Technical Specifications

AA222

Impedance Audiometer

Interacoustics

D-0116007-C – 2017/11

Included and optional parts

The AA222 consists of the following parts:

Included parts	AA222 instrument Power supply unit UE60-240250SPA3 Operation manual CD including Additional Information Multilingual instructions for use Cleaning cloth Clinical probe system and/or Diagnostic probe system[1] Contralateral headphone[1] Assortment bag BET55 Floss kit Daily check cavity Audiometric headset[1] Monitor headset Bone conductor[1] APS3 Patient response[1]
Optional parts	Printer kit including MTPIII printer Wall mount CAT50 calibration cavities IP30 Insert contra headphone[1] CIR insert earphone[1] TDH39 contra headphone[1] Amplivox audiocups, noise reducing headset[1] EARTone3A/5A Audiometric insert phones[1] IP30 Audiometric insert phones[1] HDA300 Audiometric headset with double mono 6.3mm jack[1] HDA280 Audiometric headset [1] TDH39 Audiometric headset[1] DD450 Audiometric headset with ambient noise isolation[1] Free field speaker Talk back microphone Diagnostic Suite software OtoAccess™ database

[1] Applied part as according to IEC60601-1

Technical specifications

General		
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 no0123	
Standards:	Safety:	IEC 60601-1, Class I, Type B applied parts
	EMC:	IEC 60601-1-2
	Impedance:	IEC 60645-5 (2004)/ANSI S3.39 (2012), Type 1
	Audiometer:	Tone Audiometer: IEC 60645 -1 (2012), ANSI S3.6 (2010), Type 2 Speech Audiometer: IEC 60645-2 (1997)/ANSI S3.6 (2010) type B or B-E. Auto threshold tests: ISO 8253-1 (2010)
Operation environment:	Temperature:	15 – 35 °C
	Relative Humidity:	30 – 90%
	Ambient Pressure:	98kPa – 104kPa
	Warm-up Time:	1 minute
Display	10 inch high resolution color display 1024x600	
Transport & Storage:	Storage Temperature: Transport Temperature: Rel. Humidity:	0°C – 50°C -20 – 50 °C 10 – 95%
Internal storage	500 clients and 50.000 sessions	
Internal Battery		CR2032 3V, 230mAh, Li. Not serviceable by user.
PC control:	USB:	Input/output for computer communication. AA222 can be fully operated from a PC. The measurements can then be followed on the PC screen. Data can be transferred to Diagnostic Suite and stored in OtoAccess™ or Noah.
Thermal printer (Optional):	Type: MPT-III	Thermal MPT-III printer with recording paper in rolls. HP Officejet Pro 251dw, HP LaserJet Pro 400 color M451nw, HP Color Laser Jet pro M252n, HP Color Laser Jet Enterprise M553. Print on command via USB
Power supply	UE60-240250SPA3	Use only specified power supply unit type Input: 100-240VAC 50-60Hz, 1.5 A Output: 24.0 VDC
Dimensions	H x W x L	9 x 33 x 44 cm 3.5 x 13 x 17.3 inches
AA222 Weight		3.1 kg / 6.8 lb

Impedance Measuring System		
Probe tone:	Frequency: Level:	226 Hz, 678 Hz, 800 Hz, 1000 Hz; pure tones; ±1% 85 dB SPL (≈ 69 dB HL) ±1.5 dB
Air pressure:	Control: Indicator: Range: Pressure limitation: Pump speed:	Automatic. Measured value is displayed on the graphical display. -600 to +400 daPa. ±5% -750 daPa and +550 daPa. Automatic, Fast 300 daPa/s, Medium 200 daPa/s, Slow 100 daPa/s, Very slow 50 daPa/s.
Compliance:	Range:	0.1 to 8.0 ml at 226 Hz probe tone (Ear volume: 0.1 to 8.0 ml) and 0.1 to 15 mmho at 678, 800 and 1000 Hz probe tone. All ±5%
Test types:	Tympanometry	Automatic, where the start and stop pressure can be user-programmed in the setup function. Manual control of all functions.
	Eustachian tube function 1 - Non perforated eardrum	Williams test
	Eustachian tube function 2 - Perforated eardrum	Toynbee test
	Eustachian tube function 3 - Patulous Eustachian tube	Continuous sensitive impedance measurement
Reflex Functions		
Signal sources:	Tone - Contra, Reflex: THD:	250, 500, 1000, 2000, 3000, 4000, 6000, 8000 Hz, Wide Band, High and Low pass. Less than 5 until 110 dB, 5 % above 110 dB (supra-aural headphones), less than 5 % until 110 dB, 10 % above 110 dB (insert earphones or probe).
	Tone - Ipsi, Reflex:	500, 1000, 2000, 3000, 4000 Hz wide band, high and low pass.
	NB noise – Contra, Reflex	250, 500, 1000, 2000, 3000, 4000, 6000, 8000 Hz
	NB noise – Ipsi, Reflex	1000, 2000, 3000, 4000 Hz
	Stimulus duration:	750 ms
	Reflex Acceptance	Adjustable between 2 % and 6 %, or 0.05 – 0.15 ml change of ear canal volume.
	Intervals	Down to 1 dB step size.
	Intensity max	90, 100, 120 dB HL.
Outputs:	Contra Earphone:	TDH39 earphone, DD45 earphone, CIR insert and/or EARtone 3A insert, IP30 for Reflex measurements.
	Ipsi Earphone:	Probe earphone incorporated in the probe system for Reflex measurements.
	Probe connection	Connection of the electrical and air system to the probe.
Test types:	Manual Reflex	Manual control of all functions.
	Automated Reflex	Single intensities Reflex growth
	Reflex Decay	Automatic, 10 dB above threshold and manually controlled with stimulus durations of 10 s.
	Reflex latency	Automated, first 300 ms from stimulus start.

Audiometry measure system	
Air Conduction	DD45: PTB/DTU report 2009 TDH39: ISO 389-1 1998, ANSI S3.6-2010 HDA300: PTB report PTB 1.61 – 4064893/13 HDA280: PTB report 2004 E.A.R Tone 3A/5A: ISO 389-2 1994, ANSI S3.6-2010 IP 30: ISO 389-2 1994, ANSI S3.6-2010 DES-2361
Bone Conduction	B71: ISO 389-3 1994, ANSI S3.6-2010 B81: ISO 389-3 1994, ANSI S3.6-2010 Placement: Mastoid
Free Field	ISO 389-7 2005, ANSI S3.6-2010
Effective masking	ISO 389-4 1994, ANSI S3.6-2010
Transducers	DD45 Headband Static Force 4.5N ±0.5N TDH39 Headband Static Force 4.5N ±0.5N HDA300 Headband Static Force 8.8N ±0.5N HDA280 Headband Static Force 4.5N ±0.5N B71 Headband Static Force 5.4N ±0.5N B81 Headband Static Force 5.4N ±0.5N E.A.R Tone 3A/5A IP30
Patient Response switch	One hand held push button
Patient communication	Talk Forward (TF) and Talk Back (TB)
Monitor	Output through built-in speaker or through external earphone or speaker.
Special tests/test battery	SISI, ABLB, Stenger, Stenger Speech, Langenbeck (tone in noise), 2 channel speech, Auto threshold Auto threshold tests: Available time for patient to respond: Same as tone presentation Increment of hearing level: 5dB.
Tone	125-8000Hz. Resolution 1/2-1/24 octave.
Warble Tone	1-10 Hz sine +/- 5% modulation
Wave file	44100Hz sampling, 16 bits, 2 channels
Masking	Automatic selection of narrow band noise (or white noise) for tone presentation and speech noise for speech presentation. Narrow band noise: IEC 60645-1:2001, 5/12 Octave filter with the same centre frequency resolution as pure Tone. White noise: 80-20000Hz measured with constant bandwidth Speech Noise: IEC 60645-2:1993 125-6000Hz falling 12dB/octave above 1KHz +/-5dB
Presentation	Manual or Reverse. Single or multiple pulses. Auto testing: duration 1-2 s adjusted in 0.1 s intervals
Intensity	Check the accompanying Appendix. Available Intensity Steps is 1, 2 or 5dB Extended range function: If not activated, the Air Conduction output will be limited to 20 dB below maximum output.
Frequency range	125Hz to 8kHz 125Hz, 250Hz, 750Hz, 1500Hz and 8kHz may freely be deselected

<table>
<tr><td>Speech</td><td>
<u>Frequency Response:</u>
<table>
<tr><th>(Typical)</th><th>Frequecy (Hz)</th><th colspan="2">Linear (dB)</th><th colspan="2">FFequv (dB)</th></tr>
<tr><th></th><th></th><th>Ext sign[1]</th><th>Int. Sign[2]</th><th>Ext sign[1]</th><th>Int. Sign[2]</th></tr>
<tr><td>TDH39 (IEC 60318-3 Coupler)</td><td>125-250
250-4000
4000-6300</td><td>+0/-2
+2/-2
+1/-0</td><td>+0/-2
+2/-1
+1/-0</td><td>+0/-8
+2/-2
+1/-0</td><td>+0/-8
+2/-2
+1/-0</td></tr>
<tr><td>DD45 (IEC 60318-3 Coupler)</td><td>125-250
250-4000
4000-6300</td><td>+0/-2
+1/-1
+0/-2</td><td>+1/-0
+1/-1
+0/-2</td><td>+0/-
+2/-2
+1/-1</td><td>+0/-7
+2/-3
+1/-1</td></tr>
<tr><td>E.A.R Tone 3A (IEC 60318-5 Coupler)</td><td>250-4000</td><td>+2/-3</td><td>+4/-1</td><td>(Non linear)</td><td></td></tr>
<tr><td>IP 30 (IEC 60318-5 Coupler)</td><td>250-4000</td><td>+2/-3</td><td>+4/-1</td><td>(Non linear)</td><td></td></tr>
<tr><td>B71/B81 Bone Conductor (IEC 60318-6 Coupler)</td><td>250-4000</td><td>+12/-12</td><td>+12/-12</td><td>(Non linear)</td><td></td></tr>
</table>
2% THD at 1000 Hz max output +9 dB (increasing at lower frequency)
Level range: -10 to 50 dB HL, overall THD <6%
1. Ext. sign: CD input 2. Int. sign: Wave files
</td></tr>
<tr><td>External signal</td><td>Speech replaying equipment connected to the CD input must have a signal-to-noise ratio of 45 dB or higher.
The speech material used must include a calibration signal suitable for adjusting the input to 0 dBVU.</td></tr>
<tr><td>Microphone (Live speech)</td><td>The included headset is used for live speech presentation. The monitor headset is a boom type microphone placed near the mouth of the operator. Before live speech is performed the microphone gain must be adjusted to 0 VU.</td></tr>
<tr><td>Free Field</td><td>
<u>Power amplifier and loudspeakers</u>
With an input of 7 Vrms - Amplifier and loudspeakers must be able to create a Sound Pressure Level of 100 dB in a distance of 1 meter - and meet the following requirements:
<table>
<tr><th colspan="2">Frequency Response</th><th colspan="2">Total Harmonic Distortion</th></tr>
<tr><td>125-250 Hz</td><td>+0/-10 dB</td><td>80 dB SPL</td><td>< 3%</td></tr>
<tr><td>250-4000 Hz</td><td>±3 dB</td><td>100 dB SPL</td><td>< 10%</td></tr>
<tr><td>4000-6300 Hz</td><td>±5 dB</td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Signal Indicator (VU)</td><td>Time weighting: 300mS
Dynamic range: 23dB
Rectifier characteristics: RMS
Selectable inputs are provide with an attenuator by which the level can be adjusted to the indicator reference position (0dB).</td></tr>
<tr><td>Data Connections (sockets)</td><td>1 x USB A (compatible with USB 1.1 and later)
1 x USB B (compatible with USB 1.1 and later)
1 x LAN
1 x HDMI (VGA 640x480)</td></tr>
</table>

External keyboard	Standard keyboard (for data entry)	
Input Specifications	TB	100uVrms at max. gain for 0dB reading Input impedance : 3.2kOhm
	CD	7mVrms at max. gain for 0dB reading Input impedance : 47kOhm
	TF	100uVrms at max. gain for 0dB reading Input impedance : 3.2kOhm
	Wave files	Plays wave file from Internal SD card
	Pat. Resp.	Hand held push button
Output Specifications	FF1 & 2	7Vrms at min. 2kOhm load 60-20000Hz -3dB
	Left & Right	7Vrms at 10 Ohms load 60-20000Hz -3dB
	Bone	7Vrms at 10 Ohms load 60-8000Hz -3dB
	Monitor	2x 3Vrms at 32 Ohms / 1.5Vrms at 8 Ohms load 60-20000Hz -3dB

Calibration Properties

Calibrated Transducers:	Contralateral Earphone:	Telephonics TDH39/DD45 with a static force of 4.5N 0.5N and/or EARtone 3A and/or CIR insert phone
	Probe system:	Ipsilateral Earphone: is integrated in the probe system
		Probe frequency transmitter and receiver and pressure transducer is integrated in the probe system
Accuracy:	General	Generally the instrument is made and calibrated to be within and better than the tolerances required in the specified standards:
	Reflex Frequencies:	±1%
	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 : Compliance measurement:	5% or 10 daPa, whichever is greater 5% or 0.1 ml, whichever is greater
Stimulus Presentation Control:	Reflexes:	ON-OFF ratio ≥ 70 dB Rise time = 20 ms Fall time = 20 ms A weighted SPL in Off = 31 dB
Impedance Calibration Properties		
Probe tone	Frequencies:	226 Hz 1%, 678 Hz 1%, 800 Hz 1%, 1000 Hz 1%
	Level:	85 dB SPL 1.5 dB measured in an IEC 60318-5 acoustic coupler. The level is constant for all volumes in the measurement range.
	Distortion:	Max 1% THD
Compliance	Range:	0.1 to 8.0 ml
	Temperature dependence:	-0.003 ml/C
	Pressure dependence:	-0.00020 ml/daPa
	Reflex sensitivity: Reflex artifact level:	0.001 ml is the lowest detectable volume change ≥95 dB SPL (measured in the 711 coupler, 0.2 ml, 0.5 ml, 2.0 ml & 5.0 ml hard walled cavities).
	Temporal reflex characteristics: *(IEC60645-5 clause 5.1.6)*	Initial latency = 35 ms (5 ms) Rise time = 42 ms (5 ms) Terminal latency = 23 ms (5 ms) Fall time = 44 ms (5 ms) Overshoot = max. 1% Undershoot = max. 1%
Pressure	Range:	Values between -600 to +400 daPa can be selected in the setup.
	Safety limits:	-750 daPa and +550 daPa, 50 daPa
Barometric pressure	The barometer pressure chances influence on the impedance measurement in the specified range (97300 – 105300calibration Pascal).	Admittance can vary inside: ± 4% The pressure accuracy is: ±10 daPa or 10%, whichever is greater.

<table>
<tr><td>Height above sea level</td><td colspan="2">The pressure sensor used, is a differential/gauge type, which means, it measure the pressure difference and therefore not affected of the height above sea level.
<table>
<tr><th>Probe tones</th><th>0 meters</th><th>500 meters</th><th>1000 meters</th><th>2000 meters</th><th>4000 meters</th></tr>
<tr><td>226 Hz</td><td>1.0 mmho</td><td>1.06 mmho</td><td>1.13 mmho</td><td>1.28 mmho</td><td>1.65 mmho</td></tr>
<tr><td>678 Hz</td><td>3.0 mmho</td><td>3.19 mmho</td><td>3.40 mmho</td><td>3.85 mmho</td><td>4.95 mmho</td></tr>
<tr><td>800 Hz</td><td>3.54 mmho</td><td>3.77 mmho</td><td>4.01 mmho</td><td>4.55 mmho</td><td>5.84 mmho</td></tr>
<tr><td>1000 Hz</td><td>4.42 mmho</td><td>4.71 mmho</td><td>5.01 mmho</td><td>5.68 mmho</td><td>7.30 mmho</td></tr>
</table>
The pressure accuracy is: ±10 daPa or 10%, whichever is greater.
To minimize the influence of temperature, barometer pressure, humidity and height above sea level, it always recommended to calibrate the unit in the local positions.</td></tr>
<tr><td>Temperature</td><td colspan="2">The temperature have no theoretic impact on the impedance calculation, but the temperature has influence on the electronic circuits. This temperature influence for the standard specified temperature range (15-35 °C) is inside: Admittance can vary inside: ± 5%, ± 0.1 cm^3, $\pm 10^{-9}$ m^3/Pa·s, whichever is greater.</td></tr>
<tr><td colspan="3">Reflex Calibration Standards and Spectral Properties:</td></tr>
<tr><td>General</td><td colspan="2">Specifications for stimulus and audiometer signals are made to follow IEC 60645-5</td></tr>
<tr><td>Contralateral Earphone</td><td>Pure tone:</td><td>ISO 389-1 for TDH39 and ISO 389-2 for CIR.</td></tr>
<tr><td></td><td>Wide Band noise (WB):
Spectral properties:</td><td>Interacoustics Standard
As “Broad band noise” specified in IEC 60645-5, but with 500 Hz as lower cut-off frequency.</td></tr>
<tr><td></td><td>Low Pass noise (LP):
Spectral properties:</td><td>Interacoustics Standard
Uniform from 500 Hz to 1600 Hz, 5 dB re. 1000 Hz level</td></tr>
<tr><td></td><td>High Pass noise (HP):
Spectral properties:</td><td>Interacoustics Standard
Uniform from 1600 Hz to 10KHz, 5 dB re. 1000 Hz level</td></tr>
<tr><td>Ipsilateral Earphone</td><td>Pure tone:</td><td>Interacoustics Standard.</td></tr>
<tr><td></td><td>Wide Band noise (WB):
Spectral properties:</td><td>Interacoustics Standard
As “Broad band noise” specified in IEC 60645-5, but with 500 Hz as lower cut-off frequency.</td></tr>
<tr><td></td><td>Low Pass noise (LP):
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Uniform from 500 Hz to 1600 Hz, 10 dB re. 1000 Hz level</td></tr>
<tr><td></td><td>High Pass noise (HP):
Spectral properties:</td><td>Interacoustics Standard
Uniform from 1600 Hz to 4000 Hz, 10 dB re. 1000 Hz level</td></tr>
<tr><td></td><td>General about levels:</td><td>The actual sound pressure level at the eardrum will depend on the volume of the ear.</td></tr>
<tr><td colspan="3">The risk of artifacts at higher stimulus levels in reflex measurements are minor and will not activate the reflex detection system</td></tr>
</table>

Reference Values for Stimulus Calibration

	Freq.	Reference Equivalent Threshold Sound Level (RETSPL) [dB re. 20 µPa]						Variation of Ipsi stimulus levels for different volumes of the ear canal Relative to the calibration performed on an IEC 126 coupler [dB]		Sound attenuation values for TDH39/DD45 earphones using MX41/AR or PN51 cushion [dB]
		ISO 389-1 (Interacoustics Standard)	ISO 389-2 (Interacoustics Standard)	ISO 382-2 (Interacoustics Standard)	Interacoustics Standard	Interacoustics Standard	ISO 389-4 (ISO 8798)	0.5 ml	1 ml	
	[Hz]	TDH39	EARtone 3A / IP30	CIR	DD45	Probe	NB Stimulus Correction Values			
RETSPL	125	45	26	26	47.5	41	4			3
	250	25.5	14	14	27	24.5	4			5
	500	11.5	5.5	5.5	13	9.5	4	9.7	5.3	7
	1000	7	0	0	6	6.5	6	9.7	5.3	15
	1500	6.5	2	2	8	5	6			21 (1600 Hz)
	2000	9	3	3	8	12	6	11.7	3.9	26
	3000	10	3.5	3.5	8	11	6	-0.8	-0.5	31 (3150 Hz)
	4000	9.5	5.5	5.5	9	3.5	5	-1.6	-0.8	32
	6000	15.5	2	2	20.5	3	5			26 (6300 Hz)
	8000	13	0	0	12	-5	5			24
	WB	-8	-5	-5	-8	-5		7.5	3.2	
	LP	-6	-7	-7	-6	-7		8.0	3.6	
	HP	-10	-8	-8	-10	-8		3.9	1.4	

*All figures in bold are Interacoustics Standard values.

Reference equivalent threshold values for transducers

Impedance - Frequencies and intensity ranges

AA222 Maximums IMP										
	TDH39		CIR		EARtone 3A / IP30		IPSI		DD45	
Center	Reading		Reading		Reading		Reading		Reading	
Freq.	Tone	NB	Tone	NB	Tone	NB	Tone	NB	Tone	NB
[Hz]	[dB HL]	[dB HL]	[dB HL]	[dB HL]	[dB HL]	[dB HL]	[dB HL]	[dB HL]	[dB HL]	[dB HL]
125	85	65	95	90	100	90	70	60	85	65
250	105	90	110	105	110	100	85	75	105	90
500	120	105	115	110	115	110	100	85	120	105
750	120	110	120	110	120	110	100	85	120	110
1000	120	110	120	110	120	110	105	90	120	110
1500	120	110	120	110	120	110	110	90	120	110
2000	120	110	120	110	120	110	105	90	120	110
3000	120	110	120	110	120	110	95	90	120	110
4000	120	110	115	105	120	105	100	85	120	110
6000	120	100	100	95	115	100	85	80	110	100
8000	110	100	90	90	90	95	80	75	110	100
10000										
WB	-	120	-	120	-	120	-	105	-	120
LP	-	120	-	120	-	120	-	110	-	120
HP	-	120	-	120	-	120	-	105	-	120