HARRIS SEMICONDUCTOR

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ICL 8023 NOT RECOMMENDED FOR NEW DESIGNS SEE ICL 7630

ICL8021/ICL8023 Low Power Bipolar Operational Amplifier

GENERAL DESCRIPTION

The Harris ICL8021 series are low power operational amplifiers specifically designed for applications requiring very low standby power consumption over a wide range of supply voltages. The electrical characteristics of the 8021 series can be tailored to a particular application by adjusting an external resistor, R_{SET}, which controls the quiescent current. This is advantageous because I_Q can be made independent of the supply voltages: it can be set to an extremely low value where power is critical, or to a larger value for high slew rate or wideband applications.

Other features of the 8021 series include low input current that remains constant with temperature, low noise, high input impedance, internal compensation and pin-for-pin compatibility with the 741.

The Harris 8023 consists of three low power operational amplifiers in a single 16-pin DIP. Each amplifier is identical to an 8021 low power op amp, and has separate connections for adjusting its electrical characteristics by means of an external resistor, R_{SET}, which controls the quiescent current of that amplifier.

FEATURES

- **V_{OS} = 3mV Max (Adjustable to Zero)**
- **± 1.5V to ± 18V Power Supply Operation**
- **Power Consumption — 20μW @ ± 1V**
- **Input Bias Current — 30nA Max**
- **Internal Compensation**
- **Pin-For-Pin Compatible With 741**
- **Short Circuit Protected**

ORDERING INFORMATION

ICL8021 C TY

- **Package**
  - TY — TO-99 Metal Can (8021 only)
  - PA — 8-pin Minidip (8021 only)
  - JE — 16-pin CERDIP (8023 only)
  - PE — 16-pin Plastic DIP (8023 only)
- **Temperature**
  - C — Commercial — (0°C to +70°C)
  - M — Military — (-55°C to +125°C)
- **Basic Part Number**
  - 8021 — Single
  - 8023 — Triple

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Part Number	Temperature Range	Package
ICL8021CJA	0°C to 70°C	8 Lead CERDIP
ICL8021CBA	0°C to 70°C	8 Lead S.O.I.C
ICL8021CPA	0°C to 70°C	8 Lead MINIDIP
ICL8021CTY	0°C to 70°C	8 Lead Metal Can
ICL8021MJA	-55°C to +125°C	8 Lead CERDIP
ICL8021MTY*	-55°C to +125°C	8 Lead Metal Can
ICL8023CJE	0°C to 70°C	16 Lead CERDIP
ICL8023CPE	0°C to 70°C	16 Lead MINIDIP
ICL8023MJE*	-55°C to +125°C	16 Lead CERDIP

*Add /88313 to Part Number if 883B processing is required.

NOTE: All typical values have been characterized but are not tested.

ABSOLUTE MAXIMUM RATINGS

Supply Voltage .... ±18V
Differential Input Voltage (Note 1) .... ±15V
Common Mode Input Voltage (Note 1) .... ±15V
Output Short Circuit Duration .... Indefinite
Power Dissipation (Note 2) 300mW

Operating Temperature Range
8021M/8023M .... −55°C to +125°C
8021C/8023C .... 0°C to +70°C
Storage Temperature Range .... −65°C to +150°C
Lead Temperature (Soldering, 10sec) .... +300°C

NOTE 1: For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.

NOTE 2: Rating applies for case temperatures to +125°C; derate linearly at 5.6 mW/°C for ambient temperatures above +95°C.

NOTE: *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.*

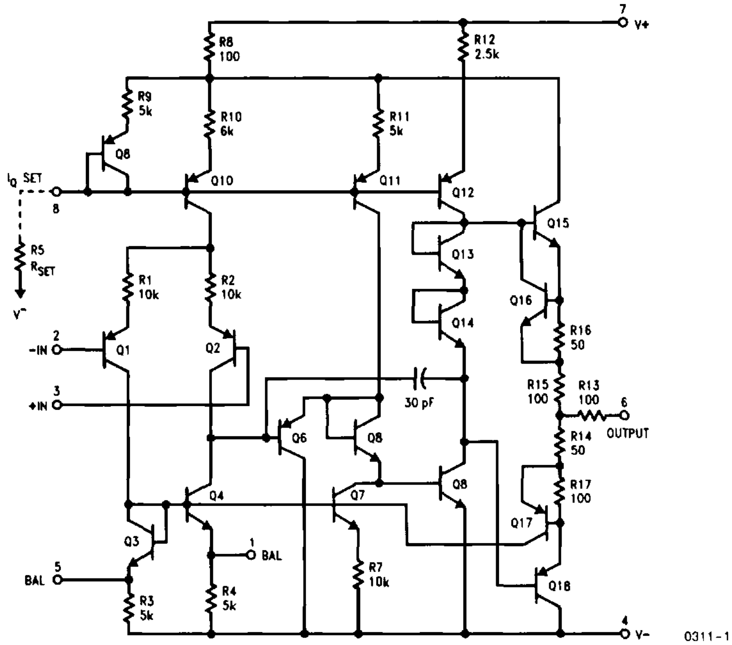

Figure 1: Functional Diagram

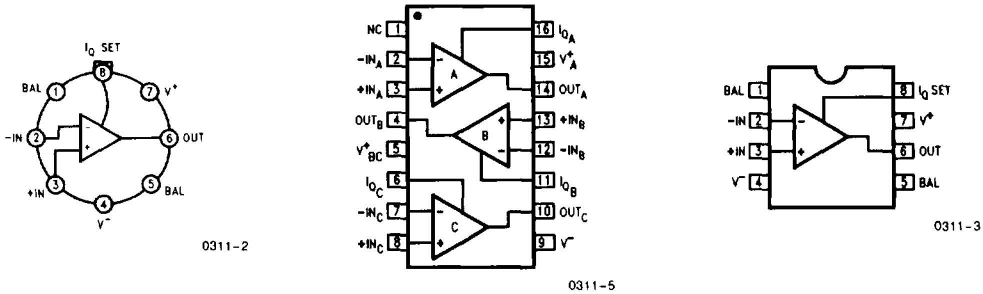

Figure 2: Pin Configurations

NOTE: All typical values have been characterized but are not tested

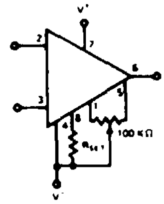

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Figure 3: Voltage Offset Null Circuit

ELECTRICAL CHARACTERISTICS ($V_{SUPPLY} = \pm 6V$, $I_Q = 30\mu A$, unless otherwise specified.)

Characteristics	Test Conditions	8021M			8021C			Units
		Min	Typ	Max	Min	Typ	Max	
The following specifications apply for $T_A = 25°C$:								
Input Offset Voltage	$R_S \leq 100k\Omega$		2	3		2	6	mV
Input Offset Current			0.5	7.5		0.7	10	nA
Input Bias Current			5	20		7	30	nA
Input Resistance(1)		3	10		3	10		MΩ
Input Voltage Range	$V_{SUPPLY} = \pm 15V$	±12	±13		±12	±13		V
Common Mode Rejection Ratio	$R_S \leq 10k\Omega$	70	80		70	80		dB
Supply Voltage Rejection Ratio	$R_S \leq 10k\Omega$		30	150		30	150	μV/V
Output Resistance	Open Loop		2			2		kΩ
Output Voltage Swing	$R_L \geq 20k\Omega$, $V_{SUPPLY} = \pm 15V$	±12	±14		±12	±14		V
	$R_L \geq 10k\Omega$, $V_{SUPPLY} = \pm 15V$	±11	±13		±11	±13		V
Output Short-Circuit Current			±13			±13		mA
Power Consumption	$V_{OUT} = 0$		360	480		360	600	μW
Slew Rate (Unity Gain)			0.16			0.16		V/μs
Unity Gain Bandwidth	$R_L = 20k\Omega$, $V_{IN} = 20mV$		270			270		kHz
Transient Response (Unity Gain)	$R_L = 20k\Omega$, $V_{IN} = 20mV$							
Risetime			1.3			1.3		μs
Overshoot			10			10		%
Specifications Applicable over Temperature		$-55°C \leq T_A \leq +125°C$			$0°C \leq T_A \leq +70°C$			
Input Offset Voltage	$R_S \leq 10k\Omega$		2.0	5.0		2.0	7.5	mV
Input Offset Current			1.0	11		1.5	15	nA
Input Bias Current			10	32		15	50	nA
Average Temperature Coefficient of Input Offset Voltage	$R_S \leq 10k\Omega$		5			5		μV/°C
Average Temperature Coefficient of Input Offset Current			1.7			0.8		pA/°C
Large Signal Voltage Gain	$R_L = 10k\Omega$	50	200		50	200		V/mV
Output Voltage Swing	$R_L \geq 10k\Omega$	±10	±13		±10	±13		V

NOTE 1: Not tested; guaranteed by design and process.

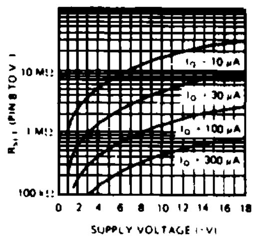
NOTE: All typical values have been characterized but are not tested.

QUIESCENT CURRENT ADJUSTMENT

QUIESCENT CURRENT SETTING RESISTOR (PIN 8 to V⁻)

V_S	I_Q			
	10μA	30μA	100μA	300μA
±1.5	1.5MΩ	470kΩ	150kΩ	-
±3	3.3MΩ	1.1MΩ	330kΩ	100kΩ
±6	7.5MΩ	2.7MΩ	750kΩ	220kΩ
±9	13MΩ	4MΩ	1.3MΩ	350kΩ
±12	18MΩ	5.6MΩ	1.5MΩ	510kΩ
±15	22MΩ	7.5MΩ	2.2MΩ	620kΩ

QUIESCENT CURRENT SETTING RESISTOR (PIN 8 to V⁻)



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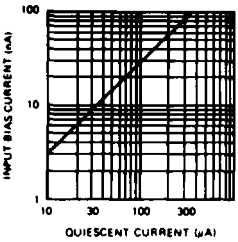
TYPICAL PERFORMANCE CHARACTERISTICS*

($T_A = +25°C$, $V_S = ±6V$, $I_Q = 30μA$ unless otherwise specified.)

INPUT BIAS CURRENT VS QUIESCENT CURRENT



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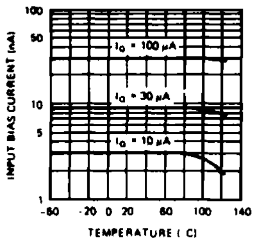
INPUT BIAS CURRENT VS AMBIENT TEMPERATURE



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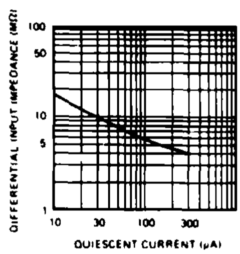
DIFFERENTIAL INPUT IMPEDANCE VS QUIESCENT CURRENT



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$$I_{SET} = \frac{V^+ + |V^-| - 0.6V}{R_{SET} + 5\,k\Omega}$$

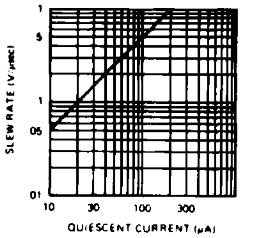
$$I_Q = \frac{I_{SET} + 3 \times 10^{-7}}{0.165}$$

NOTE All typical values have been characterized but are not tested.

TYPICAL PERFORMANCE CHARACTERISTICS*

($T_A = +25°C$, $V_S = \pm 6V$, $I_Q = 30\mu A$ unless otherwise specified.) (Continued)

SLEW RATE VS QUIESCENT CURRENT



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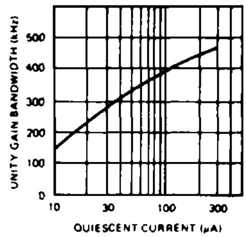
FREQUENCY RESPONSE VS QUIESCENT CURRENT



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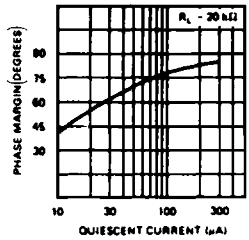
PHASE MARGIN VS QUIESCENT CURRENT



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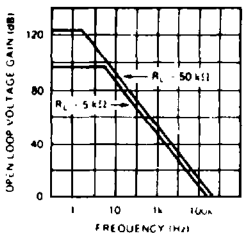
OPEN-LOOP FREQUENCY RESPONSE



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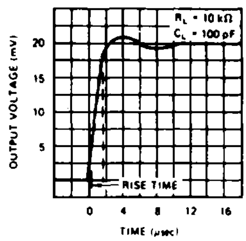
TRANSIENT RESPONSE



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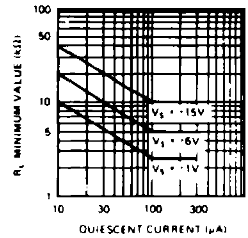
MAXIMUM LOAD VS QUIESCENT CURRENT



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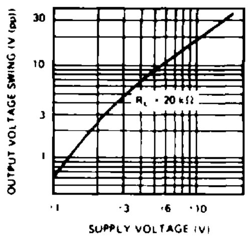
OUTPUT VOLTAGE SWING VS SUPPLY VOLTAGE



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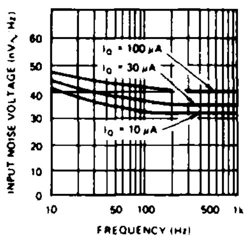
EQUIVALENT INPUT NOISE VOLTAGE VS FREQUENCY



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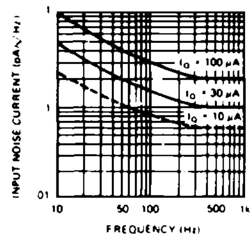
EQUIVALENT INPUT NOISE CURRENT VS FREQUENCY



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*ICL8021C guaranteed only for $0°C \le T_A \le +70°C$

NOTE All typical values have been characterized but are not tested