Linatron®Mi

Modular Interlaced High-energy X-Ray Source

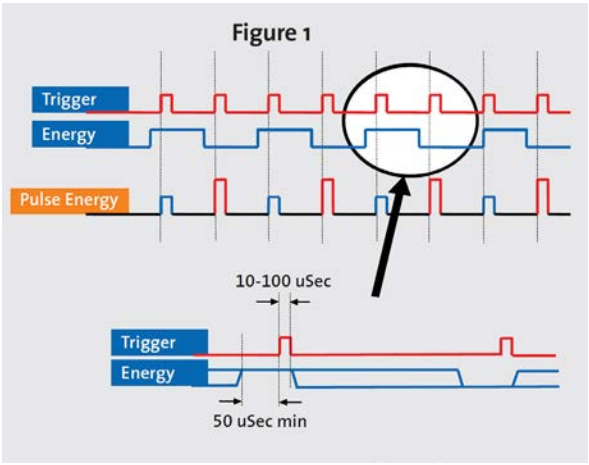
VAREX IMAGING

Making the Invisible Visible

X-Ray Head and RF Unit

The Linatron®-Mi™ is a modular interlaced high-energy X-ray source with pulse to pulse energy switching capability, especially designed for cargo screening and security applications. By rapidly alternating between two distinct energy levels, systems incorporating the Mi X-ray source can be designed to discriminate between materials based on their density characteristics.

Figure 1 illustrates the automated switching between two energy levels.



1.0 Standard Equipment and Services

1.1 Control Console

The standard control console is a touch screen display system. Includes 2 key safety and remote interlock.

1.2 X-ray Head/RF Unit

1.3 Modulator/Power Distribution Cabinet/External Signal Interface.

1.4 Temperature Control Unit (TCU)

The TCU is used to keep the system components at a nominal 30°C (86°F).

1.5 Spare Parts Kits

- Compulsory
- Standard
- Extended

1.6 Interconnecting cables include with lengths up to 100 meters (330 ft.).
Interconnecting Hoses included:
with lengths up to 91 meters (300 ft) for indoor application with lengths up to 45 meters (150 ft) for outdoor application.

1.7 Manuals

Operator Manuals are included in English.

1.8 Installation Supervision and Start-up Assistance

1.9 Varex's Standard Warranty

2.0 X-ray Beam Characteristics

2.1. Dose Rate - measured 1 meter from target in central axis of a 10-cm x 10-cm field. Listed in Gy/min-meter. (See Table 1)

2.2. Energy – measured with Half Value Layer (HVL) method in steel and listed in inches of steel as well as nominal energy in MV. (See Table 1)

2.3. Focal Spot Size – measured using Full Width Half Max method and does not exceed 2.0 mm.

*Smaller spot size options are available for Mi9 at reduced dose output. See Section 4.5

2.4. Field Flatness – measured at 1 meter from target at ±7.5° off the central axis. Listed as percent of the central axis dose rate. See Table 1.

Table 1 - X-Ray Beam Characteristics

Model	Nominal Energy (MV)	Half Value Layer (Inches of Steel)	Flatness (% @ ± 7.5°)	Max. Dose Rate (Gy/Min)
Mi6 Low Dose	4.0	1.00”	≥69.0	0.4
	6.0	1.10”	>62.0	1.0
Mi6	4.0	1.00”	≥69.0	2.5
	6.0	1.10”	>62.0	8.0
Mi9	6.0	1.10”	>62.0	10.0
	9.0	1.18”	>55.0	30.0

*Dose rate will be affected by customer collimation and flattening filter, if applicable.

2.5. Field Size – field collimation is custom for each system. See Table 3 for options.

2.6. Field Symmetry - beam asymmetry is measured at 1 meter from target and does not exceed 5% (for symmetric collimation options).

2.7. Leakage Radiation – measured along the horizontal plane at 1 meter from the beam centerline at angles > 60° outside of the primary beam. Listed as a fraction of the primary beam central axis dose rate; (excluding primary beam scatter). Leakage radiation is dependent upon X-ray Head shielding package, see options in section 4.2.

2.8 Energy Switching Rate

Energy is switched pulse to pulse when controlled through the control console. Pulse sequencing can be defined for different combinations through customer interface (see Table 2).

Table 2

Model	Pulse Range (pps)
Low	50 - 400
High	50 - 350
Interlaced	50 - 400

3.0 Customer Facility Requirements

3.1 Electrical Requirements

The Linatron M operates from a single 15 kVA power source. Two voltage ranges are available.

- 208 VAC ±10%, 3-phase, Delta (4-wire), 50 or 60 Hz
- 400 VAC ±10%, 3-phase, Wye, (5 wire), 50 or 60 Hz

3.1.1 Temperature Control Unit (TCU)

The TCU is connected to a separate 7kVA power source. Models are available that can operate on a line voltage of 220 VAC and 400 VAC, at 50Hz; or220 VAC and 480 VAC, at 60Hz. If the in-line heater package is required, power requirement is increased to 20kVA.

3.2 Operating Environment

3.2.1 Modulator / Console

The temperature range for console and modulator is 4/40°C (39/104°F), with 90% maximum relative humidity (non-condensing). Indoor use only.

3.2.2 RF Unit / X-ray Head

The temperature range for X-ray head / RF unit is -40/52°C (-40/125°F), with condensing humidity.

3.2.3 Temperature Control Unit (TCU)

TCU temperature range is -40/+55°C (-40/131°F), with condensing humidity.

4.0 Optional Equipment

4.1 Custom Beam Collimation

Nonstandard field sizes are available per customer's requirements.

4.1.1 Internal Collimator Options

Table 3 – Field Collimator Options			
Cone	Min	4°	Note Symmetric
	Max*	67° (39°)	
	Standard	15°, 30°	
Slit	Min	±2°	Note Vertical Angles may be asymmetrical
	Max	+35°/-32°	
	Width	2.5mm-6mm	
Square/ Fan	Min	±2	Note All Angles may be asymmetrical
	Max*	±39° (±19.5°)	
	Standard	22.5°, 24°	
*Ultra-Low Leakage Package limits collimator angles to those shown in parenthesis			

4.2 Lower Leakage Options listed in Table 4

Table 4 - Leakage Radiation Shielding Options			
Model	Shielding Option	Leakage (Fraction)	RFU / X-Ray Head Weight (lbs.)
Mi6	Low Leakage	1.0×10^{-3}	1800 ± 25
	Super Low Leakage	2.0×10^{-5}	2145 ± 25
	Ultra-Low Leakage*	2.5×10^{-6}	5211 ± 25
Mi9	Low Leakage	1.0×10^{-3}	2039 ± 25
	Super Low Leakage	2.0×10^{-5}	2339 ± 25
*Ultra-Low Leakage Package not available with Laser or External Collimator Options			

4.3 Power Options

Recommended for installations where line power short-term fluctuations are greater than +/-5%. A step-up or step-down transformer can also be ordered to adapt a non-standard voltage source for use with the Linatron or TCU. The regulator is CE and UL approved.

4.4 Smart Remote Customer Interface

The Linatron uses industry standard Modbus Client/ Server Protocol, configurable as RTU via serial interface or TCP via Ethernet. The customer can use a personal computer or utilize a primary control system to control/monitor the Linatron. The signals available include control, fault monitoring and analog input signals.

4.5 Small Focal Spot

1.0 to 1.5mm available for the Mi9 only.
* Maximum dose rate may be reduced.
Less than 1.0mm available at further dose reduction.

5.0 Quality

Varex Imaging Corporation, Las Vegas is an ISO 9001 registered facility.

bsi. ISO 9001 Quality Management
FM 80701

6.0 Regulatory Compliance - CE Marking

All Mi-Series Linatron models have been tested and meet all Varex Imaging Quality specifications and are in conformity with following standards for safety and EMC requirements.

7.0 Safety

IEC / EN 61010-1 Safety requirements for electrical equipment for measurement, control, and laboratory use
ANSI / UL / CSA C22.2 No. 61010-1

8.0 Electromagnetic Compatibility (EMC)

- FCC CFR Title 47 Part 18 Rules Conducted & Radiated Emissions
- CISPR 11 / EN 55011
  Conducted & Radiated Emissions

9.0 European Union Directives

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

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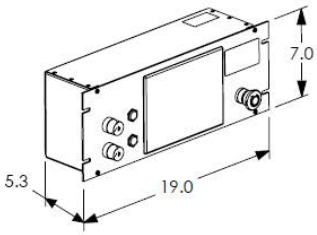
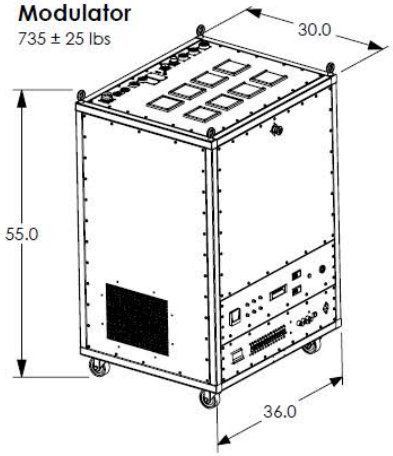
Mi PHYSICAL CONFIGURATIONS

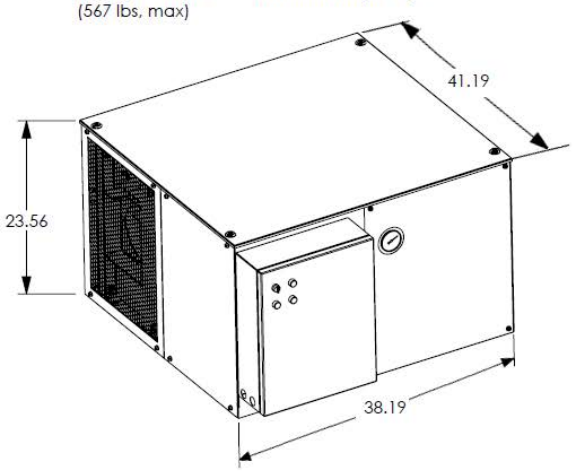
Control Console
(9 lbs)



Modulator
735 ± 25 lbs

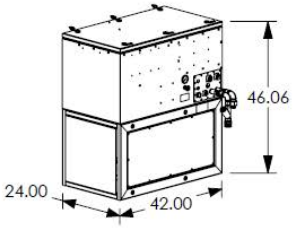


Temperature Control Unit (TCU)
(567 lbs, max)

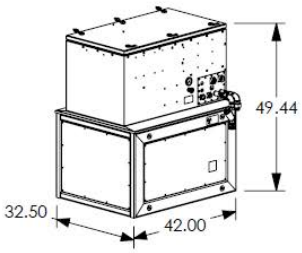


Mi-6 LOW LEAKAGE			
PARAMETERS	X	Y	Z
CENTER OF GRAVITY (in)	17.5±.5	10.5±.5	13.8±.5
FOCAL POINT (in)	9.6	9.5	9.3
TOTAL WEIGHT: 1800 ± 25 LBS			

Mi-6 SUPER LOW LEAKAGE			
PARAMETERS	X	Y	Z
CENTER OF GRAVITY (in)	17.5±.5	10.5±.5	13.8±.5
FOCAL POINT (in)	9.6	9.5	9.3
TOTAL WEIGHT: 2145 ± 25 LBS			

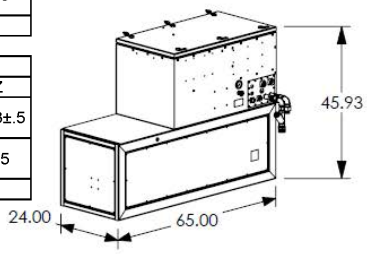


Mi-6 ULTRA LOW LEAKAGE			
PARAMETERS	X	Y	Z
CENTER OF GRAVITY (in)	19.0±.5	16.0±.5	14.0±.5
FOCAL POINT (in)	9.8	15.6	9.5
TOTAL WEIGHT: 5211 ± 25 LBS			



Mi-9 LOW LEAKAGE			
PARAMETERS	X	Y	Z
CENTER OF GRAVITY (in)	24.8±.5	13.0±.5	13.5±.5
FOCAL POINT (in)	9.6	14.0	9.5
TOTAL WEIGHT: 2039 ± 25 LBS			

Mi-9 SUPER LOW LEAKAGE			
PARAMETERS	X	Y	Z
CENTER OF GRAVITY (in)	23.3±.5	13.2±.5	13.3±.5
FOCAL POINT (in)	9.6	14.0	9.5
TOTAL WEIGHT: 2530 ± 25 LBS			



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