# Technical Specifications

# Titan


Interacoustics

D-0103650-D 05/2015

# Contents

# Titan Specifications

## 1.1 Titan Software Module & Version Overview

### 1.1.1 IMP440 – Impedance Module

| Test types/functionality: | Screener | Diagnostic | Clinical |
|---|---|---|---|
| Tympanometry 226Hz – Automatic (flexible start and stop pressure) | X | X | x |
| Tympanometry 226Hz – Manual | | | x |
| Acoustic reflex with single intensities or reflex growth – ipsilateral (automatic) | x | x | x |
| Acoustic reflex with single intensities or reflex growth – contralateral (automatic) | | x | x |
| Manual control of all reflex functions | x | x | x |
| Reflex decay, automatic 10 dB above threshold or manually controlled with stimulus duration of 10 up to 30 seconds | | x | x |
| Reflex latency, automatic 10 dB above threshold or manually controlled, first 300 ms from stimulus start | | | x |
| ETF 1 – Non-perforated eardrum (William's test) | | x | x |
| ETF 2 – Perforated eardrum (Toynbee test) | | | x |
| ETF 3 – Patulous Eustachian tube (Sensitive baselinex tympanometry for 10 up to 60 seconds) | | | x |
| High frequency probe tones (678, 800 & 1000 Hz) | Optional | Optional | x |
| Wideband absorbance | | Optional | Optional |
| Wideband 3D tympanometry | | Optional | Optional |
| Wideband research module | | Optional | Optional |
| User customizable protocols | x | x | x |
| Protocol upload | x | x | x |
| Client/session upload/download | x | x | x |
| PC-controlled testing | Optional | x | x |
| Bluetooth | x | x | x |

### 1.1.2 ABRIS440 – Auditory Brainstem Response Infant Screening Module

| Functionality: | Screener |
|---|---|
| Click stimulus | x |
| CE-Chirp® stimulus | x |
| Hi-Lo CE-Chirp® stimulus | x |
| Stimulus intensity | 30, 35, 40dB nHL |
| Bayesian weighted averaging | x |
| Residual noise limit (as stop criteria) | x |
| Test time | 1 – 10 minutes (default = 3 minutes) |
| Test montage | mastoid or nape |
| Test method | monaural or binaural |
| Enable pass/refer | x |
| User customizable protocols | x |
| Protocol upload | x |
| Client/session upload/download | x |
| PC-controlled testing | x |
| Bluetooth | x |

### 1.1.3 DPOAE440 – Distortion Product Otoacoustic Emissions Module

| Test types/functionality: | Screener | Clinical |
|---|---|---|
| Frequency range | 500 – 6000 Hz | 500 – 10000 Hz |
| Test points (frequencies) | Max 6 per test | Unlimited |
| DP-Gram | x | x |
| DP Input/Output | | x |
| Pressurized DPOAE | Optional | x |
| Enable pass/refer | x | x |
| Normative data (view, edit, import, export) | x | x |
| Manual testing (add test points, extend testing) | | x |
| User customizable protocols | x | x |
| Protocol upload | x | x |
| Client/session upload/download | x | x |
| PC-controlled testing | Optional | x |
| Bluetooth | x | x |

### 1.1.4 TEOAE440 – Transient Evoked Otoacoustic Emissions Module

| Test types/functionality: | Screener | Clinical |
|---|---|---|
| Frequency range | 1000 – 4500 Hz | 500 – 5500 Hz |
| Test time | Max 6 minutes or 4500 sweeps | Unlimited |
| Stimulus intensity | 60 – 84 dB SPL | 30 – 90 dB SPL |
| Center band frequencies (1, 1.5, 2, 3, 4) | x | x |
| Linear band frequencies (5 octave-wide bands 0.5 – 5.5 kHz) | | x |
| Custom band frequencies (user definable) | | x |
| Pressurized TEOAE | Optional | x |
| FFT Display | | x |
| Enable pass/refer | x | x |
| Normative data (view, edit, import, export) | x | x |
| Manual testing (extend testing) | | x |
| User customizable protocols | x | x |
| Protocol upload | x | x |
| Client/session upload/download | x | x |
| PC-controlled testing | Optional | x |
| Bluetooth | x | x |

## 1.2 Included and Optional Parts

The system consists of the following included and options parts:

**IMP440**

**Included parts:**
Titan handheld unit with basic probe
Power supply (with converter)
BET55 Ear tips
Lithium Battery
4 cavities (0.2, 0.5, 2 and 5cc)
Titan PC suite with IMP440
Instructions for Use
TCB Carrying Bag
USB cable, USB adaptor

**Included parts with diagnostic & clinical versions:**
Cradle
Clinical probe extension
CIR55 contra insert headset
OtoAccess™ database

**Optional parts:**
Short probe extension
Sanibel MTP-II Thermal printer
DD45C contra cup headset
EARtone 3A insert headset for contra
Cradle
Clinical probe extension
OtoAccess™ database
WBT calibration kit

**DPOAE440**

**Included parts:**
Titan handheld unit with basic probe
Cradle
Power supply (with converter)
Clinical probe extension
BET55 Ear tips
Lithium Battery
4 cavities (0.2, 0.5, 2 and 5cc)
Titan PC suite with DPOAE440
OtoAccess™ database
USB cable, USB adaptor
Instructions for Use
TCB Carrying Bag

**Included parts with screener version:**
Eartip 3-5mm flanged (25 pcs.)
Eartip 4-7mm flanged (25 pcs.)
Eartip 5-8mm flanged (25 pcs.)

**Optional parts:**
Short probe extension
Sanibel MTP-II Thermal printer

**ABRIS440**

**Included parts:**
Titan handheld unit with basic probe
Cradle
Power supply (with converter)
PreAmplifier w/clothing clip & neckstrap
Montage stickers
Short extension cable
ETSE tab surface electrode cables
Pinch style electrode cables
Sanibel tab surface electrodes (36 pcs.)
Sanibel snap surface electrodes (36 pcs.)
SPG15 preparation gel
Alcohol pads, Gauze swabs
USB cable, USB adaptor
BET55 Ear tips
Eartip 3-5mm flanged (25 pcs.)
Eartip 4-7mm flanged (25 pcs.)
Eartip 5-8mm flanged (25 pcs.)
Lithium Battery
4 cavities (0.2, 0.5, 2 and 5cc)
Titan PC suite with ABRIS440
OtoAccess™ database
Instructions for Use
TCB Carrying Bag

**Optional parts:**
EARtone ABR stereo ID earphones
EarTone EarCup stereo ID transducer
Sanibel MTP-II Thermal printer
TDH39 Stereo ID headset
DD45 stereo ID headset

**TEOAE440**

**Included parts:**
Titan handheld unit with basic probe
Cradle
Power supply (with converter)
Clinical probe extension
BET55 Ear tips
Lithium Battery
4 cavities (0.2, 0.5, 2 and 5cc)
Titan PC suite with DPOAE440
OtoAccess™ database
USB cable, USB adaptor
Instructions for Use
TCB Carrying Bag

**Included parts with screener version:**
Eartip 3-5mm flanged (25 pcs.)
Eartip 4-7mm flanged (25 pcs.)
Eartip 5-8mm flanged (25 pcs.)

**Optional parts:**
Short probe extension
Sanibel MTP-II Thermal printer

## 1.3 Titan Hardware – 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.<br>Approval of the quality system is made by TÜV – identification no0123 | |
| **Standards** | **Safety:** | IEC 60601-1, Internally powered, Type B and BF applied parts |
| | **EMC:** | IEC 60601-1-2 |
| | **Impedance:** | IEC 60645-5/ANSI S3.39, Type 1 |
| | **Test Signal:** | IEC 60645-1/ANSI S3.6 , IEC 60645-3 |
| | **OAE:** | IEC 60645-6 2009, Type 2 Otoacoustic emissions |
| | **ABR:** | IEC 60645-7 2009, Type 2 |
| **Cradle** | **Safety:**<br>**Power**<br>**Mains voltages and frequencies:**<br>**Consumption:** | IEC 60601-1, Class II<br>Astrodyne ASA30M-0301 or UE24WCP<br>100 – 240 VAC, 47 – 63 Hz<br>0.8 – 0.4 A |
| **Battery** | **Use only:** | NP120 or CGA103450 |
| **Operation environment** | **Temperature:** | 15 – 35 °C |
| | **Relative Humidity:** | 30 – 90% |
| | **Ambient Pressure:** | 98kPa – 104kPa |
| | **Warm-up Time:** | 1 minute |
| **Transport & Storage** | **Storage Temperature:**<br>**Transport Temperature:**<br>**Rel. Humidity:** | 0°C – 50°C<br>-20 – 50 °C<br>10 – 95% |
| **Impedance Measuring System** | | |
| **Probe tone** | **Frequency:**<br>**Level:** | Classic tympanometry: 226 Hz, 678 Hz, 800 Hz, 1000 Hz; pure tones; AGC controlled to protect for loud probe tone stimuli in small ear canals.<br>WBT: 226 Hz – 8000 Hz broadband stimulus, 21.5/sec.<br>226 Hz: 85 dB SPL (≈ 69 dB HL)<br>WBT: 96 dB peSPL (infant) / 100 dB peSPL (adult). (100 dB peSPL ≈ 65 dB nHL) |
| **Air pressure** | **Control:**<br>**Indicator:**<br>**Range:**<br>**Pressure limitation:**<br>**Pressure change rate:** | Automatic.<br>Measured value is displayed on the graphical display.<br>-600 to +300 daPa.<br>-750 daPa and +550 daPa.<br>Minimum, medium, maximum or automatic with minimum speed at compliance peak. Selectable in the setup. |
| **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. |
| **Test types** | **Tympanometry** | Automatic, where the start and stop pressure can be user-programmed in the setup function.<br>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 for 30 up to 150 s. |
| **Indicators** | **Graphical display** | Compliance is indicated as ml and pressure as daPa. In PC controlled mode admittance, susceptance and conductance can be printed.<br>Stimulus level is indicated as dB Hearing Level. |
| **Memory** | **Tympanometry:** | 1 curve per ear per tympanometry test. 3 curves per ear per Eustachian tube function test. And theoretically an infinite number of tests per protocol. |
| There is no deviation between static and dynamic mode. | | |
| **Reflex Functions** | | |
| **Signal sources** | **Tone - Contra, Reflex:** | 250, 500, 1000, 2000, 3000, 4000, 6000, 8000 Hz. |
| | **Tone - Ipsi, Reflex:** | 500, 1000, 2000, 3000, 4000 Hz. |
| | **NB noise - Contra, Reflex:** | 250, 500, 1000, 2000, 3000, 4000, 6000, 8000 Hz. |

| | | |
|---|---|---|
| | **NB noise - Ipsi, Reflex:** | 1000, 2000, 3000, 4000 Hz. |
| | **Noise - Contra, Reflex:** | Wide Band, High Pass, Low Pass. |
| | **Noise - Ipsi, Reflex:** | Wide Band, High Pass, Low Pass. |
| **Outputs** | **Contra Earphone:** | TDH39 earphone, DD45 earphone, CIR55 insert and/or EARtone 3A insert for Reflex measurements. |
| | **Ipsi Earphone:** | Probe earphone incorporated in the probe system for Reflex measurements. |
| | **Air:** | Connection of the air system to the probe. |
| **Test types** | **Manual Reflex** | Manual control of all functions. |
| | **Automated Reflex** | Automatic reflexes:<br>- Single intensities<br>- Reflex growth |
| | **Reflex Decay** | Automatic, 10 dB above threshold and manually controlled with stimulus durations of 10 to 30 s. |
| | **Reflex latency** | Automated, first 300 ms from stimulus start. |

| **ABR Infant Screening** | | |
|---|---|---|
| **Preamplifier** | **One Channel:** | 3 electrodes. 50 cm<br>Switchable: Software will automatically switch mastoid and ground if mastoid montage is used. So the user does not need to replace electrode during testing. |
| | **Gain:** | 64 dB |
| | **Frequency response:** | 0,5 - 5000 Hz |
| | **Noise:** | <25 nV/√Hz |
| | **CMR Ratio:** | >90 dB. |
| | **Max input offset voltage:** | 2.5 V |
| | **Input impedance:** | 10 MΩ/ 170 pF |
| | **Power from main unit:** | Isolated power supply |
| **Electrical Impedance measurement** | **Measurement frequency:** | 33 Hz |
| | **Waveform:** | Rectangular |
| | **Measurement current:** | 11.25 µA |
| | **Range:** | 0.5 kΩ – 25 kΩ ± 10 % |
| **Stimulus** | **Stimuli:** | Click range (200 Hz -11 kHz)<br>CE-Chirp® range (200 Hz – 11 kHz)<br>HiLo CE-Chirp® range (Lo – up to 1.5 kHz) & (Hi – above 1.5 kHz) |
| | **Stimulus rate:** | 90 Hz |
| | **Transducers:**<br>**(Calibrated to Standards)** | EARTone ABR insert phone<br>EARTone ABR for EarCup<br>TDH 39 or DD45 head phone (Static force: 4,5N ± 0,5N<br>IOW Probe |
| | **Channels:** | 2 |
| | **Level:** | 30 dB nHL, 35 dB nHL, 40 dB nHL |
| | **Bandwidth:** | 22.05 kHz |
| **Recording** | **Analysis time:** | 1-10 min or Residual noise 5-80 nV |
| | **A/D resolution:** | 24 bit |
| | **Artifact reject system:** | Rejection level (Peak, Min RMS, Max RMS) & Clipping (Saturation) |
| **Display** | | Stimulus level and type, Bar and Graph view |
| | | Basic and advanced view |
| **Algorithmic Sensitivity** | **CE-Chirp®:** | 99.9% |
| **Specificity** | **CE-Chirp®:** | > 96% |

## DPOAE

| | | |
|---|---|---|
| **Stimulus** | **Frequency range:** | 500 to 10000 Hz |
| | **Nominal frequency:** | f2 |
| | **Frequency step:** | 25 Hz |
| | **Level:** | 30 to 80 dB SPL (75 dB SPL for 6kHz and 65 dB SPL for 8kHz to 10kHz) |
| | **Level Step:** | 1 dB |
| | **Transducer:** | IOW Probe auto detection, auto calibrated |
| **Recording** | **Analysis time:** | Minimum 2 seconds to unlimited time |
| | **A/D Resolution:** | 24 bit, 5.38 Hz resolution |
| | **Artifact rejection system:** | -30 to +30 dB SPL or off |
| | **Stimulus tolerance:** | Adjustable between 1 and 10 dB |
| | **SNR criteria:** | Adjustable between 3 and 25 dB |
| | **Probe check window:** | 256 points frequency response of the ear canal due to a click stimulus. |
| | **DP-response window:** | 4096 points frequency response |
| | **Residual noise:** | A RMS average measurement in the DP-bin frequency area (26 bins at frequencies < 2500 Hz & 60 bins ≥ 2500 Hz). |
| **Display** | **General display gain:** | Applicable during testing |
| | **Display:** | Stimulus level and type, Bar and Graph view |
| **Probe specifications** | **Titan IOW probe:** | IMP, DPOAE, TEOAE and ABRIS capable |
| | | Replaceable probe tip |
| | | |
| **Other** | | |
| **Test Pressure** | | Ambient pressure.<br>Tympanic peak pressure. |

## TEOAE

| | | |
|---|---|---|
| **Stimulus** | **Frequency range:** | 500 to 5500 Hz |
| | **Frequency step:** | 1 Hz (Custom bands) |
| | **Stimulus type:** | Non-Linear and Linear (according to IEC 60645-3) |
| | **Level:** | 30 to 90 dB peSPL, peak to peak calibrated, AGC controlled |
| | **Level step:** | 1 dB |
| | **Click rate:** | 43 – 100 Hz |
| | **Stimulus tolerance:** | Adjustable between 1 and 3 dB |
| | **Transducer:** | IOW Probe auto detection, auto calibrated |
| **Recording** | **Analysis time:** | 5 seconds to unlimited time |
| | **A/D Resolution:** | 24 bit |
| | **Artifact rejection system:** | 0 to +60 dB SPL or off |
| | **SNR criteria:** | Adjustable between 5 and 25 dB |
| | **TE criteria:** | Band SNR, No. of Sweeps, Test time, Min Total OAE, Min Reproducibility - adjustable for use as test criteria |
| **Display** | **Stimulus time window:** | 128 points instant recording of first click in sequence of clicks |
| | **Probe check window:** | 256 points frequency response of the ear canal recorded click stimulus |
| | **Time recording window:** | 3 – 23 msec (max). A and B buffer time-samples @ sampling rate 11025 Hz |
| | **Wave reproducibility window:** | Adjustable inside the recording window |
| | **Freq. response window:** | 256 points frequency response, bin spacing 43 Hz |
| | **Other information:** | In ear status (active during test), Noise level, Tympanic peak pressure |
| | | Basic and Advanced view, FFT view, Test Summary view |
| **Probe specifications** | **Titan IOW probe:** | IMP, DPOAE TEOAE and ABRIS capable |
| | | Replaceable probe tip |
| | | |
| **Other** | | |
| **Test Pressure** | | Ambient pressure or tympanic peak pressure found in IMP module |

| General | | |
|---|---|---|
| **PC control** | **USB:** | Input/output for computer communication. Titan can be fully operated from a PC. The measurements can then be followed on the PC screen.<br>Data can be sent to and saved on the PC and stored in OtoAccess™. See separate section in Service Manual for programming details. |
| **Memory** | | Theoretically, an infinite amount of test results can be stored on the PC. The Titan hand held unit is delivered with a 8 GB memory card, enough for storing more than a quarter of a million tests. |
| **Thermal printer (Optional)** | **Type:** | Thermal (Bluetooth) printer with recording paper in rolls. Print on command through Bluetooth communication and through serial RS-232. |
| | **Paper width:** | 57.5 ± 0.5 mm on thermal printer |
| | **Printing time:** | Printing time depends on the size of the used protocol. For 2 tympanograms and 8 reflexes the thermal printer uses approximately 6s. |
| | | |
| **Dimensions** | | 6 x 6 x 28 cm / 2.4 x2.4 x11 inches |
| **Titan Weight** | | 360 g / 0.8 lbs |
| **ABR/OAE/IMP PreAmplifier weight** | | 120 g / 0.26 lbs |
| **ABR/OAE/IMP PreAmplifier dimensions** | | 10.2 x 6.8 x 2.6 cm / 4 x 2.7 x 1 inches |
| **OAE/IMP shoulder box weight** | | 64 g / 0.14lbs |
| **OAE/IMP shoulder box dimensions** | | 6.5 x 3.5 x 1.8 cm / 2.6 x 1.4 x 0.7 inches |

**Table 1: Frequencies and Intensity Ranges for IMP440**

| Titan Maximums IMP | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *TDH39* | | *CIR55* | | *EARtone 3A* | | *IOW IPSI* | | *DD45* | |
| *Center* | *Reading* | | *Reading* | | *Reading* | | *Reading* | | *Reading* | |
| *Freq. [Hz]* | *Tone [dB HL]* | *NB [dB HL]* | *Tone [dB HL]* | *NB [dB HL]* | *Tone [dB HL]* | *NB [dB HL]* | *Tone [dB HL]* | *NB [dB HL]* | *Tone [dB HL]* | *NB [dB HL]* |
| 125 | 80 | 65 | 85 | 70 | 100 | 85 | 70 | 60 | 80 | 65 |
| 250 | 100 | 85 | 100 | 85 | 110 | 100 | 85 | 75 | 100 | 85 |
| 500 | 120 | 100 | 110 | 100 | 115 | 105 | 100 | 85 | 115 | 100 |
| 750 | 120 | 105 | 110 | 105 | 120 | 110 | 100 | 85 | 120 | 105 |
| 1000 | 120 | 105 | 115 | 105 | 120 | 110 | 105 | 90 | 120 | 105 |
| 1500 | 120 | 105 | 115 | 105 | 120 | 110 | 110 | 90 | 115 | 100 |
| 2000 | 120 | 105 | 115 | 105 | 120 | 110 | 105 | 90 | 115 | 100 |
| 3000 | 120 | 105 | 115 | 105 | 120 | 110 | 95 | 90 | 125 | 105 |
| 4000 | 120 | 105 | 110 | 100 | 120 | 105 | 100 | 85 | 115 | 105 |
| 6000 | 120 | 100 | 95 | 95 | 105 | 100 | 85 | 80 | 110 | 90 |
| 8000 | 105 | 95 | 80 | 85 | 90 | 85 | 80 | 75 | 105 | 95 |
| 10000 | | | | | | | | | | |
| WB | - | 120 | - | 120 | - | 120 | - | 105 | - | 125 |
| LP | - | 120 | - | 120 | - | 120 | - | 110 | - | 120 |
| HP | - | 120 | - | 120 | - | 120 | - | 105 | - | 130 |

**Table 2: Frequencies and Intensity Ranges for DPOAE440**

| Titan Maximums DPOAE | | |
|---|---|---|
| | *IOW IPSI* | *IOW ch2* |
| | *Reading* | *Reading* |
| *Center Freq. [Hz]* | *Tone [dB SPL]* | *Tone [dB SPL]* |
| | | |
| | | |
| 500 | 80 | 80 |
| 750 | 80 | 80 |
| 1000 | 80 | 80 |
| 1500 | 80 | 80 |
| 2000 | 80 | 80 |
| 3000 | 80 | 80 |
| 4000 | 80 | 80 |
| 6000 | 75 | 75 |
| 8000 | 65 | 65 |
| 10000 | 65 | 65 |

**Titan Maximums TEOAE**
Maximum TEOAE Click Intensity: 90 dB peSPL.

**Titan Maximums ABRIS**
Maximum ABRIS levels for Click and CE-Chirp® stimuli are limited to 30, 35 & 40 dBnHL for all transducers.

## Specification of input/output connections

| Inputs | Connector type | Electrical properties | |
|---|---|---|---|
| Patient response | Jack, 3,5mm 4-pole | Handheld switch:<br>Pin 1: GND<br>Pin 2: Signal<br>Pin 3: Future use I/O<br>Pin 4: Future use I/O | 3V through 10K Ω is forced to ground when activated |
| **Outputs** | | | |
| Phones, Left/ Right | Jack, 3,5mm 4-pole | Voltage:<br>Min. load impedance:<br>Pin 1: CH1 GND<br>Pin 2: CH1 OUT (left)<br>Pin 3: CH2 OUT (right)<br>Pin 4: CH1 GND | Up to 3V rms. by 10Ω load<br>8Ω Pin 3: |
| Phones, Contralateral | Jack, 3,5mm 4-pole | Voltage:<br>Min. load impedance:<br>Pin 1: CH1 GND<br>Pin 2: CH1 OUT (left)<br>Pin 3: CH2 OUT (right)<br>Pin 4: CH1 GND | Up to 3V rms. by 10Ω load<br>8Ω |
| Transducer | IA proprietary, 12-pole | Pin 1:<br>Pin 2:<br>Pin 3:<br>Pin 4:<br>Pin 5:<br>Pin 6:<br>Pin 7:<br>Pin 8:<br>Pin 9:<br>Pin 10:<br>Pin 11:<br>Pin 12: | CH1 out<br>CH1 GND<br>DGND<br>GND A / GND Microphone<br>Microphone – input / Analog balanced in<br>Microphone + input / Analog balanced in<br>Power supply +3/+5V<br>CH2 out<br>CH2 GND<br>I2C CLK<br>I2C DATA<br>I2C Interrupt |
| **Data I/O** | | | |
| USB | USB type”B” | USB port for communication | |

## Calibration Properties

| | | |
|---|---|---|
| **Calibrated Transducers** | Contralateral Earphone: | Telephonics TDH39 with a static force of 4.5N ±0.5N and/or EARtone 3A and/or CIR55 insert phone |
| | Probe system: | Ipsilateral Earphone: is integrated in the probe system<br>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 |
| | DPOAE Levels: | ±1.5 dB for 1000 to 4000Hz and ±3 dB outside range |
| | TEOAE Levels: | ±2 dB for click stimulus |
| | ABRIS Levels: | ±2 dB for all stimulus types |
| | Pressure measurement : | ±5% or ±10 daPa, whichever is greater |
| | Compliance measurement: | ±5% or ±0.1 ml, whichever is greater |
| **Stimulus Presentation Control** | Reflexes: | ON-OFF ratio = ≥ 70 dB<br>Rise time = 27 ms<br>Fall time = 24.6 ms<br>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: | 0.001 ml is the lowest detectable volume change |
| | Reflex artifact level: | ≥95 dB SPL (measured in the 711 coupler, 0.2 ml, 0.5 ml, 2.0 ml & 5.0 ml hardwalled cavities). |
| | Temporal reflex characteristics: | Initial latency = 35 ms (±5 ms)<br>Rise time = 45 ms (±5 ms)<br>Terminal latency = 35 ms (±5 ms)<br>Fall time = 45 ms (±5 ms)<br>Overshoot = max. 1%<br>Undershoot = max 1% |
| **Pressure** | Range: | Values between -600 to +300 daPa can be selected in the setup. |
| | Safety limits: | -750 daPa and +550 daPa, ±50 daPa |

## Reflex Calibration Standards and Spectral Properties:

| | | |
|---|---|---|
| **General** | Specifications for stimulus and audiometer signals are made to follow IEC 60645-5 | |
| **Contralateral Earphone** | Pure tone: | ISO 389-1 for TDH39 and ISO 389-2 for CIR 55. |
| | Wide Band noise (WB): | Interacoustics Standard |
| | – Spectral properties: | As “Broad band noise” specified in IEC 60645-5, 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 IEC 60645-5, 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. |

The risk of artifacts at higher stimulus levels in reflex measurements are minor and will not activate the reflex detection system

**Table 3: Reference Values for Stimulus Calibration**

| | Freq. | Reference values for stimulus calibration<br>[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 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** | **Interacoustics Standard** | **Interacoustics Standard** | **ISO 389-4 (ISO 8798)** | **0.5 ml** | **1 ml** | |
| | [Hz] | TDH39 | EARtone 3A / ABR | CIR55 | DD45 | Ear Cups | IOW Probe | **IOW Probe NB** | **NB Stimulus Correction Values** (except IOW probe) | | | |
| **RETSPL** | 125 | 45 | 26 | 26 | **47.5** | | **41** | **43.5** | 4 | | | 3 |
| | 250 | 25.5 | 14 | 14 | **27** | | **24.5** | **26.5** | 4 | | | 5 |
| | 500 | 11.5 | 5.5 | 5.5 | **13** | | **9.5** | **17** | 4 | 9.7 | 5.3 | 7 |
| | 1000 | 7 | 0 | 0 | **6** | | **6.5** | **10.5** | 6 | 9.7 | 5.3 | 15 |
| | 1500 | 6.5 | 2 | 2 | **8** | | **5** | **12** | 6 | | | 21 (1600Hz) |
| | 2000 | 9 | 3 | 3 | **8** | | **12** | **11** | 6 | 11.7 | 3.9 | 26 |
| | 3000 | 10 | 3.5 | 3.5 | **8** | | **11** | **11** | 6 | -0.8 | -0.5 | 31 (3150Hz) |
| | 4000 | 9.5 | 5.5 | 5.5 | **9** | | **3.5** | **8** | 5 | -1.6 | -0.8 | 32 |
| | 6000 | 15.5 | 2 | 2 | **20.5** | | **3** | **5.5** | 5 | | | 26 (6300Hz) |
| | 8000 | 13 | 0 | 0 | **12** | | **-5** | **-0.5** | 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 | |
| **deRETSPL** | CE-Chirp | **27.5** | **31.5** | | **26** | **58.5** | **32** | | | | | |
| | CE-Chirp Low | **26.5** | **26.5** | | **25.5** | **50** | **27.5** | | | | | |
| | CE-Chirp High | **28** | **31** | | **28** | **58** | **32** | | | | | |
| | Click | **30.5** | **35** | | **32.5** | **61.5** | **33.5** | | | | | |

***All figures in bold are Interacoustics Standard values.***

## Coupler Types used for Calibration

**IMP:**
TDH39 is calibrated using a 6cc acoustic coupler made in accordance to IEC 60318-3, Ipsilateral earphone and probe tone are calibrated using a 2cc acoustic coupler made in accordance to IEC 60318-5
**ABRIS:**
Probe and insert stimuli are calibrated in SPL values using an ear simulator coupler made in accordance to IEC 60318-4. Headphones (TDH39 and DD45) stimuli are calibrated in SPL values using an artificial ear coupler according to IEC 60318-1.
**DPOAE:**
Probe stimuli L1 and L2 are calibrated individually in SPL values using the IEC 711 ear simulator coupler made in accordance to IEC 60318-4.
**TEOAE:**
Probe stimuli are calibrated in peSPL values using the IEC 711 ear simulator coupler made in accordance to IEC 60318-4.

## General Information about Specifications

Interacoustics continuously strives to improve its products and their performance. Therefore the specifications can be subject to change without notice.
The performance and specifications of the instrument can only be guaranteed if it is subject to technical maintenance at least once per year. This should be carried out by a workshop authorized by Interacoustics.

Interacoustics puts diagrams and service manuals at the disposal of authorized service companies.

## 1.4 Electromagnetic Compatibility (EMC)

Portable and mobile RF communications equipment can affect the ***TITAN*** . Install and operate the ***TITAN*** according to the EMC information presented in this chapter.
The ***TITAN*** has been tested for EMC emissions and immunity as a standalone ***TITAN*** . Do not use the ***TITAN*** adjacent to or stacked with other electronic equipment. If adjacent or stacked use is necessary, the user should verify normal operation in the configuration.
The use of accessories, transducers and cables other than those specified, with the exception of servicing parts sold by Interacoustics as replacement parts for internal components, may result in increased EMISSIONS or decreased IMMUNITY of the device.
Anyone connecting additional equipment is responsible for making sure the system complies with the IEC 60601-1-2 standard.

| **Guidance and manufacturer's declaration - electromagnetic emissions** | | |
|---|---|---|
| **The *TITAN* is intended for use in the electromagnetic environment specified below. The customer or the user of the *TITAN* should assure that it is used in such an environment.** | | |
| **Emissions Test** | **Compliance** | **Electromagnetic environment - guidance** |
| RF emissions<br>CISPR 11 | Group 1 | The ***TITAN*** uses RF energy only for its internal function.<br>Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment. |
| RF emissions<br>CISPR 11 | Class B | The ***TITAN*** is suitable for use in all commercial, industrial, business, and residential environments. |
| Harmonic emissions<br>IEC 61000-3-2 | Complies<br>Class A Category | |
| Voltage fluctuations /<br>flicker emissions<br>IEC 61000-3-3 | Complies | |

| **Recommended separation distances between portable and mobile RF communications equipment and the *TITAN* .** | | | |
|---|---|---|---|
| The ***TITAN*** is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the ***TITAN*** can help prevent electromagnetic interferences by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the ***TITAN*** 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<br>$d = 1.17\sqrt{P}$ | 80 MHz to 800 MHz<br>$d = 1.17\sqrt{P}$ | 800 MHz to 2.5 GHz<br>$d = 2.23\sqrt{P}$ |
| **0.01** | 0.12 | 0.12 | 0.23 |
| **0.1** | 0.37 | 0.37 | 0.74 |
| **1** | 1.17 | 1.17 | 2.33 |
| **10** | 3.70 | 3.70 | 7.37 |
| **100** | 11.70 | 11.70 | 23.30 |
| For transmitters rated at a maximum output power not listed above, the recommended separation distance *d* in meters (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.<br>**Note 1** At 80 MHz and 800 MHZ, the higher frequency range applies.<br>**Note 2** These guidelines may not apply to all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people. | | | |

| **Guidance and Manufacturer's Declaration - Electromagnetic Immunity** | | | |
|---|---|---|---|
| The ***TITAN*** is intended for use in the electromagnetic environment specified below. The customer or the user of the ***TITAN*** should assure that it is used in such an environment. | | | |
| **Immunity Test** | **IEC 60601 Test level** | **Compliance** | **Electromagnetic Environment-Guidance** |
| Electrostatic Discharge (ESD)<br><br>IEC 61000-4-2 | +6 kV contact<br><br>+8 kV air | +6 kV contact<br><br>+8 kV air | Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be greater than 30%. |
| Electrical fast transient/burst<br><br>IEC61000-4-4 | +2 kV for power supply lines<br><br>+1 kV for input/output lines | +2 kV for power supply lines<br><br>+1 kV for input/output lines | Mains power quality should be that of a typical commercial or residential environment. |
| Surge<br><br>IEC 61000-4-5 | +1 kV differential mode<br><br>+2 kV common mode | +1 kV differential mode<br><br>+2 kV common mode | Mains power quality should be that of a typical commercial or residential environment. |
| Voltage dips, short interruptions and voltage variations on power supply lines<br><br>IEC 61000-4-11 | < 5% *U*T<br>(>95% dip in *U*T) for 0.5 cycle<br>40% *U*T<br>(60% dip in *U*T) for 5 cycles<br>70% *U*T<br>(30% dip in *U*T) for 25 cycles<br><5% *U*T<br>(>95% dip in *U*T) for 5 sec | < 5% *U*T (>95% dip in *U*T)<br>for 0.5 cycle<br>40% *U*T (60% dip in *U*T) for<br>5 cycles<br>70% *U*T (30% dip in *U*T) for<br>25 cycles<br><5% *U*T | Mains power quality should be that of a typical commercial or residential environment. If the user of the ***TITAN*** requires continued operation during power mains interruptions, it is recommended that the ***TITAN*** be powered from an uninterruptable power supply or its battery. |
| Power frequency (50/60 Hz)<br><br>IEC 61000-4-8 | 3 A/m | 3 A/m | Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or residential environment. |
| **Note:** *U*T is the A.C. mains voltage prior to application of the test level. | | | |

| **Guidance and manufacturer's declaration — electromagnetic immunity** | | | |
|---|---|---|---|
| The ***TITAN*** is intended for use in the electromagnetic environment specified below. The customer or the user of the ***TITAN*** should assure that it is used in such an environment, | | | |
| Immunity test | IEC / EN 60601 test level | Compliance level | Electromagnetic environment – guidance |
| Conducted RF<br>IEC / EN 61000-4-6<br><br>Radiated RF<br>IEC / EN 61000-4-3 | 3 Vrms<br>150kHz to 80 MHz<br><br>3 V/m<br>80 MHz to 2,5 GHz | 3 Vrms<br><br>3 V/m | Portable and mobile RF communications equipment should be used no closer to any parts of the ***TITAN*** , including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.<br><br>Recommended separation distance<br>$d = 1,2\sqrt{P}$<br>$d = 1,2\sqrt{P}$ 80 MHz to 800 MHz<br>$d = 2,3\sqrt{P}$ 800 MHz to 2,5 GHz<br><br>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 meters (m).<br><br>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)<br><br>Interference may occur in the vicinity of equipment marked with the following symbol:<br>  |
| NOTE1 At 80 MHz and 800 MHz, the higher frequency range applies<br>NOTE 2 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 radio 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 ***TITAN*** is used exceeds the applicable RF compliance level above, the ***TITAN*** should be observed to verify normal operation, If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the ***TITAN*** .<br>[(b)] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m. | | | |

**To ensure compliance with the EMC requirements as specified in IEC 60601-1-2, it is essential to use only the following accessories:**

| ITEM | MANUFACTURER | MODEL |
|---|---|---|
| Clinical Probe Extension | Interacoustics | - |
| Short Probe Extension | Interacoustics | - |
| ABRIS Preamplifier | Interacoustics | - |
| CIR55 Insert Phone | Interacoustics | CIR55 |
| TDH39C Contra Headset | Interacoustics | TDH39C |
| DD45C Contra Headset | Interacoustics | DD45C |
| EARTone 3A with Minijack | Interacoustics | Ear3A |
| CIR55 Contra ID Earphone | Interacoustics | CIR55 |
| TDH39C Contra ID Headset | Interacoustics | TDH39C |
| DD45C Contra ID Headset | Interacoustics | DD45C |
| EARTone 3A Contra ID Earphone | Interacoustics | Ear3A |
| TDH39 Stereo ID headset | Interacoustics | TDH39 |
| DD45 Stereo ID headset | Interacoustics | TDH39 |
| EARTone ABR Stereo ID Headset | Interacoustics | Ear3A |
| EarCup Stereo ID Headset | Interacoustics | Ear3A |

**Conformance to the EMC requirements as specified in IEC 60601-1-2 is ensured if the cable types and cable lengths are as specified below:**

| Description | Length | Screened? |
|---|---|---|
| Mains Cable | 2.0m | Unscreened |
| USB Cable | 2.0m | Screened |
| PSU USB Adapter | 0.1m | Screened |
| Clinical Probe Extension | 2.0m | Unscreened |
| Short Probe Extension | 0.4m | Unscreened |
| ABRIS Preamplifier | 2.0m | Unscreened |
| CIR55 Insert Phone | 0.4m | Screened |
| TDH39C Contra Headset | 0.5m | Screened |
| DD45C Contra Headset | 0.5m | Screened |
| EARTone 3A with Minijack | 0.5m | Screened |
| CIR55 Contra ID Earphone | 0.4m | Screened |
| TDH39C Contra ID Headset | 0.5m | Screened |
| DD45C Contra ID Headset | 0.5m | Screened |
| EARTone 3A Contra ID Earphone | 0.5m | Screened |
| TDH39 Stereo ID headset | 0.5m | Screened |
| DD45 Stereo ID headset | 0.5m | Screened |
| EARTone ABR Stereo ID Headset | 0.5m | Screened |
| EarCup Stereo ID Headset | 0.5m | Screened |

**Essential performance**

For this product the following is considered essential performance:

- To generate and present stimulus signals in the audio range as specified in the applicable IEC 60645 series in normal condition
- Record and store patient responses