PQ1CY1032Z

TO-263 Surface Mount Type Chopper Regulator

■ Features

1. Maximum switching current:3.5A
2. Built-in ON/OFF control function
3. Built-in soft start function to suppress overshoot of output voltage in power on sequence or ON/OFF control sequence
4. Built-in oscillation circuit
   (Oscillation frequency:TYP. 150kHz)
5. Built-in overheat protection function
6. Built-in overcurrent shut-down function
7. TO-263 package
8. **PQ1CY1032ZZ**:Sleeve-packaged product
   PQ1CY1032ZP:Tape-packaged product
9. Variable output voltage
   (Output variable range:V_{ref} to 35V/−V_{ref} to −30V)
   [Possible to select step-down output/inversing output

■ Applications

1. LCD monitors
2. Car navigation systems
3. Switching power supplies

■ Absolute Maximum Ratings

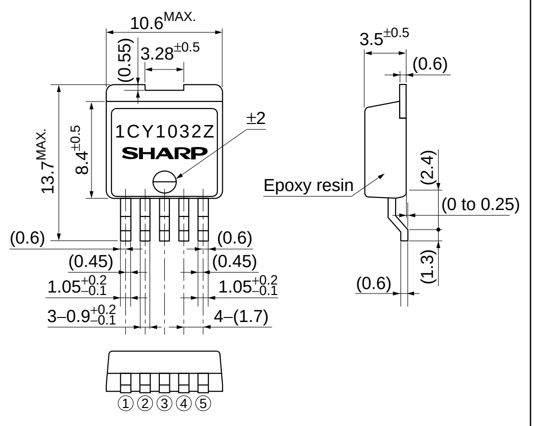
(Ta=25°C)

Parameter	Symbol	Rating	Unit
*1 Input voltage	V_{IN}	40	V
Error input voltage	V_{ADJ}	7	V
Input-output voltage	V_{I-O}	41	V
*2 Output to COM voltage	V_{OUT}	−1	V
*3 V_{soft} terminal voltage	V_{soft}	−0.3 to +40	V
Switching current	I_{SW}	3.5	A
*4 Power dissipation	P_D	35	W
*5 Junction temperature	T_j	150	˚C
Operating temperature	T_{opr}	−20 to +85	˚C
Storage temperature	T_{stg}	−40 to +150	˚C
*6 Soldering temperature	T_{sol}	260	˚C

*1 Voltage between V_{IN} terminal and COM terminal
*2 Voltage between V_{OUT} terminal and COM terminal
*3 Voltage between V_{SOFT} terminal and COM terminal
*4 P_D:With infinite heat sink
*5 Over heat protection may operate at the condition T_j=125˚C to 150˚C
*6 For 10s

■ Outline Dimensions

(Unit : mm)



① V_{IN}
② V_{OUT}
③ COM (Common to heat sink)
④ O_{adj}
⑤ V_{soft}

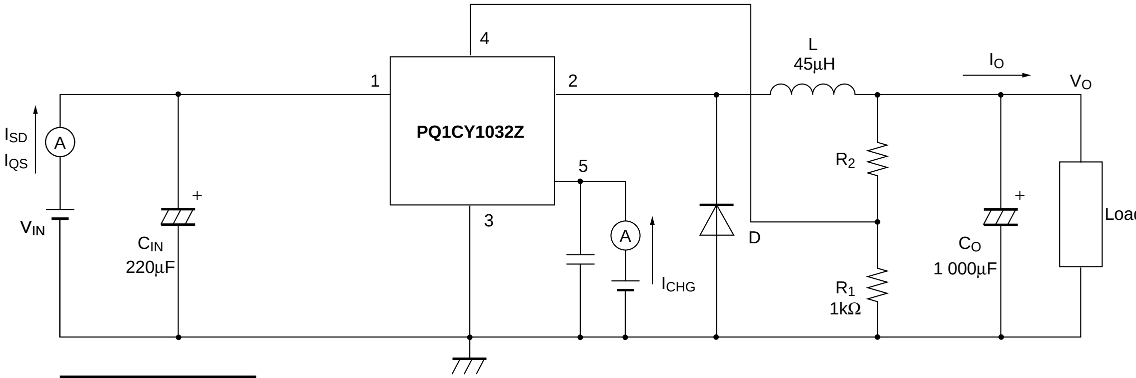
❋ (　) : Typical dimensions

■ Electrical Characteristics

(Unless otherwise specified, condition shall be V_{IN}=12V, I_O=0.5A, V_O=5V, V_{soft} terminal=0.1µF, Ta=25˚C)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Output saturation voltage	V_{SAT}	I_{SW}=3A	–	1.4	1.8	V
Reference voltage	V_{ref}	–	1.235	1.26	1.285	V
Reference voltage temperature fluctuation	ΔV_{ref}	T_j=0 to 125˚C	–	±0.5	–	%
Load regulation	$\lvert R_{eg}L \rvert$	I_O=0.5 to 3A	–	0.2	1.5	%
Line regulation	$\lvert R_{eg}I \rvert$	V_{IN}=8 to 35V	–	1	2.5	%
Efficiency	η	I_O=3A	–	80	–	%
Oscillation frequency	f_O	–	135	150	165	kHz
Oscillation frequency temperature fluctuation	Δf_O	T_j=0 to 125˚C	–	±2	–	%
Overcurrent detection level	I_L	–	3.6	4.2	5.8	A
Charge current	I_{CHG}	②,④ terminals is open, ⑤ terminal	–	–10	–	µA
Input threshold voltage	V_{THL}	Duty ratio=0%, ④ terminal=0V, ⑤ terminal	–	1.3	–	V
	V_{THH}	Duty ratio=100%, ④ terminals is open, ⑤ terminal	–	2.3	–	V
ON threshold voltage	$V_{TH(ON)}$	④ terminal=0V, ⑤ terminal	0.7	0.8	0.9	V
Overcurrent shutdown threshold voltage	V_{THIL}	⑤ terminal	3.8	4.6	5.5	V
Stand-by current	I_{SD}	V_{IN}=40V, ⑤ terminal=0V	–	140	400	µA
Output OFF-state consumption current	I_{QS}	V_{IN}=40V, ⑤ terminal=0.9V	–	8	16	mA

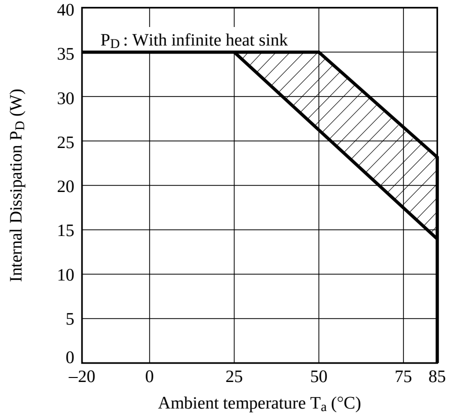
Fig.1 Standard Test Circuit



5 terminal	V_O output
LOW	OFF
HIGH	ON
OPEN	ON

L : HK-10S100-4500 (made by Toho Co.)
D :ERC80-004 (made by Fuji electronics Co.)

Fig.2 Internal Dissipation vs. Ambient Temperature



Note) Oblique line prtion:Overheat protection may operate in this area

Fig.3 Overcurrent Protection Characteristics (Typical Value)

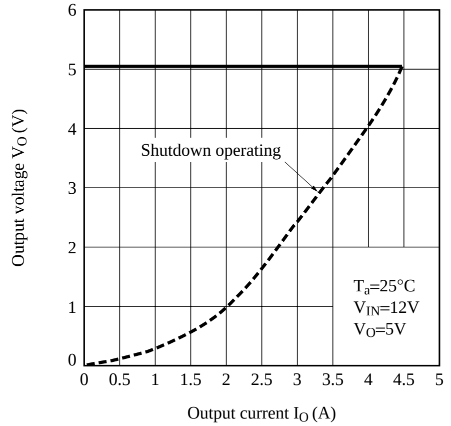


Fig.4 Efficiency vs. Input Voltage

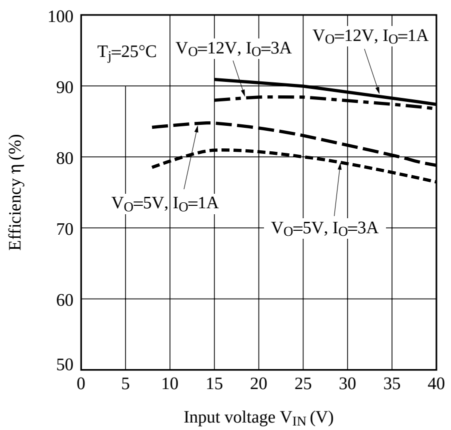


Fig.5 Switching Current vs. Output Saturation Voltage

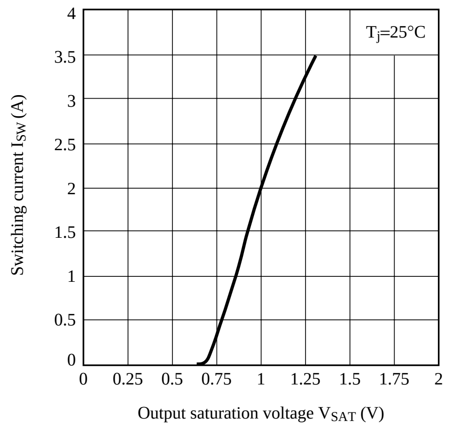


Fig.6 Operating Consumption Current vs. Input Voltage

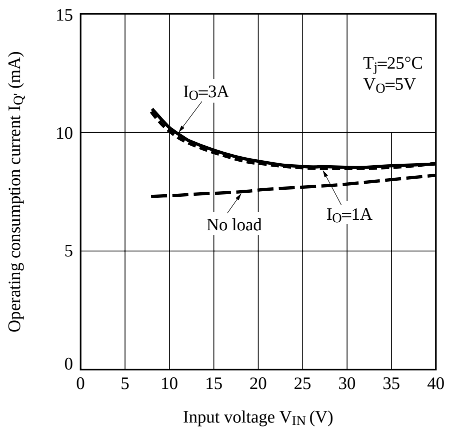


Fig.7 Reference Voltage Fluctuation vs. Junction Temperature

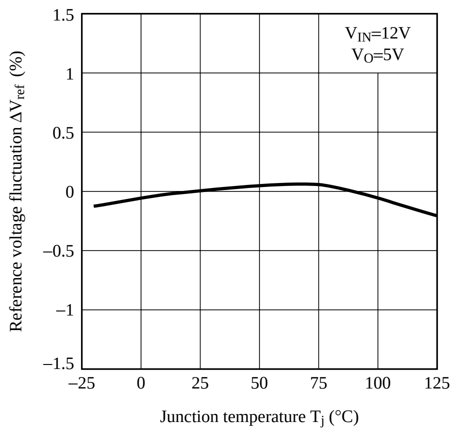


Fig.8 Load Regulation vs. Output Current

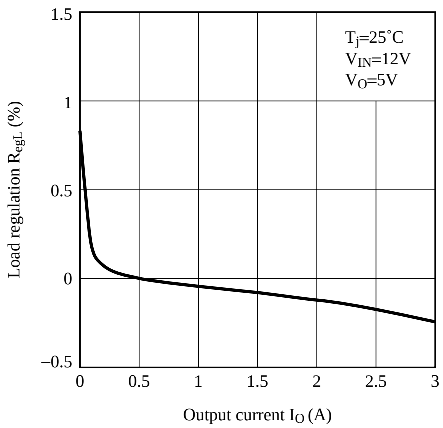


Fig.9 Line Regulation vs. Input Voltage

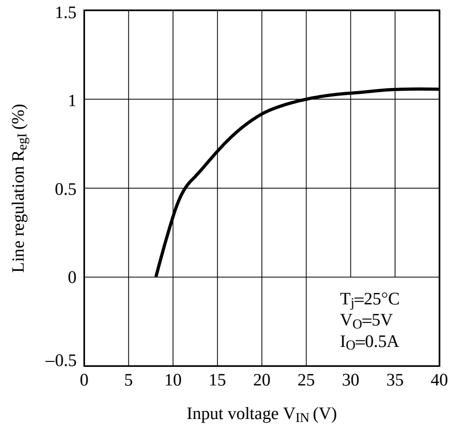


Fig.10 Oscillation Frequency Fluctuation vs. Junction Temperature

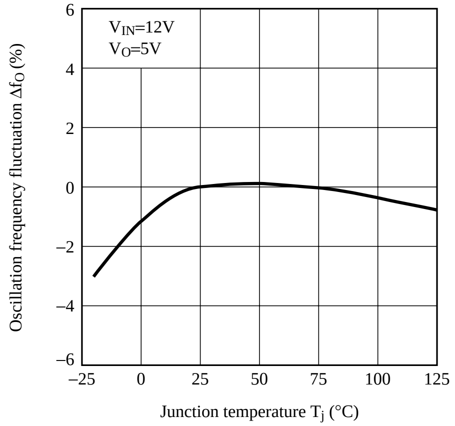


Fig.11 Overcurrent Detection Level Fluctuation vs. Junction Temperature

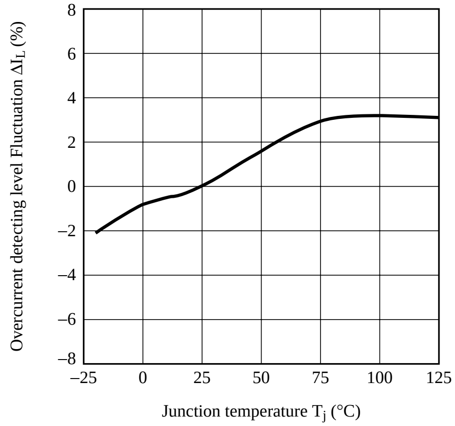


Fig.12 On Threshold Voltage vs. Junction Temperature

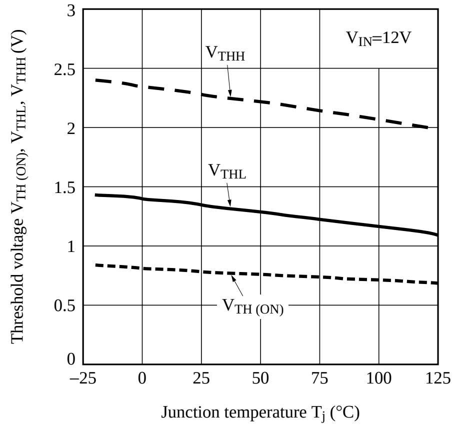


Fig.13 Overcurrent Shutdown Threshold Voltage vs. Junction Temperature

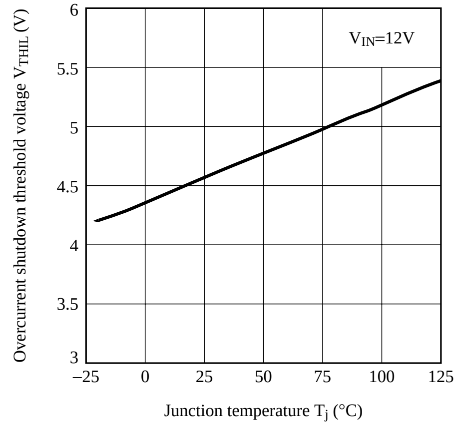
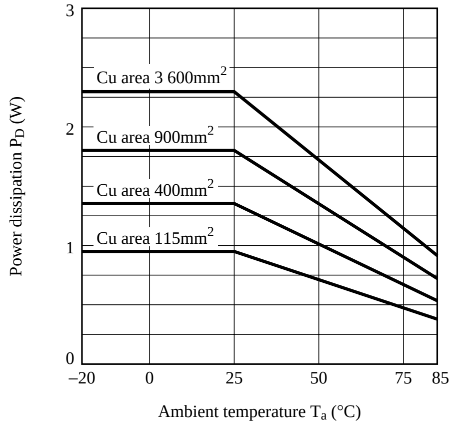
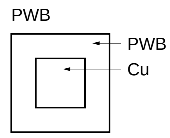


Fig.14 Power Dissipation vs. Ambient Temperature (Typical Value)





Material : Glass-cloth epoxy resin
Size : 60×60×1.6mm
Cu thickness : 65µm

Fig.15 Block Diagram

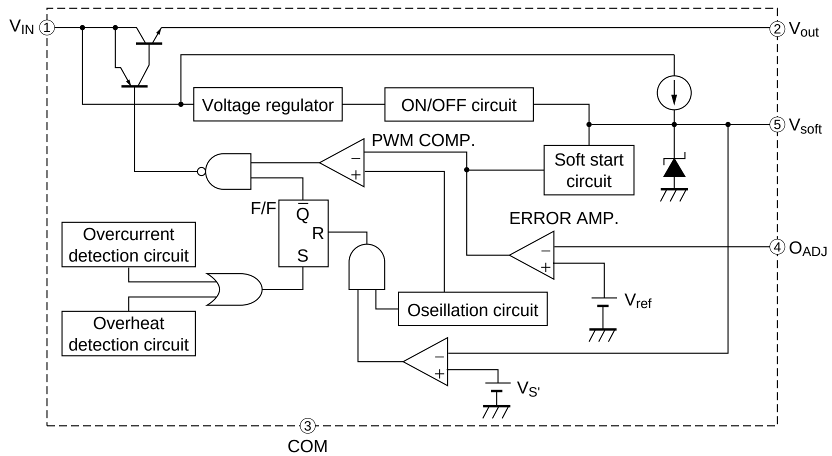


Fig.16 Step Down Type Circuit Diagram

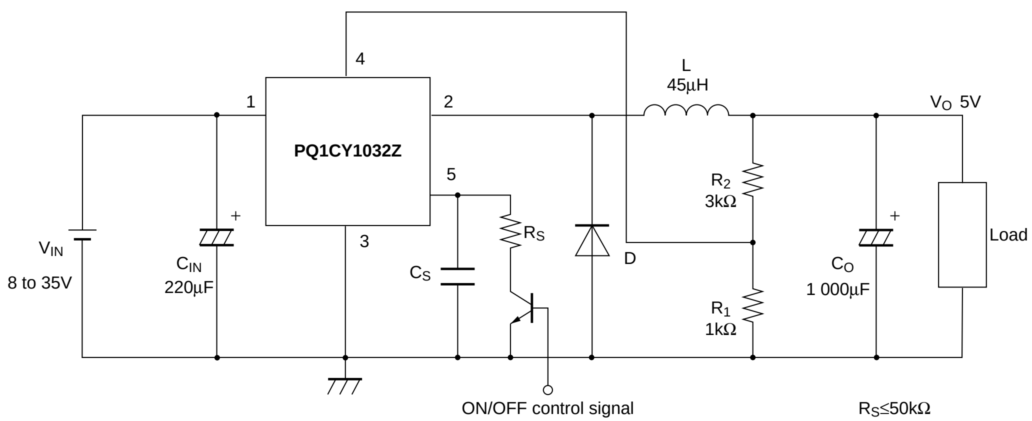
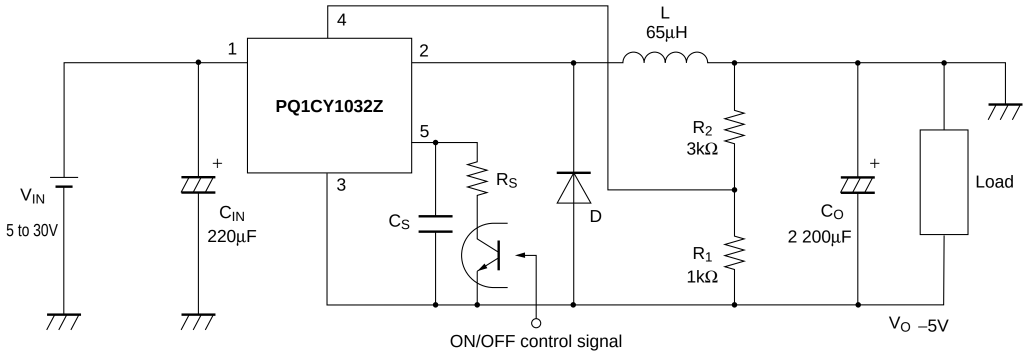
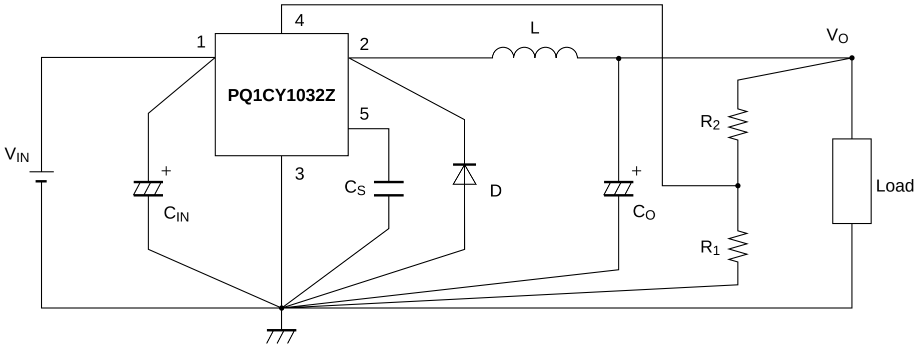


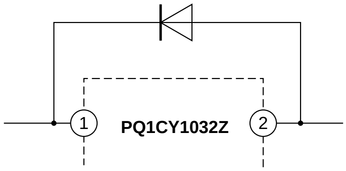
Fig.17 Polarity Inversion Type Circuit Diagram



■ Precautions for Use



1. External connection
   (1) Wiring condition is very important. Noise associated with wiring inductance may cause problems.
   For minimizing inductance, it is recommended to design the thick and short pattern (between large current diodos, input/output capacitors, and terminal 1,2.) Single-point grounding (as indicated) should be used for best results.
   (2) High switching speed and low forward voltage type schottky barrier diode should be recommended for the catch-diode D because it affects the efficiency. Please select the diode which the current rating is at least 1.2 times greater than maximum swiching current.
   (3) The output ripple voltage is highly influenced by ESR (Equivalent Series Resistor) of output capacitor, and can be minimized by selecting Low ESR capacitor.
   (4) An inductor should not be operated beyond its maximum rated current so that it may not saturate.
   (5) When voltage that is higher than V_{IN} ①, is applied to V_{OUT} ②, there is the case that the device is broken. Especially, in case V_{IN} ① is shorted to GND in normal condition, there is the case that the device is broken since the charged electric charge in output capacitor (C_O) flows into input side. In such case a schottly barrier diode or a silicon diode shall be recommended to connect as the following circuit.



Thermal Protection Design

Internal power dissipation(P)of device is generally obtained by the following equation.

$$P = I_{SW}(\text{Average.}) \times V_{SAT} \times D' + V_{IN}(\text{voltage between } V_{IN} \text{ to COM terminal}) \times I_Q'(\text{consumption current})$$

Step down type

$$D'(\text{Duty}) = \frac{T_{on}}{T(\text{period})} = \frac{V_O + V_F}{V_{IN} - V_{SAT} + V_F}$$

$$I_{SW}(\text{Average}) = I_O(\text{Output current.})$$

Polarity inversion type

$$D'(\text{Duty}) = \frac{T_{on}}{T(\text{period})} = \frac{|V_O| + V_F}{V_{IN} + |V_O| - V_{SAT} + V_F}$$

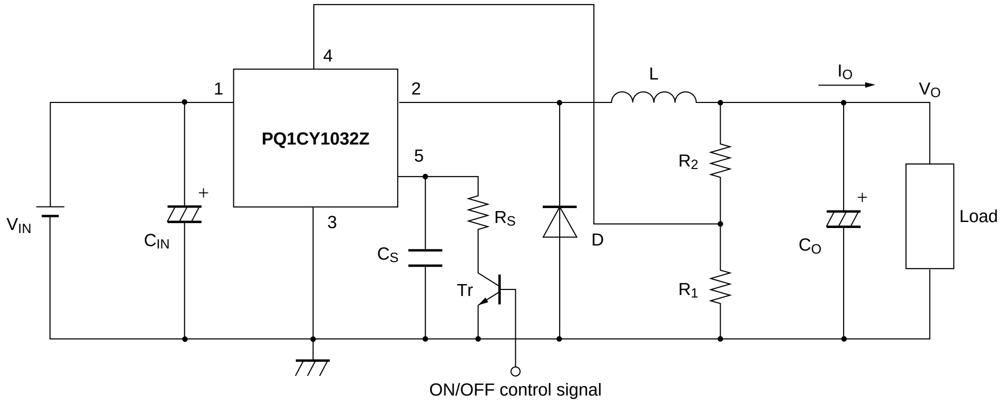
$$I_{SW}(\text{Average}) = \frac{1}{1 - D'} \times I_O(\text{Output current.})$$

V_F : Forward voltage of the diode

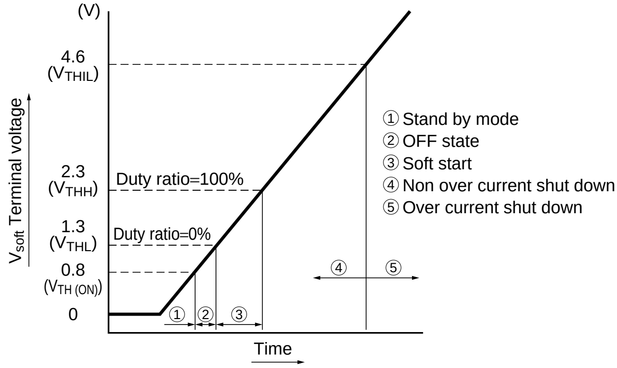
When ambient temperature Ta and power dissipation P_D(MAX)during operation are determined, use Cu plate which allows the element to operate within the safety operation area specified by the derating curve. Insufficient radiation gives an unfavorable influence to the normal operation and reliability of the device.

ON/OFF Control Terminal

1. In the following circuit,when V_{soft} terminal⑤becomes low (loss than V_{THON}) by switching transistor Tr on, output voltage may be turned OFF and the device becomes stand-by mode. Dissipation current at stand-by mode becomes Max.400µA.
   When transistor Tr becomes OFF, output voltage can be ON.
   External resistor Rs should be leaded to avold discharge current of C_S, and not to break the transistor Tr.
2. Soft startup
   When capacitor C_S is loaded, output pulse gradually expanded and output voltage will start softly.
3. Over current protection
   When the voltage of V_{soft}⑤is more than V_{THIL}, over current shut down function will operate. And when the voltage of V_{soft}⑤is less than V_{THIL}, over current protection function will operate. Since the **PQ1CY1032Z** must use an capacitor C_S, V_{soft}⑤should be more than V_{THIL}, over current shut down function will operate.



■ ON-OFF Terminal Voltage vs. Time



NOTICE