



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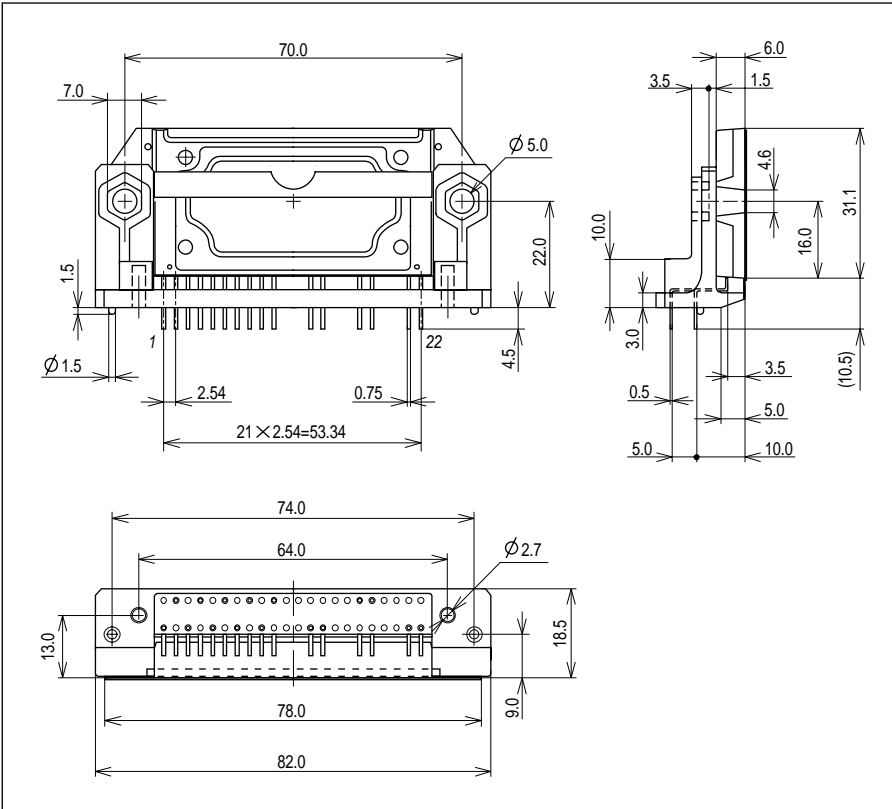
Electrical Characteristics at $T_c = 25^\circ\text{C}$, $V_{CC} = 15.0\text{V}$: Unless otherwise noted

| 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} | $V_{CC} = 15\text{V}$, $V_{ONF} = 5\text{V}$ | | | 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 | | |

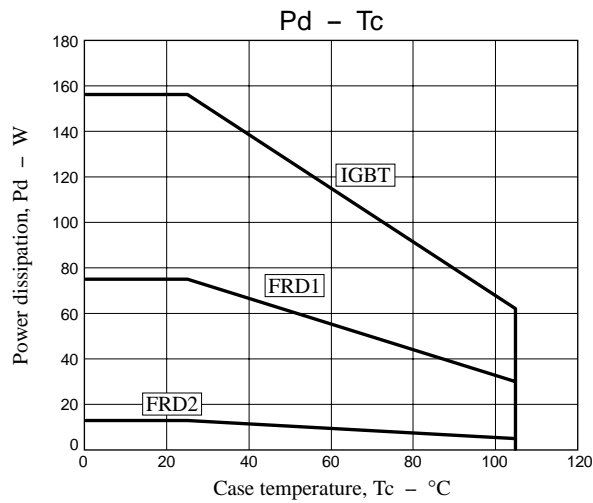
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Package Dimensions

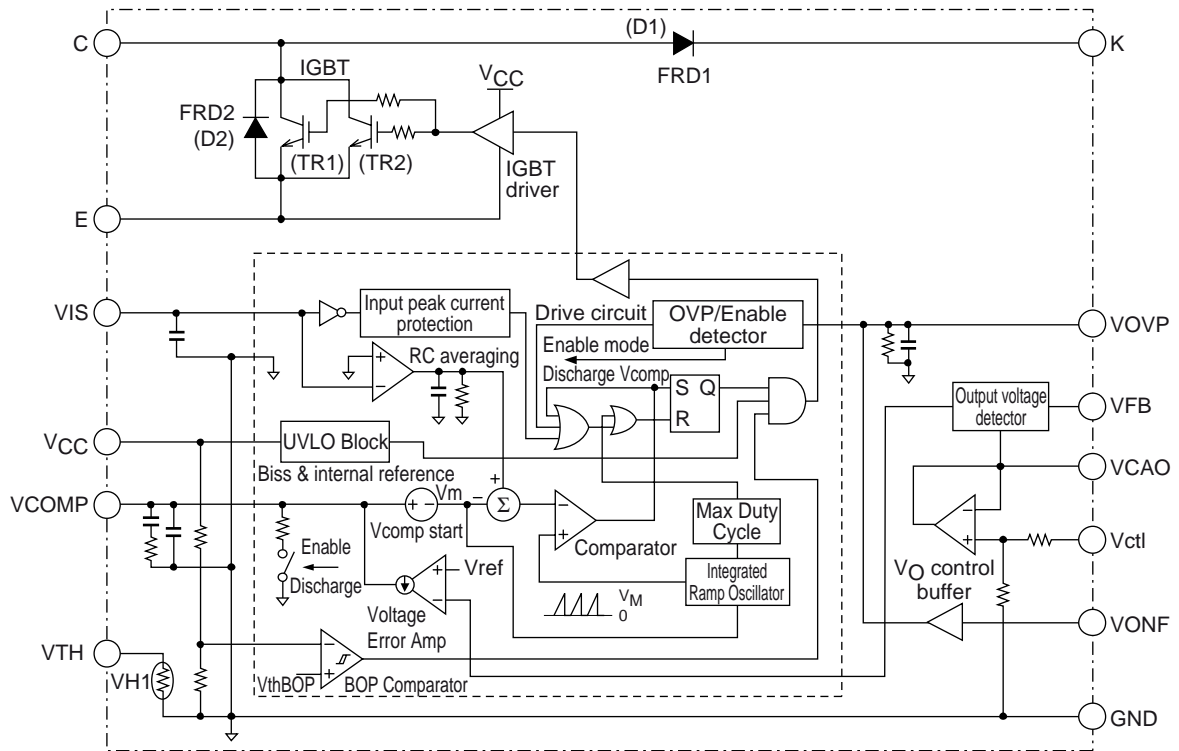
unit:mm (typ)



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



Block Diagram



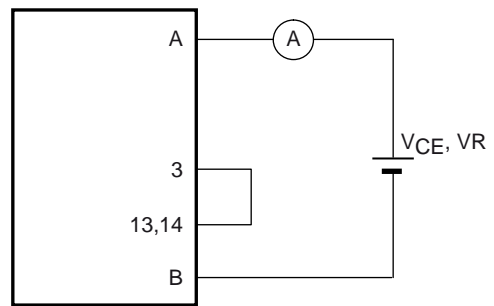
Explanation of Terminal

| 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

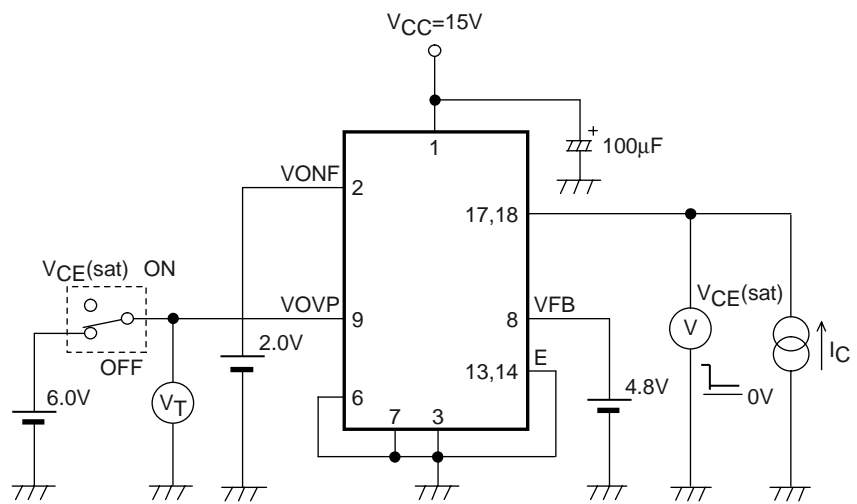
(1) I_{CES} , I_R

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



(Fig.1)

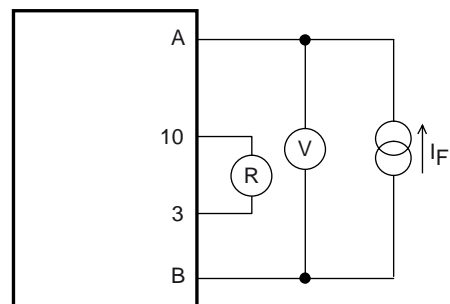
(2) $V_{CE(sat)}$ (Test by Pulse)



(Fig.2)

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

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

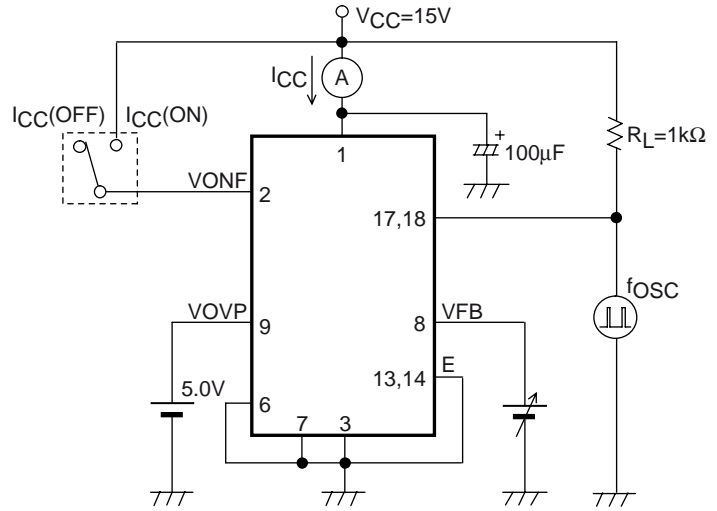


(Fig.3)

Test Circuit -2

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

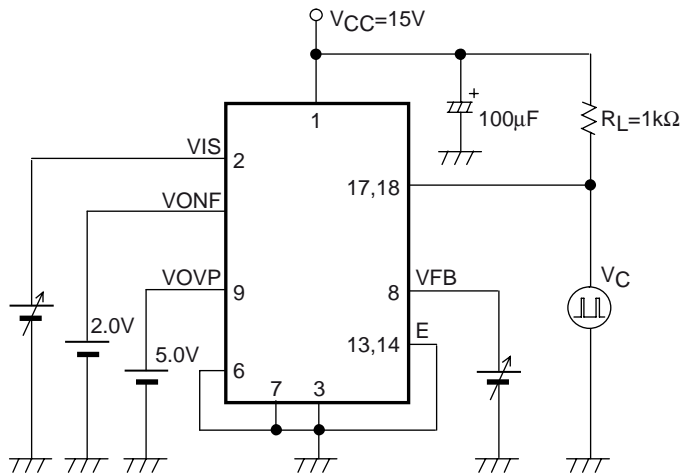
| | |
|-------------------|-------------|
| I_{CC}, f_{OSC} | VOLP |
| VFB = 1.1V | VONF = 5.0V |



(Fig.4)

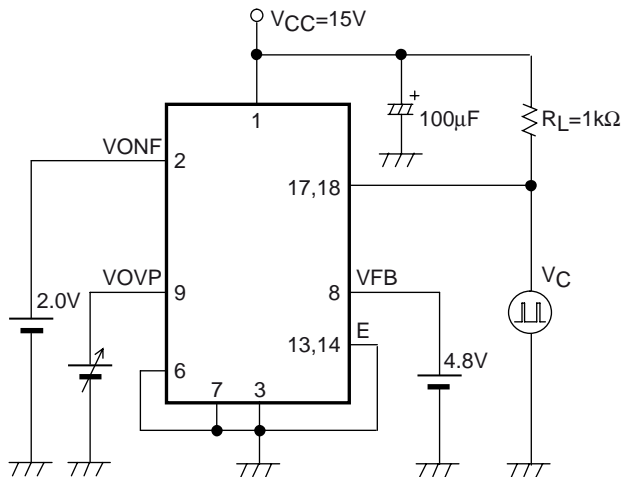
(5) V_{ref} , VIS(PK)

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



(Fig.5)

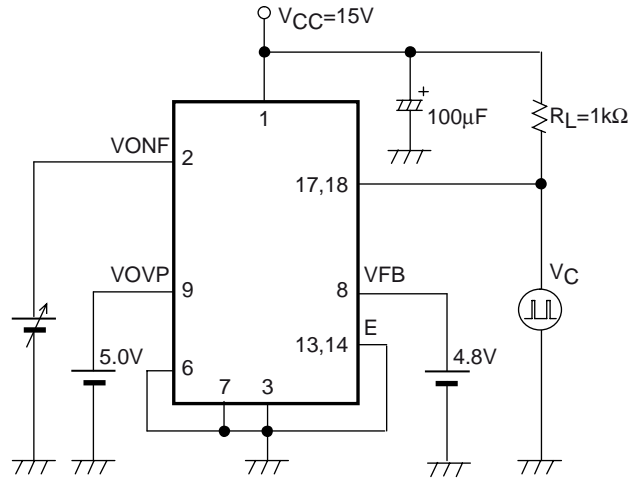
(6) VOVP(ON)



(Fig.6)

Test Circuit -3

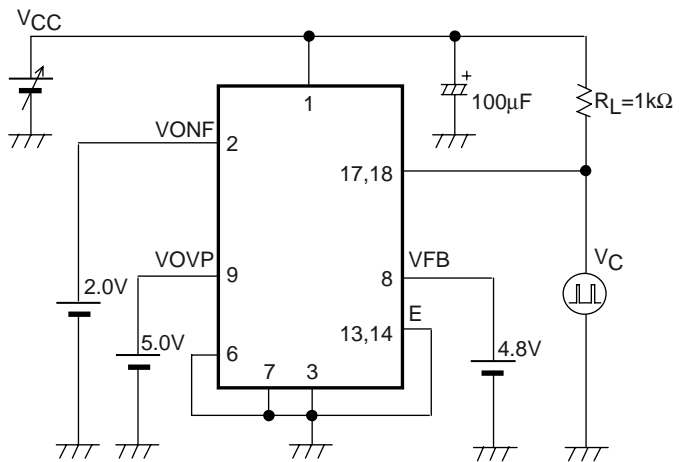
(7) V_{THON}, V_{THOFF}



(Fig.7)

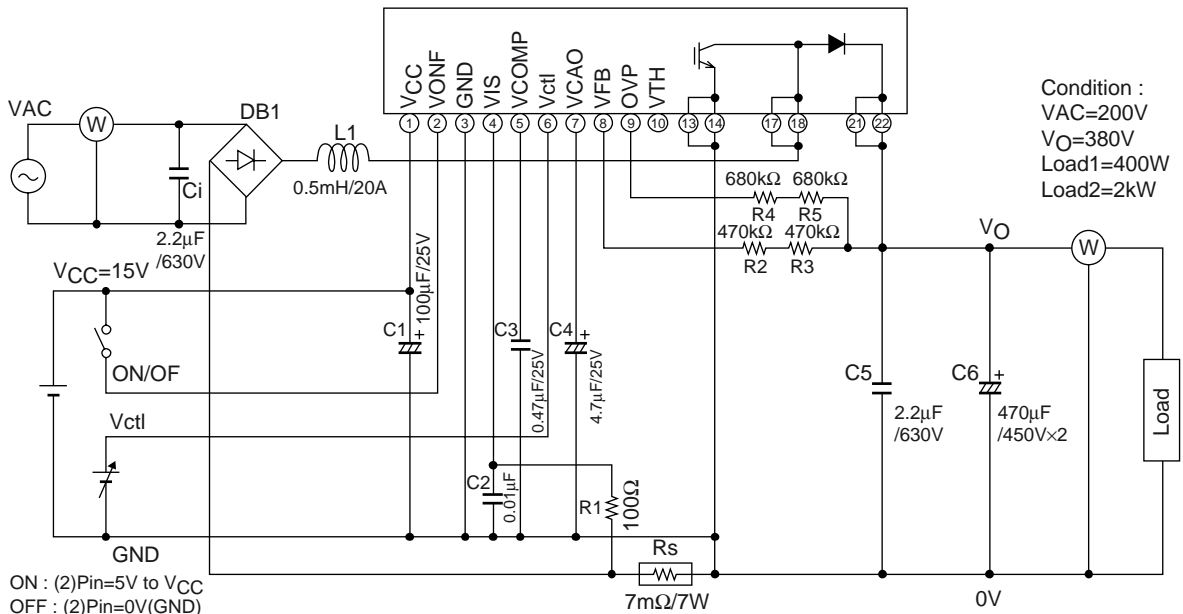
(8) V_{CC(ON)}, V_{CC(OFF)}

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



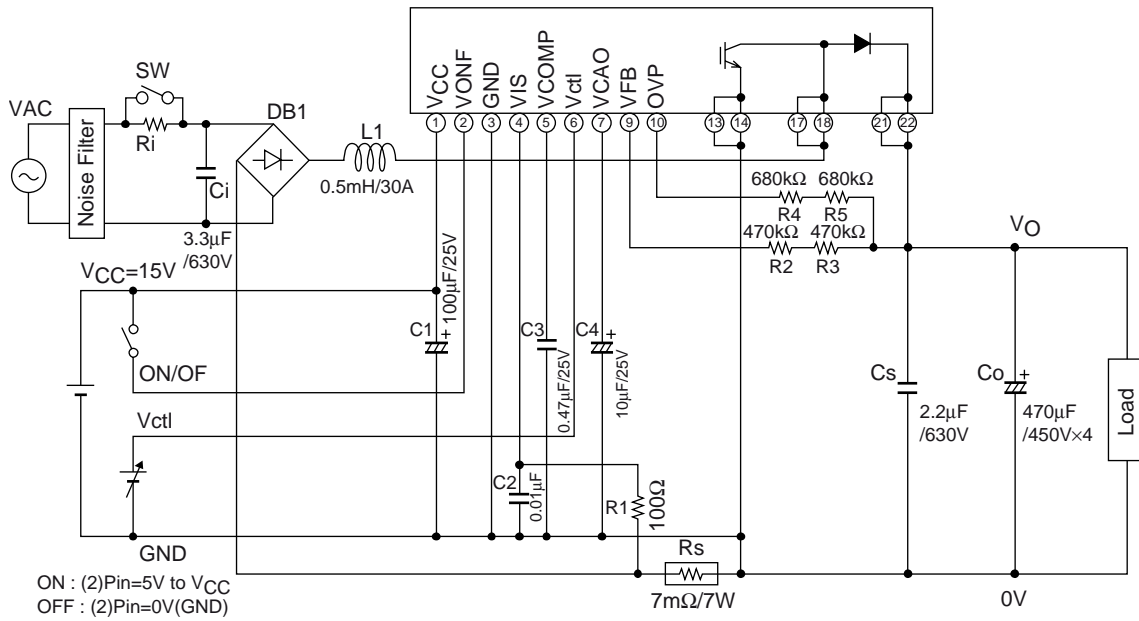
(Fig.8)

(9) Power Factor (COSφ)



(Fig.9)

Application Circuit

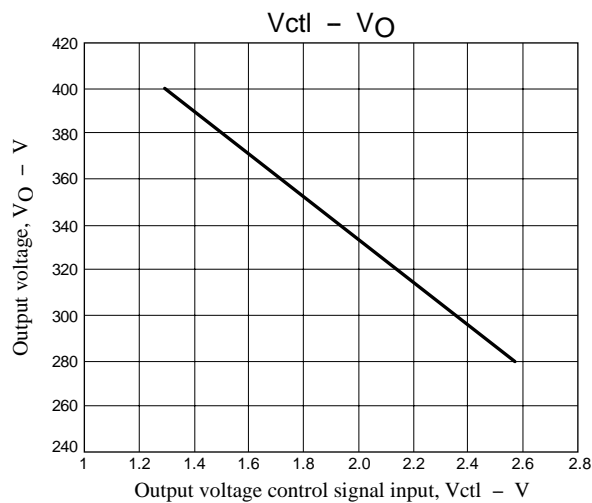


Recommended Condition

| Parameter | Symbol | Conditions | Ratings | unit |
|--------------------------------|-----------------|----------------------|--|------|
| AC Voltage | VAC | 50/60Hz | 170 to 264 | Vrms |
| Output voltage | V _O | | $VAC \times \sqrt{2} + (10 \text{ to } 15) \leq 450$ | V |
| Over-voltage detection voltage | VOV | | $V_{OUT} + (10 \text{ to } 20)$ | V |
| Control IC supply voltage | V _{CC} | V _{CC} -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 |

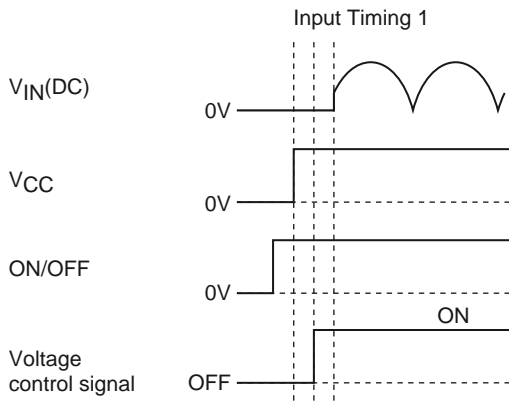
Output Voltage Control

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

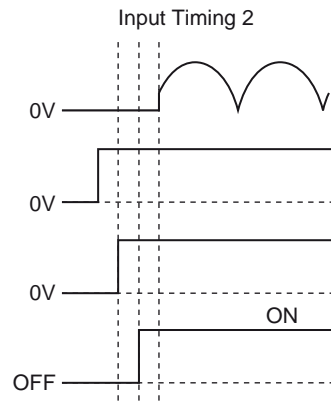


Timing Chart

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.

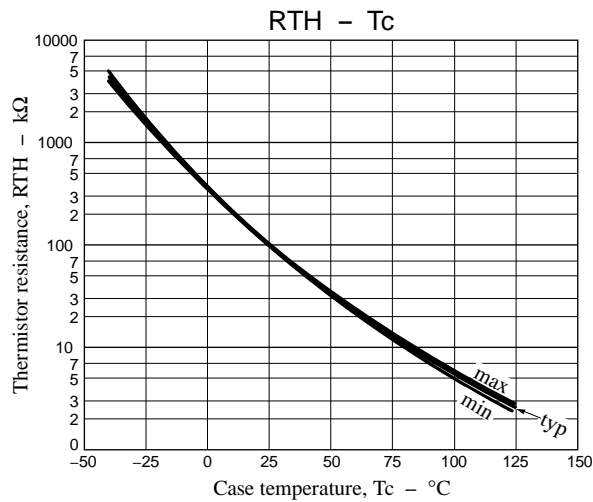


<Fig.11>



<Fig.12>

The built-in thermistor resistance temperature characteristic



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