

Description

The LM358/358A/358B consists of two independent, high gain and internally frequency compensated operational amplifiers, they are specifically designed to operate from a single power supply. Operation from split power supply is also possible and the low power supply current drain is independent of the magnitude of the power supply voltages. Typical applications include transducer amplifiers, DC gain blocks and most conventional operational amplifier circuits.

The LM358/358A/358B series is compatible with industry standard 358. The LM358A has more stringent input offset voltage than the LM358.

The LM358 is available in PDIP-8, TDIP-8, SO-8, TSSOP-8 and MSOP-8 packages, the LM358A is available in PDIP-8 and SO-8 packages and LM358B is available in TSSOP-8 package.

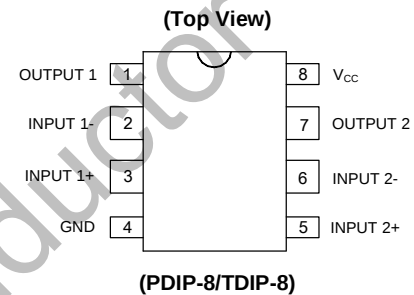
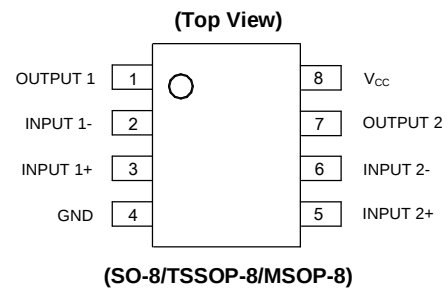
Features

- Internally Frequency Compensated for Unity Gain
- Large Voltage Gain: 100dB (Typical)
- Low Input Bias Current: 20nA (Typical)
- Low Input Offset Voltage: 2mV (Typical)
- Low Supply Current: 0.5mA (Typical)
- Wide Power Supply Voltage:
 - Single Supply: 3V to 36V
 - Dual Supplies: $\pm 1.5V$ to $\pm 18V$
- Input Common Mode Voltage Range Includes Ground
- Large Output Voltage Swing: 0V to $V_{CC} - 1.5V$
- Lead-Free Packages: SO-8, PDIP-8 and TSSOP-8
 - **Totally Lead-Free; RoHS Compliant (Notes 1 & 2)**
- Lead-Free Packages, Available in "Green" Molding Compound: SO-8, PDIP-8, TDIP-8, TSSOP-8 and MSOP-8
 - **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
 - **Halogen and Antimony Free. "Green" Device (Note 3)**

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. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

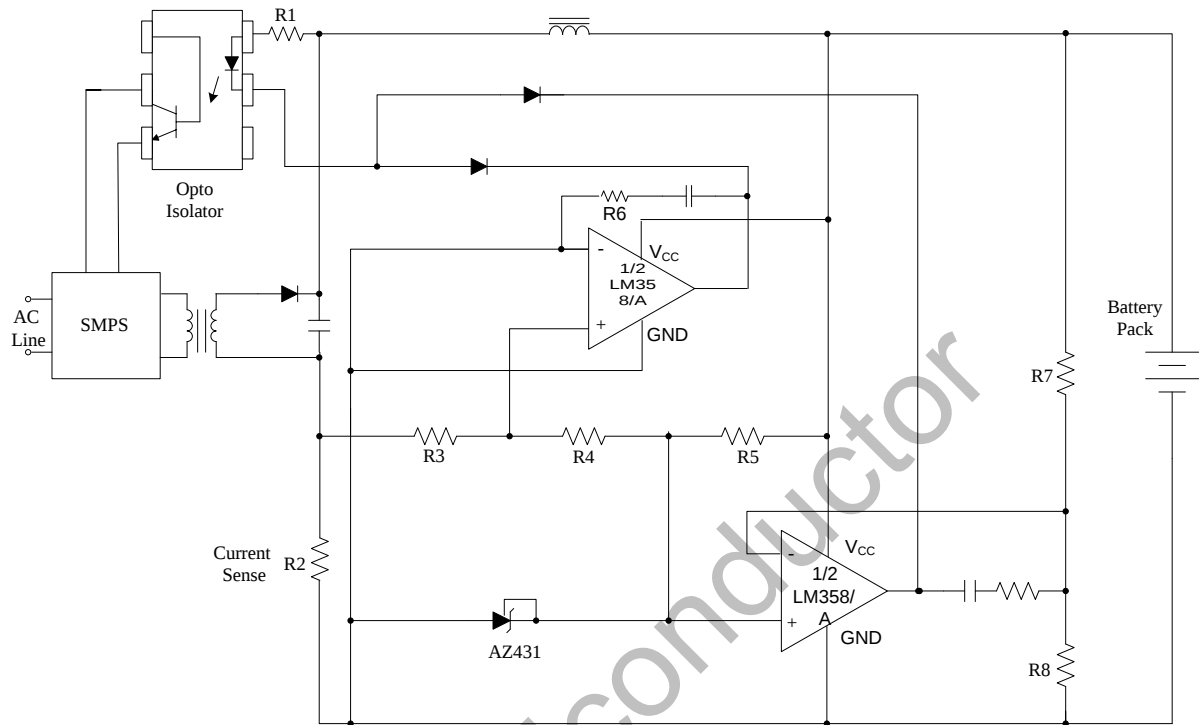
Pin Assignments



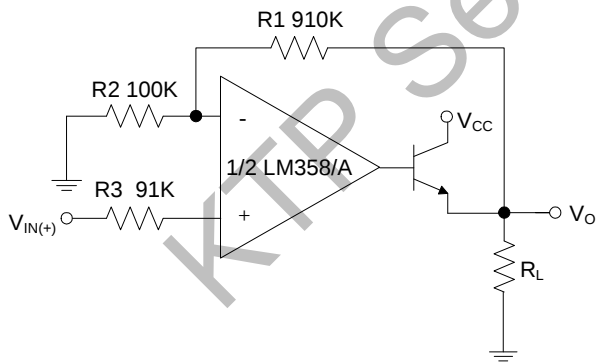
Applications

- Battery Charger
- Cordless Telephone
- Switching Power Supply

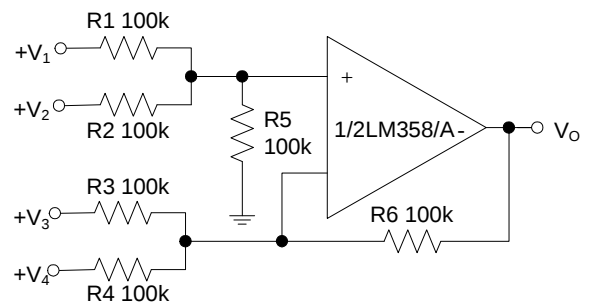
Typical Applications Circuit



Battery Charger

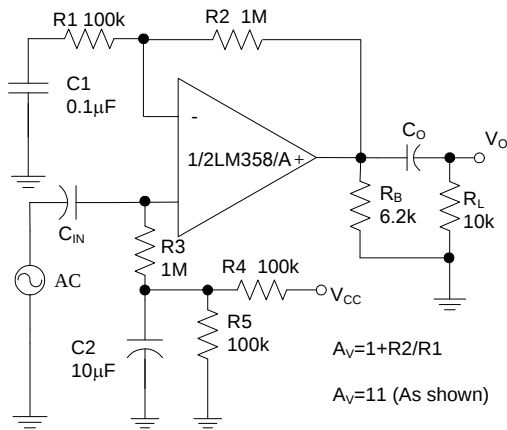


Power Amplifier

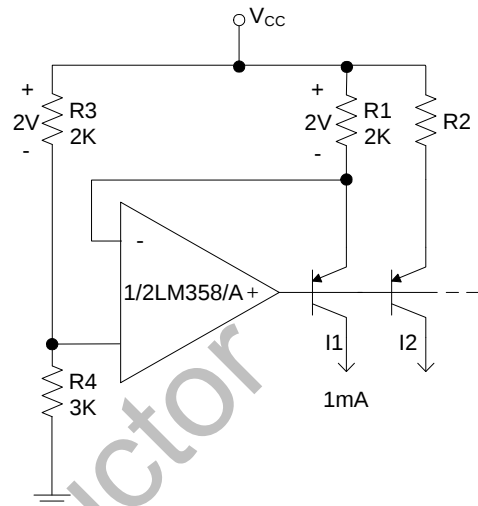


DC Summing Amplifier

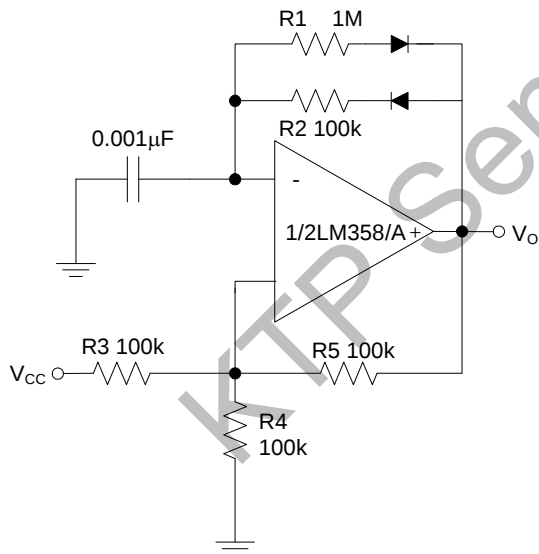
Typical Applications Circuit (Cont.)



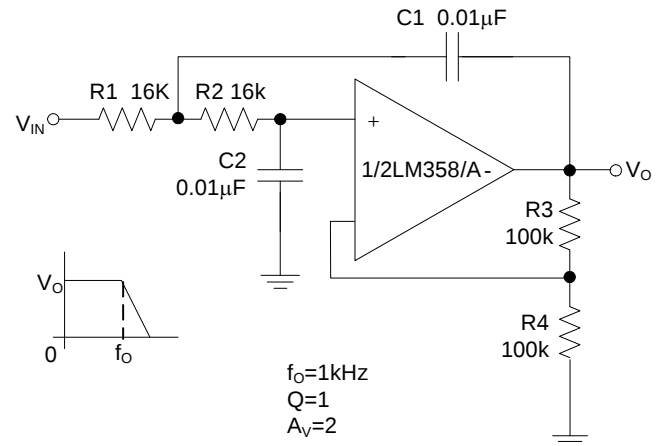
AC Coupled Non-Inverting Amplifier



Fixed Current Sources

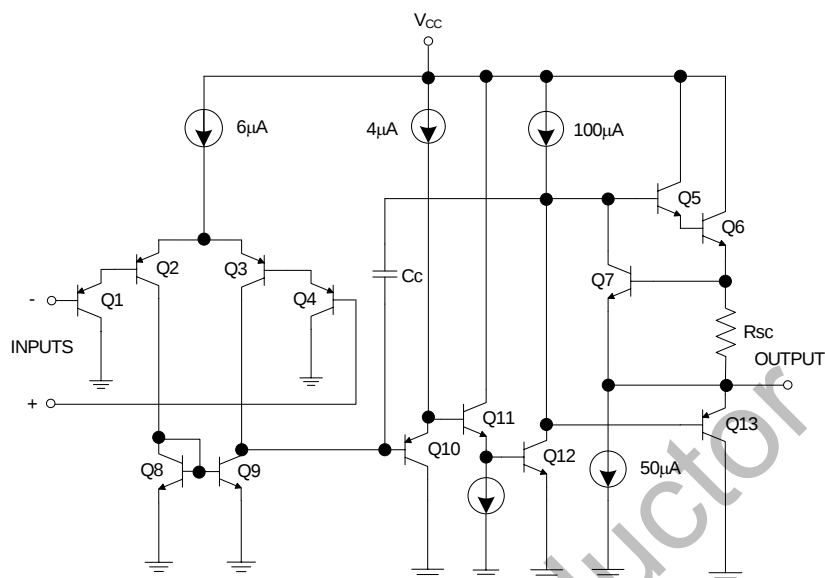


Pulse Generator



DC Coupled Low-Pass Active Filter

Functional Block Diagram



Absolute Maximum Ratings (Notes 4 & 5)

Symbol	Parameter	Rating		Unit
V_{CC}	Power Supply Voltage	40		V
V_{ID}	Differential Input Voltage	40		V
V_{IC}	Input Voltage	-0.3 to 40		V
P_D	Power Dissipation ($T_A = +25^\circ\text{C}$)	PDIP-8	830	mW
		SO-8	550	
		TSSOP-8	500	
		MSOP-8	470	
T_J	Operating Junction Temperature	+150		$^\circ\text{C}$
T_{STG}	Storage Temperature Range	-65 to +150		$^\circ\text{C}$
T_{LEAD}	Lead Temperature (Soldering, 10 Seconds)	+260		$^\circ\text{C}$

Notes: 3. Stresses greater than those listed under "Absolute Maximum Ratings" may 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 may affect device reliability.

4 . ESD sensitivity.

Recommended Operating Conditions

Symbol	Parameter	Min	Max	Unit
V_{CC}	Supply Voltage	3	36	V
T_A	Ambient Operating Temperature Range	-40	+85	$^\circ\text{C}$

Electrical Characteristics (Limits in standard typeface are for $T_A = +25^\circ\text{C}$, **bold** typeface applies over -40°C to $+85^\circ\text{C}$ (Note 6), $V_{CC} = 5\text{V}$, $\text{GND} = 0\text{V}$, unless otherwise specified.)

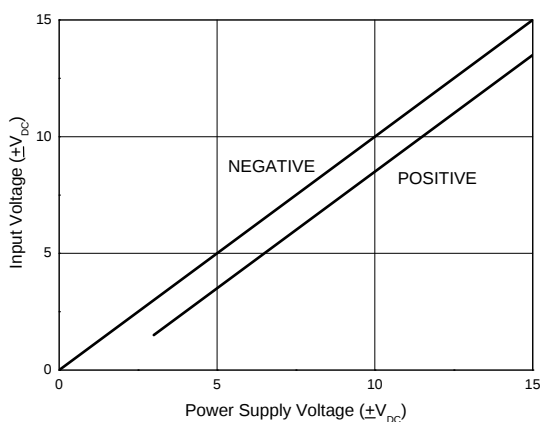
Symbol	Parameter		Conditions	Min	Typ	Max	Unit	
V _{IO}	Input Offset Voltage		V _O = 1.4V, R _S = 0Ω, V _{CC} = 5V to 30V	AS358	—	2	5	mV
				AS358A	—	—	7	
					—	2	3	
				AS358B	—	—	5	
					—	—	2	
ΔV _{IO} /ΔT	Average Temperature Coefficient of Input Offset Voltage		T _A = -40°C to +85°C		—	7	—	μV/°C
I _{BIAS}	Input Bias Current		I _{IN+} or I _{IN-} , V _{CM} = 0V		—	20	200	nA
I _{IO}	Input Offset Current		I _{IN+} - I _{IN-} , V _{CM} = 0V		—	—	200	
I _{IO}	Input Offset Current		I _{IN+} - I _{IN-} , V _{CM} = 0V		—	5	30	nA
					—	—	100	
V _{IR}	Input Common Mode Voltage Range (Note 7)		V _{CC} = 30V		0	—	V _{CC} -1.5	V
I _{CC}	Supply Current		T _A = -40°C to +85°C, R _L = ∞, V _{CC} = 30V		—	0.7	2	mA
			T _A = -40°C to +85°C, R _L = ∞, V _{CC} = 5V		—	0.5	1.2	
G _V	Large Signal Voltage Gain		V _{CC} = 15V, V _O = 1V to 11V, R _L ≥ 2kΩ		85	100	—	dB
					80	—	—	
CMRR	Common Mode Rejection Ratio		DC, V _{CM} = 0V to (V _{CC} -1.5)V		60	70	—	dB
					60	—	—	
PSRR	Power Supply Rejection Ratio		V _{CC} = 5V to 30V		70	100	—	dB
					60	—	—	
CS	Channel Separation		f = 1kHz to 20kHz		—	-120	—	dB
I _{SOURCE}	Output Current	Source	V _{IN+} = 1V, V _{IN-} = 0V, V _{CC} = 15V, V _O = 2V		20	40	—	mA
20					—	—		
I _{SINK}		Sink	V _{IN+} = 0V, V _{IN-} = 1V, V _{CC} = 15V, V _O = 2V		10	15	—	mA
					5	—	—	
			V _{IN+} = 0V, V _{IN-} = 1V, V _{CC} = 15V, V _O = 0.2V		12	50	—	μA
I _{SC}	Output Short Circuit Current to Ground				V _{CC} = 15V		—	40
V _{OH}	Output Voltage Swing		V _{CC} = 30V, R _L = 2kΩ		26	—	—	V
					26	—	—	
			V _{CC} = 30V, R _L = 10kΩ		27	28	—	
					27	—	—	
V _{OL}			V _{CC} = 5V, R _L = 10kΩ		—	5	20	mV
					—	—	30	
θ _{JC}	Thermal Resistance (Junction to Case)		SO-8		—	17	—	°C/W
			TSSOP-8			47		
			MSOP-8			22		
θ _{JA}	Thermal Resistance (Junction to Ambient)		SO-8		—	115	—	
			TSSOP-8			209		
			MSOP-8			160		

Notes: 5. Limits over the full temperature are guaranteed by design, but not tested in production.

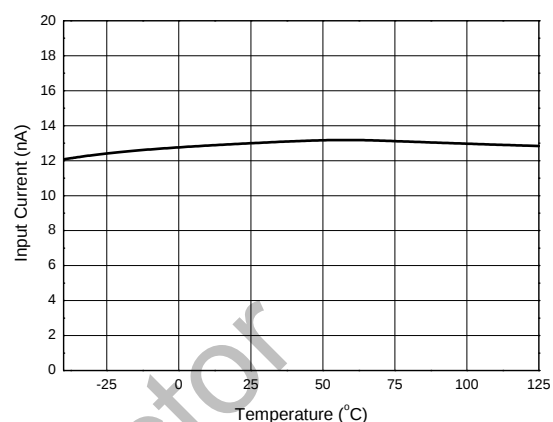
6. The input common-mode voltage of either input signal voltage should not be allowed to go negatively by more than 0.3V (at $+25^\circ\text{C}$). The upper end of the common-mode voltage range is $V_{CC} - 1.5\text{V}$ (at $+25^\circ\text{C}$), but either or both inputs can go to $+36\text{V}$ without damages, independent of the magnitude of the V_{CC} .

Performance Characteristics

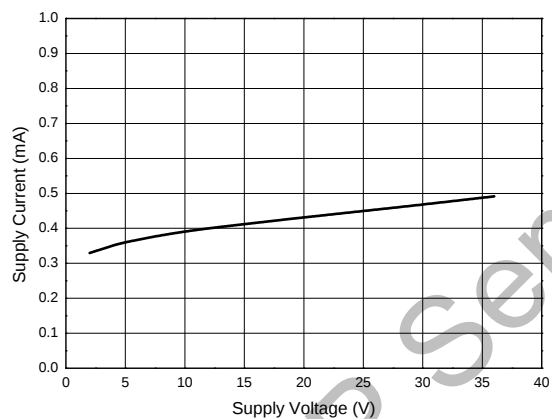
Input Voltage Range



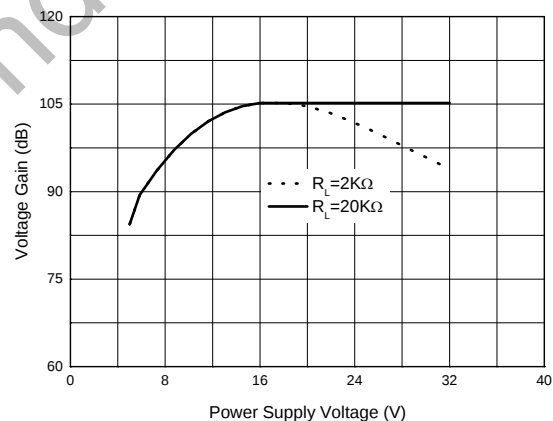
Input Current



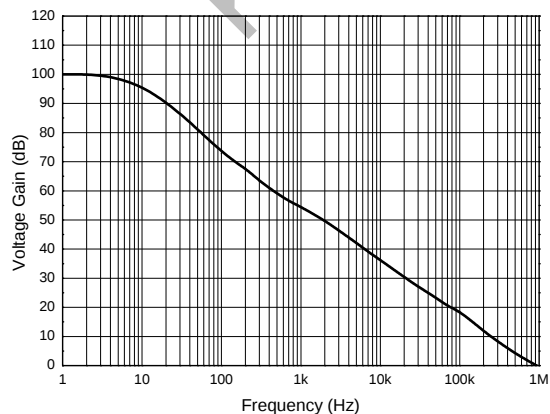
Supply Current



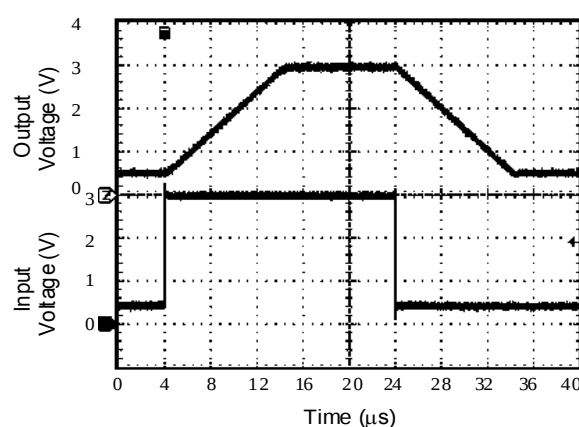
Voltage Gain



Open Loop Frequency Response

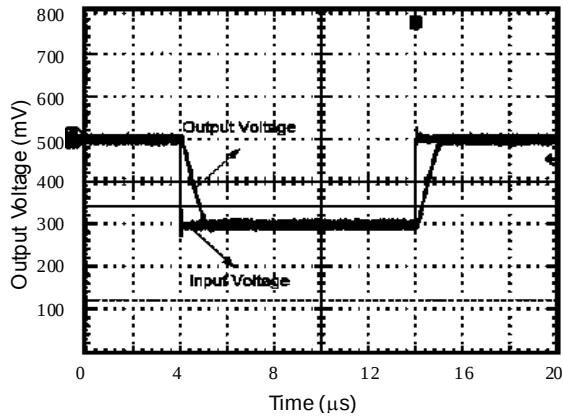


Voltage Follower Pulse Response

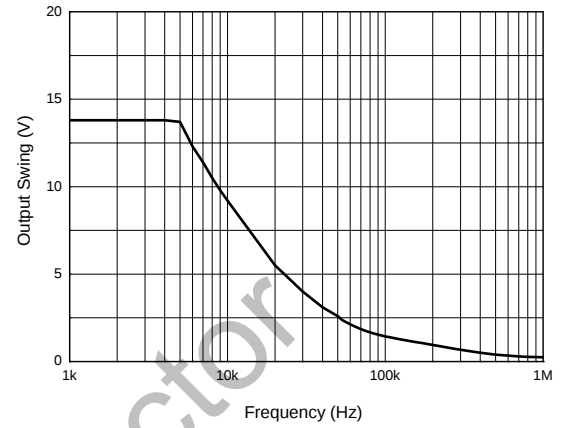


Performance Characteristics (Cont.)

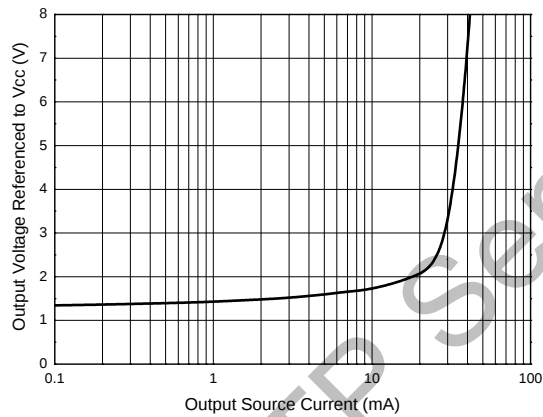
Voltage Follower Pulse Response (Small Signal)



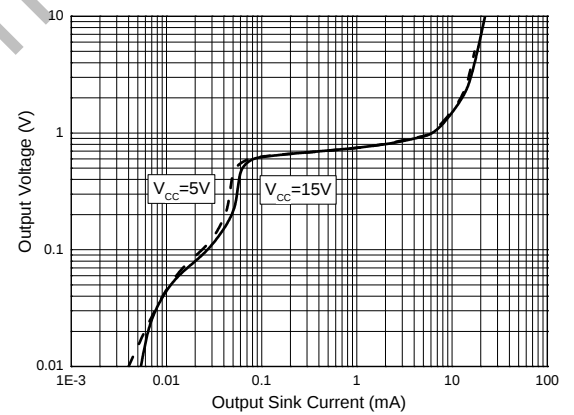
Large Signal Frequency Response



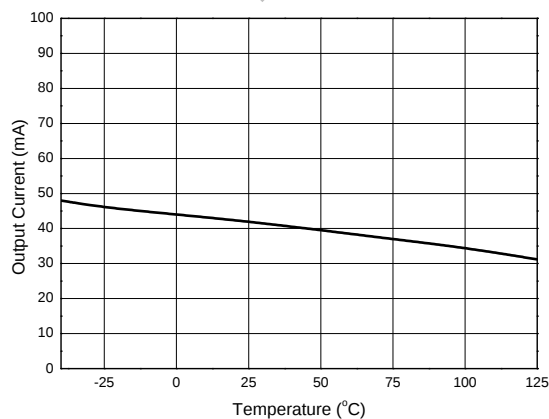
Output Characteristics: Current Sourcing



Output Characteristics: Current Sinking

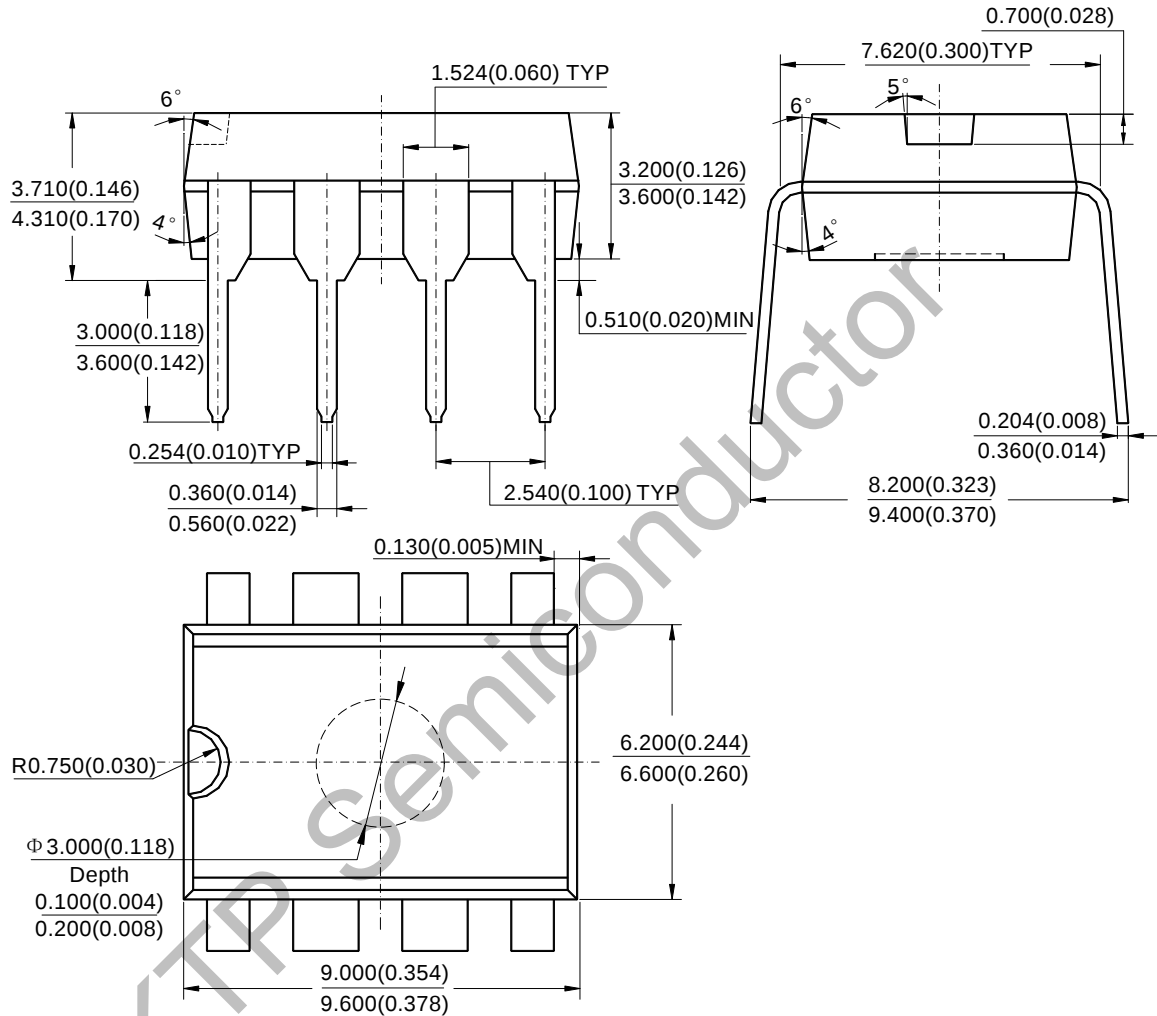


Current Limiting



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

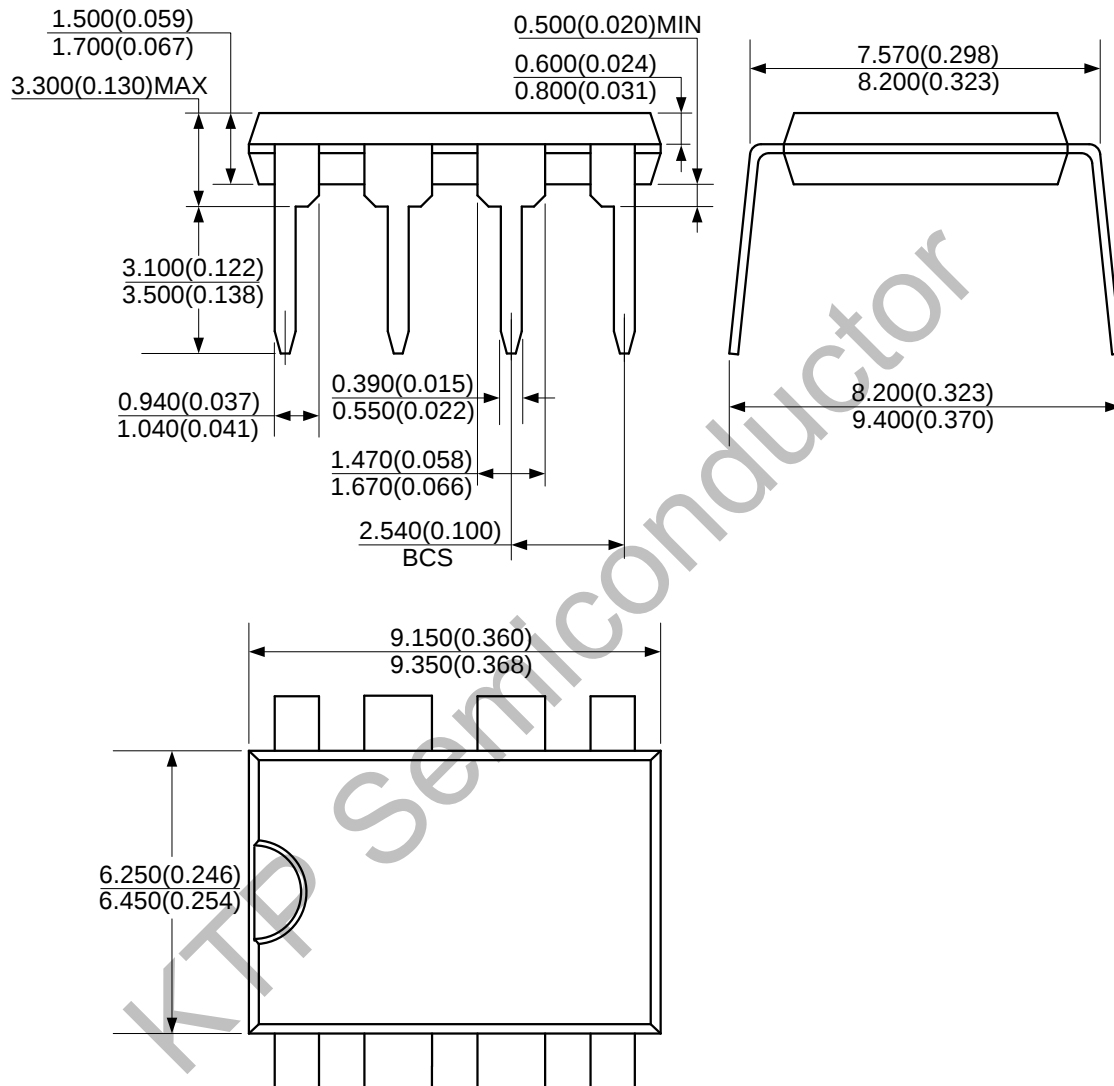
(1) Package Type: PDIP-8



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

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

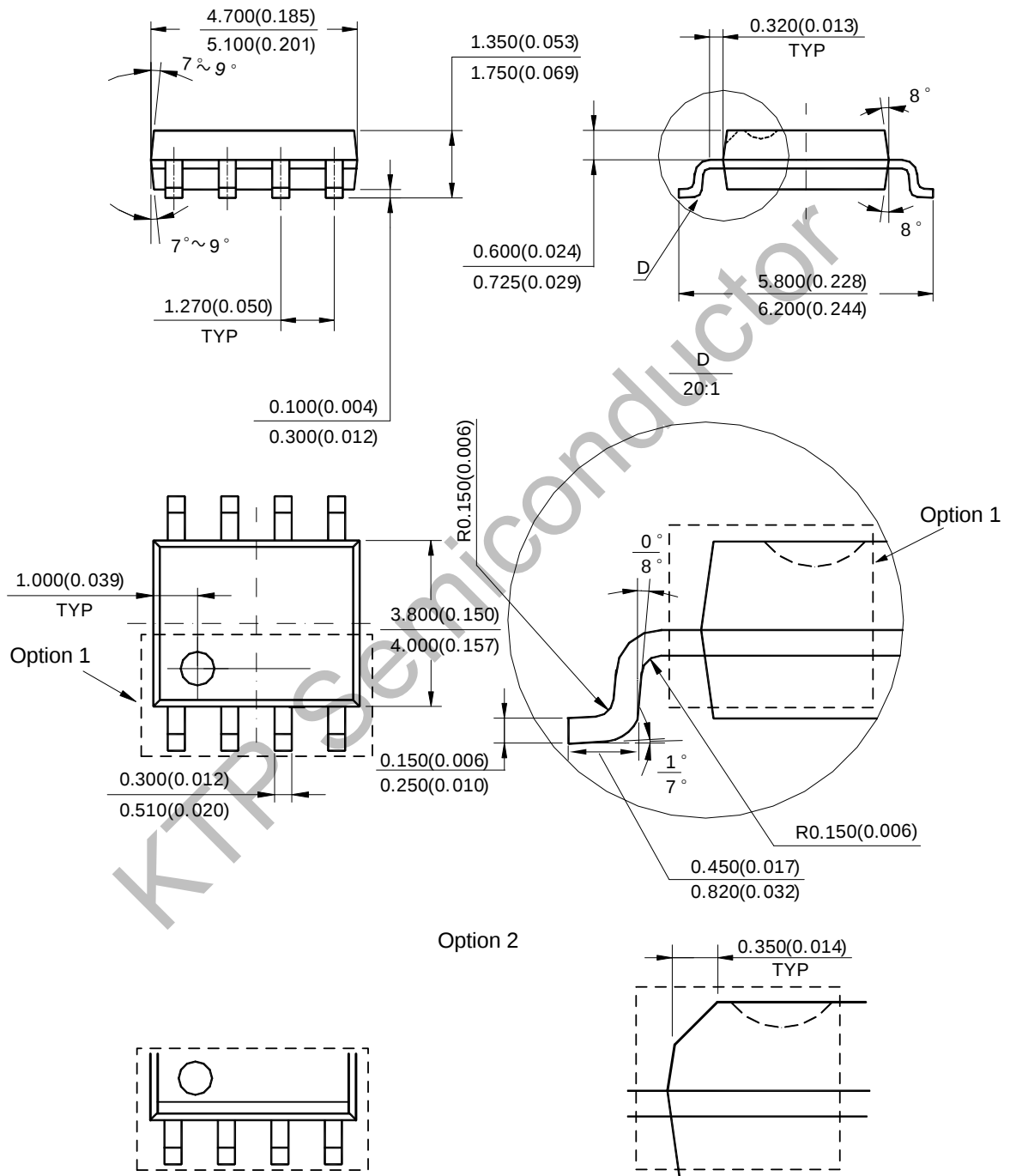
(2) Package Type: TDIP-8



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

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

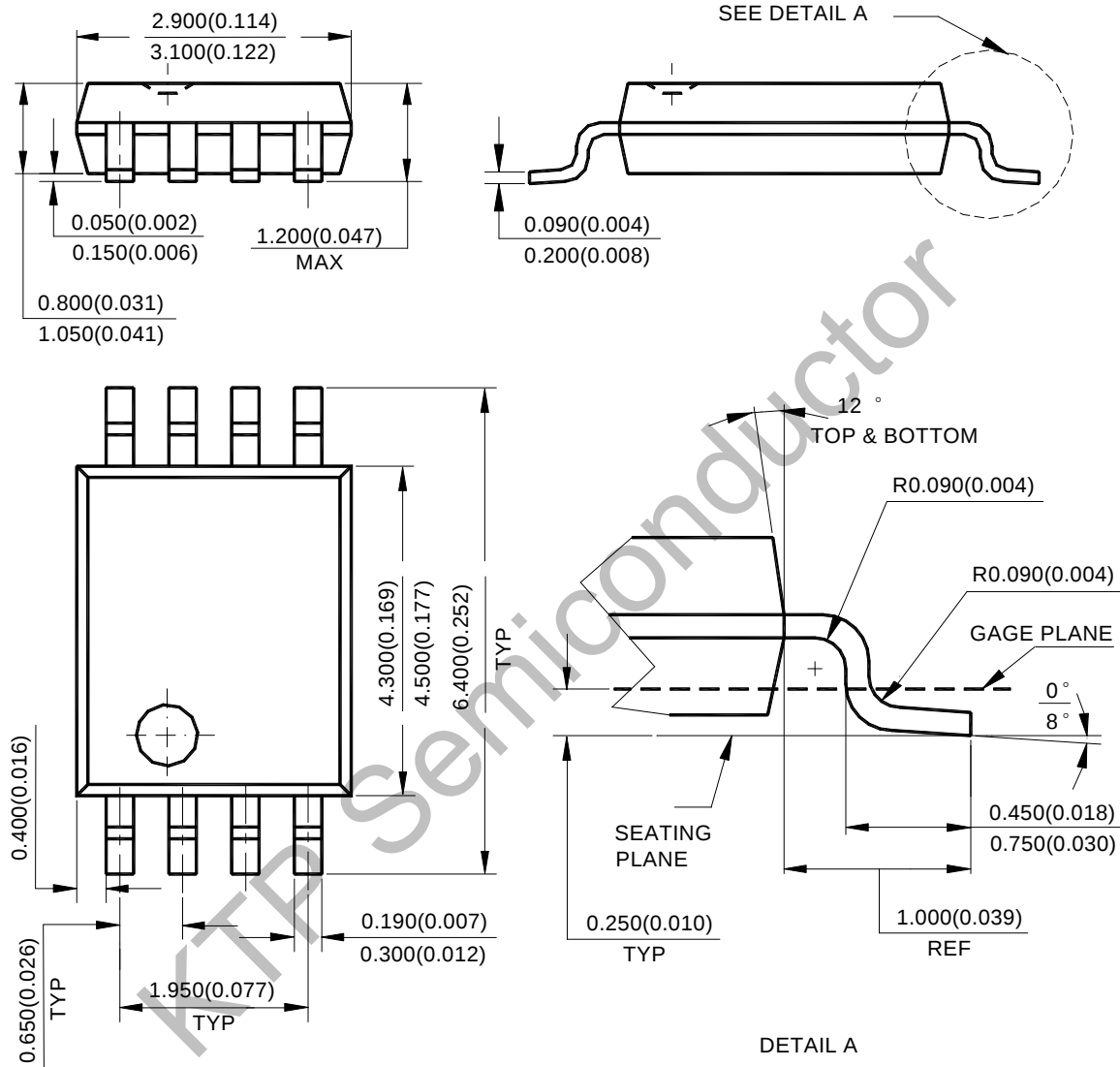
(3) Package Type: SO-8



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

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

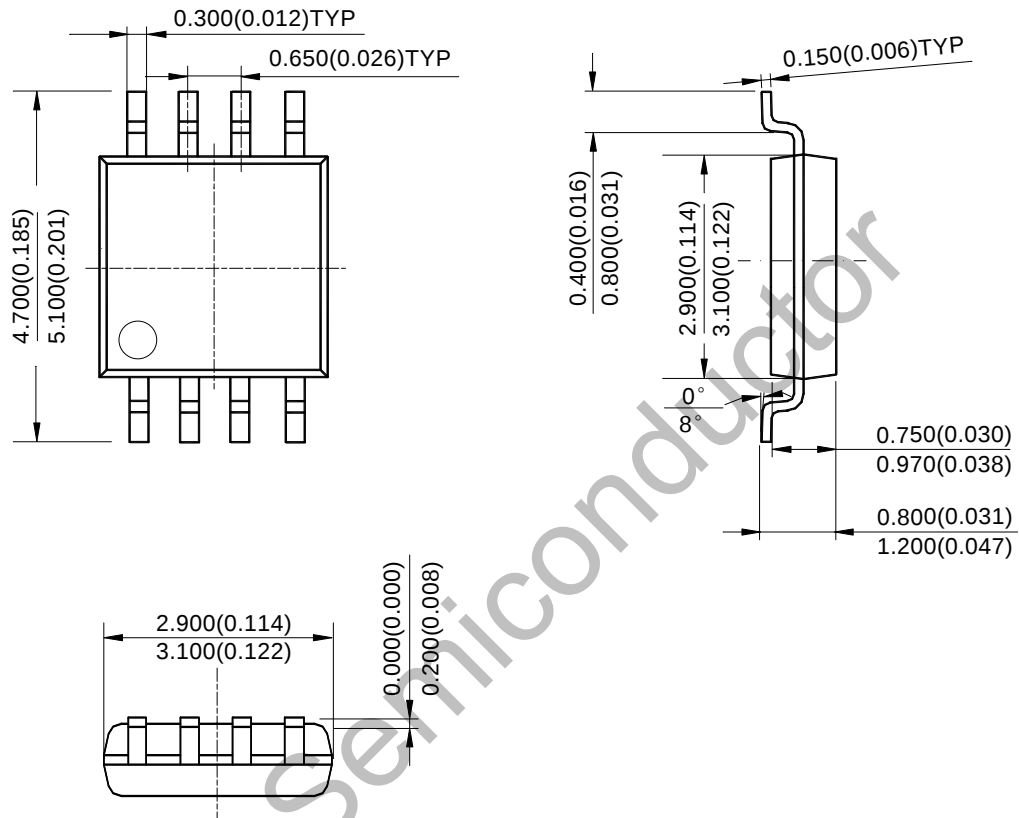
(4) Package Type: TSSOP-8



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

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

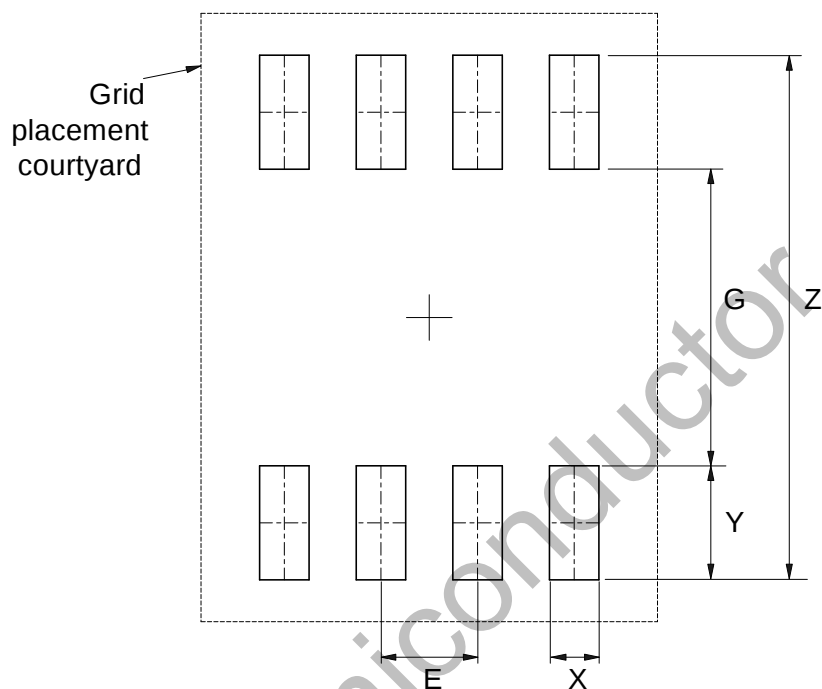
(5) Package Type: MSOP-8



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

Suggested Pad Layout

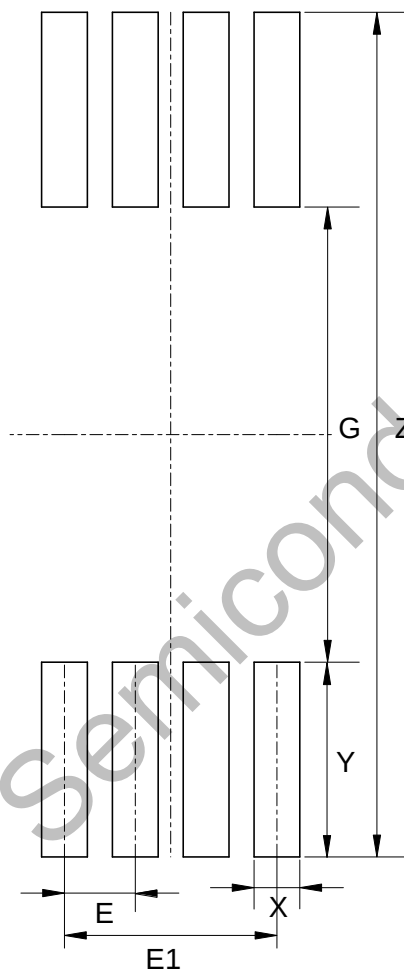
(1) Package Type: SO-8



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 (Cont.)

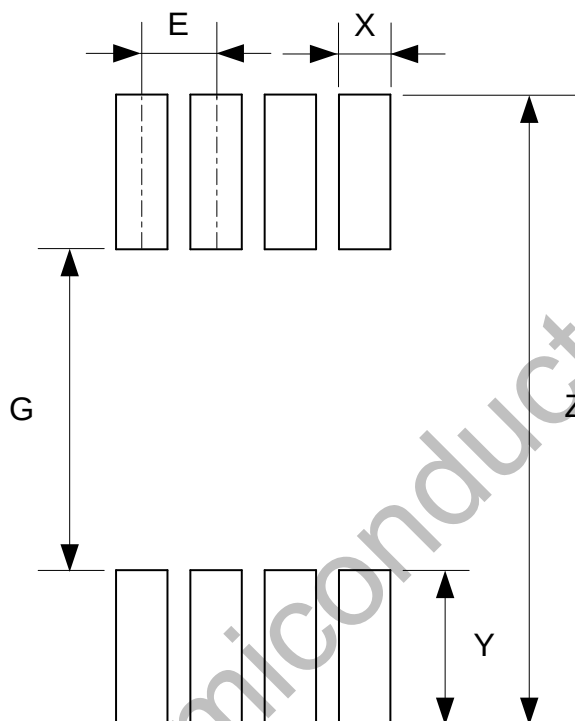
(2) Package Type: TSSOP-8



Dimensions	Z (mm)/(inch)	G (mm)/(inch)	X (mm)/(inch)	Y (mm)/(inch)	E (mm)/(inch)	E1 (mm)/(inch)
Value	7.720/0.304	4.160/0.164	0.420/0.017	1.780/0.070	0.650/0.026	1.950/0.077

Suggested Pad Layout (Cont.)

(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