UMW TLV341/342

Low-Voltage Rail-to-Rail Output CMOS Operational Amplifiers With Shutdown

1.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 0.3mV (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 45pA (typical).

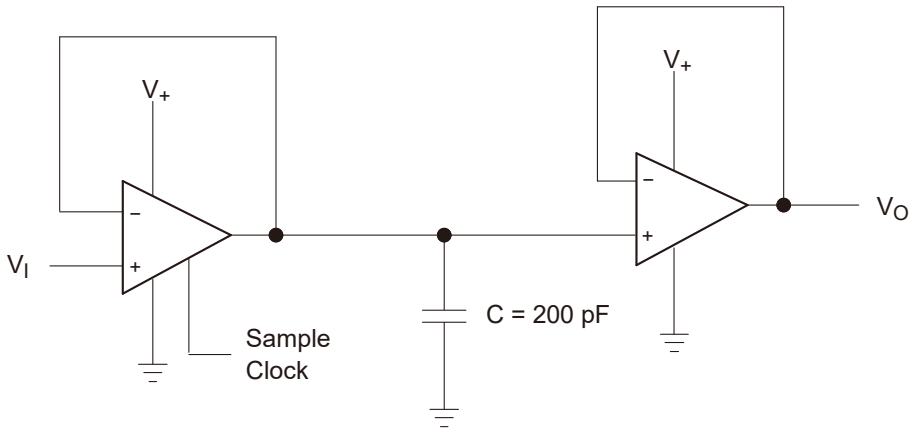
2.Features

- 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 µA/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: 5µs (Typical)
- Input Referred Voltage Noise (at 10 kHz): 20 nV/√Hz
- ESD Protection Exceeds JESD 22
- – 2000-V Human-Body Model (HBM)
- – 750-V Charged-device model (CDM

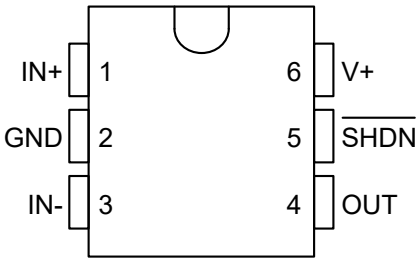
3.Applications

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

4.Sample and Hold Circuit Using Two TLV341



5.1 Pinning information

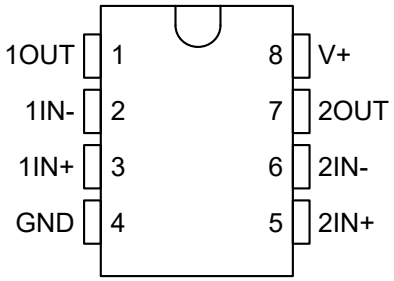


TLV341DBV or DCK Package
SOT23-6/SC70-6

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	Qutput on channel 1
GND	2	-	Ground
$\overline{\text{SHDN}}$	5	I	Shutdown active low
V+	6	-	Positive power supply

5.2 Pinning information



TLV342D
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

Notes: (1) NC – No internal connection

6.Absolute Maximum Ratings

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

Parameter	Symbol	Min	Max	Units
Supply voltage (2)	V_+	-0.3	5.5	V
Differential input voltage (3)	V_{ID}		±5.5	V
Input voltage (either input or $\overline{\text{shutdown}}$)	V_I	-0.3	5.5	V
Output voltage	V_O	-0.3	V_{CC}+0.3	V
Operating virtual-junction temperature	T_J		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, 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-

7.ESD Ratings

Parameter		Symbol	Value	Units
Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)	$V_{(ESD)}$	±2000	V
	Charged-device model (CDM), per JEDEC specification JESD22-C101(2)		±750	

8.Recommended Operating Conditions

Parameter	Symbol	Min	Max	Units
Supply voltage (single-supply operation)	V_+	1.5	5.5	V
Operating free-air temperature	T_A	-40	125	°C

9.1 Thermal Information: TLV341

Thermal Metric(1)	Symbol	DBV (SOT23)	DCK (SC70)	Units
		6 Pins	6 Pins	
Junction-to-ambient thermal resistance	$R_{\theta JA}$	193.4	196.8	°C/W
Junction-to-case (top) thermal resistance	$R_{\theta JC(top)}$	145.6	82.4	°C/W
Junction-to-board thermal resistance	$R_{\theta JB}$	44.1	95.2	°C/W
Junction-to-top characterization parameter	Ψ_{JT}	34.1	1.8	°C/W
Junction-to-board characterization parameter	Ψ_{JB}	43.4	93.2	°C/W

9.2 Thermal Information: TLV342

Thermal Metric(1)	Symbol	D(SOP)	Units
		8 Pins	
Junction-to-ambient thermal resistance	$R_{\theta JA}$	123.6	°C/W
Junction-to-case (top) thermal resistance	$R_{\theta JC(top)}$	69.8	°C/W
Junction-to-board thermal resistance	$R_{\theta JB}$	63.9	°C/W
Junction-to-top characterization parameter	Ψ_{JT}	24.4	°C/W
Junction-to-board characterization parameter	Ψ_{JB}	63.4	°C/W

10.1 Electrical Characteristics (V_+=1.8V)

V_+=1.8V, GND=0V, V_{IC}=V_O=V_+/2, R_L>1MΩ (unless otherwise noted). See Shutdown Characteristics: V_+=1.8V.

Parameter	Symbol	Conditions	T_A	Min	Typ(1)	Max	Units
Input offset voltage	V_{IO}	Standard grade	25°C		0.3	4	mV
			Full range			4.5	mV
		A grade	25°C		0.3	1.25	mV
			0°C to 125°C		0.3	1.5	mV
			-40°C to 125°C		0.3	1.7	mV
Average temperature coefficient of input offset voltage	αV_{IO}		Full range		1.9		μV/°C
Input bias current	I_{IB}		25°C		1	100	pA
			-40°C to 85°C			375	pA
			-40°C to 125°C			3000	pA
Input offset current	I_{IO}		25°C		6.6		fA
Common-mode rejection ratio	CMRR	0≤V_{ICR}≤1.2V	25°C	60	85		dB
			Full range	50			dB
Supply-voltage rejection ratio	K_{SVR}	1.8≤V_+≤5V	25°C	75	95		dB
			Full range	65			dB
Common-mode input voltage range	V_{ICR}	CMRR≥60dB	25°C	0		1.2	V
Large-signal voltage gain (2)	A_V	R_L=10kΩ to 1.35V	25°C	70	110		dB
			Full range	60			dB
		R_L=2kΩ to 1.35V	25°C	65	100		dB
			Full range	55			dB

Parameter	Symbol	Conditions		T_A	Min	Typ(1)	Max	Units
Output swing (delta from supply rails)	V_O	R_L=2kΩ to 1.35V	Low level	25°C		22	50	mV
				Full range			75	mV
			High level	25°C		25	50	mV
				Full range			75	mV
		R_L=10kΩ to 1.35V	Low level	25°C		14	20	mV
				Full range			25	mV
			High level	25°C		7	20	mV
				Full range			25	mV
Supply current (per channel)	I_{CC}			25°C		70	150	μA
				Full range			200	μA
Output short-circuit current	I_{OS}	Sourcing		25°C	6	12		mA
		Sinking			10	20		mA
Slew rate	SR	R_L=10kΩ (3)		25°C		0.9		V/μs
Unity-gain bandwidth	GBW	R_L=10kΩ, C_L=200pF		25°C		2.2		MHz
Phase margin	φ_m	R_L=100kΩ, C_L=200pF		25°C		55		°
Gain margin	G_m	R_L=100kΩ, C_L=200pF		25°C		15		dB
Equivalent input noise voltage	V_n	f=1kHz		25°C		33		nV/√Hz
Equivalent input noise current	I_n	f=1kHz		25°C		0.001		pA/√Hz
Total harmonic distortion	THD	f=1kHz,A_V=1,R_L=600Ω,V_I=1V_{PP}		25°C		0.015%		

Notes:

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

(2) GND + 0.2V≤V_O≤ V_+-0.2V

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

10.2 Electrical Characteristics (V_+=5V)

V_+=5V, GND=0V, $V_{IC}=V_O=V_+/2$, R_L>1MΩ (unless otherwise noted). See Shutdown Characteristics: V_+=5V.

Parameter	Symbol	Conditions	T_A	Min	Typ(1)	Max	Units
Input offset voltage	V_{IO}	Standard grade	25°C		0.3	4	mV
			Full range			4.5	mV
		A grade	25°C		0.3	1.25	mV
			0°C to 125°C		0.3	1.5	mV
			-40°C to 125°C		0.3	1.7	mV
Average temperature coefficient of input offset voltage	αV_{IO}		Full range		1.9		μV/°C
Input bias current	I_{IB}		25°C		1	200	pA
			-40°C to 85°C			375	pA
			-40°C to 125°C			3000	pA
Input offset current	I_{IO}		25°C		6.6		fA
Common-mode rejection ratio	CMRR	0≤V_{ICR}≤4.4V	25°C	75	90		dB
			Full range	70			dB
Supply-voltage rejection ratio	K_{SVR}	1.8≤V_+≤5V	25°C	75	95		dB
			Full range	65			dB
Common-mode input voltage range	V_{ICR}	CMRR≥70dB	25°C	0		4.4	V
Large-signal voltage gain (2)	A_V	R_L=10kΩ to 2.5V	25°C	80	110		dB
			Full range	70			dB
		R_L=2kΩ to 2.5V	25°C	75	105		dB
			Full range	60			dB

Parameter	Symbol	Conditions		T_A	Min	Typ(1)	Max	Units
Output swing (delta from supply rails)	V_O	R_L=2kΩ to 1.35V	Low level	25°C		40	60	mV
				Full range			85	mV
			High level	25°C		25	60	mV
				Full range			85	mV
		R_L=10kΩ to 1.35V	Low level	25°C		18	30	mV
				Full range			40	mV
			High level	25°C		7	15	mV
				Full range			20	mV
Supply current (per channel)	I_{CC}			25°C		75	150	μA
				Full range			200	μA
Output short-circuit current	I_{OS}	Sourcing		25°C	60	113		mA
		Sinking			80	115		mA
Slew rate	SR	R_L=10kΩ (3)		25°C		1		V/μs
Unity-gain bandwidth	GBW	R_L=10kΩ, C_L=200pF		25°C		2.3		MHz
Phase margin	φ_m	R_L=100kΩ, C_L=200pF		25°C		55		°
Gain margin	G_m	R_L=100kΩ, C_L=200pF		25°C		15		dB
Equivalent input noise voltage	V_n	f=1kHz		25°C		33		nV/√Hz
Equivalent input noise current	I_n	f=1kHz		25°C		0.001		pA/√Hz
Total harmonic distortion	THD	f=1kHz,A_V=1,R_L=600Ω,V_I=1V_{PP}		25°C		0.012%		

Notes:

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

(2) GND + 0.2V≤V_O≤ V_+-0.2V

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

11.1 Shutdown Characteristics (V_+=1.8V)

V_+=1.8V, GND=0V, V_{IC}=V_O=V_+/2, R_L>1MΩ (unless otherwise noted).

Parameter	Symbol	Conditions	T_A	Min	Typ	Max	Units
Supply current in shutdown mode	$I_{CC(SHDN)}$	V_{SD}=0V	25°C		0.001	1	μA
			Full range			1.5	μA
Amplifier turnon time	$t_{(on)}$		25°C		5		μs
Recommended shutdown pin voltage range	V_{SD}	On mode	25°C	1.5		1.8	V
		Shutdown mode		0		0.5	V

11.2 Shutdown Characteristics (V_+=5V)

V_+=5V, GND=0V, V_{IC}=V_O=V_+/2, R_L>1MΩ (unless otherwise noted).

Parameter	Symbol	Conditions	T_A	Min	Typ	Max	Units
Supply current in shutdown mode	$I_{CC(SHDN)}$	V_{SD}=0V	25°C		0.01	1	μA
			Full range			1.5	μA
Amplifier turnon time	$t_{(on)}$		25°C		5		μs
Recommended shutdown pin voltage range	V_{SD}	On mode	25°C	4.5		5	V
		Shutdown mode		0		0.8	V

12.1 Typical characteristic

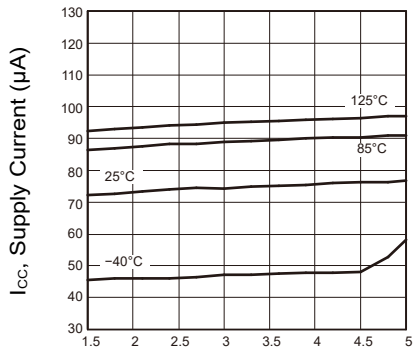


Figure 1: Supply Current vs Supply Voltage

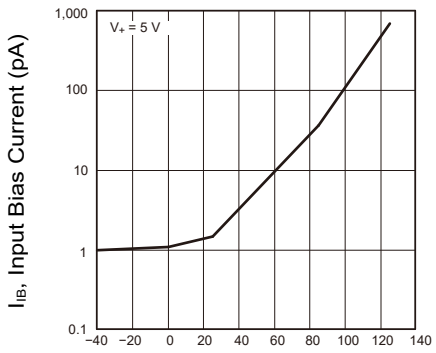


Figure 2: Input Bias Current vs Temperature

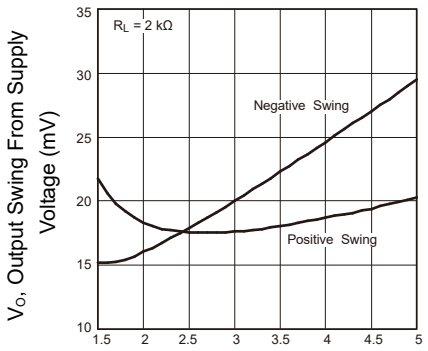


Figure 3: Output Voltage Swing vs Supply Voltage

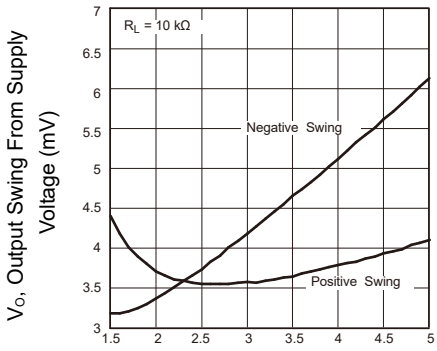


Figure 4: Output Voltage Swing vs Supply Voltage

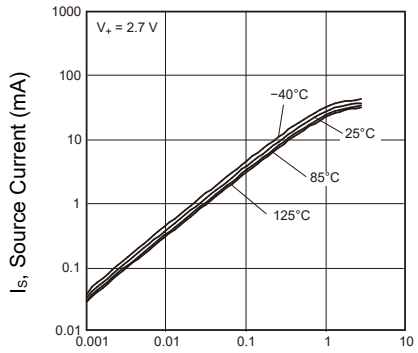


Figure 5: Source Current vs Output Voltage

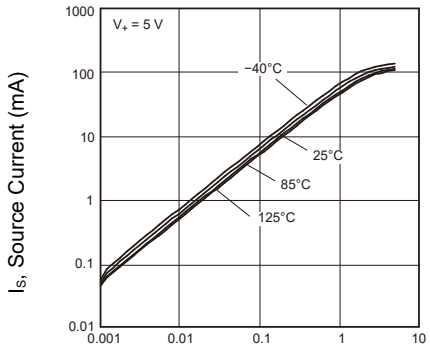
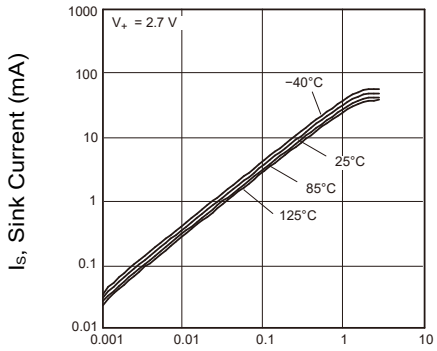


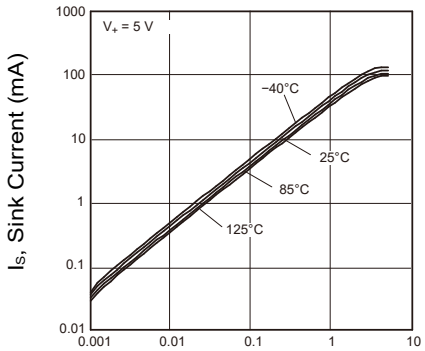
Figure 6: Source Current vs Output Voltage

12.2 Typical characteristic



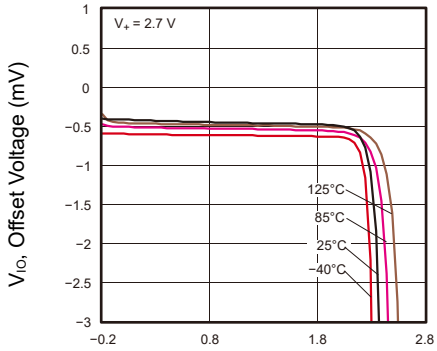
V_O, Output Voltage Referenced to V- (V)

Figure 7: Sink Current vs Output Voltage



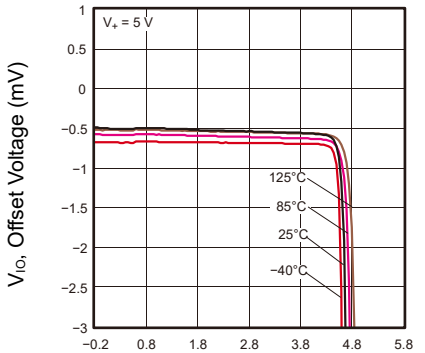
V_O, Output Voltage Referenced to V- (V)

Figure 8: Sink Current vs Output Voltage



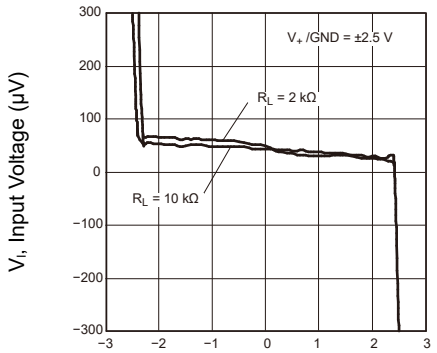
V_{IC}, Common-Mode Voltage (V)

Figure 9: Offset Voltage vs Common-Mode Voltage



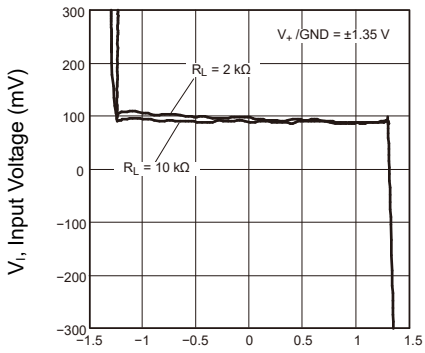
V_{IC}, Common-Mode Voltage (V)

Figure 10: Offset Voltage vs Common-Mode Voltage



V_O, Output Voltage (V)

Figure 11: Input Voltage vs Output Voltage



V_O, Output Voltage (V)

Figure 12: Input Voltage vs Output Voltage

12.3 Typical characteristic

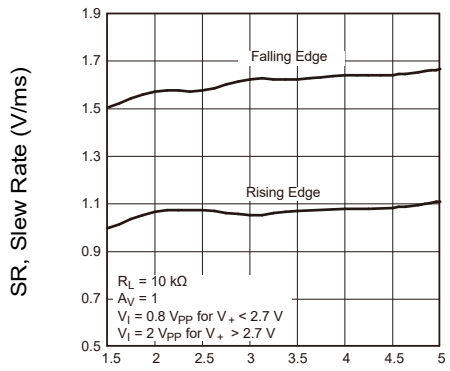


Figure 13: Slew Rate vs Supply Voltage

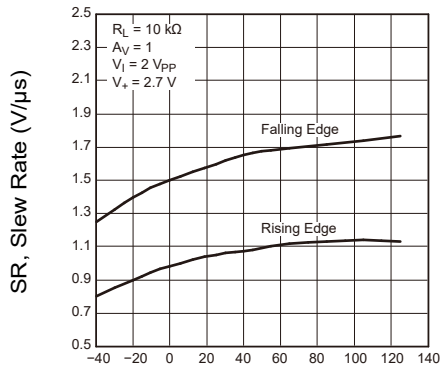


Figure 14: Slew Rate vs Temperature

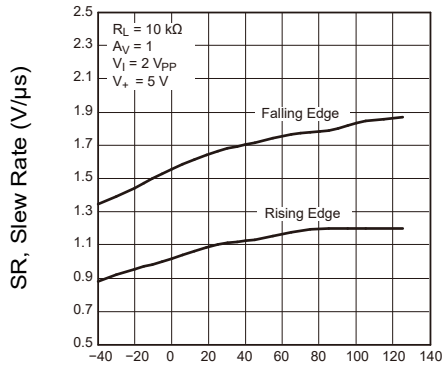


Figure 15: Slew Rate vs Temperature

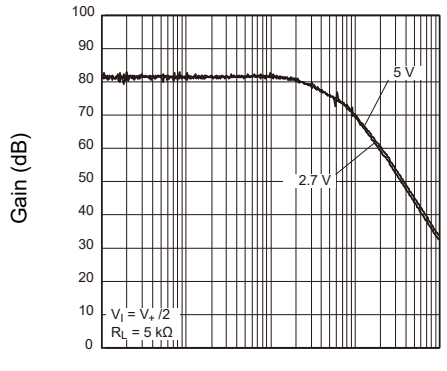


Figure 16: CMRR vs Frequency

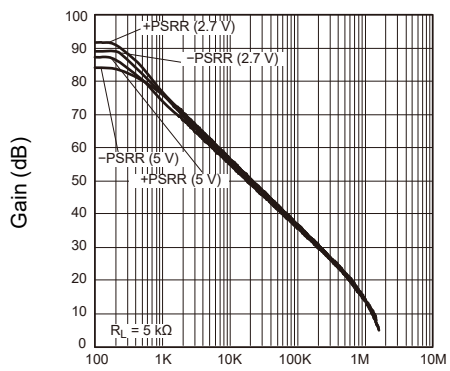


Figure 17: PSRR vs Frequency

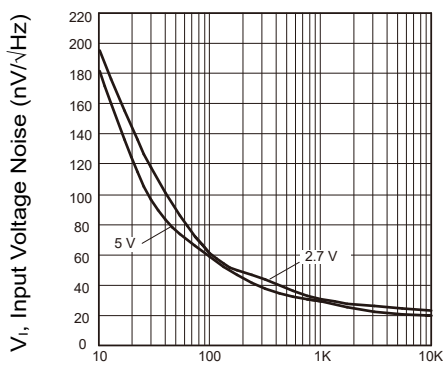


Figure 18: Input Voltage Noise vs Frequency

12.4 Typical characteristic

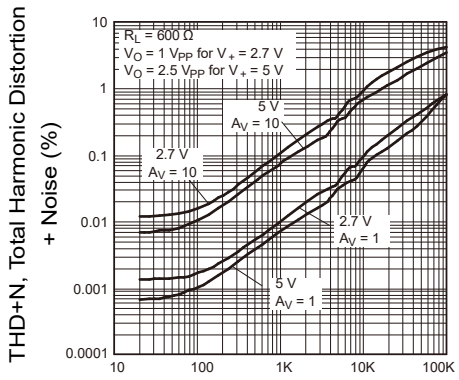


Figure 19: Total Harmonic Distortion +Noise vs Frequency

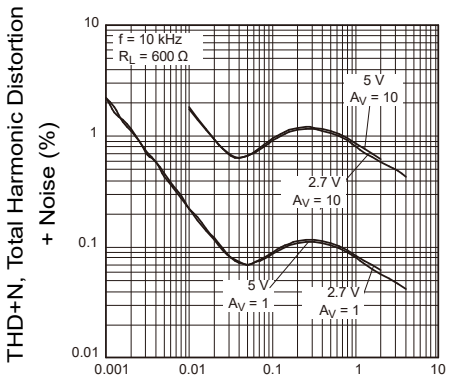


Figure 20: Total Harmonic Distortion +Noise vs Output Voltag

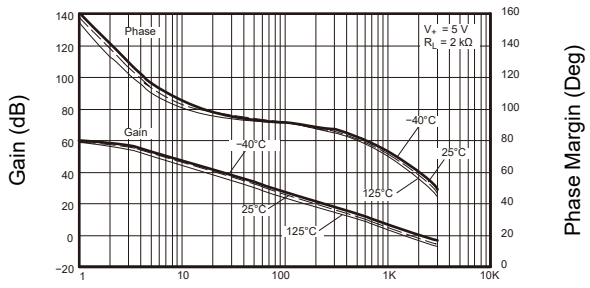


Figure 21: Frequency Response vs Temperature

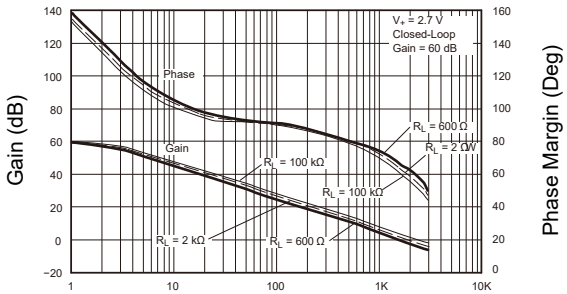


Figure 22: Frequency Response vs R_L

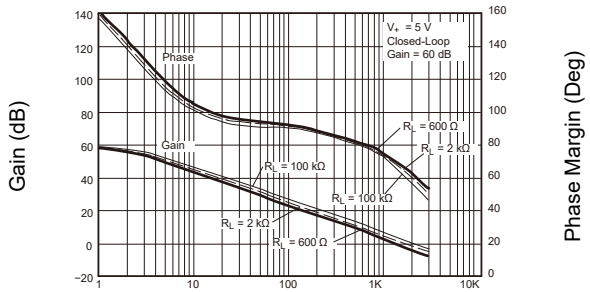


Figure 23: Frequency Response vs R_L

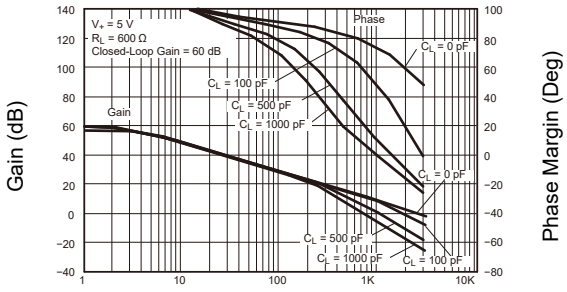
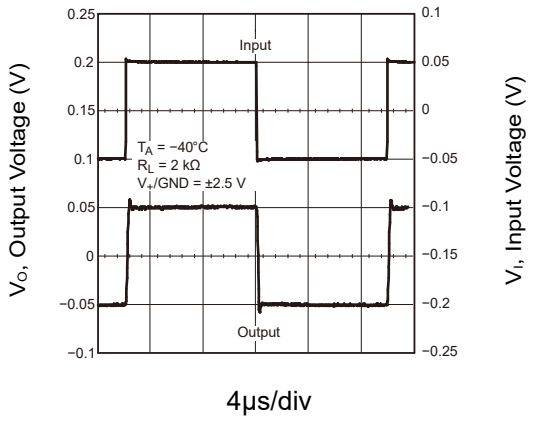


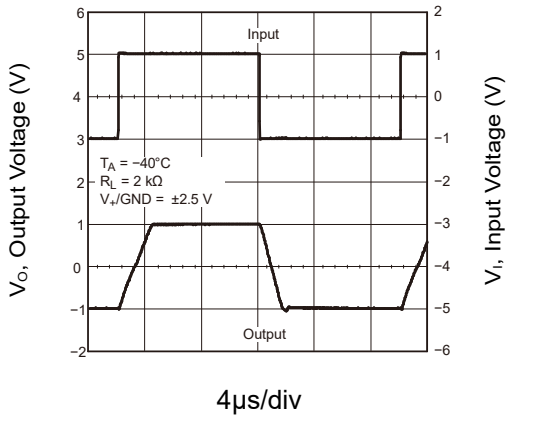
Figure 24: Frequency Response vs C_L

12.5 Typical characteristic



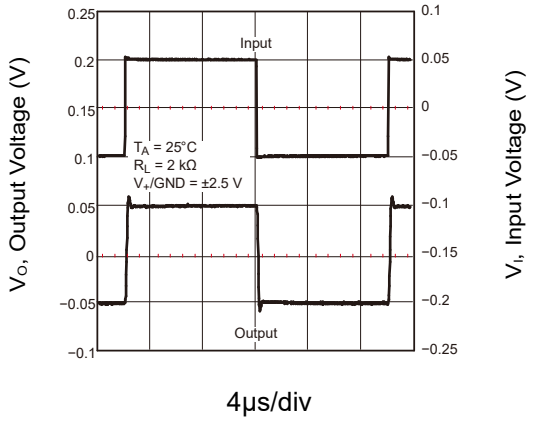
4μs/div

Figure 25: Small-Signal Noninverting Response



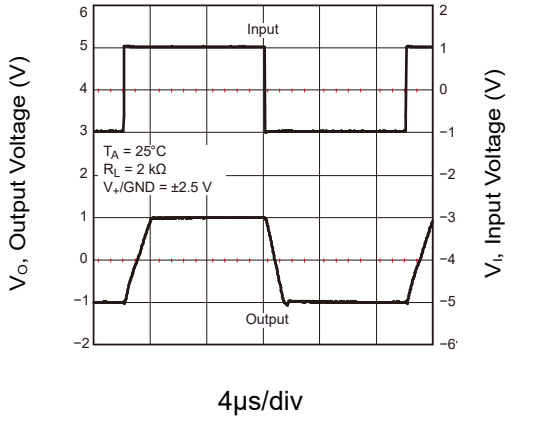
4μs/div

Figure 26: Large-Signal Noninverting Response



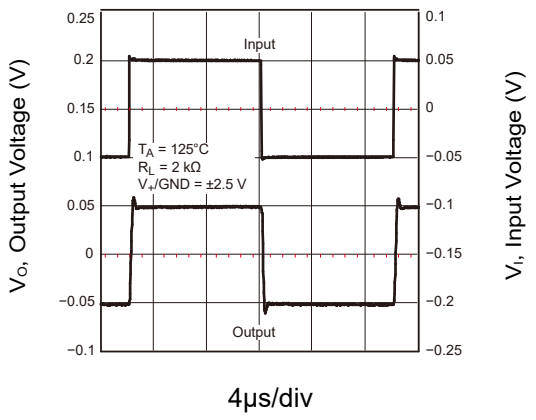
4μs/div

Figure 27: Small-Signal Noninverting Response



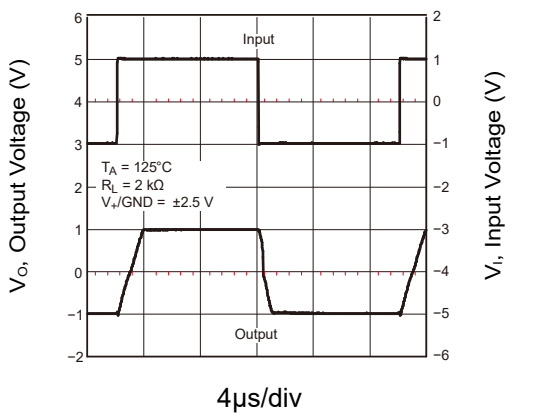
4μs/div

Figure 28: Large-Signal Noninverting Response



4μs/div

Figure 29: Small-Signal Noninverting Response



4μs/div

Figure 30: Large-Signal Noninverting Response

12.6 Typical characteristic

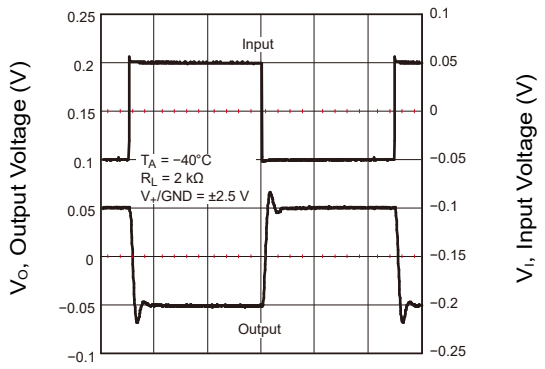


Figure 31: Small-Signal Noninverting Response

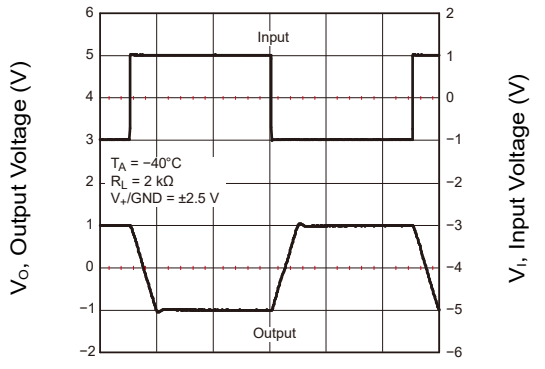


Figure 32: Large-Signal Inverting Response

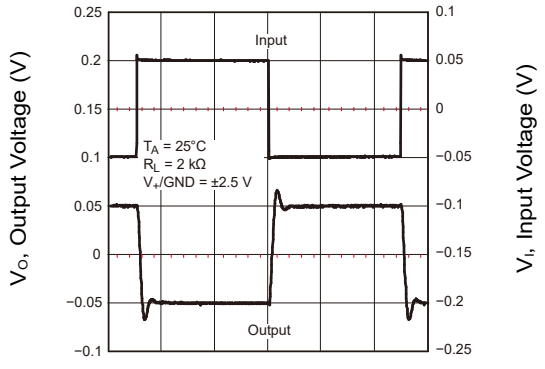


Figure 33: Small-Signal Inverting Response

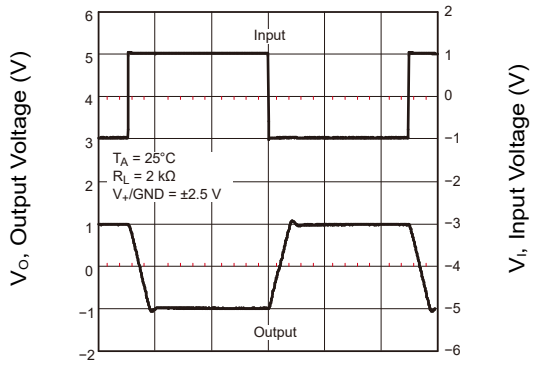


Figure 34: Large-Signal Inverting Response

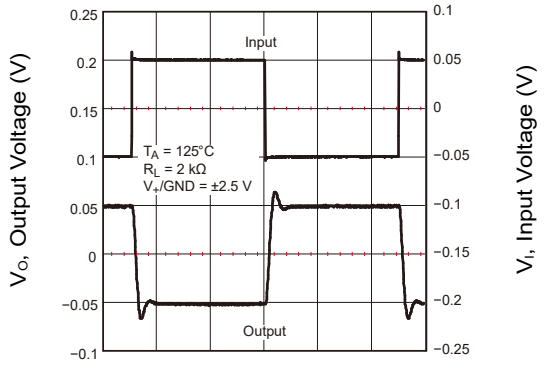


Figure 35: Small-Signal Inverting Response

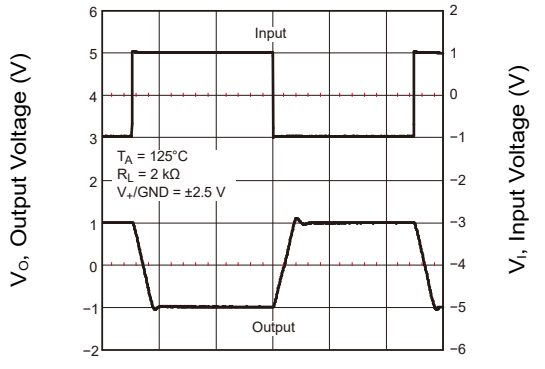
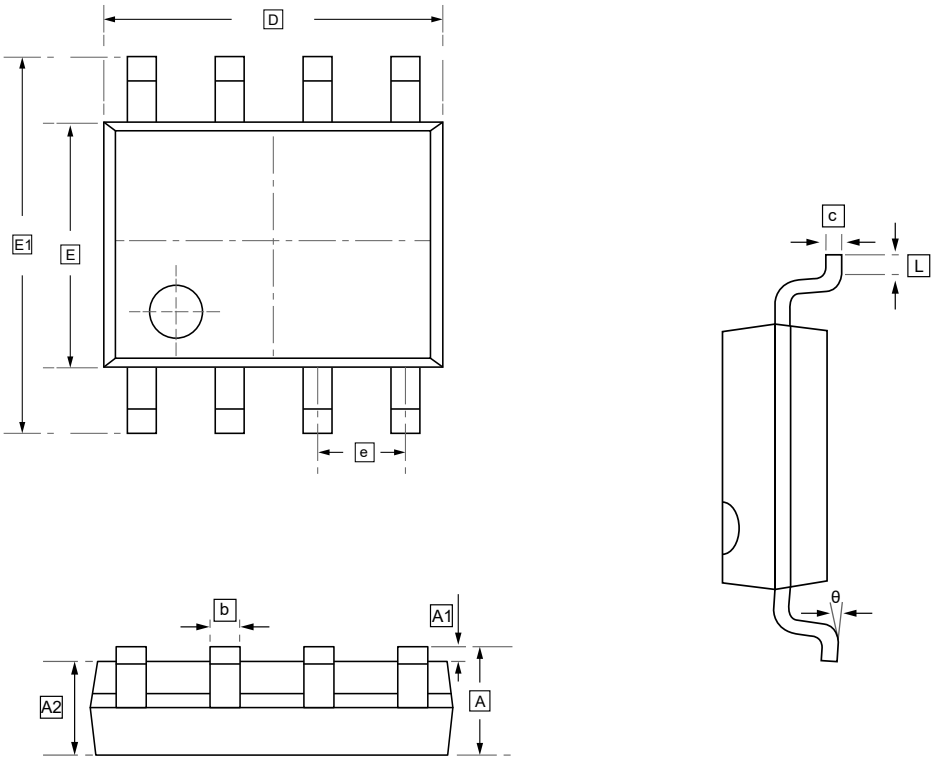


Figure 36: Large-Signal Inverting Response

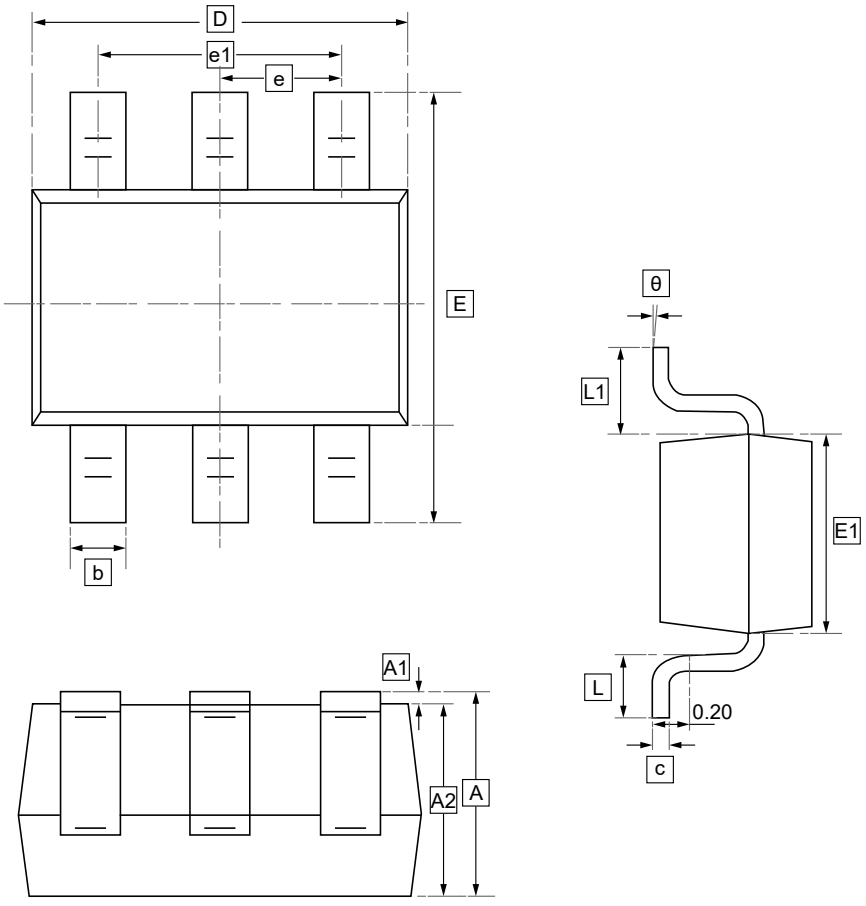
13.1 SOP-8 Package Outline Dimensions



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°

13.2 SC70-6 Package Outline Dimensions

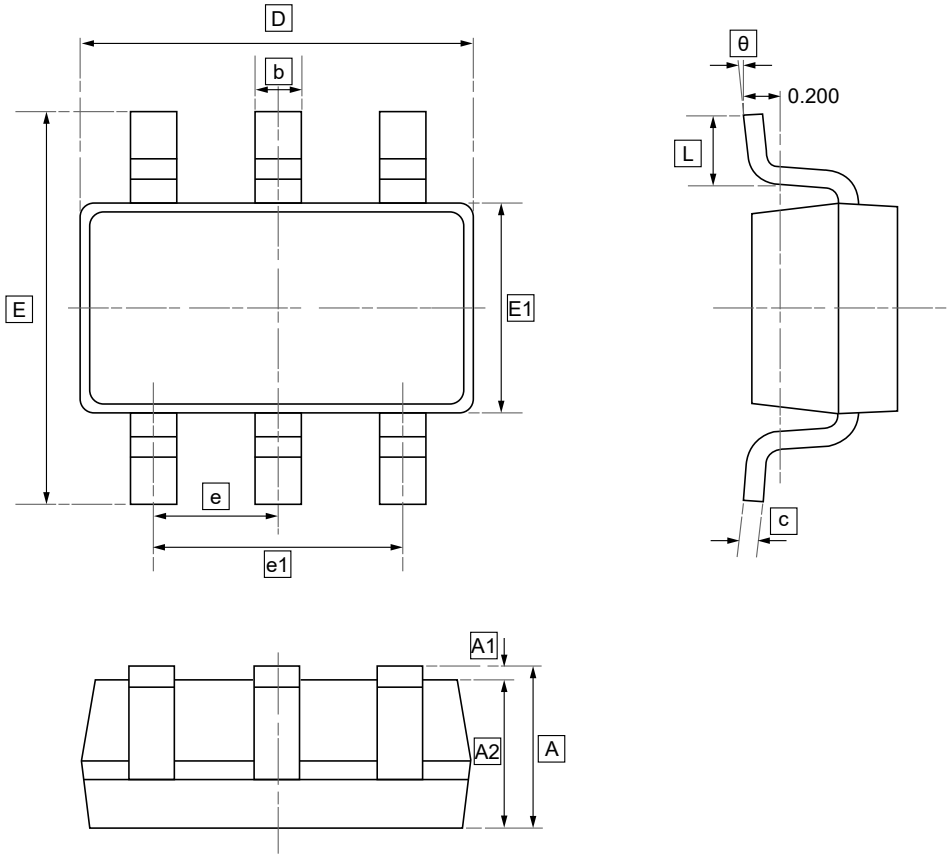


DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	A2	b	c	D	E	E1	e	e1	L	L1
Min	0.90	0.00	0.90	0.15	0.08	2.05	2.15	1.15	0.65	1.2	0.26	0.525
Max	1.10	0.10	1.00	0.35	0.15	2.25	2.45	1.35	TYP.	1.4	0.46	REF.

Symbol	θ
Min	0°
Max	8°

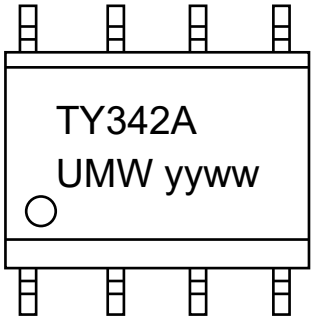
13.3 SOT23-6 Package Outline Dimensions



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°

14.Ordering information



yy: Year Code
ww: Week Code

Order Code	Marking	Package	Base QTY	Delivery Mode
UMW TLV341AIDBVR	YCGE	SOT-23-6	3000	Tape and reel
UMW TLV341IDBVR	YC9E	SOT-23-6	3000	Tape and reel
UMW TLV341AIDCKR	Y5E	SC70-6	3000	Tape and reel
UMW TLV341IDCKR	Y4E	SC70-6	3000	Tape and reel
UMW TLV342AID	TLV342	SOP-8	2500	Tape and reel
UMW TLV342IDR	TLV342	SOP-8	2500	Tape and reel
UMWTLV342AIDR	TLV342	SOP-8	2500	Tape and reel
UMWTLV342ID	TLV342	SOP-8	2500	Tape and reel

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