SEL Computers

Dependable Computation for Critical Infrastructure®

Powerful, reliable, and available computers for the most demanding applications and environments

- Broad operating temperature range of −40° to +75°C ensures reliable performance.
- Quad-core Intel® Xeon® processors deliver computational power needed for the most demanding applications.
- High-quality single-level cell (SLC) SSDs and error-correcting code (ECC) memory increase system reliability.
- Unprecedented ten-year, worldwide warranty provides confidence in the computer's long-term performance and durability.
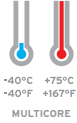
SEL

Advantages of SEL Dependable Computers

SEL Dependable Computers	Typical Computers
Operating Temperature Range	
SEL computers feature a wide temperature range and up to 95 percent relative humidity resistance for operation in outdoor, industrial, manufacturing, and utility environments.	Typical PCs are designed for use in commercial or light industrial environments—typically +10˚ to +35˚C.
Environmental Operation Conditions	
SEL computers are designed to operate in the presence of vibration, seismic, and shock (15 g) events due to nearby equipment or rough handling. They correctly operate during 15 kV electrostatic discharge (ESD) events as well as during electrical surges caused by lightning and other events.	Vibration and shock damage are the result of unsecured components, connectors, or boards common in office or typical industrial computers. ESD and electrical surges often cause typical PCs to reboot or misoperate.
Conformal coating on the internal components provides additional protection in corrosive environments.	Corrosion leads to early failures.
System Reliability and Availability	
SEL computing systems have a proven reliability ten times greater than that of traditional industrial computers (>100-year typical mean time between failures [MTBF]).	The reliability of typical industrial computer systems is 50,000 hours, or a 5.7-year MTBF.
SEL power supply reliability is greater than 1,000 years MTBF, and each supply can operate on ac or dc inputs. An optional redundant, hot-swappable power supply is available.	Power supplies, fans, and rotating disk drives are the three highest failure points.
The advanced thermal design eliminates fans and vents, so no dust or dirt is pulled into the computer and there are no moving parts to wear out.	Fans contaminate system components with dust. When the fan bearings wear out, high-power components overheat and fail.
Multiple hot-swappable SLC SSDs provide reliable and redundant storage. The SEL-3355 Computer offers up to four drives with RAID 0, 1, 5, or 10 for worry-free storage and easy replacement. The SEL-3360 Wall-Mount Industrial Computer includes up to two drives, supports RAID 0 and 1, and supports higher data densities with multilevel cell (MLC) and industrial-grade MLC (iMLC) SSD options.	Rotating hard disk bearings fail over time, and wear is accelerated by any shock or vibration. While available as an option on SEL computers, MLC SSDs have much lower program/erase cycle endurance, which reduces usable life, and are more likely to corrupt data in hot environments. SEL recommends the use of SLC and iMLC drives
ECC RAM continuously checks for bit errors and immediately corrects them, preventing computer system crashes.	Standard RAM experiences frequent random bit errors that can result in unexplained OS and application crashes.

Icon labels:
-40°C +75°C
-40°F +167°F
MULTICORE

15 kv
ESD RESISTANCE

15 g
SHOCK/VIBRATION RESISTANCE

CONFORMAL COATING

>100-YEAR MEAN TIME BETWEEN FAILURES

REDUNDANT POWER SUPPLIES

NO MOVING PARTS

SLC SSD MEMORY

ECC RAM

SEL Dependable Computers	Typical Computers

System Monitoring, Management, and Recovery

Critical system functions and the status are monitored and logged using SEL SysMon Software. A programmable watchdog controller and an alarm contact output can alert you to potential problems.

SEL computers include an optimized version of the SEL backup and recovery tool (BaRT), which can back up or restore an OS image in just a few minutes.

Intel vPro™ technology in the Intel Xeon and Intel Core™ i7 processors enables remote and local monitoring, remediation, and repair of computers, even if they are shut down or if the OS is not functional.

Basic monitoring and watchdog capability limits health monitoring to "operational" or "nonoperational." Typical PCs have no alarm output contacts.

Third-party recovery tools are available and can be expensive, hard to use, and time-consuming.

Remote monitoring may be available on PCs that include Intel vPro technology.

Secure Computing

Intel vPro technology provides remote OS patch management and security measures designed into the chipset, making SEL computers less vulnerable to computer viruses and/or loss of sensitive information.

Intel vPro technology may be available in other computers.

BIOS

A Unified Extensible Firmware Interface (UEFI) BIOS supports the latest operating systems and enhances system management. User administration prevents unauthorized access and settings changes. You can enable and disable individual USB, serial, and PCIe ports in the BIOS to secure unused ports.

A typical BIOS does not offer these features.

Secure Boot

Secure Boot verifies the integrity of UEFI drivers, boot loaders, and OS files to ensure the system will only boot up and give control to the OS if the signatures are valid.

Industrial original equipment manufacturers may also ship their computer BIOS with Secure Boot enabled.

Flexible and Powerful I/O

The SEL-3355 supports up to 5 PCIe/PCI cards to meet your unique needs.

Serial ports provide +5 V power for peripherals, such as fiber converters and modems, and distribute IRIG-B accurate time to connected devices.

USB ports provide up to 2,000 mA current to power connected devices.

Typical computers may not allow expansion cards or may require the use of proprietary cards.

Typically, computers do not offer +5 V power or IRIG-B time distribution.

Standard USB ports are only required to provide 500 mA current.

Warranty

SEL computers come with a standard ten-year, no questions-asked warranty.

Traditionally, most computers come with a one- to three-year limited warranty. Most manufacturers offer extended warranties of up to five years for an additional cost.

Reliable Even in Harsh Environments

Standard desktop computers are designed for controlled office environments and require modification for use in industrial environments, which increases the cost and maintenance. In contrast, we design and test SEL computers to exceed the rigorous industry standards required for harsh operating environments. We perform stringent type tests at our own facilities, where we are able to understand the root cause of failures and improve designs for reliable operation. Typical industrial computer manufacturers do not verify their designs with this same degree of rigorous testing.

Electrostatic Discharge

SEL computers maintain normal operation even when exposed to 15 kV of ESD as well as during electrical surges caused by lightning and other events.

Electromagnetic Immunity

SEL computers continuously perform without error in the presence of large electromagnetic fields or radio frequency (RF) interference, meeting or exceeding industry standards for electromagnetic compatibility/immunity.
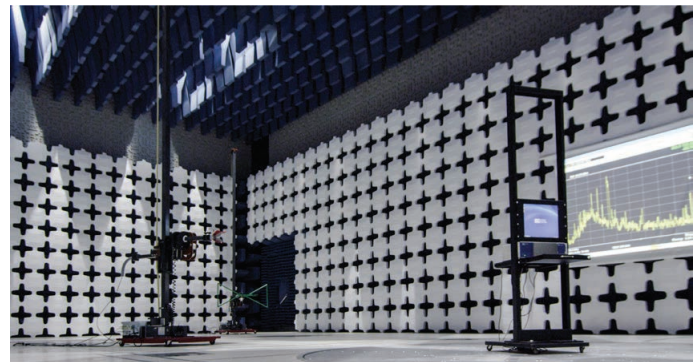

Electromagnetic Emissions

We use our state-of-the-art 10-meter RF test chamber to make sure SEL computers meet or exceed electromagnetic radiated and conductive immunity and emissions standards.

Environmental

Environmental testing ensures SEL computers reliably operate at extreme temperatures (−40° to +75°C or −40° to +60°C, depending on the CPU) and in up to 95 percent humidity.
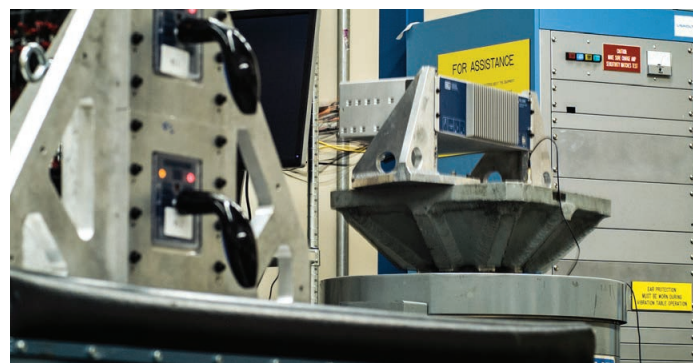
Vibration and Shock

We perform rigorous testing to ensure SEL computers operate correctly near vibrating machinery, during seismic and shock events, and after shipping and rough handling, such as dropping. With no moving parts, SEL computers exceed industry standards and operate reliably for years.

Type Tests Applied to SEL Computers

Test Category	Summary	Applicable Standards
Environmental	**Cold Test:** −40°C for 16 hours*	IEEE 1613-2009 (Class 1)*, IEC 60068-2-1:2007, IEC 61850-3:2013
	Dry Heat: +75°C for 16 hours (Xeon E3-1505L, Core i7-3555LE CPU)*, +60°C for 16 hours (Xeon E3-1505M, Core i7-3612QE CPU)*	IEEE 1613-2009 (Class 1)*, IEC 60068-2-2:2007, IEC 61850-3:2013
	Damp Heat Cyclic: 95 percent humidity over +25°C to +55°C, six 12-hour cycles*	IEEE 1613-2009 (Class 1)*, IEC 60068-2-30:2005, IEC 61850-3:2013
Electromagnetic Compatibility Immunity	**Conducted:** Subjected to high levels of conducted RF signals of 10 Vrms*	IEC 61850-3:2013*, IEC 60255-26:2013, IEC 61000-4-6:2013
	Radiated RF: Subjected to high levels of radiated RF signals 10 V/m* and 35 V/m**	IEEE 1613-2009 (Class 1)*, IEEE C37.90.2-2004**, IEC 60255-26:2013, IEC 61000-4-3:2006 + A1:2007, IEC 61850-3:2013
	Fast Transient/Bursts: Subjected to Class A severity with 4 kV and 5 kHz on power supply and outputs, 2 kV and 5 kHz on communications lines*	IEC 61850-3:2013*, IEC 60255-26:2013, IEC 61000-4-4:2012
	Magnetic Fields: Subjected to large magnetic fields of 1,000 A/m for 3 seconds and 100 A/m for 1 minute*	IEC 61850-3:2013*, IEC 61000-4-8:2009, IEC 61000-4-9, IEC 61000-4-10
	Surge Withstand and Immunity: Subjected to 2.5 kV common mode and 1 kV differential mode on power supply and outputs, 1 kV common mode on communications ports*; 2.5 kV oscillatory and 4 kV fast transient**; surge immunity severity tests of 1 kV line-to-line and 2 kV line-to-earth***	IEEE 1613-2009 (Class 1)*, IEEE C37.90.1-2012**, IEC 61850-3:2013***, IEC 60255-26:2013, IEC 60255-22-5, IEC 61000-4-5:2005
Electrostatic Discharge	**ESD:** Subjected to 2 kV, 4 kV, 6 kV, and 8 kV contact-discharge events and 2 kV, 4 kV, 8 kV, and 15 kV indirect discharge events*	IEEE C37.90.3-2001*, IEC 60225-26:2013, IEC 61000-4-2:2008, IEEE 1613-2009 (Class 1), IEC 61850-3:2013
Electromagnetic Compatibility Emissions	**Radiated and Conducted Emissions:** Will not cause conducted or radiated emissions above specified levels, which may affect the satisfactory operation of other equipment; tested to Class A standards*	CISPR 11:2009 + A1:2010, CISPR 22:2008, CISPR 32:2015, IEC 61000-6-4:2006, IEC 61850-3:2013, FCC 15.107:2014, FCC 15.109:2014
Vibration/Shock	**Vibration:** Subjected to 10–150 Hz, 20 bidirectional sweep cycles (40 unidirectional sweeps) at 2.0 g acceleration (Endurance 200)*; 10–150 Hz, 1 bidirectional sweep cycle (2 unidirectional sweeps) at 1.0 g acceleration (Response 200)*; three 11 ms, half-sine wave pulses in each direction at 15.0 g acceleration (Shock Withstand 100)**; 16 ms half-sine wave pulse, 1,000 pulses each direction at 10.0 g acceleration (Bump 100)**; three 11 ms, half-sine wave pulses at 10.0 g acceleration (Shock Response 200)**; 5–35 Hz, 1.1–2.0 g acceleration (Seismic Quake 2 Horizontal)***; 5–35 Hz, 0.5–1.0 g acceleration (Seismic Quake 2 Vertical)***	IEC 61850-3:2013*, IEC 60255-21-2:1988**, IEC 60255-21-3:1993***, IEC 60255-21-1:1988, IEEE 1613-2009 (Class 1)
Safety	**Dielectric Strength:** Subjected to 3,600 Vdc on power supply, 2,500 Vac on contact output, and 1,500 Vac on Ethernet ports for 1 minute*	IEEE C37.90-2005*, IEC 60255-27:2013, IEEE 1613-2009 (Class 1)
	Impulse: Subjected to 0.5 J, 5 kV impulse on power supply and input/output contacts*	IEEE 1613-2009 (Class 1)*, IEC 60255-27:2013

Note: Asterisks designate the test levels and severity of testing that are relative to the specific standards for each test category.

Ensuring Quality With World-Class Manufacturing

State-of-the-art manufacturing facilities reflect our strong commitment to offering unmatched value in products and services. A focus on lean manufacturing keeps costs low, translating into better value for you. At SEL, we comply with the highest quality standards, such as IPC-A-610 Class 3 and ISO 9001, and constantly strive to exceed those requirements.

We continually strive to exceed your expectations and quality standards by:

- Rigorously monitoring and controlling all processes to exceed the ISO 9001 Quality Management Systems Standard.
- Developing robust, repeatable, and scalable manufacturing processes to continually improve designs and reduce process errors.
- Ensuring that our test and calibration laboratories use the latest equipment and follow National Institute of Standards and Technology traceable standards for accuracy and maintenance.
- Partnering with our suppliers to ensure the highest possible component quality.
- Designing, testing, manufacturing, and repairing our computers in the U.S.A.

Highly Skilled Employees

Our employees are trained to meet IPC-A-610 Class 3 certification. All manufacturing positions require operator certification, and employees receive both classroom and hands-on training.

Manufactured in the U.S.A.

All SEL computers are designed, tested, and manufactured in our state-of-the-art facility in Pullman, Washington.

Product Hospital Improves Reliability

The SEL ten-year warranty means products come back to our Product Hospital for repair and root cause analysis. We feed the information learned back into the design and manufacturing process to further improve product reliability.

Vertical Integration

We design and build many of the components used in SEL products. Automation and vertical integration allow us to achieve repeatable, high-quality results.
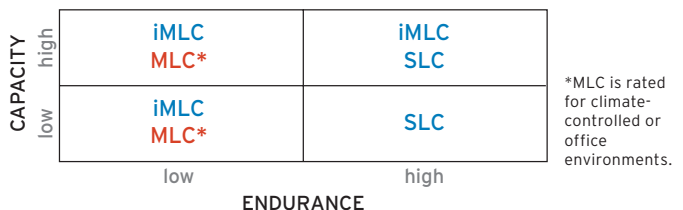
SSD Selection

We offer three types of SSDs for SEL computers:

- SLC drives provide the highest endurance and reliability. These drives are suited for the most demanding applications and where data integrity is critical.
- iMLC drives provide higher capacity with reduced endurance. These drives support the full operating temperature of the computer and are suited for industrial environments requiring a large amount of storage.
- Commercial MLC drives provide the highest capacities and lowest cost per bit but are not rated for industrial environments and have the lowest endurance. These drives are suitable for office environments that do not require high endurance.

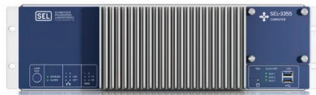### Decision Matrix for SSD Memory Types, Weighing Endurance Vs. Capacity

Use the chart and table to determine the appropriate drive type based on your specific application needs.

CAPACITY high	iMLC MLC*	iMLC SLC
low	iMLC MLC*	SLC
	low	high
	ENDURANCE	

*MLC is rated for climate-controlled or office environments.

SSD Attributes

	SLC	IMLC	MLC
Write Endurance	100,000	20,000	3,000
Temperature Range	−40° to +85°C	−40° to +85°C	0° to +60°C
Conformal Coating	Yes	Yes	No
Warranty	SEL 10 Years	Manufacturer 5 Years	Manufacturer 3 Years
Capacity	32–256 GB	120–480 GB	256 GB–2 TB

Specifications

	SEL-3355	SEL-3360S	SEL-3360E
CPU	Xeon E3-1505L quad-core 2.0 GHz base, 2.8 GHz turbo, 1 MB L2, 8 MB L3: −40° to +75°C (−40° to +167°F) Xeon E3-1505M quad-core 2.8 GHz base, 3.7 GHz turbo, 1 MB L2, 8 MB L3: −40° to +60°C (−40° to +140°F) Core i7 2.5 GHz dual-core with 4−16 GB ECC RAM: −40° to +75°C (−40° to +167°F) Core i7 2.1 GHz quad-core with 4−16 GB ECC RAM: −40° to +60°C (−40° to +140°F)	Same	Xeon E3-1505L quad-core 2.8 GHz base, 3.7 GHz turbo, 1 MB L2, 8 MB L3: −40° to +60°C (−40° to +140°F) Core i7 2.5 GHz dual-core with 4−16 GB ECC RAM: −40° to +60°C (−40° to +140°F)
Operating Systems Supported	Microsoft® Windows® 7 Microsoft Windows 8/8.1 Microsoft Windows 10* Microsoft Windows Server® 2008 R2 Microsoft Windows Server 2012 R2* Microsoft Windows Server 2016* CentOS Linux® 6 CentOS Linux 7 Red Hat® Enterprise Linux 6 Red Hat Enterprise Linux 7 VMware® ESXi™ 5.x−6.0 Customer OS image**	Same	Same
Mass Storage	One to four 2.5" SLC SSDs (32, 64, 128, and 256 GB); optional iMLC SSD (120, 240, 480 GB) and one to two MLC SSDs (256 GB, 512 GB, 1 TB, and 2 TB) also available SATA II 3.0 GB/s, RAID 0, 1, 5, 10 Hot-swappable	One to two 2.5" SLC SSDs (32, 64, 128, and 256 GB); optional iMLC SSD (120, 240, 480 GB) and MLC SSD (256 GB, 512 GB, 1 TB, and 2 TB) also available SATA II 3.0 GB/s, RAID 0, 1 Hot-swappable	One to two 2.5" SLC SSDs (32, 64, 128, and 256 GB); optional iMLC SSD (120, 240, 480 GB) and MLC SSD (256 GB, 512 GB, 1 TB, and 2 TB) also available SATA II 3.0 GB/s, RAID 0, 1 Hot-swappable
Standards	IEC 61850-3 ANSI/IEEE 1613 (Class 1) ANSI/IEEE C37.90 IEC 60255	IEC 61850-3 ANSI/IEEE 1613 (Class 1) ANSI/IEEE C37.90 IEC 60255 Hazardous location approvals (for Core i7 only): Class I, Division 2, Groups A, B, C, and D; European ATEX standards	IEC 61850-3 ANSI/IEEE 1613 (Class 1) ANSI/IEEE C37.90 IEC 60255
Expansion Slots	5 (1 PCI, 2 PCIe x1, 2 PCIe x4)	None	2 (1 PCIe x1, 1 PCIe x4)
Mounting	19" rack mount, 3RU	Panel mount, DIN mount	Panel mount
Certifications	ISO 9001: Designed, manufactured RoHS CE: CE Mark EMC Directive, Low-Voltage Directive UL, cUL: UL 60950-1, C22.2 No. 60950-1 FCC: 47 CFR 15B, Class A	Same	Same

*Orderable as a factory-installed option   **Contact SEL