

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 consumption. Outputs are stable with capacitive loads of over 1000 pF with no external compensation. Supply current is less than 500 μ A 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.

3. Features

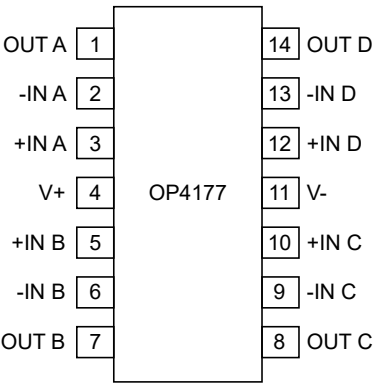
- Low offset voltage: 60 μ V maximum
- Very low offset voltage drift: 0.7 μ V/ $^{\circ}$ C maximum
- Low input bias current: 2 nA maximum
- Low noise: 8 nV/ $\sqrt{\text{Hz}}$ typical
- CMRR, PSRR, and AVO > 120 dB minimum
- Low supply current: 400 μ A per amplifier

2. Applications

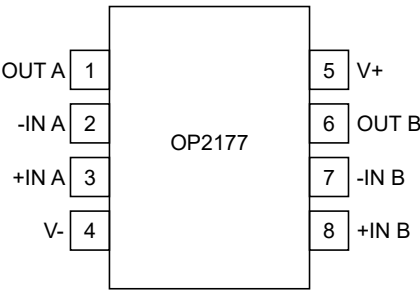
- Wireless base station control circuits
- Optical network control circuits
- Instrumentation
- Sensors and controls
 - Thermocouples
 - Resistor thermal detectors (RTDs)
 - Strain bridges
 - Shunt current measurements
- Precision filters
- Dual supply operation: ± 2.5 V to ± 15 V
 - Unity-gain stable
- 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	$\pm$ 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



6.1 Electrical Characteristics

$V_S = \pm 5.0V$, $V_{CM} = 0V$, $T_A = 25^\circ C$, unless otherwise noted.

Parameter		Symbol	Conditions	Min	Typ	Max	Units
Offset Voltage	OP2177/OP4177	V _{OS}			15	75	μV
	OP2177			25	100	μV	
	OP4177			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		ΔV _{OS} /ΔT	−40°C<T _A <+125°C		0.2	0.7	μV/°C
OP4177		ΔV _{OS} /ΔT	−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 _n p-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



6.2 Electrical Characteristics

$V_S = \pm 15V$, $V_{CM} = 0V$, $T_A = 25^\circ C$, unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Offset Voltage						
OP2177/OP4177	V_{OS}			15	75	μV
OP2177	V_{OS}	$-40^\circ C < T_A < +125^\circ C$		25	100	μV
OP4177	V_{OS}	$-40^\circ C < T_A < +125^\circ C$		25	120	μV
Input Bias Current	I_B	$-40^\circ C < T_A < +125^\circ C$	-2	0.5	2	nA
Input Offset Current	I_{OS}	$-40^\circ C < T_A < +125^\circ C$	-1	0.2	1	nA
Input Voltage Range			-13.5		13.5	V
Common-Mode Rejection Ratio	CMRR	$V_{CM} = -13.5 V \text{ to } +13.5 V$				
		$-40^\circ C < T_A < +125^\circ C$	120	125		dB
Large Signal Voltage Gain	A_{VO}	$R_L = 2k\Omega$ to V_{CM} , $V_O = -13.5V$ to $13.5V$	1000	3000		V/mV
Offset Voltage Drift						
OP2177	$\Delta V_{OS}/\Delta T$	$-40^\circ C < T_A < +125^\circ C$		0.2	0.7	$\mu V/^\circ C$
OP4177	$\Delta V_{OS}/\Delta T$	$-40^\circ C < T_A < +125^\circ C$		0.3	0.9	$\mu V/^\circ C$
Output Voltage High	V_{OH}	$I_L = 1mA$, $-40^\circ C < T_A < +125^\circ C$	14	14.1		V
Output Voltage Low	V_{OL}	$I_L = 1mA$, $-40^\circ C < T_A < +125^\circ C$		-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	$V_S = \pm 2.5V$ to $\pm 15V$	118	121		dB
		$-40^\circ C < T_A < +125^\circ C$	114	120		dB
Supply Current per Amplifier	I_{SY}	$V_O = 0V$		400	500	μA
		$-40^\circ C < T_A < +125^\circ C$		500	600	μA
Slew Rate	SR	$R_L = 2k\Omega$		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/ $\sqrt{Hz}$
Current Noise Density	i_n	f=1kHz		0.2		pA/ $\sqrt{Hz}$
Multiple Amplifiers	C_s	f=1kHz		0.01		$\mu V/V$
Channel Separation		DC				
		f=100kHz		-120		dB



7.1 Typical Characteristic

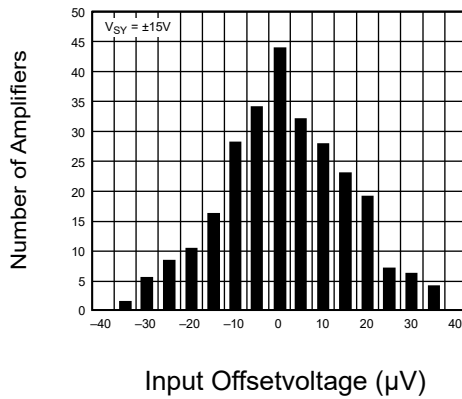


Figure 1: Input Offset Voltage Distribution

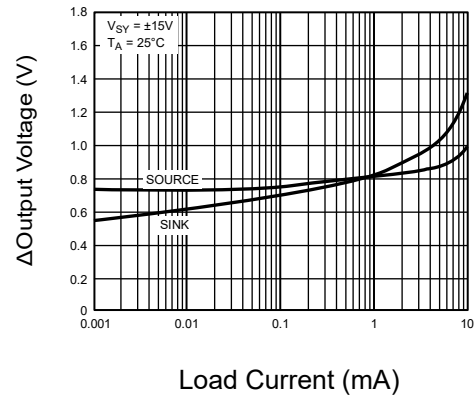


Figure 2: Output Voltage to Supply Rail vs. Load Current

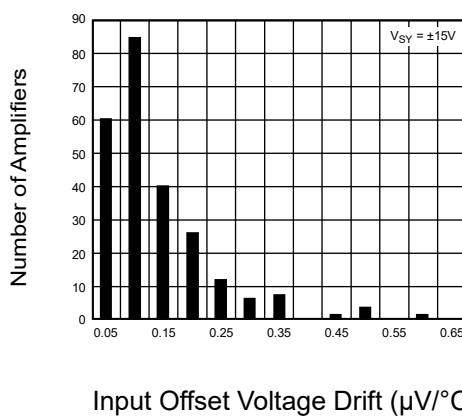


Figure 3: Input Offset Voltage Drift Distribution

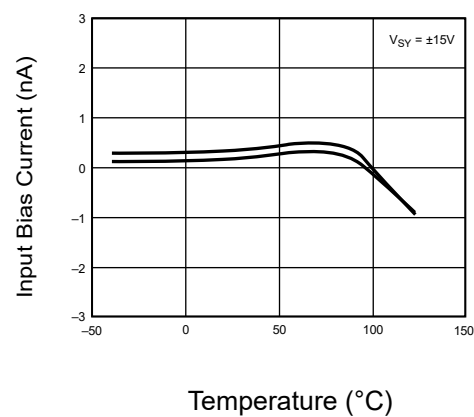


Figure 4: Input Bias Current vs. Temperature

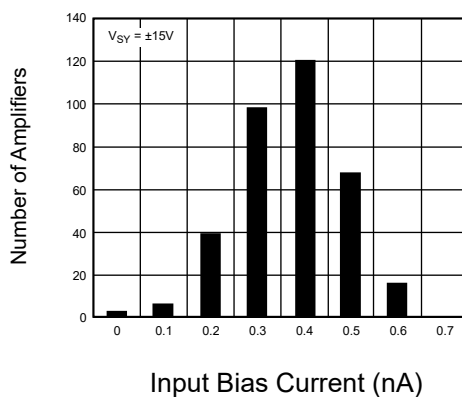


Figure 5: Input Bias Current Distribution

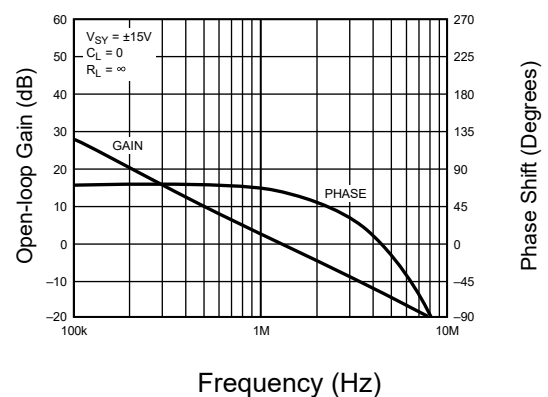


Figure 6: Open-Loop Gain and Phase Shift vs. Frequency



7.2 Typical Characteristic

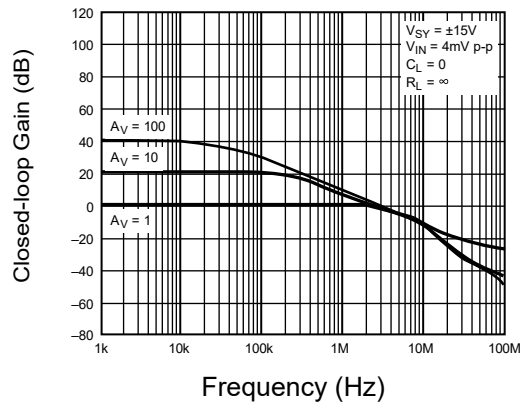


Figure 7: Closed-Loop Gain vs. Frequency

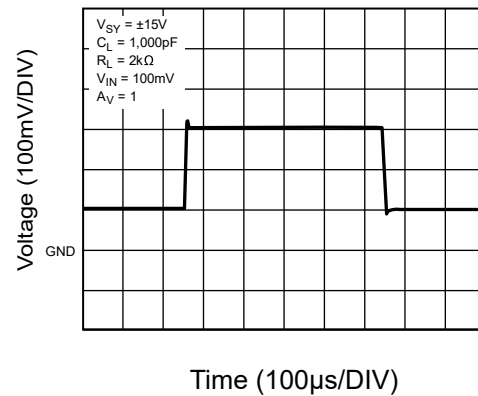


Figure 8: Small Signal Transient Response

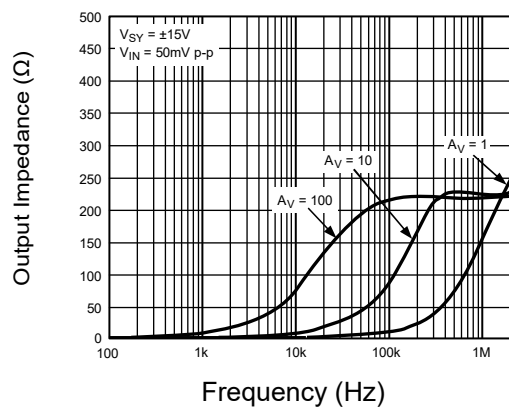


Figure 9: Output Impedance vs. Frequency

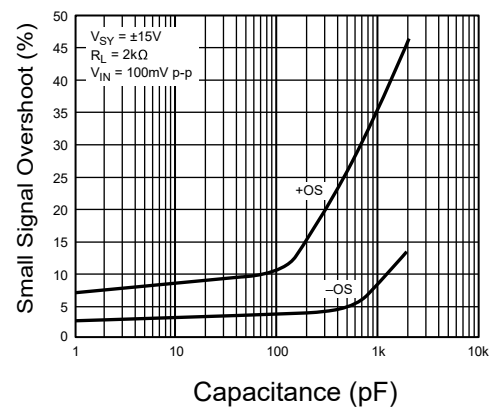


Figure 10: Small Signal Overshoot vs. Load Capacitance

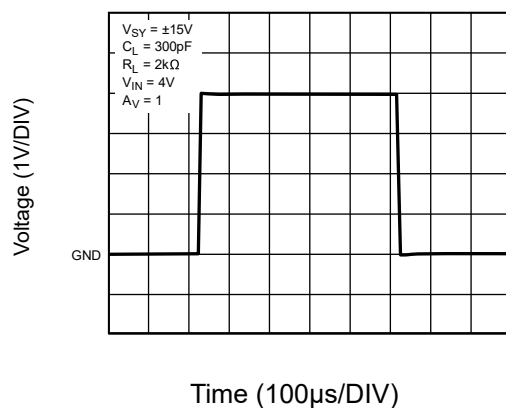


Figure 11: Large Signal Transient Response

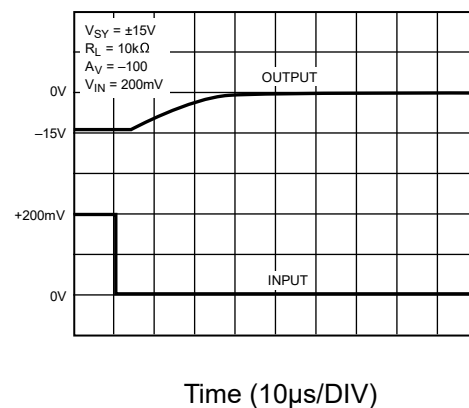
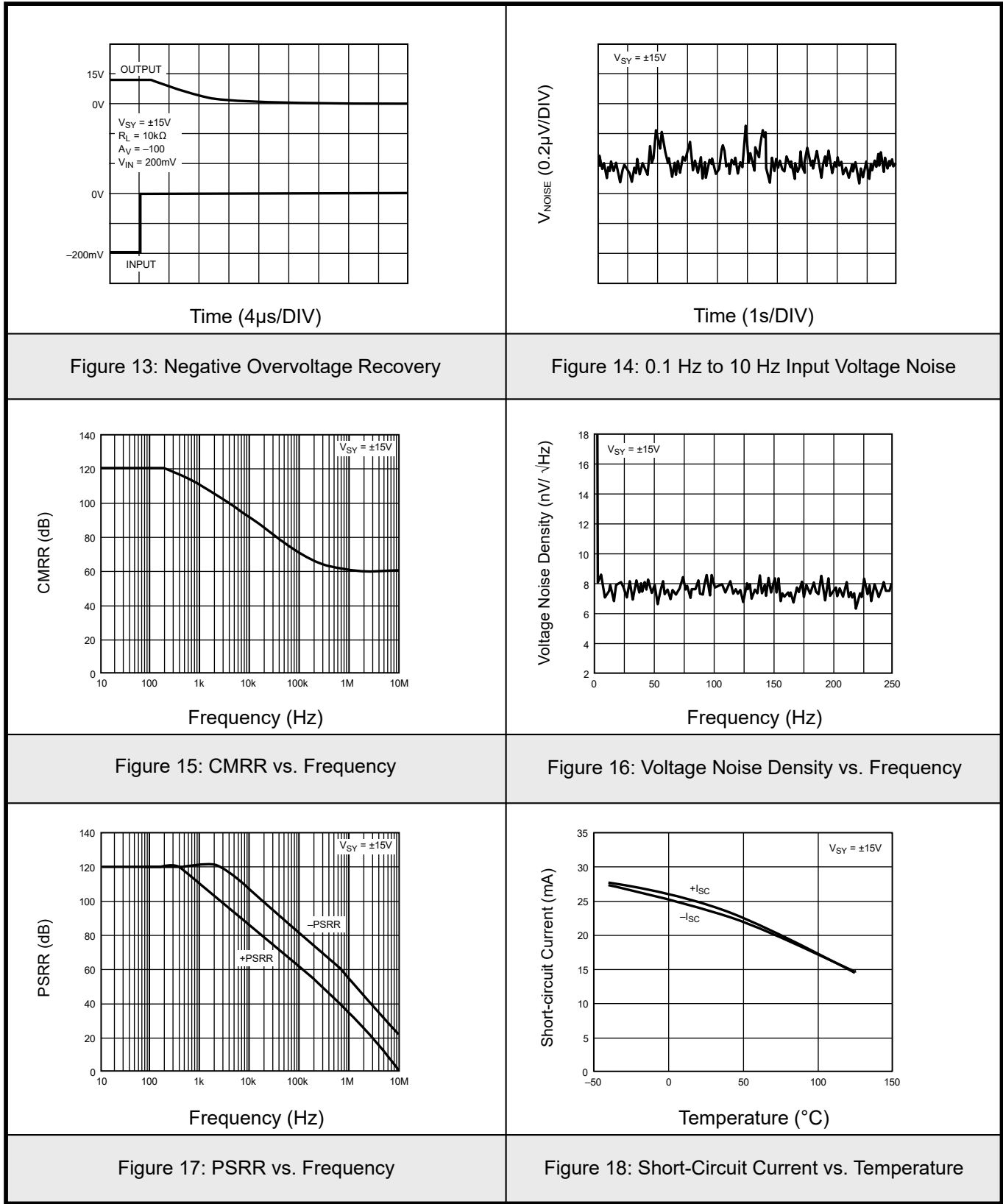


Figure 12: Positive Overvoltage Recovery

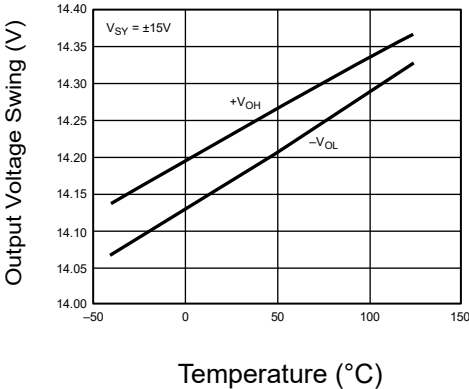
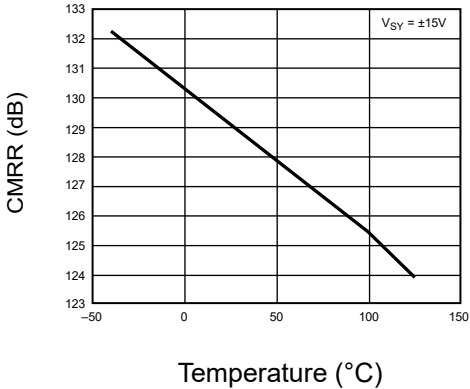
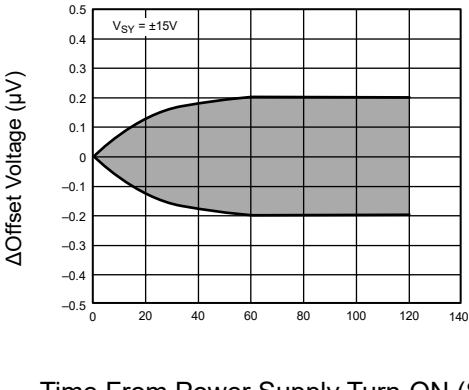
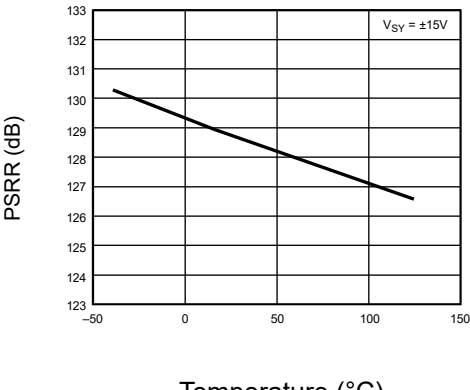
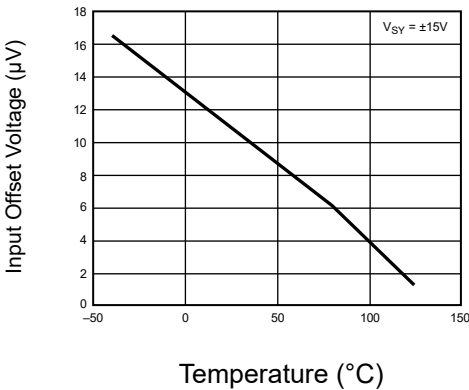
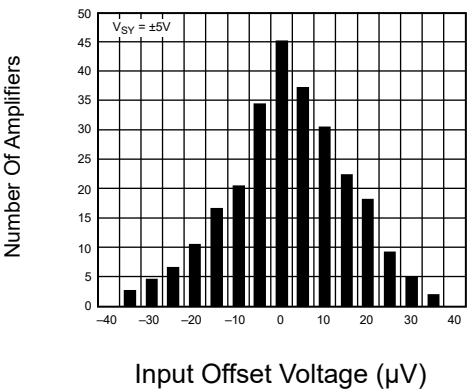


7.3Typical Characteristic



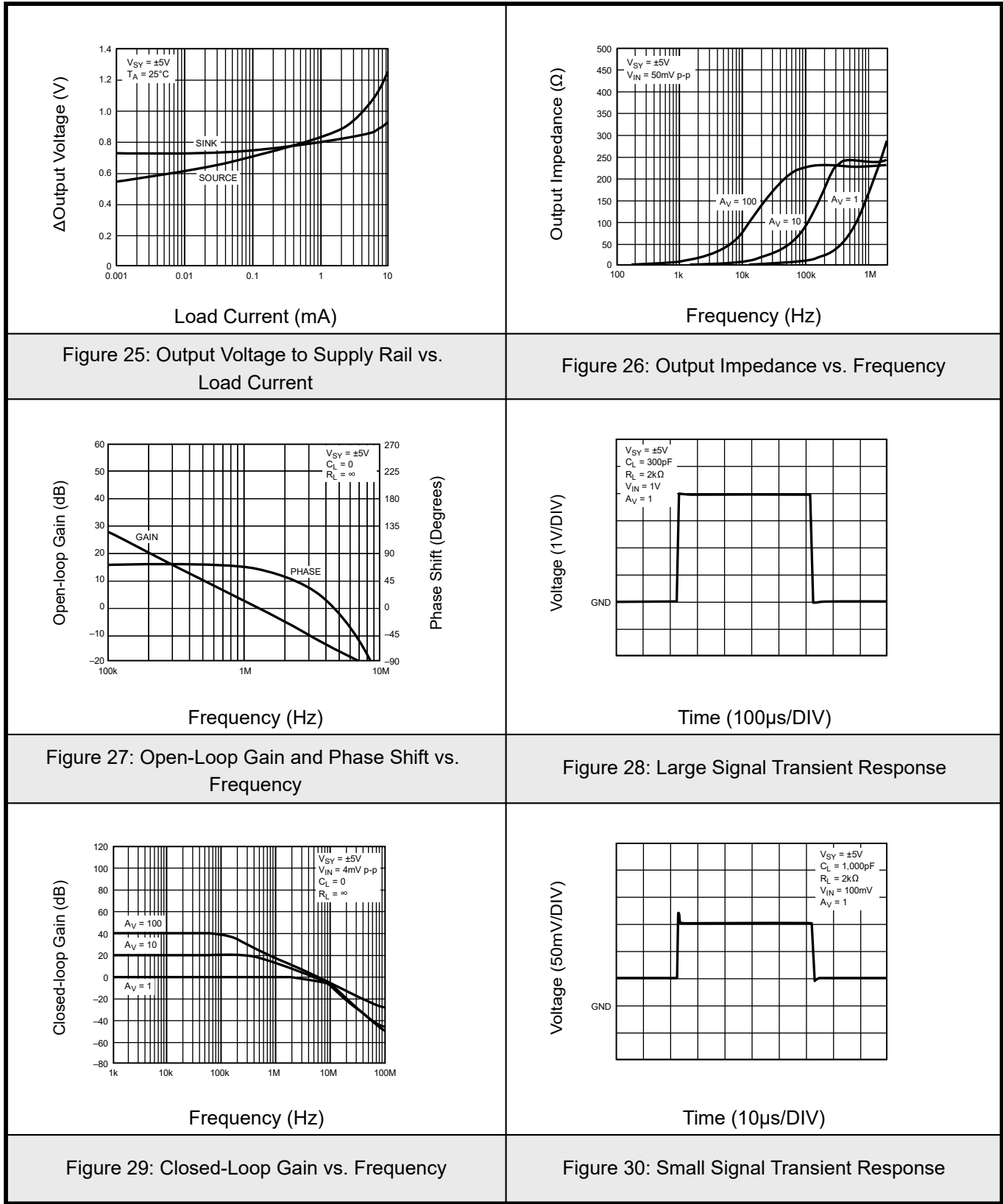


7.4Typical Characteristic

	
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

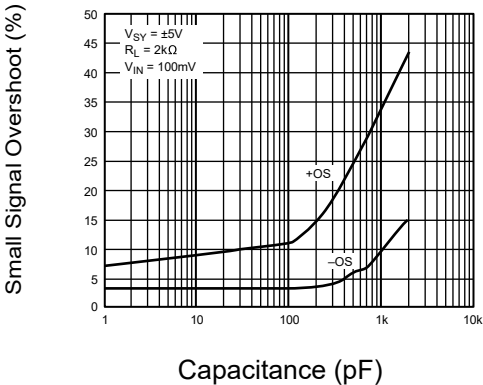
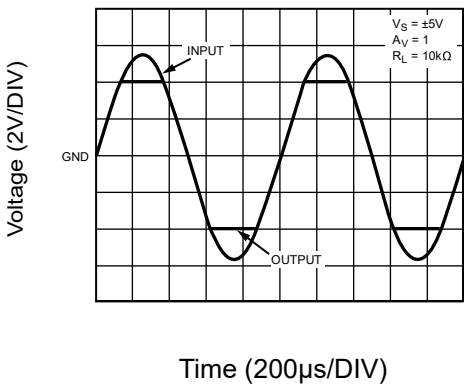
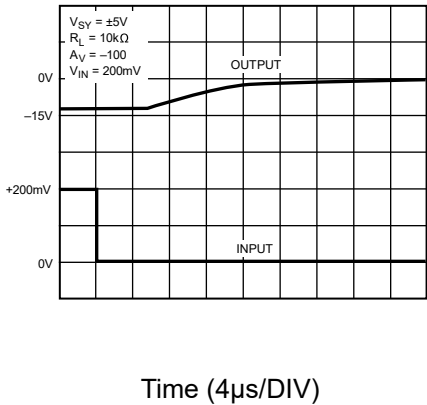
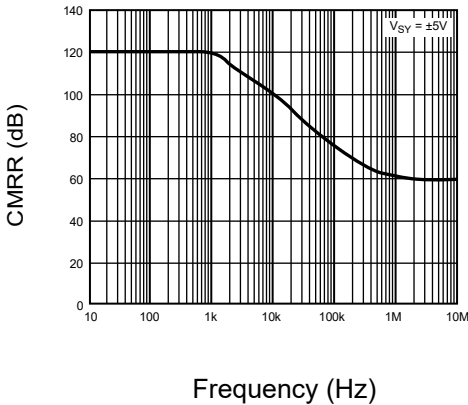
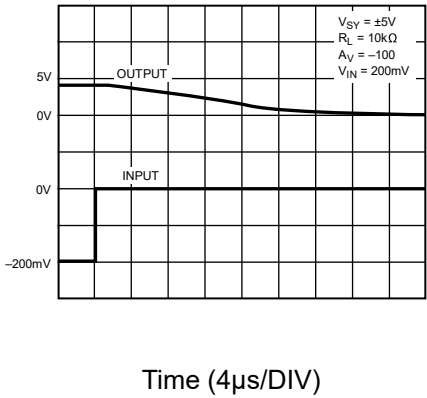
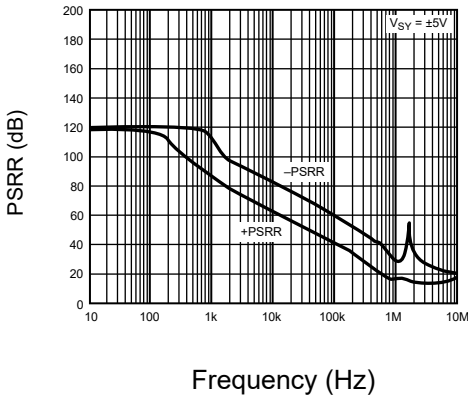


7.5Typical Characteristic





7.6Typical Characteristic

 Small Signal Overshoot (%) Capacitance (pF) Figure 31: Small Signal Overshoot vs. Load Capacitance	 Voltage (2V/DIV) Time (200μs/DIV) Figure 32: No Phase Reversal
 Time (4μs/DIV) Figure 33: Positive Overvoltage Recovery	 CMRR (dB) Frequency (Hz) Figure 34: CMRR vs. Frequency
 Time (4μs/DIV) Figure 35: Negative Overvoltage Recovery	 PSRR (dB) Frequency (Hz) Figure 36: PSRR vs. Frequency

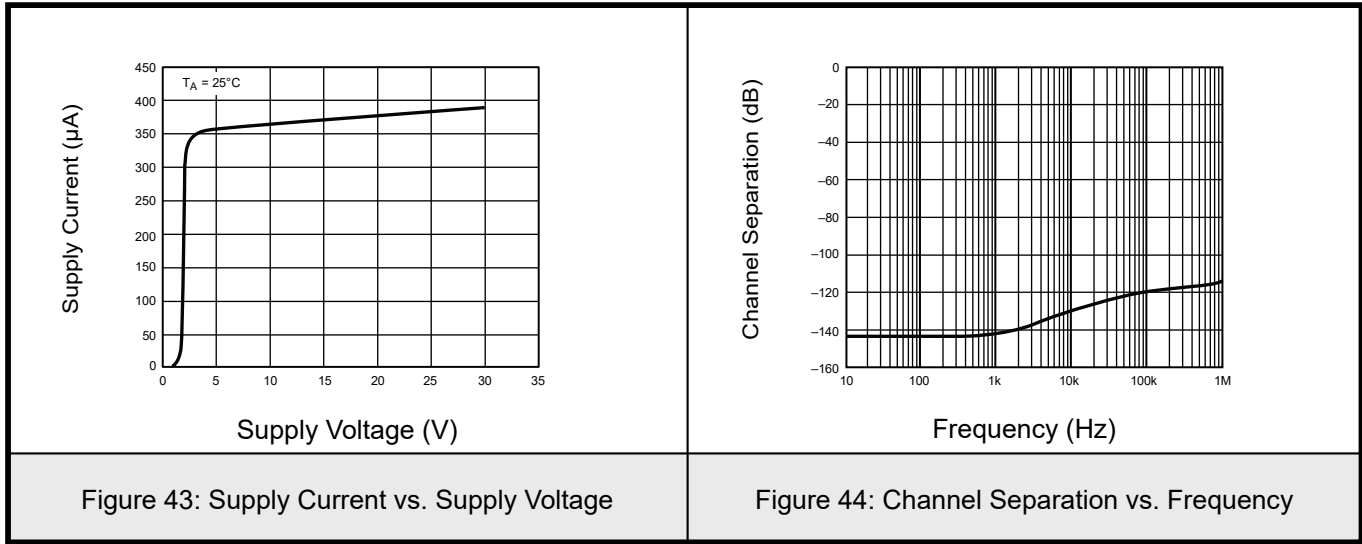


7.7Typical Characteristic

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

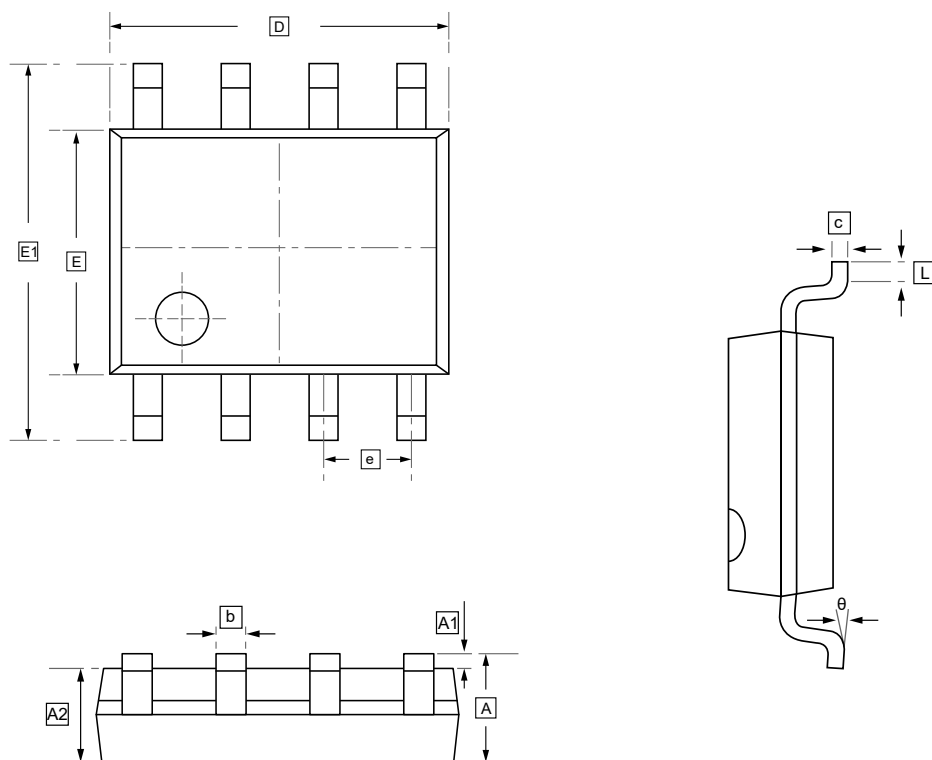


7.8Typical Characteristic





8.1 SOP-8 Package Outline Dimensions

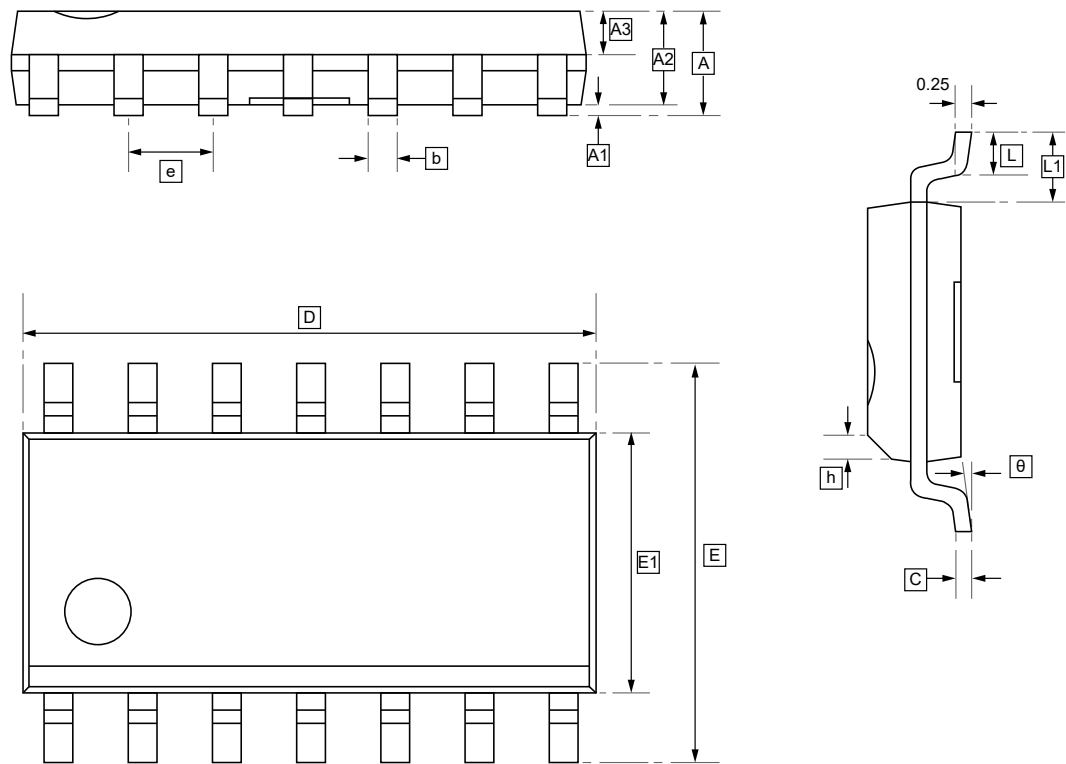


DIMENSIONS (mm are the original dimensions)

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



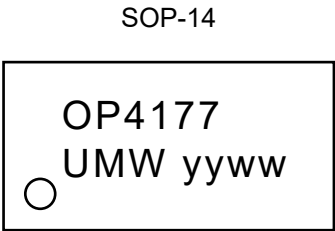
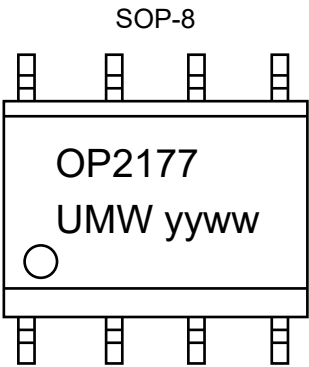
DIMENSIONS (mm are the original dimensions)

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



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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