Wide V_{IN} DC/DC Power Solutions

For Industrial, Automotive, and Communications Applications

Texas Instruments

ti.com/widevin

2014

Increased Power Density and Reliability

For Applications Requiring Max Operating Voltages ≥30V

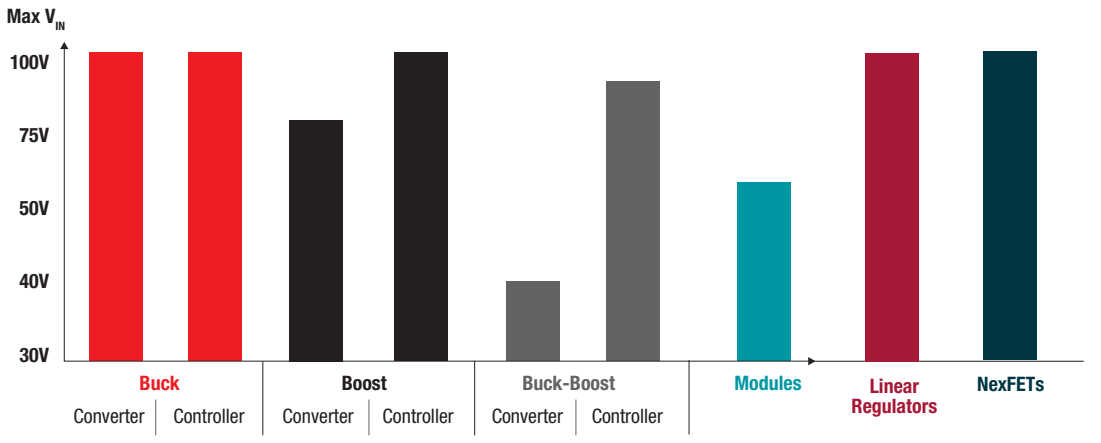
Texas Instruments provides the industry's most comprehensive wide input voltage range DC/DC converter portfolio with rich feature sets to meet the demands of today's high-performance systems. With operating voltages of up to 100V, TI's Wide V_{IN} portfolio eliminates input protection components to reduce cost and solution size. Extra margin is provided for robustness of un-characterized system conditions to increase system reliability. Additionally, a single device can operate across several voltage rails to provide scalability and allow reuse of power converter designs.

TI's easy-to-use, high-density, feature-rich Wide V_{IN} converters, controllers, and power modules reduce BOM size and cost while improving scalability and reliability without compromising performance.

Wide V_{IN} Power Benefits

Wide V_{IN} Capability	System Benefit
Increased robustness against input transients	Eliminates the need for external transient protection components, saves PCB area
Ability to convert high V_{IN} to low V_{OUT}	Eliminates two-stage conversions, saves PCB area
High-power density modules	Saves PCB area, simplifies design
Low noise, low EMI solutions	Eliminates external filtering, improves quality of data signals
Stackable devices with current sharing	Enables re-use across multiple applications
WEBENCH® design tools support	Easy to design and optimize custom circuits

Wide V_{IN} DC/DC Portfolio



Applications Requiring Wide V_{IN} DC/DC Conversion

Delivering High Performance Power Solutions for the Most Demanding Systems

Rugged Industrial Equipment

- 40V+ Wide V_{IN} operation for 24V backplanes
- Isolated bias power for PLCs and motor drives
- Integrated FET buck converters for reducing PCB power footprint
- Power modules with integrated inductor to increase power density and reduce EMI
- Low noise LDOs for powering precision circuits

Advanced Automotive Electronics

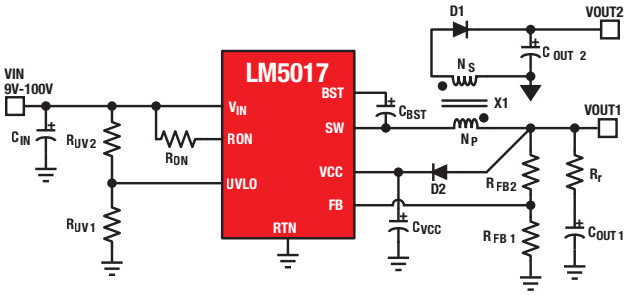
- 42V/60V Wide V_{IN} rating to survive load dump
- >2 MHz operation to reduce radio interference
- Low standby / shutdown Iq to reduce battery drain
- Buck controllers for infotainment and USB power
- Boost solutions with 3V min V_{IN} for continuous operation during start-stop events
- Ultra-small IC packaging to reduce PCB footprint

Sensitive Communications Systems

- 75V/100V Wide V_{IN} operation for 48V backplanes
- High-performance buck controllers and MOSFETs for powering high-current systems
- Low EMI integrated power modules for reducing noise and PCB footprint
- Constant frequency operation for managing power supply noise
- High PSRR and low-noise regulators for powering RF circuits

Wide V_{IN} Converters

Integrated and Easy-to-Use for Space-Constrained Applications



LM5017 Family of 100V Regulators Enhance Reliability for High-Voltage Systems

- Wide 9 – 100V operating input range provides improved transient protection
- Integrated 100V FETs reduce external components and BOM cost
- COT architecture requires no loop compensation, reducing solution size
- Also features intelligent peak current limit, adjustable UVLO, and thermal shutdown

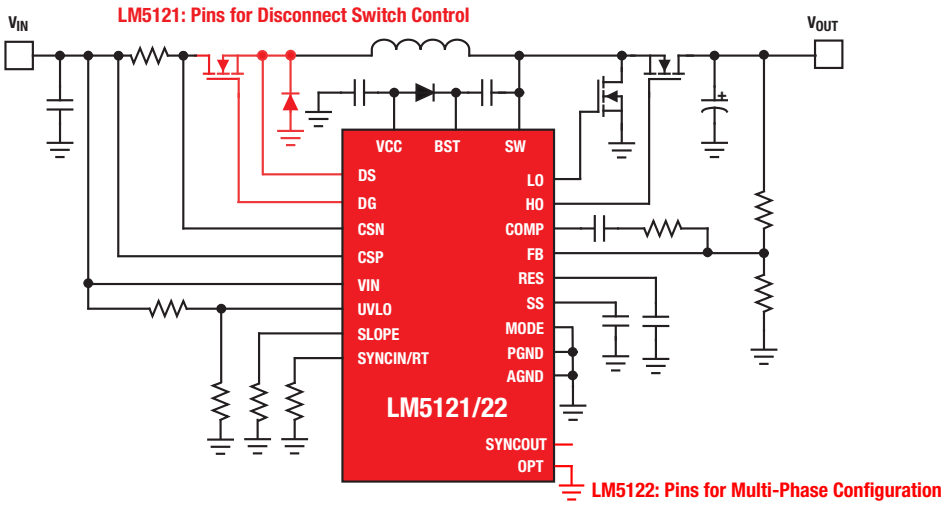
Wide V_{IN} Converters

Device	Output Current (A)	Input Voltage Range (V)	Output Voltage Range (V)	Frequency Range (kHz) and Sync	Synchronous	AECQ	PWM Mode
Buck Converters							
TPS54062/1	0.05/0.2	4.7 to 60	0.8 to 58	50 to 1100, Sync	✔	– / ✔	CM
LM(2)5017/8/9*	0.6/0.3/0.1	9 to 48/100	1.25 to 40/90	50 to 1000	✔	—	COT
LM5008A/9A	0.35/0.15	6 to 95	2.5 to 85	50 to 600	—	—	COT
LMR14203/6	0.3/0.6	4.5 to 42	0.765 to 34	1250	—	—	CM
LM(2)5574/5/6*	0.5/1.5/3	6 to 42/75	1.23 to 70	50 to 1000	—	✔	ECM
LM22674/75/80	0.05/1/2	4.5 to 42	1.285 to 37	200 to 1000	—	✔	VM
LM(2)5007*	0.5	9 to 75	2.5 to 37/73	50 to 800	—	—	COT
LM34919C	0.6	4.5 to 50	2.5 to 45	up to 2600	—	✔	COT
LM5006	0.65	6 to 75	2.5 to 75	50 to 800	✔	—	COT
LM(2)5010A*	1	6 to 42/75	2.5 to 37/70	50 to 1000	—	✔	COT
LMR24210/20	1/2	4.5 to 42	0.8 to 24	1000 max	✔	—	COT
TPS54140/60 A	1.5	3.5 to 42/60	0.8 to 40/58	100 to 2500, Sync	—	✔	CM
LM25011	2	6 to 42	2.5 to 40	up to 2000	—	✔	COT
LM(2)5005*	2.5	7 to 42/75	1.23 to 37/70	50 to 500, Sync	—	—	ECM
TPS54240/60	2.5	3.5 to 42/60	0.8 to 40/58	100 to 2500, Sync	—	✔	CM
LM43602/03	2/3	3.5 to 36	1.0 to 28	200 to 2200, Sync	✔	✔ / —	CM
TPS54340/60	3.5	4.5 to 42/60	0.8 to 58.8	100 to 2500, Sync	—	✔	CM
LM22677/8/9	5	4.5 to 42	1.285 to 37	200 to 1000	—	✔	VM
TPS54540/60	5	4.5 to 42/60	0.8 to 58.8	100 to 2500, Sync	—	✔	CM
Boost Converters							
TPS55332	0.5	3.6 to 60	2.5 to 50	80 to 2200, Sync	—	✔	VM
LM5000/1/2	2/1/0.5	3.1 to 40/75	1.26 to 75	up to 1500	—	—	CM
Buck-Boost Converters							
TPS55065	0.5	1.5 to 40	5	440	—	✔	VM

** (2) indicates a lower voltage option, check data sheet for input voltage range*

Wide V_{IN} Controllers

High-Performance for High-Current Power Conversion Needs



LM5121/22 Family of Stackable, Wide V_{IN} Syncronous Boost Controllers

- Wide input/output range accommodates automotive cold crank and load dump
- 3 – 65 V_{IN} and up to 100 V_{OUT}
- LM5122 Multi-phase capability for high-power Industrial, Automotive, and Telecom
- LM5121 Disconnect switch enables fault protection and complete load disconnect

Wide V_{IN} Controllers

Device	Input Voltage Range (V)	# of Outputs	Output Min (V)	Output Max Voltage (V)	Frequency Range (kHz) and Sync	Synchronous	AECQ	PWM Mode
Buck Controllers								
LM3150/1/2	6 to 42	1	0.6/3.3/3.3	40/3.3/3.3	200 to 1000/250/500	✔	—	COT
TPS40170	4.5 to 60	1	0.6	57	100 to 600, Sync	✔	✔	VFF
LM(2)5117*	5.5 to 65	1	0.8	58	50 to 750, Sync	✔	✔	ECM
LM(2)5119*	5.5 to 65	2	0.8	58	50 to 750, Sync	✔	✔	ECM
TPS43340	4 to 40	4	0.9	11	150 to 600, Sync	✔	✔	CM
TPS43350/1	4 to 40	2	0.9	11	150 to 600, Sync	✔	✔	CM
LM(2)5116*	6 to 100	1	1.215	80	50 to 1000, Sync	✔	—	ECM
LM(2)5085/8*	4.5 to 75	1	1.25/1.2	75/70	50 to 1000	—	✔	COT/ECM
Boost Controllers								
LM5022	6 to 60	1	1.25	†	up to 1000, Sync	—	—	CM
LM3478/88	2.95 to 40	1	1.26	†	100 to 1000, Sync	—	✔	CM
LM3481	2.97 to 48	1	1.275	†	100 to 1000, Sync	—	✔	CM
LM5121/2	3 to 65	1	3	100	up to 1000, Sync	✔	✔	CM
TPS43060/1	4.5 to 40	1	4.5	60	50 to 1000, Sync	✔	–	CM
TPS40210	4.5 to 52	1	5	†	50 to 1000, Sync	✔	✔	CM
Buck-Boost and Buck + Boost Controllers								
LM(2)5118*	3 to 75	1	1.23	70	50 to 500, Sync	—	✔	ECM
TPS43330	4 to 40	3	0.09	11	150 to 600, Sync	✔	✔	CM

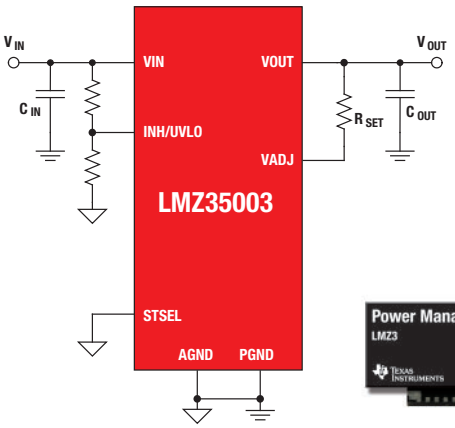
** (2) indicates a lower voltage option, check data sheet for input voltage range*
† Maximum output voltage is set by external feedback resistors

Wide V_{IN} Power Modules

For Low-Noise Designs that Require an Extremely Fast Time to Market

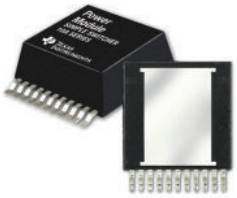
LMZ35003 2.5A SIMPLE SWITCHER® Power Module in Low Profile QFN Package

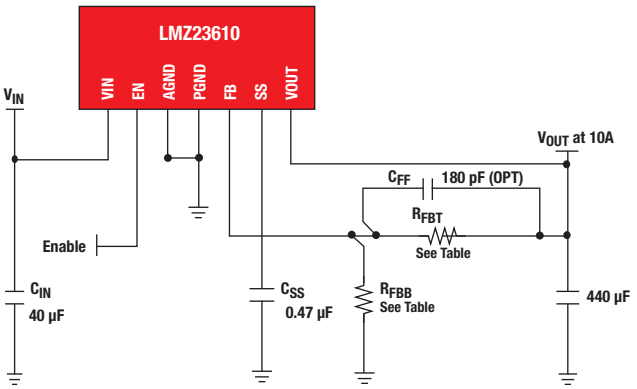
- Wide input voltage range from 7V to 50V (65V surge capability)
- Output adjustable from 2.5V to 15V
- Efficiency up to 96%
- Low EMI: meets EN55022 class B



LMZ23610 10A SIMPLE SWITCHER Power Module in Easy-to-Use PFM Package

- Wide input voltage range from 6V to 36V
- Output adjustable from 0.8V to 6V
- Single exposed pad and standard pinout for easy mounting and manufacturing
- Low EMI: meets EN55022 class B





Wide V_{IN} SIMPLE SWITCHER® Modules

Device	Output Current (A)	Input Voltage Range (V)	# of Outputs	Output Voltage Range (V)	Frequency Range (kHz) & Sync	Current Sharing
Buck Modules						
LMZ14201/H	1	6 to 42	1	0.8 to 6/5 to 24	adj to 1000	
LMZ14202/H	2	6 to 42	1	0.8 to 6/5 to 24	adj to 1000	
LMZ35003	2.5	7 to 50	1	2.5 to 15	400 to 1000	
LMZ14203/H	3	6 to 42	1	0.8 to 6/5 to 24	adj to 1000	
LMZ23603/5	3/5	6 to 36	1	0.8 to 6	650 to 950, Sync	
LMZ13608/10	8/10	6 to 36	1	0.6 to 6	360	
LMZ23608/10	8/10	6 to 36	1	0.6 to 6	315 to 600, Sync	✔
Inverting Modules						
LMZ34002	2	4.5 to 40	1	-3 to -17	500 to 800	

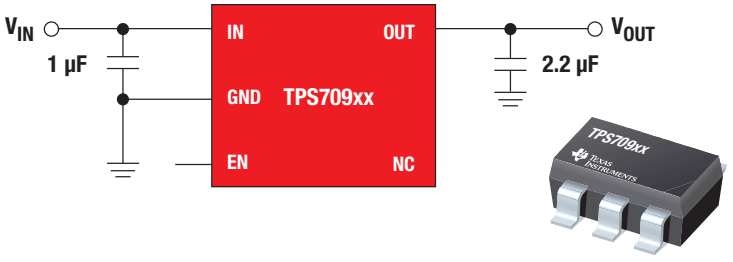
** Modules available for extended temperature operation to -55°C*

Wide V_{IN} Linear Regulators

Delivering Low Noise and Fast Transient Response for Sensitive Applications

TPS709xx Family: 30V, 150 mA Ultralow Iq LDO with Reverse Current Protection and enable

- Wide 2.7V to 30V input voltage range
- Output current up to 150 mA
- Ultra-low Iq: 1.3 5 µA
- Low dropout: 24 5 mV at 50 mA load



Wide V_{IN} Linear Regulators

Device	Output Current (A)	Input Voltage Range (V)	Output Voltage Range (V)	Dropout (mV) at Max Load	PSRR at 100kHz (dB)	Output Noise (µVrms)	Key Features
TPS7A40	0.05	7 to 100	1.1 to 90	780	65 dB at 100 Hz	*	Fast transient response
LM2936HV	0.05	5.5 to 60	3 to 5	200	60 dB at 120 Hz	†	Reverse voltage protection
LM9036	0.05	3.3 to 40	3.3 to 5	200	60 dB at 120 Hz	*	Reverse voltage protection
TPS7A16	0.1	3 to 60	1.2 to 18.5	265	50 dB at 100 Hz	†	5µA Iq, Power Good
LM9076	0.15	3.3 to 40	3.3 to 5	150	60 dB at 120 Hz	*	Integrated reset
TPS709	0.15	2.7 to 30	1.2 to 5	460	52 dB at 1kHz	†	1.35 µA Iq
TPS7A49	0.15	3 to 36	1.2 to 33	333	53 dB	12.7 µVrms	Low noise, high PSRR
TPS7A30	0.2	-3 to -36	-1.18 to -33	325	55 dB	14 µVrms	Low noise, high PSRR
TPS7A47	1	3 to 36	1.4 to 34	307	60 dB	4 µVrms	Low noise, high PSRR
TPS7A33	1	-3 to -36	-1.2 to -33	307	64 dB	16 µVrms	Low noise, high PSRR

** Output noise not specified, see datasheet for more details*
† Refer to datasheet for output noise at different frequencies

Wide V_{IN} NexFET™ Power MOSFETs

Optimized for DC/DC Power Conversion with Low R_{DSON} and Gate Charge

- 60V and 100V NexFET pairs provide best-in-class performance for DC/DC conversion needs

Wide V_{IN} NexFETs

Device	BVSS (V)	Vgs (V)	RDS(ON) typ 10V (mW)	ID at 25°C (A)	Qg at 10V Typ (nC)	Qgd Typ (nC)	Qgs Typ (nC)	Qrr 300A/µs Typ (nC)
CSD18501Q5A	40	20	3	155	42	6	8	70
CSD18502Q5B	40	20	2	204	25	8	10	88
CSD18537NQ5A[1]	60	20	10	62	14	2	5	54
CSD18563Q5A[1]	60	20	6	98	29	5	7	57
CSD19502Q5B	80	20	3	138	48	9	14	275
CSD19532Q5B	100	20	4	124	48	9	13	249
CSD19534Q5A[2]	100	20	13	137	17	3	5	134
CSD19533Q5A[2]	100	20	8	100	27	5	8	163

[1] [2] Recommended high-side and low-side pairs

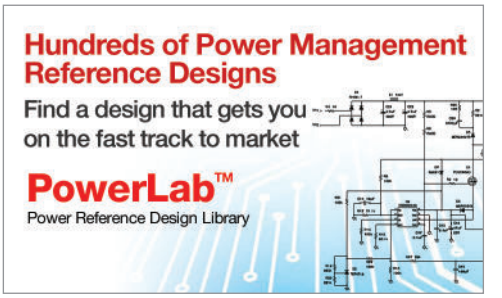
For more Wide V_{IN} NexFET™ products, visit ti.com/nexfet

Design Resources and References

See TI's complete portfolio of Wide V_{IN} DC/DC power solutions at ti.com/widevin

TI simplifies your design process with resources and tools including a wide selection of EVMs, reference designs, application notes, and WEBENCH® Power Designer tools to get you to market faster.

Quickly create custom designs to meet your exact requirements.

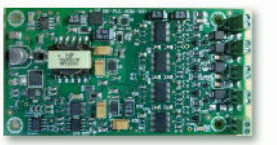


Find application-specific designs in the PowerLab™ reference design library.

Designs

Reference Design Library
Jump start system design and speed time to market

TI Designs Offer:



- Comprehensive designs include schematics or block diagrams, BOMs, design files and test reports
- Created by experts with deep system knowledge
- Span TI's portfolio of analog, embedded processor, and connectivity products
- Support for a broad range of applications including industrial, automotive, consumer, medical, and more

TI E2E™ Community

E2E Power Forum
ti.com/powerforum

Find answers to your power management questions

Texas Instruments

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265