DATA SHEET

TEA1504
GreenChip™; SMPS control IC

Preliminary specification
File under Integrated Circuits, IC11

1998 Mar 17

Philips
Semiconductors

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PRODUCT HIGHLIGHTS

Distinctive features

- High level of integration leads to 20 to 50 fewer components compared to power supply with discrete components
- On-chip efficient startup current source giving fast startup
- ON/OFF function replaces expensive mains switch with functional switch
- Direct off-line operation (90 to 276 Vac)
- On-chip 5% accurate oscillator.

Green features

- Low power consumption in off-mode (<100 mW)
- Burst mode stand-by (<2 W) for overall improved system efficiency
- Low power operation mode with lower frequency to reduce switching losses.

Protection features

- Demagnetization protection
- Cycle by cycle current limitation with programmable current trip level
- Accurate over voltage protection which tracks the output voltage
- Over temperature protection
- Safe-restart mode with reduced power for system fault conditions.

Highly versatile

- Usable in Buck and Flyback topology
- Interfaces both primary and secondary side feedback.

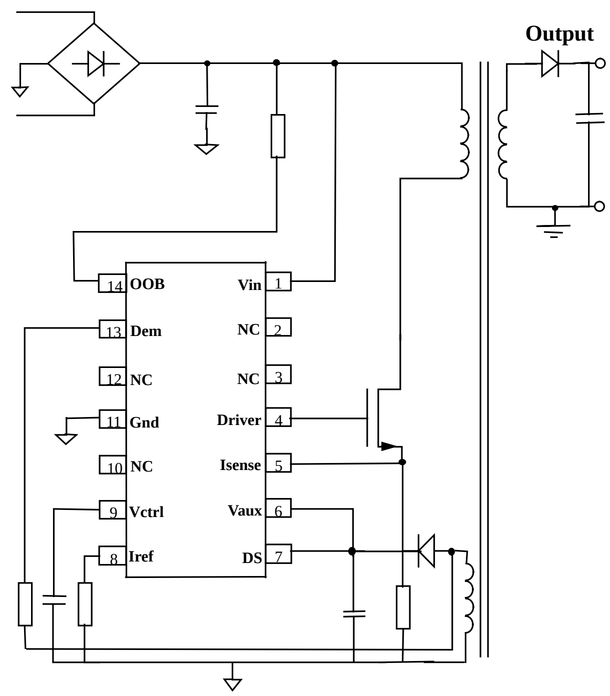


Fig.1 Typical Flyback Application.

GENERAL DESCRIPTION

The GreenChip™, intended for off-line 90 to 276 Vac power supply applications, is a monolithic high voltage family of ICs that combines analog and digital circuits to implement all necessary control functions for a switched mode power supply. The functions include integrated high voltage startup current source, voltage mode PWM control, 5% accurate trimmed oscillator, bandgap derived reference voltages, comprehensive fault protection, and leading edge blanking. High level of integration leads to cost effective power supplies that are compact, weigh less, and at the same time give higher efficiency, are more reliable and simple to design. Efficient green features lead to very low power operation modes and a novel ON/OFF function helps replace the expensive mains switch with a low cost functional switch.

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TEA1504	DIP14	plastic dual in-line package; 14 leads (300 mil)	SOT27-1

FUNCTIONAL BLOCK DIAGRAM

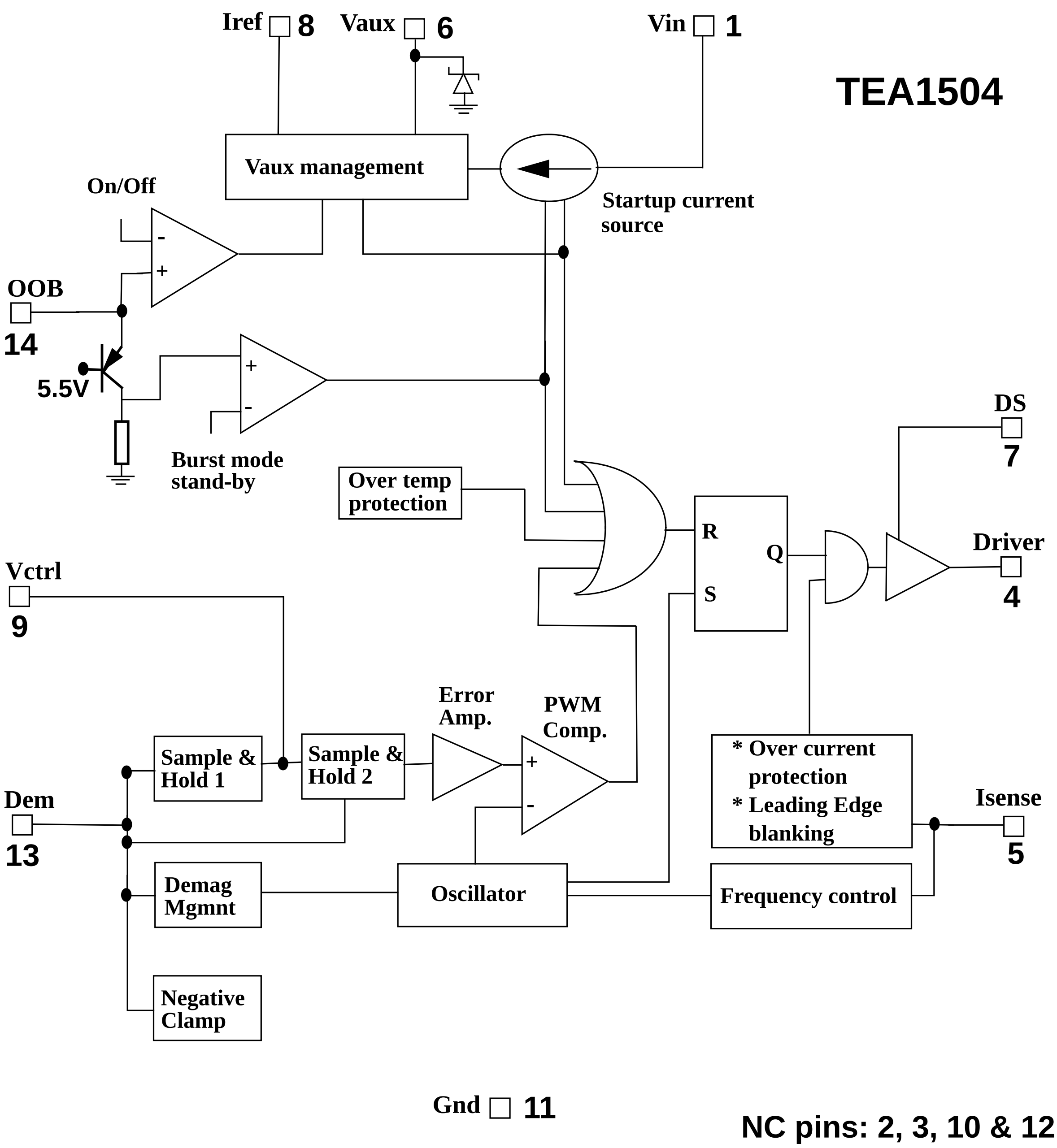


Fig.2 Functional Block Diagram.

PINNING

SYMBOL	PIN	DESCRIPTION
Vin	1	MOSFET Drain connection
HVS	2	High voltage safety spacer
NC	3	Not connected
Driver	4	MOSFET gate driver output
Isense	5	Programmable current sense resistor
Vaux	6	IC supply capacitor
DS	7	Supply for driver circuit
Iref	8	Reference resistor for setting internal reference currents
Vctrl	9	Feedback voltage for duty cycle control
NC	10	Not connected
Gnd	11	Ground
NC	12	Not connected
Dem	13	Demagnetization input signal from primary side auxiliary winding
OOB	14	On/Off/Burst Mode input signal

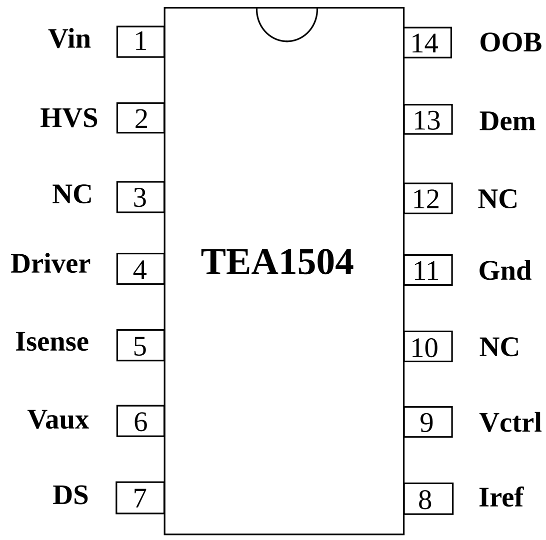


Fig.3 Pin assignment.

FUNCTIONAL DESCRIPTION

The GreenChip™ family of ICs are highly integrated, with most common PWM functions like error amplifier, oscillator, bias current generator, and band gap based reference voltage circuits fully integrated in the ICs. High level of integration leads to easy and cost effective design of power supplies. The ICs have been fabricated in a Philips proprietary high voltage BCDMOS process that enables devices of up to 650 V to be fabricated on the same chip with low voltage circuitry.

An efficient on-chip startup circuit enables fast startup and dissipates negligible power after start up. On-chip accurate oscillator generates a saw tooth waveform which is used by the voltage mode feedback control circuitry to generate a pulse width modulated signal for driving the gate of the power MOSFET. A novel regulation scheme is used to implement both primary and secondary side regulation to minimize external component count. Protection features like over voltage, over current, over temperature, and demagnetization protection, give comprehensive safety against system fault conditions. The GreenChip™ offers some advanced features that greatly enhance the efficiency of the overall system. Off-mode reduces the power consumption of the IC below 100 mW. Burst mode stand-by reduces the power consumption of the system to below 2 W. Low power operation mode reduces the operating frequency of the system, when the system is working under low load conditions, to reduce the switching losses.

Startup current source and vaux management

A versatile on-chip startup current source makes an external, highly dissipative, trickle-charge circuit unnecessary. Refer to Fig.2 for a block diagram of the IC. The startup current source derives power from the mains via the Vin (drain) pin. It supplies current (see Istart-low and Istart-high in Chapter “Characteristics”) to charge the Vaux (IC supply) capacitor and at the same time provides current to the control circuitry of the IC. Once the Vaux capacitor is charged to its startup voltage level (11 V), the on chip oscillator starts oscillating and the IC starts switching the power MOSFET. Power is then supplied to the load via the secondary winding. Figure 1 shows a typical flyback application diagram. The Vaux capacitor is also supplied by an auxiliary winding on the primary side. This winding is coupled to the secondary side winding supplying the output capacitor. As the output capacitor voltage increases and approaches its nominal value, the re-supply of the Vaux capacitor is done by the auxiliary winding. Figure 4 shows relevant waveforms at startup. For successful take over of supply of Vaux capacitor by the auxiliary winding, it is important that the re-supply of Vaux capacitor starts before its voltage drops to its Under Voltage Lockout (UVLO) level of 8.15 V.

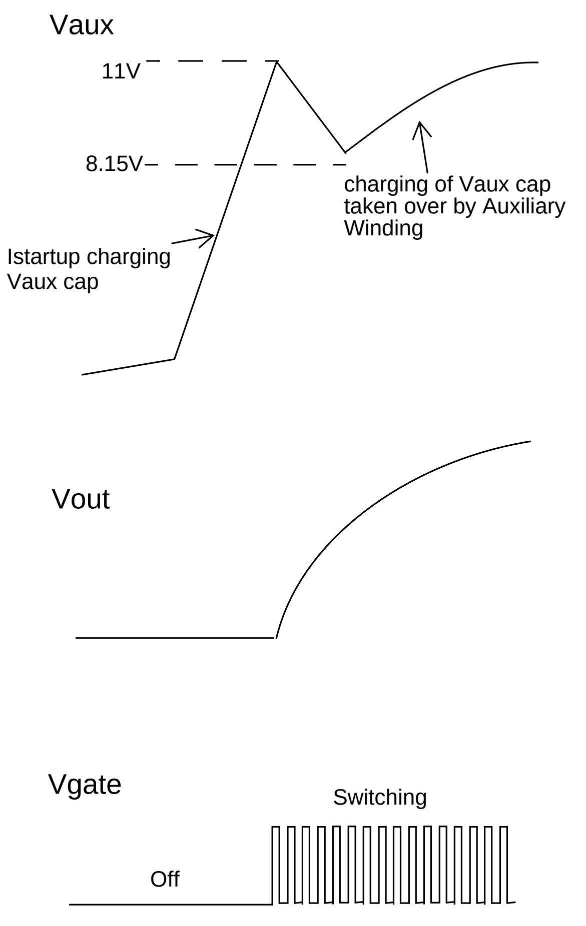


Fig.4 Normal startup waveforms.

The startup current source also helps implement the safe-restart or "hiccup" mode during system fault conditions like output short circuit, output open circuit, and Over Voltage Protection (OVP). In all the above fault situations, the IC reacts by inhibiting the normal operation of the system and stops delivering power to the output. In case of output short circuit, the Vaux capacitor is no longer supplied by the auxiliary winding and its voltage drops till it reaches the UVLO level. If the output is an open circuit, the output voltage will rise till it reaches the OVP level. The IC will detect this state and stop switching. In absence of switching of the power device, the Vaux capacitor will not be re-supplied and its voltage will drop till it reaches UVLO level. Once the Vaux voltage drops to UVLO level, the startup current source is re-activated and it charges the Vaux capacitor to its start level and the system goes through a cycle similar to the startup cycle. Figure 5 shows the relevant waveforms during safe-restart mode. The charging current (see Irestart-prot in Chapter "Characteristics") from the startup circuit during the safe-restart mode is lower than the normal startup current (see Istart-high in Chapter "Characteristics") in order to implement a low "hiccup" duty cycle. This helps insure devices on the output secondary winding do not get destroyed during output short circuit, violating safety conditions.

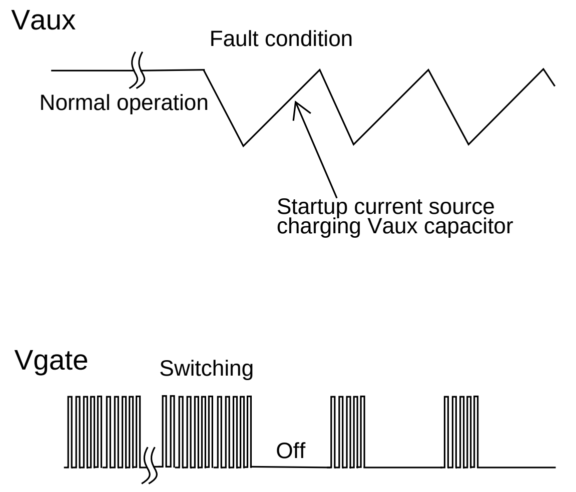


Fig.5 Safe-restart mode waveforms.

The startup current source also plays a key role in implementation of burst mode stand-by (see Irestart-stdby in Chapter "Characteristics"), which will be explained later.

All reference voltages are derived from a temperature compensated, on-chip, band-gap. The bandgap reference voltage is also used, together with an external resistor connected at the Iref pin, to generate accurate, temperature independent, bias currents in the chip.

Sample and Hold

GreenChip™ ICs employ voltage mode feedback for regulating the output voltage. In primary feedback mode, a novel Sample and Hold circuit is used. The Sample and Hold circuit works by sampling the current into the demag pin, which is related to the output voltage via Rdem, during the time that the secondary current is flowing:

$V_{out} = I_{ref} \times R_{dem} + V_{dem+}$

This sampled current information is stored on the external capacitor connected to the Vctrl pin. The pulse width modulator uses this voltage information to set the duty cycle of operation for the power MOSFET. In secondary feedback, the feedback voltage is provided by an opto-coupler.

Pulse Width Modulator

The pulse width modulator, which is made up of an inverting error amplifier and a comparator (Fig.2), drives the power MOSFET with a duty cycle which is inversely proportional to the voltage at the Vctrl pin. In primary feedback, this is the voltage on the Sample and Hold capacitor and in secondary feedback, this voltage is provided by an opto-coupler. A signal from the oscillator sets a latch that turns on the power MOSFET. The latch is reset by the signal from the pulse width modulator or by the duty cycle limiting circuit. The latching PWM mode of operation prevents multiple switching of the power switch. The maximum duty cycle is set internally at 80%. Figure 6 shows the normal switching operation of the IC.

Oscillator

The oscillator is used to set the switching duty cycle by comparing the oscillator ramp to the output of the error amplifier in the pulse width modulator circuit. The oscillator is fully integrated and works by charging and discharging an internal capacitor between two voltage levels to create a sawtooth waveform with a rising edge which is 80% of the oscillator cycle. This ratio is used to set a maximum switching duty cycle of 80% for the IC. The oscillator is internally trimmed to 5% accuracy. The oscillator frequency can be adjusted between 49 to 91 kHz (see $f_{osc\text{-}h\text{-}range}$ in Chapter “Characteristics”) by changing the external reference resistor (see Rref in Chapter “Characteristics”) that sets the chip bias currents. This gives additional flexibility to the power supply designer in the choice of his system components.
The frequency is correlated with the value of the Rref resistor:

$$f_{osc} = f_{osc-typical} \times \frac{24.900}{Rref} [Hz]$$

$f_{osc\text{-}typical}$ is specified in Chapter “Characteristics”, $f_{osc\text{-}l}$ and $f_{osc\text{-}h}$. The operating Rref resistor range is specified in Chapter “Characteristics”, Rref.

Multi Frequency Control

The oscillator is also capable of working at a lower frequency (see $f_{osc\text{-}l}$ in Chapter “Characteristics”). A ratio of 1 : 2.5 is maintained between high and low frequency of the oscillator. Low frequency operation is invoked if the power supply is working at or below one ninth of its peak power. By working at a lower frequency, the switching losses in the power supply are reduced. A novel scheme is used to ensure that the transfer of high to low frequency and vice versa has no effect on the regulation of the output voltage.

Gate Driver

The gate driver has a totem-pole output stage that has current sourcing capability of 120 mA and a current sink capability of 500 mA. This is to enable fast turn on and turn off of the power device for efficient operation. In the DIL14 controller version, the driver supply and driver output pins are available separately to the power supply designer.
In this way the power supply designer can control the source and sink currents of the gate driver circuit with a minimum of external components.

Demagnetization Protection

This feature guarantees discontinuous conduction mode operation for the power supply which simplifies the design of feedback control and gives faster transient response.

Demagnetization protection is an additional protection feature that protects against saturation of the transformer/inductor. Demagnetization protection also protects the power supply components against excessive stresses at startup, when all energy storage components are completely discharged, and during shorted output system fault condition.

Negative Clamp

The negative clamp circuit does not let the voltage at the demag pin go below –0.4 V, when the auxiliary winding voltage goes negative during the time that the power device is turned on, to ensure correct operation of the IC.

Over Voltage Protection

An OVP mode has been implemented in the GreenChip™ series. This circuit works by sensing the Vaux voltage.

If the output voltage exceeds the preset voltage limit, the OVP circuit turns off the power MOSFET. With no switching of the power device, the Vaux capacitor is not re-supplied and discharges to UVLO level and the system goes into the low dissipation safe-restart mode described earlier. The system recovers from the safe-restart mode only if the OVP condition is removed.

Over Current Protection

Cycle by cycle Over Current Protection (OCP) is provided by sensing the voltage on an external resistor which is connected to the source of the power MOSFET.
The voltage on the current sense resistor, which reflects the amplitude of the primary current, is compared internally with a reference voltage using a high speed comparator. If the power MOSFET current exceeds the current limit, the comparator trips and turns off the power MOSFET. The power MOSFET is typically turned off in 210 nsec (see t_D in Chapter “Characteristics”).

The availability of the current sense resistor off-chip for programming the OCP trip level increases design flexibility for the power supply designer. An off-chip current sense resistor also reduces the risk of an OCP condition being sensed incorrectly. At power MOSFET turn-on the dv/dt limiters capacitance discharge current doesn’t have to flow through the sense resistor, because this capacitor can be connected between drain and source of the power MOSFET directly.

The leading edge blanking (LEB) circuit works together with the OCP circuit and inhibits the operation of the OCP comparator for a short duration (see t_{LEB} in Chapter “Characteristics”) when the power device is turned on. This ensures that the power device is not turned off prematurely due to false sensing of an OCP condition because of current spikes caused by discharge of primary-side snubber and parasitic capacitances.
LEB time is not fixed and it tracks the oscillator frequency.

Over Temperature Protection

Protection against excessive temperature is provided by an analog temperature sensing circuit that turns off the power device when the temperature exceeds typically 130 °C.

ON/OFF Mode

The expensive mains switch can be replaced by an in-expensive functional switch by using the ON/OFF mode. Figure 7 shows a Flyback converter configured to use the ON/OFF mode. Depending upon the position of the switch S1, either voltage close to ground or a voltage of greater than typical 2.5 V exists at the OOB pin.
The difference between these voltages is detected internally by the IC. The IC goes into an “off-mode” if the voltage is low, where it consumes a current of typical 400 μA (see Iin-off in Chapter “Characteristics”). If the voltage at the OOB is typically 2.5 V (see Von/off in Chapter “Characteristics”), the IC goes through the startup sequence and commences normal operation. In Fig.8, a “Mains Under Voltage Lock Out” (MUVLO) function has been created using 3 resistors. Assuming that R3 is choosen very high ohmic, the GreenChip™ starts operating if: $V_{MAINS} \approx \frac{R1}{R2} \times V_{OOB} \ (R1 \gg R2)$

In this way it is assured that the power supply only starts working above a Vmains of e.g. 80 V. The bleeder current through R1 should be low (e.g. 30 μA at 300 V).

Burst Mode Stand-by

The OOB pin is also used to implement the burst mode stand-by. In Burst mode stand-by, the power supply goes into a special low dissipation state where it typically consumes less than 2 W of power. Figure 8 shows a Flyback converter using the burst mode stand-by feature. The system enters burst mode when the microprocessor (μP) closes switches S2 and S3 on the secondary side. Switch S2 shorts the output capacitor to the voltage level of the μP capacitor. The output secondary winding now supplies the μP capacitor. When the voltage on the μP capacitor exceeds the zener voltage, Vz, the opto-coupler is activated which sends a signal to the OOB pin.
In response to this signal, the IC stops switching and goes into a “hiccup” mode. Figure 6 shows the burst-mode operation graphically. The hiccup mode during burst mode operation differs from the hiccup in safe-restart mode during system fault. For safe restart mode, the power has to be reduced. For burst mode, sufficient power to supply the μP has to be delivered. To prevent transformer rattle, the transformer peak current is reduced by a factor of 3. Burst mode stand-by operation continues till the μP opens switches S2 and S3. The system then goes through the startup sequence and commences normal switching behaviour.

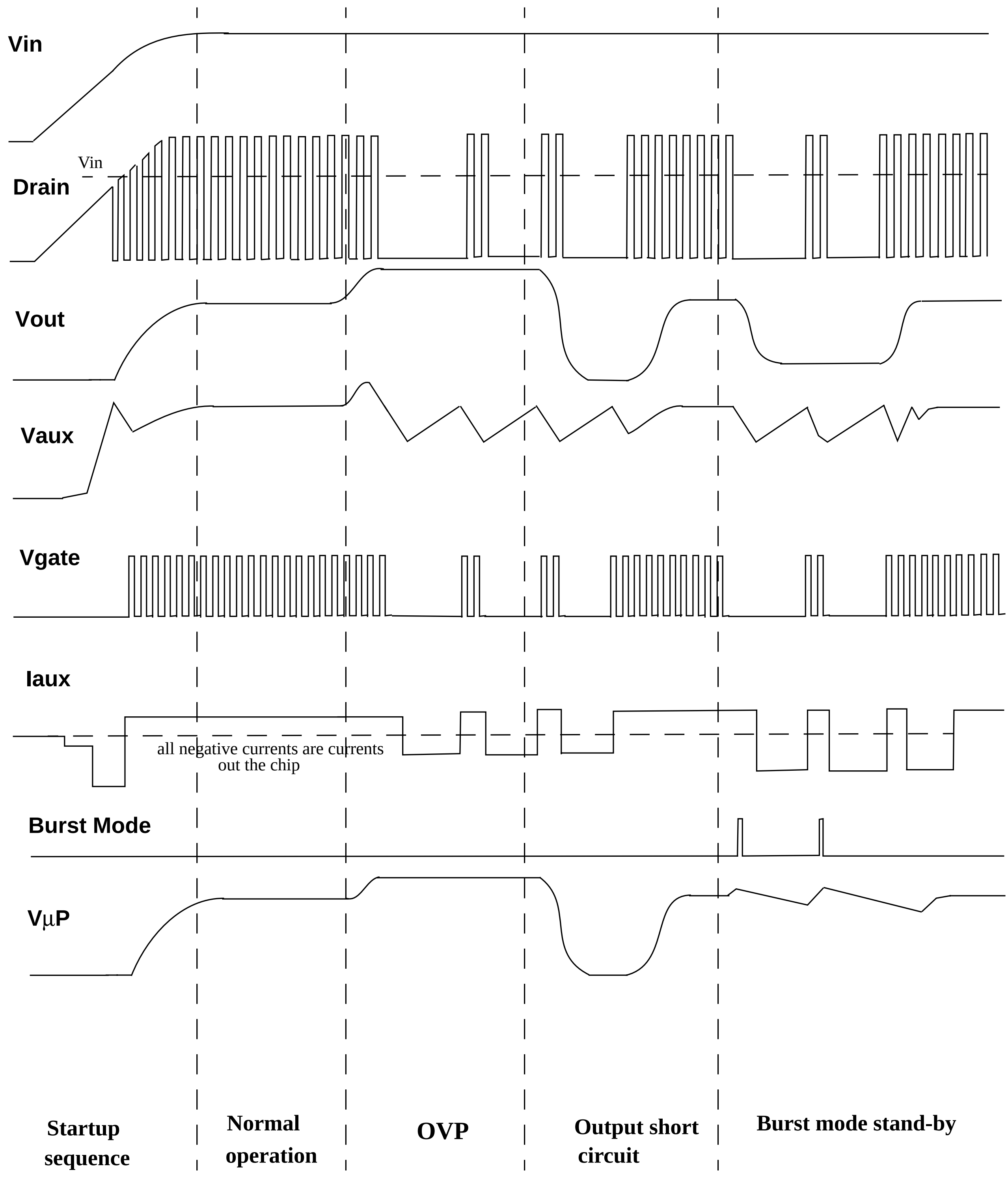


Fig.6 Typical waveforms.

ABSOLUTE MAXIMUM RATINGS

Unless noted all voltages are referenced to the GND pin.

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V_{in}(1)		–	600	V
$V_{in, max}$(2)		–	650	V
V_{OOB}		–0.3	+14	V
I_{demag}		–	±1	mA
V_{ctrl}, V_{Isense}		–0.3	+5	V
I_{ref}		–	–1	mA
V_{aux}		–0.3	+18	V
T_j	operating junction temperature	–10	+140	°C
T_{stg}	storage temperature	–40	+150	°C

Notes

1. Repetitive V_{in} voltage.
2. Absolute maximum V_{in} voltage.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
Rth_{j-a}	Thermal resistance from junction to ambient	70	°C/W

CHARACTERISTICS

(T_j = –10 to +110 °C, V_{in} = 300 V, I_{ref} resistor = 24.9 KΩ, 0.1% and Vaux = 8 to 13 V). All currents into the chip are positive and all currents out of the chip are negative. All voltages are referred to ground.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Startup current source and vaux management (pins 1 and 6)						
Vdlow	minimum start drain voltage at pin 1		100	–	–	V
Vstart	startup voltage at pin 6		10.4	11	11.6	V
Vuvlo	under voltage lockout at pin 6		7.4	8.15	8.6	V
Vaux-hyst.	operation voltage hysteresis at pin 6	(Vstart-Vuvlo)	2.60	2.85	3.10	V
Iin	Vin current at pin 1	normal operation	20	60	100	µA
Iin-off	off mode current at pin 1	V_{OOB} < 1.95 V	200	400	600	µA
Istart-low	startup current at pin 6	0 V < Vaux < 0.73 V	–270	–230	–190	µA
Istart-high	startup current at pin 6	0.5 V < Vaux < Vstart	–5.0	–3.0	–1.0	mA
Iaux	IC operating supply current at pin 6	no load on driver pin	3.5	3.85	4.2	mA
Irestart-prot	restart current at pin 6	in protection mode	–600	–530	–460	µA
Irestart-stdby	restart current at pin 6	in standby mode	–2.5	–2.1	–1.7	mA
Vclamp	Vaux clamp level at pin 6	Iaux = 5 mA	14.5	–	18	V
Reference block (pin 8)						
Vref	reference voltage		2.4	2.5	2.6	V
Rref	operating resistor range		16.9	24.9	33.2	kΩ

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Oscillator						
$f_{osc\text{-}l}$	low frequency	low power mode	27.5	29	30.5	kHz
$f_{osc\text{-}h}$	high frequency	normal mode	66	70	74	kHz
δmax	maximum duty cycle	$f = f_{osc\text{-}h}$	78	80	82	%
frat	ratio $f_{osc\text{-}h}/f_{osc\text{-}l}$		2.30	2.45	2.60	
$f_{osc\text{-}h\text{-}rang}$	range of $f_{osc\text{-}h}$	with changing Rref	49	70	91	kHz
Demag (pin 13)						
Vdem-th	demag comparator threshold	Vdemag decreasing	50	65	80	mV
tp-dem-del	prop delay to output buffer		200	400	600	ns
Idem	input bias current	Vdem = 65 mV	–0.50(1)		–0.10(1)	μA
Vcl–	negative clamp level	Idem = –500 μA	–0.36	–0.32	0	V
Vdem+	positive clamp level	Idem = 100 μA	2.0	2.5	3.2	V
Sample and hold (pin 13)						
Idem	normal control current	Iref = 100 μA	90	100	110	μA
sh-th	sample current threshold	% of Idem	78	83	88	%
tp-shr	prop delay current comparator	dVdemag/dt positive (500 V/μsec)	170	450	730	ns
tp-shf	prop delay current comparator	dVdemag/dt negative (10 V/μsec)	75	90	105	ns
OVP (pin 6)						
Vovp-aux	absolute max OVP prot level	fixed max level	13.5	14	14.5	V
tovp	ovp delay time		150	350	600	ns
Isense and low power (pin 5)						
t_{LEB}	Leading Edge Blanking time	Rref = 0.7 × Rref-nom	180	260	340	ns
t_{LEB}	Leading Edge Blanking time	Rref = Rref-nom	240	340	440	ns
t_{LEB}	Leading Edge Blanking time	Rref = 1.3 × Rref-norm	415	470	560	ns
Vth-Imax	max current limit		0.46	0.49	0.53	V
t_D	delay to MOSFET off at pins 4 and 5	time to MOSFET off at dv/dt = 200 mV/μs, Cgs = 500 pF	150	210	270	ns
$V_{THLOPOWER}$	threshold voltage for switch over to low power		160	170	180	mV
Control (pin 9)						
dδ/dV	gain	$f_{osc\text{-}h}$	–95	–85	–75	%/V
dδ/dV	gain	$f_{osc\text{-}l}$	–60	–50	–40	%/V
Vctrl-min	min control voltage		2.00	2.15	2.30	V
Vctrl-max	max control voltage		2.90	3.05	3.20	V
Ictrl-leak	leakage current in/out of Vctrl pin		–1(1)	–	+1	μA
Over temperature protection						
Ttrip	temperature limit		120	130	140	°C

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
ON/OFF/burst mode (pin 4)						
Von/off	ON/OFF trip level		2.3	2.5	2.8	V
Iburst-active	burst mode trip level		0.5	–	1	mA
Iburst-inactive			–	–	100	µA
I_{OOB}	current out of OOB pin		–0.1(1)	–	+2	µA
Driver						
Rdson-h	Rdson of transistor when output going high	Vaux = 8.5 V and Vdriver = 6.5 V	15	18	45	Ω
Rdson-l	Rdson of transistor when output going low	Vaux = 8.5 V and Vdriver = 2 V	3	6	15	Ω
Isource	current capacity of source transistor	Vaux = 8.5 V and Vdriver = 2 V	–280	–120	–100	mA
Isink	current capacity of sink transistor	Vaux = 8.5 V and Vdriver = 2 V	200	250	500	mA
Isink	current capacity of sink transistor	Vaux = 8.5 V and Vdriver = 8.5 V	400	550	900	mA

Note

1. Guaranteed by design.

GENERAL APPLICATION INFORMATION

A converter using the GreenChip™ is usually a Flyback or a Buck converter that is made up of the EMI filter, full bridge rectifier, filter capacitor, transformer, output stage(s), and some snubber circuitry. Depending upon the type of feedback used, either an auxiliary winding (primary regulation) or an opto-coupler (secondary regulation) is used. GreenChip™, due to its high level of integration uses very few external components. A sense resistor converts the primary current into a voltage at the Isense pin (pin 5). The IC uses this information for setting the peak current in the converter. A capacitor supplied by an auxiliary winding buffers the internal supply of the IC and is connected at the Vaux pin (pin 6). The auxiliary winding is also used for primary mode output voltage regulation. A resistor connected at the Iref pin sets the reference currents in the IC (pin 8). A small capacitor (0.2 to 2 nF) connected at the Vctrl pin (pin 9) is used by the internal Sample and Hold circuit for regulation in primary feedback scheme. The same pin is also used for secondary sensing and serves as the input for the signal from the opto-coupler. Pin 11 is the ground connection. The primary side auxiliary winding is connected via a resistor to the demag pin (pin 13). Besides being used for demagnetization protection, demag pin is also used for primary side regulation. Pin 14 too is a multi use pin and depending upon connection can be used for implementation of the ON/OFF/Burst mode functions. Pin 2 is not connected and serves as a high voltage spacer pin. Pin 1 is used by the internal startup current source as a supply for charging up the Vaux capacitor during startup and safe-restart modes.

For additional information also see: *“Application Note AN98011: 200 W SMPS with TEA1504”*.

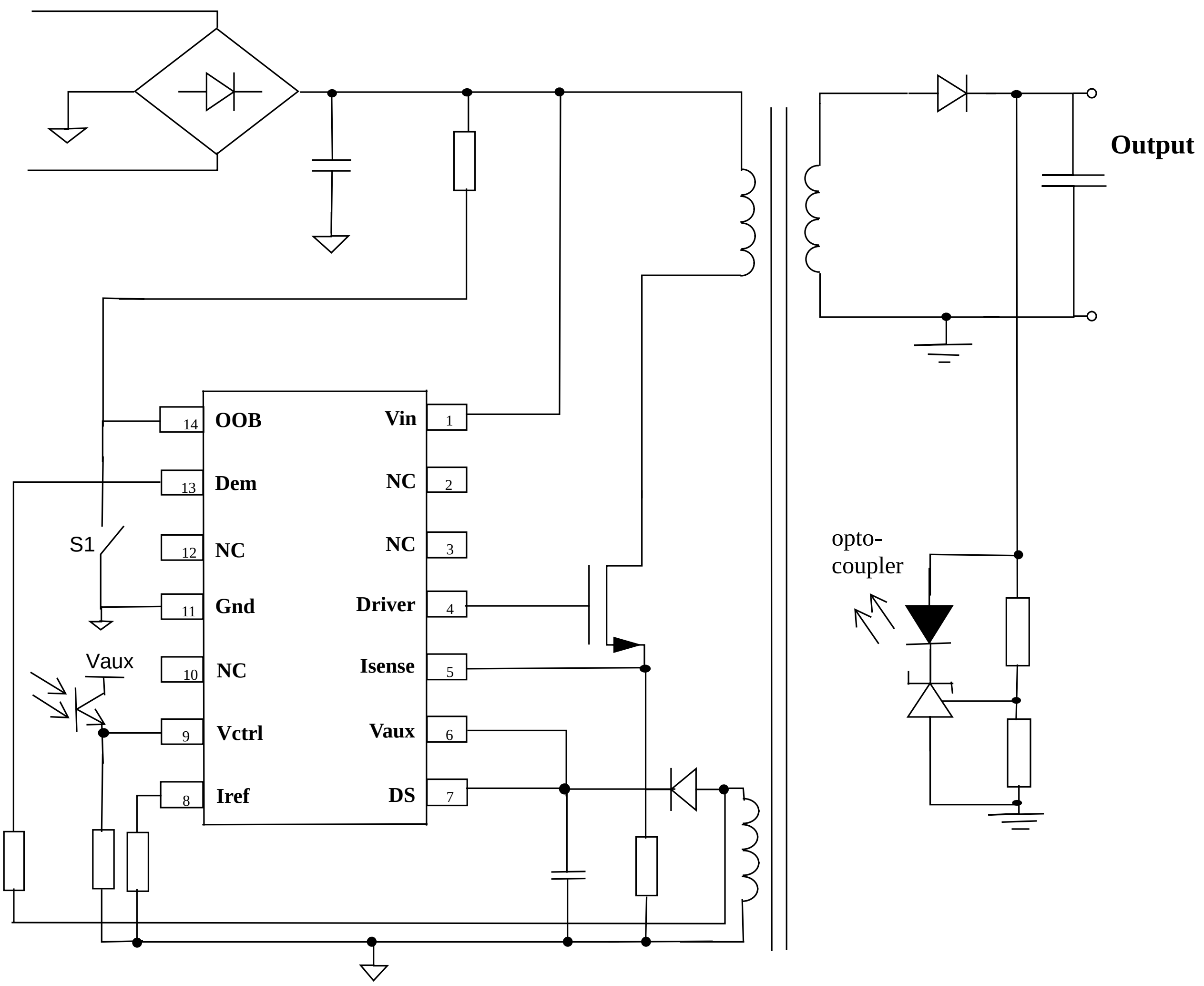


Fig.7 Typical Flyback configuration with secondary sensing and ON/OFF feature.

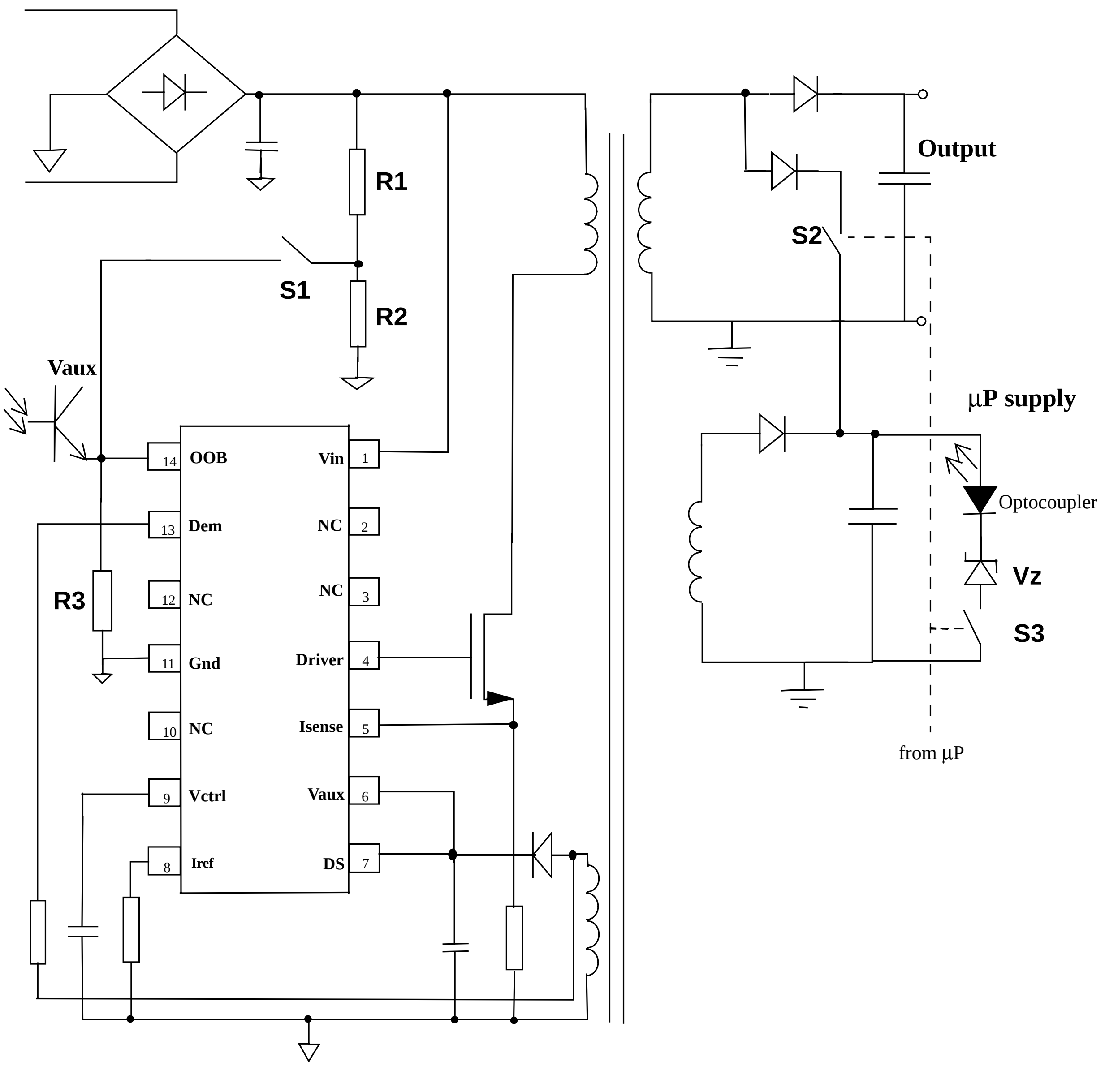


Fig.8 Flyback configuration using the Burst mode Stand-by and ON/OFF feature.

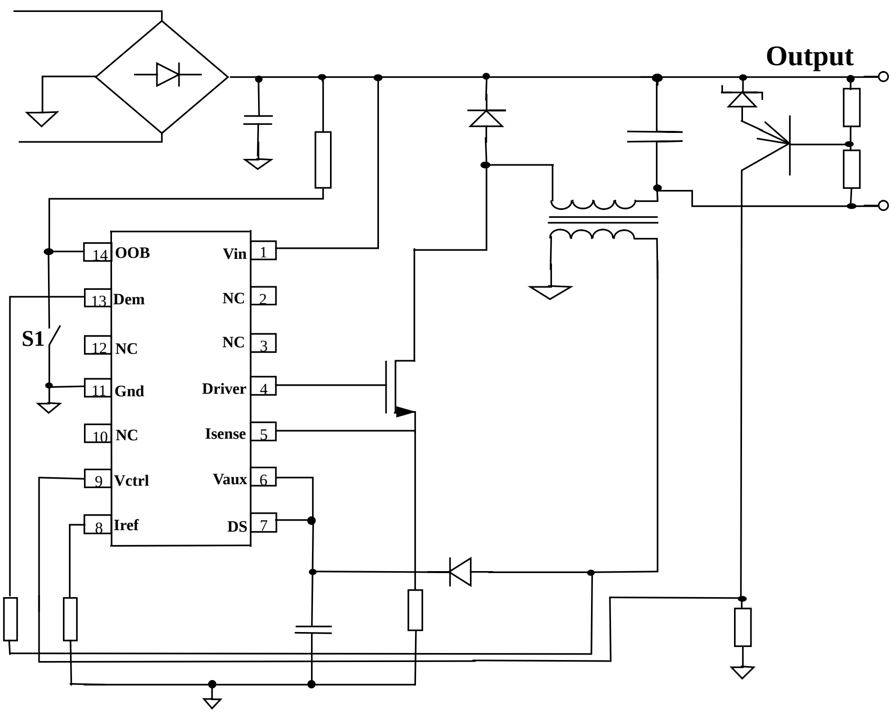


Fig.9 Typical Buck configuration with secondary sensing.

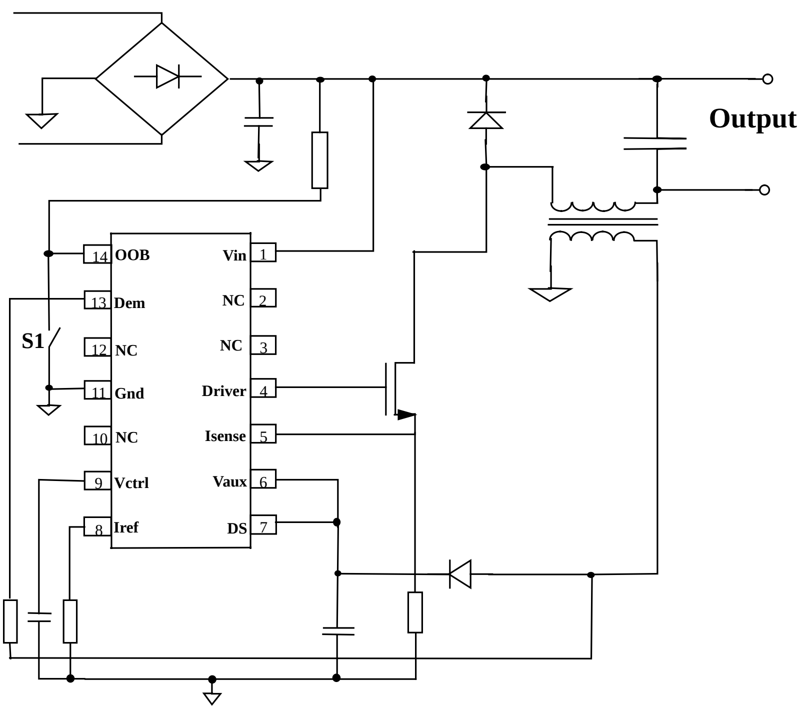
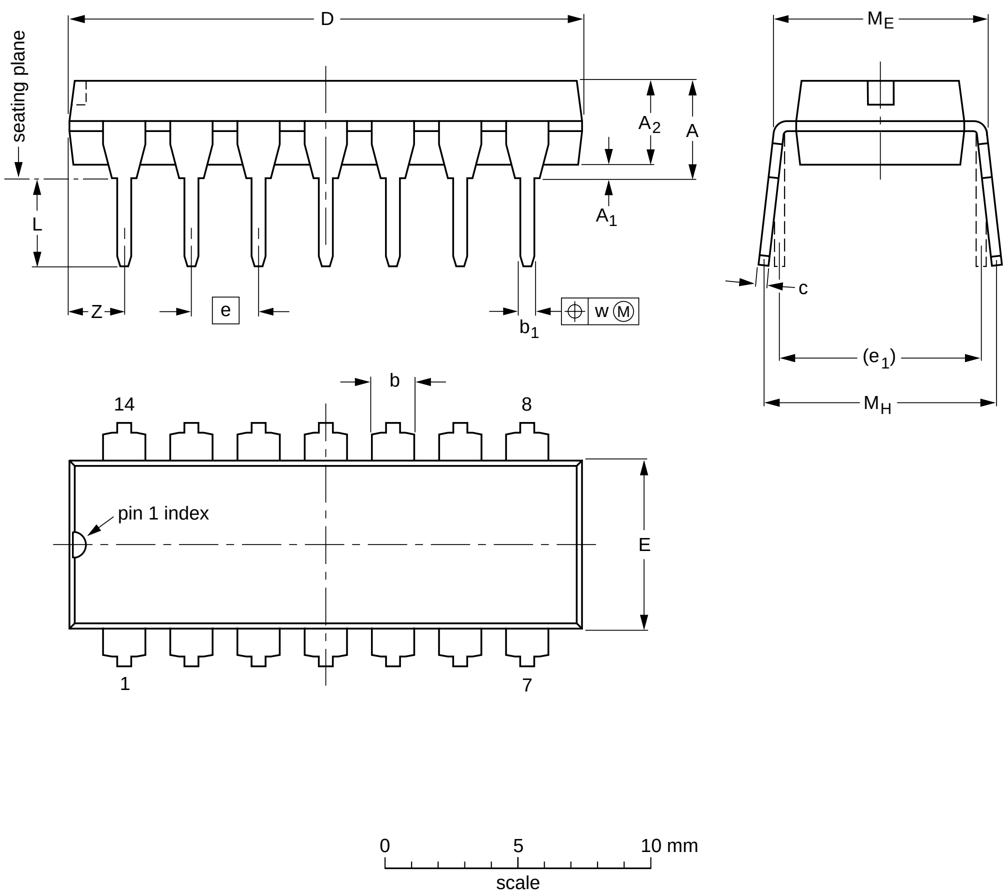


Fig.10 Typical Buck configuration with primary sensing.

PACKAGE OUTLINE

DIP14: plastic dual in-line package; 14 leads (300 mil) **SOT27-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.2	0.51	3.2	1.73 1.13	0.53 0.38	0.36 0.23	19.50 18.55	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	2.2
inches	0.17	0.020	0.13	0.068 0.044	0.021 0.015	0.014 0.009	0.77 0.73	0.26 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.087

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT27-1	050G04	MO-001AA				~~92-11-17~~ 95-03-11

SOLDERING

Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"IC Package Databook"* (order code 9398 652 90011).

Soldering by dipping or by wave

The maximum permissible temperature of the solder is 260 °C; solder at this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds.

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified maximum storage temperature ($T_{stg\ max}$). If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

Repairing soldered joints

Apply a low voltage soldering iron (less than 24 V) to the lead(s) of the package, below the seating plane or not more than 2 mm above it. If the temperature of the soldering iron bit is less than 300 °C it may remain in contact for up to 10 seconds. If the bit temperature is between 300 and 400 °C, contact may be up to 5 seconds.

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

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