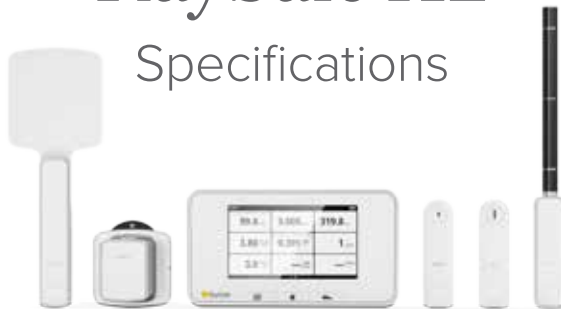


# RaySafe X2

## Specifications



## X2 GENERAL

<b>EMC TESTED</b>	According to IEC 61326-1:2012
<b>STANDARD</b>	Complies with IEC 61674
<b>EXPOSURES NEEDED</b>	One
<b>USB CABLES</b>	2 m (6.6 ft), 5 m (16.4 ft) and 5 m active extender
<b>SIZE BASE UNIT</b>	34 x 85 x 154 mm (1.3 x 3.3 x 6.1 in)
<b>WEIGHT BASE UNIT</b>	521 g (18.4 oz)
<b>OPERATING TEMPERATURE</b>	15 – 35 °C (59 – 95 °F)
<b>STORAGE TEMPERATURE</b>	-25 – 70 °C (-13 – 158 °F)
<b>POWER SOURCE</b>	Rechargeable Li ion battery
<b>BATTERY TIME</b>	~ 10 hours intensive usage
<b>BATTERY TESTED</b>	According to UN 38.3
<b>DISPLAY</b>	4.3" LCD with capacitive touch
<b>MEMORY</b>	~ 10000 latest exposures
<b>SOFTWARE</b>	X2 View for data handling and analysis. Also exports data to Microsoft Excel.
<b>PTB APPROVAL</b>	<u>23.04</u> <u>14.01</u>

## X2 mAs

<b>mAs</b>	
<b>RANGE</b>	0.001 – 9999 mAs
<b>RESOLUTION</b>	0.001 mAs
<b>UNCERTAINTY</b>	1 %
<b>mA</b>	
<b>RANGE (PEAK)</b>	0.1 – 1500 mA
<b>RESOLUTION</b>	0.01 mA
<b>UNCERTAINTY</b>	1 %
<b>TIME</b>	
<b>RANGE</b>	1 ms – 999 s
<b>RESOLUTION</b>	0.1 ms
<b>BANDWIDTH</b>	1 kHz
<b>UNCERTAINTY</b>	0.5 %
<b>PULSES</b>	
<b>RANGE</b>	1 – 9999 pulses
<b>RESOLUTION</b>	1 pulse
<b>PULSE RATE</b>	
<b>RANGE</b>	0.1 – 200 pulses/s
<b>RESOLUTION</b>	0.1 pulse/s
<b>mAs/PULSE</b>	
<b>RANGE</b>	0.001 – 9999 mAs
<b>RESOLUTION</b>	0.001 mAs
<b>UNCERTAINTY</b>	1 %
<b>WAVEFORM</b>	
<b>RESOLUTION</b>	125 µs*
<b>BANDWIDTH</b>	1 kHz

\* automatically reduced for exposures longer than 3 s

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### UNFORS RAYSAFE UNCERTAINTY DEFINITION

The expanded uncertainty is stated as the combined uncertainty of measurement multiplied by the coverage factor  $k=2$ , which assuming a normal distribution has a coverage probability of 95 % (complies with GUM by ISO (1995, ISBN 92-67-10188-9)).

Instrument specifications are subject to purchased configuration. All specifications may change without notice.

# X2 R/F SENSOR

<b>WEIGHT</b>	42 g (1.5 oz)
<b>SIZE</b>	14 x 22 x 79 mm (0.5 x 0.9 x 3.1 in)
<b>ACTIVE COMPENSATION</b>	
Beam quality independent for the following ranges:	
<b>DOSE/DOSE RATE</b>	40 – 150 kVp, 1 – 14 mm Al HVL
<b>kVp</b>	40 – 150 kVp, up to 1 mm Cu
<b>TF</b>	60 – 120 kVp, up to 1 mm Cu
<b>DOSE</b>	
<b>RANGE</b>	1 nGy – 9999 Gy (0.1 µR – 9999 R)
<b>UNCERTAINTY</b>	5 % or 5 nGy (0.5 µR)
<b>DOSE RATE</b>	
<b>RANGE</b>	1 nGy/s – 500 mGy/s (5 µR/min – 3400 R/min)
<b>RESOLUTION</b>	1 nGy/s (5 µR/min)
<b>TRIG LEVEL</b>	50 nGy/s (340 µR/min)
<b>UNCERTAINTY</b>	5 % or 10 nGy/s (70 µR/min) x duty cycle
<b>kVp</b>	
<b>RANGE</b>	40 – 150 kVp
<b>MINIMUM DOSE</b>	50 µGy (6 mR)
<b>MINIMUM DOSE RATE (PEAK)</b>	10 µGy/s (70 mR/min)
<b>UNCERTAINTY</b>	2 %
<b>HVL</b>	
<b>RANGE</b>	1 – 14 mm Al
<b>MINIMUM DOSE</b>	1 µGy (120 µR)
<b>MINIMUM DOSE RATE (PEAK)</b>	0.5 µGy/s (3.5 mR/min) at > 70 kV 2.5 µGy/s (17 mR/min) at 50 kV
<b>UNCERTAINTY</b>	10 %

<b>TOTAL FILTRATION</b>	
<b>RANGE</b>	1.5 – 35 mm Al
<b>MINIMUM DOSE</b>	50 µGy (6 mR)
<b>MINIMUM DOSE RATE (PEAK)</b>	10 µGy/s (70 mR/min)
<b>UNCERTAINTY</b>	10 % or 0.3 mm Al

<b>TIME</b>	
<b>RANGE</b>	1 ms – 999 s
<b>RESOLUTION</b>	0.1 ms
<b>BANDWIDTH</b>	4 Hz – 4 kHz*
<b>UNCERTAINTY</b>	0.5 %

\* automatically adjusted depending on signal level

<b>PULSES</b>	
<b>RANGE</b>	1 – 9999 pulses
<b>MINIMUM DOSE RATE (PEAK)</b>	0.5 µGy/s (3.5 mR/min)

<b>PULSE RATE</b>	
<b>RANGE</b>	0.1 – 200 pulses/s
<b>MINIMUM DOSE RATE (PEAK)</b>	0.5 µGy/s (3.5 mR/min)

<b>DOSE/PULSE</b>	
<b>RANGE</b>	1 nGy/pulse – 999 Gy/pulse (0.1 µR/pulse – 999 R/pulse)
<b>MINIMUM DOSE RATE (PEAK)</b>	0.5 µGy/s (3.5 mR/min)

<b>WAVEFORMS</b>	
<b>RESOLUTION</b>	62.5 µs*
<b>BANDWIDTH kV</b>	0.1 – 0.4 kHz**
<b>BANDWIDTH DOSE RATE</b>	4 Hz – 4 kHz**

\* automatically reduced for exposures longer than 1.5 s

\*\* automatically adjusted depending on signal level

# X2 MAM SENSOR

<b>WEIGHT</b>	42 g (1.5 oz)
<b>SIZE</b>	14 x 22 x 79 mm (0.5 x 0.9 x 3.1 in)

## ACTIVE COMPENSATION

Beam quality independent for the following ranges:

### DOSE/DOSE RATE & HVL

No selections needed.

With or without paddle, with or without phantom.

<b>Mo/Mo, Mo/Rh</b>	20 – 40 kVp
<b>Rh/Ag</b>	27 – 40 kVp
<b>Mo/AI, W/Rh, W/Ag, W/AI, Rh/Rh, Rh/AI</b>	20 – 50 kVp
<b>Mo/Cu, Rh/Cu, W/Cu</b>	40 – 50 kVp

### kVp

User selectable beam qualities.

Paddle compensation available when relevant.

<b>W/Ag</b>	20 – 40 kVp
<b>W/AI</b>	20 – 50 kVp Measuring over 40 kVp requires an X2 R/F Sensor + 2 mm Al (incl.)
<b>W/Rh</b>	20 – 40 kVp
<b>Mo/Mo</b>	20 – 40 kVp
<b>Mo/Rh</b>	32 – 40 kVp using + 2 mm Al (incl.)
<b>Rh/Ag</b>	27 – 40 kVp
<b>Mo/Cu, W/Cu</b>	40 – 50 kVp, using the X2 R/F Sensor

## DOSE

<b>RANGE</b>	1 $\mu$ Gy – 9999 Gy (0.1 mR – 9999 R)
<b>UNCERTAINTY</b>	5 %

## DOSE RATE

<b>RANGE</b>	10 $\mu$ Gy/s – 300 mGy/s (70 mR/min – 2000 R/min)
<b>UNCERTAINTY</b>	5 %

## kVp

<b>RANGE</b>	20 – 50 kVp* Measuring over 40 kVp requires an X2 R/F Sensor + 2 mm Al (incl.)
<b>MINIMUM DOSE</b>	50 $\mu$ Gy (6 mR)
<b>MINIMUM DOSE RATE (PEAK)</b>	10 $\mu$ Gy/s (70 mR/min)
<b>UNCERTAINTY</b>	2 % or 0.5 kV (without paddle) 2 % or 0.7 kV (with paddle)

\* depending on beam quality, see active compensation

## HVL

<b>RANGE</b>	0.2 – 3.6 mm Al
<b>MINIMUM DOSE</b>	1 $\mu$ Gy (0.1 mR)
<b>UNCERTAINTY</b>	5 % above 25 kV 10% below 25 kV

## TIME

<b>RANGE</b>	1 ms – 999 s
<b>RESOLUTION</b>	0.1 ms
<b>BANDWIDTH</b>	400 Hz
<b>UNCERTAINTY</b>	0.5 %

## PULSES

<b>RANGE</b>	1 – 9999 pulses
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## PULSE RATE

<b>RANGE</b>	0.1 – 200 pulses/s
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## DOSE/PULSE

<b>RANGE</b>	1 $\mu$ Gy/pulse – 999 Gy/pulse (0.1 mR/pulse – 999 R/pulse)
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## WAVEFORMS

<b>RESOLUTION</b>	62.5 $\mu$ s*
<b>BANDWIDTH</b>	400 Hz

\* automatically reduced for exposures longer than 1.5 s

# X2 LIGHT SENSOR

<b>WEIGHT</b>	136 g (4.8 oz)
<b>SIZE</b>	48 x 60 x 68 mm (1.9 x 2.4 x 2.7 in)
<b>CLASSIFICATION</b>	DIN 5032 part 7 class B
<b>STANDARDS</b>	Complies with relevant parts of AAPM TG18, IEC 62563-1 and IEC 61223-2-5.

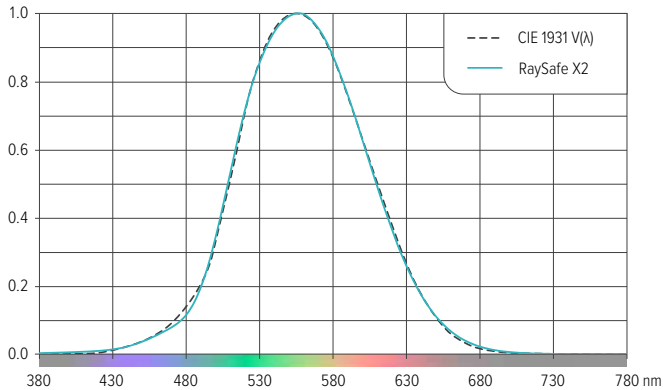
## LUMINANCE

<b>RANGE</b>	0.01 – 10 000 cd/m <sup>2</sup> (0.03 – 34 000 fL)
<b>RESOLUTION</b>	0.001 cd/m <sup>2</sup> (0.001 fL)
<b>APERTURE ANGLE</b>	5°
<b>MEASUREMENT AREA</b>	∅ 10 mm (0.4 in)
<b>UNCERTAINTY ILLUMINANT A</b>	3%
<b>DEVIATION FROM HUMAN EYE V(λ) (f<sub>1</sub>' )</b>	< 3 % (see figure Photopic Response)

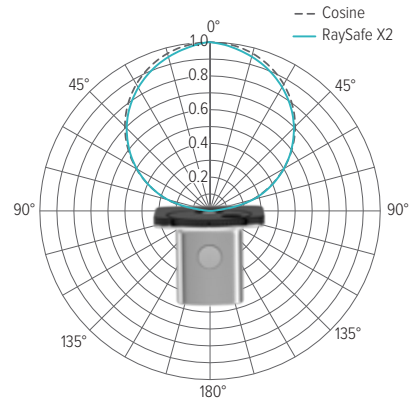
## ILLUMINANCE

<b>RANGE</b>	0.1 – 100 000 lux (0.01 – 9000 fc)
<b>RESOLUTION</b>	0.01 lux (0.001 fc)
<b>UNCERTAINTY ILLUMINANT A</b>	3%
<b>DEVIATION FROM HUMAN EYE V(λ) (f<sub>1</sub>' )</b>	< 3 % (see figure Photopic Response)
<b>COSINE DEVIATION (f<sub>2</sub>' )</b>	< 3 % (see figure Cosine Response)

Photopic Response



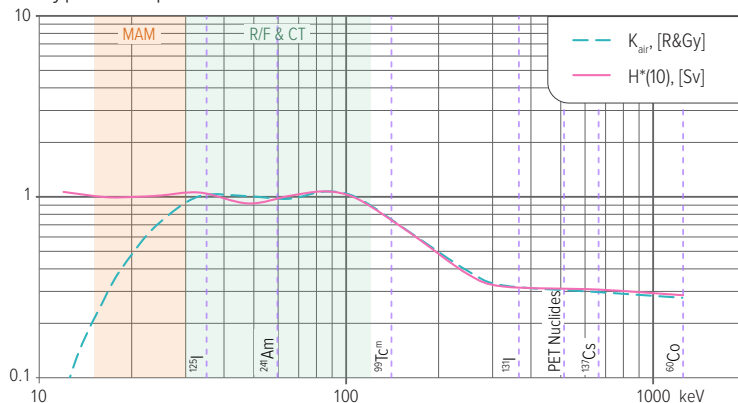
Cosine Response



# X2 SURVEY SENSOR

<b>DIMENSIONS</b>	14 x 66 x 192 mm (0.5 x 2.6 x 7.6 in)	<b>AIR KERMA RATE</b>	
<b>WEIGHT</b>	140 g (4.9 oz)	<b>RANGE</b>	0 $\mu$ Gy/h – 100 mGy/h (0 mR/h – 10 R/h)
<b>ACTIVE COMPENSATION</b>	H*(10) – when selecting Sv Air kerma – when selecting Gy or R	<b>UNCERTAINTY</b>	5 % or 0.3 $\mu$ Gy/h (0.03 mR/h), RQA 50 – 150 kV 10% or 0.3 $\mu$ Gy/h (0.03 mR/h), N-series 40 – 150 kV
<b>TRIG MODES</b>		<b>MEAN ENERGY</b>	
<b>MANUAL</b>	Manual start and stop of measurement	<b>RANGE</b>	30 – 120 keV
<b>AUTO</b>	Trig level (N80): 10 $\mu$ Gy/h (1.2 mR/h) or 20 $\mu$ Sv/h	<b>UNCERTAINTY</b>	10 %
<b>H*(10)</b>		<b>MINIMUM DOSE RATE</b>	10 $\mu$ Sv/h or 10 $\mu$ Gy/h (1 mR/h)
<b>RANGE</b>	0 nSv – 9999 Sv	<b>DEFINING STANDARD:</b>	ISO 4037-1
<b>RESOLUTION</b>	1 nSv	<b>TIME</b>	
<b>UNCERTAINTY</b>	10 %, N-series 20 – 150 kV	<b>RANGE</b>	0.1 – 9999 s
<b>H*(10) RATE</b>		<b>RESOLUTION</b>	0.01 s
<b>RANGE</b>	0 $\mu$ Sv/h – 150 mSv/h	<b>BANDWIDTH</b>	1 Hz
<b>UNCERTAINTY</b>	10 % or 0.3 $\mu$ Sv/h, N-series 20 – 150 kV	<b>WAVEFORM</b>	
<b>AIR KERMA</b>		<b>RESOLUTION</b>	10 ms
<b>RANGE</b>	0 nGy – 9999 Gy (0 $\mu$ R – 9999 R)	<b>BANDWIDTH</b>	1 Hz
<b>RESOLUTION</b>	1 nGy (0.1 $\mu$ R)	<b>MINIMUM DOSE RATE</b>	1 $\mu$ Sv/h or 1 $\mu$ Gy/h (0.1 mR/h)
<b>UNCERTAINTY</b>	5 %, RQA 50 – 150 kV 10 %, N-series 40 – 150 kV		

Typical response



## X2 CT SENSOR

<b>WEIGHT</b>	86 g (3.0 oz)
<b>SIZE</b>	14 x 22 x 219 mm (0.5 x 0.9 x 8.6 in)
<b>SIZE Ø</b>	12.0 mm (0.47 in)
<b>STANDARD</b>	For measurements in accordance with IEC 60601-2-44
<b>ACTIVE LENGTH</b>	100 mm (3.94 in)
<b>ENERGY DEPENDENCE</b>	< 5 % for 70 – 150 kV (RQR, RQA and RQT beam qualities)
<b>AUTOMATIC ENVIRONMENTAL COMPENSATION</b>	80 – 106 kPa, 15 – 35 °C (59 – 95 °F)

### DOSE

<b>RANGE</b>	10 µGy – 999 Gy (1 mR – 999 R)
<b>UNCERTAINTY</b>	5 %

### DOSE LENGTH PRODUCT

<b>RANGE</b>	100 µGycm – 9999 Gycm (10 mRcm – 9999 Rcm)
<b>UNCERTAINTY</b>	5 %

### DOSE RATE

<b>RANGE</b>	10 µGy/s – 250 mGy/s (70 mR/min – 1700 R/min)
<b>UNCERTAINTY</b>	5 %

### TIME

<b>RANGE</b>	10 ms – 999 s
<b>RESOLUTION</b>	1 ms
<b>BANDWIDTH</b>	10 Hz
<b>UNCERTAINTY</b>	0.5 %

### WAVEFORMS

<b>RESOLUTION</b>	1 ms
<b>BANDWIDTH</b>	10 Hz

Unfors RaySafe offers comprehensive solutions for the X-ray room to measure the performance of X-ray equipment and to monitor medical staff dose in real-time. RaySafe helps you avoid unnecessary radiation.

[www.raysafe.com](http://www.raysafe.com)

