Features

- **700 MHz to 2500 MHz Operating Frequency**
- **Very Low Noise Floor Performance**
- **Very Good Carrier and Sideband Suppression**
- **Supports Wideband Baseband Input**
- **Low LO Drive Requirements**
- **Power-down Mode**
- **No External IF Filter**
- **Supply Voltage 5 V**
- **Small SSOP16 Package**

Applications

- **Infrastructure Digital Communication Systems**
- **DCS/PCS/UMTS Transceivers**
- **ISM Band Transceivers**
- **GMSK, QPSK, QAM, 8PSK, SSB Modulators**

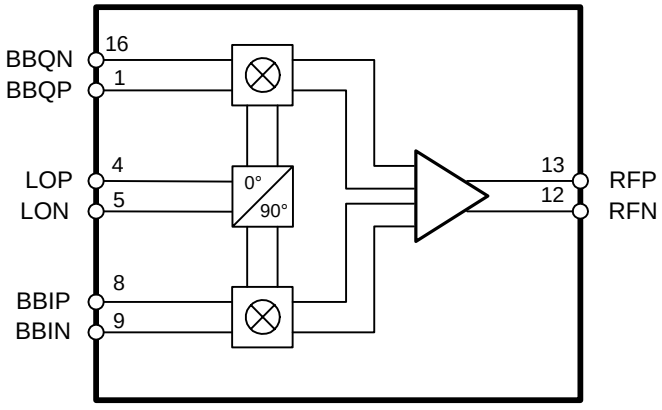
Electrostatic sensitive device.
Observe precautions for handling.

Description

The T0790 is a direct quadrature modulator using Atmel's Silicon-Germanium (SiGe) process. It features a frequency range from 700 up to 2500 MHz with excellent carrier and sideband suppression and a low noise floor. The typical output power is -11 dBm with an IM3 suppression greater than 60 dB.

The T0790 targets a wide range of communication applications including 3G wireless.

Figure 1. Block Diagram



700 to 2500 MHz Direct Quadrature Modulator

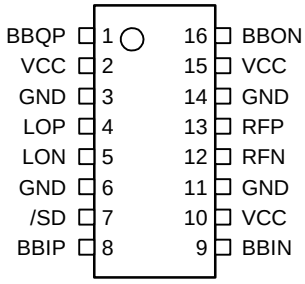
T0790

Preliminary

Rev. 4555A–SIGE–12/02

Pin Configuration

Figure 2. Pinning SSOP16



Pin Description

Pin	Symbol	Function
1	BBQP	Q-channel baseband, positive input
2	VCC	+5 V power supply
3	GND	Ground
4	LOP	Local oscillator, positive input
5	LON	Local oscillator, negative input
6	GND	Ground
7	/SD	Shut-down control
8	BBIP	I-channel baseband, positive input
9	BBIN	I-channel baseband, negative input
10	VCC	+5 V power supply
11	GND	Ground
12	RFN	RF, negative output
13	RFP	RF, positive output
14	GND	Ground
15	VCC	+5 V power supply
16	BBQN	Q-channel baseband, negative input

Absolute Maximum Ratings

All voltages are referred to GND.

Parameters	Symbols	Value	Unit
Supply voltage	V_{CC}	5.5	V
LO, RF input	LOP, LON, RFP, RFN	10	dBm
Input voltage	BBIP, BBIN, BBQP, BBQN	3	V
Operating temperature	T_{OP}	-40 to +85	°C
Storage temperature	T_{stg}	-65 to +150	°C

Thermal Resistance

Parameters	Symbols	Value	Unit
Junction ambient	R_{thJA}	TBD	K/W
Junction case	R_{thJC}	46	°C/W

Electrical Characteristics

Test conditions: V_{CC} = +5 V, T_{amb} = +25°C, baseband inputs: 1.9 V DC bias, 200 kHz frequency, 300 mV_{p-p}, 600 mV_{p-p} differential drive, I/Q signals in quadrature, LO input: -5 dBm at 1960 MHz

No.	Parameters	Test Conditions	Pin	Symbols	700 to 1000 MHz Operation			1700 to 2500 MHz Operation			Unit	Type*
					Min.	Typ.	Max.	Min.	Typ.	Max.		
1	**RF Output**											
1.1	Frequency range		12, 13	f	700		1000	1700		2500	MHz	B
1.2	Output power		12, 13	$P_{RF\ out}$	-13.0	-10.5	-9.0	-15.0	-11.5	-10	dBm	A
1.3	RF port return loss	Matched to 50 Ω (refer to schematics)	12, 13	RL		20			16		dB	D
1.4	1dB-output compression point	Compression point	12, 13	P1dB	3	4		2	3		dBm	A
1.5	LO leakage		12, 13	A_{LO}		-40	-34		-40	-32	dBm	D
1.6	Sideband suppression		12, 13	A_{SB}	34	40		34	40		dB	D
1.7	IM3 suppression	Two-tone baseband input at 600 mV_{p-p} differential per tone	12, 13	A_{IM3}	58	62		58	65		dB	D

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

Electrical Characteristics (Continued)

Test conditions: V_{CC} = +5 V, T_{amb} = +25°C, baseband inputs: 1.9 V DC bias, 200 kHz frequency, 300 mV_{p-p}, 600 mV_{p-p} differential drive, I/Q signals in quadrature, LO input: -5 dBm at 1960 MHz

					700 to 1000 MHz Operation			1700 to 2500 MHz Operation				
No.	**Parameters**	**Test Conditions**	**Pin**	**Symbols**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**	**Unit**	**Type***
1.8	Broadband noise floor	Baseband inputs tied to 1.9 V_{DC}, -20 MHz offset from carrier	12, 13	P_{noise}		-154	-148		-155	-148	dBm/ Hz	C
1.9	Quadrature phase error		12, 13		-2	±0.5	+2	-2	±0.5	+2	°C	B
1.10	I/Q amplitude balance		12, 13		-0.2	±0.5	+0.2	-0.2	±0.5	+0.2	dB	B
2	**Modulation Input**											
2.1	Baseband frequency input	-3dB bandwidth, baseband inputs terminated in 50 Ω	1, 8, 9, 16	f_{BB}	DC		500	DC		500	MHz	D
2.2	Baseband input resistance	Per pin	1, 8, 9, 16	R_{BB}		4.4			4.4		kΩ	D
2.3	Baseband input capacitance	Per pin	1, 8, 9, 16	C_{BB}		0.5			0.5		pF	D
3	**LO Input**											
3.1	LO frequency		4, 5	f_{LO}	700		2500	700		2500	MHz	B
3.2	LO drive level		4, 5	P_{LO}	-8	-5	-2	-8	-5	-2	dBm	D
3.3	LO port return loss	Matched to 50 Ω (refer to schematic)	4, 5	RL_{LO}		16			16		dB	C
4	**Miscellaneous**											
4.1	Shut-down attenuation		7	A_{SD}		60			60		dB	D
4.2	Shut-down pin resistance	at 1 MHz	7	R_{SD}		11.9			11.9		kΩ	D
4.3	Shut-down pin capacitance	at 1 MHz	7	C_{SD}		5.2			5.2		pF	D
4.4	Shut-down input thresholds	Shut-down disabled (normal operation)	7		3.75		V_{CC}	3.75		V_{CC}	V	D
		Shut-down enable	7		0		1.5	0		1.5	V	D

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

Electrical Characteristics (Continued)

Test conditions: V_{CC} = +5 V, T_{amb} = +25°C, baseband inputs: 1.9 V DC bias, 200 kHz frequency, 300 mV_{p-p}, 600 mV_{p-p} differential drive, I/Q signals in quadrature, LO input: -5 dBm at 1960 MHz

No.	Parameters	Test Conditions	Pin	Symbols	700 to 1000 MHz Operation			1700 to 2500 MHz Operation			Unit	Type*
					Min.	Typ.	Max.	Min.	Typ.	Max.		
4.5	Shut-down settling time		7			16			16		ns	
4.6	Supply voltage		2, 10, 15	V_{CC}	4.75	5	5.25	4.75	5	5.25	V	A
4.7	Supply current		2, 10, 15			73	82		73	82	mA	A

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

700 MHz to 1000 MHz: Typical Device Performance

Figure 3. SSB Power Versus LO Frequency

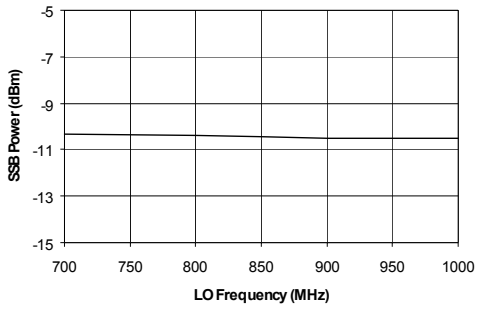


Figure 4. Output P1dB Versus LO Frequency

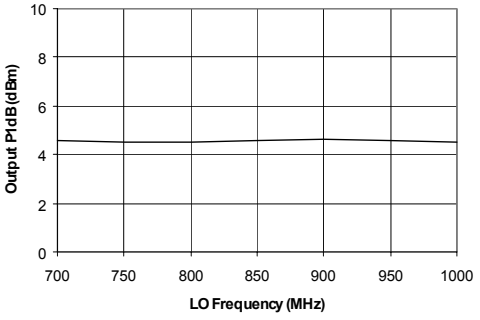


Figure 5. Carrier Feedthrough Versus LO Frequency

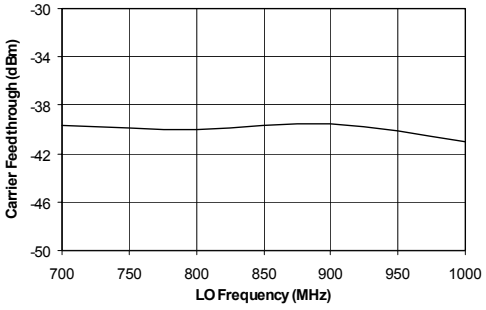


Figure 6. Sideband Suppression Versus LO Frequency

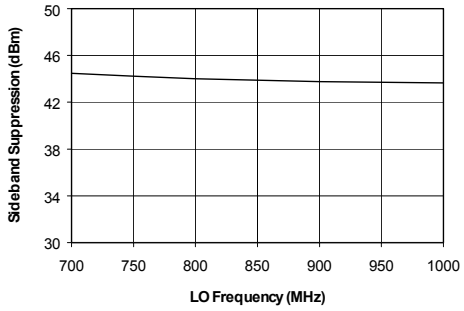


Figure 7. Intermodulation Distortion Versus SSB Output Power

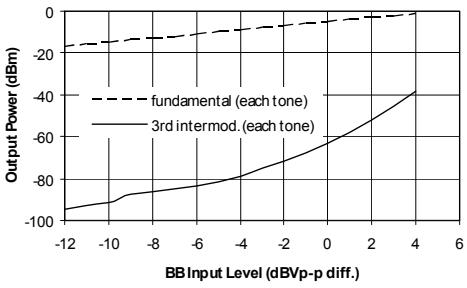
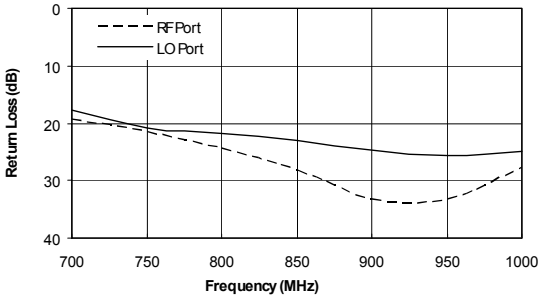


Figure 8. RF and LO Return Losses



1500 MHz to 2500 MHz: Typical Device Performance

Figure 9. SSB Power Versus LO Frequency

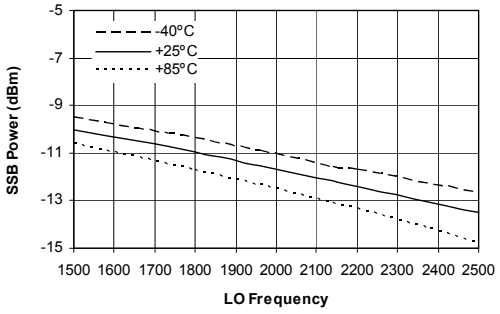


Figure 10. Output P1dB Versus LO Frequency

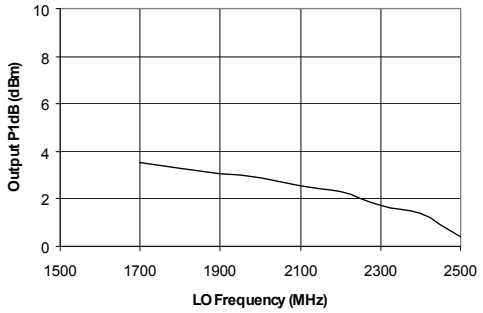


Figure 11. Carrier Feedthrough Versus LO Frequency

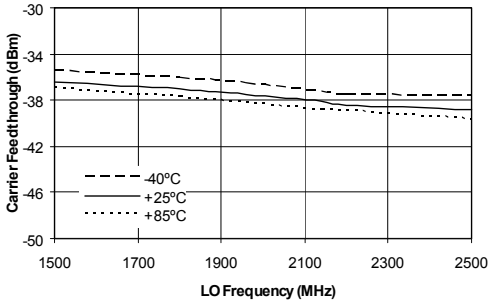


Figure 12. Sideband Suppression Versus LO Frequency

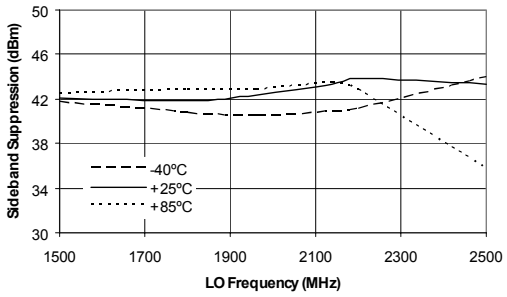


Figure 13. Intermodulation Distortion Versus SSB Output Power

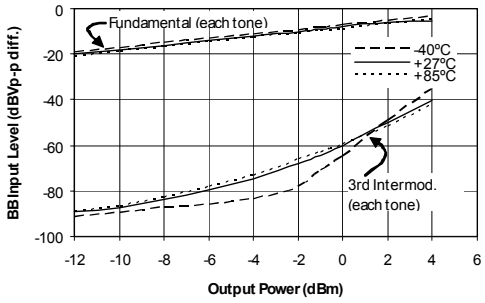


Figure 14. RF and LO Return Losses

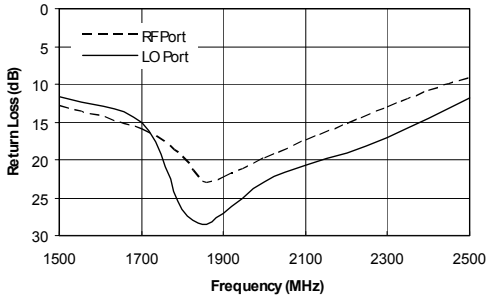
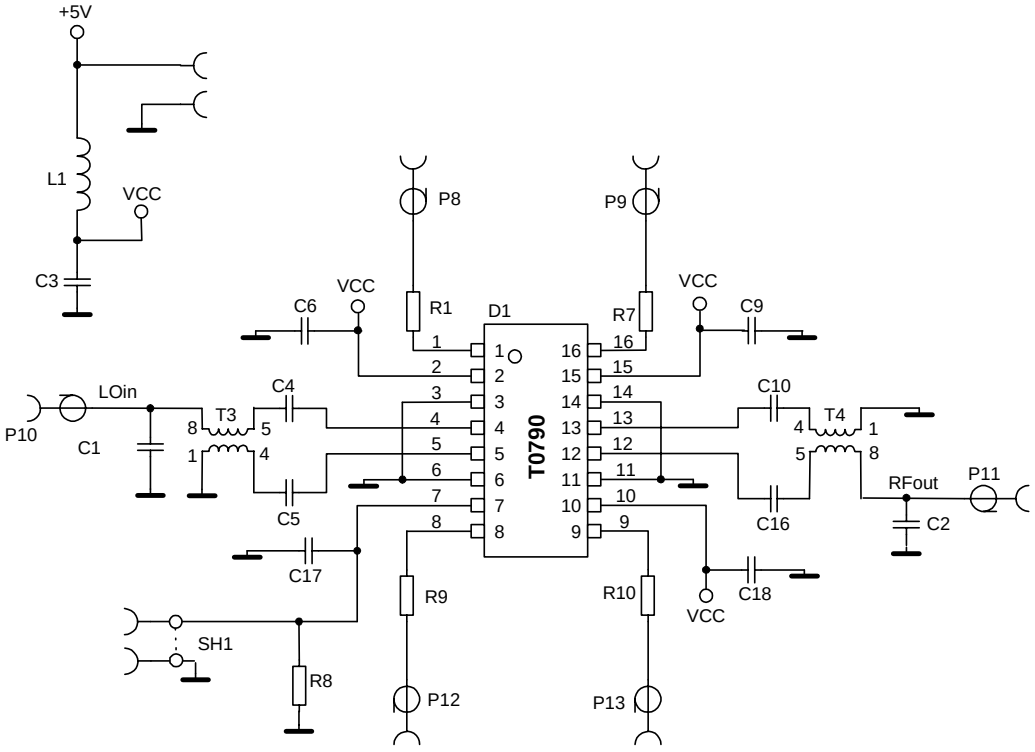


Figure 15. Application Schematic



Bill of Materials (700 MHz to 1000 MHz Evaluation Board)

Component Designator	Value (1)	Vendor	Part Number	Description
D1		Atmel	T0790	I/Q modulator
P8, P9, P10, P11, P12, P13		Johnson Components	142-0701-856	SMA connector, end launch with tab, for 0.062 inch board
T3, T4	1:1	Panansonic	EHF-FD1618	RF transformer, 700 MHz to 1300 MHz
L1	1 µH	Würth Elektronik	74476401	Inductor, 1210 footprint, ±10% tolerance
R1, R7, R9, R10	200 Ω			Resistor, 1206 footprint, ±1% tolerance
R8	1 kΩ			Resistor, 0603 footprint, ±1% tolerance
C6,C18	33 pF			Capacitor, 0603 footprint, COG dielectric, ±0.25 pF tolerance
C9,C17	1 nF			Capacitor, 0603 footprint, COG dielectric, ±5% tolerance
C3	2.2 µF			Capacitor, 1206 footprint, Y5V dielectric, 16 V rating
C4, C5, C10, C16	10 pF			Capacitor, 0603 footprint, COG dielectric, ±0.25 pF tolerance
C1, C2	n.c.			Capacitor, 0603 footprint, COG dielectric, ±0.25 pF tolerance
SH1				Shunt for 2-pin header

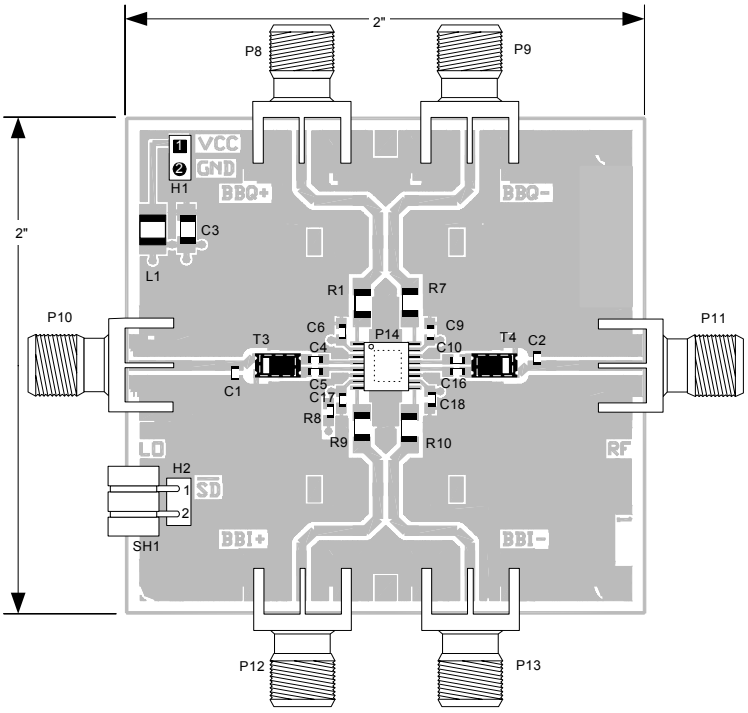
Notes: 1. May vary due to printed board layout and material.

Bill of Materials (for 1700 MHz to 2500 MHz Evaluation Board)

Component Designator	Value [1]	Vendor	Part Number	Description
D1		Atmel	T0790	I/Q modulator
P8, P9, P10, P11, P12, P13		Johnson Components	142-0701-856	SMA connector, end launch with tab, for 0.062 inch board
T3, T4	1:1	Panansonic	EHF-FD1619	RF transformer, 1200 MHz to 2200 MHz
L1	1 µH	Würth Elektronik	74476401	Inductor, 1210 footprint, ±10% tolerance
R1, R7, R9, R10	200 Ω			Resistor, 1206 footprint, ±1% tolerance
R8	1 kΩ			Resistor, 0603 footprint, ±1% tolerance
C6,C18	6.8 pF			Capacitor, 0603 footprint, COG dielectric, ±0.25 pF tolerance
C9,C17	1 nF			Capacitor, 0603 footprint, COG dielectric, ±5% tolerance
C3	2.2 µF			Capacitor, 1206 footprint, Y5V dielectric, 16 V rating
C4, C5, C10, C16	2.7 pF			Capacitor, 0603 footprint, COG dielectric, ±0.25 pF tolerance
C1, C2	0.5 pF			Capacitor, 0603 footprint, COG dielectric, ±0.25 pF tolerance
SH1				Shunt for 2-pin header

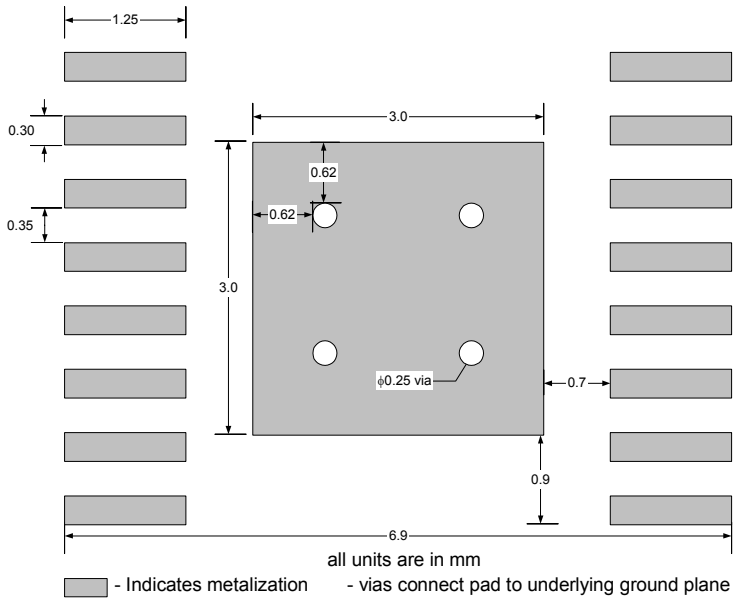
Note: 1. May vary due to printed board layout and material.

Figure 16. Demo Test Board (Fully Assembled PCB)



Recommended Package Footprint

Note: In order to avoid soldering problems, plugging of the ground vias under the heat slug is recommended!

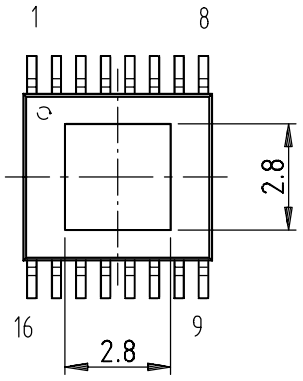


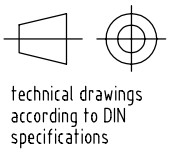
Ordering Information

Extended Type Number	Package	Remarks
T0790-6C	SSOP16	TBD

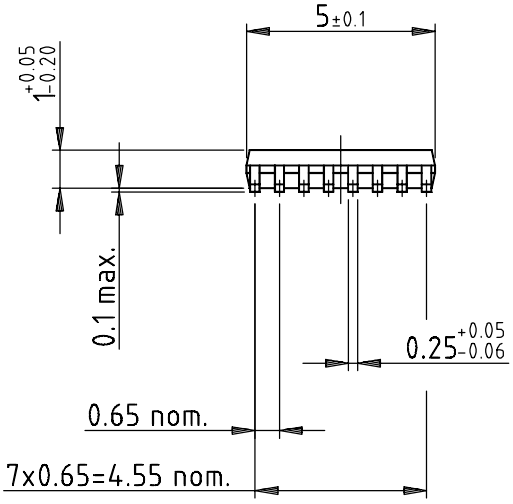
Package Information

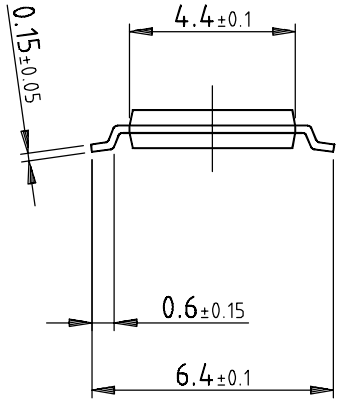
Package: SSOP16
(acc. JEDEC SMALL OUTLINE No. MO-153)
Dimensions in mm





technical drawings
according to DIN
specifications





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

4555A–SIGE–12/02 xM