

Acoustic Modems

We are used to using cable connections for underwater data transfer between two locations. This is the most commonly used method for long-distance transmission. However, wireless underwater data telemetry technology is currently proving capable of providing an alternative method. Acoustic modems are designed to offer a seamless interface for subsurface data transmission and are already in use in many applications.

So the technology works. But practicality is the issue in many cases where, for instance, horizontal and vertical performance is involved. A system might perform to full satisfaction in one case but a change in conditions or application may reduce performance. Optimum performance of wireless acoustic modem systems depends upon several conditions: speed of sound, water depth, existence of thermoclene zones, ambient noise and seasonal change. It appears that long-term average rates of successful transmission may fall dramatically at a range of several km in the typically adverse shallow-water acoustic channel. This might be adequate for networked acoustic modems to be cost-effective in providing quantities of data typically required for data assimilative modelling of coastal oceanographic processes. However, systems equipped with message storage and handshaking-protocol technology can improve the liability and performance of the wireless data connection. Most systems are capable of being mounted on moving platforms such as AUVs, drifters, submarines, ships and buoys. These applications require multiphase Doppler correction algorithm in order to render them capable of compensating for relative movements between source and receiver. For longer-distance connections, network solutions with repeater stations are another possibility.

Hydro International is much indebted to all the manufacturers who contributed to this product survey, thus exposing their products to scrutiny. Some manufacturers, announced the launch of new data-communication products later this year. These are not included in this Product Survey. We would also like to acknowledge the assistance of Paul van Walree of TNO, who helped prepare the survey.

Company Nane	Aquates		
Name of Product	Aquatec AOUAmodem		
Year of initial development	1998		
General Specifications L/W/H (cm)	From 24.2cm long x 16.5cm diameter (external		
L/W/H (cm)	power)		
Housing material	Anodised Aluminium 6082 standard, other materials to suit application		
Weight in air (kg)	From 5kg (external power)		
Weight in water (kg)	Appr. I.5kg (external power)		
Operating power voltage	10V to 20V standard or to application		
Transmit mode power consumption (W) Receive mode power consumption (W)	20W typical 600mW		
Sleep mode power consumption (W)	5mW (low power acoustic wakeup mode)		
Max deployment depth (m)	1000m standard, or according to housing		
Operating temperature range (°C)	-5°C - 40°C		
Max battery lifetime	According to pack, wakeup and transmit cycle		
Acoustics			
Source level (dB re IµPa@Im)	185 dB re 1µPa@1m typical		
Transducer beam width (deg)	Hemispherical as illustrated, others according to		
May working range in see water (re)	application Up to 10km, according to acoustic path		
Max working range in sea water (m) Operating frequency range (Hz)	8-12kHz as illustrated, 20-27kHz and 55-65kHz alter-		
operating requester range (112)	natives		
Signal Processing Data link modulation type (e.g. PSK, FSK, OFDM, DSSS)	DSSS or MFSK		
Raw data rate (bit/s)	1000		
User data rate (bit/s) (user data divided by the total transmit time, taking into account channel estimation, training, coding, etc.)	300		
Bit error rate	Typically 1e-6		
Minimum required SNR (dB)	6dB		
Doppler tolerance (relative velocity in m/s)	10m/s		
Maximum channel delay spread (ms)	Depends on operating mode		
Other specifications	NIMEA 0103 . L ACCII ACCII DI		
Type of dataformat	NMEA-0183 style ASCII, ASCII, Binary, or customer agreed		
Interfacing (eg RS232)	RS232 or USB		
Half duplex or full duplex?	Half duplex		
Is the performance specified for a verti- cal link, horizontal link, or?	Vertical, Horizontal, Shallow water reverberant		
Multiplexing capability available?	Customised functions / processing available at customers request		
Can the subsea modem be powered from other source?	Υ Υ		
What data storage capabilities?	IGB SD Card		
What processing features are available?	Customised functions / processing available at customers request		
Are repeater functions available?	Υ		
Does the system provide range information?	Y		
Ranging accuracy (m)	< Im		
Does the subsea modem have release functionality?	No, but can be used to trigger an external release		
Does the system support network capability?	Υ		
Can the system be used for covert communications?	N		
What is the typical application for your			
system (max 30 words)	This system may be used in vertical applications, but		
	has been optimised for acoustically difficult environ- ments, including shallow water reverberant conditions and long range Arctic under-ice communication.		

N/A Not Applicable
☐ No information received



and long range Arctic under-ice communication



HAMNODE 2005	develogic GmbH	EvoLogics GmbH	EvoLogics GmbH
2005 2005 2005 2005 2005 2005 2005 2005	Digital Hydroacoustic Modem with Multi-Node Capability	Hydroacoustic Modem S2C M 7/17 H	
Electronics: I florm diameter, I45nm height Sewater resistant aluminium, hard anotized and PTFE consocial (standard, Trainmin, sport degles steel and synthetics housings available upon request. 125 w/ 126 most (standard) aluminium housing) 126 w/ 126 words (standard) aluminium housing) 127 w/ 126 words (standard) aluminium housing) 128 w/ 126 words (standard) aluminium housing) 129 w/ 126 words (standard) aluminium housing) 129 w/ 126 words (standard) aluminium housing) 120 w/ 126 words (standard) aluminium housing) 120 w/ 126 words (standard) aluminium housing, 4000m with deep rated distingent of the standard aluminium housing, 5000m with deep rated distingent of the standard aluminium housing, 5000m with deep rated distingent or sport degles the steep housing of the standard aluminium housing, 5000m with deep rated distingent or sport degles the steep housing of the standard aluminium housing, 5000m with deep rated distingent or sport degles with the standard aluminium housing, 5000m with deep rated distingent or sport degles with the standard aluminium housing, 5000m with deep rated distingent or sport degles with the standard aluminium housing, 5000m with deep rated distingent or sport degles with the standard aluminium housing, 5000m with deep rated distingent or sport degles with the standard aluminium housing, 5000m with deep rated distingent or sport degles with the standard aluminium housing, 5000m with deep rated distingent or sport degles with the standard aluminium housing, 5000m with deep rated distingent or sport degles with the standard aluminium housing, 5000m with deep rated distingent or sport degles with the standard aluminium or sequent distingent or sport degles with the standard aluminium or sequent distingent or sport degles with the standard distingent or sport degles with the standard distingent or sport degles with the standard distingent or sport degles with the sport	HAM.NODE		
Seawater resistant aluminium, hard anodized and PTFE coxed (transfur), Transium, super duplex steel and synthet. 12	2000	2005	2005
Seewater resistant aluminium, hard anodized and PTFE costed (candral). Trianium, spee duples steel and syndest-costed (candral). Trianium, spee duples steel and syndest-costed (candral). Trianium, super duples steel and syndest-costed (candral). Trianium, super duples steel and syndest-costed (candral). Aluminium housing). 40	Floatronics: LIOmm diameter 145mm height	E4 v 12cm	25 x 12cm without betteries 40 x 12cm with internal
Transium, stainless steel or durinium on request	Electronics: 110mm diameter, 145mm neight	34 X T3CIII	
coated (sandard). Titanium, super duplex steel and synthetic lise housings wildling upon request. 13 (a) Wo batteries (sandard aluminium housing) 2	Seawater resistant aluminium, hard anodized and PTFE	Titanium, stainless steel or aluminium on request	Aluminium alloy, stainless steel or titanium on request
ize housings available upon request. 128g w/o bettered (standard aluminium housing) 128g w/o (color) 129g w/o (color) 129g w/o (color) 129g		4	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
48g w/o Stateries	ics housings available upon request.		
\$\frac{3.360PC_{\text{lefow} receiver only }{2.80 \text{ 500PC}_{\text{lefow}			
Up to 500W peak, 30-80W pipela Adjustable 10., 100W 200-800mW	4kg w/o batteries		
 X 3 W	536VDC (below 11V receiver only)		
Service Serv			
1200m standard aluminium housing, 6000m with deep rated composite aluminum housing, 6000m with deep rated titu-inium or upper duplex steel housing, 3-40°C 10°C - 40°C 10°C - 40°C 9Ah, others on request 10°C - 40°C 9Ah, others on request 10°C - 40°C 10°C - 40°C 9Ah, others on request 10°C - 40°C 10°C - 40°C 10°C - 40°C 9Ah, others on request 10°C - 40°C 10°C - 40°C			
composite aluminum housing, 900m with deep rated tite- nitim or super diplex steel housing, 3° - 40°C. 10°C - 40°C. 75°C -			
nium or super duplex steet housing. 5- 40°C 10°C - 40°C - 40°C 10°C		23011 (0,000111 Optional)	200111 (2000111 opt)
- 10°C - 40°C -10°C			
Typically 2-1-2 years, depending on mission scenario and battery configuration On request Shattery configuration Shattery co		-10°C - 40°C	-10°C - 40°C
Depending on transducer choice Up to 191dB, adjustable Hemispherical Hem	Typically >1-2 years, depending on mission scenario and		9Ah, others on request
Omidirectional beam, toroidal beam or directional beam or depending on transducer choice. 25.500m with ITC 2002 transducer Depending on transducer from 3-6kHz up to 40-75kHz. OFDM-MDPSK, DF-Equalizing (OFDM-Orthogonal frequency Division Multiplexing, MDPSK: Marry Differential Depending on transducer, from 3-6kHz up to 40-75kHz. OFDM-MDPSK, DF-Equalizing (OFDM-Orthogonal frequency Division Multiplexing, MDPSK: Marry Differential Depending on transducer, choice, channel characteristics and parameterization up to 32 kbits with high frequency wideband transducer. Is bit if up to 2-910 kbits, depending on channel characteristics and carrier bandwidth Depending on channel characteristics, operation mode (uniforbidirectional) and error correction mode. 486 Depending on channel characteristics, operation mode (uniforbidirectional) and error correction mode. 487 Woo-plass Doppier compensation for relative movements with electeration to 10 mg and short period movements with electeration to 10 mg and short period movements with electeration up to 3 mg. (Long and short period movements with electeration) and error correction mode. 488 489 Woo-plass Doppier compensation for relative movements with electeration up to 3 mg. (Long and short period movements with electeration) and error correction mode. 489 480 Wor chan 2 mg. (Long and short period movements with electeration) and error correction mode. 489 Wor chan 2 mg. (Long and short period movements with electeration) and error correction mode. 489 Wor chan 2 mg. (Long and short period movements with electeration) and error correction mode. 489 Wor chan 2 mg. (Long and short period movements with electeration) and error correction mode. 480 Wor chan 2 mg. (Long and short period movements with electeration) and error correction and an error electrons. 480 Wor chan 2 mg. (Long and short period movements with electrons) and error electrons. 481 Wor chan 2 mg. (Long and short period movements with electrons) and error electrons. 482 Any RE3232/RS4	battery configuration	'	' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' '
Omnidrectional beam, toroidal beam or directional beam, depending on transducer choice. >25.000 with ITC 2002 transducer Depending on transducer, from 3-6kHz up to 40-75kHz. OFDM-MPSK, DF-Equalizing (OFDM-Orthogonal Frequency Division Multiplexing, MDFSK, M-ary Differential Dispending on transducer, choice, channel characteristics and parameterization up to 32 kbits with high frequency wideband transducer. Depending on transducer choice, channel characteristics and parameterization up to 32 kbits with high frequency wideband transducer. Depending on channel characteristics, operation mode (uniforbiding on channel characteristics and carrier bandwidth Depending on channel characteristics, operation mode (uniforbiding on channel characteristics) and error correction mode. Depending on channel characteristics, operation mode (uniforbiding on channel characteristics) and error correction mode. Depending on channel characteristics, operation mode (uniforbiding on channel characteristics) and error correction mode. Depending on channel characteristics, operation mode (uniforbiding on channel characteristics) and error correction mode. Depending on channel characteristics, operation mode (uniforbiding on channel characteristics) and error correction mode. Depending on channel characteristics, operation mode (uniforbiding on channel characteristics) and error correction mode. Depending on channel characteristics, operation mode (uniforbiding on channel characteristics) and error correction mode. Any Bobbas Depending on channel characteristics and carrier bandwidth of the processing of the processing of the processing on the processing on the processing on the processing on the processing available upon request publication can be specified for both, shallow water and near vertical channels, specified more more external, Rechargable batteries (internal or external), Experal power supply. Valuation of the processing available upon request place of the processing available upon request place of the processing			
depending on transducer choice. 25,000m with ITC 2002a transducer Depending on transducer from 3-6kHz up to 40-75kHz. OFDM-MDPSK, DF-Equalizing (OFDM: Orthogonal Frequency Division Multiplexing, MDPSK: Mary Differential Plass Shift Keyntal on the 12 kbit's with high frequency wideband transducer. Depending on transducer choice, channel characteristics and parameterization up to 32 kbit's with high frequency wideband transducer. 150 bit's up to 310 bit's, depending on channel characteristics and carrier bandwidth Depending on channel characteristics, operation mode (unior bidirectional) and error correction mode. Less than 10e-7 Any More than 3m/s More than 3m/s No restrictions Res232 and Ethernet Interface. Interface as a papicable for both, shallow water and read vertical facinates are applicable			
>>5.000m with ITC 2002a transducer Depending on transducer from 3-6kHz up to 40-75kHz. OFFDM-MDPSK, DF-Equalizing (OFDM: Orthogonal Frequency Division Multiplexing, MDPSK: M-ary Differential Phase Shift Keying) Depending on transducer choice, channel characteristics and characteristics of the state of		Hemispherical	Horizontally omnidirectional
Depending on transducer, from 3-6kHz up to 40-75kHz. 48,000Hz - 78,000Hz S2C		9.000	3 F00m
Frequency Division Multiplexing, MDPSK: Phary Differential Phase Shift Keying) Depending on transducer choice, channel characteristics and parameterization up to 32 kbit/s with high frequency widebard transducer. 150 bit/s up to >>10 kbit/s, depending on channel characteristics and parameterization up to 32 kbit/s with high frequency widebard transducer. 150 bit/s up to >>10 kbit/s, depending on channel characteristics and carrier bandwidth Depending on channel characteristics, operation mode (university to 2 L2mks, incl. long and short period movements with acceleration up to 1½. Frequency Division Multiplexing, MDPSK: M-ary Differential Phase Shift Keying) Depending on channel characteristics, operation mode (university to 2 L2mks, incl. long and short period movements with acceleration up to 1½. Frequency Division Multiplexing, MDPSK: M-ary Differential Phase Shift Keying) Frequency Division Multiplexing, MDPSK: M-ary Differential Phase Shift Keying) Ca. 8,000 bit/s. Tange dependent, self-adaptive Ca. 8,000 bit/s, range dependent, self-adaptive Ca. 8,000 bit/s. Tange dependent, self-a			
Frequency Division Multiplexing, MDPSK: M-ary Differential Phase Shift Keying) Depending on transducer choice, channel characteristics and parameterization up to 32 kbirls with high frequency wideband transducer. 150 birls up to >10 birls, depending on channel characteristics and carrier bandwidth Depending on channel characteristics, operation mode (unitratible in the proper compensation for relative movements with acceleration up to 1g. Two-phase Doppler compensation for relative movements with acceleration up to 1g. Transparent or telegram based Any RS232/RS422 (selectable), optionally up to 4 additional interfaces are applicable for near vertical channels, specified maximum data rates are applicable for near vertical channels, specified maximum data rates are applicable for near vertical channels (internal or external); Rechargeable batteries (internal or external); Sectoral power sources: Primary batteries (internal or external); External power sources: Primary batteries (internal or external); External power supply SD card (up to 4.6B) also usable for user data Propending on environment Im Y Y Y Y Y Y Y Y Y Y Y Y Y	Depending on transducer, from 3-6kHz up to 40-75kHz.	70,00002 - 70,00002	10,000ΠΖ - 34,000ΠΖ
Frequency Division Multiplexing, MDPSK: M-ary Differential Phase Shift Keying) Depending on transducer choice, channel characteristics and parameterization up to 32 kbirls with high frequency wideband transducer. 150 birls up to >10 birls, depending on channel characteristics and carrier bandwidth Depending on channel characteristics, operation mode (unitratible in the proper compensation for relative movements with acceleration up to 1g. Two-phase Doppler compensation for relative movements with acceleration up to 1g. Transparent or telegram based Any RS232/RS422 (selectable), optionally up to 4 additional interfaces are applicable for near vertical channels, specified maximum data rates are applicable for near vertical channels, specified maximum data rates are applicable for near vertical channels (internal or external); Rechargeable batteries (internal or external); Sectoral power sources: Primary batteries (internal or external); External power sources: Primary batteries (internal or external); External power supply SD card (up to 4.6B) also usable for user data Propending on environment Im Y Y Y Y Y Y Y Y Y Y Y Y Y			
Frequency Division Multiplexing, MDPSK: M-ary Differential Phase Shift Keying) Depending on transducer choice, channel characteristics and parameterization up to 32 kbirls with high frequency wideband transducer. 150 birls up to >10 birls, depending on channel characteristics and carrier bandwidth Depending on channel characteristics, operation mode (unitratible in the proper compensation for relative movements with acceleration up to 1g. Two-phase Doppler compensation for relative movements with acceleration up to 1g. Transparent or telegram based Any RS232/RS422 (selectable), optionally up to 4 additional interfaces are applicable for near vertical channels, specified maximum data rates are applicable for near vertical channels, specified maximum data rates are applicable for near vertical channels (internal or external); Rechargeable batteries (internal or external); Sectoral power sources: Primary batteries (internal or external); External power sources: Primary batteries (internal or external); External power supply SD card (up to 4.6B) also usable for user data Propending on environment Im Y Y Y Y Y Y Y Y Y Y Y Y Y	OFDM-MDPSK, DF-Equalizing: (OFDM: Orthogonal	S2C	S2C
Phase Shiff. Keying) Depending on transducer choice, channel characteristics and parameterization up to 32 kbit/s with high frequency wideband transducer. 150 bit/s up to >>10 kbit/s, depending on channel characteristics, operation mode (unicori bidirectional) and error correction mode. 4d8 Depending on channel characteristics, operation mode (unicori bidirectional) and error correction mode. 4d8 Saba Saba Saba More than 2m/s Inapplicable due to equalizing and cyclic pre-/postfixing Transparent or telegram based RS232/RS422 (selectable), optionally up to 4 additional interfaces Time division duplexing Doppler tolerance is specified for both, shallow water and near vertical channels, specified maximum data rates are applicable for near vertical channels, specified maximum data rates are applicable for near vertical channels, specified maximum data rates are applicable for near vertical channels (see above), decreasing with distance and shallow water/horizontal channels. Y N/A Optional power sources: Primary batteries (internal or external); External power supply SD card (up to 4GB) also usable for user data Data compression/other processing available upon request Imagerity, and multipath structure diagnosis. Y Y Y Y Y Y Y Y Y Y Y Y Y			
Depending on transducer choice, channel characteristics and parameterization up to 32 kbit/s with high frequency wideband transducer. 150 bit/s up to > 10 bit/s, to > 10 bit/s, depending on channel characteristics and carrier bandwidth Depending on channel characteristics, operation mode (unity or bidirectional) and error correction mode. 48 Two-phase Doppler compensation for relative movements up to 1 2 m/s, incl. long and short period movements with acceleration up to 1g and present or 1 2 m/s, incl. long and short period movements with acceleration up to 1g and present or 1 2 m/s, incl. long and short period movements with acceleration up to 1g and present or 1 2 m/s, incl. long and short period movements with acceleration up to 1g and present or 1 m/s and present or 1			
wideband transducer. 150 bit/s up to >>10 bit/s, po >>10 bit/s, pending on channel characteristics and carrier bandwidth 150 bit/s up to >>10 bit/s, po >>10 bit/s, pending on channel characteristics, operation mode (unity) bit/s, pending of the pending on channel characteristics, operation mode (unity) bit/s, pending of the pending on channel characteristics, operation mode (unity) bit/s, pending on characteristics, operation mode (unity)		Up to 6,500 bit/s	14,000 bit/s
150 bits' up to >>10 bits', depending on channel characteristics and carrier bandwidth Ca. 8,500 bits, range dependent, self-adaptive Ca. 8,000 bits, range dependent, self-adapti	and parameterization up to 32 kbit/s with high frequency		
Depending on channel characteristics, operation mode (unior bidirectional) and error correction mode. 4.08 Two-phase Doppler compensation for relative movements with acceleration up to 1g Inapplicable due to equalizing and cyclic pre-/postfixing Transparent or telegram based Any RS232/RS422 (selectable), optionally up to 4 additional interfaces Time division duplexing Doppler tolerance is specified for both, shallow water and near vertical channels, specified maximum data rates are applicable for near vertical channels (see above), decreasing with distance and shallow water/horizontal channels Y Norestrictions No restrictions No restrictions RS232/RS422 (selectable), optionally up to 4 additional interfaces RS232 and Ethernet, others on request Half duplex Horizontal and vertical link Horizontal and vertical link Horizontal and vertical link N/A N/A N/A Optional power sources: Primary batteries (internal or external); External power supply Sto Card (up to 4GB) also usable for user data Data compression/other processing available upon request Image of the compression of the processing available upon request Image of the compression of the processing available precision ranging optionally and multipath structure diagnosis. Y Runtime based ranging available, precision ranging optionally and multipath structure diagnosis. Y Runtime based ranging available, precision ranging optionally and multipath structure diagnosis. Y Runtime based ranging available as option N N N N N N N N N N N N N			
Depending on channel characteristics, operation mode (unior bidirectional) and error correction mode. 4dB Two-phase Doppler compensation for relative movements with acceleration up to 1g 12m/s, incl. long and short period movements with acceleration up to 1g. Transparent or telegram based RS232/RS422 (selectable), optionally up to 4 additional interfaces Transparent or telegram based Any RS232/RS422 (selectable), optionally up to 4 additional interfaces Transparent or telegram based Any RS232/RS422 (selectable), optionally up to 4 additional interfaces Transparent or telegram based Any RS232 and Ethernet, others on request Half duplex Horizontal and vertical link Horizontal and vertical link Province of the following of the processing washable upon request externally, Rechargeable batteries (internal or external); External power supply SD card (up to 4GB) also usable for user data Data compression/other processing available upon request Data compression/other processing available upon request In the province of the processing available upon request In the province of the processing available upon request In the province of the processing available upon request In the province of the processing available upon request In the province of the processing available upon request In the province of the processing available upon request In the province of the processing available upon request In the province of the processing available upon request In the province of the processing available upon request In the province of the processing available upon request In the province of the processing available upon request In the province of the processing available upon request In the province of the processing available upon request In the province of the processing available upon request In the province of the processing available upon request In the province of the processing available upon request In the province of the province of the processing available upon request In the province		Ca. 3,500 bit/s, range dependent, self-adaptive	Ca. 8,000 bit/s, range dependent, self-adaptive
or bidirectional) and error correction mode. 4dB Two-phase Doppler compensation for relative movements up to ± 12m/s, incl. long and short period movements with acceleration up to 1g Inapplicable due to equalizing and cyclic pre-/postfixing No restrictions RS232/RS422 (selectable), optionally up to 4 additional interfaces Time division duplexing Doppler tolerance is specified for both, shallow water and an ear vertical channels, specified maximum data rates are applicable for near vertical channels (see above), decreasing with distance and shallow water/horizontal channels. Y N/A Optional power sources: Primary batteries (internal or external); External power supply SD card (up to 4GB) also usable for user data Data compression/other processing available upon request integrity and multipath structure diagnosis. Y Runtine based ranging available, precision ranging optionally available Depending on environment Y, mechanical release interface available as option N Y Y Y Y Y Y Y Y Y Y Y Y	teristics and carrier bandwidth		
or bidirectional) and error correction mode. 4dB Two-phase Doppler compensation for relative movements up to ± 12m/s, incl. long and short period movements with acceleration up to 1g Inapplicable due to equalizing and cyclic pre-/postfixing No restrictions RS232/RS422 (selectable), optionally up to 4 additional interfaces Time division duplexing Doppler tolerance is specified for both, shallow water and an ear vertical channels, specified maximum data rates are applicable for near vertical channels (see above), decreasing with distance and shallow water/horizontal channels. Y N/A Optional power sources: Primary batteries (internal or external); External power supply SD card (up to 4GB) also usable for user data Data compression/other processing available upon request integrity and multipath structure diagnosis. Y Runtine based ranging available, precision ranging optionally available Depending on environment Y, mechanical release interface available as option N Y Y Y Y Y Y Y Y Y Y Y Y			
or bidirectional) and error correction mode. 4dB Two-phase Doppler compensation for relative movements up to ± 12m/s, incl. long and short period movements with acceleration up to 1g Inapplicable due to equalizing and cyclic pre-/postfixing No restrictions No restrictions No restrictions No restrictions No restrictions No restrictions RS232/RS422 (selectable), optionally up to 4 additional interfaces Transparent or telegram based Any RS232/RS422 (selectable), optionally up to 4 additional interfaces Time division duplexing Doppler tolerance is specified for both, shallow water and near vertical channels, specified maximum data rates are applicable for near vertical channels (see above), decreasing with distance and shallow water/horizontal channels. Y N/A Optional power sources: Primary batteries (internal or external); Rechargeable batteries (internal or external); External power supply SD card (up to 4GB) also usable for user data Data compression/other processing available upon request FEC, data packet management, up to 8 internal data channels, see the management, distance and velocity measurement, USBL opt, Signal integrity and multipath structure diagnosis. Y Runtime based ranging available, precision ranging optionally available Depending on environment V, mechanical release interface available as option N N Y Y Y Y Y Y Y Y Y Y Y		1 10 7	1 10 7
3dB 3dB 5dB		Less than Tue-7	Less than 10e-7
Two-phase Doppler compensation for relative movements up to ± 12m/s, incl. long and short period movements with acceleration up to 1g Inapplicable due to equalizing and cyclic pre-/postfixing Transparent or telegram based Any RS232/RS422 (selectable), optionally up to 4 additional interfaces Transparent or telegram based Any RS232/RS422 (selectable), optionally up to 4 additional interfaces Transparent or telegram based Any RS232 and Ethernet, others on request interfaces Half duplex Half duplex Horizontal and vertical link Horizontal and vertical link Horizontal and vertical link Province and shallow water/horizontal channels, see above), decreasing with distance and shallow water/horizontal channels. Y N/A Optional power sources: Primary batteries (internal or external); Esternal power supply SD card (up to 4GB) also usable for user data Data compression/other processing available upon request page and the processing available upon request integrity and multipath structure diagnosis. Y Runtime based ranging available, precision ranging option-ally available Depending on environment Y, mechanical release interface available as option N Y Norestrictions Norestrictions		2 dD	EAD
up to ½ 12m/s, incl. long and short period movements with acceleration up to 1g Inapplicable due to equalizing and cyclic pre-/postfixing No restrictions Transparent or telegram based Any Any RS232/RS422 (selectable), optionally up to 4 additional interfaces Time division duplexing RS232 and Ethernet, others on request interfaces are applicable for near vertical channels, specified maximum data rates are applicable for near vertical channels (see above), decreasing with distance and shallow water/horizontal channels. Y N/A Optional power sources: Primary batteries (internal or external); External power supply SD card (up to 4GB) also usable for user data Data compression/other processing available upon request Cata (up to 4GB) also usable for user data Data compression/other processing available upon request Integrity and multipath structure diagnosis. Y Runtime based ranging available, precision ranging optionally available Depending on environment Im N Y Y Y Y Y Y Y Y Y Y Y Y			
Inapplicable due to equalizing and cyclic pre-/postfixing No restrictions No restrictions		Tiore dian 211/3	Tiore than 5m/5
Inapplicable due to equalizing and cyclic pre-/postfixing Transparent or telegram based Any RS232/RS422 (selectable), optionally up to 4 additional interfaces Time division duplexing Doppler tolerance is specified for both, shallow water and near vertical channels, specified maximum data rates are applicable for near vertical channels (see above), decreasing with distance and shallow water/horizontal channels. Y Optional power sources: Primary batteries (internal or external); External power supply SD card (up to 4GB) also usable for user data Data compression/other processing available upon request FEC, data packet management, up to 8 internal data channels, distance and velocity measurement, USBL opt, Signal integrity and multipath structure diagnosis. Y Runtime based ranging available, precision ranging optionally available Depending on environment Transparent or telegram based Any RS232 and Ethernet, others on request Half duplex Horizontal and vertical link Horizontal and vertical link Transparent or telegram based RS232 and Ethernet, others on request RS232 and Ethernet Transparent or equest RS232 and Ethernet RS232 and Ethernet Any Horizontal and vertical link Transparent or equest RS232 and Ethernet RS232 and			
RS232 (selectable), optionally up to 4 additional interfaces Time division duplexing Doppler tolerance is specified for both, shallow water and near vertical channels, specified maximum data rates are applicable for near vertical channels (see above), decreasing with distance and shallow water/horizontal channels. Y N/A Optional power sources: Primary batteries (internal or external); External power supply SD card (up to 4GB) also usable for user data Data compression/other processing available upon request Y IMbyte FEC, data packet management, up to 8 internal data channels, distance and velocity measurement, USBL opt, Signal integrity and multipath structure diagnosis. Y Y RY Y RY Y Y RY Y RY Y Y		No restrictions	No restrictions
RS232 (selectable), optionally up to 4 additional interfaces Time division duplexing Doppler tolerance is specified for both, shallow water and near vertical channels, specified maximum data rates are applicable for near vertical channels (see above), decreasing with distance and shallow water/horizontal channels. Y N/A Optional power sources: Primary batteries (internal or external); External power supply SD card (up to 4GB) also usable for user data Data compression/other processing available upon request Y IMbyte FEC, data packet management, up to 8 internal data channels, distance and velocity measurement, USBL opt, Signal integrity and multipath structure diagnosis. Y Y RY Y RY Y Y RY Y RY Y Y			
interfaces Time division duplexing Time division duplexing Doppler tolerance is specified for both, shallow water and near vertical channels, specified maximum data rates are applicable for near vertical channels (see above), decreasing with distance and shallow water/horizontal channels. Y N/A N/A N/A N/A Optional power sources: Primary batteries (internal or external); External power supply SD card (up to 4GB) also usable for user data Data compression/other processing available upon request of the processing available upon request of the processing available upon request of the processing available, precision ranging optionally available Depending on environment Y, mechanical release interface available as option N Half duplex Horizontal and vertical link Horizontal and vertical link Horizontal and vertical link Horizontal and vertical link Horizontal and vertical link Horizontal and vertical link N/A N/A N/A N/A Y External power supply SD card (up to 4GB) also usable for user data Data compression/other processing available upon request integrity and multipath structure diagnosis. Y Y Runtime based ranging available, precision ranging optionally available Depending on environment Y, mechanical release interface available as option N Im Y, up to 15 nodes in bidirectional mode Y	Transparent or telegram based	Any	Any
interfaces Time division duplexing Time division duplexing Doppler tolerance is specified for both, shallow water and near vertical channels, specified maximum data rates are applicable for near vertical channels (see above), decreasing with distance and shallow water/horizontal channels. Y N/A N/A N/A Optional power sources: Primary batteries (internal or external); External power supply SD card (up to 4GB) also usable for user data Data compression/other processing available upon request integrity and multipath structure diagnosis. Y Runtime based ranging available, precision ranging optionally available Depending on environment Y, mechanical release interface available as option N Half duplex Horizontal and vertical link Horizontal and vertical link Horizontal and vertical link Horizontal and vertical link Horizontal and vertical link Horizontal and vertical link N/A N/A N/A N/A Imbyte FEC, data packet management, distance and veloc urement, USBL opt, Signal integrity and multipath diagnosis. Y Runtime based ranging available, precision ranging optionally available Depending on environment Y, mechanical release interface available as option N Im Y, up to 15 nodes in bidirectional mode Y	D0020/D0400 (D0020 151	00000
Time division duplexing Doppler tolerance is specified for both, shallow water and near vertical channels, specified maximum data rates are applicable for near vertical channels (see above), decreasing with distance and shallow water/horizontal channels. Y N/A N/A N/A Optional power sources: Primary batteries (internal or external); External power supply SD card (up to 4GB) also usable for user data Data compression/other processing available upon request integrity and multipath structure diagnosis. Y Runtime based ranging available, precision ranging optionally available Depending on environment Y, mechanical release interface available as option A lalf duplex Horizontal and vertical link Ink Y Y Y Imbyte FEC, data packet management, up to 8 internal data channels, distance and velocity measurement, USBL opt, Signal integrity and multipath diagnosis. Y Y Imbyte FEC, data packet management, up to 8 internal data channels, distance and velocity measurement, USBL opt, Signal integrity and m		RS232 and Ethernet, others on request	RS232 and Ethernet
Doppler tolerance is specified for both, shallow water and near vertical channels, specified maximum data rates are applicable for near vertical channels (see above), decreasing with distance and shallow water/horizontal channels. Y Optional power sources: Primary batteries (internal or external); Rechargeable batteries (internal or external); Rechargeable batteries (internal or external); External power supply Data compression/other processing available upon request of the power of the powe		Light duplay	Lief duelass
near vertical channels, specified maximum data rates are applicable for near vertical channels (see above), decreasing with distance and shallow water/horizontal channels. Y N/A N/A Optional power sources: Primary batteries (internal or external); Rechargeable batteries (internal or external); External power supply SD card (up to 4GB) also usable for user data Data compression/other processing available upon request integrity and multipath structure diagnosis. Y Runtime based ranging available, precision ranging optionally available Depending on environment P N N/A N/A N/A N/A IMbyte FEC, data packet management, up to 8 internal data channels, distance and velocity measurement, USBL opt, Signal integrity and multipath diagnosis. Y Runtime based ranging available, precision ranging optionally available Depending on environment N Im Im Im Y, mechanical release interface available as option N Y Y Y Y Y Y Y Y Y Y Y Y			
applicable for near vertical channels (see above), decreasing with distance and shallow water/horizontal channels. Y N/A Optional power sources: Primary batteries (internal or external); Rechargeable batteries (internal or external); External power supply SD card (up to 4GB) also usable for user data Data compression/other processing available upon request alto a compression/other processing available upon request alto a processing available as option Y Runtime based ranging available, precision ranging optionally available Depending on environment Y, up to 15 nodes in bidirectional mode N/A N/A N/A N/A N/A IMbyte FEC, data packet management, up to 8 internal data channels, distance and velocity measurement, USBL opt, Signal integrity and multipath diagnosis. Y Y Y N Im Im Im Y, up to 15 nodes in bidirectional mode Y Y Y Y Y Y Y Y Y Y Y Y Y		TIGHT SHEAT AND VEHICAL HIR	FIGURESHICA AND VOLUCIAL HIIK
with distance and shallow water/horizontal channels. Y N/A Optional power sources: Primary batteries (internal or external); Rechargeable batteries (internal or external); Rechargeable batteries (internal or external); External power supply SD card (up to 4GB) also usable for user data Data compression/other processing available upon request compression/other processing available upon request patternal processing available processing available upon request patternal processing available processing available upon request patternal processing available upon request processing available processing availabl			
Y Optional power sources: Primary batteries (internal or external); Rechargeable batteries (internal or external); Rechargeable batteries (internal or external); External power supply SD card (up to 4GB) also usable for user data Data compression/other processing available upon request rels, distance and velocity measurement, USBL opt, Signal integrity and multipath structure diagnosis. Y Runtime based ranging available, precision ranging optionally available Depending on environment Depending on environment V, mechanical release interface available as option Y Im N Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y			
external); Rechargeable batteries (internal or external); External power supply Do card (up to 4GB) also usable for user data Data compression/other processing available upon request Whyte FEC, data packet management, up to 8 internal data channels, distance and velocity measurement, USBL opt, Signal integrity and multipath structure diagnosis. Y Runtime based ranging available, precision ranging optionally available Depending on environment Y, mechanical release interface available as option Y, up to 15 nodes in bidirectional mode Impure Management, up to 8 internal data channels, distance and velocity measurement, USBL opt, Signal integrity and multipath diagnosis. Y Y Y Impure Management, up to 8 internal data channels, distance and velocity measurement, USBL opt, Signal integrity and multipath diagnosis. Y Y Impure Management, up to 8 internal data channels, distance and velocity measurement, USBL opt, Signal integrity and multipath diagnosis. Y Y N Y A Y Y Y Y Y Y Y Y Y Y Y		N/A	N/A
external); Rechargeable batteries (internal or external); External power supply Do card (up to 4GB) also usable for user data Data compression/other processing available upon request Whyte FEC, data packet management, up to 8 internal data channels, distance and velocity measurement, USBL opt, Signal integrity and multipath structure diagnosis. Y Runtime based ranging available, precision ranging optionally available Depending on environment Y, mechanical release interface available as option Y, up to 15 nodes in bidirectional mode Impure Management, up to 8 internal data channels, distance and velocity measurement, USBL opt, Signal integrity and multipath diagnosis. Y Y Y Impure Management, up to 8 internal data channels, distance and velocity measurement, USBL opt, Signal integrity and multipath diagnosis. Y Y Impure Management, up to 8 internal data channels, distance and velocity measurement, USBL opt, Signal integrity and multipath diagnosis. Y Y N Y A Y Y Y Y Y Y Y Y Y Y Y			
external); Rechargeable batteries (internal or external); External power supply Data compression/other processing available upon request Part of 15 nodes in bidirectional mode Imbyte Imb	Optional power sources: Primary batteries (internal or	Υ	Υ
SD card (up to 4GB) also usable for user data Data compression/other processing available upon request Bata compression/other processing available upon request SD card (up to 4GB) also usable for user data Data compression/other processing available upon request SEC, data packet management, upon to 8 internal data channels, distance and velocity measurement, USBL opt, Signal integrity and multipath structure diagnosis. Y Runtime based ranging available, precision ranging optionally available Depending on environment Depending on environment N N Im N Y, up to 15 nodes in bidirectional mode Im N Y Y Y Y Y Y Y Y Y Y Y Y Y	external); Rechargeable batteries (internal or external);		
Data compression/other processing available upon request FEC, data packet management, up to 8 internal data channels, distance and velocity measurement, USBL opt, Signal integrity and multipath structure diagnosis. Y Runtime based ranging available, precision ranging optionally available Depending on environment Y, mechanical release interface available as option N Y FEC, data packet management, distance and velocity measurement, USBL opt, Signal integrity and multipath diagnosis. Y Y Im Im Im N Y Y Y Y Y Y Y Y Y Y Y Y		I.M.	The state of the s
nels, distance and velocity measurement, USBL opt, Signal integrity and multipath diagnosis. Y Runtime based ranging available, precision ranging optionally available Depending on environment Y, mechanical release interface available as option Y, up to 15 nodes in bidirectional mode Nels, distance and velocity measurement, USBL opt, Signal integrity and multipath diagnosis. Y Y Y Im N Im N Y Y Y Y Y Y Y Y Y Y Y Y		I Mbyte	
integrity and multipath structure diagnosis. Y Y Y Runtime based ranging available, precision ranging optionally available Depending on environment Y, mechanical release interface available as option Y, up to 15 nodes in bidirectional mode integrity and multipath structure diagnosis. Y Y Y Y Y Y Y A A A A A A	Data compression/other processing available upon request	FEC, data packet management, up to 8 internal data chan-	FEC, data packet management, distance and velocity meas-
Y Runtime based ranging available, precision ranging optionally available Depending on environment Y, mechanical release interface available as option N Y, up to 15 nodes in bidirectional mode Y Y Y Y Y Y Y Y Y Y Y Y Y			
Runtime based ranging available, precision ranging optionally available Depending on environment Y, mechanical release interface available as option Y, up to 15 nodes in bidirectional mode Y Y Y Y Y Y Y Y Y Y Y	Υ		
ally available Depending on environment Y, mechanical release interface available as option Y, up to 15 nodes in bidirectional mode Y Y	•		
Depending on environment Y, mechanical release interface available as option N Y, up to 15 nodes in bidirectional mode Y Y			
Y, mechanical release interface available as option N N Y, up to 15 nodes in bidirectional mode Y Y		Im	Im
Y, up to 15 nodes in bidirectional mode Y			
	Y, up to 15 nodes in bidirectional mode	Υ	Υ
Y			
	Υ	Υ	Υ
Digital unique data appropriation has used and appropriate the state of the state o	Digital univaless data transmission has 0	Door on ALIV offsham in Lucius to	ALIV effet one industry by the second
Digital wireless data transmission between seafloor sen-			AOV, oiisnore industry, nydrography etc.
sor systems and surface buoys;; Communication and data transmission to and from research vessels and autonomous hydrography etc.		nyurography etc.	
transmission to and from research vessels and autonomous underwater vehicles; Wireless underwater networks.			







Hydro International June 2007



Company Nane	EvoLogics GmbH	L-3 Communications ELAC Nautik GmbH	Sonardyne
Name of Product	Hydroacoustic Modem S2C M 48/78	Digital Underwater Modem UM 30	uCOMM Omni MF
Year of initial development	2005	2005	2006
General Specifications			
L/W/H (cm)	25 x 13 cm without batteries, 40 x 13 cm with internal accumulators	Diameter 151mm; length 541mm (without transducer)	500mm x 95mm OD (incl. batt.)
Housing material	Aluminium alloy, stainless steel or titanium on request	Stainless steel (other materials e.g. titan on request)	Aluminium Alloy or Titanium
Weight in air (kg)		Approx. 16kg	5kg (Al version)
Weight in water (kg)		Approx. 6.3kg	2.1kg (Al version)
Operating power voltage	24VDC (I2VDC option)	24VDC	18 - 50VDC input range
Transmit mode power consumption	Adjustable 10100W	100W	<50 Watts
(W) Receive mode power consumption (W)	200-800mW	3W	IW
Sleep mode power consumption (W)	8mW	10mWatts	0.030W
Max deployment depth (m)	250m (2000m opt.)	Depending on selected transducer; UM 30: 6000m with titan housing	3000m or 7000m
Operating temperature range (°C)	-10 / 40	0+55°C	-5 +40 °C
Max battery lifetime	9Ah, others on request	No internal battery, ext. power required	Battery dependent (30 days min)
Acoustics			
Source level (dB re µPa@ m)	Up to 194 dB, adjustable	Depending on selected transducer, here TSE7 185 dB μPa	188dB
Transducer beam width (deg)	Horizontally omnidirectional	Omni	240°
Max working range in sea water (m)	2,000m	DEPENDING ON TRANSDUCER	3
Operating frequency range (Hz)	48,000Hz - 78,000Hz	LF: 12 ± 2kHz; HF: 30 ± 5kHz	19-36kHz
Signal Processing Data link modulation type (e.g. PSK,	S2C	MFSK	QPSK
FSK, OFDM, DSSS)			
Raw data rate (bit/s)	Up to 28,000 bit/s	LF: 1536 bit/s; HF: 3840 bit/s	1,500 - 15,000bit/s
User data rate (bit/s) (user data divi-	Ca. 15,000 bit/s, range dependent, self-adap-	LF: 1536 bit/s; HF: 3840 bit/s	>600 to >10,000bit/s
ded by the total transmit time, taking into account channel estimation, trai-	tive		
ning, coding, etc.)			
Bit error rate	Less than 10e-8	10 e-4	<10e-9
Minimum required SNR (dB)	-7dB	10dB	10dB
Doppler tolerance (relative velocity in m/s)	More than 3m/s	I5m/s	5m/s
Maximum channel delay spread (ms)	No restrictions	N/A	N/A
Other specifications			
Type of dataformat	Any	ELAC proprietary	ASCII or Binary
Interfacing (eg RS232)	RS232 and Ethernet	RS232	RS232 / 485
Half duplex or full duplex?	Half duplex	Half duplex	Full-duplex
Is the performance specified for a vertical link, horizontal link, or?	Horizontal and vertical link	Horizontal link	Environment dependent
Multiplexing capability available?	N/A	N	On request
Can the subsea modem be powered from other source?	Υ	Υ	Υ
What data storage capabilities?	IMbyte	No internal data-storage capabilities	256kbytes
What processing features are available?	FEC, data packet management, up to 8 internal data channels, distance and velocity measurement, USBL opt, Signal integrity and	Several data coding schemes	N/A
A	multipath structure diagnosis.	N	0
Are repeater functions available? Does the system provide range information?	Y	N N	On request Y
Ranging accuracy (m)	Im	N/A	0.01m
Does the subsea modem have release functionality?	N	N N	On request
Does the system support network	Υ	N	Y can address multiple instruments
capability? Can the system be used for covert	Υ	N	On request
communications? What is the typical application for your system (max 30 words)			
	High-speed data and video image transmission, AUV, offshore industry, hydrography etc.	Data exchange between two host computers using 2 x UM30 or 1 x UM30 + ELAC underwater comms system UT3000	Real-time recovery of data from internal or external sensors; (pressure, temperature, current, sound velocity, heading, attitude etc); Sonardyne can provide integrated systems with positioning & telemetry functionality.



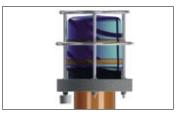






Sonardyne	Sonardyne	Wireless Fibre Systems Ltd	Wireless Fibre Systems Ltd
uCOMM Dir MF	uCOMM Dir LMF	S1510 Radio Modem	S5510 Broadband Data Link
2006	2006	2006	2006
510mm x 95mm OD (incl. batt.)	585mmx183mm OD (incl. batt.)	Modem 31.5cm x 31.5cm x 20cm Antenna 50cm x 50cm x 3cm	Modem 31.5cmx31.5cmx20cm Antenna 20cmx20cmx2cm
Aluminium Alloy or Titanium	Aluminium Alloy or Titanium	Metal or plastic	Metal or plastic
6.5kg (Al version)	IIkg (Al version)	9kg	3kg
3.1kg (Al version)	6kg (Al version)	Ikg	0.5kg
18 - 50VDC input range	18 - 50VDC input range	24Vdc	12Vdc
<50 W	<50 W	2.4W	4.2W
IW	IW	IW	IW
0.030W	0.030W	6mW	6mW
3000m or 7000m	3000m or 7000m	4,000m	4,000m
-5°C - +40°C	-5°C - +40°C	- 10°C - + 35°C	- 10°C - + 35°C
Battery dependent (30 days min)	Battery dependent (30 days min)	2 years in listening mode	2 years in listening mode
193dB	196dB	N/A - This system is electromagnetic	N/A - Electromagnetic Technology
+/-50°	+/-25°	N/A	N/A
5	7000	N/A	N/A
19-36kHz	14-22kHz	N/A	N/A
QPSK	QPSK	Any	All
1,500 - 15,000bit/s	1,500 - 15,000bit/s	25 to 16,0000 Bits/s	
>600 to >10,000bit/s	>600 to >10,000bit/s		
<10e-9	<10e-9	Very low	I to I00MBits/s
IOdB	I OdB	N/A	N/A
5m/s	5m/s	Very high	Very high
N/A	N/A	0	0
ASCII or Binary	ASCII or Binary	Analogue or digital	Analogue or Digital
RS232 / 485	RS232 / 485	RS232	RS232
Full-duplex	Full-duplex	Both	Y
Environment dependent	Environment dependent	Both	
On request	On request	256 channels	Both
Υ	Y	Y	Y
256kbytes	256kbytes	Can be incorporated	Υ
N/A	N/A	Can be tailored	Can be added
On request	On request	Y	Can be tailored
Y	Y	N/A	Y
0.01m	0.01m	N/A	N
On request	On request	N/A	N/A
Y can address multiple instruments	Y can address multiple instruments	Υ	N
On request	On request	Y	Both
		Transfer of data through water, through water/air boundary. Can be used for	Broadband data harvesting by UUVs from underwater data loggers, Data transfer from
		diver comms, instrumentation comms & control and real time control of AUVs or actuators. Use in Environmental Monitoring, Oceanography, Oil & Gas exploration and Harbour Security.	AUVs to mother ship, AUV docking.









Hydro INTERNATIONAL June 2007