1.8 V Low Power CMOS Rail-to-Rail Input/Output Operational Amplifier

GENERAL DESCRIPTION

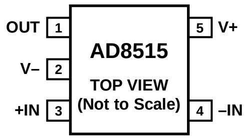
The AD8515 is a rail-to-rail amplifier that can operate from a single-supply voltage as low as 1.8 V.

The AD8515 single amplifier, available in 5-lead SOT-23 and 5-lead SC70 packages, is small enough to be placed next to sensors, reducing external noise pickup.

The AD8515 is a rail-to-rail input and output amplifier with a gain bandwidth of 5 MHz and typical offset voltage of 1 mV from a 1.8 V supply. The low supply current makes these parts ideal for battery-powered applications. The 2.7 V/μs slew rate makes the AD8515 a good match for driving ASIC inputs such as voice codecs.

The AD8515 is specified over the extended industrial temperature range of −40°C to +125°C.

PIN CONFIGURATION



SOT23-5/SC70-5

APPLICATIONS

- Portable communications
- Portable phones
- Sensor interfaces
- Laser scanners
- PCMCIA cards
- Battery-powered devices
- New generation phones
- Personal digital assistants

FEATURES

- Single-supply operation: 1.8 V to 5 V
- Offset voltage: 6 mV maximum
- Space-saving SOT23-5 and SC70-5 packages
- Slew rate: 2.7 V/μs
- Bandwidth: 5 MHz
- Rail-to-rail input and output swing
- Low input bias current: 2 pA typical
- Low supply current @ 1.8 V: 450 μA maximum

SPECIFICATIONS

ELECTRICAL CHARACTERISTICS

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

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	V_{CM} = V_S/2		1	6	mV
		−40°C < T_A < +125°C			8	mV
Input Bias Current	I_B	V_S = 1.8 V		2	30	pA
		−40°C < T_A < +85°C			600	pA
		−40°C < T_A < +125°C			8	nA
Input Offset Current	I_{OS}			1	10	pA
		−40°C < T_A < +125°C			500	pA
Input Voltage Range			0		1.8	V
Common-Mode Rejection Ratio	CMRR	0 V ≤ V_{CM} ≤ 1.8 V	50			dB
		−40°C < T_A < +125°C	47			dB
Large Signal Voltage Gain	A_{VO}	R_L = 100 kΩ, 0.3 V ≤ V_{OUT} ≤ 1.5 V	110	400		V/mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$			4		μV/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	I_L = 100 μA, −40°C < T_A < +125°C	1.79			V
		I_L = 750 μA, −40°C < T_A < +125°C	1.77			V
Output Voltage Low	V_{OL}	I_L = 100 μA, −40°C < T_A < +125°C			10	mV
		I_L = 750 μA, −40°C < T_A < +125°C			30	mV
Short-Circuit Limit	I_{SC}			20		mA
POWER SUPPLY						
Supply Current/Amplifier	I_{SY}	V_{OUT} = V_S/2		325	450	μA
		−40°C < T_A < +125°C			500	μA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 10 kΩ		2.7		V/μs
Gain Bandwidth Product	GBP			5		MHz
NOISE PERFORMANCE						
Voltage Noise Density	e_n	f = 1 kHz		22		nV/√Hz
		f = 10 kHz		20		nV/√Hz
Current Noise Density	i_n	f = 1 kHz		0.05		pA/√Hz

V_S = 3.0 V, V_{CM} = V_S/2, T_A = 25°C, unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	V_{CM} = V_S/2		1	6	mV
		−40°C < T_A < +125°C			8	mV
Input Bias Current	I_B	V_S = 3.0 V		2	30	pA
		−40°C < T_A < +85°C			600	pA
		−40°C < T_A < +125°C			8	nA
Input Offset Current	I_{OS}			1	10	pA
		−40°C < T_A < +125°C			500	pA
Input Voltage Range			0		3	V
Common-Mode Rejection Ratio	CMRR	0 V ≤ V_{CM} ≤ 3.0 V	54			dB
		−40°C < T_A < +125°C	50			dB
Large Signal Voltage Gain	A_{VO}	R_L = 100 kΩ, 0.3 V ≤ V_{OUT} ≤ 2.7 V	250	1000		V/mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$			4		µV/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	I_L = 100 µA, −40°C < T_A < +125°C	2.99			V
		I_L = 750 µA, −40°C < T_A < +125°C	2.98			V
Output Voltage Low	V_{OL}	I_L = 100 µA, −40°C < T_A < +125°C			10	mV
		I_L = 750 µA, −40°C < T_A < +125°C			20	mV
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = 1.8 V to 5.0 V	65	85		dB
		−40°C < T_A < +125°C	57	80		dB
Supply Current/Amplifier	I_{SY}	V_{OUT} = V_S/2		350	450	µA
		−40°C < T_A < +125°C			500	µA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 10 kΩ		2.7		V/µs
Gain Bandwidth Product	GBP			5		MHz
NOISE PERFORMANCE						
Voltage Noise Density	e_n	f = 1 kHz		22		nV/√Hz
		f = 10 kHz		20		nV/√Hz
Current Noise Density	i_n	f = 1 kHz		0.05		pA/√Hz

V_S = 5.0 V, V_{CM} = V_S/2, T_A = 25° C, unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	V_{CM} = V_S/2		1	6	mV
		−40°C < T_A < +125°C			8	mV
Input Bias Current	I_B	V_S = 5.0 V		5	30	pA
		−40°C < T_A < +85°C			600	pA
		−40°C < T_A < +125°C			8	nA
Input Offset Current	I_{OS}			1	10	pA
		−40°C < T_A < +125°C			500	pA
Input Voltage Range			0		5.0	V
Common-Mode Rejection Ratio	CMRR	0 V ≤ V_{CM} ≤ 5.0 V	60	75		dB
		−40°C < T_A < +125°C	54			dB
Large Signal Voltage Gain	A_{VO}	R_L = 100 kΩ, 0.3 V ≤ V_{OUT} ≤ 4.7 V	450	2000		V/mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$			4		μV/°C
OUTPUT CHARACTERISTICS			4.99			
Output Voltage High	V_{OH}	I_L = 100 μA, −40°C < T_A < +125°C	4.98			V
		I_L = 750 μA, −40°C < T_A < +125°C				V
Output Voltage Low	V_{OL}	I_L = 100 μA, −40°C < T_A < +125°C			10	mV
		I_L = 750 μA, −40°C < T_A < +125°C			20	mV
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = 1.8 V to 5.0 V	65	85		dB
		−40°C < T_A < +125°C	57	80		dB
Supply Current/Amplifier	I_{SY}	V_{OUT} = V_S/2		410	550	μA
		−40°C < T_A < +125°C			600	μA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 10 kΩ		2.7		V/μs
Gain Bandwidth Product	GBP			5		MHz
NOISE PERFORMANCE						
Voltage Noise Density	e_n	f = 1 kHz		22		nV/√Hz
		f = 10 kHz		20		nV/√Hz
Current Noise Density	i_n	f = 1 kHz		0.05		pA/√Hz

ABSOLUTE MAXIMUM RATINGS

T_A = 25°C, unless otherwise noted.

Parameter	Rating
Supply Voltage	6 V
Input Voltage	GND to V_S
Differential Input Voltage	±6 V or ±V_S
Output Short-Circuit Duration to GND	Observe derating curves
Storage Temperature Range	
KS and RJ Packages	−65°C to +150°C
Operating Temperature Range	
AD8515	−40°C to +125°C
Junction Temperature Range	
KS and RJ Packages	−65°C to +150°C
Lead Temperature (Soldering, 60 sec)	300°C

TYPICAL PERFORMANCE CHARACTERISTICS

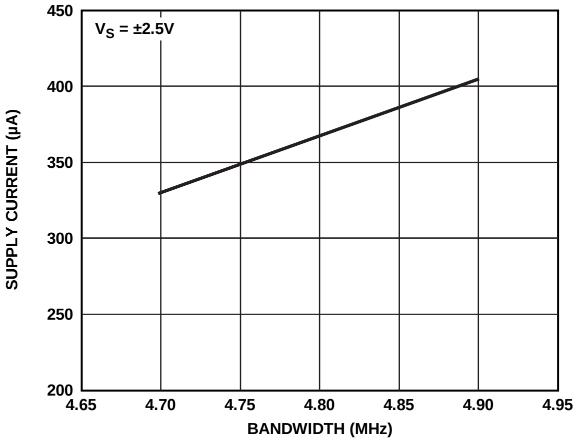


Figure 2. Supply Current vs. Bandwidth

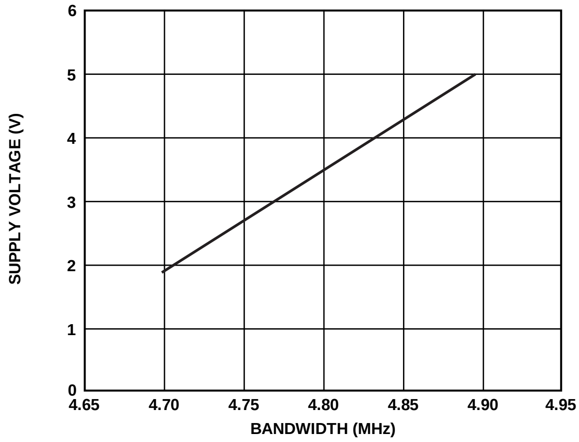


Figure 5. Supply Voltage vs. Bandwidth

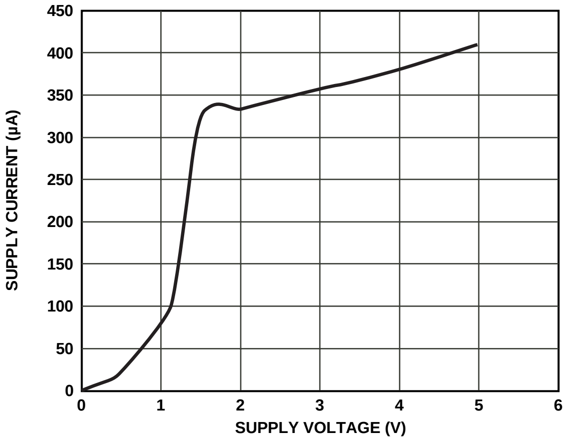


Figure 3. Supply Current vs. Supply Voltage

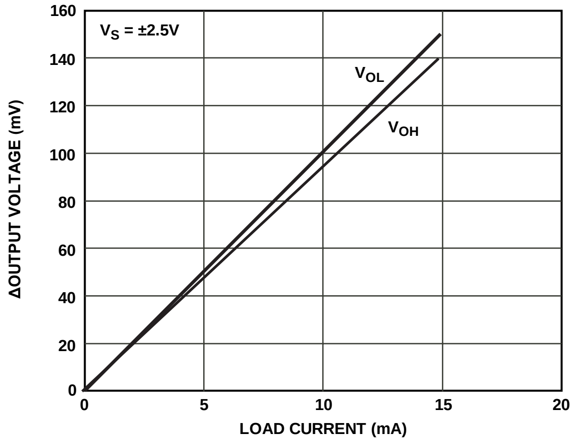


Figure 6. Output Voltage to Supply Rail vs. Load Current

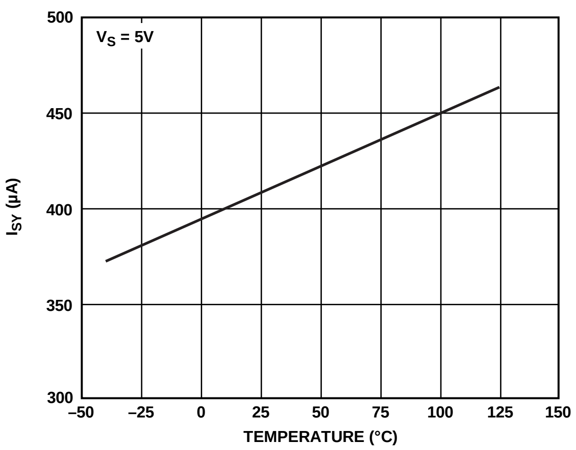


Figure 4. I_{SY} vs. Temperature

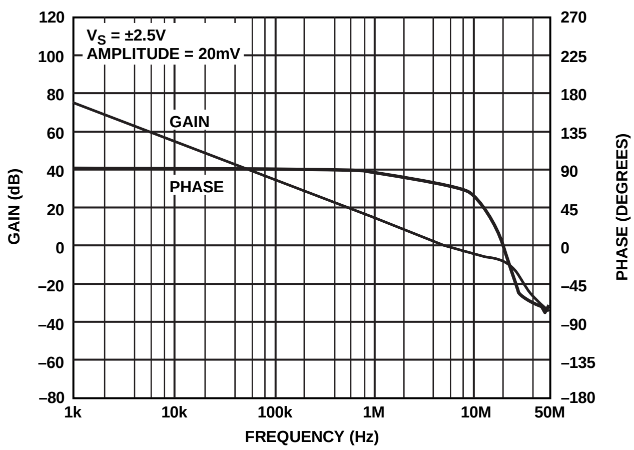


Figure 7. Gain and Phase vs. Frequency

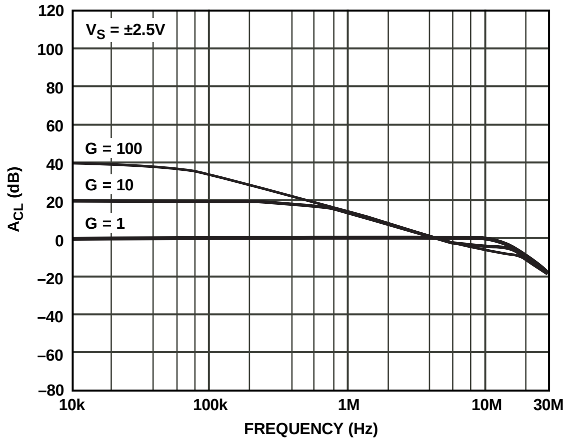


Figure 8. A_{CL} vs. Frequency

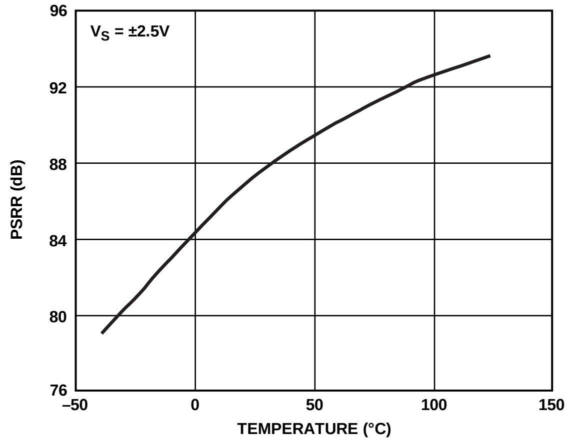


Figure 11. PSRR vs. Temperature

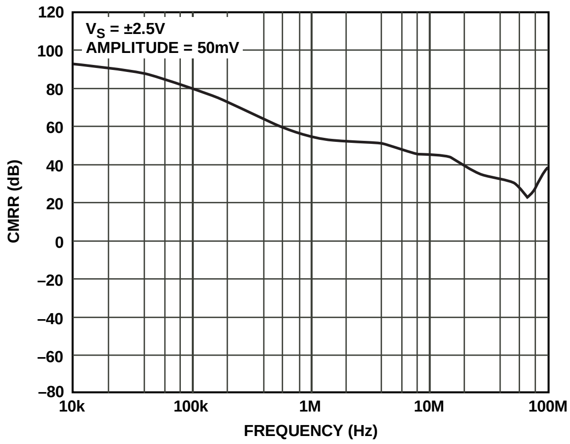


Figure 9. CMRR vs. Frequency

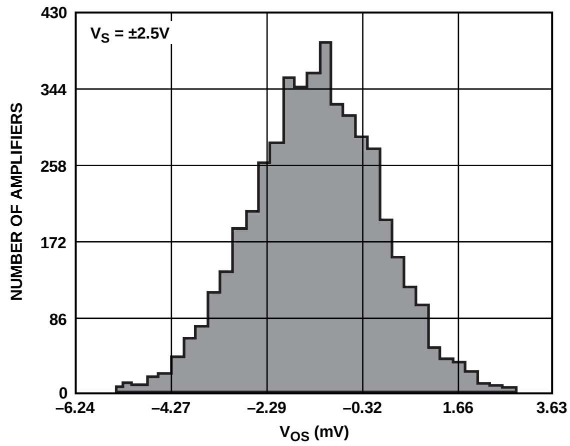


Figure 12. V_{OS} Distribution

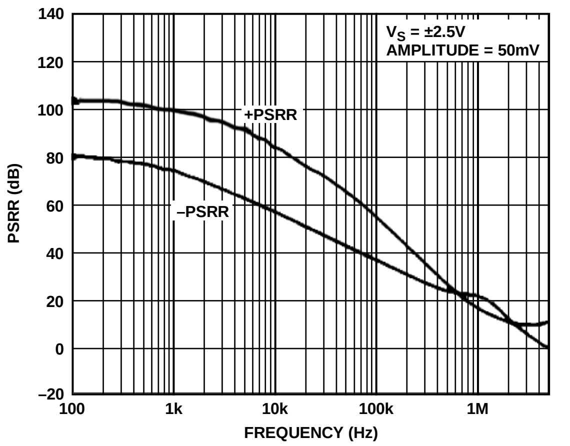


Figure 10. PSRR vs. Frequency

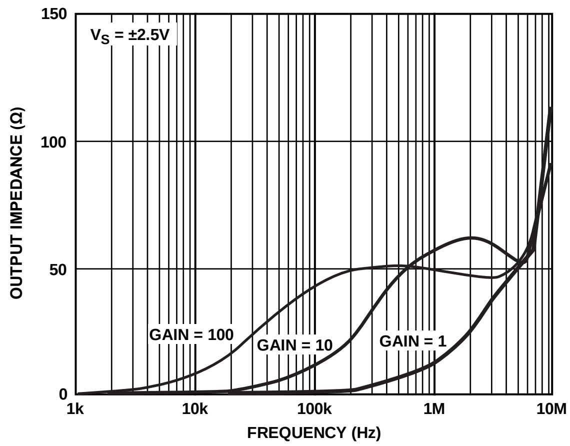


Figure 13. Output Impedance vs. Frequency

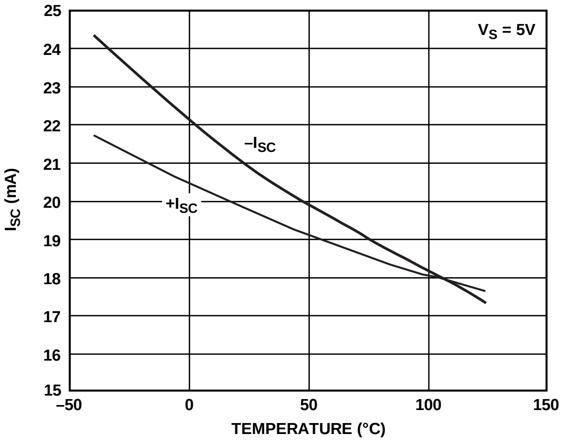


Figure 14. I_{SC} vs. Temperature

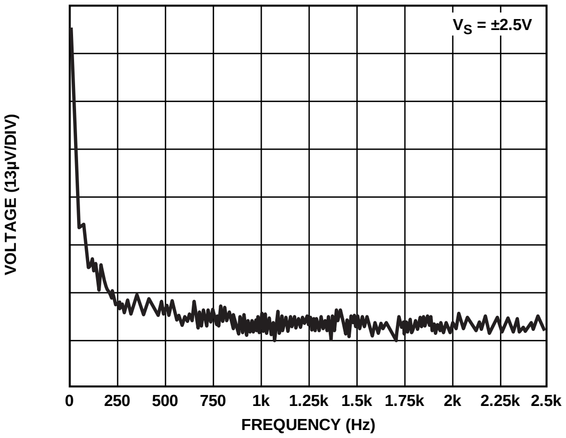


Figure 15. Voltage Noise Density

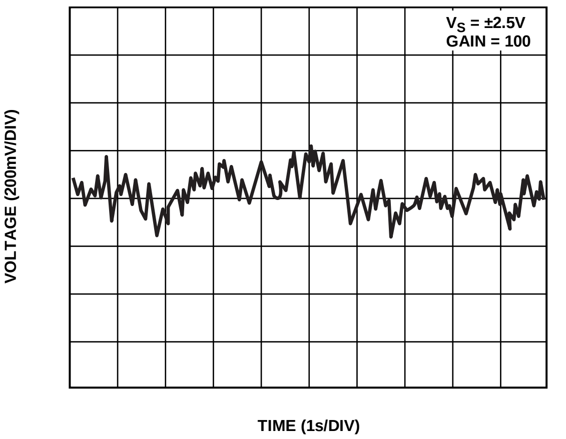


Figure 16. Input Voltage Noise

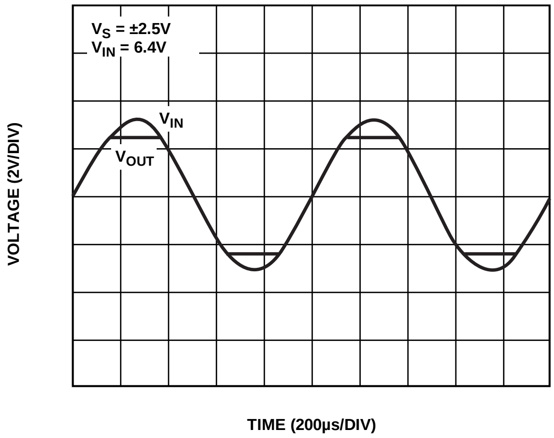


Figure 17. No Phase Reversal

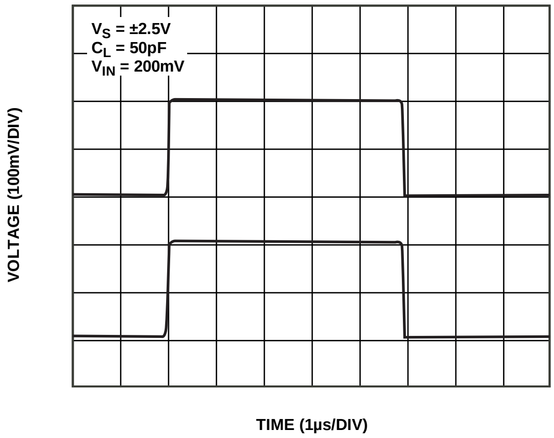


Figure 18. Small Signal Transient Response

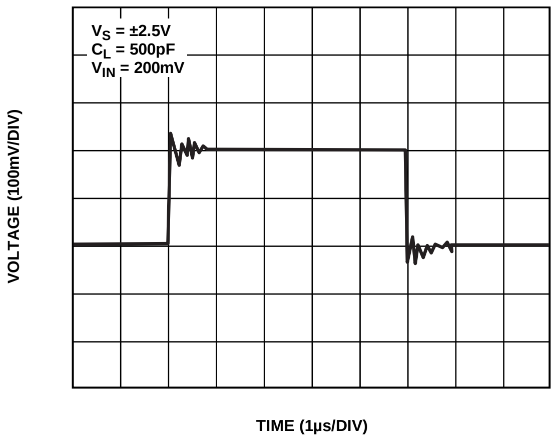


Figure 19. Small Signal Transient Response

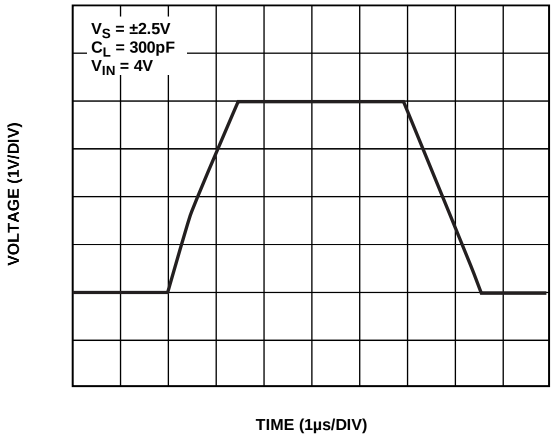


Figure 20. Large Signal Transient Response

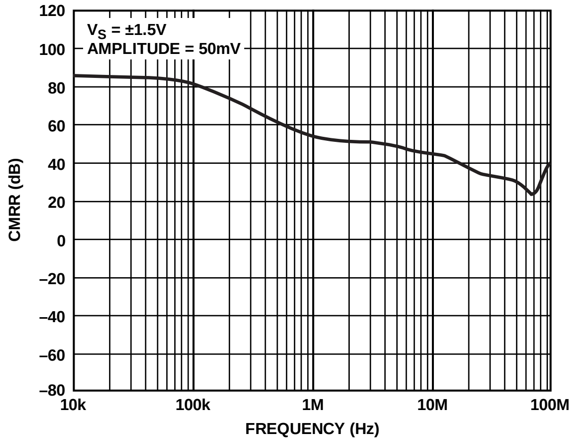


Figure 23. CMRR vs. Frequency

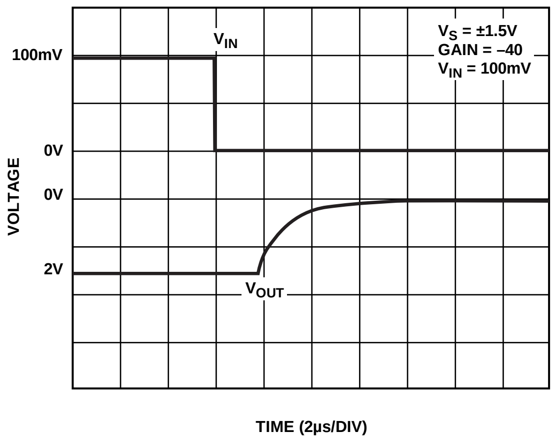


Figure 21. Saturation Recovery

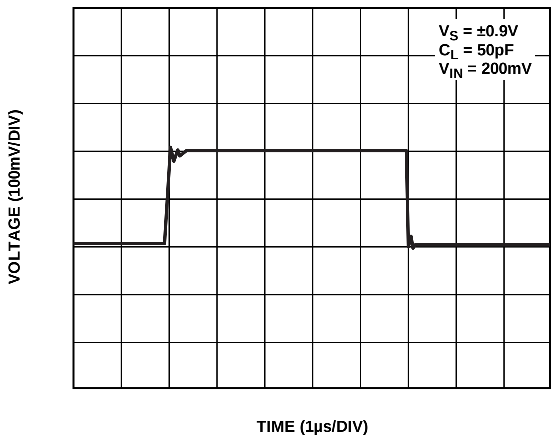


Figure 24. Small Signal Transient Response

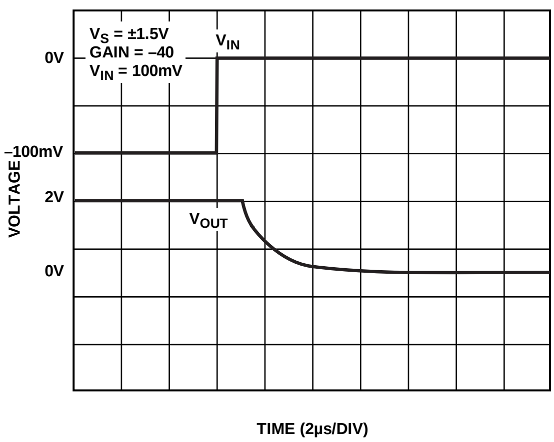


Figure 22. Saturation Recovery

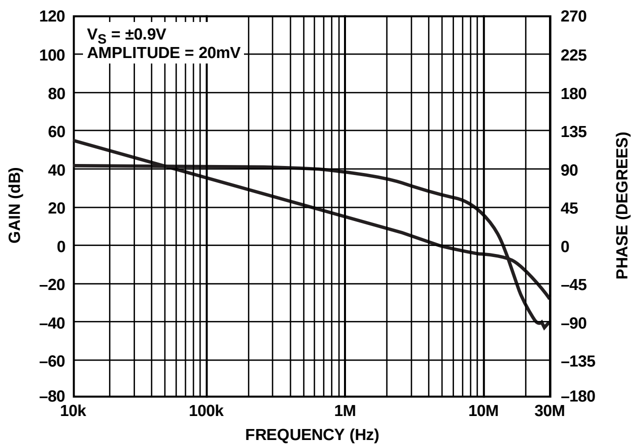


Figure 25. Gain and Phase vs. Frequency

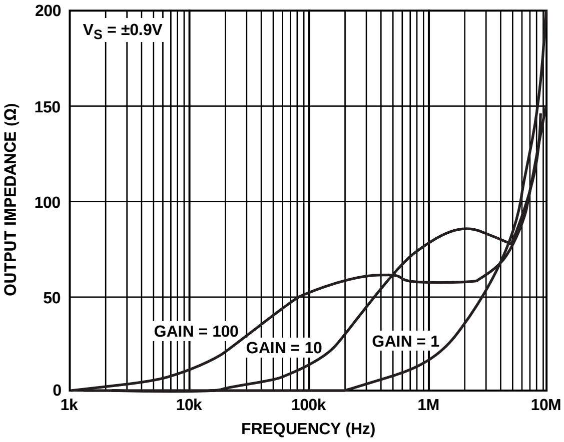


Figure 26. Output Impedance vs. Frequency

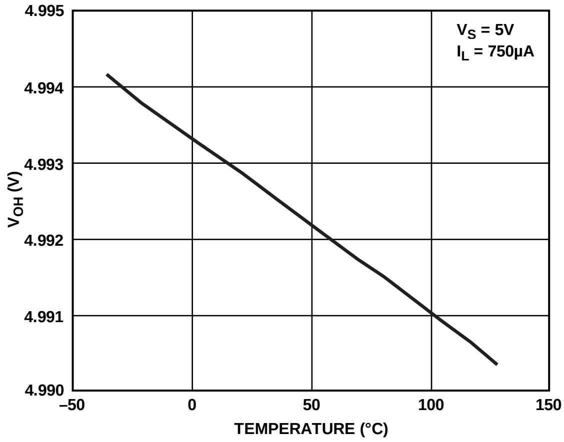


Figure 29. V_{OH} vs. Temperature

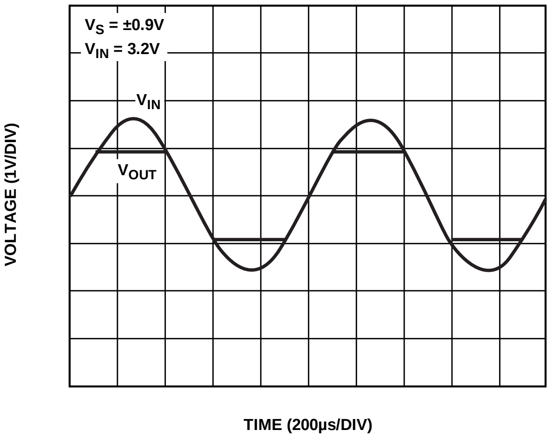


Figure 27. No Phase Reversal

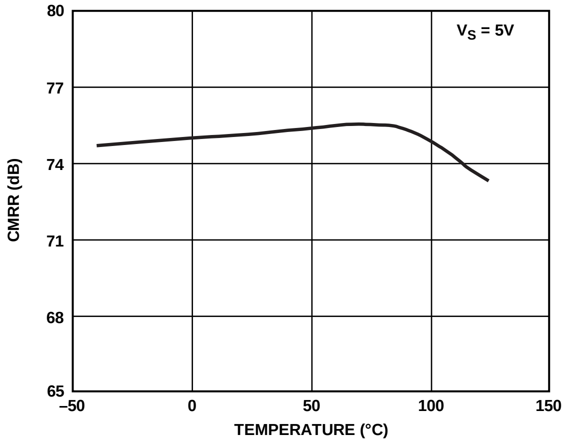


Figure 30. CMRR vs. Temperature

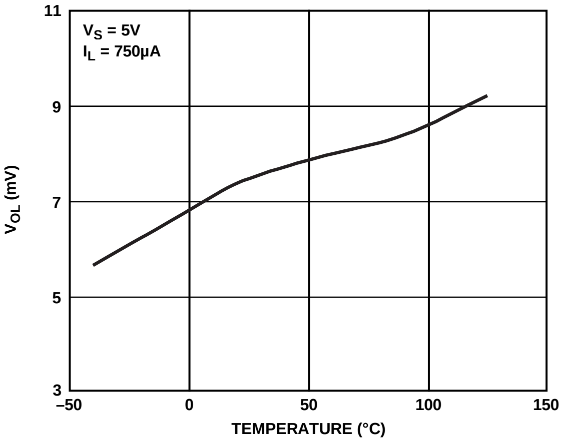
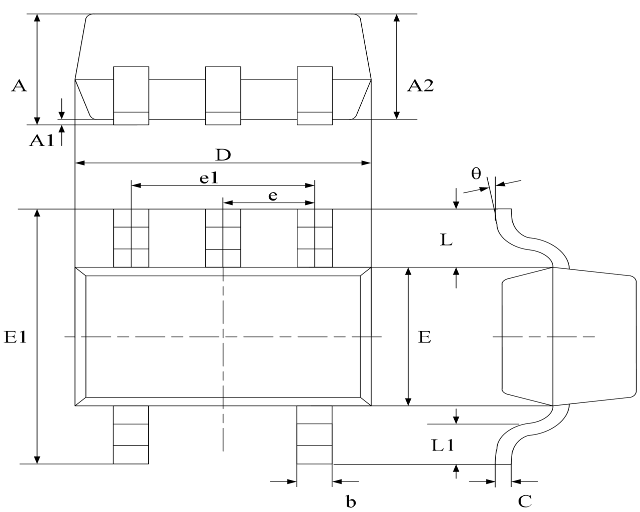


Figure 28. V_{OL} vs. Temperature

Package Dimension

SC70-5（SOT353）



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.800	1.100	0.035	0.043
A1	0.000	0.100	0.000	0.004
A2	0.800	0.900	0.035	0.039
b	0.150	0.350	0.006	0.014
C	0.080	0.150	0.003	0.006
D	1.8500	2.150	0.079	0.087
E	1.100	1.400	0.045	0.053
E1	1.950	2.200	0.085	0.096
e	0.850 typ.		0.026 typ.	
e1	1.200	1.400	0.047	0.055
L	0.42 ref.		0.021 ref.	
L1	0.260	0.460	0.010	0.018
θ	0°	8°	0°	8°

Ordering information

Order code	Package	Baseqty	Deliverymode	Marking
UMW AD8515ARTZ	SOT23-5	3000	Tape and reel	BDA U
UMW AD8515ART	SOT23-5	3000	Tape and reel	BDA U
UMW AD8515AKSZ	SC70-5	3000	Tape and reel	BDA U