Operational Amplifiers

LM110/LM210 voltage followers

general description

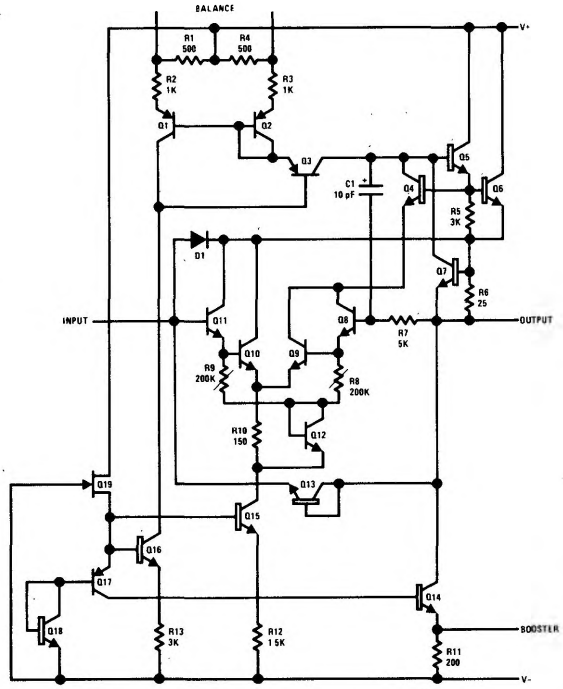
The LM110 and LM210 are monolithic operational amplifiers internally connected as unity-gain non-inverting amplifiers. They use super-gain transistors in the input stage to get low bias current without sacrificing speed. Directly interchangeable with 101, 741 and 709 in voltage follower applications, these devices have internal frequency compensation and provision for offset balancing. Outstanding characteristics include:

- Input current: 10 nA max. over temperature
- Small signal bandwidth: 20 MHz
- Slew rate: 30V/μs
- Supply voltage range: ±5V to ±18V

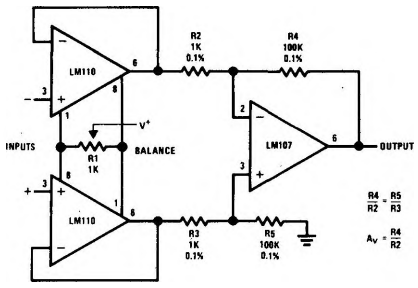
The LM110 and LM210 are useful in fast sample and hold circuits, active filters or as general-purpose buffers. Further, the frequency response is enough better than standard IC amplifiers that the followers can be included in the feedback loop without introducing instability. They are plug-in replacements for the LM102 or LM202 voltage followers, offering lower offset voltage, drift, bias current and noise in addition to higher speed and wider operating voltage range.

The LM210 is identical to the LM110, except that its performance is specified over a −25°C to 85°C temperature range instead of −55°C to 125°C.

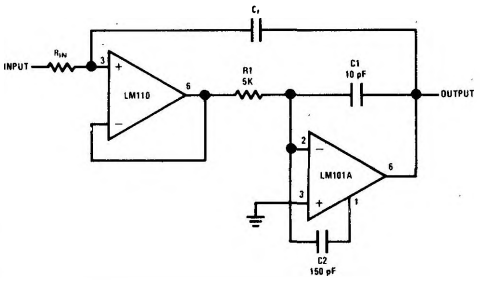
schematic diagram



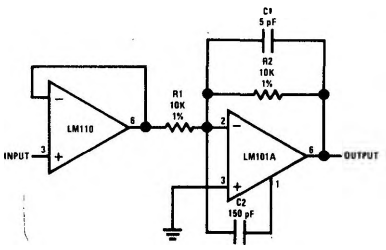
typical applications



Differential Input Instrumentation Amplifier

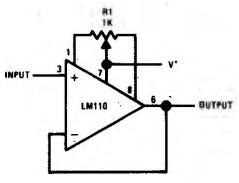


Fast Integrator with Low Input Current

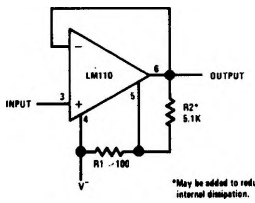


Fast Inverting Amplifier with High Input Impedance

auxiliary circuits



Offset Balancing Circuit



Increasing Negative Swing Under Load

absolute maximum ratings

Supply Voltage	±18V
Power Dissipation (Note 1)	500 mW
Input Voltage (Note 2)	±15V
Output Short Circuit Duration (Note 3)	Indefinite
Operating Temperature Range LM110	−55°C to 125°C
LM210	−25°C to 85°C
Storage Temperature Range	−65°C to 150°C
Lead Temperature (Soldering, 10 sec)	300°C

electrical characteristics (Note 4)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage	$T_A = 25°C$		1.5	4.0	mV
Input Bias Current	$T_A = 25°C$		1.0	3.0	nA
Input Resistance	$T_A = 25°C$	10^{10}	10^{12}		Ω
Input Capacitance			1.5		pF
Large Signal Voltage Gain	$T_A = 25°C$, $V_S = ±15V$ $V_{OUT} = ±10V$, $R_L = 8K\Omega$	0.999	0.9999		V/V
Output Resistance	$T_A = 25°C$		0.75	2.5	Ω
Supply Current	$T_A = 25°C$		3.9	5.5	mA
Input Offset Voltage				6.0	mV
Offset Voltage Temperature Drift	$-55°C \leq T_A \leq 85°C$ $T_A = 125°C$		6 12		μV/°C μV/°C
Input Bias Current				10	nA
Large Signal Voltage Gain	$V_S = ±15V$, $V_{OUT} = ±10V$ $R_L = 10K\Omega$	0.999			V/V
Output Voltage Swing (Note 5)	$V_S = ±15V$, $R_L = 10K\Omega$	±10			V
Supply Current	$T_A = 125°C$		2.0	4.0	mA
Supply Voltage Rejection Ratio	$±5V \leq V_S \leq ±18V$	70	80		dB

Note 1: The maximum junction temperature of the LM110 is 150°C, while that of the LM210 is 100°C. For operating at elevated temperatures, devices in the TO-5 package must be derated based on a thermal resistance of 150°C/W, junction to ambient, or 45°C/W, junction to case. For the flat package, the derating is based on a thermal resistance of 185°C/W when mounted on a 1/16-inch-thick epoxy glass board with ten, 0.03-inch-wide, 2-ounce copper conductors. The thermal resistance of the dual-in-line package is 100°C/W, junction to ambient.

Note 2: For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.

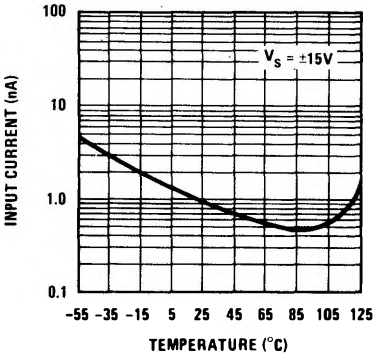
Note 3: Continuous short circuit is allowed for case temperatures to 125°C and ambient temperatures to 70°C. It is necessary to insert a resistor greater than 2kΩ in series with the input when the amplifier is driven from low impedance sources to prevent damage when the output is shorted.

Note 4: These specifications apply for $±5V \leq V_S \leq ±18V$ and $-55°C \leq T_A \leq 125°C$, unless otherwise specified. With the LM210, however, all temperature specifications are limited to $-25°C \leq T_A \leq 85°C$.

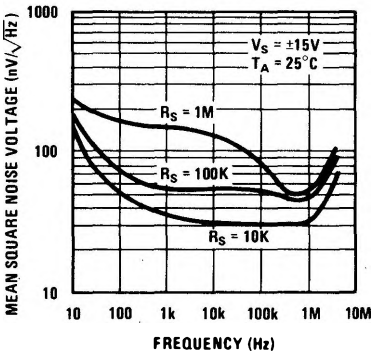
Note 5: Increased output swing under load can be obtained by connecting an external resistor between the booster and V^- terminals. See curve.

typical performance

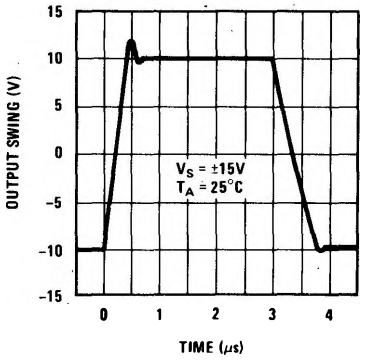
Input Current



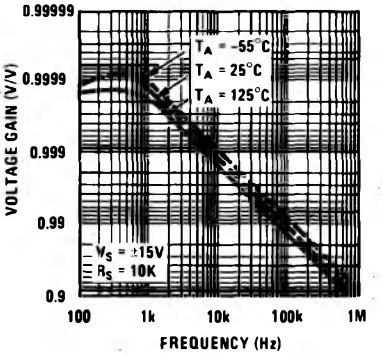
Output Noise Voltage



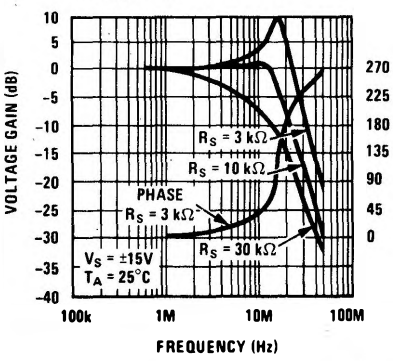
Large Signal Pulse Response



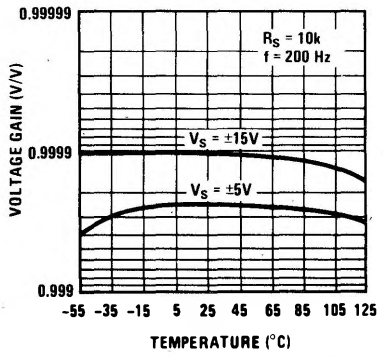
Voltage Gain



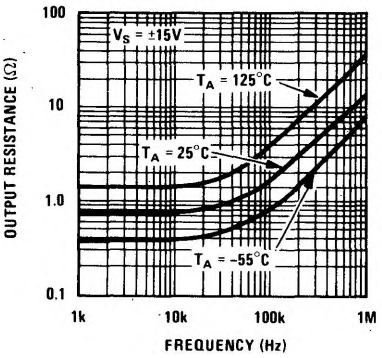
Voltage Gain



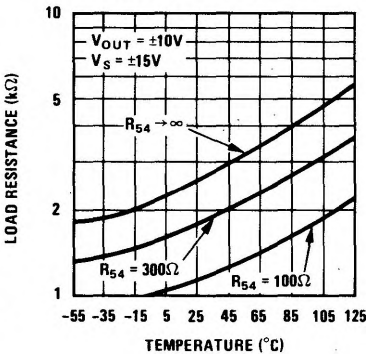
Voltage Gain



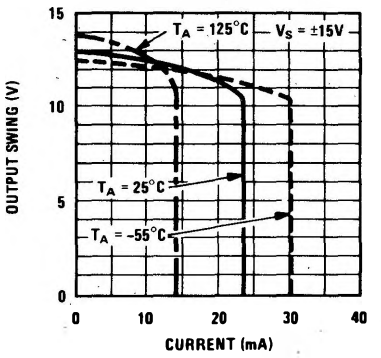
Output Resistance



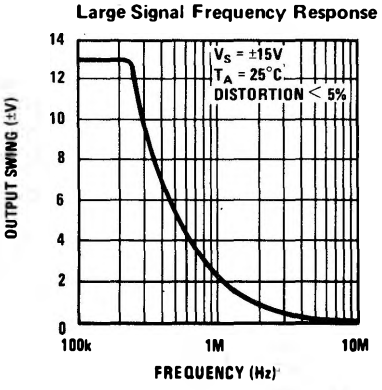
Symmetrical Output Swing



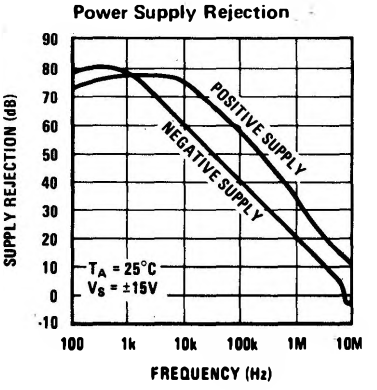
Positive Output Swing



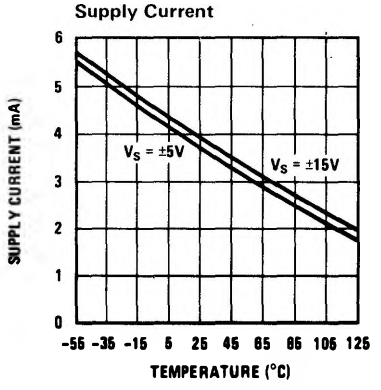
Large Signal Frequency Response



Power Supply Rejection

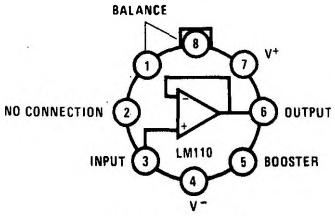


Supply Current



connection diagrams

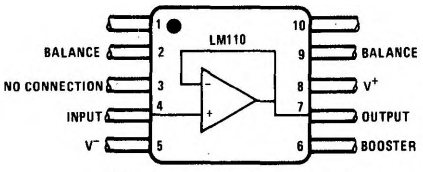
Metal Can



NOTE: Pin 4 connected to case.

TOP VIEW

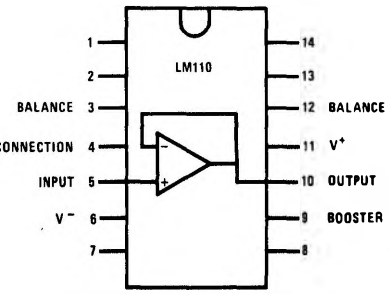
Flat Package



NOTE: Pin 5 connected to bottom of package.

TOP VIEW

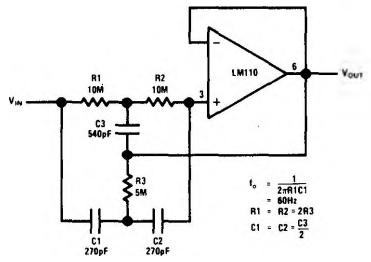
Dual-In-Line



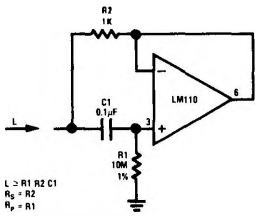
NOTE: Pin 6 connected to bottom of package.

TOP VIEW

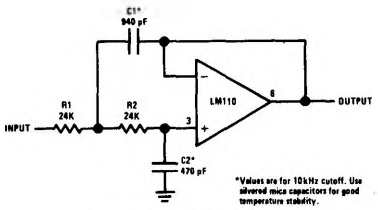
typical applications



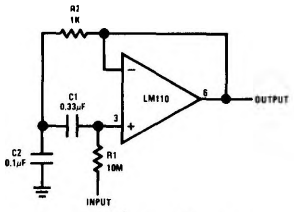
High Q Notch Filter



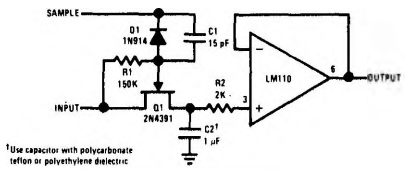
Simulated Inductor



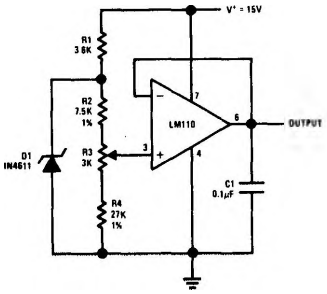
Low Pass Active Filter



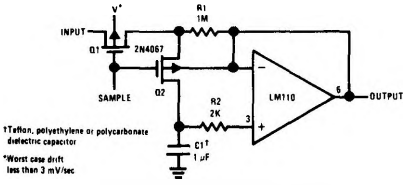
Bandpass Filter



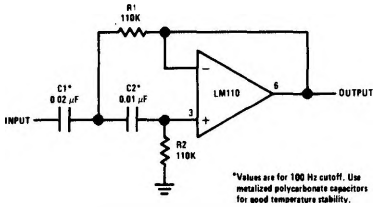
Sample and Hold



Buffered Reference Source

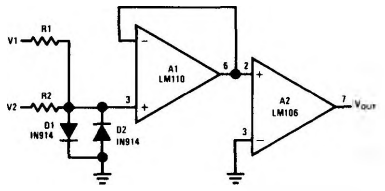


Low Drift Sample and Hold*

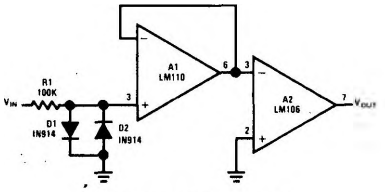


High Pass Active Filter

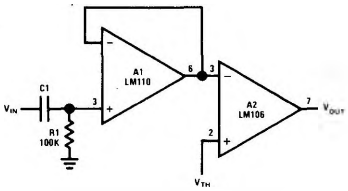
typical applications



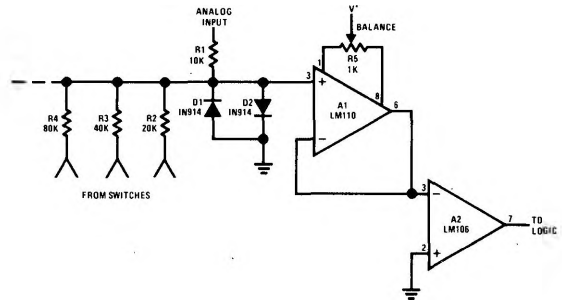
Comparator for Signals of Opposite Polarity



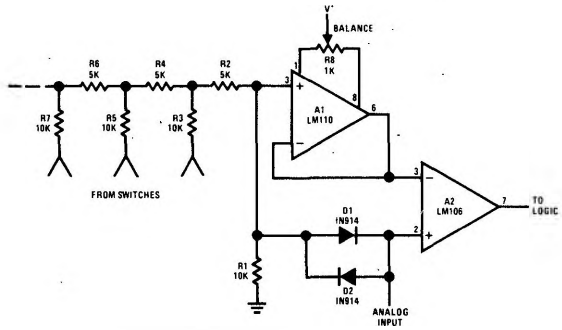
Zero Crossing Detector



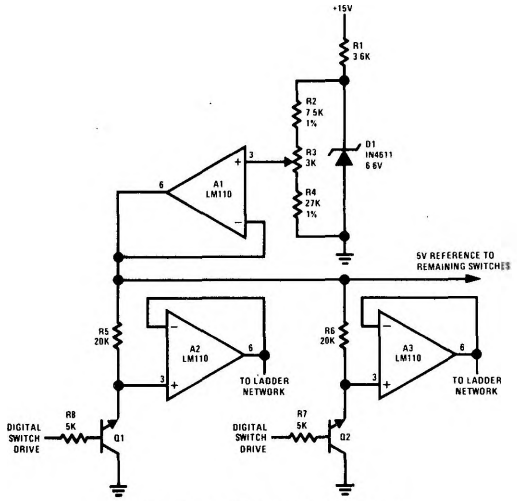
Comparator for AC Coupled Signals



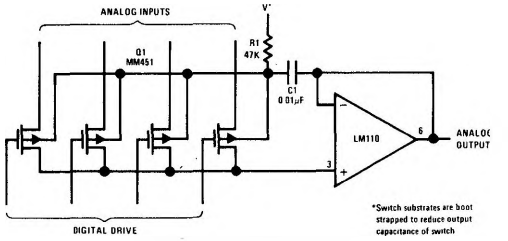
Comparator for A/D Converter
Using a Binary-Weighted Network



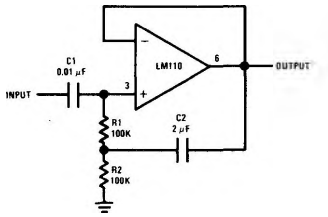
Comparator for A/D Converter
Using a Ladder Network



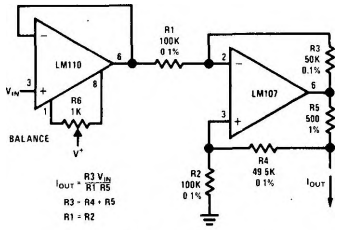
Driver for A/D Ladder Network



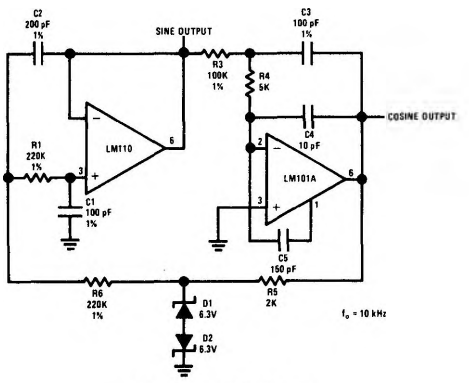
Buffer for Analog Switch*



High Input Impedance AC Amplifier



Bilateral Current Source



Sine Wave Oscillator