



Triple, Wideband, Voltage-Feedback OPERATIONAL AMPLIFIER With Disable

FEATURES

- FLEXIBLE SUPPLY RANGE:
+5V to +12V Single Supply
 $\pm 2.5V$ to $\pm 6V$ Dual Supply
- WIDEBAND +5V OPERATION: 220MHz ($G = +2$)
- HIGH OUTPUT CURRENT: 190mA
- OUTPUT VOLTAGE SWING: $\pm 4.0V$
- HIGH SLEW RATE: 1800V/ μs
- LOW SUPPLY CURRENT: 5.5mA/ch
- LOW DISABLED CURRENT: 100 μA /ch

APPLICATIONS

- VIDEO LINE DRIVING
- HIGH-SPEED IMAGING CHANNELS
- ADC BUFFERS
- PORTABLE INSTRUMENTS
- TRANSIMPEDANCE AMPLIFIERS
- ACTIVE FILTERS

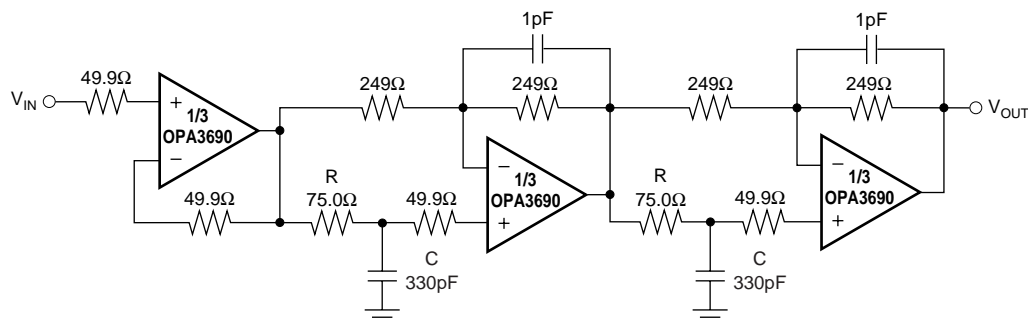
DESCRIPTION

The OPA3690 represents a major step forward in unity-gain stable, voltage-feedback op amps. A new internal architecture provides slew rate and full power bandwidth previously found only in wideband current-feedback op amps. A new output stage architecture delivers high currents with a minimal headroom requirement. These give exceptional single-supply operation. Using a single +5V supply, the OPA3690 can deliver a 1V to 4V output swing with over 100mA drive current and 150MHz bandwidth. This combination of features makes the OPA3690 an ideal RGB line driver or single-supply Analog-to-Digital Converter (ADC) input driver.

The OPA3690's low 5.5mA/ch supply current is precisely trimmed at 25°C. This trim, along with low temperature drift, ensures lower maximum supply current than competing products. System power may be reduced further using the optional disable control pin. Leaving this disable pin open, or holding it HIGH, will operate the OPA3690 normal. If pulled LOW, the OPA3690 supply current drops to less than 100 μA /ch while the output goes into a high impedance state. This feature may be used for power savings.

OPA3690 RELATED PRODUCTS

	SINGLES	DUALS	TRIPLES
Voltage Feedback	OPA690	OPA2690	OPA3680
Current Feedback	OPA691	OPA2691	OPA3691
Fixed Gain	OPA692	OPA2682	OPA3692



Buffered Analog Delay Line



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

Power Supply	±6.5VDC
Internal Power Dissipation	See Thermal Information
Differential Input Voltage	±1.2V
Input Voltage Range	±V _S
Storage Temperature Range: D, DBQ	-40°C to +125°C
Lead Temperature (soldering, 10s)	+300°C
Junction Temperature (T _J)	+175°C
ESD Resistance: HBM	2kV
MM	200V

NOTE: (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.



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.

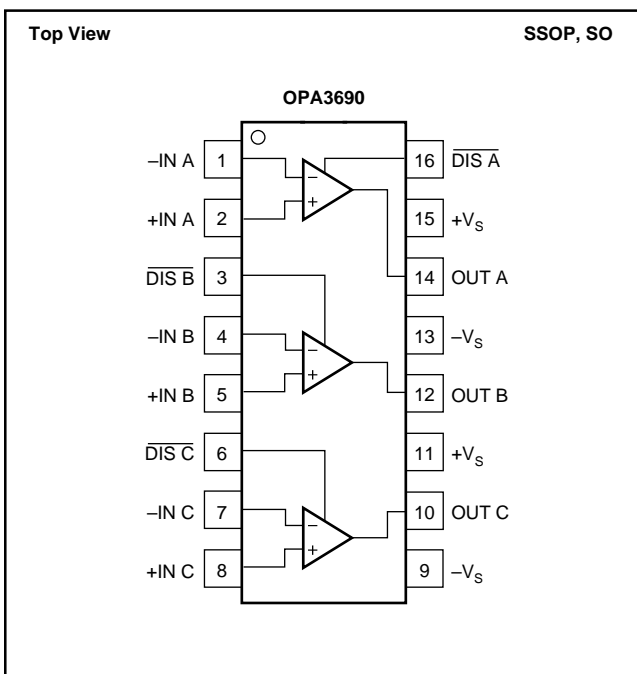
ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

PACKAGE/ORDERING INFORMATION

PRODUCT	PACKAGE-LEAD	PACKAGE DESIGNATOR ⁽¹⁾	TEMPERATURE RANGE	SPECIFIED PACKAGE MARKING	ORDERING NUMBER	TRANSPORT MEDIA
OPA3690IDBQ	SSOP-16 Surface-Mount	DBQ	-40°C to +85°C	OPA3690	OPA3690IDBQT	Tape and Reel, 250
"	"	"	"	"	OPA3690IDBQR	Tape and Reel, 2.5K
OPA3690ID	SO-16 Surface-Mount	D	-40°C to +85°C	OPA3690	OPA3690ID	Rails, 48
"	"	"	"	"	OPA3690IDR	Tape and Reel, 2.5K

NOTE: (1) For the most current specifications and package information, refer to our web site at www.ti.com.

PIN CONFIGURATION



ELECTRICAL CHARACTERISTICS: $V_S = \pm 5V$

Boldface limits are tested at **25°C**.

$R_F = 402\Omega$, $R_L = 100\Omega$, $G = +2$, (see Figure 1 for AC performance only), and $R_F = 25\Omega$ for $G = +1$, unless otherwise noted.

PARAMETER	CONDITIONS	OPA3690ID, IDBQ					MIN/ MAX	TEST LEVEL ⁽³⁾
		TYP	MIN/MAX OVER TEMPERATURE					
		+25°C	+25°C ⁽¹⁾	0°C to 70°C ⁽²⁾	-40°C to +85°C ⁽²⁾	UNITS		
AC PERFORMANCE (see Figure 1)								
Small-Signal Bandwidth	$G = +1$, $V_O = 0.5V_{p-p}$, $R_F = 25\Omega$	400				MHz	typ	C
	$G = +2$, $V_O = 0.5V_{p-p}$	220				MHz	min	C
	$G = +10$, $V_O = 0.5V_{p-p}$	30				MHz	min	C
Gain Bandwidth Product	$G \geq 10$	300				MHz	min	C
Bandwidth for 0.1dB Gain Flatness	$G = +2$, $V_O < 0.5V_{p-p}$	30				MHz	typ	C
Peaking at a Gain of +1	$V_O < 0.5V_{p-p}$	4				dB	typ	C
Large-Signal Bandwidth	$G = +2$, $V_O = 5V_{p-p}$	175				MHz	typ	C
Slew Rate	$G = +2$, 4V Step	1800				V/ μs	min	C
Rise-and-Fall Time	$G = +2$, $V_O = 0.5V$ Step	1.4				ns	max	C
	$G = +2$, $V_O = 4V$ Step	2.8				ns	max	C
Settling Time to 0.02%	$G = +2$, $V_O = 2V$ Step	12				ns	typ	C
0.1%	$G = +2$, $V_O = 2V$ Step	8				ns	typ	C
Harmonic Distortion	$G = +2$, $f = 5MHz$, $V_O = 2V_{p-p}$							
2nd Harmonic	$R_L = 100\Omega$	-72				dBc	typ	C
	$R_L \geq 500\Omega$	-83				dBc	typ	C
3rd Harmonic	$R_L = 100\Omega$	-74				dBc	typ	C
	$R_L \geq 500\Omega$	-85				dBc	typ	C
Crosstalk	Input Referred, $f = 5MHz$, All Hostile	-58				dBc	typ	C
Input Voltage Noise	$f > 1MHz$	4.5				nV/ \sqrt{Hz}	max	C
Input Current Noise	$f > 1MHz$	2.3				pA/ \sqrt{Hz}	max	C
Differential Gain	$G = +2$, NTSC, $V_O = 1.4V_{p-p}$, $R_L = 150$	0.06				%	typ	C
Differential Phase	$G = +2$, NTSC, $V_O = 1.4V_{p-p}$, $R_L = 150$	0.01				deg	typ	C
DC PERFORMANCE⁽⁴⁾								
Open-Loop Voltage Gain (A_{OL})	$V_{OL} = 0V$, $R_L = 100\Omega$	65	58	56	54	dB	min	A
Input Offset Voltage	$V_{CM} = 0V$	± 1.0	± 4.5	± 5	± 5.2	mV	max	A
Average Offset Voltage Drift	$V_{CM} = 0V$			± 12	± 12	$\mu V/^\circ C$	max	B
Input Bias Current	$V_{CM} = 0V$	+5	± 10	± 11	± 12	μA	max	A
Average Bias Current Drift (magnitude)	$V_{CM} = 0V$			± 20	± 40	nA/ $^\circ C$	max	B
Input Offset Current	$V_{CM} = 0V$	± 0.1	± 1.0	± 1.4	± 1.6	μA	max	A
Average Offset Current Drift	$V_{CM} = 0V$			± 7	± 9	nA/ $^\circ C$	max	B
INPUT								
Common-Mode Input Range (CMIR) ⁽⁵⁾		± 3.5	± 3.4	± 3.3	± 3.2	V	min	A
Common-Mode Rejection Ratio (CMRR)	$V_{CM} = \pm 1.0V$	65	60	57	56	dB	min	A
Input Impedance								
Differential Mode		190 0.6				k Ω pF	typ	C
Common Mode		3.2 0.9				M Ω pF	typ	C
OUTPUT								
Voltage Output Swing	No Load	± 4.0	± 3.8	± 3.7	± 3.6	V	min	A
	100 Ω Load	± 3.9	± 3.7	± 3.6	± 3.3	V	min	A
Current Output, Sourcing	$V_O = 0$	+190	+160	+140	+100	mA	min	A
Sinking	$V_O = 0$	-190	-160	-140	-100	mA	min	A
Short-Circuit Current	$V_O = 0$	± 250				mA	typ	C
Closed-Loop Output Impedance	$G = +2$, $f = 100kHz$	0.03					typ	C

ELECTRICAL CHARACTERISTICS: $V_S = \pm 5V$ (Cont.)

Boldface limits are tested at 25°C.

$R_F = 402\Omega$, $R_L = 100\Omega$, $G = +2$, (see Figure 1 for AC performance only), and $R_F = 25\Omega$ for $G = +1$, unless otherwise noted.

PARAMETER	CONDITIONS	OPA3690ID, IDBQ						TEST LEVEL ⁽²⁾
		TYP	MIN/MAX OVER TEMPERATURE ⁽¹⁾				MIN/ MAX	
		+25°C	+25°C	0°C to 70°C	-40°C to +85°C	UNITS		
DISABLE								
Power-Down Supply Current (+ V_S)	Disable Low $V_{DIS} = 0V$, All Channels	-300	-600	-720	-780	μA	max	A
Disable Time		200				ns	typ	C
Enable Time		25				ns	typ	C
Off Isolation	$G = +2$, 5MHz	70				dB	typ	C
Output Capacitance in Disable		4				pF	typ	C
Turn On Glitch	$G = +2$, $R_L = 150\Omega$, $V_{IN} = 0$	± 50				mV	typ	C
Turn Off Glitch	$G = +2$, $R_L = 150\Omega$, $V_{IN} = 0$	± 20				mV	typ	C
Enable Voltage		3.3	3.5	3.6	3.7	V	min	A
Disable Voltage		1.8	1.7	1.6	1.5	V	max	A
Control Pin Input Bias Current	$V_{DIS} = 0V$, Each Channel	75	130	150	160	μA	max	A
POWER SUPPLY								
Specified Operating Voltage		± 5				V	typ	C
Maximum Operating Voltage Range			± 6	± 6	± 6	V	max	A
Max Quiescent Current (3 Channels)	$V_S = \pm 5V$	16.5	17.4	18	18.6	mA	max	A
Min Quiescent Current (3 Channels)	$V_S = \pm 5V$	16.5	15.9	15.3	14.1	mA	min	A
Power-Supply Rejection Ratio (+PSRR)	Input Referred	75	68	66	64	dB	min	A
THERMAL CHARACTERISTICS								
Specified Operating Range D, DBQ Package		-40 to +85				°C	typ	C
Thermal Resistance, θ_{JA}								
D SO-16		100				°C/W	typ	C
DBQ SSOP-16		100				°C/W	typ	C

NOTES: (1) Junction temperature = ambient for 25°C specifications. (2) Junction temperature = ambient at low temperature limit; junction temperature = Ambient +20°C at high temperature limit for over temperature specifications. (3) Test Levels: (A) 100% tested at 25°C. Over temperature limits by characterization and simulation. (B) Limits set by characterization and simulation. (C) Typical value only for information. (4) Current is considered positive out-of-node. V_{CM} is the input common-mode voltage. (5) Tested < 3dB below minimum CMRR specification at $\pm CMIR$ limits.

ELECTRICAL CHARACTERISTICS: $V_S = +5V$

Boldface limits are tested at **25°C**.

$R_F = 402\Omega$, $R_L = 100\Omega$ to $V_S/2$, $G = +2$, (see Figure 2 for AC performance only), and $R_F = 25\Omega$ for $G = +1$, unless otherwise noted.

PARAMETER	CONDITIONS	OPA3690ID, IDBQ						TEST LEVEL ⁽³⁾
		TYP	MIN/MAX OVER TEMPERATURE				MIN/MAX	
		+25°C	+25°C ⁽¹⁾	0°C to 70°C ⁽²⁾	-40°C to +85°C ⁽²⁾	UNITS		
AC PERFORMANCE (see Figure 2)								
Small-Signal Bandwidth	$G = +1, V_O < 0.5V_{p-p}$	330				MHz	typ	C
	$G = +2, V_O < 0.5V_{p-p}$	220				MHz	min	C
	$G = +10, V_O < 0.5V_{p-p}$	25				MHz	min	C
Gain Bandwidth Product	$G \geq 10$	250				MHz	min	C
Bandwidth for 0.1dB Gain Flatness	$G = +2, V_O < 0.5V_{p-p}$	20				MHz	typ	C
Peaking at a Gain of +1	$V_O < 0.5V_{p-p}$	5				dB	typ	C
Large-Signal Bandwidth	$G = +2, V_O = 2V_{p-p}$	175				MHz	typ	C
Slew Rate	$G = +2, 2V$ Step	1000				V/ μ s	min	C
Rise Time	$G = +2, V_O = 0.5V$ Step	1.6				ns	typ	C
Fall Time	$G = +2, V_O = 2V$ Step	2.0				ns	typ	C
Settling Time to 0.02%	$G = +2, V_O = 2V$ Step	12				ns	typ	C
0.1%	$G = +2, V_O = 2V$ Step	8				ns	typ	C
Harmonic Distortion	$G = +2, f = 5MHz, V_O = 2V_{p-p}$							
2nd Harmonic	$R_L = 100\Omega$	-71				dBc	typ	C
	$R_L \geq 500\Omega$	-79				dBc	typ	C
3rd Harmonic	$R_L = 100\Omega$	-72				dBc	typ	C
	$R_L \geq 500\Omega$	-77				dBc	typ	C
Input Voltage Noise	$f > 1MHz$	4.7				nV/ \sqrt{Hz}	max	C
Input Current Noise	$f > 1MHz$	2.5				pA/ \sqrt{Hz}	max	C
Differential Gain	$G = +2, NTSC, V_O = 1.4V_{p-p}, R_L = 150$ to $V_S/2$	0.06				%	typ	C
Differential Phase	$G = +2, NTSC, V_O = 1.4V_{p-p}, R_L = 150$ to $V_S/2$	0.02				deg	typ	C
DC PERFORMANCE⁽⁴⁾								
Open-Loop Voltage Gain (A_{OL})	$V_O = 0V, R_L = 100\Omega$	63	56	54	52	dB	min	A
Input Offset Voltage	$V_{CM} = 2.5V$	± 1.0	± 4.5	± 4.8	± 5.2	mV	max	A
Average Offset Voltage Drift	$V_{CM} = 2.5V$			± 10	± 10	$\mu V/^\circ C$	max	B
Input Bias Current	$V_{CM} = 2.5V$	+5	± 10	± 11	± 12	μA	max	A
Average Bias Current Drift (magnitude)	$V_{CM} = 2.5V$			± 20	± 40	nA/ $^\circ C$	max	B
Input Offset Current	$V_{CM} = 2.5V$	± 0.3	± 1	± 1.4	± 1.6	μA	max	A
Average Offset Current Drift	$V_{CM} = 2.5V$			± 7	± 9	nA/ $^\circ C$	max	B
INPUT								
Least Positive Input Voltage ⁽⁵⁾		1.5	1.6	1.7	1.8	V	min	A
Most Positive Input Voltage ⁽⁵⁾		3.5	3.4	3.3	3.2	V	max	A
Common-Mode Rejection Ratio (CMRR)	$V_{CM} = 2.5V$	63	58	56	54	dB	min	A
Input Impedance								
Differential Mode		92 1.4				k Ω pF	typ	C
Common Mode		2.2 1.5				M Ω pF	typ	C
OUTPUT								
Most Positive Output Voltage	No Load	4	3.8	3.6	3.5	V	min	A
	$R_L = 100\Omega, 2.5V$	3.9	3.7	3.5	3.4	V	min	A
Least Positive Output Voltage	No Load	1	1.2	1.4	1.5	V	min	A
	$R_L = 100\Omega, 2.5V$	1.1	1.3	1.5	1.7	V	min	A
Current Output, Sourcing		+160	+120	+100	+80	mA	min	A
Sinking		-160	-120	-100	-80	mA	min	A
Short-Circuit Current	$V_O = V_S/2$	± 250				mA	typ	C
Closed-Loop Output Impedance	$G = +2, f = 100kHz$	0.03					typ	C

ELECTRICAL CHARACTERISTICS: $V_S = +5V$ (Cont.)

Boldface limits are tested at 25°C.

$R_F = 250\Omega$, $R_L = 100\Omega$ to $V_S/2$, $G = +2$, (see Figure 2 for AC performance only), and $R_F = 25\Omega$ for $G = +1$, unless otherwise noted.

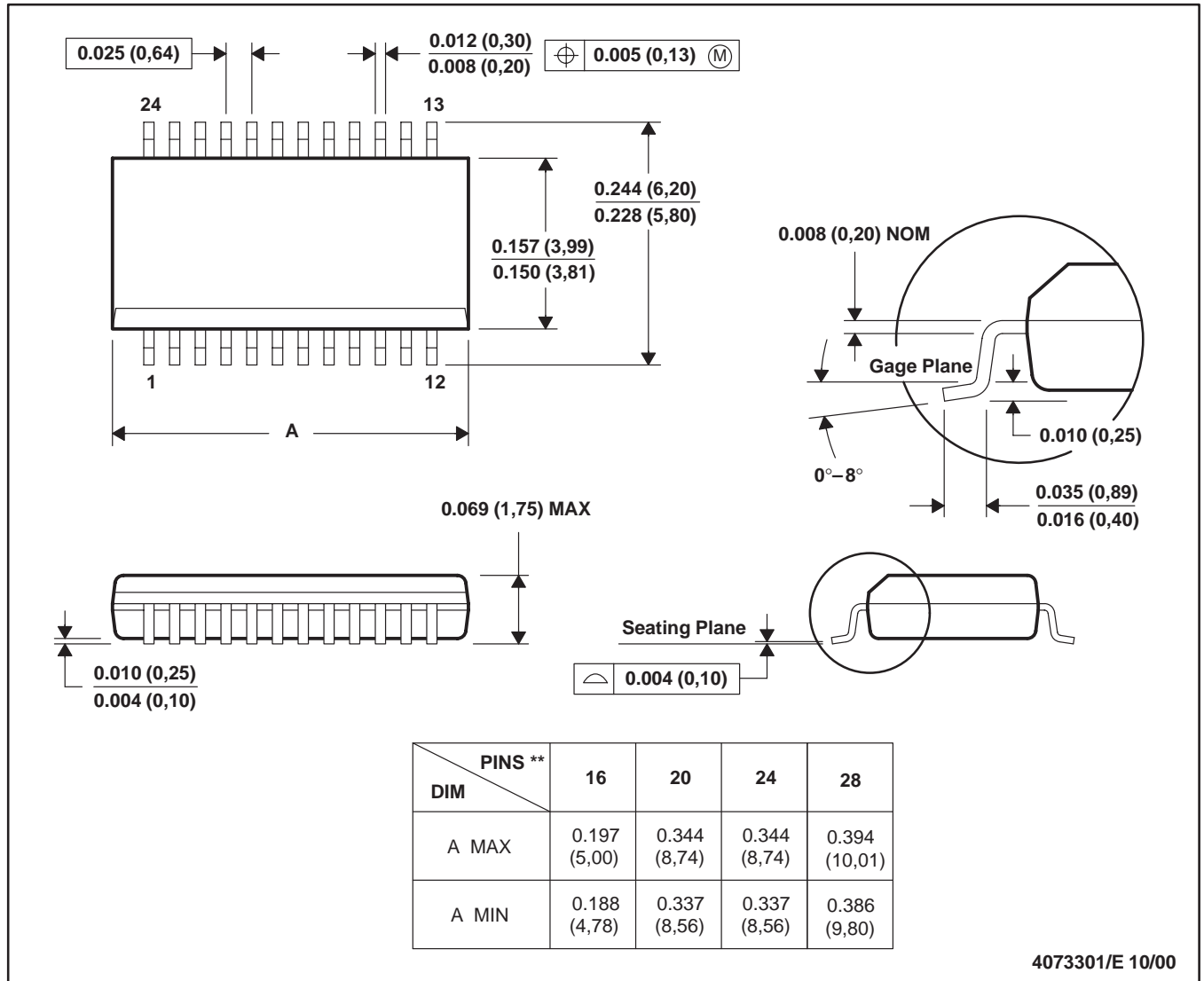
PARAMETER	CONDITIONS	OPA3690ID, IDBQ						TEST LEVEL ⁽²⁾
		TYP	MIN/MAX OVER TEMPERATURE ⁽¹⁾				MIN/ MAX	
		+25°C	+25°C	0°C to 70°C	-40°C to +85°C	UNITS		
DISABLE								
Power-Down Supply Current (+ V_S)	Disable Low $V_{\overline{DIS}} = 0V$, All Channels	-300	-600	-720	-780	μA	max	A
Disable Time		200				ns	typ	C
Enable Time		25				ns	typ	C
Off Isolation	$G = +2$, 5MHz	65				dB	typ	C
Output Capacitance in Disable		4				pF	typ	C
Turn On Glitch	$G = +2$, $R_L = 150\Omega$, $V_{IN} = V_S/2$	± 50				mV	typ	C
Turn Off Glitch	$G = +2$, $R_{LP} = 150\Omega$, $V_{IN} = V_S/2$	± 20				mV	typ	C
Enable Voltage		3.3	3.5	3.6	3.7	V	min	A
Disable Voltage		1.8	1.7	1.6	1.5	V	max	A
Control Pin Input Bias Current	$V_{\overline{DIS}} = 0V$, Each Channel	75	130	150	160	μA	typ	C
POWER SUPPLY								
Specified Single-Supply Operating Voltage		5				V	typ	C
Maximum Single-Supply Operating Voltage			12	12	12	V	max	A
Max Quiescent Current (3 Channels)	$V_S = +5V$	14.7	15.6	16.2	16.8	mA	max	A
Min Quiescent Current (3 Channels)	$V_S = +5V$	14.7	14.1	13.2	12.0	mA	min	A
Power-Supply Rejection Ratio (+PSRR)	Input Referred	72				dB	typ	C
TEMPERATURE RANGE								
Specification: D, DBQ		-40 to +85				°C	typ	C
Thermal Resistance, θ_{JA}								
D SO-16		100				°C/W	typ	C
DBQ SSOP-16		100				°C/W	typ	C

NOTES: (1) Junction temperature = ambient for 25°C specifications. (2) Junction temperature = ambient at low temperature limit; junction temperature = Ambient +20°C at high temperature limit for over temperature specifications. (3) Test Levels: (A) 100% tested at 25°C. Over temperature limits by characterization and simulation. (B) Limits set by characterization and simulation. (C) Typical value only for information. (4) Current is considered positive out-of-node. V_{CM} is the input common-mode voltage. (5) Tested < 3dB below minimum CMRR specification at $\pm CMIR$ limits.

DBQ (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

24 PINS SHOWN



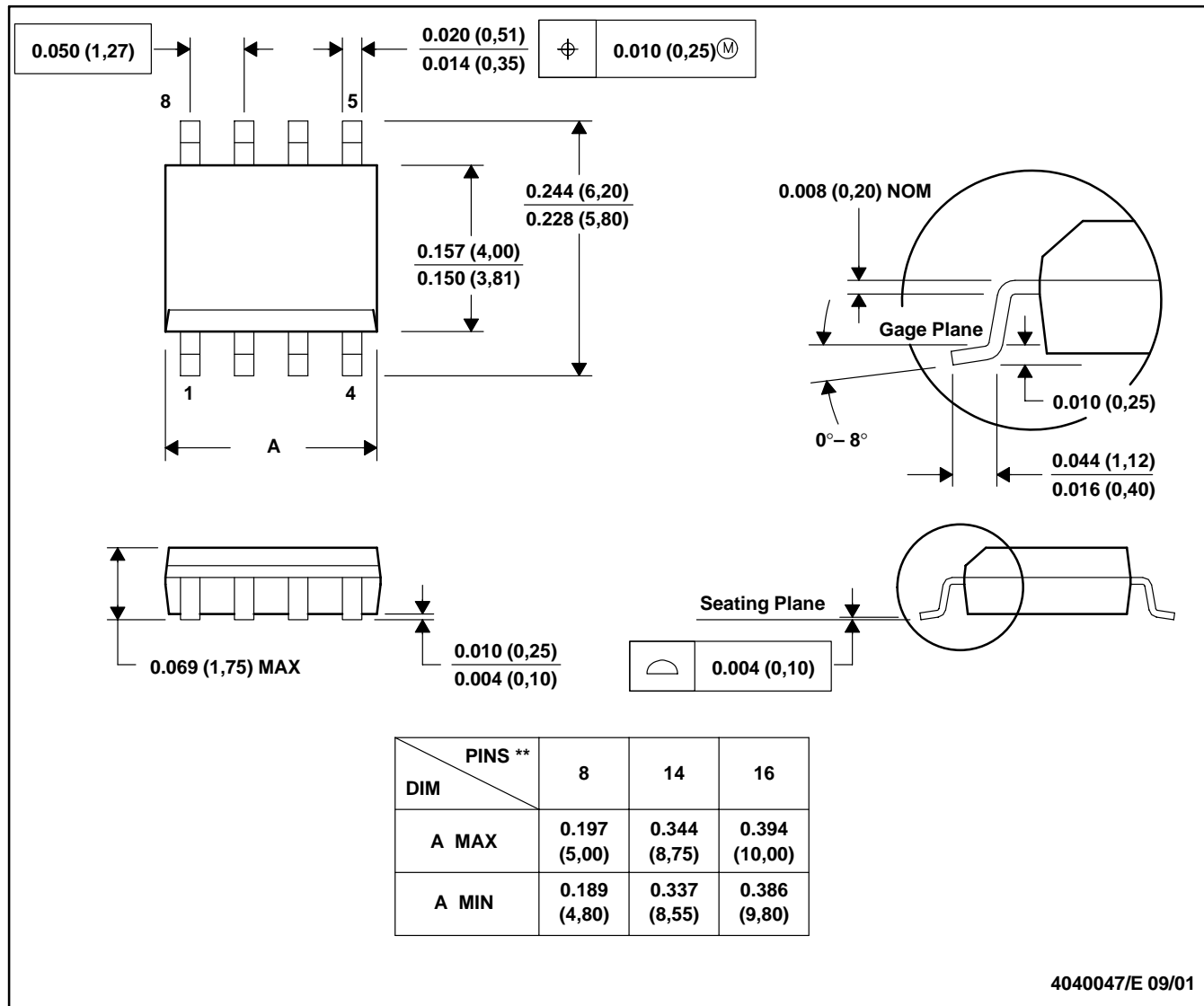
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- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 D. Falls within JEDEC MO-137

D (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

8 PINS SHOWN



- 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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