SILAC

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SIEMENS Healthineers

Features and benefits

Siemens Healthineers
Industrial Linear Accelerator

Product description
The SILAC linear accelerator system is an advanced MeV X-ray source, especially designed for imaging applications in non-destructive testing (NDT) and security screenings of vehicles and cargo.

By realizing pulse-to-pulse energy and dose switching at pulse rates up to 1000 Hz, SILAC enables material discrimination also for high-throughput applications.

Engineered for continously adjustable operation points including features like cabin mode and fast dose reduction the latest high-energy X-ray imaging standards are fullfilled.

Configurability of all components allows customers to meet even exceptional demands and therefore maximizes possible use cases of SILAC.

Its radiation resistant design is optimized for lifetime and versatility , accomodating both fixed installations in protected environments and mobile configurations on trucks or gantries.

To ensure reliable performance across diverse locations (e.g., maritime, tropical, desert), the specific design enables operation at a wide range of environmental conditions (details see “Technical data”).

Possible applications:

- Cargo inspection: trucks, ships, rolling stock
- Non-destructive testing
- Quality control in casting technology
- Metrology in complex assemblies
- Various research fields

Product overview

Control cabinet
- Including Solid State Modulator adjustably powering the X-ray source with variable pulse properties
- Enabling full system control via PLC or GUI
- Providing external interfaces including signal processing
- Onboard oscilloscope for monitoring internal signals

X-ray head
- Transferring the HV pulse to a photon beam of variable energy, dose and collimation
- Internal beam hardening possible
- Rotatable in 3 axes

Temperatur Control Unit
- Enabling independency from ambient temperature for all system components among two possible temperature ranges
- Creating and maintaining a stable system temperature of 40°C

Interface connections
- Creating flexibility in spatial arrangement by connecting components
- Maximum connection lengths between control cabinet and X-ray head from 12 m up to 20 m

Beam configuration
- Customized parameter setups
- Up to 4 possible configurations
- One configuration includes 4 modes specified by energy and dose:
  - E.g., security: High Mode, Low Mode, Cabin Mode & 1 additional mode
  - E.g., NDT: 4× Single modes

Documents
- Operator Manual for startup, operation and preventive maintenance
- Service Manual for corrective maintenance including troubleshooting
- Providing information comprehensively and transparently
- Detailed spare part calatogue

Customer service and training
- Prompt and flexibile customer service offering remote and on-site support
- Special trainings for qualifying technicians to independently work with SILAC (e.g., for commisioning or maintenance)

Miscellaneous
- Lifetime-optimized design by using solid-state technology
- Long-time spare part and service availability for minimum 10 years
- Consultation and guidance during planning, ramp-up phase and developement

Detailed view: beam configuration

Energy and dose
The energy of the photon beam is defined by the ratio D20 and D10 (iron) according to DIN 6809-1 chapter 5.4 and IEC 62976.

The dose is defined as the energy deposited in water.

More details on request.

		Silac p 7MeV	Silac p 9MeV
Maximum dose rates (Gy/min) at absorbed dose H_2O, (p = 1)	3 MeV (HVL = 2.3 cm)	2 Gy/min	–
	4 MeV (HVL = 2.5 cm)	5 Gy/min	–
	5 MeV (HVL = 2.6 cm)	8 Gy/min	2 Gy/min
	6 MeV (HVL = 2.7 cm)	10 Gy/min	12 Gy/min
	7 MeV (HVL = 2.8 cm)	4 Gy/min	18 Gy/min
	8 MeV (HVL = 2.9 cm)	–	32 Gy/min
	9 MeV (HVL = 3 cm)	–	24 Gy/min

Spot size
The photon spot size depends on the chosen operation point. A photon spot size of less than 2 mm can be guaranteed. The spot size is determined similar to EN 12543-5, by measuring the penumbra of a tungsten edge under high magnification.

Leakage radiation
Leakage radiation is defined along the horizontal and vertical plane at 1 m from the focal spot at angles greater than 60°. Depending on the configuration, the ratio between leakage radiation and primary beam is in a minimum range of 10^{-6}.

More details on request.

Dose and energy stability
The dose stability is the standard deviation of sequential pulses. For a dose controlled system the dose stability is better than 2%.

Rising time: By using a special trigger regime pulse to pulse dose enabling is possible with specified dose.

Repetition rate
600 Hz, 800 Hz and 1000 Hz are available as maximum repetition rates (different hardware configurations). Further, the repetition rate can be set in the software between 50 Hz and the chosen hardware maximum (interlaced and single energy mode).

Interlaced Mode
In the interlaced mode the energy of sequential pulses is alternating between high and low energy with equal dose (details see “Interfaces and trigger”).

Beam collimation
Two different types of inlays can be ordered:
Cone collimator: max. ±15° in x and y axis.
Slit collimator: max. 35° upwards / –35° downwards opening angle (2 to 5.5 mm slit width)

Different angles on request. Tungsten and lead are the basic materials.

Dimensions and technical data

XRH – 7MeV
Mass: 1600 kg
IP 66

Dimensions (L × W × H):
1210 × 900 × 1210 mm

Maintenance room:
XRH: 600 mm left, right, front,
1000 mm top and back

XRH – 9MeV
Mass: 2000 kg
IP 66

Dimensions (L × W × H):
1700 × 900 × 1210 mm

Maintenance room:
XRH: 600 mm left, right, front,
1000 mm top and back

Control Cabinet
Mass: 600 kg
IP 66

Dimensions (L × W × H):
790 × 940 × 1410 mm

Maintenance room:
CC: 600 mm in all directions

Mobile Chiller
Mass: 356 kg
IP56
–40°C to 60°C

Dimensions (L × W × H):
1010 × 1250 × 600 mm

Maintenance room:
700 mm on the top
600 mm for control box

Air inlet side: min. 1000 mm
Air outlet top: min. 1500 mm

Stationary Chiller
Mass: 220 kg
IP 54
–20°C to 40°C

Dimensions (L × W × H):
1200 × 740 × 1450 mm

Maintenance room:
400 mm connection side
800 mm for control box

Air inlet side: min. 1000 mm
Air outlet top: min. 1500 mm

Interfaces and signals

Electrical input
- 3 phase, N, PE, 400 V AC, @50/60 Hz, according to IEC-60038
- Clockwise rotation field
- 30 kVA max. power consumption
- Min. 35 A fuse

PLC control signals
24V VDC TTL

Ethernet communication
- Control software
- On-board oscilloscope
- TCP/IP IEEE 802.3

Customized pulse control
Signal Type: 4× RS-422
- Trigger
- Energy select
- Dose select
- Injection on/off

More details on request.

Quality and regulations

ISO 9001:2015, assessed and certified

Directives
2014/35/EU – Low Voltage Directive
2014/30/EU – EMC Directive
2011/65/EU – Reduction of Hazardous Substances (RoHS)

CE marking
The SILAC is CE-marked.

The conformity if the indentified product with the provision of 2014/35/EU and 2014/30/EU is proved through the application of the following standards:

- **EN 61010-1:2010 + A1:2019 + A1:2019/AC:2019**
  Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements
- **EN 60529:1991 + A1:2000 + A2:2013**
  Degrees of protection provided by enclosures (IP 66 for control cabinet and X-ray head, IP54 for standard range TCU, IP56 for extended range TCU)
- **EN IEC 61326-1:2021**
  Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements and Generic standards for industrial environments

Safety integrity level
Performance level (PL/ISO 13849) e
Probability of dangerous failure per hour (PFHD)
7.3E-8 (1/h)

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The information in this document contains general descriptions of the technical options available, which do not always have to be present in individual cases. The required features should therefore be specified in each individual case at the time of closing the contract.

This component does not contain any substances that exceed the limitations defined in the Directive 2011/65/EU, Annex II, on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

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