

KUDUWAVE

Pro

Datasheet

Work faster, smarter,
and more
cost-efficiently with
the Kuduwave Pro



KUDUWAVE[™] PRO

The Kuduwave Pro is a portable diagnostic audiometer offering diagnostic audiological testing up to 16 kHz without the need of a sound booth.

The Kuduwave Pro combines the audiometer, bone conductor, extended high frequency headset, and sound booth, into a single, lightweight device. It includes pure tone air and bone conduction, high frequency testing with automatic masking and speech testing, and is capable of accurately testing without a sound booth!



Standard features	eMoyo EMR Software
<ul style="list-style-type: none"> - Boothless operation - Insert earphones - Digital frequency accuracy - Extended high frequency testing up to 16 kHz - Pure tone air conduction intensity range: <ul style="list-style-type: none"> - 20 dBHL to 120 dBHL in midrange frequencies - Forehead bone conduction intensity range: <ul style="list-style-type: none"> - 20 dBHL to 120 dBHL in midrange frequencies - Narrowband noise masking - Automatic and manual non-test ear masking for air and bone conduction - Automatic and manual diagnostic tone thresholds testing (air, bone, and masking) - Speech testing software, including: <ul style="list-style-type: none"> - Integrated speech audiometry (WR, SRT, and more pre-recorded word lists) - Speech-weighted random noise and four-talker babble noise - Free standard word list plugins - Talk forward - False-positive response indicator - Windows-PC controlled - X-Check automated calibration verification - Active noise monitoring - Tele-medicine enabled (location-independent) - Stenger test - Various threshold-seeking methods - Cloud synchronisation using your Google Drive, Microsoft OneDrive, Dropbox, and more 	<p>Free of charge, with no annual licensing fee</p> <ul style="list-style-type: none"> - Patient management and medical record suite - Automatic patient response monitoring - Customisable automatic & manual testing protocols with auto-threshold seeking - Custom-branded reports - Standard threshold shift, milestone baseline, PLH, HSE & more - Assistive interpretation tools - Talk forward - Smart folders workflow management tools: <ul style="list-style-type: none"> - Ototoxicity monitoring - School screening - Mass screening - Occupational health - Customisable testing protocols



Ambi-Dome sound blocking technology allows testing to be performed without a soundproof booth. It includes active noise monitoring, which uses integrated microphones to monitor ambient environmental noise levels, and can report on affected frequencies for possible retesting.



System:

- Kuduwave Pro device
- Bone vibrator with bone vibrator spring (connected to the headband)
- Extended high frequency range
- USB patient response button
- Kuduwave dual 3 m long USB cables
- Spare sound tubes and couplers
- Free eMoyo EMR software: <https://geoaxon.com/software>
- Free online video product training: <https://geoaxon.com/kuduwave-training>

Kuduwave Pro technical specifications

Audiometry

Specification	Details	
Pure tone testing		
Air conduction transducer	Kuduwave built-in insert earphone	
Bone vibrator transducer	RadioEar B71, B71W, or B81; or BHM-Tech Production Company BC-1	
Bone vibrator placement	Forehead	
Air conduction frequency range	125 – 8000 Hz standard 9000 – 16000 Hz extended	
Bone vibrator frequency range	250 – 4000 Hz	
Frequency accuracy	< 0.05 %	
Air conduction total harmonic distortion	< 3 %	
Bone vibrator total harmonic distortion	< 6 %	
Bone vibrator headband static force	5.4 N ± 0.5 N	
Air conduction calibration coupler	<ul style="list-style-type: none"> - IEC 60318-4 (IEC 711) - Ear Simulator - RETSPL as per ISO 389-2, ISO 389-4, and ISO 389-5 * 	
Bone vibrator calibration coupler	<ul style="list-style-type: none"> - IEC 60318-1 Ear Simulator with IEC 60318-6 Artificial Mastoid - RETSPL as per ISO 389-3 	
Tone presentation	<ul style="list-style-type: none"> - Pure tone - Warble tone - Pulsed tone 	
Warble tone	Waveform	Sinusoidal
	Repetition rate	4 – 20 Hz, default = 5 Hz



	Frequency deviation	5 – 25 %, default = 10 %
Masking		Narrowband noise automatically centred at test frequency
Speech audiometry		
Transducer		Kuduwave built-in insert earphone
Masking		<ul style="list-style-type: none"> - Speech-weighted random noise - Spectrum constant from 125 – 1000 Hz, then <ul style="list-style-type: none"> – 12 dB/oct from 1000 – 6000 Hz (tolerance: – 3 dB to + 5 dB)
Calibration		All pre-recorded words in word lists are calibrated against a 1 kHz calibration signal
Additional audiometry		
Talk forward		~40 – 100 dBHL adjustable
Modes of operation		<ul style="list-style-type: none"> - Manual - Automatic shortened ascending (Hughson and Westlake method - ISO 8253-1) - Automatic standard ascending shortened and standard bracketing - Fixed frequency Békésy sweep (optional) - Pure tone Stenger (optional)
Air conduction system sound attenuation characteristics using Ambi-Dome technology; combined earcup and ear insert attenuation		31.0 dB at 125 Hz 37.7 dB at 250 Hz 43.8 dB at 500 Hz 40.8 dB at 1000 Hz 38.1 dB at 2000 Hz 52.3 dB at 4000 Hz 45.8 dB at 8000 Hz
Operational background sound pressure levels to test down to 0 dBHL (ANSI S3.1, ISO 8253-1, SANS 10182)		< 70 dB SPL at 125 Hz < 69 dB SPL at 250 Hz < 58 dB SPL at 500 Hz < 53 dB SPL at 1000 Hz < 50 dB SPL at 2000 Hz < 59 dB SPL at 4000 Hz < 59 dB SPL at 8000 Hz

* The default EHF (9000 – 16000 Hz) reference equivalent threshold sound pressure levels (RET SPL) are different to those of ISO 389-5 for insert earphones. ET SPL for EHF, as per internal clinical trial.

Frequency

Air conduction

Frequency [Hz]	RET SPLs [dB] Foam eartip	ET SPLs [dB] Silicone eartip	Maximum output [dBHL]
125	28.0	40.0	95



250	17.5	25.5	95
500	9.5	13.5	120
750	6.0	10.5	120
1000	5.5	12.5	120
1500	9.5	11.5	120
2000	11.5	16.5	120
3000	13.0	17.0	110
4000	15.0	14.0	105
6000	16.0	15.0	100
8000	15.5	19.5	90
9000	13.5	-	85
10000	12.5	-	95
11200	21.5	-	85
12500	25.5	-	80
14000	32.5	-	70
16000	41	-	55

Bone conduction

Frequency [Hz]	RETFLs [dB]	Maximum forehead hearing levels [dBHL]
125	-	-
250	79	35
500	72	50
750	61.5	60
1000	51	60
1500	47.5	70
2000	42.5	60
3000	42	60
4000	43.5	50



Maximum permissible ambient noise levels (MPANLs)

The table below presents the maximum permissible ambient noise levels (MPANLs) for the Kuduwave according to BS EN ISO 8253-1:2010.

Frequency [Hz]	Average attenuation provided by		Difference between the average attenuation provided by the two earphones	MPANL in one-third-octave bands, for AC audiometry for hearing threshold levels down to 0 dB when typical current supra-aural earphones are used			Difference in attenuation + MPANL for typical supra-aural earphones for hearing threshold levels down to 0 dB. (MPANL when a Kuduwave is used)		
	industry standards headsets	the Kuduwave							
125	3	31.0	28.0	28 ¹	39 ²	51 ³	56.0 ¹	67.0 ²	79.0 ³
250	5	37.7	32.7	19 ²		37 ³	51.7 ²		69.7 ³
500	7	43.8	36.8	18			54.8		
1000	15	40.8	25.8	23			48.8		
2000	26	38.1	12.1	30			42.1		
4000	32	52.3	20.3	36			56.3		
8000	24	45.8	21.8	33			54.8		

¹ Test tone range: 125 – 8000 Hz

² Test tone range: 250 – 8000 Hz

³ Test tone range: 500 – 8000 Hz

The table below presents the MPANLs for the Kuduwave according to ANSI S3.1-1999.

Frequency [Hz]	Average attenuation provided by		Difference between the average attenuation provided by the two earphones	MPANLs <i>dB SPL</i> for a typical supra-aural headset testing to a minimum threshold of 0 <i>dB HL</i> ; test frequency range 125 – 8000 Hz	MPANLs <i>dB SPL</i> for the Kuduwave insert earphones with forehead bone conductor testing to a minimum threshold of 0 <i>dB HL</i> ; test frequency range 125 – 8000 Hz	MPANLs <i>dB SPL</i> for the Kuduwave insert earphones testing to a minimum threshold of 25 <i>dB HL</i> ; test frequency range 500 – 8000 Hz
	industry standards headsets	the Kuduwave				
125	3	31.0	28.0	35	63.0	-
250	5	37.7	32.7	25	57.7	-
500	7	43.8	36.8	21	57.8	82.8
1000	15	40.8	25.8	26	51.8	76.8
2000	26	38.1	12.1	34	46.1	71.1
4000	32	52.3	20.3	37	57.3	82.3
8000	24	45.8	21.8	37	58.8	83.8

Narrowband masking

Frequency [Hz]	Maximum output [<i>dB HL</i>]	Tested Type 3 maximum output [<i>dB HL</i>]	Cutoff frequency [Hz]	
			Lower	Upper



125	60	60	110	148.75
250	60	60	215	292.5
500	75	75	430	577.5
750	90	80	650	885
1000	90	80	865	1160
1500	90	80	1287.5	1762.5
2000	90	80	1750	2287.5
3000	90	80	2612.5	3537.5
4000	90	80	3475	4730
6000	90	-	5291.7	7131.9
8000	80	-	6760	9360

Instrument

Specification		Details
Dimensions	Device, including carry case	210 × 260 × 110 <i>mm</i>
	Shipping	410 × 320 × 190 <i>mm</i>
Weight	Net * (single unit)	754 <i>g</i>
	Shipping	1917 <i>g</i>
Power supply		Two standard laptop USB ports (5 V, 900 <i>mA</i> max. per port)
Data transfer		<ul style="list-style-type: none"> - Twisted Kuduwave dual USB cable - Two standard 3 <i>m</i> A Male to Mini B Male USB cables
Environmental conditions		Operational temperature: 15 – 35 °C Operational humidity (non-condensing): 30 – 90 % Operational ambient pressure: 98 – 104 <i>kPa</i> Shipping and storage temperature: 10 – 40 °C Shipping and storage humidity (non-condensing): 30 – 75 % Shipping and storage ambient pressure: 70 – 106 <i>kPa</i>
Warm-up time		10 – 20 <i>s</i>
Patient response system		Handheld tactile push button (response button) - USB connection



Sound tubes	- Medical grade PVC 80 shore, clear - L: 180 mm, ID: 1.7 mm, OD: 2.9 mm
	Single tube per earcup

* The net weight of a single unit consists of the device, the USB cables, and the response button.

Standards

Standard type	Details
Pure tone audiometry	ANSI S3.6 (Pure tone Type 2), BS EN 60645-1 (Type 1)
Additional	ANSI S3.21, ANSA S3.55, ANSI S3.13, BS EN 60601-1, BS EN 60601-1-2, BS EN 60601-1-6, BS EN ISO 13485, BS EN ISO 14971, BS EN 62304, BS EN ISO 14155, BS EN ISO 15223-1, EN 1041
Calibrations	Laboratory calibrated in accordance with: BS EN 60645-1, EN 60645-2, SANS 10154-1, SANS 10154-2, and ANSI S3.6

Kuduwave electromagnetic compatibility (EMC)

The three tables that follow provide information on the EMC of the Kuduwave Pro. The device has been tested to BS EN 60601-1-2:2015 for both immunity (susceptibility to interference from external sources) and emissions (interference generated by the Kuduwave). To ensure correct operation, the following precautions must be adhered to:

- The use of components and cables other than those specified or sold by GeoAxon Global may result in increased emission or decreased immunity of the Kuduwave. That which affects compliance is the USB cable, Type A to mini-B, with a maximum length of 3 m.
- The Kuduwave should not be used adjacent to or stacked with other equipment. If adjacent or stacked use is necessary then the Kuduwave should be observed to verify normal operation in the configuration in which it will be used.

Guidance and manufacturer's declaration: The Kuduwave Pro is intended for use in the electromagnetic environment specified in the three tables below. The customer or operator of the device must ensure that it is used in such an environment.

For all tables, please refer to the guidance and manufacturer's declaration above.

Electromagnetic emissions


Emissions test	Compliance	Electromagnetic environment - guidance
RF emissions CISPR 11	Group 1	The Kuduwave uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
	Class A	The Kuduwave is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network which supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	N/A	



Voltage fluctuations / flicker emissions IEC 61000-3-3		
---	--	--

Electromagnetic immunity

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment - guidance
Electrostatic discharge (ESD) IEC 61000-4-2	$\pm 8 \text{ kV}$ contact $\pm 2 \text{ kV}$, $\pm 4 \text{ kV}$, $\pm 8 \text{ kV}$, $\pm 15 \text{ kV}$ air		Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30 %.
Electrical fast transient / burst IEC 61000-4-4	Power supply lines: $\pm 2 \text{ kV}$ Input / output lines: $\pm 1 \text{ kV}$ 100 kHz repetition frequency (SIP / SOP port)	Power supply lines: N/A, see Note 1 Input / output lines: $\pm 1 \text{ kV}$ 100 kHz repetition frequency (SIP / SOP port)	See Note 1
Surge IEC 61000-4-5	$\pm 1 \text{ kV}$ differential mode $\pm 2 \text{ kV}$ common mode		
Voltage dips, short interruptions, and voltage variations on power supply input lines IEC 61000-4-11	< 5 % UT * (> 95 % dip in UT *) for 0.5 cycle 40 % UT * (60 % dip in UT *) for 5 cycles 70 % UT * (30 % dip in UT *) for 25 cycles < 5 % UT * (> 95 % dip in UT *) for 5 sec	N/A, see Note 1	
Power frequency (50 / 60 Hz) magnetic field IEC 61000-4-8	3 A/m 50 or 60 Hz		Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Conducted RF IEC 61000-4-6	3 V 0.15 MHz - 80 MHz 6 V in ISM bands between 0.15 MHz and 80 MHz 80 % AM at 1 kHz		Portable and mobile RF communications equipment should be no closer to any part of the Kuduwave, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.
Radiated RF IEC 61000-4-3	3 V/m 80 MHz - 2.7 GHz 80 % AM at 1 kHz	10 V/m 80 MHz - 2.7 GHz 80 % AM at 1 kHz	Recommended separation distance: $d = 1.2\sqrt{P}$ $d = 1.2\sqrt{P}$ 80 MHz to 800 MHz $d = 2.3\sqrt{P}$ 800 MHz to 2.5 GHz where P is the maximum output power rating of the transmitter in Watts (W) according to the transmitter manufacturer and d is the recommended separation distance in metres (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey:

			<p>a) should be less than the compliance level in each frequency range</p> <p>b) interference may occur in the vicinity of equipment marked with the following symbol:</p> 
--	--	--	--

* UT is the a.c. mains voltage prior to application of the test level.

Note 1: Power supply line electrical fast transient is not applicable because the Kuduwave is powered from the USB port of a laptop running on its battery.

Note 2: At 80 MHz and 800 MHz, the higher frequency range applies.

Note 3: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

- a) Field strengths from fixed transmitters, such as base stations for radio (cellular / cordless) telephones and land mobile radios, amateur radio, AM and FM broadcast, and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the Kuduwave is used exceeds the applicable RF compliance level above, the Kuduwave should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the Kuduwave.
- b) Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

Recommended separation distance between portable and mobile RF communications equipment and the Kuduwave

The Kuduwave is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the operator of the Kuduwave can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the Kuduwave as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter [W]	Separation distance according to frequency of transmitter [m]		
	150 kHz to 80 MHz $d = 1.2\sqrt{P}$	80 MHz to 800 MHz $d = 1.2\sqrt{P}$	800 MHz to 2.5 GHz $d = 2.3\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

For transmitters rated at a maximum output power not listed above, recommended separation distance d in metres (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in Watts (W) according to the transmitter manufacturer.

Note 1: At 80 MHz and 800 MHz, the separation distance for the higher frequency applies.

Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

Minimum controller PC system requirements

- Windows® 10 or later (32 or 64-bit)
- Intel® i5 Processor or better
- 2 GB RAM
- 1 GB free HDD space
- 2 available USB 2.0 ports or 1 USB-C port with USB hub



X-Check (pronounced “cross-check”) is an integrated digital calibration verification tool designed for accurate electro-acoustic calibration verification in only 30 seconds. Like biological checks, X-Check does not replace the need for regular calibrations as per the prevailing standards. It is, however, an accurate and objective test that is quicker and more accurate than your standard subjective biological calibration check.

X-Check uses the specifications below for the pass criteria of pure tone amplitude errors.

Difference [dB]	Frequency range [Hz]
± 5.0	125 – 4000
± 6.2	4000 – 8000
± 6.5	8000 – 16000

Please note: X-Check does not replace the need for device calibrations as per local standards.





We believe in the immense power of the human spirit



WELL BEYOND INNOVATION