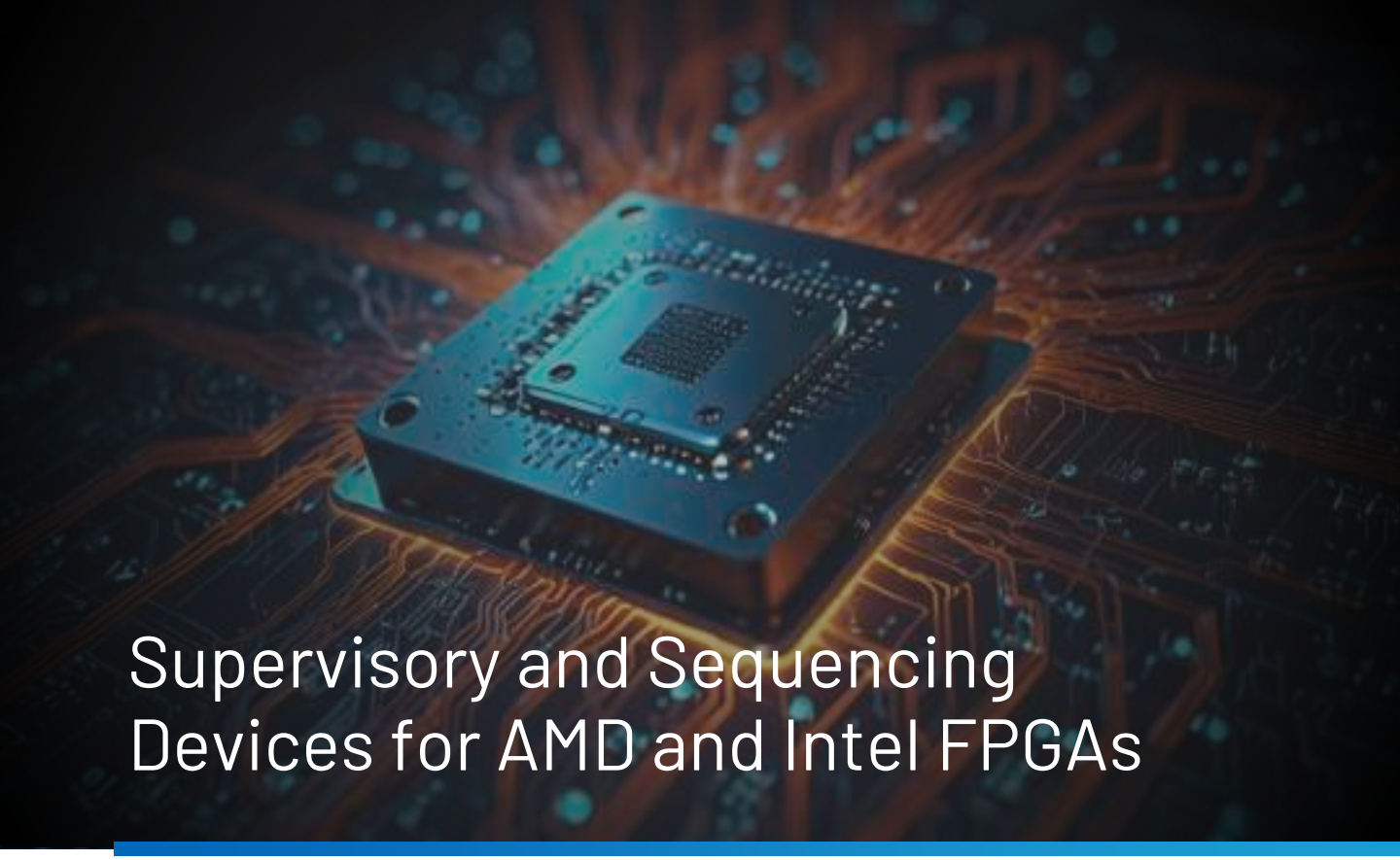


Supervisory and Sequencing Devices for AMD and Intel FPGAs

Modern FPGA designs leverage advance fabrication techniques, enabling smaller process geometries and lower core voltages. This trend, however, necessitate the use of multiple voltage rails to accommodate legacy I/O standards. To guarantee system stability and prevent unexpected behavior, each of these voltage rails requires dedicated supervision.

Analog Devices offers a comprehensive portfolio of voltage monitoring solutions, including simple supervisors and window supervisors. Our range spans from basic single-channel to feature-rich multi-voltage supervisors, boasting industry-leading accuracy (up to ±0.3% across temperatures).

The core and I/O voltage requirements for various FPGA families are presented in a clear and easy-to-reference table. Core voltage ranges typically span from 0.70 V to 1.2 V, while I/O voltage levels can vary between 1 V and 3.3 V.

Lower core voltages demand high threshold accuracy for reliability

MAX16193

0.3%Accuracy Dual-Channel Supervisory Circuit

- ±0.3% Threshold Accuracy
- 0.6V to 0.9V IN1 Threshold Range
- 0.9V to 3.3V IN2 Threshold Range
- ±2% to ±5% UV/OV Monitoring Range
- Enables Functional Safety at System Level

MAX42500

Four- to Seven-Input Industrial Power System Monitor Family

- IEC 61508 SIL 3 Certified
- Five Fixed-Voltage Monitoring Inputs
- Two Differential DVS Tracking-Voltage Monitoring Inputs with Remote Ground Sense
- Flexible Power-Sequencing Recording
- Simple or Challenge/Response Windowed Watchdog

Multi-voltage Supervisors for AMD & Intel FPGAs

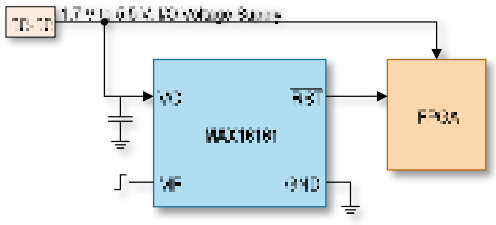
The tables provide data on the typical core voltages, auxiliary voltages, and I/O voltages for FPGA devices from AMD and Intel. These voltages are crucial for the optimal performance and stability of the FPGA devices, ensuring they operate within their specified parameters.

AMD & Intel FPGA Core and I/O Voltages

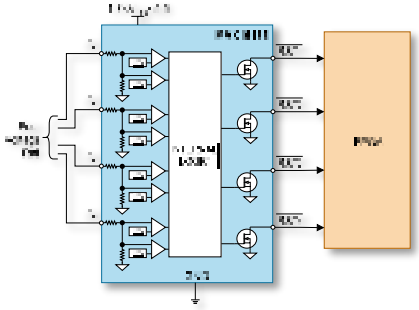
AMD			
AMD FPGA Family	**Core Voltage (V)**	**Auxiliary Voltage (V)**	**I/O Voltage (V)**
Virtex UltraScale+	0.85, 0.72, 0.90	1.8	1.0, 1.2, 1.35, 1.5, 1.8, 2.5, 3.3
Virtex UltraScale	0.95, 1	1.8	1.0, 1.2, 1.35, 1.5, 1.8, 2.5, 3.3
Virtex 7	1, 0.90	1.8, 2.0	1.2, 1.35, 1.5, 1.8, 2.5, 3.3
Kintex UltraScale+	0.85, 0.72, 0.90	1.8	1.0, 1.2, 1.35, 1.5, 1.8, 2.5, 3.3
Kintex UltraScale	0.95, 0.90, 1.0	1.8	1.0, 1.2, 1.35, 1.5, 1.8, 2.5, 3.3
Kintex 7	1, 0.90, 0.95	1.8	1.2, 1.35, 1.5, 1.8, 2.5, 3.3
Artix UtraScale+	0.85, 0.72	1.8	1.0, 1.2, 1.35, 1.5, 1.8, 2.5, 3.3
Artix 7	1.0, 0.95, 0.90	1.8	1.2, 1.35, 1.5, 1.8, 2.5, 3.3
Spartan Ultrascale+	0.85, 0.72, 0.90	1.8	1.0, 1.2, 1.35, 1.5, 1.8, 2.5, 3.3
Spartan 7	1, 0.95	1.8	1.2, 1.35, 1.5, 1.8, 2.5, 3.3
INTEL			
Intel FPGA Family	**Core Voltage (V)**	**Auxiliary Voltage (V)**	**I/O Voltage (V)**
Agilex 7 F	0.70 - 0.90	-	1.2, 1.5
Agilex 7 I	0.70 - 0.90	-	1.2, 1.5
Stratix 10	0.8 - 0.94	-	1.2, 1.25, 1.35, 1.5, 1.8, 2.5, 3, 3.3
Stratix V	0.85, 0.9	-	1.2, 1.25, 1.35, 1.5, 1.8, 2.5, 3.0
Stratix IV	0.9	-	1.2, 1.5, 1.8, 2.5, 3.0
Arria 10	0.9, 0.95	-	1.2, 1.25, 1.35, 1.5, 1.8, 2.5, 3.0
Arria V GX	1.1, 1.15	-	1.2, 1.25, 1.35, 1.5, 1.8, 2.5, 3.0, 3.3
Arria V GZ	0.85	-	1.2, 1.25, 1.35, 1.5, 1.8, 2.5, 3.0
Cyclone 10 GX	0.9	-	1.2, 1.25, 1.35, 1.5, 1.8, 2.5, 3.0
Cyclone 10 LP	1.0, 1.2	-	1.2, 1.5, 1.8, 2.5, 3, 3.3
Cyclone V	1.1, 1.15		1.2, 1.25, 1.35, 1.5, 1.8, 2.5, 3.0, 3.3
Cyclone IV	1.0, 1.2		1.2, 1.5, 1.8, 2.5, 3, 3.3
MAX 10	1.2 or 3.0, 3.3		1.0, 1.2, 1.35, 1.5, 1.8, 2.5, 3, 3.3

ADI Multi-voltage Supervisors with AMD & Intel FPGAs

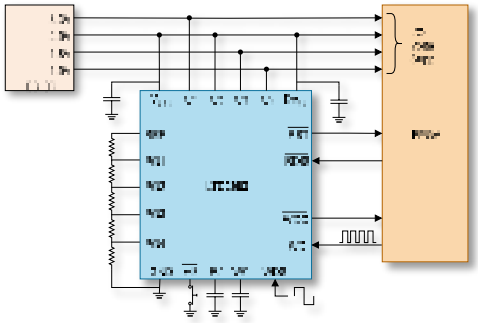
Number of Voltages Monitored	Part Number	Monitoring Type	Voltages Monitored (V)	Accuracy (%)
1	MAX16132	Window	1.0 to 5.0	±1
1	MAX16161, MAX16162	Simple	1.7 to 4.85, 0.6 to 4.85	±1.5
2	MAX16193	Window	0.6 to 0.9, 0.9 to 3.3	±0.3
3	MAX16134	Window	5.0, 4.8, 4.5, 3.3, 3.0, 2.5, 1.8, 1.2, 1.16, 1.0	±1
4	LTC2962, LTC2963, LTC2964	Window	5.0, 3.3, 2.5, 1.8, 1.5, 1.2, 1.0, 0.5V	±0.5
4	MAX16135	Window	5.0, 4.8, 4.5, 3.3, 3.0, 2.5, 2.3, 1.8, 1.5, 1.36, 1.22, 1.2, 1.16, 1.0	±1
4	MAX16060	Simple	3.3, 2.5, 1.8, 0.62 (adj)	±1
6	LTC2936	Window	0.2 to 5.8 (Programmable)	±1
7	MAX42500	Window	0.1 to 5.5 (Programmable)	±1



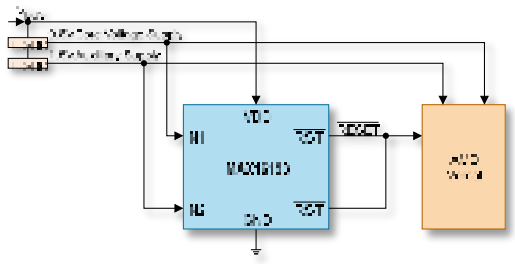
MAX16161: nanoPower Supply Supervisor with Glitch-Free Power-Up and Manual Reset



MAX16135: ±1% Low-Voltage, Quad-Voltage Window Supervisor



LTC2963: ±0.5% Quad Configurable Supervisor with Watchdog Timer



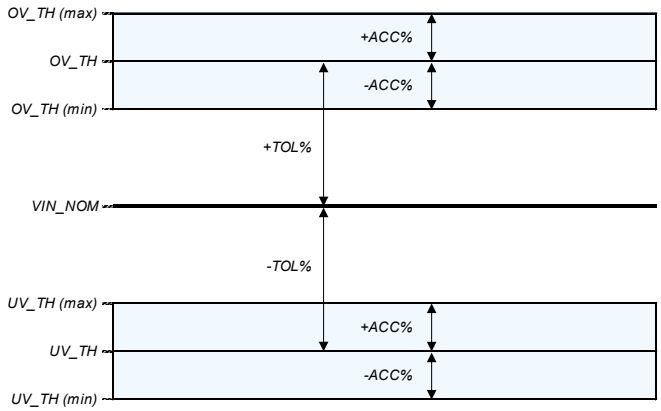
MAX16193: ±0.3% Accuracy Dual-Channel Window-Detector Supervisory Circuit

Window Voltage Supervisors

Window voltage supervisors are used to ensure FPGAs operate within a safe voltage specification range. They do this by having undervoltage (UV) and overvoltage (OV) thresholds and generating a reset output signal if it goes beyond the tolerance window to avoid system errors and prevent damage to your FPGAs and other processing devices. There are two main things to consider when choosing a window voltage supervisor: Tolerance and Threshold Accuracy.

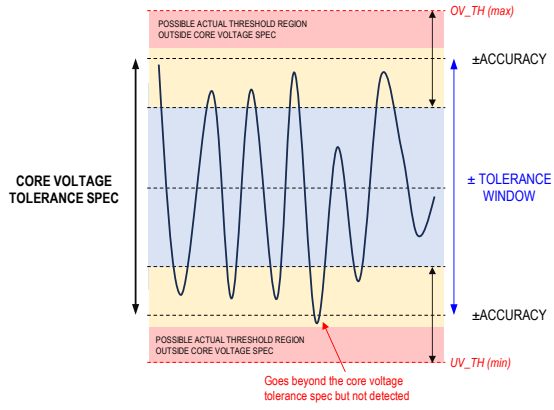
Tolerance is the range around the nominal monitored value which sets the overvoltage and undervoltage thresholds. While, Threshold Accuracy, typically expressed in percentage, is the degree of the conformance of the actual to the target reset thresholds.

Undervoltage and overvoltage threshold variation with Threshold Accuracy

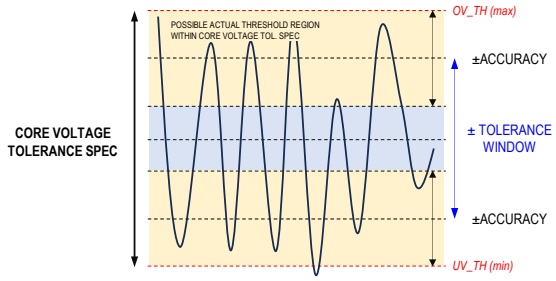


Selecting the Right Tolerance Window

Choosing a window supervisor with the same tolerance as the core voltage requirement can lead to malfunctions due to threshold accuracy. Setting the same tolerance with the operating requirement of the FPGA can trigger a reset output near the maximum overvoltage threshold OV_TH (max) and minimum undervoltage threshold UV_TH (min). The figure below illustrates tolerance setting (a) same with core voltage tolerance vs. (b) within the core voltage tolerance.



(a)

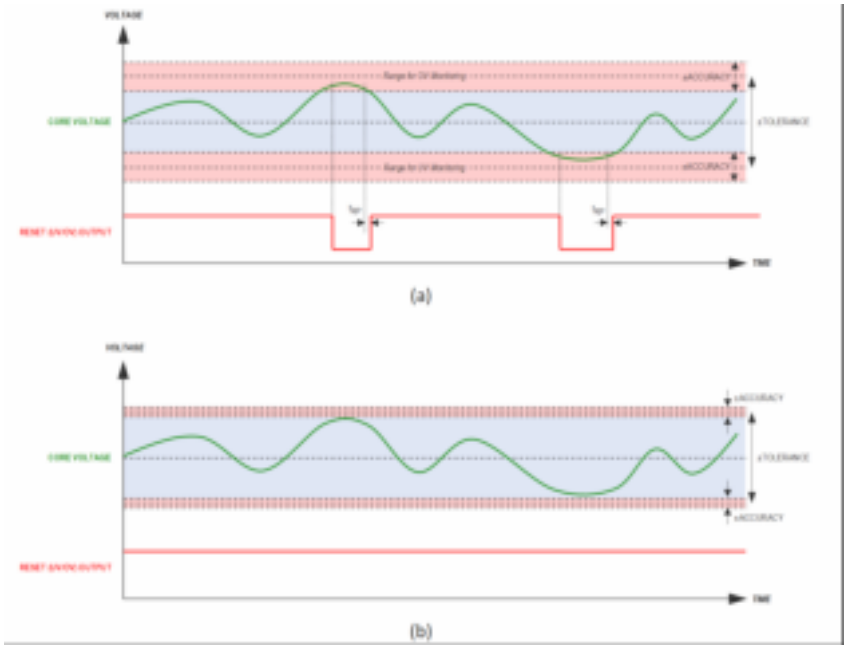


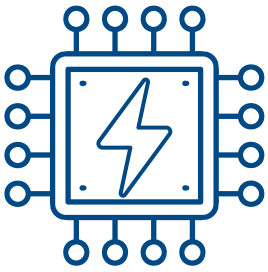
(b)

Impact of Threshold Accuracy

Compare two window voltage supervisors with different threshold accuracy monitoring the same core voltage supply rail. The supervisor with higher threshold accuracy will deviate less from the threshold limits in comparison to voltage supervisors with lower accuracy.

Examining the figure below, window supervisors with lower accuracy (a) creates a narrow power supply window since the reset output signal can assert anywhere within the UV and OV monitoring range. In applications with unreliable power supply regulation, this could pose a more sensitive system prone to oscillation. On the other hand, supervisors with high threshold accuracy (b) expands this range to provide a wider safe operating range for your power supply which improves the systems overall performance.





Power Supply Sequencing for AMD and Intel FPGAs

Modern FPGAs utilize multiple voltage rails for optimal performance. Defined power-up and power-down sequencing requirement is crucial for FPGA reliability. Improper sequencing introduce glitches, logic errors, and even permanent damage to sensitive FPGA components.

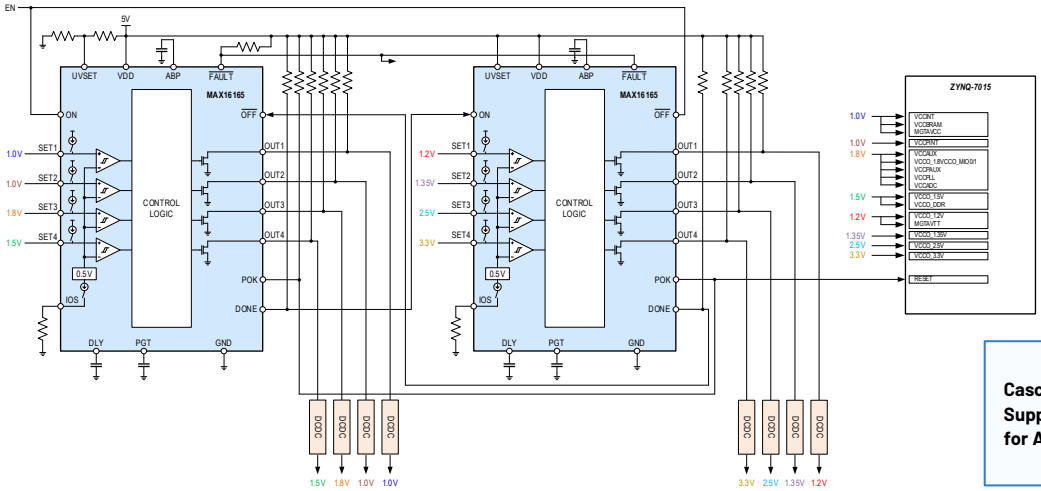
Analog Devices offers a comprehensive range of supervisory/sequencing circuits specifically designed to address the challenges of FPGA power management. These devices orchestrate the power-up and power-down sequence of various voltage rails, guaranteeing that each rail reaches its designated voltage level within its required ramp time and order. This power management solution minimizes inrush current, prevents voltage undershoot/overshoot conditions, and ultimately safeguards the integrity of your FPGA design

MAX16165

Highly Integrated, 4-Channel Sequencer and Supervisor

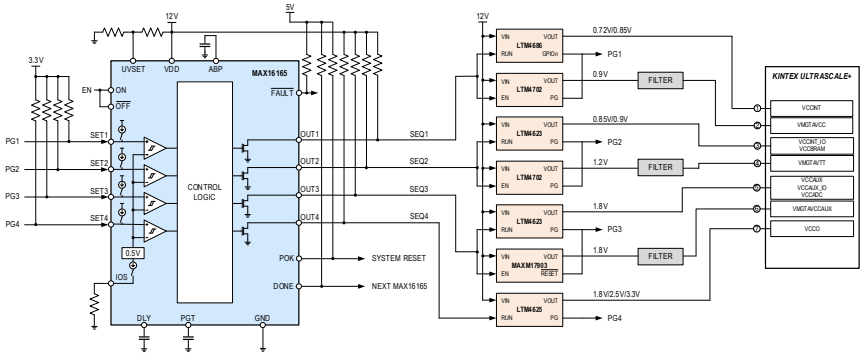
(Widest Voltage Range Sequencer in Smallest Footprint with Integrated Supervisory)

- 2.7V to 16.0V Wide Operating Voltage
- Monitor Up to Five Voltages and Sequence Up to Four Voltages
- Power-Off in Reverse Order or Simultaneously
- Unlimited Daisy-Chain
- Capacitor-Adjustable Sequencing Delay and Power-Good Timeout



Cascaded Power Supply Sequencing for AMD Zynq™ 7015

Power Supply Sequencing requiring 8 Power Regulators using ***MAX16165***



Power Supply Sequencing for AMD Kintex™ Ultrascale+

with voltage monitoring using **MAX16193** supervisory circuit

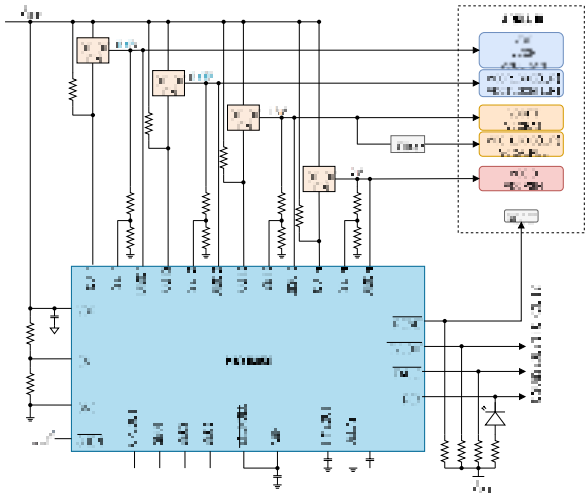
MAX16165/MAX16166: *Highly Integrated, 4-Channel Sequencer and Supervisor*

MAX16050

Sequencer-Supervisor with Reverse-Sequencing Capability

(Easy-to-Use, Four-/Five-Voltage, Power-Up/Power-Down Sequencer/Monitors)

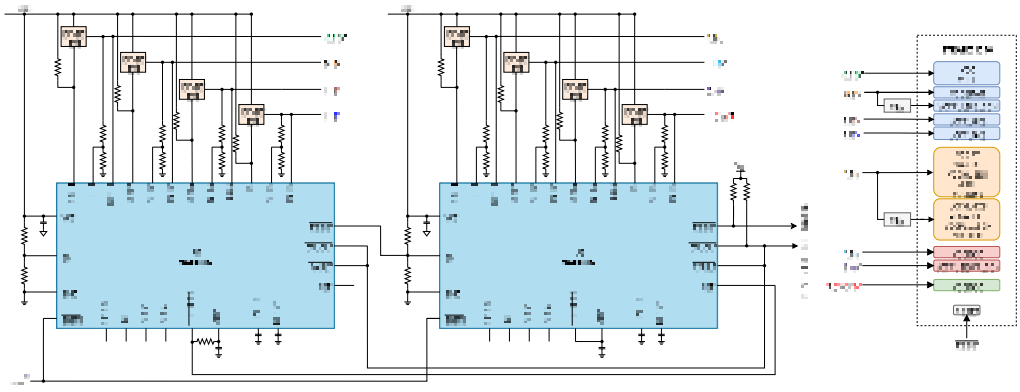
- Monitor Up to Five Voltages and Sequence Up to Four Voltages
- Pin-Selectable Sequencing Order
- Reverse-Sequencing Capability on Shutdown
- ±1.5% Accurate Overvoltage Monitoring with Independent Output
- Daisy-Chaining Capability to Communicate Across Multiple Devices



Power Supply Sequencing for Intel® Arria® 10 GX
with Transceiver Data Rate <= 11.3 Gbps for Chip-to-Chip Applications

Legend:
Power Group 1 - Blue
Power Group 2 – Orange
Power Group 3 – Red

MAX16050/MAX16051: *Voltage Monitors/Sequencer Circuits with Reverse-Sequencing Capability*



Legend:
Power Group 1 - Blue
Power Group 2 – Orange
Power Group 3 – Red
Power Group 4 - Green

Power Supply Sequencing for Intel® Stratix® 10 GX
(only for the HF35 Package) with 15 Gbps < Transceiver Data Rate <= 28.3 Gbps

Power Supply Sequencing with ***MAX16050*** *using daisy chaining capability*

Power Supply Sequencing

Number of Supplies Monitored	Part Number	Operating Vrange	Threshold Accuracy	Sequence	Programming Method	Package
1: cascadable	MAX16895	1.5 to 5.5V	1%	Up	R's, C's	6 uDFN
1: cascadable	MAX16052, MAX16053	2.25 to 28V	1.8%	Up	R's, C's	6 SOT23
2: cascadable	MAX6819, MAX6820	0.9 to 5.5V	2.6%	Up	R's, C's	6 SOT23
2	MAX16041	2.2 to 28V	2.7% and 1.5%	Up	R's, C's	16 TQFN
3	MAX16042					20 TQFN
4	MAX16043					24 TQFN
4: cascadable	MAX16165, MAX16166	2.7 to 16V	0.80%	Up, Reverse-Power Down	R's, C's	20 WLP, 20L TQFN
	MAX16050	2.7 to 16V	1.5%	Up, Reverse-Power Down	R's, C's	28 TQFN
5: cascadable	MAX16051					
6: cascadable	LTC2937	4.5 to 16.5V	<1.5%	Programmable	I2C, SMBus	28 QFN
8	ADM1168	3 to 16V	<1%	Programmable	SMBus	32 LQFP
8	ADM1169	3 to 16V	<1%	Programmable	SMBus	32 LQFP, 40 LFCSP
10: cascadable (max of 4)	ADM1260	3 to 16V	<1%	Programmable	SMBus	40 LFCSP
12: cascadable	ADM1166	3 to 16V	<1%	Programmable	SMBus	40 LFCSP, 48 TQFP
17: cascadable	ADM1266	3 to 15V	<1%	Programmable	PMBus	64 LFCSP

Design Tools

Find more power components from Analog Devices at analog.com/power

ANALOG DEVICES
AHEAD OF WHAT'S POSSIBLE™

VISIT ANALOG.COM/SUPERVISORY

For regional headquarters, sales, and distributors or to contact customer service and technical support, visit analog.com/contact.

Ask ADI technology experts tough questions, browse FAQs, or join a conversation at the EngineerZone Online Support Community. Visit ez.analog.com.