INTEGRATED CIRCUITS

DATA SHEET

UBA2000T

Electronic TL-lamp starter

Product specification
File under Integrated Circuits, IC11

1996 Jan 03

Philips Semiconductors

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Electronic TL-lamp starter — UBA2000T

FEATURES

- Electronic starter, fully compatible with conventional glow-switch starters
- Reliable and instant ignition
- Accurate defined preheat time derived from the mains frequency
- Increased starter life since no mechanical parts are used
- No radio-interference (according to *"IEC926 10.5"*)
- Automatic reset after interruption of supply voltage
- Large operating temperature range: –40 to +85 °C
- Maximum current protection of the preheat current
- Ignition shut-off at end of lamp life; no overheating of load.

GENERAL DESCRIPTION

The UBA2000T is an integrated circuit for electronic TL-lamp starters and is fully compatible with conventional glow switch starters. The circuit controls the preheating and ignition of the lamp. The preheat time is well defined without spread, since it is derived from the mains frequency. When the lamp fails, ignition is shut-off after 7 ignition attempts. The circuit has an automatic reset when the supply voltage is interrupted.

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
UBA2000T	SO8	plastic small outline package; 8 leads; body width 3.9 mm	SOT96-1

BLOCK DIAGRAM

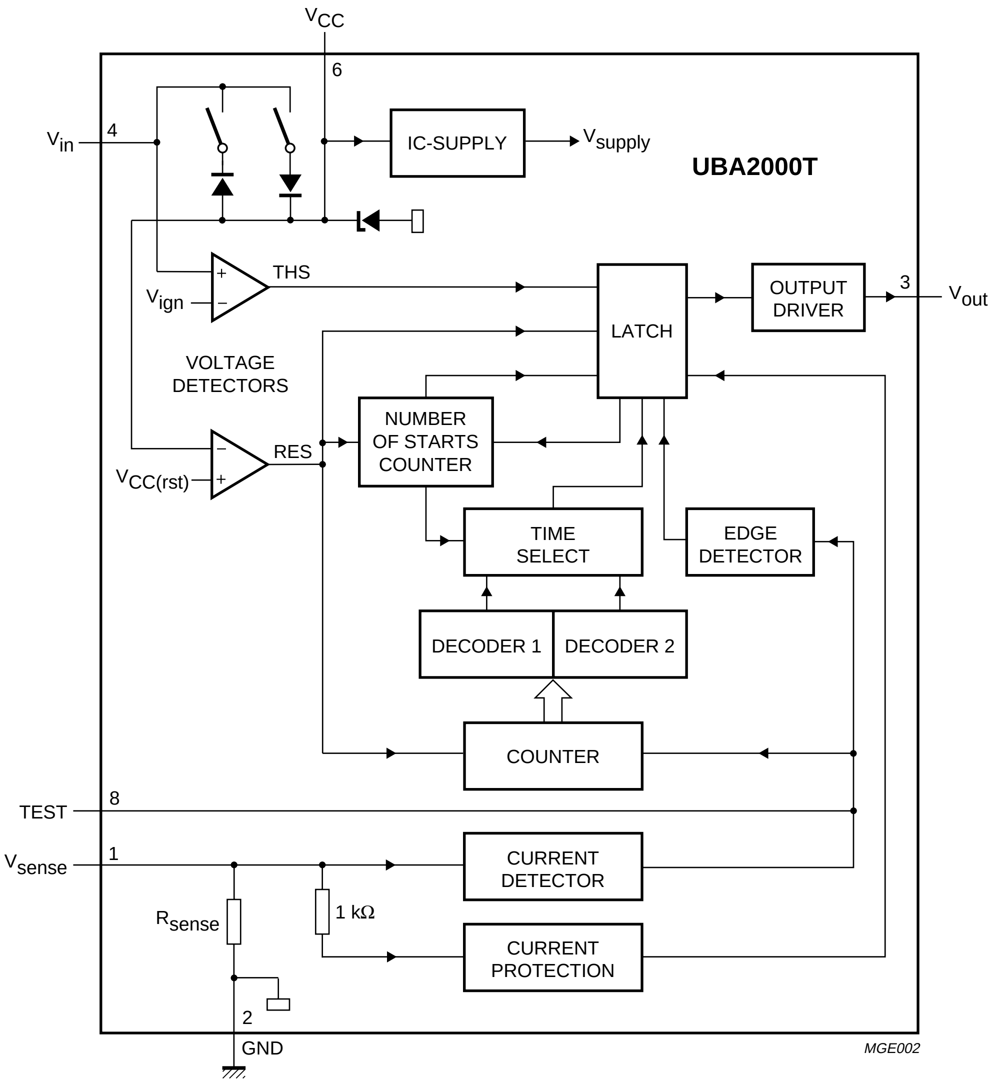


Fig.1 Block diagram.

PINNING

SYMBOL	PIN	DESCRIPTION
V_{sense}	1	sense voltage
GND	2	ground (0 V)
V_{out}	3	output voltage
V_{in}	4	input voltage
n.c.	5	not connected
V_{CC}	6	supply voltage
n.c.	7	not connected
TEST	8	test pin

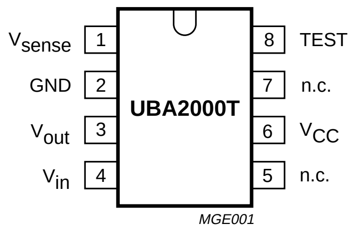


Fig.2 Pin configuration.

FUNCTIONAL DESCRIPTION

The UBA2000T is an Integrated Circuit that performs all functions necessary to ignite a TL-lamp. The circuit is connected to the lamp circuit according to Figs. 7 or 8. The mains voltage is rectified and divided over resistors R1 and R2 to a lower level. When the mains power is switched on, the buffer capacitor C1 is charged through the resistive divider and internal switch S1. As long as the supply voltage at the buffer capacitor (V_{CC}, see “Characteristics”) is below the reset level ($V_{CC(rst)}$), the UBA2000T initializes its internal circuitry.

When V_{CC} has reached the start level ($V_{CC(sl)}$) and the peak value of $V_{in} > V_{ign}$ (indicating that the mains supply is near its peak value), the external switching device TH1 will be turned on. This results in a current through the electrodes of the TL-lamp, the switching device and an integrated sense resistor. Because the current starts to flow when the mains voltage is near its peak value, transient currents are limited.

When the switching device is turned on, the circuit draws its supply current from buffer capacitor C1. A typical wave shape of the voltage at pin 6 (V_{CC}) is given in Fig.3. During the preheat periods the buffer capacitor is discharged. The rectified current through the sense resistor is detected and the output signal of the detector is used as a clock signal for the counter. The preheat time is defined to 1.52 s (at 50 Hz mains supply) using this counter. The preheat time is very accurate, since it only depends on the frequency of the mains supply.

After preheating, the switching device is turned off when the current through the internal sense resistor equals at least 285 mA. As a result of the current interruption and the presence of an inductive load, a voltage peak is generated that will normally ignite the TL-lamp. After ignition, the lamp voltage is lower than the mains voltage. An ignited TL-lamp prevents the voltage at pin 6 (V_{CC}) to exceed start level. In Fig.3 the TL-lamp is ignited after two ignition attempts.

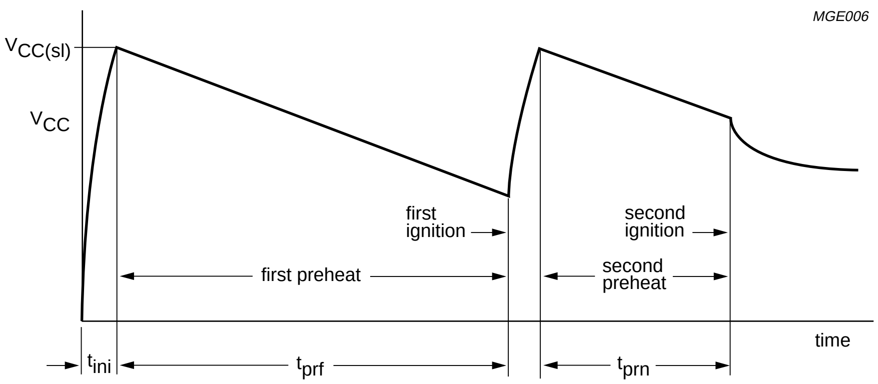


Fig.3 Typical wave shape of supply voltage.

During preheating, the integrated circuit draws its supply current from the buffer capacitor. As a result, the voltage over the buffer capacitor decreases. When the ignition has failed after the ignition pulse, the voltage on the buffer capacitor increases to start level and the external switching device will be turned on again. This time the preheat time is reduced to 0.64 seconds because the lamp electrodes are still warm. An internal counter limits the number of ignitions attempts to 7. This prevents the lamp from flickering at end of lamp life.

The UBA2000T has an integrated current protection. When the current through the sense resistor exceeds the protection level (I_{prot}), the switching device is turned off and the circuit will enter a standby state. Switching the mains voltage off and on again will reset the circuit.

The flow chart of the starting process is given in Fig.5. In the following subsections the several blocks of the block diagram are described in more detail.

IC supply

When the mains power is switched on, the buffer capacitor is charged and the internal current source is started. The internal voltage is stabilized, making it independent of the voltage at the buffer capacitor. An internal zener diode limits the voltage at pin 6 (V_{CC}) to start level ($V_{CC(sl)}$).

Voltage detectors

The voltage detectors measure the voltage on the buffer capacitor and activate the switching device when the start value ($V_{CC(sl)}$) is reached. The time required to charge the capacitor is the initial time (t_{ini}, see also Fig.3). This time depends on the value of C1, the IC current and the source resistance at pin V_{in} (R1//R2). When the mains voltage is near its peak value, the switching device is actually turned on. When the voltage decreases to a value indicating that the mains supply is interrupted, the starter is ready to start preheating and igniting the TL-lamp at the moment the mains supply returns.

Latch

The internal state of the latch represents the state of the switching device. The setting of the latch depends on the outputs of the voltage detectors, the number of starts counter and the standby state. Resetting the latch is controlled by the timer, the current detector and the current protection circuit.

Current detector

The current detector detects when the switching device must be turned off. The current detector also generates the clock pulses to activate the counter (see Fig.4). For proper functioning, the preheat current should be within the range indicated by I_{pr}. By including an hysteresis, unwanted current peaks on the preheat current have no effect on the counter. Because the current detector has a low-pass transfer function, it is not influenced by spikes. This circuitry eliminates the effect of spikes on the preheat time.

Edge detector

The edge detector ensures that the switching device will be turned off when the rectified preheat current is on the negative-going edge.

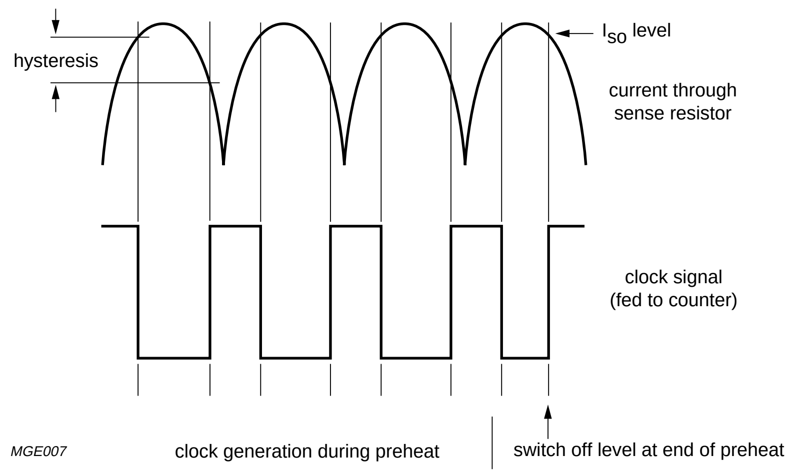


Fig.4 Current detection.

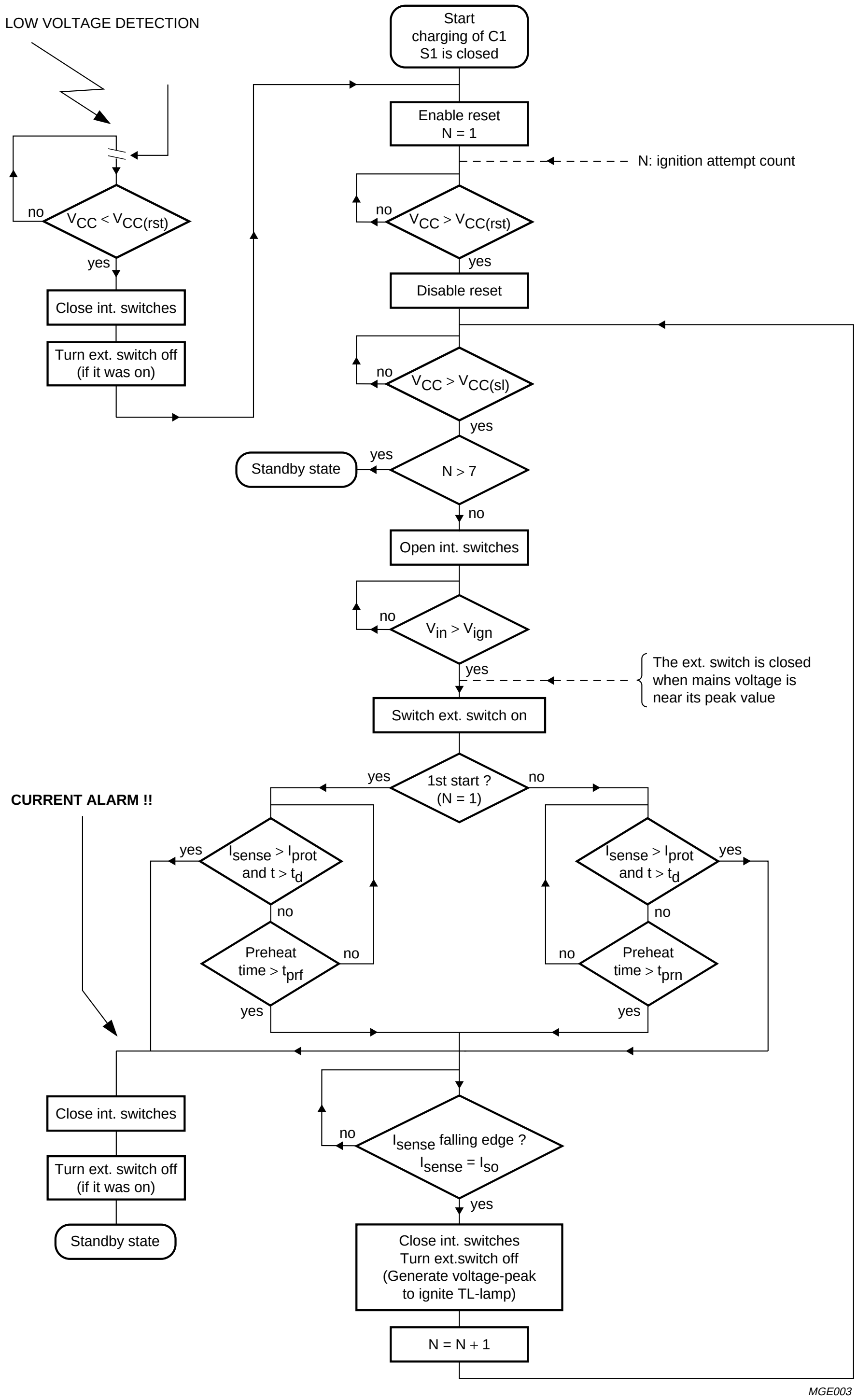


Fig.5 Flow chart.

Counter

With the counter, which is supplied with pulses with twice the frequency of the mains supply, the preheat time for the first preheat and (if necessary) the next six preheats is defined.

Time select

Depending on the state of the counter a long (t_{prf} = 1.52 s) or a short (t_{prn} = 0.64 s) preheat time is selected.

Number of starts counter

The number of starts are counted by a counter. After seven ignition attempts the IC is brought into standby state. In standby state the supply current (I_{CC}) is increased. Due to the increased current, the buffer capacitor C1 will discharge faster when the starter is disconnected from the mains. This makes it possible to automatically reset the starter the moment a malfunctioning tube is replaced by a new one.

Current protection

When the current through the sense resistor exceeds its limit (I_{prot}), the switching device will be turned off. During the first few periods of conduction, the current protection is disabled (disable time t_d) to ensure that transient currents do not trigger the current protection. When the current has exceeded its limit, the switching device is turned off and the IC enters the standby state that prevents re-activating the switching device. Only an interruption of the supply voltage will reset the standby state.

Output driver

The output driver is capable of driving a low input current trigger device as well as a device controlled by a gate. During start-up the output is kept low to prevent turning on the external switching device.

TRIGGER DEVICE

A typical application that uses a low input current trigger device (such as TN22) as switching device is given in Fig.7. The resistive divider R1//R2 is not connected to ground but to the gate of the trigger device. This has a minimal effect on the voltage division ratio, since the voltage at the gate of the trigger device is low. The output driver generates the current pulse, which is necessary to activate the external switching device TH1. This current pulse is synchronized with the voltage at pin 4 (V_{in}). The switching device is triggered when V_{in} reaches the V_{ign} level. In that way the current through resistors R1 and R2 is a part of the current needed to activate the switching device. If necessary, the current pulse is delivered every half cycle of the mains voltage. When the switching device must be turned off, the output driver is capable of sinking the gate turn-off current of the switching device.

It might be necessary to limit the current peaks, which flow through the switching device at turn-on, resulting from discharging the suppressor capacitor (C2). This can be achieved using a resistor (R3).

GATE INPUT DEVICE

A typical application that uses a MOSFET is given in Fig.8. In this circuit the resistive divider is connected to ground. The output driver of the IC operates the same way as when a trigger device is used. The output current pulse will charge the gate of the MOSFET. As a result, the MOSFET will be activated.

To keep the MOSFET conductive, a high ohmic pull-up resistor is connected between the gate of the MOSFET and the buffer capacitor C1. This is necessary, because the output current is a pulse and not a continuous signal. This pull-up resistor increases the current which is drawn from the buffer capacitor. An internal zener diode in the IC limits the voltage at the output (and thus at the gate of the MOSFET) to a typical value of 6.8 V.

Both switching devices require the breakdown voltage ($V_{(BR)AK}$ or $V_{(BR)DS}$) to be larger than the ignition voltage of the TL-lamp.

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{out}	output voltage	note 1	–	6	V
V_{in}	input voltage	note 2	–	125	V
V_{TEST}	voltage at test pin		–	6	V
I_{sense}	current through sense resistor	note 3	–	6	A
P_{tot}	total power dissipation		–	395	mW
T_{stg}	storage temperature	non-operating	–55	150	°C
T_{amb}	ambient temperature	operating	–40	85	°C

Notes

1. This pin is connected to an internal zener diode (typical working voltage is 6.8 V).
2. This pin is connected to an internal zener diode (working voltage between 130 and 230 V). The current entering this pin must be limited to <10 mA.
3. Inrush current, duration <2 ms.

QUALITY SPECIFICATION

In accordance with *"SNW-FQ-611-E"* with the following exception: With respect to the integrated sense resistor a lifetime of 60000 lamp starts (with max. 7 start attempts) at maximum preheat current level of 1.4 A (RMS) is guaranteed. The number of the quality specification can be found in the *"Quality Reference Handbook"*. The handbook can be ordered using the code 9397 750 00192.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient in free air	160	K/W

CHARACTERISTICS

T_{amb} = 25 °C; all voltages referenced to GND; see application diagrams (Figs. 7 and 8); V_{mains} = 220 V, 50 Hz; N is the number of ignition attempts; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
IC voltages						
$V_{CC(sl)}$	supply voltage start level		40	44	49	V
$V_{CC(rst)}$	supply voltage reset level		–	–	9	V
V_{ign}	ignition voltage	striking switching device	67	–	97	V
Lamp voltages						
V_{lamp}	TL-lamp voltage		50	–	140	V
Supply current						
I_{CC}	supply current	V_{CC} = 30 V; note 1	–	32	42	µA
		after 7th start attempt; V_{CC} = 30 V	–	145	–	µA
I_c	control current	note 2	–	170	–	µA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output stage						
I_{source}	peak source current (pulse shape Fig.6)	V_{out} < 2 V; striking switching device	1.5	–	10	mA
I_{sink}	output sink current	V_{out} = 0.8 V	50	–	–	mA
t_W	pulse width	V_{CC} = 30 V	5	–	–	µs
Q_p	pulse charge	V_{CC} = 30 V; note 3	21	–	–	nC
V_{out}	output voltage	I_{sink} = 0.5 mA; driving gate device in preheat mode	–	6.8	–	V
Timing						
t_{prf}	preheat time (first)	N = 1; note 4	–	1.52	–	s
t_{prn}	preheat time (next)	2 ≤ N ≤ 7; note 5	–	0.64	–	s
t_{ini}	initial time		–	125	–	ms
Current protection						
$I_{prot(m)}$	current protection level (peak value)		2.2	3.4	–	A
t_d	delay time before current protection is enabled	note 6	–	70	–	ms
Sense resistor						
R_{sense}	internal sense resistor	note 7	–	26	–	mΩ
Preheat current						
$I_{pr(rms)}$	preheat current (RMS value)	note 8	0.33	–	1.4	A
Switching off current						
I_{so}	preheat current level at the moment it is switched off	note 9	285	380	475	mA

Notes

1. When the switching device is triggered, $I_{CC} = I_{source}$.
2. This is the active current when the lamp is lit. The given value is valid for V_{lamp} = 115 V. The total current at V_{in} equals: $I_{in} = I_{CC} + I_c$ (leakage currents are neglected).
3. $Q_p = I_{source} \times t_p$.
4. Time is derived from the mains frequency; division factor equals 76.
5. Time is derived from the mains frequency; division factor equals 32.
6. The delay time is set by a clock signal, which is derived from the current through the sense resistor. Due to inrush transients of the preheat current, variation of t_d is possible.
7. This is the resistance of the internal sense circuit (excluding the bonding wires).
8. To guarantee good functioning, a crest factor of at least 1.5 is needed at low currents.
9. When the holding current of TH1 is lower than I_{so}, TH1 is switched off at the holding current (in case of a trigger device).

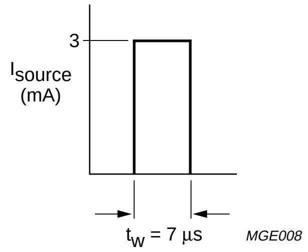


Fig.6 Pulse shape (typical value).

APPLICATION INFORMATION

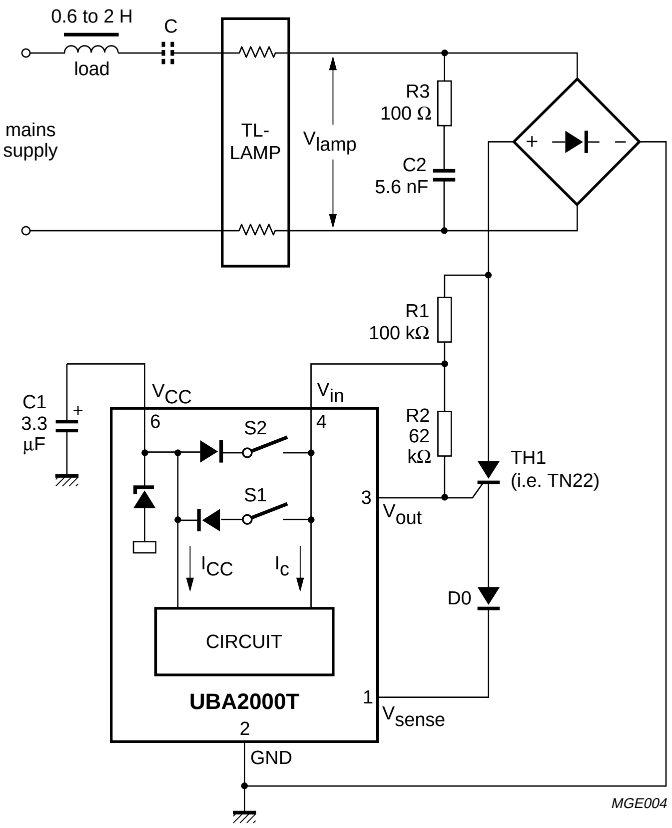


Fig.7 Application diagram (with trigger device).

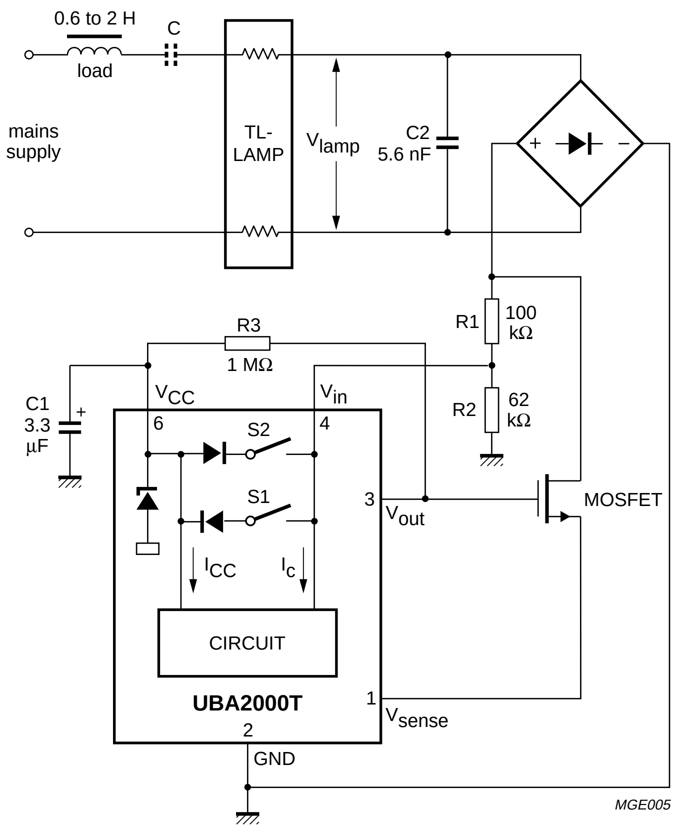
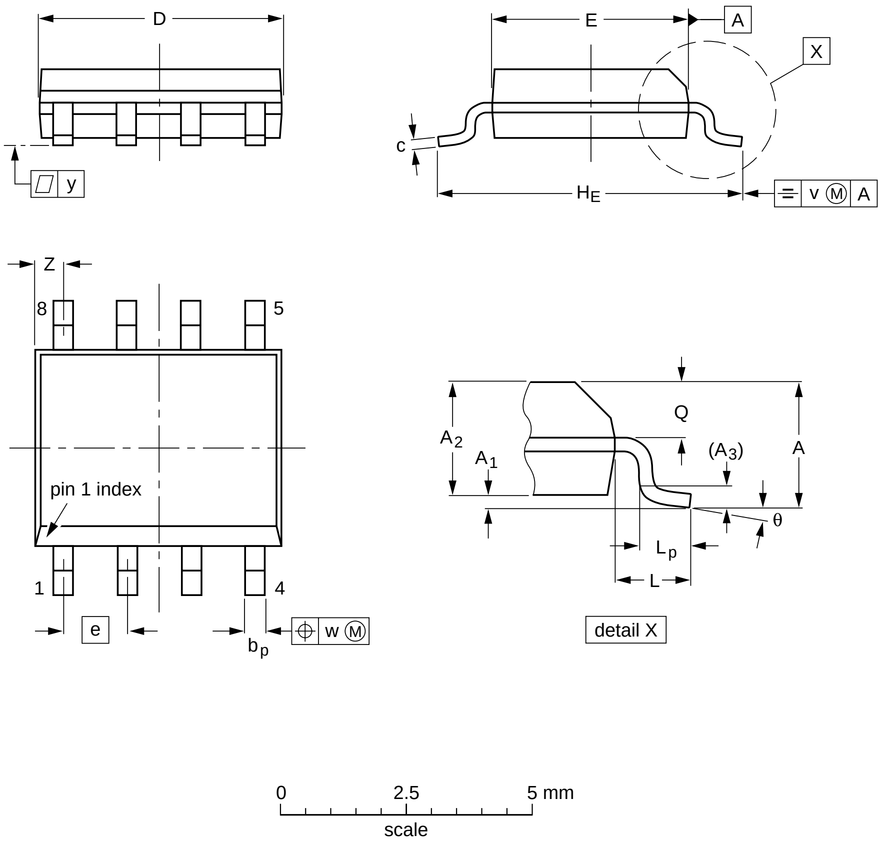


Fig.8 Application diagram (with MOSFET device).

PACKAGE OUTLINE

SO8: plastic small outline package; 8 leads; body width 3.9 mm **SOT96-1**



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

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	5.0 4.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.20 0.19	0.16 0.15	0.050	0.244 0.228	0.041	0.039 0.016	0.028 0.024	0.01	0.01	0.004	0.028 0.012	

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT96-1	076E03S	MS-012AA				~~95-02-04~~ 97-05-22

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).

Reflow soldering

Reflow soldering techniques are suitable for all SO packages.

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several techniques exist for reflowing; for example, thermal conduction by heated belt. Dwell times vary between 50 and 300 seconds depending on heating method. Typical reflow temperatures range from 215 to 250 °C.

Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 minutes at 45 °C.

Wave soldering

Wave soldering techniques can be used for all SO packages if the following conditions are observed:

- A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.
- The longitudinal axis of the package footprint must be parallel to the solder flow.
- The package footprint must incorporate solder thieves at the downstream end.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Maximum permissible solder temperature is 260 °C, and maximum duration of package immersion in solder is 10 seconds, if cooled to less than 150 °C within 6 seconds. Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

Repairing soldered joints

Fix the component by first soldering two diagonally-opposite end leads. Use only a low voltage soldering iron (less than 24 V) applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C. When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

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

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