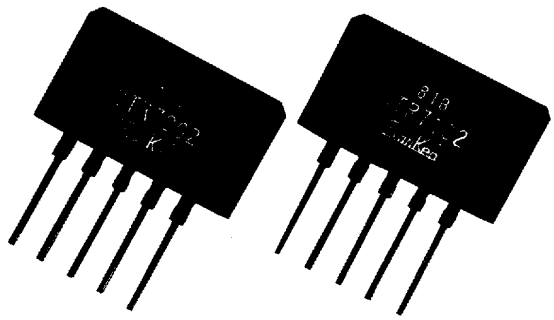
STR7000/7100 Series

Switching Type—Chopper • Separate Excitation Type

Features

- High output/efficiency and stable operation
- A wide range of DC input voltage
- Provided with adjustable constant current protection circuit
- Foldback type overcurrent protection may be easily set externally
- Externally variable output voltage
- Output ON/OFF by external signal
- High reliability due to use of SANKEN's semiconductor elements



External View

Applications

- For computer terminals, NC appliances and office equipments

■Line-Up

Control Hybrid IC (SI-8020 series)	Main Switcher Hybrid IC (STR7000, 7100 series)	
	I_{OUT} = 6A	I_{OUT} = 12A
SI-8020 (V_{OUT} = 5V)	STR7001	STR7101
SI-8021 (V_{OUT} = 12V)	STR7002	STR7102
SI-8022 (V_{OUT} = 15V)	STR7002	STR7102
SI-8023 (V_{OUT} = 24V)	STR7003	STR7103

■Absolute Maximum Ratings

Main Switcher HIC: STR7000, STR7100 Series (Ta = 25°C)

Description	Symbol	Ratings		Unit
		STR7000 Series	STR7100 Series	
Power Transistor Withstand Voltage	V_{4-1}	60		V
Drive Transistor Withstand Voltage	V_{4-5}	60		V
Diode Withstand Voltage	V_{1-2}	60		V
Collector Current	I_C	6 (peak 7.5A)	12 (peak 15A)	A
Power Dissipation	P_D	100 (T_C = 25°C)	125 (T_C = 25°C)	W
		4.3 (No Fin)		
Power Transistor Thermal Resistance	Rth (j−c)	1.25	1.0	°C/W
Power Transistor Junction Temperature	Tj	−30 to +150		°C
Operating Case Temperature	T_C	−30 to +125		°C
Storage Temperature	Tstg	−30 to +125		°C

Control HIC: SI-8020 Series (Ta = 25°C)

Description	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}	55	V
Power Dissipation	P_D	1	W
Operating Temperature	Top	−20 to +85	°C
Storage Temperature	Tstg	−20 to +100	°C

■ Electrical Characteristics (Ta = 25°C): 6A Type

Description	Symbol	Ratings												Unit
		STR7001, SI-8020			STR7002, SI-8021			STR7002, SI-8022			STR7003, SI-8023			
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
DC Input Voltage Range	V_{IN}	11		40	18		50	21		50	30		50	V
Output Voltage	V_O	5.0	5.1	5.2	11.8	12.0	12.2	14.8	15.0	15.2	23.7	24.0	24.3	V
	Condition	V_{IN} = 20V, Io = 3A			V_{IN} = 27V, Io = 3A			V_{IN} = 30V, Io = 3A			V_{IN} = 40V, Io = 3A			
Line Regulation	ΔV_{LINE}			80			120			150			200	mV
	Condition	V_{IN} = 15 to 25V, Io = 3A			V_{IN} = 22 to 32V, Io = 3A			V_{IN} = 25 to 35V, Io = 3A			V_{IN} = 35 to 45V, Io = 3A			
Load Regulation	ΔV_{LOAD}			30			40			40			50	mV
	Condition	V_{IN} = 20V, Io = 1 to 5A			V_{IN} = 27V, Io = 1 to 5A			V_{IN} = 30V, Io = 1 to 5A			V_{IN} = 40V, Io = 1 to 5A			
Efficiency	η		72			84			86			90		%
	Condition	V_{IN} = 20V, Io = 3A			V_{IN} = 27V, Io = 3A			V_{IN} = 30V, Io = 3A			V_{IN} = 40V, Io = 3A			
Ripple Rejection	R_{REJ}		45			45			45			45		dB
	Condition	f = 100 to 120 Hz												
Over Current Protection*	I_{S1}	6.0		7.5	6.0		7.5	6.0		7.5	6.0		7.5	A
	I_{S2}	6.0		7.5	6.0		7.5	6.0		7.5	6.0		7.5	A
	Condition	Rs = 0.02Ω												

* See applications item 2 in page 12.

■ Electrical Characteristics (Ta = 25°C): 12A Type

Description	Symbol	Ratings												Unit
		STR7101, SI-8020			STR7102, SI-8021			STR7102, SI-8022			STR7103, SI-8023			
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
DC Input Voltage Range	V_{IN}	11		40	18		50	21		50	30		50	V
Output Voltage	V_O	5.0	5.1	5.2	11.8	12.0	15.2	14.8	15.0	15.2	23.7	24.0	24.3	V
	Condition	V_{IN} = 20V, Io = 6A			V_{IN} = 27V, Io = 6A			V_{IN} = 30V, Io = 6A			V_{IN} = 40V, Io = 6A			
Line Regulation	ΔV_{LINE}			80			120			150			200	mV
	Condition	V_{IN} = 15 to 25V, Io = 6A			V_{IN} = 22 to 32V, Io = 6A			V_{IN} = 25 to 35V, Io = 6A			V_{IN} = 35 to 45V, Io = 6A			
Load Regulation	ΔV_{LOAD}			30			40			40			50	mV
	Condition	V_{IN} = 20V, Io = 3 to 9A			V_{IN} = 27V, Io = 3 to 9A			V_{IN} = 30V, Io = 3 to 9A			V_{IN} = 40V, Io = 3 to 9A			
Efficiency	η		70			82			84			87		%
	Condition	V_{IN} = 20V, Io = 6A			V_{IN} = 27V, Io = 6A			V_{IN} = 30V, Io = 6A			V_{IN} = 40V, Io = 6A			
Ripple Rejection	R_{REJ}		45			45			45			45		dB
	Condition	f = 100 to 120 Hz												
Over Current Protection*	I_{S1}	12		15	12		15	12		15	12		15	A
	I_{S2}	12		15	12		15	12		15	12		15	A
	Condition	Rs = 0.01Ω												

* See applications item 2 in page 12.

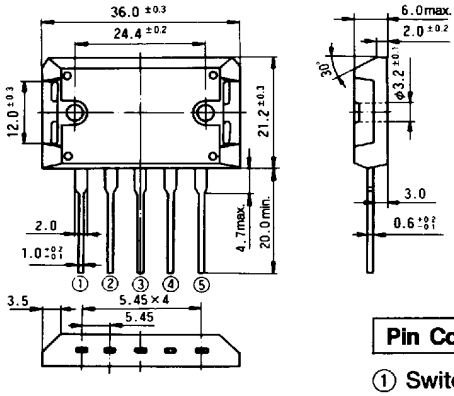
STR7000/7100 Series

SANKEN ELECTRIC CO LTD

Switching Type— Chopper • Separate Excitation Type

■Outline Drawings/Pin Connections (unit: mm)

STR7000/7100 Series

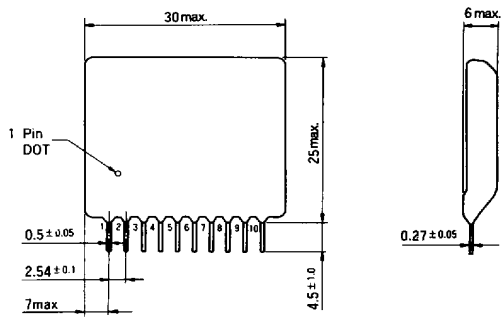


Plastic Mold Package Type
Flammability: UL94V-O or equivalent
Weight: Approx. 14.5g

Pin Connections

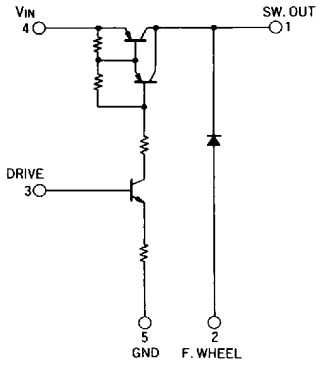
① Switching Output (backside of case)
② Fly Wheel (ground)
③ Drive
④ Input
⑤ Ground

SI-8020 Series

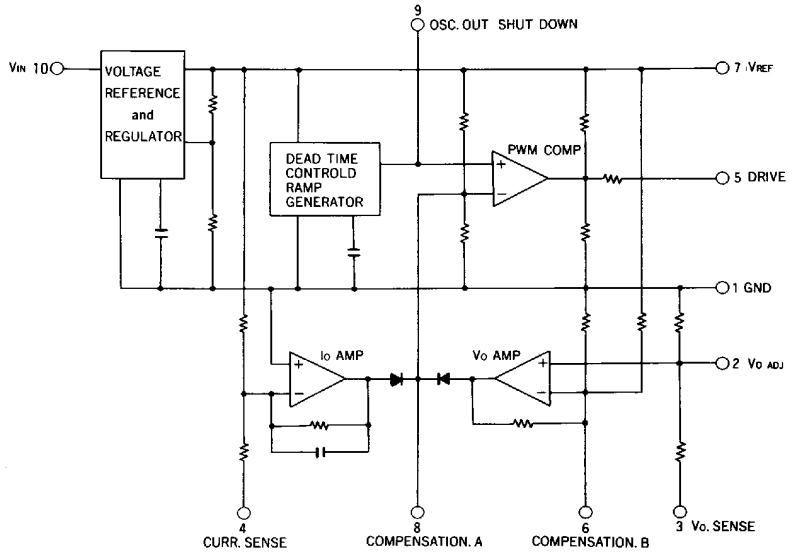


■Equivalent Circuits

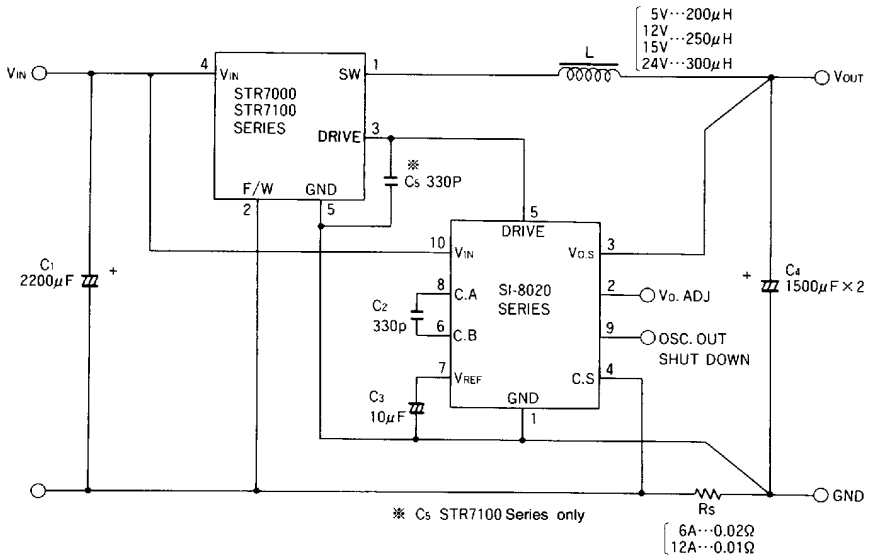
STR7000/7100 Series



SI-8020 Series

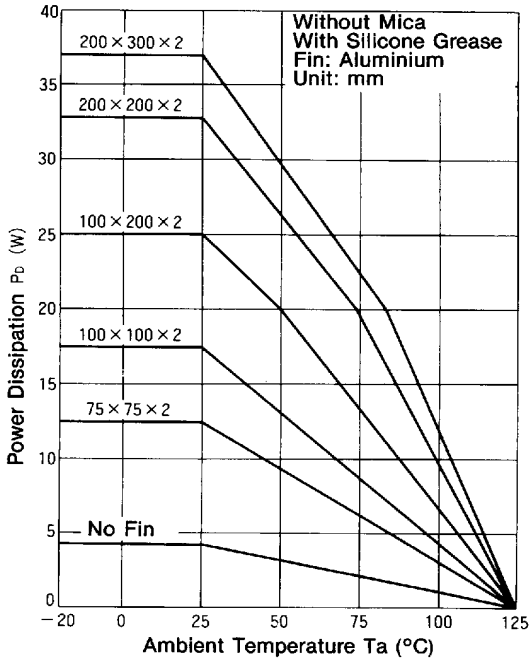


■External Circuit

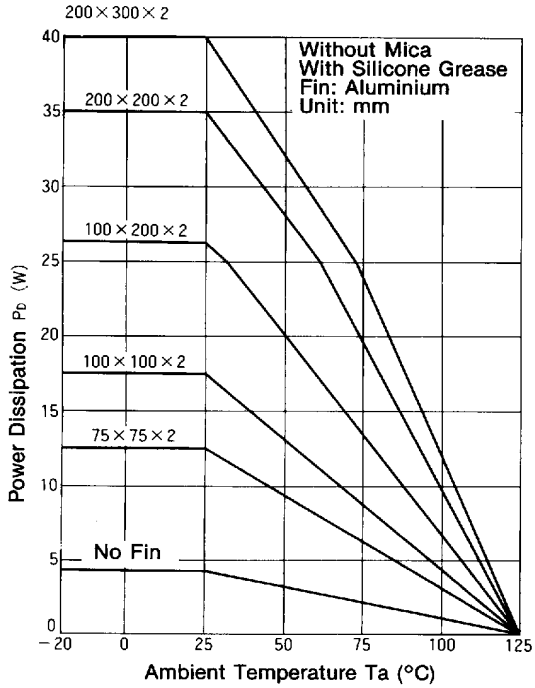


■Typical Operating Characteristics

Power Dissipation (STR7000 Series)



Power Dissipation (STR7100 Series)



STR7000/7100 Series

Read Before Use

Caution

1. Selecting the external parts

1) Inductance L

To maintain the stable operation of inductance L, dangerous conditions including operations under saturation or high temperature due to self heat generation must be avoided.

Take the following into consideration when selecting inductance L:

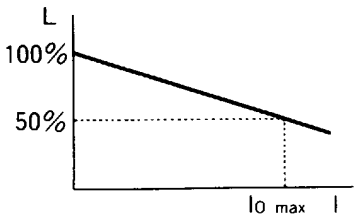
a) It shall be for switching regulator.
Do not use the inductor for noise filter, as it generates excess heat.

b) It shall have the appropriate inductance value.
The inductance values shown in external circuits are those at zero current and are suitable for the output voltage.
An appropriate inductance may also be obtained by following:
Io(min.) = critical current value f = 35 kHz

$$L = \frac{(V_{IN} - Vo)Vo}{2 \cdot Io(min.) \cdot V_{IN} \cdot f} \quad \cdots\cdots(1)$$

c) Rated current shall be maintained.
Inductance will decrease drastically at excess of rated current, and is ultimately saturated. Be careful as high frequency impedance will decrease under such condition, applying an excess current.

d) It shall have excellent DC Current superposition characteristics.
Inductance has the tendency to be decreased by increase in current. When selecting the inductance, keep in mind that it is usable up to 50% decrease at rated current.



- Contact coil manufacturers for selection of choke coils.

2) Capacitor C_1

Capacitor C_1 supplies the steep current generated during switching and compensates for the voltage drop in input.
Therefore, it is important that capacitor C_1 is placed adjacent to IC as follows:
Keep the following in mind when selecting C_1.

a) It shall have the rated voltage which is not below the input voltage.

b) It shall fulfill the value of allowable ripple current.

Use of the capacitor over the derating value shortens the life expectancy of the capacitor (by bursting, decrease in capacity, increase of ESR), and may also induce the abnormal oscillation of IC. Therefore, it is important to select C_1 with sufficient margin.

3) Capacitor C_4

Capacitor C_4 is a smoothing capacitor for switching output.
The pulse section ΔI_L of inductance current is charged/discharged at C_4.
Therefore, it is important to keep in mind the voltage resistance and allowable ripple current as in selection of C_1.

4) Current Detection Resistor Rs

Be careful for dissipation, as a large amount of current is applied to Rs.

5) Capacitor C_2

Capacitor C_2 is a phase compensation capacitor for voltage error amplifier.

6) Capacitor C_3

Capacitor C_3 is for stabilization of reference voltage. Oscillation may occur if C_3 is not provided.

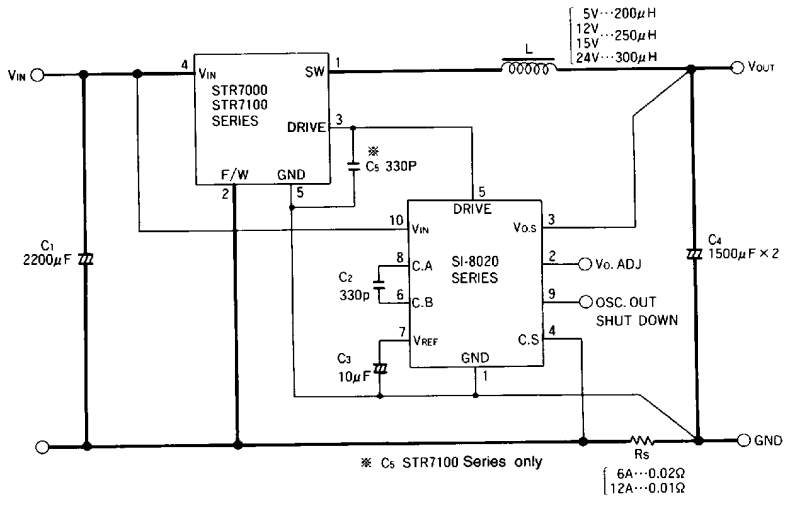
7) Capacitor C_5

Capacitor C_5 is for delaying the waveform of drive output.

2. Notes for Pattern Designing

1) Thick lines in the external circuit below are areas where a large amount of current flows. Design these patterns as thick as possible.
2) Place the capacitor C_1 on input side as closely as possible to the pins 2 and 4 of STR7000/7100 series. It may be used in combination with smoothing capacitor for rectifying, but above notes must be taken into consideration. In case where C_1 is not provided or it is placed too far from the pins given above, abnormal oscillation due to decreased transient response or increased ringing may be caused.
3) Connect voltage sensing pins Vo.s and GND as closely as possible with output capacitor C_4 (the flow current of Vo.s pin is approximately 1 mA). In case where they are placed too far from C_4, abnormal oscillation due to decreased regulation or increased switching ripple may be caused.
4) Connect current sensing pins C.S and GND as closely as possible with detection resistor Rs (the flow current of CS pin is approximately 0.5 mA).
   In case where they are placed too far from Rs, decrease of overcurrent setting point due to voltage drop in the pattern or malfunction of protection circuit due to increased ringing may be caused.

External Circuit



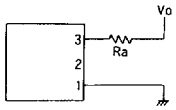
Applications

1. Adjustment of Output Voltage

Output voltage may be adjusted by using pin No.1 through 3 of SI-8020 series.
Adjustable ranges are shown below. Voltage difference of at least 6 V is required between input and output.

Fixed Voltage	Adjustable Range	$R_{2\text{-}3}$
5V	3.5 to 10V	2100
12V	7 to 17V	9000
15V	10 to 20V	12000
24V	19 to 29V	21000

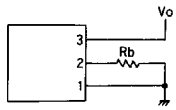
A. To adjust higher than fixed voltage:
1) UP1



Vo ····· Output voltage after adjustment
Vo' ····· Output voltage before adjustment

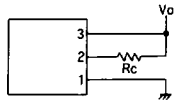
$$Ra \fallingdotseq (Vo - Vo') \cdot 1000 \ (\Omega) \cdots (2)$$

2) UP2



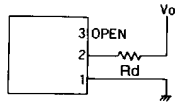
$$Rb \fallingdotseq \frac{1}{\frac{Vo-3}{3R_{2-3}} - \frac{1}{3000}} \ (\Omega) \cdots (3)$$

B. To adjust lower than fixed voltage:
1) DOWN



$$Rc \fallingdotseq \frac{1}{\frac{0.001}{Vo-3} - \frac{1}{R_{2-3}}} \ (\Omega) \cdots (4)$$

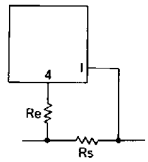
C. To adjust the entire range
1) UP•DOWN1
Combination of UP2•DOWN
2) UP•DOWN2

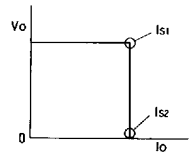


$$Rd \fallingdotseq \frac{Vo-3}{0.001} \ (\Omega) \cdots (5)$$

2. Adjustment of Constant Current Protection Characteristics

Adjustment of protection characteristics is made by using pin No.4 of SI-8020 series and Rs.
It may not be adjusted in excess of rated current.





1) Determine the setting value of Rs based on $I_{S1} = I_{S2}$.

- $Rs \fallingdotseq 0.02$ to 0.2Ω
- Beware of dissipation in Rs

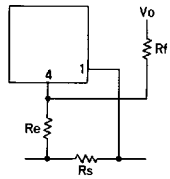
$$\text{However, } Rs \geqq \frac{0.13}{I_{S2}}$$

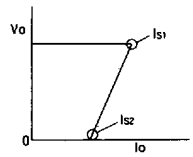
2) Determine the value of Re according to the following equation.

$$Re \fallingdotseq \frac{Rs \cdot I_{S2} - 0.13}{52 \times 10^{-5}} \quad \cdots\cdots (6)$$

3. Foldback Protection

Foldback protection is that adjustment of constant current is applied, and may be made by adding Rf between output voltage and pin No.4.





1) Determine I_{S2} in the same manner as adjustment of constant current protection is done.
2) Determine Rf based on the setting value of I_{S1}.

$$Rf \fallingdotseq \frac{Vo \cdot Re}{(I_{S1} - I_{S2})Rs} \quad \cdots\cdots (7)$$