

# PQ1CZ21H2Z

## Low Dissipation Current at OFF-state Chopper Regulator

### ■ Features

1. Maximum switching current:1.5A
2. Low dissipation current at OFF-state ( $I_{qs}=\text{Max. } 1\mu\text{A}$ )
3. Built-in oscillation circuit  
(Oscillation frequency:TYP.100kHz)
4. Built-in overheat/overcurrent protection function
5. Variable output voltage  
(Output variable range: $V_{\text{ref}}$  to  $35V/-V_{\text{ref}}$  to  $-30V$ )  
[Possible to select step-down output/inverting output according to external connection circuit]  
**PQ1CZ21H2ZZ**:sleeve-packaged product  
**PQ1CZ21H2ZP**:tape-packaged product

### ■ Applications

1. Facsimiles
2. Printers
3. Switching power supplies

### ■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
*1 Input voltage	$V_{\text{IN}}$	40	V
Output adjustment terminal voltage	$V_{\text{ADJ}}$	7	V
Dropout voltage	$V_{\text{I-O}}$	41	V
*2 Output-COM voltage	$V_{\text{OUT}}$	-1	V
*3 ON/OFF control voltage	$V_{\text{C}}$	-0.3 to +40	V
Switching current	$I_{\text{SW}}$	1.5	A
*4 Power dissipation	$P_{\text{D}}$	8	W
*5 Junction temperature	$T_{\text{J}}$	150	°C
Operating temperature	$T_{\text{opr}}$	-40 to +85	°C
Storage temperature	$T_{\text{stg}}$	-40 to +150	°C
*6 Soldering temperature	$T_{\text{sol}}$	260	°C

\*1 Voltage between  $V_{\text{IN}}$  terminal and COM terminal

\*2 Voltage between  $V_{\text{OUT}}$  terminal and COM terminal

\*3 Voltage between ON/OFF control and COM terminal

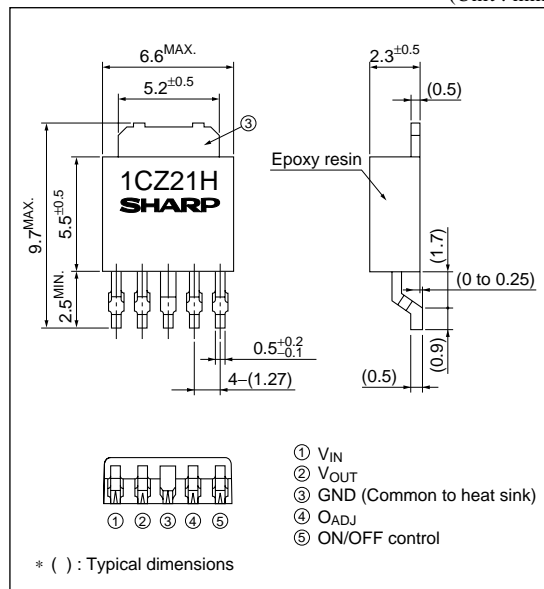
\*4  $P_{\text{D}}$ :With infinite heat sink

\*5 Overheat protection may operate at the condition  $T_{\text{J}}$ :125°C to 150°C

\*6 For 10s

### ■ Outline Dimensions

(Unit : mm)

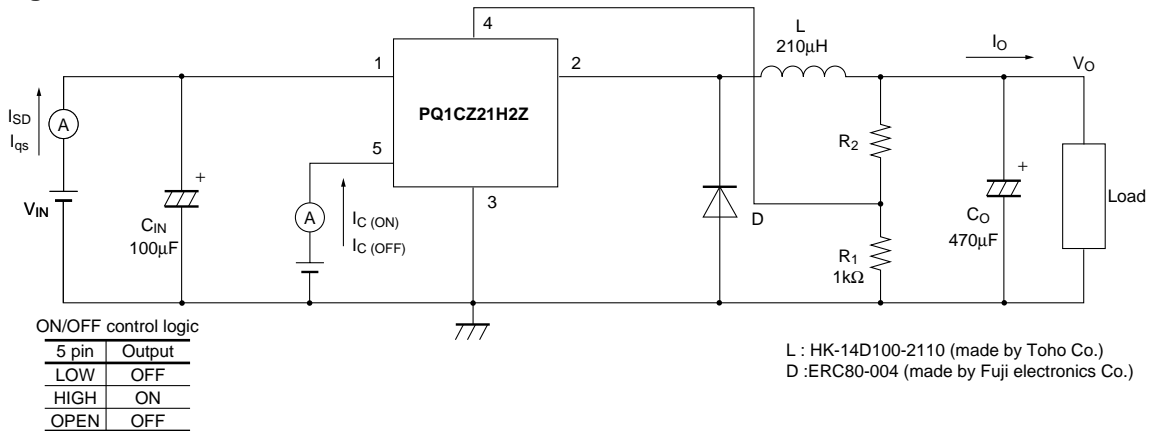


**Electrical Characteristics**

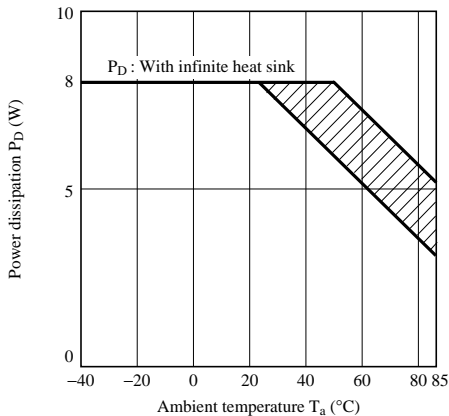
(Unless otherwise specified, condition shall be  $V_{IN}=12V$ ,  $I_o=0.2A$ ,  $V_o=5V$ , ON-OFF terminal=2.7V,  $T_a=25^\circ C$ )

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Output saturation voltage	$V_{SAT}$	$I_{sw}=1A$	—	0.9	1.5	V
Reference voltage	$V_{ref}$	—	1.235	1.26	1.285	V
Reference voltage temperature fluctuation	$\Delta V_{ref}$	$T_j=0$ to $125^\circ C$	—	$\pm 0.5$	—	%
Load regulation	$ R_{egL} $	$I_o=0.2$ to $1A$	—	0.1	1.5	%
Line regulation	$ R_{egI} $	$V_{IN}=8$ to $35V$	—	0.5	2.5	%
Efficiency	$\eta$	$I_o=1A$	—	82	—	%
Oscillation frequency	$f_o$	—	80	100	120	kHz
Oscillation frequency temperature fluctuation	$\Delta f_o$	$T_j=0$ to $125^\circ C$	—	$\pm 3$	—	%
Overcurrent detecting level	$I_L$	No L, C, D	1.55	2	2.6	A
ON threshold voltage	$V_{TH(ON)}$	④ terminal=0V, ⑤ terminal	0.8	1.5	2	V
Output ON control current	$I_C(ON)$	⑤ terminal=2.7V	—	—	200	$\mu A$
Output OFF control current	$I_C(OFF)$	⑤ terminal=0.4V	—	—	2	$\mu A$
Stand-by current	$I_{SD}$	$V_{IN}=40V$ , ⑤ terminal=0V	—	—	1	$\mu A$
Output OFF-state consumption current	$I_{QS}$	$V_{IN}=40V$ , ④ terminal=3V	—	8	12	mA

**Fig.1 Standard Test Circuit**



**Fig.2 Power Dissipation vs. Ambient Temperature**



**Fig.3 Overcurrent Protection Characteristics (Typical value)**

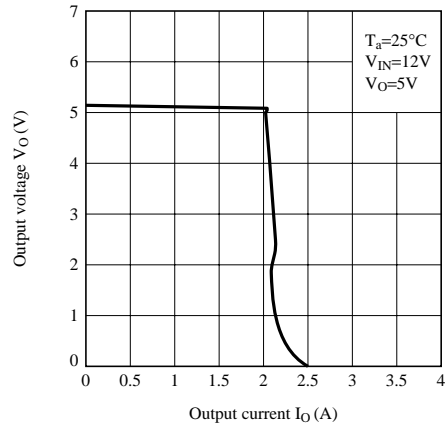


Fig.4 Efficiency vs. Input Current

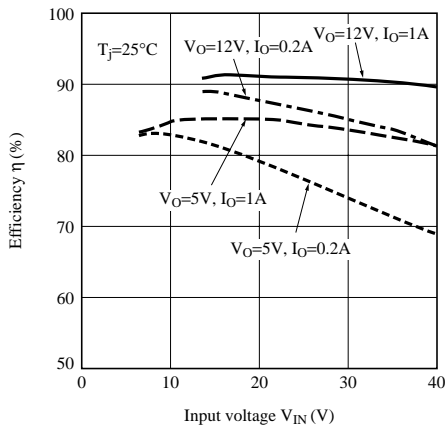


Fig.5 Switching Current vs. Output Saturation Voltage

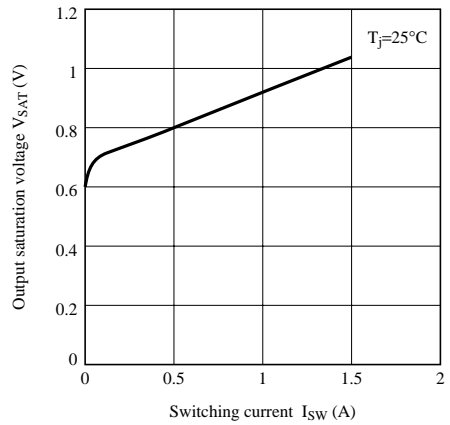


Fig.6 Reference Voltage Fluctuation vs. Junction Temperature

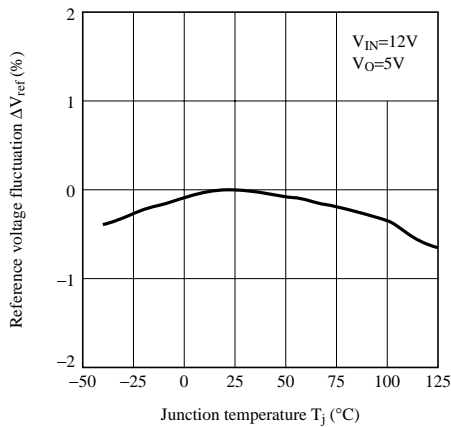


Fig.7 Load Regulation vs. Output Current

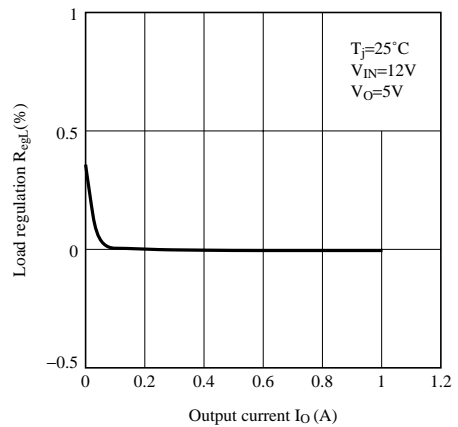


Fig.8 Line Regulation vs. Input Voltage

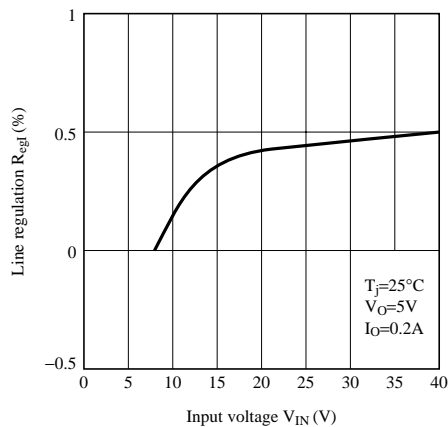
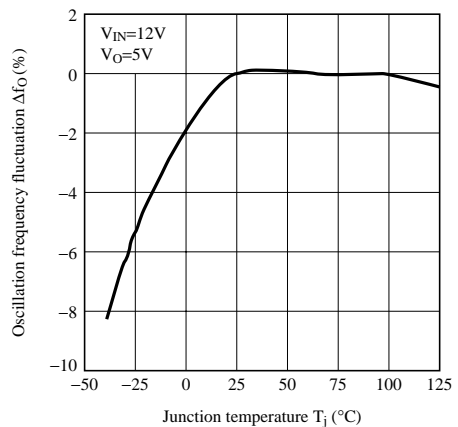
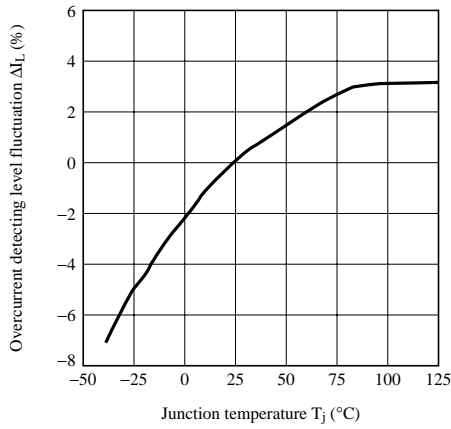


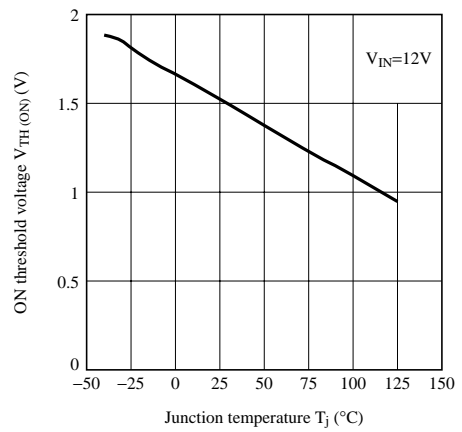
Fig.9 Oscillation Frequency Fluctuation vs. Junction Temperature



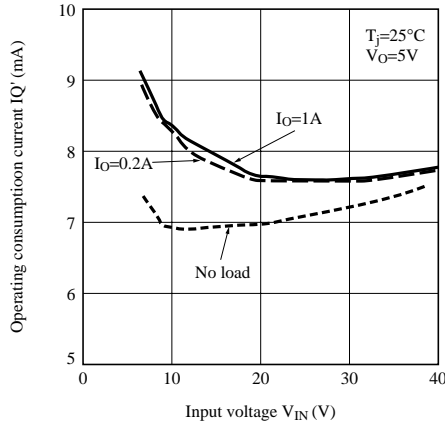
**Fig.10 Overcurrent Detection Level Fluctuation vs. Junction Temperature**



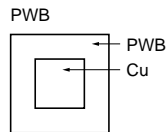
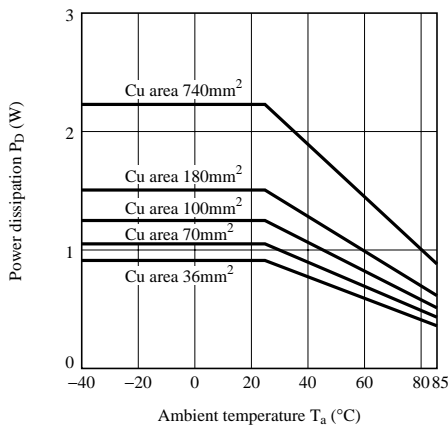
**Fig.11 ON Threshold Voltage vs. Junction Temperature**



**Fig.12 Operating Consumption Current vs. Input Voltage**

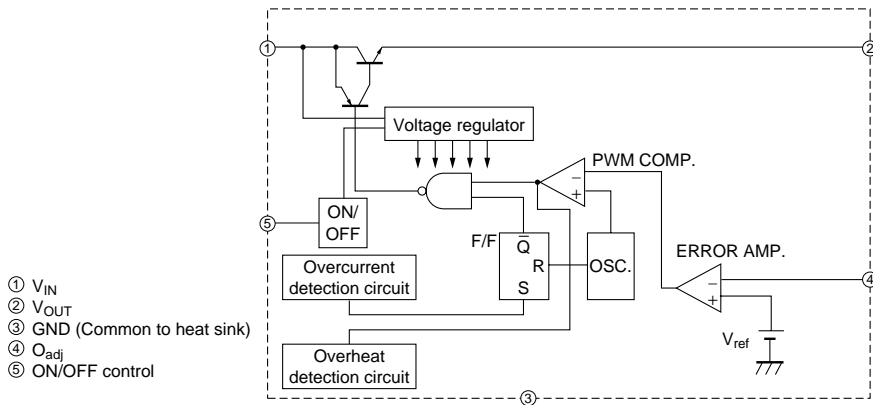


**Fig.13 Power Dissipation vs. Ambient Temperature (Typical Value)**



Material : Glass-cloth epoxy resin  
 Size : 50×50×1.6mm  
 Cu thickness : 35μm

Fig.14 Block Diagram



- ①  $V_{IN}$
- ②  $V_{OUT}$
- ③ GND (Common to heat sink)
- ④  $O_{adj}$
- ⑤ ON/OFF control

Fig.15 Step Down Type Circuit Diagram (5V output)

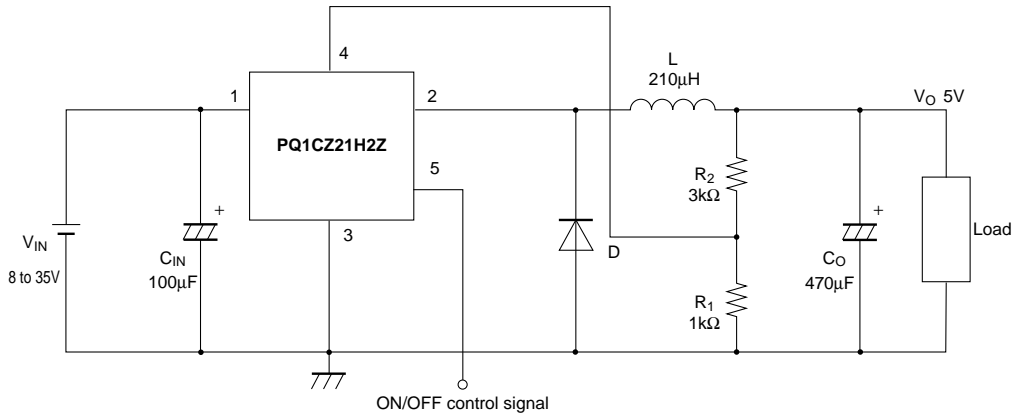
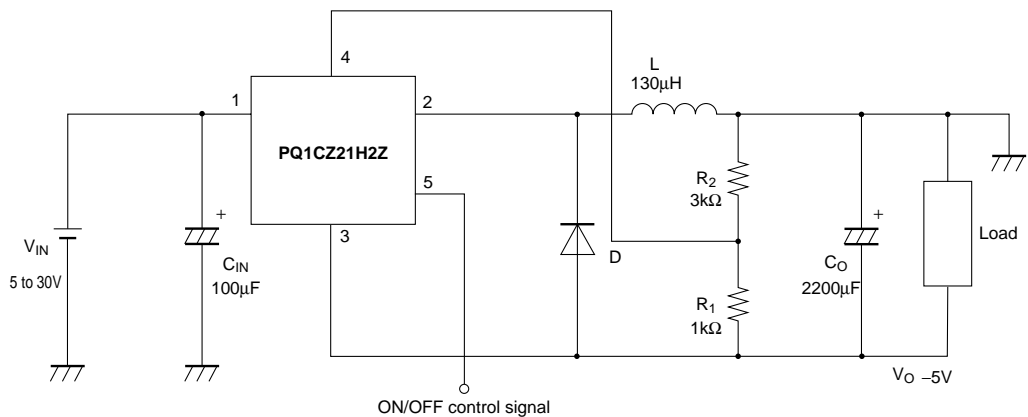


Fig.16 Polarity Inversion Type Circuit Diagram (-5V output)



## ■ Precautions for Use

### 1. External connection

- (1) Wiring condition is very important. Noise associated with wiring inductance may cause problems.

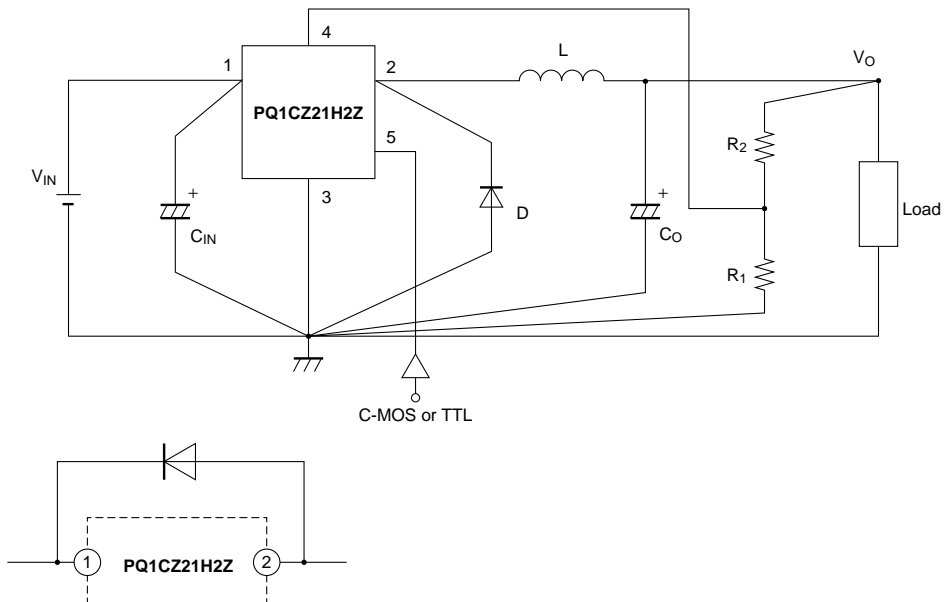
For minimizing inductance, it is recommended to design the thick and short pattern (between large current diodes, input/output capacitors, and terminal 1,2.) Single-point grounding (as indicated) should be used for best results.

- (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 switching 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 schottky 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

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

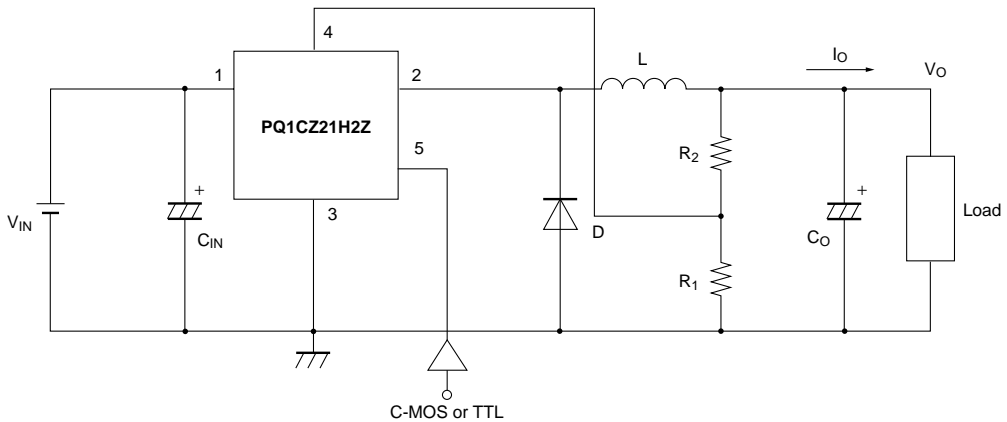
$$I_{sw}(\text{Average.}) = \frac{1}{1-D'} \times I_o(\text{Output current.})$$

$V_F$  : Forward voltage of the diode

When ambient temperature  $T_a$  and power dissipation  $P_D(\text{MAX})$  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 ON/OFF control terminal (5) becomes low by switching transistor  $T_r$  on, output voltage may be turned OFF and the device becomes stand-by mode. Dissipation current at stand-by mode becomes  $\text{Max. } 1\mu\text{A}$ .
2. ON/OFF control terminal (5) is compatible with LS-TTL. It enables to be directly drive by TTL or C-MOS standard logic (RCA4000 series). If ON/OFF control terminal is not used, it is recommended to directly connect applicable terminals with input terminal.



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