

# Linatron<sup>®</sup>Mi

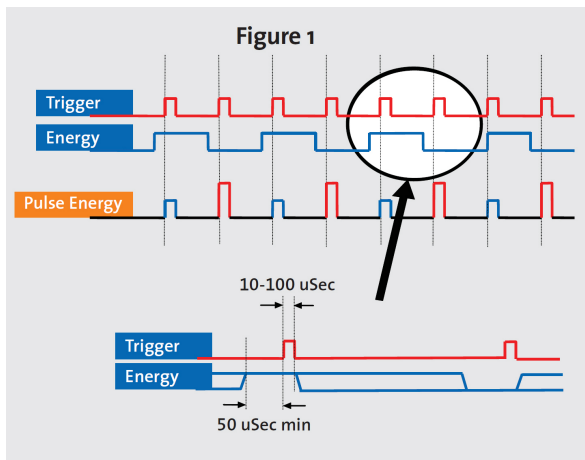
## Modular Interlaced High-energy X-Ray Source



X-Ray Head and RF Unit

The Linatron<sup>®</sup>-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  $\pm 7.5^\circ$  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 (% @ $\pm 7.5^\circ$ )	Max. Dose Rate (Gy/Min)
Mi6 Low Dose	4.0	1.00"	$\geq 69.0$	0.4
	6.0	1.10"	$> 62.0$	1.0
Mi6	4.0	1.00"	$\geq 69.0$	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  $> 60^\circ$  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  $\pm 10\%$ , 3-phase, Delta (4-wire), 50 or 60 Hz
- 400 VAC  $\pm 10\%$ , 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; or 220 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.

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### 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	$1.0 \times 10^{-3}$	1800 ± 25
	Super Low Leakage	$2.0 \times 10^{-5}$	2145 ± 25
	Ultra-Low Leakage*	$2.5 \times 10^{-6}$	5211 ± 25
Mi9	Low Leakage	$1.0 \times 10^{-3}$	2039 ± 25
	Super Low Leakage	$2.0 \times 10^{-5}$	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 Mi-9 only.

\* Maximum dose rate may be reduced.

Less than 1.0mm available at further dose reduction.

### Quality

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



### 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.

### Safety

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

### Electromagnetic Compatibility (EMC)

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

### European Union Directives

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

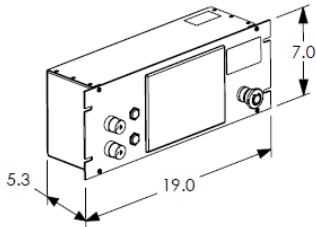
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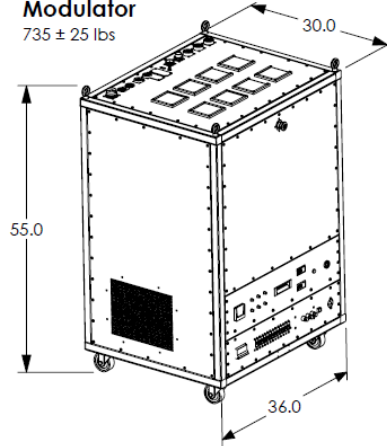


## MI PHYSICAL CONFIGURATIONS

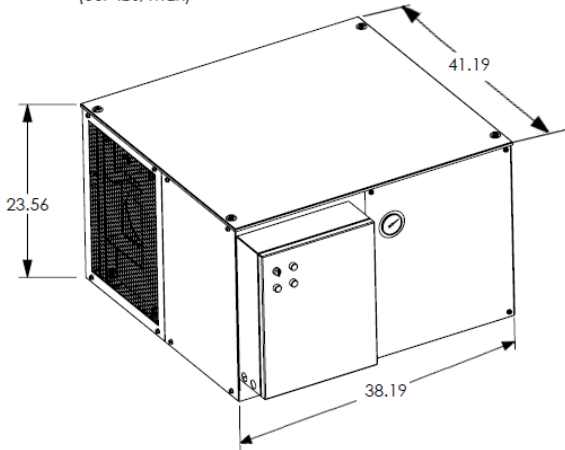
**Control Console**  
(9 lbs)



**Modulator**  
735 ± 25 lbs



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



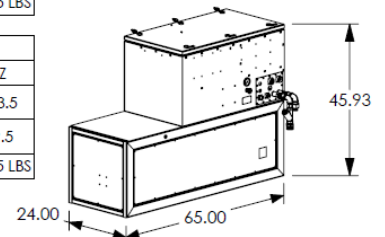
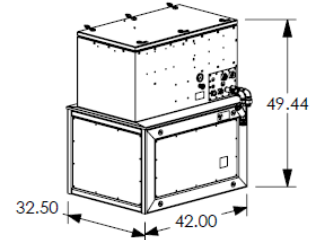
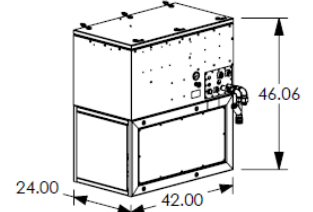
MI-6 LOW LEAKAGE			
PARAMETERS	X	Y	Z
CENTER OF GRAVITY	17.5±.5	10.5±.5	13.8±.5
FOCAL POINT	9.6	9.5	9.3
TOTAL WEIGHT: 1800 ± 25 LBS			

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

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

MI-9 LOW LEAKAGE			
PARAMETERS	X	Y	Z
CENTER OF GRAVITY	24.8	13.0	13.5
FOCAL POINT	9.6	14.0	9.5
TOTAL WEIGHT: 2039 ± 25 LBS			

MI-9 SUPER LOW LEAKAGE			
PARAMETERS	X	Y	Z
CENTER OF GRAVITY	24.8	13.3	13.5
FOCAL POINT	9.6	14.0	9.5
TOTAL WEIGHT: 2339 ± 25 LBS			



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