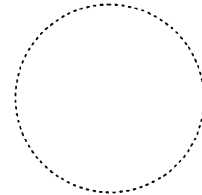


REFERENCE DATA

## SPECIFICATION

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1. Purpose

TK11333M is a low power low saturated linear regulator with a built in electronic switch.

Features

- Internal thermal sensor
- Over current sensor
- Internal electronic switch (Low level on)
- Low noise with external capacitor

2. TOKO Part Number

TK11333M

3. Function

Series regulator (linear type)

4. Applications

Used for power supply

5. Structure

The structure is a silicon monolithic bipolar circuit

6. Package Outline

6Lead—Surface Mount Discrete Package :SOT23L-6

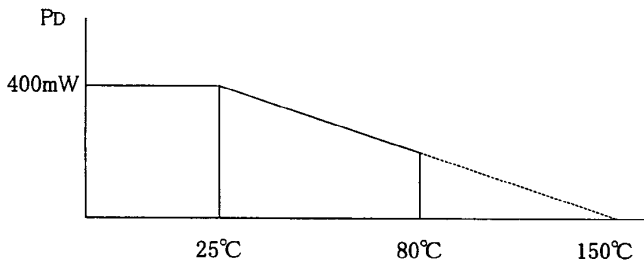
7. Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit	Condition
Supply Voltage	VCC MAX	16	V	
Power Dissipation	Pd	Internal limited		※1
Operating Voltage Range	VOP	1.8 ~ 14	V	
Storage Temperature Range	Tstg	-55 ~ +150	°C	
Operating Temperature Range	TOP	-30 ~ +80	°C	※2
Output Current	IO MAX	240	mA	
Overheat Prevention	TOH	Tj=150	°C	

※1: Maximum junction temperature (Tj) is limited 150°C.

Power dissipation must be derated at rate of 3.2mW/°C for operation at 25°C and over.  
Power dissipation≠400mW (when mounted as recommended). SEE(13.Definition).

※2: Attention, output side capacitor degrade below zero centigrade.



**8. Electrical Characteristics**

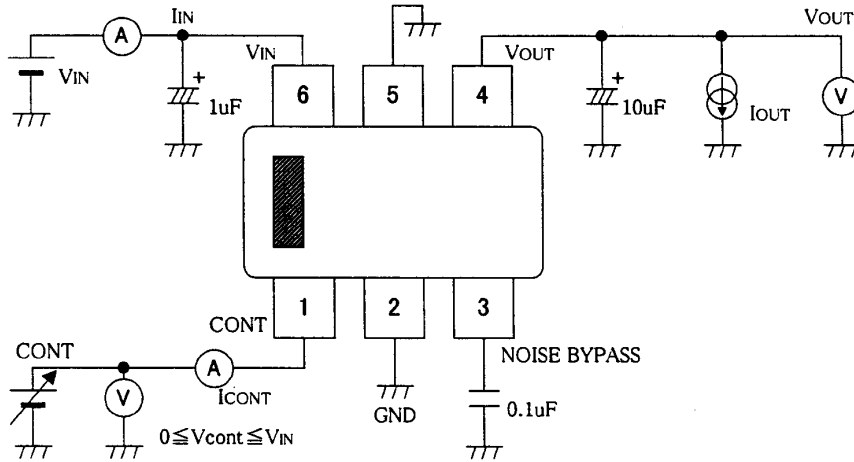
Condition :  $T_a=25^{\circ}\text{C}$ ,  $V_{CC}=4.3\text{V}$ ,  
according to the appointed test circuit.

Parameter	Symbol	Value			Unit	Condition
		MIN	TYP	MAX		
Supply Current	$I_{CC}$		170	350	$\mu\text{A}$	$I_O=0\text{mA}$ , except $I_{CONT}$
Standby Supply Current	$I_{CCS}$			0.1	$\mu\text{A}$	$V_{IN}=8\text{V}$ , Output off
Output Voltage	$V_O$	3.22	3.30	3.38	V	$I_O=30\text{mA}$
Output Current	$I_O$	180	240		mA	Note 1
Recommended Output Current	$I_{OR}$			150	mA	
In/Out Voltage Drop 1	$V_{drop1}$		0.16	0.26	V	$I_O=60\text{mA}$
In/Out Voltage Drop 2	$V_{drop2}$		0.29	0.4	V	$I_O=150\text{mA}$
Line Regulation	$LinReg$		3.0	20	mV	$V_{IN}=4.3\text{V} \rightarrow 9.3\text{V}$
Load Regulation 1	$LoaReg1$		10	50	mV	$I_O=5\text{mA} \sim 60\text{mA}$ Note 2
Load Regulation 2	$LoaReg2$		20	100	mV	$I_O=5\text{mA} \sim 100\text{mA}$ Note 2
Load Regulation 3	$LoaReg3$		30	160	mV	$I_O=5\text{mA} \sim 150\text{mA}$ Note 2
Ripple Rejection	RR		55		dB	100mVrms, $f=400\text{Hz}$ , $I_O=10\text{mA}$
Temperature Dependency of $V_{out}$	$\Delta V_O/\Delta T_a$		0.05		mV/ $^{\circ}\text{C}$	$I_O=10\text{mA}$ , $T_a=-25 \sim +75^{\circ}\text{C}$
Output Noise Voltage	$V_{no}$		30		$\mu\text{Vrms}$	10Hz < f < 100kHz, $I_O=30\text{mA}$ , $C_P=0.1\mu\text{F}$
Control Terminal Specification						
Control Terminal Current	$I_{cont}$		12	30	$\mu\text{A}$	Output ON, $V_{cont}=V_{CC}-1.8\text{V}$
Control Terminal Voltage 1	$V_{cont1}$	0		$V_{CC}-1.8$	V	Output ON
Control Terminal Voltage 2	$V_{cont2}$	$V_{CC}-0.6$		$V_{CC}$	V	Output OFF
Output Rise Time	$T_R$		0.3		nS	$I_O=30\text{mA}$ , $V_{cont}=V_{CC} \rightarrow (V_{CC}-1.8)\text{V}$
Bypass Terminal Voltage			1.25		V	

Note 1:  $I_O$ (Load current) is the measured current when  $V_O$  drops 0.3V with respect to ( $V_O$  at  $I_O=30\text{mA}$ )

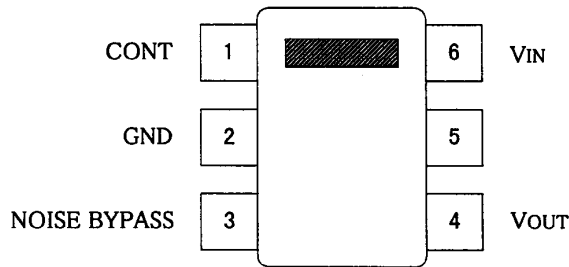
Note 2: This measurement (pulse measurement) is with a constant  $T_j$ .  
The output change due to temperature change is not included.

9. Test Circuit



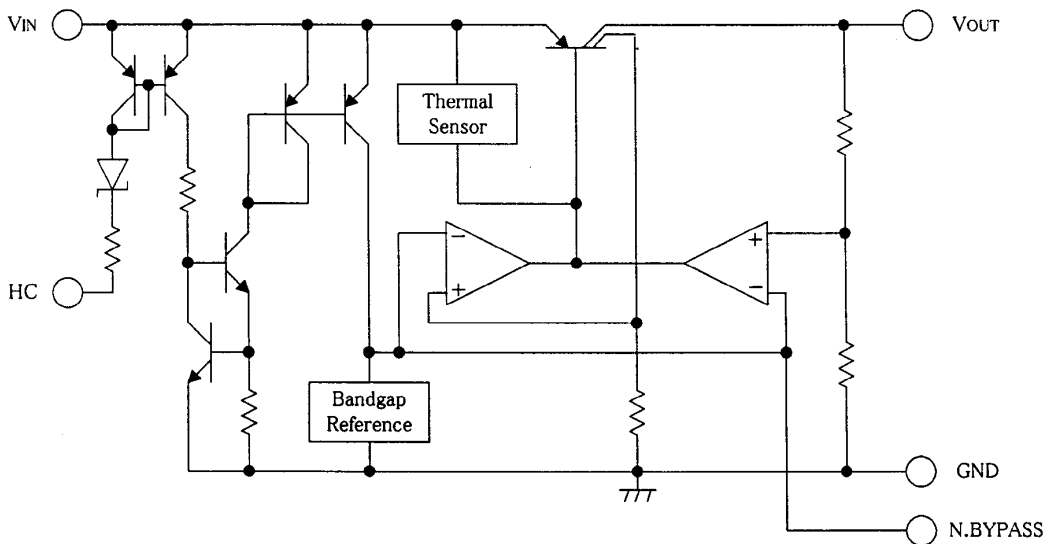
Pin #5 to be grounded for heat dissipation  
 Tantalum capacitor to be used

10. Pin Assignment



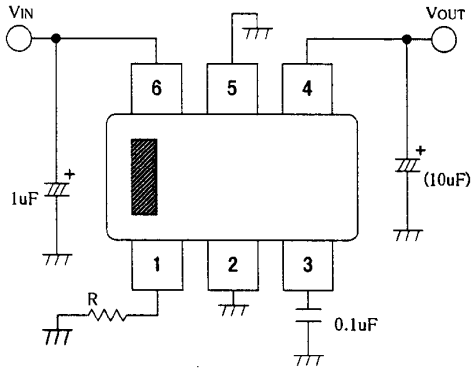
pin #5 to be grounded for heat dissipation

11. Block Diagram



12. Application

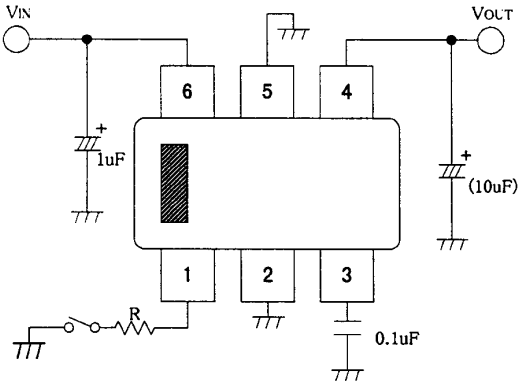
a) No use of control function



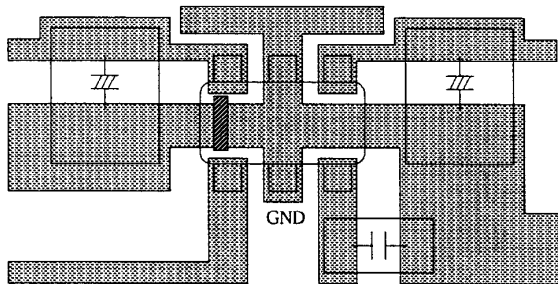
Connect control terminal to GND.  
R is good for quiescent current but bad for operation starting voltage (R:0 Ω ~ 300k Ω)

b) Use control function

(turn on by putting control terminal at the same level as GND)  
(turn off by putting control terminal at the same level as VIN)



Noise pass pin is high impedance, so be careful to external noise if Cp is not used.



Make a large copper pattern as much as possible to have better heat dissipation.  
(pin 5 is heatsink)  
PD=400mW (Mounted as recommended)

Connect the bypass capacitor as close as possible to the GND terminal of IC, otherwise oscillation may occur.  
Use a 2.2uF tantalum capacitor, or 3.3uF electrolytic to ensure stability. (Ta=25°C)  
for low temperatures, select a capacitor with low ESR at the desired temperature range.  
Use as large a capacitor as needed to meet transient, output impedance, and noise requirements.

13. Definition

•Line Regulation (Lin Reg)

The output change against the input voltage change measured at the pulse under the condition of low voltage loss and no influence of average chip temperature.

•Loa Regulation (Loa Reg)

Output voltage change against the load current change at a certain chip temperature.

•Dropout Voltage (VDROP)

The difference between the input voltage and output voltage when the circuit stops stable operation due to the drop of input voltage. It is measured when the output voltage has dropped 100mV from normal value optioned at  $V_{IN}=V_{OUT}+1V$ . It depends on the load current and the temperature of junction.

•Output Noise Voltage

Output noise voltage is the actual AC voltage at an output voltage under the condition that there are no input noise and a certain load current. It is measured at the specified output side capacitance and frequency range.

•Thermal Sensor

The circuit will be “OFF” when the chip temperature rises about 150°C and will be “ON” as soon as the chip temperature decreases. Therefore, if you watch wave form by using a scope, it seems that the output is oscillating.

•Package Power (PD)

It means the input power when the overheat sensor start to activate. The IC device has a built-in heat sensor. The heat sensor is activated when the junction device temperature ( $T_j$ ) reaches to approximately 150°C. The loss, which is equivalent to difference between input power ( $V_{IN} \times I_{IN}$ ) and the output power ( $V_{OUT} \times I_{OUT}$ ), causes the device temperature to rise. The value of the temperature rise depends on the circuit board, the PCB pattern, the materials of PCB and the ambient temperature. When the radiation of heat is good, the device temperature will be low even if the power loss is great.

With the recommended PCB pattern the loss is greater than 400mW. We believe the loss of approximately 400mW is acceptable at the design stage. In this case, at an ambient temperature of above 25°C, power dissipation must be derated at 3.2mW/°C.

To find the PD when mounted, mount the IC on the PCB, then deliberately increase the output current or raise the input voltage to activate the overheat sensor circuit and calculate the PD (Input Power—Output Power) when the circuit is activated.

When taking the required measurements, be sure to allow for the ambient temperature of the PCB.

The value obtained by dividing the PD by  $[150 - T_a]$ °C is the rate of derating per degree.

Try to ensure good heat release to reduce temperature.

Generally as the lower the temperature of element, the better the reliability of the device.

**•Input/Output Decoupling Capacitor Considerations**

Voltage regulators require input and output decoupling capacitors. The exact value of these capacitors can change with the particular application and other factors.

Capacitors made by different manufacturers may have different characteristics, particularly with regard to high frequencies and equivalent series resistance (ESR) over temperature.

The type of capacitor used is also important, while a 3.3 $\mu$ F aluminum electrolytic may be required for certain application, a tantalum capacitor of 2.2 $\mu$ F would work just as well.

It is necessary to pay special attention to the temperature characteristics of the decoupling capacitors.

TOKO's regulators are designed to operate at a temperature as low as  $-40^{\circ}\text{C}$ , while all capacitors may not operate properly at this temperature.

The capacitance of many aluminum electrolytic capacitors may decrease to 0 at low temperatures. This can cause oscillation on the output of the regulator since capacitance is required to guarantee stability.

Therefore, the capacitor must be rated to the lowest expected operating temperature of the regulator circuit.

The other critical operating parameter for decoupling capacitors is ESR (equivalent series resistance).

The lowest ESR capacitor you can afford should be used. The ESR will increase with temperature.

Tantalum capacitors have lower ESR than aluminum capacitors as a rule, but low ESR electrolytic that compare with tantalums are now available from several manufacturers.

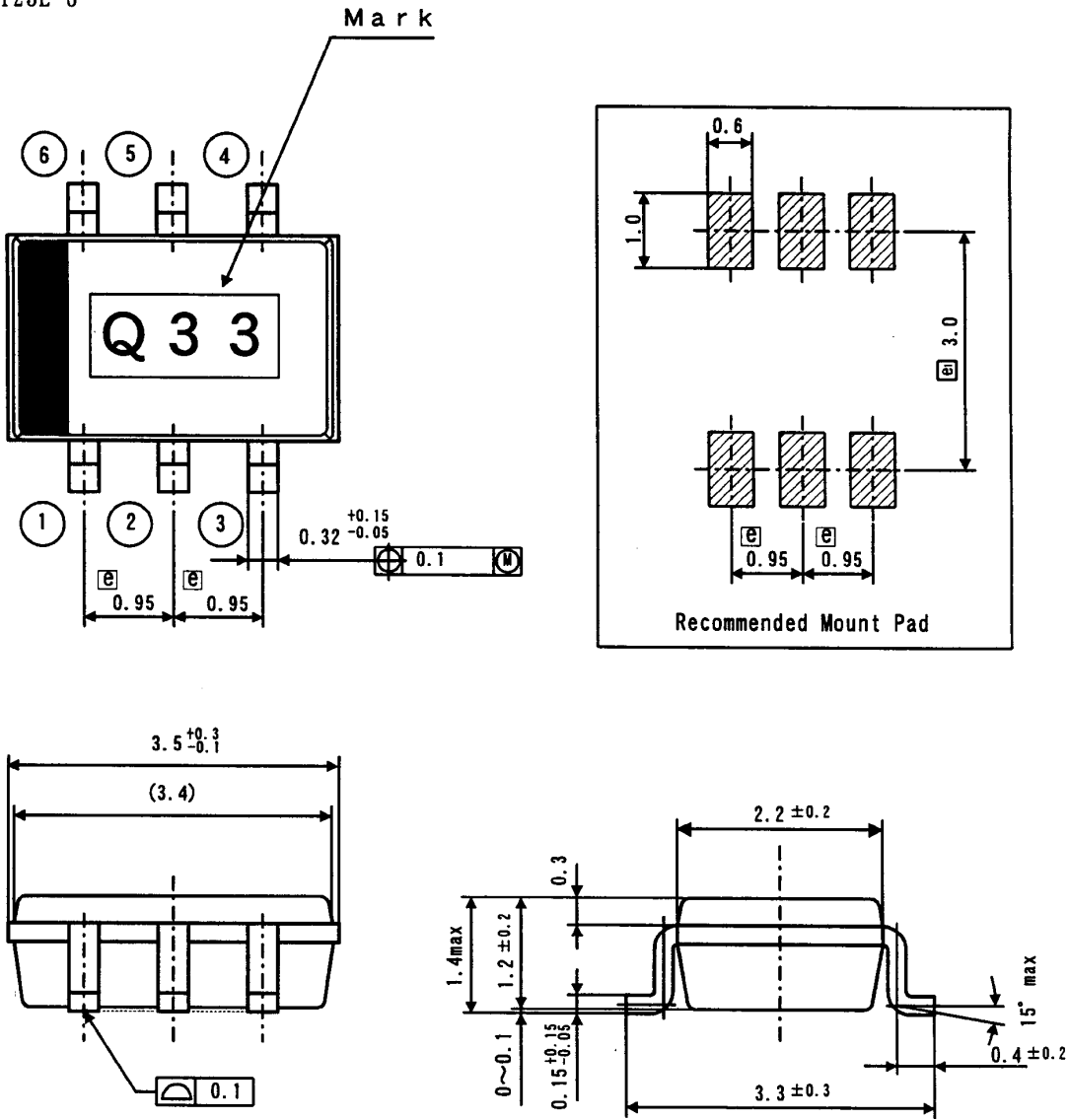
Usually a bench test is sufficient to determine the minimum capacitance required for a particular application.

When this capacitance is determined, taking into consideration can be set as two times the minimum capacitance. This will be the approximate value listed in the application manual.

Regulators with low voltage output have high internal loop gain. This requires special care to guard against oscillation due to insufficient decoupling capacitance. The use of high quality decoupling capacitors suited for your particular application will guarantee proper operation of your regulator circuit.

14. Package Outline Dimensions/Marking

SOT23L-6



- |                    |                           |
|--------------------|---------------------------|
| Molded Resin       | : Epoxy Resin             |
| Lead Frame         | : 42 Alloy                |
| Terminal Treatment | : Solder Plating(5~15 μm) |
| Mark Method        | : Ink                     |
| Country of Origin  | : Korea                   |
| Weight             | : 0.021 g                 |

Unit : mm  
 General Tolerance : ±0.2



15. Cautions

15-1. WARNING - Life support applications policy

TOKO,INC. products shall not be used within any life support systems without the specific written consent of TOKO,INC. A life support system is a product or system intended to support or sustain life which, if it fails, can be reasonably expected to result in a significant personal injury or death.

15-2. Examples of characteristics given here are typical for each product and being technical data, these do not constitute a guarantee of characteristics or conditions of use.

The circuits shown in this specification are intended to explain typical applications of the products concerned. Accordingly, TOKO is not responsible for any circuit problems, nor for any infringement of third party patents or any other intellectual property rights that may arise from the use of these circuits. Moreover, this catalog does not signify that TOKO agrees implicitly or explicitly to license any patent rights or other intellectual property rights which it holds.

15-3. This part is not designed for anti-nuclear radiation structure.

Please do not use this part in an environment where nuclear radiation may occur.

15-4. We may not accept the return of parts damaged by careless handling.

16. Others

16-1. No Ozone Depleting Substances were used in the manufacture of these parts.

16-2. No material used in this part contains brominated PBBOs or PBBs as the flame-retardant.

16-3. In the event of any confusion concerning this "Specifications", both parties shall settle such confusion through reasonable discussions.

16-4. The announcement number of CISTEC list is as follows.

TK113\*\*\*\*\* No. : 0002500010000014 Announcement time : September 1992

16-5. For the cautions to storage and device mounting, please refer to the Quality Specification No. QH7-B106.

16-6. For the package, please refer to the Package Specification No. DP3-F016.