

UC1832 UC2832/3 UC3832/3

# **Precision Low Dropout Linear Controllers**

## **FEATURES**

- Precision 1% Reference
- Over-Current Sense Threshold Accurate to 5%
- Programmable Duty-Ratio Over-Current Protection
- 4.5 V to 36 V Operation
- 100mA Output Drive, Source, or Sink
- Under-Voltage Lockout
   Additional Features of the UC2832 series:
- Adjustable Current Limit to Current Sense Ratio
- Separate +VIN terminal
- Programmable Driver Current Limit
- Access to V<sub>REF</sub> and E/A(+)
- Logic-Level Disable Input

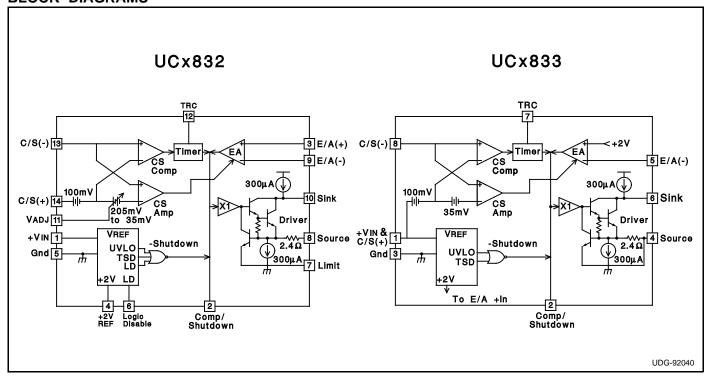
## **DESCRIPTION**

The UC2832 and UC3833 series of precision linear regulators include all the control functions required in the design of very low dropout linear regulators. Additionally, they feature an innovative duty-ratio current limiting technique which provides peak load capability while limiting the average power dissipation of the external pass transistor during fault conditions. When the load current reaches an accurately programmed threshold, a gated-astable timer is enabled, which switches the regulator's pass device off and on at an externally programmable duty-ratio. During the on-time of the pass element, the output current is limited to a value slightly higher than the trip threshold of the duty-ratio timer. The constant-current-limit is programmable on the UCx832 to allow higher peak current during the on-time of the pass device. With duty-ratio control, high initial load demands and short circuit protection may both be accommodated without extra heat sinking or foldback current limiting. Additionally, if the timer pin is grounded, the duty-ratio timer is disabled, and the IC operates in constant-voltage/constant-current regulating mode.

These IC's include a 2 Volt ( $\pm 1\%$ ) reference, error amplifier, UVLO, and a high current driver that has both source and sink outputs, allowing the use of either NPN or PNP external pass transistors. Safe operation is assured by the inclusion of under-voltage lockout (UVLO) and thermal shutdown.

The UC3833 family includes the basic functions of this design in a low-cost, 8-pin mini-dip package, while the UC2832 series provides added versatility with the availability of 14 pins. Packaging options include plastic (N suffix), or ceramic (J suffix). Specified operating temperature ranges are: commercial (0°C to 70°C), order UC3832/3 (N or J); and industrial (–40°C to 85°C), order UC2832/3 (N or J). Surface mount packaging is also available.

# **BLOCK DIAGRAMS**



## ABSOLUTE MAXIMUM RATINGS

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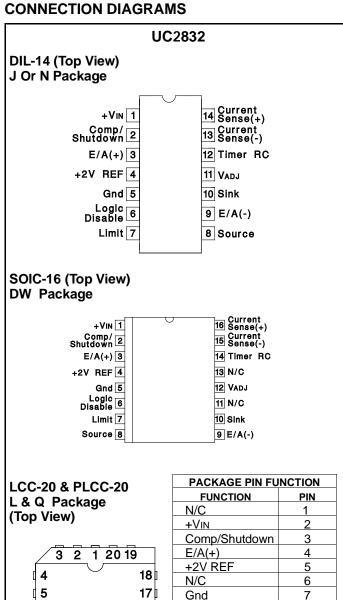
Note 1: Unless otherwise indicated, voltages are referenced to ground and currents are positive into, negative out of, the specified terminals.

Note 2: See Unitrode Integrated Circuits databook for information regarding thermal specifications and limitations of packages.

UC3833

DIL-8 (Top View)

J Or N Package



Logic Disable

Limit

N/C

E/A(-)

Sink

VADJ

N/C

Timer RC

Current Sense(-)

Current Sense(+)

Source

16

15

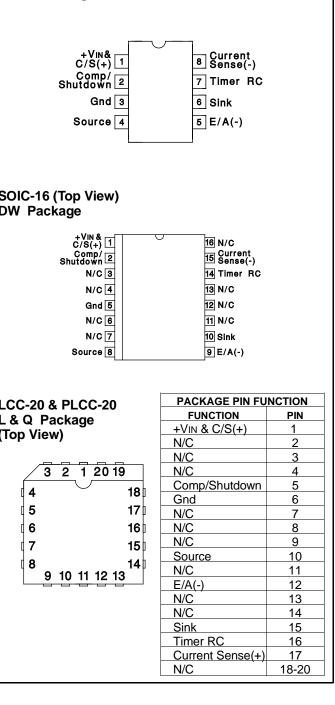
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 $\begin{tabular}{lll} \textbf{ELECTRICAL} & \textbf{CHARACTERISTICS:} & Unless otherwise stated, specifications hold for $$TA = 0^{\circ}C$ to $70^{\circ}C$ for the UC3832/3, $$-40^{\circ}C$ to $85^{\circ}C$ for the UC2832/3, $$+VIN = 15V$, Driver sink = $$+VIN$, $$C/S(+)$ voltage = $$+VIN$. $$TA=TJ$. \end{tabular}$ 

			_		1
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Input Supply					
Supply Current	+VIN = 6 V		6.5	10	mA
	+VIN = 36 V		9.5	15	mA
	Logic Disable = 2 V (UCx832 only)		3.3		mA
Reference Section			I		1
Output Voltage (Note 3)	TJ = 25°C, IDRIVER = 10 mA	1.98	2.00	2.02	V
	over temperature, IDRIVER = 10 mA	1.96	2.00	2.04	V
Load Regulation (UCx832 only)	Io = 0 to 10 m	-10	-5.0		mV
Line Regulation	+VIN = 4.5 V to 36 V, IDRIVER = 10 m		0.033	0.5	mV/V
Under-Voltage Lockout Threshold			3.6	4.5	V
Logic Disable Input (UCx832 only)			1		
Threshold Voltage		1.3	1.4	1.5	V
Input Bias Current	Logic Disable = 0 V	-5.0	-1.0		μΑ
<b>Current Sense Section</b>					
Comparator Offset		95	100	105	mV
	Over Temperature	93	100	107	mV
Amplifier Offset (UCx833 only)		110	135	170	mV
Amplifier Offset (UCx832 only)	VadJ = Open	110	135	170	mV
	VADJ = 1 V	180	235	290	mV
	VADJ = 0 V	250	305	360	mV
Input Bias Current	VCM = +VIN	65	100	135	μΑ
Input Offset Current (UCx832 only)	VCM = +VIN	-10		10	μΑ
Amplifier CMRR (UCx832 only)	VCM = 4.1 V to + VIN + 0.3		80		dB
Transconductance	ICOMP = $\pm 100 \mu\text{A}$		65		mS
VADJ Input Current (UCx832 only)	VADJ = 0V	-10	-1		μΑ
Timer		-			-
Inactive Leakage Current	C/S(+) = C/S(-) = +VIN; TRC pin = 2 V		0.25	1.0	μΑ
Active Pullup Current	C/S(+) = +VIN, C/S(-) = +VIN - 0.4V; TRC pin = 0 V	-345	-270	-175	μΑ
Duty Ratio (note 4)	ontime/period, RT = 200k, CT = 0.27μF		4.8		%
Period (notes 4,5)	ontime + offtime, RT = 200k, CT = 0.27μF		36		ms
Upper Trip Threshold (Vu)			1.8		V
Lower Trip Threshold (VI)			0.9		V
Trip Threshold Ratio	Vu/VI		2.0		V/V
Error Amplifier					•
Input Offset Voltage (UCx832 only)	VCM = VCOMP = 2 V	-8.0		8.0	mV
Input Bias Current	VCM = VCOMP = 2 V	-4.5	-1.1		μΑ
Input Offset Current (UCx832 only)	Vcm = Vcomp = 2 V	-1.5		1.5	μA
AVOL	VCOMP = 1 V to 13 V	50	70		dB
CMRR (UCx832 only)	Vcm = 0V to +Vin - 3 V	60	80		dB
PSRR (UCx832 only)	VcM = 2 V, +VIN = 4.5 V to 36		90		dB
Transconductance	ICOMP = $\pm 10 \mu\text{A}$		43		mS
VOH	ICOMP = 0, Volts below +VIN		.95	1.3	V
VOL	ICOMP = 0		.45	0.7	V
IOH	VCOMP = 2 V	-700	-500	-100	μΑ

# **ELECTRICAL CHARACTERISTICS (cont.)**Unless otherwise stated, specifications hold for TA = 0°C to 70°C for the UC3832/3, -40°C to 85°C for the UC2832/3, +VIN = 15 V, Driver sink = +VIN, C/S(+) voltage = +VIN. TA=TJ.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Error Amplifier (cont.)					
IOL	VCOMP = 2 V, C/S(-) = +VIN	100	500	700	μΑ
	VCOMP = 2 V, C/S(-) = +VIN - 0.4 V	2	6		mA
Driver					
Maximum Current	Driver Limit & Source pins common; T <sub>J</sub> = 25°C	200	300	400	mA
	Over Temperature	100	300	450	mA
Limiting Voltage (UCx832 only)	Driver Limit to Source voltage at current limit,				
	ISOURCE = -10 mA; TJ = 25°C (Note 6)		.72		V
Internal Current Sense Resistance	T <sub>J</sub> = 25°C (Note 6)		2.4		Ω
Pull-Up Current at Driver Sink	Compensation/Shutdown = 0.4 V; Driver Sink = +VIN - 1V	-800	-300	-100	μΑ
	Compensation/Shutdown = 0.4 V, +VIN = 36 V; Driver				
	Sink = 35 V	-1000	-300	-75	μΑ
Pull-Down Current at Driver Source	Compensation/Shutdown = 0.4 V; Driver Source = 1 V	150	300	700	μΑ
Saturation Voltage Sink to Source	Driver Source = 0 V; Driver Current = 100 mA		1.5		V
Maximum Source Voltage	Driver Sink = +VIN, Driver Current = 100 mA				
	Volts below + VIN		3.0		V
UVLO Sink Leakage	+VIN = C/S(+) = C/S(-) = 2.5 V, Driver Sink = 15 V, Driver				
	Source = 0 V, TA = 25°C		25		μΑ
Maximum Reverse Source Voltage	Compensation/Shutdown = 0 V; ISOURCE = 100 μA,				
	+VIN = 3 V		1.6		V
Thermal Shutdown			160		°C

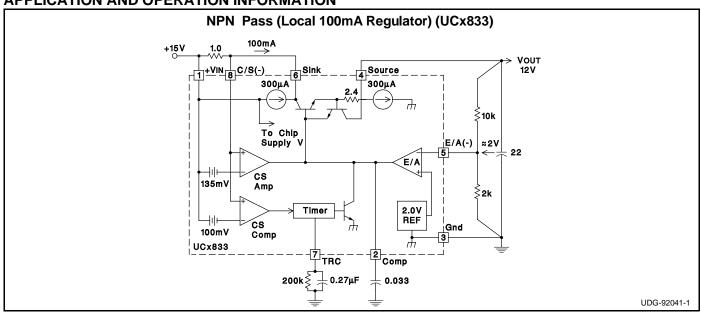
Note 3: On the UCx833 this voltage is defined as the regulating level at the error amplifier inverting input, with the error amplifier driving VSOURCE to 2 V.

Note 4: These parameters are first-order supply-independent, however both may vary with supply for +VN less than about 4 V. This supply variation will cause a slight change in the timer period and duty cycle, although a high off-time/on-time ratio will be maintained.

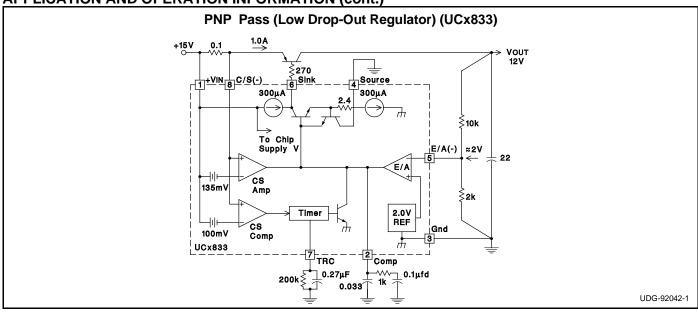
Note 5: With recommended RT value of 200k, Toff≈ RT CT \* In(Vu/VI) ±10%.

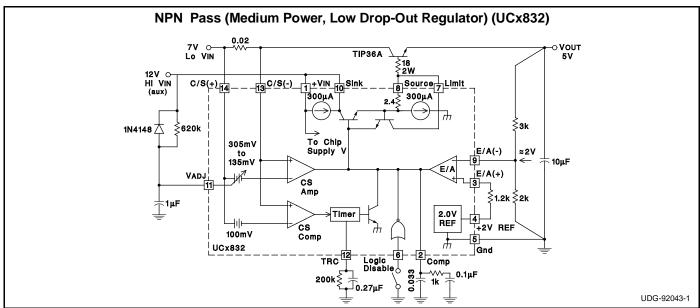
Note 6: The internal current limiting voltage has a temperature dependence of approximately -2.0 mV/°C, or -2800 ppm/°C. The internal 2.4  $\Omega$  sense resistor has a temperature dependance of approximately +1500 ppm/°C.

# **APPLICATION AND OPERATION INFORMATION**



# **APPLICATION AND OPERATION INFORMATION (cont.)**





# **Estimating Maximum Load Capacitance**

For any power supply, the rate at which the total output capacitance can be charged depends on the maximum output current available and on the nature of the load. For a constant-current current-limited power supply, the output will come up if the load asks for less than the maximum available short-circuit limit current.

To guarantee recovery of a duty-ratio current-limited power supply from a short-circuited load condition, there is a maximum total output capacitance which can be charged for a given unit ON time. The design value of ON time can be adjusted by changing the timing capacitor. Nominally,  $ToN = 0.693 \times 10k \times CT$ .

Typically, the IC regulates output current to a maximum of  $IMAX = K \times ITH$ , where ITH is the timer trip-point current,

and 
$$K = \frac{Current \ Sense \ Amplifier \ Offset \ Voltage}{100 \ mA}$$

 $\approx$ 1.35 for UCx833, and is variable from 1.35 to 3.05 with VADJ for the UCx832.

For a worst-case constant-current load of value just less than ITH, CMAX can be estimated from:

$$C_{MAX} = ((K-1)I_{TH}) \left(\frac{T_{ON}}{V_{OUT}}\right)$$

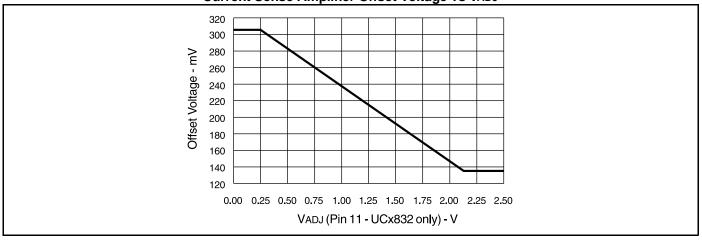
where Vout is the nominal regulator output voltage.

For a resistive load of value RL, the value of CMAX can be estimated from:

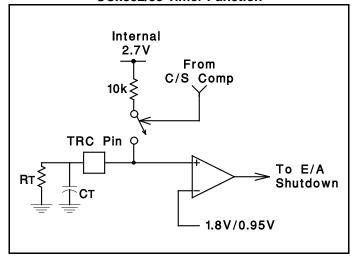
$$C_{MAX} = \frac{T_{ON}}{R_L} \bullet \frac{1}{ln \left[ \left( 1 - \frac{V_{OUT}}{K \bullet I_{TH} \bullet R_L} \right)^{-1} \right]}.$$

# **APPLICATION AND OPERATION INFORMATION (cont.)**

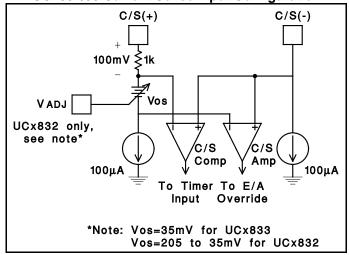
# **Current Sense Amplifier Offset Voltage vs VADJ**



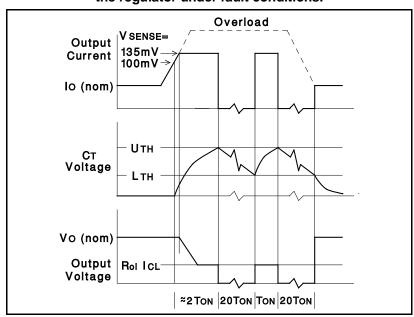
# **UCx832/33 Timer Function**



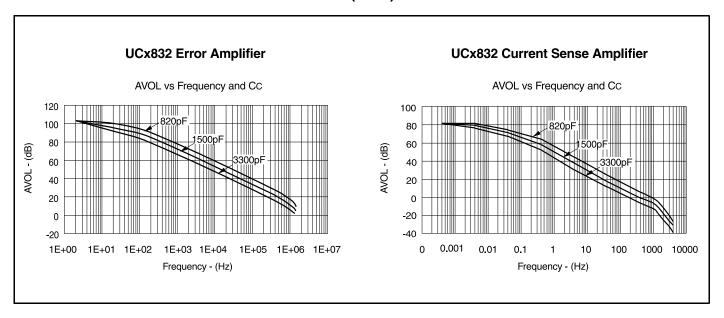
# UCx832/33 Current Sense Input Configuration

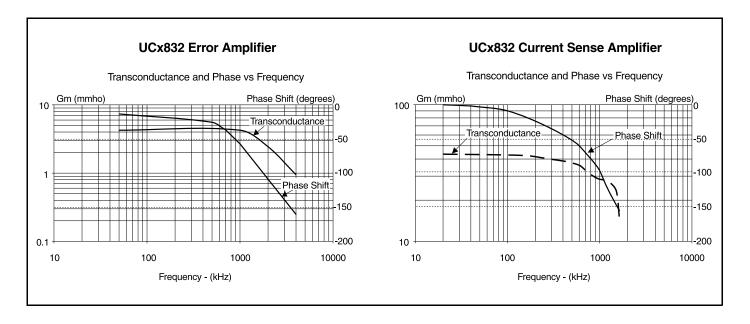


# Load current, timing capacitor voltage, and output voltage of the regulator under fault conditions.



# **APPLICATION AND OPERATION INFORMATION (cont.)**





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# **PACKAGING INFORMATION**

Orderable part number	Status (1)	Material type	Package   Pins	Package qty   Carrier	<b>RoHS</b> (3)	Lead finish/ Ball material	MSL rating/ Peak reflow	Op temp (°C)	Part marking (6)
5962-9326501M2A	Active	Production	LCCC (FK)   20	55   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962- 9326501M2A UC1832L/ 883B
5962-9326501MCA	Active	Production	CDIP (J)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-9326501MC A UC1832J/883B
5962-9326501V2A	Active	Production	LCCC (FK)   20	55   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962- 9326501V2A UC1832L QMLV
5962-9326501V2A.A	Active	Production	LCCC (FK)   20	55   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962- 9326501V2A UC1832L QMLV
5962-9326501VCA	Active	Production	CDIP (J)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-9326501VC A UC1832JQMLV
5962-9326501VCA.A	Active	Production	CDIP (J)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-9326501VC A UC1832JQMLV
UC1832J	Active	Production	CDIP (J)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	UC1832J
UC1832J.A	Active	Production	CDIP (J)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	UC1832J
UC1832J883B	Active	Production	CDIP (J)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-9326501MC A UC1832J/883B
UC1832J883B.A	Active	Production	CDIP (J)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-9326501MC A UC1832J/883B
UC1832L883B	Active	Production	LCCC (FK)   20	55   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962- 9326501M2A UC1832L/ 883B



0 to 70

0 to 70

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UC3833DW

UC3833DW



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Orderable part number	Status (1)	Material type (2)	Package   Pins	Package qty   Carrier	(3)	Lead finish/ Ball material	MSL rating/ Peak reflow	Op temp (°C)	Part marking (6)
UC1832L883B.A	Active	Production	LCCC (FK)   20	55   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962- 9326501M2A UC1832L/ 883B
UC2832DW	Active	Production	SOIC (DW)   16	40   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-25 to 85	UC2832DW
UC2832DW.A	Active	Production	SOIC (DW)   16	40   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-25 to 85	UC2832DW
UC2833DW	Active	Production	SOIC (DW)   16	40   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	UC2833DW
UC2833DW.A	Active	Production	SOIC (DW)   16	40   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	UC2833DW
UC2833DWG4	Active	Production	SOIC (DW)   16	40   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	UC2833DW
UC2833DWTR	Active	Production	SOIC (DW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	UC2833DW
UC2833DWTR.A	Active	Production	SOIC (DW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	UC2833DW
UC3832DW	Active	Production	SOIC (DW)   16	40   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	0 to 70	UC3832DW
UC3832DW.A	Active	Production	SOIC (DW)   16	40   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	0 to 70	UC3832DW
UC3833DW	Active	Production	SOIC (DW)   16	40   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	0 to 70	UC3833DW
UC3833DW.A	Active	Production	SOIC (DW)   16	40   TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	0 to 70	UC3833DW

Active

Active

UC3833DWTR

UC3833DWTR.A

Yes

Yes

**NIPDAU** 

**NIPDAU** 

Level-2-260C-1 YEAR

Level-2-260C-1 YEAR

2000 | LARGE T&R

2000 | LARGE T&R

Production

Production

SOIC (DW) | 16

SOIC (DW) | 16

<sup>(1)</sup> Status: For more details on status, see our product life cycle.

<sup>(2)</sup> Material type: When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

<sup>(3)</sup> RoHS values: Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

<sup>(4)</sup> Lead finish/Ball material: Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

<sup>(5)</sup> MSL rating/Peak reflow: The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

<sup>(6)</sup> Part marking: There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.



# PACKAGE OPTION ADDENDUM

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Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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#### OTHER QUALIFIED VERSIONS OF UC1832, UC1832-SP, UC2832, UC3832:

Catalog: UC3832, UC1832

■ Enhanced Product : UC2832-EP

Military: UC2832M, UC1832

Space : UC1832-SP

#### NOTE: Qualified Version Definitions:

- Catalog TI's standard catalog product
- Enhanced Product Supports Defense, Aerospace and Medical Applications
- Military QML certified for Military and Defense Applications
- Space Radiation tolerant, ceramic packaging and qualified for use in Space-based application

# **PACKAGE MATERIALS INFORMATION**

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# TAPE AND REEL INFORMATION





A0	Dimension designed to accommodate the component width
В0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

# QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



#### \*All dimensions are nominal

Device	Package Type	Package Drawing		SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
UC2833DWTR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
UC3833DWTR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1

# **PACKAGE MATERIALS INFORMATION**

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# \*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
UC2833DWTR	SOIC	DW	16	2000	353.0	353.0	32.0
UC3833DWTR	SOIC	DW	16	2000	353.0	353.0	32.0

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# **TUBE**



\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
5962-9326501M2A	FK	LCCC	20	55	506.98	12.06	2030	NA
5962-9326501V2A	FK	LCCC	20	55	506.98	12.06	2030	NA
5962-9326501V2A.A	FK	LCCC	20	55	506.98	12.06	2030	NA
UC1832L883B	FK	LCCC	20	55	506.98	12.06	2030	NA
UC1832L883B.A	FK	LCCC	20	55	506.98	12.06	2030	NA
UC2832DW	DW	SOIC	16	40	507	12.83	5080	6.6
UC2832DW.A	DW	SOIC	16	40	507	12.83	5080	6.6
UC2833DW	DW	SOIC	16	40	507	12.83	5080	6.6
UC2833DW.A	DW	SOIC	16	40	507	12.83	5080	6.6
UC2833DWG4	DW	SOIC	16	40	507	12.83	5080	6.6
UC3832DW	DW	SOIC	16	40	507	12.83	5080	6.6
UC3832DW.A	DW	SOIC	16	40	507	12.83	5080	6.6
UC3833DW	DW	SOIC	16	40	507	12.83	5080	6.6
UC3833DW.A	DW	SOIC	16	40	507	12.83	5080	6.6

7.5 x 10.3, 1.27 mm pitch

SMALL OUTLINE INTEGRATED CIRCUIT

This image is a representation of the package family, actual package may vary. Refer to the product data sheet for package details.





SOIC



# NOTES:

- 1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing
- per ASME Y14.5M.

  2. This drawing is subject to change without notice.

  3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
- 4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm, per side.
- 5. Reference JEDEC registration MS-013.



SOIC



# NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SOIC



## NOTES: (continued)

- 8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
- 9. Board assembly site may have different recommendations for stencil design.



8.89 x 8.89, 1.27 mm pitch

LEADLESS CERAMIC CHIP CARRIER

This image is a representation of the package family, actual package may vary. Refer to the product data sheet for package details.



**INSTRUMENTS** www.ti.com

CERAMIC DUAL IN LINE PACKAGE



Images above are just a representation of the package family, actual package may vary. Refer to the product data sheet for package details.

4040083-5/G





CERAMIC DUAL IN LINE PACKAGE



## NOTES:

- 1. All controlling linear dimensions are in inches. Dimensions in brackets are in millimeters. Any dimension in brackets or parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
- 2. This drawing is subject to change without notice.
- 3. This package is hermitically sealed with a ceramic lid using glass frit.
- His package is remitted by sealed with a ceramic its using glass mit.
   Index point is provided on cap for terminal identification only and on press ceramic glass frit seal only.
   Falls within MIL-STD-1835 and GDIP1-T14.



CERAMIC DUAL IN LINE PACKAGE



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