

Reference Design



EBC10070



**iW1760B-00 for 15W Dual Output
Home Appliance Switched Mode Power Supply Design**

iW1760B-00 for 15W Dual Output Home Appliance Switched Mode Power Supply Design (AC Input 90-264V_{AC}, Dual Output 12V/1A and 15V/0.1A) EBC10070

1.0. Introduction	3
2.0. Design Features	3
3.0. Design Specification	4
4.0. Schematic	5
5.0. PCB Layout.....	5
6.0. Bill of Materials	6
7.0. Transformer Drawing	7
8.0. Performance	8
8.1. Efficiency.....	8
8.2. Conducted EMI	9

1.0 Introduction

This document provides a reference design for a universal input, dual rail, 12V, 1A and 15V, 0.1A isolated flyback power supply for 15W home appliance switched-mode power supplies. This design uses Dialog's iW1760B-00 AC/DC PWM controller. This document contains the complete specification of the power supply, a detailed circuit diagram, an entire bill of materials required to build the power supply, a drawing of the power transformer, and the test data for the most important performance.

2.0 Design Features

- AC input range 90-264 V_{AC}
- DC output 12/1A and 15V/0.1A
- Output power: 13.5W
- Low output ripple < 150mV_{P-P} (max.)
- PrimAccurate™ primary-only sensing eliminates opto-isolator feedback and simplifies design
- Meets stringent global energy efficiency standards, including U.S. DoE, EU CoC Version 5, Tier 1
 - < 100mW no-load standby power consumption
- Fast dynamic load response

3.0 Design Specification

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

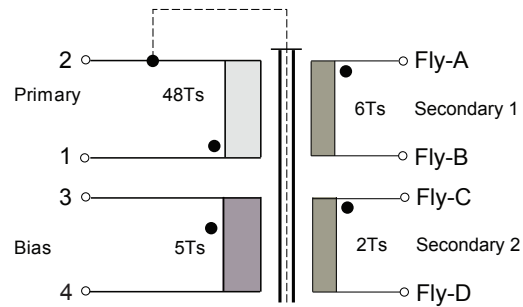
Description	Symbol	Min	Typ	Max	Units	Comment
Input						
Voltage	V_{IN}	90		264	V _{AC}	2 wire
Frequency	f_{LINE}	47	50/60	63	Hz	
No-load input power(230V _{AC})				100	mW	
Output						
Output voltage	V_{OUT1}	11.4	12.0	12.6	V	Measured at the end of PCB
	V_{OUT2}	13.5	15.0	16.5		
Output current	I_{OUT1}	0		1	A	
	I_{OUT2}	0		0.1		
Output ripple voltage	V_{RIPPLE}			150	mA _{P-P}	Connected with 10μF E-Cap and 100nF C-Cap $I_{OUT1}=1.0A, I_{OUT2}=0.1A@T_A = 25^{\circ}C$ 20 MHz Bandwidth
Total Output Power						
Continuous output power	P_{OUT}		13.5		W	
Over current protection	OCP			$1.2(I_{OUT1})$	A	Auto-restart
Environmental						
Safety		Designed to meet IEC60065, UL1950 Class II				
Ambient temperature	T_{AMB}	0		40	°C	Free convection, sea level

6.0 Bill of Materials

Item	Qty.	Ref.	Description
1	1	U1	iW1760B-00, off-line digital PWM controller, SOIC-8
2	1	C1	10 μ F, 400V, E-cap, Φ 10mmX16mm
3	1	C8	10 μ F, 400V, E-cap, Φ 10mmX16mm
4	1	C3	10nF, 1kV, ceramic capacitor
5	1	C4	22 μ F, 50V, low ESR E-cap, Φ 6.3mmX11mm
6	1	C5	100nF, 50V, X7R, SMD-0603
7	1	C6	680pF, 50V, X7R, SMD-0603
8	1	C51	100 μ F, 25V, low ESR E-cap, Φ 6.3mmX12mm
9	1	C52	1000 μ F, 25V, low ESR E-cap, Φ 10mmX20mm
10	1	CY1	100pF, Y-cap
11	4	D1, D2, D3, D4	1N4007, 1A1000V, rectifier diode, DO-41
12	3	D5, D7, D12	FR102, 1A100V, fast recovery rectifier (Trr=150ns), DO-41
13	1	D6	FR107, 1A1000V, fast recovery rectifier (Trr=500ns), DO-41
14	1	D8	1N4148, 0.15A75V, switching diode, SOD-323
15	1	D51	WCD24H, 2A40V, Schottky diode, TO277
16	1	D52	PFS5V100, 5A100V, Schottky diode, 1206
17	1	F1	T2A/250V, fuse
18	1	L1	470 μ H, color ring inductor, 0510
19	1	Z1	BZD17C120P, 120V, 2W, Zener diode, SMD-1206
20	1	Q1	CS6N70A3D1G, 6A/700V, MOSFET, TO-251
21	2	R1,R18	2.2 Ω \pm 1%, SMD-1206
22	1	R4	13k Ω \pm 1%, SMD-0805
23	3	R5,R12,R19	1M Ω \pm 5%, SMD-1206
24	1	R6	10k Ω \pm 5%, SMD-1206
25	1	R7	1k Ω \pm 5%, SMD-1206
26	1	R8	36k Ω \pm 1%, SMD-0805
27	1	R9	4.7 Ω \pm 5%, SMD-0805
28	1	R10	12k Ω \pm 1%, SMD-0603
29	1	R11	1k Ω \pm 1%, SMD-0603
30	1	R13	1.8k Ω \pm 5%, SMD-0603
31	1	R14	2.4k Ω \pm 1%, SMD-0603
32	2	R15,R17	100 Ω \pm 1%, SMD-0805
33	1	R20	10 Ω \pm 5%, SMD-0805
34	1	R21	10k Ω \pm 5%, SMD-0805
35	1	R22	1k Ω \pm 1%, SMD-0805
36	1	R23	1.5M Ω \pm 1%, SMD-0805
37	1	R51	20k Ω \pm 5%, SMD-0805
38	1	T2	RM7, transformer, vertical
39	1	PCB	Single side board, FR-4, 60mmX38mm

7.0 Transformer Drawing

Schematic:



Notes:

- Dot (●) denotes electrical start.
- Electrical start could be different from mechanical start.
- Core is connected to pin-2 with wire

Electrical Specifications:

1.	Primary inductance (L_p) = $700 \pm 5\% \mu\text{H}$ @10kHz, 1V
2.	Primary leakage inductance (L_k) $< 5\% * L_p$, Short pin 3, 4, A, B, C, D
3.	Electrical strength = 3kV, 50/60Hz, 1min (pins 1~4 to pins A~D)

Materials:

1.	Core: RM7 (ferrite material TDK PC40 or equivalent)
2.	Bobbin: RM7 vertical
3.	Magnet wires (pri): type 2-UEW
4.	Magnet wires(sec): triple insulated wire
5.	Layer insulation tape: 3M1298 or equivalent

Finished:

1.	Varnish the complete assembly
2.	Transformer outside winding 2 turns tape
3.	The length of tube A, B 20mm, Fly A~D tin length = 5mm

8.0 Performance

8.1 Regulation, Ripple and Efficiency Measurement

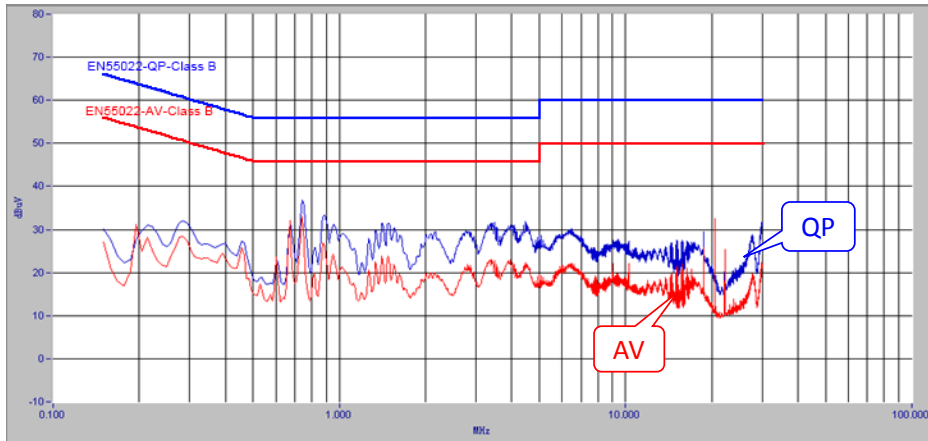
* Note: Output voltage is measured at end of PCB

V _{in} (V _{AC})	P _{in} (W)	V _{out} (12V) (V)	V _{out} (15V) (V)	I _{out} (12V) (mA)	I _{out} (15V) (mA)	V _{ripple} (12V) (mV _{P-P})	V _{ripple} (15V) (mV _{P-P})	P _{out} (W)	η (%)
90	0.030	11.77	15.39	0	0	/	/	/	/
	13.670	11.66	15.90	1000	0	/	/	11.660	85.30
	1.830	11.64	15.05	0	100	/	/	1.505	82.24
	15.600	11.66	15.46	1000	100	80	70	13.206	84.65
115	0.030	11.77	15.38	0	0	/	/	/	/
	13.540	11.66	15.90	1000	0	/	/	11.660	86.12
	1.860	11.64	15.05	0	100	/	/	1.505	80.91
	15.420	11.66	15.46	1000	100	80	70	13.206	85.64
230	0.070	11.77	15.39	0	0	/	/	/	/
	13.550	11.66	15.91	1000	0	/	/	11.660	86.05
	1.940	11.64	15.04	0	100	/	/	1.504	77.53
	15.390	11.66	15.46	1000	100	70	60	13.206	85.81
264	0.080	11.77	15.38	0	0	/	/	/	/
	13.600	11.65	15.91	1000	0	/	/	11.650	85.66
	1.990	11.65	15.05	0	100	/	/	1.505	75.63
	15.400	11.66	15.46	1000	100	70	50	13.206	85.75

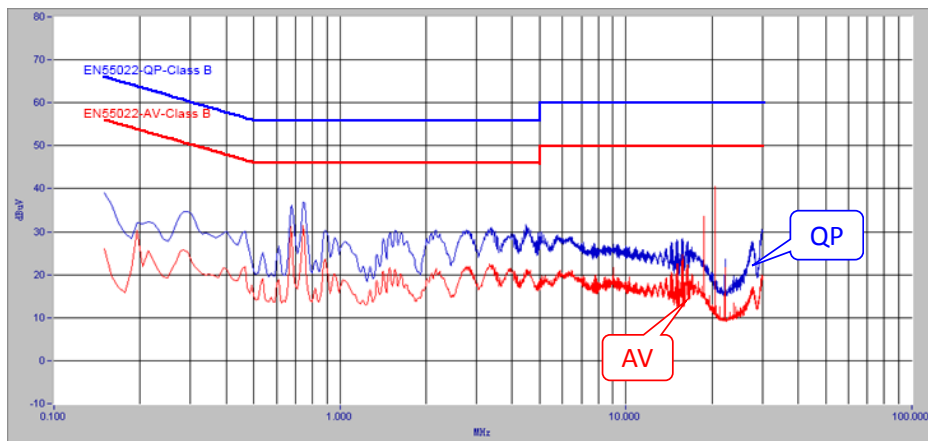
8.0 Performance (Cont.)

8.2 Conducted EMI

$V_{IN} = 230V_{AC}$, Live



$V_{IN} = 230V_{AC}$, Natural





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