



**SANYO Semiconductors**

# DATA SHEET

An ON Semiconductor Company

## STK760-213-E — Thick-Film Hybrid IC Single-phase rectification Active Converter Hybrid IC

### Overview

This IC is average current control type Active Converter Hybrid IC for power factor improvement of single-phase AC power supply, that containing power devices of step-up active converter, control IC over-current and over-voltage protection circuits.

### Applications

- Single-phase rectification active filter for power rectification for air conditioners and general-purpose inverters.

### Features

- Power switching device for active converter is adopting IGBT.
- Soft start functions and the over current, the over voltage, and the low-voltage are including as protection circuit
- Capable of controlling ON/OFF by logic level input signal.
- Output voltage changeability functions by control signal.

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# STK760-213-E

## Specifications

**Absolute Maximum Ratings** at  $T_a = 25^\circ\text{C}$

Parameter		Symbol	Conditions	Ratings	unit	
IGBT (TR1+TR2)	Collector-emitter voltage	VCE		600	V	
	Repetitive peak collector current	ICP	*1	300	A	
	Collector current	IC		105	A	
	Power dissipation	PC1		156	W	
FRD1 (D1)	Diode reverse voltage	VRM		600	V	
	Repetitive peak forward current	IF1P	*1	110	A	
	Diode forward current	IF1		36	A	
	Power dissipation	PD1		75	W	
FRD2 (D2)	Repetitive peak forward current	IF2P	*1	15	A	
	Diode forward current	IF2		7	A	
	Power dissipation	PD2		13	W	
Supply voltage ( $V_{CC-GND}$ )		$V_{CC}$		20	V	
Signal pin input voltage	Pin 4	VIS		-10 to 0.3	V	
	Pin 5	VCOMP		-0.3 to 6.5		
	Pin 8	VFB				
	Pin 9	VOVP				
	Pin 2	VONF		-0.3 to $V_{CC}$		
	Pin 6	Vctl				
Maximum input AC voltage		VAC	Single-phase Full-rectified	264	V	
Maximum output voltage		$V_O$	Under the Application condition (VAC=200V)	450	V	
Maximum output power		$W_o$		6	kW	
Input AC current (normal condition)		$I_{IN}$		30	Arms	
Junction temperature		$T_J$		150	$^\circ\text{C}$	
Operating case temperature		$T_c$	HIC case temperature	*2	-20 to +100	$^\circ\text{C}$
Storage temperature		$T_{stg}$			-40 to +125	$^\circ\text{C}$
Tightening torque			A screw part	*3	1.17	N•m
Withstand voltage		VINS	50Hz sine wave AC 1minute	*4	2000	VRMS

[Note]

\*1: Duty ratio  $D = 0.1$ ,  $t_p = 1\text{ms}$

\*2: Measure point is between 5mm to center of back.

\*3: Torque should be set within 0.79 to 1.17N•m. Flatness of the heat-sink should be lower than 0.2mm.

\*4: The test condition: AC2500V, 1 second.

## STK760-213-E

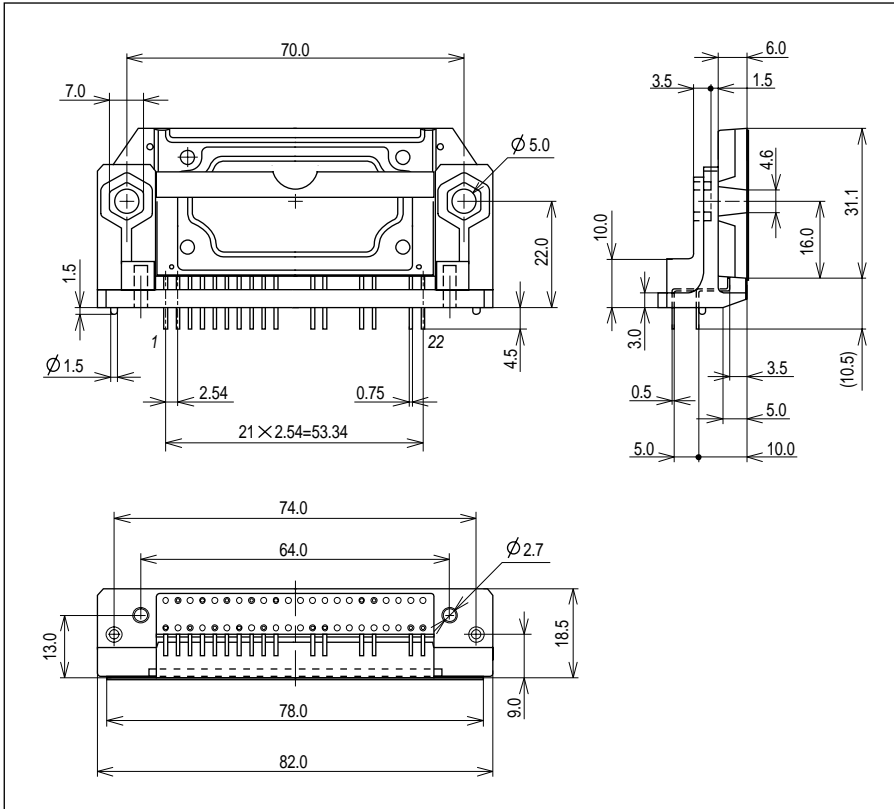
**Electrical Characteristics** at  $T_c = 25^\circ\text{C}$ ,  $V_{CC} = 15.0\text{V}$ : Unless otherwise noted

Parameter	Symbol	Conditions	Test circuit	Ratings			unit	
				min	typ	max		
Power output part								
Collector-emitter leak current (IGBT)	$I_{CES}$	$V_{CE} = 600\text{V}$	Fig.1			200	$\mu\text{A}$	
Collector-emitter saturation voltage (IGBT)	$V_{CE(sat)}$	$I_C = 40\text{A}$	Fig.2		1.2	1.8	V	
Diode reverse current (FRD1)	$I_R$	$V_R = 600\text{V}$	Fig.1			200	$\mu\text{A}$	
Diode forward voltage (FRD1)	$V_{F1}$	$I_F = 40\text{A}$	Fig.3		2.2	2.8	V	
Diode forward voltage (FRD2)	$V_{F2}$	$I_F = 5\text{A}$	Fig.3		2.5	3.5	V	
Junction to case thermal resistance	$\theta_{j-c1}$	IGBT (TR1+TR2)			0.80		$^\circ\text{C/W}$	
	$\theta_{j-c2}$	FRD1 (D1)			1.65		$^\circ\text{C/W}$	
	$\theta_{j-c3}$	FRD2 (D2)			9.0		$^\circ\text{C/W}$	
Control IC part								
Control IC input current	$I_{CC(ON)}$	$V_{CC} = 15\text{V}$ , $V_{ONF} = 5\text{V}$	Fig.4		14	20	mA	
	$I_{CC(OFF)}$	$V_{CC} = 15\text{V}$ , $V_{ONF} = 0\text{V}$			2.5	5		
Oscillation frequency	$f_{OSC}$	$V_{CC} = 15\text{V}$ , $V_{ONF} = 5\text{V}$			19.5	22.0	24.5	kHz
Open loop protection threshold voltage	VOLP				0.8	0.95	1.1	V
Error-amp reference voltage	$V_{ref}$		Fig.5	4.88	5.0	5.12	V	
Peak current protection threshold voltage	$V_{IS(PK)}$			-0.58	-0.5	-0.42	V	
Over voltage protection threshold voltage	$V_{OVP(ON)}$			Fig.6	5.095	5.3	5.51	V
ON/OFF threshold voltage	$V_{THON}$	$V_{CC} = 15\text{V}$	Fig.7	3.0			V	
	$V_{THOFF}$					0.5	V	
Start-up $V_{CC}$ voltage	$V_{CC(ON)}$	$V_{ONF} = 5\text{V}$	Fig.8	12.4	13.25	14.1	V	
Shut-down $V_{CC}$ voltage	$V_{CC(OFF)}$			9.4	10.0	10.7	V	
Substrate temperature monitor resistance	RTH	Resistance between VTH-GND	Fig.3	90	100	110	$\text{k}\Omega$	
Application circuit : $V_{AC} = 200\text{V}$ , $V_O = 380\text{V}$ ( $V_{ctl} = 1.507\text{V}$ )								
Output voltage	$V_O$	$W_o = 2\text{kW}$	Fig.9	366	380	394	V	
Power Factor	$\cos\phi$	$W_o = 400\text{W}$		0.98	0.99			
		$W_o = 2\text{kW}$		0.99	0.995	1.0		

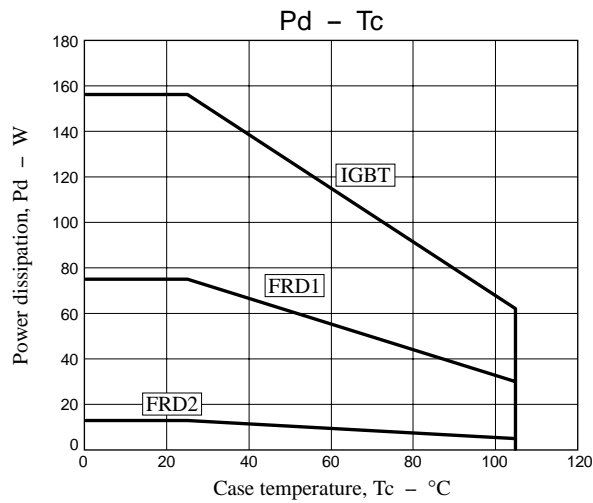
# STK760-213-E

## Package Dimensions

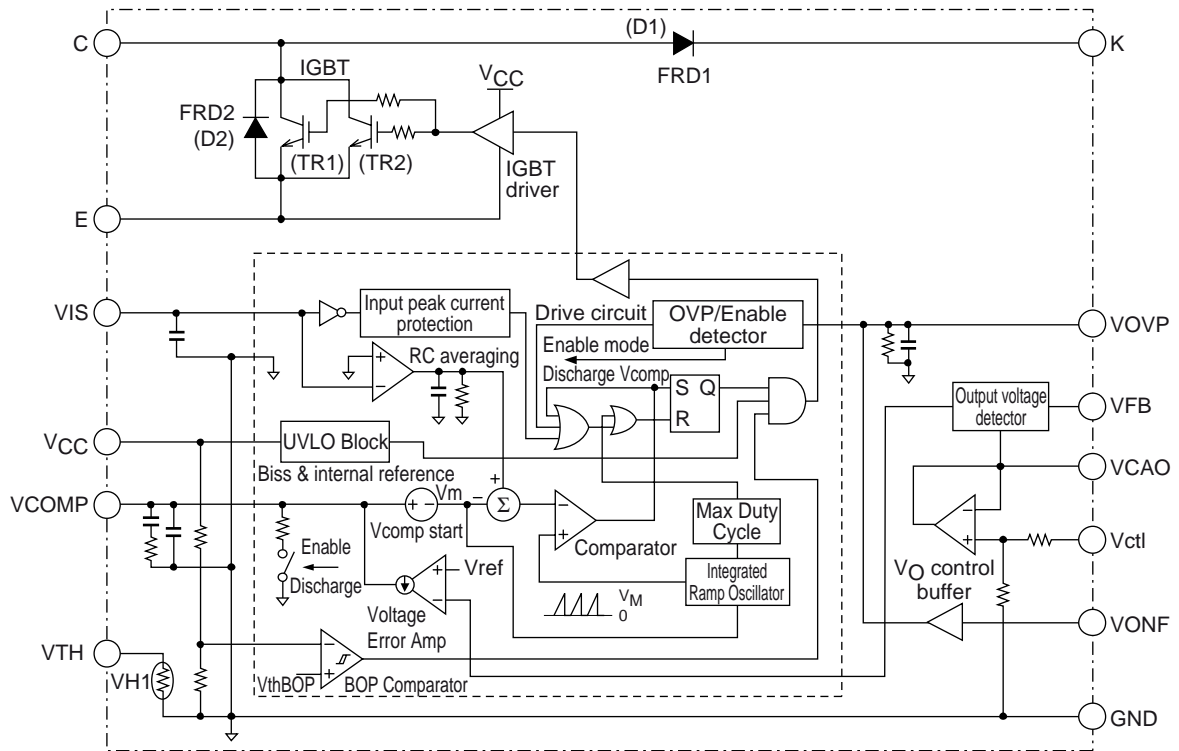
unit:mm (typ)



## IGBT (TR1+TR2), FRD1 (D1) & FRD2 (D2) vs. Temperature Derating ( $T_a = 25^\circ\text{C}$ )



Block Diagram



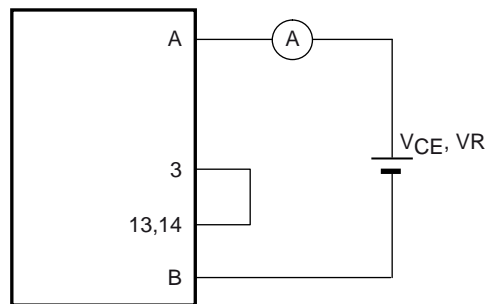
Explanation of Terminal

Terminal No.	Symbol	Explanation
1	VCC	Control IC power supply input
2	VONF	ON/OFF control terminal
3	GND	Signal GND
4	VIS	Current detection terminal
5	VCOMP	Phase compensation terminal (Voltage error amplifier out)
6	Vctl	Output voltage control signal input
7	VCAO	Output voltage control amplifier output
8	VFB	Output voltage feed back terminal
9	VOVP	Over voltage protection terminal
10	VTH	Terminal of thermistor TH1
11, 12	-	An empty terminal
13, 14	E	IGBT (TR1+TR2) Emitter
15, 16	-	An empty terminal
17, 18	C	IGBT (TR1+TR2) Collector
19, 20	-	An empty terminal
21, 22	K	FRD1 (D1) Cathode

Test Circuit -1

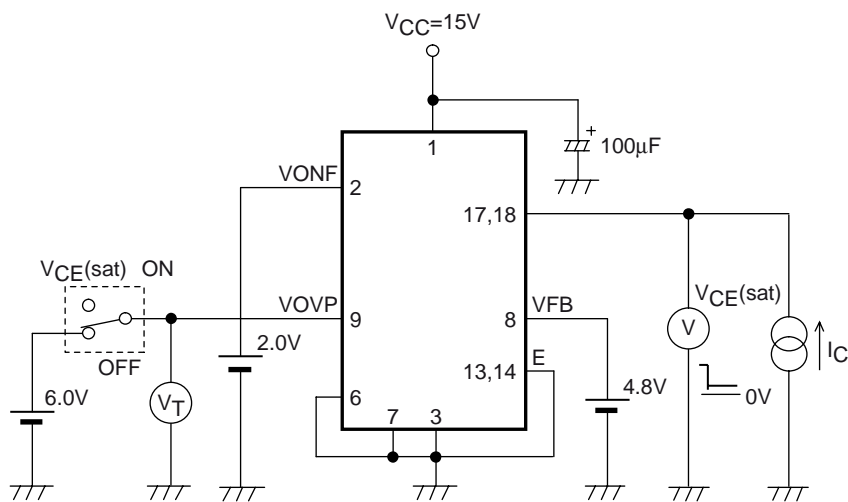
(1)  $I_{CES}$ ,  $I_R$

	IGBT	FRD1
A	17, 18	21, 22
B	13, 14	17, 18



(Fig.1)

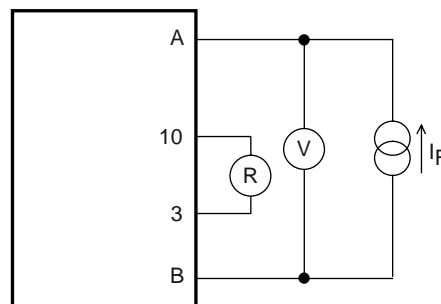
(2)  $V_{CE(sat)}$  (Test by Pulse)



(Fig.2)

(3)  $V_{F1}$ ,  $V_{F2}$  (Test by Pulse),  $R_{TH}$

	FRD1	FRD2
A	17, 18	13, 14
B	21, 22	17, 18

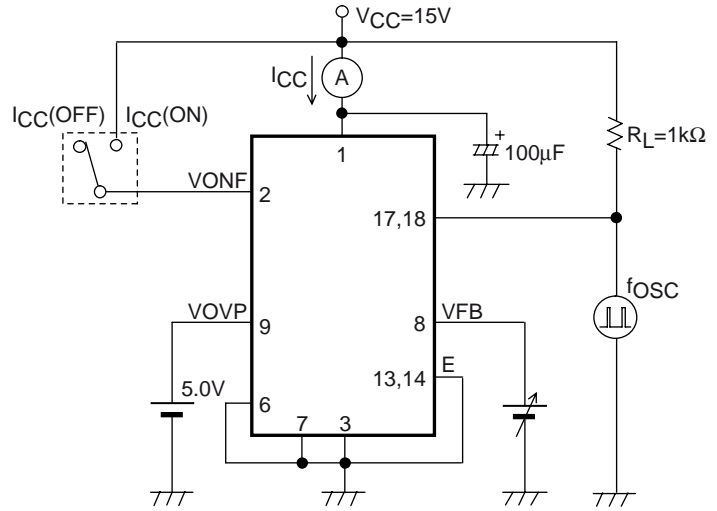


(Fig.3)

Test Circuit -2

(4)  $I_{CC(ON)}/I_{CC(OFF)}$ , VOLP,  $f_{OSC}$

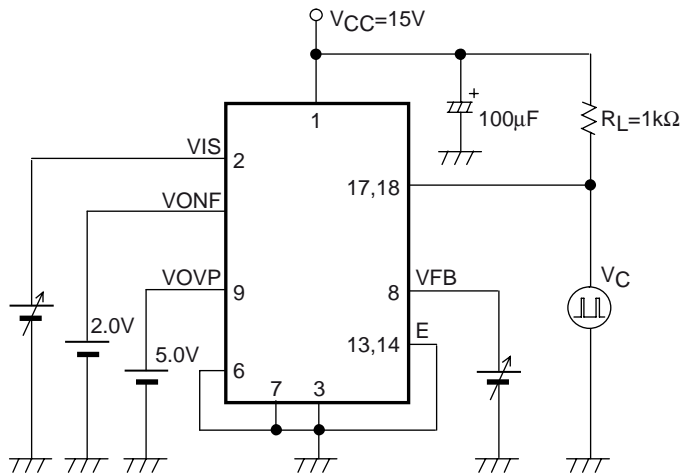
$I_{CC}, f_{OSC}$	VOLP
VFB = 1.1V	VONF = 5.0V



(Fig.4)

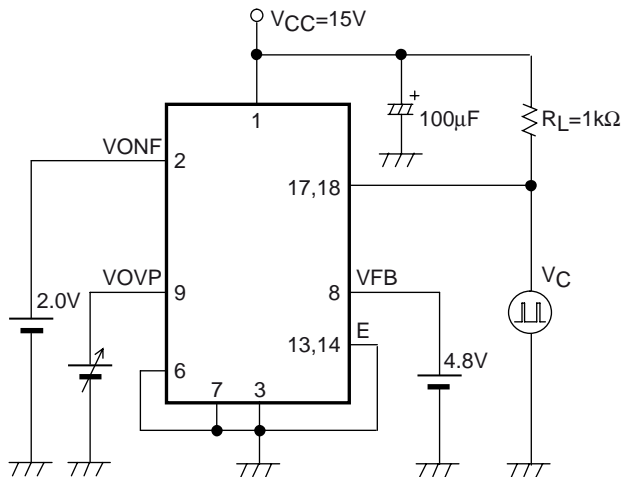
(5)  $V_{ref}$ , VIS(PK)

$V_{ref}$	VIS(PK)
VIS = -0.6V	VFB = 4.8V



(Fig.5)

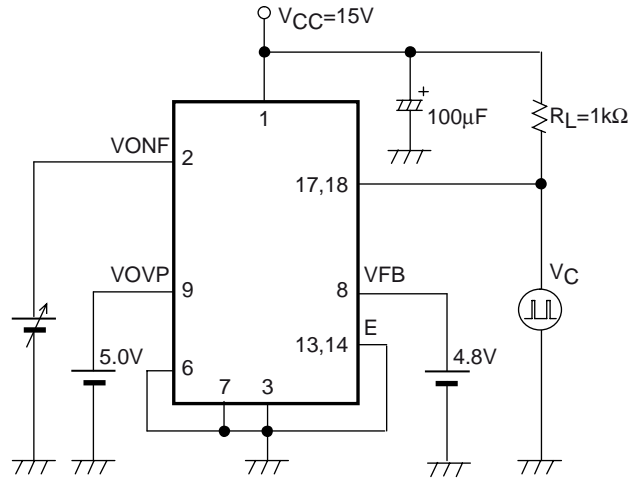
(6) VOVP(ON)



(Fig.6)

Test Circuit -3

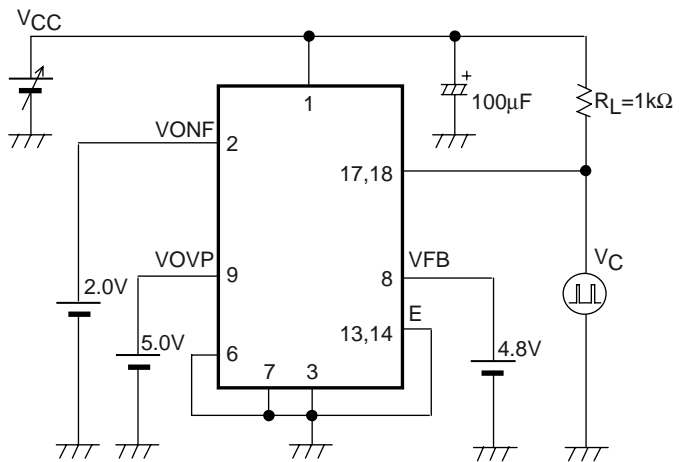
(7) V<sub>THON</sub>, V<sub>THOFF</sub>



(Fig.7)

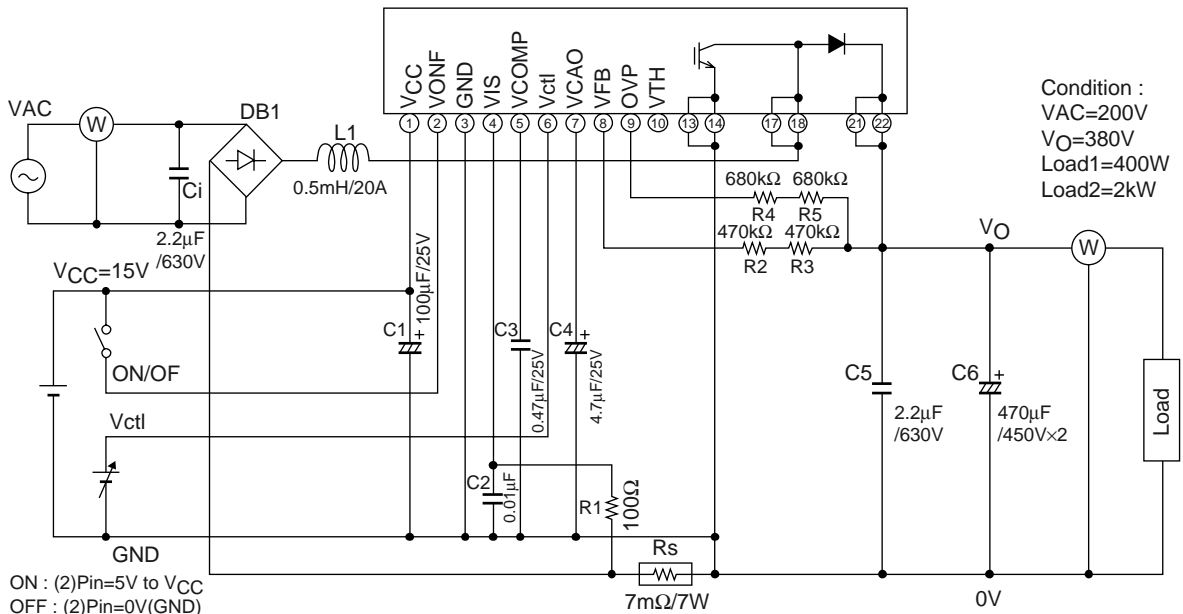
(8) V<sub>CC(ON)</sub>, V<sub>CC(OFF)</sub>

V <sub>CC(ON)</sub>	V <sub>CC(OFF)</sub>
V <sub>c-ON</sub>	V <sub>c-OFF</sub>



(Fig.8)

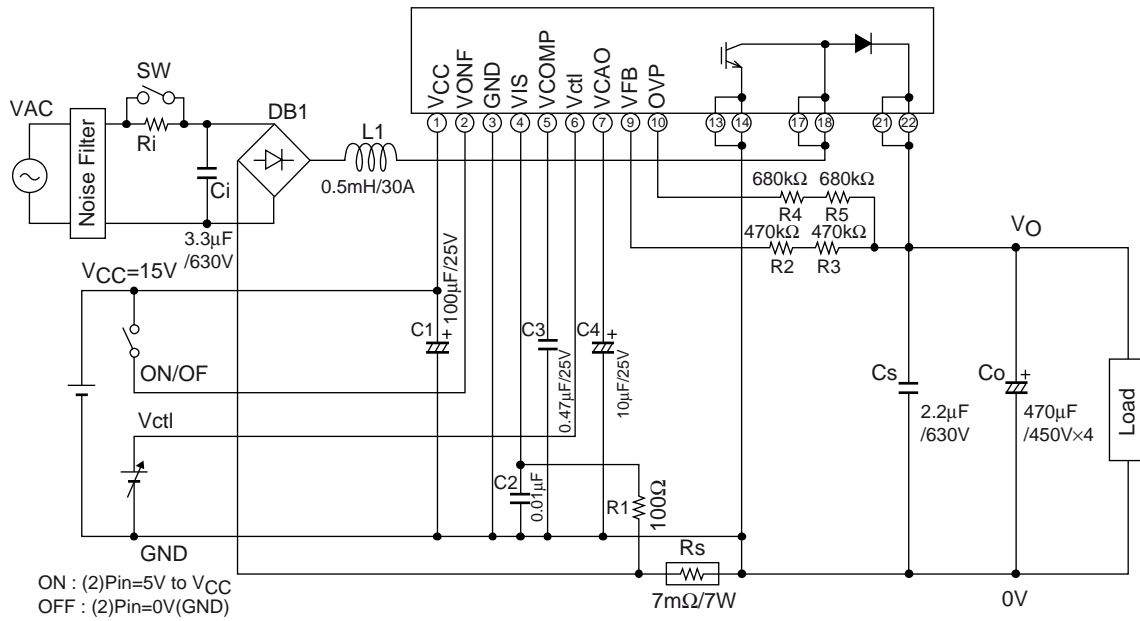
(9) Power Factor (COSφ)



(Fig.9)



Application Circuit

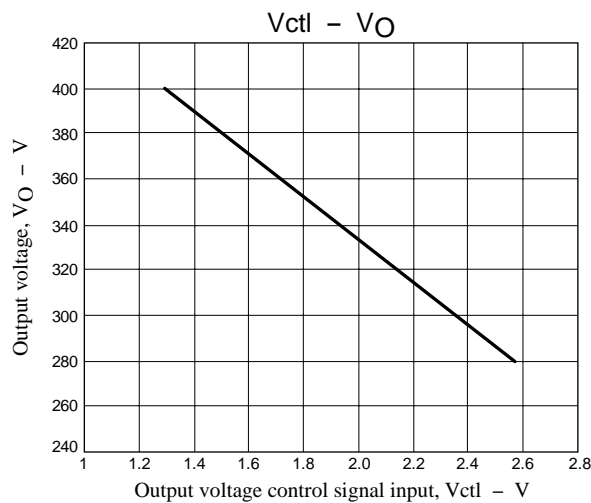


Recommended Condition

Parameter	Symbol	Conditions	Ratings	unit
AC Voltage	VAC	50/60Hz	170 to 264	Vrms
Output voltage	V <sub>O</sub>		$VAC \times \sqrt{2} + (10 \text{ to } 15) \leq 450$	V
Over-voltage detection voltage	VOV		$V_{OUT} + (10 \text{ to } 20)$	V
Control IC supply voltage	V <sub>CC</sub>	V <sub>CC</sub> -GND	14.5 to 17.0	V
Inductor	L1		0.5	mH
Input film capacitor	Ci		$3.3 \leq C_i$	µF
Output film capacitor	Cs		$2.2 \leq C_s$	µF
Output electrolytic capacitor	Co		$1880 \leq C_o$	µF

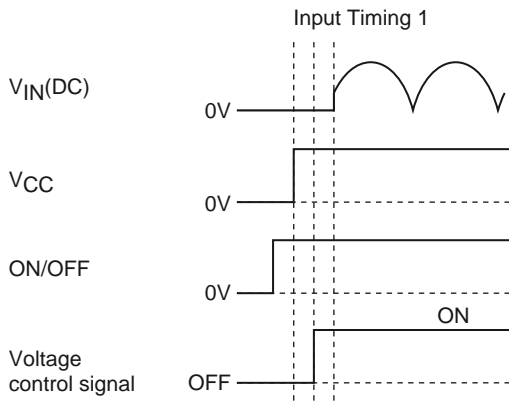
Output Voltage Control

Output voltage control signal V<sub>ctl</sub> sets referring to the V<sub>ctl</sub>-V<sub>O</sub> characteristic of the figure below.

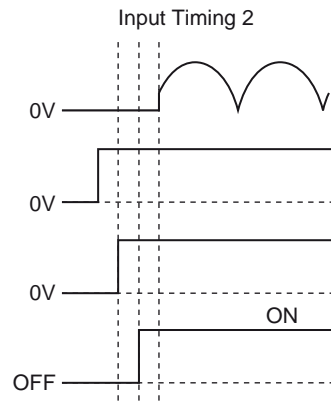


**Timing Chart**

Even if power supply and signal at any timing are input, this IC is not destroyed. However, soft start circuit doesn't operate when  $V_{IN(DC)}$  is input at the timing of Figure 11 and 12. Therefore, overcurrent protection circuit will operate, and audio frequency noise from coil may generate. Please turn on ON/OFF or  $V_{CC}$  after  $V_{IN(DC)}$  to avoid this.

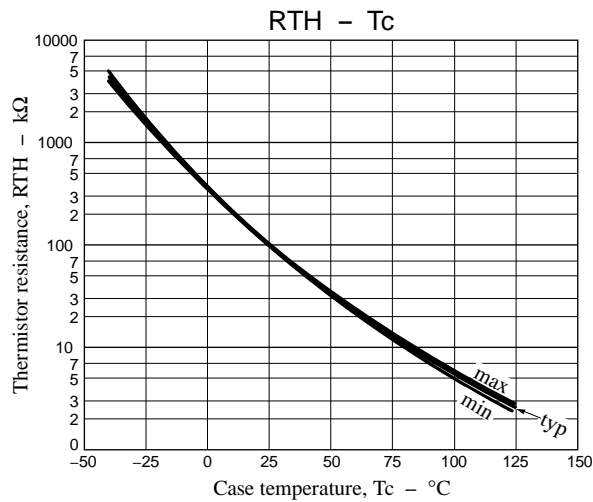


<Fig.11>



<Fig.12>

**The built-in thermistor resistance temperature characteristic**



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