SD484X

AC-DC Circuit (SSR solution)

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Tel: 0755-83475897

➢ Introduction to SD484X IC

SD484X(X：0/1/2/3/4)is a current mode PWM controller with built-in high voltage MOSFET. At 85V～265V input voltage, the following output power are available: 7.2W, 12W, 14W, 15W, 18W(developing environment).

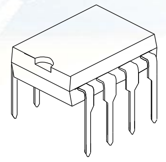
SD484X features low standby power dissipation, low start-up current. In standby mode, the circuit enters burst mode to reduce the standby power dissipation. The switch frequency is 67KHz with jitter frequency for low EMI.

Features:

- Low start-up current(6μA)
- ***Frequency jitter for low EMI***
- Over current/over voltage/temperature protections
- Auto restart
- Built-in soft-start circuit
- ***Built-in high voltage 650V MOSFET***
- Burst mode operation
- Cycle by cycle current limit

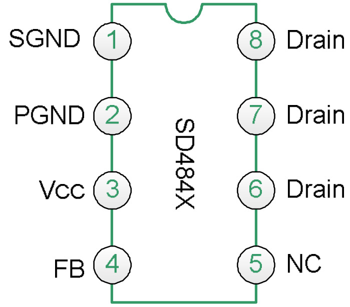
SD484X IC Package & Block Diagram

Package

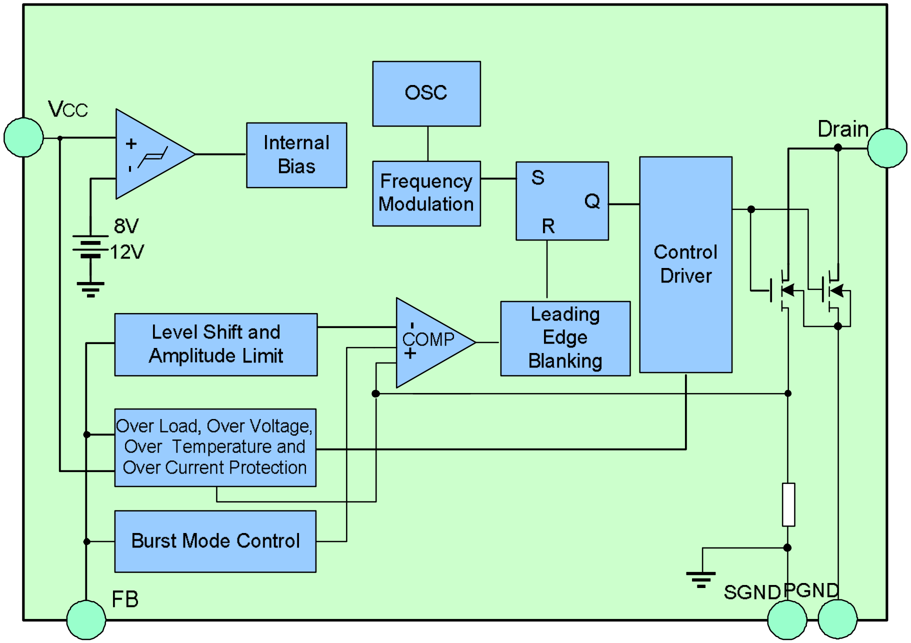


DIP-8A-300-2.54

Pin Configuration



Block Diagram



SD484X IC Pin and Power Description

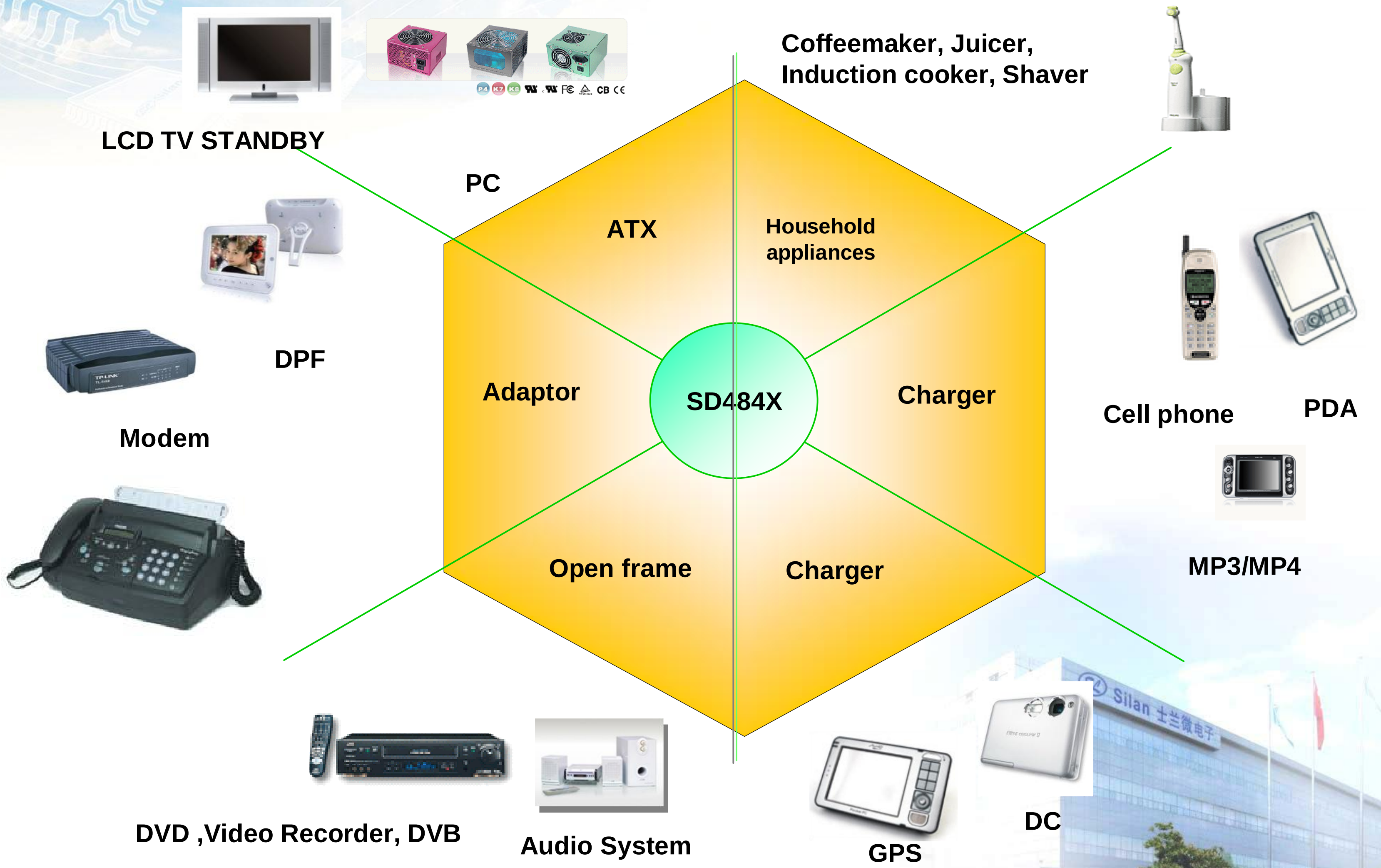
Pin Description

Pin No.	Symbol	Function description
1	SGND	GND of control circuit
2	PGND	GND of MOSFET
3	VCC	Power supply
4	FB	Feedback input
5	NC	No connection
6	Drain	Drain end of MOSFET
7	Drain	Drain end of MOSFET
8	Drain	Drain end of MOSFET

IC power output list

Part No.	190V~265V		85V~265V		Ron	Ipeak
	Adapter	Out Frame	Adapter	Out Frame		
SD4840	7W	9W	5W	7.2W	16.8	0.6
SD4841	10W	14W	8W	12W	9.6	0.75
SD4842	12W	17W	10W	14W	6	0.9
SD4843	14W	19W	12W	15W	4.8	1.2
SD4844	16W	21W	14W	18W	3.6	1.5

➢ SD484X IC Applications



➢ SD4840 Competitor

Charger

Power 3-6W(5V/600mA, 1A, 1.2A)

Product SD4840

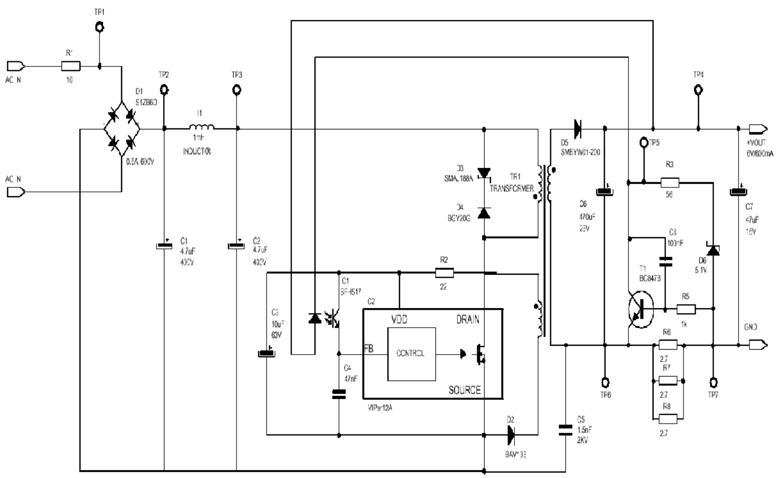
Application Cell phone, MP3/MP4, PMP , Household appliances Etc.

Main Competitors

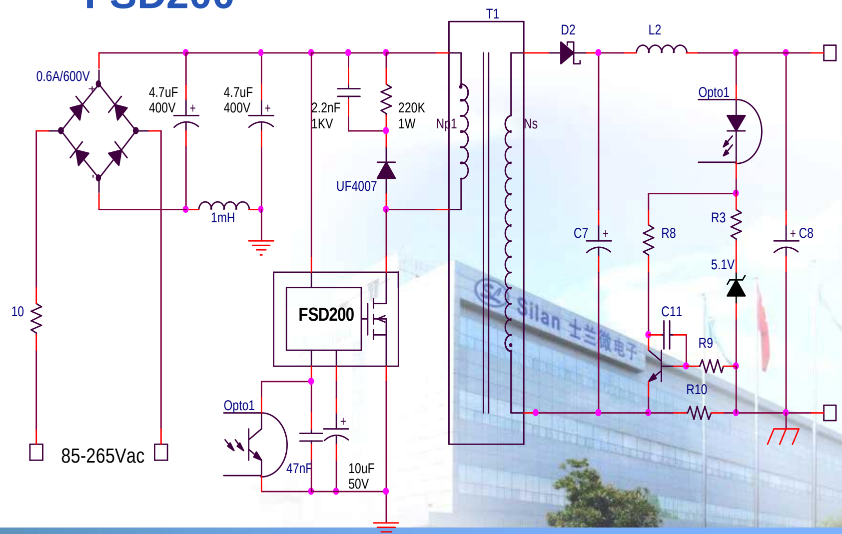
SD4840：

Vipper12/FSD200/ACT30/RCC/THX202

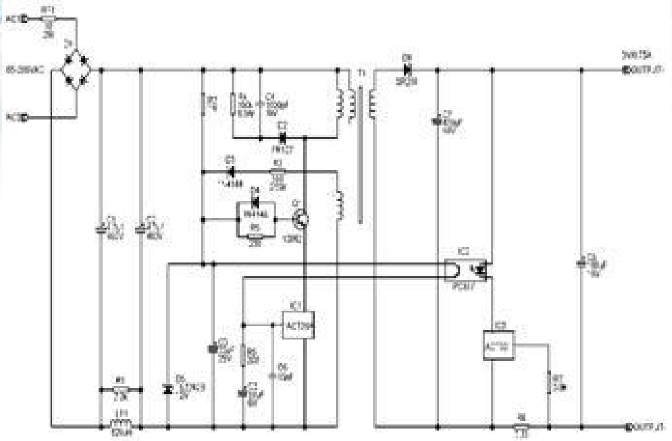
Vipper12



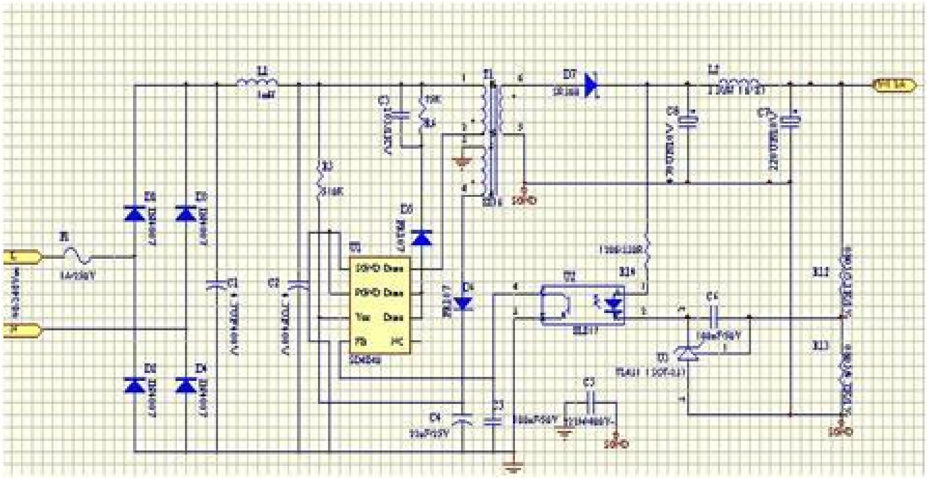
FSD200



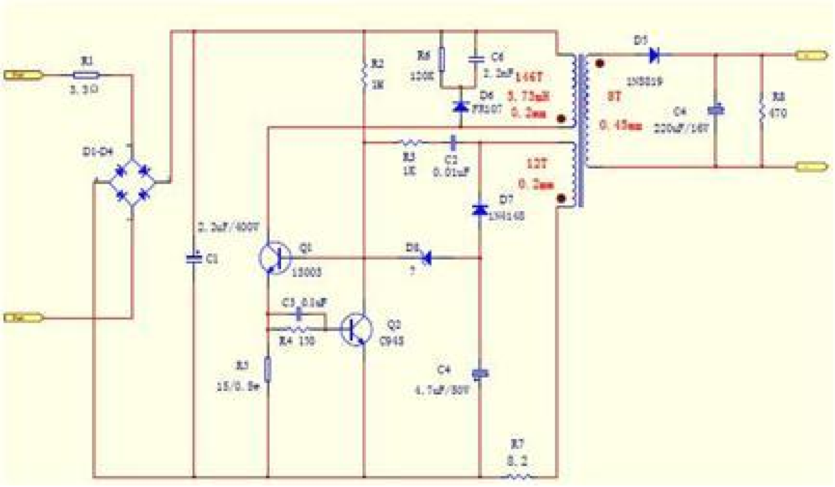
ACT30+NPN



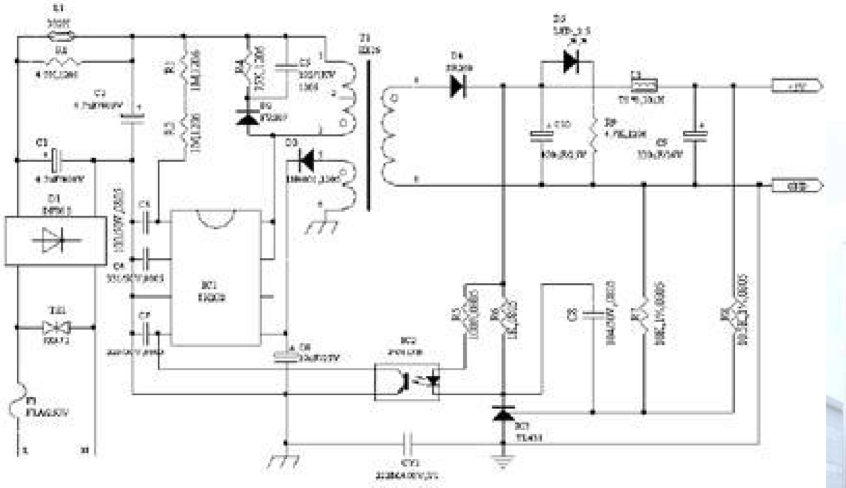
SD4840



RCC



THX202



➢ SD4842/3/4 Competitor

Adaptor

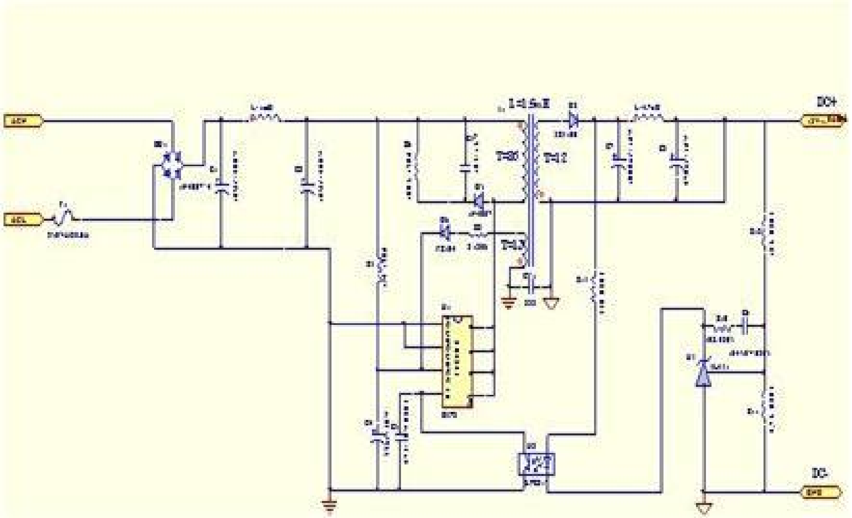
Power	10-20W(9V/1A, 9V/1.5A, 12V/1A, 12V/1.5A)
Products	SD4842/4843/4844
Application	Modem, DPF, Portable device Etc.

Main competitors

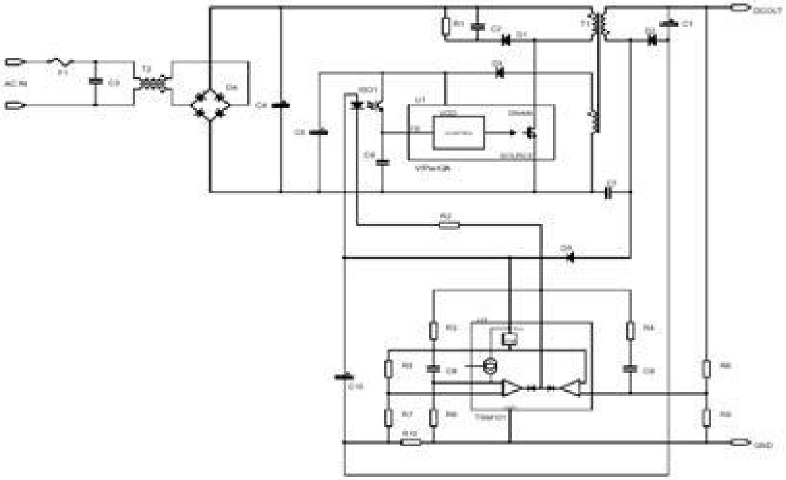
SD4843：
FSD321/VIPPER22(ST)/THX203/SM8002/A6251/2A0565/OB2354/OB2358

SD4844：
FSD0365/2A0565/(OB2263/LD7535/50/CR6851)+MOS

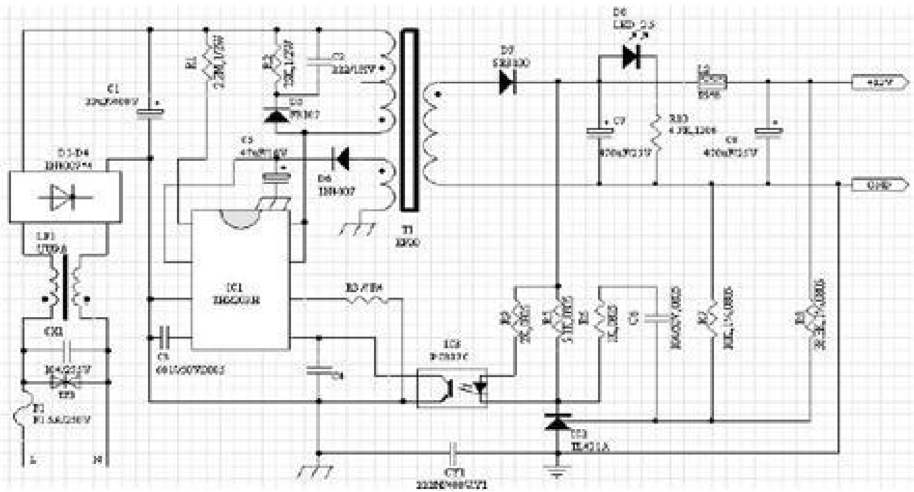
SD4843/4



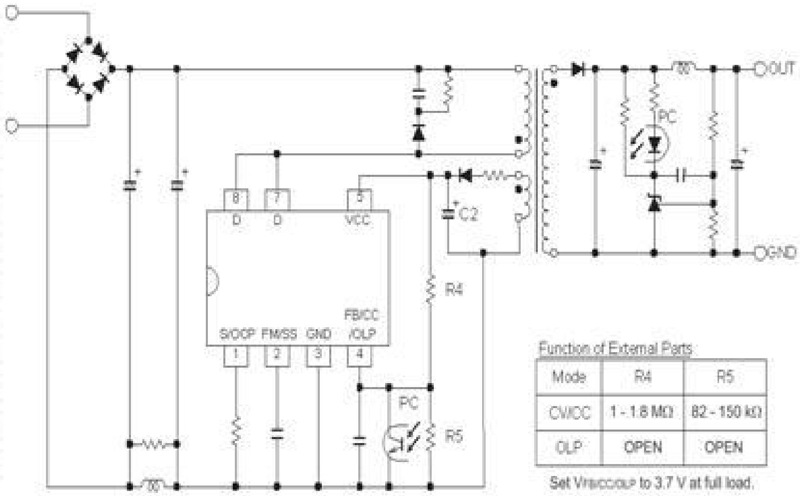
VIPPER22



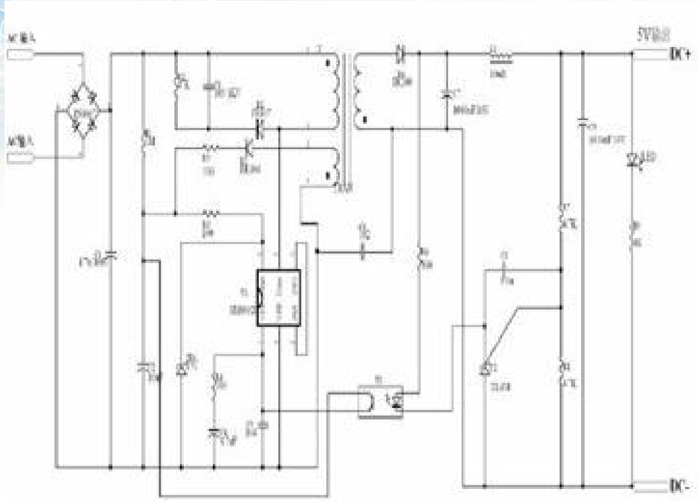
THX203



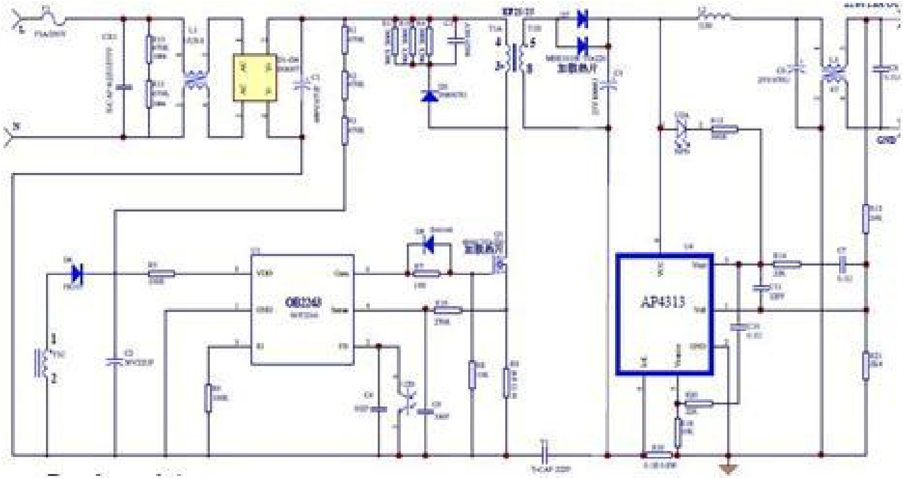
STR-A6251/2



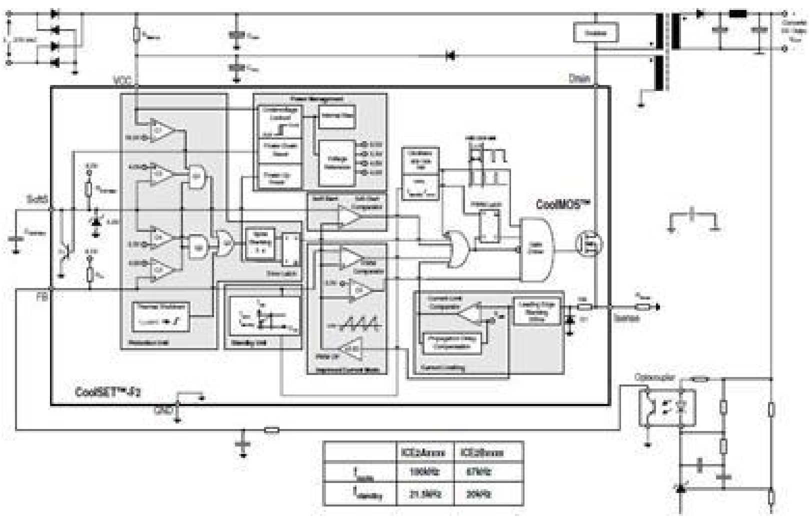
SM8002



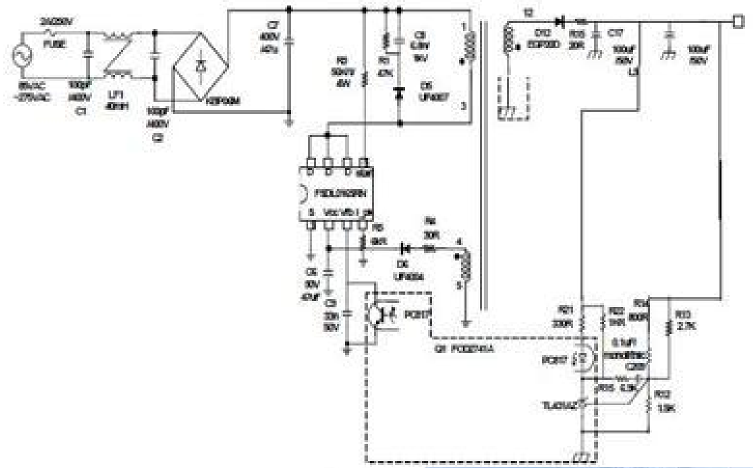
OB2263+MOS



2A0565



FSD0165/0265/0365



SD4841 Competitor

Open frame

Power 5-25W

Products SD4840/4841/4842/4843/4844

Application DVD 10W

DVB 5-25W

ATX 10-15W

Main competitors

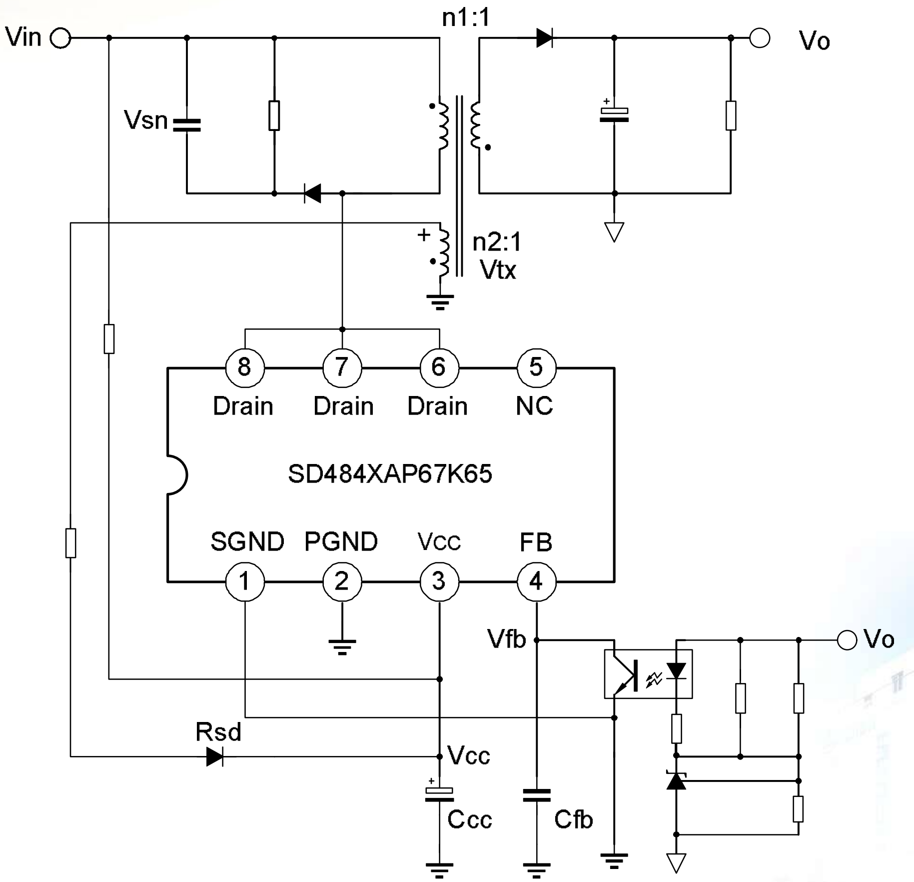
SD4841(DVD)：FSD321/VIPPER22/THX203/SM8002/2604/POWER22

SD4841(DVB-S10W)：FSD321/VIPPER22/OB2358/THX203/SM8002/2604

SD4843/4(DVB-T20W)：FSD0365/0B2263+MOS

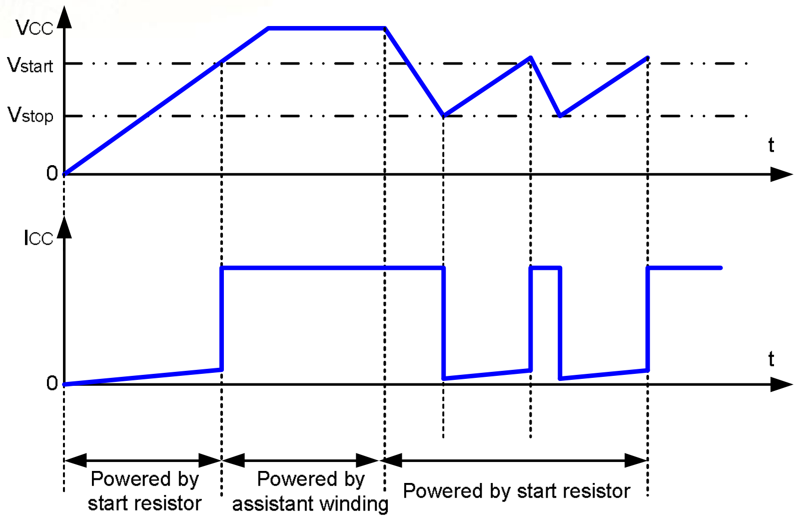
SD4841, 2, 3(ATX)：FSDM321/FSD0165/FSD0365/RCC

➢ SD484X IC Typical application circuit



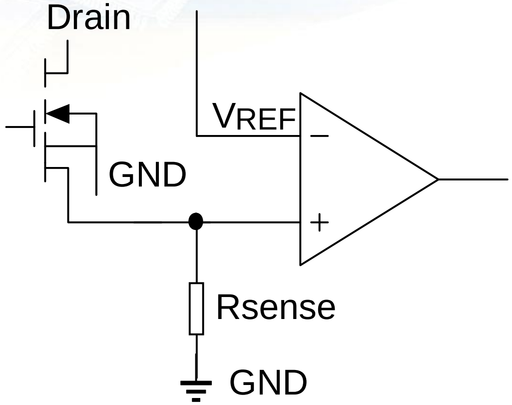
SD484X IC Function Descriptions

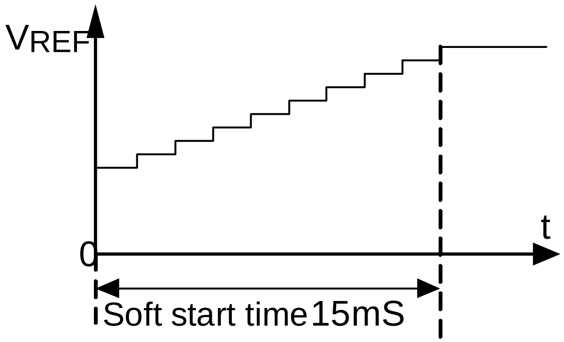
Under Voltage Lockout and Self-start



In general application, the capacitor connected to pin VCC is charged via start resistor by high voltage AC and the circuit starts to work if voltage at VCC is 12V. The output is shutdown if there is any protection during normal operation and VCC is decreased because of powering down of auxiliary winding, and the whole control circuit is shut down if voltage at VCC is 8V below. At this time, the current dissipation is reduced and the capacitor is recharged via start resistor for restarting. Larger start resistor can be used for low standby power dissipation due to the start current is only 6μA.

Soft-start circuit

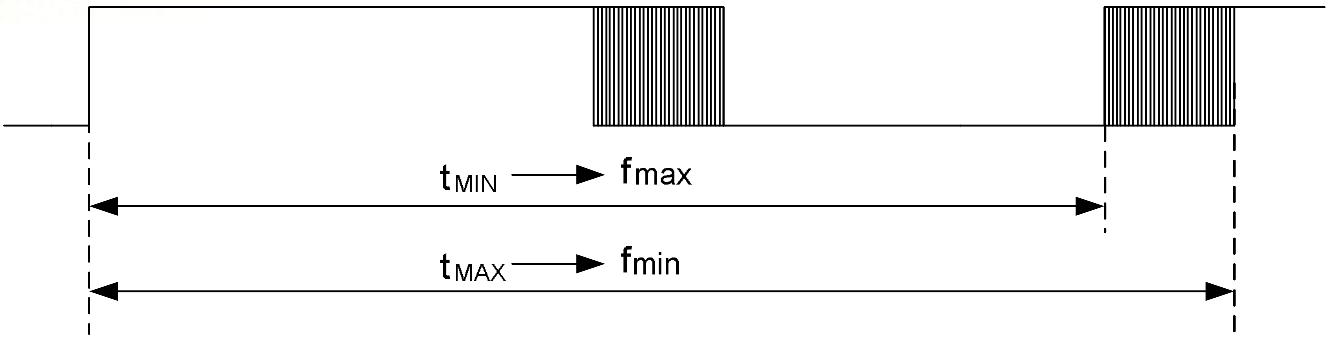




Soft-start circuit is used to reduce the transformer stress during the start up and avoid saturation of the core.

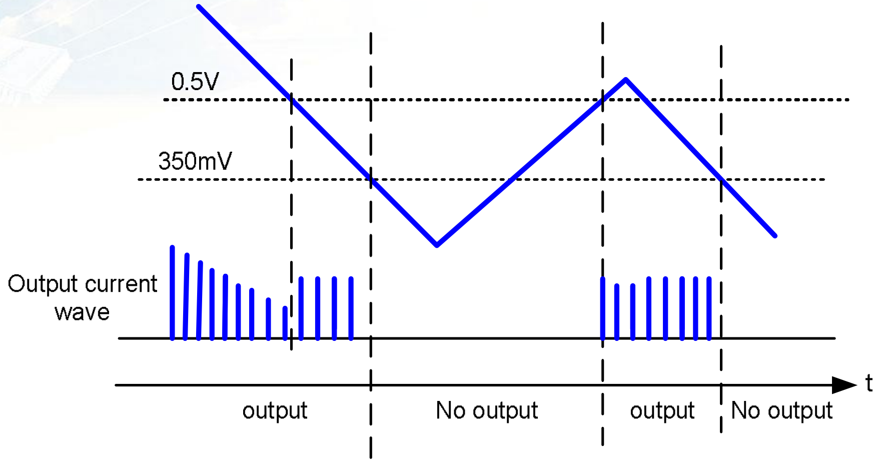
Operational principle: the maximum current on the primary coil is decided by comparative point VREF that can control the current. When the circuit is soft-start, VREF that decided by internal circuit increases slowly and the soft-start time is about 15 ms.

Frequency Jitter



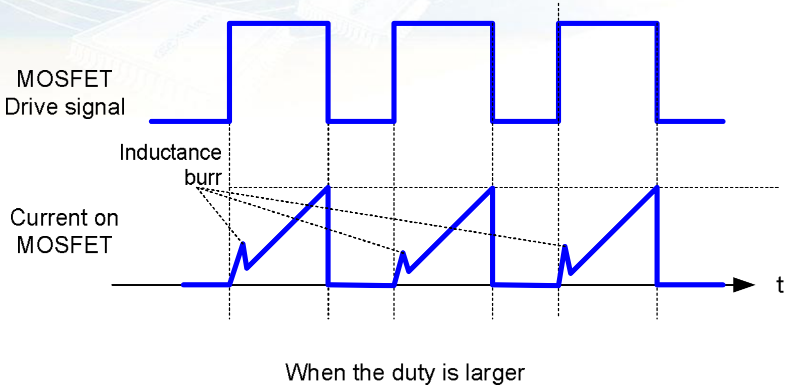
The oscillation frequency is kept changed for low EMI and decreasing radiation on one frequency. The oscillation frequency changes within a very small range to simplify EMI design. The rule of frequency changing: change from 65KHz to 69KHz in 4mS with 16 frequency points.

Light Load Mode

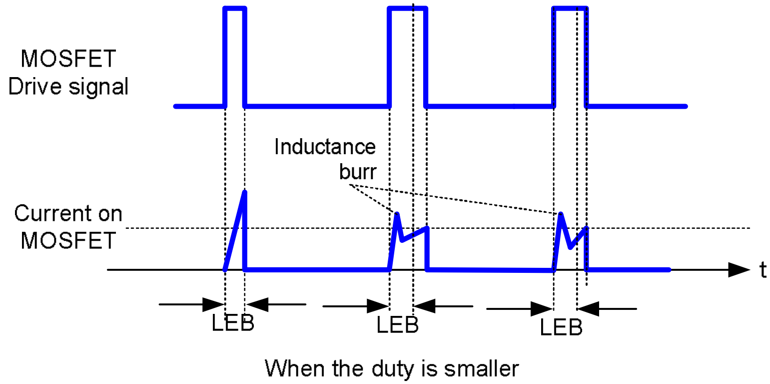


Working in this mode can reduce power dissipation. It works normally when FB is 500mV above and during 350mV<FB <500mV, there are two different conditions: when FB changes from low to high, there is no action for switch and it is the same with condition of FB lower than 350mV; the other is that FB changes form high to low, comparison value is increased for increasing turning on time to decrease switch loss. For this mode, during FB changes form high to low, the output voltage increases (increasing speed is decided by load) because of the high comparison value to decrease FB until it is 350mV below; when FB <350mV, there is no action for switch and output voltage decrease (decreasing speed is also decided by load) to increase FB. This is repeated to decrease action of switch for lower power dissipation.

Leading Edge Blanking



When the duty is larger



When the duty is smaller

For this current-controlled circuit, there is pulse peak current during the transient of switch turning on and there is an error operation if the current is sampled during this time. And leading edge blanking is adopted to eliminate this error operation. The output of PWM comparator is used for output control after a Leading Edge Blanking (LEB) time to avoid the error operation as shown in above figure. If no other abnormal conditions, once the circuit is start up, there is a minimum output pulse width which is the LEB time.

Peak Current Limit Cycle by Cycle

During each cycle, the peak current value is decided by the comparison value of the comparator, which will not exceed the peak current limited value to guarantee the current on MOSFET will not be more than the rating current. The output power will not increase if the current reaches the peak value to limit the max. output power. The output voltage decreases and FB voltage increases if there is overload and corresponding protection occurs.

Various Abnormal State Protections

The circuit is shut down after abnormal state protections occur and the decreased VCC will make the circuit keep on restarting until the error is eliminated.

1.Over Voltage Protection

The output is shutdown if voltage at Vcc exceeds the protection voltage and this state is kept until the circuit is powered on reset. The protection voltage is decided by the ratio of auxiliary winding and output winding. Assume that: winding ratio is N, and given protection voltage of Vcc is 19V, then, the output protection voltage is 19/N V

2.Over Load Protection

FB voltage increases if there is overload and the output is shutdown when FB voltage is up to the feedback shutdown voltage. This state is kept until the circuit is powered on reset.

3. Abnormal Over Current Protection

That secondary diode is short, or the transformer is short will cause this event. At this time, once it is over current in spite of the leading edge blanking (LEB) time, protection will begin at once, and is active for every cycle. When the voltage on the current sense resistor is 1.6V, this protection will occur and the output is shut down. This state is kept until the under voltage occurs, and the circuit will start.

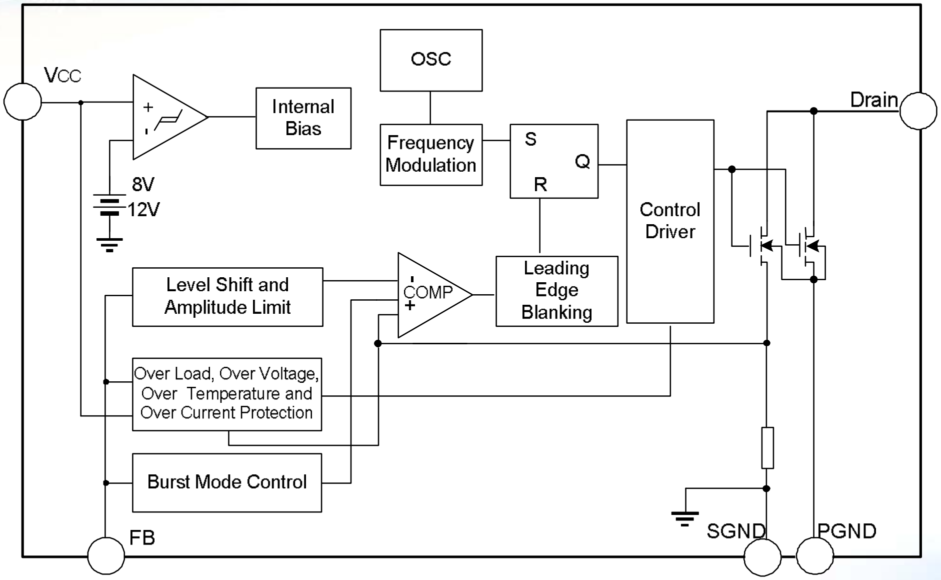
4.Thermal Shutdown

If the circuit is over temperature, the over temperature protection will shut down the output to prevent the circuit from damage. This state is kept until the under voltage occurs, and the circuit will start.

SD484X PGND-SGND

The function of the current limit resistor that connected to PGND.

- Block Diagram:



There are two high voltage power MOSFET in the IC. Smaller one is used to sample the current delivered to MOSFET, and the larger one is used as main power MOSFET, and the ratio of the two is close to 100:1.

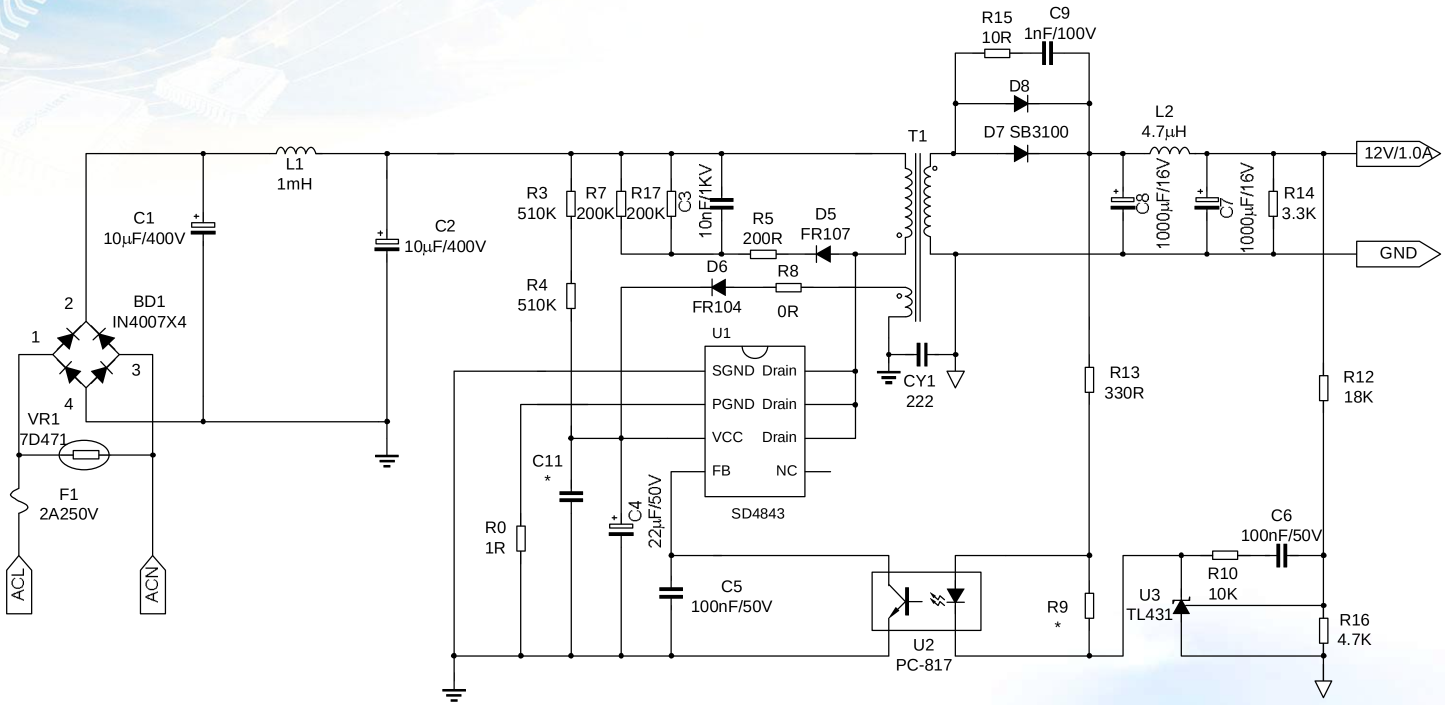
- When the IC is working, most current is delivered to the larger MOSFET, while the current on smaller MOSFET is small which will reduce the power dissipation on the sample resistor.
- The peak current of SD484X is decided by internal circuit. A current limit resistor can be connected between PGND and SGND to adjust the output power. This resistor can adjust the current ratio on the two power MOSFET, and the larger the resistor is, the smaller the total current is. And thus the total output power can be reduced.

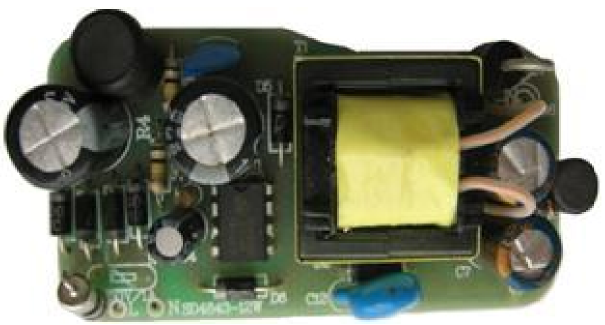
SD4843
Adaptor
Application
12V/1A
Demo Design

➢Design Specification

Description	Symbol	Min	Typ	Max	Units	comment/conditions
Input						
Voltage	VIN	85		265	Vac	2 Wire – no P.E
No-load Input Power				0.24	W	Input 240 Vac
Output						
Load Output Voltage	Vout		12		V	
Load Output Current	Iout		1		A	
Ripple				70	mV	20 MHz Bandwidth
Efficiency	η	80			%	Input 115Vac & 230Vac
Total Output Power						
Continuous Output Power	Pout		12		W	Total power
Conducted EMI Margin		6			dB	EN55022 class B@RTN-GND
Ambient Temprature	Tamb		25		C	Free convection, sea level

➤Application circuit





BOM

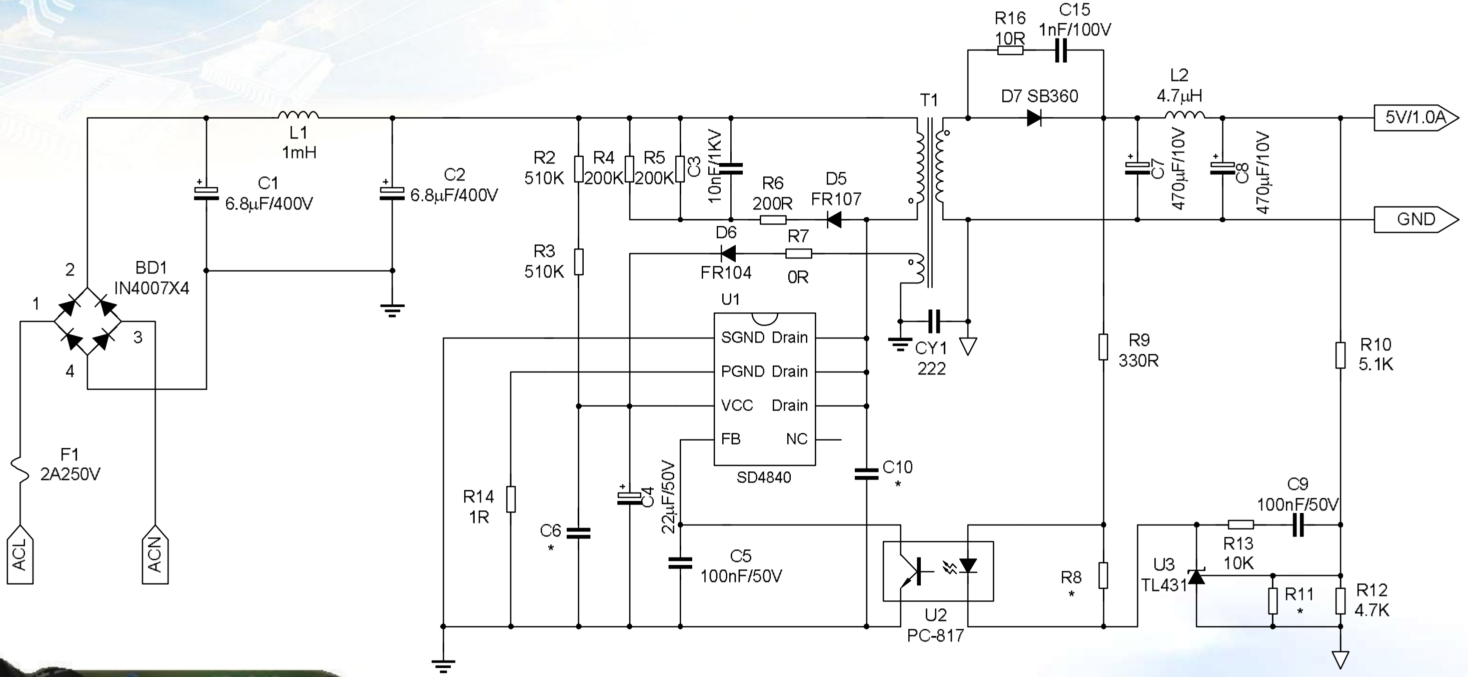
Part Type	Designator	Part Type	Designator
Capacitor, 10uF/400V	C1/C2	Resistor,470K,1206	R2/R2/R3/R4
Capacitor, 0.01uF/1.0KV,RAD0.2	C3	Resistor,0Ω,0805	R10
Electrolytic Capacitor, 1000uF/16V	C7/C8	Resistor,330,0603/0805	R13
Capacitor, 0.1uF/25V, 0603/0805	C5	Resistor,18K,0603/0805	R12
Electrolytic Capacitor, 10uF/50V	C4	Resistor,4.7K,0603/0805	R11
Capacitor, 0.1uF/25V, 0603/0805	C8	DIODE,FR107,DIODE0.2	D5
Capacitor, 222pF/275V~,RAD0.2	CY1	DIODE,SR310,DIODE0.2	D7
Capacitor, 0.1uF/25V, 0603/0805	C10	DIODE,FR104,DIODE0.2	D6
FUSE,1A/250Vac,FUSE.2	FTH	SD4843,DIP8	U1
Inductance,1mH,W9.8	L2	PC817,DIP4	U2
Inductance,3.3uH	L3	SA431A,TO-92	U3
DIODE,IN4007,DIODE0.2	D1/2/3/4	Transformer,EF20	T1

➢Transformer design specification

	Material	Start	End	Turns	Note
First Layer: shielding layer（S１）	0.25*2mm	GND	—	15TS	Connect to high voltage GND
Second layer: primary layer（W1）	0.25mm	3Pin	1Pin	86TS	Close winding
Third layer: shielding layer（S2）	Copper	-	—	1.1TS	Connect to high voltage GND
Fourth layer: secondary layer（W2）	0.35mm*2	6、7Pin	9、10Pin	9TS	Close winding
Fifth layer: ＶＣＣ（W3）	0.15mm	4Pin	5Pin	10TS	Close winding

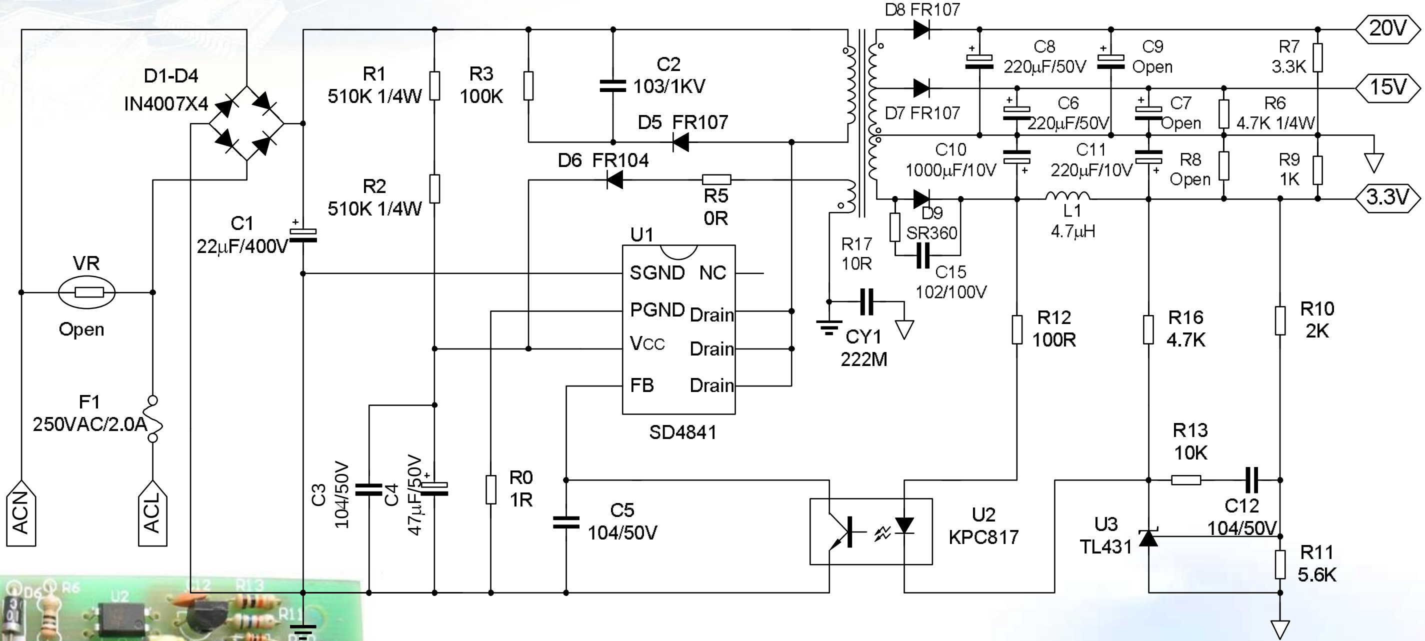
➢Electrical performance testing index

Items		Target Spec	SD4843
Input Voltage/Frequency		85-265Vac/ 47-63Hz	85-265Vac/ 47-63Hz
Oscillate Frequency		61-73KHz	67KHz
Frequency Jitter		±1.5-±2.5KHz	±2.0KHz
start-up Voltage		＜85V	＜ 85V
Standby Power Consumption	110Vac	< 0.3W	0.07W
	220Vac	< 0.3W	0.14W
	265Vac	< 0.3W	0.17W
Line Regulation		<90mV	34mV
Load Regulation		<90mV	20mV
Ripple and Noise		<180mV	45/80mV
Conversion Efficiency		＞80%	＞80%
Short Circuit Protection		yes	yes


R16
10R
C15
1nF/100V
T1
D7 SB360
L2
4.7µH
5V/1.0A
GND
L1
1mH
C1
6.8µF/400V
C2
6.8µF/400V
R2
510K
R4
200K
R5
200K
C3
10nF/1KV
R6
200R
D5
FR107
C7
470µF/10V
C8
470µF/10V
D6
FR104
R7
0R
R3
510K
BD1
IN4007X4
U1
SGND Drain
PGND Drain
VCC Drain
FB NC
SD4840
CY1
222
R9
330R
R10
5.1K
C10
*
F1
2A250V
ACL
ACN
R14
1R
C6
*
C4
22µF/50V
C5
100nF/50V
U2
PC-817
R8
*
U3
TL431
R13
10K
C9
100nF/50V
R11
*
R12
4.7K

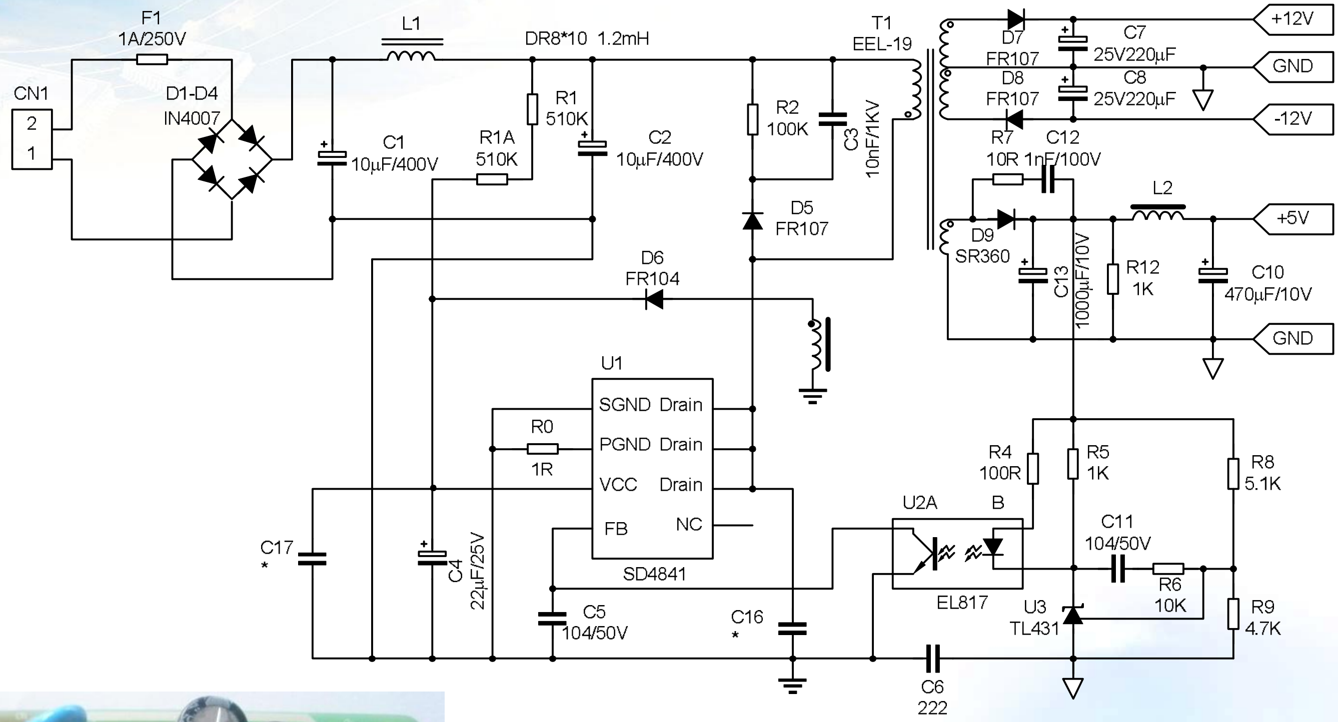

SD4840
5V/1A
SD4840

➤ DVB-C (SD4841)

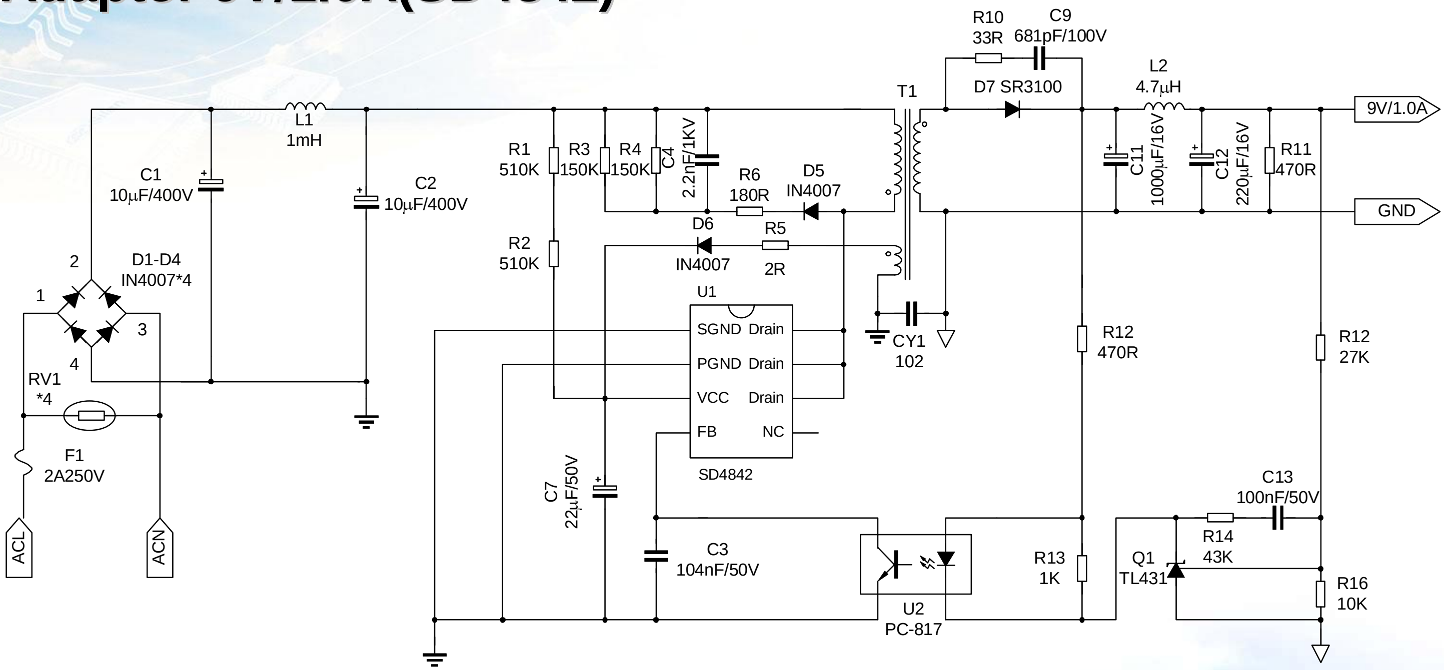

D1-D4
IN4007X4
R1
510K 1/4W
R3
100K
C2
103/1KV
D5 FR107
D6 FR104
R5
0R
R2
510K 1/4W
C1
22μF/400V
VR
Open
F1
250VAC/2.0A
ACN
ACL
U1
SGND
NC
PGND
Drain
VCC
Drain
FB
Drain
SD4841
C3
104/50V
C4
47μF/50V
R0
1R
C5
104/50V
D8 FR107
D7 FR107
C8
220μF/50V
C9
Open
C6
220μF/50V
C7
Open
R7
3.3K
R6
4.7K 1/4W
C10
1000μF/10V
C11
220μF/10V
R8
Open
R9
1K
20V
15V
3.3V
D9
SR360
L1
4.7μH
R17
10R
C15
102/100V
CY1
222M
R12
100R
R16
4.7K
R10
2K
R13
10K
C12
104/50V
U2
KPC817
U3
TL431
R11
5.6K


SD4841
DVB V1.0
SILAN

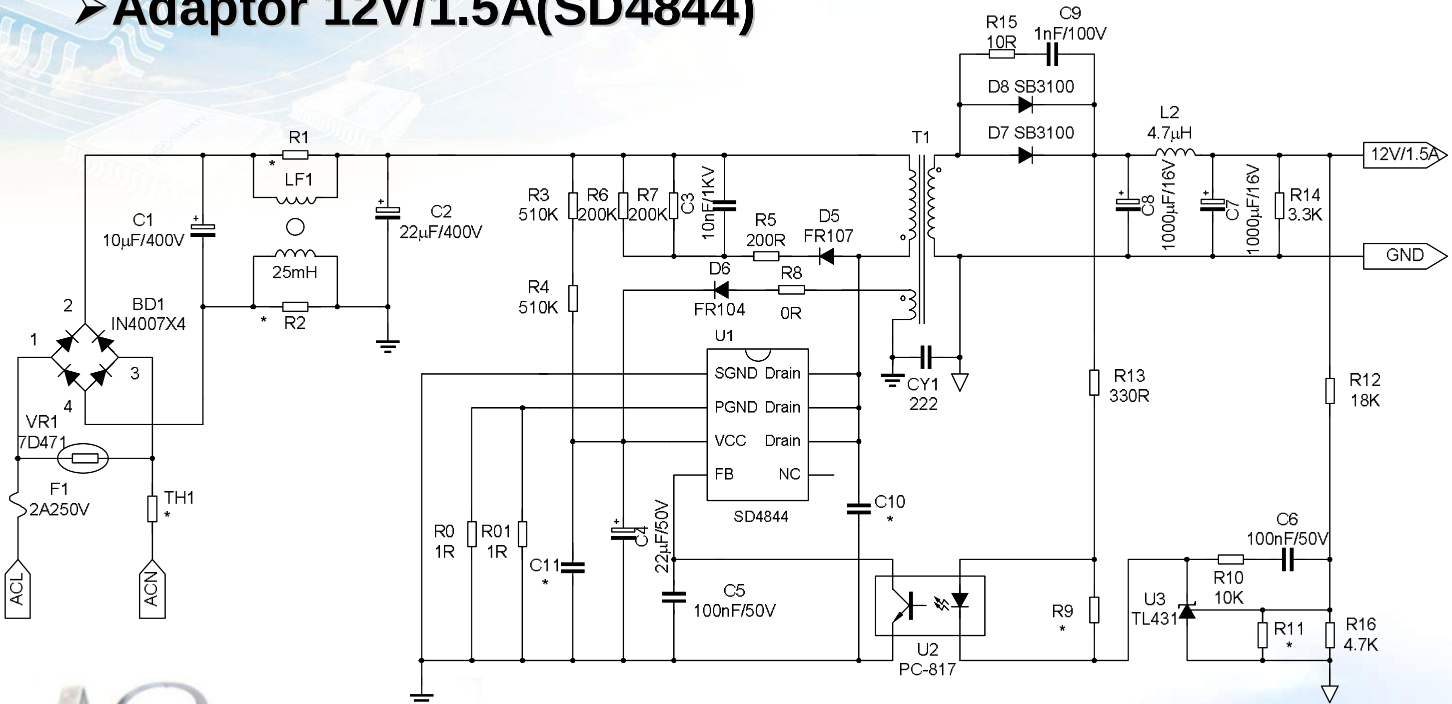
➢DVD（SD4841）

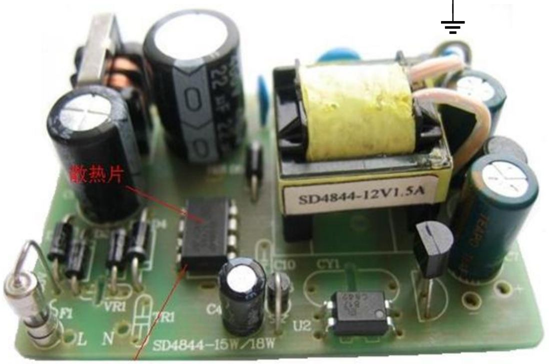

F1
1A/250V
L1
DR8*10 1.2mH
T1
EEL-19
CN1
D1-D4
IN4007
C1
10μF/400V
R1A
510K
R1
510K
C2
10μF/400V
R2
100K
C3
10nF/1KV
D5
FR107
D6
FR104
D7
FR107
C7
25V220μF
D8
FR107
C8
25V220μF
R7
10R
C12
1nF/100V
L2
D9
SR360
C13
1000μF/10V
R12
1K
C10
470μF/10V
+12V
GND
-12V
+5V
GND
U1
SGND Drain
PGND Drain
VCC Drain
FB NC
SD4841
R0
1R
C17
*
C4
22μF/25V
C5
104/50V
C16
*
U2A
B
EL817
R4
100R
R5
1K
R8
5.1K
C11
104/50V
R6
10K
U3
TL431
R9
4.7K
C6
222

➢Adaptor 9V/1.0A(SD4842)



➢Adaptor 12V/1.5A(SD4844)





SD4844

Part No.	Function	Package	Competitor	Output power
SD4851DD3X	PSR (CC/CV)	PWM+MOS（DIP-7)	BCD3706/8、IW1690/2/6、ACT35、TEA1501、EZ1216、LNK613	600mA
SD4851DD4X				800mA
SD4851DDAX				1000mA
SD4851DDBX				1200mA
SD4840	SSR	PWM+MOS(DIP-8)	Vipper12/FSD200/ACT30/RCC/THX202	7.2W
SD4841			FSD321/VIPPER22/THX203/SM8002/2604/POWE22	12W
SD4842				14W
SD4843			FSD321/VIPPER22/THX203/SM8002/A6251/2A0565	15W
SD4844			FSD0365/2A0565/OB2263/LD7535/50+MOS	18W
SD4870		PWM(SOT-23-6)	OB2263、CR6841、LD7535	36W
SC6105		PWM(DIP-20)	SG6105	400W
SD6109		PWM(DIP-20)	SG6105	400W
SA7527	PFC	PWM(DIP-8/SOP8)	L6561、FSN7527	200W
SVD1N60	MOS	TO-220F	WFFXN60、STKX60N、AUKXN60、UTCXN60	0-5W
SVD2N65				5-18W
SVD4N65				18-36W
SVD7N60				36-60W
SVD10N60				60-80W
SVD12N60				80W above

SD4851

AC-DC Circuit (Primary Side Regulate Solution)

Contact: Mr. Cao
Tel: 0755-83475897

➢ Brief Introduction

SD4851 is a primary side power controlled AC-DC IC with built-in high voltage MOSFET, it functions cable drop compensation, peak current compensation without Opto-coupler. It adopts Pulse Frequency Modulation (PFM) technology for flyback power supply controller. SD4851 provides accurate constant voltage, constant current (CV/CC) regulation for higher efficiency and higher reliability. By using SD4851 for flyback power controller, few peripheral components are needed, the Opto-coupler and secondary control circuitry is not needed and the loop compensation circuitry for maintaining stability is also unnecessary.

Features:

- Low start-up current
- Primary side control
- Leading edge blanking
- ***Pulse-frequency Modulation***
- Over voltage/under voltage/over temperature protections
- ***Built-in high voltage MOSFET***
- Cycle by cycle current limiting
- Open loop protection
- ***Cable drop compensation***

Typical applications:

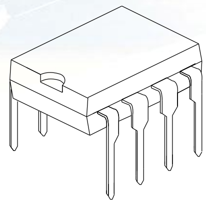
- Small power adapter
- Chargers for mobile

! ! !

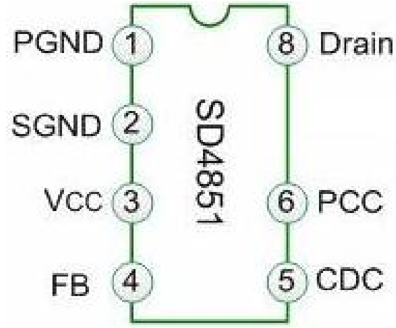
Built-in high voltage MOSFET

➢ Package and block diagram

Package

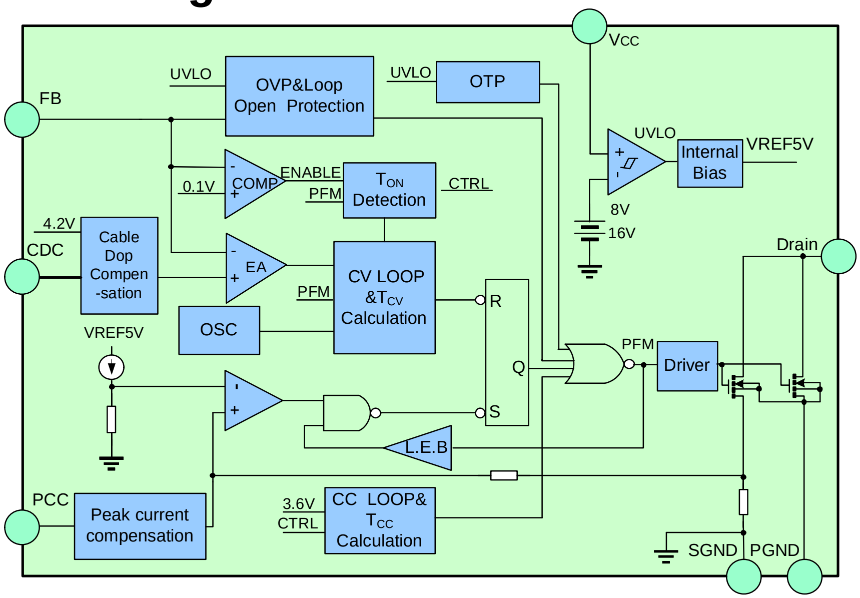


DIP-8A-300-2.54



Pin Configuration

Block Diagram



Function and power description

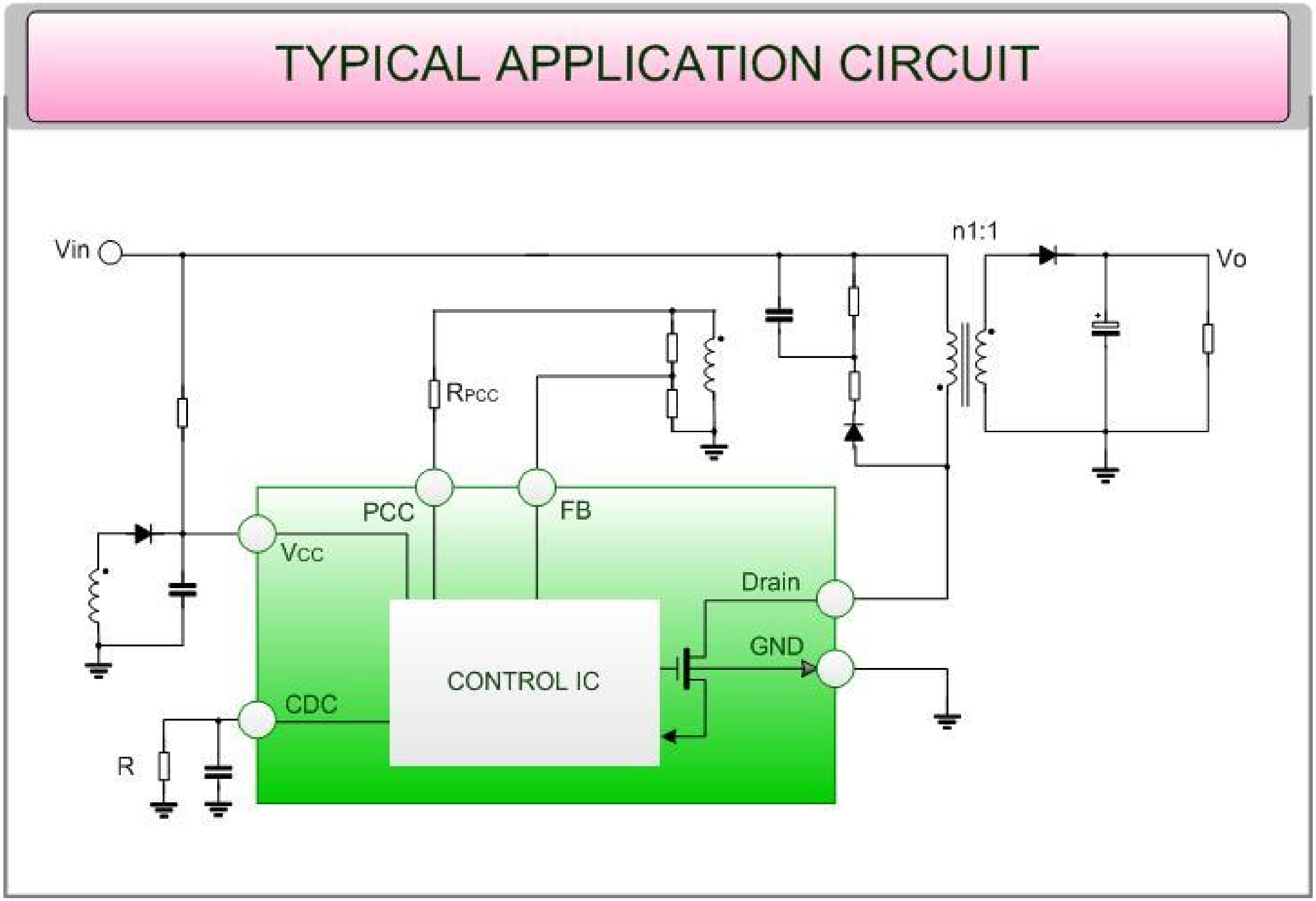
Pin Description

Pin No.	Pin Name	Description
1	PGND	MOSFET Ground
2	SGND	Control part ground
3	VCC	Power supply pin
4	FB	Feedback input pin
5	CDC	Cable drop compensation pin
6	PCC	Input AC line voltage compensation for peak current limiting
7	NC	NC
8	Drain	MOSFET drain pin

IC output power

No.	Device No.	Output power
1	SD4851DD3	3W
2	SD4581DD35	3.5W
3	SD4851DD4	4W
4	SD4851DD5	5W

➢Typical application circuit



SD4851 Principle

When M1 is off, the flyback voltage is expressed as follows:

$V_{OR} = \frac{N_F}{N_S}(V_O + V_{D1})$, N_F—auxiliary winding turns, N_S—secondary winding turns.

T_{CV} value can be counted for the stabilized system after conversion such as voltage division, error amplification, level sample and PFM, based on feedback information from V_O through V_{OR}. and this system is the negative feedback stabilized system and vice versa.

$$V_O \uparrow \Rightarrow V_{OR}、V_{FB} \uparrow \Rightarrow T_{CV} \uparrow \Rightarrow V_O \downarrow$$

From figure 1 shown below, I_{SEC} average value is the output current.

$I_O = \frac{I_{SECP}}{2} \times \frac{t_{OFF1}}{t} = \frac{t_{OFF1}}{2t} \cdot \frac{N_P}{N_S} I_{PP}$, I_{SECP} is the max. value of secondary current, I_{PP} is the Peak value of primary current. hence, constant current is available only when $\frac{t_{OFF1}}{t}$ is fixed. t_{ON} is determined by peak current, input AC voltage and shutdown delay time.

T_{OFF1} which is duration of secondary current decreasing to zero, is used for calculating T_{OFF2}, time of holding secondary current at zero. Then, T_{CC} can be calculated based on $T_{CC} = T_{OFF1} + T_{OFF2}$. And output current is constant when $T_{ON} + T_{OFF2} = T_{OFF1}$ is provided.

T_{OFF} is controlled both by constant voltage and constant current circuits. Constant voltage is output when T_{CV} is longer than T_{CC}, constant current is output otherwise.

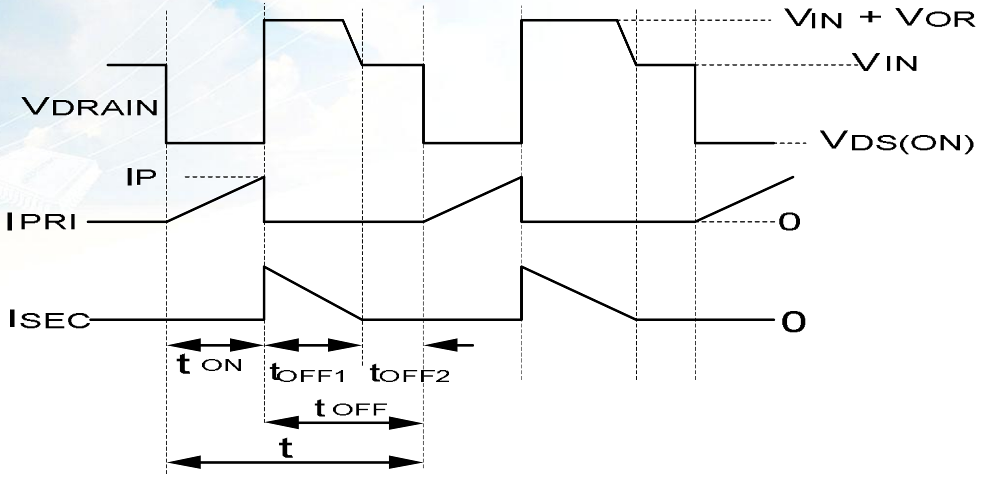


Figure 1: Waveform in DCM

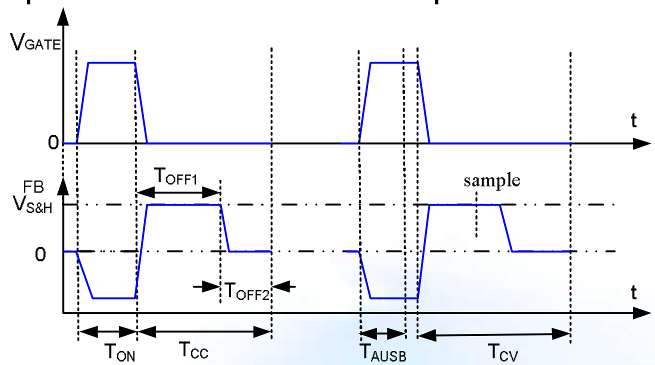
The whole work period is divided into peak current detect and feedback voltage detect:

When MOSFET is on, primary current is detected by sample resistor and voltage at pin FB is negative, load is powered by output capacitor and output voltage V_O decreases; When primary current exceeds the higher limit, MOSFET is off and voltage at pin FB is detected. Output capacitor is charged by secondary circuit and V_O increases and provides power supply to load. MOSFET is on again only after stop for T_{CV} and hold for T_{CC}. And then, it comes to peak current detect again.

➢FB principle

- **Feedback principle and R select**

When MOSFET is off, voltage at pin FB is positive and voltage is sampled at 2/3 of the positive voltage. The sampled voltage is used for stall time TCV control of constant voltage loop after amplified, held and compared. Durations of positive FB voltage, negative FB voltage and low FB voltage are counted at the same time respectively. Positive FB voltage indicates there is current delivered to the secondary side of transformer, while negative and FB low voltage indicate there is no current delivered to the secondary side of transformer. Under the condition that the peak current is constant, TOFF1＝TOFF2＋TON should be kept for constant current output. Hence, TCC is determined by these three time parameters to guarantee constant current output.



Feedback voltage

- **FB resistor select**

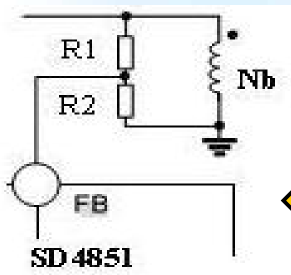
Output voltage is determined by R1 and R2, described below:

$$V_{S@H} = \frac{n_2 \cdot (V_{out} + V_F) \cdot R2}{R1+R2}$$

Where, $V_{S@H}$ **:internal reference voltage, about 4.2V**

Vf: diode voltage drop at secondary side

Vout: output voltage



Schematic diagram

n_2 **: circle ratio of feedback winding and output winding. R1, R2 are about tens of kΩ**

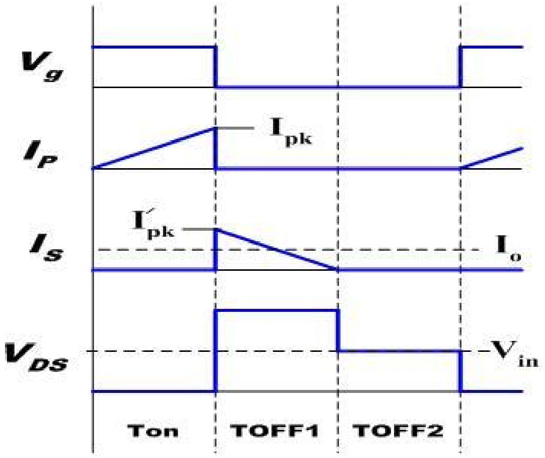
➢PCC Principle

Peak current compensation and R select (1)

For DCM mode with 85~265V input, the flyback converter waveform is shown below. The output current is described as:

$$I_o = \frac{1}{2}\frac{T_{OFF1}}{T} \cdot I'_{PK}$$

Ipk is constant in the IC, it is only needed to guarantee constant off1/T during transformer design for CC.



Peak current compensation and R select (2)

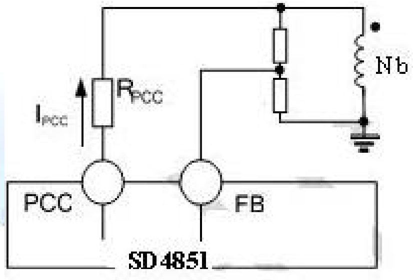
Peak current is decided by the IC and can be changed by adjusting R. The principle is described below.

Peak current at primary side: $I_{pk}=I_{pk0}+\Delta I_{pk}=I_{pk0}+\frac{V_{dc}}{L_m}\cdot t_{delay}-K\cdot\frac{V_{dc}}{R_{PCC}}$

Let: $\frac{V_{dc}}{L_m}\cdot t_{delay}=K\cdot\frac{V_{dc}}{R_{PCC}}$

Schematic diagram

Sample rate of MOSFET is 90:1（600mA） $R_{PCC}=1058\cdot\frac{L_m}{n_2\cdot t_{delay}}$



where, t_{delay}--off delay time, L_m --primary inductance,

n_2--turns ratio of primary winding and feedback winding.

t_{delay} can be tested according to the first adjust.

R_{PCC} can be calculated according to the formula.

For high AC voltage, the compensation current will be high. By adjusting the resistor, the compensation peak current limit can be adjusted. The higher resistor indicates lower compensation.

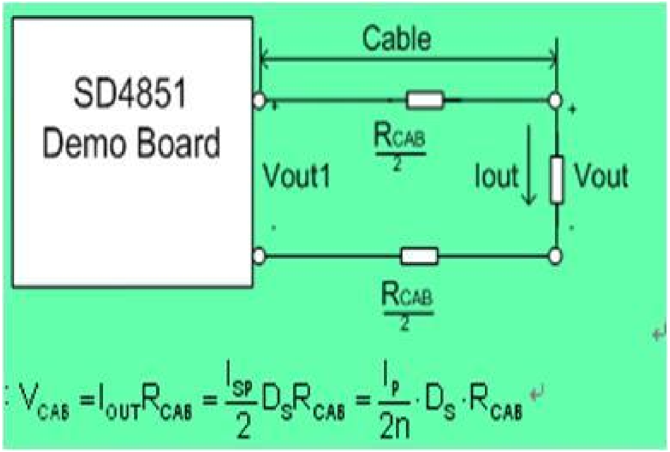
➢ CDC Principle

Cable Drop Compensation and R Select (1)

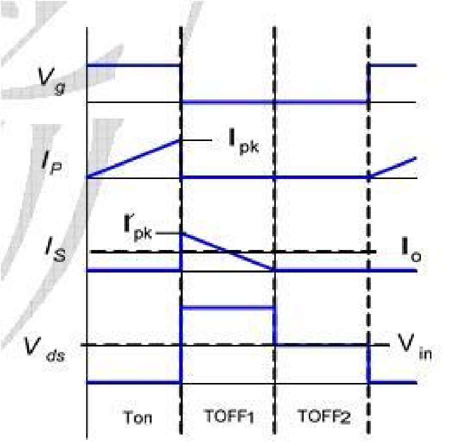
Cable voltage drop is proportional to output current and cable resistance, and is different with different output currents. Compensation circuit is needed for voltage compensation and should be adjustable following cable length. Resistor (RCDC) is connected to simulate cable resistance. The compensation can be adjusted through external resistor and no compensation is needed when pin CDC is earthed. The compensation voltage is described as below:

$$V_{CDC} = 6.88 \times 10^{-6} \cdot D_S \cdot R_{CDC}$$

Where, VCDC is the compensation voltage, and this voltage is added to 4.2V (reference voltage) for internal error amplifier reference voltage. Ds is the secondary current duty factor and RCDC is the compensation resistor connected to pin CDC.

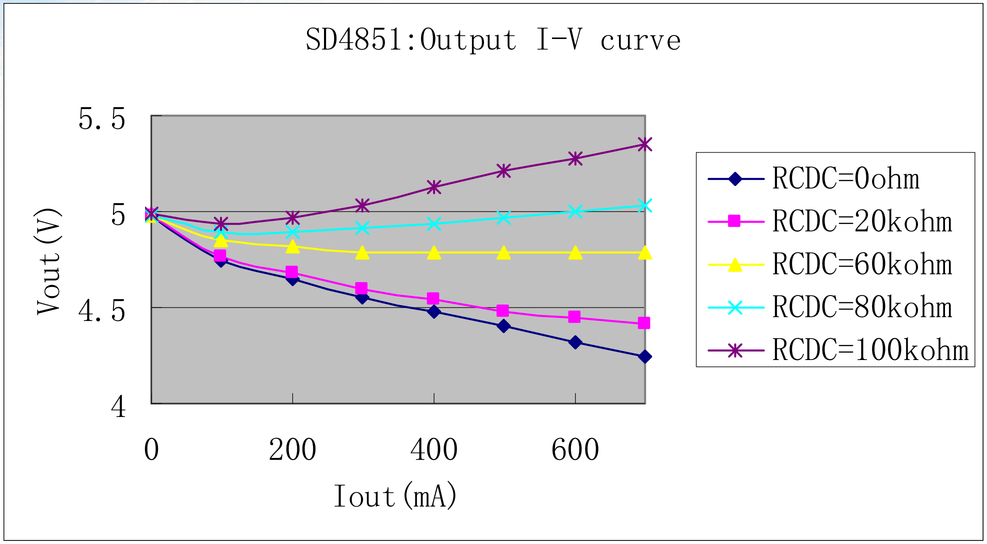


Simulation diagram



$$Ds = \frac{TOFF1}{Ton + TOFF1 + TOFF2}$$

Cable Drop Compensation and R select (2)



$R_{CDC} = kR$, ($k=7.5\times10^4$~9.0×10^4)

Different Cables	The right R_{CDC}
1.8m AWG28 (R＝0.85Ω)	70kΩ
0.8m AWG28 (R＝0.38Ω)	31.3 kΩ
1.8mAWG26(R＝0.55Ω)	45kΩ

➢ Dummy Resistor

The dummy resistor R0 determines the no-load output voltage offset.
With no load, the operating frequency is about 333Hz and the power is given as:

$$P = \frac{1}{2} L_m I_{pk}^2 f$$

Where,

L_m :Primary inductance,

I_{pk} :Primary peak current,

f :operating frequency, about 333Hz.

Suppose Lm is 2.1mH, Ipk is 250mA, and it gives P=21.8mW. Power dissipation on IC is about 6mW and 5W power dissipation on absorbing circuit. So on dummy resistor is about P1=10.8mW. So, R0 is given by:

$$R_0 = \frac{V_{out}^2}{P_1}$$

If output voltage is 5V, R0 is 2.3k. This is only the evaluated value.

Transformer Principle

Transformer primary and secondary turns ratio

$$I_o = \frac{n}{4} \cdot \frac{V_{IPK}}{R_{sens}} = \frac{n}{4} \cdot I_{pk} \qquad (1)$$

Ipk is decided by IC

With constant current, the circuit is in critical status and the duty factor is 0.442 (internal decided). According to the magnetic balance, there is:

$$D = \frac{n \cdot (V_{out} + V_F + V_{cab})}{n \cdot (V_{out} + V_F + V_{cab}) + V_{inmin}} \qquad (2)$$

Hence, Vinmin is calculated with given value of n and Dmax. And input voltage lower than Vinmin will cause the worse constant current characteristic.

According to the formula (2), nmax for the constant current can be calculated with given values of Vinmin, Vout, VF and Vcab. For practical use, the n should be lower than the nmax to guarantee the constant current characteristic.

The output current and n can be calculated according to formulas (1) and (2). → n

Inductance Lm

Suppose the maximum operating frequency f=56kHz, according to the power balance, there is:

$$\frac{1}{2} L_m I_{pk}^2 f \eta = (V_{out} + V_F + V_{cab}) I_O$$

→ Lm

➢ Transformer design principle

- **Primary turns**

$$N_p \Delta B \cdot A_e = L_m I_{pk}$$

→ NP please refer corresponding transformer files for ⊿B and Ae

- **Secondary turns**

Ns=Np/n

→ Ns

- **Feedback winding turns**

$$N_B/V_{cc}=N_S/(V_O+V_f+V_{cap})$$

→ NB

Determine the final turns: Np: NS: NB and Lm

➢ Factors affect CC

Primary and secondary turns ratio

With the same inductance, the lower turns ratio, the lower constant current and the higher precision, and vice versa.

Primary inductance

With the same turns ratio, large inductance cause the low constant current and low precision.

Compensation resistance

With the same turns ratio and inductance, large resistance brings low compensation and low precision, and vice versa.

Feedback winding turns

The CV voltage decreases following the feedback winding turns increase.

- **FB voltage value**

In general, the center value of FB voltage is about 4.2V. Other value will lower down the precision.

- **Dummy resistor value**

With no load, the output voltage precision will be effected by the dummy resistor value. The bigger dummy resistance, the higher precision.

- **Cable drop compensation resistor**

The bigger resistance, the lower compensation. And vice versa.

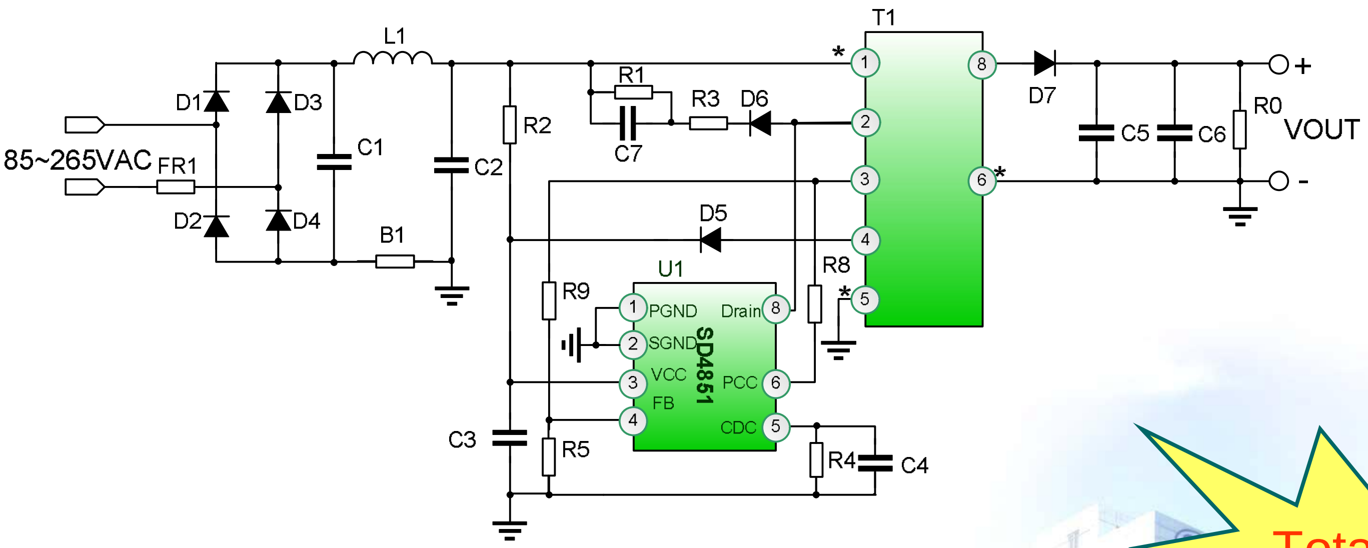
Example
5V/600mA
Demo design

➢ DEMO Specifications

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Remark
Input voltage	V_{IN}	85		265	V_{AC}	2-line
Line frequency	f_{LINE}	47	50/60	63	Hz	
No-load stand-by power dissipation				100	mW	
Output voltage	V_{OUT}	4.75	5.0	5.25	V	Test on 1.5m AWG28 Cable line
Output current	I_{OUT_CC}	540	600	660	mA	
Output ripple	V_{RIPPLE}			150	mV_{P_P}	Bandwidth: 20MHZ/Iout=0.6A@TA=25℃
Output power	P_{OUT}			3	W	
Over current protection	I_{OUT_MAX}			660	mA	
Efficiency	η	68			%	EPS2.0 specification
EMI		Meet CISPR22B/EN55022B				
Safety		Meet IEC950, UL1950 grade-2				
Ambient temperature	T_{AMB}	-5		50	℃	

➢ Application circuit

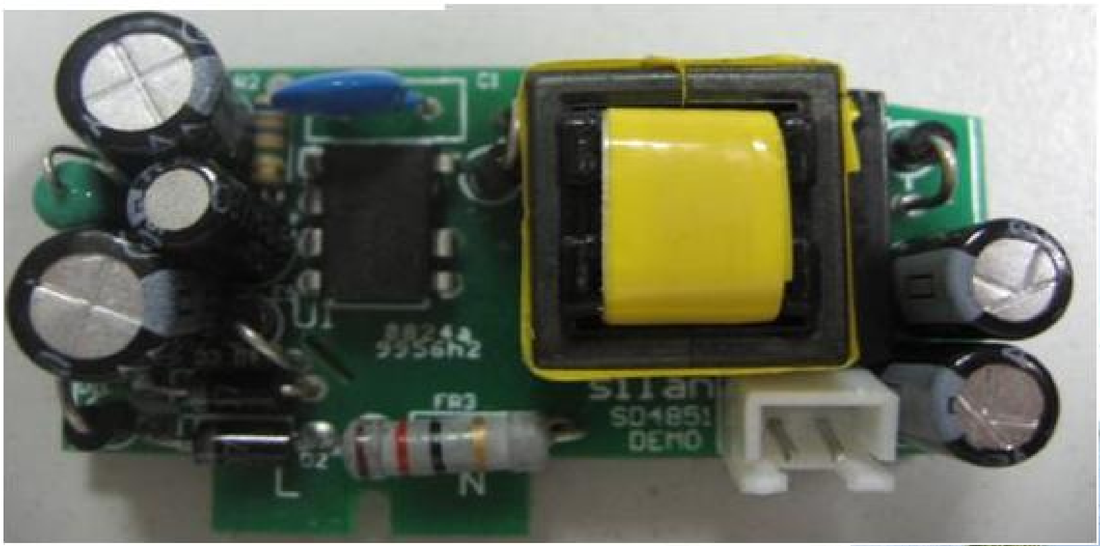
TYPICAL APPLICATION CIRCUIT



Total 27 components

Demo Picture

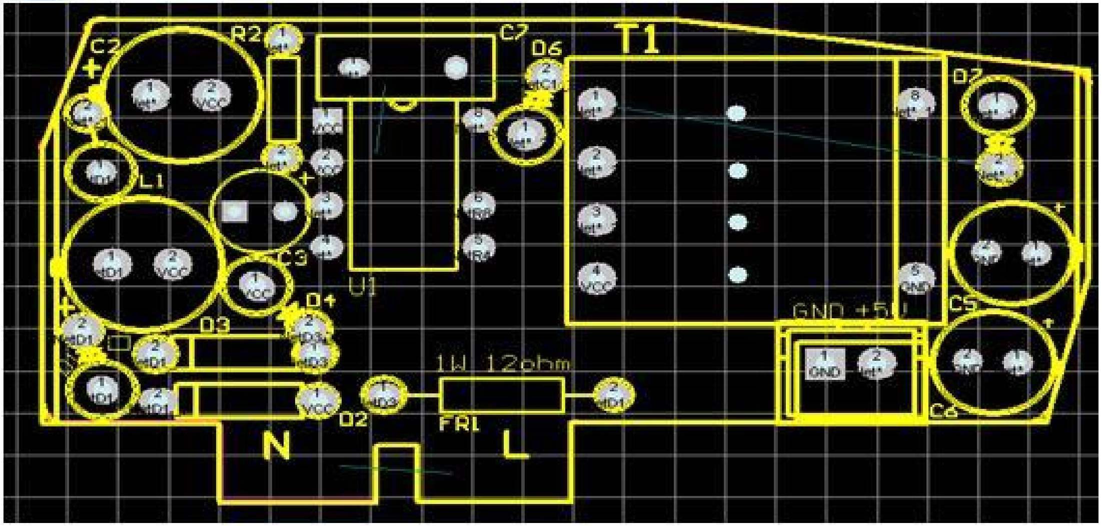
Demo Appearance

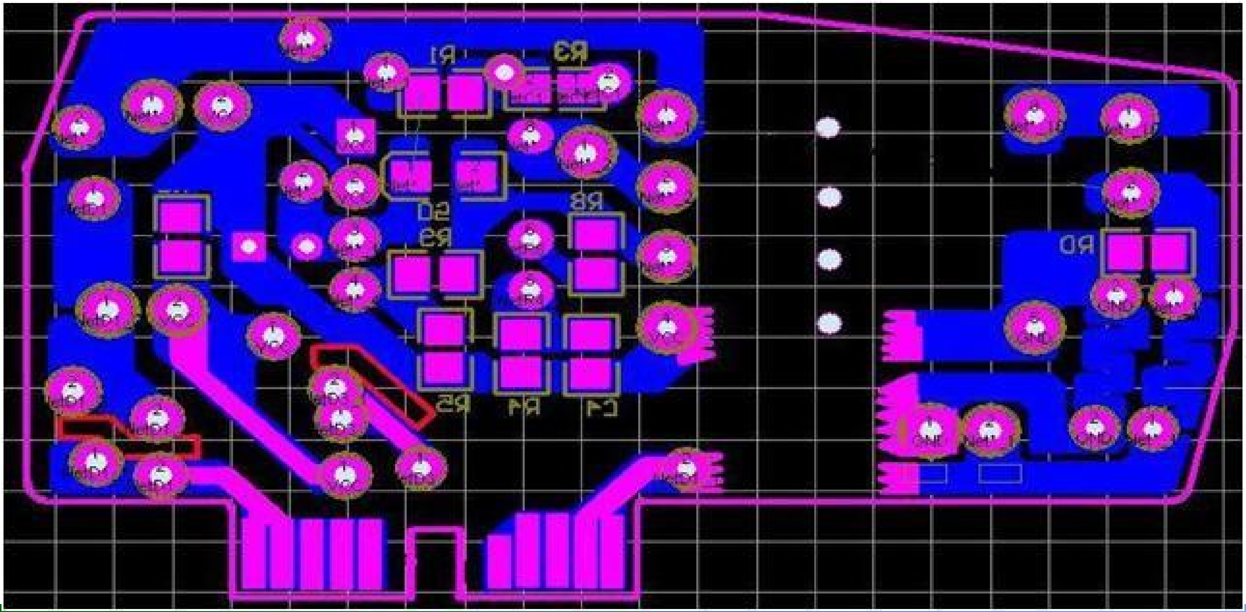


Demo top view

➢ Demo PCB layout

Top





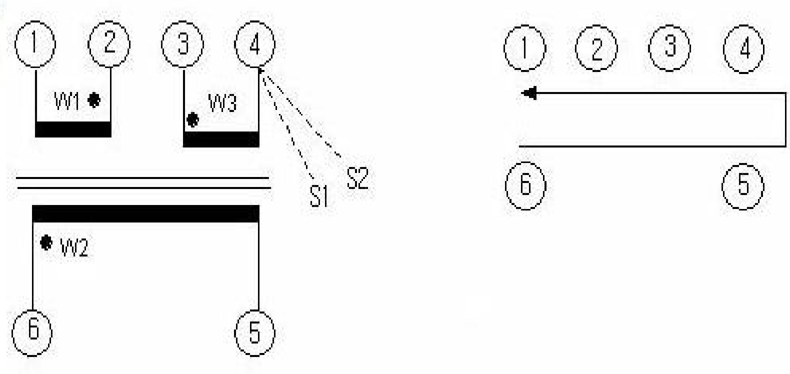
Bottom Layout

➢Demo BOM List

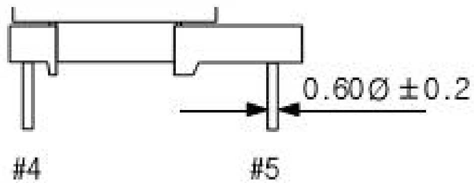
Item	Description	Item	Description
D1,2,3,4	1N4007	R0	1.5k Ω/0.125W 0805
D7	SB240	R1	200k Ω /0.125W 0805
D5	Diode 4148 SMD	R2	6.8M Ω /0.125W 0805
D6	IN4007	FR1	12 Ω /1W
C1,2	4.7uF/400V	R4	56k Ω /0.125W 0805
C5,6	330uF/10V	R5	25k Ω /0.125W 0805 1%
C3	4.7uF/50V	R3	200 Ω /0.125W 0805
L1	1mH	R8	910k Ω /0.125W 0805
C1	CD222M	R9	51k Ω /0.125W 0805 1%
C4	0.1uF	U1	SD4851DD3
B1	3.3uH	T1	Transformer EE1615H

➢Demo Transformer Design

- **Schematic: Bobbin－EE1615H-4+2Pin**



- **Transformer outline**

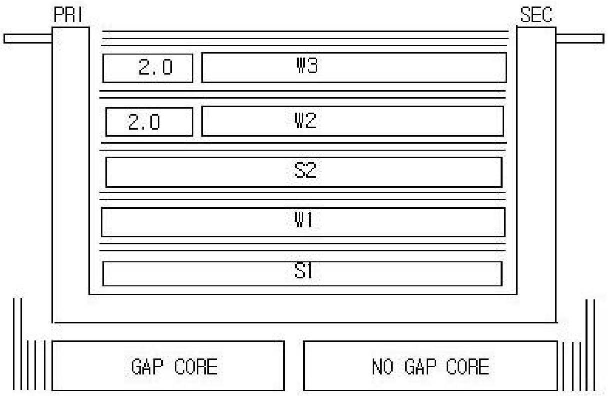


- **Transformer specifications**

Primary Inductance	Pin 1-2,all other windings open, measured at 1kHz, 0.4VRMS	2.1mH, ±7%
Primary Leakage Inductance	Pin 1-2, all other windings shorted, measured at 10kHz, 0.4VRMS	100 uH (Max.)

➢Demo Transformer Design

- **Internal Construction**



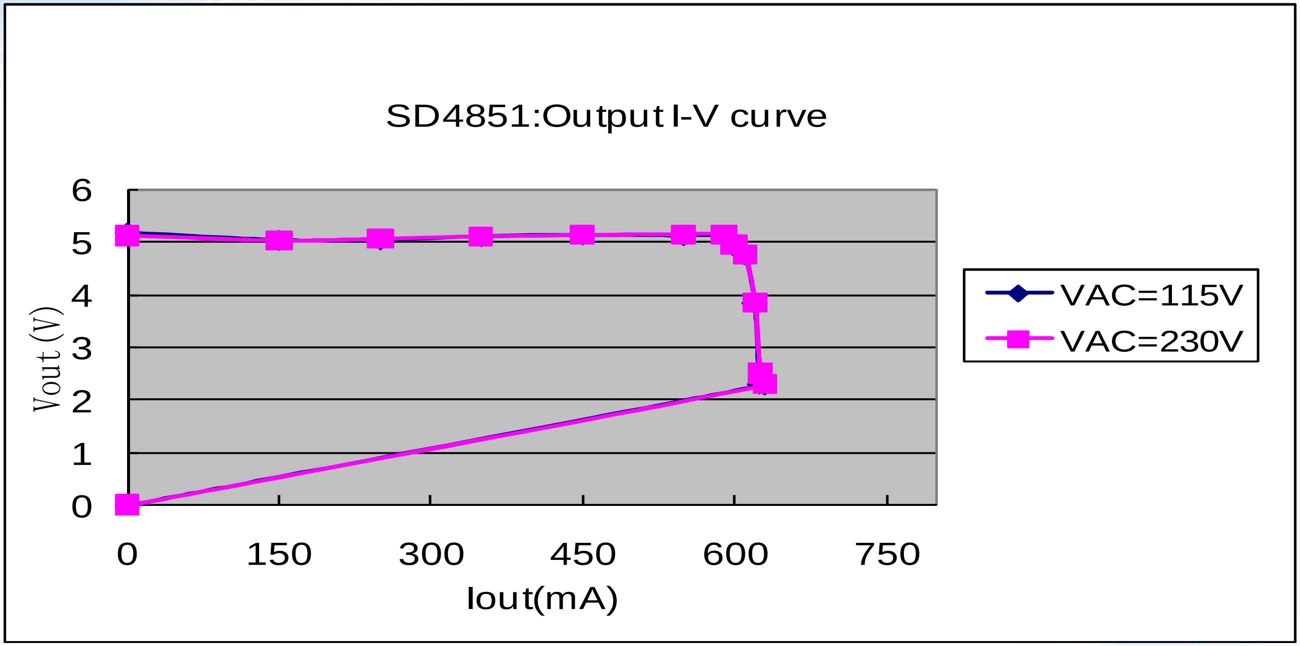
- **Winding**

NO	TERMINAL (S - F)		W I R E	TURNS	WINDING METHOD	INSULATION			BARRIER	
						MATERIAL	T/W	Ts	PRI ǀ SEC	Ts
S1	4	-	UEW 0.21∅x2#	17.5t	SOLENOID (C.C.W)	P.S TAPE	0.025/8.0	2	-	1
W1	2	1	UEW 0.18∅	105 t	SOLENOID (C.C.W)	P.S TAPE	0.025/8.0	2	-	3
S2	4	-	UEW 0.21∅x4#	7.5 t	SOLENOID (C.C.W)	P.S TAPE	0.025/8.0	2	-	1
W2	⑥	⑤	TEX 0.37∅	9 t	SOLENOID (C.C.W)	P.S TAPE	0.025/8.0	2	0.25T 2.0mm,0mm	1
W3	3	4	UEW 0.18∅	23t	SOLENOID (C.C.W)	P.S TAPE	0.025/8.0 (Y)	3	2.0mm,0.25T	1
CORE FIXING TAPE						P.S TAPE	0.025/4.5 (YELLOW)	3	-	

➢Demo regulation and eff measurement

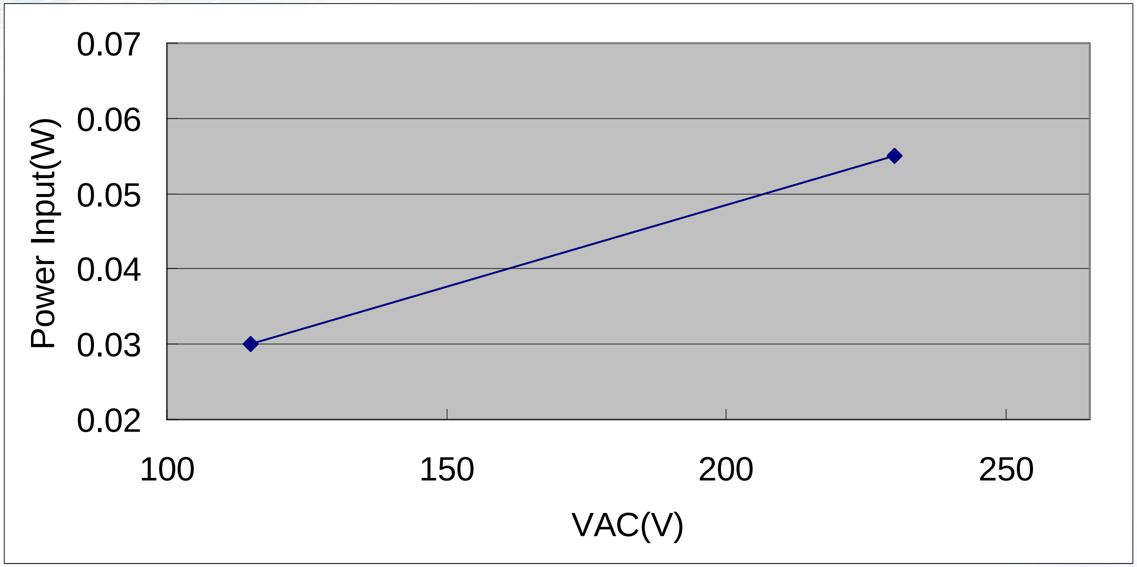
Vin (AC)	Iout (mA)	Vout (V)	Pin (W)	Pout (W)	η (%)	OCP (mA)	AV-EFF (%)	EPA2.0 η (%)
85V	150	4.95	1.03	0.7425	72.08	620	70.89	**0.075xLn(3.0)+0.561=64.3%**
	300	5.02	2.10	1.506	71.7			
	450	5.04	3.22	2.268	70.4			
	600	5.08	4.39	3.048	69.4			
115V	150	4.96	1.02	0.744	72.9	630	71.92	
	300	5.02	2.07	1.506	72.75			
	450	5.05	3.18	2.2725	71.4			70.7%
	600	5.10	4.33	3.06	70.66			
230V	150	4.95	1.06	0.7425	70	630	69.59	
	300	5.01	2.14	1.503	70.23			
	450	5.02	3.23	2.256	69.7			
	600	5.08	4.39	3.048	69.4			
265V	150	4.95	1.08	0.7425	68.75	630	68.66	
	300	5.01	2.18	1.503	68.9			
	450	5.03	3.29	2.2635	68.8			
	600	5.07	4.46	3.042	68.2			

➢Demo output V-I Curve



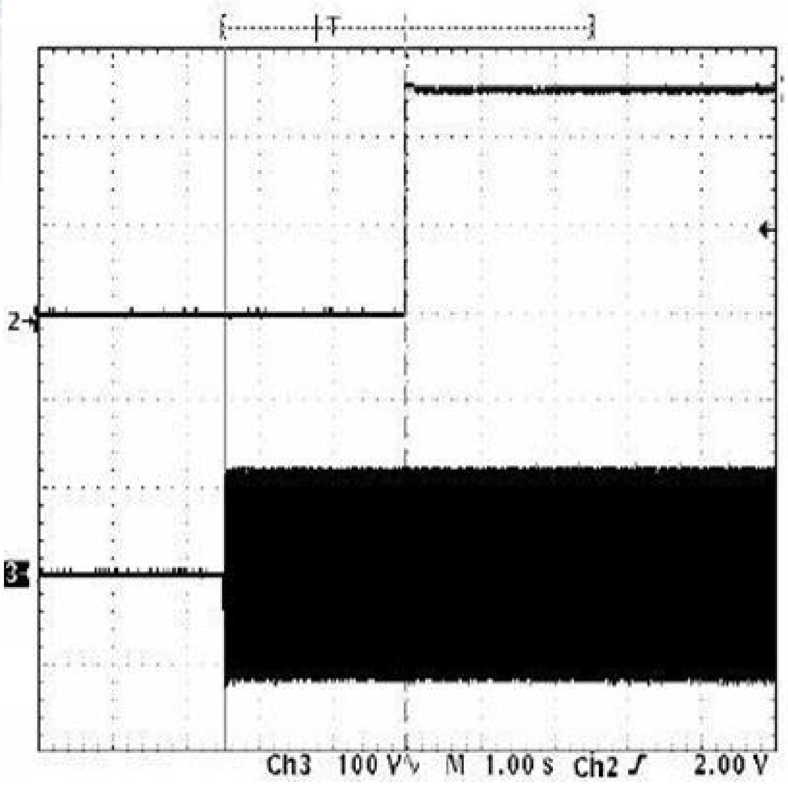
V_{AC}=115V, Vout=2.3V,Iout(max)=620mA
V_{AC}=230V, Vout=2.4V,Iout(max)=630mA

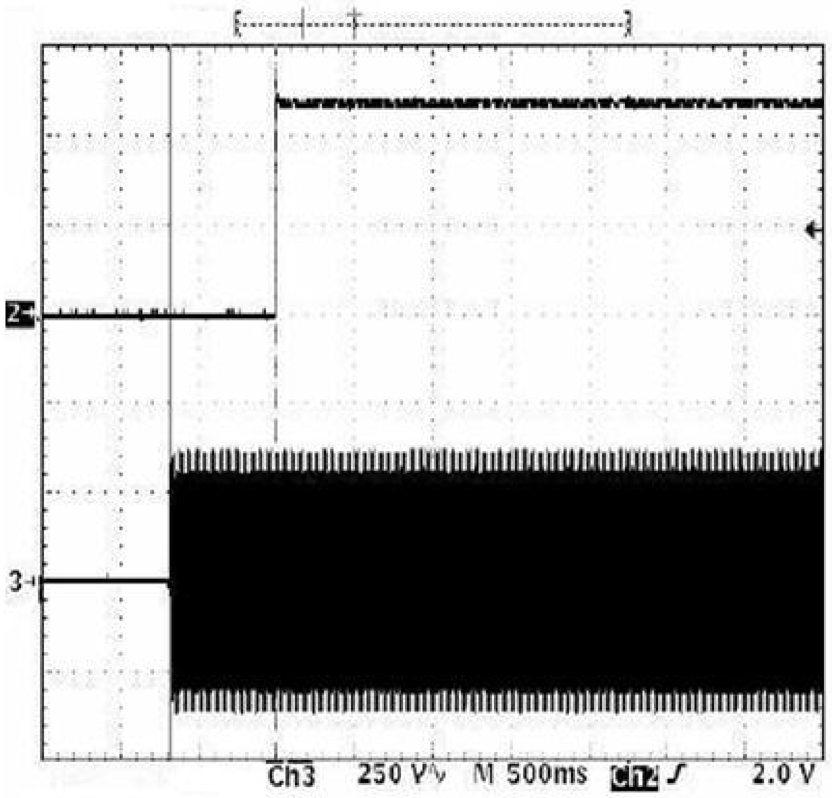
➢Demo Standby power



Measured No Load Input Power:
115VAC/50Hz: 30mW
230VAC/50Hz: 55mW

➢Demo Turn-on delay time

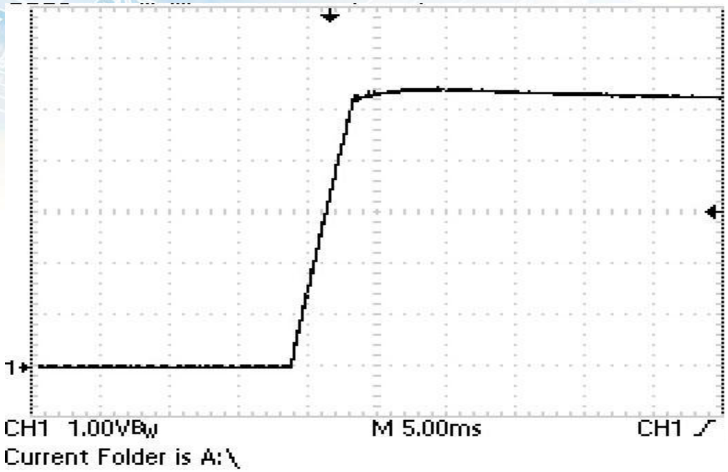




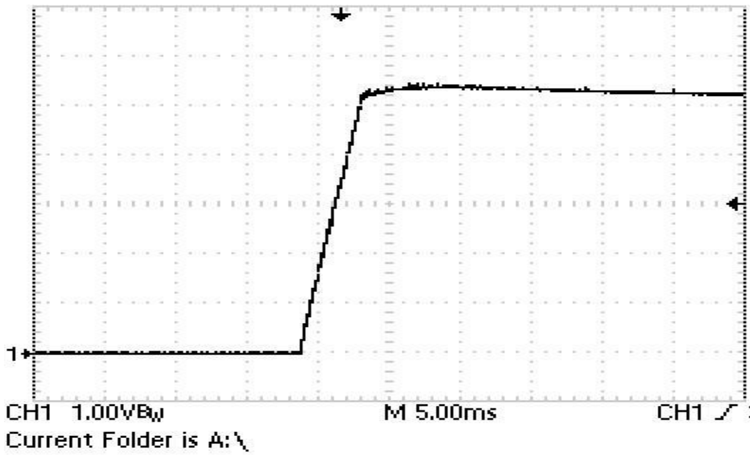
85V,FULL，Delay time=2.36s

265V,FULL，Delay time=766ms

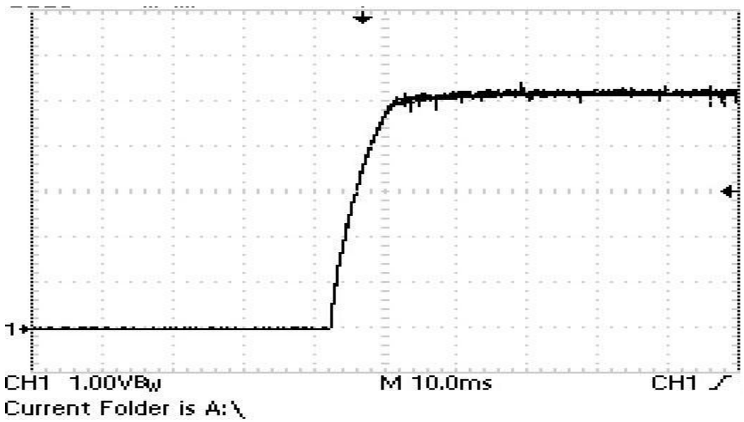
➤Demo rise-time



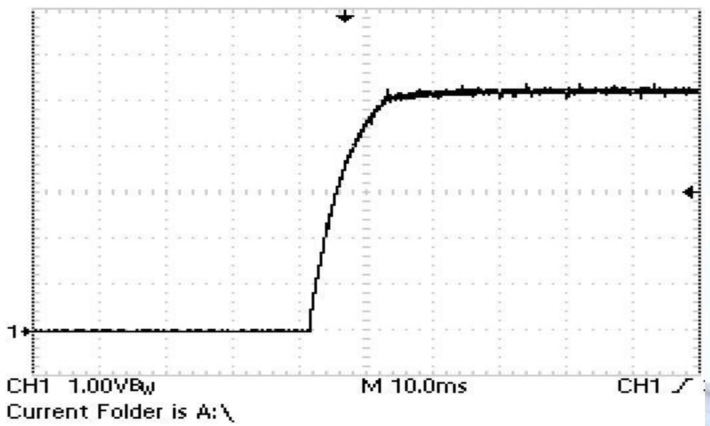
Rise time =4.40mS



Rise time= 4.00mS

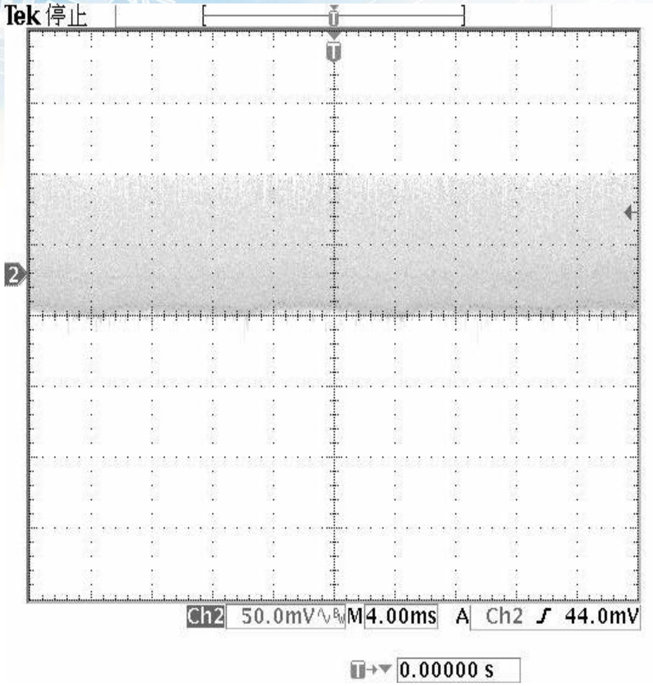


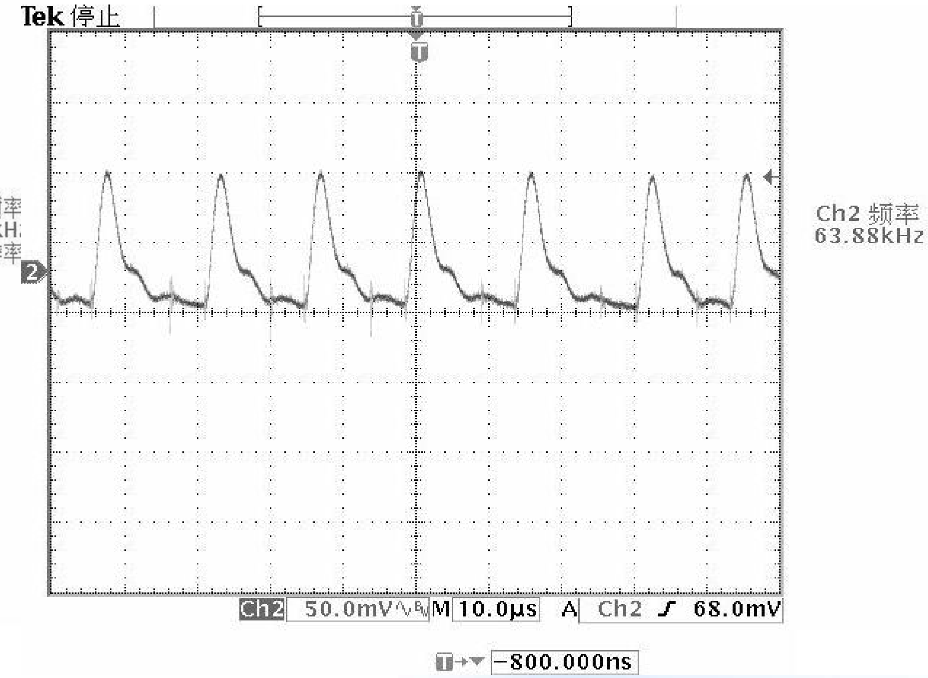
Rise time =9.80mS



Rise time =11.20mS

➢Demo vipple test

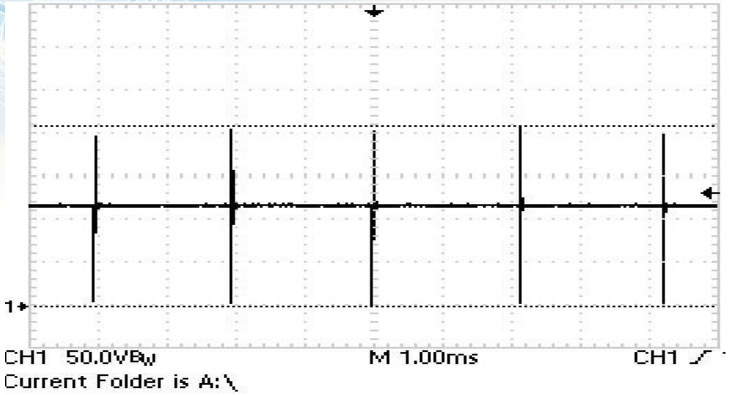




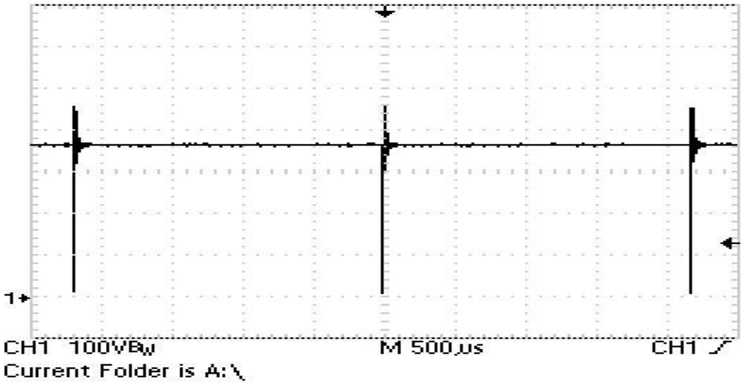
85Vac Input, Full Load
Output Ripple = 100mV (Low frequency)

85Vac Input, Full Load
Output Ripple = 100mV (Low frequency)

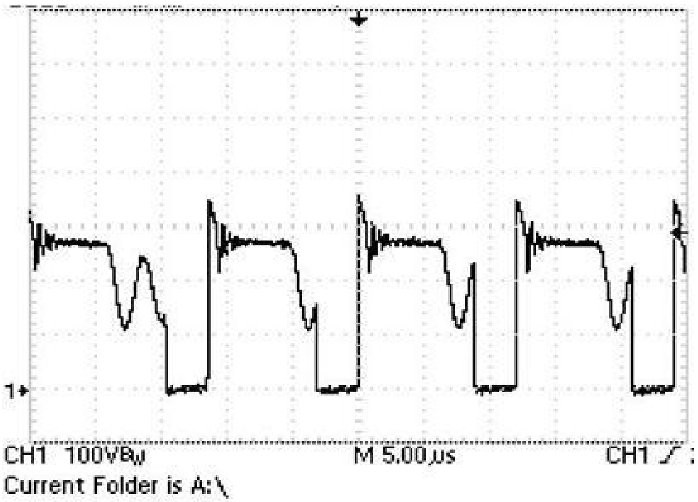
➤ **Demo *switching* waveform**



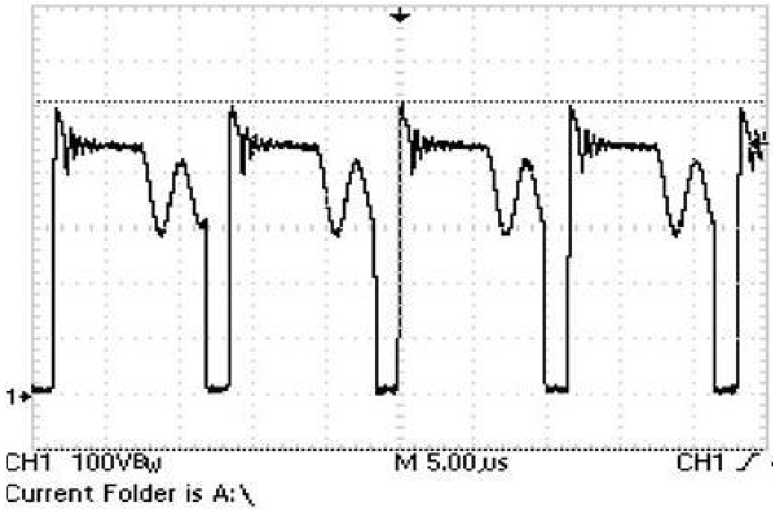
Drain Voltage :210.0VP_P



Drain Voltage :464.0VP_P



Drain Voltage :322.0VP_P



Drain Voltage :552.0VP_P

➢Demo temperature test

Test conditions:

AC at 85V ; full load(5V,600mA),2hour

AC at 150V ; full load(5V,600mA),2hour

AC at 220V ; full load(5V,600mA),2hour

AC at 265V ; full load(5V,600mA),2hour

No.	Parts	Surface Temp	Criteria	Result
1	IC (SD4851)	60.8 °C	0~100°C	pass
2	FR	49.6 °C	0~100 °C	pass
3	Tran Wire	56.2 °C	0~100 °C	pass
4	Tran core	50.2 °C	0~100 °C	pass
6	Output Diode（SB240）	67.6 °C	0~100 °C	pass
7	input capacitor	46.7 °C	0~100 °C	pass
8	case	37.6 °C	0~50 °C	pass

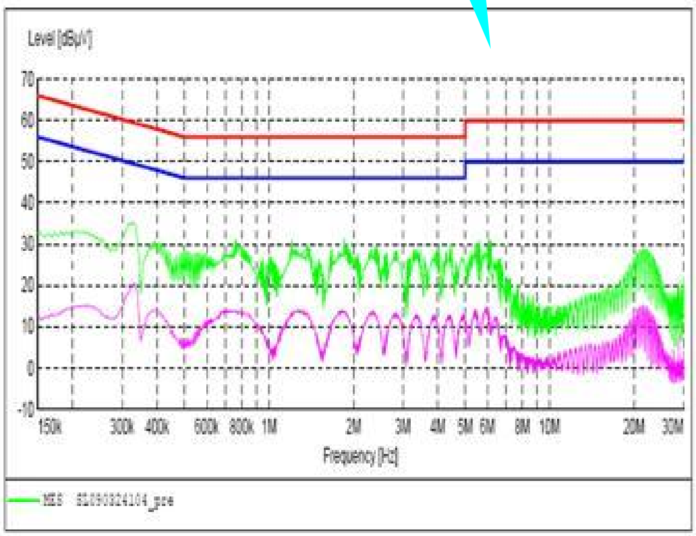
➢Demo EMC Conduction Test

N Direction Conduction

Voltage Mains EN55022B

EUT:	M/N:5V/600mA
Manufacturer:	SLIAN
Operating Condition:	FULL LOAD
Test Site:	SHIELDED ROOM
Operator:	Rock
Test Specification:	AC 230V/50Hz
Comment:	N LINE
	Temperature:24 Humiuity:55

SCAN TABLE: "Voltage(150K-30M)FIN"
Short Description: 150K-30M Voltage



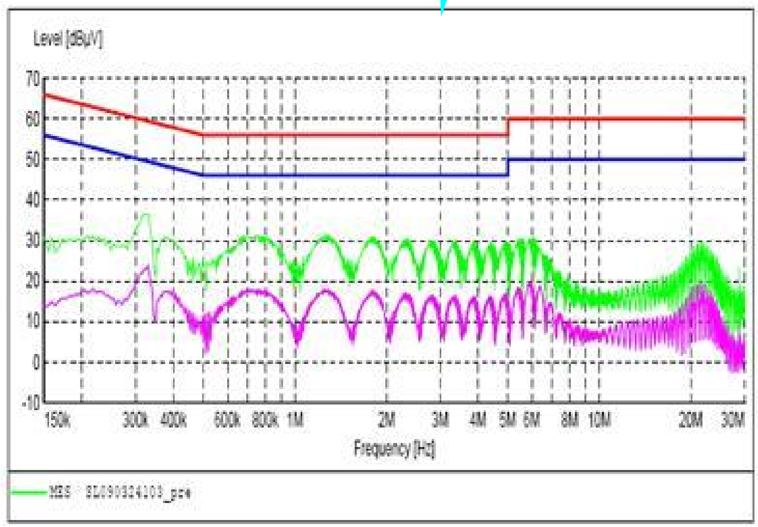
L Direction Conduction

Bontek Comp...

Voltage Mains EN55022B

EUT:	M/N:5V/600mA
Manufacturer:	SLIAN
Operating Condition:	FULL LOAD
Test Site:	SHIELDED ROOM
Operator:	Rock
Test Specification:	AC 230V/50Hz
Comment:	L LINE
	Temperature:24 Humiuity:5

SCAN TABLE: "Voltage(150K-30M)FIN"
Short Description: 150K-30M Voltage



➢Demo EMC Radiation Test

Radiation (Vertical)

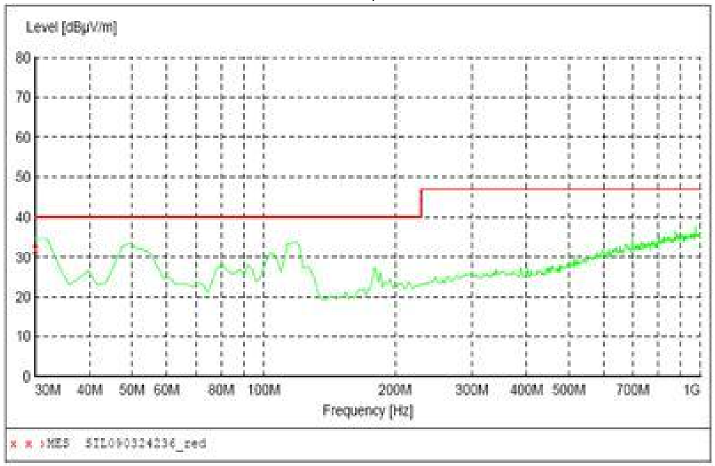
RADIATED

EUT:
Manufacture
Operating
Test Site: CHAMBER
Operator: Mars
Test Specification: AC230V/50HZ
Comment: Polarisation:V
Start of Test: 3/24/2009 / 16:08:4

SWEEP TABLE: "test (30M-1G)"

Short Description: Field St

Start Frequency	Stop Frequency	Detector	Meas. Time	Bandw.	Transducer
30.0 MHz	1.0 GHz	MaxPeak	Coupled	0 kHz	VULB9163 NEW



MEASUREMENT RESULT: "SIL090324236_red"

3/24/2009 16:12

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
30.000000	32.00	15.3	40.0	8.0	QP	100.0	0.00	VERTICAL

Radiation (Horizontal)

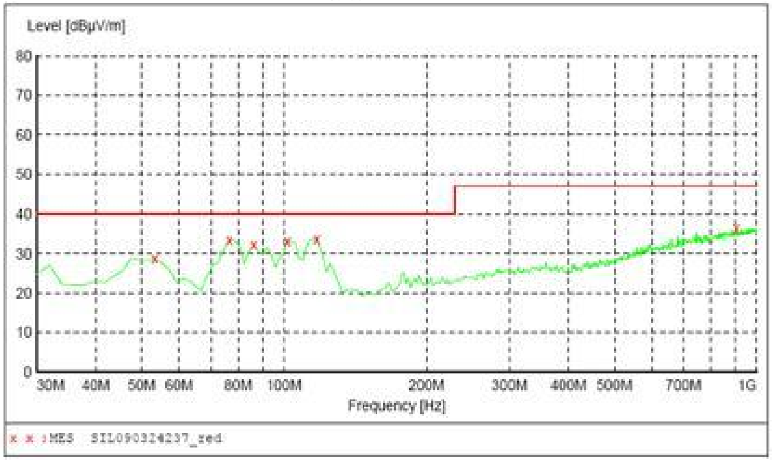
RADIATED EMI

EUT:
Manufacturer:
Operating Cond
Test Site:
Operator: Mars
Test Specification: AC230V/50HZ
Comment: Polarisation:H
Start of Test: 3/24/2009 / 16:13:56

SWEEP TABLE: "test (30M-1G)"

Short Description: Field Streng

Start Frequency	Stop Frequency	Detector	Meas. Time	Bandw.	Transducer
30.0 MHz	1.0 GHz	MaxPeak	Coupled	kHz	VULB9163 NEW



MEASUREMENT RESULT: "SIL090324237_red"

3/24/2009 16:16

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
53.280000	28.70	16.6	40.0	11.3	---	300.0	0.00	HORIZONTAL
76.560000	33.40	12.9	40.0	6.6	---	300.0	0.00	HORIZONTAL
86.260000	32.20	15.7	40.0	7.8	---	300.0	0.00	HORIZONTAL
101.780000	33.10	18.2	40.0	6.9	---	300.0	0.00	HORIZONTAL
117.300000	33.60	16.4	40.0	6.4	---	300.0	0.00	HORIZONTAL
904.940000	36.50	29.3	47.0	10.5	---	300.0	0.00	HORIZONTAL

➢Demo EMS ESD and Surge Tests

深圳市华标电子科技有限公司
Bontek Compliance Testing Laboratory Ltd

ESD Immunity Test Data

Standard	☑IEC 61000-4-2 ☐EN 61000-4-2	Result: ☑PASS /☐FAIL

Applicant: 杭州士兰微电子股份有限公司

M/N: SD4831

Air Discharge: +/-15 KV　Criterion: A

Contact Discharge: +/-8 KV

#For Positive and negative each 10 time

Ambient Condition: 25 ℃ 55 %RH 101 kPa

Input Voltage: AC230V/50HZ

Operation Mode: FULL LOAD

Location	Kind C- Air Discharge C-Contact Discharge	Results
Shell	A	PASS
Gap	A	PASS
VCP/HCP	C	PASS

Note: Equipment powered

Test Equipment: Schaffner ESD Tester　Model: NSG 437

Discharge should be considered on Contact Air and Horizontal Coupling Plane(HCP) and Vertical Coupling plane(VCP)

ESD>±8KV, >±15KV

Surge>1KV

Surge Immunity Test Data

编号: TR-4-E-005 Rev:A/0

Standard	☑EN 61000-4-5 ☐IEC 61000-4-5	Result: ☑ PASS /☐FAIL

Applicant: 杭州士兰微电子股份有限公司

EUT: Adapter　M/N: SD4851L

Repetition: 5 times per test　Interval: 60 seconds　Criteria: ☑B ☐C

Ambient Condition: 25 ℃ 55 %RH 101 kPa

Input Voltage: 230 V 50 Hz

Operation Mode: FULL LOAD

Line: ☑ AC Mains　☐ DC Supply　☐ Signal Line: Telephone Line

Conductor	Volt	500V		1.0kV		2.0kV		3.0kV		4.0kV	
	Phase	+	-	+	-	+	-	+	-	+	-
L-N	0°			PASS	PASS						
	90°			PASS	PASS						
	180°			PASS	PASS						
	270°			PASS	PASS						
L-PE	0°										
	90°										
	180°										
	270°										
N-PE	0°										
	90°										
	180°										
	270°										
L-N-PE	0°										
	90°										
	180°										
	270°										
Telephone Line	L_1-L_2										
	L_1-PE										
	L_2-PE										

Note:

Test Equipment: SCHAFFNER　Model: MODULA6150

Date: 2009.03.26　Test:

Date: 2009.3.26　Approve:

Tel: +86 755 86106120　Fax: +86 755 86095568

➢ Silan AC/DC Power Products

Device No.	Function	Package	Output
SD4851DD3	PSR (CC/CV)	PWM+MOS（DIP-7)	600mA
SD4851DD4			800mA
SD4851DD5			1000mA
SD4851DD6			1200mA
SD4840	SSR	PWM+MOS(DIP-8)	７.2W
SD4841			12W
SD4842			14W
SD4843			15W
SD4844			18W
SD4870		PWM(SOT-23-6)	36W
SC6105		PWM(DIP-20)	400W
SD6109		PWM(DIP-20)	400W
SA7527	PFC	PWM(DIP-8/SOP8)	200W
SVD1N60/70	MOS	TO-251/T0220	1A/600V/700V
SVD2N60/70			2A600V/700V
SVD4N65		TO-220F	4A650V/700V
SVD7N60			7A/600V
SVD10N65			10A/650V
SVD12N65			12A650V
SVD730T			6A/400V
SVD830/840T			5A/8A/500V

➢ Silan's SD4851 Advantages

Company advantage	The public company with big scale, is widely accepted and has built cooperation with many multinational companies, such as Funni/philips/sumsung/LG.
	Owning the wafer manufacture line, continuous lowering down price available
	Perfect quality management system for guaranteeing the product quality
	Powerful design team for continuously design new product
	Power technical support for good service
Advantage in product	High CC/CV precision, CC±10%, CV<±5%
	Cost-effective, few peripheral components, only 27 components
	High efficiency, meet EPA2.0 specification
	Good performance in EMC, ESD
Patent advantage	Self-design patent

➢ Your specifications

Items	Specification		Your requirements	Remark
	Samsung solution	LG low-end solution		
Quantity needed				
Input voltage	85-265Vac	85-265Vac		
Input frequency	47~63Hz	47~63Hz		
Transient peak current	25A	25A		
Standby power dissipation	<0.1W	<0.15W		
Conversion efficiency	> 68%	> 68%		(average value with 25%, 50%, 75%, 100% load)
Output voltage	4.9~5.4V(Central value 5.15V)	4.8~6.4V		
Output current	700~950mA (Central value 825MA)	400~800mA		-5℃～50℃
Output rated current	700mA	400mA		
Output ripple	<150mV	<200mV		
Cable specification	1.5m AWG28	1.5m AWG28		

Mixed Signal and RF Products

Tiger Hu

Contents

Silan in Tuner

Contents

Introduction

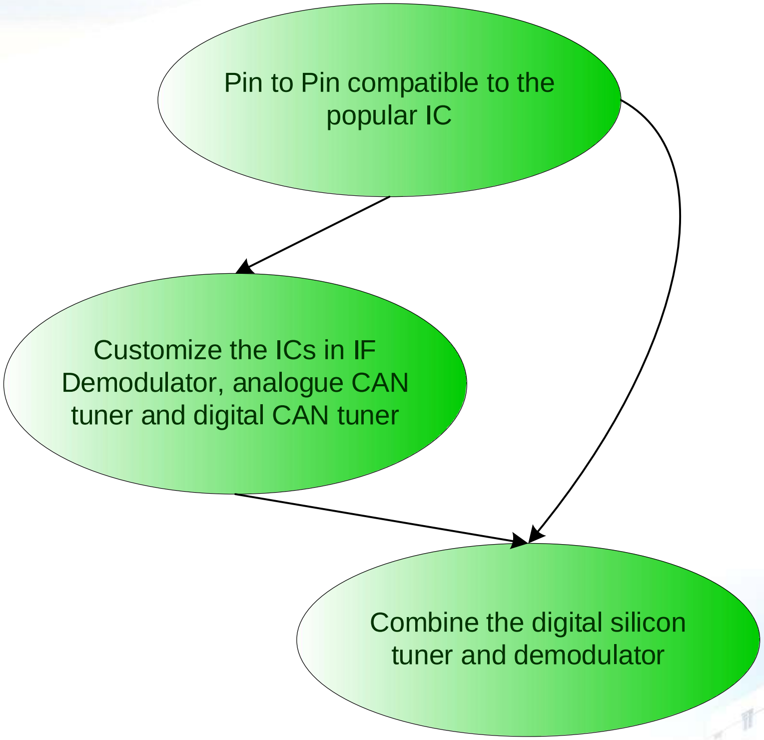
Return

- Silan provides total solution for TV tuner makers, includes IF Demodulators, Can Tuner ICs, Silicon Tuner ICs, RF Modulators, and 33V DC-DC converter for CAN tuner.

- All of the ICs in IF Demodulator, Can Tuner, Silicon Tuner, RF Modulator, DC-DC Converter are designed based on Silan's high frequency high performance BICMOS process. And there is no patent issue in our products.

- We are working on: Cost down the IF-Demodulator of analog TV; Customize the analog can tuner IC; Integrate the silicon tuner and demodulator into one chip.

Introduction

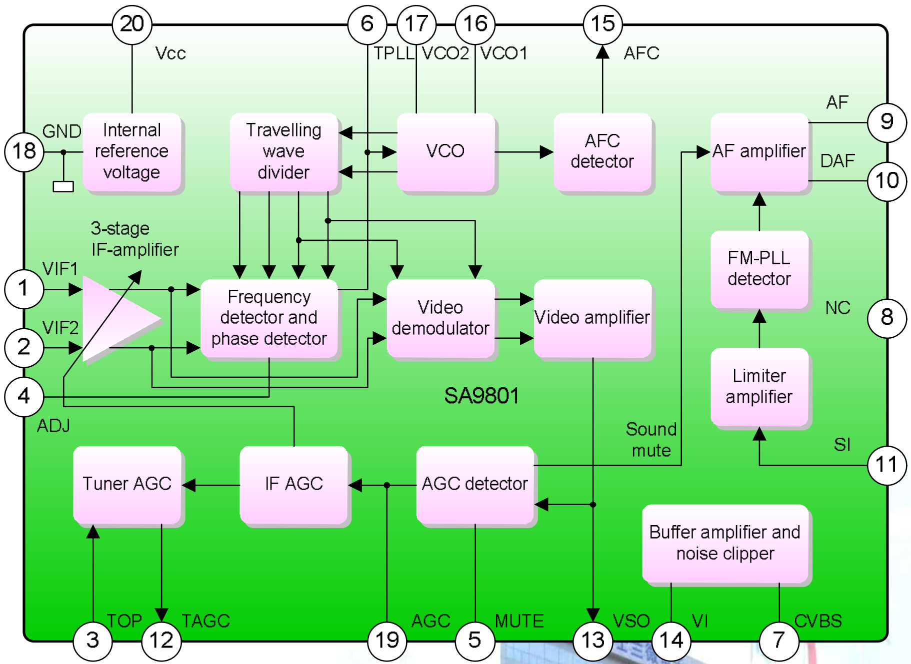


Silan's Strategy in Tuner

IF Demodulator

Return

- ***Single Standard IF Demodulator: SA9801***
  - Applicable for IF Frequency 38.9, 45.75 and 58.75MHz
  - Gain controlled wide-band VIF amplifier
  - Peak Sync pulse AGC
  - AFC detector without extra reference circuit



IF Demodulator

- ***Multi-Standard IF Demodulator: SD9885/9886***
  - I²C bus controlled
  - Applicable for IF Frequency 33.4/33.9/38.0/38.9/45.75/58.75, 45.75 and 58.75MHz
  - Integrated sound trap for 4.5/5.5/6.0/6.5MHz
  - Gain controlled wide-band VIF amplifier
  - Peak Sync pulse AGC
  - Digital acquisition help and fully digital AFC detector