



Precision Low Dropout Linear Controllers

FEATURES

- Precision 1% Reference
- Over-Current Sense Threshold Accurate to 5%
- Programmable Duty-Ratio Over-Current Protection
- 4.5V to 36V Operation
- 100mA Output Drive, Source or Sink
- Under-Voltage Lockout

Additional Features of the UC1832 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

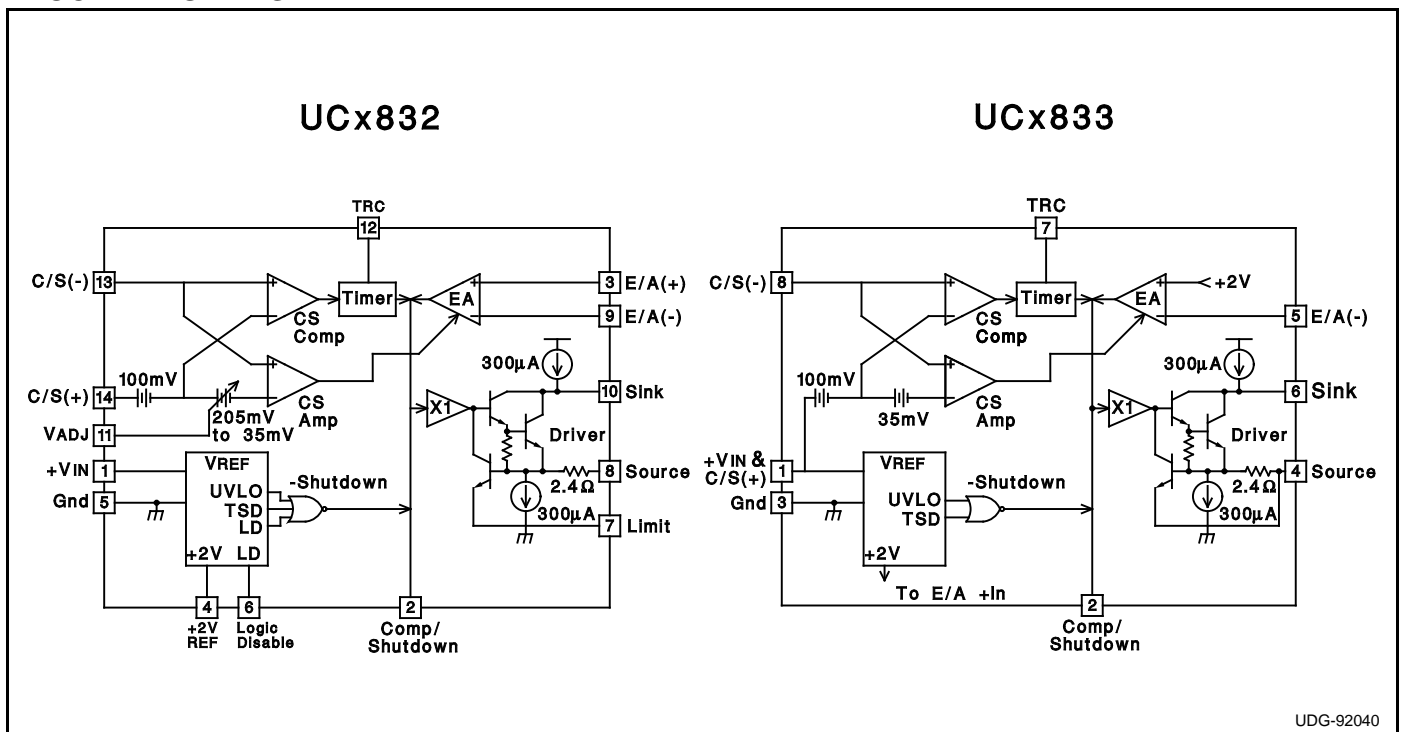
DESCRIPTION

The UC1832 and UC1833 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 UC1833 family includes the basic functions of this design in a low-cost, 8-pin mini-dip package, while the UC1832 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); industrial (-25°C to 85°C), order UC2832/3 (N or J); and military (-55°C to 125°C), order UC1832/3J. 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

UC1832

**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 |

UC1833

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

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

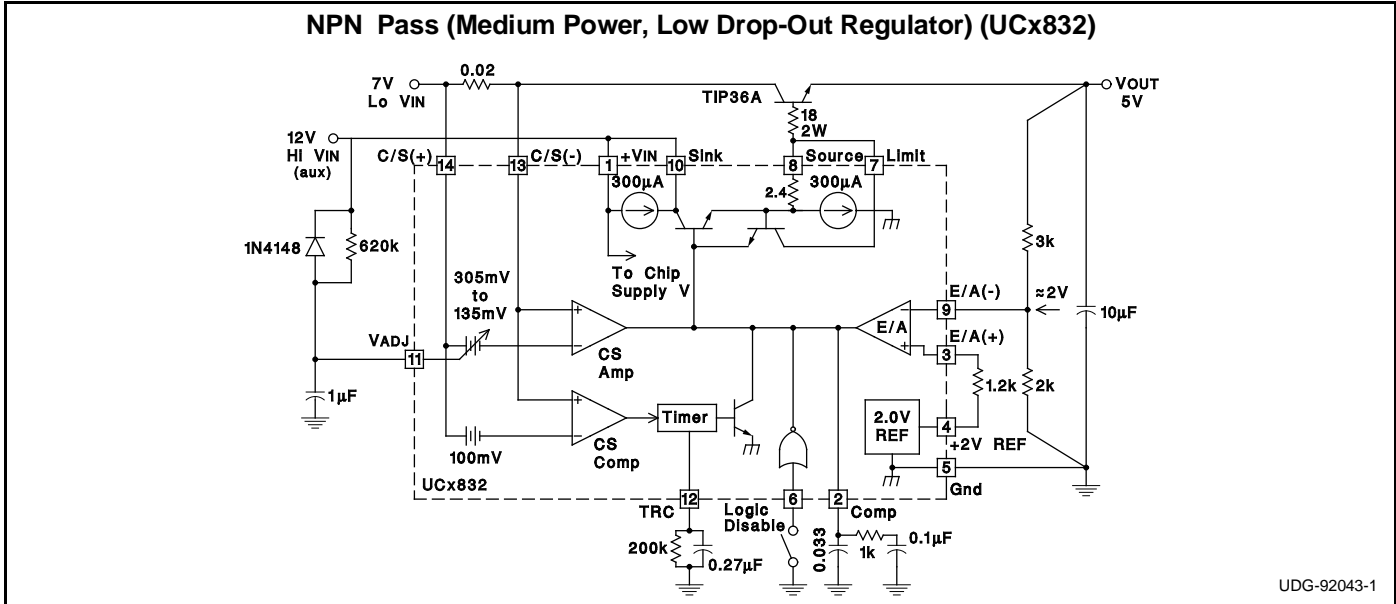
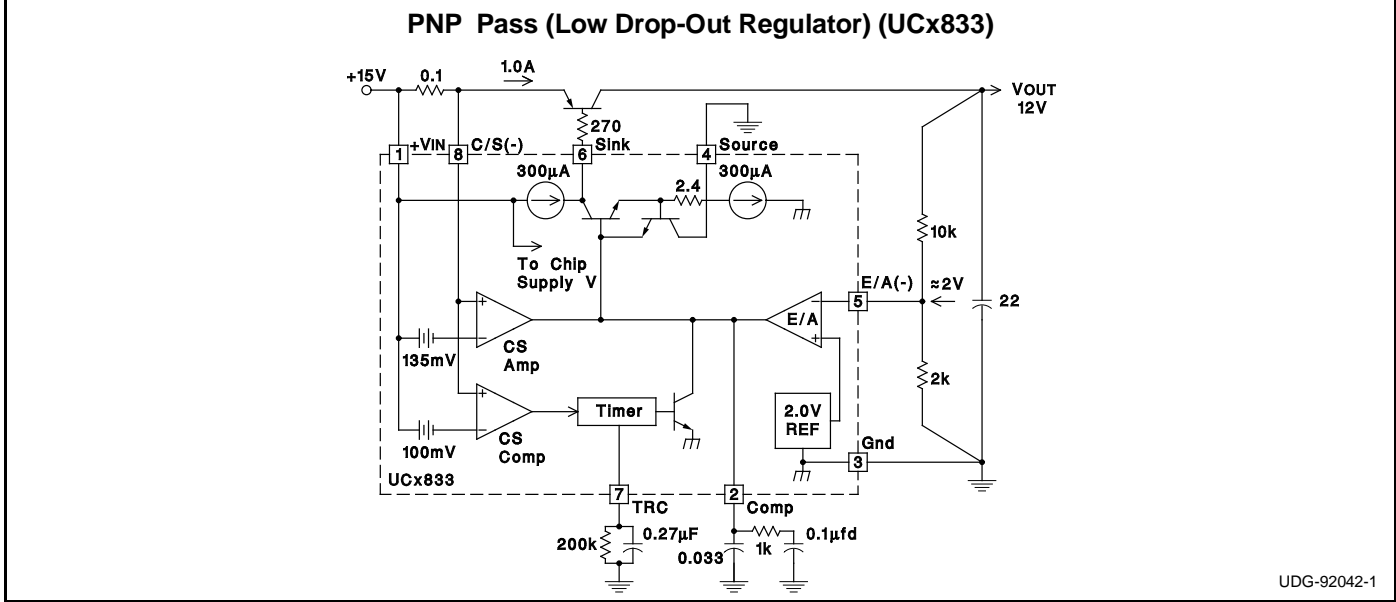
**LCC-20 & PLCC-20
L & Q Package
(Top View)**

| 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 |
| Timer RC | 14 |
| Current Sense(-) | 15 |
| N/C | 16 |
| N/C | 17 |
| N/C | 18 |
| N/C | 19 |
| N/C | 20 |

ELECTRICAL CHARACTERISTICS: Unless otherwise stated, specifications hold for $T_A = 0^\circ\text{C}$ to 70°C for the UC3832/3, -25°C to 85°C for the UC2832/3, and -55°C to 125°C for the UC1832/3, $+V_{IN} = 15\text{V}$, Driver sink = $+V_{IN}$, C/S(+) voltage = $+V_{IN}$. $T_A = T_J$.

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNITS |
|--|--|------|-------|------|---------------|
| Input Supply | | | | | |
| Supply Current | $+V_{IN} = 6\text{V}$ | | 6.5 | 10 | mA |
| | $+V_{IN} = 36\text{V}$ | | 9.5 | 15 | mA |
| | Logic Disable = 2V (UCx832 only) | | 3.3 | | mA |
| Reference Section | | | | | |
| 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) | $I_{OUT} = 0$ to 10mA | -10 | -5.0 | | mV |
| Line Regulation | $+V_{IN} = 4.5$ to 36V , $I_{DRIVER} = 10\text{mA}$ | | 0.033 | 0.5 | mV/V |
| Under-Voltage Lockout Threshold | | | 3.6 | 4.5 | V |
| Logic Disable Input (UCx832 only) | | | | | |
| Threshold Voltage | | 1.3 | 1.4 | 1.5 | V |
| Input Bias Current | Logic Disable = 0V | -5.0 | -1.0 | | μA |
| Current Sense Section | | | | | |
| 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 | μA |
| Input Offset Current (UCx832 only) | $V_{CM} = +V_{IN}$ | -10 | | 10 | μA |
| Amplifier CMRR (UCx832 only) | $V_{CM} = 4.1\text{V}$ to $+V_{IN} + 0.3\text{V}$ | | 80 | | dB |
| Transconductance | $I_{COMP} = \pm 100\mu\text{A}$ | | 65 | | mS |
| V_{ADJ} Input Current (UCx832 only) | $V_{ADJ} = 0\text{V}$ | -10 | -1 | | μA |
| Timer | | | | | |
| Inactive Leakage Current | C/S(+) = C/S(-) = $+V_{IN}$; TRC pin = 2V | | 0.25 | 1.0 | μA |
| Active Pullup Current | C/S(+) = $+V_{IN}$, C/S(-) = $+V_{IN} - 0.4\text{V}$; TRC pin = 0V | -345 | -270 | -175 | μA |
| 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 |
| Error Amplifier | | | | | |
| 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 | | μA |
| Input Offset Current (UCx832 only) | $V_{CM} = V_{COMP} = 2\text{V}$ | -1.5 | | 1.5 | μA |
| AVOL | $V_{COMP} = 1\text{V}$ to 13V | 50 | 70 | | dB |
| CMRR (UCx832 only) | $V_{CM} = 0\text{V}$ to $+V_{IN} - 3\text{V}$ | 60 | 80 | | dB |
| PSRR (UCx832 only) | $V_{CM} = 2\text{V}$, $+V_{IN} = 4.5$ to 36V | | 90 | | dB |
| Transconductance | $I_{COMP} = \pm 10\mu\text{A}$ | | 4.3 | | 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 | μA |

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

≈ 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:

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

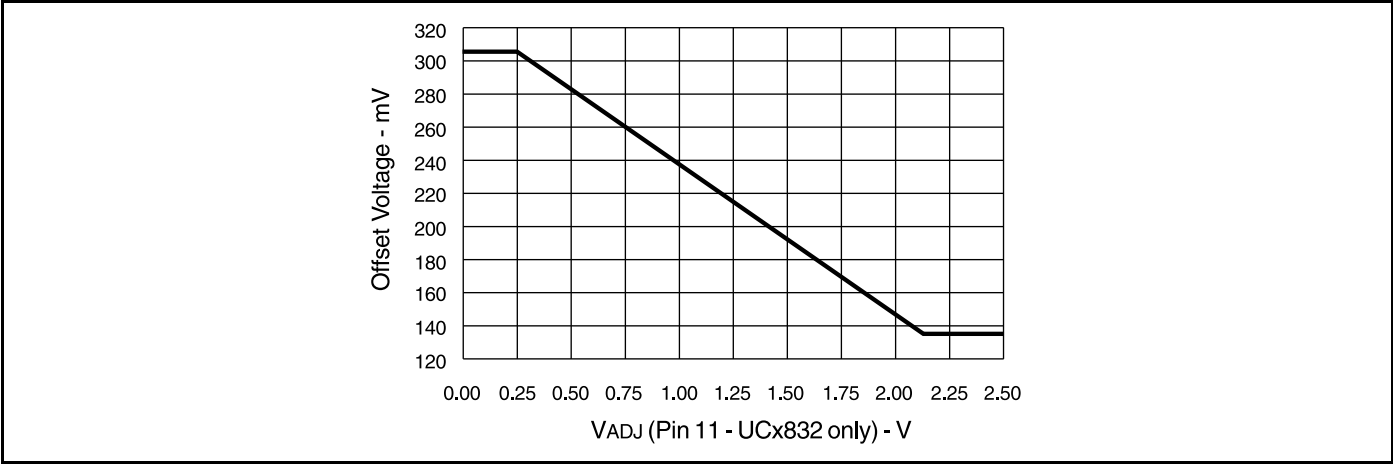
where V_{OUT} is the nominal regulator output voltage.

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

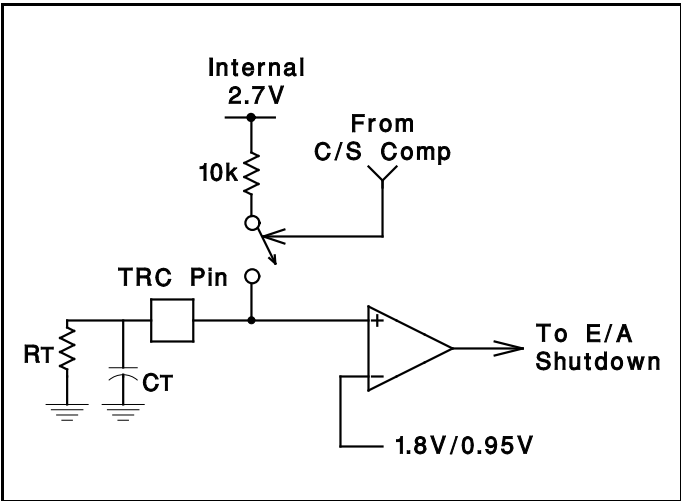
$$C_{MAX} = \frac{T_{ON}}{R_L} \cdot \frac{1}{\ln \left[\left(1 - \frac{V_{OUT}}{K \cdot I_{TH} \cdot R_L} \right)^{-1} \right]}$$

APPLICATION AND OPERATION INFORMATION (cont.)

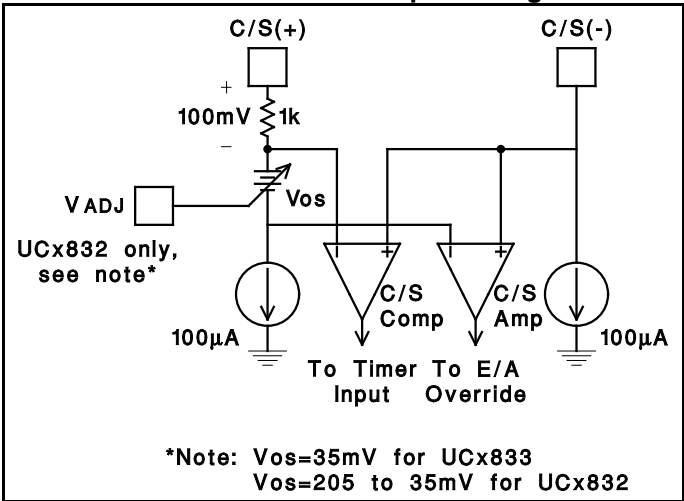
Current Sense Amplifier Offset Voltage vs VADJ



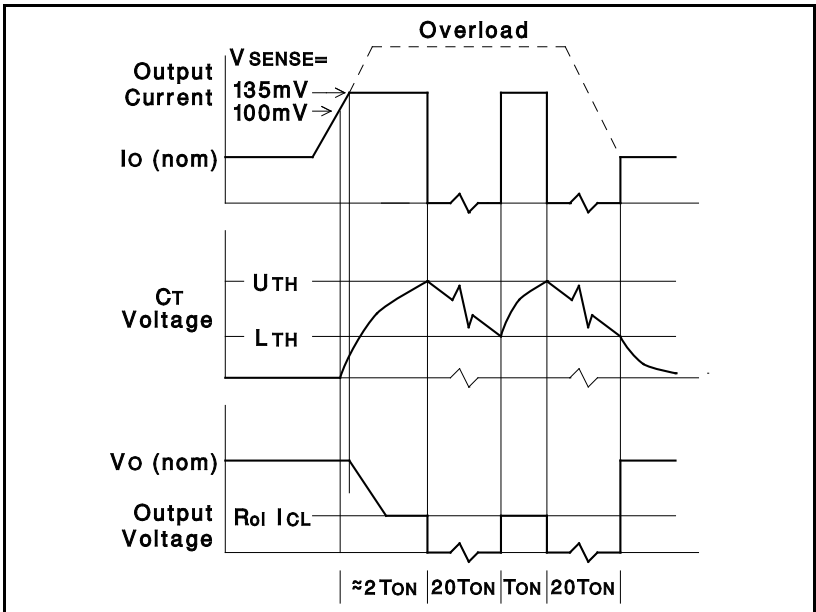
UCx832/33 Timer Function



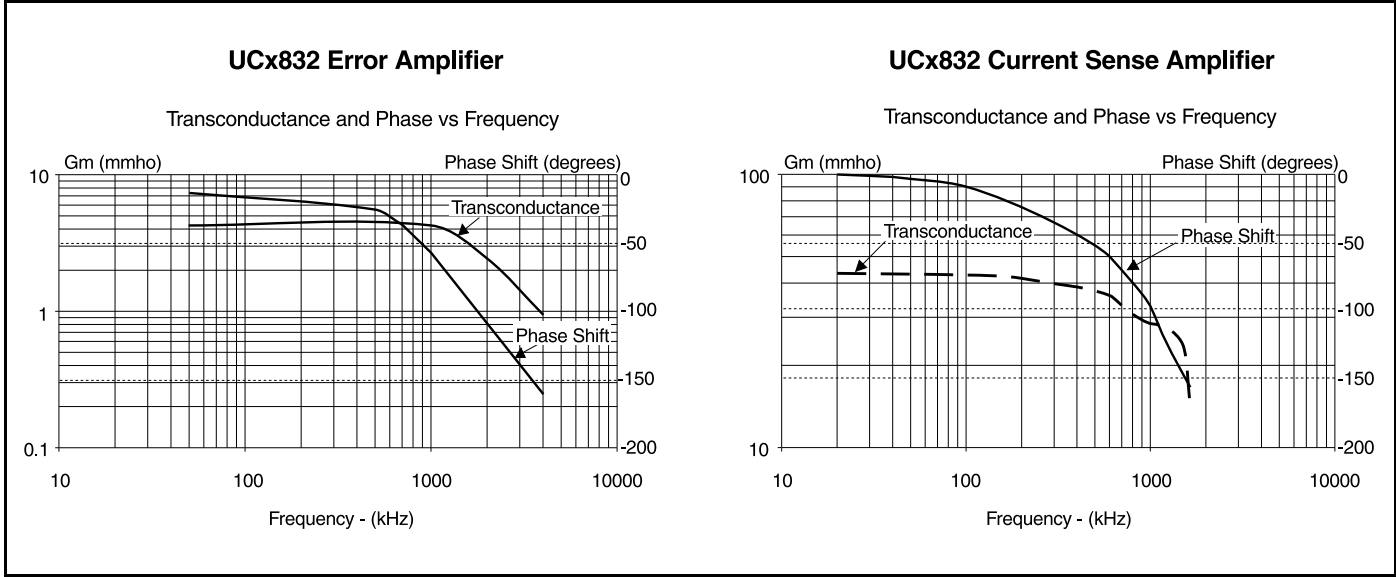
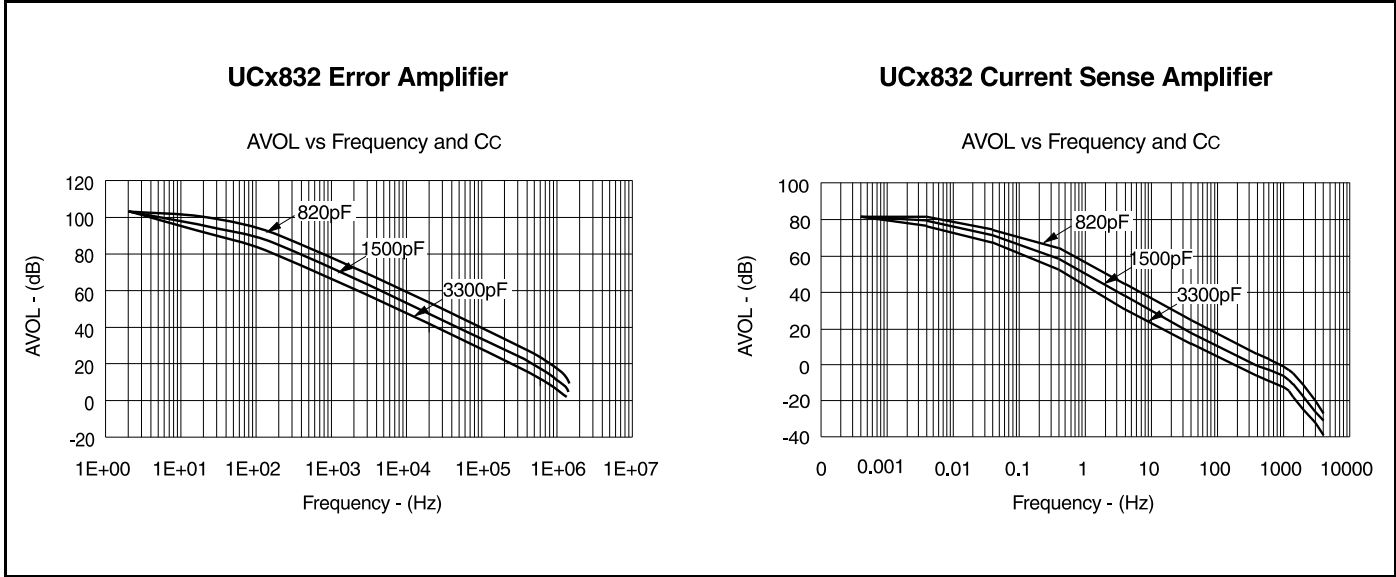
UCx832/33 Current Sense Input Configuration



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



APPLICATION AND OPERATION INFORMATION (cont.)



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