UMW TSV321/358/324

General purpose input/output rail-to-rail low-power operational amplifiers

1.Description

The UMW TSV358, TSV358A, TSV324, and TSV324A (dual and quad) devices are low voltage versions of the UMW LM358 and LM324 commodity operational amplifiers. The TSV321 and TSV321A are the single version. All devices operate with voltages as low as 2.5 V and feature both I/O rail-to-rail.

2.Features

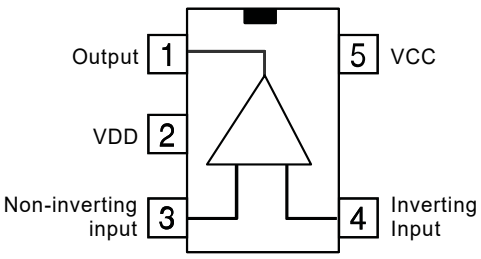
- Operating range V_{CC}=2.5V to 6V
- Rail-to-rail input and output
- Extended Vicm (V_{DD} - 0.2V to V_{CC} + 0.2V)
- Capable of driving a 32Ω load resistor
- High stability: 500 pF
- Operating temperature range: -40 to 125°C

3.Applications

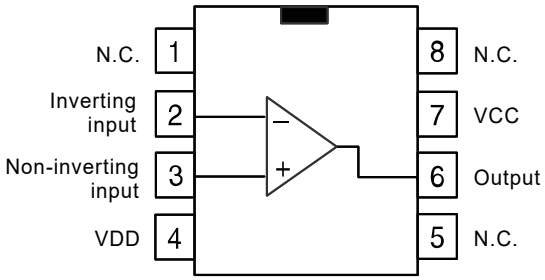
- Battery powered applications
- Audio driver (headphone driver)
- Sensor signal conditioning
- Laptop/notebook computers

4.Pinning information

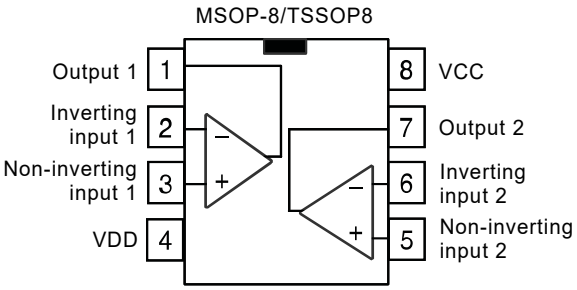
SOT23-5



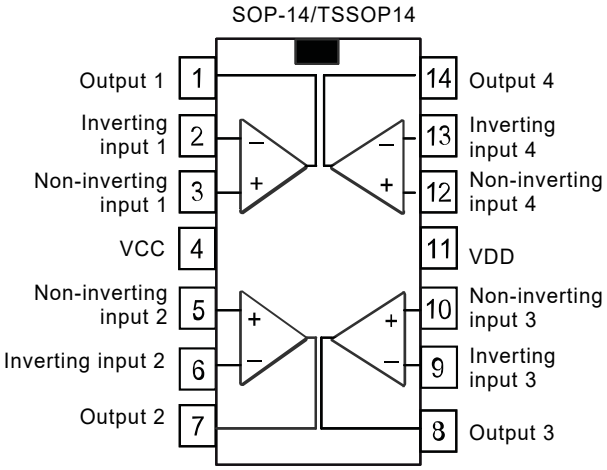
SOP-8



MSOP-8/TSSOP8



SOP-14/TSSOP14



5.Absolute Maximum Ratings

Parameter		Symbol	Rating	Units
Supply voltage (1)		V_{CC}	7	V
Differential input voltage (2)		V_{id}	±1	V
Input voltage		V_{in}	V_{DD} - 0.3 to V_{CC} + 0.3	V
Storage temperature		T_{STG}	-65 to 150	°C
Maximum junction temperature		T_J	150	°C
Thermal resistance junction-to-case(3)	SOT23-5	R_{thja}	250	°C/W
	SOP-8		125	°C/W
	MSOP-8		190	°C/W
	TSSOP8		120	°C/W
	SO14		105	°C/W
	TSSOP14		100	°C/W
Thermal resistance junction-to-case(3)	SOT23-5	R_{thjC}	81	°C/W
	SOP-8		40	°C/W
	MSOP-8		39	°C/W
	TSSOP8		37	°C/W
	SO14		31	°C/W
	TSSOP14		32	°C/W
HBM: human body model (4)		ESD	2	kV
MM: machine model (5)			200	V
CDM: charged device model (6)			1.5	kV
Latch-up immunity			200	mA
Lead temperature (soldering, 10 s)			250	°C
Qutput short-circuit duration			See (7)	

NOTES:

1. All voltage values, except the differential voltage are with respect to the network terminal.
2. The differential voltage is the non-inverting input terminal with respect to the inverting input terminal. If Vid >±1 V, the maximum input current must not exceed ±1 mA. When Vid > ±1 V, an input series resistor must be added to limit input current.
3. Short-circuits can cause excessive heating and destructive dissipation. Rth are typical values.
4. Human body model: 100 pF discharged through a 1.5 kΩ resistor between two pins of the device, done for all couples of pin combinations with other pins floating.
5. Machine model: a 200 pF capacitor is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5 Ω), done for all couples of pin combinations with other pins floating.
6. Charged device model: all pins plus package are charged together to the specified voltage and then discharged directly to ground.
7. Short-circuits from the output to V_{CC} can cause excessive heating. The maximum output current is approximately 80 mA, independent of the magnitude of V_{CC}. Destructive dissipation can result from simultaneous short-circuits on all amplifiers.

6.Operating conditions

Parameter		Symbol	Rating	Units
Supply voltage		V_{CC}	2.5 to 6	V
Common mode input voltage range	T_{amb}=25°C, 2.5≤V_{CC} ≤6V	V_{icm}	V_{DD} - 0.2 to V_{CC} + 0.2	V
	T_{min}<T_{amb}<T_{max}, 2.5 ≤V_{CC}≤5.5V		V_{DD} to V_{CC}	V
Operating free air temperature range		T_{oper}	40 to +125	°C

7.1 Electrical Characteristics

V_{CC}=+3V, V_{DD}=0V, R_L, C_L connected to V_{CC}/2, and Tamb=25°C (unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input offset voltage	V_{io}	$V_{icm}=V_{out}=V_{CC}/2$				mV
		UMW TSV321/358/324		0.2	3	mV
		$T_{min}\leq T_{amb}\leq T_{max}$			6	mV
		UMW TSV321A/358A/324A		0.1	1	mV
		$T_{min}\leq T_{amb}\leq T_{max}$			3	mV
Input offset voltage drift	$\Delta V_{io}/\Delta T$			2		μV/°C
Input offset current	I_{io}	$V_{icm}=V_{out}=V_{CC}/2$ (1)		3	30	nA
		$T_{min}\leq T_{amb}\leq T_{max}$			60	nA
Input bias current	I_{ib}	$V_{icm}=V_{out}=V_{CC}/2$ (1)		40	125	nA
		$T_{min}\leq T_{amb}\leq T_{max}$			150	nA
Common mode rejection ratio 20 log ($\Delta V_{ic}/\Delta V_{io}$)	CMR	$0\leq V_{icm}\leq V_{CC}$, $V_{out}=V_{CC}/2$	60	80		dB
Large signal voltage gain	A_{vd}	V_{out}=0.5V to 2.5V, R_L=2kΩ	80	92		dB
		V_{out}=0.5V to 2.5V, R_L=600Ω	74	95		dB
High level output voltage, $V_{OH}=V_{out}$	V_{OH}	V_{id}=100mV, R_L=2kΩ	2.82	2.95		V
		V_{id}=100mV, R_L=600Ω	2.8	2.95		V
		V_{id}=100mV, $T_{min}\leq T_{amb}\leq T_{max}$, R_L=2kΩ	2.82			V
		V_{id}=100mV, $T_{min}\leq T_{amb}\leq T_{max}$, R_L=600Ω	2.8			V
Low level output voltage	V_{OL}	V_{id}=-100mV, R_L=2kΩ		88	120	mV
		V_{id}=-100mV, R_L=600Ω		115	160	mV
		V_{id}=-100mV,$T_{min}\leq T_{amb}\leq T_{max}$,$R_L$=2kΩ			120	mV
		V_{id}=-100mV,$T_{min}\leq T_{amb}\leq T_{max}$,$R_L$=600Ω			160	mV
Output source current	I_O	V_{id}=100mV, $V_O=V_{DD}$	20	80		mA
Output sink current		V_{id}=-100mV, $V_O=V_{CC}$	20	80		mA

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Supply current (per amplifier)	I_{CC}	A_{VCL}=1, no load		420	650	μA
		$T_{min} \leq T_{amb} \leq T_{max}$			690	μA
Gain bandwidth product	GBP	R_L=10kΩ, C_L=100pF, f=100kHz	1	1.3		MHz
Slew rate	SR	R_L=10kΩ, C_L=100pF	0.42	0.6		V/μs
Phase margin	ϕm	C_L=100pF		53		Degrees
Input voltage noise	en			27		nV/√Hz
Total harmonic distortion	THD			0.01		%

1. Maximum values include unavoidable inaccuracies of the industrial tests.

7.2 Electrical Characteristics

V_{CC}=+5V, V_{DD}=0V, R_L, C_L connected to V_{CC}/2, and Tamb=25°C (unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input offset voltage	V_{io}	$V_{icm}=V_{out}=V_{CC}/2$				mV
		UMW TSV321/358/324		0.2	3	mV
		$T_{min}\leq T_{amb}\leq T_{max}$			6	mV
		UMW TSV321A/358A/324A		0.1	1	mV
		$T_{min}\leq T_{amb}\leq T_{max}$			3	mV
Input offset voltage drift	$\Delta V_{io}/\Delta T$			2		μV/°C
Input offset current	I_{io}	$V_{icm}=V_{out}=V_{CC}/2$ (1)		3	30	nA
		$T_{min}\leq T_{amb}\leq T_{max}$			60	nA
Input bias current	I_{ib}	$V_{icm}=V_{out}=V_{CC}/2$ (1)		70	125	nA
		$T_{min}\leq T_{amb}\leq T_{max}$			150	nA
Common mode rejection ratio 20 log ($\Delta V_{ic}/\Delta V_{io}$)	CMR	$0\leq V_{icm}\leq V_{CC}$, $V_{out}=V_{CC}/2$	65	85		dB
Supply voltage rejection ratio 20 log ($\Delta V_{CC}/\Delta V_{io}$)	SVR	V_{CC}=2.5V to 5V	70	90		dB
Large signal voltage gain	A_{vd}	V_{out}=0.5V to 2.5V, R_L=2kΩ	83	92		dB
		V_{out}=0.5V to 2.5V, R_L=600Ω	77	85		dB
High level output voltage, $V_{OH}=V_{out}$	V_{OH}	V_{id}=100mV, R_L=2kΩ	4.8	4.95		V
		V_{id}=100mV, R_L=600Ω	4.75	4.9		V
		V_{id}=100mV, $T_{min}\leq T_{amb}\leq T_{max}$, R_L=2kΩ	4.8			V
		V_{id}=100mV, $T_{min}\leq T_{amb}\leq T_{max}$, R_L=600Ω	4.75			V
Low level output voltage	V_{OL}	V_{id}=-100mV, R_L=2kΩ		88	130	mV
		V_{id}=-100mV, R_L=600Ω		115	188	mV
		V_{id}=-100mV,$T_{min}\leq T_{amb}\leq T_{max}$,$R_L$=2kΩ			130	mV
		V_{id}=-100mV,$T_{min}\leq T_{amb}\leq T_{max}$,$R_L$=600Ω			188	mV
Output source current	I_O	V_{id}=100mV, $V_O=V_{DD}$	20	80		mA
Output sink current		V_{id}=-100mV, $V_O=V_{CC}$	20	80		mA

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Supply current (per amplifier)	I_{CC}	A_{VCL}=1, no load		500	835	μA
		$T_{min} \le T_{amb} \le T_{max}$			875	μA
Gain bandwidth product	GBP	R_L=10kΩ, C_L=100pF, f=100kHz	1	1.4		MHz
Slew rate	SR	R_L=10kΩ, C_L=100pF	0.42	0.6		V/μs
Phase margin	ϕm	C_L=100pF		55		Degrees
Input voltage noise	en			27		nV/√Hz
Total harmonic distortion	THD			0.01		%

1. Maximum values include unavoidable inaccuracies of the industrial tests.

8.1 Typical characteristic

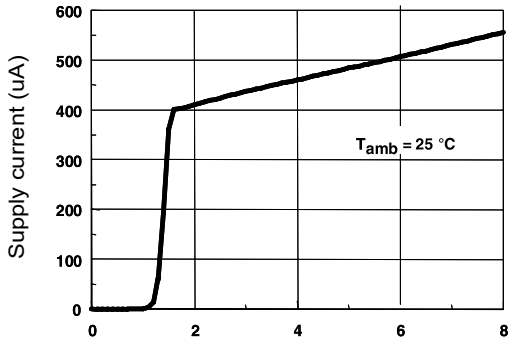


Figure 1: Supply current/amplifier vs. supply voltage

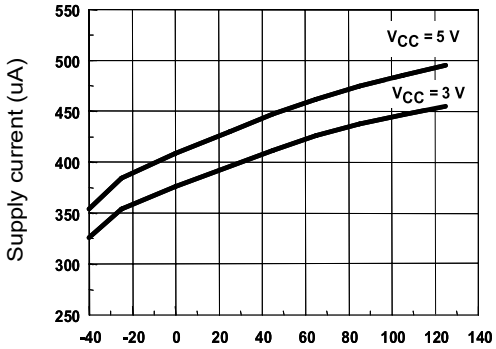


Figure 2: Supply current/amplifier vs. temperature

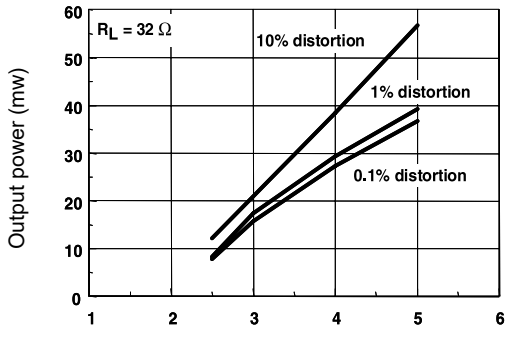


Figure 3: Output power vs. supply voltage

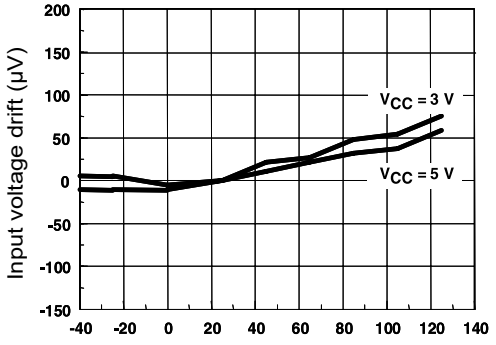


Figure 4: Input offset voltage drift vs. temperature

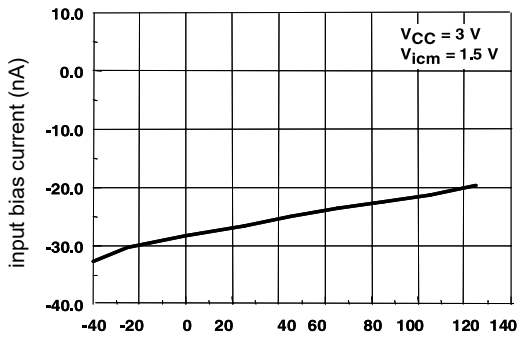


Figure 5: Input bias current vs. temperature

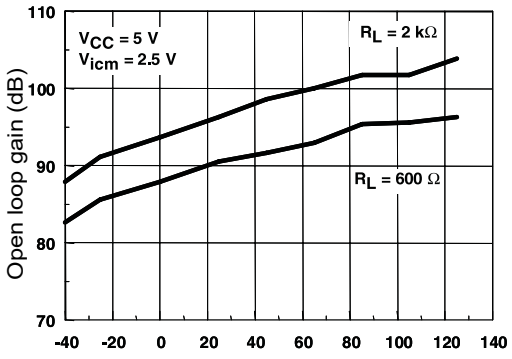


Figure 6: Open loop gain vs. temperature at V_{CC}=5V

8.2 Typical characteristic

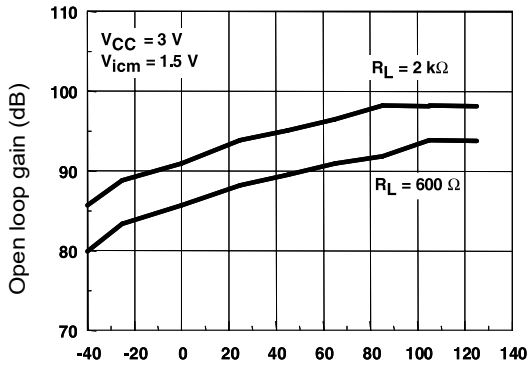


Figure 7: Open loop gain vs. temperature at V_{CC}=3V

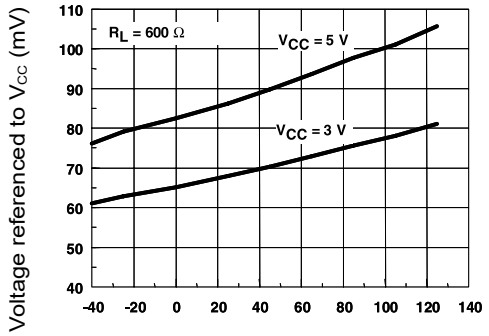


Figure 8: High level output voltage vs. temperature

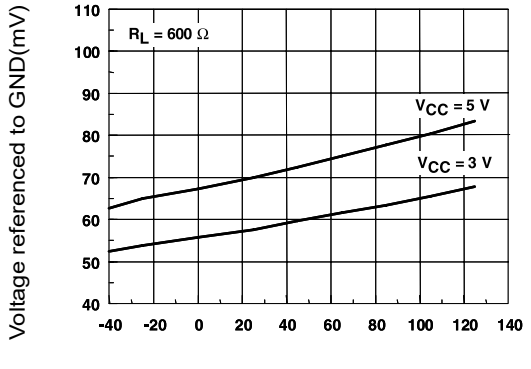


Figure 9: Low level output voltage vs. temperature

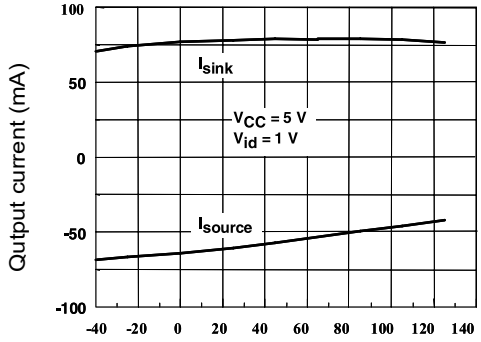


Figure 10: Output current vs. temperature at V_{CC}=5V

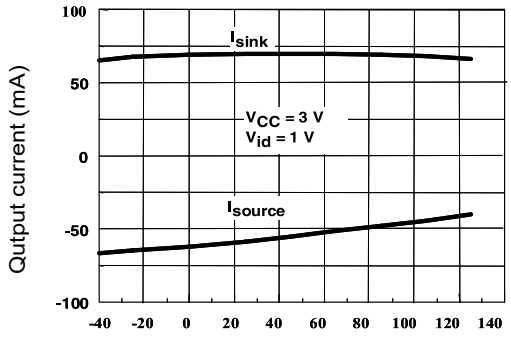


Figure 11: Output current vs. temperature at V_{CC}=3V

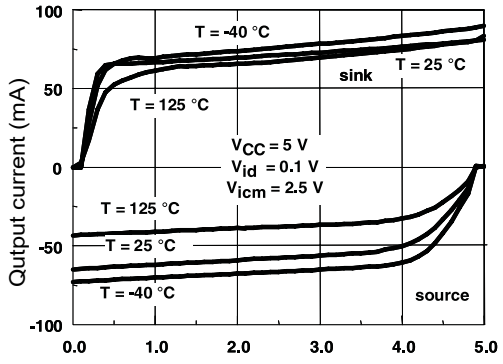


Figure 12: Output current vs. output voltage at V_{CC}=5V

8.3 Typical characteristic

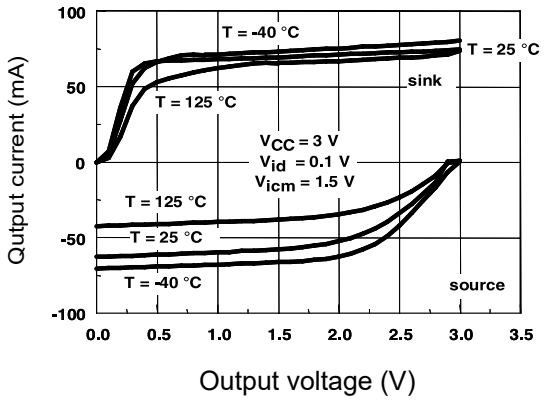


Figure 13: Output current vs. output voltage at V_{CC}=3V

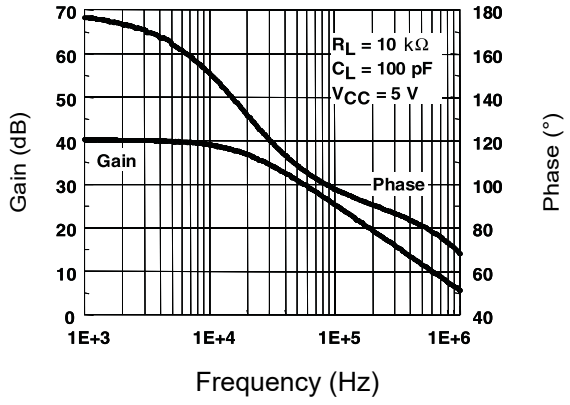


Figure 14: Gain and phase vs. frequency at V_{CC}=5V

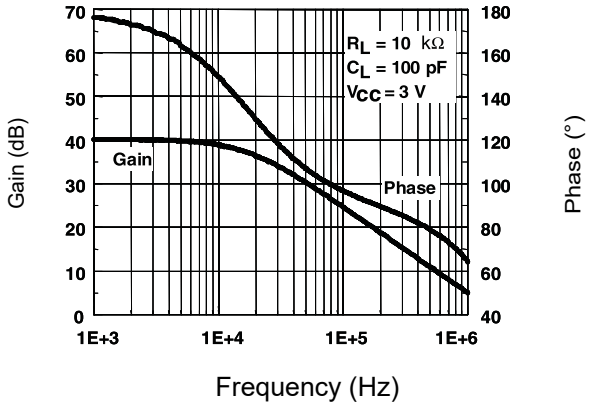


Figure 15: Gain and phase vs. frequency at V_{CC}=3V

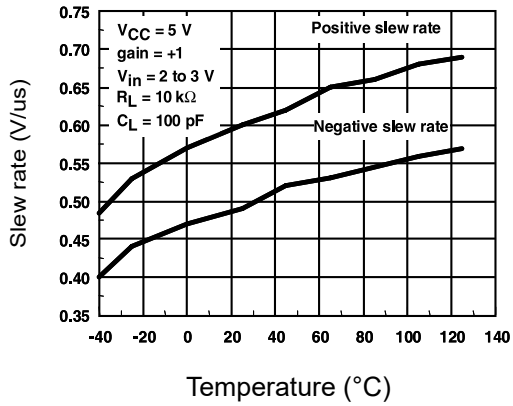


Figure 16: Slew rate vs. temperature at V_{CC}=5V

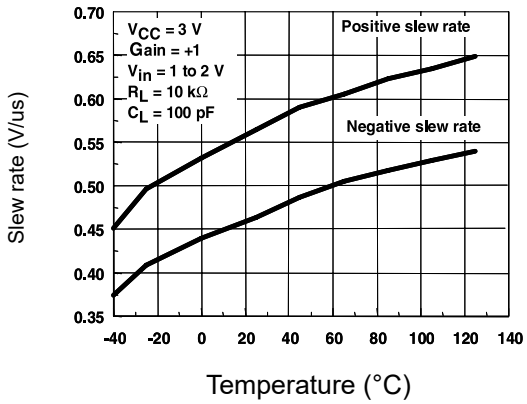


Figure 17: Slew rate vs. temperature at V_{CC}=3V

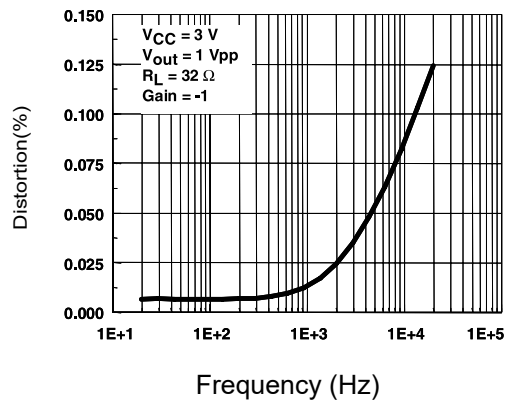
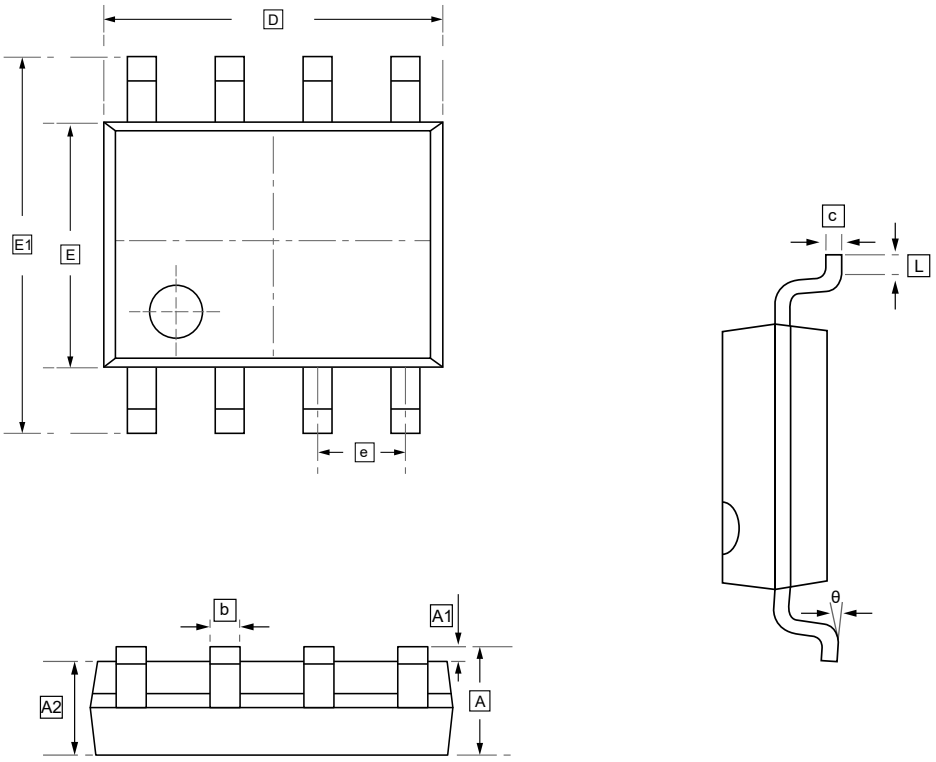


Figure 18: Distortion vs. frequency

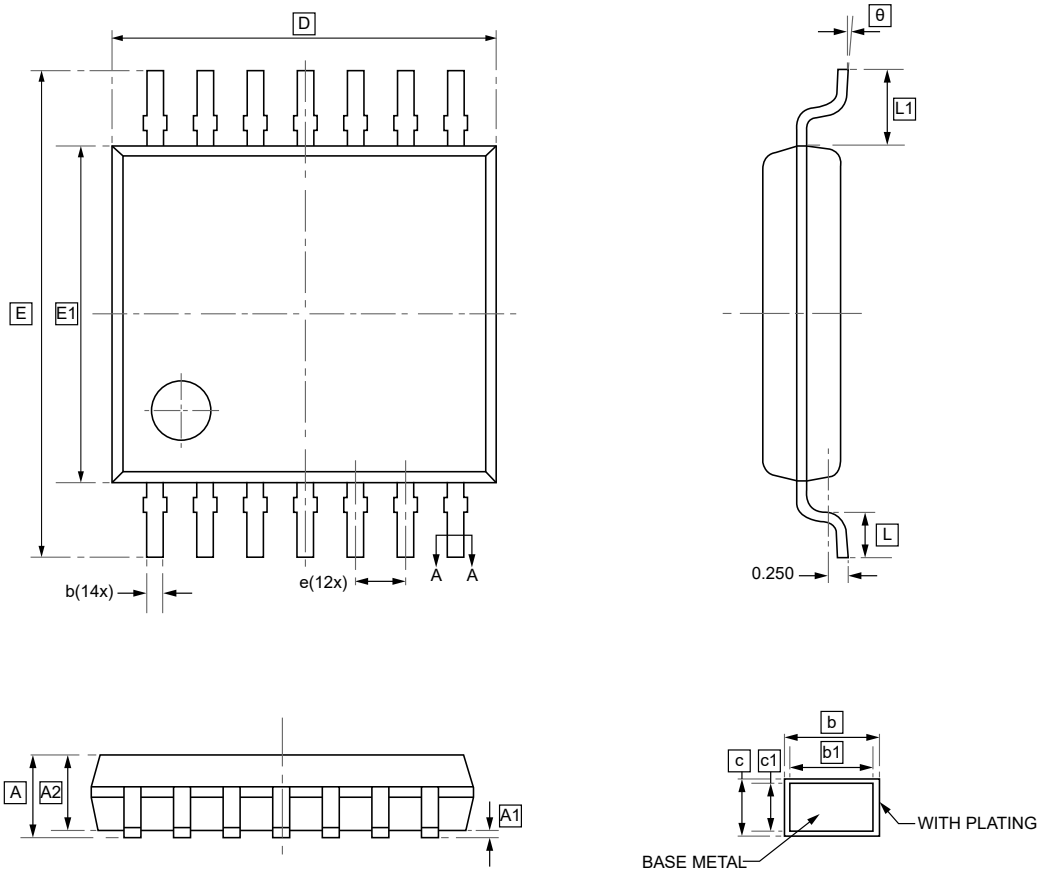
9.1 SOP-8 Package Outline Dimensions



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°

9.2 TSSOP-14 Package Outline Dimensions

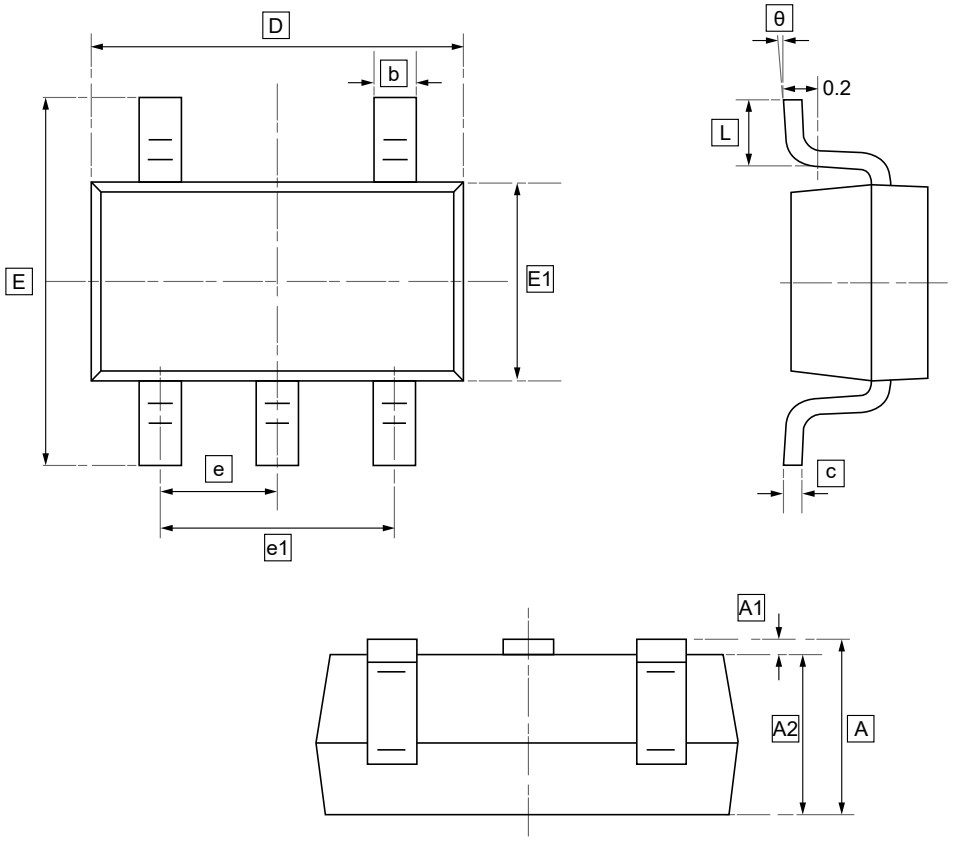


DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	A2	b	b1	c	c1	D	E	E1	e	L1
Min	-	0.05	0.90	0.20	0.19	0.13	0.120	4.90	6.20	4.30	0.65	0.85
Max	1.20	0.15	1.05	0.28	0.25	0.17	0.14	5.10	6.60	4.50	BSC	1.15

Symbol	L	θ
Min	0.45	0°
Max	0.75	8°

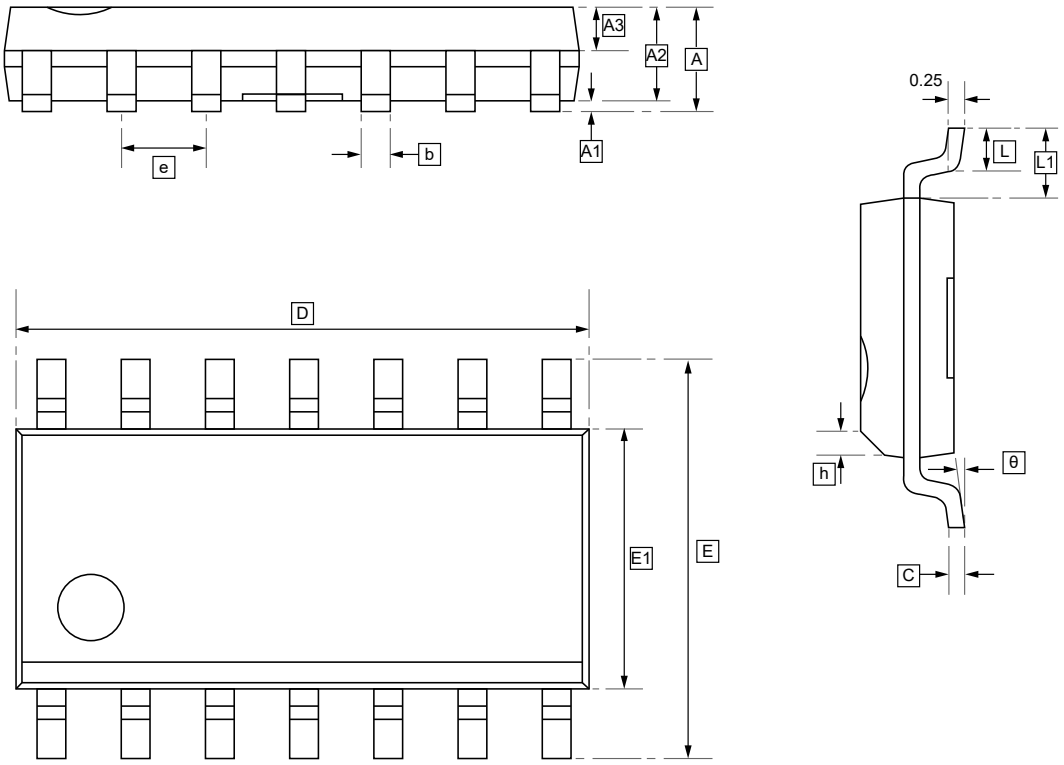
9.3 SOT-23-5 Package Outline Dimensions



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°

9.4 SOP-14 Package Outline Dimensions

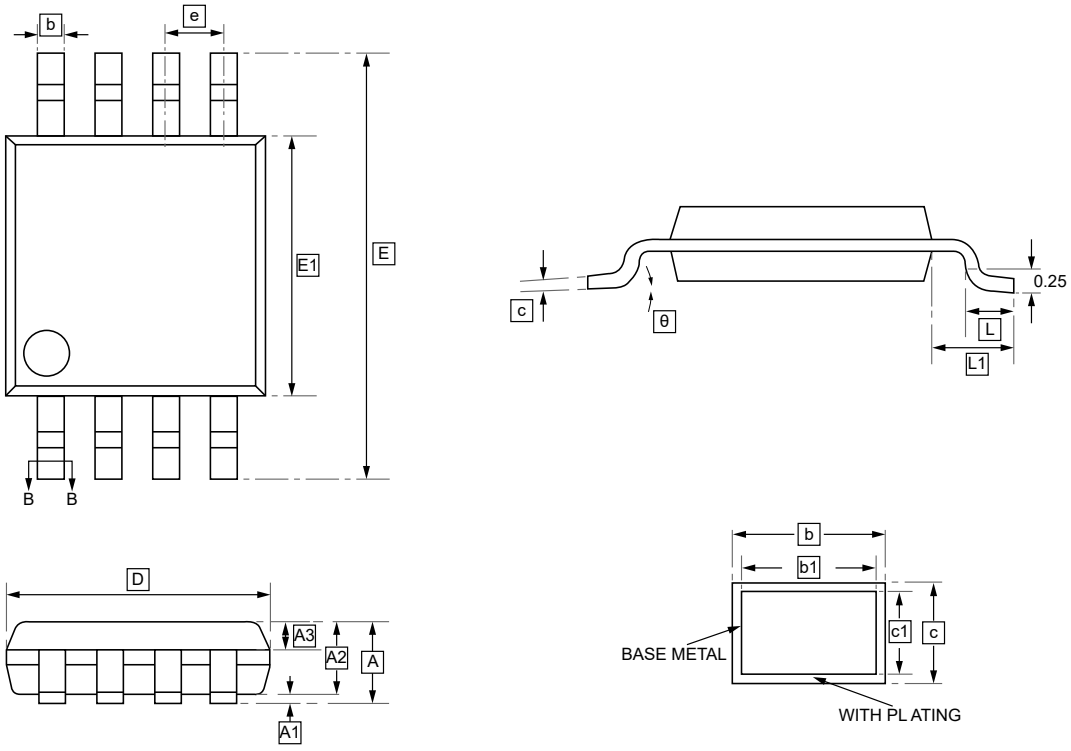


DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	A2	A3	b	C	D	E	E1	e	h	L
Min	-	0.05	1.35	0.65	0.203	0.17	8.45	5.80	3.80	1.24	0.25	0.40
Max	1.75	0.25	1.55	0.75	0.305	0.25	8.85	6.20	4.00	1.30	0.50	0.80

Symbol	L1	θ
Min	1.00	0°
Max	1.10	8°

9.5 MSOP-8 Package Outline Dimensions

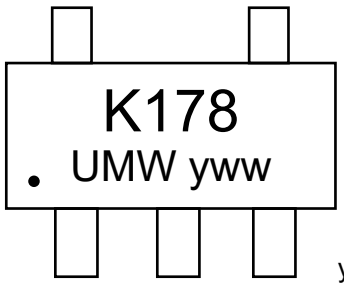


DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	A2	A3	b	b1	c	c1	D	E	E1	e
Min	-	0.05	0.75	0.30	0.28	0.27	0.15	0.14	2.90	4.70	2.90	0.65
Max	1.10	0.15	0.95	0.40	0.36	0.33	0.19	0.16	3.10	5.10	3.10	BSC

Symbol	L	L1	θ
Min	0.40	0.95	0°
Max	0.70	REF	8°

10.Ordering information



yww: Batch Code

Order Code	Marking	Package	Base QTY	Delivery Mode
UMW TSV321RAILT	K178	SOT23-5	3000	Tape and reel
UMW TSV321RILT	K174	SOT23-5	3000	Tape and reel
UMW TSV324IDT	V324ID	SOP-14	3000	Tape and reel
UMW TSV324IPT	V324IP	TSSOP-14	3000	Tape and reel
UMW TSV358IDT	V358ID	SOP-8	3000	Tape and reel
UMW TSV358AIDT	V358AI	SOP-8	3000	Tape and reel
UMW TSV358AIST	K184	MSOP-8	3000	Tape and reel
UMW TSV358IST	K175	MSOP-8	3000	Tape and reel
UMW TSV358IPT	V358I	TSSOP-8	3000	Tape and reel

11.Disclaimer

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