SNA321H/358H/324H 1MHZ High Voltage Bipolar Opamp

Features

- Single-Supply Operation: +3V ~ +36V
- Dual-Supply Operation: ±1.5V ~ ±18V
- Gain-Bandwidth Product: 1MHz (Typ)
- Low Input Bias Current: 20nA (Typ)
- Low Offset Voltage: 5mV (Max)
- Quiescent Current: 250μA per Amplifier (Typ)
- Input Common Mode Voltage Range Includes Ground
- Large Outpu Voltage Swing: 0V to V_{DD}-1.5V
- Operating Temperature: -25°C ~ +85°C
- Small Package:
  - SNA321H Available in SOT23-5 Package
  - SNA358H Available in SOP-8 and MSOP-8 Packages
  - SNA324H Available in SOP-14 Package

General Description

The SNA321H/358H/324H family have a high gain-bandwidth product of 1MHz, a slew rate of 0.2V/μs, and a quiescent current of 250μA at 5V. The SNA321H/358H/324H family is designed to provide optimal performance in low voltage and low noise systems.

Applications

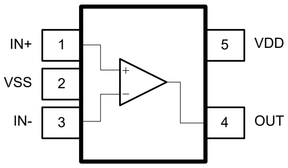
- Walkie-Talkie
- Battery Management Solution
- Transducer Amplifiers
- Summing Amplifiers
- Multivibrators
- Oscillators
- Switcching Telephone
- Portable Systems

Ordering Information

Model	Channel	Package	Ordering Number	Packing Option
SNA321H	Single	SOT-23-5	SNA321H00AB5	Tape and Reel,3000
SNA358H	Dual	SOP-8	SNA358H00AA8	Tape and Reel,4000
		MSOP-8	SNA358H00AM8	Tape and Reel,3000
SNA324H	Quad	SOP-14	SNA324H00AAF	Tape and Reel,2500

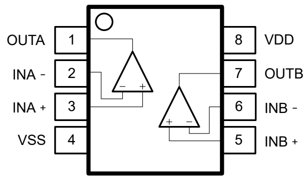
Pin Assignment

SNA321H



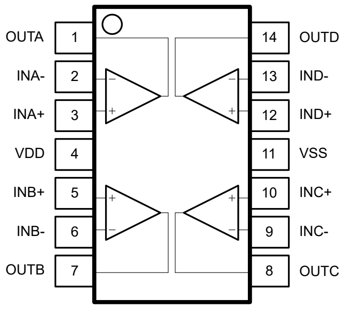
SOT-23-5

SNA358H



SOP-8/MSOP-8

SNA324H



SOP-14

Pin	SOT-23-5	SOP-8/MSOP-8	SOP-14	Type	Function
1	IN+	3/5	3/5/10/12	I	Noninverting input
2	VSS	4	11	—	Negative (lowest) power supply
3	IN-	2/6	2/6/9/13	I	Inverting input
4	OUT	1/7	1/7/8/14	O	Output
5	VDD	8	4	—	Positive (highest) power sup

Absolute Maximum Ratings

Parameter	Min	Max	Unit
Power Supply Voltage (V_{DD} to V_{SS})	-20	+20 or 40	V
Differential input voltage		40	V
Input Voltage	-0.3	40	V
Operating Temperature Range	-25	+85	°C
Storage Temperature Range	-65	150	°C

Note: 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.

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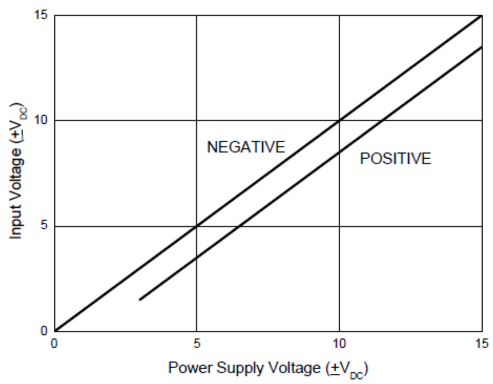
1 Electrical Characteristics

At V_{DD} = +5V, T_A = 25°C, unless otherwise noted.

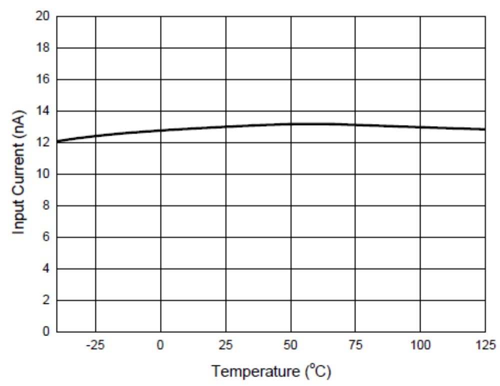
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Input Offset Voltage	V_{OS}	V_{CM} = V_{DD}/2		0.4	5	mV
Input Bias Current	I_B			20		nA
Input Offset Current	I_{OS}			5		nA
Common-Mode Voltage Range	V_{CM}	V_{DD} = 5.5V		-0.1~+4		V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0V to V_{DD}-1.5V	60	70		dB
Open-Loop Voltage Gain	A_{OL}	R_L = 5kΩ, V_O = 1V to 11V	85	100		dB
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta T$			7		μV/°C
OUTPUT CHARACTERISTICS						
Output Voltage Swing from Rail	V_{OH}	R_L = 2kΩ		11		V
	V_{OL}	R_L = 2kΩ		5	20	mV
	V_{OH}	R_L = 10kΩ		12		V
	V_{OL}	R_L = 10kΩ		5	20	mV
Output Current	I_{SOURCE}	R_L = 10Ω to V_{DD}/2		40	60	mA
	I_{SINK}			40	60	mA
POWER SUPPLY						
Operating Voltage Range			3		36	V
Power Supply Rejection Ratio	PSRR	V_{DD} = +5V to +36V, V_{CM} = +0.5V	70	100		dB
Quiescent Current / Amplifier	I_Q	V_{DD} = 36V, RL=∞		0.25	2.0	μA
DYNAMIC PERFORMANCE (C_L = 100pF)						
Gain-Bandwidth Product	GBP			1		MHz
Slew Rate	SR	G = +1, 2V Output Step		0.2		V/μs

2 Typical Performance Characteristics

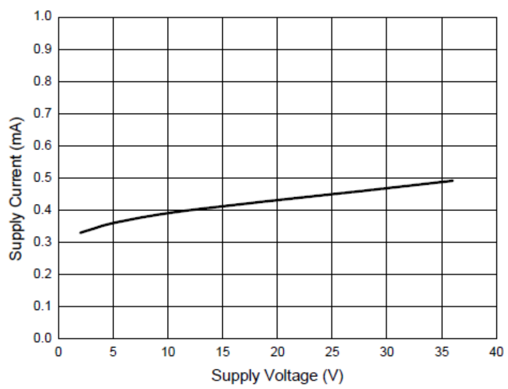
Input Voltage Range



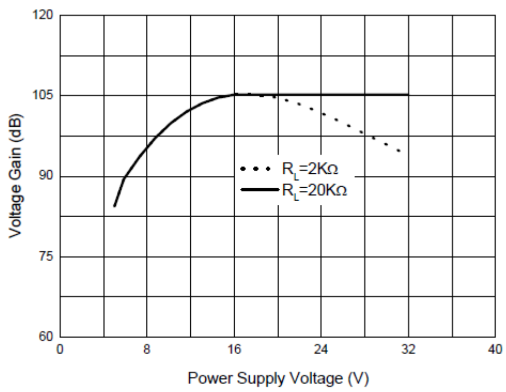
Input Current



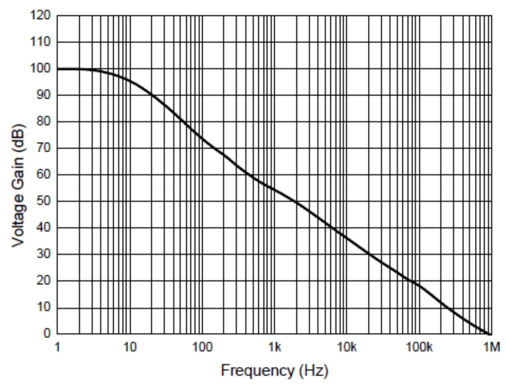
Supply Current



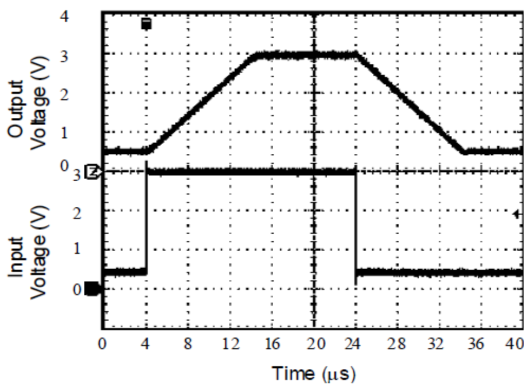
Voltage Gain



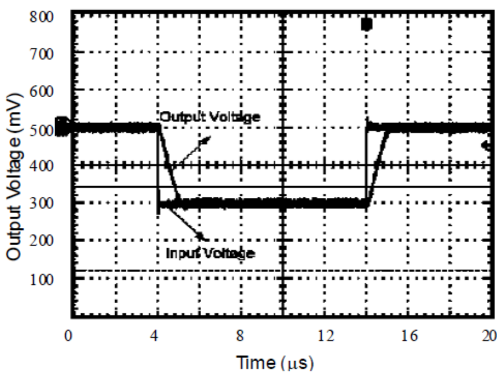
Open Loop Frequency Response



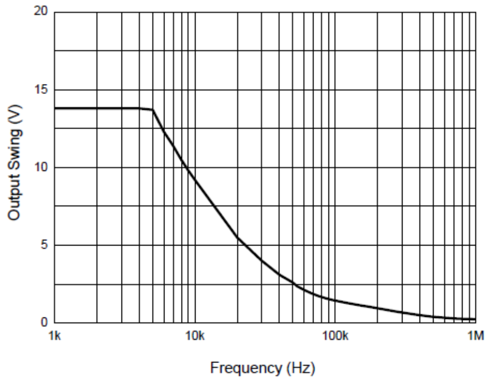
Voltage Follower Pulse Response



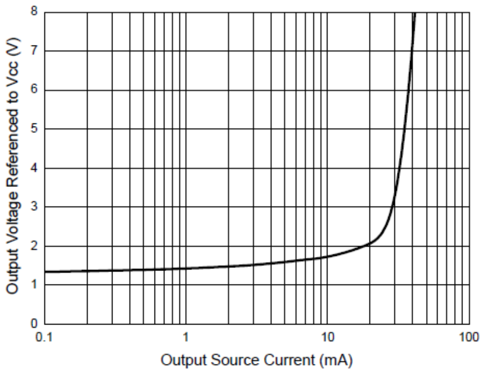
Voltage Follower Pulse Response (Small Signal)



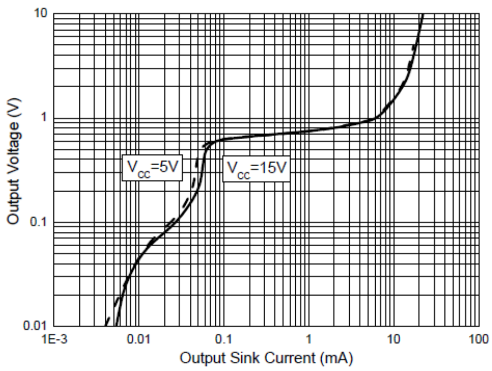
Large Signal Frequency Response



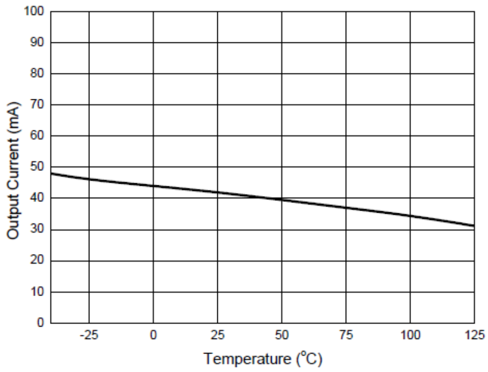
Output Characteristics: Current Sourcing



Output Characteristics: Current Sinking



Current Limiting



3 Application Note

3.1 Size

SNA321H/358H/324H family series op amps are unity-gain stable and suitable for a wide range of general-purpose applications. The small footprints of the SNA321H/358H/324H family packages save space on printed circuit boards and enable the design of smaller electronic products.

3.2 Power Supply Bypassing and Board Layout

SNA321H/358H/324H family series operates from a single 3V to 36V supply or dual ±1.5V to ±18V supplies. For best performance, a 0.1μF ceramic capacitor should be placed close to the V_{DD} pin in single supply operation. For dual supply operation, both V_{DD} and V_{SS} supplies should be bypassed to ground with separate 0.1μF ceramic capacitors.

3.3 Low Supply Current

The low supply current (typical 250μA per channel) of SNA321H/358H/324H family will help to maximize battery life. They are ideal for battery powered systems.

3.4 Operating Voltage

SNA321H/358H/324H family operates under wide input supply voltage (3V to 36V). In addition, all temperature specifications apply from -25°C to +85°C. Most behavior remains unchanged throughout the full operating voltage range. These guarantees ensure operation throughout the single Li-Ion battery lifetime.

3.5 Capacitive Load Tolerance

The SNA321H/358H/324H family is optimized for bandwidth and speed, not for driving capacitive loads. Output capacitance will create a pole in the amplifier's feedback path, leading to excessive peaking and potential oscillation. If dealing with load capacitance is a requirement of the application, the two strategies to consider are (1) using a small resistor in series with the amplifier's output and the load capacitance and (2) reducing the bandwidth of the amplifier's feedback loop by increasing the overall noise gain. Figure 3-1 shows a unity gain follower using the series resistor strategy. The resistor isolates the output from the capacitance and more importantly, creates a zero in the feedback path that compensates for the pole created by the output capacitance.

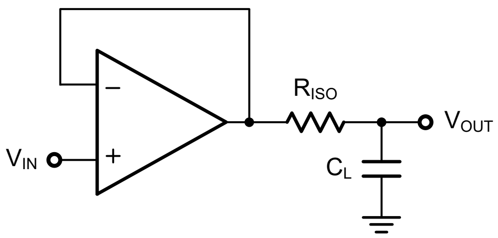


Figure 3-1 Indirectly Driving a Capacitive Load Using Isolation Resistor

The bigger the R_{ISO} resistor value, the more stable V_{OUT} will be. However, if there is a resistive load R_L in parallel with the capacitive load, a voltage divider (proportional to R_{ISO}/R_L) is formed, this will result in a gain error.

The circuit in Figure 3-2 is an improvement to the one in Figure 3-1. R_F provides the DC accuracy by feed-forward the V_{IN} to R_L. C_F and R_{ISO} serve to counteract the loss of phase margin by feeding the high frequency component of the output signal back to the amplifier's inverting input, thereby preserving the phase margin in the overall feedback loop. Capacitive drive can be increased by increasing the value of C_F. This in turn will slow down the pulse response.

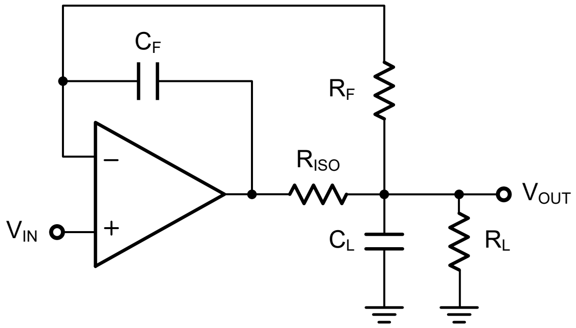


Figure 3-2 Indirectly Driving a Capacitive Load with DC Accuracy

4 Typical Application Circuits

4.1 Differential amplifier

The differential amplifier allows the subtraction of two input voltages or cancellation of a signal common the two inputs. It is useful as a computational amplifier in making a differential to single-end conversion or in rejecting a common mode signal. Figure 4-1 shown the differential amplifier using SNA321H/358H/324H family.

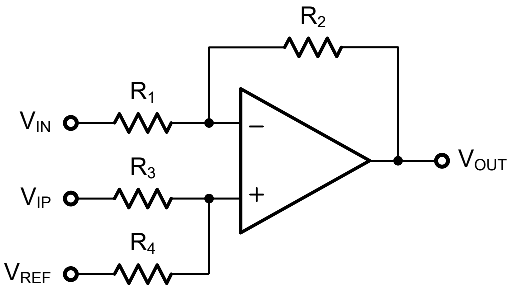


Figure 4-1 Differential Amplifier

$$V_{OUT} = \frac{(R_1+R_2)}{(R_3+R_4)}\frac{R_4}{R_1}V_{IN} - \frac{R_2}{R_1}V_{IP} + \frac{(R_1+R_2)}{(R_3+R_4)}\frac{R_3}{R_1}V_{REF}$$

If the resistor ratios are equal (i.e. R_1=R_3 and R_2=R_4), then

$$V_{OUT} = \frac{R_2}{R_1}(V_{IP} - V_{IN}) + V_{REF}$$

4.2 Low Pass Active Filter

The low pass active filter is shown in Figure 4-2. The DC gain is defined by $-R_2/R_1$. The filter has a -20dB/decade roll-off after its corner frequency $f_C=1/(2\pi R_3 C_1)$.

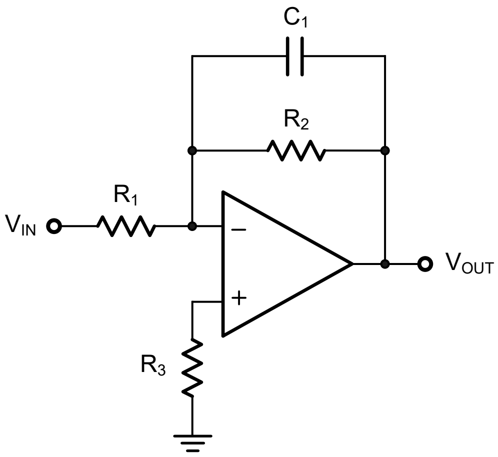


Figure 4-2 Low Pass Active Filter

4.3 Instrumentation Amplifier

The triple SNA321H/358H/324H family can be used to build a three-op-amp instrumentation amplifier as shown in Figure 4-3. The amplifier in Figure 4-3 is a high input impedance differential amplifier with gain of R_2/R_1. The two differential voltage followers assure the high input impedance of the amplifier.

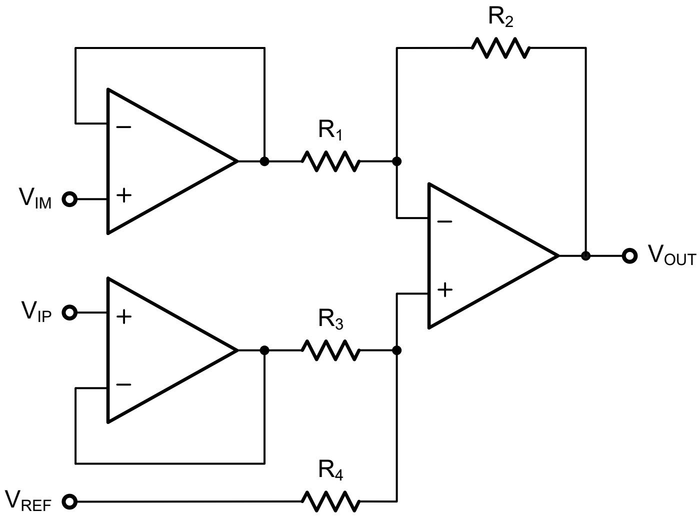
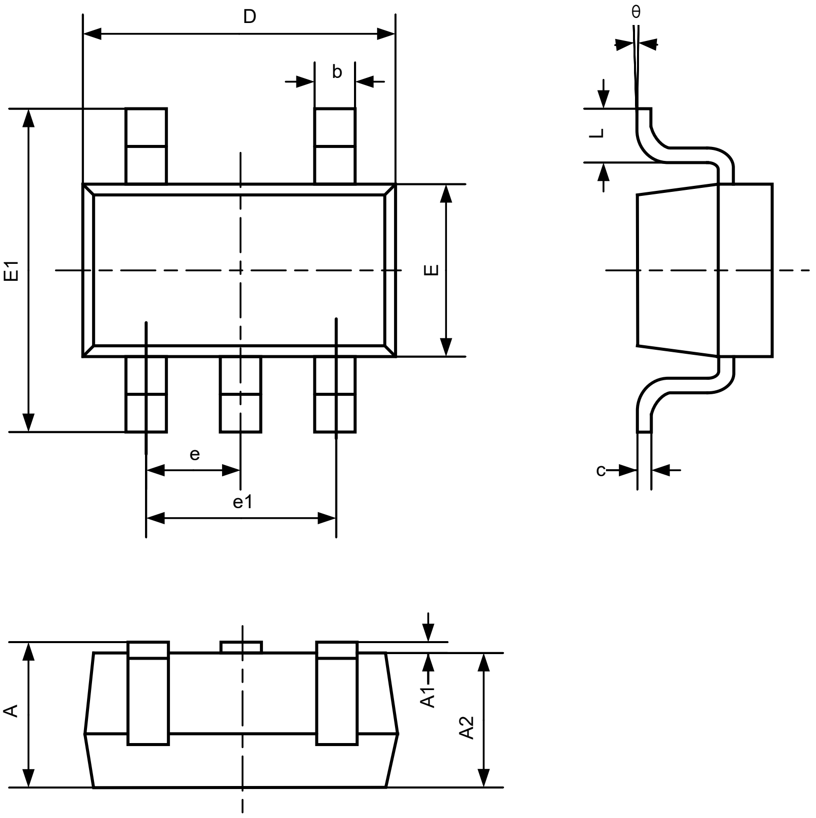


Figure 4-3 Instrument Amplifier

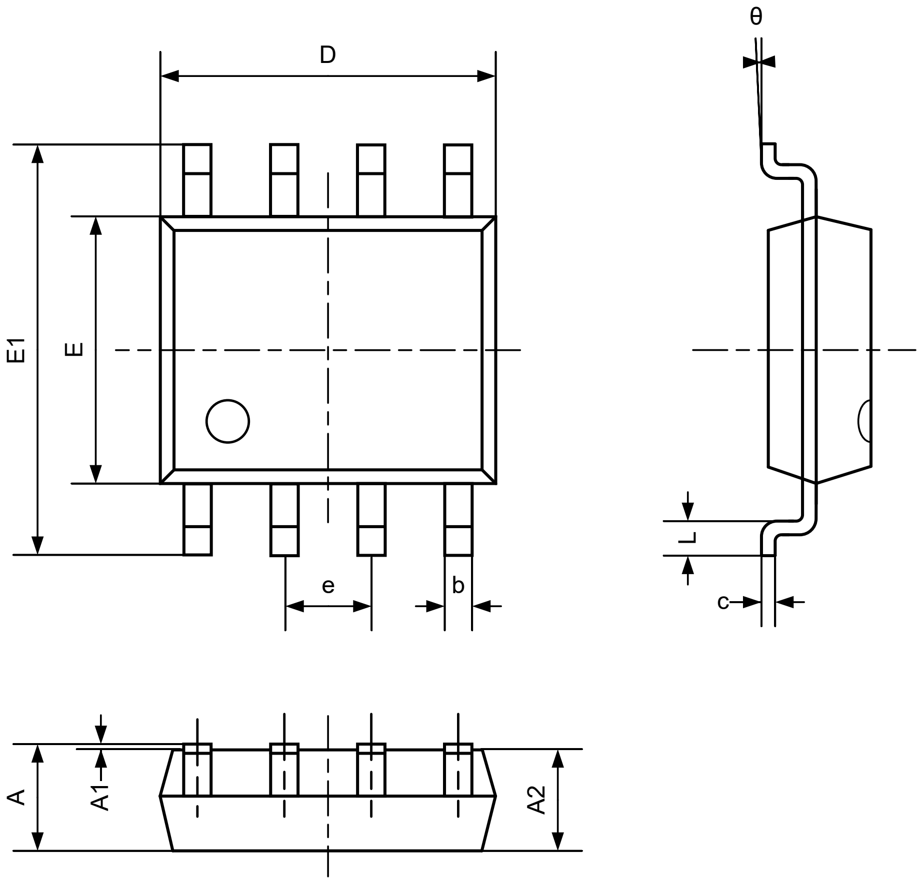
5 Package Information

5.1 SOT-23-5



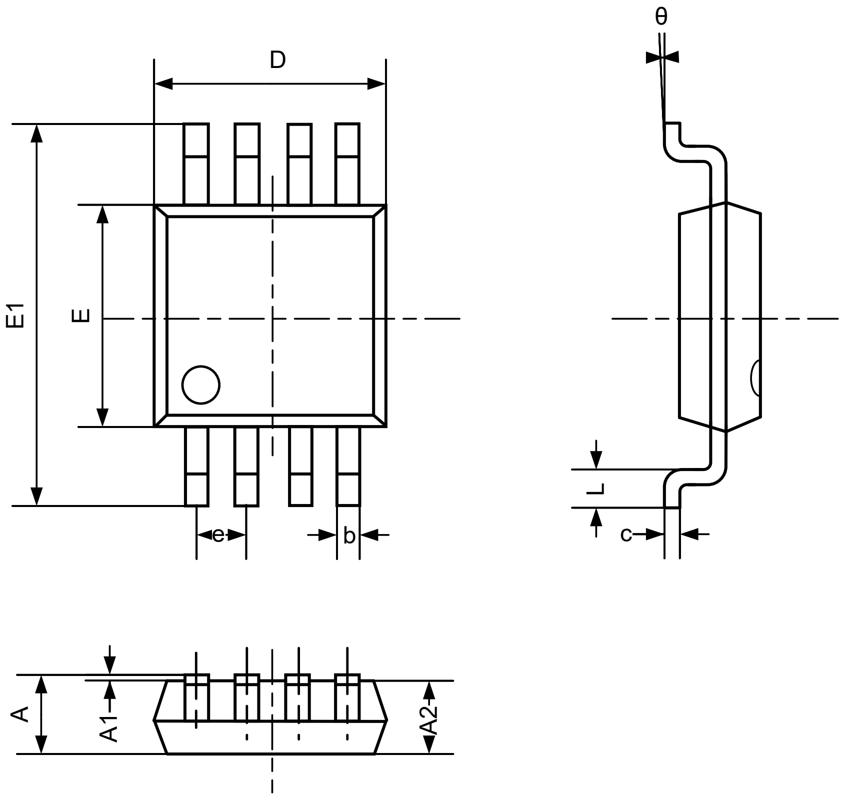
Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 BSC	
e1	1.900 BSC		0.075 BSC	
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

5.2 SOP-8



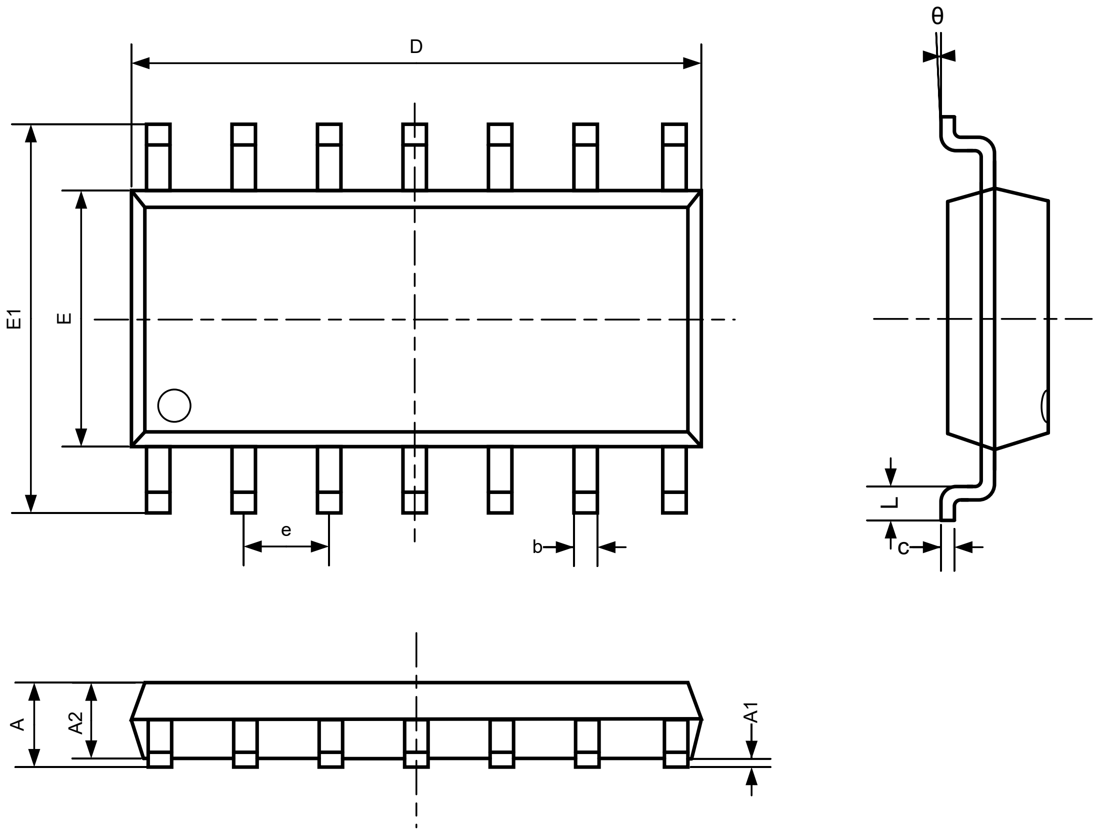
Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270 BSC		0.050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

5.3 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	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026 BSC	
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

5.4 SOP-14



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	1.250	1.650	0.049	0.065
b	0.360	0.490	0.014	0.019
c	0.130	0.250	0.005	0.010
D	8.530	8.730	0.336	0.344
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270 BSC		0.050 BSC	
L	0.450	0.800	0.018	0.032
θ	0°	8°	0°	8°

6 Revision History

Version	Date	Description
0.1	2022/07/12	Initial release