



## LR1801

CMOS IC

### 1.0A FAST ULTRA LOW DROPOUT LINEAR REGULATOR

#### DESCRIPTION

The UTC **LR1801/LR1801AD** operate from a +1.5V ~ +6V input supply as fast ultra low-dropout linear regulators. Wide output voltage range options are available. The fast response characteristic to make UTC **LR1801/LR1801AD** suitable for low voltage microprocessor application. The low quiescent current operation and low dropout quality caused by the CMOS process.

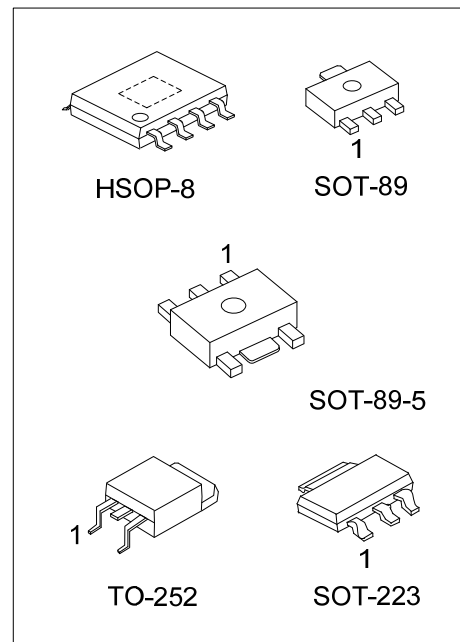
The UTC **LR1801/LR1801AD** has low dropout voltage. The ground pin current is typically 60uA.

Output Voltage Precision: Multiple output voltage options are available and ranging from 1.2V ~ 5.0V at room temperature with a guaranteed accuracy of  $\pm 1.5\%$ , and  $\pm 3.0\%$  when varying line and load.

The output voltage types of UTC **LR1801-xx** are fixed one in the IC and UTC **LR1801AD** are adjustable one.

#### FEATURES

- \* Low Dropout Voltage
- \* The Guaranteed Output Current is 1A DC
- \* Output Voltage Accuracy  $\pm 1.5\%$
- \* Over temperature Protection And Over current Protection



## ORDERING INFORMATION

Ordering Number		Package	Pin Assignment ①				Packing
Lead Free	Halogen Free		Pin Code	1	2	3	
LR1801L-xx-AA3-①-R	LR1801G-xx-AA3-①-R	SOT-223	A	G	O	I	Tape Reel
LR1801L-xx-AB3-①-R	LR1801G-xx-AB3-①-R	SOT-89	B	O	G	I	
LR1801L-xx-TN3-①-R	LR1801G-xx-TN3-①-R	TO-252	C	G	I	O	
			D	I	G	O	
LR1801G-xx-AB5-R	LR1801G-xx-AB5-R	SOT-89-5	refer to Pin Configuration				Tape Reel
LR1801L-xx-SH2-R	LR1801G-xx-SH2-R	HSOP-8	refer to Pin Configuration				Tape Reel
LR1801ADL-AA3-①-R	LR1801ADG-AA3-①-R	SOT-223	A	G	O	I	Tape Reel
LR1801ADL-AB3-①-R	LR1801ADG-AB3-①-R	SOT-89	B	O	G	I	
LR1801ADL-TN3-①-R	LR1801ADG-TN3-①-R	TO-252	C	G	I	O	
			D	I	G	O	
LR1801ADG-AB5-R	LR1801ADG-AB5-R	SOT-89-5	refer to Pin Configuration				Tape Reel
LR1801ADL-SH2-R	LR1801ADG-SH2-R	HSOP-8	refer to Pin Configuration				Tape Reel

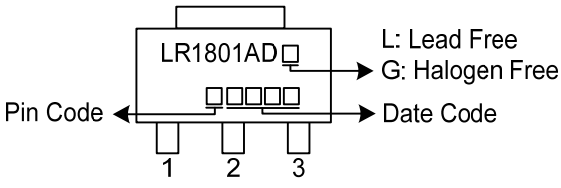
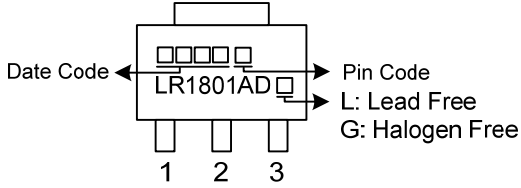
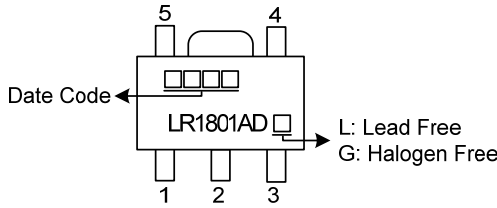
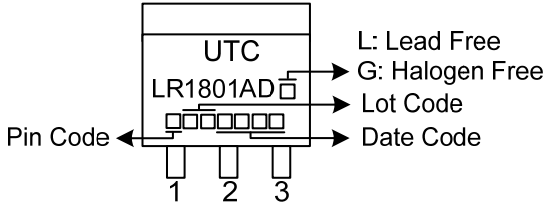
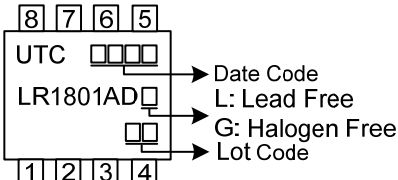
Note: Pin Assignment: G: GND O: V<sub>OUT</sub> I: V<sub>IN</sub>

<p>LR1801G-xx-AA3-①-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 (2) Refer to Pin Assignment (3) AA3: SOT-223, AB3: SOT-89, AB5: SOT-89-5 TN3: TO-252, SH2: HSOP-8 (4) xx: refer to Marking Information (5) G: Halogen Free and Lead Free, L: Lead Free</p>
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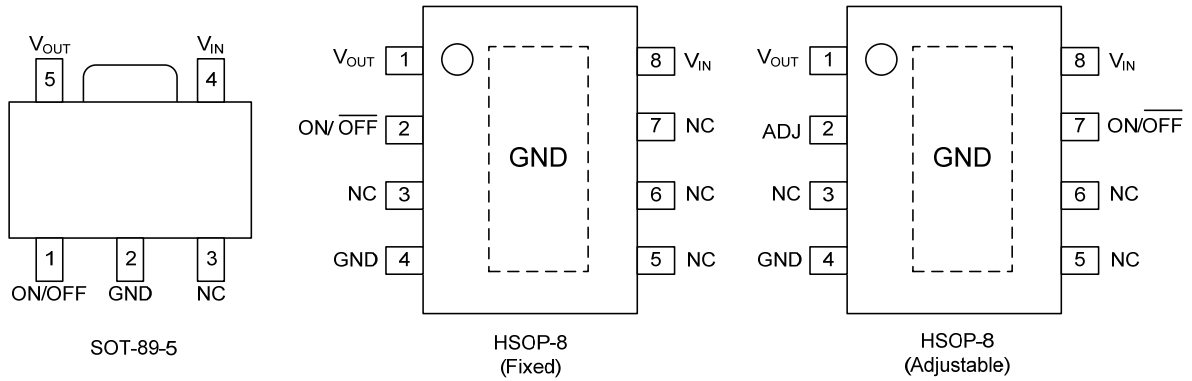
MARKING INFORMATION

PACKAGE	VOLTAGE CODE	MARKING
SOT-223	12: 1.2V 15 : 1.5V 18: 1.8V 25: 2.5V 30: 3.0V 33: 3.3V 50: 5.0V	
SOT-89		
SOT-89-5		
TO-252		
HSOP-8		

■ MARKING INFORMATION (For LR1801AD)

PACKAGE	MARKING
SOT-223	 <p>LR1801AD □</p> <p>Pin Code ← □ □ □ □ → Date Code</p> <p>1 2 3</p> <p>L: Lead Free G: Halogen Free</p>
SOT-89	 <p>□ □ □ □ □</p> <p>Date Code ← LR1801AD □ → Pin Code</p> <p>1 2 3</p> <p>L: Lead Free G: Halogen Free</p>
SOT-89-5	 <p>5 4</p> <p>Date Code ← □ □ □ □</p> <p>LR1801AD □</p> <p>1 2 3</p> <p>L: Lead Free G: Halogen Free</p>
TO-252	 <p>UTC</p> <p>LR1801AD □</p> <p>Pin Code ← □ □ □ □ □ → Date Code</p> <p>1 2 3</p> <p>L: Lead Free G: Halogen Free</p>
HSOP-8	 <p>8 7 6 5</p> <p>UTC □ □ □ □</p> <p>LR1801AD □</p> <p>□ □</p> <p>1 2 3 4</p> <p>Date Code L: Lead Free G: Halogen Free Lot Code</p>

## ■ PIN CONFIGURATION



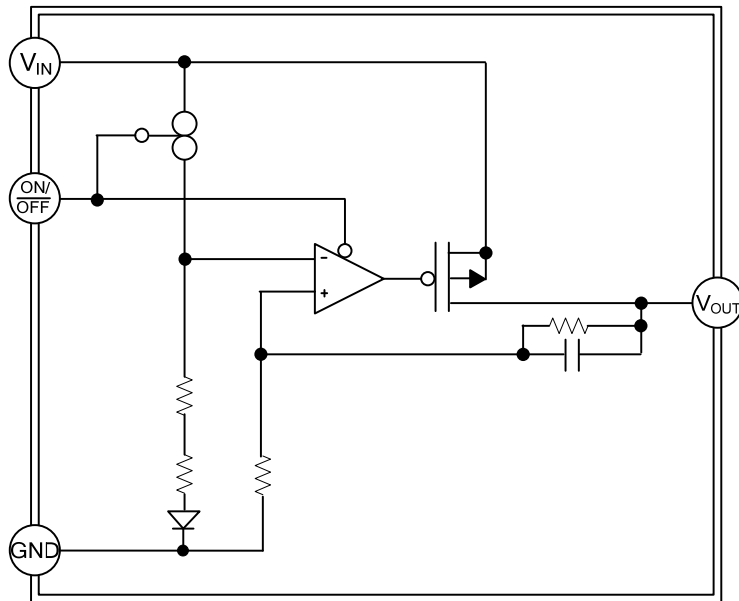
## ■ PIN DESCRIPTION

PIN NO.			PIN NAME	PIN DESCRIPTION
SOT-89-5	HSOP-8 (Fixed)	HSOP-8 (Adjustable)		
2	4	4	GND	GND
5	1	1	V <sub>OUT</sub>	Output Voltage
4	8	8	V <sub>IN</sub>	Input Voltage
1	2	7	ON/OFF	ON/OFF select pin, Active High
3	3, 5, 6, 7	3, 5, 6,	NC	No Connection
-	-	2	ADJ	Adjustable Pin

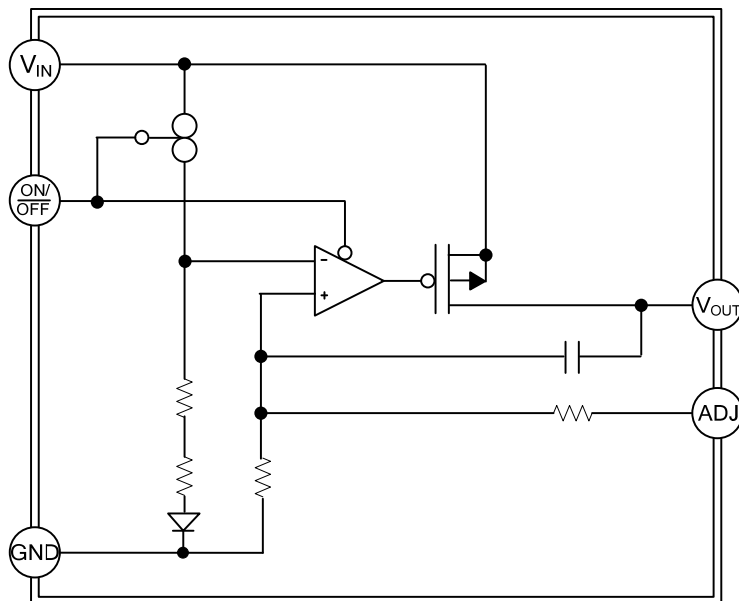
Note: The NC pin is electrically open.  
The NC pin can be connected to V<sub>IN</sub> or GND.

## ■ BLOCK DIAGRAM

### Fixed Output Voltage



### Adjustable Output Voltage



■ ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATINGS	UNIT
Input Voltage	$V_{IN}$	7	V
Shutdown Input Voltage	$V_{IN(SHDN)}$	$-0.3 \sim V_{IN}$	V
Maximum Operating Current (DC)		1	A
Power Dissipation (Note 3)	$P_D$	Internally Limited	
Junction Temperature	$T_J$	+125	°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.

■ THERMAL DATA

PARAMETER	SYMBOL	RATINGS	UNIT	
Junction to Ambient	$\theta_{JA}$	SOT-223	165	°C/W
		SOT-89	185	°C/W
		SOT-89-5		
		TO-252	115	°C/W
		HSOP-8	143	°C/W
Junction to Case	$\theta_{JC}$	SOT-223	23	°C/W
		SOT-89	85	°C/W
		SOT-89-5		
		TO-252	20	°C/W
		HSOP-8	45	°C/W

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

For LR1801xx

PARAMETER	SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNIT
Input Voltage	$V_{IN}$			1.5		6	V
Output Voltage (Note 3)	$V_{OUT(E)}$	$V_{IN}=V_{OUT(S)}+1V$ $I_{OUT}=100mA$	$1.0V \leq V_{OUT(S)} < 1.5V$	$V_{OUT(S)}$ - 0.015	$V_{OUT(S)}$	$V_{OUT(S)}$ + 0.015	V
			$1.5V \leq V_{OUT(S)} \leq 5.0V$	$V_{OUT(S)}$ x 0.99	$V_{OUT(S)}$	$V_{OUT(S)}$ x 1.01	V
Output Voltage Line Regulation	$\frac{\Delta V_{OUT1}}{(\Delta V_{IN} \times V_{OUT})}$	$V_{OUT(S)}+0.5V \leq V_{IN} \leq 5.5V, I_{OUT}=100mA$			0.05	0.2	%/V
		$V_{OUT(S)}+5.5V \leq V_{IN} \leq 6.0V, I_{OUT}=100mA$			0.05	0.2	%/V
Output Voltage Load Regulation	$\Delta V_{OUT2}$	$V_{IN}=V_{OUT(S)}+0.5\sim 0.6V$ $1mA \leq I_{OUT} \leq 300mA$		-20	-3	20	mV
Dropout Voltage(Note 4)	$V_{drop}$	$I_{OUT}=300mA$	$1.2V \leq V_{OUT(S)} < 1.5V$		0.34	0.38	V
			$1.5V \leq V_{OUT(S)} < 2.6V$		0.10	0.15	
			$2.6V \leq V_{OUT(S)} \leq 5.0V$		0.07	0.10	
		$I_{OUT}=1000mA$	$1.2V \leq V_{OUT(S)} < 1.5V$		0.70		
			$1.5V \leq V_{OUT(S)} < 2.0V$		0.40		
			$2.0V \leq V_{OUT(S)} < 2.6V$		0.32		
		$2.6V \leq V_{OUT(S)} \leq 5.0V$		0.23			
Output Current(Note 5)	$I_{OUT}$	$V_{IN} \geq V_{OUT(S)}+1V$		1000 (Note 7)			mA
Ground Pin Current In Normal Operation Mode	$I_{SS1}$	$V_{IN}=V_{OUT(S)}+1V, ON/\overline{OFF}$ pin=ON, No Load			60	90	$\mu\text{A}$
Ground Pin Current In Power-off Mode	$I_{SS2}$	$V_{IN}=V_{OUT(S)}+1V, ON/\overline{OFF}$ pin=OFF, No Load			0.1	1.0	$\mu\text{A}$
Short Circuit Current	$I_{SC}$	$V_{IN}=V_{OUT(S)}+1V, ON/\overline{OFF}$ pin=ON, $V_{OUT}=0V$			2		A
ON/ $\overline{OFF}$ Pin Input Voltage "H"	$V_{SH}$	$V_{IN}=V_{OUT(S)}+1V, R_L=1.0K\Omega$		1.5			V
ON/ $\overline{OFF}$ Pin Input Voltage "L"	$V_{SL}$	Determined by $V_{OUT}$ output level				0.3	
ON/ $\overline{OFF}$ Pin Input Current "H"	$I_{SH}$	$V_{IN}=V_{OUT(S)}+1V, V_{ON/\overline{OFF}}=5.5V$		-0.1		0.1	$\mu\text{A}$
ON/ $\overline{OFF}$ Pin Input Current "L"	$I_{SL}$	$V_{IN}=V_{OUT(S)}+1V, V_{ON/\overline{OFF}}=0V$		-0.1		0.1	$\mu\text{A}$
Ripple Rejection	RR	$V_{IN}=V_{OUT(S)}+1V,$ $f=1kHz,$ $\Delta V_{rip}=0.5V_{rms},$ $I_{OUT}=100mA$	$1.2V \leq V_{OUT(S)} < 3.0V$		65		dB
			$3.0V \leq V_{OUT(S)} \leq 3.5V$		60		
			$3.5V \leq V_{OUT(S)} \leq 5.0V$		55		
Thermal Shutdown detection temperature	$T_{SD}$	Junction temperature			150		$^\circ\text{C}$
Thermal Shutdown release temperature	$T_{SR}$	Junction temperature			120		$^\circ\text{C}$



## ■ ELECTRICAL CHARACTERISTICS (Cont.)

### For LR1801AD

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
Input Voltage	$V_{IN}$		1.5		6	V	
Reference Voltage for Adjustable Voltage Regulator	$V_{OUT}$	$V_{OUT}=V_{ADJ}$ , $V_{IN}=2.0V$ , $I_{OUT}=100mA$	1.176	1.200	1.224	V	
Output Voltage Range	$RV_{OUT}$		1.200		$V_{IN}$	V	
Internal Resistance Value of Adjust Pin	$R_{IC}$			1		$M\Omega$	
Output Voltage Line Regulation	$\frac{\Delta V_{OUT1}}{(\Delta V_{IN} \times V_{OUT})}$	$V_{OUT(S)}+0.5V \leq V_{IN} \leq 5.5V$ , $I_{OUT}=100mA$		0.05	0.2	%/V	
Output Voltage Load Regulation	$\Delta V_{OUT2}$	$V_{IN}=V_{OUT(S)}+1V$ , $1mA \leq I_{OUT} \leq 300mA$	-20	-3	20	mV	
Dropout Voltage(Note 4)	$V_{drop}$	$V_{OUT}=V_{ADJ}$	$I_{OUT}=300mA$		0.34	0.38	V
			$I_{OUT}=1000mA$		0.70		
Output Current(Note 5)	$I_{OUT}$	$V_{IN} \geq V_{OUT(S)}+1V$		1000 (Note 7)		mA	
Ground Pin Current In Normal Operation Mode	$I_{SS1}$	$V_{IN}=V_{OUT(S)}+1V$ , ON/ $\overline{OFF}$ pin=ON, No Load		60	90	$\mu A$	
Ground Pin Current In Power-off Mode	$I_{SS2}$	$V_{IN}=V_{OUT(S)}+1V$ , ON/ $\overline{OFF}$ pin=OFF, No Load		0.1	1.0	$\mu A$	
Short Circuit Current	$I_{SC}$	$V_{IN}=V_{OUT(S)}+1V$ , ON/ $\overline{OFF}$ pin=ON, $V_{OUT}=0V$		2		A	
ON/ $\overline{OFF}$ Pin Input Voltage "H"	$V_{SH}$	$V_{IN}=V_{OUT(S)}+1V$ , $R_L=1.0K\Omega$ Determined by $V_{OUT}$ output level	1.5			V	
ON/ $\overline{OFF}$ Pin Input Voltage "L"	$V_{SL}$				0.3		
ON/ $\overline{OFF}$ Pin Input Current "H"	$I_{SH}$	$V_{IN}=V_{OUT(S)}+1V$ , $V_{ON/\overline{OFF}}=5.5V$	-0.1		0.1	$\mu A$	
ON/ $\overline{OFF}$ Pin Input Current "L"	$I_{SL}$	$V_{IN}=V_{OUT(S)}+1V$ , $V_{ON/\overline{OFF}}=0V$	-0.1		0.1	$\mu A$	
Ripple Rejection	RR	$V_{IN}=V_{OUT(S)}+1V$ , $f=1kHz$ , $\Delta V_{rip}=0.5V_{rms}$ , $I_{OUT}=100mA$	$1.2V \leq V_{OUT(S)} < 3.0V$		65	dB	
			$3.0V \leq V_{OUT(S)} \leq 3.5V$		60		
Thermal Shutdown detection temperature	$T_{SD}$	Junction temperature		150		$^{\circ}C$	
Thermal Shutdown release temperature	$T_{SR}$	Junction temperature		120		$^{\circ}C$	

Notes: 1. The UTC LR1801 output must be diode-clamped to ground. If used in a dual-supply system where the regulator load is returned to a negative supply.

2. Devices must be derated based on package thermal resistance at elevated temperatures.

3.  $V_{OUT(S)}$ : Specified output voltage

$V_{OUT(E)}$ : Actual output voltage

Output voltage when fixing  $I_{OUT}(=100ma)$  and inputting  $V_{OUT(S)}+1.0V$

4.  $V_{drop}=V_{IN1}-(V_{OUT3} \times 0.98)$

$V_{OUT3}$  is the output voltage when  $V_{IN}=V_{OUT(S)}+1.0V$  and  $I_{OUT}=300mA$ ,  $1000mA$ .

5. The output current at which the output voltage becomes 95% of  $V_{OUT(E)}$  after gradually increasing the output current.

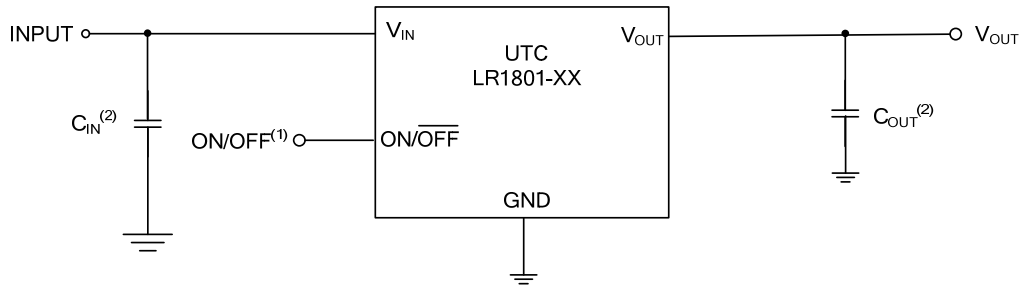
6. The output current can be at least this value.

Due to restrictions on the package power dissipation, this value may not be satisfied. Attention should be paid to the power dissipation of the package when the output current is large.

This specification is guaranteed by design.

■ TYPICAL APPLICATION CIRCUIT

**Fixed Output Voltage**



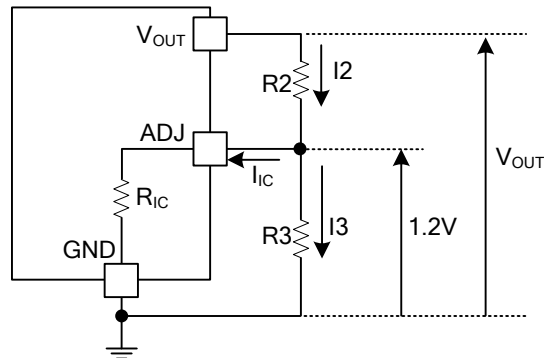
(1) ON/  $\overline{\text{OFF}}$  pins must be pulled high through a 10k $\Omega$  pull-up resistor.

(2) Generally a series regulator may cause oscillation, depending on the selection of external parts. The following conditions are recommended for this IC. However, be sure to perform sufficient evaluation under the actual usage conditions for selection, including evaluation of temperature characteristics.

Input capacitor ( $C_{IN}$ ): 2.2 $\mu\text{F}$  or more  
 Output capacitor ( $C_L$ ): 2.2 $\mu\text{F}$  or more

## ■ TYPICAL APPLICATION CIRCUIT (Cont.)

### Adjustable Output Voltage



The Output Voltage may be adjustable for any output voltage between its 1.2V reference and its  $V_{DD}$  setting level. An external pair of resistors is required, as shown above.

The complete equation for the output voltage is described step by step as follows;

$$I_2 = I_{IC} + I_3 \quad (1)$$

$$I_3 = 1.2 / R_3 \quad (2)$$

Thus,

$$I_2 = I_{IC} + 1.2 / R_3 \quad (3)$$

Therefore,

$$V_{OUT} = 1.2 + R_2 \times I_2 \quad (4)$$

Put Equation (3) into Equation (4), then

$$\begin{aligned} V_{OUT} &= 1.2 + R_2 ( I_{IC} + 1.2 / R_3 ) \\ &= 1.2 ( 1 + R_2 / R_3 ) + R_2 \times I_{IC} \end{aligned} \quad (5)$$

In 2nd term, or  $R_2 \times I_{IC}$  will produce an error in  $V_{OUT}$ .

In Equation (5),

$$I_{IC} = 1.2 / R_{IC} \quad (6)$$

$$\begin{aligned} R_2 \times I_{IC} &= R_2 \times 1.2 / R_{IC} \\ &= 1.2 \times R_2 / R_{IC} \end{aligned} \quad (7)$$

For better accuracy, choosing  $R_2 \ll R_{IC}$  reduces this error.

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