TEA1703TS

GreenChip SMPS standby control IC

Rev. 1 — 7 June 2012 Product data sheet

1. General description

The TEA1703TS is a low power standby controller IC intended to be used in applications which require an extreme low no-load standby power.

The TEA1703TS includes circuitry for detecting output voltage, output power and switching of the SMPS. The TEA1703TS integrates a switched-mode optocoupler driver, which enables an optocoupler to be driven with a high peak current while keeping the required power low[1].

The typical current consumption of a TEA1703TS is 30 µA. In a typical notebook adapter application, the power consumption of a TEA1703TS is < 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 µA) 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
TEA1703TS	TSOP6	plastic surface mounted package; 6 leads	SOT457

1. NXP Semiconductors patented.

5. Block diagram

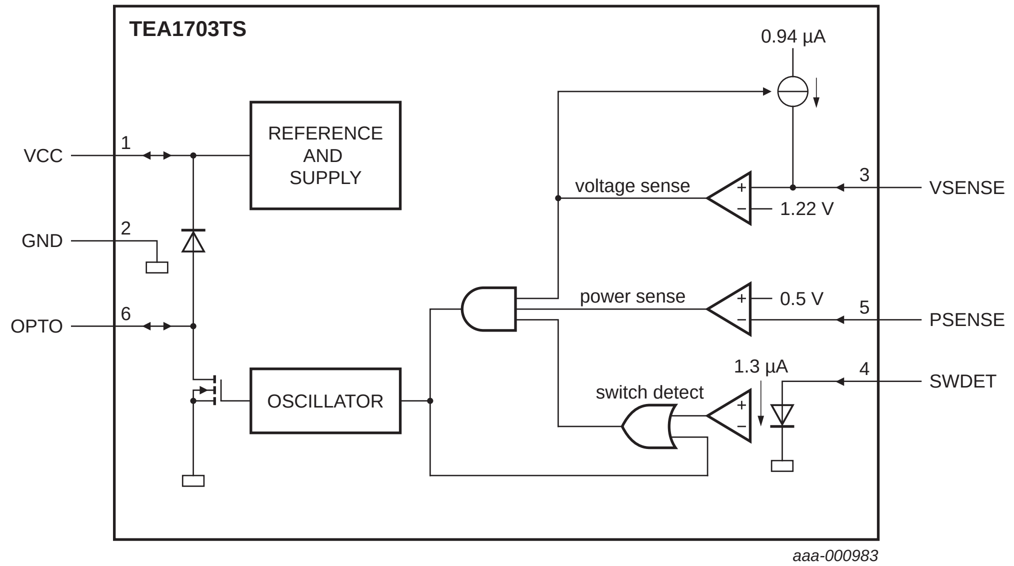


Fig 1. Block diagram

6. Pinning information

6.1 Pinning

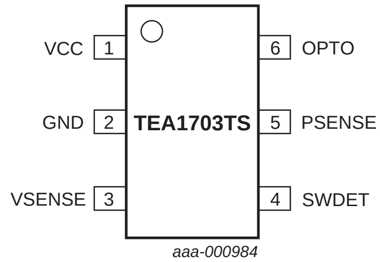


Fig 2. Pin configuration (SOT457)

6.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
VCC	1	supply voltage
GND	2	ground
VSENSE	3	voltage sense input
SWDET	4	switch detect input
PSENSE	5	power sense input
OPTO	6	optocoupler driver

7. Functional description

7.1 General control

The TEA1703TS contains a standby controller for switched-mode power supplies. Typical configurations are shown in Figure 3 and Figure 4.

Typically the TEA1703TS senses the output voltage and output power of a switched-mode power supply. The output voltage is sensed using a resistive divider network connected to the VSENSE pin. 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.

The TEA1703TS can be used in combination with a TEA1753 flyback controller. The TEA1753T VINSENSE pin can be used to enter Standby mode. However, the VINSENSE pin is also used to reset a latched protection in the TEA1753T. The TEA1703TS has an integrated switching detection circuit which prevents unintentional resetting of a latched protection.

When the TEA1753T is not switching, the TEA1703TS does not activate Standby mode. Switching is detected using the SWDET pin as shown in Figure 3.

When configured with the TEA1733, switching detection is only required if the primary-side V_{CC} (TEA1733 VCC pin) is discharged below the latched protection reset level. In Figure 4 a Zener diode Z1 is connected in series with the NPN transistor Q1 which discharges V_{CC} on the VCC pin. The Zener diode is chosen to keep V_{CC} on the VCC pin just below the TEA1733 V_{CC} start-up level while the application is in Standby mode, guaranteeing a short restart time. If the Zener diode is omitted, connect the switching detection input as shown in Figure 4. Otherwise connect the SWDET pin using a series resistor to a fixed voltage.

The TEA1703TS has an open-drain optocoupler driver output with an integrated freewheeling diode to the VCC pin. The optocoupler is efficiently driven in pulse mode which ensures that the optocoupler Current Transfer Ratio (CTR) remains high; see Section 7.7 and Section 7.8.

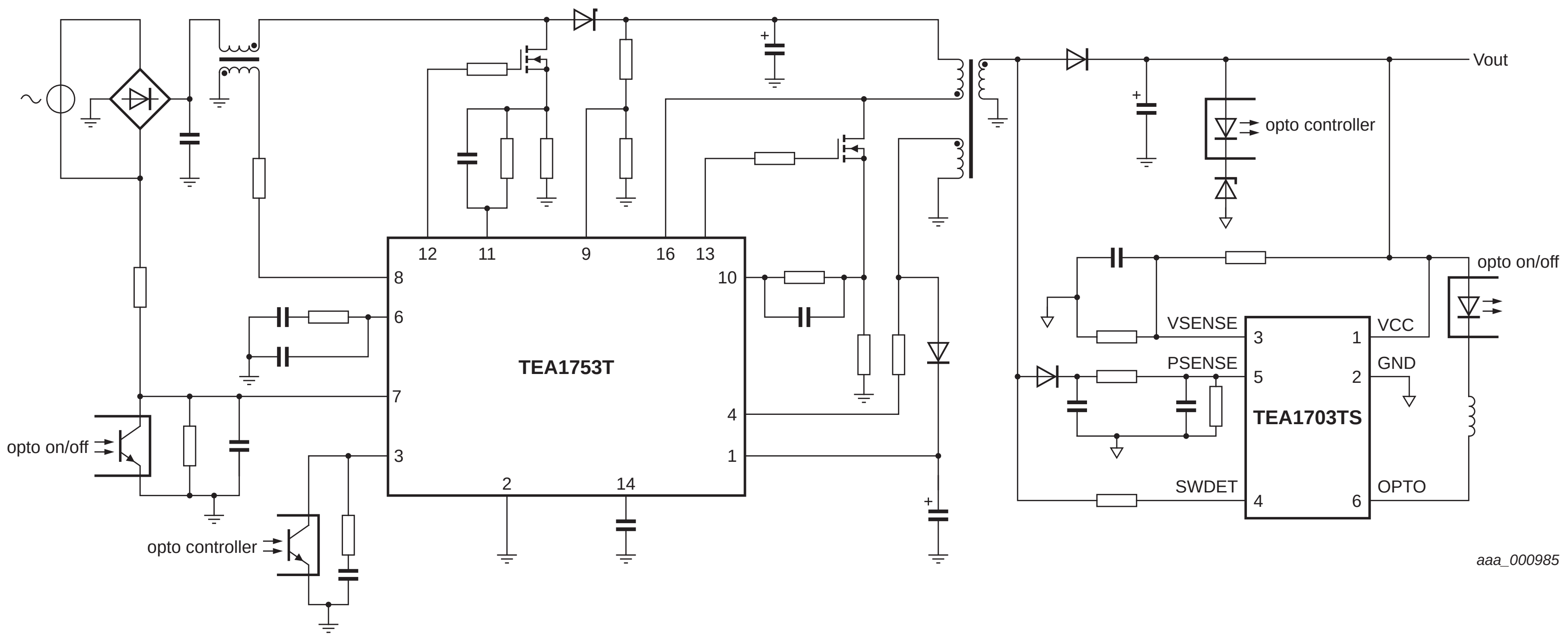


Fig 3. Typical configuration of TEA1703TS with TEA1753

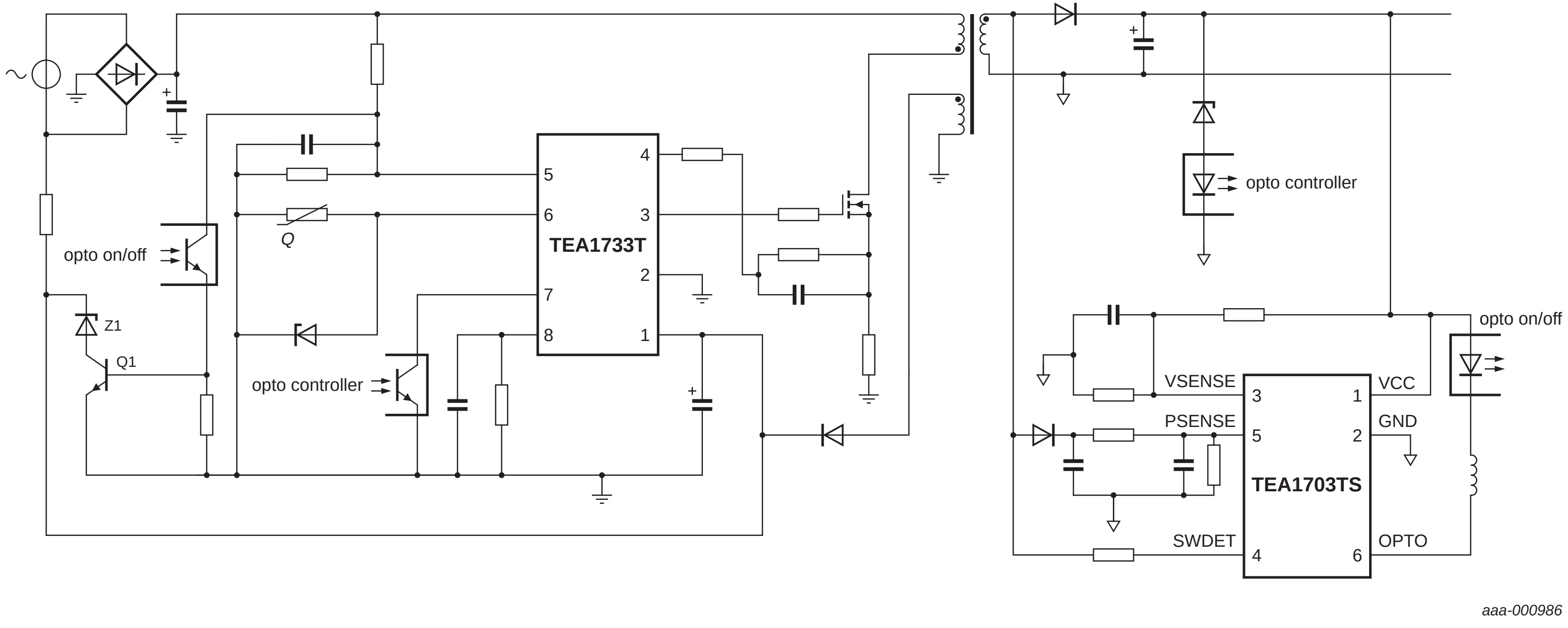


Fig 4. Typical configuration of TEA1703TS with TEA1733

7.2 Standby mode operation

When the output load of the switched-mode power supply falls, the voltage on the PSENSE pin also falls. When the voltage on the PSENSE pin is < $V_{th(PSENSE)}$, the TEA1703TS activates the OPTO pin output when the SWDET pin current is > $I_{th(det)sw}$.

When the OPTO pin output is activated in a typical application, the TEA1703TS disables the switched-mode power supply. The output voltage starts to fall. After a period dependent on the connected output power and the output capacitor value, the VSENSE voltage falls below the $V_{th(VSENSE)}$ level. The OPTO pin output is then disabled again. This function restarts the primary-side converter.

If the output power 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.

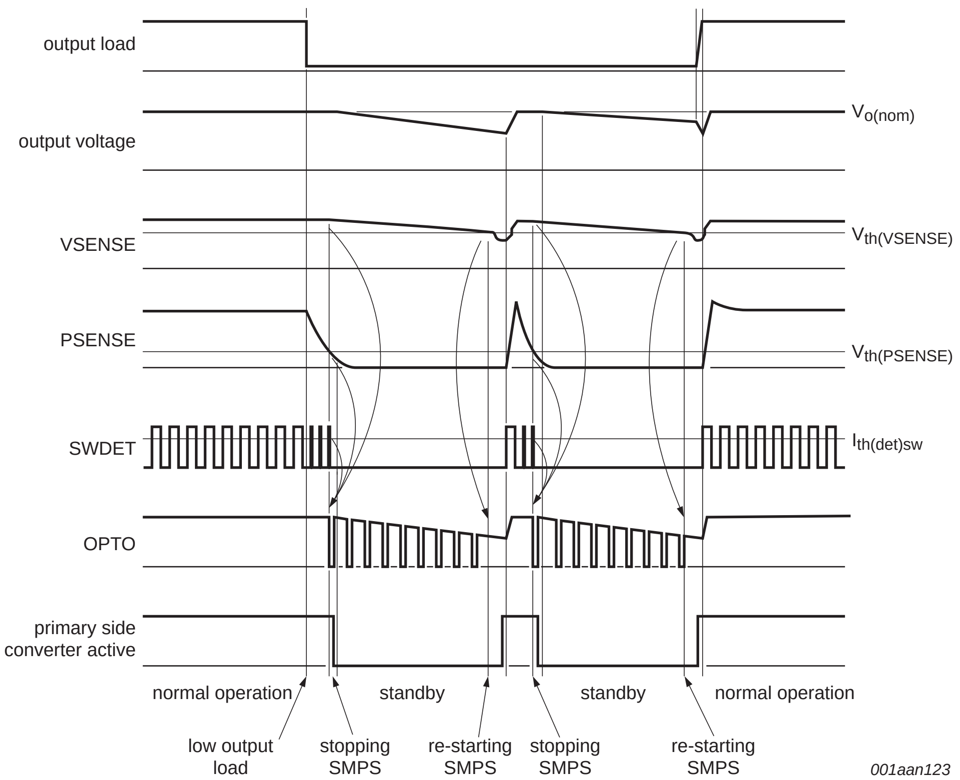


Fig 5. Standby mode operation signals

7.3 Voltage sensing (pin VSENSE)

If the voltage on the VSENSE pin is > $V_{th(VSENSE)}$, the VSENSE pin outputs a current $I_{O(VSENSE)}$. This current 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 > $V_{th(PSENSE)}$ when the output capacitor is not charged up to the normal output voltage level.

7.4 Power sensing (pin PSENSE)

Output power sensing is implemented using an external filter network on the PSENSE pin. The PSENSE input is not latched internally. If, during Standby mode, the PSENSE pin is pulled above the $V_{th(PSENSE)}$ level, the OPTO output is disabled. The hysteresis on the PSENSE pin makes the system less sensitive to voltage ripple.

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 the SWDET pin 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 the VCC pin using a series resistor. The current into the SWDET pin 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 ($t_{on(OPTO)}$).

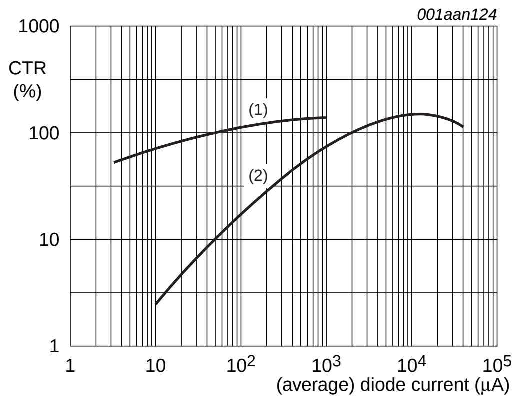
The optocoupler diode current can be set by choosing the value of the series inductor. The current is not limited internally.

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 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 is still low.

Figure 6 shows that 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 mode. Therefore, the energy 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 supply[2]. Driving the optocoupler with a series inductor improves the efficiency by a factor of 10 compared to driving it with a series resistor.

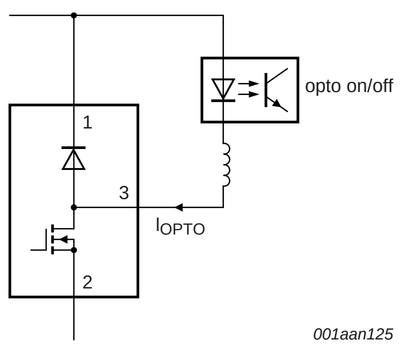


Fig 7. Switched-mode optocoupler driver

2. NXP Semiconductors patented.

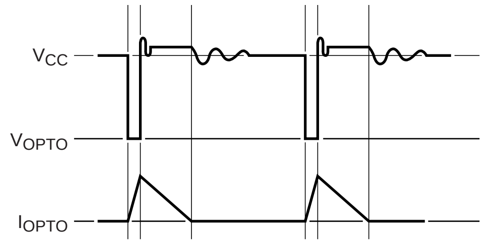


Fig 8. Switched-mode optocoupler drive signals

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	$T_{amb} < 75$ °C		-	0.2	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	259	K/W
$R_{th(j-c)}$	thermal resistance from junction to case	in free air; JEDEC test board	152	K/W

10. Characteristics

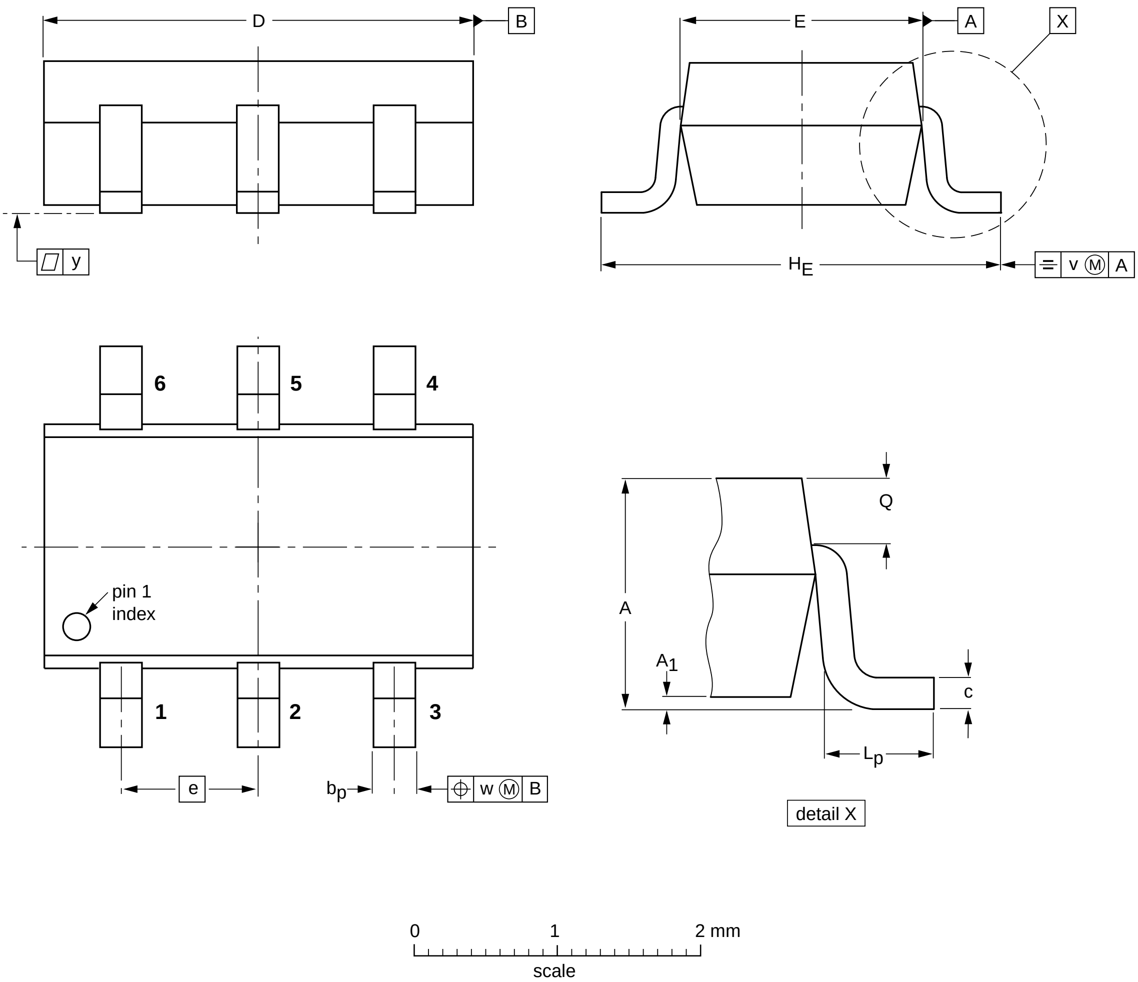
Table 5. Characteristics

T_{amb} = 25 °C; V_{CC} = 20 V; all voltages are measured with respect to ground (pin GND); 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)						
$V_{th(PSENSE)}$	threshold voltage on pin PSENSE		0.45	0.5	0.55	V
$V_{hys(PSENSE)}$	hysteresis voltage on pin PSENSE		16	25	34	mV
$I_{O(PSENSE)}$	output current on pin PSENSE		–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

Plastic surface-mounted package (TSOP6); 6 leads **SOT457**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b_p	c	D	E	e	H_E	L_p	Q	v	w	y
mm	1.1 0.9	0.1 0.013	0.40 0.25	0.26 0.10	3.1 2.7	1.7 1.3	0.95	3.0 2.5	0.6 0.2	0.33 0.23	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT457			SC-74			~~05-11-07~~ 06-03-16

Fig 9. Package outline SOT457 (TSOP6)

12. Revision history

Table 6. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
TEA1703TS v.1	20120607	Product 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.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term ‘short data sheet’ is explained in section “Definitions”.

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15. Contents

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Date of release: 7 June 2012

Document identifier: TEA1703TS