

PROGRAMMABLE PRECISION REFERENCES

The KIA2431P/S/T/AP/AS/AT/BP/BS/BT are integrated circuits are three-terminal programmable shunt regulator diodes. These monolithic IC voltage reference operate as a low temperature coefficient zener which is programmable from V_{ref} to 18 volts with two external resistors. These devices exhibit a wide operating current range of $5.0\mu A$ to $25mA$ with a typical dynamic impedance of 0.22Ω . The characteristics of these references make them excellent replacements for zener diodes in many applications such as digital voltmeters, power supplies, and op amp circuitry.

FEATURES

- Programmable Output Voltage to 18 Volts.

LINE UP

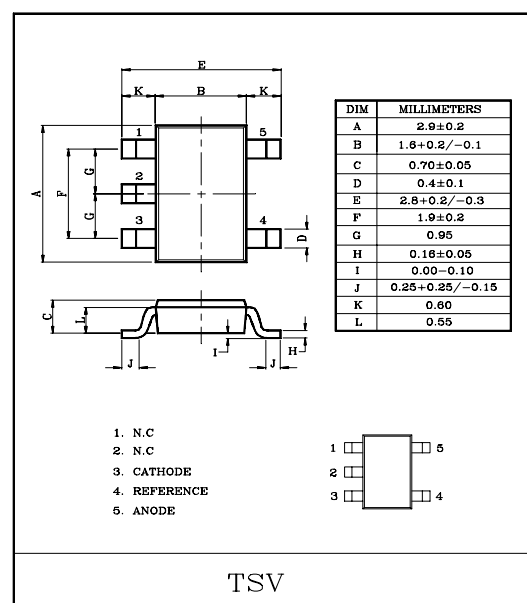
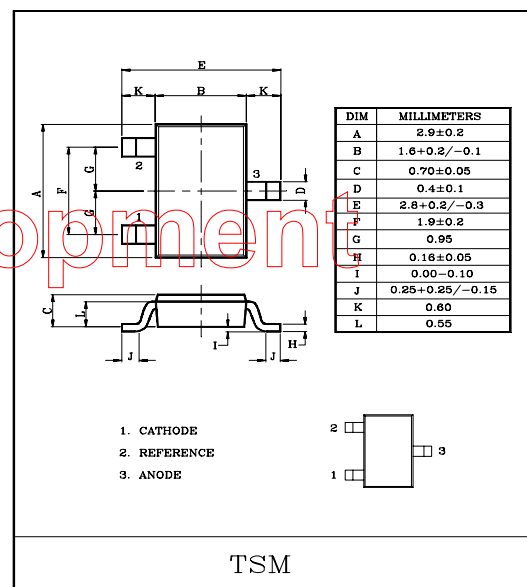
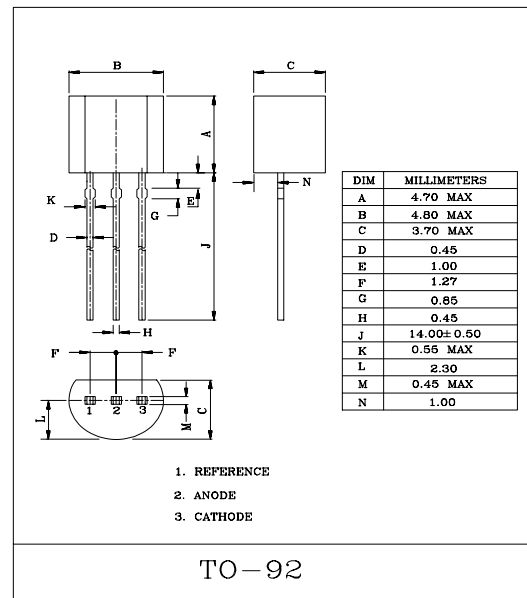
ITEM		Package	Vref Tolerance (%)
* KIA2431	P	TO-92	1.5
	S	TSM	
	T	TSV	
* KIA2431	AP	TO-92	1.0
	AS	TSM	
	AT	TSV	
* KIA2431	BP	TO-92	0.5
	BS	TSM	
	BT	TSV	

Note) * : Under development

- Low Dynamic Output Impedance : 0.22Ω (Typ.).
- Sink Current Capability of $50\mu A$ to $25mA$.
- Equivalent Full-Range Temperature Coefficient of $30ppm/^{\circ}C$ (Typ.).
- Temperature Compensated for Operation Over Full Rated Operating Temperature Range.
- Low Output Noise Voltage.

MARKING

Type No.	Marking
KIA2431T/S	24A
KIA2431AT/AF	24B
KIA2431BT/BS	24C



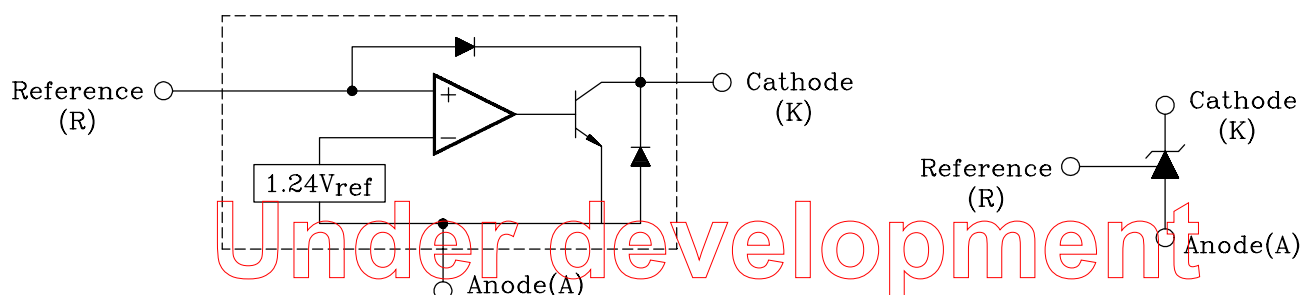
KIA2431P/S/T/AP/AS/AT/BP/BS/BT

MAXIMUM RATINGS

(Full operating ambient temperature range applies unless otherwise noted.)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Cathode To Anode Voltage		V_{KA}	20	V
Cathode Current Range, Continuous		I_K	-30 ~ 30	mA
Reference Input Current Range, Continuous		I_{ref}	-0.05 ~ 10	mA
Operating Junction Temperature		T_j	150	°C
Operating Temperature		T_{opr}	-40 ~ 85	°C
Storage Temperature		T_{stg}	-65 ~ 150	°C
Total Power Dissipation	KIA2431P/AP/BP	P_D	700	mW
	KIA2431S/AS/BS		350	
	KIA2431T/AT/BT		550	

BLOCK DIAGRAM

ELECTRICAL CHARACTERISTICS (T_a=25°C)

CHARACTERISTICS		SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Reference Input Voltage	KIA2431P/S/F	V_{ref}	Figure 1	$V_{\text{KA}}=V_{\text{ref}}$, $I_{\text{K}}=10\text{mA}$		1.222	1.240	1.258	V
	KIA2431AP/AS/AT					1.228	1.240	1.252	V
	KIA2431BP/BS/BT					1.234	1.240	1.246	V
Reference Input Voltage Deviation Over Temperature Range		ΔV_{ref}	Figure 1 (Note 1)	$V_{\text{KA}}=V_{\text{ref}}$, $I_{\text{K}}=10\text{mA}$		-	7.0	20	mV
Ratio of Change in Reference Input Voltage to Change in Cathode to Anode Voltage		$\frac{\Delta V_{\text{ref}}}{\Delta V_{\text{KA}}}$	Figure 2	$I_{\text{K}}=10\text{mA}$	$\Delta V_{\text{KA}}=18\text{V} \sim V_{\text{ref}}$	-	-0.6	-1.5	mV/V
Reference Input Current	$T_a=25^\circ\text{C}$	I_{ref}	Figure 2	$I_{\text{K}}=10\text{mA}$, $R1=10\text{k}\Omega$, $R2=\infty$		-	0.15	0.3	μA
Reference Input Current Deviation Over Temperature Range		ΔI_{ref}	Figure 2	$I_{\text{K}}=10\text{mA}$, $R1=10\text{k}\Omega$, $R2=\infty$		-	0.05	0.08	μA
Minimum Cathode Current For Regulation		I_{min}	Figure 1	$V_{\text{KA}}=V_{\text{ref}}$		-	55	80	μA
Off-State Cathode Current		$I_{\text{KC(off)}}$	Figure 3	$V_{\text{KA}}=18\text{V}$, $V_{\text{ref}}=0\text{V}$		-	2.6	1000	nA
Dynamic Impedance		Z_{ka}	Figure 1 (Note 2)	$V_{\text{KA}}=V_{\text{ref}}$, $I_{\text{K}}=0.05\text{mA} \sim 25\text{mA}$, $f \leq 1.0\text{kHz}$		-	0.22	0.4	Ω

KIA2431P/S/T/AP/AS/AT/BP/BS/BT

FIGURE 1—TEST CIRCUIT FOR $V_{KA} = V_{ref}$

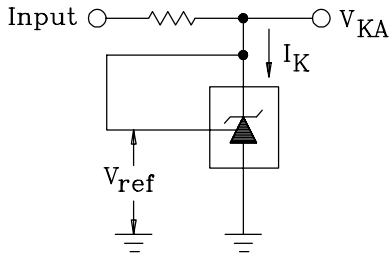
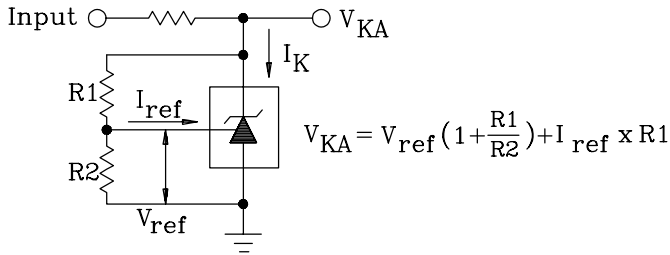
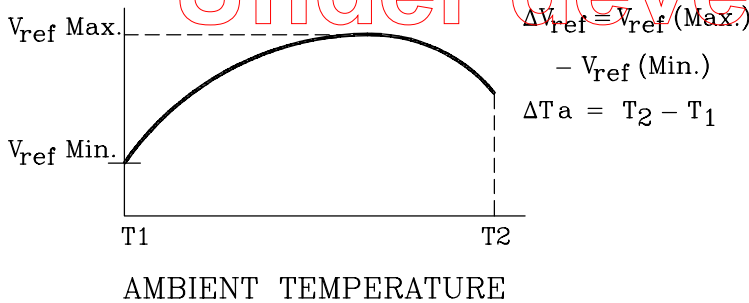


FIGURE 2—TEST CIRCUIT FOR $V_{KA} > V_{ref}$



Note 1:

The deviation parameter ΔV_{ref} is defined as the differences between the maximum and minimum values obtained over the full operating ambient temperature range that applies.



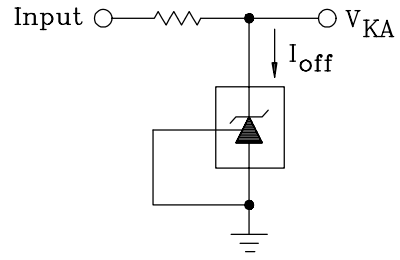
The average temperature coefficient of the Reference input voltage, αV_{ref} , is defined as:

$$\alpha V_{ref} \left(\frac{\text{ppm}}{^{\circ}\text{C}} \right) = \frac{\left(\frac{\Delta V_{ref}}{V_{ref} \text{ at } 25^{\circ}\text{C}} \right) \times 10^6}{\Delta T_a}$$

$$= \frac{\Delta V_{ref} \times 10^6}{\Delta T_a (V_{ref} \text{ at } 25^{\circ}\text{C})}$$

αV_{ref} can be positive or negative depending on whether $V_{ref} \text{ Min.}$ or $V_{ref} \text{ Max.}$ occurs at the lower ambient temperature.

FIGURE 3—TEST CIRCUIT FOR I_{off}



Example : $\Delta V_{ref} = 5.0\text{mV}$ and slope is positive, V_{ref} at $25^{\circ}\text{C} = 1.245\text{V}$, $\Delta T_a = 110^{\circ}\text{C}$

$$\alpha V_{ref} = \frac{0.005 \times 10^6}{110 \times 1.245} = 36.5 \text{ ppm}/^{\circ}\text{C}$$

Note 2:

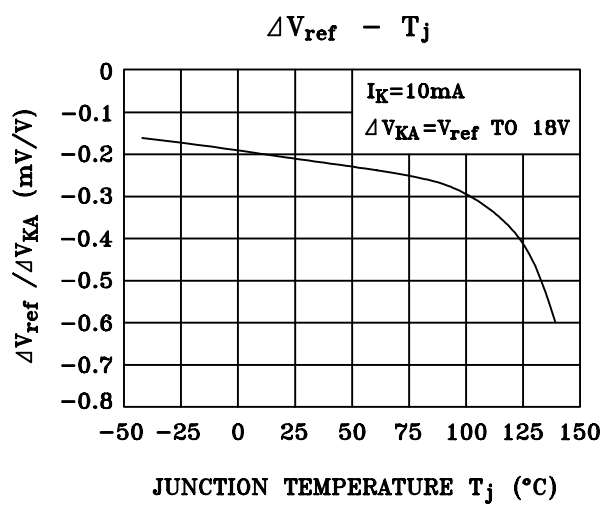
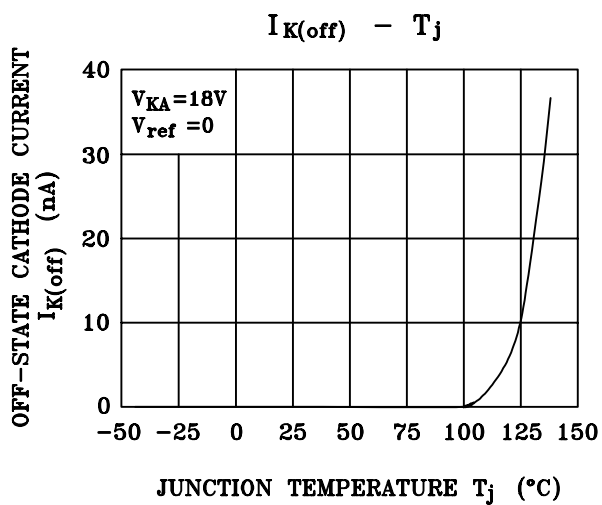
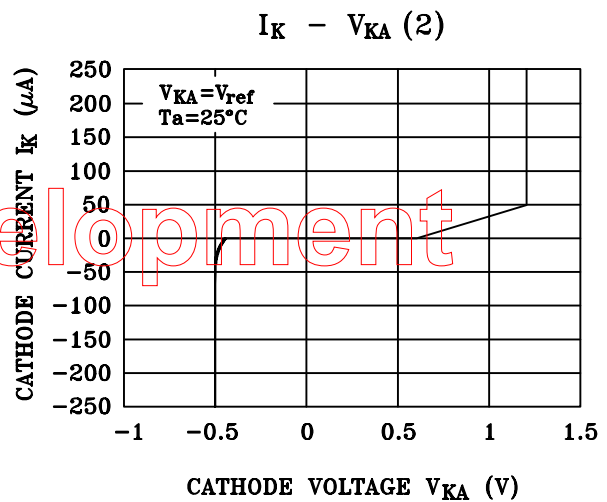
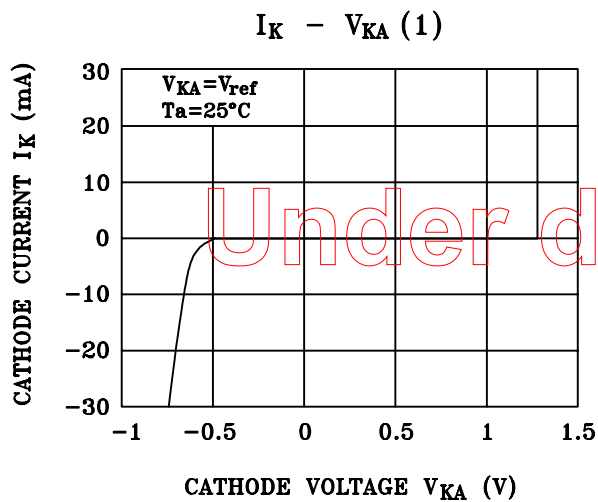
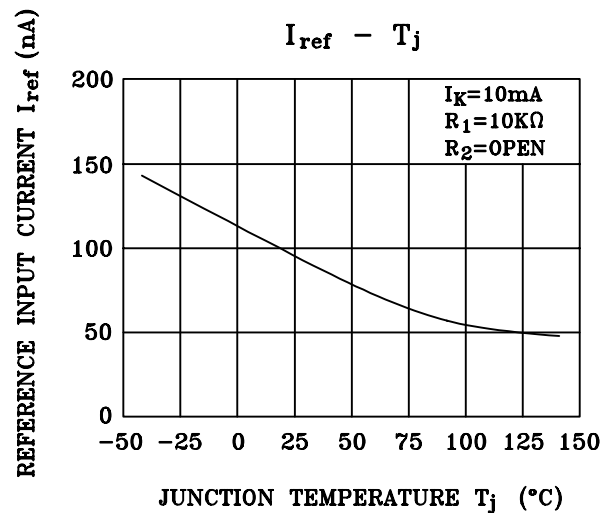
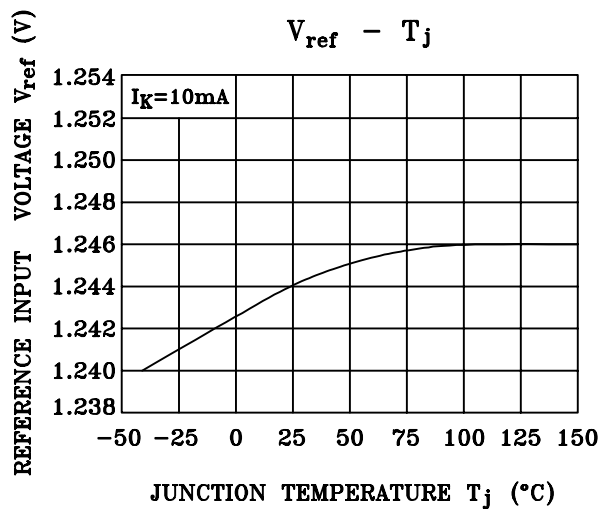
The dynamic impedance Z_{ka} is defined as:

$$|Z_{ka}| = \frac{\Delta V_{KA}}{\Delta I_k}$$

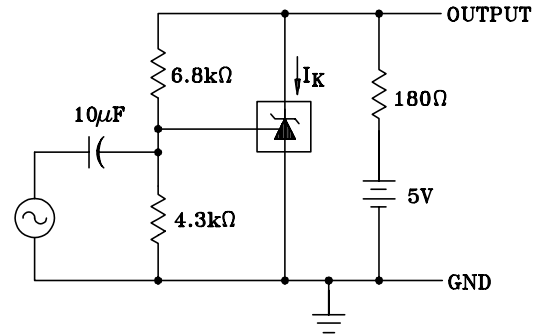
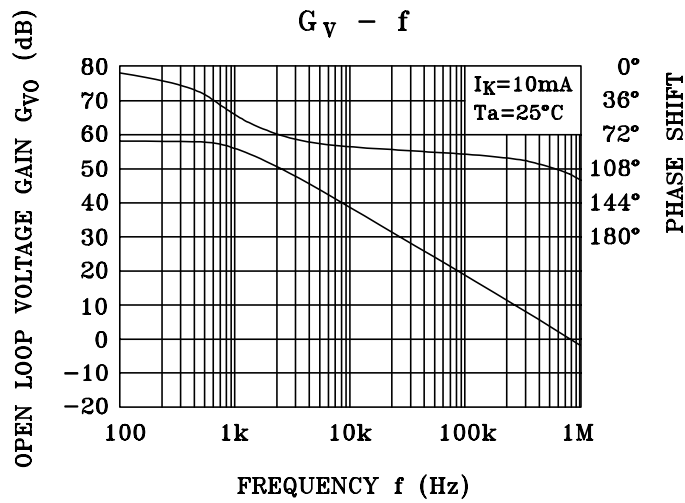
When the device is programmed with two external resistors, $R1$ and $R2$, (refer to Figure 2) the total dynamic impedance of the circuit is defined as:

$$|Z_{ka'}| = |Z_{ka}| \left(1 + \frac{R1}{R2} \right)$$

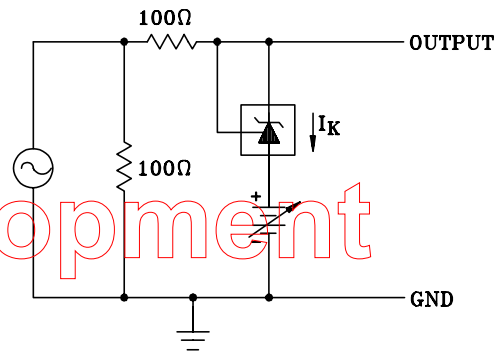
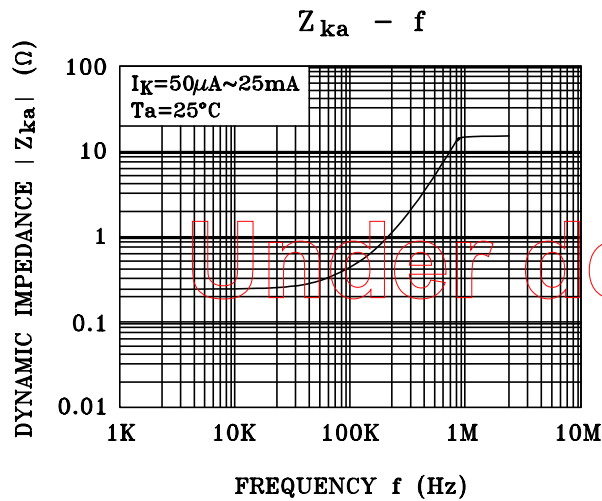
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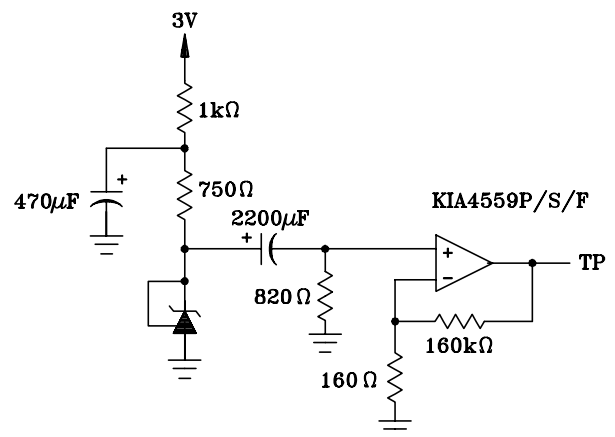
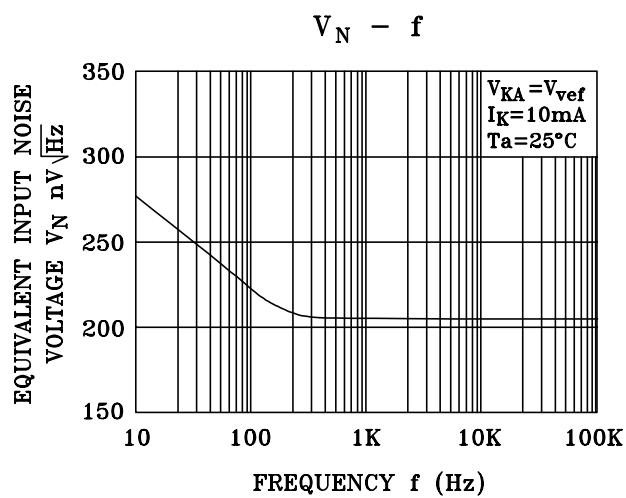
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TEST CIRCUIT FOR VOLTAGE GAIN AND PHASE MARGIN



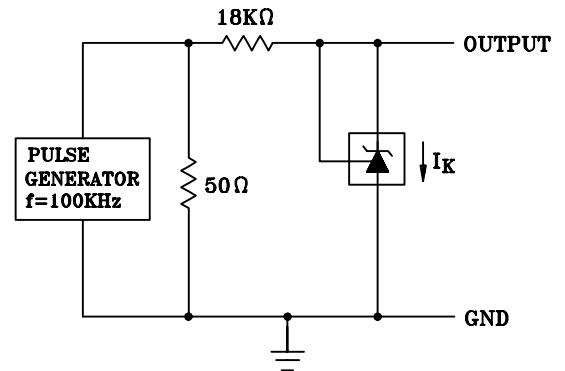
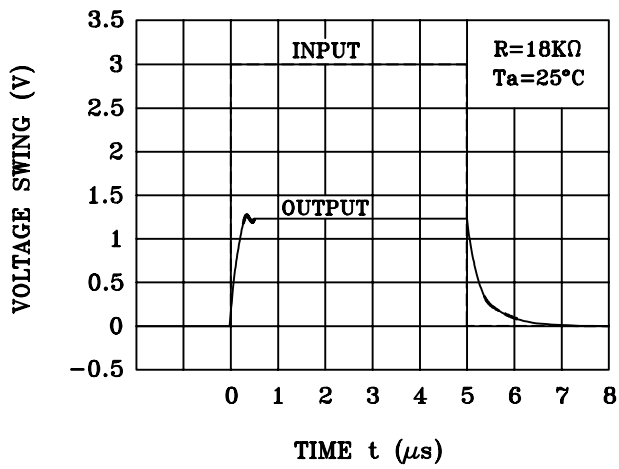
TEST CIRCUIT FOR DYNAMIC IMPEDANCE



TEST CIRCUIT FOR EQUIVALENT NOISE VOLTAGE

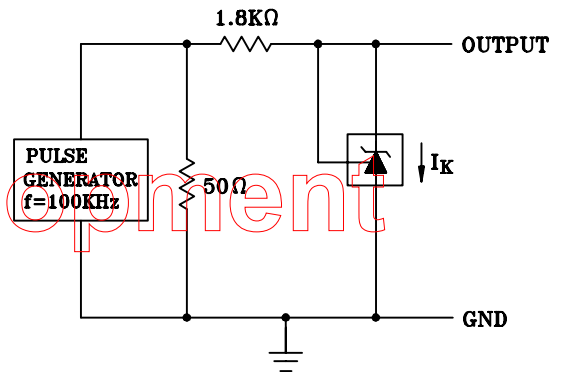
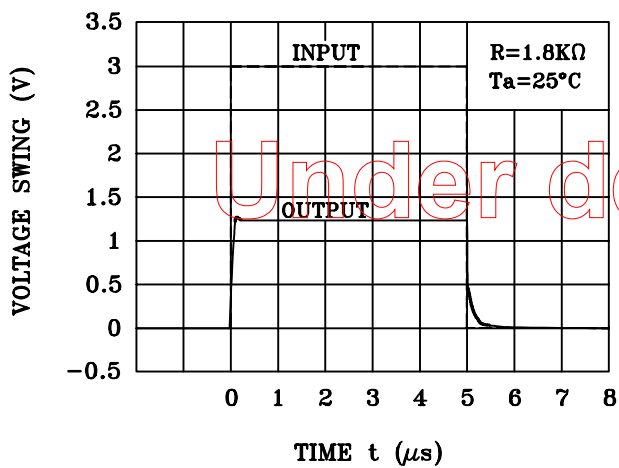
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PULSE RESPONSE-1



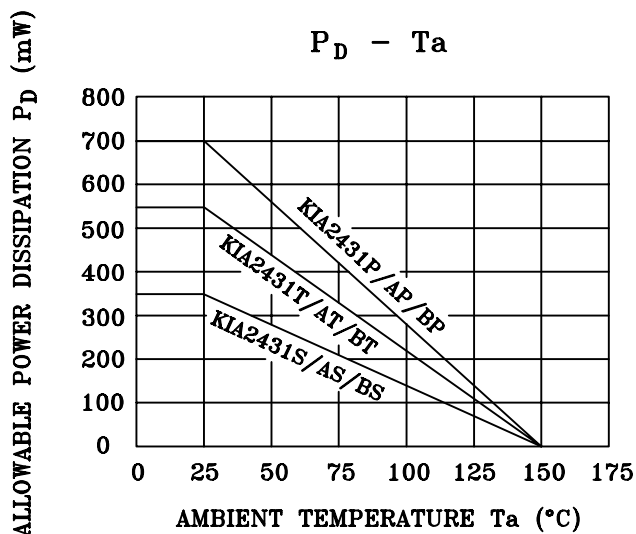
TEST CIRCUIT FOR PULSE RESPONSE2

PULSE RESPONSE-2



TEST CIRCUIT FOR PULSE RESPONSE2

$P_D - T_a$



PRECAUTION FOR USE

SOLDERING

Flat Package (TSM/TSV Package)

Elements mounting styles of electronic devices are gaining in further diversification over recent years, and needs for components are all the more expanding in varieties. Especially, surface mounting is steadily penetrating into industrial segments as a world-wide popular technical trend. Although exposure to high temperature is inevitable during soldering we recommend limiting the soldering temperature to low levels as shown in figure for the sake of retaining inherent excellent reliability.

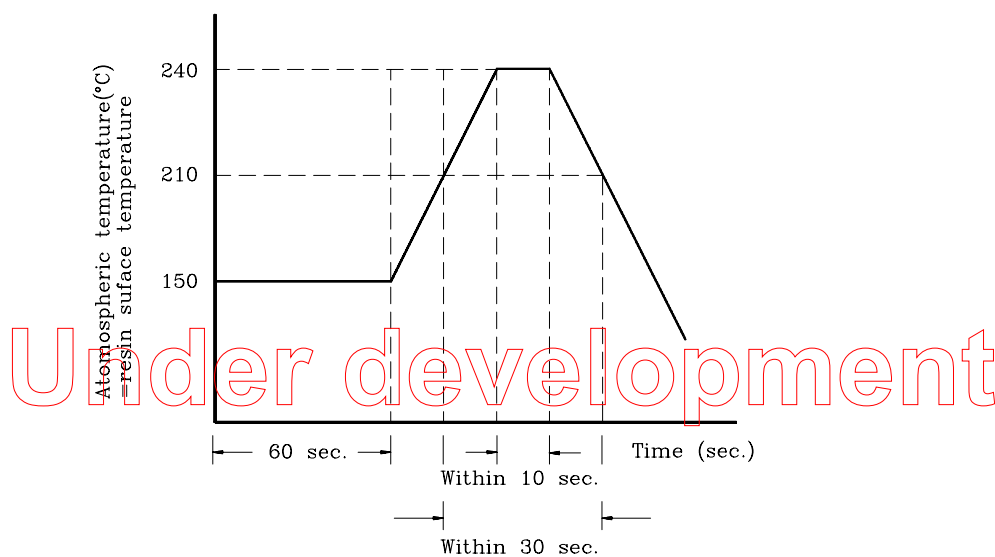


Fig 6

(a) When employing solder reflow method

- ① Atmospheric temperature around resin surfaces must be less than 240°C, not exceeding the time length of 10 sec.
- ② Recommend temperature profile
- ③ Precautions on heating method

When resin is kept exposed to high temperature for a long time, device reliability may be marred. Therefore, it is essential to complete soldering in the shortest time possible to prevent temperature of resin from rising.

(b) When employing halogen lamps or infrared-ray heaters

When halogen lamps or infrared-ray heaters are used, avoid direct irradiation onto resin surfaces; such devices cause extensive localized temperature rise.

※ Please keep a reflow solder operating when TSM/TSV package's soldering.