

SI-80000Z Series

Switching Voltage Regulator

Features:

- High efficiency – 90%
- High-power dissipation
- Built-in current limiter circuit
- High reliability house-made passivated power chip
- External ON-OFF control for output current
- Wide DC input voltage range

Absolute Maximum Ratings (Ta=25°C)

Description	Type No.	Type No.								Conditions
		SI-80506Z	SI-81206Z	SI-81506Z	SI-82406Z	SI-80512Z	SI-81212Z	SI-81512Z	SI-82412Z	
DC Input Voltage (V)		45	55	55	70	45	55	55	70	
Output Current (A)		6.5				12.5				
Power Dissipation (W)		40				90				Tc=25°C
		5				8				No Fin
Thermal Resistance (°C/W)		2.5				1.1				
Junction Temperature (°C)		-30 ~ +125								
Operating Temperature (°C)		-20 ~ +90								
Storage Temperature (°C)		-30 ~ +125								

Electrical Characteristics (Ta=25°C)

Description	Type No.	SI-80506Z			SI-81206Z			SI-81506Z			SI-82406Z			SI-80512Z			SI-81212Z			SI-81512Z			SI-82412Z		
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
DC Input Voltage	*1 (V)	12		33	19		45	22		45	32		60	12		33	19		45	22		45	32		60
Output Voltage	Cond.	Output Current: 6A												Output Current: 12A											
		input	4.95	5.05	5.15	11.8	12	12.2	14.8	15	15.2	23.8	24	24.2	4.95	5.05	5.15	11.8	12	12.2	14.8	15	15.2	23.8	24
Output Current *2 (A)	Cond.	3A												6A											
		output	0		6	0		6	0		6	0		6	0		12	0		12	0		12	0	
Frequency (kHz)		19~24																							
Efficiency (%)	Cond.	6A												12A											
		input	72		84		85		90		68		80		82		87		20V	27V	32V	45V	20V	27V	32V
Line Regulation (mV)	Cond.	3A												6A											
		input	60	120	150	300	150	300	200	400	60	120	150	300	150	300	200	400	12~33V	19~45V	22~45V	32~60V	12~33V	19~45V	22~45V
Load Regulation *3 (mV)	Cond.	3A												6A											
		input	10	20	15	30	15	30	25	50	20	40	30	60	30	60	50	100	20V	27V	32V	45V	20V	27V	32V
Temperature Coefficient (mV/°C)	Cond.	3A												6A											
		output	±0.5		±1		±1		±2.5		±0.5		±1		±1		±2.5		0.5~6A	1~6A	1~6A	1.5~6A	0.5~12A	1~12A	1~12A
Current Limiting Starting Range (A)		6.5~8												12.5~14											
Dielectric Strength		1 minute at AC 500V																							
Insulation Resistance		50MΩ at DC 500V																							

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Switching Voltage Regulator

*1: The value of minimum input voltage is at $L = 100\mu\text{H}$.

*2: The minimum current (I_{min}) is given by:

$$I_{0(\text{min.})} = \frac{(V_{\text{IN}} - V_0) \cdot V_0}{2L \cdot V_{\text{in}} \cdot f}$$

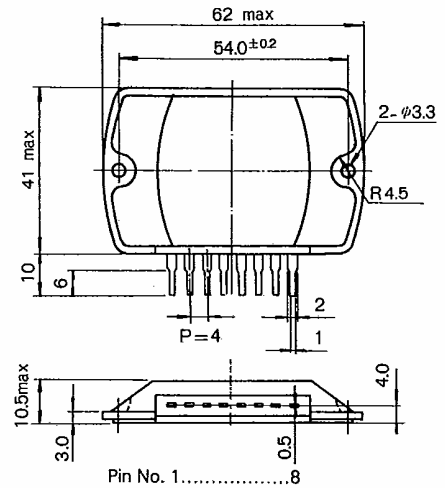
where: f is switching frequency in Hz (19,224kHz)

*3: Total output voltage regulation ($\Delta V_0/V_0$) without load is tabulated as:

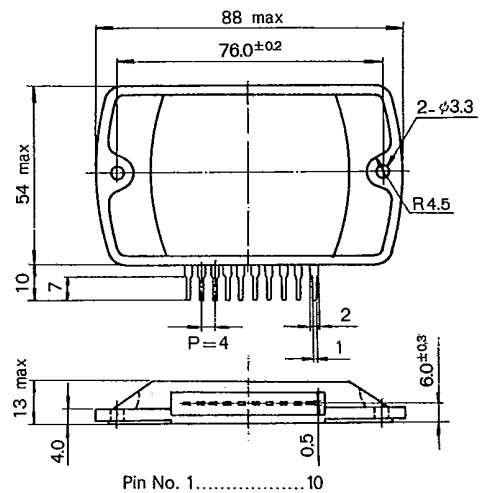
where ΔV_0 : Total output voltage fluctuation
 V_0 : The initial setting voltage of output

Outline Drawings Unit: mm

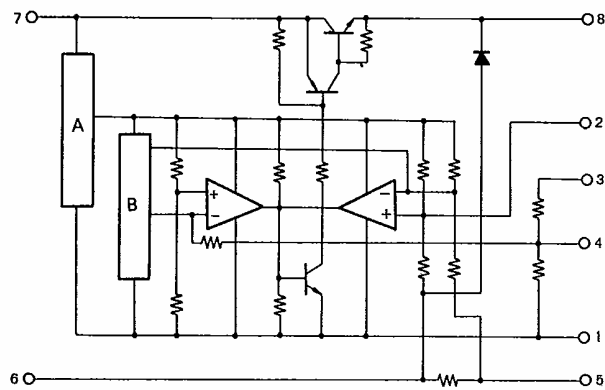
6A



12A

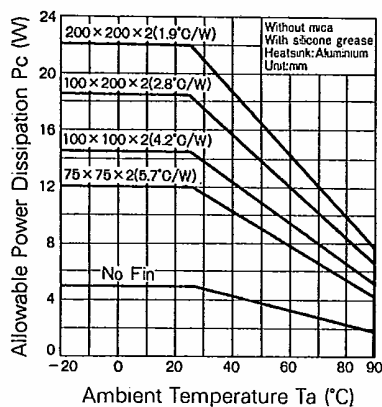


Equivalent Circuit

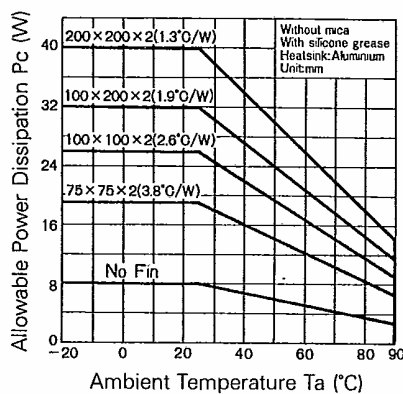


A: Reference Voltage Generator
 B: Triangle Wave Generator

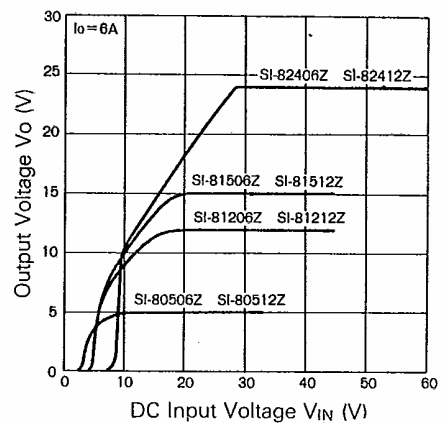
Derating (6A)



Derating (12A)



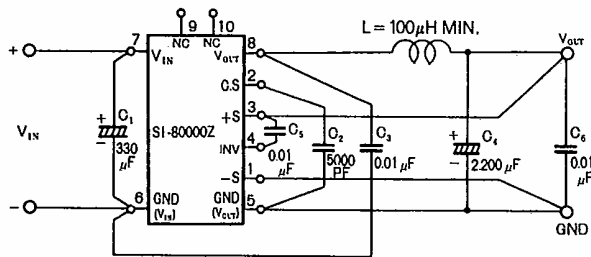
Output Voltage vs. DC Input Voltage Characteristics



Switching Voltage Regulator

Wiring of External Components

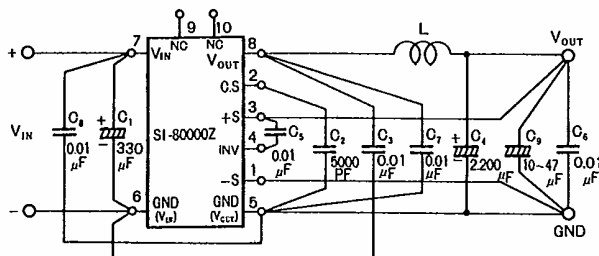
- The capacitor C₁ is to compensate voltage drop through DC input leads (This is not an AC filter capacitor). When input DC is obtained by rectification of AC, an additional filter capacitor is required.
The spacing between C₁ and the terminal 6, 7 should be less than 2cm.
When the leads between input DC source and the terminal 6 and 7 are short enough (within 5cm), C₁ can be as low as 0.1μF.
- C₂ is the capacitor preventing the improper activation of short-circuit protection by the noise etc.
Sometime, you could get better regulation by changing the capacitor size (500pF~0.047μF) and wiring (2-5 to 2-1) depending on the wiring/mounting of the IC.
- The capacitor C₃ is for the compensation of free-wheel reverse recovery characteristics. Noise can be reduced by employing the larger capacitor.



Spike noise suppression

When the spike noise causes a problem, it can be suppressed by additional capacitors.

- Install the film capacitor of 0.01μF between pin-7 and pin-5, and also same capacitor between pin-8 and pin-5.
- Install film capacitor 0.01μF and electrolytic capacitor of 10~47μF in parallel with the load.



Design of Coil L and Capacitor C₄

- Inductance L is given by:

$$L \approx \frac{V_{IN} - V_0}{2I_{O(MIN.)}} \cdot \frac{V_0}{V_{IN}} \cdot \frac{1}{f}$$

- Maximum current I_{L(max.)} is given by the following equation.

$$I_{L(max.)} \approx \left(\frac{V_{IN} - V_0}{2L} \cdot \frac{V_0}{V_{IN}} \cdot \frac{1}{f} \right) + I_0$$

- Recommended Cores

Tohoku Metal Type No	Output Voltage Edc(V)	Rated Current Idc= (A)	±20%f: Inductance(μH)20kHz	
			Idc=0	Idc=Rating
MS-0503	5	3	120	100
MS-0505	5	5	80	60
MS-0510	5	10	40	30
MS-0520	5	20	15	12
MS-1203	12	3	270	230
MS-1205	12	5	200	140
MS-1210	12	10	130	70
MS-2403	24	3	600	460
MS-2405	24	5	550	280

- Capacitor C₄ is given by the following equation.

$$C_4 \approx \frac{(V_{IN} - V_{OUT}) V_{OUT}}{8Lf^2 V_{IN} \cdot \Delta V_{OUT}}$$

ΔV_{OUT}: Regulation of output voltage including load regulation and line regulation.

- Ripple current of C₄ is given by the following equation.

$$I_{RIPPLE} \approx \frac{V_{IN} - V_0}{L} \cdot \frac{V_{OUT}}{V_{IN}} \cdot \frac{1}{f}$$

Design of Heat Sink

Power dissipation (P_c) of IC is given by the following equation:

$$P_c = \left(P_0 \frac{100}{\eta'} - 1 \right)$$

η': Efficiency

P₀: V × I₀

Efficiency is slightly decreased in proportion to the increase of input voltage and is given by the following equation:

$$\eta' = \eta + \alpha (V_{IN} - V'_{IN})$$

η : Rated Efficiency.

V'_{IN} : Maximum average design input voltage.

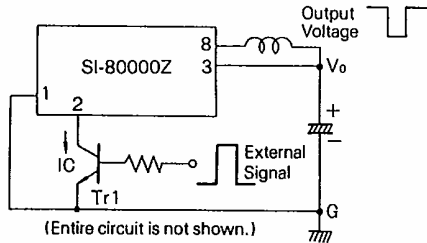
V_{IN}, α : Refer to the following table.

Type No.	V _{IN}	α
SI-80506Z, SI-80512Z	20	0.15
SI-81206Z, SI-81212Z	27	0.2
SI-81506Z, SI-81512Z	32	0.2
SI-82406Z, SI-82412Z	45	0.25

Inapplicable Operation

- Parallel operation
- Booster circuit

On-off control of output current by external signal



The output can be turned-off by a small signal transistor Tr_1 . Transistor size can be as small as $P_c \approx 100\text{mW}$.

Adjustment of Current Limiting Starting Point

Current limiting starting point can be adjusted by the external resistor.

= Adjustment =

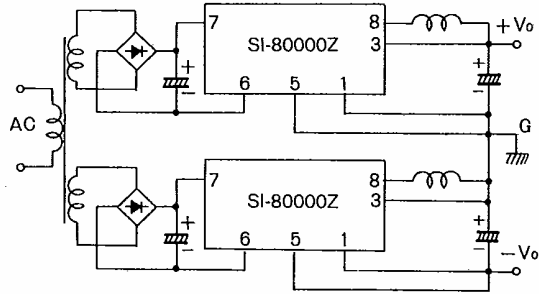
To adjust the I_{S1}

- 1) Set the output current higher than the required I_{S1} by 5% and adjust the variable resistor.
- 2) Set the output voltage about 20% lower than the setting output voltage and adjust the variable resistor.

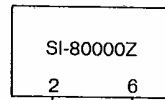
External Connection for Split Power Supply

The following drawing shows the application of split power supply by external connection.

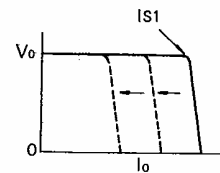
- 1) Each secondary winding of AC transformer should be independent.
- 2) Centertap transformer cannot be used.



Current Limit Starting Point

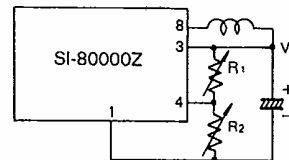


R: 200k Ω 1/8W



Output Voltage Adjustment

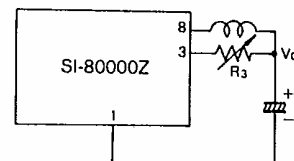
Type No.	Output Voltage Adjustment Range	Input Voltage Adjustment Range
5V type	5~25V	12~33V
12V type	10~30V	19~45V
15V type	10~30V	22~45V
24V type	20~30V	32~60V



Both "Increase" and "Decrease" of output voltage are adjustable. The circuit shows temperature compensating function.

Remarks:

1. Required voltage difference between input and output is 8V minimum.
2. R_1 , R_2 , R_3 values are of several k Ω range.



Output voltage can be raised.