Horn Analyzer
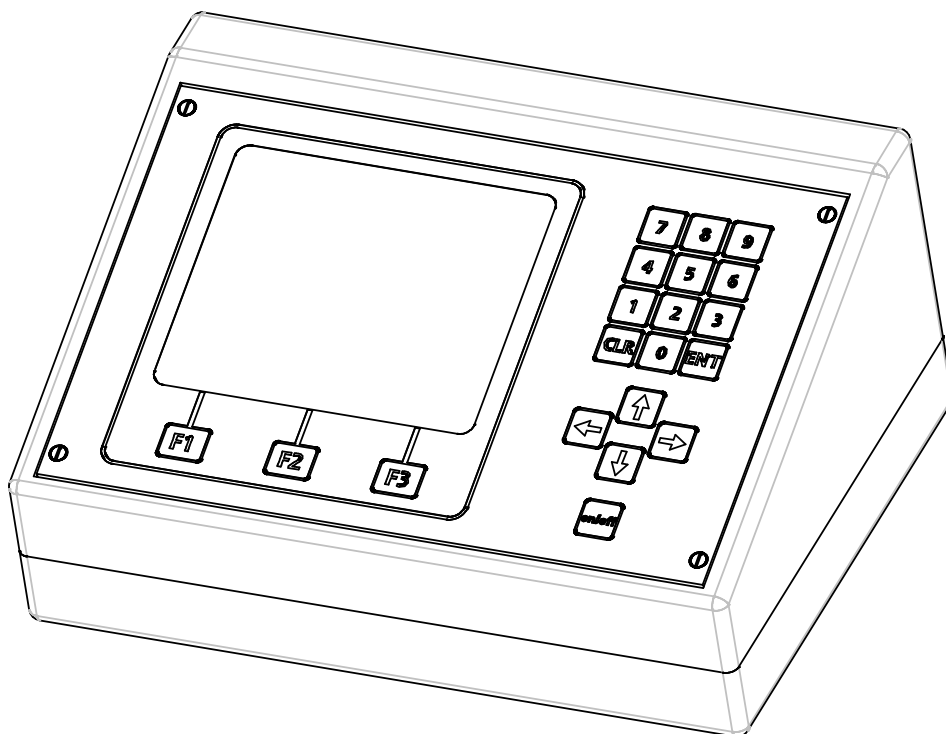
ST-10 Expert

for serial and parallel resonance Resonators

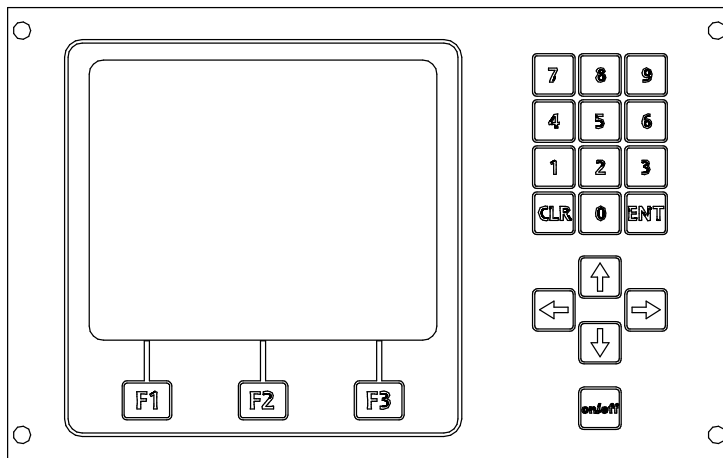# Operator Manual

Version 2.5

www.baer-elektronik.ch

Indice

1.0 | Controls

Input keys:
F1, F2, F3,
CLR, ENT, 0-9

Cursor control keys:
▼, ▲, ▶, ◀

Switch on and off:
on/off

1.1 | Cable connections

a : The table mains part operates with tensions of 90-240VAC 50-60HZ and has an exit voltage of **12 V DC** 1.3 A stabilized.

b : BNC Connector at the RF exit (high frequency)

c : Connector for amplitude measuring probe.

d : Connection RS232 for needle printer.

a   b   c   d
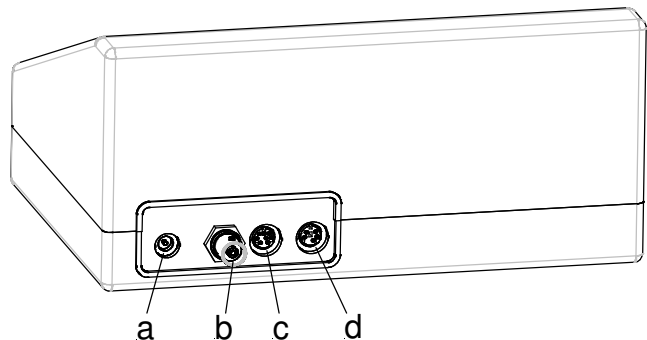
Warning:

1. The resonator unit is not allowed to be grounded!

2. The horn must not be touched during the measurement. It must be able to oscillate freely!

2.0 Switch-on

1. Connect RF-Output (high Frequency) to the converter with the cable of the equipment.
2. Connect table mains part **ST1** (2-pole, hole plug 5.5mm/2.5mm).
3. Plug in mains connector.
4. Press **ON/OFF** at mains switch.

3.0 First mask after switch-on

	Horn Analyzer	
	ST10 Expert	
	Version V X.X	
	Baer Elektronik	
	Ultraschall Messgeräte	
	Hauptstrasse 39	
	8594 Güttingen	
	www.baer-elektronik.ch	
Chart	**Menu**	**Analogue**
F1	**F2**	**F3**

Graphic	**F1**	Start of a graphical measurement
Menu	**F2**	Access to the main menu.
Analogue	**F3**	Start of an analogue measurement

The different features are activated by the **F**-buttons. In the bottom row the different texts are dedicated to the buttons.

Changes have to be confirmed with **ENT**.

Note:
The display lighting is reduced after 5 minutes. With the use of the keyboard the lighting is reactivated!

4.0   Analogue Measurement

Sonotrodes, booster or converters are tuned by means of the analogue measurement.

The **serial** and **parallel** resonance frequency is determined automatically.

The start and stop frequency has to be defined to wished range.

The measurement is started with the $\boxed{\text{F1}}$ button.

4.1   Mask on the display after start with F1

	Frequency kHz	Impedance Ω	Differ.Freq. Hz	
a)	S 029.536	369		
	P 029.808	016.0K	272	b)
				■
				■ e)
				■
d)	Serial + parallel resonance			■
c)	27.000 kHz	>>	32.000 kHz	
	Start	Menu	Setup	

F1	F2	F3

a) Frequency in kHz:

S = Serial resonance point (f. ex. Rinco Ultrasonics)
P = Parallel resonance point (f. ex. Branson)

Impedance in Ω:

Serial resonance (kHz): The smaller the impedance is, the smaller is the power loss of the oscillating unit. A good oscillating unit has low impedance.

Parallel resonance (KHz): The bigger the impedance is the smaller is the power loss of the oscillating unit. A good oscillating unit has high impedance.
A maximum of five resonance points are displayed. In a normal oscillator there is mostly only one resonance point within +/- 1000Hz.

b) Differential frequency in Hz:

Parallel resonance – Serial resonance = Differential frequency.

c) Start - and Stop - Frequency in Hz:

Entry of the start-frequency between 100 and 89500 Hz. The search takes longer, if the frequency step is chosen too big.

Ideal calibration:
Start frequency = wished frequency -1000Hz
Stop frequency = wished frequency + 500Hz

For example required working frequency 20`000 Hz
Start frequency = 19´000 Hz
Stop frequency = 20´500 Hz

Entry of the stop frequency of max. 90'000 Hz. The stop frequency has always to be bigger than the start frequency.
The stop frequency can be typed, when the position is reached with the button $\boxed{\blacktriangledown}$.

d) Serial Resonance:

Select a Mode with the CLR button:
- Serial resonance
- Parallel resonance
- Serial + Parallel resonance

Secondo il modo di misurazione nel panello de comunicazione, appaiono le frequenze misurate:
Solo il punto seriale, parallelo o i due punti.

e) Bar display:

During the measurement, the bar display is running according to the process from start- to stop-frequency.

Frequency kHz	Impedance Ω	Differ. Freq. Hz	
S 029.536	369		
P 029.808	016.0K	272	
			■
			■
			■
Serial + parallel Resonance			■
27.000 kHz	>>	32.000 kHz	
Start	**Menu**	**Setup**	

a)

▲
▼

Further menu items are shown with the cursor **button** downwards (and back).

b)

List >>	Freq. Range	Print
F1	F2	F3

F1 a)	**Start**	Start of the measurement with **F1**.
F1 b)	**List >>**	Further resonances, if existent (list>>>), are shown with **F1**.

F2 a)	**Menu**	With **F2** the main menu is displayed.
F2 b)	**Freq. Range**	The areas 1-6, which are preset in „menu -> range", can be chosen with **F2** i. e. 19.000 – 21.000 KHz.

F3 a)	**Setup**	Access to different settings of the analogue mode with **F3** (cap. 4.2)
F3 b)	**Print**	A print, with a matrix or dot printer(RS232), of the resonance frequencies can be released with **F3**.

```
Tuning protocol      :  02.03.09  17.04.11
Frequency range      :  29000 -> 31000 Hz

 1 Resonance point
Serial resonance     :  29.718 KHz   0383   Ohm
Parallel resonance   :  30.024 KHz    015.0 KOhm
Difference frequency :  0306 Hz

 2 Resonance point
Serial resonance     :  No Data available
```

4.2 Setup Analogue Mode

Selecting Setup, a mask opens for the setup dialogue of the analogue mode, which is similar to the graphic mode.

	Setup analogue mode	
1.	Frequency Range	
2.	Imp. Limit	1500 Ohm
3.	Print	Off
-	**Analogue**	**+**

F1	F2	F3

4.3 Frequency Range (analogue mode)

ENT Posicion the cursor on line 1 and enter in to the list of programmed frequencies with ENT . The frequency range can be pro-Grammed freely.

F1 > Type the Start - frequency (F-Start). It must be lower than the Stop – frequency.

F3 > Type the Stop – frequency (F-Stop).

F2 > Return to the main menu.

ENT > Confirm all the modifications with ENT.

	Frequency Range
1.	14.000 – 16.000 kHz
2.	19.000 – 21.000 kHz
3.	29.000 – 31.000 kHz
4.	34.000 – 36.000 kHz
5.	39.000 – 41.000 kHz
6.	69.000 – 71.000 kHz

F-Start	Menu	F-Stop
F1	F2	F3

4.4 Limit

This input determines the difference between the series and parallel resistance. This value declares which points of resonance should be registered in the list. At 200 Ohm, also weak resonances are registered in the list of measured data.

If only stronger resonances have to be considered, the value has to be chosen higher. (Standard value 1500 Ohm / Input area from 0200 > 2000 Ohm)

To change the value, position the cursor on the current value, overwrite it and confirm with **ENT**.
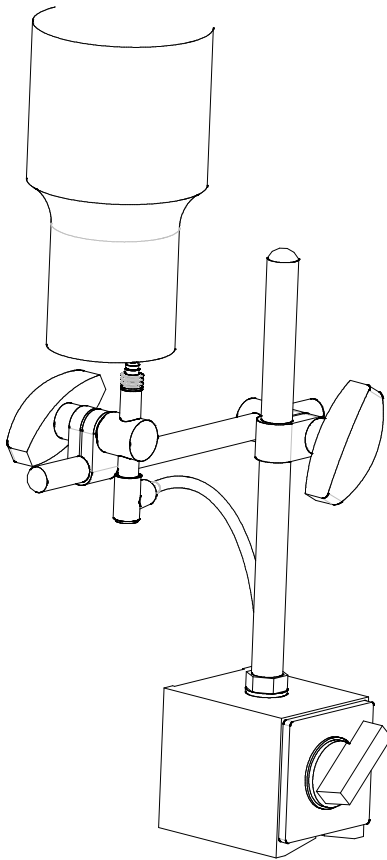
4.5 Print

Actuates the protocol output after the measurement. If the selected value is on „on", a protocol is outputted after completion of the measurement!

To perform a print command, put the cursor on the correspondent line and switch with **F1**/**F3** between "on" resp. "off". Confirm with **ENT**.

5.0 | Amplitude measurement

The Amplitude can only be measured with our digital gauge.

Important:

Never switch on the ultrasound when the measuring sensor is on the catch!!

The digital gauge could be destroyed!

The resolution indicated on the display must correspond with the connected digital gauge! (Compare with delivery documents)

The resolution can be changed by using the ▼ button.

Three gauge types are available: With a resolution of **0.1, 0.5** and **1.0 µm.**
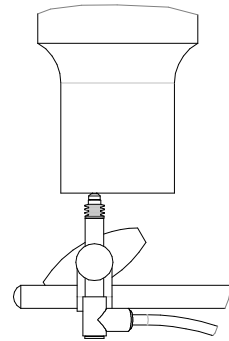
F1 > Delete actual value (ACT)
F2 > Return to main menu
F3 > Delete maximum value (MAX)

Amplitude Meter		
	0.0 µm MAX	
	0.0 µm REAL	
Resolution 0.1 µm		
CLR	**Menu**	**CLR max**

Setting check:
If the sensor has a measurement range of 2mm, on the display a value of approx. 2500.0 µm has to appear, when the sensor is pushed by hand against its mechanical stop.

6.0 | Main Menu

```
        Horn Analyzer
         ST10 Expert
         Version V X.X

         Baer Elektronik
      Ultraschall Messgeräte
        Hauptstrasse 39
         8594 Güttingen
      www.baer-elektronik.ch

   Graphic    Menu    Analogue
```

F1	F2	F3

Enter with F2 into the (main) menu:

→

```
 1.   Mode              Analogue

 2.   Language          English
 3.   Setup
 4.   Lightning    I-----I--------I
 5.   Contrast     I-----I--------I

        +         Start         -
```

F1	F2	F3

6.1 | Mode

Operating mode selection. Available are:

Mode	**Analogue**	Frequency Measuring with Analogue Mode
	Amplit.	Amplitude > Amplitude Measuring
	Manual	
	Graph	

F1	F3

The mode can be changed with **F1** and **F3** in the main menu.

F2

Start the mode with **F2**, which will return to the former one after on/off. If the mode has to be memorized, a confirmation with **ENT** is necessary. The stored mode will reappear after "switch on" the unit and F2 (menu) selection.

6.2 | Language

```
 1.   Mode              Analogue
 2.   Language          English
 3.   Setup
 4.   Lightning    I-----I--------I
 5.   Contrast     I-----I--------I


        +         Menu          -
```

F1	F2	F3

Setting:

Position cursor with the ▼/▲ keys on the language (2).
Vary the language with **F1** / **F3.**
Confirm the new setting with **ENT**.

If the modifications are not confirmed, after on/off, the system will return to the old setting.

6.3 Setup

	Setup		
1.	**Date**	:	18.06.2009
2.	**Time**	:	10.00.01
3.	**Day**	:	Monday
4.	**Baud Rate**	:	19200
5.	**Cursor**	:	8
6.	**Flashing**	:	0.5 sec
+	**Menu**		**-**

F1	F2	F3

Date Format: Day, month, year
Time Format: hour, minute, second
Day: Monday - Sunday (change with **F1** / **F3**)
Baud Rate: **19200, 38400, 9600,** change with **F1** and **F3**
Select with **F1**/**F3** between 8 cursor types. Height adaptable.
Type the flashing time between 0.2 and 1.0 sec

Write data: with the number keys.
Navigation between data: With the keys ► / ◄ / ▼ / ▲
Confirm modifications: with **ENT**

6.4 Lightning

1.	**Mode**	**Analogue**
2.	**Language**	**English**
3.	**Setup**	
4.	**Lightning**	**I-----I--------I**
5.	**Contrast**	**I-----I--------I**
+	**Menu**	**-**

F1	F2	F3

Setting:

Position cursor with the ▼/▲ keys on the lightning scale (4).
Vary the lightning grade with **F1** / **F3.**
Confirm the new setting with **ENT**.

If the modifications are not confirmed, after on/off, the system will return to the old setting.

6.5 Contrast

1.	**Mode**	**Analogue**
2.	**Language**	**English**
3.	**Setup**	
4.	**Lightning**	**I-----I--------I**
5.	**Contrast**	**I-----I--------I**
+	**Menu**	**-**

F1	F2	F3

Setting:

Position cursor with the ▼/▲ keys on the contrast scale (5).
Vary the grade of contrast with **F1** / **F3.**
Confirm the new setting with **ENT**.

If the modifications are not confirmed, after on/off, the system will return to the old setting.

7.0 | Manual Tuning

a) Display of the resonance frequency.

b) Display of the impedance in Ω or KΩ.

c) Display of the capacity of the converter.

d) Entry of the start frequency.

	20000 Hz	
	150.0 Ω	
	5.8 nF	
Start	**20.000 kHz**	
-	**Menu**	**+**
F1	**F2**	**F3**

Functions:
Input of the start frequency 100 - 90000Hz.

ENT   After the confirmation with ENT, the frequency is shown on the display (Pos. a)

F1   The frequency is decreased by 1 Hz with F1.

F3   The frequency is increased by 1 Hz with F3.
The display will increase automatically if the button is pressed longer than 2 seconds. The appropriate impedance is continuously calculated and displayed on position b) of the display.

8.0   Graphical Measurement

With the graphical measurement the impedance is shown in ration to the frequency. Depending on the settings this interpretation is not as accurate as the analogue measurement. The frequency or the impedance may vary.

8.1   Mask on the Display after the Start

a   Graphical record of the impedance in ratio to the frequency.
b   Display of the Start / Stop- Frequency and Hz / DIV.
c   Input of Start and Stop-Frequency.

CLR   Select the frequency range stored in setup

▼   Move the cursor downwards, in order to modify the stop frequency (max. 200'000 Hz). The initial position is marked by the flashing cursor.

▼   With the next push on the downwards button, a list with personal frequencies is shown. **(see point 8.2)**
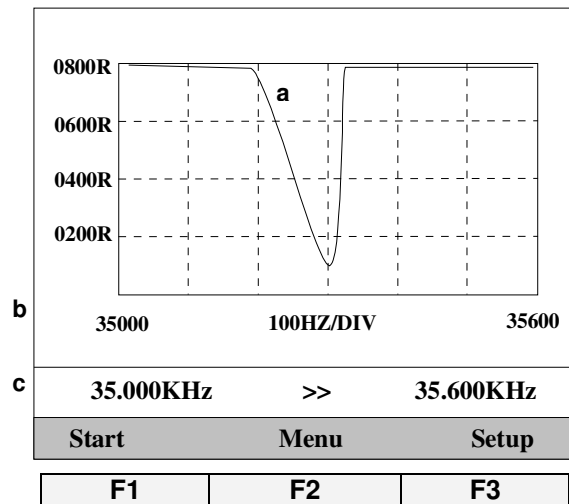
F1   Start of the measurement.
The start frequency is always lower than the stop frequency. If the entry is false, the stop frequency is always set to „Start frequency+50". The frequency range is from 100Hz to 200KHz. Only the first 5 resonance points are stored in a list. On the display, all the resonances, which are in the area, are shown.

F2   Return to main menu.

F3   Various settings for the graphical mode..

8.2   Functions F1, F2, F3

Frequency kHz	Imped. Ω	Diff. F Hz	
S 029.536	369		
P 029.808	016.0 K	272	
027.000kHz	**>>**	**032.000kHz**	
List	Freq. Range	Print	

F1	F2	F3

CLR   The graphic is displayed again with CLR!

F1   **= List**
The found resonance points are shown in a list. It's the same presentation as in the analogue mode!

F2   **= Freq. Range**
The areas 1-6, which are preset in the „menu -> setup graphic mode mask 2", can be chosen with F 2;
I. e. 019.000 – 021.000 kHz

F3   **= Print**
The resonance frequencies can be printed with a matrix printer (RS232), activating the key F3.

```
Tuning protocol      :   02.03.09  17.04.11
Frequency range      :   29000 -> 31000 Hz

 1  Resonance point
Series resonance     :   29.718 KHz    0383   Ohm
Parallel resonance   :   30.024 KHz     015.0 KOhm
Difference frequency :    0306 Hz

 2  Resonance point
Series resonance     :    No data available
```

▼ Confirm with cursor downwards key.

8.3	**Zoom Function**

▼ With the confirmation, the zoom function opens.
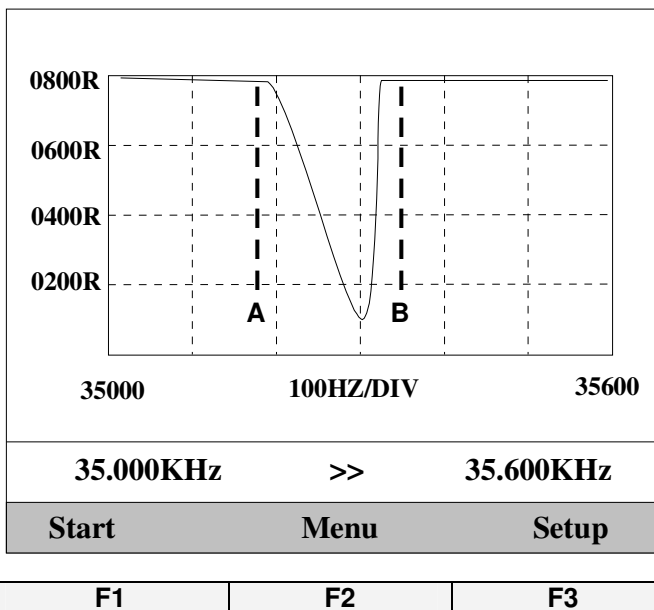
With the zoom function a particular area can be shown closely.

With the limitations A and B the wished area can be marked.

◄ The „limitation A" can be moved in
► direction of the cursor. The „limita-
   defines the start frequency.

▼ Push the down cursor button after having set the „limitation A".

◄ Now the „limitation B" can be mo-
► ved in direction of the cursor but-
   tons. The „limitation B" defines the stop frequency.

| F1 | F2 | F3 |

F1 The zoom function is started with F1.

9. Setup Graphical Mode Mask 1

Setup chart mode		
1.	Imp. Range	400 Ω
2.	Measuring Time	01 ms
3.	Frequency step	01 Hz
4.	Transmission delay	00 ms
5.	Division with	;
6.	Send CR/LF	off
-	Chart	+

F1	F2	F3

9.1 Impedance Range

10 measurement ranges are available.
Change the range with (**+/-**) respectively with **F1/F3**.

If the serial resonance point is sought, choose the range 400Ω or 800Ω.

If the parallel resonance point is sought, choose the range 15KΩ or 35KΩ.

1.	Imp.Range	400Ω
		800Ω
		1.5K
		3.5K
		7.0K
		15K
		25K
		35K
		55K
		75K
		95K

9.2 Measuring time

Waiting time until the analogue value is measured.
Range: 0 – 50 ms (Standard value 1 ms) > Setting > Typing the value (ENT).
By a longer waiting period the graph can be displayed more precisely.

9.3 Frequency Step (Hub)

Range: 1 – 50 Hz. > Setting > Typing the value (ENT).
In graphical mode the frequency is increased by this value and the impedance is measured.
Increasing the step size, the accuracy of the impedance reduces!
The accuracy of the frequency is depending on the size of the step!
If a large frequency range is measured, an increased step size can shorten the measurement time.

9.4 Sending Delay

Waiting time until the next figure is sent.
Range: 0 – 10 ms (Standard value 0 ms) > Setting > Typing the value (ENT).
If there is a problem receiving the data on the PC, increasing the sending delay, might eliminate this fault.

9.5	Division with

A separator is necessary for easy implementation of the measurement data into a chart calculation program (i. e. Excel). A separator can be defined for the data output to a computer.

5.	Separate with	;
		.
		:
		SPC
		off

Select the division signal with **F1** or **F3** and confirm the choice with **ENT.**

9.6	Send CR/LF

If this option is activated a CR/LF is sent after the separator.
With the cursor on the line of this function, it can be switched on or off with the key **F1** or **F3**.

With ▼ a further page is shown (mask 2 of the chart mode).

10.0　Setup Chart Mode, mask 2

Pass from mask1 to mask2 of the graphical mode, pushing the ▼ button.

	Setup chart mode	
1.	**Frequency Range**	
2.	**Limit**	**1500 Ohm**
3.	**Print**	**off**
4.	**Relais on**	**5 K**
-	**Chart**	**+**

F1	**F2**	**F3**

10.1　Frequency Range

ENT　Enter in the table of programed frequencies with ENT.
The frequency areas are freely selectable.

.

F1　> Type the start frequency, which must be lower than the stop frequency.

F3　> Type the stop frequency.

F2　> Return to the main menu (graphic)

ENT　> Confirmation of each modification with ENT.

	Frequency Range	
1.	**014.000 – 016.000 kHz**	
2.	**019.000 – 021.000 kHz**	
3.	**029.000 – 031.000 kHz**	
4.	**034.000 – 036.000 kHz**	
5.	**039.000 – 041.000 kHz**	
6.	**069.000 – 071.000 kHz**	
F-Start	**Chart**	**F-Stop**

F1	**F2**	**F3**

10.2　Limit

This input determines the difference between the serial and parallel resonance. This value decides which points of resonance should be registered in the list. At 200 Ohm, weak resonances are also registered in the list of measured data.
If only strong resonances have to be considered, the value must be chosen higher.
Input area from 200 till 2000 Ohm. (Standard value 1500 Ohm)
To change the limit value, put the cursor on the existent one, overwrite it and confirm with **ENT**.

10.3　Print

Activates the protocol output after a measurement. If the printer status is „on", a protocol is outputted after the completion of a measurement!
The "on/off" selection of the "print" command is done by putting the cursor on the existing status and change it with **F1**/**F3**. Confirm with **ENT**.

10.4　Relais on

If the measurement is not shown properly on the display, this value can be changed.
A vibrating unit can influence the measured values at certain resonance points! By changing the switch-over point this mistake can be avoided.
To switch between the value **5**, **7** e **9** K, place the cursor on the current "Relais on" value, change it with **F1**/**F3** and confirm the new setting with **ENT**.

11.0 Data Storage in the Chart Mode

A maximum frequency step of 15 KHz can be stored in the graphical mode. For example: Frequency 10.000 kHz -> 25.000 kHz. The data is stored in **ASCII**-Format and are recallable with a control character via the RS232-interface.

The amount of measurements is calculated the following way:
Stop frequency – Start frequency = Amount of measurements

The following example shows the display with the settings:

1. Frequency increase **01Hz**
2. Separator   **(;)**
3. CR/LF sending   **off**
4. 35500 – 35000 = 500 Hz

Start frequency					Separator	Stop frequency					Separator	Step size		Seperator
3	5	0	0	0	;	3	5	5	0	0	;	0	1	;

Impedance. in Ohm				Separator	Impedance. in Ohm				Separator					
0	0	1	2	0	;	0	0	1	2	5	;			

Impedance. in Ohm				Separator	Impedance. in Ohm				Separator					
0	0	1	3	0	;	0	0	1	4	8	;			

Etc.. 500 Ohm values follow
At the end of the data the figure „;0" is sent

Data String:
35000;35500;01;00120;00125;00130;00148;nnnnn;0;

Data String with CR/LF:
35000;
35500;
01;
00120;
00125;
00130;
00148;
nnnnn;
0
String closed with „CR" ($0D) !

The data can for example be collected in an Excel- chart and valuated graphically. With our macro, which was written for an Excel-chart, you can read out the data from the instrument with one click!
Only for **Excel99**!

11.1 Protocol

The protocol can be recalled over the RS232-Interface. If the PC sends the control character „A", the analogue data is being sent. Close the string with "CR" ($0D)!

```
Tuning protocol      :   17.10.08  10.33.08
Frequency range      :   34000 ->  36000 Hz

1. Resonance point
Serial resonance     :   35.020 KHz    156.2 Ohm
Parallel resonance   :   35.068 KHz    021.3 KOhm

2. Resonance point
Serial resonance     :    No Data
```

If the PC sends the control character „G", the Graphic data is being sent. Close the String with "CR" ($0D)!
:Example:

```
34950;35050;0.833;1994;1987;1693;1361;1188;1247;1364;1347;1233;1147;116
5;1241;1298;1236;1171;1141;1170;1226;1235;1202;1148;1126;1137;1163;1178
;1164;1129;1101;1095;1104;1114;1116;1107;1088;1063;1046;1042;1043;1044;
1040;1027;1009;993;981;974;969;962;956;949;938;922;906;894;879;869;857;
846;837;828;815;800;785;769;753;737;725;714;700;687;672;656;643;629;612
;598;583;569;554;539;520;501;481;462;443;429;415;398;385;372;360;346;33
2;322;310;299;288;279;272;265;260;256;253;251;250;252;255;262;272;282;3
00;324;357;392;448;528;578;707;849;1020;1237;1364;0;
```

11.2 | RS232 Cable / D-Sub Connector > > > Mini DIN:

D-Sub 9 Poli Socket	Mini DIN 5 Pole Connector	D-Sub 20 Pole Socket	Function
3	2	2	TxD
5	4	7	GND
2	5	3	RxD
4	3	20	DTR
PC Connection	Horn Analyzer	PC Connection	

TxD = Transmit Data   / PC exit
RxD = Receive Data   / PC input
DTR = Data Terminal Ready   / PC exit

The standard cable has a length of 2 meters.

12.0 | Technical Data

Power supply (tension)	Table mains part AC100-240V Exit 12VDC 15W
Ouput voltage	Sinus 8 Veff
Frequency range (analogue)	100Hz to 90.000 kHz
Frequency range (graphic)	100Hz to 200.000 kHz
Impedance range:	1Ω to 100 KΩ 1%
Capacity:	500pF -> 50nF 20%