

AEC chamber

VacuDAP

Radiation Dose Measurement in X-ray Diagnostics

DAP and Air Kerma Measurement

AEC chambers

General The AEC chamber is an accessory for X-ray systems (projection radiography). The AEC chamber provides a signal proportional to the image receptor dose, enabling X-ray imaging with optimal diagnostic image quality with minimal patient radiation exposure. The AEC chamber is designed for continuous operation in professional health care facilities (clinics, hospitals, medical practices).

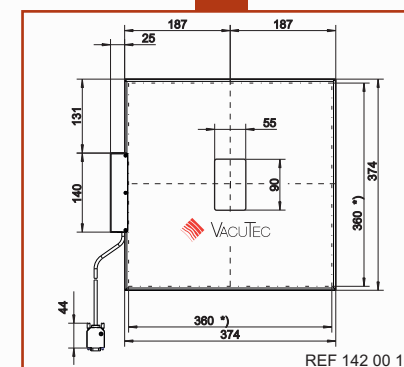
Configuration The AEC chambers are air-filled parallel-plate ionization chambers with typically one or three independent sensor fields. Several different outer dimensions are available. Each VacuTec AEC chamber is equipped with a preamplifier and electronics, which converts the low ionization current into EMC stable digital signals (see figure below). Additionally it supplies the voltage for the chamber operation and allows selection of the sensor fields. Optionally the digital output signal can be transformed into an analogue voltage by using an additional ramp module.

The positioning of the AEC chamber is close to the image detector. If an anti-scatter grid is used, the sensor has to be placed between the grid and the image detector. The AEC chamber has to be connected to an automatic exposure controller at the generator site.

Calibration Each VacuTec AEC chamber is factory calibrated to radiation quality RQA5.

Selection of AEC chambers with digital interface:

REF	No. of Measuring fields	Connector	size (mm)
140 00 13	3	Sub-D 9 pin	374 x 354
141 00 18	3	Sub-D 9 pin	374 x 374
141 00 20	3	Sub-D 9 pin	320 x 320
142 00 13	1	Sub-D 9 pin	374 x 374
143 00 06	3	Sub-D 9 pin	374 x 450
145 00 44	3	Sub-D 9 pin	450 x 450
145 00 45	3	RJ45	450 x 450
151 00 18	3	Sub-D 9 pin	450 x 450
151 00 21	3	Sub-D 9 pin	450 x 470
151 00 22	3	RJ45	450 x 470



Selection of ramp modules (for Sub-D type AEC chambers):

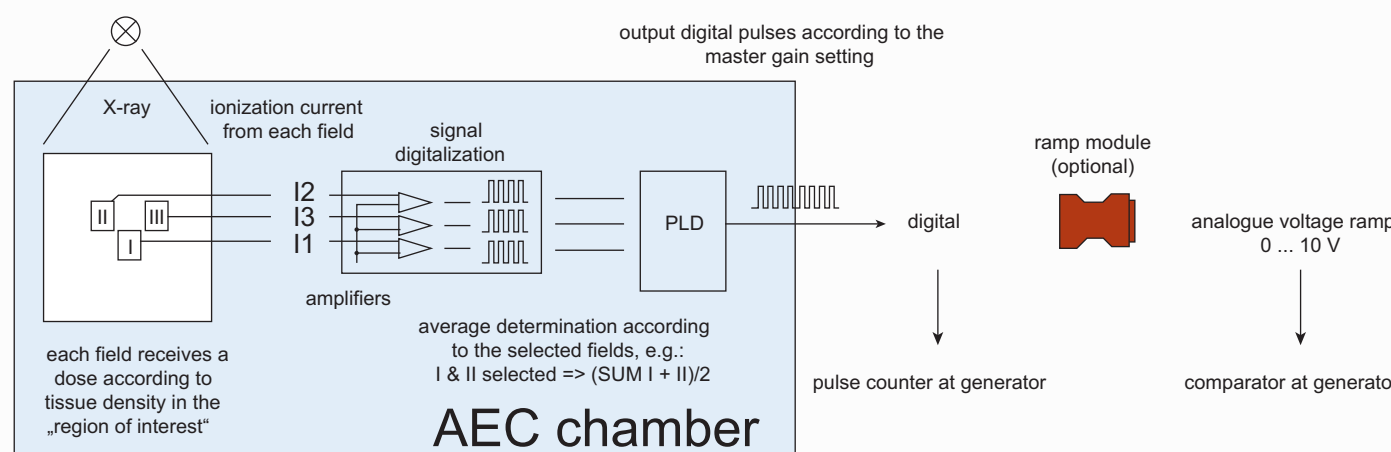
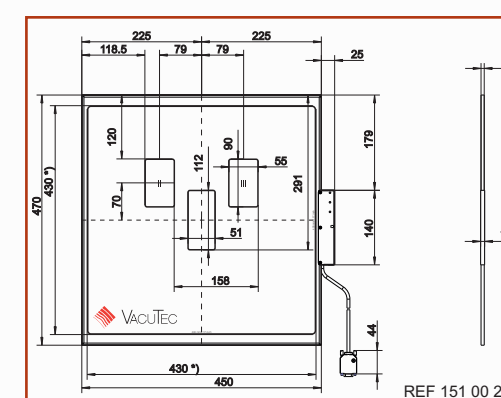
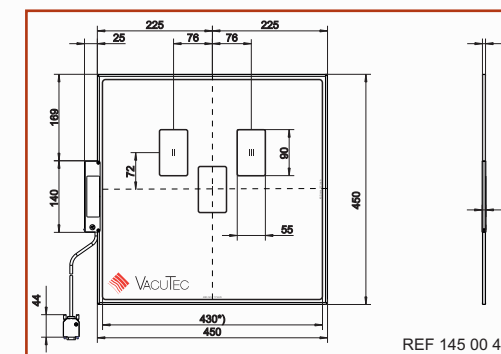
REF	Description
902 00 42	for 1 and 3 field AEC chambers
902 00 11	for 1 and 3 field AEC chambers, with cable extension



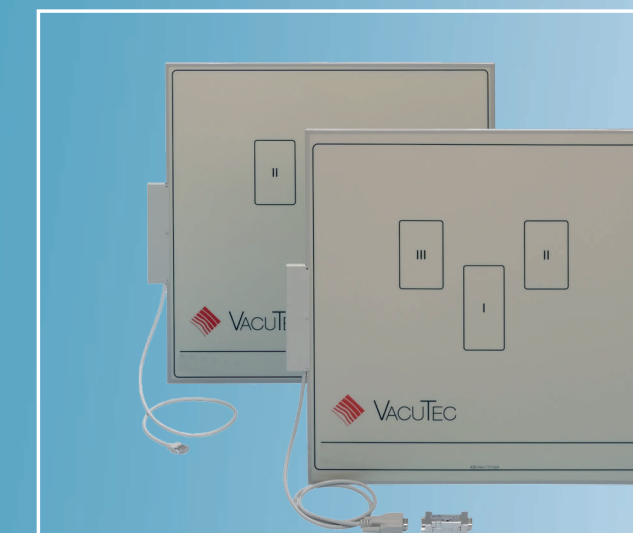
Specifications:

Energy range / tube voltage (40 ... 150) kV
Dose rate range (0.5 ... 1000) $\mu\text{Gy/s}$
Exposure dose range (1 ... 100) μGy
Digital resolution (selectable) 0.025 μGy
Exposure time range 1 ms ... 10 s
Sensitivity tolerance between sensor fields <5%
Attenuation factor <1.04
Aluminum equivalent < 0.75 mm Al
Supply voltage AEC chamber $\pm(12 \dots 16)$ V DC
Power consumption max. 2 W
Digital output Differential signal (RS 422), pulse width 2 μs

When using ramp module:
Supply voltage $\pm(12 \dots 16)$ V DC
Ramp output (0 ... 10) V



Dose / Dose Area Product Measuring System
VacuDAP



Ionization Chambers for Automatic
X-Ray Exposure Control

DAP Measurement

DAP meter (VacuDAP)

General A DAP meter measures the incident air kerma area product (DAP).

According to specific national guidelines, the recording of the DAP value is required for comparison with diagnostic reference levels in radiology and fluoroscopy.

Configuration VacuTec provides a wide range of rectangular light transparent DAP chambers suitable for most of the X-ray systems on the market. Circular DAP chambers, customized for use in different C-arm machines are also available.

The rectangular light transparent DAP meters are slid into the accessory rails at light field collimators, whereas in C-arm machines the DAP chamber is usually installed inside the housing of the X-ray source. Pulse interface or serial data transfer to the host is possible. Stand alone DAP meters with an external or integrated display are ideal for retrofitting of existing X-ray systems. Special features such as an independent battery power supply or a wireless data transfer to an external display or host simplify the installation.

Most modern X-ray systems are equipped with a built-in DAP meter. In this case the measured values are directly linked to the digital X-ray image.

Calibration The standard VacuDAP factory calibration is done at 70 kV with a tube filtration of 2.5 mm Al and without additional absorbers.

Combined DAP/Air Kerma meter (VacuDAP duo)

General A DAP/Air Kerma meter measures incident air kerma at the reference point in addition to the DAP. The recording and display of air kerma at the reference point is required for interventional and fluoroscopy procedures (IEC 60601-2-54, IEC 60601-2-43, CFR 1020.32).

Since the air kerma depends on the distance from the focus, it is important to clearly define the position of the measurement chamber and the reference point. Both distances affect the measuring values and must be transferred and updated to the air kerma meter.






Configuration Nearly all VacuDAP models are available as VacuDAP duo versions. The design and mechanics are equivalent to VacuDAP. The installation options are as described for the VacuDAP systems.




For the air kerma measurement, the measuring chamber is divided into a central field and an outer field. The signal generated in the central field is proportional to the air kerma, while the sum of the signals from central and outer field is proportional to the DAP. Both signals are amplified in two independent measuring channels of the electronics.

Calibration Factory calibration of the DAP channel is done as described for VacuDAP. The factory calibration of the air kerma channel is done with default values for the distance of focus to chamber and the distance of focus to reference point. These default values have to be adjusted to the true values for each installation.

VacuDAP

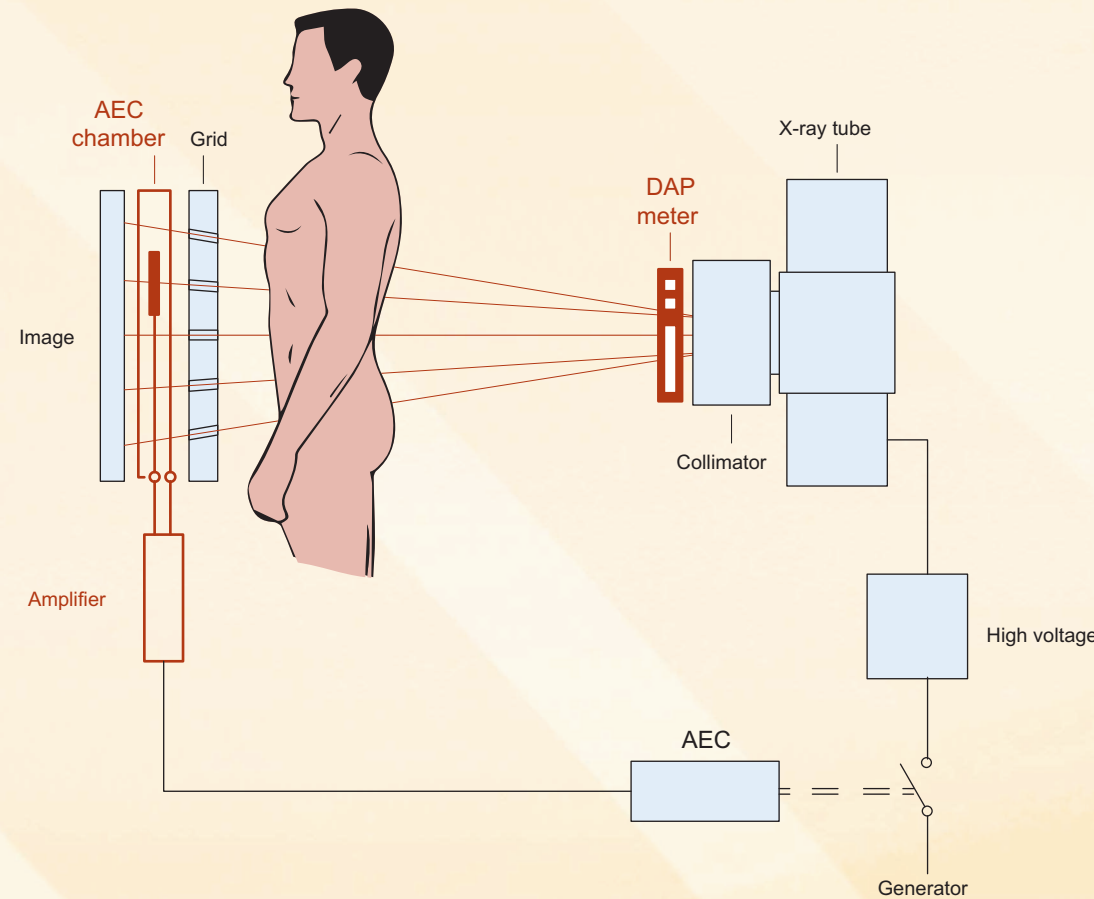
Overview Models:

VacuDAP standard	VacuDAP fluoro	VacuDAP twin	VacuDAP Bluetooth®	VacuDAP compact
				
one line display	two line display (DAP/DAP rate)	display for two DAP chambers	Bluetooth communication between chamber and display	integrated display
display provides RS232 interface to connect PC or printer				interface to printer or secondary display
complete system powered through display unit by power supply (110 ... 240) VAC			*chamber power options display powered by power supply	
measurement of DAP, DAP rate, irradiation time				
REF 158(6) 00 15 + REF 943 00 01 + REF 943 00 40 + REF 950 00 57(8, 9)	REF 158(6) 00 15 + REF 943 00 04 + REF 943 00 40 + REF 950 00 57(8, 9)	REF 158(6) 00 15 + REF 943 00 02 + REF 943 00 40 + REF 950 00 57(8, 9)	REF 158(6) 00 14 + REF 943 00 06 + chamber power options + REF 950 00 57(8, 9)	REF 158(6) 00 05 + *chamber power options

VacuDAP - OEM	VacuDAP Bluetooth®	VacuDAP 2004 OEM
		
RS485 interface, optional with RS485/232 or CAN converter	Bluetooth interface	pulse interface RS422
(10 ... 30) VDC	*chamber power options	(10 ... 24) VDC
measurement of DAP, DAP rate, irradiation time		measurement of DAP, DAP rate
REF 158(6) 00 15	REF 158(6) 00 14	REF 157 00 15, 156 00 10

*chamber power options:

- (10 ... 30 V)
- from collimator (e.g. through AC/DC converter)
- by battery for VacuDAP
- by plug in power supply



Dimensions:

	outer dimension [mm]	active area [mm]	transparent yes/no	REF
rectangular VacuDAP/ VacuDAP duo	158 x 140 x 18	123 x 123	yes	156(456) 00 15
	185 x 140 x 18	123 x 123	yes	156 00 05(14)
	182 x 164 x 18	147 x 147	yes	158(458) 00 15
	209 x 164 x 18	147 x 147	yes	158 00 05(14)
circular chambers VacuDAP - C	Ø 60	Ø 44	no	159 00 xy
	Ø 90	Ø 68	yes	159 00 01
	Ø 100	Ø 72	no	159 00 xy
	Ø 157	Ø 100	yes	159 00 13
rectangular chambers VacuDAP - C	100 x 105 x 18	86 x 86	yes	160 00 03
	158 x 140 x 18	123 x 123	yes	160 00 16
	182 x 164 x 18	147 x 147	yes	160 00 18
	290 x 31 x 20	242 x 8	no	160 00 01
display units	169 x 94 x 37			943 00 xy
electronics for VacuDAP - C	80 x 50 x 17			922 00 xy

Rated range of use (Does not apply to VacuDAP-C, VacuDAP-C duo and VacuDAP 2004 OEM):

		VacuDAP	VacuDAP duo
DAP	Digital resolution	0.01 µGy·m²	
	Measuring range	0.1 ... 99 999 999 µGy·m²	
DAP rate	Digital resolution	0.6 µGy·m²/min	
	Measuring range	6 ... 2 200 000 µGy·m²/min	
Dose	Digital resolution**	0.003 mGy	
	Measuring range**	(0.03 ... 99 999 999) mGy	
Dose rate	Digital resolution**	0.2 mGy/min	
	Measuring range**	(2 ... 12 000) mGy/min	

** Distance focus-chamber: 28 cm; Distance focus-reference point: 100 cm, minimal field width 1.4 cm

Additional equipment and components:



Battery for VacuDAP

The VacuDAP compact in combination with the rechargeable battery is the first complete stand alone DAP system and ideally suited for mobile X-ray systems. The battery pack is also best suited for use with VacuDAP Bluetooth®. Dimension: (100 x 48 x 25) mm

Adapter for additional filter

Allows operation of VacuDAP in the use of filters in combination with the measuring chamber.



AC/DC Converter

The converter provides the supply voltage from a primary SELV of 20 ... 50 VDC or 14 ... 35 VAC.

RS 485/232 Converter

Interface cable with integrated RS 485/232 converter are available with different lengths in increments of 5 m. Dimension: (53 x 33 x 16) mm + cable

CAN Converter

The rugged mechanical adapter allows the use of filters in combination with the measuring chamber. Allows operation of VacuDAP in an ISO 11898 compliant bus. Sub-D 9 or RJ45 connectors. Dimension: (54 x 33 x 16) mm + cable



Printer

The label printer Zebra ZD410 and the low cost thermal printer Seiko DPU414 can be used at the serial interface to print a protocol.

Fixing rails





Rails for fixing the rectangular measuring chambers to a collimator are available from 140 mm to 190 mm width.

Plug in power supply

EU, UK, US type or universal world wide plug in power supply according MDD for 110-240 V AC to power several VacuDAP systems are available optionally.

General technical specifications:

- IEC 60580, IEC 60601-2-54, IEC 60601-2-43, CFR 1020.32 compliant
- Radiation quality (40...150 kV)
- Atmospheric pressure (80...106) kPa
- Temperature (+10...+40) °C
- Airhumidity (10...80)% rel. humidity (max. 20 g/m³)

VacuDAP - C with display	VacuDAP - C	VacuDAP - C rectangular transparent	VacuDAP - C rectangular non transparent	VacuDAP - C duo with display	VacuDAP - C duo
					
display provides RS232 interface to connect PC or printer	RS232 or RS485 interface, optional with CAN converter			display provides RS232 interface to connect PC or printer	RS232 or RS485 interface, optional with CAN converter
all VacuDAP-C configurations can be operated with optional Bluetooth adapter					
complete system powered through display unit by power supply (110 ... 240) VAC	(10 ... 30) VDC			complete system powered through display unit by power supply (110 ... 240) VAC	(10 ... 30) VDC
circular chamber diameter/active area (in mm): 60/44, 100/72 non transparent; 90/68, 157/100 transparent		active area (in mm): 86 x 86, 123 x 123, 147 x 147	length: 290 mm	circular chamber diameter/active area (in mm): 100/72 non transparent	
measurement of DAP, DAP rate, irradiation time				measurement of DAP, DAP rate, Dose, Dose rate, irradiation time	
REF 159 xx+922 xx + REF 943 00 04 + REF 943 00 40 + REF 950 00 57(8, 9)	REF 159 xx+922 xx	REF 160 xx+922 xx		REF 161 xx+922 xx + REF 943 00 04 + REF 943 00 40 + REF 950 00 57(8, 9)	REF 161 xx+922 xx