

# SeCorrPhon AC 06

# Operating Instructions



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Congratulations. You have chosen a quality instrument manufactured by Hermann Sewerin GmbH.

Our equipment will provide you with the highest standards of performance, safety and efficiency. They correspond with the national and international guide-lines.

Please read and understand the following operating instructions before using the equipment; they will help you to use the instrument quickly and competently. If you have any queries we are available to offer advice and assistance at any time.

Yours

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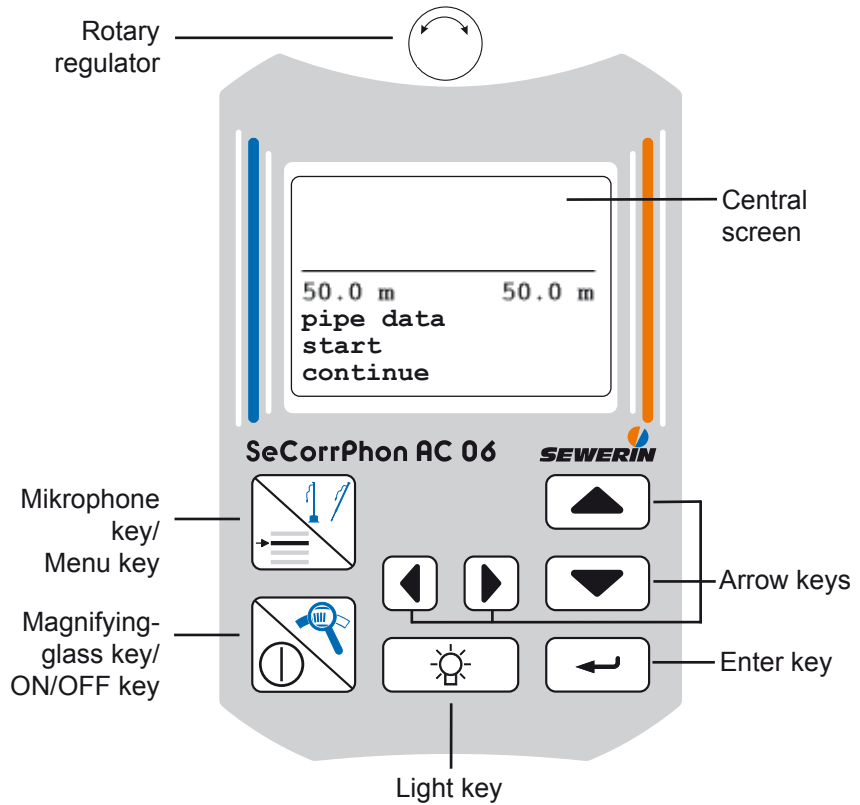
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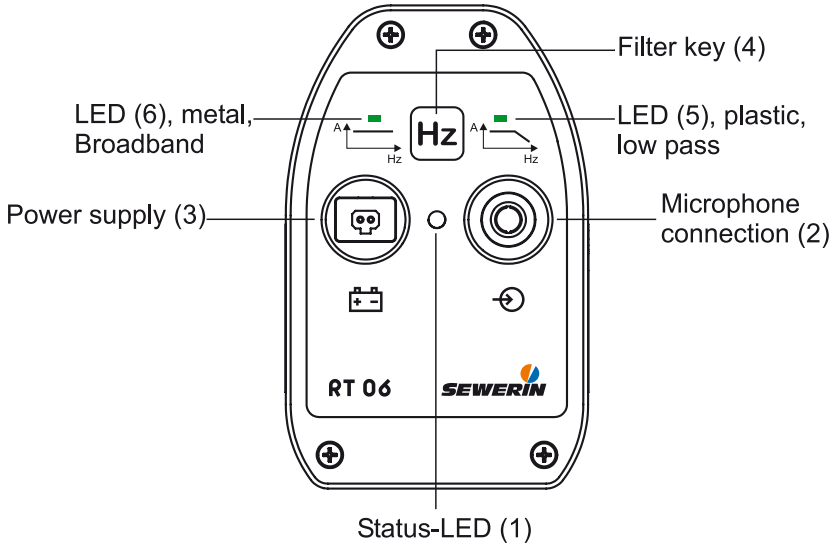
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**Operating Instructions**

# **SeCorrPhon AC 06**

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## Warranty & Used symbols

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The following instructions must be complied with in order for any warranty to be applicable in respect of the functionality and safe operation of this equipment.

Hermann Sewerin GmbH accepts no liability for any damages resulting from failure to observe these instructions. The warranty and liability provisions of the terms of sale and delivery of Hermann Sewerin GmbH are not affected by the information given below.

- The product must only be operated after the relevant operating instructions have been read and understood.
- The product must only be used for its intended purpose.
- The product is only suitable for use in industrial and commercial applications.
- Repairs must only be carried out by a specialist technician or by other suitably trained personnel.
- Changes or modifications to this product must not be carried out without approval from Hermann Sewerin GmbH. The manufacturer cannot be held responsible for damages if non-approved modifications have been made.
- All repairs must be carried out using replacement parts that have been approved by Hermann Sewerin GmbH.
- The manufacturer reserves the right to make technical modifications in the course of further development.

Generally applicable safety and accident-prevention regulations must be complied with, in addition to the information provided in this manual.

### Used symbols:



#### **CAUTION!**

This symbol is used to indicate dangers which may either result in hazards for the operators or in severe damage – or even destruction – of the product.



#### **Note:**

This symbol is used to call attention to information and tips which may be helpful and which are exceeding the basic operating procedures.

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# 1 Functional description

## 1.1 Use

The **SeCorrPhon AC 06** is used for electroacoustic water leak detection and acoustic pipeline location. It can also detect leaks in underground pressure line systems by correlation.

## 1.2 How electroacoustic water leak detection works

The **SeCorrPhon AC 06** is used to detect water leaks by electroacoustic means. The device is used in conjunction with various microphones which are listed in section “Accessories”.

When pressure pipelines leak, water gushes out of the crack into the ground.

The consequences:

The pipe material begins to vibrate at the leakage point. These vibrations are transmitted by the pipe and can even be felt at distant contact points, e.g. fittings. The **SeCorrPhon AC 06** makes this structure-borne sound audible.

The water jet and the pipe in the vicinity of the leak also cause the ground to vibrate. These vibrations are transmitted through the ground to the earth’s surface where they manifest themselves as ground noise.

The human ear continues to play a crucial role in electroacoustic leak detection. With the right training, it can compare the type and sound of different noises and distinguish between the noise of a leak and background noise.

## 1.3 How acoustic pipeline detection works

Plastic pipes cannot be located by conventional electromagnetic means because they are not electroconductive.

The acoustic method of locating pipes applies a different principle:

Pipes transmit mechanical vibrations better than the surrounding ground. When the pipe is caused to vibrate appropriately, these vibrations are transmitted along the pipe and then through the ground to the earth’s surface. Here they can be picked up using

a ground microphone and the corresponding receiver with headphones according to the **water leak detection** principle.

Just like with water leak detection, the pipeline is usually wherever the greatest intensity is detected. Fibre cement pipes and metal pipes can also be located in this way.

If you want to locate pipes by acoustic means, follow the operating instructions for the vibration detector (e.g. COMBIPHON). To locate the pipe, proceed as you would when detecting a water leak. The **SeCorrPhon AC 06** offers an extra mode to help you locate the pipeline (see section 3.4).

### 1.4 How correlation works

Sensitive microphones record the noise from leaks at accessible fittings and transmit them by radio to the correlator.

The **SeCorrPhon AC 06** then calculates the position of the leak using Fast Fourier Transformation (FFT = mathematical calculation rule).

Additional functions allow you to, for example, improve the leak display, enter several sections of pipe or measure the sound velocity.

Radio transmitter **RT 06** can automatically measure the input level of the microphone and optimally adjust its amplifier modulation accordingly. Features such as the microphone used, the battery condition and the amplifier setting are transmitted to the correlator by radio data where they are analysed. This ensures optimal results in all situations with maximum ease of use (switch on by plugging in the microphone).



**Note:**

These operating instructions refer to the **SeCorrPhon AC 06**. They explain the functions of software version 1.X. The manufacturer reserves the right to make technical changes.

## 2 Starting up

### 2.1 Starting up for the first time



#### **CAUTION!**

The batteries of the **AC 06** and **RT 06** must be fully charged once before starting up for the first time. If the batteries are only partially charged, their capacity and consequently their operating time may be reduced.



#### **CAUTION!**

Safety measures

- Do not use the headphones at a high volume. Hearing specialists warn against using headphones at a high volume constantly or for a prolonged period.
- Set the volume so that you only hear the sounds at a moderate level.
- Disable the headphones as soon as you realise that interference noise may occur (footsteps, vehicles etc.).
- Disable the headphones when the microphone is in motion.
- Please note that it is more difficult to pick up sounds in traffic.

### 2.2 Switching on and off for electroacoustic water leak detection

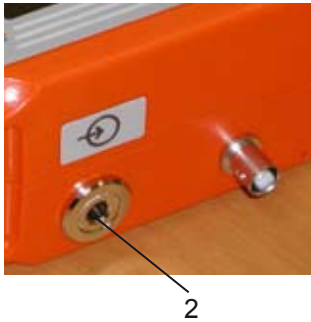
If you switch the device on as follows, you will be in what is known as AQUAPHON mode. Certain functions are only possible in this mode.

- Place a probe in the appropriate input
- The software version will appear in the display
- The condition of the batteries will appear in the display
- The type of probe plugged in is recognised automatically
- Remove the probe to switch off the system

Type of microphone	Display
Ground microphone BO-4 and 3P-4	BO-4 / 3P-4
Test rod T-4	T-4
Piezo microphone EM 30	M 01

### 2.3 Switching on for correlation

If you switch the device on as follows, you will be in what is known as correlator mode. Certain functions are only possible in this mode, others are not available.



- Fit the two piezo microphones to accessible fittings. When the round magnet is screwed onto the piezo microphone, remove the very securely attached round magnet protector if necessary.

- Insert the two microphone connection cables into the sockets of the RT 06 radio transmitters (1). If you are only using one RT 06, you must connect one microphone directly to the input (2) of the **AC 06**.

LED 1 on the RT 06 should light up green.

- Connect the headphones to the input (3) of the **AC 06**.
- Switch on the **AC 06** by holding down the ON key.

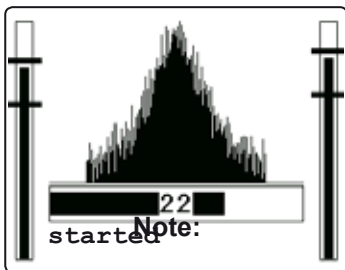
The main screen will appear briefly displaying the software version number and the battery capacity.

Next the main screen (see inside cover) will appear. From here you can go to the menu (menu key) or perform one of the functions.

- To switch the appliance off, hold down the ON key until it responds.

2.3.1 Channel allocation

	Channel 1	Channel 2
Denotes „Battery empty“ message	RT 06-1	RT 06-2
Display	Left	Right
Model with <b>one</b> radio channel	Direct microphone connection to the <b>AC 06</b>	Orange radio transmitter 2
Model with <b>two</b> radio channels	Blue radio transmitter 1	Orange radio transmitter 2
Only one radio transmitter in use (e.g. if faulty):		
● Version 1 (blue radio transmitter in use)	Blue radio transmitter 1	Direct microphone connection to the <b>AC 06</b>
● Version 2 (orange radio transmitter in use)	Direct microphone connection to the <b>AC 06</b>	Orange radio transmitter 2



- The noise intensity of the two microphone channels is displayed to the left and right of the correlation function during the correlation measurement.

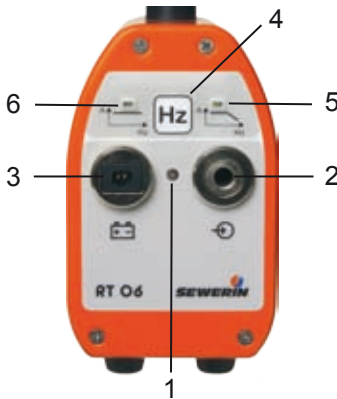


**Note!**

A microphone can also be connected directly to an **AC 06** model with two radio transmitters, e.g. if one of the radio transmitters is faulty (see also section 8.8.3).



### 2.3.2 Radio transmitter RT 06



Radio transmitter **RT 06** can be operated with various sensors, EM30 microphones and the HA hydrophone. It is recommended to use active filter ZF01 if you want to filter out interference noise or if you only want to transmit a certain acoustic frequency range to correlator **AC 06**.



#### CAUTION!

Always first connect the sensor to the measuring point (connect microphone to slide gate, hydrants etc.) before switching on the **RT 06** by plugging the sensor into the socket (2).

This ensures that the automatic amplification in the **RT 06** is set quickly and correctly.

The **RT 06** is switched on by plugging the sensor into the socket (2).

Always press the filter key (4) for plastic piping. The right LED (5) lights up to indicate the switch. At this setting only the lower frequencies (low pass) are transmitted to the correlator by radio. This often increases the quality of the correlation measurement. Every time the RT 06 is switched on all frequencies are transmitted and the left LED (6) lights up.

The carrying knob fitted to the top of the aerial is ideal for transportation.

The LED (1) indicates the status of the **RT 06**:

Operation:	green
Undervoltage:	flashing red
Charging:	1 x flashing green
Buffering:	2 x flashing green
Not charging:	red (because temperature below 0 °C)

### 3 Controls

#### 3.1 ON/OFF key/Magnifying-glass key



In **correlator mode** this key is the **ON/OFF key**.

- To switch on and off, hold the key down until the **AC 06** responds.
- Pressing the key briefly stops the current function (e.g. ongoing correlation). If you are in the menu, you can move up a level by briefly pressing the **ON key**.
- If you stop a correlation, you can enlarge the image (correlation function). Press any key to return to the normal view.



In **AQUAPHON mode** this key is the **magnifying-glass key**.

- The **magnifying-glass key** sets the basic amplification.
  - 10 = high noise amplification
  - 100 = average noise amplification
  - 1000 = low noise amplification

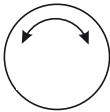
Basic amplification is useful for adapting to extreme situations. The higher the basic amplification, the louder the noise in the headphones.



The scale for the analogue display is also set. Change the basic amplification when the analogue display is constantly in the bottom/top range.

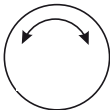
If the basic amplification is too high, the analogue display scale will flash.

### 3.2 Rotary regulator



The **rotary regulator** serves the following functions in **correlator mode**:

- Turning the regulator moves the selection or the cursor to the left/right or up/down.
- In input fields with numeric values (e.g. for entering the pipe length), you can change the value directly by turning the knob.
- Pressing the rotary regulator switches the direction of movement between up/down and left/right. Pressing the rotary regulator has the same effect as the Enter key.



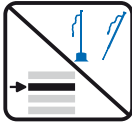
In **AQUAPHON mode** the enter key is only used to set the volume and for activation/deactivation.

### 3.3 Enter key



- Pressing the **Enter key** performs the function currently selected. Selecting the “cancel” function in the menu takes you back to the main screen.

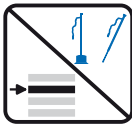
### 3.4 Microphone key/Menu key



In **correlator mode** this key is the **menu key**.

Pressing the **menu key** brings up the menu.

In **AQUAPHON mode** this key is the **microphone key**.



- Pressing the **microphone key** activates the **AC 06**. Pressing it again deactivates the **AC 06**.

### 3.5 Left/right arrow keys



- Pressing the arrow keys takes you through the functions to the left and right. You can also make a selection in some menus.



- When you are in a menu, you can move up a level with the “**left**” **arrow key**, albeit only when no left or right cursor movement is possible at the respective position.

**3.6 Up/down arrow keys**

- Pressing the arrow keys takes you up and down within the menus. You can also make a selection in some menus.

**3.7 Light key**

- Pressing the **light key** illuminates the display. The light remains on for a short time before going off automatically. (see section 8.8.4).

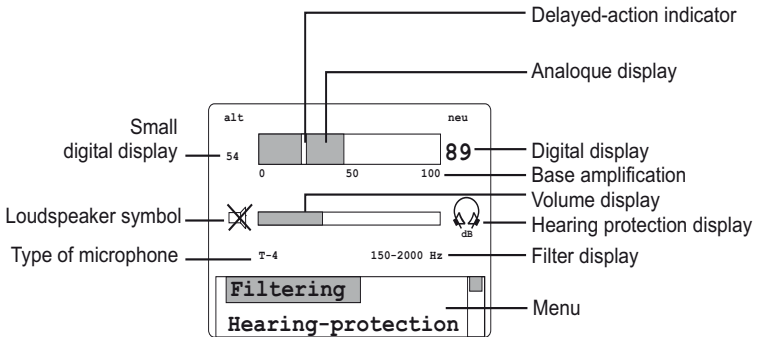
**3.8 Adjusting the contrast**

- The display contrast is automatically controlled according to the temperature.
- You can adjust the contrast manually by holding down the **light key** and then pressing the **arrow key** up or down.

## 4 Electroacoustic water leak detection

### 4.1 Display

The display contains the following display elements:



#### 4.1.1 Analogue display

The analogue display shows the current measurement value. (See also section 3.1).

#### 4.1.2 Digital display

The digital display (new) - depending on the firmware language - displays the smallest measured value during a single measurement.

In "MAX" mode, the digital display always shows the highest measured value.

#### 4.1.3 Small digital display

The small digital display (old) always shows the previously measured value for comparison purposes.

#### 4.1.4 Loudspeaker symbol

The loudspeaker symbol shows that the headphones of the **AC 06** are activated.

## 4.2 Menu

### 4.2.1 Filter

The frequency filter setting can be changed in the **filter** menu. The bandpass of the filter can be adjusted from 1 Hz to 9950 Hz; it is at least 300 Hz wide.

Leak noises have different ranges in which they can be heard particularly well. Even the same sound is perceived differently by different people. A bandpass can be set to optimise the acoustic perception. This means that only one particular frequency range will be relayed to the headphones. You can either find the best setting yourself by trial and error or the **AC 06** can search for it automatically.

#### **Automatic search for the best frequency range**

With the filter optimisation function the **AC 06** can automatically search for the best frequency range provided this is done when there is little background noise interference. Furthermore, the noise from the leak, in particular the ground noise, should already be discernible.

#### **Automatic**

- The **AC 06** records and analyses a “noise sample”.
- The display will show various frequency ranges during the analysis process. You will also hear on the headphones the noise produced from the displayed filter values.
- The **AC 06** sets the frequency range which distinguishes the leak particularly vividly.

#### **Default**

- Here you can reset the default bandpass setting (factory setting) for the probe currently plugged in. The bandpass setting for other probes will not be reset.

### 4.2.2 Hearing protection

The **AC 06** features a hearing protection function which reduces the volume of the headphones in the case of sudden, loud noises. If the noise gets even louder, the headphones will be switched off. Once the source of the noise goes quiet, the **AC 06** recommences its work. The hearing protection function prevents the ears from being exposed to excessive acoustic pressure.



If the hearing protection display appears, the sound will no longer be emitted clearly at the right volume to the headphones. If necessary, change the hearing protection level or the volume.

#### **Sensitive**

The hearing protection function activates at a low (quiet) threshold.

#### **Average**

The hearing protection function activates at a moderate threshold (default setting).

#### **Insensitive**

The hearing protection function activates at a high (loud) threshold.



#### **CAUTION!**

Only use SEWERIN headphones, as these are specially designed for the **AC 06**.



#### **Note:**

The hearing protection function should only be set to “sensitive” for quiet ambient sounds so that it activates with moderate noise. In situations where loud ambient noise is common, the threshold should be set to “average”. In exceptional circumstances the threshold can be set to “insensitive”. The hearing protection function is only activated at very loud noise values. To prevent the **hearing protection function from activating very frequently** and thus making leak detection more difficult, **the headphone volume and the basic amplification should not be set too high!**



#### 4.2.3 “MAX” mode

This mode helps detect pipelines by acoustic means. Instead of showing the minimum values, this mode always shows the maximum values.

“MAX” appears in the display when this mode is activated. The mode is not saved.

#### 4.2.4 Default values

This function restores (resets) all the default settings (factory settings) of AQUAPHON mode.

#### 4.2.5 Measuring mode

This setting determines how the rotary regulator activates/deactivates a measurement or the headphones.

##### **1 x press**

The measurement is activated by briefly pressing the rotary regulator and will remain active for as long as the rotary regulator is pressed down. The measurement is deactivated when the rotary regulator is released. This key principle is the default setting.

##### **2 x press**

The measurement is activated by briefly pressing the rotary regulator. The measurement is only deactivated when you press the rotary regulator again (switch principle).

### 4.3 Probe overview

#### 4.3.1 Ground microphone BO-4



Ground microphone BO-4 is used to locate leaks under fixed surfaces.

#### 4.3.2 Ground microphone 3P-4



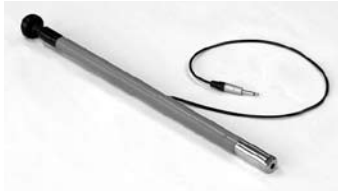
Ground microphone 3P-4 is used to locate leaks under non-fixed earth surfaces. A spike can be screwed on for soft ground. The three feet provide stable contact at all times.

#### 4.3.3 Carrying rod H-4



The carrying rod can be used with both ground microphones. Microphone BO-4 or 3P-4 is screwed onto the bottom end of the carrying rod.

### 4.3.4 Test rod T-4



The test rod is used in the preliminary detection of leaks. The test rod is attached to fittings on the pipe under examination.

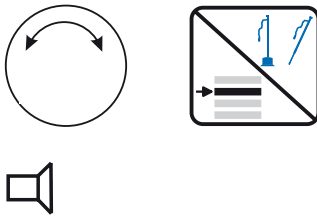
### 4.3.5 Piezo microphone EM 30



The piezo microphone is used for preliminary detection and for detection mainly in buildings.

Thanks to the screw-on M 10 tripod, it can be used for floors and for fittings and sections of piping with the straight probe.

#### 4.4 Preliminary detection



Metal pipe materials transmit structure-borne sound over a particularly wide area. The test rod can therefore be used very effectively for pre-detection.

- Connect the headphones to the **AC 06**.
- Connect the test rod to the **AC 06**.
- Place the test rod at the first measurement location.
- Activate the **AC 06** with the **rotary regulator** or the **microphone key**.

During the measurement the **loudspeaker symbol** is not crossed out in the display.

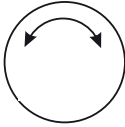
The analogue display shows the current volume measurement.

The noise can be heard through the headphones.

During this measurement, the large digital display shows the smallest value measured.

During this measurement, the small digital display shows the smallest value measured during the last measurement. (This value is 0 during the first measurement.)

During this measurement the analogue display shows the smallest measured value inverted.



- To deactivate the **AC 06** release the **rotary regulator** or press the **microphone key** again.

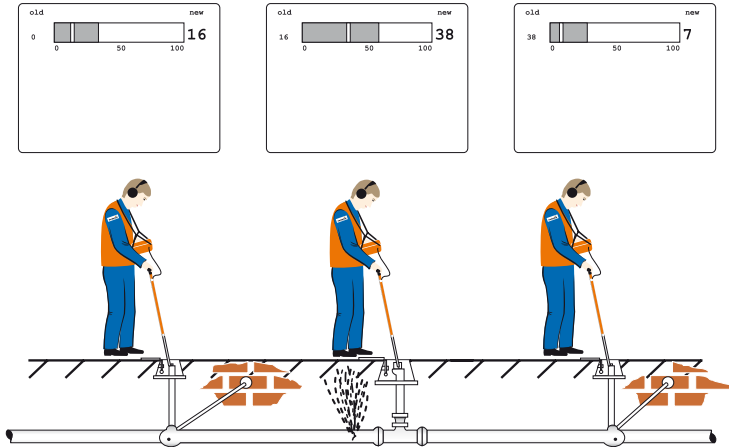
If the **AC 06** does not go off when you release the rotary regulator, the function of the rotary regulator has been changed. In this case press the rotary regulator again.

- Place the test rod at the next measurement location and proceed as above.

The previously measured value will now appear in the small digital display for comparison purposes.

## 4 Electroacoustic water leak detection

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The illustration above is an example of what might be displayed in the course of detecting a water leak.

The sound is loudest close to the leak, the further away you get, the quieter it is.

**Left:** The analogue display shows approx. 30% scale division, this is the **current noise value**.

The analogue display, however, often fluctuates heavily due to the changing ambient noise. It is even hard to discern a trend. For this reason the large digital display (number 16) shows the smallest noise value measured at this measurement location over the measuring time (**current slider value**). Even if the noise gets louder (ambient), the display will freeze, if the noise gets quieter, the display will continue to fall.

In the analogue display the numeric value 16 will also be displayed as an inverse segment.

The small digital display shows “0”: there is no value in the memory yet.

**Centre:** The analogue display shows approx. 60% scale division.

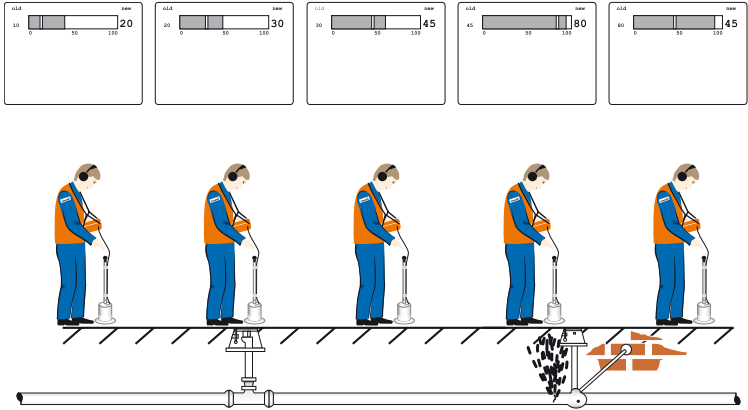
The large digital display (number 38) shows a greater value than at the measurement location on the left. This indicates that the place of the leak is closer.

The small digital display now shows “16”: it is a reminder of the result from the last measurement location (**last slider value**).

This helps you determine whether or not you have reached the leak, or if you have already gone past it.

**Right:** The current slider value has dropped because the leak is further away. The last slider value shows “38” again for comparison.

## 4.5 Locating leaks

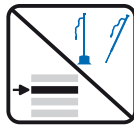
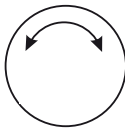


Non-metal pipe materials transmit the structure-borne sound less effectively. It is therefore not enough to examine the fittings. A ground microphone is used to perform an additional check on the length of piping between the fittings.

Using the ground microphone at regular intervals enables the leak to be located without excavation. Once again, the **AC 06** shows an accurate optical comparison of the noise intensities.

The illustration above is an example of how the display changes when a leak occurs.

- Connect the ground microphone to the **AC 06**.
- Place the ground microphone on the ground.
- Activate the **AC 06** with the **rotary regulator** or the **microphone key**.



A loudspeaker symbol appears in the display during the measurement.

The analogue display shows the current volume measurement.

The current noise can be heard on the headphones.

The digital display shows the smallest value measured.

The small digital display shows the value measured previously. This value is 0 for the first measurement.

The smallest value measured is shown inverted in the analogue display.



- To deactivate the **AC 06** release the **rotary regulator** or press the **microphone key** again.

If the **AC 06** does not go off when you release the rotary regulator, the function of the rotary regulator has been changed. In this case press the rotary regulator again.

- Place the ground microphone at the next measurement location and proceed as above.

The previously measured value will now appear in the small digital display for comparison purposes.

- Using the ground microphone, listen to the section of pipe where you suspect the leak is situated.

The illustration on the previous page is an example of what the display shows when you cross a leak.



## 5 Performing a correlation measurement

### 5.1 Entering pipe data

The pipe data must be entered in preparation for each measurement.



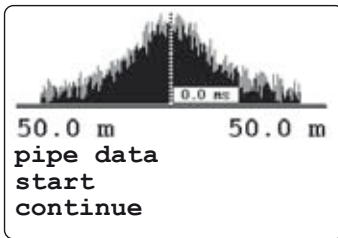
- Using the **arrow keys** select “Pipe data” from the menu and confirm by pressing the **Enter key**. You will be asked how many pipe sections there are.
- Select “one”, “two”, or “three” pipe sections accordingly with the arrow keys and then press Enter.
- Next you will be asked to enter the pipe length. The **left/right arrow keys** allow you to move between the digits.
- The **up/down arrow keys** increases or reduces the respective digit by one.
- Confirm the length by pressing **Enter**.
- Select the material of the pipe section from the list using the **arrow keys** or select “manual” to enter the sound velocity directly.
- Please note: the values in the list are approximate and can cause inaccuracies (see section 6).
- Select the pipe diameter from the list using the **arrow keys**.
- Repeat these entries for the second and third sections of pipe as necessary.

**Note:**

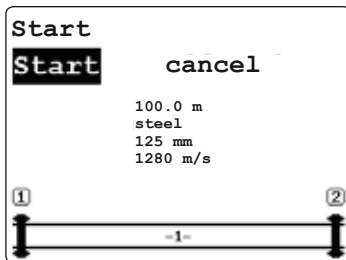
As well as the standard “cross correlation”, the **AC 06** can also perform “auto correlation”, see section 8.6.5.

### 5.2 Starting a measurement

This function must be selected to measure a section for the first time, or after the first measurement if errors have occurred (transmitter not switched on, badly connected microphone etc.).



- Using the **arrow keys** select “Start” and confirm by pressing the **Enter key**. Use the headphones to check the progression of the measurement acoustically (safety measures: see section 2.1).

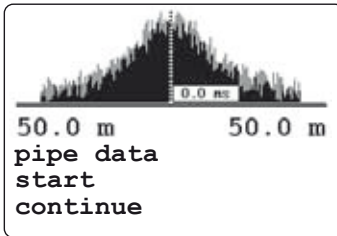


- A summary of the pipe data entered will be shown.
- Mark “start” using the **arrow keys**. Press the **Enter key**. The correlation measurement will begin.

- Depending on the setting (see section 8.6.2) 16, 32, 64 or 128 averaging procedures (measuring processes) will be performed.

The display will show which averaging procedure is currently being performed.

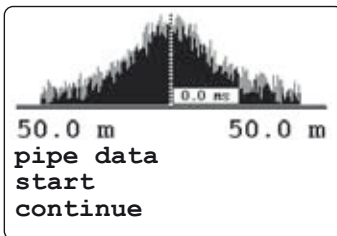
The correlation function is updated continually during the measurement.



- You can pause the correlation measurement at any time by briefly pressing the **ON** key. You can continue the paused measurement at any time.

- The result will be shown after the measurement. The illustration on the left is an example of the progression of the correlation function. The mode of curve depends on the setting in the Filters/Setup menu.

### 5.3 Analysing results



- The correlation function indicates in the form of peaks where a leak may be located. The “x-axis” shows the time difference in ms (milliseconds). The marking is automatically set at the highest peak.



### CAUTION!

If you see a peak right in the middle of the screen, this may indicate that radio transmitter RT 06 is too close to the **AC 06** (receiver). Increase the distance between the two appliances to several (5 – 10) metres.

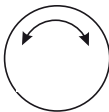
### 5.3.1 Filtering

Please read section 8.4 on the basic principles of filtering.

The filtering option here from the function in the main screen offers faster access to manual functioning than via Menu/Filter/Manual. The range of functions here is, however, limited.

- Select “Filter“ in the main screen.
- The left filter limit flashes and can be set.
- Enter key: calculates the result function; the other filter limit can be set (can be repeated as often as you wish).
- ON key: returns to the main screen, the result is displayed.

### 5.3.2 Cursor

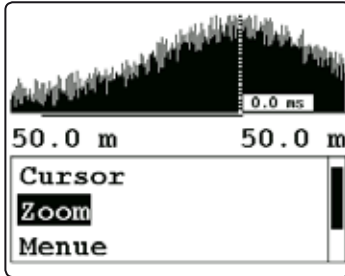


- If you select the “cursor” function with the **arrow keys**, you can place the cursor in any position you desire with the **arrow keys** or the **rotary regulator**.

The measurement will be recalculated immediately in accordance with the marked position. The time indicated beside the cursor indicates the time difference setting.

The distances stated under the correlation function indicate the distance of the cursor position from the two microphones.

## 5.3.3 Zoom



The “zoom” function allows you to enlarge areas of the correlation function.

- Select “zoom” with the **arrow keys**.
- The “**right**” **arrow key** enlarges the mode of curve. Position bar 1 below the correlation function shows which part of the entire pipe length is displayed.
- The “**left**” **arrow key** displays the entire correlation function again.

**Note:**

Subjective evaluation of the form of the cross correlation function (CCF) is particularly important when applying the correlation procedure. The knowledge required for this cannot be taught as a theory; practical experience is essential.

The measurement is based on the value marked in the CCF and on the pipe data you have entered. The CCF represents, in simple terms, the time relationship in terms of quality of the two sounds recorded by the two microphones to each other.

It is impossible to distinguish between the (sought) leak sounds and the background noise. The measurement may not always, therefore, indicate a leak; sources of background noise can also be detected!

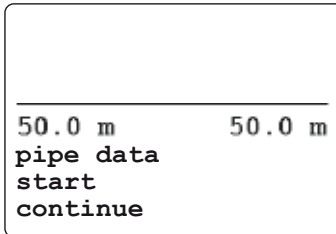
If there is “no” noise present, a random measurement will be calculated. In such cases you should look for other connection points for the microphones where the leak noise can be picked up much more clearly.

### 5.4 Continuing a measurement

This function starts the correlation measurement with the old pipe data. All the previous results from any prior correlation will be retained.

Any pipe data which has changed since the last correlation will not be taken into account.

You should continue the measurement if the result of the first correlation measurement (number of averaging procedures e.g. 32) is not yet reliable enough.



```
50.0 m      50.0 m
pipe data
start
continue
```

- Using the **arrow keys** select “continue” and confirm by pressing the **Enter key**.

The measuring procedure is the same as if you were starting a new measurement.

## 6 Measuring the sound velocity

### 6.1 General

Sound velocity measurements are necessary because it is important to enter the correct sound velocity for an exact measurement. The sound velocity values are contained in an internal table (see section 8.6.7). The sound velocity data in “pipe data” is, however, approximate. Furthermore, you may not know the pipe dimension or the material.

This function requires a source of noise,

- for example, an open hydrant,
- which produces a clear symbol in the CCF, in other words is “correlatable”,
- which must have a known position,
- which must not be positioned in the “middle area” of the measuring section in order to increase accuracy.

If the measuring section comprises several pipe sections (material or dimension intersections), the sound velocity measurement will produce erroneous results.

### 6.2 Performing a measurement

The measuring procedure is very similar to a correlation measurement.

- First connect the microphones and radio transmitter as described (see sections 2.3).
- Activate “Measuring method” “Sound velocity” in the menu (see section 8.5).
- Select “Pipe data” from the menu and enter the data accordingly.
- When asked about a “man-made leak” you must enter the distance of the man-made leak from microphone 1:
- If it is outside of the measuring section and beyond
  - microphone 1, enter 0 m for the distance.
  - microphone 2, enter the total length of the measuring section for the distance, i.e. the „pipe length“.

- To create a source of noise, either generate a man-made leak (e.g. open hydrant) or bang on the fitting in quick succession using a hammer.
- Select „start“ using the arrow keys.  
The measuring procedure will begin.
- After the measurement, the correlation function will appear in the display.
- The cursor will automatically be placed at the position with the greatest value. Check whether this position is your man-made leak. If necessary, move the cursor to the man-made leak using the arrow keys or the rotary regulator.
- If you select “accept“ in the menu:
  - The calculated sound velocity will be applied in the internal memory.
  - You will exit the “measure sound velocity” measuring method (and return to the “standard” measuring method).
  - Return to the main screen.

You can now perform a correlation measurement to detect the real leak. When entering any modifications to the pipe data, also enter the calculated sound velocity by selecting “manual” under pipe material.
- If you select “cancel“ in the menu:
  - the calculated sound velocity will not be applied.
  - you will exit the “measure sound velocity” measuring method (and return to the “standard” measuring method).
  - Return to the main screen.



## 7 Charging equipment



Power is supplied to the **AC 06** and the **RT 06** by the integrated NiMH batteries.

The **AC 06** can be operated for approx. 8 hours. The operating time may be reduced considerably when using the display light or in low outside temperatures (display heating).

The **RT 06** radio transmitter can be operated for at least 8 hours.

Alternatively, (if the battery is empty) the **AC 06** and the **RT 06** transmitter can be operated using an external 12 V = power source (e.g. vehicle cable).

**Docking station HS 1.2 A** and the AC/DC adapter or the vehicle cable are required for charging or for external operation. The **AC 06** charges in 4 hours maximum, radio transmitter **RT 06** in 5 hours maximum.

The vehicle cable must be plugged into socket 1 of the docking station or socket 3 of the **RT 06** transmitter.



The **AC 06** and **RT 06** transmitters can also be charged directly in the case.

To do this, connect vehicle cable L or AC/DC adapter L to socket 1 in the case.



Cables 2 and 4 must be connected to each of the **RT 06** transmitters and cable 3 must be connected to docking station HS 1.2 A.

### 7.1 Battery condition

The battery condition is shown in the **AC 06** display in the form of a battery symbol with the text

- **RT 06-1** or **RT 06-1** or **AC 06**

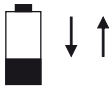
if the respective component has less than approx. 15 minutes' operating time remaining.

The status LEDs provide further information on the **RT 06** (see section 2.3.2).

## 7.2 Charging/battery maintenance

Whilst charging, the **AC 06** displays the remaining charging time in hours. When in this mode the “battery maintenance” function can be selected using the **menu key**. This discharges the battery and recharges it again, thereby eliminating chemical deposits in the battery and improving its storage capacity. The process takes approx. 10 hours and should be carried out approx. every 60 days, especially with appliances which are not used often.

Symbols and what they mean during the charging process:



“Battery maintenance” is activated



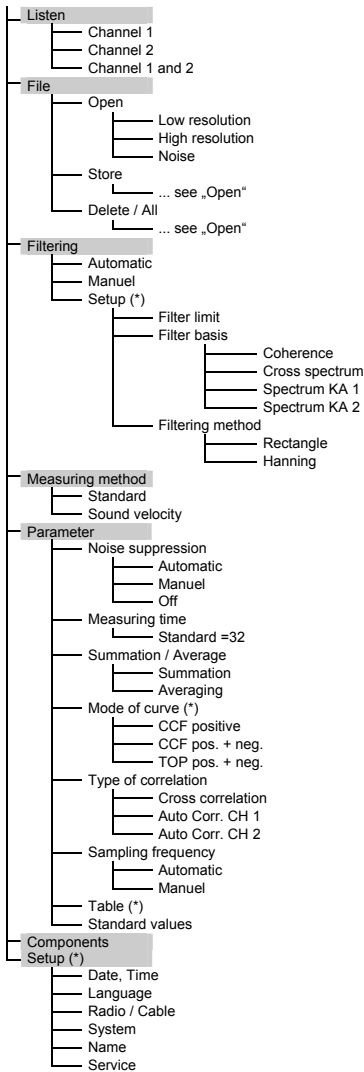
The temperature is below 0 °C, the battery cannot be charged.



The temperature is above 45 °C, the battery cannot be charged.

# 8 Menu (in correlator mode)

## 8.1 Menu structure



(\*) Settings which remain in effect even after the device has been switched off. All others are reset to the default values. (See section 8.6.8)

## 8.2 Listening

The “listen” function allows you to adjust the volume of the two channels.

- Using the **arrow keys** select the channel to be adjusted.
- You can adjust the volume of the selected channel using the **arrow keys** or the **rotary regulator**.
- If “channel 1” is selected, you will hear channel 1 through both ears (mono mode). The same applies for “channel 2”. If “channel 1 and 2” is set, you will hear both channels at the same time (stereo mode).

## 8.3 File

In this menu you can open, save and delete individual measurements and noises. The data is filed in the internal memory of the **AC 06** and can be accessed even after the appliance has been switched off.

### 8.3.1 Saving

The following number of memory slots are available:

- a) 50 memory slots (low resolution)
- b) 25 (1 – 25) memory slots (high resolution)
- c) 5 (1 – 5) memory slots (noises)

Note:

b) and c) share one memory area

Measurements saved at a low resolution cannot be processed later, e.g. filtered.

Only the main screen can be viewed.

Functions: view main screen,  
move cursor,  
start, continue.

There are 50 memory slots of low resolution available.

Measurements saved at a high resolution can be processed later. In other words, all functions that are possible after the end of a

measurement (after a measurement has been stopped), are also possible here.

Exception: it is not possible to “continue” the measurement.

There are up to 25 memory slots available, they are used together with the memory slots for “noises”.

If you select “noises” approx. 7 seconds of the current noise is saved.

Please note that the saving process takes approx. 35 seconds due to the high storage volume. The process cannot be cancelled.

- Use the **arrow keys** to select what you want to save: low resolution, high resolution or noises.
- Once you press the **Enter key**, the measurement or the noise will be saved.

### 8.3.2 Opening

The “open” function allows you to reload measurements/noises.

- Use the **arrow keys** to select what you want to open: low resolution, high resolution or noises. Please note that it takes approx. 25 seconds to load a noise. Confirm your selection by pressing the **Enter key**.

A list containing the files stored in the **AC 06** memory will appear.

- Using the **arrow keys** select a file and then confirm by pressing the **Enter key**.

This file will appear when you open a measurement.

If you open a noise, the 7 second noise clip will be played on repeat. You can cancel the playback by briefly pressing the **ON key**.

### 8.3.3 Deleting

- Using the **arrow keys** select what you want to delete: “low resolution”, “high resolution” or “noises”. Confirm your selection by pressing the **Enter key**. A list containing the files stored in the **AC 06** memory will appear.
- Using the **arrow keys** select the file you want to delete and then confirm by pressing the **Enter key**.

The file will be deleted.

## 8.4 Filtering

The filter function allows you to hide certain frequencies from the correlation function to improve the result.

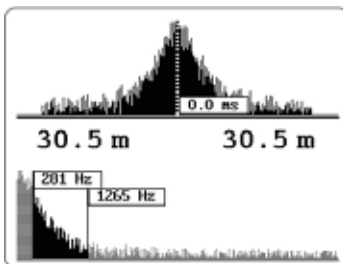
You can choose between manual and automatic filtering.

### 8.4.1 Automatic filtering

The **AC 06** performs automatic filtering (processing control) after a measurement. The filters are automatically optimised.

### 8.4.2 Manual filtering

An image will appear which will display a frequency response below (filter basis, see section 8.4.3.3) and the result above (mode of curve, see section 8.6.4) from the set filters.





- Pressing the **Enter key** takes you into processing mode.
- Using the **arrow keys** select which filter limit is to be adjusted:
  - Filter left
  - Filter right
  - Hide left
  - Hide right
- Use the **arrow keys** to move the relevant limit.

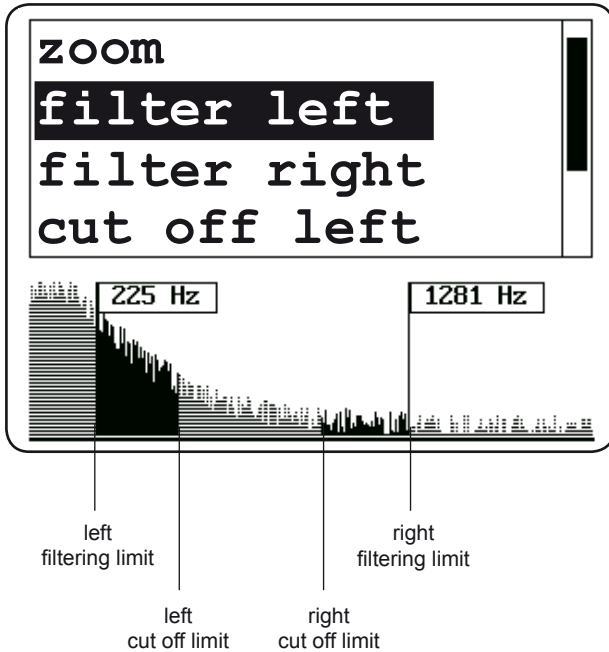
The corresponding frequency will be shown in the display.

Light grey frequency ranges will be hidden.

Black areas will be included in the correlation.

If you want to enlarge the frequency range, you must first change the filter limit settings in the Setup (see section 8.4.3.2).





- Using the **arrow keys** select "OK".

The set filters will be applied and the frequency response with the result will be updated.

- Pressing the **Enter key** takes you back to the "manual filtering" mode of curve where you can change the filter limits again if necessary.
- Selecting "back" takes you back to the main screen, the filter settings will remain effective.

### 8.4.3 Setup

Settings are saved in the setup so that you do not have to call up the required individual functions again and again. Place the cursor on the desired option and then pres the **Enter key**.

#### 8.4.3.1 Filter limits

Setting option for the filter settings to be used for manual filtering (see section 8.4.3.1).

Factory setting: if you enter a sound velocity above or below 700 m/s for a measurement, the correlator will adjust itself to:

lower limit / Hz		upper limit / Hz	
< 700 m/s	5	500	Plastic
> 700 m/s	0	3000	Metal

It does not matter whether the sound velocity is entered by manually selecting the numeric value or by selecting the corresponding pipe parameters.

#### 8.4.3.2 Filter basis

Here you can change the mode of curve of the frequency curve for the filter settings.

- Coherence  
The similarity of the frequencies is displayed.
- Cross spectrum  
The cross spectrum from the two channels is displayed.
- Spectrum, Ka 1  
The frequency spectrum of channel 1 is displayed.
- Spectrum, Ka 2  
The frequency spectrum of channel 2 is displayed.

#### 8.4.3.3 Filtering method

Under “square” the signal is filtered exactly at the marked position.

Under “Hanning” a “soft transition” is created around the marked position.

## 8.5 Measuring method

The “measuring method” function allows you to switch between the standard measurement (= correlation measurement) and the sound velocity measurement (see section 6).

## 8.6 Measuring parameters

The “measuring parameters” submenus allow you to set various parameters which affect the measurement.

### 8.6.1 Noise suppression

“Noise suppression” is a function to reduce the negative impact of temporary interference noise (vehicles, pedestrians).

With “noise suppression” it is assumed that optimal results can be achieved at moments when the noise (signal) measured is relatively small. This is when the permanent leak noise is by and large free from interference.

When the signal is relatively high, the additional noises must stem from a source of interference which has a negative effect on the measuring result.

Noise suppression ensures that correlation (averaging) only takes place when the signals are in a certain level range (volume). If the signals are outside of the level range, the measurement will be discontinued.

The level range is limited by the lower threshold and the upper threshold. These thresholds are shown for signals 1 and 2 as horizontal lines on the far left / far right of the display when the measurement is taking place. The level range is always reset when **starting** the measurement. The correlator uses the level values measured at the start as a point of reference.

#### **a) Automatic mode (Default setting)**

This setting is suitable for achieving good results in all standard cases.

After a certain time, the level range is automatically raised slowly if the current level values are permanently over the level range. In the same way, the level range is lowered if the current level values are permanently below the level range.

### **b) Manual mode**

This setting is recommended if you want to work with maximum noise suppression and have maximum individual influence on the measurement.

If the measurement is interrupted for too long because the noise is too loud, the level range can be manually raised by pressing “continue” and thus made less sensitive. The measurement will continue as the user ignores a certain amount of interference noise.

Once the current level values fall below the level range an automatic adjustment takes place and the correlator becomes more sensitive to interference noise.

### **c) Off**

This setting should only be selected if the constantly heavily fluctuating signals mean that the measurement is often interrupted and correlation would not be possible otherwise.

Noise suppression is disabled. It is accepted that interference noise occasionally masks the leak noise.

## **8.6.2 Measuring time**

The “measuring time” function allows you to specify how many single measurements are to be performed before measurement stops.

## **8.6.3 Summation/Averaging**

The “summation” function uses all the individual results for the mode of curve of the CCF and analyses them equally.

The “averaging” function evaluates the individual results differently: the most recently performed measurement has greatest influence on the CCF; the previous ones much less etc.

The “averaging” setting of the CCF thus tends to reflect the current noise.

## **8.6.4 Mode of curve**

You can change the mode of curve of the correlation function:

- CCF positive  
The CCF only has positive values.

- CCF pos. + neg.  
The CCF contains positive and negative values.
- TOP positive  
The mode of curve is like the “CCF positive” one, but the top values are usually more prominent.
- TOP pos. + neg.  
The mode of curve is like the “CCF pos. + neg.” one, but the top values are usually more prominent.

### 8.6.5 Type of correlation

The **cross correlation** uses channel 1 and channel 2 to measure; the source of noise to be located must be within the measuring section.

**Auto correlation** uses either channel 1 or channel 2. The second signal required for correlation is produced by reflecting the noise to be located at a reflection point. It must be received by the channel in use.

As the energy from the reflected noise is usually very low, this procedure is rarely feasible. The chances are usually better if there are gaseous media in the pipe.

The position of the reflection point must be known for auto correlation.

The auto correlation function (ACF) always has a symmetrical progression. Only the negative area of the ACF ( $\Delta t < 0$ ) is of interest.

### 8.6.6 Sampling frequency

The continuous time signal of the channels used is scanned and digitised at a certain frequency, the sampling frequency.

The lower the sampling frequency, the less calculating time is required for averaging. However, the sampling theorem requires a sampling frequency which is at least twice as high as the highest frequency contained in the signal! If the sampling frequency setting is too low, measuring errors may occur. For this reason, the sampling frequency should only be reduced in exceptional circumstances, for noises of very low frequency.

The sampling frequency is at the maximum with "automatic".

Select "manual" for a manual setting. You can change the sampling frequency using the arrow keys.

All subsequent measurements will be performed at this sampling frequency.

### 8.6.7 Table

This menu offers a choice of 3 tables for the sound velocity measurement. You can choose between two set and one individually editable table.

Table 1: Particularly good experience in France

Table 2: Internationally applicable

Table 3: Individually editable

#### Selecting a table

- Select the respective row and press the Enter key. If you choose individual table 3, another window will open which you should confirm accordingly.

#### Creating and editing the table

When creating a table for the first time, think about the basis (table 1 or 2) on which your table should be created. The values present in the preset table are (in the background) copied into individual table 3 (still blank) where they can be changed. Tables 1 and 2 will remain unchanged.

- Select the desired table (table 1 or 2).
- In the menu select **Table – Individual – Edit**.  
You can now edit table 3.
- Select the material from the list followed by the diameter to be changed.
- Press the Enter key to enter edit mode and set the desired value.
- If you select **Individual** (1 ... 3) under material, a window will appear in which you can edit the name of the material and the respective values.

This data will not be overwritten when you update the appliance. However, as a precautionary measure you are advised to make a note of the values.

### Deleting the table

- In the menu select **Table – Individual – Delete**. After a warning prompt (Yes / No) table 3 will be deleted.

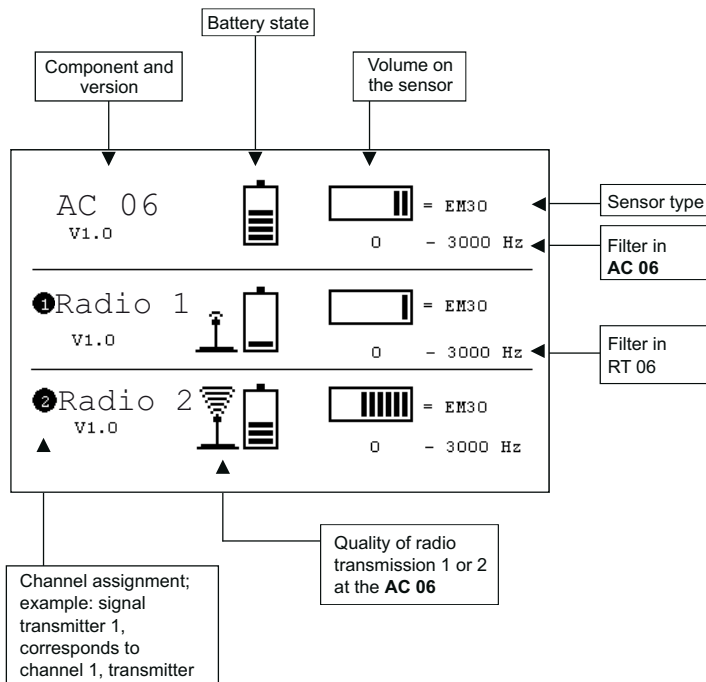
You will now have the option of creating a new table 3 based on table 1 or 2.

### 8.6.8 Default values

All parameters in the measuring parameters menu of the **AC 06** are reset to the default values. This also includes those that are preserved after the device is switched off. The language setting and the individual sound velocity table will remain unchanged.







### 8.7 Components

The screen shows an overview of the main information about the 3 (maximum) main system components (2 x **RT 06**, 1 x **AC 06** correlator).





## Explanation of symbols

	Accu empty		Accu full
	Low volume		High volume
	Poor radio reception		Good radio reception

## 8.8 Setup

### 8.8.1 Date, time

This menu item allows you to set the current date and time. You can also select the date format.

### 8.8.2 Language

This menu item allows you to change the language.



**Note:**

When American English is set, the product-related use of some units will change accordingly.

For example:

- Distance feet (ft),
- Diameter inches (in)
- Speed feet per second (ft/s)

### 8.8.3 Radio/cable

This menu item determines which channel is radio-operated and which one is directly connected to the **AC 06**.



- Using the **arrow keys** select the channel you would like to change.



- Confirm by pressing the **Enter key**.

- Using the **arrow keys** you can switch between “**RT 06-X**” and “**AC 06**”, where “**RT 06**” represents radio operation and “**AC 06**” stands for cable operation.

- Confirm by pressing the **Enter key**.

### 8.8.4 System

This menu item allows you to make the following settings:

- The time when the light goes out automatically.
- The time when the device switches off automatically.

### 8.8.5 Name

This menu item allows you to enter the name, company and the address.

### 8.8.6 Service

This menu item is reserved for the Sewerin Service team.

## 9 Options for optimising measurement results

The ability to detect a leak depends on the correct calculation of the time difference. In cases where the leak noises are strong enough and there are no external sources of noise, the time difference displayed after just a few averaging procedures (4 to 16) should suffice.

But what can you do when a “nice” incisive peak just will not form? The following advice cannot of course replace the practice and experience required for difficult cases, but it can provide an insight. Regardless of this, however, you must always remember: when the leak noises do not reach the microphones with enough intensity, correlation is not possible.

### 9.1 Changing the number of averaging procedures

If the result is still unsatisfactory after the initial averagings, you can increase the number of averagings as often as you wish. The result will improve because the calculation can be based on additional information over the progression of the leak noise. From experience, however, the result does not improve any further after 64 to 128 averagings.

### 9.2 Using filters

Use the possibilities offered by mathematical filters. Unfortunately universal “formulae” can rarely be given. Only your own experience and trial and error will result in success.

Usually it is only recommended to select frequency ranges for the CCF in which the coherence function has a significant excessive increase compared to the surrounding area, in other words, features a “hump”.

Single frequencies from various sources of interference produce a continuously sinusoidal CCF. They can be identified in the spectra as a sharp line.

### 9.3 Automatic filtering

The **AC 06** can perform automatic filtering (processing control) after a measurement (see section 8.4.1). This involves optimising the coherence function filters using statistical methods to achieve an optimal correlation result.

A frequency analysis can be performed on ongoing measurements and saved measurements.

### 9.4 Checking the microphone connection

Ensure that the microphone contact to the fittings is as secure and undamped as possible; remove any dirt and rust.

### 9.5 Using accessories

Use Sewerin accessories and tools. Use a hydrophone for plastic piping. The active filter creates new possibilities. The “teach-yourself tape” allows you to check the system and with a minimum of effort you can practise and keep yourself “in training”.

### 9.6 Changing location

Change the location of the microphones. Even fittings further away can achieve a better result if they transmit the sound better.

### 9.7 Saving time

If it transpires during a measurement that no peak can be measured, any painstaking calculation of the exact pipe data prior to the measurement may have been a waste of time. Practical experience has shown that it is therefore advisable to start the measurement initially with estimated pipe data. If the length of the pipe is greater and/or the sound velocity less than assumed, a potential peak will appear in any case within the CCF and will therefore never be “overlooked”.

If you use this practical approach, you must of course calculate the exact pipe data at the end.

## 10 Communication with the PC

It is possible to transfer the “high resolution measurements” saved in the **AC 06** to a PC. These files can be archived and processed on the PC (e.g. create log). If you have a printer you can also print out the data and images. The saved “noises” and “low resolution measurements” cannot be transferred.

### 10.1 Requirements

PC (operating systems Windows 95 / 98 / 2000 or XP)

“SeCorr 05” program (PC correlator program) Version 10.16 and up from 15/1/2003

### 10.2 Installing the software and establishing a connection

Install the SeCorr 05 software (demo version on CD) on the PC.

- Connect the communication cable (accessory) from any serial interface on the PC to the **AC 06** (socket with cover cap on the left side of the appliance). The PC interface must not be configured higher than COM 4.
- Place the **AC 06** in the 12 V= powered HS docking station. It does not matter whether the **AC 06** is switched on or off.
- Transferring data from the **AC 06**:

Start the SeCorr 05 program and in the “File” menu select the “SeCorr 08” function.

The data will be transferred, converted and saved in the **SeCorr 08** target directory. The duration of this process depends on the size and number of measurements and is displayed on the PC in the form of an animation for each measurement. The **SeCorr 08** target directory is created under the working directory from which the SeCorr 05 program was started, e.g. C:\Programs\SEWERIN\SeCorr 05.

The file names are allocated automatically from the measurement date and the exact (to-the-minute) measuring time in the **AC 06**. They take the following form:

HA\_DD-MM-YYYY\_HH-MM.COR

The abbreviations stand for the following:

DD-MM-YYYY = Date (day, month, year)

HH-MM = Time (hour, minute)

You can manage the files in the usual way (rename, move).

– Opening measurements

Open the measurements in the SeCorr 05 program via File/Open file. All further instructions on how to use the SeCorr 05 program can be found in its help function.

## 11 Technical information

### **SeCorrPhon AC 06 correlator**

Operating time:	approx. 8 hours
Operating temperature:	-10 °C – +40 °C
Storage temperature:	-20 °C – +60 °C
Charging time:	4 hours
Weight:	1.3 kg
Type of protection:	IP65
Dimensions (W × H × D):	125 × 180 × 65 mm

### **SeCorrPhon AC 06 correlator in AQUAPHON mode**

Transmission bandwidth	1 – 9950 Hz
Adjustable filter	50, 500 and 1000 Hz increments
Filter, minimum bandwidth	300 Hz

### **Radio transmitter RT 06**

Transmitting power:	500 mW
Charging time:	5 hours
Operating time:	10 hours
Broadband filter setting:	0 – 3000 Hz
Low pass filter setting:	0 – 300 Hz
Weight:	1.3 kg
Dimensions (W × H × D):	73 × 190 × 125 mm (with aerial = 510 mm)
Type of protection:	IP67

## 12 Accessories

<b>Case</b>	with foam insert, for two hydrophones and two airborne noise microphones
<b>Hydrophone type HA</b>	e.g. for connecting to PE house service connections following removal of water meter.
<b>Hydrophone adapter UFH DN 80 on 1" female threads</b>	between underground hydrant and hydrophone type HA
<b>Main pipe adapter M10</b>	to permanently connect a microphone to slide gate or hydrant
<b>House connection adapter M10</b>	to permanently connect a microphone to a house shut-off valve
<b>Active filter</b>	to filter out interference frequencies
<b>Test-and-teach-yourself tape</b>	with set of cables
<b>Test-and-teach-yourself CD</b>	with set of cables



**12.1 Accessories for electroacoustic water leak detection**

<b>Test rod T-4</b>	with screw-on tip. Cable with angle plug
<b>Ground microphone BO-4</b>	with soundproofing against exterior noise, especially suitable for fixed surfaces
<b>Carrying rod H-4</b>	for ground microphone BO4 and ground microphone 3P-4
<b>Ground microphone 3P-4</b>	with 3 feet for fixed and non-fixed surfaces. Incl. screw-on 20 cm measuring rod
<b>Extension</b>	Aluminium stainless steel, M10/600 mm, required for listening to fittings in shafts

## 13 Error messages

<b>Error code</b>	<b>Description</b>
Radio! RT 06-1	<p>This message may appear when a correlation measurement is to be started. It is a warning. However, a correlation measurement may be possible nevertheless, but the quality of the radio connection is poor.</p> <p>This error message appears when:</p> <ul style="list-style-type: none"><li>● the radio transmitter is not in operation</li><li>● there are technical obstructions (e.g. a building) between the <b>AC 06</b> and <b>RT 06</b> preventing transmission</li><li>● there is a vast distance between <b>AC 06</b> and <b>RT 06</b>.</li></ul> <p><u>Corrective action:</u></p> <ul style="list-style-type: none"><li>● Check the radio transmitters concerned. Are they switched on?</li><li>● Position the radio transmitters to the correlator so as to create the best possible transmission path (line-of-sight between transmitter and receiver)</li><li>● Check the radio transmission using the headphones. Can you hear (leak) noises or just a hissing?</li></ul>
Radio! RT 06-2	See „radio! RT 06-1“
Microphone! Channel 1	<ul style="list-style-type: none"><li>● There is no microphone connected</li></ul>
Channel 1 (or 2)	<ul style="list-style-type: none"><li>● Microphone is being adjusted (progress bar displayed simultaneously)</li></ul>

<b>Error code</b>	<b>Description</b>
F 52	Data flash occurred The error is self-retaining. Switch on the device again.
F200	Communication error Error F200 can be ignored if it occurs occasionally. If it occurs regularly contact SEWERIN Service for help.
F201	Communication error Error F201 can be ignored if it occurs occasionally. If it occurs regularly contact SEWERIN Service for help.



**Note:**

In the case of other error codes please contact our SEWERIN service team!

## 14 Hints on Disposal

The disposal of instruments and accessories is governed by the European Waste Catalogue (EWC).

Type of Waste	Corresponding EWC Code
Instrument	16 02 13
Battery, accu	16 06 05

### Old Instruments

Old instruments can be returned to Hermann Sewerin GmbH. We will arrange the qualified disposal free of charge through certified specialists.



## EC Declaration of Conformity

Product: **SeCorrPhon AC 06**  
Intended use: Water leak detector  
Manufacturer: Hermann Sewerin GmbH  
Address: Robert-Bosch-Str.3  
33334 Gütersloh - Germany

The product complies with the following directives:

**89/336/EEC** EC Directive: Electromagnetic compatibility  
**92/31/EEC** Amendment to above  
**93/68/EEC** Amendment to above

For evaluation of conformity the following harmonised standards apply:

EN 61000-6-1  
EN 61000-6-2  
EN 61000-6-4

Gütersloh, 16.05.2007

A handwritten signature in black ink that reads "S. Sewerin".

Dr. S. Sewerin  
(General Manager)

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