Precision MicroPower Rail to Rail Input/Output Low Noise CMOS Operational Amplifier

Preliminary Technical Data **AD8603, AD8607, AD8609**

FEATURES

Low Offset Voltage: 40µV typ
Low Input Bias Current: 1pA max
Single-Supply Operation: 1.8 to 5 Volts
Low Noise: 27 nV/√Hz
Micropower: 50 µA/Amp max.
No Phase Reversal
Unity Gain Stable

APPLICATIONS

Battery Powered Instrumentation
Multi-pole Filters
Capacitive and Inductive Sensors
Low power ASIC Input or Output Amplifier

GENERAL DESCRIPTION

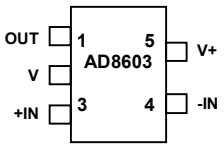
The AD8603, AD8607, AD8609 are single, dual and quad micro-power rail-to-rail input and output amplifiers featuring very low offset voltage, low input voltage and current noise. These amplifiers use a patented trimming technique that achieves superior precision without laser trimming. All are fully specified to operate from +1.8V to +5.0V single supply (or ±0.9 and ±2.5V Dual Supply). The combination of low offsets, low noise, very low input bias currents, and low power consumption make these amplifiers especially useful in portable and loop-powered instrumentation.

The ability to swing rail-to-rail at both the input and output enables designers to buffer CMOS ADCs, DACs, ASICs and other wide output swing devices in low power single supply systems.

The AD8603, single, is available in the tiny 5-lead TSOT-23 package. The AD8607, dual, is available in the 8-lead micro-SOIC and narrow SOIC surface mount packages. The AD8609, quad, is available in 14-lead TSSOP and narrow 14-pin SOIC packages. SOT, MSOP and TSSOP versions are available in tape and reel only.

PIN CONFIGURATIONS

5- Lead TSOT-23 (UJ Suffix)



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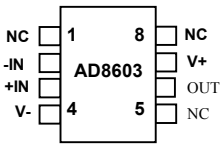
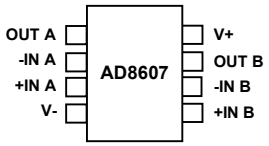
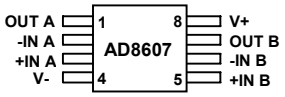


NC = NO CONNECT

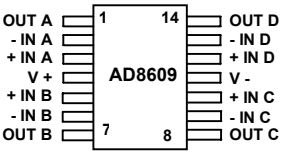
8- Lead SOIC (R Suffix)



8- Lead MSOP (RM Suffix)



14- Lead TSSOP



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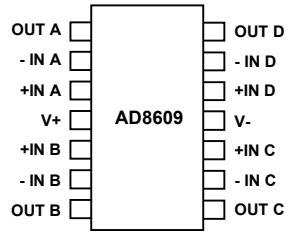

Rev. PrA

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REVISION HISTORY

Revision A: Initial Version

ELECTRICAL CHARACTERISTICS

(@ V_S = 1.8V (or ±0.9 Dual Supply), V_{CM} = Vs/2, T_A = +25°C, unless otherwise noted.)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	$0V \leq V_{CM} \leq 1.8V$		40	300	µV
		$-40° < T_A < +85°C$			700	µV
Input Bias Current	I_B			0.2	1	pA
		$-40° < T_A < +85°C$			100	pA
Input Offset Current	I_{OS}			0.1	0.5	pA
		$-40° < T_A < +85°C$			50	pA
Input Voltage Range	IVR		-0.2		1.9	V
Common-Mode Rejection Ratio	CMRR	$0V \leq V_{CM} \leq 1.8V$	80	98		dB
Large Signal Voltage Gain	A_{VO}	R_L = 10 kΩ , $0.5 \leq Vo \leq 1.3V$	50	500		V/mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	$-40° < T_A < +85°C$		1	4.5	µV/°C
Input Capacitance	Cin			TBD		pF
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	I_L = 1mA	1.65	1.72		V
		-40°C to +85°C	1.6			
Output Voltage Low	V_{OL}	I_L = 1mA		38	60	mV
		-40°C to +85°C			80	mV
Output Current	I_{OUT}	$0.5 \leq Vo \leq 1.3V$		TBD		mA
Closed Loop Output Impedance	Z_{OUT}	F = 10Khz, Av =1		16		Ω
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	$1.8V \leq V_S \leq 5V$	80	100		dB
Supply Current/Amplifier	I_{SY}	V_O = 0 V		40	50	µA
		$-40° < T_A < +85°C$			60	µA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 10 kΩ		0.1		V/µs
Gain Bandwidth Product	GBP	R_L = 50 kΩ, C_L = 100pF		360		Khz
Phase Margin	∅o	R_L = 50 kΩ, C_L = 100pF		55		degrees
NOISE PERFORMANCE						
Voltage Noise Density	e_n	F = 1 khz		27		nV/√Hz
Voltage Noise Density	e_n	F = 10 khz		22		nV/√Hz
Current Noise Density	i_n	F = 1 kHz		0.05		pA/√Hz

ELECTRICAL CHARACTERISTICS

(@ V_S = 5 V (or ±2.5 Dual Supply), V_{CM} = 0 V, T_A = +25°C, unless otherwise noted.)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	$0V \leq V_{CM} \leq 5V$		40	300	µV
		$-40° < T_A < +125°C$			750	µV
Input Bias Current	I_B			0.2	1	pA
		$-40° < T_A < +85°C$			100	pA
		$-40° < T_A < +125°C$			500	pA
Input Offset Current	I_{OS}			0.1	0.5	pA
		$-40° < T_A < +85°C$			50	pA
		$-40° < T_A < +125°C$			250	pA
Input Voltage Range	IVR		-0.2		5.2	V
Common-Mode Rejection Ratio	CMRR	$0V \leq V_{CM} \leq 5V$	85	100		dB
Large Signal Voltage Gain	A_{VO}	$R_L = 10\ k\Omega,\ 0.5V \leq V_0 \leq 4.5V$	130	500		V/mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	$-40° < T_A < +85°C$		1	4.5	µV/°C
Input Capacitance	Cin			TBD		pF
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	I_L = 1mA	4.95	4.97		V
		-40°C to +125°C	4.9			
		I_L = 10mA	4.65	4.97		V
		-40°C to +125°C	4.55			
Output Voltage Low	V_{OL}	I_L = 1mA		16	30	mV
		-40°C to +85°C			50	mV
		I_L = 10mA		160	250	mV
		-40°C to +125°C			300	mV
Output Current	I_{OUT}	$1V \leq Vo \leq 4V$		TBD		mA
Closed Loop Output Impedance	Z_{OUT}	f = 10Khz, Av =1		36		Ω
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	$1.8V \leq V_S \leq 5V$	80	100		dB
Supply Current/Amplifier	I_{SY}	V_O = 0 V		40	50	µA
		$-40° < T_A < +85°C$			60	µA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 10 kΩ		0.1		V/µs
Gain Bandwidth Product	GBP	R_L = 50 kΩ, C_L = 100pF		360		Khz
Phase Margin	∅o	R_L = 50 kΩ, C_L = 100pF		55		degrees
NOISE PERFORMANCE						
Voltage Noise Density	e_n	f = 1 khz		27		nV/√Hz
Voltage Noise Density	e_n	f = 10 khz		22		nV/√Hz
Current Noise Density	i_n	f = 1 kHz		0.05		pA/√Hz

ABSOLUTE MAXIMUM RATINGS

Parameter	Rating
Supply Voltage	6 V
Input Voltage	V_S– to V_S+
Differential Input Voltage	±6 V
Output Short-Circuit Duration	Observe Dearting Curve
Storage Temperature Range	
UJ, R, RM, RU Packages	-65°C to +150°C
Operating Temperature Range	
AD8603, AD8607, AD8609	-40°C to +125°C
Junction Temperature Range	
UJ, R, RM, RU Packages	-65°C to +150°C
Lead Temperature Range (Soldering, 60 Sec)	300°C

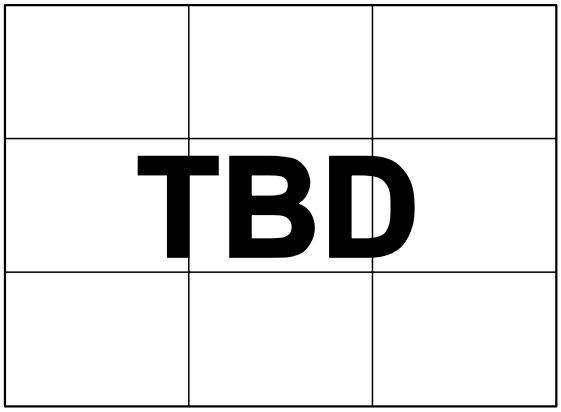
Package Type	θ_{JA}	θ_{JC}	Unit
5-Lead TSOT (UJ)	230	146	°C/W
8-Lead MSOP (RM)	190	44	°C/W
8-Lead SOIC (R)	158	43	°C/W
14-Pin SOIC (R)	120	36	°C/W
14-Pin TSSOP (RU)	180	35	°C/W

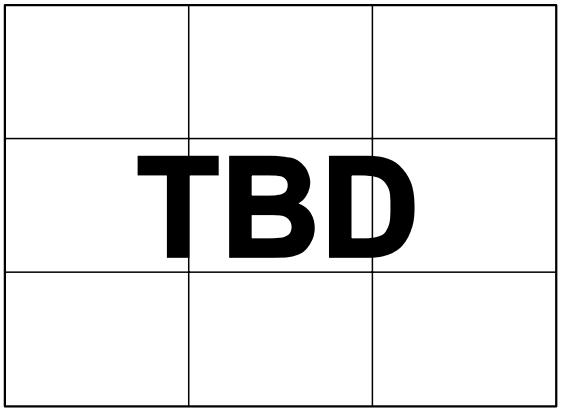
θ_{JA} is specified for the worst-case conditions, i.e., θ_{JA} is specified for device soldered in circuit board for surface-mount packages.

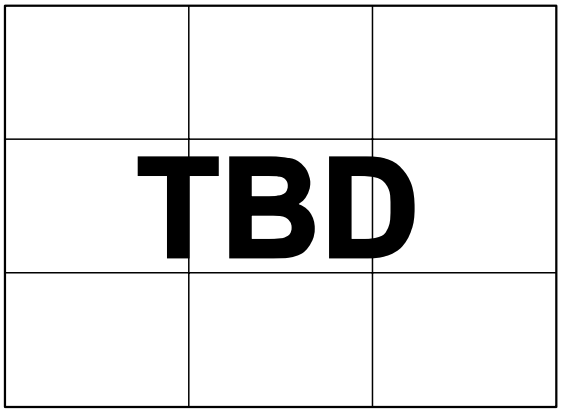
Absolute maximum ratings apply at 25°C, unless otherwise noted.

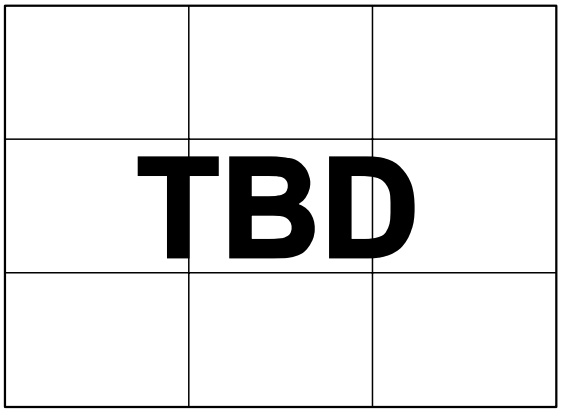
Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other condition s above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

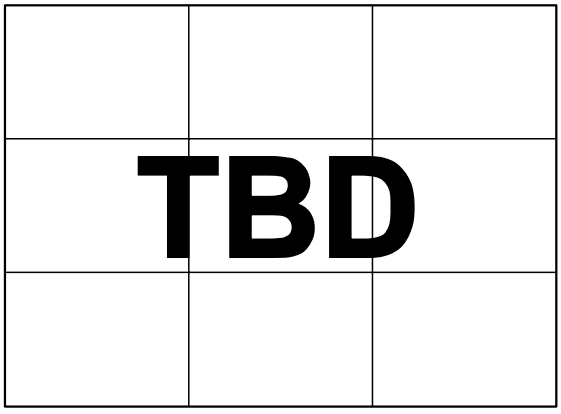
TYPICAL PERFORMANCE CHARACTERISTICS

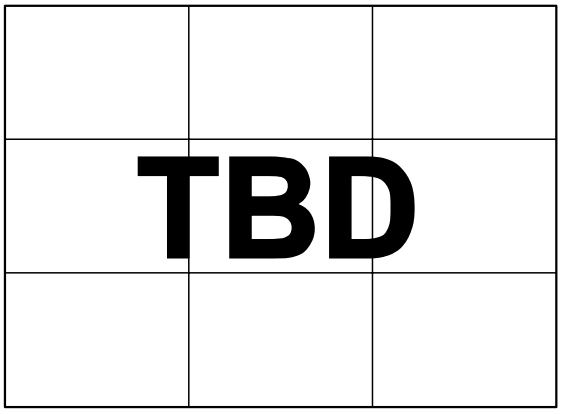


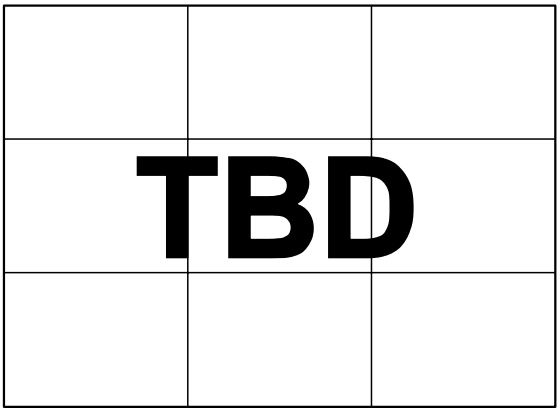








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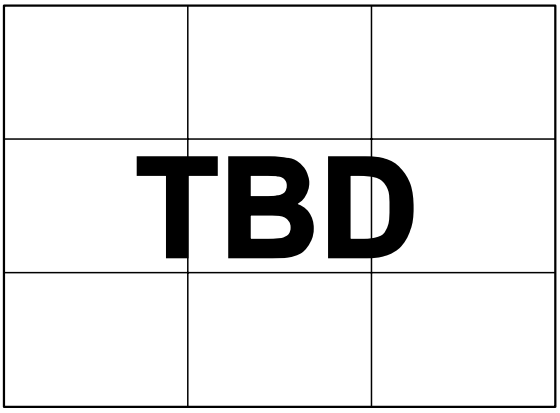
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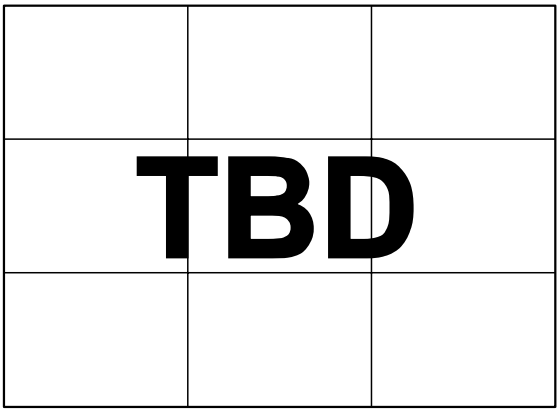
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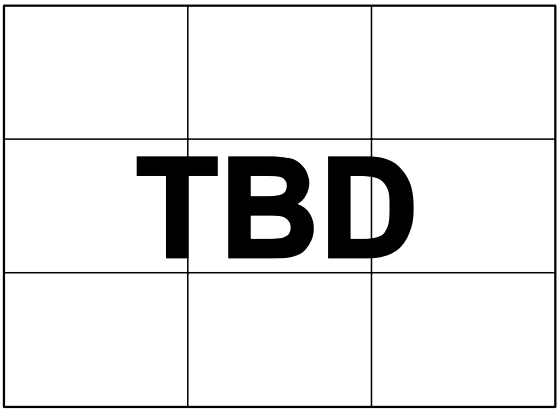
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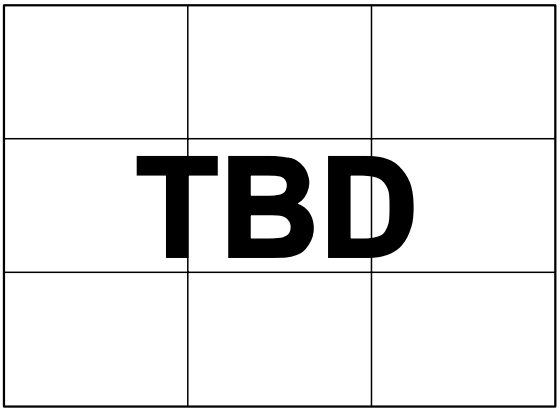
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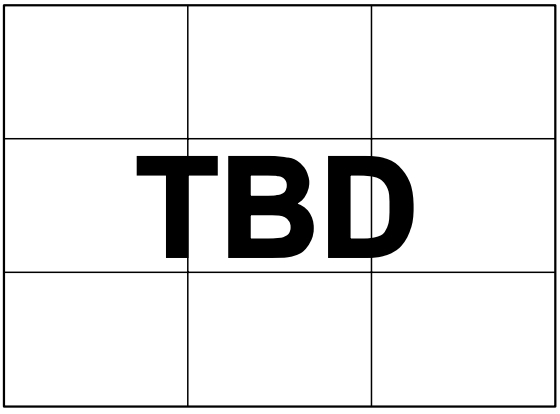
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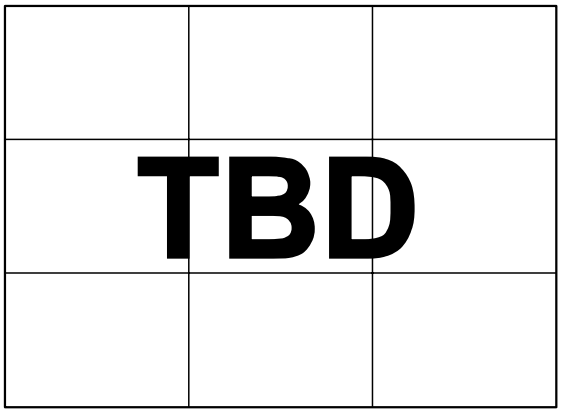
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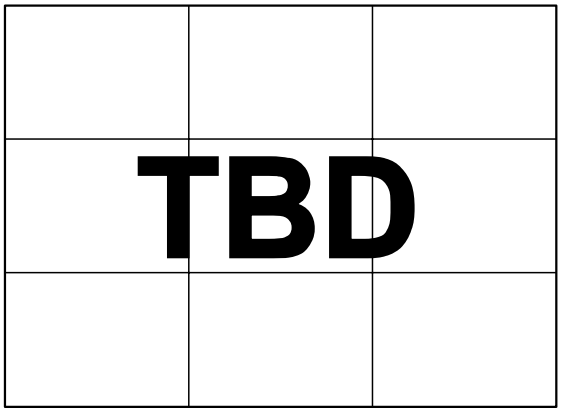
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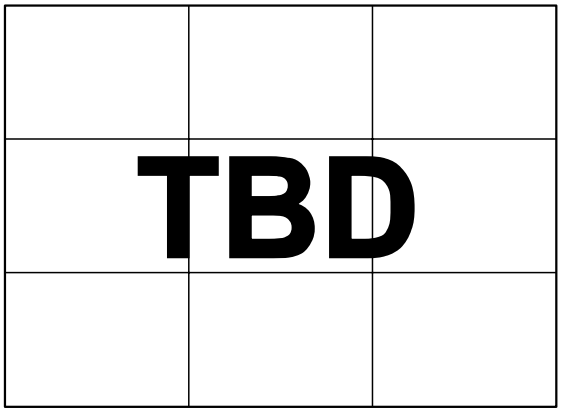
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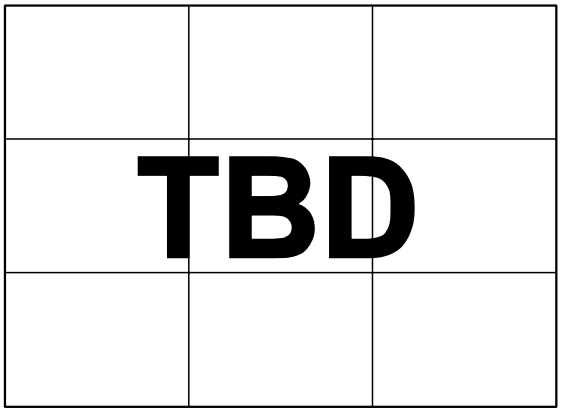
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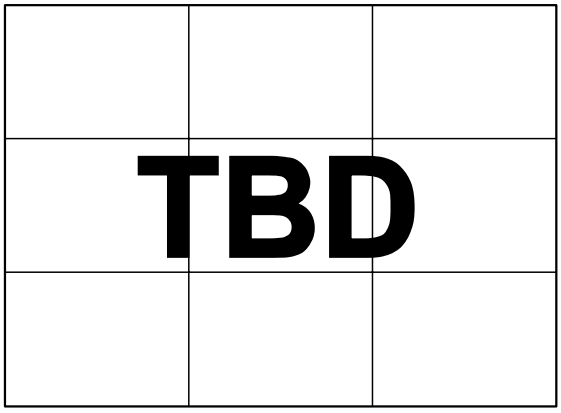
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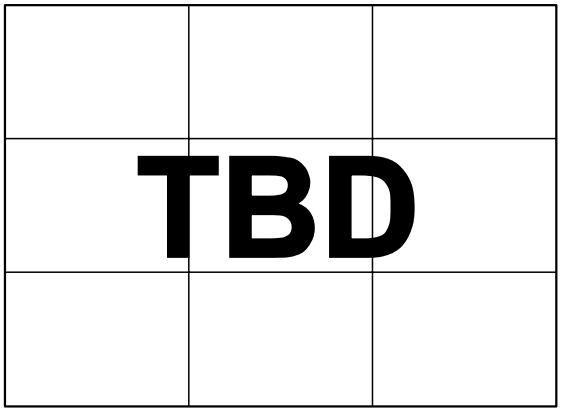
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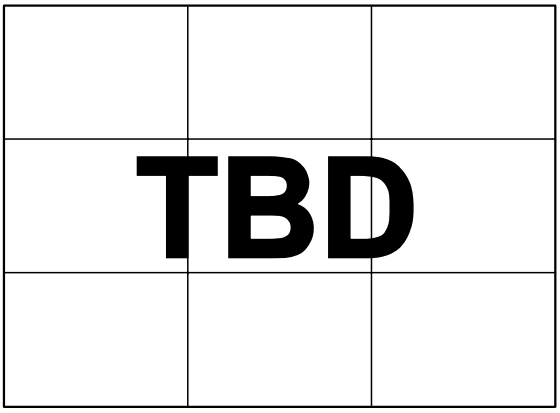
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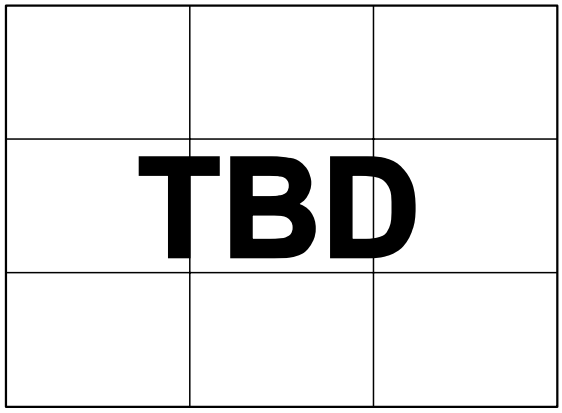
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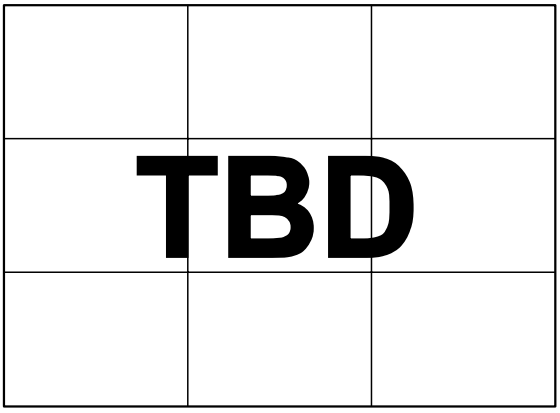
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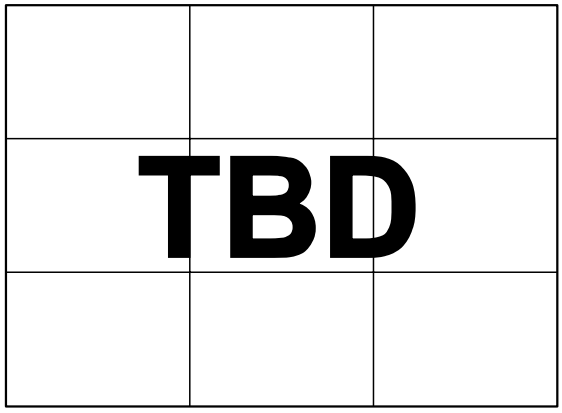
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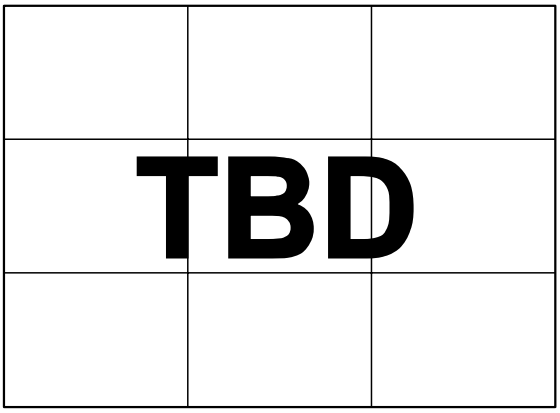
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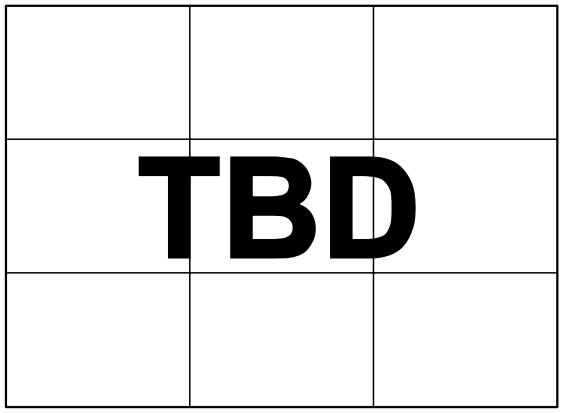
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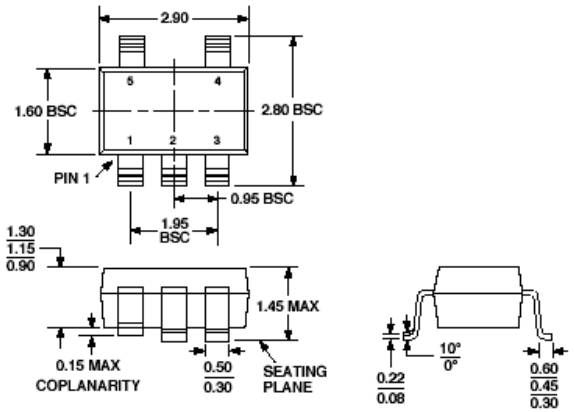
APPLICATIONS

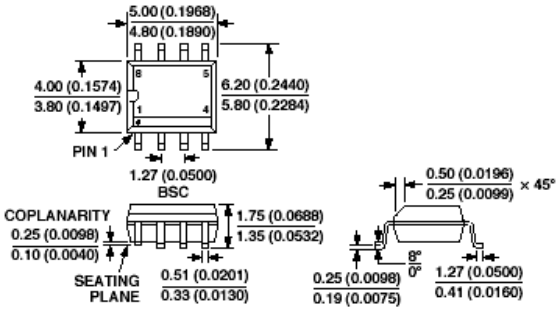
OUTLINE DIMENSIONS

5-Lead Plastic Surface-Mount Package [SOT-23]
(RT-5)
Dimensions shown in millimeters



COMPLIANT TO JEDEC STANDARDS MO-178AA

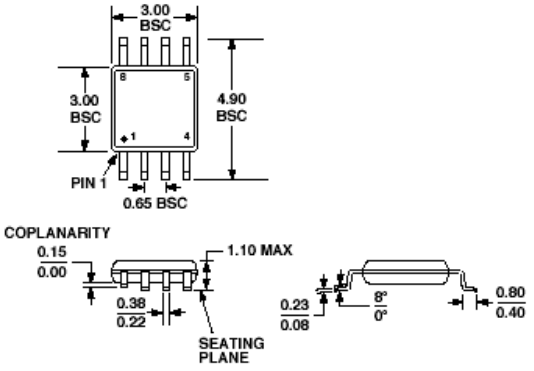
8-Lead Standard Small Outline Package [SOIC]
(R-8) Narrow Body
Dimensions shown in millimeters and (inches)



CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN

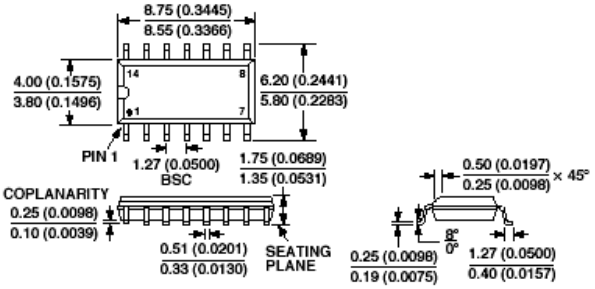
COMPLIANT TO JEDEC STANDARDS MS-012AA

8-Lead microSOIC Package [MSOP]
(RM-8)
Dimensions shown in millimeters



COMPLIANT TO JEDEC STANDARDS MO-187AA

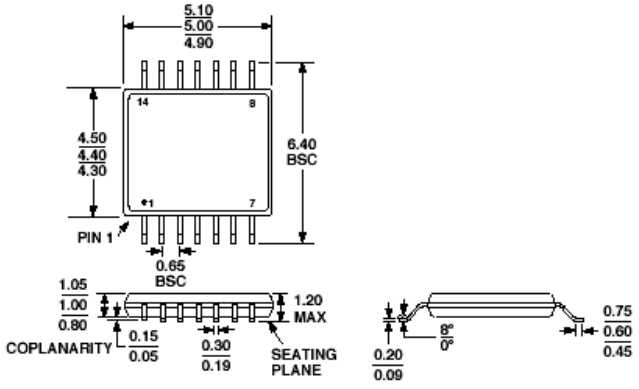
14-Lead Standard Small Outline Package [SOIC]
(R-14) Narrow Body
Dimensions shown in millimeters and (inches)



CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN

COMPLIANT TO JEDEC STANDARDS MS-012AB

14-Lead Thin Shrink Small Outline Package [TSSOP]
(RU-14)
Dimensions shown in millimeters



COMPLIANT TO JEDEC STANDARDS MO-153AB-1

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although this product features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option	Branding Info
AD8603AUJ	-40°C to 125°C	5-Pin TSOT	UJ-5	BFA
AD8607ARM	-40°C to +125°C	8-Pin MSOP	RM-8	A00
AD8607AR	-40°C to +125°C	8-Pin SOIC	R-8	
AD8609AR	-40°C to +125°C	14-Pin SOIC	R-14	
AD8609ARU	-40°C to +125°C	14-Pin TSSOP	RU-14	

C03726-0-04/03(0)

ANALOG DEVICES

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