

High Speed PWM Controller

FEATURES

- Compatible with Voltage or Current-Mode Topologies
- Practical Operation @ Switching Frequencies to 1.0MHz
- 50ns Propagation Delay to Output
- High Current Totem Pole Output (1.5A peak)
- Wide Bandwidth Error Amplifier
- Fully Latched Logic with Double Pulse Suppression
- Pulse-by-Pulse Current Limiting
- Soft Start/Max. Duty Cycle Control
- Under-Voltage Lockout with Hysteresis
- Low Start Up Current (1.1mA)
- Trimmed Bandgap Reference (5.1V $\pm$ 1%)

DESCRIPTION

The UC1823 family of PWM control ICs is optimized for high frequency switched mode power supply applications. Particular care was given to minimizing propagation delays through the comparators and logic circuitry while maximizing bandwidth and slew rate of the error amplifier. This controller is designed for use in either current-mode or voltage-mode systems with the capability for input voltage feed-forward.

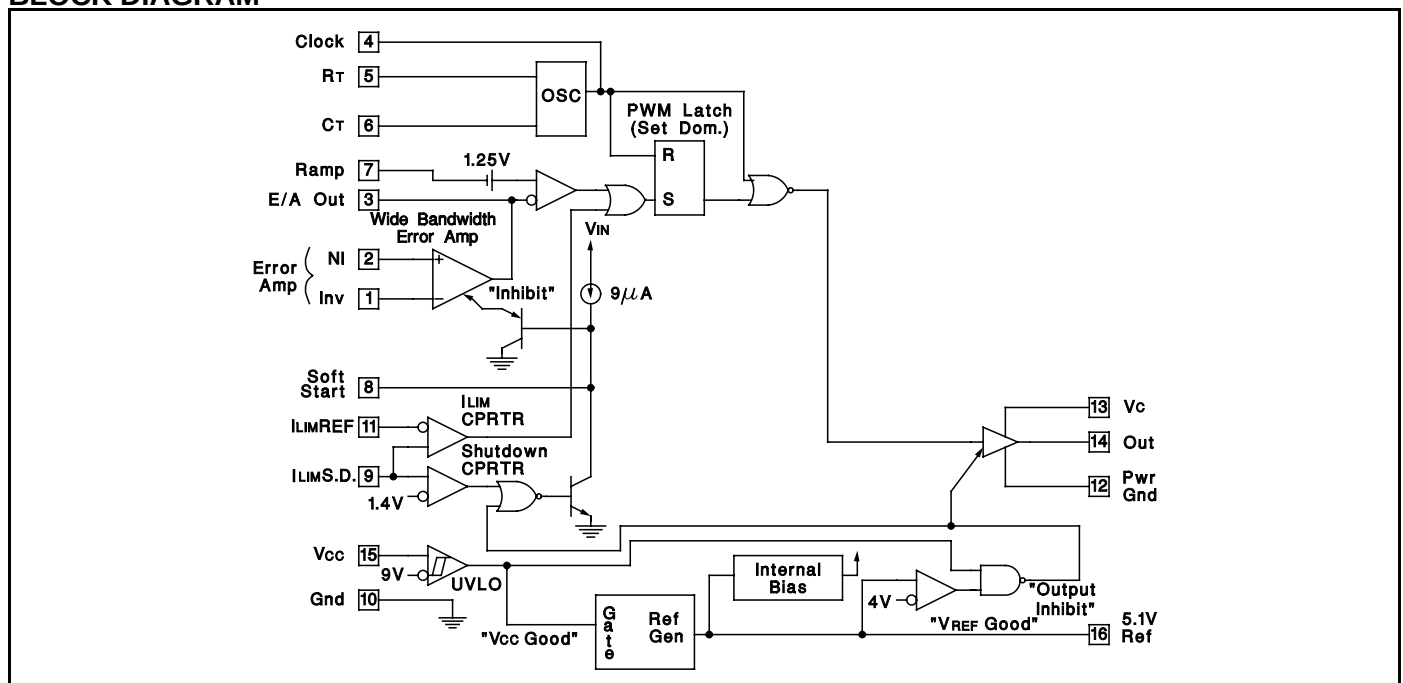
Protection circuitry includes a current limit comparator, a TTL compatible shutdown port, and a soft start pin which will double as a maximum duty cycle clamp. The logic is fully latched to provide jitter free operation and prohibit multiple pulses at the output. An under-voltage lockout section with 800mV of hysteresis assures low start up current. During under-voltage lockout, the output is high impedance. The current limit reference (pin 11) is a DC input voltage to the current limit comparator. Consult specifications for details.

These devices feature a totem pole output designed to source and sink high peak currents from capacitive loads, such as the gate of a power MOSFET. The on state is defined as a high level.

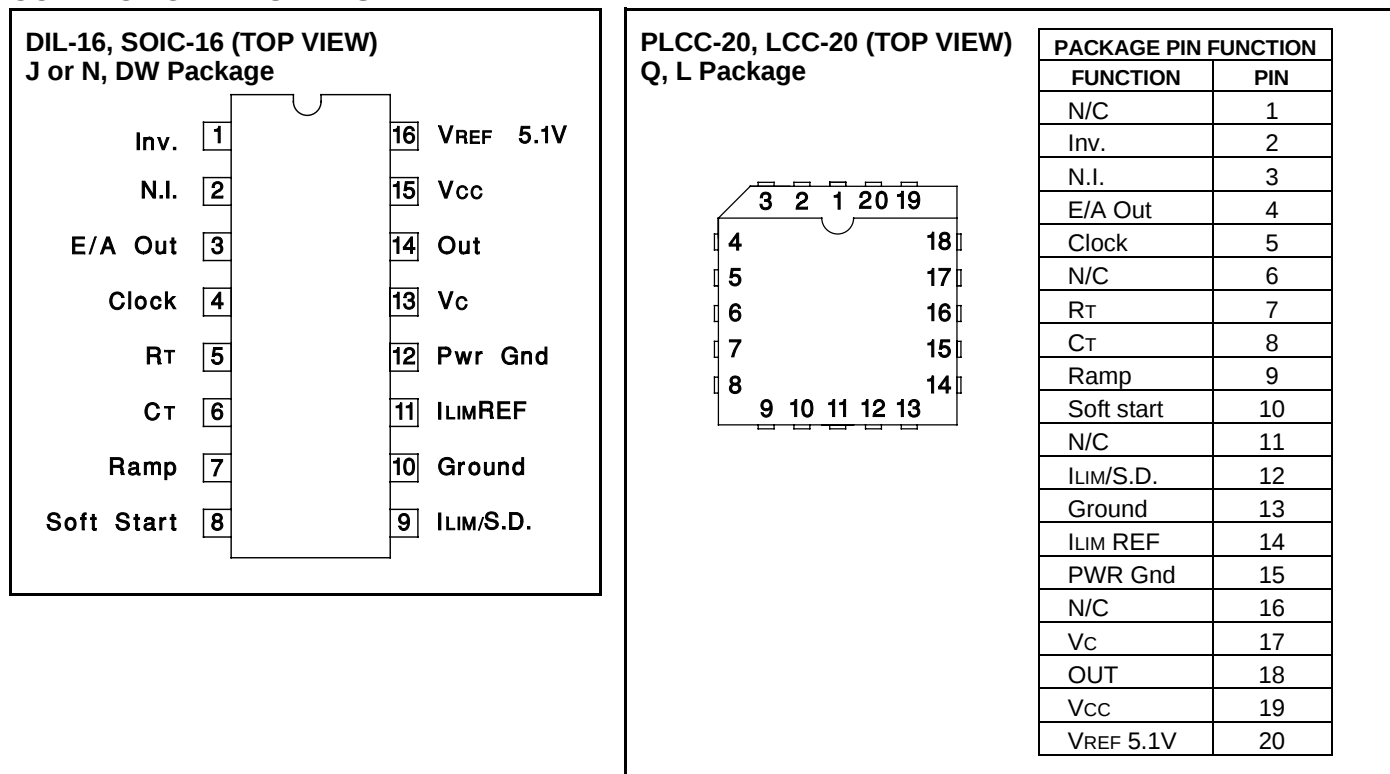
ABSOLUTE MAXIMUM RATINGS

Supply Voltage (Pins 15, 13)	30V	Oscillator Charging Current (Pin 5)	-5mA
Output Current, Source or Sink (Pin14)		Power Dissipation at $T_A = 60^\circ\text{C}$	1W
DC	0.5A	Storage Temperature Range	-65°C to +150°C
Pulse (0.5 μ s)	2.0A	Lead Temperature (Soldering, 10 seconds)	300°C
Analog Inputs (Pins 1, 2, 7, 8, 9, 11)	-0.3V to +6V	Note: All voltages are with respect to ground, Pin 10.	
Clock Output Current (Pin 4)	-5mA	Currents are positive into the specified terminal.	
Error Amplifier Output Current (Pin 3)	5mA	Consult Packaging Section of Databook for thermal limitations and considerations of packages.	
Soft Start Sink Current (Pin 8)	20mA		

BLOCK DIAGRAM



CONNECTION DIAGRAMS



ELECTRICAL CHARACTERISTICS: Unless otherwise noted, these specifications apply for $R_T = 3.65k$, $C_T = 1nF$, $V_{CC} = 15V$, $0^\circ C < T_A < +70^\circ C$ for the UC3823, $-25^\circ C < T_A < +85^\circ C$ for the UC2823, and $-55^\circ C < T_A < +125^\circ C$ for the UC1823, $T_A = T_J$.

PARAMETER	TEST CONDITIONS	UC1823 UC2823			UC3823			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
Reference Section								
Output Voltage	T _J = 25°C, I _o = 1mA	5.05	5.10	5.15	5.00	5.10	5.20	V
Line Regulation	10 < V _{CC} < 30V		2	20		2	20	mV
Load Regulation	1 < I _o < 10mA		5	20		5	20	mV
Temperature Stability*	T _{MIN} < T _A < T _{MAX}		0.2	0.4		0.2	0.4	mV/°C
Total Output Variation*	Line, Load, Temp.	5.00		5.20	4.95		5.25	
Output Noise Voltage*	10Hz < f < 10kHz		50			50		μV
Long Term Stability*	T _J = 125°C, 1000 hrs.		5	25		5	25	mV
Short Circuit Current	V _{REF} =0V	-15	-50	-100	-15	-50	-100	mA
Oscillator Section								
Initial Accuracy*	T _J =25°C	360	400	440	360	400	440	kHz
Voltage Stability*	10 < V _{CC} < 30V		0.2	2		0.2	2	%
Temperature Stability*	T _{MIN} <T _A < T _{MAX}		5			5		%
Total Variation*	Line, Temp.	340		460	340		460	kHz
Clock Out High		3.9	4.5		3.9	4.5		V
Clock Out Low			2.3	2.9		2.3	2.9	V
Ramp Peak*		2.6	2.8	3.0	2.6	2.8	3.0	V
Ramp Valley*		0.7	1.0	1.25	0.7	1.0	1.25	V
Ramp Valley to Peak*		1.6	1.8	2.0	1.6	1.8	2.0	V

* These parameters are guaranteed by design but not 100% tested in production.

ELECTRICAL CHARACTERISTICS: Unless otherwise noted, these specifications apply for $R_T = 3.65k$, $C_T = 1nF$, $V_{CC} = 15V$, $0^\circ C < T_A < +70^\circ C$ for the UC3823, $-25^\circ C < T_A < +85^\circ C$ for the UC2823, and $-55^\circ C < T_A < +125^\circ C$ for the UC1823, $T_A = T_J$.

PARAMETER	TEST CONDITIONS	UC1823 UC2823			UC3823			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
Error Amplifier Section								
Input Offset Voltage				10			15	mV
Input Bias Current			0.6	3		0.6	3	μA
Input Offset Current			0.1	1		0.1	1	μA
Open Loop Gain	1 < Vo < 4V	60	95		60	95		dB
CMRR	1.5 < VCM < 5.5V	75	95		75	95		dB
PSRR	10 < VCC < 30V	85	110		85	110		dB
Output Sink Current	V _{PIN 3} =1V	1	2.5		1	2.5		mA
Output Source Current	V _{PIN 3} = 4V	-0.5	-1.3		-0.5	-1.3		mA
Output High Voltage	I _{PIN 3} = −0.5mA	4.0	4.7	5.0	4.0	4.7	5.0	V
Output Low Voltage	I _{PIN 3} = 1mA	0	0.5	1.0	0	0.5	1.0	V
Unity Gain Bandwidth*		3	5.5		3	5.5		MHz
Slew Rate*		6	12		6	12		V/μS
PWM Comparator Section								
Pin 7 Bias Current	V _{PIN 7} = 0V		-1	-5		-1	-5	μA
Duty Cycle Range		0		80	0		85	%
Pin 3 Zero D.C. Threshold	V _{PIN 7} = 0V	1.1	1.25		1.1	1.25		V
Delay to Output*			50	80		50	80	ns
Soft-Start Section								
Charge Current	V _{PIN 8} = 0.5V	3	9	20	3	9	20	μA
Discharge Current	V _{PIN 8} = 1V	1			1			mA
Current Limit/Shutdown Section								
Pin 9 Bias Current	0 < V _{PIN 9} < 4V			±10			±10	μA
Current Limit Offset	V _{PIN 11} = 1.1V			15			15	mV
Current Limit Common Mode Range (V _{PIN 11})		1.0		1.25	1.0		1.25	V
Shutdown Threshold		1.25	1.40	1.55	1.25	1.40	1.55	V
Delay to Output*			50	80		50	80	ns
Output Section								
Output Low Level	I _{OUT} = 20mA		0.25	0.40		0.25	0.40	V
	I _{OUT} = 200mA		1.2	2.2		1.2	2.2	V
Output High Level	I _{OUT} = −20mA	13.0	13.5		13.0	13.5		V
	I _{OUT} = −200mA	12.0	13.0		12.0	13.0		V
Collector Leakage	V _C = 30V		100	500		100	500	μA
Rise/Fall Time*	C _L = 1nF		30	60		30	60	ns
Under-Voltage Lockout Section								
Start Threshold		8.8	9.2	9.6	8.8	9.2	9.6	V
UVLO Hysteresis		0.4	0.8	1.2	0.4	0.8	1.2	V
Supply Current								
Start Up Current	V _{CC} = 8V		1.1	2.5		1.1	2.5	mA
I _{CC}	V _{PIN 1} , V _{PIN 7} , V _{PIN 9} =0V, V _{PIN 2} = 1V		22	33		22	33	mA

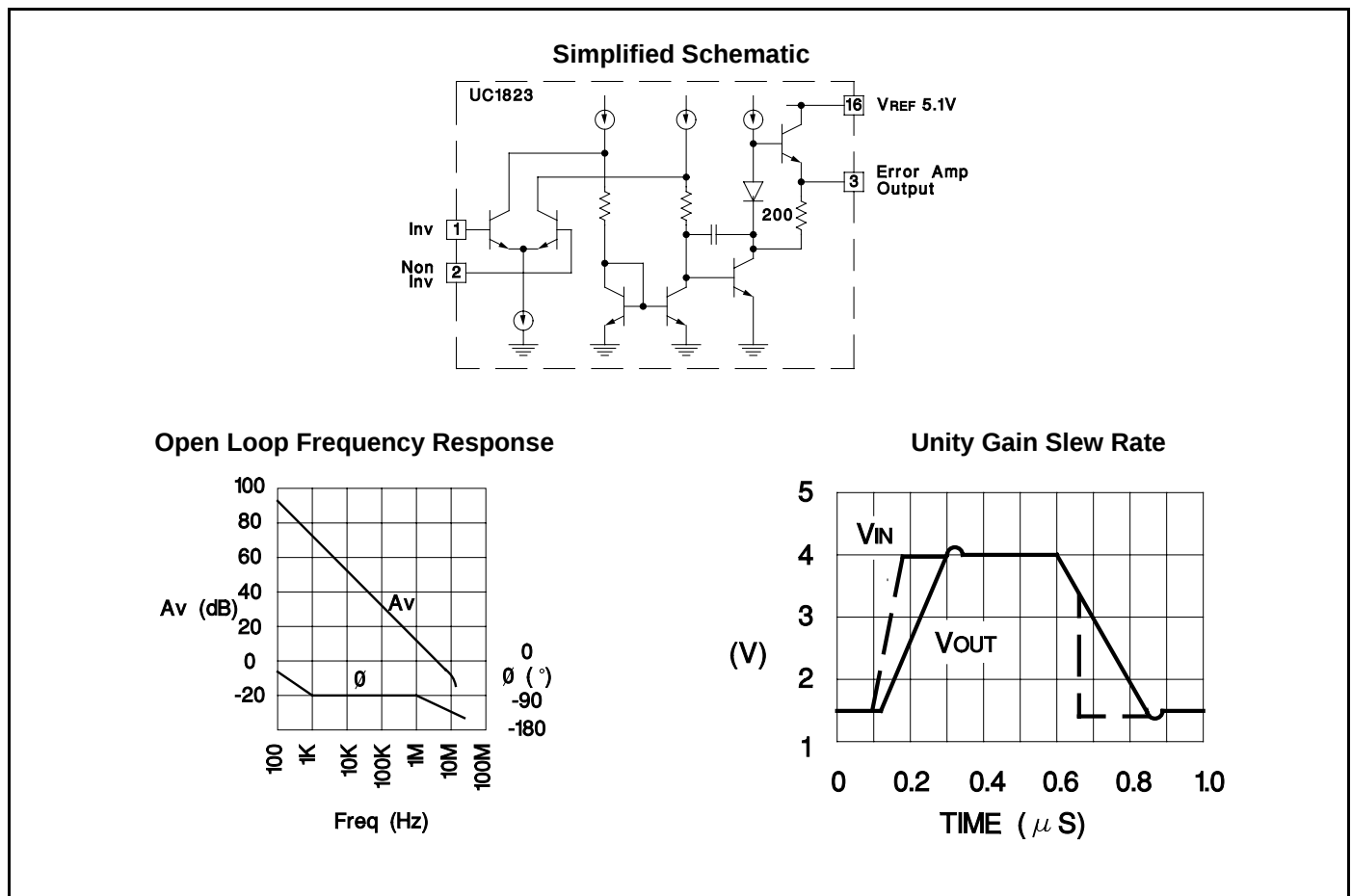
* These parameters are guaranteed by design but not 100% tested in production.

UC1823 PRINTED CIRCUIT BOARD LAYOUT CONSIDERATIONS

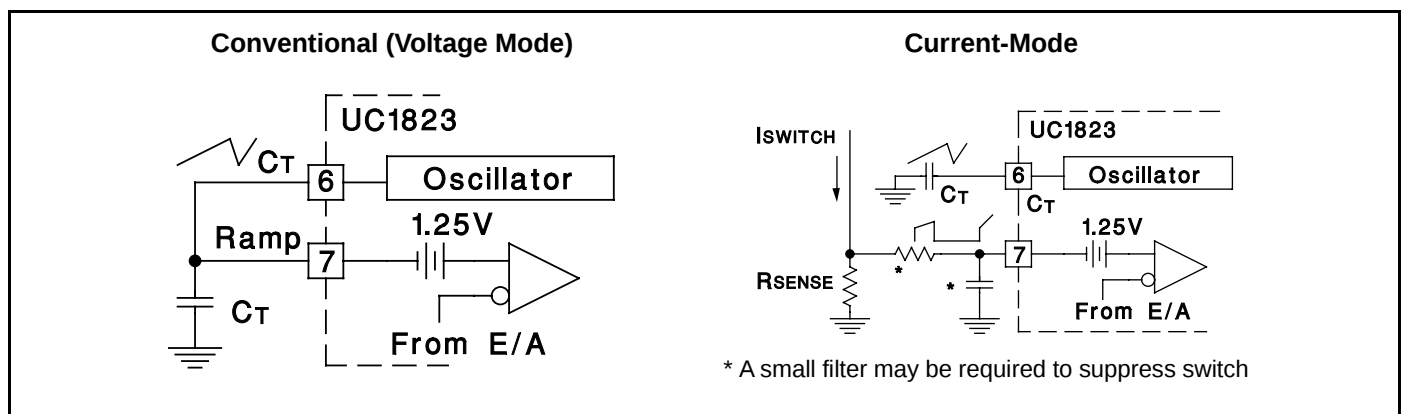
High speed circuits demand careful attention to layout and component placement. To assure proper performance of the UC1823, follow these rules. 1) Use a ground plane. 2) Damp or clamp parasitic inductive kick energy from the gate of driven MOSFET. Don't allow the output pins to ring below ground. A series gate resistor or a shunt 1 Amp Schottky diode at the output pin will serve

this purpose. 3) Bypass V_{CC} , V_C , and V_{REF} . Use $0.1\mu F$ monolithic ceramic capacitors with low equivalent series inductance. Allow less than 1 cm of total lead length for each capacitor between the bypassed pin and the ground plane. 4) Treat the timing capacitor, C_T , like a bypass capacitor.

ERROR AMPLIFIER CIRCUIT

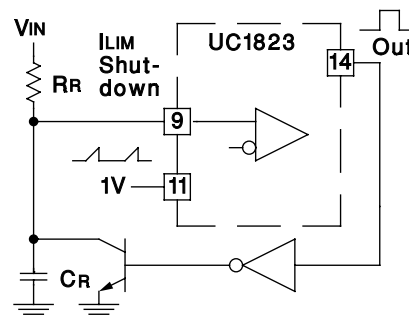


PWM APPLICATIONS



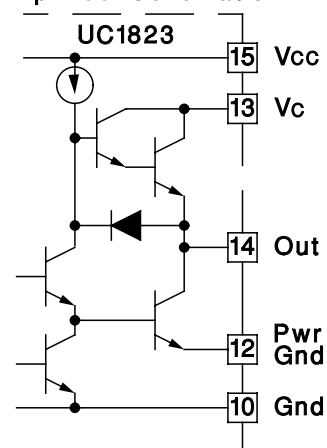
CONSTANT VOLT-SECOND CLAMP CIRCUIT

The circuit shown here will achieve a constant volt-second product clamp over varying input voltages. The ramp generator components, R_T and C_R are chosen so that the ramp at Pin 9 crosses the 1V threshold at the same time the desired maximum volt-second product is reached. The delay through the inverter must be such that the ramp capacitor can be completely discharged during the minimum deadtime.

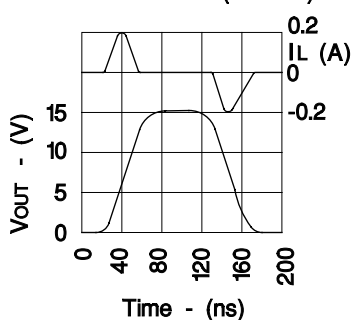


OUTPUT SECTION

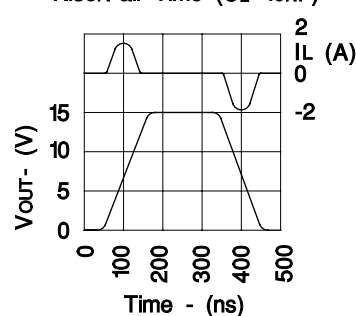
Simplified Schematic



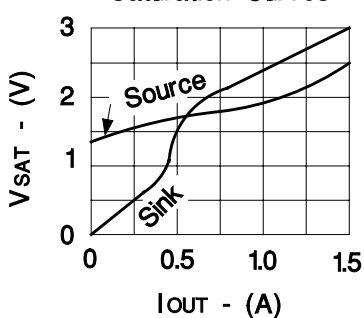
Rise/Fall Time ($C_L=1nF$)



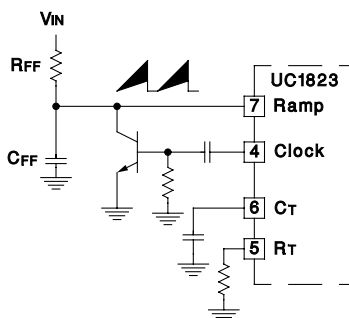
Rise/Fall Time ($C_L=10nF$)



Saturation Curves



FEED FORWARD TECHNIQUE FOR OFF-LINE VOLTAGE MODE APPLICATION



IMPORTANT NOTICE

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

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

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. 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 of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.