D804

General Description

The D804 is a high performance AC/DC power supply controller for battery charger and adapter applications. The device uses Pulse Frequency Modulation (PFM) method to build discontinuous conduction mode (DCM) flyback power supplies.

The D804 provides constant voltage, constant current (CV/CC) regulation without requiring an opto-coupler and secondary control circuitry. It also eliminates the need of loop compensation circuitry while maintaining stability.

The D804 achieves excellent regulation and high power efficiency, the no-load power consumption is less than 200mW at 265VAC input.

Features

- Primary Side Control for Rectangular Constant Current and Constant Voltage Output
- Eliminates Opto-Coupler and Secondary CV/CC Control Circuitry
- Eliminates Control Loop Compensation Circuitry
- Flyback Topology in DCM Operation
- Random Frequency Modulation to Reduce System EMI
- Valley Turn on of External Power NPN Transistor
- Built-in Soft Start
- Open Circuit Protection
- Over Voltage Protection
- Short Circuit Protection

Applications

- Adapters/Chargers for Cell/Cordless Phones, PDAs, MP3 and Other Portable Apparatus
- Standby and Auxiliary Power Supplies

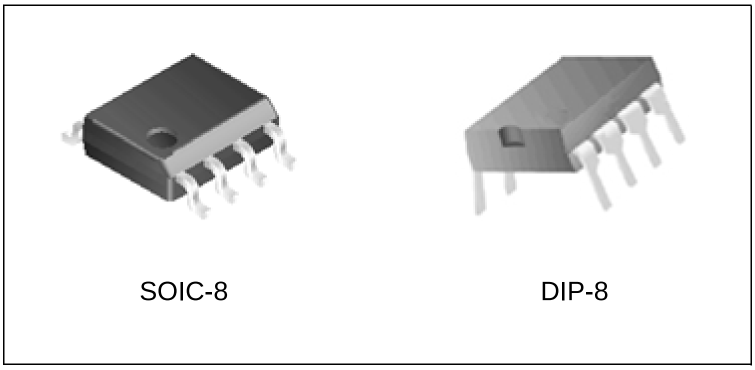


Figure 1. Package Types of D804

Pin Configuration

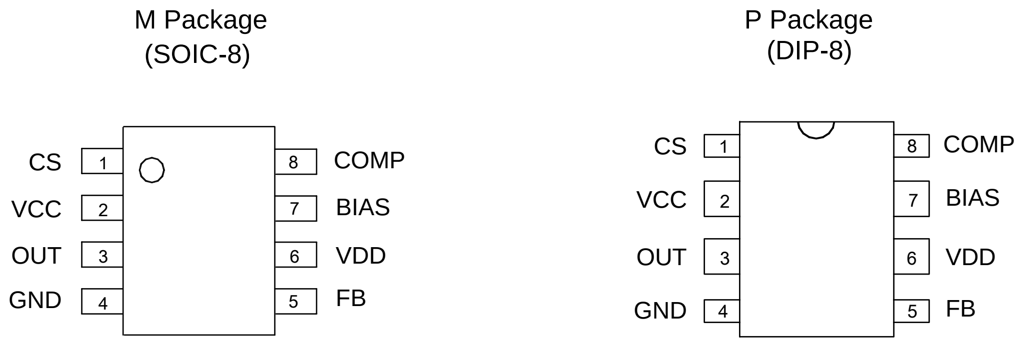


Figure 2. Pin Configurations of D804 (Top View)

Pin Description

Pin Number	Pin Name	Function
1	CS	The primary current sense
2	VCC	Supply voltage
3	OUT	This pin drives the base of external power NPN switch
4	GND	Ground
5	FB	The voltage feedback from the auxiliary winding
6	VDD	The 5.5V output of the internal voltage regulator
7	BIAS	This pin sets the bias current inside D804 with an external resistance to GND
8	COMP	This pin connects a bypass capacitor for CC function

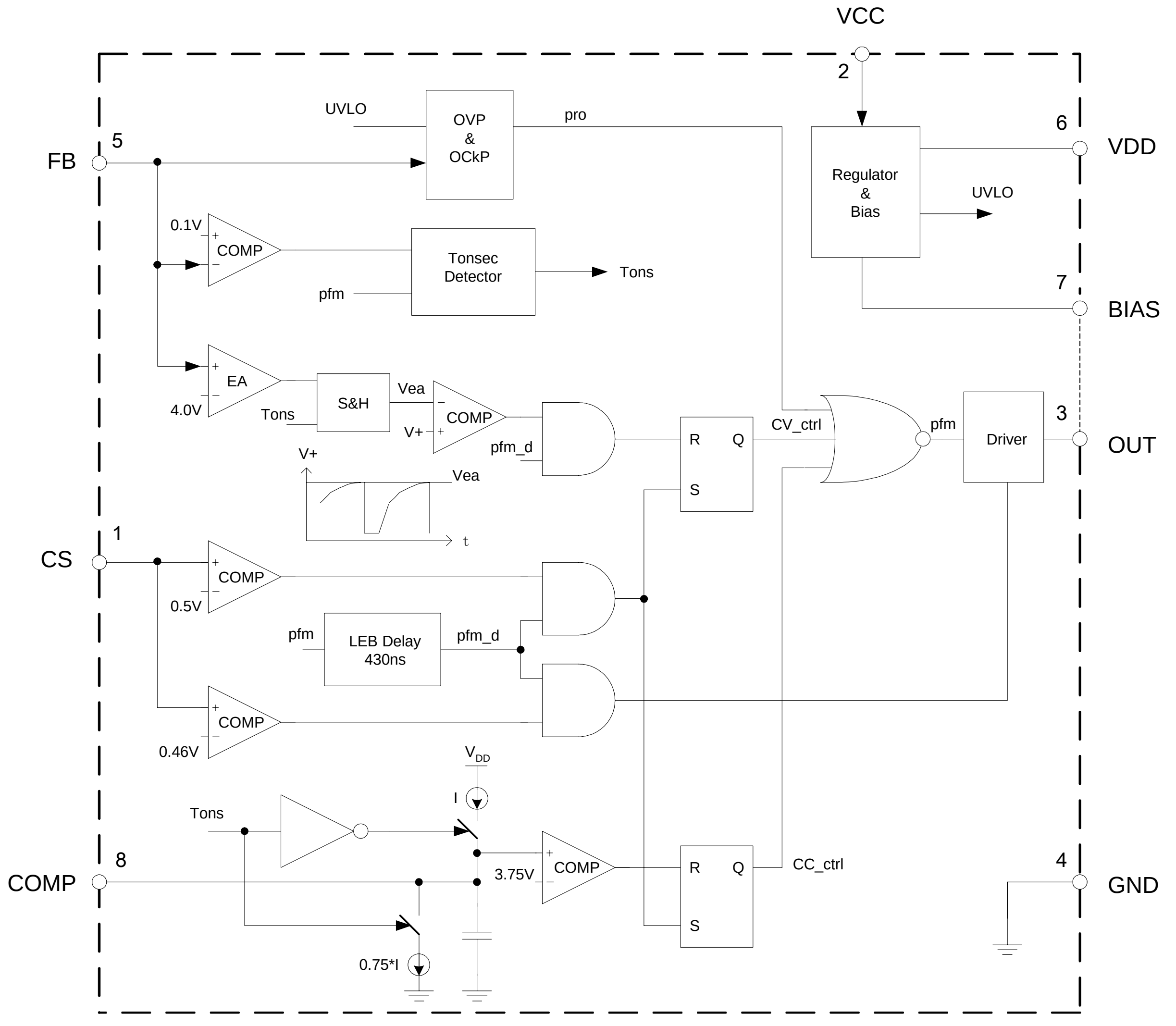
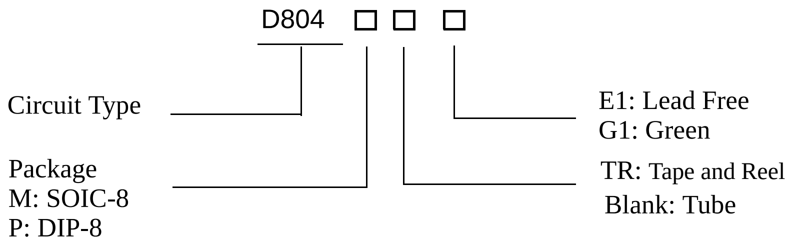


Figure 3. Functional Block Diagram of D804

Ordering Information



Package	Temperature Range	Part Number		Marking ID		Packing Type
		Lead Free	Green	Lead Free	Green	
SOIC-8	-40 to 85°C	D804 M-E1	D804M-G1	D804M-E1	D804M-G	Tube
		D804MTR-E1	D804MTR-G1	D804M-E1	D804M-G	Tape & Reel
DIP-8		D804P-E1	D804P-G1	D804P-E1	D804P-G1	Tube

Absolute Maximum Ratings (Note 1)

Parameter	Value		Unit
Supply Voltage VCC	-0.3 to 30		V
Voltage at CS, BIAS, OUT, VDD, COMP to GND	-0.3 to 7		V
FB input (Pin 5)	-40 to 10		V
Output Current at OUT	Internally limited		A
Power Dissipation at T_A=25°C	0.657		W
Operating Junction Temperature	150		°C
Storage Temperature	-65 to 150		°C
Lead Temperature (Soldering, 10s)	300		°C
Thermal Resistance Junction-to-Ambient	SOIC-8	190	°C/W
	DIP-8	100	
ESD (HBM)	2000		V

Note 1: Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

Electrical Characteristics

(V_{CC}=15V, T_A=25°C, unless otherwise specified.)

Parameter		Symbol	Conditions	Min	Typ	Max	Unit
UVLO SECTION							
Start-up Threshold		$V_{TH\ (ST)}$		17.5	19	20.5	V
Minimal Operating Voltage		V_{OPR}(min)	After turn on	7	8.7	9.8	V
REFERENCE VOLTAGE SECTION							
BIAS Pin Voltage		V_{BIAS}	R_{BIAS}=200kΩ, Before turn on	1.150	1.19	1.23V	
VDD Pin Voltage		VDD		5.2	5.5	5.8	V
STANDBY CURRENT SECTION							
Start-up Current		I_{ST}	V_{CC} = $V_{TH\ (ST)}$-0.5V, R_{BIAS}=200kΩ, Before turn on		70	80	µA
Operating Current		$I_{CC(OPR)}$	R_{BIAS}=200kΩ		680	900	µA
DRIVE OUTPUT SECTION							
OUT Maximum Current	Sink	I_{OUT}	R_{BIAS}=200kΩ	50			mA
	Source			25	30		
CURRENT SENSE SECTION							
Current Sense Threshold		V_{CS}		485	505	525	mV
Pre-Current Sense		$V_{CS(PRE)}$		385	410	435	mV
Leading Edge Blanking					430		ns
FEEDBACK INPUT SECTION							
Feedback Pin Input Leakage Current		I_{FB}	V_{FB}=4V	7.0	9.8	12.6	µA
Feedback Threshold		V_{FB}		3.90	4.00	4.10	V
Enable Turn-on Voltage		$V_{FB(EN)}$		-0.9	-0.7	-0.5	V
COMP THRESHOLD VOLTAGE SECTION							
Turn-on Threshold Voltage		V_{COMP}		3.42	3.60	3.78	V
PROTECTION SECTION							
Over Voltage Protection		$V_{FB(OVP)}$		7	8	9	V

Operation Description

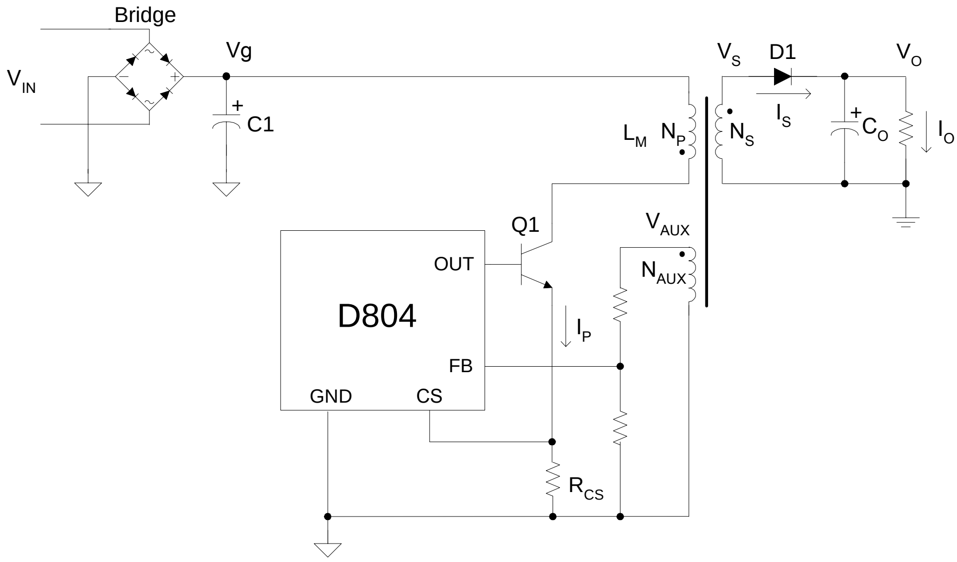


Figure 4. Simplified Flyback Converter Controlled by D804

Figure 4 illustrates a simplified flyback converter controlled by D804.

Constant Primary Peak Current

The primary current ip(t) is sensed by a current sense resistor R_{CS} as shown in Figure 4.

The current rises up linearly at a rate of:

$$\frac{dip(t)}{dt} = \frac{vg(t)}{L_M} \qquad \text{................(1)}$$

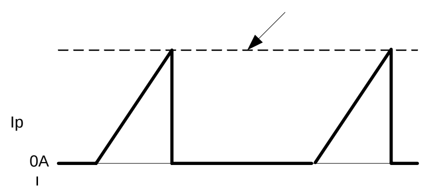


Figure 5. Primary Current Waveform

As illustrated in Figure 5, when the current ip(t) rises up to Ipk, the switch Q1 turns off. The constant peak current is given by:

$$Ipk = \frac{Vcs}{Rcs} \qquad \text{................(2)}$$

The energy stored in the magnetizing inductance LM each cycle is therefore:

$$Eg = \frac{1}{2} \times L_M \cdot Ipk^2 \qquad \text{................(3)}$$

So the power transferring from the input to the output is given by:

$$P = \frac{1}{2} \times L_M \times Ipk^2 \times f_{SW} \qquad \text{................(4)}$$

Where the fsw is the switching frequency. When the peak current Ipk is constant, the output power depends on the switching frequency fsw.

Constant Voltage Operation

The D804 captures the auxiliary winding feedback voltage at FB pin and operates in constant-voltage (CV) mode to regulate the output voltage. Assuming the secondary winding is master, the auxiliary winding is slave during the D1 on-time. The auxiliary voltage is given by:

$$V_{AUX} = \frac{N_{AUX}}{N_S} \times (Vo + Vd) \qquad \text{................(5)}$$

Operation Description (Continued)

Where the Vd is the diode forward drop voltage.

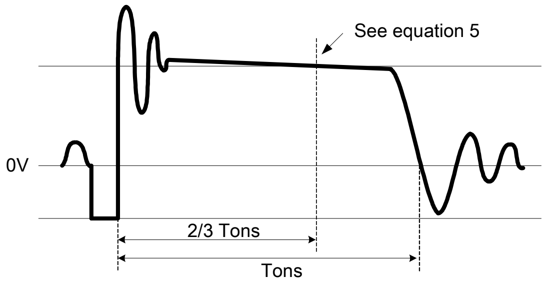


Figure 6. Auxiliary Voltage Waveform

The output voltage is different from the secondary voltage in a diode forward drop voltage. The diode drop voltage depends on the current. If the secondary voltage is always detected at a constant secondary current, the difference between the output voltage and the secondary voltage will be a fixed Vd. The voltage detection point is at two-thirds of the D1 on-time. The CV loop control function of D804 then generates a D1 off-time to regulate the output voltage.

Constant Current Operation

The D804 is designed to work in constant-current (CC) mode. Figure 7 shows the secondary current waveforms.

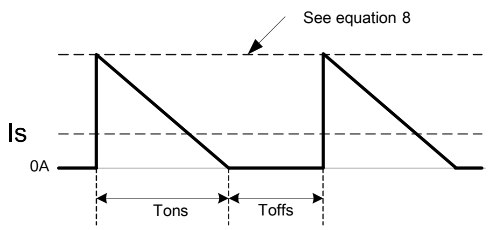


Figure 7 . Secondary Current Waveform

In CC operation, the CC loop control function of D804 will keep a fixed proportion between D1 on-time Tons and D1 off-time Toffs by discharging or charging the capacitance connected in COMP pin. The fixed proportion is

$$\frac{Tons}{Toffs}=\frac{4}{3} \qquad ....(6)$$

The relationship between the output constant-current and secondary peak current Ipks is given by:

$$Iout=\frac{1}{2}\times Ipks\times\frac{Tons}{Tons+Toffs} \qquad ....(7)$$

At the instant of D1 turn-on, the primary current transfers to the secondary at an amplitude of:

$$Ipks=\frac{N_P}{N_S}\times Ipk \qquad ....(8)$$

Thus the output constant-current is given by:

$$Iout=\frac{1}{2}\times\frac{N_P}{N_S}\times Ipk\times\frac{Tons}{Tons+Toffs}=\frac{2}{7}\times\frac{N_P}{N_S}\times Ipk \qquad ....(9)$$

Leading Edge Blanking

When the power switch is turned on, a turn-on spike will occur on the sense-resistor. To avoid false-termination of the switching pulse, a 430ns leading-edge blanking is built in. During this blanking period, the current sense comparator is disabled and the gate driver can not be switched off.

CCM Protection

The D804 is designed to operate in discontinuous conduction mode (DCM) in both CV and CC modes. To avoid operating in continuous conduction mode (CC), the D804 detects the falling edge of the FB input voltage on each cycle. If a 0.1V falling edge of FB is not detected, the D804 will stop switching.

OVP & OCkP

The D804 includes output over-voltage protection (OVP) and open circuit protection (OCkP) circuitry as shown in Figure 8. If the voltage at FB pin exceeds 8V, 100% above the normal detection voltage, or the -0.7V falling edge of the FB input can not be monitored, the D804 will immediately shut off and enters hiccup mode. The D804 sends out a fault detection pulse every 8ms in hiccup mode until the fault has been removed.

Operation Description (Continued)

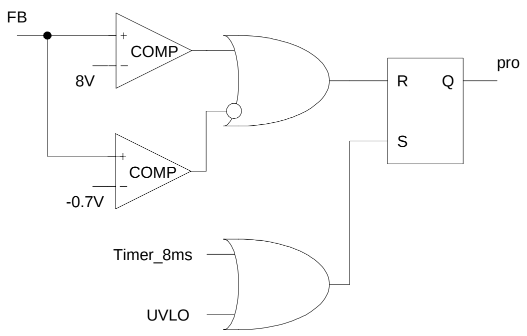


Figure 8. OVP and OCkP Function Block

Typical Application

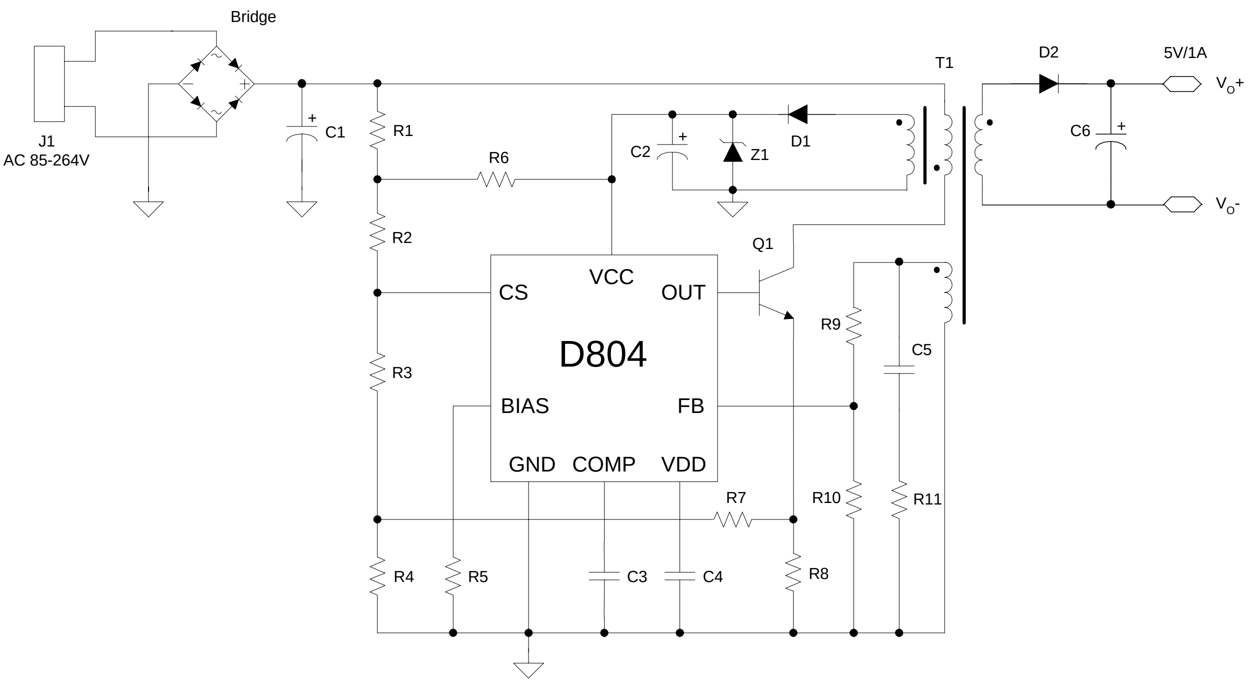


Figure 9. 5V/1A Output for Battery Charger of Mobile Phone