

# TDA3663

## Very low dropout voltage/quiescent current 3.3 V voltage regulator

Rev. 06 — 26 June 2007

Product data sheet

### 1. General description

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The TDA3663 is a fixed 3.3 V voltage regulator with a very low dropout voltage and quiescent current, which operates over a wide supply voltage range.

### 2. Features

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- Fixed 3.3 V, 100 mA regulator
- Supply voltage range up to 45 V
- Very low quiescent current of 15  $\mu$ A (typical value)
- Very low dropout voltage
- High ripple rejection
- Protections:
  - ◆ Reverse polarity safe (down to  $-25$  V without high reverse current)
  - ◆ Negative transient of 50 V ( $R_S = 10\ \Omega$ ,  $t < 100$  ms)
  - ◆ Able to withstand voltages up to 18 V at the output (supply line may be short-circuited)
  - ◆ ESD protection on all pins
  - ◆ DC short-circuit safe to ground and  $V_P$  of the regulator output
  - ◆ Temperature protection (at  $T_j > 150\ ^\circ\text{C}$ )

3. Quick reference data

Table 1: Quick reference data  
 $V_P = 14.4\text{ V}$ ;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ ; measured with test circuit of Figure 15; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Supply voltage: pin $V_P$						
$V_P$	supply voltage	regulator operating	[1] 3	14.4	45	V
$I_q$	quiescent current	$V_P = 4.5\text{ V}$ ; $I_{REG} = 0\text{ mA}$	-	10	-	$\mu\text{A}$
		$V_P = 14.4\text{ V}$ ; $I_{REG} = 0\text{ mA}$	-	15	30	$\mu\text{A}$
		$6\text{ V} \leq V_P \leq 22\text{ V}$ ; $I_{REG} = 10\text{ mA}$	-	0.2	0.5	mA
		$6\text{ V} \leq V_P \leq 22\text{ V}$ ; $I_{REG} = 50\text{ mA}$	-	1.4	2.5	mA
Regulator output: pin REG						
$V_{REG}$	output voltage	$8\text{ V} \leq V_P \leq 22\text{ V}$ ; $I_{REG} = 0.5\text{ mA}$	3.16	3.3	3.44	V
		$0.5\text{ mA} \leq I_{REG} \leq 100\text{ mA}$	3.13	3.3	3.47	V
		$6\text{ V} \leq V_P \leq 45\text{ V}$ ; $I_{REG} = 0.5\text{ mA}$ ;	3.13	3.3	3.47	V
$V_{REG(drop)}$	dropout voltage	$V_P = 3.1\text{ V}$ ; $T_{amb} \leq 85\text{ }^{\circ}\text{C}$ ; $I_{REG} = 50\text{ mA}$ ;	-	0.18	0.3	V

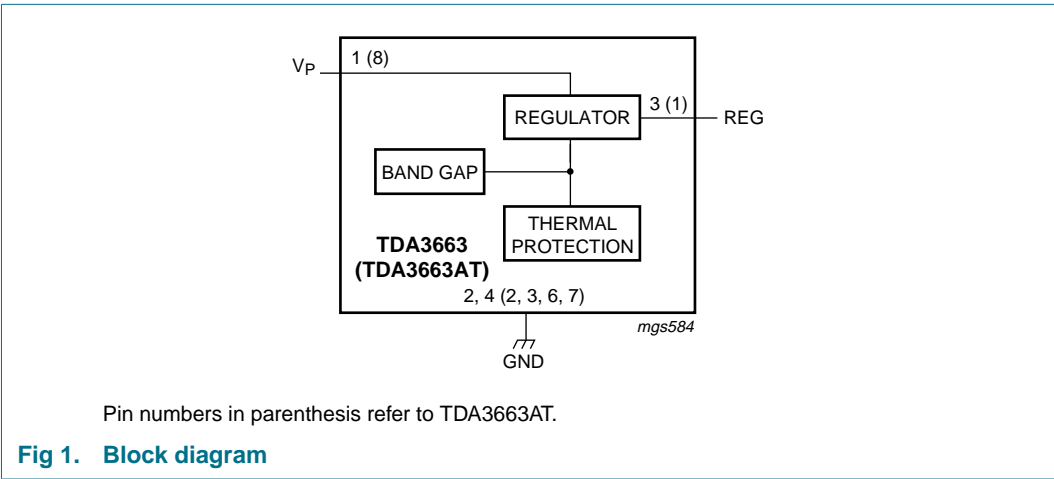
[1] The regulator output will follow  $V_P$  if  $V_P < V_{REG} + V_{REG(drop)}$ .

4. Ordering information

Table 2: Ordering information

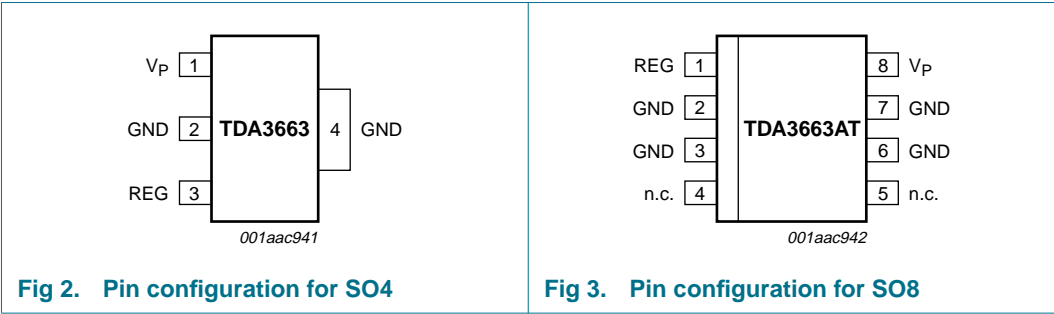
Type number	Package		Version
	Name	Description	
TDA3663	SO4	plastic small outline package; 4 leads; body width 3.5 mm	SOT223-1
TDA3663AT	SO8	plastic small outline package; 8 leads; body width 3.9 mm	SOT96-1

5. Block diagram



6. Pinning information

6.1 Pinning



## 6.2 Pin description

**Table 3: Pin description**

Symbol	Pin		Description
	SO4	SO8	
V <sub>P</sub>	1	8	supply voltage
GND	2 and 4	2, 3, 6 and 8	ground <sup>[1]</sup>
REG	3	1	regulator output
n.c.	-	4 and 5	not connected

[1] For the SO8 package all GND pins are connected to the lead frame and can also be used to reduce the total thermal resistance  $R_{th(j-a)}$  by soldering these pins to a ground plane. The ground plane on the top side of the PCB acts like a heat spreader.

## 7. Functional description

The TDA3663 is a fixed 3.3 V regulator which can deliver output currents up to 100 mA. The regulator is available in SO8 and SO4 packages. The regulator is intended for portable, mains and telephone applications. To increase the lifetime of batteries, a specially built-in clamp circuit keeps the quiescent current of this regulator very low, also in dropout and full load conditions.

The device remains operational down to very low supply voltages and below this voltage it switches off.

A temperature protection circuit is included which switches off the regulator output at a junction temperature above 150 °C.

## 8. Limiting values

**Table 4: Limiting values**

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

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>P</sub>	supply voltage		-	45	V
V <sub>P(rp)</sub>	reverse polarity supply voltage	non-operating	-	-25	V
P <sub>tot</sub>	total power dissipation				
	TDA3663	temperature of copper area is 25 °C	-	4.1	W
	TDA3663AT	T <sub>amb</sub> = 25 °C	-	5	W
T <sub>stg</sub>	storage temperature	non-operating	-55	+150	°C
T <sub>amb</sub>	ambient temperature	operating	-40	+125	°C
T <sub>j</sub>	junction temperature	operating	-40	+150	°C

## 9. Thermal characteristics

**Table 5: Thermal characteristics**

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient			
	SO4	in free air; soldered	100	K/W
	SO8	in free air; soldered	155	K/W
$R_{th(j-c)}$	thermal resistance from junction to case			
	SO4	to center pins; soldered	25	K/W
	SO8	to center pins; soldered	30	K/W

## 10. Characteristics

**Table 6: Characteristics**

$V_P = 14.4$  V;  $T_{amb} = 25$  °C; measured with test circuit of [Figure 15](#); unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Supply voltage: pin V <sub>P</sub>						
V <sub>P</sub>	supply voltage	regulator operating	[1] 3	14.4	45	V
I <sub>q</sub>	quiescent current	V <sub>P</sub> = 4.5 V; I <sub>REG</sub> = 0 mA	-	10	-	μA
		V <sub>P</sub> = 14.4 V; I <sub>REG</sub> = 0 mA	-	15	30	μA
		6 V ≤ V <sub>P</sub> ≤ 22 V; I <sub>REG</sub> = 10 mA	-	0.2	0.5	mA
		6 V ≤ V <sub>P</sub> ≤ 22 V; I <sub>REG</sub> = 50 mA	-	1.4	2.5	mA
Regulator output: pin REG						
V <sub>REG</sub>	output voltage	8 V ≤ V <sub>P</sub> ≤ 22 V; I <sub>REG</sub> = 0.5 mA	3.16	3.3	3.44	V
		0.5 mA ≤ I <sub>REG</sub> ≤ 100 mA	3.13	3.3	3.47	V
		6 V ≤ V <sub>P</sub> ≤ 45 V; I <sub>REG</sub> = 0.5 mA	3.13	3.3	3.47	V
V <sub>REG(drop)</sub>	dropout voltage	V <sub>P</sub> = 3.1 V; T <sub>amb</sub> ≤ 85 °C; I <sub>REG</sub> = 50 mA	-	0.18	0.3	V
V <sub>REG(stab)</sub>	output voltage long-term stability	per 1000 h	-	20	-	mV
ΔV <sub>REG(line)</sub>	line input regulation voltage	7 V ≤ V <sub>P</sub> ≤ 22 V; I <sub>REG</sub> = 0.5 mA	-	1	30	mV
		7 V ≤ V <sub>P</sub> ≤ 45 V; I <sub>REG</sub> = 0.5 mA	-	1	50	mV
ΔV <sub>REG(load)</sub>	load output regulation voltage	0.5 mA ≤ I <sub>REG</sub> ≤ 50 mA	-	10	50	mV
SVRR	supply voltage ripple rejection	f <sub>i</sub> = 120 Hz; V <sub>i(ripple)</sub> = 1 V (RMS); I <sub>REG</sub> = 0.5 mA	50	60	-	dB
I <sub>REG(crl)</sub>	output current limit	V <sub>REG</sub> > 2.8 V	0.17	0.25	-	A
I <sub>LO(rp)</sub>	output leakage current at reverse polarity	V <sub>P</sub> = −15 V; V <sub>REG</sub> ≤ 0.3 V	-	1	500	μA

[1] The regulator output will follow  $V_P$  if  $V_P < V_{REG} + V_{REG(drop)}$ .

## 11. Application information

### 11.1 Noise

The output noise is determined by the value of the output capacitor. The noise figure is measured at a bandwidth of 10 Hz to 100 kHz (see [Table 7](#)).

**Table 7: Noise figures**

Output current $I_{REG}$ (mA)	Noise figure ( $\mu$ V)		
	C2 = 10 $\mu$ F	C2 = 47 $\mu$ F	C2 = 100 $\mu$ F
0.5	550	320	300
50	650	400	400

### 11.2 Stability

For stable operation:

- The maximum output capacitor ESR should not exceed 22  $\Omega$  (worst-case) and for the minimum ESR, see [Table 8](#).
- The ESR of the output capacitor is limited.
- See [Table 8](#) for the minimum ESR values of the output capacitor, at  $T_{amb}$  given the load and output capacitance.

**Remark:** In the event of using different types of capacitors, a minimum ESR needs to be created by using an additional resistor that is placed in series with the output capacitor, see [Figure 4](#).

- It is recommended not to use below 1 mA output current because of reduced phase margin.

**Table 8: Minimum ESR values required**

$I_{REG}$ (mA) max	C2 = 100 nF	C2 = 1 $\mu$ F	C2 = 10 $\mu$ F	C2 = 100 $\mu$ F
1	> 0 $\Omega$	> 1.5 $\Omega$	> 2.5 $\Omega$	> 0 $\Omega$
5	> 1 $\Omega$	> 0.5 $\Omega$	> 1 $\Omega$	> 0 $\Omega$
10	> 0 $\Omega$	> 0.5 $\Omega$	> 4 $\Omega$	> 0 $\Omega$
100	> 0 $\Omega$	> 0.5 $\Omega$	> 4 $\Omega$	> 0 $\Omega$

### 11.3 Application circuits

The maximum output current of the regulator equals:

$$I_{REG(max)} = \frac{150 - T_{amb}}{R_{th(j-a)} \times (V_P - V_{REG})} = \frac{150 - T_{amb}}{100 \times (V_P - 3.3)} (mA)$$

When  $T_{amb} = 21$  °C and  $V_P = 14$  V the maximum output current equals 116 mA.

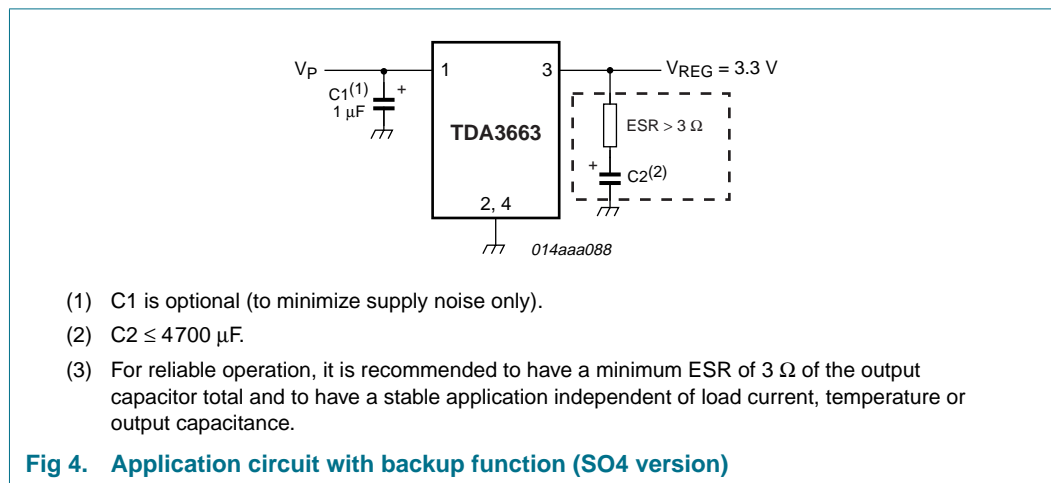
The total thermal resistance of the TDA3663 can be decreased from 155 K/W to 30 K/W for the SO8 version. For the SO4 version it can be decreased from 100 K/W to 25 K/W when GND pins 2 and 4 of the package are soldered to the printed-circuit board.

### 11.3.1 Application circuit with backup function

Sometimes a backup function is needed to supply, for example, a microcontroller for a short period of time when the supply voltage spikes to 0 V (or even  $-1$  V).

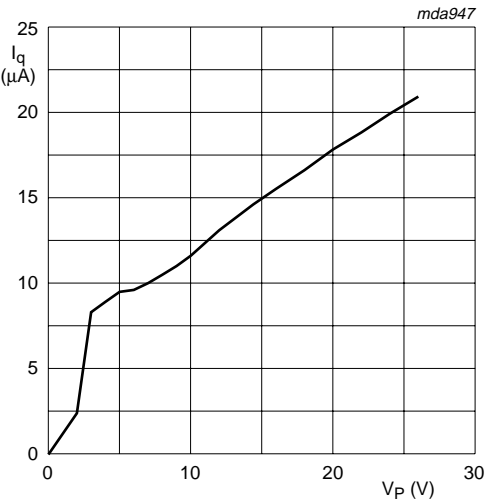
This function can easily be built with the TDA3663 by using an output capacitor with a large value. When the supply voltage is 0 V (or  $-1$  V), only a small current will flow into pin REG from this output capacitor (a few  $\mu\text{A}$ ).

The application circuit is given in [Figure 4](#).



11.4 Additional application information

This section gives typical curves for various parameters measured on the TDA3663AT. Standard test conditions are:  $V_P = 14.4\text{ V}$ ;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ .



$I_{REG} = 0\text{ mA}$ .

Fig 5. Quiescent current as a function of the supply voltage

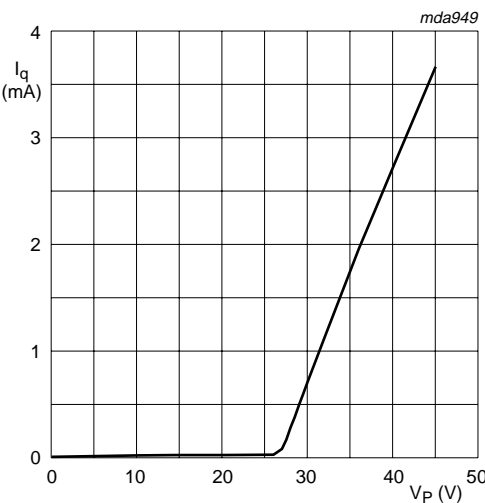
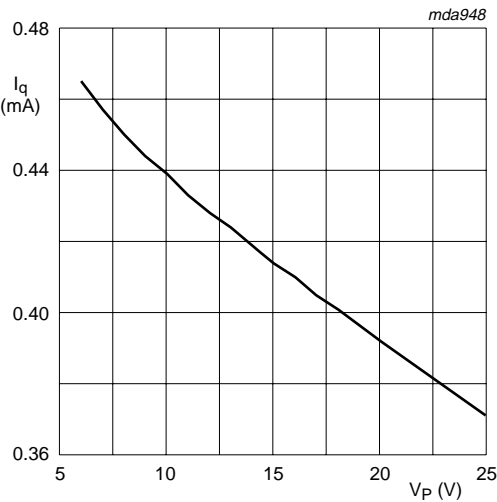
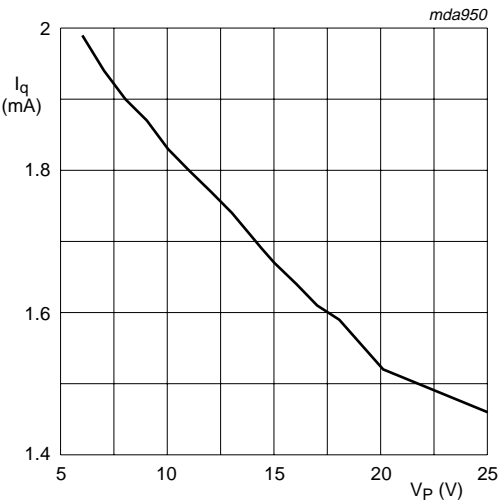


Fig 6. Quiescent current increase as a function of the high supply voltage



$I_{REG} = 10\text{ mA}$ .

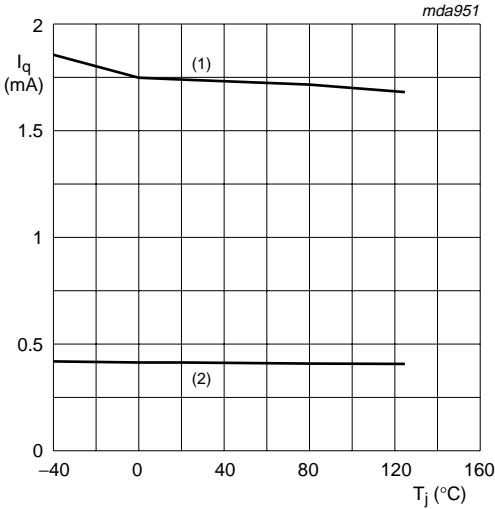
Fig 7. Quiescent current as a function of the supply voltage



$I_{REG} = 50\text{ mA}$ .

Fig 8. Quiescent current as a function of the supply voltage





- (1)  $I_q$  at 50 mA load.
- (2)  $I_q$  at 10 mA load.

Fig 9. Quiescent current as a function of the junction temperature

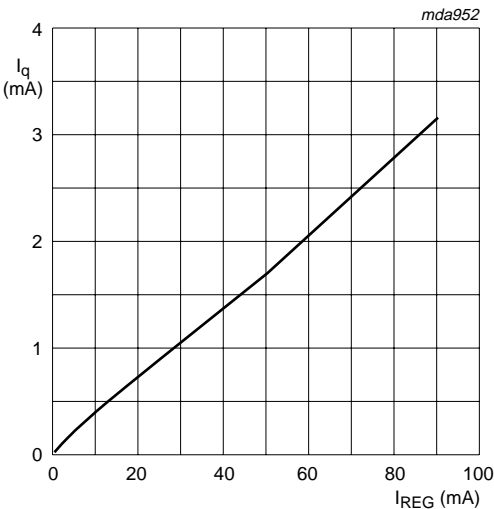
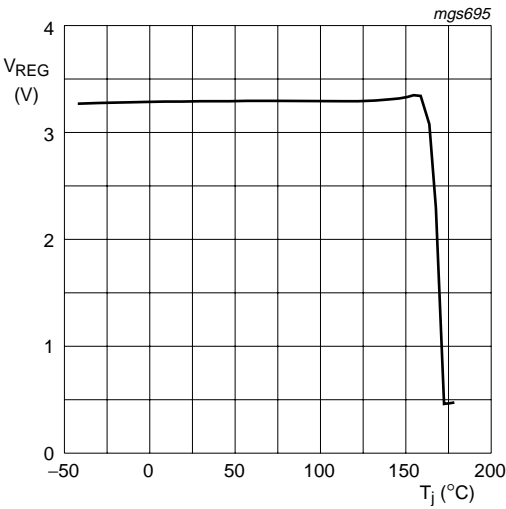


Fig 10. Quiescent current as a function of the output current



$I_{REG} = 0$  mA.

Fig 11. Output voltage thermal protection as a function of the junction temperature

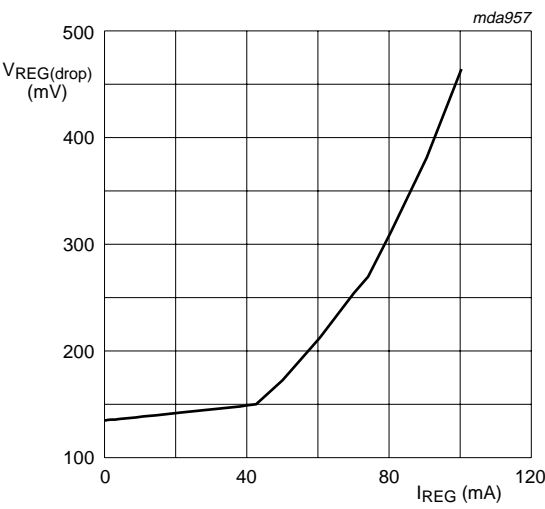
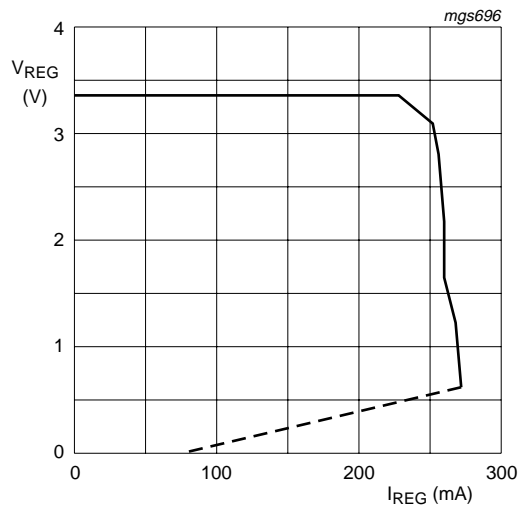
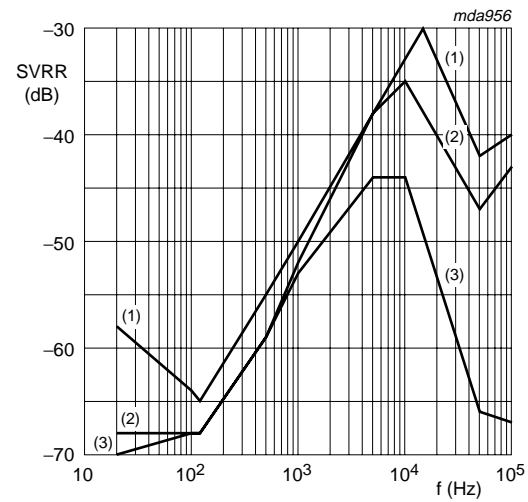


Fig 12. Dropout voltage as a function of the output current



$V_P = 8$  V and pulsed load.

Fig 13. Fold back protection mode

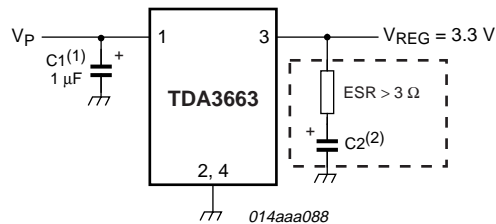


$I_{REG} = 10$  mA;  $C_2 = 10 \mu F$ .

- (1) SVRR at  $R_L = 100 \Omega$ .
- (2) SVRR at  $R_L = 500 \Omega$ .
- (3) SVRR at  $R_L = 10 k\Omega$ .

Fig 14. Supply voltage ripple rejection as a function of the ripple frequency

## 12. Test information



(1)  $C1$  is optional (to minimize supply noise only).

Fig 15. Test circuit (SO4)

### 12.1 Quality information

The *General Quality Specification for Integrated Circuits*, SNW-FQ-611 is applicable.

13. Package outline

SO4: plastic small outline package; 4 leads; body width 3.5 mm

SOT223-1

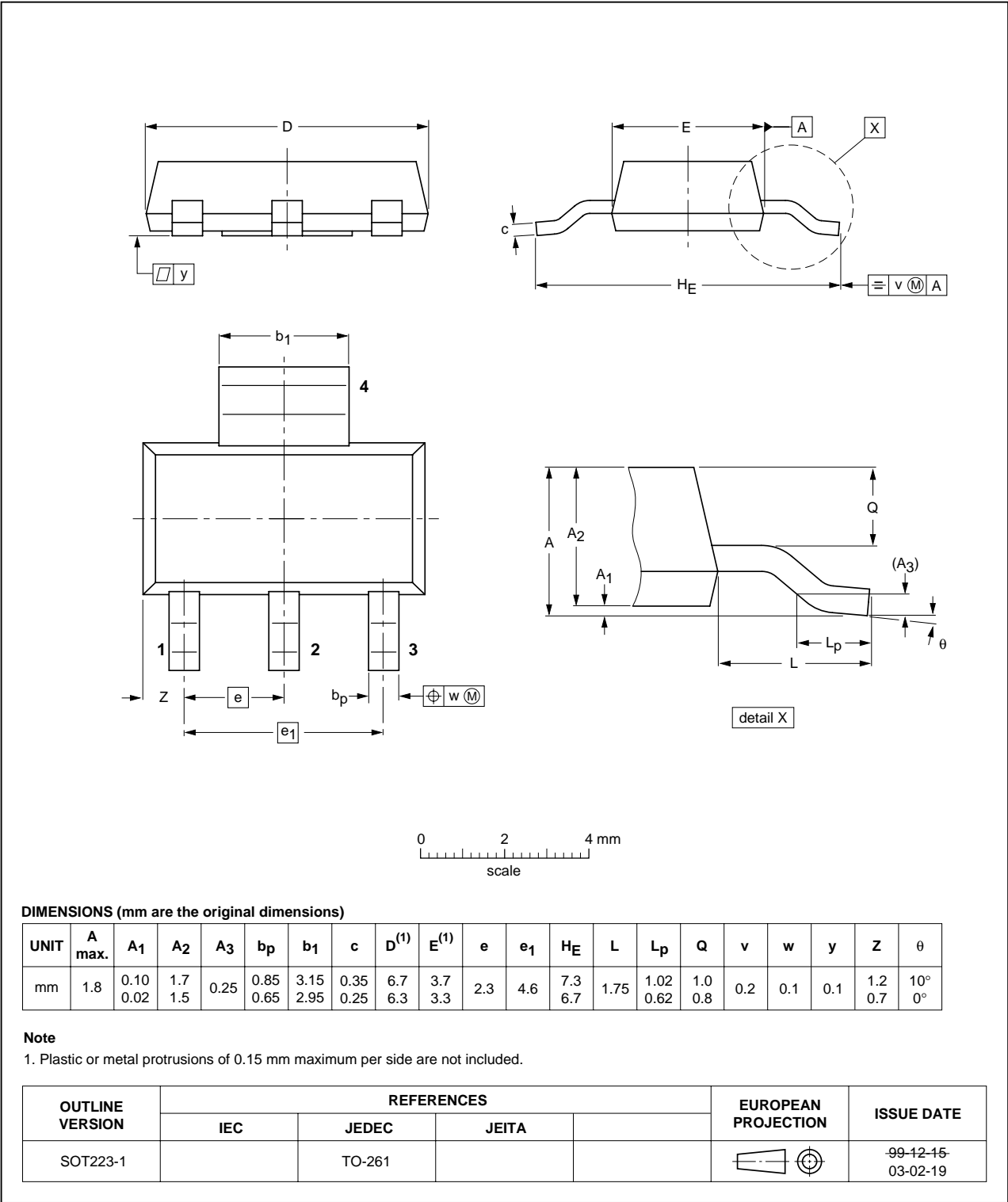


Fig 16. Package outline SOT223-1 (SO4)

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

SOT96-1

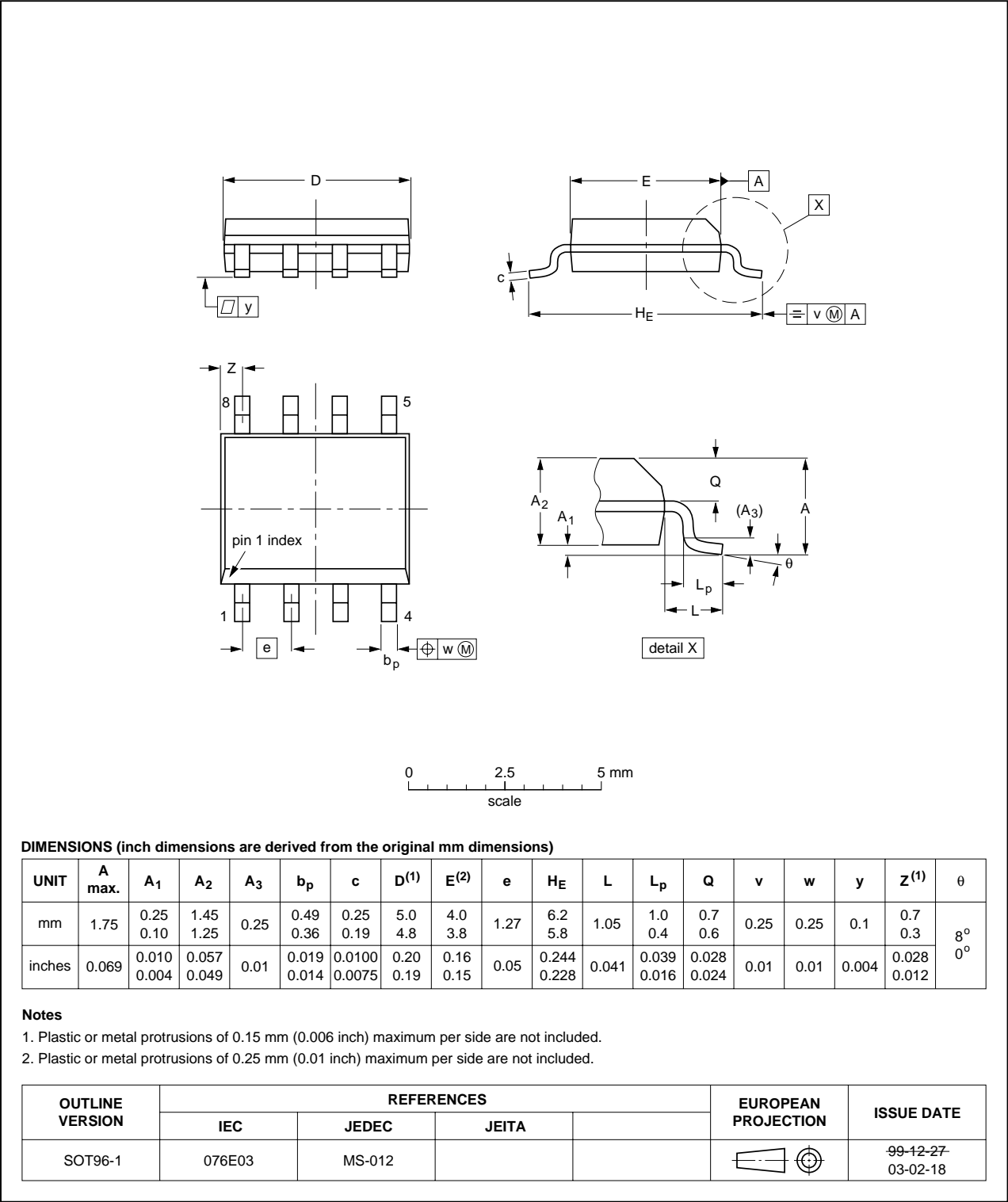


Fig 17. Package outline SOT96-1 (SO8)

## 14. Revision history

**Table 9:** Revision history

Document ID	Release date	Data sheet status	Change notice	Doc. number	Supersedes
TDA3663_6	20070626	Product data sheet	-	-	TDA3663_5
Modifications	<ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> <li>Minor changes made to bulleted list in <a href="#">Section 11.2</a></li> <li>Minor changes made to <a href="#">Table 8</a></li> <li>Component additions to <a href="#">Figure 4</a> and <a href="#">Figure 15</a>.</li> </ul>				
TDA3663_5	20050613	Product data sheet	-	9397 750 15047	TDA3663_4
TDA3663_4	20001214	Product specification	-	9397 750 07864	TDA3663_3
TDA3663_3	20001208	Preliminary specification	-	9397 750 07555	TDA3663_2
TDA3663_2	20000201	Preliminary specification	-	9397 750 06798	TDA3663_1
TDA3663_1	19990929	Preliminary specification	-	9397 750 06068	-

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### 15.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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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