

# 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

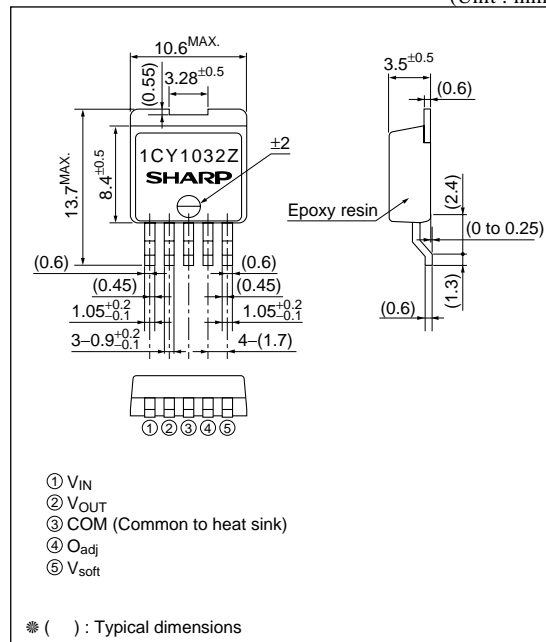
\*4  $P_D$ :With infinite heat sink

\*5 Over heat protection may operate at the condition  $T_j=125^{\circ}C$  to  $150^{\circ}C$

\*6 For 10s

### ■ Outline Dimensions

(Unit : mm)

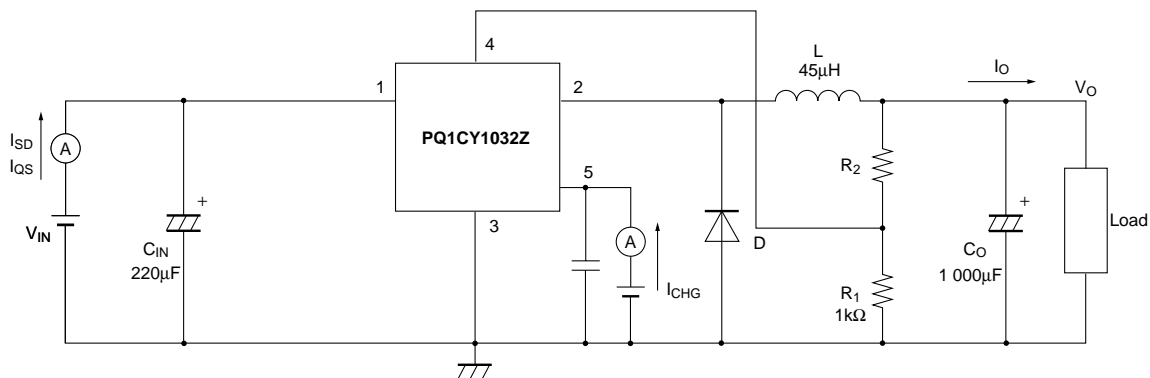


## ■ Electrical Characteristics

(Unless otherwise specified, condition shall be  $V_{IN}=12V$ ,  $I_o=0.5A$ ,  $V_o=5V$ ,  $V_{soft\ terminal}=0.1\mu F$ ,  $T_a=25^\circ C$ )

| 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     | $\Delta V_{ref}$ | $T_j=0$ to $125^\circ C$                        | —     | $\pm 0.5$ | —     | %       |
| Load regulation                               | $ R_{egL} $      | $I_o=0.5$ to $3A$                               | —     | 0.2       | 1.5   | %       |
| Line regulation                               | $ R_{egI} $      | $V_{IN}=8$ to $35V$                             | —     | 1         | 2.5   | %       |
| Efficiency                                    | $\eta$           | $I_o=3A$  | —     | 80        | —     | %       |
| Oscillation frequency                         | $f_o$            | —   | 135   | 150       | 165   | kHz     |
| Oscillation frequency temperature fluctuation | $\Delta f_o$     | $T_j=0$ to $125^\circ C$                        | —     | $\pm 2$   | —     | %       |
| Overcurrent detection level                   | $I_L$            | —   | 3.6   | 4.2       | 5.8   | A       |
| Charge current                                | $I_{CHG}$        | ②, ④ terminals is open, ⑤ terminal              | —     | -10       | —     | $\mu A$ |
| Input threshold voltage                       | $V_{THL}$        | Duty ratio=0%, ④ terminal=0V, ⑤ terminal        | —     | 1.3       | —     | V       |
|   | $V_{THH}$        | Duty ratio=100%, ④ terminal 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   | $\mu A$ |
| Output OFF-state consumption current          | $I_{QS}$         | $V_{IN}=40V$ , ⑤ terminal=0.9V                  | —     | 8         | 16    | mA      |

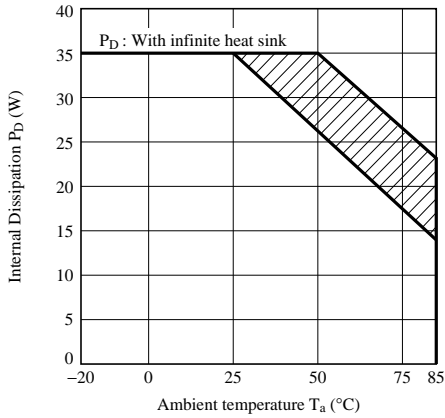
Fig.1 Standard Test Circuit



| 5 terminal | $V_o$ output |
|------------|--------------|
| LOW        | OFF          |
| HIGH       | ON           |
| OPEN       | ON           |

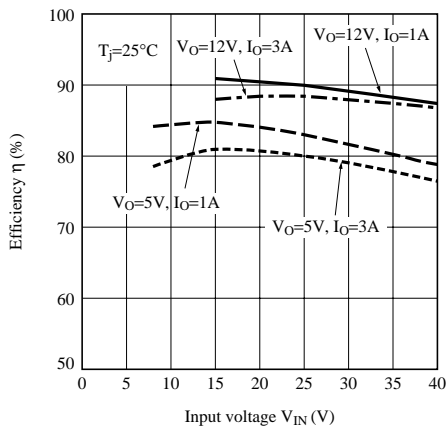
L : HK-10S100-4500 (made by Toho Co.)  
D : ERC80-004 (made by Fuji electronics Co.)

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

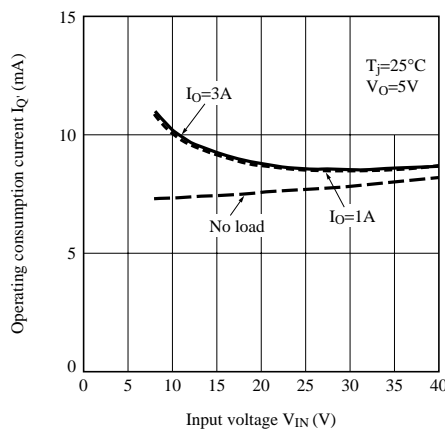


Note) Oblique line prtion:Overheat protection may operate in this area

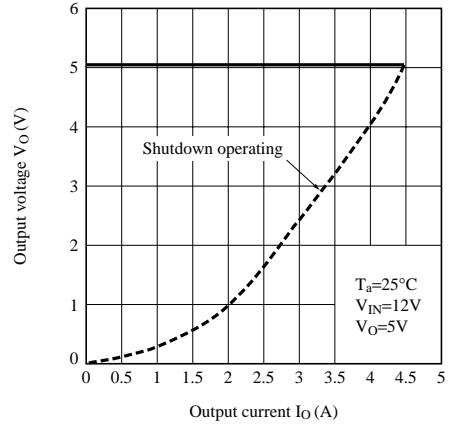
**Fig.4 Efficiency vs. Input Voltage**



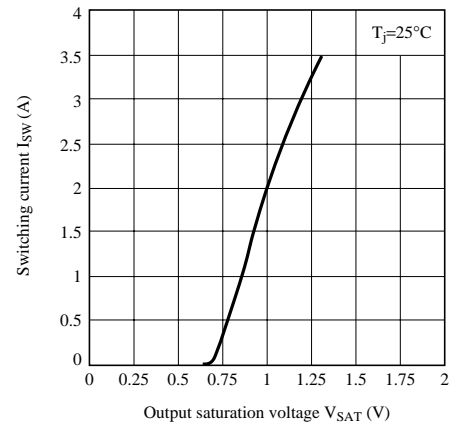
**Fig.6 Operating Consumption Current vs. Input Voltage**



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



**Fig.5 Switching Current vs. Output Saturation Voltage**



**Fig.7 Reference Voltage Fluctuation vs. Junction Temperature**

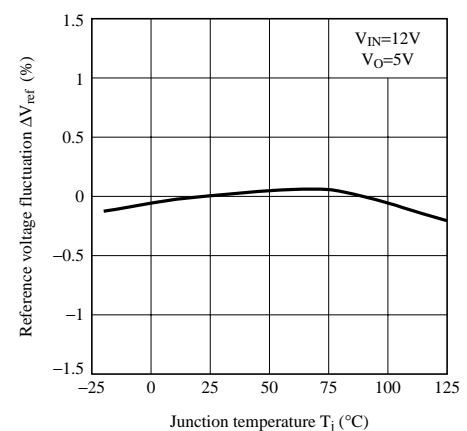


Fig.8 Load Regulation vs. Output Current

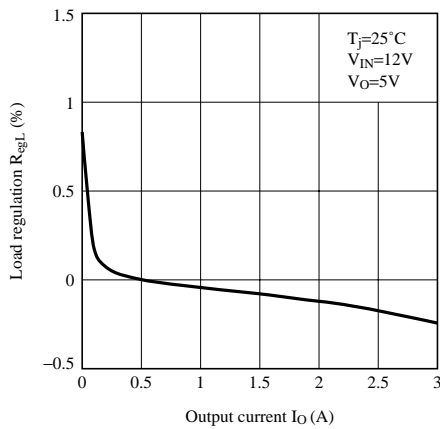


Fig.9 Line Regulation vs. Input Voltage

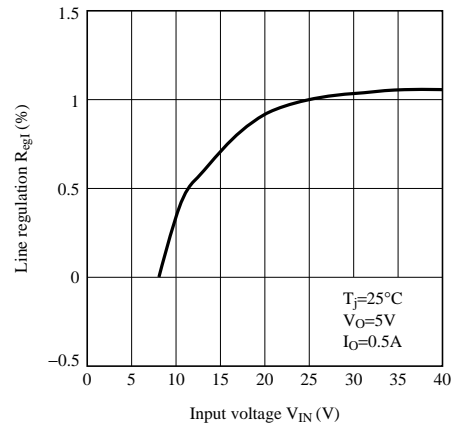


Fig.10 Oscillation Frequency Fluctuation vs. Junction Temperature

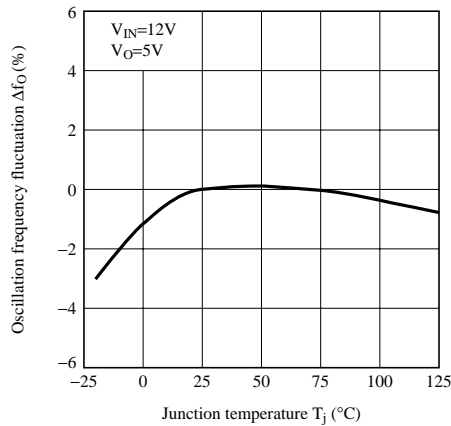


Fig.11 Overcurrent Detection Level Fluctuation vs. Junction Temperature

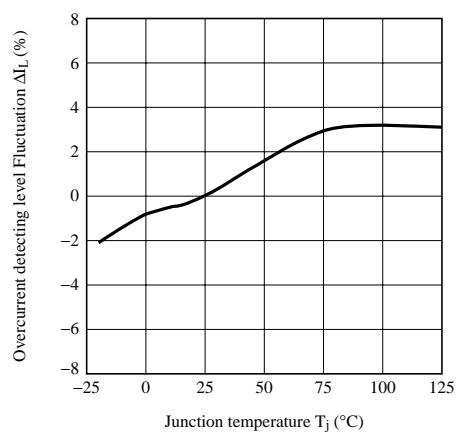


Fig.12 On Threshold Voltage vs. Junction Temperature

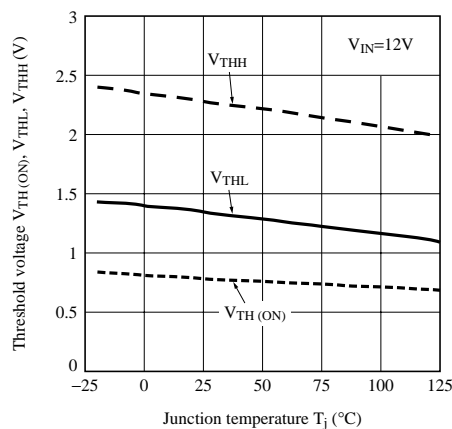


Fig.13 Overcurrent Shutdown Threshold Voltage vs. Junction Temperature

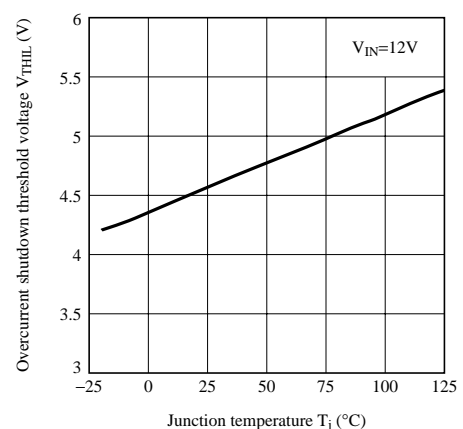
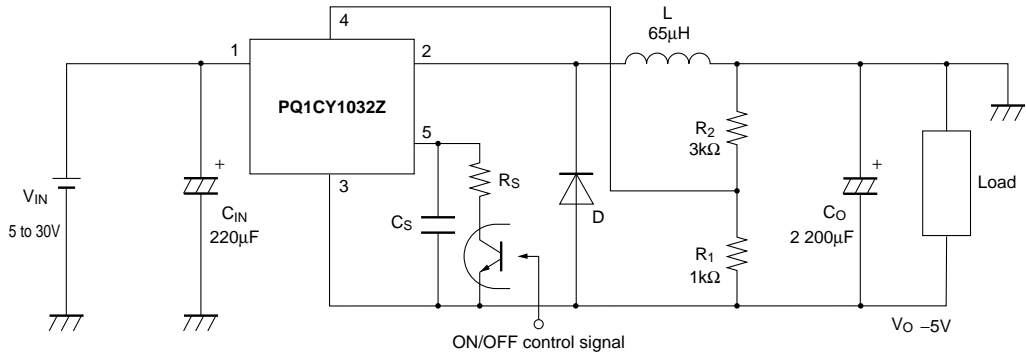
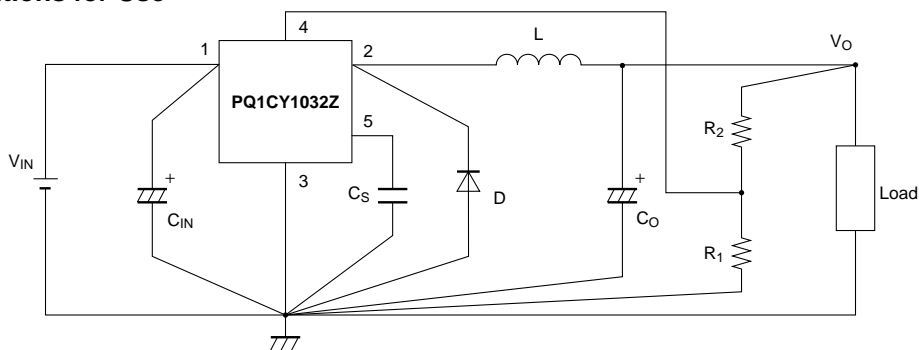




Fig.17 Polarity Inversion Type Circuit Diagram



### ■ Precautions for Use

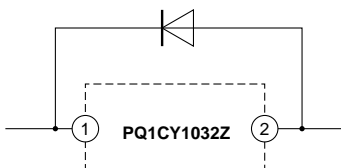


#### 1. External connection

- (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 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  $V_{soft}$  terminal (5) becomes low (less 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.  $400\mu\text{A}$ .

When transistor  $Tr$  becomes OFF, output voltage can be ON.

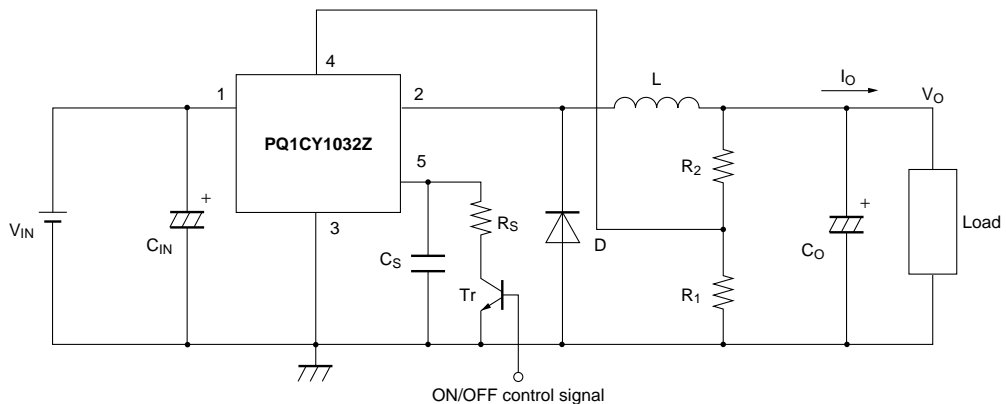
External resistor  $R_s$  should be led to avoid discharge current of  $C_s$ , and not to break the transistor  $Tr$ .

2. Soft startup

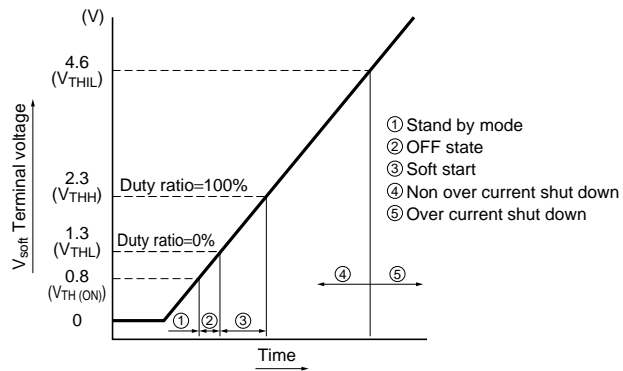
When capacitor  $C_s$  is loaded, output pulse gradually expanded and output voltage will start softly.

3. Over current protection

When the voltage of  $V_{soft}$  (5) is more than  $V_{THIL}$ , over current shut down function will operate. And when the voltage of  $V_{soft}$  (5) is less than  $V_{THIL}$ , over current protection function will operate. Since the **PQ1CY1032Z** must use an capacitor  $C_s$ ,  $V_{soft}$  (5) should be more than  $V_{THIL}$ , over current shut down function will operate.



## ■ ON-OFF Terminal Voltage vs. Time





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