

1.Description

The UMW TSV91x and TSV91xA operational amplifiers (op amps) offer low voltage operation and rail-to-rail input and output, as well as an excellent speed/power consumption ratio, providing an 8 MHz gain-bandwidth product while consuming only 1.1mA maximum at 5V. The op amps are unity gain stable and feature an ultra-low input bias current. The devices are ideal for sensor interfaces, battery-supplied and portable applications, as well as active filtering.

3.Applications

- battery-powered applications
- Portable devices
- Signal conditioning

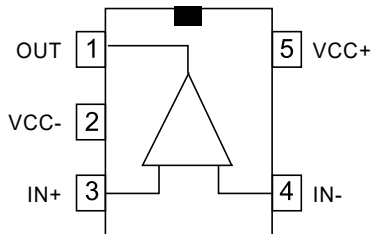
2.Features

- Rail-to-rail input and output
 - Wide bandwidth
 - Low power consumption: 820µA typ.
 - Unity gain stability
 - High output current: 35mA
 - Operating from 2.5V to 5.5V
 - Low input bias current, 1pA typ.
 - Low input offset voltage: 1.5mV max.(A grade)
 - ESD internal protection≥5kV
 - Latch-up immunity
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- Active filtering
 - Medical instrumentation
 - Automotive applications

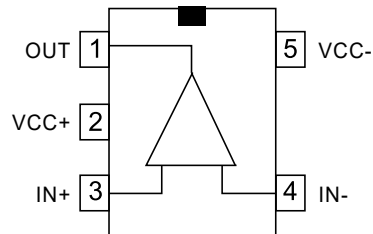


Single, dual, and quad rail-to-rail input/output 8 MHz operational amplifiers

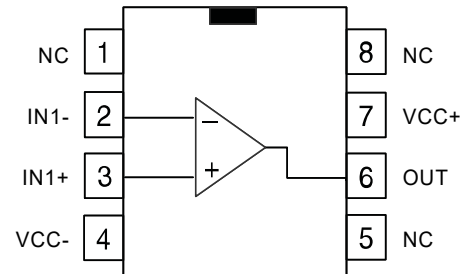
4. Pinning information



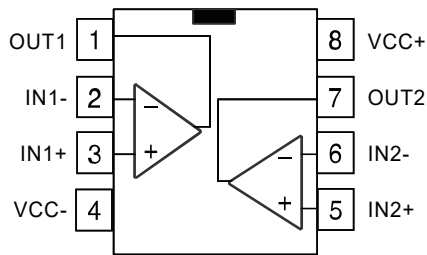
**SOT23-5
TSV911ILT**



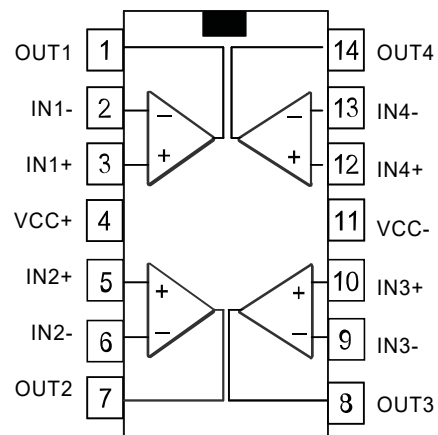
**SOT23-5
TSV911RILT**



**SOP-8
(single)**



SOP-8(dual)



SO14/TSSOP14



Single, dual, and quad rail-to-rail input/output 8 MHz
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5. Absolute Maximum Ratings

Parameter		Symbol	Rating	Units
Supply voltage ⁽¹⁾		V_{CC}	6	V
Differential input voltage ⁽²⁾		V_{id}	$\pm V_{CC}$	V
Input voltage ⁽³⁾		V_{in}	$(V_{CC-})-0.2$ to $(V_{CC+})+0.2$	V
Storage temperature ⁽⁴⁾		I_{in}	10	mA
Storage temperature		T_{STG}	-65 to 150	°C
Maximum junction temperature		T_J	150	°C
Thermal resistance junction to ambient ⁽⁵⁾⁽⁶⁾	SOT23-5	R_{thja}	250	°C/W
	SOP-8		125	°C/W
	SOP-14		103	°C/W
	TSSOP-14		100	°C/W
Thermal resistance junction-to-case ⁽⁵⁾⁽⁶⁾	SOT23-5	R_{thjC}	81	°C/W
	SOP-8		40	°C/W
	SOP-14		39	°C/W
	TSSOP-14		31	°C/W
HBM: human body model ⁽⁷⁾			5	kV
MM: machine model ⁽⁸⁾			400	V
CDM: charged device model ⁽⁹⁾	SOT23-5	ESD	1500	V
	SOP-8		1500	V
	TSSOP-14		750	V
	SOP-14		500	V
Latch-up immunity			200	mA



Single, dual, and quad rail-to-rail input/output 8 MHz operational amplifiers

Notes:

1. All voltage values, except the differential voltage, are with respect to network ground terminal.
2. Differential voltages are the non-inverting input terminal with respect to the inverting input terminal
3. $V_{CC} - V_{IN}$ must not exceed 6V
4. Input current must be limited by a resistor in series with the inputs
5. Short-circuits can cause excessive heating and destructive dissipation.
6. Rth are typical values
7. 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.
8. Machine model: 200 pF 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
9. Charged device model: all pins plus packages are charged together to the specified voltage and then discharged directly to the ground.

6. Operating conditions

Parameter		Symbol	Value	Units
Supply voltage	$-40^{\circ}\text{C} < T_{op} < 125^{\circ}\text{C}$	V_{CC}	2.5 to 5.5	V
	$0^{\circ}\text{C} < T_{op} < 125^{\circ}\text{C}$		2.3 to 5.5	V
Common mode input voltage range		V_{icm}	$(V_{CC-}) - 0.1$ to $(V_{CC+}) + 0.1$	V
Operating free air temperature range		T_{op}	-40 to +125	°C



7.1 Electrical Characteristics

(V_{CC+})=2.5V with (V_{CC-})=0V, $V_{icm}=V_{CC}/2$, with R_L connected to $V_{CC}/2$, $T=25^{\circ}\text{C}$ (unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
DC performance						
Offset voltage, TSV91x	V _{io}	T _{op} =25 °C		0.1	4.5	mV
		T _{min} <T _{op} <T _{max}			7.5	mV
Offset voltage, TSV91xA		T _{op} =25 °C			1.5	mV
T _{min} <T _{op} <T _{max}				3	mV	
Input offset voltage drift	ΔV _{io} /ΔT			5		μV/°C
Input offset current ⁽¹⁾	I _{io}	T _{op} =25 °C		1	10	pA
		T _{min} <T _{op} <T _{max}			100	pA
Input bias current ⁽¹⁾	I _{ib}	T _{op} =25 °C		1	10	pA
		T _{min} <T _{op} <T _{max}			100	pA
Common mode rejection ratio, 20 log (ΔV _{ic} /ΔV _{io})	CMR	0 V to 2.5V, V _{out} =1.25V, T _{op} =25°C	58	75		dB
		T _{min} <T _{op} <T _{max}	53			dB
Large signal voltage gain	A _{vd}	R _L =10kΩ, V _{out} =0.5V to 2V, T _{op} =25°C	80	89		dB
		T _{min} <T _{op} <T _{max}	75			dB
High-level output voltage	V _{CC} -V _{OH}	R _L =10kΩ		15	40	mV
		T _{min} <T _{op} <T _{max}			40	mV
		R _L =600Ω		45	150	mV
		T _{min} <T _{op} <T _{max}			150	mV
Low-level output voltage	V _{OL}	R _L =10kΩ		15	40	mV
		T _{min} <T _{op} <T _{max}			40	mV
		R _L =600Ω		45	150	mV
		T _{min} <T _{op} <T _{max}			150	mV
I _{sink}	I _{OUT}	V _O =2.5V, T _{op} =25°C	18	32		mA
		T _{min} <T _{op} <T _{max}	16			mA
I _{source}		V _O =0V, T _{op} =25°C	18	35		mA
		T _{min} <T _{op} <T _{max}	16			mA



Single, dual, and quad rail-to-rail input/output 8 MHz
operational amplifiers

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Supply current (per channel)	I _{CC}	No load, V _{out} =V _{CC} /2		0.78	1.1	mA
		T _{min} <T _{op} <T _{max}			1.1	mA
AC performance						
Gain bandwidth product	GBP	R _L =2kΩ,C _L =100pF,f=100kHz,T _{op} =25°C		8		MHz
Unity gain frequency	F _u	R _L =2kΩ,C _L =100pF,T _{op} =25°C		7.2		MHz
Phase margin	φ _m	R _L =2kΩ,C _L =100pF,T _{op} =25°C		45		Degrees
Gain margin	G _m	R _L =2kΩ,C _L =100pF,T _{op} =25°C		8		dB
Slew rate	SR	R _L =2kΩ, C _L =100pF,A _V =1, T _{op} =25°C		4.5		V/μs
Equivalent input noise voltage	e _n	f=10kHz, T _{op} =25°C		21		nV/√Hz
Total harmonic distortion + noise	THD+e _n	G=1, f=1kHz, R _L =2kΩ, BW=22kHz T _{op} =25°C, V _{icm} =(V _{CC} +1)/2,V _{out} =1.1V _{pp}		0.001		%



7.2 Electrical Characteristics

(V_{CC+})=3.3V with (V_{CC-})=0V, $V_{icm}=V_{CC}/2$, with R_L connected to $V_{CC}/2$, $T=25^{\circ}\text{C}$ (unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
DC performance						
Offset voltage, TSV91x	V _{io}	T _{op} =25 °C		0.1	4.5	mV
		T _{min} <T _{op} <T _{max}			7.5	mV
Offset voltage, TSV91xA		T _{op} =25 °C			1.5	mV
T _{min} <T _{op} <T _{max}				3	mV	
Input offset voltage drift	ΔV _{io} /ΔT			5		μV/°C
Input offset current ⁽¹⁾	I _{io}	T _{op} =25 °C		1	10	pA
		T _{min} <T _{op} <T _{max}			100	pA
Input bias current ⁽¹⁾	I _{ib}	T _{op} =25 °C		1	10	pA
		T _{min} <T _{op} <T _{max}			100	pA
Common mode rejection ratio, 20 log (ΔV _{ic} /ΔV _{io})	CMR	0 V to 3.3V, V _{out} =1.65V, T _{op} =25°C	60	78		dB
		T _{min} <T _{op} <T _{max}	55			dB
Large signal voltage gain	A _{vd}	R _L =10kΩ, V _{out} =0.5V to 2.8V, T _{op} =25°C	80	89		dB
		T _{min} <T _{op} <T _{max}	75			dB
High-level output voltage	V _{CC} -V _{OH}	R _L =10kΩ		15	40	mV
		T _{min} <T _{op} <T _{max}			40	mV
		R _L =600Ω		45	150	mV
		T _{min} <T _{op} <T _{max}			150	mV
Low-level output voltage	V _{OL}	R _L =10kΩ		15	40	mV
		T _{min} <T _{op} <T _{max}			40	mV
		R _L =600Ω		45	150	mV
		T _{min} <T _{op} <T _{max}			150	mV
I _{sink}	I _{OUT}	V _O =3.3V, T _{op} =25°C	18	32		mA
		T _{min} <T _{op} <T _{max}	16			mA
I _{source}		V _O =0V, T _{op} =25°C	18	35		mA
		T _{min} <T _{op} <T _{max}	16			mA



Single, dual, and quad rail-to-rail input/output 8 MHz
operational amplifiers

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Supply current (per channel)	I _{CC}	No load, V _{out} =V _{CC} /2		0.8	1.1	mA
		T _{min} <T _{op} <T _{max}			1.1	mA
AC performance						
Gain bandwidth product	GBP	R _L =2kΩ, C _L =100pF, f=100kHz, T _{op} =25°C		8		MHz
Unity gain frequency	F _u	R _L =2kΩ, C _L =100pF, T _{op} =25°C		7.2		MHz
Phase margin	φ _m	R _L =2kΩ, C _L =100pF, T _{op} =25°C		45		Degrees
Gain margin	G _m	R _L =2kΩ, C _L =100pF, T _{op} =25°C		8		dB
Slew rate	SR	R _L =2kΩ, C _L =100pF, A _v =1, T _{op} =25°C		4.5		V/μs
Equivalent input noise voltage	e _n	f=10kHz, T _{op} =25°C		21		nV/√Hz
Total harmonic distortion + noise	THD+e _n	G=1, f=1kHz, R _L =2kΩ, BW=22kHz T _{op} =25°C, V _{icm} =(V _{CC} +1)/2, V _{out} =1.9V _{pp}		0.0007		%



7.3 Electrical Characteristics

(V_{CC+})=5V with (V_{CC-})=0V, $V_{icm}=V_{CC}/2$, with R_L connected to $V_{CC}/2$, $T=25^{\circ}\text{C}$ (unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
DC performance						
Offset voltage, TSV91x	V _{io}	T _{op} =25 °C		0.1	4.5	mV
		T _{min} <T _{op} <T _{max}			7.5	mV
Offset voltage, TSV91xA		T _{op} =25 °C			1.5	mV
T _{min} <T _{op} <T _{max}				3	mV	
Input offset voltage drift	ΔV _{io} /ΔT			5		μV/°C
Input offset current ⁽¹⁾	I _{io}	T _{op} =25 °C		1	10	pA
		T _{min} <T _{op} <T _{max}			100	pA
Input bias current ⁽¹⁾	I _{ib}	T _{op} =25 °C		1	10	pA
		T _{min} <T _{op} <T _{max}			100	pA
Common mode rejection ratio, 20 log (ΔV _{ic} /ΔV _{io})	CMR	0 V to 5V, V _{out} =2.5V, T _{op} =25°C	62	82		dB
		T _{min} <T _{op} <T _{max}	58			dB
Supply voltage rejection ratio 20 log (ΔV _{CC} /ΔV _{io})	SVR	V _{CC} =2.5 to 5V	70	86		dB
Large signal voltage gain	A _{vd}	R _L =10kΩ, V _{out} =0.5V to 4.5V, T _{op} =25°C	80	91		dB
		T _{min} <T _{op} <T _{max}	75			dB
High-level output voltage	V _{CC} -V _{OH}	R _L =10kΩ		15	40	mV
		T _{min} <T _{op} <T _{max}			40	mV
		R _L =600Ω		45	150	mV
		T _{min} <T _{op} <T _{max}			150	mV
Low-level output voltage	V _{OL}	R _L =10kΩ		15	40	mV
		T _{min} <T _{op} <T _{max}			40	mV
		R _L =600Ω		45	150	mV
		T _{min} <T _{op} <T _{max}			150	mV



Single, dual, and quad rail-to-rail input/output 8 MHz operational amplifiers

Parameter	Symbol	Conditions	Min	Typ	Max	Units
I _{sink}	I _{OUT}	V _O =5V, T _{op} =25°C	18	32		mA
		T _{min} <T _{op} <T _{max}	16			mA
I _{source}		V _O =0V, T _{op} =25°C	18	35		mA
		T _{min} <T _{op} <T _{max}	16			mA
Supply current (per channel)	I _{CC}	No load, V _{out} =2.5V		0.78	1.1	mA
		T _{min} <T _{op} <T _{max}			1.1	mA
AC performance						
Gain bandwidth product	GBP	R _L =2kΩ, C _L =100pF, f=100kHz, T _{op} =25°C		8		MHz
Unity gain frequency	F _u	R _L =2kΩ, C _L =100pF, T _{op} =25°C		7.5		MHz
Phase margin	φ _m	R _L =2kΩ, C _L =100pF, T _{op} =25°C		45		Degrees
Gain margin	G _m	R _L =2kΩ, C _L =100pF, T _{op} =25°C		8		dB
Slew rate	SR	R _L =2kΩ, C _L =100pF, A _v =1, T _{op} =25°C		4.5		V/μs
Equivalent input noise voltage	e _n	f=1kHz, T _{op} =25°C		27		nV/√Hz
		f=10kHz, T _{op} =25°C		21		nV/√Hz
Total harmonic distortion	THD+e _n	G=1, f=1kHz, R _L =2kΩ, BW=22kHz T _{op} =25°C, V _{icm} =(V _{CC} +1)/2, V _{out} =3.6V _{pp}		0.0004		%



Single, dual, and quad rail-to-rail input/output 8 MHz operational amplifiers

8.1 Typical characteristic

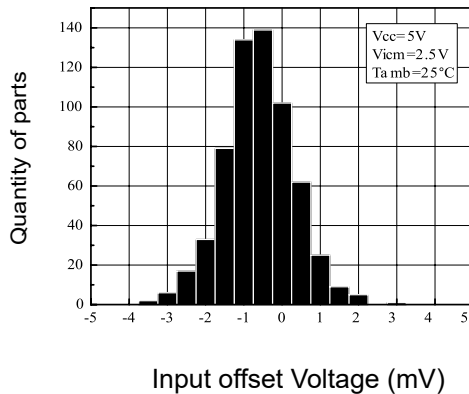


Figure 1: Input offset voltage distribution at $T=25^{\circ}\text{C}$

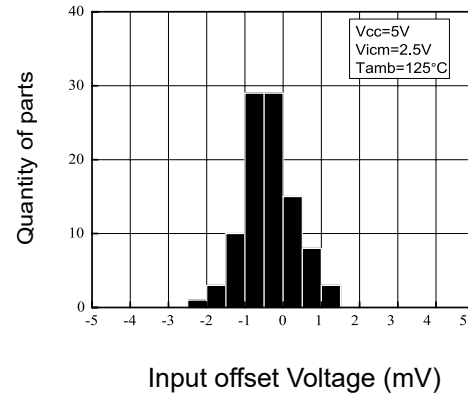


Figure 2: Input offset voltage distribution at $T=125^{\circ}\text{C}$

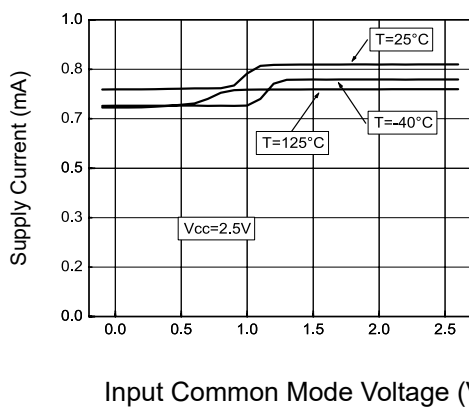


Figure 3: Supply current vs. input common-mode voltage at $V_{CC}=2.5\text{V}$

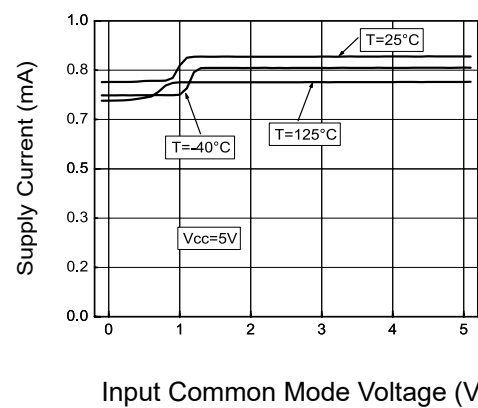


Figure 4: Supply current vs. input common-mode voltage at $V_{CC}=5\text{V}$

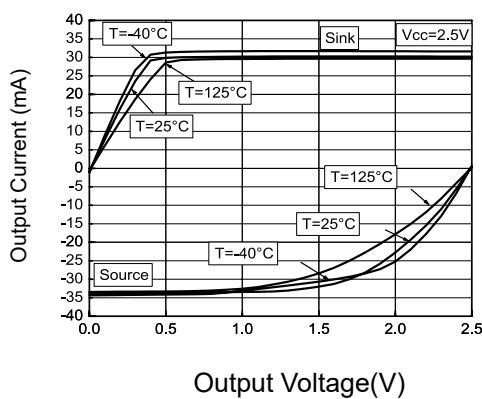


Figure 5: Output current vs. output voltage at $V_{CC}=2.5\text{V}$

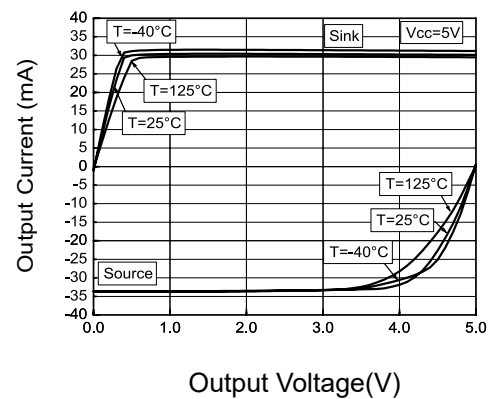


Figure 6: Output current vs. output voltage at $V_{CC}=5\text{V}$



Single, dual, and quad rail-to-rail input/output 8 MHz operational amplifiers

8.2 Typical characteristic

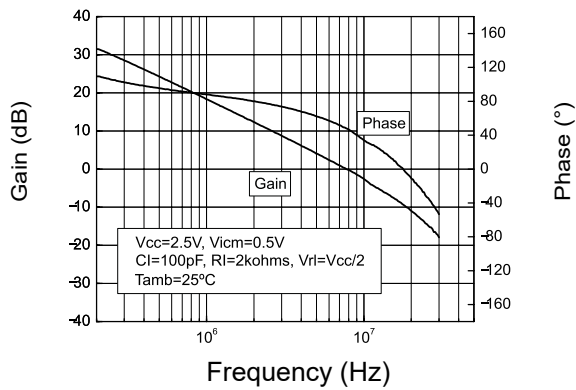


Figure 7: Voltage gain and phase vs. frequency at $V_{CC}=2.5V$ and $V_{icm}=0.5V$

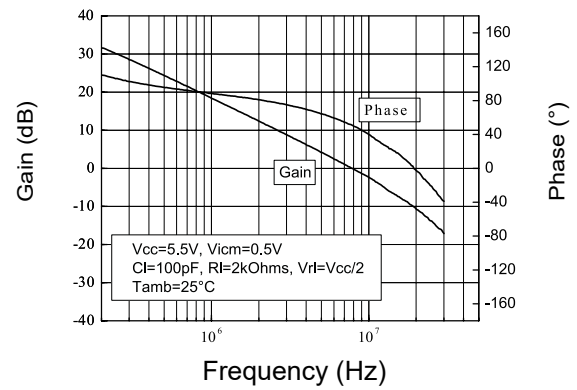


Figure 8: Voltage gain and phase vs. frequency at $V_{CC}=5.5V$ and $V_{icm}=0.5V$

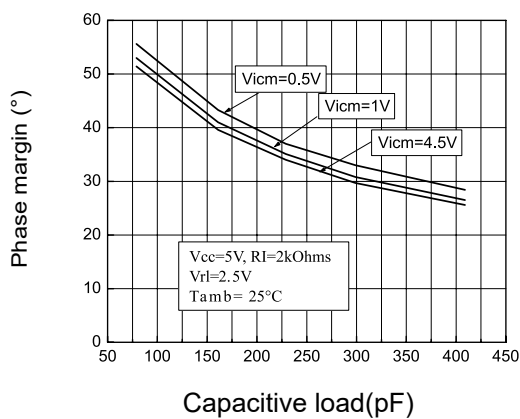


Figure 9: Phase margin vs. capacitive load

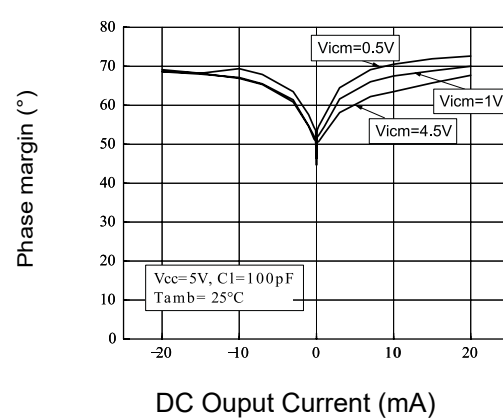


Figure 10: Phase margin vs. output current

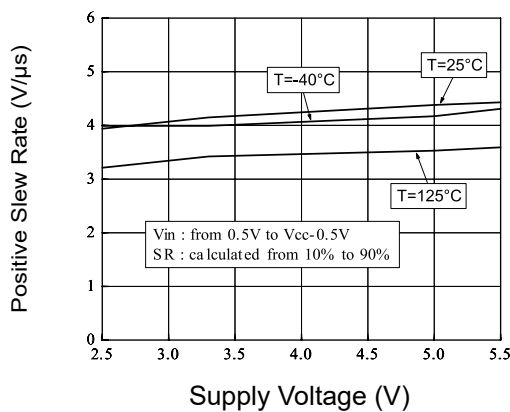


Figure 11: Positive slew rate

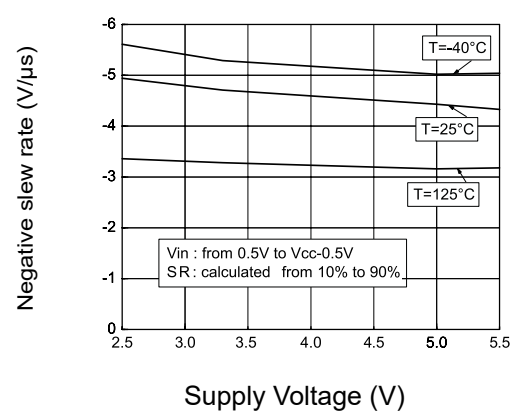


Figure 12: Positive slew rate



Single, dual, and quad rail-to-rail input/output 8 MHz operational amplifiers

8.3 Typical characteristic

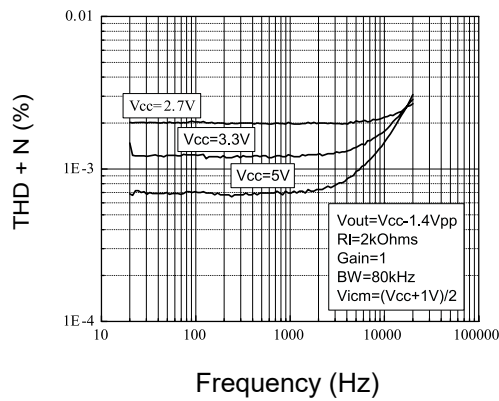


Figure 13: Distortion + noise vs. frequency

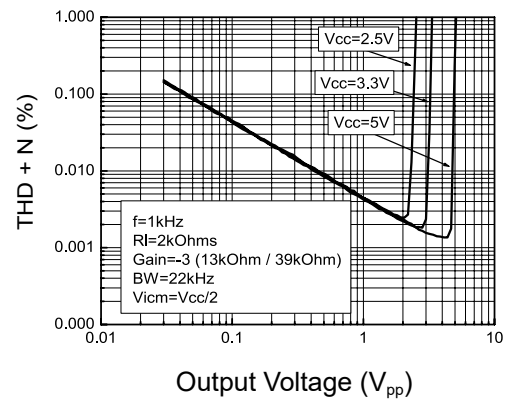


Figure 14: Distortion + noise vs. output voltage

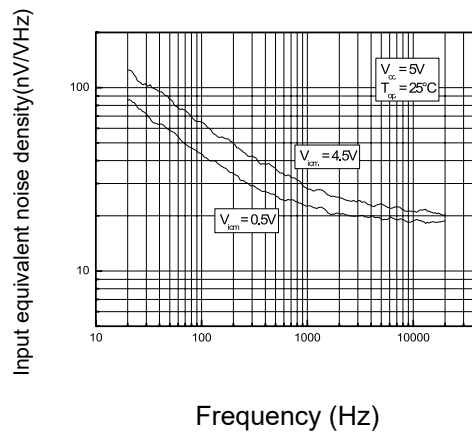


Figure 15: Noise vs. frequency

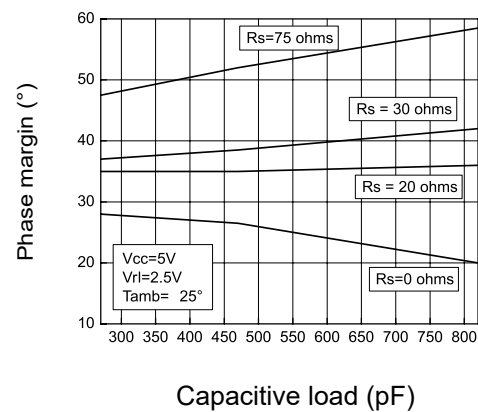


Figure 16: Phase margin vs. capacitive load and serial resistor

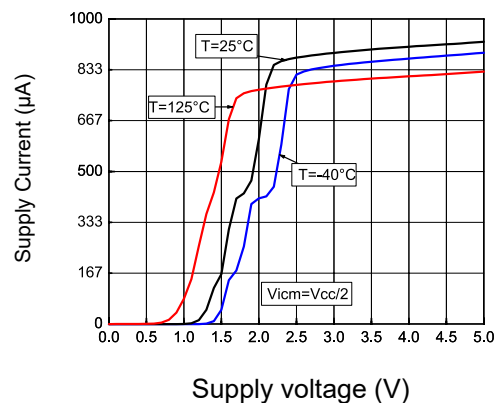
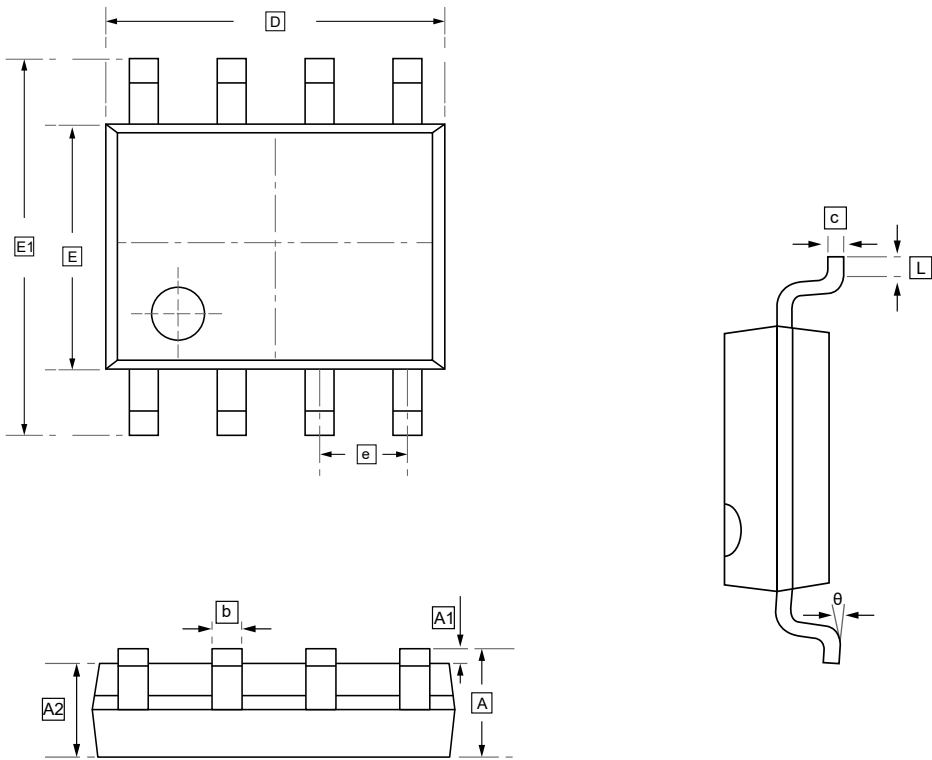


Figure 17: Supply current vs. supply voltage



Single, dual, and quad rail-to-rail input/output 8 MHz operational amplifiers

9.1 SOP-8 Package Outline Dimensions



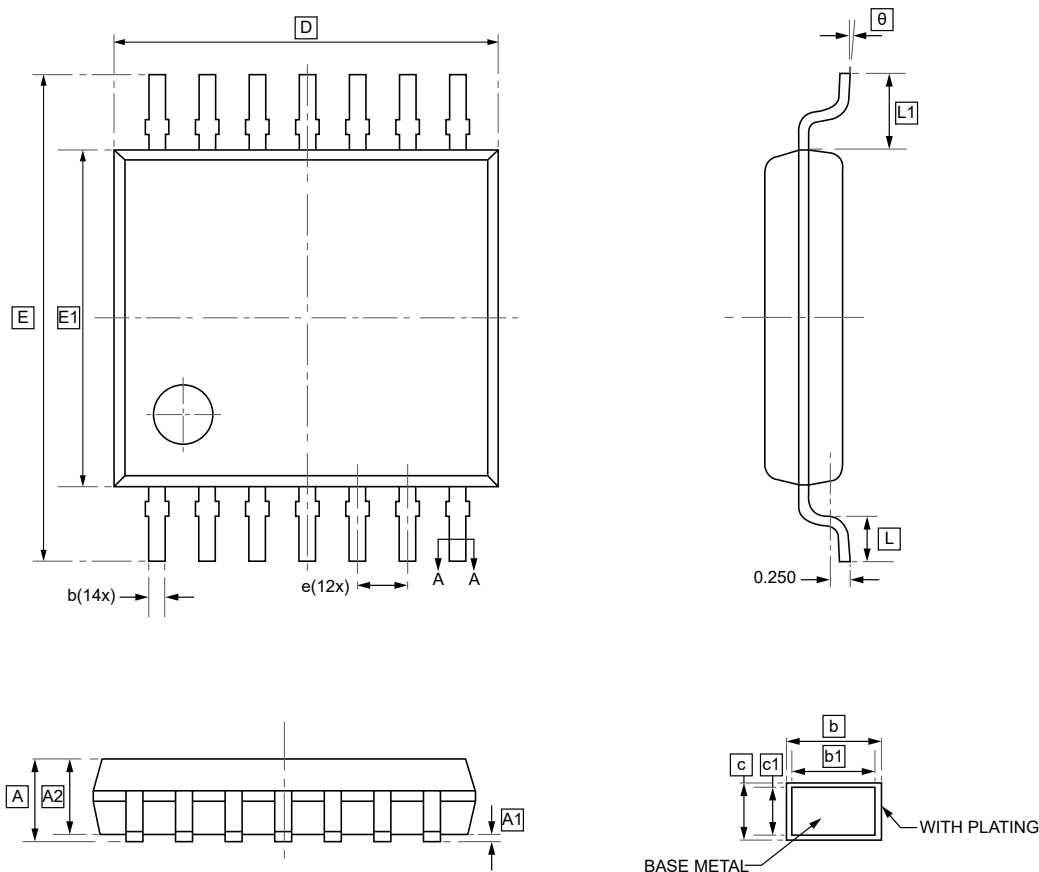
DIMENSIONS (mm are the original dimensions)

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°



Single, dual, and quad rail-to-rail input/output 8 MHz operational amplifiers

9.2 TSSOP-14 Package Outline Dimensions



DIMENSIONS (mm are the original dimensions)

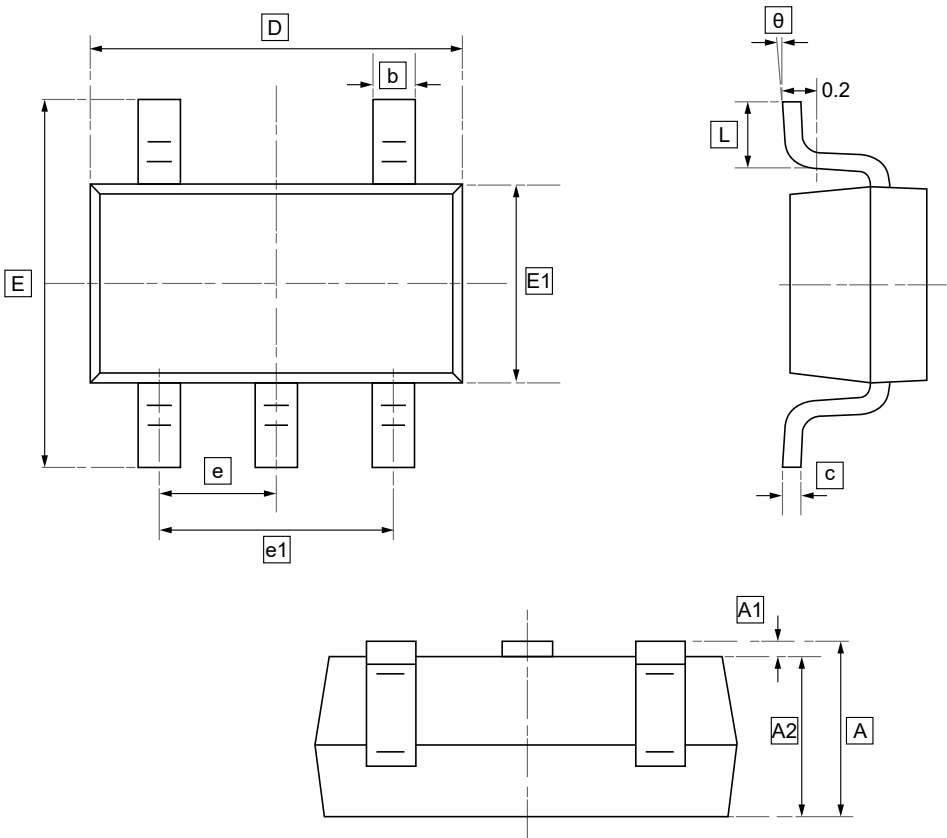
Symbol	A	A1	A2	b	b1	c	c1	D	E	E1	e	L1
Min	-	0.05	0.90	0.20	0.19	0.13	0.120	4.90	6.20	4.30	0.65	0.85
Max	1.20	0.15	1.05	0.28	0.25	0.17	0.14	5.10	6.60	4.50	BSC	1.15

Symbol	L	θ
Min	0.45	0°
Max	0.75	8°



Single, dual, and quad rail-to-rail input/output 8 MHz operational amplifiers

9.3 SOT-23-5 Package Outline Dimensions



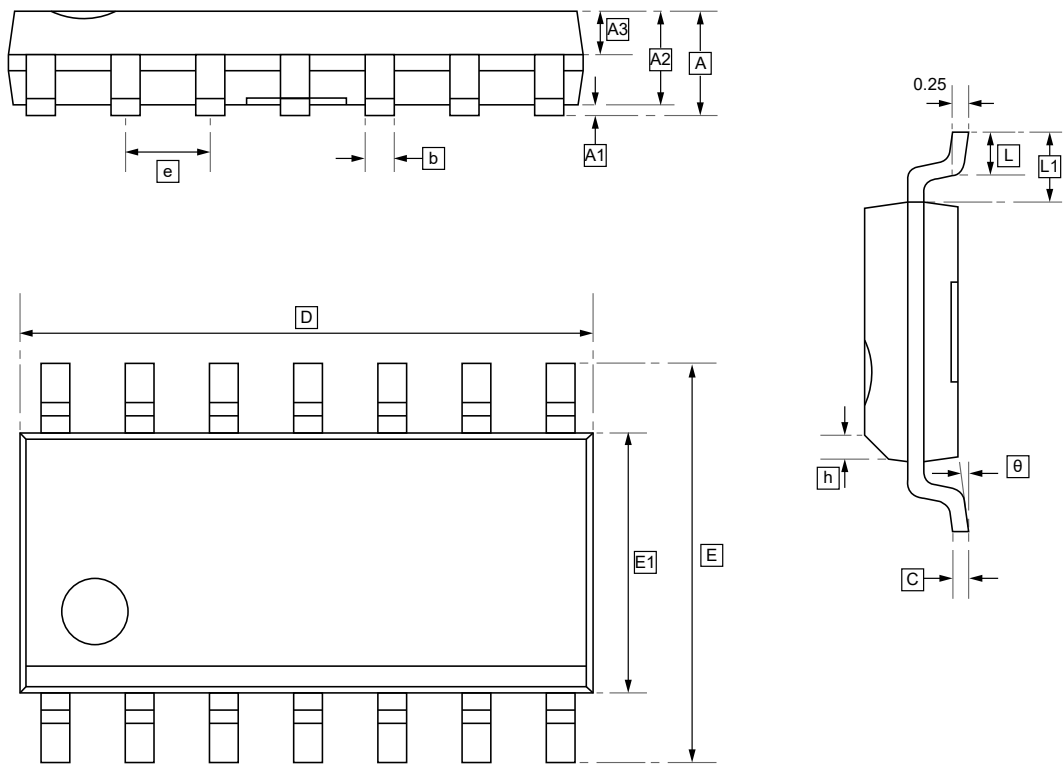
DIMENSIONS (mm are the original dimensions)

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°



Single, dual, and quad rail-to-rail input/output 8 MHz operational amplifiers

9.4 SOP-14 Package Outline Dimensions



DIMENSIONS (mm are the original dimensions)

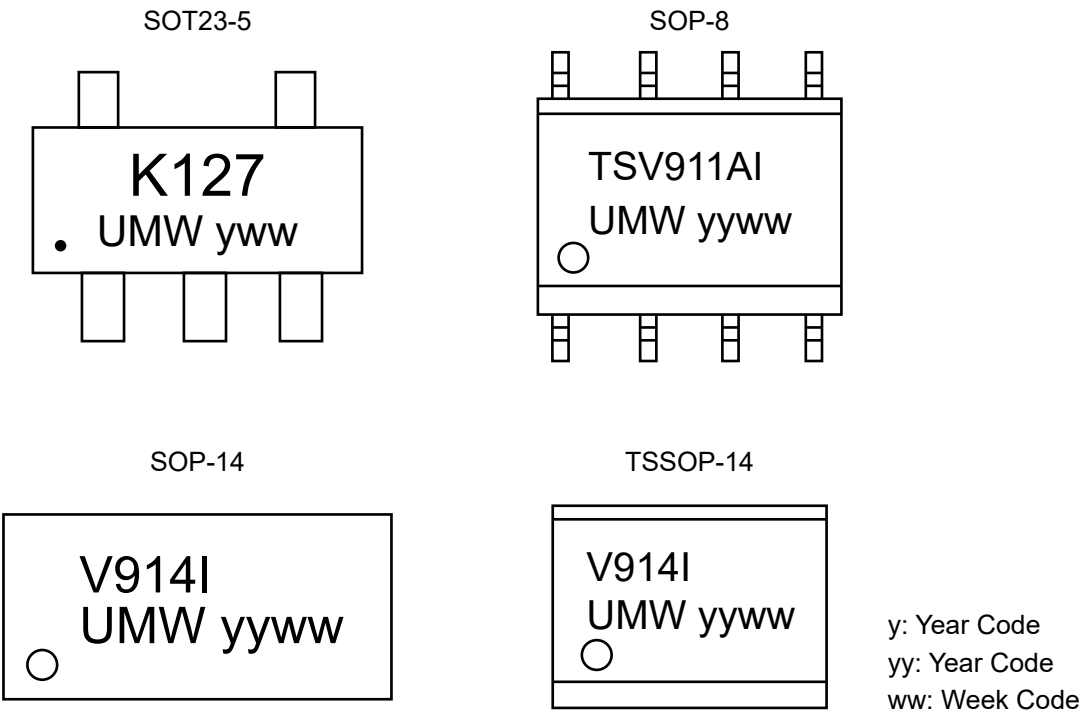
Symbol	A	A1	A2	A3	b	C	D	E	E1	e	h	L
Min	-	0.05	1.35	0.65	0.203	0.17	8.45	5.80	3.80	1.24	0.25	0.40
Max	1.75	0.25	1.55	0.75	0.305	0.25	8.85	6.20	4.00	1.30	0.50	0.80

Symbol	L1	θ
Min	1.00	0°
Max	1.10	8°



Single, dual, and quad rail-to-rail input/output 8 MHz operational amplifiers

10.Ordering information



Order Code	Marking	Package	Base QTY	Delivery Mode
UMW TSV911ILT	K127	SOT23-5	3000	Tape and reel
UMW TSV912IDT	V912I	SOP-8	2500	Tape and reel
UMW TSV911IYDT	TSV911	SOP-8	2500	Tape and reel
UMW TSV911AILT	K128	SOT23-5	3000	Tape and reel
UMW TSV911AIYDT	TSV911AI	SOP-8	2500	Tape and reel
UMW TSV914IDT	V914I	SOP-14	2500	Tape and reel
UMW TSV914IPT	V914I	TSSOP-14	4000	Tape and reel



11.Disclaimer

UMW reserves the right to make changes to all products, specifications. Customers should obtain the latest version of product documentation and verify the completeness and currency of the information before placing an order.

When applying our products, please do not exceed the maximum rated values, as this may affect the reliability of the entire system. Under certain conditions, any semiconductor product may experience faults or failures. Buyers are responsible for adhering to safety standards and implementing safety measures during system design, prototyping, and manufacturing when using our products to prevent potential failure risks that could lead to personal injury or property damage.

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