GARMIN®

TECHNICAL REFERENCE FOR GARMIN® NMEA 2000® PRODUCTS

NMEA 2000 Network Fundamentals

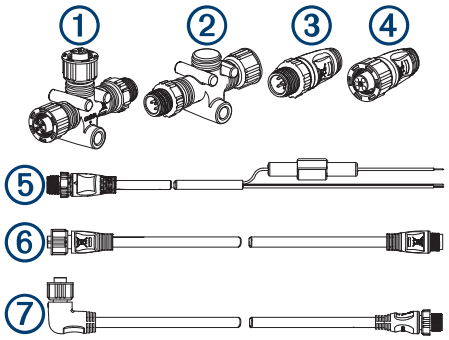
This technical reference provides basic NMEA 2000 component identification (*NMEA 2000 Components*, page 2), basic NMEA 2000 network-building instructions (*NMEA 2000 Network Planning and Construction*, page 4), and a list of NMEA 2000 data that may be used by some Garmin NMEA 2000 certified devices (*General NMEA 2000 Data Types*, page 12).

What is NMEA 2000?

NMEA 2000 is a plug-and-play communications standard used for connecting marine sensors and display devices within ships and boats, and is considered the successor to the NMEA® 0183 serial data bus standard. You can learn more about NMEA 2000 and purchase the NMEA 2000 standard documentation at nmea.org/content/STANDARDS/NMEA_2000.

Garmin uses NMEA 2000 micro connectors on devices, sensors, and T-connectors that are compatible with other NMEA 2000 micro connectors, cables, and NMEA 2000 compatible devices.

NMEA 2000 Components



Item	Description	Garmin Part Number	Notes
1	T-connector	010-11078-00	Connects devices to the backbone. You must use T-connectors properly when connecting devices to your NMEA 2000 network (*Linear Backbone Construction*, page 6).
2	In-line terminator	010-11096-00	You can use this instead of a T-connector and separate male terminator (*Network Termination*, page 11).
2	Power isolator	010-11580-00	Prevents a device from providing power to the NMEA 2000 (*Power Isolation*, page 10).
3	Male terminator	010-11080-00	You must install terminators on both ends of the backbone (*Network Termination*, page 11).
4	Female terminator	010-11081-00	You must install terminators on both ends of the backbone.
5	Power cable	010-11079-00	Connects the NMEA 2000 network to a 12 Vdc power source (*Power Connection Considerations*, page 7). 2 m (6.5 ft.) 3 A fuse included
6	Backbone or drop cable	010-11076-03: 0.3 m (1 ft.) 010-11076-00: 2 m (6.5 ft.) 010-11076-04: 4 m (13 ft.) 010-11076-01: 6 m (20 ft.) 010-11076-02: 10 m (33 ft.) 010-11171-01: 30 m (98 ft.) (spool)	A cable up to 6 m (20 ft) can be used as a backbone cable or a drop cable. A cable longer than 6m (20 ft) can be used as a backbone cable only.
7	Right-angle drop cable	010-11089-01: 0.3 m (1 ft.) 010-11089-00: 2 m (6.5 ft.)	Can be used when connecting to a device with minimal clearance for the rear connectors.

Item	Description	Garmin Part Number	Notes
Not pictured	Field-installable connector	010-11094-00: male 010-11095-00: female	Can be used to create a backbone or drop cable for a custom length. Can be used to shorten any Garmin NMEA 2000 backbone or drop cable

NMEA 2000 Glossary

Backbone: This is the main communication path of the NMEA 2000 network. The backbone can be as simple as three T-connectors connected side to side with terminators on both ends, or can expand to include many T-connectors separated by backbone cables. The backbone must always be constructed in a linear manner for the network to function properly (*Linear Backbone Construction*, page 6).

Backbone Cable: Backbone cables extend the NMEA 2000 backbone to connect NMEA 2000 devices located in different places on the boat. The maximum length of a single backbone cable is 100 m (328 ft.). Backbone cables must connect to the sides of two T-connectors to maintain linear backbone construction, and must never connect to the top of a T-connector (*Linear Backbone Construction*, page 6).

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

Drop Cable: A cable connecting an NMEA 2000 device to the NMEA 2000 backbone. Drop cables are limited to 6 m (20 ft.) maximum length. Drop cables must connect to the top of a T-connector or to the side of an in-line terminator (*Linear Backbone Construction*, page 6).

In-line Terminator: A special terminator that can be used in place of a male terminator (not available as a female connector), that allows direct connection to the a device at the end of the NMEA 2000 backbone. The inline terminator simplifies installation by not requiring a T-connector, male terminator, and drop cable for the device at the end of the backbone (*Network Termination*, page 11).

LEN (Load Equivalency Number): A simplified value that represents the amount of current a device draws from the NMEA 2000 network. A LEN of 1 = 50 mA. Each device should have an LEN specified on the product or in the product documentation that you should use when calculating the power needs and balance of your NMEA 2000 network (*Power Distribution and Balance*, page 8).

Network Power: 12 Vdc power supplied to the NMEA 2000 network. Power to the NMEA 2000 network should be connected through a switch (instead of directly connected to the battery) because some NMEA 2000 devices are always on when power is present, and this may drain the battery. NMEA 2000 devices must operate from 9 to 16 Vdc, with a nominal voltage of 12 Vdc (*Linear Backbone Construction*, page 6).

Terminator: A 120 ohm resistor located at each end of the NMEA 2000 backbone. Proper termination is required to ensure signal integrity across the entire length of the backbone (*Linear Backbone Construction*, page 6).

T-connector: A three-way connector with one male and two female micro connectors. A T-connector is used to connect an NMEA 2000 device to the NMEA 2000 backbone.

NMEA 2000 Network Planning and Construction

The backbone is the main communication channel of an NMEA 2000 network to which your NMEA 2000 devices connect. You must connect each NMEA 2000 device to the backbone using a T-connector. You must connect the NMEA 2000 backbone to a power source, and you must install terminators at both ends of the network for proper functionality.

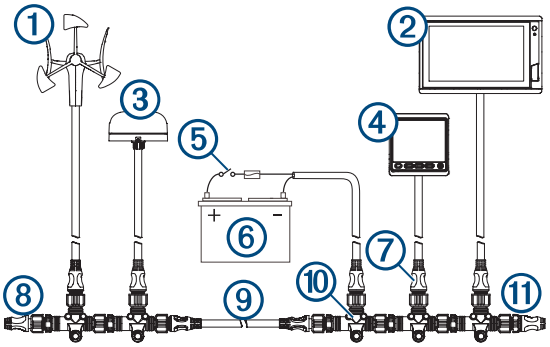
When you design an NMEA 2000 network, you should start by creating a diagram of the network. When creating the diagram, be as detailed as possible, observing these considerations.

- You should include all of the devices you intend to connect to the network.
- You should note the approximate location on the boat for the backbone and each of the connected devices.
- You should measure the distances between the location of each device and the backbone, and you should measure the overall length of the backbone.
- You should note the power consumption (LEN) of each connected device.

After you create a diagram of your network, you should apply the principles of proper NMEA 2000 network construction and adjust your plan as needed. You must understand and apply these concepts.

- Linear backbone construction (*Linear Backbone Construction*, page 6)
- Power connection and distribution (*Power Connection Considerations*, page 7)
- Proper network termination (*Network Termination*, page 11)
- Cable length and device limits (*NMEA 2000 Cable Length and Device Limitations*, page 12)

Sample NMEA 2000 Network



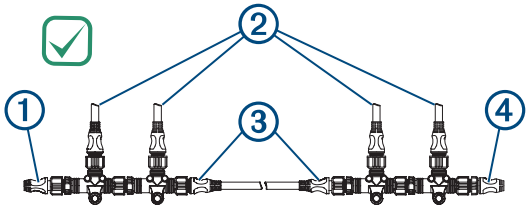
NOTE: This diagram illustrates only the NMEA 2000 data connections to each device or sensor on the network. Some devices or sensors can be powered by the NMEA 2000 network, and others may require a separate power connection. Consult the installation instructions for each device you connect to your NMEA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

1	Wind sensor
2	Chartplotter or multifunction device (MFD)
3	Antenna (GPS or satellite)
4	Marine instrument
5	Ignition or in-line switch and fuse
6	12 Vdc power source
7	Drop cable
8	Female terminator
9	Backbone extension cable
10	T-connector
11	Male terminator

Linear Backbone Construction

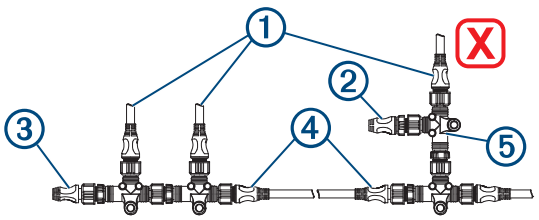
The backbone is the main communication path of the NMEA 2000 network, so it is extremely important to construct the backbone properly. An improperly constructed backbone may prevent the network from functioning, or you may experience unexpected performance.

The backbone consists of a combination of T-connectors and cables, terminated on both ends. All T-connectors must connect to the sides of one another either directly or through a backbone cable extension. The top of a T-connector is used to connect a device or power to the network only, and the backbone cannot route through the top of a T-connector.



NMEA 2000 Network with Correct Linear Backbone Construction

1	Female terminator installed correctly The terminator must connect to the side of the last T-connector in the backbone.
2	NMEA 2000 devices and power NMEA 2000 drop cables and network power cables must connect to the top of a T-connector, and never to the sides.
3	Backbone cable If needed, the backbone can be extended using a cable connected to the sides of a T-connector. The maximum length of a single backbone cable is 100 m (328 ft.)
4	Male terminator The terminator must connect to the side of the last T-connector in the backbone.



NMEA 2000 Network with Incorrect Linear Backbone Construction

1	NMEA 2000 devices and power NMEA 2000 drop cables and network power cables must connect to the top of a T-connector, and never to the sides.
2	Male terminator installed **incorrectly** The terminator must connect to the side of the last T-connector in the backbone, and cannot connect to the top of a T-connector.
3	Female terminator installed correctly
4	Backbone cable installed correctly
5	T-connector installed **incorrectly** T-connectors must connect to one another using the sides only, never the top.

Power Connection Considerations

NOTICE

Connecting the NMEA 2000 network to a power source greater than 12 Vdc may damage devices connected to the network.

You must connect the NMEA 2000 network to power through the ignition or other external switch, or it will drain the boat battery when not in use.

You should not connect an NMEA 2000 network to power in more than one place without using a power isolator in between the two network power connections.

An NMEA 2000 network must connect to a 12 Vdc power source using a dedicated NMEA 2000 power cable.

When connecting the NMEA 2000 network to power, you must observe these considerations:

- The dedicated NMEA 2000 power cable must connect to a 12 Vdc. Connecting to a 24 Vdc or any power source greater than 12 Vdc may damage the NMEA 2000 network components or devices.
- The dedicated NMEA 2000 power cable should connect to the power source through the auxiliary power switch on the boat. If there is not an auxiliary power switch, or if connecting to the auxiliary power switch causes electrical interference, you must connect the power cable to the power source through an in-line switch.
- The dedicated NMEA 2000 power cable must connect to the top of a T-connector, not the side.
- The power cable can connect to the top of a T-connector located in the backbone of your NMEA 2000 network on either end or in the middle, depending on the length of the backbone and the power needs of the devices on the network (*Power Distribution and Balance*, page 8).
- Some NMEA 2000 devices provide power to the NMEA 2000 network, and this may not be ideal for every NMEA 2000 design. To avoid having two power connections to the network, you can install these devices using a power isolator (*Power Isolation*, page 10).

Power Distribution and Balance

Selecting the proper location of the power connection to the NMEA 2000 network depends on the length of the backbone and the power needs of the devices on the network.

For the NMEA 2000 network to work properly there must not be more than a 1.67 Vdc drop in the supply voltage between the T-connector with the power cable and the NMEA 2000 device located farthest from this T-connector.

To determine the voltage drop in your NMEA 2000 network, use this equation:

Voltage drop	=	Resistance	×	Distance	×	Load	×	0.1
Voltage drop	=	Cable resistance (ohms/m) Garmin cable resistance value = 0.053	×	Distance from the power connection to the furthest device (in meters)	×	Network load Sum of the LEN numbers from the power connection to the end of the network	×	0.1

Voltage drop = resistance × distance × load × 0.1

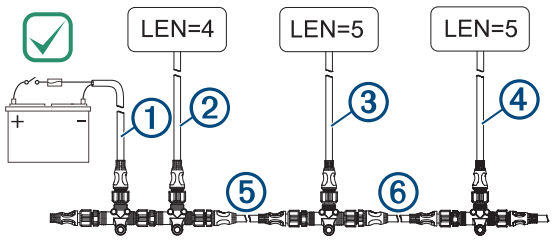
Resistance: Refers to cable resistance (ohms/m). The Garmin cable resistance value is 0.053.

Distance: Refers to the distance from the power connection to the device located furthest away on the network (in meters).

Load: Refers to the network load. The network load is the sum of the LEN numbers of all devices from the power connection to the end of the network.

When evaluating the results of your calculation, consider the following:

- If you calculate a voltage drop of **1.67 Vdc** or less, you can connect power to either the end or the middle of the NMEA 2000, and it will function correctly.
- If you calculate a voltage drop of more than **1.67 Vdc**, you must connect power to the middle of the NMEA 2000 network. The location of the power connection in the network depends on the network load and distance from the battery. You should try to balance the voltage drop equally on both sides of the power connection.
- If a voltage drop of under **1.67 Vdc** is not possible on the NMEA 2000 network, contact a professional installer for assistance.



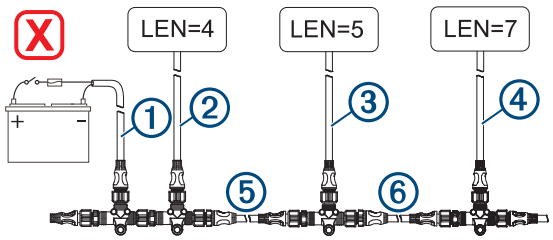
End-Powered NMEA 2000 Network Designed Correctly

①	Power cable Length = 2 m
②	Drop cable Length = 2 m
③	Drop cable Length = 6 m
④	Drop cable Length = 4 m

⑤	Backbone cable Length = 10 m
⑥	Backbone cable Length = 6 m

When the voltage-drop formula is applied to this example, the voltage drop is less than 1.67 Vdc. This NMEA 2000 network will function correctly when powered at the end:

Resistance	×	Distance	×	Load	×	0.1	=	**Voltage drop**
0.053	×	22 (2 + 10 + 6 + 4)	×	14 (4 + 5 + 5)	×	0.1	=	**1.63 Vdc**

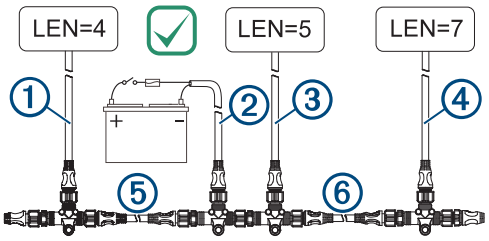


End-Powered NMEA 2000 Network Designed Incorrectly

①	Power cable Length = 2 m
②	Drop cable Length = 2 m
③	Drop cable Length = 4 m
④	Drop cable Length = 6 m
⑤	Backbone cable Length = 10 m
⑥	Backbone cable Length = 6 m

When the voltage-drop formula is applied to this example, the voltage drop is greater than 1.67 Vdc. This NMEA 2000 network will not function correctly when powered at the end. to function correctly, this NMEA 2000 network must be redesigned with the power connected to the center of the network.

Resistance	×	Distance	×	Load	×	0.1	=	**Voltage drop**
0.053	×	24 (2 + 10 + 6 + 6)	×	16 (4 + 5 + 7)	×	0.1	=	**2.04 Vdc**



Middle-Powered NMEA 2000 Network Designed Correctly

①	Drop cable Length = 2 m
②	Power cable Length = 2 m
③	Drop cable Length = 4 m
④	Drop cable Length = 6 m
⑤	Backbone cable Length = 10 m
⑥	Backbone cable Length = 6 m

When the NMEA 2000 network is redesigned with the power source in the center, 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 the device connected to that T-connector as part of the calculation for both directions.

Voltage Drop to the Left of the Power Connection

Resistance	×	Distance	×	Load	×	0.1	=	**Voltage drop**
0.053	×	14 (2 + 10 + 2)	×	4	×	0.1	=	**0.30 Vdc**

Voltage Drop to the Right of the Power Connection

Resistance	×	Distance	×	Load	×	0.1	=	**Voltage drop**
0.053	×	12 (2 + 6 + 4)	×	12 (5 + 7)	×	0.1	=	**0.80 Vdc**

Power Isolation

Some NMEA 2000 devices, such as a boat engine, provide power to the NMEA 2000 network. In some cases, this may be sufficient to provide the appropriate power to the network, but in other cases this may result in providing power to the network in two places, and could result in unexpected behavior or may damage other connected devices.

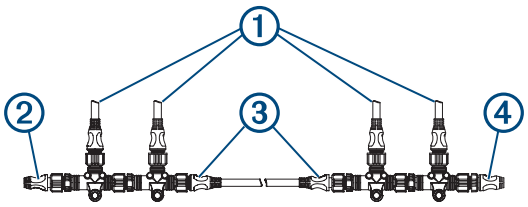
To accommodate two power connections to the network, you can install a power isolator (010-11580-00) in the backbone to when connecting devices to the network that also provide power. The power isolator allows data communication, but does not allow power to pass through.

Network Termination

You must install terminators at the ends of an NMEA 2000 backbone for it to function correctly. You can install either two standard terminators or one female terminator and an in-line terminator on an NMEA 2000 network.

NOTE: You must not install more than two terminators on an NMEA 2000 network.

If the NMEA 2000 network is built using correct linear backbone construction, you should install one female terminator and one male terminator on the sides of the final T-connectors on opposite ends of the backbone.



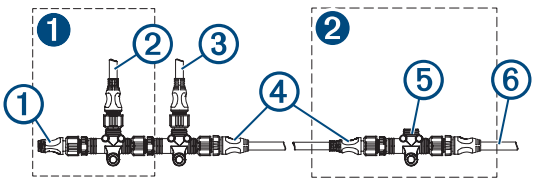
NMEA 2000 Network with Standard Terminators

1	To power and NMEA 2000 devices
2	Female terminator
3	Backbone extension cable
4	Male terminator

If the final NMEA 2000 device on the NMEA 2000 network is separated from the backbone by a long length of backbone extension cable, and the typical T-connector/drop cable/terminator combination is not feasible or is too bulky for the area, you can use an in-line terminator instead of the final T-connector on the backbone. You can connect the final device to the in-line terminator using the appropriate length of drop cable, or connect the final device directly to the in-line terminator without using a drop cable.

An in-line terminator may be useful when connecting a wind sensor or other device at the top of a mast, for example.

NOTE: An in-line terminator connects to the NMEA 2000 backbone using a male connector, and to the final NMEA 2000 device using a female connector. Because of this, you can only use one in-line terminator on an NMEA 2000 network, in place of a male terminator.



NMEA 2000 Network with an In-line Terminator

1	This end of the backbone uses a standard female terminator connected to T-connector for the last device.
2	This end of the backbone uses an in-line terminator to connect to the last device. Note how using the in-line terminator is used in place of the final T-connector and terminator.

1	Female terminator
2	To the final NMEA 2000 device on this side of the backbone

③	NMEA 2000 power
④	Backbone extension cable
⑤	In-line terminator
⑥	To the final NMEA 2000 device on this side of the backbone

NMEA 2000 Cable Length and Device Limitations

When building your NMEA 2000 network, consider these limitations:

- The distance between any two points on an NMEA 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-connectors 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 from the top of a T-connector to NMEA 2000 device is 6 m (20 ft).
- No more than 50 NMEA 2000 devices can be connected to an NMEA 2000 network.

Considerations for Existing NMEA 2000 Networks

If a boat has an existing NMEA 2000 installation, and you would like to add Garmin NMEA 2000 equipment, you should observe these considerations.

Cable and Connector Type: Garmin uses NMEA 2000 micro connectors for all cables and connectors. An existing NMEA 2000 network may use NMEA 2000 mini connectors and cables in the backbone. Mini connectors are larger than micro connectors, so you must use a converter or adapter to connect a Garmin NMEA 2000 device to a backbone with mini connectors.

Power: You must determine whether the existing NMEA 2000 network is connected to a power source, because an NMEA 2000 network must connect to power to function correctly (*Power Connection Considerations*, page 7). If you must connect power to the NMEA 2000 network at more than one location, you must install a power isolator in the backbone between the two power connections (*Power Isolation*, page 10).

Termination: You must determine whether terminators are installed on the ends of the existing NMEA 2000 backbone, because anNMEA 2000 network must be properly terminated to function correctly. You must not add more terminators to an NMEA 2000 network if it is already properly terminated.

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

General NMEA 2000 Data Types

Every NMEA 2000 certified sensor provides unique information to NMEA 2000 certified display devices 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.

NMEA 2000 Engine Data

Data Type	PGN Data Required	Typical Sender
Battery voltage	127489: Dynamic engine parameters	NMEA 2000 compatible engine
Fuel flow rate	127489: Dynamic engine parameters	Fuel flow sensor
Hours	127489: Dynamic engine parameters	NMEA 2000 compatible engine
Oil pressure	127489: Dynamic engine parameters	NMEA 2000 compatible engine
Engine RPM	127489: Dynamic engine parameters	NMEA 2000 compatible engine
Temperature	127489: Dynamic engine parameters	NMEA 2000 compatible engine
Coolant pressure	127489: Dynamic engine parameters	NMEA 2000 compatible engine
Fuel pressure	127489: Dynamic engine parameters	NMEA 2000 compatible engine
Oil temperature	127489: Dynamic engine parameters	NMEA 2000 compatible engine
Boost pressure	127489: Dynamic engine parameters	NMEA 2000 compatible engine
Trim	127489: Dynamic engine parameters	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

NMEA 2000 Fuel Information

Data Type	PGN Data Required	Typical Sender
Total fuel flow rate	127489: Dynamic engine parameters	Fuel flow sensor
Total fuel onboard	127489: Dynamic engine parameters	Fuel flow sensor
Fuel economy **NOTE:** The fuel economy data type is configurable, based on the speed source.	127489: Dynamic engine parameters (GPS speed or water speed)	Fuel flow sensor and speed sensor
Cruising range	127489: Dynamic engine parameters (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

NMEA 2000 Navigation Information

Data Type	PGN Data Required	Typical Sender
Course made good	129026: COG and SOG 129029: GNSS position data 129284: Nav data 129285: Navigation (route and waypoint) 129283: Cross track error	Garmin chartplotter and GPS antenna
Distance made good	129026: COG/SOG 129029: GNSS position 129284: Nav data 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 129029: GNSS position	GPS antenna
GPS speed	129026: COG/SOG 129029: GNSS position	GPS antenna
Position	129026: COG/SOG 129029: GNSS position	GPS antenna
Turn	129026: COG/SOG 129029: GNSS position 129284: Nav data	Garmin chartplotter and GPS antenna

NMEA 2000 Trip Data

Data Type	PGN Data Required	Typical Sender
Odometer	129026: COG and SOG 129029: GNSS position data	GPS antenna
Trip odometer	129026: COG and SOG 129029: GNSS position data	GPS antenna
Average GPS speed	129026: COG and SOG 129029: GNSS position data	GPS antenna
Maximum GPS speed	129026: COG and SOG 129029: GNSS position data	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

NMEA 2000 Weather Data

Data Type	PGN Data Required	Typical Sender
Barometer	130310 and 130311: Environmental parameters (old) or 130314: Actual pressure	Barometric pressure sensor
Air temperature	130310 and 130311: Environmental parameters (old) 130312: Temperature (old) or 130316: Temperature, extended range	Air temperature sensor
Humidity	130311: Environmental parameters or 130313: Humidity	Humidity sensor
Wind speed	127250: Vessel heading 128259: Water speed 129026: COG/SOG 129029: GNSS position 130306: Wind data	A wind sensor, a water speed sensor, a heading sensor, and a GPS antenna
Wind speed (less-accurate[1])	129026: COG/SOG 129029: GNSS position 130306: Wind data	A wind sensor and a GPS Antenna
Wind speed (less-accurate[2])	127250: Vessel heading 128259: Water speed 130306: Wind data	A wind sensor, a water speed sensor, and a heading sensor
Wind direction	127250: Vessel heading 128259: Water speed 129026: COG/SOG 129029: GNSS position 130306: Wind data	A wind sensor, a water speed sensor, a heading sensor, and a GPS antenna
Wind direction (less-accurate[1])	129026: COG/SOG 129029: GNSS position 130306: Wind data	A wind sensor and a GPS Antenna
Wind direction (less-accurate[2])	127250: Vessel heading 128259: Water speed 130306: Wind data	A wind sensor, a water speed sensor, and a heading sensor
Cardinal wind direction	127250: Vessel heading 128259: Water speed 129026: COG/SOG 129029: GNSS position 130306: Wind data	A wind sensor, a water speed sensor, a heading sensor, and a GPS antenna
Cardinal wind direction (less-accurate[1])	129026: COG/SOG 129029: GNSS position	A wind sensor and a GPS Antenna

[1] If a heading sensor and water speed sensor are not present, a less-accurate reading can be calculated using only a wind sensor and GPS antenna.
[2] If a GPS antenna is not present, a less-accurate reading can be calculated using only a wind sensor, a water speed sensor, and a heading sensor.

Data Type	PGN Data Required	Typical Sender
	130306: Wind data	
Cardinal wind direction (less-accurate[1])	127250: Vessel heading 128259: Water speed 130306: Wind data	A wind sensor, a water speed sensor, and a heading sensor
Beaufort scale	127250: Vessel heading 128259: Water speed 129026: COG/SOG 129029: GNSS position 130306: Wind data	A wind sensor, a water speed sensor, a heading sensor, and a GPS antenna
Beaufort scale (less-accurate[2])	129026: COG/SOG 129029: GNSS position 130306: Wind data	A wind sensor and a GPS Antenna
Beaufort scale (less-accurate[1])	127250: Vessel heading 128259: Water speed 130306: Wind data	A wind sensor, a water speed sensor, and a heading sensor
Sunrise/sunset	129026: COG/SOG 29029: GNSS position	GPS antenna

[1] If a GPS antenna is not present, a less-accurate reading can be calculated using only a wind sensor, a water speed sensor, and a heading sensor.
[2] If a heading sensor and water speed sensor are not present, a less-accurate reading can be calculated using only a wind sensor and GPS antenna.

NMEA 2000 Sailing Data

Data Type	PGN Data Required	Typical Sender
Apparent wind speed	130306: Wind data	Wind sensor
Apparent wind angle	130306: Wind data	Wind sensor
True wind speed	128259: Water speed 130306: Wind data	Wind sensor and a water speed sensor
True wind speed (less-accurate[1])	129026: COG/SOG 129029: GNSS position 130306: Wind data	Wind sensor and a GPS antenna
True wind angle	128259: Water speed 130306: Wind data	Wind sensor and a water speed sensor
True wind angle (less-accurate[1])	129026: COG/SOG 129029: GNSS position 130306: Wind data	Wind sensor and a GPS antenna
Wind Velocity Made Good (VMG)	128259: Water speed 130306: Wind data	Wind sensor and a water speed sensor
Wind VMG (less-accurate[1])	129026: COG/SOG 129029: GNSS position 130306: Wind data	Wind sensor and a GPS antenna
Waypoint VMG	129284: Nav data	Garmin chartplotter and a GPS antenna
Maximum apparent wind speed	130306: Wind data	Wind sensor
Maximum true wind speed	128259: Water speed 130306: Wind data	Wind sensor and a water speed sensor
Maximum true wind speed (less-accurate[1])	129026: COG/SOG 129029: GNSS position 130306: Wind data	Wind sensor and a GPS antenna
Opposite tack heading	127250: Vessel heading 128259: Water speed 130306: Wind data	A wind sensor, a heading sensor, and a water speed sensor
Opposite tack heading (less-accurate[1])	129026: COG/SOG 129029: GNSS Position 127250: Vessel heading 130306: Wind data	A wind sensor, a heading sensor, and a GPS antenna

[1] If a water speed sensor is not present, a less-accurate reading can be calculated using a GPS antenna instead.

NMEA 2000 Water Data

Data Type	PGN Data Required	Typical Sender
Depth	128267: Water depth	Depth transducer
Temperature	130310: Environmental parameters (old) 130311: Environmental parameters 130312: Temperature	Water temperature sensor
Speed	128259 - Water speed	Water speed sensor
Set	127250: Vessel heading 128259: Water speed 129026: COG and SOG 129029: GNSS position data	A GPS antenna, a water speed sensor, and a heading sensor
Drift	127250 - Vessel heading 128259 - Water speed 129026 - COG/SOG 129029 - GNSS position	A GPS antenna, a water speed sensor, and a heading sensor

NMEA 2000 System Data

Data Type	PGN Data Required	Typical Sender
Time of day	129026: COG/SOG 129029: GNSS position data	GPS antenna
Date	129026 - COG/SOG 129029 - GNSS position data	GPS antenna