF
- Thermoplastic PUR/Clear – TRL-NM, TRL-NF

**Contact Carrier Mat/Color:**
- Contact Mat/Plating: Brass/Gold – TR-NM, TRL-NM
- Coupling Nut Mat/Plating: Brass/Nickel

**Electrical**
- Rated Voltage: 9.0 Amps
- Rated Voltage: 250 V

**Environmental**
- Protection Class: IEC IP67, NEMA 1,3,4,6 P
- Temperature Rating: -40°C to 80°C (-40°F to 176°F)

**Approvals**
- NMEA 2000® Approved
- IEC 61162-3

---

### Products

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELB-NM-NF</td>
<td>Mini 90° Male to Female Connector</td>
</tr>
</tbody>
</table>

---

### Specifications

**Mechanical**
- Molded Body Mat/Color: Thermoplastic PUR/Blue-Gray – TR-NM, TR-NF
- Thermoplastic PUR/Clear – TRL-NM, TRL-NF

**Contact Carrier Mat/Color:**
- Contact Mat/Plating: Brass/Gold – TR-NM, TRL-NM
- Coupling Nut Mat/Plating: Brass/Nickel

**Electrical**
- Rated Voltage: 600 V

**Environmental**
- Protection Class: IEC IP67, NEMA 1,3,4,6 P
- Temperature Rating: -40°C to 80°C (-40°F to 176°F)

**Approvals**
- NMEA 2000® Approved
- IEC 61162-3

---

### Products

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM-CF</td>
<td>Mini Male to Micro Female Reducer</td>
</tr>
</tbody>
</table>
Maretron cables have a male connector on one end and a female connector on the other end. Normally, the male connector points back towards the network power supply, but on some occasions, this gets reversed and a gender changer can be used to get back to the desired connector type.

- Waterproof seals for reliable connections
- Easily swap connector gender to get back to desired connector type

The Bulkhead Feed-Thru allows ease of installation through panels or bulkheads and establishes future connection points in a network installation. The bulkhead feed-thru also maintains the integrity of watertight bulkheads by providing a waterproof seal and connection.

- Features rugged keyways for positive alignment of connections
- Waterproof rated to IP67

The N2KMeter enables trained and untrained personnel to diagnose and trouble-shoot network installations quickly and easily. Completely passive on the network, the meter analyzes both data and power lines on the network. In seconds, both network-wide and device-specific traffic as well as power monitoring information is captured and displayed on a simple user interface.

- Diagnostic tool for NMEA 2000® networks
- Evaluates physical layer device functions on a network
- Data at boat can be locked in and then evaluated later on bench

Copyright 2009 Maretron, LLP. All rights reserved. As Maretron is constantly improving its products, all specifications are subject to change without notice. Maretron’s products are designed to be accurate and reliable; however, they should be used only as aids to navigation and vessel monitoring, and not as a replacement for traditional navigation and vessel monitoring techniques. A prudent captain or navigator never relies on a single source for navigation or system monitoring information. “NMEA 2000” is a registered trademark of the National Marine Electronics Association.
Mini Gender Changers

Mini Bulkhead Feed-Thru

N2KMeter

Specifications

**MECHANICAL**
Molded Body Mat/Color:
Contact Carrier Mat/Color:
Contact Nut Mat/Plating:
Coupling Nut Mat/Plating:

**ELECTRICAL**
Rated Current:
Rated Voltage:

**ENVIRONMENTAL**
Protection Class:
Temperature Range:

**APPROVALS**
NMEA:
IEC:

**Part Number**
**Description**
NM-NM
Mini Gender Changer (Male/Male)
NF-NF
Mini Gender Changer (Female/Female)

**MECHANICAL**
Contact Carrier Mat/Color:
Housing Mat/Plating:
Contact Mat/Plating:
Gasket Material:
Accommodates Wall (thick):

**ELECTRICAL**
Voltage Rating:
Max Amperage:
Number of Conductors:

**ENVIRONMENTAL**
Protection Class:
Temperature Range:

**APPROVALS**
NMEA:
IEC:

**Part Number**
**Description**
BHF-NM-NF
Mini Bulkhead Feed-Thru

**Electrician Mode (Simple)**
1. Plug in and set N2KMeter rotary switch to “autosearch”
2. Identify network health
   - Happy face = healthy
   - Neutral face = nominal
   - Sad face = faulty
3. Scroll through faults. Refer to user manual to link these faults to most likely network problems or freeze and lock settings for review back at the shop by an NMEA 2000® expert.

**Expert Mode (Advanced)**
1. Scroll through NMEA 2000® parameters for each active NMEA 2000® node (mac id)
   - Communication errors (rate, cumulative #)
   - Bandwidth (% of full usage)
   - Power supply and shield voltages
   - Data bit quality (dominant, recessive, +,-, differential voltage, cmv)
2. Check values (both numeric and icons)
   - Happy face = within spec
   - Neutral face = very close to limit
   - Sad face = out of limit
3. Refer to user manual to link these faults to most likely network problems

**Part Number**
**Description**
N2KMETER-01
Diagnostic Meter w/1m Micro Cordset

**MECHANICAL**
Power Supply:
Connectors:
Band Rates:
Analog Accuracy:
Analog Range:

**ENVIRONMENTAL**
Protection Class:
Temperature Range:

**APPROVALS**
NMEA:

**Part Number**
**Description**
N2KMETER-01
Diagnostic Meter w/1m Micro Cordset

**Part Number**
**Description**
NM-NM
Mini Gender Changer (Male/Male)
NF-NF
Mini Gender Changer (Female/Female)
Installing an NMEA 2000® Network

Installing an NMEA 2000® network consists of inter-connecting NMEA 2000® electronic devices using plug-and-play cables and connectors. The following pages provide a brief description of how to setup a NMEA 2000® network using five basic steps:

1. Cable and Connector Network Basics
2. Installing Terminators
3. Supplying Power
4. Grounding the Network
5. Checking the Network

Please note that this installation guide contains a brief description of the basic concepts of installing an NMEA 2000® network and Maretron suggests that you consult a trained professional for any installation. You can learn more about installing NMEA 2000® networks by contacting the National Marine Electronics Association (NMEA) at www.nmea.org and consulting the following documents:

- NMEA 2000® Standard for Serial-Data Networking of Marine Electronic Devices
- NMEA Installation Standards

1. Cable and Connector Network Basics

1.1 Network Topology

The NMEA 2000® cable system uses a trunk (sometimes referred to as the backbone) and drop line topology as shown in Figure 1.

The NMEA 2000® cable system includes five wires within a single waterproof cable: two signal wires, power and ground wires, and a drain wire. The drain wire shields the signal, power, and ground wires from external Radio Frequency Interference (RFI) and helps reduce RFI emission from the cable.

You can connect devices using one of three cable options:

- Mini - This is commonly used for the trunk line on the network because of its greater current carrying capacity (8 amps) as

---

**Figure 1**
NMEA 2000®
Network Topology

---
opposed to Micro cable (4 amps). Mini cable has an outside diameter in the range from 0.41 to 0.49 inches. Its maximum installed bend radius is 7x the cable diameter. You can also use this type of cable for drop lines.

**Mid** - This is commonly used for smaller networks as either the network trunk line or as drop lines. Mid cable and connectors are rated to 4 amps just like the Micro cable, however the larger diameter power conductors within the Mid cable provides for less voltage drop over Micro cable, especially for long runs. The diameter of the Mid cable is 0.33 inches.

**Micro** - This cable type is typically used as the drop line connecting devices to the main trunk line with an outside diameter in the range from 0.24 to 0.28 inches. Micro cable has a smaller diameter and is more flexible than mini cable with an installation bend radius of 7x the cable diameter. Smaller networks use this type of cable for both the trunk and drop lines.

You construct the trunk line using double-ended cordsets connected between tees or taps. One end of the cordset has a male connector with male pins while the other end of the cordset has a female connector and female receptacles. The connectors are keyed so they can only connect to each other in one way. As an alternative to double-ended cordsets, you can make your own trunk line using bulk cable and field-attachable connectors. If you decide to add equipment later, you can simply disconnect a cordset from a tee, add another tee directly to the existing tee, re-connect the cordset and add the new component to the system using a drop cable. Alternatively, you could cut the trunk line, add two field-attachable connectors and insert a new tee. Trunk lines can also be run up to watertight bulkheads and connected to a waterproof bulkhead feed-thru connector to maintain the integrity of watertight compartments.

To drop off the trunk line, you connect a device using a tee connector. Daisy chaining of devices is not allowed, as it is a requirement to be able to remove a component from the network without affecting any other device. This allows you to remove a device for servicing while the rest of the network remains operational. Multi port boxes are also available where instruments tend to be clustered, around the helm for example.

### 1.2 Maximum Cable Distance

The cable distance between any two points in the cable system must not exceed 200 meters (656 feet) for the Mini cable or 100 meters (328 feet) for the Micro and Mid cable.

For most cases, the maximum distance should be measured
between termination resistors. However, if the distance from a trunk line tee to the farthest device connected to the trunk line is greater than the distance from the tee to the nearest terminating resistor (TR), then you MUST include the drop line length as part of the cable length in your maximum cable distance calculation. Figure 2 shows an example where both 5 meter drops must be included in the maximum cable distance since the drops are longer than the distance from the tee to termination resistor.

**1.3 Cumulative Drop Line Length**
The cumulative drop line length refers to the sum of all drop lines, Mini, Mid or Micro cable in the cabling system. This sum cannot exceed 78 meters (256 feet). Figure 3 shows an example using four drop tees and two multiport drops to attach 11 devices to the trunk line. The cumulative drop line length is 37 meters (122 feet) and no single device is more than 6 meters (20 feet) from the trunk line.

**1.4 Maximum Drop Line Length**
The maximum cable distance from any device on a branching drop line to the trunk line is 6 meters (20 feet).

**1.5 Maximum Number of Devices**
A maximum of 50 physical devices shall be connected to the network, and the disconnection of any device shall not interrupt any other device on the network.

**1.6 NMEA 2000® Cable**
The Mini, Mid and Micro cables contain five wires: One twisted pair (red and black) for 12VDC power, one twisted pair (blue and white) for signal and a drain wire (bare).

The following table shows the color, name, and usage for each wire contained within the cable.

<table>
<thead>
<tr>
<th>Color</th>
<th>Name</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>NET-H</td>
<td>Signal</td>
</tr>
<tr>
<td>Blue</td>
<td>NET-L</td>
<td>Signal</td>
</tr>
<tr>
<td>Bare</td>
<td>SHIELD</td>
<td>Drain</td>
</tr>
<tr>
<td>Black</td>
<td>NET-C</td>
<td>Ground</td>
</tr>
<tr>
<td>Red</td>
<td>NET-S</td>
<td>Power</td>
</tr>
</tbody>
</table>

**Figure 3**
Maximum Cumulative Drop Line Length Determination
1.7 NMEA 2000® Connectors
Connectors attach cables to devices or other components of the NMEA 2000® cable system. This allows the network to be completely “plug-and-play”. Connections can be made with pre-molded cordsets or with field-attachable connectors. The following diagram shows the pins found within Mini connector and the Micro and Mid connector and the corresponding wire colors for those pins.

2. Installing Terminators
Termination resistors are attached to each end of the trunk cable to reduce reflections of the communication signals on the network. If you do not use termination resistors as described, the network will not operate properly. Termination resistors are typically connected directly to the last tee on the trunk line although they can be connected to a cordset extending from the last tee on a trunk line. Inline terminators are also available and they are used to terminate the network at the last product.

3. Supplying Power
NMEA 2000® networks can use a power supply originating from a single-point connection to the vessel’s 12 volt battery or one or more isolated power supplies distributed along the network, but not a combination of battery and power supply connections. For the purpose of this installation guide, we will focus on the power source being a single-point connection to the vessel’s battery. Over current protection should be provided and should be sized in accordance with ABYC E-11, AC and DC ELECTRICAL SYSTEMS ON BOATS, taking into consideration the smallest gauge of cable being used for the backbone or drop cables. The NET-S wire is connected to the positive side of the battery while NET-C is connected to the negative side of the battery.

3.1 Mini Power Connection
Power is supplied to a Mini trunk line via a Powertap that is shown in Figure 4. Note that the Mini power cable does not have a shield wire as this connection is made to the screw terminal on the Powertap itself.

3.2 Mini Power Capability
Although Mini cable is rated to 8 amps, the cable system can support a total load of more than 8 amps. For example, 16 amps of power could be supplied to the middle of the trunk where 8 amps is supplied to both sides of the power tap. The
Powertap can handle large loads as long as no more than 8 amps is drawn through any single segment of the trunk line. However, cable resistance may limit your application to less than 8 amps.

### 3.3 Micro/Mid Power Connection
Like the Mini power connection, power is supplied to a Micro/Mid trunk line via a Powertap, which is shown in Figure 5.

### 3.4 Micro/Mid Power Capability
Micro/Mid cable is rated to 4 amps but like Mini cable, strategic placement of the power source could support higher current. For example, 8 amps of power could be supplied to the middle of the trunk where 4 amps is supplied to both sides of the power tap. It can handle large loads as long as no more than 4 amps is drawn through any single segment of the trunk line. However, cable resistance may limit your application to less than 4 amps.

### 3.5 End-Powered Network
End-powered networks are typically seen on smaller vessels with only a few NMEA 2000® devices. Figure 6 shows an end-powered network.

### 3.6 Middle-Powered Network
A middle-powered network is typically found on larger vessels and is any network where the power is connected to the network at some location other than at the end. This network consists of two legs, one leg extending in each direction from the power insertion point. Figure 7 shows a middle-powered network.

### 3.7 Maximum Power Supply Voltage Drop
The NMEA 2000® network is designed to work properly as long as there is no more than a 1.5 volt difference in the power supply voltage between any two devices on the network. Therefore, you should perform an estimate of the voltage drop across a network using the following equation:

\[
\text{Voltage Drop} = 0.1 \times \text{Network Loads} \times \text{Network Length} \times \frac{\text{Cable Resistance}}{100}
\]

Where:
- Network Loads is sum of Load Equivalent Numbers (LEN) for all devices (see device nameplate)
- Network Length is in meters
- Cable resistance is in ohms/100 meters (see pages 1 and 9 specifications)

Power supply voltage drop estimates resulting in less than 1.5 volts across the entire network require no further analysis. Likewise, estimates ranging between 1.5 and 3.0 volts require no further analysis as long as a mid-powered network is used. Occasionally, estimated power supply voltage drops will occur outside these limits and will require further consideration through detailed calculations by certified technicians.

### 4. Ground the Network
The NMEA 2000® network should be grounded at ONE
location. Grounding at more than one location may produce ground loops, which can cause problems with communications on the network. In addition to the ground wire, connect the drain or SHIELD wire at the supply ground location and NO other place.

5. Checking Your Network
Verify that the network has been correctly designed and installed by reviewing the following checklist:

- Number of devices does not exceed 50
- Maximum Mini cable distance between any two devices does not exceed 200 meters (656 feet)
- Maximum Micro/Mid cable distance between any two devices does not exceed 100 meters (328 feet)
- Maximum cumulative drop line length does not exceed 78 meters (256 feet)
- No drop should be greater than 6 meters (20 feet)
- Termination resistors are installed on both ends of the trunk
- The network is grounded at a single location
- The SHIELD wire is connected to a single point, the supply ground

If you are having difficulties with the network make sure to check the following most common network problems:

- More or less than two terminating resistors
- Loose connections, make sure that all connectors are securely fastened
- Excessive trunk line length—especially with Micro cable
- Excessive drop line cable length
- Improper shield and ground connection at the power supply
- Shorts and opens in field-attachable connectors
- Failure to perform power distribution calculations for new installations and when adding new devices
- Using a typical device current rather than maximum current for power distribution calculations

In order to insure the proper installation and configuration of an NMEA 2000® network, it is a good idea to have available at least one N2KMeter. The N2KMeter greatly simplifies network diagnostics and can detect many fault conditions including:

- Opens and shorts
- Incorrect topology
- Bad nodes
- Bad termination
- Improper shield connection
- Intermittent problems
- Excessive scan rate
- Common mode voltage