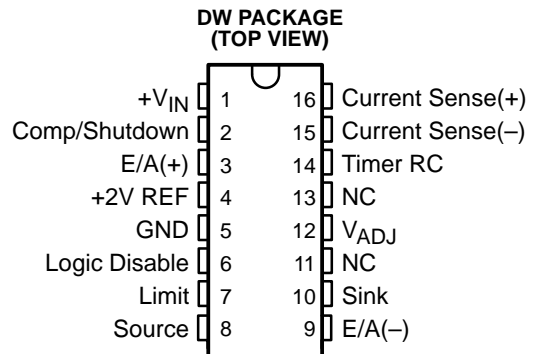


# UC2832-EP PRECISION LOW DROPOUT LINEAR CONTROLLER

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- **Controlled Baseline**
  - One Assembly/Test Site, One Fabrication Site
- **Extended Temperature Performance of –40°C to 105°C**
- **Enhanced Diminishing Manufacturing Sources (DMS) Support**
- **Enhanced Product Change Notification**
- **Qualification Pedigree†**
- **Precision 1% Reference**
- **Over-Current Sense Threshold Accurate to 5%**
- **Programmable Duty-Ratio Over-Current Protection**
- **4.5 V to 36 V Operation**
- **100 mA Output Drive, Source or Sink**
- **Under-Voltage Lockout**
- **Adjustable Current Limit to Current Sense Ratio**
- **Separate +V<sub>IN</sub> terminal**
- **Programmable Driver Current Limit**
- **Access to VREF and E/A(+)**
- **Logic-Level Disable Input**

† Component qualification in accordance with JEDEC and industry standards to ensure reliable operation over an extended temperature range. This includes, but is not limited to, Highly Accelerated Stress Test (HAST) or biased 85/85, temperature cycle, autoclave or unbiased HAST, electromigration, bond intermetallic life, and mold compound life. Such qualification testing should not be viewed as justifying use of this component beyond specified performance and environmental limits.



NC = No Connect

## description

The UC2832 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 UC2832 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.

## ORDERING INFORMATION‡

T <sub>A</sub>	PACKAGE§		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 105°C	SOP – DW	Tape and reel	UC2832TDWREP	UC2832TEP
–40°C to 105°C	SOP – DW	Tube	UC2832TDWEP	UC2832TEP

‡ Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS  
INSTRUMENTS**

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# UC2832-EP PRECISION LOW DROPOUT LINEAR CONTROLLER

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## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†‡

V <sub>IN</sub> supply voltage	40 V
Driver output current (sink or source), I <sub>O</sub>	450 mA
Driver sink to source voltage	40 V
TRC pin voltage	–0.3 V to 3.2 V
Other input voltages	–0.3 V to supply voltage
Operating junction temperature range, T <sub>J</sub>	–55°C to 150°C
Storage temperature range, T <sub>stg</sub>	–65°C to 150°C
Lead temperature soldering 1,6 mm (1/16 inch) from case for 10 seconds	300°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

‡ Unless otherwise indicated, voltages are reference to ground and currents are positive into and negative out of the specified terminals.

## electrical characteristics, T<sub>A</sub> = –40°C to 105°C for the UC2832T-EP, +V<sub>IN</sub> = 15 V, Driver sink = +V<sub>IN</sub>, C/S(+) voltage = +V<sub>IN</sub>, and T<sub>A</sub> = T<sub>J</sub> (unless otherwise stated)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	
<b>Input Supply</b>						
Supply current	+V <sub>IN</sub> = 6 V		6.5	10	mA	
	+V <sub>IN</sub> = 36 V		9.5	15		
	Logic Disable = 2 V		3.3	10		
<b>Reference Section</b>						
Output voltage	I <sub>DRIVER</sub> = 10 mA	T <sub>J</sub> = 25°C	1.98	2	2.02	V
		T <sub>J</sub> = Full range	1.96	2	2.04	
Load regulation voltage	I <sub>OUT</sub> = 0 to 10 mA	–10	–5	10	mV	
Line regulation	+V <sub>IN</sub> = 4.5 V to 36 V, I <sub>DRIVER</sub> = 10 mA		0.033	0.5	mV/V	
Under-voltage lockout threshold			3.6	4.5	V	
<b>Logic Disable Input</b>						
Threshold voltage		1.3	1.4	1.5	V	
Input bias current	Logic Disable = 0 V	–5	–1	0.1	μA	
<b>Current Sense Section</b>						
Comparator offset	T <sub>J</sub> = 25°C	95	100	105	mV	
	T <sub>J</sub> = Full range	93	100	107		
Amplifier offset	V <sub>ADJ</sub> = Open	110	135	170	mV	
	V <sub>ADJ</sub> = 1 V	180	235	290		
	V <sub>ADJ</sub> = 0 V	250	305	360		
Input bias current	V <sub>CM</sub> = +V <sub>IN</sub>	65	100	135	μA	
Input offset current	V <sub>CM</sub> = +V <sub>IN</sub>	–10		10	μA	
Amplifier CMRR	V <sub>CM</sub> = 4.1 V to +V <sub>IN</sub> + 0.3 V		80		dB	
Transconductance	I <sub>COMP</sub> = ±100 μA		65		ms	
V <sub>ADJ</sub> input current	V <sub>ADJ</sub> = 0 V	–10	–1		μA	



# UC2832-EP

## PRECISION LOW DROPOUT LINEAR CONTROLLER

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electrical characteristics,  $T_A = -40^\circ\text{C}$  to  $105^\circ\text{C}$  for the UC2832T-EP,  $+V_{IN} = 15\text{ V}$ , Driver sink =  $+V_{IN}$ , C/S(+) voltage =  $+V_{IN}$ , and  $T_A = T_J$  (unless otherwise stated)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	
<b>Timer</b>						
Inactive leakage current	C/S(+) = C/S(-) = $+V_{IN}$ , TRC pin = 2 V		0.25	1	$\mu\text{A}$	
Active pull-up current	C/S(+) = $+V_{IN}$ , TRC pin = 0 V, C/S(-) = $+V_{IN} - 0.4\text{ V}$	-345	-270	-175	$\mu\text{A}$	
Duty ratio (See Note 1)	ontime/period, $R_T = 200\text{ k}\Omega$ , $C_T = 0.27\text{ }\mu\text{F}$		4.8		%	
Period (See Notes 1 and 2)	ontime + offtime, $R_T = 200\text{ k}\Omega$ , $C_T = 0.27\text{ }\mu\text{F}$		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 Section</b>						
Input offset voltage	$V_{CM} = V_{COMP} = 2\text{ V}$	-8		8	mV	
Input bias current	$V_{CM} = V_{COMP} = 2\text{ V}$	-4.5	-1.1		$\mu\text{A}$	
Input offset current	$V_{CM} = V_{COMP} = 2\text{ V}$	-1.5		1.5	$\mu\text{A}$	
Open loop voltage gain ( $A_{VOL}$ )	$V_{COMP} = 1\text{ V}$ to $13\text{ V}$	50	70		dB	
Common mode rejection ratio (CMRR)	$V_{CM} = 0\text{ V}$ to $+V_{IN} - 3\text{ V}$	60	80		dB	
PSRR	$V_{CM} = 2\text{ V}$ , $+V_{IN} = 4.5\text{ V}$ to $36\text{ V}$		90		dB	
Transconductance	$I_{COMP} = \pm 10\text{ }\mu\text{A}$		4.3		ms	
High-level output voltage ( $V_{OH}$ )	$I_{COMP} = 0$ , Volts below $+V_{IN}$		0.95	1.3	V	
Low-level output voltage ( $V_{OL}$ )	$I_{COMP} = 0$		4.5	0.7	V	
Output high current ( $I_{OH}$ )	$V_{COMP} = 2\text{ V}$	-700	-500	-100	$\mu\text{A}$	
Output low current ( $I_{OL}$ )	$V_{COMP} = 2\text{ V}$	C/S(-) = $+V_{IN}$	100	500	700	$\mu\text{A}$
		C/S(-) = $+V_{IN} - 0.4\text{ V}$	2	6		mA

- NOTES: 1. These parameters are first-order supply-independent, however, both may vary with supply for  $+V_{IN}$  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.  
 2. With recommended  $R_T$  value of 200 k $\Omega$ ,  $T_{OFF} \approx R_T C_T * \ln(V_U/V_L) \pm 10\%$ .



# UC2832-EP PRECISION LOW DROPOUT LINEAR CONTROLLER

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electrical characteristics,  $T_A = -40^\circ\text{C}$  to  $105^\circ\text{C}$  for the UC2832T-EP,  $+V_{IN} = 15\text{ V}$ , Driver sink =  $+V_{IN}$ , C/S(+) voltage =  $+V_{IN}$ , and  $T_A = T_J$  (unless otherwise stated)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	
<b>Driver Section</b>						
Maximum current	Driver limit and source pins common	$T_J = 25^\circ\text{C}$	200	300	400	mA
		$T_J = \text{Full range}$	100	300	450	
Limiting voltage	Driver limit to source voltage at current limit, $I_{\text{SOURCE}} = -10\text{ mA}$ , $T_J = 25^\circ\text{C}$ , See Note 3		0.72		V	
Internal current sense resistance	$T_J = 25^\circ\text{C}$ , See Note 3		2.4		$\Omega$	
Pull-up current at driver sink	Compensation/Shutdown = 0.4 V	Driver sink = $+V_{IN} - 1\text{ V}$	-800	-300	-100	$\mu\text{A}$
		$+V_{IN} = 36\text{ V}$ , Driver sink = 35 V	-1000	-300	-75	
Pull-down current at driver source	Compensation/Shutdown = 0.4 V, Driver source = 1 V	150	300	700	$\mu\text{A}$	
Saturation voltage sink to source	Driver source = 0 V, Driver current = 100 mA		1.5		V	
Maximum source voltage	Driver sink = $+V_{IN}$ , Driver current = 100 mA, Volts below $+V_{IN}$		3		V	
UVLO sink leakage	$+V_{IN} = \text{C/S}(+) = \text{C/S}(-) = 2.5\text{ V}$ , Driver sink = 15 V, Driver source = 0 V, $T_A = 25^\circ\text{C}$		25		$\mu\text{A}$	
Maximum reverse source voltage	Compensation/Shutdown = 0 V, $I_{\text{SOURCE}} = 100\ \mu\text{A}$ , ( $+V_{IN} = 3\text{ V}$ )		1.6		V	
Thermal shutdown			160		$^\circ\text{C}$	

NOTES: 3. The internal current limiting voltage has a temperature dependence of approximately  $-2.0\text{ mV}/^\circ\text{C}$ , or  $-2800\text{ ppm}/^\circ\text{C}$ . The internal  $2.4\ \Omega$  sense resistor has a temperature dependence of approximately  $+1500\text{ ppm}/^\circ\text{C}$ .

## APPLICATION AND OPERATION INFORMATION

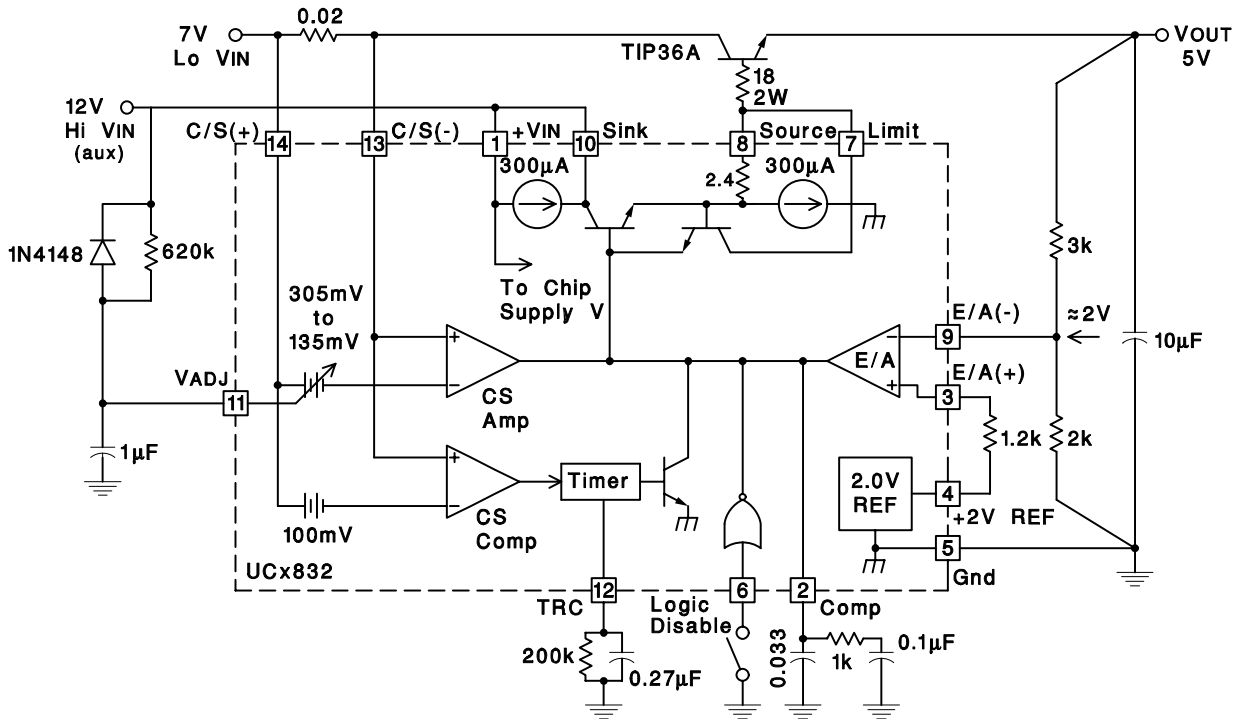


Figure 1. NPN Pass (Medium Power, Low Drop-Out Regulator)



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## APPLICATION AND OPERATION INFORMATION

### 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 ensure 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,  $T_{ON} = 0.693 \times 10 \text{ k}\Omega \times C_T$ .

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

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

and is variable from 1.35 to 3.05 with  $V_{ADJ}$ .

For a worst-case constant-current load of value just less than  $I_{TH}$ ,  $C_{MAX}$  can be estimated from:

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

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:

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

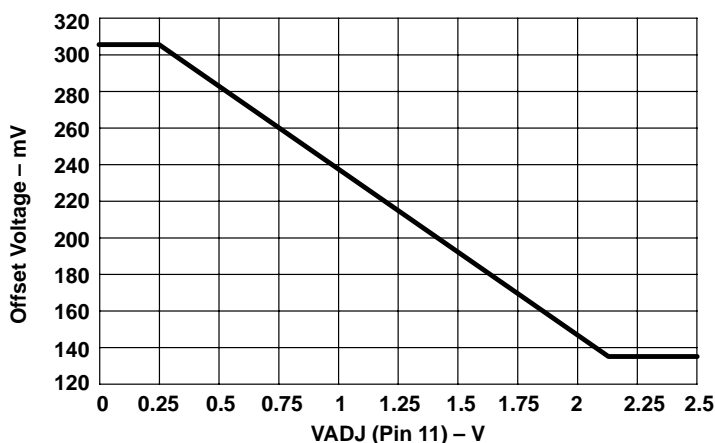
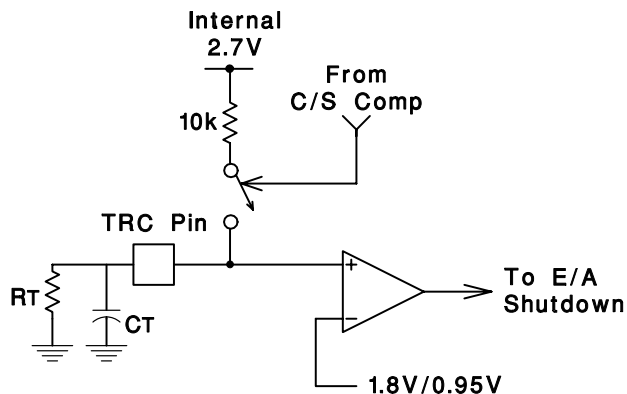
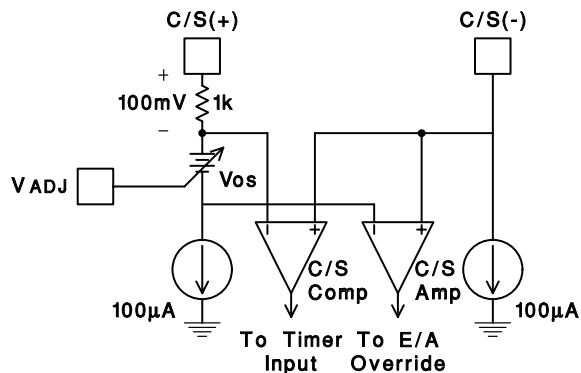


Figure 2. Current Sense Amplifier Offset Voltage vs  $V_{ADJ}$

**APPLICATION AND OPERATION INFORMATION**

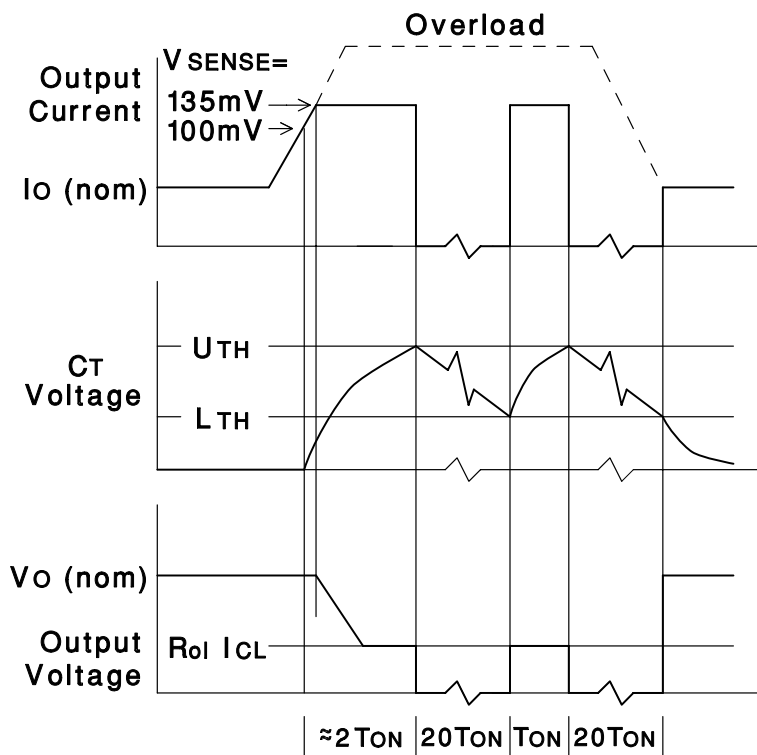


**Figure 3. Timer Function**



NOTE A:  $V_{OS} = 205 \text{ mV to } 35 \text{ mV}$

**Figure 4. Current Sense Input Configuration**



**Figure 5. Load Current, Timing Capacitor Voltage, and Output Voltage of the Regulator Under Fault Conditions**

# UC2832-EP PRECISION LOW DROPOUT LINEAR CONTROLLER

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## APPLICATION AND OPERATION INFORMATION

### UCx832 Error Amplifier

AVOL vs Frequency and Cc

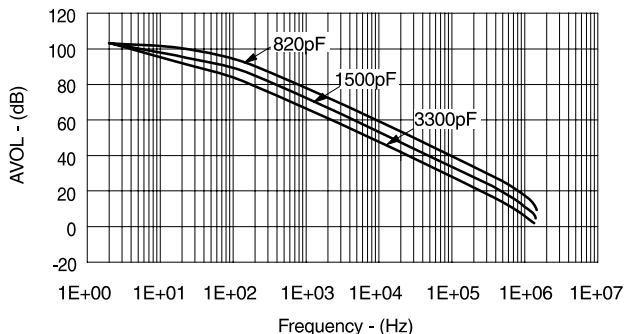


Figure 6. UCx832 Error Amplifier

### UCx832 Current Sense Amplifier

AVOL vs Frequency and Cc

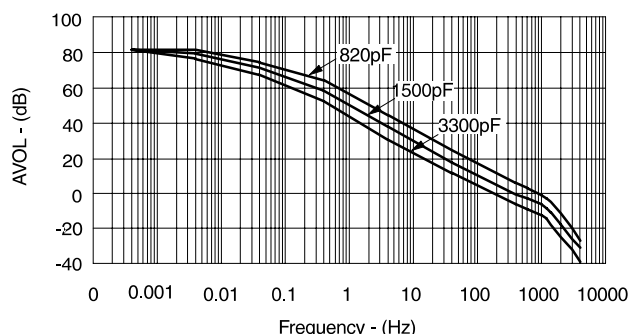


Figure 7. UCx832 Current Sense Amplifier

### UCx832 Error Amplifier

Transconductance and Phase vs Frequency

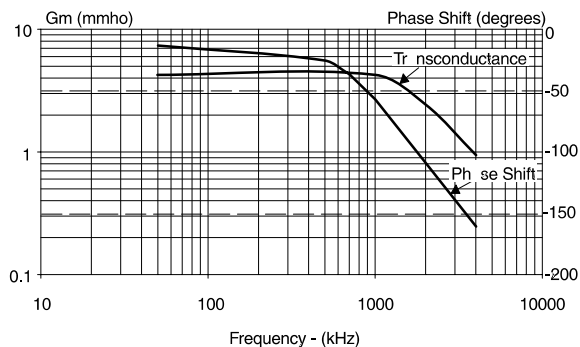


Figure 8. UCx832 Error Amplifier

### UCx832 Current Sense Amplifier

Transconductance and Phase vs Frequency

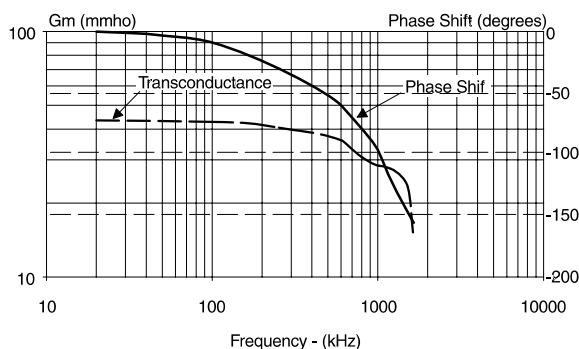


Figure 9. UCx832 Current Sense Amplifier



**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
UC2832TDWEP	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 105	UC2832TEP	<b>Samples</b>

(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.

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**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.

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**OTHER QUALIFIED VERSIONS OF UC2832-EP :**

- Catalog: [UC2832](#)

## NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

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