



SANYO Semiconductors

DATA SHEET

An ON Semiconductor Company

STK760-213A-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.

■ Any and all SANYO Semiconductor Co.,Ltd. products described or contained herein are, with regard to "standard application", intended for the use as general electronics equipment. The products mentioned herein shall not be intended for use for any "special application" (medical equipment whose purpose is to sustain life, aerospace instrument, nuclear control device, burning appliances, transportation machine, traffic signal system, safety equipment etc.) that shall require extremely high level of reliability and can directly threaten human lives in case of failure or malfunction of the product or may cause harm to human bodies, nor shall they grant any guarantee thereof. If you should intend to use our products for new introduction or other application different from current conditions on the usage of automotive device, communication device, office equipment, industrial equipment etc. , please consult with us about usage condition (temperature, operation time etc.) prior to the intended use. If there is no consultation or inquiry before the intended use, our customer shall be solely responsible for the use.

■ Specifications of any and all SANYO Semiconductor Co.,Ltd. products described or contained herein stipulate the performance, characteristics, and functions of the described products in the independent state, and are not guarantees of the performance, characteristics, and functions of the described products as mounted in the customer's products or equipment. To verify symptoms and states that cannot be evaluated in an independent device, the customer should always evaluate and test devices mounted in the customer's products or equipment.

STK760-213A-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.

STK760-213A-E

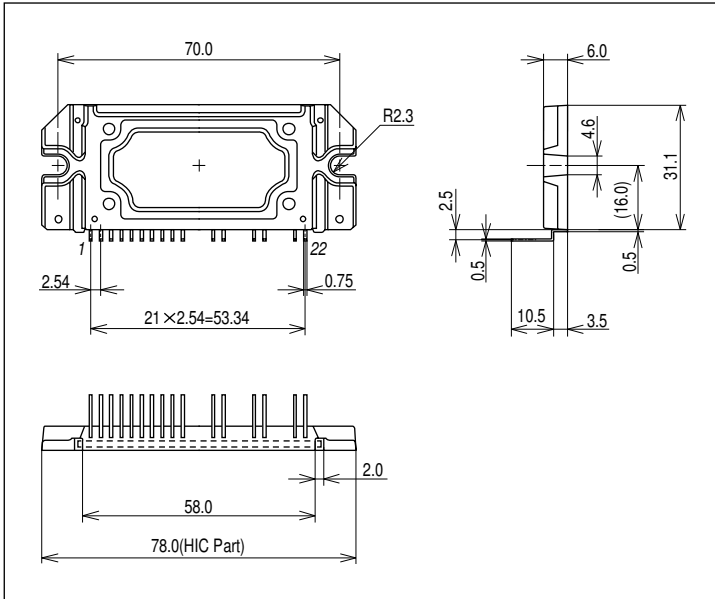
Electrical Characteristics at $T_c = 25^\circ\text{C}$, $V_{CC} = 15.0\text{V}$: Unless otherwise noted

| 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 | 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 | |

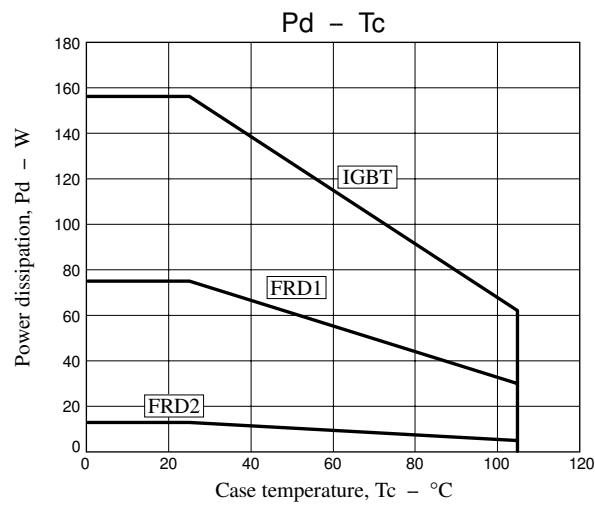
STK760-213A-E

Package Dimensions

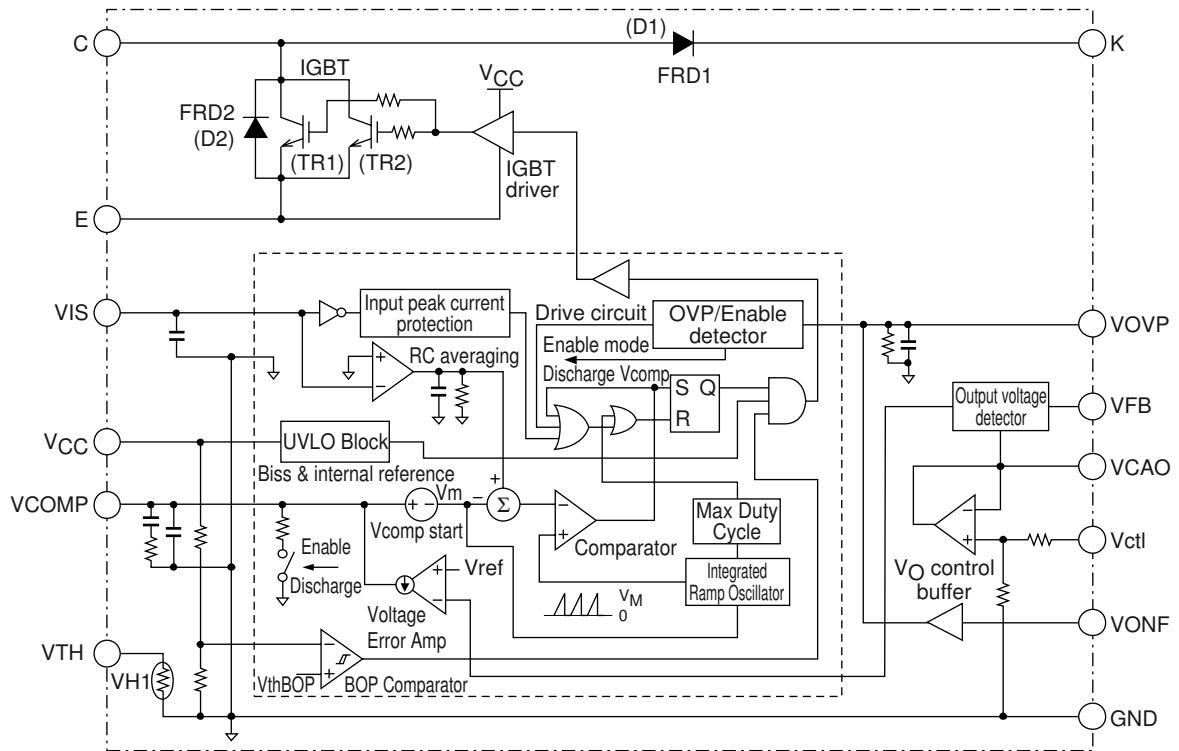
unit:mm (typ)



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



Block Diagram



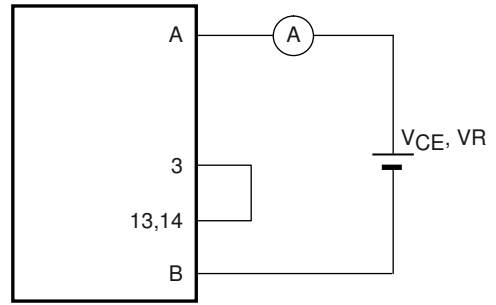
Explanation of Terminal

| 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

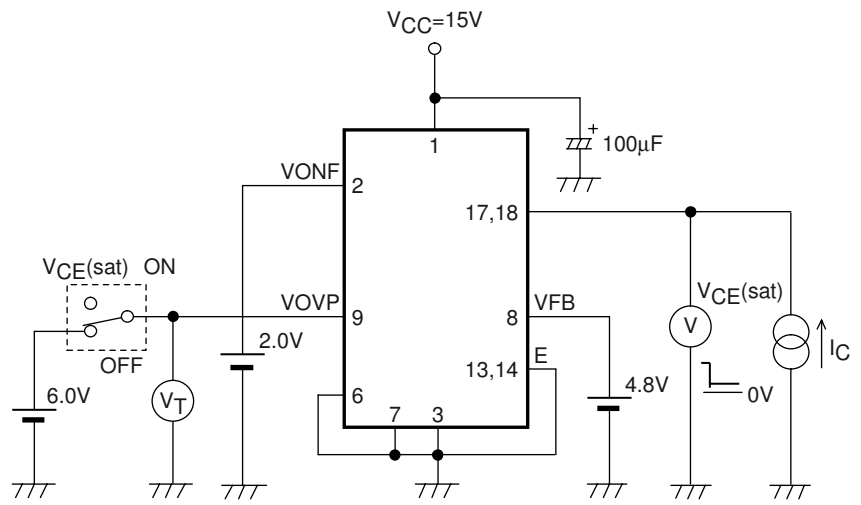
(1) I_{CES} , I_R

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



(Fig.1)

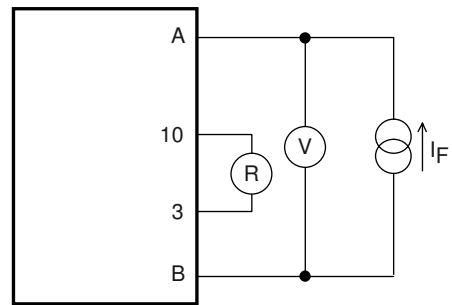
(2) $V_{CE(sat)}$ (Test by Pulse)



(Fig.2)

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

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

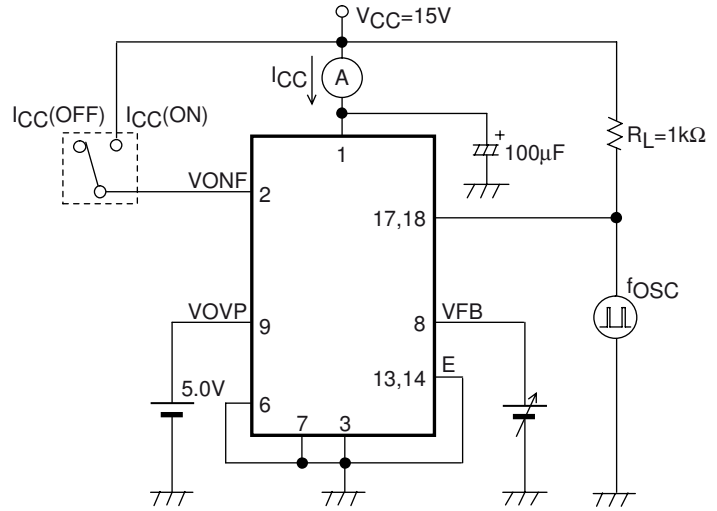


(Fig.3)

Test Circuit -2

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

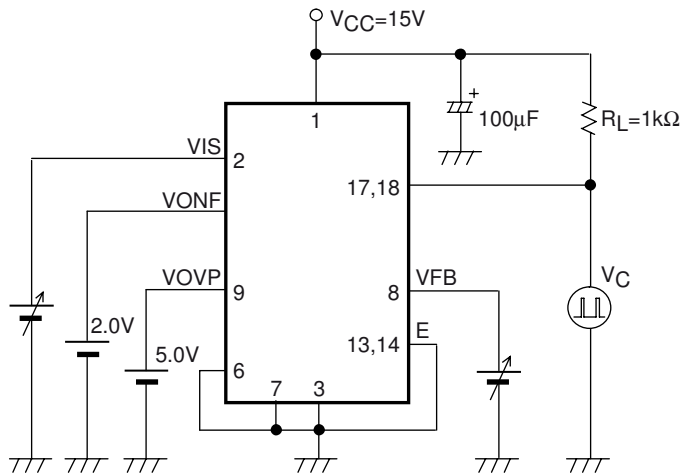
| | |
|-------------------|-------------|
| I_{CC}, f_{OSC} | VOLP |
| VFB = 1.1V | VONF = 5.0V |



(Fig.4)

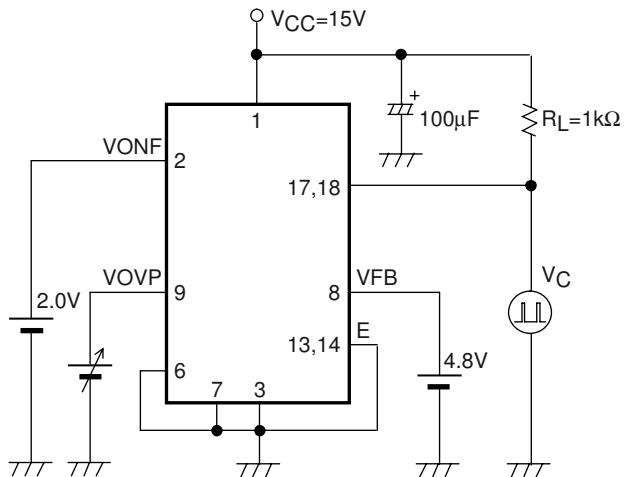
(5) V_{ref} , VIS(PK)

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



(Fig.5)

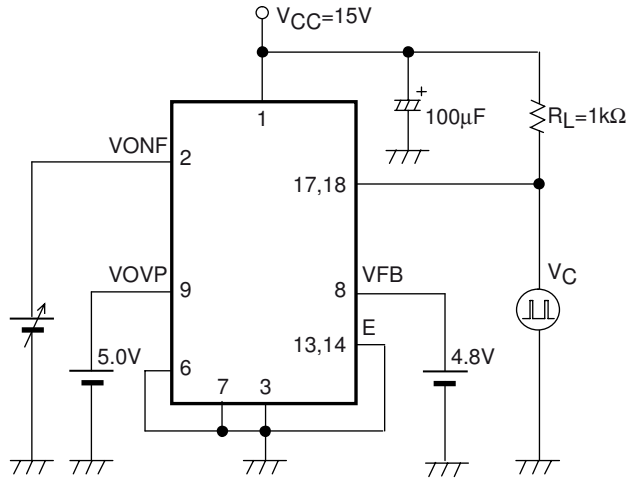
(6) VOVP(ON)



(Fig.6)

Test Circuit -3

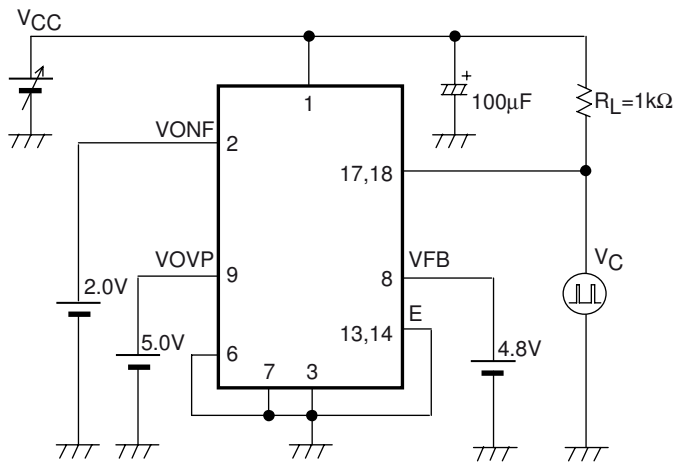
(7) V_{THON}, V_{THOFF}



(Fig.7)

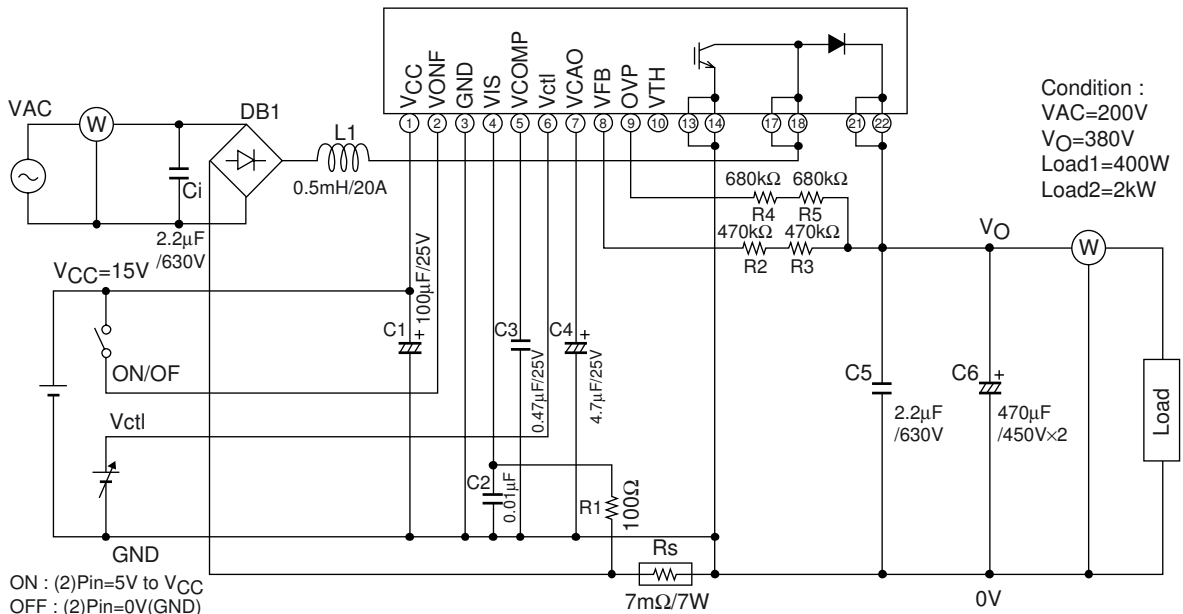
(8) V_{CC(ON)}, V_{CC(OFF)}

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



(Fig.8)

(9) Power Factor (COSφ)

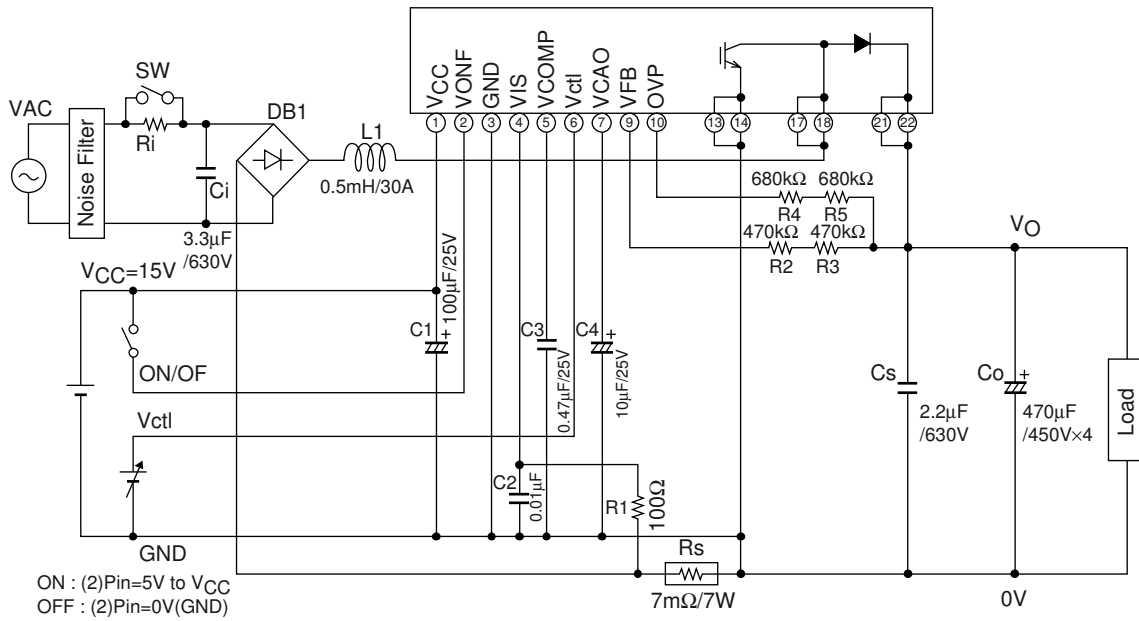


Condition :
 VAC=200V
 VO=380V
 Load1=400W
 Load2=2kW

ON : (2)Pin=5V to V_{CC}
 OFF : (2)Pin=0V(GND)

(Fig.9)

Application Circuit

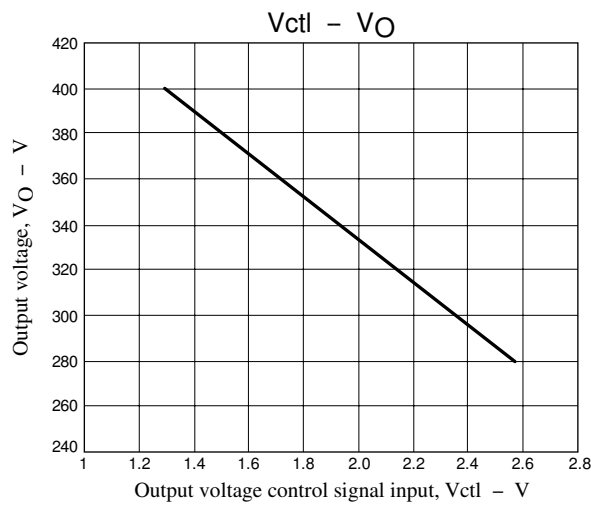


Recommended Condition

| 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 | C _i | | $3.3 \leq C_i$ | µF |
| Output film capacitor | C _s | | $2.2 \leq C_s$ | µF |
| Output electrolytic capacitor | C _o | | $1880 \leq C_o$ | µF |

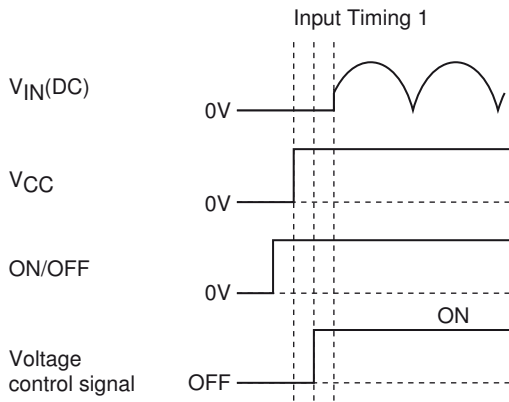
Output Voltage Control

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

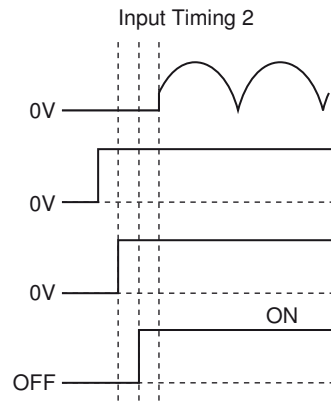


Timing Chart

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.

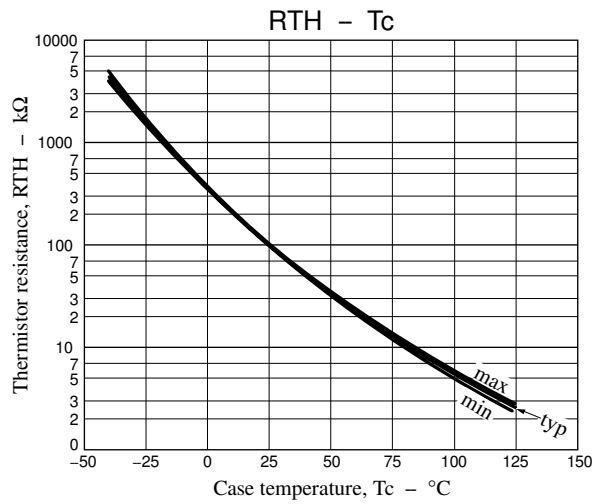


<Fig.11>



<Fig.12>

The built-in thermistor resistance temperature characteristic



- SANYO Semiconductor Co.,Ltd. assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all SANYO Semiconductor Co.,Ltd. products described or contained herein.
- Regarding monolithic semiconductors, if you should intend to use this IC continuously under high temperature, high current, high voltage, or drastic temperature change, even if it is used within the range of absolute maximum ratings or operating conditions, there is a possibility of decrease reliability. Please contact us for a confirmation.
- SANYO Semiconductor Co.,Ltd. strives to supply high-quality high-reliability products, however, any and all semiconductor products fail or malfunction with some probability. It is possible that these probabilistic failures or malfunction could give rise to accidents or events that could endanger human lives, trouble that could give rise to smoke or fire, or accidents that could cause damage to other property. When designing equipment, adopt safety measures so that these kinds of accidents or events cannot occur. Such measures include but are not limited to protective circuits and error prevention circuits for safe design, redundant design, and structural design.
- In the event that any or all SANYO Semiconductor Co.,Ltd. products described or contained herein are controlled under any of applicable local export control laws and regulations, such products may require the export license from the authorities concerned in accordance with the above law.
- No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or any information storage or retrieval system, or otherwise, without the prior written consent of SANYO Semiconductor Co.,Ltd.
- Any and all information described or contained herein are subject to change without notice due to product/technology improvement, etc. When designing equipment, refer to the "Delivery Specification" for the SANYO Semiconductor Co.,Ltd. product that you intend to use.
- Upon using the technical information or products described herein, neither warranty nor license shall be granted with regard to intellectual property rights or any other rights of SANYO Semiconductor Co.,Ltd. or any third party. SANYO Semiconductor Co.,Ltd. shall not be liable for any claim or suits with regard to a third party's intellectual property rights which has resulted from the use of the technical information and products mentioned above.

This catalog provides information as of October, 2012. Specifications and information herein are subject to change without notice.