INTERSIL

LM102/302
LM110/310
High Performance Voltage Followers

FEATURES

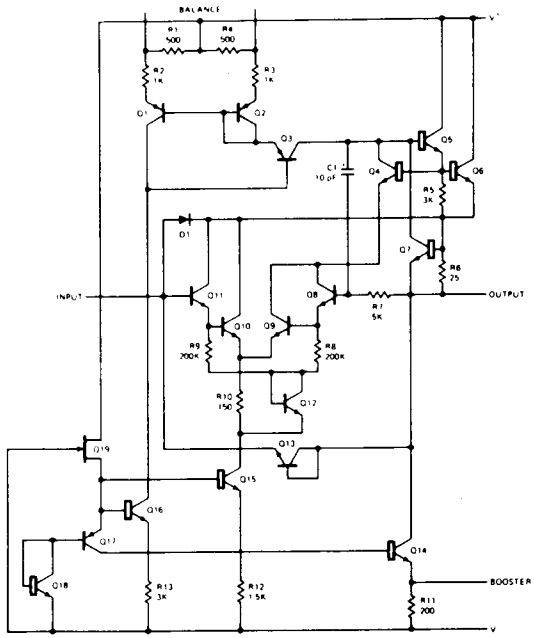
- Low Input Current – 7 to 30 nA Max
- High Slew Rate – 10 to 30 V/μs
- Wide Bandwidth – 20 MHz (LM110/LM310)
- Internal Frequency Compensation
- Interchangeable with 741 in Follower Applications

GENERAL DESCRIPTION

The LM102/LM302 and LM110/LM310 are monolithic high performance voltage followers. In buffer applications they offer substantial advantages compared with general purpose operational amplifiers: input current, bandwidth, and slew rate are all significantly improved. Applications include high speed sample and hold circuits, instrumentation amplifiers, active filters, as well as general purpose buffers.

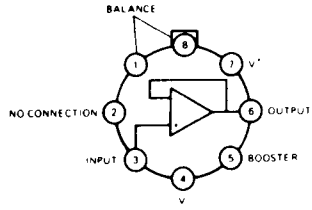
For new designs the LM110/LM310 is recommended.

EQUIVALENT CIRCUIT



PIN CONFIGURATIONS

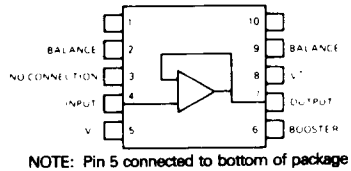
(outline dwg TY)



NOTE: Pin 4 connected to case

TOP VIEW

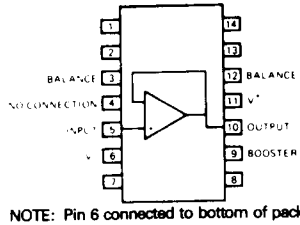
(outline dwg FB)



NOTE: Pin 5 connected to bottom of package

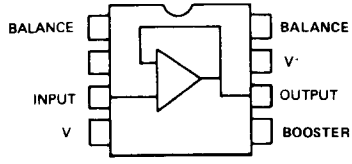
TOP VIEW

(outline dwg JD)



NOTE: Pin 6 connected to bottom of package

(outline dwg PA)



ORDERING INFORMATION

Part number	TO-99 Can	10 pin Flatpak	14 pin CER DIP	8 pin Plastic DIP	Dice
LM102	LM102H	LM102F	—	—	LM102/D
LM110	LM110H*	LM110F*	LM110J	—	LM110/D
LM302	LM302H	—	—	—	LM302/D
LM310	LM310H	LM310F	LM310J	LM310N	LM310/D

*Add 883B to order number if 883B processing is desired.

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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	102, 110	-55°C to +125°C
	202, 210	-25°C to +85°C
	302, 310	0°C to +70°C
Storage Temperature Range		-65°C to +150°C
Lead Temperature (Soldering, 10 sec)		300°C

ELECTRICAL CHARACTERISTICS 102/202/302 (Note 4)

PARAMETER	CONDITIONS	LM102			LM202			LM302			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
Offset Voltage			2	5		3	10		5	15	mV
Average Temperature Coefficient of Offset Voltage			6			15			20		µV/°C
Input Current			3	10		7	15		10	30	nA
Input Resistance		10^{10}	10^{12}		10^{10}	10^{12}		10^{9}	10^{12}		Ω
Voltage Gain	$R_L \geq 10\ k\Omega$	0.999	0.9996		0.999	0.9995	1.000	0.9985	0.9995	1.000	
Output Resistance			0.8	2.5		0.8	2.5		0.8	2.5	Ω
Output Voltage Swing (Note 6)	$R_L \geq 8\ k\Omega$	±10	±13		±10			±10			V
Supply Current			3.5	5.5		3.5	5.5		3.5	5.5	mA
Positive Supply Rejection		60			60			60			dB
Negative Supply Rejection		70			70			70			dB
Input Capacitance			3.0			3.0			3.0		pF
Offset Voltage	$T_{MIN} \leq T_A \leq T_{MAX}$			7.5			15			20	mV
Input Current	$T_A = T_{MAX}$		3	10		1.5	5.0		3.0	15	nA
	$T_A = T_{MIN}$		30	100		30	50		20	50	nA
Voltage Gain	-55°C ≤ T_A ≤ 125°C, $R_L \geq 10\ k\Omega$	0.999									
Supply Current	$T_A = 125°C$		2.6	4.0							mA

ELECTRICAL CHARACTERISTICS 110/210/310 (Note 5)

PARAMETER	CONDITIONS	LM110			LM210			LM310			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
Input Offset Voltage	$T_A = 25°C$		1.5	4.0		1.5	4.0		2.5	7.5	mV
Input Bias Current	$T_A = 25°C$		1.0	3.0		1.0	3.0		2.0	7.0	nA
Input Resistance	$T_A = 25°C$	10^{10}	10^{12}		10^{10}	10^{12}		10^{10}	10^{12}		Ω
Input Capacitance			1.5			1.5			1.5		pF
Large Signal Voltage Gain	$T_A = 25°C$, $V_S = \pm15V$, $V_{OUT} = \pm10V$, $R_L = 8\ k\Omega$	0.999	0.9999		0.999	0.9999		0.999	0.9999		V/V
Output Resistance	$T_A = 25°C$		0.75	2.5		0.75	2.5		0.75	2.5	Ω
Supply Current	$T_A = 25°C$		3.9	5.5		3.9	5.5		3.9	5.5	mA
Input Offset Voltage				6.0			6.0			10	mV
Offset Voltage Temperature Drift			10			10			10		µV/°C
Input Bias Current				10			10			10	nA
Large Signal Voltage Gain	$V_S = \pm15V$, $V_{OUT} = \pm10V$, $R_L = 10\ k\Omega$	0.999			0.999			0.999			V/V
Output Voltage Swing (Note 6)	$V_S = \pm15V$, $R_L = 10\ k\Omega$	±10			±10			±10			V
Supply Current	$T_A = T_{MAX}$		2.0	4.0		2.0	4.0				mA
Supply Voltage Rejection Ratio	$\pm5V \leq V_S \leq \pm18V$	70	80		70	80		70	80		dB

NOTE 1: The maximum junction temperature of the 102 and 110 is 150°C, that of the 202 and 210 is 100°C, while that of the 302 and 310 is 85°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 2 kΩ in series with the input when the amplifier is driven from low impedance sources to prevent damage when the output is shorted.

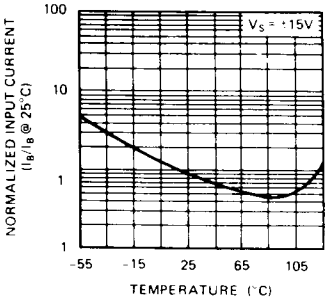
NOTE 4: These specifications apply for $T_A = 25°C$, $V_S = \pm15V$ and $C_L = 100$ pF unless otherwise noted.

NOTE 5: These specifications apply for $\pm5V \leq V_S \leq \pm18V$ and $-55°C \leq T_A \leq 125°C$, unless otherwise specified. With the 210, however, all temperature specifications are limited to $-25°C \leq T_A \leq 85°C$, while for the 310 the limits are $0°C \leq T_A \leq 70°C$.

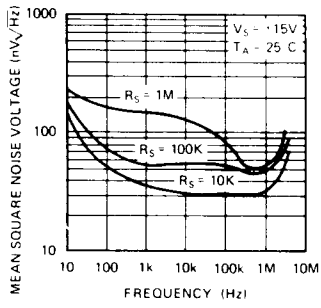
NOTE 6: Increased output swing under load can be obtained by connecting an external resistor between the booster and V^- terminals. See curve

TYPICAL PERFORMANCE

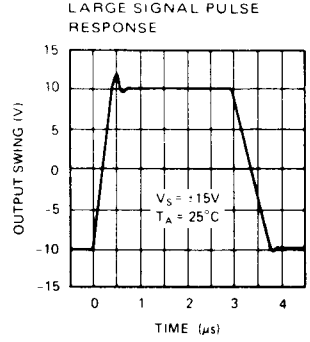
NORMALIZED INPUT CURRENT



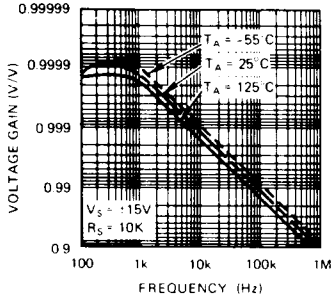
OUTPUT NOISE VOLTAGE



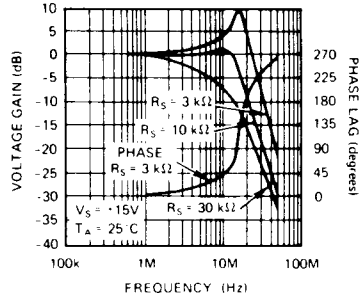
LARGE SIGNAL PULSE RESPONSE



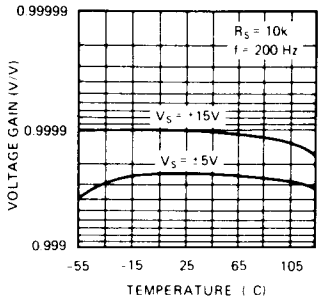
VOLTAGE GAIN



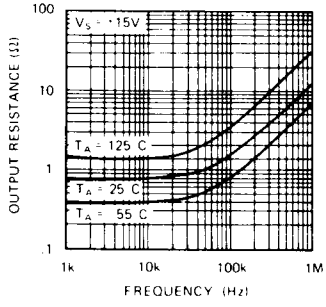
VOLTAGE GAIN*



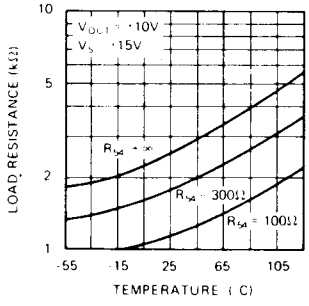
VOLTAGE GAIN



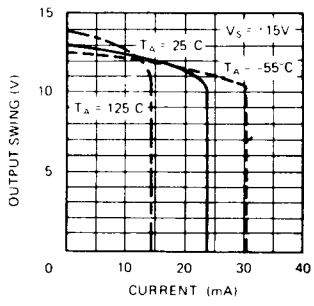
OUTPUT RESISTANCE



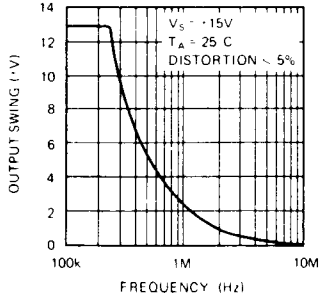
SYMMETRICAL OUTPUT SWING



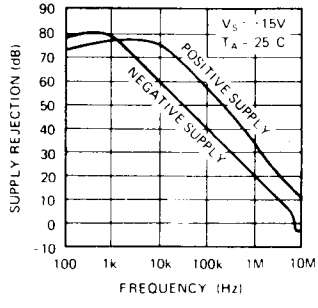
POSITIVE OUTPUT SWING



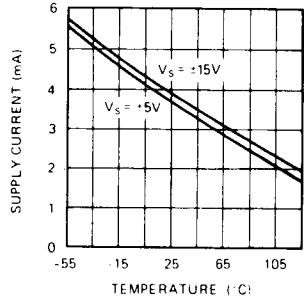
LARGE SIGNAL FREQUENCY RESPONSE



POWER SUPPLY REJECTION



SUPPLY CURRENT



*Note that optimum stability is obtained for a source resistance of 10 kΩ. For source resistances lower than 10 kΩ, it is advisable to put additional resistance in series with the input to ensure adequate stability margin.

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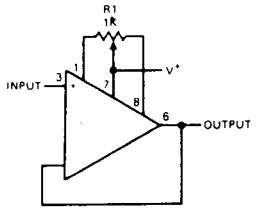
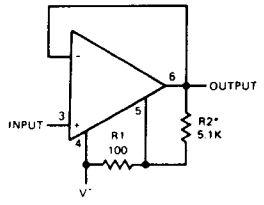
OFFSET BALANCING



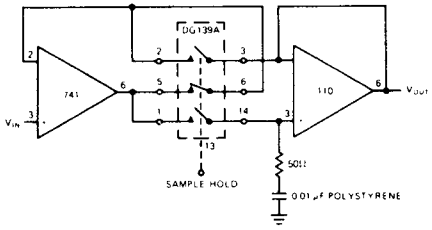
INCREASING NEGATIVE SWING UNDER LOAD



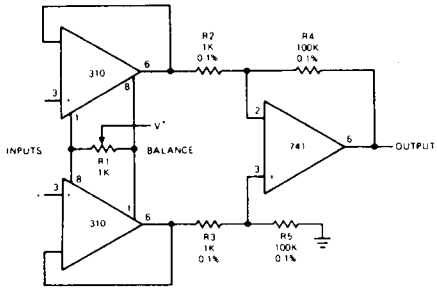
*May be added to reduce internal dissipation

APPLICATIONS

SAMPLE AND HOLD



INSTRUMENTATION AMPLIFIER



DEFINITION OF TERMS

OFFSET VOLTAGE: The voltage at the output of the amplifier with the input at zero.

OFFSET VOLTAGE TEMPERATURE DRIFT: The average drift rate of offset voltage for a thermal variation from room temperature to the indicated temperature extreme.

INPUT CURRENT: The current into the input of the amplifier with the input at zero.

INPUT RESISTANCE: The ratio of the rated output voltage swing to the change in input current required to drive the output from zero to this voltage.

LARGE SIGNAL VOLTAGE GAIN: The ratio of the output voltage swing to the change in input voltage required to drive the output from zero to this voltage.

OUTPUT RESISTANCE: The ratio of the change in output voltage to the change in output current with constant input voltage.

OUTPUT VOLTAGE SWING: The peak output voltage swing, referred to zero, that can be obtained without the large-signal voltage gain falling below the minimum specified value.

SUPPLY CURRENT: The current required from the power supply to operate the amplifier, with no load, anywhere within its linear range.

POWER SUPPLY REJECTION: The ratio of the change in input offset voltage to the change in power supply voltage producing it.

SLEW RATE: The internally-limited rate of change in output voltage with a large-amplitude step function applied to the input.