



SANYO Semiconductors

**DATA SHEET**

# STK760-220A-E

Thick-Film Hybrid IC  
Single-phase Rectification  
PFC Hybrid IC

## Overview

The STK760-220A-E is an average current control type hybrid IC that integrates in a single package the power stages for the step-up active converter and the control IC, and overcurrent/overvoltage protection circuits. It is designed to improve the power factor of single-phase AC power supplies.

## Applications

- Power rectification for air conditioners and general-purpose inverters as a single-phase rectification active converter.

## Features

- IGBT switching power device employed in the active converter output stage.
- On-chip regulator for PFC control supports a wide range of input voltage (up to 50V).
- Full complement of protection circuits, including overcurrent, overvoltage, and undervoltage protection, plus soft start function.
- Logic level PFC controlled ON/OFF control.
- On-chip light-load correction circuit that minimizes output voltage increase when no load is applied.
- SIP package providing a high degree freedom for mounting the IC in the set.

■ 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 (home appliances, AV equipment, communication device, office equipment, industrial equipment etc.). 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 applications outside the standard applications of our customer who is considering such use and/or outside the scope of our intended standard applications, please consult with us 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.

**SANYO Semiconductor Co., Ltd.**

TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110-8534 JAPAN

## STK760-220A-E

### Specifications

**Absolute maximum ratings** at  $T_c = 25^\circ\text{C}$

Parameter		Symbol	Conditions	Ratings	unit
IGBT (TR2+TR3)	Collector-to-emitter voltage	V <sub>CE</sub> S		600	V
	Repetitive peak collector current	I <sub>CP</sub>	*1	180	A
	Collector current	I <sub>C</sub>		70	A
	Allowable power dissipation	P <sub>d</sub>		166	W
FRD (D2)	Diode reverse voltage	V <sub>RM</sub>		600	V
	Repetitive peak forward current	I <sub>F2P</sub>	*1	160	A
	Forward Current	I <sub>F2</sub>		41	A
	Allowable power dissipation	P <sub>d</sub>		73	W
FRD (D3)	Repetitive peak forward current	I <sub>FP</sub>	*1	15	A
	Forward current	I <sub>F3</sub>		7	A
	Allowable power dissipation	P <sub>d</sub>		13	W
Supply voltage (Pin 1)		V <sub>s</sub>		21 to 50	V
Supply current (Pin 1)		I <sub>sc</sub>		60	mA
Signal pin input voltage	Pin 5	V <sub>VDET</sub>		-0.3 to 5.0	V
	Pin 12	V <sub>EI</sub>			
	Pin 13	V <sub>OV</sub> P			
	Pin 9	V <sub>IS</sub>		-10 to 5.0	V
	Pin 4	V <sub>ONF</sub>		-0.3 to V <sub>CC</sub>	V
Oscillation frequency		f <sub>OSC</sub>		40	kHz
Maximum AC input voltage		V <sub>AC</sub>	Single-phase full-wave rectification waveform voltage	264	V
Maximum output voltage		V <sub>O</sub>	Under the operating conditions of the application circuit	450	V
Input current (in steady state)		I <sub>IN</sub>	Under the operating conditions of the application circuit.	20	Arms
Load power		W <sub>o</sub>	V <sub>AC</sub> =200V	4	kW
Chip junction temperature		T <sub>J</sub>		150	°C
Operating case temperature		T <sub>c</sub>	Center of the resin package on the reverse side *2	-20 to +105	°C
Storage temperature		T <sub>stg</sub>		-40 to +125	°C
Tightening torque			M4 screws *3	1.17	N • m
Dielectric strength voltage		V <sub>INS</sub>	Sine wave, 50Hz, AC 1 minute *4	2000	VRMS

\*1. Repetitive peak current with the duty ratio of  $D=0.1$  and  $t_p=1\text{ms}$ .

\*2. The measurement point must be within 10 millimeters square wide in the center of the resin package on the reverse side.

\*3. The tightening torque must be within the range of 0.79 to 1.17N • m.  
The flatness of the heat sink to be connected must be 0.15mm or less.

\*4. Test conditions: AC 2500V for 1 second.

**Electrical Characteristics** at  $T_c=25^\circ\text{C}$ ,  $V_s=21\text{V}$  with the designated circuit

(Apply  $V_{CC}=18.0\text{V}$  directly to pin 2 unless  $V_s$  input is specified.)

Parameter	Symbol	Conditions	min	typ	max	unit	Test circuit
Power output block							
Collector-to-emitter cutoff current (TR2+TR3)	I <sub>CE</sub> S	V <sub>CE</sub> =600V			200	μA	Fig.1
Collector-to-emitter saturation voltage (TR2+TR3)	V <sub>CE</sub> (sat)	V <sub>CC</sub> =18.0V, I <sub>C</sub> =40A		1.9	2.4	V	Fig.2
Diode reverse voltage (D2)	I <sub>R</sub>	V <sub>R</sub> =600V			100	μA	Fig.1
Diode forward voltage (D2)	V <sub>F</sub>	I <sub>F</sub> =40A		2.1	2.6	V	Fig.3
Diode forward voltage (D3)	V <sub>F</sub>	I <sub>F</sub> =5A		2.5	3.5	V	Fig.3
Junction-to-case thermal resistance	θ <sub>j-c1</sub>	IGBT (TR2+TR3)		0.75		°C /W	
	θ <sub>j-c2</sub>	FRD (D2)		1.7		°C /W	
	θ <sub>j-c3</sub>	FRD (D3)		9.0		°C /W	

Continued on next page.

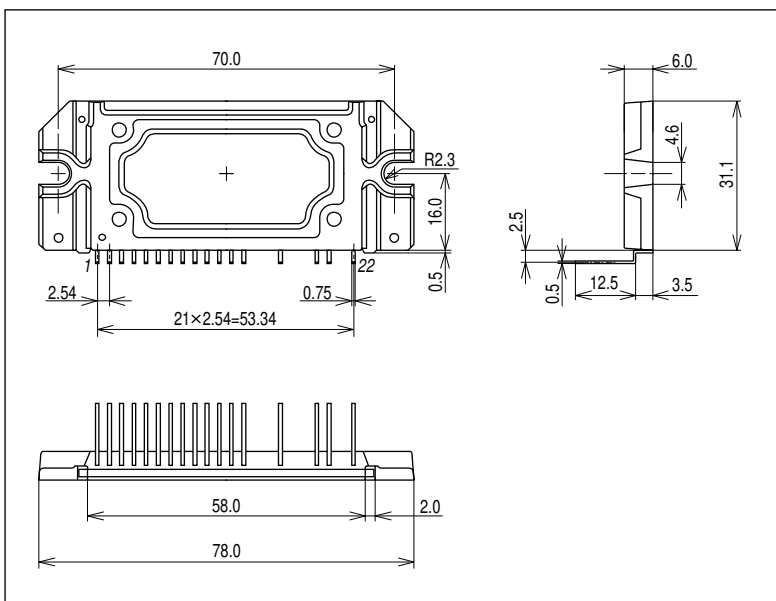
## STK760-220A-E

Continued from preceding page.

Parameter	Symbol	Conditions	min	typ	max	unit	Test circuit
<b>V<sub>CC</sub> regulator block</b>							
V <sub>CC</sub> regulator output voltage	V <sub>CC</sub>	V <sub>s</sub> =21V, I <sub>CC</sub> OUT=0 to 40mA	17.9	18.7	19.6	V	Fig.4
<b>Control IC block</b>							
Control circuit current dissipation	I <sub>CC</sub> (ON)	V <sub>CC</sub> =18.0V, ONF=5V		7	11	mA	Fig.5
	I <sub>CC</sub> (OFF)	V <sub>CC</sub> =18.0V, ONF=0V		0.06	0.5	mA	
Reference voltage	V <sub>REF</sub>	V <sub>CC</sub> =18.0V, ONF=5V	4.75	5.0	5.25	V	Fig.5
Oscillation frequency	f <sub>OSC</sub>	V <sub>CC</sub> =18.0V, ONF=5V	21	25	28	kHz	
Overcurrent protection input threshold voltage	V <sub>THOCP</sub>	V <sub>CC</sub> =18.0V, ONF=5V	-1.20	-1.10	-1.00	V	Fig.6
Voltage error amplifier reference voltage	V <sub>r</sub>	V <sub>CC</sub> =18.0V, ONF=5V	1.509	1.55	1.591	V	
OVP threshold voltage	V <sub>THOVP</sub>	V <sub>CC</sub> =18.0V, ONF=5V	1.607	1.64	1.673	V	Fig.7
SS charge current	I <sub>CHG</sub>	V <sub>CC</sub> =18.0V, ONF=5V		11		μA	
SS input threshold voltage	V <sub>THSS0</sub>	Duty cycle=0%		0.34		V	
	V <sub>THSSM</sub>	Duty cycle=D <sub>MAX</sub>		3.4		V	
ON/OFF threshold voltage	V <sub>THON</sub>	V <sub>CC</sub> =18.0V	3.5	3.95	4.4	V	Fig.8
	V <sub>THOFF</sub>	V <sub>CC</sub> =18.0V	2.4	2.8	3.2	V	
Startup V <sub>CC</sub> voltage	V <sub>THUON</sub>	ONF=5V	15.5	16.5	17.5	V	Fig.9
Shutdown V <sub>CC</sub> voltage	V <sub>THUOFF</sub>	ONF=5V	8.2	8.9	9.6	V	
<b>Power output block</b>							
Switching time	t <sub>ON</sub>	I <sub>C</sub> =30A, Inductive load	0.2	0.35	0.8	μs	Fig.10
	t <sub>OFF</sub>			0.85	1.4	μs	
	t <sub>rr</sub>			0.04		μs	
Diode recovery current (D2)	I <sub>rr</sub>			20		A	
Application circuit operation: Set to V <sub>AC</sub> =200V, and V <sub>O</sub> =380V.							
Power factor	cosφ	W <sub>o</sub> =400W	0.9	0.95			Fig.11
		W <sub>o</sub> =2kW	0.98	0.99	1.0		

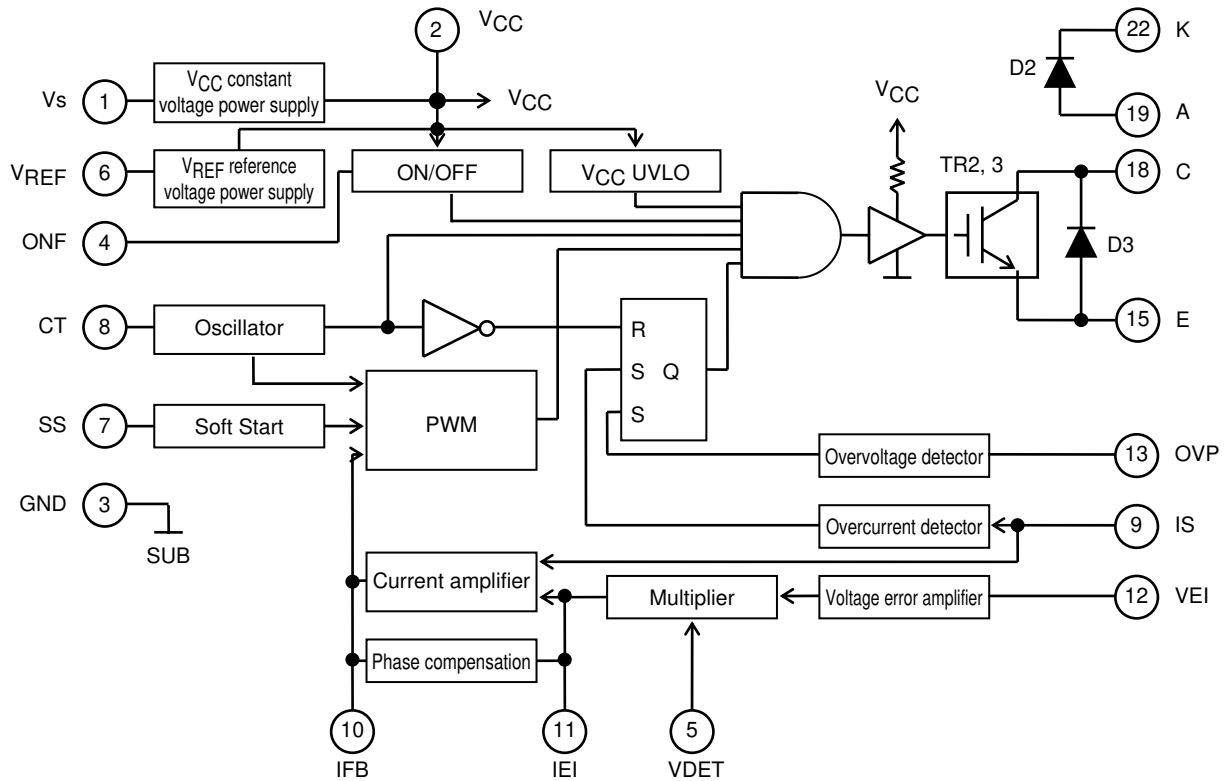
### Package Dimensions

unit:mm (typ)



**STK760-220A-E**

**Block Diagram**



**Pin Functions**

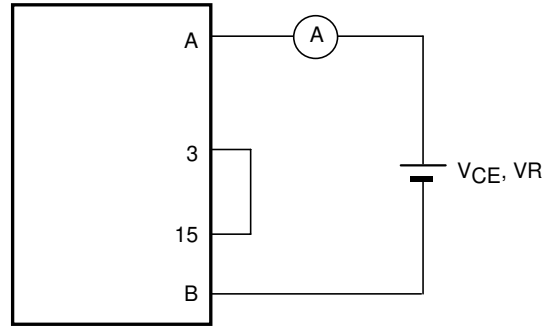
Pin No.	Pin Name	Description
1	Vs	Operating supply voltage (+18V Reg. input)
2	VCC	+18V VCC power supply output
3	GND	GND pin
4	ONF	ON/OFF control pin
5	VDET	Multiplication input
6	VREF	+5V reference voltage output
7	SS	Soft start pin
8	CT	Operating frequency setting pin
9	IS	Current detection signal
10	IFB	Phase compensation (current amplification output)
11	IEI	Current amplification input
12	VEI	Output voltage control input
13	OVP	Overvoltage limiting
14	-	No connection
15	E	TR2, 3 (IGBT) emitter
16, 17	-	No connection
18	C	TR2, 3 (IGBT) collector
19	A	D2 (FRD) anode
20, 21	-	No connection
22	K	D2 (FRD) cathode

**STK760-220A-E**

**Test Circuit**

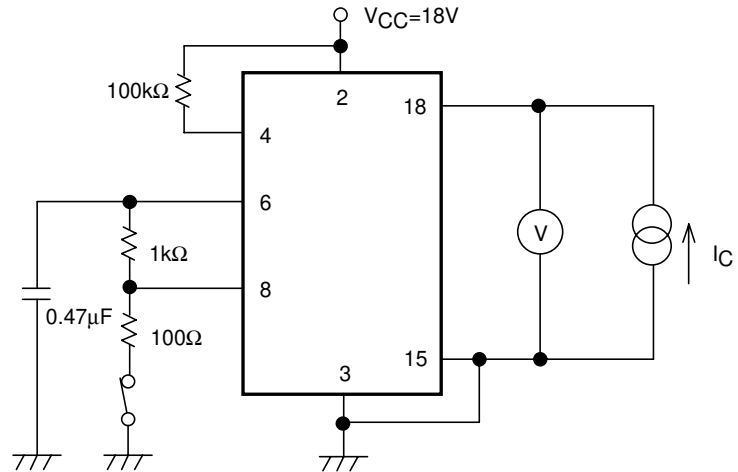
1: IR, ICES

	TR1	D2
A	18	22
B	15	19



<Fig.1>

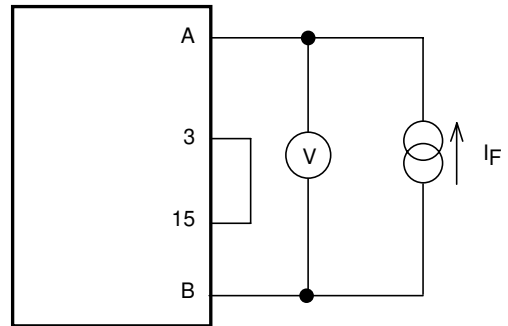
2: V<sub>CE(sat)</sub> (Test by pulse)



<Fig.2>

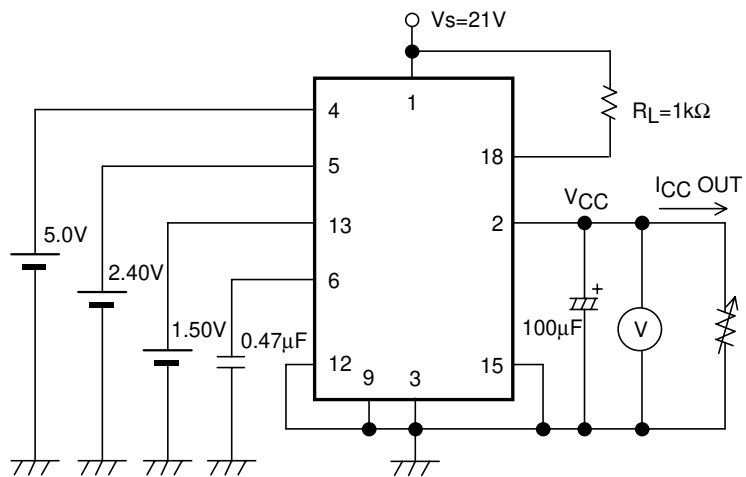
3: V<sub>F</sub> (Test by pulse)

	D2	D3
A	19	15
B	22	18



<Fig.3>

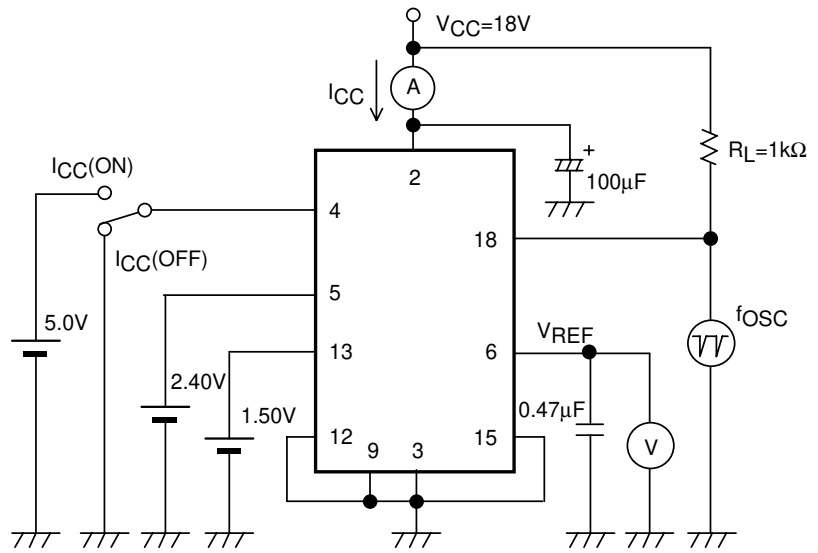
4: V<sub>CC</sub> (V<sub>CC</sub>-Reg.OUT)



<Fig.4>

**STK760-220A-E**

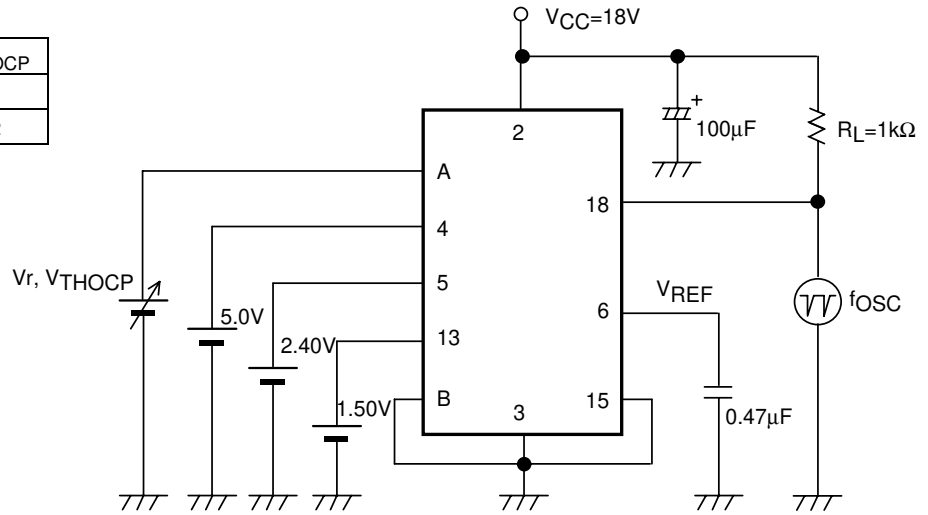
5:  $I_{CC(ON)}$ / $I_{CC(OFF)}$ ,  $V_{REF}$ ,  $f_{OSC}$



<Fig.5>

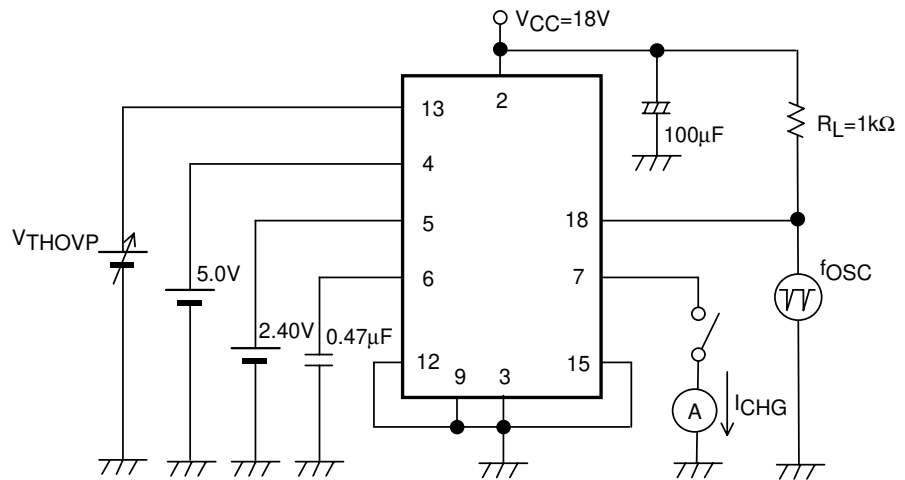
6:  $V_r$ ,  $V_{THOCP}$

	$V_r$	$V_{THOCP}$
A	12	9
B	9	12



<Fig.6>

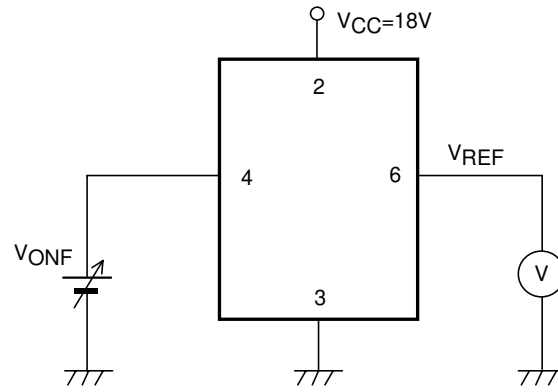
7:  $V_{THOVP}$ ,  $I_{CHG}$



<Fig.7>

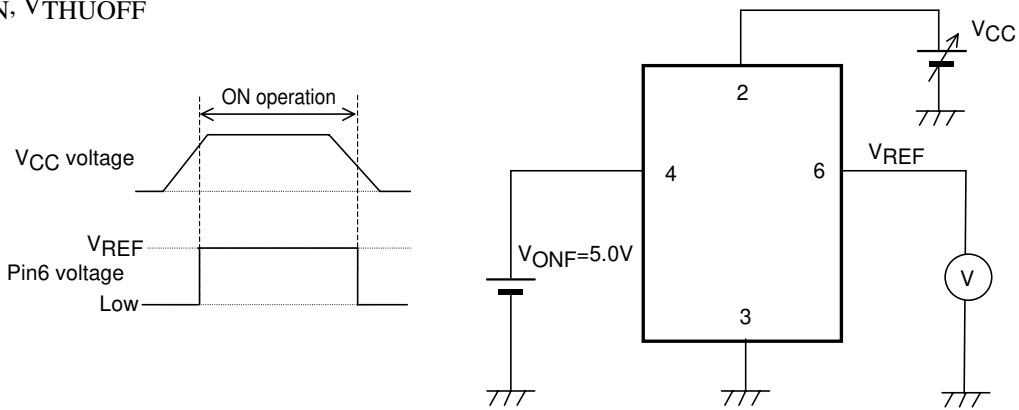
**STK760-220A-E**

8:  $V_{THON}$ ,  $V_{THOFF}$



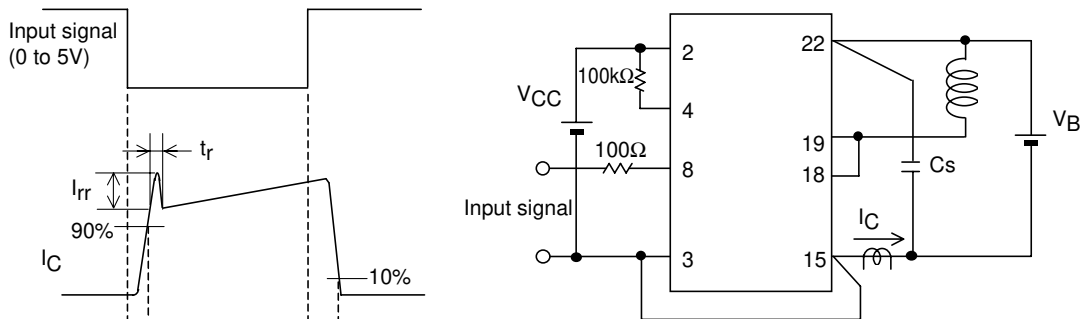
<Fig.8>

9:  $V_{THUON}$ ,  $V_{THUOFF}$



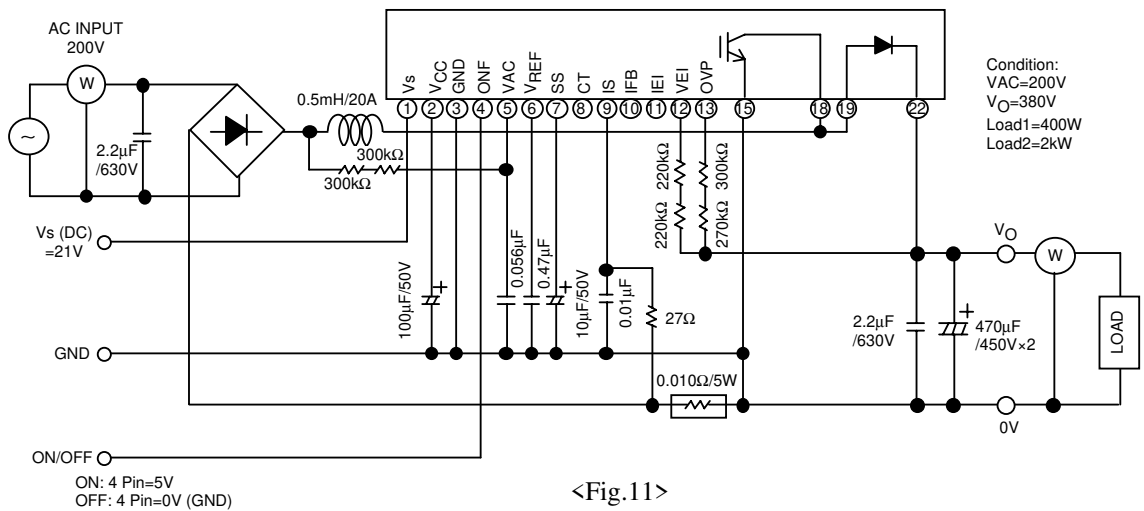
<Fig.9>

10:  $t_{ON}$ ,  $t_{OFF}$ ,  $t_{rr}$ ,  $I_{rr}$



<Fig.10>

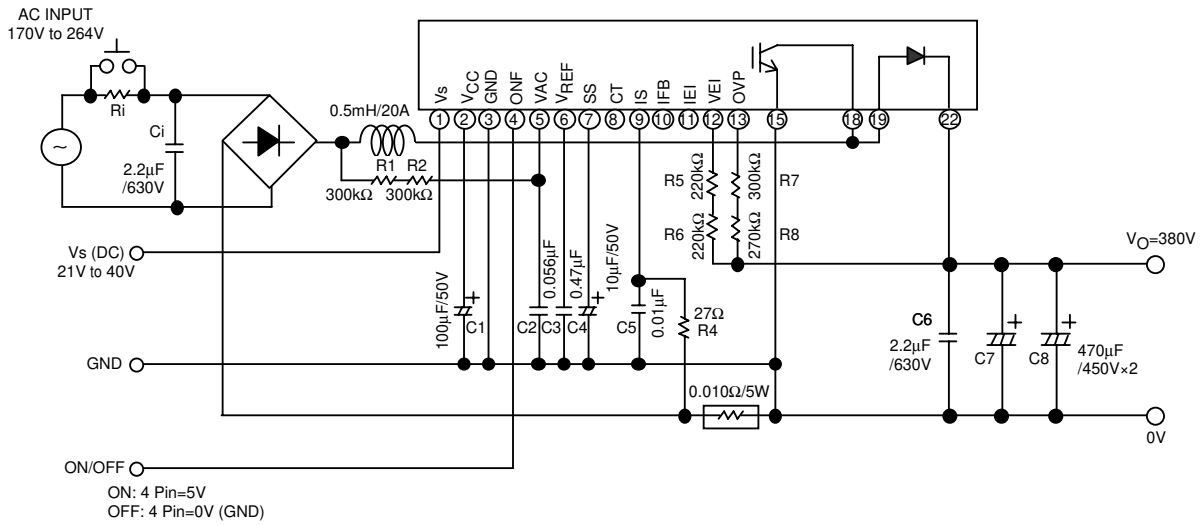
11: Power factor ( $\cos\phi$ )



<Fig.11>

**STK760-220A-E**

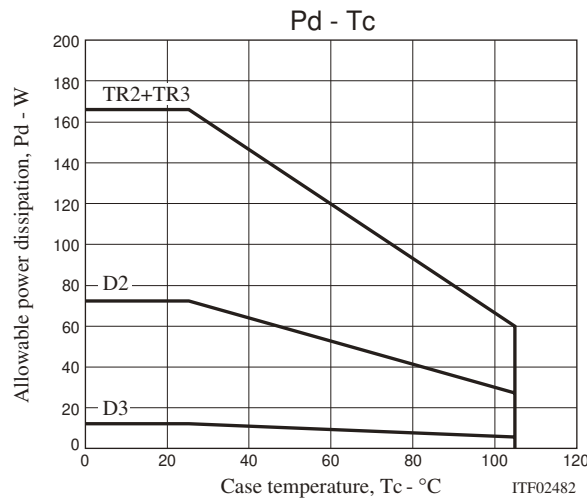
**Sample Application Circuit**



\* When using the IC in a system having an input power voltage of 200V, insert a rush current limiting circuit, which consists of a limiting resistor  $R_i$  and a switch, to prevent the internal diodes from being damaged by the charging current from the output capacitor

**Recommended conditions**

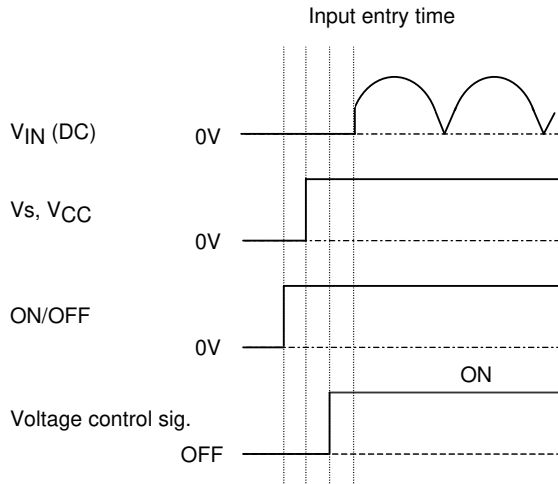
Parameter	Symbol	Conditions	Recommended values	unit
Commercial AC voltage	VAC	50/60Hz	170 to 264	Vrms
Output voltage	$V_O$		$V_{AC} \times \sqrt{2} + (10 \text{ to } 15) \leq 450$	V
Output overvoltage detection voltage	$V_{OV}$		$V_{OUT} + (10 \text{ to } 20)$	V
Supply voltage (Pin 1)	$V_s$		21 to 40	V



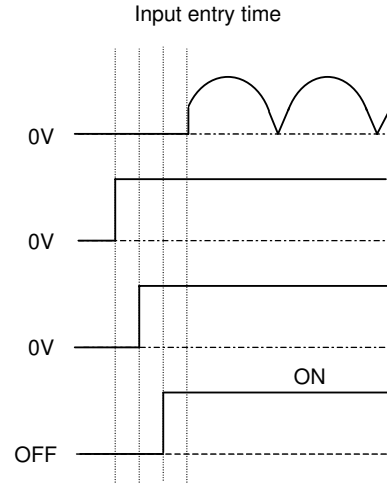


## Timing Charts

The IC will never be subjected to fatal damage when a power supply input or signals are applied or are not applied at any timing. If the  $V_{IN}$  (DC) input is applied to the IC at the timing shown in Figure 12 or 13, however, since the soft start circuit is inactive in this case, it is likely that the overcurrent protection circuit is activated and audible tone is generated out of the coil. To avoid this area of timing, it is necessary that the ON/OFF or  $V_{CC}$  input be applied after  $V_{IN}$  (DC).



<Fig.12>



<Fig.13>

- 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.
- 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.
- Information (including circuit diagrams and circuit parameters) herein is for example only; it is not guaranteed for volume production.
- 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 June, 2008. Specifications and information herein are subject to change without notice.