Service Manual

Impedance Audiometer AT235

Part number 80650106
Valid from instrument no. 750659

Contents

Contents **1**

General Technical Specifications **3**
- Impedance Measuring System 3
- Reflex and Audiometer Functions 3
- Table 1: Frequencies and intensity ranges 4
- Specification of input/output connections 5
- Calibration properties 6
- Coupler types used by calibration 7
- Output voltages (regulated): 7
- General about specifications 8

Calibration Procedure **9**
- General Information 9
  - Service, Adjustment and Repair 9
  - Error in stored data (EEPROM Error) 9
  - Equipment for the Calibration 10
- Air System 10

Hardware Calibration **11**
- Attenuator Calibration 11
- Fixed Attenuator Check 12

Software Calibration **13**
- Probe Calibration 13
  - Pressure Calibration 14
  - Probe Tone Calibration 15
  - Compliance Calibration 16
  - Probe Real Mode 17
  - Ipsi Calibration 17
- Headset Calibration 19
  - The information window 19
- Factory Calibration Values 20
  - Insert Factory Calibration Values 20

Disassembly **21**
- Open Cabinet 21
- Pump Tube Connections 21
- Pump Tube Replacement 22
- Electrical Assembling Instrument 23
  - Rear Panel Connections 23
- Transducer Wire and Tube Connections 24
- Transducer Spare parts 25
- Printer Connections 26

Schematics **27**
- Analog Block Diagram 27
- Keyboard Diagram 28
  - Components Index and Values 29
  - Keyboard Part List 30
- Main board Diagram 31
  - Components Index 38
  - Main board Part List 39
- Transducer Board Diagram 45
  - Components Index 46
  - Transducer Part List 47

Appendix A Description of Serial Interface 1
General Specification 1
Installing the USB Driver on the PC 1
Communication 3
Audiological Information 5
Impedance Audiometry 5
EEPROM Commands 9
Information 9
Remote Commands 10
Status 11
IPSI Calibration 11
Setup Items 12
Online Communication 14
Cochlear Implant 17
Communication in Windows 18

Appendix B User Setup 1
Set-up Navigation 1
User Setup 2
Setting up Reflex Tests 3
Common Setup 11
Clinic Setup 13

Appendix C Advanced User Setup 1
Advanced User Setup 1
Advanced Reflex User Setup 3
Advanced Audiometry User Setup 5
Letter Printout Error (Internal printer) 8
Storing/Restoring the Setup 8

Appendix U - Update News 1

General Technical Specifications

Medical CE-mark:	The CE-mark indicates that Interacoustics A/S meets the requirements of Annex II of the Medical Device Directive 93/42/EEC.	
	Approval of the quality system is made by TÜV – identification no. 0123.	
Standards:	**Safety:**	EN 60601-1, Class I, Type B
	EMC:	EN 60601-1-2
	Impedance:	EN 61027/ANSI S3.39, Type 2
	Audiometer:	EN 60645-1/ANSI S3.6 , Type 4 Tone audiometer
Power, UPS400:	**Consumption:**	15 W (Max 60W)– See separate service manual
	Mains voltages and fuses:	T1 A (Voltage)
Operation environment:	**Temperature:**	15 – 35 °C
	Rel. Humidity:	30 – 90%
Storing/handling:		Temperatures below 0°C and above 50°C may cause permanent damage on the instrument and its accessories.
Warm up time:		10 minutes at room temperature (20 °C).

Impedance Measuring System

Probe tone:	**Frequency:**	226 Hz
	Level:	85 dB SPL with AGC, assuring constant level at different volume.
Air pressure:	**Control:**	Automatic.
	Indicator:	Measured value is displayed on the graphical display.
	Range:	-600 to +300 daPa.
	Pressure limitation:	-800 daPa and +600 daPa.
	Pressure change rate:	Minimum (50 daPa/s), medium, maximum or automatic with minimum speed at compliance peak. Selectable in the set-up.
Compliance:	**Range:**	0.1 to 6.0 ml (Ear volume: 0.1 to 8.0 ml).
Test types:	**Tympanometry**	Automatic, where the start and stop pressure can be user-programmed in the set-up function.
	Eustachian Tube Function	Williams test (automatic function).
Indicators:	**Graphical display**	Compliance is indicated as ml and pressure as daPa.
		Stimulus level is indicated as dB Hearing Level.
Memory:	**Tympanometry:**	1 curve per ear.
	Eustachian Tube Function:	3 curves per ear.

Reflex and Audiometer Functions

Signal sources:	**Tone - Contra, Reflex:**	250, 500, 1000, 2000, 3000, 4000, 6000, 8000 Hz.
	Tone , Audiometry:	125, 250, 500, 750, 1000, 1500, 2000, 3000, 4000, 6000, 8000 HZ.
	Tone - Ipsi, Reflex:	500, 1000, 2000, 3000, 4000 Hz.
	Noise - Contra, Reflex:	Wide Band, High Pass, Low Pass.
	Noise - Ipsi, Reflex:	Wide Band, High Pass, Low Pass.
Inputs:	**Patient Response:**	Connection for patient response switch.
Outputs:	**Earphone Right/ Left**	Can be selected to be either standard earphones or insert phones by pressing *shift* Right/Left
	Contra Earphone:	TDH39 earphone for Reflex or Audiometry measurements.
	Ipsi Earphone:	Probe earphone incorporated in the probe system for Reflex measurements.
	Air:	Connection of the air system to the probe.
	USB:	Input/output for computer communication. An external PC can be made to both monitor and control the instrument. The control actions can be followed on the display and operation panel.
		Online communication can be selected, where the measured data will be sent to an external PC.
		See separate section in Service Manual for programming details.
	Keyboard:	Connection for external keyboard, standard PC type.
Attenuator:	**Range:**	0 to 130 dB in 1 or 5 dB steps. Typical range is –10 to 120 dB HL. Range is individual for different modes- see table 1
Test types:	**Manual Audiometry**	Manual control of all functions.
	Automatic Audiometry	Auto threshold according to ISO 8253-1 (Patient controlled Hughson-Westlake). The threshold is determined by the activation of the patient response.
Test types:	**Manual Reflex**	Manual control of all functions.
	Reflex Decay:	Manually controlled with stimulus duration of 10 s.
Memory:		6 ipsi and 6 contra graphs/curves. Each can have up to 6 pulses.

There is additional capacity for 6 manual tests.

Printer (Optional):	**Type:**	Thermal printer with recording paper in rolls.
	Paper width:	112 mm
	Printing time:	21 s for worst case (2 tympanograms + 16 reflexes + 2 audiograms)

Table 1: Frequencies and intensity ranges

Frequency	**Reflex**				**Audiometry**	
	Contralateral		**Ipsilateral**		**TDH39**	
	Min	Max*	Min	Max*	Min	Max
Hz	dB HL	dB HL	dB HL	DB HL	dB HL	dB HL
250	10	110	-	-	-10	110
500	10	120	10	105	-10	120
1000	10	120	10	110	-10	120
2000	10	120	10	105	-10	120
3000	10	120	10	100	-10	120
4000	10	120	10	100	-10	120
6000	10	120	-	-	-10	120
8000	10	110	-	-	-10	110
WB noise	10	120	10	105		
LP noise	10	120	10	105		
HP noise	10	120	10	105		

* Note: Max values are obtainable by selecting “Ext. Range” in the set-up.

Specification of input/output connections

Inputs	**Connector type**	**Electrical properties**	
Patient response	Jack, 6.3mm stereo	Handheld switch:	5V through 10kΩ is forced to gnd. level when activated.
Keyboard	DIN, 5 pole	Pin 1:	NC
		Pin 2: (Grey)	RXA1
		Pin 3: (Violet)	Sync clk.
		Pin 4: (White)	VDD, 5V
		Pin 5: (Black)	Gnd.
Outputs:			
Phones, Left/ Right	Jack, 6.3mm mono	Voltage:	Up to 5.5V rms. by 10Ω load
		Min. load impedance:	5Ω
Phones, Contralateral	Jack, 6.3mm mono	Voltage:	Up to 5.5V rms. by 10Ω load
		Min. load impedance:	5Ω
Transducer	CANON, 15 pole	Pin 1:	Press. 1 signal
		Pin 2:	12V
		Pin 3:	-12V
		Pin 4:	Remote key
		Pin 5:	Probe tone
		Pin 6:	Mic. signal
		Pin 7:	LED blue
		Pin 8:	Press. 2 signal
		Pin 9:	LED green
		Pin 10:	Ipsi Stim. Gnd.
		Pin 11:	Ipsi Stim. Signal
		Pin 12:	Probe tone Gnd.
		Pin 13:	Gnd.
		Pin 14:	Vref., 5V
		Pin 15:	LED red
Data I/O:			
USB	USB type"B"	USB port for communication	See appendix A in service manual for detailed information

Calibration properties

Calibrated Transducers:	Contralateral Earphone:	Telephonics TDH39 with a static force of 4.5N ±0.5N
	Probe system:	Ipsilateral Earphone: is integrated in the probe system 226 Hz transmitter and receiver and pressure transducer is integrated in the probe system
	Audiometry headset:	Telephonics TDH39 with a static force of 4.5N ±0.5N
Accuracy:	General	Generally the instrument is made and calibrated to be within and better than the tolerances required in the specified standards:
	Audiometer and Reflex Frequencies:	±3%
	Contralateral Reflex and Audiometer Tone Levels:	±3 dB for 250 to 4000Hz and ±5 dB for 6000 to 8000Hz
	Ipsilateral Reflex Tone Levels:	±5 dB for 500 to 2000Hz and +5/-10 dB for 3000 to 4000Hz
	Pressure measurement :	±5% or ±10 daPa, whichever is greater
	Compliance measurement:	±5% or ±0.1 ml, whichever is greater

Impedance calibration properties

Probe tone	Frequency:	226 Hz ±1%
	Level:	85 dB SPL ±1.5 dB measured in an IEC 126 acoustic coupler. The level is constant for all volumes in the measurement range.
	Distortion:	Max 5% THD
Compliance	Range:	0.1 to 6.0 ml
	Temperature dependence:	-0.003 ml/°C
	Pressure dependence:	-0.00020 ml/daPa
	Reflex sensitivity:	0.001 ml is the lowest detectable volume change
	Temporal reflex characteristics:	Initial latency = 10 ms (±5 ms)
		Rise time = 75 ms (±5 ms)
		Terminal latency = 10ms (±5 ms)
		Fall time = 75 ms (±5 ms)
		Overshoot = max. 8%
		Undershoot = max 10%
Pressure	Range:	Values between -600 to +300 daPa can be selected in the set-up.
	Safety limits:	-700 daPa and +500 daPa, ±100 daPa

Reflex/audiometer calibration standards and spectral properties:

General	Specifications for stimulus and audiometer signals are made to follow EN 60645-1	
Contralateral Earphone	Pure tone:	ISO 389-1 for TDH39.
	Wide Band noise (WB):	Interacoustics Standard
	– Spectral properties:	As “Broad band noise” specified in EN 61027, but with 500 Hz as lower cut-off frequency.
	Low Pass noise (LP):	Interacoustics Standard
	– Spectral properties:	Uniform from 500 Hz to 1600 Hz, ±5 dB re. 1000 Hz level
	High Pass noise (HP):	Interacoustics Standard
	– Spectral properties:	Uniform from 1600 Hz to 10KHz, ±5 dB re. 1000 Hz level
Ipsilateral Earphone	Pure tone:	Interacoustics Standard.
	Wide Band noise (WB):	Interacoustics Standard
	– Spectral properties:	As “Broad band noise” specified in EN 61027, but with 500 Hz as lower cut-off frequency.
	Low Pass noise (LP):	Interacoustics Standard
	– Spectral properties:	Uniform from 500 Hz to 1600 Hz, ±10 dB re. 1000 Hz level
	High Pass noise (HP):	Interacoustics Standard
	– Spectral properties:	Uniform from 1600 Hz to 4000 Hz, ±10 dB re. 1000 Hz level
	General about levels:	The actual sound pressure level at the eardrum will depend on the volume of the ear. See Table 2 for details.

Table 2

Freq.	Reference values for stimulus and audiometer calibration				Variation of ipsi stimulus levels for different volumes of the ear canal Relative to the calibration performed on an IEC 126 coupler		Sound attenuation values for TDH39 earphones using MX41/AR or PN51 cushion
	ISO 389-1	**ISO 389-2**	**Interacoustics Standard**		**0.5 ml**	**1 ml**	
[Hz]	**TDH39** [dB re. 20 µPa]	**IPSI EAR3A** (CIR22) [dB re. 20 µPa]	**TDH39** [dB re. 20 µPa]	**Ipsi** [dB re. 20 µPa]	[dB]	[dB]	[dB]
125	45						3
250	25,5						5
500	11,5	5,5			9.7	5.3	7
1000	7	0			9.7	5.3	15
1500	6,5						21 (1600 Hz)
2000	9	3,0			11.7	3.9	26
3000	10	3,5			-0.8	-0.5	31 (3150 Hz)
4000	9,5	5,5			-1.6	-0.8	32
6000	15,5						26 (6300 Hz)
8000	13						24
WB			-8.0	-5.0	7.5	3.2	
LP			-6.0	-7.0	8.0	3.6	
HP			-10.0	-8.0	3.9	1.4	

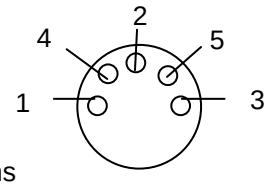
Coupler types used by calibration

TDH39 is calibrated using a 6cc acoustic coupler made in accordance to IEC 303

Ipsilateral earphone and probe tone are calibrated using a 2cc acoustic coupler made in accordance to IEC 126

Output voltages (regulated):

Pin no.	Voltage	Cont. current A	Peak current A
1	Gnd.	-	-
2	Gnd.	-	-
3	+5	0.5	1.0
4	-12	0.7	3.0
5	+12	0.5	1.5



View on output pins

General about specifications

Interacoustics continuously strive to improve the products and their performance. Therefore the specifications can be subject to change without notice.
The performance and specifications of the instrument can only be guarantied if it is subject to a technical maintenance at least once a year. This should be made by a workshop, authorised by Interacoustics.
Questions about representatives and products may be sent to:

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Calibration Procedure

General Information

Service, Adjustment and Repair

This instrument can be serviced, adjusted and repaired without losing the validity of the CE-marking provided the measuring equipment used is fulfilling the demands below, the adjustment procedure are followed and the personnel is having the necessary qualifications approved by Interacoustics.

Before any kind of the calibration can take place, the AT235 must have been on power for at least 3-5 minutes in a normal temperature milieu, and the instrument must be in the same milieu for a reasonable time.

While keeping <*shift*> and <Print> buttons down, switch power on at the rear panel of the instrument. By use of the F keys enter password: 1 2 3 4 . The AT235 is now in software calibration menu.

If a printer is connected to the instrument is it possible to get a complete detailed description of the instrument set-up.
While keeping <*shift*> and <Store> buttons down, switch power on at the rear panel of the instrument.

The AT235 has to kinds of calibration: hardware and software calibration. The software calibration can be done without opening the instrument. When the instrument has been hardware calibrated, it must be followed by a software calibration.

Error in stored data (EEPROM Error)
If any error occurs in stored data an error dialog box is displayed when powering up. The text will be “EEPROM Error!!!”, "Contact Technician!".

Please power off and on the instrument once, if the problem still occurs please see instruction below.

Before trying anything, please read the whole instruction and be aware that **the instrument needs to be re-calibrated no mater what you do.**

What happens if …

1. Should this error box occur press <shift>+<Print>
2. Enter the password for entering the Calibration menu
3. Select the EEPROM menu (F4)
4. Press F6 for doing a totally data recovery. By doing so the program inserts factory data all over the EEPROM.
5. Turn off/on power and see if the error box comes again.
6. If so replace the EEPROM IC on the main board (HN58C65)
7. Recalibrate the instrument under all circumstances.

Note! This error is probably an indication of an unstable EEPROM IC so even though the system should work after at total recovery it is recommended to change the IC.

Equipment for the Calibration

In order to assure correct calibration of the audiometric equipment, it is important that the necessary measuring equipment is used and that it is reliable and stable.

Minimum requirements for measuring equipment:

- Measuring amplifier with input for condenser microphone or a sound level meter, fulfilling the demands of IEC 651 Type 1.
- Acoustics coupler, 6cc and 2cc fulfilling the demand of IEC 303 and IEC 126.
- 1" pressure field condenser microphone for the above-mentioned couplers, fulfilling the demands of the IEC 1094-1.
- Manometer with a range from at least +300 to – 600 daPa and a accuracy of ± 5% of reading or ± 5 daPa which ever is the greatest. Including a syringe (manual pump).
- The CAT40 calibration cavities (0.5, 2.0 and 5.0 ml)
- It is recommended to have an acoustic calibrator for the control of the complete measuring chain
- General purpose frequency counter
- General purpose digital multimeter
- General purpose oscilloscope in order to trace and monitor signals

Air System

The safety valves and the pump system are adjusted in correct way from factory. Normally it should not be adjusted, but if the pump tube has to be exchanged it is necessary to readjust the spring on the pump. Please always use pre-cutted pump tubes ordered from Interacoustics.

Control of the pump system:
Go to Calibration > Probe > Press > Real menu. Place the probe into a cavity (airtight connection). Press the → button (F2) until you reached +300 daPa in the "Pump Ctrl" field on the display. If the build-up pressure keep at 300 daPa the system is airtight.

If the instrument is out of calibration you can connect an external manometer and a syringe between the air connection on the rear plate and the probe tube. Press the syringe until +300 daPa is reached and inspect the manometer. If the pressure is stable the system is airtight.

Safety valve:
The safety valve must release the pressure then the pressure is out of limit. It means if the pressure is larger than +500 daPa (± 100 daPa) or if the pressure is larger then –700 daPa (± 100 daPa).

Adjustment of the pump spring:
Disconnect the probe tube from the air connection on the rear plate. Connect a manometer and a syringe between the air connection and the probe tube. Go to Calibration > Probe > Press > Real menu. Place the probe into a cavity (airtight connection). Press the → button until +400 daPa is reached and inspect the manometer. Adjust the spring until the pressure decrease very slow down. Pump again until +400 daPa is reached. Inspect the manometer and if the pressure is stable or decrease very slow the adjustment is fine, else turn the screw clockwise until the manometer is stable. Repeat the pump procedure again and inspect the manometer for stable pressure. Repeat this until the pressure is stable. Now the spring is correct adjusted.

Before the contra nut is fasten the screw has to bee turned three times clockwise to be sure that the system is and will stay airtight.

Hardware Calibration

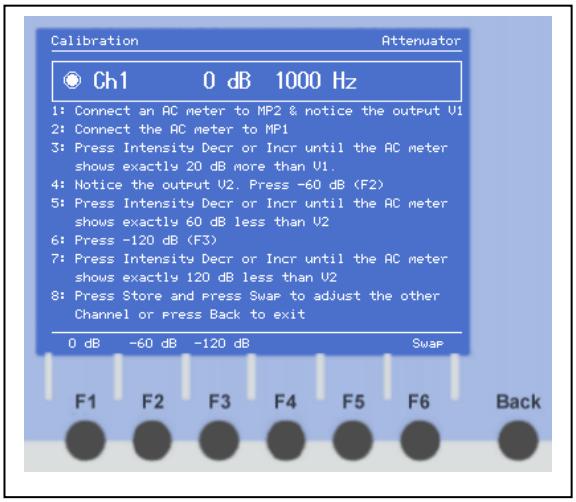
To enter the calibration menus please switch off power – hold down shift while pressing Print key – turn on power again. Hold the keys down until you can enter a password. The factory setting of the password is 1 2 3 4, but dealer may have changed it in order to protect the calibration.

Note! The hardware calibration is normally only done once in the instrument lifetime and at the factory.
Measuring points (**MP**) refers to Main board Index page 38.
Measurements are made with reference to MP13, MP4 and MP15 (GND)

Attenuator Calibration

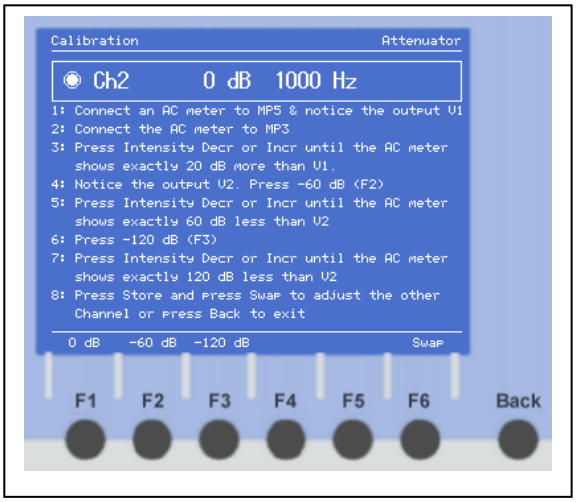
Enter the Attenuator Calibration menu from the Calibration menu by pressing F5 – “Att”.

This is the calibration picture for channel 1.



Attenuator Calibration channel 1. Figure 1

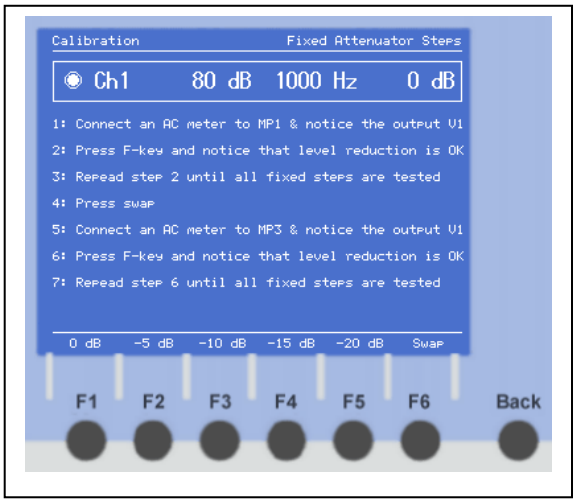
Change to Channel 2 by pressing Swap (F6) in order to calibrate channel 2.



Attenuator Calibration channel 2.Figure 2

Fixed Attenuator Check

Enter the Fixed Attenuator Check menu from the Calibration menu by pressing F6 – “Fixed”.



Attenuator Calibration. Figure 3

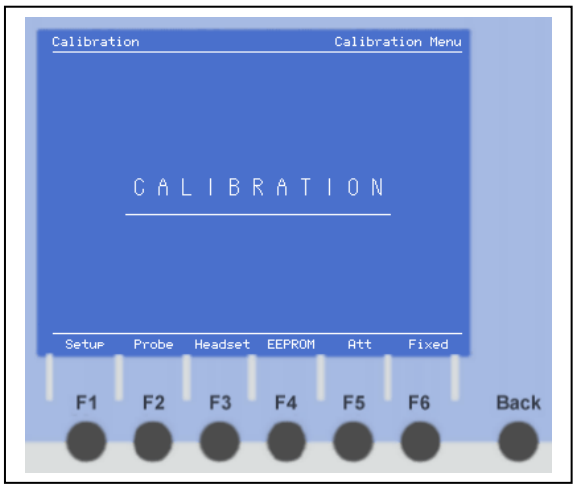
Follow the instructions on the screen.

Software Calibration

A software calibration must always be performed when the instrument has been opened for hardware calibration or if an EEPROM error has occurred.

The calibration is a service calibration, which means, that if the instrument has changed its values during time or because of manual chock, corrections for moderate changes in the software can be made by means of the figures in the EEPROM.

To enter the calibration menus please switch off power – hold down shift while pressing Print key – turn on power again. Hold the keys down until you can enter a password. The factory setting of the password is 1 2 3 4, but dealer may have changed it in order to protect the calibration. If an EEPROM Error occurs during the power up, press shift + print to continue to the password screen.

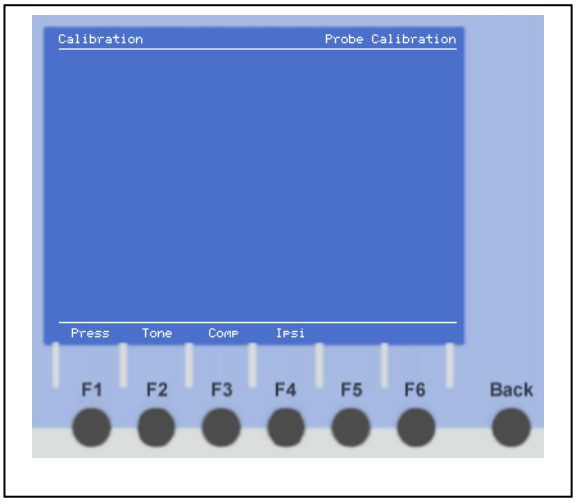


The Calibration Menu. Figure 4

Notice!
For calibration of the Universal Transducer for both types of probetips, you must carry out the probe calibration twice.
Repeat pages 17-21 after switching probe tip.

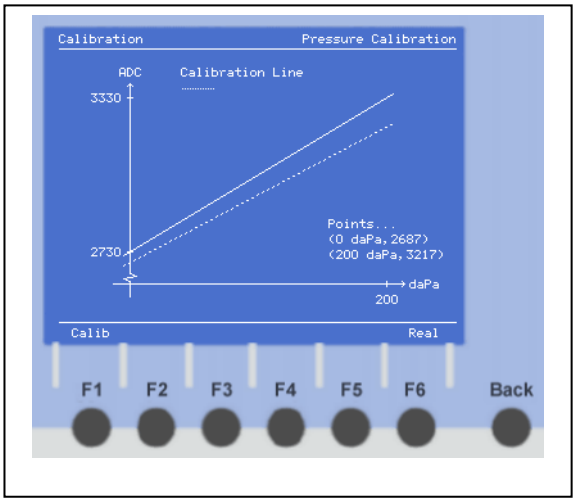
Probe Calibration

To enter this menu from the Calibration Menu Press “Probe” (F2).



Probe Calibration Menu. Figure 5

Pressure Calibration



Pressure Calibration. Figure 6

Looking at the picture you will see two lines (if the instrument is calibrated) in a diagram. The dotted line is the calibration line that graphically gives you information regarding the calibration of the pressure. The normal line is an average line and by comparing the two lines you can get quick overview of the pressure calibration. You can also read the actual ADC values under Points if necessary.

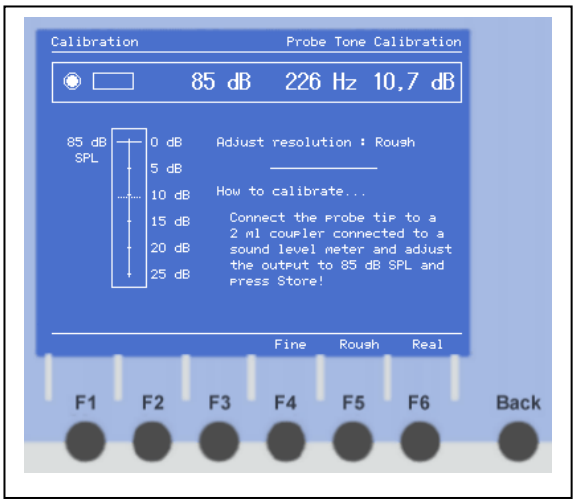
To Calibrate Pressure System

Press Calib (F1) and follow the instructions on the screen.

To Test the Probe Calibration

If the probe is calibrated you can test the calibration among other things in the “Probe Real Mode”. Select Real (F6) to enter this menu.

Probe Tone Calibration



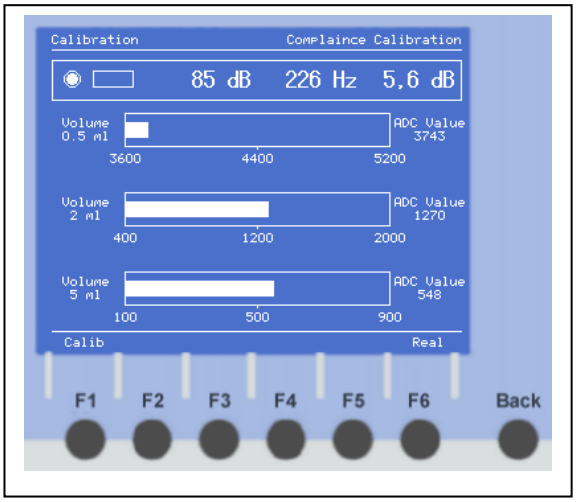
Probe Tone Calibration Figure 7

This is the menu for calibration of the different probe tones. The dotted line in the bar shows the adjustment level.

To calibrate Probe tone levels
Follow instructions on the screen.

Fine (F4) and Rough (F5)
Fine and Rough gives the resolution of the steps when adjusting the probe tone level. You can see what resolution that is selected when looking at “Adjust Resolution” at the display. Selecting Fine the resolution will be 0,1 dB and selecting Rough the resolution will be 0,5 dB.

Compliance Calibration



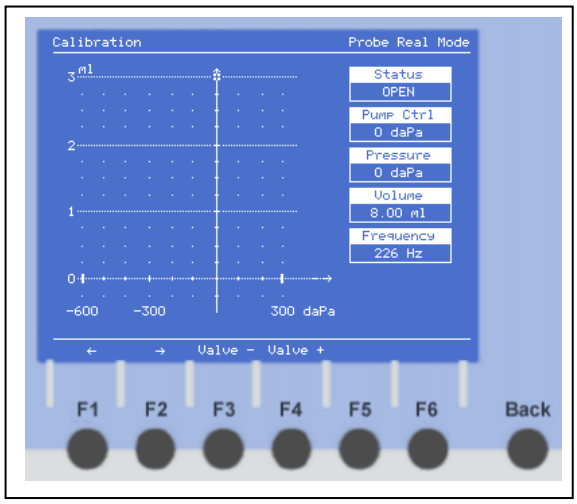
Compliance Calibration. Figure 8

Entering this menu you need to confirm that the Probe Tone is calibrated correctly (see Probe Tone Calibration). If not press Exit (F6) and go trough the procedures of Pressure Calibration and Probe Tone Calibration.

To calibrate Compliance
Press Calib (F1) and follow the instructions on the screen.

To test the Probe Calibration
If the probe is calibrated you can test the calibration among other things in the “Probe Real Mode”. Select Real (F6) to enter this menu.

Probe Real Mode



Probe Real Mode Figure 9

This menu is designed for testing the calibration of the Probe system and the pressure safety valves.

Manual pump control
Use F1 or F2 to change “Pump Control” (status window to the right) until it shows the descried pump pressure. Notice the “Pressure” status window below.

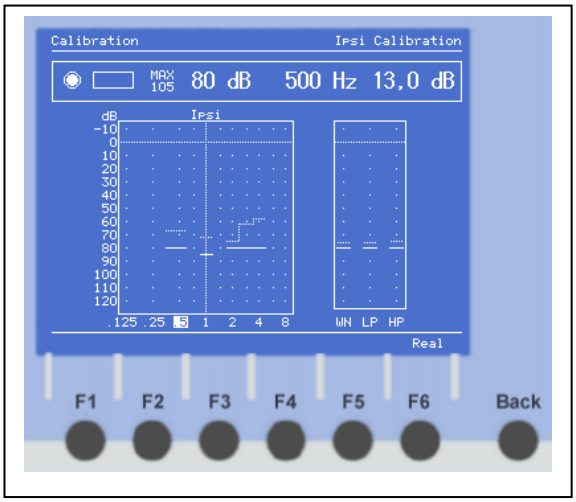
Safety valve test
The safety valve in the pressure system is designed with -800 daPa as minimum and +600 daPa as maximum limits for pump pressure (normal pressure range is –600 to 300 daPa). Note! The safety valve may release before limits.

Connect a manometer to the pressure system that can measure pressures from –800 daPa to +600 daPa.

Press “Valve -” (F3) until the manometer stops its movement. Notice the pressure and if the pressure lies within –800 and –650 daPa the valve works properly.

Press “Valve +” (F4) until the manometer stops its movement. Notice the pressure and if the pressure lies within +350 and +600 daPa the valve works properly.

Ipsi Calibration

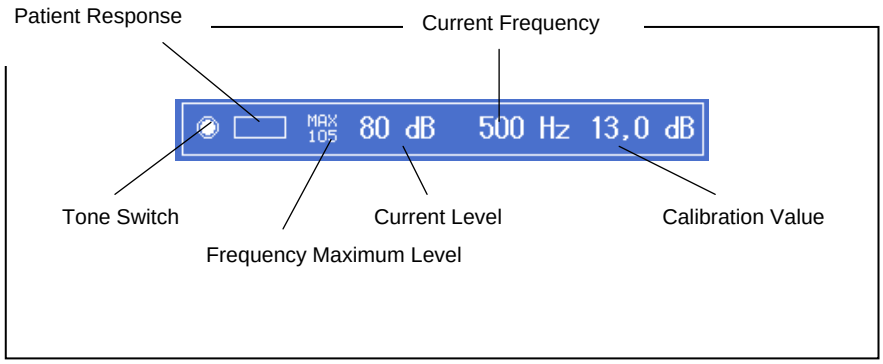


Ipsi Calibration Menu. Figure 10

This is the ipsi calibration menu.

In the audiogram in the screen picture you can see the calibration of the ipsi transducer and the calibration level by looking at lines. The dotted lines are the calibration values drawn with offset in the calibration level (normal line). Above the audiogram we have an information window.

The information window
The information window contains information that can be helpful working with the calibration. The figure below shows what kind of information that is displayed.



Information Window. Figure 11

How to calibrate…

1. Select by means of frequency increase/decrease the frequency to be calibrated or start to calibrate the pre-selected frequency.

2. Press intensity increase/decrease for channel 1 until the desired sound pressure level has been achieved.

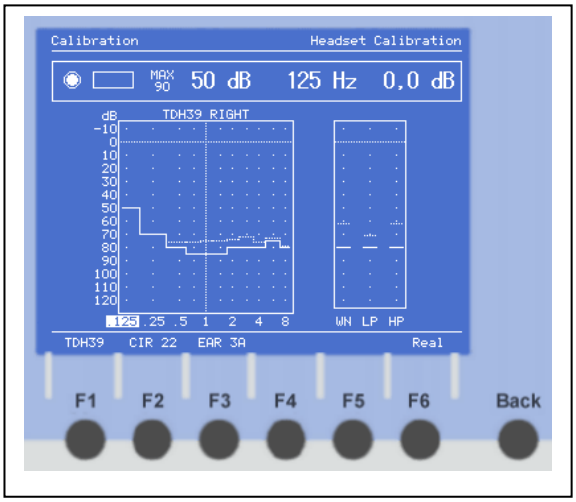
3. Press store. The instrument will automatically jump to the next frequency.

4. Continue to calibrate the new frequency or select another.

To Test the Ipsi Calibration

When done with the ipsi calibration you can enter the “Ipsi Real Mode” to test the calibration. Select Real (F6) to enter this menu.

Headset Calibration

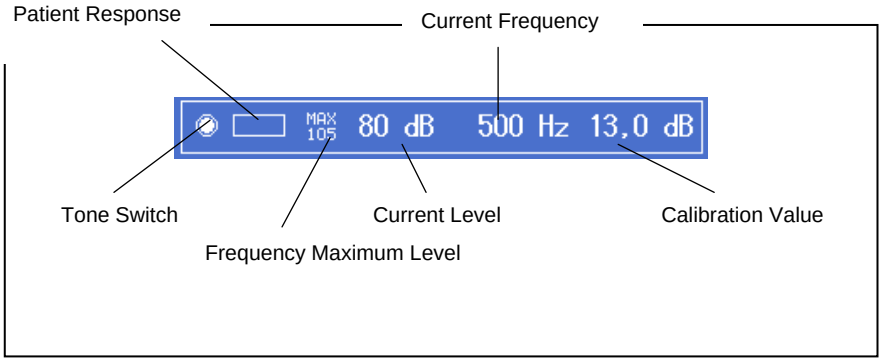


Headset calibration. Figure 12

This is the headset calibration menu.

In the audiogram in the screen picture you can see the calibration of the transducer and the calibration level by looking at lines. The dotted lines are the calibration values drawn with offset in the calibration level (normal line). Above the audiogram we have an information window.

The information window
The information window contains information that can be helpful working with the calibration. The figure below shows what kind of information that is displayed.



Information Window. Figure 13

How to calibrate

1. Select by means of frequency increase/decrease the frequency to be calibrated or start to calibrate the pre-selected frequency.
2. Press intensity increase/decrease for channel 1 until the desired sound pressure level has been achieved.
3. Press store. The instrument will automatically jump to the next frequency.
4. Continue to calibrate the new frequency or select another.
5. Select a new output by pressing Right or Left and repeat from step 1.
6. Select a new output (TDH39, CIR22 or EAR3A) by pressing F1, F2 or F3 and repeat from step 1.

To test the headset Calibration

When done with the headset calibration you can enter the “Headset Real Mode” to test the calibration. Select Real (F6) to enter this menu.

Factory Calibration Values

EEPROM Service Menu. Figure 14

If needed it is possible to insert factory data for either the calibration or for the whole setting of the instrument.

Insert Factory Calibration Values
The Calib (F5) function inserts factory values all over the calibration (calibration values, maximum levels, calibration levels, extended range settings and filter settings), but leaves the set-up data untouched.

The Total function
Total (F6) is a function that is designed for pre calibrating the EEPROM if the IC are replaced. The function inserts values into the calibration and the set-up that lies close to the final calibration.

Note! Using the “Calib” and the “Total” function always requires the instrument to be recalibrated.

Disassembly

Open Cabinet

Remove 2 Torx screws A -use Torx tool T20 Remove 3 EMC screws B – use PZD1 tool
The main part of the two-piece bottom plate can now be removed for calibration

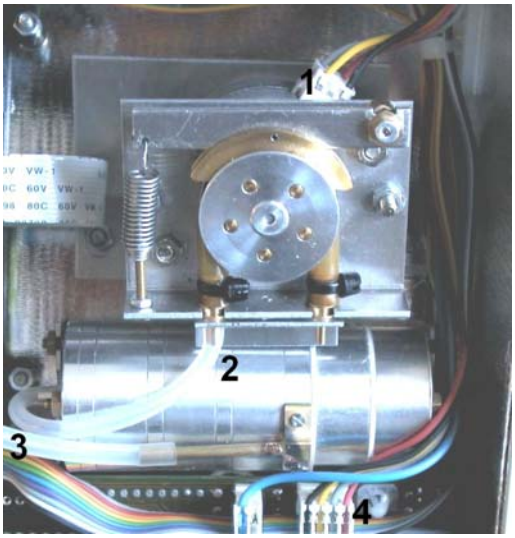
For exchange of the pump tube, remove 2 Torx screws C –use Torx tool T20

Pump Tube Connections

1 & 4 Wire connections from pump to Main board CO19

2 Tube from air reservoir to pump
Part number 38004101, length 85mm

3. Tube from air reservoir to Rear Panel Air Pipe
Part number 38000301, length 320mm



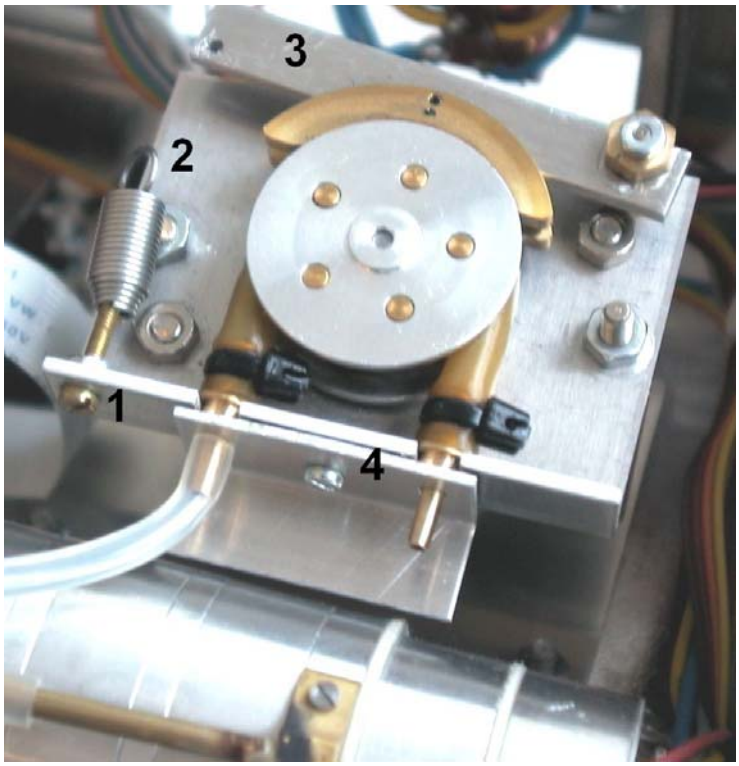
Pump Tube Replacement

Loosen the spring fixing screw (1), unhook the spring (2) and the pump arm (3) can be drawn out

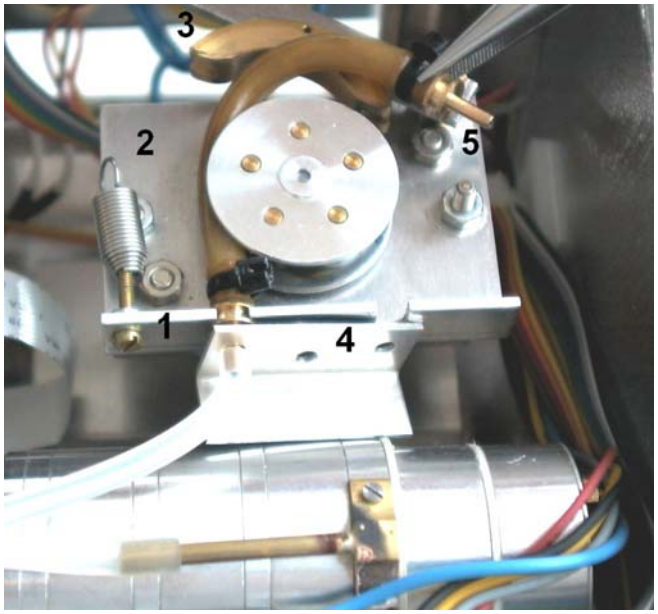
Remove the screw (4) and the tube fixing plate is loose

Spare part numbers:

Pump complete	56000201
Pump tube complete	56002301



After the screw and the tube fixing plate is loose, the tube (5) can now be pulled out for replacement

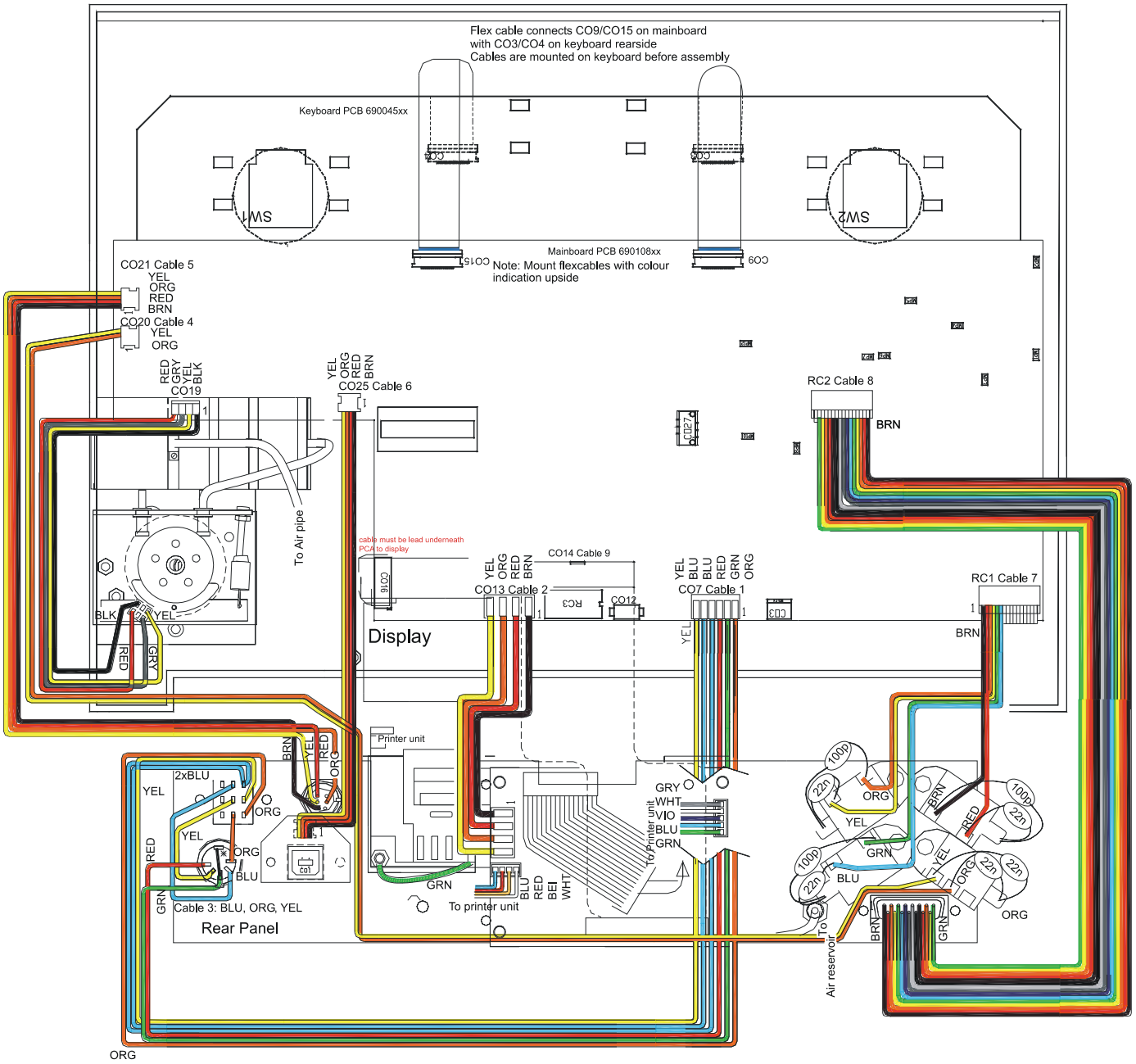


For reassembling:

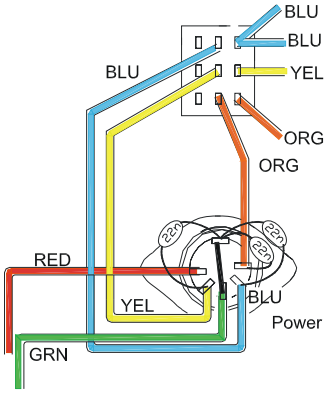
Put in the new tube and mount the fixing plate
Push in the pump arm, fix with the spring and tighten the spring

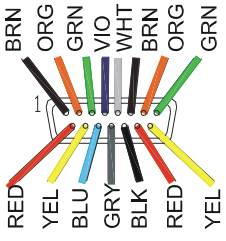
Electrical Assembling Instrument

I06004002



Rear Panel Connections

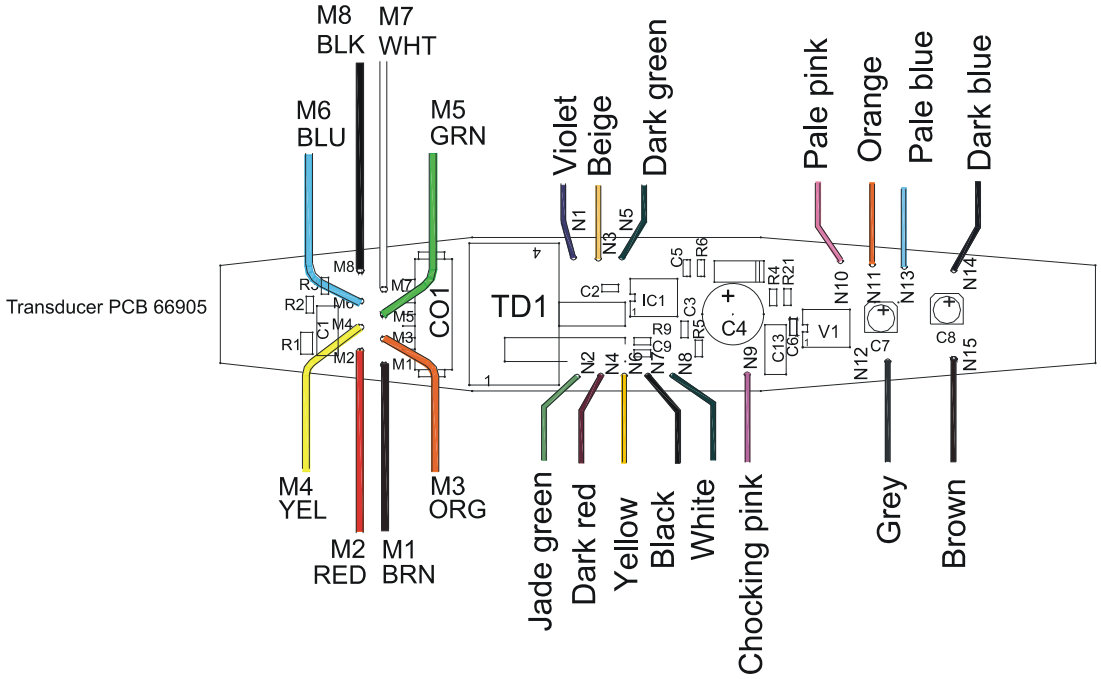


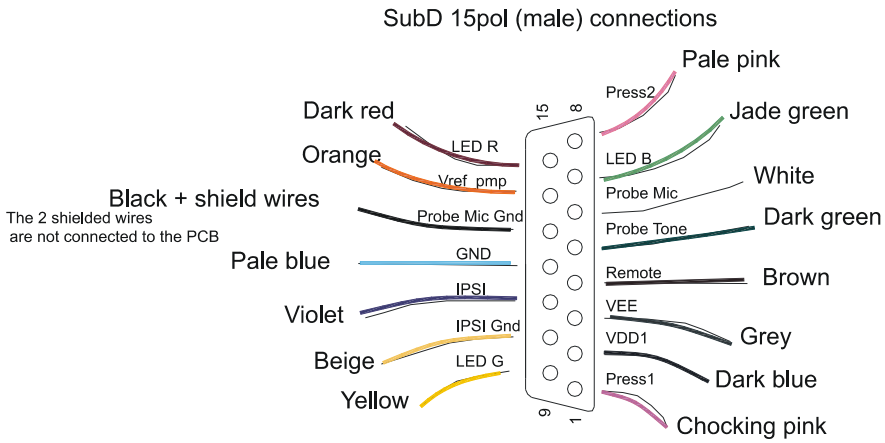


Probe

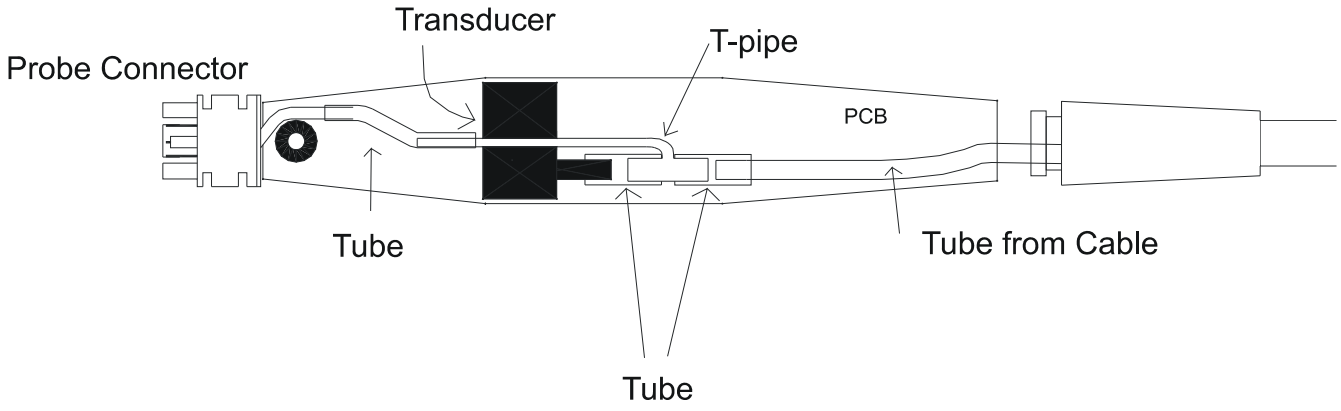
Transducer Wire and Tube Connections

Wire Connections





Tube Connections



Transducer Spare parts

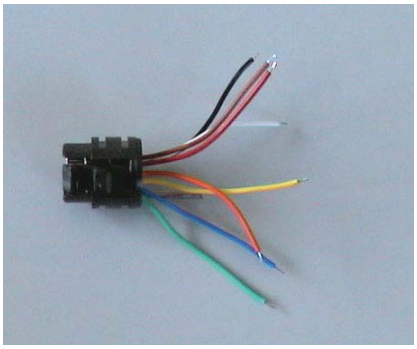
ATP-AT235u Transducer
Part number 80300201

AT235u Probe, clinical
Part number 80310101

AT235u Probe, diagnostic
Part number 80310201

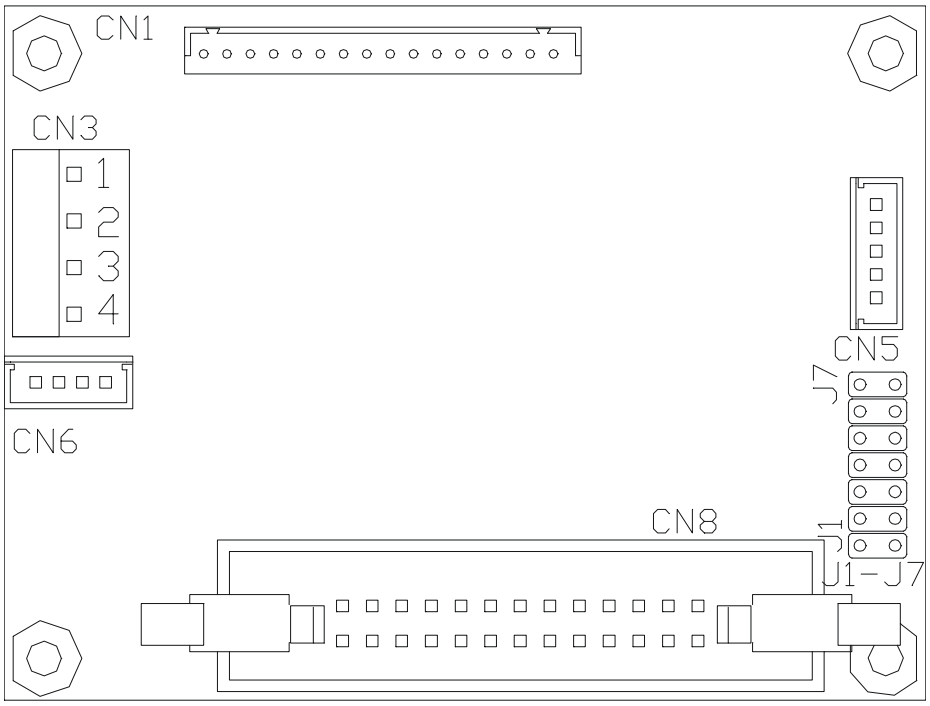
Silicone hose Part number 38000201 40mm

Kit probe module with wires 050/.. Part number 80310601

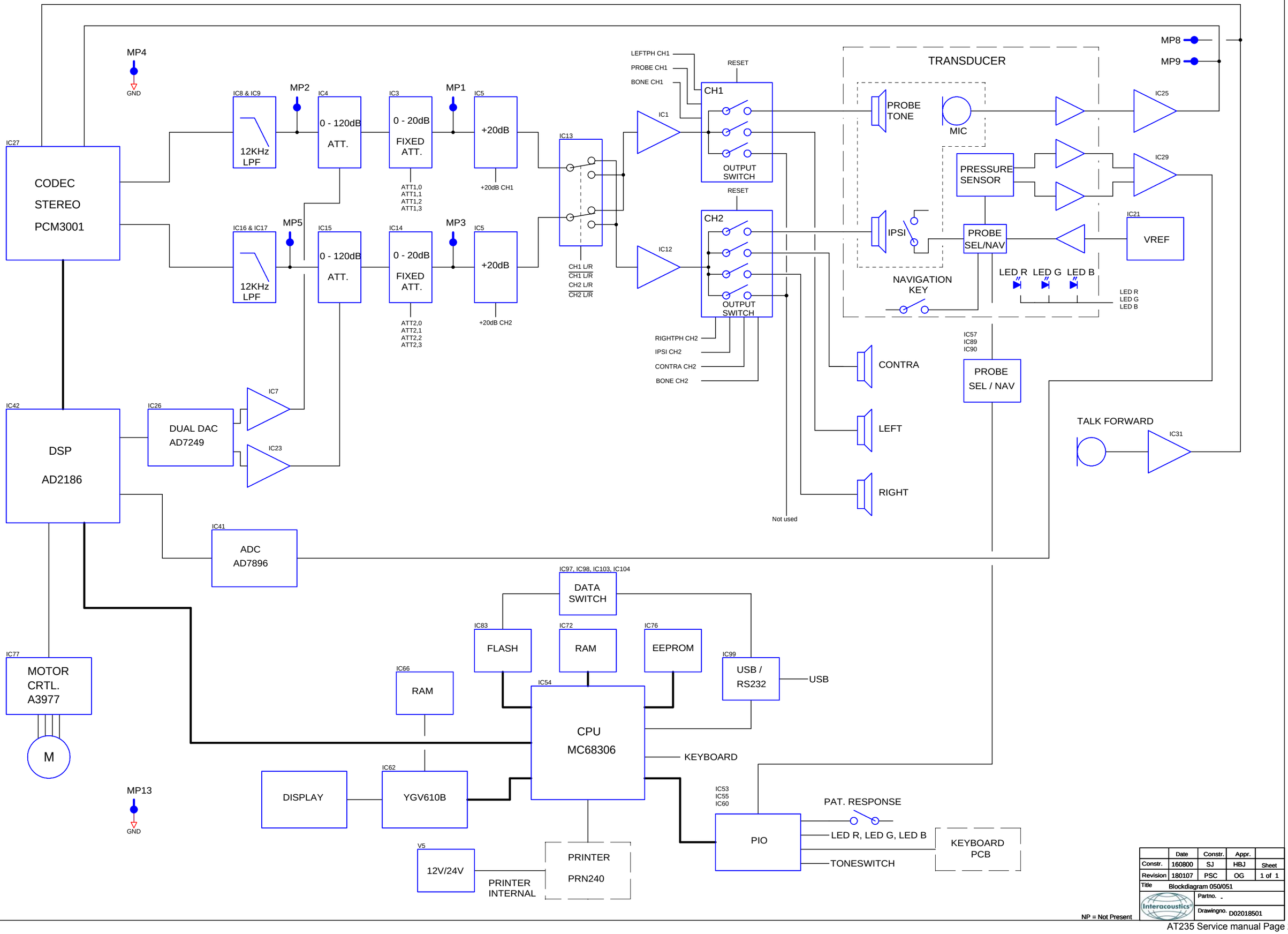


Gasket Part number 34111201 Probe tip Part number 34626003 Cap Probe Part number 31423502

Printer Connections

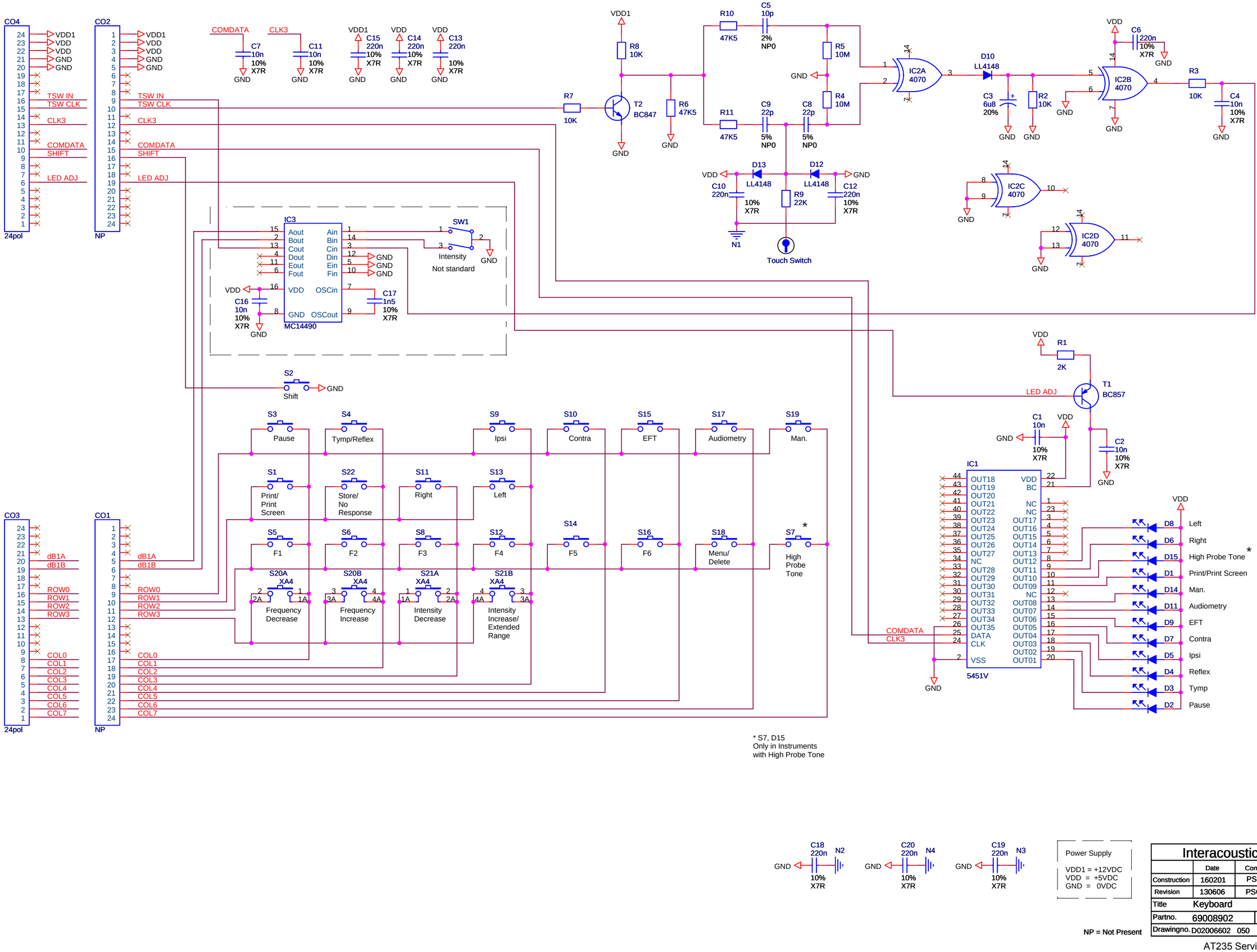


Connector No.	Function	
CN1	Thermo head	
CN3	Power	
	Pin	
	1	+24V
	2	GND
	3	GND
	4	+5V
CN5	Detector	
CN6	Motor	
CN8	Parallel Port/Centronics	
Jumper J1-J7	Keyboard and LED's Place a jumper on J3 to enable restore fonts	



	Date	Constr.	Appr.	
Constr.	160800	SJ	HBJ	Sheet
Revision	180107	PSC	OG	1 of 1
Title	Blockdiagram 050/051			
	Partno. -			
	Drawingno. D02018501			

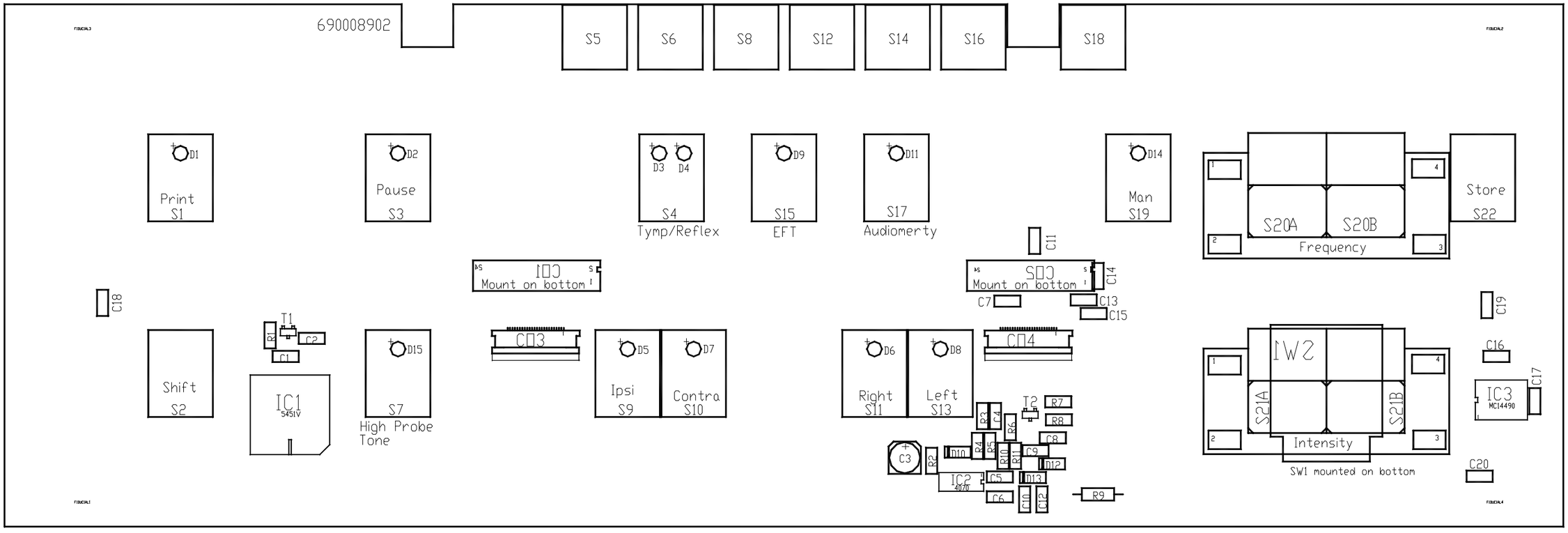
NP = Not Present



Interacoustics A/S			
	Date	Constr.	Approved
Construction	160201	PSC	HBJ
Revision	130606	PSC	OG
Title	Keyboard		
Partno.	69008902	Sheet 1 of 1	
Drawingno.	D02006602 050		

Components Index and Values

Notice: CO1 and CO2 are sited on the rear side of the PCB
S7 High Probe Tone switch is only present on the AT232h

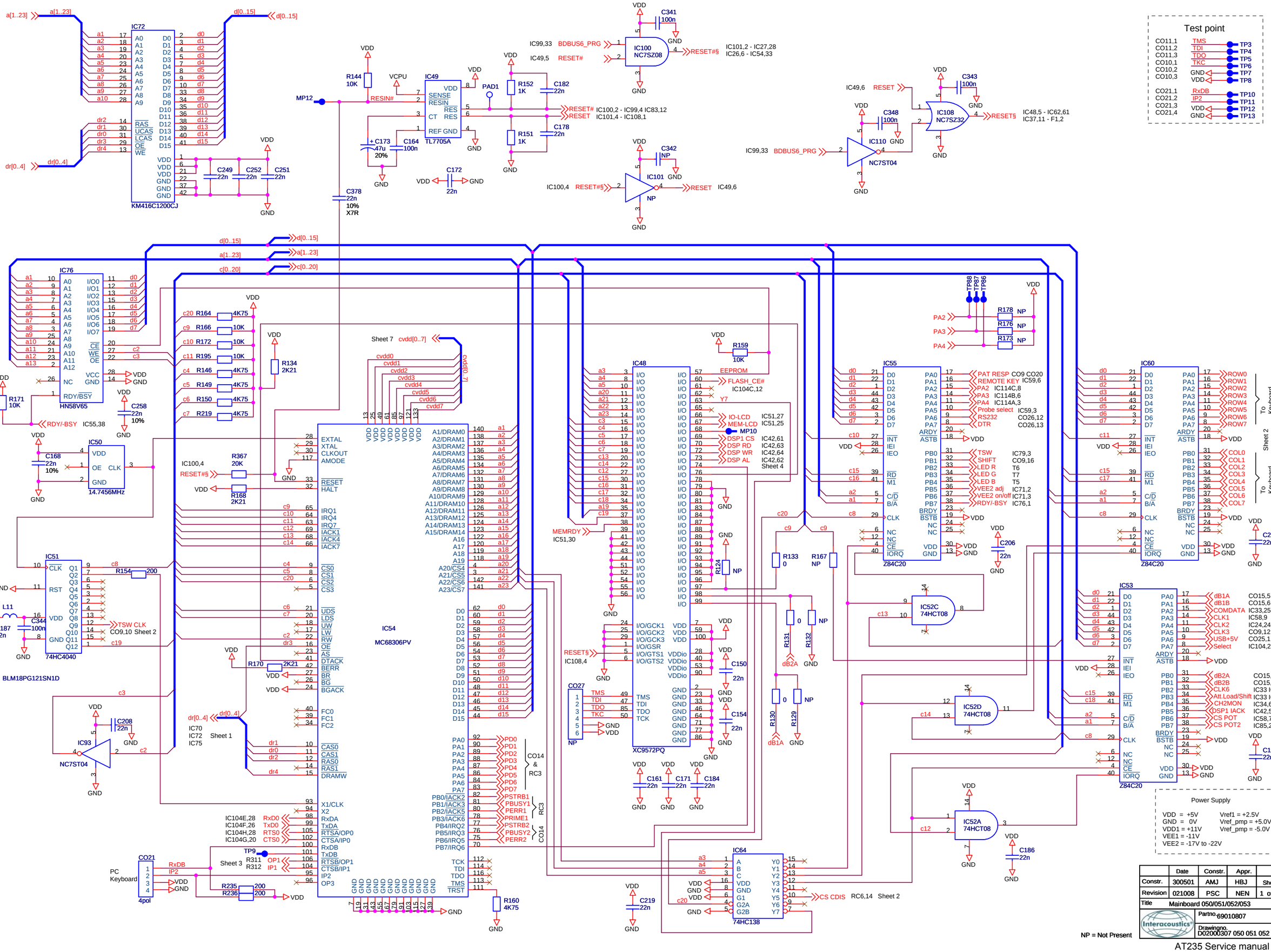


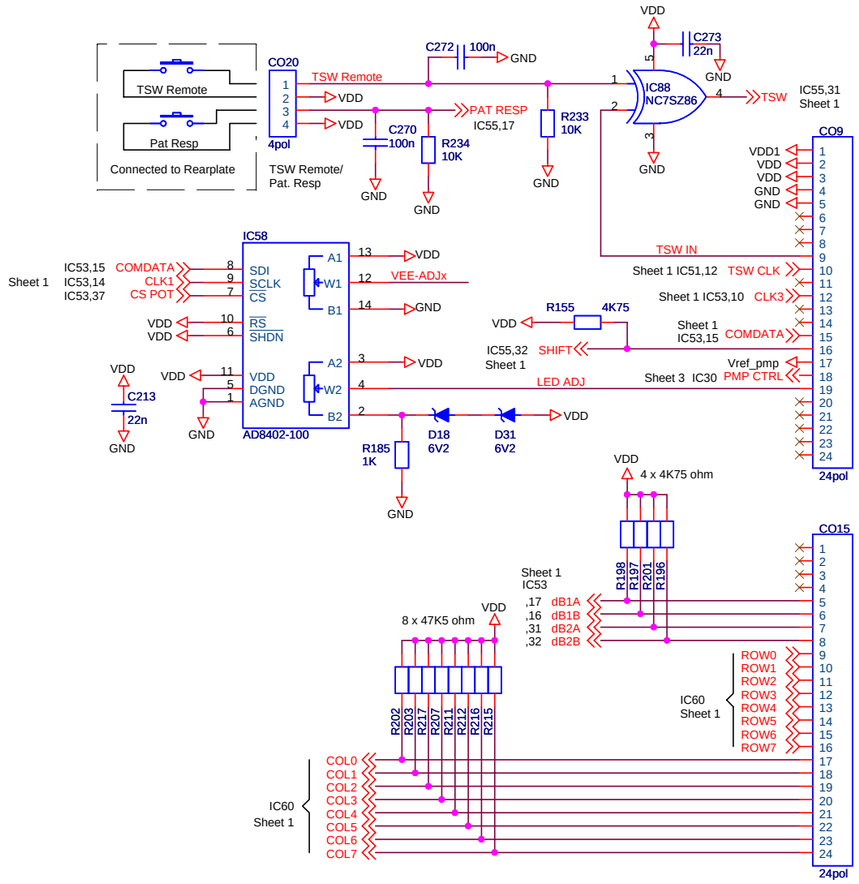
Interacoustics A/S			
	Date	Constr.	Approved
Construction	230498	AMJ	HBJ
Revision	130706	AMJ	DG
Title	Keyboard 050/051		
Partno.	69008902		Sheet 1 of 1
Drawingno.	D01007302		

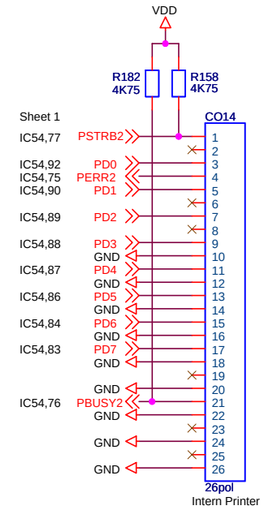
Keyboard Part List

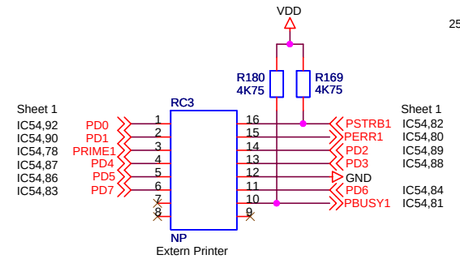
PCB 69008902 Assembled Board PCA 51003302

Quantity	Part Reference	Part Number	Value	Tolerance
6	C1 C2 C4 C7 C11 C16	61410001	10n	10%
1	C17	61419601	1n5	10%
1	C3	61002701	6u8	20%
1	C5	61400801	10p	2%
9	C6 C10 C12 C13 C14 C15 C18 C19 C20	61408701	220n	10%
2	C8 C9	61400401	22p	5%
2	CO3 CO4	65002901	24pol	
11	D1 D2 D3 D4 D5 D6 D7 D8 D9 D11 D14	71700101	LED	
3	D10 D12 D13	61700201	LL4148	
1	IC1	62010601	5451V	
1	IC2	62000301	4070	
1	IC3	62002301	MC14490	
1	R1	60211601	2K	1%
4	R2 R3 R7 R8	60210001	10K	1%
2	R4 R5	60205101	10M	1%
3	R6 R10 R11	60222901	47K5	1%
1	R9	70100101	22K	5%
12	S1 S2 S3 S4 S9 S10 S11 S13 S15 S17 S19 S22	36302001	SW PUSHBUTTON	
7	S1 S3 S9 S10 S15 S17 S19	36307101	tast_1	
1	S11	36307501	tast_1	
1	S13	36307401	tast_1	
1	S2	36309201	tast_0	
4	S20 S21	35400101	nut	
8	S20 S21	35500201	pertinaxskive	
3	S20 S21 S24	51000301	XA4	
1	S22	36309301	tast_0	
1	S4	36307201	tast_2	
7	S5 S6 S8 S12 S14 S16 S18	33502401	carbon Switch	
14	S5 S6 S8 S12 S14 S16 S18	35303601	screw	
7	S5 S6 S8 S12 S14 S16 S18	36302901	xmkn0008	
1	T1	64600101	BC857	
1	T2	64600401	BC847	


IC72
KM416C1200CJ
IC49
TL7705A
IC100
NC7SZ08
IC101
NC7ST04
IC108
NC7SZ32
IC110
NC7ST04
IC76
HN58V65
IC48
XC9572PQ
IC55
Z84C20
IC60
Z84C20
IC53
Z84C20
IC50
14.7456MHz
IC51
74HC4040
IC54
MC68306PV
IC64
74HC138
IC52C
74HCT08
IC52D
74HCT08
IC52A
74HCT08
IC93
NC7ST04
CO21
4pol
CO27
Test point
Power Supply
VDD = +5V
GND = 0V
VDD1 = +11V
VEE1 = -11V
VEE2 = -17V to -22V
Vref1 = +2.5V
Vref_pmp = +5.0V
Vref_pmp = -5.0V
NP = Not Present
L11: BLM18PG121SN1D
Interacoustics
Partno. 69010807
Drawingno. D02000307 050 051 052
Date 300501 AMJ HBJ Sheet
Constr. 021008 PSC NEN 1 of 7
Title Mainboard 050/051/052/053
AT235 Service manual page 31



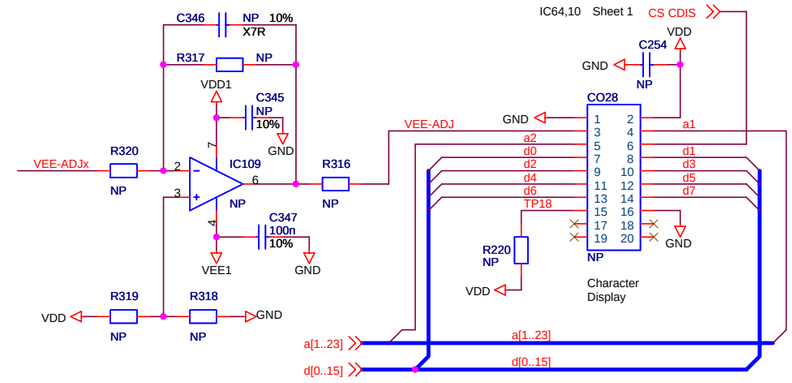




25 pin Sub-D Connector

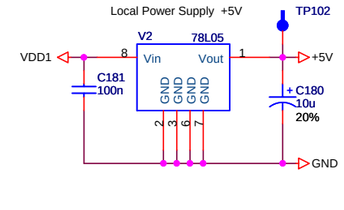
Strobe	1		
Data0	2	14	Auto Feed XT
Data1	3	15	Error
Data2	4	16	Init
Data3	5	17	Select in
Data4	6	19-25	GND
Data5	7		
Data6	8		
Data7	9		
Ack	10		
Busy	11		
Paper End	12		
Select	13		

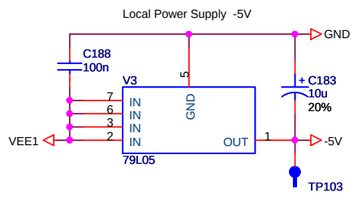
(25) (VDD ISO)

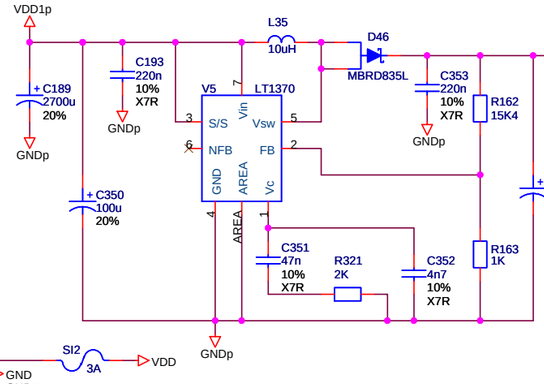


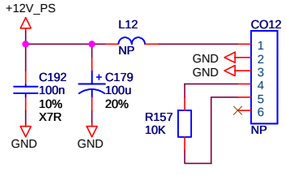
Test point

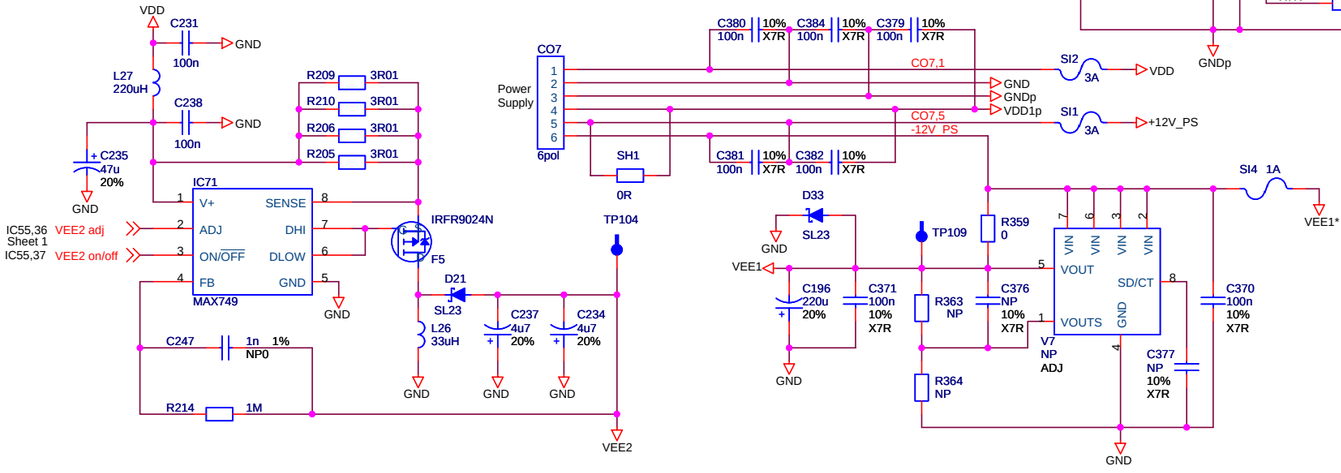
CO20,1 CO20,2	TSW Remote VDD	TP14 TP15
CO20,3 CO20,4	PAT RESP VDD	TP16 TP17
CO28,15 CO28,16	TP18 GND	TP18 TP19
CO7,1 CO7,2 CO7,3 CO7,4	CO7,1 GND GNDp VDD1p	TP20 TP21 TP22 TP23
CO7,5 CO7,6	CO7,5 -12V_PS	TP24 TP25

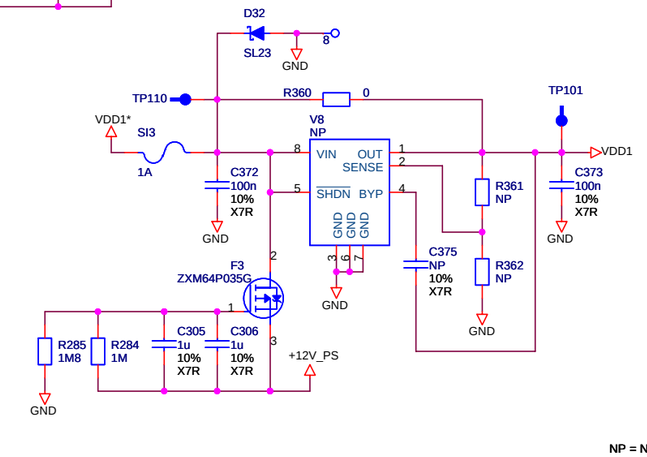












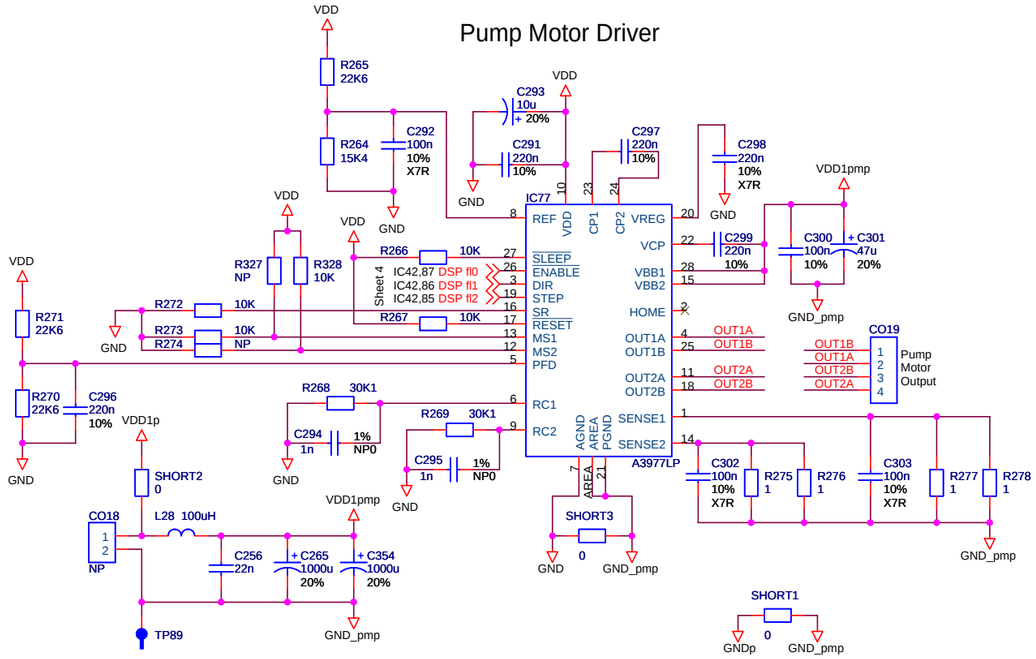
Power Supply

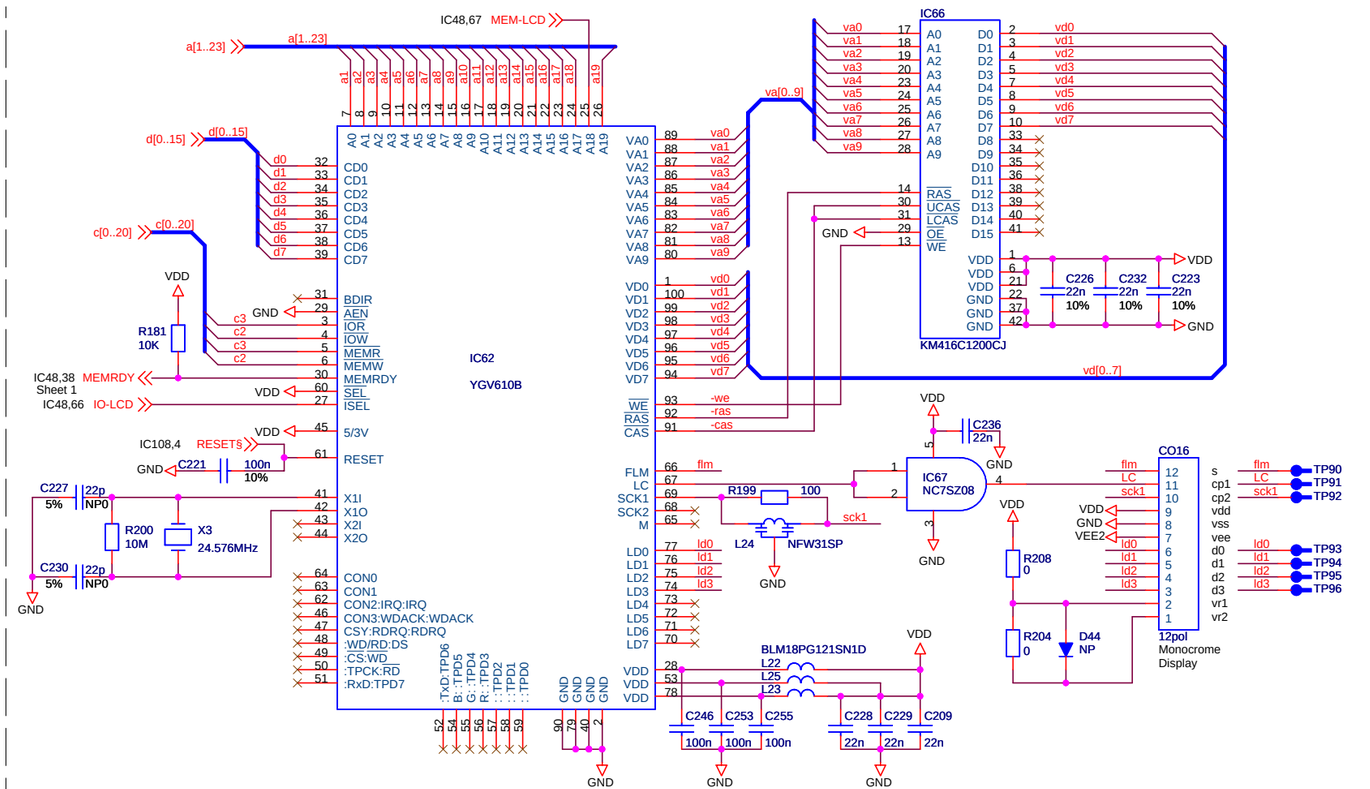
VDD = +5V
GND = 0V
VDD1 = +11V
VEE1 = -11V
VEE2 = -17V to -22V
Vref1 = +2.5V
Vref_pmp = +5.0V
Vref_pmp = -5.0V

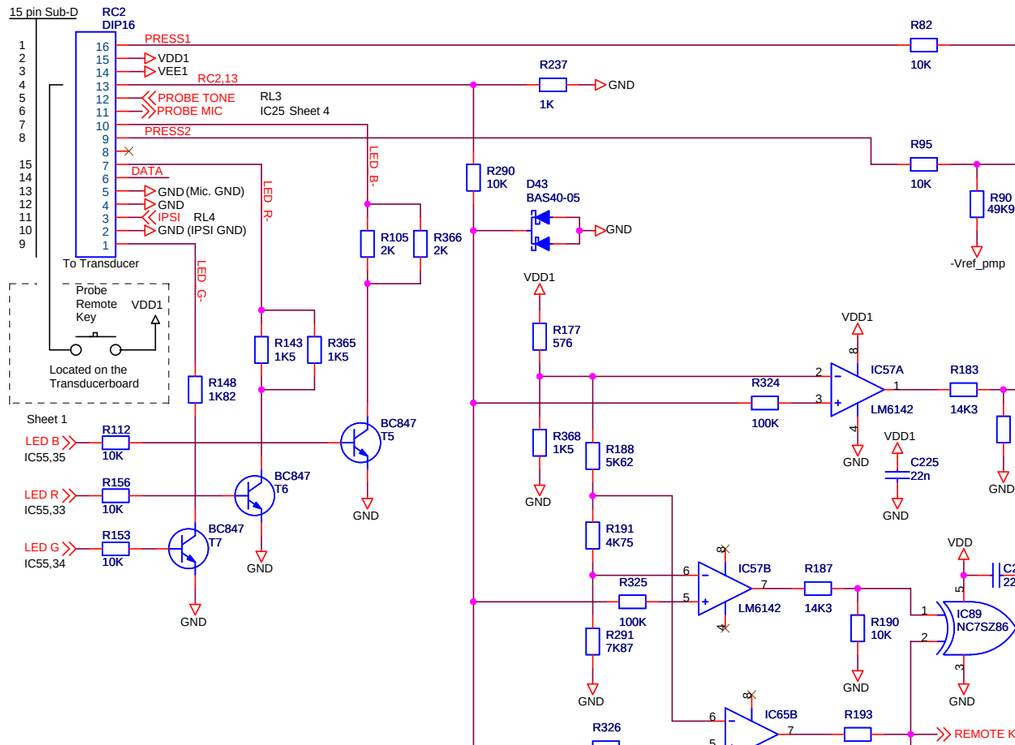
	Date	Constr.	Appr.	
Constr.	300501	AMJ	HBJ	Sheet
Revision	021008	PSC	OG	2 of 7
Title	Mainboard 050/051/052/053			
Interacoustics	Partno. 69010807			
	Drawingno. D02000307 050 051 052			

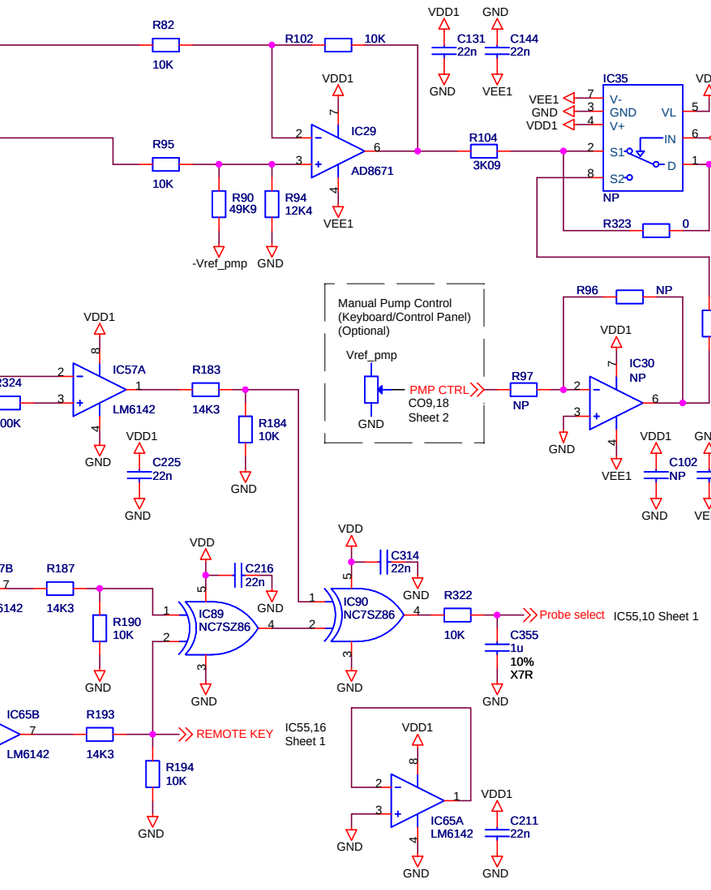
NP = Not Present

Pump Motor Driver









Pressure ADC

Test point

L28,2	VDD1pmp TP26
CO19,1	OUT1B TP27
CO19,2	OUT1A TP28
CO19,3	OUT2B TP29
CO19,4	OUT2A TP30
RC2,16	PRESS1 TP31
RC2,15	VDD1 TP32
RC2,14	VEE1 TP33
RC2,13	RC2,13 TP34
RC2,12	PROBE TONE TP35
RC2,11	PROBE MIC TP36
RC2,10	LED_B- TP37
RC2,9	PRESS2 TP38
RC2,8	PA4 TP39
RC2,7	LED_R- TP40
RC2,6	DATA TP41
RC2,5	GND TP42
RC2,4	GND TP43
RC2,3	IPSI TP44
RC2,2	GND TP45
RC2,1	LED_G- TP46

Power Supply

VDD = +5V
GND = 0V
VDD1 = +11V
VEE1 = -11V
VEE2 = -17V to -22V
Vref1 = +2.5V
Vref_pmp = +5.0V
Vref_pmp = -5.0V

NP = Not Present

	Date	Constr.	Appr.	
Constr.	300501	AMJ	HBJ	Sheet
Revision	021008	PSC	OG	3 of 7
Title	Mainboard 050/051/052/053			
Interacoustics	Partno. 69010807			
	Drawingno. D020000307 050 051 052			

Digital Signal Processor

IC42 ADSP-2186

XTAL, CLKIN, CLKOUT, RESET, BR, BG, BGH, IOMS, BMS, DMS, CMS, PMS, WR, RD, IRQ2+PF7, IRQL1+PF6, IRQL0+PF5, IRQE+PF4, PF3, PF2[MODE C], PF1[MODE B], PF0[MODE A], PWD, PWDACK

IC100,4 RESET#§ — Sheet 3

IC41,8 DSP pf7 — IC41,7 DSP pf6 — IC35,6 DSP pf5

d[0..15] — IC48,72 DSP WR — IC48,70 DSP RD — IC48,73 DSP AL — IC48,69 DSP1 CS — IC53,36 DSP1 IACK — Sheet 1

FL0 DSP fl0 IC78,11 — FL1 DSP fl1 IC78,6 Sheet 3 — FL2 DSP fl2 IC78,7

TFS1, RFS1, SCLK1, DR1, DT1 — IC41,5 DSP dr1 — DSP RFS1 IC52,4 — DSP SCLK1 IC52,5 Sheet 3

TFS0, RFS0, SCLK0, DR0, DT0

dsp vdd[1..6] — dsp vdd[1..6] Sheet 7

Test point

CO1,1 CO1,2 CO1,3 — TP47 TP48 TP49

CO6,1 CO6,2 CO6,3 — TP50 TP51 TP52

CO2,1 CO2,2 CO2,3 — TP53 TP54 TP55

CO8,1 CO8,2 CO8,3 — TP56 TP57 TP58

CO3,1 CO3,2 CO3,3 — TP59 TP60 TP61

CO4,1 CO4,2 — TP62 TP63

Stereo CODEC

IC27 PCM3001

VinL, Cin+L, Cin-L, VrefL, VrefR, Cin+R, Cin-R, VinR, LRCIN, BCKIN, DIN, DOUT, RSTB, FMT0, FMT1, FMT2, CLKIO, XTI, XTO, VoutL, VCOM, VoutR, VDD, DGND, VccADC, GNDADC, VccDAC, GNDDAC

IC108,4 RESET§ — IC100,4 RESET#§

VoutL → CH1 OUT IC9 — VCOM → Vref_source IC22,3 Sheet 5 — VoutR → CH2 OUT IC17

Power Supply

VDD = +5V
GND = 0V
VDD1 = +11V
VEE1 = -11V
VEE2 = -17V to -22V
Vref1 = +2.5V
Vref_pmp = +5.0V
Vref_pmp = -5.0V

Local Power Supply, +5V

Attenuator Control DAC

IC26 AD7249

REFOUT, REFIN, SCLK, SDIN, SYNC, CLR, LDAC, BIN/COMP, VDD, DGND, VEE, ROFSA, ROFSB, VOUTA, VOUTB, AGND

IC22,5 Vref_dac — IC100,4 RESET#§ — ATTDC1 IC7 — ATTDC2 IC23

Input Amplifiers / Buffers

Tape/CD1 — Tape/CD2 — TB/Mic2 — Probe Mic

PROBE MIC — RC2,11 Sheet 3

Sheet 5 MP2 CH1 LPF Out — Sheet 5 MP5 CH2 LPF Out — CH2MON IC53,35 Sheet 1

IC24.30 ATT3.0 — IC24.31 ATT3.1 — IC24.37 ATT3.2

IC24.27 ATT4.0 — IC24.28 ATT4.1 — IC24.29 ATT4.2 — Sheet 6

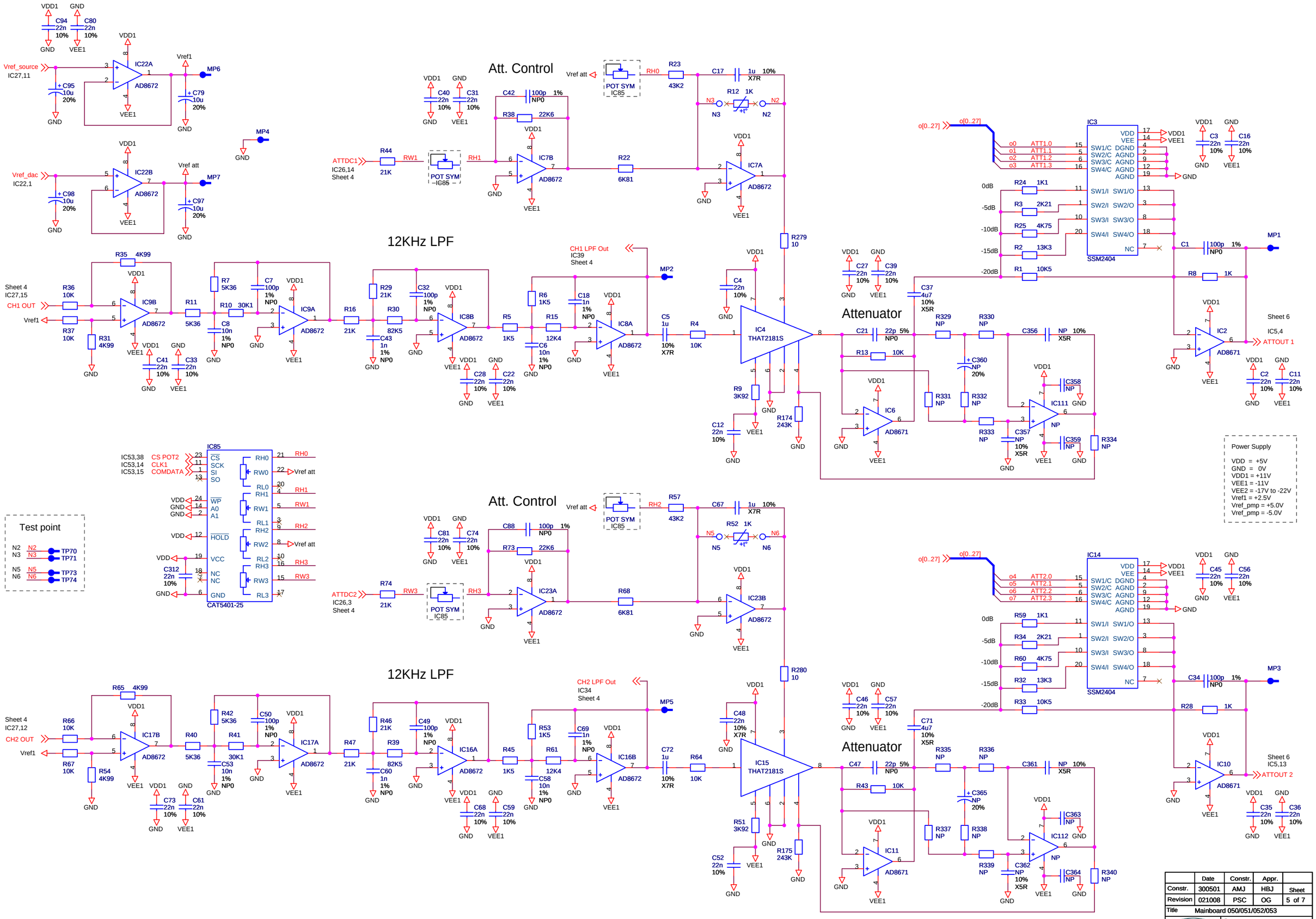
Input Mixer

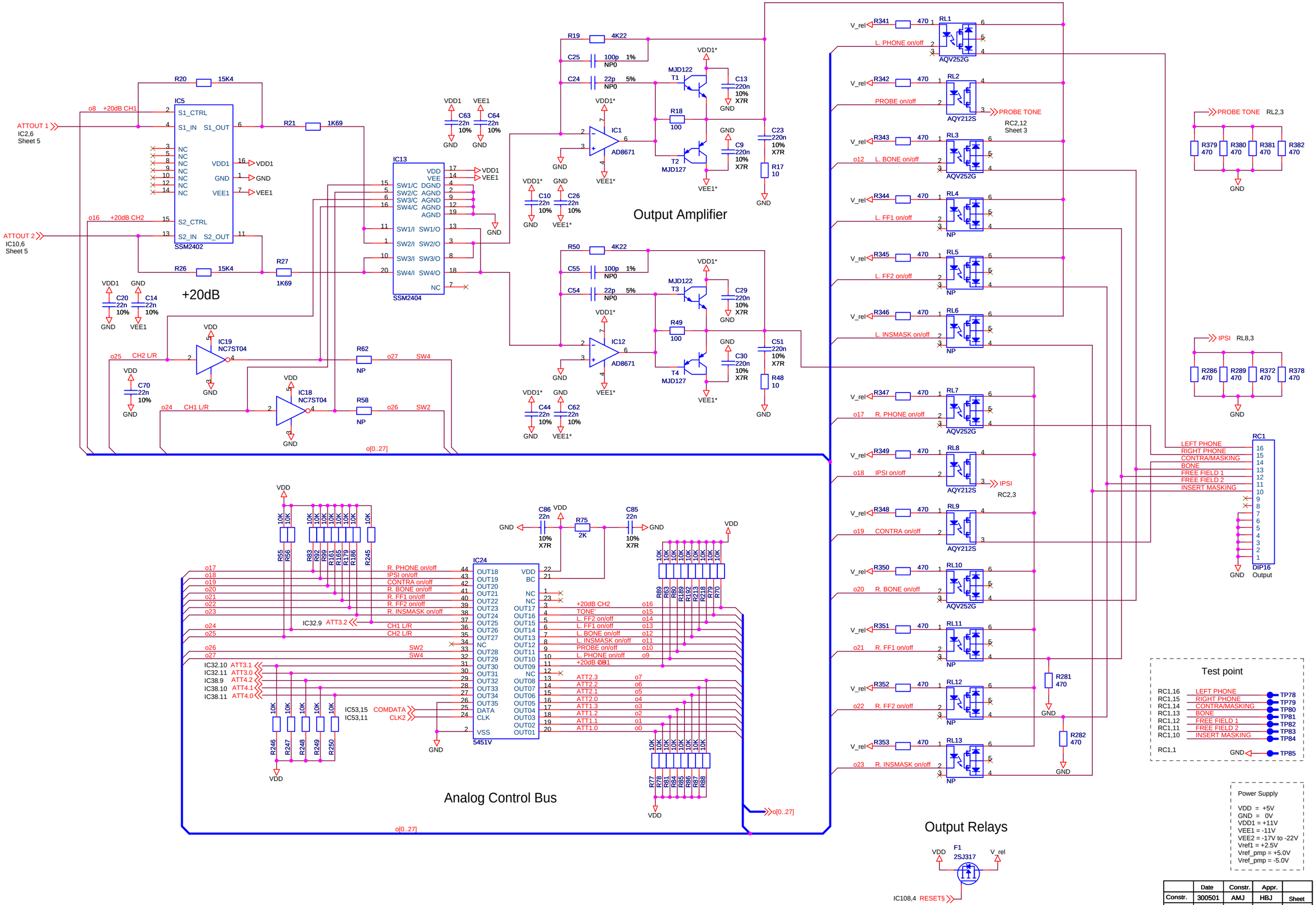
IC53,33 CLK6 Att.Load/Shift IC53,34 — IC53,33 CLK6 Att.Load/Shift IC53,34 Sheet 1 — COMDATA IC53,15

Monitor

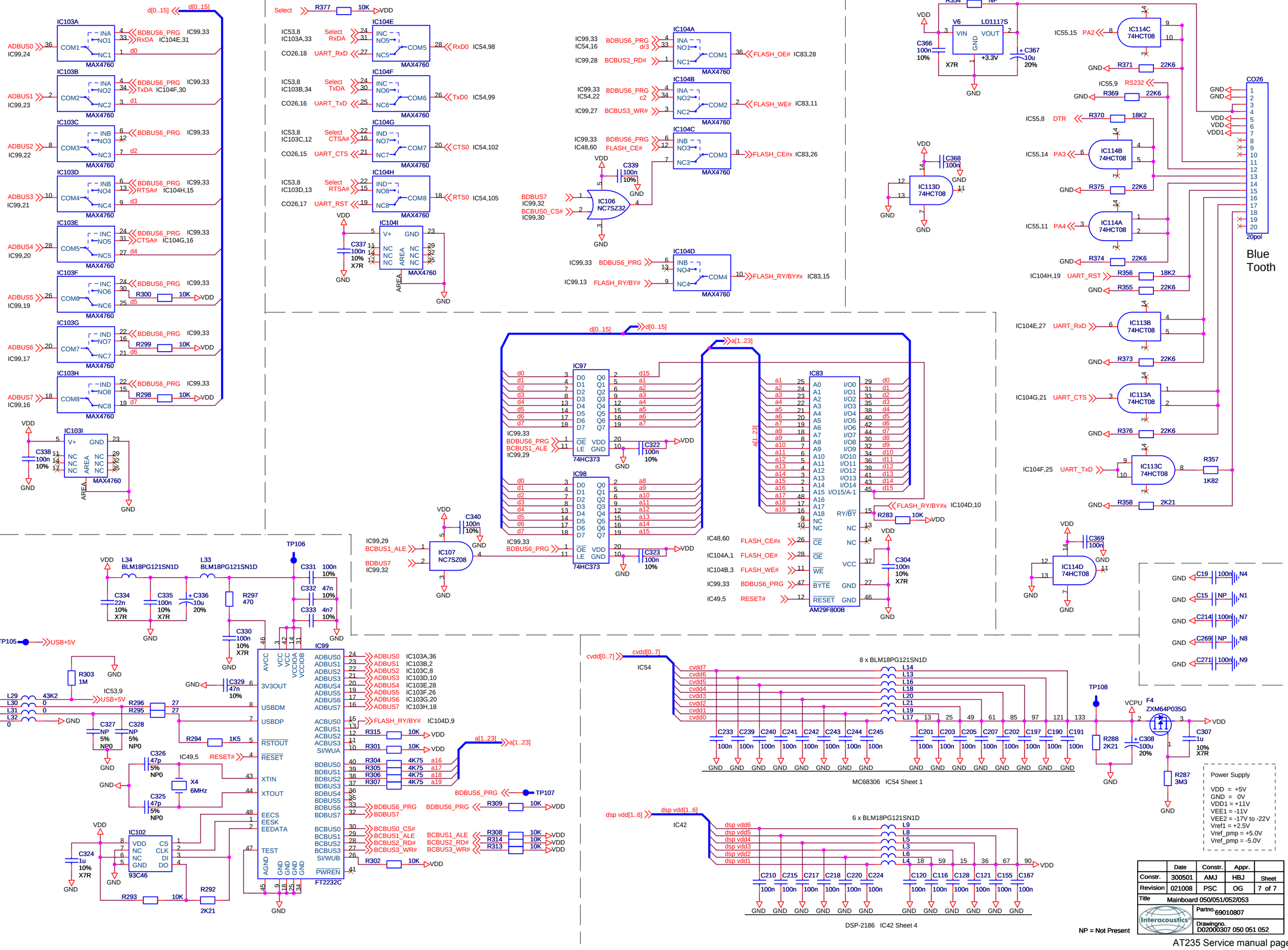
NP = Not Present

	Date	Constr.	Appr.	
Constr.	300501	AMJ	HBJ	Sheet
Revision	021008	PSC	OG	4 of 7
Title	Mainboard 050/051/052/053			
Interacoustics	Partno. 69010807			
	Drawingno. D02000307 050 051 052			

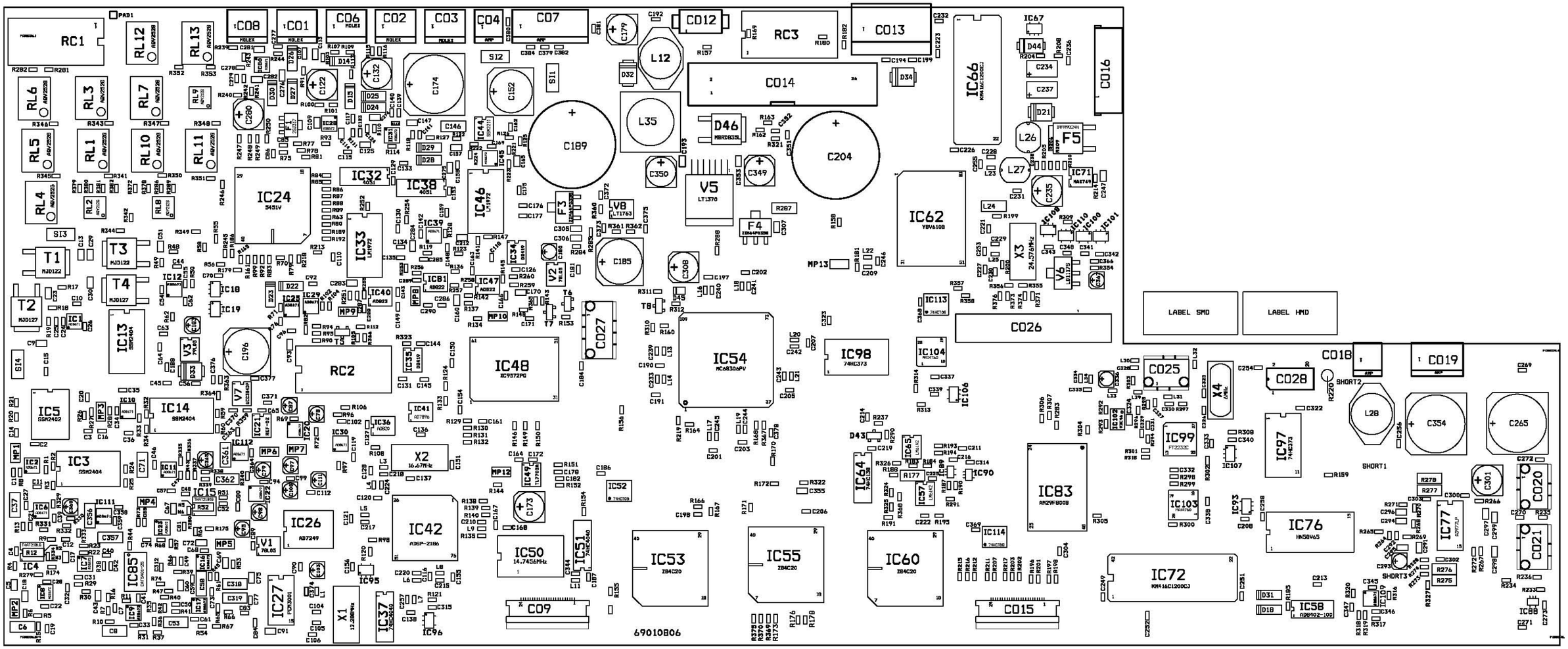

Att. Control
12KHz LPF
Attenuator
IC85
CAT5401-25
IC22A
IC22B
IC9B
IC17B
IC9A
IC17A
IC8B
IC16A
IC8A
IC16B
IC7B
IC23A
IC7A
IC23B
IC4
THAT2181S
IC15
THAT2181S
IC3
SSM2404
IC14
SSM2404
IC6
IC11
IC111
IC112
IC2
IC10
AD8672
AD8671
Power Supply
VDD = +5V
GND = 0V
VDD1 = +11V
VEE1 = -11V
VEE2 = -17V to -22V
Vref1 = +2.5V
Vref_pmp = +5.0V
Vref_pmp = -5.0V
Test point
NP = Not Present
Interacoustics
Partno. 69010807
Drawingno. D02000307 050 051 052
Date 300501 AMJ HBJ
Constr. 021008 PSC OG
Revision
Sheet 5 of 7
Title Mainboard 050/051/052/053



	Date	Constr.	Appr.	
Constr.	300501	AMJ	HBJ	Sheet
Revision	021008	PSC	OG	6 of 7
Title	Mainboard 050/051/052/053			
Interacoustics	Partno. 69010807			
	Drawingno. D02000307 050 051 052			


IC103A
IC103B
IC103C
IC103D
IC103E
IC103F
IC103G
IC103H
IC103I
MAX4760
ADBUS0
ADBUS1
ADBUS2
ADBUS3
ADBUS4
ADBUS5
ADBUS6
ADBUS7
BDBUS6_PRG
RxDA
TxDA
RTSA#
CTSA#
R300
R299
R298
10K
VDD
d[0..15]
IC104E
IC104F
IC104G
IC104H
IC104I
Select
R377
RxD0
TxD0
CTS0
RTS0
UART_RxD
UART_TxD
UART_CTS
UART_RST
C337
C338
IC104A
IC104B
IC104C
IC104D
IC106
NC7SZ32
FLASH_OE#
FLASH_WE#
FLASH_CE#x
FLASH_RY/BY#x
BDBUS7
BCBUS0_CS#
C339
IC97
IC98
74HC373
IC107
NC7SZ08
C322
C323
C340
a[1..23]
IC83
AM29F800B
FLASH_RY/BY#
R283
C304
IC48,60
IC104A,1
IC104B,3
IC49,5
RESET#
IC113D
74HCT08
C368
IC55,15
IC55,9
IC55,8
IC55,14
IC55,11
IC104H,19
IC104E,27
IC104G,21
IC104F,25
PA2
PA3
PA4
RS232
DTR
IC114C
IC114B
IC114A
IC113B
IC113A
IC113C
R371
R369
R370
R375
R374
R356
R355
R373
R376
R358
22K6
18K2
2K21
CO26
20pol
Blue Tooth
R354
NP
V6
LD1117S
VIN
VOUT
+3.3V
C366
C367
TP106
L34
BLM18PG121SN1D
L33
BLM18PG121SN1D
C331
C332
C333
C334
C335
C336
R297
470
C330
IC99
TP105
USB+5V
CO25
4pol
R303
1M
IC53,9
R296
R295
C327
C328
C326
C325
X4
6MHz
R294
1K5
IC102
93C46
C324
R293
R292
2K21
C329
3V3OUT
USBDM
USBDP
RSTOUT
RESET
XTIN
XTOUT
EECS
EESK
EEDATA
TEST
PWREN
FT2232C
ACBUS0
ACBUS1
ACBUS2
ACBUS3
SI/WUA
BDBUS0
BDBUS1
BDBUS2
BDBUS3
BDBUS4
BDBUS5
BDBUS6
BDBUS7
SI/WUB
BCBUS0
BCBUS1
BCBUS2
BCBUS3
R315
R301
R304
R305
R306
R307
4K75
R309
R308
R314
R313
R302
TP107
IC54
cvdd[0..7]
8 x BLM18PG121SN1D
MC68306 IC54 Sheet 1
TP108
VCPU
F4
ZXM64P035G
C307
1u
R288
2K21
C308
100u
R287
3M3
Power Supply
VDD = +5V
GND = 0V
VDD1 = +11V
VEE1 = -11V
VEE2 = -17V to -22V
Vref1 = +2.5V
Vref_pmp = +5.0V
Vref_pmp = -5.0V
IC42
dsp vdd[1..6]
6 x BLM18PG121SN1D
DSP-2186 IC42 Sheet 4
C369
IC114D
74HCT08
C19
C15
C214
C269
C271
N4
N1
N7
N8
N9
NP = Not Present
Date
Constr.
Appr.
Sheet
300501
AMJ
HBJ
Revision
021008
PSC
OG
7 of 7
Title
Mainboard 050/051/052/053
Interacoustics
Partno. 69010807
Drawingno. D02000307 050 051 052

Components Index



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Constr.	310398	AMJ	HBJ	Sheet
Revision	021008	AMJ	06	1 of 1
Title	Mainboard 050/051/052/053			
Interacoustics	Partno.	69010807		
	Drawingno.	D01000205		

Main board Part List

PCB 69010807 Assembled Board PCA 51007410

PCS	Part ref.	Part No.	Desciption	Description 2
17	C1 C7 C25 C32 C34 C42 C49 C50 C55 C84 C88 C106 C117 C124 C140 C141 C288	61400201	100p 1% 50V 0603	Capacitor ceramic NP0
92	C2 C3 C4 C10 C11 C12 C14 C16 C20 C22 C26 C27 C28 C31 C33 C35 C36 C39 C40 C41 C44 C45 C46 C48 C52 C56 C57 C59 C61 C62 C63 C64 C65 C68 C70 C73 C74 C80 C81 C85 C86 C92 C94 C96 C127 C131 C136 C143 C144 C150 C154 C156 C161 C163 C166 C168 C171 C172 C178 C182 C184 C186 C187 C194 C198 C199 C206 C208 C209 C211 C213 C216 C219 C222 C223 C225 C226 C228 C229 C232 C236 C249 C251 C252 C256 C258 C273 C312 C314 C315 C334 C378	61400101	22n 10% 25V 0603	Capacitor ceramic X7R
12	C5 C17 C67 C72 C160 C170 C274 C305 C306 C307 C324 C355	61401601	1u 10% 16V 0805	Capacitor ceramic X7R
4	C6 C8 C53 C58	61401701	10n 1% 25V 1206	Capacitor ceramic NP0
18	C9 C13 C23 C29 C30 C51 C75 C91 C93 C125 C147 C193 C291 C296 C297 C298 C299 C353	61414301	220n 10% 25V 0805	Capacitor ceramic X7R
7	C18 C43 C60 C69 C247 C294 C295	61401801	1n 1% 50V 0805	Capacitor ceramic NP0
83	C19 C89 C90 C99 C112 C116 C120 C121 C123 C128 C138 C139 C155 C164 C167 C181 C188 C190 C191 C192 C197 C201 C202 C203 C205 C207 C210 C214 C215 C217 C218 C220 C221 C224 C231 C233 C238 C239 C240 C241 C242 C243 C244 C245 C246 C253 C255 C257 C270 C271 C272 C292 C300 C302 C303 C304 C322 C323 C330 C331 C335 C337 C338 C339 C340 C341 C343 C344 C347 C348 C366 C368 C369 C370 C371 C372 C373 C374 C379 C380 C381 C382 C384	61401102	100n 10% 16V 0603	Capacitor ceramic X7R
10	C21 C24 C47 C54 C104 C105 C137 C151 C227 C230	61400501	22p 5% 50V 0603	Capacitor ceramic NP0
4	C37 C71 C318 C319	61413001	4u7 10% 16V 1206	Capacitor ceramic X5R
2	C77 C83	61401501	470p 5% 50V 0603	Capacitor ceramic C0G
14	C78 C79 C87 C95 C97 C98 C100 C103 C111 C180 C183 C293 C336 C367	61003301	10u 20% 16V Ø3x5.5	Capacitor lyt Standard 105ºC
5	C122 C132 C173 C235 C301	61004101	47u 20% 16V Ø6.3x5.2	Capacitor lyt Low Impedance
1	C152.	61004301	1000u 20% 10V Ø10.0x10.0	Capacitor lyt Standard 85ºC
1	C174.	61004001	2200u 20% 6.3V Ø12.5X13.5	Capacitor lyt Low Impedance
4	C179 C308 C349 C350	61003101	100u 20% 35V Ø6.3x8	Capacitor lyt Standard 85ºC
2	C185 C196	61003201	220u 20% 16V Ø10x10	Capacitor lyt Standard 105ºC

PCS	Part ref.	Part No.	Desciption	Description 2
2	C234 C237	61202001	4u7 20% 25V Package C	Capacitor tantal
2	C265 C354	61004201	1000u 20% 16V Ø12.5x13.5	Capacitor lyt Low Impedance
2	C325 C326	61407901	47p 5% 50V 0603	Capacitor ceramic NP0
3	C329 C332 C351	61415201	47n 10% 16V 0603	Capacitor ceramic X7R
2	C333 C352	61415001	4n7 5%/10% 50V 0603	Capacitor ceramic X7R
2	CO9 CO15	65002901	24Pol FFC/FPC Conn. SMT PCB	Right angle 0.5mm Bottom Cont.
1	CO16.	65000501	12Pol FFC/FPC Conn. SMT PCB	Right angle 1.0mm Top Cont.
3	CO20 CO21 CO25	65006001	4Pol Picoflex Male SMT PCB	Conn. 1.27mm REEL/CAP MOLEX
1	CO26.	65000101	20Pol SEI-Connector	Conn. SMD 1mm SAMTEC onTape
4	D14 D15 D18 D31	61700501	6.2V 0.5W Minimelf	Zener diode Philips
3	D21 D32 D33	61700301	SL23 30V 2.0A DO214AA	Schottky diode Vishay
6	D22 D23 D24 D25 D28 D29	61700601	3.3V 0.5W Minimelf	Zener diode Vishay
1	D34.	61705501	SMBJ5.0A 5V DO214AA	TransZorb diode 600W Vishay
1	D43.	61704301	BAS40-05 40V 120mA SOT23	Schottky diode Catode/Catode
1	D46.	61711501	MBRD835LG 35V 8A TO252AA	Schottky diode Motorola
1	F1.	64602901	2SJ317 MOSFET P-Ch. SOT89	Transistor -12V 0.4R RENESAS
2	F3 F4	64601001	ZXM64P035G MOSFET P-Ch. SOT223	Transistor -40V 0.060R ZETEX
1	F5.	64608501	IRFR9024N MOSFETT P-Ch. TO252	Transistor -55V 0.175R IRF
8	IC1 IC2 IC6 IC10 IC11 IC12 IC25 IC29	62034901	AD8671ARMZ-REEL MSOP8	IC Op-Amp. Analog Devices
2	IC103 IC104	62047001	MAX4760ETX QFN36	IC Quad DPDT Switches MAXIM
3	IC113 IC114 IC52	62049801	74HCT08PW TSSOP14	IC AND-Gate PHILIPS
9	IC16 IC17 IC20 IC22 IC23 IC31 IC7 IC8 IC9	62035001	AD8672ARMZ-REEL MSOP8	IC Op-Amp. Dual Analog Devices
3	IC3 IC13 IC14	62001201	SSM2404S SO20	IC Audio Switch AD
2	IC4 IC15	62001101	THAT2181SB SO8 reel	IC Voltage Controlled Amp.
1	IC5.	62002101	SSM2402S SOL16	IC Audio Switch AD
6	IC18 IC19 IC93 IC95 IC96 IC110	62004601	NC7ST04M5X SOT23-5	IC Single HST Inverter Fair.
1	IC21.	62007001	REF02CS SO8	IC Ref./Temp. Transducer
1	IC24.	62010601	MM5451YV PLCC44	IC LED Display Driver Micrel
1	IC26.	62001001	AD7249ARZ SOL16	IC D/A Converter AD
1	IC27.	62000801	PCM3001E SSOP28	IC CODEC Burr Brown
1	IC36.	62006401	AD820AR SO8	IC Op-Amp. Analog Devices
2	IC37 IC51	62000901	MM74HC4040M SO16	IC Binary Ripple counter Fairc

PCS	Part ref.	Part No.	Desciption	Description 2
1	IC41.	62007901	AD7896AR SO8	IC A/D Converter
1	IC42.	62009801	ADSP-2186KST-133 QFP100	IC DSP Microcomputers AD
1	IC47.	62018001	AD822AR SO8	IC RailToRail FET Op-Amp. Dual
1	IC48.	62011401	XC9572-15PQ100C QFP100	IC Programmable CPLD Xilinx
1	IC49.	62001401	TL7705ACD1/A SO8	IC Suplly Voltage Supervisor
1	IC50.	63201701	14.7456MHz SG-615P 14.0x9.8mm	Crystal Oscillator 5V EPSON
3	IC53 IC55 IC60	62010101	Z84C2008VEG PLCC44	IC Z80 PIO Zilog
1	IC54.	62010201	MC68306AG16B TQFP144	IC CPU Motorola
2	IC57 IC65	62002401	LM6142BIM SO8	IC Dual OP-Amp. National
1	IC58.	62008701	AD8402AR100 SO14	IC Digital Potentiometers AD
1	IC62.	62011001	YGV610B QFP100	IC CPD Controller Yamaha
1	IC64.	62001701	74HC138D SO16	IC Line Decoder/Demultiplexer
2	IC66 IC72	62008901	K4F151611D-JC60 SOJ-42P	IC 1Mx16Bit DRAM 60nS +5V Sam.
3	IC67 IC100 IC107	62004801	NC7SZ08M5 SOT23-5	IC Single UHS AND-Gate
1	IC71.	62007201	MAX749CSA SO8	IC LCD Bias Supply MAXIM
1	IC76.	62011801	HN58V65AFP-10 FD28D	IC EEPROM
1	IC77.	62035801	A3977SLP-T TSSOP28	IC Microstepping Driver
1	IC83.	62048201	AM29F800BT-55ED TSOP48	IC 5Volt Flash Memory AMD
1	IC85.	62045201	CAT5401YI-25 TSSOP24	IC 4 x Dig. Program. Pot-meter
3	IC88 IC89 IC90	62045301	NC7SZ86P5X SC70/5	IC Sing. UHS Exclusive-OR-Gate
2	IC97 IC98	62014201	74HC373D SO20	IC Transparent Latch PHILIPS
1	IC99.	62046901	FT2232D LQFP48	IC Dual USB UART / FIFI FTDI
1	IC102.	62030101	AT93C46-10TU-2.7 TSSOP8	IC EEprom 2.7V - 5.5V ATMEL
2	IC106 IC108	62004701	NC7SZ32M5 SOT23-3	IC Single UHS OR-Gate
22	L1 L3 L4 L5 L6 L7 L8 L9 L11 L13 L14 L16 L17 L18 L19 L20 L21 L22 L23 L25 L33 L34	63704601	BLM18PG121SN1D 120R ±25 0603	Inductor 2A 0.05R MURATA
1	L24.	63800701	NFW31SP506X1E4L	Filter Chip 50Hz/200mA/25V
1	L26.	63701001	CD54-330LC 33uH 15% Ø5.8x5.2	Coil 880mA 0.23R
1	L27.	63700901	CD54-221KC 220uH 10% Ø5.8x5.2	Coil 350mA 1.57R SUMIDA

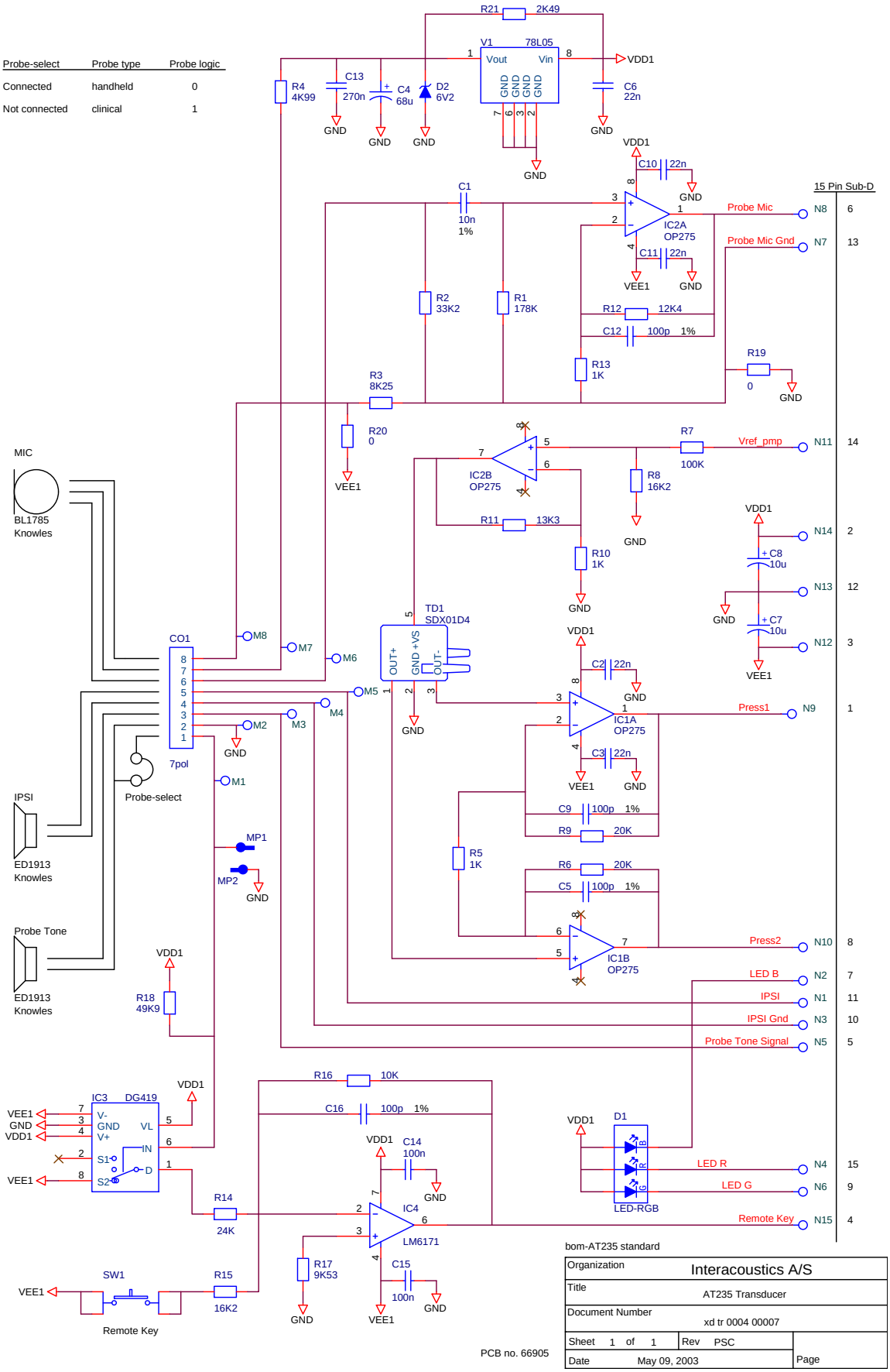
PCS	Part ref.	Part No.	Desciption	Description 2
1	L28.	63705801	IDC-5020 100uH 20% 12.95x9.4mm	Inductor 0.28R 1.3A VISHAY
1	L29.	60429301	43K2 1% 0.1W 0603	Resistor
2	R23 R57	60429301	43K2 1% 0.1W 0603	Resistor
3	L30 L31 L32	60400102	0R 0.1W 0603	Resistor
11	R109 R130 R131 R133 R204 R208 R252 R254 R323 R359 R360	60400102	0R 0.1W 0603	Resistor
1	L35.	63705701	SCBB1207-100E 10uH	Inductor 21.6R 5.40A MOTOCRAFT
12	MP1 MP2 MP3 MP4 MP5 MP6 MP7 MP8 MP9 MP10 MP12 MP13	64000101	Testpin 1206	Testpin RCSCTE KOA
2	R1 R33	60404001	10K5 1% 0.1W 0603	Resistor
2	R2 R32	60403901	13K3 1% 0.1W 0603	Resistor
9	R3 R34 R134 R168 R170 R288 R292 R310 R358	60403801	2K21 1% 0.1W 0603	Resistor
89	R4 R13 R36 R37 R43 R55 R56 R63 R64 R66 R67 R69 R70 R72 R77 R78 R79 R80 R81 R82 R83 R84 R85 R86 R87 R88 R89 R92 R95 R99 R102 R108 R112 R137 R142 R144 R145 R153 R156 R157 R159 R161 R165 R166 R171 R172 R179 R181 R184 R186 R189 R190 R192 R194 R195 R213 R218 R221 R222 R223 R224 R233 R234 R245 R246 R247 R248 R249 R250 R266 R267 R272 R273 R283 R290 R293 R298 R299 R300 R301 R302 R308 R309 R313 R314 R315 R322 R328 R377	60400201	10K 1% 0.1W 0603	Resistor
8	R5 R6 R45 R53 R143 R294 R365 R368	60401901	1K5 1% 0.1W 0603	Resistor
4	R7 R11 R40 R42	60403101	5K36 1% 0.1W 0603	Resistor
13	R8 R28 R114 R127 R136 R140 R151 R152 R163 R185 R237 R257 R259	60403601	1K 1% 0.1W 0603	Resistor
2	R9 R51	60403501	3K92 1% 0.1W 0603	Resistor
6	R10 R41 R110 R118 R268 R269	60403201	30K1 1% 0.1W 0603	Resistor
3	R15 R61 R94	60402301	12K4 1% 0.1W 0603	Resistor
6	R16 R29 R44 R46 R47 R74	60400301	21K 1% 0.1W 0603	Resistor
4	R17 R48 R279 R280	60401301	10R 1% 0.1W 0603	Resistor
3	R18 R49 R199	60401201	100R 1% 0.1W 0603	Resistor
2	R19 R50	60424301	4K22 1% 0.1W 0603	Resistor
4	R20 R26 R162 R264	60424501	15K4 1% 0.1W 0603	Resistor
2	R21 R27	60424401	1K69 1% 0.1W 0603	Resistor
2	R22 R68	60421301	6K81 1% 0.1W 0603	Resistor
2	R24 R59	60403701	1K1 1% 0.1W 0603	Resistor
24	R25 R60 R107 R115 R146 R149 R150 R155 R158 R160 R164 R169 R180 R182 R191 R196 R197 R198 R201 R219 R304 R305 R306 R307	60401101	4K75 1% 0.1W 0603	Resistor
2	R30 R39	60400401	82K5 1% 0.1W 0603	Resistor
4	R31 R35 R54 R65	60403001	4K99 1% 0.1W 0603	Resistor
12	R38 R73 R265 R270 R271 R355 R369 R371 R373 R374 R375 R376	60423401	22K6 1% 0.1W 0603	Resistor
2	R71 R367	60402001	20K 1% 0.1W 0603	Resistor
4	R75 R105 R321 R366	60400901	2K 1% 0.1W 0603	Resistor
11	R76 R111 R117 R202 R203 R207 R211 R212 R215 R216 R217	60402501	47K5 1% 0.1W 0603	Resistor

PCS	Part ref.	Part No.	Desciption	Description 2
1	R90.	60420301	49K9 1% 0.1W 0603	Resistor
4	R98 R154 R235 R236	60401801	200R 1% 0.1W 0603	Resistor
2	R103 R113	60402901	2K49 1% 0.1W 0603	Resistor
1	R104.	60424601	3K09 1% 0.1W 0603	Resistor
2	R120 R121	60425201	82R5 1% 0.1W 0603	Resistor
6	R135 R138 R139 R324 R325 R326	60401701	100K 1% 0.1W 0603	Resistor
2	R148 R357	60424901	1K82 1% 0.1W 0603	Resistor
2	R356 R370	60402401	18K2 1% 0.1W 0603	Resistor
2	R174 R175	60402701	243K 1% 0.1W 0603	Resistor
1	R177.	60229001	576R 1% 0.25W 1206	Resistor
3	R183 R187 R193	60400801	14K3 1% 0.1W 0603	Resistor
1	R188.	60421601	5K62 1% 0.1W 0603	Resistor
1	R200.	60402601	10M 1% 0.1W 0603	Resistor
4	R205 R206 R209 R210	60425801	3R01 1% 0.1W 0603	Resistor
3	R214 R284 R303	60400501	1M 1% 0.1W 0603	Resistor
2	R258 R260	60421801	2K74 1% 0.1W 0603	Resistor
4	R275 R276 R277 R278	60214401	1R 1% 0.25W 1206	Resistor 100/300ppm
24	R281 R282 R286 R289 R297 R341 R342 R343 R344 R345 R346 R347 R348 R349 R350 R351 R352 R353 R372 R378 R379 R380 R381 R382	60406101	470R 1% 0.1W 0603	Resistor
1	R285.	60418401	1M8 1% 0.1W 0603	Resistor
1	R287.	60215901	3M30 1% 0.25W 1206	Resistor
1	R291.	60421001	7K87 1% 0.1W 0603	Resistor
2	R295 R296	60405401	27R 1% 0.1W 0603	Resistor
4	RL1 RL3 RL7 RL10 RL	64500901	AQV252GAZ HE PhotoMOS	Relay PANASONIC
3	RL2 RL8 RL9	64501001	AQY212S GU PhotoMOS SOP4	Relay PANASONIC
2	SI1 SI2	63600401	3A 125V Subminiature R452	Fuse SLO-BLO Littelfuse
2	SI3 SI4	63600801	1A 125V Subminiature R452	Fuse SLO-BLO Littelfuse
2	T1 T3	64600201	MJD122 Darlington NPN TO252	Transistor MOTOROLA
2	T2 T4	64600301	MJD127 DARLINGTON PNP TO252	Transistor MOTOROLA
3	T5 T6 T7	64600402	BC847B NPN SOT23	Transistor ONsemi
2	V1 V2	64300301	MC78L05ACD +5V SO8	Voltage regulator ON-Semi
1	V3.	64300101	MC79L05ACD -5V SO8	Voltage reg. 100mA TEXAS
1	V5.	64308601	LT1370IR R-Package 7Pin DD Pak	Switching Regulator LINEAR
1	V6.	64301001	LD1117S33TR 3.3V SOT223	Low drop Voltage reg. STM
1	X1.	63201401	12.288MHz NX1255GB 11.8x5.5mm	Crystal NDK
1	X2.	63201501	16.670MHz NX1255GB 11.8x5.5mm	Crystal NDK
1	X3.	63200701	24.576MHz NX1255GB 11.8x5.5mm	Crystal NDK
1	X4.	63202701	6.000MHz HC49/4H SMX 11.4x4.9	Crystal C-MAC
2	C189 C204	71004301	2700u 25V Ø18x25 M7.5	Capacitor lyt radial

PCS	Part ref.	Part No.	Desciption	Description 2
2	CO2 CO3	75804001	3Pol Molex Male PCB	Conn. Straight with lock
1	CO7.	75808301	6Pol AMP Male PCB	Conn. Straight with lock TYCO
1	CO13.	75805001	4Pol Conn Male PCB	Conn. Straight 3.96mm W/Lock
1	CO14.	75806001	26Pol Pin Header W/House PCB	Conn. Straight Dual row
1	CO19.	75808101	4Pol AMP Male PCB	Conn. Straight with lock TYCO
2	R12 R52	70121901	Temperature sensor PT1000	Resistor Class C
2	RC1 RC2	75801301	16Pol IC Socket PCB	Conn. 0.3" Preci-Dip

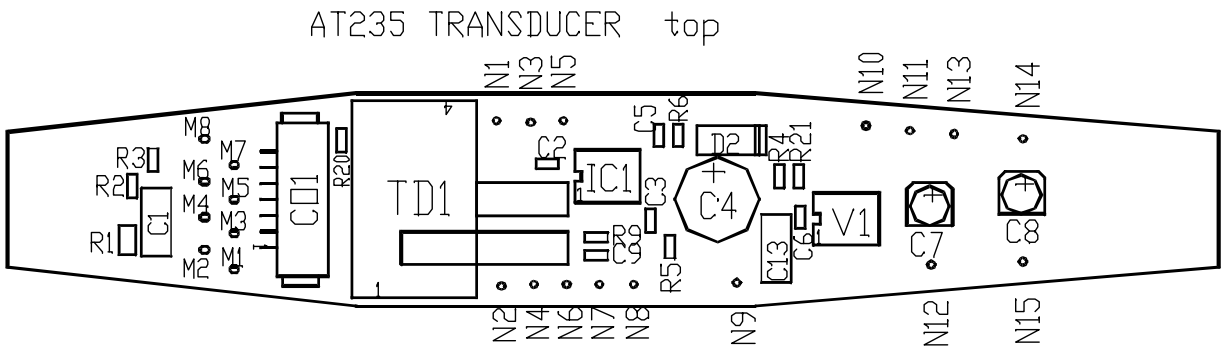
Transducer Board Diagram

D02006401

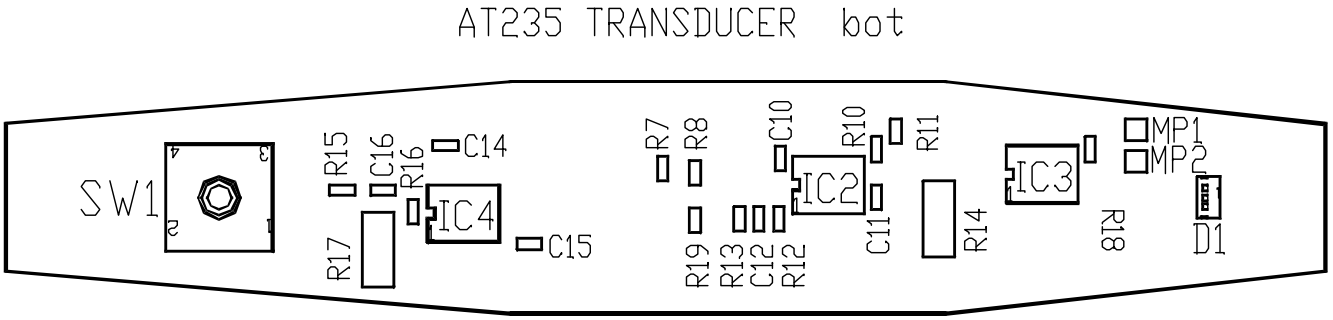


Components Index

Top side
xitr 0005 00006=D01007001



Bottom side
xitr 0006 00005=D01007101



Transducer Part List

PCB 69009601 (66905) – Assembled Board PCA 51000101 (66918)

Quantity	Part Reference	Part Number	Value	Tolerance
2	A1 A2	45108401	labels	
1	C1	61401701	10n	1%
5	C2 C3 C6 C10 C11	61400101	22n	10%
4	C5 C9 C12 C16	61400201	100p	1%
2	C7 C8	61003301	10u	20%
1	C13	61444301	270n	
2	C14 C15	61401101	100n	10%
1	D1	61702901	LED-RGB	
1	IC3	62008201	DG419	
1	IC4	62006001	LM6171	
2	IC1 IC2	62000701	OP275	
8	M1 M2 M3 M4 M5 M6 M7 M8		Pad	
2	MP1 MP2		Mp	
15	N1 N2 N3 N4 N5 N6 N7 N8 N9 N10 N11 N12 N13 N14 N15		Pad	
1	R1	60304001	178K	1%
1	R2	60420401	33K2	1%
1	R3	60423901	8K25	1%
1	R4	60403001	4K99	1%
3	R5 R10 R13	60403601	1K	1%
2	R6 R9	60402001	20K	1%
1	R7	60401701	100K	1%
2	R8 R15	60406401	16K2	1%
1	R11	60403901	13K3	1%
1	R12	60402301	12K4	1%
1	R14	60208601	24K	1%
1	R16	60400201	10K	1%
1	R17	60225601	9K53	1%
1	R18	60420301	49K9	1%
1	SW1	73902201	KSA211	
1	TD1	76000401	SDX01D4	
1	V1	64300301	78L05	

Appendix A Description of Serial Interface

General Specification

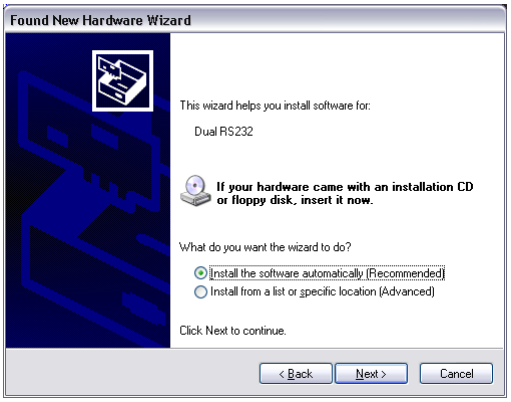
The Serial interface is designed to transmit data from the audiometer to a computer, and to control the audiometer from a computer.

The Baud rate is 38400 B/S and the data format is 8 data bits, Even parity and one stop bit.

Installing the USB Driver on the PC

Connect the Instrument to the PC with a USB cable and turn on the instrument, the following window should appear. The Driver is available from Windows Update if the PC is connected to the internet or it can be found on the CD with the operation manual.

Click Next and the following window should appear.

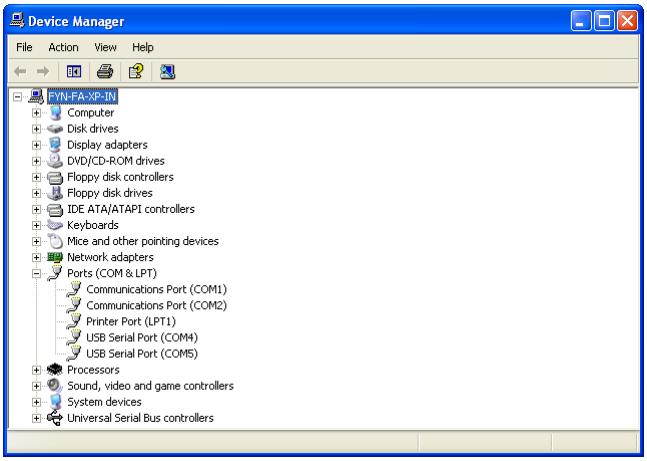


Insert the CD, if the PC is not connected to the internet, click Next.

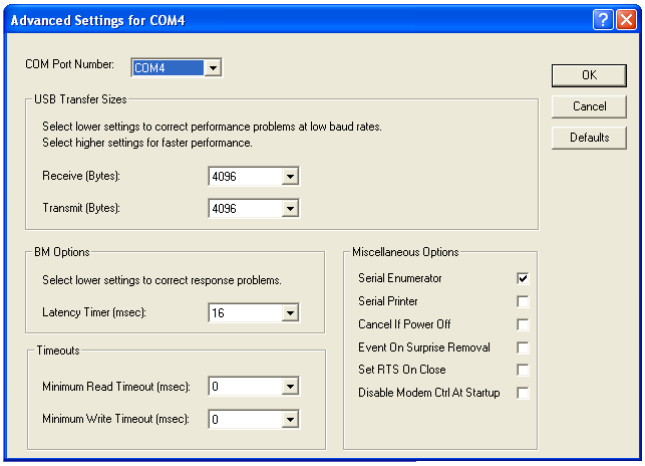
When the Driver is found the following window appears:

Click Finish, the Found New Hardware Wizard now starts over again because a driver for Serial Converter B needs to be installed, follow the directions above.

The Driver for the USB Serial Converter is now installed, to find out which COM port to use when communicating with the instrument start the Device Manager (Click Start, My Computer -> properties, Hardware -> Device Manager). The Port is recognized as “USB Serial Port” use the one with the lowest number.



If the COM port number is higher than it is possible to set in the PC application, it is possible to change the number by selecting properties for the USB Serial Port, then Click Hardware and Advanced, the following window should appear:

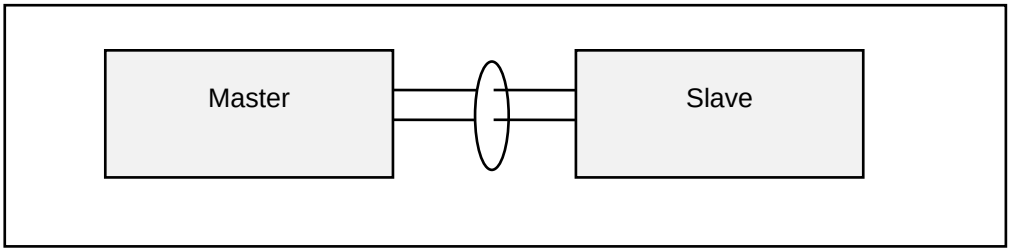


Change the COM port number in the drop down box.

Communication

Serial Standard for Interacoustics A/S

Both the computer and the instrument can send out a request for information or send back requested information. To make it easier to understand how the philosophy behind the Serial communication standard works for an instrument and a PC the following terms will be used. The part that request information will be called a Master and the part who will send back requested information will be called a Slave.



Master/slave communication. Figure 2

Data transmission between the Master and the Slave are using the following format.

Data packet from a Master device.

Recipient	Sender	Direction	Header	Data	CRC (optional)

Data packet from a Slave device.

Recipient	Sender	Header	Data

“Recipient” and “sender” are revered for later use and can be ignored. Both the Recipient and the Sender are consisting of two bytes each.

A data packet form a Master will always contain a Direction. This direction tells the slave if it has to store or to send out the kind of data the header describes. The header is an indicator for the type of data and how the are transmitted.

Control Codes

All information's in the transmission between a Master and a Slave are controlled by control codes (see table 1).

Code	Hex	Description	Code	Hex	Description
STX	02	Start of TeXt	GS	1D	Group Separator
EOT	04	End Of Transmission	RS	1E	Record Separator
SOH	01	Start Of Header	SI	0F	Shift In
US	1F	Unit Separator	SO	0E	Shift Out
OK	18	CRC Ok	ERR	19	CRC Error

Control Codes. Table 1.

A data packet from a Master will look like this with all its control codes:

STX	Recipient	**US**	Sender	**US**	Direction	**SOH**	Header	**US**	Data	**US**	**EOT**

Or with CRC check

STX	Recipient	**US**	Sender	**US**	Direction	**SOH**	Header	**US**	Data	**US**	CRC Value 5 digits	**EOT**

Direction can either be SO or SI. If It is a SO (shift out) direction the Master wants to send data into the slave and if it is a SI (shift in) direction the Master wants to receive data.
A data packet from a Slave will look like this with all its control codes:

STX	Recipient	**US**	Sender	**US**	**SOH**	Header	**US**	Data	**EOT**

Note! When a Master is using a SO direction the slave will send back nothing! When the master uses CRC check, the slave respond with OK or ERR.

Each time data is transmitted a US control code is added. Ex. 10 US 125 US .... With this construction it is always possible to see when all bytes in a single data transmission is completed.

CRC Check

The Instrument supports CRC Check on the bytes received from the PC. If the data packet contains a CRC value the Instrument calculates the CRC value of the bytes received and responds with OK or ERR. If the Instrument responds with ERR, send the data packet again. The CRC value is calculated from the STX to and including the EOT, the CRC value is added between the last US and EOT, and must always be 5 digits.

Header and Data Formats

A header consists of a control code (SOH) and 6 bytes (header). Each header tells witch kind of data that follows and how the data format is. The following table describes the different types of headers and their data format.

Block Start Header and Block End Header

If the Master wants to send a sequence of headers, and do not want the Slave to respond on the EOT's, the headers is send with a Block Start in the beginning and a Block End at the end. The slave waits for the Block End, before it processes the data. Similar when the Slave sends back data to the Master, it can pack the data headers in between a Block Start and a Block End, to indicate when all the requested data is send.

Block Start

Header	Description	Format
BLST00	Block Start	

Block End

Header	Description	Format
BLEN00	Block End	

Audiological Information

Tone Audiogram

Left Phone

Header	Description	Format
GTLP00	Hearing Level	Frequency US dB US frequency US ....

Right Phone

Header	Description	Format
GTRP00	Hearing Level	Frequency US dB US frequency US ....

Impedance Audiometry

Tympanogram

Left Ear

Header	Description	Format
GCLE00	Tympanogram Left Ear (Old format)	Compliance US Volume US Pressure US Gradient US Press1 US Compl1 US Press2 US compl2 US.....
GCLE01	Tympanogram Left Ear	ComplianceReal US ComplianceImg US VolumeReal US VolumeImg US Pressure US Gradient US GradientUnit US NumberOfPoints US StartPressure US StopPressure US Pumpspeed US ProbeToneFreq US Press[0] US Complreal[0] US Complimg[0] US …….. Press[NumberOfPoints] US Complreal[NumberOfPoints] US Complimg[NumberOfPoints] US EOT

Right Ear

Header	Description	Format
GCRE00	Tympanogram Right Ear (Old format)	Compliance US Volume US Pressure US Gradient US Press1 US Compl1 US Press2 US compl2 US.....
GCRE01	Tympanogram Right Ear	ComplianceReal US ComplianceImg US VolumeReal US VolumeImg US Pressure US Gradient US GradientUnit US NumberOfPoints US StartPressure US StopPressure US Pumpspeed US ProbeToneFreq US Press[0] US Complreal[0] US Complimg[0] US …….. Press[NumberOfPoints] US Compleal[NumberOfPoints] US Complimg[NumberOfPoints] US EOT

IPSI Reflex

Left Ear

Header	Description	Format
GRIL00	IPSI Reflex Left Ear (Old format)	Stimulus1 US dBHL1 US Pressure1 US Compl11 US Compl12 US.....US GS Stimulus2 US dBHL2 US Pressure2 US Compl21 US Compl22 US.....
GRIL01	IPSI Reflex Left Ear	RS Frequency US Pressure US Method US NumberOfPoints US GS dB1 US mS[0] US ml[0] US …….mS[NumberOfPoints] US ml[NumberOfPoints] US GS dB2 US <CurveData> GS *until* dB6 *if the method is sequence and 6 reflexes recorded.*

Right Ear

Header	Description	Format
GRIR00	IPSI Reflex Right Ear (Old format)	Stimulus1 US dBHL1 US Pressure1 US Compl11 US Compl12 US.....US GS Stimulus2 US dBHL2 US Pressure2 US Compl21 US Compl22 US.....
GRIR01	IPSI Reflex Right Ear	RS Frequency US Pressure US Method US NumberOfPoints US GS dB1 US mS[0] US ml[0] US …….mS[NumberOfPoints] US ml[NumberOfPoints] US GS dB2 US <CurveData> GS *until* dB6 *if the method is sequence and 6 reflexes recorded.*

Contra Reflex

Left Ear

Header	Description	Format
GRCL00	Contra Reflex Left Ear (Old format)	Stimulus1 US dBHL1 US Pressure1 US Compl11 US Compl12 US.....US GS Stimulus2 US dBHL2 US Pressure2 US Compl21 US Compl22 US.....
GRCL01	Contra Reflex Left Ear	RS Frequency US Pressure US Method US NumberOfPoints US GS dB1 US mS[0] US ml[0] US …….mS[NumberOfPoints] US ml[NumberOfPoints] US GS dB2 US <CurveData> GS *until* dB6 *if the method is sequence and 6 reflexes recorded.*

Right Ear

Header	Description	Format
GRCR00	Contra Reflex Right Ear (Old format)	Stimulus1 US dBHL1 US Pressure1 US Compl11 US Compl12 US.....US GS Stimulus2 US dBHL2 US Pressure2 US Compl21 US Compl22 US.....
GRCR01	Contra Reflex Right Ear	RS Frequency US Pressure US Method US NumberOfPoints US GS dB1 US mS[0] US ml[0] US …….mS[NumberOfPoints] US ml[NumberOfPoints] US GS dB2 US <CurveData> GS *until* dB6 *if the method is sequence and 6 reflexes recorded.*

Decay IPSI Reflex

Left Ear

Header	Description	Format
GAIL00	Decay IPSI Reflex Left Ear (Old format)	Stimulus1 US dBHL1 US Pressure1 US Result1 US Timebase1 US Compl11 US Compl12 US....US GS Stimulus2 US dBHL2 US Pressure2 US Result2 US Timebase2 US Compl21 US.....
GAIL01	Decay IPSI Reflex Left Ear	Frequency US Pressure US Method US NumberOfPoints US GS dB1 US mS[0] US ml[0] US ……mS[NumberOfPoints] US ml[NumberOfPoints] US GS dB2 US <CurveData> GS *until* dB6 *if the method is sequence and 6 reflexes recorded.*

Right Ear

Header	Description	Format
GAIR00	Decay IPSI Reflex Right Ear (Old format)	Stimulus1 US dBHL1 US Pressure1 US Result1 US Timebase1 US Compl11 US Compl12 US....US GS Stimulus2 US dBHL2 US Pressure2 US Result2 US Timebase2 US Compl21 US.....
GAIR01	Decay IPSI Reflex Right Ear	Frequency US Pressure US Method US NumberOfPoints US GS dB1 US mS[0] US ml[0] US ……mS[NumberOfPoints] US ml[NumberOfPoints] US GS dB2 US <CurveData> GS *until* dB6 *if the method is sequence and 6 reflexes recorded.*

Decay Contra Reflex

Left Ear

Header	Description	Format
GACL00	Decay Contra Reflex Left Ear (Old format)	Stimulus1 US dBHL1 US Pressure1 US Result1 US Timebase1 US Compl11 US Compl12 US....US GS Stimulus2 US dBHL2 US Pressure2 US Result2 US Timebase2 US Compl21 US.....
GACL01	Decay Contra Reflex Left Ear	Frequency US Pressure US Method US NumberOfPoints US GS dB1 US mS[0] US ml[0] US ……mS[NumberOfPoints] US ml[NumberOfPoints] US GS dB2 US <CurveData> GS *until* dB6 *if the method is sequence and 6 reflexes recorded.*

Right Ear

Header	Description	Format
GACR00	Decay Contra Reflex Right Ear (Old format)	Stimulus1 US dBHL1 US Pressure1 US Result1 US Timebase1 US Compl11 US Compl12 US....US GS Stimulus2 US dBHL2 US Pressure2 US Result2 US Timebase2 US Compl21 US.....
GACR01	Decay Contra Reflex Right Ear	Frequency US Pressure US Method US NumberOfPoints US GS dB1 US mS[0] US ml[0] US ……mS[NumberOfPoints] US ml[NumberOfPoints] US GS dB2 US <CurveData> GS *until* dB6 *if the method is sequence and 6 reflexes recorded.*

ETF1

Left Ear

Header	Description	Format
GILE00	ETF1 Left Ear (Old format)	Volume US Pressure1 US Press11 US Compl11 US Press12 US Compl12 US.....US GS Pressure2 US Press21 US Compl21 US Press22 US Compl22 US....
GILE01	ETF1 Left Ear	EarVolume US NumberOfPoints US StartPressure US EndPressure US PumpSpeed US GS Pressure1 US <Curve1> US GS Pressure2 US <Curve2> US GS Pressure3 US <Curve3> Curve = Pressure[0] US ml[0] US …….. Pressure[NumberOfPoints] US ml[NumberOfPoints] US EOT

Right Ear

Header	Description	Format
GIRE00	ETF1 Right Ear (Old format)	Volume US Pressure1 US Press11 US Compl11 US Press12 US Compl12 US.....US GS Pressure2 US Press21 US Compl21 US Press22 US Compl22 US....
GIRE01	ETF1 Right Ear	EarVolume US NumberOfPoints US StartPressure US EndPressure US PumpSpeed US GS Pressure1 US <Curve1> US GS Pressure2 US <Curve2> US GS Pressure3 US <Curve3> Curve = Pressure[0] US ml[0] US …….. Pressure[NumberOfPoints] US ml[NumberOfPoints] US EOT

ETF2

Left Ear

Header	Description	Format
GPLE00	ETF2 Left Ear	Timebase US Open1 US Close1 US Open2 US Close2 US Open3 US Close3 US Press1 US Press2 US Press3 US.....

Right Ear

Header	Description	Format
GPRE00	ETF2 Right Ear	Timebase US Open1 US Close1 US Open2 US Close2 US Open3 US Close3 US Press1 US Press2 US Press3 US.....

Get All Data

Header	Description	Format
SGGA00	Get All Data (Old format)	Returns with all data stored. Look for headers in the return string and see in this manual for format description. The Tymp and the reflexes are transferred in the old format.

Header	Description	Format
SGGA01	Get All Data (New format)	Returns with all data stored. Look for headers in the return string and see in this manual for format description. The Tymp and the reflexes are transferred in the new format.

EEPROM Commands

Set or get EEPROM data

Header	Description	Format
GDE100	EEPROM Data	Data1 US Data2 US …….. Data8192 US EOT
GDE101	EEPROM Data from Address + number of bytes	*Master SI:* Address US NumberOfBytes US EOT *Slave:* Data[Address] US …….. Data[NumberOfBytes] US EOT *Master SO:* Address US NumberOfBytes US Data[0] US …….. Data[NumberOfBytes] US EOT

Calculate Checksum

When the values in the EEPROM are changes with the two commands above, the Instrument has to calculate a new checksum of the values in the EEPROM.

Header	Description	Format
CHKS00	Calculate Checksum	

Information

Header	Description	Format
GDID00	Identification of communication version	data US
GDID01	Instrument name and version	data US
GDID03	Serial number and date	xxxxxxx US ddmmyyyy US EOT

Remote Commands

It is possible to remote control the Instrument via the USB connection.

Header	Description	Format
SPKY00	Set a key or menu in the instrument	Keynumber or Menunumber US EOT
SPF100	Set frequency in channel 1	Frequency US EOT
SPA100	Set attenuator for channel 1	DB US EOT
SPA101	Set attenuator calibration for channel 1 Used for auto calibration	(Intensity – Measured Intensity) US EOT
SPA200	Set attenuator for channel 2	DB US EOT
SPI100	Set interrupter for channel 1	“1” is sound off and “0” is sound on
SICP01	Delete all patient data	
SICP02	Reset to Power-up menu	
SICP03	Update display (only in Headset calibration)	
SPIN00	Set Instrument Name	“name” US EOT max. 15 characters
SPDN00	Set Dealer Name	“name” US EOT max. 20 characters

To control the keys on the Instrument use the following table to find the key number.

Key name	Code	Key name	Code	Key Name	Code
F1	**1017**	Shift + F1	**1117**	Tymp/Reflex	**1002**
F2	**1018**	Shift + F2	**1118**	ETF	**1006**
F3	**1019**	Shift + F3	**1119**	Audiometry	**1007**
F4	**1020**	Shift + F4	**1120**	Man	**1008**
F5	**1021**	Shift + F5	**1121**		
F6	**1022**	Shift + F6	**1122**		
Back	**1023**	Shift + Back	**1123**		
				Ipsi	**1004**
Print	**1009**	Print Screen	**1109**	Contra	**1005**
Pause	**1001**	New Subject	**1101**		
				Right	**1011**
Store	**1010**	No Response	**1110**	Left	**1012**
Frequency Decr	**1025**	Frequency Incr	**1026**		
Intensity Decr	**1027**	Intensity Incr	**1028**	Ext. Range	**1128**

Status

Header	Description	Format
SGRS02	Reduced instrument status	Intensity Ch1 US Intensity Ch2 US Frequency US Input US Output US Transducer US Store Flag US EOT
SGME00	Menu Status	Active Menu US Submenu US EOT

Input, Output and Transducer

The Input and Output parameter in the reduced status is a numerical value, use the table below to obtain the Input- and Output type.

Input type	Code	Output type	Code	Transducer	Code
Pure Tone	**1**	Right Phone	**2200**	TDH39	**1250**
Low Pass Noise	**10**	Left Phone	**2201**	EAR	**1251**
High Pass Noise	**11**	Contra Phone	**2202**	CIR22	**1252**
Wide Band Noise	**12**	Probe Tone	**2203**	Handheld Probe	**1253**
		Probe Ipsi speaker	**2204**	Clinic Probe	**1254**
		No output	**2206**		

Active Menu and Submenu

The Menu Status returns the Active Menu and Submenu as a numerical value, use the table below to obtain the name of the menus. The Submenu is only used in Impedance Menu. It is possible to select a Menu with the SPKY00 command and the codes below.

Active Menu	Code	Active Menu	Code
Main	**12000**	Pressure Calibration	**12024**
Setup	**12001**	Compliance Calibration	**12025**
Common Setup	**12003**	Probe Tone Calibration	**12027**
Subject	**12007**	Probe Real Mode	**12028**
Calibration	**12009**	Clinic	**12029**
Tympanometry Setup	**12011**	Modify	**12030**
Password	**12012**	Manual Audiometry	**12031**
Reflex Setup	**12013**	Impedance	**12032**
Headset Real Mode	**12015**	Famili Test	**12033**
Fixed Attenuator	**12016**	HW Test	**12034**
Advanced Setup	**12017**	Manual Reflex	**12035**
EEPROM Setup	**12018**	ETF1	**12036**
Advanced Reflex	**12019**	IPSI Calibration	**12037**
Advanced Audiometry	**12020**	Submenu	Code
Attenuator	**12021**	Tympanogram	**10**
Headset Calibration	**12022**	Reflex	**11**
Probe Calibration	**12023**	Tympanogram + Reflex	**12**

Setup Items

The Setup Items in the Instrument can be read and written with the following header. In the table below the setup items are listed with their number and value range.

Header	Description	Format
GDSD00	Sets or Gets a Setup Item in the Instrument.	*Master:* SO US Item No US Value US EOT *Slave:* Sends nothing back *Master:* SI US Item No US EOT *Slave:* Value US EOT

Setup Name	Setup Item	Number	Value Range
Tympanometry Setup	Start Pressure	191	25 = 25 daPa … 36 = 300 daPa
	Stop Pressure	192	0 = -600 daPa … 23 = -25 daPa
	Pump Speed	193	10 = Low, 11 = Medium 12 = High, 13 = Automatic
	Compensation Mode	195	10 = Comp., 11 = Non Comp.
	Gradient Unit	196	10 = ml, 11 = daPa, 12 = Off
Reflex Setup A	Reflex Method	91	10 = Fixed, 11 = Screening, 12 = Auto, 13 = Sequence
	Test Stop Criteria	92	0 = Off, 1 = On
	Reflex Senitivity	93	10 = Sensitive, 11 = Normal, 12 = Robust
	Reflexes pr Sequence	94	10 = 2 reflexes … 14 = 6 reflexes
	Level increase	95	10 = 5 dB … 15 = 10 dB 16 = 15 dB … 19 = 30 dB
	Compensate for general drifting	96	0 = Off, 1 = Normal
	Reflex 1 Output	100	10 = IPSI … 11 = Contra
	Reflex 1 Frequency	101	10 = 125 Hz … 23 = HP
	Reflex 1 Level	102	60 = 60 dB … Max = Max Output
	Reflex 1 Status	103	0 = Off, 1 = On
To get Reflex Setup B add 50 to Number	Reflex 2..6 has the same value range, the number is Reflex 1 Number + 4 for Reflex 2……		
Common Setup	Power-up	215	10 = Tymp 11 = Tymp and Reflex
	Pause	220	0 = Off, 1 = On
	Remote Switch	212	10 = L/R, 11 = Pause, 12 = L/R or Pause, 13 = Off
	Manual Reflex Attenutor	213	10 = 1 dB, 11 = 2 dB, 12 = 5 dB
	Reflex Icon Boxes	217	4 = 4, 6 = 6
	Printer	211	10 = Internal, 12 = Off
	Subject Data Printout	223	0 = Off, 1 = On
	Clinic Data Printout	218	0 = Off, 1 = On
	Print After Test	216	0 = Off, 1 = On
	Keyboard Connected	221	0 = No, 1 = Yes
	Language	224	0 = English, 1 = German

Setup Name	Setup Item	Number	Value Range
Advanced Setup	Start Ear	70	10 = Right, 11 = Left
	Password	71(MSB) -74(LSB)	0 – 9
	Contra Headset	76	10 = Cir22, 11 = TDH39, 12 = EAR
	Impedance Transducer	79	10 = Handheld, 11 = Clinic, 12 = Combi
	Enable ETF Test	77	0 = Disable, 1 = Enable
	Height above sea level	78	0 = 0 – 100m, 25 = 2500 – 2599m
	Seal Sensitivity	80	10 = Normal, 11 = Sensitive
Advanced Reflex Setup	Display Reflexes	40	10 = Positive, 11 = Negative
	Compliance Change	43	10 = ml, 11 = %
	Max Reflex scale limit	59	10 = 0,10 ml, 11 = 0,15 ml, 12 = 0,20 ml, 13 = 0,25 ml
	Stimuli Selection		
	250 Hz	46	0 = Off, 1 = On
	750 Hz	48	0 = Off, 1 = On
	1500 Hz	50	0 = Off, 1 = On
	3000 Hz	52	0 = Off, 1 = On
	4000 Hz	53	0 = Off, 1 = On
	6000 Hz	54	0 = Off, 1 = On
	8000 Hz	55	0 = Off, 1 = On
	WB	56	0 = Off, 1 = On
	LP	57	0 = Off, 1 = On
	HP	58	0 = Off, 1 = On
	Autotest max upper limit	60	90 = 90 dB … 110 = 110 dB In steps of 5 dB.
	Default manual intensity	63	60 = 60 dB … 110 = 110 dB In steps of 1 dB.
	AGC for IPSI reflex stim.	42	0 = Off, 1 = On
Advanced Audiometry	Audiometry Headset	0	10 = TDH39, 11 = EAR3A
	Default Intensity	2	0 = Off, 10 = -10 dB, 70 = 50 dB
	Not Heard Lines	3	0 = Off, 1 = On
Manual Audiometry	Audiometer Frequencies		
	125 Hz	5	0 = Off, 1 = On
	250 Hz	6	0 = Off, 1 = On
	750 Hz	8	0 = Off, 1 = On
	1500 Hz	10	0 = Off, 1 = On
	3000 Hz	12	0 = Off, 1 = On
	6000 Hz	14	0 = Off, 1 = On
	8000 Hz	15	0 = Off, 1 = On
	Frequency Jump Mode	1	10 = Bottom, 11 = Butterfly
	Intensity Step Down	28	10 = Off, 11 = 5 dB … 18 = 40 dB
Automatic Audiometry	HW Frequencies		
	125 Hz	16	0 = Off, 1 = On
	250 Hz	17	0 = Off, 1 = On
	750 Hz	19	0 = Off, 1 = On
	1500 Hz	21	0 = Off, 1 = On
	3000 Hz	23	0 = Off, 1 = On
	6000 Hz	25	0 = Off, 1 = On
	8000 Hz	26	0 = Off, 1 = On
	Conditions	4	10 = 2 out of 3, 11 = 3 out of 5

Examples of Transmission

All ASCII characters are separated form control codes with " " ! Ex. "00" means two byte each representing a zero.

Ex. 1 Transmitting all EEPROM data from the Instrument

Master:	STX "00" US "00" US SI SOH "GDE100" US EOT	Ask for EEPROM data.
Slave:	STX "00" US "00" US SOH "GDE100" US data..... EOT	Send EEPROM data.

Ex. 2 Sending all EEPROM data from the PC to the Instrument

Master:	STX "00" US "00" US SO SOH "GDE100" US data..... EOT	Send EEPROM data.
Slave:	Nothing.	
Master:	STX "00" US "00" US SO SOH "CHKS00" US EOT	Calculate new checksum
Slave:	Nothing.	

Ex. 3 Setting a key or menu in the Instrument

Master:	STX "00" US "00" US SO SOH "SPKY00" US "12001" US EOT	Select Setup menu.
Slave:	Nothing.	

Ex. 4 Getting all relevant subject data from the Instrument

Master:	STX "00" US "00" US SI SOH "SGGA00" US EOT	Ask for all data.
Slave:	STX "00" US "00" US SOH "BLST00" US EOT STX "00" US "00" US SOH "SGGA00" US data... EOT STX "00" US "00" US SOH "BLEN00" US EOT	Send all stored subject data between a Block Start and Block End.

Ex. 5 Getting data - left phone from the Instrument

Master:	STX "00" US "00" US SI SOH "GTLP00" US EOT	Ask for data.
Slave:	STX "00" US "00" US SOH "GTLP00" US data..... EOT	Send left phone data.

Online Communication

Valid from software version AT235h 1.10108 and AT235 1.11108

The AT235 is capable to send information to the PC, whenever things change in the instrument and when data is obtained from the probe. The online communication is enabled from the PC, because it only is used together with a PC. The Online Communication is not completely implemented yet, so subject to change.

Header	Description	Format
OLEN00	Enable online communication	
OLDI00	Disable online communication	

How the instrument works

When the AT235 is doing its normal measurements it is running in automated mode where everything is preset. That why the menu is called "Auto impedance". There are three screens in this mode. One where "all" information are put together (Tymp and Reflex mixed), one full screen with tymp (extended tymp) and one full screen with reflex (extended reflex). When an automated session takes place the instrument switches to a menu without any graphically interface called "Do Test". This is the control centre of the instrument where the list of tasks to perform are placed and executed. Further more there are a "Do Tymp" menu and a "Do Reflex" menu also without graphically interface that deals with the measuring of data. That's why the "menu" item changes during a measurement.

Menu's like EFT and Manual Reflex measurement uses the "Do Tymp" menu and the "Do Reflex" menu without the "Do Test" menu.

The inside (both hardware and software) of the instrument is designed with two sound channels. This is necessary when we need to produce both a probe tone and stimuli at the same time. The CPU is in control of a DSP with a two channel Codex. When monitoring the state of the instrument you therefore needed to show the state of two channels. The probe tone is always controlled from channel 2.

Headers from the Instrument when things change

Header	Description	Format
OLMU02	Menu Changed	Menu US EOT
OLMU03	Submenu Changed	Submenu US EOT
OLKY00	Key pressed	Key US Status US EOT

This is what strings the instrument can send when it sends the OLMU02 (Menu Changed) header

"Main", "Setup", "Common Setup", "Subject", "Calibration", "Tymp Setup", "Password", "Reflex Setup", "Headset Real", "Fixed Attenuator", "Advanced Setup", "EEPROM Setup", "Advanced Imp Setup", "Advanced Aud Setup", "Attenuator Calibration", "Headset Calibration", "Probe Calibration", "Pressure Calibration", "Compliance Calibration", "Probe Tone Calibration", "Probe Real", "Clinic", "Modify", "Tone", "Auto Impedance", "HW Family", "HW Test", "Manual Impedance", "ETF1", "Ipsi Calibration", "ETF3", "Headset Options", "ETF2", "Manual Audiometry Setup", "Audiometry Setup", "Test Audiometry Setup", "Impeadence Setup", "ABLB", "Stenger", "Function", "SISI", "Talkforward", "Reset", "Speech", "Speech Setup", "Attenuator Setup", "Cochlear Implant", "Speech USA", "Do Reflex", "Do Tymp", "Do Test" ", "Error".

This is what strings the instrument can send when it sends the OLMU03 (Sub Menu Changed) header

"Extended Tymp", "Extended Reflex", "Reflex and Tymp Mixed".

This is what strings the instrument can send when it sends the OLKY00 (Key pressed) header

"Pause", "Tymp", "Reflex", "Ipsi", "Contra", "ETF", "Audiometry", "Manual", "Print", "Store", "Right", "Left", "F1", "F2", "F3", "F4", "F5", "F6", "Back", "High Tymp", "Hz Decr", "Hz Incr", "dB Decr Ch1", "dB Incr Ch1", "Impedance", "Talk Forward", "Manual/Auto", "Function", "Bone", "dB Decr Ch2", "dB Decr Ch2", "Auto", "Bone Right", "Bone Left", "Ch2 Off", "Mic", "CD 1 and 2", "CD 1", "CD 2", "Monitor Talkback", "Monitor", "Talkback", "FF 1 and 2", "FF 1", "FF 2", "Store No Response", "Extended Range", "Print Screen", "New Subject", "Error".

Analog changes

Header	Description	Format
OLAN06	Input Changed	Input type US Channel US EOT
OLAN01	Intensity Changed	Intensity dB US Channel US EOT
OLAN07	Plus 20 dB Changed	Status US Channel US EOT
OLAN08	Interrupter Changed	Status US Channel US EOT
OLAN09	Output Changed	Output type US Channel US EOT
OLAN10	Transducer Changed	Transducer type US Channel US EOT

This is what strings the instrument can send when it sends the OLAN06 (Input Changed) header

“125”, “250”, “500”, “750”, “1000”, “1500”, “2000”, “3000”, “4000”, “6000”, “8000”, “WN”, “LP”, “HP”, “SN”, “CD 1”, “CD 2”, “Mic”, “226”, “678”, “800”, “1000”, “Probe Mic”, “Talk Forward”, “Talk Back”, “No Input”, “30000”, ”Error”. “30000“ Means no data.
This is what strings the instrument can send when it sends the OLAN07 (Plus 20 dB Changed) header

“Off”, “Internal”, “External”, “Error”.

Internal means that the plus 20 dB step is switched on and can not be changed by pressing the Extended Range key.

External means that the plus 20 dB step can be switched on/of by pressing the Extended Range key.

This is what strings the instrument can send when it sends the OLAN08 (Interrupter Changed) header

“On”, “Off”, “Auto Off”, “Error”.

“Auto Off” is a state where the DSP itself switches off the interrupter after x mS. Used in a reflex measurement where tone is on for 500 mS.

This is what strings the instrument can send when it sends the OLAN09 (Output Changed) header

“Right”, “Left”, “Contra”, “Probe Tone”, “Probe Ipsi”, “Probe Pressure”, “No Output”, “Bone Right”, “Bone Left”, “FF1 Right”, “FF1 Left”, “FF2 Right”, “FF2 Left”, “Insert Right”, “Insert Left”, “Error”.

This is what strings the instrument can send when it sends the OLAN10 (Transducer Changed) header

“TDH39”, “EAR”, “CIR22”, “Handheld Probe”, “Clinical Probe”, “B71”, “Free Field”.

Tymp Measurement

Header	Description	Format
OLTY02	Tymp Test Start	Start Pressure US Stop Pressure US Ear Volume US Ear US probe tone frequency US pump speed US data US EOT
OLTY01	Tymp Test Done	Compliance of max. US Pressure of max. US Gradient US NumberOfPoints US EOT
	Tymp Data	Compliance US Pressure US EOT (The data pairs are transferred to the PC between the Test Start and Test Done or Test Aborted)
OLTA00	Test Aborted	NumberOfPoints US EOT

Reflex Measurement

Header	Description	Format
OLRE02	Reflex Test Start	Ear US Pressure at which reflex is tested US probe tone frequency US Reflex Method US Output US frequency US intensity (dB) US Reflex Box number US Count Of Reflexes in the current box US Index of Reflex in the Current Box US PointsInReflex US TimeBase US EOT
OLRE01	Reflex Test Done	NumberOfPoints at this level US EOT
	Reflex Data	Compliance US EOT (The data pairs are transferred to the PC between the Test Start and Test Done or Test Aborted)

HW Measurement

Header	Description	Format
OLHW00	Header Event	Event US EOT

Events for HW Measurement

“Test Started”, “Test Done”, “Test Interrupted”, “Test Failed”, “Changed Ear”, “Retest Failed”, “Retesting”.

Audiometry Measurement (also active during HW measurement)

Header	Description	Format
OLSA00	Store Information	Intensity Ch1 US Frequency US Masking Intensity US Status US EOT
OLPA00	Patient Response	Status US EOT

Status in OLSA00 can be “Heard” and “Not Heard”.

When using the online mode it is not advisable to use static headers that requests data to be send out of the instrument (SI) at the same time. It will disturb the online transmissions from the instrument.

Most parameters send with the headers are send as text. Example : If the Right key is pressed the text “Right” is send.

Cochlear Implant

For measuring on patients with Cochlear Implant, it is possible to select a menu through USB, where the compliance data is transmitted continuous to the host. The data format is 1000 = 1 ml and is transmitted in ASCII with an US and an EOT at the end for each data, the sample rate is 226 Hz.

Header	Description	Format
SPKY00	Set the CI menu in the instrument	12060 US EOT
CIEN00	Start the CI measurement	
CIDI00	Stop the CI measurement	
CIPR00	Get the Pressure	Pressure US EOT
CIPP00	“Pump to” Pressure	Pressure US EOT (min –600 daPa and max 300 daPa)

Communication in Windows

In this section sample code show how the communication could be made, it is using the ActiveX Control MSComm32, the code is compiled in Visual C++ 6.0.

This function opens the specified com port at 38400 baud, even parity, 8 bits and 1 stop bit. The receive threshold is set to 1 byte

```
BOOL OpenPort(int PortNo)
{
  CString SettingStr;

  SettingStr = "38400,E,8,1";

  m_CommControl.SetCommPort(PortNo);

  m_CommControl.SetSettings(SettingStr);

  m_CommControl.SetHandshaking(2);

  m_CommControl.SetPortOpen(TRUE);

  m_CommControl.SetRThreshold(1);

  return m_CommControl.GetPortOpen();
}
```

This function sends a string out on the com port

```
void SendString(CString StringToSend)

{
  VARIANT OutString;

  OutString.vt = VT_BSTR;

  OutString.bstrVal = StringToSend.AllocSysString();

  m_CommControl.SetOutput(OutString);
}
```

This function calculates the CRC value and inserts into the string.

```
CString CTestAT235Dlg::CalculateCRC(CString StringToCalculate)

{
  int CRCValue = 0, Counter;
  CString CRCString;

  for (Counter = 0; Counter < StringToCalculate.GetLength(); Counter++)
    CRCValue += StringToCalculate.GetAt(Counter);

  sprintf( CRCString.GetBuffer(10) , "%.5d", CRCValue );

  StringToCalculate.Insert(StringToCalculate.GetLength()-1, CRCString);

  return StringToCalculate;
}
```

This function receives data form the com port. The MSComm32 control generates an event when characters arrives at the com port and if any errors occur, see documentation of the MSComm32 control.

```
void CTestAT235Dlg::OnOnCommMscomm1()
{
```

```
  VARIANT InStringVar;
  CHAR ch;
  DWORD LastPosition;

  switch (m_CommControl.GetCommEvent())
  {
    case 2: InStringVar = m_CommControl.GetInput();
            InString += InStringVar.bstrVal;
            LastPosition = InString.GetLength()-1;

            ch = InString.GetAt(LastPosition);
            if (ch == 4) // The EOT is received
            {
              // Now deal with the data in the InString

              InString.Empty();
            }
            break;
  }
}
```

Appendix B User Setup

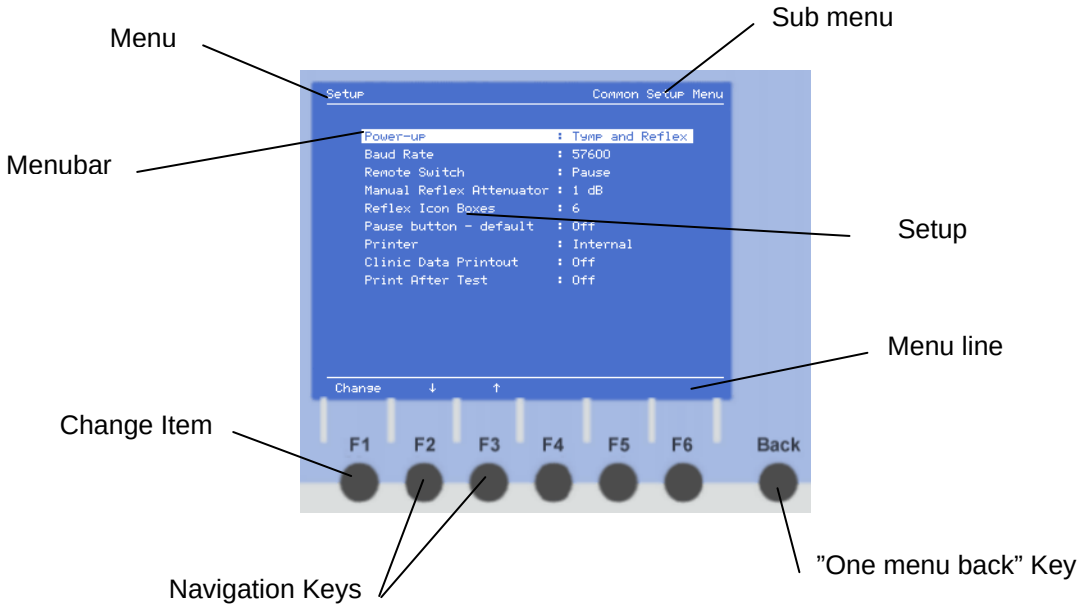
Set-up Navigation

Entering the Set-up

Press <shift> + <Back> and the instrument will return to the AT235 Main menu from any selected menu.
Press Set-up (F2) and you will enter the user set-up of the AT235.

Navigation

In each menu is possible to move a bar (see figure 1) trough the set-up items and change the settings for the set-up item.

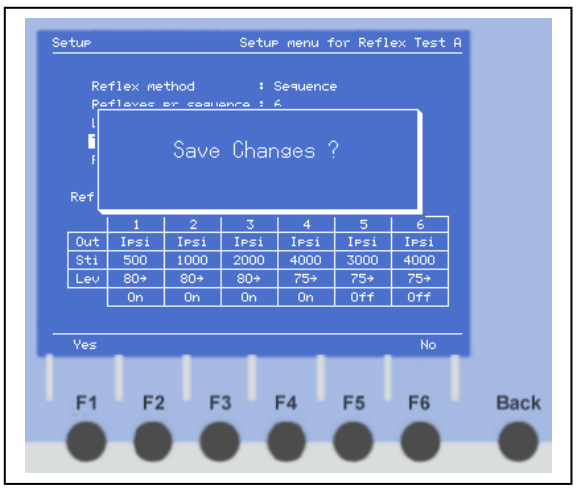


Menu Keywords Figure 15

Pressing the arrow down (F2) or up (F3) the menu bar moves and by pressing Change (F1) you can change the settings for the item selected by the menu bar.

Leaving a Menu

When the changes are made press the <Back> key. No changes are stored before you leave the menu and if anything is changed the instrument will ask you to save data or not. Please note that you have to press Yes (F1) or No (F6).

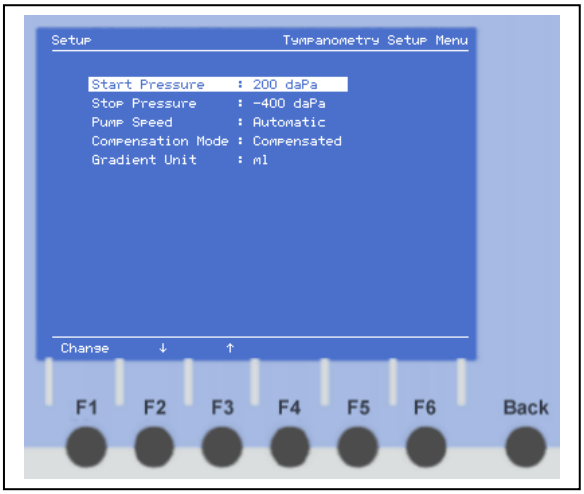


Save data at menu exit. Figure 16

User Setup

This is the description of the navigation in the User Setup in AT235 and which options can be changed from the setup.

Tympanometry Setup



Tympanometry Setup. Figure 17

Start Pressure

Factory 200 daPa **Range** 300 to 25 daPa in 25 daPa steps

Description Start Pressure indicates what pressure will be established as start out point for the pressure sweep.

Stop Pressure

Factory -400 daPa **Range** -25 to -600 daPa in 25 daPa steps

Description Is the pressure where the sweep will stop.

Pump Speed

Factory Automatic (150 daPa/sec, 50 daPa/sec, 150 daPa/sec)

Range Minimum (17 daPa/sec), Medium (50 daPa/sec), Maximum (150 daPa/sec) or Automatic (150 daPa/sec, 50 daPa/sec, 150 daPa/sec).

Description A slow speed will be more time consuming, but may give more detailed information. The horizontally displacement of the tympanogram peak in the sweeping direction caused by inherent hysteresis of the system will be smaller with lower speed.

Automatic is a mode where sweep speed at the beginning will be Maximum (150 daPa/sec) and when the gradient is smaller than 5 the speed will be slowed to Medium (50 daPa/sec). When the peak is bigger than 5 again the speed will be set to Maximum (150 daPa/sec) again.

Compensation Mode

Factory Compensated **Range** Compensated or Non compensated

Description Mode is set to “Compensated” if you want to have the curve displayed at the floor of the coordinate system. In “Non compensated” mode the tymp curve will be displayed including the ear canal volume.

Gradient Unit

Factory ml **Range** ml, daPa or Off

Description The gradient is an expression of the shape of the tymp curve. Narrow or wide.

If ml is selected the gradient will be calculated the following way: The program will go 50 daPa to each side from compliance value and save the two ml values. The gradient is the average of the two ml values subtracted from the compliance value.

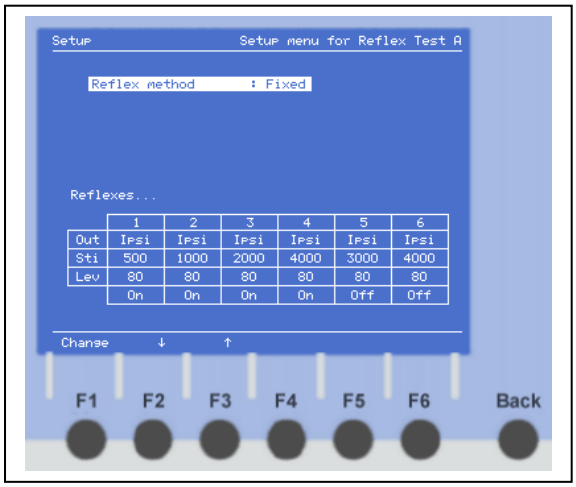
If daPa is selected the gradient will be calculated the following way: The program searches from each end of the tymp curve and stores the pressure where the point at the tymp curve is equal to compliance value divided with 2. Gradient is equal to the two stored pressures subtracted from one another.

If Off is selected the gradient box will be removed from the user interface.

Setting up Reflex Tests

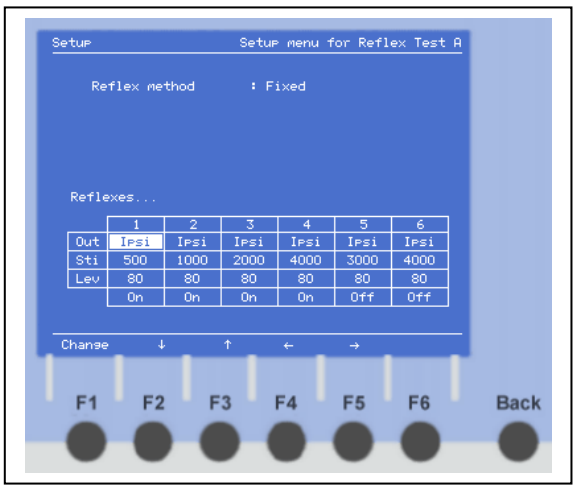
The AT235 can hold information for two reflex tests: Reflex Test A and Reflex Test B. Each test can hold setup options for 6 reflexes expressed in the table in the bottom of the screen figure (see figure 5). The upper part of the screen describes how and with what method the 6 reflexes will be taken. So the reflex setup is a matter of determined the start conditions for each of the 6 reflexes in the table (output, stimuli, level and if in use or not) and with what method the reflex will be taken.

Note that it is the same method for all 6 reflexes. If you want one reflex with one method and another reflex with another method, use Reflex Test A and Reflex Test B.



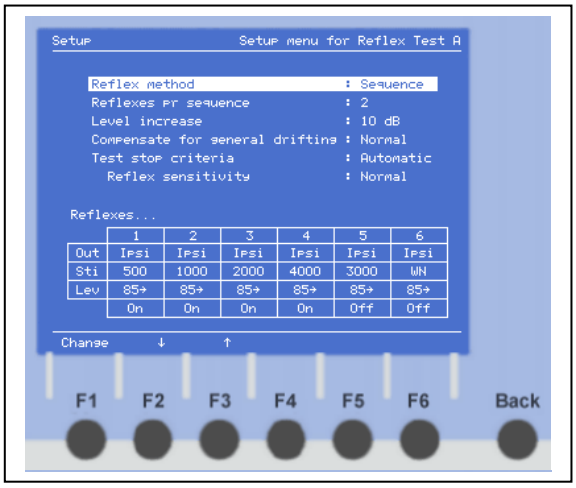
Reflex Test (method is Fixed). Figure 18

Navigating and changing in the Table
Use the 4 arrow keys to move the bar in the table. You can use change to select another option for a given item, but you may also use the dedicated keys as well. If for an example you want to change the level you can use the dB keys instead of the Change (F1). See Figure 3.



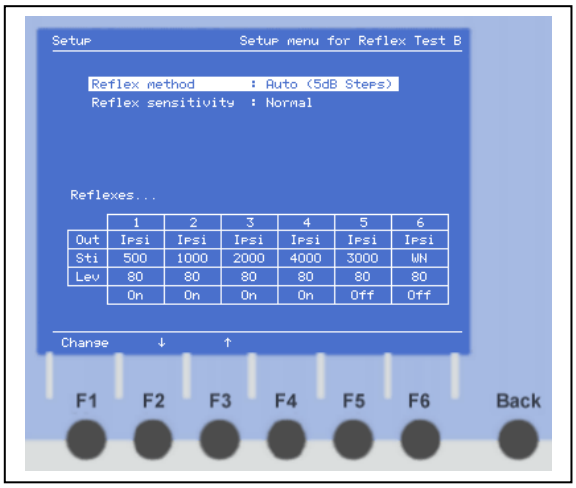
Reflex Table. Figure 19

Following figure is equal to factory settings for Reflex Test A.



Reflex Test A. Figure 20

Following figure is equal to factory settings for Reflex Test B.



Reflex Test B. Figure 21

Output

Factory See Table 1 **Range** Ipsi or contra.

Description Can be assigned to Ipsi or contra as output.

Stimuli Frequency

Factory See Table 1

Range Ipsi is 500 Hz, 1000 Hz, 2000 Hz, 3000 Hz, 4000 Hz, WN, LP or HP. Contra is 125 Hz, 250 Hz, 500 Hz, 750 Hz, 1000 Hz, 1500 Hz, 2000 Hz, 3000 Hz, 4000 Hz, 6000 Hz, 8000 Hz, WN, LP or HP.

Description Can assign new stimuli to Ipsi or contra.

Level

Factory See Table 1

Range 60 dB to Maximum (depend of transducer and selected frequency).

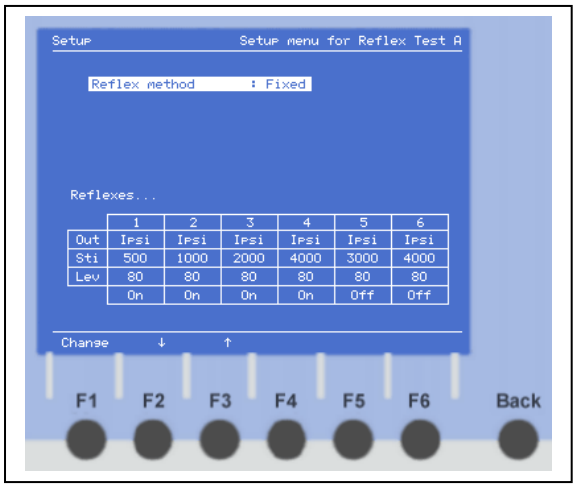
Description If Reflex Method is selected to Sequence an arrow will be put after the intensity value to indicate that this is the start level.

In table 1 you will find that the factory test configuration will perform 4 of the 6 reflexes. Setting the last row to on/off depending on what you want to start with can choose this.

Reflex Methods

The Reflex Method can be assigned to 4 different methods where three of the four methods have additional setup points. In the following you can see what they do and how to set them up.

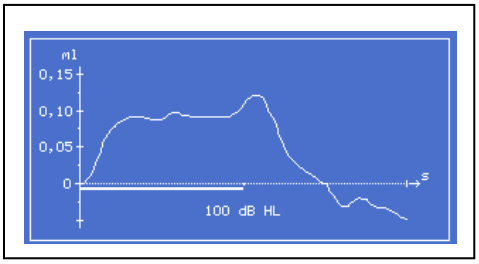
Fixed



Reflex Method Fixed. Figure 22

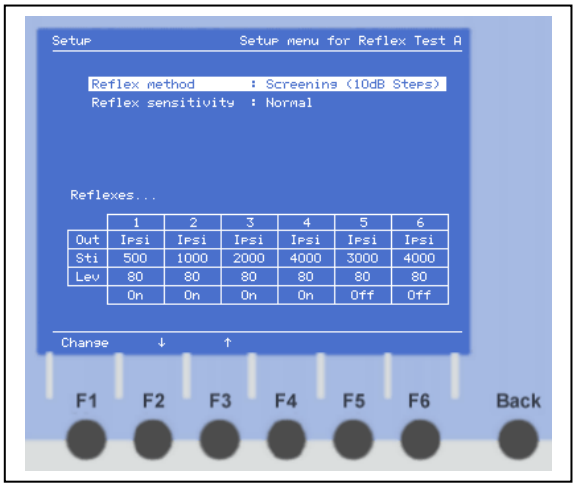
Method description

A fixed intensity reflex is one reflex taken at one intensity level like the one in Figure 7.



Fixed Reflex. Figure 23

Screening (10 dB Steps)



Reflex Method Screening (10 dB Steps). Figure 24

Method description

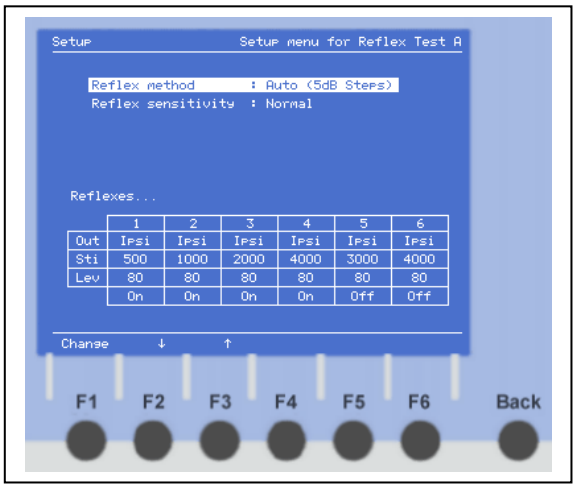
The Screening method is an auto test for detecting reflexes. Starting at level from the reflex table the automation will do a reflex measurement and verify the reflex against the reflex sensitivity box (see “Reflex Sensitivity”). If the reflex is bigger than the sensitivity box the test is done. If not the intensity level will increase with 10 dB and do another reflex. This will continue until the reflex is bigger than the sensitivity box or until maximum intensity level has been reached.

Reflex Sensitivity

Factory Normal **Range** Sensitive, Normal or Robust.

Description See “Reflex Sensitivity”

Auto (5 dB Steps)



	1	2	3	4	5	6
Out	Ipsi	Ipsi	Ipsi	Ipsi	Ipsi	Ipsi
Sti	500	1000	2000	4000	3000	4000
Lev	80	80	80	80	80	80
	On	On	On	On	Off	Off

Reflex Method Auto (5 dB). Figure 25

Method description

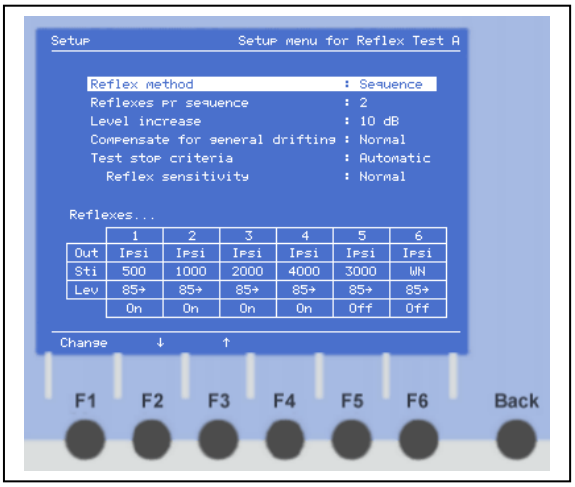
The auto test method is a bit different from the screening method. It presents a stimulus for a time of approximately 80 mS where after it verifies the compliance against the start compliance. If the difference is bigger than the size of the reflex sensitivity test box (see “Reflex Sensitivity”), it performs a reflex measurement. The reflex is then tested against the reflex sensitivity test box. If the reflex is outside the test box the reflex measurement is done. If not the instrument performs the same test once again. If the search fails after second attempt the instrument will continue the search with the screening method in 5 dB steps instead of the currently auto search. If the reflex intensity level reaches maximum intensity level for the transducer the search is done accepting the reflex found.

Reflex sensitivity

Factory Normal **Range** Sensitive, Normal or Robust.

Description See “Reflex Sensitivity”

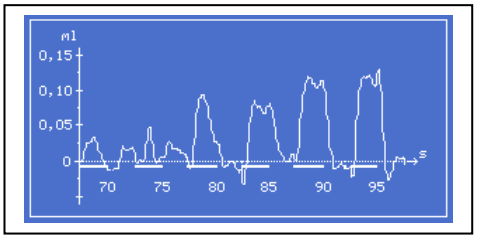
Sequence



Reflex Method Sequence. Figure 26

Method description

The sequence method gives the possibility of having up to 6 single reflexes in one Figure. The level from the table is used as start level and the jump between each reflex can be set in “Level increase”. The screening method has stop criteria so it stops the measurement if the reflex is equal to or bigger than the reflex sensitivity test box. The function can be selected on or off and the level of sensitivity can be selected in the “Reflex Sensitivity” item.



Reflex Sequence.Figure 27

Reflexes pr sequence

Factory 6 reflexes pr sequence **Range** 2,3,4,5 or 6 reflexes pr sequence

Description Lets you have up to 6 reflexes pr sequence. Note that the higher the number of reflexes is the less detailed the graphic will be.

Level of increase

Factory 5 dB **Range** 5,6,7,8,9 or 10 dB

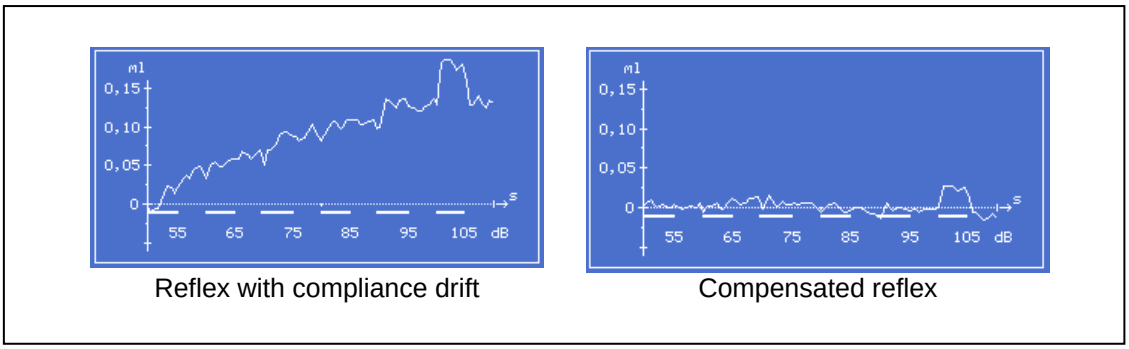
Description How many dB the intensity will be increased between each single reflex.

Compensation for general drifting

Factory Normal

Range Off and Normal

Description During a sequence reflex measurement the compliance may drift as you can see in the figure below. To compensate for this drift select the “Normal” and the reflex drift will be removed.



Compliance drifting. Figure 28

Test stop criteria

Factory Off **Range** On or Off

Description Let you select if you want to skip the rest of the reflexes in a sequence when the condition are matched and continue with the next sequence.

Reflex Sensitivity

Factory Normal **Range** Sensitive, Normal or Robust.

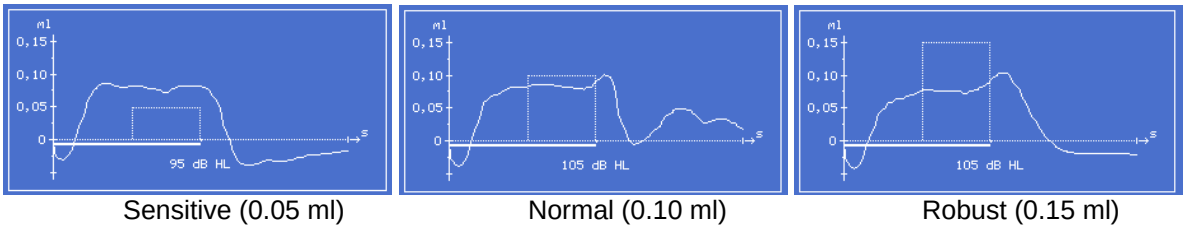
Description See “Reflex Sensitivity”

Reflex sensitivity

When using reflex the automatic methods Automatic or Screening, the AT235 uses an algorithm to determined if a reflex is okay or not. The level of sensitivity can be set with setup item “Reflex Sensitivity” where you can choose between Sensitive, Normal or Robust. The AT235 has two different modes of leveling sensitivity : ml or % (can be set in the Advanced User Setup) and depending on what method you will get different results. Look in the following Figures for the difference.

When using auto search for reflexes the algorithms in the software will go on until intensity has reached maximum level for the selected transducer at the give frequency. So the software in two ways can accept the reflex: the reflex does not touch the test box (the test box is normally invisibly) or intensity is at maximum level. You can se what a test box is by looking at the Figures below. The test box is the dotted rectangle in the middle of the Figure.

Reflex sensitivity in ml

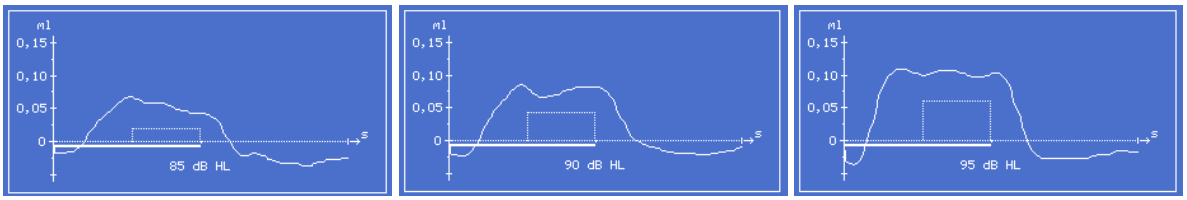


Sensitive (0.05 ml) Normal (0.10 ml) Robust (0.15 ml)

Reflex Sensitivity in ml. Figure 29

The first reflex is okay because the reflex does not touch the test box. The two last reflexes is not okay according to the algorithm but has been accepted because of maximum intensity level.

Reflex sensitivity in %



Sensitive (2 %) Normal (4 %) Robust (6 %)

Reflex Sensitivity in %. Figure 30

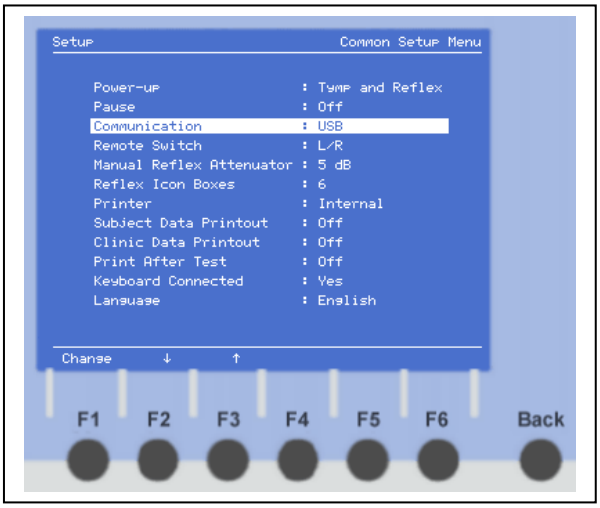
All three reflexes are okay because none of them is inside or touching the test box.

The height of the test box when using % sensitivity depends on the size of the ear volume.

The sensitivity condition is used by the auto method, screening method and by the sequence method.

Note! The test box is not shown in the AT235 software. It only serves as examples of what sensitivity is and how we do it.

Common Setup



Common Setup. Figure 31

Power-up

Factory Tymp and Reflex **Range** "Tymp" or "Tymp and Reflex "

Description Selects what menu the instrument will go to after power-up.

Pause - default

Factory Off **Range** On or Off

Description If "On" is selected the pause key is pre selected when a test is finished and when entering the automatic impedance menu.

Communication

Factory USB **Range** USB

Remote Switch

Factory L/R **Range** Pause, Off or L/R

Description Selects the function of the key on the impedance transducer.

Manual Reflex Attenuator

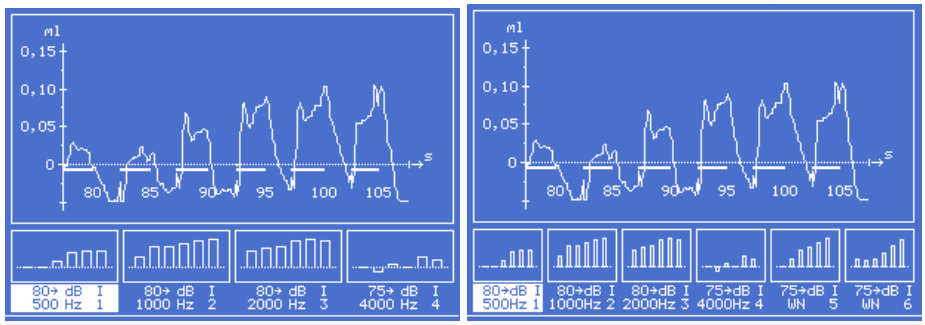
Factory 5 dB **Range** 1, 2 or 5 dB

Description How many dB's the intensity will increase/decrease when pressing the dB keys in manual impedance mode.

Reflex Icon Boxes

Factory 6 boxes **Range** 4 or 6 Boxes

Description Selects between 4 or 6 reflex icon boxes (see Figure)



4 vs. 6 Reflex Icon Boxes. Figure 32

Printer

Factory Internal **Range** Internal, HP PCL L3, IBM Mode or Off.

Description Select what type of printer that is attached to the instrument.

Note! The HP PCL L3 mode shall be selected in when connecting a HP Laser printer.

Subject data printout

Factory On **Range** On or Off

Description If “On” is selected the subject information will be printed together with subject data.

Note! Only available when using internal printer.

Clinic data printout

Factory On **Range** On or Off

Description If “On” is selected the clinic information will be printed together with subject data.

Print After Test

Factory Off **Range** On or Off

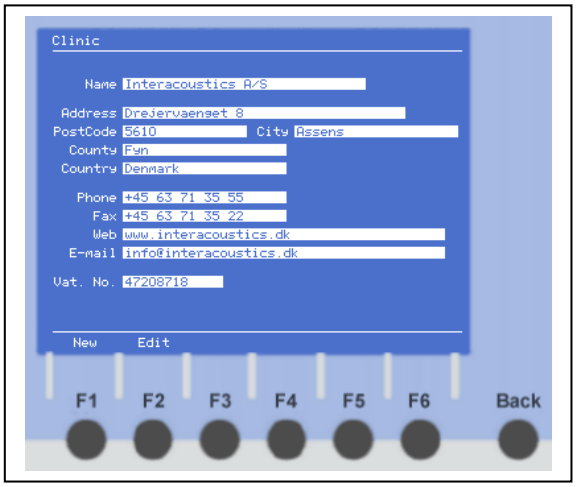
Description When a test is done and data are recorded on both ears a print out will be done on the selected printer.

Keyboard Connected

Factory No **Range** Yes or No

Description If “Yes” is selected the subject menu will appear when pressing <New Subject> where it is possible to enter subject data and/or delete current data and proceed with a new measurement. If “No” is selected a dialog box saying “All Data Deleted!” will appear shortly and the instrument is ready for a new measurement.

Clinic Setup



Clinic Setup. Figure 33

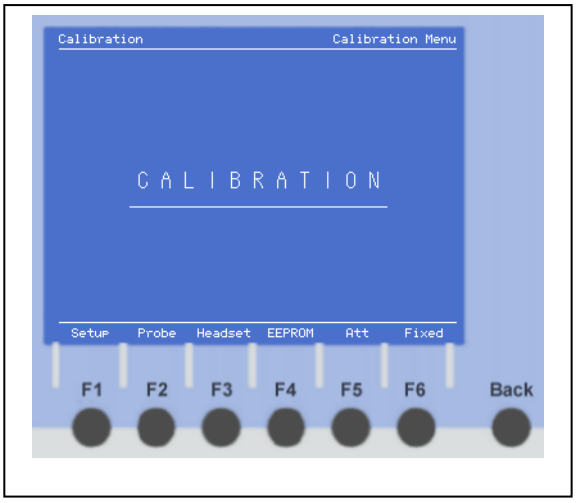
The Clinic Setup lets you insert your clinic data used for printouts. Note that the setup item “Clinic Data Printout” in the Common Menu needs to be On before data comes out on paper.

To enter data you need an AT keyboard (ordinary PC keyboard) attached to the AT235 while entering data.

Appendix C Advanced User Setup

Advanced User Setup

This appendix describes the advanced setup functions of the AT235.

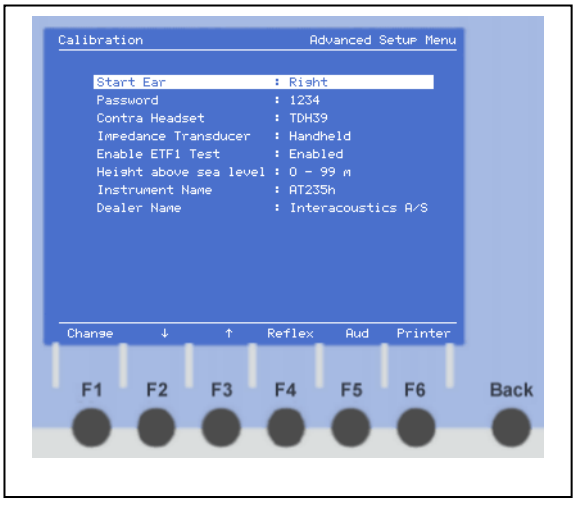


The Calibration Menu. Figure 34

In the Calibration menu there are two issues of interest for setting up the AT235. The first is the Advanced User Setup and the second is the setup storage facilities in the EEPROM menu. Note that it requires a password to access the Calibration and that entering the calibration menu is done during power up by holding down <shift> and <print> until you can enter the password.

The Advanced User Setup

The first setup that appears when pressing Setup (F1) in the calibration menu is a setup for common stuff.



Advanced User Setup. Figure 35

Start Ear

Factory Right **Range** Right or Left

Description Here you may choose which ear to select automatically for the first test.

Password

Factory 1234 **Range** Each digit can be change within a range of 0 to 9

Description Makes it possible to change the password for entering the calibration.

Note! You need an AT Keyboard to change this item and Keyboard “On” must be selected in the Common menu.

Contra Headset

Factory TDH39 **Range** Cir22, TDH39 or EAR 3A

Description Here you may choose which contra headset to use.

Impedance Transducer

Factory Handheld **Range** Handheld or Clinic

Description Gives you the possibility to change between the Clinical and the Handheld impedance transducer. Note that the transducer might need to be calibrated before use and that the AT235 can hold calibration sets for both transducers at the same time.

Enalbel ETF1 Test

Factory Enable **Range** Enable or Disable

Description If you select disable it is not possible to start the ETF test.

Height above sea level

Factory 0 - 99 m **Range** 0 - 2599 m in 100 m steps

Description To give a more precise measuring system – especially at high probe tone tympanometry.

Instrument Name

Factory AT235

Description Makes it possible to change the instrument name.

Note! You need an AT Keyboard to change this item and Keyboard “On” must be selected in the Common menu.

Dealer Name

Factory Interacoustics A/S

Description Makes it possible to change the Dealer name. The Dealer name appears on the top of thermo printout.

Note! You need an AT Keyboard to change this item and Keyboard “On” must be selected in the Common menu.

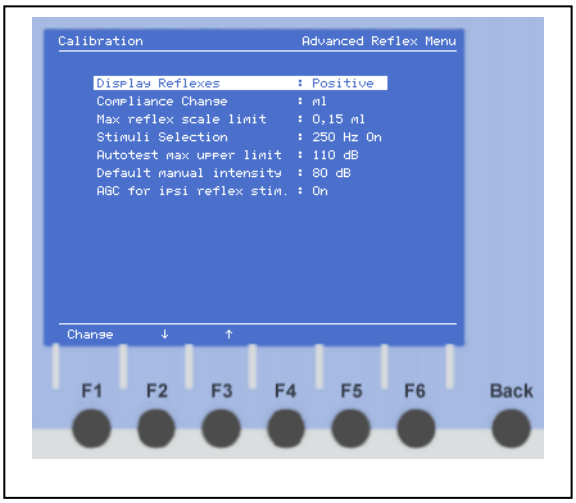
Seal sensitivity:

Sensitive This gives reproducible results. Require quiet probe handling.

Normal Quicker seal detection and less sensitive than the above selection.

Robust Very quick seal detection. AGC on the probe tone is disabled.

Advanced Reflex User Setup

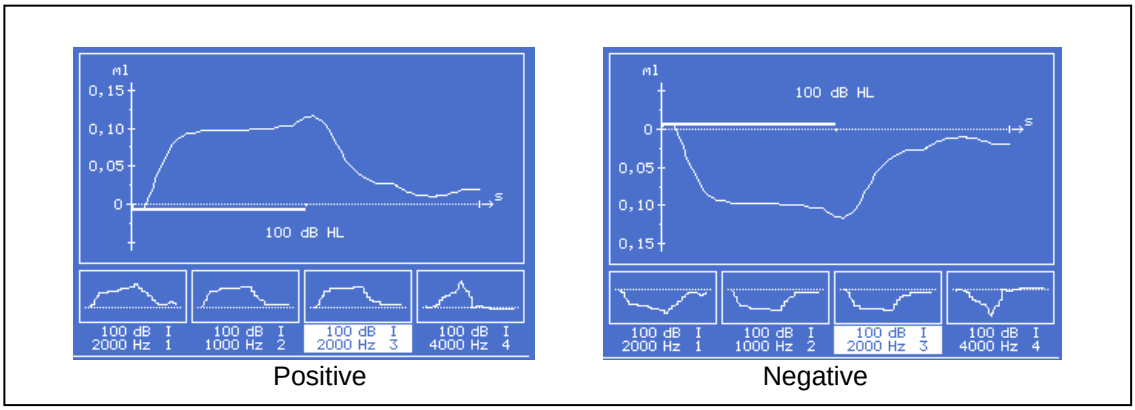


Advanced Reflex User Setup. Figure 36

Display Reflexes

Factory Positive **Range** Positive or Negative

Description Selects how to display the reflexes in the diagrams.



Positive and Negative reflex display. Figure 37

Complaince Change

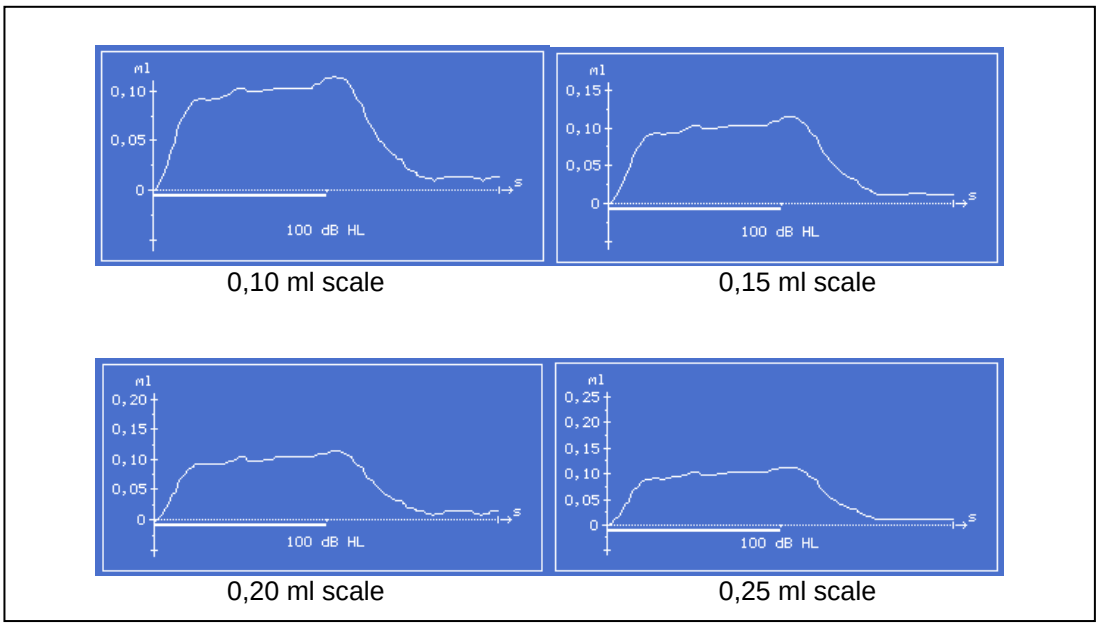
Factory ml **Range** ml or %

Description This setup item is used in connection with the “Reflex Sensitivity” setup item from the Reflex Test A/B menu. Choose between ml (0.05, 0.10 or 0.15 ml) and % (2, 4 or 6 % of ear volume).

Max Reflex scale limit

Factory 0,15 ml **Range** 0,10 ml, 0,15 ml, 0,20 ml or 0,25 ml

Description Is used to select the scale of the ml axis of the reflex diagram.



Same Reflex in different scales. Figure 38

Stimuli Selection

Factory All frequencies are selected as factory setting

Range 250 Hz, 750 Hz, 1500 Hz, 3000 Hz, 4000 Hz, 6000 Hz, 8000 Hz, WN, LP and HP can be selected as On or Off.

Description Use the frequency keys to select the desired frequency and press Change (F1) to select “On” or “Off”. Note! This item has influence on both ipsi and contra frequencies.

Ipsi frequencies: 500 Hz, 1000 Hz, 2000 Hz, 3000 Hz, 4000 Hz, WN, LP, HP.

Contra frequencies: 250 Hz, 500 Hz, 750 Hz, 1000 Hz, 1500 Hz, 2000 Hz, 3000 Hz, 4000 Hz, 6000 Hz, 8000 Hz, WN, LP, HP.

Autotest Max upper limit

Factory 110 dB **Range** From 90 dB to 110 dB in 5 dB steps.

Description Safety percussion to prevent the subject to get a higher output level than the level from this setup item during an impedance auto test measurement.

Default manual intensity

Factory 80 dB **Range** From 60 dB to 90 dB in 1 dB steps.

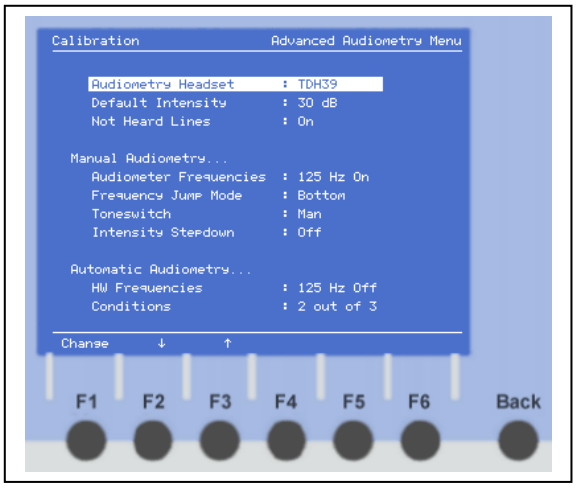
Description Start intensity level for manual impedance audiometry.

AGC for ipsi reflex stimuli

Factory Off **Range** On or Off

Description If ear volume is smaller than 2 ml the AGC (Acoustic Gain Control) for ipsi reflex stimuli will correct the level with the same level correction as for the AGC Probe tone control. The function will avoid too high levels in ear with smaller ear volumes. If the ear volume is higher than or equal to 2 ml the AGC Stimuli system will do nothing.

Advanced Audiometry User Setup



Advanced Audiometry User Setup. Figure 39

Audiometry Headset

Factory TDH39 **Range** TDH39 or EAR 3A.

Description Selects what headset to be used in audiometry menus. Note that by choosing another transducer you may need to calibrate the transducer. The AT235 can hold calibration values for both transducers.

Default intensity

Factory 30 dB **Range** Off, -10 to 50 dB in 5 dB steps

Description If Off is selected the instrument will behave as follows:

In manual audiometry the intensity it will hold its level when shifting transducer and will initially go to 30 when selecting the manual audiometry.

In the HW test the intensity will always go to 40 dB no matter what the previous intensity was.

If a value is selected the instrument will behave as follows:

Entering on of the two menus or changing transducer the intensity will go to the selected level.

Not Heard Lines

Factory On **Range** On or Off

Description Selects to draw line to not heard symbols or not.

Manual Audiometry

Audiometry Frequencies

Factory All frequencies are selected as factory setting

Range 125 Hz, 250 Hz, 750 Hz, 1500 Hz, 3000 Hz, 6000 Hz and 8000 Hz can be selected as On or Off.

Description Use the frequency keys to select the desired frequency and press Change (F1) to select “On” or “Off”.

Frequency Jump Mode

Factory Bottom **Range** Bottom or Butterfly

Description Is used to select how the frequency jumps, when activating the frequency keys.

Bottom
Trying to increase the frequency selection beyond 8000 Hz, will cause the frequency to jump to 125 Hz, ready to perform increasing frequency selection.

Butterfly
Trying to increase the frequency selection beyond 8000 Hz, will cause the frequency to jump to 1000 Hz, ready to perform decreasing frequency selection. Trying to decrease the frequency below the lowest frequency will cause the frequency to go to 1000 Hz ready to perform increasing frequency selection.

Tone switch

Factory Man **Range** Man or Rev

Description Is used to select how the Toneswitch controls the sound stimulation.

Man
The sound is presented to the patient when the Toneswitch is activated.

Rev
The sound is presented continuously to the patient until the Toneswitch is activated.

Intensity Stepdown

Factory Off **Range** Off - 5 - 10 - 15 - 20 - 25 - 30 - 35 - 40 dB

Description Is used to select how much the Intensity is decreased when the frequency is changed.

HW Frequencies

Factory All frequencies are “Off” as factory setting

Range 125 Hz, 250 Hz, 750 Hz, 1500 Hz, 3000 Hz, 6000 Hz and 8000 Hz can be selected as On or Off.

Description Use the frequency keys to select the desired frequency and press Change (F1) to select “On” or “Off”.

Conditions

Factory 2 out of 3 **Range** “2 out of 3” or “3 out of 5”

Description Is used to select the threshold method in ‘H.W. Test’. The possibilities are 2 responses out of 3 presentations, or 3 responses out of 5 presentations on the same dB value.

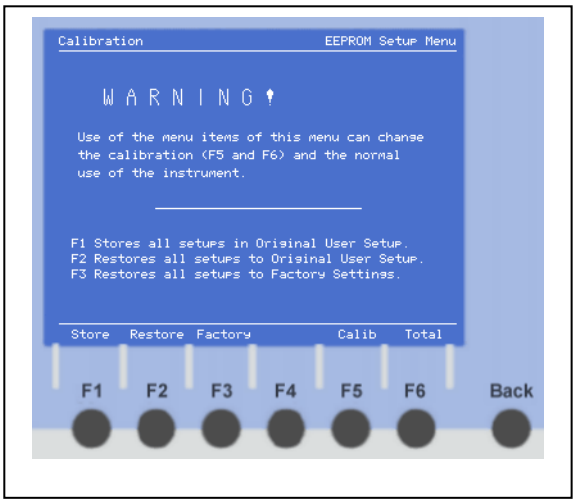
Letter Printout Error (Internal printer)

Some of the internal printer modules (thermo printer) can loose their font data and therefore do printouts with errors in the letters. If this error should occur please use this option to restore fonts in the internal printer module. Note! If not the internal printer option is selected in the Common menu this menu item will be invisible

Press Print (F6) in the Advanced User Setup and follow the instructions on the screen.

Note! Before restoring the fonts a jumper must be placed on the printer interface board connector J3, see Printer Connections for details.

Storing/Restoring the Setup



EEPROM Menu. Figure 40

The AT235 provides a tool for administrating the information stored in the setups. It can store, restore the setup and initiate to factory settings either from this EEROM menu or restore setup data trough a key press during power up.

When the setup of the instrument is done you can enter this menu and store all settings as an original setup. If a user changes in some setup items and cannot get the instrument to work properly afterwards ask the person to switch off power, hold down <shift>+<F4>, switch power on again and press “Yes” (F1) when the instrument asks you to restore setup to original setup. By doing so you bring the setup back to the settings you stored before you send it to the user.

You can also guide the user in to this EEPROM menu, but that requires you to tell the user the password.

Factory setting is our way of doing the setup.

Appendix U - Update News

Following Improvements are made for instruments from no. 750659

***New* Main board complete assembled board PCA version 51007410 (PCB 69010807)**
Compatible to previous version

Optimisation of the pump driver IC77

Following Improvements are made for instruments from no. 737336

***New* Main board complete assembled board PCA version 51007409**
Compatible to previous version

Resistor R367 is modified to improve tolerance for flash programming

Following Improvements are made for instruments from no. 639427
Not compatible to previous versions

***New* Main board**
Redesign for USB connection

***New* Keyboard**
Connections for Main board modified

***New* Rear panel**
Serial communication modified from RS232 to USB

***New* software version 2.00200**

Following Improvements are made for instruments from no. 206321

Ferrites L1, L4, L6 and L7 are replaced with 0R resistors due to intermittent measurement errors after introducing lead-free version of DSP.

All instruments shipped after 29.03.2006 have been modified, including some instruments with lower serial number than 206321.

This modification is described in technical note 0602 dated 22.03.2006

Following Improvements are made for instruments from no. 189850

***New* Display**
Compatible to previous Display
Fulfilling the RoHS directive

Inverter PCB is not longer mounted
0R resistor R204 is mounted