1.Description

The UMW OPA2333,OPA333 series of CMOS operational amplifiers use a proprietary auto-calibration technique to simultaneously provide very low offset voltage (10 μV, maximum) and near-zero drift over time and temperature. These miniature, high-precision, low quiescent current amplifiers offer high-impedance inputs that have a common-mode range 100 mV beyond the rails, and rail-to-rail output that swings within 50 mV of the rails. Single or dual supplies as low as 1.8 V (±0.9 V) and up to 5.5 V (±2.75 V) can be used. These devices are optimized for low-voltage, single-supply operation.

The OPAx333 family offers excellent CMRR without the crossover associated with traditional complementary input stages. This design results in superior performance for driving analog-to-digital converters (ADCs) without degradation of differential linearity.

The OPA333 (single version) is available in the 5-pin SOT-23, SOT, and 8-pin SOP packages, while the OPA2333 (dual version) is available in the 8-pin SOP packages. All versions are specified for operation from -40°C to 125°C.

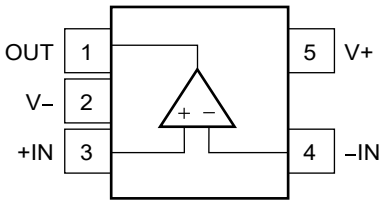
2.Features

- Low Offset Voltage: 10μV(Maximum)
- Zero Drift: 0.05 μV/°C (Maximum)
- 0.01-Hz to 10-Hz Noise: 1.1μV_{PP}
- Quiescent Current: 17μA
- Single-Supply Operation
- Supply Voltage: 1.8V to 5.5V
- Rail-to-Rail input/Output
- microSize Packages: SC70 and SOT23

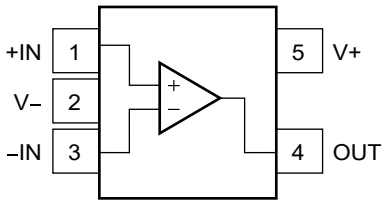
3.Applications

- Transducers
- Temperature Measurements
- Electronic Scales
- Medical instrumentation
- Battery-Powered Instruments
- Handheld Test Equipment

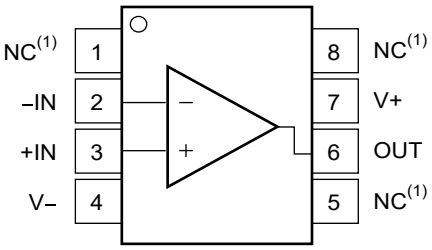
4.1 Pinning Information (OPA333)



SOT23-5



SC70-5

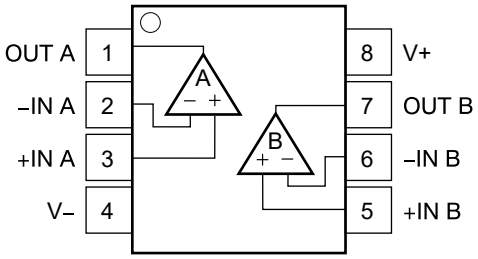


SOP-8

Pin Functions

PIN				I/O	Description
Name	SOP	SOT	SC70		
+IN	3	3	1	I	Noninverting input
-IN	2	4	3	I	Inverting input
NC	1,5,8	-	-	-	No internal connection (can be left floating)
OUT	6	1	4	O	Output
V+	7	5	5	-	Positive (highest) power supply
V-	4	2	2	-	Negative (lowest) power supply

4.2 Pinning Information (OPA2333)



SOP-8

Pin Functions

PIN		I/O	Description
Name	SOP		
+IN	-	I	Noninverting input
+INA	3	I	Noninverting input, channel A
+INB	5	I	Noninverting input, channel B
-IN	-	I	Inverting input
-INA	2	I	Inverting input, channel A
-INB	6	I	Inverting input, channel B
OUT	-	O	Output
OUTA	1	O	Output, channel A
OUTB	7	O	Output, channel B
V+	8	-	Positive (highest) power supply
V-	4	-	Negative (lowest)power supply

5.Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)

Parameter		Symbol	Min	Max	Units
Voltage	Supply voltage			7	V
	Signal input terminals (2)		-0.3	(V+)+0.3	V
Current	Signal input terminals (2)		-1	1	mA
	Output short circuit (3)		Continuous		
Operating junction temperature		T_J		150	°C
Operating temperature		T_A	-40	150	°C
Storage temperature		T_{STG}	-65	150	°C

Notes:

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

(2) Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.3 V beyond the supply rails should be current limited to 10 mA or less.

(3) Short-circuit to ground, one amplifier per package

6.ESD Ratings

Parameter		Symbol	Value	Units
Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)	$V_{(ESD)}$	±4000	V
	Charged-device model (CDM), per JEDEC specification JESD22-C101(2)		±1000	V

Notes:

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

7.Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

Parameter	Min	Max	Units
Supply voltage, V_S	1.8	5.5	V
Specified temperature	-40	125	°C

8.1 Thermal Information (OPA333)

Thermal Metric (1)	Symbol	D(SOIC)	DBV(SOT)	DCK(SC70)	Units
		8 Pins	5 Pins	5 Pins	
Junction-to-ambient thermal resistance	$R_{\theta JA}$	140.1	220.8	298.4	°C/W
Junction-to-case (top) thermal resistance	$R_{\theta JC(top)}$	89.8	97.5	65.4	°C/W
Junction-to-board thermal resistance	$R_{\theta JB}$	80.6	61.7	97.1	°C/W
Junction-to-top characterization parameter	ψ_{JT}	28.7	7.6	0.8	°C/W
Junction-to-board characterization parameter	ψ_{JB}	80.1	61.1	95.5	°C/W
Junction-to-case(bottom)thermal resistance	$R_{\theta JC(bot)}$	-	-	-	°C/W

8.2 Thermal Information (OPA2333)

Thermal Metric (1)	Symbol	D(SOP)	Units
		8 Pins	
Junction-to-ambient thermal resistance	$R_{\theta JA}$	124	°C/W
Junction-to-case (top) thermal resistance	$R_{\theta JC(top)}$	73.7	°C/W
Junction-to-board thermal resistance	$R_{\theta JB}$	64.4	°C/W
Junction-to-top characterization parameter	ψ_{JT}	18	°C/W
Junction-to-board characterization parameter	ψ_{JB}	63.9	°C/W
Junction-to-case(bottom)thermal resistance	$R_{\theta JC(bot)}$	-	°C/W

9.Electrical Characteristics

At T_A=+25°C, R_L=10kΩ connected to V_S / 2, V_{CM}=V_S/2, and V_{OUT}=V_S/2, unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
OFFSET VOLTAGE						
Input offset voltage	V_{OS}	V_S=5V		2	10	μV
Input offset voltage drift	dV_{OS}/dT	T_A=-40°C to 125°C		0.02	0.05	μV/°C
Power-supply rejection ratio	PSRR	V_S=1.8V to 5.5V,T_A=-40°C to 125°C		1	5	μV/V
Long-term stability (1)			See note (1)			μV
Channel separation, dc				0.1		μV/V
INPUT BIAS CURRENT						
Input bias current	I_B	T_A=25°C		±70	±200	pA
		T_A=-40°C to 125°C		±150		pA
Input offset current	I_{OS}			±140	±400	pA
NOISE						
Input voltage noise		f=0.01Hz to 1Hz		0.3		$μV_{PP}$
		f=0.1Hz to 10Hz		1.1		$μV_{PP}$
Input current noise	i_n	f=10Hz		100		fA/√Hz
INPUT VOLTAGE						
Common-mode voltage range	V_{CM}		(V-)-0.1		(V+)+0.1	V
Common-mode rejection ratio	CMRR	(V-)-0.1V<V_{CM}<(V+)+0.1V T_A=-40°C to 125°C	106	130		dB
INPUT CAPACITANCE						
Differential				2		pF
Common-mode				4		pF
OPEN-LOOP GAIN						
Open-loop voltage gain	A_{OL}	(V-)+100mV<V_O<(V+)-100mV R_L=10kΩ, T_A=-40°C to 125°C	106	130		dB
FREQUENCY RESPONSE						
Gain-bandwidth product	GBW	C_L=100pF		350		kHz
Slew rate	SR	G=+1		0.16		V/μs

Parameter	Symbol	Conditions	Min	Typ	Max	Units
OUTPUT						
Voltage output swing from rail		R_L=10kΩ		30	50	mV
		R_L=10kΩ, T_A=-40°C to 125°C			70	mV
Short-circuit current	I_{SC}			±5		mA
Capacitive load drive	C_L		See Typical Characteristics			
Open-loop output impedance		f=350kHz, I_O=0A		2		kΩ
POWER SUPPLY						
Specified voltage range	V_S		1.8		5.5	V
Quiescent current per amplifier	I_Q	I_O=0A		17	25	μA
		T_A=-40°C to 125°C			28	μA
Turn-on time		V_S=5V		100		μs
TEMPERATURE						
Specified range	T_A		-40		125	°C
Operating range			-40		150	°C
Storage range	T_{STG}		-65		150	°C

(1) 300-hour life test at 150°C demonstrated randomly distributed variation of approximately 1μV.

10.1 Typical characteristic

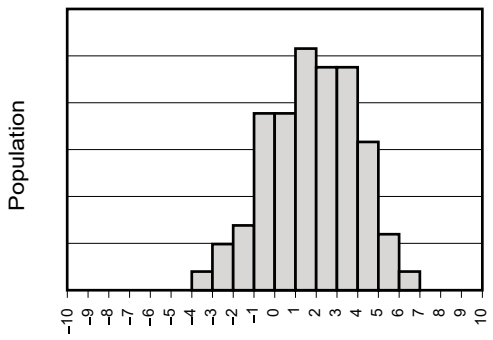


Figure 1: Offset Voltage Production Distribution

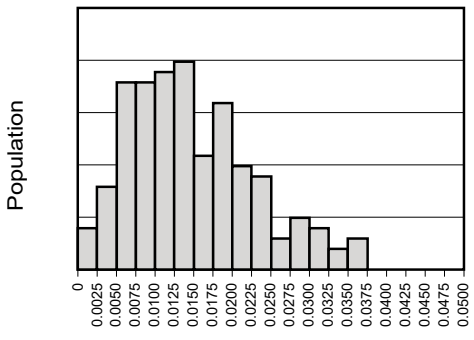


Figure 2: Offset Voltage Drift Production Distribution

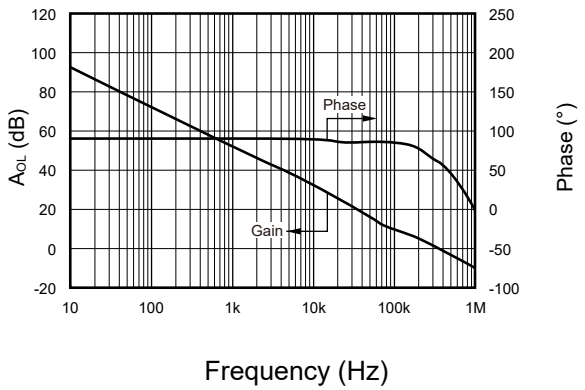


Figure 3: Open-Loop Gain and Phase vs Frequency

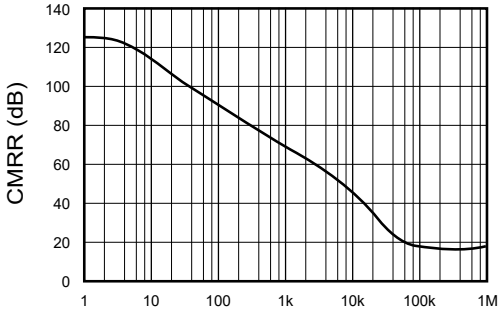


Figure 4: Common-Mode Rejection Ratio vs Frequency

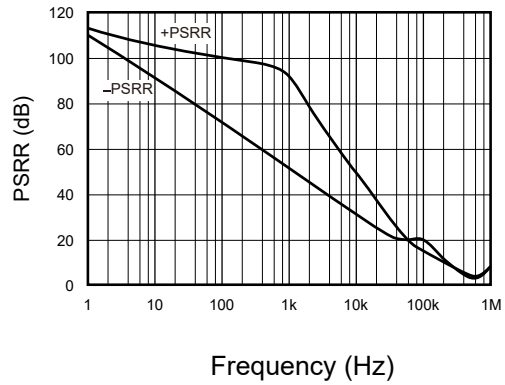


Figure 5: Power-Supply Rejection Ratio vs Frequency

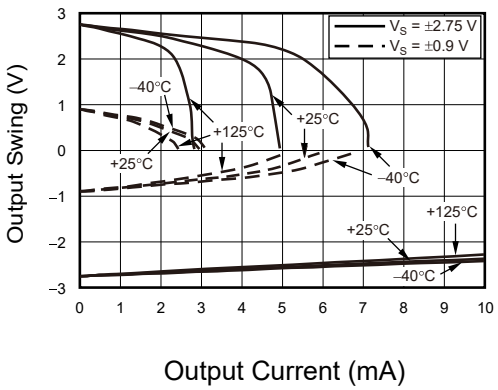


Figure 6: Output Voltage Swing vs Output Current

10.2 Typical characteristic

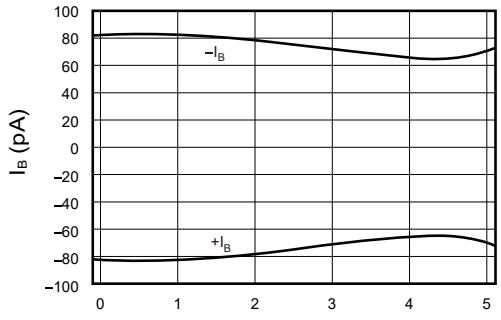


Figure 7: Input Bias Current vs Common-Mode Voltage

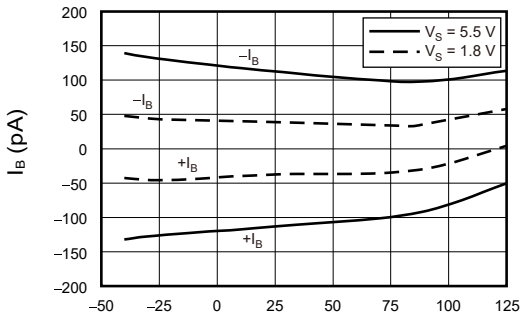


Figure 8: Input Bias Current vs Temperature

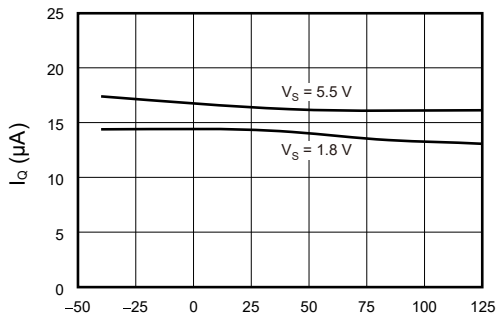


Figure 9: Quiescent Current vs Temperature

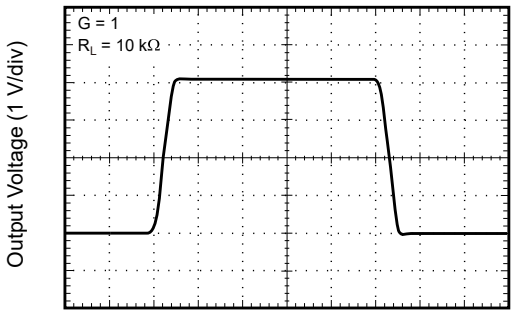


Figure 10: Large-Signal Step Response

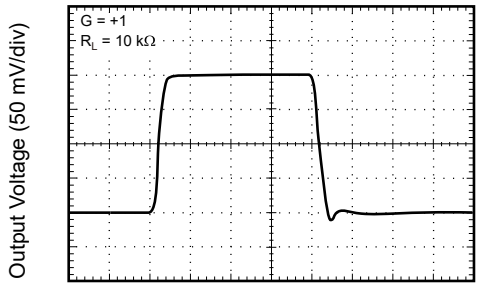


Figure 11: Small-Signal Step Response

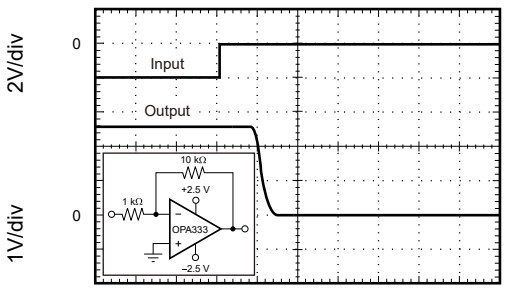
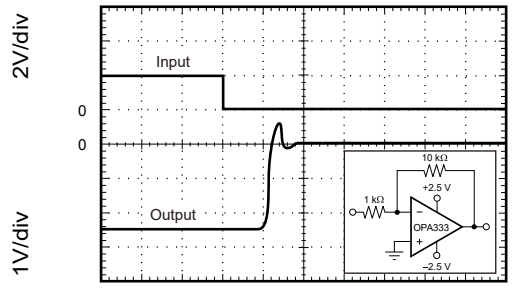


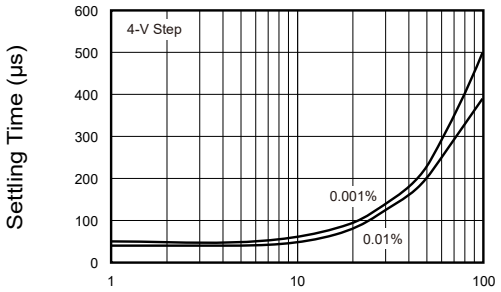
Figure 12: Positive Overvoltage Recovery

10.3 Typical characteristic



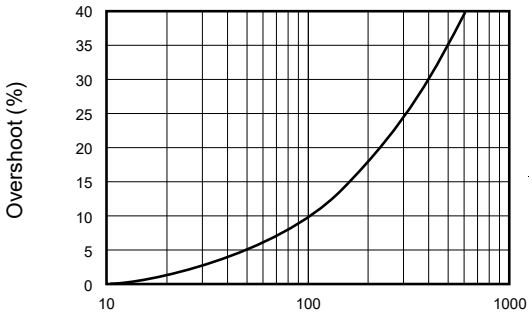
Time (50µs/div)

Figure 13: Negative Overvoltage Recovery



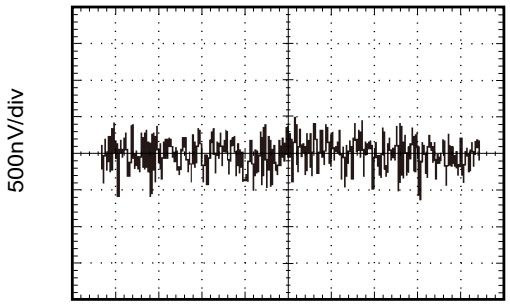
Gain (dB)

Figure 14: Settling Time vs Closed-Loop Gain



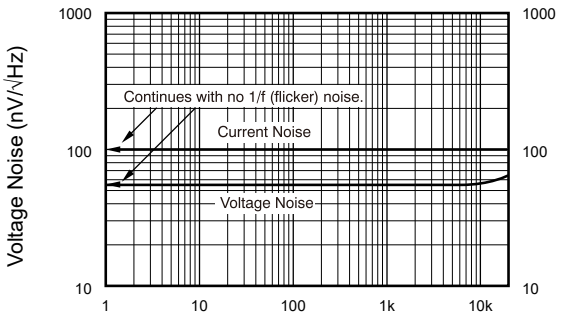
Load Capacitance (pF)

Figure 15: Small-Signal Overshoot vs Load Capacitance



1s/div

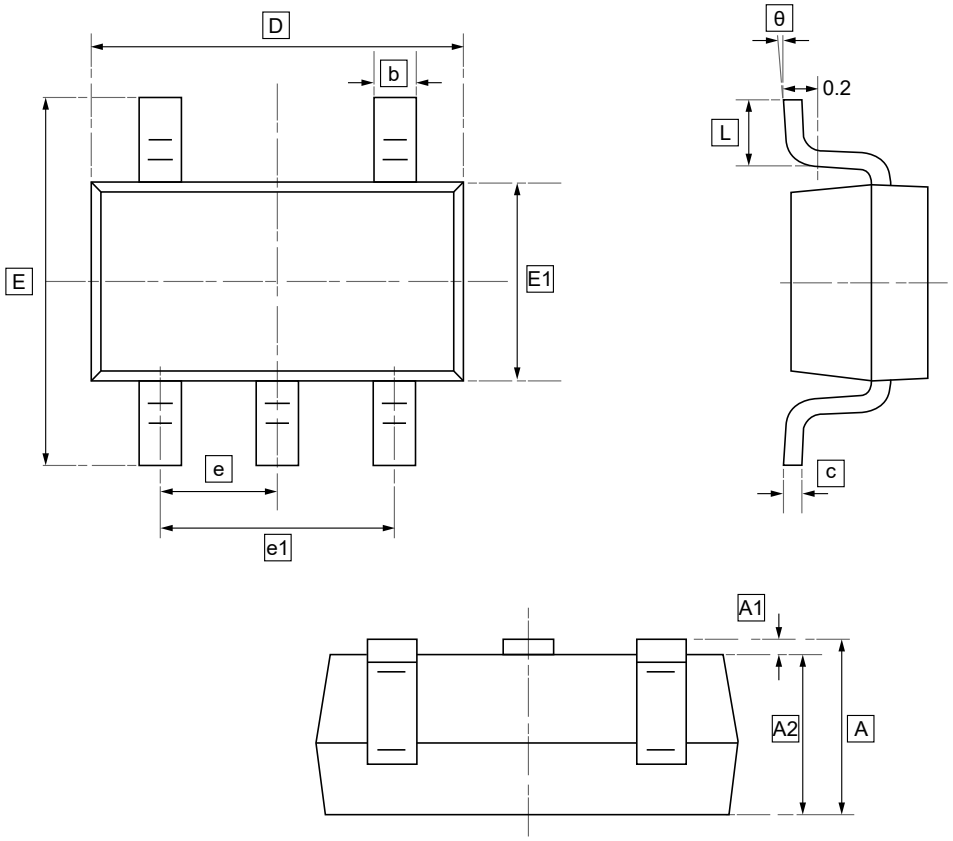
Figure 16: 0.1-Hz to 10-Hz Noise



Frequency (Hz)

Figure 17: Current and Voltage Noise Spectral Density vs Frequency

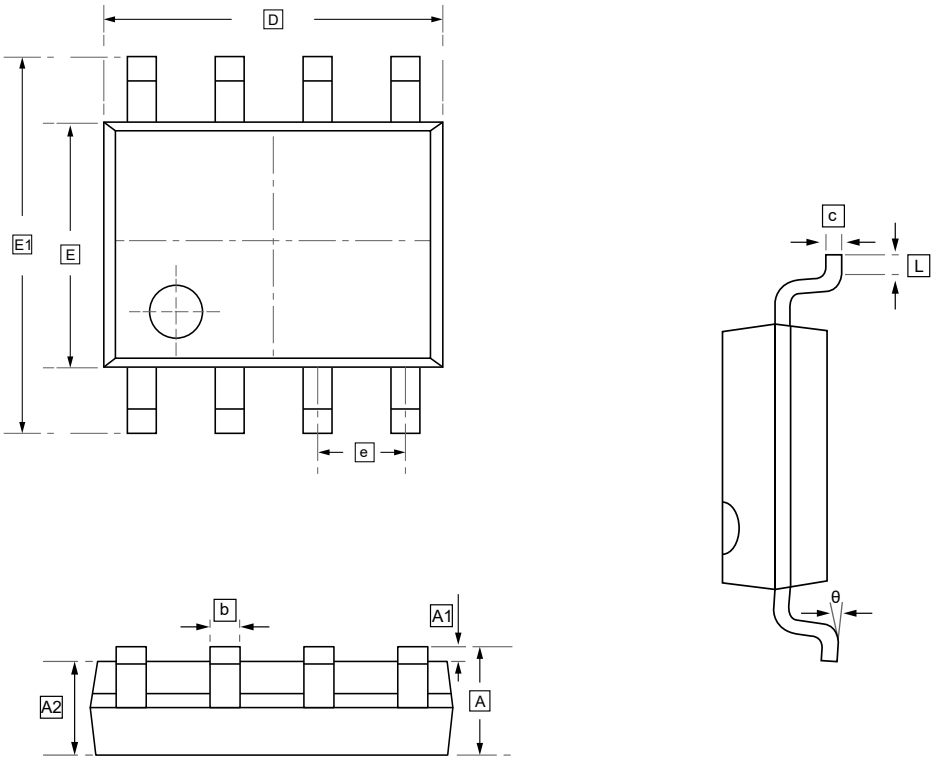
11.1 SOT-23-5 Package Outline Dimensions



DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	A2	b	c	D	E1	E	e	e1	L	θ
Min	1.050	0.000	1.050	0.300	0.100	2.820	1.500	2.650	0.950	1.800	0.300	0°
Max	1.250	0.100	1.150	0.500	0.200	3.020	1.700	2.950	BSC	2.000	0.600	8°

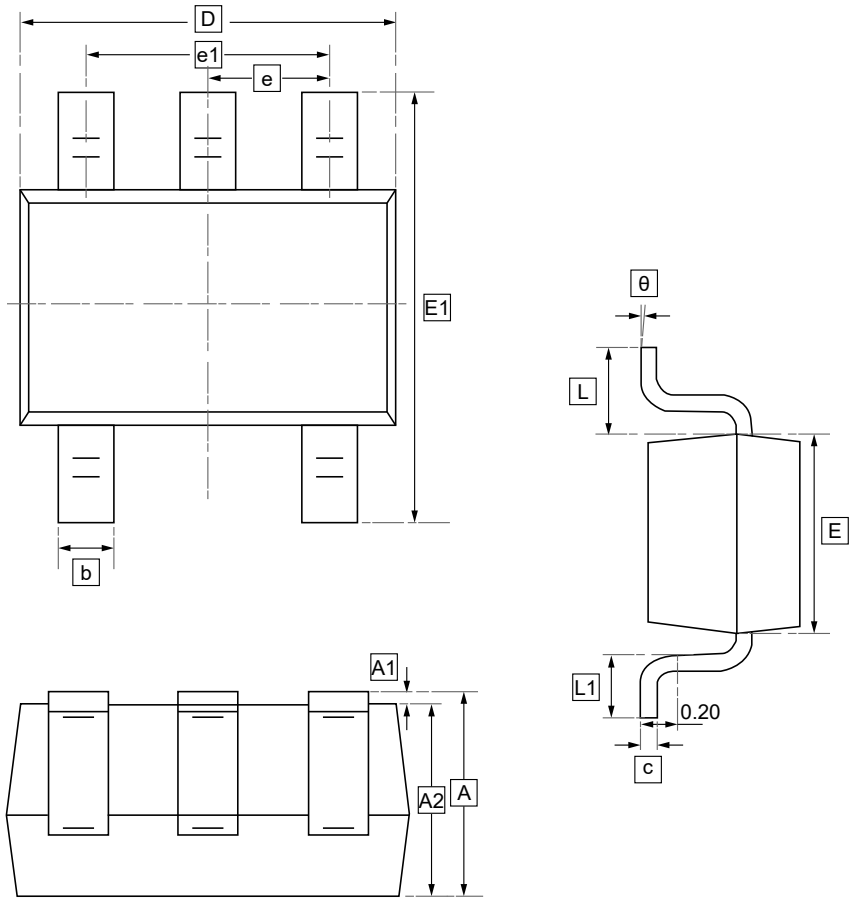
11.2 SOP-8 Package Outline Dimensions



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°

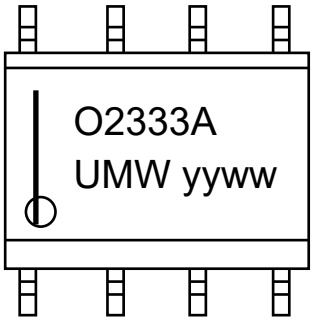
11.3 SC70-5 Package Outline Dimensions



DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	A2	b	c	D	E	E1	e	e1	L	θ
Min	0.90	0.00	0.90	0.15	0.08	1.80	1.15	2.15	0.65	1.20	0.26	7°
Max	1.10	0.10	1.00	0.35	0.15	2.25	1.35	2.45	TYP	1.40	0.46	REF.

12.Ordering Information



yy: Year Code
ww: Week Code

Order Code	Marking	Package	Base QTY	Delivery Mode
UMW OPA2333AIDR	O2333A	SOP-8	2500	Tape and reel
UMW OPA333AIDR	O333A	SOP-8	2500	Tape and reel
UMW OPA333AIDBVR	OAXQ	SOT23-5	3000	Tape and reel
UMW OPA333AIDCKR	BQY	SC70-5	3000	Tape and reel

13.Disclaimer

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