



SANYO Semiconductors

DATA SHEET

An ON Semiconductor Company

STK760-211-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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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	185	A
	Collector current	IC		72	A
	Power dissipation	PC1		125	W
FRD1 (D1)	Diode reverse voltage	VRM		600	V
	Repetitive peak forward current	IF1P	*1	106	A
	Diode forward current	IF1		36	A
	Power dissipation	PD1		73	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		4	kW
Input AC current (normal condition)		I _{IN}		20	Arms
Junction temperature		T _j		150	°C
Operating case temperature		T _c	HIC case temperature *2	-20 to +100	°C
Storage temperature		T _{stg}		-40 to +125	°C
Tightening torque			A screw part *3	1.0	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 1.0N·m. Flatness of the heat-sink should be lower than 0.15mm.

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

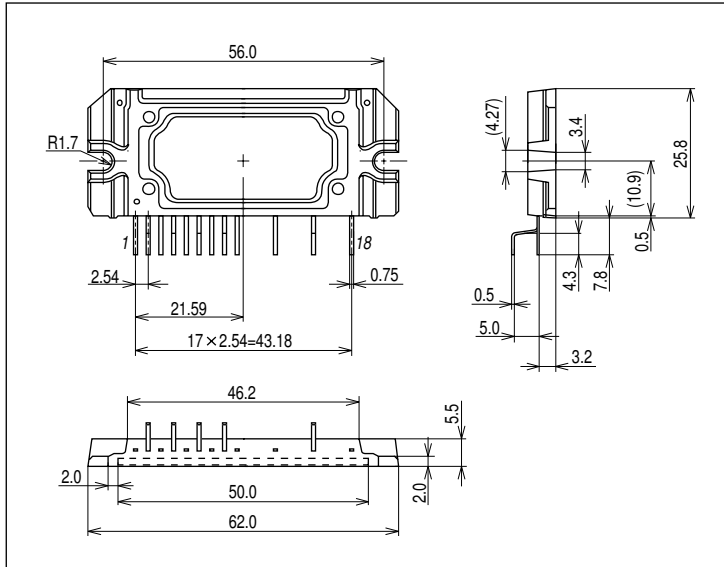
STK760-211-E

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

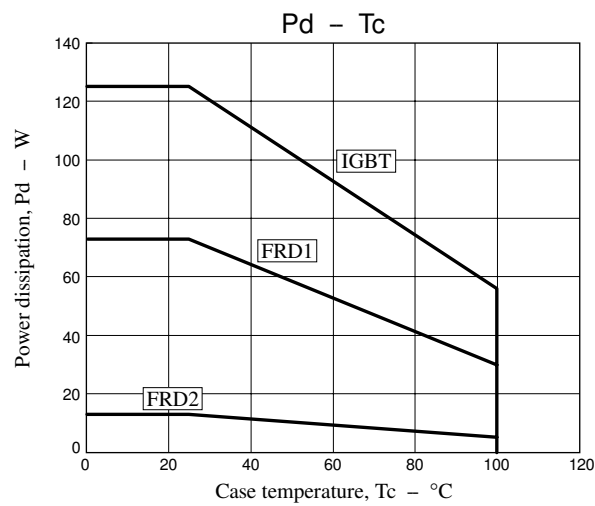
Parameter	Symbol	Conditions	Test circuit	Ratings			unit
				min	typ	max	
Power output part							
Collector-emitter leak current (IGBT)	I _{CES}	V _{CE} = 600V	Fig.1			200	μA
Collector-emitter saturation voltage (IGBT)	V _{CE(sat)}	I _C = 30A	Fig.2		1.4	2.0	V
Diode reverse current (FRD1)	I _R	V _R = 600V	Fig.1			200	μA
Diode forward voltage (FRD1)	V _{F1}	I _F = 30A	Fig.3		2.0	2.6	V
Diode forward voltage (FRD2)	V _{F2}	I _F = 5A	Fig.3		2.5	3.5	V
Junction to case thermal resistance	θ _{j-c1}	IGBT (TR1+TR2)			1.0		°C/W
	θ _{j-c2}	FRD1 (D1)			1.7		°C/W
	θ _{j-c3}	FRD2 (D2)			9.0		°C/W
Control IC part							
Control IC input current	I _{CC(ON)}	V _{CC} = 15V, V _{ONF} = 5V	Fig.4		14	20	mA
	I _{CC(OFF)}	V _{CC} = 15V, V _{ONF} = 0V			2.5	5	
Oscillation frequency	f _{OSC}	V _{CC} = 15V, V _{ONF} = 5V			19.5	22.0	24.5
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
ON/OFF threshold voltage	V _{THON}	V _{CC} = 15V	Fig.7	3.0			V
	V _{THOFF}					0.5	V
Start-up V _{CC} voltage	V _{CC(ON)}	V _{ONF} = 5V	Fig.8	12.4	13.25	14.1	V
Shut-down V _{CC} voltage	V _{CC(OFF)}			9.4	10.0	10.7	V
Application circuit : V _{AC} = 200V, V _O = 380V (V _{ctl} = 1.507V)							
Output voltage	V _O	W _o = 2kW	Fig.9	366	380	394	V
Power Factor	cosφ	W _o = 400W		0.98	0.99		
		W _o = 2kW		0.99	0.995	1.0	

Package Dimensions

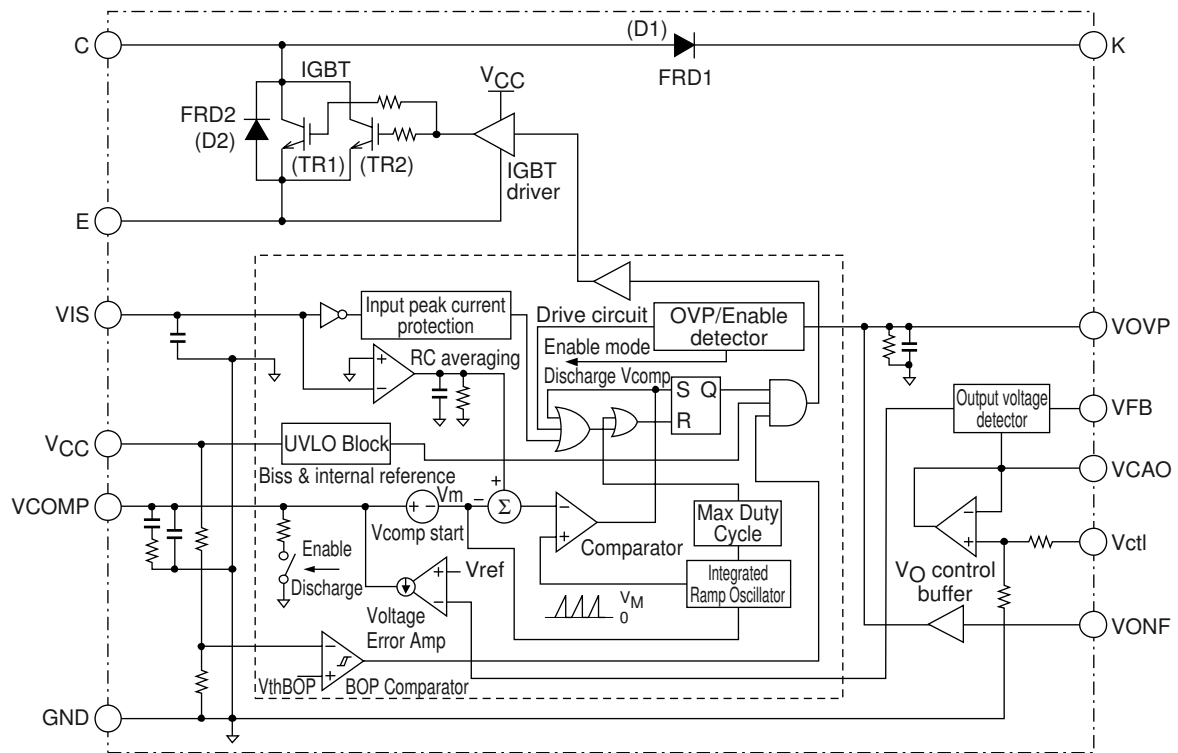
unit:mm (typ)



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



Block Diagram



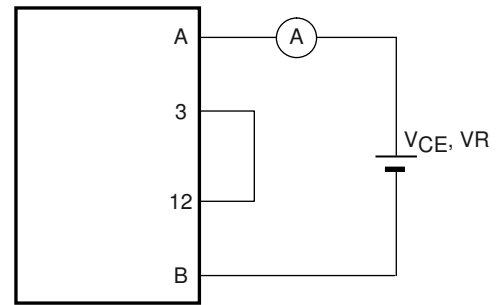
Explanation of Terminal

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, 11	-	An empty terminal
12	E	IGBT (TR1+TR2) Emitter
13, 14	-	An empty terminal
15	C	IGBT (TR1+TR2) Collector
16, 17	-	An empty terminal
18	K	FRD1 (D1) Cathode

Test Circuit -1

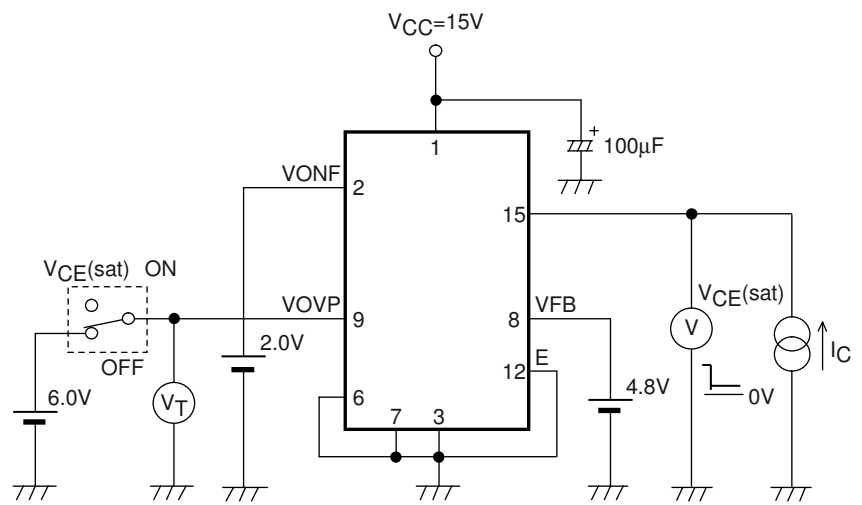
(1) I_{CES} , I_R

	IGBT	FRD1
A	15	18
B	12	15



〈Fig.1〉

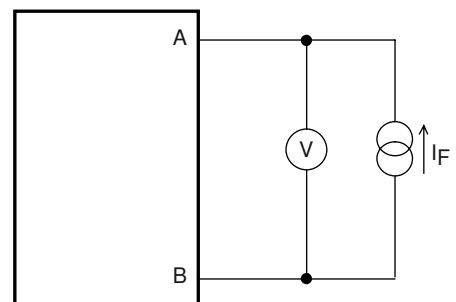
(2) $V_{CE(sat)}$ (Test by Pulse)



〈Fig.2〉

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

	FRD1	FRD2
A	15	12
B	18	15

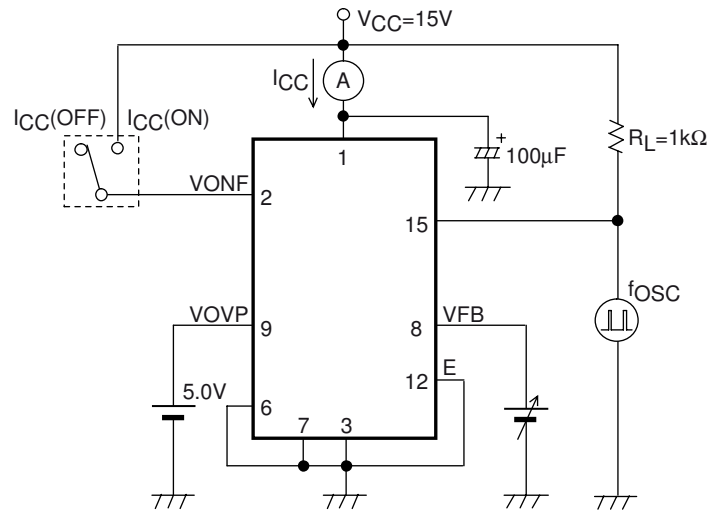


〈Fig.3〉

Test Circuit -2

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

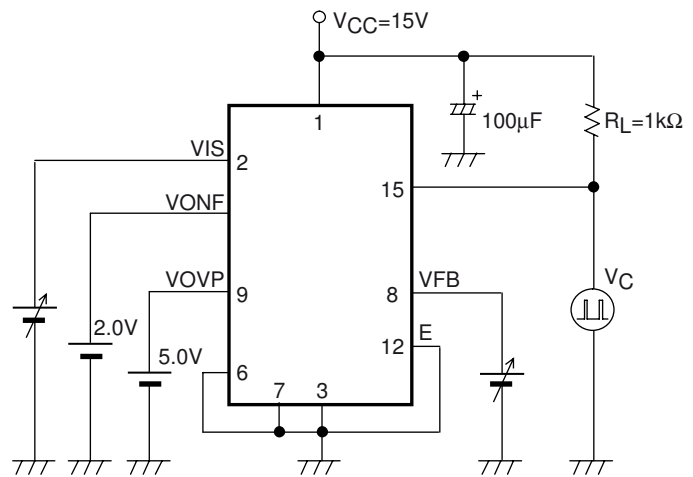
I_{CC}, f_{OSC}	$VOLP$
$VFB = 1.1V$	$VONF = 5.0V$



(Fig.4)

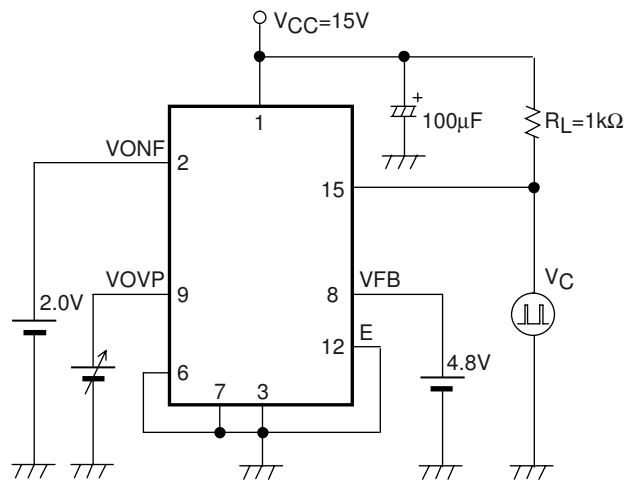
(5) V_{ref} , $VIS(PK)$

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



(Fig.5)

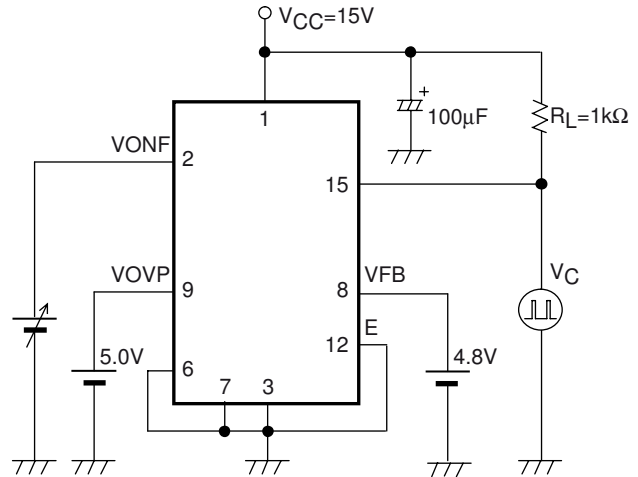
(6) $VOVP(ON)$



(Fig.6)

Test Circuit -3

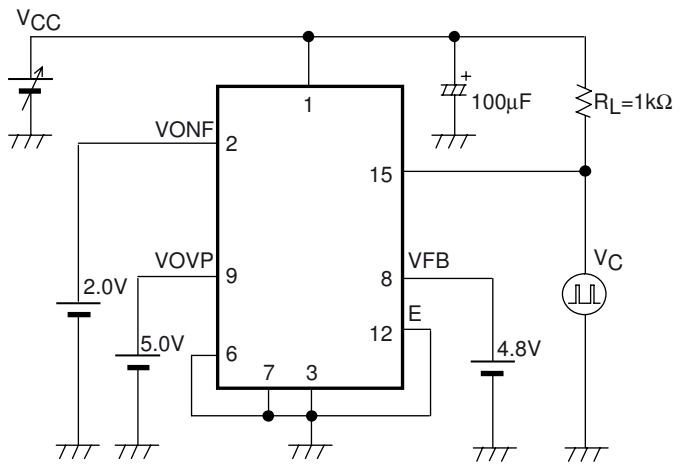
(7) V_{THON}, V_{THOFF}



(Fig.7)

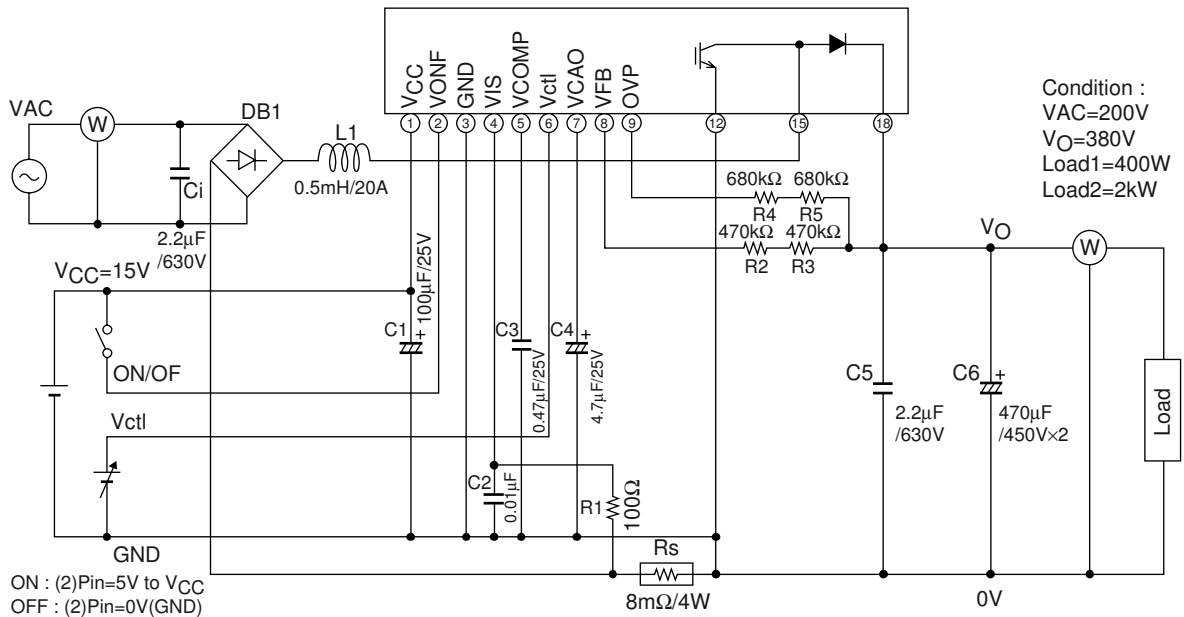
(8) V_{CC(ON)}, V_{CC(OFF)}

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



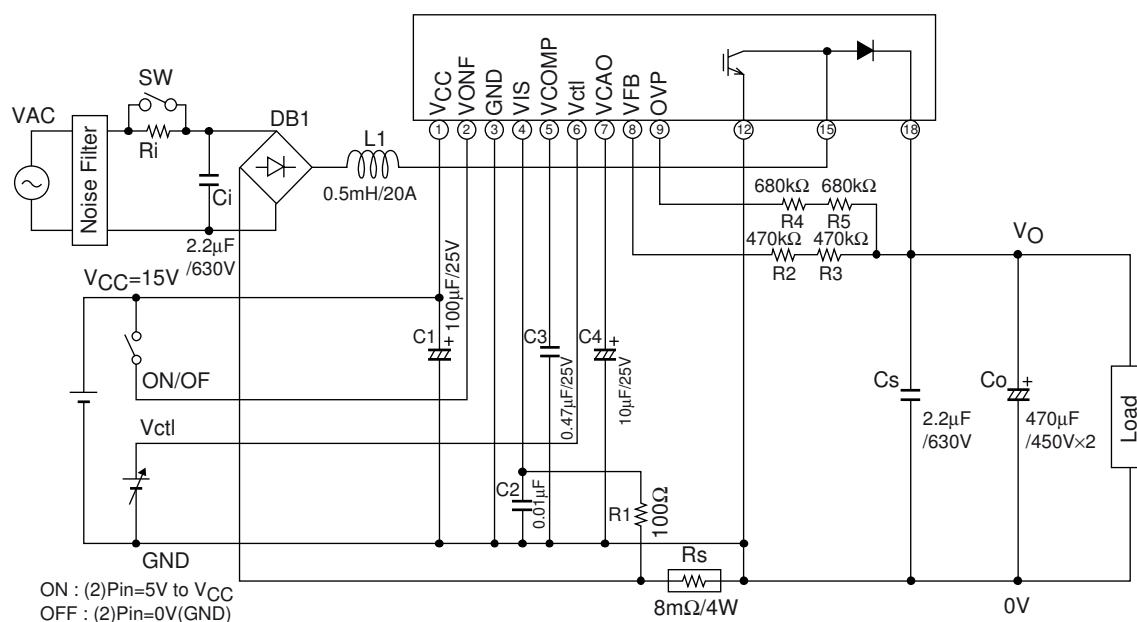
(Fig.8)

(9) Power Factor (COSφ)



(Fig.9)

Application Circuit

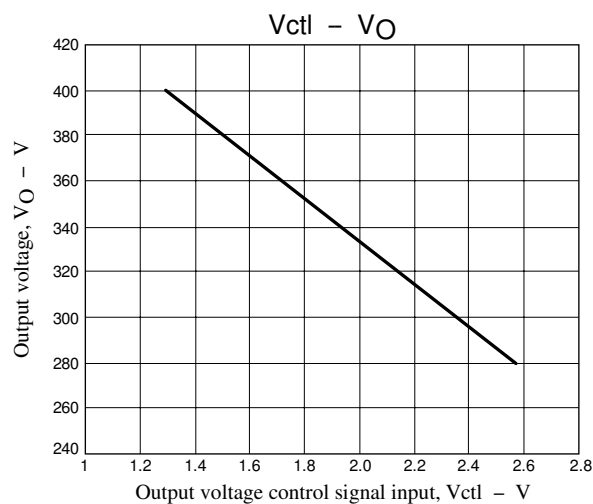


Recommended Condition

Parameter	Symbol	Conditions	Ratings	unit
AC Voltage	VAC	50/60Hz	170 to 264	Vrms
Output voltage	V _O		$V_{AC} \times \sqrt{2} + (10 \text{ to } 15) \leq 450$	V
Over-voltage detection voltage	VOV		V _{OUT} +(10 to 20)	V
Control IC supply voltage	V _{CC}	V _{CC} -GND	14.5 to 17.0	V
Inductor	L1		0.5	mH
Input film capacitor	Ci		2.2≤Ci	μF
Output film capacitor	Cs		2.2≤Cs	μF
Output electrolytic capacitor	Co		940≤Co	μF

Output Voltage Control

Output voltage control signal V_{ctl} sets referring to the V_{ctl} - V_O characteristic of the figure below.



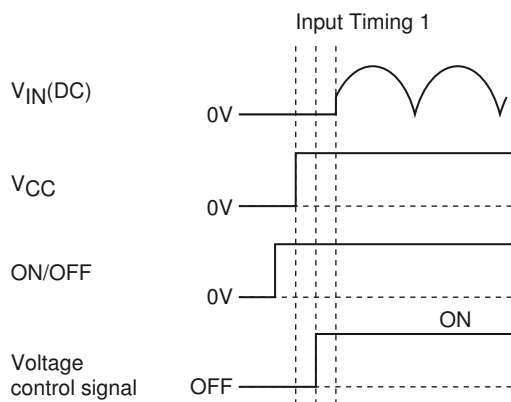
Timing Chart

Even if power supply and signal at any timing are input, this IC is not destroyed.

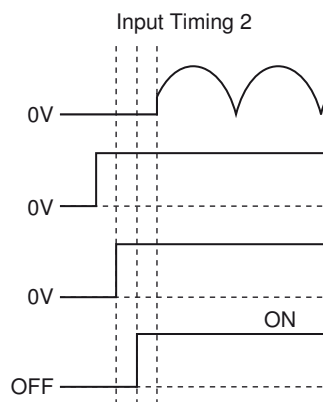
However, soft start circuit doesn't operate when $V_{IN}(DC)$ is input at the timing of Figure 11 and 12.

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〉

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