



## M385

## LINEAR INTEGRATED CIRCUIT

### MICROPOWER VOLTAGE REFERENCE

#### ■ DESCRIPTION

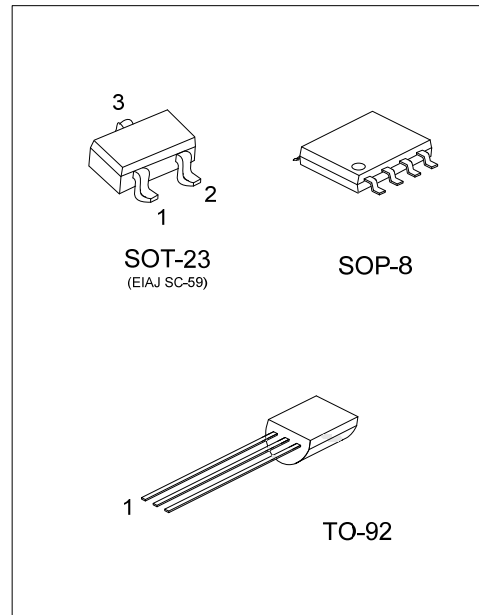
The UTC **M385** is a micropower voltage reference. This device features good temperature stability and extreme low dynamic impedance when it is operated over a 20 $\mu$ A to 20mA current. Low noise and good long-term stability are achieved because the UTC **M385** bandgap reference applies only bipolar transistors and resistors.

The UTC **M385** can be used in almost any reference application due to the exceptional tolerance of capacitive loading. This voltage reference can be applied in portable meters, regulators, or general-purpose analog circuitry with battery life approaching shelf life. The wide dynamic operating range contributes to its use with widely varying supplies with excellent regulation. The low power drain of the UTC **M385** is useful for micropower circuitry. On-chip trimming gives it the tight voltage tolerance. Furthermore, the wide operating current can replace older references with a tighter tolerance.

The UTC **M385** can be used in such applications, for example, portable and battery-powered equipment, instrumentation, process control, energy management, product testing, automotive, precision audio components, and so on.

#### ■ FEATURES

- \* Initial tolerance: 1%
- \* Operating current range: 10 $\mu$ A~20mA for  $V_R=1.235V$   
20 $\mu$ A~20mA for  $V_R=2.5V$
- \* Low temperature coefficient
- \* Low voltage reference



## ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
M385L-xx-AE3-R	M385G-xx-AE3-R	SOT-23	A	K	NC	Tape Reel
M385L-xx-AE3-A-R	M385G-xx-AE3-A-R	SOT-23	K	A	NC	Tape Reel
M385L-xx-S08-R	M385G-xx-S08-R	SOP-8	refer to PIN CONNECTIONS			Tape Reel
M385L-xx-T92-B	M385G-xx-T92-B	TO-92	NC	K	A	Tape Box
M385L-xx-T92-K	M385G-xx-T92-K	TO-92	NC	K	A	Bulk

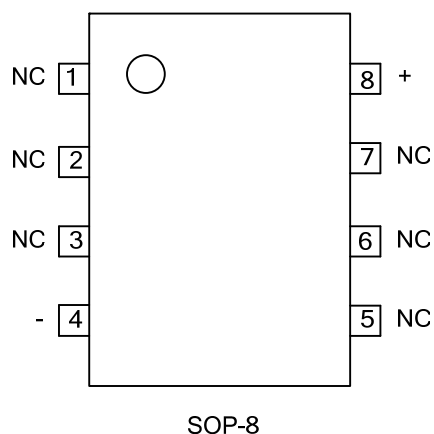
Note: xx: Output Voltage, refer to Marking Information.

<p>M385G-xx-AE3-A-R</p> <p>(1) Packing Type (2) Pin Assignment (3) Package Type (4) Output Voltage Code (5) Green Package</p>	<p>(1) R: Tape Reel, B: Tape Box, K: Tape Box (2) refer to Pin Assignment (3) AE3: SOT-23, S08: SOP-8, T92: TO-92 (4) xx: refer to Marking Information (5) G: Halogen Free and Lead Free, L: Lead Free</p>
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## MARKING INFORMATION

PACKAGE	VOLTAGE CODE	MARKING
SOT-23	12: 1.2V 25: 2.5V	<p>Pin Code Voltage Code</p>
SOP-8		<p>Date Code L: Lead Free G: Halogen Free Lot Code Voltage Code</p>
TO-92		<p>L: Lead Free G: Halogen Free Date Code</p>

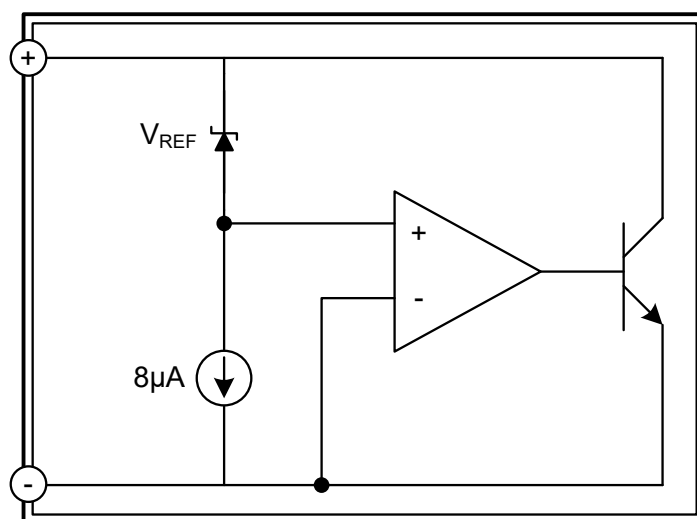
## ■ PIN CONNECTIONS



## ■ PIN DESCRIPTIONS

PIN NO.	PIN NAME	PIN FUNCTION
1	NC	Not connected
2	NC	Not connected
3	NC	Not connected
4	-	Pin-sources current for normal application, the current value is the same as Pin+
5	NC	Not connected
6	NC	Not connected
7	NC	Not connected
8	+	Sinks current with a range from 20 $\mu$ A to 20mA for normal applications, a stable positive voltage, relative to Pin-, occurs on Pin-

## ■ BLOCK DIAGRAM



## ■ ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATINGS	UNIT
Reverse Current	$I_R$	30	mA
Forward Current	$I_F$	10	mA
Junction Temperature	$T_J$	+125	°C
Operating 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.

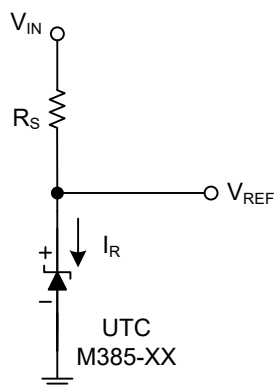
■ ELECTRICAL CHARACTERISTICS ( $T_A=25^{\circ}\text{C}$ , unless otherwise specified.)**M385-1.2V**

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Reverse Breakdown Voltage	$V_R$	$I_R=100\mu\text{A}$	1.222	1.235	1.248	V
Reverse Breakdown Voltage Charge with Current	$\Delta V_R$	$10\mu\text{A} < I_R < 1\text{mA}$ $1\text{mA} < I_R < 20\text{mA}$			2 20	mV mV
Reverse Dynamic Impedance	$Z_R$	$I_R=100\mu\text{A}$ , $f=20\text{Hz}$			1	$\Omega$
Minimum Operating Current	$I_{R(MIN)}$			8	15	$\mu\text{A}$
Wideband Noise	$e_N$	$I_R=100\mu\text{A}$ , $10\text{Hz} \leq f \leq 10\text{KHz}$		60		$\mu\text{V}_{rms}$
Average Temperature Coefficient	$\alpha V_R$	$I_R=100\mu\text{A}$		100		ppm/°C
Long Term Stability	$\frac{\Delta V_R}{\Delta t}$	$I_R=100\mu\text{A}$ , $T=1000\text{Hrs}$ , $T_A=25^{\circ}\text{C}$		20		ppm

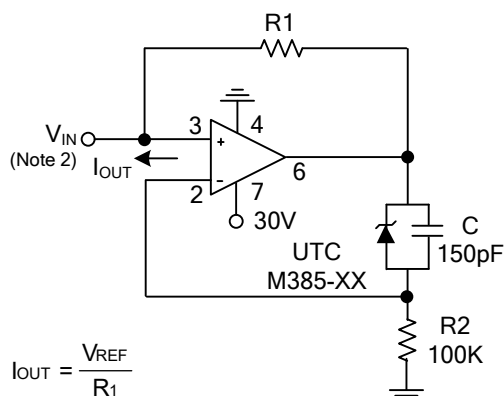
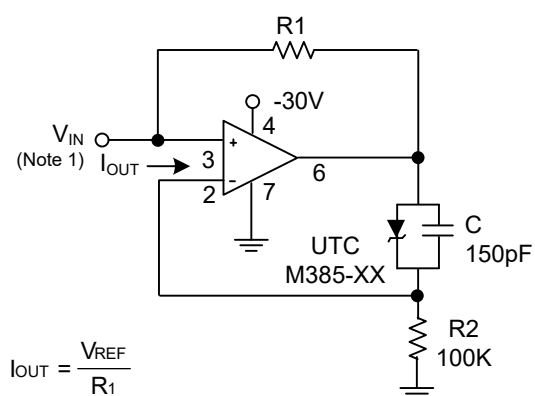
**M385-2.5V**

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Reverse Breakdown Voltage	$V_R$	$I_R=100\mu\text{A}$	2.475	2.5	2.525	V
Reverse Breakdown Voltage Charge with Current	$\Delta V_R$	$20\mu\text{A} < I_R < 1\text{mA}$ $1\text{mA} < I_R < 20\text{mA}$			3.2 20	mV mV
Reverse Dynamic Impedance	$Z_R$	$I_R=100\mu\text{A}$ , $f=20\text{Hz}$			1	$\Omega$
Minimum Operating Current	$I_{R(MIN)}$			15	25	$\mu\text{A}$
Wideband Noise	$e_N$	$I_R=100\mu\text{A}$ , $10\text{Hz} \leq f \leq 10\text{KHz}$		60		$\mu\text{V}_{rms}$
Average Temperature Coefficient	$\alpha V_R$	$I_R=100\mu\text{A}$		100		ppm/°C
Long Term Stability	$\frac{\Delta V_R}{\Delta t}$	$I_R=100\mu\text{A}$ , $T=1000\text{Hrs}$ , $T_A=25^{\circ}\text{C}$		20		ppm

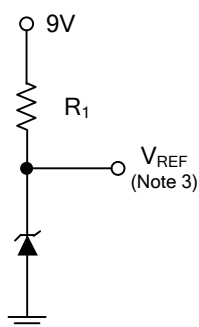
## ■ TEST CIRCUIT



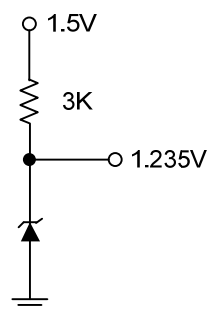
## ■ APPLICATION CIRCUITS



**Precision 1μA to 1mA Current Source**



**Micropower Reference from 9V Battery**



**Reference from 1.5V Battery (Only for M385-1.2V)**

- Notes: 1.  $V_{REF}=1.235V$ ,  $-2.3V \leq V+ \leq -27V$ ,  $V_{REF}=2.5V$ ,  $-3.7V \leq V+ \leq -27V$   
 2.  $V_{REF}=1.235V$ ,  $2.3V \leq V+ \leq 27V$ ,  $V_{REF}=2.5V$ ,  $3.7V \leq V+ \leq 27V$   
 3.  $V_{REF}=1.235V$ ,  $R_1=900K\Omega$ ,  $V_{REF}=2.5V$ ,  $R_1=220K\Omega$

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