



## 3V Single-Supply Video Amplifier with Filter in SC70

### FEATURES

- **EXCELLENT VIDEO PERFORMANCE**  
0.5dB GAIN FLATNESS: 20MHz  
DIFF. GAIN: 0.02%, DIFF. PHASE: 0.05°
- **DC-COUPLED INPUT**
- **DC-COUPLED OUTPUT**
  - No Output Capacitors Needed<sup>(1)</sup>
- **HIGH SLEW RATE: 70V/μs**
- **INPUT RANGE INCLUDES GROUND**
- **RAIL-TO-RAIL OUTPUT**
- **LOW QUIESCENT CURRENT: 5mA**
- **SINGLE-SUPPLY OPERATING RANGE:**  
2.7V to 3.3V
- **MicroSIZE PACKAGE: SC70-6, SOT23-6**

<sup>(1)</sup> The final product will have additional circuitry that prevents the output from saturating, even with 0V sync tip level at the input video signal.

### SPECIAL FEATURES

- **INTERNAL GAIN = 2 (OPA359 and OPA360)**
- **2-POLE ANTI-ALIASING FILTER (OPA360 only)**
- **SAG CORRECTION (OPA359 and OPA360)**
  - Reduces Coupling Capacitor Size

### APPLICATIONS

- **DIGITAL STILL CAMERAS**
- **CAMERA PHONES**
- **DIGITAL VIDEO CAMERAS**
- **SET-TOP-BOX VIDEO FILTERS**
- **DIGITAL TELEVISIONS**

### AVAILABLE OPTIONS

MODEL	CHANNELS <sup>(1)</sup>	INTERNAL G = 2	SHUTDOWN	FILTER	SAG CORRECTION	SC70-6	SOT23-6
OPA358	1		✓			✓	✓
OPA359	1	✓	✓		✓	✓	✓
OPA360	1	✓	✓	✓	✓	✓	✓

<sup>(1)</sup> Contact factory for other gain configurations and higher channel counts.

### DESCRIPTION

The OPA358, OPA359, and OPA360 high-speed video amplifiers are optimized for 3V single-supply operation. The output swings within 200mV of the positive power-supply rail and 70mV to the negative rail with a typical video load. The input common-mode range includes GND and extends to within 1V of the positive power supply. These devices offer excellent video performance: 0.5dB gain flatness is 20MHz, differential gain is 0.02%, and differential phase is 0.05°. Quiescent current is only 5mA per channel.

The OPA359 and OPA360 have been optimized for space-sensitive applications by integrating internal G = 2 setting resistors, a 2-pole Digital-to-Analog converter (DAC) anti-aliasing filter (OPA360 only), and sag correction (OPA359 and OPA360) to reduce the size of the output coupling capacitors. See the Available Options table below. For gains other than 6dB, please contact your local TI sales representative.

In shutdown mode, the quiescent current is reduced to <5μA, dramatically reducing power consumption. This is especially important in battery-operated equipment such as digital still cameras (DSCs) or digital camcorders.

The OPA358, OPA359, and OPA360 are available in SC70-6 and SOT23-6, the smallest video packages currently available. For higher channel counts, please contact your local TI sales representative.

PRODUCT PREVIEW



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## PRELIMINARY ORDERING INFORMATION<sup>(1)</sup>

PRODUCT	PACKAGE	PACKAGE DESIGNATOR	SPECIFIED TEMPERATURE RANGE	PACKAGE MARKING	ORDERING NUMBER	TRANSPORT MEDIA, QUANTITY
OPA358	SC70-6	DCK	–40°C to +125°C	AUS	OPA358IDCKT	Tape and Reel, 250
					OPA358IDCKR	Tape and Reel, 3000
OPA358	SOT23-6	DBV	–40°C to +125°C	AUT	OPA358IDBVT	Tape and Reel, 250
					OPA358IDBVR	Tape and Reel, 3000
OPA359	SC70-6	DCK	–40°C to +125°C	AUR	OPA359IDCKT	Tape and Reel, 250
					OPA359IDCKR	Tape and Reel, 3000
OPA359	SOT23-6	DBV	–40°C to +125°C	AUX	OPA359IDBVT	Tape and Reel, 250
					OPA359IDBVR	Tape and Reel, 3000
OPA360	SC70-6	DCK	–40°C to +125°C	AUU	OPA360IDCKT	Tape and Reel, 250
					OPA360IDCKR	Tape and Reel, 3000
OPA360	SOT23-6	DBV	–40°C to +125°C	AUW	OPA360IDBVT	Tape and Reel, 250
					OPA360IDBVR	Tape and Reel, 3000

<sup>(1)</sup> For the most current package and ordering information, see the Package Option Addendum located at the end of this datasheet.

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

Supply Voltage, V+ to V–	+3.6V
Signal Input Terminals, Voltage <sup>(2)</sup>	(V–) –0.5V to (V+) + 0.5V
Current <sup>(2)</sup>	±10mA
Output Short-Circuit <sup>(3)</sup>	Continuous
Operating Temperature	–55°C to +150°C
Storage Temperature	–65°C to +150°C
Junction Temperature	+160°C
Lead Temperature (soldering, 10s)	+300°C

<sup>(1)</sup> 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.

<sup>(2)</sup> 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.

<sup>(3)</sup> Short-circuit to ground, one amplifier per package.



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.

**ELECTRICAL CHARACTERISTICS:  $V_S = +2.7V$  TO  $+3.3V$  SINGLE-SUPPLY**
**Boldface** limits apply over the specified temperature range,  $T_A = -40^{\circ}C$  to  $+125^{\circ}C$ .

All specifications at  $T_A = +25^{\circ}C$ ,  $R_F = 150\Omega$ , and connected to  $V_S/2$ , unless otherwise noted.

PARAMETER	CONDITION	OPA358, OPA359, OPA360			UNIT
		MIN	TYP	MAX	
<b>OFFSET VOLTAGE</b>					
Input Offset Voltage $V_{OS}$	$V_S = +3.3V$		$\pm 2$	$\pm 9$	mV
<b>Over Temperature</b>	<b>Specified Temperature Range</b>			$\pm 15$	mV
<b>Drift</b>	<b>Specified Temperature Range</b>		<b>TBD</b>	<b>TBD</b>	$\mu V/^{\circ}C$
vs Power Supply $dV_{OS}/dT$ PSRR	$V_S = +2.7V$ to $+3.3V$		$\pm 80$	$\pm 350$	$\mu V/V$
<b>INPUT BIAS CURRENT</b>					
Input Bias Current $I_B$			$\pm 3$	$\pm 50$	pA
Input Offset Current $I_{OS}$			$\pm 1$	$\pm 50$	pA
<b>NOISE</b>					
Input Voltage Noise Density $e_n$	$f = 1MHz$		5.8		$nV/\sqrt{Hz}$
Input Current Noise Density $i_n$	$f = 1MHz$		50		$fA/\sqrt{Hz}$
<b>INPUT VOLTAGE RANGE</b>					
Common-mode Voltage Range $V_{CM}$	$V_S = +3.3V$ , $-0.1V < V_{CM} < 2.3V$	(V-) -0.1 66 <b>66</b>	80	(V+) -1	V
Common-mode Rejection Ratio CMRR	<b>Specified Temperature Range</b>				<b>dB</b> <b>dB</b>
<b>INPUT IMPEDANCE</b>					
Differential			$10^{13} \parallel 1.5$		$\Omega \parallel pF$
Common-mode			$10^{13} \parallel 1.5$		$\Omega \parallel pF$
<b>OPEN-LOOP GAIN</b>					
Open-Loop Voltage Gain, OPA358 $A_{OL}$	$V_S = +3.3V$ , $0.07V < V_O < V_S - 0.2V$	84 <b>80</b>	92		<b>dB</b> <b>dB</b>
<b>Over Temperature</b>	<b><math>V_S = +3.3V</math>, <math>0.07V &lt; V_O &lt; V_S - 0.2V</math></b>				
<b>VOLTAGE GAIN</b>					
OPA359, OPA360	$V_S = +3.3V$ , $0V < V_{IN} < 1.8V$		2		V/V
<b>FREQUENCY RESPONSE</b>					
Small-Signal Bandwidth, OPA358 $f_{-3dB}$	$G = +1$ , $V_O = 100mV_{PP}$ , $R_F = 0\Omega$		80		MHz
Gain-Bandwidth Product, OPA358 GBW	$G = +10$ , $R_L = 1k\Omega$		70		MHz
OPA359 $f_{-3dB}$	$G = +2$ , $V_O = 100mV_{PP}$ , $R_F = 560\Omega$		35		MHz
Filter Response, OPA360					
Gain: $f_{in} = 4.5MHz$	$G = +2$ , $V_O = 2V_{PP}$		-0.5	TBD	dB
$f_{in} = 13.5MHz$	$G = +2$ , $V_O = 2V_{PP}$		-3		dB
$f_{in} = 27MHz$	$G = +2$ , $V_O = 2V_{PP}$		-21	TBD	dB
Bandwidth for 0.1dB Gain Flatness $f_{0.1dB}$	$G = +2$ , $V_O = 100mV_{PP}$ , $R_F = 560\Omega$		15		MHz
0.5dB Gain Flatness $f_{0.5dB}$	$G = +2$ , $V_O = 100mV_{PP}$ , $R_F = 560\Omega$		35		MHz
Slew Rate SR	$V_S = +3.3V$ , $G = +2$ , 3V Output Step		70		V/ $\mu s$
Differential Gain Error	NTSC, $R_L = 150\Omega$		0.02		%
Differential Phase Error	NTSC, $R_L = 150\Omega$		0.05		$^{\circ}$
Group Delay (OPA360)			TBD		ns
Signal-to-Noise Ratio SNR			TBD		dB
<b>OUTPUT</b>					
Positive Voltage Output Swing from Rail	$V_S = +3.3V$ , $G = 2$ , $V_{IN} = 1.65$ , $R_L = 150\Omega$ to GND		100	200	mV
Negative Voltage Output Swing from Rail	$V_S = +3.3V$ , $G = 2$ , $V_{IN} = 1.65$ , $R_L = 150\Omega$ to GND		30	70	mV
Positive Output Swing from Rail	$V_S = +3.3V$ , $G = 2$ , $V_{IN} = 1.65$ , $R_L = 75\Omega$ to GND		TBD		mV
Negative Output Swing from Rail	$V_S = +3.3V$ , $G = 2$ , $V_{IN} = 1.65$ , $R_L = 75\Omega$ to GND		TBD		mV
Voltage Output Swing from Rail	$V_S = +3.3V$ , $R_L = 1k\Omega$		100		mV
Output Current $I_O$	$V_S = +3.3V$		$\pm 80$		mA
Closed-Loop Output Impedance	$f < 100kHz$		0.02		$\Omega$
<b>POWER SUPPLY</b>					
Specified Voltage Range $V_S$		2.7		3.3	V
Minimum Operating Voltage			2.5 to 3.6		V
Quiescent Current (per amplifier) $I_Q$	$V_S = +3.3V$ , Enabled, $I_O = 0$		5.2	6.5	mA
	<b>Specified Temperature Range</b>			<b>TBD</b>	<b>mA</b>

(1) Logic low and high levels are CMOS-logic compatible.

# **ELECTRICAL CHARACTERISTICS: $V_S = +2.7V$ TO $+3.3V$ SINGLE-SUPPLY (continued)**

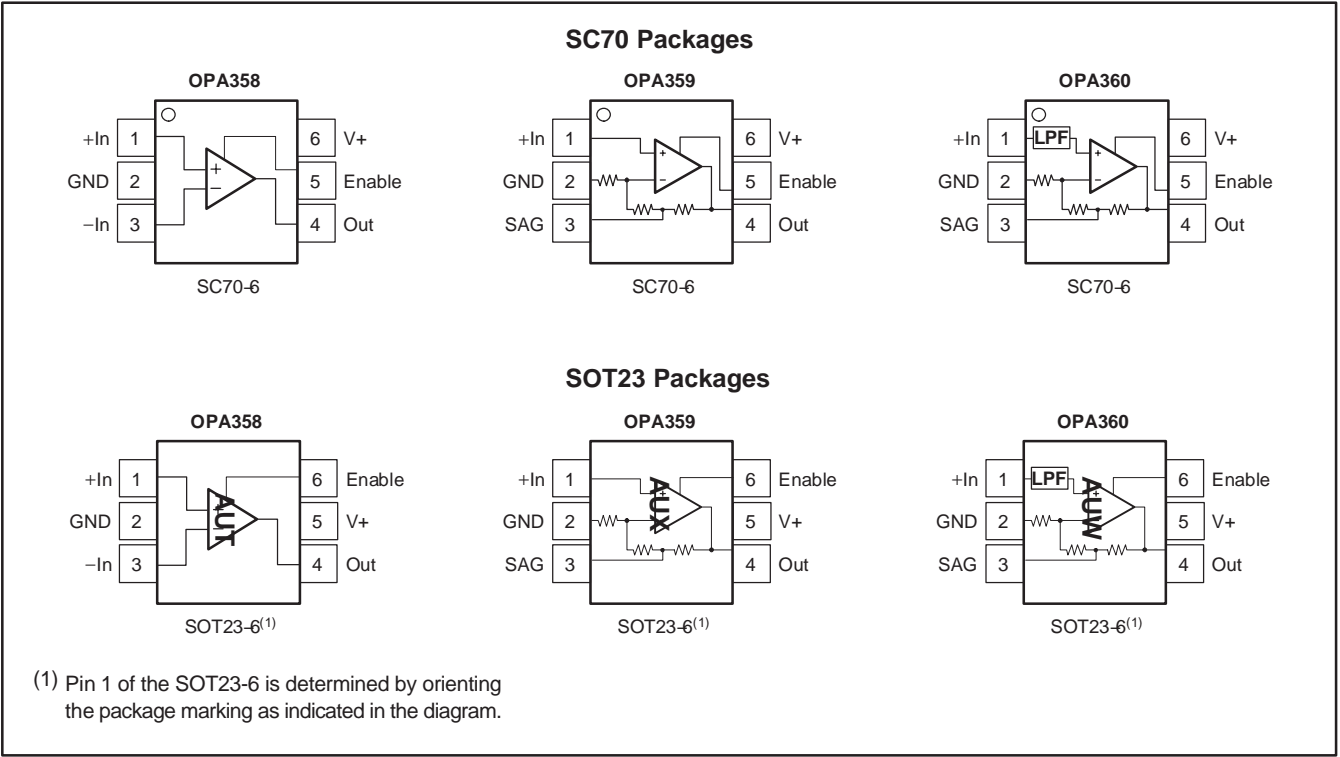
**Boldface** limits apply over the specified temperature range,  $T_A = -40^{\circ}C$  to  $+125^{\circ}C$ .

All specifications at  $T_A = +25^{\circ}C$ ,  $R_F = 150\Omega$ , and connected to  $V_S/2$ , unless otherwise noted.

PARAMETER	CONDITION	OPA358, OPA359, OPA360			UNIT
		MIN	TYP	MAX	
<b>ENABLE/SHUTDOWN FUNCTION</b>	V <sub>S</sub> = +3.3V, Disabled	2		0.8	V
Disabled (logic-low threshold) <sup>(1)</sup>					V
Enabled (logic-high threshold) <sup>(1)</sup>					
Enable Time			100	ns	
Disable Time			30	ns	
Shutdown Current (per amplifier)			3.4	5	μA
<b>TEMPERATURE RANGE</b>	θ <sub>JA</sub>	−40 −55 −65		+125 +150 +150	°C
Specified Range					°C
Operating Range					°C
Storage Range					°C
Thermal Resistance					
SC70		250	°C/W		
SOT23		200	°C/W		

<sup>(1)</sup> Logic low and high levels are CMOS-logic compatible.

## **PIN CONFIGURATIONS**



## PACKAGING INFORMATION

ORDERABLE DEVICE	STATUS(1)	PACKAGE TYPE	PACKAGE DRAWING	PINS	PACKAGE QTY
OPA358AID	PREVIEW	SOIC	D	8	
OPA358AIDBVR	PREVIEW	SOP	DBV	6	
OPA358AIDBVT	PREVIEW	SOP	DBV	6	
OPA358AIDCKR	PREVIEW	SOP	DCK	6	
OPA358AIDCKT	PREVIEW	SOP	DCK	6	
OPA358AIDR	PREVIEW	SOIC	D	8	
OPA359AIDBVR	PREVIEW	SOP	DBV	6	
OPA359AIDBVT	PREVIEW	SOP	DBV	6	
OPA359AIDCKR	PREVIEW	SOP	DCK	6	
OPA359AIDCKT	PREVIEW	SOP	DCK	6	
OPA360AIDBVR	PREVIEW	SOP	DBV	6	
OPA360AIDBVT	PREVIEW	SOP	DBV	6	
OPA360AIDCKR	PREVIEW	SOP	DCK	6	
OPA360AIDCKT	PREVIEW	SOP	DCK	6	

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

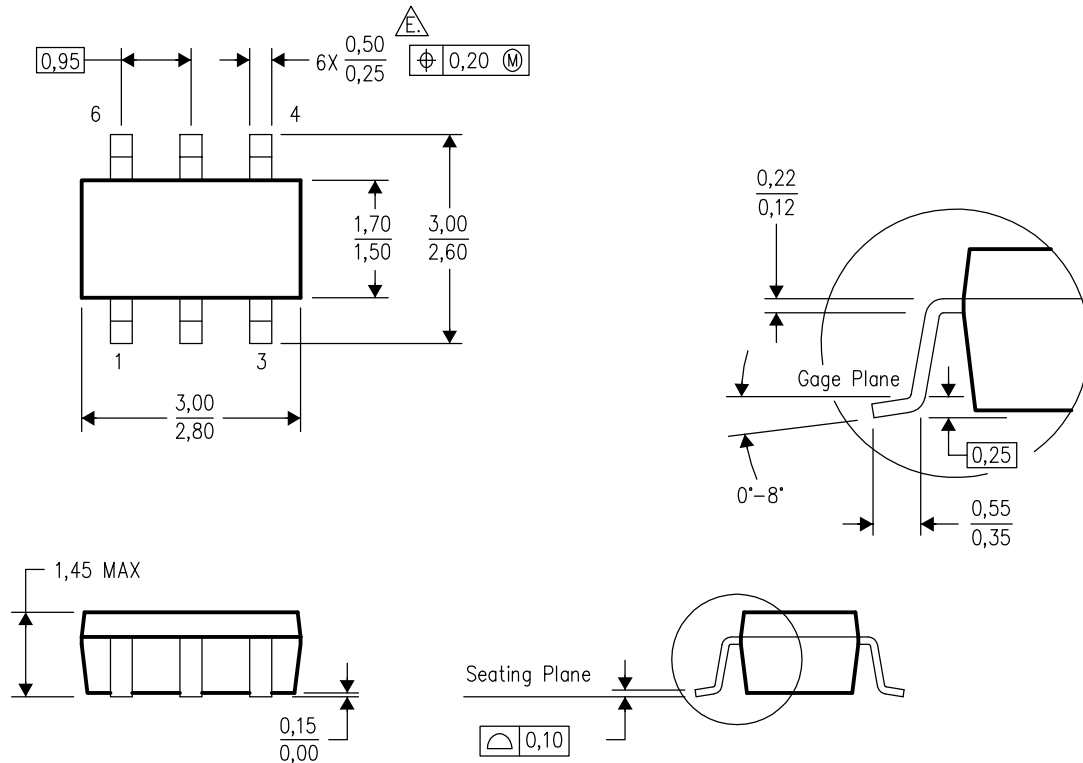
**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.


**OBSOLETE:** TI has discontinued the production of the device.

## DBV (R-PDSO-G6)

## PLASTIC SMALL-OUTLINE PACKAGE

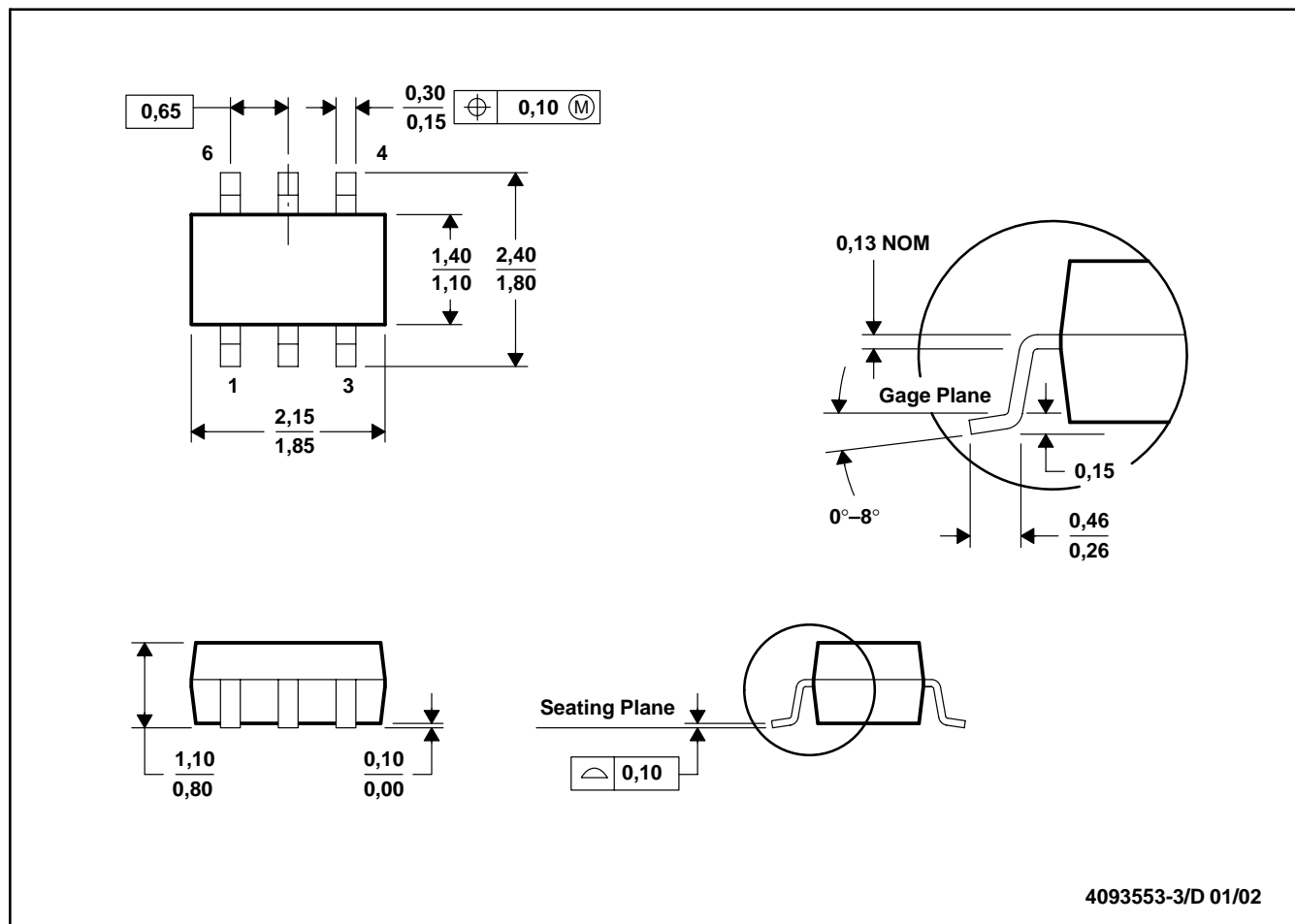


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- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion.
  - D. Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.
  -  Falls within JEDEC MO-178 Variation AB, except minimum lead width.

## DCK (R-PDSO-G6)

## PLASTIC SMALL-OUTLINE PACKAGE

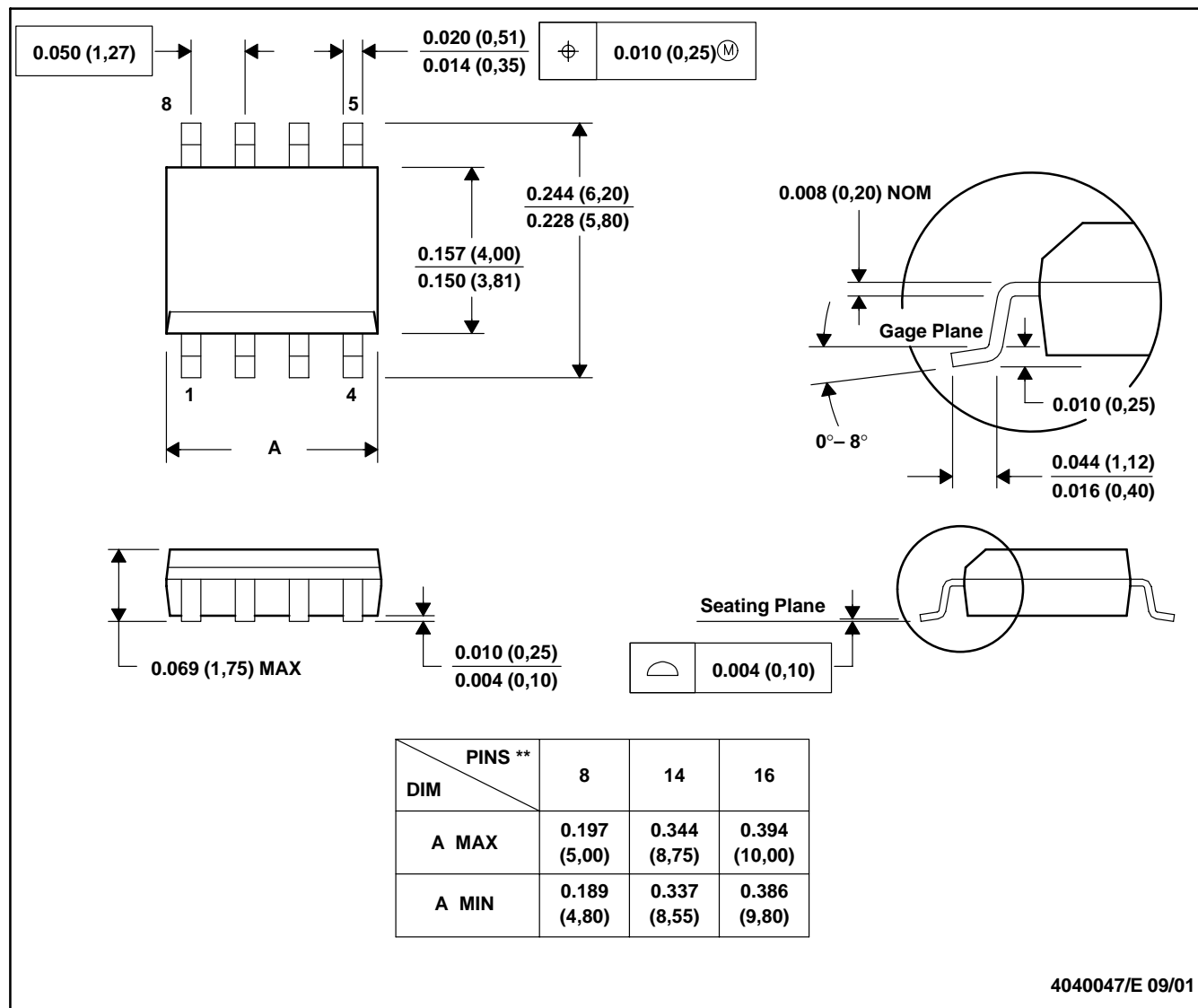


- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Body dimensions do not include mold flash or protrusion.
  - Falls within JEDEC MO-203

## 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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