AS348/AS2348

LOW NOISE, LOW POWER, 1MHZ, RRIO SINGLE / DUAL CMOS OPERATIONAL AMPLIFIERS

Description

The DIODES AS348/AS2348 are single/dual channels RRIO amplifiers (rail-to-rail input and output), which provide not only maximum output-voltage swing capability but also an extended 300mV common-mode voltage beyond the supply rail. The devices are fully specified to operate from 1.6V to 5.5V single-supply, or ±0.8V and ±2.5V dual-supply applications.

The devices feature a good speed/power consumption ratio, offering 1MHz gain bandwidth while consuming 70µA per channel (typ). They are unity-gain stable for capacitive loads up to 100pF. The low noise density 27nV/√Hz, low input offset voltage 0.5mV and low input offset drift 2µV/°C make them ideal for applications that require precision. With the input bias current is 1pA at room temperature, it is well suitable for low-voltage, low-noise, and low-power applications.

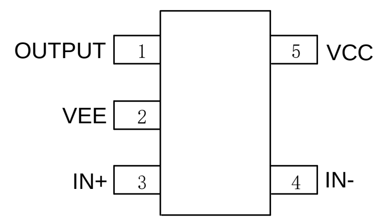
The AS348/AS2348 offer industry-standard packages. The AS348 is available in the SOT25 package, and the AS2348 is offered in the MSOP-8 and SO-8 packages. Temperature is specified for operation: from -40°C to +125°C among all supply voltages. The wide temperature ranges and high ESD tolerance facilitate their use in harsh applications.

Features

- Single-Supply Voltage Range: 1.6V to 5.5V
- Dual-Supply Voltage Range: ±0.8V to ±2.5V
- Ultra-Low Input Bias Current: 1pA (typ)
- Offset Voltage: 0.5mV (typ), 2.5mV (max)
- Low Input Offset Drift: 2µV/°C (typ)
- Rail-to-Rail Input
  V_{CM}: 300mV Beyond Supply Rail @ V_{CC} = 3V or 5V
  Rail-to-Rail Output Swing:
  10kΩ Load: 4mV from Rail
  1kΩ Load: 25mV from Rail
- Supply Current: 70µA/Channel (typ)
- Unity-Gain Stable up to 100pF Capacitive Load
  Gain Bandwidth: 1.0MHz
- Slew Rate: 0.45V/µs @ V_{CC} = 5.0V
- Operation Ambient Temperature Range: -40°C to +125°C
- ESD Protection JESD 22, 4000V HBM (A114)
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/104/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please contact us or your local Diodes representative.**
  https://www.diodes.com/quality/product-definitions/

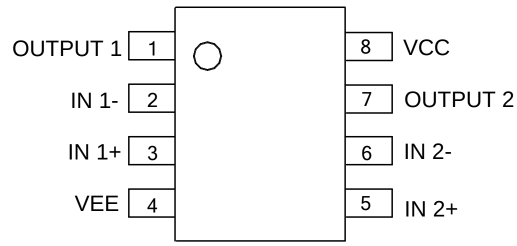
Pin Assignments

(Top View)



SOT25 (AS348)

(Top View)



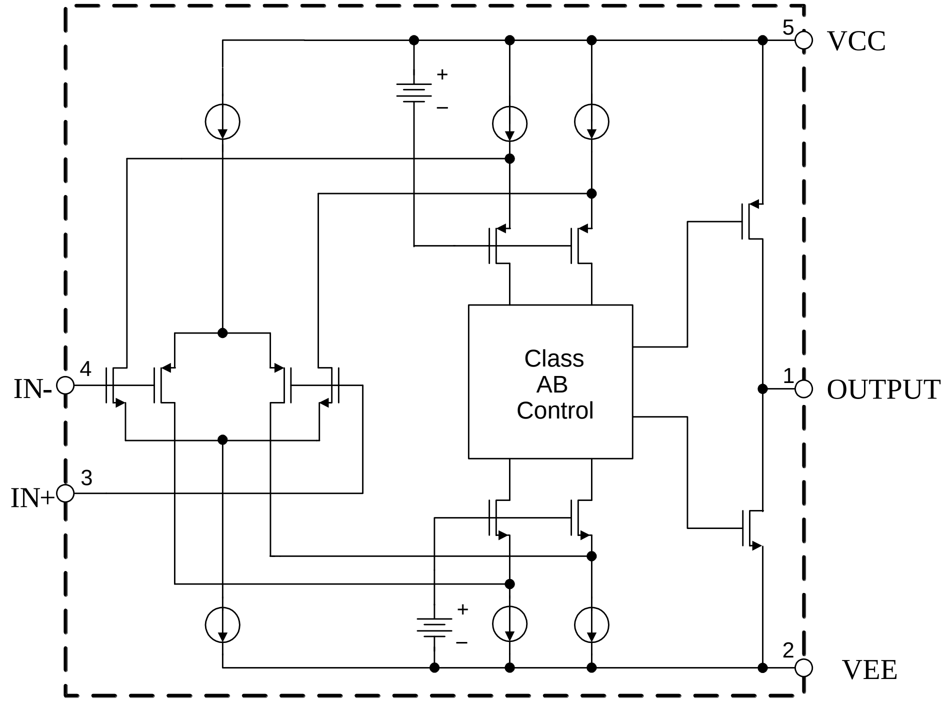
SO-8/MSOP-8 (AS2348)

Applications

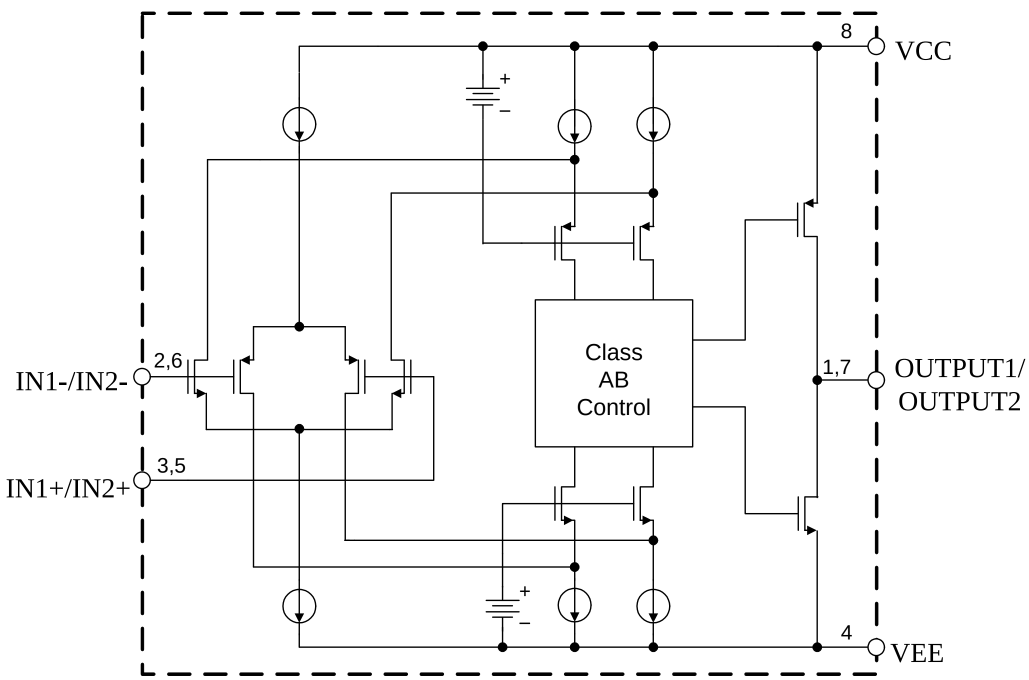
- Active filters
- Sensors interfaces
- Photodiode amplification
- Smoke alarms, CO detectors
- Battery-powered applications
- Portable equipment
- Medical instrumentation
- Pulse blood oximeters, glucose meters

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

Functional Block Diagram



Block Diagram of AS348



Block Diagram of AS2348

Absolute Maximum Ratings (Note 4)

Symbol	Parameter	Rating		Unit
V_{CC}	Power-Supply Voltage	6.0		V
V_{ID}	Differential Input Voltage	6.0		V
V_{IN}	Input Voltage	-0.3 to V_{CC}+0.5		V
T_J	Operating Junction Temperature	+150		°C
$θ_{JA}$	Thermal Resistance (Junction to Ambient)	SOT25	220	°C/W
		SO-8	150	
		MSOP-8	200	
T_{STG}	Storage Temperature Range	-65 to +150		°C
T_{LEAD}	Lead Temperature (Soldering, 10 Seconds)	+260		°C
—	ESD (Human Body Model)	±4000		V
—	ESD (Machine Model)	±300		V

Note 4: Stresses greater than those listed under "*Absolute Maximum Ratings*" can cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "*Recommended Operating Conditions*" is not implied. Exposure to "*Absolute Maximum Ratings*" for extended periods can affect device reliability.

Recommended Operating Conditions

Symbol	Parameter	Min	Max	Unit
V_{CC}	Supply Voltage	1.6	5.5	V
T_A	Operating Ambient Temperature Range	-40	+125	°C

Electrical Characteristics

1.6V DC Electrical Characteristics (V_{CC} = 1.6V, V_{EE} = 0, V_{OUT} = V_{CC}/2, V_{CM} = V_{CC}/2, T_A = +25°C, unless otherwise specified.)

Symbol	Parameter		Conditions	Min	Typ	Max	Unit
V_{OS}	Input Offset Voltage		—	—	0.5	2.5	mV
I_B	Input Bias Current		—	—	1.0	—	pA
I_{OS}	Input Offset Current		—	—	1.0	—	pA
V_{CM}	Input Common-Mode Voltage Range		—	-0.2	—	1.8	V
CMRR	Common-Mode Rejection Ratio		V_{CM} = -0.2V to 1.8V	55	75	—	dB
G_V	Large Signal Voltage Gain		R_L = 10kΩ to V_{CC}/2, V_{OUT} = 0.2V to 1.4V	90	110	—	dB
$\Delta V_{OS}/\Delta T$	Input Offset Voltage Drift		—	—	2.0	—	µV/°C
V_{OL}/V_{OH}	Output-Voltage Swing from Rail		R_L = 1kΩ to V_{CC}/2	—	30	50	mV
			R_L = 10kΩ to V_{CC}/2	—	3	15	
I_{SINK}	Output Current	Sink	V_{OUT} = V_{CC}	8	10	—	mA
I_{SOURCE}		Source	V_{OUT} = 0V	5	8.5	—	
Z_{OUT}	Closed-Loop Output Impedance		f = 10kHz, A_V = 1	—	9	—	Ω
PSRR	Power-Supply Rejection Ratio		V_{CC} = 1.6V to 5.0V	66	80	—	dB
I_{CC}	Supply Current (Per Amplifier)		V_{OUT} = V_{CC}/2, I_{OUT} = 0	—	70	90	µA

1.6V AC Electrical Characteristics (V_{CC} = 1.6V, V_{EE} = 0, V_{OUT} = V_{CC}/2, V_{CM} = V_{CC}/2, T_A = +25°C, unless otherwise specified.)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
GBP	Gain Bandwidth Product	C_L = 100pF	—	1.0	—	MHz
SR	Slew Rate (Note 5)	1V Step, C_L = 100pF, R_L = 10kΩ	—	0.32	—	V/µs
φ_M	Phase Margin	R_L = 100kΩ	—	67	—	Degrees
THD+N	Total Harmonic Distortion+Noise	f = 1kHz, A_V = 1, V_{IN} = 1V_{PP}, R_L = 10kΩ, C_L = 100pF	—	-70	—	dB
e_n	Voltage Noise Density	f = 1kHz	—	27	—	$nV/\sqrt{Hz}$

Note 5: Number specified is the positive slew rate.

Electrical Characteristics (continued)

1.8V DC Electrical Characteristics (V_{CC} = 1.8V, V_{EE} = 0, V_{OUT} = V_{CC}/2, V_{CM} = V_{CC}/2, T_A = +25°C, unless otherwise specified.)

Symbol	Parameter		Conditions	Min	Typ	Max	Unit
V_{OS}	Input Offset Voltage		—	—	0.5	2.5	mV
I_B	Input Bias Current		—	—	1.0	—	pA
I_{OS}	Input Offset Current		—	—	1.0	—	pA
V_{CM}	Input Common-Mode Voltage Range		—	-0.2	—	2.0	V
CMRR	Common-Mode Rejection Ratio		V_{CM} = -0.2V to 2.0V	55	75	—	dB
G_V	Large Signal Voltage Gain		R_L = 10kΩ to V_{CC}/2, V_{OUT} = 0.2V to 1.6V	90	112	—	dB
$\Delta V_{OS}/\Delta T$	Input Offset Voltage Drift		—	—	2.0	—	µV/°C
V_{OL}/V_{OH}	Output-Voltage Swing from Rail		R_L = 1kΩ to V_{CC}/2	—	25	50	mV
			R_L = 10kΩ to V_{CC}/2	—	3	15	
I_{SINK}	Output Current	Sink	V_{OUT} = V_{CC}	12	16	—	mA
I_{SOURCE}		Source	V_{OUT} = 0V	10	14	—	
Z_{OUT}	Closed-Loop Output Impedance		f = 10kHz	—	9	—	Ω
PSRR	Power-Supply Rejection Ratio		V_{CC} = 1.6V to 5.0V	66	80	—	dB
I_{CC}	Supply Current (Per Amplifier)		V_{OUT} = V_{CC}/2, I_{OUT} = 0	—	70	90	µA

1.8V AC Electrical Characteristics (V_{CC} = 1.8V, V_{EE} = 0, V_{OUT} = V_{CC}/2, V_{CM} = V_{CC}/2, T_A = +25°C, unless otherwise specified.)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
GBP	Gain Bandwidth Product	C_L = 100pF	—	1.0	—	MHz
SR	Slew Rate (Note 5)	1V Step, C_L = 100pF, R_L = 10kΩ	—	0.34	—	V/µs
φ_M	Phase Margin	R_L = 100kΩ	—	67	—	Degrees
THD+N	Total Harmonic Distortion+Noise	f = 1kHz, A_V = 1, V_{IN} = 1V_{PP}, R_L = 10kΩ, C_L = 100pF	—	-70	—	dB
e_n	Voltage Noise Density	f = 1kHz	—	27	—	$nV/\sqrt{Hz}$

Note 5: Number specified is the positive slew rate.

Electrical Characteristics (continued)

3.0V DC Electrical Characteristics (V_{CC} = 3.0V, V_{EE} = 0, V_{OUT} = V_{CC}/2, V_{CM} = V_{CC}/2, T_A = +25°C, unless otherwise specified.)

Symbol	Parameter		Conditions	Min	Typ	Max	Unit
V_{OS}	Input Offset Voltage		—	—	0.5	2.5	mV
I_B	Input Bias Current		—	—	1.0	—	pA
I_{OS}	Input Offset Current		—	—	1.0	—	pA
V_{CM}	Input Common-Mode Voltage Range		—	-0.3	—	3.3	V
CMRR	Common-Mode Rejection Ratio		V_{CM} = -0.3V to 1.8V	62	80	—	dB
			V_{CM} = -0.3V to 3.3V	58	75	—	
G_V	Large Signal Voltage Gain		R_L = 1kΩ to V_{CC}/2 , V_{OUT} = 0.2V to 2.8V	90	110	—	dB
			R_L = 10kΩ to V_{CC}/2, V_{OUT} = 0.1V to 2.9V	95	115	—	
$\Delta V_{OS}/\Delta T$	Input Offset Voltage Drift		—	—	2.0	—	µV/°C
V_{OL}/V_{OH}	Output-Voltage Swing from Rail		R_L = 1kΩ to V_{CC}/2	—	20	50	mV
			R_L = 10kΩ to V_{CC}/2	—	3	15	
I_{SINK}	Output Current	Sink	V_{OUT} = V_{CC}	50	60	—	mA
I_{SOURCE}		Source	V_{OUT} = 0V	50	65	—	
Z_{OUT}	Closed-Loop Output Impedance		f = 10kHz	—	9	—	Ω
PSRR	Power-Supply Rejection Ratio		V_{CC} = 1.6V to 5.0V	66	80	—	dB
I_{CC}	Supply Current (Per Amplifier)		V_{OUT} = V_{CC}/2, I_{OUT} = 0	—	70	90	µA

3.0V AC Electrical Characteristics (V_{CC} = 3.0V, V_{EE} = 0, V_{OUT} = V_{CC}/2, V_{CM} = V_{CC}/2, T_A = +25°C, unless otherwise specified.)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
GBP	Gain Bandwidth Product	C_L = 100pF	—	1.0	—	MHz
SR	Slew Rate (Note 5)	G = 1, 2V Step, C_L = 100pF, R_L = 10kΩ	—	0.40	—	V/µs
φ_M	Phase Margin	R_L = 100kΩ	—	67	—	Degrees
THD+N	Total Harmonic Distortion+Noise	f = 1kHz, G = 1, V_{IN} = 1V_{PP}, R_L = 10kΩ, C_L = 100pF	—	-70	—	dB
e_n	Voltage Noise Density	f = 1kHz	—	27	—	$nV/\sqrt{Hz}$

Note 5: Number specified is the positive slew rate.

Electrical Characteristics (continued)

5.0V DC Electrical Characteristics (V_{CC} = 5.0V, V_{EE} = 0, V_{OUT} = V_{CC}/2, V_{CM} = V_{CC}/2, T_A = +25°C, unless otherwise specified.)

Symbol	Parameter		Conditions	Min	Typ	Max	Unit
V_{OS}	Input Offset Voltage		—	—	0.5	2.5	mV
I_B	Input Bias Current		—	—	1.0	—	pA
I_{OS}	Input Offset Current		—	—	1.0	—	pA
V_{CM}	Input Common-Mode Voltage Range		—	-0.3	—	5.3	V
CMRR	Common-Mode Rejection Ratio		V_{CM} = -0.3V to 3.8V	70	85	—	dB
			V_{CM} = -0.3V to 5.3V	65	90	—	
G_V	Large Signal Voltage Gain		R_L = 1kΩ to V_{CC}/2, V_{OUT} = 0.2V to 4.8V	80	92	—	dB
			R_L = 10kΩ to V_{CC}/2, V_{OUT} = 0.05V to 4.95V	85	98	—	
$\Delta V_{OS}/\Delta T$	Input Offset Voltage Drift		—	—	2.0	—	μV/°C
V_{OL}/V_{OH}	Output-Voltage Swing from Rail		R_L = 1kΩ to V_{CC}/2	—	25	50	mV
			R_L = 10kΩ to V_{CC}/2	—	4	15	
I_{SINK}	Output Current	Sink	V_{OUT} = V_{CC}	100	150	—	mA
I_{SOURCE}		Source	V_{OUT} = 0V	110	185	—	
—	Closed-Loop Output Impedance		f = 1kHz, A_V = 1	—	9	—	Ω
PSRR	Power-Supply Rejection Ratio		V_{CC} = 1.6V to 5.0V	66	80	—	dB
I_{CC}	Supply Current (Per Amplifier)		V_{OUT} = V_{CC}/2, I_{OUT} = 0	—	70	90	μA

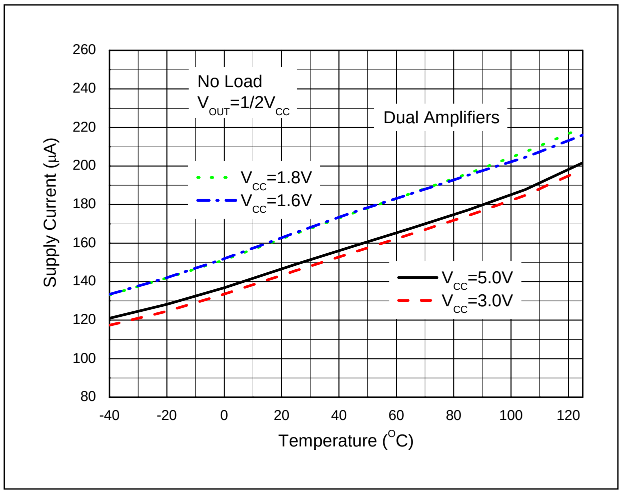
5.0V AC Electrical Characteristics (V_{CC} = 5.0V, V_{EE} = 0, V_{OUT} = V_{CC}/2, V_{CM} = V_{CC}/2, T_A = +25°C, unless otherwise specified.)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
GBP	Gain Bandwidth Product	C_L = 100pF	—	1.0	—	MHz
SR	Slew Rate (Note 5)	2V Step, C_L = 100pF, R_L = 10kΩ	—	0.45	—	V/μs
φ_M	Phase Margin	R_L = 100kΩ	—	67	—	Degrees
THD+N	THD+N	f = 1kHz, A_V = 1, V_{IN} = $1V_{PP}$, R_L = 10kΩ, C_L = 100pF	—	-70	—	dB
e_n	Voltage Noise Density	f = 1kHz	—	27	—	$nV/\sqrt{Hz}$

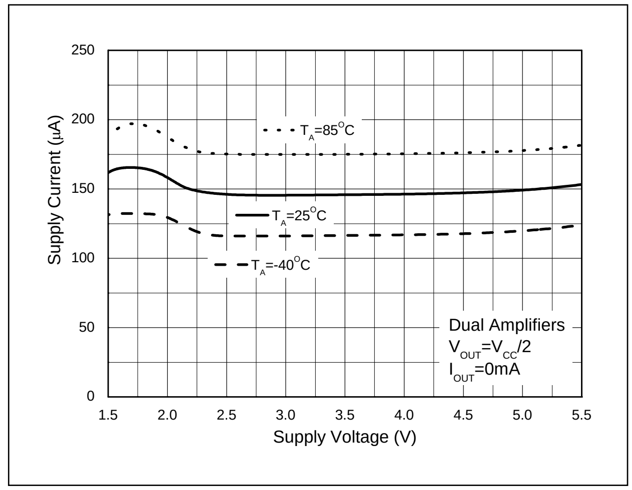
Note 5: Number specified is the positive slew rate.

Performance Characteristics

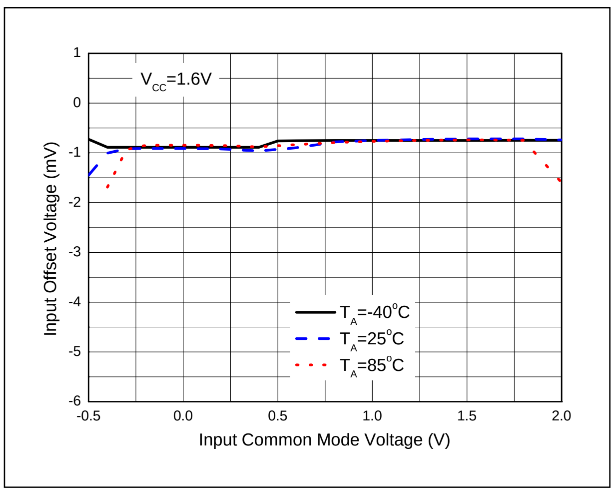
Supply Current vs. Temperature



Supply Current vs. Supply Voltage



Input Offset Voltage vs.
Input Common Mode Voltage



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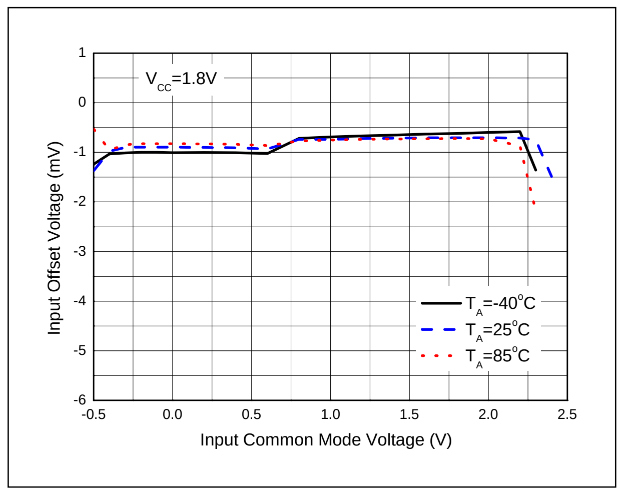
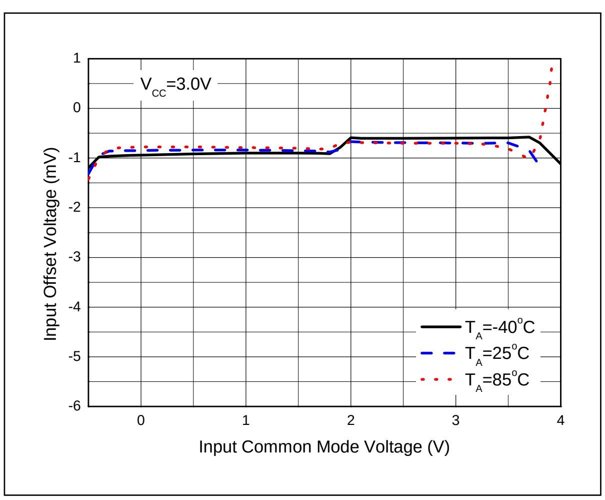
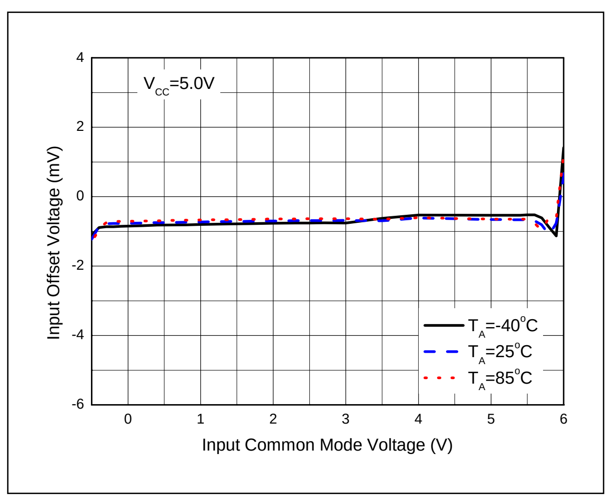
Input Common Mode Voltage



Input Offset Voltage vs.
Input Common Mode Voltage

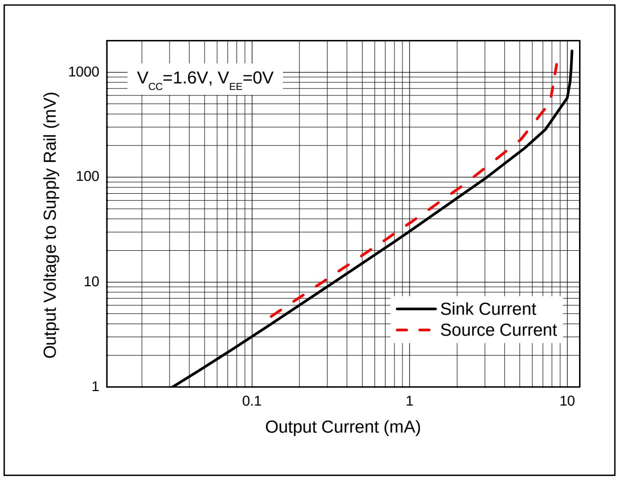


Input Offset Voltage vs.
Input Common Mode Voltage

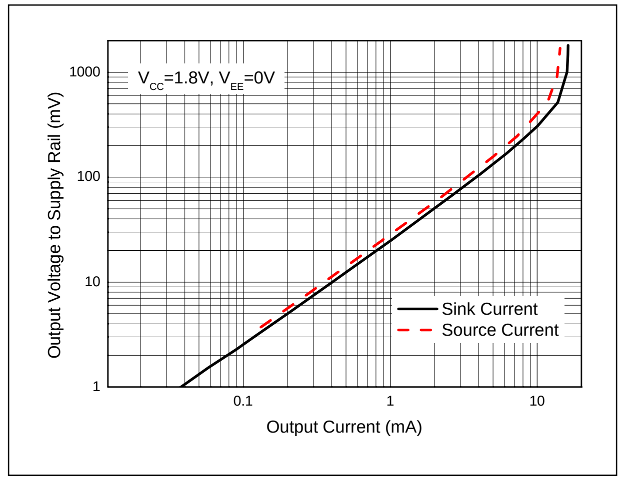


Performance Characteristics (continued)

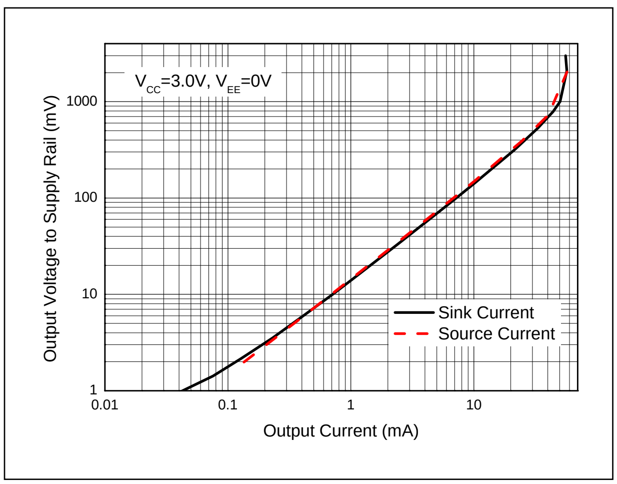
Output Voltage vs. Output Current



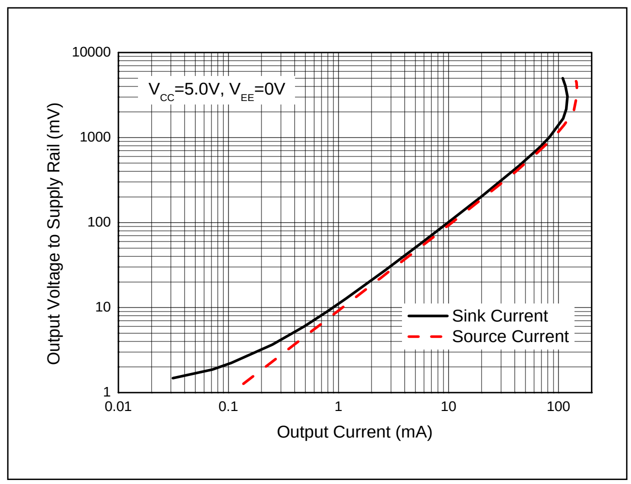
Output Voltage vs. Output Current



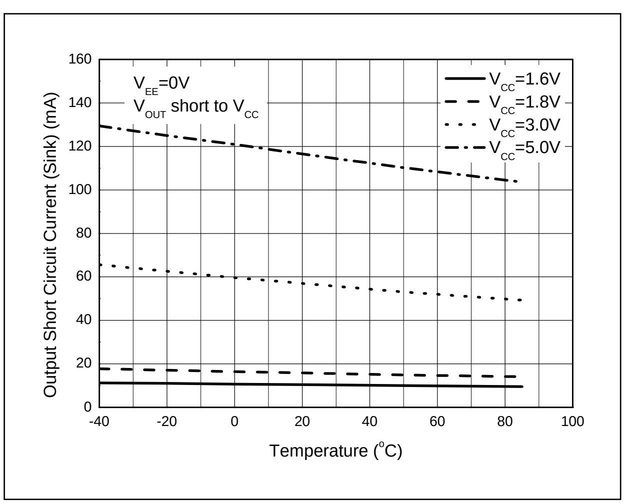
Output Voltage vs. Output Current



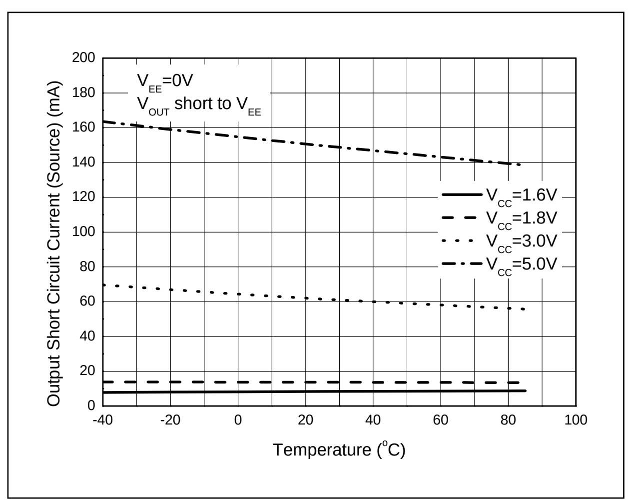
Output Voltage vs. Output Current



Output Short Circuit Current vs. Temperature

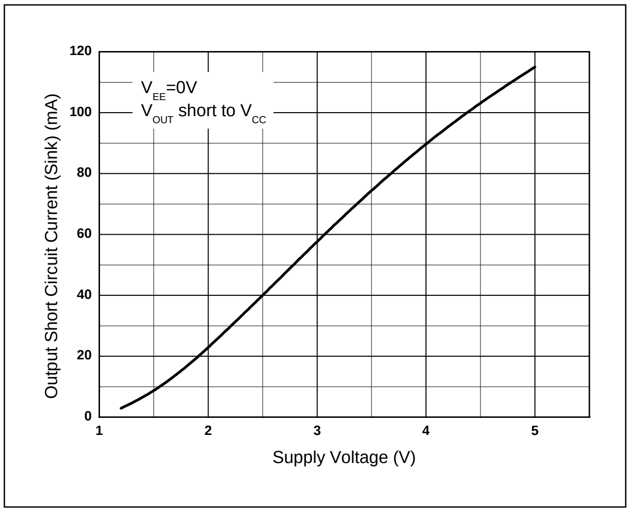


Output Short Circuit Current vs. Temperature

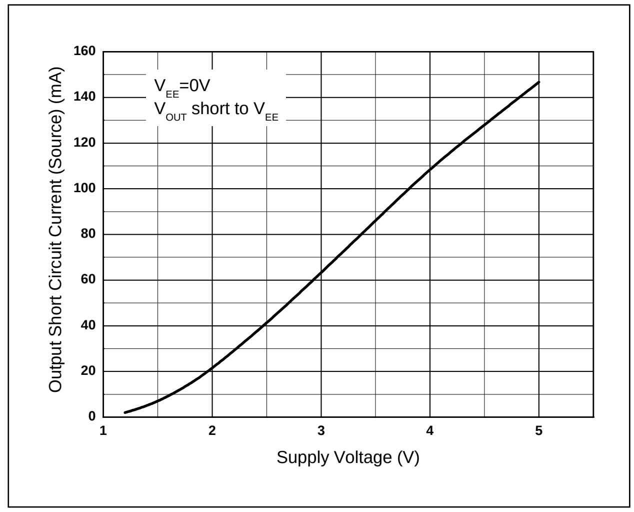


Performance Characteristics (continued)

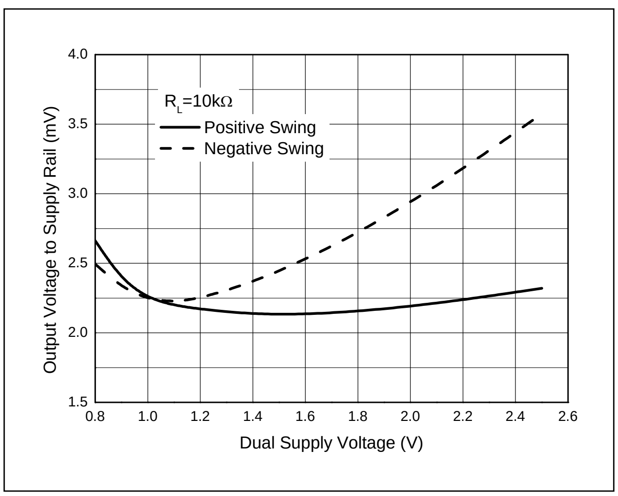
Output Short Circuit Current vs. Supply Voltage



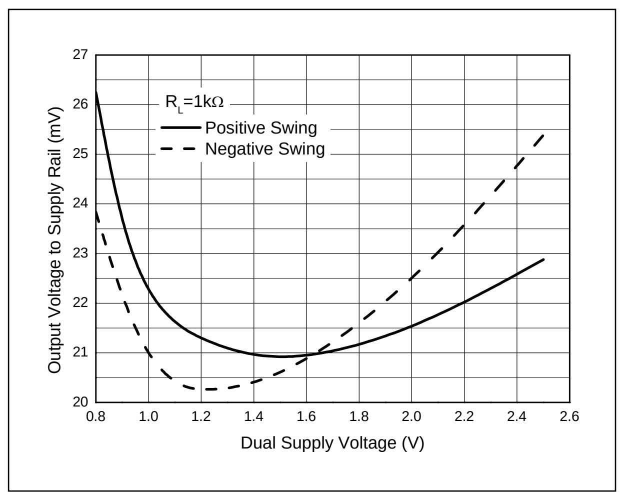
Output Short Circuit Current vs. Supply Voltage



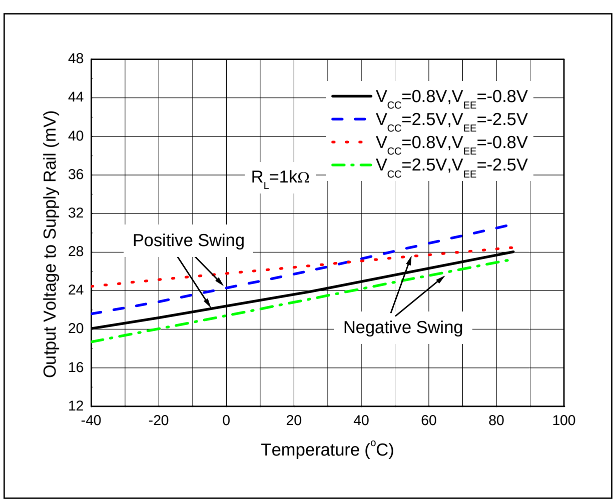
Output Voltage Swing vs. Supply Voltage



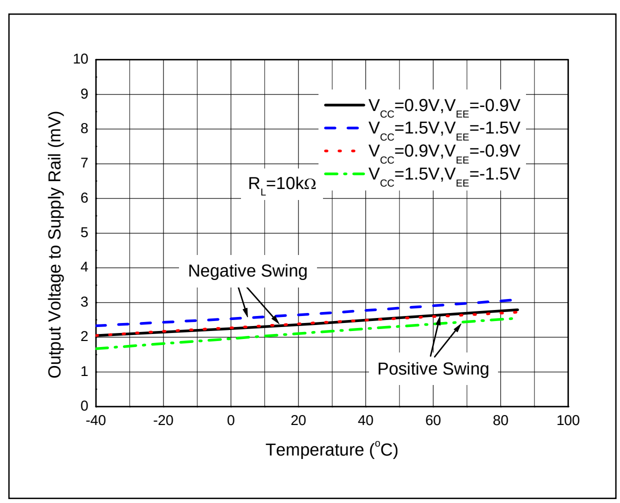
Output Voltage Swing vs. Supply Voltage



Output Voltage Swing vs. Temperature

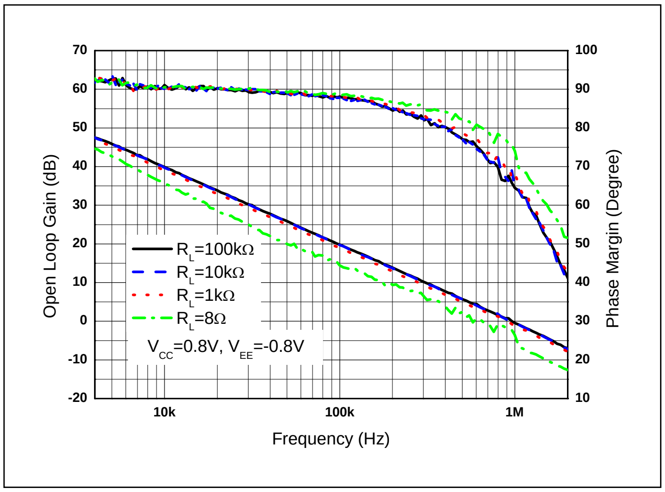


Output Voltage Swing vs. Temperature

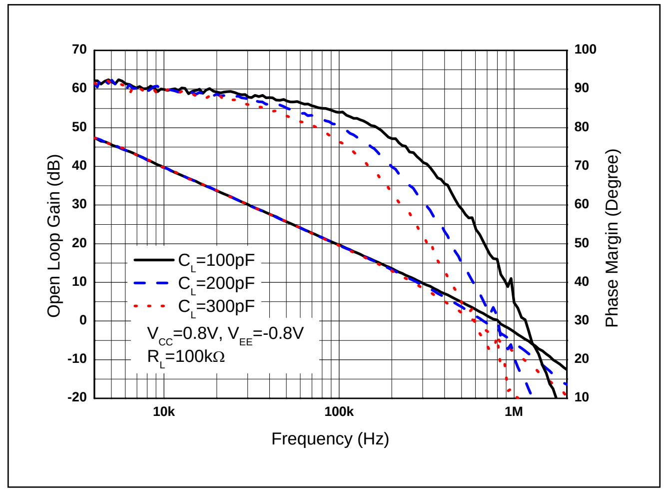


Performance Characteristics (continued)

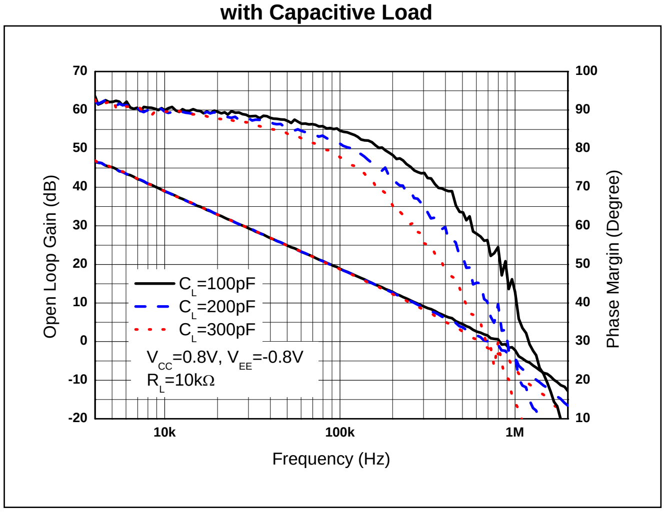
Gain and Phase vs. Frequency with Resistive Load



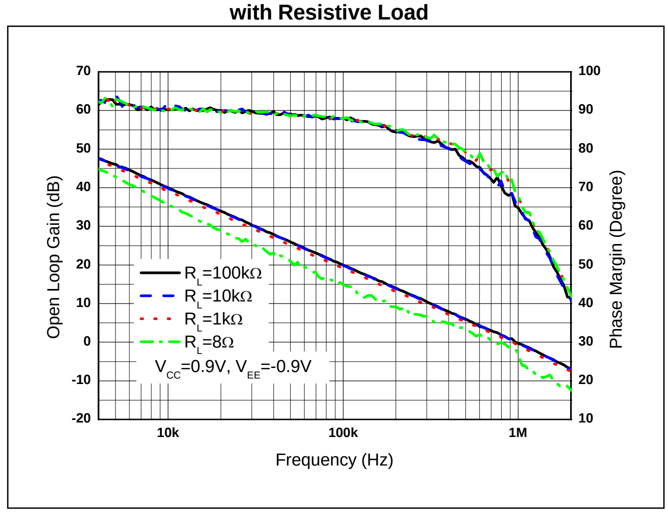
Gain and Phase vs. Frequency with Capacitive Load



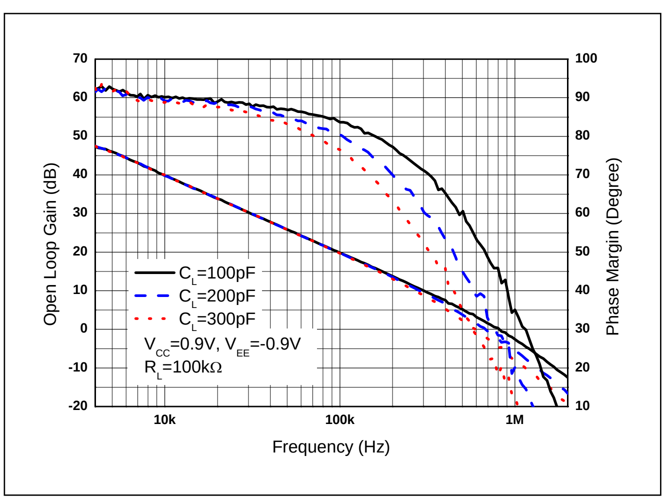
Gain and Phase vs. Frequency with Capacitive Load



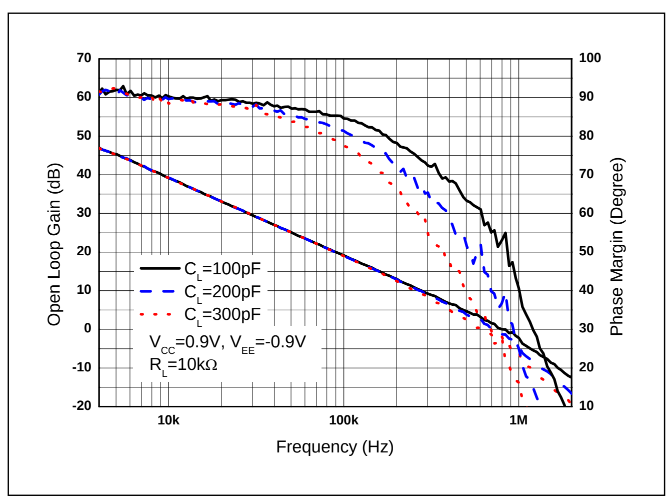
Gain and Phase vs. Frequency with Resistive Load



Gain and Phase vs. Frequency with Capacitive Load

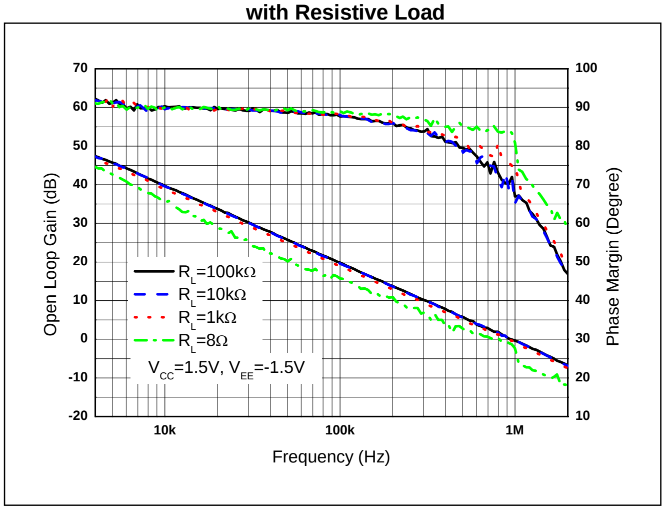


Gain and Phase vs. Frequency with Capacitive Load

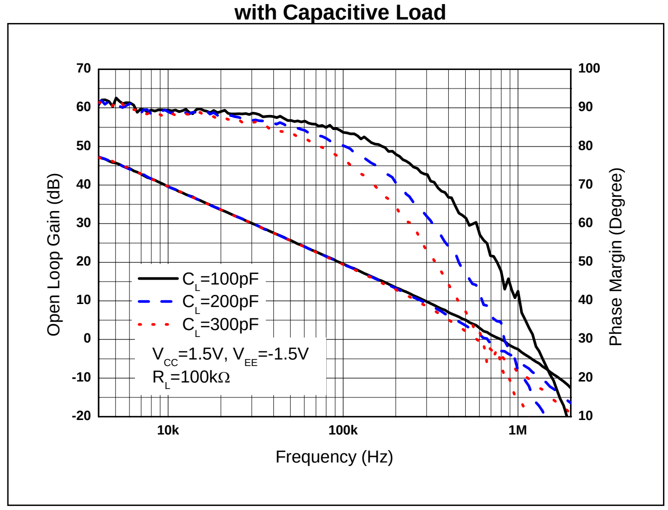


Performance Characteristics (continued)

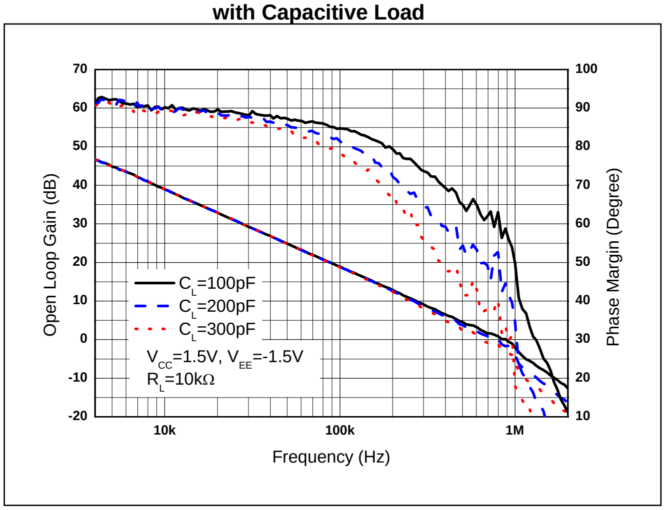
Gain and Phase vs. Frequency with Resistive Load



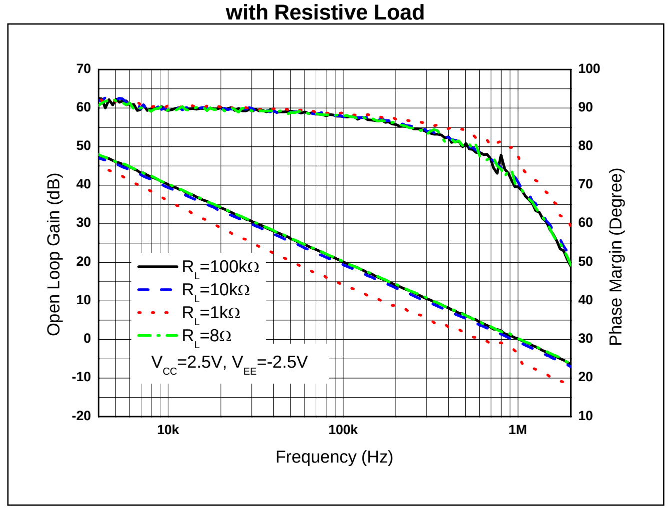
Gain and Phase vs. Frequency with Capacitive Load



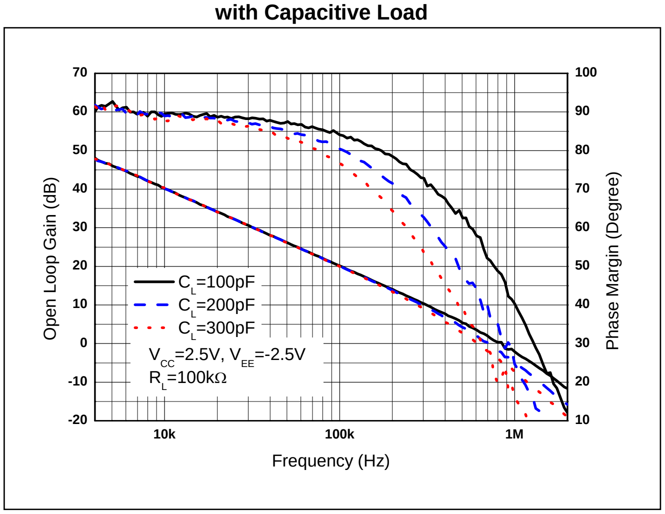
Gain and Phase vs. Frequency with Capacitive Load



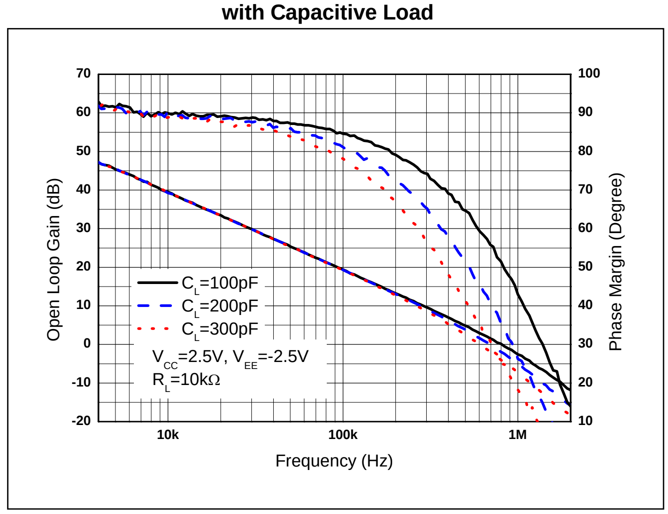
Gain and Phase vs. Frequency with Resistive Load



Gain and Phase vs. Frequency with Capacitive Load

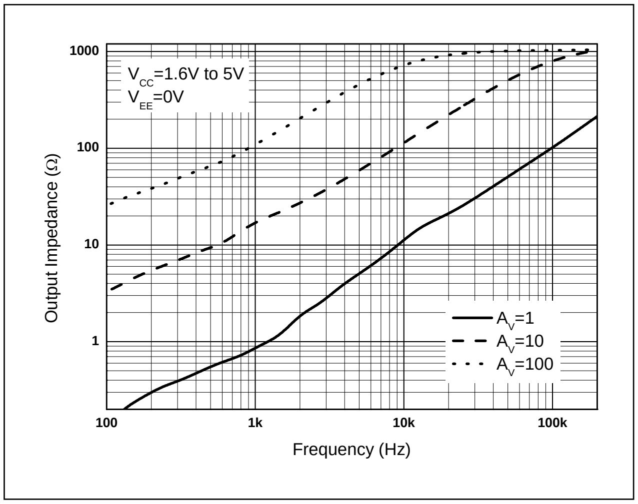


Gain and Phase vs. Frequency with Capacitive Load

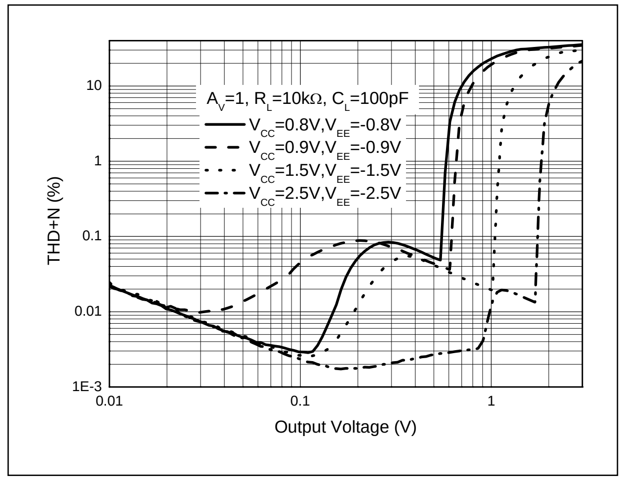


Performance Characteristics (continued)

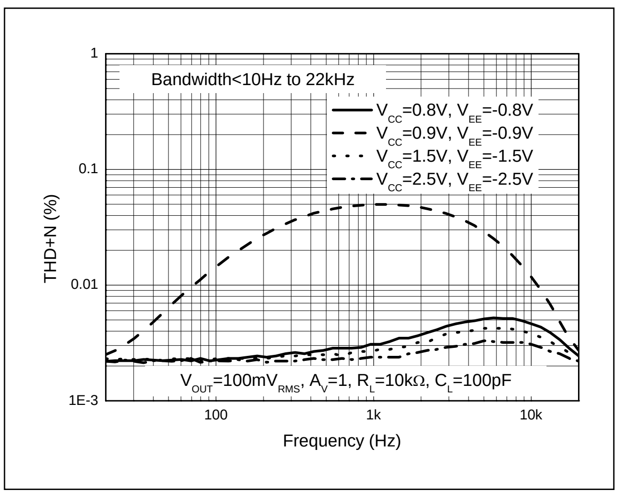
Output Impedance vs. Frequency



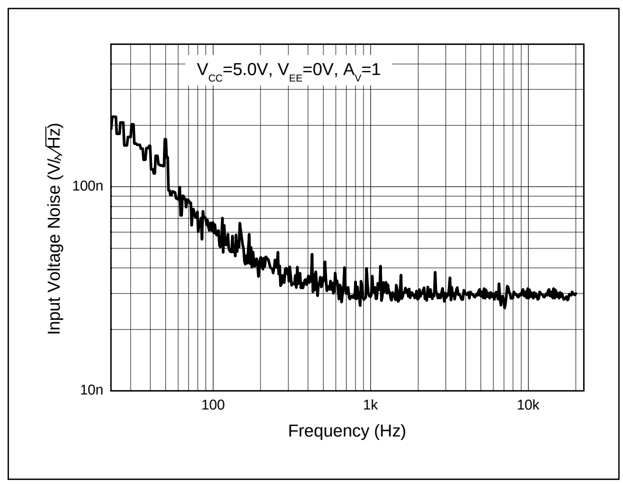
THD+N vs. Output Voltage



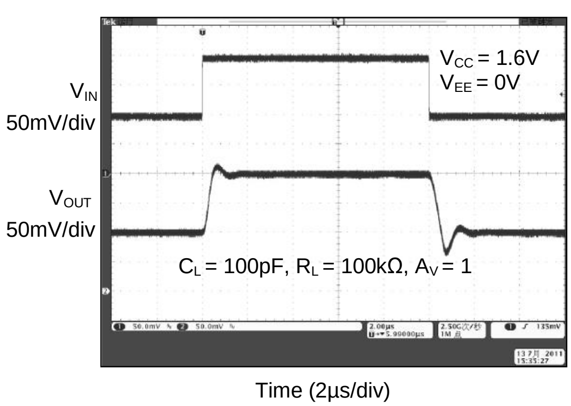
THD+N vs. Frequency



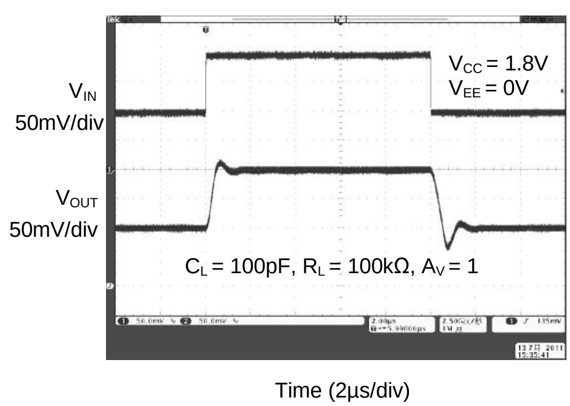
Input Voltage Noise Density



Small Signal Pulse Response

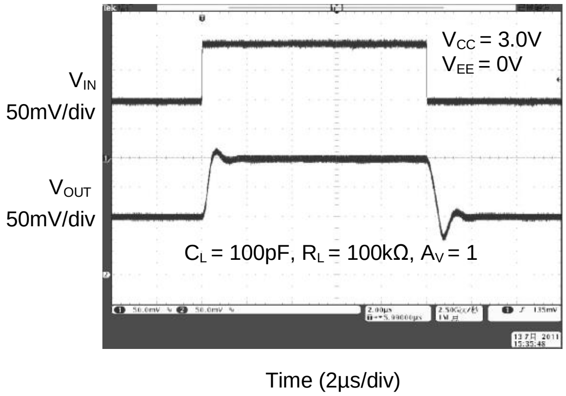


Small Signal Pulse Response

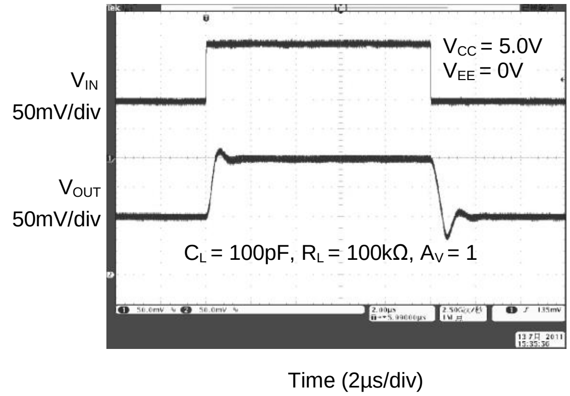


Performance Characteristics (continued)

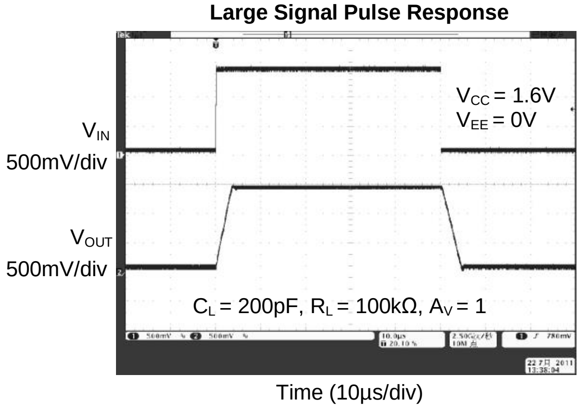
Small Signal Pulse Response



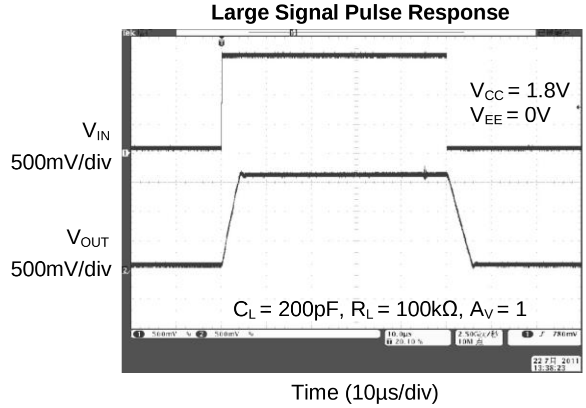
Small Signal Pulse Response



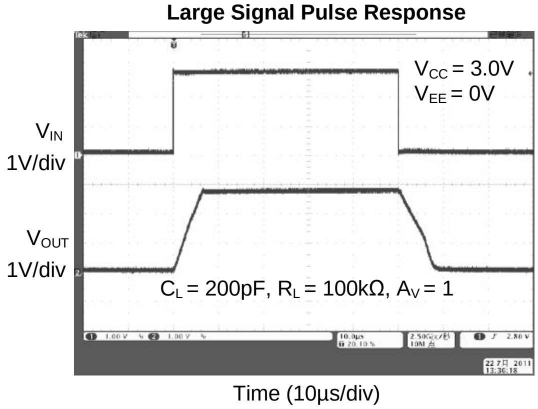
Large Signal Pulse Response



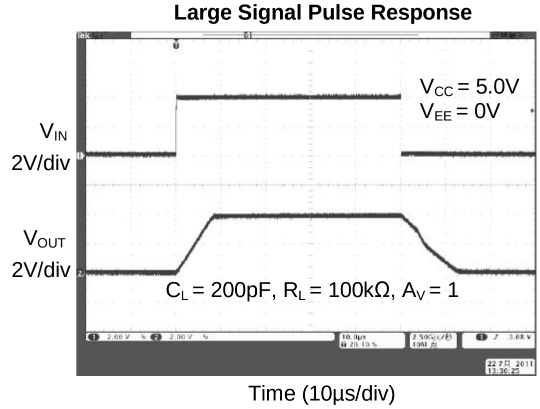
Large Signal Pulse Response



Large Signal Pulse Response

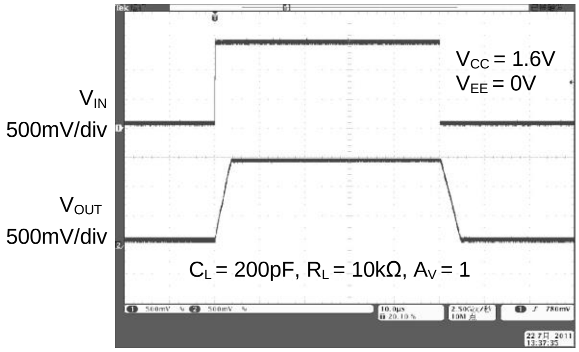


Large Signal Pulse Response



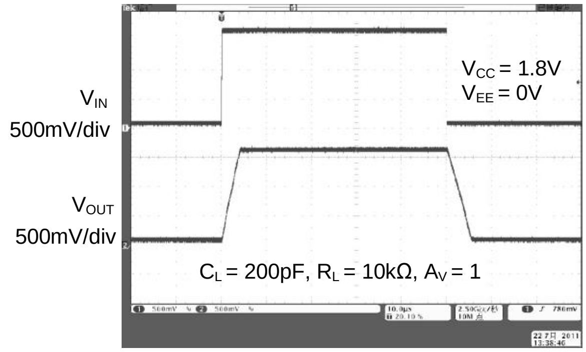
Performance Characteristics (continued)

Large Signal Pulse Response



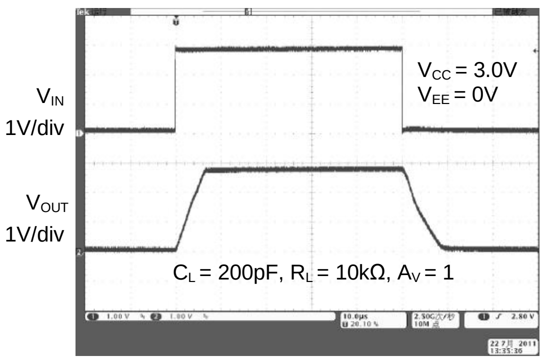
Time (10µs/div)

Large Signal Pulse Response



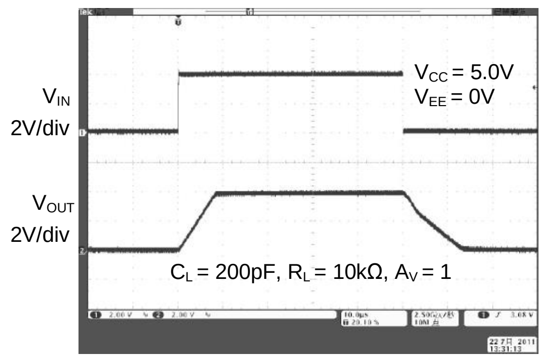
Time (10µs/div)

Large Signal Pulse Response



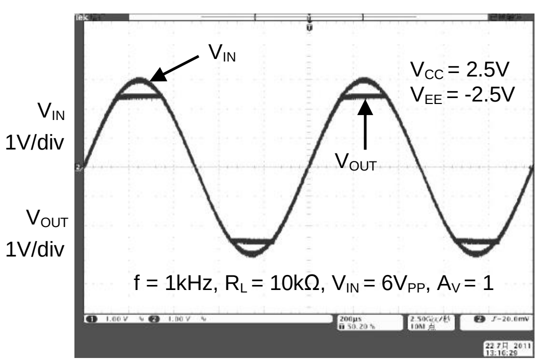
Time (10µs/div)

Large Signal Pulse Response



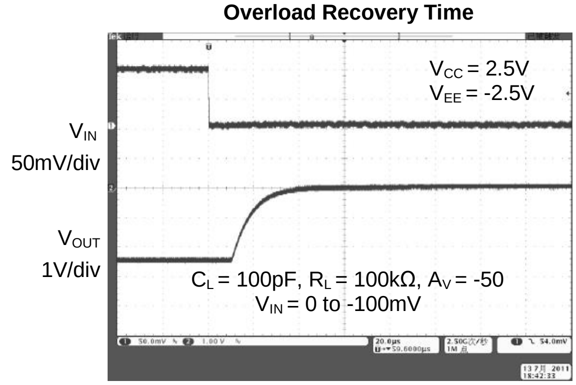
Time (10µs/div)

No Phase Reversal



Time (200µs/div)

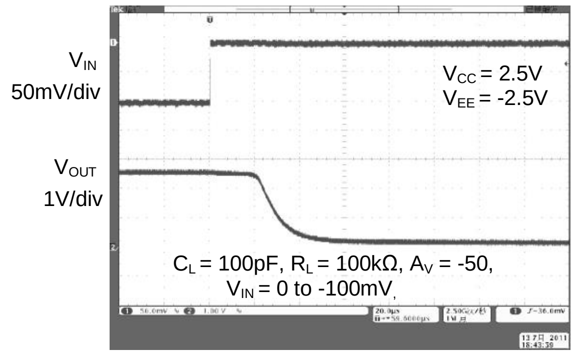
Overload Recovery Time



Time (20µs/div)

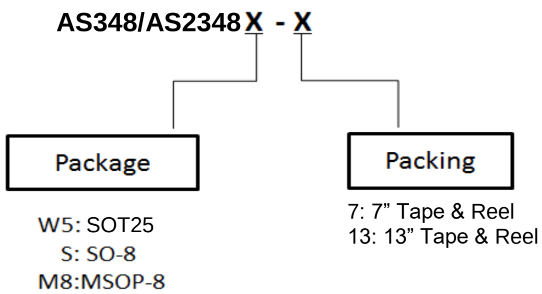
Performance Characteristics (continued)

Overload Recovery Time



Time (20µs/div)

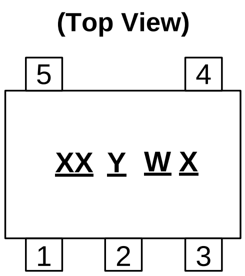
Ordering Information



Part Number	Package Code	Package	Packing	
			Qty.	Carrier
AS348W5-7	W5	SOT25	3,000	7" Tape and Reel
AS2348S-13	S	SO-8	4,000	13" Tape and Reel
AS2348M8-13	M8	MSOP-8	3,000	13" Tape and Reel

Marking Information

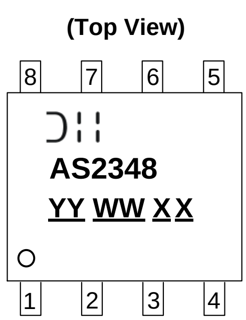
(1) SOT25



XX : Identification Code
Y : Year 0 to 9
W : Week : A to Z : 1 to 26 week;
a to z : 27 to 52 week; z represents 52 and 53 week
X : Internal Code

Part Number	Package	Identification Code
AS348W5-7	SOT25	PH

(2) SO-8

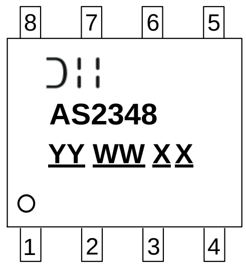


YY : Year : 23, 24, 25~
WW : Week : 01~52; 52 represents 52 and 53 week
X X : Internal Code

Part Number	Package	Identification Code
AS2348S-13	SO-8	AS2348

(3) MSOP-8

(Top View)



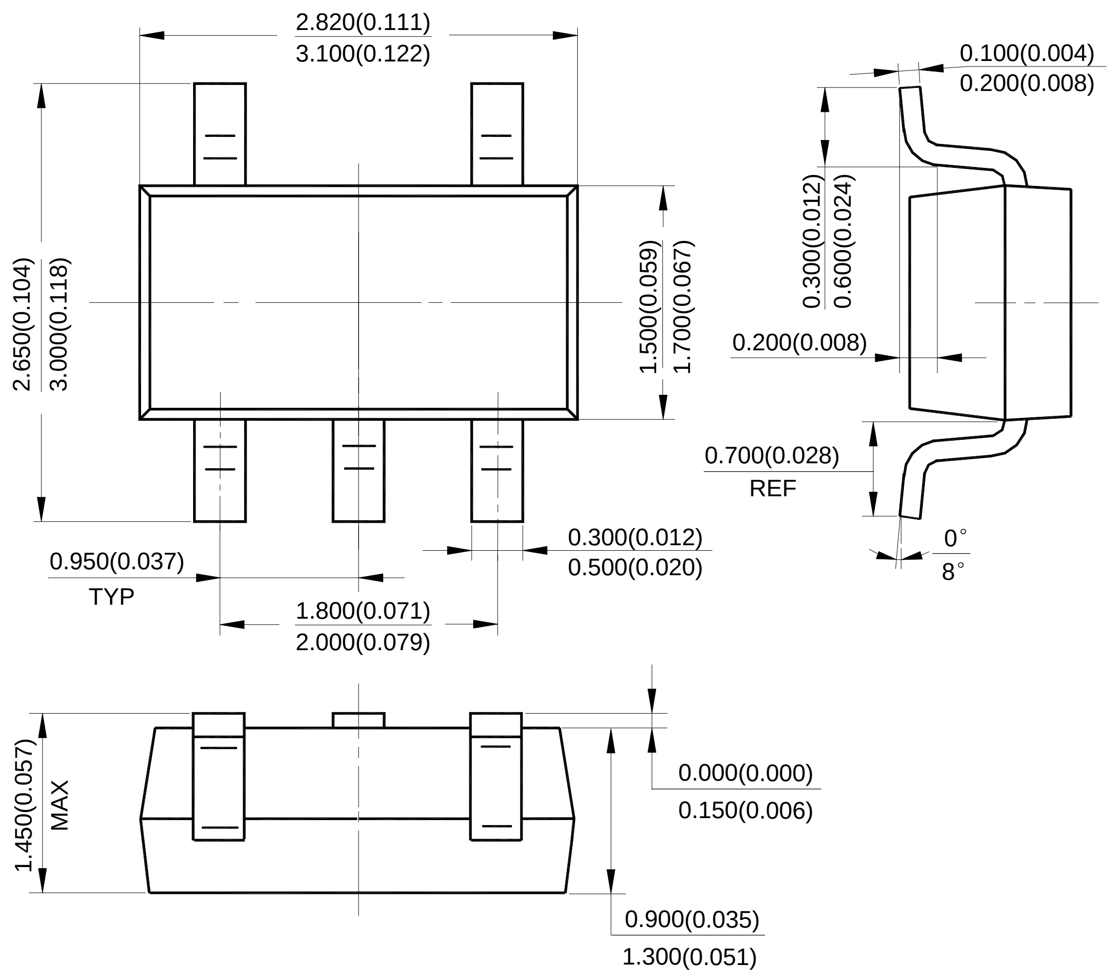
YY : Year : 23, 24, 25~
WW : Week : 01~52; 52 represents 52 and 53 week
XX : Internal Code

Part Number	Package	Identification Code
AS2348M8-13	MSOP-8	AS2348

Package Outline Dimensions (All dimensions in mm(inch).)

Please see http://www.diodes.com/package-outlines.html for the latest version.

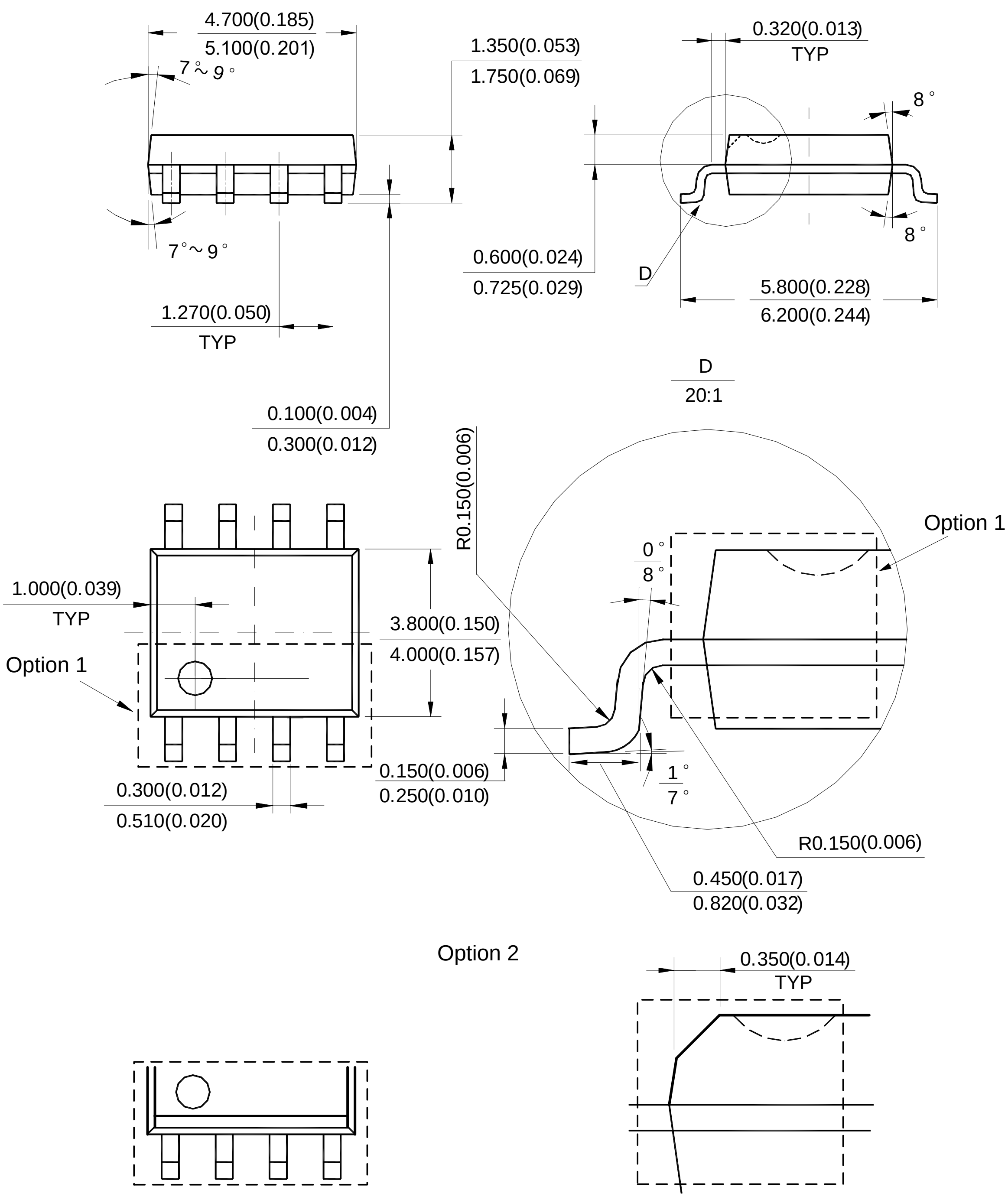
(1) Package Type: SOT25



Package Outline Dimensions (All dimensions in mm(inch).) (continued)

Please see http://www.diodes.com/package-outlines.html for the latest version.

(2) Package Type: SO-8

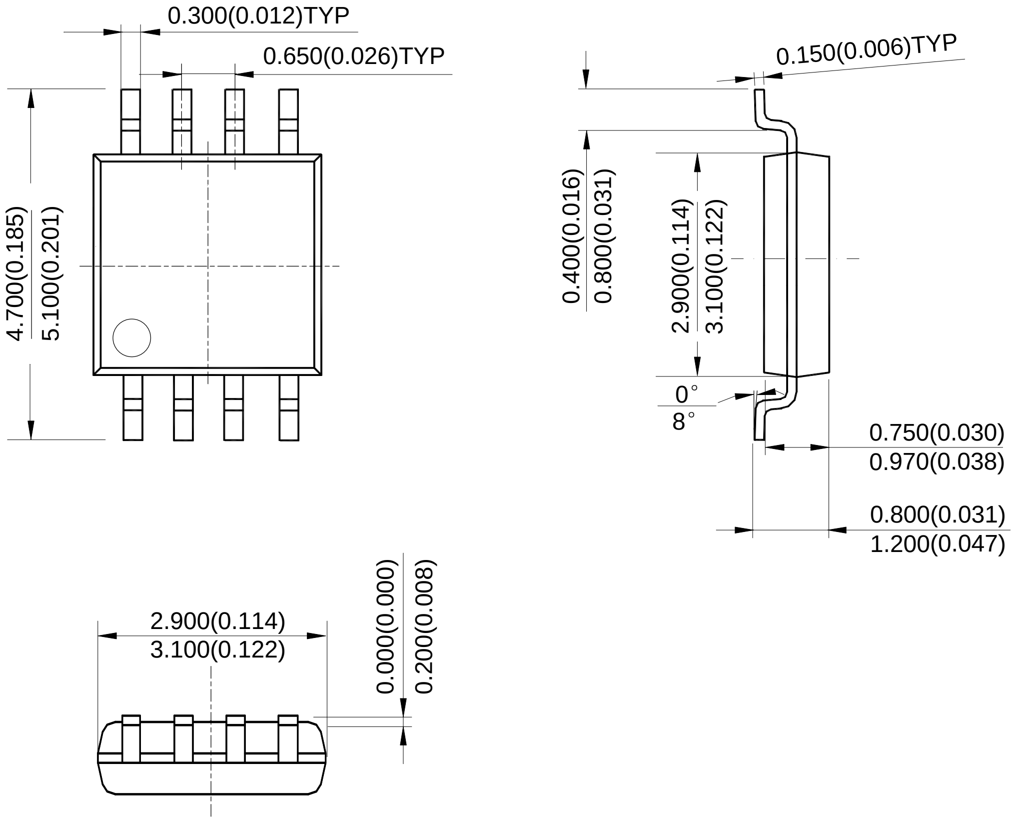


Note: Eject hole, oriented hole and mold mark is optional.

Package Outline Dimensions (All dimensions in mm(inch).) (continued)

Please see http://www.diodes.com/package-outlines.html for the latest version.

(3) Package Type: MSOP-8

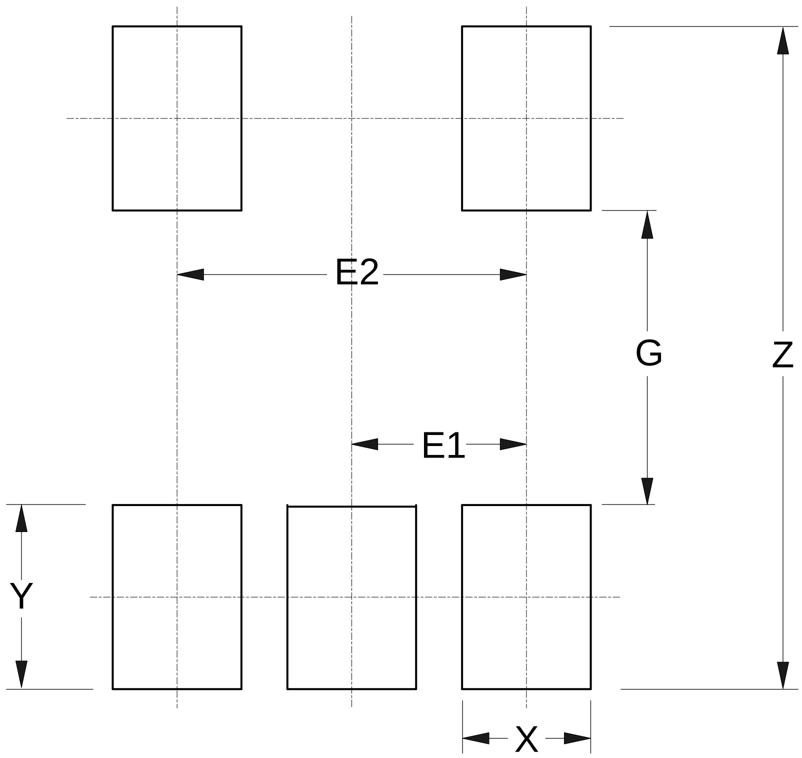


Note: Eject hole, oriented hole and mold mark is optional.

Suggested Pad Layout

Please see http://www.diodes.com/package-outlines.html for the latest version.

(1) Package Type: SOT25

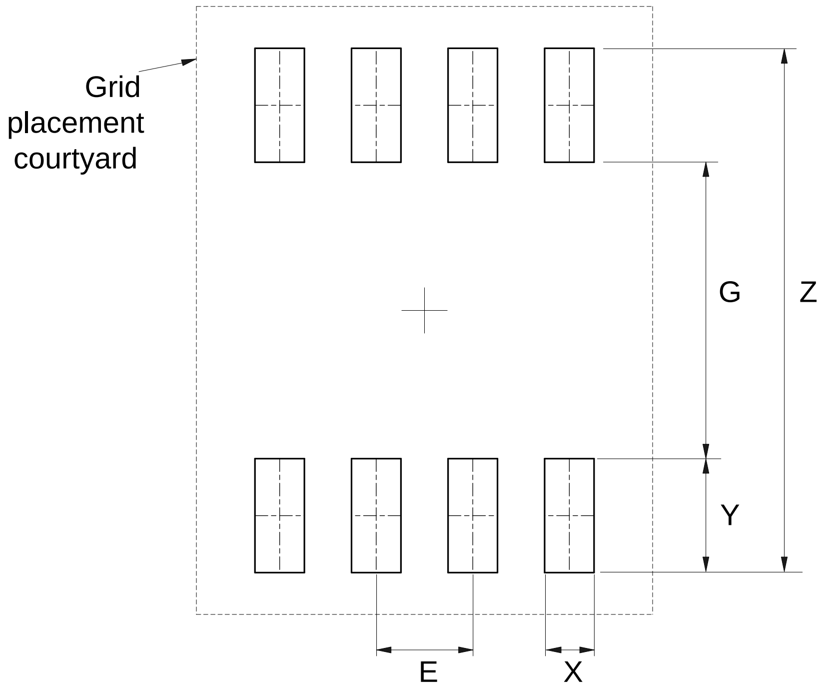


Dimensions	Z (mm)/(inch)	G (mm)/(inch)	X (mm)/(inch)	Y (mm)/(inch)	E1 (mm)/(inch)	E2 (mm)/(inch)
Value	3.600/0.142	1.600/0.063	0.700/0.028	1.000/0.039	0.950/0.037	1.900/0.075

Suggested Pad Layout (continued)

Please see http://www.diodes.com/package-outlines.html for the latest version.

(2) Package Type: SO-8

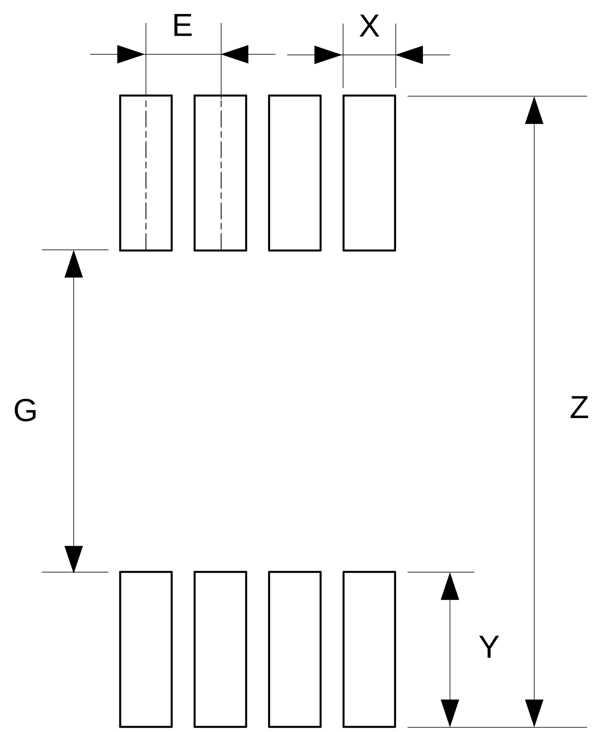


Dimensions	Z (mm)/(inch)	G (mm)/(inch)	X (mm)/(inch)	Y (mm)/(inch)	E (mm)/(inch)
Value	6.900/0.272	3.900/0.154	0.650/0.026	1.500/0.059	1.270/0.050

Suggested Pad Layout (continued)

Please see http://www.diodes.com/package-outlines.html for the latest version.

(3) Package Type: MSOP-8



Dimensions	Z (mm)/(inch)	G (mm)/(inch)	X (mm)/(inch)	Y (mm)/(inch)	E (mm)/(inch)
Value	5.500/0.217	2.800/0.110	0.450/0.018	1.350/0.053	0.650/0.026

Mechanical Data

SOT25

- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish – Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208 (e3)
- Weight: 0.015 grams (Approximate)

SO-8

- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish – Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208 (e3)
- Weight: 0.074 grams (Approximate)

MSOP-8

- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish – Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208 (e3)
- Weight: 0.0246 grams (Approximate)

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