## **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 packageTDA3664AT: SO8 packageTDA3664TT: 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 ( $R_S = 10 \Omega$ ; 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<sub>P</sub> of the regulator output
  - ◆ Temperature protection (T<sub>i</sub> > 150 °C)



#### Very low dropout voltage/quiescent current 5 V voltage regulator

## 3. Quick reference data

Table 1. Quick reference data

VP = 14.4 V;  $T_{amb} = 25 \,^{\circ}\text{C}$ ; measured with test circuit of Figure 15; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Тур	Max	Unit
Supply vol	ltage					
$V_P$	supply voltage	regulator on	<u>[1]</u> 3	14.4	45	V
Iq	quiescent current	$V_P = 4.5 V;$ $I_{REG} = 0 \text{ mA}$	-	10	-	μΑ
		$V_P = 14.4 \text{ V};$ $I_{REG} = 0 \text{ mA}$	-	15	30	μΑ
		$6 \text{ V} \le \text{V}_{\text{P}} \le 22 \text{ V}$ ; $\text{I}_{\text{REG}} = 10 \text{ mA}$	-	0.2	0.5	mA
		$6 \text{ V} \le \text{V}_{\text{P}} \le 22 \text{ V}$ ; $\text{I}_{\text{REG}} = 50 \text{ mA}$	-	1.4	2.5	mA
Regulator	output: pin REG					
$V_{REG}$	output voltage	$8 \text{ V} \le \text{V}_{\text{P}} \le 22 \text{ V}$ ; $\text{I}_{\text{REG}} = 0.5 \text{ mA}$	4.8	5.0	5.2	V
		$6 \\ V \le V_P \le 45 \text{ V}; \\ I_{REG} = 0.5 \text{ mA}$	4.75	5.0	5.25	V
		$0.5 \text{ mA} \le I_{REG} \le 100 \text{ mA}$	2 4.75	5.0	5.25	V
		$6~V \leq V_P \leq 45~V$	4.75	5.0	5.25	V
$V_{REG(drop)}$	dropout voltage	$V_P = 4.5 \text{ V};$ $I_{REG} = 50 \text{ mA};$ $T_{amb} \le 85 \text{ °C}$	-	0.18	0.3	V

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

## 4. Ordering information

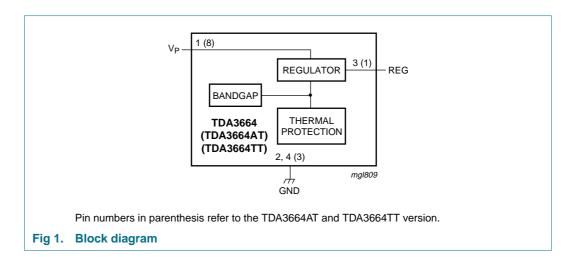
**Table 2: Ordering information** 

Type number	Package	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									

<sup>[2]</sup> TDA3664TT:  $I_{REG} \le$  15 mA at  $T_{amb} \le$  125 °C;  $I_{REG} \le$  30 mA at  $T_{amb} \le$  85 °C.

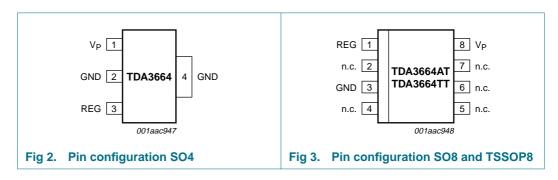
#### Very low dropout voltage/quiescent current 5 V voltage regulator

## 5. Block diagram



## 6. Pinning information

## 6.1 Pinning



#### 6.2 Pin description

Table 3: Pin description

Symbol	Pin			Description
	SO4	SO8	TSSOP8	
V <sub>P</sub>	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

#### Very low dropout voltage/quiescent current 5 V voltage regulator

## 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  $^{\circ}$ C.

#### Very low dropout voltage/quiescent current 5 V voltage regulator

## 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 <sub>P(rp)</sub>	reverse polarity supply voltage	non-operating	-	-25	V
P <sub>tot</sub>	total power dissipation	temperature of copper area is 25 °C			
	TDA3664AT		-	8.0	W
	TDA3664TT		-	0.56	W
	TDA3664		-	5	W
T <sub>stg</sub>	storage temperature	non-operating	-55	+150	°C
T <sub>amb</sub>	ambient temperature	operating	-40	+125	°C
Tj	junction temperature	operating	-40	+150	°C

### 9. Thermal characteristics

Table 5: Thermal characteristics

Symbol	Parameter	Conditions	Тур	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 <sub>th(j-c)</sub>	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	Тур	Max	Unit
Supply vo	Itage					
$V_P$	supply voltage	regulator operating	[1] 3	14.4	45	V
Iq	quiescent current	$V_P = 4.5 \text{ V}; I_{REG} = 0 \text{ mA}$	-	10	-	μΑ
		$V_P = 14.4 \text{ V}; I_{REG} = 0 \text{ mA}$	-	15	30	μА
		6 V $\leq$ V <sub>P</sub> $\leq$ 22 V; I <sub>REG</sub> = 10 mA	-	0.2	0.5	mA
		6 V $\leq$ V <sub>P</sub> $\leq$ 22 V; I <sub>REG</sub> = 50 mA	-	1.4	2.5	mA

#### Very low dropout voltage/quiescent current 5 V voltage regulator

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	Tvn	Max	Unit
		Conditions	IVIIII	Тур	IVIAX	Onit
Regulator of	output: pin REG					
$V_{REG}$	output voltage	8 V $\leq$ V <sub>P</sub> $\leq$ 22 V; I <sub>REG</sub> = 0.5 mA	4.8	5.0	5.2	V
		$6 \text{ V} \leq \text{V}_{\text{P}} \leq 45 \text{ V}; \text{I}_{\text{REG}} = 0.5 \text{ mA}$	4.75	5.0	5.25	V
		$0.5 \text{ mA} \le I_{REG} \le 100 \text{ mA}$	<sup>[2]</sup> 4.75	5.0	5.25	V
		6 V ≤ V <sub>P</sub> ≤ 45 V	4.75	5.0	5.25	V
V <sub>REG(drop)</sub>	dropout voltage	$V_P$ = 4.5 V; $I_{REG}$ = 50 mA; $T_{amb} \le 85$ °C	-	0.18	0.3	V
V <sub>REG(stab)</sub>	output voltage long-term stability	per 1000 h	-	20	-	mV
$\Delta V_{REG(line)}$	line regulation voltage	8 V $\leq$ V <sub>P</sub> $\leq$ 16 V; I <sub>REG</sub> = 0.5 mA	-	1	10	mV
		$7 \text{ V} \le V_P \le 22 \text{ V}; I_{REG} = 0.5 \text{ mA}$	-	1	30	mV
		$7 \text{ V} \le V_P \le 45 \text{ V}; I_{REG} = 0.5 \text{ mA}$	-	1	50	mV
$\Delta V_{REG(load)}$	load regulation voltage	$0.5 \text{ mA} \leq I_{REG} \leq 50 \text{ mA}$	-	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 <sub>REG(crl)</sub>	current limit	V <sub>REG</sub> > 4.5 V	0.17	0.25		Α
I <sub>LO(rp)</sub>	output leakage current at reverse polarity	$V_P = -15 \text{ V}; V_{REG} = \le 0.3 \text{ V}$	-	1	500	μΑ

<sup>[1]</sup> 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 (see Table 7).

Table 7: Noise figures

Output current	Noise figure (μV)[1]									
I <sub>O</sub> (mA)	C2 = 10 μF	C2 = 47 μF	C2 = 100 μF							
0.5	550	320	300							
50	650	400	400							

<sup>[1]</sup> 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  $\Omega$  (worst-case) and for the minimum ESR, see Table 8.
- The ESR of the output capacitor is limited.
- See <u>Table 8</u> for the minimum ESR values of the output capacitor, at T<sub>amb</sub> given the load and output capacitance.

<sup>[2]</sup> TDA3664TT:  $I_{REG} \le 15$  mA at  $T_{amb} \le 125$  °C;  $I_{REG} \le 30$  mA at  $T_{amb} \le 85$  °C.

#### Very low dropout voltage/quiescent current 5 V voltage regulator

**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 <sub>REG</sub> (mA) max	C2 = 100 nF	C2 = 1 μF	C2 = 10 μF	<b>C2</b> = <b>100</b> μ <b>F</b>
1	> 0 Q	> 1.5 Ω	> 2.5 Ω	> 0 Ω
5	> 1 Ω	> 0.5 Ω	> 1 Ω	> 0 Ω
10	> 0 Q	> 0.5 Ω	> 4 Ω	> 0 Ω
100	> 0 Ω	> 0.5 Ω	> 4 Ω	> 0 Q

#### 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.

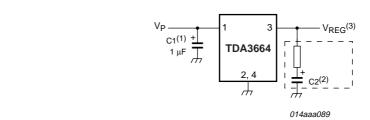
The total thermal resistance of the TDA3664 (SOT223-1 package) can be decreased to lower values when pin 4 and body of the package are soldered to the printed-circuit board.

#### 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  $\mu$ A).

The application circuit is given in Figure 4.



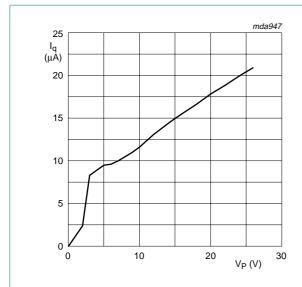
- (1) C1 is optional (to minimize supply noise only)
- (2)  $C2 \le 4700 \mu F$
- (3)  $V_{REG} = 5 V$
- (4) For reliable operation, it is recommended to have a minimum ESR of 3  $\Omega$  of the output capacitor total (see Figure 4 above) and to have a stable application independent of load current, temperature or output capacitance.

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

#### Very low dropout voltage/quiescent current 5 V voltage regulator

## 11.4 Additional application information

This section gives typical curves for various parameters measured on the TDA3664AT. Standard test conditions are:  $V_P = 14.4 \text{ V}$ ;  $T_{amb} = 25 \text{ C}$ 



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

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

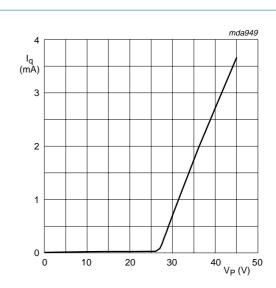
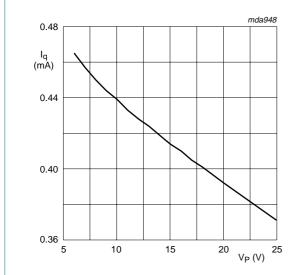
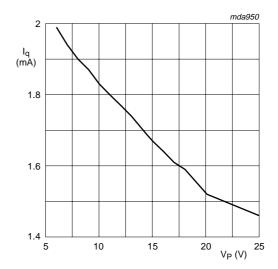


Fig 6. Quiescent current increase at high supply voltage



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

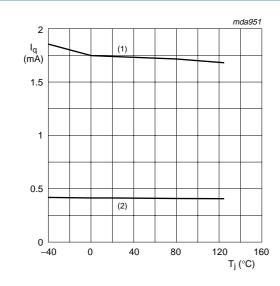
Fig 7. Quiescent current as a function of the supply voltage.



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

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

#### Very low dropout voltage/quiescent current 5 V voltage regulator



- (1) I<sub>q</sub> at 50 mA load
- (2) I<sub>q</sub> at 10 mA load

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

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

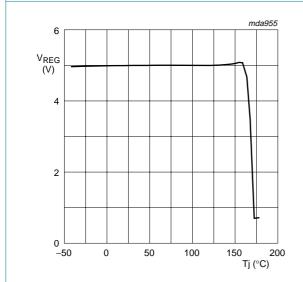


Fig 11. Output voltage thermal protection as a function of the junction temperature

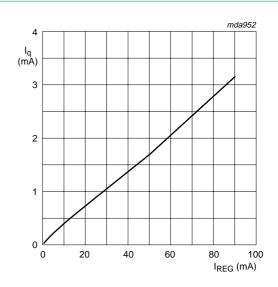


Fig 10. Quiescent current as a function of the load current

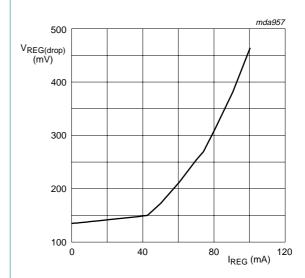
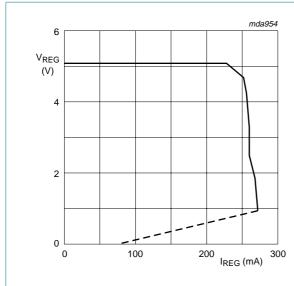


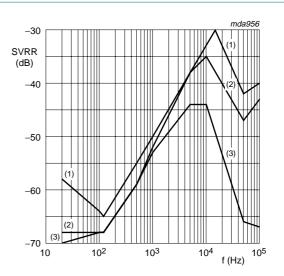
Fig 12. Dropout voltage as a function of load current

#### Very low dropout voltage/quiescent current 5 V voltage regulator



V<sub>P</sub> = 8 V; pulsed load.

Fig 13. Foldback protection mode

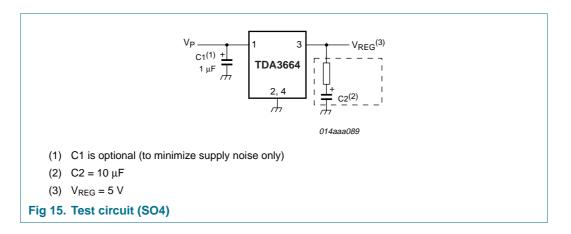


 $C_0 = 10 \, \mu F$ 

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

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

#### 12. Test information



### 12.1 Quality information

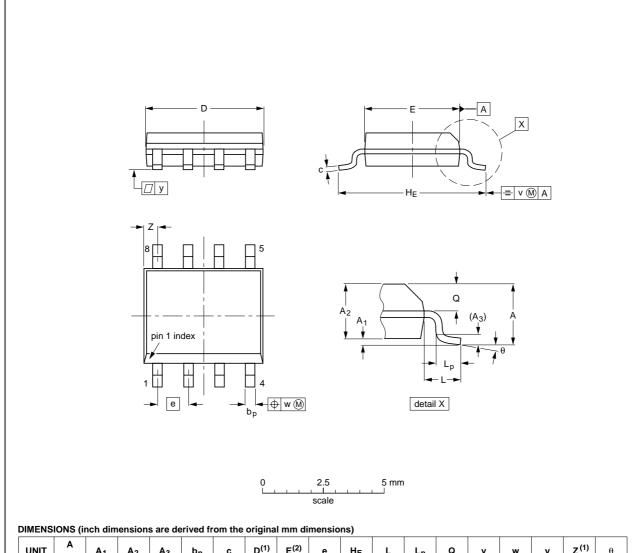
The General Quality Specification for Integrated Circuits, SNW-FQ-611 is applicable.

#### Very low dropout voltage/quiescent current 5 V voltage regulator

## 13. Package outline

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

SOT96-1



UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	bp	С	D <sup>(1)</sup>	E <sup>(2)</sup>	е	HE	L	Lp	Q	v	w	у	z <sup>(1)</sup>	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°
inches	0.069	0.010 0.004	0.057 0.049	0.01		0.0100 0.0075	0.20 0.19	0.16 0.15	0.05	0.244 0.228	0.041	0.039 0.016		0.01	0.01	0.004	0.028 0.012	0°

#### 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.

OUILINE	OUTLINE REFERENCES				EUROPEAN	ISSUE DATE
VERSION	IEC	JEDEC	JEITA		PROJECTION	ISSUE DATE
SOT96-1	076E03	MS-012				<del>99-12-27</del> 03-02-18
_	VERSION	VERSION IEC	VERSION IEC JEDEC	VERSION IEC JEDEC JEITA	VERSION IEC JEDEC JEITA	VERSION   IEC   JEDEC   JEITA   PROJECTION

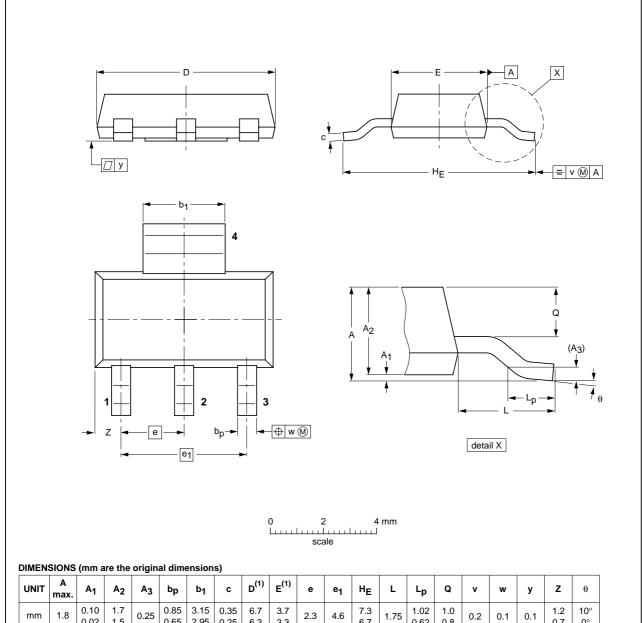
Fig 16. Package outline SOT96-1 (SO8)

**TDA3664 NXP Semiconductors** 

### Very low dropout voltage/quiescent current 5 V voltage regulator

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

SOT223-1



UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	Α3	bp	b <sub>1</sub>	O	D <sup>(1)</sup>	E <sup>(1)</sup>	e	e <sub>1</sub>	HE	L	Lp	ø	>	*	у	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		REFER	EUROPEAN	ISSUE DATE			
VERSION	IEC	JEDEC	JEITA		PROJECTION	ISSUE DATE	
SOT223-1		TO-261				<del>99-12-15</del> 03-02-19	

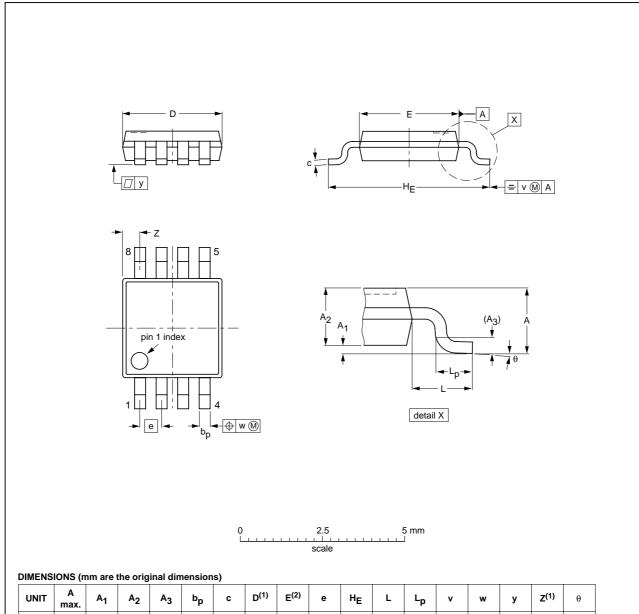
Fig 17. Package outline SOT223-1 (SO4)

**TDA3664 NXP Semiconductors** 

#### Very low dropout voltage/quiescent current 5 V voltage regulator

TSSOP8: plastic thin shrink small outline package; 8 leads; body width 3 mm

SOT505-1



UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	bp	С	D <sup>(1)</sup>	E <sup>(2)</sup>	е	HE	L	Lp	v	w	у	Z <sup>(1)</sup>	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°

- 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.

TLINE		REFER	EUROPEAN	ISSUE DATE			
RSION	IEC	JEDEC	JEITA		PROJECTION	ISSUE DATE	
T505-1						<del>-99-04-09-</del> 03-02-18	
	RSION 0T505-1	RSION IEC	RSION IEC JEDEC	RSION IEC JEDEC JEITA	RSION IEC JEDEC JEITA	RSION IEC JEDEC JEITA PROJECTION	

Fig 18. Package outline SOT505-1 (TSSOP8)

## Very low dropout voltage/quiescent current 5 V voltage regulator

## 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		t of this data sheet has bee conductors.	en redesigned to o	comply with the nev	v identity guidelines of				
	<ul> <li>Legal texts have been adapted to the new company name where appropriate.</li> </ul>								
	<ul> <li>Minor changes made to bulleted list in <u>Section 11.2</u></li> </ul>								
	<ul> <li>Minor changes made to <u>Table 8</u></li> </ul>								
	<ul> <li>Componer</li> </ul>	nt 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	-				

#### Very low dropout voltage/quiescent current 5 V voltage regulator

## 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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## Very low dropout voltage/quiescent current 5 V voltage regulator

## 17. Contents

1	General description
2	Features
3	Quick reference data 2
4	Ordering information 2
5	Block diagram 3
6	Pinning information
6.1	Pinning
6.2	Pin description
7	Functional description 4
8	Limiting values 5
9	Thermal characteristics 5
10	Characteristics 5
11	Application information 6
11.1	Noise
11.2	Stability 6
11.3	Application circuits
11.3.1	Application circuit with backup function 7
11.4	Additional application information
12	Test information
12.1	Quality information
13	Package outline 11
14	Revision history
15	Legal information
15.1	Data sheet status
15.2	Definitions
15.3	Disclaimers
15.4	Trademarks15
16	Contact information
17	Contents 16