

# SKIPPER

## ETT985 Echo Sounder and Transducer Tester Operation Manual



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# Information:

- Please visit our web site [www.skipper.no](http://www.skipper.no) for additional information. Here you will find product bulletins, software updates, instruction manuals, installation procedures etc.
- ETT985 is designed for simple and correct testing of transducers and echo sounders. Although it is accurate, it is not a calibrated device. The system has self testing and will notify if the values are not within manufacturers limits.

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## **A. INTRODUCTION**

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### **ECHO SOUNDER TESTER**

The ETT985 can measure the output of an echo sounder, and if required, reply with a user defined signal to simulate operation of the transducer.

### **TRANSDUCER TESTER**

The ETT985 is a tester that measures the characteristics of the transducer, showing the resonance and electrical characteristics of the transducer. The system can be setup to measure user defined frequencies or by using pre-programmed limits. The user can select a pre-programmed transducer and check with the factory values. A simple pass/fail is given. The tester works for most transducer (directly to transducer, not through circuitry).

### **SOFTWARE (OPTIONAL)**

Optional software changes the tester to a lab tool/simulator by increasing the functionality of the tester. Using a serial port, the tester can be connected to the PC based software enabling the user to access extra parameters of the system. Adding a PC to the serial port, and with the tester software (option) the ETT985 is converted into a bench tester with a number of extra options for impedance analysis and simulation.

The simulator can be directly controlled and be made to also generate fish signals for fish-finder echo sounders. It also allows a serial input function to change the depth and settings of the unit (ideal for bridge simulators).

The transducer tester becomes a full (un-calibrated) impedance analyser showing the full plot of frequency vs. impedance, susceptance, conductance, and phase as well as detecting the resonance, anti-resonance and calculating the approximate bandwidth of the transducer. In addition, the limits of most transducer can be pre-programmed such that the pass/fail integrity test of the transducer can be checked in the field without the need for the software.

### **NMEA TESTER**

Using the NMEA serial port, the ETT985 can monitor the NMEA messages from a NMEA 0183 (IEC 61162-1, single talker and multiple listeners) talker. It can also be made to send one of a series of standard messages to the device, allowing the user to test the I/O. The ETT985 can also be used as a simple NMEA to RS-232 converter for use with a terminal emulator on a PC.

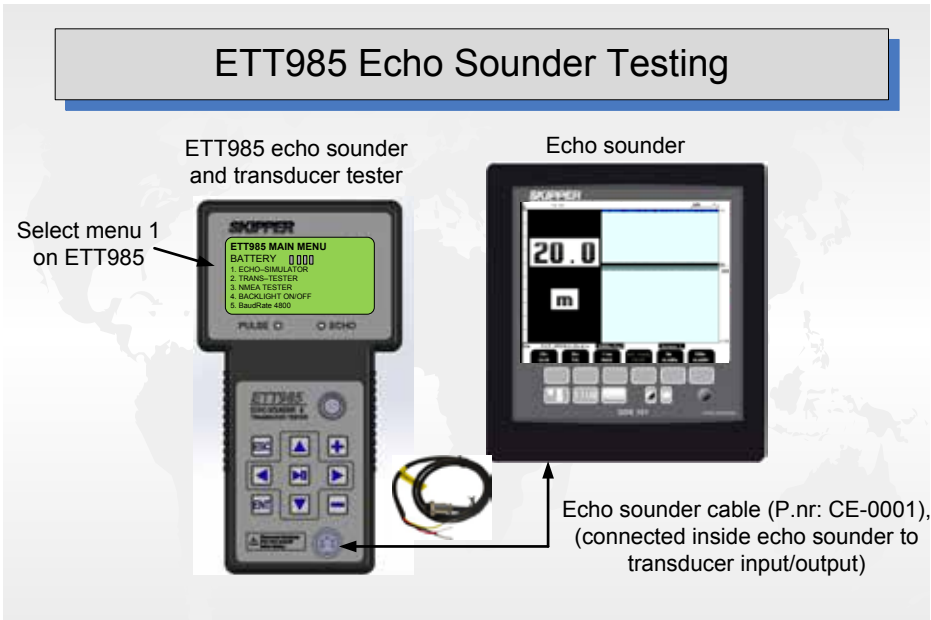
**B. SYSTEM COMPOSITION**

The ETT985 is constructed by three main parts:

- Echo sounder tester
- Transducer tester
- NMEA tester

They are illustrated below and on the next page.

**ECHO SOUNDER TESTER**



### TRANSDUCER TESTER

#### ETT985 testing transducer, PC control (optional)



### NMEA TESTER

#### ETT985 testing NMEA sentences

Speed log, echo sounder or equipment with NMEA port



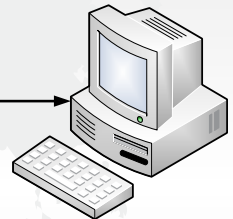
NMEA cable with clips (P.nr: CE-0003) from NMEA input/output connector on external equipment (or standard RS-232, 9 pin D-type cable for SKIPPER equipment).



Select menu 3 on ETT985



ETT985 echo sounder and transducer tester



PC control (optional)

**C. CONNECTION DESCRIPTION**

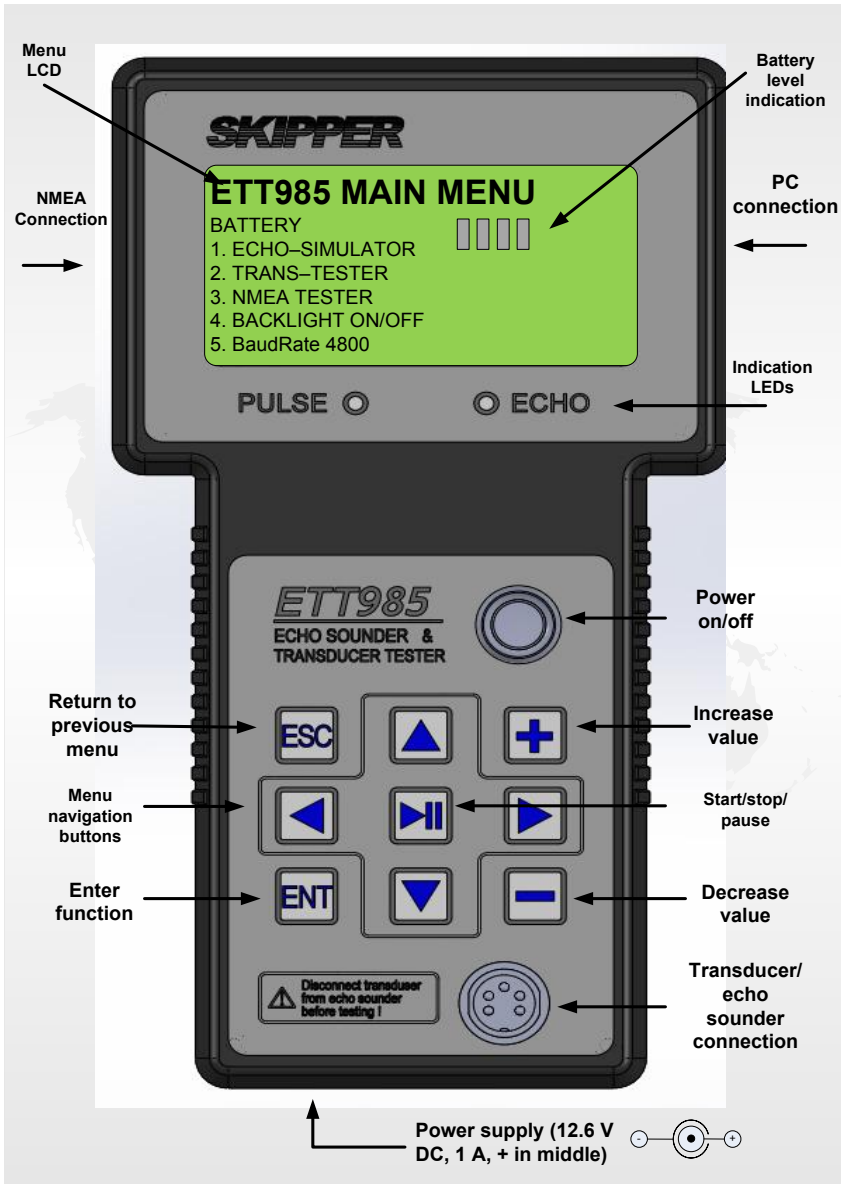
Make sure that the following parts are included in the package:

Part number	Description	Qty	Comment
ETT985-SASW or ETT985-SA	Echosounder & Transducer tester with or without activation code	1	
CE-0001	Cable, echo sounder w/ plugs, ETT985	1	
CE-0002	Transducer cable w/ clips, ETT985	1	
CE-0003	NMEA cable w/clips, ETT985	1	
ZZH-01032	Adapter w/cable USB-RS232, ETT985	1	
ZAA-01309	Driver CD, ETT985	1	
ZAA-01310	Travel case, ETT985	1	
ZZH-01033	Adapter power 100-230V, 12.6VDC, 1A + in middle ETT985	1	
DM-T001	Operation manual for ETT985 echo sounder/transducer tester	1	The one you are reading now.
AC-ETT985	Software activation sticker (on rear of unit)	(Opt)	



**D. PANEL LAYOUT**

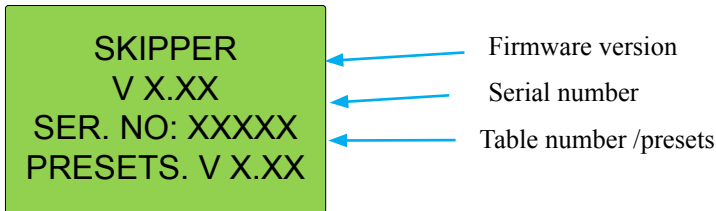
**BUTTON DESCRIPTION**



**E. MENU DESCRIPTION**

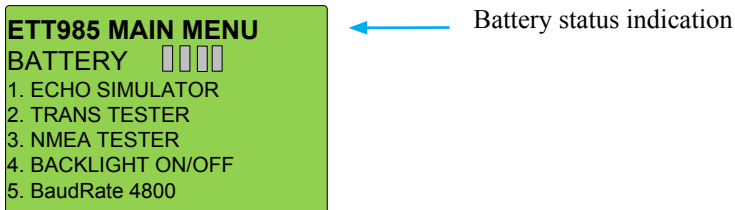
**AUTO-TEST**

On startup, the screen will show the system serial number, firmware version and current table number (presets). These can be compared with the latest versions released by the producer using the software. Presets should always be kept updated, using the SKIPPER service software. The screen will say ‘upgrade available’ if it detects an old version of firmware or preset table is in use.



**MAIN MENU**

After the auto self-test procedure, the ETT985 MAIN MENU appears.



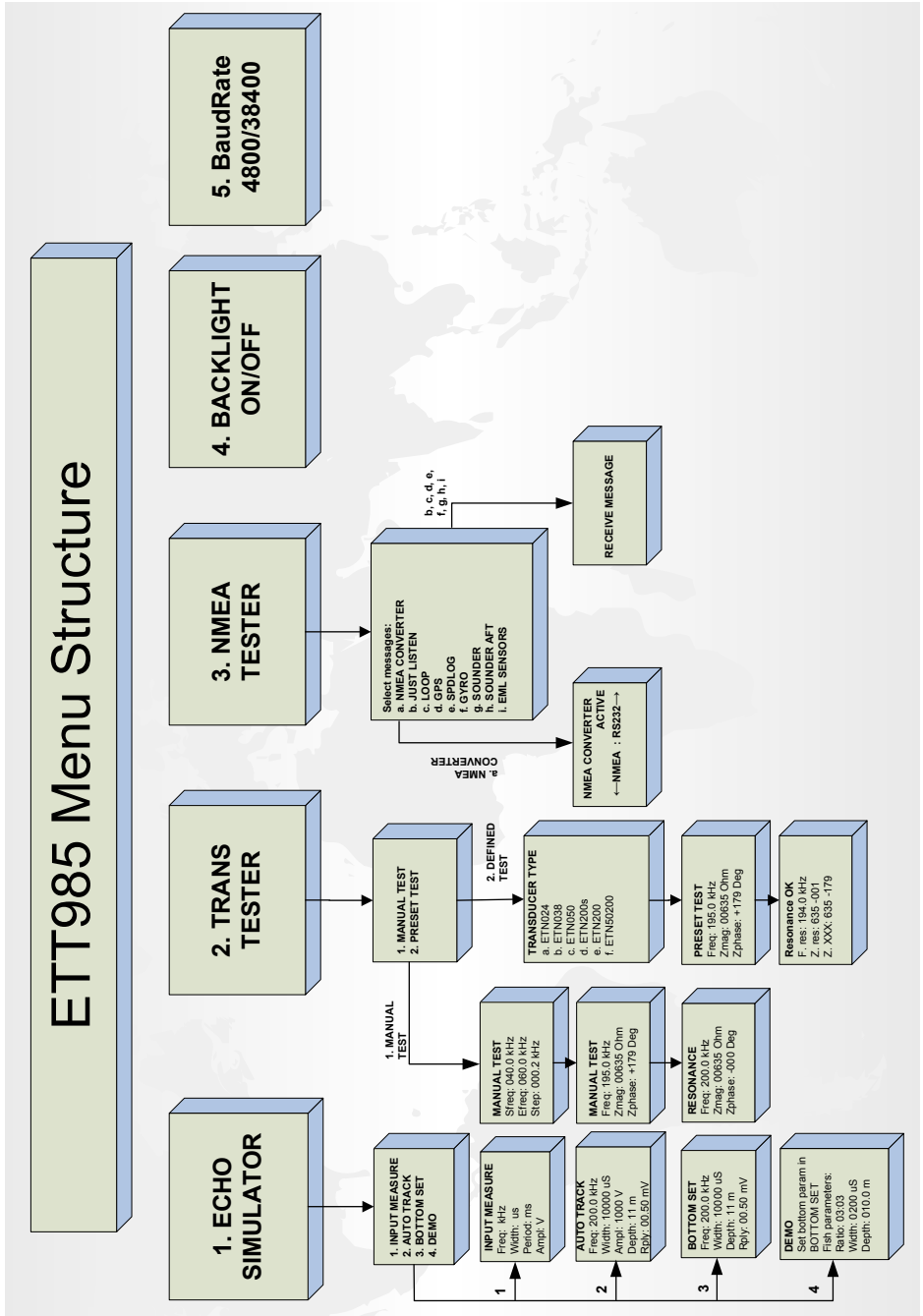
The ETT985 also shows the battery status. The battery should last about 4 hours for NMEA tester and transducer tester and shorter for simulator. In echo sounder simulator mode, the signal will become noisy as the voltage gets lower. It is therefore recommended to use the power supply in this mode. If the battery level gets less than 50 %, a low-battery warning will show.

On the tester, press or to change the location of the flashing cursor, and press to enter the function accordingly.

**LCD Backlight Control**

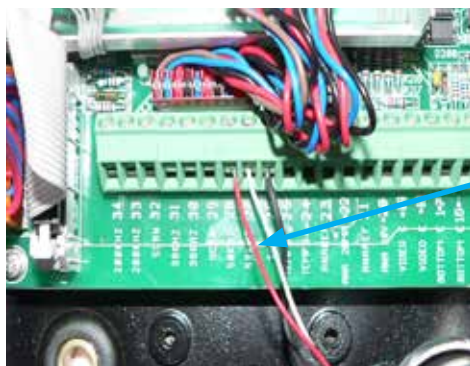
After the power-on, you can turn on and off the backlight by using and then select 4. BACKLIGHT ON/OFF, then press .

ETT985 MENU STRUCTURE



## 1.0 ECHO SIMULATOR (STAND ALONE OPERATION)

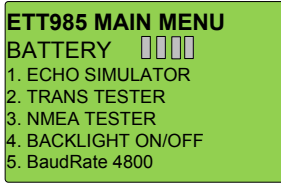
Connect the echo sounder to the ETT985. The echo simulator is used to verify that the transceiver electronics is working satisfactorily. This should be used if the system seems to have shorter range than normal, if there is too much noise on the screen, or if the system loses the bottom. Preset tests are preprogrammed in the ETT985 software (requires activation code). If this is not available, a set of data bulletins are available from the skipper web page [www.skipper.no](http://www.skipper.no), describing the settings required and how they should look on the echo sounder screen. Generally we need to test the output strength and the input sensitivity.



Picture showing echo sounder connection wire CE-0001 connected to the 50 kHz output inside GDS101.

- Black to screen.
- White and red to output.

**Important, warning:** Use the cable CE-0001, the one **without** cable clips. The wires are different and damage can be caused by using the other wire (CE-0002).



Use or and select 1. ECHO SIMULATOR and press .

The following screen picture will appear:

Screen picture	Description
	<b>1. INPUT MEASURE</b> is used for showing the transmitter signal values from the echo sounder.
	<b>2. AUTO TRACK</b> is used to measure in the incoming pulse and return the same pulse width and frequency with a user determined amplitude and depth.
	<b>3. BOTTOM SET</b> is used to fix all the returned parameters including frequency and bottom width.
	<b>4. DEMO</b> is used to show a moving bottom, with fish if required.

### 1.1 INPUT MEASURE

Use or and select 1. INPUT MEASURE and press .

The ETT985 will now search for **input signals** from the attached echo sounder. The following screen picture shown in table will appear:












Screen picture	Description
	<b>Freq:</b> The frequency of the connected echo sounder output.
	<b>Width:</b> The width of the received pulse from the echo sounder.
	<b>Period:</b> The time between the received pulses.
	<b>Ampl:</b> The signal level (Vpp) on the received pulse from the echo sounder.

**Note:** In this mode the simulator will not return a signal. The echo sounder may search for the bottom and adjust its pulse characteristics. If this happens, use AUTO TRACK mode instead. Press to return to previous menu. Use or and select 2. AUTO TRACK and press .

### 1.2 AUTO TRACK









Screen picture	Description
<div style="border: 1px solid black; padding: 5px; background-color: #d9ead3;">                     AUTO TRACK                      Freq: 50.0 kHz                      Width: 322 us                      Ampl: 1000 V                      Depth: 30 m                      Reply: 1.00 mV                 </div>	<b>Freq:</b> The measured frequency of the transmitted pulse to the echo sounder.
	<b>Width:</b> The measured width of the transmitted pulse to the echo sounder.
	<b>Ampl:</b> The signal level on the received pulse from the echo sounder.
	<b>Depth:</b> User defined simulated depth.
	<b>Reply:</b> The user defined value of the signal level on the transmitted pulse to the echo sounder.

This mode both receives the pulse, and then sends back the identical pulse in frequency and pulse width. It also allows the user to set the return pulse amplitude and depth. This mode allows the user to inspect normal operation conditions.




Press    or  to change the place of the flashing cursor, and press  or  to change the value of the number where the cursor flashed. If the settings are finished, press  to send the bottom echo that you set. In this mode only amplitude and depth are available. Press  to return to previous menu. Use  or  and select 3. BOTTOM SET and press .

### 1.3 BOTTOM SET

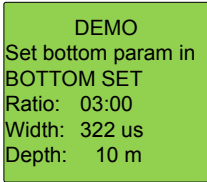
Screen picture	Description
<div style="border: 1px solid black; padding: 5px; background-color: #d9ead3;">                     BOTTOM SET                      Freq: 49.8 kHz                      Width: 322 us                      Depth: 20 m                      Reply: 0.50 mV                 </div>	<b>Freq:</b> The user defined frequency of the transmitted pulse to the echo sounder.
	<b>Width:</b> The user defined width of the transmitted pulse to the echo sounder.
	<b>Depth:</b> The user defined selected depth.
	<b>Reply:</b> The user defined value of the signal level on the transmitted pulse to the echo sounder.

This mode allows the user to set all the return pulse parameters and simulate extreme conditions. Press    or  to change the place of the flashing cursor, and press  or  to change the value of the number where the cursor flashed. If the settings are finished, press  to send the bottom echo that you set. In any menu you can press  to go back to the previous menu.

## 1.4 DEMO

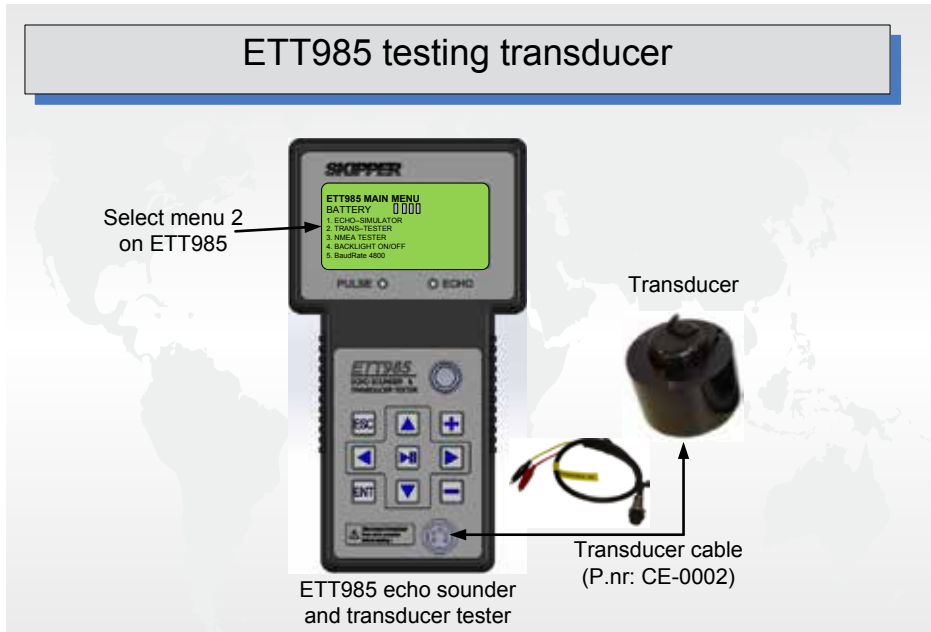
Use  or  and select 4. DEMO and press 

DEMO mode will slowly vary the depth around the depth and bottom parameters set in the the BOTTOM SET screen. If fish are required, the parameters on this screen can be used to select how strong and how often fish returns show. These will also vary between the set depth and the bottom.

Screen picture	Description
	<b>Ratio:</b> How often fish show.
	<b>Width:</b> The width of the fish echo.
	<b>Depth:</b> The minimum depth of the fish echo.

## 2.0 TRANS(DUCER) TESTER (STAND ALONE OPERATION)

Connect the ETT985 tester with transducer tester cable attached to the actual transducer. The transducer tester allows the user to test a transducer to find whether it is behaving as it should. Generally it will have an impedance and resonance that should be within manufacturer set limits. These limits are preset, or can also be found in the ETT985 datasheet on [www.skipper.no](http://www.skipper.no).



**Note:** The cable **with** cable clips must be used.



ETT985 with transducer cable



ETT985 Connected to transducer

**Note:** Do not connect to transducer screen.

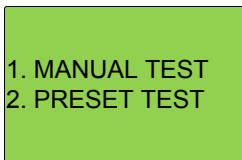





**Important:** The transducer should preferably **be submerged into water** when testing. Both resonance frequency and impedance may change in air. The preset tests are measured with the transducer in water, and may fail if the transducer is in air, usually showing a higher resonant frequency and impedance. For details, see [“The difference between testing in air, in a bucket, in deep water.” on page 31.](#)

- The ETT985 will find resonance frequency and measure impedance at this frequency.

The tester is designed to sweep through a series of frequencies and measure the characteristics of the transducer. Like a bell that rings at a particular (resonant) frequency, most transducers have a frequency where they perform best. For optimal use of the transducer, this frequency should be the same, or close to the frequency that the echo sounder is sending. The tester will measure the impedance as a factor of magnitude and phase through the defined frequency range and find the point where these are lowest, defining this as the resonant point.

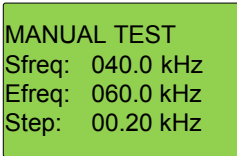
If you choose 2.TRANS-TESTER function on the main menu, then the Trans-Test selection menu will appear on the display.








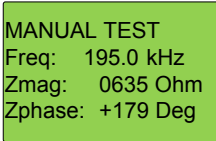
Press  or  to change the location of the flashing cursor, and press  to enter the function accordingly.




## 2.1 MANUAL TEST

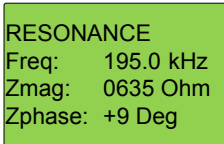
If you choose the 1. MANUAL TEST function, then the MANUAL TEST menu appears on the display. In this mode, the user selects the frequency region to be measured and how big frequency steps to be used.

Screen picture	Description
	<b>Sfreq:</b> The <b>start</b> frequency of the test sweep.
	<b>Efreq:</b> The <b>end</b> frequency of the test sweep.
	<b>Step:</b> The frequency step interval.

Press    or  to change the place of the flashing cursor. When the settings are finished, press  to begin the test. When the test starts, the MANUAL TEST menu appears on the display.

Screen picture	Description
	<b>Freq:</b> The frequency at which the impedance is currently being measured.
	<b>Zmag:</b> The impedance magnitude at this frequency.
	<b>Zphase:</b> The phase angle at this frequency.

You can press  to stop the change of the frequency. The impedance and phase angle at the frequency now is shown on the screen. Press  to continue the sweep. Press  to go back to the Trans-Test selection menu. When the sweep is finished, the RESONANCE menu will appear on the display.

Screen picture	Description
	<b>Freq:</b> The resonant frequency of the tested transducer.
	<b>Zmag:</b> The impedance of the tested transducer at resonance.
	<b>Zphase:</b> The resonant phase angle.




This data shows the resonant point of the transducer. This is the point where the transducer is most effective. Generally this should be within about 5 % of the echo sounder frequency. Zmag is the impedance measured at the resonant frequency. This is usually within the range of 20 to 300 ohms, however the exact ranges are available from the manufacturer. If this value is very high or very low, then the transducer may be at fault.

## 2.2 PRESET TEST

In this mode, the user selects a transducer part number and the limits are preset. The system will pass or fail and give resonance values. In addition, it will give the impedance value at the factory given main frequency of the transducer (e.g. 50 kHz). This value is the value the echo sounder will operate with. If the transducer fails, record the values or try again using the manual test mode. If the values are close to the expected results (for details, see “[1. Transducer parameters](#)” on page 37,) then contact the manufacturer, otherwise, replace the transducer.

Self defined values may be programmed by other manufacturers than SKIPPER. For this, the software option must be purchased. If you choose 2. PRESET TEST, then the TRANSDUCER TYPE menu will appear on the display.

```
TRANSDUCER TYPE
a. ETN024
b. ETN038
c. ETN050
d. ETN200S
e. ETN200
f. ETN50200
```

Press  or  to change the location of the flashing cursor, and press  to enter the specific transducer type test accordingly. Each type has some preset parameters. It will perform the automatic test. If the test is passed, the display will show “Resonance PASS!”. If not, “Resonance FAIL!” will be shown on the display.




```
Resonance PASS!
F.res: 40.0 kHz
Z.res: 150 +030
Z.050: 153 +039
```

```
Resonance FAIL!
F.res: 40.0 kHz
Z.res: 65535 +001
Z.050: 65535 +179
```

Typical results can be seen in [“I. Appendix” on page 37.](#)

The results here are shown in the form of magnitude and phase. In addition, a result is shown for the expected resonant frequency. This is where the echo sounder transmits, and these results should also be within the acceptable limits.

### 3.0 THE NMEA TESTER


The NMEA tester allows the user to plug directly into a SKIPPER graphic cabinet, or to wire to any other NMEA 0183 communication port (IEC61162-1). Use  or  and select 3. NMEA TESTER and press . Entering the NMEA tester menu the user can select to do the following:

Screen picture	Description
<div style="background-color: #90EE90; padding: 10px; border: 1px solid black;"> <p><b>SELECT MESSAGES:</b>                      a NMEA COVERTER                      b JUST LISTEN                      c LOOP                      d GPS                      e SPDLOG                      f GYRO                      g SOUNDER                      h SOUNDER AFT                      i EML SENSORS</p> </div>	<p><b>a NMEA CONVERTER:</b> The ETT985 will re-transmit messages from the NMEA port to the RS-232 port, and the opposite. The unit becomes a converter.</p>
	<p><b>b JUST LISTEN:</b> The screen will show the start (identifier) of the incoming messages.</p>
	<p><b>c LOOP:</b> The unit will listen and report incoming messages and send out the same messages.</p>
	<p><b>d GPS:</b> The unit will listen and report incoming messages and send out a static format for the selected instrument type.</p>
	<p><b>e SPDLOG:</b> The unit will listen and report incoming messages and send out a static format for the selected instrument type.</p>
	<p><b>f GYRO:</b> The unit will listen and report incoming messages and send out a static format for the selected instrument type.</p>
	<p><b>g SOUNDER:</b> The unit will listen and report incoming messages and send out a static format for the selected instrument type.</p>
	<p><b>h SOUNDER AFT:</b> The tester will send a SKIPPER proprietry message for the aft transducer.</p>
	<p><b>i EML SENSORS:</b> The unit will send a proprietry signal to simulate an EML sensor in a compact display configuration (connect to sensor input).</p>

The exact messages can be found in [“NMEA Tester” on page 23](#). If there are more options available, the user has downloaded a table from software. (The software allows any message to be sent from the NMEA port.)

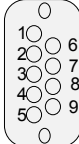
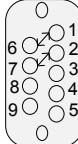
The baud rate of the unit can be toggled from 4800 to 38400 on the main menu. This will be reset to the 4800 default at startup.

**MASTER RESET.**

If tables have been updated and/or something does not work correctly, the system can be reset to the factory default settings by turning off the unit, and turning on while the  button is pressed. We recommend you then to download the latest table from the SKIPPER website and update using the software. This product is new and contains many functions that may need some improvement. If you experience problems with the tester, please report this to [support@skipper.no](mailto:support@skipper.no). New firmware versions and tables will be reported on the version table in the SKIPPER service software.

**E. SPECIFICATIONS**

**GENERAL**

Dimensions:	235 mm x 135 mm x 55 mm
Weight:	750 g (1.2 kg with bag and cables)
Power supply:	Internal: Rechargeable li-ion battery (12.6 V DC)
	External: 12.6 V/350 mA operation and battery charging
Connections:	In/out to echo sounder
	In/out to transducer
	COM port to PC connection
	<p>NMEA connection (SKIPPER Standard)</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>9 Pin D-SUB (female connector) in cabinet front seen from outside.</p>  <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> <p>NMEA IN: Pin 1-2, RCV1 A, B                      NMEA IN: Pin 6-7, RCV2 A, B                      NMEA OUT: Pin 4-5, XMT1 A, B                      NMEA OUT: Pin 8-9, XMT2 A, B</p> </div> </div> <div style="text-align: center;"> <p>9 Pin D-SUB (male connector) in ETT front seen from outside.</p>  <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> <p>NMEA IN: Pin 4-5, RCV1 A, B                      NMEA OUT: Pin 1-2, XMT1 A, B                      NMEA OUT: Pin 6-7, XMT2 A, B</p> </div> </div> </div>
Temperature:	-15 - 55 C

**ECHO SOUNDER TESTER**

Parameter	Alias	Range	Resolution	Accuracy
Input frequency	Ifreq	10 kHz - 999.9 kHz	0.1 kHz	±1 kHz
Input width	Iwidth	20 us - 60 000 us	1 us	±10 us
Input period	Iperiod	1 ms - 6 553.5 ms	0.1 ms	±1 ms
Input amplitude	Vipp	50 V - 2 500 V	1 V	±10 V
Output frequency	Ofreq	10 kHz - 999.9 kHz	0.01 kHz	±0.1 kHz
Output bottom width	Obwidth	20 us - 60 000 us	1 us	±5 us
Output bottom depth	Obdepth	0.2 m - 999.9 m	0.1 m	±0.2 m

Parameter	Alias	Range	Resolution	Accuracy
Output fish width	Ofwidth	20 us - 60 000 us	1 us	±1 us
Output fish depth	Ofdepth	0.2 m - 999.9 m	0.1 m	±0.2 m
Output amplitude	Vopp	0.02 mV - 599.99 mV	0.01 mV	±0.2 mV
Output fish ratio	Ofr	00:00 - 99:99	N/A	N/A

**Note:** Specified for input width greater than 9 ms

## TRANSDUCER TESTER

Parameter	Alias	Range	Resolution	Accuracy
Scan frequency	Fs	10 kHz - 999.9 kHz	0.01 kHz	±0.1 kHz
Resonant frequency	Fr	10 kHz - 999.9 kHz	0.01 kHz	±0.5 kHz
Resonant impedance of the transducer	Zr	1 ohm - 65 535 ohm	1 ohm	±10 ohm
Resonant phase of the transducer	Qr	±180 deg	0.01 deg	±10 deg *

\*Phase values are calculated, and at times can show large error. The phase noise values are worse when the impedance is low.

## NMEA TESTER

Pinned for direct contact to SKIPPER standard NMEA 9 pin D-type plug.

Pre- programmed parameter	On Screen
GPGLL,5718.7574,N,00550.1394,E,120734.12,A*01	GPS
GPVTG,171.5,T,,05.52,N,,,A*25	GPS
VDVBW,10.00,2.34,A,14.99,-2.48,A*73	SDPLOG
VDVLW,54321.0,N,123.4,N,99998.7,N,12345.6,N*52	SPDLOG
HETHS,12.1,A*1F	GYRO
HEHDT,017.95,T*15	GYRO
TIROT,4.94,T*17	GYRO

<b>Pre- programmed parameter</b>	<b>On Screen</b>
SDDBT,164.04,f,50.00,M,27.34,F*36	SOUNDER
PSKPDPT,10.3,-0.5,100,5,2,FWD*21	SOUNDER
PSKPDPT,10.3,-0.5,100,5,1,AFT*24	SOUNDERAFT
PSKPVWF,10.00,2.34,A,,,,,V*12	EML SENSORS
Programmable from software	<user defined>



## G. UPGRADING AND UPDATING

SKIPPER Electronics has developed a service software that can be used for updating and test of many SKIPPER products. This should be downloaded from the SKIPPER website [www.skipper.no](http://www.skipper.no) and installed on the local machine. This software is continually being updated with more diagnostic and service tools, and contains a function to check all the latest available versions for the listed products. The service software can be run on Windows 2000, XP or Windows 7 operating systems. If a AC-ETT985 software activation code is purchased, this will be part of the serial number sticker on the rear of the ETT985 unit. The ETT985 mode of the software has limited functionality. To get full functionality, an activation code can be purchased from SKIPPER when you supply the serial number of the unit.

**Note:** Some upgrading functions are available **without** the activation codes.

- Preset (table) updating.
- Firmware upgrade.

### 1. INSTALLING THE SOFTWARE

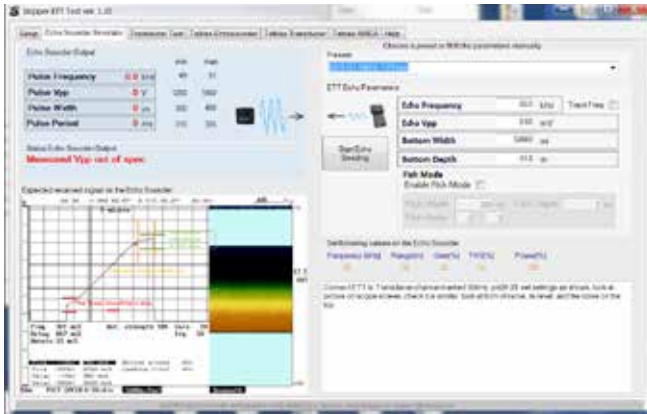
The ETT985 will convert from NMEA to RS-232 internally. By using the supplied RS-232 to USB cable (p. nr. ZHH-01032), connected to the ETT985 RS-232 port, the USB port can be used on PCs with no inbuilt RS-232 port. To use this cable you need to install the supplied driver when requested (when the cable is plugged into the USB port on the PC for the first time. (Drivers can also be downloaded from the SKIPPER website). Once the RS-232 port is installed, download the latest SKIPPER service software from the SKIPPER web page, [www.skipper.no/downloads/software](http://www.skipper.no/downloads/software) and install as instructed.

### 2. START THE SERVICE SOFTWARE

The service software will start with an introduction screen. Connect the ETT985 unit, and turn on the power. Click the ETT985 option. The software will attempt to find the ETT985 unit. If this succeeds, it will upload the current presets (tables) within the unit, and also the serial number. If you have an activation code, enter the serial number and activation code in the table. (The activation code can be found on the back of the ETT985 unit).

Click on the tables tab. From here you can load in a table, and download it to the ETT985 device. The software has extensive help files to support the product and more instructions are available there.



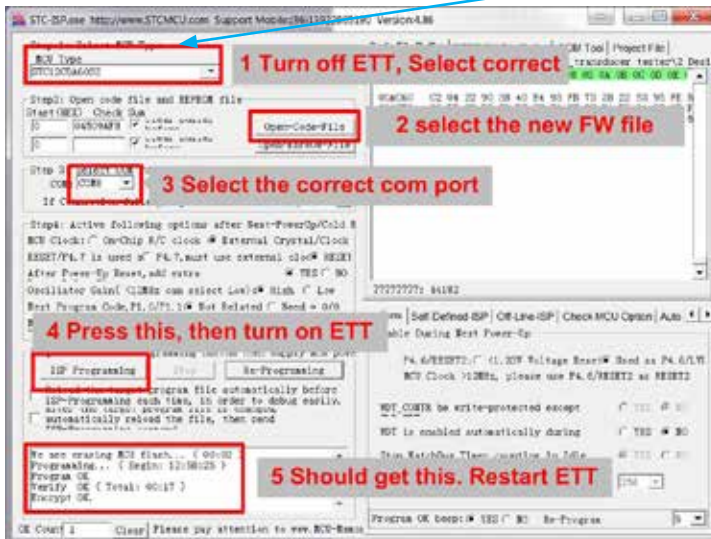


### 3. UPGRADING THE FIRMWARE

A separate program (ETT firmware downloader) must be used to upgrade the ETT985 firmware. This software can be downloaded from [www.skipper.no](http://www.skipper.no).

- Note which com port the device is connected to.
- Close the SKIPPER service application and start the firmware downloader. The first time this is used, it will need to be installed. Unfortunately the software has chinese text, please select the left (ok) button to install.
- Follow numbers 1- 5 as shown. In 1, select STC12C5A60S2 as MCU type.
- Restart the ETT985 unit, check the firmware number is correct.
- Perform a master reset (press ENT at power on).

STC12C5A60S2



#### **4. THE FULL VERSION OF THE ETT985 SOFTWARE.**

The full version of the ETT985 software is integrated into the standard version of the SKIPPER service software and is activated using a code supplied from SKIPPER.

This software is documented in help files within the software, and has the following analysis features:

- Graphs with impedance magnitude, phase, conductance and susceptance.
- Scan with resistance, conductance, susceptance and phase.
- Preset testing of transducers.
- Export for service reports.
- Simulator control.
- Preset tests for SKIPPER echo sounders.
- NMEA terminal emulator (using the tester as a RS-232 to NMEA converter).
- NMEA proprietary message programming for the ETT tester.

In addition, other producers can generate their own preset tables for both transducers and echo sounders. Activation codes can be purchased from [sales@skipper.no](mailto:sales@skipper.no) when you provide your serial number (on start up screen or on back of unit).

**H. HOW THE SYSTEM WORKS**

**INTERPRETING THE DATA FROM THE ETT985**

The ETT985 takes you deep into the transducer engineers world, and provides a tools often used in the echo sounder and transducer manufacturing process.

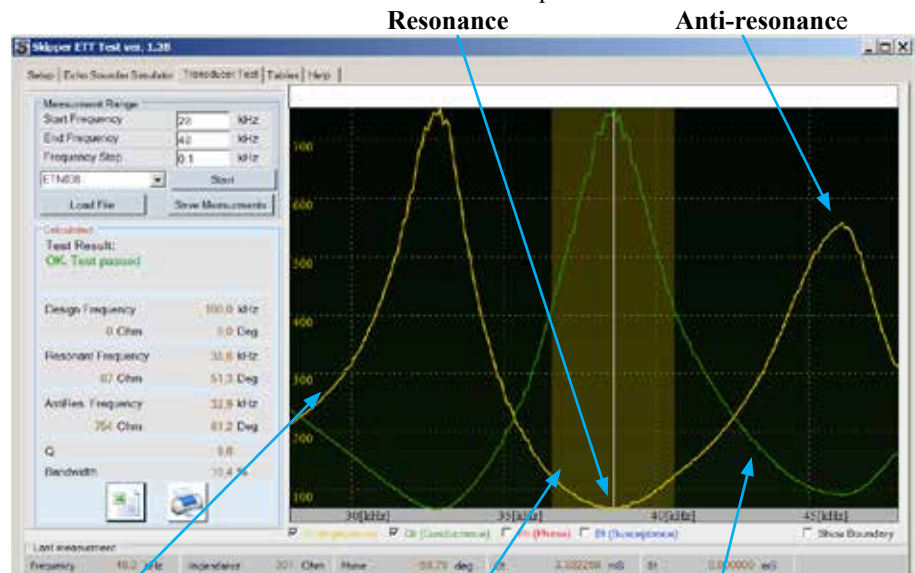
**TERMINOLOGY**

**RESONANT FREQUENCY**

A transducer is like a bell, it will vibrate if it is given a short hit. The frequency at which it vibrates most readily is the resonant frequency. At this frequency the conductance is a maximum and transducer most efficiently converts the electrical energy input into mechanical energy. A transducer will have a number of resonances, some better than others at creating sound.

**ANTI-RESONANCE**

The electrical characteristics of a transducer has a low impedance point (usually the resonant point), and this is usually followed by a high impedance point normally at a slightly higher frequency. This point generally gives the best receive characteristics of the transducer and is known as the anti-resonance point.



**Impedance curve (yellow), Bandwidth (yellow column), Conductance curve (green)**

## IMPEDANCE

The transducer has electrical characteristics that follow the physical resonance of the device. This means that by measuring the impedance, we can find the points where the transducer is most effective. This electrical impedance is split into 2 components, a real component, (resistance) and an imaginary part, reactance (equivalent to a capacitor or inductor). Energy in imaginary part is wasted and converted mainly to heat. Ideally we want just resistance and no imaginary part. This happens best at the resonant frequencies of a transducer.

Impedance can be represented mathematically in 2 ways:

1.  $Z=|Z_0|.e^{(j.\theta)}$  where  $|Z_0|$  is the magnitude at the current frequency and  $\theta$  is the phase angle.
2.  $Z=R+jX$  where  $R$  is resistance at a frequency, and  $X$  is the reactance (capacitance or inductance). This is related to  $Y$  admittance by  $Z=1/Y$  where  $Y=G+jB$ .  $Y$  is the admittance,  $G$  is the conductance and  $B$  is the susceptance.

The ETT985 tester will give values for  $|Z_0|$  and the phase, at the resonant point or at the assumed resonant point. If the ETT985 software is activated, the conductance and susceptance will also be plotted allowing bandwidth to be calculated.

## BANDWIDTH AND Q-FACTOR

The bandwidth of a transducer is defined as the frequency range at which the output power of the transducer is down 50 % from the resonant frequency value. The bandwidth can be calculated from the conductance curve, which shows a strong peak at resonant frequency  $f(r)$ . The point where the conductance and susceptance curves cross, gives the half power points  $f(1)$  and  $f(2)$ . The mechanical Q-factor can then be defined by  $Q=f(r)/[f(2)-f(1)]$ . The higher the Q-factor, the narrower is the bandwidth between half-power points. You get an accurate bandwidth that is measured as a % of a resonant frequency, or  $1 / \%$  gives a value of Q-factor. Bandwidth is the region where the transducer is most effective and give the best combined output and input sensitivity.

To get the most out of an echo sounder, it is important that the transducer impedance is within the limits set by the echo sounder producer at the frequency that the echo sounder transmits. As long as the echo sounder frequency is within the top half of the conductance peak (within the bandwidth), it is ok, even if the resonance is slightly off. If the echo sounder frequency can be changed, such as in the GDS102, it can be optimized by moving the transmit frequency to the resonant point or conductance peak. The software and tester give the impedance at this frequency, if it is known (from the presets/tables).

---

## ELECTRICAL RESISTANCE AND CONDUCTANCE

The electrical resistance of an electrical element is the opposition to the passage of an electric current through that element. The inverse quantity is electrical conductance, the ease at which an electric current passes. Electrical resistance shares some conceptual parallels with the mechanical notion of friction. The SI unit of electrical resistance is the ohm ( $\Omega$ ), while electrical conductance is measured in siemens (S). An object of uniform cross section has a resistance proportional to its resistivity and length and inversely proportional to its cross-sectional area. All materials show some resistance, except for superconductors, which have a resistance of nearly zero.

### SUSCEPTANCE.

In electrical engineering, susceptance (B) is the imaginary part of admittance. The inverse of admittance is impedance and the real part of admittance is conductance. In SI units, susceptance is measured in siemens (S). The general equation defining admittance is given by  $Y = G + jB$  where Y is the admittance, measured in siemens (S) (a.k.a. mho, the inverse of ohm). G is the conductance, measured in siemens, J is the imaginary unit and B is the susceptance, also measured in siemens (S).

### WHAT CAN GO WRONG?

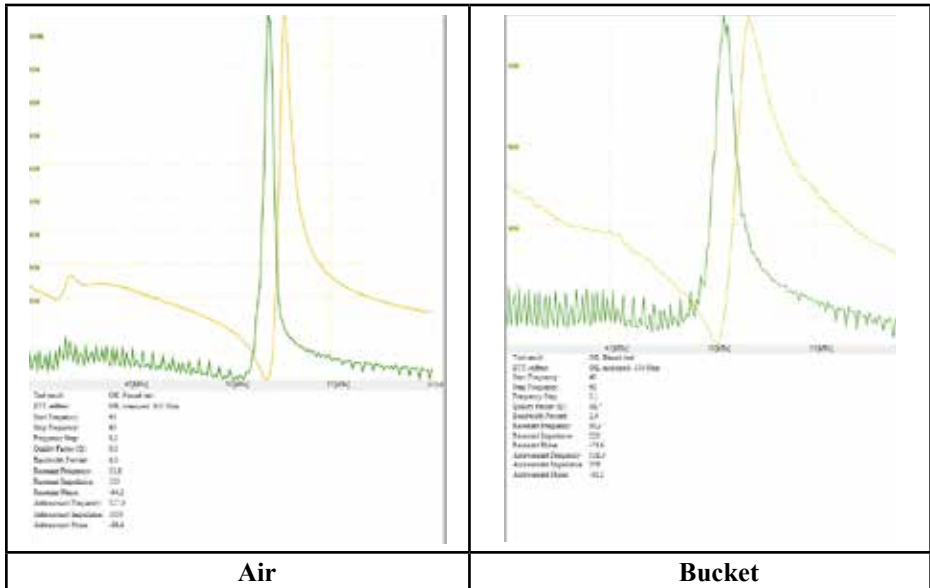
A transducer can fail in a number of ways. Most common is that it is physically hit by an object or by the vessel scraping the bottom. The sound maker is a piezoelectric disk, that is typically made of ceramic, and therefore fragile. A failure of this type will normally be extreme, and seen by a total loss of resonant frequency so resistance is always high, even at DC >5 M Ohm, maybe a short circuit giving 0 ohms at DC. Another way to ruin a transducer is to heat it to above its working temperature. Above this temperature the ceramic partially or fully loses its piezoelectric properties, and will move or destroy its resonance permanently. Heat is generated by leaving the transducer out of water for a long time, or by putting too much power on it (too high voltage Vpp). Ceramics are destroyed at temperatures typically of 120 – 600 degrees. Each transducer will have its own power tolerance, and many echo sounders have an option to limit the power output, temporarily or permanently.

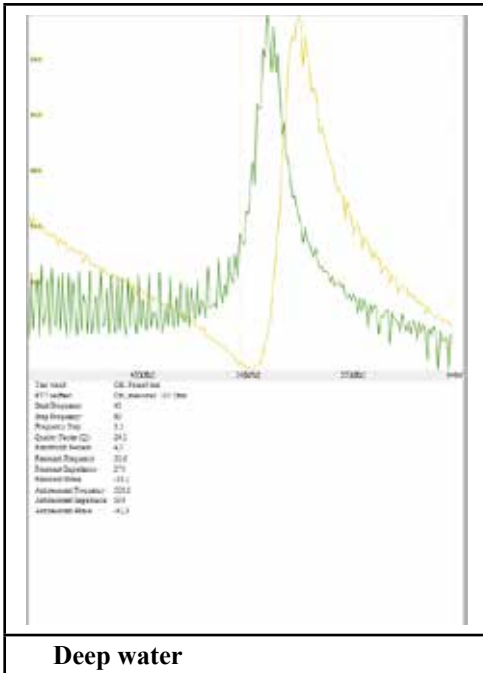
### HOW TO TEST?

If you suspect the transducer has a problem, disconnect it from the echo sounder. Connect the transducer to the ETT985 tester and run a sweep across the expected resonance frequency. Look at the resonant frequency, the impedance and check it against the manufacturers specification. Generally, if the resonance frequency is within 5 % of the designed frequency or the impedance is between 20 and 350 ohms, the transducer is ok. If a preset exists for the transducer, use that and the manufacturers parameters will be checked. If the transducer fails, you can see the parameters in the

tables tab of the software. If you have the fully activated software, use this and check the conductance curve. If the transducer fails the test, check with the manufacturer by sending the print (print to PDF and email, send an MMS of the screen shot, or send the values given by the export button). If the software is not available, send the test parameters from the defined test screen, together with you serial number, firmware version and table version (available on the tester start screen).

## THE DIFFERENCE BETWEEN TESTING IN AIR, IN A BUCKET, IN DEEP WATER.





The plots show the difference of a transducer measured in air, in a bucket and in a deep tank/sea. It can be seen that the characteristics in air are drastically different. Whereas difference in a bucket and deep water are the same, but bucket is noisier. The air plot can move resonances closer and this can cause readings to be drastically different.

**Conclusion:** Always test in at least a bucket of water with the transducer fully submerged.

## ECHO SOUNDER

The ETT985 tester will test echo sounders that give out a single frequency ping. The tester contains an input resistor load of 300 ohms. With this load the echo sounder output will give a voltage with a fixed peak to peak reading (Vpp). This value will maybe sink if a long pulse is used. The tester measures the start of the pulse and the length. This can give an indication of the maximum power being given out by the system. However, exact calculation of the power is dependant on the load from the transducer. Echo sounder function is checked using two tests.

### 1) TEST THE TRANSCIEVER OUTPUT

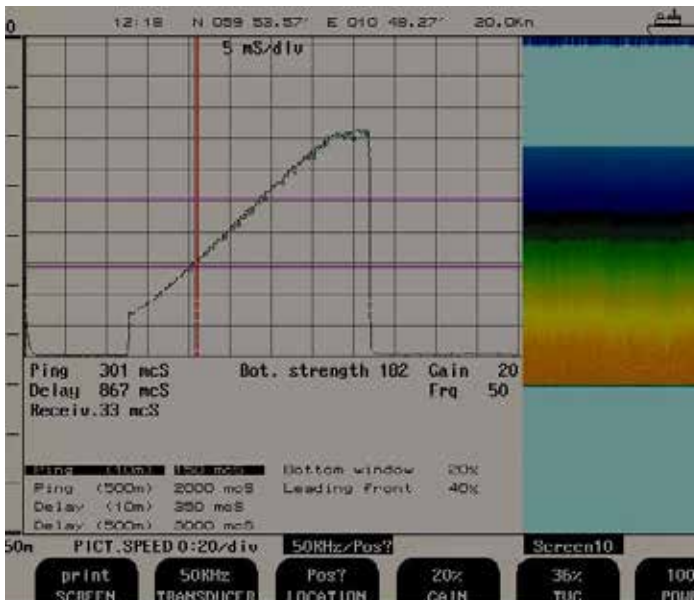
Measuring the output amplitude and pulse length. If amplitude or pulse length are not



correct, check that the settings on the echo sounder are as recommended. If it is still wrong, you may need to replace the transceiver card (however, always also check the transducer, maybe it has broken the transceiver and also needs replacing).

## 2) TEST THE TRANSCIVER INPUT

**a. Signal strength and TVG.** The ETT985 sends a long pulse at a depth where the TVG curve can be clearly seen and compared against the standard picture shown below. This shows if the TVG is working as expected, but also that the signal levels are ok in the shallower waters. Depth may vary, as a small amount of noise at this setting will cause a large change of depth.



TVG curve  
on GDS101

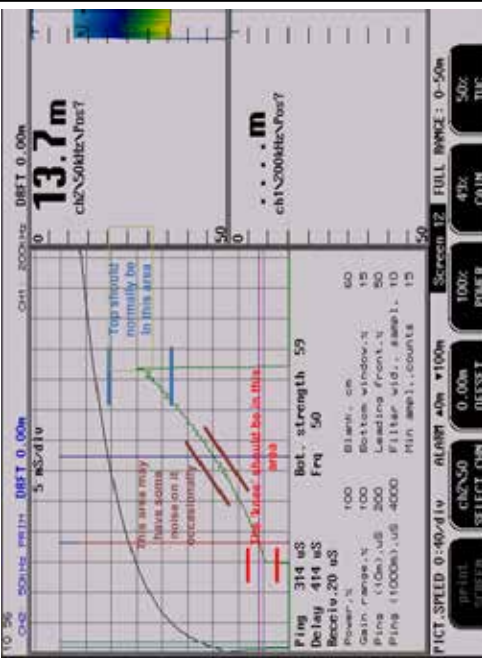
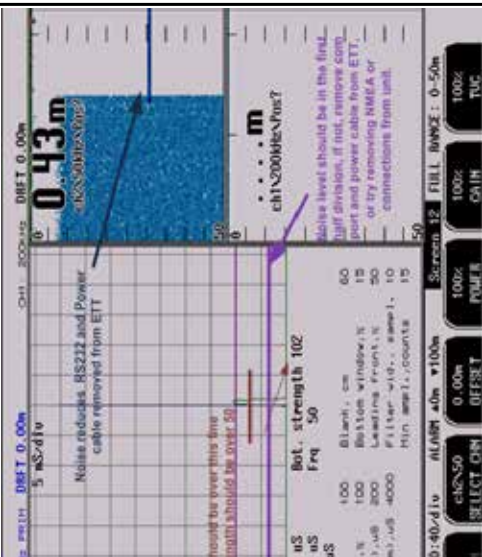
**b. Noise test.** This sets the minimum signal levels for depths outside of the TVG area and shows that the receiver is picking up a low signal. This test is performed at a depth of approx. 200 m, but is actually simulating a depth much greater. If the noise is very high, check the battery level on the simulator as more noise is generated by the simulator at low battery levels. Check the wiring to the tester, but also to the power and communications. Try removing connections and terminating them correctly (see manuals) to reduce the noise. If noise is still too high or the TVG is not as shown in the picture, there may be an error in the transceiver, contact the manufacturer. For details, see [“GDS101 TVG and noise curves” on page 34](#) and [“GDS102 TVG and noise curves” on page 35](#).

**Note:** More details available in separate service data bulletin in the download section on [www.skipper.no](http://www.skipper.no).

GDS101 TVG AND NOISE CURVES

GDS101 Noise		GDS101 TVG Curve	
<p><b>Tester Settings</b></p> <p><b>BOTTOM SET</b>                      Freq: 50.0 kHz                      Width: 323 us                      Depth: 300 m                      Reply: 0.13 mV</p>	<p><b>GDS101 Settings</b></p> <p>Screen 10:</p> <ul style="list-style-type: none"> <li>FREQ: 50 kHz</li> <li>TVG: 36 %</li> <li>GAIN: 20 %</li> <li>POWER: 100 %</li> <li>RANGE: 500 m</li> </ul>	<p><b>Tester Settings</b></p> <p><b>BOTTOM SET</b>                      Freq: 50.0 kHz                      Width: 32000 us                      Depth: 11 m                      Reply: 0.50 mV</p>	<p><b>GDS101 Settings</b></p> <p>Screen 10:</p> <ul style="list-style-type: none"> <li>FREQ: 50 kHz</li> <li>TVG: 36 %</li> <li>GAIN: 20 %</li> <li>POWER: 100 %</li> <li>RANGE: 50 m</li> </ul>

GDS102 TVG AND NOISE CURVES

<p style="text-align: center;"><b>GDS102 TVG Curve</b></p> <p style="text-align: center;"><u>Tester Settings</u></p> <p>Screen 12, Channel 1 and 2.</p> <ul style="list-style-type: none"> <li>• FREQ: 50 kHz</li> <li>• TVG: 32000 us</li> <li>• DEPTH: 11 m</li> <li>• GAIN: 50 %</li> <li>• POWER: 100 %</li> <li>• RANGE: 50 m</li> </ul>	<p style="text-align: center;"><b>GDS102 Noise</b></p> <p style="text-align: center;"><u>Tester Settings</u></p> <p>Screen 12, Channel 1 and 2.</p> <ul style="list-style-type: none"> <li>• FREQ: 50 kHz</li> <li>• TVG: 1000 us</li> <li>• DEPTH: 30 m</li> <li>• GAIN: 100 %</li> <li>• POWER: 100 %</li> <li>• RANGE: 50 m</li> </ul>
	

**WHAT CAN GO WRONG ON AN ECHO SOUNDER?**

Many things can happen, but the tester can measure for unusually high noise (usually wiring problems), wrong output frequencies, reduced power and bad power capacity. Most of these problems are caused by transceiver failure or wrong settings in the unit.

**L APPENDIX****1. TRANSDUCER PARAMETERS**

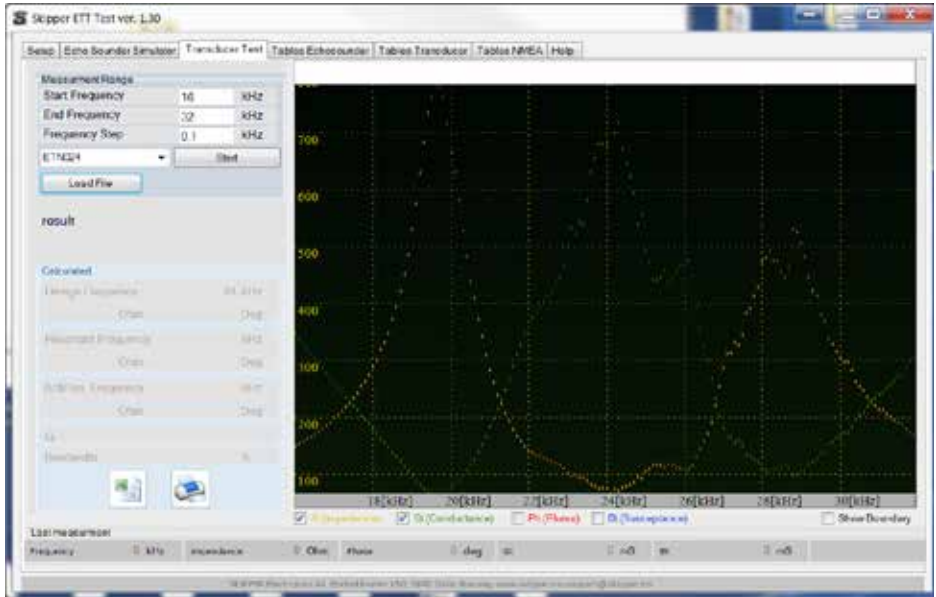
ID	Title	Fmax (kHz)	Fmin (kHz)	Zmax (ohm)	Zmin (ohm)	Start (kHz)	Stop (kHz)	Step (khz)	Qmax
a	ETN024	26	22	100	20	16	32	0.1	10
b	ETN038	40	36	100	20	28	48	0.1	10
c	ETN050	54	46	450	100	40	60	0.1	10
d	ETN200S	210	190	450	100	180	220	1	10
e	ETN200	210	190	80	20	180	220	0.1	10
f	ETN50200	230	180	700	350	170	230	1	10
g	Self-Def	0	0	0	0	0	0	0	0

**2. TYPICAL RESULTS OF TRANSDUCERS**

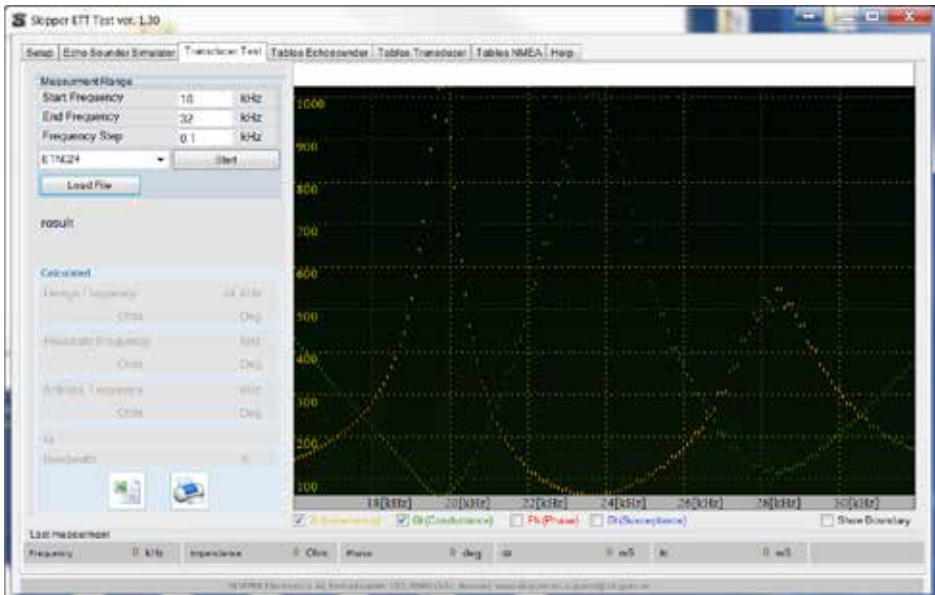
The following are measured results showing typical results of transducer tests in a large bucket (1 m deep) and in the sea.

Transducer	Location	Link
ETN024	In bucket	<a href="#">“ETN024 in bucket” on page 38</a>
ETN024	In sea	<a href="#">“ETN024 in sea” on page 38</a>
ETN038	In bucket	<a href="#">“ETN038 in bucket” on page 39</a>
ETN038	In sea	<a href="#">“ETN038 in sea” on page 39</a>
ETN050	In bucket	<a href="#">“ETN050 in bucket” on page 40</a>
ETN050	In sea	<a href="#">“ETN050 in sea” on page 40</a>
ETN200	In bucket	<a href="#">“ETN200 in bucket” on page 41</a>
ETN200	In sea	<a href="#">“ETN200 in sea” on page 41</a>
ETN200S	In bucket	<a href="#">“ETN200S in bucket” on page 42</a>
ETN200X	In bucket	<a href="#">“ETN200X in bucket” on page 42</a>

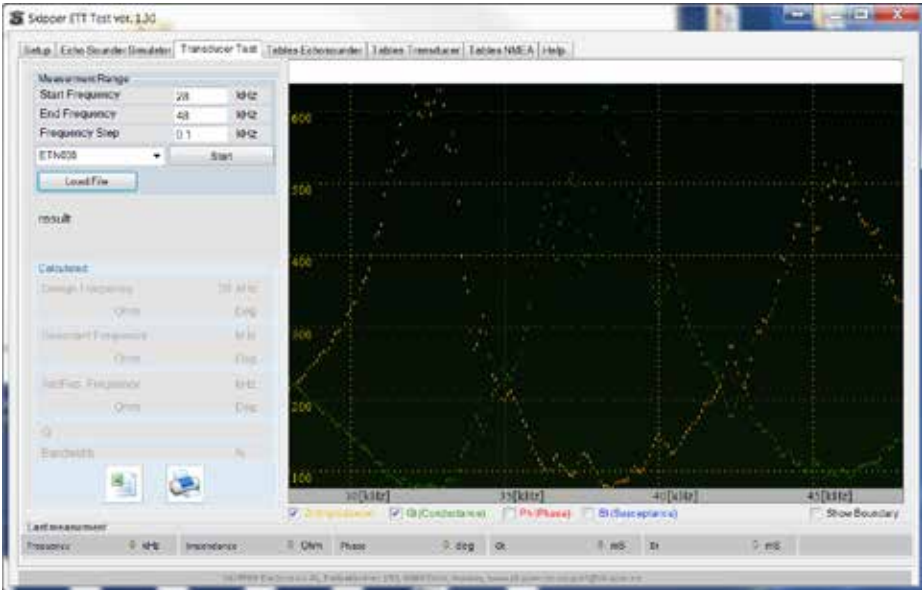
ETN024 IN BUCKET



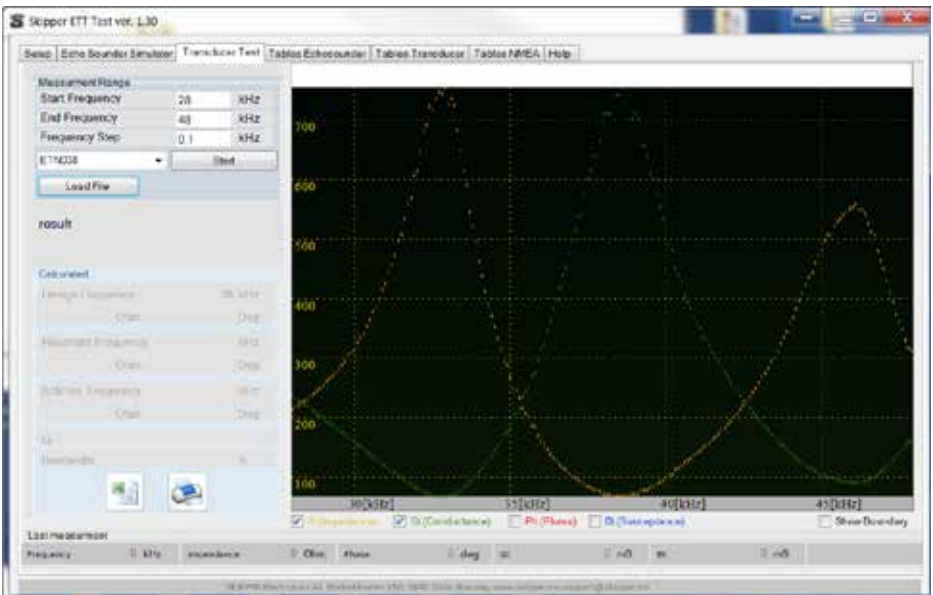
ETN024 IN SEA



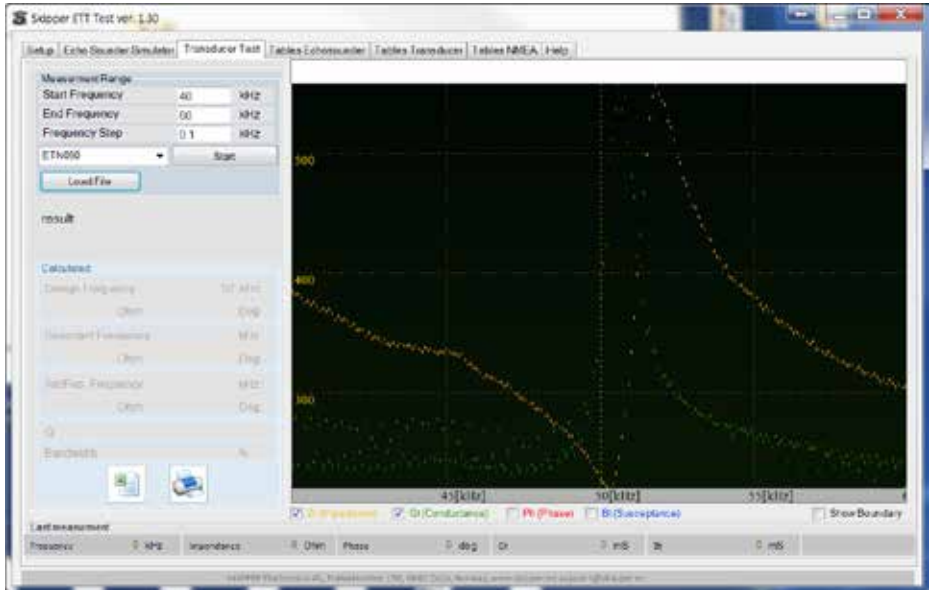
**ETN038 IN BUCKET**



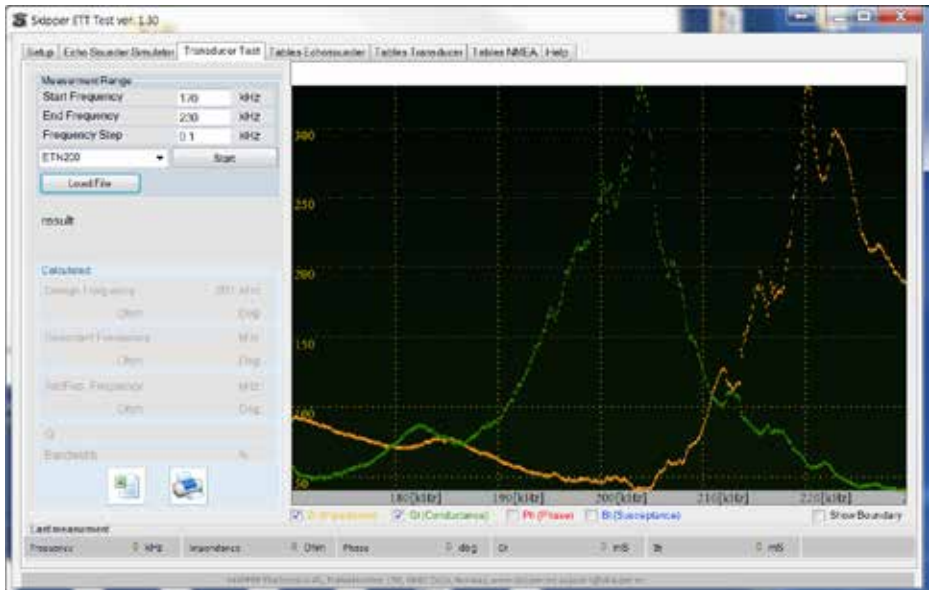
**ETN038 IN SEA**



**ETN050 IN BUCKET**

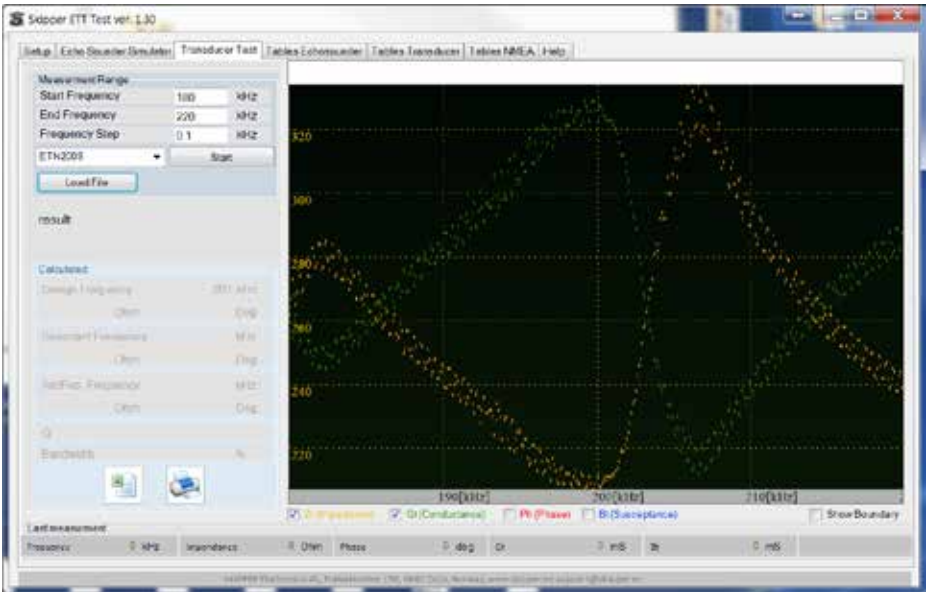


**ETN050 IN SEA**

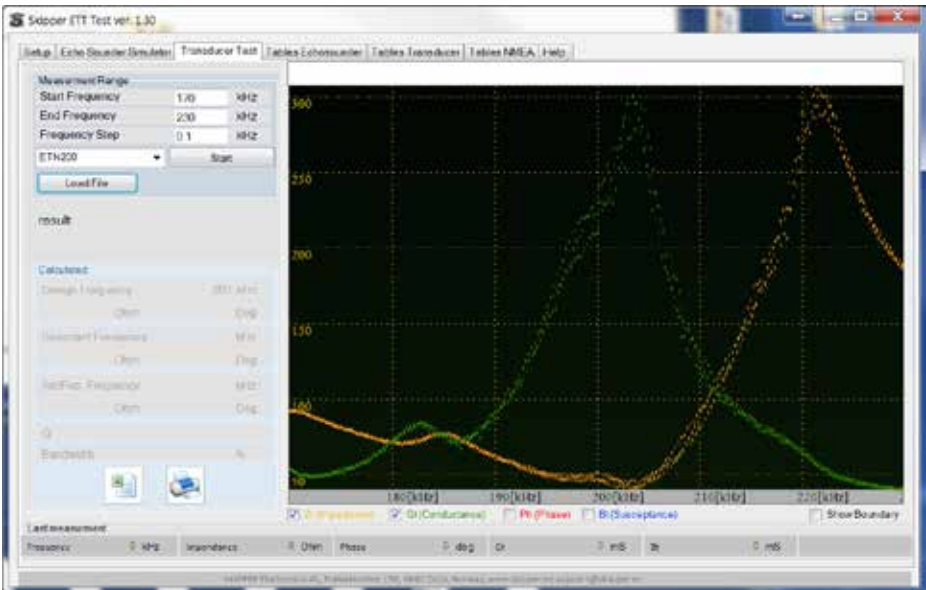




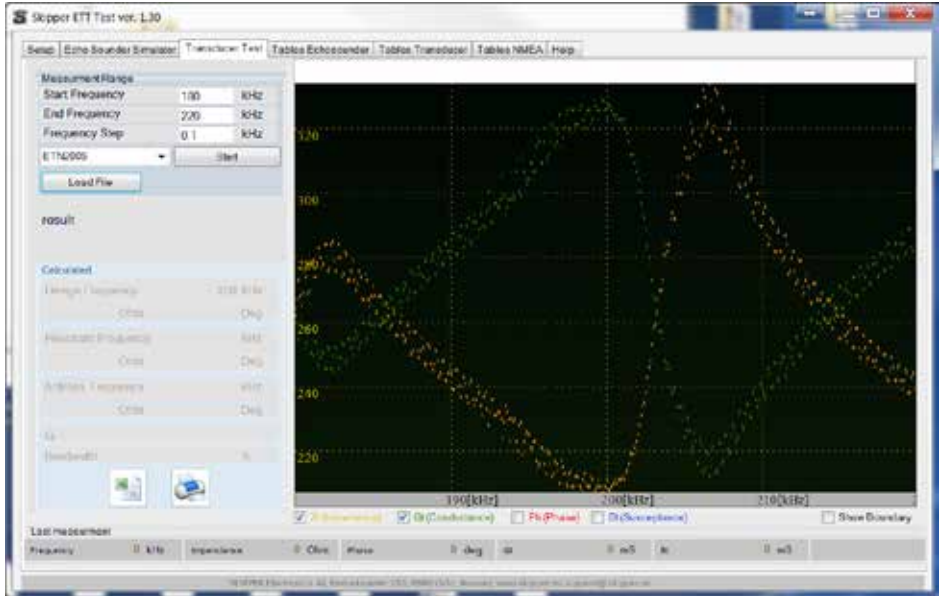
### ETN200 IN BUCKET



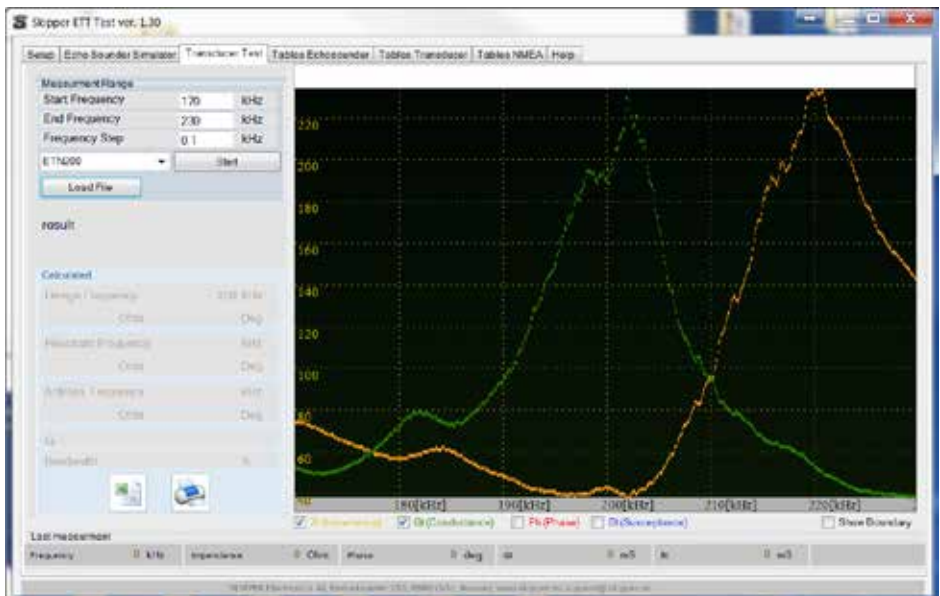
### ETN200 IN SEA



**ETN200S IN BUCKET**



**ETN200X IN BUCKET**



**J. NOTES**

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