



## LV2460/2461

Preliminary

LINEAR INTEGRATED CIRCUIT

### FAMILY OF LOW-POWER RAIL-TO-RAIL INPUT/OUTPUT OPERATIONAL AMPLIFIERS WITH SHUTDOWN

#### DESCRIPTION

The UTC **LV2460/2461** is a low-power rail-to-rail input/output op amplifier with low supply current (500uA) and low voltage (2.7-6V), that can be designed into a wide range of applications. The UTC **LV2460** offers a shutdown terminal, which places the amplifier in an ultralow supply current mode ( $I_{CC} = 0.3\mu A$ ).

The UTC **LV2460/2461** have a guaranteed 1.6 V/ $\mu s$  slew rate and low supply current. rail-to-rail output and high output current make the IC's ideal for buffering analog-to-digital converters. And the input common-mode voltage range includes ground and  $V_{CC}$ . Besides, they are also able to drive large capacitive loads.

Good AC performance can be provided because of 6.4MHz of bandwidth and 1.6 V/ $\mu s$  of slew rate. Furthermore, low input noise voltage ( $11nV/\sqrt{Hz}$ ) and low input offset voltage (100 $\mu V$ ) make good DC performance.

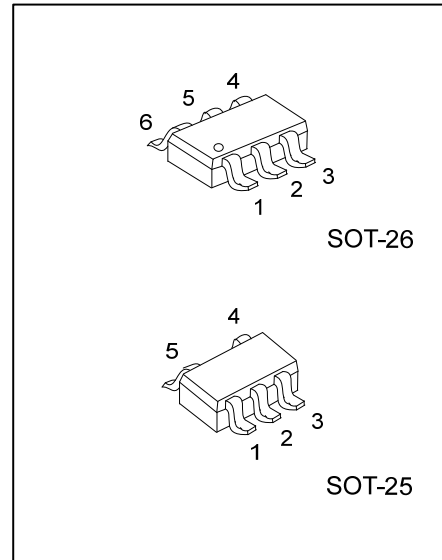
#### FEATURES

- \* Rail-to-Rail Output Swing
- \* Gain Bandwidth Product: 6.4 MHz
- \*  $\pm 48mA$  Output Drive Capability
- \* Supply Current: 500 $\mu A$
- \* Input Offset Voltage: 100 $\mu V$
- \* Input Noise Voltage:  $11nV/\sqrt{Hz}$
- \* Slew Rate: 1.6V/ $\mu s$
- \* Universal Operational Amplifier
- \* Micropower shutdown mode (LV2460) 0.3 $\mu A$

#### ORDERING INFORMATION

Ordering Number		Package	Packing
Lead Free	Halogen Free		
LV2460L-AG6-R	LV2460G-AG6-R	SOT-26	Tape Reel
LV2461L-AF5-R	LV2461G-AF5-R	SOT-25	Tape Reel

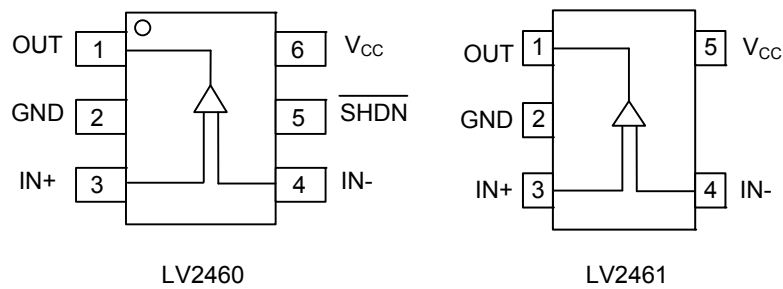
<p>LV2460G-AG6-R</p> <ul style="list-style-type: none"> <li>(1)Packing Type</li> <li>(2)Package Type</li> <li>(3)Green Package</li> </ul>	<ul style="list-style-type: none"> <li>(1) R: Tape Reel</li> <li>(2) AG6: SOT-26, AF5: SOT-25</li> <li>(3) G: Halogen Free and Lead Free, , L: Lead Free</li> </ul>
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MARKING

LV2460	LV2461

PIN CONFIGURATION

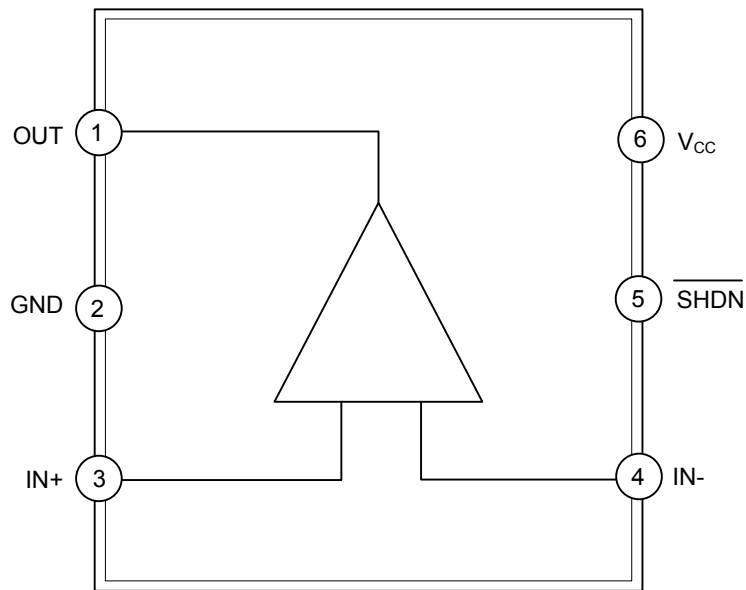


PIN DESCRIPTION

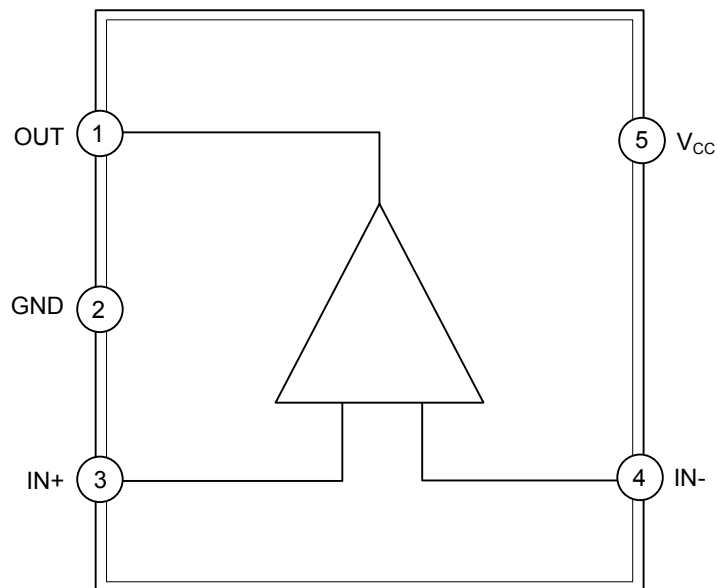
PIN NO.		PIN NAME	DESCRIPTION
LV2460	LV2461		
1	1	OUT	Output
2	2	GND	Ground
3	3	IN+	Positive input
4	4	IN-	Negative input
5	-	$\overline{\text{SHDN}}$	Shutdown
6	5	V <sub>CC</sub>	Supply power

■ BLOCK DIAGRAM

For LV2460

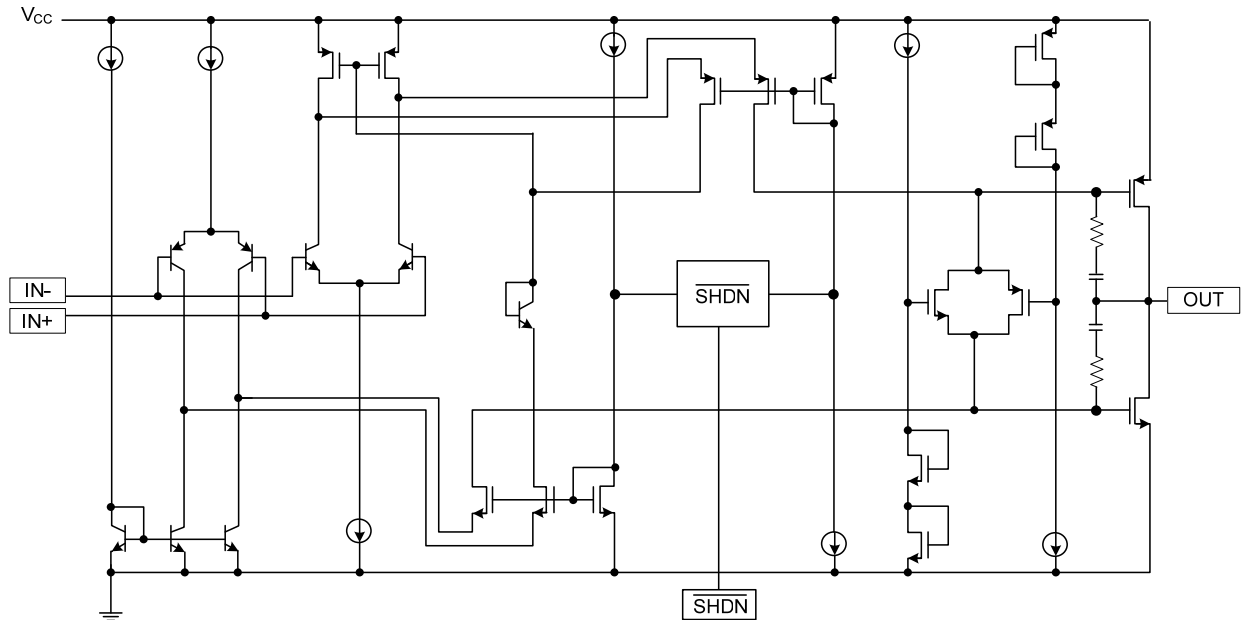


For LV2461

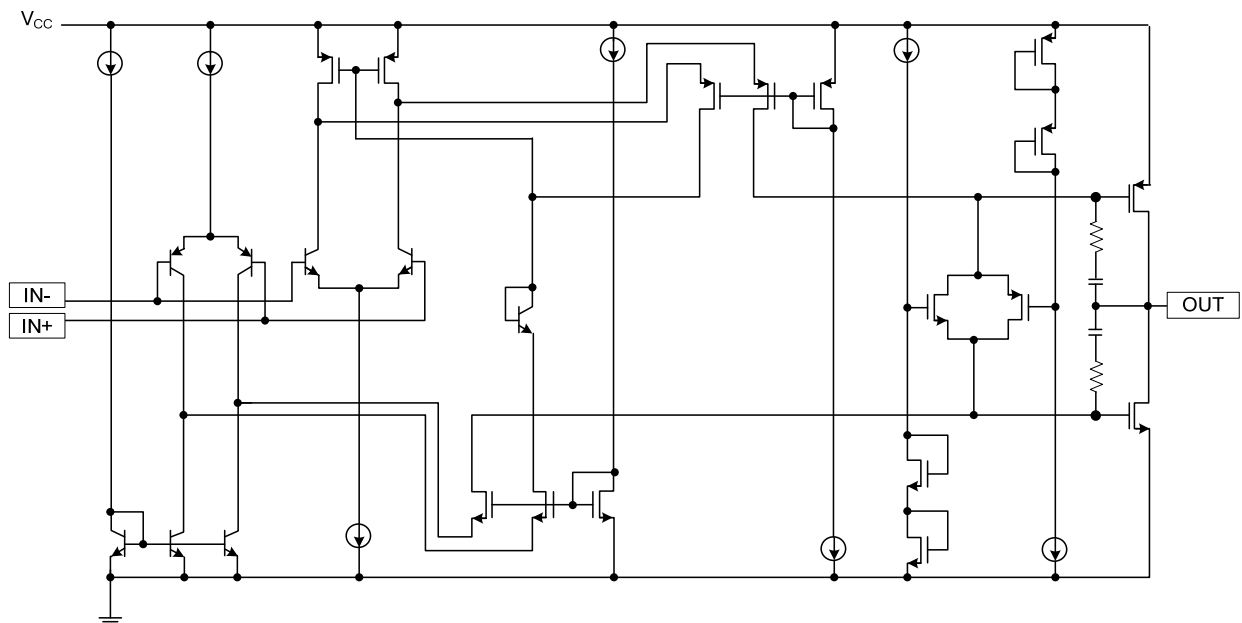


■ INTERNAL SIMPLE CIRCUIT

For LV2460



For LV2461



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

PARAMETER		SYMBOL	RATINGS	UNIT
Supply Voltage (Note 1)		$V_{CC}$	6	V
Differential Input Voltage		$V_{ID}$	$-0.2 \sim V_{CC}+0.2$	V
Output Current		$I_O$	$\pm 175$	mA
Power Dissipation	$T_A \leq 25^\circ\text{C}$ SOT-25	$P_D$	385	mW
	$T_A \leq 25^\circ\text{C}$ SOT-26		425	
Operating Free-Air Temperature		$T_A$	$-40 \sim +125$	$^\circ\text{C}$
Junction Temperature		$T_J$	+150	$^\circ\text{C}$
Storage Temperature		$T_{STG}$	$-60 \sim +150$	$^\circ\text{C}$

Notes: 1. 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.

2. All voltage values, except differential voltages, are with respect to GND.

■ THERMAL DATA

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	SOT-25	$\theta_{JA}$	324	$^\circ\text{C}/\text{W}$
	SOT-26		294	$^\circ\text{C}/\text{W}$
Junction to Case	SOT-25	$\theta_{JC}$	55	$^\circ\text{C}/\text{W}$
	SOT-26		55	$^\circ\text{C}/\text{W}$

■ RECOMMENDED OPERATING CONDITIONS

PARAMETER		SYMBOL	RATINGS	UNIT
Supply Voltage	Single supply	$V_{CC}$	$2.7 \sim 6$	V
	Split supply		$\pm 1.35 \sim \pm 3$	V
Common-Mode Input Voltage		$V_{ICR}$	$0 \sim V_{CC}$	V
Operating Free-Air Temperature		$T_A$	$-40 \sim +125$	$^\circ\text{C}$
Shutdown on/off voltage level (Note 1)		$V_{IH \text{ MIN}}$	2	V
		$V_{IL \text{ MAX}}$	0.7	V

Note: Relative to voltage on the GND terminal of the device.

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

$V_{CC}=3\text{V}$

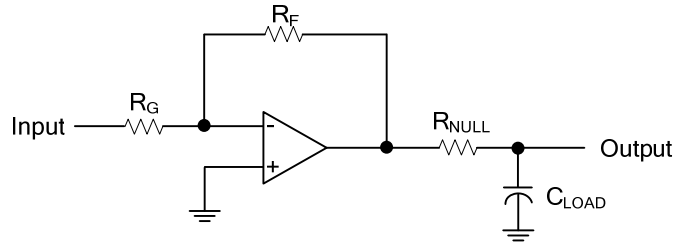
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input Offset Voltage	$V_{IO}$	$V_{CC}=3\text{V}$ , $V_{IC}=1.5\text{V}$ , $V_O=1.5\text{V}$ , $R_S=50\Omega$		500	2000	$\mu\text{V}$
Input Offset Current	$I_{IO}$	$V_{CC}=3\text{V}$ , $V_{IC}=1.5\text{V}$ ,		2.8	7	nA
Input Bias Current	$I_{IB}$	$V_O=1.5\text{V}$ , $R_S=50\Omega$		4.4	14	nA
High-Level Output Voltage	$V_{OH}$	$I_{OH}=-2.5\text{mA}$		2.9		V
		$I_{OH}=-10\text{mA}$		2.7		V
Low-Level Output Voltage	$V_{OL}$	$V_{IC}=1.5\text{V}$ , $I_{OL}=2.5\text{mA}$		0.1		V
		$V_{IC}=1.5\text{V}$ , $I_{OL}=10\text{mA}$		0.3		V
Short-Circuit Output Current	$I_{OS}$	Sourcing		50		mA
		Sinking		40		mA
Output Current	$I_O$	Measured 1V form rail		$\pm 40$		mA
Large-Signal Differential Voltage Amplification	$A_{VD}$	$R_L=10\text{k}\Omega$ , $V_{O(PP)}=1\text{V}$	90	105		dB
Differential Input Resistance	$r_{I(D)}$	$T_A=25^\circ\text{C}$		$10^9$		$\Omega$
Common-Mode Input Capacitance	$C_{I(C)}$	$f=10\text{kHz}$ , $T_A=25^\circ\text{C}$		7		pF
Closed-Loop Output Impedance	$Z_O$	$f=100\text{kHz}$ , $A_V=10$ , $T_A=25^\circ\text{C}$		33		$\Omega$
Common-Mode Rejection Ratio	CMRR	$V_{ICR}=0\sim 3\text{V}$ , $R_S=50\Omega$	66	80		dB
Supply Voltage Rejection Ratio ( $\Delta V_{CC}/\Delta V_{IO}$ )	$k_{SVR}$	$V_{CC}=2.7\sim 6\text{V}$ , $V_{IC}=V_{CC}/2$ , No load	80	85		dB
		$V_{CC}=3\sim 5\text{V}$ , $V_{IC}=V_{CC}/2$ , No load	85	95		dB
Supply Current	$I_{CC}$	$V_O=1.5\text{V}$ , No load		0.5	0.575	mA
Supply current in shutdown(LV2460)	$I_{CC(SHDN)}$	$SHDN < 0.7\text{V}$		0.3		$\mu\text{A}$
Slew Rate at Unity Gain	SR	$V_{O(PP)}=0.8\text{V}$ , $R_L=10\text{k}\Omega$ , $C_L=160\text{pF}$	0.9	1.6		$\text{V}/\mu\text{s}$
Equivalent Input Noise Voltage	$V_N$	$f=100\text{Hz}$		16		$\text{nV}/\sqrt{\text{Hz}}$
		$f=1\text{kHz}$		11		$\sqrt{\text{Hz}}$
Equivalent Input Noise Current	$I_N$	$f=1\text{kHz}$		0.13		$\text{pA}/\sqrt{\text{Hz}}$
Total Harmonic Distortion Plus Noise	THD+N	$V_{O(PP)}=2\text{V}$ , $R_L=10\text{k}\Omega$ , $f=1\text{kHz}$	$A_V=1$	0.006		%
			$A_V=10$	0.02		%
			$A_V=100$	0.08		%
Gain-Bandwidth Product		$f=10\text{kHz}$ , $C_L=160\text{pF}$ , $R_L=10\text{k}\Omega$		5.2		MHz
Setting Time	$t_S$	$V_{(STEP)PP}=2\text{V}$ , $R_L=10\text{k}\Omega$ , $A_V=-1$ , $C_L=10\text{pF}$	0.1%	1.47		$\mu\text{s}$
			0.01%	1.78		$\mu\text{s}$
		$V_{(STEP)PP}=2\text{V}$ , $R_L=10\text{k}\Omega$ , $A_V=-1$ , $C_L=56\text{pF}$ ,	0.1%	1.77		$\mu\text{s}$
			0.01%	1.98		$\mu\text{s}$
Phase Margin at Unity Gain	$\Phi_M$	$R_L=10\text{k}\Omega$ , $C_L=160\text{pF}$		44		$^\circ$
Gain Margin				7		dB

■ ELECTRICAL CHARACTERISTICS (Cont.)

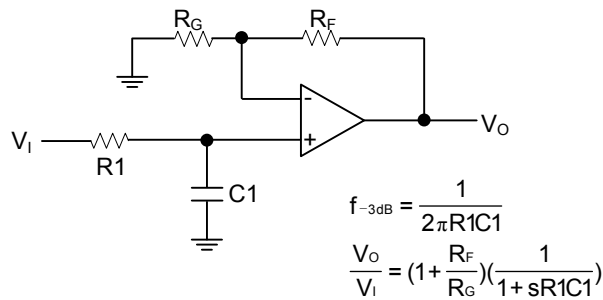
$V_{CC}=5V$

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input Offset Voltage	$V_{IO}$	$V_{CC}=5V, V_{IC}=2.5V, V_O=2.5V, R_S=50\Omega$		500	2000	$\mu V$
Input Offset Current	$I_{IO}$	$V_{CC}=5V, V_{IC}=2.5V, V_O=2.5V, R_S=50\Omega$		0.3	7	nA
Input Bias Current	$I_{IB}$			1.3	14	nA
High-Level Output Voltage	$V_{OH}$	$I_{OH}=-2.5mA$		4.9		V
		$I_{OH}=-10mA$		4.8		V
Low-Level Output Voltage	$V_{OL}$	$V_{IC}=2.5V, I_{OL}=2.5mA$		0.1		V
		$V_{IC}=2.5V, I_{OL}=10mA$		0.2		V
Short-Circuit Output Current	$I_{OS}$	Sourcing		145		mA
		Sinking		100		mA
Output Current	$I_O$	Measured 1V form rail		$\pm 48$		mA
Large-Signal Differential Voltage Amplification	$A_{VD}$	$V_{IC}=2.5V, R_L=10k\Omega, V_O=1\sim 4V$	92	109		dB
Differential Input Resistance	$r_{i(D)}$	$T_A=25^\circ C$		$10^9$		$\Omega$
Common-Mode Input Capacitance	$C_{i(C)}$	$f=10kHz, T_A=25^\circ C$		7		pF
Closed-Loop Output Impedance	$Z_O$	$f=100kHz, A_V=10, T_A=25^\circ C$		29		$\Omega$
Common-Mode Rejection Ratio	CMRR	$V_{ICR}=0\sim 5V, R_S=50\Omega$	71	85		dB
Supply Voltage Rejection Ratio ( $\Delta V_{CC}/\Delta V_{IO}$ )	$k_{SVR}$	$V_{CC}=2.7\sim 6V, V_{IC}=V_{CC}/2, \text{No load}$	80	85		dB
		$V_{CC}=3\sim 5V, V_{IC}=V_{CC}/2, \text{No load}$	85	95		dB
Supply Current	$I_{CC}$	$V_O=2.5V, \text{No load}$		0.55	0.65	mA
Supply current in shutdown(LV2460)	$I_{CC(SHDN)}$	$SHDN < 0.7V$		1		$\mu A$
Slew Rate at Unity Gain	SR		0.9	1.6		V/ $\mu s$
Equivalent Input Noise Voltage	$V_N$	$f=100Hz$		14		nV/ $\sqrt{Hz}$
		$f=1kHz$		11		$\sqrt{Hz}$
Equivalent Input Noise Current	$I_N$	$f=1kHz$		0.13		pA/ $\sqrt{Hz}$
Total Harmonic Distortion Plus Noise	THD+N	$V_{O(PP)}=4V, R_L=10k\Omega, f=1kHz$	$A_V=1$	0.004		%
			$A_V=10$	0.01		%
			$A_V=100$	0.04		%
Gain-Bandwidth Product		$f=10kHz, C_L=160pF, R_L=10k\Omega$		6.4		MHz
Setting Time	$t_s$	$V_{(STEP)PP}=2V, R_L=10k\Omega, A_V=-1, C_L=10pF$	0.1%	1.53		$\mu s$
			0.01%	1.83		$\mu s$
		$V_{(STEP)PP}=2V, R_L=10k\Omega, A_V=-1, C_L=56pF$	0.1%	3.13		$\mu s$
			0.01%	3.33		$\mu s$
Phase Margin at Unity Gain	$\Phi_M$	$R_L=10k\Omega, C_L=160pF$		45		$^\circ$
Gain Margin				7		dB

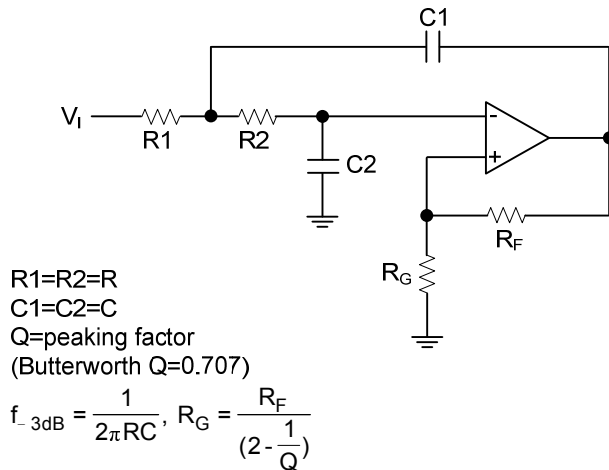
■ TYPICAL APPLICATION CIRCUIT



Driving A Capacitive Load



Single-Pole Low-Pass Filter



2-Pole Low-Pass Sallen-Key Filter

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