Zero-Drift、MicroPower、CMOS Operational Amplifiers

1 Features

- Low Offset Voltage
  - 2μV (Typical)
  - 10μV (Maximum)
- Zero Drift: 0.05μV/℃ (Maximum)
- Micropower
  - 17μA (single version)
  - 30μA (dual version)
- Rail-to-Rail Input/Output
- Supply Voltage: 1.8V-5.5V
- 0.1Hz to 10Hz Noise: 1.1μV
- Support Single Power Supply

2 Applications

- Transducers
- Temperature Measurements
- Electronic Scales
- Bridge Circuit Read-Out
- Medical Instrumentation

3 Description

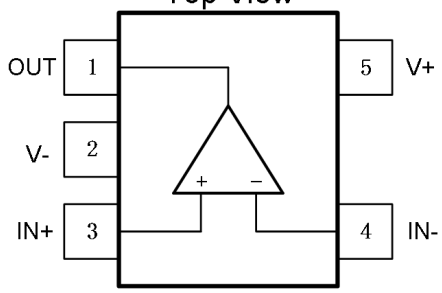
The KTAx333 series are low power, rail-to-rail CMOS operational amplifiers and support single power supply. While using a proprietary auto-calibration technique to provide very low offset voltage (2μV typical) and near-zero drift over time and temperature. The amplifiers offer high-impedance inputs that have a common-mode range 100mV beyond the rails. Single or dual supplies as low as1.8V (±0.9V) and up to 5.5V (±2.75V) can be used.

The KTAx333 series can offer 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 KTA333 (single version) is available in the SOT-23-5, SC70-5 and SOIC-8 packages, while the KTA233 (dual version) is available in SOIC-8, MSOP-8 and DFN-2×2-8 packages.

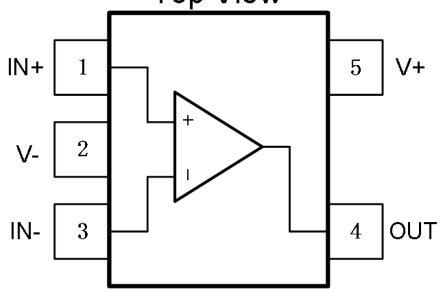
4 PIN Configurations and Functions

KTA333
Top View



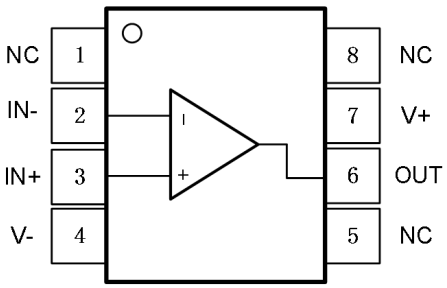
SOT-23-5

KTA333
Top View



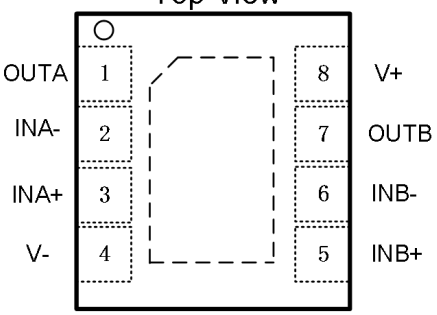
SC70-5

KTA333
Top View



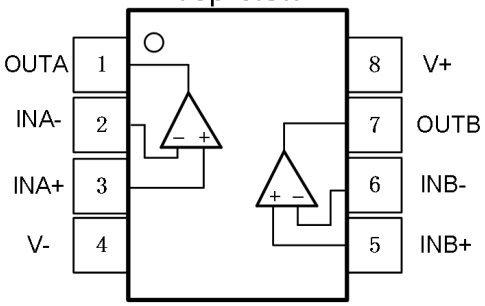
SOIC-8

KTA2333
Top View



DFN-2×2-8

KTA2333
Top View



SOIC-8/MSOP-8

Pin Functions: KTA333

PIN				I/O	DESCRIPTION
NAME	SOIC	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

Pin Functions: KTA2333

PIN			I/O	DESCRIPTION
NAME	DFN	SOIC、MSOP-8		
INA+	3	3	I	Noninverting input, channel A
INA-	2	2	I	Inverting input, channel A
INB+	5	5	I	Noninverting input, channel B
INB-	6	6	I	Inverting input, channel B
OUTA	1	1	O	Output, channel A
OUTB	7	7	O	Output, channel B
V+	8	8	—	Positive (highest) power supply
V-	4	4	—	Negative (lowest) power supply

Product Model

KTAX333-XXX

Package: ST5: SOT23-5
SF5: SOT353-5
SC5: SC70-5
SP8: SOP-8
MP8: MSOP-8
DZ8: DFN2020-8
SC8: SOIC-8

Channel: Blank: Single
2: Dual

5 Specifications

5.1 Absolute Maximum Ratings

See(1)

	MIN	MAX	UNIT
Power Supply	6.5		V
Signal input terminals	V^- - 0.2	V^+ + 0.2	V
Operating junction temperature，T_J		150	℃
Storage temperature，T_{stg}	-65	150	℃

(1) Stress beyond those listed under Absolute Maximum Ratings may cause permanent damage to the devices. These are stress ratings only, which do not imply functional operational 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.

5.2 ESD Ratings

ESD	VALUE	UNIT
HBM	7K	V

5.3 Recommended Operating Conditions

	MIN	MAX	UNIT
Supply Voltage	1.8	5.5	V
Specified temperature	-40	125	℃

6 Electrical Characteristics

(@TA=+25℃, V_{CM}=Vs/2, VOUT=Vs/2, unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input Characteristics						
V_{OS}	Input offset voltage	Vs=5V		2	10	μV
dV_{OS}/dT	Input offset voltage drift	T_A= –40°C to 125°C		0.02	0.05	μV/℃
I_B	Input bias current			±100		pA
I_{OS}	Input offset current			±120		pA
V_{CM}	Common-mode voltage range		(V–) – 0.1		(V+) + 0.1	V
CMRR	Common-mode rejection ratio	(V–) – 0.1V < V_{CM} < (V+) + 0.1V, T_A = –40°C to 125°C		120		dB
A_{OL}	Open-loop voltage gain	(V–) + 0.1V < V_O < (V+) – 0.1V, R_L = 10kΩ，T_A = –40°C to 125°C		120		dB
Output Characteristics						
Voltage output swing from rail		R_L=10K		30	70	mV
I_{SC}	Short-circuit current			±17		mA
Power Supply						
V_S	Specified voltage range		1.8		5.5	V
I_Q	Quiescent current	I_O=0A, T_A= –40°C to125°C （single version）		17		μA
		I_O=0A，T_A= –40°C to 125°C (dual version)		30		μA
PSRR	Power Supply Rejection Ratio	V_S=1.8V to 5.5V, T_A= –40°C to 125°C		1	5	μV/V
Turn-on time		V_S=+5V		200		μs
Frequency Response						
GBW	Gain-bandwidth product	C_L=100pF		350		KHz
SR	Slew rate	G=1		0.16		V/μs
Noise						
Input voltage noise		f=0.1Hz to 10Hz		1.1		μV_{PP}
Temperature						
T_A	Specified range		-40		125	℃

7 Typical Characteristics (@TA=+25℃, Vs=5V, C_L=0pF, unless otherwise noted)

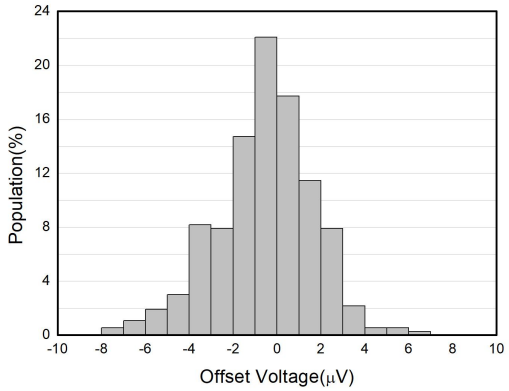


Figure 1. Offset Voltage production Distribution

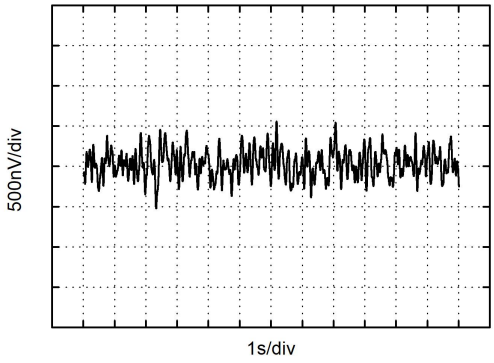


Figure 2. 0.1Hz to 10Hz Noise

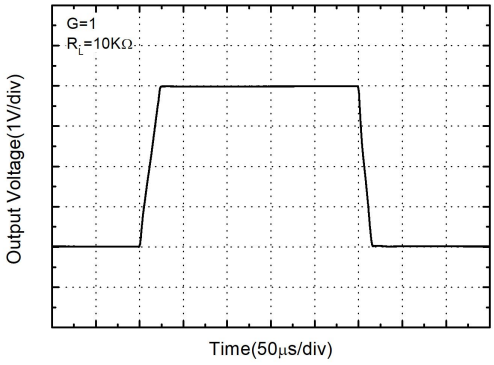


Figure 3. Large-Signal Step Response

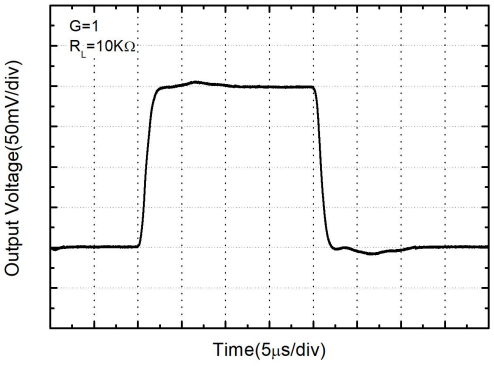


Figure 4. Small-Signal Step Response

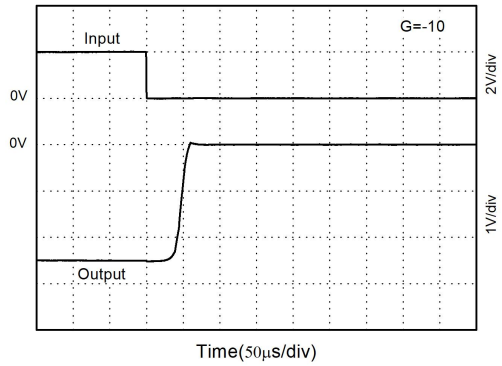


Figure 5. Negative Overvoltage Recovery

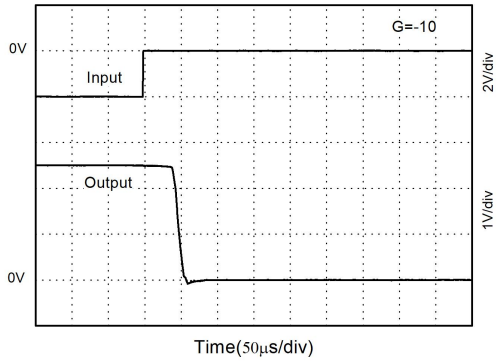


Figure 6. Positive Overvoltage Recovery

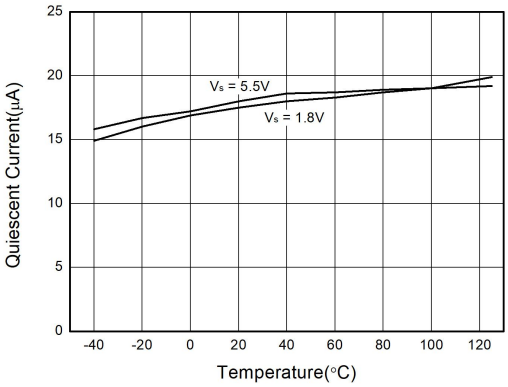


Figure 7. Quiescent Current vs Temperature

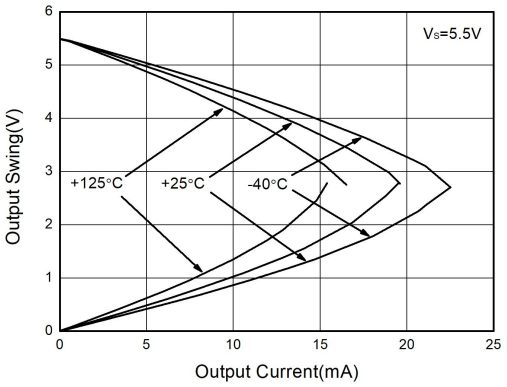


Figure 8. Output Voltage Swing vs Output Current

8 Detailed Description

The KTAx333 series are unity-gain stable, and are suitable for a wide range of general-purpose applications. The Zero-Drift architecture provides ultra low offset voltage and near-zero offset voltage drift.

8.1 Operating Voltage

The KTAx333 series operate over a power-supply range of 1.8V to 5.5V (±0.9V to ±2.75V). Supply voltages higher than +6.5V (absolute maximum) can permanently damage the device. For better performance, it is recommended to place a 0.1μf bypass capacitance near the positive power supply pin.

8.2 Rail-To-Rail Input/Output

The KTAx333 series support rail-to-rail input and output operation, and have a common-mode range 100mV beyond the rails by using complementary input stages.

8.3 Input Protection

The KTAx333 series use two ESD diodes, connected between the power rails and input stage, as shown in figure 9. When the input voltage is higher than 300mV of any power rails, the ESD diode is turned on to protect the internal devices by discharging large current. Typically, the input bias current is 100pA. However, an input voltage exceeding the power supply voltage may cause excessive current to flow in or out of the input pins. It may cause permanently damage to internal devices when input current is beyond 10mA. This limitation is easily accomplished with an input resistor, as shown in figure 10.

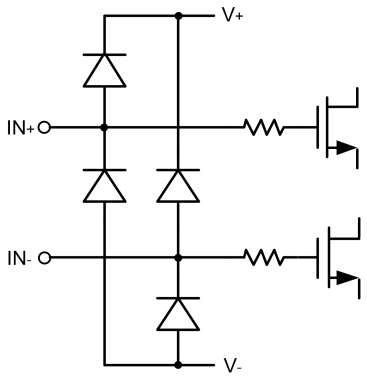


Figure 9. Input ESD Diodes

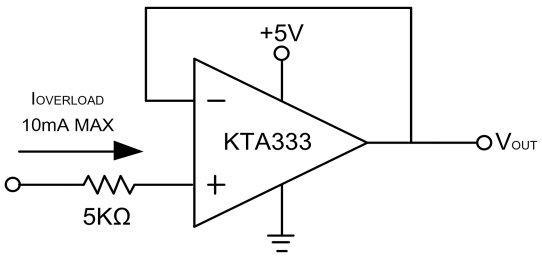


Figure 10. Input Current Protection

8.4 Internal Offset Correction

The KTAx333 series use an auto-calibration technique with a time-continuous operational amplifier in the signal path. Upon power up, the amplifier acquires approximately 200μs to achieve specified offset accuracy.

8.5 Residual Voltage Ripple

The KTAx333 series use chopping technique to eliminate the offset due to the internal notch filter. Although the chopping related voltage ripple is suppressed, higher noise spectrum exits at chopping frequency and its harmonics. To further suppress the noise at the chopping frequency, it is recommended that a post filter be placed at the output of the amplifier.

9 Typical Applications

9.1 Temperature Measurement Application

Figure 11 shows a temperature measurement application.

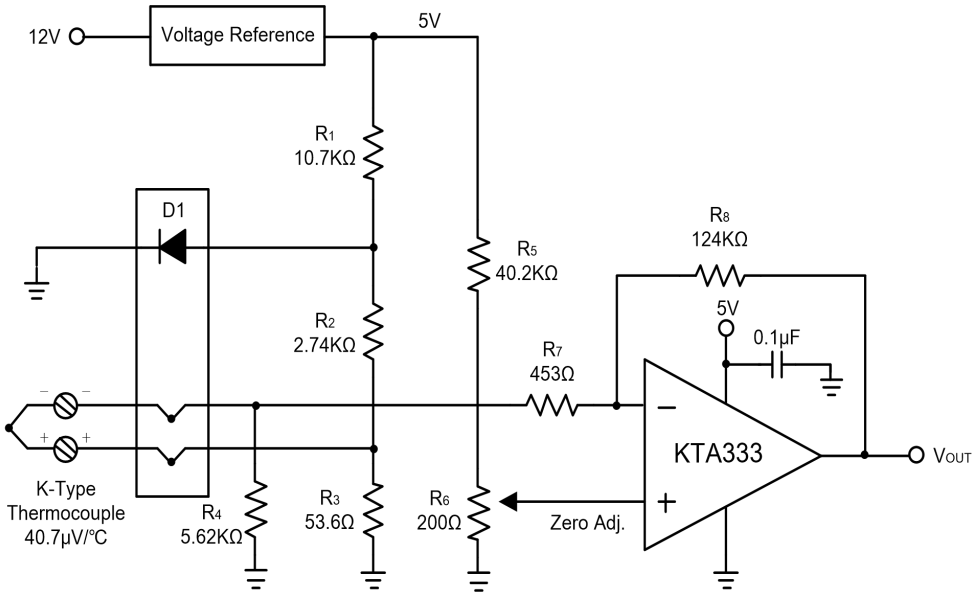


Figure 11. Temperature Measurement

9.2 Thermistor Measurement Application

Figure 12 shows a thermistor measurement application.

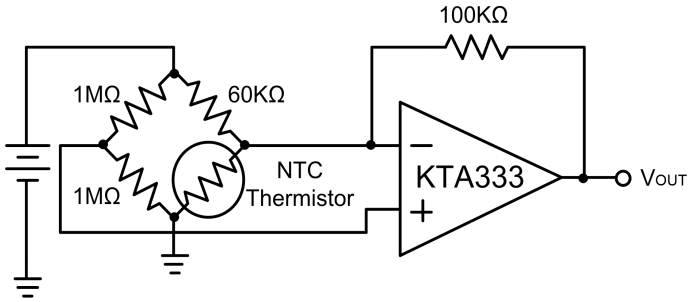


Figure 12. Thermistor Measurement

9.3 Low-Side Current Monitor Application

Figure 13 shows a low-side current monitor application.

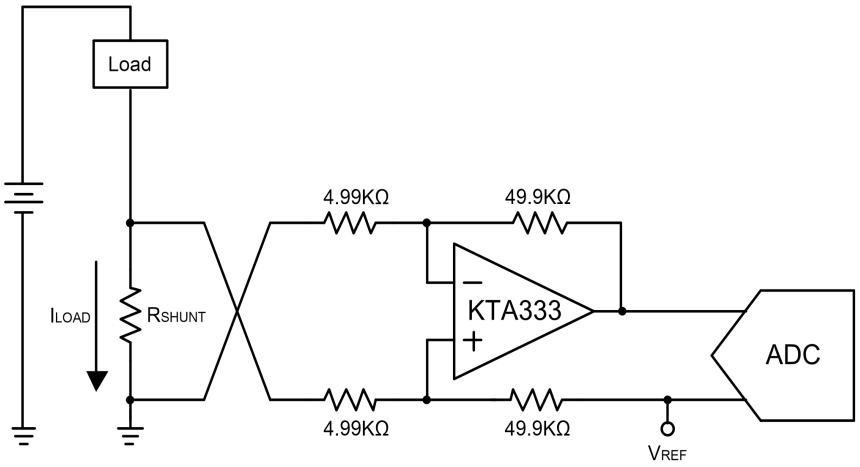
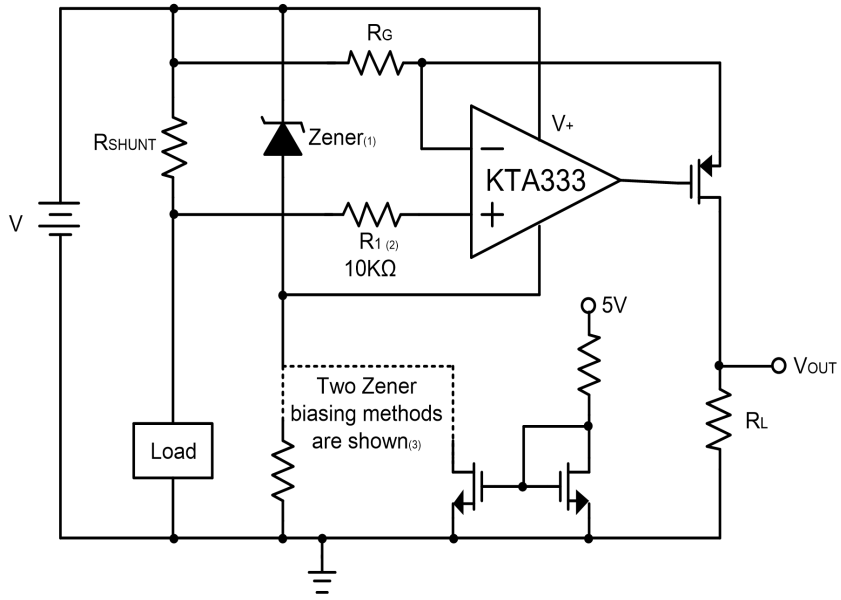


Figure 13. Low-Side Current Monitor

9.4 High-Side Current Monitor Application

Figure 14 shows a high-side current monitor application.



NOTES:(1)Zener rated for op amp supply capability(that is 5.1V for KTA333).
(2)Current-limiting resistor.
(3)Chhose Zener biasing resistor or dual NMOSFETs

Figure 14. High-Side Current Monitor

9.5 Precision Instrumentation Amplifier Application

Figure 15 shows a precision instrumentation amplifier application.

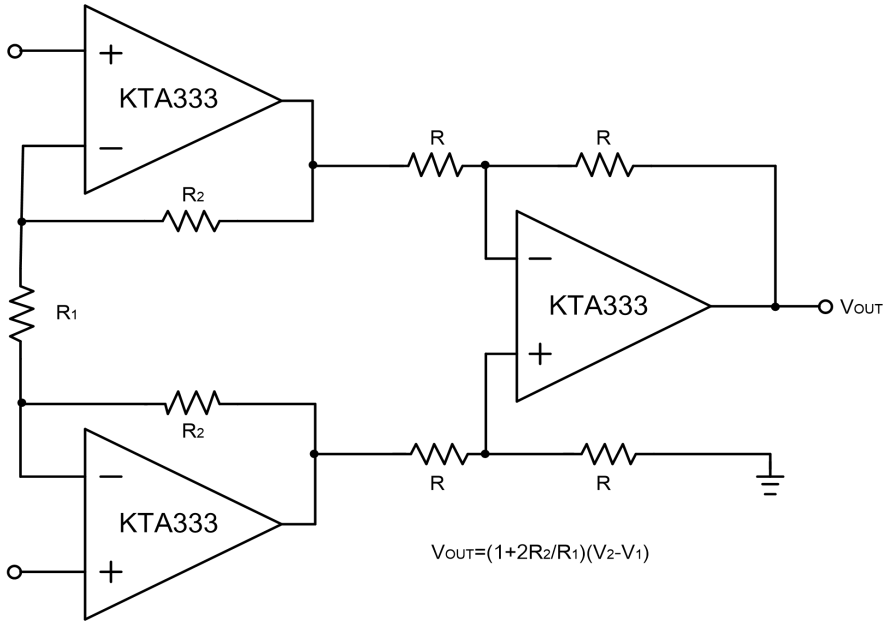


Figure 15. Precision Instrumentation Amplifier

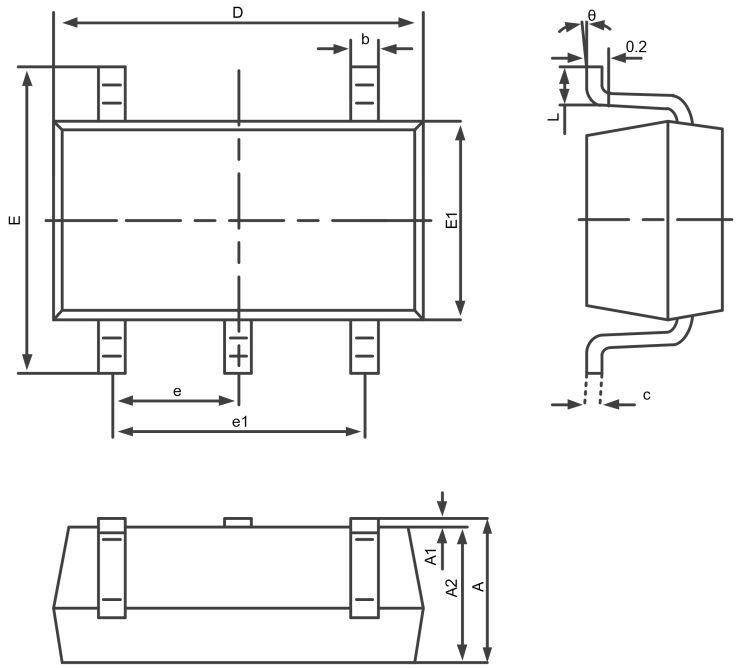
Order Information

Order Number	Package	PIN Number	Package Qty	Temperature
KTA333-ST5	SOT23-5	5	3000	-40℃~125℃
KTA2333-MP8	MSOP-8	8	4000	-40℃~125℃
KTA333-SF5*	SOT353-5	5	-	-40℃~125℃
KTA333-SC5*	SC70-5	5	-	-40℃~125℃
KTA333-SC8*	SOIC-8	8	-	-40℃~125℃
KTA2333-DZ8*	DFN2020-8	8	-	-40℃~125℃
KTA2333-SP8*	SOP-8	8	4000	-40℃~125℃

*Only a small number of samples are provided,and large-scale is not supported temporarily.

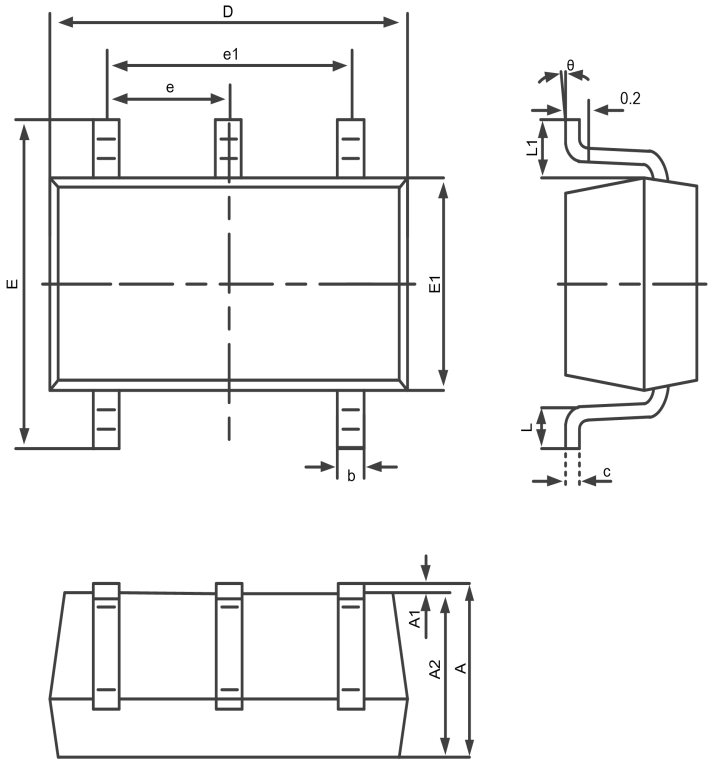
Packaging Information

SOT23-5



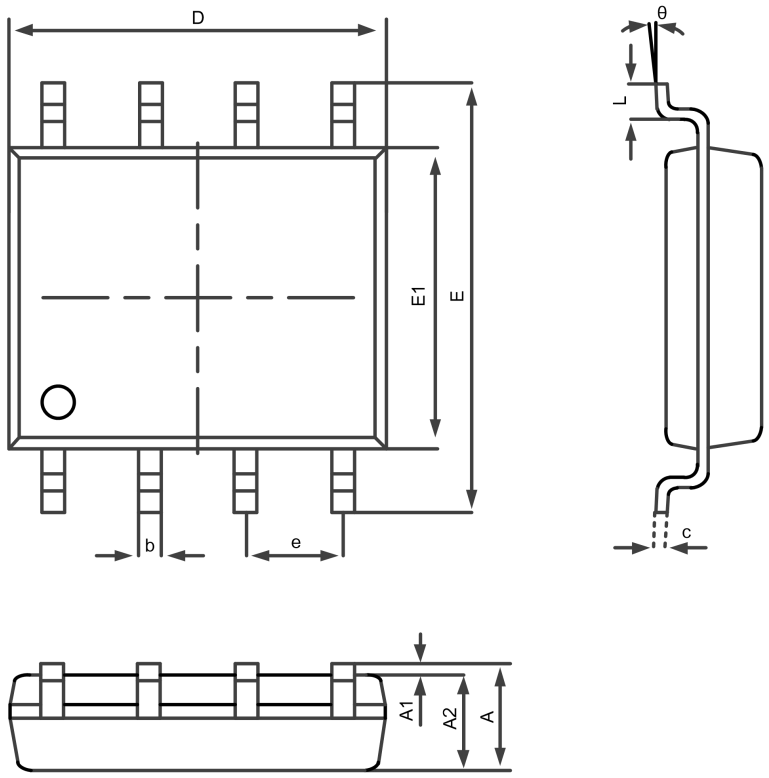
Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	2.650	2.950	0.104	0.116
E1	1.500	1.700	0.059	0.067
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

SC70-5(SOT353)



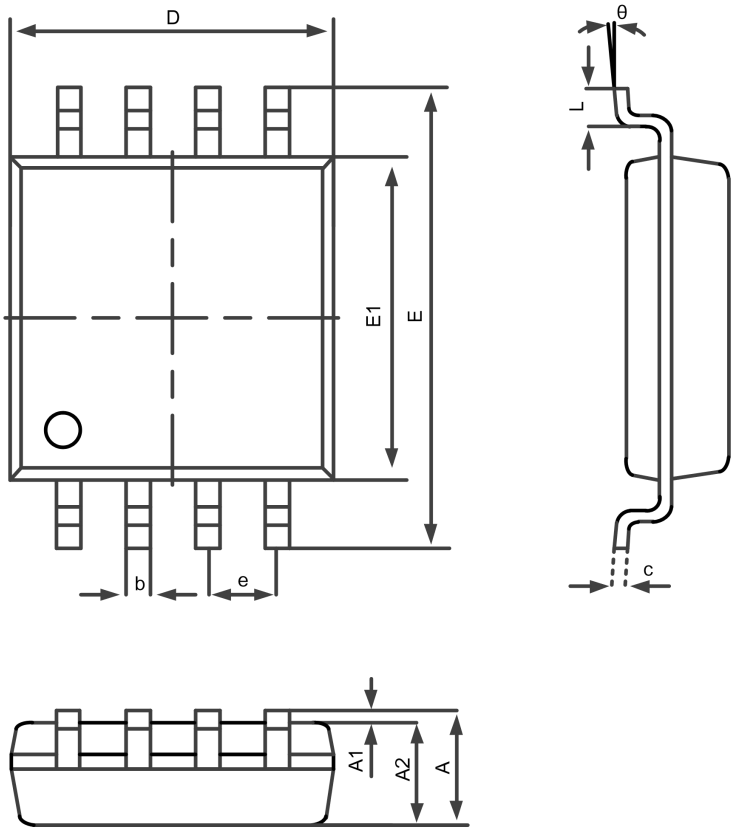
Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	0.900	1.100	0.035	0.043
A1	0.000	0.100	0.000	0.004
A2	0.900	1.000	0.035	0.039
b	0.150	0.350	0.006	0.014
c	0.110	0.175	0.004	0.007
D	2.000	2.200	0.079	0.087
E	2.150	2.450	0.085	0.096
E1	1.150	1.350	0.045	0.053
e	0.650 TYP.		0.026 TYP.	
e1	1.200	1.400	0.047	0.055
L	0.300	0.600	0.012	0.024
L1	0.525 REF.		0.021 REF.	
θ	0°	8°	0°	8°

SOIC-8(SOP-8)



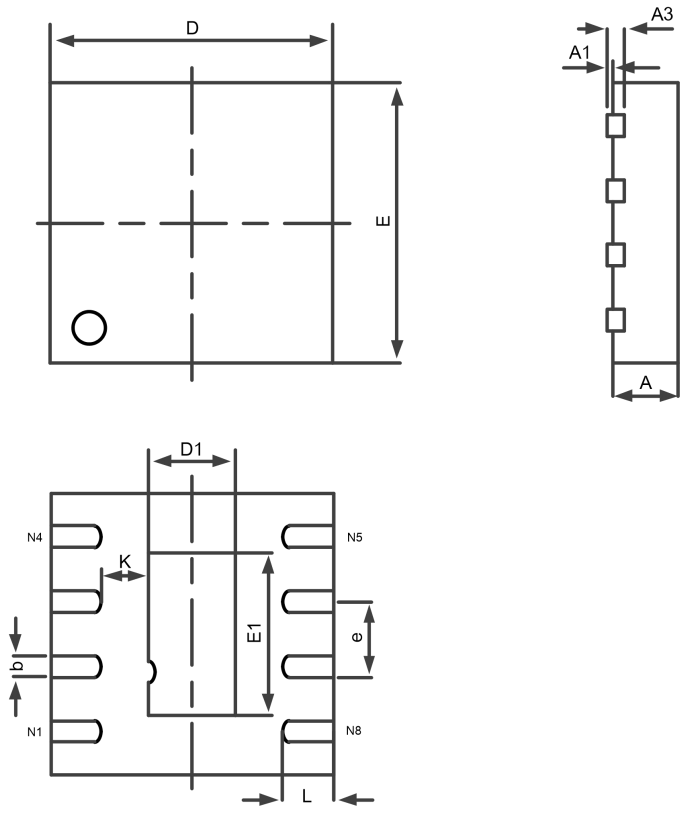
Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 TYP.		0.050 TYP.	
L	0.400	0.800	0.016	0.031
θ	0°	8°	0°	8°

MSOP-8



Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.015
D	2.900	3.100	0.114	0.122
E	4.750	5.050	0.187	0.199
E1	2.900	3.100	0.114	0.122
e	0.650 TYP.		0.026 TYP.	
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

DFN-8 2*2



Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A3	0.203 REF.		0.008 REF.	
D	1.900	2.100	0.075	0.083
E	1.900	2.100	0.075	0.083
D1	0.500	0.700	0.020	0.028
E1	1.100	1.300	0.043	0.051
K	0.350 REF.		0.014 REF.	
b	0.200	0.300	0.008	0.012
e	0.500 BSC.		0.020 BSC.	
L	0.274	0.426	0.011	0.017