

# Fast LDO Linear Regulator

## FEATURES

- Fast Transient Response
- 10mA to 5A Load Current
- Short Circuit Protection
- Maximum Dropout of 500mV at 5A Load Current
- Separate Bias and VIN Pins
- Available in Adjustable or Fixed Output Voltages
- 5 Pin Package allows Kelvin Sensing of Load Voltage
- Reverse Current Protection

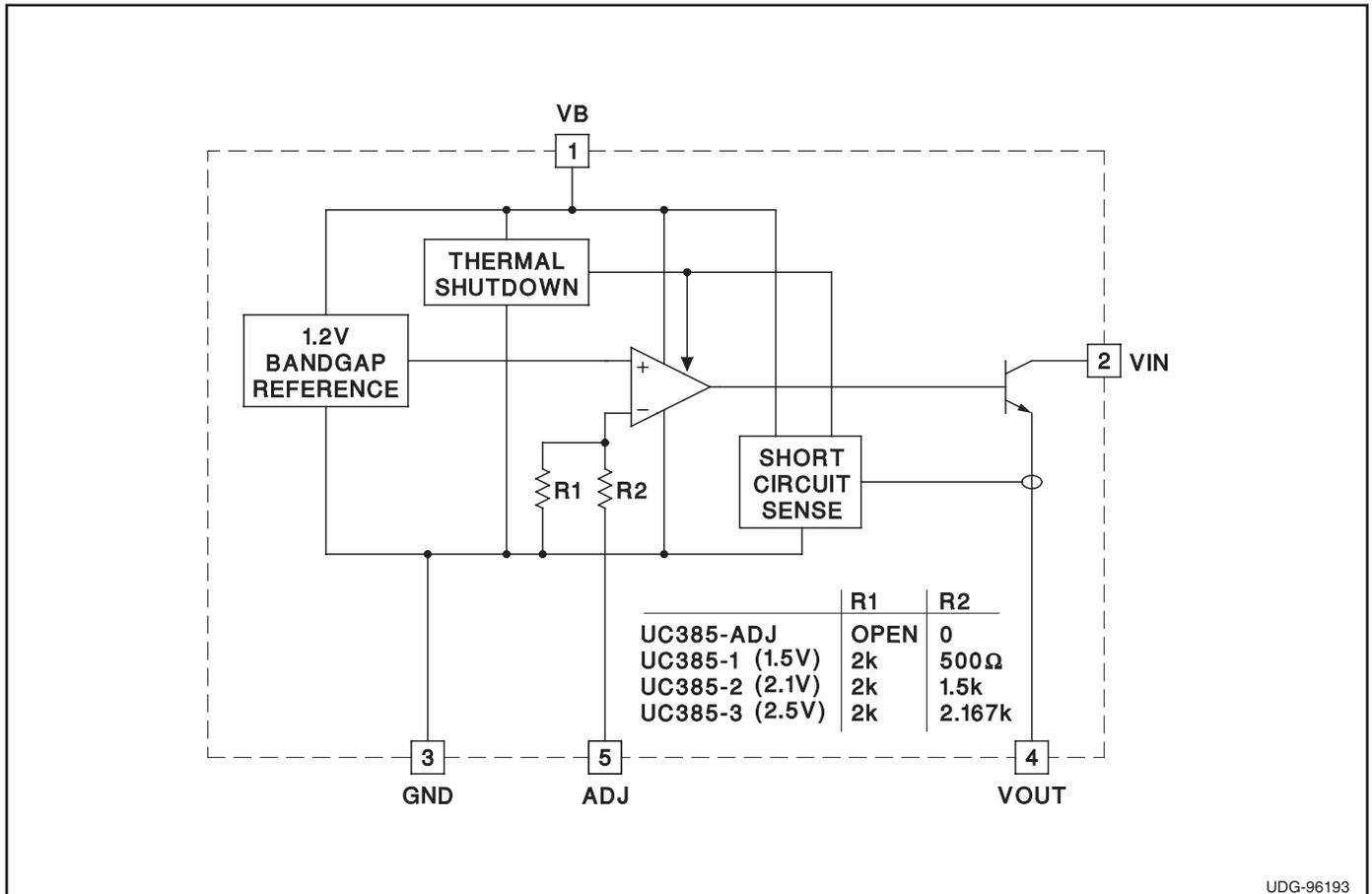
## DESCRIPTION

The UC385 is a low dropout linear regulator providing a quick response to fast load changes. Combined with its precision on-board reference, the UC385 excels at driving GTL and BTL buses. Due to its fast response to load transients, the total capacitance required to decouple the regulator's output can be significantly decreased when compared to standard LDO linear regulators.

Dropout voltage ( $V_{IN}$  to  $V_{OUT}$ ) is only 490mV maximum and 350mV typical at 5A load ( $-40^{\circ}\text{C}$  to  $+100^{\circ}\text{C}$ ).

The on-board bandgap reference is stable with temperature and scaled for a 1.200V input to the internal power amplifier. The UC385 is available in fixed output voltages of 1.5V, 2.1V, or 2.5V. The output voltage of the adjustable version can be set with two external resistors. If the external resistors are omitted, the output voltage defaults to 1.2V.

## BLOCK DIAGRAM



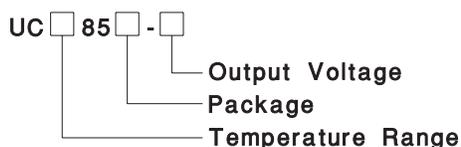
UDG-96193

### ABSOLUTE MAXIMUM RATINGS\*

VIN	+7.5V
Output Voltage	+1.2V to 6.0V
Storage Temperature	-65°C to +150°C
Junction Temperature	-55°C to +150°C
Lead Temperature (Soldering, 10 sec.)	+300°C

\* Values beyond which damage may occur. Currents are positive into, negative out of the specified terminal. Consult Packaging Section of Databook for thermal limitations and considerations of packages.

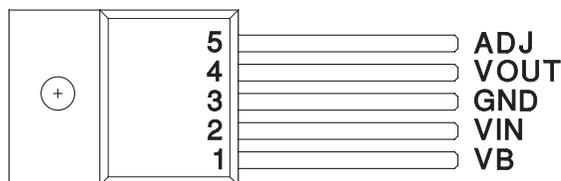
### ORDERING INFORMATION



Temperature Range	Package	Output Voltage
1: -55°C to +125°C	T: TO-220	1: 1.5V
2: -40°C to +100°C	TD: TO-263	2: 2.1V
3: 0°C to +100°C		3: 2.5V
		ADJ: 1.2V or Adjustable

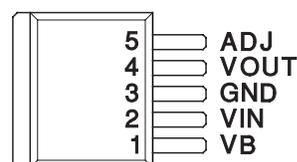
### CONNECTION DIAGRAMS

5-Pin TO-220 (Top View)  
 T Package



Note: Tab = Ground

5-Pin TO-263 (Top View)  
 TD Package



Note: Tab = Ground

**ELECTRICAL CHARACTERISTICS:** Unless otherwise stated, these parameters apply for  $T_A = -55^\circ\text{C}$  to  $125^\circ\text{C}$  for the UC185-X series,  $-40^\circ\text{C}$  to  $+100^\circ\text{C}$  for the UC285-X series and  $0^\circ\text{C}$  to  $+100^\circ\text{C}$  for the UC385-X,  $V_B = 5\text{V}$ ;  $V_{IN} = 3.3\text{V}$ ,  $V_{OUT} = 2.5\text{V}$ ,  $T_A = T_J$ .

PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT
<b>UC385-3 Fixed 2.5V, 5A Family</b>					
Output Voltage ( $I_{VOUT} = 100\text{mA}$ )	UC385-3	2.475	2.5	2.525	V
	UC285-3 and UC185-3	2.45	2.5	2.525	V
Load Regulation	$I_{VOUT} = 10\text{mA}$ to 5A		0.5	4	mV
VIN PSRR		80	110		dB
VB PSRR		50	65		dB
VIN Dropout Voltage = $V_{IN} - V_{OUT}$	$I_{VOUT} = 5\text{A}$ , $T_J = 25^\circ\text{C}$		350	425	mV
	$I_{VOUT} = 5\text{A}$ , UC385-3		350	490	mV
	$I_{VOUT} = 5\text{A}$ , UC285-3 and UC185-3		350	500	mV
VB Dropout = $V_B - V_{OUT}$	$I_{VOUT} = 5\text{A}$ , UC385-3		1.9		V
	$I_{VOUT} = 5\text{A}$ , UC285-3		1.9		V
	$I_{VOUT} = 5\text{A}$ , UC185-3		1.9		V
Short Circuit Current Limit		5.1		7.5	A
VB Current	$I_{VOUT} = 10\text{mA}$		8	15	mA
	$I_{VOUT} = 5\text{A}$		40	100	mA
VIN Current	$I_{VOUT} = 5\text{A}$	4.9	4.96		A
<b>UC385-2 Fixed 2.1V, 5A Family</b>					
Output Voltage ( $I_{VOUT} = 100\text{mA}$ )	UC385-2	2.079	2.1	2.121	V
	UC285-2 and UC185-2	2.058	2.1	2.121	V
Load Regulation	$I_{VOUT} = 10\text{mA}$ to 5A		0.5	4	mV
VIN PSRR		80	110		dB
VB PSRR		50	67		dB

**ELECTRICAL CHARACTERISTICS:** Unless otherwise stated, these parameters apply for  $T_A = -55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$  for the UC185-X series,  $-40^{\circ}\text{C}$  to  $+100^{\circ}\text{C}$  for the UC285-X series and  $0^{\circ}\text{C}$  to  $+100^{\circ}\text{C}$  for the UC385-X,  $V_B = 5\text{V}$ ;  $V_{IN} = 3.3\text{V}$ ,  $V_{OUT} = 2.5\text{V}$ ,  $T_A = T_J$ .

PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT
<b>UC385-2 Fixed 2.1V, 5A Family (cont.)</b>					
VIN Dropout Voltage = $V_{IN} - V_{OUT}$	$I_{VOUT} = 5\text{A}$ , $T_J = 25^{\circ}\text{C}$		350	425	mV
	$I_{VOUT} = 5\text{A}$ , UC385-2		350	490	mV
	$I_{VOUT} = 5\text{A}$ , UC285-2 and UC185-2		350	500	mV
VB Dropout = $V_B - V_{OUT}$	$I_{VOUT} = 5\text{A}$ , UC385-2		1.9		V
	$I_{VOUT} = 5\text{A}$ , UC285-2		1.9		V
	$I_{VOUT} = 5\text{A}$ , UC185-2		1.9		V
Short Circuit Current Limit		5.1		7.5	A
VB Current	$I_{VOUT} = 10\text{mA}$		8	15	mA
	$I_{VOUT} = 5\text{A}$		40	100	mA
VIN Current	$I_{VOUT} = 5\text{A}$	4.9	4.96		A
<b>UC385-1 Fixed 1.5V, 5A Family</b>					
Output Voltage ( $I_{VOUT} = 100\text{mA}$ )	UC385-1	1.485	1.5	1.515	V
	UC285-1 and UC185-1	1.470	1.5	1.515	V
Load Regulation	$I_{VOUT} = 10\text{mA}$ to $5\text{A}$		0.5	4	mV
VIN PSRR		80	110		dB
VB PSRR		50	65		dB
VIN Dropout Voltage = $V_{IN} - V_{OUT}$	$I_{VOUT} = 5\text{A}$ , $T_J = 25^{\circ}\text{C}$		350	425	mV
	$I_{VOUT} = 5\text{A}$ , UC285-1		350	490	mV
	$I_{VOUT} = 5\text{A}$ , UC285-2 and UC185-1		350	500	mV
VB Dropout = $V_B - V_{OUT}$	$I_{VOUT} = 5\text{A}$ , UC385-1		1.9		V
	$I_{VOUT} = 5\text{A}$ , UC285-1		1.9		V
	$I_{VOUT} = 5\text{A}$ , UC185-1		1.9		V
Short Circuit Current Limit		5.1		7.5	A
VB Current	$I_{VOUT} = 10\text{mA}$		8	15	mA
	$I_{VOUT} = 5\text{A}$		40	100	mA
VIN = Current	$I_{VOUT} = 5\text{A}$	4.9	4.96		A
<b>UC385-ADJ Adjustable, 5A Family</b>					
ADJ Voltage ( $I_{VOUT} = 100\text{mA}$ )	UC385-ADJ	1.188	1.2	1.212	V
	UC285-ADJ and UC185-ADJ	1.176	1.2	1.212	V
Load Regulation	$I_{VOUT} = 10\text{mA}$ to $5\text{A}$		0.5	4	mV
VIN PSRR	$V_{OUT}$ Programmed for 2.5V	80	110		dB
VB PSRR $V_{OUT}$	Programmed for 2.5V	50	65		dB
VIN Dropout Voltage = $V_{IN} - V_{OUT}$	$I_{VOUT} = 5\text{A}$ , $T_J = 25^{\circ}\text{C}$		350	425	mV
	$I_{VOUT} = 5\text{A}$ , UC385-ADJ		350	490	mV
	$I_{VOUT} = 5\text{A}$ , UC285-ADJ and UC185-ADJ		350	500	mV
VB Dropout = $V_B - V_{OUT}$	$I_{VOUT} = 5\text{A}$ , UC385-ADJ		1.9		V
	$I_{VOUT} = 5\text{A}$ , UC285-ADJ		1.9		V
	$I_{VOUT} = 5\text{A}$ , UC185-ADJ		1.9		V
Short Circuit Current Limit		5.1		7.5	A
VB Current	$I_{VOUT} = 10\text{mA}$		8	15	mA
	$I_{VOUT} = 5\text{A}$		40	100	mA
VIN Current	$I_{VOUT} = 5\text{A}$	4.9	4.96		A

## PIN DESCRIPTIONS

**ADJ:** In the adjustable version, the user programs the output voltage with two external resistors. The resistors should be 0.1% for high accuracy. The output amplifier is configured as a non-inverting operational amplifier. The resistors should meet the criteria of  $R3 \parallel R4 < 100\Omega$ . Connect ADJ to VOUT for an output voltage of 1.2V. Note that the point at which the feedback network is connected to the output is the Kelvin sense point.

**GND:** For accurate results, the GND pin should be referenced to the load ground.

**VB:** Supplies power to all circuits of the regulator except the output power transistor. The 2V headroom from VB to VOUT allows the use of a Darlington output stage for inherently low output impedance and fast response.

(Dropout is derated for junction temperatures below 0°C.)

**VIN:** Supplies the current to the collector of the output power transistor only. The dropout ( $V_{IN} - V_{OUT}$ ) is under 100mV for light loads; maximum dropout is 490mV at 5A for  $T_J = 0^\circ\text{C}$  to  $+110^\circ\text{C}$ . (Dropout is derated for junction temperatures over  $110^\circ\text{C}$ .)

**VOUT:** This pin should be connected to the load via a low impedance path. Avoid connectors which add significant inductance and resistance. Note that even though a Kelvin sense is available through a 5 pin package, care must be taken since voltage drops along wire traces add to the dropout voltage.

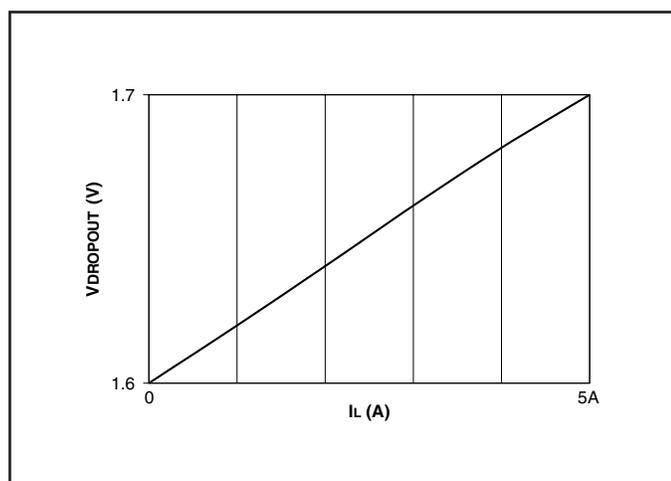


Figure 1. Typical dropout ( $V_B - V_{OUT}$ ),  $T_J = 27^\circ\text{C}$ .

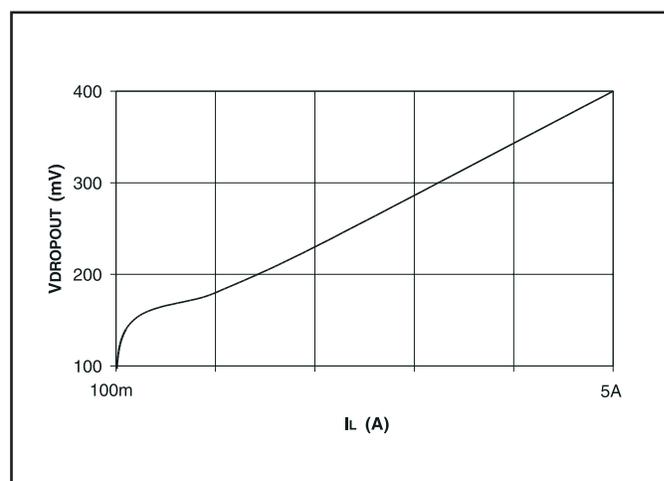


Figure 2. Typical dropout ( $V_{IN} - V_{OUT}$ ),  $T_J = 27^\circ\text{C}$ .

## APPLICATION INFORMATION

The UC385 is easy to use. The adjustable version requires two resistors to set the output voltage. The fixed versions of the UC385 require no external resistors. All versions of the UC385 require decoupling capacitors on the input and output. In a typical application, VB and VIN are driven from switching power supplies which may have large filter capacitors at their outputs. If the UC385 is further than 12 inches from the power supply, it is recommended to add local decoupling as close as possible to the linear regulator.

Decouple the output of the UC385 with at least  $100\mu\text{F}$  of high quality tantalum or Sanyo OSCON capacitors close to the VOUT pin for maximum stability. Many applications involving ultra fast GTL or BTL applications require

additional capacitance close to the load. The exact amount will vary according to speed and magnitude of the load transients and the tolerance allowed for transients on VOUT. When specifying the decoupling capacitors, the series resistance of the capacitor bank is an important factor in its ability to filter load transients.

The UC385 allows for Kelvin sensing the voltage at the load. This improves regulation performance and eliminates the voltage drops due to wire trace resistance. This voltage drop must be added to the headroom ( $V_{IN}$  to  $V_{OUT}$  and  $V_B$  to  $V_{OUT}$ ). The dropout of 450mV is measured at the pins and does not include additional drops due to trace resistance.

APPLICATION INFORMATION (cont.)

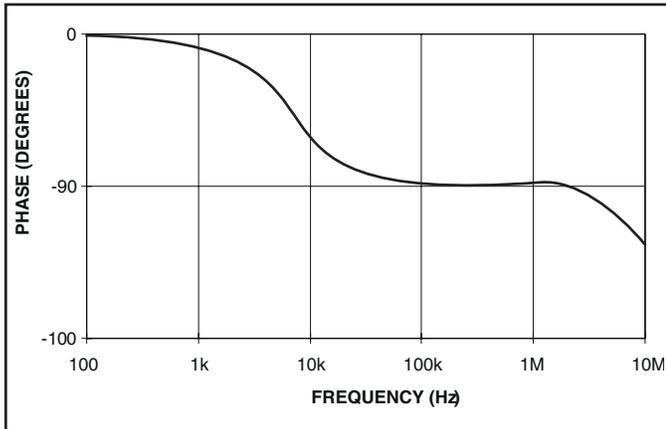


Figure 3. Open loop phase (100 $\mu$ f output capacitance, 1A load).

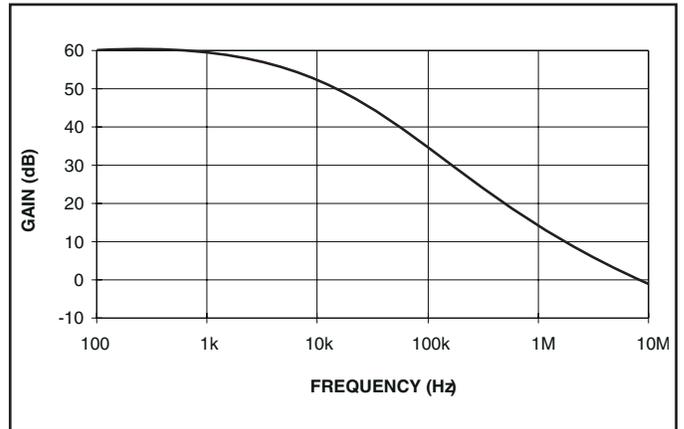


Figure 4. Open loop gain (100 $\mu$ f output capacitance, 1A load).

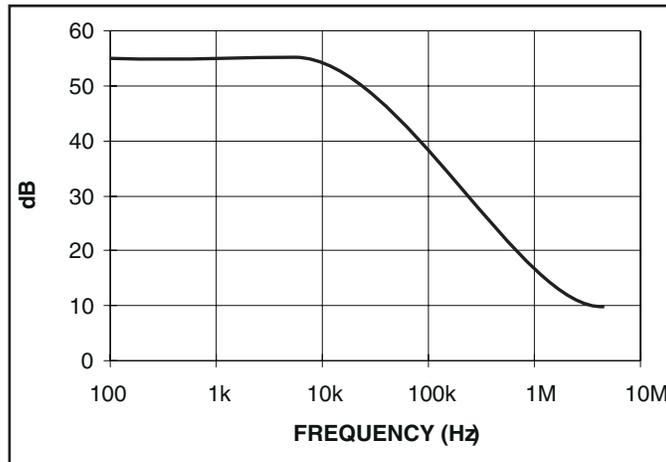


Figure 5. PSRR (VB).

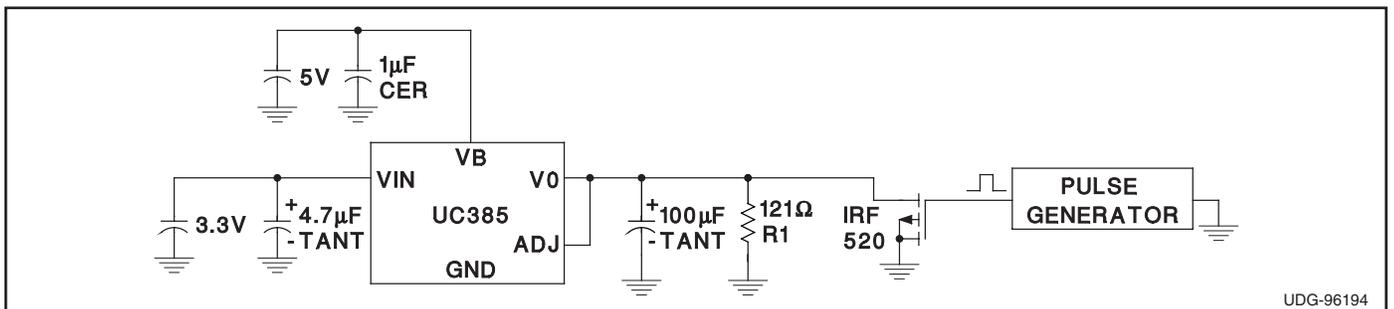


Figure 6. Transient test circuit.

UDG-96194

APPLICATION INFORMATION (cont.)

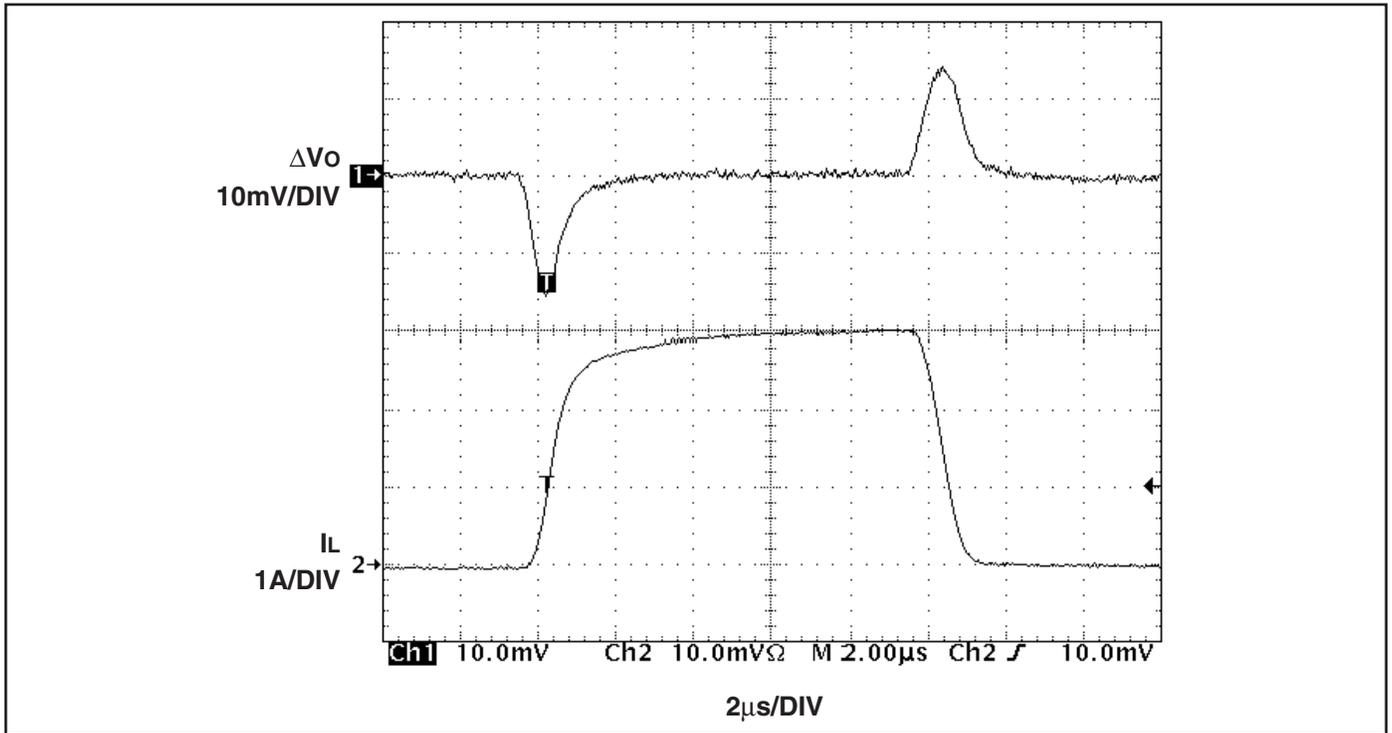


Figure 7. 10mA to 3A/μs load transient response.

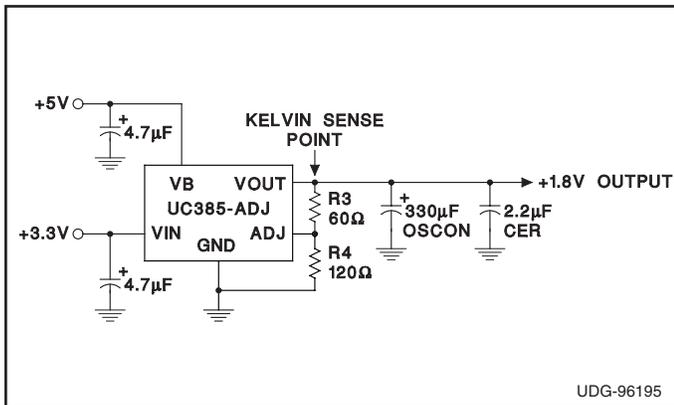


Figure 8. Typical UC385-ADJ application.

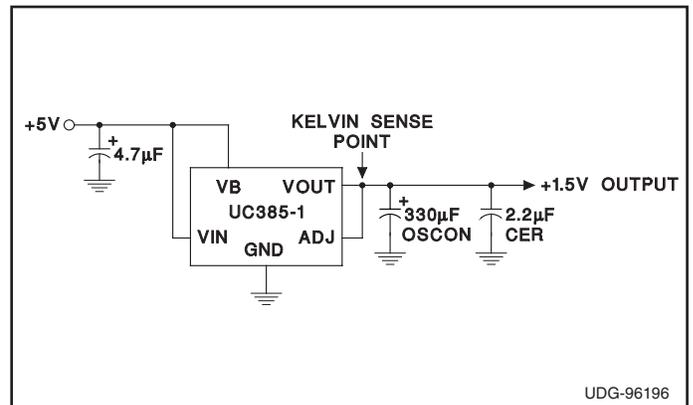


Figure 9. Typical UC385-1, -2, or -3 application.