



Setup and Configuration Options of **NMEA 2000 Networks** **General Information**

NMEA 2000 is a new buss network specifically designed for boats. This is a very young industry standard recently developed by the National Marine Electronics Association. At the time of printing, few boats being built now have a NMEA 2000 buss installed. Over the next few years, however, NMEA 2000 will become much more common. To help you get the most out of this technology, Lowrance has introduced a line of products (the blue connector units) that can communicate over a NMEA 2000 network.

In the following pages, we'll explain to you the basics of what it takes to make a NMEA 2000 network work, how to use one to connect your Lowrance and LEI products, and provide some tips on configuring and using the operational network.

Terminology

There are several key phrases you'll need to know before we can explain how the NMEA 2000 system works. Some of these are technical terms, some of them are names taken from the NMEA 2000 standard, and some of them are our own names, developed for clarity. All of them will help you understand what we're saying.

"NMEA 2000 Network"

When we talk about the "NMEA 2000 network," we're talking about the communications link between two or more units that transfer NMEA 2000 information. Think of this like a computer network, or even like the phone wiring in your house. If you pick up a phone in your living room, you can hear someone talking into the phone in the bedroom.

Well, a NMEA 2000 network is a way to let more than one GPS unit "listen in" on the GPS antenna's conversation, or to let more than one sonar unit overhear the messages being sent by a temperature sensor.

If you have a Lowrance GPS unit with an LGC-2000 GPS module installed, then its Y-adapter extension cable actually functions as a dedi-

cated NMEA 2000 network, passing GPS signal information along the network (that is, the extension cable) to the GPS unit. This is a very limited application of the term "network."

The other end of the scale is a network buss (described in the following segment) built into your boat, with ports at intervals allowing you to connect several GPS or sonar units, temperature or water speed sensors, or any other NMEA 2000 device.

Such a network could, for example, host the temperature readings from two different sensors (one at the water surface, and another in your live well) as well as the reading from a paddlewheel speed sensor on the transom *and* the GPS signal from an LGC-2000. The network would then share all of this information with a sonar-GPS combo unit mounted in the dash, and with a smaller sonar-only unit at the stern and another up on the bow by your trolling motor. All three units would have access to all of the sensor information from every accessory attached to the network...as long as all of the units are also attached to it.

That is the power of a NMEA 2000 network. Every unit or sensor attached to the network communicates with all the others. Of course, location, speed and temperature are not the only kinds of information that can be shared. As more and more manufacturers produce NMEA 2000-ready products, the network will be able to share the amount of fuel remaining in your tanks, detailed engine information such as oil pressure and fuel efficiency, and much more.

NOTE:

You probably noticed there's no transducer mentioned in that list (or anywhere else in this document). The sonar signal from a transducer is far too powerful for a NMEA 2000 network, so sonar readings *cannot* be shared. Every sonar unit requires its own transducer to make sonar readings.

"NMEA 2000 Buss" or "Network Buss"

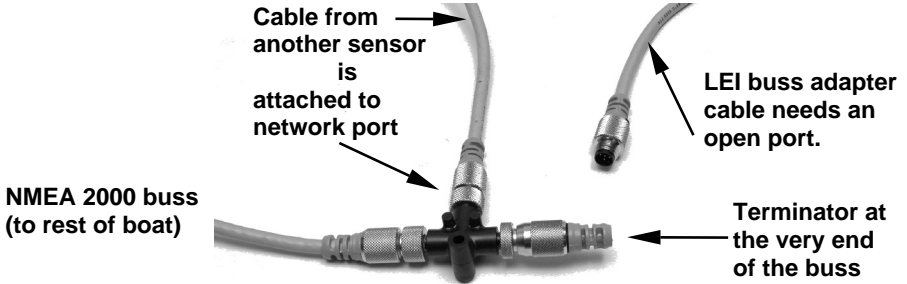
Technically, any physical cable properly installed and used to transfer network information is a "network buss," but in our documentation we use this term to refer to the standard manufacturer installation appearing in new boats. This "network buss" is an installed and operational network cable running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

"Network Ports"

Network ports are connectors built into the network cable that allow you to attach units or sensors to the network. If we stick with our earlier ex-

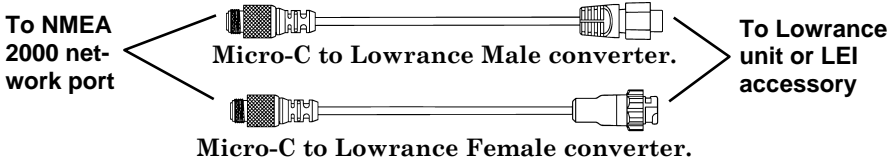
ample, network ports are the equivalent of phone jacks spread throughout your boat, and only units plugged into them can communicate.

On the typical NMEA 2000 buss, network ports are T-shaped Micro-C connectors. Connectors found in the middle of the buss (near your dash, for instance) will have one or more of these T-shaped connectors with the network cable plugged into both sides. Connectors at the end of the buss will have the network cable plugged into one side, and a small terminator plugged into the other, as shown in the following figure.



NMEA 2000 network port located at the end of a NMEA 2000 buss.

Of course, the NMEA 2000 standard Micro-C connector is different from the connectors we use for our units, so you'll need a NMEA 2000 Buss Adapter Cable to connect a Lowrance or LEI product to a NMEA 2000 buss. This adapter cable may be either of the following types:



With either adapter cable you can connect the Micro-C plug (shown left in these figures) to an available network port on your boat's NMEA 2000 buss. The Lowrance plug (shown right) connects to your unit or sensor.

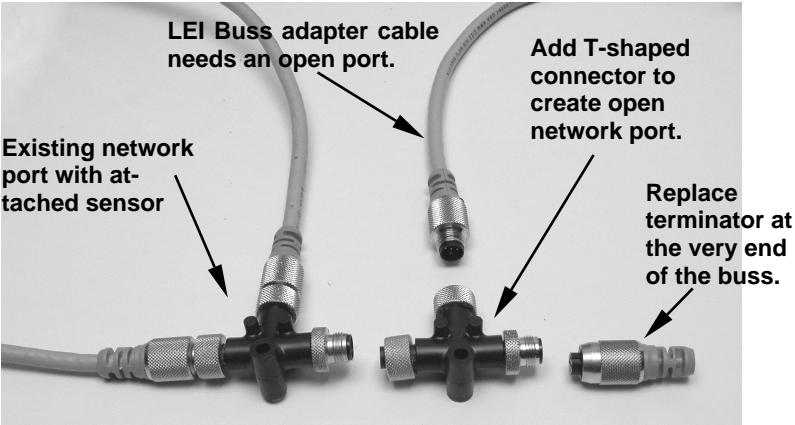
All of the ports on your boat's network will probably be filled, but if you want to add something to it, just order a buss adapter cable and a Micro-C T-shaped connector from LEI (ordering information appears on the back page of this booklet).



This T-shaped connector adds a port to your NMEA 2000 buss.

You can add a port anywhere your network buss has T-shaped connectors. If you want to add one in the middle of the line, then separate the network cable from one end of the attached T-shaped connectors, and attach your new T-shaped connector between them and the network cable.

If you want to add a port at the end of the line (as shown in the following figure), remove the terminator from the very last connector, securely attach the new T-shaped connector, and then replace the terminator on the new connector. Either method will leave one new port available.



Add an empty network port to a NMEA 2000 buss by attaching a T-shaped connector between two full ports, or between a port and the terminator at the end of the line.

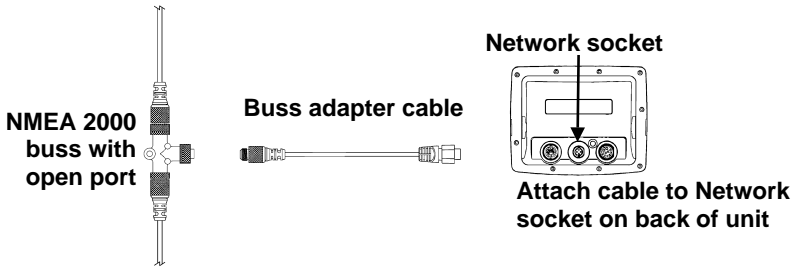
Connecting to a Working Network Buss

If your boat already has a NMEA 2000 buss installed, you don't have to worry about power or terminators or configuring cables. Just install additional network ports as described in the last section, and connect your Lowrance or LEI devices to the network using the LEI NMEA buss adapter cables, as described in the following section.

Remember that there are two types of NMEA buss adapter cable: the Micro-C to Lowrance Male converter, and Micro-C to Lowrance Female.

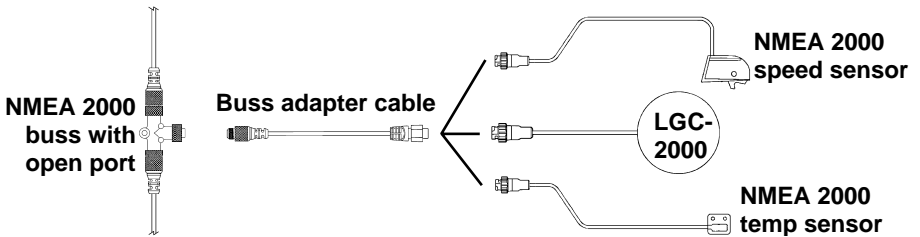
Connecting Lowrance Male Plug to Unit or Sensor

Most installations will use the Lowrance Male to Micro-C converter to connect a Lowrance or LEI product directly to a network port. To connect a sonar or GPS or sonar/GPS combo unit directly to a NMEA 2000 network, attach the adapter cable's Lowrance Male plug to the Network socket on the back of the unit.



Use the buss adapter cable to connect a Lowrance unit to a network port.

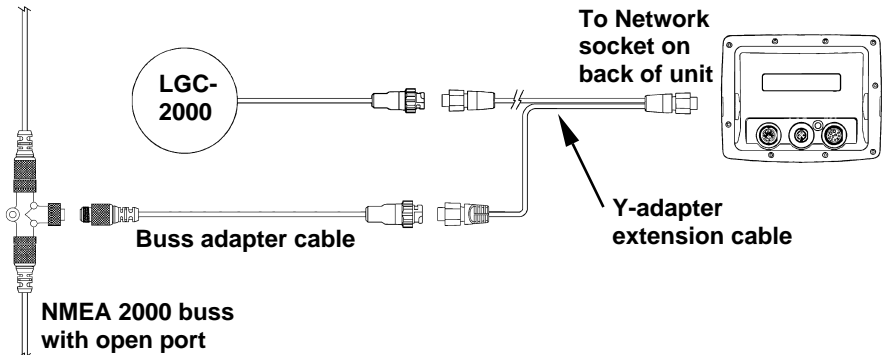
To connect an LEI sensor or GPS module directly to the network, attach the accessory's blue connector to the adapter cable's Lowrance Male plug.



Use the buss adapter cable to connect any NMEA 2000-ready LEI or Lowrance accessory to a network port

Connecting Lowrance Female Plug to Extension Cable

With the LGC-2000 GPS module, we provide a Y-adapter extension cable that allows you to connect both the GPS unit and the GPS module to a single NMEA 2000 network port. This installation requires the Micro-C to Lowrance *Female* converter. Connect the GPS module to the unit using the extension cable as described in the unit's manual.



LGC-2000 and GPS unit connection to NMEA 2000 buss.

The GPS module's extension cable will have a 60-ohm terminator attached to the shorter branch. Remove the terminator and connect the buss adapter cable's Lowrance Female plug to the extension cable's shorter branch.

If you do this, be sure the unit's NMEA 2000 Power cable *is not* connected to your boat's power supply. **Never connect another power source to an operational NMEA 2000 buss.** If it's working, it's already powered, and a NMEA 2000 network should *never* be connected to more than one power source.

NOTE:

Keep the terminator! If you ever disconnect the NMEA 2000 network connection, you'll have to re-attach the terminator in order for the GPS module to function correctly.

Making a Lowrance NMEA 2000 Network Work

As we said before, few boats being built now (spring, 2004) come with network busses installed, and if you've had your boat for a year or two, you almost certainly don't have a network buss in it. But don't let that stop you! You can install your own Lowrance NMEA 2000 network using cables provided by LEI.

For those of us who *aren't* electricians, the principles involved in getting a NMEA 2000 network functioning are pretty complicated. However, *making it work* isn't quite the same thing as understanding the principles involved. If you can grasp a few essential concepts, you can configure your NMEA 2000 network to do what you need it to do, and keep it running properly.

Power

In order for a NMEA 2000 network to operate, the cable must be connected to a power source. NMEA 2000 networks require 12 volts DC power. If your boat came with a NMEA 2000 buss, it's probably connected directly to the boat's battery.

- No matter how large or small the network, no matter how many devices are sharing information along it, a NMEA 2000 network *must* be connected to a power source to operate.

So if you're only running a unit and an LGC-2000 on the Y-adapter extension cable, you'll still have to connect the unit's NMEA 2000 Power cable to your boat's battery in order to power the dedicated network.

- **Never connect a power source to an operational NMEA 2000 buss.** If it's working, it's already powered, and a NMEA 2000 network should *never* be connected to more than one power source.

So if you're attaching a GPS unit and an LGC-2000 to an operational NMEA 2000 buss (using the Micro-C to Lowrance Female converter), make sure you *do not* connect the unit's NMEA 2000 Power cable to your boat's battery.

All blue connector Lowrance units come packed with a power/data cable that includes wires to power a NMEA 2000 buss. As we said before, if you're connecting just a unit and an LGC-2000 using the Y-adapter extension cable, this counts as a small dedicated network and you'll have to attach both the unit's power cable and the unit's NMEA 2000 power cable to your boat's battery.

However, it's possible to hook up *several* sonar or GPS units to a single network (that's sort of the point). If you do, remember that ***only one unit should provide power to the network!*** Even though all the units on the network come with a NMEA 2000 Power cable, you should only attach one of them. If you connect multiple power sources to a NMEA 2000 network, you could over current the cable and possibly even cause a fire!

Terminators

A NMEA 2000 network is an electrical circuit set up in parallel.

- In order for it to work properly, the circuit needs to be terminated with a 60-ohm terminator (or, in some cases, two 120-ohm terminators – we'll explain that later).

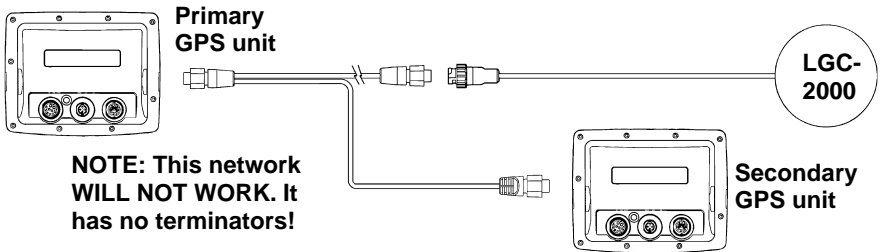
If you have an LGC-2000, you've probably seen the small plug connected to the short branch of the Y-adapter extension cable. This is the 60-ohm terminator for the extension cable's dedicated network. If your boat came with an installed NMEA 2000 buss, that buss also has a terminator or terminators attached.

The terminators provide resistance necessary for units to communicate along the network. This communication takes the form of electrical pulses sent out by the unit transmitting information. In order for the network to operate, you need 60-ohms of resistance to pull the network back to its baseline state after a signal, so the next pulse can be heard. We use terminators (either one 60-ohm terminator or two 120-ohm terminators in parallel) to create this resistance.

- **Never attach terminators to an operational NMEA 2000 network buss.** If it's working, it's already terminated.
- If you are using two 120-ohm terminators, it's best to connect them to sockets on the network as far from *each other* as possible.

There are several ways to set up your NMEA 2000 network, and we'll explain them in the following pages. However, before we start, you need to understand the necessity of terminators. In order for it to work, a NMEA 2000 network *must* have either **one** 60-ohm terminator or **two** 120-ohm terminators. How do you decide which option to use? We'll answer that question in the next section. For now, just remember that you *must* have a terminated network.

Let's imagine you've got two GPS units on your boat, and you want them both to receive signal information from one GPS antenna. You can't simply disconnect the 60-ohm terminator from the Y-adaptor and connect the second unit (shown in the following figure).



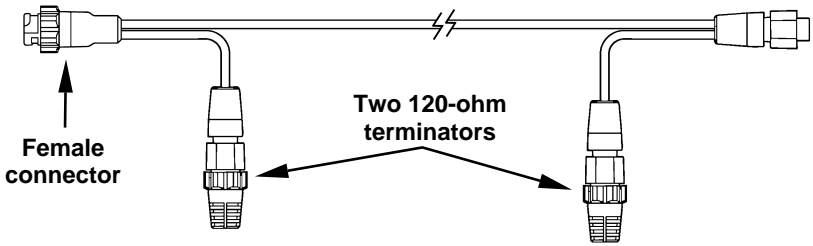
A NMEA 2000 network without terminators like the one shown *will not work*. The GPS unit cannot receive data on an unterminated buss.

This configuration *will not work*. Remember, a NMEA 2000 network *must* have either **one** 60-ohm terminator or **two** 120-ohm terminators. The network in the previous image has no terminators attached, so it won't work at all. Both GPS units would show the warning "GPS module not responding."

Since there's not an available socket for the second GPS unit, you'll need to use a network expansion cable to increase your options.

Expanding the Network

If you're using cables provided by Lowrance or LEI to establish your NMEA 2000 network, we also provide network expansion cables. These 25-foot (7.62 meters) cables have Y-adaptors at both ends. They come packed with two 120-ohm terminators.



LEI NMEA 2000 Network Expansion Cable

When you plug an expansion cable into a Lowrance NMEA 2000 network, you can either move the 60-ohm terminator onto the expansion cable, or replace it with the two 120-ohm terminators in parallel. Choosing which option to use is simple. Just remember, the NMEA 2000 buss is *powered*, so any empty plugs on the buss are exposed power sources.

WARNING:

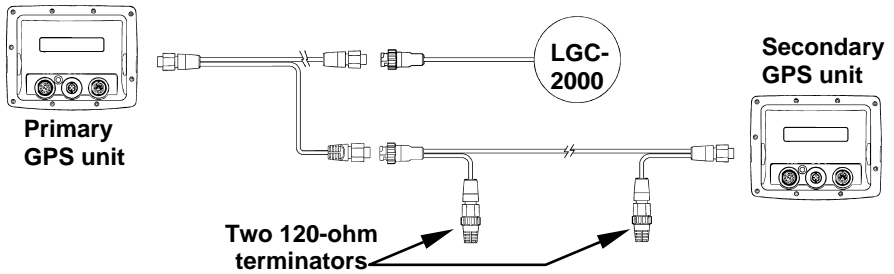
An exposed power source presents a high risk of electrical short, which can cause damage to your network or boat, or even personal injury.

So, to *avoid* leaving an exposed power source, we provide you with two options that should cover any scenario. Follow this rule:

- **Always make sure your NMEA 2000 network has all of its plugs attached to *something*.**

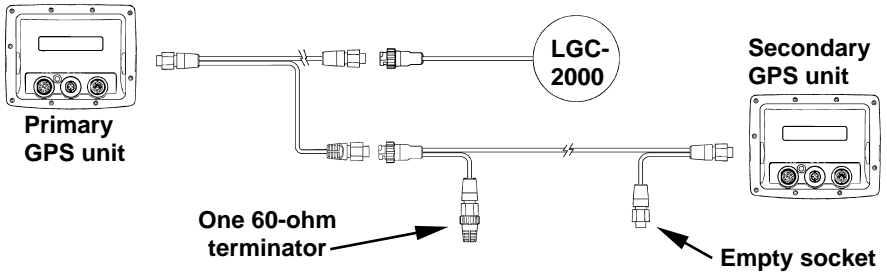
We'll return to the example we used before. You've got two GPS display units on your boat, and you want them both to receive signal information from one GPS receiver. You know you can't simply disconnect the 60-ohm terminator from the Y-adaptor and connect the second unit, because then you'd have no terminator. Instead, disconnect the 60-ohm terminator and connect an LEI NMEA 2000 network expansion cable (as shown in the following figures).

Figure 1



Lowrance NMEA 2000 expanded network with two 120-ohm terminators.

Figure 2



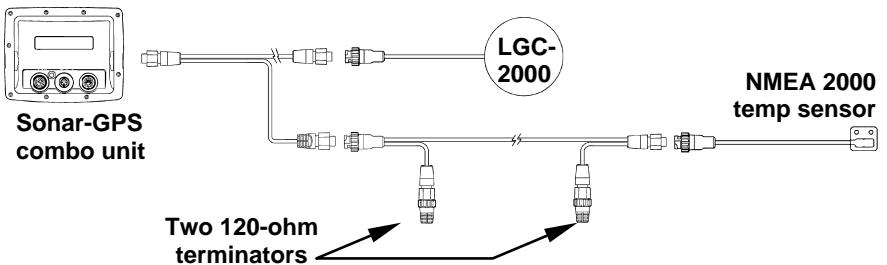
Lowrance NMEA 2000 expanded network with one 60-ohm terminator.

Either of these configurations will work. As long as one of the units (and *only* one of them) has the NMEA 2000 Power cable connected to a power source, the LGC-2000 will operate, and both units will receive position information from it along the network.

However, as shown in Figure 2, using one 60-ohm terminator leaves an empty, powered socket. To avoid this situation, we recommend the configuration in Figure 1. Remember, you can use either *one* 60-ohm terminator or *two* 120-ohm terminators, but always make sure every plug on the network is attached to *something*.

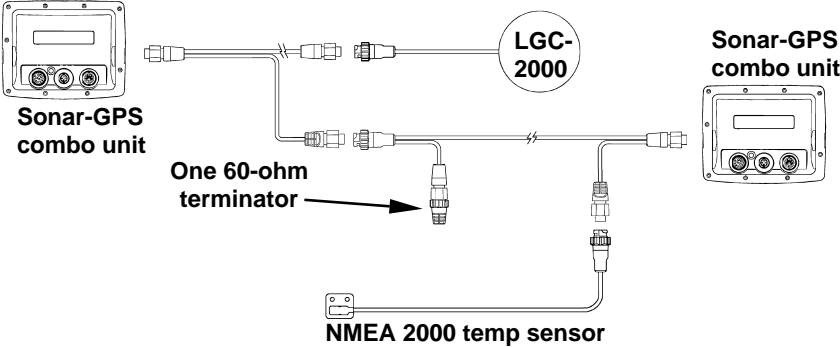
In this example, your network would be set up with two different GPS units (or sonar-GPS combo units, or one of each) both receiving GPS signal information from the LGC-2000.

If you wanted, instead of a secondary GPS unit, you could have the extra network port attached to a NMEA 2000 temp sensor. Then your sonar-GPS combo unit would receive both the GPS signal from the LGC-2000 and the temperature information from the temp sensor.



Lowrance NMEA 2000 network with unit, GPS module and temp sensor.

Or you could connect *two* sonar-GPS combo units to the network, and also attach an LGC-2000 *and* a temp sensor. To do that, we use the same cable configuration, but replace the two 120-ohm terminators with one 60-ohm terminator (as shown in Figure 2 earlier) and attach the empty socket to a temp sensor.



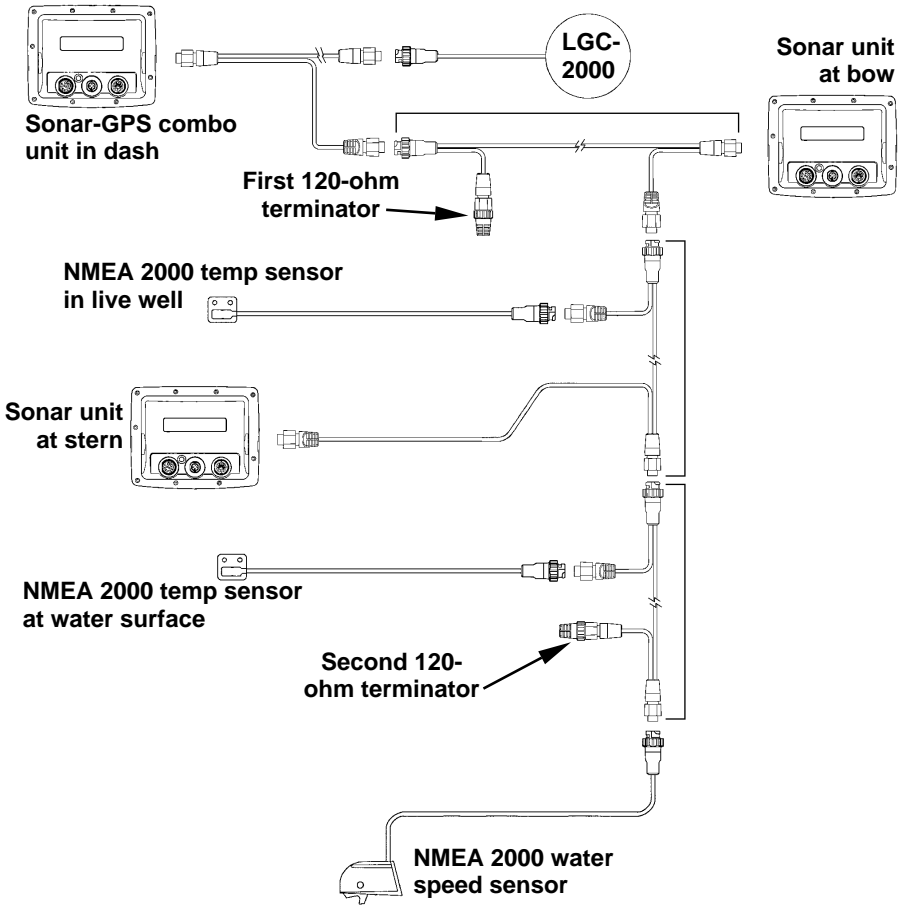
Lowrance NMEA 2000 network with two sonar-GPS units, a GPS module and temp sensor.

When attaching terminators, you can *only* use either *one* 60-ohm terminator or *two* 120-ohm terminators. So if you have a full network using two 120-ohm terminators and you want to add one more sensor, just remove *both* terminators, attach the sensor to one socket and the 60-ohm terminator to the other.

If you wanted to add another port beyond that, you'd have to buy a new network expansion cable, and switch *back* to two 120-ohm terminators. That would leave you with one empty port on your network.

You can continue expanding with network expansion cables until your network contains everything you want to include. The following figure shows the extensive example network we described in the introduction to this booklet.

In addition to all the units and sensors, you'll notice it includes two 120-ohm terminators, and three network expansion cables. There's virtually no limit to the expansion possibilities, but we do recommend you keep your network to less than about 300 feet (about 100 meters) of cable.



Extensive NMEA 2000 network using LEI cables. Shown: Three sonar or sonar-GPS combo units, each receiving position information from the LGC-2000, temperature information from temp sensors at two different locations, and water speed from the paddlewheel speed sensor.

Looking Ahead

As you probably know, the NMEA 2000 communication standard is not a new concept. It was developed to replace the old standard, NMEA 0183. In fact, you might own some Lowrance products that communicate using that standard.

NMEA 0183 developed over a period of many years, and it changed dramatically over that time. So dramatically, in fact, that NMEA 0183 devices developed in the early days of the standard (NMEA 0183 ver. 1) are no longer compatible with NMEA 0183 devices developed recently (NMEA 0183 ver. 3).

In order to correct this, and to prevent something similar happening again, NMEA decided to adopt a new standard, NMEA 2000, which is a radical departure from the old NMEA 0183. NMEA 2000 devices won't necessarily communicate with NMEA 0183 devices – they aren't supposed to. Rather, NMEA 2000 is planned from the beginning to be a consistent system capable of incorporating future growth.

As we said in the introduction, not all of this functionality is available yet. Boats with a built-in NMEA 2000 buss are just now starting to appear on the market, and many of the sensors and other products that will provide information to the network are still being developed by many companies, including Lowrance. However, NMEA 2000 *is* the industry's adopted standard, and with all the power and versatility it offers, you can expect to see a lot of growth quickly.

We mentioned engines capable of reporting detailed operation information along the network. This is one of the major benefits of NMEA 2000 and it's being heavily pursued. But, like many aspects of the new technology, it's still in development. We expect by mid-2006 most engine manufacturers will be providing NMEA 2000-ready engines.

Unfortunately, the interfaces of these systems still in development may not be standard. While we're working with some manufacturers to ensure our units can report the information their engines are transmitting, some other devices may not be able to display correctly on our units right away.

But we are dedicated to helping you get the most out of this technology. Remember that Lowrance often offers free software updates for their units on the website, www.lowrance.com. As NMEA 2000 technology evolves, you can count on Lowrance and LEI to change with it, constantly developing to help you get the most possible from your products.

Notes

Notes

How to Obtain Service...

...in the USA:

Contact the Factory Customer Service Department. Call toll-free:

For Lowrance: 800-324-1356. For Eagle: 800-324-1354

8 a.m. to 5 p.m. Central Standard Time, M-F

Lowrance Electronics and Eagle Electronics may find it necessary to change or end their shipping policies, regulations and special offers at any time. They reserve the right to do so without notice.

...in Canada:

Contact the Factory Customer Service Department. Call toll-free:

800-661-3983

905-629-1614 (not toll-free)

8 a.m. to 5 p.m. Eastern Standard Time, M-F

...outside Canada and the USA:

Contact the dealer in the country where you purchased your unit. To locate a dealer near you, see the instructions in paragraph number 1 below.

Accessory Ordering Information

LEI Extras™, Inc. is the accessory source for sonar and GPS products manufactured by Lowrance Electronics and Eagle Electronics. To order Lowrance or Eagle accessories, please contact:

1) Your local marine dealer or consumer electronics store. To locate a Lowrance dealer, visit the web site, www.lowrance.com, and look for the Dealer Locator. To locate an Eagle dealer, visit the web site, www.eaglesonar.com, and look for the Dealer Locator. Or, consult your telephone directory for listings.

2) U.S. customers: LEI Extras Inc., PO Box 129, Catoosa, OK 74015-0129
Call toll free in the U.S., 800-324-0045, 8 a.m. to 5 p.m. Central Standard Time, M-F, or visit our web site www.lei-extras.com.

3) Canadian customers: Lowrance/Eagle Canada, 919 Matheson Blvd. E. Mississauga, Ontario L4W2R7 or fax 905-629-3118.

Call toll free in Canada, 800-661-3983, or dial 905 629-1614 (not toll free), 8 a.m. to 5 p.m. Eastern Standard Time, M-F.



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