



# TL1093

## LINEAR INTEGRATED CIRCUIT

### PROGRAMMABLE PRECISION REFERENCE

■ **DESCRIPTION**

The UTC **TL1093** is a three-terminal adjustable regulator with a guaranteed thermal stability over applicable temperature ranges. The output voltage may be set to any value between  $V_{REF}$  (approximately 2.5V) and 36 V with two external resistors. It provides very wide applications, including shunt regulator, series regulator, switching regulator, voltage reference and others.

■ **FEATURES**

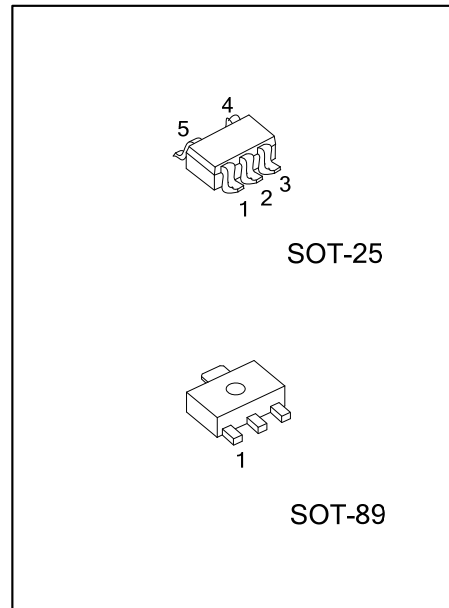
- \*Programmable output Voltage to 36V.
- \*Low dynamic output impedance 0.2Ω.
- \*Sink current capability of 1.0 to 100mA.
- \*Equivalent full-range temperature coefficient of 50ppm/ °C typical for operation over full rated operating temperature range.

■ **ORDERING INFORMATION**

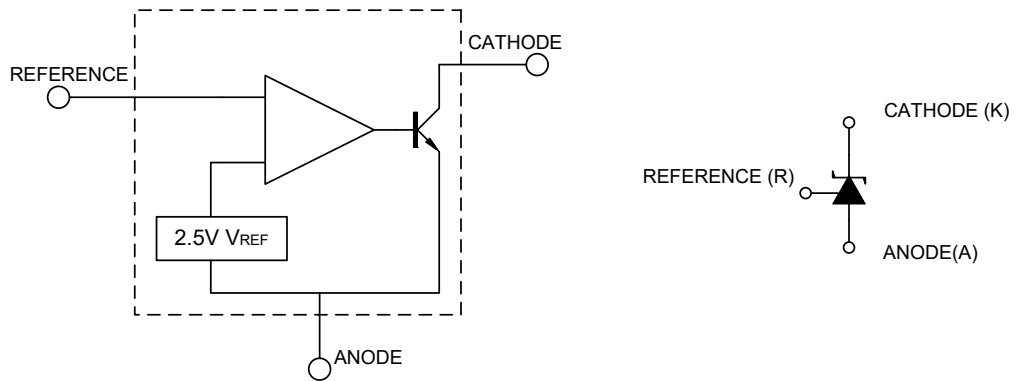
Ordering Number		Package	Pin Assignment					Packing
Lead Free	Halogen Free		1	2	3	4	5	
TL1093L-AB3-R	TL1093G-AB3-R	SOT-89	K	A	R	-	-	Tape Reel
TL1093L-AF5-R	TL1093G-AF5-R	SOT-25	R	A	K	A	NC	Tape Reel

Note: Pin Code: K: Cathode A: Anode R: Reference NC: No Connection

<p>TL1093G-AB3-R</p> <p>(1) Packing Type</p> <p>(2) Package Type</p> <p>(3) Green Package</p>	<p>(1) R: Tape Reel</p> <p>(2) AB3: SOT-89, AF5: SOT-25</p> <p>(3) G: Halogen Free and Lead Free, L: Lead Free</p>
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### ■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATINGS (Operating temperature range applies unless otherwise specified)

PARAMETER		SYMBOL	RATINGS	UNIT
Cathode Voltage		$V_{KA}$	37	V
Cathode Current Range(Continuous)		$I_{KA}$	-100 ~ +150	mA
Reference Input Current Range		$I_{REF}$	-0.05 ~ +10	mA
Power Dissipation	SOT-89	$P_D$	800	mW
	SOT-25		300	mW
Operating Junction Temperature		$T_J$	+150	°C
Operating Ambient Temperature		$T_{OPR}$	-40 ~ +85	°C
Storage Temperature		$T_{STG}$	-65 ~ +150	°C

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

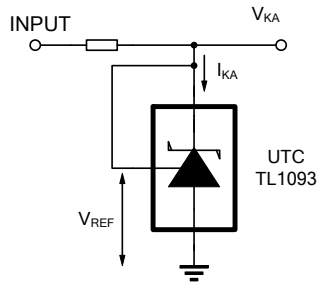
■ RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Cathode Voltage	$V_{KA}$	$V_{REF}$		36	V
Cathode Current	$I_{KA}$	1		100	mA

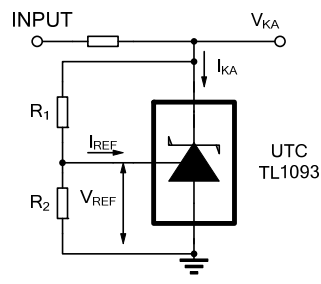
■ ELECTRICAL CHARACTERISTICS ( $T_C=25^{\circ}\text{C}$ , unless otherwise specified.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Reference Input Voltage	$V_{REF}$	$V_{KA}=V_{REF}, I_{KA}=10\text{mA}$	2.470	2.495	2.520	V
Deviation of reference Input Voltage Over temperature	$\frac{\Delta V_{REF}}{\Delta T}$	$V_{KA}=V_{REF}, I_{KA}=10\text{mA}$ $0^{\circ}\text{C} \leq T_a \leq 70^{\circ}\text{C}$		4.5	17	mV
Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage	$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	$I_{KA}=10\text{mA}$	$\Delta V_{KA}=10\text{V} \sim V_{REF}$	-1.0	-2.7	mV/V
			$\Delta V_{KA}=36\text{V} \sim 10\text{V}$	-0.5	-2.0	mV/V
Reference Input Current	$I_{REF}$	$I_{KA}=10\text{mA}, R_1=10\text{k}\Omega, R_2=\infty$		1.5	4	$\mu\text{A}$
Deviation of Reference Input Current Over Full Temperature Range	$\frac{\Delta I_{REF}}{\Delta T}$	$I_{KA}=10\text{mA}, R_1=10\text{k}\Omega, R_2=\infty$ $T_a = \text{full Temperature}$		0.4	1.2	$\mu\text{A}$
Minimum Cathode Current for Regulation	$I_{KA(MIN)}$	$V_{KA}=V_{REF}$		0.19	0.5	mA
Off-State Cathode Current	$I_{KA(OFF)}$	$V_{KA}=36\text{V}, V_{REF}=0$		0.05	1.0	$\mu\text{A}$
Dynamic Impedance	$Z_{KA}$	$V_{KA}=V_{REF}, I_{KA}=1 \text{ to } 100\text{mA}$ $f \leq 1.0\text{kHz}$		0.15	0.5	$\Omega$

## TEST CIRCUIT

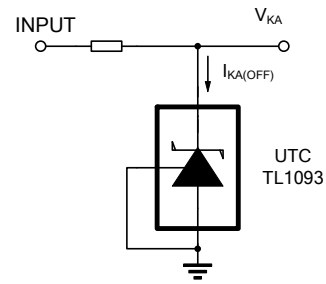


For  $V_{KA} = V_{REF}$



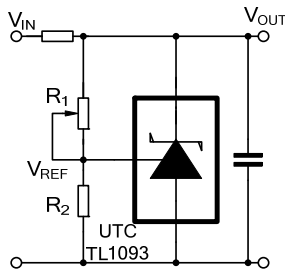
$$V_{KA} = V_{REF} \times (1 + R_1/R_2) + I_{REF} \times R_1$$

For  $V_{KA} \geq V_{REF}$



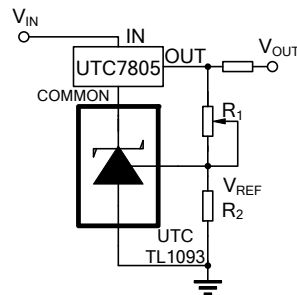
For  $I_{KA(OFF)}$

## APPLICATION CIRCUIT



$$V_{OUT} = (1 + R_1/R_2) \times V_{REF}$$

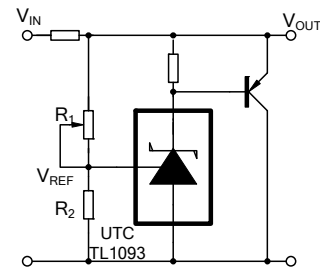
Shutdown Regulator



$$V_{OUT} = (1 + R_1/R_2) \times V_{REF}$$

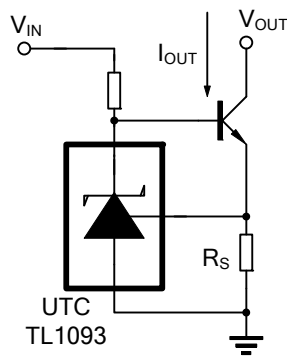
Minimum  $V_{OUT} = V_{REF} + 5V$

Output Control of a Three-Terminal Fixed Regulator



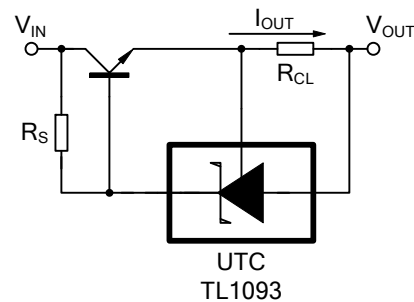
$$V_{OUT} = (1 + R_1/R_2) \times V_{REF}$$

Higher-current Shunt Regulator



$$I_{OUT} = V_{REF}/R_S$$

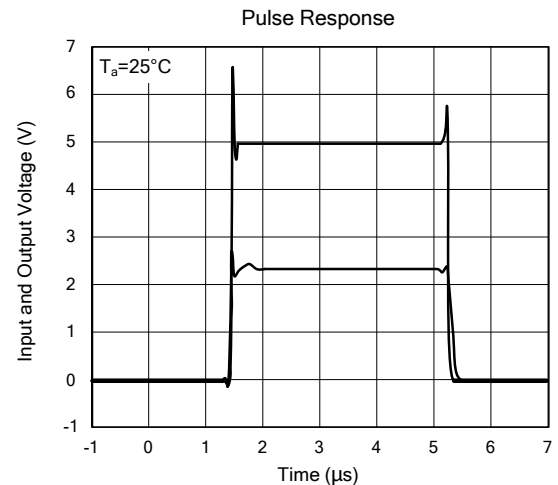
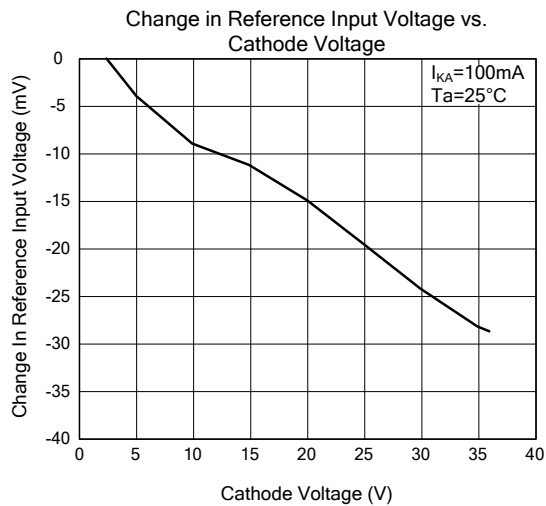
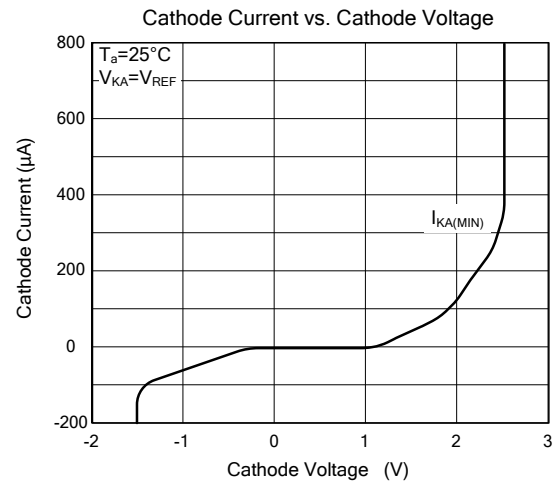
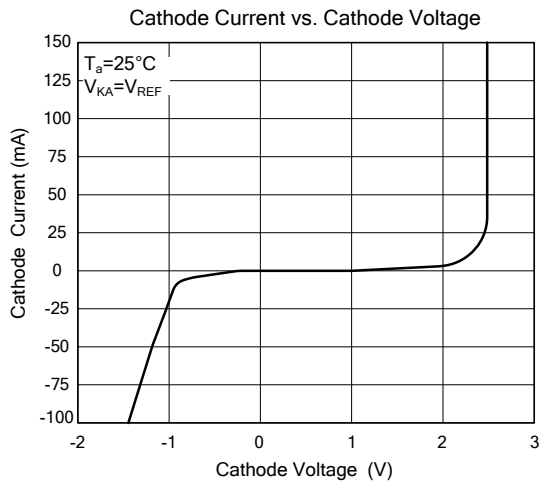
Constant-current Sink



$$R_S = V_{REF}/R_{CL}$$

Current Limiting or Current Source

## ■ TYPICAL CHARACTERISTICS



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