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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.

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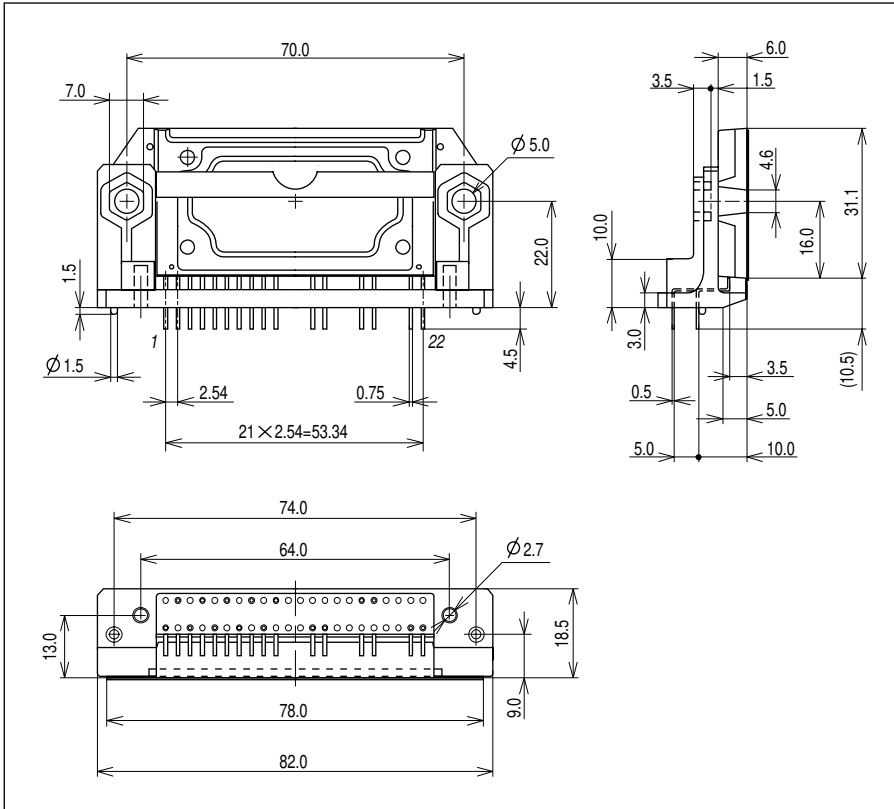
Electrical Characteristics at $T_c = 25^\circ\text{C}$, $V_{CC} = 15.0\text{V}$: Unless otherwise noted

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	μA
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	μA
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	θ_{j-c1}	IGBT (TR1+TR2)			0.80		$^\circ\text{C/W}$
	θ_{j-c2}	FRD1 (D1)			1.65		$^\circ\text{C/W}$
	θ_{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}	$V_{CC} = 15\text{V}$, $V_{ONF} = 5\text{V}$	Fig.4	19.5	22.0	24.5	kHz
Open loop protection threshold voltage	VOLP			0.8	0.95	1.1	V
Error-amp reference voltage	Vref		Fig.5	4.88	5.0	5.12	V
Peak current protection threshold voltage	VIS(PK)			-0.58	-0.5	-0.42	V
Over voltage protection threshold voltage	VOVP(ON)		Fig.6	5.095	5.3	5.51	V
ON/OFF threshold voltage	VTHON	$V_{CC} = 15\text{V}$	Fig.7	3.0			V
	VTHOFF					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	

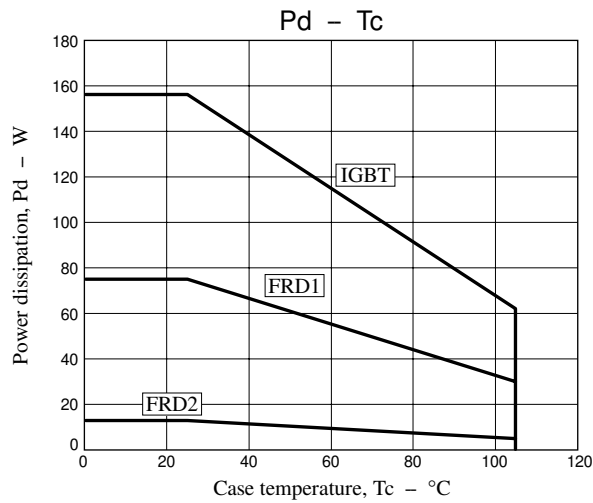
STK760-213-E

Package Dimensions

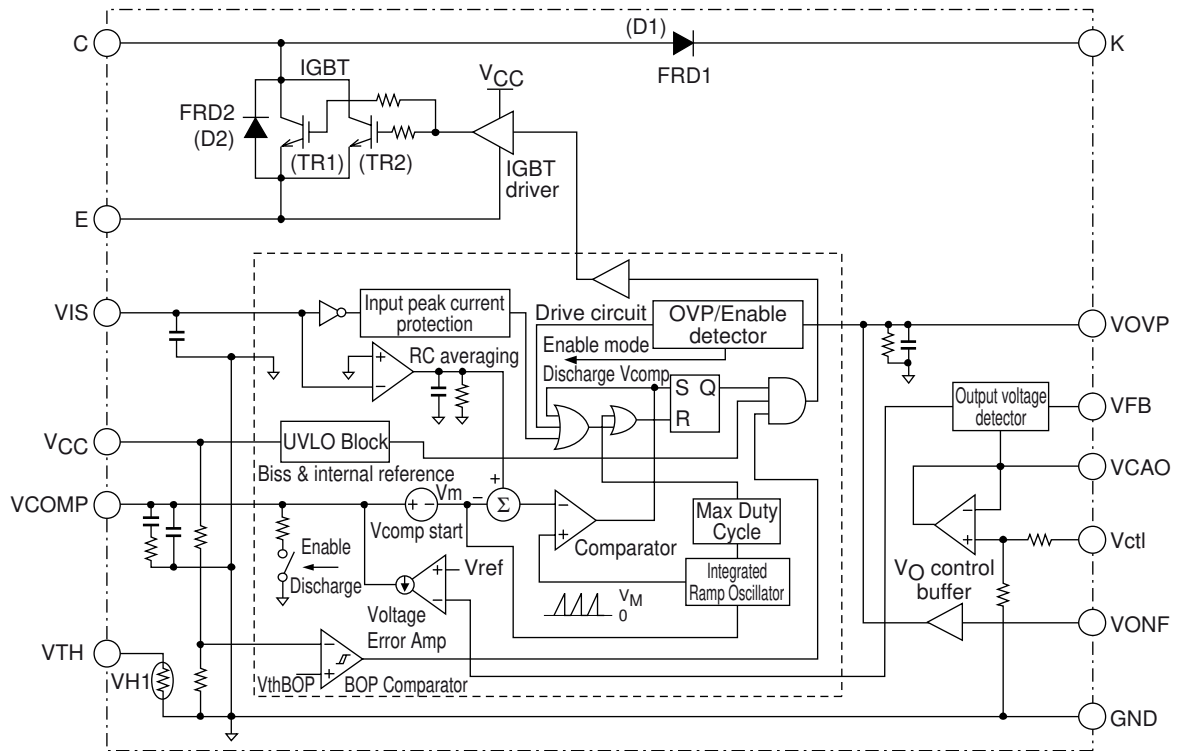
unit:mm (typ)



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



Block Diagram



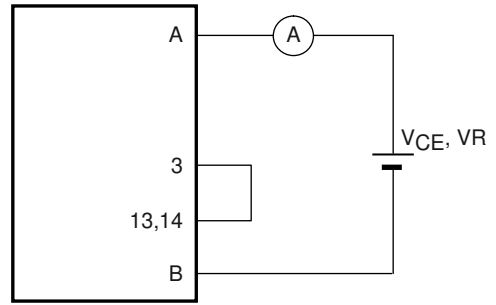
Explanation of Terminal

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

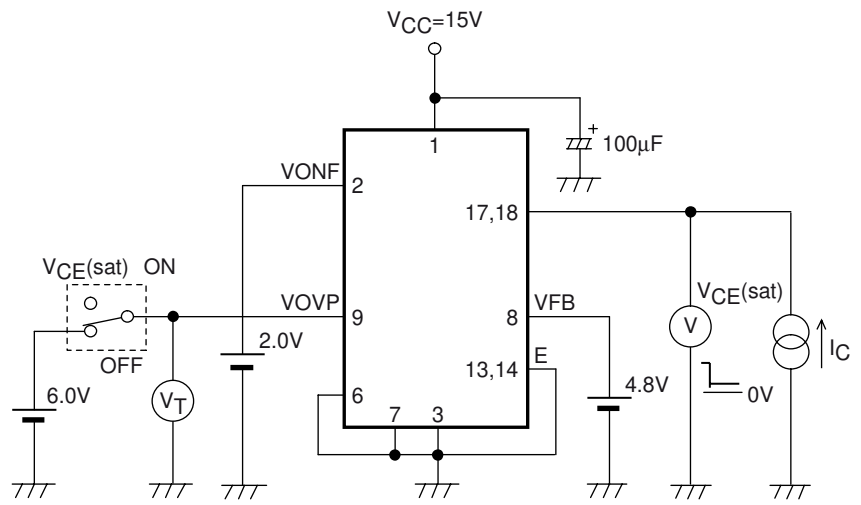
(1) I_{CES} , I_R

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



(Fig.1)

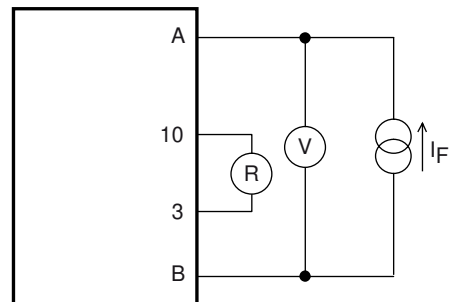
(2) $V_{CE(sat)}$ (Test by Pulse)



(Fig.2)

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

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

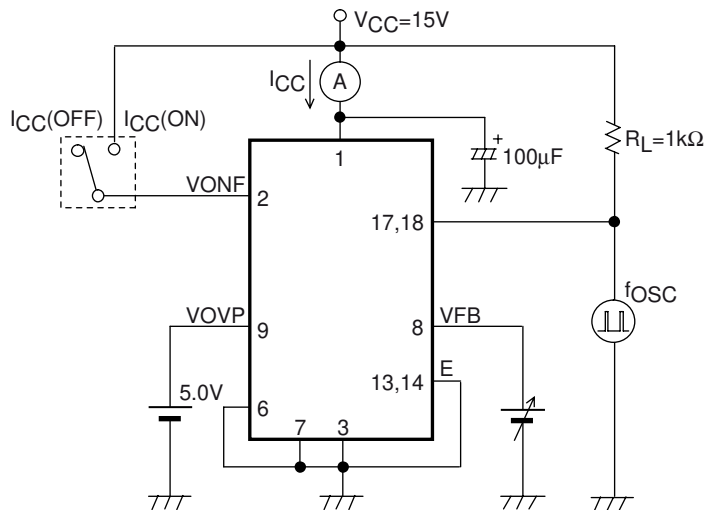


(Fig.3)

Test Circuit -2

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

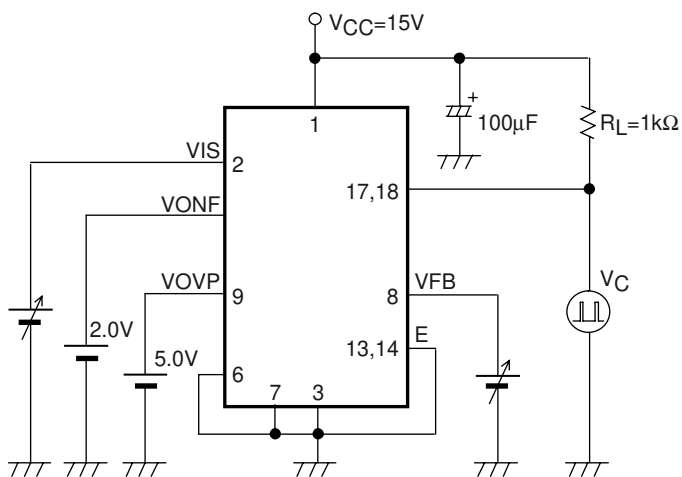
I_{CC}, f_{OSC}	VOLP
VFB = 1.1V	VONF = 5.0V



(Fig.4)

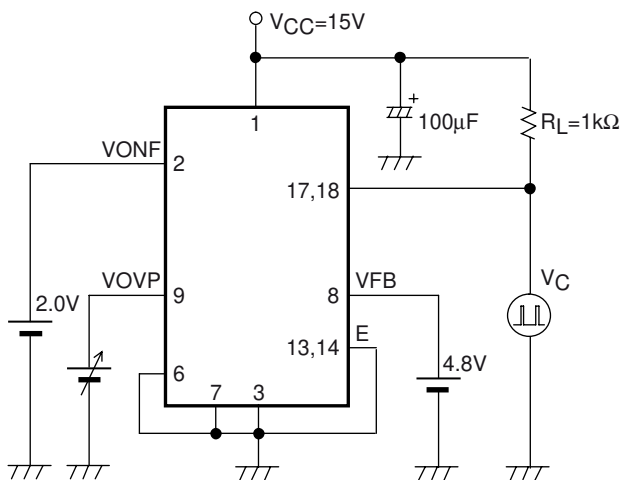
(5) V_{ref} , VIS(PK)

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



(Fig.5)

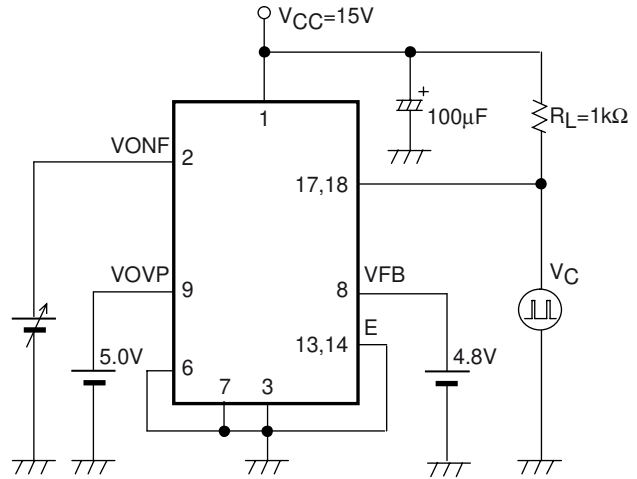
(6) VOVP(ON)



(Fig.6)

Test Circuit -3

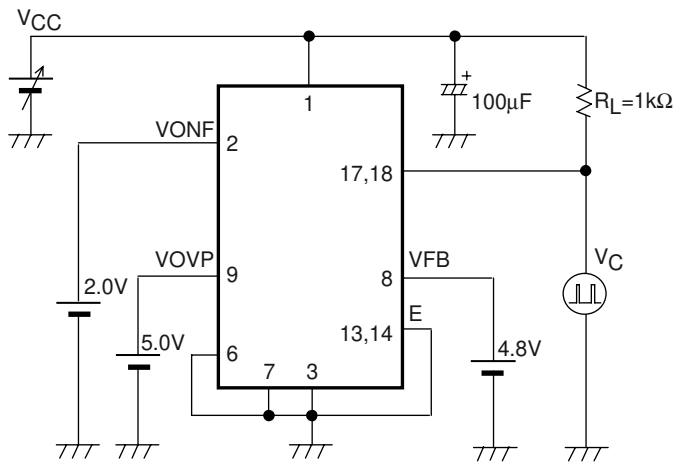
(7) V_{THON}, V_{THOFF}



(Fig.7)

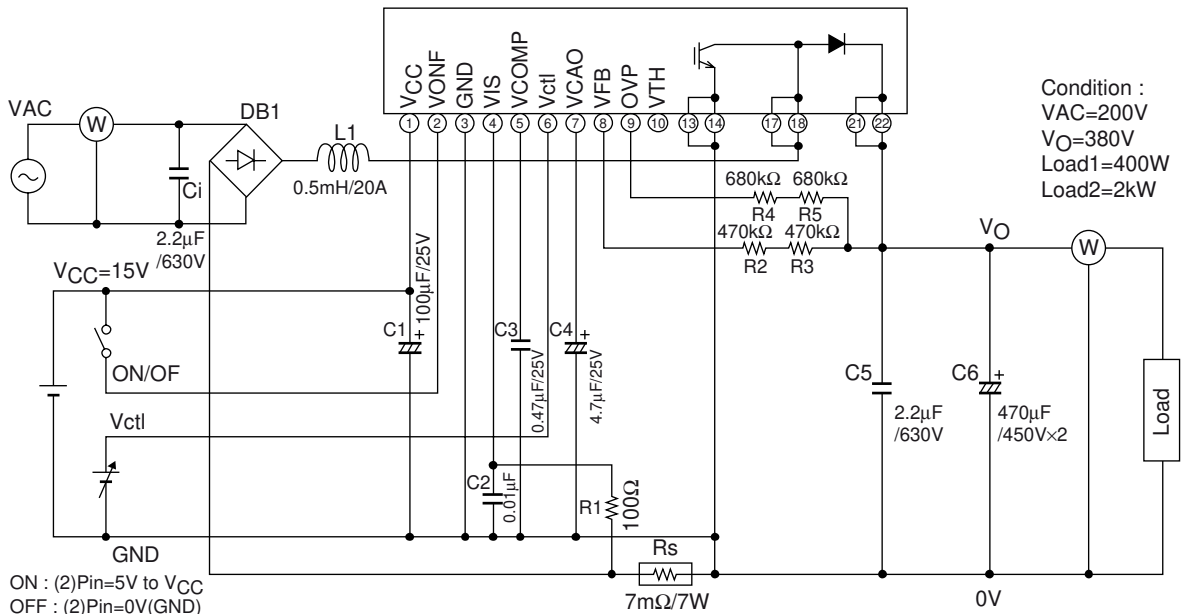
(8) V_{CC(ON)}, V_{CC(OFF)}

V _{CC(ON)}	V _{CC(OFF)}
V _{c-ON}	V _{c-OFF}



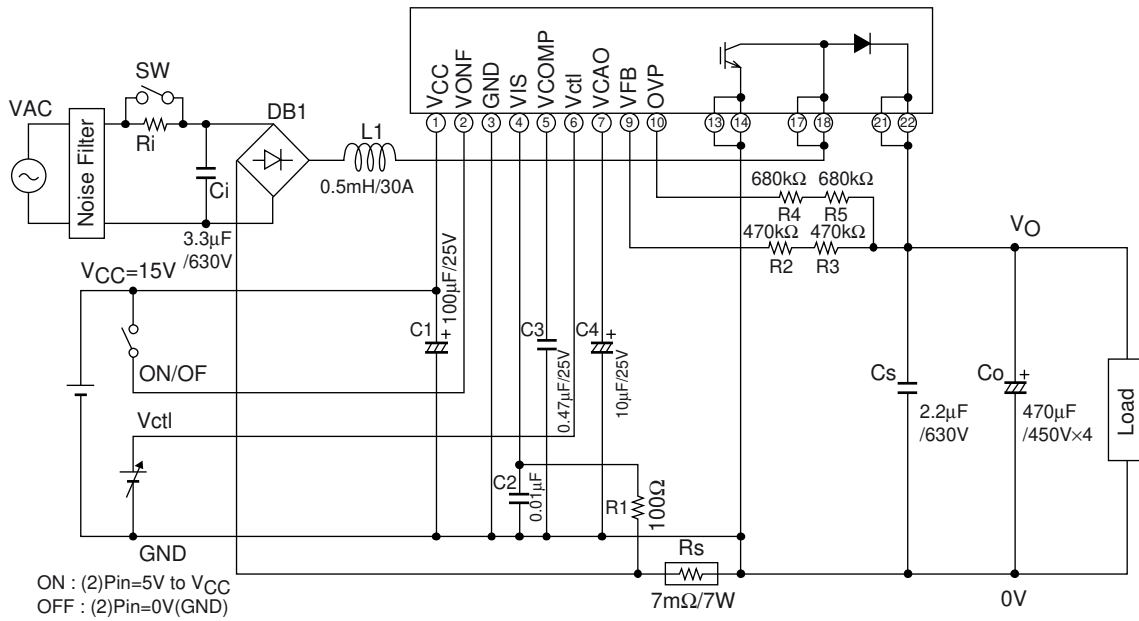
(Fig.8)

(9) Power Factor (COSφ)



(Fig.9)

Application Circuit

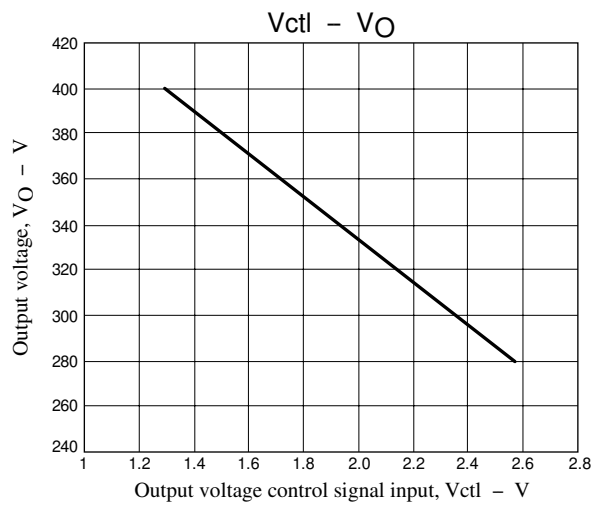


Recommended Condition

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

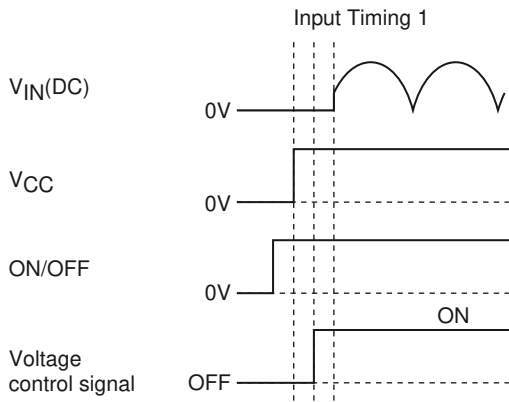
Output Voltage Control

Output voltage control signal Vctl sets referring to the Vctl-VO characteristic of the figure below.

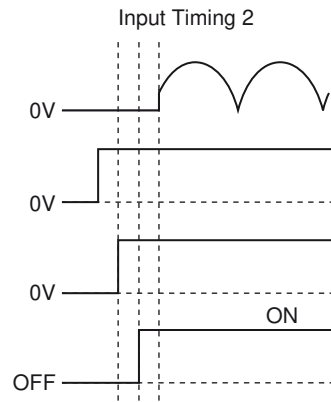


Timing Chart

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.

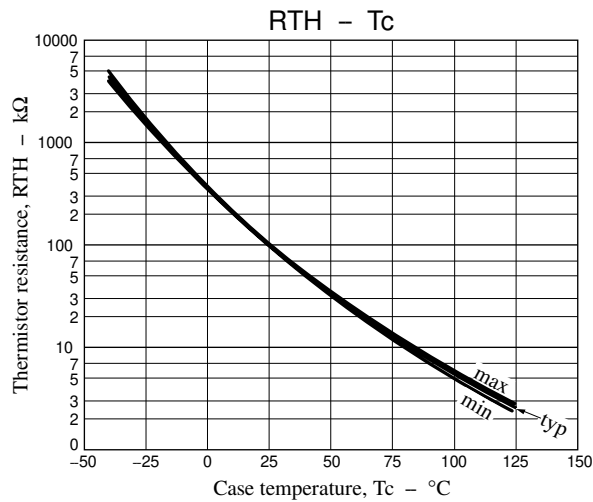


<Fig.11>



<Fig.12>

The built-in thermistor resistance temperature characteristic



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