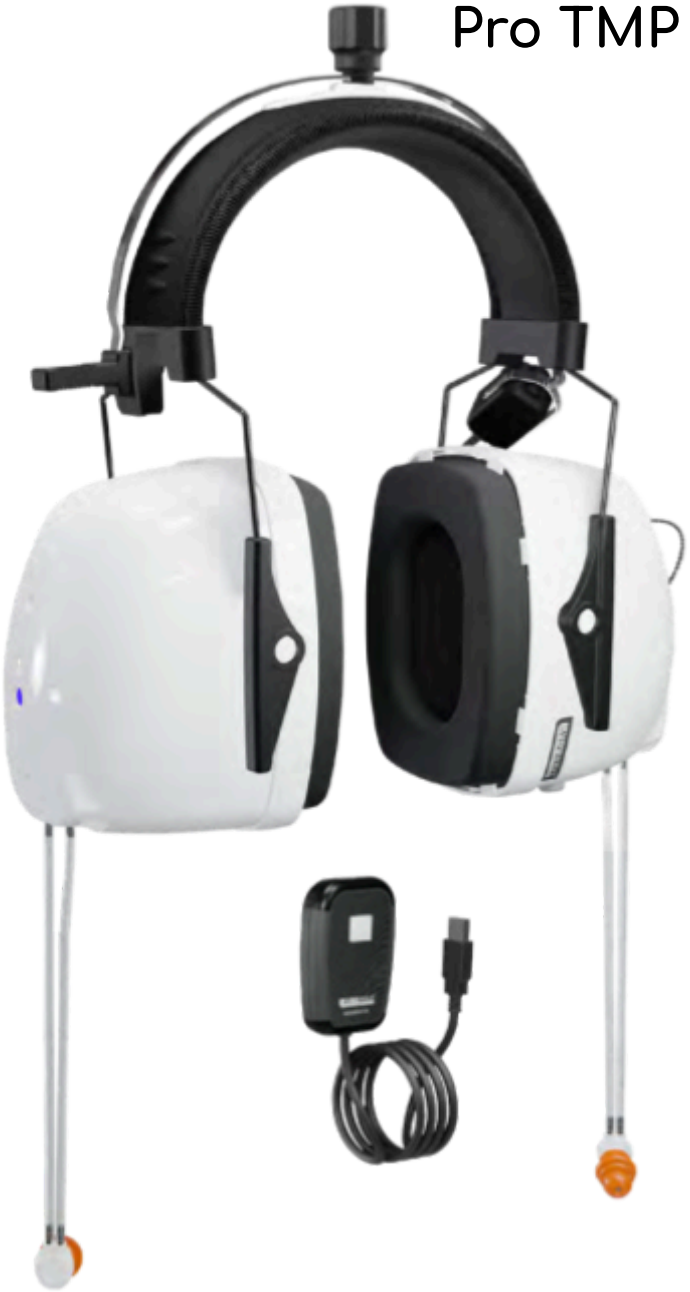
Document number: GGKW-TD0091-v1

KUDUWAVE

Pro TMP

Datasheet



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

GEOAXON GLOBAL

KUDUWAVE™ PRO-TMP

The Kuduwave Pro is a portable diagnostic audiometer offering diagnostic audiological testing up to 16 kHz without the need of a sound booth. It integrates tympanometry functionality into the Kuduwave Pro headset.

The Kuduwave Pro combines the audiometer, bone conductor, extended high frequency headset, dual tympanometers, 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 simultaneous bilateral tympanometry. It is capable of accurately testing without a sound booth.

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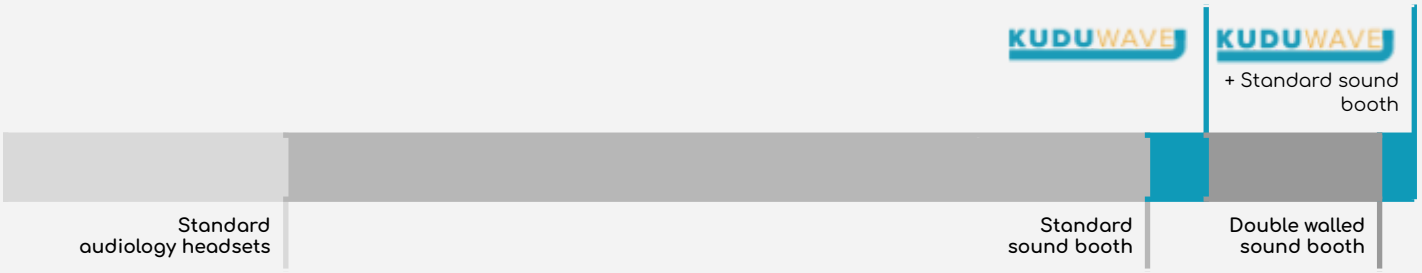
Standard features	eMoyo EMR Software

- Boothless operation
- Insert earphones
- Bilateral tympanometry
- Ipsi and contralateral acoustic reflexes
- Automated, semi-automated, or manual acoustic reflexes
- Digital frequency accuracy
- Extended high frequency testing up to $16\ kHz$
- Pure tone air conduction intensity range: $-\ 20\ dBHL$ to $120\ dBHL$ in midrange frequencies
- Forehead bone conduction intensity range: $-\ 20\ dBHL$ 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:
  - 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
	Free of charge, with no annual licensing fee
	
	- 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:
	  - Ototoxicity monitoring
	  - School screening
	  - Mass screening
	  - Occupational health
	  - Customisable testing protocols

Ambi-Dome

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.



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System:

- Kuduwave Pro TMP 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

Key features of the Kuduwave Pro TMP

Feature	Description
Bilateral adult tympanometry	Automatic tympanogram classification suggestion
Automatic pressure control	Built into the Kuduwave
Probe tone of $226\ Hz$	CalPods (tympanometer calibration pods)
Superimposed tympanograms	Measurement plane and meatus compensated tympanometry
Real-time data presentation	

Kuduwave Pro TMP specifications

Audiometry

Specification		Details
Pure tone testing		
Transducer	Air conduction	Kuduwave built-in insert earphone
	Bone vibrator	RadioEar B71, B71W, or B81; or BHM-Tech Production Company BC-1
	Tympanometer	Kuduwave built-in transducer
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		$5.4\ N \pm 0.5\ N$

Air conduction calibration coupler		- IEC 60318-4 (IEC 711) - Ear Simulator - RETSPL as per ISO 389-2, ISO 389-4, and ISO 389-5 *
Bone vibrator calibration coupler		- IEC 60318-1 Ear Simulator with IEC 60318-6 Artificial Mastoid - RETSPL as per ISO 389-3
Tone presentation		- 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		- Speech-weighted random noise - Spectrum constant from $125 - 1000\ Hz$, then $-12\ dB/oct$ 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		$\sim 40 - 100\ dBHL$ adjustable
Modes of operation		- 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)		$< 70\ dBSPL$ at $125\ Hz$ $< 69\ dBSPL$ at $250\ Hz$ $< 58\ dBSPL$ at $500\ Hz$ $< 53\ dBSPL$ at $1000\ Hz$ $< 50\ dBSPL$ at $2000\ Hz$ $< 59\ dBSPL$ at $4000\ Hz$

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	$< 59\ dBSPL$ at $8000\ Hz$
Air conduction system sound attenuation characteristics using Ambi-Dome technology; combined earcup and immittance silicone insert eartip	$9.0\ dB$ at $125\ Hz$ $10.0\ dB$ at $250\ Hz$ $30.0\ dB$ at $500\ Hz$ $33.3\ d$B at $750\ Hz$ $29.7\ dB$ at $1000\ Hz$ $33.0\ dB$ at $1500\ Hz$ $38.0\ dB$ at $2000\ Hz$ $46.0\ dB$ at $3000\ Hz$ $44.3\ dB$ at $4000\ Hz$ $35.7\ dB$ at $6000\ Hz$ $27.0\ dB$ at $8000\ Hz$

* The default EHF ($9000 - 16000\ Hz$) reference equivalent threshold sound pressure levels (RETSPL) are different to those of ISO 389-5 for insert earphones. ETSPL for EHFs, as per internal clinical trial.

Tympanometry

Specification	Details

Influence of ambient pressure and temperature on calibration	- Environmental sensor which measures:
	  - atmospheric pressure
	  - temperature
	  - relative humidity
	- Conversion between volume and admittance is handled automatically
	- Recalibration with the calibration cavities requested if environment changes significantly

Probe dimensions	Use only the tympanometry probes (identified on the packaging)

Maintenance information	- Visually inspect probe at each use
	- If dirty, clean using fluffy dental floss
	  - Put floss in at one end of the probe and pull it out the other side
	  - If signs of damage, replace with a new probe

Impedance measuring system

Specification	Values
Probe signal	
Frequencies	$226\ Hz$
Level	$85\ dBSPL$ ($\approx 69\ dBHL$) $\pm 3\ dB$ in an IEC 60318-5 coupler Typical variation with loading: - $6\ dB$ at $0.5\ cm^3$ - $0\ dB$ at $2\ cm^3$ - $-6\ dB$ at $5.0\ cm^3$
Frequency accuracy	$\pm 1\ \%$
THD	$< 1\ \%$

<table>
<tr><th colspan="2">Pneumatic system</th></tr>
<tr><td>Pressure range</td><td>$+\ 400\ daPa$ to $-\ 600\ daPa$</td></tr>
<tr><td>Speed</td><td>$50\ daPa/s$
$200\ daPa/s$
$400\ daPa/s$</td></tr>
<tr><td>Direction</td><td>Positive-to-negative and negative-to-positive</td></tr>
<tr><td>Maximum limits</td><td>$-\ 750\ daPa$ and $+\ 550\ daPa$ as measured in a $0.5\ cm^3$ cavity</td></tr>
<tr><td>Safety mechanism</td><td>Automatic valve release at safety maximum limits</td></tr>
<tr><td>Pressure accuracy</td><td>$\pm 10\ daPa$ or $\pm 10\ \%$, whichever is greater (in cavities from $0.5\ cm^3$ to $5.0\ cm^3$)</td></tr>
<tr><td>Speed accuracy</td><td>$50\ daPa/s$: $\pm 10\ daPa/s$
200 and $400\ daPa/s$: $\pm 40\ daPa/s$
(in cavities from $0.5\ cm^3$ to $5.0\ cm^3$)</td></tr>
<tr><td>Control</td><td>Automatic or manual</td></tr>
<tr><td>Indicator</td><td>Graphical display on PC</td></tr>
<tr><th colspan="2">Admittance measurements</th></tr>
<tr><td>Units</td><td>cm^3 or acoustic $mmho$ (1 acoustic $mmho = 10^{-8}\ m^3/(Pa{\cdot}s)$)</td></tr>
<tr><td>Range</td><td>$0.2\ cm^3$ to $5\ cm^3$ (measurement plane)</td></tr>
<tr><td>Accuracy</td><td>$\pm 5\ \%$ or $\pm 0.1\ cm^3$ of the equivalent volume or ± 0.1 acoustic $mmho$, whichever is greater, applicable for both static and dynamic modes of operation</td></tr>
<tr><td>Dependence on barometric pressure</td><td>Environmental sensor which automatically compensates for the conversion between volume and admittance</td></tr>
<tr><td>Analysis performed</td><td>Compliance peak level; compliance peak pressure level; ear canal volume; peak width; tympanogram type</td></tr>
<tr><th colspan="2">Reflex measurements</th></tr>
<tr><td>Reflex test types</td><td>Ipsilateral, contralateral, and bilateral (simultaneous ipsi and contralateral)</td></tr>
<tr><td>Reflex stimuli</td><td>500, 1000, 2000, and, $4000\ Hz$, and broadband noise
Frequency: $\pm 1\ \%$
THD: $< 5\ \%$
Broadband noise: $\pm 5\ dB$ from 500 to $4000\ Hz$</td></tr>
<tr><td>Stimulus level control</td><td>Step: $5\ dB$
Accuracy: $\pm 5\ dB$
<table>
<tr><th>Stimulus</th><th>Minimum [$dBHL$]</th><th>Maximum [$dBHL$]</th></tr>
<tr><td>$500\ Hz$</td><td>50</td><td>100</td></tr>
<tr><td>$1000\ Hz$</td><td>50</td><td>100</td></tr>
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<tr><td></td><td>
<table>
<tr><td>2000 Hz</td><td>50</td><td>100</td></tr>
<tr><td>4000 Hz</td><td>50</td><td>90</td></tr>
<tr><td>Broadband noise</td><td>50</td><td>90</td></tr>
</table>
</td></tr>
<tr><td>Stimulus presentation control</td><td>On-off ratio: $> 70\ dB$
Rise and fall times: $20\ ms$
Residual A-weighted SPL with stimulus off: $< 25\ dBSPL$</td></tr>
<tr><td>Stimulus level variation with ear canal volume</td><td>Since both ipsilateral and contralateral stimuli use probes, the stimulus SPL in the ear canal may vary depending on the ear canal volume; possible variations are tabulated below relative to a $2.0\ cm^3$ cavity (in which the stimulus is calibrated):
<table>
<tr><th rowspan="2">Stimulus frequency [Hz]</th><th colspan="2">Ear canal SPL for different ear canal volumes relative to $2\ cm^3$ [dB]</th></tr>
<tr><th>$0.5\ cm3$</th><th>$1.0\ cm3$</th></tr>
<tr><td>$500\ Hz$</td><td>14</td><td>8</td></tr>
<tr><td>$1000\ Hz$</td><td>11</td><td>6</td></tr>
<tr><td>$2000\ Hz$</td><td>12</td><td>7</td></tr>
<tr><td>$4000\ Hz$</td><td>12</td><td>7</td></tr>
</table>
</td></tr>
<tr><td>Reflex sensitivity</td><td>$0.01\ cm^3$ is the smallest displayed volume change</td></tr>
<tr><td>Reflex stimulus artefact level</td><td>At stimulus levels greater than these, there is a possibility of artefactural change which exceeds $0.03\ cm^3$ occuring in the measurement display synchronously with the reflex stimulus in an ipsilateral measurement; measured in cavities from 0.5 to $5.0\ cm^3$.
<table>
<tr><th>Test signal [Hz]</th><th>Ipsilateral reflex stimulus [$dBHL$]</th></tr>
<tr><td>$500\ Hz$</td><td>> 100</td></tr>
<tr><td>$1000\ Hz$</td><td>> 100</td></tr>
<tr><td>$2000\ Hz$</td><td>> 100</td></tr>
<tr><td>$4000\ Hz$</td><td>> 95</td></tr>
<tr><td>Broadband noise</td><td>> 95</td></tr>
</table>
</td></tr>
<tr><td>Temporal reflex characteristics</td><td>Initial latency: $20\ ms \pm 15\ ms$
Rise and fall time: $30\ ms \pm 15\ ms$
Terminal latency: $10\ ms \pm 15\ ms$
Undershoot and overshoot: $< 10\ \%$</td></tr>
<tr><td>Pulsed stimulus characteristics</td><td>Rise and fall time: $5\ ms$
On time: $55\ ms$</td></tr>
</table>

	Off time: $60\ ms$ Accuracy: $0\ ms$

Frequency

Air conduction

Frequency $[Hz]$	RETSPLs $[dB]$ Foam eartip	ETSPLs $[dB]$ 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

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1000	51	60
1500	47.5	70
2000	42.5	60
3000	42	60
4000	43.5	50

Speech

Frequency [Hz]	RETSPLs [dB] Foam eartip	Maximum output [$dBHL$]
1000	5.5	120
Speech	-	100

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	MPANLs $dBSPL$ for a typical supra-aural headset testing to a minimum threshold	MPANLs $dBSPL$ for the Kuduwave insert earphones with forehead bone	MPANLs $dBSPL$ for the Kuduwave insert earphones testing to a
	industry standards	the				

	headsets	Kuduwave	provided by the two earphones	of 0 $dBHL$; test frequency range 125 – 8000 Hz	conductor testing to a minimum threshold of 0 $dBHL$; test frequency range 125 – 8000 Hz	minimum threshold of 25 $dBHL$; test frequency range 500 – 8000 Hz
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 [$dBHL$]	Tested Type 3 maximum output [$dBHL$]	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	$210 \times 260 \times 110\ mm$
	Shipping	$410 \times 320 \times 190\ mm$
Weight	Net * (single unit)	$939\ g$
	Shipping	$2102\ g$

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Power supply	Two standard laptop USB ports ($5\ V$, $900\ mA$ max. per port)
Data transfer	- Twisted Kuduwave dual USB cable - Two standard $3\ m$ A Male to Mini B Male USB cables
Environmental conditions	Operational temperature: $15 - 35\ °C$ Operational humidity (non-condensing): $30 - 90\ \%$ Operational ambient pressure: $98 - 104\ kPa$ Shipping and storage temperature: $10 - 40\ °C$ Shipping and storage humidity (non-condensing): $30 - 75\ \%$ Shipping and storage ambient pressure: $70 - 106\ kPa$
Warm-up time	$10 - 20\ s$
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: $2.9\ mm$
	Two tubes per earcup
Calibration cavity volumes	$0.5\ cm^3$, $2.0\ cm^3$, and $5.0\ cm^3$

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

Standards

Standard type		Details
Audiometry	Pure tone	ANSI S3.6 (Pure tone Type 2), BS EN 60645-1 (Type 1)
	Tympanometry	ANSI S3.39 (Type 1), BS EN 60645-5 (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 TMP. 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:

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- 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 TMP 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	$\pm 8\ kV$ contact $\pm 2\ kV$, $\pm 4\ kV$, $\pm 8\ kV$, $\pm 15\ kV$ 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: $\pm 2\ kV$ Input / output lines: $\pm 1\ kV$ $100\ kHz$ repetition frequency (SIP / SOP port)	Power supply lines: N/A, see Note 1 Input / output lines: $\pm 1\ kV$ $100\ kHz$ repetition frequency (SIP / SOP port)	See Note 1
Surge IEC 61000-4-5	$\pm 1\ kV$ differential mode $\pm 2\ kV$ 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	N/A, see Note 1	

	< 5 % UT * (> 95 % dip in UT *) for 5 sec		
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. 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: a) should be less than the compliance level in each frequency range b) interference may occur in the vicinity of equipment marked with the following symbol:
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	

* 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
compliance made easy

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.

FDA listed

International Organization for Standardization ISO

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

Difference $[dB]$	Frequency range $[Hz]$
$\pm\ 5.0$	$125\ -\ 4000$
$\pm\ 6.2$	$4000\ -\ 8000$
$\pm\ 6.5$	$8000\ -\ 16000$

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

GeoAxon GLOBAL

KUDUWAVE™ PRO-TMP

We believe in the immense power of the human spirit

WELL BEYOND INNOVATION

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