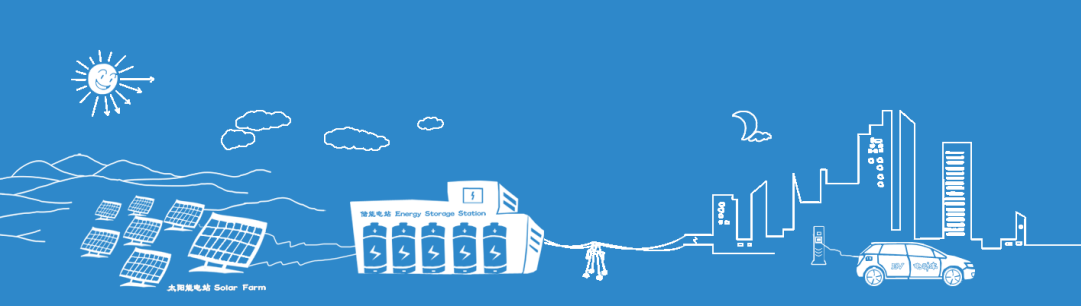




# *BF1556 For 5V1A Charger Design*



*Build Your Dreams*

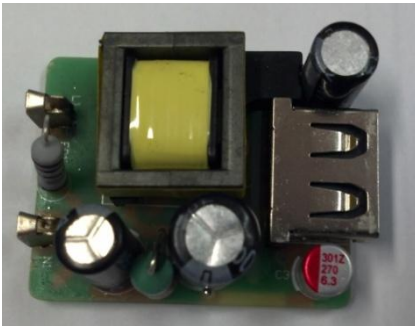


## BF1556 for High efficiency Charger Design: (AC Input 90-264Vac, Output 5V 1A, No-Load Standby Power <100mW, Meet “Level VI” efficiency)

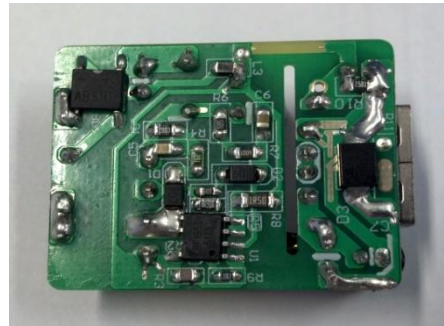
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This document provides a reference design for a universal AC input, 5V 1A isolated fly-back adapter. For this design the BF1556 is used. It contains the complete specification of the power supply, a detailed circuit diagram and PCB layout, the entire bill of materials required to build the power supply, drawing of the power transformer, and test data of the most important performance.



**PCB Top view**



**PCB Bottom view**

*Figure 1 Circuit Board Photograph*



## 2. Design Features



- AC input range 90-264Vac
- DC output 5V 1A
- Meet *"100mW" no-load standby power consumption requirement*
- Meet *"Level VI" Efficiency requirement at end of USB*
- Max ripple < 80mV
- Meet *"USB3.0" Dynamic Load Response Requirement*

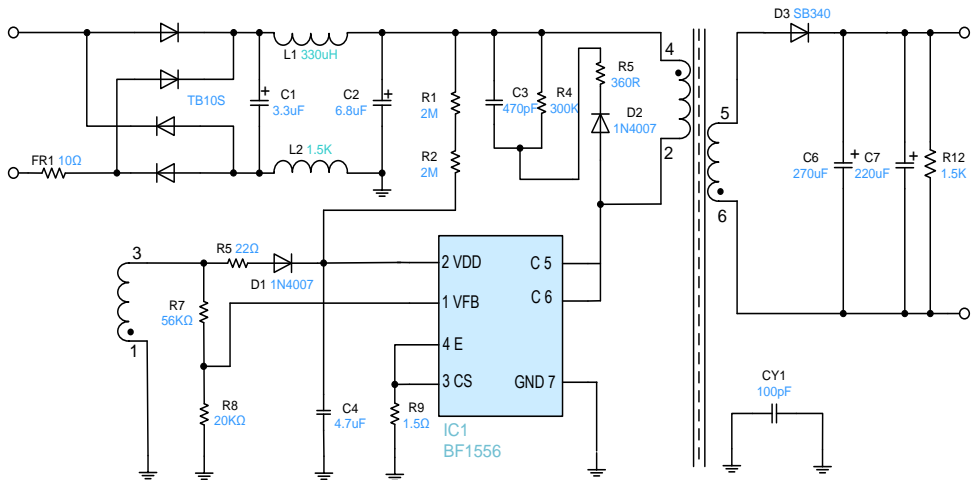


### 3. Power Supply Design Specification



The table below represents the minimum acceptable performance of the design.

Description	Symbol	Min	Type	Max	Units	Comment	
<b>Input Section</b>							
Input Voltage	Vin	90	/	264	Vac	/	
Line Frequency	f	47	50/60	63	Hz	/	
Standby Power	/	/	/	100	mW	230Vac	
<b>Output Characteristics</b>							
CV	Output Voltage	Vout_cv	4.75	5	5.25	V	Measured at end of USB
	Output Current	Iout_cv	0	/	1.2	A	/
CC	Output Voltage	Vout_cc	2	/	/	V	/
	Output Current	Iout_cc	1	/	1.2	A	/
Ripple&Noise	Vripple	/	/	80	mV	Measured at end of USB Iout=1A 20MHz Bandwidth	
Continuous Output Power	Pout	/	5	/	W	/	
Over Current Protection	Iout_max	/	/	1.2	A	Auto-restart	
Active Mode Efficiency	$\eta$	73.6	/	/	%	Measured at end of USB Vin=115Vac&230Vac	
<b>Time sequence</b>							
Turn-on delay time	/	/	/	2	S	Full load	
Hold up time	/	10	/	/	mS	Full load	
<b>Environmental</b>							
Conducted/Radiation EMI	Meets CISPR22B/EN55022B					/	
Safety	Meets IEC950,UL1950,Class II					/	
ESD	/	15	/	/	KV	/	
Ambient Temperature	TAMB	-5	/	45	°C	Free convection,sea level	





Item	Designator	Description	Qty
1	C1	E-Capacitor 3.3uF/400V 6*12 105 °C ±20%	1
2	C2	E-Capacitor 6.8uF/400V 8*12 105 °C ±20%	1
3	C4	SMD Capacitor 4.7uF/25V 105 °C ±20% 0805	1
4	C3	SMD Capacitor 470pF/250V 105 °C ±20% 0805	1
5	C6	S-Capacitor 270uF/6.3V 5*7 105 °C ±20%	1
6	C7	E-Capacitor 220uF/10V 5*11 105 °C ±20%	1
7	R1 R2	SMD Resistor 0805 2M ±5%	2
8	R3	SMD Resistor 0805 360R ±5%	1
9	R4	SMD Resistor 0805 300K ±5%	1
10	R5	SMD Resistor 0603 22R ±5%	1
11	R8	SMD Resistor 0603 20K ±1%	1
12	R7	SMD Resistor 0603 56K ±1%	1
13	R9	SMD Resistor 1206 1.5R ±1%	1
14	R12	SMD Resistor 0805 1.5K ±5%	1
15	BD1	TB8S 1A800V TBS	1
16	D1 D2	1N4007 1A1KV SOD-123	2
17	D3	SB340 3A/40V SMB	1
18	L1	Fixed inductor 330uH 5*10	1
19	L2	SMD 1.5K@300MHz 0805	1
20	IC1	PWM Controller IC BF1556 SOP7	1
21	FR1	Fuse Resistor 10R/1W 10%	1
22	T1	Transformer EM15 Lp=2.3mH	1
23	CY1	Y-Capacitor 100pF/250V 105 °C ±20%	1
24	<b>Total</b>		<b>25</b>

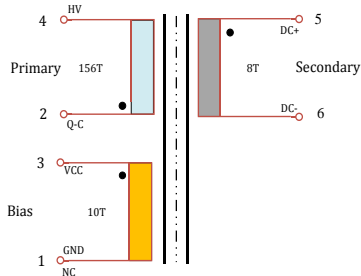
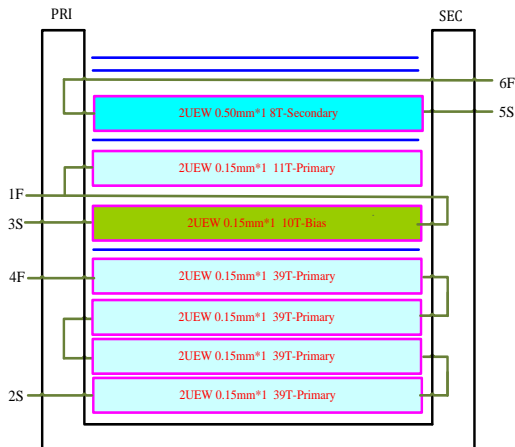


## Regulation, Ripple and Efficiency Measurement

\* Note: Output voltage is measured at the end of PCB

Vin (Vac)	Pin (W)	Iout (mA)	Measure at the end of PCB				F(KHz)
			Vout (V)	Pout(W)	$\eta$ (%)	AVG $\eta$ (%)	
115V/ 50Hz	0.04	0.00	4.99	0.00	/	77.03	45.87
	1.64	250.00	4.99	1.25	76.25		
	3.25	500.00	5.01	2.51	77.08		
	4.91	750.00	5.06	3.80	77.37		
	6.59	1000.00	5.10	5.10	77.40		
230V/ 50Hz	0.08	0.00	5.00	0.00	/	77.23	52.63
	1.68	250.00	5.00	1.25	74.63		
	3.25	500.00	5.02	2.51	77.23		
	4.83	750.00	5.04	3.78	78.26		
	6.46	1000.00	5.09	5.09	78.79		
Europe COC Tier 2 Efficiency(%) :73.6(0.0834*LnPo-0.0014*Po+0.609)							



**Electrica Specifications:**

**1.Primary Inductance(LP)=2.2±7% $\mu$ H@10KHz;**

**2.primary Leakage Inductance (LK)<150 $\mu$ H @10KHZ;**

**3.Core:EM15(Ferrite Material TDK PC40 or equivalent);**

**4.Bobbin:EM15;**

**5.Magnet wire : TYPE 2 - UEW(Primary),Triple Insulated Wires (Secondary);**

**6.HI-POT:**

**PRI. TO SEC: AC3000V 5mA 3SEC**

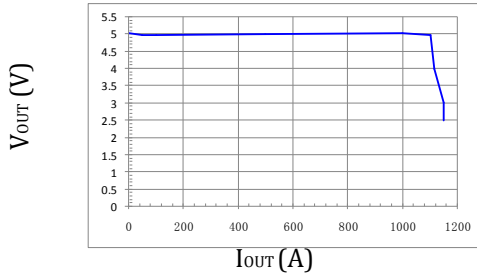
**SEC. TO CORE: AC1500V 5mA 3SEC**

**PRI. TO CORE: AC1500V 5mA 3SEC**

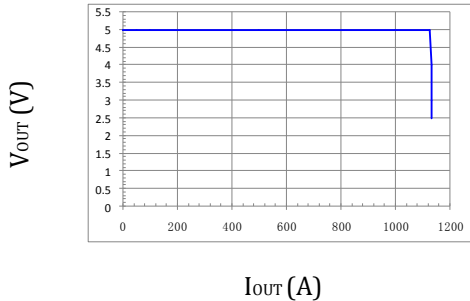
- PS: 1. 磁芯接地，即PIN1；  
2. 反馈与线屏线圈需交叉疏绕。



### VI Curve ( $V_{in}=115V_{ac}/60Hz$ )

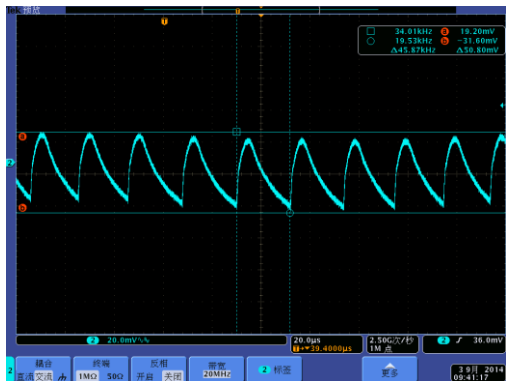


### VI Curve ( $V_{in}=230V_{ac}/50Hz$ )



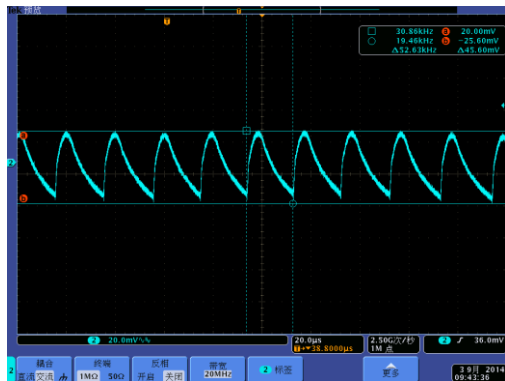


## 9. Output Ripple Voltage



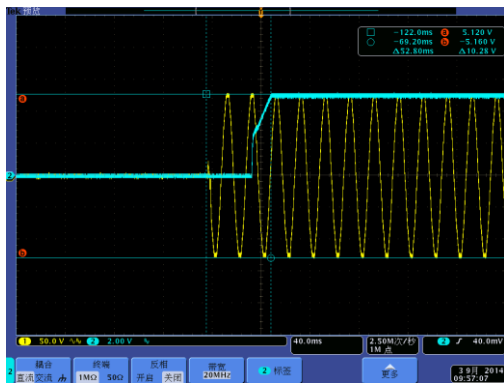
Vin=115V Full Load

$\Delta V=51\text{mV}$



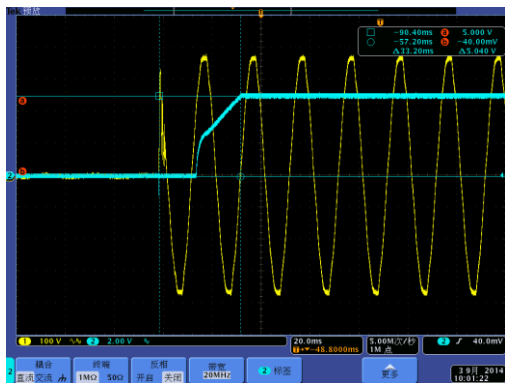
Vin=230V Full Load

$\Delta V=45\text{mV}$



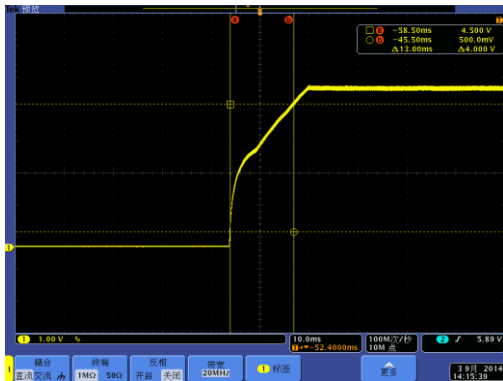
Vin=90V, Full Load

$\Delta T=52.80\text{mS}$



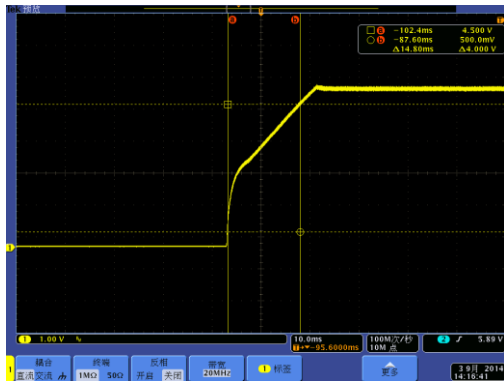
Vin=264V, Full Load

$\Delta T=33.20\text{mS}$



Vin=90V, Full Load

$\Delta T=13.00\text{ms}$



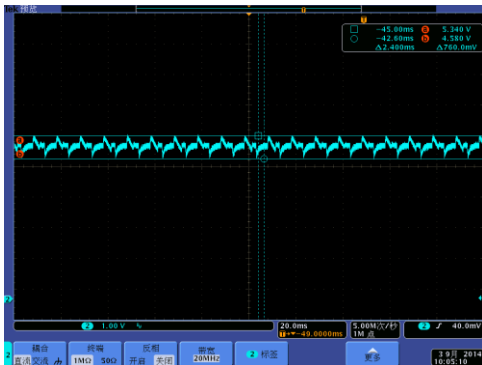
Vin=264V, Full Load

$\Delta T=14.80\text{ms}$

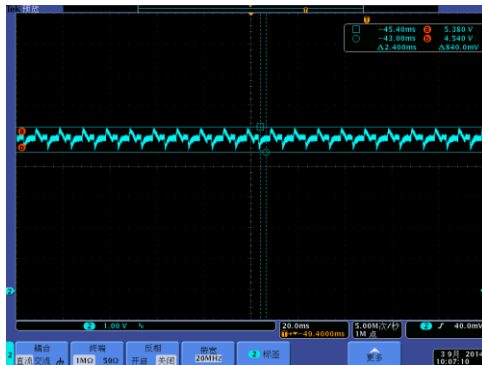


Test Conditions:

1. Load: 0.1A-1.0A-0.1A;
2. Frequency: 200Hz;
3. Duty-Cycle: 50%;
4. Slew-Rate: 0.1A/us.



Vin=90V  
Vo\_max=5.340V  
Vo\_min=4.580V



Vin=264V  
Vo\_max=5.380V  
Vo\_min=4.540V



Test Conditions:

1.  $V_{in}=230V_{ac}/50Hz$ ;
2. Load: 5R Resistive Load;
3. The Length of Output DC-Cable: 1M;



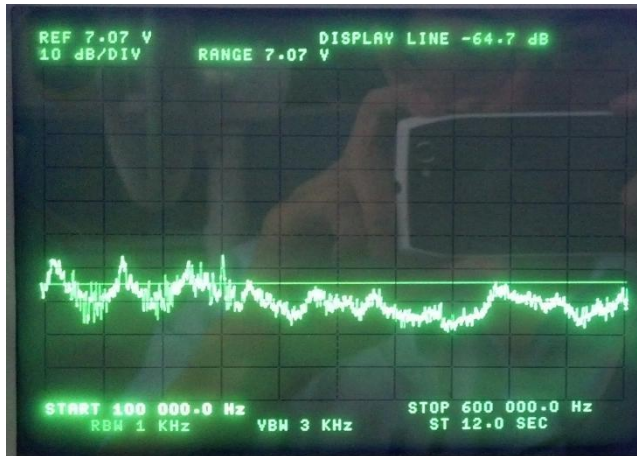
EPS Switching Frequency Component

$V_{pp}=930mV$



Test Conditions:

1.  $V_{in}=230V_{ac}/50Hz$ ;
2. Load: 5R Resistive Load;
3. The Length of Output DC-Cable: 1M;

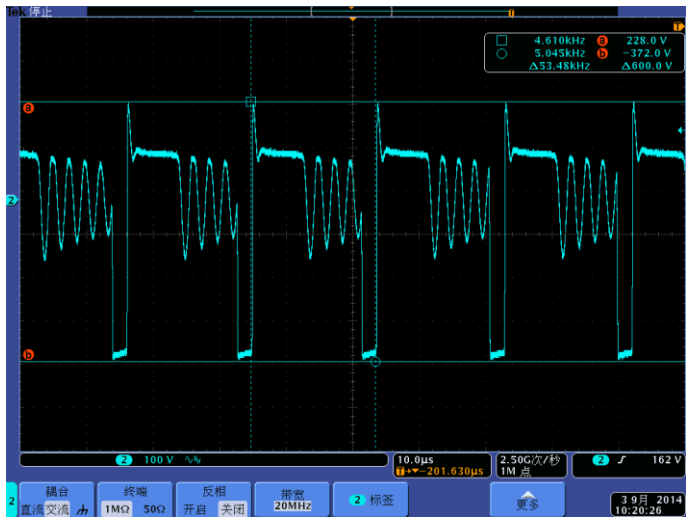


$V_{pp} = -64.7\text{dB}$





Test Conditions:  $V_{in}=264V_{ac}/47Hz$ ;  $I_o=1A$

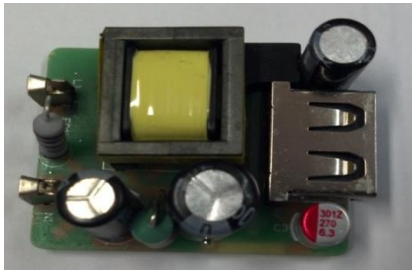


Test Result:  $V_{peak}=600V$

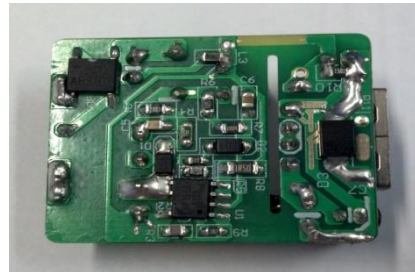


Note: The UUT is assembled with case and placed in a temperature chamber.

Item	I <sub>out</sub> =1A	
	V <sub>in</sub> =90Vac	
	T(°C)	Tr(°C)
IC1(BF1556)	105	60
Transformer Wire(T1,EM15)	93	48
Transformer Core(T1, EM15)	82	37
Schottky Diode(D6,SB340)	92	47
Ambient Temperature	45°C	



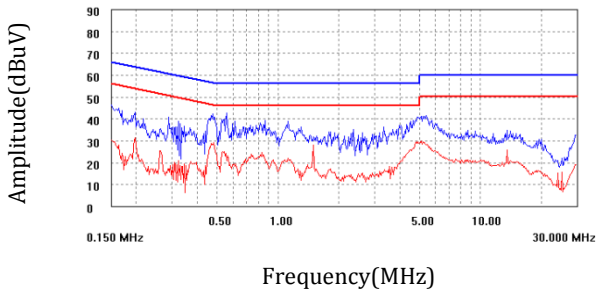
PCB Top view



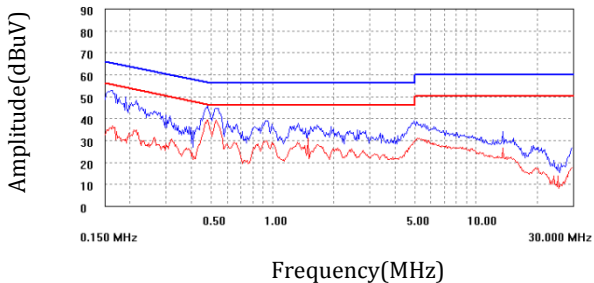
PCB Bottom view



Vin=230Vac/50Hz, Neutral

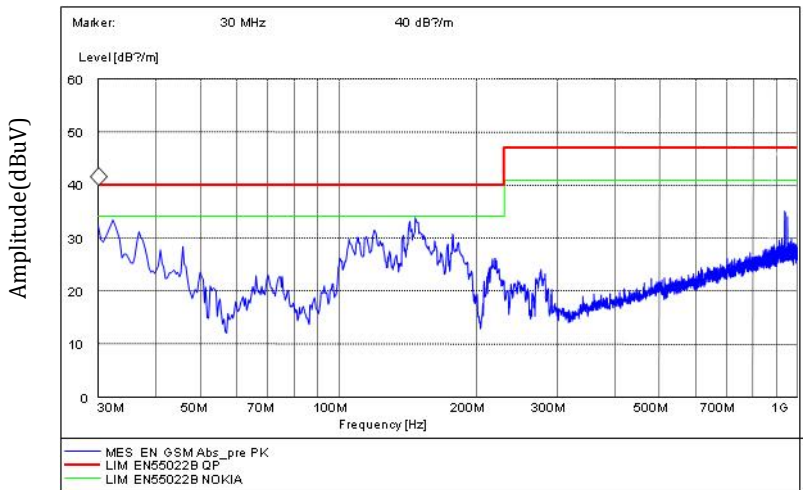


Vin=230Vac/50Hz, Live





Vin=230Vac/50Hz



Frequency (MHz)