



# 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 VREF and E/A(+)
- Logic-Level Disable Input

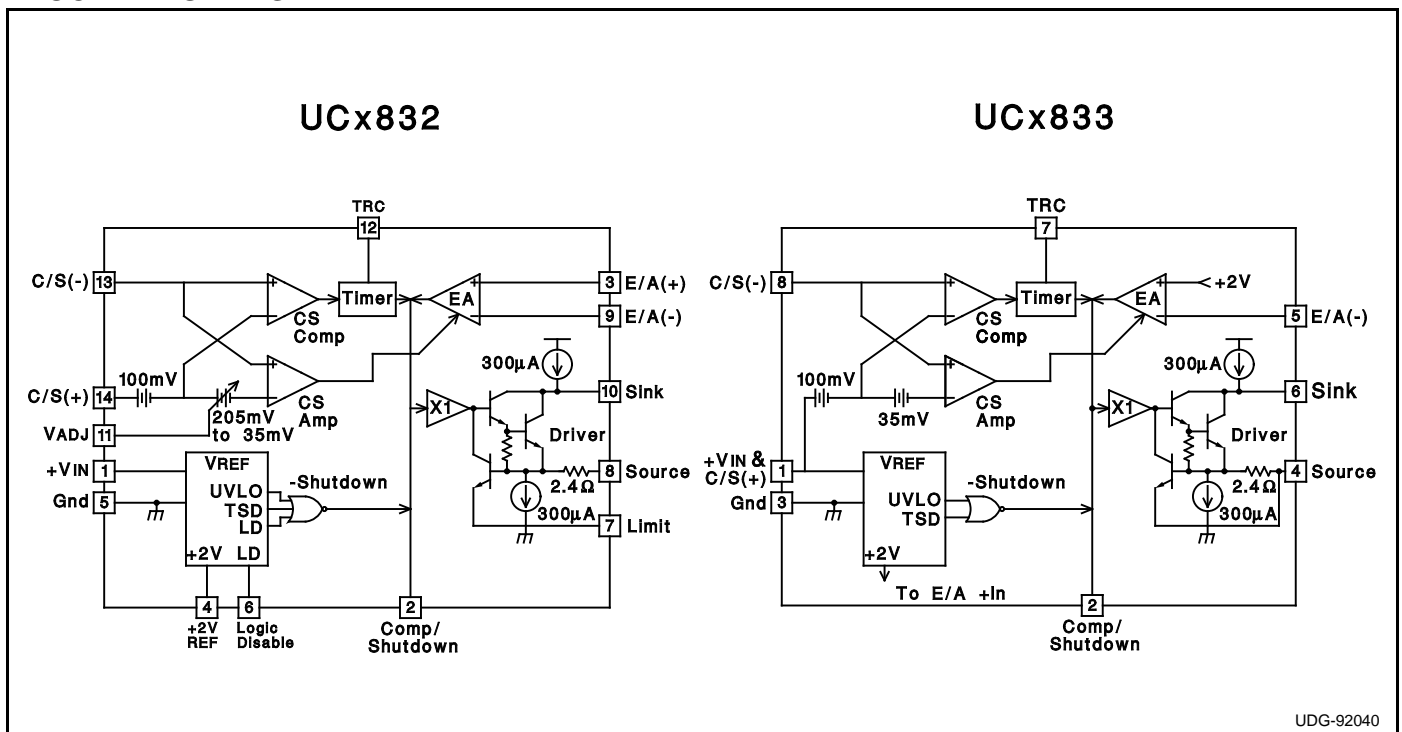
## DESCRIPTION

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 ( $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ ), order UC3832/3 (N or J); and industrial ( $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ ), order UC2832/3 (N or J). Surface mount packaging is also available.

## BLOCK DIAGRAMS



UDG-92040

**ABSOLUTE MAXIMUM RATINGS**

Supply Voltage +VIN	40V
Driver Output Current (Sink or Source)	450mA
Driver Sink to Source Voltage	40V
TRC Pin Voltage	-0.3V to 3.2V
Other Input Voltages	-0.3V to +VIN
Operating Junction Temperature (note 2)	-55°C to +150°C
Storage Temperature	-65°C to +150°C
Lead Temperature (Soldering, 10 Seconds)	300°C

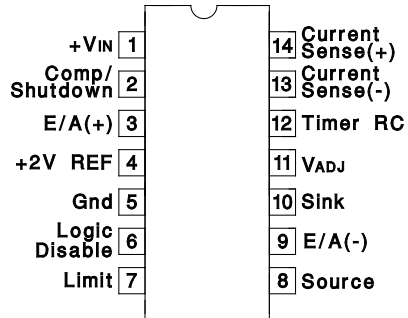
Note 1: Unless otherwise indicated, voltages are referenced to ground and currents are positive into, negative out of, the specified terminals.

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

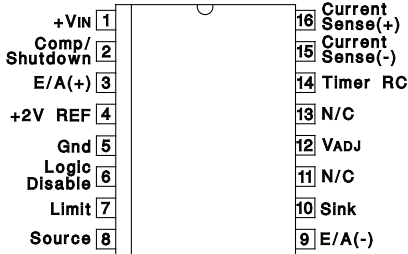
**CONNECTION DIAGRAMS**

**UC2832**

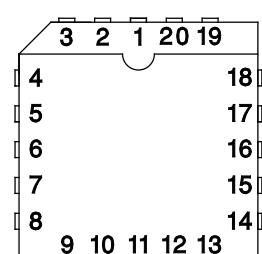
**DIL-14 (Top View)  
J Or N Package**



**SOIC-16 (Top View)  
DW Package**



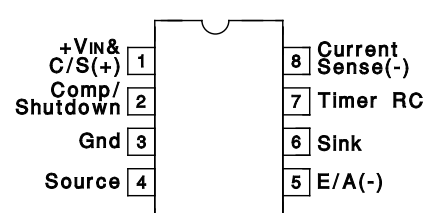
**LCC-20 & PLCC-20  
L & Q Package  
(Top View)**



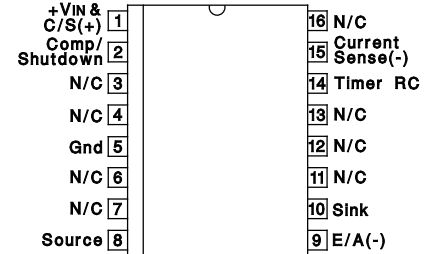
PACKAGE PIN FUNCTION	
FUNCTION	PIN
N/C	1
+VIN	2
Comp/Shutdown	3
E/A(+)	4
+2V REF	5
N/C	6
Gnd	7
Logic Disable	8
Limit	9
Source	10
N/C	11
E/A(-)	12
Sink	13
VADJ	14
N/C	15-17
Timer RC	18
Current Sense(-)	19
Current Sense(+)	20

**UC3833**

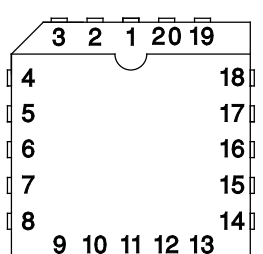
**DIL-8 (Top View)  
J Or N Package**



**SOIC-16 (Top View)  
DW Package**



**LCC-20 & PLCC-20  
L & Q Package  
(Top View)**



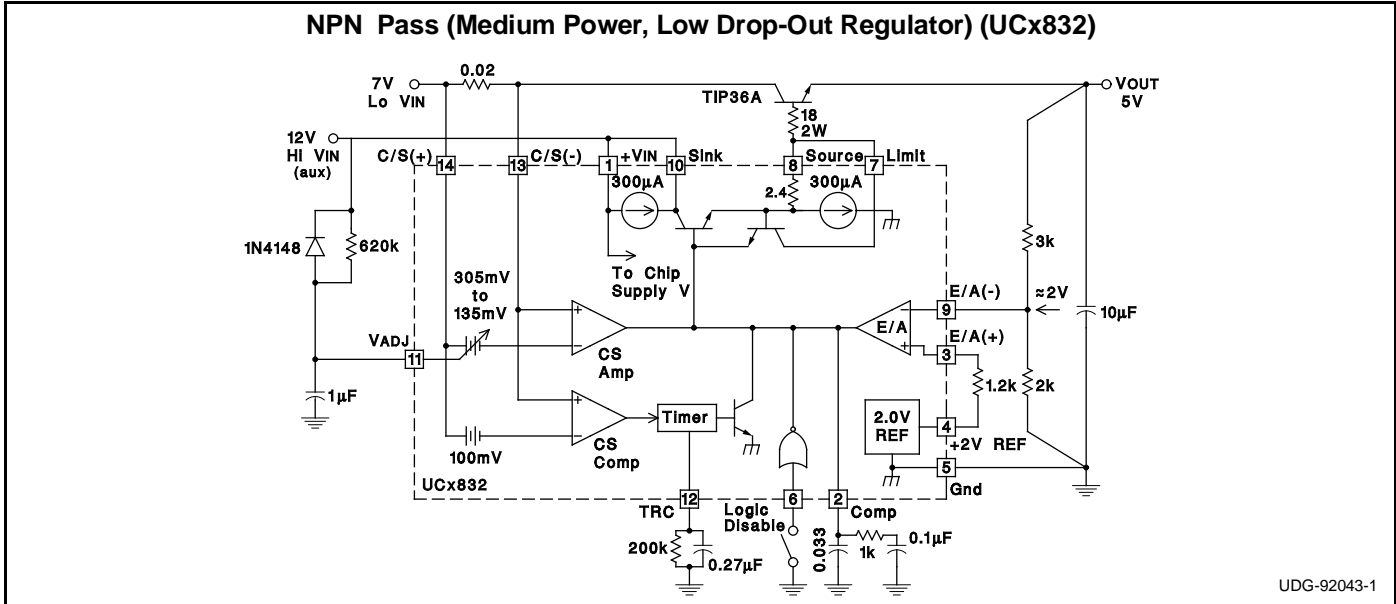
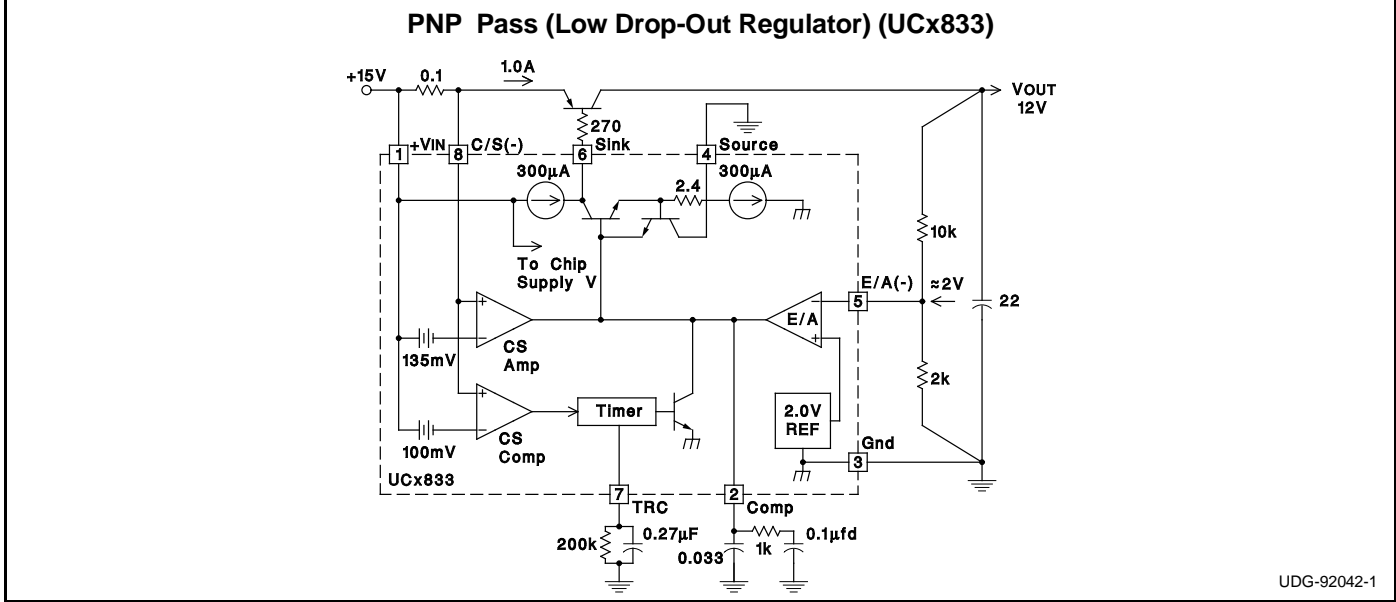
PACKAGE PIN FUNCTION	
FUNCTION	PIN
+VIN & C/S(+)	1
Comp/Shutdown	2
N/C	3
N/C	4
Gnd	5
N/C	6
N/C	7
Source	8
E/A(-)	9
Sink	10
N/C	11
N/C	12
N/C	13
Sink	14
Timer RC	15
Timer RC	16
Current Sense(+)	17
N/C	18-20

**ELECTRICAL CHARACTERISTICS:** Unless otherwise stated, specifications hold for  
 $T_A = 0^\circ\text{C}$  to  $70^\circ\text{C}$  for the UC3832/3,  $-40^\circ\text{C}$  to  $85^\circ\text{C}$   
for the UC2832/3,  $+V_{IN} = 15\text{V}$ , Driver sink =  $+V_{IN}$ , C/S(+) voltage =  $+V_{IN}$ .  $T_A = T_J$ .

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
<b>Input Supply</b>					
Supply Current	$+V_{IN} = 6\text{V}$		6.5	10	mA
	$+V_{IN} = 36\text{V}$		9.5	15	mA
	Logic Disable = 2 V (UCx832 only)		3.3		mA
<b>Reference Section</b>					
Output Voltage (Note 3)	$T_J = 25^\circ\text{C}$ , $I_{DRIVER} = 10\text{mA}$	1.98	2.00	2.02	V
	over temperature, $I_{DRIVER} = 10\text{mA}$	1.96	2.00	2.04	V
Load Regulation (UCx832 only)	$I_o = 0$ to 10 m	-10	-5.0		mV
Line Regulation	$+V_{IN} = 4.5\text{V}$ to 36 V, $I_{DRIVER} = 10\text{m}$		0.033	0.5	mV/V
Under-Voltage Lockout Threshold			3.6	4.5	V
<b>Logic Disable Input (UCx832 only)</b>					
Threshold Voltage		1.3	1.4	1.5	V
Input Bias Current	Logic Disable = 0 V	-5.0	-1.0		$\mu\text{A}$
<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)	$V_{ADJ} = \text{Open}$	110	135	170	mV
	$V_{ADJ} = 1\text{V}$	180	235	290	mV
	$V_{ADJ} = 0\text{V}$	250	305	360	mV
Input Bias Current	$V_{CM} = +V_{IN}$	65	100	135	$\mu\text{A}$
Input Offset Current (UCx832 only)	$V_{CM} = +V_{IN}$	-10		10	$\mu\text{A}$
Amplifier CMRR (UCx832 only)	$V_{CM} = 4.1\text{V}$ to $+V_{IN} + 0.3$		80		dB
Transconductance	$I_{COMP} = \pm 100\ \mu\text{A}$		6		mS
$V_{ADJ}$ Input Current (UCx832 only)	$V_{ADJ} = 0\text{V}$	-10	-1		$\mu\text{A}$
<b>Timer</b>					
Inactive Leakage Current	C/S(+) = C/S(-) = $+V_{IN}$ ; TRC pin = 2 V		0.25	1.0	$\mu\text{A}$
Active Pullup Current	C/S(+) = $+V_{IN}$ , C/S(-) = $+V_{IN} - 0.4\text{V}$ ; TRC pin = 0 V	-345	-270	-175	$\mu\text{A}$
Duty Ratio (note 4)	ontime/period, $R_T = 200\text{k}$ , $C_T = 0.27\ \mu\text{F}$		4.8		%
Period (notes 4,5)	ontime + offtime, $R_T = 200\text{k}$ , $C_T = 0.27\ \mu\text{F}$		36		ms
Upper Trip Threshold ( $V_u$ )			1.8		V
Lower Trip Threshold ( $V_l$ )			0.9		V
Trip Threshold Ratio	$V_u/V_l$		2.0		V/V
<b>Error Amplifier</b>					
Input Offset Voltage (UCx832 only)	$V_{CM} = V_{COMP} = 2\text{V}$	-8.0		8.0	mV
Input Bias Current	$V_{CM} = V_{COMP} = 2\text{V}$	-4.5	-1.1		$\mu\text{A}$
Input Offset Current (UCx832 only)	$V_{CM} = V_{COMP} = 2\text{V}$	-1.5		1.5	$\mu\text{A}$
AVOL	$V_{COMP} = 1\text{V}$ to 13 V	50	70		dB
CMRR (UCx832 only)	$V_{CM} = 0\text{V}$ to $+V_{IN} - 3\text{V}$	60	80		dB
PSRR (UCx832 only)	$V_{CM} = 2\text{V}$ , $+V_{IN} = 4.5\text{V}$ to 36		90		dB
Transconductance	$I_{COMP} = \pm 10\ \mu\text{A}$		43		mS
VOH	$I_{COMP} = 0$ , Volts below $+V_{IN}$		.95	1.3	V
VOL	$I_{COMP} = 0$		.45	0.7	V
IOH	$V_{COMP} = 2\text{V}$	-700	-500	-100	$\mu\text{A}$



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,  $T_{ON} = 0.693 \times 10k \times C_T$ .

Typically, the IC regulates output current to a maximum of  $I_{MAX} = K \times I_{TH}$ , where  $I_{TH}$  is the timer trip-point current,

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

$\approx 1.35$  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  $I_{TH}$ ,  $C_{MAX}$  can be estimated from:

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

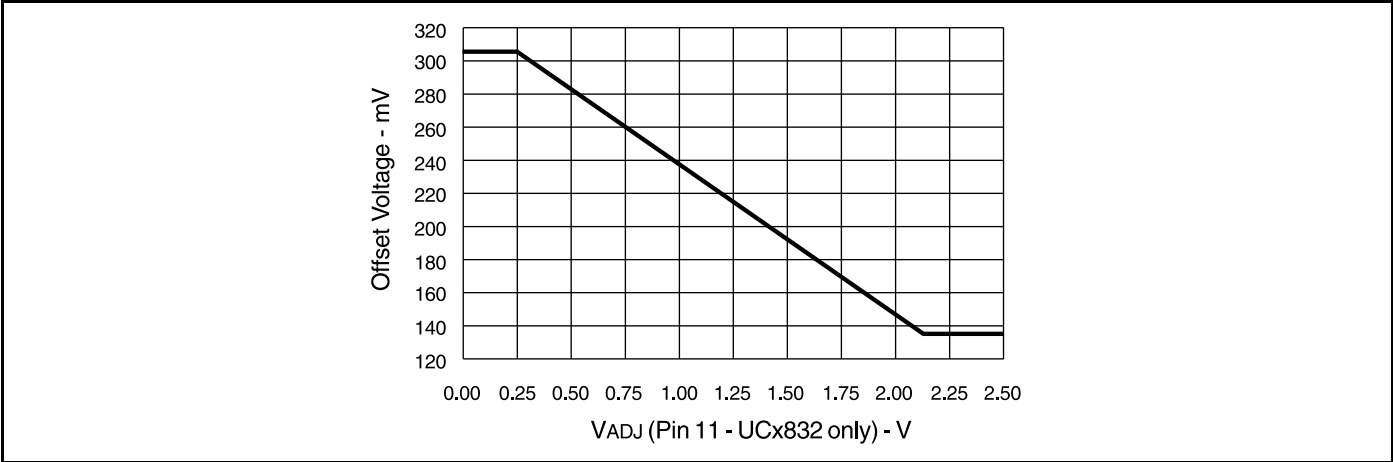
where  $V_{OUT}$  is the nominal regulator output voltage.

For a resistive load of value  $R_L$ , the value of  $C_{MAX}$  can be estimated from:

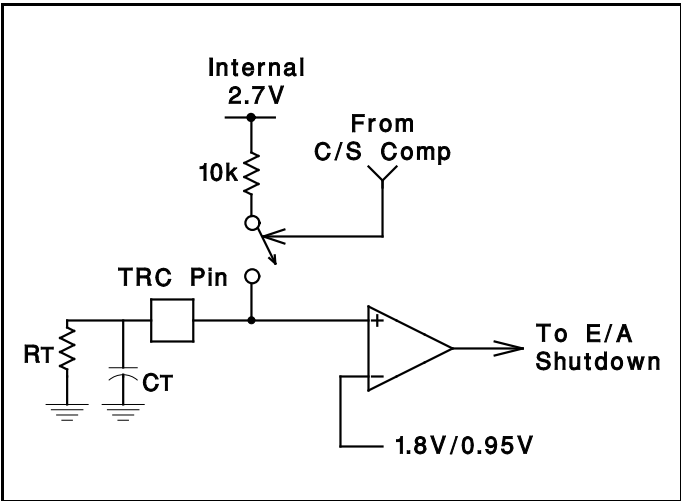
$$C_{MAX} = \frac{T_{ON}}{R_L} \cdot \frac{1}{\ln \left[ \left( 1 - \frac{V_{OUT}}{K \cdot I_{TH} \cdot R_L} \right)^{-1} \right]}$$

APPLICATION AND OPERATION INFORMATION (cont.)

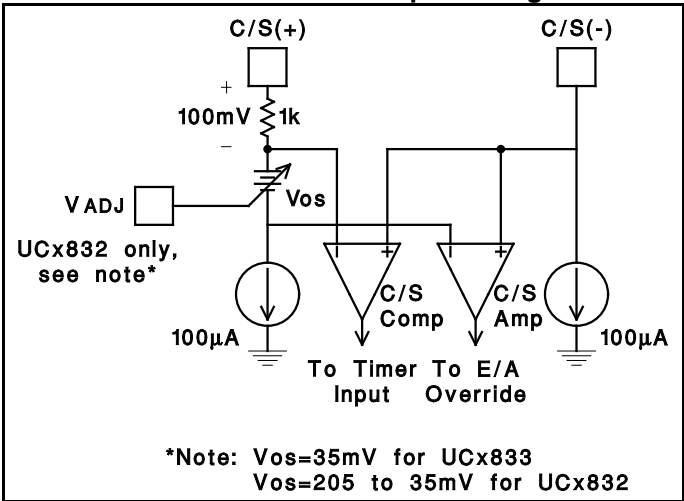
Current Sense Amplifier Offset Voltage vs VADJ



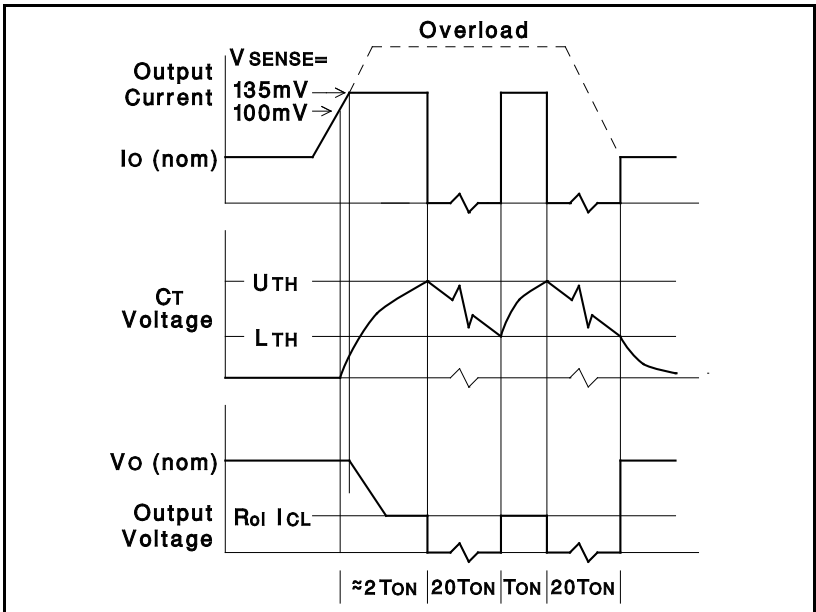
UCx832/33 Timer Function



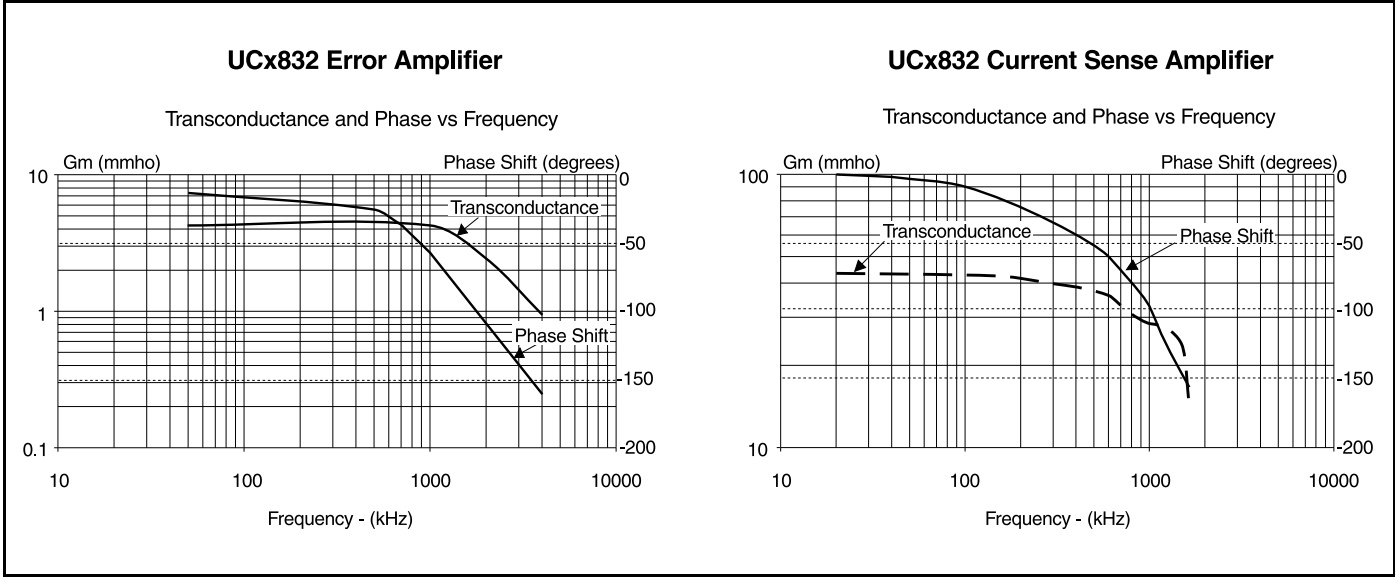
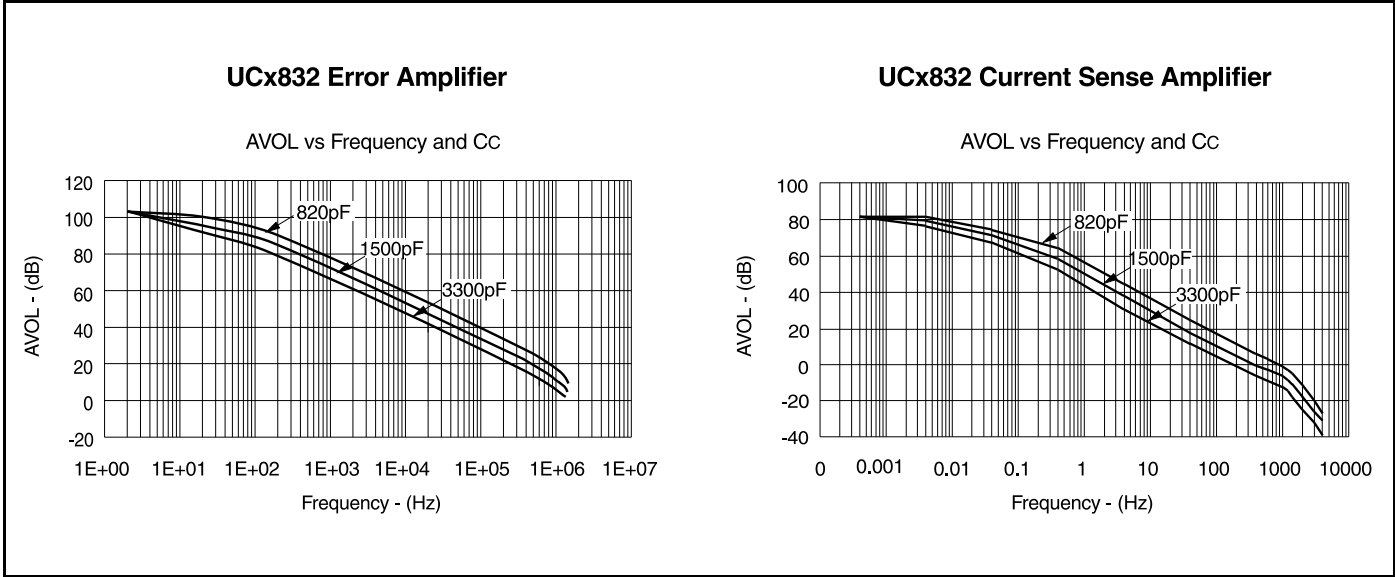
UCx832/33 Current Sense Input Configuration



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



APPLICATION AND OPERATION INFORMATION (cont.)



**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
5962-9326501M2A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
5962-9326501MCA	ACTIVE	CDIP	J	14	1	TBD	A42 SNPB	N / A for Pkg Type
5962-9326501V2A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
5962-9326501VCA	ACTIVE	CDIP	J	14	1	TBD	A42	N / A for Pkg Type
UC1832J	ACTIVE	CDIP	J	14	1	TBD	A42 SNPB	N / A for Pkg Type
UC1832J883B	ACTIVE	CDIP	J	14	1	TBD	A42 SNPB	N / A for Pkg Type
UC1832L883B	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
UC2832DW	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UC2832DWG4	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UC2832DWTR	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UC2832DWTRG4	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UC2833DW	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UC2833DWG4	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UC2833DWTR	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UC2833DWTRG4	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UC2833J	OBSOLETE	CDIP	JG	8		TBD	Call TI	Call TI
UC2833N	ACTIVE	PDIP	P	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type
UC2833NG4	ACTIVE	PDIP	P	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type
UC3832DW	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UC3832DWG4	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UC3832DWTR	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UC3832DWTRG4	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UC3832N	ACTIVE	PDIP	N	14	25	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type
UC3832NG4	ACTIVE	PDIP	N	14	25	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type
UC3833DW	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UC3833DWG4	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UC3833DWTR	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UC3833DWTRG4	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR



Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
UC3833J	OBSOLETE	CDIP	JG	8		TBD	Call TI	Call TI
UC3833N	ACTIVE	PDIP	P	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type
UC3833NG4	ACTIVE	PDIP	P	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

<sup>(3)</sup> 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.

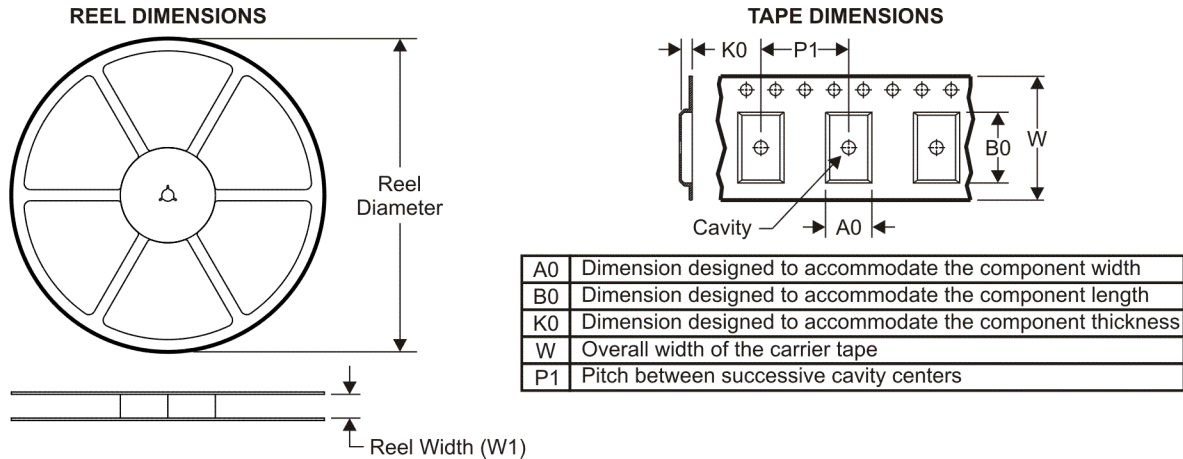
**OTHER QUALIFIED VERSIONS OF UC1832, UC1832-SP, UC2832, UC3832, UC3833 :**

- Enhanced Product: [UC2832-EP](#)
- Military: [UC1833](#)

NOTE: Qualified Version Definitions:

- Enhanced Product - Supports Defense, Aerospace and Medical Applications
- Military - QML certified for Military and Defense Applications

**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
UC2832DWTR	SOIC	DW	16	2000	330.0	16.4	10.85	10.8	2.7	12.0	16.0	Q1
UC2833DWTR	SOIC	DW	16	2000	330.0	16.4	10.85	10.8	2.7	12.0	16.0	Q1
UC3832DWTR	SOIC	DW	16	2000	330.0	16.4	10.85	10.8	2.7	12.0	16.0	Q1
UC3833DWTR	SOIC	DW	16	2000	330.0	16.4	10.85	10.8	2.7	12.0	16.0	Q1

**TAPE AND REEL BOX DIMENSIONS**



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
UC2832DWTR	SOIC	DW	16	2000	346.0	346.0	33.0
UC2833DWTR	SOIC	DW	16	2000	346.0	346.0	33.0
UC3832DWTR	SOIC	DW	16	2000	346.0	346.0	33.0
UC3833DWTR	SOIC	DW	16	2000	346.0	346.0	33.0

J (R-GDIP-T\*\*)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



DIM \ PINS **	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:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package is hermetically sealed with a ceramic lid using glass frit.
  - Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
  - 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



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package can be hermetically sealed with a metal lid.
  - D. The terminals are gold plated.
  - E. Falls within JEDEC MS-004

P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE



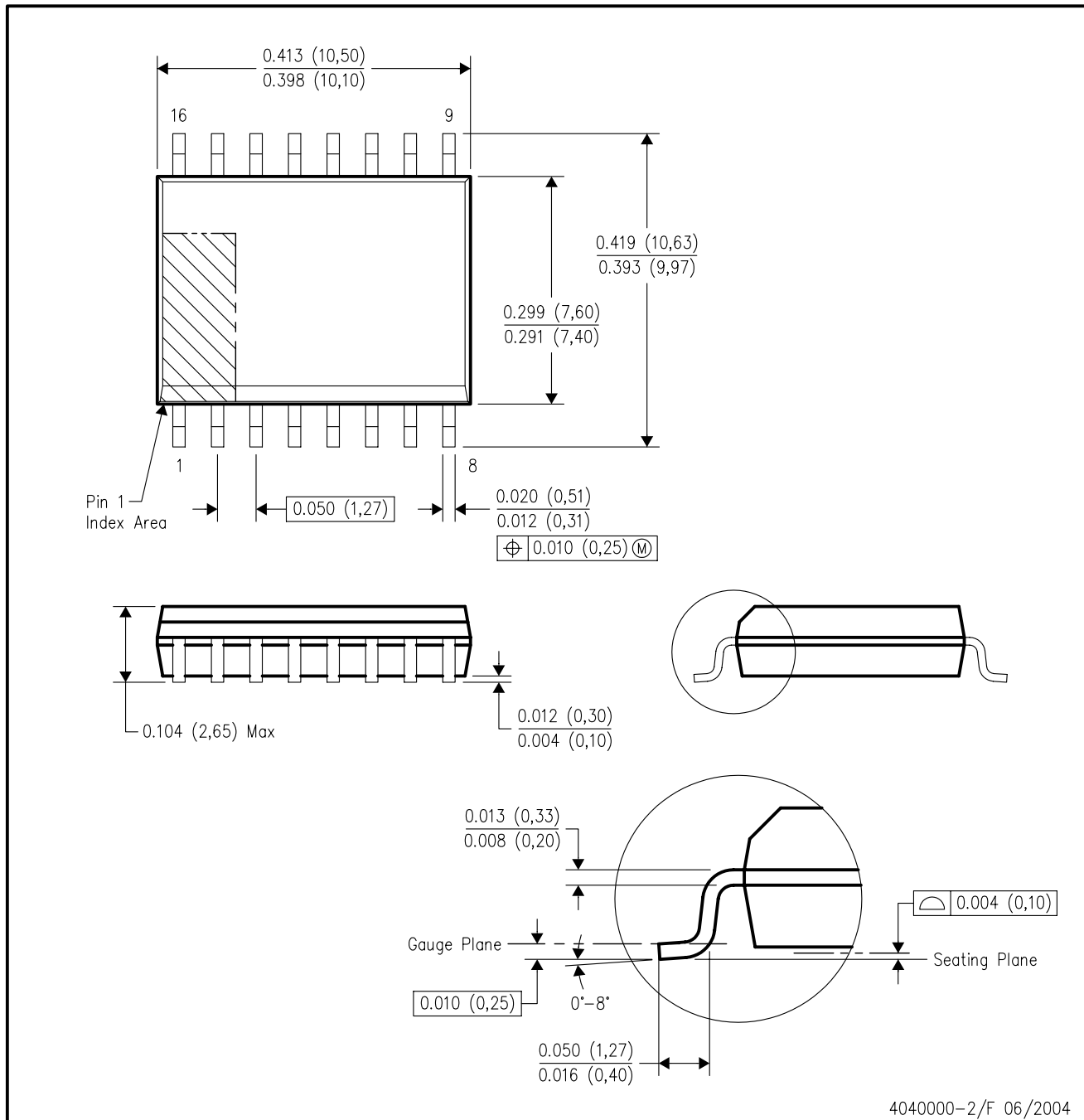
- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. Falls within JEDEC MS-001

For the latest package information, go to [http://www.ti.com/sc/docs/package/pkg\\_info.htm](http://www.ti.com/sc/docs/package/pkg_info.htm)



DW (R-PDSO-G16)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
  - D. Falls within JEDEC MS-013 variation AA.

JG (R-GDIP-T8)

CERAMIC DUAL-IN-LINE



- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. This package can be hermetically sealed with a ceramic lid using glass frit.  
 D. Index point is provided on cap for terminal identification.  
 E. Falls within MIL STD 1835 GDIP1-T8



N (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - The 20 pin end lead shoulder width is a vendor option, either half or full width.

## 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

Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
RF/IF and ZigBee® Solutions	<a href="http://www.ti.com/lprf">www.ti.com/lprf</a>

### Applications

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Broadband	<a href="http://www.ti.com/broadband">www.ti.com/broadband</a>
Digital Control	<a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Military	<a href="http://www.ti.com/military">www.ti.com/military</a>
Optical Networking	<a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Telephony	<a href="http://www.ti.com/telephony">www.ti.com/telephony</a>
Video & Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
Wireless	<a href="http://www.ti.com/wireless">www.ti.com/wireless</a>

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2008, Texas Instruments Incorporated