

Description

The TLV34x devices are single and dual CMOS operational amplifiers, respectively, with low-voltage, low-power, and rail-to-rail output swing capabilities. The PMOS input stage offers an ultra-low input bias current of 1 pA (typical) and an offset voltage of 0.3 mV (typical). For applications requiring excellent dc precision, the A grade (TLV34xA) has a low offset voltage of 1.25 mV (maximum) at 25°C.

These single-supply amplifiers are designed specifically for ultra-low-voltage (1.5 V to 5 V) operation, with a common-mode input voltage range that typically extends from -0.2 V to 0.5 V from the positive supply rail.

The TLV341 (single) and TLV342 (dual) in the RUG package also offer a shutdown (SHDN) pin that can be used to disable the device. In shutdown mode, the supply current is reduced to 45 pA (typical).

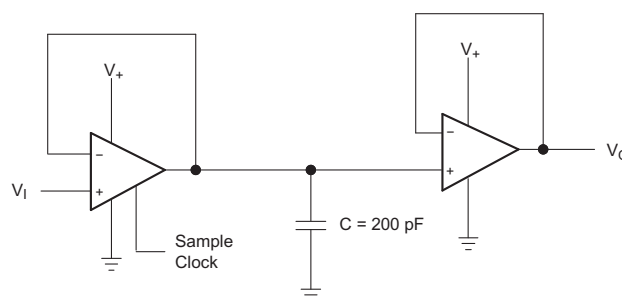
Features

- 1.8-V and 5-V Performance
- Low Offset (A Grade)
 - 1.25 mV Maximum (25°C)
 - 1.7 mV Maximum (-40°C to 125°C)
- Rail-to-Rail Output Swing
- Wide Common-Mode Input Voltage Range: -0.2 V to $(V_+ - 0.5$ V)
- Input Bias Current: 1 pA (Typical)
- Input Offset Voltage: 0.3 mV (Typical)
- Low Supply Current: 70 $\mu\text{A}/\text{Channel}$
- Low Shutdown Current:
 - 10 pA (Typical) Per Channel
- Gain Bandwidth: 2.3 MHz (Typical)
- Slew Rate: 0.9 V/ μs (Typical)
- Turnon Time From Shutdown: 5 μs (Typical)
- Input Referred Voltage Noise (at 10 kHz): 20 nV/ $\sqrt{\text{Hz}}$
- ESD Protection Exceeds JESD 22
 - 2000-V Human-Body Model (HBM)
 - 750-V Charged-device model (CDM)

Applications

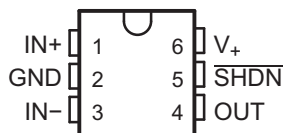
- Cellular Phones
- Consumer Electronics (Laptops)
- Audio Preamplifier for Voice
- Portable and Battery-Powered Electronic Equipment
- Supply Current Monitoring
- Battery Monitoring
- Buffers
- Filters

Sample and Hold Circuit Using Two TLV341



Pin Configuration and Functions

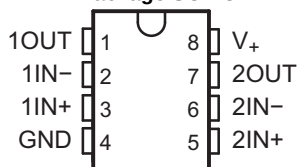
TLV341DBV or DCK Package
SOT23-6 or SC70-6



Pin Functions: TLV341

PIN		I/O	DESCRIPTION
NAME	SOT23-6, SC70-6		
1IN+	1	I	Noninverting input on channel 1
1IN–	3	I	Inverting input on channel 1
1OUT	4	O	Output on channel 1
GND	2	—	Ground
SHDN	5	I	Shutdown active low
V ₊	6	—	Positive power supply

TLV342 D
Package SOP-8



Pin Functions: TLV342

PIN		I/O	DESCRIPTION
NAME	SOP-8		
1IN+	3	I	Noninverting input on channel 1
1IN–	2	I	Inverting input on channel 1
1OUT	1	O	Output on channel 1
2IN+	5	I	Noninverting input on channel 2
2IN–	6	I	Inverting input on channel 2
2OUT	7	O	Output on channel 2
GND	4	—	Ground
NC ⁽¹⁾	—	—	Not connected
V ₊	8	—	Positive power supply

(1) NC – No internal connection

Absolute Maximum Ratings

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

		MIN	MAX	UNIT
V ₊	Supply voltage ⁽²⁾	−0.3	5.5	V
V _{ID}	Differential input voltage ⁽³⁾		±5.5	V
V _I	Input voltage (either input or shutdown)	−0.3	5.5	V
V _O	Output voltage	−0.3	V _{CC} + 0.3	V
T _J	Operating virtual-junction temperature		150	°C
T _{stg}	Storage temperature	−65	150	°C

(1) Stresses beyond 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-rated conditions for extended periods may affect device reliability.

(2) All voltage values (except differential voltages) are with respect to the network GND.

(3) Differential voltages are at IN+ with respect to IN−.

ESD Ratings

		VALUE	UNIT
V _(ESD)	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾	±2000
		Charged-device model (CDM), per JEDEC specification JESD22-C101 ⁽²⁾	±750

Recommended Operating Conditions

		MIN	MAX	UNIT
V ₊	Supply voltage (single-supply operation)	1.5	5.5	V
T _A	Operating free-air temperature	−40	125	°C

Thermal Information: TLV341

THERMAL METRIC ⁽¹⁾		TLV341		UNIT
		DBV (SOT-23)	DCK (SC70)	
		6 PINS	6 PINS	
R _{θJA}	Junction-to-ambient thermal resistance	193.4	196.8	°C/W
R _{θJC(top)}	Junction-to-case (top) thermal resistance	145.6	82.4	°C/W
R _{θJB}	Junction-to-board thermal resistance	44.1	95.2	°C/W
ψ _{JT}	Junction-to-top characterization parameter	34.1	1.8	°C/W
ψ _{JB}	Junction-to-board characterization parameter	43.4	93.2	°C/W

Thermal Information: TLV342

THERMAL METRIC ⁽¹⁾		TLV342	UNIT
		D (SOP)	
		8 PINS	
R _{θJA}	Junction-to-ambient thermal resistance	123.6	°C/W
R _{θJC(top)}	Junction-to-case (top) thermal resistance	69.8	°C/W
R _{θJB}	Junction-to-board thermal resistance	63.9	°C/W
ψ _{JT}	Junction-to-top characterization parameter	24.4	°C/W
ψ _{JB}	Junction-to-board characterization parameter	63.4	°C/W

Electrical Characteristics: $V_+ = 1.8\text{ V}$
 $V_+ = 1.8\text{ V}$, $\text{GND} = 0\text{ V}$, $V_{\text{IC}} = V_{\text{O}} = V_+/2$, $R_{\text{L}} > 1\text{ M}\Omega$ (unless otherwise noted). See Shutdown Characteristics: $V_+ = 1.8\text{ V}$.

PARAMETER		TEST CONDITIONS		T _A	MIN	TYP ⁽¹⁾	MAX	UNIT	
V _{IO}	Input offset voltage	Standard grade		25°C	0.3		4	mV	
				Full range		4.5			
		A grade		25°C	0.3		1.25		
				0°C to 125°C		0.3			1.5
				−40°C to 125°C		0.3			1.7
α _{VIO}	Average temperature coefficient of input offset voltage			Full range	1.9			μV/°C	
I _{IB}	Input bias current			25°C	1		100	pA	
				−40°C to 85°C		375			
				−40°C to 125°C		3000			
I _{IO}	Input offset current			25°C	6.6			fA	
CMRR	Common-mode rejection ratio	0 ≤ V _{ICR} ≤ 1.2 V		25°C	60	85		dB	
				Full range		50			
k _{SVR}	Supply-voltage rejection ratio	1.8 V ≤ V ₊ ≤ 5 V		25°C	75	95		dB	
				Full range		65			
V _{ICR}	Common-mode input voltage range	CMRR ≥ 60 dB		25°C	0		1.2	V	
A _V	Large-signal voltage gain ⁽²⁾	R _L = 10 kΩ to 1.35 V		25°C	70	110		dB	
				Full range		60			
		R _L = 2 kΩ to 1.35 V		25°C	65	100			
				Full range		55			
V _O	Output swing (delta from supply rails)	R _L = 2 kΩ to 1.35 V	Low level	25°C	22		50	mV	
				Full range		75			
			High level	25°C	25		50		
				Full range		75			
		R _L = 10 kΩ to 1.35 V	Low level	25°C	14		20		
				Full range		25			
			High level	25°C	7		20		
				Full range		25			
I _{CC}	Supply current (per channel)			25°C	70		150	μA	
				Full range		200			
I _{OS}	Output short-circuit current	Sourcing		25°C	6	12		mA	
		Sinking			10	20			
SR	Slew rate	R _L = 10 kΩ ⁽³⁾		25°C	0.9			V/μs	
GBW	Unity-gain bandwidth	R _L = 10 kΩ, C _L = 200 pF		25°C	2.2			MHz	
φ _m	Phase margin	R _L = 100 kΩ, C _L = 200 pF		25°C	55			°	
G _m	Gain margin	R _L = 100 kΩ, C _L = 200 pF		25°C	15			dB	
V _n	Equivalent input noise voltage	f = 1 kHz		25°C	33			nV/√Hz	
I _n	Equivalent input noise current	f = 1 kHz		25°C	0.001			pA/√Hz	
THD	Total harmonic distortion	f = 1 kHz, A _V = 1, R _L = 600 Ω, V _I = 1 V _{PP}		25°C	0.015%				

(1) Typical values represent the most likely parametric norm.

(2) $\text{GND} + 0.2\text{ V} \leq V_{\text{O}} \leq V_+ - 0.2\text{ V}$

(3) Connected as voltage follower with 2- V_{PP} step input. Number specified is the slower of the positive and negative slew rates.

Electrical Characteristics: $V_+ = 5\text{ V}$

$V_+ = 5\text{ V}$, $\text{GND} = 0\text{ V}$, $V_{\text{IC}} = V_{\text{O}} = V_+/2$, $R_{\text{L}} > 1\text{ M}\Omega$ (unless otherwise noted). See Shutdown Characteristics: $V_+ = 5\text{ V}$.

PARAMETER		TEST CONDITIONS		T_{A}	MIN	TYP ⁽¹⁾	MAX	UNIT
V_{IO}	Input offset voltage	Standard grade		25°C		0.3	4	mV
				Full range			4.5	
	A grade			25°C		0.3	1.25	
				0°C to 125°C		0.3	1.5	
				-40°C to 125°C		0.3	1.7	
α_{VIO}	Average temperature coefficient of input offset voltage			Full range		1.9		$\mu\text{V}/^\circ\text{C}$
I_{IB}	Input bias current			25°C		1	200	pA
				-40°C to 85°C			375	
				-40°C to 125°C			3000	
I_{IO}	Input offset current			25°C		6.6		fA
CMRR	Common-mode rejection ratio	$0 \leq V_{\text{ICR}} \leq 4.4\text{ V}$		25°C	75	90		dB
				Full range	70			
k_{SVR}	Supply-voltage rejection ratio	$1.8\text{ V} \leq V_+ \leq 5\text{ V}$		25°C	75	95		dB
				Full range	65			
V_{ICR}	Common-mode input voltage range	$\text{CMRR} \geq 70\text{ dB}$		25°C	0		4.4	V
A_{V}	Large-signal voltage gain ⁽²⁾	$R_{\text{L}} = 10\text{ k}\Omega$ to 2.5 V		25°C	80	110		dB
				Full range	70			
		$R_{\text{L}} = 2\text{ k}\Omega$ to 2.5 V		25°C	75	105		
				Full range	60			
V_{O}	Output swing (delta from supply rails)	$R_{\text{L}} = 2\text{ k}\Omega$ to 2.5 V	Low level	25°C		40	60	mV
				Full range			85	
			High level	25°C		25	60	
				Full range			85	
		$R_{\text{L}} = 10\text{ k}\Omega$ to 2.5 V	Low level	25°C		18	30	
				Full range			40	
			High level	25°C		7	15	
				Full range			20	
I_{CC}	Supply current (per channel)			25°C		75	150	μA
				Full range			200	
I_{OS}	Output short-circuit current	Sourcing		25°C	60	113		mA
		Sinking			80	115		
SR	Slew rate	$R_{\text{L}} = 10\text{ k}\Omega$ ⁽³⁾		25°C		1		V/ μs
GBW	Unity-gain bandwidth	$R_{\text{L}} = 10\text{ k}\Omega$, $C_{\text{L}} = 200\text{ pF}$		25°C		2.3		MHz
ϕ_{m}	Phase margin	$R_{\text{L}} = 100\text{ k}\Omega$, $C_{\text{L}} = 200\text{ pF}$		25°C		55		°
G_{m}	Gain margin	$R_{\text{L}} = 100\text{ k}\Omega$, $C_{\text{L}} = 200\text{ pF}$		25°C		15		dB
V_{n}	Equivalent input noise voltage	$f = 1\text{ kHz}$		25°C		33		$\text{nV}/\sqrt{\text{Hz}}$
I_{n}	Equivalent input noise current	$f = 1\text{ kHz}$		25°C		0.001		$\text{pA}/\sqrt{\text{Hz}}$
THD	Total harmonic distortion	$f = 1\text{ kHz}$, $A_{\text{V}} = 1$, $R_{\text{L}} = 600\text{ }\Omega$, $V_{\text{I}} = 1\text{ V}_{\text{PP}}$		25°C		0.012%		

(1) Typical values represent the most likely parametric norm.

(2) $\text{GND} + 0.2\text{ V} \leq V_{\text{O}} \leq V_+ - 0.2\text{ V}$

(3) Connected as voltage follower with 2- V_{PP} step input. Number specified is the slower of the positive and negative slew rates.

Shutdown Characteristics: $V_+ = 1.8\text{ V}$
 $V_+ = 1.8\text{ V}$, $\text{GND} = 0\text{ V}$, $V_{\text{IC}} = V_{\text{O}} = V_+/2$, $R_{\text{L}} > 1\text{ M}\Omega$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	T_{A}	MIN	TYP	MAX	UNIT
$I_{\text{CC(SHDN)}}$ Supply current in shutdown mode	$V_{\text{SD}} = 0\text{ V}$	25°C		0.01	1	μA
		Full range			1.5	
$t_{\text{(on)}}$ Amplifier turnon time		25°C		5		μs
V_{SD} Recommended shutdown pin voltage range	On mode	25°C	1.5		1.8	V
	Shutdown mode		0		0.5	

Shutdown Characteristics: $V_+ = 5\text{ V}$
 $V_+ = 5\text{ V}$, $\text{GND} = 0\text{ V}$, $V_{\text{IC}} = V_{\text{O}} = V_+/2$, $R_{\text{L}} > 1\text{ M}\Omega$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	T_{A}	MIN	TYP	MAX	UNIT
$I_{\text{CC(SHDN)}}$ Supply current in shutdown mode	$V_{\text{SD}} = 0\text{ V}$	25°C		0.01	1	μA
		Full range			1.5	
$t_{\text{(on)}}$ Amplifier turnon time		25°C		5		μs
V_{SD} Recommended shutdown pin voltage range	On mode	25°C	4.5		5	V
	Shutdown mode		0		0.8	

Typical Characteristics

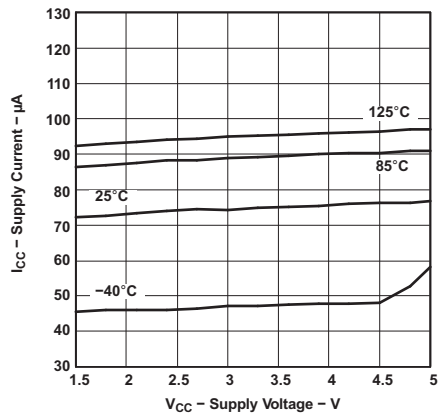


Figure 1. Supply Current vs Supply Voltage

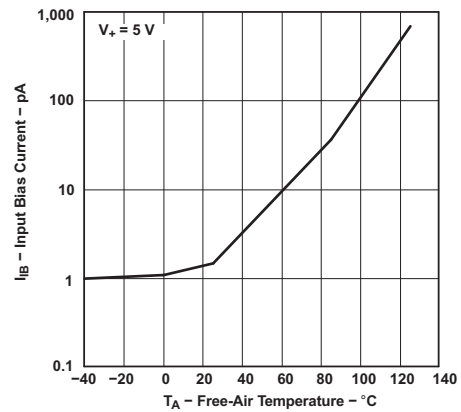


Figure 2. Input Bias Current vs Temperature

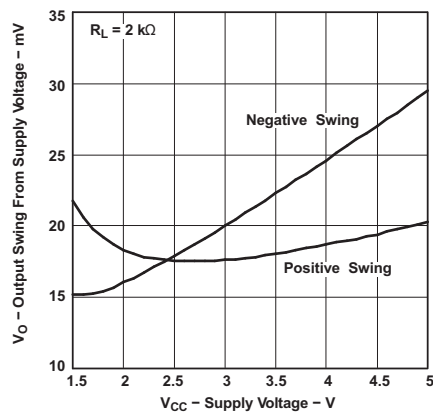


Figure 3. Output Voltage Swing vs Supply Voltage

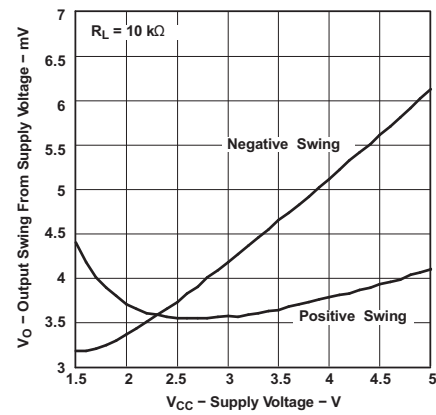


Figure 4. Output Voltage Swing vs Supply Voltage

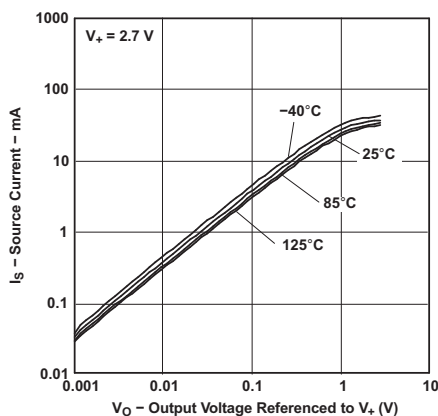


Figure 5. Source Current vs Output Voltage

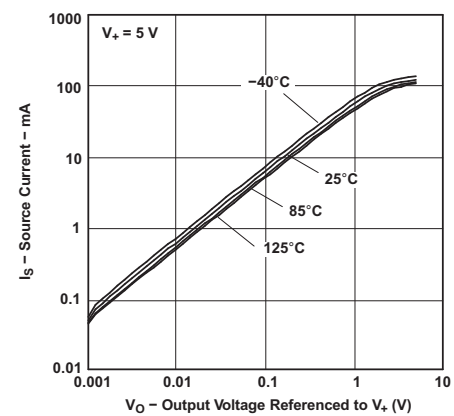


Figure 6. Source Current vs Output Voltage

Typical Characteristics

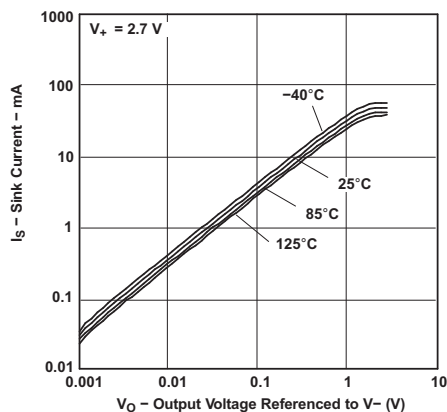


Figure 7. Sink Current vs Output Voltage

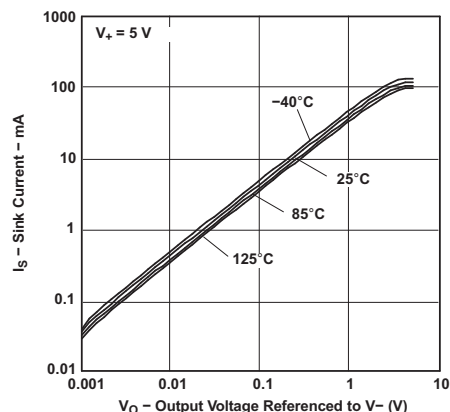


Figure 8. Sink Current vs Output Voltage

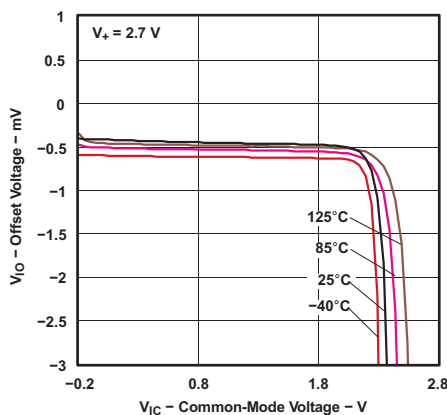


Figure 9. Offset Voltage vs Common-Mode Voltage

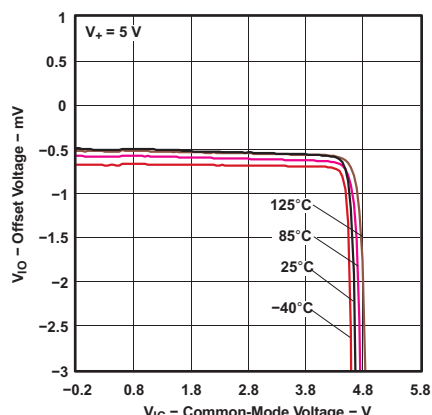


Figure 10. Offset Voltage vs Common-Mode Voltage

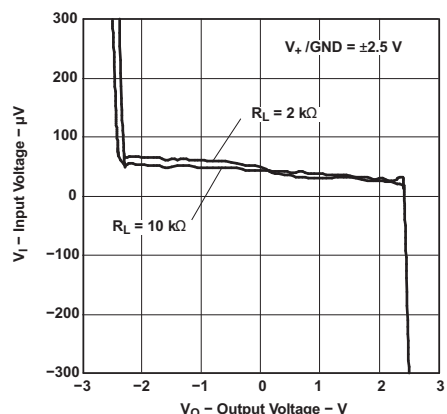


Figure 11. Input Voltage vs Output Voltage

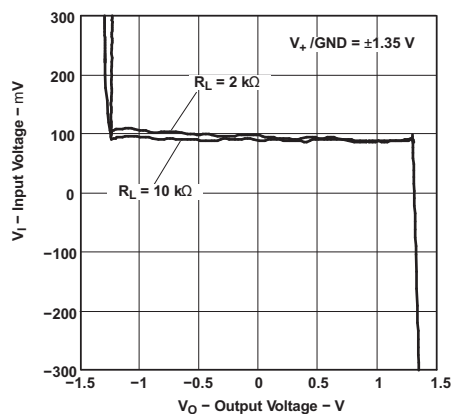


Figure 12. Input Voltage vs Output Voltage

Typical Characteristics

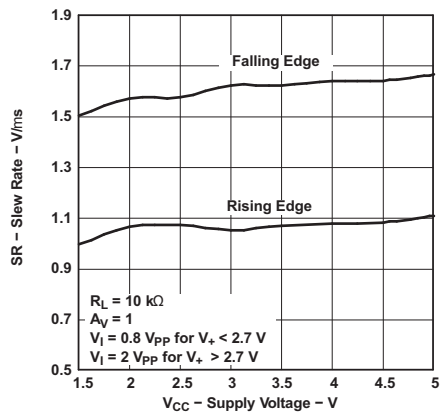


Figure 13. Slew Rate vs Supply Voltage

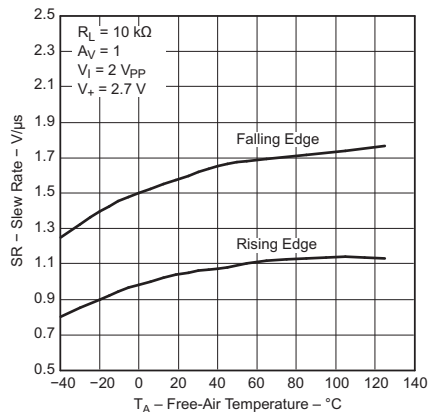


Figure 14. Slew Rate vs Temperature

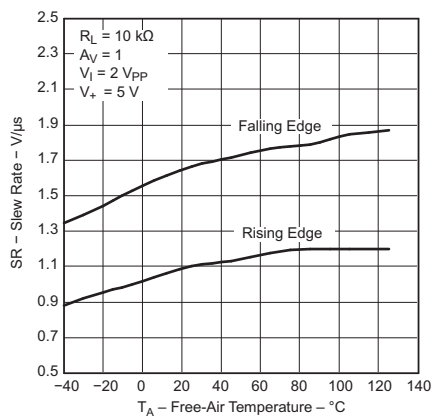


Figure 15. Slew Rate vs Temperature

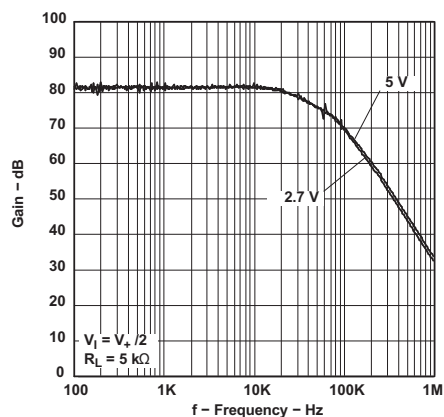


Figure 16. CMRR vs Frequency

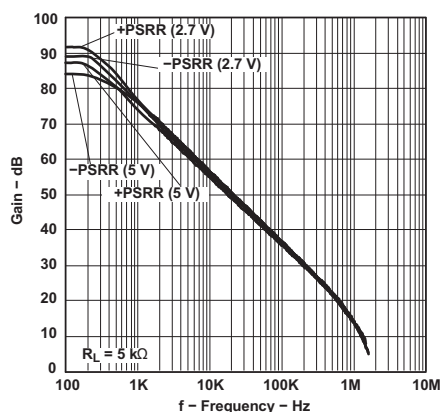


Figure 17. PSRR vs Frequency

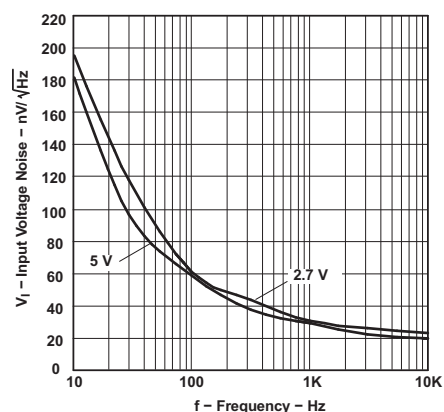


Figure 18. Input Voltage Noise vs Frequency

Typical Characteristics

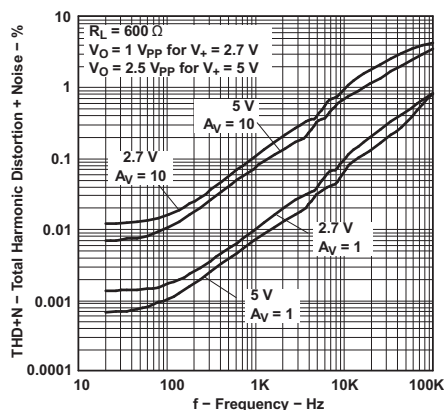


Figure 19. Total Harmonic Distortion +Noise vs Frequency

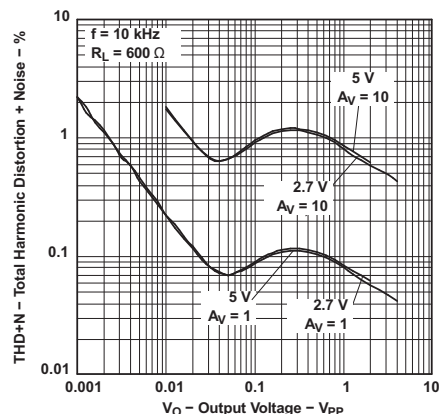


Figure 20. Total Harmonic Distortion +Noise vs Output Voltage

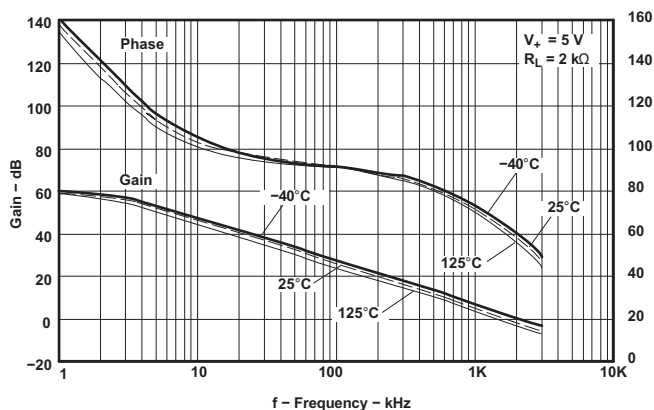


Figure 21. Frequency Response vs Temperature

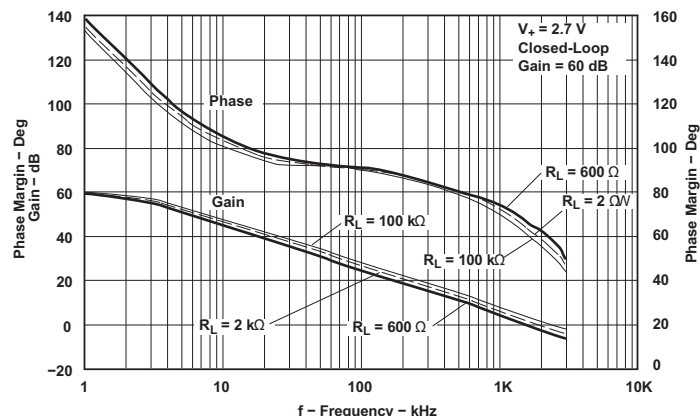


Figure 22. Frequency Response vs R_L

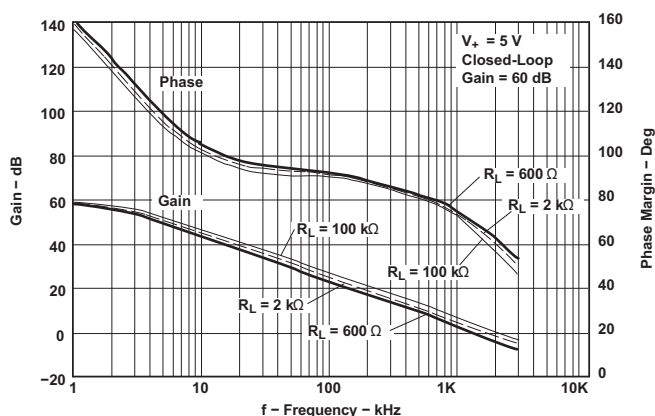


Figure 23. Frequency Response vs R_L

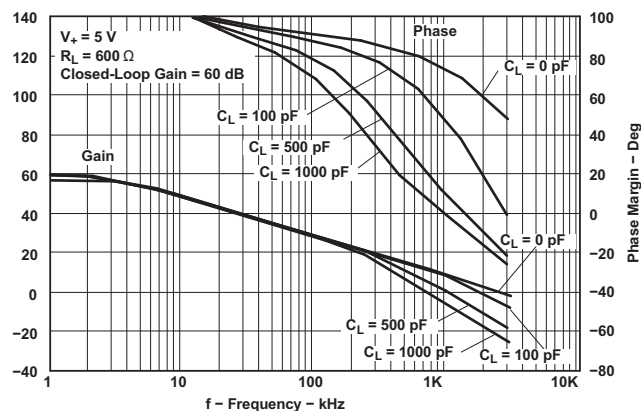


Figure 24. Frequency Response vs C_L

Typical Characteristics

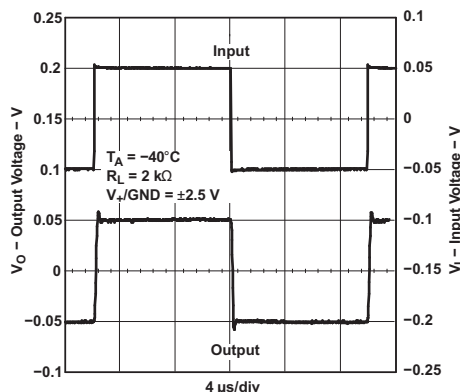


Figure 25. Small-Signal Noninverting Response

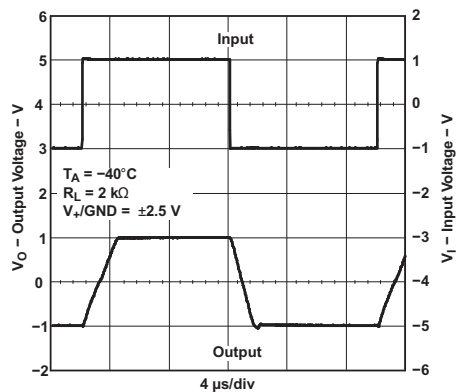


Figure 26. Large-Signal Noninverting Response

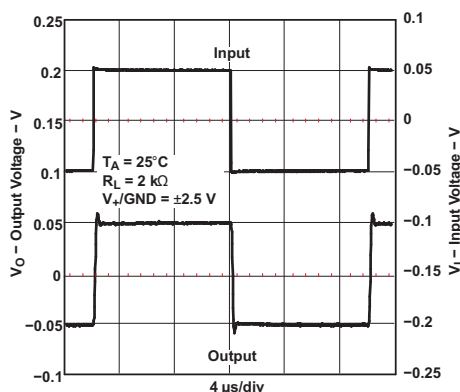


Figure 27. Small-Signal Noninverting Response

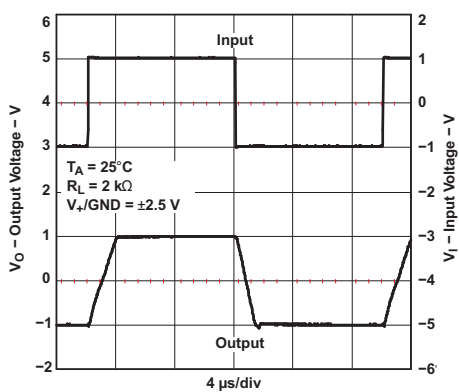


Figure 28. Large-Signal Noninverting Response

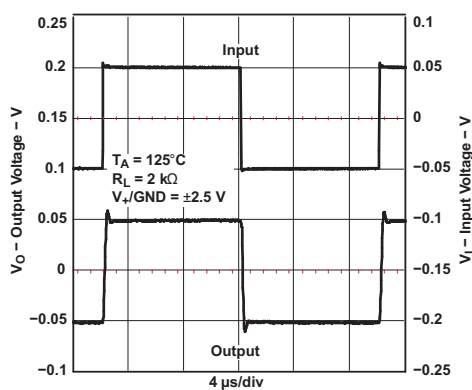


Figure 29. Small-Signal Noninverting Response

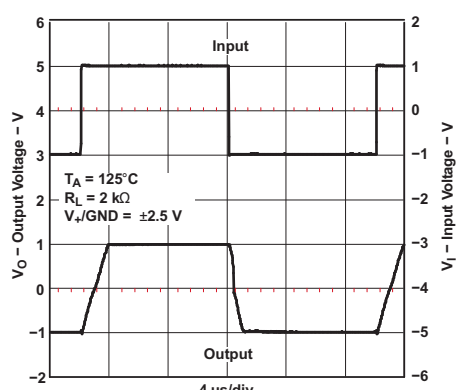


Figure 30. Large-Signal Noninverting Response

Typical Characteristics

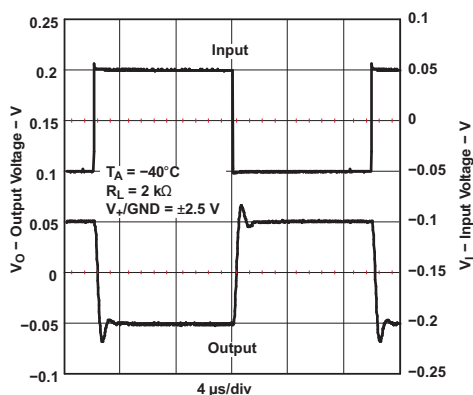


Figure 31. Small-Signal Noninverting Response

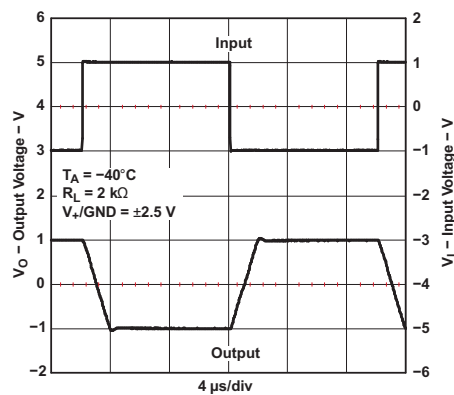


Figure 32. Large-Signal Inverting Response

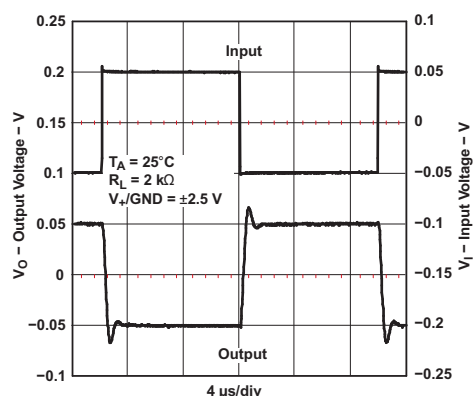


Figure 33. Small-Signal Inverting Response

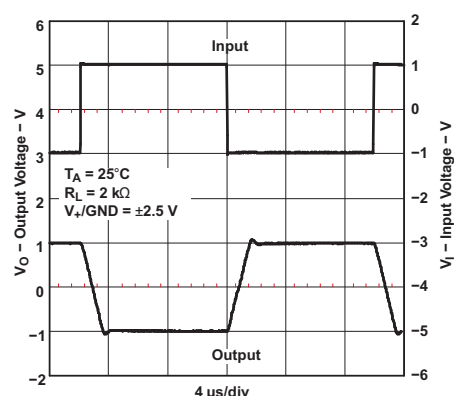


Figure 34. Large-Signal Inverting Response

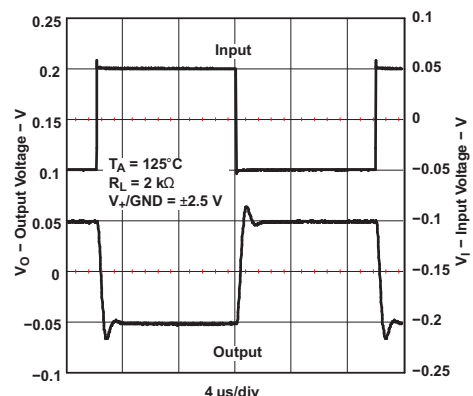


Figure 35. Small-Signal Inverting Response

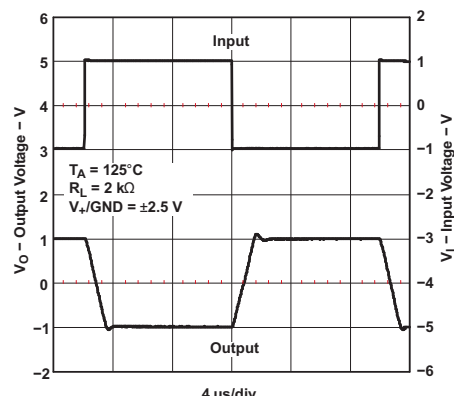
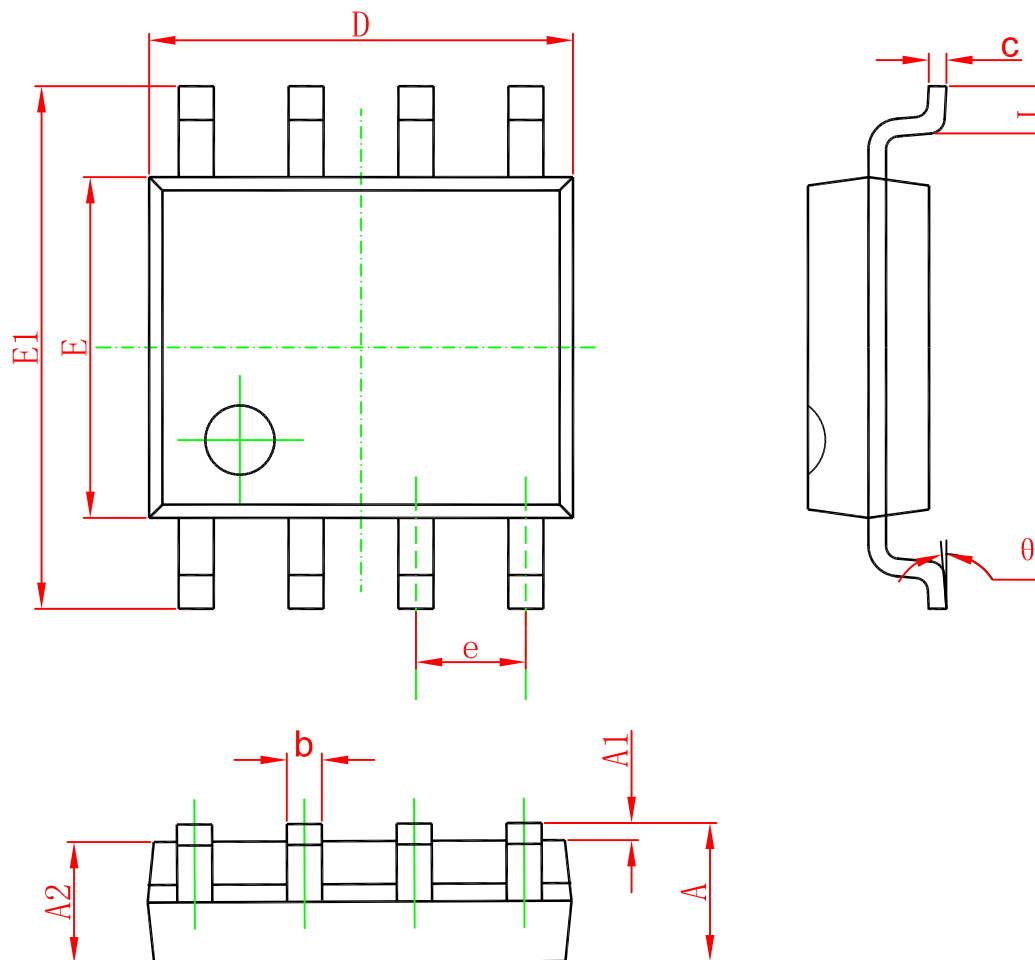


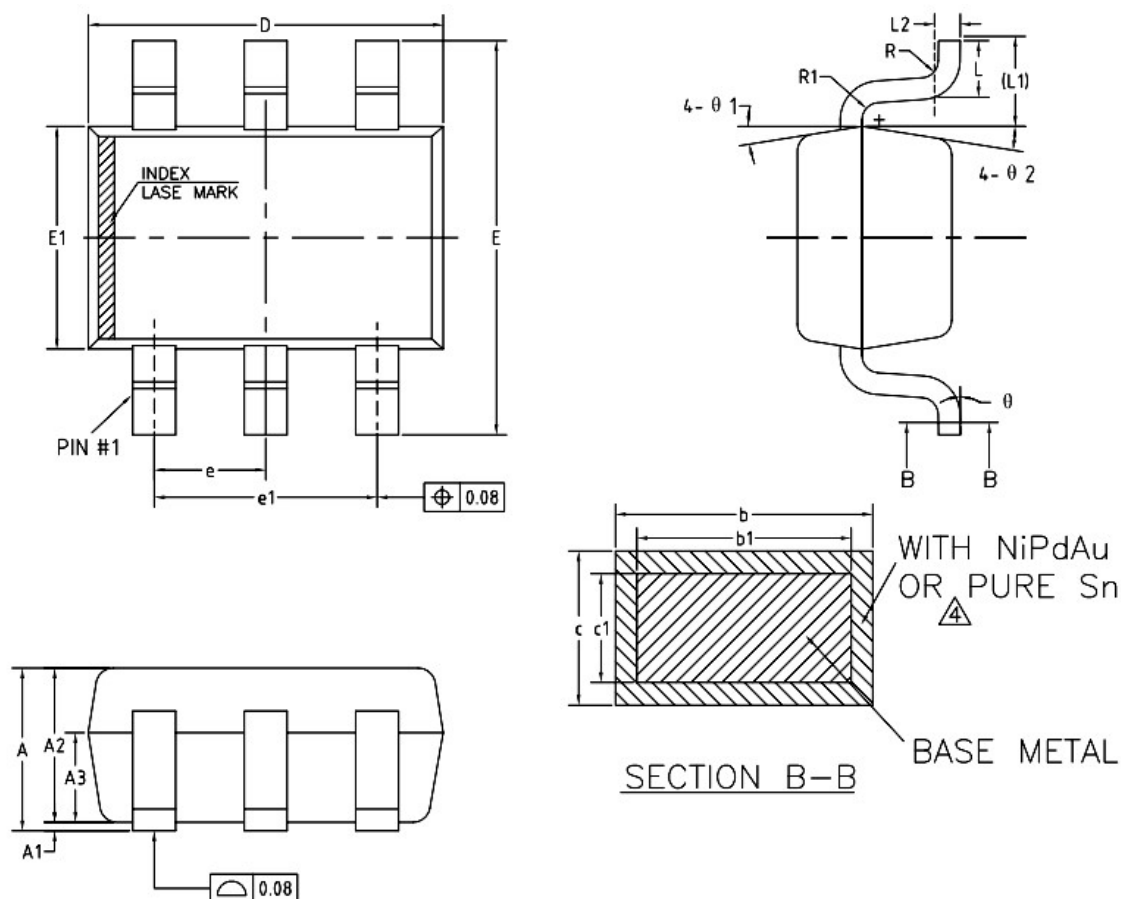
Figure 36. Large-Signal Inverting Response

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°

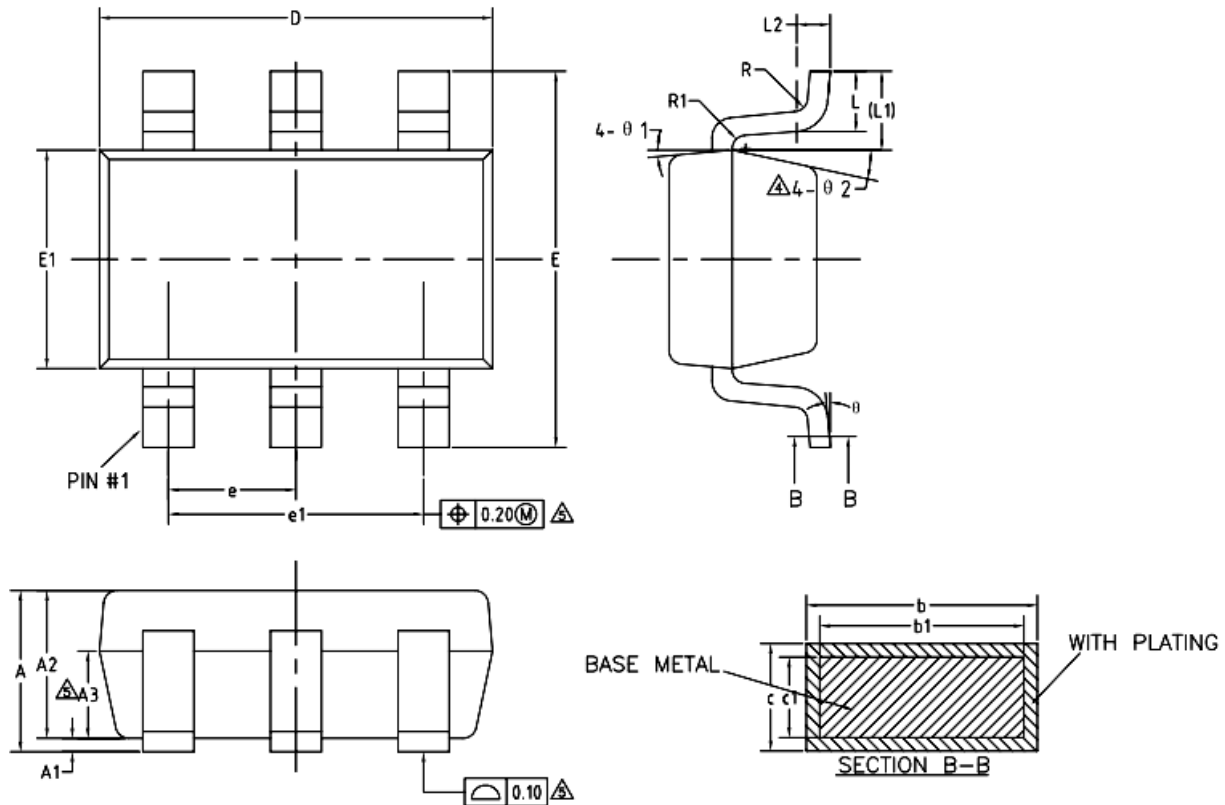
SC70-6



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	0.85	—	1.05
A1	0	—	0.10
A2	0.80	0.90	1.00
A3	0.47	0.52	0.57
b	NiPdAu 0.22 PURE Sn 0.23	—	0.29 0.33
b1	0.22	0.25	0.28
c	NiPdAu 0.115 PURE Sn 0.12	—	0.15 0.18
c1	0.115	0.13	0.14
D	2.02	2.07	2.12
E	2.20	2.30	2.40
E1	1.25	1.30	1.35
e	0.60	0.65	0.70
e1	1.20	1.30	1.40
L	0.28	0.33	0.38
L1	0.50REF		
L2	0.15BSC		
R	0.10	—	—
R1	0.10	—	0.25
θ	0°	—	8°
θ 1	6°	9°	12°
θ 2	6°	9°	12°

SOT23-6



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	—	—	1.25
A1	0	—	0.15
A2	1.00	1.10	1.20
A3	0.60	0.65	0.70
b	0.36	—	0.50
b1	0.36	0.38	0.45
c	0.14	—	0.20
c1	0.14	0.15	0.16
D	2.826	2.926	3.026
E	2.60	2.80	3.00
E1	1.526	1.626	1.726
e	0.90	0.95	1.00
e1	1.80	1.90	2.00
L	0.35	0.45	0.60
L1	0.59REF		
L2	0.25BSC		
R	0.10	—	—
R1	0.10	—	0.20
θ	0°	—	8°
θ 1	3°	5°	7°
θ 2	6°	—	14°

Ordering information

Order code	Package	Baseqty	Deliverymode	Marking
UMW TLV342AIDR	SOP-8	2500	Tape and reel	TLV342
UMW TLV342AID	SOP-8	2500	Tape and reel	TLV342
UMW TLV342IDR	SOP-8	2500	Tape and reel	TLV342
UMW TLV342ID	SOP-8	2500	Tape and reel	TLV342
UMW TLV341AIDBVR	SOT-23-6	3000	Tape and reel	YCGE
UMW TLV341AIDCKR	SC70-6	3000	Tape and reel	Y5E
UMW TLV341IDBVR	SOT-23-6	3000	Tape and reel	YC9E
UMW TLV341IDCKR	SC70-6	3000	Tape and reel	Y4E