

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

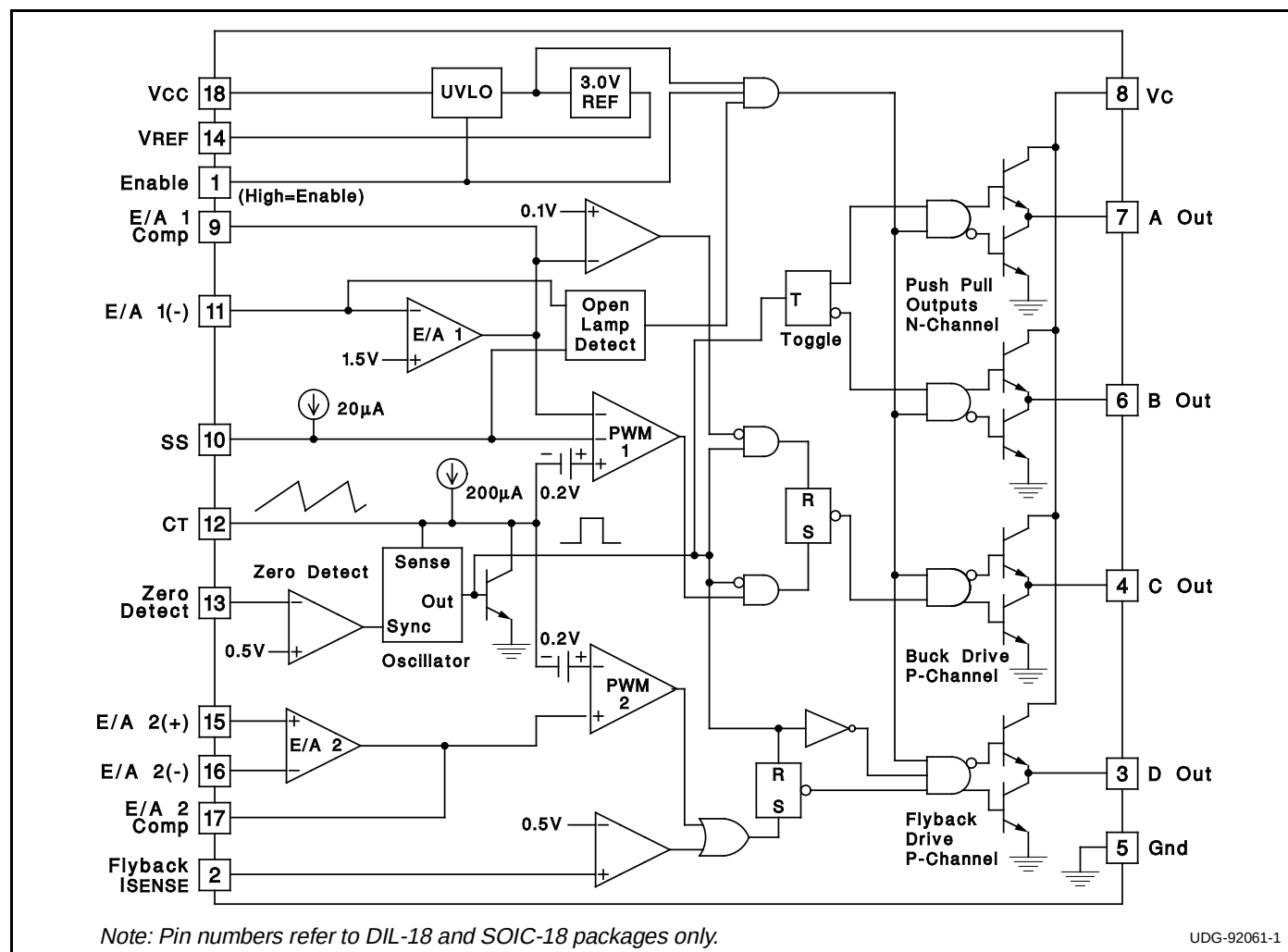
The UC1871 Family of IC's is optimized for highly efficient fluorescent lamp control. An additional PWM controller is integrated on the IC for applications requiring an additional supply, as in LCD displays. When disabled the IC draws only 1 μ A, providing a true disconnect feature, which is optimum 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



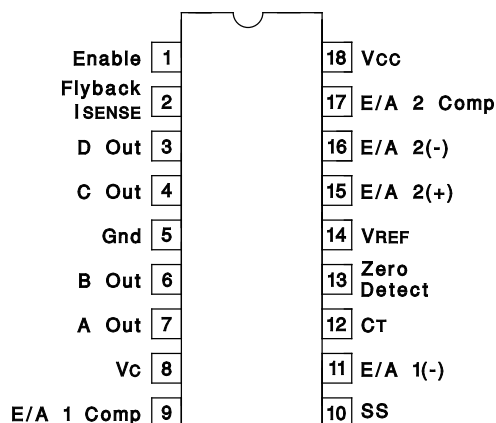
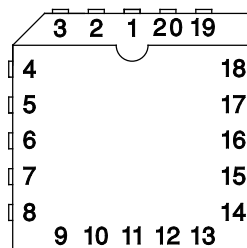
UDG-92061-1

ABSOLUTE MAXIMUM RATINGS

Analog Inputs	−0.3 to +10V
V _{CC} , V _C Voltage	+20V
Zero Detect Input Current	
High Impedance Source	+10mA
Zero Detect	
Low Impedance Source	+20V
Power Dissipation at T _A = 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**DIL-18, SOIC-18 (TOP VIEW)****J or N, DW Package****PLCC-20 (Top View)
Q Package****PACKAGE PIN FUNCTION**

FUNCTION	PIN
Gnd	1
B Out	2
A Out	3
V _C	4
E/A 1 Comp	5
SS	6
E/A 1(-)	7
N/C	8
CT	9
Zero Detect	10
N/C	11
VREF	12
E/A 2(+)	13
E/A 2(-)	14
E/A 2 Comp	15
V _{CC}	16
Enable	17
Flyback ISENSE	18
D Out	19
C Out	20

ELECTRICAL CHARACTERISTICS

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

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Reference Section					
Output Voltage	T _J =25°C	2.963	3.000	3.037	V
	Overtmp	2.940	3.000	3.060	V
Line Regulation	V _{CC} = 4.75V to 18V			10	mV
Load Regulation	I _o =0 to −5mA			10	mV
Oscillator Section					
Free Running Freq	T _J =25°C	57	68	78	kHz
Max Sync Frequency	T _J =25°C	160	200	240	kHz
Charge Current	V _{CT} = 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	V _O = 2V	1.445	1.475	1.505	V
Input Bias Current			−0.4	−2	μA
Open Loop Gain	V _O = 0.5 to 3V	65	90		dB
Output High	V _{EA} (-) = 1.3V	3.1	3.5	3.9	V
Output Low	V _{EA} (-) = 1.7V		0.1	0.2	V
Output Source Current	V _{EA} (-) = 1.3V, V _O = 2V	−350	−500		μA
Output Sink Current	V _{EA} (-) = 1.7V, V _O = 2V	10	20		mA
Common Mode Range		0		V _{IN} −1V	V
Unity Gain Bandwidth	T _J = 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

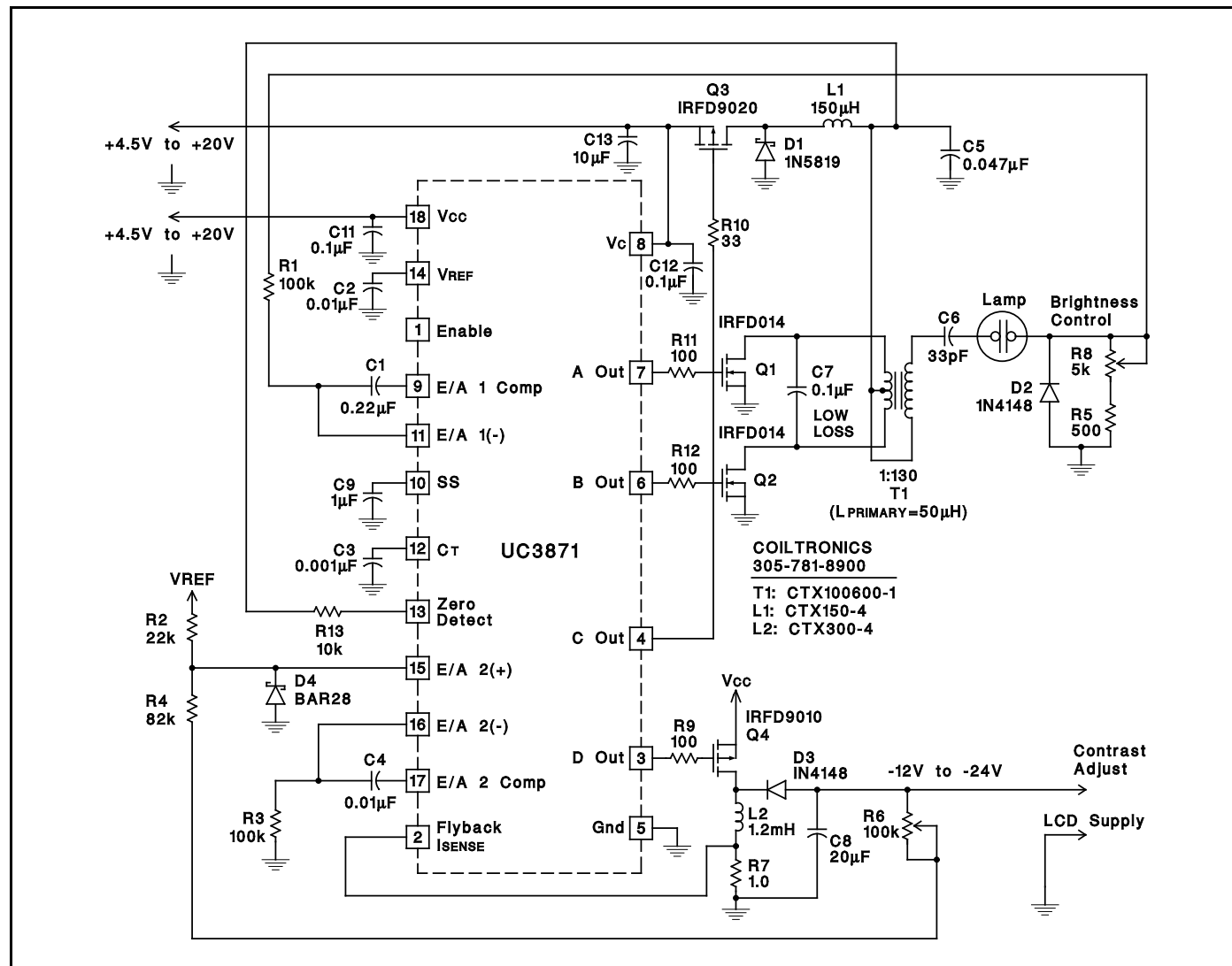


Figure 1

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 its 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.)

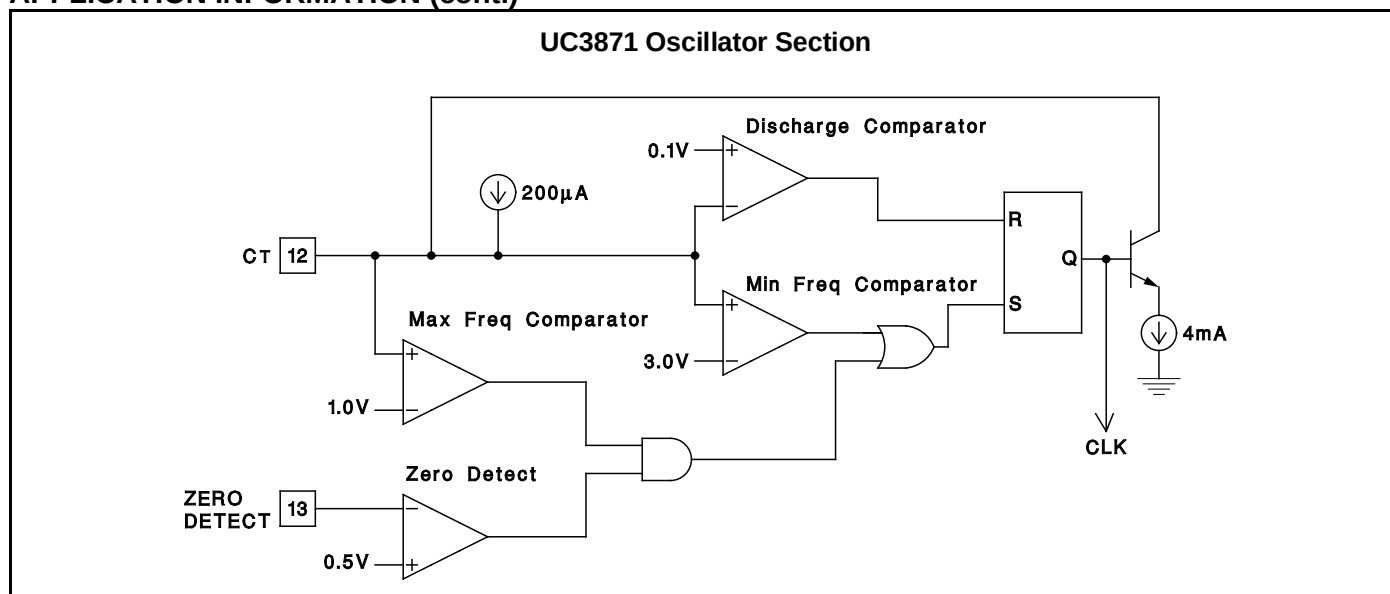


Figure 2

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 $1\mu\text{A}$. 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.

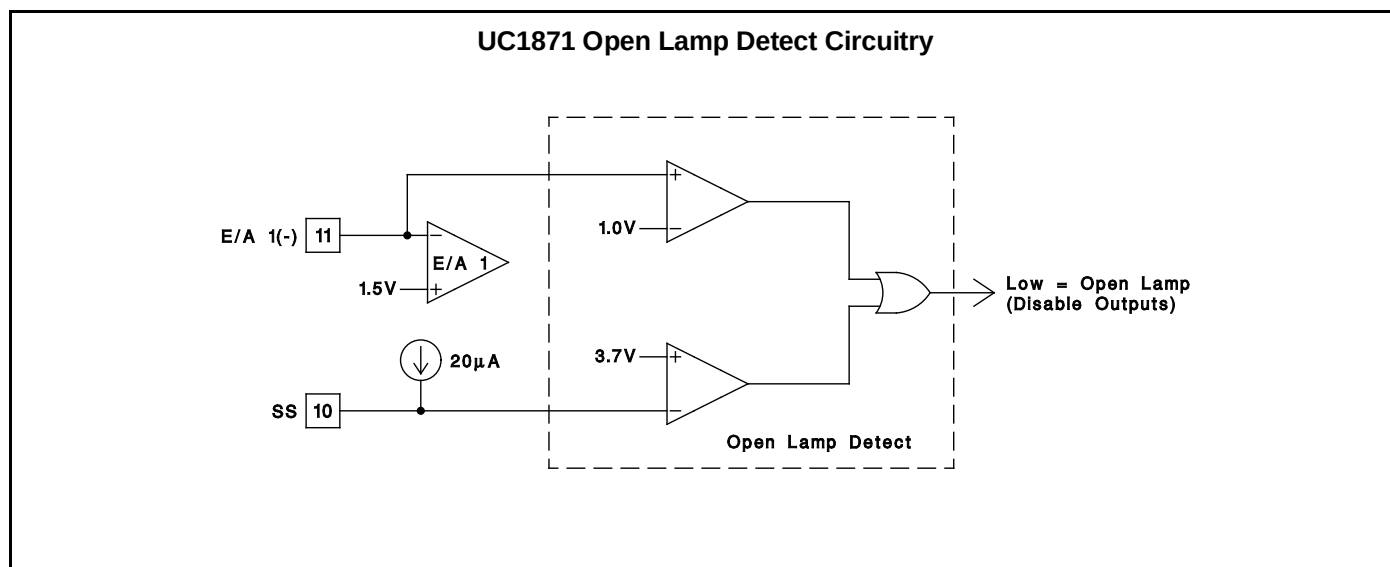


Figure 3

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/ Ball Finish	MSL Peak Temp ⁽³⁾	Samples (Requires Login)
5962-9462201MVA	OBSOLETE			18		TBD	Call TI	Call TI	
5962-9462201Q2A	OBSOLETE	LCCC	FK	20		TBD	Call TI	Call TI	
UC1871J	OBSOLETE	CDIP	J	18		TBD	Call TI	Call TI	
UC1871J883B	OBSOLETE	CDIP	J	18		TBD	Call TI	Call TI	
UC1871L883B	OBSOLETE	TO/SOT	L	20		TBD	Call TI	Call TI	
UC2871DW	ACTIVE	SOIC	DW	18	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
UC2871DWG4	ACTIVE	SOIC	DW	18	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
UC2871N	ACTIVE	PDIP	N	18	20	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type	
UC2871NG4	ACTIVE	PDIP	N	18	20	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type	
UC3871DW	ACTIVE	SOIC	DW	18	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
UC3871DWG4	ACTIVE	SOIC	DW	18	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
UC3871DWTR	ACTIVE	SOIC	DW	18	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
UC3871DWTRG4	ACTIVE	SOIC	DW	18	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
UC3871N	ACTIVE	PDIP	N	18	20	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type	
UC3871NG4	ACTIVE	PDIP	N	18	20	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type	
UC3871QG3	ACTIVE	PLCC	FN	20		TBD	Call TI	Call TI	

⁽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.

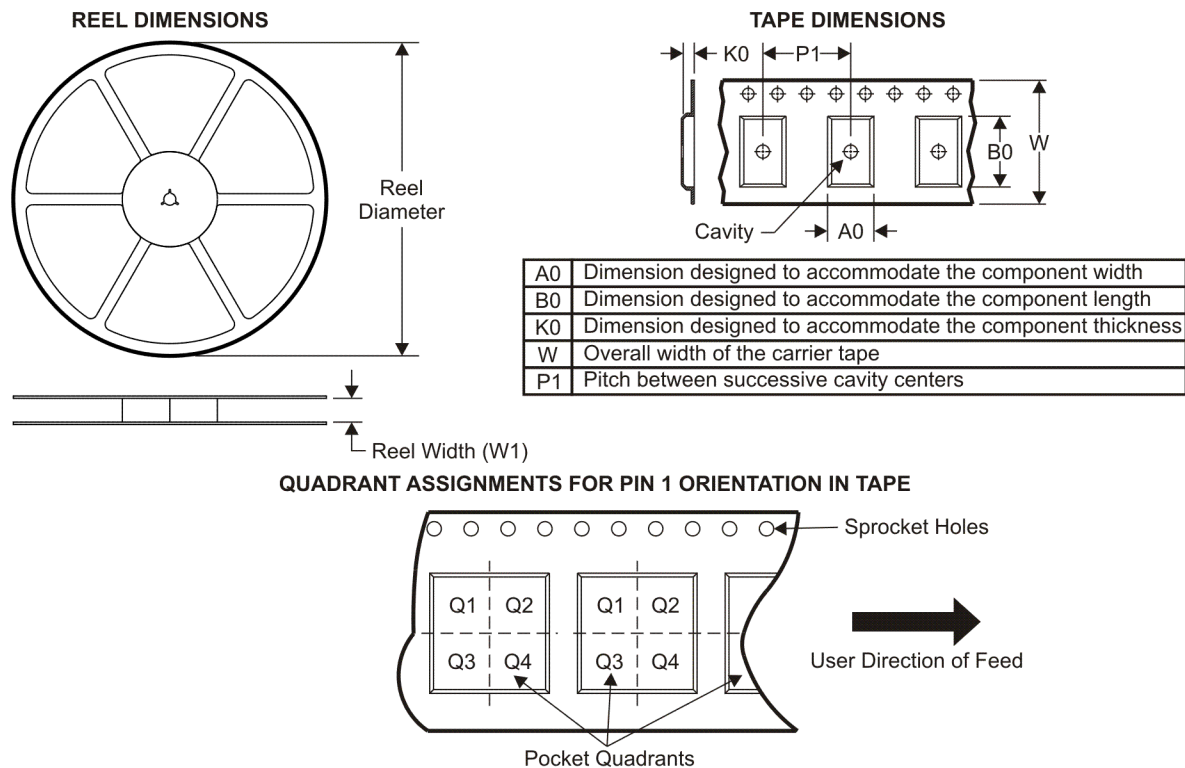
OTHER QUALIFIED VERSIONS OF UC1871, UC3871 :

● Catalog: [UC3871](#)

● Military: [UC1871](#)

NOTE: Qualified Version Definitions:

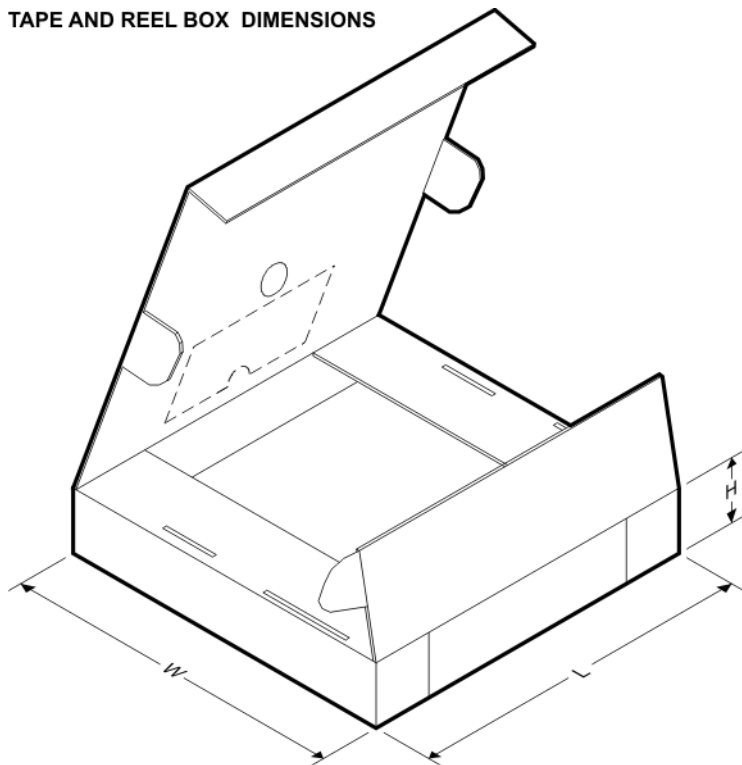
- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

TAPE AND REEL INFORMATION


*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



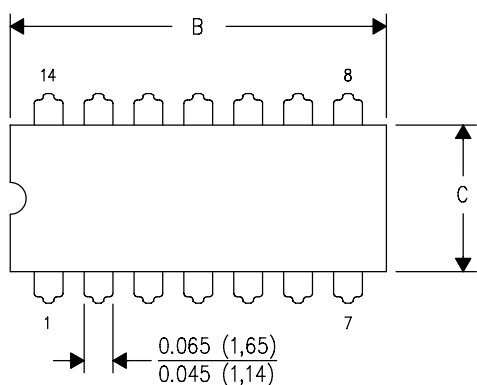
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
UC3871DWTR	SOIC	DW	18	2000	346.0	346.0	41.0

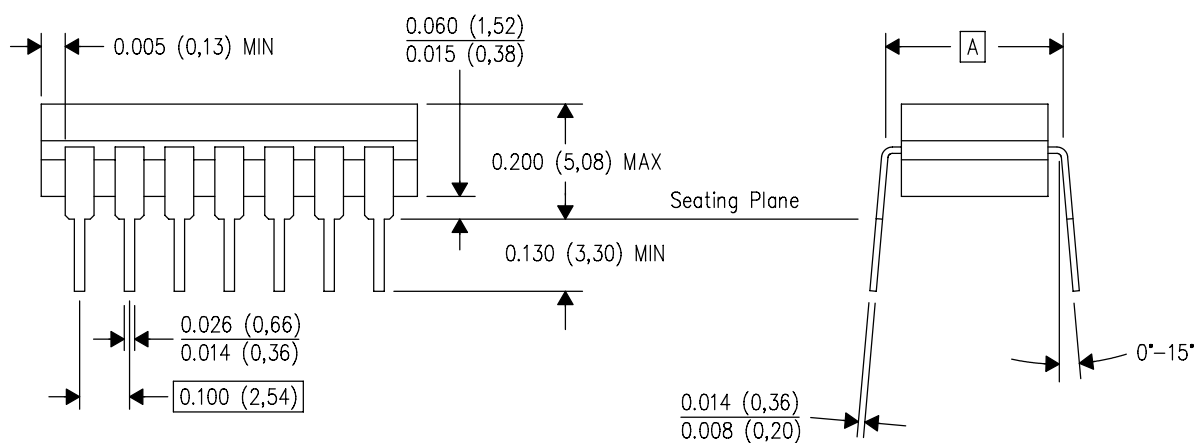
J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



PINS ** DIM	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



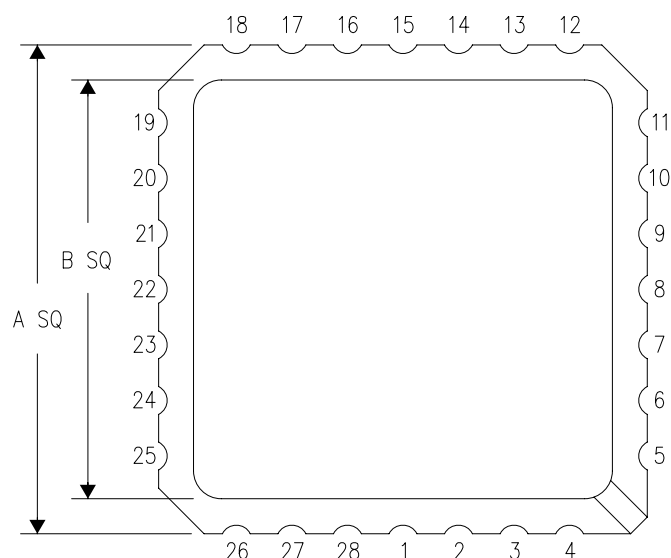
4040083/F 03/03

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package is hermetically sealed with a ceramic lid using glass frit.
 - D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
 - E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

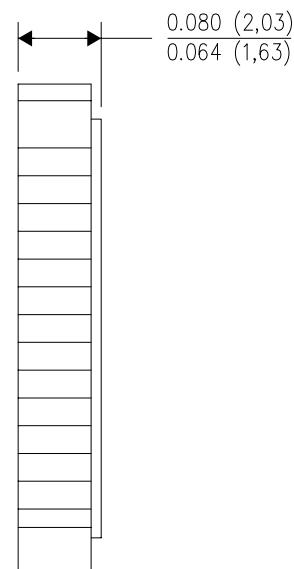
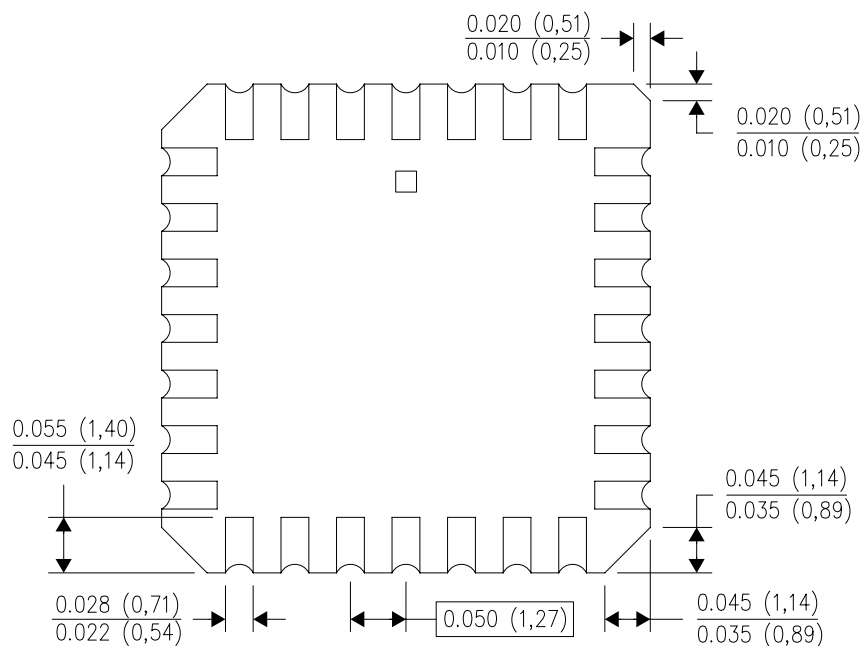
FK (S-CQCC-N**)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



NO. OF TERMINALS **	A		B	
	MIN	MAX	MIN	MAX
20	0.342 (8,69)	0.358 (9,09)	0.307 (7,80)	0.358 (9,09)
28	0.442 (11,23)	0.458 (11,63)	0.406 (10,31)	0.458 (11,63)
44	0.640 (16,26)	0.660 (16,76)	0.495 (12,58)	0.560 (14,22)
52	0.740 (18,78)	0.761 (19,32)	0.495 (12,58)	0.560 (14,22)
68	0.938 (23,83)	0.962 (24,43)	0.850 (21,6)	0.858 (21,8)
84	1.141 (28,99)	1.165 (29,59)	1.047 (26,6)	1.063 (27,0)

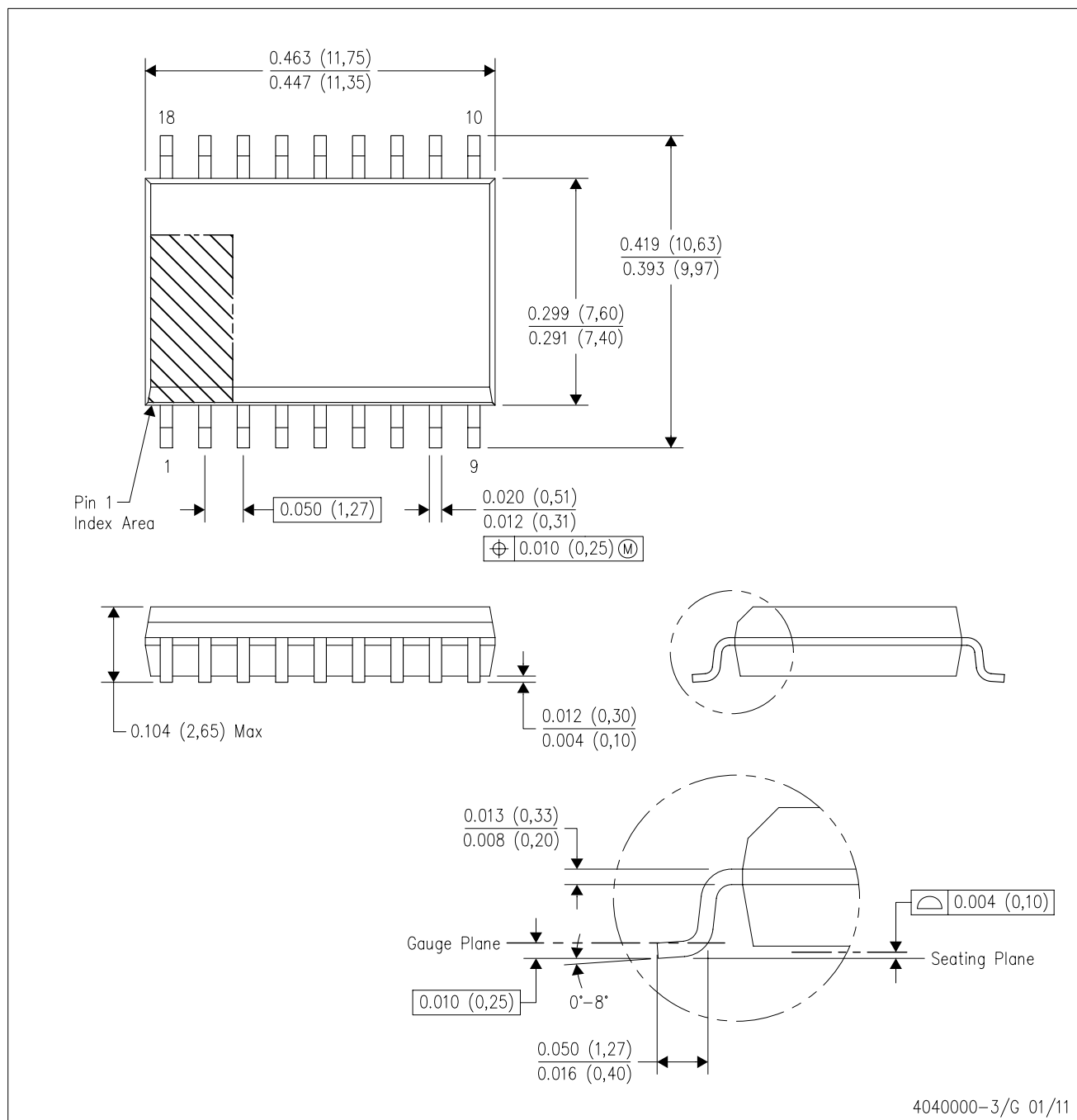


4040140/D 01/11

- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - This package can be hermetically sealed with a metal lid.
 - Falls within JEDEC MS-004

DW (R-PDSO-G18)

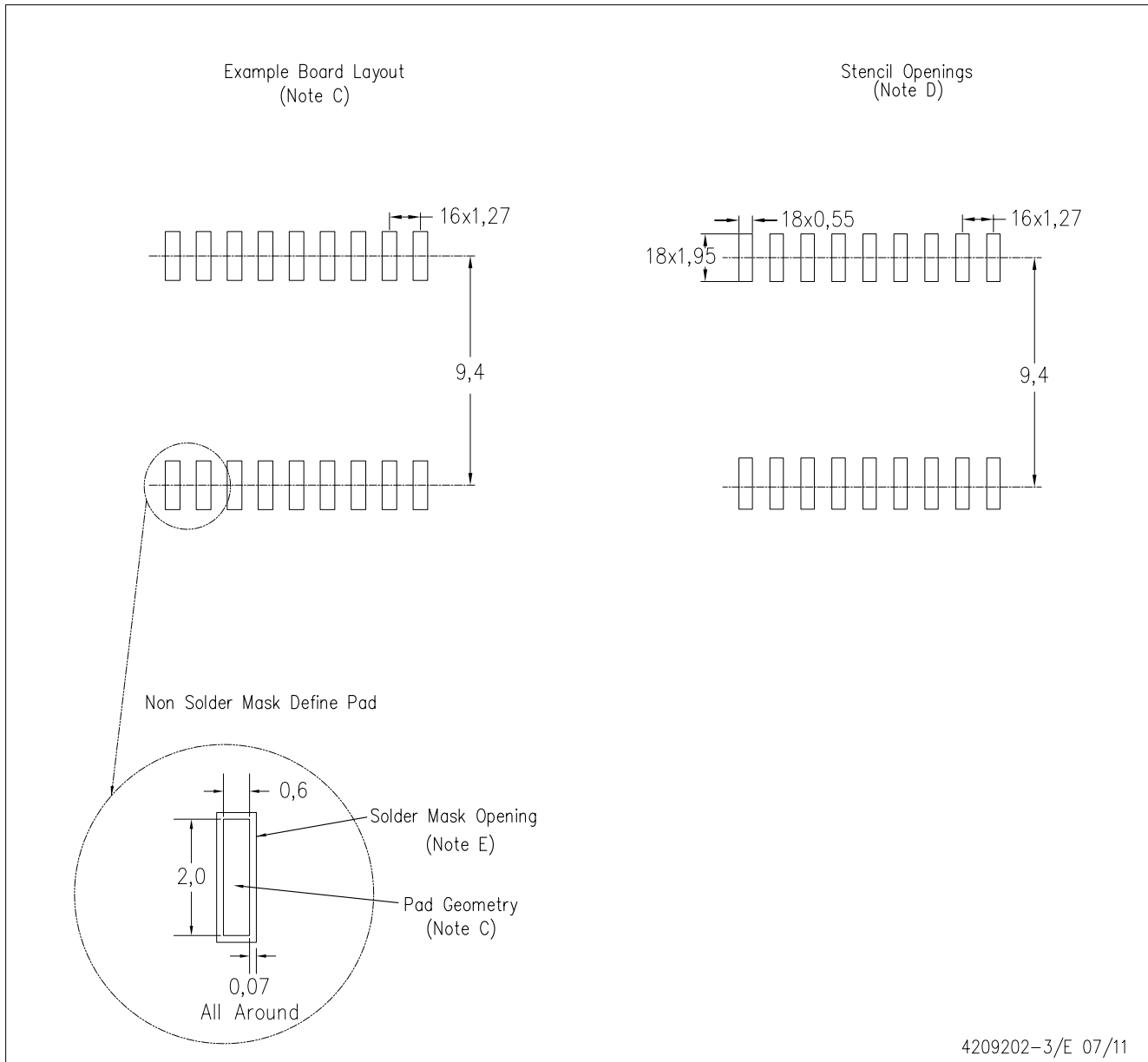
PLASTIC SMALL OUTLINE



- 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

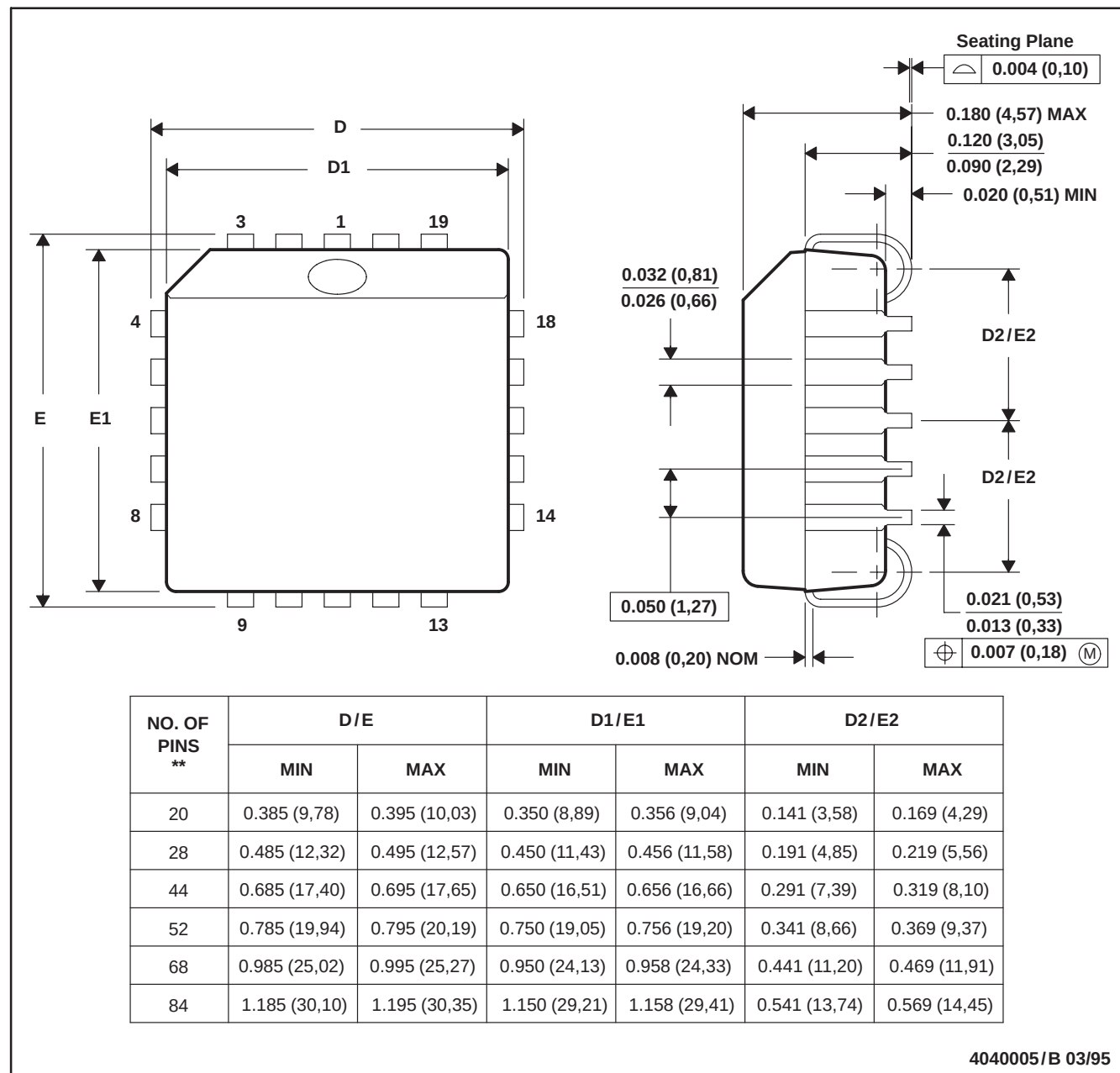


- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Refer to IPC7351 for alternate board design.
 - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their 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.

FN (S-PQCC-J**)

PLASTIC J-LEADED CHIP CARRIER

20 PIN SHOWN



- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Falls within JEDEC MS-018

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

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
RF/IF and ZigBee® Solutions	www.ti.com/lprf

Applications

Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Transportation and Automotive	www.ti.com/automotive
Video and Imaging	www.ti.com/video
Wireless	www.ti.com/wireless-apps

TI E2E Community Home Page

e2e.ti.com

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