TDA3663

Very low dropout voltage/quiescent current 3.3 V voltage regulator

Rev. 06 — 26 June 2007 Product data sheet

1. General description

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

- Fixed 3.3 V, 100 mA regulator
- Supply voltage range up to 45 V
- Very low quiescent current of 15 µA (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 Ω, 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 °C)

3. Quick reference data

Table 1: Quick reference data

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_P							
V_P	supply voltage	regulator operating	[1]	3	14.4	45	V
I_q	quiescent current	V_P = 4.5 V; I_{REG} = 0 mA		-	10	-	μA
		V_P = 14.4 V; I_{REG} = 0 mA		-	15	30	μA
		6 V ≤ V_P ≤ 22 V; I_{REG} = 10 mA		-	0.2	0.5	mA
		6 V ≤ V_P ≤ 22 V; I_{REG} = 50 mA		-	1.4	2.5	mA
Regulator output: pin REG							
V_{REG}	output voltage	8 V ≤ V_P ≤ 22 V; I_{REG} = 0.5 mA		3.16	3.3	3.44	V
		0.5 mA ≤ I_{REG} ≤ 100 mA		3.13	3.3	3.47	V
		6 V ≤ V_P ≤ 45 V; I_{REG} = 0.5 mA;		3.13	3.3	3.47	V
$V_{REG(drop)}$	dropout voltage	V_P = 3.1 V; T_{amb} ≤ 85 °C; I_{REG} = 50 mA;		-	0.18	0.3	V

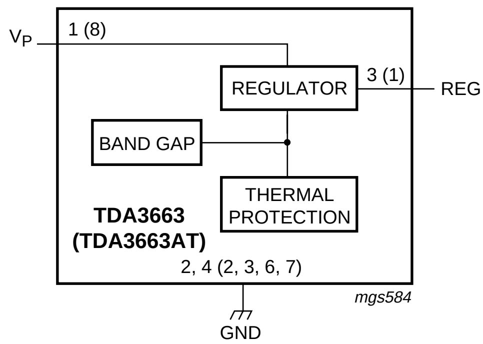
[1] The regulator output will follow V_P if $V_P < V_{REG} + V_{REG(drop)}$.

4. Ordering information

Table 2: Ordering information

Type number	Package		
	Name	Description	Version
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



Pin numbers in parenthesis refer to TDA3663AT.

Fig 1. Block diagram

6. Pinning information

6.1 Pinning

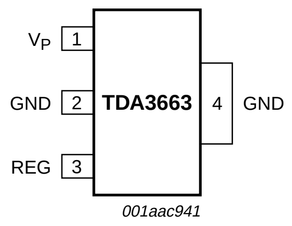


Fig 2. Pin configuration for SO4

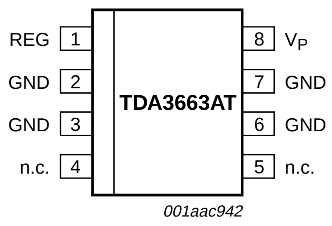


Fig 3. Pin configuration for SO8

6.2 Pin description

Table 3: Pin description

Symbol	Pin		Description
	SO4	SO8	
V_P	1	8	supply voltage
GND	2 and 4	2, 3, 6 and 8	ground[1]
REG	3	1	regulator output
n.c.	-	4 and 5	not connected

[1] For he 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_P	supply voltage		-	45	V
$V_{P(rp)}$	reverse polarity supply voltage	non-operating	-	–25	V
P_{tot}	total power dissipation				
	TDA3663	temperature of copper area is 25 °C	-	4.1	W
	TDA3663AT	T_{amb} = 25 °C	-	5	W
T_{stg}	storage temperature	non-operating	–55	+150	°C
T_{amb}	ambient temperature	operating	–40	+125	°C
T_j	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_P						
V_P	supply voltage	regulator operating [1]	3	14.4	45	V
I_q	quiescent current	V_P = 4.5 V; I_{REG} = 0 mA	-	10	-	µA
		V_P = 14.4 V; I_{REG} = 0 mA	-	15	30	µA
		6 V ≤ V_P ≤ 22 V; I_{REG} = 10 mA	-	0.2	0.5	mA
		6 V ≤ V_P ≤ 22 V; I_{REG} = 50 mA	-	1.4	2.5	mA
Regulator output: pin REG						
V_{REG}	output voltage	8 V ≤ V_P ≤ 22 V; I_{REG} = 0.5 mA	3.16	3.3	3.44	V
		0.5 mA ≤ I_{REG} ≤ 100 mA	3.13	3.3	3.47	V
		6 V ≤ V_P ≤ 45 V; I_{REG} = 0.5 mA	3.13	3.3	3.47	V
$V_{REG(drop)}$	dropout voltage	V_P = 3.1 V; T_{amb} ≤ 85 °C; I_{REG} = 50 mA	-	0.18	0.3	V
$V_{REG(stab)}$	output voltage long-term stability	per 1000 h	-	20	-	mV
$\Delta V_{REG(line)}$	line input regulation voltage	7 V ≤ V_P ≤ 22 V; I_{REG} = 0.5 mA	-	1	30	mV
		7 V ≤ V_P ≤ 45 V; I_{REG} = 0.5 mA	-	1	50	mV
$\Delta V_{REG(load)}$	load output regulation voltage	0.5 mA ≤ I_{REG} ≤ 50 mA	-	10	50	mV
SVRR	supply voltage ripple rejection	f_i = 120 Hz; $V_{i(ripple)}$ = 1 V (RMS); I_{REG} = 0.5 mA	50	60	-	dB
$I_{REG(crl)}$	output current limit	V_{REG} > 2.8 V	0.17	0.25	-	A
$I_{LO(rp)}$	output leakage current at reverse polarity	V_P = –15 V; V_{REG} ≤ 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 (μV)		
	C2 = 10 μF	C2 = 47 μF	C2 = 100 μF
0.5	550	320	300
50	650	400	400

11.2 Stability

For stable operation:

- The maximum output capacitor ESR should not exceed 22 Ω (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 is 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 μF	C2 = 10 μF	C2 = 100 μF
1	> 0 Ω	> 1.5 Ω	> 2.5 Ω	> 0 Ω
5	> 1 Ω	> 0.5 Ω	> 1 Ω	> 0 Ω
10	> 0 Ω	> 0.5 Ω	> 4 Ω	> 0 Ω
100	> 0 Ω	> 0.5 Ω	> 4 Ω	> 0 Ω

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.

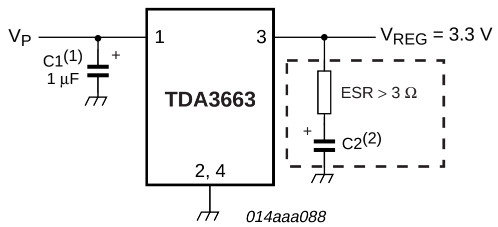
The total thermal resistance of the TDA3663 can be decreased from 155 K/W to 30 K/W for the SO8 version. For the SO4 version it can be decreased from 100 K/W to 25 K/W when GND pins 2 and 4 of the package are soldered to the printed-circuit board.

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 µA).

The application circuit is given in Figure 4.



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

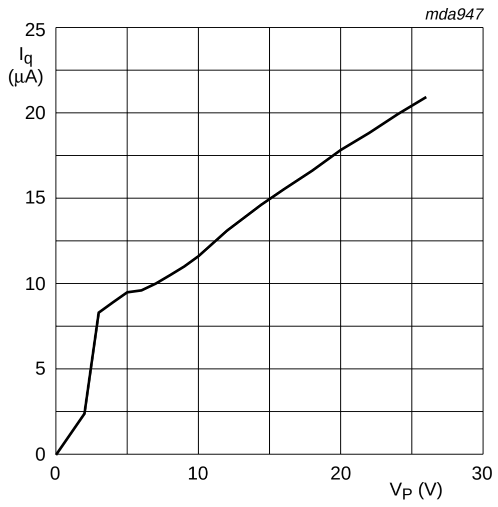
(2) C2 ≤ 4700 µF.

(3) For reliable operation, it is recommended to have a minimum ESR of 3 Ω of the output capacitor total and to have a stable application independent of load current, temperature or output capacitance.

Fig 4. Application circuit with backup function (SO4 version)

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 V; T_{amb} = 25 °C.



I_{REG} = 0 mA.

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

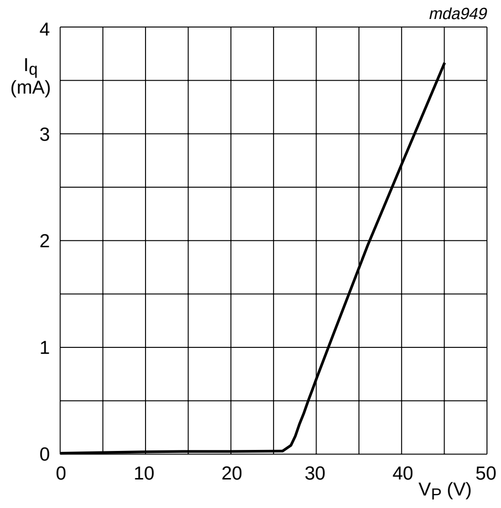
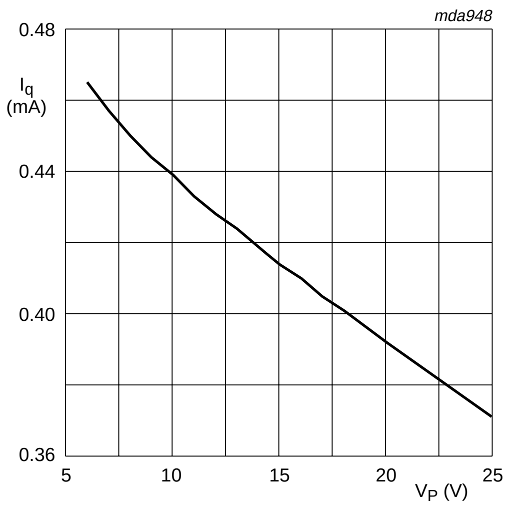
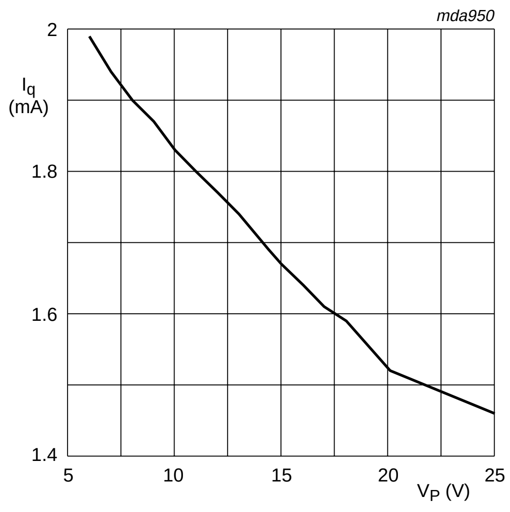


Fig 6. Quiescent current increase as a function of the high supply voltage



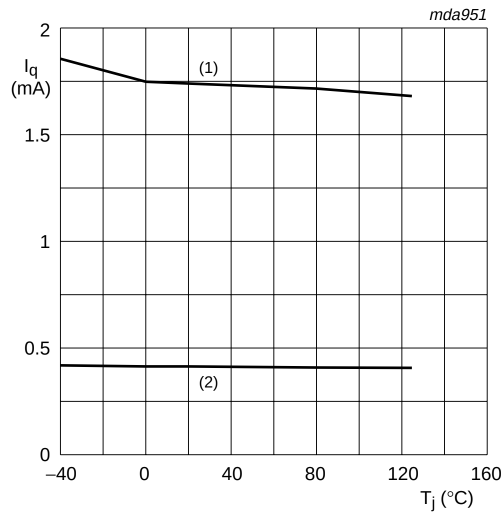
I_{REG} = 10 mA.

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



I_{REG} = 50 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

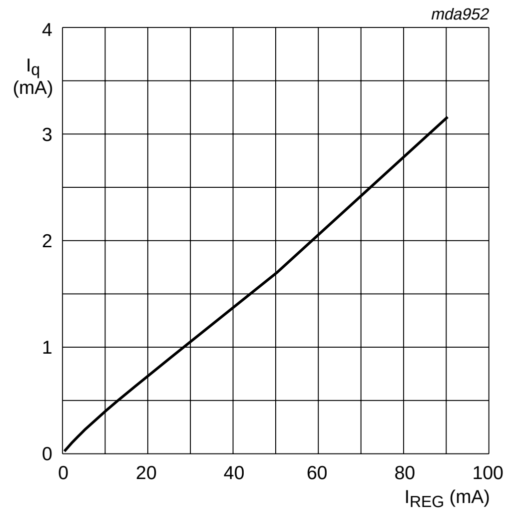
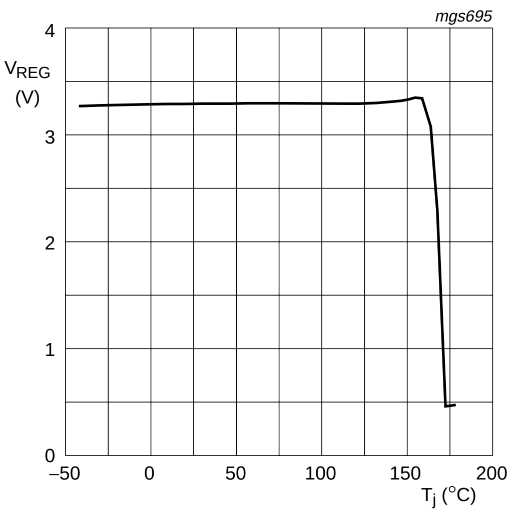


Fig 10. Quiescent current as a function of the output current



I_{REG} = 0 mA.

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

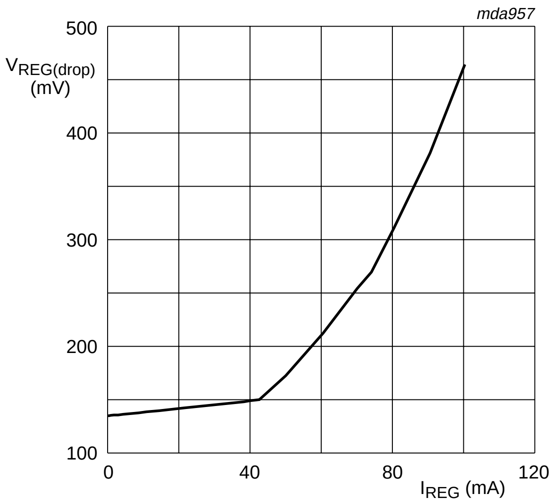
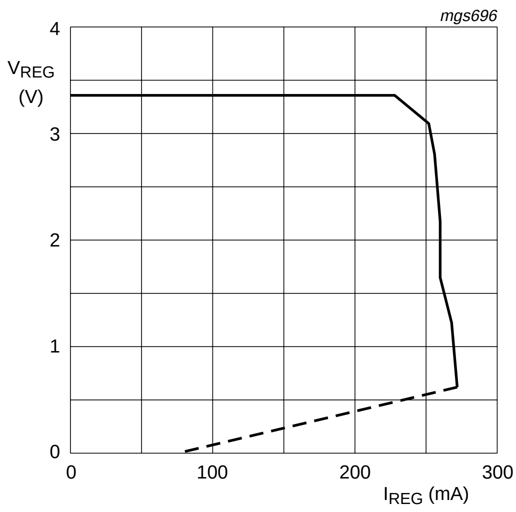
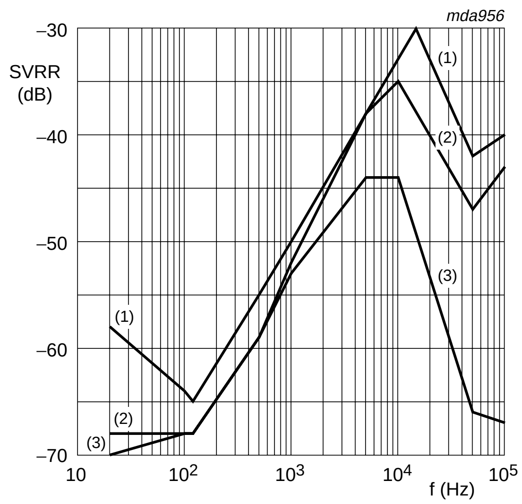


Fig 12. Dropout voltage as a function of the output current



V_P = 8 V and pulsed load.

Fig 13. Fold back protection mode



I_{REG} = 10 mA; C2 = 10 μF.

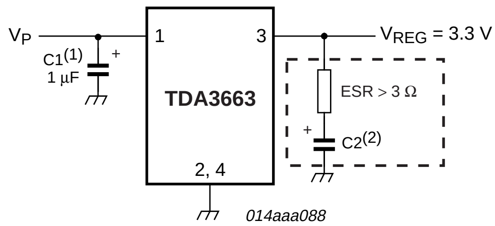
(1) SVRR at R_L = 100 Ω.

(2) SVRR at R_L = 500 Ω.

(3) SVRR at R_L = 10 kΩ.

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).

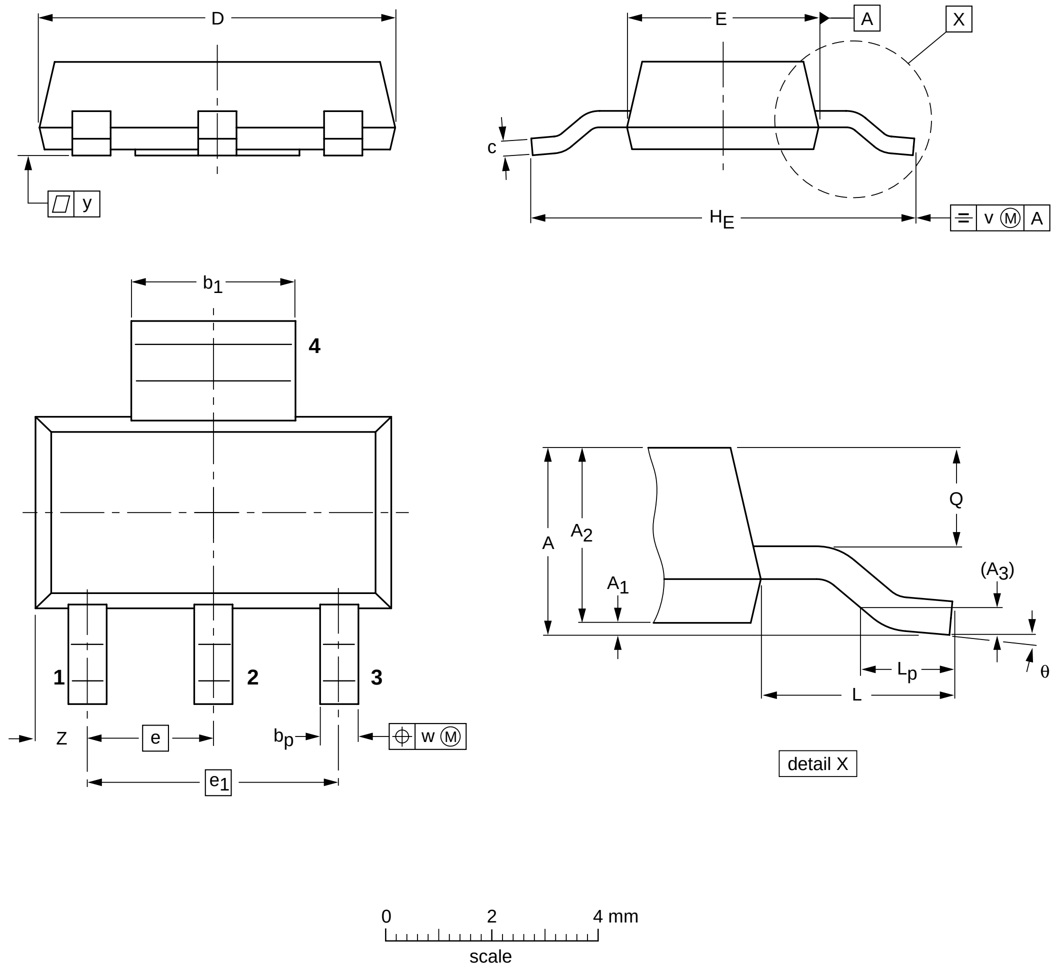
Fig 15. Test circuit (SO4)

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**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	b_1	c	D(1)	E(1)	e	e_1	H_E	L	L_p	Q	v	w	y	Z	θ
mm	1.8	0.10 0.02	1.7 1.5	0.25	0.85 0.65	3.15 2.95	0.35 0.25	6.7 6.3	3.7 3.3	2.3	4.6	7.3 6.7	1.75	1.02 0.62	1.0 0.8	0.2	0.1	0.1	1.2 0.7	10° 0°

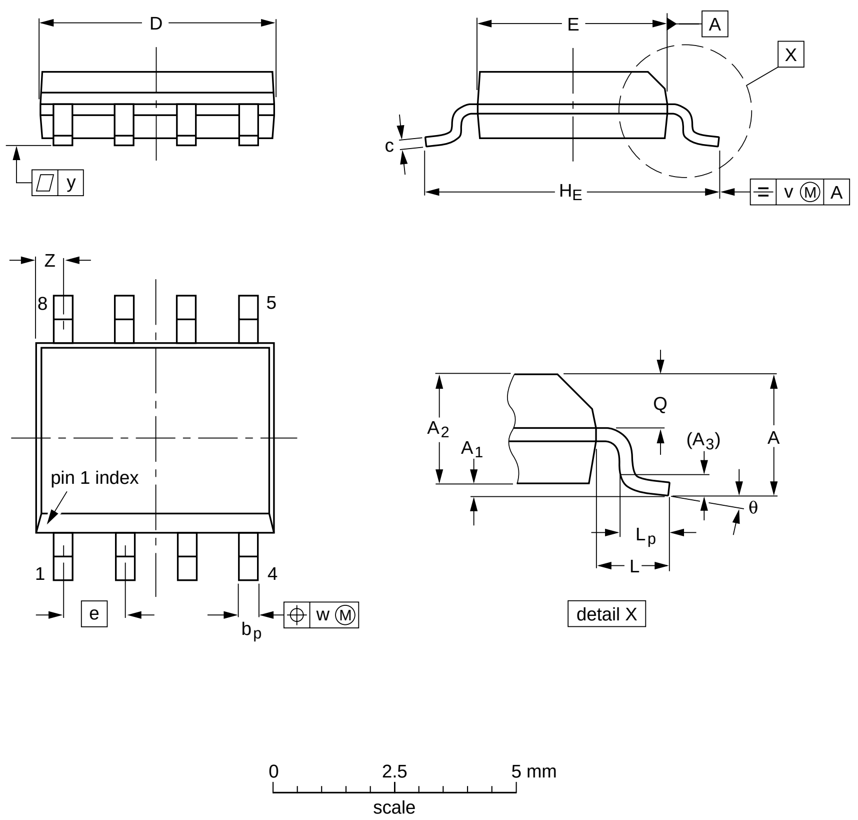
Note

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

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT223-1		TO-261				~~99-12-15~~ 03-02-19

Fig 16. Package outline SOT223-1 (SO4)

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^{o} 0^{o}
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	0.05	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 (0.006 inch) maximum per side are not included.
2. Plastic or metal protrusions of 0.25 mm (0.01 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT96-1	076E03	MS-012				~~99-12-27~~ 03-02-18

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	• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. • Legal texts have been adapted to the new company name where appropriate. • Minor changes made to bulleted list in Section 11.2 • Minor changes made to Table 8 • Component additions to Figure 4 and Figure 15.				
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	-

15. Legal information

15.1 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”.

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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17. Contents

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