Actisense NDC-2-C NMEA Data Combiner User Manual

NMEA Data Combiner
NDC-2-C
Install User Manual
Issue 2.35

- Multiple talker interface for use with the NMEA 0183 standard for serial-data networking of marine electronic devices/instruments
- Personal computer (RS232) interface to NMEA 0183
- Advanced NMEA 0183 filtering and priority levels to fully control the flow of NMEA 0183 data

Important Notices

The Actisense™ NMEA Data Combiner (NDC-2) is intended for use in a marine environment, primarily for below-deck use. If the unit is to be used in a more severe environment, such use may be considered misuse under the seller's warranty.

The Actisense™ NMEA Data Combiner (NDC-2) has been certified to comply with the European directive for ElectroMagnetic Compatibility (EN60945), and is appropriately CE marked. The operation of the unit should be in conjunction with appropriate CE-approved shielded connectors and cabling used in accordance with the CE directive EN60945. Any EMC-related issues should be reported to Active Research immediately to allow the company to rectify or resolve EMC-related problems in accordance with its obligations under EN60945.

If the unit is connected such that compliance failure occurs beyond the company's control, the company shall not be held responsible for compliance failure until suitable EMC guidelines for connection are seen to have been taken.

Notices
When using this document, keep the following in mind:
The products described in this manual and the specifications thereof may be changed without prior notice. To obtain up-to-date information and/or specifications, contact Active Research Limited or visit the Actisense™

website (www.actisense.com).

Active Research Limited will not be liable for infringement of copyright, industrial property rights, or other rights of a third party caused by the use of information or drawings described in this manual.

Active Research Limited will not be held responsible for any damage to the user that may result from accidents or any other reasons during the operation of the user's unit according to this document.

The NDC-2 does not validate the NMEA data it receives in any way. Neither the NMEA sentence checksum nor the data contained within the NMEA sentence is validated.
Therefore, the electronic device(s) supplying the NDC2 with NMEA data retains the sole responsibility for the NMEA data's validity.

Foreword
Actisense™ recognizes that instructions are often skipped, so we have aimed to write this document in an informative, yet direct manner that will aid the user. We have tried to cover all the points a typical user may need to know. Please read all sections before installing and using the Actisense™ NMEA Data Combiner product and any related software programs.

Contents

Introduction

The Actisense™ NMEA Data Combiner (NDC-2) product was developed out of the requirement to solve two fundamental problems with the existing marine industry NMEA 0183 communications standard.

In theory, the NMEA 0183 standard allows any suitably designed marine electronic device to share its gathered information with any other device on a vessel. Unfortunately, there is one very large drawback with this standard – only one device on a connected network can actually send data (a single talker), with multiple devices (determined by the current limit of the sending unit) listening to that data (multiple listeners).

If the vessel owner has an instrument that ideally requires the data output of two or more devices, for example, a chart plotter, then the owner has no alternative but to settle on connecting only the most important device (that which supplies the most used information), normally that is the GPS unit. All other devices cannot be used.
What happens if the owner prefers the vessel's gyrocompass heading output to that of the GPS, or requires that the current depth be displayed on the plotted chart to help avoid the possible case of running the vessel aground

on a shifting sand bank? The NMEA 0183 standard cannot supply an answer to those questions as it can handle only **one transmitting device.**

These two elementary problems can be solved simply and easily with the Actisense™ NMEA Data Combiner's very flexible design approach. In this way, all NMEA 0183 devices can share their information with each other (multiple talkers – multiple listeners).
Alternately, if the vessel has two or more identical NMEA devices (e.g. GPS's or depth sounders) the system solution could be to use the Actisense™ NMEA Autoswitch.
Full information on the complete Actisense™ product range can be found on the Actisense™ website.

General features

4 NMEA 0183 data input ports
Each NMEA 0183 input port has an "Inclusion List" that details all the NMEA sentences that are allowed to pass through the NMEA Data Combiner (NDC-2) and out on the combined NMEA 0183 output. This allows the NDC-2 to filter out all unwanted NMEA data and so reduce the loading on the NMEA combined output.

Each NMEA 0183 input port also has a priority level. This is set by default to the logical order that matches the port numbers, i.e. port 1 has the highest priority and port 4 the lowest priority.

An NMEA 0183 data combined output port
This output combines the input data into one standard NMEA output. The inputs and the output have the same baud rate. This means that the output can only carry as much data as one of the inputs – therefore, the combined data from all four NMEA input channels could exceed the data-carrying capacity of the NMEA output channel. Then the output channel is overloaded, new data of the same type as older data, still in the buffer, will overwrite the older sentence. This will only happen when the output load becomes too high and ensures that the combiner cannot build up excess old data in the case where the output stream is fully loaded or overloaded.

A PC compatible RS232 bi-directional port
A PC can use the RS232 port to read all the NMEA data traversing through the NDC. This allows for the possibility of a "virtual cockpit" of instruments displaying all available data in any manner the user requires (available from a number of manufacturers).
All the above ports are re-configurable and offer various Baud rates to improve device connection compatibility with other NMEA 0183 instruments.

Software updates

The NDC-2's built-in software is held in "flash" memory and can be quickly and easily updated / "flashed" by using the simple Windows (98/ME/NT/2000/XP) user interface program (Flash Centre), running on a connected PC.
It is our policy to provide these updates free on our website, **www.actisense.com**, so that your combiner can become more sophisticated with time, and should there be any bugs reported in the software, they can be promptly fixed without the unit coming out of commission. This upgrade can be performed with the unit completely in-situ, via a PC connected to the RS232 port.

Technical features

16-bit high-speed micro-controller capable of 8 million instructions per second.
Flash ROM technology that supports automatic programming for quick and easy updates, 10,000 erase cycles and a 10-year Data Retention provides carefree user configuration.
On-board memory store allows buffering of short-term NMEA data, allowing the unit to smooth short-term peaks in the NMEA data flow.

NMEA 0183 inputs are opto-isolated differential inputs to fully comply with the NMEA 0183 standard specification. This allows the inputs to work correctly with long cable runs and in a noisy environment. The typical

operating voltage is 2.0V to 15V. The unit can withstand +/- 35V continuously, and +/- 40V transients. The optoisolators can protect any upstream equipment (chart plotter / PC / radar etc.) from up to 2000V of the common-mode voltage difference.

NMEA 0183 full-differential output driver. This can drive up to 15 typical NMEA 0183 device loads, with a 30mA (maximum) drive capability. The full-differential output ensures better quality communications and lower noise emissions on unshielded twisted pair cabling.

Full specification RS232 interface ensures that any marine electronic device (or PC) that has an RS232 port receives all the input NMEA data, and can add its own NMEA data to the combined output. This connection also allows the unit to be updated via the free flash upgrade software (Flash Centre) that will be made available on the Actisense™ website if the NDC-2 software has been enhanced in any way.

Low Power Consumption is typically 100-110mA at 12 volts and 50-60mA at 24 volts.

A diagnostic LED indicates the mode of operation of the NDC-2 if any faults have been detected, or the peak load currently on any one of the NMEA inputs.

The very tough Polycarbonate case is certified to IP66 (classified as “totally protected against dust and protection against low-pressure jets of water from all directions”). Being Polycarbonate, it is also incredibly strong, offering a wide temperature range and superior protection to the electronics inside. The IP66 rating of the case is only limited by the sealing gasket strip, which can be enhanced by applying a suitable non-acid-based marine sealant to the gasket after wiring and testing. This will allow use of the unit in areas where salt spray could enter, accidental immersion may occur, or in environments where maximum long-term reliability is paramount.

Connecting devices together The basics

NMEA data is transmitted from an information source such as GPS, depth sounder, gyrocompass, etc. These data sending devices are called “Talkers”. Equipment receiving this information such as a chart plotter, radar, or NMEA display is called a **“Listener”.**
Unfortunately, only one Talker can be connected to a single NMEA 0183 system at any one time. Two or more Talkers are simply not possible because they are not synchronized to each other, and will attempt to ‘talk’ at the same time (over each other), resulting in corruption of the NMEA data, and potentially in disaster if valuable data such as navigation information is lost or corrupted so that it is incorrect and/or misleading.
Actisense™ produces a full range of products to solve all NMEA interfacing requirements.
Please visit the **Actisense™ website** for full details on these and other **Actisense™** interfacing, Depth sounding, and Sonar products.

The NMEA signals

The NMEA 0183 system v2.0 and later uses a ”differential” signaling scheme, whereby two wires are used to transmit the NMEA data. These connections will be labeled as either NMEA “**A**” and “**B**“ or NMEA “+” and “-“ respectively, depending on the instrument and manufacturer. When connecting between different manufacturers, there can be some confusion, but it is simple and easy to remember: NMEA “**A**” connects to NMEA “+” and NMEA “**B**“ connects to NMEA “-“. When connecting between different manufacturers, there can be some confusion, but it is simple and easy to remember: NMEA “**A**” connects to NMEA “+” and NMEA “**B**“ connects to NMEA “-“.

The different NMEA standards

The NMEA 0183 specification has slowly evolved over the years, so connecting one device to another is not always a straightforward matter. The earlier versions of NMEA 183
(before v2.0, as detailed above), used slightly different connection methods and signal levels: the instruments had just one “NMEA” data line (‘Tx’ or ‘Out’), and used the ground as the other line – similar to the way a computer serial port works. This connection method is referred to as “single-ended” instead of the “differential” method used by NMEA 0183 v2.0 devices.

The data format is largely the same between both systems, with v2.0 adding some extra sentence strings, and removing older (redundant) sentence strings from the specification. The situation is further complicated, as many manufacturers still use the old (“single-ended”) method of connection because it is cheaper to implement. So how can an older type NMEA device be connected to a newer type device? Care is needed – it is possible to damage or overload the output of a newer differential device if it is incorrectly connected to an older device.

This is because the older devices used ground as the return, whereas the newer devices actually drive the MEA “-/B” line between 5v and 0v. Thus, connecting this output to the ground will result in high currents being drawn by the driver instrument, resulting in potential overheating and damage to the driver circuits.

To connect a new type differential device to an old type single-ended system, connect the NMEA “+/A” output from the differential driver to the single-ended NMEA “Rx” or “In” input of the device. Leave the NMEA “-/B” output floating. Connect the ground line of the differential output device to the ground of the single-ended device. This provides the required data signal return current path.

To connect an old type single-ended device to a new type differential device, connect the NMEA ”Tx” or “Out” output from the single-ended driver to the differential NMEA “+/A” input of the device. Connect the ground line of the single-ended output device to the NMEA “-/B” input of the differential device. This provides the data signal return current path. If the NMEA “-/B” input is left floating, then data corruption/errors may occur.
Please refer to the Output Connections section for an example of these connection methods.

NMEA Data Combiner – NDC-2-C

Connections

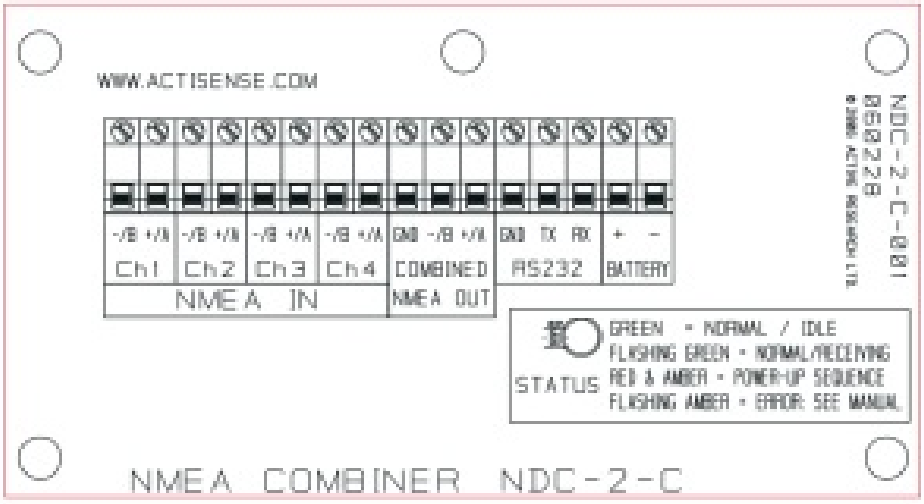

Figure 1 – All external connections

The NMEA Data Combiner (NDC-2) has screw-terminal “Phoenix” type external connections for: –

1. Four NMEA 0183 inputs.
   All NMEA 0183 inputs are of the differential optoisolated type and use the unique Actisense™ low current drain circuitry (2mA @ 2.0V) to conform in full with the NMEA 0183 marine electronic device network communication standard, and are flexible enough to interface to all full and most partially compliant NMEA devices.
2. An NMEA (data combined) 0183 output.
   The NMEA 0183 data output comprises of three connections: ‘+’, ‘-‘ and ‘Ground’ and conforms in full to the NMEA 0183 standard. This allows the NDC to interface to various different devices that require any combination of these outputs.
3. An RS232 input/output.

The bi-directional RS232 port is designed for direct connection to a computer (PC) or another marine device capable of interfacing to a standard RS232 port.

4. Battery supply input (8 to 30 volts DC).

Note:

1. To complete the NMEA 0183 standard all device interconnection NMEA cables used should meet the two-conductor, shielded, twisted-pair configuration specification. The shield connection of these wires should be connected at the instrument end only to prevent ground loops.
2. Refer to the Specifications section for the full details on input/output specifications.
3. If the laptop / PC to be used with the NDC does not have an RS232 serial port available, the **Actisense™ USB to RS232 adapter cable** has been tried and tested to provide a compatible communications port. Please visit the Actisense™ website for full details on this, and other Actisense™ products.

Connecting to NMEA 0183 devices

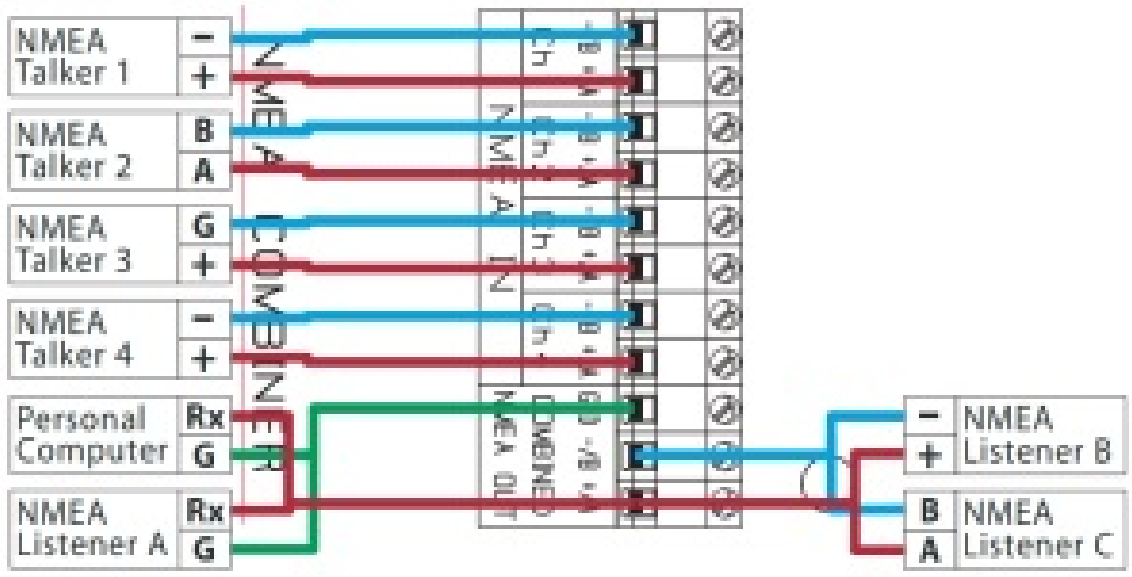

Figure 2 – NMEA 0183 connections

NMEA 0183 Inputs

The NMEA 0183 differential optoisolated inputs are designed to handle a variety of NMEA 0183 device output specifications. Please determine (from device manufacturer's information) if the device(s) required to be connected to the Actisense™ NDC-2 conforms in full to the NMEA 0183 network communication standard. If it does not, the flexible Actisense™ NDC-2 inputs should still be capable of interfacing with the device, though this is not guaranteed.

The diagram above shows a typical installation with both fully compliant NMEA devices with differential inputs/ outputs, and non-differential output devices that output NMEA using the ground line as the "NMEA -" line.

NMEA Talker devices 1, 2 and 4: These devices conform in full to the NMEA 0183 standard. Devices 1 and 4 share the same connection ID's as the Actisense™ NDC, so the connection is a simple matter of matching the ID's (refer to figure 2). Device 2 uses the RS485 convention connection ID's. Simply connect 'A' to '+/A' and 'B' to ' -/B' (refer to figure 2).

NMEA Talker device 3: This device does not conform completely to the NMEA 0183 standard. However, by connecting '+' to '+/A' and its 'G/Ground' to the NDC "-/B" the NDC should be able to receive the NMEA data

correctly.

NMEA 0183 Output
The NMEA 0183 buffered output is capable of driving up to 20 NMEA 0183 fully compliant listening devices, or a mixture of NMEA 0183 devices and a Personal Computer (PC) serial communication port.
NMEA Listener device's B and C: These devices conform in full to the NMEA 0183 standard and their connection ID's match that of the NDC.

Personal Computer: Whilst the RS232 port is designed for connection to a PC, the NMEA 0183 output can also be read by most PCs. Simply connect '+/A' to 'Rx' and 'Gnd' to 'Ground' on a standard 9- pin D-type (probably male) connector.

NMEA Listener device A: This device does not conform in full to the NMEA 0183 standard. However, by connecting '+/A' to 'Rx/In' and 'Gnd' to 'G/Ground' the device should be able to receive the NMEA data correctly, though this is not guaranteed.

Note:

1. Wire colors are for guidance only.

Other Connections

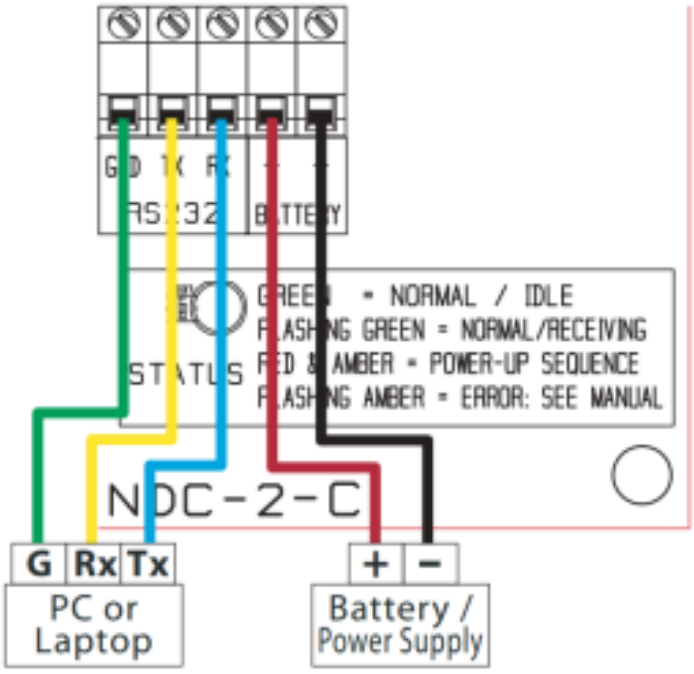

Figure 3 – RS232 and Battery connections

Figure 3 – RS232 and Battery connections

Connecting to a Personal Computer
The RS232 port can be connected to a PC serial communications port using a cable conforming to the following specification:

1. A D-type female (socket) connector for the PC end of the cable.
2. A minimum of 3 c ores are required in a shielded cable. Higher quality cable will naturally yield higher performance / higher Signal-to-Noise Ratio (SNR). Most typical cables have two twisted pairs inside. In this

case, use one pair for the TX line and one for the RX line. Use the spare wire in each pair as ground, and connect the cable shield to the ground only at the computer end.

3. The TX of the NDC-2 should be connected to the RX of the PC's serial port (standard D-type, pin 2) and the NDC-2 RX should be connected to the TX of the PC's serial port (pin 3). The NDC-2 GND should be connected to the PC's serial port ground (pin 5).

Connecting to the battery supply

The Actisense™ NDC-2 should be wired to the vessel's battery supply in the most direct manner possible, to minimize interference from other electronic devices. The cable used should be of sufficient gauge to handle the power requirements of the Actisense™ NDC-2 (refer to the Specifications sections).

Note:

1. Wire colors are for guidance only.

Actisense PC Software suites

The Actisense™ NMEA Data Combiner hardware can be configured, monitored and tested using its own dedicated Control Centre software suite. The Actisense™ NDC can be updated/upgraded using the latest Flash Centre software suite. This section provides a complete users guide to installing and uninstalling these two software suites. These programs are currently only available for Windows™ platforms (98/ME/NT/2000/XP), however, it has been proven possible to use the NDC Control Centre / Flash Centre on a Mac running Windows emulation software.

To install Actisense PC software

Replace the generic "<Product Name>" text below with the name of the actual software you are installing: "NDC Control Centre", or "NDC Flash Centre".

1. Download the latest version of the software from the Actisense™ website, or locate the files on the Actisense™ CD included with the NDC-2.
2. If a previous version of the software has already been installed, uninstall the previous version and delete the program directory before installing the new version. Refer to the To uninstall Actisense PC software section for full details.
3. If the program is contained within a zip file, extract the three files ('<Product Name>.001,' '<Product Name>.002' and 'setup.exe') that are contained within the zip file using any available unzip program to a temporary directory (e.g. "C:\Temp").
4. Double click on the 'setup.exe' program file and follow the on-screen instructions of the standard Windows™ install program. The install location can be changed at this point, however, the default location is normally acceptable (refer to figure 4 and 5).

   Once the install operation is complete, the temporary files and/or directory can be deleted. Keep the original zip file safe.
5. To start/run the program, use the Windows™ 'Start' menu and navigate to the installed program's directory. There will be a program icon – double click on it (refer to figure 6 and 7).

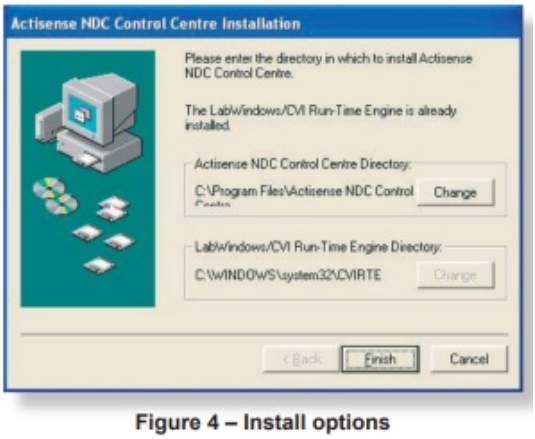

Figure 4 – Install options

Figure 5 – Installation complete

Useful Tip: If you access the program regularly you can 'copy and paste' the program icon from the Windows™ 'Start' menu onto the desktop or the 'Quick Launch' short-cut bar to create an easy-to-access short-cut.

To uninstall Actisense PC software

Replace the generic "<Product Name>" text below with the name of the actual software you are installing: "NDC Control Centre", or "NDC Flash Centre".

1. If at any time you wish to remove the installed Actisense™ program, simply use the standard Windows™ 'Start → All Programs → Actisense <Product Name> → Uninstall Actisense <Product Name>' menu option to perform this operation (refer to figure 7).
2. Alternatively, there is a very convenient uninstall icon included in the program's folder (see figure 6).
3. Once the uninstall operation has been requested, the confirmation box (figure 8) will be displayed. Answer 'Yes' and the uninstall operation will be performed automatically. After successfully uninstalling the Actisense PC software, the uninstall completion box will appear (refer to figure 9).
4. In addition, the program directory can also be deleted to completely remove the program. In this way all the program files will be uninstalled in a clean and complete manner.

   If however, you are going to install a new version after this uninstall, you can keep the program directory and the configuration file stored within it. In this way, all the user settings you had for the previous version will be immediately available with the new version.

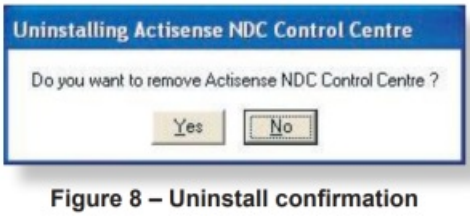

Figure 8 – Uninstall confirmation

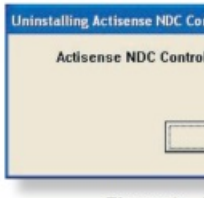

Figure 9 –

Using Actisense PC software suites
The complete explanation of how to use the Actisense™ NMEA Data Combiner (NDC) software suites is contained within the full user manual available from the Actisense™ website and the Actisense™ CD.

NDC Control Centre
The **Actisense™** NDC Control Centre enables the user to modify all available configuration options:

- NMEA 0183 Inclusion / filter lists.
- Input priorities.
- Input/output Baud rates.
- Various other options.

NDC Flash Centre
The Actisense™ NDC Flash Centre enables the user to flash update / upgrade their NDC hardware. This new firmware could enable new features, modify existing ones, or remove 'bugs' that have been found since the product was manufactured.

The update process is a simple one-button operation that only takes a couple of minutes to perform.
It is worthwhile to keep your NDC's firmware up to date by monitoring the **Actisense™ website**, or alternatively, by signing up to the Actiscope newsletter. Actiscope will keep you up to date on any new firmware versions available for all Actisense™ products (only sent out once every 2-4 months on average).

Troubleshooting guide

This guide will concentrate on all relevant troubleshooting issues above simple cable connection faults. Therefore, the cables between the NDC-2 hardware and any other device should be checked as a matter of course, before continuing with this guide.

Diagnostic LED
The NDC-2 hardware supports a tricolor diagnostic LED that indicates the current operating mode of the hardware, or if an error has been detected during the self-test initiation process. Table 1 details what each LED color represents and if any user interaction is required.

LED Colour / Flash Count	Mode / Error condition	Required user response
	Normal operation modes	The sequence below indicates a successful power-up of th e NDC-2 and the commencement of data combining.
Red. No flashing	Start-up mode. No error	No response is required. A normal operation mode that should last for no more than 1.5 seconds. Any longer indic ates an error with the main program.
Red. No flashing	Flash updating mode. No error	No response is required. LED will stay red for the duration of the flash update operation (using Flash Centre). Once th e operation is complete. NDC hardware will be automaticall y reset.
Amber. No flashing	Initialize and self-test mode. No error	No response is required. A normal operation mode that foll ows after the Start-up mode and should last for approximat ely one second.
Green. No flashing	Normal and no data mode, No error	No response is required. A normal operation mode that foll ows the Initialise and self-test mode. Indicates that no error was detected during the self-test operation. Also indicates that no data is currently being received by th e NDC-2 hardware.
Green. Flashing (1-10 per second)	Normal and data Rx mode. No error	No response is required. A normal operation mode indicate s that data is currently being received (on at least one channel) by the NDC-2 hardware. Flash rate proportional t o Rx rate.
	Error conditions	If the error persists the NDC-2 unit should be returned to A ctisenser" (refer to the Contact Information section).
Amber. Flashing (Once every 4 seconds)	Error trap mode. EEPROM memory error	An error with the EEPROM memory has been detected dur ing the self-test mode. Reset the NDC-2 hardware.
Amber. Flashing (Twice every 4 seconds)	Error trap mode. RAM memory error	An error with the RAM memory has been detected during t he self-test mode. Reset the NDC-2 hardware.
Amber. Flashing (Thrice every 4 seconds)	Error trap mode. external UART memory error	An error with the external UART has been detected during the self-test mode. Reset the NDC-2 hardware.

Specifications

Parameter	Conditions	Min.	Max.	Unit
Supply				
Supply voltage		8	30	V
Supply current (see note 1)	Supply voltage = 12v	55	75	mA
	Supply voltage = 24v	30	40	mA
NMEA				
Input voltage between +/-	Logical T/stop bit	–15.0	0.5	V
	Logicalt7start bit	4.0	15.0	V
Input current	Maximum is under +35v overload c ondition	2.0	30	mA
Differential input voltage	Required level for NMEA to be dete cted	2.	2.0	V
Output voltage between +/- and ground (see note 2)	Logical ‘1’/stop bit	0.0	0.5	V
		5.	5.	V
Output current (see note 2)	At maximum load, drive voltage red uces to 2V		20	mA
Output short circuit current.			35	mA
Baud rate – fixed (see note 3)		4800	38400	bits/sec
Data propagation delay		1.0	100	MS
RS232				
Input voltage range		-15	+15	V
Input voltage threshold	LOW	0.8	1.	V
	HIGH	2.	3.	V
Output voltage swing	Loaded with 3K.C2 to Ground	±5	±9	V
Output resistance	(RS232 Vout = ±2V)	300		Ohms
Output short circuit current (Infinite durat ion)			±18	mA
Baud rate		19200	115200	bits/sec
Data propagation delay		1.0	100	MS
General				
Ambient temperature		-20	+70	°C

Table 2 – NDC-2 specifications

All specifications are taken with reference to an ambient temperature (TA) of +25°C.

Note:

1. Current consumption measured under no-load conditions
2. NMEA output is RS485
3. NMEA 0183 requires 4800 Baud (factory default). However, to maximize compatibility with other devices and Hi-Speed NMEA 0183, the baud rate is selectable between the values shown. NMEA input 2 also has an extra Hi-speed option of 57600 Baud to allow use with AIS transponders (however, this option will force all other NMEA 0183 inputs to 4800 Baud to control the total bandwidth).

System block diagram

Details the flow of data through the NMEA Data Combiner's system.

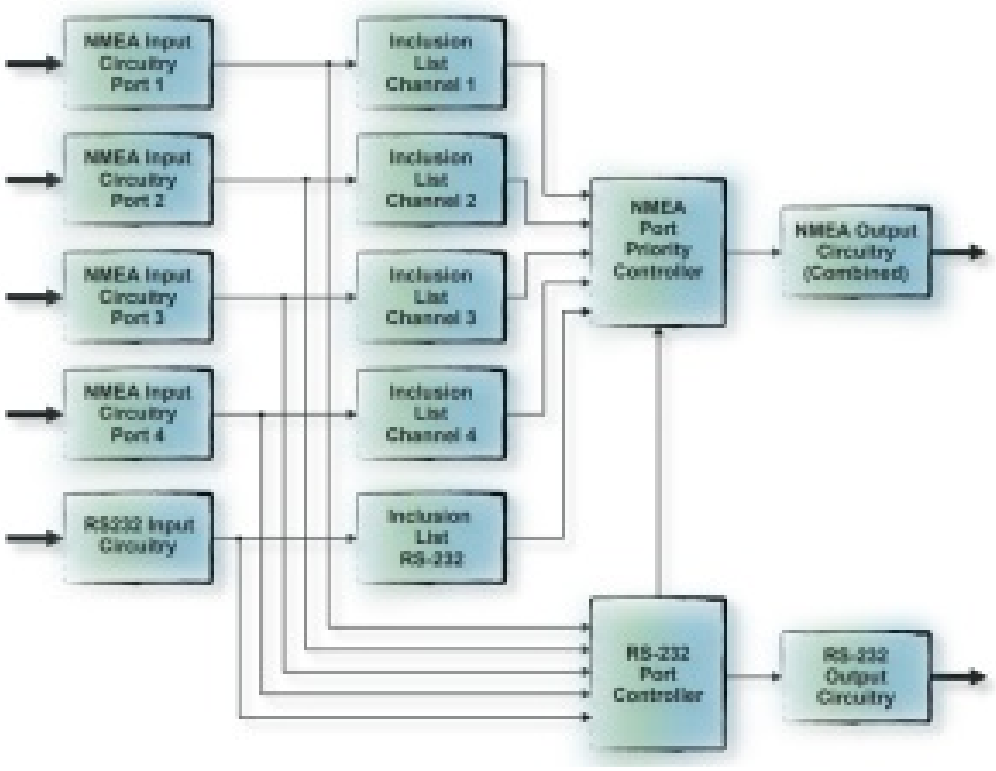

Figure 10 – NMEA Data Combiner signal flow block diagram

Notes:

NMEA Input (1-4)	NMEA Device co
RS232 Input & RS232 Output	**NMEA Device co**
NMEA Combined Output	**NMEA Device co**

Company Information

Active Research Limited
5, Wessex Trade Centre
Ringwood Road, Poole, Dorset
UK
BH12 3PF

Telephone: 01202 746682 (International : +44 1202 746682)
Fax: 01202 746683 (International : +44 1202 746683)
Actisense™ on the Web: For advice, support and product details
E-mail: **support@actisense.com**
Website: **www.actisense.com**
Active Research on the Web: For specialist consultancy and customization
E-mail: **support@activer.com**
Website: **www.activer.com**

Documents / Resources

	**Actisense NDC-2-C NMEA Data Combiner** [pdf] User Manual NDC-2-C, NMEA Data Combiner