Ordering number : ENA1790A

STK760-213A-E

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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.

Specifications

Absolute Maximum Ratings at Ta = 25°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			Wo			6	kW
Input AC current (normal condition)			I_{IN}			30	Arms
Junction temperature			Tj			150	°C
Operating case temperature			Tc	HIC case temperature	*2	-20 to +100	°C
Storage temperature			Tstg			-40 to +125	°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, tp = 1ms
*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.

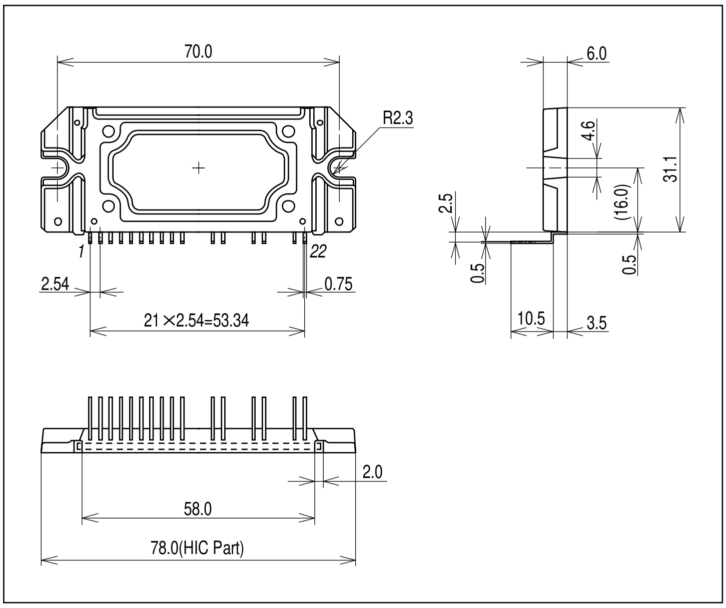
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

Electrical Characteristics at Tc = 25°C, V_{CC} = 15.0V: Unless otherwise noted

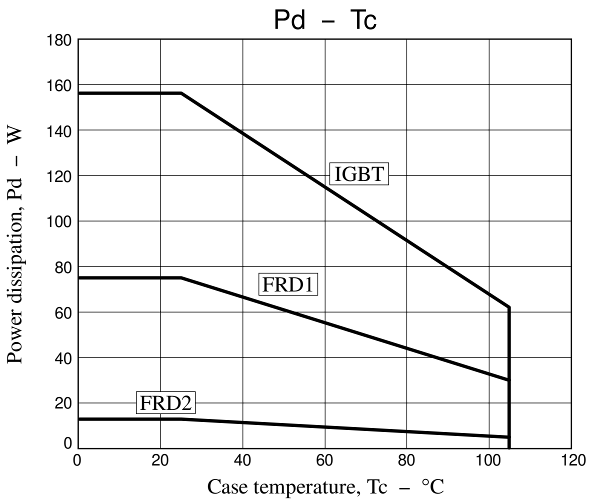
Parameter	Symbol	Conditions	Test circuit	Ratings			unit
				min	typ	max	
Power output part							
Collector-emitter leak current (IGBT)	I_{CES}	V_{CE} = 600V	Fig.1			200	µA
Collector-emitter saturation voltage (IGBT)	V_{CE}(sat)	I_C = 40A	Fig.2		1.2	1.8	V
Diode reverse current (FRD1)	I_R	V_R = 600V	Fig.1			200	µA
Diode forward voltage (FRD1)	V_F1	I_F = 40A	Fig.3		2.2	2.8	V
Diode forward voltage (FRD2)	V_F2	I_F = 5A	Fig.3		2.5	3.5	V
Junction to case thermal resistance	θj-c1	IGBT (TR1+TR2)			0.80		°C/W
	θj-c2	FRD1 (D1)			1.65		°C/W
	θj-c3	FRD2 (D2)			9.0		°C/W
Control IC part							
Control IC input current	I_{CC}(ON)	V_{CC} = 15V, VONF = 5V	Fig.4		14	20	mA
	I_{CC}(OFF)	V_{CC} = 15V, VONF = 0V			2.5	5	
Oscillation frequency	f_{OSC}	V_{CC} = 15V, VONF = 5V		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} = 15V	Fig.7	3.0			V
	VTHOFF					0.5	V
Start-up V_{CC} voltage	V_{CC}(ON)	VONF = 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
Substrate temperature monitor resistance	RTH	Resistance between VTH-GND	Fig.3	90	100	110	kΩ
Application circuit : VAC = 200V, V_O = 380V (Vctl = 1.507V)							
Output voltage	V_O	Wo = 2kW	Fig.9	366	380	394	V
Power Factor	cosφ	Wo = 400W		0.98	0.99		
		Wo = 2kW		0.99	0.995	1.0	

Package Dimensions

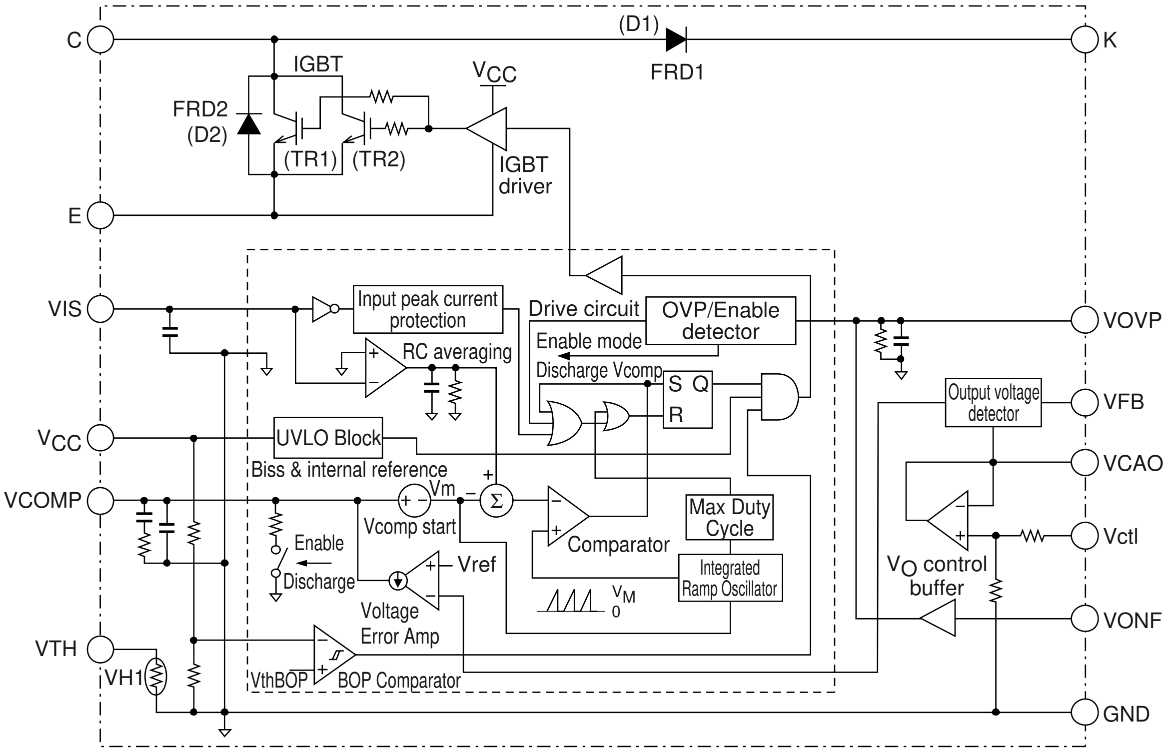
unit:mm (typ)



IGBT (TR1+TR2), FRD1 (D1) & FRD2 (D2) vs. Temperature Derating (Ta = 25°C)



Block Diagram



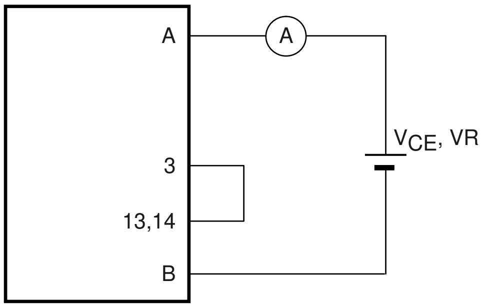
Explanation of Terminal

Terminal No.	Symbol	Explanation
1	V_{CC}	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

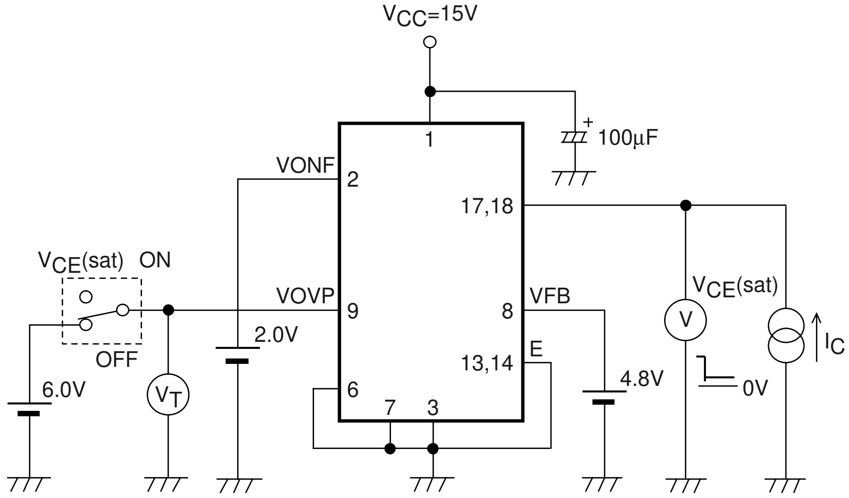
(1) I_{CES}, I_R

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



⟨Fig.1⟩

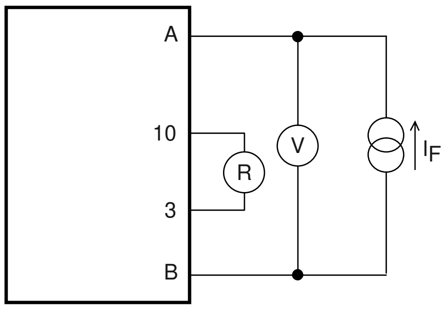
(2) V_{CE}(sat) (Test by Pulse)



⟨Fig.2⟩

(3) V_F1, V_F2 (Test by Pulse), RTH

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

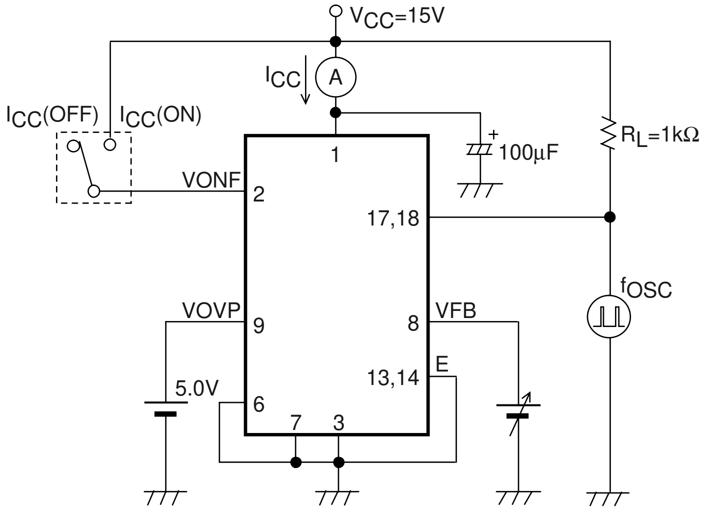


⟨Fig.3⟩

Test Circuit -2

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

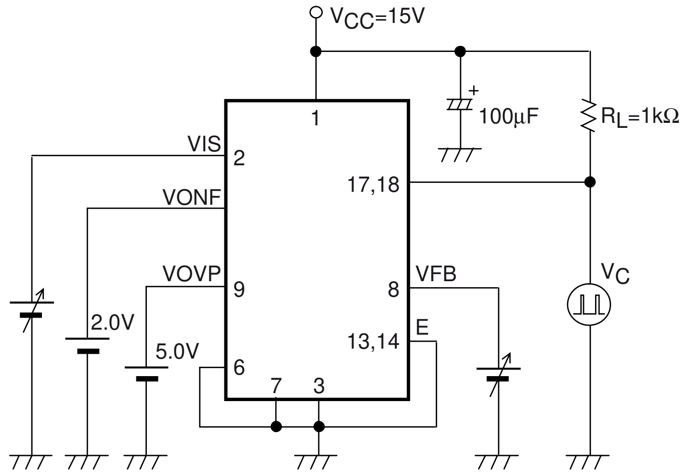
I_{CC}, f_{OSC}	VOLP
VFB = 1.1V	VONF = 5.0V



⟨Fig.4⟩

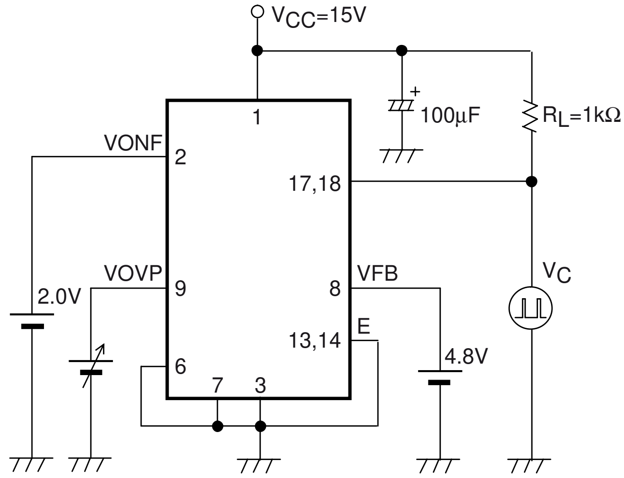
(5) Vref, VIS(PK)

Vref	VIS(PK)
VIS = -0.6V	VFB = 4.8V



⟨Fig.5⟩

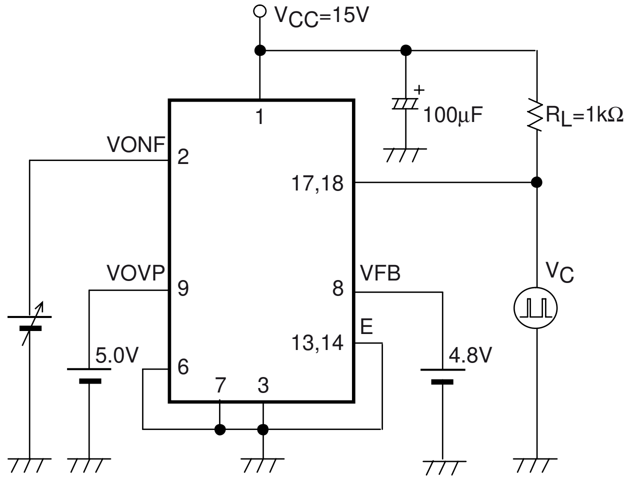
(6) VOVP(ON)



⟨Fig.6⟩

Test Circuit -3

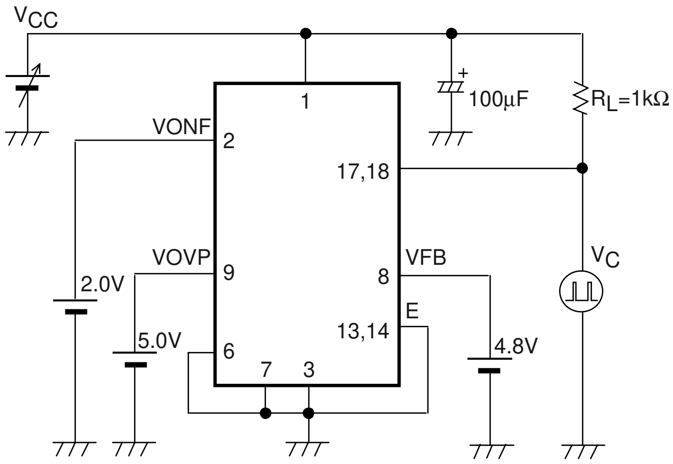
(7) VTHON, VTHOFF



〈Fig.7〉

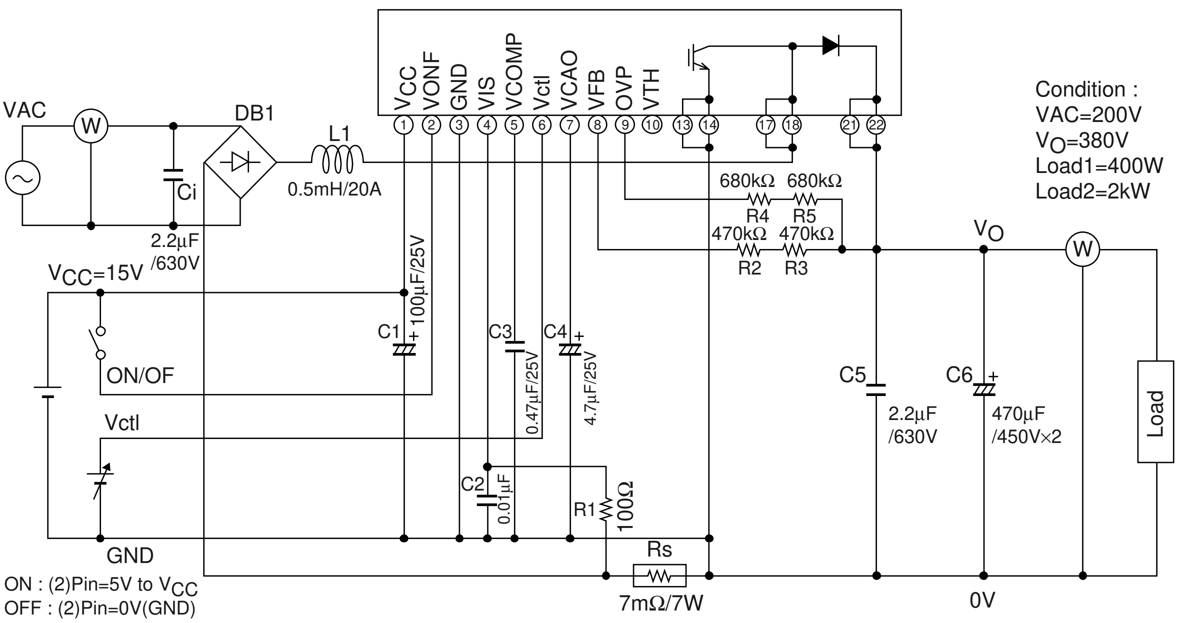
(8) V_{CC}(ON), V_{CC}(OFF)

V_{CC}(ON)	V_{CC}(OFF)
Vc-ON	Vc-OFF



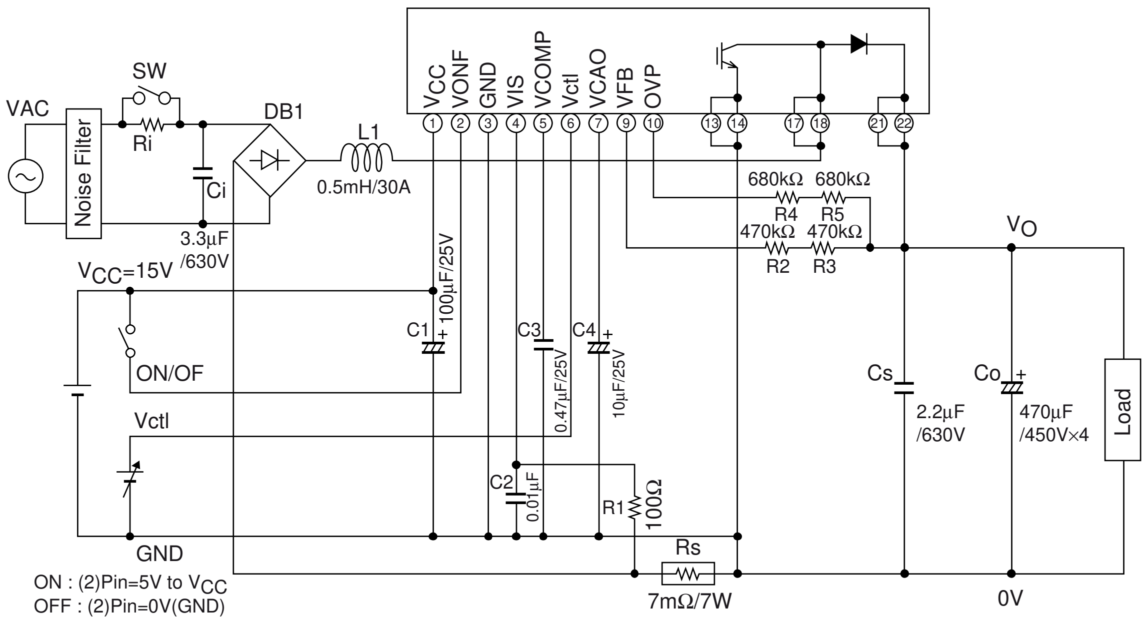
〈Fig.8〉

(9) Power Factor (COSϕ)



〈Fig.9〉

Application Circuit

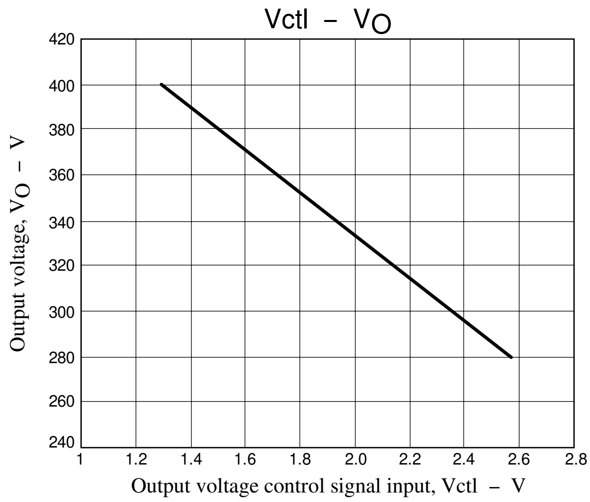


Recommended Condition

Parameter	Symbol	Conditions	Ratings	unit
AC Voltage	VAC	50/60Hz	170 to 264	Vrms
Output voltage	V_O		VAC×√2+(10 to 15)≤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		3.3≤Ci	µF
Output film capacitor	Cs		2.2≤Cs	µF
Output electrolytic capacitor	Co		1880≤Co	µF

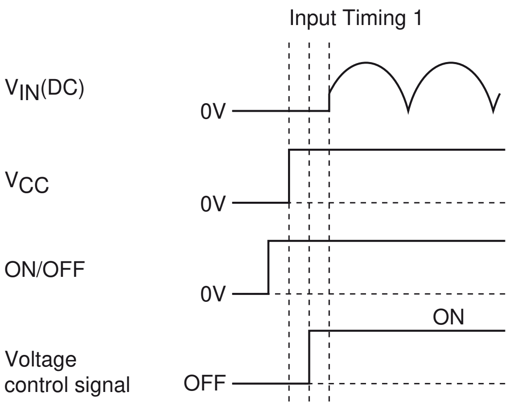
Output Voltage Control

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

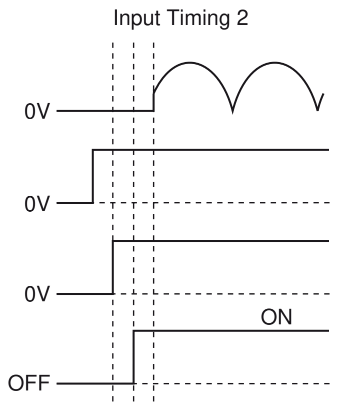


Timing Chart

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⟩

The built-in thermistor resistance temperature characteristic