1.Description

The OP2177/4177 family consists of very high precision, single, dual,and quad amplifiers featuring extremely low offset voltage and drift, low input bias current, low noise, and low power consump-tion. Outputs are stable with capacitive loads of over 1000 pF with no external compensation. Supply current is less than 500 µA per amplifier at 30 V. Internal 500 Ω series resistors protect the inputs, allowing input signal levels several volts beyond either supply without phase reversal.

2.Applications

- Wireless base station control circuits
- Optical network control circuits
- Instrumentation
- Sensors and controls

  Thermocouples

  Resistor thermal detectors (RTDs)

  Strain bridges

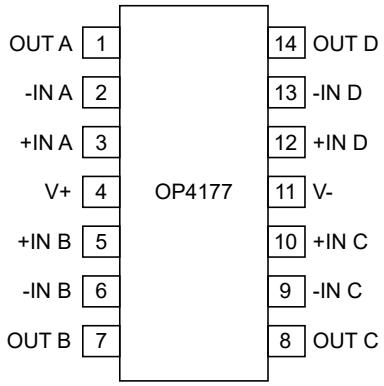
  Shunt current measurements
- Precision filters

3.Features

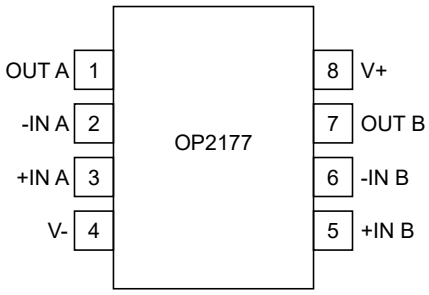
- Low offset voltage: 60 µV maximum
- Very low offset voltage drift: 0.7µV/°C maximum Low input bias current: 2 nA maximum
- Low noise: 8 nV/√Hz typical
- CMRR, PSRR, and AVO > 120 dB minimum
- Low supply current: 400 µA per amplifier
- Dual supply operation: ±2.5V to ±15V

  Unity-gain stable
- No phase reversal
- Inputs internally protected beyond supply voltage

4.Pinning Information



SOP-14



SOP-8

5.Absolute Maximum Ratings

Description	Rating
Supply Voltage	36V
Input Voltage	V_{S-} to V_{S+}
Differential input Voltage	±Supply Voltage
Storage Temperature Range R, RM, and RU Packages	−65°C to +150°C
Operating Temperature Range OP1177/OP2177/OP4177	−40°C to +125°C
Junction Temperature Range R, RM, and RU Packages	−65°C to +150°C
Lead Temperature, Soldering (10 sec)	300°C

6.1Electrical Characteristics

V_S=±5.0V, V_{CM}=0V, T_A=25°C, unless otherwise noted.

Parameter		Symbol	Conditions	Min	Typ	Max	Units
Offset Voltage	OP2177/OP4177	V_{OS}			15	75	μV
	OP2177		−40°C <T_A<+125°C		25	100	μV
	OP4177		−40°C <T_A<+125°C		25	120	μV
Input Bias Current		I_B	−40°C <T_A<+125°C	-2	0.5	2	nA
Input Offset Current		I_{OS}T	−40°C <T_A<+125°C	-1	0.2	1	nA
Input Voltage Range				-3.5		3.5	V
Common-Mode Rejection Ratio		CMRR	V_{CM}=-3.5 V to +3.5 V	120	126		dB
			−40°C<T_A<+125°C	118	125		dB
Large Signal Voltage Gain		A_{VO}	R_L=100kΩ to V_{CM}, V_O= −3.5V to 3.5V	1000	2000		V/mV
Offset Voltage Drift							
OP2177		$\Delta V_{OS}/\Delta T$	−40°C<T_A<+125°C		0.2	0.7	μV/°C
OP4177		$\Delta V_{OS}/\Delta T$	−40°C<T_A<+125°C		0.3	0.9	μV/°C
Output Voltage High		V_{OH}	I_L=1mA, −40°C<T_A<+125°C	4	4.1		V
Output Voltage Low		V_{OL}	I_L=1mA, −40°C<T_A<+125°C		-4.1	-4	V
Output Current		I_{OUT}	$V_{DROPOUT}$<1.2V		±10		mA
Power Supply Rejection Ratio							
OP2177/OP4177		PSRR	V_S=±2.5V to ±15V	118	121		dB
			−40°C<T_A<+125°C	114	120		dB
Supply Current per Amplifier		I_{SY}	V_O=0V		400	500	μA
			−40°C<T_A<+125°C		500	600	μA
Slew Rate		SR	R_L=2kΩ		0.7		V/μs
Gain Bandwidth Product		GBP			1.3		MHz
Voltage Noise		e_np-p	0.1Hz to 10Hz		0.4		μV_{p-p}
Voltage Noise Density		e_n	f=1kHz		7.9	8.5	nV/√Hz
Current Noise Density		i_n	f=1kHz		0.2		pA/√Hz
Multiple Amplifiers		C_S	DC		0.01		μV/V
Channel Separation			f=100kHz		-120		dB

6.2Electrical Characteristics

V_S=±15V, V_{CM}=0V, T_A=25°C, unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Offset Voltage						
OP2177/OP4177	V_{OS}			15	75	μV
OP2177	V_{OS}	−40°C <T_A<+125°C		25	100	μV
OP4177	V_{OS}	−40°C <T_A<+125°C		25	120	μV
Input Bias Current	I_B	−40°C <T_A<+125°C	-2	0.5	2	nA
Input Offset Current	I_{OS}	−40°C <T_A<+125°C	-1	0.2	1	nA
Input Voltage Range			-13.5		13.5	V
Common-Mode Rejection Ratio	CMRR	V_{CM}=-13.5 V to +13.5 V				
		−40°C<T_A<+125°C	120	125		dB
Large Signal Voltage Gain	A_{VO}	R_L=2kΩ to V_{CM}, V_O= −13.5V to 13.5V	1000	3000		V/mV
Offset Voltage Drift						
OP2177	$\Delta V_{OS}/\Delta T$	−40°C<T_A<+125°C		0.2	0.7	μV/°C
OP4177	$\Delta V_{OS}/\Delta T$	−40°C<T_A<+125°C		0.3	0.9	μV/°C
Output Voltage High	V_{OH}	I_L=1mA, −40°C<T_A<+125°C	14	14.1		V
Output Voltage Low	V_{OL}	I_L=1mA, −40°C<T_A<+125°C		-14.1	-14	V
Output Current	I_{OUT}	$V_{DROPOUT}$<1.2V		±10		mA
Short-Circuit Current	I_{SC}			±25		mA
Power Supply Rejection Ratio						
OP2177/OP4177	PSRR	V_S=±2.5V to ±15V	118	121		dB
		−40°C<T_A<+125°C	114	120		dB
Supply Current per Amplifier	I_{SY}	V_O=0V		400	500	μA
		−40°C<T_A<+125°C		500	600	μA
Slew Rate	SR	R_L=2kΩ		0.7		V/μs
Gain Bandwidth Product	GBP			1.3		MHz

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Voltage Noise	e_np-p			0.4		μV_{p-p}
Voltage Noise Density	e_n	0.1Hz to 10Hz		7.9	8.5	nV/√Hz
Current Noise Density	i_n	f=1kHz		0.2		pA/√Hz
Multiple Amplifiers Channel Separation	C_S	f=1kHz		0.01		μV/V
		DC				
		f=100kHz		-120		dB

7.1Typical Characteristic

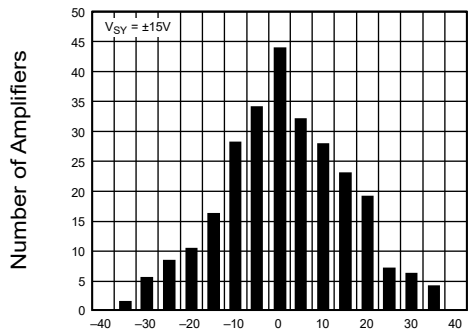


Figure 1: Input Offset Voltage Distribution

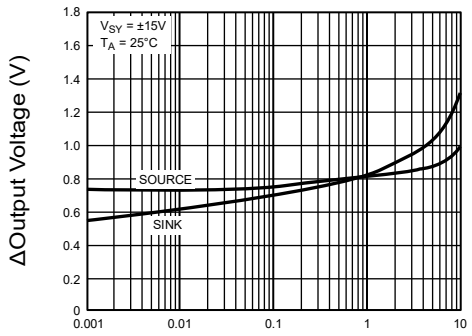


Figure 2: Output Voltage to Supply Rail vs. Load Current

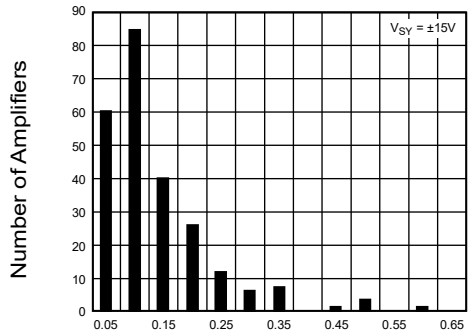


Figure 3: Input Offset Voltage Drift Distribution

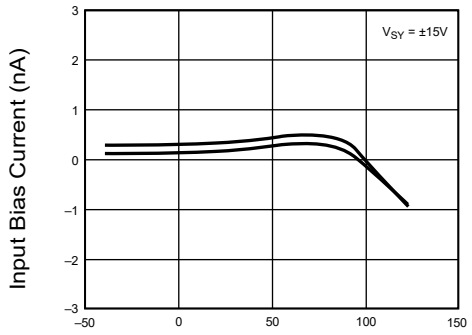


Figure 4: Input Bias Current vs. Temperature

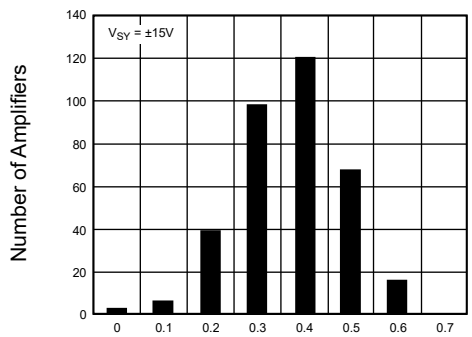


Figure 5: Input Bias Current Distribution

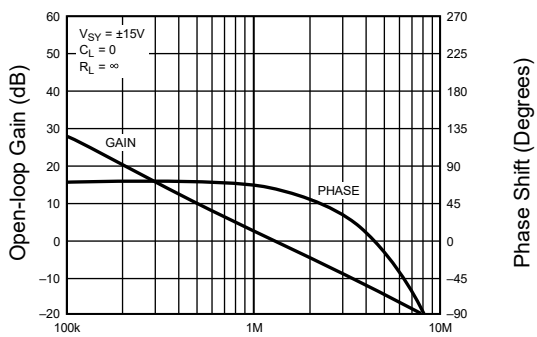


Figure 6: Open-Loop Gain and Phase Shift vs. Frequency

7.2Typical Characteristic

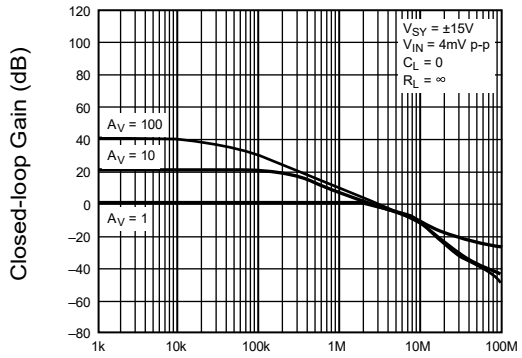


Figure 7: Closed-Loop Gain vs. Frequency

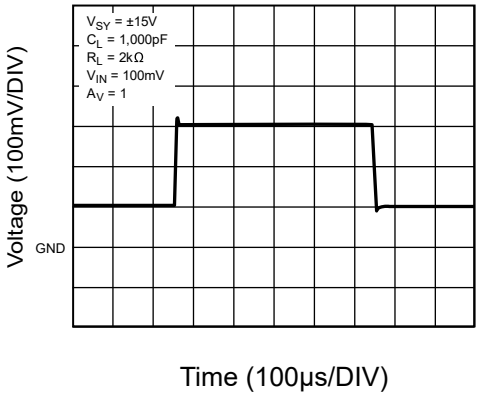


Figure 8: Small Signal Transient Response

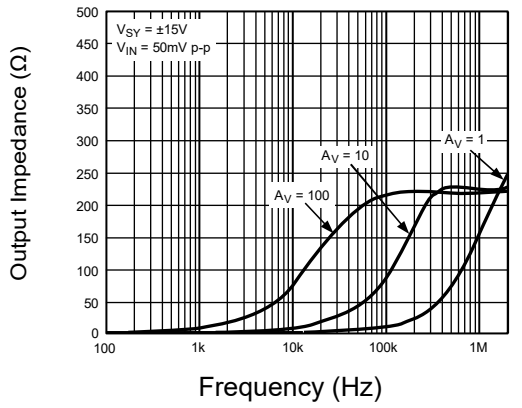


Figure 9: Output Impedance vs. Frequency

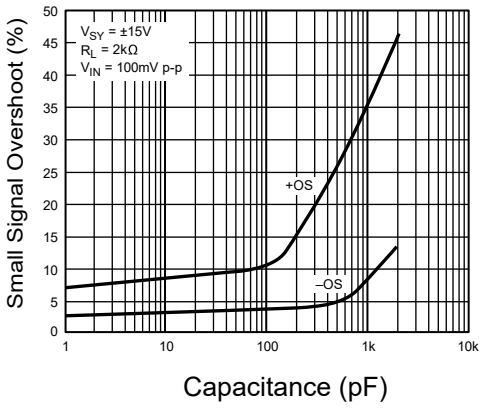


Figure 10: Small Signal Overshoot vs. Load Capacitance

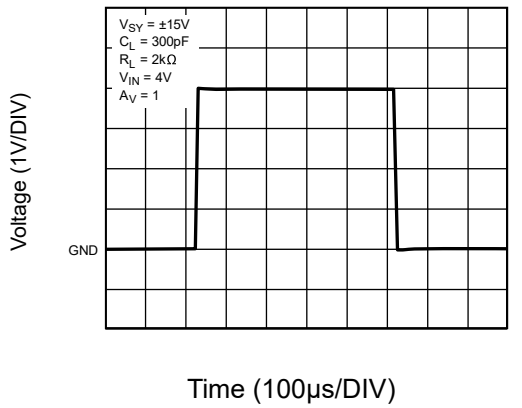


Figure 11: Large Signal Transient Response

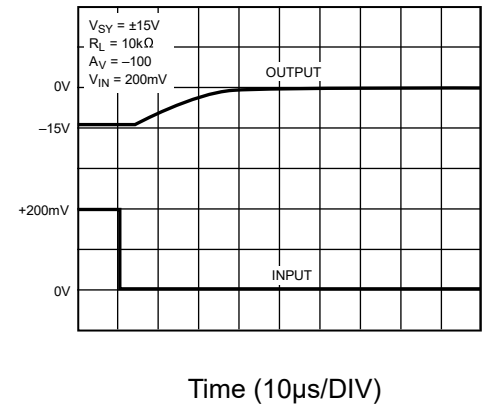


Figure 12: Positive Overvoltage Recovery

7.3Typical Characteristic

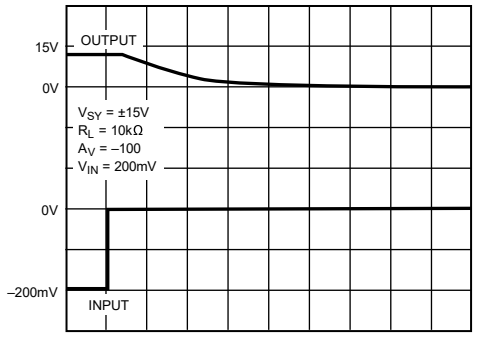


Figure 13: Negative Overvoltage Recovery

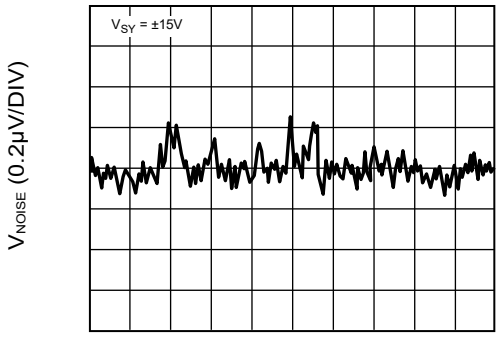


Figure 14: 0.1 Hz to 10 Hz Input Voltage Noise

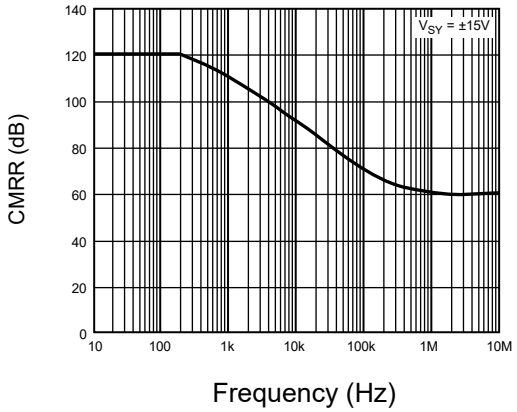


Figure 15: CMRR vs. Frequency

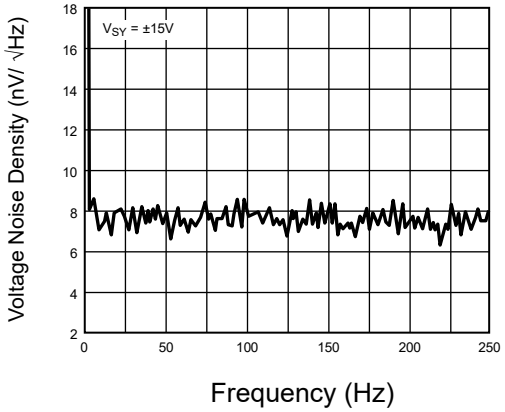


Figure 16: Voltage Noise Density vs. Frequency

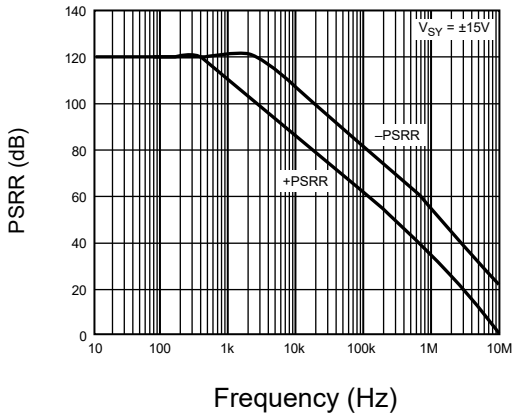


Figure 17: PSRR vs. Frequency

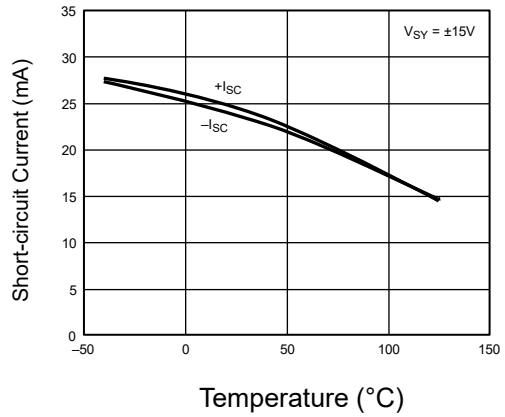


Figure 18: Short-Circuit Current vs. Temperature

7.4Typical Characteristic

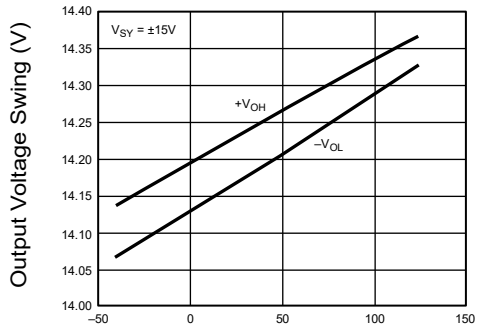


Figure 19: Output Voltage Swing vs. Temperature

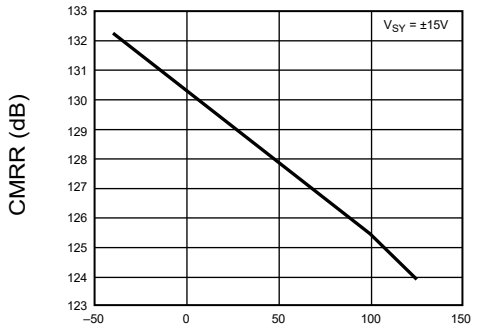


Figure 20: CMRR vs. Temperature

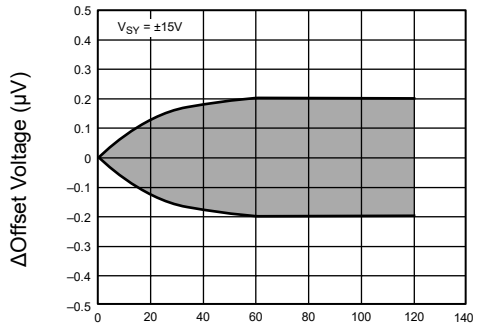


Figure 21: Warm-Up Drift

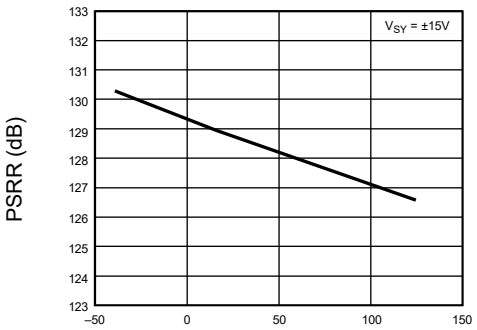


Figure 22: PSRR vs. Temperature

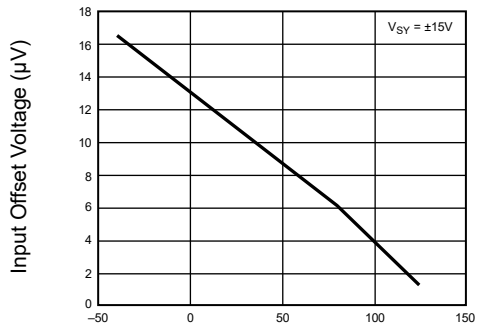


Figure 23: Input Offset Voltage vs. Temperature

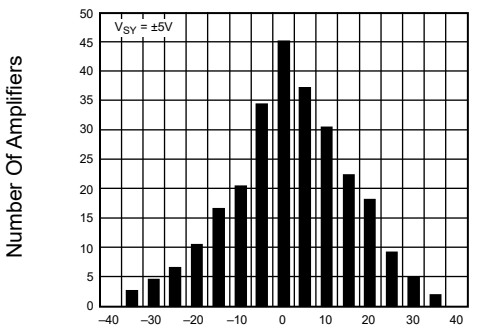


Figure 24: Input Offset Voltage Distribution

7.5Typical Characteristic

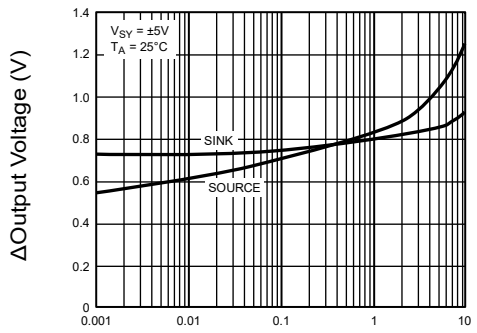


Figure 25: Output Voltage to Supply Rail vs. Load Current

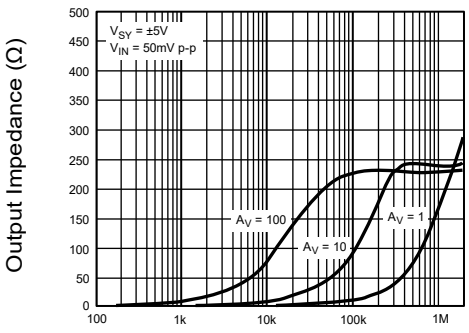


Figure 26: Output Impedance vs. Frequency

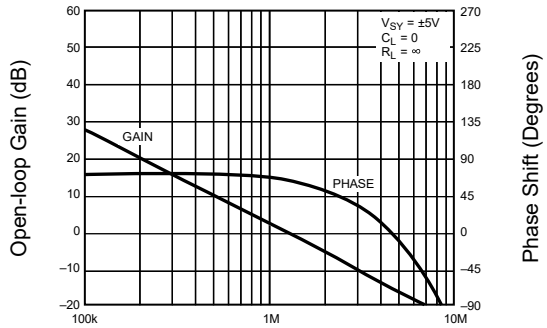


Figure 27: Open-Loop Gain and Phase Shift vs. Frequency

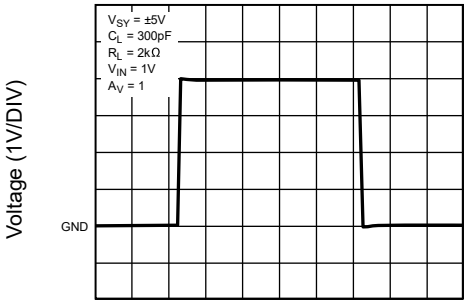


Figure 28: Large Signal Transient Response

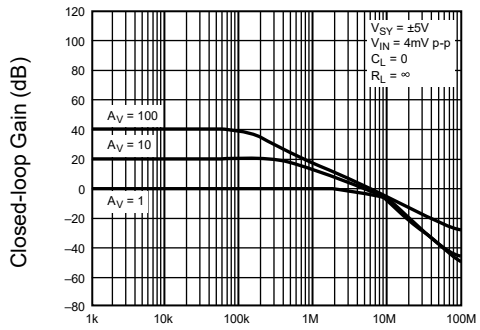


Figure 29: Closed-Loop Gain vs. Frequency

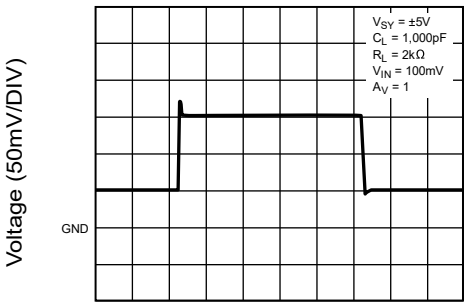


Figure 30: Small Signal Transient Response

7.6Typical Characteristic

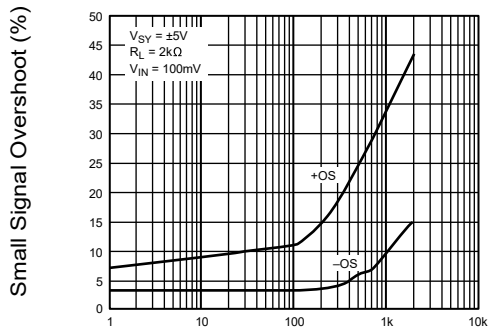


Figure 31: Small Signal Overshoot vs. Load Capacitance

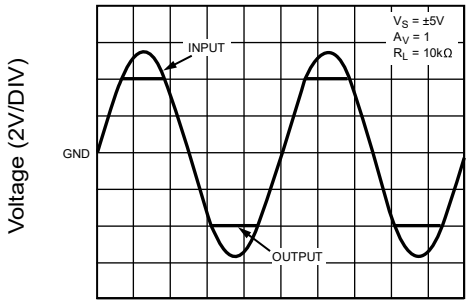


Figure 32: No Phase Reversal

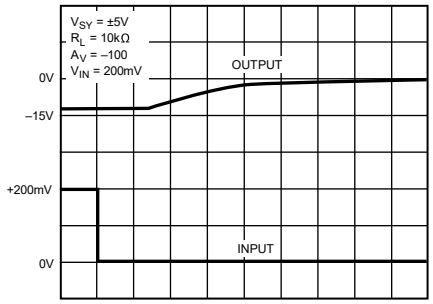


Figure 33: Positive Overvoltage Recovery

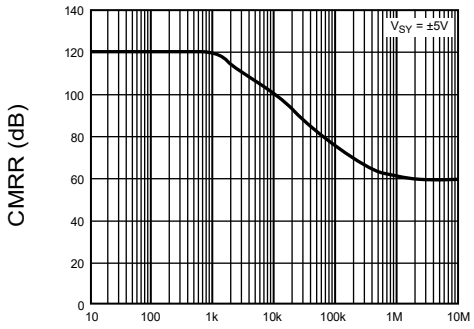


Figure 34: CMRR vs. Frequency

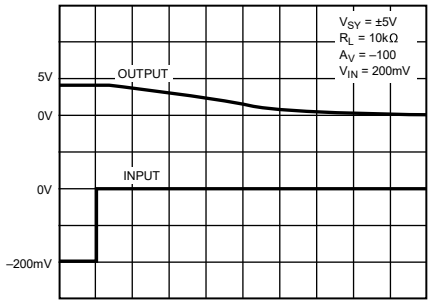


Figure 35: Negative Overvoltage Recovery

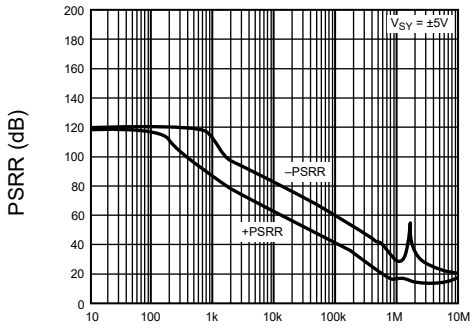


Figure 36: PSRR vs. Frequency

7.7Typical Characteristic

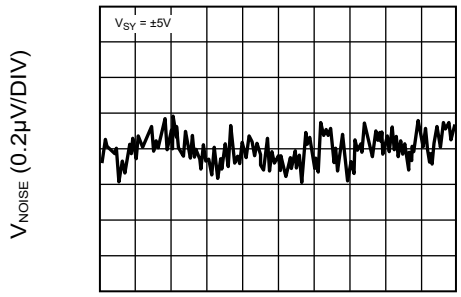


Figure 37: 0.1 Hz to 10 Hz Input Voltage Noise

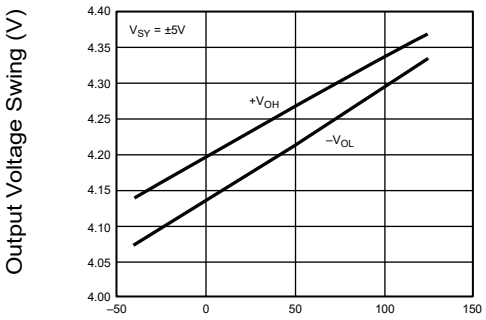


Figure 38: Output Voltage Swing vs. Temperature

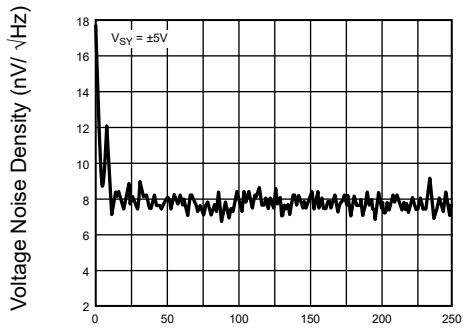


Figure 39: Voltage Noise Density vs. Frequency

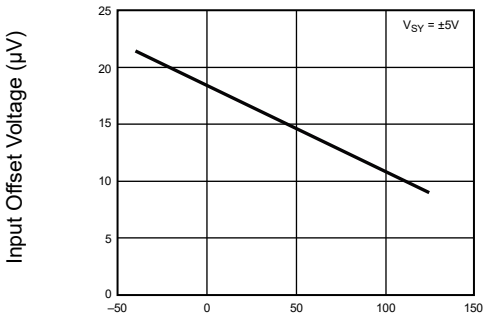


Figure 40: Input Offset Voltage vs. Temperature

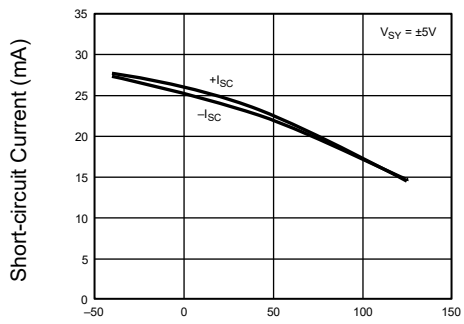


Figure 41: Short-Circuit Current vs. Temperature

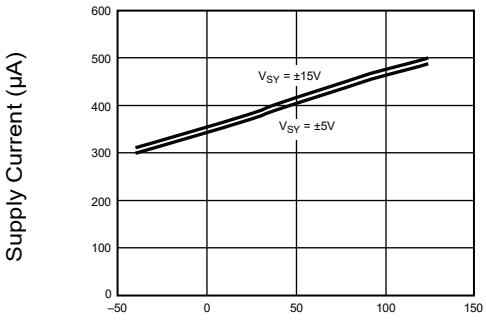


Figure 42: Supply Current vs. Temperature

7.8Typical Characteristic

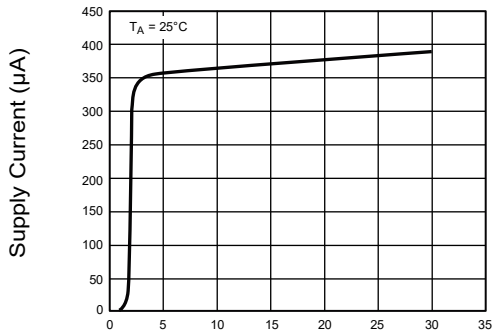


Figure 43: Supply Current vs. Supply Voltage

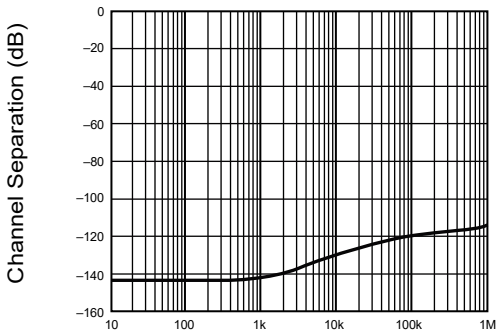
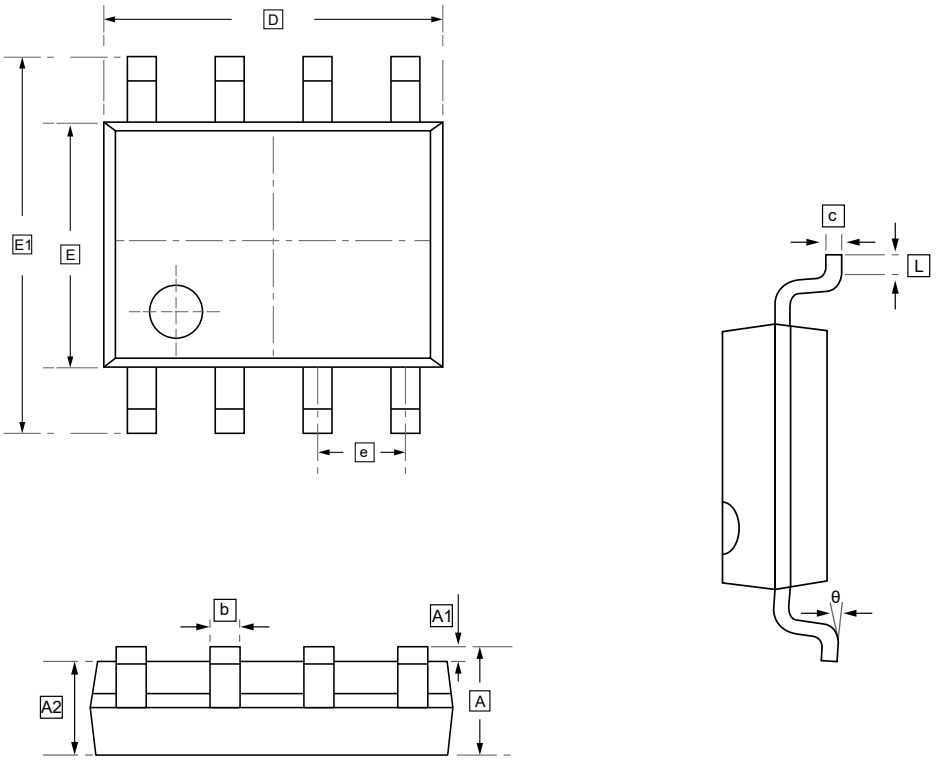


Figure 44: Channel Separation vs. Frequency

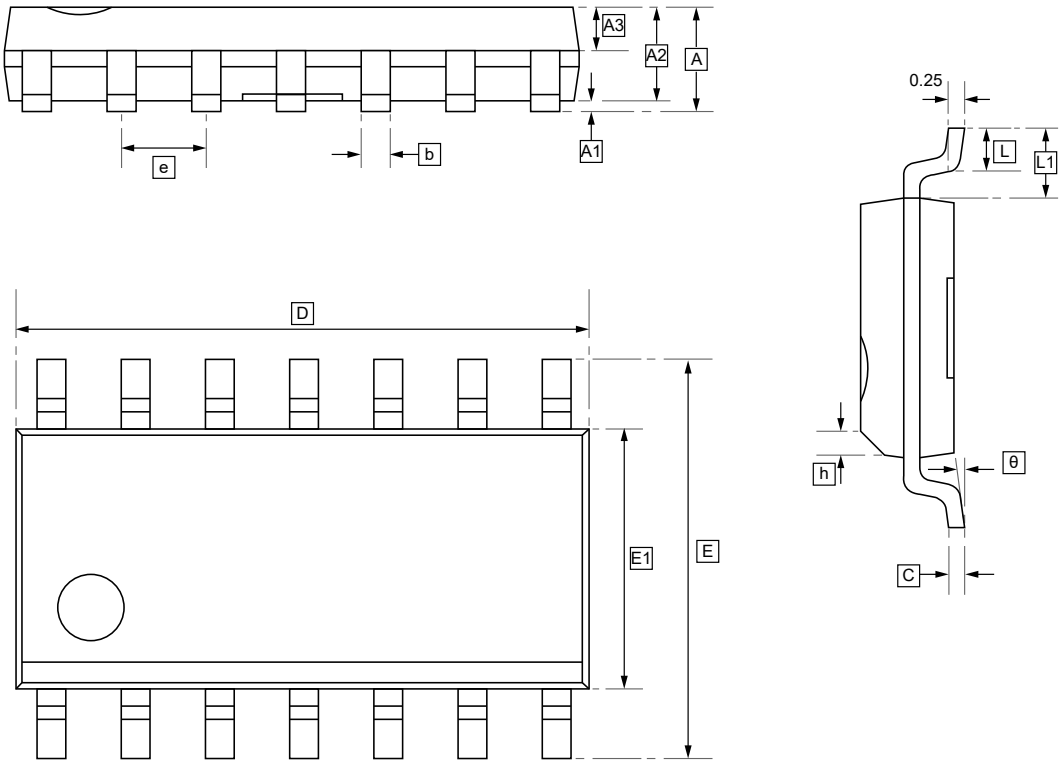
8.1SOP-8 Package Outline Dimensions



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°

8.2SOP-14 Package Outline Dimensions



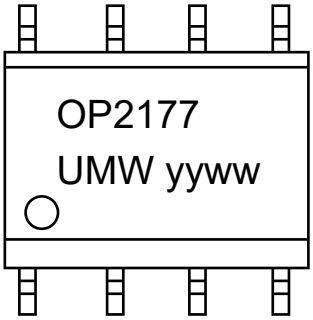
DIMENSIONS (mm are the original dimensions)

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

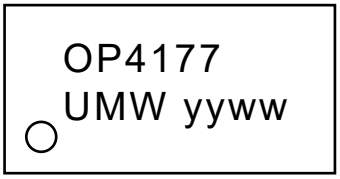
Symbol	L1	θ
Min	1.00	0°
Max	1.10	8°

9.Ordering Information

SOP-8



SOP-14



yy: Year Code
ww: Week Code

Order Code	Marking	Package	Base QTY	Delivery Mode
UMW OP2177ARZ	OP2177	SOP-8	2500	Tape and reel
UMW OP4177ARZ	OP4177	SOP-14	2500	Tape and reel

10.Disclaimer

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