



INDEPENDENT X-RAY
QUALITY ASSURANCE



Mako | Specifications

Unparelled performance and versatility.

New sensor technology

Experience the groundbreaking new sensor technology with best-ever accuracy, unrivalled in the market ($\pm 1.5\%$ kVp uncertainty across entire measurement range). Place Mako Probes in any orientation in the X-ray beam, for the most efficient measurements of kVp, time, HVL, total filtration, dose and dose rate, while revelling in the captivation presentation of waveform data. Offering the broadest application range, across all diagnostic X-ray modalities (Radiography, Fluoroscopy, Mammography, CT and Dental).

Simplified excellence with Plug n Play

Mako adapts to your needs with plug-and-play simplicity, boosting your entire workflow. It's the world's most efficient meter, with the highest practical accuracy and the broadest application range.

All-in-one X-ray testing solution

Mako is designed for modern X-ray equipment and tailored to your needs. The complete solution includes the Mako meter, Mako Display, Ocean Next™ software, and our full probe line-up.

Future-proof by design, Mako evolves with new functions, probes, and an ever-expanding application range. The Mako Display gives you fast, wireless touchscreen access to QA data – no laptop required. With quick-access buttons, and easy export, testing is simpler than ever.

If you prefer to use your own mobile device, download our app to connect wirelessly and get instant results directly on your phone.

Mako Base Unit with Ion Chamber Module docked, and CT Ion Chamber attached. Instant measurements with the Mako Display.



Mako Base Unit with R/F Probe docked, mAs Module connected and mAs cable.



Mako System General Specifications

Live Measurement Display	Mako display device (incl. tablet, laptop, PC)
Software	Ocean Next™
Operating System	Windows 10, 11
Simultaneous Dose Measure	Yes
Bluetooth Range	100 m (free-in-air)
Exposures needed	One
Warranty	2-year
Extended Warranty	10-year
Calibration Cycle	2-year
Standard	According to IEC 61674 and IEC 61676
Directives:	According to 2014/30/EU EMC, 2014/35/EU LVD and 2015/863/ EU RoHS

*Specifications in this document may be changed without notice

Mako Base Unit Specifications

Size	117.3 x 73 x 23.2 mm (4.62 x 2.87 x 0.91 in)
Weight	250 g (8.82 oz)
Interface to Mako Display	Wireless (Bluetooth) or via USB cable
Interface to Probes	USB-C connection
Bluetooth Range	100 m (free-in-air)
Power Source	Rechargeable Li ion battery
Battery Life	20 hours (practical measurement time)
Battery Tested	According to UN 38.3
Memory	Unlimited (via Mako Display)
Operating Temperature	15 – 35°C
Storage Temperature	-10 – 50°C



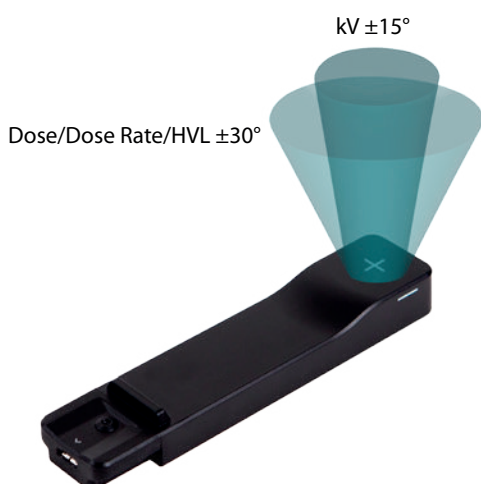


Mako Probes (R/F, Mammo, Dental) General Specifications

Size	122.5 x 28 x 14.5 mm (4.82 x 1.1 x 0.57 in)
Weight	55 g (1.94 oz)
Detector active areas	Smallest 0.9 x 0.9 mm ² , Largest 7 x 7 mm ²
Detector position check	Orientation independent, no check required
Backscatter Protection	Yes

Broadest angular range

Unique detector design provides unbeaten angular sensitivity, offering the broadest range of use and best accuracy in practice.



Mako Ion Chamber Module General Specifications

Size	80 x 27 x 16.5 mm (3.15 " x 1.06" x 0.65")
Weight	32 g (1.3 oz)
Compatible probes which can be connected to module:	RTI CT Ion Chamber (10 cm and 30 cm) RTI DAP Chamber (86 x 86 mm and 147 x 147 mm), Ion Chamber Magna 1cc, and other Ion Chambers using Triaxial- to-Lemo adapter

Mako mAs Module General Specifications

Size	68 x 27 x 14.5 mm (2.68" x 1.06" x 0.57")
Weight	16 g (0.6 oz)
Compatible probes which can be connected to module:	Mako mAs Cable, RTI MAS-2, Mako Test Point Cables

Mako Legacy Module General Specifications

Size	68 x 27 x 14.5 mm (2.68" x 1.06" x 0.57")
Weight	20 g (0.7 oz)
Compatible probes which can be connected to module:	RTI CT Dose Profiler, RTI Light Probe, RTI Dose Probe, T20, MAS-1, and MAS-2



Mako R/F Specifications (R/F Probe)

Tube Potential

Range	35 – 155 kV
Min dose rate	2 µGy/s
PPV and kVp	Yes
Uncertainty	±1.5 %

Dose

Range	1 nGy – 9999 Gy
Uncertainty	±5 % or 5 nGy

Dose Rate

Range	1 nGy/s – 500 mGy/s
Resolution	0.1 nGy/s
Trigg level	25 nGy/s @ exp. time >200 ms 3 µGy/s @ 1 ms 0.3 µGy/s @ 10 ms
Uncertainty	±5 % or 1 nGy/s

Time

Range	0.33 ms – 48 h
Resolution	0.33 ms
Bandwidth	Up to 1 kHz
Uncertainty	±0.5 % or 0.33 ms

HVL

Range	1 – 15 mm Al
Min dose rate	0.5 µGy/s
Uncertainty	±5 % or 0.2 mm Al

Total Filtration

Range	1 – 90 mm Al equivalent
Min dose rate	2 µGy/s
Uncertainty	±10 % or 0.2 mm Al

Pulses

Range	1 – 5 000 000
Min peak dose rate	0.25 µGy/s
Min pulse width	0.33 ms

Pulse Rate

Range	0.2 – 260 Hz
Min peak dose rate	0.25 µGy/s
Min pulse width	0.33 ms

Waveforms

Range	0 – 240 s
Resolution	0.33 ms at exposures <15 s
Bandwidth kV	1 kHz
Bandwidth Dose Rate	1 kHz



Mako Mammography Specifications (Mammo Probe)

Tube Potential

Range	18 – 49 kV
Min dose rate	2 µGy/s
PPV and kVp	Yes
Uncertainty	±1.5 % or 0.5 kV

Dose

Range	1 nGy – 9999 Gy
Uncertainty	±5 % or 5 nGy

Dose Rate

Range	2 nGy/s – 1 Gy/s
Resolution	0.1 nGy/s
Trigg level	50 nGy/s @ exp. time >200 ms 6 µGy/s @ 1 ms 0.6 µGy/s @ 10 ms
Uncertainty	±5 % or 2 nGy/s

Time

Range	0.33 ms – 48 h
Resolution	0.33 ms
Bandwidth	Up to 1 kHz
Uncertainty	±0.5 % or 0.33 ms

HVL

Range	0.2 – 4.0 mm Al
Min dose rate	1 µGy/s
Uncertainty	±5 % or 0.025 mm Al

Waveforms

Range	0 – 240 s
Resolution	0.33 ms at exposures <15 s
Bandwidth kV	1 kHz
Bandwidth Dose Rate	1 kHz

Supported Radiation Qualities for kV

Every mammography radiation quality also covers use of compression paddle, and use of PMMA and Aluminium phantoms up to 2.5 mm Al equivalent.

W / 0.70 mm Al	0.5 – 3.5 mm Al
W / 50 µm Rh	45 – 55 µm Rh
W / 60 µm Rh	55 – 65 µm Rh
W / 50 µm Ag	45 – 55 µm Ag
W / 75 µm Ag	70 – 80 µm Ag
W / 0.30 mm Cu	0.25 – 0.35 mm Cu
W / 1 mm Ti	1 – 1.5 mm Ti
Mo / 30 µm Mo	25 – 35 µm Mo
Mo / 25 µm Rh	20 – 30 µm Rh
Mo / 1.0 mm Al	0.8 – 1.2 mm Al
Mo / 0.25 mm Cu	0.25 – 0.35 mm Cu
Rh / 25 µm Rh	20 – 30 µm Rh
Rh / 1.0 mm Al	0.8 – 1.2 mm Al
Rh / 30 µm Ag	25 – 35 µm Ag
Rh / 0.25 mm Cu	0.25 – 0.35 mm Cu



Mako Dental Specifications (Dental Probe)

Tube Potential

Range	35 – 125 kV
Min dose rate	2 μ Gy/s
PPV and kVp	Yes
Uncertainty	± 1.5 %

Dose

Range	1 nGy – 9999 Gy
Uncertainty	± 5 % or 5 nGy

Dose Rate

Range	1 nGy/s – 500 mGy/s
Resolution	0.1 nGy/s
Trigg level	25 nGy/s @ exp. time >200 ms 3 μ Gy/s @ 1 ms 0.3 μ Gy/s @ 10 ms
Uncertainty	± 5 % or 1 nGy/s

Time

Range	0.33 ms – 48 h
Resolution	0.33 ms
Bandwidth	Up to 1 kHz
Uncertainty	± 0.5 % or 0.33 ms

HVL

Range	1 – 15 mm Al
Min dose rate	0.5 μ Gy/s
Uncertainty	± 5 % or 0.2 mm Al

Total Filtration

Range	1 – 25 mm Al equivalent
Min dose rate	2 μ Gy/s
Uncertainty	± 10 % or 0.2 mm Al

Pulses

Range	1 – 5 000 000
Min peak dose rate	0.25 μ Gy/s
Min pulse width	0.33 ms

Pulse Rate

Range	0.2 – 260 Hz
Min peak dose rate	0.25 μ Gy/s
Min pulse width	0.33 ms

Waveforms

Range	0 – 240 s
Resolution	0.33 ms at exposures <15 s
Bandwidth kV	1 kHz
Bandwidth Dose Rate	1 kHz

Invasive mA and mAs specifications (Mako mAs Module with Mako mAs Cable)

mAs

Range	0.001–9999 mAs
Resolution	0.001 mAs
Uncertainty	± 1 % or 0.001 mAs

mA

Range	0.1 - 2000 mA
Resolution	0.01 mA
Uncertainty	± 1 % or 0.01 mA

Time

Range	0.5 ms - 48 h
Resolution	0.5 ms
Bandwidth	0.7 kHz
Uncertainty	± 0.5 % or 0.5 ms

Pulses

Range	1 – 5 000 000
Min pulse width	0.5 ms
Uncertainty	± 0.5 pulses

Pulse Rate

Range	0.2 – 260 Hz
Min pulse width	0.5 ms
Uncertainty	± 0.5 pulses/s

mAs/Pulse

Range	0.001 - 9999
Resolution	0.001 mAs
Uncertainty	± 1 %

Waveforms

Range	0 – 120 s
Resolution	0.5 ms at exposures <15 s
Bandwidth	0.7 kHz

Mako mAs Cable:	3m length
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Non-invasive mA and mAs specifications (Mako mAs Module with MAS-2)

mAs	
Range	0.1–9999 mAs
Resolution	0.1 mAs
Uncertainty	±5 %
mA	
Range	10 - 4000 mA
Resolution	1 mA
Uncertainty	±5 % or 2 mA
Time	
Range	0.5 ms – 48 h
Resolution	0.5 ms
Bandwidth	0.7 kHz
Uncertainty	±0.5 % or 0.5 ms
Pulses	
Range	1 – 5 000 000
Min pulse width	0.5 ms
Uncertainty	±0.5 pulses
Pulse Rate	
Range	0.2 – 260 Hz
Min pulse width	0.5 ms
Uncertainty	±0.5 pulses/s
mAs/Pulse	
Range	0.1– 9999
Resolution	1 mAs
Uncertainty	±5 %
Waveforms	
Range	0 – 120 s
Resolution	0.5 ms at exposures <15 s
Bandwidth	0.7 kHz



RTI CT Ion Chamber 10 & 30 cm Specifications (with Mako Ion Chamber Module)

Connector type	LEMO triaxial
Cable	2 m, low noise triaxial
Active volume	5.3 cm ³ (16 cm ³)
Effective length	100 mm (300 mm)
Diameter	12 mm, 12.6 incl O-rings
Typical leakage	±20 fA
Radiation quality	70 – 150 kV
Sensitivity	30 mGycm/nC
Energy dependence	±1 %
Dose Length Product	
Range	0.01 mGycm – 9999 mGycm
Uncertainty	±5 % or 0.01 mGycm
Rate	
Range	0.3 mGycm/s – 3 Gycm/s
Resolution	0.01 mGycm/s
Uncertainty	±5 % or 0.03 mGycm/s
Time	
Range	3.3 ms – 48 h
Resolution	3.3 ms
Bandwidth	100 Hz
Uncertainty	±0.5 % or 3.3 ms
Waveforms	
Range	0 – 120 s
Resolution	3.3 ms at exposure <15 s
Bandwidth	100 Hz

Notice: Information within brackets () are valid for the 30 cm chamber.



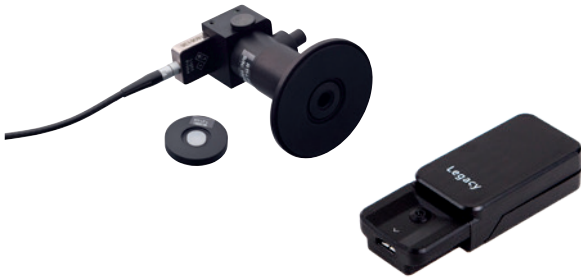
RTI DAP Chamber Specifications 86x86 & 147x147 mm (with Mako Ion Chamber Module)

Cable length	2.0 m (6.6 ft)
Quality equivalent filtration (70 kV)	0.2 mm Al
Dose Area Product	
Range	0.03 mGycm ² – 1 kGycm ²
Uncertainty	±5 % or 0.03 mGycm ²
DAP Rate	
Range	0.3 mGycm ² /s – 1500 mGycm ² /s
Uncertainty	±5 % or 0.03 mGycm ² /s
Time	
Range	3.3 ms – 48 h
Resolution	3.3 ms
Bandwidth	100 Hz
Uncertainty	±0.5 % or 3.3 ms
Waveforms	
Range	0 – 120 s
Resolution	3.3 ms at exposure <15 s
Bandwidth	100 Hz



Ion Chamber Magna 1cc Specifications (with Mako Ion Chamber Module)

Active volume	1 cm ³
Height	25.4 mm
Diameter	41.3 mm
Inner plate separation	8 mm
Weight	200 g
Cable length	2 m
Materials	Air equivalent plastic, acrylic
Entrance window	Kapton conductive film
Typical leakage	±5 fA
Radiation quality	20 – 150 kV
Energy dependence	±2 %
Typical sensitivity	20 mGy/nC
Dose	
Range	0.002 mGy – 1 kGy
Dose Rate	
Range	0.02 mGy/s – 2 Gy/s
Uncertainty	±5 % or 0.02 mGy/s
Time	
Range	3.3 ms – 48 h
Resolution	3.3 ms
Bandwidth	100 Hz
Uncertainty	±0.5 % or 3.3 ms
Waveforms	
Range	0 – 120 s
Resolution	3.3 ms at exposure <15 s
Bandwidth	100 Hz



RTI Light Probe Specifications (with Mako Legacy Module)

Spectral Response CIE V(λ) (Photopic)

Field of view

Lux adapter 180° (Cosine)
Monitor adapter Ø 7 mm

Luminance

Range 0.04 cd/m² – 128 kcd/m²
Uncertainty ±5 % or ±0.008 cd/m²

Illuminance

Range 0.014 lx – 48 klx
Uncertainty ±5 % or 0.003 lx



RTI CT Dose Profiler Specifications (with Mako Legacy Module)

General specifications

Length 210 mm
Diameter 12.5 mm
Weight 50 g
Sensor width 250 µm
Cable length 4.0 m (13.1 ft)

Dose

Range 0.05 µGy – 9999 Gy
Uncertainty ±5 %

Dose Rate

Range 0.5 µGy/s – 3 Gy/s
Uncertainty ±5 % or 0.1 µGy/s



RTI Dose Probe Specifications (with Mako Legacy Module)

General specifications

Dimensions	20 x 45 x 7.4 mm (0.79" x 1.8" x 0.29")
Weight	85 g (3 oz)
Cable length	2.0 m (6.6 ft)
Backscatter protected	Yes

Dose

Range	100 pGy – 1.5 kGy 12 nR – 170 kR
Uncertainty	±5 %

Dose rate

Range	4 nGy/s – 150 mGy/s 0.46 µR/s – 16 R/s
Uncertainty	±5 % or ±10 nGy/s ±5 % or ±1 µR/s

Time

Range	0.33 ms – 34000 s
Uncertainty	±1 % or ±0.33 ms

Pulses

Range	1 – 65535 pulses
Uncertainty	±1 pulse

Dose per pulse

Range	1 nGy/pulse – 0.3 Gy/pulse
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Pulse rate/frequency

Range	0.5 – 100 Hz
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Pulse width

Range	4 ms – 2000 s
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RTI T20 Specifications (with Mako Legacy Module)

General specifications

Dimensions	35 × 320 × 6.0 mm (metal 23,5 × 5,6 mm)
Weight approx.	75 g (2.6 oz)
Cable length	2.0 m (6.6 ft)

Operating temp. and humidity relative humidity	-10 °C to +50 °C at <85 %
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Temperature and air pressure	Insensitive, no TP correction is necessary
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Backscatter protection	Yes
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Angular dependence	Very close to ideal Cosine (flat sensor)
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Dose

Range	700 pGy – 10 kGy 80 nR – 11 MR
Uncertainty	±5 %

Dose rate

Range	27 nGy/s – 500 mGy/s 3 µR/s – 57 R/s
Uncertainty	±5 % or ±100 nGy/s ±5 % or ±10 µR/s

Time

Range	0.33 ms – 9999 s
Uncertainty	±1 % or ±0.33 ms

Pulses

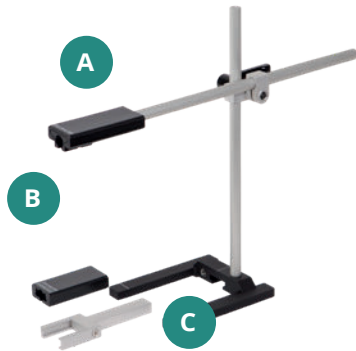
Range	3 – 9999 pulses
Uncertainty	±1 pulse

Pulse rate/frequency

Range	1/6 - 260 Hz
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Typical energy dependence

Range	+1.6 to – 0.4 % (radiation quality R1) +1.9 to – 1.5 % (radiation quality RQR)
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Mako Stand with Holders

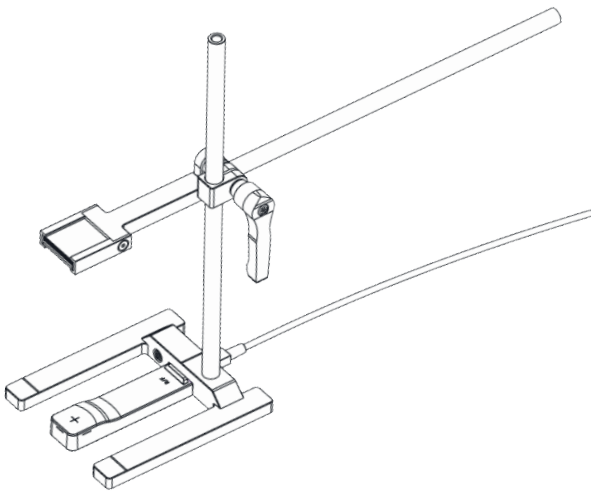
The Mako Stand with Holders has one Stand framework with three different Holder configurations.

Holder A is compatible with the Mako R/F Probe, the Mako Mammo Probe and the Mako Dental Probe.

Holder B is compatible with the RTI Dose Probe and RTI CT Ion Chamber (10 cm & 30 cm).

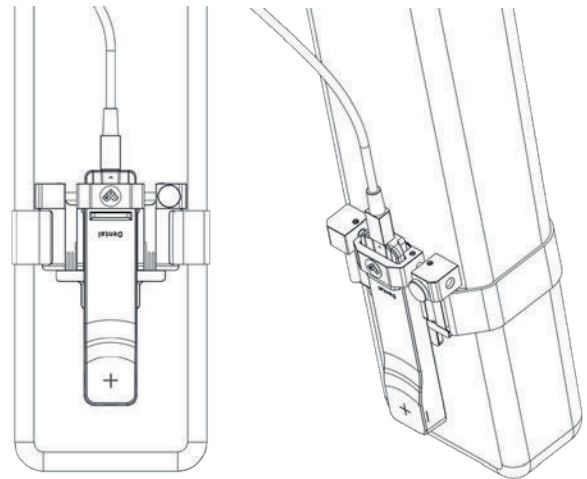
Holder C is compatible with HVL filters provided with the Mako kits (dimensions 33 x 33 mm).

The base of the Stand can also hold the Mako R/F, Mammo & Dental Probes.



Mako Panoramic Dental Holder

The Mako Panoramic Dental Holder is designed to hold the Mako Dental Probe in position during panoramic dental measurements.



c/o RTI

What we do matters. To patients. To professionals. To us.

It is more than algorithms, technology and design.

It is about setting the standard for quality assurance
of X-ray imaging.



INDEPENDENT X-RAY
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