

1. Description

The ADA4505-1/ADA4505-4 are single and quad micropower amplifiers featuring rail-to-rail input and output swings while operating from a single 1.8 V to 5 V power supply or from dual ± 0.9 V to ± 2.5 V power supplies. Employing a new circuit technology, these low cost amplifiers offer zero input crossover distortion (excellent PSRR and CMRR performance) and very low bias current, while operating with a supply current of less than 10 μ A per amplifier.

This combination of features makes the ADA4505-x amplifiers ideal choices for battery-powered applications because they minimize errors due to power supply voltage variations over the lifetime of the battery and maintain high CMRR even for a rail-to-rail op amp. Remote battery-powered sensors, handheld instrumentation and consumer equipment, hazard detectors (for example, smoke, fire, and gas), and patient monitors can benefit from the features of the ADA4505-x amplifiers.

The ADA4505-x family is specified for both the industrial temperature range (-40°C to $+85^{\circ}\text{C}$) and the extended industrial temperature range (-40°C to $+125^{\circ}\text{C}$)

2. Features

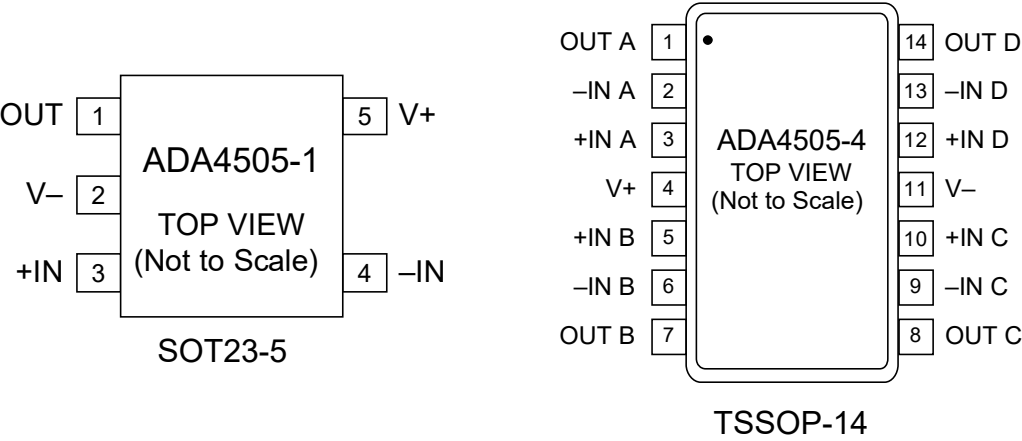
- PSRR: 100 dB minimum
- CMRR: 105 dB typical
- Very low supply current: 10 μ A per amplifier maximum 1.8 V to 5 V single-supply or ± 0.9 V to ± 2.5 V dual-supply
- operation Rail-to-rail input and output 3 mV offset voltage maximum
- Very low input bias current: 0.5 pA typical

3. Applications

- Pressure and position sensors
- Remote security
- Medical monitors
- Battery-powered consumer equipment
- Hazard detectors



4.Pinning Information





5. Absolute Maximum Ratings ($T_A = 25^\circ\text{C}$)

Description	Rating
Supply Voltage	5.5V
Input Voltage	$\pm V_{SY} \pm 0.1\text{V}$
Input Current ¹	+10 mA
Differential input Voltage ²	$\pm V_{SY}$
Output Short-Circuit Duration to GND	Indefinite
Storage Temperature Range	-65°C to $+150^\circ\text{C}$
Operating Temperature Range	-40°C to $+125^\circ\text{C}$
Junction Temperature Range	-65°C to $+150^\circ\text{C}$
Lead Temperature (Soldering, 60 sec)	300°C

¹ Input pins have clamp diodes to the supply pins. Limit input current to 10 mA or less whenever the input signal exceeds the power supply rail by 0.1 V.

² Differential input voltage is limited to 5 V or the supply voltage, whichever is less.



6.1 Electrical Characteristics

$V_{SY}=1.8V$, $V_{CM}=V_{SY}/2$, $T_A=25^\circ C$, $R_L=100k\Omega$ to GND, unless otherwise specified.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input Characteristics						
Offset Voltage	V_{OS}	$0V \leq V_{CM} \leq 1.8V$		0.5	3	mV
		$-40^\circ C \leq T_A \leq +125^\circ C$			4	mV
Input Bias Current	I_S			0.5	2	pA
		$-40^\circ C \leq T_A \leq +85^\circ C$			50	pA
		$-40^\circ C \leq T_A \leq +125^\circ C$			375	pA
Input Offset Current	I_{OS}			0.05	1	pA
		$-40^\circ C \leq T_A \leq +85^\circ C$			25	pA
		$-40^\circ C \leq T_A \leq +125^\circ C$			130	pA
Input Voltage Range		$-40^\circ C \leq T_A \leq +125^\circ C$	0		1.8	V
Common -Mode Rejection Ratio	CMRR	$0V \leq V_{CM} \leq 1.8V$	85	100		dB
		$-40^\circ C \leq T_A \leq +85^\circ C$	85			dB
		$-40^\circ C \leq T_A \leq +125^\circ C$	80			dB
Large Signal Voltage Gain	A_{VO}	$0.05V \leq V_{OUT} \leq 1.75V, R_L=100k\Omega$ to V_{CM}	95	115		dB
		$-40^\circ C \leq T_A \leq +125^\circ C$	95			dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	$-40^\circ C \leq T_A \leq +125^\circ C$		2.5		$\mu V/^\circ C$
Input Resistance	R_{IN}			220		G Ω
Input Capacitance Differential Mode	C_{INDM}			2.5		pF
Input Capacitance Common Mode	C_{INCM}			4.7		pF
Output Characteristics						
Output Voltage High	V_{OH}	$R_L=100k\Omega$ to GND	1.78	1.79		V
		$-40^\circ C \leq T_A \leq +125^\circ C$	1.78			V
		$R_L=10k\Omega$ to GND	1.65	1.75		V
		$-40^\circ C \leq T_A \leq +125^\circ C$	1.65			V



Parameter	Symbol	Conditions	Min	Typ	Max	Units
Output Voltage Low	V _{OL}	R _L =100kΩ to V _{SY}		2	5	mV
		−40°C ≤T _A ≤+125°C			5	mV
		R _L =10kΩ to V _{SY}		12	25	mV
		−40°C ≤T _A ≤+125°C			25	mV
Short-Circuit Limit	I _{SC}	V _{OUT} =V _{SY} or GND		±3.8		mA
Power Supply						
Power Supply Rejection Ratio	PSRR	V _{SY} =1.8V to 5V	100	110		dB
		−40°C ≤T _A ≤+85°C	100			dB
		−40°C ≤T _A ≤+125°C	95			dB
Supply Current per Amplifier	I _{SY}	V _{OUT} =V _{SY} /2				
ADA4505-1			10	11.5	μA	
		−40°C ≤T _A ≤+125°C			15	μA
ADA4505-4			7	10	μA	
		−40°C ≤T _A ≤+125°C			15	μA
Dynamic Performance						
Slew Rate	SR	R _L =100kΩ, C _L =20pF, G=1		6.5		mV/μs
Gain Bandwidth Product	GBP	R _L =1MΩ, C _L =20pF, G=1		50		kHz
Phase Margin	∅ _M	R _L =1MΩ, C _L =20pF, G=1		52		Degrees
Noise Performance						
Voltage Noise	e _n p-p	f=0.1Hz to 10Hz		2.95		μV _{p-p}
Voltage Noise Density	e _n	f=1kHz		65		nV/√Hz
Current Noise Density	i _n	f=1kHz		20		pA/√Hz



6.2 Electrical Characteristics

$V_{SY}=5V$, $V_{CM}=V_{SY}/2$, $T_A=25^\circ C$, $R_L=100k\Omega$ to GND, unless otherwise specified.

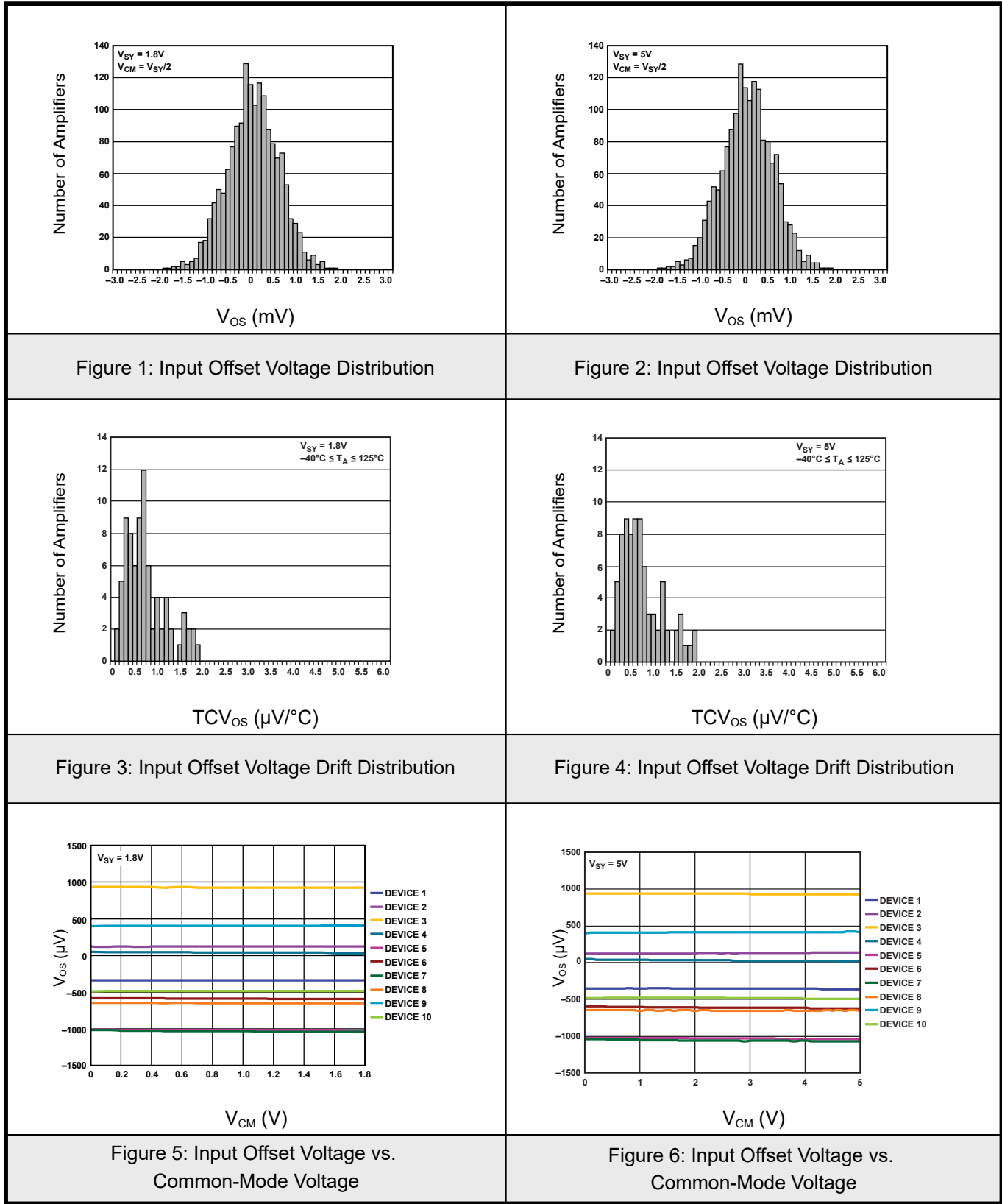
Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input Characteristics						
Offset Voltage	V_{OS}	$0V \leq V_{CM} \leq 5V$		0.5	3	mV
		$-40^\circ C \leq T_A \leq +125^\circ C$			4	mV
Input Bias Current	I_S			0.5	2	pA
		$-40^\circ C \leq T_A \leq +85^\circ C$			50	pA
		$-40^\circ C \leq T_A \leq +125^\circ C$			375	pA
Input Offset Current	I_{OS}			0.05	1	pA
		$-40^\circ C \leq T_A \leq +85^\circ C$			25	pA
		$-40^\circ C \leq T_A \leq +125^\circ C$			130	pA
Input Voltage Range		$-40^\circ C \leq T_A \leq +125^\circ C$	0		5	V
Common -Mode Rejection Ratio	CMRR	$0V \leq V_{CM} \leq 5V$	90	105		dB
		$-40^\circ C \leq T_A \leq +85^\circ C$	90			dB
		$-40^\circ C \leq T_A \leq +125^\circ C$	85			dB
Large Signal Voltage Gain	A_{VO}	$0.05V \leq V_{OUT} \leq 4.95V, R_L=100k\Omega$ to V_{CM}	105	120		dB
		$-40^\circ C \leq T_A \leq +125^\circ C$	100			dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	$-40^\circ C \leq T_A \leq +125^\circ C$		2		$\mu V/^\circ C$
Input Resistance	R_{IN}			220		G Ω
Input Capacitance Differential Mode	C_{INDM}			2.5		pF
Input Capacitance Common Mode	C_{INCM}			4.7		pF
Output Characteristics						
Output Voltage High	V_{OH}	$R_L=100k\Omega$ to GND	4.98	4.99		V
		$-40^\circ C \leq T_A \leq +125^\circ C$	4.98			V
		$R_L=10k\Omega$ to GND	4.9	4.95		V
		$-40^\circ C \leq T_A \leq +125^\circ C$	4.9			V



Parameter	Symbol	Conditions	Min	Typ	Max	Units
Output Voltage Low	V _{OL}	R _L =100kΩ to V _{SY}		2	5	mV
		−40°C ≤T _A ≤+125°C			5	mV
		R _L =10kΩ to V _{SY}		10	25	mV
		−40°C ≤T _A ≤+125°C			25	mV
Short-Circuit Limit	I _{SC}	V _{OUT} =V _{SY} or GND		±40		mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V _{SY} =1.8V to 5V	100	110		dB
		−40°C ≤T _A ≤+85°C	100			dB
		−40°C ≤T _A ≤+125°C	95			dB
Supply Current per Amplifier	I _{SY}	V _{OUT} =V _{SY} /2				
ADA4505-1			9	10.5	μA	
		−40°C ≤T _A ≤+125°C			15	μA
ADA4505-4			7	10	μA	
		−40°C ≤T _A ≤+125°C			15	μA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R _L =100kΩ, C _L =20pF, G=1		6		mV/μs
Gain Bandwidth Product	GBP	R _L =1MΩ, C _L =20pF, G=1		50		kHz
Phase Margin	∅ _M	R _L =1MΩ, C _L =20pF, G=1		52		Degrees
NOISE PERFORMANCE						
Voltage Noise	e _n p-p	f=0.1Hz to 10Hz		2.95		μV _{p-p}
Voltage Noise Density	e _n	f=1kHz		65		nV/√Hz
Current Noise Density	i _n	f=1kHz		20		pA/√Hz



7.1Typical Characteristic





7.2 Typical Characteristic

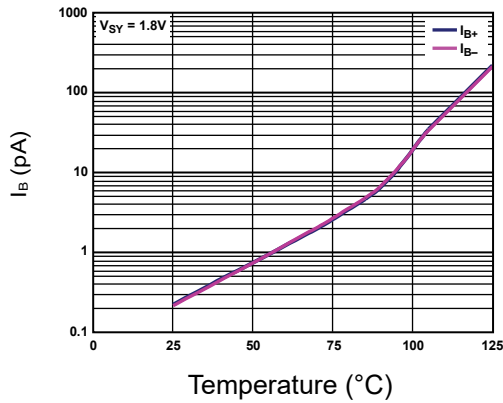


Figure 7: Input Bias Current vs. Temperature

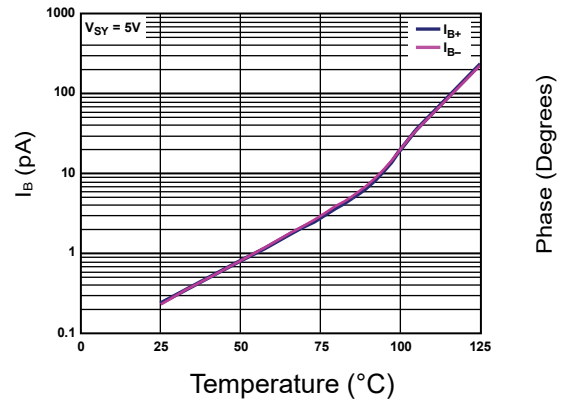


Figure 8: Input Bias Current vs. Temperature

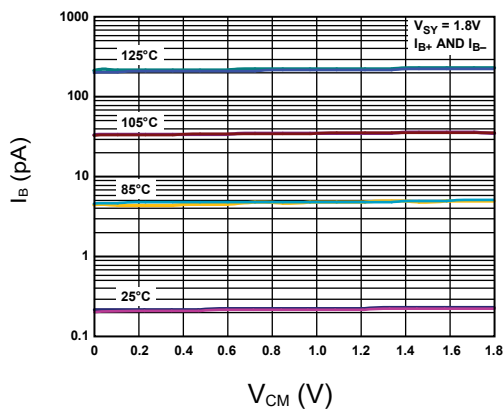


Figure 9: Input Bias Current vs. Common-Mode Voltage and Temperature

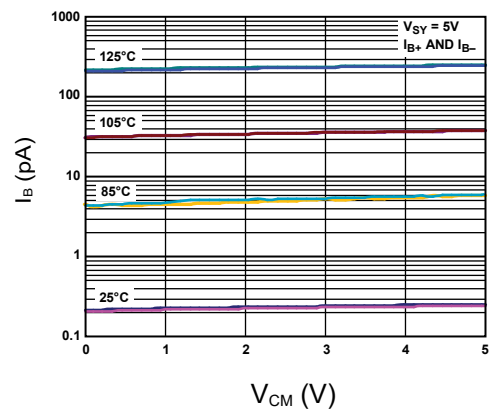
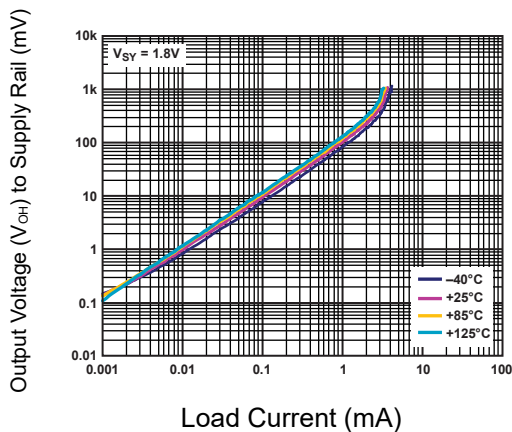
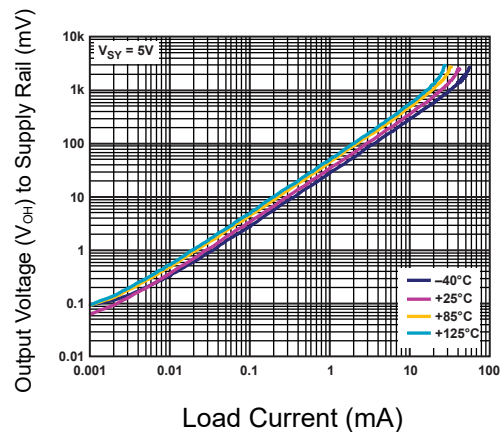
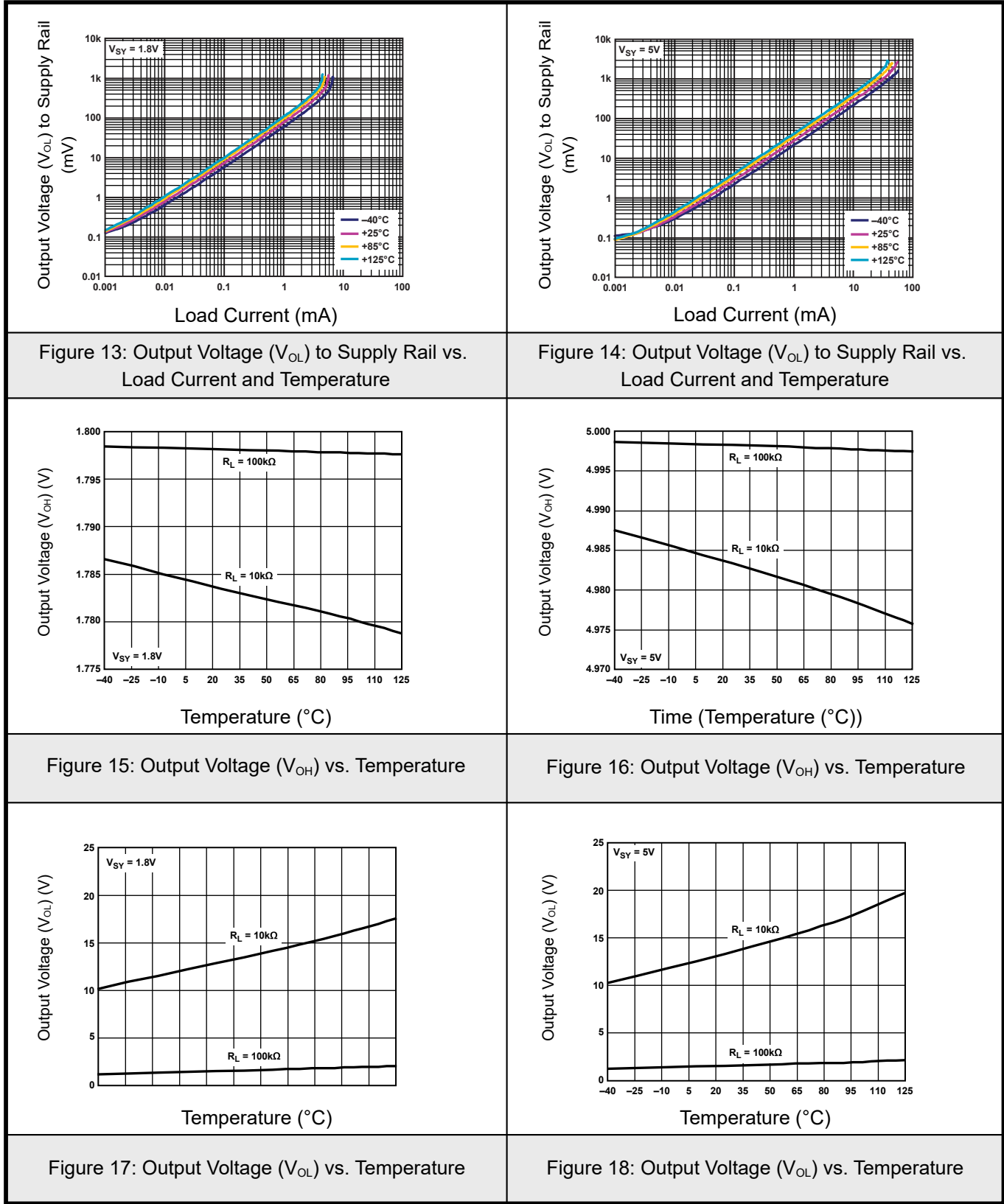


Figure 10: Input Bias Current vs. Common-Mode Voltage and Temperature

Figure 11: Output Voltage (V_{OH}) to Supply Rail vs. Load Current and TemperatureFigure 12: Output Voltage (V_{OH}) to Supply Rail vs. Load Current and Temperature



7.3Typical Characteristic





7.4 Typical Characteristic

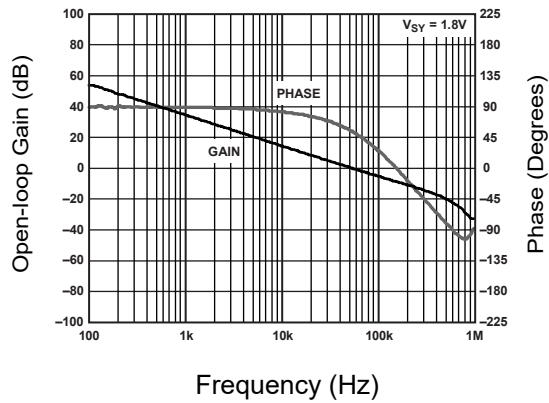


Figure 19: Open-Loop Gain and Phase vs. Frequency

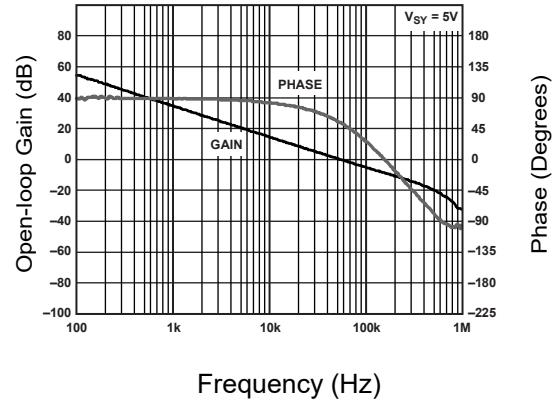


Figure 20: Open-Loop Gain and Phase vs. Frequency

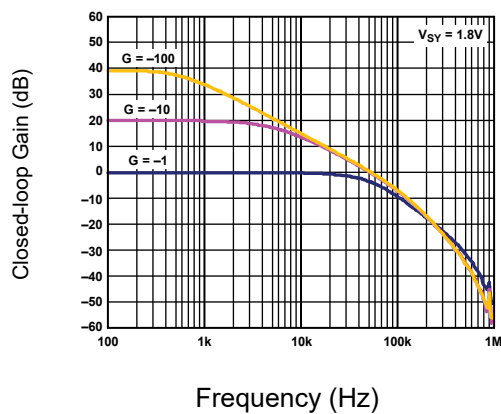


Figure 21: Closed-Loop Gain vs. Frequency

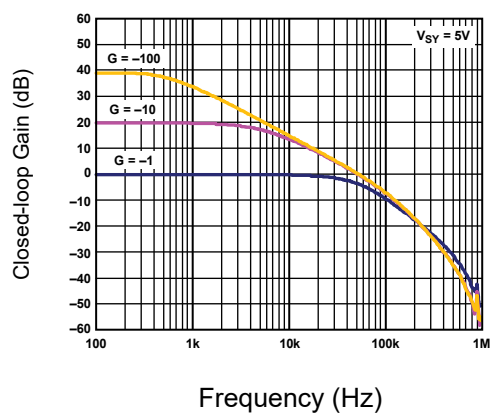


Figure 22: Closed-Loop Gain vs. Frequency

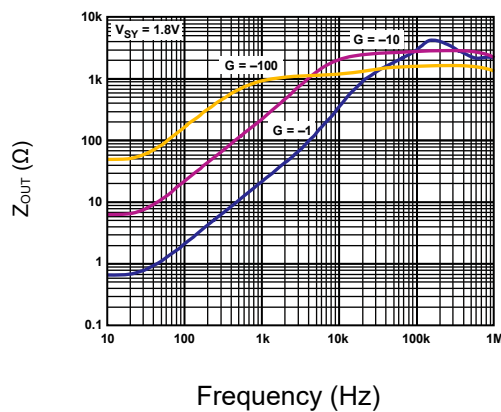


Figure 23: Output Impedance vs. Frequency

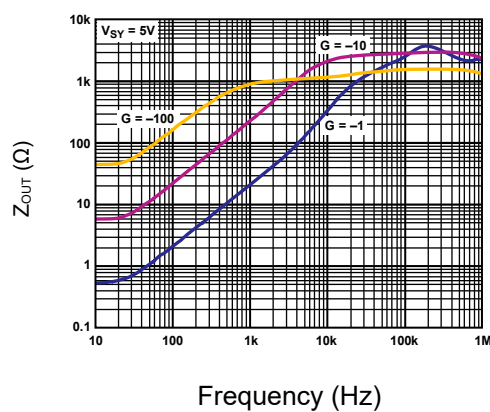
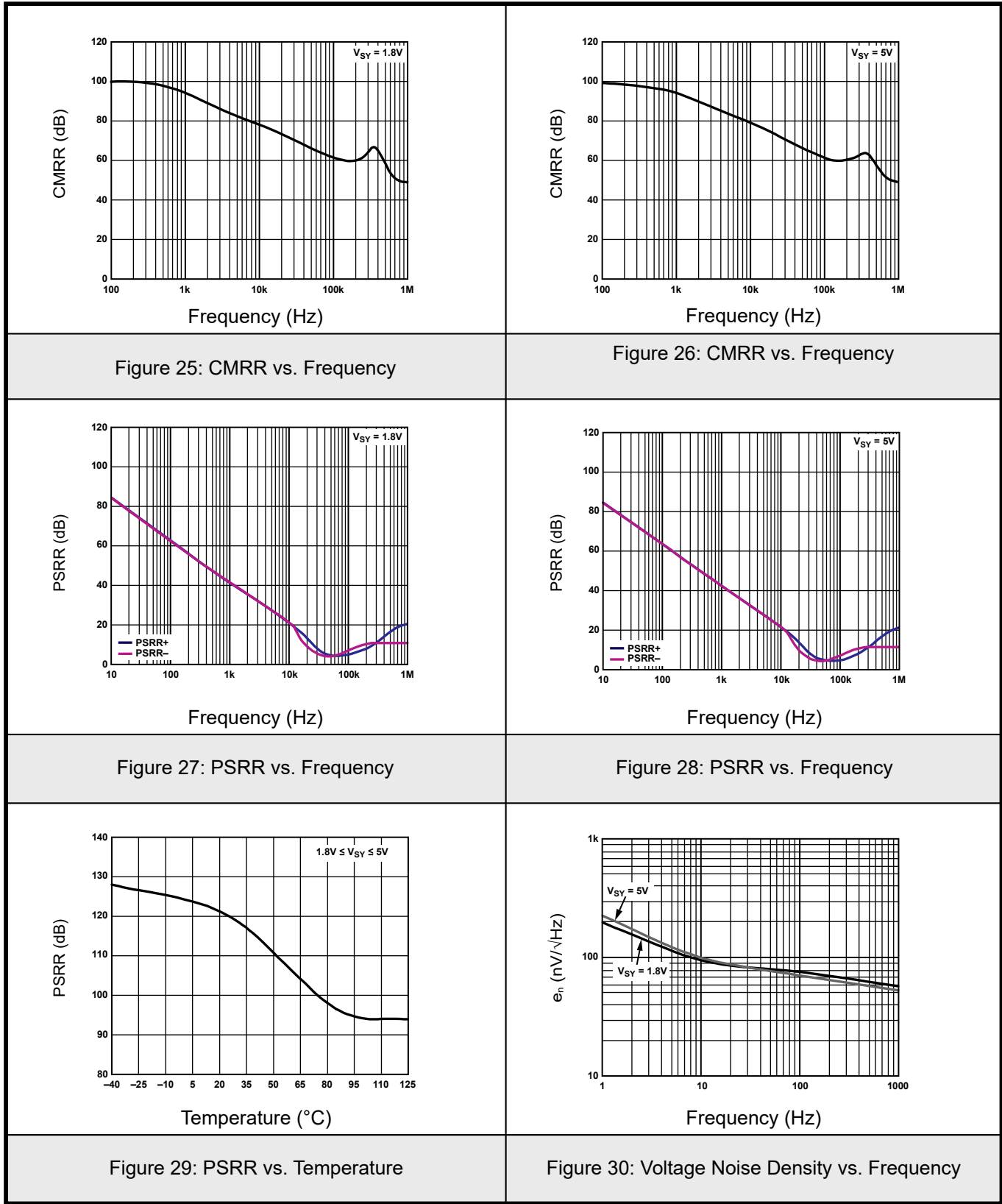


Figure 24: Output Impedance vs. Frequency



7.5Typical Characteristic





7.6 Typical Characteristic

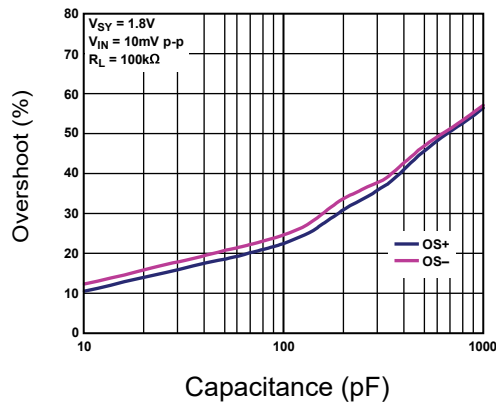


Figure 31: Small Signal Overshoot vs. Load Capacitance

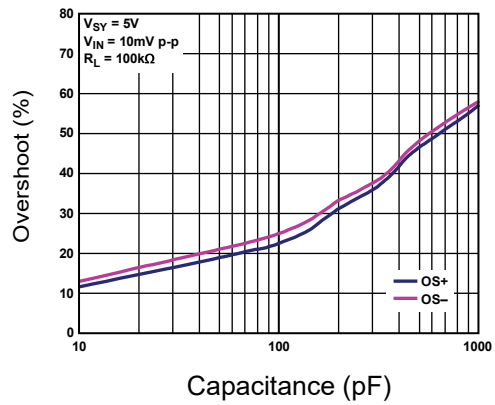


Figure 32: Small Signal Overshoot vs. Load Capacitance

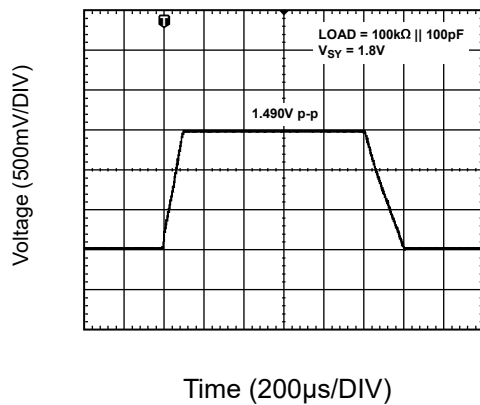


Figure 33: Large Signal Transient Response

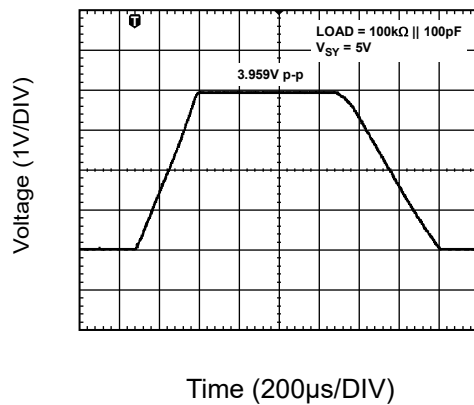


Figure 34: Large Signal Transient Response

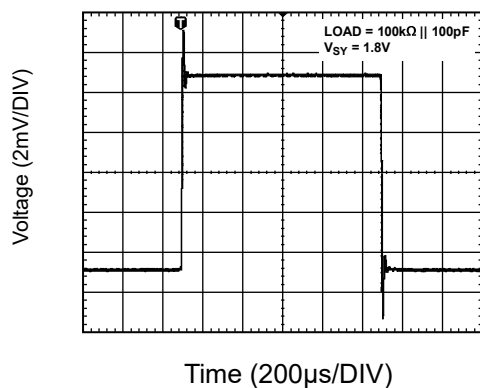


Figure 35: Small Signal Transient Response

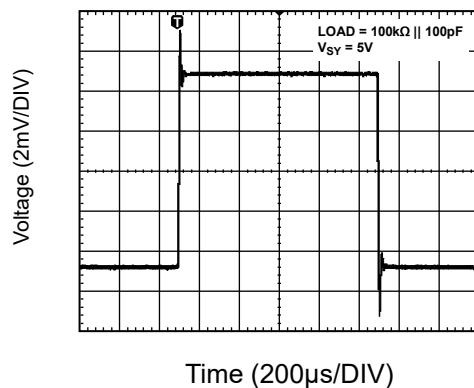


Figure 36: Small Signal Transient Response



7.7 Typical Characteristic

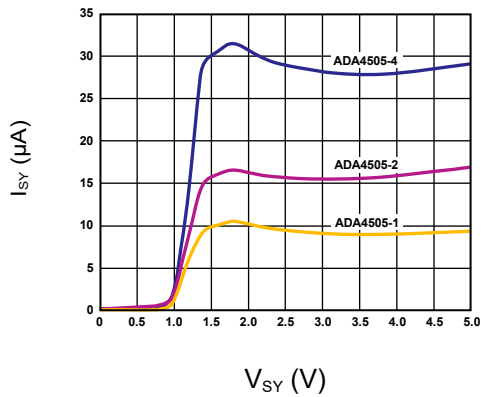


Figure 37: Supply Current vs. Supply Voltage

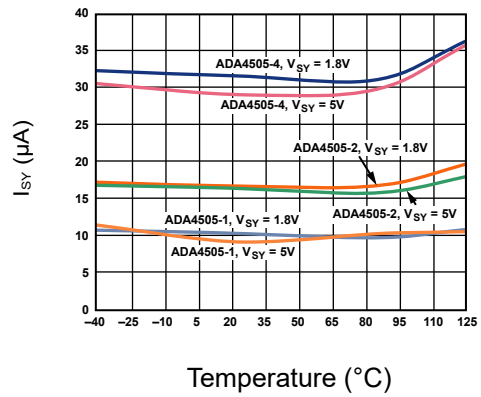


Figure 38: Total Supply Current vs. Temperature

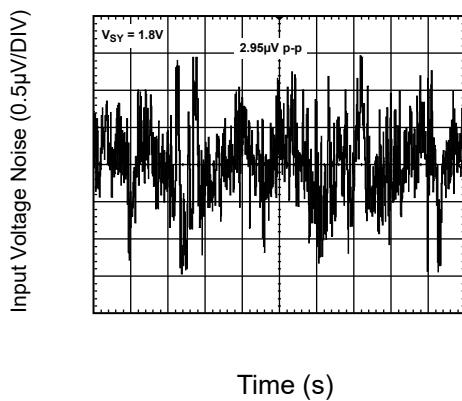


Figure 39: Input Voltage Noise, 0.1 Hz to 10 Hz Noise

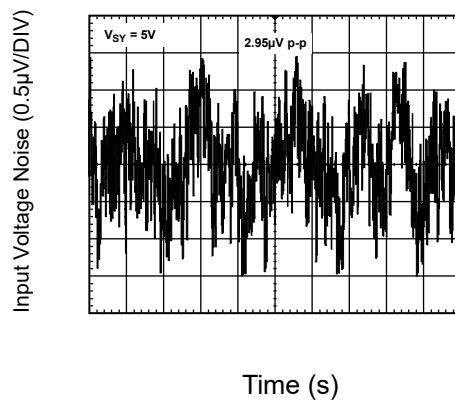


Figure 40: Input Voltage Noise, 0.1 Hz to 10 Hz Noise

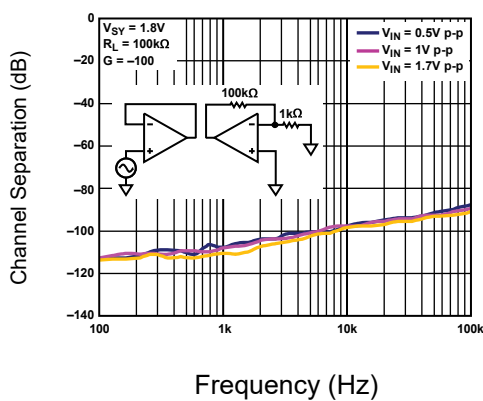


Figure 41: Channel Separation vs. Frequency

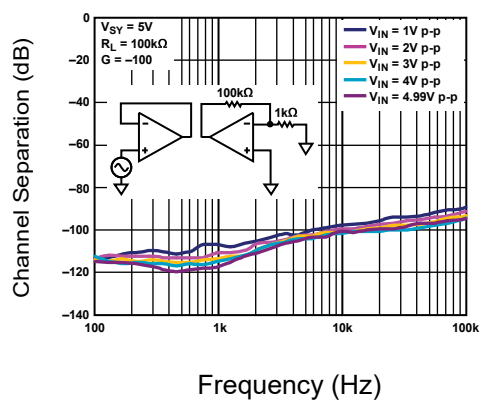
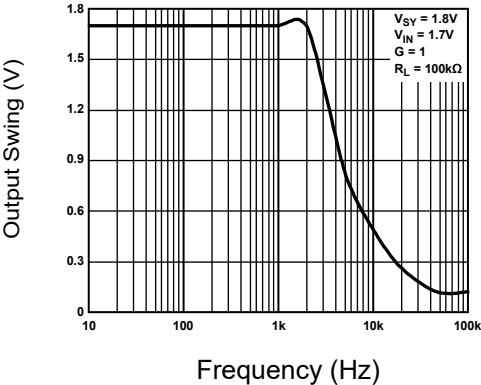
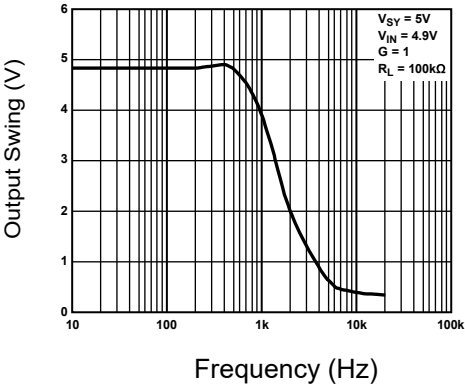
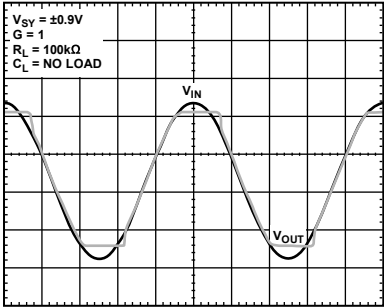
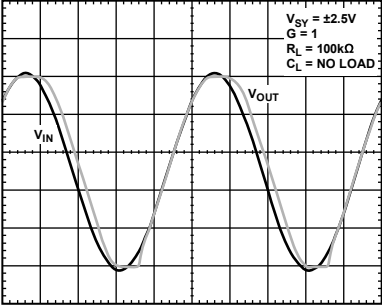


Figure 42: Channel Separation vs. Frequency

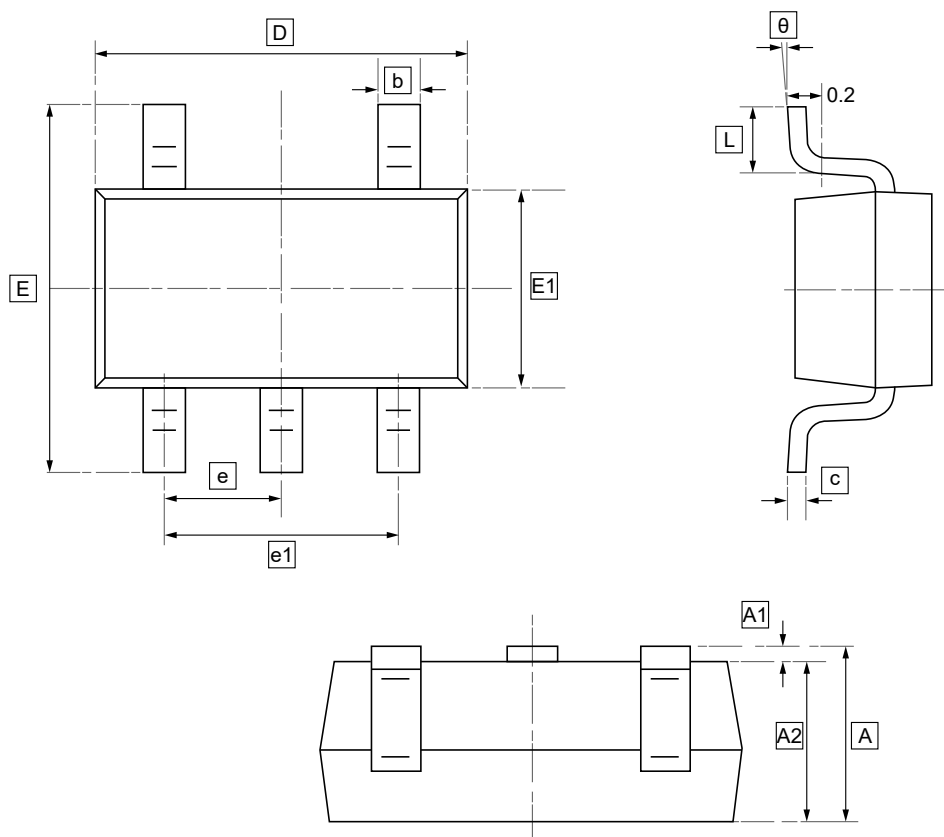


7.8Typical Characteristic

	
Figure 43: Output Swing vs. Frequency	Figure 44: Output Swing vs. Frequency
	
Figure 45: No Phase Reversal	Figure 46: No Phase Reversal



8.1 SOT23-5 Package Outline Dimensions

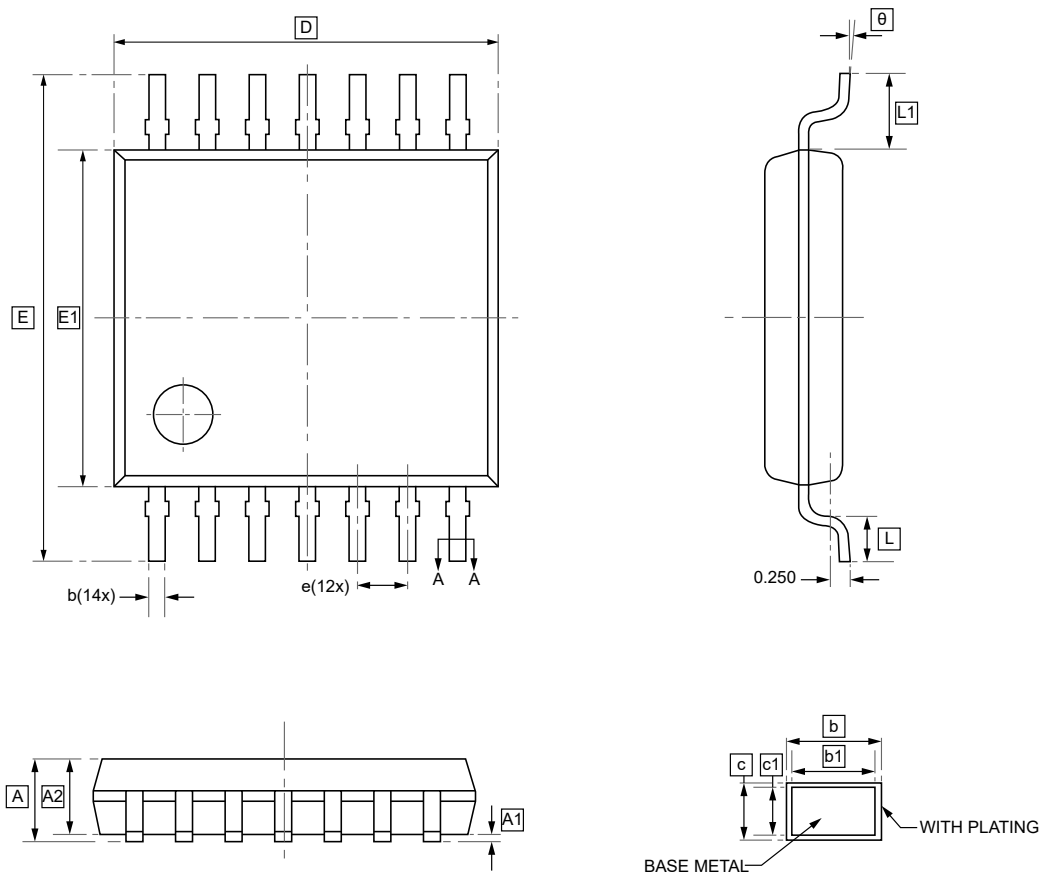


DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	A2	b	c	D	E1	E	e	e1	L	θ
Min	1.050	0.000	1.050	0.300	0.100	2.820	1.500	2.650	0.950	1.800	0.300	0°
Max	1.250	0.100	1.150	0.500	0.200	3.020	1.700	2.950	BSC	2.000	0.600	8°



8.2TSSOP-14 Package Outline Dimensions



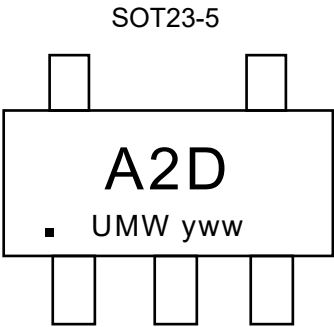
DIMENSIONS (mm are the original dimensions)

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

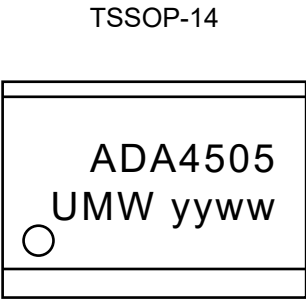
Symbol	L	θ
Min	0.45	0°
Max	0.75	8°



9.Ordering information



y: Year Code
ww: Week Code



yy: Year Code
ww: Week Code

Order Code	Marking	Package	Base QTY	Delivery Mode
UMW ADA4505-1ARJZ	A2D	SOT-23-5	3000	Tape and reel
UMW ADA4505-4ARUZ	ADA4505	TSSOP-14	4000	Tape and reel



10.Disclaimer

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