



Setup and Installation of NMEA 2000[®] Networks General Information


A NMEA 2000 network is a communication bus network developed by the National Marine Electronics Association (NMEA) for use in boats. Suzuki Marine has introduced a line of products that can communicate over a NMEA 2000 network, helping you get the most out of this technology.

This instruction sheet will show how a NMEA 2000 network is created, configured and installed.

Read the next few pages to become familiar with some of the following terms: NMEA 2000 Network/Suzuki Modular Instrument System (SMIS), NMEA 2000 Bus/Network Bus, Network Backbone, Network Nodes and Linear Architecture.

Important

WARNING / CAUTION / NOTE

Please read this manual and follow its instructions carefully. To emphasize special information, the symbol  and the words **WARNING**, **CAUTION** and **NOTE** have special meanings. Pay special attention to the messages highlighted by these signal words:

WARNING

Indicates a potential hazard that could result in death or injury.

CAUTION

Indicates a potential hazard that could result in boat or equipment damage.

NOTE: Indicates special information to make maintenance easier or instructions clearer.

NMEA 2000[®] Network or SMIS

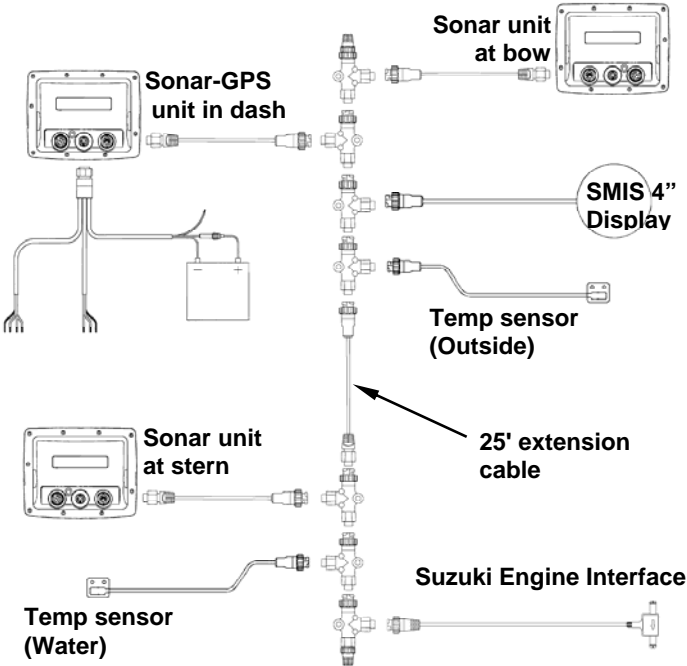
A NMEA 2000 network is a communications link between two or more devices that transfer NMEA 2000 information. **SMIS** is the NMEA 2000 networking system developed by Suzuki Marine. A NMEA 2000 network functions like the phone wiring in a house. If, for example, you pick up a phone in the living room you will be able to hear the conversation someone is having on a phone in the bedroom.

In similar fashion, a NMEA 2000 network allows multiple display units to receive data from a GPS antenna or multiple sonar units to receive messages sent by a temperature sensor. A NMEA 2000 network gives you the flexibility to view engine diagnostics and fuel level data on digital gauges or display units located anywhere on your boat.

If you have a **SMIS** display unit with a GPS module installed, you have a NMEA 2000 network. The connectors and cables that came with your GPS module function as a dedicated NMEA 2000 network, passing GPS data along the network to the GPS display unit. This is a simple form of a NMEA 2000 network.

On the other end of the scale is a large network bus. A network bus allows users to expand the network by adding multiple digital gauges, GPS and sonar display units, temperature sensors and water speed sensors as well as other NMEA 2000 devices.

The network could share information with a sonar-GPS combo unit mounted in the dash, a sonar-only unit mounted at the stern and another display unit mounted on the bow. In that scenario, all three display units attached to the bus would have access to information from every sensor attached to the network. That is the advantage of a NMEA 2000 network. A network configuration could look like the one in the following diagram.



NMEA 2000 network with three sonar or sonar-GPS combo display units, temperature information from temp sensors at two different locations and information from a Suzuki engine interface.

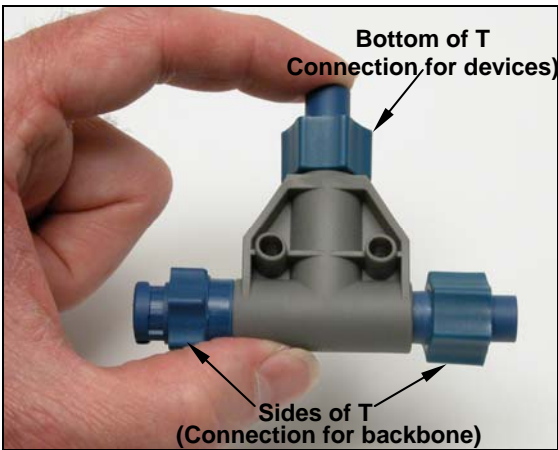
Every display unit, gauge or sensor attached to the network can communicate with all other devices on the network. Location, speed and tempera-

ture, however, are not the only kinds of information that can be shared. Fuel Remaining data along with engine information like fuel efficiency are among a large number of data options that may be shared on the network.

NOTE: Sonar returns from a transducer CANNOT be transmitted on a NMEA 2000 network, because a full sonar chart reading from a transducer takes too much bandwidth for the network. Every sonar display unit requires its own transducer. If, however, you have a sonar display unit (with sonar bottom lock) connected to the NMEA bus, it will share the digital depth with all display units on the network.

NMEA 2000 Bus or Network Bus

Technically, any physical cable used to transfer network information is a network bus, but in our documentation we use this term to refer to the standard manufacturer installation appearing in new boats. This network bus is an installed and operational network cable running the length of your boat, already connected to a power supply and properly terminated. It will provide access to network nodes at various locations around your boat.



This T connector allows you to add a device to your NMEA 2000 bus creating a network node.

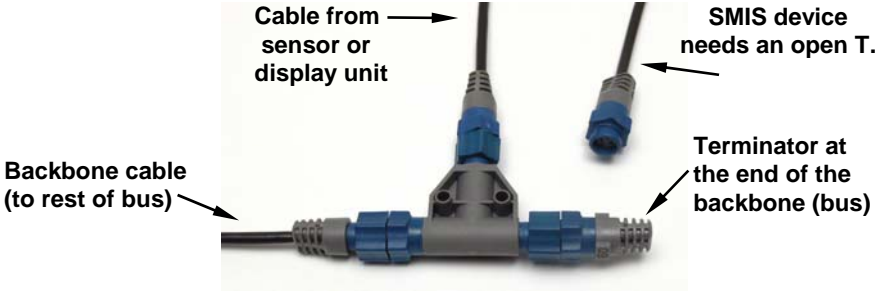
Network Backbone and Network Nodes

A network bus backbone consists of network cabling and T connectors. Network nodes are made by fitting T-shaped connectors into the backbone (using the sockets on the sides) and attaching any network device to the bottom of the T.

Staying with the previous phone wiring example, T connectors on the backbone are the equivalent of phone jacks spread throughout a house. To pick up a phone and be able to hear a conversation from another

phone in the house, both phones have to be connected to the main phone line. In similar fashion, only sensors and display units plugged into the NMEA network can share information. The network backbone is like the phone wiring that runs throughout a home.

It connects the network nodes, allowing them to communicate across the network. Connections found in the middle of the bus could have T connectors or backbone network cable plugged into one or both sides. Connections at the end of a network will have the backbone cable plugged into one side and a terminator plugged into the other, as shown in the following figure.



NMEA 2000 network node located at the end of a NMEA 2000 backbone.

All T connectors on your boat's network probably will be connected to a device. If you want to add another node to a working network, add another T connector. T connectors may be purchased from your local Suzuki Marine Dealer. If you are adding any other sensors you will need to order a T connector for each one.



Shown above is a "hard" T connector, which is used for connecting devices in a NMEA 2000 network.

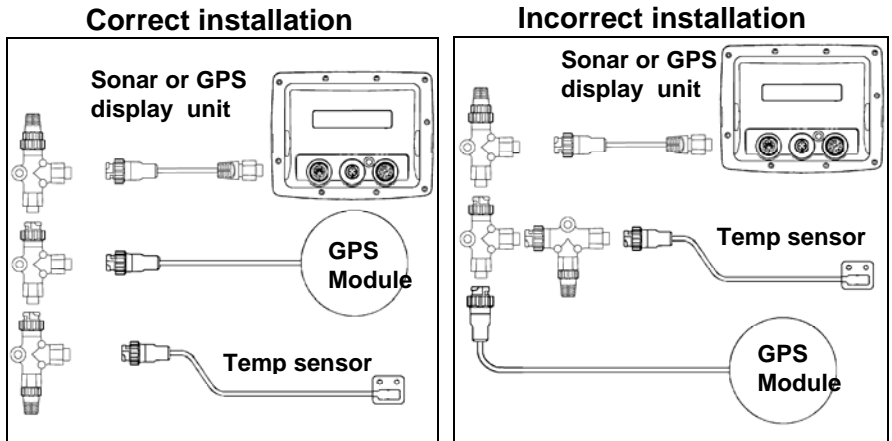
Linear Architecture

NMEA 2000 networks are constructed using a linear pattern. It is important linear architecture is maintained when the network is modified or a node is added to the network.

Linear architecture refers to way the network's nodes are connected to the network backbone. Note that every T connector has one female socket and two male sockets. This means you *could* connect it in two different ways. Using linear construction, the nodes will be connected side by

side, leaving the bottom of the T available for connection to a display unit or NMEA 2000 device, like the "Correct installation" figure on the bottom left. A network built following a linear construction is easier to maintain and expand. It also allows you to ensure the two terminators are at the *ends* of the backbone. If your installation does not follow a linear architecture, the network may not function.

You could use the recommended installation, plugging the sensor or display unit into the bottom of the T and the backbone cable into the side of the T. You *also* could plug the sensor or display unit into the side of the T and the backbone connection into the bottom of the T. The sockets would allow you to make that connection, but you would lose the linear construction. Both installations are detailed in the figures below.



Two possible network designs. The design on the left maintains a linear architecture while the one on the right does not. You should always maintain linear architecture when building a NMEA 2000 network.

Both network designs in these images contain the same set of components. Both networks are terminated and all of connectors are able to be connected to one another, but the installation on the left comes to a clear end with terminators on each end of the backbone. The non-linear installation on the right has no clear end, increasing the chance of an installation error. It also makes network expansion more difficult and could even prevent the network from functioning.

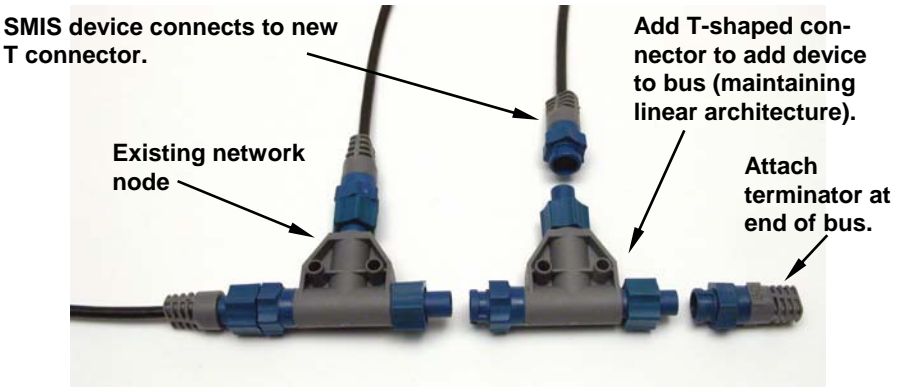
Always maintain linear architecture when modifying your network. Make sure display units or sensors are attached to the *bottom* of the T. Attach the sides of the T to backbone extension cables, terminators or

other T connectors – nothing else.

All network examples in this document show networks built with a linear architecture.

Adding a Network Node

You can add a node to any existing connection, anywhere along the network backbone. This connection could be between a T connector and a terminator, between two T connectors, between a T connector and a backbone extension cable or between two extension cables. Wherever you want to add the new node, separate the sockets of the existing connection and install the T connector between them.

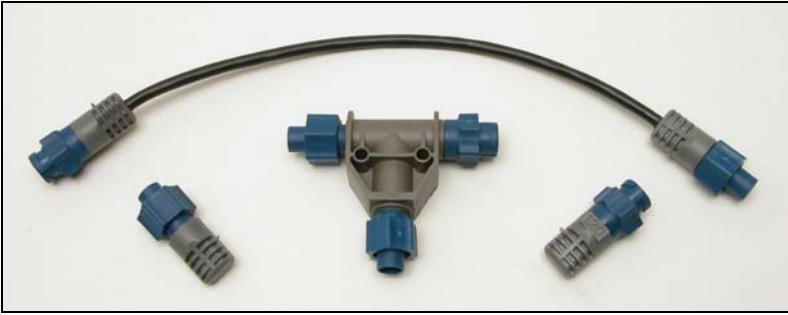


In this example, a new device is added to the NMEA 2000 bus by installing a T connector between a T connector and a terminator at the end of the backbone (network bus).

If you want to add a node at the end of the backbone (network bus) remove the terminator from the last connector, like the figure above. Install the new T connector, then attach the terminator to the side of the connector.

Adding an Extension Cable

Suzuki Genuine Accessories provides **SMIS** extension cables in various lengths, giving you the flexibility to match node installation to the desired location on your boat. Every extension cable has a male connector on one end and a female connector on the other allowing you to insert it anywhere on the network where there is an existing connection.



Pictured above is a 2 foot extension cable, T connectors, 120-ohm male terminator and 120-ohm female terminator.

You, for example, could have a cluster of T connectors at the bow of your boat with a 15' extension cable attached to the last T on the cluster. You could run the 15' extension cable to your boat's console, where another cluster of T connectors could be installed. Just like the first cluster of T connectors, the last T on the cluster at the console could be connected to another extension cable running to the stern of the boat, where another cluster of T connectors could be installed. ***To ensure communication, keep your network backbone to less than 300 feet (100 meters).***

You can also attach an extension cable between a device on the network and its connection point at the bottom of the T connector. That would allow you to position the device right where you want it. You, however, should never have more than 18' (about 6 meters) of cable between a device and its T connector.

Building a SMIS NMEA 2000 Network

In 2005, boat manufacturers (Original Equipment Manufacturers — OEMs) began installing NMEA 2000 networks as standard equipment on new boats. If your boat does not have an OEM-installed NMEA 2000 network, you will have to install your own or take it to a qualified NMEA 2000 technician to have one installed for you.

Power

For a NMEA 2000 network to operate, the bus must be connected to a switched power source (generally a switch on your boat's accessory panel). NMEA 2000 networks require 12 volts DC power regardless of the size of the network or the number of devices attached.

*NOTE: Your NMEA 2000 power cable must be connected to a switched power source to power the network, even if you have the simplest of network configurations — you still will have to connect the a NMEA 2000 **SMIS** Power cable to a switched power source in order to power the network.*

If your boat came with a NMEA 2000 bus installed, it should already be

connected to a switched power source that draws from the boat's battery. To confirm how the bus was installed, consult your boat dealer or manufacturer.

Always use a switched power source for your NMEA 2000 bus. Do not connect the NMEA 2000 Power cable directly to your boat's battery. You need to be able to turn the network's power on and off.

Many of the devices on the NMEA 2000 bus are drawing current whenever the network has power. They do not have their own on/off switches. In order to preserve your battery, you need to make sure your NMEA bus power supply can easily be switched on and off. Most installations connect the NMEA power cable to a switch on the boat's accessory panel.

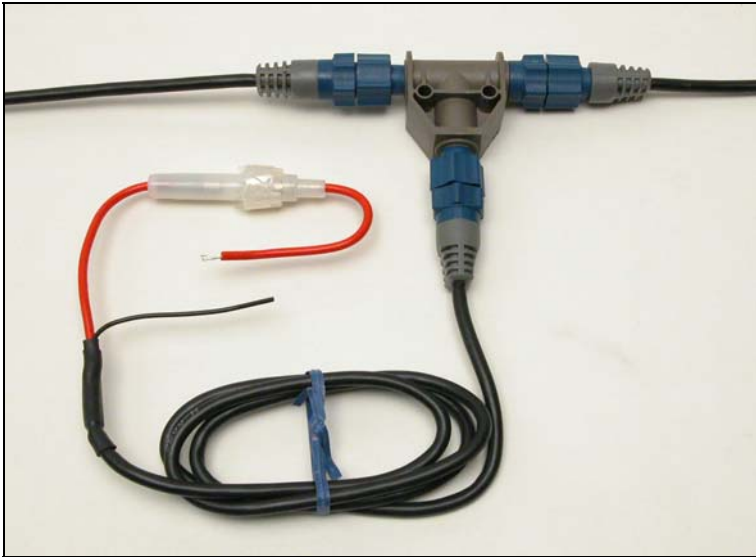
CAUTION

Never connect an additional power source to a NMEA 2000 bus that is already powered. A NMEA 2000 network should *never* be connected to more than one

If you are attaching a GPS display unit and a GPS module to a NMEA 2000 bus that is *already powered*, make sure you **DO NOT** connect the display unit's NMEA 2000 Power cable to another power source. Cap unused power wires with wire nuts or electrical tape.

Several sonar or GPS display units can be connected to a single network. If you do, remember — ***only one power connection should provide power to the network***. Even though all the display units on the network come with a NMEA 2000 Power cable you should only attach one of them. Cap the unused power wires with wire nuts or electrical tape.

Many manufacturer-installed networks use a Network Power cable. If your network already includes this power sources **DO NOT** connect the NMEA 2000 power cable of *any* of your GPS or sonar display units. Cap the unused power wires with wire nuts or electrical tape.



OEM factory installations typically use a Network Power Cable to supply power to the network bus. The red and black leads are connected to a switched power source, allowing the user to turn off power to the bus.

CAUTION

If you connect multiple power sources to a NMEA 2000 network you could cause severe damage to the network, attached devices and your boat!

Terminators

A NMEA 2000 network needs to be terminated with two 120-ohm terminators, for it to work properly. The most common and preferred setup uses two 120-ohm terminators – one at each end of the bus. 120 ohm terminators have 120 imprinted on the plastic grip. **Two 120 ohm terminators MUST be used if you intend to use three or more devices on the bus.**

The terminators provide resistance necessary for devices to communicate along the network. This communication takes the form of electrical pulses sent out by the device transmitting information. In order for the network to operate, you need 60-ohms of resistance to pull the network back to its recessive state after a signal, so the next pulse can be heard. Terminators (two 120-ohm terminators in parallel) are used to create this resistance. Attach one at each end of the backbone.

NOTE: NEVER attach a terminator to an NMEA 2000 network bus that has already been terminated.

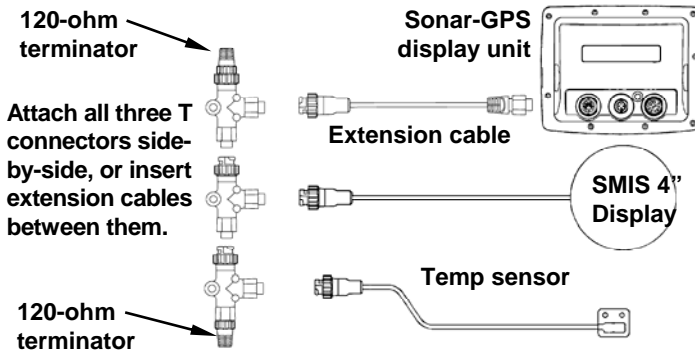
Setting up a Network

Suzuki Marine provides all the cables you will need to create a NMEA 2000 network and provides T connectors and extension cables so you can add devices along the backbone wherever you want. Once you have a working network, every sensor will need a T connector for easy expansion.

Adding a New Device to a Working Network Bus

Once your boat has a working NMEA 2000 bus, you no longer will have to be concerned about power or terminators or configuring cables. Install additional T connectors as described earlier and connect your **SMIS** devices to the network.

Another option for expanding a network would be adding a network node with a NMEA 2000 temp sensor & SMIS 4" Display. Then your sonar-GPS display unit would provide the GPS signal from for speed readings and the temperature information from the temp sensor would all be displayed on the SMIS 4" display head unit..



SMIS NMEA 2000 network with 4" display head unit, Sonar/GPS unit and temp sensor.

You can continue expanding your network by adding new network nodes.

Connecting to a non-SMIS Network

Some boats will come with a manufacturer-installed NMEA 2000 network that does not use **SMIS** T connectors. Many of these networks will use the DeviceNet Micro T connector shown in the following image.



The Micro-C T connector used in some NMEA-2000 buses.

For your convenience Suzuki Genuine Accessories offers a Bus Adapter Cable (below) to connect **SMIS** products to Micro-C T connectors.

**To NMEA 2000
network port**



**To SMIS Network
T connector**

Micro-C to SMIS male converter.

With this adapter cable, you can connect the Micro-C plug (left end of cable) to an available network node on your boat's NMEA 2000 bus. The **SMIS** plug (right end of cable) connects to a **SMIS** display unit or NMEA 2000/**SMIS** sensor.

Looking Ahead

The NMEA 2000 communication standard is not a new concept. It was developed to replace the old standard NMEA 0183. NMEA 0183 developed over a period of many years and changed dramatically during that time. The development was so drastic that some of the older NMEA 0183 devices (NMEA 0183 ver. 1) are no longer compatible with NMEA 0183 devices developed recently (NMEA 0183 ver. 3).

NMEA 2000 devices WILL NOT communicate with NMEA 0183 devices.

In order to prevent something similar happening again, NMEA adopted a new standard, NMEA 2000, a radical departure from the old NMEA 0183. NMEA 2000 was planned to be a consistent system capable of incorporating future growth.

One of the major benefits of NMEA 2000 is the connection to engines capable of reporting detailed operation information along the network.

