

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)

[illegible]

Electrical Characteristics (Ta=25°C)

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
Description																										
DC Input ※1 (V)			12		33	19		45	22		45	32		60	12		33	19		45	22		45	32		60
Voltage	Conditions		Output Current: 6A												Output Current: 12A											
Output Voltage	Cond.	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	24.2
		output	3A												6A											
Output Current ※2 (A)			0		6	0		6	0		6	0		6	0		12	0		12	0		12	0		12
Frequency (kHz)			19~24																							
Efficiency (%)	Cond.	input		72			84			85			90			68			80			82			87	
		output	6A												12A											
Line Regulation (mV)	Cond.	input		60	120		150	300		150	300		200	400		60	120		150	300		150	300		200	400
		output	3A												6A											
Load Regulation ※3 (mV)	Cond.	input		10	20		15	30		15	30		25	50		20	40		30	60		30	60		50	100
		output	0.5~6A												1~6A											
Temperature Coefficient (mV/°C)				±0.5			±1			±1			±2.5			±0.5			±1				±1			±2.5
Current Limiting Starting Range (A)			6.5~8												12.5~14											
Dielectric Strength			1 minute at AC 500V																							
Insulation Resistance			50MΩ at DC 500V																							

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

*2: The minimum current ($I_{\text{min.}}$) is given by:

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

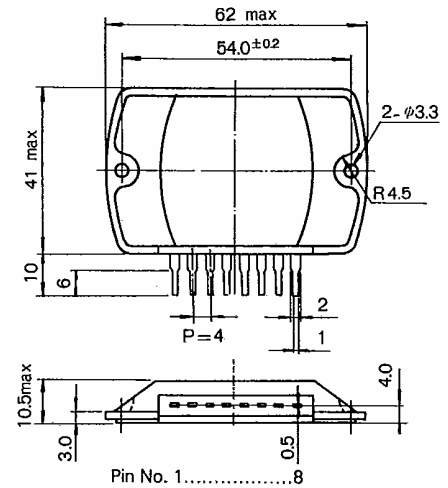
where: f is switching frequency in Hz (19,224kHz)

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

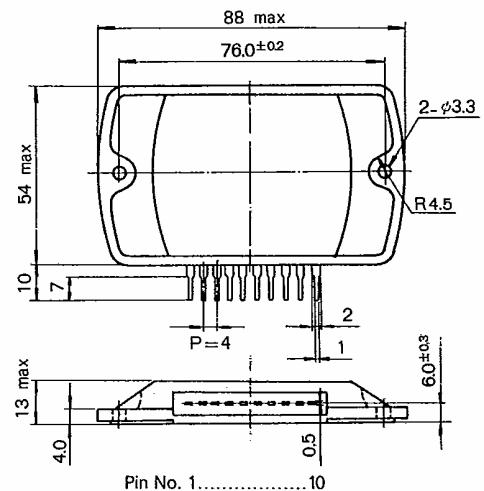
where ΔV_0 : Total output voltage fluctuation
 V_0 : The initial setting voltage of output

Outline Drawings Unit: mm

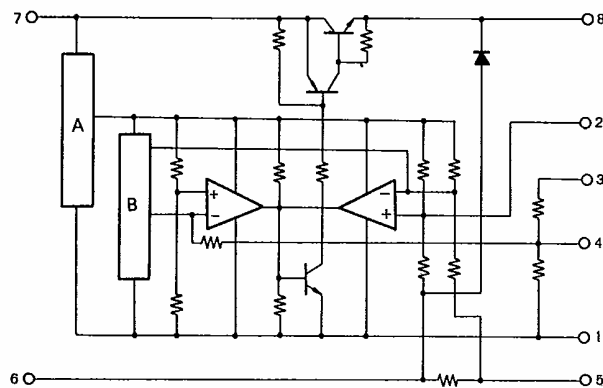
6A



12A



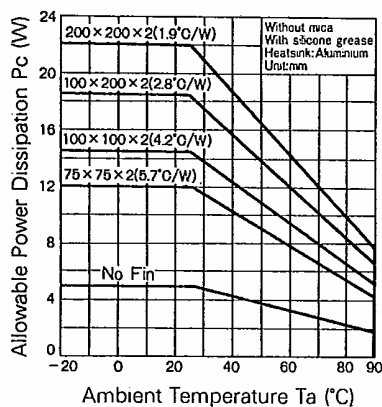
Equivalent Circuit



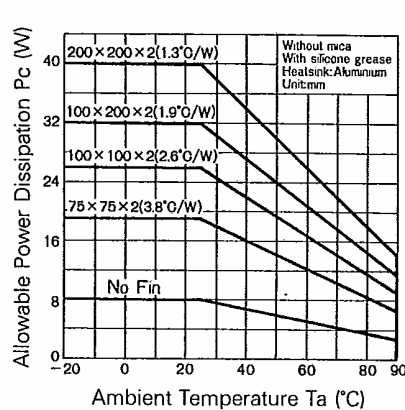
A: Reference Voltage Generator

B: Triangle Wave Generator

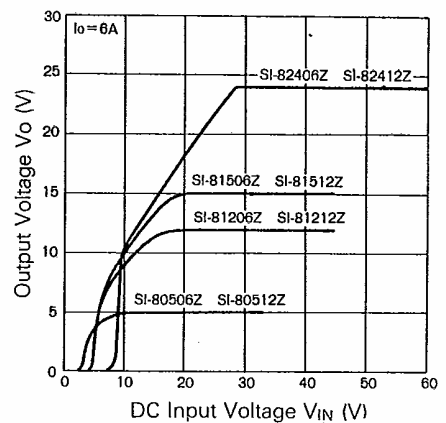
Derating (6A)



Derating (12A)



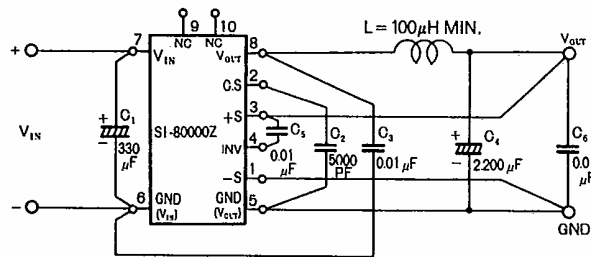
Output Voltage vs. DC Input Voltage Characteristics



Switching Voltage Regulator

Wiring of External Components

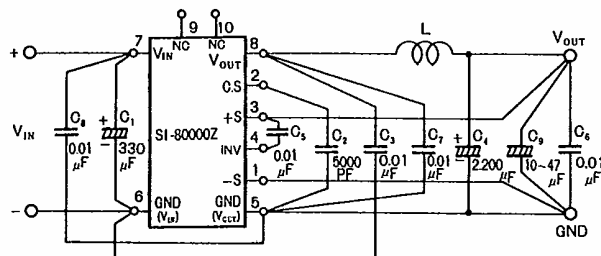
- (1) The capacitor C_1 is to compensate voltage drop through DC input leads (This is not an AC filter capacitor). When input DC is obtained by rectification of AC, an additional filter capacitor is required.
The spacing between C_1 and the terminal 6, 7 should be less than 2cm.
When the leads between input DC source and the terminal 6 and 7 are short enough (within 5cm), C_1 can be as low as $0.1\mu\text{F}$.
- (2) C_2 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 ($500\text{pF} \sim 0.047\mu\text{F}$) and wiring (2-5 to 2-1) depending on the wiring/mounting of the IC.
- (3) The capacitor C_3 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.

- 1) Install the film capacitor of $0.01\mu\text{F}$ between pin-7 and pin-5, and also same capacitor between pin-8 and pin-5.
- 2) Install film capacitor $0.01\mu\text{F}$ and electrolytic capacitor of $10 \sim 47\mu\text{F}$ in parallel with the load.



Design of Coil L and Capacitor C_4

- (1) Inductance L is given by:

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

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

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

- (3) Recommended Cores

Tohoku Metal Type No	Output Voltage $E_{dc}(V)$	Rated Current $I_{dc}(A)$	$\pm 20\% f$: Inductance(μH)20kHz	
			$I_{dc}=0$	$I_{dc}=\text{Rating}$
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

- (4) Capacitor C_4 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.

- (5) Ripple current of C_4 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

P_0 : $V \times I_0$

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.

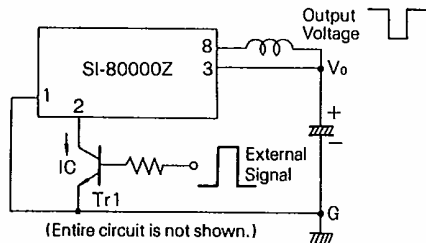
V_{IN}, α : Refer to the following table.

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

1. Parallel operation
2. Booster circuit

On-off control of output current by external signal

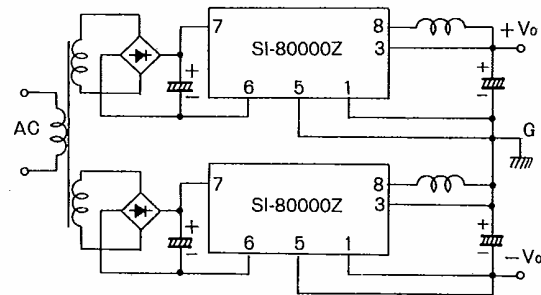


The output can be turned-off by a small signal transistor Tr_1 . Transistor size can be as small as $P_c \approx 100\text{mW}$.

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.



Adjustment of Current Limiting Starting Point

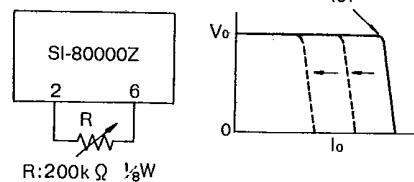
Current limiting starting point can be adjusted by the external resistor.

= Adjustment =

To adjust the I_{S1}

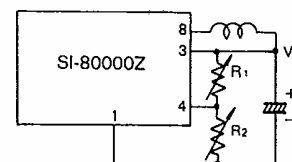
- 1) Set the output current higher than the required I_{S1} by 5% and adjust the variable resistor.
- 2) Set the output voltage about 20% lower than the setting output voltage and adjust the variable resistor.

Current Limit Starting Point



Output Voltage Adjustment

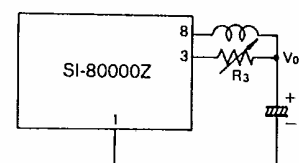
Type No.	Output Voltage Adjustment Range	Input Voltage Adjustment Range
5V type	5~25V	12~33V
12V type	10~30V	19~45V
15V type	10~30V	22~45V
24V type	20~30V	32~60V



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 $k\Omega$ range.



Output voltage can be raised.