UMW TSV631

Rail-to-rail input/output, 60 μA, 880 kHz, 5V
CMOS operational amplifiers

1.Description

The UMW TSV631 devices are single operational amplifiers offering low voltage, low poweroperatio and rail-to-rail input and output.These devices have a very low input bias current and a low offset voltage making them ideal for applications that require precision. They can operate at power supplies ranging from 1.5 V to 5.5 V, and are th-er efore very suitable for battery powered devices, extending battery life.

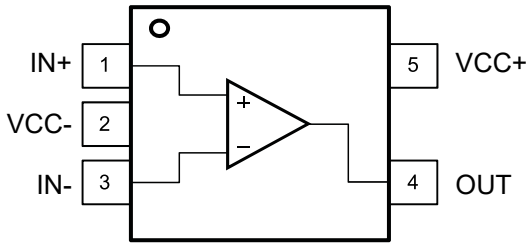
2.Features

- Low offset voltage: 500μV max (A version)
- Low power consumption: 60 μA typ at 5 V
- Low supply voltage: 1.5 V - 5.5 V
- Gain bandwidth product: 880 kHz typ
- Unity gain stability
- Low power shutdown mode: 5nA typ
- High output current: 63 mA at V_{CC}=5V
- Low input bias current: 1pA typ
- Rail-to-rail input and output
- Extended temperature range: -40°C to 125°C

3.Applications

- Battery-powered applications
- Portable devices
- Active filtering
- Medical instrumentation

4.Pinning information



SOT23-5/SC70-5

5.Absolute Maximum Ratings

Parameter		Symbol	Value	Units
Supply voltage		V_{CC}	6	V
Differential input voltage		V_{id}	$\pm V_{CC}$	V
Input voltage		V_{in}	(V_{CC-})-0.2 to (V_{CC+})+0.2	V
Input current		I_{in}	10	mA
Shutdown voltage		SHDN	6	V
Storage temperature		T_{STG}	-65 to 150	°C
Maximum junction temperature		T_J	150	°C
Thermal resistance junction-to-ambient	SC70-5	R_{thja}	205	°C/W
	SOT23-5		250	°C/W

6.Operating conditions

Parameter	Symbol	Rating	Units
Supply voltage	V_{CC}	1.5 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_{oper}	40 to +125	°C

7.1 Electrical Characteristics

(V_{CC+})=1.8V with (V_{CC-})=0V, V_{icm}=V_{CC}/2, T_{amb}=25°C, and R_L connected to V_{CC}/2 (unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Offset voltage	V_{io}	UMW TSV631			3	mV
		UMW TSV631A			0.5	mV
		-40°C<T_{op}<125°C, UMW TSV631			4.5	mV
		-40°C<T_{op}<125°C, UMW TSV631A			2	mV
Input offset voltage drift	$\Delta V_{io}/\Delta T$			2		µV/°C
Input offset current, V_{out}=V_{CC}/2	I_{io}	-40°C<T_{op}<125°C		1	10	pA
				1	100	pA
Input bias current, V_{out}=V_{CC}/2	I_{ib}	-40°C<T_{op}<125°C		1	10	pA
				1	100	pA
Common mode rejection ratio, 20 log ($\Delta V_{ic}/\Delta V_{io}$)	CMR	0V to 1.8V, V_{out}=0.9V	53	74		dB
		-40°C<T_{op}<125°C	51			dB
Large signal voltage gain	A_{vd}	R_L=10kΩ, V_{out}=0.5V to 1.3V	85	95		dB
		-40°C<T_{op}<125°C	80			dB
High-level output voltage V_{OH}=V_{CC}-V_{out}	V_{OH}	R_L=10kΩ		5	35	mV
		-40°C<T_{op}<125°C			50	mV
Low-level output voltage	V_{OL}	R_L=10kΩ		4	35	mV
		-40°C<T_{op}<125°C			50	mV
I_{sink}	I_{OUT}	V_O=1.8V	6	12		mA
		-40°C<T_{op}<125°C	4			mA
I_{source}		V_{out}=0V	6	10		mA
		-40°C<T_{op}<125°C	4			mA
Supply current $\overline{SHDN}$=V_{CC+}	I_{CC}	No load, V_{out}=V_{CC}/2	40	50	60	µA
		-40°C<T_{op}<125°C			62	µA

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Gain bandwidth product	GBP	R_L=2kΩ, C_L=100pF, f=100kHz	700	790		kHz
Phase margin	ϕm	R_L=2kΩ, C_L=100pF		48		Degrees
Gain margin	G_m			11		dB
Slew rate	SR	R_L=2kΩ, C_L=100pF, A_V=1	0.2	0.27		V/μs
Equivalent input noise voltage	e_n	f=1kHz		67		nV/√Hz
		f=10kHz		53		nV/√Hz

7.2 Electrical Characteristics

Shutdown characteristics V_{CC}=1.8V

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Supply current in shutdown mode (all operators)	I_{CC}	SHDN=V_{CC-}		2.5	50	nA
		-40°C<T_{op}<85°C			200	nA
		-40°C<T_{op}<125°C			1.5	μA
Amplifier turn-on time	t_{on}	R_L=2kΩ		300		ns
Amplifier turn-off time	t_{off}	V_{out}=(V_{CC-})+0.2V to (V_{CC+})-0.2V		20		ns
SHDN logic high	V_{IH}		1.3			V
SHDN logic low	V_{IL}				0.5	V
SHDN current high	I_{IH}	SHDN=V_{CC+}		10		pA
SHDN current low	I_{IL}	SHDN=V_{CC-}		10		pA
Output leakage in shutdown mode	I_{OLeak}	SHDN=V_{CC-}		50		pA
		-40°C<T_{op}<125°C		1		nA

7.3 Electrical Characteristics

(V_{CC+})=3.3V with (V_{CC-})=0V, V_{icm}=V_{CC}/2, T_{amb}=25°C, and R_L connected to V_{CC}/2 (unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Offset voltage	V_{io}	UMW TSV631			3	mV
		UMW TSV631A			0.5	mV
		-40°C<T_{op}<125°C, UMW TSV631			4.5	mV
		-40°C<T_{op}<125°C, UMW TSV631A			2	mV
Input offset voltage drift	$\Delta V_{io}/\Delta T$			2		µV/°C
Input offset current	I_{io}	-40°C<T_{op}<125°C		1	10	pA
				1	100	pA
Input bias current	I_{ib}	-40°C<T_{op}<125°C		1	10	pA
				1	100	pA
Common mode rejection ratio, 20 log ($\Delta V_{ic}/\Delta V_{io}$)	CMR	0V to 3.3V, V_{out}=1.75V	57	79		dB
		-40°C<T_{op}<125°C	53			dB
Large signal voltage gain	A_{vd}	R_L=10kΩ, V_{out}=0.5V to 2.8V	88	98		dB
		-40°C<T_{op}<125°C	83			dB
High-level output voltage V_{OH}=V_{CC}-V_{out}	V_{OH}	R_L=10kΩ		6	35	mV
		-40°C<T_{op}<125°C			50	mV
Low-level output voltage	V_{OL}	R_L=10kΩ		7	35	mV
		-40°C<T_{op}<125°C			50	mV
I_{sink}	I_{OUT}	V_O=3.3V	30	45		mA
		-40°C<T_{op}<125°C	25	42		mA
I_{source}		V_{out}=0V	30	38		mA
		-40°C<T_{op}<125°C	25			mA
Supply current $\overline{SHDN}$=V_{CC+}	I_{CC}	No load, V_{out}=1.75V	43	55	64	µA
		-40°C<T_{op}<125°C			66	µA

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Gain bandwidth product	GBP	R_L=2kΩ, C_L=100pF, f=100kHz	710	860		kHz
Phase margin	ϕm	R_L=2kΩ, C_L=100pF		50		Degrees
Gain margin	G_m			11		dB
Slew rate	SR	R_L=2kΩ, C_L=100pF, A_V=1	0.22	0.29		V/μs
Equivalent input noise voltage	e_n	f=1kHz		64		nV/√Hz
		f=10kHz		51		nV/√Hz

7.4 DC Electrical Characteristics

(V_{CC+})=5V with (V_{CC-})=0V, V_{icm}=V_{CC}/2, T_{amb}=25°C, and R_L connected to V_{CC}/2 (unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Offset voltage	V_{io}	UMW TSV631			3	mV
		UMW TSV631A			0.5	mV
		-40°C<T_{op}<125°C, UMW TSV631			4.5	mV
		-40°C<T_{op}<125°C, UMW TSV631A			2	mV
Input offset voltage drift	DV_{io}			2		µV/°C
Input offset current	I_{io}	-40°C<T_{op}<125°C		1	10	pA
				1	100	pA
Input bias current	I_{ib}	-40°C<T_{op}<125°C		1	10	pA
				1	100	pA
Common mode rejection ratio, 20 log ($\Delta V_{ic}/\Delta V_{io}$)	CMR	0V to 5V, V_{out}=2.5V	60	80		dB
		-40°C<T_{op}<125°C	55			dB
Supply voltage rejection ratio 20 log, $\Delta V_{CC}/\Delta V_{io}$	SVR	V_{CC}=1.8 to 5V	75	102		dB
		-40°C<T_{op}<125°C				dB
Large signal voltage gain	A_{vd}	R_L=10kΩ, V_{out}=0.5V to 4.5V	89	98		dB
		-40°C<T_{op}<125°C	84			dB
High level output voltage V_{OH}=V_{CC} - V_{out}	V_{OH}	R_L=10kΩ		7	35	mV
		-40°C<T_{op}<125°C			5035	mV
Low level output voltage	V_{OL}	R_L=10kΩ		6	50	mV
		-40°C<T_{op}<125°C				mV
I_{sink}	I_{OUT}	V_O=5V	40	69		mA
		-40°C<T_{op}<125°C	35	65		mA
I_{source}		V_{out}=0V	40	74		mA
		-40°C<T_{op}<125°C	36	68		mA
Supply current $\overline{SHDN}$=V_{CC+}	I_{CC}	No load, V_{out}=V_{CC}/2	50	60	69	µA
		-40°C<T_{op}<125°C			72	µA

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Gain bandwidth product	GBP	R_L=2kΩ, C_L=100pF, f=100kHz	730	880		kHz
Unity gain frequency	F_u	R_L=2kΩ, C_L=100pF		830		kHz
Phase margin	ϕm			50		Degrees
Gain margin	G_m			12		dB
Slew rate	SR	R_L=2kΩ, C_L=100pF, A_V=1	0.25	0.34		V/μs
Equivalent input noise voltage	e_n	f=1kHz		60		nV/√Hz
		f=10kHz		47		nV/√Hz
Total harmonic distortion	THD+e_n	f=1kHz, A_V=1, R_L=100kΩ, V_{icm}=V_{CC}/2, V_{out}=2V_{PP}		0.0017		%

7.5 Electrical Characteristics

Shutdown characteristics V_{CC}=5V

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Supply current in shutdown mode (all operators)	I_{CC}	SHDN=V_{CC-}		5	50	nA
		-40°C<T_{op}<85°C			200	nA
		-40°C<T_{op}<125°C			1.5	μA
Amplifier turn-on time	t_{on}	R_L=2kΩ		300		ns
Amplifier turn-off time	t_{off}	V_{out}=(V_{CC-})+0.2V to (V_{CC+})-0.2V		30		ns
SHDN logic high	V_{IH}		4.5			V
SHDN logic low	V_{IL}				0.5	V
SHDN current high	I_{IH}	SHDN=V_{CC+}		10		pA
SHDN current low	I_{IL}	SHDN=V_{CC-}		10		pA
Output leakage in shutdown mode	I_{OLeak}	SHDN=V_{CC-}		50		pA
		-40°C<T_{op}<125°C		1		nA

8.1 Typical characteristic

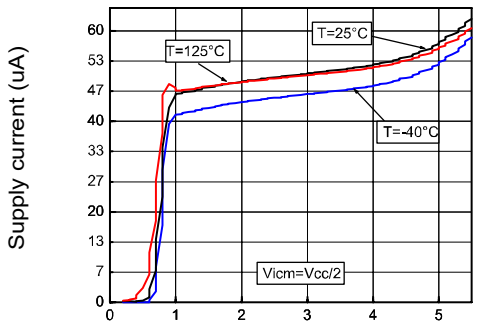


Figure 1: Supply current vs. supply voltage at $V_{icm}= V_{CC}/2$

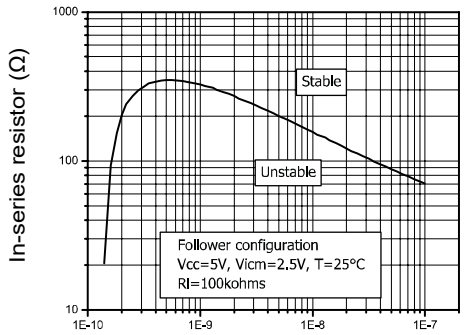


Figure 2: In-series resistor (Riso) vs. capacitive load

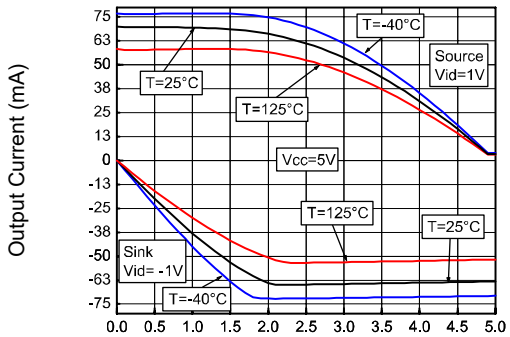


Figure 3: Output current vs. output voltage at V_{CC}=5V

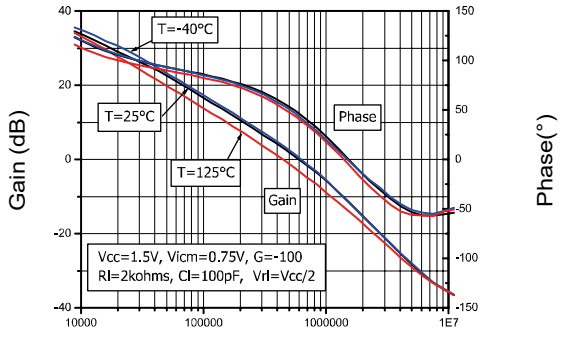


Figure 4: Voltage gain and phase vs. frequency at V_{CC}=1.5V

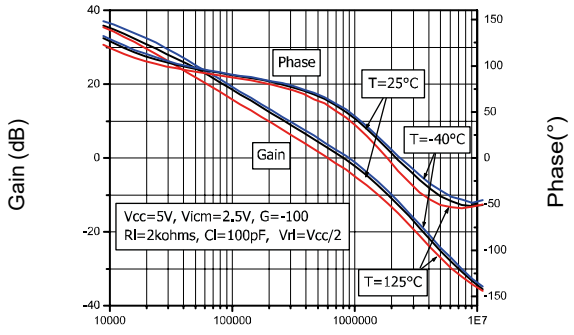


Figure 5: Voltage gain and phase vs. frequency at V_{CC}=5V

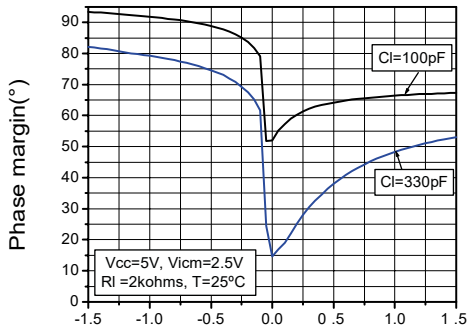


Figure 6: Phase margin vs. output current at V_{CC}=5V

8.2 Typical characteristic

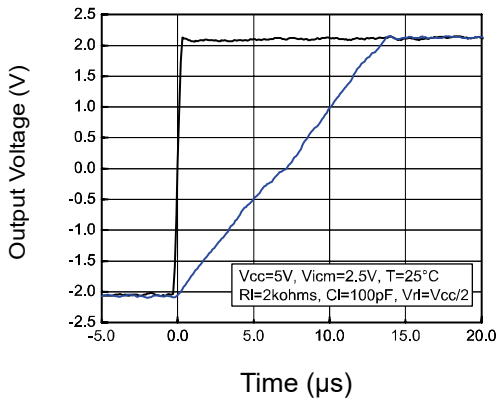


Figure 7: Positive slew rate vs. time

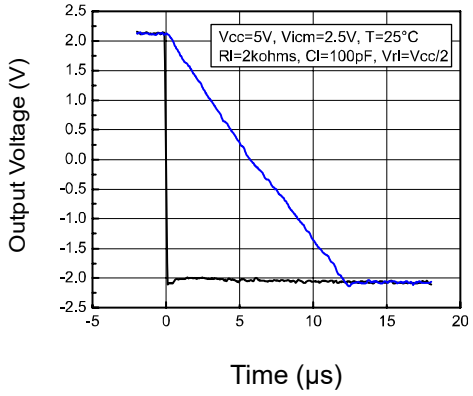


Figure 8: Negative slew rate vs. time

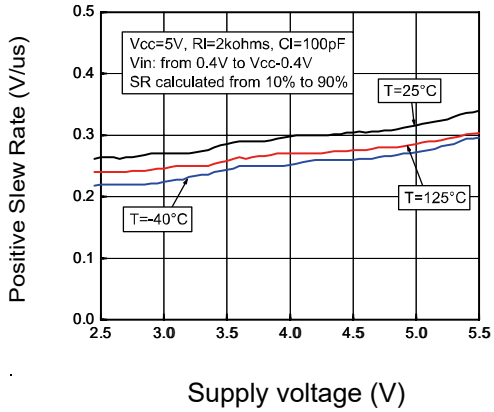


Figure 9: Positive slew rate vs. supply voltage

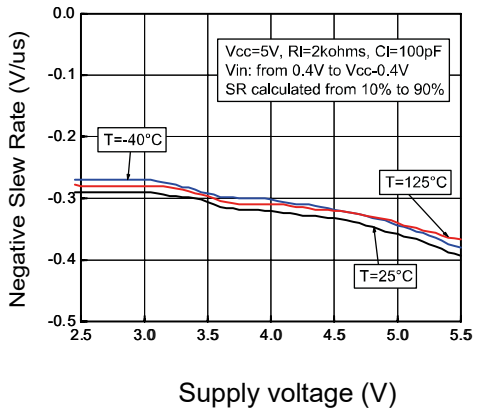


Figure 10: Negative slew rate vs. supply voltage

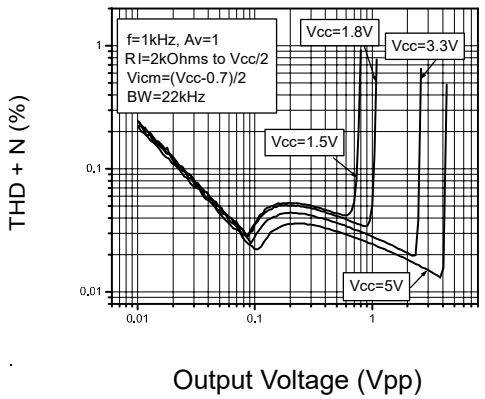


Figure 11: Distortion + noise vs. output voltage (R_L=2kΩ)

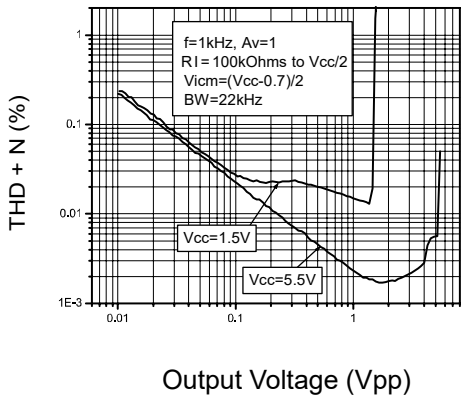


Figure 12: Distortion + noise vs. output voltage (R_L=100kΩ)

8.3 Typical characteristic

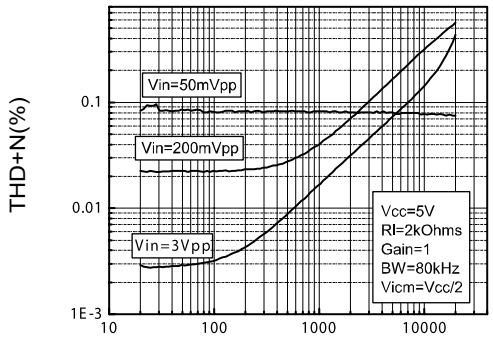


Figure 13: Distortion + noise vs. frequency and input voltage

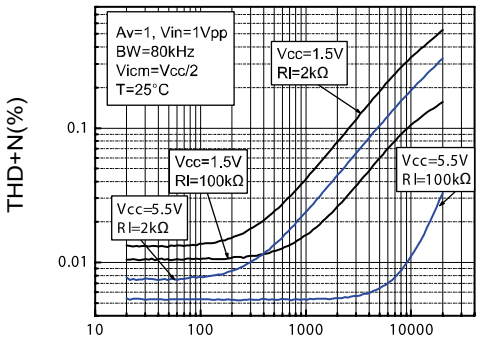


Figure 14: Distortion + noise vs. frequency and output load resistor

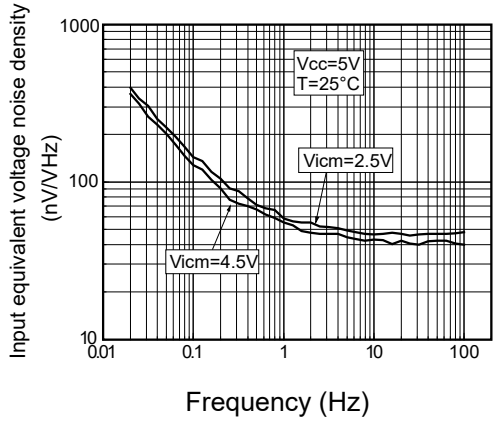


Figure 15: Noise vs. frequency

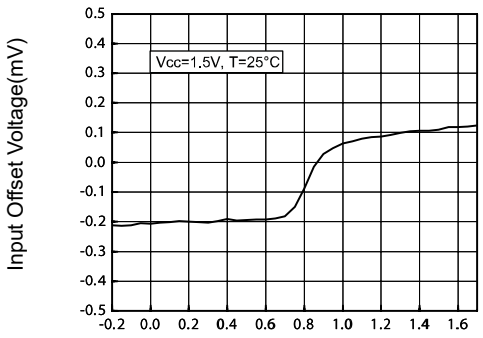


Figure 16: Input offset voltage vs input common mode at V_{CC}=1.5V

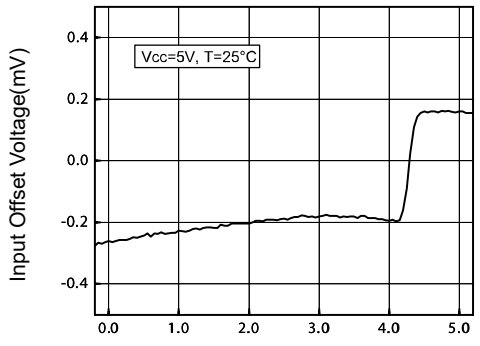


Figure 17: Input offset voltage vs input common mode at V_{CC}=5V

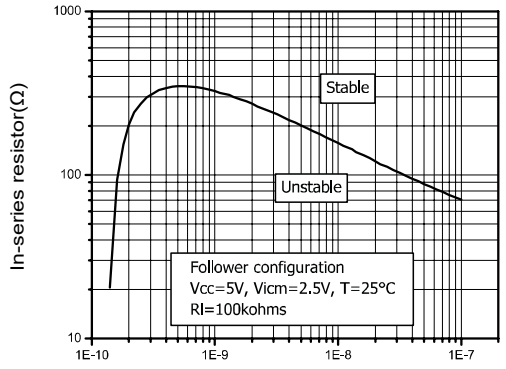
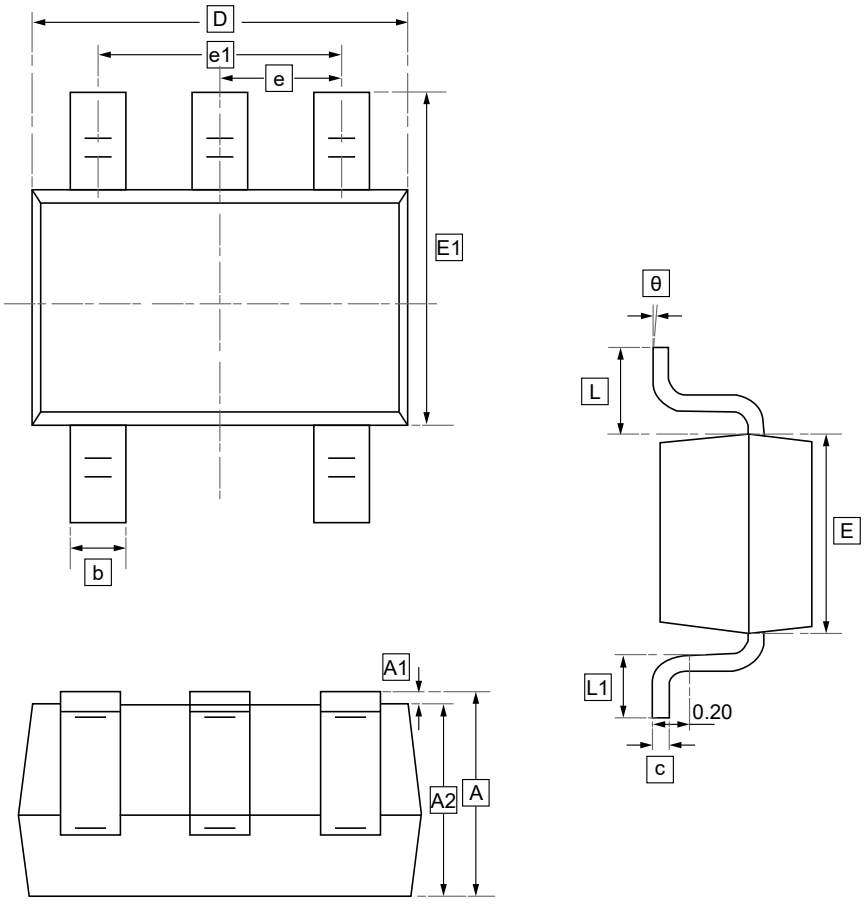


Figure 18: In-series resistor vs. capacitive load

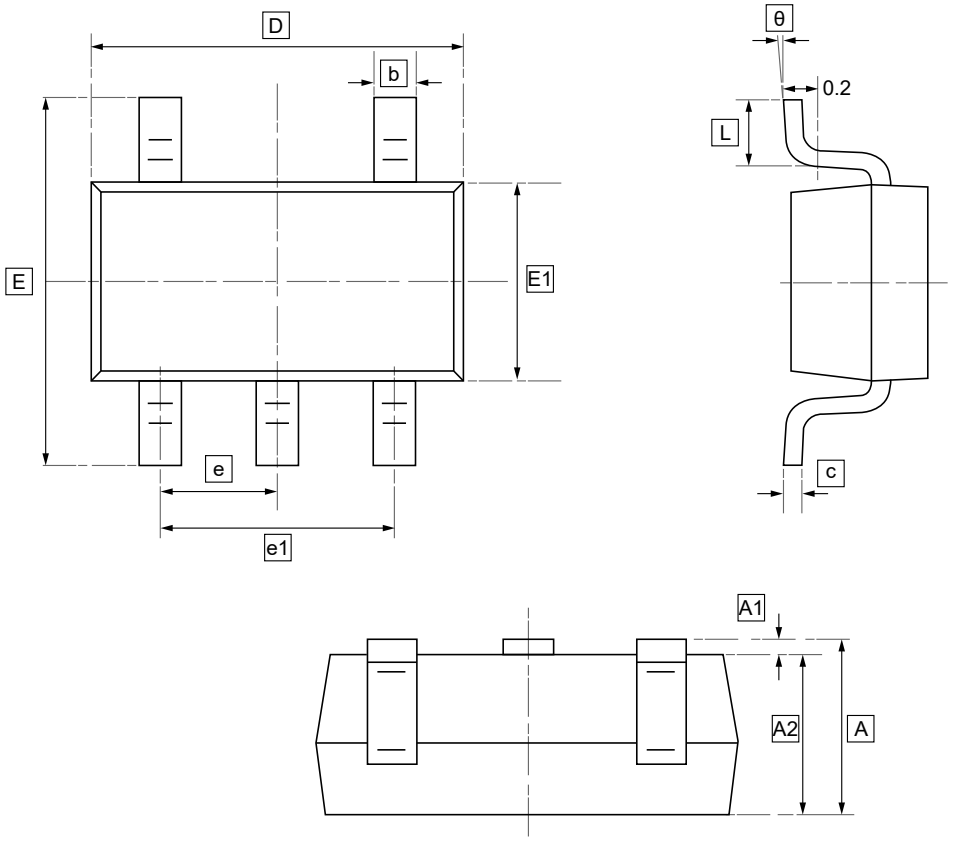
9.1 SC70-5 Package Outline Dimensions



DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	A2	b	c	D	E	E1	e	e1	L	θ
Min	0.90	0.00	0.90	0.15	0.08	2.05	1.15	2.15	0.65	1.20	0.26	7°
Max	1.10	0.10	1.00	0.35	0.15	2.25	1.35	2.45	TYP	1.40	0.46	REF.

9.2 SOT-23-5 Package Outline Dimensions

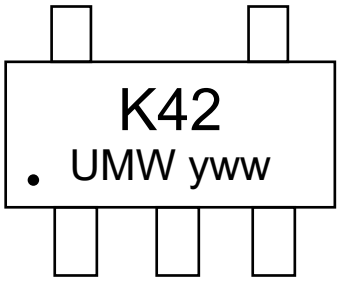


DIMENSIONS (mm are the original dimensions)

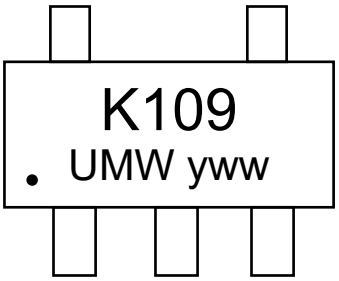
Symbol	A	A1	A2	b	c	D	E1	E	e	e1	L	θ
Min	1.050	0.000	1.050	0.300	0.100	2.820	1.500	2.650	0.950	1.800	0.300	0°
Max	1.250	0.100	1.150	0.500	0.200	3.020	1.700	2.950	BSC	2.000	0.600	8°

10.Ordering information

SC70-5



SOT23-5



yww: Batch Code

Order Code	Marking	Package	Base QTY	Delivery Mode
UMW TSV631ICT	K19	SC70-5	3000	Tape and reel
UMW TSV631AICT	K42	SC70-5	3000	Tape and reel
UMW TSV631AILT	K142	SOT23-5	3000	Tape and reel
UMW TSV631ILT	K109	SOT23-5	3000	Tape and reel

11.Disclaimer

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