Low Standby Power Off-Line PSR Driver

Description

The LP3773D is a high performance AC/DC power supply controller for battery charger and adapter applications which integrated 850V high voltage BJT. The device uses Pulse Frequency Modulation (PFM) method to build discontinuous conduction mode (DCM) flyback power supplies.

The LP3773D provides accurate constant voltage, constant current (CV/CC) regulation without requiring opto-coupler and the secondary control circuitry. It also eliminates the need of loop compensation circuitry while maintaining good stability.

The LP3773D can achieve excellent regulation and high average efficiency which meets no-load consumption less than 75 mW.

The LP3773D provides many protections which include OVP ,OTP and output short protection.

The LP3773D is available in SOP7.

Features

- Suitable for 5V/1.5A application
- Valley voltage Turn on to advance efficiency
- 800V BJT integrated
- High precision CC/CV output
- ≦ 75 mW Standby power
- Proprietary cable voltage drop compensation
- FB Pin open-short Protection
- VCC Pin UVLO Protection
- Over temperature Protection

Application

- Adapters/Chargers for Cell/cordless Phones, PDAs, MP3 and Other Portable Devices
- Upgrading the best choice - linear power supply and RCC switching power supply
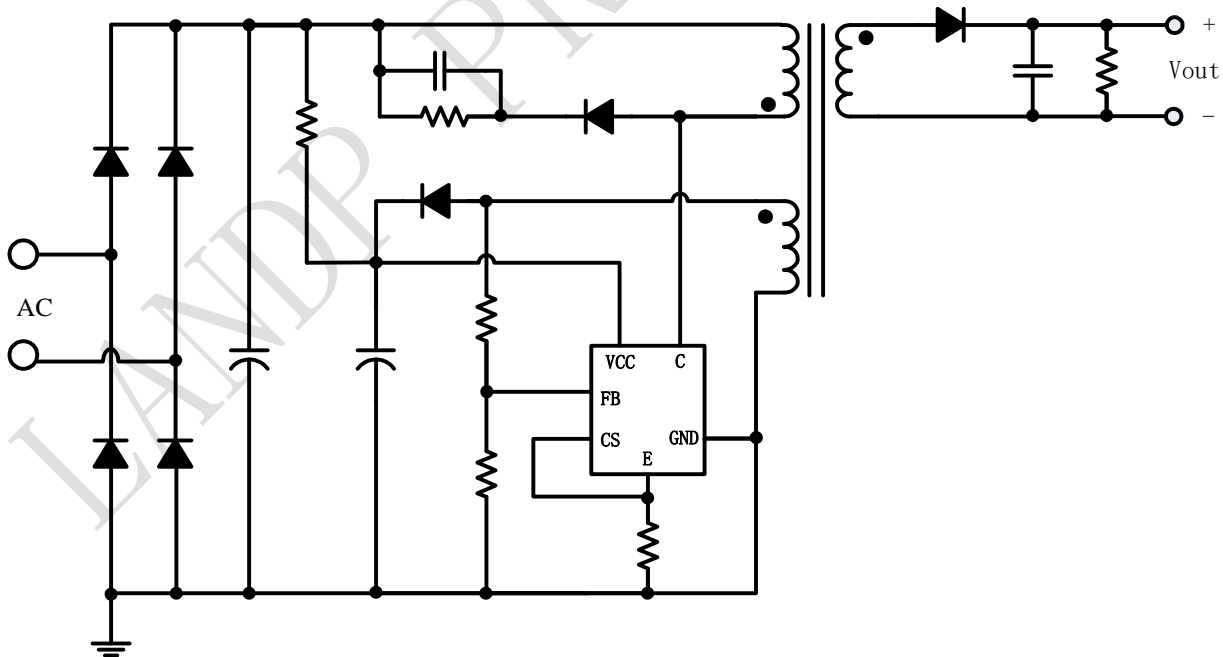- Standby and Auxiliary Power Supplies

Typical Application

Figure 1: Typical Application Circuit

Ordering Information

Version	Package	Packing Form	Marking
LP3773D	SOP7	Tape 3,000 Piece/Roll	LP3773 Dxxxx

Pin Definition

xxxx：IC Indetifier
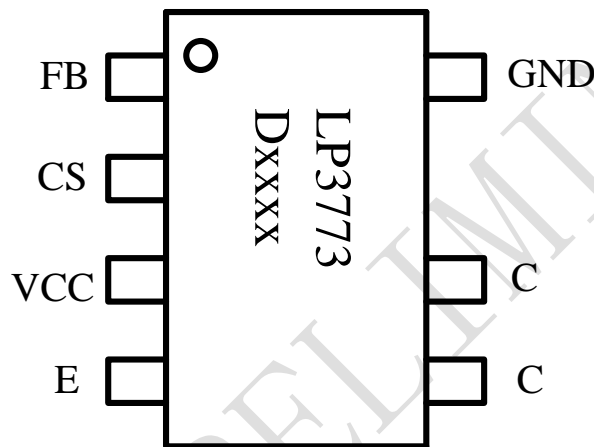
Figure 2: Pin Definition

Terminal Description

Number	Definition	Description
1	FB	The input of the primary side feedback voltage
2	CS	The primary side current signal input which is used for cycle to cycle current limit
3	VCC	The power supply pin for the IC
4	E	The emitter pin of the integrated BJT
5，6	C	The collector pin of the integrated BJT
7	GND	The ground pin of the IC

Absolute Maximum Ratings (note 1)

Symbol	Description	Parameter Scope	Unit
VCC	The IC supply voltage	-0.3~30	V
CS	The current sensing input	-0.3~7	V
FB	The input pin of the PSR feedback voltage	-30~8.5	V
P_{DMAX}	The power dissipation(note2)	0.45	W
θ_{JA}	The thermal resistance from junction to ambient	120	℃/W
θ_{JC}	The thermal resistance from junction to case	70	℃/W
T_J	Operating junction temperature range	-40 to 150	℃
T_{STG}	The storage temperature range	-55 to 150	℃
	ESD (note3)	2	KV

Note 1: Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. Under "recommended operating conditions" the device operation is assured, but some particular parameter may not be achieved. The electrical characteristics table defines the operation range of the device, the electrical characteristics is assured on DC and AC voltage by test program. For the parameters without minimum and maximum value in the EC table, the typical value defines the operation range, the accuracy is not guaranteed by spec.

Note 2: The maximum power dissipation decrease if temperature rise, it is decided by T_{JMAX}, θ_{JA}, and environment temperature (T_A). The maximum power dissipation is the lower one between $P_{DMAX} = (T_{JMAX} - T_A)/ \theta_{JA}$ and the number listed in the maximum table.

Note 3: Human Body mode, 100pF capacitor discharge on 1.5KΩ resistor

Recommended Operation Conditions

Version	Vin：90VAC~265VAC，50/60Hz
LP3773D	7.5W（5V/1500mA）

Electrical Characteristics (Notes 4, 5) (Unless otherwise specified, V_{CC}=15V and T_A =25 ℃)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Supply Voltage Section						
V_{CC_ST}	V_{CC} Start up Voltage	V_{CC} Rising	14	15.5	18	V
V_{CC_UVLO}	V_{CC} UVLO Voltage	V_{CC} Falling	3.5	4	4.5	V
I_{ST}	V_{CC} Start up Current	V_{CC}= $V_{CC\text{-}ST}$- 1V	0	0.2	0.6	uA
I_{cc}	V_{CC} Operating Current			500		uA
BJT Driver Section						
I_{SOURCE}	BJT Driving Current		30	35	40	mA
I_{SINK}	BJT Pull Down Current		450	500	550	mA
Current Sense Section						
V_{CS1}	The high load current threshold			500		mV
V_{CS2}	The light load current threshold			330		mV
T_{LEB}	The Leading Edge Blanking Time			500		ns
T_{DELAY}	The turn off delay of the BJT			200		ns
Feedback Section						
R_{FB}	The input resistance of the FB	V_{FB}=4V	1	1.6	2	MΩ
V_{FB}	The reference voltage of FB		3.94	4	4.06	V
Output Cable Compensation Section						
V_{COMP_LINE}	The Output cable compensation parameter	V_{FB}=-10V，R_{LINE}=30K		120		mV
Protection Section						
V_{FB_OVP}	FB over voltage reference		6.5	7.0	7.5	V
T_{ON_MAX}	Maximum turn on time			25		uS
T_{SD}	The over temp reference			150		℃
T_{HYS}	The hysteresis window of OTP			30		℃
Integrated BJT Parameter						
V_{CBO}	BJT CB break down voltage	I_C=0.1mA	850			V
I_{CESAT}	Collector limit current	I_B=40mA		0.8		A

Note 4: production testing of the chip is performed at 25 ℃.

Note 5: the maximum and minimum parameters specified are guaranteed by test, the typical value are guaranteed by design, characterization and statistical analysis
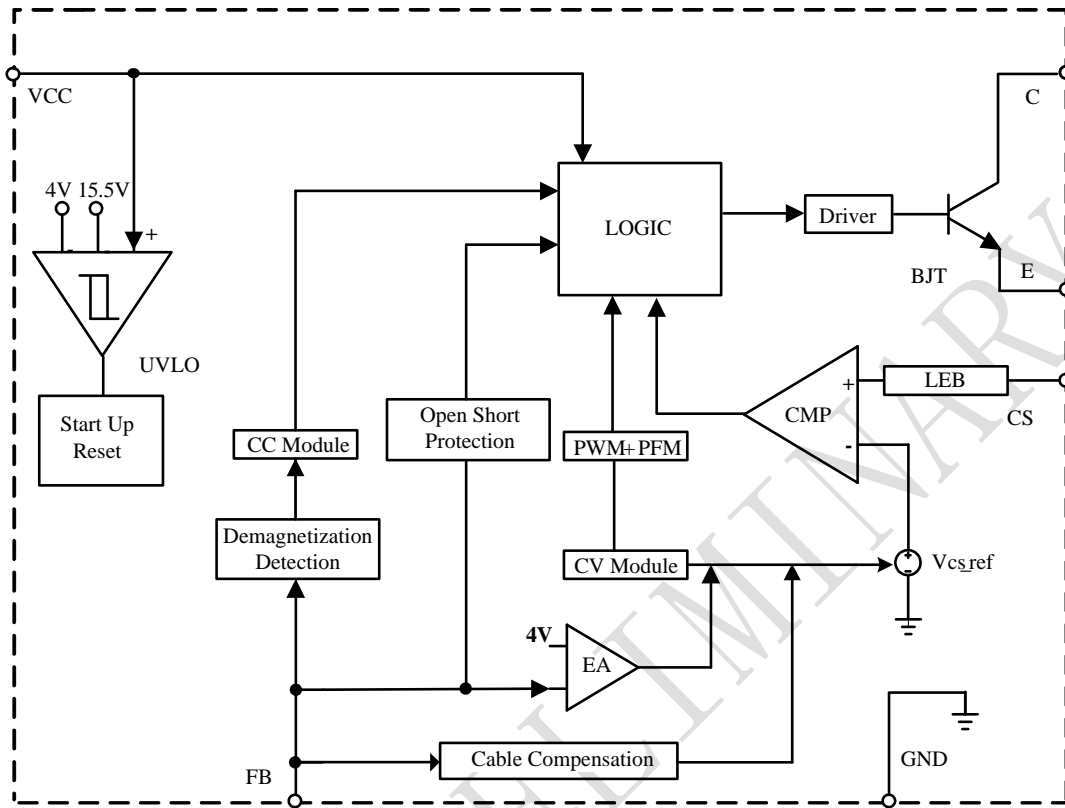
Internal Block Diagram

Figure 3: Internal Block Diagram

Application Information

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Start Up

After system powered up, the VCC pin capacitor is charged up by the start up resistor. When the VCC pin voltage reaches the turn on threshold, the internal circuits start operating. Because of the very small startup current, the startup resistor can de designed very large to achieve low standby power. After the IC start up, the VCC voltage is supplied by the transformer auxiliary winding.

Peak Current Control

The IC detects the transformer primary side current cycle by cycle by the external Rcs resistor. When the voltage on the Rcs higher than the internal voltage reference 500mV, the IC will turn off the BJT

The heavy load current limit can be calculated by the following formula:

$$I_{P\_PK} = \frac{500}{R_{CS}}\ (mA)$$

The internal peak comparator involves a 500ns LEB time.

The output current can be calculated by the following formula：

$$I_O = \frac{1}{4} \times I_{\mathrm{P\_PK}} \times \frac{N_P}{N_S}$$

For which the Np is the transformer primary winding turns, Ns is the transformer secondary winding turns and the Ip_pk is the peak current limit.

The CV Control and Output Voltage Setting

LP3773D achieves the constant voltage regulation by sampling the auxiliary winding voltage when the secondary side demagnetization. The output voltage can be calculated by the following formula:

$$V_O = \frac{4 * (R_{FBL} + R_{FBH})}{R_{FBL}} * \frac{N_S}{N_{aux}}$$

For which the R_{FBL} is the FB pull down resistor and the R_{FBH} is the FB pull up resistor and the N_{aux} is the transformer auxiliary winding turns.

Protection Function

LP3773D offers rich protection functions to improve the system reliability, including FB resistor open short protection, output short protection and over temperature protection.

PCB Layout

The following rules should be followed in LP3773D PCB layout:

Bypass Capacitor

The bypass capacitor on V_{CC} pin should be as close as possible to the V_{CC} Pin and GND pin.

FB Pin

The FB divided resistor should be as close as possible to the FB Pin and as far as possible to the voltage noise point.

Ground Path

The power ground path for current sense should be short, and the power ground path should be separated from small signal ground path.

The Area of Power Loop

The area of main current loop should be as small as possible to reduce EMI radiation, such as the inductor, the power BJT, the output diode and the bus capacitor loop.

C Pin

To increase the copper area of C pin for better thermal dissipation. However too large copper area may compromise EMI performance.

Physical Dimensions

SOP7 PACKAGE OUTLINE DIMENSIONS

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270 (BSC)		0.050 (BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°