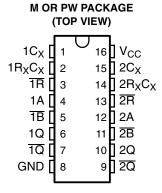
SCLS595A - NOVEMBER 2004 - REVISED APRIL 2008

- Qualified for Automotive Applications
- Retriggerable/Resettable Capability
- Trigger and Reset Propagation Delays Independent of R_X, C_X
- Triggering From the Leading or Trailing Edge
- Q and Q Buffered Outputs Available
- Separate Resets
- Wide Range of Output Pulse Widths
- Schmitt-Trigger Input on A and B Inputs
- Retrigger Time Is Independent of C_X
- Fanout (Over Temperature Range)
 - Standard Outputs ... 10 LSTTL Loads
 - Bus Driver Outputs ... 15 LSTTL Loads

description/ordering information

The CD74HC4538 is a dual retriggerable/resettable precision monostable multivibrator for fixed-voltage timing applications. An external resistor (R_X) and

- Balanced Propagation Delay and Transition
 Times
- Significant Power Reduction Compared to LSTTL Logic ICs
- V_{CC} Voltage = 2 V to 6 V
- High Noise Immunity N_{IL} or N_{IH} = 30% of V_{CC}, V_{CC} = 5 V



external capacitor (C_X) control the timing and accuracy for the circuit. Adjustment of R_X and C_X provides a wide range of output pulse widths from the Q and \overline{Q} terminals. The propagation delay from trigger input-to-output transition and the propagation delay from reset input-to-output transition are independent of R_X and C_X .

Leading-edge triggering (A) and trailing-edge triggering (\overline{B}) inputs are provided for triggering from either edge of the input pulse. An unused A input should be tied to GND and an unused \overline{B} input should be tied to V_{CC} . On power up, the IC is reset. Unused resets and sections must be terminated. In normal operation, the circuit retriggers on the application of each new trigger pulse. To operate in the nontriggerable mode, \overline{Q} is connected to \overline{B} when leading-edge triggering (A) is used, or Q is connected to A when trailing-edge triggering (\overline{B}) is used. The period (τ) can be calculated from τ = (0.7) R_X , C_X ; R_{MIN} is 5 $k\Omega$. C_{MIN} is 0 pF.

ORDERING INFORMATION[†]

T _A	PACKAGE‡		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 125°C	SOIC - M	Tape and reel	CD74HC4538QM96Q1	HC4538M
-40°C to 125°C	TSSOP - PW	Tape and reel	CD74HC4538QPWRQ1	HC4538M

[†] For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at http://www.ti.com.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.



[‡] Package drawings, thermal data, and symbolization are available at http://www.ti.com/packaging.

SCLS595A - NOVEMBER 2004 - REVISED APRIL 2008

FUNCTION TABLE

	INPUTS		OUT	PUTS
R	Α	В	Q	Q
L	Х	Х	L	Н
Х	Н	Χ	L	Н
Х	Χ	L	L	Н
Н	L	\downarrow	Л	Т
Н	\uparrow	Н	Л	ъ

NOTE: H = High voltage level

L = Low voltage level

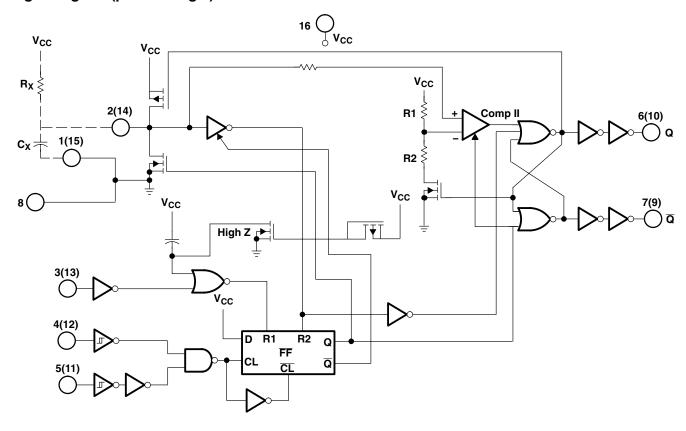
 \uparrow = Transition from low to high level

↓ = Transition from high to low level

☐ = one low-level pulse

X = Irrelevant

logic diagram (positive logic)





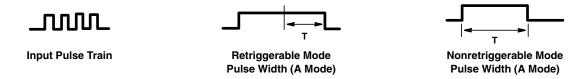
SCLS595A - NOVEMBER 2004 - REVISED APRIL 2008

FUNCTIONAL TERMINAL CONNECTIONS

FUNCTION	V _{CC} TO TERMINAL NUMBER			TO NUMBER	INPUT PI TERMINAL	ULSE TO . NUMBER	OTHER CONNECTIONS	
	MONO ₁	MONO ₂	MONO ₁	MONO ₂	MONO ₁	MONO ₂	MONO ₁	MONO ₂
Leading-edge trigger/retriggerable	3, 5	11, 13			4	12		
Leading-edge trigger/nonretriggerable	3	13			4	12	5–7	11–9
Trailing-edge trigger/retriggerable	3	13	4	12	5	11		
Trailing-edge trigger/nonretriggerable	3	13			5	11	4–6	12–10

NOTES: 1. A retriggerable one-shot multivibrator has an output pulse width that is extended one full time period (T) after application of the last trigger pulse.

2. A nontriggerable one-shot multivibrator has a time period (T) referenced from the application of the first trigger pulse.



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage range, V _{CC} (see Note 1)	0.5 V to 7 V
Input clamp current, I_{IK} ($V_I < -0.5 \text{ V or } V_I > V_{CC} + 0.5 \text{ V}$)	±20 mA
Output clamp current, I_{OK} ($V_O < -0.5 \text{ V}$ or $V_O > V_{CC} + 0.5 \text{ V}$)	±20 mA
Switch current per output pin, I_O ($V_O > -0.5$ V or $V_O < V_{CC} + 0.5$ V)	±25 mA
Continuous current through V _{CC} or GND	±50 mA
Package thermal impedance, θ_{JA} (see Note 2): M package	73°C/W
PW package	108°C/W
Maximum junction temperature, T _J	150°C
Lead temperature (during soldering):	
At distance $1/16 \pm 1/32$ inch $(1,59 \pm 0,79 \text{ mm})$ from case for 10 s max	300°C
Storage temperature range, T _{stg}	-65°C to 150°C

[†] Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. All voltages are referenced to GND, unless otherwise specified.
 - 2. The package thermal impedance is calculated in accordance with JESD 51-7.



SCLS595A - NOVEMBER 2004 - REVISED APRIL 2008

recommended operating conditions (see Note 3)

				MIN	MAX	UNIT
V_{CC}	Supply voltage			2	6	V
			V _{CC} = 2 V	1.5		
V_{IH}	High-level input voltage	V _{CC} = 4.5 V	3.15		V	
		V _{CC} = 6 V	4.2			
			V _{CC} = 2 V		0.5	
V_{IL}	Low-level input voltage	V _{CC} = 4.5 V		1.35	V	
		V _{CC} = 6 V		1.8		
VI	Input voltage	0	V_{CC}	V		
Vo	Output voltage			0	V_{CC}	V
		Reset input	V _{CC} = 2 V	0	1000	
			V _{CC} = 4.5 V	0	500	
١.	langua kanang iki na kaina na na da da UN kina n		V _{CC} = 6 V	0	400	
t _t	Input transition (rise and fall) time		V _{CC} = 2 V	0	Unlimited	ns
		Trigger inputs A or B	V _{CC} = 4.5 V	0	Unlimited	
		V _{CC} = 6 V	0	Unlimited		
R _X	External timing resistor (see Note 4)			5		kΩ
C _X	External timing capacitor (see Note 4)	•	0		F	
T _A	Operating free-air temperature	·	·	-40	125	°C

NOTES: 3. All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, Implications of Slow or Floating CMOS Inputs, literature number SCBA004.

4. The maximum allowable values of R_X and C_X are a function of leakage of capacitor C_X , leakage of the CD74HC4538, and leakage due to board layout and surface resistance. Values of R_X and C_X should be chosen so that the maximum current into pin 2 or pin 14 is 30 mA. Susceptibility to externally induced noise signals may occur for $R_X > 1$ M Ω .



SCLS595A - NOVEMBER 2004 - REVISED APRIL 2008

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST (l _o	v _{cc}	T _A = 25°C		T _A = -40°C TO 85°C		T _A = -40°C TO 125°C		UNIT	
		(mA)		MIN	MAX	MIN	MAX	MIN	MAX		
				2 V	1.9		1.9		1.9		
		CMOS loads	-0.02	4.5 V	4.4		4.4		4.4		
V _{OH}	$V_i = V_{iH}$ or V_{iL}			6 V	5.9		5.9		5.9		V
		TTI locale	-4	4.5 V	3.98		3.84		3.7		
		TTL loads	-5.2	6 V	5.48		5.34		5.2		
	$V_{I} = V_{IH}$ or V_{IL}	CMOS loads		2 V		0.1		0.1		0.1	V
			0.02	4.5 V		0.1		0.1		0.1	
V _{OL}				6 V		0.1		0.1		0.1	
		TTL loads	4	4.5 V		0.26		0.33		0.4	
			5.2	6 V		0.26		0.33		0.4	
	V VOND	A, B, R		6 V		±0.1		±1		±1	•
I _I	$V_I = V_{CC}$ or GND	R _X C _X (see Note 5)		6 V		±0.05		±0.5		±0.5 μΑ	
		Quiescent	0	6 V		8		80		160	μΑ
Icc	$V_I = V_{CC}$ or GND	Active, Q = high, Pins 2 and 14 at V _{CC} /4	0	6 V		0.6		0.8		1	mA
C _{IN}	C _L = 50 pF					10		10		10	pF

NOTE 5: When testing I_{IL} , the Q output must be high. If Q is low (device not triggered), the pullup P device is ON and the low-resistance path from V_{DD} to the test pin causes a current far exceeding the specification.

timing requirements over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)

PARAMETER		V _{CC}	T _A = 25°C			T _A = -40°C TO 85°C		T _A = -40°C TO 125°C		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
		2 V	80			100		120		
t _w Input puls	Input pulse width	4.5 V	16			20		24		ns
		6 V	14			17		20		
		2 V	5			5		5		
t _{su}	Reset setup time	4.5 V	5			5		5		ns
		6 V	5			5		5		
t _{rr}	Retrigger time (see Figure 4)	5 V		175						ns
	Output pulse-width match, same package			±1						%

SCLS595A - NOVEMBER 2004 - REVISED APRIL 2008

switching characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)

PARAMETER	FROM	TO	LOAD	1 V 1		_A = 25°C	;	T _A = -		T _A = -		UNIT				
	(INPUT)	(OUTPUT)	CAPACITANCE		MIN	TYP	MAX	MIN	MAX	MIN	MAX					
			2 V			250		315		375						
	A 15	0 0	C _L = 50 pF	4.5 V			50		63		75					
	A, \overline{B}	Q or Q		6 V			43		54		64					
		C _L = 15 pF	5 V		21											
t _{pd}								2 V			250		315		375	ns
	R Q or Q	0 0	$C_L = 50 pF$	$C_L = 50 pF$	$C_L = 50 pF$	4.5 V			50		63		75			
	К	Q or Q	QorQ		6 V			43		54		64				
			C _L = 15 pF	5 V		21										
				2 V			75		95		110					
t _t	t _t		C _L = 50 pF	4.5 V			15		19		22	ns				
				6 V			13		16		19					
τţ			C _L = 50 pF	3 V	0.64		0.78	0.612	0.812	0.605	0.819	me				
η, ι	τ' $C_L = 50$		OL = 50 pr	5 V	0.63		0.77	0.602	0.798	0.595	0.805	ms				

 $[\]overline{^{\dagger}}$ Output pulse width with R_X = 10 k Ω and C_X = 0.1 μ F

operating characteristics, $V_{CC} = 5 \text{ V}$, $T_A = 25^{\circ}\text{C}$, input t_r , $t_f = 6 \text{ ns}$, $C_L = 15 \text{ pF}$

	PARAMETER	TYP	UNIT
С	Power dissipation capacitance (see Note 6)	136	pF

NOTE 6: C_{pd} is used to determine the dynamic power consumption, per one shot.

 $P_{D} = (C_{pd} + C_{X}) V_{CC}^{2} f_{I} \Sigma (C_{L} V_{CC}^{2} f_{O})$

f_I = input frequency

f_O = output frequency

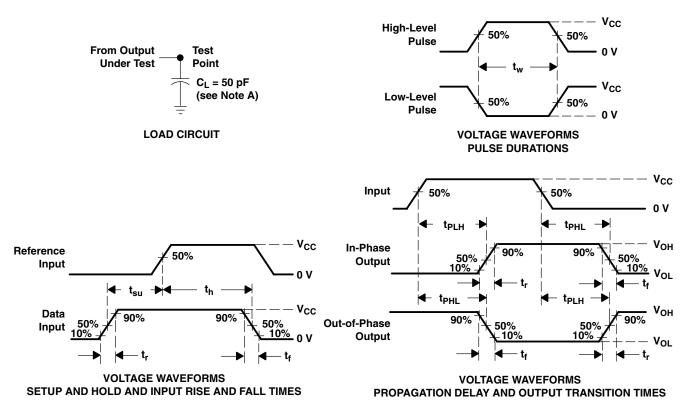
C_L = output load capacitance

C_X = external capacitance

 V_{CC} = supply voltage, assuming $f_I \ll I/\tau$

SCLS595A - NOVEMBER 2004 - REVISED APRIL 2008

PARAMETER MEASUREMENT INFORMATION



NOTES: A. C_L includes probe and test-fixture capacitance.

- B. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics: PRR \leq 1 MHz, $Z_O = 50 \Omega$, $t_r = 6 \text{ ns}$, $t_f = 6 \text{ ns}$.
- C. For clock inputs, f_{max} is measured when the input duty cycle is 50%.
- D. The outputs are measured one at a time, with one input transition per measurement.
- E. t_{PLH} and t_{PHL} are the same as t_{pd}.

Figure 1. Load Circuit and Voltage Waveforms

SCLS595A - NOVEMBER 2004 - REVISED APRIL 2008

TYPICAL CHARACTERISTICS

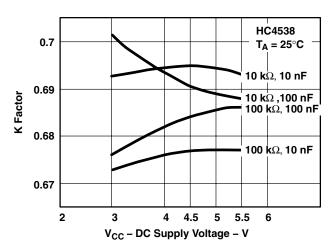


Figure 2. K Factor vs DC Supply Voltage

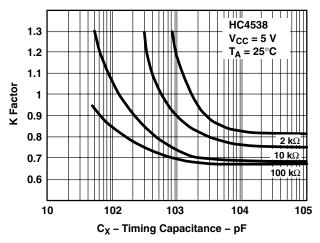


Figure 3. K Factor vs C_X

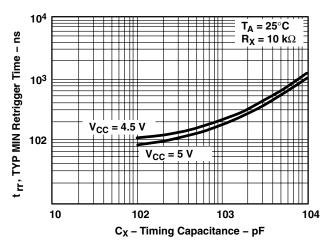


Figure 4. Minimum Retrigger Time vs Timing Capacitance



SCLS595A - NOVEMBER 2004 - REVISED APRIL 2008

TYPICAL APPLICATION DATA

power-down mode

During a rapid power-down condition (as would occur with a power-supply short circuit with a poorly filtered power supply), the energy stored in C_X could discharge into pin 2 or pin 14. To avoid possible device damage in this mode when C_X is $\geq 0.5 \, \mu F$, a protection diode with a 1-A rating or higher (1N5395 or equivalent) and a separate ground return for C_X should be provided (see Figure 5).

An alternate protection method is shown in Figure 6, where a $51-\Omega$ current-limiting resistor is inserted in series with C_X . Note that a small pulse-duration decrease occurs, however, and R_X must be increased appropriately to obtain the originally desired pulse duration.

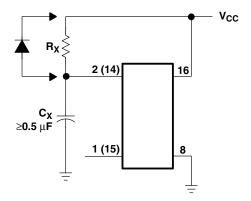


Figure 5. Rapid-Power-Down Protection Circuit

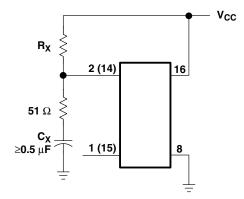


Figure 6. Alternative Rapid-Power-Down Protection Circuit

PACKAGE OPTION ADDENDUM

www.ti.com 23-Mar-2010

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	e Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
CD74HC4538QM96G4Q1	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC4538QM96Q1	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC4538QPWRG4Q1	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC4538QPWRQ1	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF CD74HC4538-Q1:

Catalog: CD74HC4538Military: CD54HC4538

NOTE: Qualified Version Definitions:

- Catalog TI's standard catalog product
- Military QML certified for Military and Defense Applications

D (R-PDS0-G16)

PLASTIC SMALL OUTLINE



- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
- Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
- E. Reference JEDEC MS-012 variation AC.



D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Publication IPC-7351 is recommended for alternate designs.
- D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
- E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



PW (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M—1994.
- B. This drawing is subject to change without notice.
- Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
- Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
- E. Falls within JEDEC MO-153



PW (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Publication IPC-7351 is recommended for alternate designs.
- D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
- E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

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

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI 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 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. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

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

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

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

TI E2E Community Home Page

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265 Copyright © 2011, Texas Instruments Incorporated

e2e.ti.com