

TSic™101/106/201/206/301/306/506

Rapid Response, Low-Cost Temperature Sensor IC
with Analog or digital Output Voltage

A central graphic featuring a square integrated circuit (IC) chip with the text 'TSic™' on it. The chip is set against a circular background with a blue-to-white gradient. The background contains faint binary code (0s and 1s) and a large white degree Celsius symbol (°C) at the bottom left.

Data Sheet

Rev. 3.7 / November 2008

TSic™101/106/201/206/301/306/506

Brief Description

The TSic™ temperature sensor IC family are fully tested and calibrated sensors with absolute measurement accuracy on delivery, no further calibration needed.

The TSic™ combines outstanding accuracy with long term stability, yet it is very simple to use.

The TSic™ series is specifically designed for high performance, cost-effective solutions for sensing temperature in building automation, automotive, industrial, office automation, white goods and low-power/mobile applications.

TSic™ employs a high precision bandgap reference with PTAT output; a low-power, precision ADC; and an on-chip DSP core with EEPROM to precisely calibrate the output temperature signal.

The TSic™ series includes ICs with two linear analog signal output options, such as standard 0~1Vout (Supply voltage (V+) = 3.0V to 5.5V) or ratiometric (10~90% of supply voltage); or the digital serial output signal for interfacing with microcontrollers.

Standard TSic™ devices are available with digital (ZacWire, TSic™x06) or analogue (0-1V, TSic™x01) output Signal.

Features

- Low cost, precision temperature sensor
- Analog 0 to 1 Volt signal output¹⁾
- Resolution: 0.1°C (0.034°C TSic™506)
- Single-wire 11-bit digital serial signal output²⁾
- Communication range > 10 meters²⁾
- Accuracy: up to ±0.1°C over span of 40°C
- Wide measurement range:
 - 50 to +150 °C (TSic™ 10x/20x/30x)
 - 10 to +60 °C (TSic™ 506)
- Signal read-out every 0.1s (other rates available on request)
- Supply Voltage 3.0V to 5.5V; high accuracy operation in range 4.5V to 5.5V¹⁾
- Package: 8-pin SOP, 3-pin TO-92, Die on Wafer
- Low quiescent current to minimize self-heating and power consumption (45µA typ.)

- System-on-chip based on advanced mixed-signal CMOS technology integrating precision temperature sensing bandgap reference with proportional-to-absolute-temperature (PTAT) output, digital signal processor (DSP) core, and electrically erasable memory (EEPROM)

Benefits

- Several accuracy classes available with 100% upward compatibility
- No calibration by customer needed; absolute calibration specified
- Simple to integrate, reducing cost and time for application-development
- Fast data measurement – optimal for temperature control
- Packages for standard SMD, THT or application specific assembly
- Very low power consumption – ideal for mobile and standard applications
- Field reconfiguration/recalibration option available (high volume customers only)

Available Support

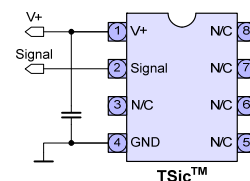
For TSic™ evaluation ZMD provides a special Evaluation Tool. (Ordering Code: TSic Lab Kit)

Further application support is available through the hotline:

email: tsic@zmd.de

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TSic™101/106/201/206/301/306/506 Overview



1) For TSic™ with analog output only (TSic™101/201/301)

2) For TSic™ with digital output only (TSic™106/206/306/506)



TSic™101/106/201/206/301/306/506

Contents

Contents	3
List of Figures	4
List of Tables	4
1 Electrical Characteristics	5
1.1. Absolute Maximum Ratings	5
1.2. Operating Conditions	5
2 Accuracy of Temperature Measurement.....	6
3 Output Examples for TSic™101/106/201/206/301/306/506	7
4 Lifetime for TSic™101/106/201/206/301/306/506 Devices	7
5 Pin configuration and Package	8
5.1. Pin Configuration	8
5.2. Package Outline	10
6 Additional Documents	13
7 Document Revision History.....	13

TSic™101/106/201/206/301/306/506

List of Figures

Figure 2-1	Accuracy Overview TSic™ Family	6
Figure 5-1	TSic™101/106/201/206/301/306/506 Pin Diagram SOP8	8
Figure 5-2	TSic™101/106/201/206/301/306/506 Pin Diagram TO-92	9
Figure 5-3	SOP 8 Package dimensions	10
Figure 5-4	TO-92 Package dimensions	11
Figure 5-5	Bare Die Dimensions	12

List of Tables

Table 1-1	Absolute Maximum Ratings	5
Table 1-2	Operating Conditions	5
Table 2-1	Accuracy TSic™101/106/201/206/301/306/506 ¹⁾	6
Table 3-1	Output Examples for TSic™101/106/201/206/301/306/506	7
Table 4-1	Output Examples for TSic™101/106/201/206/301/306/506	7
Table 5-1	TSic™101/106/201/206/301/306/506 PIN Diagram SOP8	8
Table 5-2	TSic™101/106/201/206/301/306/506 PIN Diagram TO-92	9
Table 5-3	SOP 8 Package dimensions [mm]	10
Table 5-4	TO-92 Package dimensions [mm]	11
Table 5-5	TSic™101/106/201/206/301/306/506 PIN Diagram Bare Die	12

TSic™101/106/201/206/301/306/506

1 Electrical Characteristics

1.1. Absolute Maximum Ratings

Table 1-1 Absolute Maximum Ratings

Symbol	Parameter	Min	Max	Unit
V+	Supply Voltage	-0.3	6.0	V _{DC}
V _{INA} , V _{OUTA}	Voltages at analog I/O – Pins	-0.3	V _{DDA} +0.3	V _{DC}
T _{Stor}	Storage temperature	-50	150	°C

1.2. Operating Conditions

Table 1-2 Operating Conditions

Symbol	Parameter	Min	Typ	Max	Unit
V+	Supply ¹⁾ Voltage to Gnd	3.0	5.0	5.5	V
I _{V+}	Supply Current ²⁾³⁾ @ V+ = 3.3V, RT			200	μA
I _{V+}	Supply Current ²⁾⁴⁾ @ V+ = 3.3V, RT	30	45	80	μA
T _{amb}	Ambient Temperature ⁵⁾ Range	-50		150	°C
C _{V+}	External Capacitance between V+ and GND ⁶⁾ (C _{V+})	80	100	470	nF
C _L	Output Load Capacitance (C _L) ⁴⁾			15	nF
	Output Load Resistance between signal and GND (or V+) ³⁾	47	100		kΩ
	Output Load Resistance between signal and GND (or V+) ⁴⁾	1			MΩ

1) Best accuracy with supply voltage 4.5V – 5.5V. With supply voltage 3.5V – 4.5V(TSic™101/201/301) 3.5V – 4.5V (TSic™106/206/306/506) accuracy reduced

2) Without load

3) For TSic™ with analog output only (TSic™101/201/301)

4) For TSic™ with digital output only (TSic™106/206/306/506)

5) Output signal is limited to this ambient temperature ±3°C (with regard to calibration, offset and gain)

6) Recommended as close to TSic V+ and GND-Pins as possible

TSic™101/106/201/206/301/306/506

2 Accuracy of Temperature Measurement

The accuracy describes the specification plus quantization error of 1 bit (0.1°C). This device gets calibrated at a supply voltage of 5V. For applications which require the best accuracy at a supply voltage of 3V the possibility to create a customer specific 3V calibrated device exists. Other TSic™ products with customer specific calibration are available on request (i.e. with special calibration where the 80°C span (bandgap) with the high precision temperature range of ±0.5 °C is shifted to another (lower or higher) temperature range).

Figure 2-1 Accuracy Overview TSic™ Family

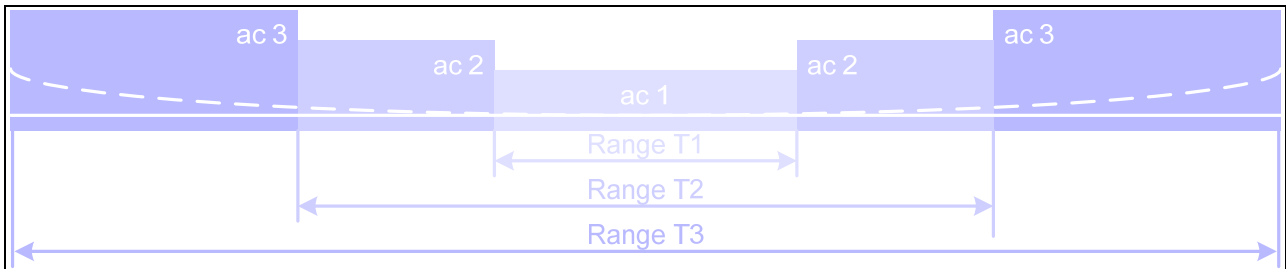


Table 2-1 Accuracy TSic™101/106/201/206/301/306/506¹⁾

Product Version	Resolution	T-Range 3					
		T-Range 2				T-Range 3	
		T-Range 1		T-Range 2			
		T-Range 1	Accuracy 1	T-Range 2	Accuracy 2	T-Range 3	Accuracy 3
TSic 101/106	0.1°C	+15°C to +25°C	<±0.5°C	+0°C to +40°C	<±1.0°C	-50°C to +150°C	no limits (typ ±1.5°C)
TSic 201/206	0.1°C	+10°C to +90°C	<±0.5°C	-20°C to +110°C	<+0.95°C >-0.5°C	-50°C to +150°C	<+2.0°C >-0.5°C
TSic 301/306	0.1°C	+10°C to +90°C	<±0.3°C	-20°C to +110°C	<+0.95°C >-0.3°C	-50°C to +150°C	<+2.0°C >-0.5°C
TSic 506	0.034°C	+5°C to +45°C	<±0.1°C	-5°C to +55°C	<+0.2°C >-0.1°C	-10°C to +60°C	<+0.3°C >-0.1°C

1) Accuracy for supply voltage within V+ = 4.5V to 5.5V

TSic™101/106/201/206/301/306/506

3 Output Examples for TSic™101/106/201/206/301/306/506

Table 3-1 Output Examples for TSic™101/106/201/206/301/306/506

Temp (°C)	Temp (°F)	Analog 0~1V (TSic™ 101/201/301) ¹⁾⁴⁾	Digital (TSic™ 106/206/306) ¹⁾³⁾	Digital (TSic™ 506) ²⁾³⁾
-50	-58	0.000	0x000	-
-10	14	0.200	0x199	0x000
0	32	0.250	0x200	0x124
25	77	0.375	0x2FF	0x3FF
60	140	0.550	0x465	0x7FF
125	257	0.875	0x6FE	-
150	302	1.000	0x7FF	-

1) Temperature Measurement Range -50(LT)°C to 150(HT)°C or -58°F to 302°F (Wide Range Device)
 2) Temperature Measurement Range -10(LT)°C to 60(HT)°C or 14°F to 140°
 3) Temperature = (Digital_signal/2047*(HT-LT)+LT) [°C]
 4) Temperature = (Sig[Volt]*(HT-LT)+LT) [°C]

4 Lifetime for TSic™101/106/201/206/301/306/506 Devices

Table 4-1 Output Examples for TSic™101/106/201/206/301/306/506

Operating Temperature	expected Lifetime
140°C...150°C	min. 1500h
125°C...140°C	min. 3000h

TSic™101/106/201/206/301/306/506

5 Pin configuration and Package

5.1. Pin Configuration

Available packages for the TSic™101/106/201/206/301/306/506 is are SOP8 and TO92 package.

Figure 5-1 TSic™101/106/201/206/301/306/506 Pin Diagram SOP8

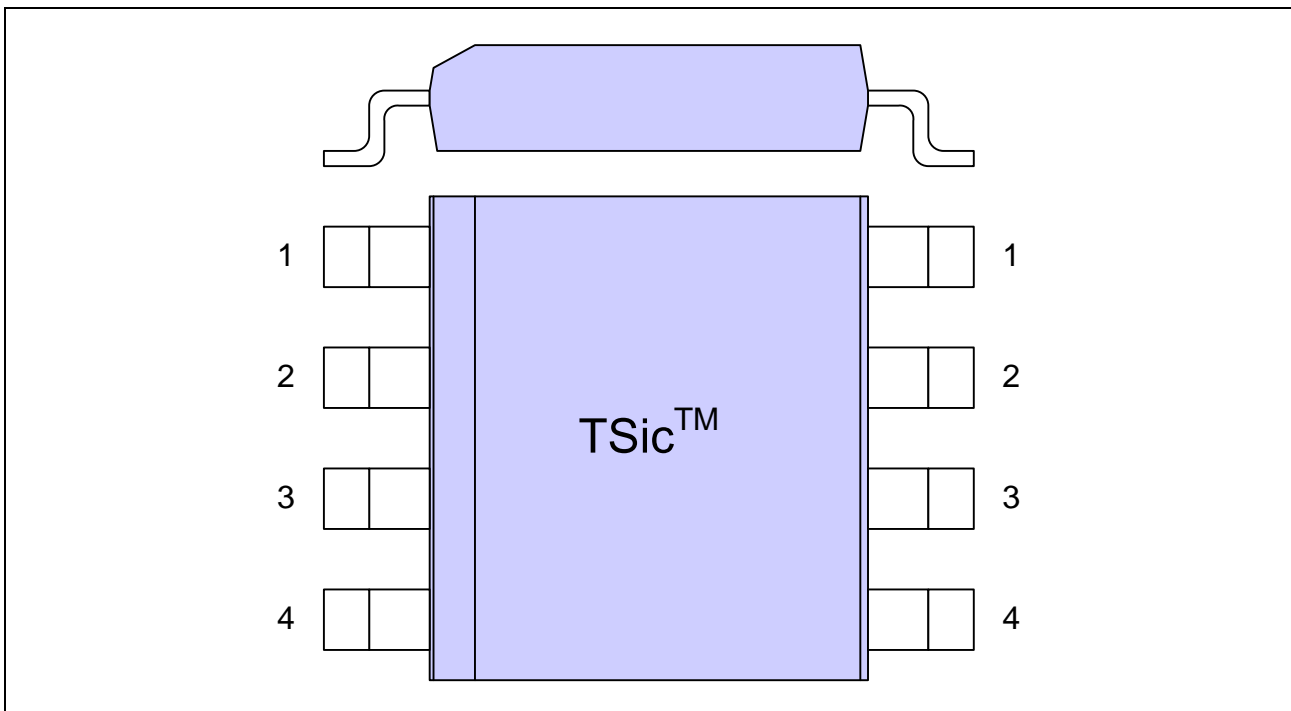


Table 5-1 TSic™101/106/201/206/301/306/506 PIN Diagram SOP8

Pin	Name	Description
1	V+	Supply voltage (3.0-5.5V)
2	Signal	Temperature output signal
4	GND	Ground
3, 5-8	TP/NC	Test pin / NC Do not connect

TSic™101/106/201/206/301/306/506

Figure 5-2 TSic™101/106/201/206/301/306/506 Pin Diagram TO-92

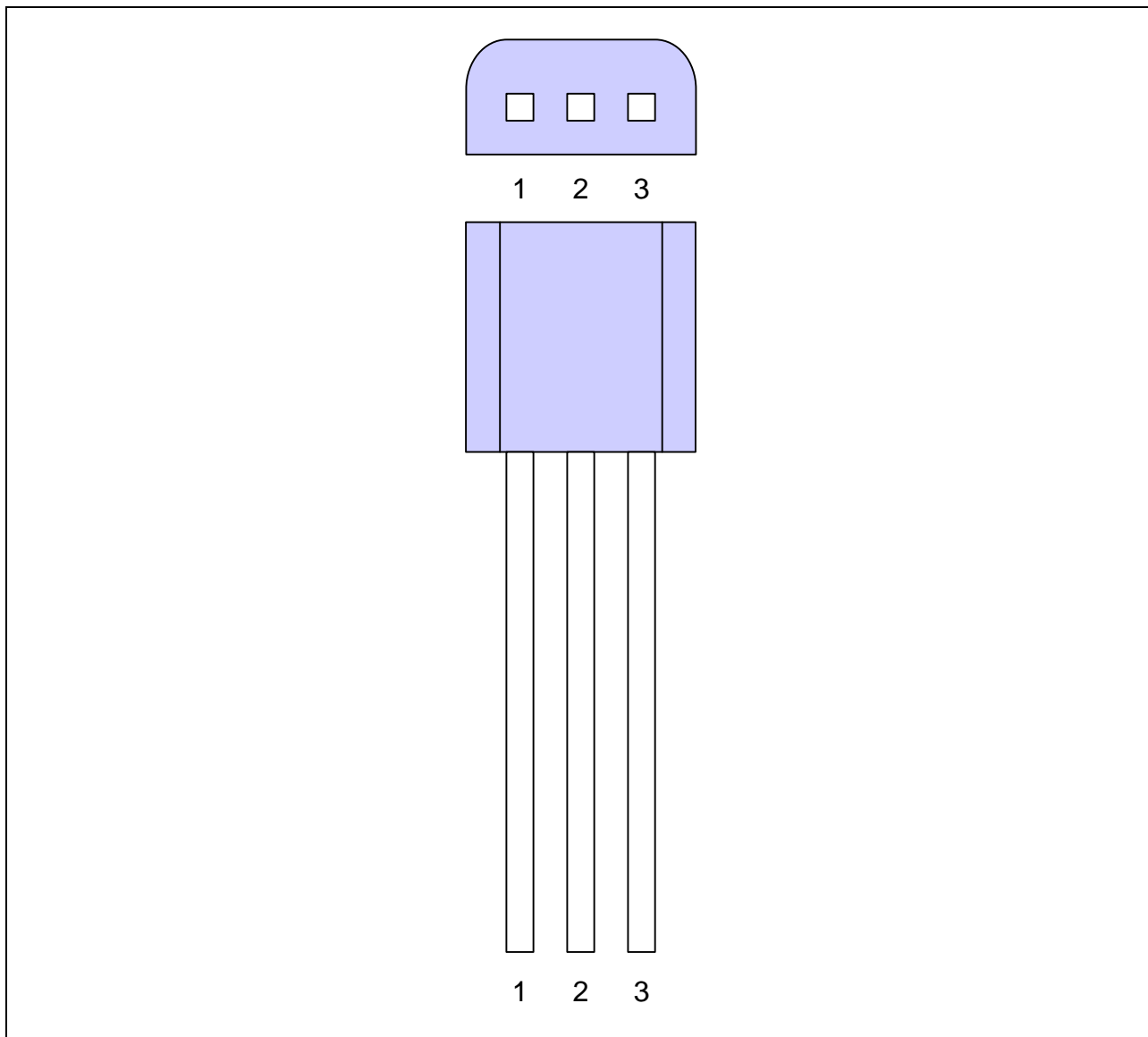


Table 5-2 TSic™101/106/201/206/301/306/506 PIN Diagram TO-92

Pin	Name	Description
1 ¹⁾	GND	Ground
2	Signal	Temperature output signal
3 ¹⁾	V+	Supply Voltage (3.0-5.5V)

1) The e-line package (discontinued) has swapped pins 1 and 3

TSic™101/106/201/206/301/306/506

5.2. Package Outline

Figure 5-3 SOP 8 Package dimensions

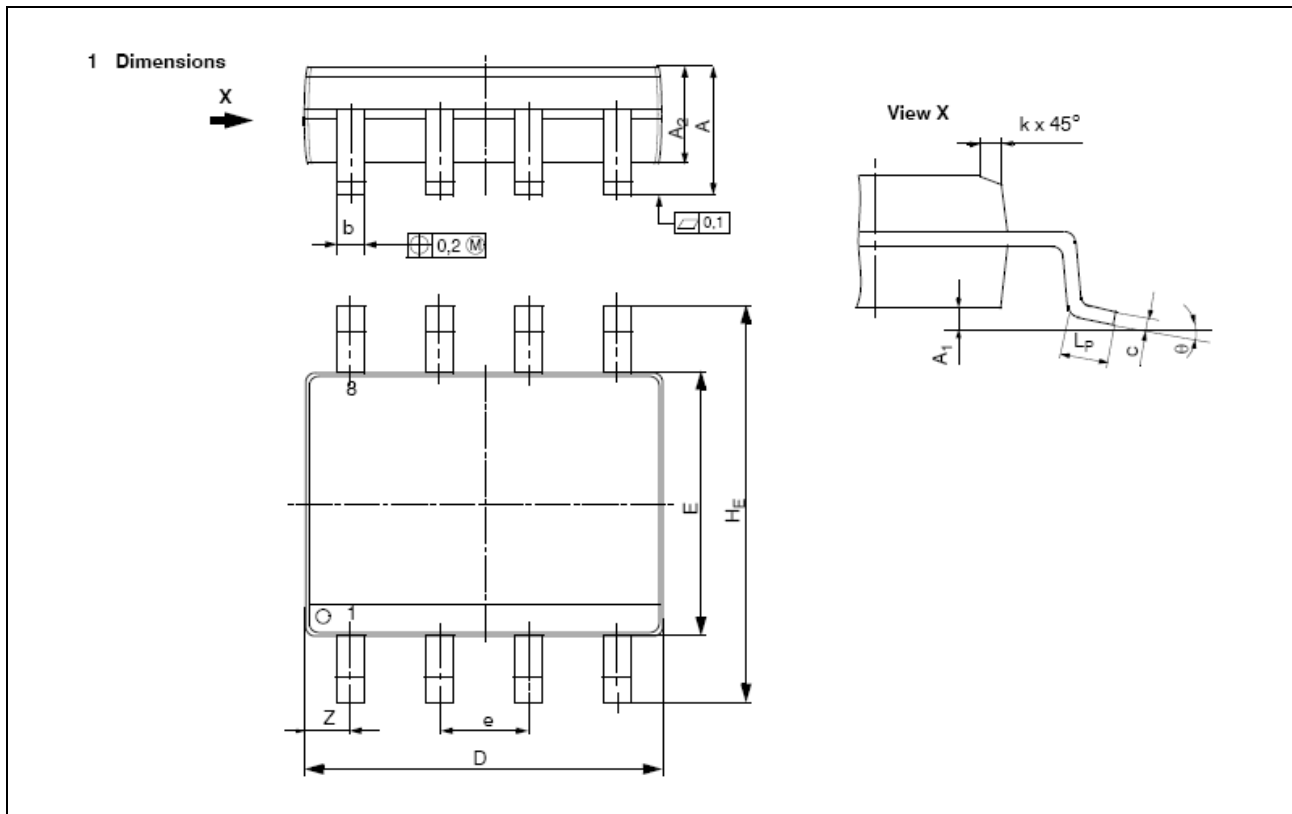


Table 5-3 SOP 8 Package dimensions [mm]

	min	max
A	1,55	1,95
A ₁	0,1	0,3
A ₂	1,4	1,8
b _P	0,35	0,49
c	0,15	0,25
D	4,8	5
E	3,8	4,0
e _{nom}	1,27	
H _E	5,8	6,3
k	0,3	
L _P	0,4	
θ	0°	8°
Z	0,635	

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Figure 5-4 TO-92 Package dimensions

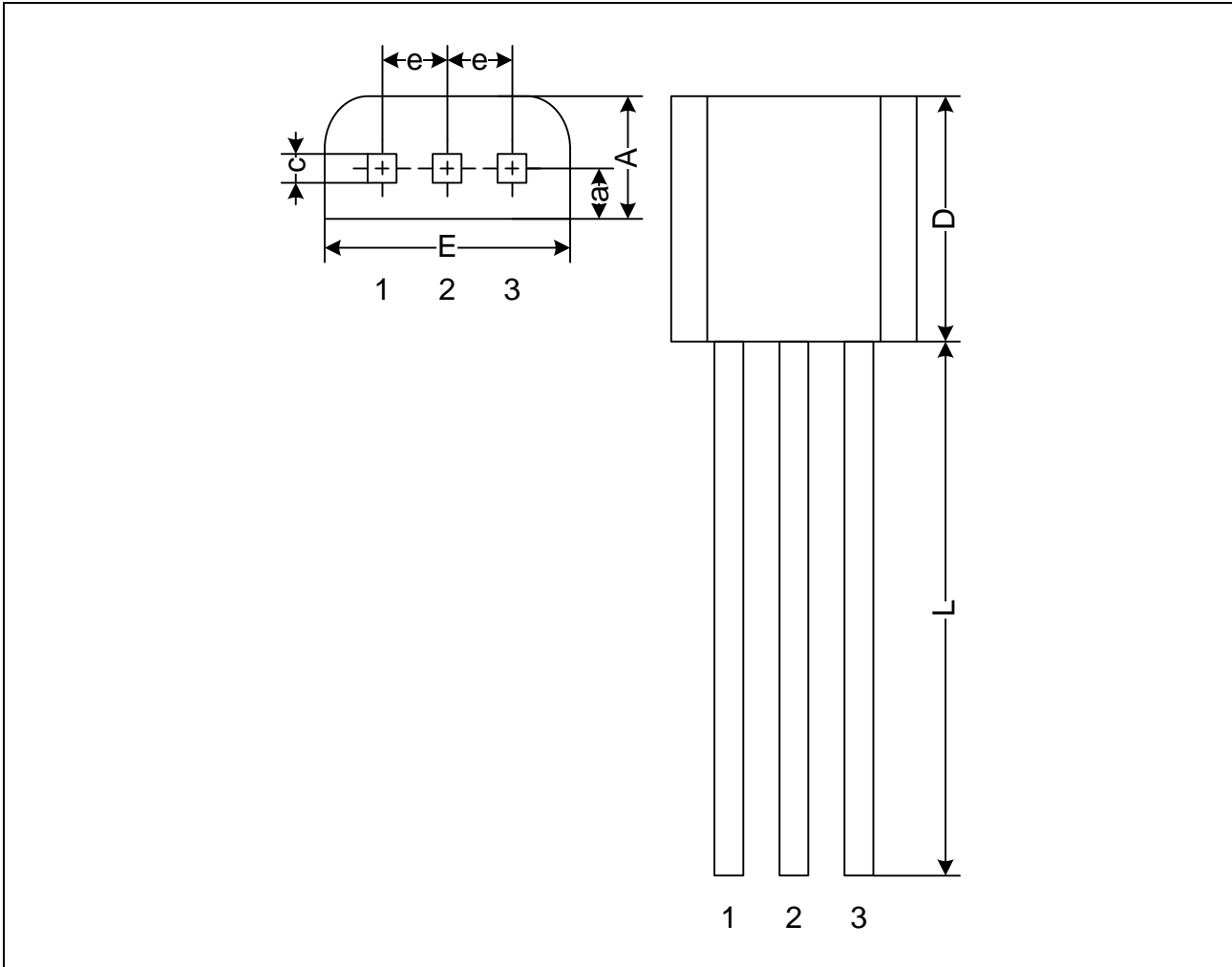


Table 5-4 TO-92 Package dimensions [mm]

	min	max
A	2,16	2,41
a	1,10	1,20
b	0,41	0,495
c	0,41	0,495
D	3,61	4,01
E	4,37	4,77
e	1,27	
L	13,0	13,97

TSic™101/106/201/206/301/306/506

Figure 5-5 Bare Die Dimensions

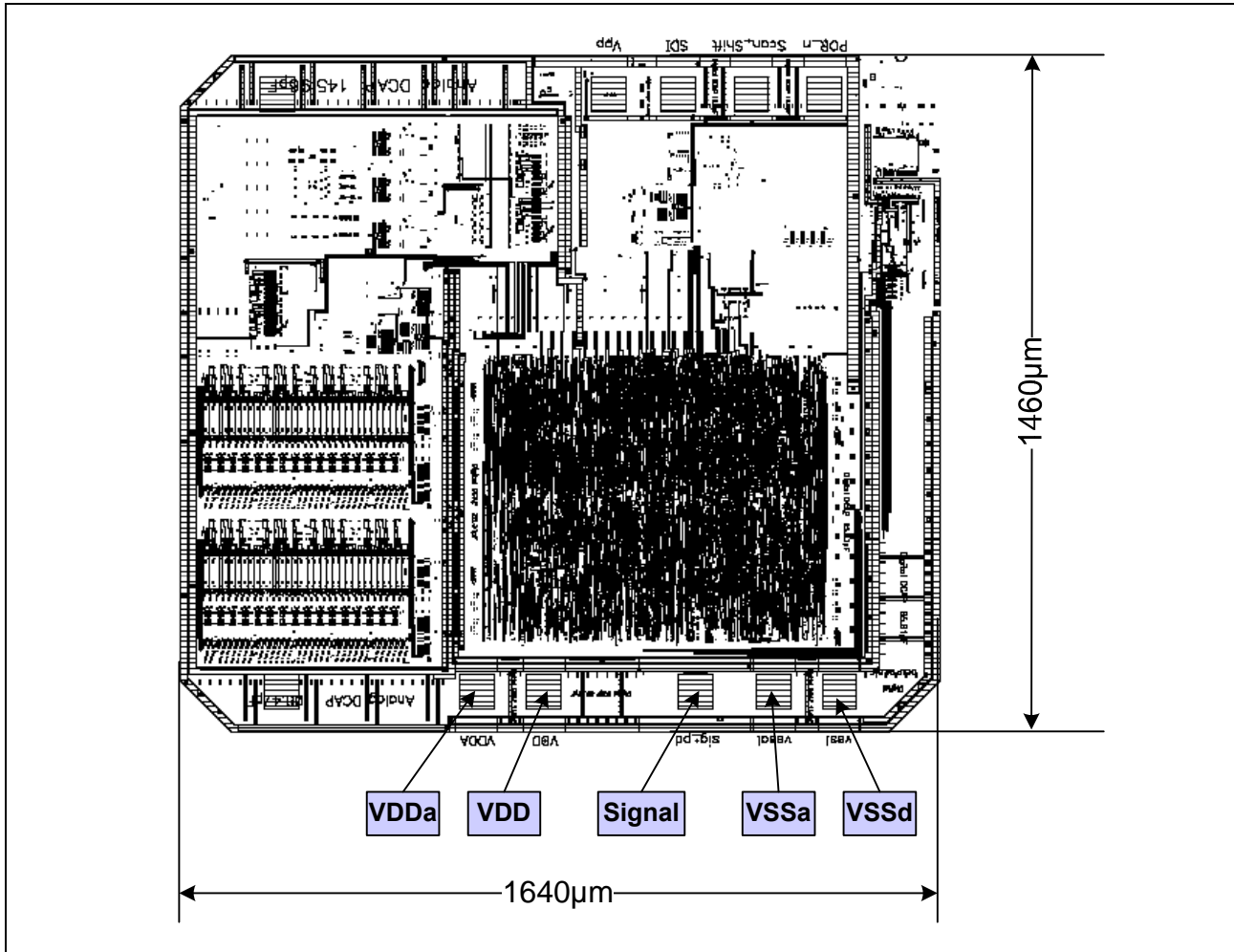


Table 5-5 TSic™101/106/201/206/301/306/506 PIN Diagram Bare Die

Pin	Name	X Coordinate [µm]	Y Coordinate [µm]	Notes
VSSd	GND	215.8	1371.9	VSS must be connected.
VSSa	GND	356.2	1371.9	VSS analog must be connected.
Signal	Signal	524.9	1371.9	SIG™
VDD	V+	851.5	1371.9	VDD must be connected.
VDDa	V+	996.9	1371.9	VDD analog must be connected.



TSic™ 101/106/201/206/301/306/506

6 Additional Documents

Document	File Name
ZACWire Technical Note	IST_TSic_ZACwire_Vx.x Digital Output_xdatex.pdf
PCN	PCN_eline_Jan07.pdf
TSic™ Ordering Guide	TSic_Ordering_Guide_Rev.x.x.pdf

Visit ZMD's website www.zmd.biz or contact your nearest sales office for the latest version of these documents.

7 Document Revision History

Revision	Date	Description
3.5	August 11, 2006	Update after review
3.6	June 12, 2007	Update after review
3.7	November 7, 2008	- Combination of documents: datasheet TSic™ 10x to 50x and Packaging information - changes in Pin configuration and Package

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