



Resonant Fluorescent Lamp Driver

FEATURES

- 1 μ A ICC when Disabled
- PWM Control for LCD Supply
- Zero Voltage Switched (ZVS) on Push-Pull Drivers
- Open Lamp Detect Circuitry
- 4.5V to 20V Operation
- Non-saturating Transformer Topology
- Smooth 100% Duty Cycle on Buck PWM and 0% to 95% on Flyback PWM

DESCRIPTION

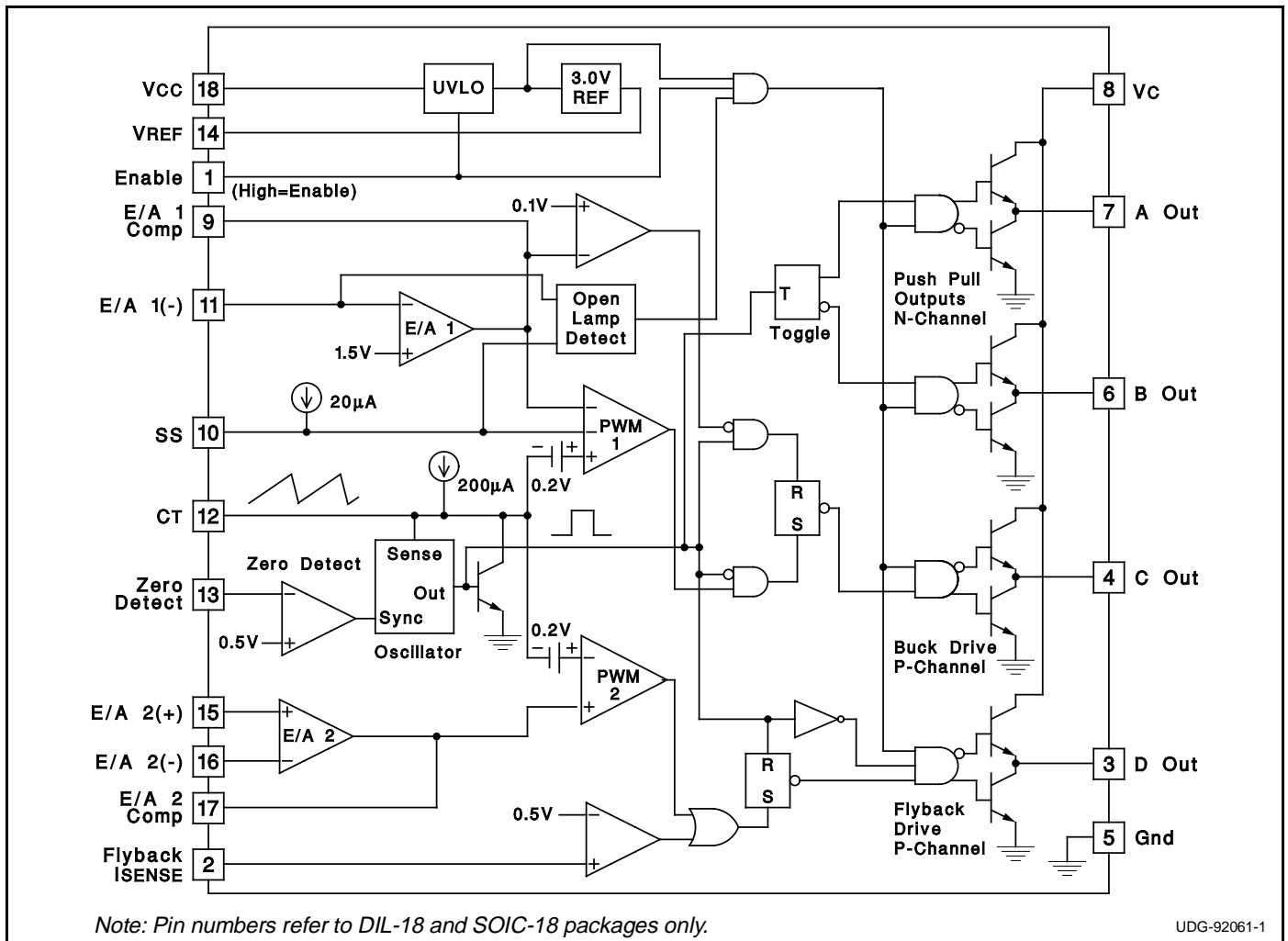
The UC1871 Family of IC's is optimized for highly efficient fluorescent lamp control. An additional PWM controller is integrated on the IC for applications requiring an additional supply, as in LCD displays. When disabled the IC draws only 1 μ A, providing a true disconnect feature, which is optimum for battery powered systems. The switching frequency of all outputs are synchronized to the resonant frequency of the external passive network, which provides Zero Voltage Switching on the Push-Pull drivers.

Soft-Start and open lamp detect circuitry have been incorporated to minimize component stress. An open lamp is detected on the completion of a soft-start cycle.

The Buck controller is optimized for smooth duty cycle control to 100%, while the flyback control ensures a maximum duty cycle of 95%.

Other features include a precision 1% reference, under voltage lockout, flyback current limit, and accurate minimum and maximum frequency control.

BLOCK DIAGRAM



UDG-92061-1

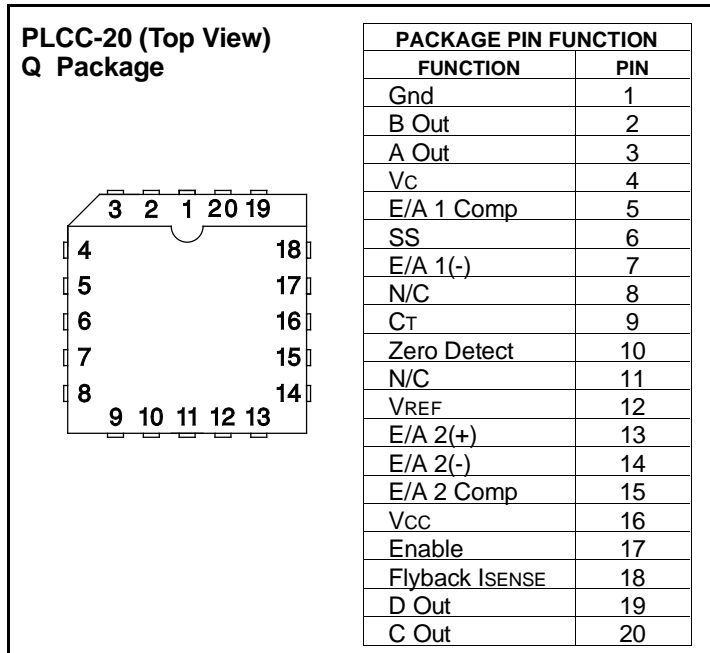
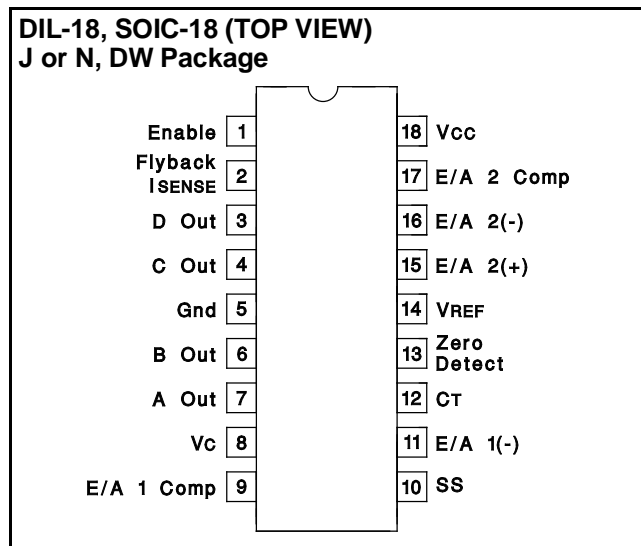
ABSOLUTE MAXIMUM RATINGS

Analog Inputs	-0.3 to +10V
Vcc, Vc Voltage	+20V
Zero Detect Input Current	
High Impedance Source	+10mA
Zero Detect	
Low Impedance Source	+20V
Power Dissipation at TA = 25°C	1W
Storage Temperature	-65°C to +150°C
Lead Temperature	300°C

Note 1: Currents are positive into, negative out of the specified terminal.

Note 2: Consult Packaging Section of Databook for thermal limitations and considerations of package.

CONNECTION DIAGRAMS



ELECTRICAL CHARACTERISTICS Unless otherwise stated, these parameters apply for TA = -55°C to +125°C for the UC1871; -25°C to +85°C for the UC2871; 0°C to +70°C for the UC3871; Vcc = 5V, Vc = 15V, VENABLE = 5V, CT = 1nF, Zero Det = 1V.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Reference Section					
Output Voltage	TJ=25°C	2.963	3.000	3.037	V
	Overtemp	2.940	3.000	3.060	V
Line Regulation	VCC = 4.75V to 18V			10	mV
Load Regulation	Io=0 to -5mA			10	mV
Oscillator Section					
Free Running Freq	TJ=25°C	57	68	78	kHz
Max Sync Frequency	TJ=25°C	160	200	240	kHz
Charge Current	VCT = 1.5V	180	200	220	µA
Voltage Stability				2	%
Temperature Stability			4	8	%
Zero Detect Threshold		0.46	0.5	0.56	V
Error Amp 1 Section					
Input Voltage	Vo = 2V	1.445	1.475	1.505	V
Input Bias Current			-0.4	-2	µA
Open Loop Gain	Vo = 0.5 to 3V	65	90		dB
Output High	VEA(-) = 1.3V	3.1	3.5	3.9	V
Output Low	VEA(-) = 1.7V		0.1	0.2	V
Output Source Current	VEA(-) = 1.3V, Vo = 2V	-350	-500		µA
Output Sink Current	VEA(-) = 1.7V, Vo = 2V	10	20		mA
Common Mode Range		0		VIN-1V	V
Unity Gain Bandwidth	TJ = 25°C (Note 4)		1		MHz
Maximum Source Impedance	Note 5			100k	Ω

**ELECTRICAL
CHARACTERISTICS (cont.)**

Unless otherwise stated, these parameters apply for $T_A = -55^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ for the UC1871; -25°C to $+85^{\circ}\text{C}$ for the UC2871; 0°C to $+70^{\circ}\text{C}$ for the UC3871; $V_{CC} = 5\text{V}$, $V_C = 15\text{V}$, $V_{ENABLE} = 5\text{V}$, $C_T = 1\text{nF}$, Zero Det = 1V.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Open Lamp Detect Section					
Soft Start Threshold	$V_{EA(-)} = 0\text{V}$	2.9	3.4	3.8	V
Error Amp Threshold	$V_{SS} = 4.2\text{V}$	0.7	1.0	1.3	V
Soft Start Current	$V_{SS} = 2\text{V}$	10	20	40	μA
Error Amp 2 Section					
Input Offset Voltage	$V_O = 2\text{V}$		0	10	mV
Input Bias Current			-0.2	-1	μA
Input Offset Current				0.5	μA
Open Loop Gain	$V_O = 0.5$ to 3V	65	90		dB
Output High	$V_{ID} = 100\text{mV}$, $V_O = 2\text{V}$	3.6	4	4.4	V
Output Low	$V_{ID} = -100\text{mV}$, $V_O = 2\text{V}$		0.1	0.2	V
Output Source Current	$V_{ID} = 100\text{mV}$, $V_O = 2\text{V}$	-350	-500		μA
Output Sink Current	$V_{ID} = -100\text{mV}$, $V_O = 2\text{V}$	10	20		mA
Common Mode Range		0		$V_{IN}-2\text{V}$	V
Unity Gain Bandwidth	$T_J = 25^{\circ}\text{C}$ (Note 4)		1		MHz
Isense Section					
Threshold		0.475	0.525	0.575	V
Output Section					
Output Low Level	$I_{OUT} = 0$, Outputs A and B		0.05	0.2	V
	$I_{OUT} = 10\text{mA}$		0.1	0.4	V
	$I_{OUT} = 100\text{mA}$		1.5	2.2	V
Output High Level	$I_{OUT} = 0$, Outputs C and D	14.7	14.9		V
	$I_{OUT} = -10\text{mA}$	13.5	14.3		V
	$I_{OUT} = -100\text{mA}$	12.5	13.5		V
Rise Time	$T_J = 25^{\circ}\text{C}$, $C_I = 1\text{nF}$ (Note 4)		30	80	ns
Fall Time	$T_J = 25^{\circ}\text{C}$, $C_I = 1\text{nF}$ (Note 4)		30	80	ns
Output Dynamics					
Out A and B Duty Cycle		48	49.9	50	%
Out C Max Duty Cycle	$V_{EA1(-)} = 1\text{V}$	100			%
Out C Min Duty Cycle	$V_{EA1(-)} = 2\text{V}$			0	%
Out D Max Duty Cycle	$V_{EA2(+)}- V_{EA2(-)} = 100\text{mV}$		92	96	%
Out D Min Duty Cycle	$V_{EA2(+)}- V_{EA2(-)} = -100\text{mV}$			0	%
Under Voltage Lockout Section					
Start-Up Threshold		3.7	4.2	4.5	V
Hysteresis		120	200	280	mV
Enable Section					
Input High Threshold		2			V
Input low Threshold				0.8	V
Input Current	$V_{ENABLE} = 5\text{V}$		150	400	μA
Supply Current Section					
VCC Supply Current	$V_{CC} = 20\text{V}$		8	14	mA
VC Supply Current	$V_C=20\text{V}$		7	12	mA
ICC Disabled	$V_{CC} = 20\text{V}$, $V_{ENABLE} = 0\text{V}$		1	10	μA

Note 3: Unless otherwise specified, all voltages are with respect to ground.

Currents are positive into, and negative out of the specified terminal.

Note 4: Guaranteed by design but not 100% tested in production.

Note 5: Impedance below specified maximum guarantees proper operation of the Open Lamp Detect.

TYPICAL APPLICATION

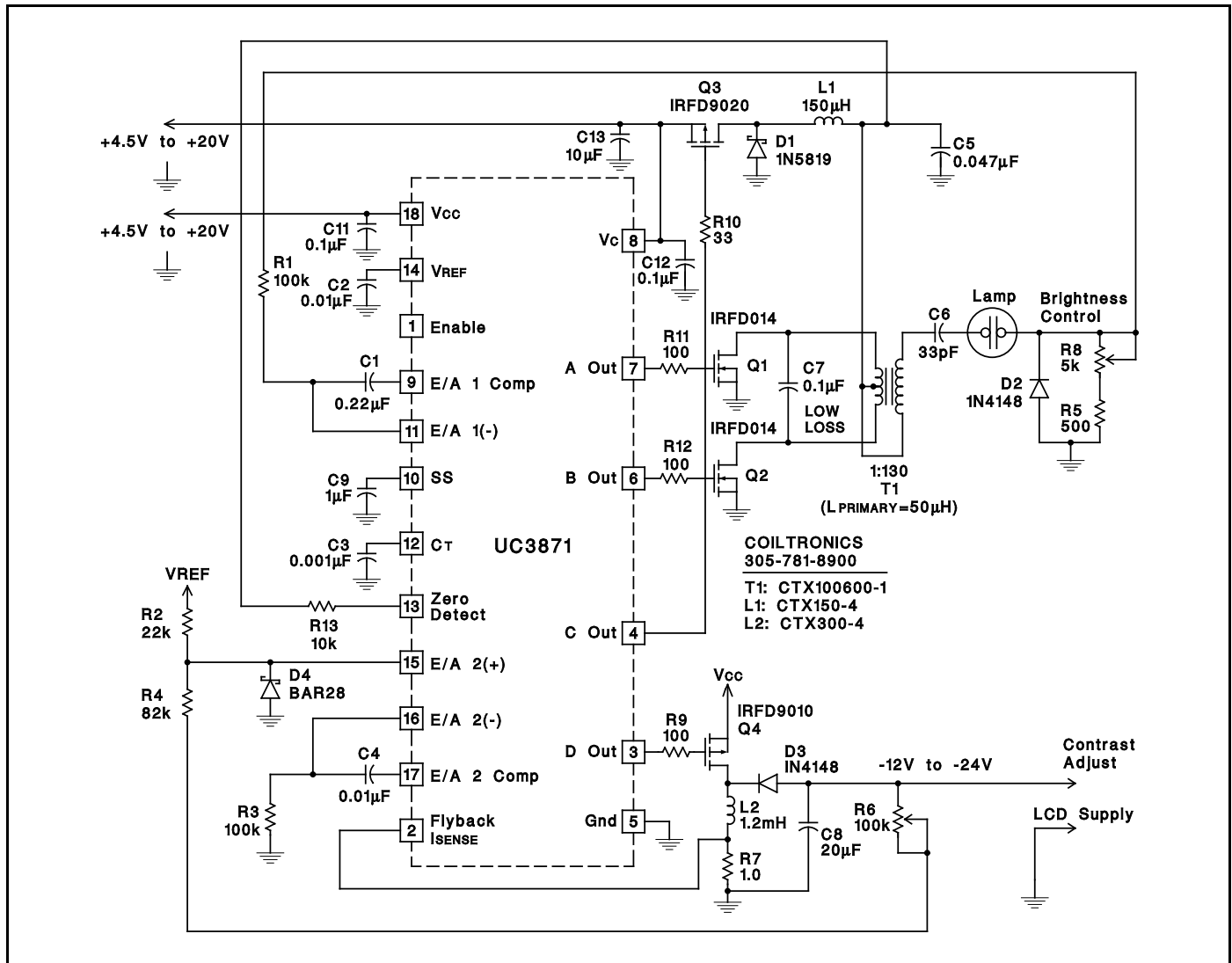


Figure 1

APPLICATION INFORMATION

Figure 1 shows a complete application circuit using the UC3871 Resonant Fluorescent lamp and LCD driver. The IC provides all drive, control and housekeeping functions to implement CCFL and LCD converters. The buck output voltage (transformer center-tap) provides the zero crossing and synchronization signal. The LCD supply modulator is also synchronized to the resonant tank.

The buck modulator drives a P-channel MOSFET directly, and operates over a 0-100% duty-cycle range. The modulation range includes 100%, allowing operation with minimal headroom. The LCD supply modulator also directly drives a P-channel MOSFET, but it's duty-cycle is limited to 95% to prevent flyback supply foldback.

The oscillator and synchronization circuitry are shown in Figure 2. The oscillator is designed to synchronize over a 3:1 frequency range. In an actual application however, the frequency range is only about 1.5:1. A zero detect

comparator senses the primary center-tap voltage, generating a synchronization pulse when the resonant waveform falls to zero. The actual threshold is 0.5 volts, providing a small amount of anticipation to offset propagation delay.

The synchronization pulse width is the time that the 4mA current sink takes to discharge the timing capacitor to 0.1 volts. This pulse width sets the LCD supply modulator minimum off time, and also limits the minimum linear control range of the buck modulator. The 200µA current source charges the capacitor to a maximum of 3 volts. A comparator blanks the zero detect signal until the capacitor voltage exceeds 1 volt, preventing multiple synchronization pulse generation and setting the maximum frequency. If the capacitor voltage reaches 3 volts (a zero detection has not occurred) an internal clock pulse is generated to limit the minimum frequency.

APPLICATION INFORMATION (cont.)

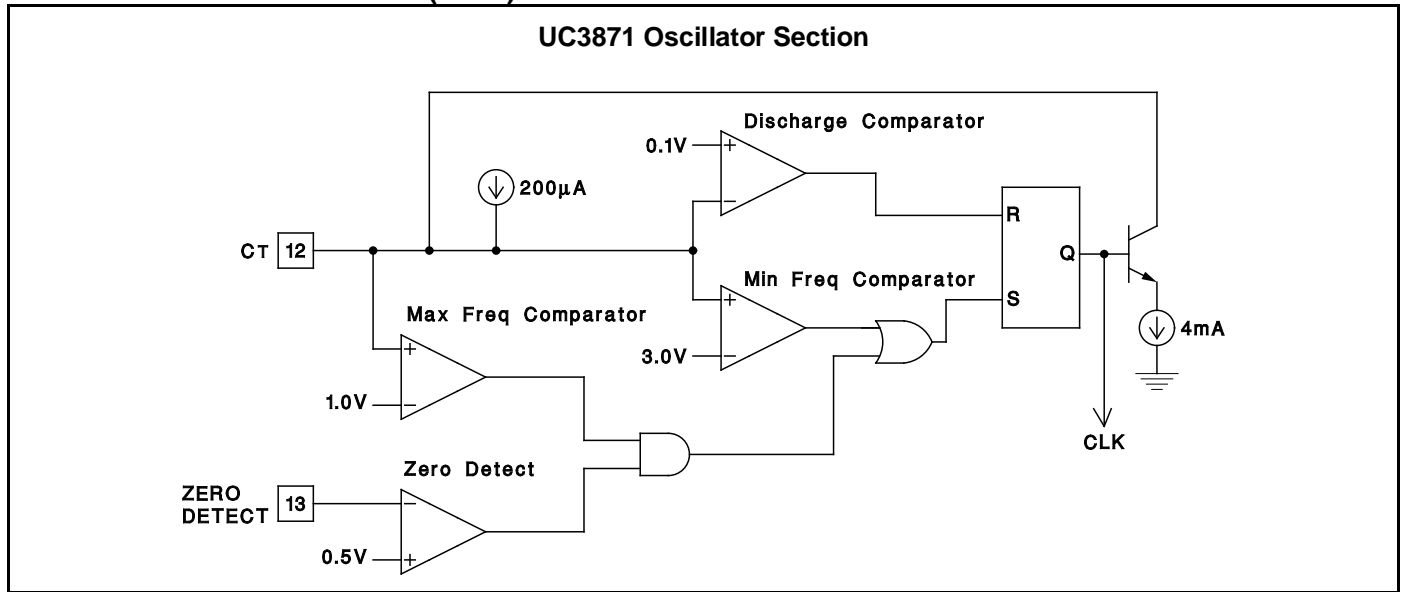


Figure 2

A unique protection feature incorporated in the UC3871 is the Open Lamp Detect circuit. An open lamp interrupts the current feedback loop and causes very high secondary voltage. Operation in this mode will usually breakdown the transformer's insulation, causing permanent damage to the converter. The open lamp detect circuit, shown in Figure 3 senses the lamp current feedback signal at the error amplifiers input, and shuts down the outputs if insufficient signal is present. Soft-start circuitry limits initial turn-on currents and blanks the open lamp detect signal.

Other features are included to minimize external circuitry

requirements. A logic level enable pin shuts down the IC, allowing direct connection to the battery. During shutdown, the IC typically draws less than 1µA. The UC3871, operating from 4.5V to 20V, is compatible with almost all battery voltages used in portable computers. Under-voltage lockout circuitry disables operation until sufficient supply voltage is available, and a 1% voltage reference insures accurate operation. Both inputs to the LCD supply error amplifier are uncommitted, allowing positive or negative supply loop closure without additional circuitry. The LCD supply modulator also incorporates cycle-by-cycle current limiting for added protection.

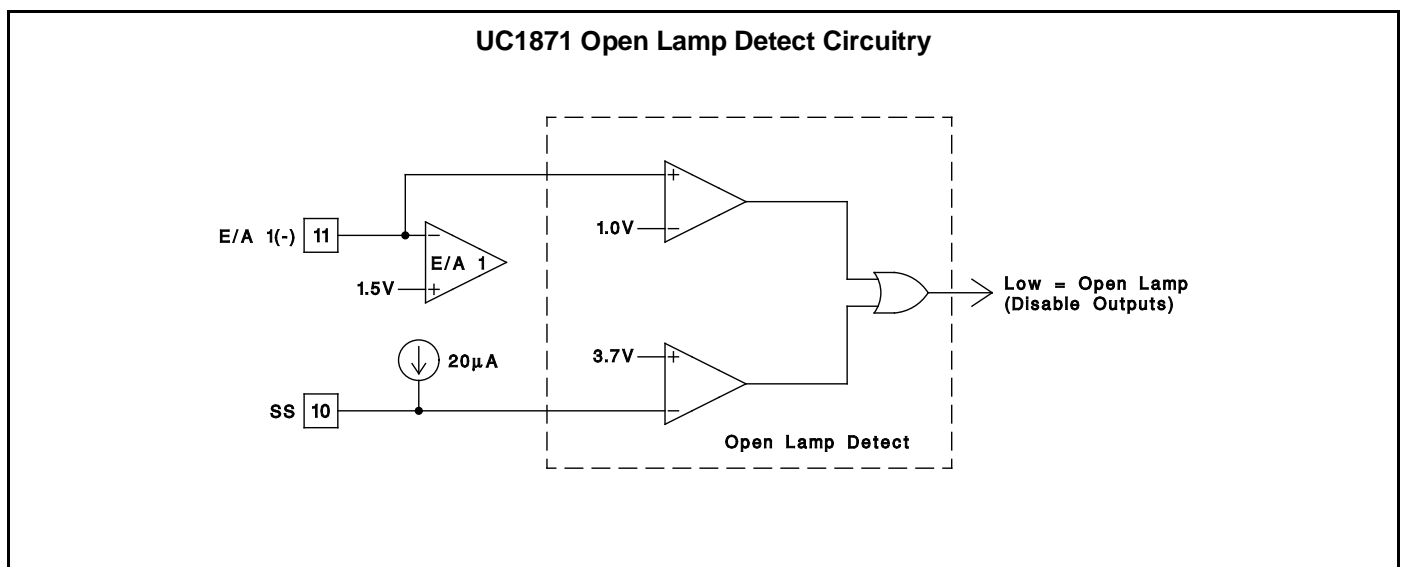


Figure 3

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
UC2871DW	ACTIVE	SOIC	DW	18	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	UC2871DW	Samples
UC2871DWG4	ACTIVE	SOIC	DW	18	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	UC2871DW	Samples
UC3871DW	ACTIVE	SOIC	DW	18	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	0 to 70	UC3871DW	Samples
UC3871DWG4	ACTIVE	SOIC	DW	18	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	0 to 70	UC3871DW	Samples
UC3871DWTR	ACTIVE	SOIC	DW	18	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	0 to 70	UC3871DW	Samples

(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.

OBSELETE: 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.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

⁽⁶⁾ Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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.

TAPE AND REEL INFORMATION



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
UC3871DWTR	SOIC	DW	18	2000	330.0	24.4	10.9	12.0	2.7	12.0	24.0	Q1

TAPE AND REEL BOX DIMENSIONS

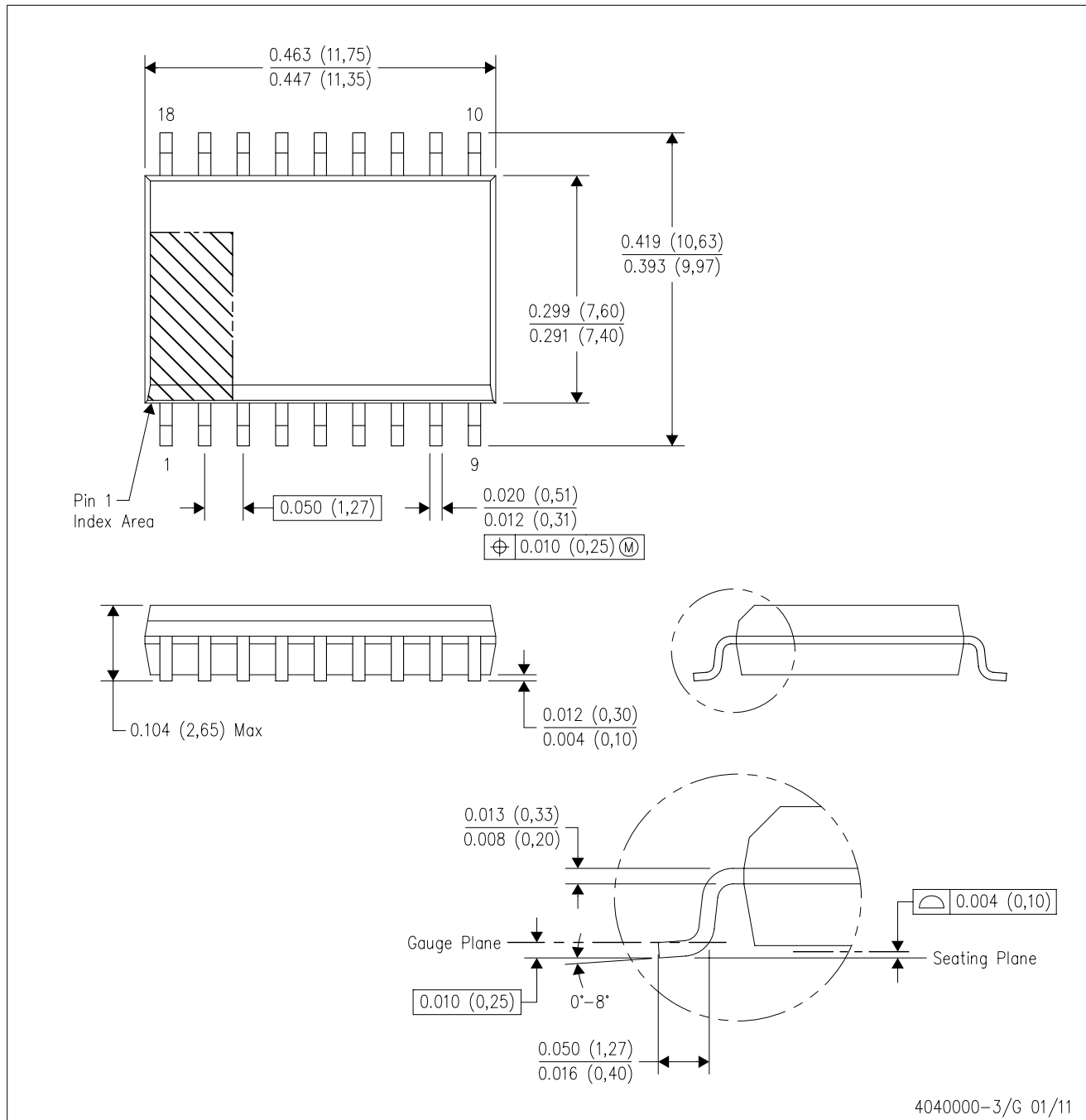


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
UC3871DWTR	SOIC	DW	18	2000	367.0	367.0	45.0

DW (R-PDSO-G18)

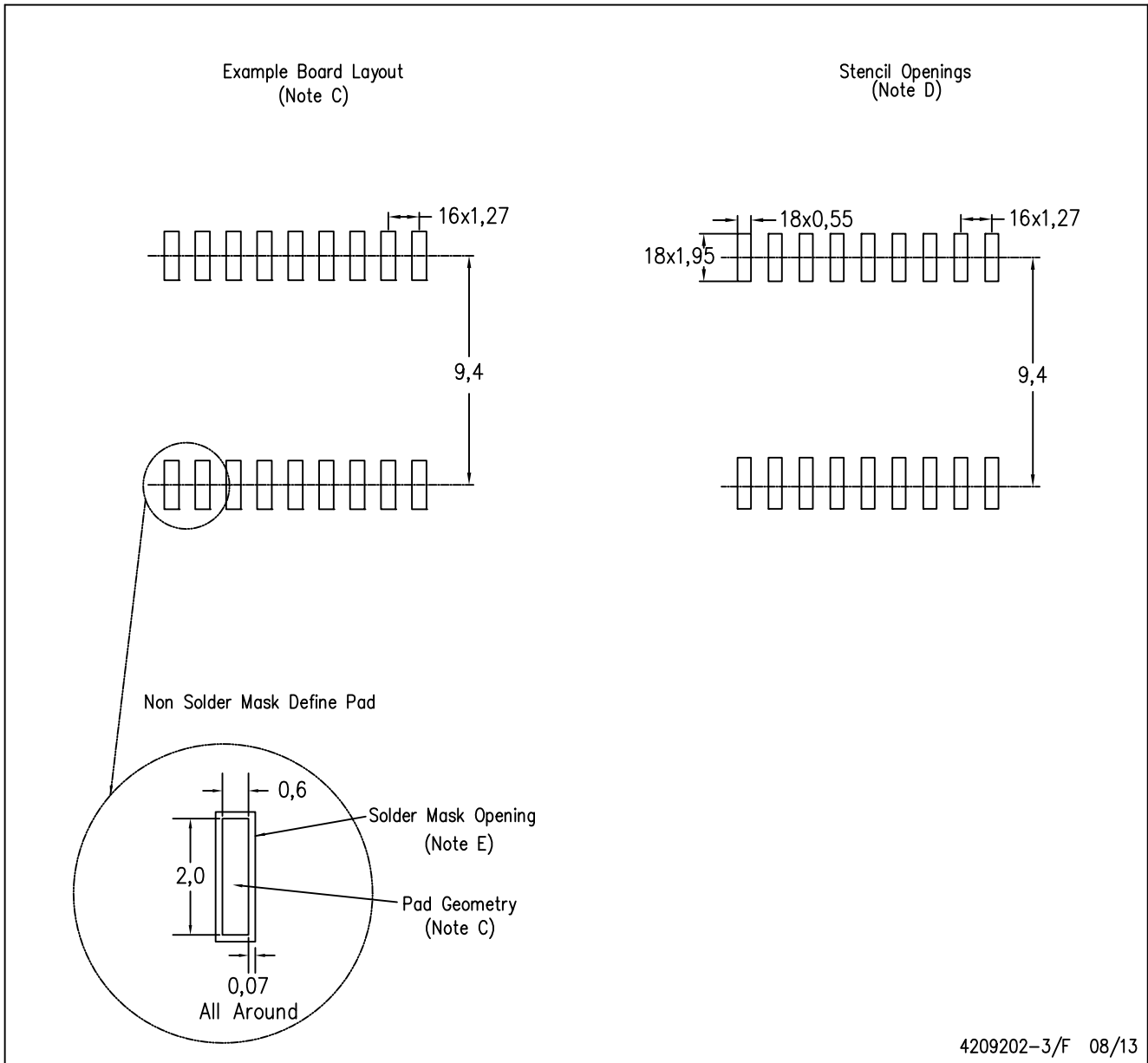
PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M-1994.
 - This drawing is subject to change without notice.
 - Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - Falls within JEDEC MS-013 variation AB.

DW (R-PDSO-G18)

PLASTIC SMALL OUTLINE



4209202-3/F 08/13

- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Refer to IPC7351 for alternate board design.
 - 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
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

IMPORTANT NOTICE

Texas Instruments Incorporated (TI) reserves 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.

TI's published terms of sale for semiconductor products (<http://www.ti.com/sc/docs/stdterms.htm>) apply to the sale of packaged integrated circuit products that TI has qualified and released to market. Additional terms may apply to the use or sale of other types of TI products and services.

Reproduction of significant portions of TI information in TI 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 reproduced 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.

Buyers and others who are developing systems that incorporate TI products (collectively, "Designers") understand and agree that Designers remain responsible for using their independent analysis, evaluation and judgment in designing their applications and that Designers have full and exclusive responsibility to assure the safety of Designers' applications and compliance of their applications (and of all TI products used in or for Designers' applications) with all applicable regulations, laws and other applicable requirements. Designer represents that, with respect to their applications, Designer has all the necessary expertise to create and implement safeguards that (1) anticipate dangerous consequences of failures, (2) monitor failures and their consequences, and (3) lessen the likelihood of failures that might cause harm and take appropriate actions. Designer agrees that prior to using or distributing any applications that include TI products, Designer will thoroughly test such applications and the functionality of such TI products as used in such applications.

TI's provision of technical, application or other design advice, quality characterization, reliability data or other services or information, including, but not limited to, reference designs and materials relating to evaluation modules, (collectively, "TI Resources") are intended to assist designers who are developing applications that incorporate TI products; by downloading, accessing or using TI Resources in any way, Designer (individually or, if Designer is acting on behalf of a company, Designer's company) agrees to use any particular TI Resource solely for this purpose and subject to the terms of this Notice.

TI's provision of TI Resources does not expand or otherwise alter TI's applicable published warranties or warranty disclaimers for TI products, and no additional obligations or liabilities arise from TI providing such TI Resources. TI reserves the right to make corrections, enhancements, improvements and other changes to its TI Resources. TI has not conducted any testing other than that specifically described in the published documentation for a particular TI Resource.

Designer is authorized to use, copy and modify any individual TI Resource only in connection with the development of applications that include the TI product(s) identified in such TI Resource. NO OTHER LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE TO ANY OTHER TI INTELLECTUAL PROPERTY RIGHT, AND NO LICENSE TO ANY TECHNOLOGY OR INTELLECTUAL PROPERTY RIGHT OF TI OR ANY THIRD PARTY IS GRANTED HEREIN, including but not limited to any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information regarding or referencing third-party products or services does not constitute a license to use such products or services, or a warranty or endorsement thereof. Use of TI Resources 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.

TI RESOURCES ARE PROVIDED "AS IS" AND WITH ALL FAULTS. TI DISCLAIMS ALL OTHER WARRANTIES OR REPRESENTATIONS, EXPRESS OR IMPLIED, REGARDING RESOURCES OR USE THEREOF, INCLUDING BUT NOT LIMITED TO ACCURACY OR COMPLETENESS, TITLE, ANY EPIDEMIC FAILURE WARRANTY AND ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF ANY THIRD PARTY INTELLECTUAL PROPERTY RIGHTS. TI SHALL NOT BE LIABLE FOR AND SHALL NOT DEFEND OR INDEMNIFY DESIGNER AGAINST ANY CLAIM, INCLUDING BUT NOT LIMITED TO ANY INFRINGEMENT CLAIM THAT RELATES TO OR IS BASED ON ANY COMBINATION OF PRODUCTS EVEN IF DESCRIBED IN TI RESOURCES OR OTHERWISE. IN NO EVENT SHALL TI BE LIABLE FOR ANY ACTUAL, DIRECT, SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF TI RESOURCES OR USE THEREOF, AND REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Unless TI has explicitly designated an individual product as meeting the requirements of a particular industry standard (e.g., ISO/TS 16949 and ISO 26262), TI is not responsible for any failure to meet such industry standard requirements.

Where TI specifically promotes products as facilitating functional safety or as compliant with industry functional safety standards, such products are intended to help enable customers to design and create their own applications that meet applicable functional safety standards and requirements. Using products in an application does not by itself establish any safety features in the application. Designers must ensure compliance with safety-related requirements and standards applicable to their applications. Designer may not use any TI products in life-critical medical equipment unless authorized officers of the parties have executed a special contract specifically governing such use. Life-critical medical equipment is medical equipment where failure of such equipment would cause serious bodily injury or death (e.g., life support, pacemakers, defibrillators, heart pumps, neurostimulators, and implantables). Such equipment includes, without limitation, all medical devices identified by the U.S. Food and Drug Administration as Class III devices and equivalent classifications outside the U.S.

TI may expressly designate certain products as completing a particular qualification (e.g., Q100, Military Grade, or Enhanced Product). Designers agree that it has the necessary expertise to select the product with the appropriate qualification designation for their applications and that proper product selection is at Designers' own risk. Designers are solely responsible for compliance with all legal and regulatory requirements in connection with such selection.

Designer will fully indemnify TI and its representatives against any damages, costs, losses, and/or liabilities arising out of Designer's non-compliance with the terms and provisions of this Notice.