Features

- **800-2500 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.

800 - 2500 MHz Direct Quadrature Modulator

T0790

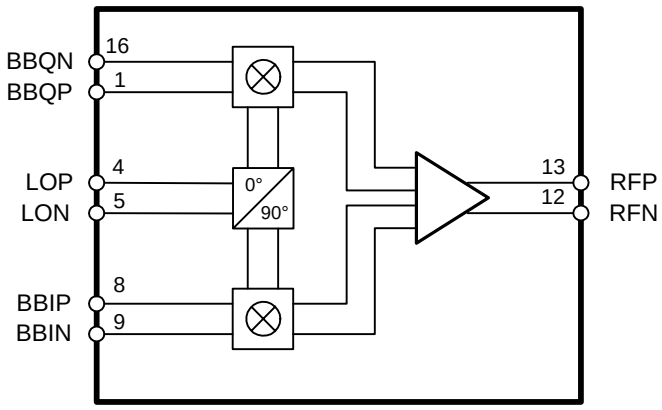
Description

The T0790 is a direct quadrature modulator using Atmel's Silicon-Germanium (SiGe) process. It features a frequency range from 800 MHz up to 2500 MHz with excellent carrier and sideband suppression and a low noise floor. The typical output power is -10 dBm with an IM3 suppression greater than 60 dB.

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

Block Diagram

Figure 1.



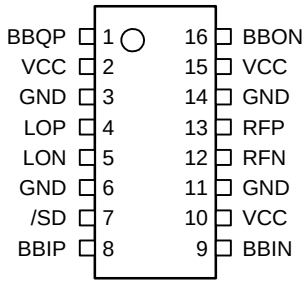
Rev. A2, 30-Nov-01

Ordering Information

Extended Type Number	Package	Remarks
T0790	SSOP16	t.b.d.

Pin Configuration

Figure 2. Pinning



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.

Parameter	Symbol	Value	Unit
Supply voltage	V_{CC}	5.5	V
LO, RF input	LOP, LON, RFP, RFN	10	dBm
Input voltage	BBIP, BBIN, BBQP, BBQN	0 to 3	V
Operating temperature	T_{OP}	-40 to +85	°C
Storage temperature	T_{stg}	-65 to +150	°C

Thermal Resistance

Parameter	Symbol	Value	Unit
Junction ambient	R_{thJA}	t.b.d.	K/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 m V $_{p–p}$ differential drive, I/Q signals in quadrature, LO input: –5 dBm @ 2000 MHz

No.	Parameters	Test Conditions	Pin	Symbol	Min.	Typ.	Max.	Unit	Type*
1	**RF output**								
1.1	Frequency range		12, 13	f	800		2500	MHz	B
1.2	Output power		12, 13	$P_{RF\ out}$	-14	-11.5	-9	dBm	A
1.3	RF port return loss	Matched to 50 Ω ref	12, 13	RL	14			dB	D
1.4	1dB-output compression point	Compression point	12, 13	P1dB		+3		dBm	A
1.5	LO leakage		12, 13	A_{LO}		-40	-32	dBm	D
1.6	Sideband suppression		12, 13	A_{SB}	+34	40		dB	D
1.7	IM3 suppression	Two-tone baseband input @ 600mVp-p differential per tone	12, 13	A_{IM3}		65		dB	D
1.8	Broadband noise floor	Baseband inputs tied to 1.9 V_{DC}, -20 MHz offset from LO	12, 13	P_{noise}		-154	-148	dBm/ Hz	C
1.9	Quadrature phase error		12, 13		-2		+2	deg	B
1.10	I/Q amplitude balance		12, 13		-0.2		+0.2	dB	B

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

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 m V $_{p–p}$ differential drive, I/Q signals in quadrature, LO input: –5 dBm @ 2000 MHz

No.	Parameters	Test Conditions	Pin	Symbol	Min.	Typ.	Max.	Unit	Type*
2	**Modulation input**								
2.1	Baseband frequency input	-3dB bandwidth, baseband inputs terminated in 50 Ω	1, 8, 9, 16	f_{BB}	DC		1000	MHz	D
2.2	Baseband input resistance	Per pin	1, 8, 9, 16	R_{BB}		4.4		kΩ	D
2.3	Baseband input capacitance	Per pin	1, 8, 9, 16	C_{BB}		0.5		pF	D
3	**LO input**								
3.1	Usable LO frequency		4, 5	f_{LO}	800		2500	MHz	B
3.2	LO drive level		4, 5	P_{LO}	-8	-5	-2	dBm	D
3.3	LO port return loss	Matched to 50 Ω ref	4, 5	RL_{LO}	14			dB	C
4	**Miscellaneous**								
4.1	Shut-down attenuation		7	A_{SD}		60		dB	D
4.2	Shut-down pin resistance	@ 1MHz	7	R_{SD}		11.9		kΩ	D
4.3	Shut-down pin capacitance	@ 1MHz	7	C_{SD}		5.2		pF	D
4.4	Shut-down input thresholds		7			CMOS		—	D
4.5	Shut-down settling time		7			<500		ns	
4.6	Supply voltage		2, 10, 15		+4.75	+5	+5.25	V	A
4.7	Supply current		2, 10, 15		60	73	80	mA	A

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

Figure 3. SSB power vs. LO frequency

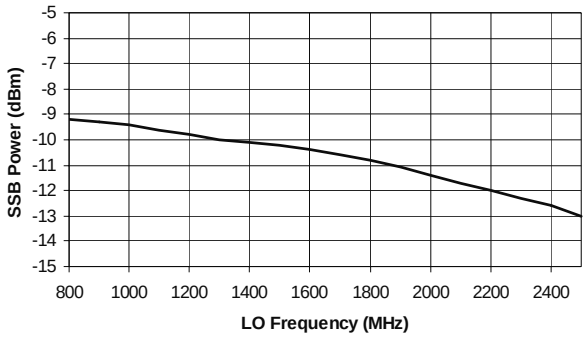


Figure 4. Output P1dB vs. LO frequency

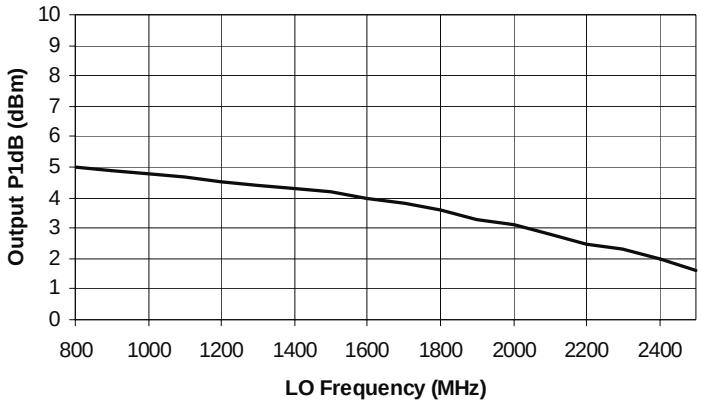


Figure 5. Carrier feedthrough vs. LO frequency

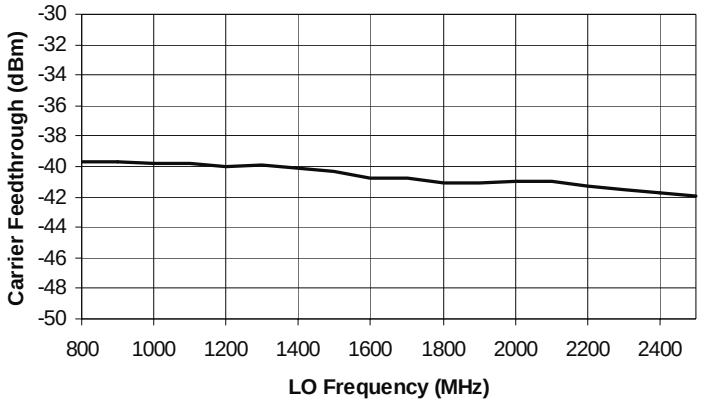


Figure 6. Sideband suppression vs. LO frequency

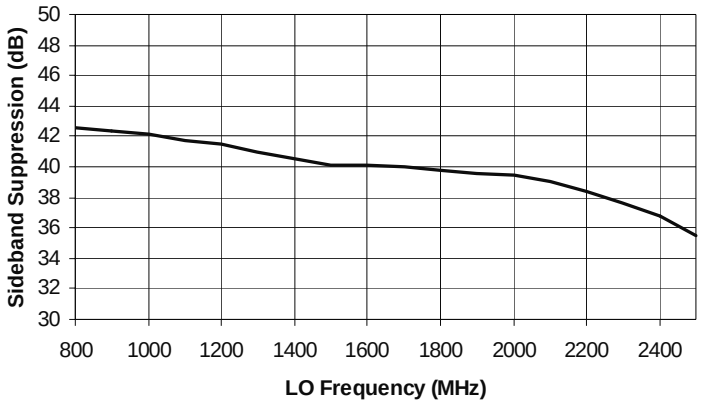
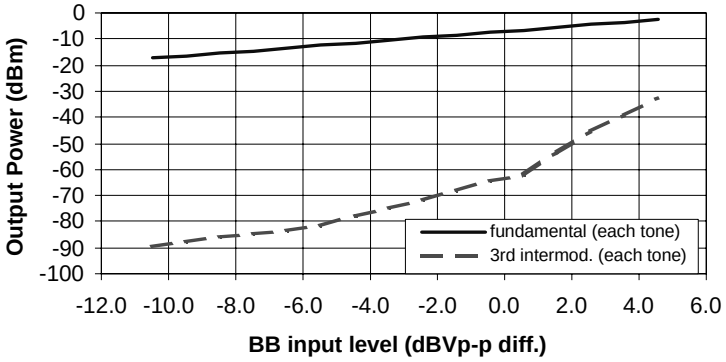


Figure 7. Intermodulation distortion vs. SSB output power



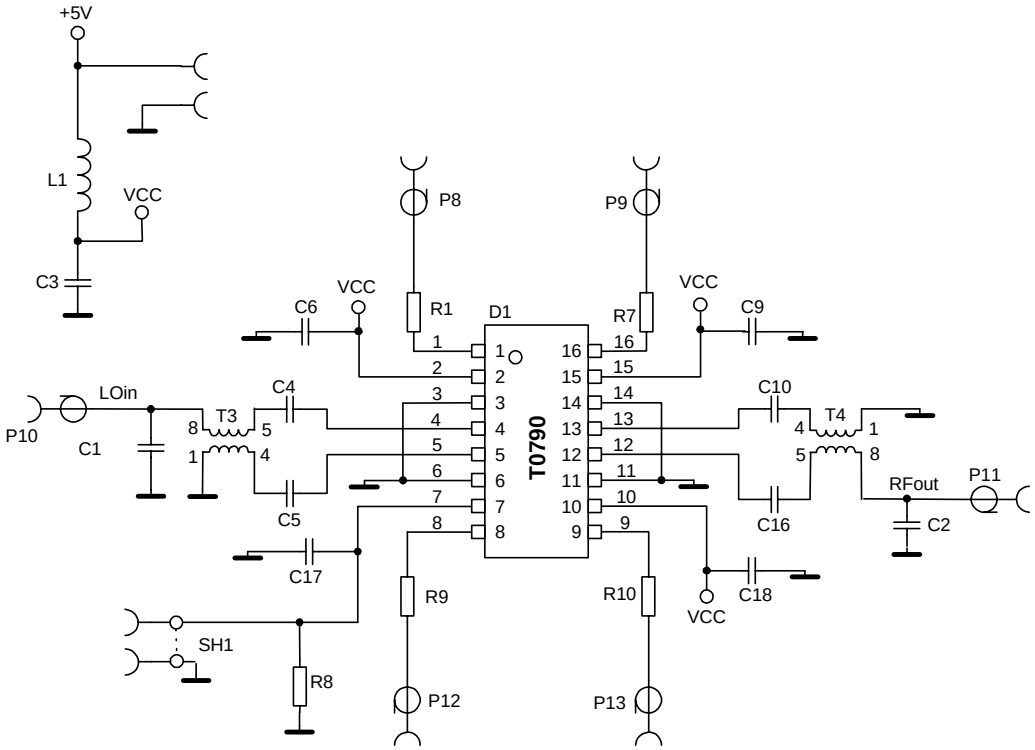
Small Signal S-Parameter

Frequency (MHz)	RF Port				LO Port			
	Single-Ended		Differential		Single-Ended		Differential	
	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
800	0.364	162.7	0.125	89.26	0.948	-29.69	0.106	81.92
900	0.366	160.3	0.141	86.34	0.940	-33.43	0.119	80.9
1000	0.368	157.9	0.156	83.74	0.931	-37.18	0.132	79.89
1100	0.370	155.6	0.171	81.38	0.921	-40.95	0.145	78.88
1200	0.372	153.3	0.186	79.2	0.910	-44.75	0.158	77.87
1300	0.374	151.1	0.200	77.18	0.898	-48.56	0.171	76.87
1400	0.377	148.8	0.214	75.27	0.886	-52.39	0.184	75.86
1500	0.380	146.6	0.227	73.48	0.873	-56.25	0.197	74.85
1600	0.383	144.4	0.240	71.77	0.859	-60.13	0.210	73.85
1700	0.387	142.2	0.253	70.15	0.845	-64.03	0.223	72.84
1800	0.391	139.9	0.265	68.6	0.830	-67.96	0.236	71.84
1900	0.395	137.6	0.277	67.12	0.814	-71.89	0.248	70.84
2000	0.398	135.2	0.289	65.71	0.798	-75.84	0.261	69.84
2100	0.402	132.7	0.301	64.35	0.781	-79.79	0.273	68.84
2200	0.404	130.3	0.312	63.04	0.765	-83.77	0.286	67.84
2300	0.406	128.0	0.322	61.79	0.748	-87.78	0.298	66.85
2400	0.407	125.7	0.333	60.58	0.732	-91.83	0.310	65.86
2500	0.408	123.6	0.343	59.41	0.716	-95.94	0.322	64.86

Notes: 1) VCC = +5.0V, T = +25ºC.
2) For single-ended S-parameters, the corresponding differential pin is left floating.
3) Data is referenced to the foot of the package lead and does not include the applications circuit.
4) All data simulated.

Application Circuit

Figure 8.

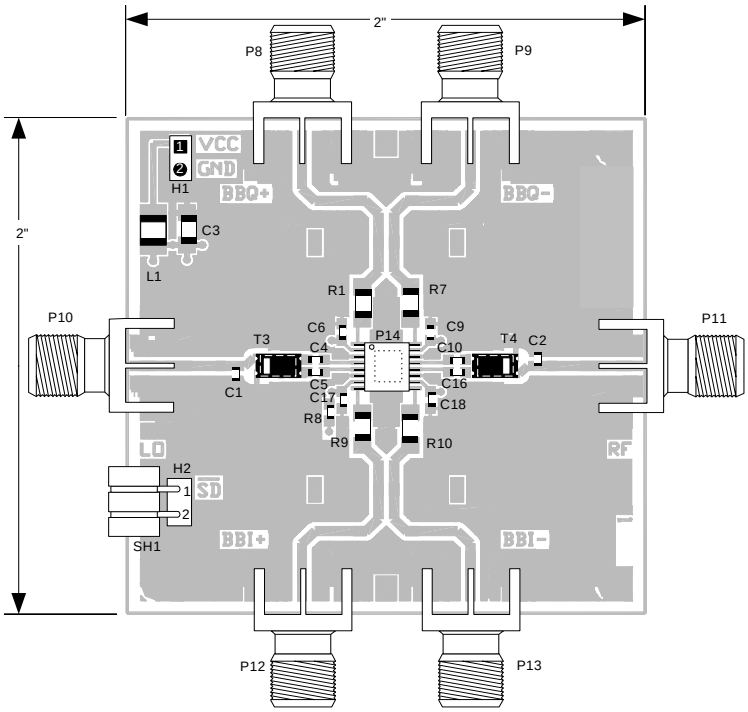


Component Designator	Value	Vendor	Part Number	Description
D1		Atmel	T0790	I/Q modulator
P8, P9, P10, P11, P12, P13		Johnson Components	142-0701-856	SMA connector, end launch with tab, for .062 inch thick board
T3, T4	1:1	Panansonic	EHF-FD1619	RF transformer, 1200 to 2200 MHz
L1	1 µH			Inductor, 1210 footprint, +/- 10% tolerance
R1, R7, R9, R10	200 Ω			Resistor, 1206 footprint
R8	1 kΩ			Resistor, 0603 footprint,
C6,C18	6.8 pF			Capacitor, 0603 footpr., COG dielectric, +/- 0.25 pF
C9,C17	1 nF			Capacitor, 0603 footpr.,COG dielectric, +/- 5%
C3	2.2 µF			Capacitor, 1206 footpr., Y5V dielectric, 16 V rating
C4, C5, C10, C16	2.2 pF			Capacitor, 0603 footpr., COG dielectric, +/- 0.25 pF
C1, C2	0.5 pF			Capacitor, 0603 footpr., COG dielectric, +/- 0.25 pF
SH1				Shunt for 2-pin header

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

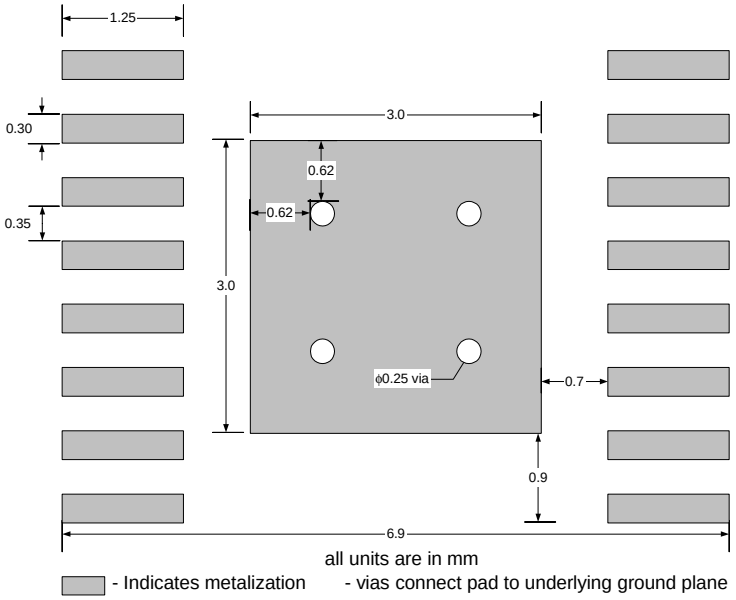
Demo Test Board (Fully Assembled PCB)

Figure 9.

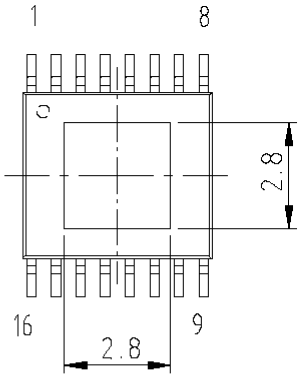


Recommended Package Footprint

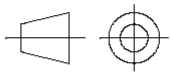
Figure 10.



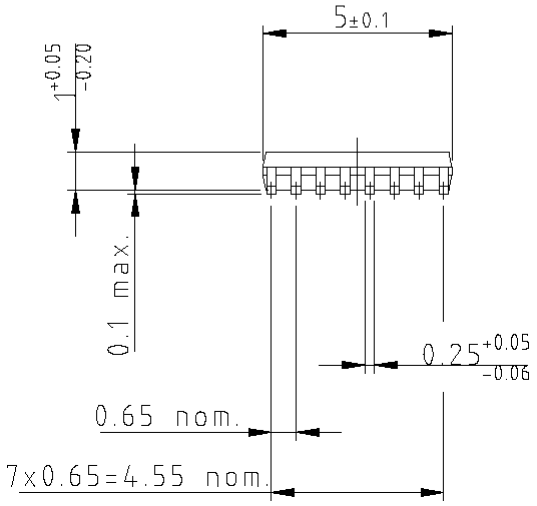
Package Information

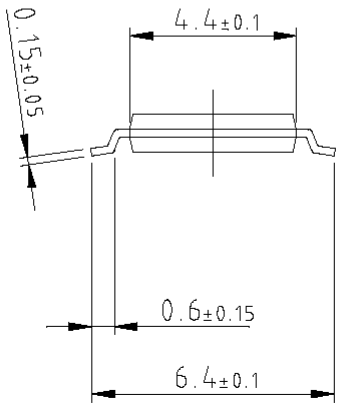


Package: SSOP16
(acc. JEDEC SMALL OUTLINE No. MO-153)
Dimensions in mm



technical drawings
according to DIN
specifications





Ozone Depleting Substances Policy Statement

It is the policy of **Atmel Germany GmbH** to

1. Meet all present and future national and international statutory requirements.

2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

Atmel Germany GmbH has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively

2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA

3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

Atmel Germany GmbH can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

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