

Industrial Functional Safety for Power

In safety-critical applications where a single system fault can endanger people or property, functional safety ensures that equipment continues operating safely even when failures occur. Compliance with standards such as **IEC 61508**¹ provides a structured framework and recommended design practices that help system integrators develop reliable safety-related systems (SRSs)². Power supplies are especially important because they support sensors, controllers, actuators, and communication interfaces, and they must be designed to transition the system into a safe state whenever a failure occurs³.

To achieve this, power supplies integrate supervisory and protection circuits such as voltage monitors, watchdog timers, surge stoppers, and ideal diodes. These features help eliminate systematic failures and improve diagnostic coverage against dangerous random faults⁴⁻⁵. Functional safety components are further classified into categories based on compliance level, documentation, and certification, which helps designers select the right parts for their safety-related applications.

Functional Safety Category	FS-Enabled	FS-Evaluated	FS-Compliant	FS-Certified
Functional Safety Capability	Enables FS at System Level		Compliant at Device Level	
ADI Quality Management	•	•	•	•
Reliability Predictions	•	•	•	•
Failure Mode Distribution	•	•	•	•
Pin Failure Modes and Effects Analysis (FMEA)	•	•	•	•
Failure Modes, Effects, and Diagnostis Analysis (FMEDA)		•	•	•
Safety Datasheet		•		
Safety Manual			•	•
External Certification				•

FS-Enabled

This category of parts enables functional safety at the system level by providing safety application notes containing failure rates, FMD, and Pin FMEA to help designers with their safety analysis.

Supervisors

Part Name	Features	Operating Voltage (V)	Window Monitoring	Window Supervisor	Supply Current (μ A)	Threshold Accuracy	High Voltage	Output Topology	Package Size (mm x mm)
MAX16193B/C	High Accuracy Dual-Channel Supervisor	1.7 to 5.5	•	•	50	0.3%		Open-Drain	2 x 3, 8-pin TDFN
MAX16134	Low Voltage, Precision μ Power Supervisor	1.71 to 5.5	•	•	12.5	1%		Open-Drain	8SOT23
MAX6762	Low Power Window Detector	0.9 to 5	•	•	10	5%		Open-Drain	SOT23/TDFN
MAX6759	Low Power Window Detector	0.9 to 5	•	•	10	5%		Open-Drain	SOT23/TDFN
MAX6764	Low Power Window Detector	0.9 to 5	•	•	10	5%		Open-Drain	SOT23/TDFN
MAX16059	μ Power Supervisory Circuit	1.1 to 5.5		•	125	2.5%		Open-Drain	6/8-pin TDFN
LTC2933	Programmable Supervisor with I2C/SMBus Interface	3.4 to 13.9	•	•		1%	•	Open-Drain	5 x 4, 16-pin DFN

Protection

Part Name	Features	Operating Voltage (V)	Overvoltage Protection	Thermal Shutdown	Reverse Voltage Protection	High Voltage	Output Topology	Package Size (mm x mm)
MAX17525	Adjustable Power Limiter	5.5 to 60	Adjustable	•	•	•	Open-Drain	5 x 5, 20-pin TQFN
MAX16010	Ultra-Small, Overvoltage Protection Circuits	5.5 to 72	Adjustable			•	Open-Drain	8-pin TDFN
MAX16128	Load-Dump Protectors and Limiters	-36 to +90	Fixed	•	•	•	Open-Drain	8-pin μ MAX
MAX16126	Load-Dump/Reverse-Voltage Protection Circuits	-36 to +90	Adjustable	•	•	•	Open-Drain	12-pin TQFN
MAX6399	High-Voltage Protection Switch Controller	5.75 to 72	Adjustable	•	•	•	Open-Drain	8-pin TDFN

Linear & Switching Regulators

Part Name	Features	Operating Voltage (V)	Shutdown Current (μ A)	Output Current (A)	Quiescent Current (I_q) (mA)	Accuracy	Package Size (mm x mm)
ADP7156	1.2A, Ultralow Noise RF Linear Regulator	2.3 to 5.5	.2	1.2	4	1.5%	3 x 3, LFCSP
LT8300	100 V _{IN} Micropower Isolated Flyback Converter	6 to 100	70 (sleep mode)	.26	.33		5-lead TSOT-23

FS-Evaluated

Parts in this category will offer another level of functional safety support by providing FMEDA and safety datasheets that will help designers in their safety analysis and proper integration of such parts in their safety-related systems. These standard parts will generally include Built-in Self-Test features or on-chip diagnostics, which will deliver more safety capabilities within a reduced footprint.

FS-Compliant

Compliant parts will meet IEC 61508 requirements at the device level, providing many advantages.⁶ All FS documentation in compliance with the functional safety standard will be available, while the safety manual and FMEDA will be provided upon request.

FS-Certified

FS-Certified parts are externally certified to IEC, 61508 further improving the degree of independence and streamlining the certification process. Aside from having functional safety documentation found in FS-Compliant parts, FS-Certified parts also have a certification provided by industry-leading functional safety assessors.

MAX42500: Four to Seven-Input Industrial Power System Monitor

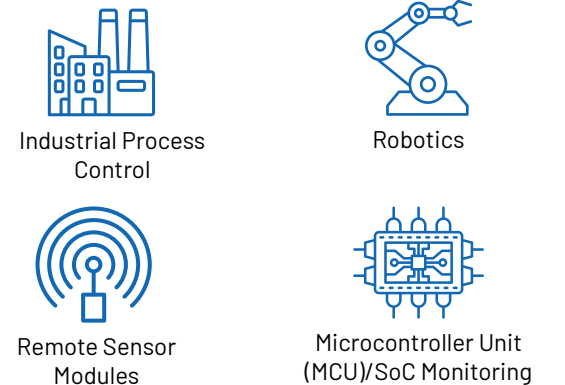
The industry's first power system monitor certified to IEC 61508, delivering proven reliability for safety functions up to SIL 3. Engineered with exceptional flexibility, it seamlessly adapts to any power tree architecture.



Features

- 2.35V to 5.5V Operating Supply Range
- **OV/UV Threshold Accuracy**
- $\pm 1\%$ from -40°C to 85°C
- $\pm 1.3\%$ from -40°C to 125°C
- **I²C interface**
- Programmable UV/OV thresholds and RESET pin
- **Built-in Self-Test (BIST)**
- Power sequencing recording
- Simple or challenge/response windowed watchdog
- Fault recording
- Dynamic Voltage Scaling
- 16-pin TQFN with exposed pad (3mm x 3mm)
- Operational temperature range: -40°C to $+125^\circ\text{C}$

Applications



References

¹IEC 61508 All Parts, Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems. International Electrotechnical Commission, 2010.

²Tom Meany. "Functional Safety and Industry 4.0." Analog Devices, Inc., March 2018.

³Bryan Borres and Christopher Macatangay. "Improving Industrial Functional Safety Compliance with High Performance Supervisory Circuits—Part 1" Analog Devices, Inc., February 2018.

⁴Tom Meany. "Functional Safety for Integrated Circuits." Analog Devices, Inc., February 2018.

⁵Bryan Borres and Christopher Macatangay. "Improving Industrial Functional Safety Compliance with High Performance Supervisory Circuits - Part 1." Analog Dialogue, Issue 226, August 2024.

⁶Bryan Borres. "Improving Industrial Functional Safety Compliance with High Performance Supervisory Circuits: Using SIL-Rated Components—Part 2" Analog Devices, Inc., March 2025.

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