General Description

BF1565 is a high performance, highly integrated AC/DC power supply control device which is operating in primary side sensing and regulation. The device operates at PFM in CC mode and at PWM+PFM in CV mode to achieve excellent regulation and high efficiency without requiring an opto-coupler and secondary control circuitry.

BF1565 has built-in line voltage compensation for CC mode and cable drop compensation for CV mode without external components, so that it can provide excellent CC and CV performance.

BF1565 can directly drive power BJT, which can further lower system cost. It has a number of key built-in functions and protection features, so that it can minimize the external component count, simplify EMI design and lower the total bill of material cost.

Applications

- Cell Phone Charger
- Low Power Adaptor
- Auxiliary Power for PC, TV etc.
- LED Driver

Features

- Primary Side Regulation eliminates Opto-coupler and secondary CV/CC control circuitry
- Multi-mode operation for highest overall efficiency
- ±5% Constant Voltage and high precision Constant Current regulation at universal AC Input
- No-load power consumption <150mW at 230Vac with typical application circuit
- Max output power 6W
- Built-in Soft-Start circuit
- Built-in Cable Drop Compensation
- Low Start-up current (Max.5uA)
- Built-in Frequency Jitter easily meets global EMI standards
- Built-in Short Circuit Protection, output Over Voltage Protection, Auxiliary line Open Protection
- Built-in Over Temperature Protection (OTP)
- Built-in Leading Edge Blanking (LEB)
- Cycle-by-Cycle current limiting
- Dynamic base current control
- VDD Under Voltage Lockout (UVLO) with hysteresis
- SOT23-6 Package

Typical Application

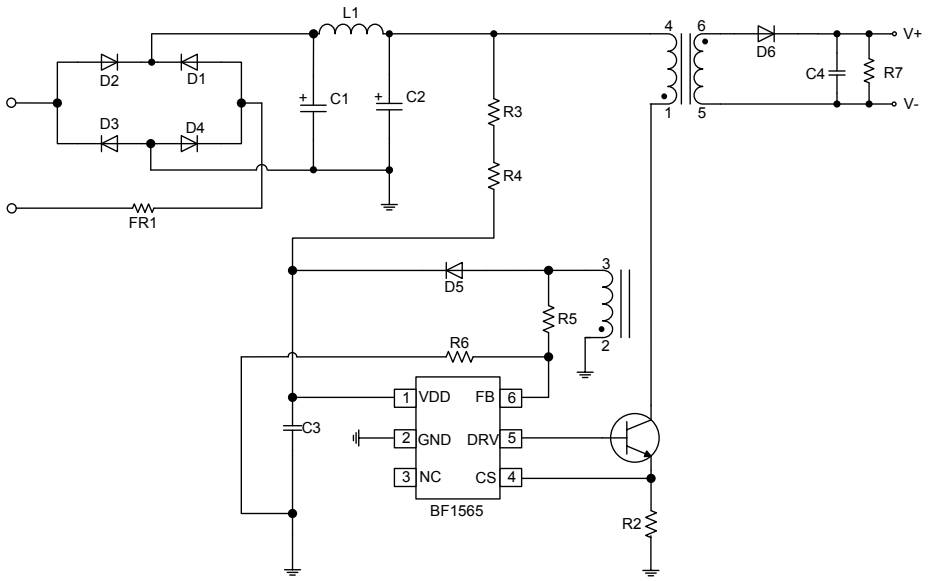


Figure 1: BF1565 Typical Application Circuit

Block Diagram

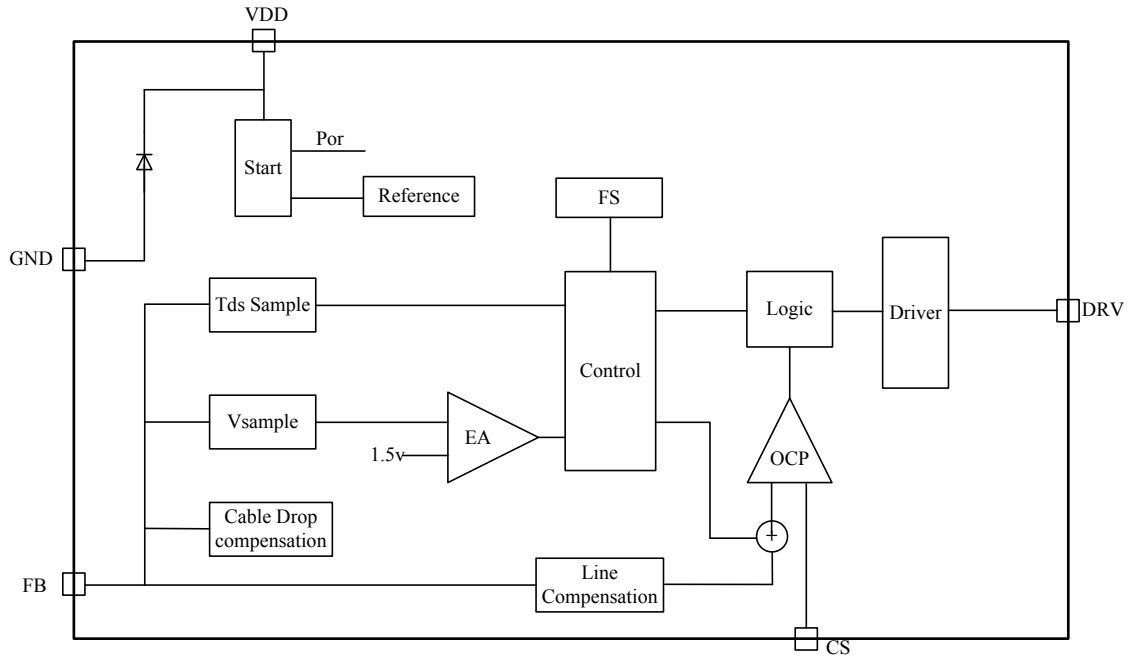


Figure 2: BF1565 Functional Block Diagram

Package Type

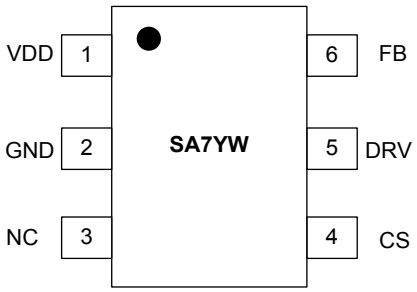


Figure 3: BF1565 Pin Configuration

SA7: Internal Code

Y: Year Code W: Week Code

Pin Description

Pin No.	Pin Name	Description
1	VDD	Power supply
2	GND	Ground
3	NC	No connection
4	CS	Primary current sense
5	DRV	Base drive for BJT
6	FB	Output feedback

Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
DC supply voltage	VDD	-0.3 to 7.7	V
Power dissipation	P_D	400	mW
Sense pin input voltage	V_{VFB} V_{IFB}	-0.3 to 7.7	V
Lead temperature	T_L	260	℃
Operating junction temperature	T_J	-40 to +125	℃
Storage temperature range	T_{STJ}	-55 to +150	℃
ESD capability HBM		2000	V

Attention: Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

Electrical Characteristic

(T_A = 25°C, unless otherwise noted)

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Supply voltage						
Start-up current	$I_{DD\ ST}$	VDD=5V		2.5	5	μA
Operation current	$I_{DD\ op}$	VDD=7.2V		300	650	μA
Operation voltage	$V_{DD\ op}$			7		V
Turn-on threshold voltage	UVLO(ON)		5.6	6.4	7.2	V
Turn-off threshold voltage	UVLO(OFF)		2.6	2.8	3	V
VDD latch voltage	V_{LATCH}			7.6		V
Oscillator						
Maximum operating frequency	$f_{SW\ MAX}$		60			KHz
Minimum operating frequency	$f_{SW\ MIN}$		0.4	0.65	0.9	KHz
Current Sensing						
Leading edge blanking	T_{LEB}			460		ns
Maximum current sense detection voltage	$V_{OCP\ MAX}$		0.48	0.5	0.52	V
Minimum current sense detection voltage	$V_{OCP\ MIN}$			0.2		V
Voltage Sensing						
Reference voltage for EA	$V_{CV\ REF}$		1.48	1.5	1.52	V
Else						
Line voltage compensation ratio	K_{LC}			6		
Output driver current (max)	I_{DRIVER}		20	25	30	mA
Driver pull-down on-resistance	R_{DSON}			1.5		Ω
Soft start time	T_{SS}			3		ms

Operation Description

● CC/CV Operation

The BF1565 uses PFM control mode in CC mode while PWM+PFM mode in CV mode. In charger applications, a discharged battery starts charging in the CC mode, the IC switches to CV mode until the battery is nearly full charged. In order to achieve constant output current and voltage, the working frequency and primary-side peak current will be changed to regulate the power input.

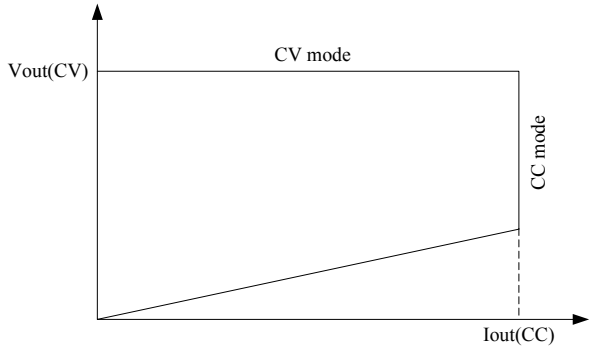


Figure 4: Power Envelope

In Constant Voltage (CV) mode, the device samples the voltage on FB, which reflects the power output voltage. And it compare with the reference to regulate the working frequency and primary-side peak current with EA .

The output voltage is given by:

$$V_{OUT} = 1.5 \cdot \frac{R_5 + R_6}{R_6} \cdot \frac{N_S}{N_A} - V_D \qquad (1)$$

Where, V_D is the drop voltage of output Diode, N_S/N_A is the transformer secondary-auxiliary turns ratio. R_5, R_6 are voltage divided resistance on FB.

In Constant Current (CC) mode, the device sample the timing information at the FB pin and current information at the CS pin, let the product of T_{DS} and f_{SW} (T_{DS}*f_{SW}) to be a constant, allow accurate regulation of the secondary average current.

The output current is given by:

$$I_{OUT} = \frac{1}{5} \cdot \frac{N_P}{N_S} \cdot I_P \qquad (2)$$

Where, I_P is the maximum peak current of primary winding, N_P/N_S is the primary-secondary turns ratio.

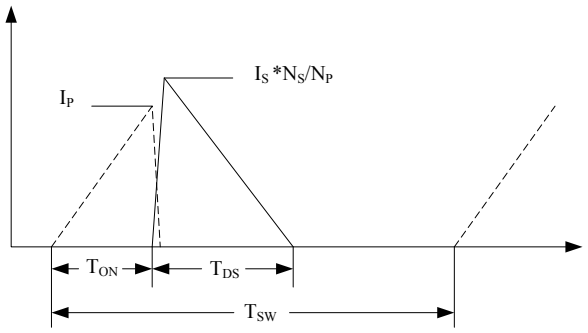


Figure 5: Transformer Currents

● Cycle-by-Cycle Current Limiting

The primary-side current flow through the sense-resistor and make the voltage on CS pin ramp up. When the voltage exceeds the internal threshold voltage value, the power BJT will be turned off immediately. The threshold voltage is changing gradually in CV mode while constant in CC mode.

● Soft Start

A built-in soft start circuit is applied at start-up state. Once the VDD reaches UVLO (ON), the working frequency will start in a constant value for a while because of the soft start circuit.

● Built-in Cable Drop Compensation

The BF1565 includes a proprietary built-in output cable drop compensation block which can provide a constant output voltage at the end of the cable over entire load range in CV mode. So that it can compensate typically several percentage of voltage drop on the cable, achieve a good load regulation.

● Built-in Line-voltage Compensation

BF1565 has a built-in line voltage compensation block which provides the function of feed-forward to eliminate change in I_P due to change in di/dt and the propagation delay of the internal comparator and BJT turn-off time. The device detects the voltage on FB in the Ton period, then converts it to the current compensation and flow it into an internal compensation resistance which is connected with CS pin.

The compensation voltage is giver by:

$$V_{LC} = \sqrt{2} \cdot V_{AC} \cdot \frac{N_A}{N_P} \cdot \frac{1}{R_5} \cdot K_{LC} \quad (3)$$

Where, V_{AC} is the input AC voltage, N_A/N_P is the auxiliary-primary turns ratio, R5 is the divided resistance on FB, K_{LC} is the compensation coefficient.

● Over Voltage Protection (OVP)

The BF1565 includes such a function that protect against output over-voltage and under-voltage, which could be monitored by FB pin and VDD pin. If the voltage at FB pin exceeds the over-voltage threshold, the external power BJT will be turned off immediately and the controller will restart. Once VDD drops below the UVLO(OFF) threshold, the controller will reset itself and go into a new start cycle. The controller will continue the start cycle until the error condition is removed.

● VDD Latch

The BF1565 has a built-in VDD latch block to provide the function of VDD over voltage protection and latch. When the voltage on VDD pin exceeds the threshold, the external power BJT will be turned off and device pull down VDD with an 8 mA current, until UVLO, the controller will restart.

● Dynamic Base Drive

BF1565 directly drives a BJT switching device with base current control to optimize performance. The BJT base current ranges from 12mA to 30mA, the base current is related to $V_{PK,}$ as shown in figure 6:

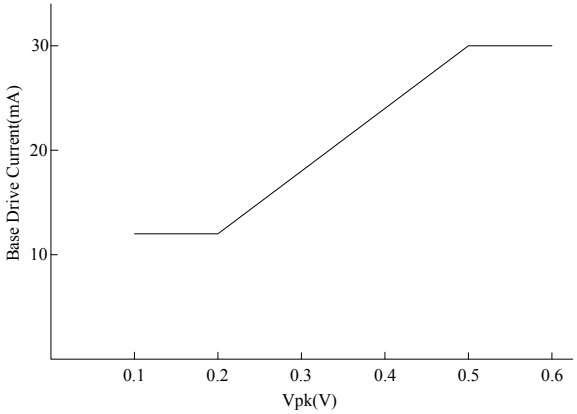
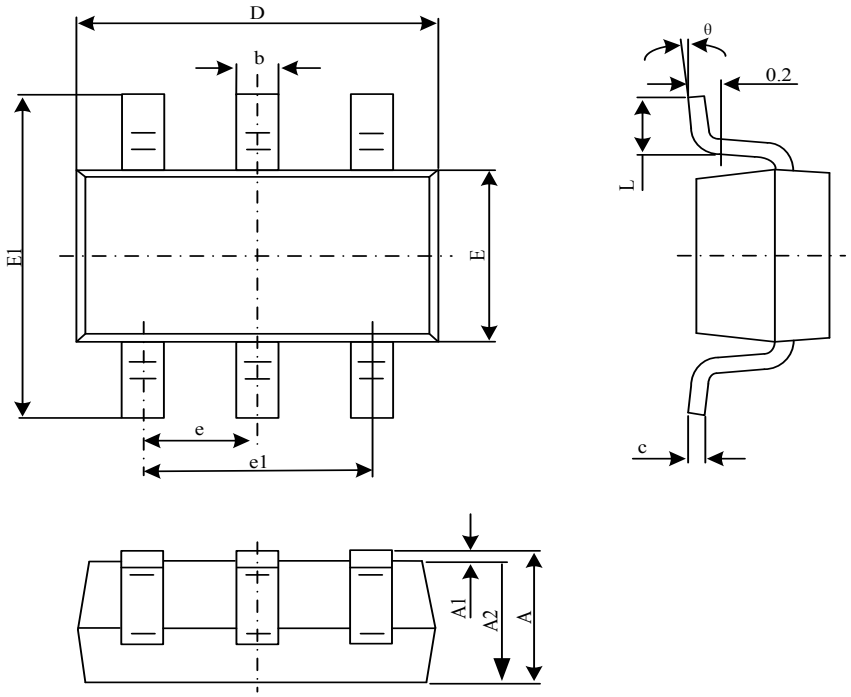


Figure 6: Base Drive Current vs V_{PK}

Package Outline

SOT23-6



Symbol	Dimensions In Millimetres		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

Packing

MBB packing
7”reel: Pizza box 200mm*200mm*100mm.Carton 420mm*420*mm*320mm.3000PCS per reel.

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