GARMIN

Technical Reference

for Garmin®

NMEA 2000® Products

Introduction

A NMEA 2000 network consists of connected NMEA 2000 devices that communicate using basic plug-and-play functionality. This technical reference provides basic NMEA 2000 component identification, basic NMEA 2000 network-building instructions, and a list of NMEA 2000-specific data used with Garmin NMEA 2000-certified displays and sensors.

- The first section, NMEA 2000 Fundamentals, provides descriptions of the NMEA 2000 connectors and cables sold by Garmin, and the fundamental concepts of installing a NMEA 2000 network on your boat.

- The second section, General NMEA 2000 Data Type Requirements, provides a table to help you determine which NMEA 2000 sensors provide the particular data type you want.

- The last two sections provide Parameter Group Number (PGN) information for Garmin chartplotters and marine instruments as well as configuration and PGN information for Garmin NMEA 2000 sensors. These sections contain PGN and configuration information for the following products:
  - GPSMAP® 4/5000 Series chartplotters
  - GMI™ 10
  - GFS™ 10
  - Intelliducers™
  - GWS™ 10
  - GHP™ 10 (CCU and GHC™ 10)
  - GXM™ 51
  - VHF 200

> **NOTE:** PGN information is also included in the installation instructions provided with the Garmin NMEA 2000-certified device. Sensor configuration information is also included in a *Sensor Configuration Guide* provided with each Garmin NMEA 2000-certified sensor.

- At the end is a checklist. Use this checklist when installing a NMEA 2000 network to be sure you have correctly followed installation-critical procedures.

Contact Garmin

If you experience difficulty installing a NMEA 2000 network, or have other questions about NMEA 2000-certified Garmin devices, contact Garmin Product Support or a certified NMEA 2000 technician. In the USA, go to www.garmin.com/support, or contact Garmin USA by phone at (913) 397-8200 or (800) 800-1020.

In the UK, contact Garmin (Europe) Ltd. by phone at 0808 2380000.

In Europe, go to www.garmin.com/support and click **Contact Support** for in-country support information, or contact Garmin (Europe) Ltd. by phone at +44 (0) 870.8501241.

Table of Contents

NMEA 2000 Fundamentals

A NMEA 2000 network is made of connected NMEA 2000 devices that communicate using basic plug-and-play functionality.

If your boat already contains a NMEA 2000 network and you would like to add Garmin NMEA 2000 components, see page 8.

For a glossary of commonly used NMEA 2000 terms, see page 8.

After you have installed your NMEA 2000 network, use the checklist on page 25 to verify the installation.

Garmin NMEA 2000 Device Overview

Garmin uses NMEA 2000 micro connectors on units, sensors, and T-connectors that are compatible with other NMEA 2000 micro connectors, cables, and NMEA 2000-compatible devices. Garmin sensors may be packaged with a drop cable and a T-connector. Garmin displays may also include additional NMEA 2000 components (such as a power cable). The NMEA 2000 components included with a Garmin sensor or display are listed in the product documentation. A diagram on the product box shows which NMEA 2000 components are included.
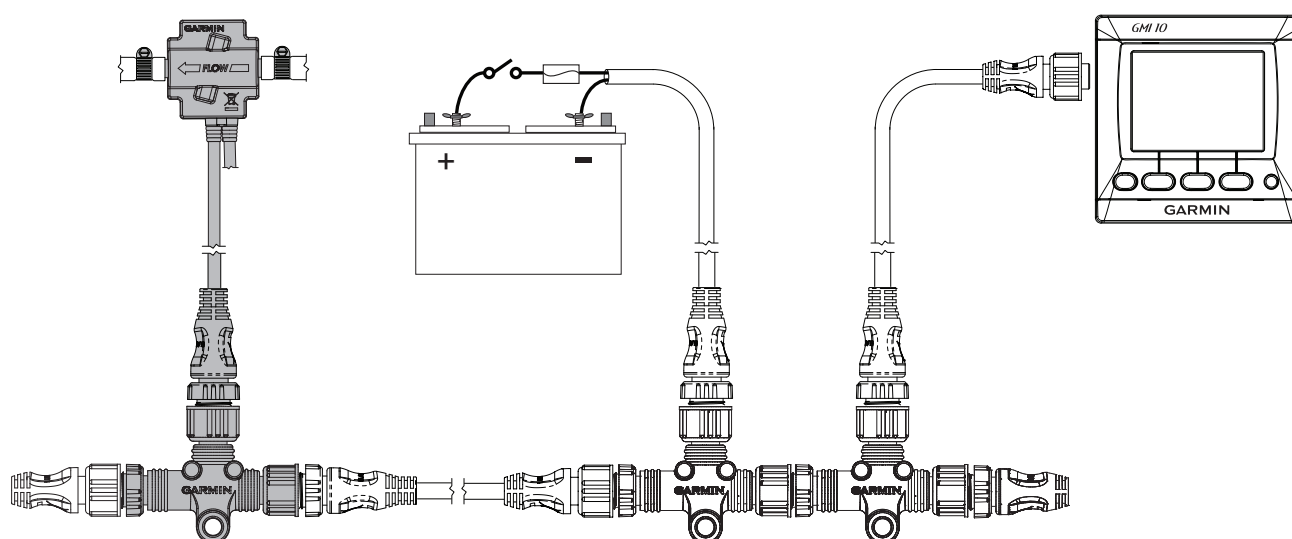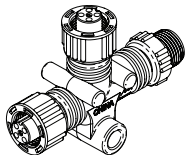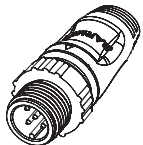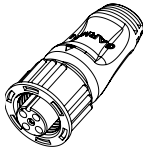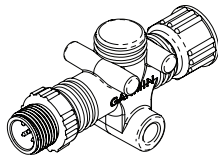
Sample Box Diagram (GFS 10)

In the sample box diagram, a complete NMEA 2000 network is shown, and the parts included with the sensor are shaded. In this example, a T-connector is included with a Garmin GFS 10 fuel sensor. A NMEA 2000 power cable, terminators, an additional drop/backbone cable, and additional T-connectors are not included with a GFS 10 fuel sensor. The GFS 10 fuel sensor, as shown by the shaded components on the box diagram, is intended to be connected to an existing NMEA 2000 network on your boat. If you do not have a NMEA 2000 network on your boat, this guide will help you assemble one.

NMEA 2000 Components

The main components of a NMEA 2000 network are T-connectors, terminators, backbone/drop cables, and a power cable. The following cables, connectors, and terminators are sold by Garmin, and as of January 2009, they are NMEA 2000 approved. NMEA 2000-approved cables sold by Garmin feature the NMEA 2000 logo on the tag with the part number.

T-connector	Male Terminator	Female Terminator	In-line Terminator
010-11078-00 (Garmin part number)	010-11080-00	010-11081-00	010-11096-00
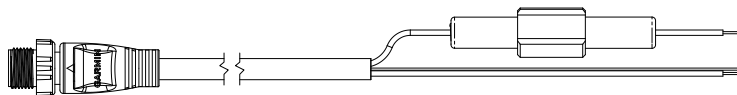
Power Cable
010-11079-00 (2 meters [6.5 feet]) (3 A fuse included)
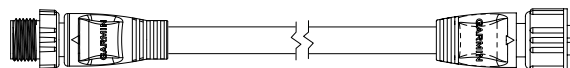
Backbone/Drop Cable	
305 millimeters (1 foot)	010-11076-03
2 meters (6.5 feet)	010-11076-00
6 meters (20 feet)	010-11076-01
10 meters (33 feet) (backbone only)	010-11076-02
30 meter spool (98.5 feet) (backbone only)	010-11171-01

Specialty Cable/Connectors	
Right-angle drop-cable, 2 meters (6.5 feet) (pictured)	010-11089-00
Field-installable connector - Male* (not pictured)	010-11094-00
Field-installable connector - Female* (not pictured)	010-11095-00
NMEA 2000 network power switch (not pictured)	K00-00368-00
NMEA 2000 in-line lightning arrestor** (not pictured)	010-11171-02
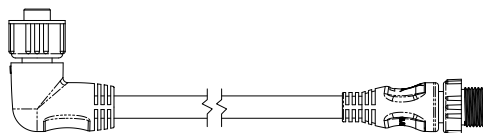
* The field-installable connectors are used to create custom-length drop cables and custom-length backbone extension cables. The field-installable connectors can be used to shorten any Garmin NMEA 2000 drop/backbone cable.

** The gray in-line lightning arrestor is designed to help prevent damage due to nearby lightning strikes, but it is not able to protect against direct lightning strikes. Garmin is not responsible for lightning-strike related damage.

> **NOTE:** All male/female connections are interchangeable. Ensure that the T-connectors are used properly when constructing your NMEA 2000 network. See page 4.

Building a NMEA 2000 Network

The main communication channel of a NMEA 2000 network is a backbone to which your NMEA 2000 devices connect. Each NMEA 2000 device connects to the backbone with a T-connector. The NMEA 2000 backbone must be connected to power, and terminators must be installed at both ends for the network to function correctly.

When you design a NMEA 2000 network, start by creating a diagram of the network. When creating the diagram, be as detailed as possible:

- Include all of the devices you intend to connect to your network
- Note the approximate location of the backbone and devices on your boat
- Measure the distances between devices and the backbone, as well as the overall length of the backbone
- Note the power consumption of each device (Load Equivalency Number)

Sample NMEA 2000 Network
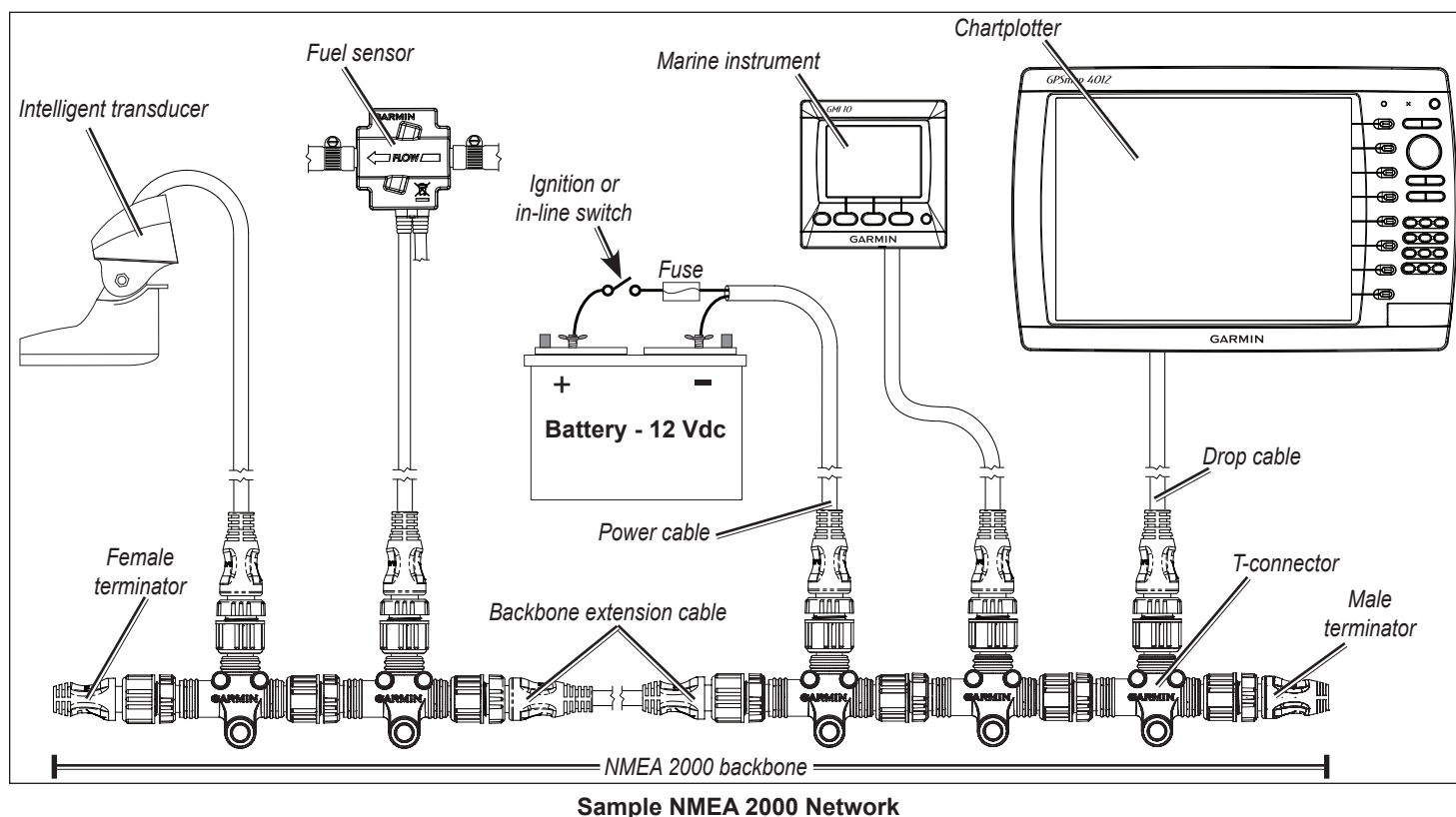
NOTE: This diagram illustrates the NMEA 2000 data connections to each device or sensor. Some devices or sensors can be powered by the NMEA 2000 network; others may require a separate power connection. Consult the installation instructions for each device you connect to your NMEA 2000 network to be sure you supply power to the device appropriately.

When building a NMEA 2000 network, you must follow certain rules to make sure your NMEA 2000 network functions correctly. Be sure to understand the following concepts:

- Linear backbone construction (page 4)
- Power connection and distribution (page 5)
- Proper termination (page 7)
- Cable length and device limits (page 8)

Linear Backbone Construction

Use the NMEA 2000 T-connectors to construct your NMEA 2000 backbone, and extend the backbone with appropriate lengths of backbone cable if necessary. Use one T-connector per device. Use the sides of the T-connector to construct the backbone of the NMEA 2000 network, and use the top of the T-connector to attach a NMEA 2000 device. By using only the sides of the T-connectors to construct the backbone, you create a linear construction to your NMEA 2000 network. T-connectors can be separated by backbone cables or connected directly together.

Although the male and female connectors on the T-connectors and backbone cables will fit on all sides of a T-connector, it is very important to use only the top of the T-connector to attach NMEA 2000 devices, not to attach other T-connectors or backbone cables.
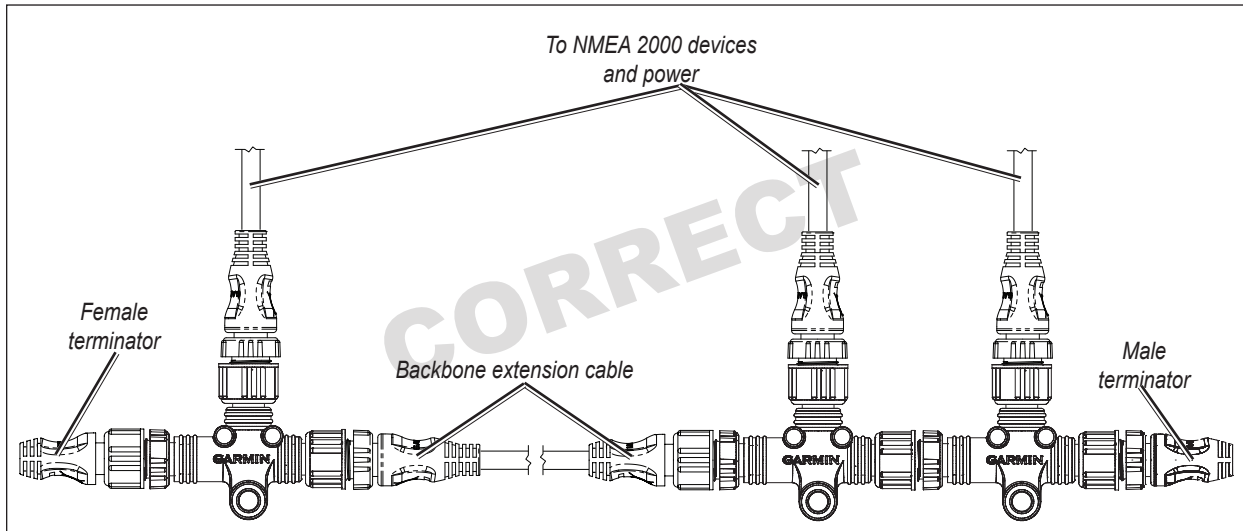
Correct Linear Backbone Construction
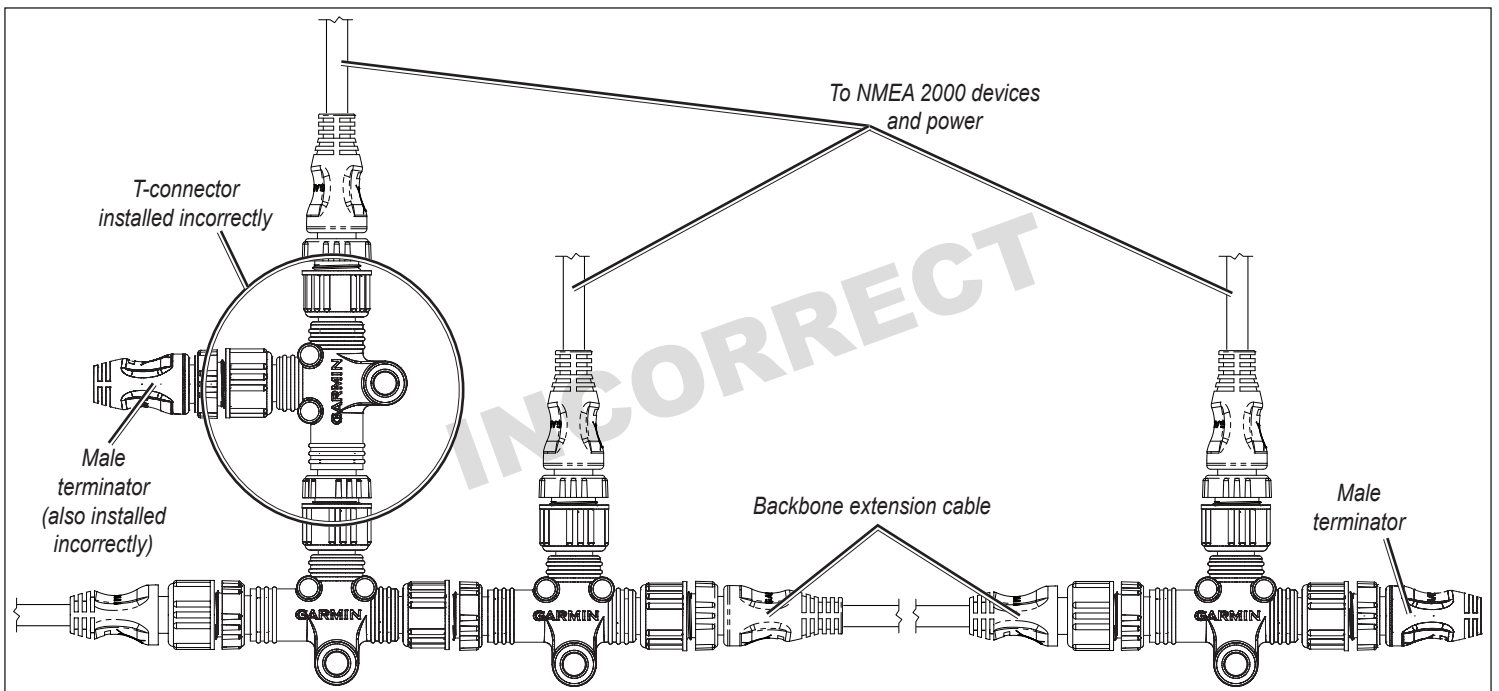
Incorrect Linear Backbone Construction

Power Connection and Distribution

Your NMEA 2000 network must be connected to a 12 Vdc power supply. Do not connect your NMEA 2000 network to any other voltage source, such as a 24 Vdc power supply. Use a NMEA 2000 power cable to connect your NMEA 2000 backbone to the auxiliary power switch on your boat. If you do not have an auxiliary power switch, or if connecting to the auxiliary power switch causes electrical interference, connect the NMEA 2000 power cable directly to the battery and install an in-line switch.

⚠️ **CAUTION:** If you connect the NMEA 2000 network to your battery without an in-line switch, it may drain your battery.

Be sure to ground the NMEA 2000 power cable. Connect the bare shield-drain wire to the same location as the ground (black) wire.

The Garmin NMEA 2000 power cable connects to a T-connector like other drop cables. Be sure to connect the NMEA 2000 power cable to the top of a T-connector; never connect the NMEA 2000 power cable to the side of a T-connector. You can connect power either at the end of your NMEA 2000 network or in the middle. When planning where to place the power cable and the T-connector on your NMEA 2000 network, you will need to evaluate how the NMEA 2000 devices connected to your network use power. The NMEA 2000 network will work properly when there is no more than a 3 Vdc drop in the supply voltage between the power source and the NMEA 2000 device located farthest from the power source on the NMEA 2000 network. To determine the voltage drop in your NMEA 2000 network, use this equation:

Voltage Drop = Cable resistance (ohms/m)* × Distance (from the battery to the farthest device, in meters) × Network Load** × 0.1

Garmin cable resistance value = 0.053
*** Network Load = the sum of Load Equivalent Numbers (LEN) between the battery and the end of the network. The LEN for each device should be visible on the device, or provided in the documentation for the device.*

- If you calculate a voltage drop of 3.0 Vdc or less, then you can connect power to either the end or the middle of your NMEA 2000 network, and it will function correctly.
- If you calculate a voltage drop of more than 3.0 Vdc, you must connect power to the middle of your NMEA 2000 network. The location will depend on the network load and distance from the battery. Try to balance the voltage drop equally on both sides of the power connection.
- If a voltage drop of under 3.0 Vdc is not possible on your NMEA 2000 network, contact a professional installer.

Examples

The following examples show a correctly designed, end-powered NMEA 2000 network; an incorrectly designed NMEA 2000 network; and a redesign of the incorrectly designed NMEA 2000 network to correctly balance power on the network.

End-powered NMEA 2000 network, correctly designed:
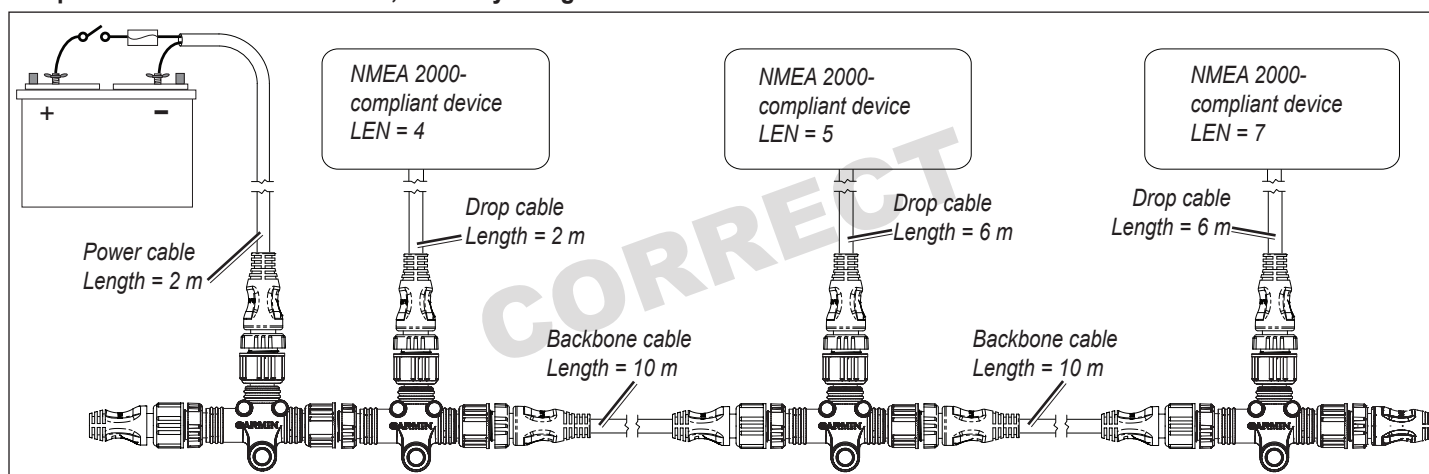
When the voltage-drop formula is applied to this example, we see that the voltage drop is less than 3.0 Vdc. This NMEA 2000 network will function correctly when powered at the end.

Voltage Drop = 0.053 × (2 + 10 + 10 + 6) × (4 + 5 + 7) × 0.1 = 2.37 Vdc
       Cable   *Distance*   *Network load*
       resistance

End-powered NMEA 2000 network, incorrectly designed:
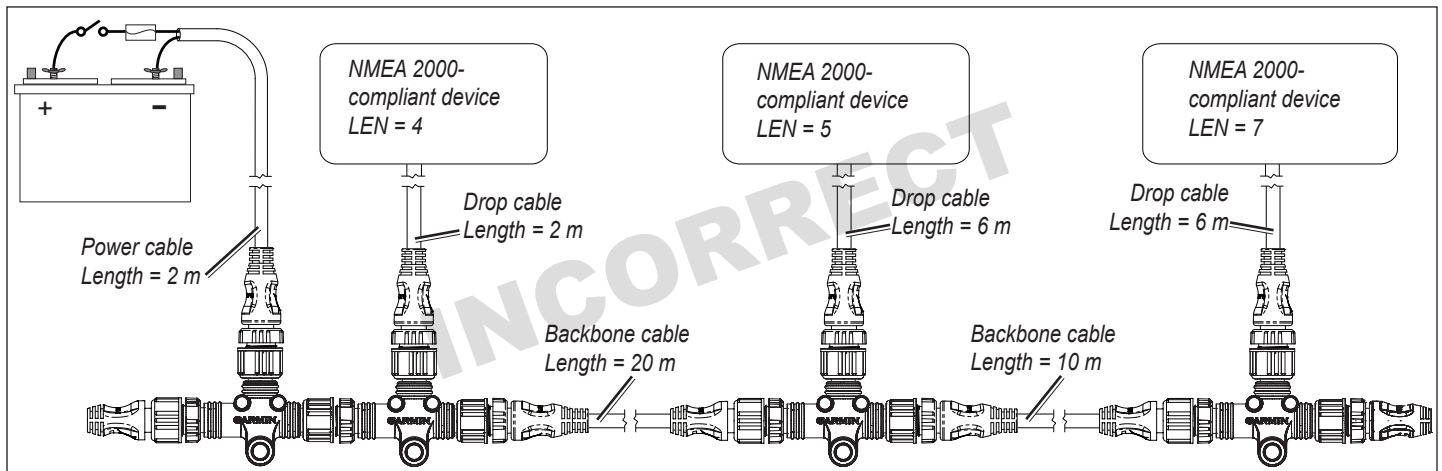
When the voltage drop formula is applied to this example, we see that the voltage drop is greater than 3.0 Vdc, so this NMEA 2000 network will not function correctly when powered at the end.

Voltage Drop = $0.053 \times (2 + 20 + 10 + 6) \times (4 + 5 + 7) \times 0.1 = 3.22$ Vdc

     Cable   *Distance*   *Network load*
  resistance

This NMEA 2000 network must be redesigned with the power connected to the center of the network in order to function correctly.

Middle-powered NMEA 2000 network, correctly designed:
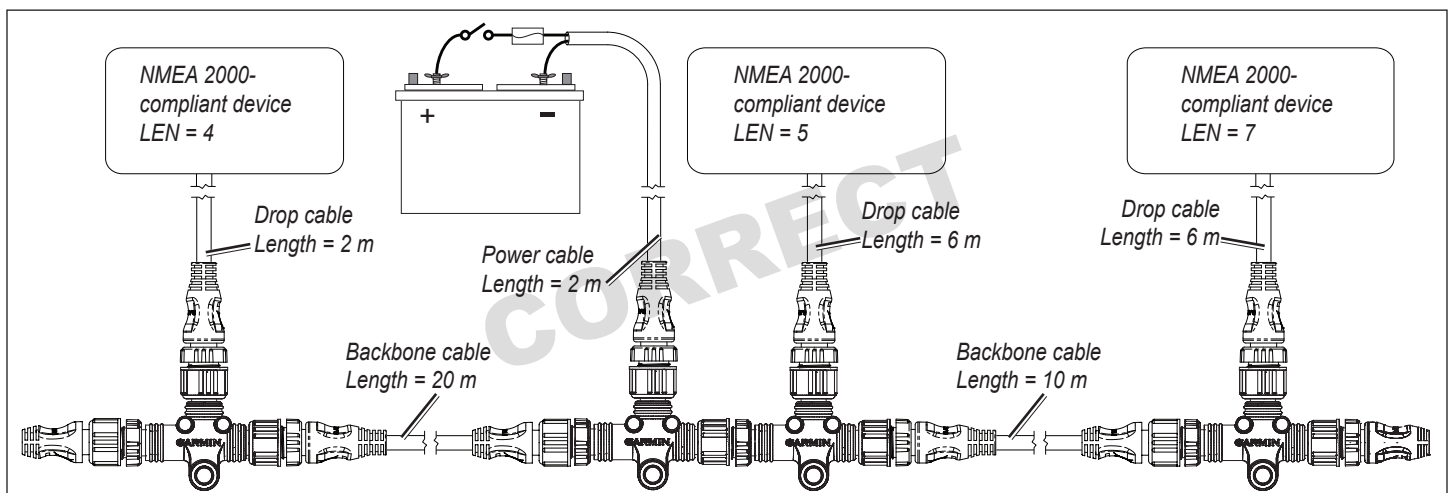
When the NMEA 2000 network is redesigned with the power source in the center, you calculate the voltage drop in both directions. If the T-connector to which you connect the power source is connected directly to another T-connector (as shown in this example), use the LEN from that device as part of the calculation for both directions.

When the voltage drop formula is applied to both the left and right sides of the power source in this example, we see that the voltage drop is less than 3.0 Vdc on each side, so the NMEA 2000 network will function correctly.

Voltage Drop Left = $0.053 \times (2 + 20 + 2) \times (4 + 5) \times 0.1 = 1.145$ Vdc

     Cable   *Distance*   *Network load*
  resistance

Voltage Drop Right = $0.053 \times (2 + 10 + 6) \times (5 + 7) \times 0.1 = 1.145$ Vdc

NOTE: The equation and examples provide conservative estimates for calculating voltage drop.

Proper Termination

You must install terminators at the ends of your NMEA 2000 backbone for it to function correctly. You have two options when installing terminators on your NMEA 2000 network.

1. Typical Terminators

If your NMEA 2000 network is built with correct linear backbone construction, use one female terminator and one male terminator. Install the terminators at opposite ends of your NMEA 2000 network.
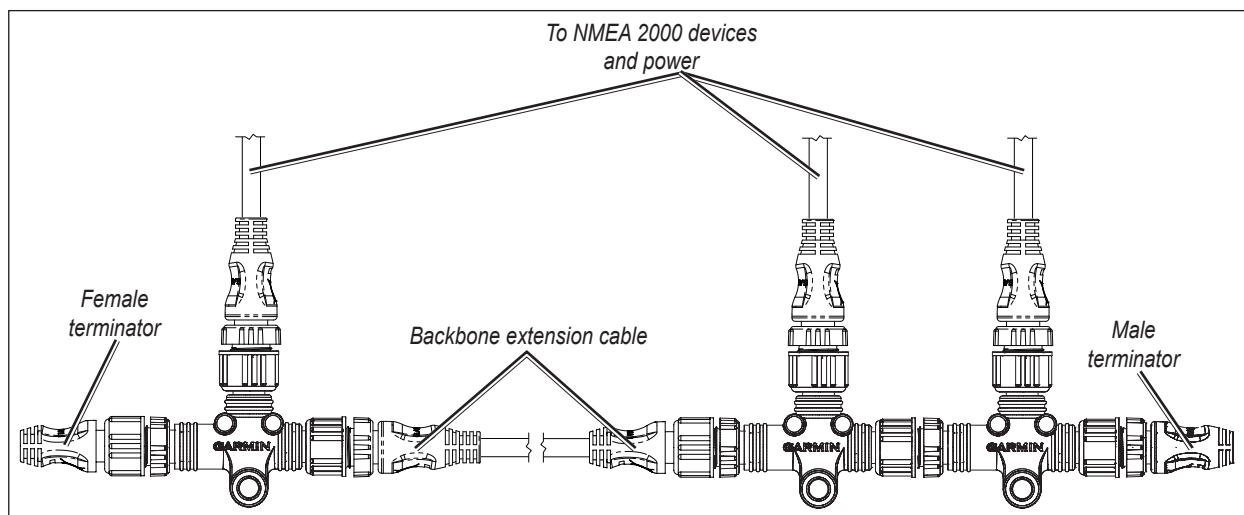
Using Standard Terminators

2. In-line Terminators

If one or both of the NMEA 2000 devices at opposite ends of your NMEA 2000 network are separated from the rest of the NMEA 2000 network by a length of backbone cable, and the typical T-connector/drop cable/terminator combination is not feasible or is too bulky for the area, use an in-line terminator instead of the final T-connector on the backbone. Connect the final device to the in-line terminator with the appropriate length of drop cable, or connect the final device directly to the in-line terminator, without a drop cable.
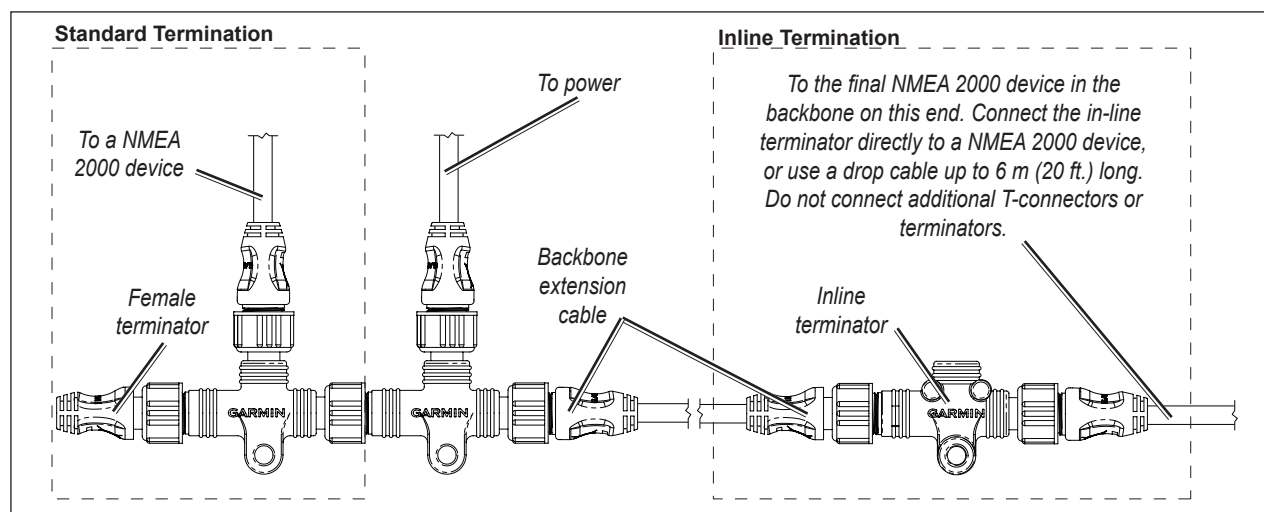
Using an Inline Terminator

⚠ **CAUTION:** Do not use more than two terminators in a NMEA 2000 network.

ℹ **NOTE:** The in-line terminator connects to the NMEA 2000 backbone with a male connector, and to the final NMEA 2000 device with a female connector. Because of this, you can only use one in-line terminator on a NMEA 2000 network.

Cable Length and Device Limits

When building your NMEA 2000 network, keep in mind these limitations:

- The distance between any two points on the NEMA 2000 network must not exceed 100 m (328 ft). To estimate this distance, measure between the terminators on your backbone and add the length of the drop cable for the devices connected to the T-connnectors at the ends of the network.
- The total length of all drop cables cannot exceed 78 m (256 ft).
- The maximum length of a single drop cable to a NMEA 2000 device is 6 m (20 ft).
- No more than 50 NMEA 2000 devices can be connected to your NMEA 2000 network.

Existing NMEA 2000 Installation Considerations

If your boat has an existing NMEA 2000 installation, and you would like to add Garmin NMEA 2000 equipment, there are a few things to consider:

Cable Type: Garmin uses NMEA 2000 micro connectors for all cables and connectors. Your existing NMEA 2000 network may use NMEA 2000 mini connectors and cables in the backbone. Mini connectors are larger than micro connectors, and you will need to use a converter or adapter to connect with Garmin NMEA 2000 devices.

Power: Is the existing NMEA 2000 network connected to power? A NMEA 2000 network must be connected to power to function correctly (page 5). Do not connect the NMEA 2000 network to power in more than one location.

Termination: Are terminators installed on the ends of the existing NMEA 2000 backbone? A NMEA 2000 network must be terminated to function correctly. Do not add more terminators to a NMEA 2000 network if it is already properly terminated.

If you are unsure of any of these considerations, contact your boat manufacturer or a certified NMEA 2000 technician for assistance.

NMEA 2000 Glossary

T-connector—Three-way connector with one male and two female micro connectors. A T-connector is used to connect a NMEA 2000 device to the NMEA 2000 backbone.

Terminator—120 ohm resistor located at each end of the NMEA 2000 backbone. Proper termination helps ensure signal integrity across the entire length of the backbone.

Inline Terminator—Special terminator with male and female connectors on either end. Allows direct connection to the a device at the end of the NMEA 2000 backbone. Simplifies installation by not requiring a T-connector, terminator, and drop cable for the device at the end of the backbone.

Drop Cable—Cable connecting a NMEA 2000 device to the NMEA 2000 backbone. Drop cables are limited to 6 m (20 ft.) maximum length.

Backbone Cable—In conjunction with T-connectors, the backbone cables create the main communication path of the NMEA 2000 network. A backbone cable extends the NMEA 2000 backbone to connect NMEA 2000 devices located in different places on the boat. The maximum backbone cable length is 100 m (328 ft.).

Device—Electronic hardware that connects to the NMEA 2000 network. A device may only receive data transmitted by other devices on the network, or may both transmit and receive data on the network.

Network Power—12 Vdc power supplied to the NMEA 2000 network. Power should be connected through a switch (instead of directly connected to the battery) because some devices are always on when NMEA 2000 power is present. NMEA 2000 devices must operate from 9 to 16 Vdc, with a nominal voltage of 12 Vdc.

LEN (Load Equivalency Number)—This number indicates the amount of current a device draws from the NMEA 2000 network. 1 LEN = 50 mA. Each device should have an LEN specified on the product or in the product documentation.

General NMEA 2000 Data Type Requirements

Each NMEA 2000-certified sensor provides unique information to the NMEA 2000-certified display devices (such as a GPSMAP 4000/5000 series chartplotter or a GMI 10) on the NMEA 2000 network. The data you can view on your display device depends on the sensors you have installed and configured. Refer to the following table for a list of data types that you can view on a display device, specific NMEA 2000 PGN information required to view or calculate that data type, and the NMEA 2000 sensor that typically provides required PGN information. In some cases, more than one sensor is necessary or a specific combination of sensors may provide more precise information. For more about PGN information, see page 13.

Category	Data Type	PGN Data Required	Typical Sender
Engine Information	Battery Voltage	127489 - Eng Dynamic	NMEA 2000-compatible engine
	Fuel Flow Rate	127489 - Eng Dynamic	Fuel Flow Sensor
	Hours	127489 - Eng Dynamic	NMEA 2000-compatible engine
	Oil Pressure	127489 - Eng Dynamic	NMEA 2000-compatible engine
	Engine RPM	127488 - Engine Rapid	NMEA 2000-compatible engine
	Temperature	127489 - Eng Dynamic	NMEA 2000-compatible engine
	Coolant Pressure	127489 - Eng Dynamic	NMEA 2000-compatible engine
	Fuel Pressure	127489 - Eng Dynamic	NMEA 2000-compatible engine
	Oil Temperature	127489 - Eng Dynamic	NMEA 2000-compatible engine
	Boost Pressure	127488 - Engine Rapid	NMEA 2000-compatible engine
	Trim	127488 - Engine Rapid	NMEA 2000-compatible engine
	Rudder Angle	127245 - Rudder	Rudder Angle Sensor
	Bow Tabs	130576 - Small Craft Status	Trim Tab Sensor
	Trim Tabs	130576 - Small Craft Status	Trim Tab Sensor
Fuel Information	Total Fuel Flow Rate	127489 - Eng Dynamic	Fuel Flow Sensor
	Total Fuel Onboard	127489 - Eng Dynamic	Fuel Flow Sensor
	Fuel Economy	127489 - Eng Dynamic (GPS Speed or Water Speed) Note: The Fuel Economy data type is configurable, based on the fuel speed source	Fuel Flow Sensor and Speed Sensor
	Cruising Range	127489 - Eng Dynamic (GPS Speed or Water Speed)	Fuel Flow Sensor and Speed Sensor
	Fuel Level	127505 - Fluid Level	Fuel Level Sensor
	Tank 1	127505 - Fluid Level	Fuel Level Sensor
	Tank 2	127505 - Fluid Level	Fuel Level Sensor
Navigation Information	Course Made Good	129026 - COG/SOG, 129029 - GNSS Position, 129284 - Nav Data, 129285 - Route, and 129283 - XTE	Garmin Chartplotter and GPS Antenna
	Distance Made Good	129026 - COG/SOG, 129029 - GNSS Position, 129284 - Nav Data, and 129285 - Route	Garmin Chartplotter and GPS Antenna
	Waypoint Name	129284 - Nav Data or 129285 - Route	Garmin Chartplotter
	Bearing to Waypoint	129284 - Nav Data	Garmin Chartplotter and GPS Antenna
	Distance to Waypoint	129284 - Nav Data	Garmin Chartplotter and GPS Antenna
	Off Course	129283 - XTE	Garmin Chartplotter and GPS Antenna
	Desired COG	129284 - Nav Data	Garmin Chartplotter and GPS Antenna
	Heading	127250 - Vessel Heading	Heading Sensor
	Course Over Ground	129026 - COG/SOG and 129029 - GNSS Position	GPS Antenna

(Continued)

Category	Data Type	PGN Data Required	Typical Sender
Navigation Information (continued)	GPS Speed	129026 - COG/SOG and 129029 - GNSS Position	GPS Antenna
	Position	129026 - COG/SOG and 129029 - GNSS Position	GPS Antenna
	Turn	129026 - COG/SOG, 129029 - GNSS Position, and 129284 - Nav Data	Garmin Chartplotter and GPS Antenna
Trip	Odometer	129026 - COG/SOG and 129029 - GNSS Position	GPS Antenna
	Trip Odometer	129026 - COG/SOG and 129029 - GNSS Position	GPS Antenna
	Average GPS Speed	129026 - COG/SOG and 129029 - GNSS Position	GPS Antenna
	Maximum GPS Speed	129026 - COG/SOG and 129029 - GNSS Position	GPS Antenna
	Water Odometer	128259 - Water Speed	Water Speed Sensor
	Water Trip Odometer	128259 - Water Speed	Water Speed Sensor
	Average Water Speed	128259 - Water Speed	Water Speed Sensor
	Maximum Water Speed	128259 - Water Speed	Water Speed Sensor
Weather	Barometer	130314 - Actual Pressure, 130310 - Envir Param Old, or 130311 - Envir Param	Barometric Pressure Sensor
	Air Temperature	130312 - Temp, 130310 - Envir Param Old, or 130311 - Envir Param	Air Temperature Sensor
	Humidity	130313 - Humidity or 130311 - Envir Param	Humidity Sensor
	Wind Speed	130306 - Wind Data, 129026 - COG/SOG, 129029 - GNSS Position, 127250 - Vessel Heading, and 128259 - Water Speed *(If a Heading Sensor and Water Speed Sensor are not present, a less accurate reading can be calculated using only the Wind Sensor and GPS antenna [130306 - Wind Data, 129026 - COG/SOG and 129029 - GNSS Position])* *(If a GPS antenna is not present, a less accurate reading can be calculated using only the Wind Sensor, Water Speed Sensor, and Heading Sensor [130306 - Wind Data, 127250 - Vessel Heading, and 128259 - Water Speed])*	Either: • Wind Sensor, a Water Speed Sensor, a Heading Sensor, and a GPS Antenna • *Wind Sensor and a GPS Antenna* • *Wind Sensor and a Water Speed Sensor, and a Heading Sensor*
	Wind Direction	130306 - Wind Data, 129026 - COG/SOG, 129029 - GNSS Position, 127250 - Vessel Heading, and 128259 - Water Speed *(If a Heading Sensor and Water Speed Sensor are not present, a less accurate reading can be calculated using only the Wind Sensor and GPS antenna [130306 - Wind Data, 129026 - COG/SOG and 129029 - GNSS Position])* *(If a GPS antenna is not present, a less accurate reading can be calculated using only the Wind Sensor, Water Speed Sensor, and Heading Sensor [130306 - Wind Data, 127250 - Vessel Heading, and 128259 - Water Speed])*	Either: • Wind Sensor, a Water Speed Sensor, a Heading Sensor, and a GPS Antenna • *Wind Sensor and a GPS Antenna* • *Wind Sensor and a Water Speed Sensor, and a Heading Sensor*

(Continued)

Category	Data Type	PGN Data Required	Typical Sender
	Cardinal Wind Direction	130306 - Wind Data, 129026 - COG/SOG, 129029 - GNSS Position, 127250 - Vessel Heading, and 128259 - Water Speed *(If a Heading Sensor and Water Speed Sensor are not present, a less accurate reading can be calculated using only the Wind Sensor and GPS antenna [130306 - Wind Data, 129026 - COG/SOG and 129029 - GNSS Position])* *(If a GPS antenna is not present, a less accurate reading can be calculated using only the Wind Sensor, Water Speed Sensor, and Heading Sensor [130306 - Wind Data, 127250 - Vessel Heading, and 128259 - Water Speed])*	Either: • Wind Sensor, a Water Speed Sensor, a Heading Sensor, and a GPS Antenna • *Wind Sensor and a GPS Antenna* • *Wind Sensor and a Water Speed Sensor, and a Heading Sensor*
	Beaufort Scale	130306 - Wind Data, 129026 - COG/SOG, 129029 - GNSS Position, 127250 - Vessel Heading, and 128259 - Water Speed *(If a Heading Sensor and Water Speed Sensor are not present, a less accurate reading can be calculated using only the Wind Sensor and GPS antenna [130306 - Wind Data, 129026 - COG/SOG and 129029 - GNSS Position])* *(If a GPS antenna is not present, a less accurate reading can be calculated using only the Wind Sensor, Water Speed Sensor, and Heading Sensor [130306 - Wind Data, 127250 - Vessel Heading, and 128259 - Water Speed])*	Either: • Wind Sensor, a Water Speed Sensor, a Heading Sensor, and a GPS Antenna • *Wind Sensor and a GPS Antenna* • *Wind Sensor and a Water Speed Sensor, and a Heading Sensor*
	Sunrise/Sunset	129026 - COG/SOG and 129029 - GNSS Position	GPS Antenna
Sailing	Apparent Wind Speed	130306 - Wind Data	Wind Sensor
	Apparent Wind Angle	130306 - Wind Data	Wind Sensor
	True Wind Speed	130306 - Wind Data and 128259 - Water Speed *(If a Water Speed Sensor is not present, a less accurate reading can be calculated using a GPS antenna instead [129026 - COG/SOG and 129029 - GNSS Position])*	Either a Wind Sensor and Speed Sensor *or a Wind Sensor and a GPS Antenna*
	True Wind Angle	130306 - Wind Data and 128259 - Water Speed *(If a Water Speed Sensor is not present, a less accurate reading can be calculated using a GPS antenna instead [129026 - COG/SOG and 129029 - GNSS Position])*	Either a Wind Sensor and Speed Sensor *or a Wind Sensor and a GPS Antenna*
	Wind VMG (Velocity Made Good)	130306 - Wind Data and 128259 - Water Speed *(If a Water Speed Sensor is not present, a less accurate reading can be calculated using a GPS antenna instead [129026 - COG/SOG and 129029 - GNSS Position])*	Either a Wind Sensor and Speed Sensor *or a Wind Sensor and a GPS Antenna*
	Waypoint VMG	129284 - Nav Data	Garmin Chartplotter and GPS Antenna
	Maximum Apparent Wind Speed	130306 - Wind Data	Wind Sensor
	Maximum True Wind Speed	130306 - Wind Data and 128259 - Water Speed *(If a Water Speed Sensor is not present, a less accurate reading can be calculated using a GPS antenna instead [129026 - COG/SOG and 129029 - GNSS Position])*	Either a Wind Sensor, a Heading Sensor, and Speed Sensor *or a Wind Sensor, a Heading Sensor, and a GPS Antenna*
	Opposite Tack Heading	130306 - Wind Data, 127250 - Vessel Heading, and 128259 - Water Speed *(If a Water Speed Sensor is not present, a less accurate reading can be calculated using a GPS antenna instead [129026 - COG/SOG and 129029 - GNSS Position])*	Either a Wind Sensor and both Water Speed and Heading Sensors, *or a Wind Sensor and a GPS Antenna*

(Continued)

Category	Data Type	PGN Data Required	Typical Sender
Water	Depth	128267 - Water Depth	Depth Transducer
	Temperature	130312 - Temp, 130310 - Envir Param Old, or 130311 - Envir Param	Water Temperature Sensor
	Speed	128259 - Water Speed	Water Speed Sensor
	Set	129026 - COG/SOG, 129029 - GNSS Position, 128259 - Water Speed, and 127250 - Vessel Heading	GPS Antenna, Water Speed Sensor, and Heading Sensor
	Drift	129026 - COG/SOG, 129029 - GNSS Position, 128259 - Water Speed, and 127250 - Vessel Heading	GPS Antenna, Water Speed Sensor, and Heading Sensor
System	Time Of Day	129026 - COG/SOG and 129029 - GNSS Position	GPS Antenna
	Date	129026 - COG/SOG and 129029 - GNSS Position	GPS Antenna
	Timer	None	None
	Unit Voltage	None	None

NMEA 2000-Certified Display Device PGN Information

All data transmitted on a NMEA 2000 network are organized into groups. These groups are identified by a Parameter Group Number (PGN) that describes the type of data contained in the group. All Garmin NMEA 2000 devices use the proprietary PGN numbers 126720 and 61184. All the other PGN numbers follow the NMEA 2000 standard.

The following tables list the non-proprietary PGN information for all Garmin NMEA 2000-certified display devices.

For NMEA 2000 configuration information on every available Garmin NMEA 2000-certified display devices, see the owner's manual for your display device.

GPSMAP 4000/5000 Series Chartplotters

Receive		Transmit	
059392	ISO Acknowledgment	059392	ISO Acknowledgment
059904	ISO Request	059904	ISO Request
060928	ISO Address Claim	060928	ISO Address Claim
126208	NMEA - Command/Request/Acknowledge Group Function	126208	NMEA - Command/Request/Acknowledge Group Function
126464	Transmit/Receive PGN List Group Function	126464	Transmit/Receive PGN List Group Function
126992	System Time	126996	Product Information
126996	Product Information	127250	Vessel Heading
127250	Vessel Heading	127258	Magnetic Variation
127488	Engine Parameters - Rapid Update	128259	Speed - Water Referenced
127489	Engine Parameters - Dynamic	128267	Water Depth
127505	Fluid Level	129025	Position - Rapid Update
128259	Speed - Water Referenced	129026	COG & SOG - Rapid Update
128267	Water Depth	129029	GNSS Position Data
129025	Position - Rapid Update	129540	GNSS Sats in View
129026	COG & SOG - Rapid Update	129283	Cross Track Error
129029	GNSS Position Data	129284	Navigation Data
129539	GNSS DOPs	12985	Navigation - Route/Waypoint Information
129540	GNSS Sats in View	130306	Wind Data
130306	Wind Data	130312	Temperature
130310	Environmental Parameters		
130311	Environmental Parameters		
130312	Temperature		
130313	Humidity		
130314	Actual Pressure		

GMI 10

Receive		Transmit	
059392	ISO Acknowledgment	059392	ISO Acknowledgment
059904	ISO Request	059904	ISO Request
060928	ISO Address Claim	060928	ISO Address Claim
126208	NMEA - Command/Request/Acknowledge Group Function	126208	NMEA - Command/Request/Acknowledge Group Function
126464	Transmit/Receive PGN List Group Function	126464	Transmit/Receive PGN List Group Function
126992	System Time	126996	Product Information
126996	Product Information		
127250	Vessel Heading		
127488	Engine Parameters - Rapid Update		
127488	Boost Pressure		
127489	Coolant Pressure		
127489	Fuel Pressure		
127489	Oil Temperature		
127489	Engine Parameters - Dynamic		
127505	Fluid Level		
128259	Speed - Water Referenced		
128267	Water Depth		
129025	Position - Rapid Update		
129026	COG & SOG - Rapid Update		
129029	GNSS Position Data		
129044	Datum		
129283	Cross Track Error		
129284	Navigation Data		
129285	Navigation - Route/WP information		
129539	GNSS DOPs		
129540	GNSS Sats in View		
130306	Wind Data		
130310	Environmental Parameters		
130311	Environmental Parameters		
130312	Temperature		
130313	Humidity		
130314	Actual Pressure		

NMEA 2000-Certified Sensor PGN Information

The following tables list the non-proprietary PGN information for every available Garmin NMEA 2000-certified sensor.

GPS 17x (GPS Antenna)

Transmit		Receive	
059392	ISO Acknowledgment	059392	ISO Acknowledgment
060928	ISO Address Claim	059904	ISO Request
126208	NMEA - Command/Request/Acknowledge Group Function	060928	ISO Address Claim
126464	Transmit/Receive PGN List Group Function	126208	NMEA - Command/Request/Acknowledge Group Function
126992	System Time and Date		
126996	Product Information		
129025	Position - Rapid Update		
129026	COG & SOG - Rapid Update		
129029	GNSS Position Data		
129539	GNSS DOPs		
129540	GNSS Sats in View		

GFS 10 (Garmin Fuel Sensor)

Transmit		Receive	
059392	ISO Acknowledgement	059392	ISO Acknowledgement
060928	ISO Address Claim	059904	ISO Request
126208	NMEA–Command/Request/Acknowledge Group Function	060928	ISO Address Claim
126464	Transmit/Receive PGN List Group Function	126208	NMEA–Command/Request/Acknowledge Group Function
126996	Product Information	127489	Engine Parameters - Dynamic
127489	Engine Parameters–Dynamic	127497	Trip Parameters, Engine
127497	Trip Parameters, Engine	127505	Fluid Level (when calibrated using a Garmin chartplotter or marine instrument)
127505	Fluid Level (when calibrated using a Garmin chartplotter or marine instrument)		

Intelliducer (Intelligent Depth Transducer–Transom Mount and Thru-Hull)

Transmit		Receive	
059392	ISO Acknowledgement	059392	ISO Acknowledgement
060928	ISO Address Claim	059904	ISO Request
126208	NMEA–Command/Request/Acknowledge Group Function	060928	ISO Address Claim
126464	Transmit/Receive PGN List Group Function	126208	NMEA–Command/Request/Acknowledge Group Function
126996	Product Information		
128267	Water Depth		
130312	Temperature		

GWS 10 (Garmin Wind Sensor)

Transmit		Receive	
059392	ISO Acknowledgment	059392	ISO Acknowledgment
060928	ISO Address Claim	059904	ISO Request
126208	NMEA - Command/Request/Acknowledge Group Function	060928	ISO Address Claim
126464	Transmit/Receive PGN List Group Function	126208	NMEA - Command/Request/Acknowledge Group Function
126996	Product Information		
130306	Wind Data		
130312	Temperature		
130314	Actual Pressure		

GHP 10 (Marine Autopilot System)

The GHP 10 autopilot system contains two components that utilize NMEA 2000, the CCU and the GHC 10.

CCU

Transmit		Recieve	
059392	ISO Acknowledgment	059392	ISO Acknowledgment
059904	ISO Request	059904	ISO Request
060928	ISO Address Claim	060928	ISO Address Claim
126208	NMEA - Command/Request/Acknowledge Group Function	126208	NMEA - Command/Request/Acknowledge Group Function
126464	Transmit/Receive PGN List Group Function	126464	Transmit/Receive PGN List Group Function
126996	Product Information	126996	Product Information
127250	Vessel Heading	127258	Magnetic Variation
		127488	Engine Parameters - Rapid Update
		129025	Position - Rapid Update
		129026	COG & SOG - Rapid Update
		129283	Cross Track Error
		129284	Navigation Data

GHC 10

Transmit		Recieve	
059392	ISO Acknowledgment	059392	ISO Acknowledgment
059904	ISO Request	059904	ISO Request
060928	ISO Address Claim	060928	ISO Address Claim
126208	NMEA - Command/Request/Acknowledge Group Function	126208	NMEA - Command/Request/Acknowledge Group Function
126464	Transmit/Receive PGN List Group Function	126464	Transmit/Receive PGN List Group Function
126996	Product Information	126996	Product Information
129025	Position - Rapid Update	127250	Vessel Heading
129026	COG & SOG - Rapid Update	127488	Engine Parameters - Rapid Update
129029	GNSS Position Data	129025	Position - Rapid Update
129283	Cross Track Error	129029	GNSS Position Data
129284	Navigation Data	129284	Navigation Data
129285	Navigation - Route/WP information	129285	Navigation - Route/WP information
129540	GNSS Sats in View		

GXM 51

Transmit		Receive	
059392	ISO Acknowledgment	059392	ISO Acknowledgment
060928	ISO Address Claim	059904	ISO Request
126208	NMEA - Command/Request/Acknowledge Group Function	060928	ISO Address Claim
126464	Transmit/Receive PGN List Group Function	126208	NMEA - Command/Request/Acknowledge Group Function
126996	Product Information		

VHF 200

Transmit		Receive	
059392	ISO Acknowledgment	059392	ISO Acknowledgment
060928	ISO Address Claim	059904	ISO Request
126208	NMEA Request/Command/Acknowledge Group Function	060928	ISO Address Claim
126464	PGN List	126208	NMEA - Command/Request/Acknowledge Group Function
126996	Product Information	129026	COG (course over ground) and SOG (speed over ground) - Rapid Update
129799	Radio Frequency/Mode/Power		
129808	DSC Call Information	129029	GNSS (Global Navigation Satellite System) Position Data

NMEA 2000-Certified Sensor Configuration Information

Garmin NMEA 2000-certified sensors each have a *Sensor Configuration Guide* included in the package. For convenience, this section contains the configuration information for every available Garmin NMEA 2000 sensors. All NMEA 2000 device configuration options are set from the NMEA 2000 configuration menu on your NMEA 2000 display device.

Important: To access the NMEA 2000 configuration menu on your display device, consult the documentation provided with your display device.

GPS 17x (GPS Antenna)

Enabling and Disabling WAAS (Wide Area Augmentation System)/EGNOS (Euro Geostationary Navigation Overlay Service)

When enabled, WAAS/EGNOS provides more accurate position information. For more information on WAAS/EGNOS, visit www.garmin.com.

1. While viewing the NMEA 2000 configuration menu, select the GPS 17x device.
2. Select **Config** > **WAAS/EGNOS.**
3. On a Garmin chartplotter, select **On** or **Off**.

Setting the Speed Filter

The speed filter setting on the GPS 17x can help reduce unnecessary drift alarm triggers as well as potentially sporadic position information. The speed filter averages the data provided by the GPS 17x to provide smoother position data updates. The speed filter is most helpful when stationary or in low-speed situations.

1   While viewing the NMEA 2000 configuration menu, select the GPS 17x device.
2. Select **Config** > **Speed Filter**.
3. Choose from the following options:
   • **Off**—position information from the GPS 17x is provided to the NMEA 2000 network as it is gathered.
   • **On**—position information from the GPS 17x is gathered and averaged before it is provided to the NMEA 2000 network. Select the interval at which the position information is gathered.
   • **Auto**—the speed filter toggles on in low-speed situations and toggles off in high-speed situations.

Refreshing GPS Satellite Acquisition

In some situations, if you have moved the boat many miles without using the GPS 17x, for example, you can force the GPS 17x to re-initialize and find your current position.

1. While viewing the NMEA 2000 configuration menu, select the GPS 17x device.
2. Select **Config** > **Auto Locate**.
3. Wait for the GPS 17x to acquire satellites.

Restoring Factory Default Settings

You can restore factory default settings to the GPS 17x. You will lose all custom configuration settings when you restore factory default settings.

To restore factory default settings:
1. While viewing the NMEA 2000 configuration menu, select the GPS 17x device.
2. Select **Config** > **Factory Defaults**.

GFS 10 (Garmin Fuel Sensor)

⚠️ **CAUTION:** The GFS 10 is a sensor that helps you better determine the amount of fuel used on your boat; you should not rely solely on the GFS 10 for fuel-level information. Carefully compare information displayed on the unit to all available fuel-level instruments and sources.

Using Fuel-Flow Information With a Garmin Chartplotter or Marine Instrument

⚠️ **CAUTION:** The Garmin chartplotter or marine instrument must be powered on to calculate remaining fuel based on the fuel-flow rate.

Important: When using the GFS 10 to calculate remaining fuel based on the fuel-flow rate, you must specify the amount of fuel each time you add fuel to the tank.

To specify the amount of fuel added:
1. While viewing the fuel page or fuel instrument screen on your NMEA 2000 device, select **Menu**.
2. Choose from the following options:
   - **Fill Up Tank**—set fuel level to the maximum capacity.
   - **Add Fuel to Boat**—specify the amount of fuel added.
   - **Set Total Fuel Onboard**—specify the amount of fuel currently available in the fuel tank or tanks.

Changing the Fuel Economy Source

The Garmin chartplotter or marine instrument requires a speed sensor in addition to the GFS 10 to calculate fuel economy.

To change the fuel economy source:
1. While viewing the fuel page or fuel instrument screen on your NMEA 2000 device, select **Menu** > **Fuel Economy Source**.
2. Select either **GPS Speed** or **Water Speed** to specify which speed sensor is used to calculate fuel economy.

Using Fuel-Level Information With a Garmin Chartplotter or Marine Instrument

To receive fuel-level information, connect the wiring harness on the GFS 10 to the fuel gauge or fuel-level sensor of your boat according to the *GFS 10 Installation Instructions*.

To calibrate fuel-level information from the GFS 10:
1. While in still water, on the NMEA 2000 device configuration menu, select the GFS 10 device that is connected to the fuel tank you want to configure.

🔺 **TIP:** The serial number of each GFS 10 is shown on the NMEA 2000 device configuration screen to help differentiate among multiple GFS 10 devices.

2. Select **Config** > **Level Calibration** > **Add Calibration Point** and enter a calibration point that corresponds to the current fuel level in that fuel tank.

Entering more calibration points will provide a more-accurate reading. For example, entering five calibration points (empty tank, 1/4 tank, 1/2 tank, 3/4 tank, and full tank) will provide a more-accurate reading than entering two calibration points (empty tank and full tank).

🔺 **TIP:** For a quick calibration, start with an empty tank, and enter calibration points as you fill up the tank.

To reset the fuel-level calibration:
1. While viewing the NMEA 2000 device configuration menu, select the GFS 10 device that is connected to the fuel tank you want to configure.
2. Select **Config** > **Level Calibration** > **Reset Calibration**.

Configuring Engine and Tank Information

If you have a multi-engine or a multi-tank setup on your boat, specify which engine or tank is associated with each GFS 10.

> **TIP:** The serial number of each GFS 10 is shown on the NMEA 2000 device configuration menu to help differentiate among multiple GFS 10 devices.

To configure tank and engine information for the GFS 10:

1. While viewing the NMEA 2000 device configuration menu, select the GFS 10 device you want to configure, and select **Config**.

2. Select from the following options:

   • **Engine Number**—for a multi-engine installation, assign the selected GFS 10 to a specific engine.

   • **Tank Number**—for a multi-tank installation, assign the selected GFS 10 to a specific tank.

   • **Tank Capacity**—define the fuel capacity of the fuel tank that the selected GFS 10 is connected to.

Troubleshooting Fuel Gauge Type

When wired to a fuel gauge, the gauge type defaults to Auto Detect. If the fuel-level reading on your Garmin chartplotter or marine instrument changes with the engine RPM, the GFS 10 could be detecting the wrong type of gauge.

> **NOTE:** The fuel level changes with the motion of the boat. Perform this test when the boat is not moving.

To test the gauge-type setting:

1. When the boat is not moving, put the engine in neutral.

2. Use the throttle to increase the engine RPM. If the fuel-level reading changes with the engine RPM, change the gauge type.

To change the gauge-type setting:

1. While viewing the NMEA 2000 device configuration menu, select the GFS 10 device.

2. Select **Config** > **Gauge Type**.

3. Choose **1 Coil** or **2 Coil** and repeat the gauge-type setting test.

Troubleshooting the Fuel-Flow Rate

If the fuel-flow information received from the GFS 10 appears inaccurate, you can manually adjust the fuel-flow reading.

To adjust the fuel-flow rate:

1. While viewing the NMEA 2000 device configuration menu, select the GFS 10 device.

2. Select **Config** > **Flow Adjustment**.

3. Enter a positive or negative adjustment.

For example, when you set the Flow Adjustment to +10% , a flow reading of 20 gal./hr. (75 L/h) would change to a reading of 22 gal./hr. (82.5 L/h), because 20 gal. × 110% = 22 gal. (75 L × 110% = 82.5 L).

Restoring Factory Default Settings

You can restore factory default settings to the GFS 10. You will lose all custom configuration and calibration settings when you restore factory default settings.

To restore factory default settings:

1. While viewing the NMEA 2000 configuration menu, select the GFS 10 device.

2. Select **Config** > **Factory Defaults**.

Intelliducer (Intelligent Depth Transducer–Transom Mount and Thru-Hull)

Setting the Keel Offset

Adjust the **Keel Offset** to display a depth reading from the water line or from the lowest point of the boat (keel) rather than the actual location of the Intelliducer.

To adjust the keel offset:

1. While viewing the NMEA 2000 device configuration menu, select a specific Intelliducer and select **Config** > **Keel Offset**.

2. Enter the measured distance from the Intelliducer location to the water line or to the keel of the boat.

   - If you are measuring down to the keel (Intelliducer installed at the water line), enter a (+) positive number.

   - If you are measuring up to the water line (Intelliducer installed on the keel), enter a (-) negative number.

Keel Offset
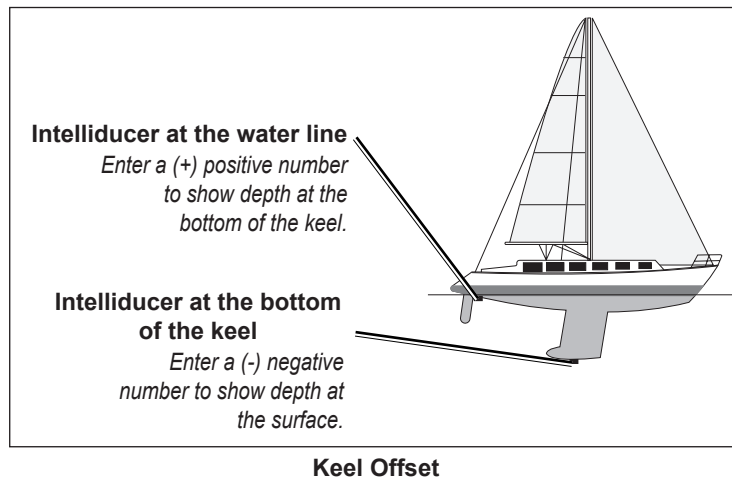
GWS 10 (Garmin Wind Sensor)

Configuring the Wind Angle Offset (Orientation)

When mounting the sensor, you must adjust the angle offset if you did not orient the GWS 10 as described in the *GWS 10 Installation Instructions*.

To configure the wind angle offset (orientation):

1. While viewing the NMEA 2000 device information, select **Config** > **Wind Angle Offset**.

2. Select the angle in degrees to adjust for the difference in orientation.

TIP: The angles are configured clockwise around the mast of the boat. For example, 90 degrees is on the starboard side of the boat, and 270 degrees is on the port side.

Configuring the Wind Speed Filter

The wind speed filter governs how quickly the NMEA 2000-compatible display device shows a change in the wind speed. A lower filter setting shows changes in the wind speed more gradually, and may stabilize the display.

To configure the wind speed filter:

1. While viewing the NMEA 2000 device information, select **Config** > **Wind Speed Filter**.

2. Choose from the following options to adjust the filter settings.

   • **Off**—the wind speed data is not filtered.

   • **On**—select a lower number to show a change in the wind speed more gradually, and help the gauge needle or wind speed number to move or change more steadily.

   • **Auto**—automatically adjusts the filter settings based on wind conditions.

Configuring the Wind Angle Filter

The wind angle filter governs how quickly the NMEA 2000-compatible display device shows a change in the wind angle. A lower filter setting shows changes in the wind angle more gradually, and may stabilize the display.

To configure the wind angle filter:

1. While viewing the NMEA 2000 device information, select **Config** > **Wind Angle Filter**.

2. Choose from the following options to adjust the filter settings.

   • **Off**—the wind angle data is not filtered.

   • **On**—select a lower number to update the display device less often, and help the gauge needle or wind angle number to move or change more steadily.

   • **Auto**—automatically adjusts the filter settings based on wind conditions.

Configuring the GWS 10 if the Filter and Offset Selections Are Not Displayed

Depending on the version of software loaded on your Garmin marine instrument, the specific configuration options may not be displayed on the configuration screens.

To configure the wind angle offset if the menu option is not displayed:

1. Select **Generic Configuration** to specify data for the filter and offset settings.

2. Enter the following command: **"ANGLEOFFSET="**

3. Follow the command with a number between 0 and 359, in degrees (for example: ANGLEOFFSET=180).

To configure the wind angle filter if the menu option is not displayed:

1. Select **Generic Configuration** to specify data for the filter and offset settings.

2. Enter the following command: **"ANGLEFILTER="**

3. Follow the command with a number between 0 and 254, representing a time constant in increments of 0.25 second, or 255 to represent the Automatic setting (for example: ANGLEFILTER=12).

To configure the wind speed filter:

1. Select Generic Configuration to specify data for the filter and offset settings.

2. Enter the following command: **"SPEEDFILTER="**

3. Follow the command with a number between 0 and 254, representing a time constant in increments of 0.25 second, or 255 to represent the Automatic setting (for example: SPEEDFILTER=215).

NMEA 2000 Checklist

Use this checklist to confirm your NMEA 2000 installation.

	Is the NMEA 2000 network connected to power, and is the power balanced correctly on the network? (page 5)
	Is the NMEA 2000 network power connected through the ignition switch–if not, did you install a switch? (page 5)
	Is the NMEA 2000 power cable grounded? Is the bare wire connected to the same ground location? (page 5)
	Is the NMEA 2000 network backbone built using linear construction? (page 4)
	Are there terminators on both ends of the NMEA 2000 network? (page 7)
	Are all drop cables less than 20 ft. (6 m)? (page 8)

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