

GENERAL DESCRIPTION

The ADA4692-2 are dual and the ADA4692-4 are the quad rail-to-rail output, single-supply amplifiers featuring low power, wide bandwidth, and low noise.

The ADA4692-4 is a quad version without shutdown.

These amplifiers are ideal for a wide variety of applications. Audio, filters, photodiode amplifiers, and charge amplifiers, all benefit from this combination of performance and features. Additional applications for these amplifiers include portable consumer audio players with low noise and low distortion that provide high gain and slew rate response over the audio band at low power. Industrial applications with high impedance sensors, such as pyroelectric and IR sensors, benefit from the high impedance and low 0.5 pA input bias, low offset drift, and enough bandwidth and response for low gain applications.

FEATURES

- Low power: 180 μ A typical
- Very low input bias currents: 0.5 pA typical
- Low noise: 16 nV/ $\sqrt{\text{Hz}}$ typical
- 3.6 MHz bandwidth
- Offset voltage: 500 μ V typical
- Low offset voltage drift: 4 μ V/ $^{\circ}$ C maximum
- Low distortion: 0.003% THD + N
- 2.7 V to 5 V single supply or ± 1.35 V to ± 2.5 V dual supply

APPLICATIONS

- Photodiode amplifiers
- Sensor amplifiers
- Portable medical and instrumentation
- Portable audio: MP3s, PDAs, and smartphones
- Communications
- Low-side current sense
- ADC drivers
- Active filters
- Sample-and-hold

PIN CONFIGURATIONS

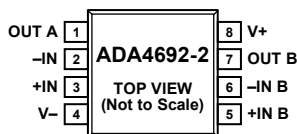


Figure 7. SOP-8_N (R-8)

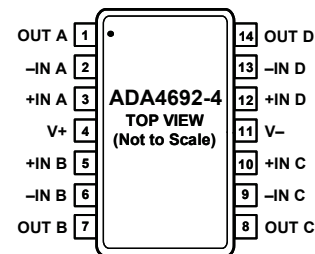


Figure 8. TSSOP-14 (RU-14)

Low Power, 3.6 MHz, Low Noise, Rail-to-Rail Output, Operational Amplifiers
SPECIFICATIONS
ELECTRICAL CHARACTERISTICS—2.7 V OPERATION

 Supply voltage (V_{SY}) = 2.7 V, common-mode voltage (V_{CM}) = $V_{SY}/2$, T_A = 25°C, unless otherwise specified.

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
Offset Voltage	V_{OS}	$V_{CM} = -0.3 \text{ V to } +1.6 \text{ V}$		0.5	2.5	mV
Dual (ADA469x -2)		$V_{CM} = -0.1 \text{ V to } +1.6 \text{ V}; -40^\circ\text{C} < T_A < +125^\circ\text{C}$			3.5	mV
Quad (ADA469x -4)		$V_{CM} = -0.1 \text{ V to } +1.6 \text{ V}; -40^\circ\text{C} < T_A < +125^\circ\text{C}$			4.0	mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	$-40^\circ\text{C} < T_A < +125^\circ\text{C}$		1	4	$\mu\text{V}/^\circ\text{C}$
Input Bias Current	I_B			0.5	5	pA
Input Offset Current	I_{OS}	$-40^\circ\text{C} < T_A < +125^\circ\text{C}$		1	360	pA
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$			8	pA
Input Voltage Range		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$	-0.3		225	pA
Common -Mode Rejection Ratio	CMRR	$V_{CM} = -0.3 \text{ V to } +1.6 \text{ V}$	70	90	+1.6	V
Large Signal Voltage Gain	A_{VO}	$V_{CM} = -0.1 \text{ V to } +1.6 \text{ V}; -40^\circ\text{C} < T_A < +125^\circ\text{C}$	62			dB
		Load resistance (R_L) = 2 k Ω , output voltage (V_{OUT}) = 0.5 V to 2.2 V	90	100		dB
		$-40^\circ\text{C} < T_A < +85^\circ\text{C}$	80			dB
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$	63			dB
		$R_L = 600 \Omega$, $V_{OUT} = 0.5 \text{ V to } 2.2 \text{ V}$	85	95		dB
Input Capacitance	C_{IN}					
Differential I Mode	C_{INDM}			2.5		pF
Common Mode	C_{INCM}			7		pF
Logic High Voltage (Enabled)	V_{IH}	$-40^\circ\text{C} < T_A < +125^\circ\text{C}$	1.6			V
Logic Low Voltage (Power -Down)	V_{IL}	$-40^\circ\text{C} < T_A < +125^\circ\text{C}$			0.5	V
Logic Input Current (Per Pin)	I_{IN}	$-40^\circ\text{C} < T_A < +125^\circ\text{C}$, 0 V \leq shutdown voltage (V_{SD}) \leq 2.7 V			1	μA
Output Voltage High	V_{OH}	$R_L = 2 \text{ k}\Omega \text{ to } V_{CM}$	2.65	2.67		V
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$	2.6			V
		$R_L = 600 \Omega \text{ to } V_{CM}$	2.55	2.59		V
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$	2.5			V
Output Voltage Low	V_{OL}	$R_L = 2 \text{ k}\Omega \text{ to } V_{CM}$		24	33	mV
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$			43	mV
		$R_L = 600 \Omega \text{ to } V_{CM}$		78	103	mV
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$			138	mV
Short-Circuit Current	I_{SC}	$V_{OUT} = V_{SY} \text{ or } \text{GND}$		± 15		mA
Closed-Loop Output Impedance	Z_{OUT}	Frequency (f) = 1 MHz, voltage gain (A_V) = -100		372		Ω
Output Pin Leakage Current		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$, shutdown active, $V_{SD} =$ negative supply voltage (V_{SS})		10		nA
Power Supply Rejection Ratio	PSRR	$V_{SY} = 2.7 \text{ V to } 5.5 \text{ V}$	80	90		dB
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$	75			dB
Supply Current Per Amplifier	I_{SY}	$V_{OUT} = V_{SY}/2$		165	200	μA
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$			240	μA
Supply Current Shutdown Mode	I_{SD}	All amplifiers shut down, $V_{SD} = V_{SS}$		10		nA
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$			2	μA

Low Power, 3.6 MHz, Low Noise, Rail-to-Rail Output, Operational Amplifiers

Parameter	Symbol	Test Conditions /Comments	Min	Typ	Max	Unit
Slew Rate	SR	$R_L = 600 \Omega$, load capacitance (C_L) = 20 pF, $A_V = +1$		1.1		V/ μ s
		$R_L = 2 \text{ k}\Omega$, $C_L = 20 \text{ pF}$, $A_V = +1$		1.4		V/ μ s
Settling Time to 0.1%	t_s	Step = 0.5 V, $R_L = 2 \text{ k}\Omega$, 600 Ω		1		μ s
Gain Bandwidth Product	GBP	$R_L = 1 \text{ M}\Omega$, $C_L = 35 \text{ pF}$, $A_V = +1$		3.6		MHz
Phase Margin	Φ_M	$R_L = 1 \text{ M}\Omega$, $C_L = 35 \text{ pF}$, $A_V = +1$		49		Degrees
Turn-On/Turn-Off Time		$R_L = 600 \Omega$		1		μ s
Distortion	THD+N	$A_V = -1$, $R_L = 2 \text{ k}\Omega$, $f = 1 \text{ kHz}$, input voltage (V_{IN}) rms = 0.15 V rms		0.009		%
		$A_V = -1$, $R_L = 600 \Omega$, $f = 1 \text{ kHz}$, V_{IN} rms = 0.15 V rms		0.01		%
		$A_V = +1$, $R_L = 2 \text{ k}\Omega$, $f = 1 \text{ kHz}$, V_{IN} rms = 0.15 V rms		0.006		%
		$A_V = +1$, $R_L = 600 \Omega$, $f = 1 \text{ kHz}$, V_{IN} rms = 0.15 V rms		0.009		%
Voltage Noise	e_n p-p	$f = 0.1 \text{ Hz to } 10 \text{ Hz}$		3.1		μ V p-p
Voltage Noise Density	e_n	$f = 1 \text{ kHz}$		16		nV/ $\sqrt{\text{Hz}}$
		$f = 10 \text{ kHz}$		13		nV/ $\sqrt{\text{Hz}}$

ELECTRICAL CHARACTERISTICS—5 V OPERATION
 $V_{SY} = 5 \text{ V}$, $V_{CM} = V_{SY}/2$, $T_A = 25^\circ\text{C}$, unless otherwise specified.

Parameter	Symbol	Test Conditions /Comments	Min	Typ	Max	Unit
Offset Voltage	V_{OS}	$V_{CM} = -0.3 \text{ V to } +3.9 \text{ V}$		0.5	2.5	mV
Dual (ADA4692-2)		$V_{CM} = -0.1 \text{ V to } +3.9 \text{ V}; -40^\circ\text{C} < T_A < +125^\circ\text{C}$			3.5	mV
Quad (ADA4692-4)		$V_{CM} = -0.1 \text{ V to } +3.9 \text{ V}; -40^\circ\text{C} < T_A < +125^\circ\text{C}$			4.0	mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	$-40^\circ\text{C} < T_A < +125^\circ\text{C}$		1	4	$\mu\text{V}/^\circ\text{C}$
Input Bias Current	I_B			0.5	5	pA
Input Offset Current	I_{OS}	$-40^\circ\text{C} < T_A < +125^\circ\text{C}$			360	pA
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$		1	8	pA
Input Voltage Range		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$	-0.3		+3.9	V
Common-Mode Rejection Ratio	CMRR	$V_{CM} = -0.3 \text{ V to } +3.9 \text{ V}$	75	98		dB
		$V_{CM} = -0.1 \text{ V to } +3.9 \text{ V}; -40^\circ\text{C} < T_A < +125^\circ\text{C}$	68			dB
Large Signal Voltage Gain	A_{VO}	$R_L = 2 \text{ k}\Omega$, $V_{OUT} = 0.5 \text{ V to } 4.5 \text{ V}$, $V_{CM} = 0 \text{ V}$	95	110		dB
		$-40^\circ\text{C} < T_A < +85^\circ\text{C}$	80			dB
		$-40^\circ\text{C} < T_A < +125^\circ\text{C}$	70			dB
		$R_L = 600 \Omega$, $V_{OUT} = 0.5 \text{ V to } 4.5 \text{ V}$, $V_{CM} = 0 \text{ V}$	90	100		dB
Differential Mode	C_{INDM}			2.5		pF
Common Mode	C_{INCM}			7		pF
Logic High Voltage (Enabled)	V_{IH}	$-40^\circ\text{C} < T_A < +125^\circ\text{C}$	2.0			V
Logic Low Voltage (Power -Down)	V_{IL}	$-40^\circ\text{C} < T_A < +125^\circ\text{C}$			0.8	V
Logic Input Current (Per Pin)	I_{IN}	$-40^\circ\text{C} < T_A < +125^\circ\text{C}$, $0 \text{ V} \leq V_{SD} \leq 2.7 \text{ V}$			1	μA

Low Power, 3.6 MHz, Low Noise, Rail-to-Rail Output, Operational Amplifiers

Parameter	Symbol	Test Conditions /Comments	Min	Typ	Max	Unit
Output Voltage High	V _{OH}	R _L = 2 kΩ to V _{CM}	4.95	4.97		V
		-40°C ≤ T _A ≤ +125°C	4.90			V
		R _L = 600 Ω to V _{CM}	4.85	4.88		V
		-40°C ≤ T _A ≤ +125°C	4.80			V
Output Voltage Low	V _{OL}	R _L = 2 kΩ to V _{CM}		30	40	mV
		-40°C ≤ T _A ≤ +125°C			55	mV
		R _L = 600 Ω to V _{CM}		100	128	mV
		-40°C ≤ T _A ≤ +125°C			173	mV
Short-Circuit Limit	I _{SC}	V _{OUT} = V _{SY} or GND		±55		mA
Closed-Loop Output Impedance	Z _{OUT}	ADA4691-2, f = 1 MHz, A _V = -100		364		Ω
		ADA4691-2, f = 1 MHz, A _V = -100		246		Ω
Output Pin Leakage Current		-40°C < T _A < +125°C, shutdown active, V _{SD} = V _{SS}		10		nA
Power Supply Rejection Ratio	PSRR	V _{SY} = 2.7 V to 5.5 V	80	90		dB
		-40°C ≤ T _A ≤ +125°C	75			dB
Supply Current Per Amplifier	I _{SY}	V _{OUT} = V _{SY} /2		180	225	μA
		-40°C ≤ T _A ≤ +125°C			275	μA
Supply Current Shutdown Mode	I _{SD}	All amplifiers shut down, V _{SD} = V _{SS}		10		nA
		-40°C ≤ T _A ≤ +125°C			2	μA
Slew Rate	SR	R _L = 2 kΩ, 600 Ω, C _L = 20 pF, A _V = +1		1.3		V/μs
Settling Time to 0.1%	t _s	V _{IN} = 2 V step, R _L = 2 kΩ or 600 Ω		1.5		μs
Gain Bandwidth Product	GBP	R _L = 1 MΩ, C _L = 35 pF, A _V = +1		3.6		MHz
Phase Margin	Φ _M	R _L = 1 MΩ, C _L = 35 pF, A _V = +1		52		Degrees
Turn-On/Turn-Off Time		R _L = 600 Ω		1		μs
Distortion	THD + N	A _V = -1, R _L = 2 kΩ, f = 1 kHz, V _{IN rms} = 0.8 V rms		0.006		%
		A _V = -1, R _L = 600 Ω, f = 1 kHz, V _{IN rms} = 0.8 V rms		0.008		%
		A _V = +1, R _L = 2 kΩ, f = 1 kHz, V _{IN rms} = 0.8 V rms		0.001		%
		A _V = +1, R _L = 600 Ω, f = 1 kHz, V _{IN rms} = 0.8 V rms		0.003		%
Voltage Noise	e _{n p-p}	f = 0.1 Hz to 10 Hz		3.2		μV p-p
Voltage Noise Density	e _n	f = 1 kHz		16		nV/√Hz
	e _n	f = 10 kHz		13		nV/√Hz

ABSOLUTE MAXIMUM RATINGS

Parameter	Rating
Supply Voltage	6 V
Input Voltage	$V_{SS} - 0.3 V$ to $V_{DD} + 0.3 V$
Input Current ¹	±10 mA
Shutdown Pin Rise/Fall Times	50 μs maximum
Differential Input Voltage ²	± V_{SY}
Output Short-Circuit Duration to GND	Indefinite
Temperature	
Storage Temperature Range	-65°C to +150°C
Operating Temperature Range	-40°C to +125°C
Junction Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 60 sec)	300°C

¹: Input pins have clamp diodes to the supply pins. Limit the input current to 10 mA or less whenever the input signal exceeds the power supply rail by 0.3 V.

²: Differential input voltage is limited to 6 V or the supply voltage, whichever is less.

TYPICAL PERFORMANCE CHARACTERISTICS

T_A = 25°C, unless otherwise noted.

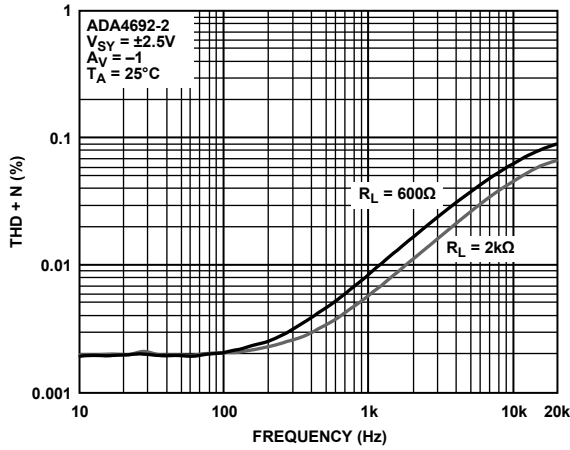


Figure 1. THD + Noise vs. Frequency

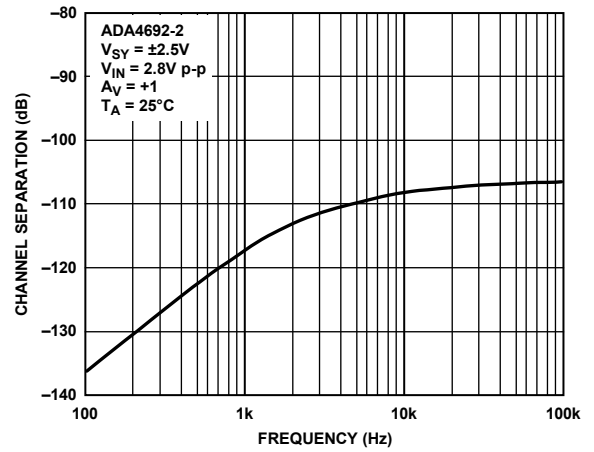


Figure 2. Channel Separation vs. Frequency

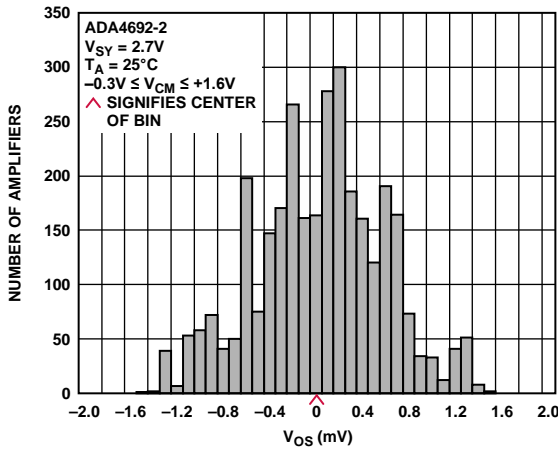


Figure 9. Input Offset Voltage Distribution

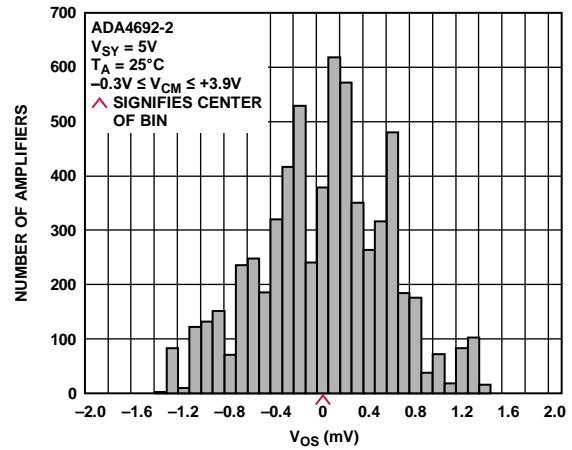


Figure 12. Input Offset Voltage Distribution

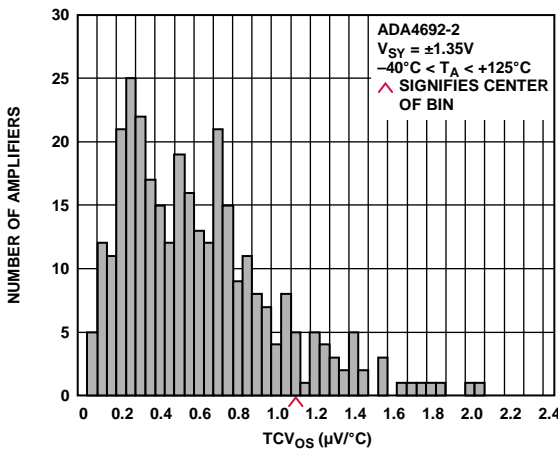


Figure 10. Input Offset Voltage Drift Distribution

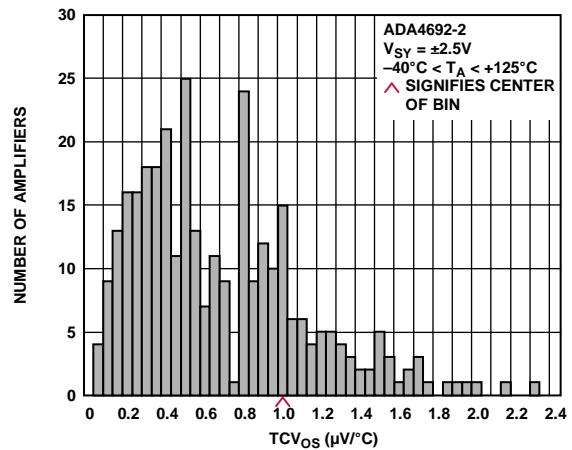


Figure 13. Input Offset Voltage Drift Distribution

Low Power, 3.6 MHz, Low Noise, Rail-to-Rail Output, Operational Amplifiers

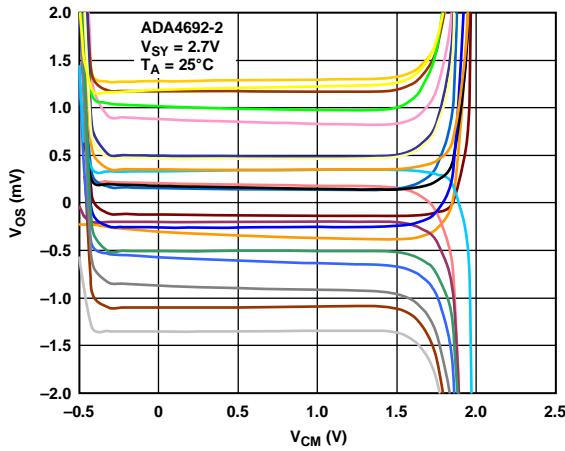


Figure 11. Input Offset Voltage vs. Common-Mode Voltage

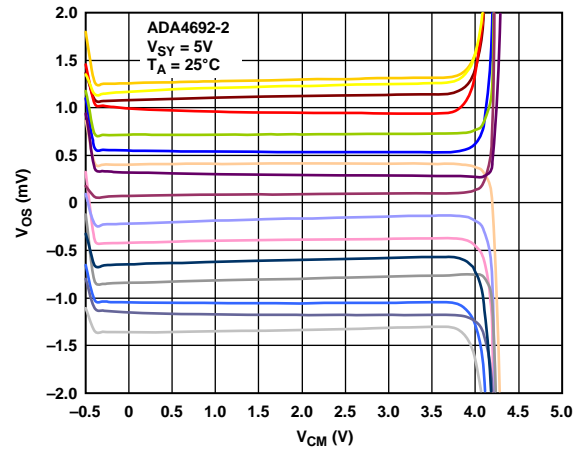


Figure 14. Input Offset Voltage vs. Common-Mode Voltage

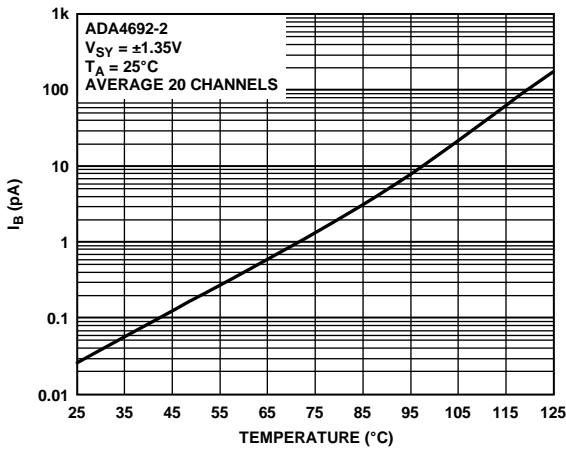


Figure 15. Input Bias Current vs. Temperature

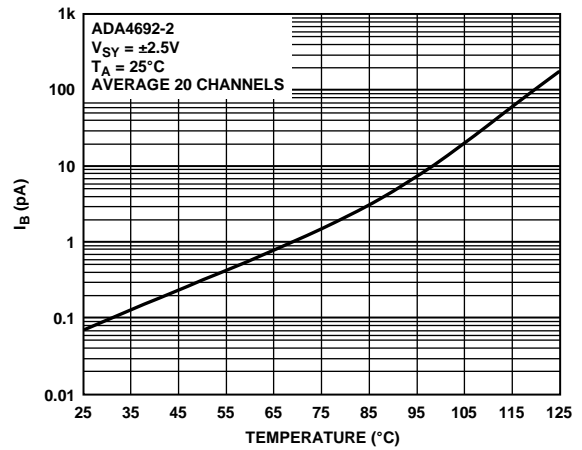


Figure 18. Input Bias Current vs. Temperature

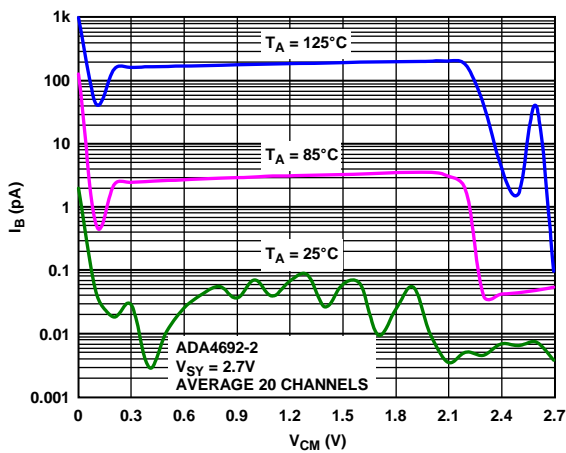


Figure 16. Input Bias Current vs. Common-Mode Voltage

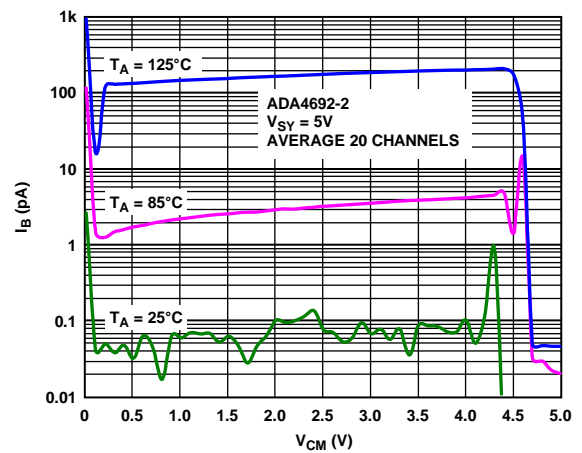


Figure 19. Input Bias Current vs. Common-Mode Voltage

Low Power, 3.6 MHz, Low Noise, Rail-to-Rail Output, Operational Amplifiers

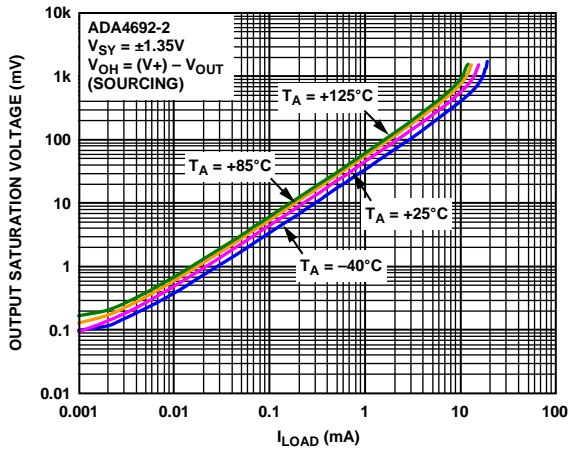


Figure 17. Output Voltage (V_{OH}) to Supply Rail vs. Load Current

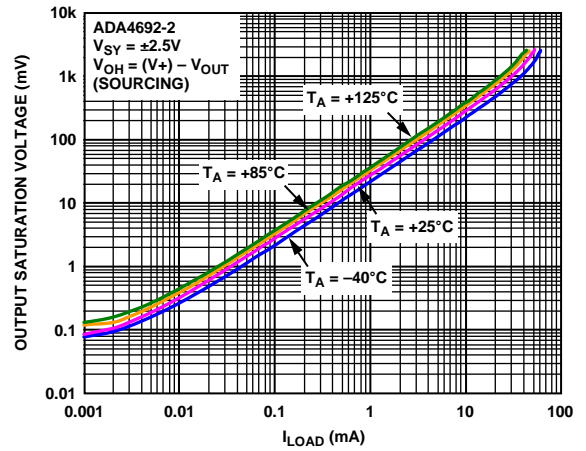


Figure 20. Output Voltage (V_{OH}) to Supply Rail vs. Load Current

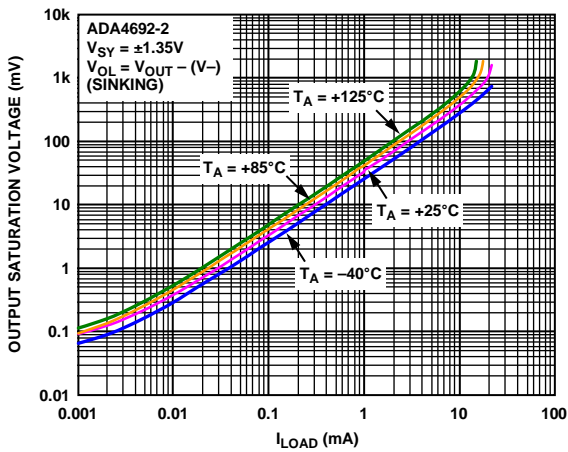


Figure 21. Output Voltage (V_{OL}) to Supply Rail vs. Load Current

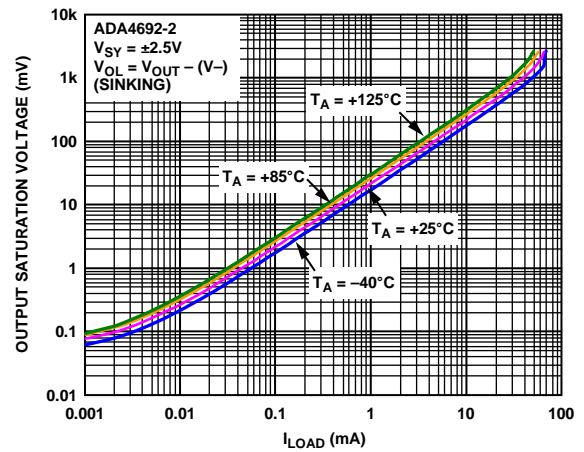


Figure 24. Output Voltage (V_{OL}) to Supply Rail vs. Load Current

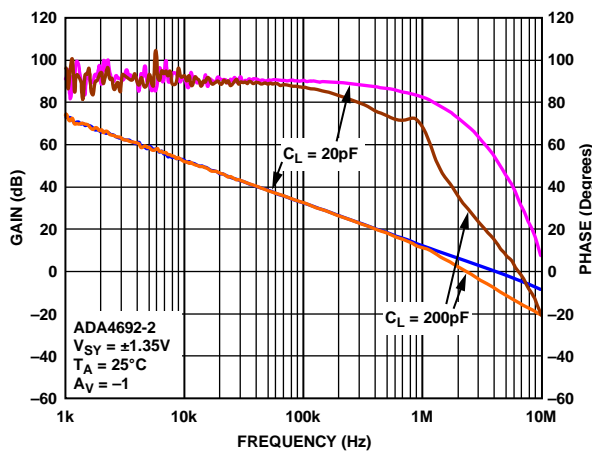


Figure 22. Open-Loop Gain and Phase vs. Frequency

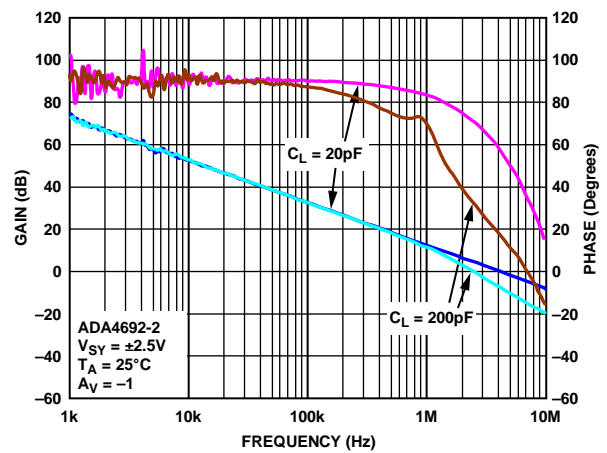


Figure 25. Open-Loop Gain and Phase vs. Frequency

Low Power, 3.6 MHz, Low Noise, Rail-to-Rail Output, Operational Amplifiers

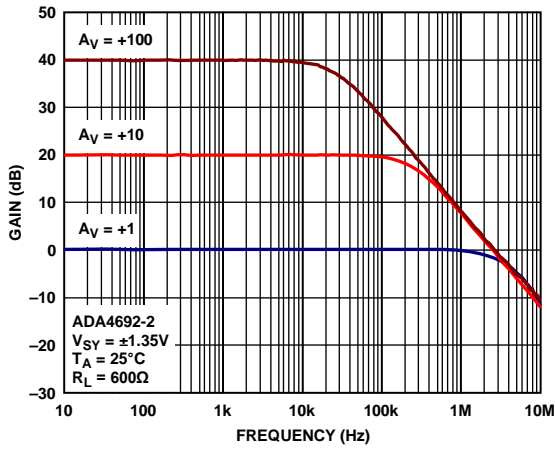


Figure 23. Closed-Loop Gain vs. Frequency

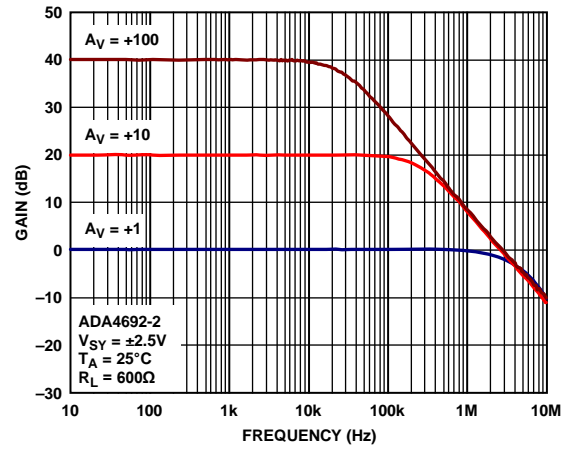


Figure 26. Closed-Loop Gain vs. Frequency

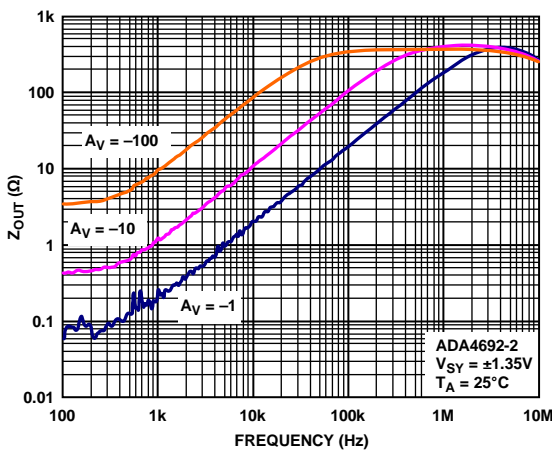


Figure 27. Output Impedance vs. Frequency

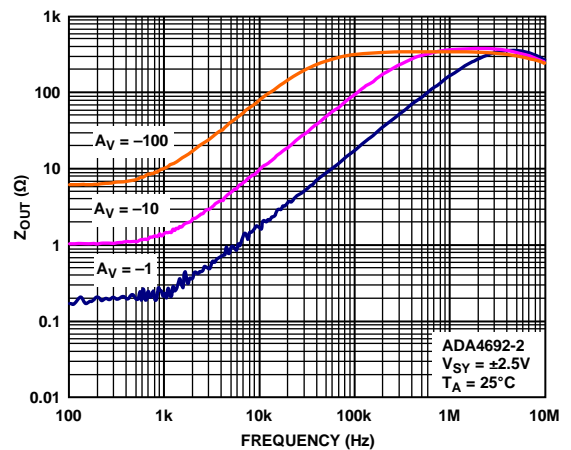


Figure 30. Output Impedance vs. Frequency

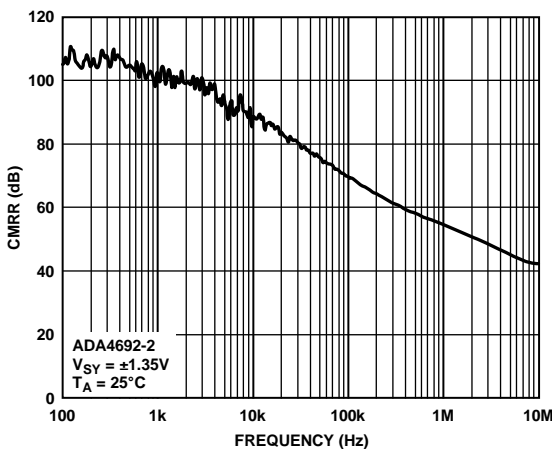


Figure 28. CMRR vs. Frequency

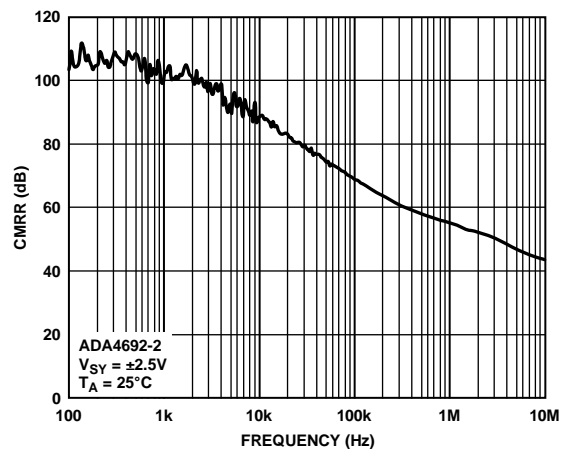


Figure 31. CMRR vs. Frequency

Low Power, 3.6 MHz, Low Noise, Rail-to-Rail Output, Operational Amplifiers

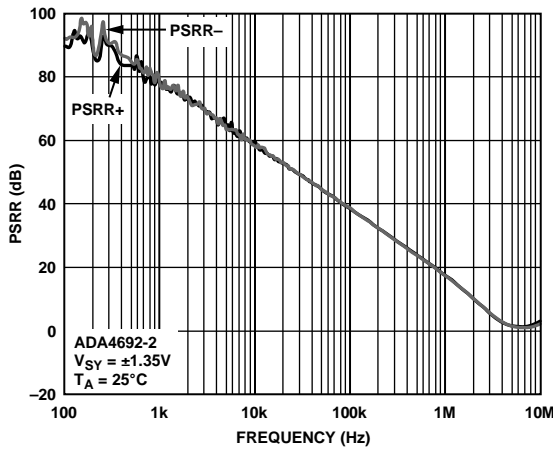


Figure 29. PSRR vs. Frequency

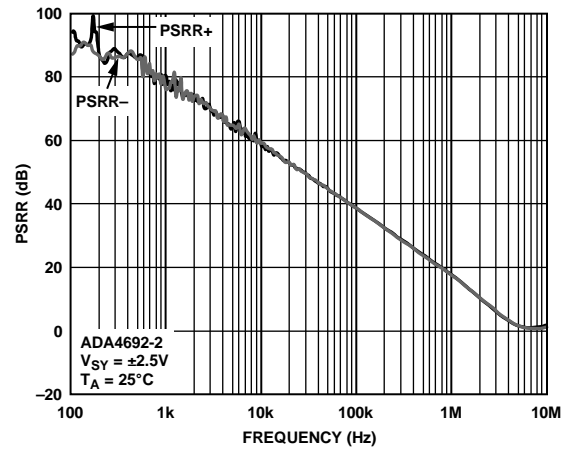


Figure 32. PSRR vs. Frequency

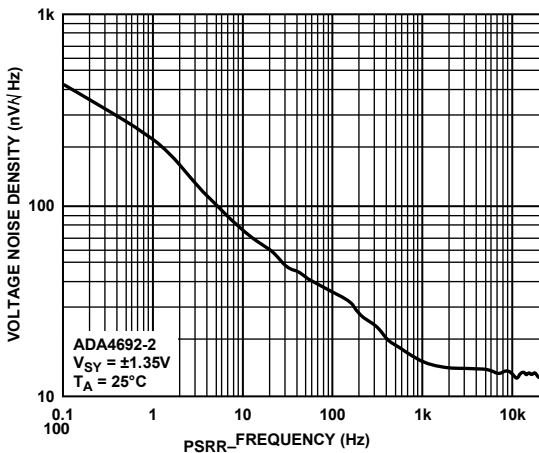


Figure 33. Voltage Noise Density vs. Frequency

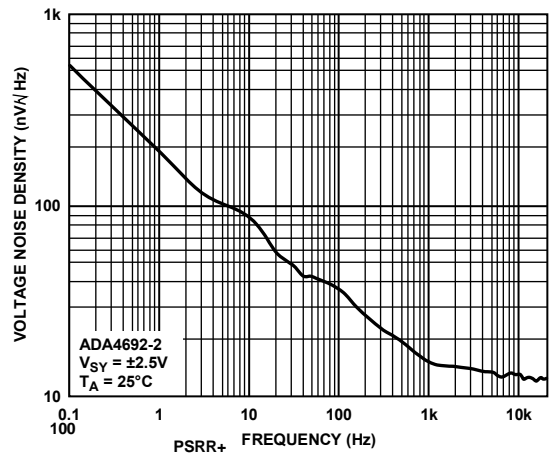


Figure 36. Voltage Noise Density vs. Frequency

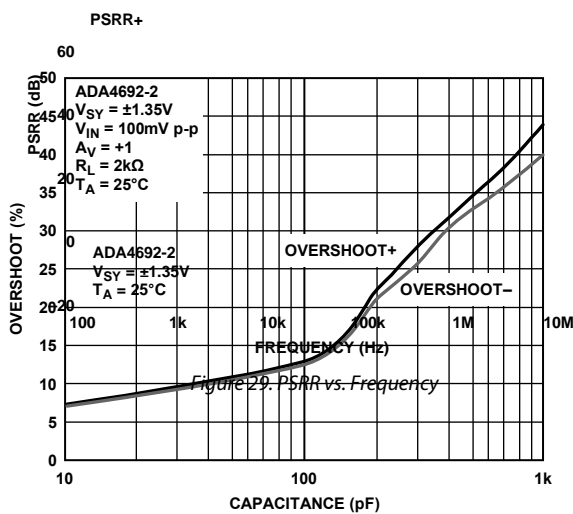


Figure 34. Small Signal Overshoot vs. Load Capacitance

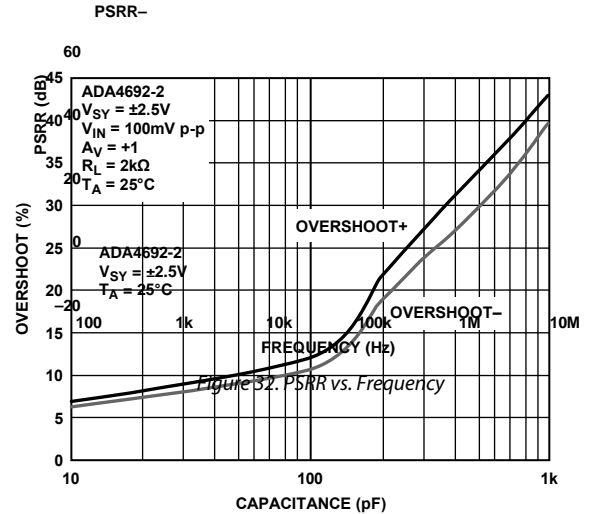


Figure 37. Small Signal Overshoot vs. Load Capacitance

Low Power, 3.6 MHz, Low Noise, Rail-to-Rail Output, Operational Amplifiers

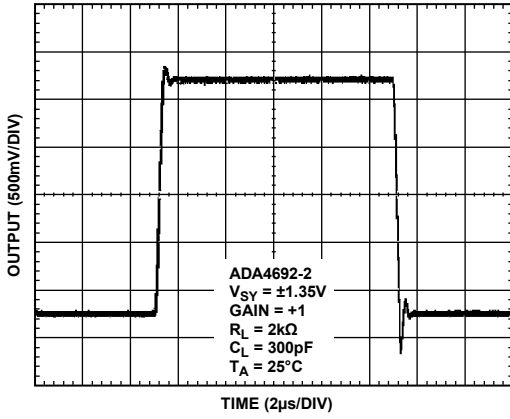


Figure 35. Large Signal Transient Response

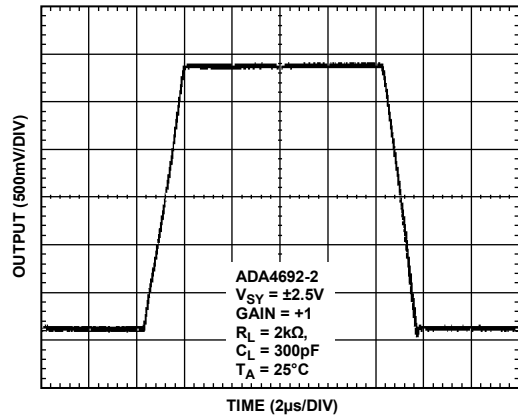


Figure 38. Large Signal Transient Response

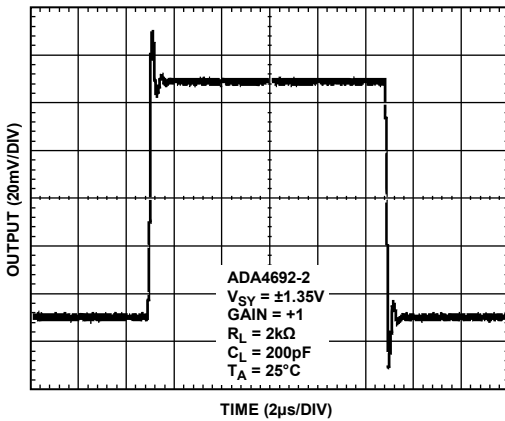


Figure 39. Small Signal Transient Response

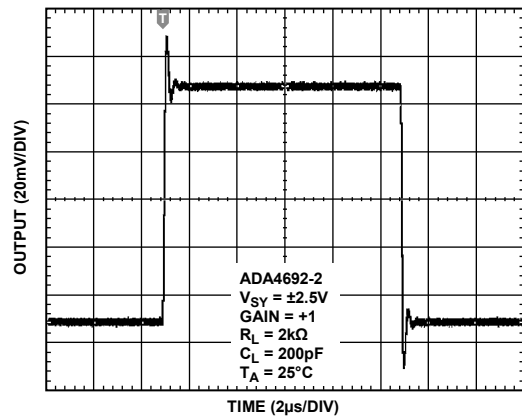


Figure 42. Small Signal Transient Response

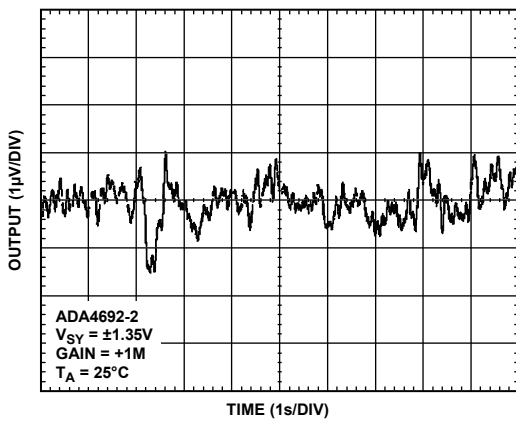


Figure 40. 0.1 Hz to 10 Hz Noise

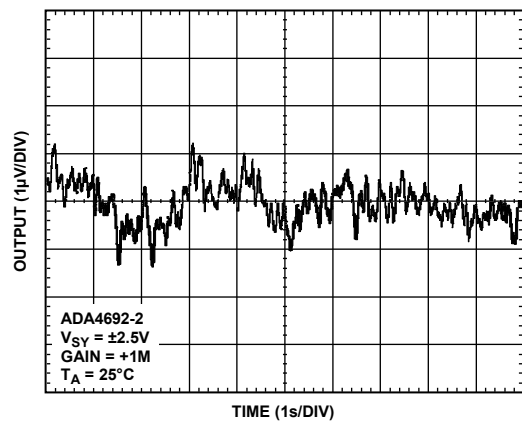


Figure 43. 0.1 Hz to 10 Hz Noise

Low Power, 3.6 MHz, Low Noise, Rail-to-Rail Output, Operational Amplifiers

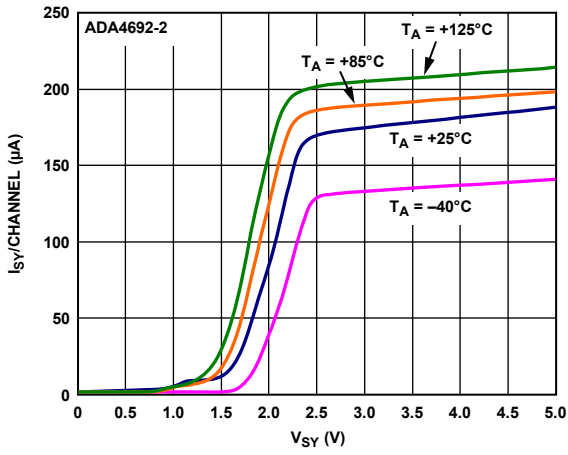


Figure 41. Supply Current per Amplifier vs. Supply Voltage

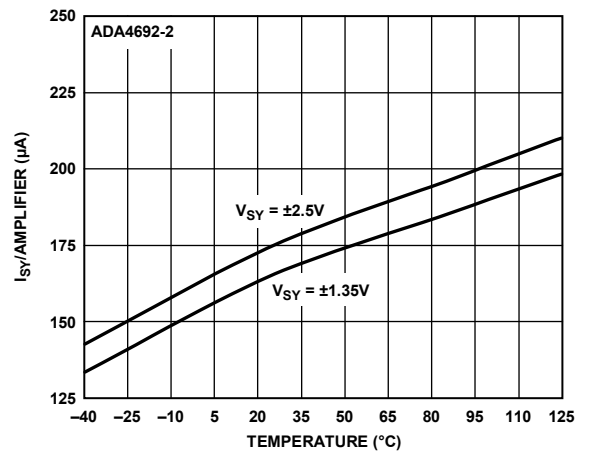
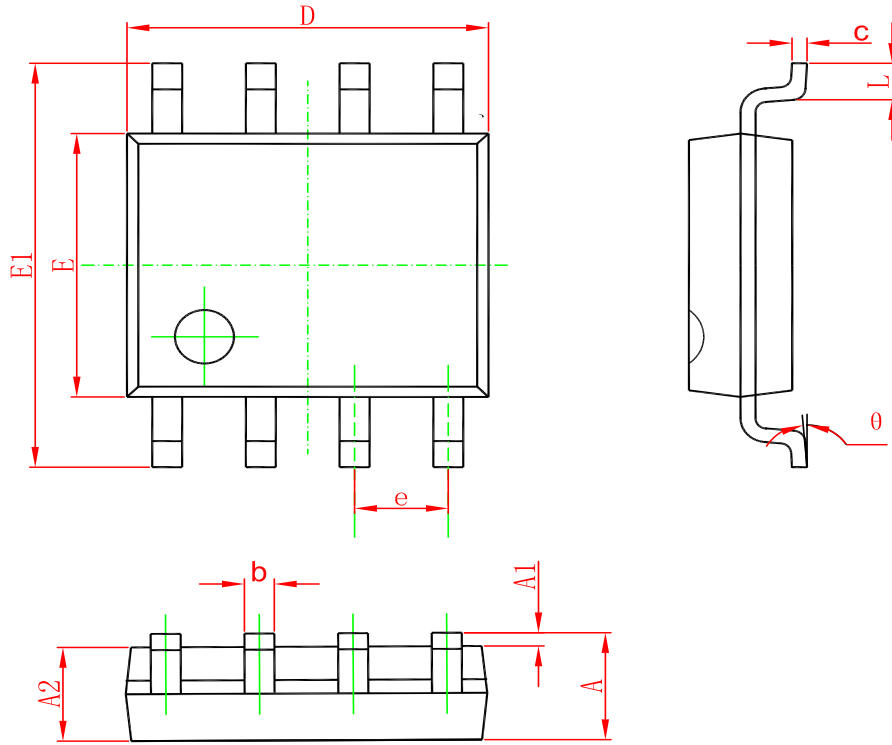


Figure 44. Supply Current per Channel vs. Temperature

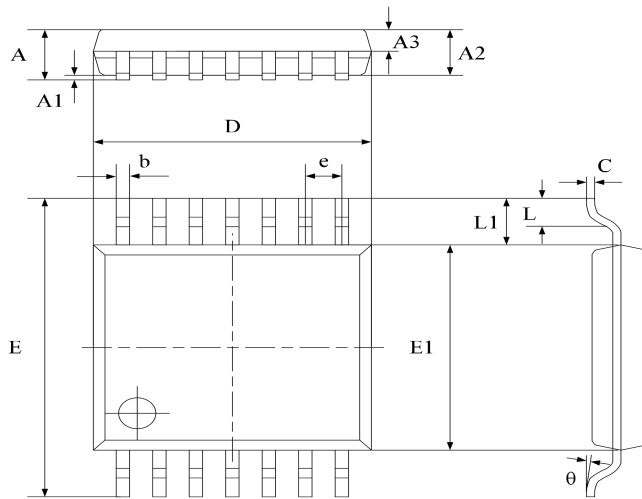
Package Dimension

SOP-8



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

TSSOP-14



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	-	1.200	-	0.0472
A1	0.050	0.150	0.002	0.006
A2	0.900	1.050	0.037	0.043
A3	0.390	0.490	0.016	0.020
b	0.200	0.290	0.008	0.012
C	0.130	0.180	0.005	0.007
D	4.860	5.060	0.198	0.207
E	6.200	6.600	0.253	0.269
E1	4.300	4.500	0.176	0.184
e	0.650 typ.		0.0256 typ.	
L1	1.000 ref.		0.0393 ref.	
L	0.450	0.750	0.018	0.031
theta	0°	8°	0°	8°

Ordering information

Order code	Package	Baseqty	Deliverymode	Marking
UMW ADA4692-2ARZ	SOP-8	2500	Tape and reel	1562A
UMW ADA4692-4ARUZ	TSSOP-14	4000	Tape and reel	1564A