



## LM4041

## LINEAR INTEGRATED CIRCUIT

### PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE

#### DESCRIPTION

As a shunt voltage reference integrated circuit, UTC **LM4041** can be used for widespread applications with enhancement of the competitive advantage by saving use of external capacitors..

In order to ensure a stable output voltage, the reference not only offers low dynamic impedance, low noise and a low temperature coefficient, but also provides tight output tolerance (Max 1.0 %) and low temperature coefficient (150ppm/°C).

However, for those applications which the output voltage needs to be adjusted between 1.233V and 10V, an external resistor divider is necessary.

#### FEATURES

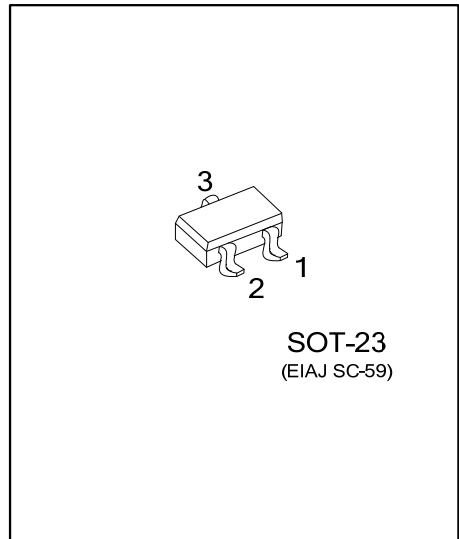
- \* Output Tolerances and Temperature Coefficient: Max 1.0%, 150 ppm/°C
- \* Low Output Noise : 20µV<sub>RMS</sub> (Typ.)
- \* Operating Current range : 45µA ~ 12mA

#### ORDERING INFORMATION

Ordering Number	Package	Packing
LM4041G-xx-AE3-R	SOT-23	Tape Reel

Note: xx: Output Voltage, refer to Marking Information.

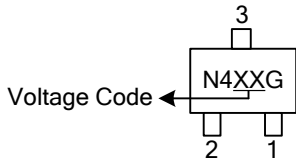
<p>LM4041G-xx-AE3-R</p> <p>(1) Packing Type (2) Package Type (3) Output Voltage Code (4) Green Package</p>	<p>(1) R: Tape Reel (2) AE3: SOT-23 (3) xx: Refer to Marking Information (4) G: Halogen Free and Lead Free</p>
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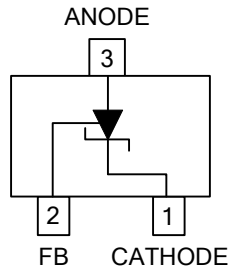
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### MARKING INFORMATION

PACKAGE	VOLTAGE CODE	MARKING
SOT-23	AD: ADJ	

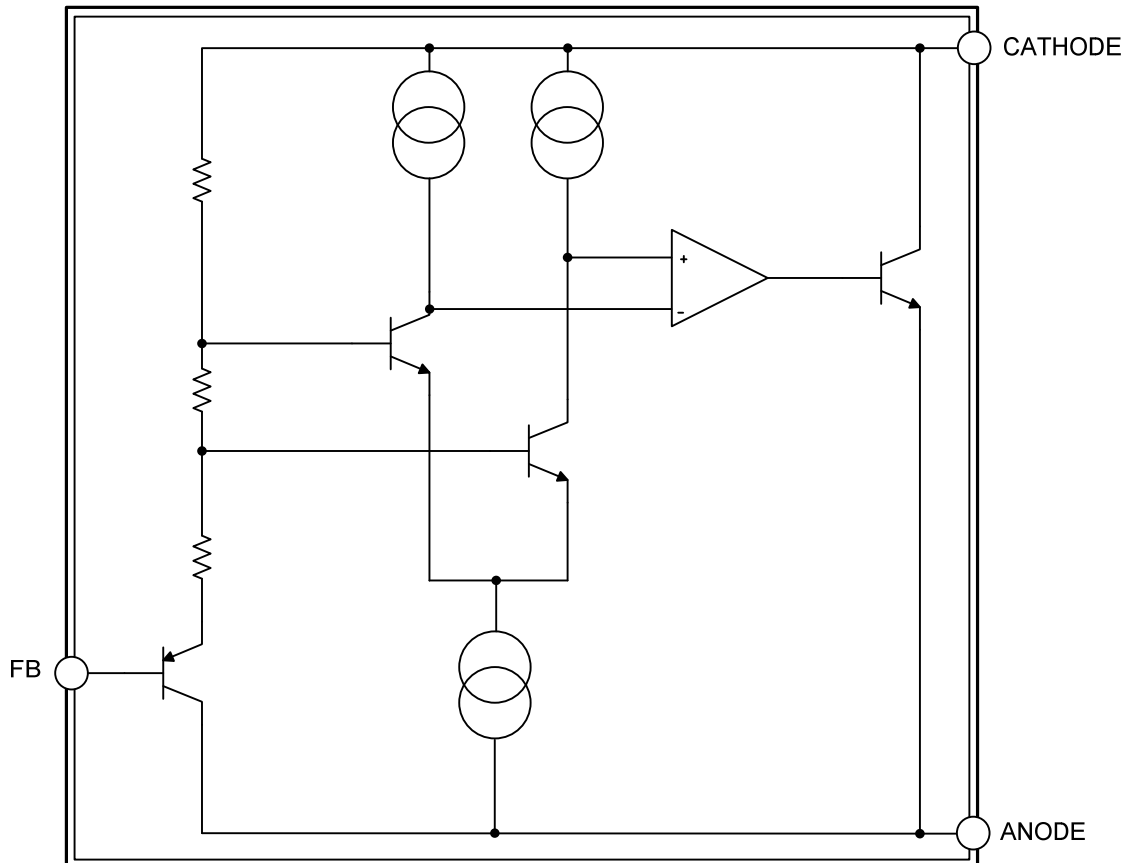
### PIN CONFIGURATION



### PIN DESCRIPTION

PIN NO.	PIN NAME	DESCRIPTION
1	Cathode	Output reference voltage, cathode terminal
2	FB	Feedback terminal
3	Anode	Output reference voltage, anode terminal

### BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATING ( $T_A = 25^\circ\text{C}$ , unless otherwise specified.)

PARAMETER	SYMBOL	RATINGS	UNIT
Continuous Cathode Voltage	$V_Z$	15	V
Continuous Cathode Current	$I_Z$	-10~+25	mA
Junction Temperature	$T_J$	150	$^\circ\text{C}$
Storage Temperature	$T_{\text{STG}}$	-65~+150	$^\circ\text{C}$

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	RATINGS	UNIT
Cathode Current (max)	$I_Z$	12	mA
Reverse Breakdown Voltage	$V_Z$	10	V
Operating Temperature	$T_A$	-40~+85	$^\circ\text{C}$

■ THERMAL DATA

PARAMETER	SYMBOL	RATINGS	UNIT
Junction to Ambient	$\theta_{JA}$	206	$^\circ\text{C}/\text{W}$

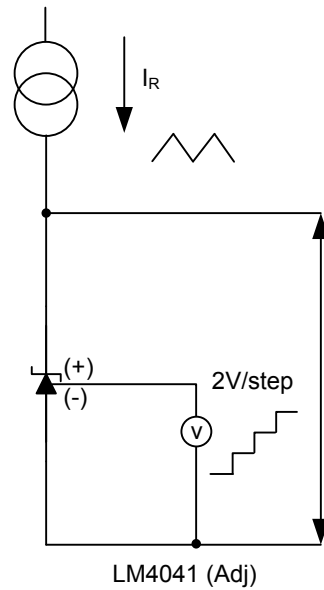
Note: Maximum power dissipation is a function of  $T_{J(\text{max})}$ ,  $\theta_{JA}$ , and  $T_a$ . The maximum allowable power dissipation at any allowable ambient temperature is  $P_D = (T_{J(\text{max})} - T_A) / \theta_{JA}$ . Operating at the absolute maximum  $T_J$  of  $150^\circ\text{C}$  can affect reliability.

■ ELECTRICAL CHARACTERISTICS ( $T_A = -40^\circ\text{C} \sim +85^\circ\text{C}$ , unless otherwise specified.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
Reference Voltage	$V_{\text{REF}}$	$V_Z=5\text{V}, I_Z = 100\mu\text{A}, T_A=25^\circ\text{C}$		1.233		V	
Reference Voltage Tolerance (Note)		$V_Z=5\text{V}, I_Z = 100\mu\text{A}$	$T_A=25^\circ\text{C}$	-12	12	mV	
			$T_A=-40^\circ\text{C} \sim +85^\circ\text{C}$	-24	24	mV	
Reference Voltage Change With Cathode Current Change	$\frac{\Delta V_{\text{REF}}}{\Delta I_Z}$	$I_Z(\text{MIN}) < I_Z < 1\text{mA}$	$T_A=25^\circ\text{C}$		0.7	2	mV
			$T_A=-40^\circ\text{C} \sim +85^\circ\text{C}$			2.5	mV
		$1\text{mA} < I_Z < 12\text{mA}$	$T_A=25^\circ\text{C}$		2	6	mV
			$T_A=-40^\circ\text{C} \sim +85^\circ\text{C}$			8	mV
Reference Voltage Change With Output Voltage Change	$\frac{\Delta V_{\text{REF}}}{\Delta V_{\text{KA}}}$	$I_Z=1\text{mA}$	$T_A=25^\circ\text{C}$	-1.55	-2	mV/V	
			$T_A=-40^\circ\text{C} \sim +85^\circ\text{C}$		-3	mV/V	
Minimum Cathode Current	$I_Z(\text{MIN})$	$T_a=25^\circ\text{C}$		45	75	$\mu\text{A}$	
		$T_a=-40^\circ\text{C} \sim +85^\circ\text{C}$			80	$\mu\text{A}$	
Feedback Current	$I_{\text{FB}}$	$T_A=25^\circ\text{C}$		60	150	nA	
		$T_A=-40^\circ\text{C} \sim +85^\circ\text{C}$			200	nA	
Temperature Coefficient of Output Voltage (Note)	$T_{\text{CVO}}$	$V_Z=5\text{V}, I_Z = 10\text{mA}, T_A=25^\circ\text{C}$		$\pm 20$		ppm/ $^\circ\text{C}$	
		$V_Z=5\text{V}, I_Z=1\text{mA}$	$T_A=25^\circ\text{C}$		$\pm 15$		ppm/ $^\circ\text{C}$
			$T_A=-40^\circ\text{C} \sim +85^\circ\text{C}$			$\pm 150$	ppm/ $^\circ\text{C}$
		$V_Z=5\text{V}, I_Z=100\mu\text{A}, T_A=25^\circ\text{C}$		$\pm 15$		ppm/ $^\circ\text{C}$	
Reverse Dynamic Impedance	$Z_Z$	$V_Z=V_{\text{REF}}, I_Z=1\text{mA}, I_{\text{AC}}=0.1I_Z$ $f=120\text{Hz}, T_A=25^\circ\text{C}$		0.3		$\Omega$	
		$V_Z=10\text{V}, I_Z=1\text{mA}, I_{\text{AC}}=0.1I_Z$ $f=120\text{Hz}, T_A=25^\circ\text{C}$		2		$\Omega$	
Output Voltage Noise	$e_{\text{N}}$	$V_Z=V_{\text{REF}}, I_Z = 100\mu\text{A}$ $10\text{Hz} \leq f \leq 10\text{kHz}, T_A=25^\circ\text{C}$		20		$\mu\text{V}_{\text{rms}}$	
Long-term Stability of Reverse Breakdown Voltage		$t=1000\text{h}, I_Z=100\mu\text{A}, T_A= 25^\circ\text{C} \pm 0.1^\circ\text{C}$ ,		120		ppm	

Note: Reference voltage tolerance and average temperature coefficient change with output voltage ( $V_Z$ ).

■ TYPICAL APPLICATION CIRCUIT



Reverse Characteristics Test Circuit

**Output Capacitor**

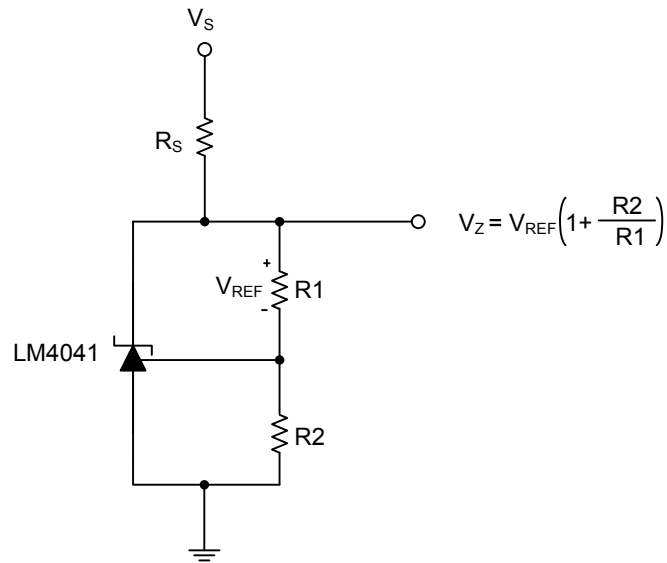
Across CATHODE and ANODE, there's no need to use output capacitor for the UTC **LM4041** stability operation.

**Pin Connections**

There is a parasitic Schottky diode connected between Cathode (pin 1) and Anode (pin 3) .Thus, pin 3 must be left floating or connected to pin 1.

## APPLICATION INFORMATION

$V_Z$  is set according to the equation shown as below which can be set by a user-defined resistor divider.

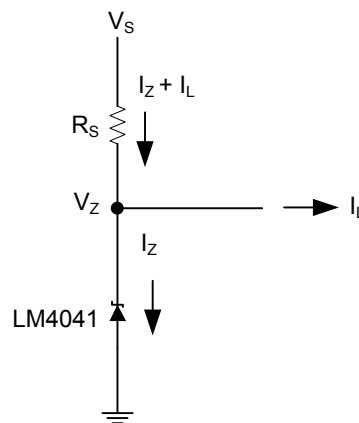


**Adjustable Shunt Regulator**

### Cathode and Load Currents

The total current available to supply the load ( $I_L$ ) and bias the UTC **LM4041** ( $I_Z$ ) is set by  $R_S$ , so its value must be set properly. In all cases,  $I_Z$  must stay in a specified range for proper operation of the reference;  $R_S$  must be small enough to supply the minimum  $I_Z$ . At maximum  $V_S$  and minimum  $I_L$ , to limit  $I_Z$  to not exceed rating of 12 mA,  $R_S$  must be large enough.

$$R_S = \frac{(V_S - V_Z)}{(I_L + I_Z)}$$



**Shunt Regulator**

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