



Features

- Active Mixer with Conversion Gain
- Integrated LO and IF Drivers
- Excellent Linearity
- Broadband 50 Ω Impedance on all Ports
- Low LO-RF Leakage
- Differential or Single Ended Inputs

Benefits

- Small and Thin 16-pin SSOP Package with Exposed Paddle
- Few External Components
- Fully ESD Protected

Application

- DCS/PCS/TDMA and CDMA2000 Transmitter
- Other Digital Communication Applications
- High Performance RF Instrumentation

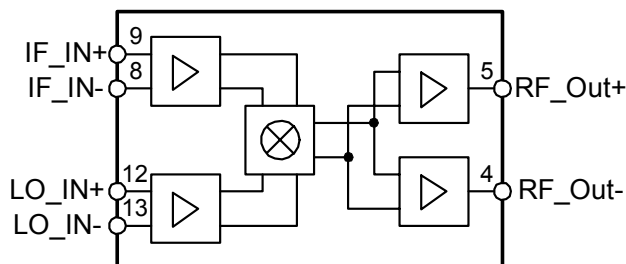
Description

The ATR0786 is a high linearity active mixer which is manufactured using Atmel's advanced Silicon Germanium technology for the use in a variety of high performance requiring RF systems such as digital communications.

This mixer features a frequency range of 1800 MHz to 2100 MHz. It operates from a single 5 V supply and provides 16 dB of conversion gain while requiring only 0 dBm input to the integrated LO driver. An IF and an LO amplifier is also included.

The ATR0786 incorporates internal matching on each RF, IF and LO port to enhance ease of use and to reduce the external components required. The RF and LO inputs can be driven differentially or single ended.

Figure 1. Block Diagram



**High Linearity
Active Transmit
Mixer for
1800 MHz to
2100 MHz**

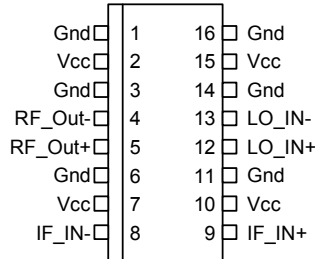
ATR0786

Rev. 4587B-SIGE-02/03



Pin Configuration

Figure 2. Pinning TSSOP16



Pin Description

| Pin | Symbol | Function |
|--------|---------|--|
| 1 | GND | Ground |
| 2 | Vcc | Supply voltage |
| 3 | GND | Ground |
| 4 | RF_OUT- | Negative RF output; nominal DC voltage is 2.3 V; (internally biased) input should be AC-coupled |
| 5 | RF_OUT+ | Positive RF output; nominal DC voltage is 2.3 V; (internally biased) input should be AC-coupled |
| 6 | GND | Ground |
| 7 | Vcc | Supply voltage |
| 8 | IF_IN- | Negative IF input; nominal DC voltage is 2.3 V, provided through off chip inductors |
| 9 | IF_IN+ | Positive IF input; nominal DC voltage is 2.3 V, provided through off chip inductors |
| 10 | Vcc | Supply voltage |
| 11 | GND | Ground |
| 12 | LO_IN+ | Negative local oscillator input; nominal DC voltage is 2.3 V; (internally biased) input should be AC-coupled |
| 13 | LO_IN- | Positive local oscillator input; nominal DC voltage is 2.3 V; (internally biased) input should be AC-coupled |
| 14 | GND | Ground |
| 15 | Vcc | Supply voltage |
| 16 | GND | Ground |
| Paddle | | Device Ground and heat sink, requires good thermal path; RF reference plane |

Absolute Maximum Ratings

| Parameters | Symbol | Value | Unit |
|--------------------------------|----------------|--------------|------|
| Supply voltages, no RF applied | V_{CC} | -0.5 to +5.5 | V |
| LO input signals | LO_IN-; LO_IN+ | +10.0 | dBm |
| IF input signals | IF_IN-; IF_IN+ | +10.0 | dBm |
| Operating case temperature | T_C | -40 to +85 | °C |
| Storage temperature | T_{STG} | -55 to +150 | °C |

Thermal Resistance

| Parameters | Symbol | Value | Unit |
|------------------|------------|-------|------|
| Junction ambient | R_{thJA} | 25 | K/W |

Electrical Characteristics

Test conditions: Unless otherwise noted, the following conditions apply to typical performance specification under static conditions: $V_{CC} = +5.0$ V, $T_{amb} = 25^\circ\text{C}$; $P_{LO} = 0$ dBm; IF = 200 MHz; $P_{IF} = -20$ dBm

| No. | Parameters | Test Conditions | Pin | Symbol | Min. | Typ. | Max. | Unit | Type* |
|----------------------------|------------------------|------------------------|-----|----------|------|------|------|------|-------|
| General Performance | | | | | | | | | |
| | Supply voltage | | | V_{CC} | 4.75 | 5.0 | 5.25 | V | |
| | Supply current | | | I_{CC} | | 200 | | mA | |
| | LO drive | Matched to 50 Ω | | | -3 | 0 | +3 | dBm | |
| | LO, IF, RF return loss | Matched to 50 Ω | | | | 14 | | dB | |

*) Type means: A = 100% tested, B = 100% correlation tested, C = Characterized on samples, D = Design parameter

RF Electrical Characteristics (1800 MHz to 2000 MHz)

Test conditions: Unless otherwise noted, the following conditions apply to typical performance specification under static conditions: $V_{CC} = +5.0$ V, $T_{amb} = 25^\circ\text{C}$; $P_{LO} = 0$ dBm; IF = 200 MHz; $P_{IF} = -20$ dBm

| No. | Parameters | Test Conditions | Pin | Symbol | Min. | Typ. | Max. | Unit | Type* |
|-----------------------------|------------------|---|-----|----------|------|------|------|------|-------|
| Mixer RF Performance | | | | | | | | | |
| | RF frequency | | | f_{RF} | 1800 | | 2000 | MHz | |
| | LO frequency | | | f_{LO} | 1600 | | 1800 | MHz | |
| | IF frequency | | | f_{IF} | 30 | 200 | 400 | MHz | |
| | Conversion gain | | | G | 15 | 17 | 19 | dB | |
| | SSB noise figure | | | NF | | 9.5 | 11.0 | dB | |
| | Output IP3 | IF1 = IF2 = -20 dBm/tone, 1 MHz spacing | | OIP3 | 20 | 24 | | dBm | |
| | Output P1dB | | | P1dB | 8 | 11 | | dBm | |
| | Leakage (LO-RF) | | | | | -20 | -10 | dBm | |
| | Leakage (LO-IF) | | | | | -45 | -35 | dBm | |

*) Type means: A = 100% tested, B = 100% correlation tested, C = Characterized on samples, D = Design parameter

RF Electrical Characteristics (2000 MHz to 2100 MHz)

Test conditions: Unless otherwise noted, the following conditions apply to typical performance specification under static conditions: $V_{CC} = +5.0\text{ V}$, $T_{amb} = 25^{\circ}\text{C}$; $P_{LO} = 0\text{ dBm}$; $f_{IF} = 200\text{ MHz}$; $P_{IF} = -20\text{ dBm}$

| No. | Parameters | Test Conditions | Pin | Symbol | Min. | Typ. | Max. | Unit | Type* |
|-----------------------------|------------------|---|-----|----------|------|------|------|------|-------|
| Mixer RF Performance | | | | | | | | | |
| | RF frequency | | | f_{RF} | 2000 | | 2100 | MHz | |
| | LO frequency | | | f_{LO} | 1800 | | 2000 | MHz | |
| | IF frequency | | | f_{IF} | 30 | 200 | 400 | MHz | |
| | Conversion gain | | | G | 13 | 16 | 18 | dB | |
| | SSB noise figure | | | NF | | 9.5 | 11.0 | dB | |
| | Output IP3 | $f_{IF1} = f_{IF2} =$ -20 dBm/tone, 1 MHz spacing | | OIP3 | 17 | 21 | | dBm | |
| | Output P1dB | | | P1dB | 6 | 9 | | dBm | |
| | Leakage (LO-RF) | | | | | -20 | -10 | dBm | |
| | Leakage (LO-IF) | | | | | -45 | -35 | dBm | |

*) Type means: A = 100% tested, B = 100% correlation tested, C = Characterized on samples, D = Design parameter

Typical Performance

Figure 3. Conversion Gain versus Frequency + Temperature

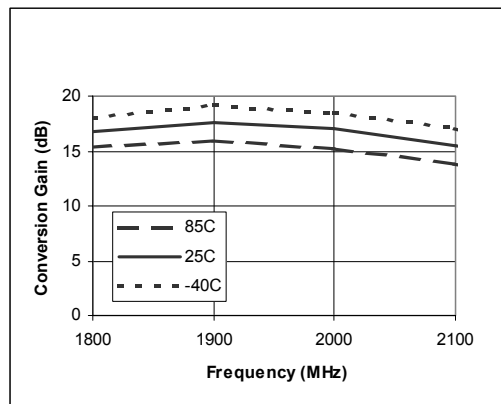


Figure 4. Output IP3 versus Frequency + Temperature

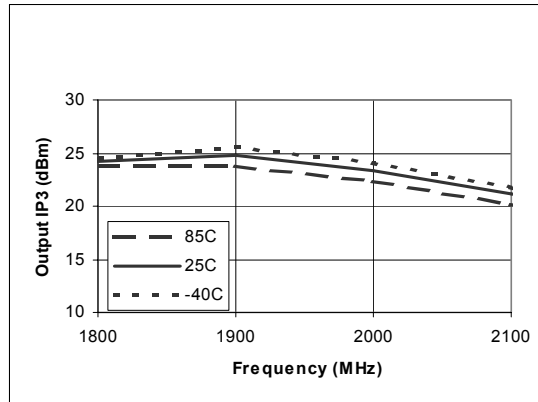


Figure 5. Output IP3 versus Frequency + LO Drive

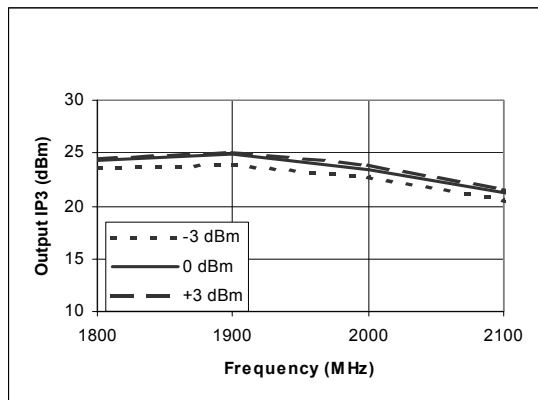


Figure 6. Conversion Gain versus Frequency + LO Drive

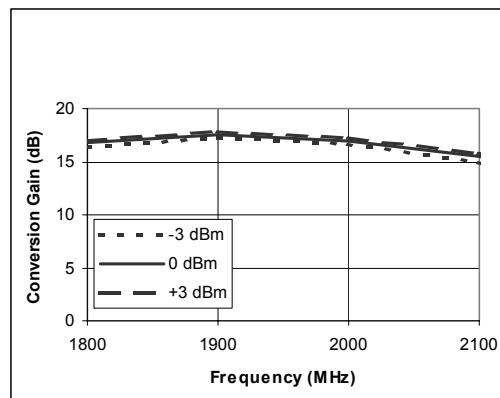


Figure 7. Leakages versus Frequency

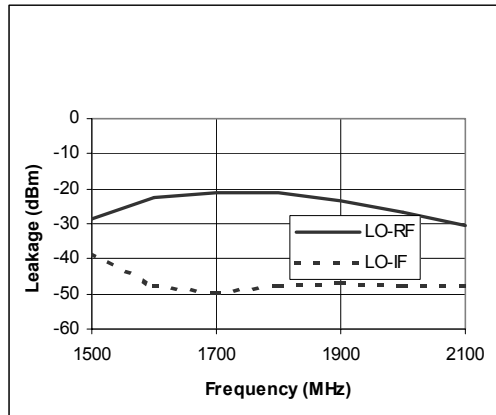


Figure 8. Noise Figure versus Frequency + Temperature

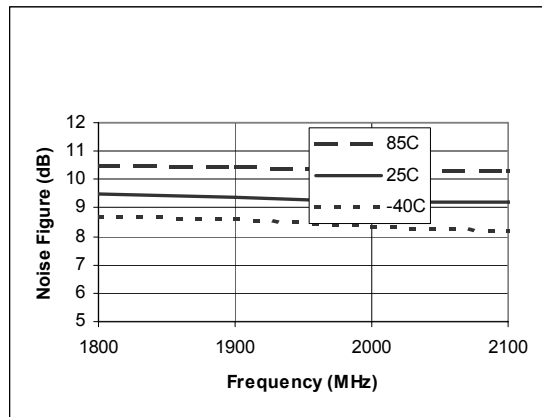


Figure 9. RF and LO Return Loss versus Frequency

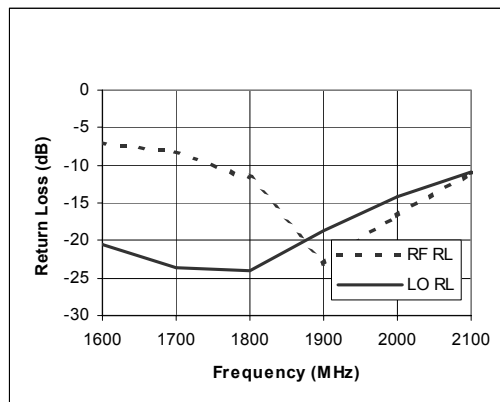


Figure 10. Output P1dB versus Frequency + Temperature

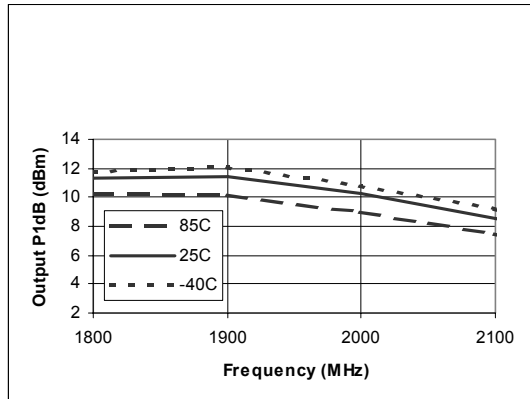


Figure 11. IF Return Loss versus Frequency

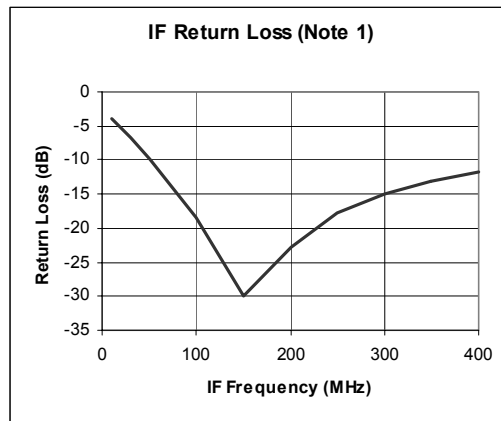


Figure 12. Output P1dB versus Frequency + LO Drive

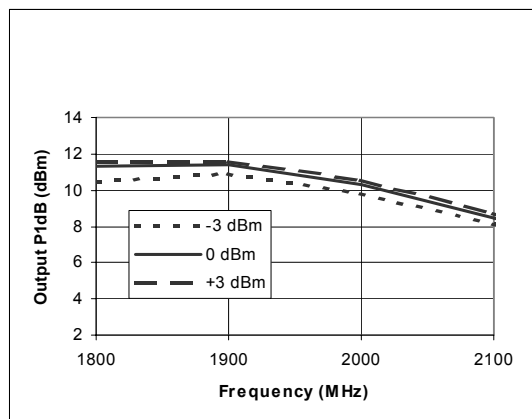
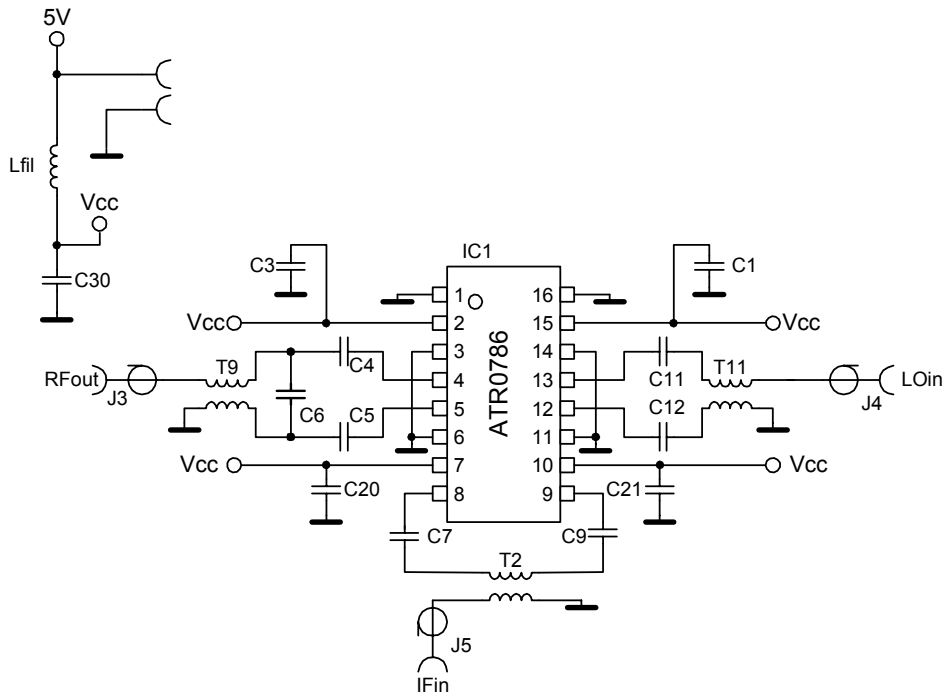


Figure 13. Demo Board Schematic

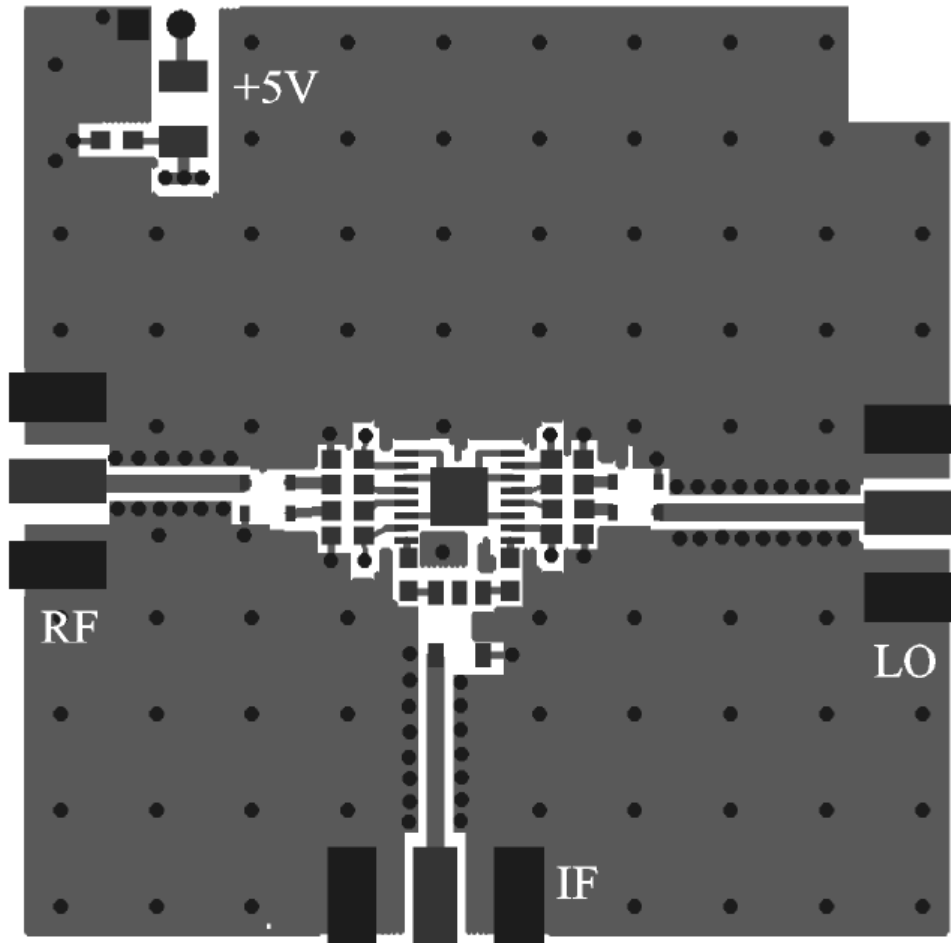


Bill of Material of Demo Board

| Parameters | Test Conditions | Pin | Symbol | Min. | Typ. |
|----------------------------|-----------------------|--------------------|--------------|-----------|--------------|
| Highly linear active mixer | | Atmel | ATR0786 | | 16-pin TSSOP |
| Capacitor | C7, C9 | | | 100 pF | 0603 |
| Capacitor | C1, C3, C20, C21, C30 | | | 6.8 pF | 0603 |
| Capacitor | C11, C12 | | | 4.7 pF | 0603 |
| Capacitor | C4, C5 | | | 3.3 pF | 0603 |
| Inductor | Lfil | Würth Elektronik | 74476401 | 1 μ H | 1210 |
| Capacitor | C6 | | | 1.2 pF | 0603 |
| Transformer | T9, T11 | Panasonic | EHF-FD1619 | | |
| Transformer | T2 | Mini-Circuits® | TC1-1 | | |
| RF connector | | Johnson Components | 142-0701-851 | | SMA |

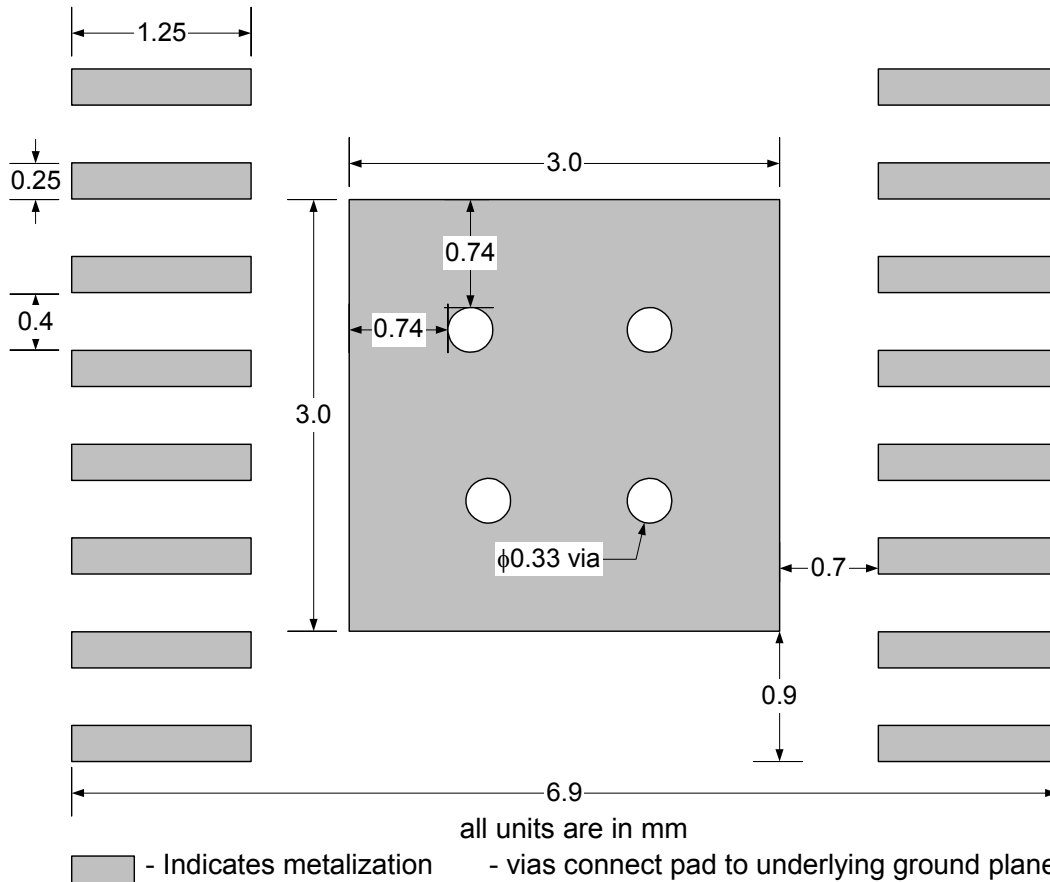
Note: 1. Other sizes are possible.

Figure 14. Demo Test Board



Recommended Package Footprint

- Notes: 1. Only ground signal traces are allowed directly under the package
 2. Primary dimensions are in millimeter alternate dimensions are in inches



Remark: Heatslug must be soldered to GND!

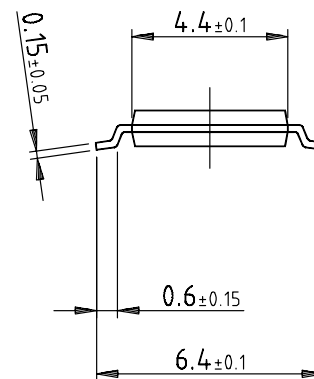
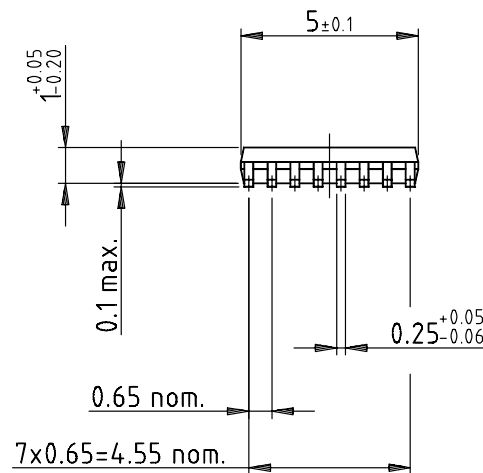
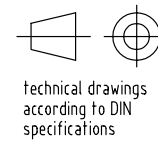
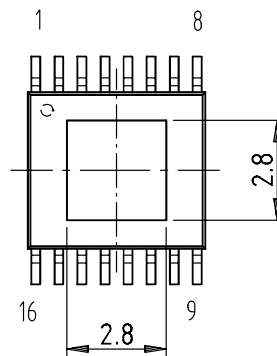
Plugging of the ground vias under the heat slug is also recommended to avoid soldering problems.

Ordering Information

| Extended Type Number | Package | Remarks |
|----------------------|---------|-----------------|
| ATR0786 | TSSOP16 | 5.0 mm × 6.4 mm |

Package Information

Package: SSOP16
 (acc. JEDEC SMALL OUTLINE No. MO-153)
 Dimensions in mm



Drawing-No.: 6.543-5079.01-4
 Issue: 1; 10.07.01



Atmel Headquarters

Corporate Headquarters

2325 Orchard Parkway
San Jose, CA 95131
TEL 1(408) 441-0311
FAX 1(408) 487-2600

Europe

Atmel Sarl
Route des Arsenaux 41
Case Postale 80
CH-1705 Fribourg
Switzerland
TEL (41) 26-426-5555
FAX (41) 26-426-5500

Asia

Room 1219
Chinachem Golden Plaza
77 Mody Road Tsimhatsui
East Kowloon
Hong Kong
TEL (852) 2721-9778
FAX (852) 2722-1369

Japan

9F, Tonetsu Shinkawa Bldg.
1-24-8 Shinkawa
Chuo-ku, Tokyo 104-0033
Japan
TEL (81) 3-3523-3551
FAX (81) 3-3523-7581

Atmel Operations

Memory

2325 Orchard Parkway
San Jose, CA 95131
TEL 1(408) 441-0311
FAX 1(408) 436-4314

Microcontrollers

2325 Orchard Parkway
San Jose, CA 95131
TEL 1(408) 441-0311
FAX 1(408) 436-4314

La Chantrerie
BP 70602
44306 Nantes Cedex 3, France
TEL (33) 2-40-18-18-18
FAX (33) 2-40-18-19-60

ASIC/ASSP/Smart Cards

Zone Industrielle
13106 Rousset Cedex, France
TEL (33) 4-42-53-60-00
FAX (33) 4-42-53-60-01

1150 East Cheyenne Mtn. Blvd.
Colorado Springs, CO 80906
TEL 1(719) 576-3300
FAX 1(719) 540-1759

Scottish Enterprise Technology Park
Maxwell Building
East Kilbride G75 0QR, Scotland
TEL (44) 1355-803-000
FAX (44) 1355-242-743

RF/Automotive

Theresienstrasse 2
Postfach 3535
74025 Heilbronn, Germany
TEL (49) 71-31-67-0
FAX (49) 71-31-67-2340

1150 East Cheyenne Mtn. Blvd.
Colorado Springs, CO 80906
TEL 1(719) 576-3300
FAX 1(719) 540-1759

Biometrics/Imaging/Hi-Rel MPU/ High Speed Converters/RF Datacom

Avenue de Rochepleine
BP 123
38521 Saint-Egreve Cedex, France
TEL (33) 4-76-58-30-00
FAX (33) 4-76-58-34-80

e-mail
literature@atmel.com

Web Site
<http://www.atmel.com>

© Atmel Corporation 2003.

Atmel Corporation makes no warranty for the use of its products, other than those expressly contained in the Company's standard warranty which is detailed in Atmel's Terms and Conditions located on the Company's web site. The Company assumes no responsibility for any errors which may appear in this document, reserves the right to change devices or specifications detailed herein at any time without notice, and does not make any commitment to update the information contained herein. No licenses to patents or other intellectual property of Atmel are granted by the Company in connection with the sale of Atmel products, expressly or by implication. Atmel's products are not authorized for use as critical components in life support devices or systems.

Atmel® is the registered trademark of Atmel.

Other terms and product names may be the trademarks of others.



Printed on recycled paper.

4587B-SIGE-02/03

xM