OPA380
OPA2380

SBOS291 – NOVEMBER 2003

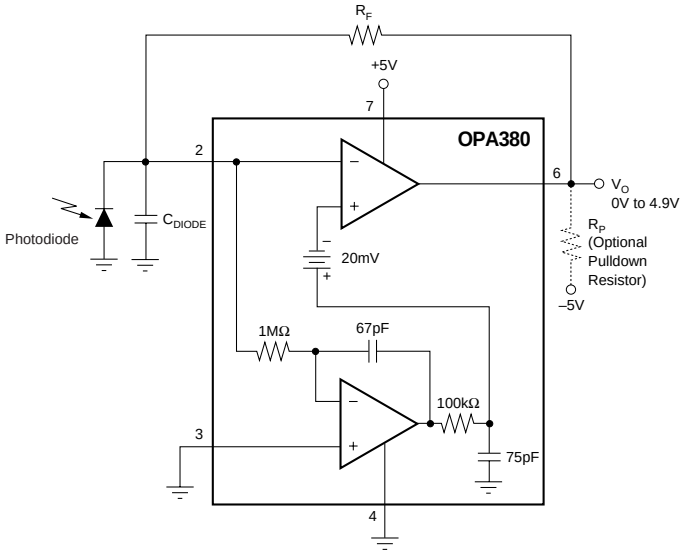
Precision, High-Speed Transimpedance Amplifier

FEATURES

- OVER 1MHz TIA BANDWIDTH
- DYNAMIC RANGE: 5 Decades
- EXCELLENT LONG-TERM STABILITY
- VERY LOW 1/f NOISE
- BIAS CURRENT: 50pA (max)
- OFFSET VOLTAGE: 25µV (max)
- DRIFT: 0.1µV/°C
- GAIN BANDWIDTH: 85MHz
- QUIESCENT CURRENT: 6mA
- SUPPLY RANGE: 2.7V to 5.5V
- SINGLE AND DUAL VERSIONS
- *Micro*SIZE PACKAGE: MSOP-8

APPLICATIONS

- PRECISION I/V CONVERSION
- PHOTODIODE MONITORING
- OPTICAL AMPLIFIERS
- CAT-SCANNER FRONTEND



DESCRIPTION

The OPA380 family of transimpedance amplifiers provides high-speed (85MHz Gain Bandwidth (GBW)) operation, with extremely high precision, excellent long-term stability, and very low 1/f noise. The OPA380 features an offset voltage of 25µV, offset drift of 0.1µV/°C, and maximum bias current of 50pA. The OPA380 far exceeds the offset, drift, and noise performance that conventional JFET op amps provide.

The signal bandwidth of a transimpedance amplifier depends largely on the GBW of the amplifier, and the parasitic capacitance of the photodiode as well as the feedback resistor. The 85MHz GBW of the OPA380 enables a transimpedance bandwidth of > 1MHz in most configurations. Therefore, the OPA380 is ideally suited for fast control loops that detect and react to fast changes in the optical power level on a fiber.

Due to the high precision and low-noise characteristics of the OPA380, a dynamic range of 5 decades can be achieved. This allows the measurement of signal currents in the order of 10nA, and up to 1mA in a single I/V conversion stage. In contrast to logarithmic amplifiers, the OPA380 provides very-wide bandwidth, even at 10nA input currents. By using an external pulldown resistor to –5V, the output voltage range can be extended to include 0V.

The OPA380 (single) is available in MSOP-8 and SO-8 packages. The OPA2380 (dual) comes in the miniature MSOP-8 package. They are specified from –40°C to +125°C.

PRODUCT PREVIEW

OPA380 RELATED PRODUCTS

PRODUCT	FEATURES
OPA355	200MHz GBW CMOS, 2.5V to 5V Supply
OPA354	100MHz GBW CMOS, RRIO, 2.5V to 5V Supply
OPA350	500µV V_{OS}, 38MHz, 2.5V to 5V Supply
OPA335	10µV V_{OS}, Zero-Drift, 2.5V to 5V Supply
OPA132	16MHz GBW, Precision FET Op Amp, ±15V
OPA656/7	230MHz, Precision FET, ±5V
LOG112	LOG amp, 7.5 decades, ±4.5V to ±18V Supply
LOG114	LOG amp, 7.5 decades, ±2.25V to ±5.5V Supply
IVC102	Precision Switched Integrator TIA

ABSOLUTE MAXIMUM RATINGS[1]

Supply Voltage	+7V
Signal Input Terminals, Voltage[2]	–0.5V to (V+) + 0.5V
Current[2]	±10mA
Output Short Circuit[3]	Continuous
Operating Temperature	–40°C to +125°C
Storage Temperature	–65°C to +150°C
Junction Temperature	+150°C
Lead Temperature (soldering, 10s)	+300°C

NOTES: (1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these, or any other conditions beyond those specified, is not implied. (2) Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.5V beyond the supply rails should be current-limited to 10mA or less. (3) Short-circuit to ground, one amplifier per package.

ELECTROSTATIC DISCHARGE SENSITIVITY

This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

PACKAGE/ORDERING INFORMATION

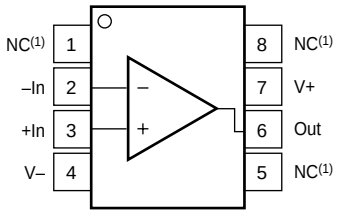
PRODUCT	PACKAGE-LEAD	PACKAGE DESIGNATOR[1]	SPECIFIED TEMPERATURE RANGE	PACKAGE MARKING	ORDERING NUMBER	TRANSPORT MEDIA, QUANTITY
OPA380	MSOP-8	DGK	–40°C to +125°C	TBD	OPA380AIDGKT	Tape and Reel, 250
"	"	"	"	"	OPA380AIDGKR	Tape and Reel, 2500
OPA380	SO-8	D	–40°C to +125°C	OPA380A	OPA380AID	Rails, 100
"	"	"	"	"	OPA380AIDR	Tape and Reel, 2500
OPA2380	MSOP-8	DGK	–40°C to +125°C	TBD	OPA2380AIDGKT	Rails, 250
"	"	"	"	"	OPA2380AIDGKR	Tape and Reel, 2500

PRODUCT PREVIEW

PIN CONFIGURATIONS

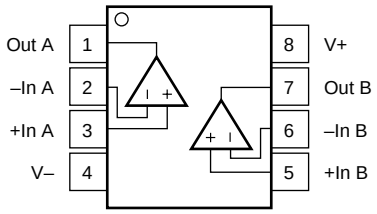
Top View

OPA380



MSOP-8, SO-8

OPA2380



MSOP-8

NOTE: (1) NC indicates no internal connection.

ELECTRICAL CHARACTERISTICS: V_S = +2.7V to +5.5V

Boldface limits apply over the specified temperature range, **T_A = –40°C to +125°C.**

At T_A = +25°C, R_L =2kΩ connected to V_S/2, and V_{OUT} = V_S/2, unless otherwise noted.

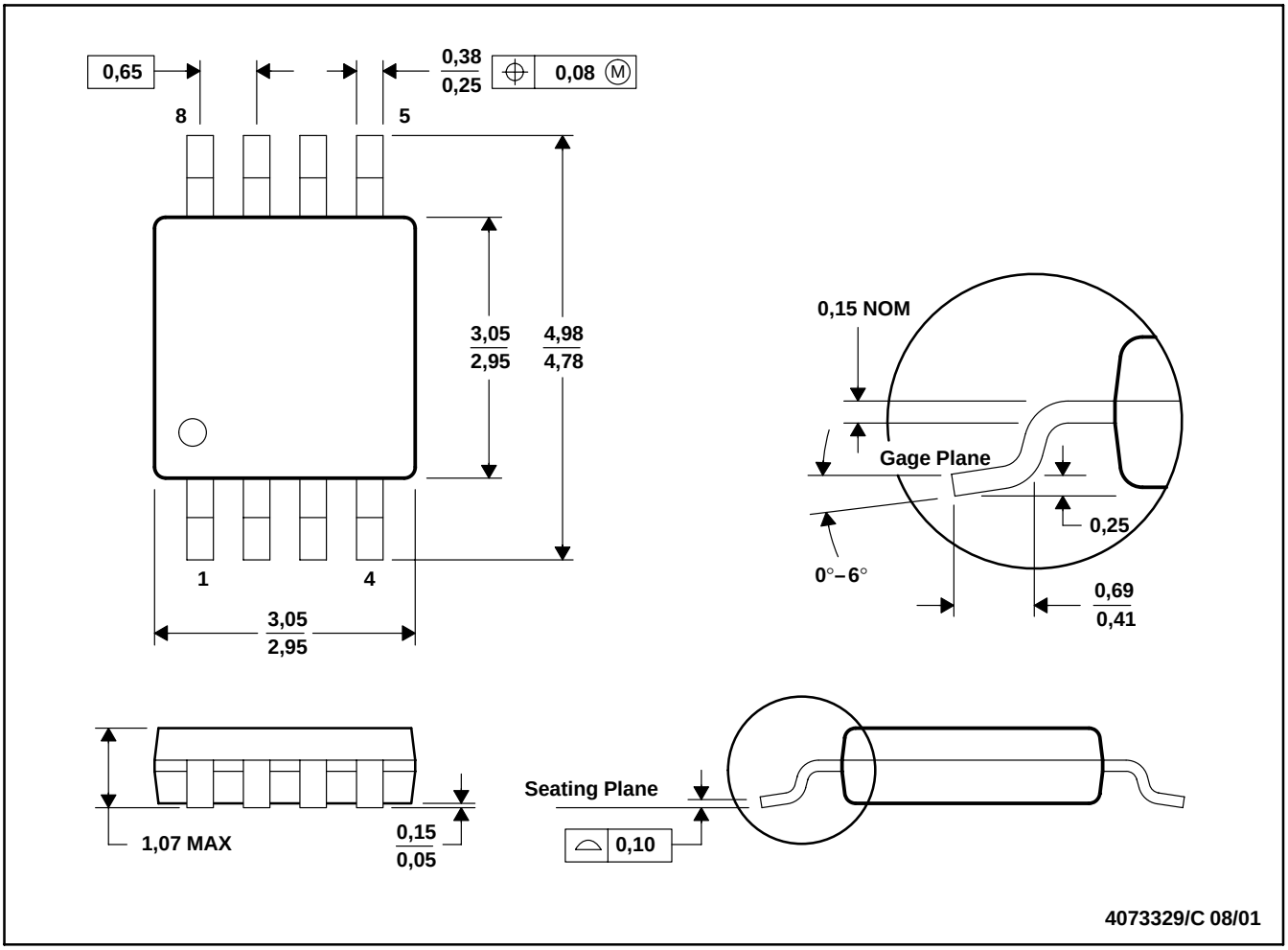
PARAMETER		CONDITION	OPA380, OPA2380 MIN	TYP	MAX	UNITS
OFFSET VOLTAGE						
Input Offset Voltage	V_{OS}	V_S = +5V, V_{CM} = 0V		4	25	µV
Drift	**dV_{OS}/dT**			**TBD**	**0.1**	**µV/°C**
vs Power Supply	PSRR	V_S = +2.7V to +5.5V, V_{CM} = 0		2.4	10	µV/V
Over Temperature		**V_S = +2.7V to +5.5V, V_{CM} = 0**			**5**	**µV/V**
Long-Term Stability[1]				See Note (1)		
Channel Separation, dc				1		µV/V
INPUT BIAS CURRENT						
Input Bias Current	I_B	V_{CM} = V_S/2		1	±50	pA
Over Temperature				Typical Characteristics		
Input Offset Current	I_{OS}			1	±100	pA
NOISE						
Input Voltage Noise, f = 0.1Hz to 10Hz	e_n	V_S = +5V, V_{CM} = 0V		3		μV_{PP}
Input Voltage Noise Density, f = 10kHz	e_n	V_S = +5V, V_{CM} = 0V		67		$nV/\sqrt{Hz}$
Input Voltage Noise Density, f = 1MHz	e_n	V_S = +5V, V_{CM} = 0V		5.5		$nV/\sqrt{Hz}$
Input Current Noise Density, f = 1kHz	i_n	V_S = +5V, V_{CM} = 0V		100		$fA/\sqrt{Hz}$
INPUT VOLTAGE RANGE						
Common-Mode Voltage Range	V_{CM}		V–		(V+) – 1.8V	V
Common-Mode Rejection Ratio	**CMRR**	**(V–) < V_{CM} < (V+) – 1.8V**	**100**	**130**		**dB**
INPUT IMPEDANCE						
Differential Capacitance				1		pF
Common-Mode Resistance and Capacitance				10^{13} || 3		Ω || pF
OPEN-LOOP GAIN						
Open-Loop Voltage Gain	**A_{OL}**	**0.1V < V_O < (V+) – 0.6V, V_{CM} = V_S/2**	**110**	**130**		**dB**
		0V < V_O < (V+) – 0.6V, V_{CM} = 0V, R_P = 2kΩ to –5V[2]	**106**	**120**		**dB**
FREQUENCY RESPONSE		C_L = 50pF				
Gain-Bandwidth Product	GBW			85		MHz
Slew Rate	SR	G = +1		80		V/µs
Settling Time, 0.01%[3]	t_S	V_S = +5.5V, 4V Step, G = +1		3.5		ns
0.0015%[3]		V_S = +5.5V, 4V Step, G = +1		9.2		µs
Overload Recovery Time[4, 5]		V_{IN} • G > V_S		0.5		µs
OUTPUT						
Voltage Output Swing from Positive Rail		**R_L = 2kΩ**		**10**	**600**	**mV**
Voltage Output Swing from Negative Rail		**R_L = 2kΩ**		**60**	**100**	**mV**
Voltage Output Swing from Positive Rail		R_P = 2kΩ to –5V[2]			600	mV
Voltage Output Swing from Negative Rail		R_P = 2kΩ to –5V[2]			0	mV
Output Current	I_{OUT}			See Typical Characteristics		
Short-Circuit Current	I_{SC}			200		mA
Capacitive Load Drive	C_{LOAD}			See Typical Characteristics		
Open-Loop Output (Impedance)		f = 1MHz, I_O = 0		TBD		Ω
POWER SUPPLY						
Specified Voltage Range	V_S		2.7		5.5	V
Quiescent Current (per Amplifier)	I_Q	I_O = 0		6	7.5	mA
Over Temperature					**8**	**mA**
TEMPERATURE RANGE						
Specified Range			–40		+125	°C
Operating Range			–40		+125	°C
Storage Range			–65		+150	°C
Thermal Resistance	θ_{JA}					
MSOP-8				150		°C/W
SO-8				150		°C/W

NOTES: (1) 300-hour life test at 150°C demonstrated randomly distributed variation approximately equal to measurement repeatability of 1µV.
(2) Tested with output connected only to R_P, a pulldown resistor connected between V_{OUT} and –5V, as in Figure xxx. See also applications section *Achieving Output Swing to the Negative Rail.*
(3) Transimpedance frequency of 200kHz.
(4) Time required to return to linear operation.
(5) From positive rail.

PRODUCT PREVIEW

MPDS028B – JUNE 1997 – REVISED SEPTEMBER 2001

DGK (R-PDSO-G8) **PLASTIC SMALL-OUTLINE PACKAGE**



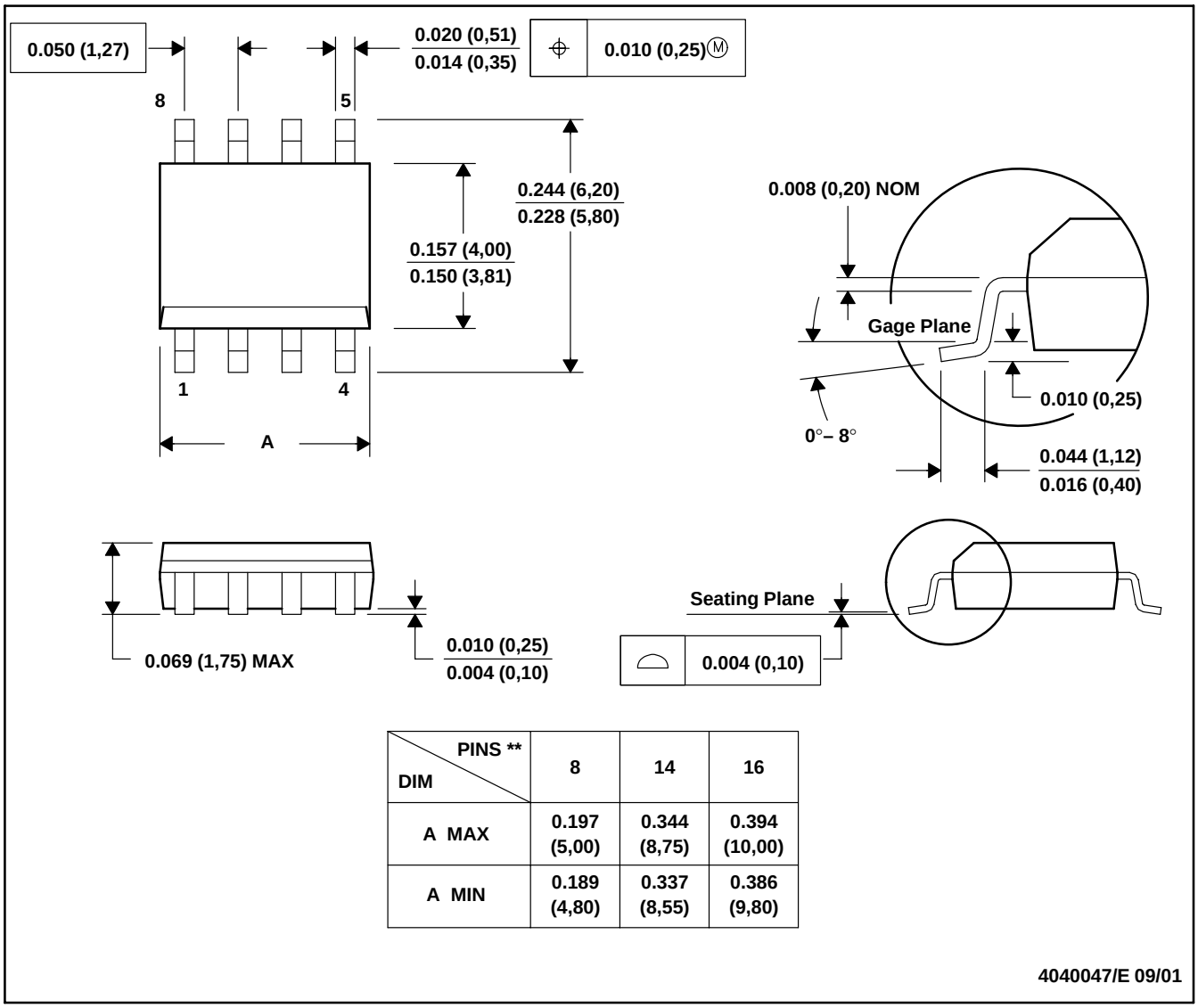
NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion.
D. Falls within JEDEC MO-187

MSOI002B – JANUARY 1995 – REVISED SEPTEMBER 2001

D (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

8 PINS SHOWN



DIM \ PINS **	8	14	16
A MAX	0.197 (5,00)	0.344 (8,75)	0.394 (10,00)
A MIN	0.189 (4,80)	0.337 (8,55)	0.386 (9,80)

4040047/E 09/01

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion, not to exceed 0.006 (0,15).
D. Falls within JEDEC MS-012

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