INTEGRATED CIRCUITS
UNITRODE

UC1725
UC2725
UC3725

Isolated High Side FET Driver

FEATURES

- Receives Both Power and Signal Across the Isolation Boundary
- 9 to 15 Volt High Level Gate Drive
- Under-voltage Lockout
- Programmable Over-current Shutdown and Restart
- Output Enable Function

DESCRIPTION

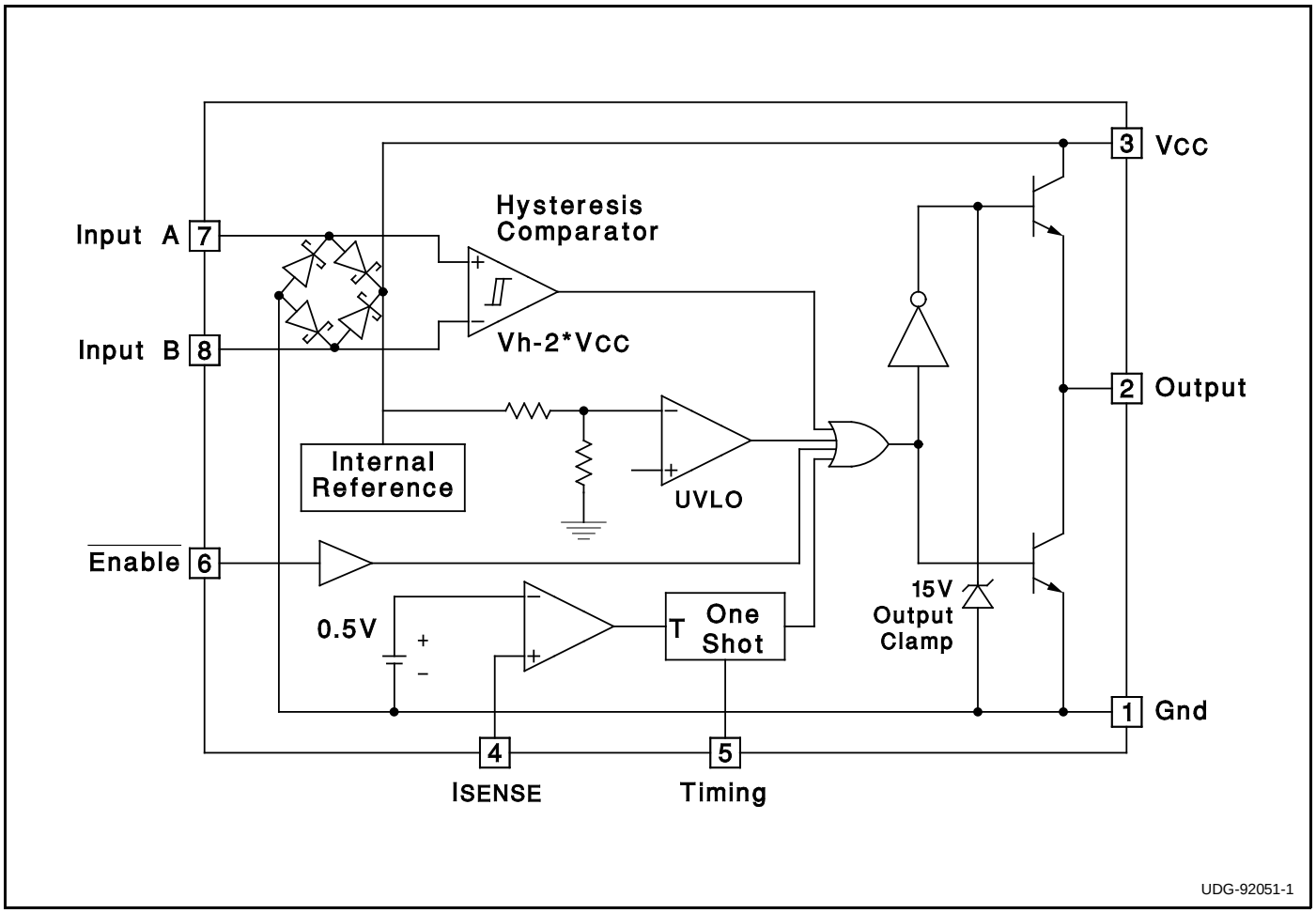
The UC1725 and its companion chip, the UC1724, provide all the necessary features to drive an isolated MOSFET transistor from a TTL input signal. A unique modulation scheme is used to transmit both power and signals across an isolation boundary with a minimum of external components.

Protection circuitry, including under-voltage lockout, over-current shutdown, and gate voltage clamping provide fault protection for the MOSFET. High level gate drive is guaranteed to be greater than 9 volts and less than 15 volts under all conditions.

Uses include isolated off-line full bridge and half bridge drives for driving motors, switches, and any other load requiring full electrical isolation.

The UC1725 is characterized for operation over the full military temperature range of -55°C to +125°C while the UC2725 and UC3725 are characterized for -25°C to +85°C and 0°C to +70°C respectively.

BLOCK DIAGRAM



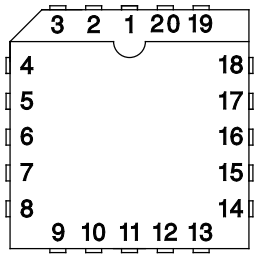
ABSOLUTE MAXIMUM RATINGS

Supply Voltage (pin 3) 30V
Power inputs (pins 7 & 8) 30V
Output current, source or sink (pin 2)
DC. 0.5A
Pulse (0.5 us) 2.0A
Enable and Current limit inputs (pins 4 & 6). . . . . -0.3 to 6V
Power Dissipation at $T_A \leq 25°C$ (DIL-8) 1W
Power Dissipation at $T_A \leq 25°C$ (SO-14) 725mW
Lead Temperature (Soldering, 10 Seconds) . . . . . 300°C

Note 1: Unless otherwise indicated, voltages are referenced to ground and currents are positive into, negative out of, the specified terminals (pin numbers refer to DIL-8 package).
Note 2: See Unitrode Integrated Circuits databook for information regarding thermal specifications and limitations of packages.

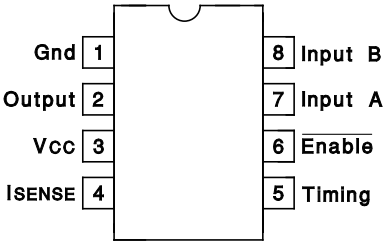
CONNECTION DIAGRAMS

PLCC-20 (Top View)
Q Package

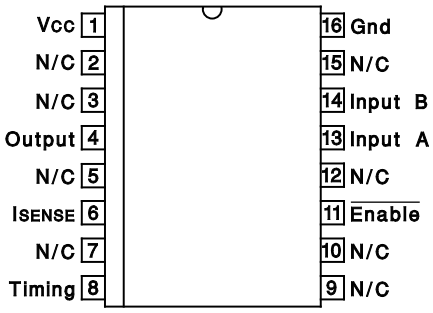


PACKAGE PIN FUNCTION	
FUNCTION	PIN
N/C	1
I_{SENSE}	2
N/C	3-5
Timing	6
$\overline{\text{Enable}}$	7
N/C	8-9
Input A	11
N/C	12-14
Input B	15
Gnd	16
V_{CC}	17
N/C	18-19
Output	20

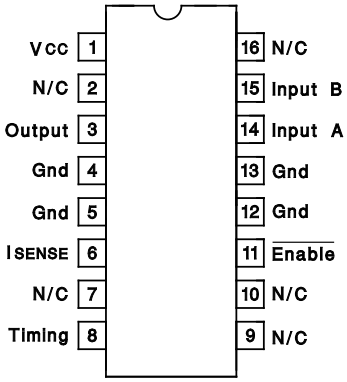
DIL-8 (Top View)
J Or N Package



SOIC-16 (Top View)
DW Package



DIL-16 (Top View)
JE Or NE Package



ELECTRICAL CHARACTERISTICS:

(Unless otherwise stated, these specifications apply for $-55°C \leq T_A \leq +125°C$ for UC1725; $-25°C \leq T_A \leq +85°C$ for UC2725; $0°C \leq T_A \leq +70°C$ for UC3725; V_{CC} (pin 3) = 0 to 15V, R_T=10k, C_T=2.2nf, $T_A = T_J$, pin numbers refer to DIL-8 package.)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
POWER INPUT SECTION (PINS 7 & 8)					
Forward Diode Drop, Schottky Rectifier	I_F = 50ma		.55	.7	V
	I_F = 500ma		1.1	1.5	V
CURRENT LIMIT SECTION (PIN 4)					
Input bias current	V_{PIN4} = OV		-1	-10	µA
Threshold voltage		0.4	0.5	0.6	V
Delay to outputs	V_{PIN4} = 0 to 1V		100	250	ns
TIMING SECTION (PIN 5)					
Output Off Time		27	30	33	µs
Upper Mono Threshold		6.3	7.0	7.7	V
Lower Mono Threshold		1.9	2.0	2.3	V
HYSTERESIS AMPLIFIER (PINS 7 & 8)					
Input Open Circuit Voltage	Inputs (pins 7 & 8), Open Circuited, T_A= 25°C	7.0	Vcc/2	8.0	V
Input Impedance	T_A = 25°C	23	28	33	kΩ
Hysteresis		26.5	2*Vcc	30.5	V
Delay to Outputs	$V_{PIN7} - V_{PIN8} = V_{CC}$ + 1V		100	300	ns

ELECTRICAL CHARACTERISTICS (cont.)

(Unless otherwise stated, these specifications apply for -55°C≤T_A≤+125°C for UC1725; -25°C≤T_A≤+85°C for UC2725; 0°C≤T_A≤+70°C for UC3725; V_{CC} (pin 3) = 0 to 15V, Rt=10k, C_T=2.2nf, T_A =T_J, pin numbers refer to DIL-8 package.)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
ENABLE SECTION (PIN 6)					
High Level Input Voltage		2.1	1.4		V
Low Level Input Voltage			1.4	.8	V
Input Bias Current			-250	-500	µA
OUTPUT SECTION					
Output Low Level	I_{OUT} = 20mA		0.35	0.5	V
	I_{OUT} = 200mA		0.6	2.5	V
Output High Level	I_{OUT} = -20mA	13	13.5		V
	I_{OUT} = -200mA	12	13.4		V
	V_{CC} = 30V, Iout = -20mA		14	15	V
Rise/Fall Time	C_T = 1nf		30	60	ns
UNDER VOLTAGE LOCKOUT					
UVLO Low Saturation	20mA, V_{CC} = 8V		0.8	1.5	V
Start-up Threshold		11.2	12	12.6	V
Threshold Hysteresis		.75	1.0	1.12	V
TOTAL STANDBY CURRENT					
Supply Current			12	16	ma

APPLICATION AND OPERATION INFORMATION

INPUTS: Figure 1 shows the rectification and detection scheme used in the UC1725 to derive both power and signal information from the input waveform. Vcc is generated by peak detecting the input signal via the internal bridge rectifier and storing on a small external capacitor, C1. Note that this capacitor is also used to bypass high pulse currents in the output stage, and therefore should be placed direclty between pins 1 and 3 using minimal lead lengths.

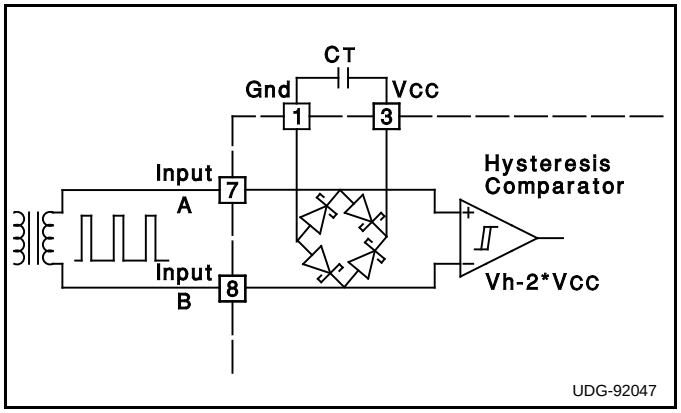


FIGURE 1 - Input Stage

Signal detection is performed by the internal hysteresis comparator which senses the polarity of the input signal as shown in Figure 2. This is accomplished by setting (resetting) the comparator only if the input signal exceeds Vcc (-Vcc). In some cases it may be necessary to add a damping resistor across the transformer secondary to minimize ringing and eliminate false triggering of the hysteresis amplifier as shown in Figure 3.

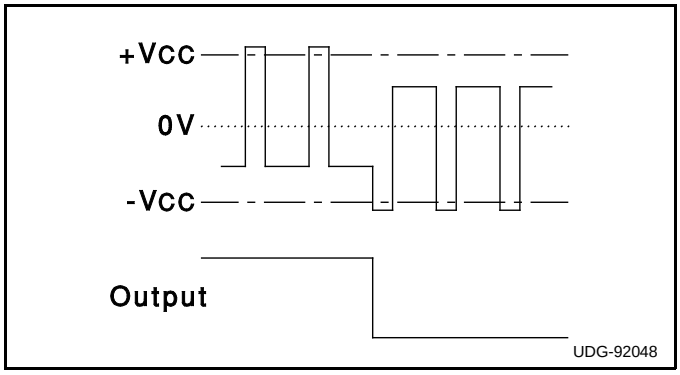


FIGURE 2 - Input Waveform (DIL-8 Pin 7 - Pin 8)

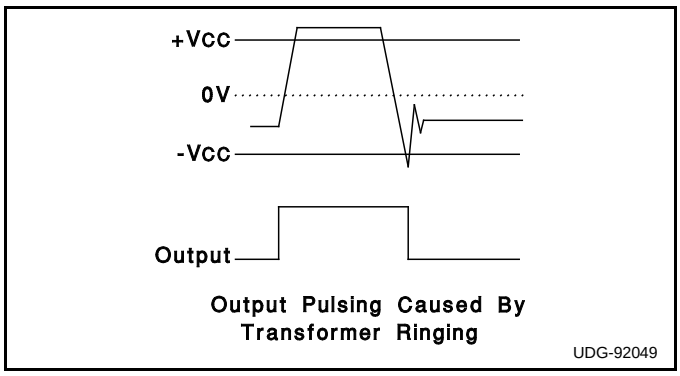


FIGURE 3 - Signal Detection

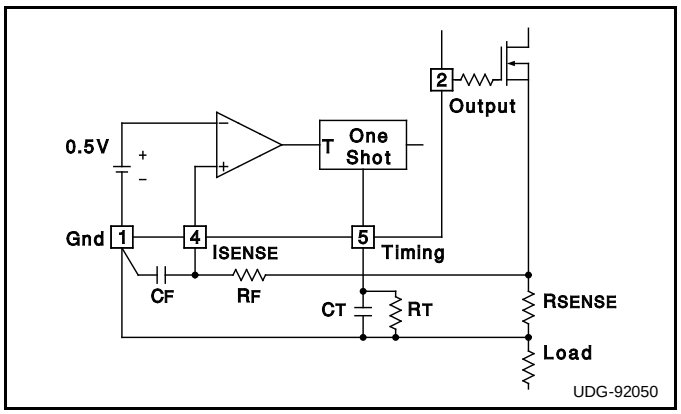


FIGURE 4 - Current Limit

CURRENT LIMIT AND TIMING: Current sensing and shutdown can be implemented directly at the output using the scheme shown in Figure 4. Alternatively, a current transformer can be used in place of RSENSE. A small RC filter in series with the input (pin 4) is generally needed to eliminate the leading edge current spike caused by parasitic circuit capacitances being charged during turn on. Due to the speed of the current sense circuit, it is very important to ground CF directly to Gnd as shown to eliminate false triggering of the one shot caused by ground drops.

One shot timing is easily programmed using an external capacitor and resistor as shown in Figure 4. This, in turn, controls the output off time according to the formula:

$$T_{OFF} = 1.28 \bullet RC.$$

If current limit feature is not required, simply ground pin 4 and leave pin 5 open.

OUTPUT: Gate drive to the power FET is provided by a totem pole output stage capable of sourcing and sinking currents in excess of 1 amp. The undervoltage lockout circuit guarantees that the high level output will never be less than 9 volts. In addition, during undervoltage lockout, the output stage will actively sink current to eliminate the need for an external gate to source resistor. High level output is also clamped to 15 volts. Under high capacitive loading however, the output may overshoot 2 to 3 volts, due to the drivers' inabitlity to switch from full to zero output current instantaneously. In a practical circuit this is not normally a concern. A few ohms of series gate resistance is normally required to prevent parasitic oscillations, and will also eliminate overshoot at the gate.

ENABLE: An enable pin is provided as a fast, digital input that can be used in a number of applications to directly switch the output. Figure 6 shows a simple means of providing a fast, high voltage translation by using a small signal, high voltage transistor in a cascode configuration. Note that the UC1725 is still used to provide power, drive and protection circuitry for the power FET.

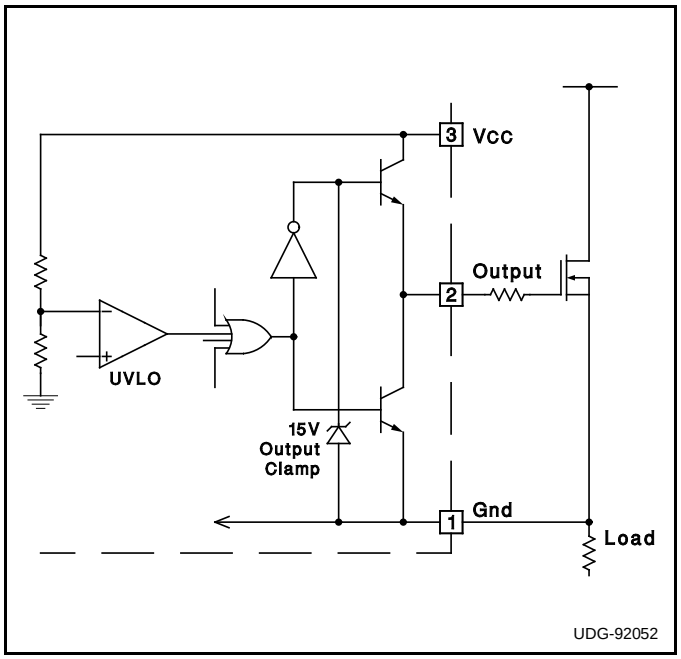


FIGURE 5 - Output Circuit

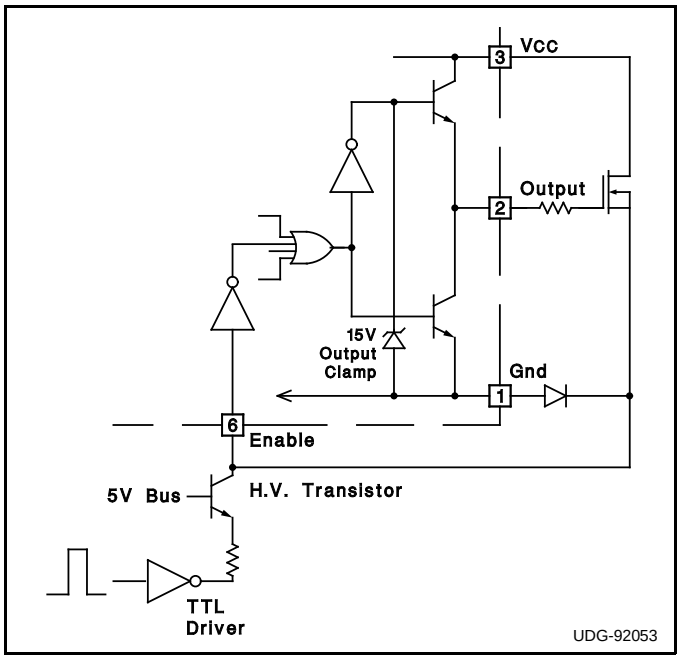


FIGURE 6 - Using Enable Pin as a High Speed Input Path

UNITRODE INTEGRATED CIRCUITS
7 CONTINENTAL BLVD. • MERRIMACK, NH 03054
TEL. (603) 424-2410 • FAX (603) 424-3460

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 JESD46C and to discontinue any product or service per JESD48B. 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 which meet ISO/TS16949 requirements, mainly for automotive use. Components which have not been so designated are neither designed nor intended for automotive use; and TI will not be responsible for any failure of such components to meet such requirements.

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 Mobile 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
Copyright © 2012, Texas Instruments Incorporated