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ZPulse® Doppler Current Sensor 4420/4520, 4420R/4520R 4830/4930, 4830R/4930R

A rugged, true vector-averaging sensor for measuring current speed and direction in the sea.

Features ZPulse Doppler Current Sensor:

- *Unique ZPulse multi-frequency acoustic technology improves data quality, sampling speed and reduces power consumption*
- *Smart sensor for easy integration on the SeaGuard platform*
- *Built in solid state three axis tilt compensated compass*
- *Direct readout of engineering data*
- *Fast sampling rate*
- *Low power consumption*
- *Insensitive to fouling*
- *Low maintenance needs*
- *4420/4520/4830/4930 model: AiCaP and RS-232 output*
- *4420R/4520R/4830R/4830R model; RS-422 output*
- *4830/4930/4830R/4930R including temperature*

The ZPulse Doppler Current Sensor (DCS) is a single-point current sensor primarily intended to be used with the Aanderaa SeaGuard platform to form a Recording Current Meter (RCM). It is designed for commercial as well as research use. There are 8 versions; 4420/4420R, 4830/4830R has a depth rating of 300 meters, while the 4520/4520R/ 4930/4930R has a depth rating of 6000 meters. 4830/4830R/ 4939/4930R have a temperature sensor included.

4420/4520/4830/4930 has both AiCaP and RS-232 ouput. The SeaGuard platform and the smart sensor are interfaced by means of a reliable CANbus interface (AiCaP), using XML for plug and play capabilities. 4420R/4520R/ 4830R/4930R has only RS-422 output for use as stand-alone sensor with long cables. The sensor version must be specified when ordered as the versions are not interchangeable. The R-version can not be used in SeaGuard applications.

The DCS sensors are based on the backscatter acoustic Doppler principle. The DCS has two orthogonal transducer axes with two transducers on each axis. This enables the DCS to measure in both directions on each axis which is a great advantage. This makes it insensitive to disturbance from vortex speeds around the sensor itself and the mooring line when the forward ping feature is enabled. One transducer on each axis transmits short ultrasonic pulses simultaneously. The same transducers receive backscattered signals from particles in the water. This gives an orthogonal x and y speed component which is tilt compensated to find the correct horizontal speed components.

The North and East speed components are calculated based on the x and y speed components and the heading from the built-in solid state electronic compass. The sensor takes several of these two-component measurements and finally calculates the averaged north and east speed components and the vector averaged absolute speed and direction.

Another great advantage is the new ZPulse technology which improves the statistical precision. Complex acoustic pulses comprising several distinct frequencies are combined into a single acoustic pulse. The ZPulse based DCS separates the received signal into different frequency bands, one for each frequency in the transmitted signal. Further it analyses the frequency shift using a high speed Digital Signal Processor using an ARMA based parametric model processing algorithm to find the Doppler shift frequencies. This multi-frequency technique reduces the required number of pings needed in order to achieve an acceptable statistical error. The achieved measurement precision is proportional to the inverse of the square root of the number of ping measurements in a measurement interval. The ZPulse DCS uses two frequencies and this gives a reduction by a factor square root of two compared to a single frequency sensor. A single frequency sensor needs twice the number of ping to achieve the same precision as the Zpulse DCS.

The solid state sensor is well suited for monitoring low current speeds due to no moving parts. Because the sensor starts measuring in an area 0.4 to 1.0 meter from the instrument, the effect of marine fouling and local turbulence is minimized.

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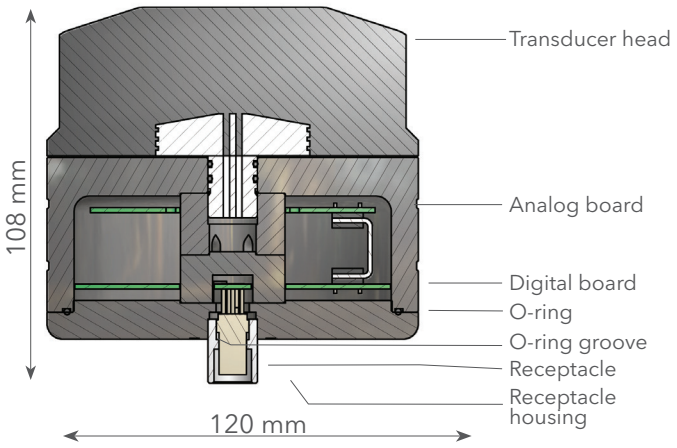
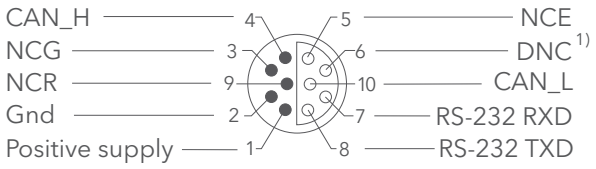
Specifications



PIN CONFIGURATION

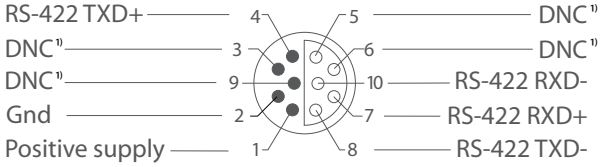
Receptacle, exterior view; pin = ● bushing = ○



DNC[1)] = Do Not Connect

PIN CONFIGURATION 4420R/4520R/4830R/4930R

Receptacle, exterior view; pin = ● bushing = ○



DNC" = Do Not Connect

Specifications subject to change without prior notice.

Current Speed: (Vector averaged)

Range:	0–300cm/s
Resolution:	0.1mm/s
Mean Accuracy:	±0.15cm/s
Relative:	± 1% of reading
Statistic precision (std):	0.3cm/s (ZPulse mode), 0.45cm/s1

Current Direction:

Range:	0–360° magnetic
Resolution:	0.01°
Accuracy:	±5° for 0-15° tilt ±7.5° for 15-35° tilt

Temperature (only 4830/4830R/4930/4930R):

Range:	-5°C to +40°C
Resolution:	0.01°C
Accuracy:	0.1°C
Settling Time(63%):	30s

Tilt Circuitry:

Range:	0-35°
Resolution:	0.01°
Accuracy:	±1.5°

Compass Circuitry:

Resolution:	0.01°
Accuracy:	±3°
Acoustics:	
Frequency:	1.9 to 2.0MHz
Power:	25 Watts in 1ms pulses
Beam angle (main lobe):	2°

Interfaces:

4420/4520/4830/4930:	AiCaP protocol, RS-232
4420R/4520R/4830R/4930R:	RS-422
RS-232/RS-422 Output:	9600 baud, 8 data bit, No parity,1 stop bit, Xon/Xoff

Maximum cable length:

RS-232:	15m
RS-422:	1500m

Installation distance:

From surface:	0.75m
From bottom:	0.5m

Supply Voltage: 6–14 Vdc

Operating Temperature: -5 to +50°C

Depth Capability:

4420/4830:	300m
4520IW/4930IW:	3000m
4520DW/4930IW:	6000m

Electrical Connection: 10-pin plug

Material and Finish:

4420/4420R:	Durotong, POM
4830/4830R:	Durotong, POM, epoxy coated titanium
4520/4930/4520R/4930R:	Durotong, epoxy coated titanium

1) Standard deviation based on 300 pings

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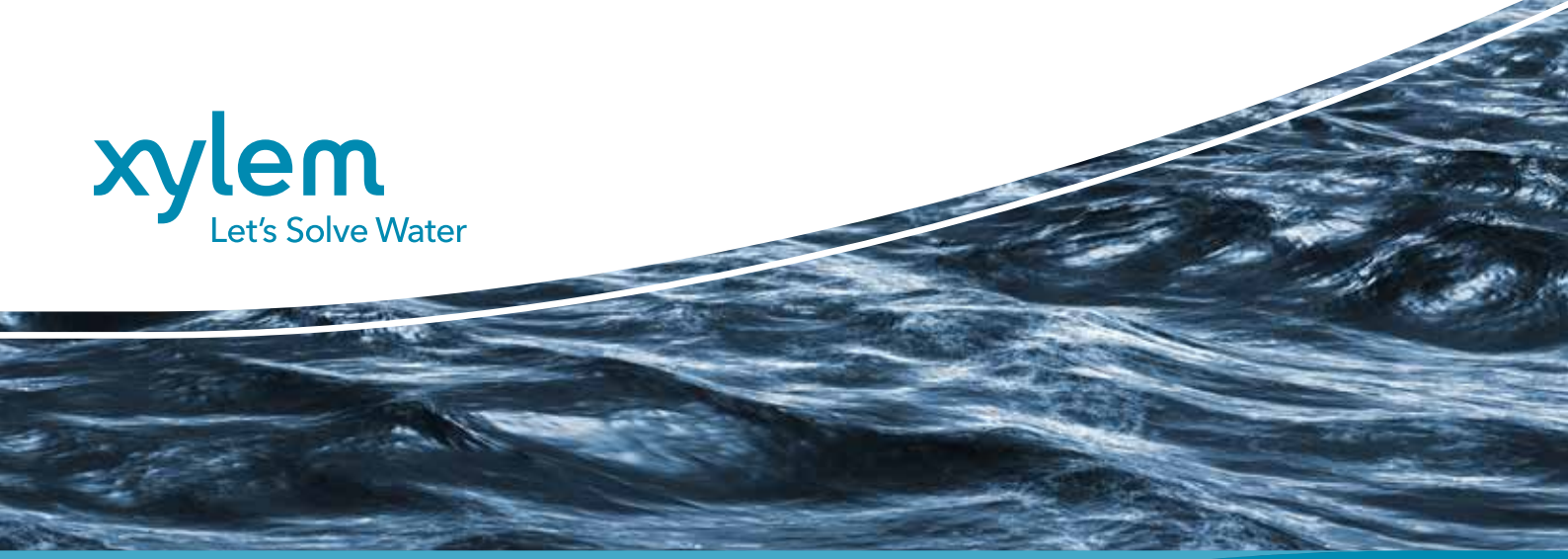

Doppler Current Profiler Sensor – DCPS

5400/5402/5403

The Doppler Current Profiler Sensor (DCPS) is a medium range, 600kHz current profiler smart sensor. It features innovative development of the acoustic profiling ability to collect high quality current information also on moving and tilting platforms. Available as 300m depth rated (5400/5400R), 4500m (5402/5402R), 6000m (5403/5403R). The 5400P/5400PR is furnished with an internal pressure sensor rated to 100m depth. The DCPS can be connected to a SeaGuardII or SmartGuard using the CANbus based AiCaP protocol. It can also be connected to a PC or third party systems through the RS-232 interface. This makes the DCPS the ideal cost effective solution for obtaining current profiles in systems already containing a Datalogger. The R-version is equipped with RS-422 interface suitable for communication over longer cables.

Advantages:

- Built-in solid state 3-axis tilt compensated compass.
- Heading and tilt compensation for each ping.
- Insensitive to fouling.
- Low maintenance needs.
- Output interval from 30 seconds to 2 hours.
- RS-232/RS-422 output for integration to most third party Dataloggers.
- Configurable output engineering data for easy integration.
- Cell size selectable from 0,5 to 5 meters.
- Up to 150 individual cells divided into three columns.

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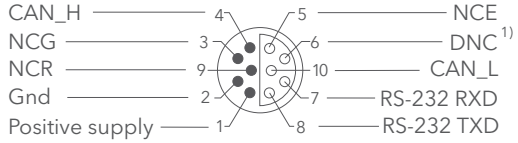
Specifications DOPPLER CURRENT PROFILER SENSOR

PIN CONFIGURATION 5400/5400P/5402/5403

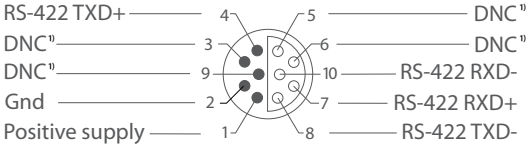
Receptacle, exterior view; pin =● bushing ○



DNC[1)] = Do Not Connect

PIN CONFIGURATION 5400R/5402R/5403R

Receptacle, exterior view; pin =● bushing = ○



DNC" = Do Not Connect

1) Typical range with normal backscatter conditions.
The measurement range is highly dependent on the scattering conditions. For waters with low amount of scatters, expect a shorter range than for waters with a high amount of scatters

2) Standard deviation for the horizontal velocity in broadband mode, 3m cell size

3) Requires pressure data, only available for 5400P/PR or when the DCP Sconnected to a SmartGuard or SeaGuard II data logger with pressure sensor.

4) Compensation calibrated up to ± 35°

5) In Broadband mode, 30min. interval, 20x2 pings, 2m cell size, 20 cells

Technical Details

Velocity Profile Measurement	
Acoustic frequency:	600 kHz
Typical profiling range:	Broadband: 30-70m. Narrowband 35-80m[1)]
Cell size:	0.5m - 5m
Cell spacing:	0.1-30m
Velocity range:	Narrowband: 0-500cm/s (up to 1000cm/s for tilt less than ± 5°) Broadband: 0-400cm/s
Velocity accuracy:	0.3cm/s or ±1% of reading
Velocity resolution:	0.1cm/s
Velocity precision:	<3,3cm[2)]
Ping rate:	Up to 10Hz (depends on config)
Output interval:	30s to 2h
Cell positioning:	Static(instrumentreferred)and/orDynamic(surfacereferred)[3)]
Number of columns:	3 simultaneous columns + Surface cell[3)]
Max. number of cells:	150total,75forfirstcolumn,50forthesecondand25forthethird
Blanking zone:	1m (5400/5400P) 2m (5402, 5403)
Transducers:	
Number of beams:	4
Beam angle:	25°
Beam width:	2.5°
Echo intensity:	
Dynamic range:	> 50dB
Resolution:	< 0.1dB
Accuracy:	< 0.1dB
Tilt and compass:	
Type:	Internal 3-axis tilt solid state
Pitch/roll range:	± 90°[4)] / ± 180°[4)]
Tilt accuracy:	<0.5°(RMS), ± 1.5°
Heading accuracy:	<2°(RMS), ± 3.5° (0-15° tilt), ± 4.5°(15-35° tilt)
Tilt/heading resolution:	< 0.1°
Interfaces:	
5400/5400P/5402/5403:	AiCaP protocol, RS-232
5400R/5402R/ 5403R/ 5400PR:	RS-422
Maximum cable length:	
RS-232:	15m
RS-422:	1500m
Embedded temperature sensor 4080 (not included/optional):	
Range:	-4 - +40°C
Resolution:	0,001°C
Accuracy:	± 0,05°C
Response time:	<5 sec
Embedded pressure sensor (5400P/PR only):	
Range:	0 -1 M Pa
Resolution:	<0,001%
Accuracy:	<0,3 %
Power	
Supply Voltage:	6-30 Vdc
Current drain example:	4,2 mA[5)]
Environmental:	
Depth rating:	PSW/PRSW:100m,SW/RSW:300m,IW/RIW:4500m,DW/RDW:6000m
Operating Temperature:	-5 to +40°C
Dimensions:	D: 160mm H: 167mm
Weight:	In Air In Sea Water
S/W	5.1kg 1.8kg
IW/DW:	7.2kg 4.0kg

Specifications subject to change without prior notice.

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TEST UNIT 5048
for DCS ZPulse

A test unit designed to verify the function of the SeaGuard RCM, and Doppler Current Sensors, DCS 4420, 4520, 4830, 4930, 5800 and 5810

The Test Unit 5048 is designed to verify that vital parts of the ZPulse Doppler Current Sensor (DCS) are working correctly. The Test Unit is designed for DCS installed on the SeaGuard, RCM Blue and for stand alone DCS in the 4420,4520,4830,4930,5800 and 5810 series. For older DCS with single frequency use Test Unit 3731

The Test Unit consists of a ring with 4 test transducers suspended by mechanical springs, enabling each test transducer to be pressed against the DCS transducers.

The test transducers pick up some of the energy transmitted by the 'ping' from the DCS. This energy is used to start oscillation of the test transducers. In the receiving stage of the DCS the test transducers are still oscillating and thus transmitting a weak signal back to the DCS.

Each of the four test transducers concist of 2 ocillators corresponding to the two frequencies in each ZPulse signal.

Two of the test transducers are made of crystals with slightly higher resonance frequency than the DCS transducers, and two are made of crystals with slightly lower resonance frequency. The high frequency corresponds to the received signal when the current direction is towards the DCS, and the low frequency corresponds to a current flowing away from the DSC.

The frequency shift corresponds to a simulated current speed of about 2.20 m/s if Forward Ping is disabled. The direction of the simulated current is along the centre line between the two low frequency test transducers, marked by a slot in the Test Unit ring.

Procedure for mounting the Test Unit to the DCS:

- Moisten the surface of the transducers for optimal contact.
- Bring the test transducers to their outer position by pulling and turning the grey handles.
- Hold the Test Unit around the DCS and align the test transducers to face the DCS transducers.
- Release carefully the mechanical springs one by one so that the test transducers are in contact with the DCS transducers

Tilting the instrument/DCS corresponds to a slight increase in current speed readings:

10° tilt corresponds to 2% increase in reading.

35° tilt corresponds to 8% increase in reading.

SeaGuard using internal display

1. Mount the Test Unit to the transducer head/DCS according to procedure.
2. Start instrument and switch off Forward pinging
3. Open Menu > Administrative Tools > Sensor Monitor to read the speed and direction from sensor.
4. Align the instrument/DCS and the Test Unit so that the orientation slot is in the north direction.
5. Always disregard the first two readings. Read speed and direction
6. Dismount the Test Unit and rotate it 90° without moving the instrument/DCS. Remount the Test Unit to the instrument/DCS. Read the Current speed and direction.
7. Repeat the 90° increment until you back to the start position.
8. Check that the Direction reading is incremented with approximatly 90° after each turning and the Speed reading is approximatly 220cm/s.
9. To check compass keep the ring on and torn instrument/sensor in 90° steps.

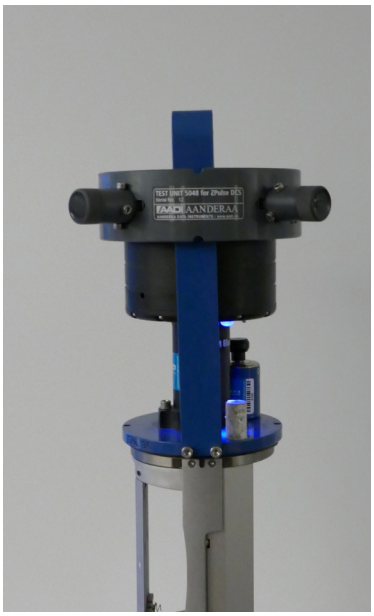
RCM Blue, SeaGuard Basic or stand-alone sensor using AADI Real-Time Collector

1. Establish contact with the sensor using Bluetooth or cable, for RCM Blue connect a wire from temperature housing under the DCS head and the battery connector to simulate in water condition. This is necessary to start the pinging on RCM Blue.
2. Start sensor and switch of Forward pinging.
3. Open Graphical tool to read speed direction, Tilt X and TiltY, see example on next page.
4. Repeat point 4. to 9. from procedure above.

Stand-alone sensor using terminal software

1. Establish contact with the sensor and switch off Forward pinging
2. Start sensor and read Speed, Direction, TilX and Tilt Y from data string
4. Repeat point 4. to 9. from procedure above.

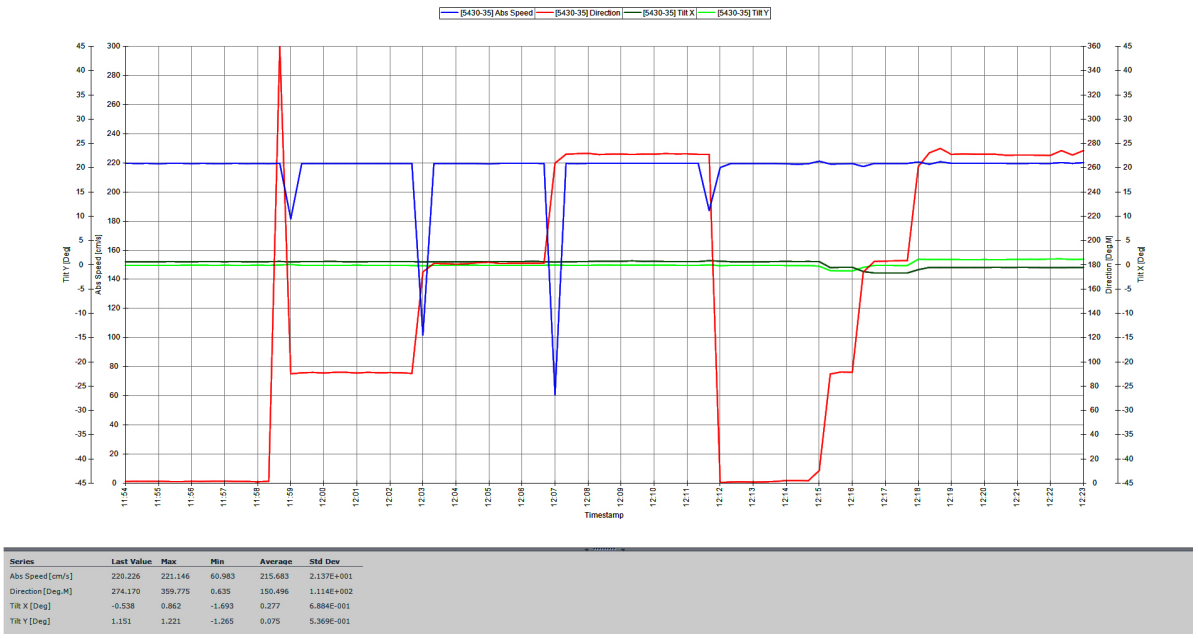
Example of use



Test Unit connected to RCM Blue

Test Unit connected to In-line DCS

Test Unit connected to SeaGuard with display



Series	Last Value	Max	Min	Average	Std Dev
Abs Speed [cm/s]	220.226	221.146	60.983	215.683	2.137E+001
Direction [Deg.M]	274.170	359.775	0.635	150.496	1.114E+002
Tilt X [Deg]	-0.538	0.862	-1.693	0.277	6.884E-001
Tilt Y [Deg]	1.151	1.221	-1.265	0.075	5.369E-001

Example of reading from sensor using AADI Real-Time Collector
Red line is showing the direction and each step is after turning the ring 90°

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Visit our Web site for the latest version of this document and more information
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