Ordering number : EN*A1052

Preliminary

SANYO Semiconductors

DATA SHEET

STK760-221A-E — Thick-Film Hybrid IC Single-phase Rectification PFC Hybrid IC

Overview

The STK760-221A-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.

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Specifications

Absolute maximum ratings at Tc = 25°C

Parameter		Symbol	Conditions	Ratings	unit
IGBT (TR2+TR3)	Collector-to-emitter voltage	VCES		600	V
	Repetitive peak collector current	ICP	*1	180	A
	Collector current	I_C		70	A
	Allowable power dissipation	Pd		166	W
FRD (D2)	Diode reverse voltage	VRM		600	V
	Repetitive peak forward current	IF2P	*1	160	A
	Forward Current	IF2		41	A
	Allowable power dissipation	Pd		73	W
FRD (D3)	Repetitive peak forward current	IFP	*1	15	A
	Forward current	IF3		7	A
	Allowable power dissipation	Pd		13	W
Supply voltage (Pin 1)		Vs		21 to 50	V
Supply current (Pin 1)		Isc		60	mA
Signal pin input voltage	Pin 5	VVDET		-0.3 to 5.0	V
	Pin 12	VEI			
	Pin 13	VOVP			
	Pin 9	VIS		-10 to 5.0	V
	Pin 4	VONF		-0.3 to V_{CC}	V
Oscillation frequency		f_{OSC}		40	kHz
Maximum AC input voltage		VAC	Single-phase full-wave rectification waveform voltage	264	V
Maximum output voltage		V_O	Under the operating conditions of the application circuit	450	V
Input current (in steady state)		I_{IN}	Under the operating conditions of the application circuit.	20	Arms
Load power		Wo	VAC=200V	4	kW
Chip junction temperature		Tj		150	°C
Operating case temperature		Tc	Center of the resin package on the reverse side *2	-20 to +105	°C
Storage temperature		Tstg		-40 to +125	°C
Tightening torque			M4 screws *3	1.17	N • m
Dielectric strength voltage		VINS	Sine wave, 50Hz, AC 1 minute *4	2000	VRMS

*1. Repetitive peak current with the duty ratio of D=0.1 and tp=1ms.

*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 Tc=25°C, Vs=21V with the designated circuit

(Apply V_{CC}=18.0V directly to pin 2 unless Vs input is specified.)

Parameter	Symbol	Conditions	min	typ	max	unit	Test circuit
Power output block							
Collector-to-emitter cutoff current (TR2+TR3)	ICES	V_{CE}=600V			200	μA	Fig.1
Collector-to-emitter saturation voltage (TR2+TR3)	V_{CE}(sat)	V_{CC}=18.0V, I_C=40A		1.9	2.4	V	Fig.2
Diode reverse voltage (D2)	I_R	V_R=600V			100	μA	Fig.1
Diode forward voltage (D2)	V_F	I_F=40A		2.1	2.6	V	Fig.3
Diode forward voltage (D3)	V_F	I_F=5A		2.5	3.5	V	Fig.3
Junction-to-case thermal resistance	θj-c1	IGBT (TR2+TR3)		0.75		°C /W	
	θj-c2	FRD (D2)		1.7		°C /W	
	θj-c3	FRD (D3)		9.0		°C /W	

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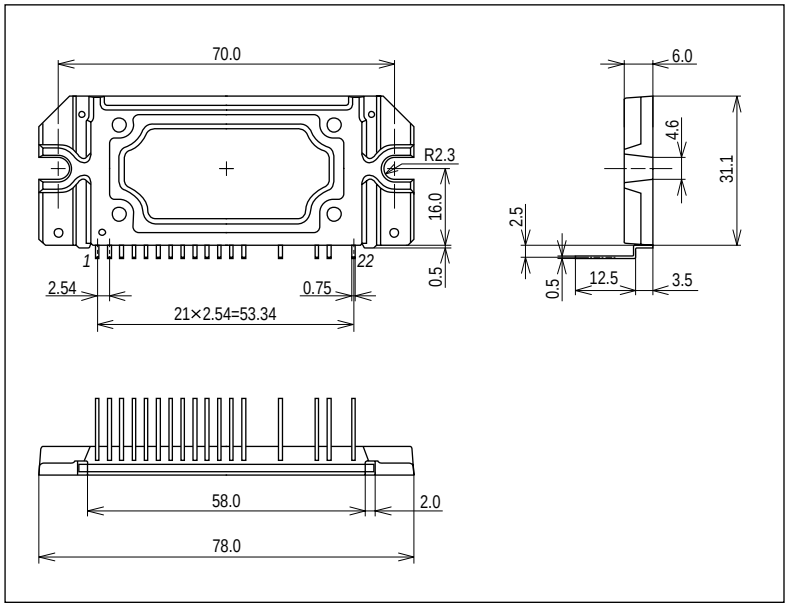
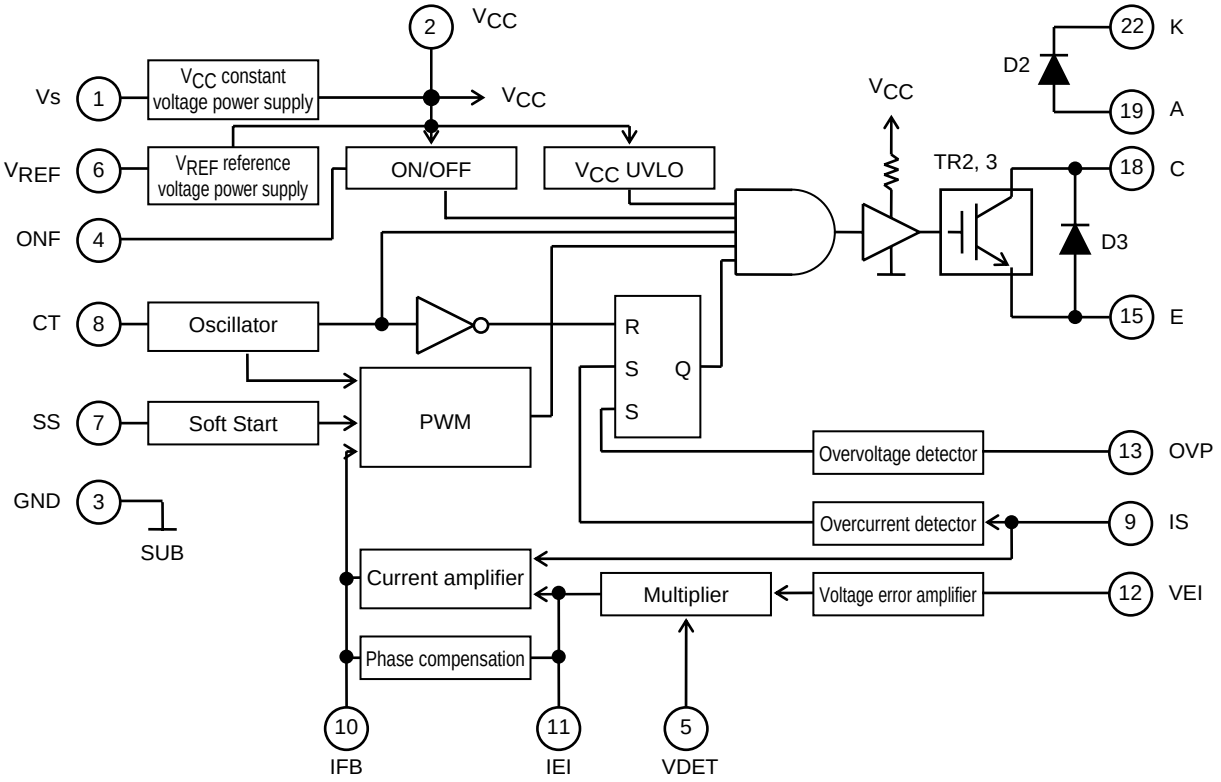
Parameter	Symbol	Conditions	min	typ	max	unit	Test circuit
V_{CC} regulator block							
V_{CC} regulator output voltage	V_{CC}	Vs=21V, I_{CC}OUT=0 to 40mA	17.9	18.7	19.6	V	Fig.4
Control IC block							
Control circuit current dissipation	I_{CC}(ON)	V_{CC}=18.0V, ONF=5V		7	11	mA	Fig.5
	I_{CC}(OFF)	V_{CC}=18.0V, ONF=0V		0.06	0.5	mA	
Reference voltage	V_{REF}	V_{CC}=18.0V, ONF=5V	4.75	5.0	5.25	V	Fig.5
Oscillation frequency	f_{OSC}	V_{CC}=18.0V, ONF=5V	19.3	21.5	23.7	kHz	
Overcurrent protection input threshold voltage	VTHOCP	V_{CC}=18.0V, ONF=5V	-1.20	-1.10	-1.00	V	Fig.6
Voltage error amplifier reference voltage	Vr	V_{CC}=18.0V, ONF=5V	1.509	1.55	1.591	V	
OVP threshold voltage	VTHOVP	V_{CC}=18.0V, ONF=5V	1.607	1.64	1.673	V	Fig.7
SS charge current	ICHG	V_{CC}=18.0V, ONF=5V		11		μA	
SS input threshold voltage	VTHSSO	Duty cycle=0%		0.34		V	
	VTHSSM	Duty cycle=D_{MAX}		3.4		V	
ON/OFF threshold voltage	VTHON	V_{CC}=18.0V	3.5	3.95	4.4	V	Fig.8
	VTHOFF	V_{CC}=18.0V	2.4	2.8	3.2	V	
Startup V_{CC} voltage	VTHUON	ONF=5V	15.5	16.5	17.5	V	Fig.9
Shutdown V_{CC} voltage	VTHUOFF	ONF=5V	8.2	8.9	9.6	V	
Power output block							
Switching time	t_{ON}	I_C=30A, Inductive load	0.2	0.35	0.8	μs	Fig.10
	t_{OFF}			0.85	1.4	μs	
	t_{rr}			0.04		μs	
Diode recovery current (D2)	I_{rr}			20		A	
Application circuit operation: Set to VAC=200V, and V_O=380V							
Power factor	cosϕ	Wo=400W	0.9	0.95			Fig.11
		Wo=2kW	0.98	0.99	1.0		

Package Dimensions

unit:mm (typ)



Block Diagram



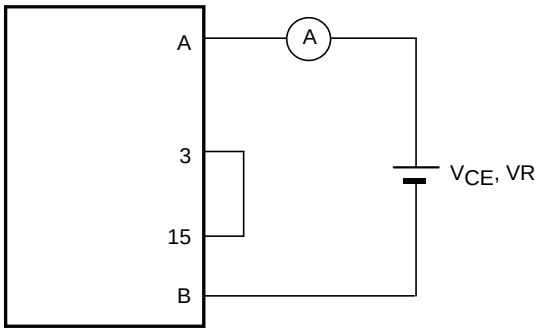
Pin Functions

Pin No.	Pin Name	Description
1	Vs	Operating supply voltage (+18V Reg. input)
2	V_{CC}	+18V V_{CC} power supply output
3	GND	GND pin
4	ONF	ON/OFF control pin
5	VDET	Multiplication input
6	V_{REF}	+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

Test Circuit

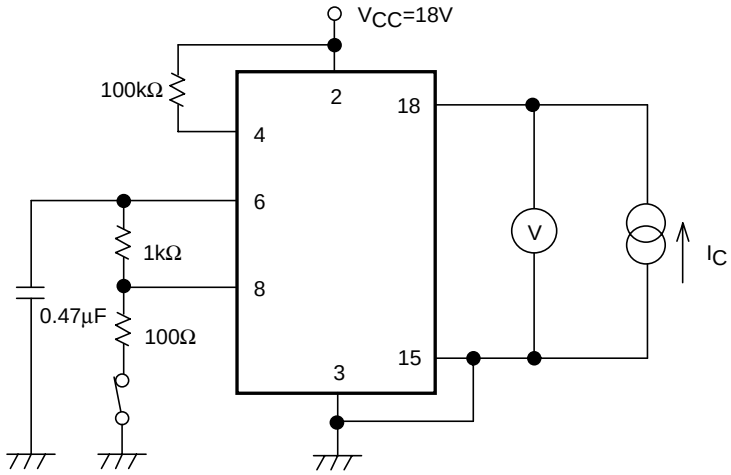
1: IR, ICES

	TR1	D2
A	18	22
B	15	19



<Fig.1>

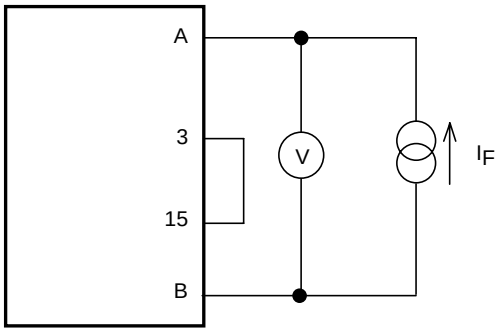
2: V_{CE}(sat) (Test by pulse)



<Fig.2>

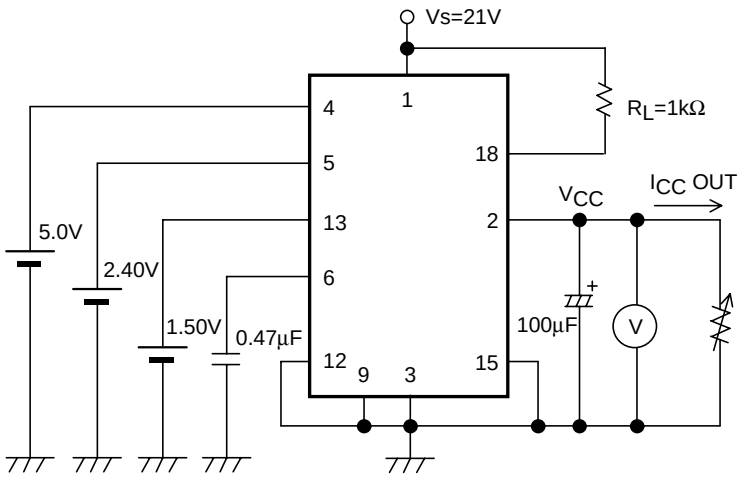
3: V_F (Test by pulse)

	D2	D3
A	19	15
B	22	18



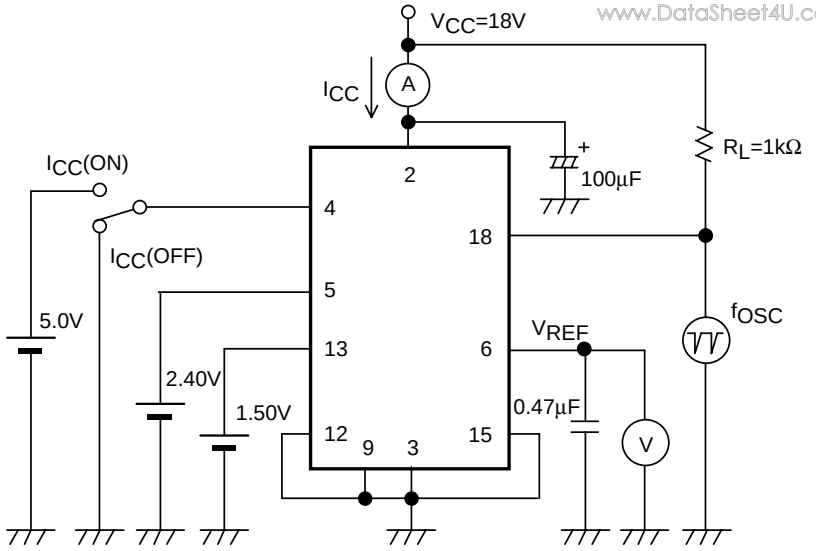
<Fig.3>

4: V_{CC} (V_{CC}-Reg.OUT)



<Fig.4>

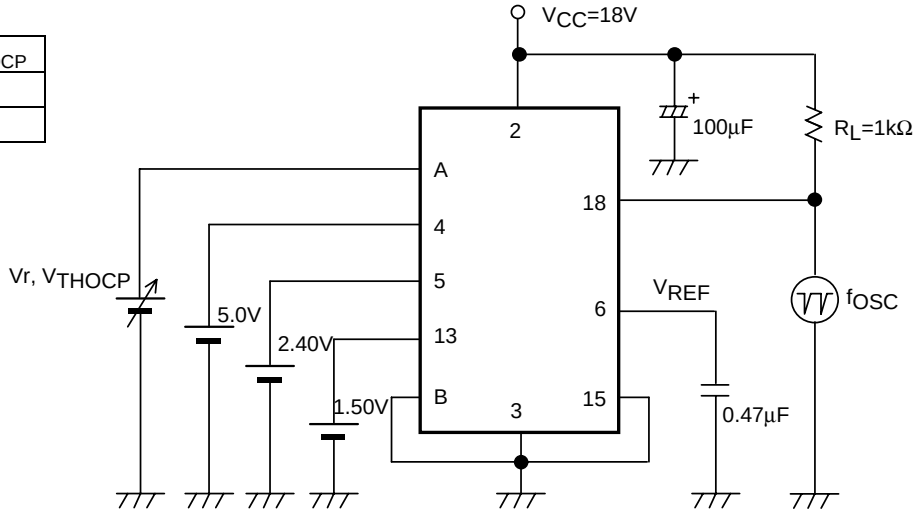
5: $I_{CC}(ON)/I_{CC}(OFF)$, V_{REF}, f_{OSC}



<Fig.5>

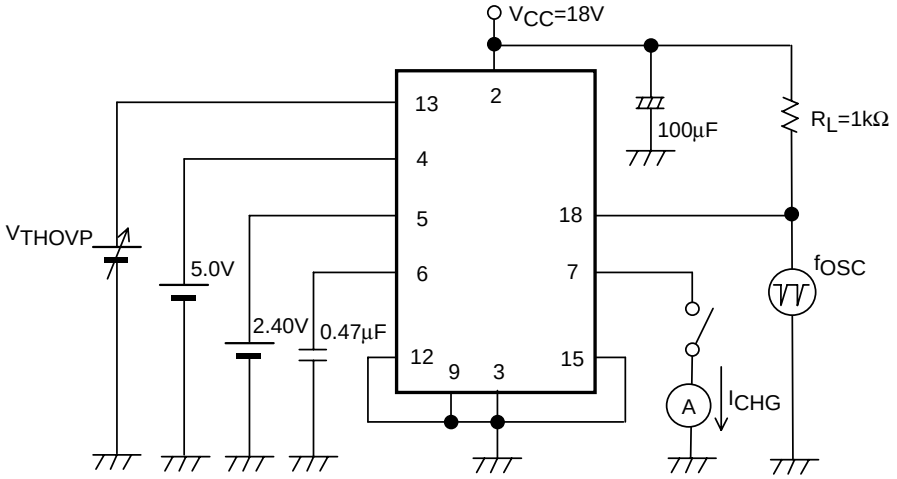
6: Vr, V_{THOCP}

	Vr	V_{THOCP}
A	12	9
B	9	12



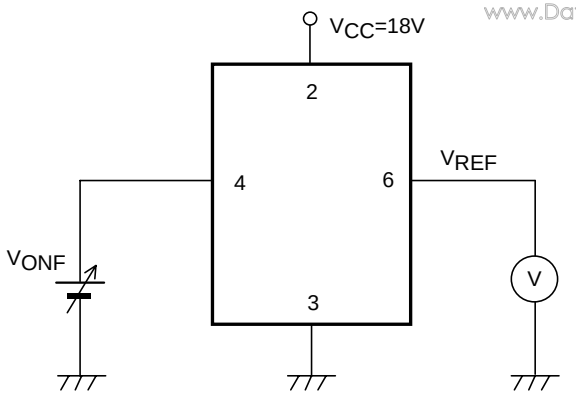
<Fig.6>

7: V_{THOVP}, I_{CHG}



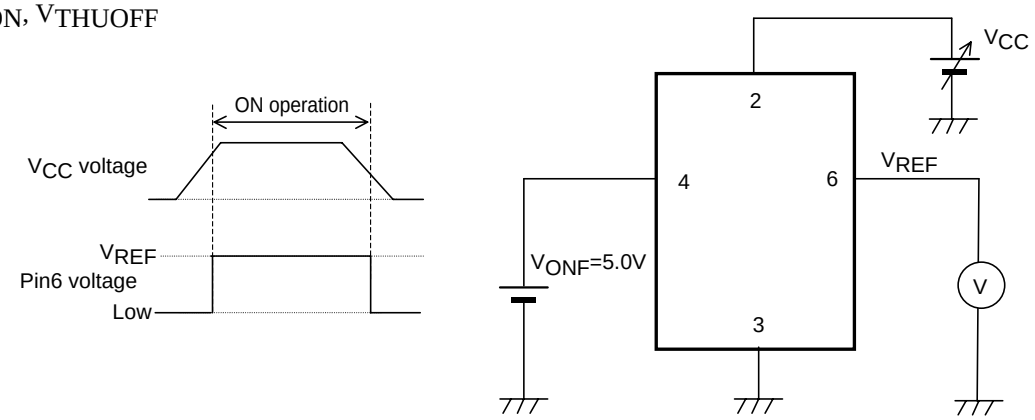
<Fig.7>

8: V_{THON}, V_{THOFF}



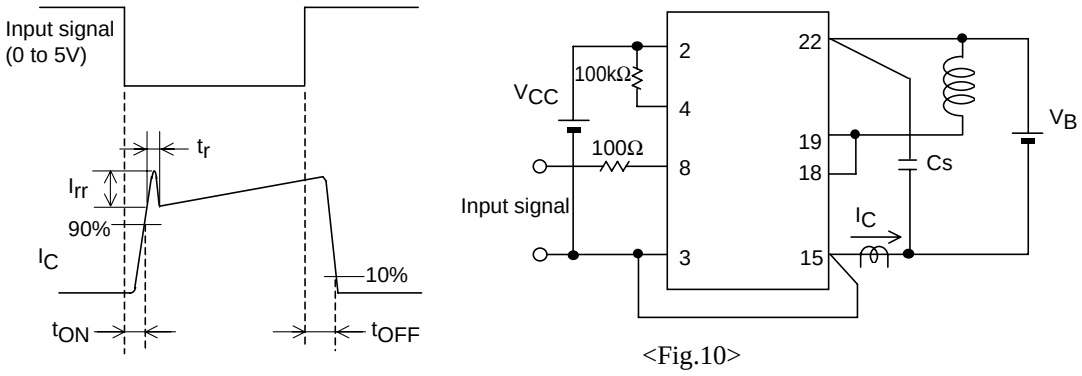
<Fig.8>

9: V_{THUON}, V_{THUOFF}



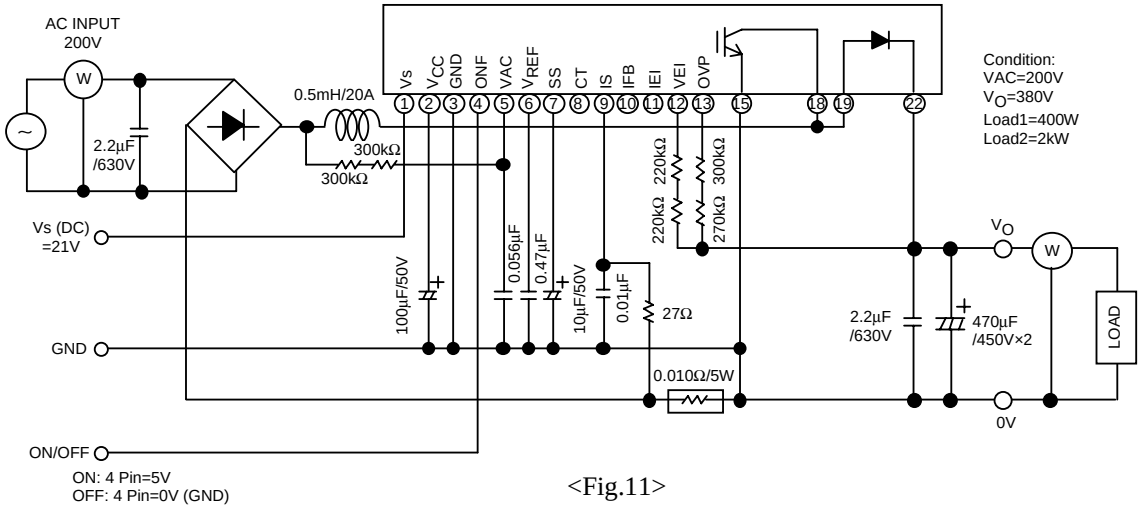
<Fig.9>

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



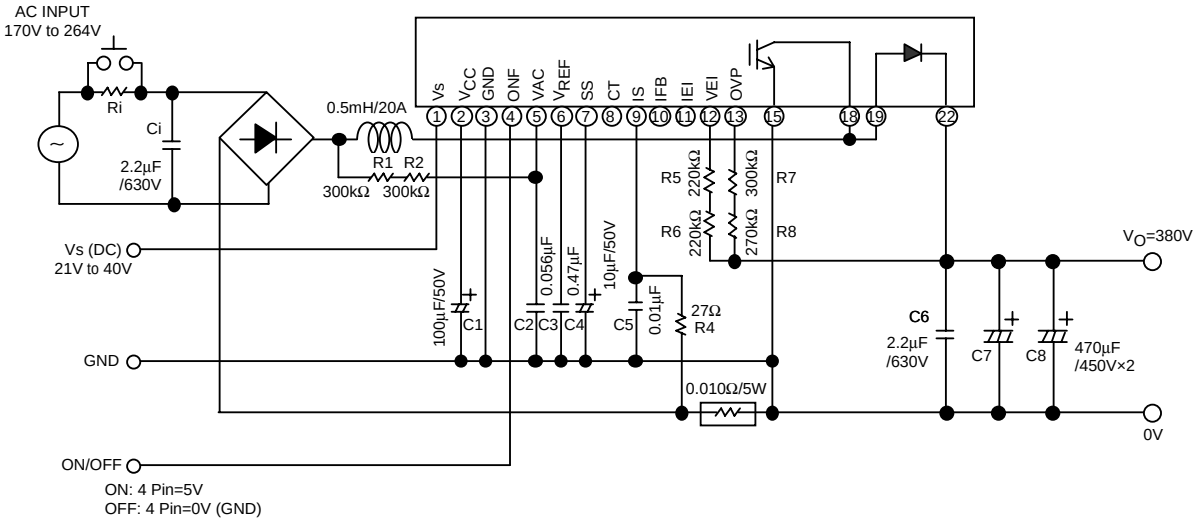
<Fig.10>

11: Power factor (COSϕ)



<Fig.11>

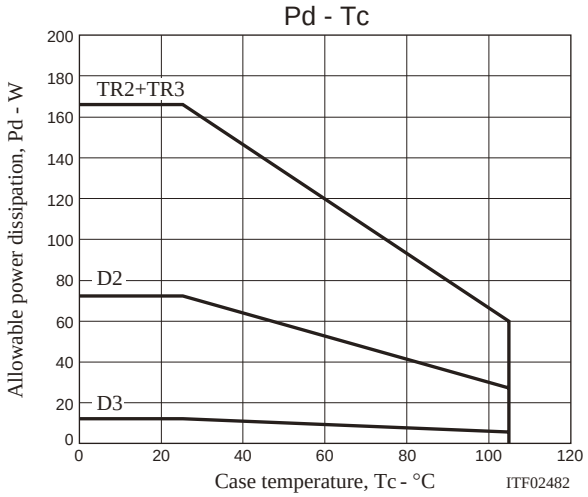
Sample Application Circuit



* 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 Ri and a switch, to prevent the internal diodes from being damaged by the charging current from the output capacitor

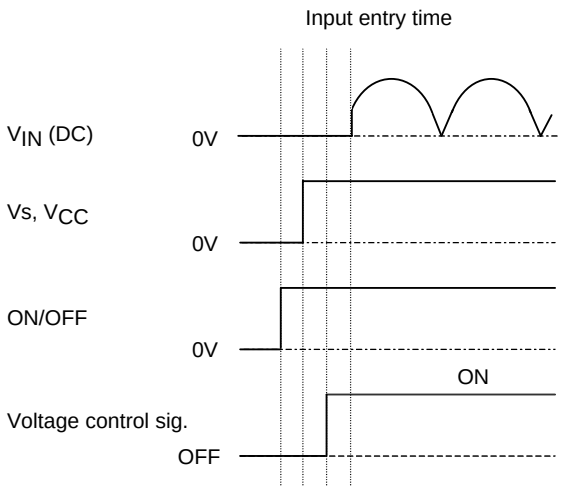
Recommended conditions

Parameter	Symbol	Conditions	Recommended values	unit
Commercial AC voltage	VAC	50/60Hz	170 to 264	Vrms
Output voltage	V_O		VAC×√2+(10 to 15)≤ 450	V
Output overvoltage detection voltage	V_{OV}		V_{OUT}+(10 to 20)	V
Supply voltage (Pin 1)	Vs		21 to 40	V

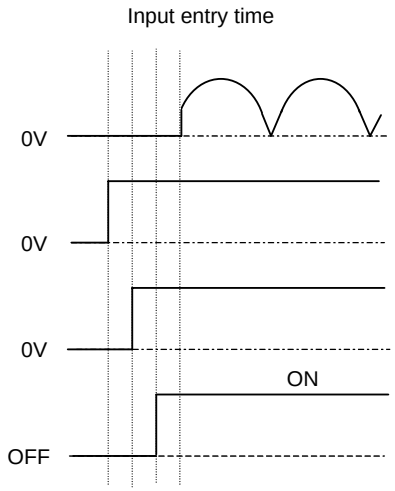


Timing Charts

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>