MARINE RELATED R&D

- ACOUSTIC TRANSMITTERS
- RECEIVERS
- MARINE INSTRUMENTATION
- CUSTOM MADE EQUIPMENT

THELMA

Marine Related R&D at THELMA

Since 2002 Thelma has been developing instrumentation for use both in fisheries research and aquaculture. In general this activity is based upon three decades of experience within acoustical fish telemetry.

Customers Among Thelma's customers are:

- The Norwegian Institute for Nature Research (NINA)
- The Norwegian Institute for Fisheries and Aquaculture Research's (Fiskeriforskning, Tromsø)
- Norwegian College of Fishery Science (NCFS)
- Institute of Marine Research, Norway (IMR)
- Norwegian Institute for Water Research (NIVA)
- The Danish Institute for Fisheries Research (DIFRES)
- University of Durham, UK
- University of British Columbia, Canada

Thelma has developed prototypes and equipment for SEAFOODplus' SmartTag[1]. SmartTag will be used as a welfare indicator in farmed fish.

Thelma is also participating in a aquaculture related project - FeedTag - run by the Department of Engineering Cybernetics at the Norwegian University of Science and Technology (NTNU) where the goal is to develop an acoustical transmitter that can detect intake of food in farmed salmon.

[1] http://www.seafoodplus.org/measuring_fish-welfare.455.0.html

THELMA

The history of Thelma goes back to the spring of 2000, when the company was founded. The competence collected in the firm, however, has a longer history, as it has been based upon experience and knowledge established in SINTEF, where a number of the employees worked for several years.
The idea behind the establishment was to create a support for manufacturing industry in areas were the industry was not able to maintain specialized expertise on a full time basis. The service offered are on the terms of the industry, aiming to develop solutions for short-term as well as future challenges.
In addition to the Marine R&D activity, Thelma has five other areas of activity: Environmental Control, Product Development & Design, Product Testing, Hyperbaric Services and Health & Safety.

CONTACT INFO:

P.o. Box 6170, Sluppen
N-7435 Trondheim
Norway
e-mail: telemetry@thelma.no
Tel: +47 73 87 78 00
Fax: +47 73 87 78 01

IMPORTANT

This document provides information that may be subject to change without notice. The document was last updated June 2007.

Cover photo: Per Eide
Layout&Design: Thelma AS
Print: Skipnes

Transmitters Since 2002 several transmitters have been developed:

- A small acoustic transmitter designed to be used on migrating wild Atlantic salmon smolt.
- Larger acoustic transmitters for use where high transmitting power and/or long battery life is vital
- 9 mm, 13mm and 16mm acoustic depth transmitters
- Prototype transmitters for detection of feeding activity and breathing activity studies (FeedTag and SmartTag)
- Prototype transmitters for bioelectrical signals (EMG/ECG)
- Transmitters measuring oxygen content in the surrounding water

Future products (June 2007) In the near future we will extend our range of products to include:

- Transmitters measuring bioelectrical signals like ECG and EMG.
- Acoustical hydrophones, receivers and loggers

In addition to offering a standardized range of products, Thelma is also interested - in cooperation with fisheries researchers - to participate in developing projects aiming at custom made transmitters/equipment for specific research where instrumentation is not available "off the shelf". Just contact us!

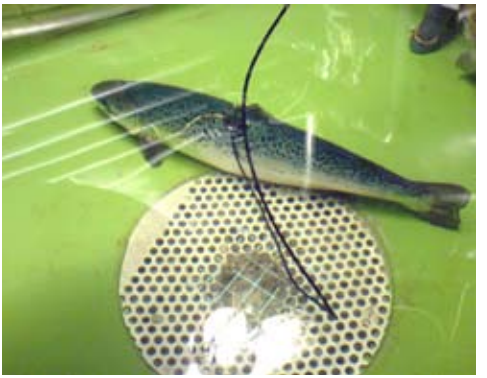
Acoustic transmitters

Thelma is also developing instrumentation for other than telemetry purposes. As an example we have developed a rotifer density analyzer based on picture analysis. The analyzer is able to identify and count rotifers used to feed fish larvae in an early stage and is at present (Dec. 2005) used for research purposes by a NTNU research programme - CODTECH[2] - that is a biological-biotechnological-technological approach to some main challenges of intensive rearing of cod juveniles. Thelma is participating as an industrial partner in this programme.

[2] http://www.ntnu.no/marin/codtech.htm

Custom Made Equipment

Assembly of prototype equipment



Fish with hard-wired sensor and amplifier (Feed Tag/ NTNU)

Where wireless data transfer is not needed or applicable, Thelma may also be able to help you with custom made hard-wired equipment for evaluation of sensors and measuring methods.

Thelma does not deliver miniature radio transmitters, but can help you with solutions based on GSM, GPS and RFID technology.

Custom acoustic transmitters, with or without sensors and other equipment, are also made on customer's specifications.

Thelma develop equipment for both wildlife telemetry and for use in aquacultural research. Please contact us for further information.

Rotifer density measurement and control

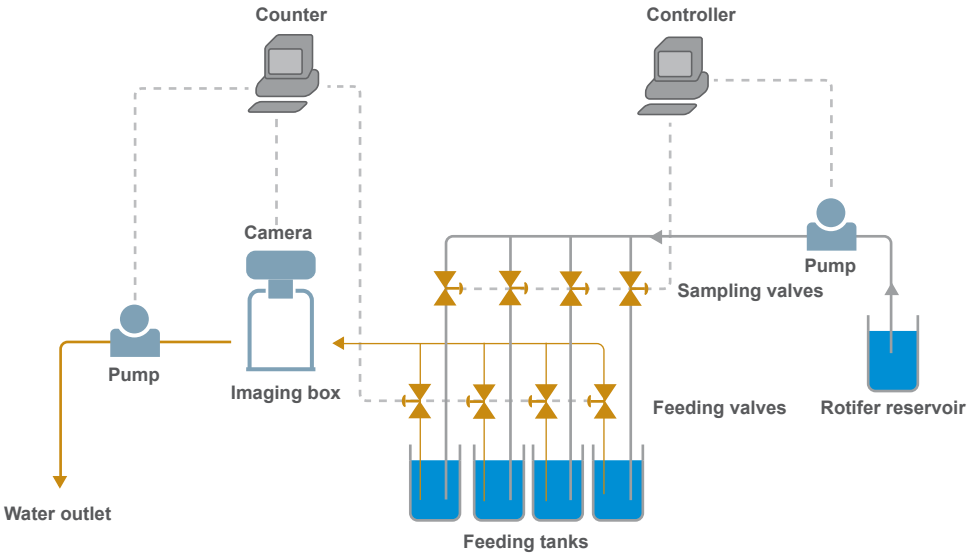
The Thelma rotifer density measurement system uses computer imaging to measure the density of rotifers used in rotifer cultures and/or fish larvae tanks. The PC-based instrument can sample from 10 different sources. Historic data and trendlines can be examined while sampling, or it can be exported to spreadsheet programs (i.e. Excel).

The system consists of the main unit contained in a 20x40x50cm casing and a PC connected through a serial and USB cable. The samples are provided through hoses that can be connected to the main unit with nipples or quick disconnect couplings.

The instrument is developed and tested in cooperation with SINTEF Fisheries and Aquaculture and NTNU through student papers, summer internships and the research program CODTECH.

For more information regarding the rotifer counter, please contact:

Torodd Tennøy (tot@thelma.no).



Project in cooperation with: SINTEF NTNU

Thelma's Acoustic Transmitters

Thelma delivers several types of acoustic transmitters:

ID transmitters are used both for automatic monitoring and manual tracking. These transmit a number of acoustic pulses, where the inter-distance between pulses makes an ID-code that can be used to identify the individual fish. Unique IDs allow multiple transmitters with the same transmitting frequency.

The transmitters can be delivered with different encoding schemes to work with existing receiver equipment or Thelma receivers.

Battery lifetime will depend on the type of encoding scheme and the mean delay between each successive transmission.

The time delay between successive transmissions of code IDs is "random" within a minimum and maximum delay specified by the customer. The delays are made random to reduce code collisions between transmitters. The time delay between transmissions must be chosen depending on required battery lifetime, chance of code collisions based on number of tagged fish and chance of detection. A short delay between transmissions is recommended for manual tracking of a small number of fish or if chance of detection is small when using automatic monitoring systems.

Pulsed transmitter without sensor

Transmitter with depth sensor

ID and Data Transmitters are much like the ID transmitters, except that they are also able to send sensor information like depth or temperature together with an ID that identifies the fish. These can be used both for automatic monitoring and for manual tracking.

Continuous Pingers are mainly used in manual tracking of fish. These transmit an acoustic pulse (ping) with a fixed time interval. The customer specifies the time interval between successive pulses and required transmitting frequency. Intervals between 1000-2000ms are most practical for manual tracking, but if longer battery lifetime is vital, longer time intervals could be chosen. Use of different transmitting frequencies allows multiple tagged fish within the same area.

Time Delay Transmitters are able to send sensor information coded as the time delay between successive pulses. These are mainly used for manual tracking, much like the continuous pingers.

Frequency Modulated Transmitters are used when the transfer of a complete signal curve is required. Examples of use can be for observation of ECG or breathing signatures. Frequency Modulation (FM) means that the signal is converted to a frequency that changes with the signal level and transferred as an acoustic signal. On the receiving side the signal is demodulated and further processed.

All transmitters are delivered with a magnetic On/Off switch. On delivery a small magnet is attached to the transmitter. Removing and re-attaching this magnet activates and de-activates the transmitter.

Contact Thelma for help or questions regarding selection of transmitter types and specifications

Some of Thelma's pulsed transmitters

(actual size)

7.3mm Acoustic Smolt Transmitter

The Thelma Acoustic Smolt Tag, developed and tested in cooperation with the Norwegian Institute for Nature Research (NINA), is specifically designed for use in smolt. The transmitter is suited for both manual tracking and automatic monitoring.

Using Thelma's Acoustic Smolt Tag, NINA[1] was able to study migration of wild Atlantic salmon smolt down to 13.5cm in length. Using existing 9mm acoustic tags, the alternative was farmed smolt down to 15.5-16cm.

Among others, Department of Biological Sciences, Durham University, has also used this transmitter on adult river lamprey.

The Acoustic Smolt Transmitters are delivered both as Continuous Pingers and ID Transmitters. The customer specifies pulse delay or coded ID and type of encoding scheme, transmitting frequency and minimum and maximum random delay for ID transmitters.

Contact Thelma for help or questions regarding specifications.

[1] Contact:
Finn Økland finn.okland@nina.no
Eva Thorstad eva.thorstad@nina.no

Atlantic Salmon Smolt (Photo: Nuria Plantalech)

Physical properties 7.3mm Acoustic Smolt Transmitter	
Length	18 mm
Diameter	7.3 mm
Power output (dB re 1 µPa at 1m)	139
Weight in air	1.9 g
Weight in water	1.2 g

The table below shows examples of expected battery lifetime with various pulse intervals.

Battery life for Continous Pingers										
Pulse interval (ms)	1000		1500		2000		3000		4000	
	Estimated	Guar.	Estimated	Guar.	Estimated	Guar.	Estimated	Guar.	Estimated	Guar.
Life (Days)	29	18	43	26	56	33	79	48	101	60

The estimated and guaranteed battery lifetime is for transmitters on time of delivery. Refer to de-activated transmitter discharge rate to account for shelf time discharge. The pulse length in calculations is 10ms.

In general, increasing the number of pulses for each code increases the number of available IDs in each code set. Specify the encoding scheme compatible with your existing receiver equipment or contact Thelma for advice.

Battery Lifetime for Coded Transmitters							
Min delay [seconds]	Max delay [seconds]	6 pulse code battery life [days]		7 pulse code battery life [days]		8 code pulse battery life [days]	
		Estimated	Guaranteed	Estimated	Guaranteed	Estimated	Guaranteed
5	15	47	28	41	25	36	22
10	30	87	52	76	46	68	41
20	60	149	90	133	80	120	1
30	90	107	118	178	107	163	98
40	120	234	154	219	128	197	118
50	150	264	154	243	146	226	135

Developed in cooperation with: NINA Norwegian Institute for Nature Research

LP-9 *MP-9-SHORT* *MP-9-LONG*

(actual sizes)

9mm Acoustic Transmitter

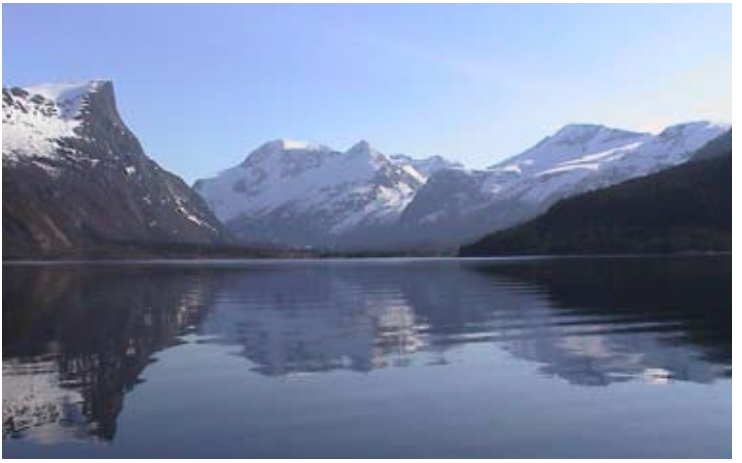
Thelma's 9mm Acoustic transmitter is intended for use where both size, output power and long transmitting life is crucial.

Manual tracking or automatic monitoring of larger salmon smolt migrating out fjords is a potential area of use.

The 9mm Acoustic Transmitters are delivered both as Continuous Pingers and ID Transmitters. The customer specifies pulse delay or coded ID and type of encoding scheme, transmitting frequency and minimum and maximum random delay for ID transmitters.

3 versions of the 9mm acoustic transmitter are available (2007): LP-9, MP-9-SHORT and MP-9-LONG. The terms LP and MP mean respectively Low-Power and Medium-Power, while SHORT and LONG refers to the length of the transmitters.

The LP-9 transmitter has the longest battery life. The physical specifications for the MP-9-SHORT are about the same as for the LP-9, but the transmitting power is higher. The MP-9-LONG has about the same transmitting power as the MP-9-SHORT, but has longer battery life.



Eresfjord, Norway (Photo: Finn Økland)

Physical Properties 9 mm Acoustic			
Transmitter	LP-9	MP-9-SHORT	MP-9-LONG
Length (mm)	23	23	28
Diameter (mm)	9	9	9
Power output (dB re 1 µPa at 1m)	142	146	147
Weight in air (g)	4.0	3.7	5.2
Weight in water (g)	2.5	2.2	3.3

The table below shows examples of expected battery lifetime with various pulse intervals

Battery Lifetime for Continuous Pingers						
Pulse interval	LP-9 Battery life [days]		MP-9-SHORT Battery life [days]		MP-9-LONG Battery life [days]	
	Estimated	Guaranteed	Estimated	Guaranteed	Estimated	Guaranteed
1000ms	108	65	49	29	81	49
1500ms	156	94	71	43	118	71
2000ms	201	121	96	55	154	92
3000ms	282	169	131	79	214	131
4000ms	354	212	167	100	278	167

The estimated and guaranteed battery lifetime is for transmitter on time of delivery. Refer to de-activated transmitter discharge rate to account for shelf time discharge. The pulse length in calculations is 10ms.

In general, increasing the number of pulses for each code increases the number of available IDs in each code set. Specify the encoding scheme compatible with your existing receiver equipment or contact Thelma for advice and an estimate of battery life.

Battery Lifetime for 6 Pulse Coded Transmitters							
Min delay [seconds]	Max delay [seconds]	LP-9 Battery life [days]		MP-9-SHORT Battery life [days]		MP-9-LONG Battery life [days]	
		Estimated	Guaranteed	Estimated	Guaranteed	Estimated	Guaranteed
5	15	172	103	78	47	130	78
10	30	307	184	143	86	239	143
20	60	507	304	246	148	411	246
30	90	648	389	324	199	540	324
40	120	753	452	385	231	641	385
50	150	833	500	433	260	722	433
60	180	897	538	473	248	788	473

LP-13 *MP-13* *HP-13*

(actual sizes)

13mm Acoustic Transmitters

Thelma's 13mm Acoustic transmitter is available in a Low-Power, Medium-Power and High-Power versions. These transmitters are intended for use where high output power and long transmitting life is crucial.

The transmitters are suited for both manual tracking and automatic monitoring of larger fish or other aquatic animals.

The 13mm Acoustic Transmitters are delivered both as Continuous Pingers and ID Transmitters.

The customer specifies pulse delay or coded ID and type of encoding scheme, transmitting frequency and minimum and maximum random delay for ID transmitters.

13mm Transmitter Technical Data			
Transmitter	LP-13	MP-13	HP-13
Length [mm]	26	31	36
Diameter [mm]	13	13	13
Weight in air [g]	9.0	11.4	TBD
Weight in water [g]	5.6	7.3	TBD
Power output [dB re 1 µPa at 1m]	~150	~153	TBD
De-activated transmitter battery discharge [30 days]	~1.2%	~1,2%	~1,2%

Battery Lifetime for Continuous 13mm Pingers						
Pulse interval	LP-13 Battery life [days]		MP-13 Battery life [days]		HP-13 Battery life [days]	
	Estimated	Guaranteed	Estimated	Guaranteed	Estimated	Guaranteed
1000ms	145	87	118	71	TBD*	TBD*
1500ms	211	126	172	103	TBD*	TBD*
2000ms	272	163	223	134	TBD*	TBD*
3000ms	383	230	318	191	TBD*	TBD*
4000ms	481	288	403	242	TBD*	TBD*

‘TBD - To Be Determined
The estimated and guaranteed battery lifetime is for transmitter on time of delivery. Refer to de-activated transmitter discharge rate to account for shelf time discharge. The pulse length in calculations is 10ms.

Coded transmitters can be delivered with various encoding schemes. The battery lifetime will depend on the type of encoding scheme (the number of pulses needed to transmit the code) and the mean delay between each successive transmission.

Generally, increasing the number of pulses for each code increases the number of available ID’s in each code set. Specify the encoding scheme compatible with your existing receiver equipment or contact Thelma for advice and an estimate of battery life.

Battery Lifetime for 6 Pulse Coded 13 mm Transmitters							
Min delay [seconds]	Max delay [seconds]	LP-13 Battery life [days]		MP-13 Battery life [days]		HP-13 Battery life [days]	
		Estimated	Guaranteed	Estimated	Guaranteed	Estimated	Guaranteed
5	15	231	139	189	114	TBD*	TBD*
10	30	417	250	347	208	TBD*	TBD*
20	60	694	417	595	357	TBD*	TBD*
30	90	893	536	781	469	TBD*	TBD*
40	120	1042	625	926	556	TBD*	TBD*
50	150	1157	694	1042	625	TBD*	TBD*
60	180	1250	750	1136	682	TBD*	TBD*

The estimated and guaranteed battery lifetime is for transmitter on time of delivery. Refer to De-activated transmitter discharge rate to account for shelf time discharge. The pulse length in calculations is 10ms.

LP-16-SHORT *LP-16-LONG*

(actual sizes)

16mm Acoustic Transmitters

Thelma's 16mm Acoustic transmitters are available in two versions (2007). These transmitters are intended for use where high output power and very long transmitting life is crucial.

The transmitters are well suited for both manual tracking and automatic monitoring of larger fish or other aquatic animals.

The first available transmitters are low-power versions (LP), but medium-power and high-power will also be available.

The 16mm Acoustic Transmitters are delivered both as Continuous Pingers and ID Transmitters.

The customer specifies pulse delay or coded ID and type of encoding scheme, transmitting frequency and minimum and maximum random delay for ID transmitters.

The tables below show the preliminary data for the transmitters.

16mm Transmitter Technical Data		
Transmitter	LP-16-SHORT	LP-16-LONG
Length [mm]	36	61
Diameter [mm]	16	16
Weight in air [g]	13.5	21.0
Weight in water [g]	6.1	8.4
Power output [dB re 1 µPa at 1m]	~153 To be confirmed	~153 To be confirmed
De-activated transmitter battery discharge [30 days]	~0,3%(maximum 10 years)	~0,2%(maximum 10 years)

Battery Lifetime for Continuous 16mm Pingers				
Pulse interval	LP-16-SHORT Battery life [days]		LP-16-LONG Battery life [days]	
	Estimated	Guaranteed	Estimated	Guaranteed
1000ms	405	243	809	485
1500ms	598	359	1196	718
2000ms	786	472	1572	943
3000ms	1147	688	2294	1376
4000ms	1488	893	2976	1786

The estimated and guaranteed battery lifetime is for transmitter on time of delivery. Refer to de-activated transmitter discharge rate to account for shelf time discharge. The pulse length in calculations is 10ms.

Coded transmitters can be delivered with various encoding schemes. The battery lifetime will depend on the type of encoding scheme (the number of pulses needed to transmit the code) and the mean delay between each successive transmission.

With the very long battery lifetime you get with a coded 16mm transmitter, Thelma will not guarantee more than 7 years battery lifetime, and does not estimate more than 10 years battery life. The battery manufacturers seldom recommend more than 10 years shelf life for a battery.

Battery Lifetime for 6 Pulse Coded 16mm Transmitters					
Min delay [seconds]	Max delay [seconds]	LP-16-SHORT Battery life [months]		LP-16-LONG Battery life [months]	
		Estimated	Guaranteed	Estimated	Guaranteed
5	15	22	13	44	26
10	30	42	25	84	51
20	60	77	46	120*	84*
30	90	107	64	120*	84*
40	120	120*	79	120*	84*
50	150	120*	84*	120*	84*
60	180	120*	84*	120*	84*

Thelma does not estimate longer than 10 years battery life, nor guarantee more than 7 years battery life.

ADT-MP-9-SHORT *ADT-MP-9-LONG* *ADT-MP-13* *ADT-MP-16*

(actual sizes)

Acoustic Depth Transmitters

The first Thelma Acoustic Depth Transmitter was developed for The Norwegian Institute for Nature Research (NINA) for manual tracking of migrating Atlantic salmon smolt.

The transmitter is capable of measuring 0 to 130 meter water depth (0-13 bar).

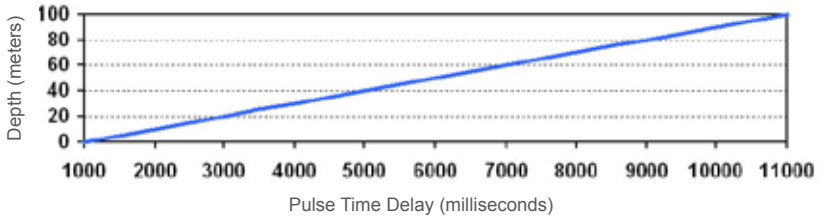
NINA used these transmitters for manual tracking of migrating Atlantic salmon post-smolt in Eresfjord, Norway (2004) and Hardangerfjord, Norway (2005 and 2006). The post-smolt was down to 23 cm long.

Time delay transmitter Measured depth is continuously encoded as the time delay between two acoustic pulses. A delay of 1000ms corresponds to 0 meters, increasing with 100ms per meter. The resolution is 10cm, corresponding to 10ms. The correspondence between depth and time delay can easily be changed on request from customers, e.g. 10ms per feet.

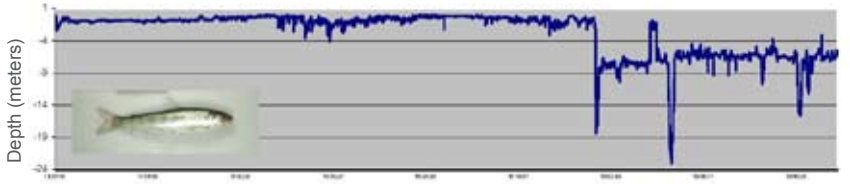
ID and Depth transmitter The transmitter can also be delivered as a coded transmitter (ID and depth), transmitting with fixed or random intervals. A coded transmitter's battery life will be independent of the fish's swimming depth.

Depth and temperature A combined temperature and pressure transmitter is also available on request. Please contact Thelma for details.

Depth (m) = (Pulse delay – 1000) (millisec) x 0.01 (m/millisec)



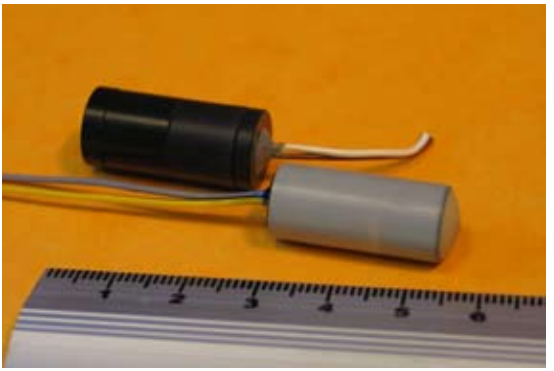
The figure below shows the swimming-depth of a salmon smolt migrating out Eresfjord in 2004. A predator fish ate the smolt about three and a half hours after the tracking started. Notice the sudden change in swimming-depth.



Swimming-depth of salmon smolt and predator, Eresfjord 2004
(NINA, Contact: Finn Økland. finn.okland@nina.no)

Acoustic Depth Transmitter Technical Data				
	ADT-MP-9-SHORT	ADT-MP-9-LONG	ADT-MP-13	ADT-MP-16
Length [mm]	34	39	42	55
Diameter [mm]	9	9	13	16
Weight in air [g]	5.3	6.8	12.5	17.5
Weight in water [g]	3.3	4.3	6.9	6.5
Power output [dB re 1 µPa at 1m]	146	146	153	~156
Measuring range	0-130 meters (0-13 bar)			
Resolution	10cm (10mbar)			
Absolute accuracy	30cm (30mbar)			
Encoding	Pulse delay or coded			

Developed in cooperation with: NINA Norwegian Institute for Nature Research



Acoustic Dissolved Oxygen Transmitter

The Thelma Acoustic Dissolved Oxygen Transmitter, developed by request from the Danish Institute for Fisheries Research (DIFRES), Department of Inland Fisheries, contains a probe capable of measuring 0% to 200% dissolved oxygen saturation in fresh and seawater. The applicability of the oxygen-transmitter in fisheries research is currently being tested at DIFRES[1]

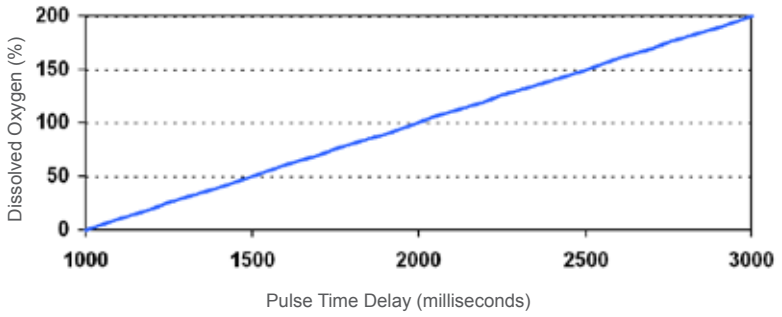
Time delay transmitter The amount of oxygen is continuously encoded as the time delay between two acoustic pulses. Each pulse has a length of 10ms, with a delay of 1000ms to 3000ms between pulses.

A delay of 1000ms corresponds to 0%, 2000ms to 100%, while 3000ms corresponds to 200% dissolved oxygen. The measurement resolution is 1%, corresponding to 10 ms.

ID and DO transmitter The transmitter can also be delivered as a coded transmitter (ID and dissolved oxygen saturation), transmitting with fixed or random intervals.

[1] Contact: Kim Aarestrup, kaa@dfu.min.dk

Dissolved oxygen (%) = (Pulse delay – 1000) (ms) x 0.1 (%/ms)



The table below shows the technical data for the transmitter. The complete transmitter may be delivered with an external sensor with two wires to the acoustic transmitter, or with an internal sensor mounted on the acoustic transmitter.

Acoustic Dissolved Oxygen Transmitter Technical Data	
Length [mm]	27 (transmitter) + 27 (sensor)
Diameter [mm]	13
Weight in air/water [g]	9.9
Weight in water [g]	8.0
Power output [dB re 1 µPa at 1m]	~150 (To be confirmed)
Estimated Battery life [days]	57[2]
Measuring range	0% to 200% DO saturation
Resolution	1%
Response time [90% of end value]	<15 sec
Encoding	Pulse delay or customer specified
De-activated transmitter battery discharge [30 days]	~5%

[2] Assuming 0% dissolved oxygen saturation (1000ms time delay between pulses)

The table below shows expected battery life for a coded transmitter where the ID and dissolved oxygen saturation is transmitted using 8 pulses.

Please contact Thelma as for further questions or details.

Battery Life for 8 Pulse Coded DO Transmitter			
Min delay [seconds]	Max delay [seconds]	Battery life [days]	
		Estimated	Guaranteed
5	15	102	61
10	30	189	114
20	60	329	197
30	90	436	262

The estimated and guaranteed battery lifetime is for transmitter on time of delivery. Refer to De-activated transmitter discharge rate to account for shelf time discharge. The pulse length in calculations is 10ms.

Developed in cooperation with:

Ministry of Food, Agriculture and Fisheries
Danish Institute for Fisheries Research

(actual size)

Differential Pressure Acoustic FM Transmitter

Thelma developed this transmitter as a SmartTag prototype for The Norwegian Institute for Fisheries and Aquaculture Research's (Fiskeriforskning[1], Tromsø) participation in the large EU funded SEAFOODplus programme.

Fiskeriforskning has performed both tank and sea cage studies on cod, and the technology will also be used in SEAFOODplus research on sea bass in France. The purpose of performing breathing activity studies is to determine the welfare of free-swimming fish in aquaculture. Previous and ongoing laboratory studies have demonstrated that breathing activity is a good welfare indicator in fish. SmartTag makes studies on fish in sea cages or on free ranging fish possible.

The same measurement technology has also been used on feeding activity studies in the FeedTag[2] project.

The transmitter contains a differential pressure sensor capable of measuring within the range ±1psi (±70cm water) differential pressure, a range suitable for breathing activity studies. ±5psi and ±15psi versions are also available.

The output of the transmitter is frequency modulated, which means that it continuously transmits an acoustic ultrasound signal where the frequency varies according to the measured differential pressure.

A receiver interface for real-time display of frequency variation and continuous calculation of breathing frequency has also been developed for Fiskeriforskning, used with the Thelma AFM-R receiver. The screenshot below shows the respiration curve of a cod.

The curves from bottom and up shows received signal strength, frequency-modulated signal from the transmitter, fixed scale demodulated signal and auto-scale demodulated signal.

---

[1] Contact: Ø. Aas-Hansen, oyvind.aas-hansen@fiskeriforskning.no

[2] Contact: Torfinn Solvang Garten, NTNU, torfinn.solvang-garten@itk.ntnu.no

Testing of the SmartTag prototypes on free-swimming cod at one of Fiskeriforskning's aquaculture research facilities in Tromsø, Norway. (Photo: Øyvind Aas-Hansen, Fiskeriforskning)

Screenshot of demodulated signal (Photo: Øyvind Aas-Hansen, Fiskeriforskning)

The table below shows the transmitter's technical data.

Transmitter Data	
Length (mm)	62
Diameter (mm)	16
Weight in air (g)	15
Weight in water (g)	5.9
Estimated Battery life (days)	25
Measuring ranges	±1psi, ±5psi, ±15psi
Encoding	Frequency modulation
Transmitting frequency	Customer specified

Developed in cooperation with:

Fiskeriforskning

Norwegian Institute of Fisheries an Aquaculture research

SEAFOOD plus

Seafood Plus

Acoustic Receiver Equipment

Thelma is developing acoustic receiver equipment, including computer software, for different purposes.

Thelma AFM-R is a receiver for frequency modulated acoustic transmitters, like the Differential Pressure FM Transmitter. Frequency modulation is useful for transferring continuous signals like breathing signature or EKG.

The Thelma AFM-R is entirely controlled through a PC-interface, which also demodulates the FM signal and displays the demodulated curves on the PC monitor.

The Thelma AR-MANUAL is a portable receiver intended for use in fish tracking and also for use in lab. It can be used with acoustic pingers, coded transmitters and pulse delay sensor transmitters. The receiver has been designed with ease of use in mind.

The Thelma AR-MANUAL is currently (2007) under development and testing, and should be available in 2007.

Thelma will also develop stationary monitoring equipment in the near future.

Please contact Thelma for further information or questions regarding development of custom receiver equipment for your needs.

The Thelma AFM-R receiver

Thelma's directional and omni-directional hydrophone

PO Box 6170, Sluppen
N-7435 Trondheim
Norway

Tlf: +47 73 87 78 00
Fax: +47 73 87 78 01

telemetry@thelma.no
www.thelma.no/marine