Dualband SiGe Power Amplifier for GSM 900/1800/1900

Description

The TST0911 is a monolithic dualband power amplifier IC. The device is manufactured using Atmel Wireless & Microcontrollers' advanced Silicon-Germanium (SiGe) process and has been designed for use in GSM-based cellular phones.

The IC offers the functionality of two amplifiers in one package and is suited for GSM 900/1800/1900 (GSM/ DCS/ PCS) dual- or triple mobile phones. With a single supply voltage operation of 3 V and a neglectable leakage current in power-down mode, the TST0911 needs few external components.

Electrostatic sensitive device.
Observe precautions for handling.

Features

- 900-MHz amplifier and 1800/1900-MHz amplifier for dual-/tripleband application
- 35 dBm output power @ 900 MHz
  32 dBm output power @ 1800/ 1900 MHz
- Power-added efficiency (PAE) 50%
- Single supply operation at 3 V
  no negative supply voltage necessary
- Current consumption in power-down mode ≤ 10 µA, no external power-supply switch required
- Power-ramp control
- Mode switch
- AC-coupled input, simple input and output matching
- SMD package (PSSOP28 with heat slug)

Block Diagram

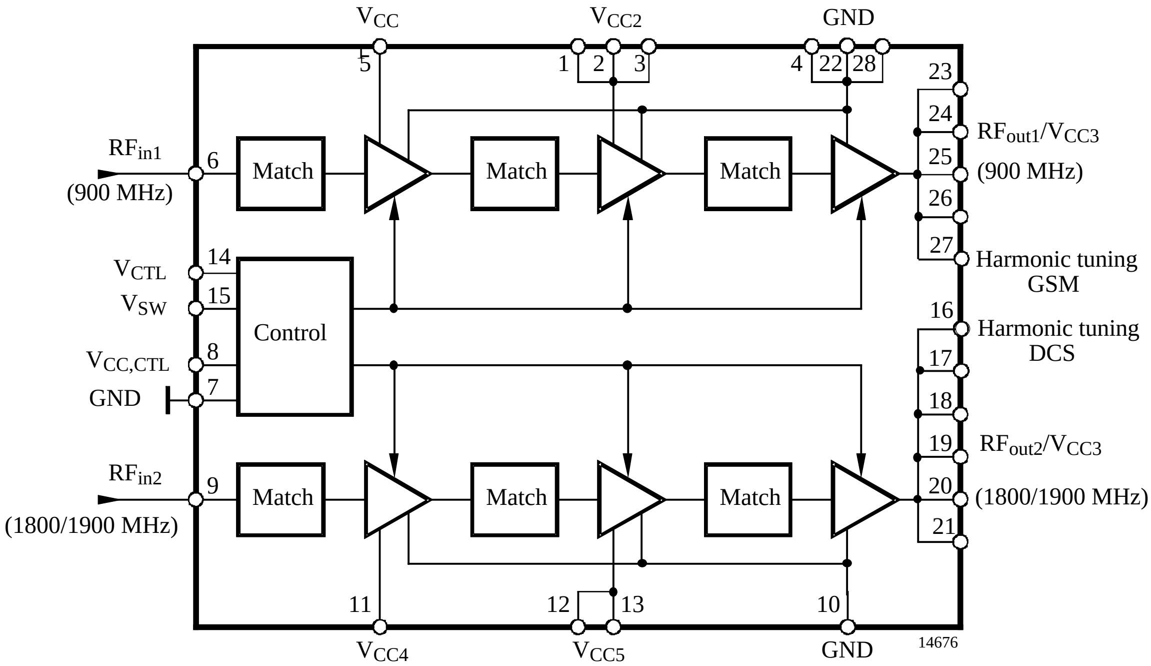


Figure 1. Block diagram

Ordering Information

Extended Type Number	Package	Remarks
TST0911-TSS	PSSOP28	Tube
TST0911-TSQ	PSSOP28	Taped and reeled

Pin Description

Pin	Symbol	Function
1	V_{CC2}	Supply voltage 2 (900-MHz amplifier)
2	V_{CC2}	
3	V_{CC2}	
4	GND	Ground
5	V_{CC1}	Supply voltage 1 (900-MHz amplifier)
6	RF_{in1}	RF input 1 (900 MHz)
7	GND	Ground (control)
8	$V_{CC,CTL}$	Supply voltage for control
9	RF_{in2}	RF input 2 (1800/1900 MHz)
10	GND	Ground
11	V_{CC4}	Supply voltage 4 (1800/1900-MHz amplifier)
12	V_{CC5}	Supply voltage 5 (1800/1900-MHz amplifier)
13	V_{CC5}	Supply voltage 5 (1800/1900-MHz amplifier)
14	VCTL	Control input
15	VSW	Mode switch
16	RF_{out2}/V_{CC6}	RF output 2 / harmonic tuning (1800/1900 MHz)
17	RF_{out2}/V_{CC6}	
18	RF_{out2}/V_{CC6}	
19	RF_{out2}/V_{CC6}	
20	RF_{out2}/V_{CC6}	
21	RF_{out2}/V_{CC6}	
22	GND	Ground
23	RF_{out1}/V_{CC3}	RF output 1 / supply voltage 3 (900 MHz)
24	RF_{out1}/V_{CC3}	
25	RF_{out1}/V_{CC3}	
26	RF_{out1}/V_{CC3}	
27	RF_{out1}/V_{CC3}	RF output 1 / harmonic tuning (900 MHz)
28	GND	Ground

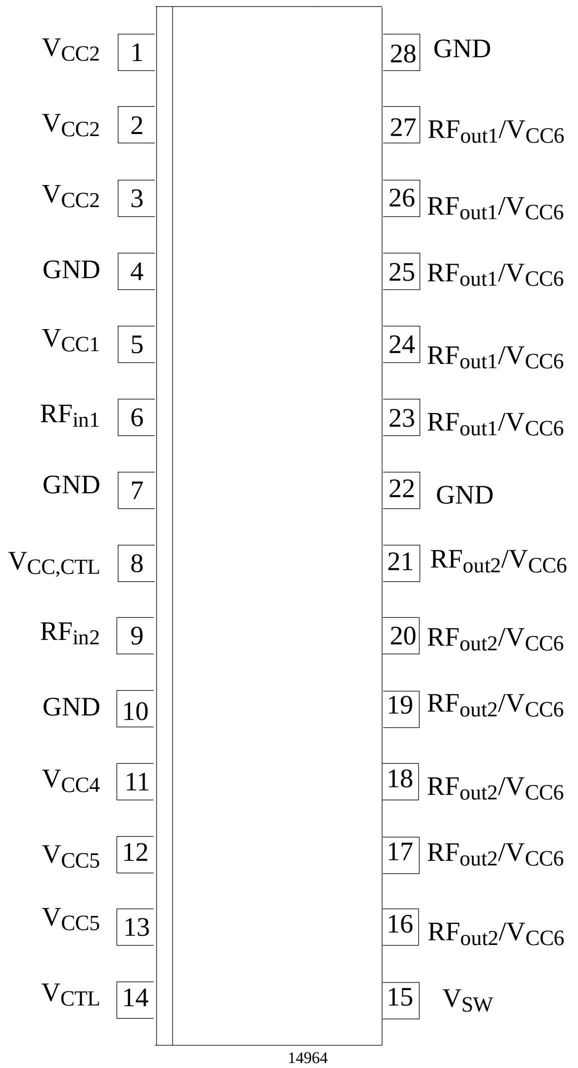


Figure 2. Pinning

Absolute Maximum Ratings

All voltages are referred to GND

Parameter		Symbol	Min.	Max.	Unit
Supply voltage V_{CC}	Pins 1, 2, 3, 5, 11, 12, 13, 16, 17, 18, 19 ,20, 21, 23, 24, 25, 26 and 27 Pin 8	V_{CC1}, V_{CC2} V_{CC3}, V_{CC4} V_{CC5}, V_{CC6} $V_{CC,\ CTL}$		5.0	V
Input power	Pin 6 (GSM) Pin 9 (DCS/PCS)	P_{in}		13 8	dBm dBm
Gain-control voltage	Pin 14	V_{CTL}	0	2.2	V
Duty cycle for operation				25	%
Burst duration		t_{burst}		1.2	ms
External voltage for mode switch	Pin 16	V_{SW}	0	V_{CC}	V
Junction temperature		T_j		+ 150	°C
Storage temperature		T_{stg}	– 40	+150	°C

Thermal Resistance

Parameter	Symbol	Value	Unit
Junction ambient	R_{thJA}	t.b.d.	K/W

Operating Range

All voltages are referred to GND

Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply voltage	V_{CC}	2.4	3.5	4.5	V
Ambient temperature	T_{amb}	– 25		+ 85	°C
Input frequency	f_{in} (Pin 6) f_{in} (Pin 9)		900 1800/1900		MHz MHz

Electrical Characteristics

Test conditions: $V_{CC} = V_{CC1}$ to V_{CC6}, $V_{CC,\ CTL}$ = + 3.5 V, V_{CTL} = 1.5 V, T_{amb} = + 25°C, t_{burst} = 0.577 ms, t_{period} = 4.615 ms (see application circuit) *) with external matching (see application circuit)

Parameter	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Power supply						
Supply voltage		V_{CC}	2.7	3.5	4.5	V
Current consumption	Active mode P_{out} = 34.5 dBm, PAE = 50% P_{out} = 32.5 dBm, PAE = 42%	I		1.7 1.13		A A
Current consumption (leakage current)	Power–down mode $V_{CTL} \leq 0.2$ V	I			10	µA

Electrical Characteristics (continued)

Test conditions: $V_{CC} = V_{CC1}$ to V_{CC6}, $V_{CC, CTL}$ = + 3.5 V, V_{CTL} = 1.5 V, T_{amb} = + 25°C, t_{burst} = 0.577 ms, t_{period} = 4.615 ms (see application circuit)   *)   with external matching (see application circuit)

Parameter	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
900-MHz amplifier (GSM)						
Frequency range		f_{in}	880	900	915	MHz
Input impedance *)		Z_i		50		Ω
Output impedance		Z_o		50		Ω
Output power	P_{in} = 3 dBm, R_L = RG = 50 Ω V_{CC} = 3.5 V, T_{amb} = +25°C V_{CC} = 2.7 V, T_{amb} = +85°C	P_{out}	34.3 32.0	34.8 33.0		dBm dBm
Minimum output power	V_{CTL} = 0.3 V	P_{out}		– 20		dBm
Input power		P_{in}		0	10	dBm
Power-added efficiency	V_{CC} = 3 V, P_{out} = 28 dBm V_{CC} = 3 V, P_{out} = 30 dBm V_{CC} = 3 V, P_{out} = 33.5 dBm	PAE	25 35 50			%
Input VSWR *)	P_{in} = 0 to 10 dBm, P_{out} = 34.5 dBm	VSWR			2 : 1	
Stability	T_{amb} = –25 to + 85 °C no spurious ≥ –60 dBc	VSWR			10 : 1	
Load mismatch (stable, no damage)	P_{out} = 34.5 dBm, all phases	VSWR			10 : 1	
Second harmonic distortion		2fo			–35	dBc
Third harmonic distortion		3fo			–35	dBc
Noise power	P_{out} = 34 dBm, RBW = 100 kHz f = 925 to 935 MHz f ≥ 935 MHz				– 70 – 82	dBm dBm
Isolation between input and output	P_{in} = 0 to 10 dBm, V_{CTL} ≤ 0.2 V (power down)		50			dB
Isolation between GSM input and DCS/PCS output	DCS/PCS powered down, P_{in} = 10 dBm		50			dB
Control curve	see figure 3 (t.b.d.)					
Rise and fall time		t_r, t_f			0.5	µs
Output power vs. input power	see figure 1 (t.b.d.)					
Power control range			60			dB
Control voltage range		V_{CTL}	0.5		2.5	V
Control current, assuming that only GSM amplifier at a time is turned on	P_{in} = 0 to 10 dBm, V_{CTL} = 0 to 2.0 V	I_{CTL}			200	µA
Power control						
Control curve slope	P_{out} ≥ 25 dBm				150	dB/ V
Power-control range	V_{CTRL} = 0.3 to 2.0 V		50			dB
Control-voltage range		V_{CTL}	0.3		2.0	V

Electrical Characteristics (continued)

Test conditions: $V_{CC} = V_{CC1}$ to V_{CC6}, $V_{CC,\,CTL}$ = + 3.5 V, V_{CTL} = 1.5 V, T_{amb} = + 25°C, t_{burst} = 0.577 ms, t_{period} = 4.615 ms (see application circuit) *) with external matching (see application circuit)

Parameter	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Control current	P_{in} = 0 to 10 dBm, V_{CTL} = 0 to 2.0 V	I_{CTL}			200	µA
1800/1900-MHz amplifier (DCS/PCS)						
Frequency range	DCS PCS	f_{in}	1710 1850		1785 1910	MHz MHz
Input impedance *)		Z_i		50		Ω
Output impedance		Z_o		50		Ω
Output power	P_{in} = 3 dBm, $R_L = R_G$ = 50 Ω V_{CC} = + 3.5 V, T_{amb} = +25°C V_{CC} = + 2.7 V, T_{amb} = +85°C	P_{out}	31.7 30.0	32.0 30.5		dBm dBm
Minimum output power	V_{CTL} = 0.3 V			– 20		dBm
Input power		P_{in}		0	6	dBm
Power-added efficiency at $P_{out,\,max}$	V_{CC} = + 3 V, P_{out} = 26 dBm V_{CC} = + 3 V, P_{out} = 28 dBm V_{CC} = + 3 V, P_{out} = 31.5 dBm	PAE	25 35 42			%
Input VSWR *)	P_{in} = 0 to 6 dBm, P_{out} = 31.5 dBm	VSWR			2 : 1	
Stability	T_{amb} = –25 to + 85°C	VSWR			10 : 1	
Load mismatch stable, no damage	P_{out} = 31.5 dBm all phases	VSWR			10 : 1	
Second harmonic distortion		IM2			–35	dBc
Third harmonic distortion		IM3			–35	dBc
Noise power	P_{out} = 31.5 dBm, RBW = 100 kHz f = 1805–1880 MHz (DCS) f = 1930–1990 MHz (PCS)				– 71 – 71	dBm dBm
Isolation between input and output	P_{in} = 0 to 6 dBm, $V_{CTL} \leq$ 0.2 V (power down)		48			dB
Isolation between DCS/ PCS input and GSM output	GSM powered down, P_{in} = 6 dBm		50			dB
Control curve slope					150	dB/ V
Rise and fall time		t_r, t_f			0.5	µs
Power control range			50			dB
Control voltage range		V_{CTL}	0.5		2.5	V
Control current, assuming that only DCS/PCS amplifier at a time is turned on	P_{in} = 0 to 6 dBm, V_{CTL} = 0 to 2.2 V	I_{CTL}			200	µA
Mode switch						
Switching voltage	900-MHz amplifier active 1800/1900-MHz amplifier active	V_{sw}	V_{CC}–0.3 0		V_{CC} 0.3	V V
Switching current	$V_{SW} = V_{CC}$	I_{sw}			200	µA

Application Circuit

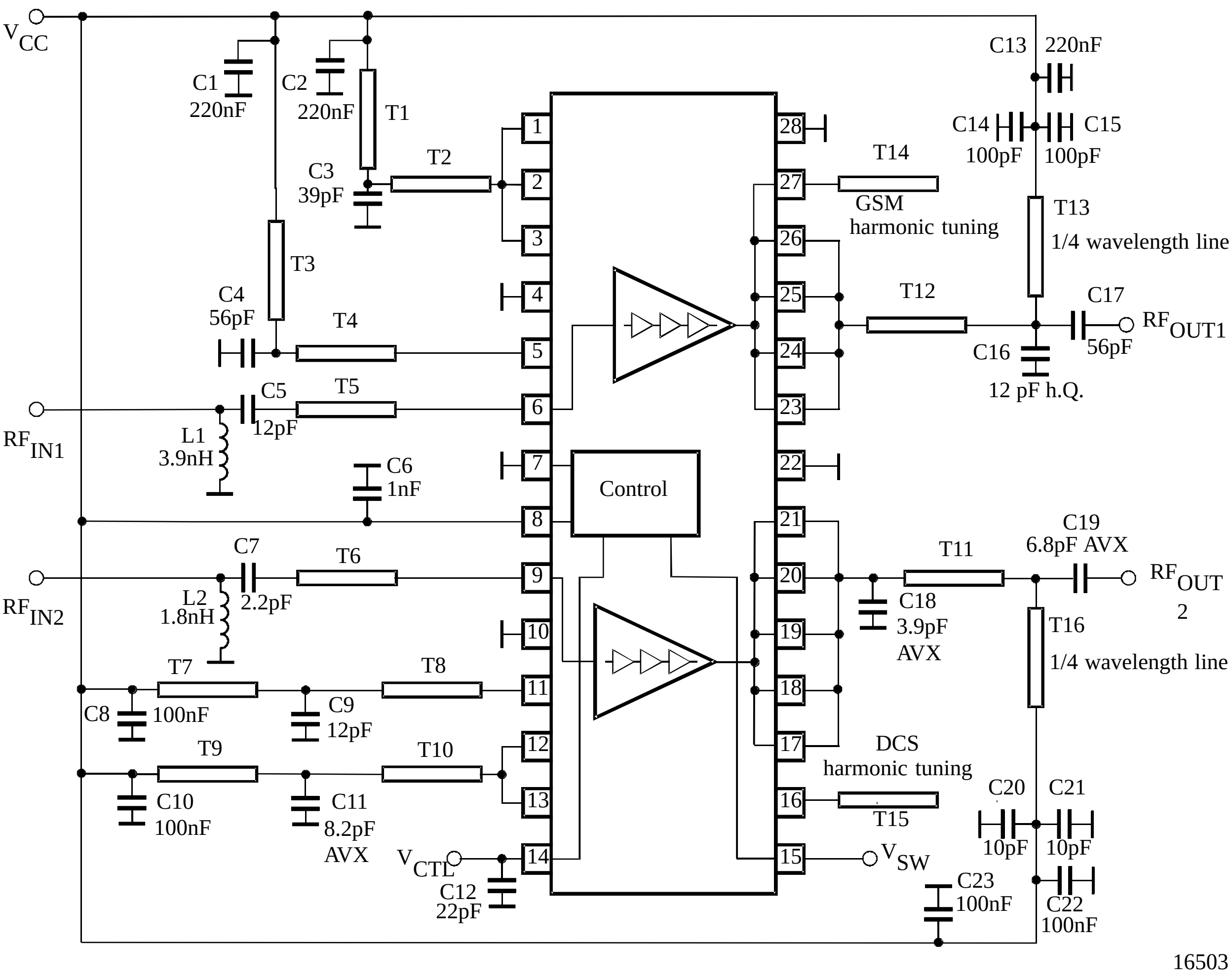


Figure 3. Application circuit

All components Tx are microstrip lines: FR4, epsilon(r) = 4.3, metal: Cu 3.5 µm;
Distance: 1. layer to RF ground = 0.5 mm

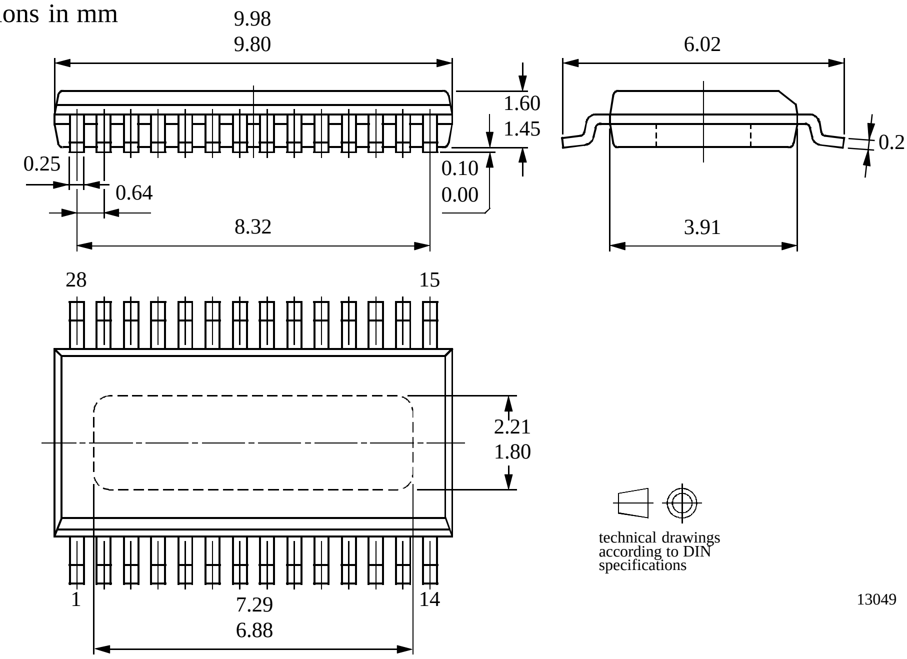
Name	l/ mm	w/ mm	
T1	21.8	0.5	
T2	2.0	1.4	
T3	37.9	0.5	
T4	10.8	0.5	
T5	2.6	1.0	+ 0.8 × 0.5
T6	1.6	1.0	+ 1.6 × 0.5
T7	31.8	0.2	
T8	4.5	0.2	

Name	l/ mm	w/ mm
T9	47.8	1.0
T10	1.7	0.5
T11	5.8	1.8
T12	8.6	1.6
T13	29.2	0.5
T14	19.6	0.2
T15	11.2	0.2
T16	29.3	0.2

Package Information

Package PSSOP28

Dimensions in mm



Preliminary Information

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.

Data sheets can also be retrieved from the Internet: http://www.atmel–wm.com

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