DATA SHEET

SA3601
Low voltage dual-band RF front-end

Product specification
Supersedes data of 1999 Nov 09

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Philips
Semiconductors

PHILIPS

Low voltage dual-band RF front-end SA3601

DESCRIPTION

The SA3601 is an integrated dual-band RF front-end that operates at both cellular (AMPS and TDMA) and PCS (TDMA) frequencies, and is designed in a 20 GHz f_T BiCMOS process—QUBiC2. The low-band (LB) receiver consists of a low-noise amplifier (LNA) and a wide-dynamic range mixer.

The high-band (HB) receiver consists of a low-noise amplifier (LNA) and a mixer, with the low-band and high-band mixers sharing the same mixer output.

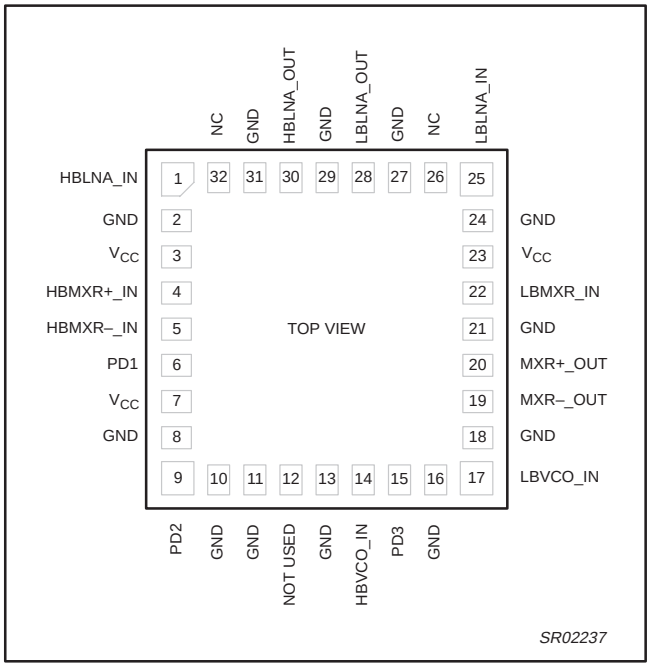
FEATURES

- Low current consumption: LB I_{CC} = 10.5 mA; HB I_{CC} = 16 mA
- Outstanding low- and high-band noise figure
- LNAs with gain control (32 dB gain step)
- LO input buffers
- Frequency doubler
- On chip logic for network selection and power down
- Very small outline package

APPLICATIONS

- 800 to 1000 MHz analog and digital receivers
- 1800 to 2000 MHz digital receivers
- Portable radios
- Mobile communications equipment

PIN CONFIGURATION



ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
SA3601W	HBCC32	Plastic, heatsink bottom chip carrier; 32 terminals; body 5 x 5 x 0.65 mm	SOT560-1

BLOCK DIAGRAM

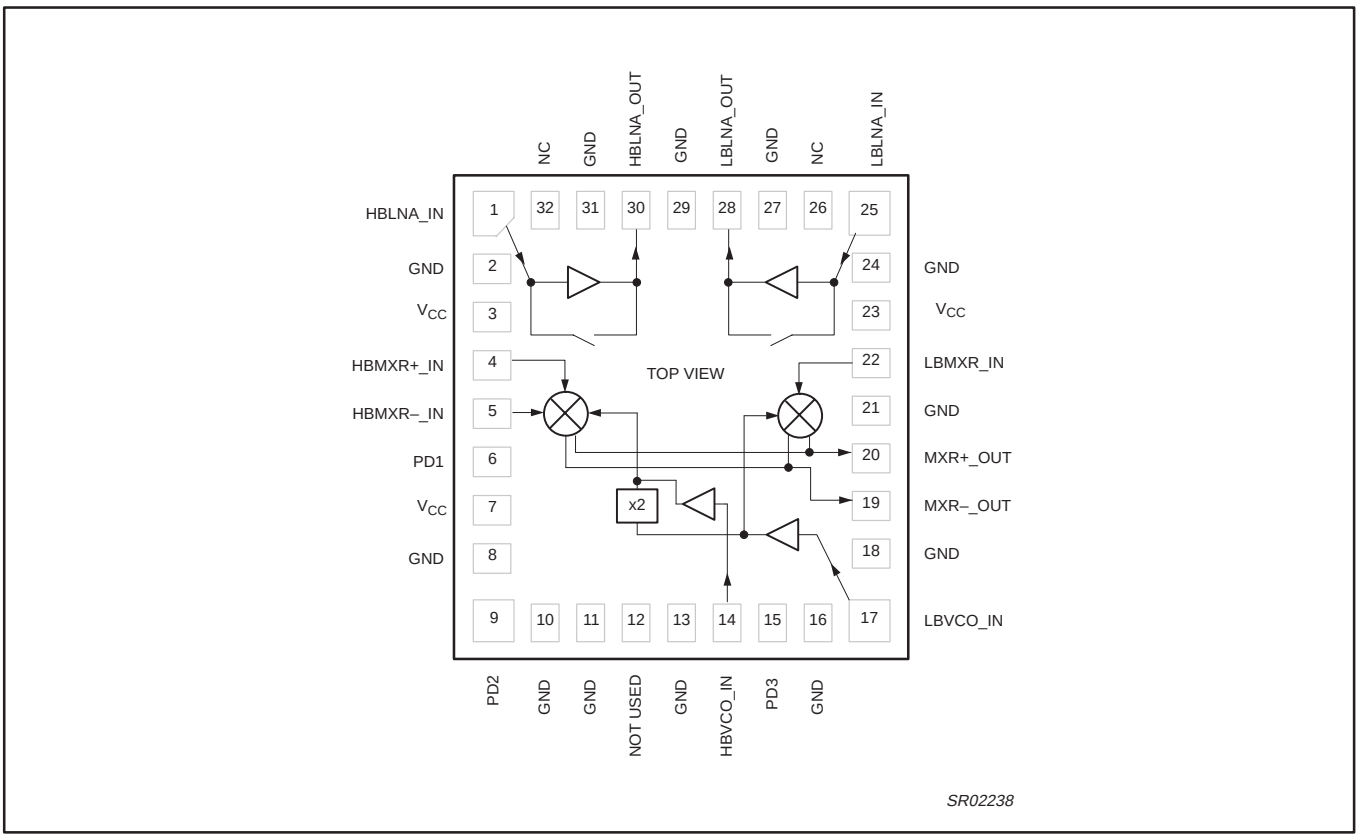


Figure 1. Block Diagram

PIN DESCRIPTIONS

PIN NO.	PIN NAME	DESCRIPTION
1	HBLNA_IN	Highband LNA input
2	GND	Ground
3	V_{CC}	Power supply
4	HBMXR+_IN	Highband mixer positive input
5	HBMXR–_IN	Highband mixer negative input
6	PD1	Power down control 1
7	V_{CC}	Power supply
8	GND	Ground
9	PD2	Power down control 2
10	GND	Ground
11	GND	Ground
12	NOT USED	LEAVE THIS PIN OPEN
13	GND	Ground
14	HBVCO_IN	Highband VCO input
15	PD3	Power down control 3
16	GND	Ground

PIN NO.	PIN NAME	DESCRIPTION
17	LBVCO_IN	Lowband VCO input
18	GND	Ground
19	MXR–_OUT	Mixer negative output
20	MXR+_OUT	Mixer positive output
21	GND	Ground
22	LBMXR_IN	Lowband mixer input
23	V_{CC}	Power supply
24	GND	Ground
25	LBLNA_IN	Lowband LNA input
26	NC	Not Connected
27	GND	Ground
28	LBLNA_OUT	Lowband LNA output
29	GND	Ground
30	HBLNA_OUT	Highband LNA output
31	GND	Ground
32	NC	Not Connected

MODE SELECT LOGIC

PD1	PD2	PD3	OPERATING MODE	Cel LNA	Cel MXR	PCS LNA	PCS MXR	x2 DBL
0	0	0	Sleep mode	off	off	off	off	off
0	0	1	Not used	off	off	off	off	off
0	1	0	Rx mode cellular, low gain	off	on	off	off	off
0	1	1	Rx mode cellular, high gain	on	on	off	off	off
1	0	0	Rx mode PCS, low gain, x2	off	off	off	on	on
1	0	1	Rx mode PCS, high gain, x2	off	off	on	on	on
1	1	0	Rx mode PCS, low gain, no x2	off	off	off	on	off
1	1	1	Rx mode PCS, high gain, no x2	off	off	on	on	off

OPERATION

The SA3601 is a highly integrated dual-band radio frequency (RF) front-end integrated circuit (IC) targeted for TDMA applications. This IC is split into separate low-band (LB) and high-band (HB) receivers. The LB receiver contains a low noise amplifier (LNA) and mixer that are designed to operate in the cellular frequency range (869–894MHz). The HB receiver contains an LNA and mixer that are designed to operate in the PCS frequency range (1930–1990 MHz). The SA3601 also contains a frequency doubler that can drive the HB mixer local oscillator (LO) port, allowing a single-band voltage controlled oscillator (VCO) to be used to drive both mixers. Modes for bypassing the doubler are also provided, in the case where a dual-band VCO is used.

The SA3601 has eight modes of operation that control the LNAs, mixers, and doubler. The select pins (PD1,2,3) are used to change modes of operation. The internal select logic powers the device down (0,0,0), enables cellular receive mode for high and low gain (0,1,X), enables PCS receive mode for high and low gain both without doubler (1,1,X) and with doubler (1,0,X).

Low-Band Receive Section

The LB circuit contains a LNA followed by a wide dynamic range active mixer. In a typical application circuit, the LNA output uses an external pull-up inductor to VCC and is AC coupled. The mixer IF outputs are differential and are combined with the high-band IF mixer outputs thereby eliminating the need for extra output pins. External inductors and capacitors can be used to convert the differential mixer outputs to single-ended. Furthermore, the LNA provides two gain settings: high gain (17dB) and low gain (–15 dB). The desired gain state can be selected by setting the logic pins (PD1,PD2,PD3) appropriately.

High-Band Receive Section

The HB circuit contains a LNA followed by a Gilbert cell mixer with differential inputs. The LNA output uses an internal pull-up inductor to VCC , which eliminates the need for an external pull-up. The mixer IF outputs are differential and are combined with the low-band IF mixer outputs thereby eliminating the need for extra output pins. Similar to the LB LNA, the HB LNA has two gain settings: high gain (16.5 dB) and low gain (–16 dB).

Control Logic Section

Pins PD1, PD2, and PD3, control the logic functions of the SA3601. The PD1 selects between LB and HB operations. In LB receive mode, the LB LNA is in high gain mode (or on) when PD1,2,3 are (0,1,1). In all other modes, the LB LNA is off. The LB mixer is on when PD1,2,3 are (0,1,X). In all other modes, the LB mixer is off.

In HB receive mode, the HB LNA is in high gain mode (or on) when PD1,2,3 are (1,X,1). In all other modes, the HB LNA is off. The HB mixer is on when PD1,2,3 are (1,X,X), and is off in all other modes. The on-chip frequency doubler (X2) is on in (1,0,X) modes. When the frequency doubler is on, the input signal from the LB LO buffer is doubled in frequency, which can then be used to drive the HB mixer LO port. The frequency doubler can also be bypassed in modes (1,1,X), in which case the HB mixer is driven directly by an external 2 GHz LO signal.

ABSOLUTE MAXIMUM RATINGS[1]

SYMBOL	PARAMETER	LIMITS		UNITS
		MIN.	MAX.	
V_{CC}	Supply voltage	–0.3	+4.5	V
V_{IN}	Voltage applied to any other pin	–0.3	V_{CC}+0.3	V
P_D	Power dissipation, T_{amb} = +25 °C (still air)	–	108	mW
$T_{J\ MAX}$	Maximum junction temperature	–	150	°C
P_{MAX}	Power input/output	–	+20	dBm
I_{MAX}	DC current into any I/O pin	–10	+10	mA
T_{STG}	Storage temperature range	–65	+150	°C
T_O	Operating temperature	–40	+85	°C

NOTES:
1. IC is protected for ESD voltages up to 500 V (human body model).

DC ELECTRICAL CHARACTERISTICS

Unless otherwise specified, all Input/Output ports are single-ended.

DC PARAMETERS

V_{CC} = +3.0 V, T_{amb} = +25 °C; unless otherwise specified

SYMBOL	PARAMETER	TEST CONDITIONS			LIMITS			UNIT
		PD1	PD2	PD3	MIN	TYP	MAX	
I_{CC}	Sleep mode	0	0	0	–	0.1	5	µA
	Not used	0	0	1	–	–	–	–
	Rx mode cellular, low gain	0	1	0	–	6.5	7.5	mA
	Rx mode cellular, high gain	0	1	1	–	10.5	12.5	mA
	Rx mode PCS, low gain, x2	1	0	0	–	14	16	mA
	Rx mode PCS, high gain, x2	1	0	1	–	20	24	mA
	Rx mode PCS, low gain, no x2	1	1	0	–	9.5	11	mA
	Rx mode PCS, high gain, no x2	1	1	1	–	16	19	mA
V_{IH}	Input HIGH voltage	–			0.5xV_{CC}	–	V_{CC}+0.3	V
V_{IL}	Input LOW voltage	–			–0.3	–	0.2xV_{CC}	V
I_{BIAS}	Input bias current	Logic 1 or logic 0			–5	–	+5	µA
V_{CC}	Voltage supply range	–			2.7	3	3.3	V

AC ELECTRICAL CHARACTERISTICS

V_{CC} = +3.0 V, f_{RF} = 881 MHz, f_{LO} = 963 MHz, T_{amb} = +25 °C, unless otherwise specified

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS			UNIT
			MIN.	TYP	MAX.	
Cascaded Gain Section						
G_{SYS}	LB LNA + Mixer, High Gain	Filter loss = 3 dB	–	22	–	dB
G_{BYP}	LB LNA + Mixer, Low Gain	Filter loss = 3 dB	–	–10	–	dB
Low-band LNA Section						
f_{RF}	RF input frequency range	–	869	881	894	MHz
G_{ENA}	Small signal gain ENABLED	–	–	17	–	dB
NF_{ENA}	Noise figure ENABLED	–	–	1.8	–	dB
$IIP3_{ENA}$	Input 3rd order Intercept Point	–	–	–7	–	dBm
$P1dB_{ENA}$	Input 1 dB Compression Point	–	–	–20	–	dBm
G_{BYP}	Small signal gain BYPASSED	–	–	–15	–	dB
NF_{BYP}	Noise figure BYPASSED	–	–	15	–	dB
$IIP3_{BYP}$	Input 3rd order Intercept Point	–	–	18	–	dBm
Z_{IN}	Input return loss	50 Ω system	–	10	–	dB
Z_{OUT}	Output return loss	50 Ω system	–	10	–	dB
Low-band Mixer Section						
f_{RF}	RF input frequency range	–	869	881	894	MHz
f_{IF}	IF output frequency	–		82	–	MHz
f_{LO}	LO input range	–	951	963	976	MHz
G_{MXR}	Small signal gain	P_{LO} = –5 dBm	–	8	–	dB
NF_{MXR}	SSB Noise figure	P_{LO} = –5 dBm	–	9.5	–	dB
$IIP3_{MXR}$	Input 3rd order Intercept Point	P_{LO} = –5 dBm	–	7	–	dBm
$P1dB_{MXR}$	Input 1 dB Compression Point	P_{LO} = –5 dBm	–	–14	–	dBm
P_{LO}	LO input power range	–	–7	–5	–3	dBm
Z_{IN}	Input return loss	50 Ω system	–	10	–	dB
Z_{OUT}	Output return loss	50 Ω system	–	10	–	dB
2-Tone	Two-tone spurious rejection:	P_{LO} = –5 dBm	–	–	–	dBm
	$2(f_{RF}–f_{Tx})$, $f_{RF}–f_{Tx} = f_{IF}/2$	f_{RF} = 890.0 MHz @–36 dBm f_{Tx} = 848.9 MHz @–20 dBm	–	–110	–	
	$3(f_{RF}–f_{Tx})$, $f_{RF}–f_{Tx} = f_{IF}/3$	f_{RF} = 876.3 MHz @–36 dBm f_{Tx} = 848.9 MHz @–20 dBm	–	–108	–	
RF–LO	RF to LO isolation	–	–	25	–	dB
LO–RF	LO to RF isolation	–	–	28	–	dB

AC ELECTRICAL CHARACTERISTICS

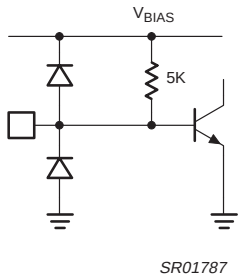
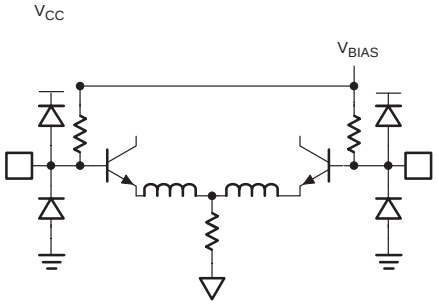
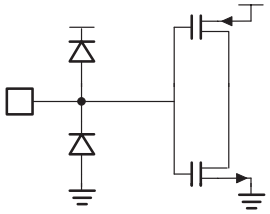
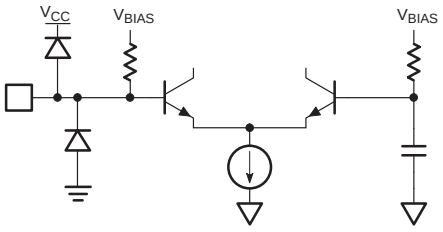
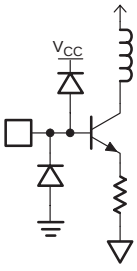
V_{CC} = +3.0 V, f_{RF} = 1960 MHz, f_{LO} = 2042 MHz, T_{amb} = +25 °C, unless otherwise specified

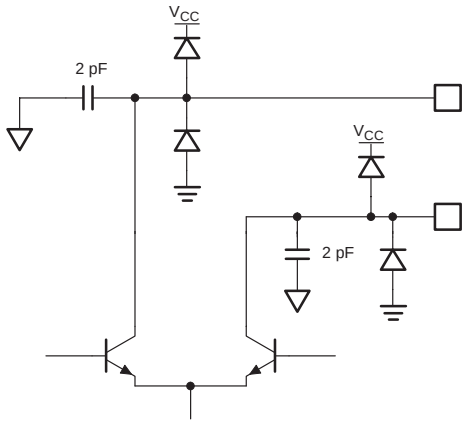
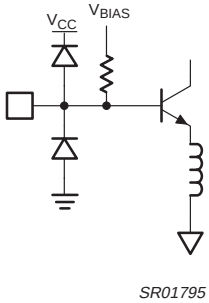
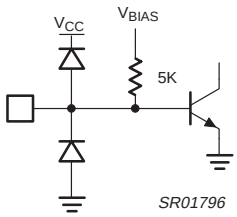
SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS			UNIT
			MIN.	TYP	MAX.	
Cascaded Gain Section						
G_{SYS}	HB LNA + Mixer, High Gain	Filter loss = 3 dB	–	20.5	–	dB
G_{BYP}	HB LNA + Mixer, Low Gain	Filter loss = 3 dB	–	–12	–	dB
High-band LNA Section						
f_{RF}	RF input frequency range	–	1930	1960	1990	MHz
G_{ENA}	Small signal gain ENABLED	–	–	16.5	–	dB
NF_{ENA}	Noise figure ENABLED	–	–	2.3	–	dB
$IIP3_{ENA}$	Input 3rd order Intercept Point	–	–	–5.5	–	dBm
$P1dB_{ENA}$	Input 1 dB Compression Point	–	–	–15	–	dBm
G_{BYP}	Small signal gain BYPASSED	–	–	–16	–	dB
NF_{BYP}	Noise figure BYPASSED	–	–	16	–	dB
$IIP3_{BYP}$	Input 3rd order Intercept Point	–	–	15	–	dBm
Z_{IN}	Input return loss	50 Ω system, ENA and BYP	–	10	–	dB
Z_{OUT}	Output return loss	50 Ω system, ENA and BYP	–	10	–	dB
High-band Mixer Section						
f_{RF}	RF input frequency range	–	1930	1960	1990	MHz
f_{IF}	IF output frequency	–		82	–	MHz
f_{LO}	LO input range	–	2012	2042	2072	MHz
G_{MXR}	Small signal gain	P_{LO} = –5 dBm	–	7	–	dB
NF_{MXR}	SSB Noise figure, doubler off	P_{LO} = –5 dBm	–	9.5	–	dB
	SSB Noise figure, doubler on	P_{LO} = –5 dBm	–	10	–	dB
$IIP3_{MXR}$	Input 3rd order Intercept Point, doubler off	–	–	5	–	dBm
	Input 3rd order Intercept Point, doubler on	–	–	4	–	dBm
$P1dB_{MXR}$	Input 1 dB Compression Point	–	–	–14	–	dBm
IF/2 rej.	Half-IF spurious rejection $2(f_{RF}–f_{LO})$, $f_{RF}–f_{LO} = f_{IF}/2$, doubler off	f_{RF} = 1972.0 MHz @–36 dBm f_{LO} = 2013.1 MHz @–5 dBm	–	–80	–	dBm
	Half-IF spurious rejection $2(f_{RF}–f_{LO})$, $f_{RF}–f_{LO} = f_{IF}/2$, doubler on		–	–80	–	
IF/3 rej.	Third-IF spurious rejection $3(f_{RF}–f_{LO})$, $f_{RF}–f_{LO} = f_{IF}/3$	f_{RF} = 1985.7 MHz @–36 dBm f_{LO} = 2013.1 MHz @–5 dBm	–	–114	–	dBm
2-Tone	Two-tone spurious rejection: $f_{RF}–f_{Tx}$, $f_{RF}–f_{Tx} = f_{IF}$	P_{LO} = –5 dBm, f_{RF} = 1933.0 MHz @–36 dBm f_{Tx} = 1850.8 MHz @–20 dBm	–	–70	–	dBm
	$2(f_{RF}–f_{Tx})$, $f_{RF}–f_{Tx} = f_{IF}/2$	f_{RF} = 1951.0 MHz @–36 dBm f_{Tx} = 1909.9 MHz @–20 dBm	–	–115	–	
	$3(f_{RF}–f_{Tx})$, $f_{RF}–f_{Tx} = f_{IF}/3$	f_{RF} = 1937.3 MHz @–36 dBm f_{Tx} = 1909.9 MHz @–20 dBm	–	–100	–	
P_{LO}	LO input power range	–	–7	–5	–3	dBm
Z_{IN}	Input return loss	50 Ω system	–	10	–	dB
Z_{OUT}	Output return loss	50 Ω system	–	10	–	dB
RF–LO	RF to LO isolation	–	–	40	–	dB
LO–RF	LO to RF isolation	–	–	40	–	dB

AC ELECTRICAL CHARACTERISTICS

V_{CC} = +3.0 V, T_{amb} = +25 °C, unless otherwise specified

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS					UNITS
			MIN.	–3 σ	TYP	+3 σ	MAX.	
x2 LO Doubler Section								
f_{LO}	LO Input frequency		1006	–	1021	–	1036	MHz
P_{IN}	LO Input power	50 Ω matched LB_VCO_IN	–7	–	–5	–	–3	dBm
Z_{IN}	Input return loss	50 Ω system	–	–	10	–	–	dB
Z_{OUT}	Output return loss	50 Ω system	–	–	10	–	–	dB

PIN NO	PIN MNEMONIC	DC V	EQUIVALENT CIRCUIT
1	HB LNA IN	0.8	 SR01787
3, 7, 23	V_{CC}		 SR01788
4	HB MXR+ IN	1.2	
5	HB MXR– IN	1.2	
6	PD1	Apply externally	 SR01789
9	PD2		
15	PD3		
12	NOT USED	LEAVE THIS PIN OPEN	
14	HB VCO IN	1.9	 SR01792
17	LB VCO IN	1	 SR01793

PIN NO	PIN MNEMONIC	DC V	EQUIVALENT CIRCUIT
19	MXR– OUT	Pull-up externally to V_{CC}	
20	MXR+ OUT		
22	LB MXR IN	1.2	
25	LB LNA IN	0.8	

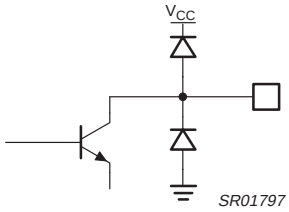
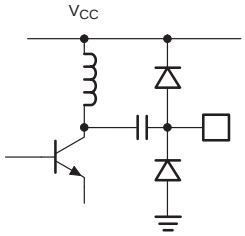
PIN NO	PIN MNEMONIC	DC V	EQUIVALENT CIRCUIT
28	LB LNA OUT	Pull-up externally to V_{CC}	 SR01797
30	HB LNA OUT		 SR01786

Table 1. Typical Low Band LNA High Gain S-Parameters (V_{CC} = +3.0 V; Input Power = –30 dBm)

	S11		S21		S12		S22	
Freq (MHz)	Mag	Ang	Mag	Ang	Mag	Ang	Mag	Ang
50	0.80	–10	9.77	172	0.00	41	0.96	–1
200	0.78	–34	9.34	156	0.00	–131	0.99	–9
400	0.71	–62	8.04	138	0.00	30	0.96	–17
600	0.62	–84	6.63	124	0.00	87	0.96	–24
800	0.55	–100	5.48	113	0.00	46	0.95	–29
850	0.53	–104	5.09	113	0.00	149	0.99	–29
900	0.51	–108	5.14	112	0.00	125	0.95	–31
950	0.49	–112	4.95	106	0.00	129	0.93	–33
1000	0.48	–116	4.54	106	0.00	–156	0.96	–33
1200	0.42	–130	4.00	100	0.00	160	0.94	–38
1400	0.38	–145	3.39	96	0.01	–132	0.93	–42
1600	0.37	–161	3.17	91	0.01	–135	0.93	–47
1800	0.37	–173	2.91	88	0.02	–140	0.91	–52
2000	0.40	179	2.60	79	0.02	–146	0.92	–61
2200	0.44	172	2.42	74	0.03	–143	0.84	–70
2400	0.47	169	1.98	65	0.03	–146	0.77	–83
2600	0.49	168	1.77	61	0.04	–146	0.72	–95
2800	0.50	166	1.37	58	0.05	–151	0.67	–109
3000	0.49	168	1.20	55	0.05	–161	0.67	–119
3200	0.48	167	0.99	59	0.06	–161	0.64	–128
3400	0.43	163	0.87	56	0.06	–157	0.68	–134
3600	0.40	160	0.77	62	0.06	–155	0.70	–136
3800	0.37	148	0.68	58	0.07	–163	0.70	–138
4000	0.36	132	0.65	62	0.07	–159	0.71	–134
4200	0.36	117	0.57	60	0.08	–158	0.72	–134
4400	0.40	104	0.52	67	0.07	–157	0.70	–129
4600	0.44	95	0.48	63	0.07	–156	0.68	–129
4800	0.52	97	0.47	69	0.08	–151	0.66	–124
5000	0.61	95	0.40	66	0.09	–150	0.64	–127

Table 2. Typical Low Band LNA High Gain Noise Parameters (V_{CC} = +3.0 V)

Freq(MHz)	NFopt	Gopt MAG	Gopt ANG	Rn
869	1.56	0.21	97	0.307
881	1.58	0.21	90	0.348
894	1.57	0.22	82	0.397

Table 3. Typical Low Band LNA Low Gain S–Parameters (V_{CC} = +3.0 V; Input Power = –30 dBm)

	S11		S21		S12		S22	
Freq(MHz)	**Mag**	**Ang**	**Mag**	**Ang**	**Mag**	**Ang**	**Mag**	**Ang**
50	0.58	–8	0.03	77	0.03	84	0.95	–2
200	0.57	–25	0.09	58	0.09	57	0.95	–14
400	0.52	–43	0.13	36	0.13	36	0.87	–23
600	0.50	–57	0.14	23	0.14	23	0.84	–29
800	0.49	–68	0.14	14	0.14	16	0.81	–34
850	0.49	–71	0.14	15	0.15	15	0.84	–34
900	0.49	–73	0.14	15	0.14	14	0.80	–36
950	0.48	–77	0.15	10	0.14	12	0.79	–37
1000	0.48	–80	0.14	11	0.14	11	0.80	–37
1200	0.47	–91	0.14	7	0.14	8	0.77	–41
1400	0.47	–104	0.13	6	0.13	7	0.75	–44
1600	0.46	–121	0.12	3	0.13	1	0.73	–48
1800	0.47	–137	0.12	4	0.12	–1	0.70	–52
2000	0.49	–154	0.11	–2	0.11	–2	0.68	–58
2200	0.55	–168	0.11	0	0.11	–4	0.62	–65
2400	0.59	–178	0.10	–3	0.09	–2	0.57	–76
2600	0.64	174	0.09	–4	0.09	2	0.54	–88
2800	0.67	168	0.08	–7	0.09	–4	0.53	–102
3000	0.69	165	0.08	–12	0.08	–13	0.54	–113
3200	0.69	160	0.07	–12	0.08	–19	0.54	–123
3400	0.63	152	0.07	–22	0.08	–17	0.59	–130
3600	0.57	142	0.07	–29	0.07	–29	0.63	–133
3800	0.47	126	0.06	–48	0.06	–51	0.64	–135
4000	0.40	102	0.05	–57	0.05	–59	0.66	–132
4200	0.35	78	0.04	–78	0.04	–77	0.67	–131
4400	0.39	62	0.04	–84	0.04	–84	0.66	–127
4600	0.43	50	0.04	–96	0.03	–91	0.64	–126
4800	0.47	54	0.04	–103	0.04	–104	0.62	–122
5000	0.54	60	0.04	–111	0.04	–116	0.60	–123

Table 4. Typical Low Band LO Buffer Input S–Parameters (V_{CC} = +3.0 V; Input Power = –30 dBm)

	S11	
Freq(MHz)	**Mag**	**Ang**
50	0.89	–4
200	0.90	–9
400	0.86	–15
600	0.84	–19
800	0.83	–24
850	0.84	–24
900	0.84	–25
950	0.85	–26
1000	0.82	–27
1200	0.84	–30
1400	0.82	–35
1600	0.82	–39
1800	0.81	–44
2000	0.81	–54
2200	0.80	–61
2400	0.79	–71
2600	0.79	–82
2800	0.79	–91
3000	0.81	–97
3200	0.80	–103
3400	0.80	–105
3600	0.81	–106
3800	0.81	–108
4000	0.81	–108
4200	0.80	–111
4400	0.76	–115
4600	0.71	–122
4800	0.69	–133
5000	0.70	–151

Table 5. Typical High Band LNA High Gain S–Parameters (V_{CC} = +3.0 V; Input Power = –30 dBm; MODE 111/101)

	S11		S21		S12		S22	
Freq(MHz)	**Mag**	**Ang**	**Mag**	**Ang**	**Mag**	**Ang**	**Mag**	**Ang**
50	0.75	–7	0.10	–95	0.00	–160	0.96	–1
200	0.75	–24	0.46	–125	0.00	73	0.98	–9
400	0.70	–44	0.49	–134	0.00	104	0.95	–17
600	0.64	–61	0.50	–122	0.00	140	0.95	–25
800	0.58	–73	0.67	–104	0.00	–173	0.92	–32
1000	0.52	–84	1.02	–95	0.00	–158	0.91	–38
1200	0.47	–93	1.59	–95	0.01	–150	0.87	–46
1400	0.44	–101	2.37	–98	0.01	–128	0.80	–56
1600	0.42	–109	3.73	–112	0.01	–113	0.70	–69
1800	0.44	–117	5.44	–135	0.01	–107	0.48	–88
1850	0.45	–120	5.60	–145	0.02	–97	0.39	–91
1900	0.47	–124	5.71	–151	0.02	–99	0.30	–93
1950	0.49	–128	5.96	–159	0.02	–104	0.22	–88
2000	0.50	–131	5.91	–168	0.03	–101	0.16	–72
2200	0.56	–146	5.35	167	0.04	–112	0.31	–21
2400	0.59	–155	4.19	148	0.04	–120	0.44	–36
2600	0.61	–160	3.41	138	0.05	–119	0.51	–52
2800	0.62	–164	2.56	131	0.05	–124	0.55	–66
3000	0.63	–161	2.15	126	0.06	–130	0.61	–75
3200	0.64	–162	1.72	128	0.06	–126	0.63	–82
3400	0.62	–162	1.48	124	0.07	–117	0.67	–87
3600	0.62	–160	1.30	132	0.07	–113	0.70	–87
3800	0.61	–165	1.14	126	0.08	–117	0.70	–88
4000	0.58	–169	1.10	130	0.09	–111	0.71	–84
4200	0.59	–177	0.98	127	0.10	–107	0.71	–85
4400	0.60	169	0.93	129	0.12	–104	0.68	–82
4600	0.60	150	0.82	122	0.13	–114	0.65	–88
4800	0.65	140	0.75	120	0.13	–115	0.60	–93
5000	0.70	126	0.58	116	0.14	–120	0.54	–106

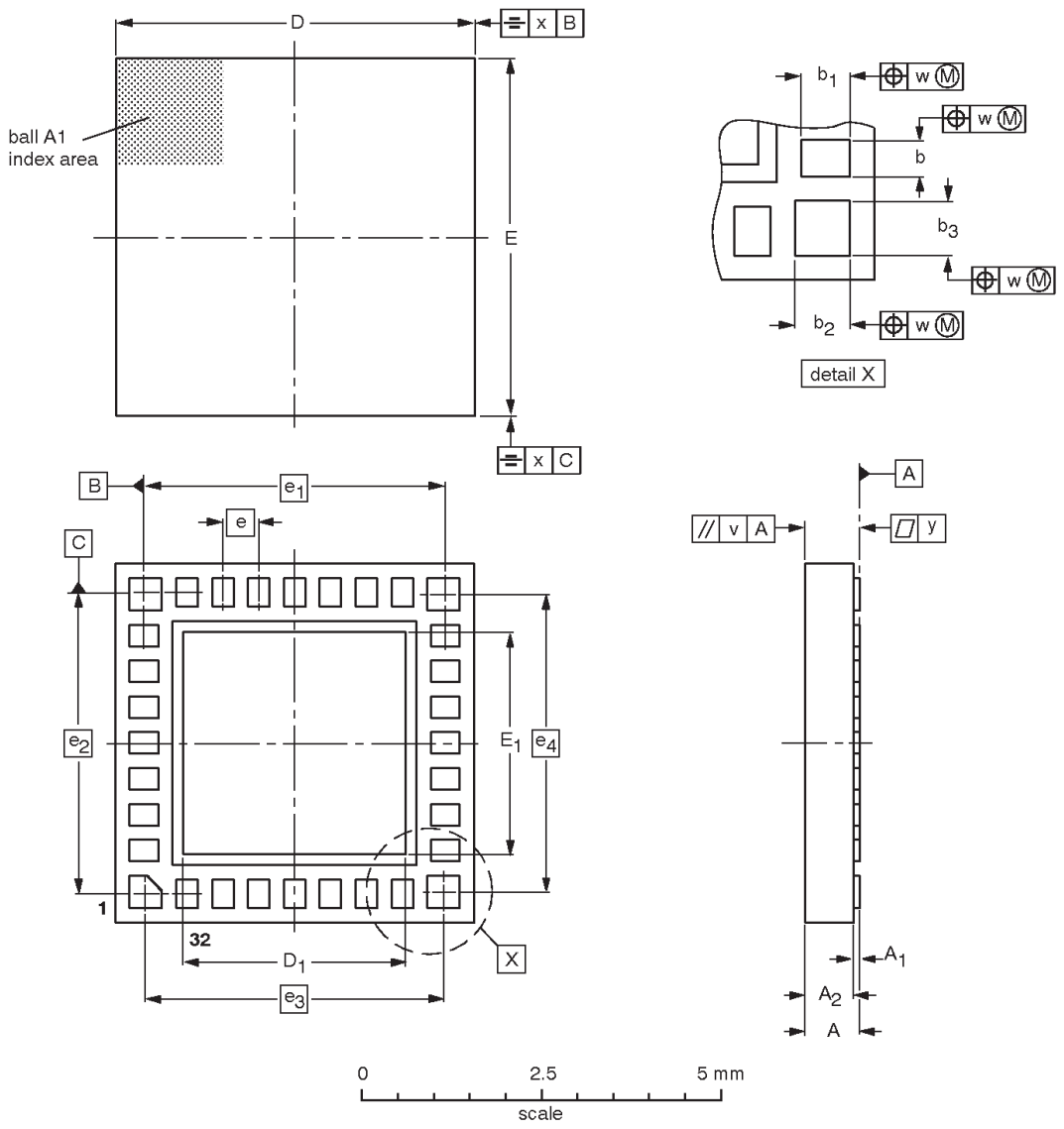
Table 6. Typical High Band LNA High Gain Noise Parameters (V_{CC} = +3.0 V; MODE 111/101)

Freq(MHz)	NFopt	Gopt MAG	Gopt ANG	Rn
1930	2.16	0.19	161	0.205
1960	2.17	0.19	138	0.273
1990	2.22	0.20	112	0.383

Table 7. Typical High Band LNA Low Gain S–Parameters (V_{CC} = +3.0V; Input Power = –30dBm; MODE 110/100)

	S11		S21		S12		S22	
Freq(MHz)	**Mag**	**Ang**	**Mag**	**Ang**	**Mag**	**Ang**	**Mag**	**Ang**
50	0.50	–5	0.00	164	0.00	164	0.96	–1
200	0.50	–15	0.00	159	0.00	–178	0.98	–9
400	0.48	–28	0.00	141	0.01	131	0.95	–17
600	0.46	–38	0.01	142	0.01	148	0.94	–25
800	0.44	–46	0.01	153	0.01	159	0.92	–32
1000	0.41	–53	0.02	171	0.02	173	0.91	–38
1200	0.39	–58	0.04	174	0.04	172	0.86	–46
1400	0.36	–64	0.06	171	0.06	171	0.79	–54
1600	0.33	–72	0.10	159	0.10	158	0.67	–65
1800	0.32	–81	0.14	140	0.13	138	0.48	–72
1850	0.32	–84	0.14	132	0.14	135	0.44	–70
1900	0.32	–89	0.14	128	0.14	129	0.39	–68
1950	0.33	–93	0.14	124	0.14	123	0.37	–65
2000	0.33	–97	0.14	117	0.15	118	0.36	–61
2200	0.36	–112	0.14	104	0.14	105	0.39	–49
2400	0.40	–124	0.12	92	0.12	93	0.44	–55
2600	0.45	–132	0.10	85	0.09	89	0.50	–65
2800	0.49	–138	0.08	83	0.08	85	0.54	–76
3000	0.52	–139	0.06	78	0.07	79	0.59	–83
3200	0.55	–141	0.04	85	0.05	84	0.60	–88
3400	0.54	–141	0.03	91	0.03	92	0.64	–93
3600	0.54	–140	0.03	105	0.03	106	0.66	–92
3800	0.52	–145	0.02	118	0.02	117	0.66	–93
4000	0.48	–148	0.01	159	0.01	151	0.66	–88
4200	0.46	–155	0.02	–176	0.02	–178	0.65	–88
4400	0.43	–169	0.02	–144	0.02	–146	0.62	–85
4600	0.40	170	0.03	–144	0.03	–139	0.57	–89
4800	0.44	158	0.04	–137	0.04	–132	0.53	–93
5000	0.52	140	0.04	–135	0.04	–134	0.47	–104

HBCC32: plastic, heatsink bottom chip carrier; 32 terminals; body 5 x 5 x 0.65 mm SOT560-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	b	b_1	b_2	b_3	D	D_1	E	E_1	e	e_1	e_2	e_3	e_4	v	w	x	y
mm	0.80	0.10 0.05	0.70 0.60	0.35 0.20	0.50 0.30	0.50 0.35	0.50 0.35	5.1 4.9	3.2 3.0	5.1 4.9	3.2 3.0	0.5	4.2	4.2	4.15	4.15	0.2	0.15	0.15	0.05

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT560-1		MO-217				~~99-09-10~~ 00-02-01

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