SI-80000Z Series

Switching Voltage Regulator

Features:
High efficiency – 90%
High-power dissipation
Built-in current limitter 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.	SI-80506Z	SI-81206Z	SI-81506Z	SI-82406Z	SI-80512Z	SI-81212Z	SI-81512Z	SI-82412Z	Conditions
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	Conditions		Output Current: 6A												Output Current: 12A											
			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
	Cond.	input	20V			27V			32V			45V			20V			27V			32V			45V		
		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		(%)		72			84			85			90			68			80			82			87	
	Cond.	input	20V			27V			32V			45V			20V			27V			32V			45V		
		output	6A												12A											
Line Regulation		(mV)		60	120		150	300		150	300		200	400		60	120		150	300		150	300		200	400
	Cond.	input	12~33V			19~45V			22~45V			32~60V			12~33V			19~45V			22~45V			32~60V		
		output	3A												6A											
Load Regulation		*3 (mV)		10	20		15	30		15	30		25	50		20	40		30	60		30	60		50	100
	Cond.	input	20V			27V			32V			45V			20V			27V			32V			45V		
		output	0.5~6A			1~6A			1~6A			1.5~6A			0.5~12A			1~12A			1~12A			1.5~6A		
Temperature Coefficient		(mV/°C)		±0.5			±1			±1			±2.5			±0.5			±1			±1			±2.5	
Current Limitting 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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*1: The value of minimum input voltage is at L = 100μH.

*2: The minimum current (I min.) is given by:

$$I_{O\,(min.)} = \frac{(V_{IN} - V_O) \cdot V_O}{2L \cdot V_{in} \cdot f}$$

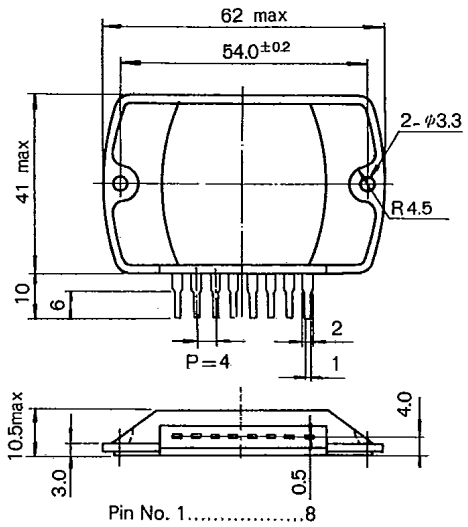
where: f is switching frequency in Hz (19,224kHz)

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

where ΔV_O: Total output voltage fluctuation
V_O: The initial setting voltage of output

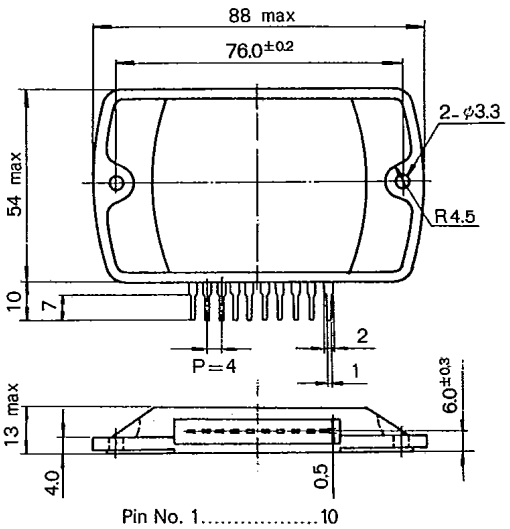
Outline Drawings Unit: mm

6A



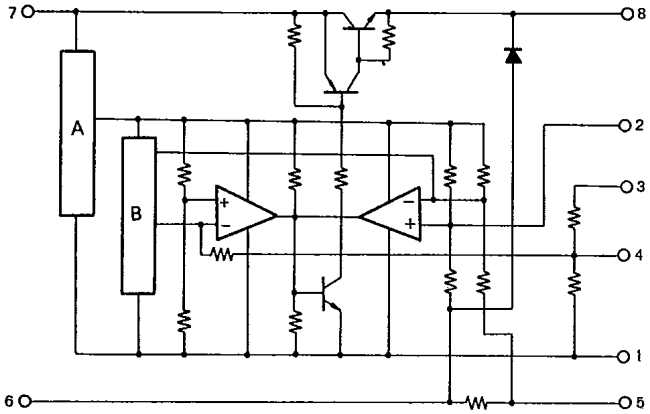
Pin No. 1.....8

12A



Pin No. 1.....10

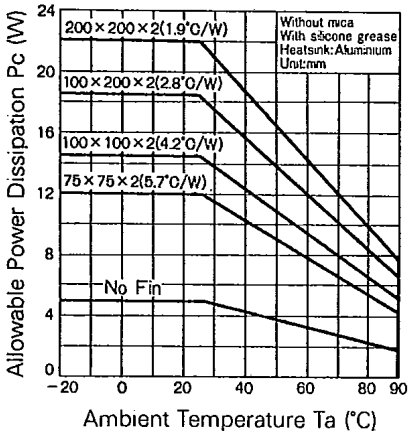
Equivalent Circuit



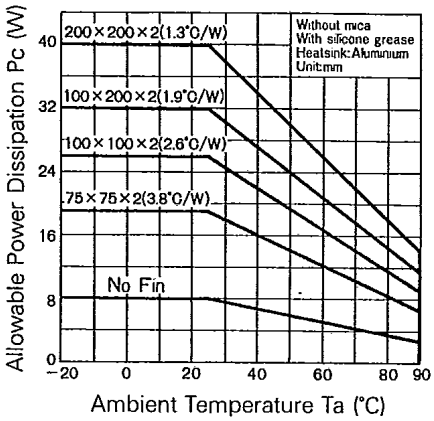
A: Reference Voltage Generator·

B: Triangle Wave Generator

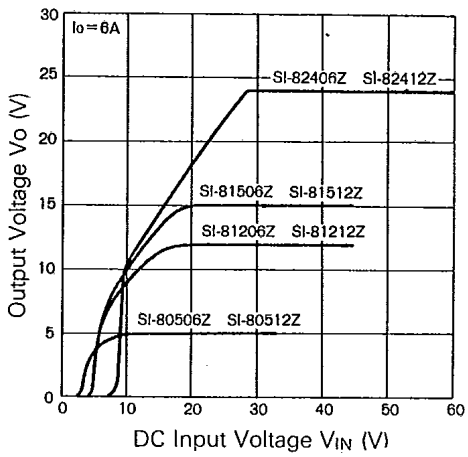
Derating (6A)



Derating (12A)



Output Voltage vs. DC Input Voltage Characteristics

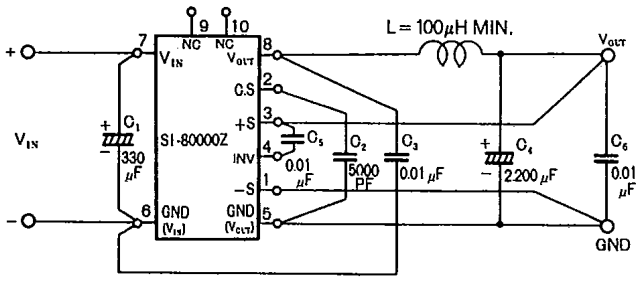


Wiring of External Components

(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 0.1μF.

(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 (500pF~0.047μF) and wiring (2-5 to 2-1) depending on the wiring/mouning of the IC.

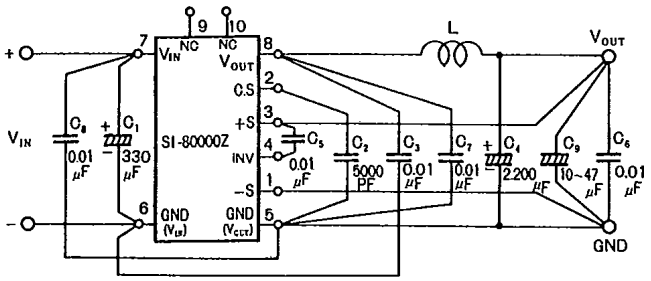
(3) The capacitor C_3 is for the compensation of free-wheel reverse recovery characteristics. Noise can be reduced by employing the larger capacitor.



Spike noise suppression

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

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



Design of Coil L and Capacitor C_4

(1) Inductance L is given by:

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

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

$$I_{L(max.)} \fallingdotseq \left(\frac{V_{IN}-V_O}{2L} \cdot \frac{V_O}{V_{IN}} \cdot \frac{1}{f}\right) + I_O$$

(3) 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

(4) Capacitor C_4 is given by the following equation.

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

$\triangle V_{OUT}$: Regulation of output voltage including load regulation and line regulation.

(5) Ripple current of C_4 is given by the following equation.

$$I_{RIPPLE} \fallingdotseq \frac{V_{IN}-V_O}{L} \cdot \frac{V_{OUT}}{V_{IN}} \cdot \frac{1}{f}$$

Design of Heat Sink

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

$$P_C = \left(P_O \frac{100}{\eta'} - 1\right)$$

η' : Efficiency
P_O : $V \times I_O$

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

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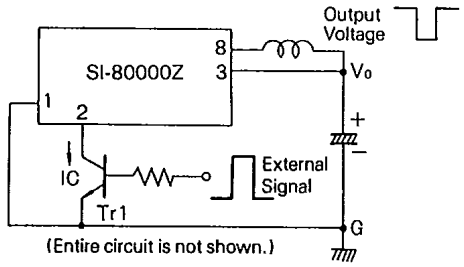
On-off control of output current by external signal

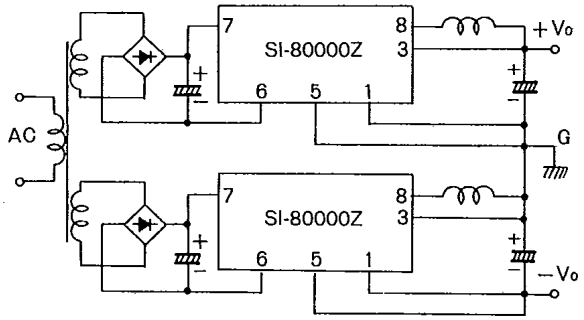


The output can be turned-off by a small signal transistor T_{r1}.
Transistor size can be as small as $P_C \fallingdotseq 100mW$.

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.

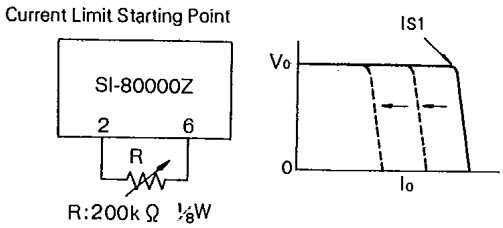


Adjustment of Current Limitting Starting Point

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

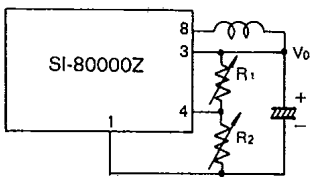
=Adjustment=
To adjust the I_{S1}

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.



Output Voltage Adjustment

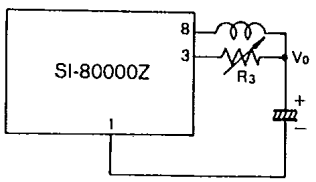
Type No.	Output Voltage Adjustment Range	Input Voltage Adjustment Range
5V type	5~25V	12~33V
12V type	10~30V	19~45V
15V type	10~30V	22~45V
24V type	20~30V	32~60V



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 kΩ range.



Output voltage can be raised.