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APPLICATION NOTES

WIND MEASURING SYSTEMS

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1. About this document

General purpose

This document includes application notes for DEIF's wind sensor and wind display, the WSS and WSDI-2. It mainly includes examples of different applications suitable for these units.

The general purpose of the application notes is to offer the designer information about suitable applications for the wind measuring system.

Intended users

The document is mainly intended for the person responsible for designing wind sensor systems. In most cases, this would be a panel designer. Naturally, other users might also find useful information in this document.

Contents/overall structure

The document is divided into chapters and in order to make the structure of the document simple and easy to use, each chapter will begin from the top of a new page.

2. Warnings and legal information

Legal information and responsibility

DEIF takes no responsibility for installation or operation of the application in total. If there is any doubt about how to install or operate the wind measuring system, the company responsible for the installation or the operation of the system must be contacted.

The units are not to be opened by unauthorised personnel. If opened anyway, the warranty will be lost.

Electrostatic discharge awareness

Sufficient care must be taken to protect the terminals against static discharges during the installation. Once the unit is installed and connected, these precautions are no longer necessary.

Definitions

Throughout this document, a number of notes and warnings will be presented. To ensure that these are noticed, they will be highlighted in order to separate them from the general text.

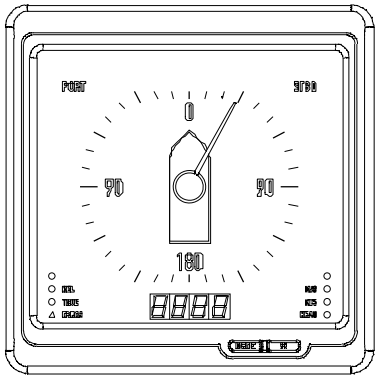
Notes

The notes provide general information which will be helpful for the reader to bear in mind.

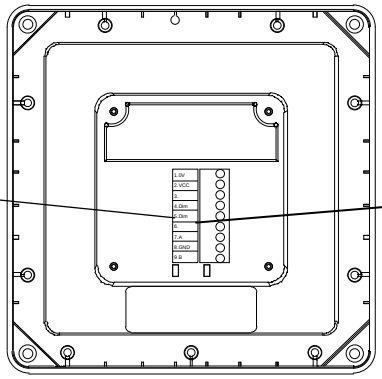
Warning

The warnings indicate a potentially dangerous situation which could result in death, personal injury or damaged equipment, if certain guidelines are not followed.

3. WSS and WSDI outline and connections

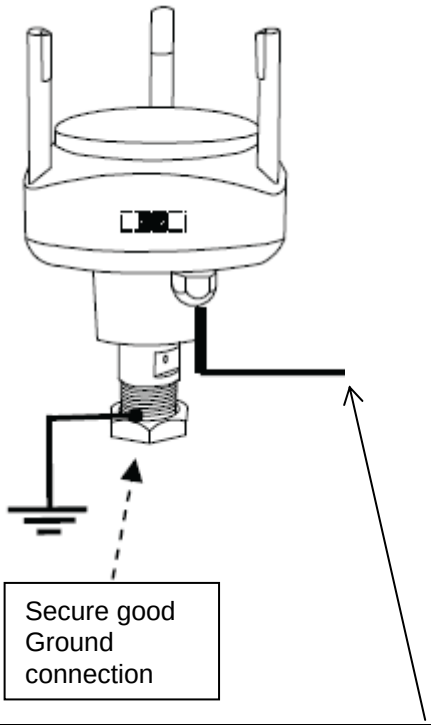


Remote Dimmer Operation
1. 0 V
2. +12/24 V
3. -
4. Dim-sw
5. Dim-sw
6. -
7. A(+)
8. GND
9. B(-)



CAN Operation
1. 0 V
2. +12/24 V
3. CAN-H
4. CAN-C
5. CAN-L
6. -
7. A(+)
8. GND
9. B(-)

Terminal no. 4 and no. 5 is either used as "remote dimmer input" or as part of the CANbus. Remote dimmer and CANbus cannot be used at the same time!



WSS Cable colour	Function		WSDI-2 connector	Note
Black	Supply voltage	-	1	DC supply voltage for the wind sensor
Red		+	2	
Orange	RS485 com	A	7	Wind speed and direction data output
Brown		B	9	
Shield	Electrical shielding of data signal		-	Shield is connected to stainless steel mounted inside the WSS. This end of the shield is not to be connected. If electrical noise is interfering with the operation of the WSDI-2, the shield may be connected to WSDI-2 terminal 8.

4. Dual relative wind indicator system

Key system features

- Presentation of wind data on two wind indicators
- Relative wind presentation on each indicator
- Separate dimmer from the push-button on the WSDI-2 indicator front
- Number of indicators can be extended by parallel coupling one or more WSDI-2's

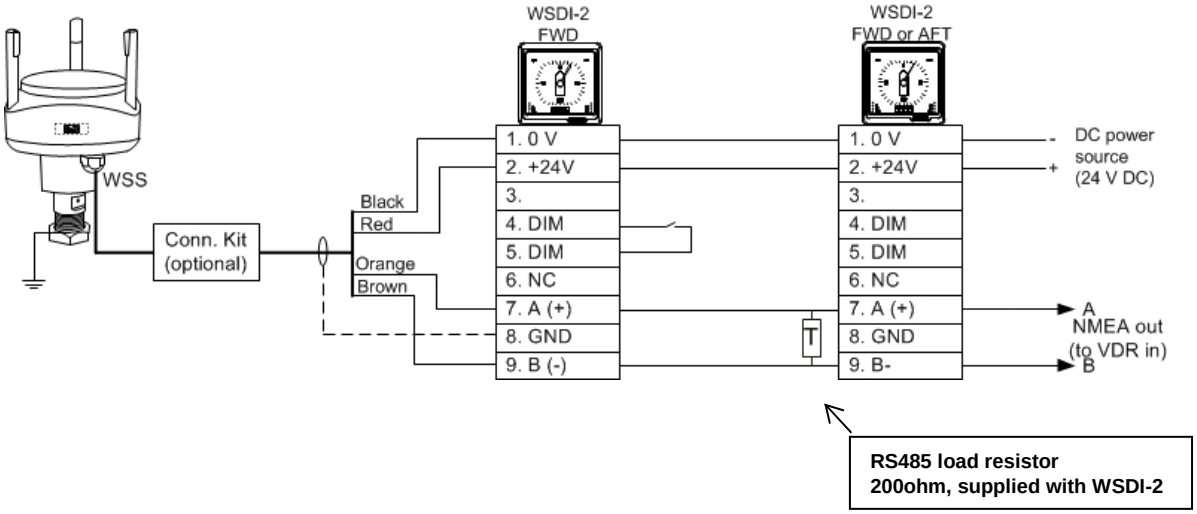
System characteristics

This is a typical installation for a wind system with two wind indicators showing the relative wind speed and direction. (see Appendix 1 for a detailed explanation of relative wind).
It can be either two forward indicators located in the overhead panel and pointing ahead or for an offshore/work boat. It may be a combination of a forward version pointing ahead and an aft version pointing astern. This last combination may also be attractive for some types of ferries.

Wind sensor data is directly distributed from the wind sensor to both WSDI-2 wind indicators, and it is possible to route the sensor data to a VDR or the navigation system, but only one external NMEA compatible (IEC 62162-1) input must be connected.

The dimming of the illumination is controlled by the push-button on either one of the WSDI-2 indicators separately. It is not possible to have the dimming synchronised between the two WSDI-2 indicators using "light groups" in this configuration. (See chapter 5. "Dual relative/true wind indicator system" for details on how to achieve this function).

Installation tips: Remember to terminate (or load) the RS485 data line with one of the resistors packed with the WSDI-2 indicators.
The WSS extension cable may be used to make the connection between the two WSDI-2 indicators.



The WSS sensor can be connected to an extension cable using either the IP67 connector kit or IP66 connection box kit (optional accessories).

NMEA sentences

The following NMEA wind sentence is provided by the WSS or WSS-L:

Data used or provided	NMEA Header	Description	Transmits
Wind speed and direction	MWR	Wind speed and angle (relative only)	x

WSDI-2 indicator setup

To make this system work, the following must be changed in the WSDI-2 indicator setup:

Wind indicator 1 setup (Left WSDI-2)

1) The wind source is the WSS sensor using NMEA0183. Therefore, the “input select” must be “r183” to activate remote dimmer switch connected to this unit.
2) If the WSS sensor is not aligned correctly in the mast, an off-set can be inserted from either one of the WSDI-2 indicators. This correction will be saved in the WSS, and the correct wind direction will be sent from the wind sensor directly to both WSDI-2 indicators and also to other connected equipment (for example a VDR or a navigation system).

Wind indicator 2 setup (Right WSDI-2)

1) The wind source is the WSS sensor using NMEA0183. Therefore, the “input select” must be “183”, (no remote dimmer switch is connected to this unit).
2) The sensor offset must not be changed since the offset is already aligned via the left WSDI-2.

Please see the “WSDI-2, user’s manual and installation note” for details on how to enter the installation menu and change the settings (the manual can be downloaded from www.deif.com).

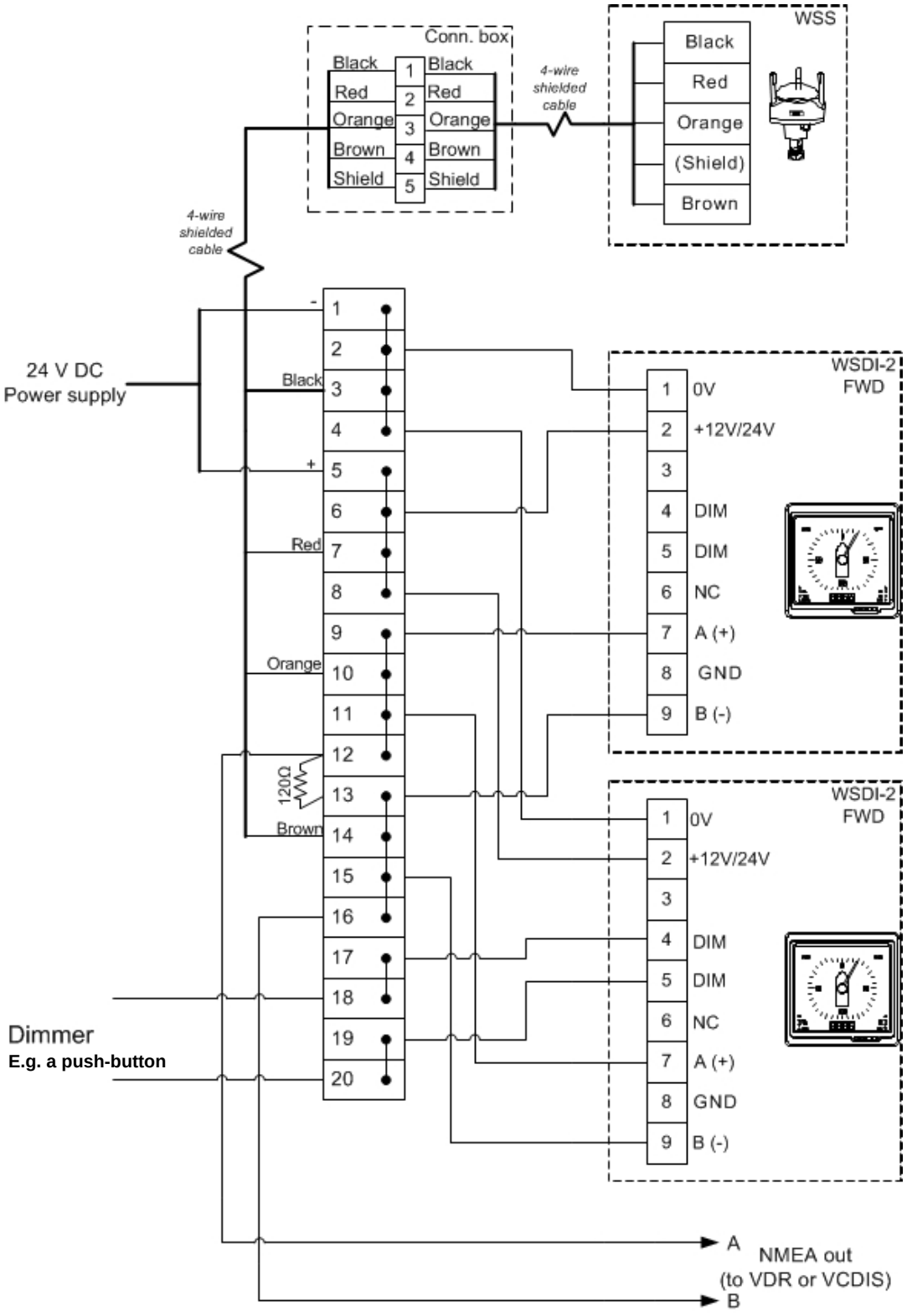
Remote dimmer function

The remote dimmer connection is shown on the 1st WSDI-2 (left) in the figure above. The switch must be a potential free push-button connected between terminal 4.Dim and 5.Dim on the WSDI-2. Remote dimmer is a local function on the 1st WSDI-2 where the push-button is connected, the dimmer push-button will step the illumination one step every time it is activated, just as the push-button on the front of the WSDI-2. Note that the illumination push-button on the WSDI-2 front will also still work.
In case the remote dimmer is also needed on the 2nd WSDI-2 (right), the push-button must be connected and set up for 2nd WSDI-2 must instead be:

1) The wind source is the WSS sensor using NMEA0183, and the remote dimmer push-button is connected. Therefore, the “input select” must be “r183”.

In this system, the WSDI-2 indicators are only able to present relative wind speed and direction.

Example of wiring:



Indicators should be wired with shielded cable.

5. Dual relative and true wind indicator system

Key system features

- Presentation of wind data on two wind indicators
- Relative or true wind presentation on each indicator
- Synchronised or individual dimmer function

See Appendix 1 for a detailed description of relative, true and geographic wind.

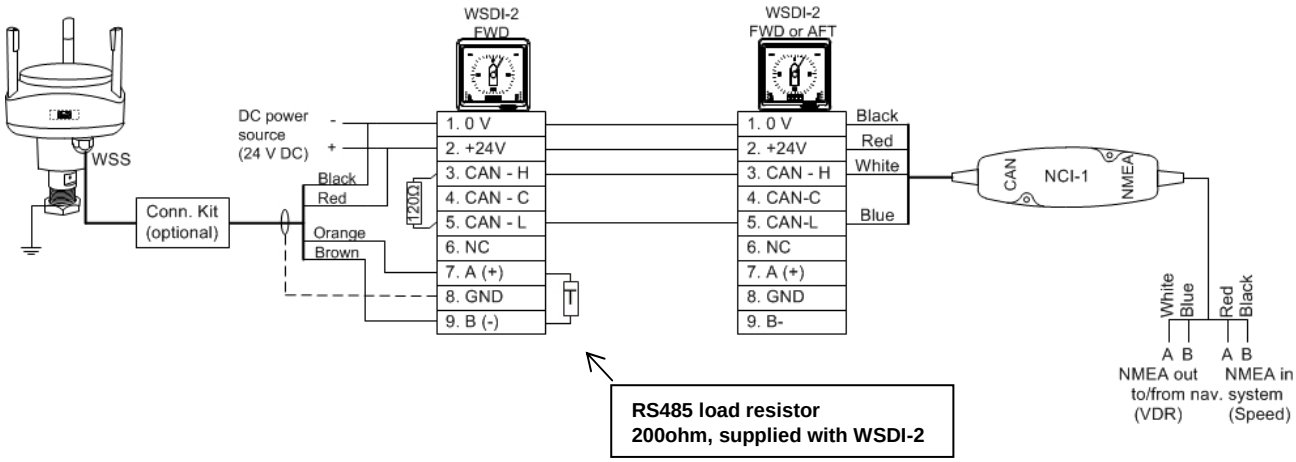
System characteristics

By utilising the CANbus between the two indicators and the NCI-1 NMEA interface box, it is possible to exchange all needed data for relative wind indication or true wind calculation on both indicators.
Wind sensor data is converted to CAN in the 1st (left) WSDI-2 indicator and is routed to the 2nd (right) indicator, and is finally also converted in the NCI-1 to NMEA0183 wind data sentences presented on the output of NCI-1 and for example connected to the voyage data recorder (VDR).

The NCI-1 NMEA input terminals must be connected to the ship's log or navigation system to receive boat speed data for true wind calculation. Speed through water or speed over ground can be used to calculate true wind relative to the ship's heading. WSDI-2 will automatically select water speed if both types are available. (See accepted sentences in the table on page 7).

If the two WSDI-2 wind indicators are set up to use the same light group, a change of dimmer setting on one indicator will automatically be transferred via the CANbus to the other, synchronising it to the same dimmer level. If you go back to the default group = "None" setting or if you select a different light group, the synchronisation will stop.

Installation tips: NCI-1 has a built-in CANbus termination resistor, so it is only needed to terminate the other end of the bus with a 120 ohm resistor (at the left indicator).
Cable should be twisted pair, e.g. Cat 5 cable or Devicenet cable.
1 twisted pair is used for connection of pin 3 and 5.
Terminal 4 is a reference terminal and should not be used.



NCI-1 NMEA cable connection to Navigation system			
NCI-1 wire colour	NCI-1 Function	Navigation system NMEA port	NMEA sentences
Blue	Out: B	In: B/-/GND/Return	VWR and MWV
White	Out: A	In: A/+/RX	
Black	Input: B	Out: B/-/GND/Return	VHW, VTG, VBW or RMC
Red	Input: A	Out: A/+/TX	
Bare (shield)	Do not connect	Do not connect	

NMEA sentences

The following NMEA sentences are supported by NCI-1

Data used or provided	NMEA Header	Description	Receives	Transmits
Wind speed and direction	MWR	Wind speed and angle (relative only)	x	x
Wind speed and direction	VWR	Old sentence (relative only)		x
Speed through water	VHW	Water speed and heading	x	
Speed through Water or over ground	VBW	Dual ground/ water speed	x	
Speed over ground	VTG	Course over ground and water speed	x	
Speed over ground	RMC	Recommended minimum specification GNSS data (GPS)	x	

MWR is the NMEA sentence transmitted from the WSS or WSS-L to the WSDI-2 (terminals 7 and 9), and alternatively <u>one</u> NMEA listener may be connected directly in parallel on those terminals (for instance a VDR).

WSDI-2 Indicator setup

To make this system work, the following must be changed in the WSDI-2 indicator setup:

Wind indicator 1 setup (left WSDI-2)

1) Change Light group (dimmer) from the setting: “None” (no light group) to light group 1 (to get dimmer level on both indicators synchronised at all time). If you adjust dimmer level on one WSDI-2 in group 1, the other WSDI-2 in group 1 will follow.
2) The wind source is the WSS sensor using NMEA0183. Therefore, the “input select” must be “183”. (Not “r183” - in which case the CANbus is disabled).
3) If the WSS sensor is not aligned correctly in the mast, a wind direction off-set can be inserted via the 1st WSDI-2 (left) connected to the sensor. This will be saved in the WSS, and the corrected wind data is therefore available directly on the WSS lines and in the wind data sent out on the CANbus from the 1st WSDI-2.

Wind indicator 2 setup (Right WSDI-2)

1) Also change the dimmer setting on the 2nd WSDI-2 from “None” (no group selected) to light group 1.
2) Wind data source is the CANbus from the 1st wind indicator (left), and therefore the “Input select” on 2nd WSDI-2 must be set to: “CAN”.
3) The sensor offset must not be changed (0^0) since the offset is already aligned via the 1st WSDI-2 indicator (note: the offset is stored in the WSS sensor).

Please see the “WSDI-2, user’s manual and installation note” for details on how to enter the installation menu and change the settings (the manual can be downloaded from www.deif.com).

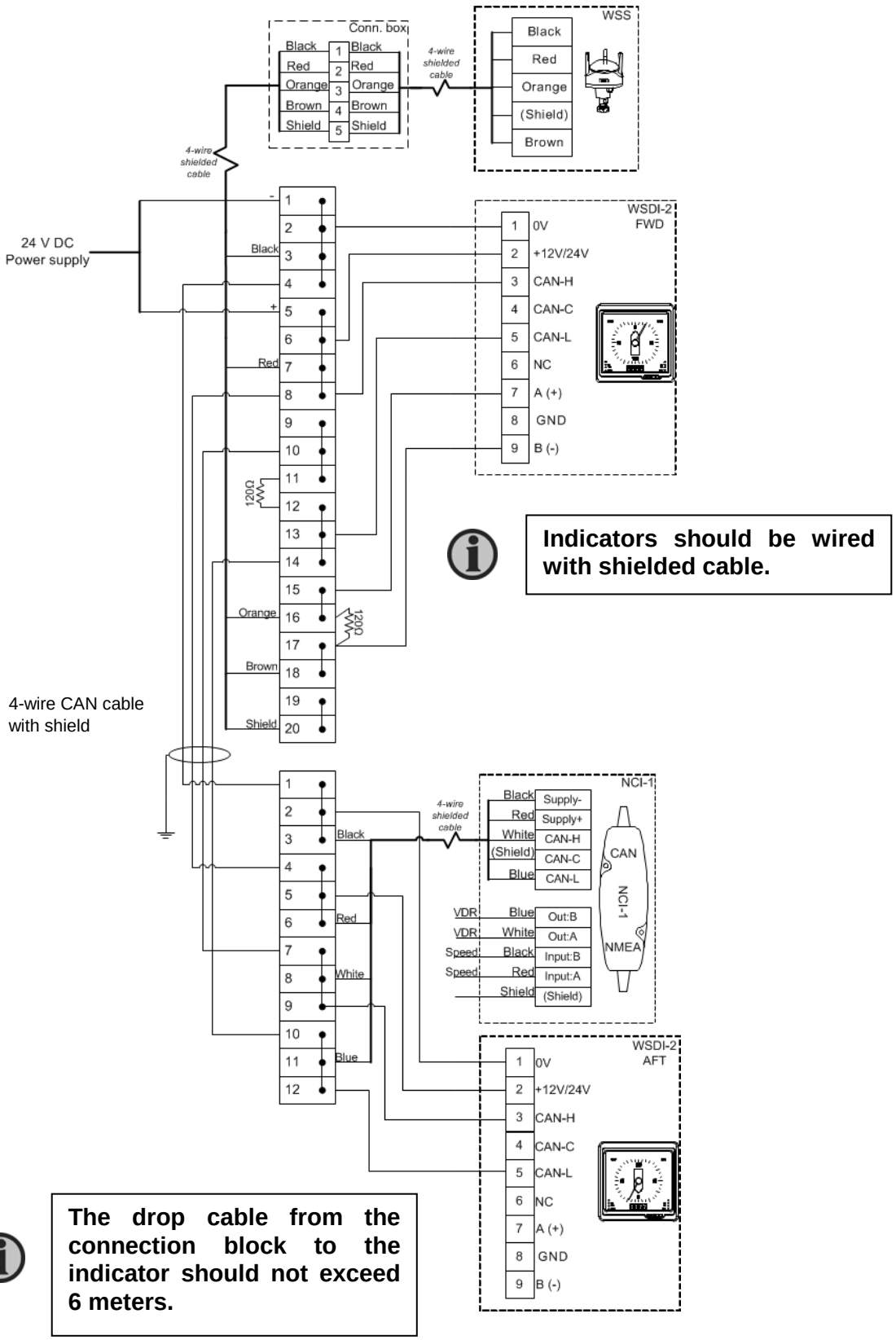
IMPORTANT: It will not work just to connect both WSDI-2 indicators to the WSS. The speed data and dimmer synchronisation will not be transferred on the data bus from the WSS sensor.

IMPORTANT: When the CANbus is in use, it is not possible to use an external dimmer push-button, since it is the same terminals that are used.

IMPORTANT: Total CANbus cable length should not exceed 200 m.

WSDI-2 is not able to present true wind direction relative to north (Geographic true wind). See Appendix 1 for details about true wind.

Example of wiring



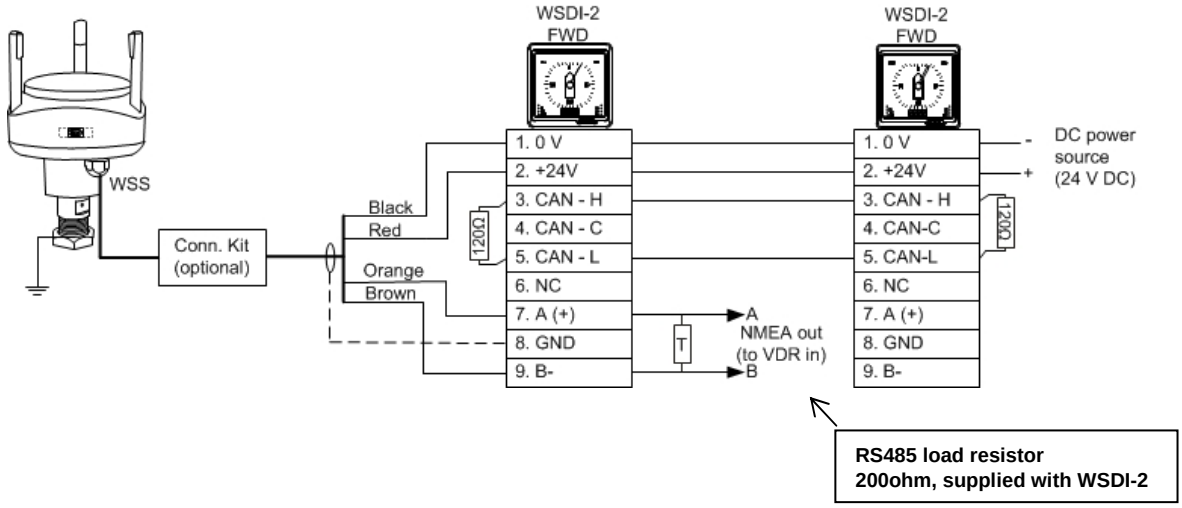
6. Wind system for bi-directional ferry

Key system features

- Presentation of wind data on two FWD wind indicators
- Relative wind data presented on each indicator but with a 180° offset

System characteristics

On bi-directional ferries (Ro-Ro ferries) you can say that bow and stern shifts place depending of the actual sailing direction. They have two navigation and manoeuvering consoles; one pointing one way, the other pointing oppositely.
Both consoles have an overhead panel with a WSDI-2 wind indicator showing the correct wind. Only the relevant WSDI-2 indicator is used at a given time, depending on the actual sailing direction.
The two wind indicators are both FWD types (bow up), but the two wind indicators need to have a 180° shift in heading reference to present data correctly.
To be able to do that, the wind data needs to be sent from the left to the right WSDI-2 using the CANbus. In that case, it is possible to insert a 180 degree offset in the right WSDI-2 indicator.



CANbus must be terminated in both ends.
Cable should be twisted pair, e.g. Cat 5 cable or Devicenet cable.
1 twisted pair used for connection of pin 3 and 5.
Pin 4 is a reference terminal (common) that is not normally used.

Wind indicator 1 setup (Left)
1) Wind data source is the WSS sensor providing NMEA0183 data. Therefore, the "input select" must be "183".

2) If the WSS sensor is not aligned correctly in the mast, a wind direction off-set can be inserted from either of the WSDI-2 indicators, this off-set will automatically be saved in the WSS sensor, and the correct wind direction will be sent from the wind sensor directly to both WSDI-2 indicators and also to other connected equipment (for example a VDR or a navigation system).

Wind indicator 2 setup (right)
1) Wind source is the CAN bus from the first wind indicator and therefor the “Input select” must be: “CAN”.
2) The sensor offset must be set to 180^0 to get the right reading on this indicator.

Please see the WSDI-2 User and installation manual for details of how to enter the installation menu and change the settings (The manual can be downloaded from www.deif.com).

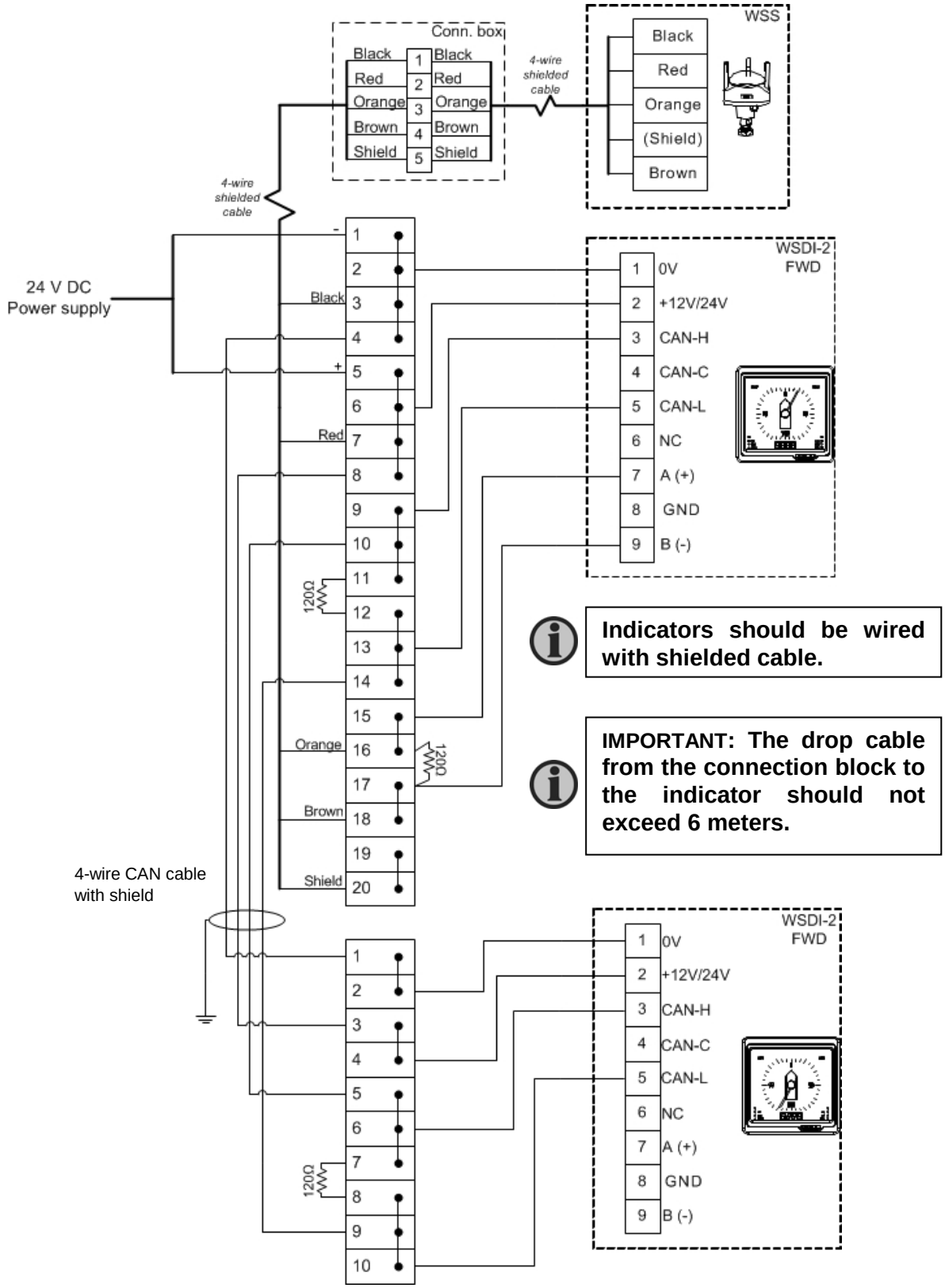
IMPORTANT: It will not work just to connect both WSDI-2 indicators to the WSS. If the two indicators have different sensor offset, it will create an “offset error” indication on one of the WSDI-2 indicators.

IMPORTANT: When the CANbus is in use, it is not possible to use an external dimmer push-button, since it is the same terminals that are used.

To synchronise the illumination light level between the two WSDI-2 indicators via the CANbus, see the instructions in chapter 5. “Dual relative and true wind indicator system”.

TRUE WIND INDICATION
To make both WSDI-2 indicators able to present true wind, connect a NCI-1 NMEA converter box to the CANbus (one termination resistor must be removed where the NCI-1 is connected since it has a built-in termination resistor) and connect its NMEA input to the ship’s speed log or navigation system. See chapter 5. “Dual relative and true wind indicator system”.

Wiring example



7. Relative/true wind measuring system

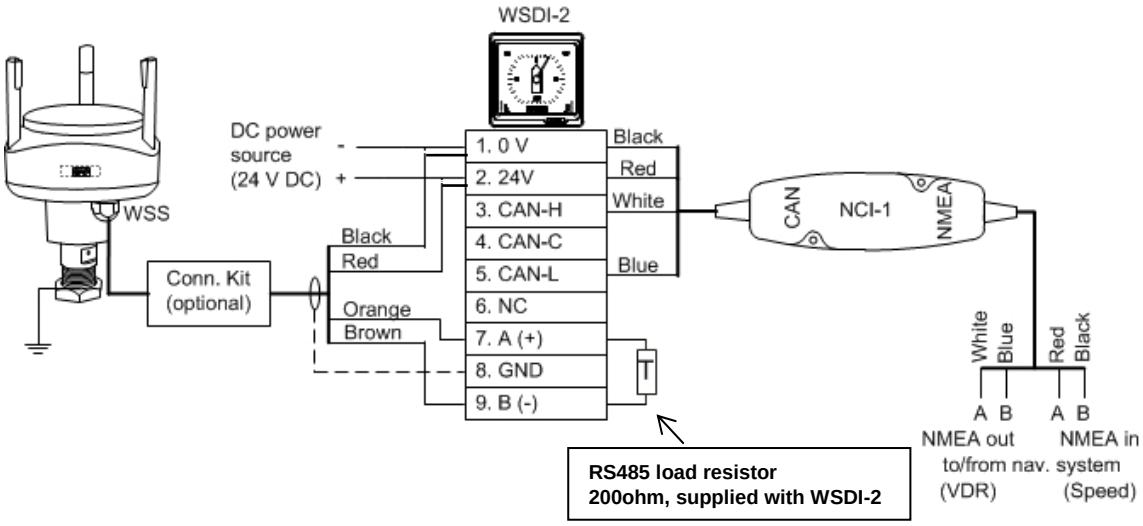
Key system features

- Relative wind speed and direction presentation on the indicator
- True wind speed and direction presentation on the indicator

See Appendix 1 for a detailed description of relative, true and geographic wind.

System characteristics

The WSDI-2 is able to toggle between “relative” and “true” wind speed and direction. The relative wind is a combination of the actual wind blowing and the speed wind of the ship. By feeding the ship’s speed data into the WSDI-2 indicator via NCI-1 NMEA converter box, the WSDI-2 is able to calculate the true wind speed and wind.



Installation tips:
The NCI-1 has a built-in CANbus termination resistor, and the NCI-1 can be connected directly to the WSDI-2 without extra termination.
If the CAN cable from NCI-1 is extended or more indicators is connected on the bus, the CAN bus must be terminated with a 120 ohm resistor at the fare end of the cable.
cable should be twisted pair, e.g. Cat 5 cable or Devicenet cable.
1 twisted pair used for connection of pin 3 and 5.

NCI-1 NMEA cable connection to Navigation system			
NCI-1 wire colour	NCI-1 Function	Navigation system NMEA port	NMEA sentences
Blue	Out: B	In: B/-/GND/Return	VWR and MWV
White	Out: A	In: A/+/RX	
Black	Input: B	Out: B/-/GND/Return	VHW, VTG, VBW or RMC
Red	Input: A	Out: A/+/TX	
Bare (shield)	Do not connect	Do not connect	

NMEA sentences

The following NMEA sentences are supported by NCI-1:

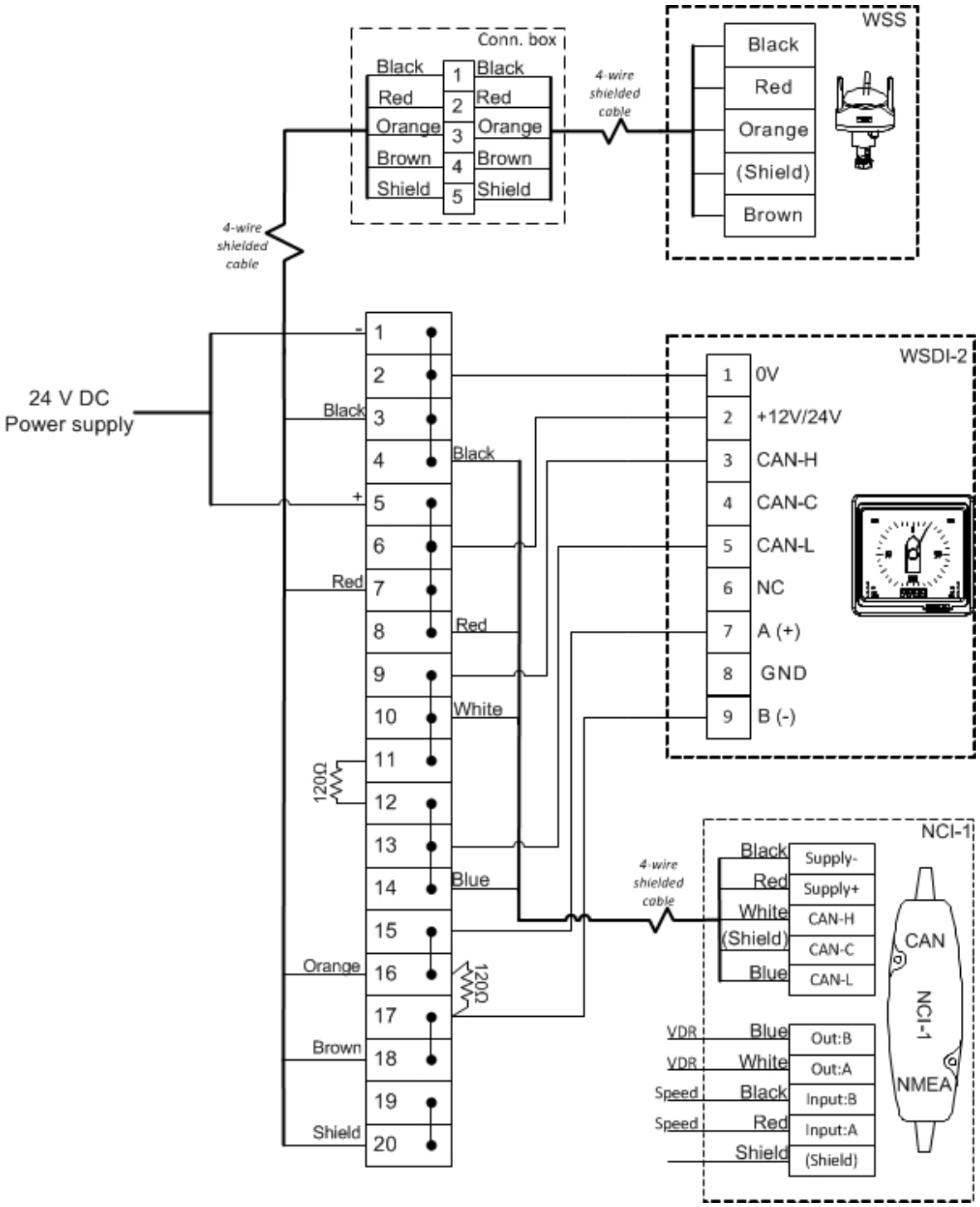
Data used or provided	NMEA Header	Description	Receives	Transmits
Wind speed and direction	MWR	Wind speed and angle (relative only)	x	x
Wind speed and direction	VWR	Old sentence (relative only)		x
Speed through water	VHW	Water speed and heading	x	
Speed through water or over ground	VBW	Dual ground/ water speed	x	
Speed over ground	VTG	Course over ground and water speed	x	
Speed over ground	RMC	Recommended minimum specification GNSS data (GPS)	x	

MWR is the NMEA sentence transmitted from the WSS or WSS-L to the WSDI-2 (terminals 7 and 9), and alternatively one NMEA listener may be connected directly in parallel on those terminals (for example a VDR).

IMPORTANT: When the CANbus is in use, it is not possible to use an external dimmer push-button, since it is the same terminals that are used. Dimmer is only possible on the push-button on the front of the WSDI-2 indicator.

WSDI-2 is not able to present the geographic true wind direction, which is the wind direction relative to north.
See Appendix 1 for details.

Example of wiring



The drop cable from the connection block to the indicator should not exceed 6 meters.

Indicators should be wired with shielded cable.

8. Data sheets and other documents

From the DEIF website www.deif.com, additional documentation such as data sheets, installation manuals, type approval certificates and additional application notes are available for download, this document included.

In the below listed documents, further information about the components in the DEIF wind indication system can be found:

- "WSDI-2 data sheet 4921250062 UK"
- "WSDI-2, user's manual and installation note 4189350032 UK"
- WSS/WSS-L: "Wind sensor static, data sheet 4921250059 UK"
- WSS/WSS-L: "Wind sensor static, installation instructions 4189350026 UK"

9. System components

The different wind measuring system described in this application notes consists of one or more of the following components.

Qty	Description
1	**WSS variant 01** Wind sensor static, type WSS, with built-in heating Stainless steel mast mount Protection: IP66
1	**WSS-L variant 02** Wind sensor static, type WSS-L, without heating Stainless steel mast mount Protection: IP66 (Same housing as WSS)
1 or 2	**WSDI-2 variant 03** **Select FWD**: Forward scale (ship's heading pointing up) Wind indicator type WSDI-2 FWD, with built-in dimmer Panel-mounted Protection: IP66 from front
1	**WSDI-2 variant 03** **Select AFT**: Aft scale (ship's heading pointing down) Wind indicator type WSDI-2 AFT, with built-in dimmer Panel-mounted Protection: IP66 from front

Accessories:

1	WSS extension cable 1 30 meter, 4x 0.75 mm^2 shielded
1	WSS extension cable 2 40 meter, 4x 0.75 mm^2 shielded
1	WSS extension cable 3 50 meter, 4x 0.75 mm^2 shielded
1	WSS extension cable 4 100 meter, 4x 0.75 mm^2 shielded
1	WSS IP66 connection box kit Connection box kit for WSS cable extension with screw terminals
1	WSS IP67 connector kit Male and female connectors for WSS extension cable (solder)
1	NCI-1, NMEA0183 interface box for WSDI-2 Ship's speed input required for true wind calculation & buffered NMEA wind data output
1	WSDI-2: IP66 rear cover with two cable glands IP66 from all directions

True wind indicator solutions:

WSDI-2 RT relative and true wind - variant 04
Select FWD: Forward scale (ship's heading pointing up)
Relative and true wind indicator package incl. NCI-1
Panel-mounted
Protection: IP66 from front

WSDI-2 RT relative & true wind - variant 04
Select AFT: Aft scale (ship's heading pointing down)
Relative and true wind indicator package incl. NCI-1
Panel-mounted
Protection: IP66 from front

Wind system solutions:

WSS wind measuring system, variant 01
Select FWD: Forward scale (ship's heading pointing up)
WSS static wind sensor with heating
WSDI-2 wind indicator
incl. 40 meter extension cable and IP66 connection box kit

WSS wind measuring system, variant 01
Select AFT: Aft scale (ship's heading pointing down)
WSS static wind sensor with heating
WSDI-2 wind indicator
incl. 40 meter extension cable and IP66 connection box kit

WSS-L wind measuring system, variant 02
Select FWD: Forward scale (ship's heading pointing up)
WSS-L static wind sensor with heating
WSDI-2 wind indicator
incl. 40 meter extension cable and IP66 connection box kit

WSS-L wind measuring system, variant 02
Select AFT: Aft scale (ship's heading pointing down)
WSS-L static wind sensor with heating
WSDI-2 wind indicator
incl. 40 meter extension cable and IP66 connection box kit

Appendix 1 – Definition of Relative, True and Geographic wind

Relative wind

The wind sensor on a ship is measuring the relative wind speed and direction where the sensor is located. This measured relative wind is the combination of the wind created by the movement of the ship (red arrow in fig. A1) and the actual wind blowing over the sea (green arrow in fig. A1).
The wind sensor is fixed on the ship and aligned with the bow of the ship. Therefore the relative wind direction is measured with the bow as the zero-direction reference.

The measured wind is called the relative or apparent wind (yellow arrow in fig. A1). It is simply how the wind appears to be when you are standing on top of the moving ship.

That means, that on a totally calm day with absolutely no wind blowing, the relative wind speed will be equal to the ship's speed, and the wind seems to come directly from the bow of the ship (red arrow on fig. A1).
On the other hand, if the ship is moored in the harbour and therefore not moving, the measured wind will be the same as the actual wind blowing (green arrow).

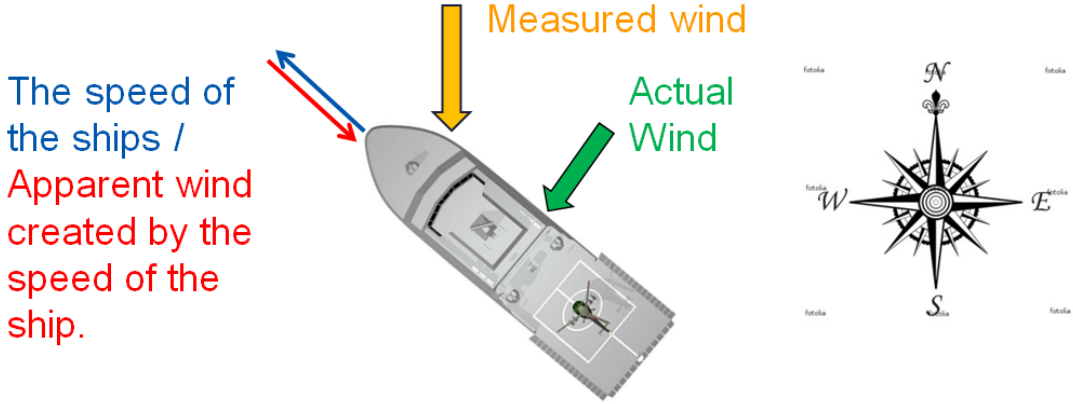


Figure A1

True wind

The true wind is the same as the actual wind blowing (green vector in fig. A1).
The direction of this actual wind blowing can be indicated with the ship's bow as the zero-degree reference, in which case we call it "true wind".
On WSDI-2, the ship's bow is the zero-degree reference for both relative and true wind, so the same wind direction scale can be used for both (see picture).

Note: when the actual wind direction is measured with geographic north as the zero-degree reference, we call it "geographic wind" (or "geographic true wind")

As explained above, the wind sensor is measuring the relative wind speed and direction (yellow vector). If the ship's speed (blue vector) is known, the effect on the wind measurement is the "speed wind" (red vector). The "true wind" (green vector) is calculated using the vector difference:

True wind = Relative wind - "Speed wind"

The ship's speed data will normally be available either from the ship's

doppler log or the GPS navigation system on a serial data output using NMEA01283 (IEC 61162) data format.
This NMEA speed data is sent to the WSDI-2 via the NCI-1 NMEA interface box and when “true” is selected in the WSDI-2 menu, it will calculate and present the true wind speed and direction on the indicator and the “true” LED is turned ON.

WSDI-2 will accept either the speed through the water or speed over the ground.
Please note, that if both types of speed are available via the interface box, the WSDI-2 will automatically use the speed through water for the true wind calculation.

Geographic wind

As stated above, the geographic wind direction has the North Pole as the zero reference.
To be able to calculate geographic wind, it is therefore necessary to have both the ship’s speed and the direction it is heading. This heading may come from the ship’s gyrocompass or GPS compass (or even the magnetic compass) sent as a NMEA0183 sentence.

To find the geographic wind direction, add the true wind direction angle (calculated above) to the ship’s true heading.
In the example in fig. A1, the true wind direction is 90 degree onto the centerline of the ship, the ship is heading 315 degree, and the geographic wind direction is then: 315 deg. + 90 deg. - 360 deg. = 45 deg.

Geographic wind data is very often presented on electronic chart displays or ECDIS systems as a wind arrow with additional digital readout of the true wind speed and geographic wind direction.

From the explanation above, it should be obvious that the “true wind speed” and the “geographic wind speed” is exactly the same, only the wind direction is different depending on whether the direction reference is the bow of the ship or the geographic North Pole.

WSDI-2 is only calculating and presenting “true wind direction” and not “geographic wind direction”.