ICL761X/ 762X/763X/764X Low Power MAXCMOS™ Operational Amplifiers

FEATURES

- Wide operating voltage range ±0.5V to ±8V
- Single Ni-cad battery operation
- High input impedance — $10^{12}\Omega$
- Programmable power consumption — as low as 10μW
- Input current lower than BIFETs — typ 1pA
- Available as singles, duals, triples, and quads
- Output voltage swing ranges to within millivolts of V− to V+
- Low power replacement for many standard op amps
- Compensated and uncompensated versions

APPLICATIONS

- Portable instruments
- Telephone headsets
- Hearing aid/microphone amplifiers
- Meter amplifiers
- Medical instruments
- High impedance buffers

A number of special options are available. They include:

- Single, dual, triple, and quad configurations
- Internally compensated and uncompensated versions
- Inputs protected to ±200V (ICL7613/15)
- Input common mode voltage range greater than supply rails (ICL7612)

Note: See page 2 for table of options.

SCHEMATIC

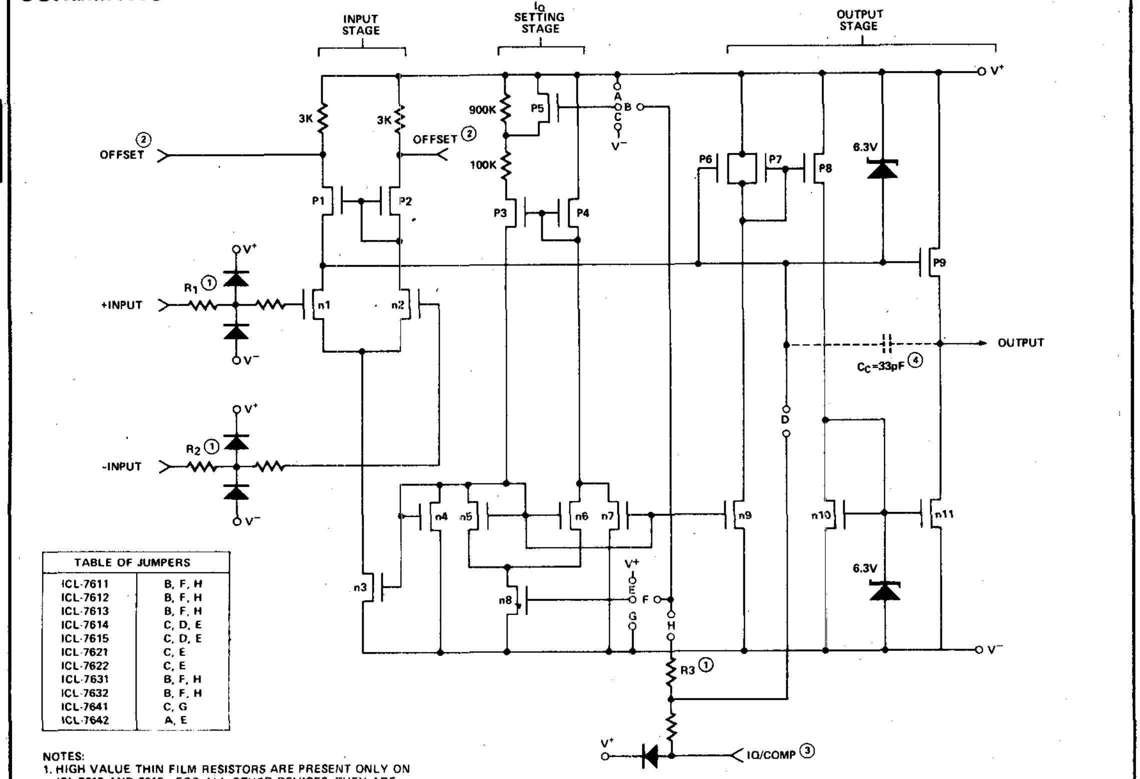


TABLE OF JUMPERS	
ICL-7611	B, F, H
ICL-7612	B, F, H
ICL-7613	B, F, H
ICL-7614	C, D, E
ICL-7615	C, D, E
ICL-7621	C, E
ICL-7622	C, E
ICL-7631	B, F, H
ICL-7632	B, F, H
ICL-7641	C, G
ICL-7642	A, E

NOTES:
1. HIGH VALUE THIN FILM RESISTORS ARE PRESENT ONLY ON ICL-7613 AND 7615. FOR ALL OTHER DEVICES, THEY ARE REPLACED BY DIRECT CONNECTIONS.
2. OFFSET NULLING PINS ARE NOT AVAILABLE ON TRIPLE (ICL-763X) AND QUAD (ICL-764X) VERSIONS.
3. I_Q AND COMP TERMINALS ARE METAL MASK OPTIONS OF THE SAME BONDING PAD; ONLY ONE OF THESE FUNCTIONS IS AVAILABLE IN A GIVEN DEVICE.
4. FOR INTERNALLY COMPENSATED VERSIONS ONLY. THIS CAPACITOR IS ABSENT FOR ALL OTHER DEVICES.

GENERAL DESCRIPTION

The ICL761X/762X/763X/764X series is a family of monolithic CMOS op amps, fabricated using Intersils' proven MAXCMOS™ process. These amplifiers provide the designer with high performance operation at low supply voltages and selectable quiescent currents, and are an ideal design tool when ultra low input current and low power drain are essential.

The basic amplifier will operate at supply voltages ranging from ±0.5 to ±8V, and may be operated from a single Ni-Cad battery.

A unique quiescent current programming pin allows setting of standby current to 1 mA, 100 μA, or 10 μA, with no external components. This results in power drain as low as 10 μW. Output swings range to within a few millivolts of the supply voltages.

Of particular significance is the extremely low (1 pA) input current, input noise current of .01pA/$\sqrt{Hz}$, and $10^{12}\Omega$ input impedance. These features optimize performance in very high source impedance applications.

The inputs are internally protected and require no special handling procedures. Outputs are fully protected against shorts to ground or to either supply.

AC performance is excellent, with a slew rate of 1.6V/μs, and unity gain bandwidth of 1 MHz at I_Q = 1 mA.

Because of the low power dissipation, operating temperatures and drift are quite low. Applications utilizing these features may include stable instruments, extended life designs, or high density packages.

SELECTION GUIDE

BASIC TYPE

76XX

OFFSET NULL CAPABILITY
Y = YES
N = NO

I_Q SETTING
L = 10μA FIXED
M = 100μA FIXED
H = 1mA FIXED
P = PROGRAMMABLE

ORDERING INFORMATION[2]

ICL76XX M N O P

V_{OS} SELECTION
A = 2mV
B = 5mV
C = 10mV
D = 15mV
E = 20mV

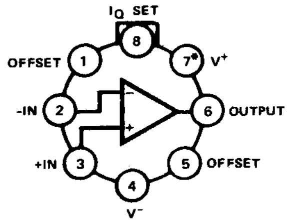
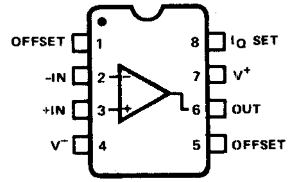
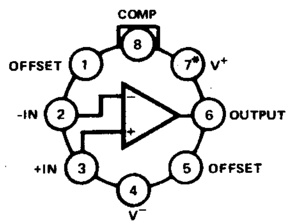
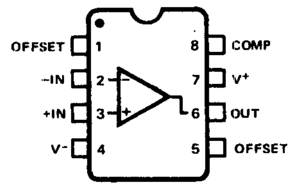
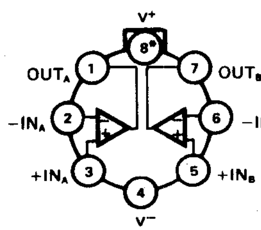
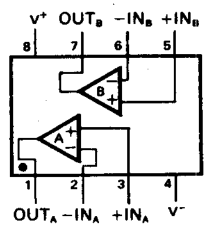
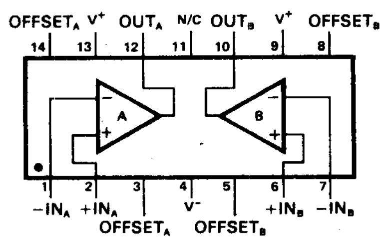
TEMP. RANGE
C = 0°C TO 70°C
M = -55°C TO +125°C

PACKAGE CODE
TY – TO-99, 8 PIN
PA – PLASTIC 8 PIN MINIDIP
PD – 14 PIN PLASTIC
PE – 16 PIN PLASTIC
JD – 14 PIN CERDIP
JE – 16 PIN CERDIP

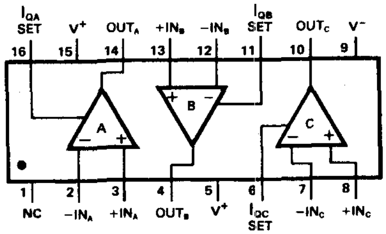
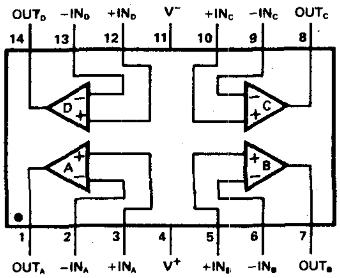
	BASIC TYPE					ORDER SUFFIX							
						TO-99		MINI DIP	PLASTIC DIP[1]	CERAMIC DIP[1]		DIE	
	COMPENSATED	EXTERNALLY COMPENSATED	COMPENSATED/ INPUT PROTECTED	EXTERNALLY COMPENSATED INPUT PROTECTED	EXTENDED CMVR	0°C to +70°C	55°C to +125°C	0°C to +70°C	0°C to +70°C	0°C to +70°C	55°C to +125°C	0°C to +70°C	55°C to +125°C
SINGLE	7611 Y P	7614 Y M	7613 Y P	7615 Y M	7612 Y P	ACTY BCTY DCTY	AMTY BMTY —	ACPA BCPA DCPA				DC/D	
DUAL 1458 PINOUT	7621 N M					ACTY BCTY DCTY	AMTY BMTY —	ACPA BCPA DCPA				DC/D	
DUAL 747 PINOUT	7622 Y M								ACPD BCPD DCPD	ACJD BCJD DCJD	AMJD BMJD —	DC/D	
TRIPLE	7631 N P	[3] 7632 N P							BCPE CCPE ECPE	BCJE CCJE ECJE	BMJE CMJE —	EC/D	
QUAD High I_Q	7641 N H								BCPD CCPD ECPD	BCJD CCJD ECPD	BMJD CMJD —	EC/D	
QUAD Low I_Q	7642 N L								BCPD CCPD ECPD	BCJD CCJD ECJD	BCJD CCJD —	EC/D	

NOTES: 1. Duals and quads are available in 14 pin DIP packages, triples in 16 pin only.
2. Ordering code must consist of basic device and order suffix, e.g., ICL7611BCPA.
3. ICL7632 is not compensatable. Recommended for use in high gain circuits only.

PIN CONFIGURATIONS

DEVICE	DESCRIPTION	PIN ASSIGNMENTS
ICL7611XCPA ICL7611XCTY ICL7611XMTY ICL7612XCPA ICL7612XCTY ICL7612XMTY ICL7613XCPA ICL7613XCTY ICL7613XMTY	Internal compensation, plus offset null capability and external I_Q control.	**TO-99** (TOP VIEW) (outline dwg TO-99)  *Pin 7 connected to case. **8 PIN DIP** (TOP VIEW) (outline dwg PA) 
ICL7614XCPA ICL7614XCTY ICL7614XMTY ICL7615XCPA ICL7615XCTY ICL7615XMTY	Fixed I_Q (100µA), external compensation, and offset null capability.	**TO-99** (TOP VIEW) (outline dwg TO-99)  * Pin 7 connected to case. **8 PIN DIP** (TOP VIEW) (outline dwg PA) 
ICL7621XCPA ICL7621XCTY ICL7621XMTY	Dual op amps with internal compensation; I_Q fixed at 100µA Pin compatible with Texas Inst. TL082 Motorola MC1458 Raytheon RC4558	**TO-99** (TOP VIEW) (outline dwg TO-99)  * Pin 8 connected to case. **8 PIN DIP** (TOP VIEW) (outline dwg PA) 
ICL7622XCPD	Dual op amps with internal compensation and offset null capability; I_Q fixed at 100µA Pin compatible with Texas Inst. TL083 Fairchild µA747	**14 PIN DIP** (TOP VIEW) (outline dwgs JD, PD)  **Note: Pins 9 and 13 are internally connected.**

PIN CONFIGURATIONS (Cont.)

DEVICE	DESCRIPTION	PIN ASSIGNMENTS
ICL7631XCPE ICL7632XCPE	**Triple op amps with internal compensation (ICL7631) and no compensation (ICL7632). Adjustable I_Q Same pin configuration as ICL8023.**	**16 PIN DIP (TOP VIEW)** (outline dwgs JE, PE)  **Note: Pins 5 and 15 are internally connected.**
ICL7641XCPD ICL7642XCPD	**Quad op amps with internal compensation. I_Q fixed at 1mA (ICL7641) I_Q fixed at 10μA (ICL7642) Pin compatible with Texas Instr. TL084 National LM324 Harris HA4741**	**14 PIN DIP (TOP VIEW)** (outline dwg JD, PD) 

5

GENERAL INFORMATION

STATIC PROTECTION

All devices are static protected by the use of input diodes. However, strong static fields should be avoided, as it is possible for the strong fields to cause degraded diode junction characteristics, which may result in increased input leakage currents.

LATCHUP AVOIDANCE

Junction-isolated CMOS circuits employ configurations which produce a parasitic 4-layer (p-n-p-n) structure. The 4-layer structure has characteristics similar to an SCR, and under certain circumstances may be triggered into a low impedance state resulting in excessive supply current. To avoid this condition, no voltage greater than 0.3V beyond the supply rails may be applied to any pin. (An exception to this rule concerns the inputs of the ICL7613 and ICL7615, which are protected to ±200V.) In general, the op amp supplies must be established simultaneously with, or before any input signals are applied. If this is not possible, the drive circuits must limit input current flow to 2 mA to prevent latchup.

CHOOSING THE PROPER I_Q

Each device in the ICL76XX family has a similar I_Q set-up scheme, which allows the amplifier to be set to nominal quiescent currents of 10 μA, 100 μA or 1 mA. These current settings change only very slightly over the entire supply voltage range. The ICL7611/12/13 and ICL7631/32 have an external I_Q control terminal, permitting user selection of each amplifiers' quiescent current. (The ICL7614/15, 7621/22, and 7641/42 have fixed I_Q settings — refer to selector guide for details.) To set the I_Q of programmable versions, connect the I_Q terminal as follows:

I_Q = 10μA — I_Q pin to V^+

I_Q = 100μA — I_Q pin to ground. If this is not possible, any voltage from V^+ -0.8 to V^- +0.8 can be used.

I_Q = 1mA — I_Q pin to V^-

NOTE: The negative output current available is a function of the quiescent current setting. For maximum p-p output voltage swings into low impedance loads, I_Q of 1 mA should be selected.

OUTPUT STAGE AND LOAD DRIVING CONSIDERATIONS

Each amplifiers' quiescent current flows primarily in the output stage. This is approximately 70% of the I_Q settings. This allows output swings to almost the supply rails for output loads of 1M, 100K, and 10K, using the output stage in a highly linear class A mode. In this mode, crossover distortion is avoided and the voltage gain is maximized. However, the output stage can also be operated in Class AB, which can supply higher output currents. (See graphs under Typical Operating Characteristics). During the transition from Class A to Class B operation, the output transfer characteristic is non-linear and the voltage gain decreases.

A special feature of the output stage is that it *approximates a transconductance amplifier, and its* gain is directly proportional to load impedance. Approximately the same open loop gains are obtained at each of the I_Q settings if corresponding loads of 10K, 100K, and 1M are used.

INPUT OFFSET NULLING

For those models provided with OFFSET NULLING pins, nulling may be achieved by connecting a 25K pot between the OFFSET terminals with the wiper connected to V^+. At quiescent currents of 1 mA and 100 μA, the nulling range provided is adequate for all V_{OS} selections; however with I_Q = 10μA, nulling may not be possible with higher values of V_{OS}.

FREQUENCY COMPENSATION

The ICL7611/12/13, 7621/22, 7631, 7641/42 are internally compensated, and are stable for closed loop gains as low as unity for capacitive loads up to 100pF.

The ICL7614 and 15 are externally compensated by connecting a capacitor between the COMP and OUT pins. A 39pF capacitor is required for unity gain compensation; for greater than unity gain applications, increased bandwidth and slew rate can be obtained by reducing the value of the compensating capacitor.

5

Since the g_m of the first stage is proportional to $\sqrt{I_Q}$, greatest compensation is required when I_Q = 1 mA. The *ICL7632 is not compensated internally, nor can it be* compensated externally. The device is stable when used as follows:

I_Q of 1 mA for gains ≥ 20
I_Q of 100 μA for gains ≥ 10
I_Q of 10 μA for gains ≥ 5

HIGH VOLTAGE INPUT PROTECTION

The ICL7613 and 7615 include on-chip thin film resistors and clamping diodes which allow voltages of up to ±200 to be applied to either input for an indefinite time without device failure. These devices will be useful where high common mode voltages, differential mode voltages, or high transients may be experienced. Such conditions may be found when interfacing separate systems with separate supplies. Unity gain stability is somewhat degraded with capacitive loads because of the high value of input resistors.

EXTENDED COMMON MODE INPUT RANGE

The ICL7612 incorporates additional processing which allows the input CMVR to exceed each power supply rail by 0.1 volt for applications where V_{SUPP} ≥ ±1.5V. For those applications where V_{SUPP} ≤ ±1.5V, the input CMVR is limited in the positive direction, but may exceed the negative supply rail by 0.1 volt in the negative direction (e.g., for V_{SUPP} = ±0.5V, the input CMVR would be +0.1 volts to −0.6 volts).

OPERATION AT V_{SUPP} = ±0.5 VOLTS

Operation at V_{SUPP} = ±0.5V is guaranteed at I_Q = 10μA only. This applies to these devices with selectable I_Q, and those devices are set internally to I_Q = 10μA (i.e., ICL7611, 7612, 7613, 7631, 7632, 7642).

Output swings to within a few millivolts of the supply rails are achievable for R_L ≥ 1 MegΩ. Guaranteed input CMVR is ±0.1V minimum and typically +0.4V to -0.2 at V_{SUPP} = ±0.5V. For applications where greater common mode range is desirable, refer to description of ICL7612 above.

The user is cautioned that, due to extremely high input impedances, care must be exercised in layout, construction, board cleanliness, and supply filtering to *avoid hum and noise pickup.*

ABSOLUTE MAXIMUM RATINGS[1]

Total Supply Voltage V^+ to V^- 18V
Input Voltage .... V^-+0.3 to V^- -0.3V
Input Voltage ICL7613/15 Only .... V^++200 to V^- -200V
Differential Input Voltage[2] ... ±|(V^++0.3) - (V^- -0.3)|V
Differential Input Voltage[2]
ICL7613/15 Only .... ± |(V^++200) - (V^- - 200)|V
Duration of Output Short Circuit[3] .... Unlimited
Continuous Power Dissipation @ 25°C — Above 25°C derate as follows:

TO-99	250mW	2mW/°C
8 Lead Minidip	250mW	2mW/°C
14 Lead Plastic	375mW	3mW/°C
14 Lead Cerdip	500mW	4mW/°C
16 Lead Plastic	375mW	3mW/°C
16 Lead Cerdip	500mW	4mW/°C

Storage Temperature Range .... -55°C to +150°C

Operating Temperature Range
M Series .... -55°C to +125°C
C Series .... 0°C to +70°C
Lead Temperature (Soldering, 10 sec) .... 300°C

Notes:

1. Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.
2. Long term offset voltage stability will be degraded if large input differential voltages are applied for long periods of time.
3. The outputs may be shorted to ground or to either supply, for V_{SUPP} ≤10V. Care must be taken to insure that the dissipation rating is not exceeded.

ELECTRICAL CHARACTERISTICS V_{SUPP} = ±5.0V, T_A = 25°C, unless otherwise specified

PARAMETER	SYMBOL	CONDITIONS	76XXA MIN.	76XXA TYP.	76XXA MAX.	76XXB MIN.	76XXB TYP.	76XXB MAX.	76XXD MIN.	76XXD TYP.	76XXD MAX.	UNITS
Input Offset Voltage	V_{OS}	R_S≤100KΩ, T_A=25°C T_{MIN}≤T_A≤T_{MAX}			2 3			5 7			15 20	mV
Temperature Coefficient of V_{OS}	$\Delta V_{OS}/\Delta T$	R_S≤100KΩ		10			15			25		μV/°C
Input Offset Current	I_{OS}	T_A=25°C ΔT_A=C[2] ΔT_A=M[2]		0.5	30 300 800		0.5	30 300 800		0.5	30 300 800	pA
Input Bias Current	I_{BIAS}	T_A=25°C ΔT_A=C ΔT_A=M		1.0	50 400 4000		1.0	50 400 4000		1.0	50 400 4000	pA
Common Mode Voltage Range (Except ICL7612)	V_{CMR}	I_Q=10μA[1] I_Q=100μA I_Q=1mA[1]	±4.4 ±4.2 ±3.7			±4.4 ±4.2 ±3.7			±4.4 ±4.2 ±3.7			V
Extended Common Mode Voltage Range (ICL7612 Only)	V_{CMR}	I_Q=10μA	±5.3			±5.3			±5.3			V
		I_Q=100μA	+5.3 -5.1			+5.3 -5.1			+5.3 -5.1			
		I_Q=1mA	+5.3 -4.5			+5.3 -4.5			+5.3 -4.5			
Output Voltage Swing	V_{OUT}	R_L=100KΩ, T_A=25°C ΔT_A=C, ΔT_A=M, I_Q=100μA	±4.9 ±4.8 ±4.6			±4.9 ±4.8 ±4.6			±4.9 ±4.8 ±4.6			V
		R_L=10KΩ, T_A=25°C ΔT_A=C, ΔT_A=M, I_Q=1 mA	±4.5 ±4.3 ±4.0			±4.5 ±4.3 ±4.0			±4.5 ±4.3 ±4.0			
Large Signal Voltage Gain	A_{VOL}	V_O=±4.0V, R_L=1MΩ I_Q=10μA[1], T_A=25°C ΔT_A=C ΔT_A=M	86 80 74	104		80 75 68	104		80 75 68	104		dB
		V_O=±4.0V, R_L=100kΩ I_Q=100μA, T_A=25°C ΔT_A=C ΔT_A=M	86 80 74	102		80 75 68	102		80 75 68	102		
		V_O=±4.0V, R_L=10kΩ I_Q=1mA[1], T_A=25°C ΔT_A=C ΔT_A=M	90 85 77	98		80 75 68	98		80 75 68	98		
Unity Gain Bandwidth	G_{BW}	I_Q=10μA[1] I_Q=100μA I_Q=1mA[1]		0.044 0.48 1.4			0.044 0.48 1.4			0.044 0.48 1.4		MHz
Input Resistance	R_{IN}			10^{12}			10^{12}			10^{12}		Ω
Common Mode Rejection Ratio	CMRR	R_S≤100KΩ, I_Q=10μA[1] R_S≤100KΩ, I_Q=100μA R_S≤100KΩ, I_Q=1mA[1]	76 76 66	96 91 87		70 70 60	96 91 87		70 70 60	96 91 87		dB
Power Supply Rejection Ratio	PSRR	R_S≤100KΩ, I_Q=10μA[1] R_S≤100KΩ, I_Q=100μA R_S≤100KΩ, I_Q=1mA[1]	80 80 70	94 86 77		80 80 70	94 86 77		80 80 70	94 86 77		dB
Input Referred Noise Voltage	e_n	R_S=100Ω, f=1KHz		100			100			100		nV/√Hz
Input Referred Noise Current	i_n	R_S=100Ω, f=1KHz		0.01			0.01			0.01		pA/√Hz
Supply Current (Per Amplifier)	I_{SUPP}	No Signal, No Load I_Q=10μA[1] I_Q=100μA I_Q=1mA[1]		0.01 0.1 1.0	0.02 0.25 2.5		0.01 0.1 1.0	0.02 0.25 2.5		0.01 0.1 1.0	0.02 0.25 2.5	mA
Channel Separation	V_{O1}/V_{O2}	A_{VOL}=100		120			120			120		dB
Slew Rate[3]	SR	A_{VOL}=1, C_L=100pF, V_{IN} = 8V_{p-p} I_Q=10μA[1], R_L=1MΩ I_Q=100μA, R_L=100KΩ I_Q=1mA[1], R_L=10KΩ		0.016 0.16 1.6			0.016 0.16 1.6			0.016 0.16 1.6		V/μs
Rise Time[3]	t_r	V_{IN}=50mV, C_L=100pF I_Q=10μA[1], R_L=1MΩ I_Q=100μA, R_L=100KΩ I_Q=1mA[1], R_L=10KΩ		20 2 0.9			20 2 0.9			20 2 0.9		μs
Overshoot Factor[3]		V_{IN}=50mV, C_L=100pF I_Q=10μA[1], R_L=1MΩ I_Q=100μA, R_L=100KΩ I_Q=1mA[1], R_L=10KΩ		5 10 40			5 10 40			5 10 40		%

Note: 1. ICL7611, 7612, 7613 only. 2. C = Commercial Temperature Range: 0°C to +70°C; M = Military Temperature Range: -55°C to +125°C. 3. ICL7614/15; 39pF from pin 6 to pin 8.

ELECTRICAL CHARACTERISTICS $V_{SUPP} = \pm0.5V$, $I_Q = 10\mu A$, $T_A = 25°C$, unless otherwise specified.
Specs apply to ICL7611/7612/7613 only.

PARAMETER	SYMBOL	CONDITIONS	76XXA MIN.	76XXA TYP.	76XXA MAX.	76XXB MIN	76XXB TYP.	76XXB MAX	UNITS
Input Offset Voltage	V_{OS}	$R_S \leq 100K\Omega$, $T_A=25°C$ $T_{MIN} \leq T_A \leq T_{MAX}$			2 3			5 7	mV
Temperature Coefficient of V_{OS}	$\Delta V_{OS}/\Delta T$	$R_S \leq 100K\Omega$		10			15		$\mu V/°C$
Input Offset Current	I_{OS}	$T_A=25°C$ $\Delta T_A=C$ $\Delta T_A=M$		0.5	30 300 800		0.5	30 300 800	pA
Input Bias Current	I_{BIAS}	$T_A=25°C$ $\Delta T_A=C$ $\Delta T_A=M$		1.0	50 500 4000		1.0	50 500 4000	pA
Common Mode Voltage Range (Except ICL7612)	V_{CMR}		±0.1			±0.1			V
Extended Common Mode Voltage Range (ICL7612 Only)	V_{CMR}		+0.1 to -0.6			+0.1 to -0.6			V
Output Voltage Swing	V_{OUT}	$R_L=1M\Omega$, $T_A=25°C$ $\Delta T_A=C$ $\Delta T_A=M$		±0.49 ±0.48 ±0.41			±0.49 ±0.48 ±0.41		V
Large Signal Voltage Gain	A_{VOL}	$V_O=\pm0.1V$, $R_L=1M\Omega$ $T_A=25°C$ $\Delta T_A=C$ $\Delta T_A=M$		 90 80 70			 90 80 70		dB
Unity Gain Bandwidth	G_{BW}			0.044			0.044		MHz
Input Resistance	R_{IN}			10^{12}			10^{12}		Ω
Common Mode Rejection Ratio	CMRR	$R_S \leq 100K\Omega$		80			80		dB
Power Supply Rejection Ratio	PSRR	$R_S \leq 100K\Omega$		80			80		dB
Input Referred Noise Voltage	e_n	$R_S=100\Omega$, f=1KHz		100			100		$nV/\sqrt{Hz}$
Input Referred Noise Current	i_n	$R_S=100\Omega$, f=1KHz		0.01			0.01		$pA/\sqrt{Hz}$
Supply Current *(Per Amplifier)*	I_{SUPP}	No Signal, No Load		6	15		6	15	μA
Slew Rate	SR	$A_{VOL}=1$, $C_L=100pF$, $V_{IN}=0.2V_{p-p}$ $R_L=1M\Omega$		0.016			0.016		V/μs
Rise Time	t_r	$V_{IN}=50mV$, $C_L=100pF$ $R_L=1M\Omega$		20			20		μs
Overshoot Factor		$V_{IN}=50mV$, $C_L=100pF$ $R_L=1M\Omega$		5			5		%

Note: C = Commercial Temperature Range (0°C to +70°C); M = Military Temperature Range (-55°C to +125°C).

5

ELECTRICAL CHARACTERISTICS $V_{SUPP}=\pm5.0V$, $T_A = 25°C$, unless otherwise specified.

PARAMETER	SYMBOL	CONDITIONS	76XXB MIN.	76XXB TYP.	76XXB MAX.	76XXC MIN.	76XXC TYP.	76XXC MAX.	76XXE MIN.	76XXE TYP.	76XXE MAX.	UNITS
Input Offset Voltage	V_{OS}	$R_S\leq100K\Omega$, $T_A=25°C$ $T_{MIN}\leq T_A\leq T_{MAX}$			5 7			10 15			20 25	mV
Temperature Coefficient of V_{OS}	$\Delta V_{OS}/\Delta T$	$R_S\leq100K\Omega$		15			20			30		μV/°C
Input Offset Current	I_{OS}	$T_A=25°C$ $\Delta T_A=C$ $\Delta T_A=M$		0.5	30 300 800		0.5	30 300 800		0.5	30 300 800	pA
Input Bias Current	I_{BIAS}	$T_A=25°C$ $\Delta T_A=C$ $\Delta T_A=M$		1.0	50 500 4000		1.0	50 500 4000		1.0	50 500 4000	pA
Common Mode Voltage Range	V_{CMR}	$I_Q=10\mu A$[1] $I_Q=100\mu A$[3] $I_Q=1mA$[2]	±4.4 ±4.2 ±3.7			±4.4 ±4.2 ±3.7			±4.4 ±4.2 ±3.7			V
Output Voltage Swing	V_{OUT}	$R_L=100K\Omega$, $T_A=25°C$ $\Delta T_A=C$, $\Delta T_A=M$, $I_Q=100\mu A$	±4.9 ±4.8 ±4.5			±4.9 ±4.8 ±4.5			±4.9 ±4.8 ±4.5			V
		$R_L=10K\Omega$, $T_A=25°C$ $\Delta T_A=C$, $\Delta T_A=M$, $I_Q=1mA$	±4.5 ±4.3 ±4.0			±4.5 ±4.3 ±4.0			±4.5 ±4.3 ±4.0			
Large Signal Voltage Gain	A_{VOL}	$V_O=\pm4.0V$, $R_L=1M\Omega$[1] $I_Q=10\mu A$[1], $T_A=25°C$ $\Delta T_A=C$ $\Delta T_A=M$	86 80 74	104		80 75 68	104		80 75 68	104		dB
		$V_O=\pm4.0V$, $R_L=100k\Omega$[3] $I_Q=100\mu A$, $T_A=25°C$ $\Delta T_A=C$ $\Delta T_A=M$	86 80 74	102		80 75 68	102		80 75 68	102		
		$V_O=\pm4.0V$, $R_L=10k\Omega$[2] $I_Q=1mA$[1], $T_A=25°C$ $\Delta T_A=C$ $\Delta T_A=M$	86 80 74	98		80 75 68	98		80 75 68	98		
Unity Gain Bandwidth	G_{BW}	$I_Q=10\mu A$[1] $I_Q=100\mu A$[3] $I_Q=1mA$[2]		0.044 0.48 1.4			0.044 0.48 1.4			0.044 0.48 1.4		MHz
Input Resistance	R_{IN}			10^{12}			10^{12}			10^{12}		Ω
Common Mode Rejection Ratio	CMRR	$R_S\leq100K\Omega$, $I_Q=10\mu A$[1] $R_S\leq100K\Omega$, $I_Q=100\mu A$ $R_S\leq100K\Omega$, $I_Q=1mA$[2]	76 76 66	96 91 87		70 70 60	96 91 87		70 70 60	96 91 87		dB
Power Supply Rejection Ratio	PSRR	$R_S\leq100K\Omega$, $I_Q=10\mu A$[1] $R_S\leq100K\Omega$, $I_Q=100\mu A$ $R_S\leq100K\Omega$, $I_Q=1mA$[2]	80 80 70	94 86 77		80 80 70	94 86 77		80 80 70	94 86 77		dB
Input Referred Noise Voltage	e_n	$R_S=100\Omega$, f=1KHz		100			100			100		$nV/\sqrt{Hz}$
Input Referred Noise Current	i_n	$R_S=100\Omega$, f=1KHz		0.01			0.01			0.01		$pA/\sqrt{Hz}$
Supply Current (Per Amplifier)	I_{SUPP}	No Signal, No Load $I_Q=10\mu A$[1] $I_Q=100\mu A$ $I_Q=1mA$[2]		0.01 0.1 1.0	0.022 0.25 2.5		0.01 0.1 1.0	0.022 0.25 2.5		0.01 0.1 1.0	0.022 0.25 2.5	mA
Channel Separation	V_{O1}/V_{O2}	$A_{VOL}=100$		120			120			120		dB
Slew Rate[4]	SR	$A_{VOL}=1$, $C_L=100pF$, $V_{IN}=8V_{p-p}$ $I_Q=10\mu A$[1], $R_L=1M\Omega$ $I_Q=100\mu A$, $R_L=100K\Omega$ $I_Q=1mA$[1], $R_L=10K\Omega$[2]		0.016 0.16 1.6			0.016 0.16 1.6			0.016 0.16 1.6		V/μs
Rise Time[4]	t_r	$V_{IN}=50mV$, $C_L=100pF$ $I_Q=10\mu A$[1], $R_L=1M\Omega$ $I_Q=100\mu A$, $R_L=100K\Omega$ $I_Q=1mA$[2], $R_L=10K\Omega$		20 2 0.9			20 2 0.9			20 2 0.9		μs
Overshoot Factor[4]		$V_{IN}=50mV$, $C_L=100pF$ $I_Q=10\mu A$[1], $R_L=1M\Omega$ $I_Q=100\mu A$, $R_L=100K\Omega$ $I_Q=1mA$[2], $R_L=10K\Omega$		5 10 40			5 10 40			5 10 40		%

Note: 1. Does not apply to 7641.
2. Does not apply to 7642.
C = Commercial Temperature Range: 0°C to +70°C
M = Military Temperature Range: -55°C to +125°C
3. ICL7631/32 only.
4. Does not apply to 7632.

ELECTRICAL CHARACTERISTICS $V_{SUPP} = \pm 0.5V$, $I_Q = 10\mu A$, $T_A = 25°C$, unless otherwise specified. Specs apply to ICL7631/7632/7642 only.

PARAMETER	SYMBOL	CONDITIONS	76XXB			76XXC			UNITS
			MIN.	TYP.	MAX.	MIN	TYP.	MAX	
Input Offset Voltage	V_{OS}	$R_S \le 100K\Omega$, $T_A = 25°C$ $T_{MIN} \le T_A \le T_{MAX}$			5 7			10 12	mV
Temperature Coefficient of Vos	$\Delta V_{OS}/\Delta T$	$R_S \le 100K\Omega$		15			20		μV/°C
Input Offset Current	I_{OS}	$T_A = 25°C$ $\Delta T_A = C$ $\Delta T_A = M$		0.5	30 300 800		0.5	30 300 800	pA
Input Bias Current	I_{BIAS}	$T_A = 25°C$ $\Delta T_A = C$ $\Delta T_A = M$		1.0	50 500 4000		1.0	50 500 4000	pA
Common Mode Voltage Range	V_{CMR}		±0.1			±0.1			V
Output Voltage Swing	V_{OUT}	$R_L = 1M\Omega$, $T_A = 25°C$ $\Delta T_A = C$ $\Delta T_A = M$		±0.49 ±0.48 ±0.41			±0.49 ±0.48 ±0.41		V
Large Signal Voltage Gain	A_{VOL}	$V_O = \pm 0.1V$, $R_L = 1M\Omega$ $T_A = 25°C$ $\Delta T_A = C$ $\Delta T_A = M$		90 80 70			90 80 70		dB
Unity Gain Bandwidth	G_{BW}			0.044			0.044		MHz
Input Resistance	R_{IN}			10^{12}			10^{12}		Ω
Common Mode Rejection Ratio	CMRR	$R_S \le 100K\Omega$		80			80		dB
Power Supply Rejection Ratio	PSRR			80			80		dB
Input Referred Noise Voltage	e_n	$R_S = 100\Omega$, f=1KHz		100			100		$nV/\sqrt{Hz}$
Input Referred Noise Current	i_n	$R_S = 100\Omega$, f=1KHz		0.01			0.01		$pA/\sqrt{Hz}$
Supply Current (Per Amplifier)	I_{SUPP}	No Signal, No Load		6	15		6	15	μA
Channel Separation	V_{O1}/V_{O2}	$A_{VOL} = 100$		120			120		dB
Slew Rate	SR	$A_{VOL} = 1$, $C_L = 100pF$, $V_{IN} = 0.2Vp\text{-}p$ $R_L = 1M\Omega$		0.016			0.016		V/μs
Rise Time	t_r	$V_{IN} = 50mV$, $C_L = 100pF$ $R_L = 1M\Omega$		20			20		μs
Overshoot Factor		$V_{IN} = 50mV$, $C_L = 100pF$ $R_L = 1M\Omega$		5			5		%

Note: C = Commercial Temperature Range (0°C to +70°C); M = Military Temperature Range (-55°C to +125°C).

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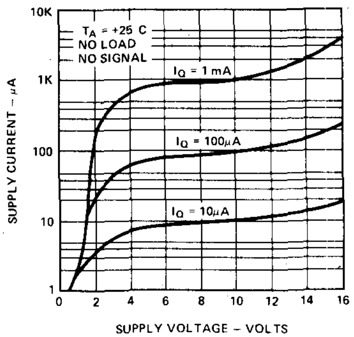
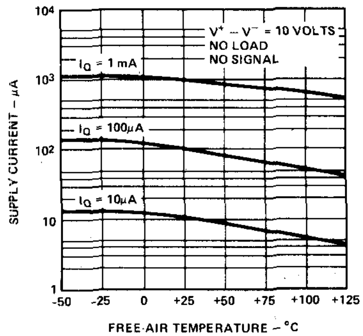
TYPICAL PERFORMANCE CHARACTERISTICS

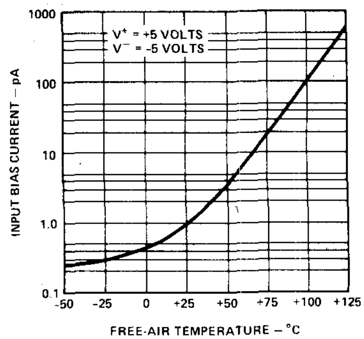
SUPPLY CURRENT PER AMPLIFIER AS A FUNCTION OF SUPPLY VOLTAGE



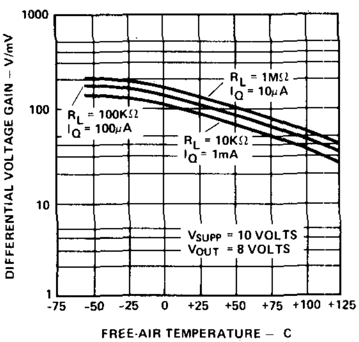
SUPPLY CURRENT PER AMPLIFIER AS A FUNCTION OF FREE-AIR TEMPERATURE



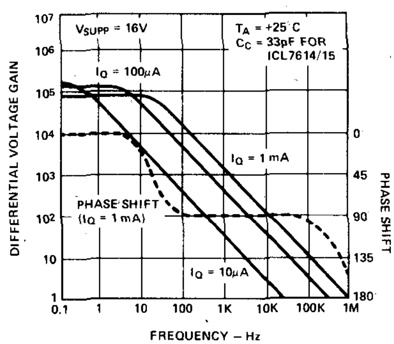
INPUT BIAS CURRENT AS A FUNCTION OF TEMPERATURE



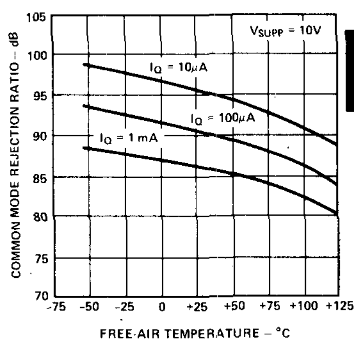
LARGE SIGNAL DIFFERENTIAL VOLTAGE GAIN AS A FUNCTION OF FREE-AIR TEMPERATURE



LARGE SIGNAL DIFFERENTIAL VOLTAGE GAIN AND PHASE SHIFT AS A FUNCTION OF FREQUENCY



COMMON MODE REJECTION RATIO AS A FUNCTION OF FREE-AIR TEMPERATURE



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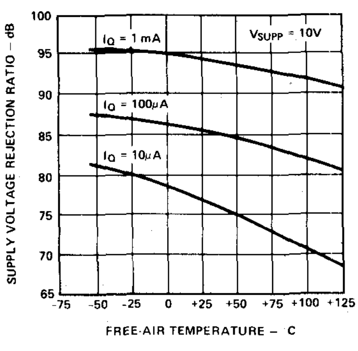
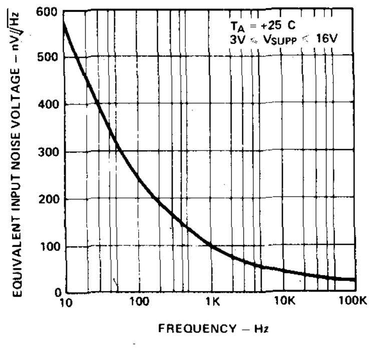
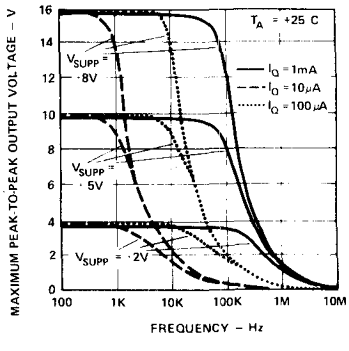
POWER SUPPLY REJECTION RATIO AS A FUNCTION OF FREE-AIR TEMPERATURE



EQUIVALENT INPUT NOISE VOLTAGE AS A FUNCTION OF FREQUENCY



PEAK-TO-PEAK OUTPUT VOLTAGE AS A FUNCTION OF FREQUENCY



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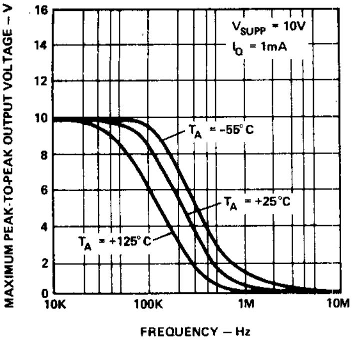
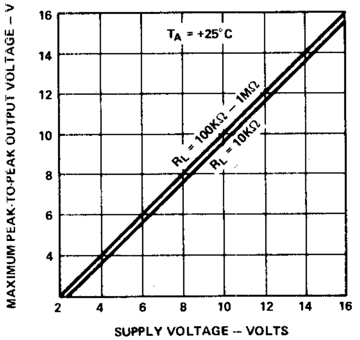
TYPICAL PERFORMANCE CHARACTERISTICS

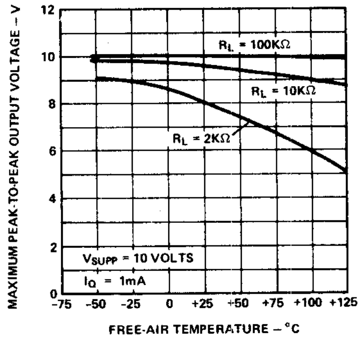
MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE AS A FUNCTION OF FREQUENCY



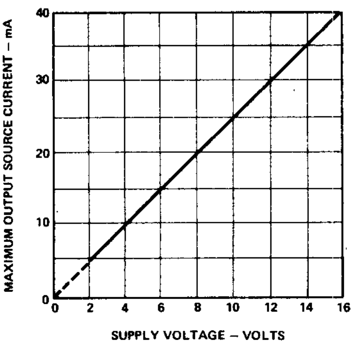
MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE AS A FUNCTION OF SUPPLY VOLTAGE



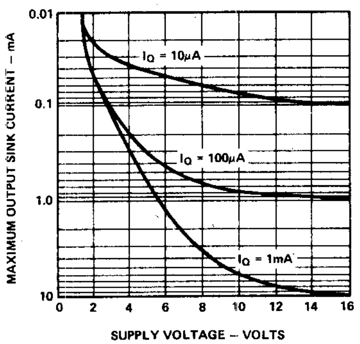
MAXIMUM PEAK-TO-PEAK VOLTAGE AS A FUNCTION OF FREE-AIR TEMPERATURE



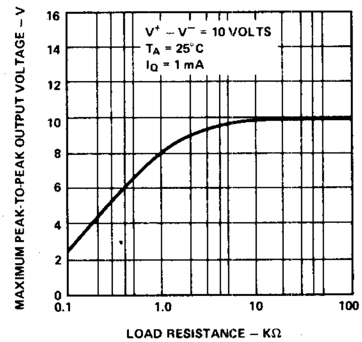
MAXIMUM OUTPUT/SOURCE CURRENT AS A FUNCTION OF SUPPLY VOLTAGE



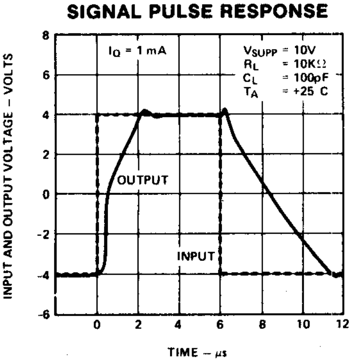
MAXIMUM OUTPUT SINK CURRENT AS A FUNCTION OF SUPPLY VOLTAGE



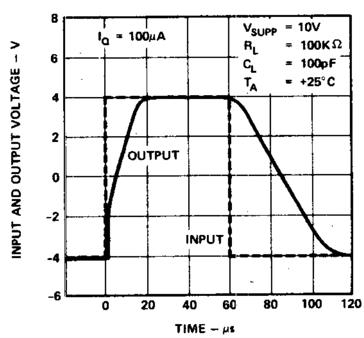
MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE AS A FUNCTION OF LOAD RESISTANCE



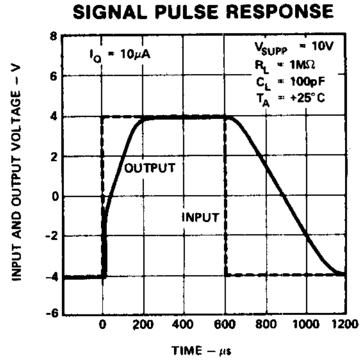
VOLTAGE FOLLOWER LARGE SIGNAL PULSE RESPONSE



VOLTAGE FOLLOWER LARGE SIGNAL PULSE RESPONSE



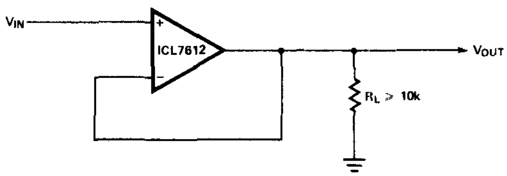
VOLTAGE FOLLOWER LARGE SIGNAL PULSE RESPONSE



APPLICATIONS

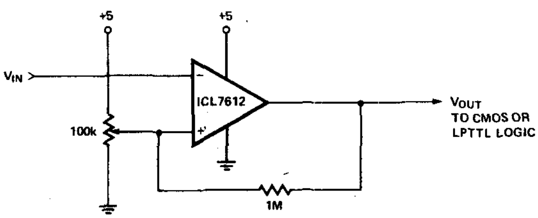
Note that in no case is I_Q shown. The value of I_Q must be chosen by the designer with regard to frequency response and power dissipation.

SIMPLE FOLLOWER*



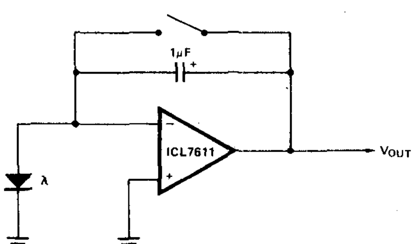
LEVEL DETECTOR*

*By using the ICL7612 in these applications, the circuits will follow rail to rail inputs.



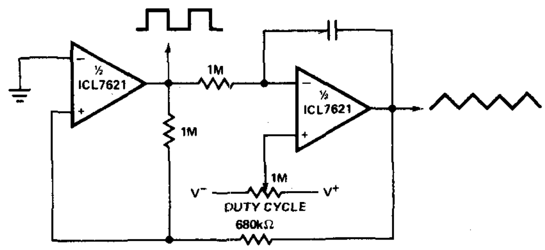
PHOTOCURRENT INTEGRATOR

Low leakage currents allow integration times up to several hours.



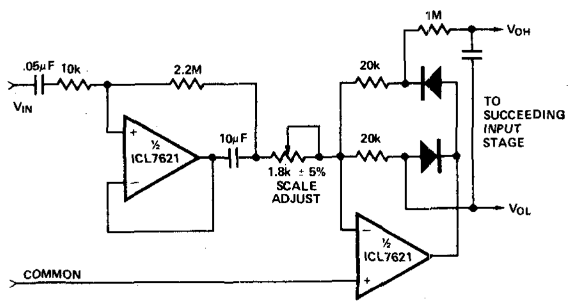
PRECISE TRIANGLE/SQUARE WAVE GENERATOR

Since the output range swings exactly from rail to rail, frequency and duty cycle are virtually independent of power supply variations.



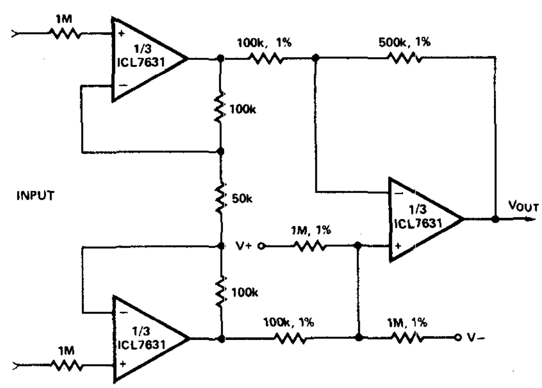
WAVEFORM GENERATOR

AVERAGING AC TO DC CONVERTER FOR A/D CONVERTERS SUCH AS ICL7106, 7107, 7109, 7116, 7117.



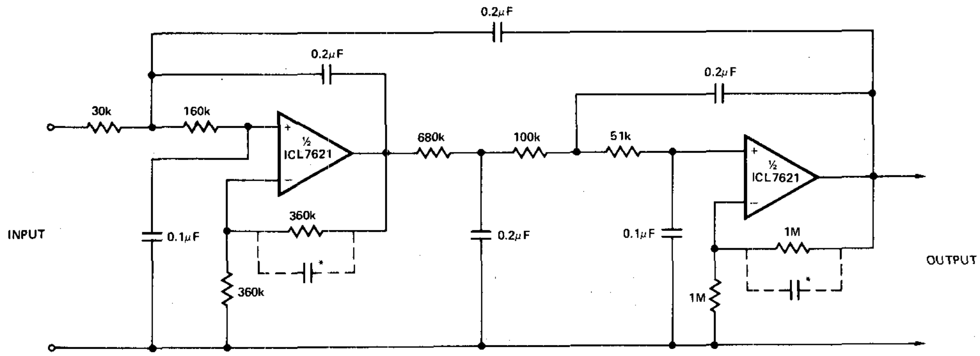
MEDICAL INSTRUMENT PREAMP

Note that A_{VOL} = 25; single Ni-cad battery operation. Input current (from sensors connected to patient) limited to < 5μA under fault conditions.



FIFTH ORDER CHEBYSHEV MULTIPLE FEEDBACK LOW PASS FILTER

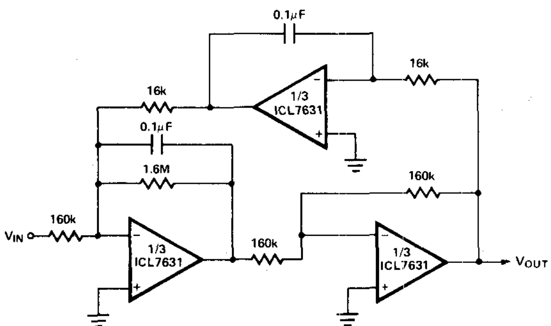
The low bias currents permit high resistance and low capacitance values to be used to achieve low frequency cutoff. $f_c = 10Hz$, $A_{VOL} = 4$, Passband ripple = 0.1 dB.



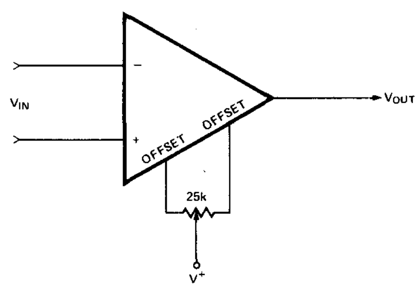
*Note that small capacitors (25-50pF) may be needed for stability in some cases.

SECOND ORDER BIQUAD BANDPASS FILTER

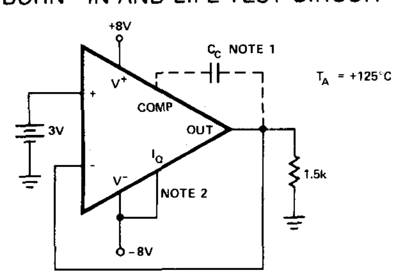
Note that I_Q on each amplifier may be different.
$A_{VOL} = 10$, Q = 100, f_o = 100Hz.



VOS NULL CIRCUIT

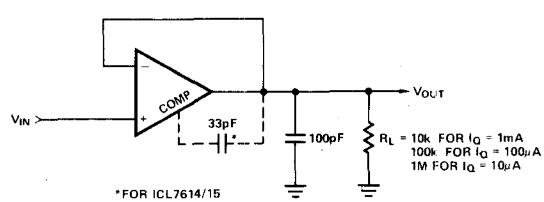


BURN—IN AND LIFE TEST CIRCUIT



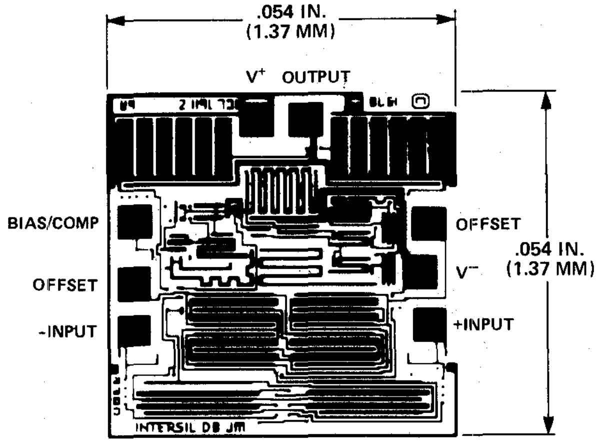
NOTES:
1. FOR DEVICES WITH EXTERNAL COMPENSATION, USE 33pF.
2. FOR DEVICES WITH PROGRAMMABLE STANDBY CURRENT, CONNECT I_Q PIN TO V^- (I_Q = 1mA MODE).

UNITY GAIN FREQUENCY COMPENSATION



*FOR ICL7614/15

CHIP TOPOGRAPHY



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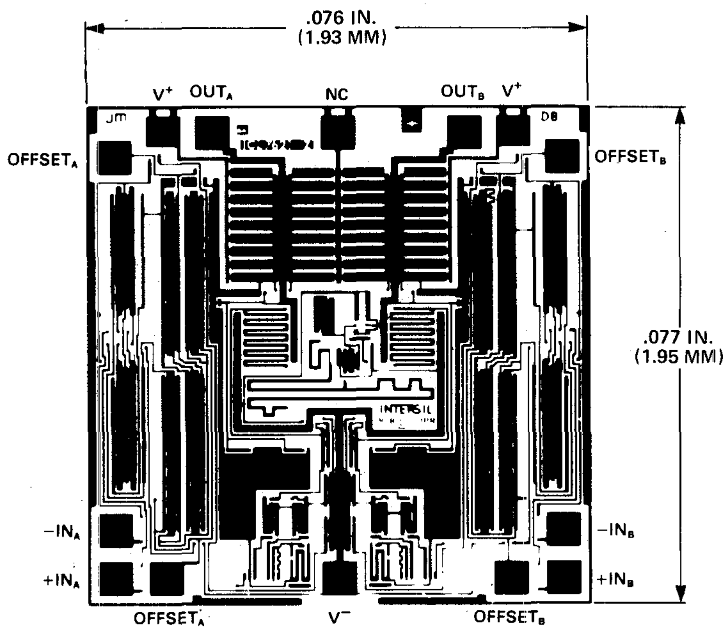
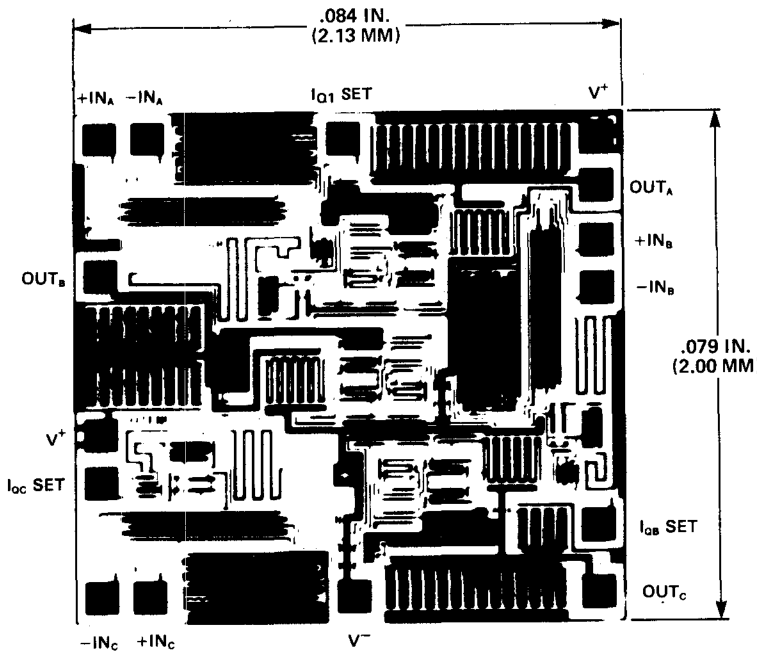


762X

CHIP TOPOGRAPHY (Cont.)



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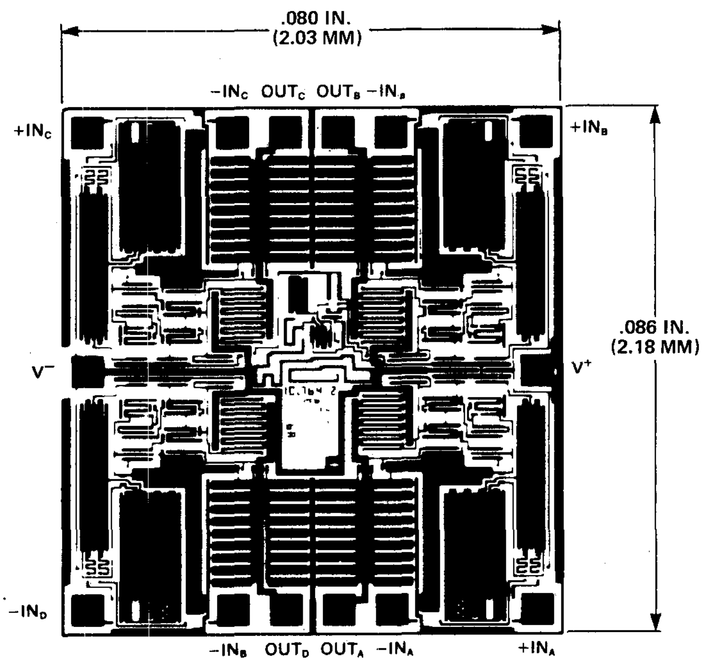

764X