TDA3664

Very low dropout voltage/quiescent current 5 V voltage regulator

Rev. 07 — 25 June 2007 Product data sheet

1. General description

The TDA3664 is a fixed voltage regulator with very low dropout voltage/quiescent current, which operates over a wide supply voltage range.

The regulator is available as:

- TDA3664: SO4 package
- TDA3664AT: SO8 package
- TDA3664TT: TSSOP8 package

2. Features

- Fixed 5 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 (T_j > 150 °C)

3. Quick reference data

Table 1. Quick reference data

VP = 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							
V_P	supply voltage	regulator on	[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		4.8	5.0	5.2	V
		6 V ≤ V_P ≤ 45 V; I_{REG} = 0.5 mA		4.75	5.0	5.25	V
		0.5 mA ≤ I_{REG} ≤ 100 mA	[2]	4.75	5.0	5.25	V
		6 V ≤ V_P ≤ 45 V		4.75	5.0	5.25	V
$V_{REG(drop)}$	dropout voltage	V_P = 4.5 V; I_{REG} = 50 mA; T_{amb} ≤ 85 °C		-	0.18	0.3	V

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

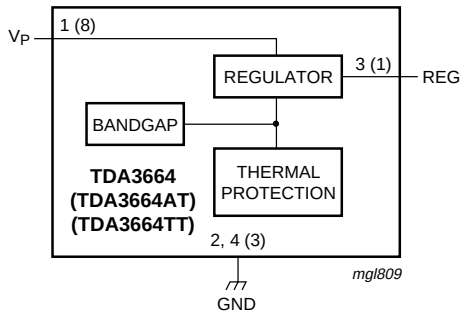
[2] TDA3664TT: I_{REG} ≤ 15 mA at T_{amb} ≤ 125 °C; I_{REG} ≤ 30 mA at T_{amb} ≤ 85 °C.

4. Ordering information

Table 2: Ordering information

Type number	Package		
	Name	Description	Version
TDA3664AT	SO8	plastic small outline package; 8 leads; body width 3.9 mm	SOT96-1
TDA3664	SO4	plastic small outline package; 4 leads; body width 3.5 mm	SOT223-1
TDA3664TT	TSSOP8	plastic thin shrink small outline package; 8 leads; body width 3 mm	SOT505-1

5. Block diagram



Pin numbers in parenthesis refer to the TDA3664AT and TDA3664TT version.

Fig 1. Block diagram

6. Pinning information

6.1 Pinning

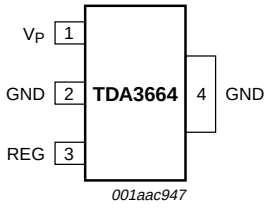


Fig 2. Pin configuration SO4

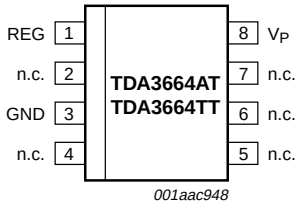


Fig 3. Pin configuration SO8 and TSSOP8

6.2 Pin description

Table 3: Pin description

Symbol	Pin			Description
	SO4	SO8	TSSOP8	
V_P	1	8	8	supply voltage
GND	2 and 4	3	3	ground
REG	3	1	1	regulator output
n.c.	-	2, 4, 5, 6 and 7	2, 4, 5, 6 and 7	not connected

7. Functional description

The TDA3664 is a fixed 5 V regulator which can deliver output currents up to 100 mA. The regulator is available in SO8, TSSOP8 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 regulator remains operational down to very low supply voltages, below which it switches off.

A temperature protection is included, which switches the regulator output off at IC temperatures 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	temperature of copper area is 25 °C			
	TDA3664AT		-	0.8	W
	TDA3664TT		-	0.56	W
	TDA3664		-	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	in free air; soldered in		
	SO8		155	K/W
	TSSOP8		220	K/W
	SO4		100	K/W
$R_{th(j-c)}$	thermal resistance from junction to case	in free air; SO4 only	25	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							
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

Table 6: Characteristics *...continued*

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
Regulator output: pin REG							
V_{REG}	output voltage	8 V ≤ V_P ≤ 22 V; I_{REG} = 0.5 mA		4.8	5.0	5.2	V
		6 V ≤ V_P ≤ 45 V; I_{REG} = 0.5 mA		4.75	5.0	5.25	V
		0.5 mA ≤ I_{REG} ≤ 100 mA	[2]	4.75	5.0	5.25	V
		6 V ≤ V_P ≤ 45 V		4.75	5.0	5.25	V
$V_{REG(drop)}$	dropout voltage	V_P = 4.5 V; I_{REG} = 50 mA; T_{amb} ≤ 85 °C		-	0.18	0.3	V
$V_{REG(stab)}$	output voltage long-term stability	per 1000 h		-	20	-	mV
$\Delta V_{REG(line)}$	line regulation voltage	8 V ≤ V_P ≤ 16 V; I_{REG} = 0.5 mA		-	1	10	mV
		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 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
$I_{REG(crl)}$	current limit	V_{REG} > 4.5 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} + $V_{REG(drop)}$

[2] TDA3664TT: I_{REG} ≤ 15 mA at T_{amb} ≤ 125 °C; I_{REG} ≤ 30 mA at T_{amb} ≤ 85 °C.

11. Application information

11.1 Noise

The output noise is determined by the value of the output capacitor (see Table 7).

Table 7: Noise figures

Output current I_O (mA)	Noise figure (µV)[1]		
	C2 = 10 µF	C2 = 47 µF	C2 = 100 µF
0.5	550	320	300
50	650	400	400

[1] Measured at a bandwidth of 10 Hz to 100 kHz

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 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 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:

$$I_{REG(max)} = \frac{150 - T_{amb}}{R_{th(j-a)} \times (V_P - V_{REG})} = \frac{150 - T_{amb}}{100 \times (V_P - 5)}(mA)$$

When T_{amb} = 21 °C, the maximum output current equals 140 mA at V_P =14 V.

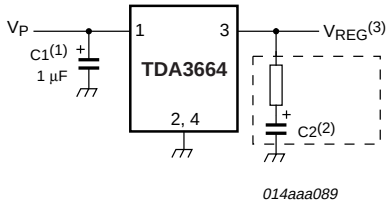
The total thermal resistance of the TDA3664 (SOT223-1 package) can be decreased to lower values when pin 4 and body of the package are soldered to the printed-circuit board.

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 TDA3664 by using a large output capacitor. When the supply voltage is 0 V (or –1 V), only a small current will flow into pin REG from this large 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

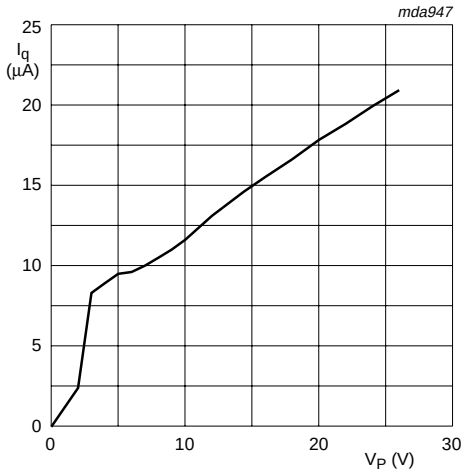
(3) V_{REG} = 5 V

(4) For reliable operation, it is recommended to have a minimum ESR of 3 Ω of the output capacitor total (see Figure 4 above) 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 TDA3664AT. 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

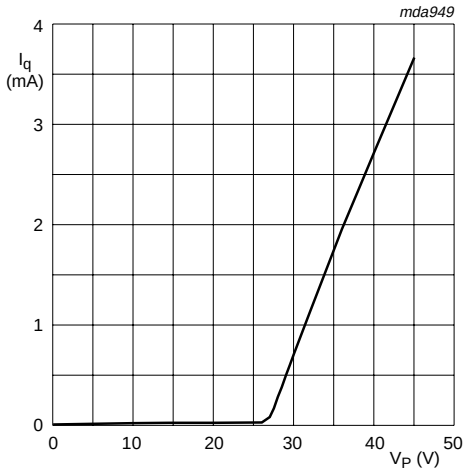
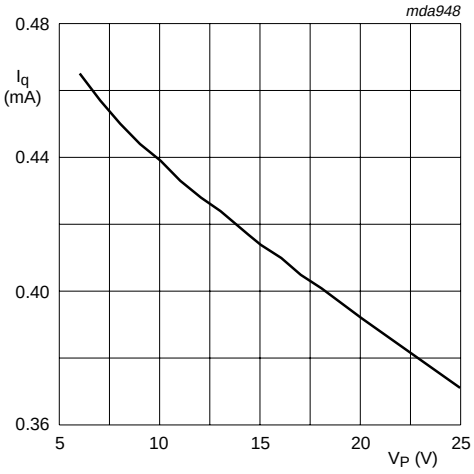
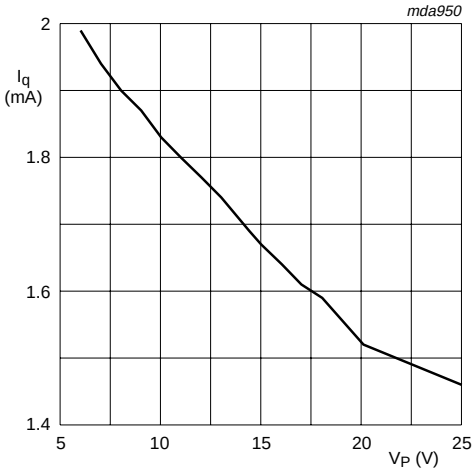


Fig 6. Quiescent current increase at high supply voltage



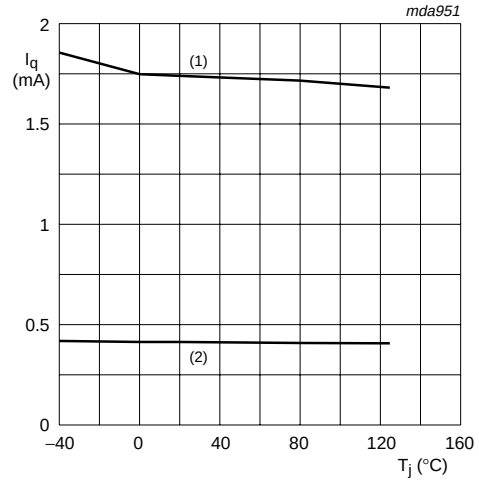
I_{REG} = 10 mA

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.

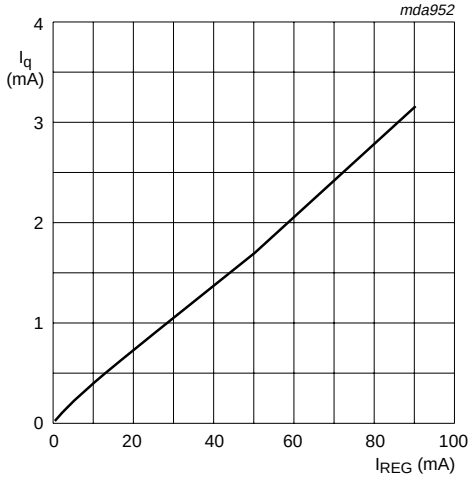
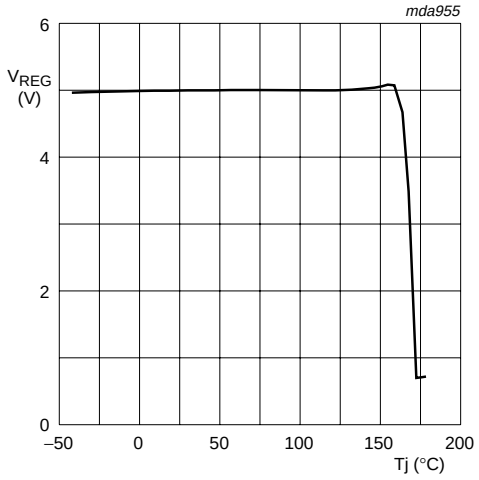


Fig 10. Quiescent current as a function of the load current



I_{REG} = 0 mA

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

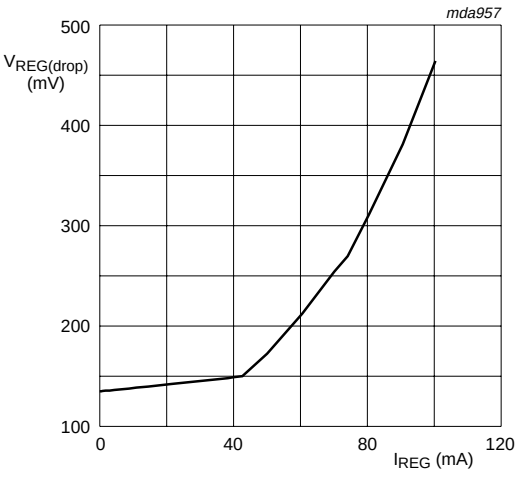
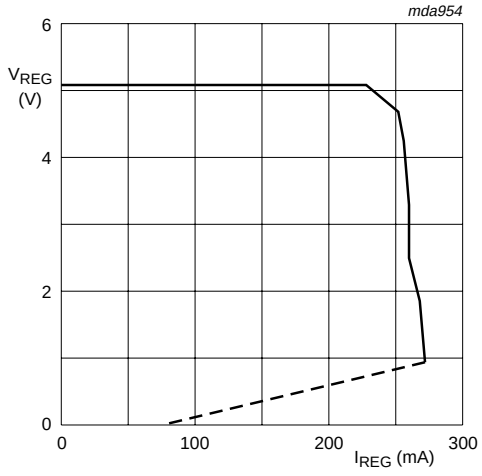
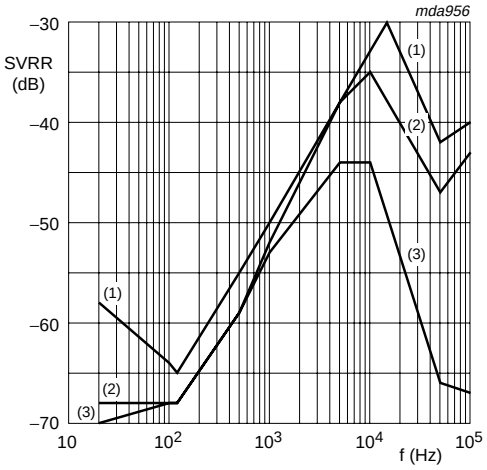


Fig 12. Dropout voltage as a function of load current



V_P = 8 V; pulsed load.

Fig 13. Foldback protection mode



C_O = 10 µF

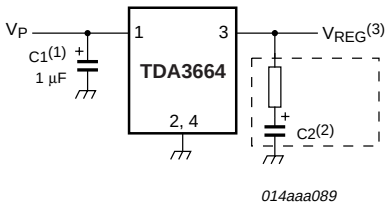
(1) SVRR at R_L = 100 Ω

(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)

(2) C2 = 10 µF

(3) V_{REG} = 5 V

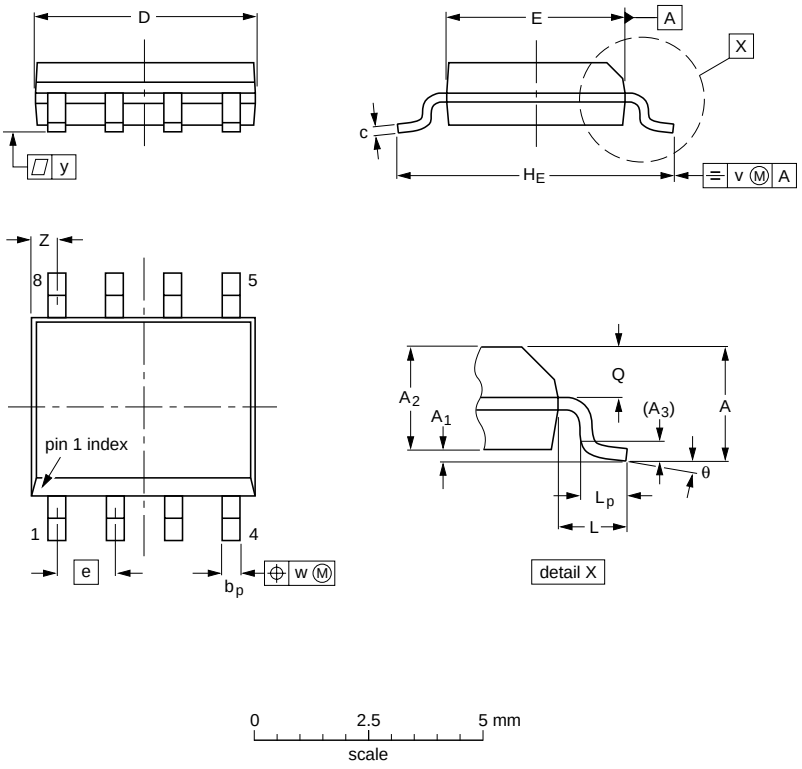
Fig 15. Test circuit (SO4)

12.1 Quality information

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

13. 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^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	

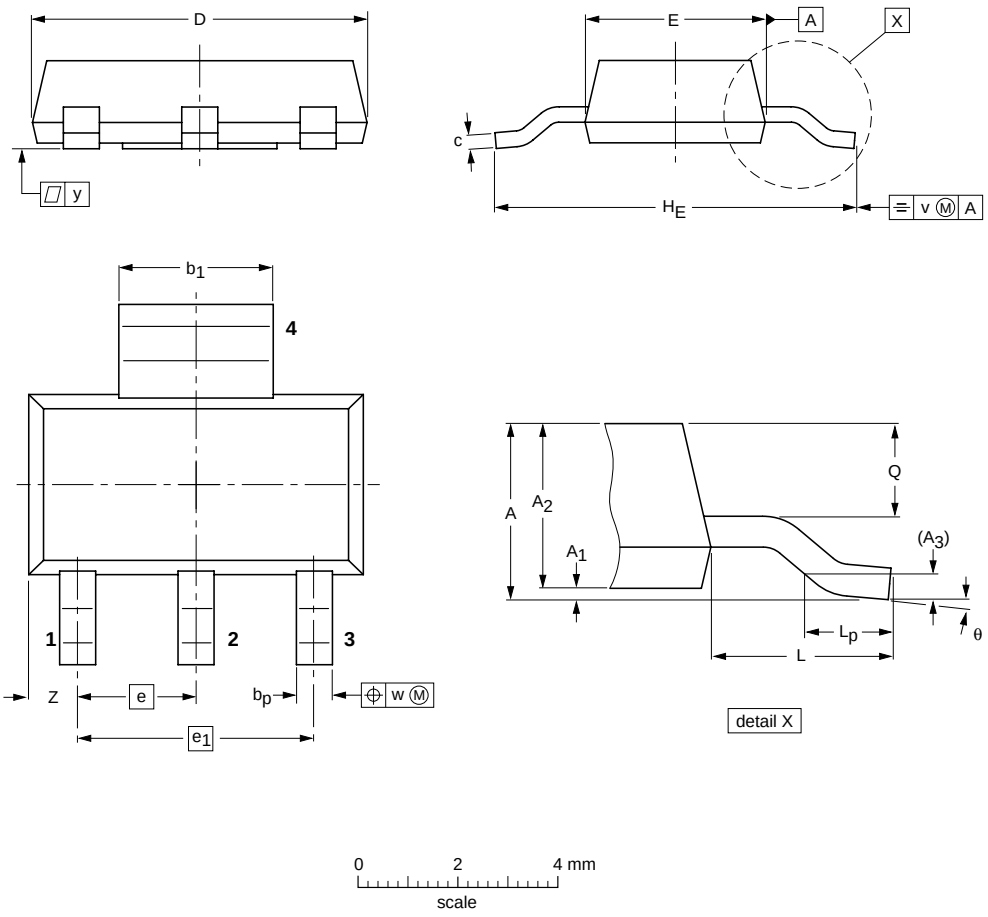
Notes

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 16. Package outline SOT96-1 (SO8)

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°

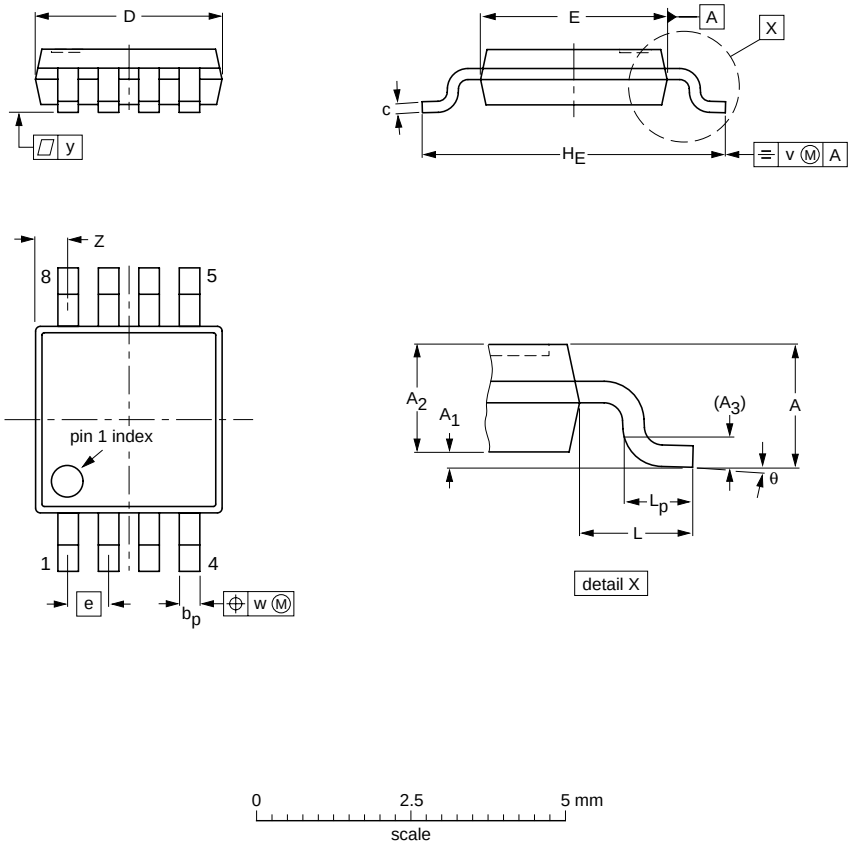
Note

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 17. Package outline SOT223-1 (SO4)

TSSOP8: plastic thin shrink small outline package; 8 leads; body width 3 mm **SOT505-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	L_p	v	w	y	$Z^{(1)}$	θ
mm	1.1	0.15 0.05	0.95 0.80	0.25	0.45 0.25	0.28 0.15	3.1 2.9	3.1 2.9	0.65	5.1 4.7	0.94	0.7 0.4	0.1	0.1	0.1	0.70 0.35	6° 0°

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	JEITA			
SOT505-1						~~99-04-09~~ 03-02-18

Fig 18. Package outline SOT505-1 (TSSOP8)

14. Revision history

Table 9: Revision history

Document ID	Release date	Data sheet status	Change notice	Doc. number	Supersedes
TDA3664_7	20070625	Product data sheet	-	-	TDA3664_6
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				
TDA3664_6	20050610	Product data sheet	-	9397 750 15048	TDA3664_5
TDA3664_5	20001214	Product specification	-	9397 750 07866	TDA3664_4
TDA3664_4	20001208	Preliminary specification	-	9397 750 07556	TDA3664_3
TDA3664_3	20000218	Preliminary specification	-	9397 750 06758	TDA3664_2
TDA3664_2	19990901	Preliminary specification	-	9397 750 06347	TDA3664_1
TDA3664_1	19990811	Preliminary specification	-	9397 750 04946	-

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