Energy Efficient, Low Power OFF-Line Switcher IC

Product Highlights

Optimized for Lowest System Cost

- Fully integrated auto-restart for short circuit and open loop protection.
- Self-biased supply – saves transformer auxiliary winding and associated bias supply components.
- Frequency jittering greatly reduces EMI.
- Meets HV creepage requirements between DRAIN and all other pins both on the PCB and at the package.
- Lowest component count switcher solution.

Extremely Energy Efficient

- Easily meets all global energy efficiency regulations with no added components.
- No-load consumption <300 mW without bias winding at 265 VAC input (<50 mW with bias winding).
- ON/OFF control provides constant efficiency to very light loads – ideal for mandatory CEC regulations.

Applications

- Chargers/adapters for cell/cordless phones, PDAs, digital cameras, MP3/portable audio players, and shavers.
- Supplies for appliances, industrial systems, and metering.

Description

TB9364 incorporates a 700 V power MOSFET, oscillator, simple ON/OFF control scheme, a high voltage switched current \source, frequency jittering, cycle-by-cycle current limit and thermal shutdown onto a monolithic IC. The start-up and operating power are derived directly from the DRAIN pin, eliminating the need for a bias winding and associated circuitry.

Features Superior to Linear/RCC

- Accurate hysteretic thermal shutdown protection – automatic recovery improves field reliability.
- Universal input range allows worldwide operation.
- Simple ON/OFF control, no loop compensation needed.
- Eliminates bias winding – simpler, lower cost transformer.
- Very low component count – higher reliability and single side printed circuit board.
- Auto-restart reduces delivered power by 95% during short circuit and open loop fault conditions.
- High bandwidth provides fast turn on with no overshoot and excellent transient load response.

Output Power Table

230VAC±15%		85-265 VAC	
Adapter(1)	Open Frame(2)	Adapter(1)	Open Frame(2)
5.5W	9W	4W	6W

Table1. Notes:

1. Minimum continuous power in a typical non-ventilated enclosed adapter measured at 50 ℃ ambient.
2. Minimum practical continuous power in an open frame design with adequate heat sinking, measured at 50 ℃ ambient.

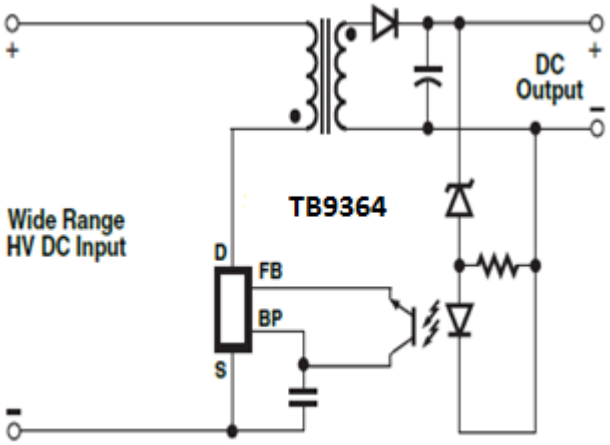

Figure 1. Typical Application of TB9364

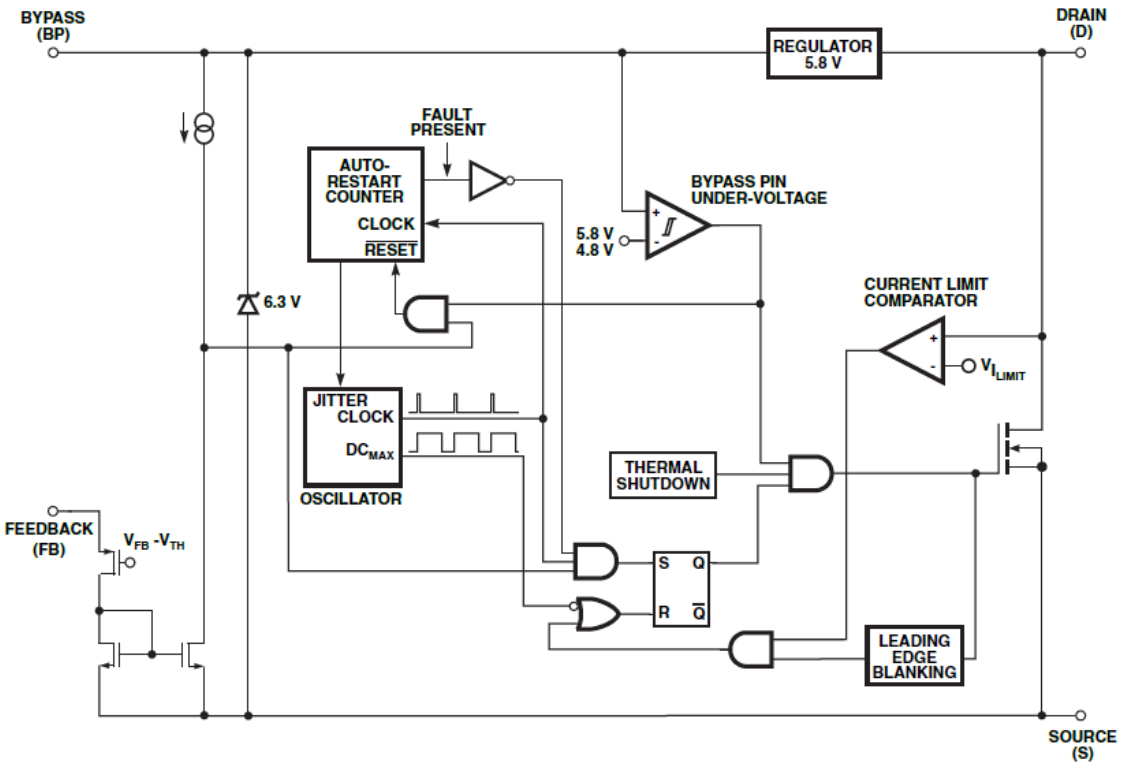

Figure 2. Function Block Diagram

Pin Functional Description

DRAIN (D) Pin:

Power MOSFET drain connection. Provides internal operating current for both start-up and steady-state operation.

BYPASS (BP) Pin:

Connection point for a 0.1 µF external bypass capacitor for the internally generated 5.8 V supply. If an external bias winding is used, the current into the BP pin must not exceed 1 mA.

FEEDBACK (FB) Pin:

During normal operation, switching of the power MOSFET is controlled by this pin. MOSFET switching is disabled when a current greater than 49 µA is delivered into this pin.

SOURCE (S) Pin:

This pin is the power MOSFET source connection. It is also the ground reference for the BYPASS and FEEDBACK pins.

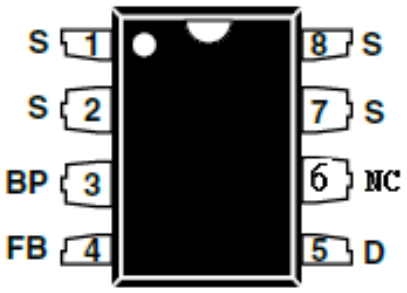

Figure 3. Pin Configuration

ABSOLUTE MAXIMUM RATINGS (1, 5)

DRAIN Voltage	-0.3 V to 700 V
Peak DRAIN Current	400 mA (750 mA)[2]
FEEDBACK Voltage	-0.3 V to 9 V
FEEDBACK Current	100 mA
BYPASS Voltage	-0.3 V to 9 V
Storage Temperature	-65 ℃ to 150 ℃
Operating Junction Temperature[3]	-40 ℃ to 150 ℃
Lead Temperature[4]	260 ℃

Notes:

1. All voltages referenced to SOURCE, TA = 25 ℃.
2. The higher peak DRAIN current is allowed while the DRAIN voltage is simultaneously less than 400 V.
3. Normally limited by internal circuitry.
4. 1/16 in. from case for 5 seconds.
5. Maximum ratings specified may be applied, one at a time, without causing permanent damage to the product. Exposure to Absolute Maximum Rating conditions for extended periods of time may affect product reliability.

Parameter	Symbol	Conditions SOURCE =0 V,T_J = -40 to 125℃ See Figure 4 (Unless Otherwise Specified)		Min	Typ	Max	Units
CONTROL FUNCTIONS							
Output Frequency	F_{OSC}	TJ = 25℃	Average	110	132	150	kHz
			Peak-Peak Jitter		9		
Maximum Duty Cycle	D_{CMAX}	S2 Open		60			%
FEEDBACK Pin Turnoff Threshold Current	I_{FB}	T_J = 25℃		30	49	68	µA
FEEDBACK Pin Voltage at Turnoff Threshold	V_{FB}	T_J = 0℃ to 125℃		1.53	1.63	1.73	V
DRAIN Supply Current	I_{S1}	$V_{FB} \geq 2$ V (MOSFET Not Switching) See Note A			200	250	µA
	I_{S2}	FEEDBACK Open (MOSFET Switching)			350	450	µA
BYPASS Pin Charge Current	I_{CH1}	V_{BP} = 0V, T_J = 25℃		-5.5	-3.5	-1.8	mA
	I_{CH2}	V_{BP} = 4V, T_J = 25℃		-3.8	-2.3	-1.0	
BYPASS Pin Voltage	V_{BP}						
BYPASS Pin Voltage Hysteresis	V_{BPH}			0.8	1.0	1.2	V
BYPASS Pin Supply Current	I_{BPSC}	See Note C		68			µA
CIRCUIT PROTECTION							
Current Limit	I_{LIMIT}	di/dt =50mA/µs T_J = 25°C		215	250	268	mA
Leading Edge Blanking Time	T_{LEB}	T_J = 25°C See Note D		170	250		ns
Current Limit Delay	T_{ILD}	T_J = 25°C See Note			125		ns
Thermal Shutdown Temperature	T_{SD}			135	142	150	°C
Thermal Shutdown	T_{SHD}	See Note E			75		°C

Hysteresis						
Parameter	**Symbol**	**Conditions** SOURCE =0 V,T_J = -40 to 125℃ See Figure 4 (Unless Otherwise Specified)	**Min**	**Typ**	**Max**	**Units**
OUTPUT						
ON-State Resistance	$R_{DS(ON)}$ I_D= 25mA	T_J = 25℃		24	28	Ω
		T_J = 100℃		38	45	
OFF-State Drain Leakage Current	I_{DSS}	V_{BP} = 6.2 V, $V_{FB} \geq$ 2 V, V_{DS} =560 V, T_J = 125℃			90	μA
Breakdown Voltage	BV_{DSS}	V_{BP} = 6.2 V, $V_{FB} \geq$ 2 V, See Note F, T_J = 25 ℃	700			V
DRAIN Supply Voltage			50			V
Output Enable Delay	T_{EN}				10	μs
Output Disable Setup Time	T_{DST}			0.5		μs
Output Disable Setup Time	T_{DST}	Output Disable Setup Time		45		μs
Auto-Restart Duty Cycle	D_{CAR}			5		%

NOTES:

A. Total current consumption is the sum of IS1 and I_{DSS} when FEEDBACK pin voltage is ≥2 V (MOSFET not switching) and the sum of I_{S2} and I_{DSS} when FEEDBACK pin is shorted to SOURCE (MOSFET switching).

B. Since the output MOSFET is switching, it is difficult to isolate the switching current from the supply current at the DRAIN. An alternative is to measure the BYPASS pin current at 6 V.

C. This current is only intended to supply an optional optocoupler connected between the BYPASS and FEEDBACK pins and not any other external circuitry.

D. This parameter is guaranteed by design.

E. This parameter is derived from characterization.

F. Breakdown voltage may be checked against minimum BVDSS specification by ramping the DRAIN pin voltage up to but not exceeding minimum BV_{DSS}.

G. Auto-restart on time has the same temperature characteristics as the oscillator (inversely proportional to frequency).

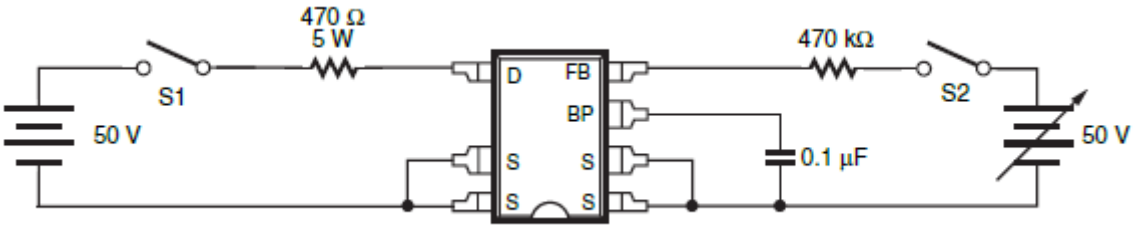

Figure 4. TB9364 General Test Circuit

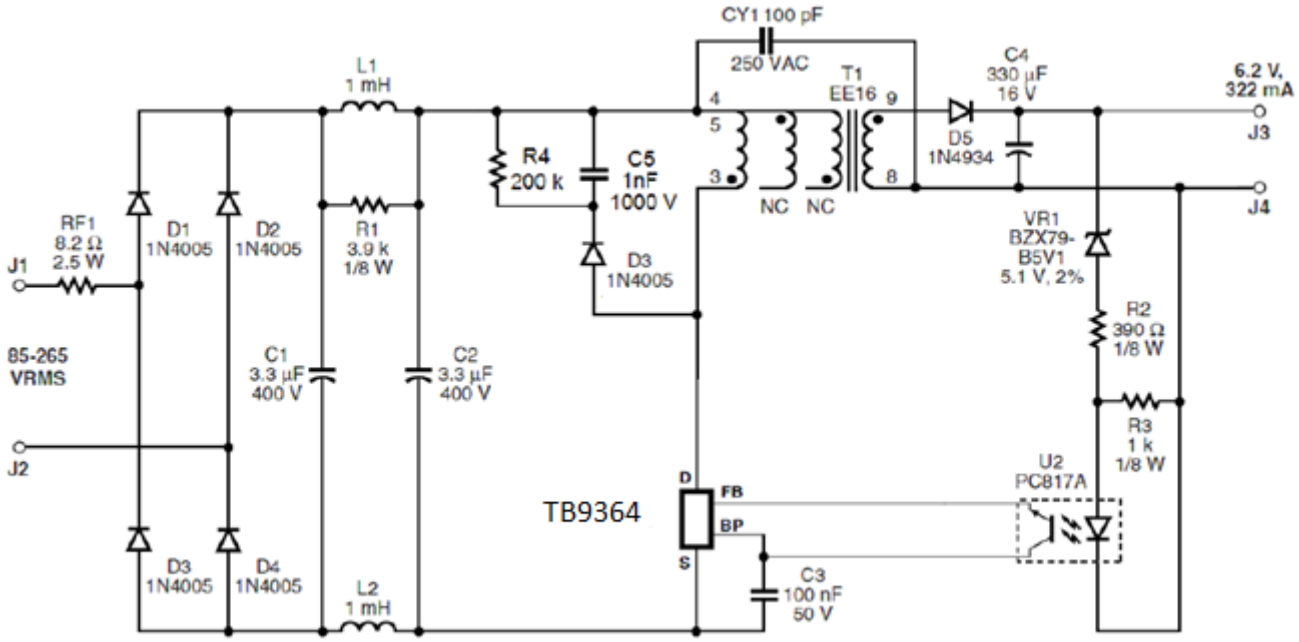

Figure 5. 2 W Universal Input CV Adapter Using TB9364

PACKAGE INFORMATION

●SOP−8

Unit: mm

■Packaging Information