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Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

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TEA1703T

GreenChip SMPS standby control IC

Rev. 2.3 — 28 April 2011

Product data sheet

1. General description

The TEA1703T is a low power standby controller IC intended to be used in applications which require an extreme low no-load standby power.

The TEA1703T includes circuitry for detecting output voltage, output power and switching. The TEA1703T integrates a switched-mode optocoupler driver, which enables an optocoupler to be driven with a high peak current while keeping the required power low¹.

The TEA1703T's typical current consumption is 30 μ A. In a typical notebook adapter application the TEA1703T's power consumption is less than 0.5 mW.

2. Features and benefits

- Switched-Mode Power Supply (SMPS) standby controller IC enabling very low power standby operation
- Large input voltage range (5 V up to 30 V)
- Very low supply current (30 μ A) typical
- Switched-mode optocoupler driver output (NXP Semiconductors patented)
- Easy application, only 6 pins to connect

3. Applications

The device can be used in applications that require a very low power no-load standby.

4. Ordering information

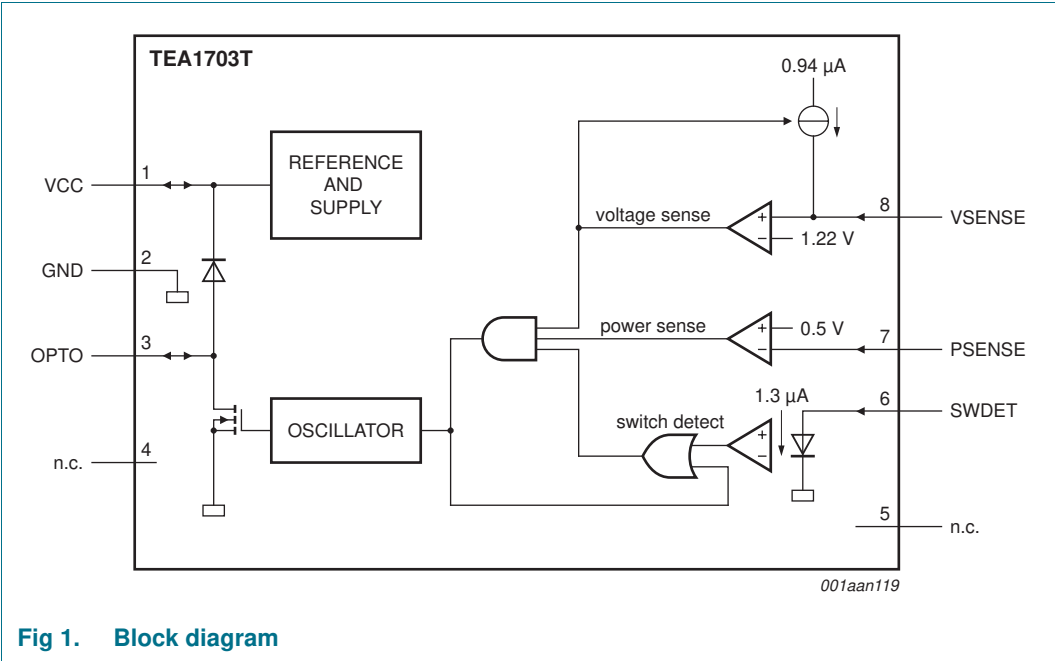
Table 1. Ordering information

Type number	Package		
	Name	Description	Version
TEA1703T	SO8	plastic small outline package; 8 leads; body width 3.9 mm	SOT96-1

1. NXP Semiconductors patented.

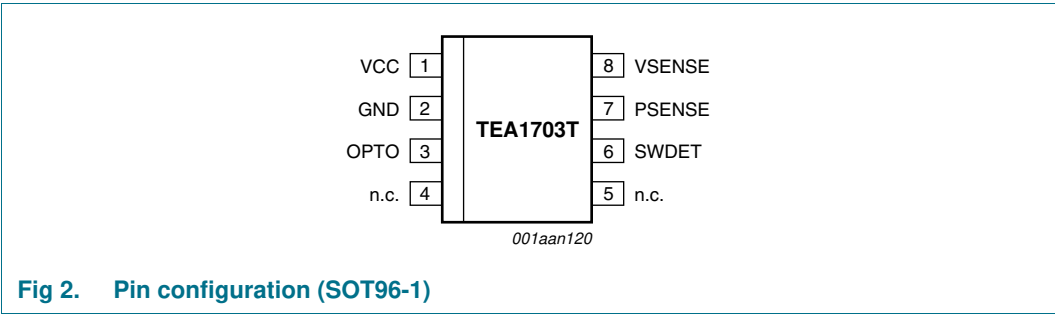


5. Block diagram



6. Pinning information

6.1 Pinning



6.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
VCC	1	supply voltage
GND	2	ground
OPTO	3	optocoupler driver
n.c.	4, 5	not connected
SWDET	6	switch detect input
PSENSE	7	power sense input
VSENSE	8	voltage sense input

7. Functional description

7.1 General control

The TEA1703T contains a standby controller for switched-mode power supplies. Typical configurations are shown in [Figure 3](#) and [Figure 4](#).

Typically the TEA1703T senses the output voltage and output power of a switched-mode power supply. The output voltage is sensed via a resistive divider network connected to pin VSENSE. The output power is sensed by determining the switching frequency of the converter using an external filtering network. The converter output power is dependent on the switching frequency, such as in a discontinuous conduction mode flyback converter which has a fixed primary peak current during low load operation.

A switching detection input on pin SWDET disables the TEA1703T output when the primary-side controller is not switching. TEA1753's pin VINSENSE is used to reset a latched protection and for standby control. If the TEA1753 is not switching due to latched protection, the TEA1703T will not activate standby mode. Activating standby mode resets latched protection.

When configured with the TEA1733, switching detection is only required if the primary-side V_{CC} (TEA1733 pin 1) is discharged below the latched protection reset level. In [Figure 4](#) a Zener diode is connected in series with the NPN transistor which discharges V_{CC} on pin 1. The Zener diode is chosen to keep V_{CC} on pin 1 just below the TEA1733's V_{CC} start-up level while the application is in standby mode, guaranteeing a short restart time. If the Zener diode is omitted, the switching detection input must be connected as shown in [Figure 4](#), otherwise pin V_{CC} can be connected via a series resistor to a fixed voltage.

The TEA1703T has an open-drain optocoupler driver output with an integrated diode to pin VCC. The optocoupler is efficiently driven in pulse mode which ensures that the optocoupler's Current Transfer Ratio (CTR) remains high; see [Section 7.7](#) and [Section 7.8](#).

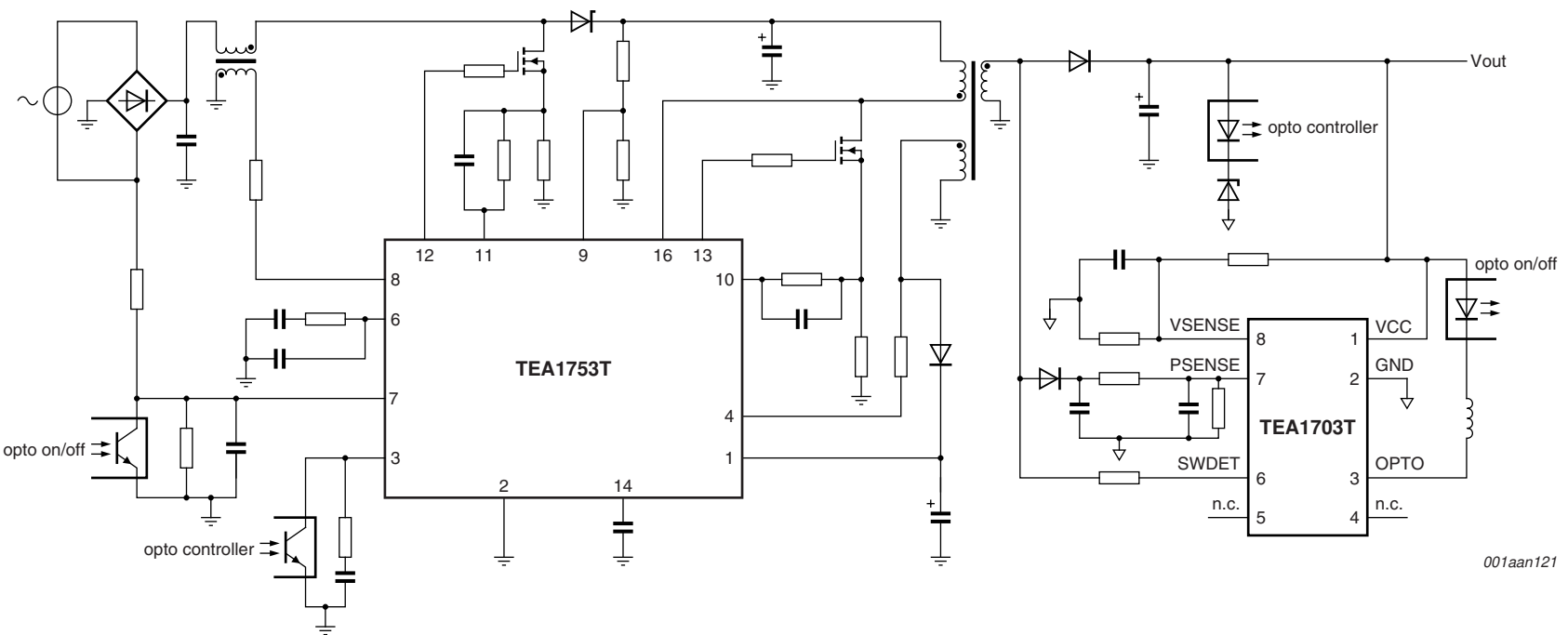
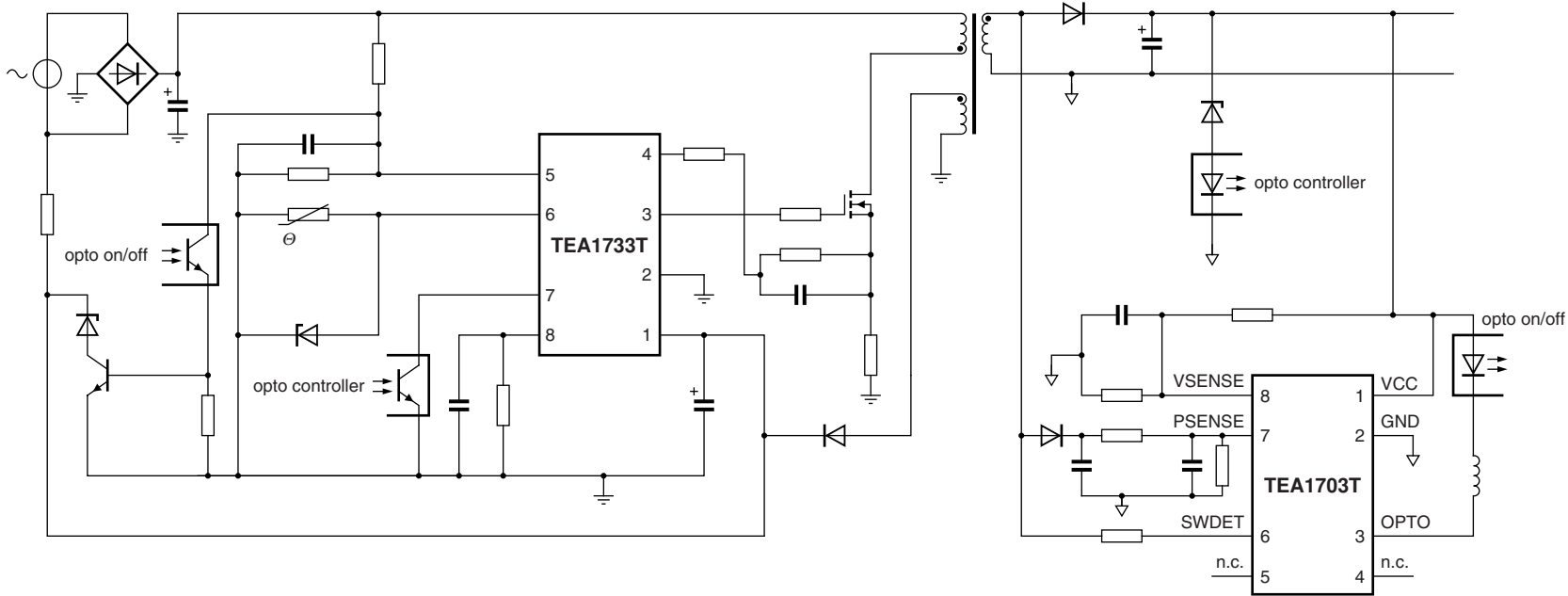


Fig 3. Typical configuration of TEA1703T with TEA1753



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Fig 4. Typical configuration of TEA1703T with TEA1733

7.2 Standby operation

When the output load of the switched-mode power supply falls, the voltage on pin PSENSE also falls. When the voltage on pin PSENSE falls below the $V_{th(Psense)}$ level, the TEA1703T activates its pin OPTO output as soon as its pin SWDET current is above the $I_{th(det)sw}$ level.

In a typical application, the switched-mode power supply is disabled by the TEA1703T as soon as its pin OPTO output is activated. The application's output voltage will then start to fall. After a period dependent on the output load and the output capacitor value, the VSENSE voltage falls below the $V_{th(Vsense)}$ level and the OPTO output is disabled again. This restarts the primary-side converter.

If the output load remains low, the application reverts to standby mode again after the output capacitor has been recharged. When a normal load is detected, the converter resumes normal operation; see [Figure 5](#).

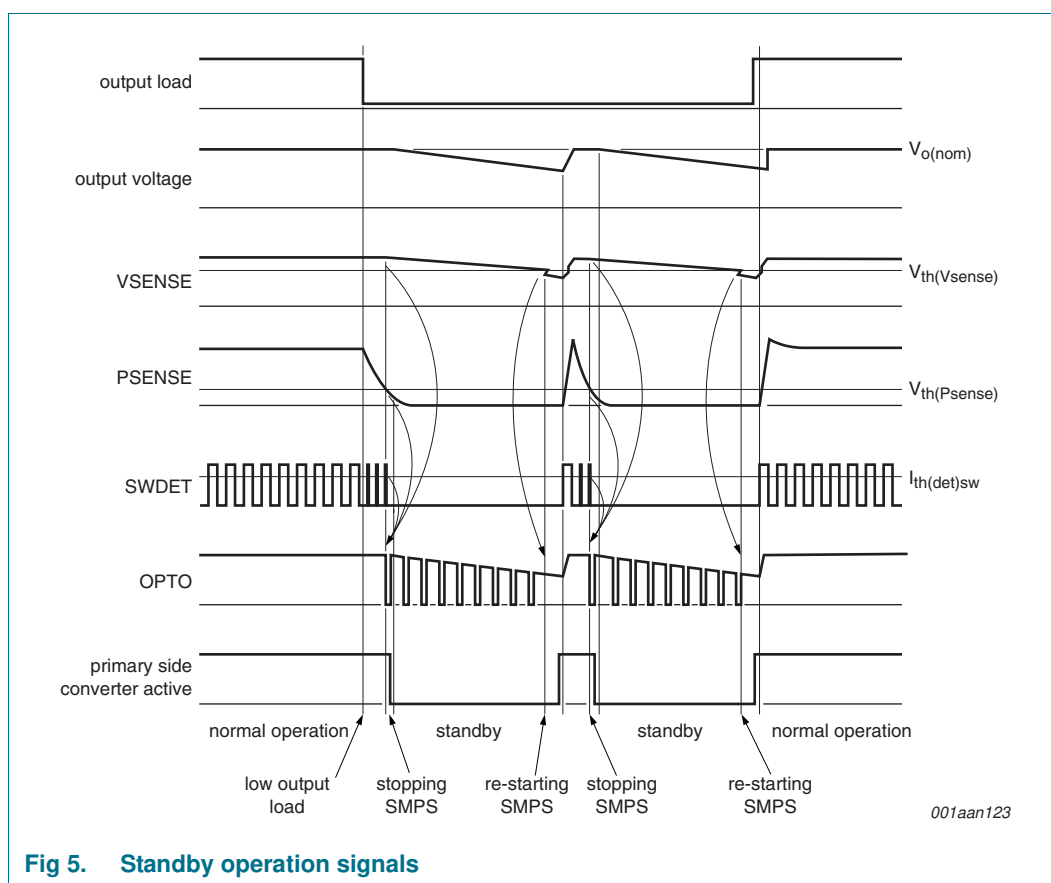


Fig 5. Standby operation signals

7.3 Voltage sensing (pin VSENSE)

If the voltage on pin VSENSE is above the $V_{th(Vsense)}$ level, pin VSENSE outputs a current $I_{O(Vsense)}$, which, in combination with the external resistive divider, creates a hysteresis on the adapter output voltage level. In a typical application, the effective output voltage hysteresis is larger than that set by $I_{O(Vsense)}$ and the resistive divider. This is because the external PSENSE filter circuit keeps the PSENSE voltage above the $V_{th(Psense)}$ level as long as the output capacitor is not charged to the normal output voltage level.

7.4 Power sensing (pin PSENSE)

Output power sensing is implemented using an external filter network on pin PSENSE. The PSENSE input is not latched internally. If, during standby mode, pin PSENSE is pulled above the $V_{th(PSENSE)}$ level, the OPTO output is disabled.

7.5 Switching detection (pin SWDET)

A switching detection pin is provided to prevent applications resetting a latched protection of the primary-side converter, such as the TEA1753. The standby mode can only be activated when the current into pin SWDET is above the $I_{th(det)sw}$ level.

The SWDET signal is latched internally. As soon as the OPTO output is activated, the SWDET signal is ignored.

If the SWDET input is not needed, it can be connected to pin VCC via a series resistor. The current into pin SWDET must be above the $I_{th(det)sw}$ level when the switched mode power supply is in normal operation.

7.6 Optocoupler output (pin OPTO)

The optocoupler output is an open-drain output with an integrated diode connected to pin VCC. The output is driven with a fixed frequency (f_{osc}) and a fixed on-time ($t_{on(OPTO)}$).

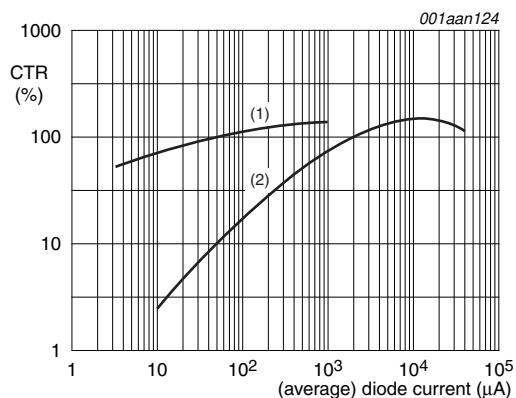
The optocoupler diode current can be set by choosing the value of the series inductor. The current is not limited internally.

7.7 Optocoupler CTR

The CTR of a typical optocoupler falls significantly when small opto-diode currents are used. With low optocoupler output currents, a significantly higher diode current is needed for a typical low-cost optocoupler.

In low standby power operation of the switched-mode power supply it is necessary to keep all currents low. To maintain a high CTR, the optocoupler diode can be driven with a high current and a small duty cycle. The average driving current will still be low.

[Figure 6](#) shows a typical optocoupler CTR plotted for a DC-driven opto-diode and a pulse-driven opto-diode. The pulse-driven diode is driven with a 2 mA duty cycle modulated current. The CTR remains high even for a very small average diode current (low duty cycle) when the diode is pulse-driven, while the CTR for a DC-driven optocoupler falls to a few percent.



- (1) Pulse driven.
(2) DC driven.

Fig 6. Typical optocoupler CTR

7.8 Optocoupler drive

If a series resistor is used to limit the optocoupler diode current and the output voltage of the application is 19 V, about 95 % of the driving energy is lost in the series resistor. The efficiency to drive the optocoupler is therefore not more than about 5 %.

In the intended application, the optocoupler is active in standby, therefore, the energy needed to drive the optocoupler must be as low as possible.

To improve the efficiency of the optocoupler drive, the optocoupler diode can be driven with a series inductor. The optocoupler diode is then driven like a switched-mode power supply². Driving the optocoupler with a series inductor improves the efficiency by a factor of 10 compared to driving it with a series resistor.

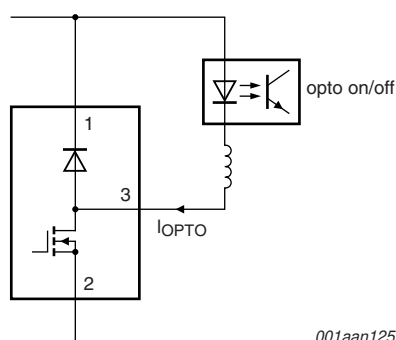


Fig 7. Switched-mode optocoupler driver

2. NXP Semiconductors patented.

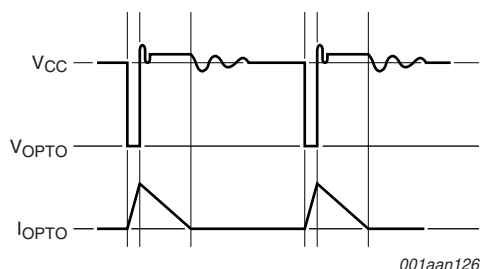


Fig 8. Switched-mode optocoupler drive signals

8. Limiting values

Table 3. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
Voltages					
V_{CC}	supply voltage	continuous	-0.4	+30	V
V_{VSENSE}	voltage on pin VSENSE	current limited	-0.4	+5	V
V_{PSENSE}	voltage on pin PSENSE	current limited	-0.4	+3	V
V_{OPTO}	voltage on pin OPTO	current limited	-0.4	$V_{CC} + 2$	V
Currents					
I_{VSENSE}	current on pin VSENSE		-1	+1	mA
I_{PSENSE}	current on pin PSENSE		-1	+1	mA
I_{SWDET}	current on pin SWDET		-1	+1	mA
I_{OPTO}	current on pin OPTO		-1	+25	mA
General					
P_{tot}	total power dissipation	$T_{amb} < 75\text{ °C}$	-	0.5	W
T_{stg}	storage temperature		-55	+150	°C
T_j	junction temperature		-40	+150	°C
ESD					
V_{ESD}	electrostatic discharge voltage	class 1			
	human body model	[1]	-	2000	V
	machine model	[2]	-	200	V
	charged device model		-	500	V

[1] Equivalent to discharging a 100 pF capacitor through a 1.5 kΩ series resistor.

[2] Equivalent to discharging a 200 pF capacitor through a 0.75 μH coil and a 10 Ω resistor.

9. Thermal characteristics

Table 4. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air; JEDEC test board	160	K/W
$R_{th(j-c)}$	thermal resistance from junction to case	in free air; JEDEC test board	72	K/W

10. Characteristics

Table 5. Characteristics

$T_{amb} = 25\text{ }^{\circ}\text{C}$; $V_{CC} = 20\text{ V}$; all voltages are measured with respect to ground (pin 2); currents are positive when flowing into the IC; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Supply voltage management (pin VCC)						
V _{CC(min)}	minimum supply voltage		3.5	4	4.5	V
I _{CC(oper)}	operating supply current		28	31	35	μA
Voltage sensing (pin VSENSE)						
V _{th(Vsense)}	voltage sense threshold voltage		1.17	1.22	1.31	V
I _{O(Vsense)}	voltage sense output current	V _{VSENSE} > 1.2 V	−1.10	−0.94	−0.75	μA
		V _{VSENSE} < 1.2 V	−30	−11	−5	nA
Power sensing (pin PSENSE)						
V _{th(Psense)}	power sense threshold voltage		0.45	0.5	0.55	V
I _{O(Psense)}	power sense output current		−30	−11	−5	nA
Switching detection (pin SWDET)						
I _{th(det)sw}	switching detection threshold current		0.8	1.3	2	μA
V _{det(sw)}	switching detection voltage	I _{SWDET} = 1.3 μA	0.7	0.74	0.8	V
Optocoupler output (pin OPTO)						
R _{DSon}	drain-source on-state resistance	V _{OPTO} = 1 V	90	100	110	Ω
t _{on(OPTO)}	on-time on pin OPTO		1.2	1.42	1.65	μs
I _{LZ}	off-state leakage current	V _{OPTO} = V _{CC}	-	-	100	nA
f _{osc}	oscillator frequency		24	28	33	kHz

11. Package outline

SO8: plastic small outline package; 8 leads; body width 3.9 mm

SOT96-1

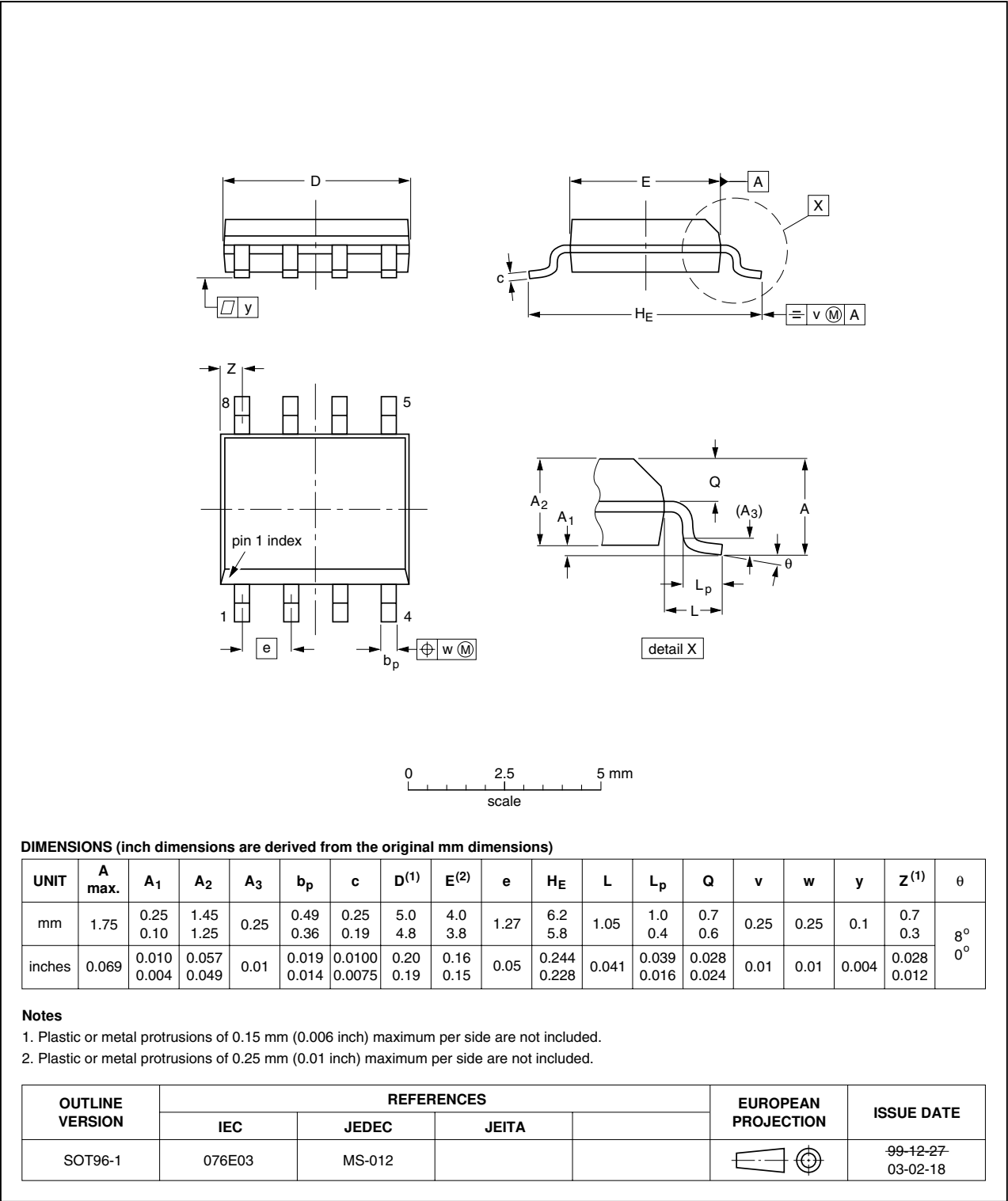


Fig 9. Package outline SOT96-1 (SO8)

12. Revision history

Table 6. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
TEA1703T v.2.3	20110428	Product data sheet	-	TEA1703T v.2.2
TEA1703T v.2.2	20110303	Objective data sheet	-	TEA1703T v.2.1
TEA1703T v.2.1	20110228	Objective data sheet	-	TEA1703T v.2
TEA1703T v.2	20110126	Objective data sheet	-	TEA1703T v.1
TEA1703T v.1	20110103	Objective data sheet	-	-

13. Legal information

13.1 Data sheet status

Document status ^{[1][2]}	Product status ^[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
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[2] The term 'short data sheet' is explained in section "Definitions".

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