Analog for Xilinx FPGAs

Solutions Guide

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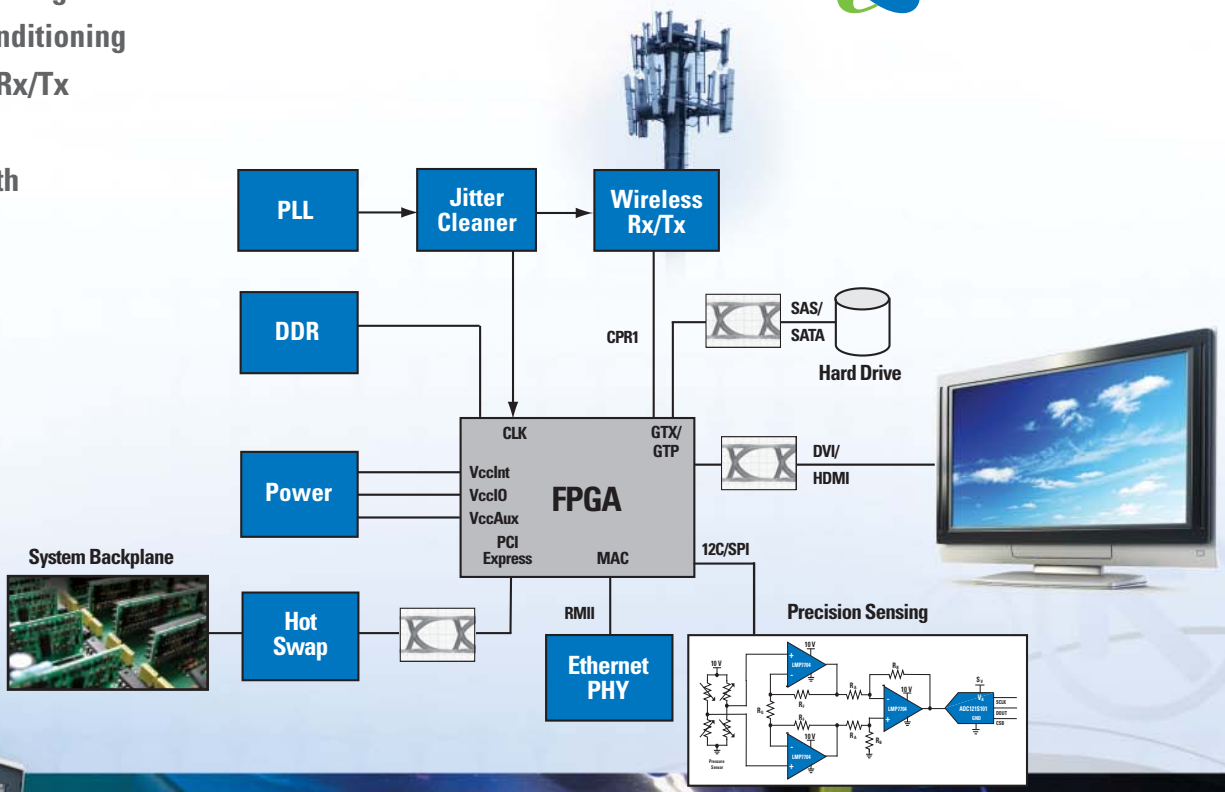
2009 Vol. 1

- Powering FPGAs
- Power Limiting
- Signal Conditioning
- Wireless Rx/Tx
- Ethernet
- Signal Path

PowerWise®



National Semiconductor

Solutions for Xilinx FPGAs

Xilinx FPGAs include high logic densities and extensive I/O capability allowing them to fit a multitude of applications. With core processing algorithms implemented in the digital fabric, analog ICs interface them to the external world. National Semiconductor, a leader in high-performance, energy-efficient solutions, offers a broad product portfolio to complement Xilinx FPGAs. National provides power, analog signal conditioning, data converters, and serial data-transfer solutions to meet the needs of technically demanding applications for displays, communications infrastructure and electronics such as medical, automotive, and test and measurement devices.

For the latest from National Semiconductor for Xilinx FPGAs see: **www.national.com/xilinx**

Powering Xilinx FPGAs

National's Power Expert tool automatically finds National power solutions for your design and populates the online WEBENCH® environment to quickly design, simulate and build a prototype. Otherwise, the following tables are a guide to help you in choosing an appropriate voltage regulator for your FPGA's specific needs.

See: http://www.national.com/analog/xilinx/power_expert

VccInt

Spartan 6, Spartan 3, Virtex 4 — 1.2V

I_{out}	V_{in} <= 5V	V_{in} 12V +
<0.5A	**LM2734**, **LM3671**, **LM3103**	**LM2734**, **LM3103**
1A	**LM2831**, **LM3100**, **LM20242**	**LM2734**, **LM3100**, **LM20242**
2A	**LM2832**, **LM3102**, **LM20123/33/43**	**LM3102**, **LM20323/33/43**
5A	**LM2854 (4A)**, **LM20125/45** **LM25085A**, LM3743	**LM3150**, **LM25085A** LM2742
10A	**LM25085A**, **LM2743** LM3743 , LM3495	**LM25085A**, **LM3150**, LM3495
20A	**LM2743**, LM3495, LM3000	**LM2743**, LM3000, LM3495

Spartan 6, Virtex 6, Virtex 5 – 1.0V

I_{out}	V_{in} <= 5V	V_{in} 12V +
1A	**LM2734**, **LM20242**, **LM3103**	**LM2734**, **LM3100**, **LM20242**
2A	**LM2832**, **LM3102** **LM20123/33/43**	**LM2738 (1.5A)**, **LM3102** **LM20323/33/43**
5A	**LM2854 (4A)**, **LM20125/45** **LM25085A**	**LM3150**, **LM25085A**, LM2742
10A	**LM25085A**, **LM2743**, LM3000 LM3743	**LM25085A**, **LM2743**, **LM3150** LM3000, LM3495
20A	**LM2743**, LM3000, LM3495	**LM2743**, LM3000, LM3495

Legend

Non Sync Sync Reg Controller **BOLD** = WEBENCH-Enabled

VccInt

Virtex-II Pro, Virtex-II — 1.5V

I_{out}	V_{in} <= 5V	V_{in} 12V +
<0.5A	**LM22671/74** **LM3103, LM3671**	**LM22671/74, LM25574** **LM3103**
1A	**LM22672/75** **LM3100, LM20242**	**LM22672/75, LM25575** **LM3100 , LM20242**
2A	**LM22680** **LM3102, LM20123/33/43**	**LM22680, LM25576** **LM3102 , LM20323/33/43**
5A	**LM22677/78/79** **LM2854 (4A),LM20125/45** **LM25085/88** LM2742	**LM22677/78/79** **LM3150, LM25085/88** LM2742
10A	**LM2743, LM25085/88,** LM2742	**LM2743, LM3150,** LM25116

Virtex-E, Spartan-IIE, CoolRunner-II — 1.8V

I_{out}	V_{in} <= 5V	V_{in} 12V +
<0.5A	**LM22671/74** **LM3103, LM3671**	**LM22671/74, LM25574** **LM3103**
1A	**LM22672/75** **LM3100, LM20242**	**LM22672/75, LM25575** **LM3100, LM20242**
2A	**LM22680** **LM3102, LM20123/33/43**	**LM22680, LM25576** **LM3102**
5A	**LM22677/78/79** **LM2854 (4A), LM20125/45** **LM25085/88** LM2742	**LM22677/78/79** **LM3150, LM25085/88** LM2742
10A	**LM2743, LM25085/88,** LM2742	**LM2743, LM3150,** LM25116

VccIO

1.5V

I_{out}	V_{in} <= 5V	V_{in} 12V +
<0.5A	**LM22671/74** **LM3103, LM3671**	**LM22671/74 , LM25574** **LM3103**
1A	**LM22672/75** **LM3100, LM20242**	**LM22672/75, LM25575** **LM3100, LM20242**
2A	**LM22680** **LM3102, LM20123/33/43**	**LM22680, LM25576, LM3102** **LM20323/33/43**
5A	**LM22677/78/79** **LM2854 (4A), LM20125/45** **LM25085/88,** LM2742	**LM22677/78/79** **LM3150,** LM2742, LM25116
10A	**LM2743, LM25085/88,** LM3743	**LM2743, LM3150,** LM25116
20A	**LM2743,** LM5642/X	**LM2743,** LM25116, LM5642/X
40A	LM5642/X	LM5642/X

1.8V

I_{out}	V_{in} <= 5V	V_{in} 12V +
<0.5A	**LM22671/74** **LM3103, LM3671**	**LM22671/74 , LM25574** **LM3103**
1A	**LM22672/75** **LM3100, LM20242**	**LM22672/75, LM25575** **LM3100 , LM20242**
2A	**LM22680** **LM3102, LM20123/33/43**	**LM22680, LM25576** **LM3102**
5A	**LM22677/78/79** **LM2854 (4A), LM20125/45** **LM25085/88,** LM2742	**LM22677/78/79** **LM3150,** LM2742, LM25116
10A	**LM2743, LM25085/88,** LM3743	**LM2743, LM3150,** LM25116
20A	**LM2743,** LM5642/X	**LM2743,** LM25116, LM5642/X
40A	LM5642/X	LM5642/X

Legend

Non Sync Sync Reg Controller **BOLD** = WEBENCH-Enabled

Powering FPGAs

VccIO

2.5V

I_{out}	V_{in} <= 5V	V_{in} 12V +
<0.5A	**LM22671/74** **LM3103, LM3671**	**LM22671/74 , LM25574** **LM3103**
1A	**LM22672/75** **LM3100, LM20242**	**LM22672/75, LM25575** **LM3100, LM20242**
2A	**LM22680** **LM3102, LM20123/33/43**	**LM22680, LM25576** **LM3102**
5A	**LM22677/78/79** **LM2854 (4A), LM20125/45** **LM25085/88,** LM2742	**LM22677/78/79** **LM3150,** LM2742
10A	**LM2743, LM25085/88,** LM3743	**LM2743, LM3150,** LM25116
20A	**LM2743,** LM5642/X	**LM2743,** LM25116, LM5642/X
40A	LM5642/X	LM5642/X

3.3V

I_{out}	V_{in} <= 5V	V_{in} 12V +
<0.5A	**LM22671/74** **LM3103, LM3671**	**LM22671/74, LM25574** **LM3103**
1A	**LM22672/75** **LM3100, LM20242**	**LM22672/75, LM25575** **LM3100, LM20242**
2A	**LM22680** **LM3102, LM20123/33/43**	**LM22680, LM25576** **LM3102**
5A	**LM22677/78/79** **LM20125/45** **LM25085/88,** LM2742	**LM22677/78/79** **LM3150,** LM2742
10A	**LM2743, LM25085/88,** LM3743	**LM2743, LM3150,** LM25116
20A	**LM2743,** LM5642/X	**LM2743,** LM25116, LM5642/X
40A	LM5642/X	LM5642/X

VccAux

2.5V

I_{out}	V_{in} <= 5V	V_{in} 12V +
<0.5A	LP3878/9 (LDO), LP38500 (LDO) **LM22671/74, LM3103**	**LM22671/74, LM25574** **LM3103**
1A	**LM22672/75,** **LM3100, LM20242**	**LM22672/75, LM25575** **LM3100, LM20242**
2A	**LM22680,** **LM3102, LM20123/33/43**	**LM22680, LM25576** **LM3102, LM20323/33/43**
5A	**LM22677/78/79,** **LM2854 (4A), LM20125/45,** **LM25085/88 W,** LM2742	**LM22677/78/79,** **LM3150,** LM2742, LM25116

WEBENCH® Online Design Environment

WEBENCH online design and prototyping tools deliver results faster than ever. Design, optimize, generate your prototype, and download your test vectors – all online

- ✓ Select It
- ✓ Design It
- ✓ Analyze It
- ✓ Build It

And do it all for free, anywhere, anytime
www.national.com/webench

Legend

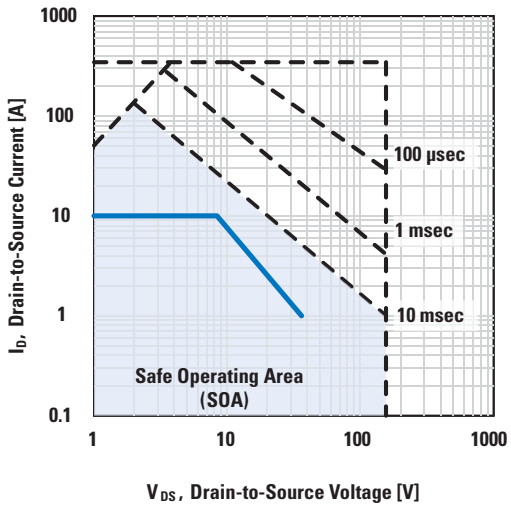
■ Non Sync ■ Sync Reg ■ Controller **BOLD** = WEBENCH-Enabled

Memory Solutions (VTT) and Reference (VREF)

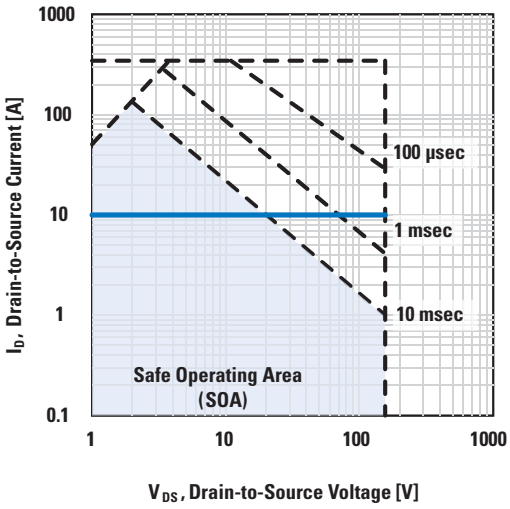
Product ID	Input Max Voltage (V)	Input (PVIN) Min Voltage (V)	Output Current (mA)	Standards	Enable	Suspend to RAM
LP2998	5.5	1.8	up to 1500	DDR, DDR-II, DDR-III	Y	Y
LM2744	16	1	5000+	DDR, DDR-II, DDR-III	Y	Y

Power Limiting Protects External Pass Device for Improved System Reliability

To ensure system reliability, any MOSFET must operate within its Safe Operating Area (SOA) in order to avoid FET failure. National's LM(2)506x hot swap controllers provide both current and power limiting to dynamically adjust the current limit at large V_{DS} and ensure the MOSFET stays in the SOA at all conditions – maximizing long-term system reliability and robustness.



Conventional Hot Swap: Current Limit Only MOSFET Out of SOA at Large V_{DS}

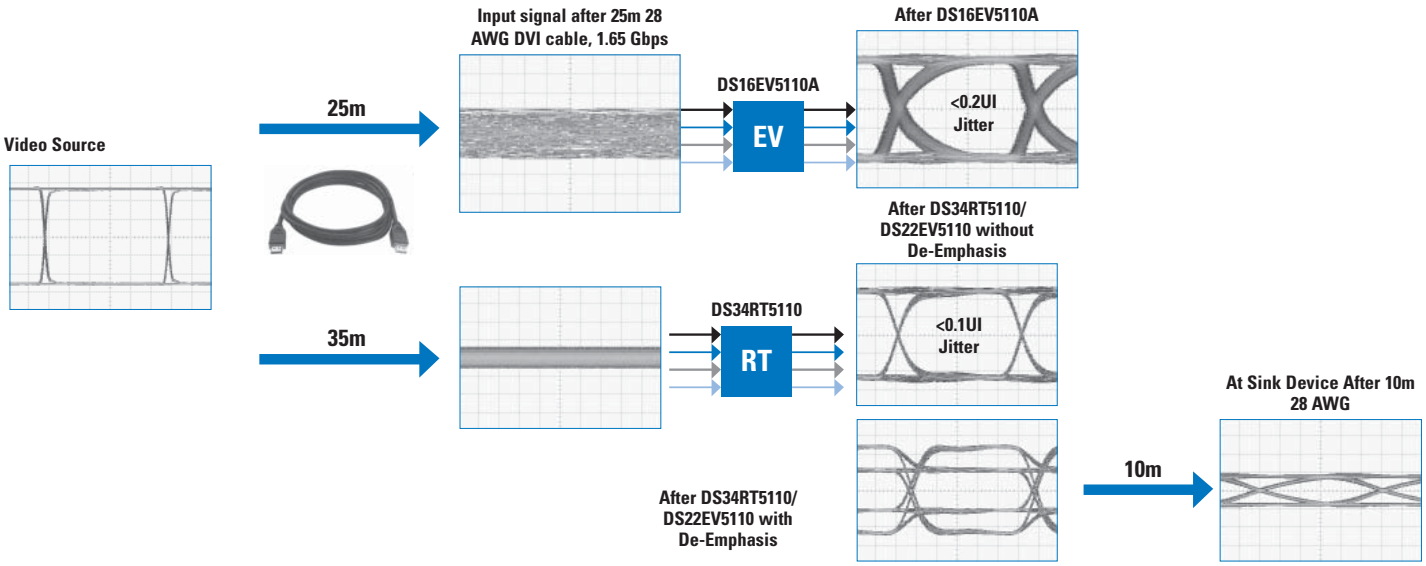


LM(2)506x: Current Limit and Power Limit Optimal Circuit and MOSFET Protection for All V_{DS}

Hot Swap/In-Rush Current Controllers

Product ID	V_{IN} Range (V)	POWER GOOD	Adjustable UVLO	Adjustable OVLO	Active In-Rush Current Limit	Active Current Limiting	Active Power Limiting	EVK
LM5067 [E]	-9V to -80	V_{DS}	✔	✔	✔	✔	✔	LM5067EVAL
LM5069 [E]	+9 to +80	V_{DS}	✔	✔	✔	✔	✔	LM5069EVAL
NEW! LM25061 [E]	+2.9 to +17	V_{OUT}(adj)	✔		✔	✔	✔	LM25061MM-2EVAL
NEW! LM25069 [E]	+2.9 to +17	V_{DS}	✔	✔	✔	✔	✔	LM25069MM-2EVAL

Signal Conditioning and Wireless Rx/Tx



Signal Conditioning

Product ID	Function	Inputs	Outputs	Input Compatibility	Output	De-Emphasis (dB)	Receive Equalization (dB)	Max Speed/ Ch (Mbps)	EVK
DS50PCI401	SAS / SATA	8	8	CML	CML	Up to -12	Up to 26.3	5000	DS50PCI401
DS64BR401	PCIExpress	8	8	CML	CML	Up to -13	Up to 28.4	6400	DS64BVR401EVK
DS50EV401	PCIExpress Quad settable	4	4	CML	CML	–	20	8000	DS50EV401
DS64EV400SQ	EQ	4	4	CML	CML	–	Up to 20	10000	DS64EV400-EVK
DS64EV100SD	Settable EQ	1	1	CML	CML	–	Up to 20	10000	DS64EV100-EVK
DS34RT5110	HDMI / DVI	3	3	LVDS/CML/LVPECL	CML	Up to -9	Up to 27	2250	DS34RT5110-EVKH DS34RT4110-EVKC
DS22EV5110	HDMI / DVI	3	3	LVDS/CML/LVPECL	CML	Up to -9	Up to 30	3400	DS22EV100-EVKH DS22EV100-EVKC
LMH0344/384	SDI EQ	1	1	SDI	CML/LVDS	–	Up to 400m Belden 1694A	2970	SDIXLEVK (Avnet) /SD384EVK
LMH303/302	SDI Cable Driver	1	1	CML	CML	–	–	2970	SD303EVK/SD302EVK

Wireless Rx/Tx

The explosive growth of mobile handsets coupled with users' appetite for bandwidth continues to drive ever increasing demands from the wireless infrastructure. National Semiconductor offers reference designs for wireless basestation (BTS) radio systems.

"RD-170" is a low IF receiver subsystem for up to 52 MHz input signals.	"RD-146" is a high IF receiver circuit with variable gain IF amplification. It provides excellent sensitivity for input signal up to 240 MHz.
Performance for a 52 MHz input signal is • **Small-signal SNR of 78.0 dBFS and SFDR > 94 dBFS** • **Large-signal SNR of 75.8 dBFS and SFDR > 84 dBFS**	Performance for a 169 MHz input signal: • Small-signal SNR of 72 dBFS and SFDR greater than 90 dBFS • Large signal SNR of 68.3 dBFS and SFDR of 77 dBFS

See the following radio reference designs at: **www.national.com/refdesigns**

Ethernet

Single Port PHYTER® 10/100 ethernet PHYs
- IEEE1588 v1 & v2 precision time protocol support (DP83640)
  - — Enable IEEE 1588 with any MAC-based FPGA, ASIC or Microcontroller
  - — Node synchronization accuracy to < 10 nS
  - — Replace E1/T1 lines and expensive GPS clocks
  - — Synchronized clock output
  - — Synchronous ethernet support
- Industry's lowest deterministic latency
- Selectable MII/RMII interface
- TDR-based cable health diagnostics
- 100 BASE-FX fiber interface

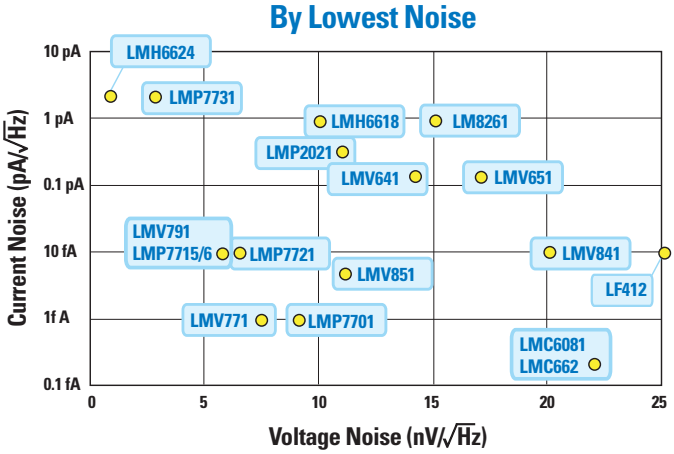
Product ID	Interface	Temp Range (^C)	JTAG	Software Utility?	Features
DP83640	MII/RMII	-40 to 85	✔	✔	IEEE 1588 v1 & v2; TDR (Time Domain Reflectometry) cable diagnostics; Includes sample code
DP83848C	MII/RMII/SNI	0 to 70	✔	✔	9x9x1.4
DP83848J/K	MII/RMII	0 to 70 / -40 to 85	✔		PHYTER Mini (6x6x0.8)
DP83849C/IF	MII/RMII	0 to 70 / -40 to 85	✔	✔	Dual PHYTER (Dual Transceivers)

For design information see: **http://www.national.com/analog/interface/refdesign_demoboards**

The Signal Path

Amplifiers

The signal path consists of, at a minimum, a sensor, amplifier and ADC. This subsystem is used in sensing and detecting precise changes in the external world. The graph at the right serves as a starting point for the designer to quickly choose an amplifier based on flat-band noise density. For clarity, only a selection of op amps suitable for precision applications is shown in the graph. Duals and quads are also available.



Analog-to-Digital Converters

National's PowerWise® Analog-to-Digital Converters (ADCs) are the lowest-power family of A/D converters on the market. They lower engineering effort because A/D converters with the same channel count and package are interchangeable. Therefore, one printed circuit board (PCB) layout supports multiple system designs that require different resolutions and sample rates.

For more information see: **www.national.com/adc**

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Indianapolis, Indiana
Longmont, Colorado
Norcross, Georgia
Phoenix, Arizona
Salem, New Hampshire
Santa Clara, California
South Portland, Maine
Tucson, Arizona

EUROPE:
Delft, Netherlands
Unterhaching, Germany
Greenock, Scotland
Milan, Italy
Oulu, Finland
Tallinn, Estonia

ASIA:
Bangalore, India
Hangzhou, China
(joint with Zhejiang University)
Hong Kong, China
Tokyo, Japan

Manufacturing Facilities

Wafer (Die) Fabrication:
Arlington, Texas
South Portland, Maine
Greenock, Scotland

Chip Test and Assembly:
Melaka, Malaysia

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