1.Description

The AD8613/AD8617/AD8619 are single, dual, and quad micro-power, rail-to-rail input and output amplifiers that feature low supply current, as well as low input voltage and current noise. The parts are fully specified to operate from 1.8 V to 5 V single supply, or ±0.9 V and ±2.5 V dual supply. The combination of low noise, very low input bias currents, and low power consumption make the AD8613/AD8617/AD8619 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.

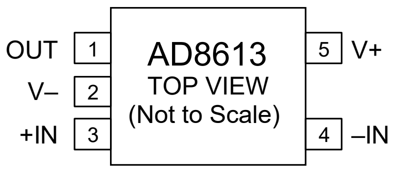
2.Features

- Offset voltage: 2.2 mV maximum
- Low input bias current: 1 pA maximum
- Single-supply operation: 1.8 V to 5.5 V
- Low noise: 22 nV/√Hz
- Micropower: 50 μA/amplifier maximum over temperature
- No phase reversal
- Unity gain stable
- Qualified for automotive applications

3.Applications

- Battery-powered instrumentation
- Multipole filters
- Current shunt sense
- Sensors
- ADC predrivers
- DAC drivers/level shifters
- Low power ASIC input or output amplifiers

4.Pinning Information



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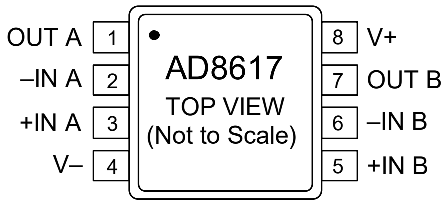
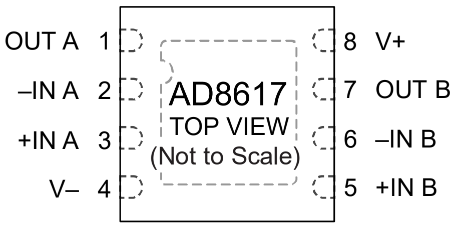


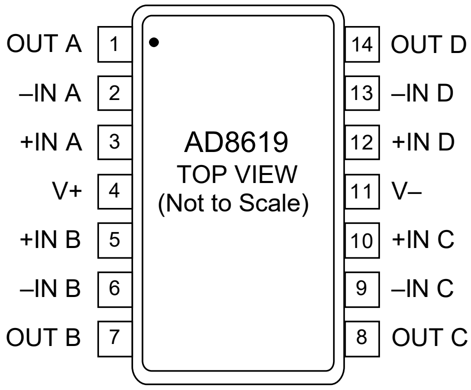
Figure 2. 8-Lead MSOP and 8-Lead SOIC_N

SOP-8



NOTES
1. PIN 4 AND THE EXPOSED PAD MUST BE CONNECTED TO V–.

SOP-8



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5.Absolute Maximum Ratings(T_A= 25°C)

Description		Rating
Supply Voltage		6 V
Input Voltage		VSS − 0.3 V to VDD + 0.3 V
Input Current Differential Input Voltage		±10 mA ±6 V
Output Short-Circuit Duration to GND		Indefinite
Storage Temperature Range		−65°C to +150°C
Operating Temperature Range		−40°C to +125°C
Junction Temperature Range		−65°C to +150°C
LeadTemperature (soldering, 60 sec)		300°C
ESD AD8613	HBM	±4000V
	FICDM	±1000V
ESD AD8617	HBM	±3000V
	FICDM	±1000V
	MM	±100V
ESD AD8619	HBM	±4000V
	FICDM	±1250V
	MM	±200V

T_A=25°C, unless otherwise noted

6.1Electrical Characteristics

V_{SY}=5 V, V_{CM}=V_{SY}/2, T_A=25°C, unless otherwise noted

Parameter	Symbol	Conditions	Min	Typ	Max	Units
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	−0.3V<V_{CM}<+5.3 V		0.4	2.2	mV
		−40°C<T_A<125°C, −0.3V<V_{CM}<5.2 V			2.2	
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	−40°C<T_A<125°C		1	4.5	μV/°C
AD8613				2.5	7	
Input Bias Current	I_B			0.2	1	pA
		−40°C<T_A<85°C			110	pA
		−40°C<T_A<125°C			780	pA
Input Offset Current	I_{OS}			0.1	0.5	pA
		−40°C<T_A<85°C			50	pA
		−40°C<T_A<125°C			250	pA
Input Voltage Range	IVR		0		5	V
Common-Mode Rejection Ratio	CMRR	0<V_{CM}<5V		95		dB
		−40°C<T_A<125°C	68			
Large Signal Voltage Gain	A_{VO}	R_L=10kΩ, 0.5V<V_O<4.5V	235	500		V/mV
Input Capacitance	C_{DIFF}			1.9		pF
	C_{CM}			2.5		
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	I_L=1mA	4.95	4.98		V
		−40°C to 125°C	4.9			
		I_L=10mA		4.7		
		−40°C to 125°C	4.5			
Output Voltage Low	V_{OL}	I_L=1mA		20	30	mV
		−40°C to 125°C			50	
		I_L=10mA		190	275	
		−40°C to 125°C			335	

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Short-Circuit Current	I_{SC}			±80		mA
Closed-Loop Output Impedance	Z_{OUT}	f=10kHz, A_V=1		15		Ω
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	1.8V<V_{SY}<5V	67	94		dB
		−40°C<T_A<+125°C	64			dB
Supply Current/Amplifier	I_{SY}	V_O=V_{SY}/2		38		μA
		−40°C<T_A<+125°C			50	μA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L=10kΩ		0.1		V/μs
Settling Time to 0.1%	t_s	G=±1, V_{IN}=2V step, C_L=20pF, R_L=1kΩ		23		μs
Gain Bandwidth Product	GBP	R_L=100kΩ		400		kHz
		R_L=10kΩ		350		kHz
Phase Margin	$Ø_M$	R_L=10kΩ, R_L=100kΩ, C_L=20pF		70		Degrees
NOISE PERFORMANCE						
Peak-to-Peak Noise	e_np-p	0.1Hz to 10Hz		2.3	3.5	μV
Voltage Noise Density	e_n	f=1kHz		25		nV/√Hz
		f=10kHz		22		nV/√Hz
Current Noise Density	i_n	f=1kHz		0.05		pA/√Hz

6.2Electrical Characteristics

V_{SY}=1.8V, V_{CM}=V_{SY}/2, T_A=25°C, unless otherwise noted

Parameter	Symbol	Conditions	Min	Typ	Max	Units
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	−0.3V<V_{CM}<1.9V		0.4	2.2	mV
		−40°C<T_A<125°C, −0.3V<V_{CM}<1.8V			2.2	
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	−40°C<T_A<125°C		1	8.5	μV/°C
AD8613				3.7	9	
Input Bias Current	I_B			0.2	1	pA
		−40°C<T_A<85°C			110	pA
		−40°C<T_A<125°C			780	pA
Input Offset Current	I_{OS}			0.1	0.5	pA
		−40°C<T_A<85°C			50	pA
		−40°C<T_A<125°C			250	pA
Input Voltage Range	IVR		0		1.8	V
Common-Mode Rejection Ratio	CMRR	0<V_{CM}<1.8V	58	86		dB
		−40°C<T_A<125°C	55			
Large Signal Voltage Gain	A_{VO}	R_L=10kΩ, 0.5V<V_O<1.3V	85	1000		V/mV
Input Capacitance	C_{DIFF}			2.1		pF
	C_{CM}			3.8		
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	I_L=1mA	1.65	1.73		V
		−40°C to 125°C	1.6			
Output Voltage Low	V_{OL}	I_L=10mA		44	60	
		−40°C to 125°C			80	

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Short-Circuit Current	I_{SC}			±7		mA
Closed-Loop Output Impedance	Z_{OUT}	f=10kHz, A_V=1		15		Ω
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	1.8V<V_{SY}<5V	67	94		dB
Supply Current/Amplifier	I_{SY}	V_O=V_{SY}/2		38		μA
		−40°C<T_A<+125°C			50	μA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L=10kΩ		0.1		V/μs
Settling Time to 0.1%	t_s	G=±1, V_{IN}=1V step, C_L=20pF, R_L=1kΩ		6.5		μs
Gain Bandwidth Product	GBP	R_L=100kΩ		400		kHz
		R_L=10kΩ		350		kHz
Phase Margin	$Ø_M$	R_L=10kΩ, R_L=100kΩ, C_L=20pF		70		Degrees
NOISE PERFORMANCE						
Peak-to-Peak Noise	e_np-p	0.1Hz to 10Hz		2.3	3.5	μV
Voltage Noise Density	e_n	f=1kHz		25		nV/√Hz
		f=10kHz		22		nV/√Hz
Current Noise Density	i_n	f=1kHz		0.05		pA/√Hz

7.1Typical Characteristic

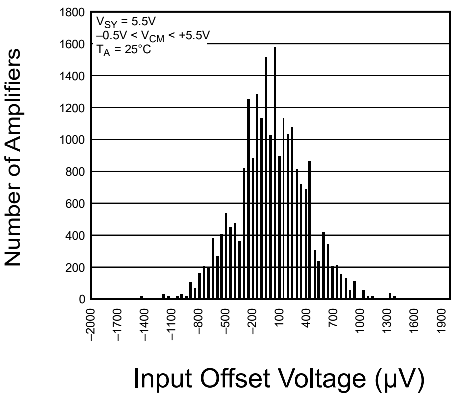


Figure 1: Input Offset Voltage Distribution

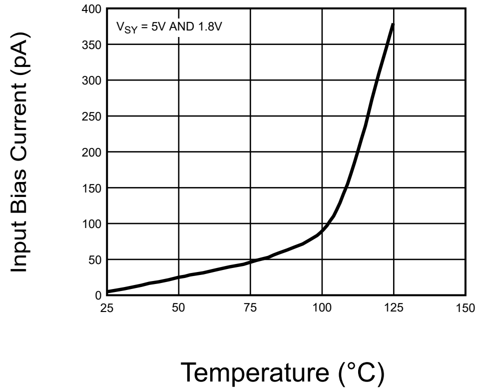


Figure 2: Input Bias Current vs. Temperature

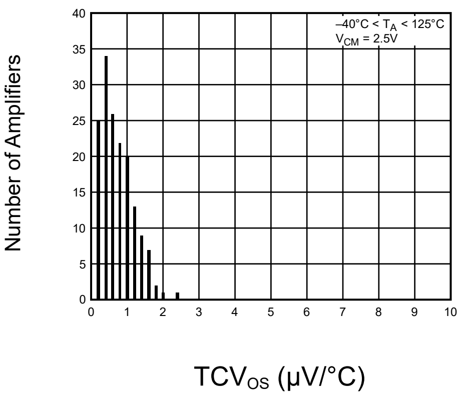


Figure 3: Input Offset Voltage Drift Distribution

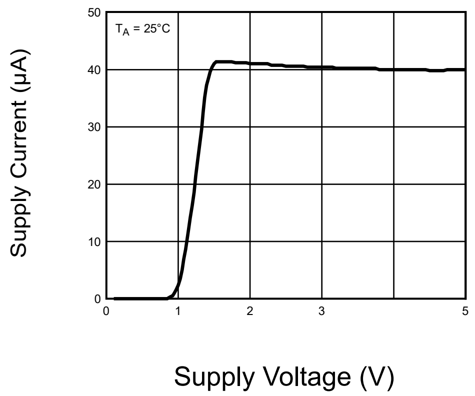


Figure 4: Supply Current vs. Supply Voltage

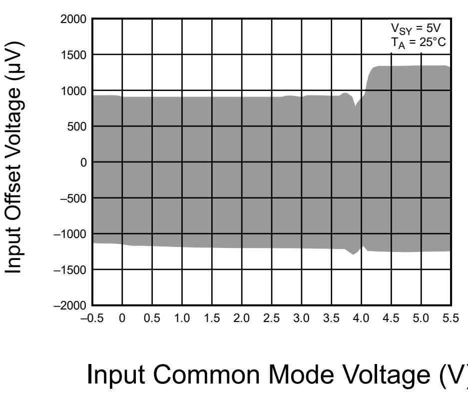


Figure 5: Input Offset Voltage vs. Input Common-Mode Voltage

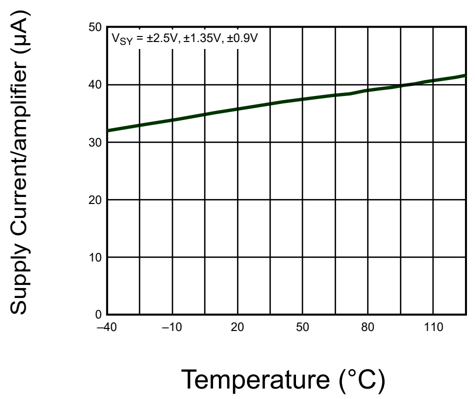


Figure 6: Supply Current vs. Temperature

7.2Typical Characteristic

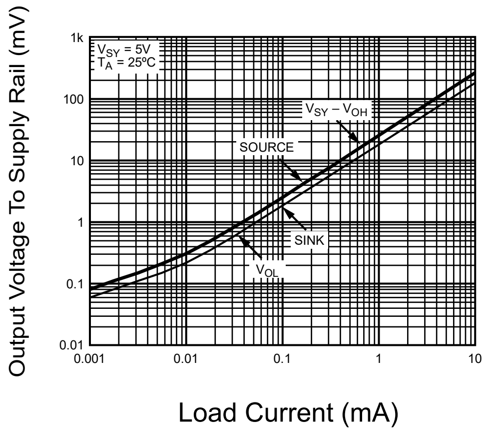


Figure 7: Output Voltage to Supply Rail vs. Load Current

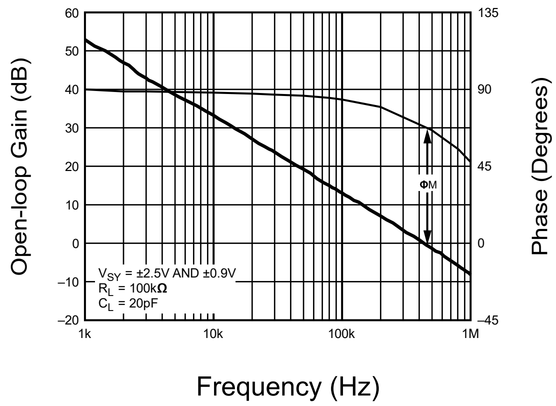


Figure 8: Open-Loop Gain and Phase vs. Frequency

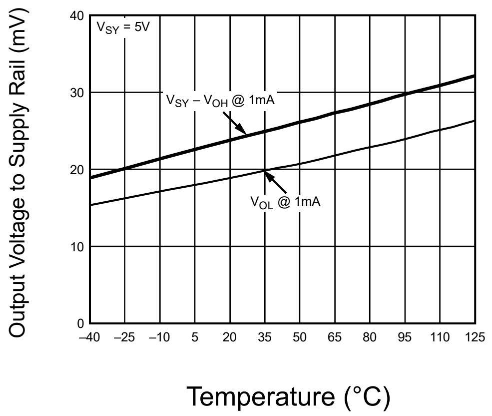


Figure 9: Output Voltage to Supply Rail vs. Temperature (I_L = 1 mA)

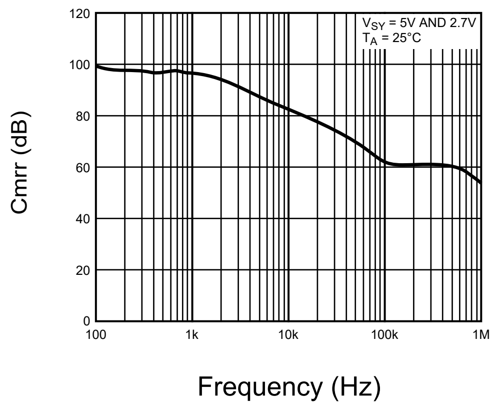


Figure 10: CMRR vs. Frequency

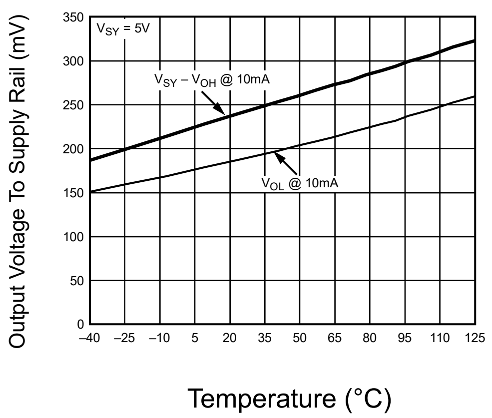


Figure 11: Output Voltage to Supply Rail vs. Temperature (I_L = 10 mA)

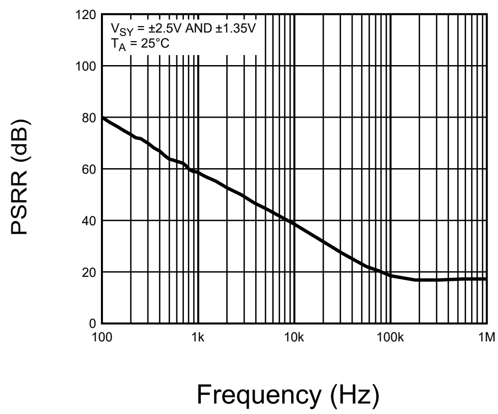


Figure 12: PSRR vs. Frequency

7.3Typical Characteristic

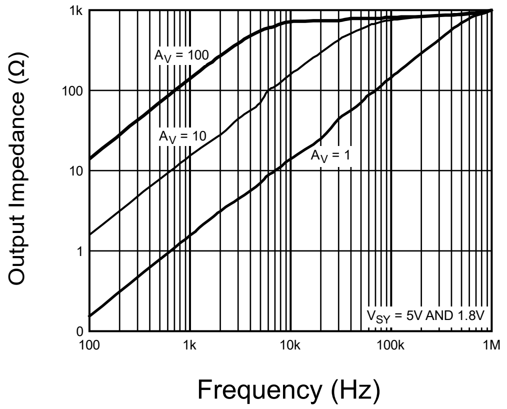


Figure 13: Output Impedance vs. Frequency

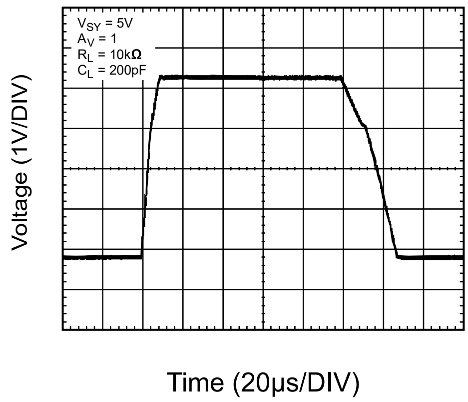


Figure 14: Large Signal Transient Response

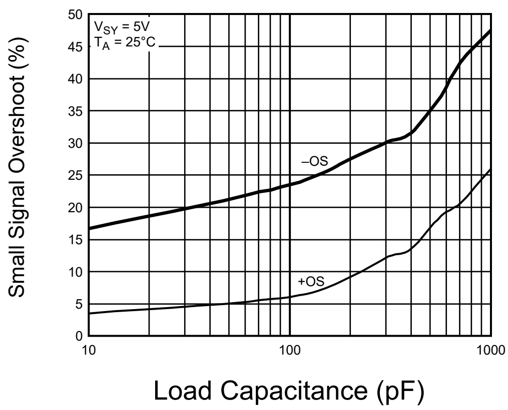


Figure 15: Small Signal Overshoot vs. Load Capacitance

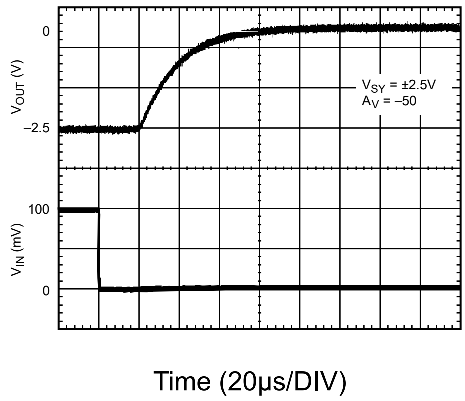


Figure 16: Positive Overload Recovery

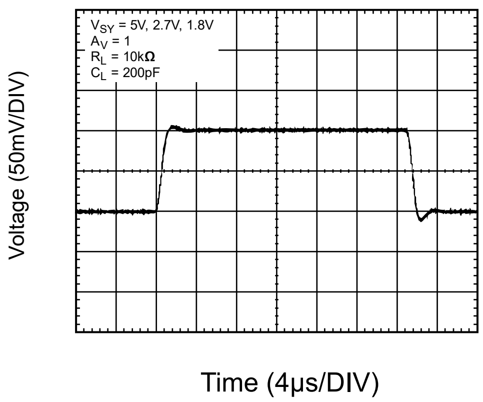


Figure 17: Small Signal Transient Response

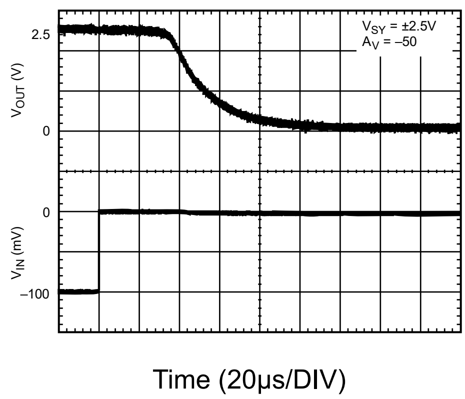


Figure 18: Negative Overload Recovery

7.4Typical Characteristic

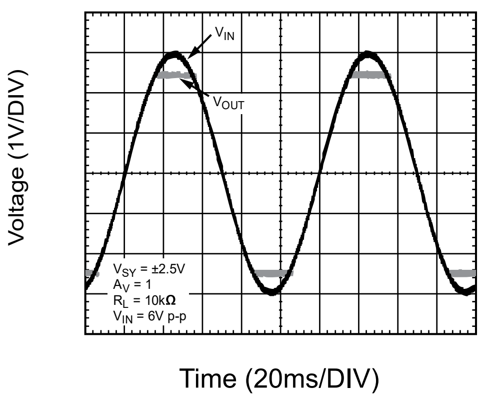


Figure 19: No Phase Reversal

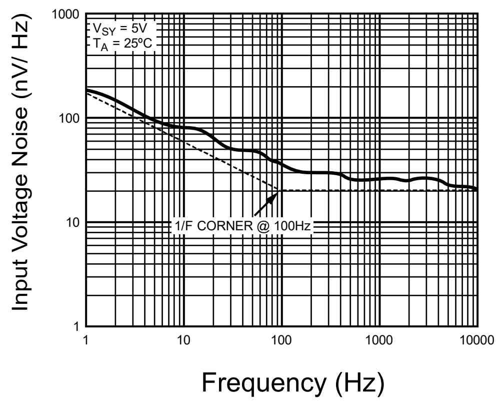


Figure 20: Voltage Noise Density

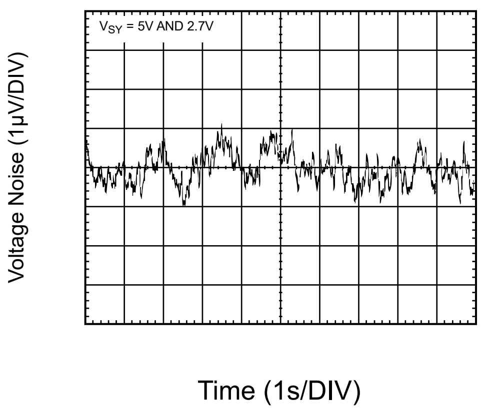


Figure 21: 0.1 Hz to 10 Hz Input Voltage Noise

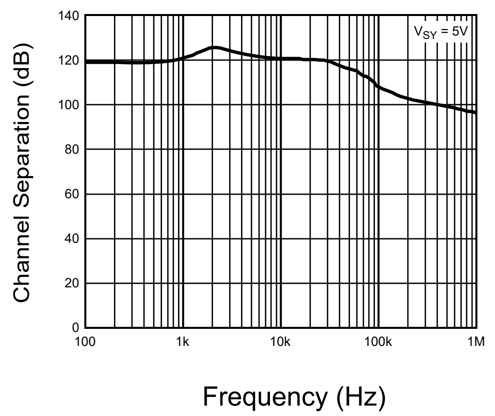


Figure 22: Channel Separation

7.5Typical Characteristic

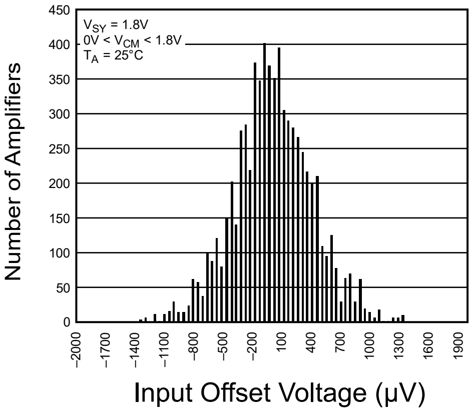


Figure 23: Input Offset Voltage Distribution

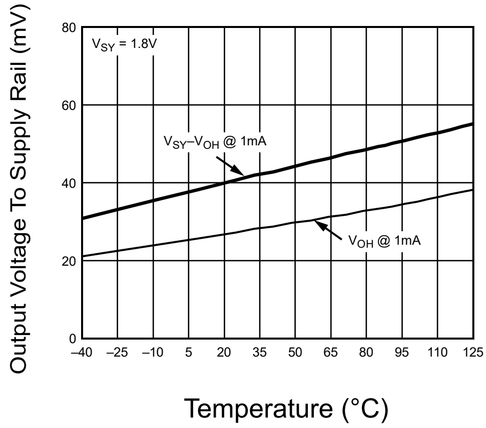


Figure 24: Output Voltage to Supply Rail vs. Temperature (I_L = 1 mA)

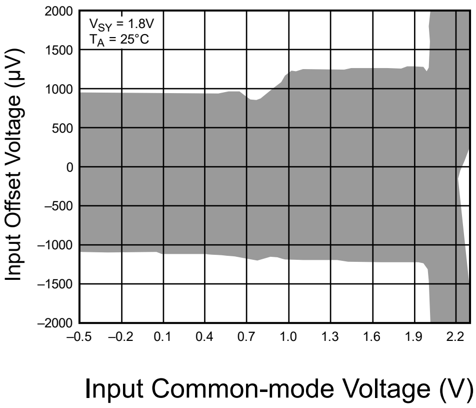


Figure 25: Input Offset Voltage vs. Input Common-Mode Voltage

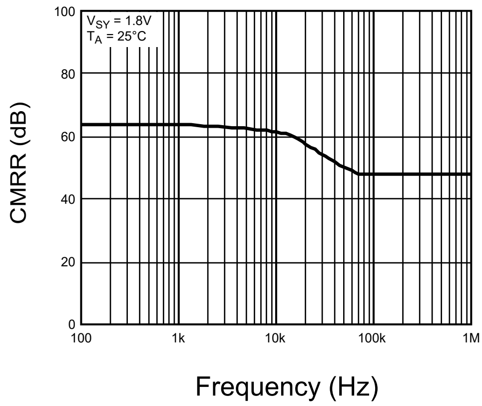


Figure 26: CMRR vs. Frequency

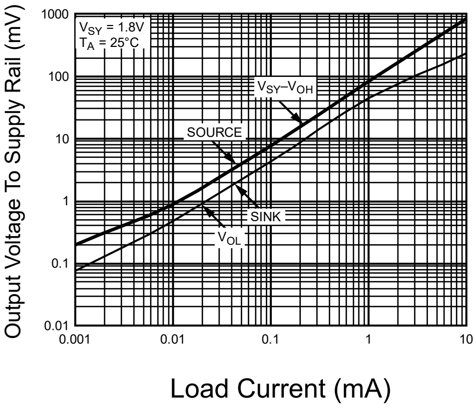


Figure 27: Output Voltage to Supply Rail vs. Load Current

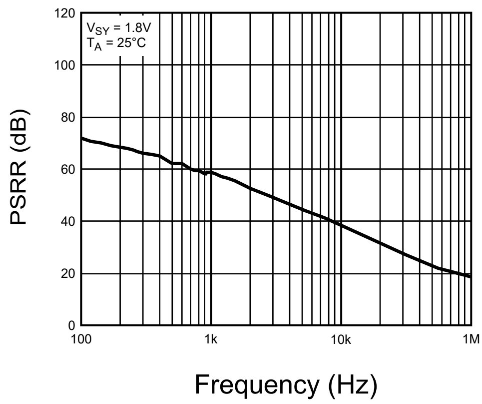


Figure 28: PSRR vs. Frequency

7.6Typical Characteristic

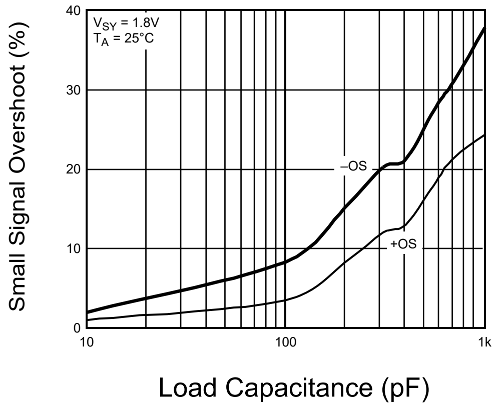


Figure 29: Small Signal Overshoot vs. Load Capacitance

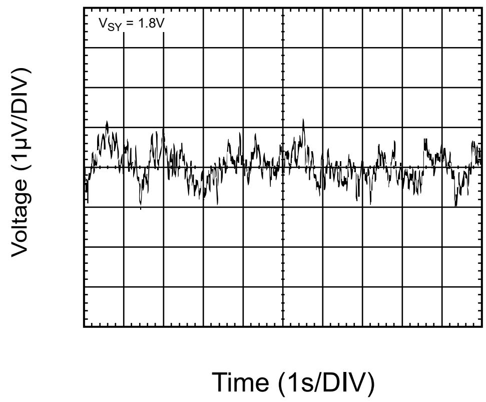


Figure 30: 0.1 Hz to 10 Hz Input Voltage Noise

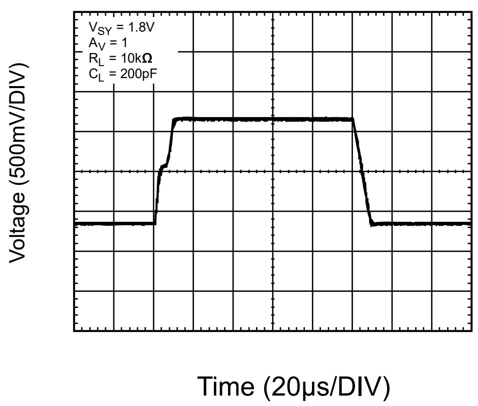


Figure 31: Large Signal Transient Response

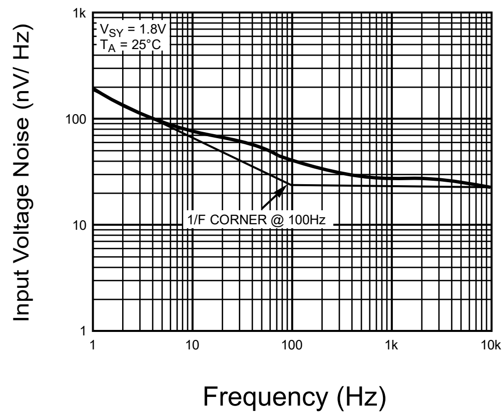
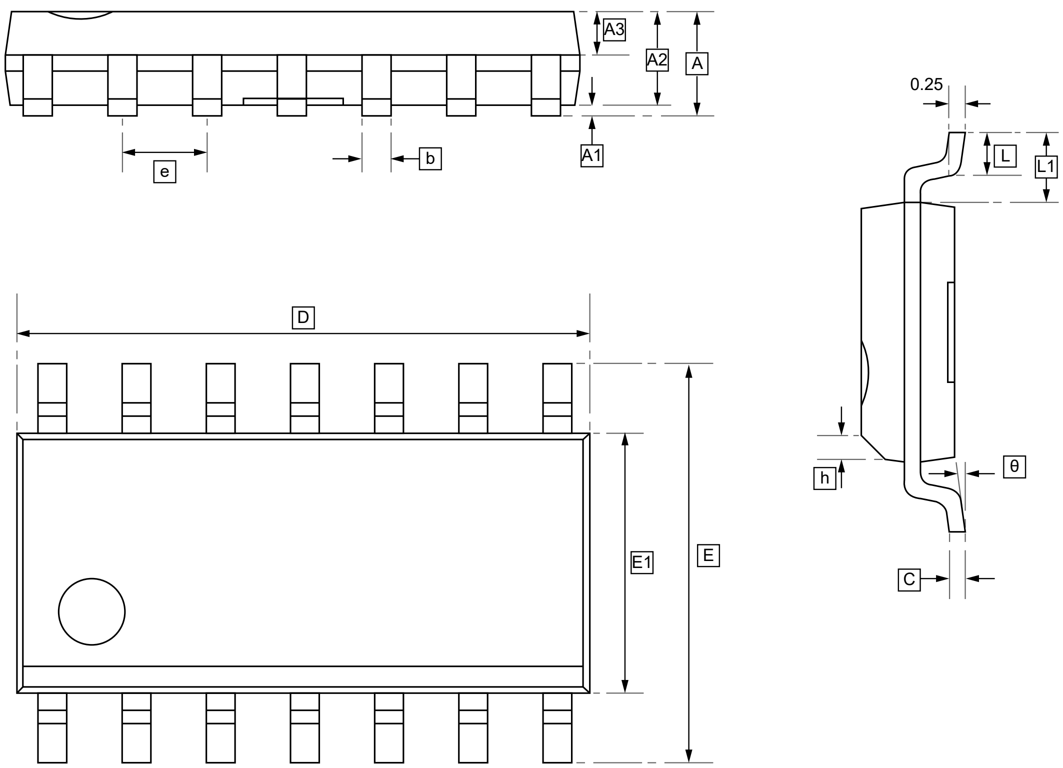


Figure 32: Voltage Noise Density

8.1SOP-14 Package Outline Dimensions

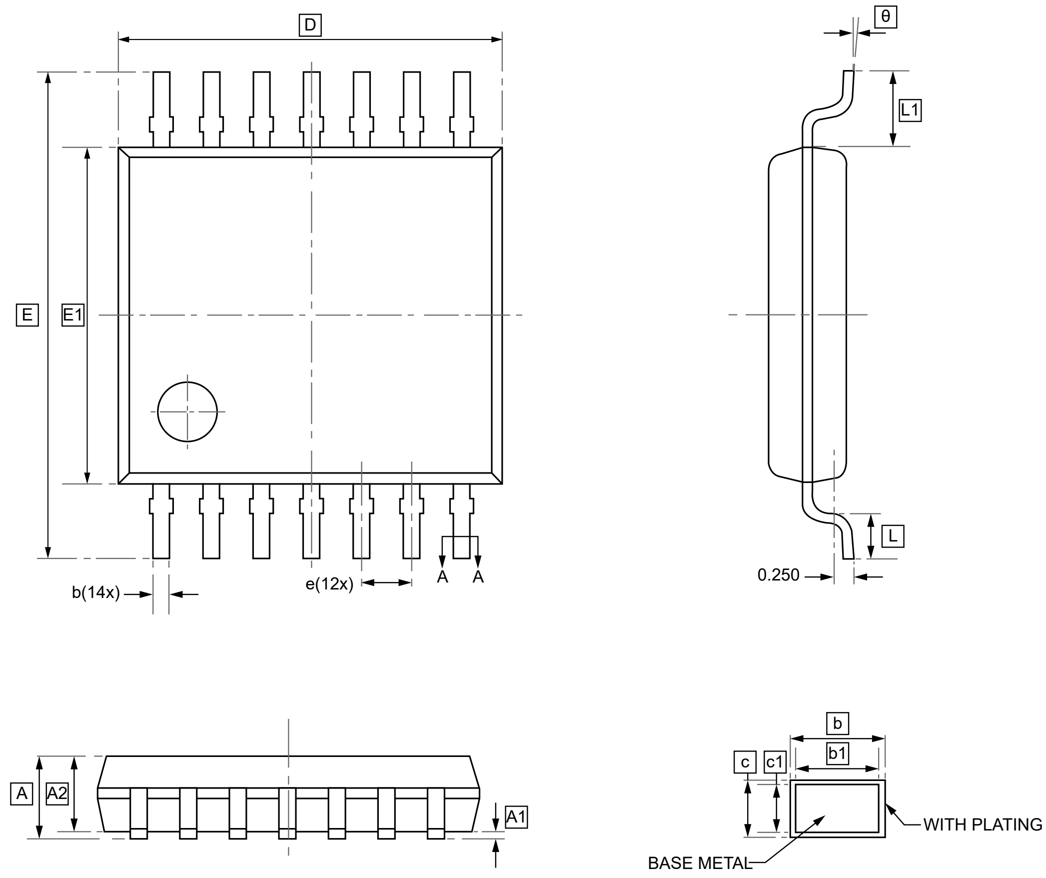


DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	A2	A3	b	C	D	E	E1	e	h	L
Min	-	0.05	1.35	0.65	0.203	0.17	8.45	5.80	3.80	1.24	0.25	0.40
Max	1.75	0.25	1.55	0.75	0.305	0.25	8.85	6.20	4.00	1.30	0.50	0.80

Symbol	L1	θ
Min	1.00	0°
Max	1.10	8°

8.2TSSOP-14 Package Outline Dimensions

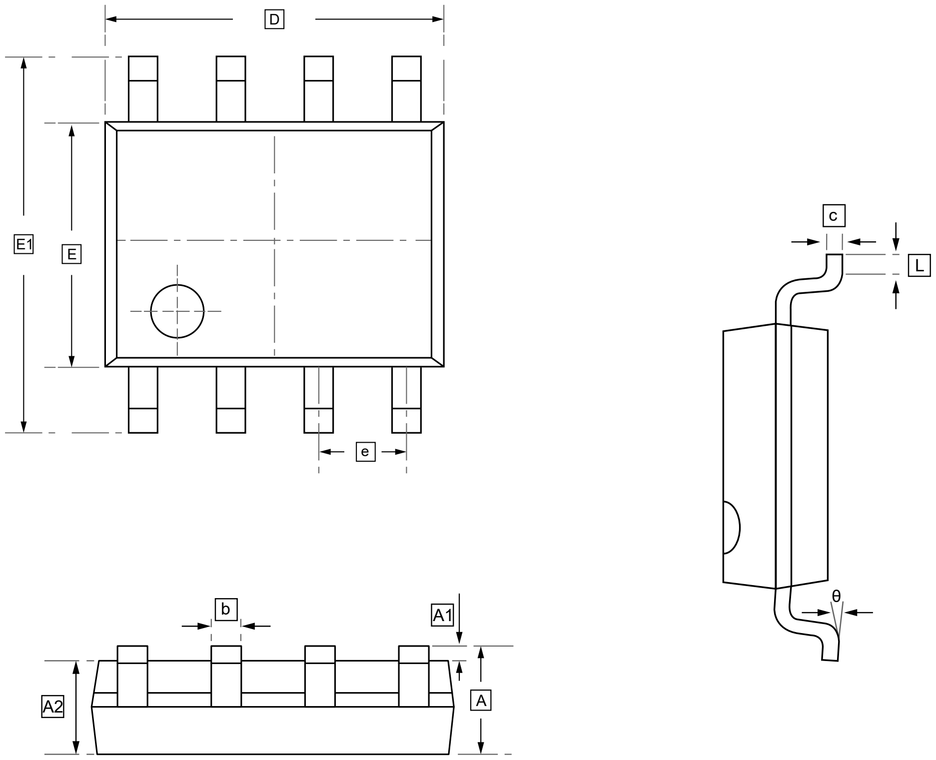


DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	A2	b	b1	c	c1	D	E	E1	e	L1
Min	-	0.05	0.90	0.20	0.19	0.13	0.120	4.90	6.20	4.30	0.65	0.85
Max	1.20	0.15	1.05	0.28	0.25	0.17	0.14	5.10	6.60	4.50	BSC	1.15

Symbol	L	θ
Min	0.45	0°
Max	0.75	8°

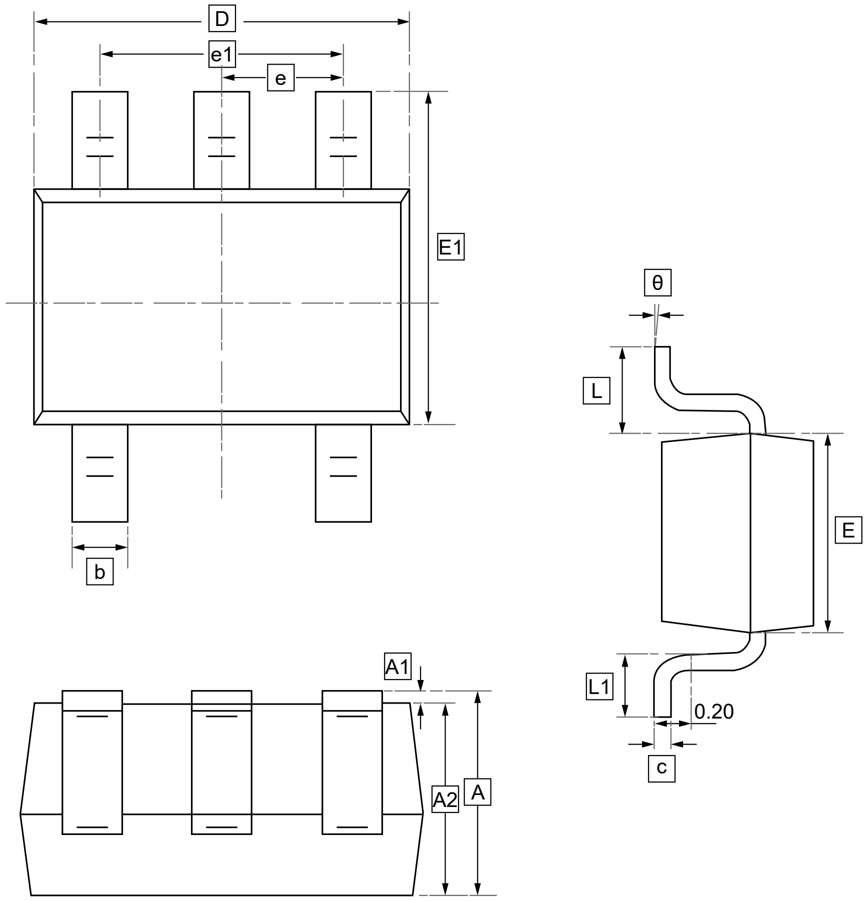
8.3SOP-8 Package Outline Dimensions



DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	A2	b	c	D	E	E1	e	L	θ
Min	1.350	0.000	1.350	0.330	0.170	4.700	3.800	5.800	1.270	0.400	0°
Max	1.750	0.100	1.550	0.510	0.250	5.100	4.000	6.200	BSC	1.270	8°

8.4SC70-5 Package Outline Dimensions



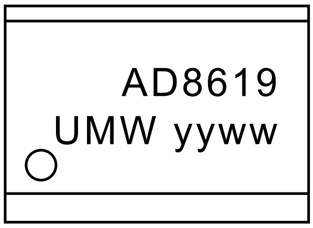
DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	A2	b	c	D	E	E1	e	e1	L	θ
Min	0.90	0.00	0.90	0.15	0.08	2.05	1.15	2.15	0.65	1.20	0.26	7°
Max	1.10	0.10	1.00	0.35	0.15	2.25	1.35	2.45	TYP	1.40	0.46	REF.

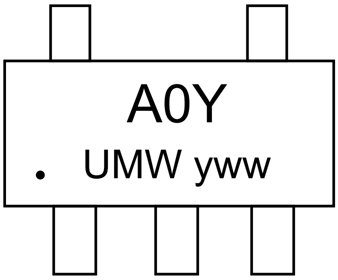
9.Ordering information

SOP-14

TSSOP-14

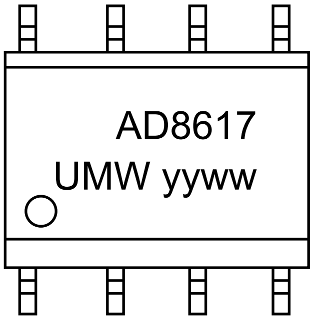


SC70-5



yww: Batch Code

SOP-8



yy: Year Code
ww: Week Code

Order Code	Marking	Package	Base QTY	Delivery Mode
UMW AD8619ARZ	AD8619	SOP-14	2500	Tape and reel
UMW AD8619ARUZ	AD8619	TSSOP-14	4000	Tape and reel
UMW AD8613AKSZ	A0Y	SC70-5	3000	Tape and reel
UMW AD8617ARZ	AD8617	SOP-8	2500	Tape and reel

10.Disclaimer

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