microelectronics group

Lucent Technologies
Bell Labs Innovations

W3020 GSM Multiband RF Transceiver

Features

- 2.7 V operation, low power consumption
- Integrated receive, transmit, and synthesizer functions
- IF frequency and transmit offset frequency generated from the same LO
- Integrated dual LNAs and mixers
- Minimizes PCB design work between systems
- Surface-mount, 64-pin TQFPT package

Applications

- GSM dual-band hand portables:
  — GSM900/1800
  — GSM900/1900
- GSM single-band hand portables:
  — GSM900
  — GSM1800
  — GSM1900

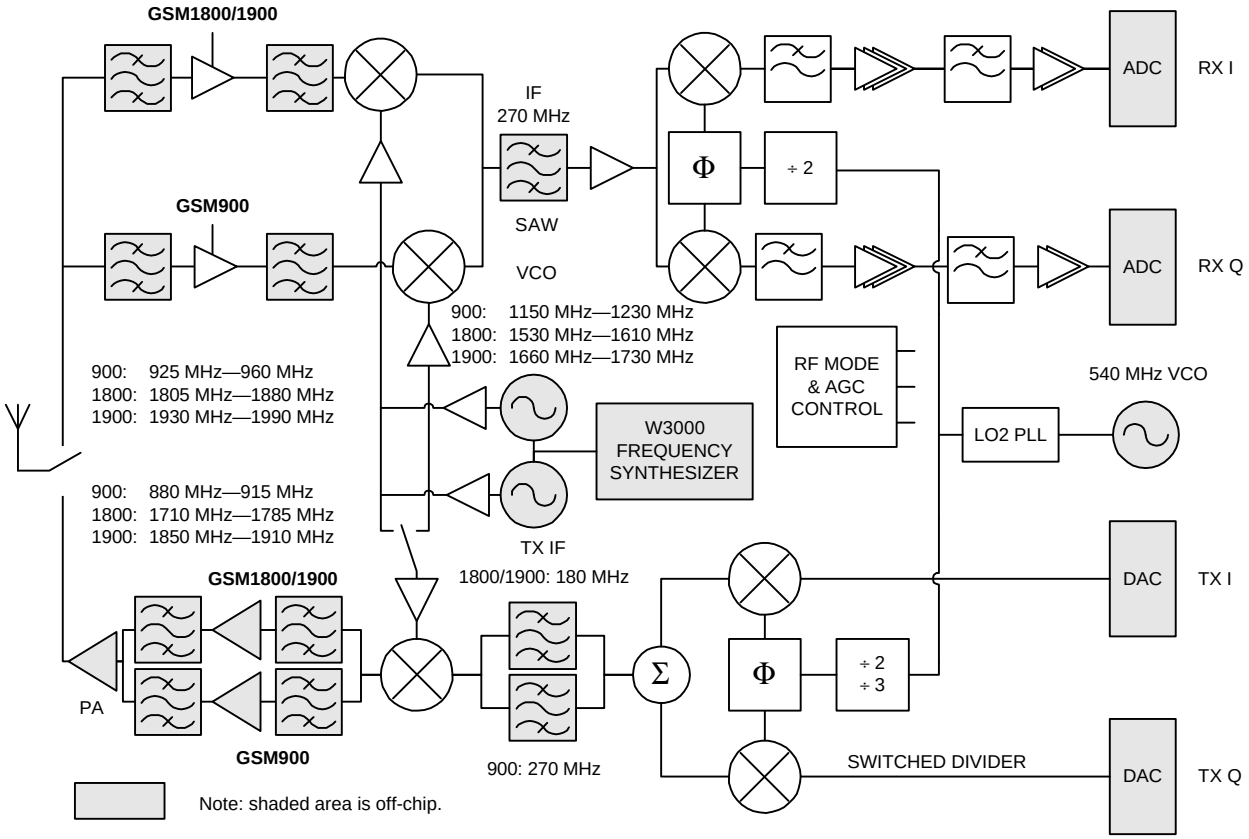

Figure 1. W3020 Circuit Block Diagram

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Description

The W3020 is a highly integrated GSM transceiver designed to operate in dual-band handsets or in single-band handsets operating at 900, 1800, and 1900 MHz frequency bands (1900 MHz performance is not verified in production). The IC architecture allows the RF designer to provide solutions for three different frequency bands with very few PCB changes, thereby providing faster time to market and reduced development time.

The W3020 RF transceiver and W3000 PLL have been designed in conjunction with the SC1 (radio interface and DSP) to provide a complete GSM cellular solution. The W3020 interfaces to the W3000 UHF high-performance PLL IC. The W3020, in combination with the W3000, provides the transmitter, receiver, and frequency synthesizer. Adding a power amplifier(s), filters, and VCO modules completes the radio channel.

The baseband modulated signal is applied to the I/Q double-balanced mixer in a differential manner. The ±45° phase-shifted local oscillator requires no trim to achieve the required modulation spectral mask. Also, I/Q input signals require no dc offset calibration to achieve high phase accuracy signal. The IF signal outputs from the I/Q mixers are summed and brought out to an external filter that reduces the noise that could be intermodulated into the receive band. This signal is then applied to the low noise up-conversion mixer and brought to the RF output.

The received signal is amplified through the low-noise amplifier, which, combined with the preceding filter, dominates the receiver sensitivity. The signal is then passed through another external filter to attenuate the image frequency to an acceptable level. The signal passes through the RF down-conversion mixer to the IF frequency. It is then filtered by an external surface acoustic wave (SAW) filter to bring the in-band blocking signals to an acceptable level. The signal is amplified in the IF strip of the receiver. The IF strip contains digital gain control (DGC) amplifiers at both the IF and baseband frequencies and precision low-pass filters. This allows the signal to be amplified while in-band blocking signals are removed. The precision I/Q demodulator splits the signal into its in-phase and quadrature signals. The I/Q signals are low-pass filtered and further amplified. The I/Q amplifier contains integrated dc offset calibration circuitry. The outputs (I/Q) are fed to the ADC for further signal processing.

The second local oscillator (LO2), comprising a buffer for the external voltage-controlled oscillator (VCO) and a phase-locked loop (PLL), feeds the IF portions of both the modulator and the receiver. An external reference source, voltage-controlled crystal oscillator (VCXO), is divided from 13 MHz to 1 MHz through a counter. The 1 MHz is called the comparison frequency. The VCO frequency of 540 MHz is also divided down to 1 MHz. Both signals are fed into a phase detector, and the resultant error signal is fed through an external low-pass filter to the control input of the VCO.

The RF receive and transmit mixers are driven by two band-switchable external VCO modules and buffered internally on the IC. The VCOs are both controlled by a single W3000 PLL synthesizer and loop filter. Fast band-locking is achieved using a proprietary scaling technique integrated in the W3000 PLL.

Description (continued)

Detailed Block Diagram

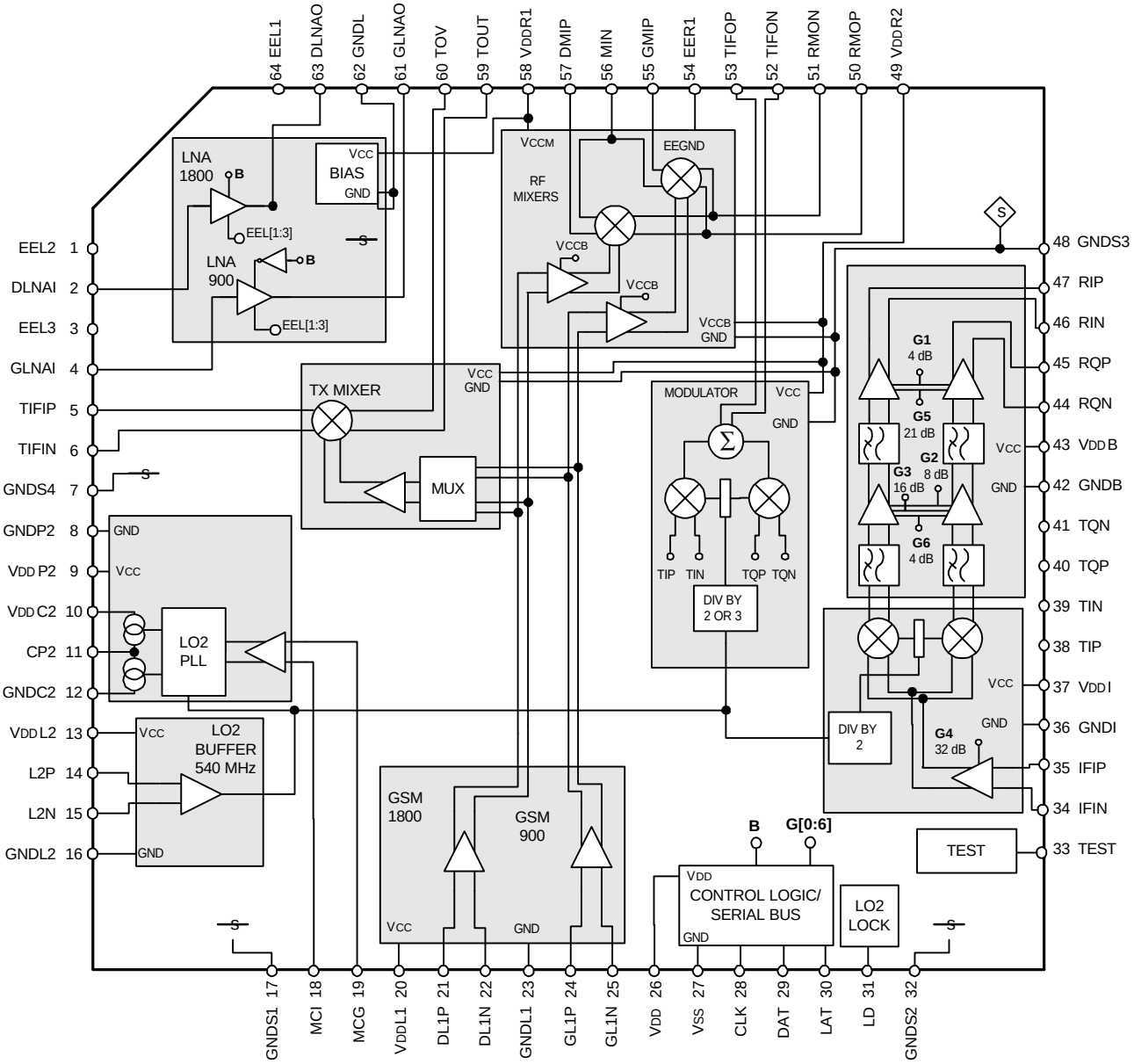


Figure 2. IC Block Diagram with Pinout

Pin Information

Table 1. Pin Assignment

Pin	Symbol	Type	Pin Description
1	EEL2	Input*	LNA Emitter Ground
2	DLNAI	Input	GSM1800/1900 Band LNA Signal Input
3	EEL3	Input*	LNA Emitter Ground
4	GLNAI	Input	GSM900 Band LNA Signal Input
5	TIFIP	Input	TX IF Input to Mixer
6	TIFIN	Input	TX IF Input to Mixer
7	GNDS4	Ground	Substrate Ground
8	GNDP2	Ground	LO2 PLL Ground
9	V_{DD}P2	Supply	LO2 PLL Voltage Supply
10	V_{DD}C2	Supply	LO2 Charge Pump Supply
11	CP2	Output	Charge Pump LO2 Output
12	GNDC2	Ground	LO2 Charge Pump Ground
13	V_{DD}L2	Supply	LO2 Buffer Supply
14	L2P	Input	LO2 Positive Input (540 MHz)
15	L2N	Input	LO2 Negative Input (on-chip ac ground)
16	GNDL2	Ground	LO2 Buffer Ground
17	GNDS1	Ground	Substrate Ground
18	MCI	Input	Master Clock Input
19	MCG	Input	Master Clock Negative Input (ac ground)
20	V_{DD}L1	Supply	V_{DD} Supply for LO1
21	DL1P	Input	GSM1800/1900 LO1 Positive Input
22	DL1N	Input	GSM1800/1900 LO1 Negative Input (on-chip ac ground)
23	GNDL1	Ground	LO1 Ground
24	GL1P	Input	GSM900 LO1 Positive Input
25	GL1N	Input	GSM900 LO1 Negative Input (on-chip ac ground)
26	V_{DD}	Supply	Voltage Supply for All Digital Circuits
27	V_{SS}	Ground	Ground for All Digital Circuits
28	CLK	Input	Clock Input for Serial Bus
29	DAT	Input	Data Input for Serial Bus
30	LAT	Input	Latch Enable Input for Serial Bus
31	LD	Output	LO2 Synthesizer Lock Indicator Output
32	GNDS2	Ground	Substrate Ground

*The emitters are considered critical inputs that need to be carefully grounded externally.

Pin Information (continued)

Table 1. Pin Assignment (continued)

Pin	Symbol	Type	Pin Description
33	Test	Output	Production Test Output
34	IFIN	Input	IF DGC Amplifier Input Negative
35	IFIP	Input	IF DGC Amplifier Input Positive
36	GNDI	Ground	Ground for IF Amplifier
37	V_{DD}I	Supply	Voltage Supply IF Amplifier
38	TIP	Input	TX In-Phase Positive Input
39	TIN	Input	TX In-Phase Negative Input
40	TQP	Input	TX Quadrature Positive Input
41	TQN	Input	TX Quadrature Negative Input
42	GNDB	Ground	Baseband RX Ground
43	V_{DD}B	Supply	Baseband RX V_{DD} Supply
44	RQN	Output	RX Quadrature Phase Negative Output
45	RQP	Output	RX Quadrature Phase Positive Output
46	RIN	Output	RX In-Phase Negative Output
47	RIP	Output	RX In-Phase Positive Output
48	GNDS3	Ground	Substrate Ground RF dc Supply
49	V_{DD}R2	Supply	RF RX/TX Voltage Supply
50	RMOP	Output	RX Mixer Output Positive
51	RMON	Output	RX Mixer Output Negative
52	TIFON	Output	TX IF Output from Modulator Negative
53	TIFOP	Output	TX IF Output from Modulator Positive
54	EER1	Input*	RX Mixer Emitter Ground
55	GMIP	Input	GSM900 Mixer Input Positive
56	MIN	Input	RF Mixer Input Negative (ac ground)
57	DMIP	Input	GSM1800 Mixer Input Positive
58	V_{DD}R1	Supply	RF RX Voltage Supply
59	TOUT	Output	Transmit Mixer Output
60	TOV	Output	Transmit Mixer Output
61	GLNAO	Output	GSM Band LNA Output
62	GNDL	Ground	LNA Substrate Ground
63	DLNAO	Output	GSM1800 Band LNA Output
64	EEL1	Input*	LNA Emitter Ground

*The emitters are considered critical inputs that need to be carefully grounded externally.

Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operations sections of this data sheet. Exposure to maximum ratings for extended periods can adversely affect device reliability.

Parameter	Symbol	Min	Max	Unit
Ambient Operating Temperature	T_A	–30	85	°C
Storage Temperature	T_{stg}	–65	150	°C
Lead Temperature (soldering, 10 s)	—	—	300	°C
Positive Supply Voltage	V_{DD}	0	4.5	V
Power Dissipation	P_D	—	550	mW
ac Peak-to-Peak Input Voltage	Vp-p	0	V_{DD}	V
Digital Voltages	—	0	V_{DD}	V

ESD Precautions

Although protection circuitry has been designed into this device, proper precautions should be taken to avoid exposure to electrostatic discharge (ESD) during handling and mounting. Lucent Technologies Microelectronics Group employs a human-body model (HBM) and a charged-device model (CDM) for ESD-susceptibility testing and design evaluation. ESD voltage thresholds are dependent on the circuit parameters used to define the model. No industry-wide standard has been adopted for CDM. However, a standard HBM (resistance = 1500 Ω, capacitance = 100 pF) is widely used and, therefore, can be used for comparison purposes. The HBM ESD threshold presented here was obtained by using these circuit parameters:

Parameter	Method	Rating	Unit
ESD Threshold Voltage	HBM	1500	V
ESD Threshold Voltage (corner pins)	CDM	1000	V
ESD Threshold Voltage	CDM	500	V

Operating Range

The device is fully functional within the following operation ranges. No claims of parametric performance are stated within this range. For parametric performance, refer to the individual specifications and operating conditions.

Parameter	Symbol	Min	Max	Unit
Operating Temperature	T_A	–30	85	°C
Nominal Operating Voltage	V_{DD}	2.7	3.6	V

Digital Serial Inputs

Parameter	Symbol	Min	Max	Unit
Logic High Voltage	V_{IH}	0.7 * V_{DD}	—	V
Logic Low Voltage	V_{IL}	—	0.3 * V_{DD}	V
Logic High Current (V_{IH} = 3.0 V)	$\|I_{IH}\|$	—	10	µA
Logic Low Current (V_{IL} = 0.0 V)	$\|I_{IL}\|$	—	10	µA
Clock Input Frequency (V_{DD} = 2.7 V)	f_{CLK}	—	10	MHz

Digital Outputs

Parameter	Symbol	Min	Max	Unit
Logic High Voltage	V_{OH}	V_{DD} – 0.4	—	V
Logic Low Voltage	V_{OL}	—	0.4	V
Logic High Current ($V_{OH} \geq V_{DD}$ – 0.4)	$\|I_{OH}\|$	2	—	mA
Logic Low Current ($V_{OL} \leq$ 0.4 V)	$\|I_{OL}\|$	2	—	mA

Enable Time

V_{DD} = 2.7 Vdc; T_A = 25 °C ± 3 °C.

Parameter	Min	Typ	Max	Unit
Logic Powerup/down Time	—	—	4.0	µs

Supply Currents

V_{DD} = 2.7 Vdc; T_A = 25 °C ± 3 °C.

System Mode	Min	Typ	Max	Unit
Powerdown (V_{DD} = 3.0 Vdc)*	—	2	50	µA
PLL RX Settling	—	33	—	mA
RX Mode (LNA = ON)	—	68	—	mA
RX Mode (LNA = OFF)	—	64	—	mA
PLL TX Settling	—	33	—	mA
TX Mode	—	92	—	mA

*This current does not include LO2 charge pump supply current. (See LO2 specification for details.)

LNA

The W3020 contains two on-chip LNAs, one to operate in the GSM900 band and one to operate in the GSM1800/1900 bands. The GSM900 operation is combined with the GSM1800 band operation in a dual-band terminal. Only one LNA operates at a time. The two on-chip LNAs with external matching networks are 50 Ω single-ended input, single-ended output type. Switching between the LNAs is determined by the band bit B and the gain control bit G0 in the TR register, as described in the Programming Information section.

Table 2. GSM900 LNA Performance

V_{DD} = 2.7 Vdc; T_A = 25 °C ± 3 °C.

Parameter	Min	Typ	Max	Unit
RF Input Band	925	—	960	MHz
Current Consumption (collector current)	—	3.5	—	mA
Noise Figure*	—	2.0	—	dB
Power Gain (942 MHz)*	—	20	—	dB
Input 1 dB Compression Level	–20	–15	—	dBm
Input Return Loss	—	14	—	dB
Off-state Gain	—	–51	—	dB

* All gain and NF include matching losses. Not tested in production.

Table 3. GSM1800/1900 LNA Performance

V_{DD} = 2.7 Vdc; T_A = 25 °C ± 3 °C.

Parameter	Min	Typ	Max	Unit
RF Input Band:				
GSM1800	1805	—	1880	MHz
GSM1900	1930	—	1990	MHz
Current Consumption (collector current)	—	3.5	—	mA
Noise Figure*	—	3.0	—	dB
Power Gain (1842 MHz)*	—	19	—	dB
Input 1 dB Compression Level	–20	–16.5	—	dBm
Input Return Loss	—	15	—	dB
Off-state Gain	—	–38	—	dB

* All gain and NF include matching losses. Not tested production.

RF Mixer

The W3020 contains two mixers: one for GSM900 band operation and one for GSM1800/1900 band operation. The RF mixers are double-balanced mixers that can be used in various modes of operation. The ac-grounded input (pin 56) requires grounding at both the RF and the IF frequencies. If grounding is not placed close to the device, the RF performance will be compromised. At the output, the mixer is connected to a balanced IF SAW filter.

Table 4. RF Performance: GSM900

V_{DD} = 2.7 V; T_A = 25 °C ± 3 °C. F_{IN} = 942 MHz

Parameter	Min	Typ	Max	Unit
RF Input Band	925	—	960	MHz
Output IF Frequency	—	270	—	MHz
LO Frequency Range	1195	—	1230	MHz
Noise Figure (SSB)	—	9	12	dB
Mixer Power Gain*		7		dB
I/P 1 dB Compression	–10	–5	—	dBm

*LO1 level = –6 dBm, F_{LO} = 1212 MHz, F_{IF}= 270 MHz.

Table 5. RF Performance: GSM1800/1900

V_{DD} = 2.7 V; T_A = 25 °C ± 3 °C. F_{IN} = 1842 MHz

Parameter	Min	Typ	Max	Unit
RF Input Band: GSM1800 GSM1900	 1805 1930	 — —	 1880 1990	 MHz MHz
Output IF Frequency	—	270	—	MHz
LO Frequency Range: GSM1800 GSM1900	 1535 1660	 — —	 1610 1720	 MHz MHz
Noise Figure (SSB)	—	9.5	12	dB
Mixer Power Gain*	4	6	—	dB
I/P 1 dB Compression	–12	–7	—	dBm

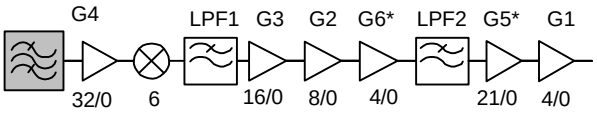
*LO1 level = –6 dBm, F_{LO} = 1572 MHz, F_{IF} = 270 MHz

IF/Baseband Amplifier

The IF amplifier is a balanced-input/balanced-output type and is connected to a balanced SAW filter. It consists of three gain stages: an IF amplifier and two sections of baseband amplifiers. The gain can be changed in steps of 32, 16, 8, and 4 dB. The baseband also contains a level-shifter stage to drive an A/D converter directly. The level-shifter stage has 21 dB of gain that can be switched off. The specifications below are for the two modes of operation.

The gain of the IF section is programmed via the three-wire serial bus.

The IF amplifier contains the 32 dB amplifier stage and has a gain of either 0 or 32 dB. The IF amplifier is followed by a quadrature mixer with a fixed gain of 4 dB. The first baseband amplifier (G3, G2, G6) after the low-pass filter and demodulator has gains selectable between 0, 4, 8, 12, 16, 20, 24, and 28 dB. Using the other gain steps, the IF and baseband gain can be varied by 64 dB in 4 dB steps. The second baseband amplifier (G5, G1) has gains selectable between 0, 4, 21, and 25 dB. The 21 dB gain step in the second baseband amplifier section is not tested and should therefore not be used. Figure 3 is a diagram of the gain steps.

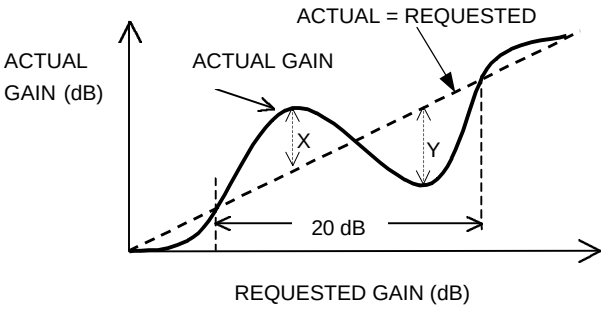


*Not tested.

Figure 3. IF Amplifier Gain Steps

The baseband amplifier section contains dc correction circuitry that minimizes dc offsets at the I/Q outputs. The low-pass filters in the baseband contain a self-calibrating circuit for tuning of filter cut-off frequency. The selectable gain settings are programmed via the TR register as described in the Programming Information section. Filter tuning and dc calibration are also explained in that section.

To achieve the specified absolute gain accuracy, the total gain should be calibrated at room temperature. This would normally be part of the overall phone calibration. Absolute gain accuracy measures the gain change over a specified temperature range relative to the room temperature measurement. In the GSM system, this specification is dependent on all the RX functional blocks and not solely on the IF strip. The relative gain accuracy is a measure of the gain stage accuracy over a 20 dB range (see Figure 4). Relative gain accuracy is determined after calibration of the 32 dB amplifier.

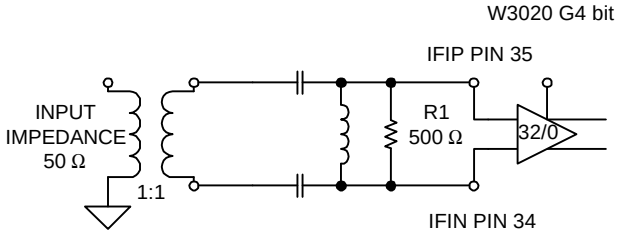


Note: $|X|, |Y|$ = relative gain accuracy.

Figure 4. Actual Gain vs. Requested Gain

The input impedance of the IF strip will vary slightly when the 32 dB amplifier is switched between the ON and OFF states. We recommend that the IF strip be matched with the 32 dB amplifier in the ON state to provide the best match to the SAW filter when the input level is at a minimum. The input matching network can match the IF input directly to the SAW filter or to 50 Ω.

A matching network to 50 Ω was chosen for the evaluation board to allow for convenient laboratory measurements. To keep the input impedance low and minimize impedance variation between gain settings of the IF stage, a resistor is shunt-connected between the input terminals. The input network can then be matched to the desired input impedance. (The specified gain includes a resistor value of 500 Ω.) For testing purposes, the input has been matched to 50 Ω, and the gains of the IF/baseband amplifier are all referred to a 50 Ω matched input impedance. The I/Q outputs are terminated in high-impedance loads. The gains are voltage gains and include the voltage gain in the impedance transformation of the input matching network. The network is illustrated in Figure 5.



Note: Balun is shown for testing purposes only.

Figure 5. IF Strip Balanced Input Matching Network

IF/Baseband Amplifier (continued)

Table 6. IF/Baseband Amplifier Performance

V_{DD} = 2.7 V; T_A = 25 °C ± 3 °C.

Parameter	Min	Typ	Max	Unit
Total Voltage Gain (referred to 50 Ω input)*	60	65	68	dB
Demodulator Gain	—	4	—	dB
Absolute Gain Accuracy†	–2.0	—	2.0	dB
Relative Gain Step Accuracy‡	–1.0	—	1.0	dB
Noise Figure (matched to 50 Ω)§	—	6.2	12	dB
O/P 1 dB Compression Point (0 dB gain setting)	—	–1.5	—	dBm(V)**
O/P 1 dB Compression Point (>16 dB baseband gain setting)	12	—	—	dBm(V)**
Output Load Capacitance (differential)	—	—	10	pF
Output Load Capacitance (single-end to ground)	—	—	10	pF
Output Load Resistance (differential)	20	—	—	kΩ
Output Load Resistance (single-end to ground)	40	—	—	kΩ
IF Enable Time	—	—	—	µs
I/Q Common-mode Output Voltage	0.5 * V_{DDB} – 0.15	0.5 * V_{DDB}	0.5 * V_{DDB} + 0.15	V
I/Q Output Current	±50	—	—	µA
I/Q Phase Accuracy§	—	3.5	—	degrees
I/Q Amplitude Mismatch§	–1	±0.1	1	dB
I/Q Differential Offset Voltage (corrected)§,††	—	5	±50	mV
Offset Correction Decay Rate§	—	2	—	mV/s
IF Input Impedance (diffferential) 32 dB gain setting 0 dB gain setting	 — —	 114 – j497 92 – j497	 — —	 Ω Ω

* 64 dB DGC setting. This voltage gain is measured from the input of the IF strip to either the I or Q channel output.

† The absolute accuracy refers to the total gain variation from the nominal condition over temperature (–30 °C to +85 °C) after gain calibration at nominal temperature.

‡ The relative gain step accuracy is determined after the 32 dB gain stage has been calibrated at nominal temperature. The total gain step accuracy at any of the possible gain conditions should not vary more than the specified amount within a 20 dB measurement window.

§ At 64 dB gain setting.

** This is a voltage and specified in dBm as if the voltage were across a 50 Ω load.

††Offset tested in coarse dc-correction mode only.

IF/Baseband Amplifier (continued)

Table 7. Low-Pass Rejection Characteristics

V_{DD} = 2.7 V; T_A = 25 °C ± 3 °C; high bandwidth.

Parameter	Min	Typ	Max	Unit
Corner Frequency*	130	168	226	kHz
Group Delay Distortion (0 kHz—75 kHz)	—	61	—	ns
Attenuation:				
75 kHz	—	0.4	—	dB
100 kHz	—	0.8	—	dB
200 kHz	—	4.7	—	dB
400 kHz	—	18	—	dB
600 kHz	—	28	—	dB
800 kHz	—	35	—	dB
1.6 MHz	—	53	—	dB
3.0 MHz	—	69	—	dB

* After filter tuning. (See FilterTune and dc Offset Correction Tuning section.)

Modulator

The modulator uses an indirect I/Q modulator architecture that is ideal for multiband operation. The IF modulation improves EVM effects due to improved carrier feedthrough. The series transmit IF filters allow improved wideband noise, which enables duplexer removal. The I/Q modulator requires no amplitude or phase calibration to achieve high phase accuracy. The modulator can be altered between GSM900 transmit mode (TX IF = 270 MHz) and GSM1800/1900 transmit mode (TX IF = 180 MHz) by the band bit setting in the TR register.

Table 8. Modulator Performance

V_{DD} = 2.7 V; T_A = 25 °C ± 3 °C. IQ common mode = 1.6 V; input differential signal = 1.0 Vp-p.

Parameter	Min	Typ	Max	Unit
I/Q Signal Path Bandwidth	—	450	—	kHz
I/Q Input Resistance to Ground	25	—	—	kΩ
I/Q Input Capacitance to Ground	—	—	10	pF
I/Q Input Resistance (differential)	10	—	—	kΩ
I/Q Input Capacitance (differential)	—	—	10	pF
I/Q Common-mode Range	1.5	—	V_{DD} – 1.05	V
I/Q Input Differential Signal for Max Output	0.8	1	1.2	Vp-p
RF Output Band:				
GSM900	880	—	915	MHz
GSM1800	1710	—	1785	MHz
GSM1900	1850	—	1910	MHz
Output Power:				
GSM900 (LO1 at 1167 MHz)	–4.5	0	6	dBm
GSM1800 (LO1 at 1567 MHz)	–4	0	6	dBm
Powerup Time*	—	—	4	µs
RMS Phase Accuracy†:				
GSM900	—	2.0	—	°rms
GSM1800	—	2.5	—	°rms
GMSK Modulation Spectrum (max) (offset from carrier):				
100 kHz @30 kHz RBW	—	—	0.5	dBc
200 kHz	—	—	–30	dBc
250 kHz	—	—	–33	dBc
400 kHz	—	—	–60	dBc
1.8 MHz—3.0 MHz @100 kHz RBW	—	—	–65	dBc
3.0 MHz—6.0 MHz	—	—	–65	dBc
>6.0 MHz	—	—	–73	dBc
Wideband Noise IF Modulator				
GSM900:				
$\|f - f_0\| \geq 10$ MHz	—	–140	—	dBc/Hz
$\|f - f_0\| \geq 20$ MHz (PM)	—	–140	—	dBc/Hz
GSM1800:				
$\|f - f_0\| \geq 20$ MHz (PM)	—	–140	—	dBc/Hz
Wideband Noise RF Mixer (See Figure 6.):				
GSM900:				
$\|f - f_0\| \geq 10$ MHz	—	–154	—	dBc/Hz
$\|f - f_0\| \geq 20$ MHz (PM)	—	–154	—	dBc/Hz
GSM1800:				
$\|f - f_0\| \geq 20$ MHz (PM)	—	–153	—	dBc/Hz

* From the programming latch going high to power available at RF output, Including TX IF filter group delay.
† Including contributions from LO1, LO2, and modulator.

Modulator (continued)

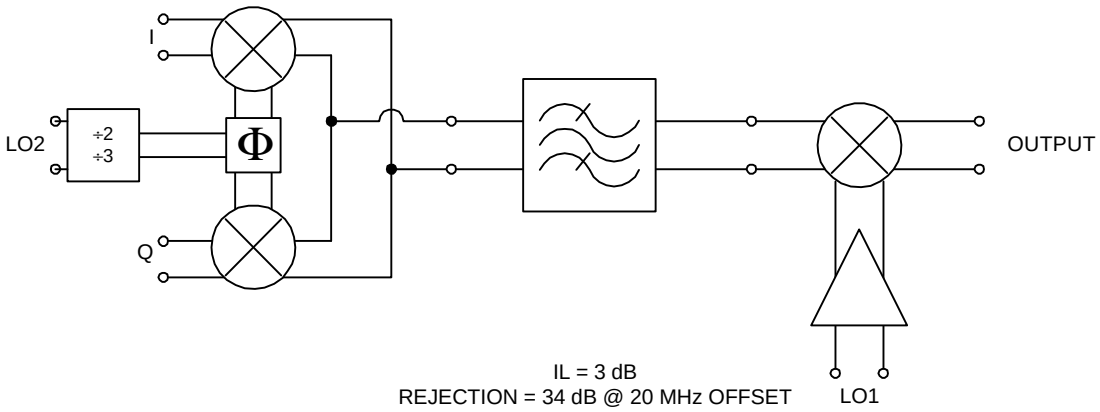


Figure 6. IF Filtering Requirements for Wideband Noise Performance

LO2 Specification

The W3020 contains an input buffer for an external VCO and a PLL for generation of a second LO signal at 540 MHz. The output of the buffer is fed to the receive and transmit circuits, where the signal is divided to the IF frequency. The phase noise includes contributions from VCO buffers to the transmit and receive circuits.

Table 9. LO2 Performance

V_{DD} = 2.7 V; T_A = 25 °C ± 3 °C.

Parameter	Min	Typ	Max	Unit
Charge Pump Supply ($V_{DD}C2$)	2.7	2.85	3.0	V
Frequency	—	540	—	MHz
LO2 Input Level	–6	–3	0	dBm
Clock Reference Frequency	—	13.0	—	MHz
Clock Input Level	0.4	1	—	Vp-p
Reference Frequency (at phase detector)	—	1.0	—	MHz
Phase Accuracy (loop bandwidth 10 kHz)	—	1.3	—	°rms
Phase Detector Gain (V_{DD} = 2.85 V)	—	200	—	µA/cycle
Powerdown Charge Pump Supply Current ($V_{DD}C2$)	—	—	1	mA
Phase Detector Voltage	0.5	1.3	$V_{DD}C2$ – 0.5	V

Note: Reference sidebands determined by external loop filter components.

LO1 Input Buffer Specification

Table 10. LO1 Performance

V_{DD} = 2.7 V; T_A = 25 °C ± 3 °C.

Parameter	Min	Typ	Max	Unit
Frequency Range:				
GSM900	1150	—	1230	MHz
GSM1800	1530	—	1610	MHz
GSM1900	1660	—	1730	MHz
Input Power Level	–6	–3	—	dBm
Input Noise Figure	—	8	10	dB

Programming Information

The W3020 and W3000 transceiver mode (IC RX/TX) and the gain and band settings are programmed using a standard three-wire bus (CLOCK, DATA, LATCH). The W3020 and W3000 registers are addressable so the two ICs can share the same data, clock, and latch times. The LATCH line initiates download and execution of the current DATA word.

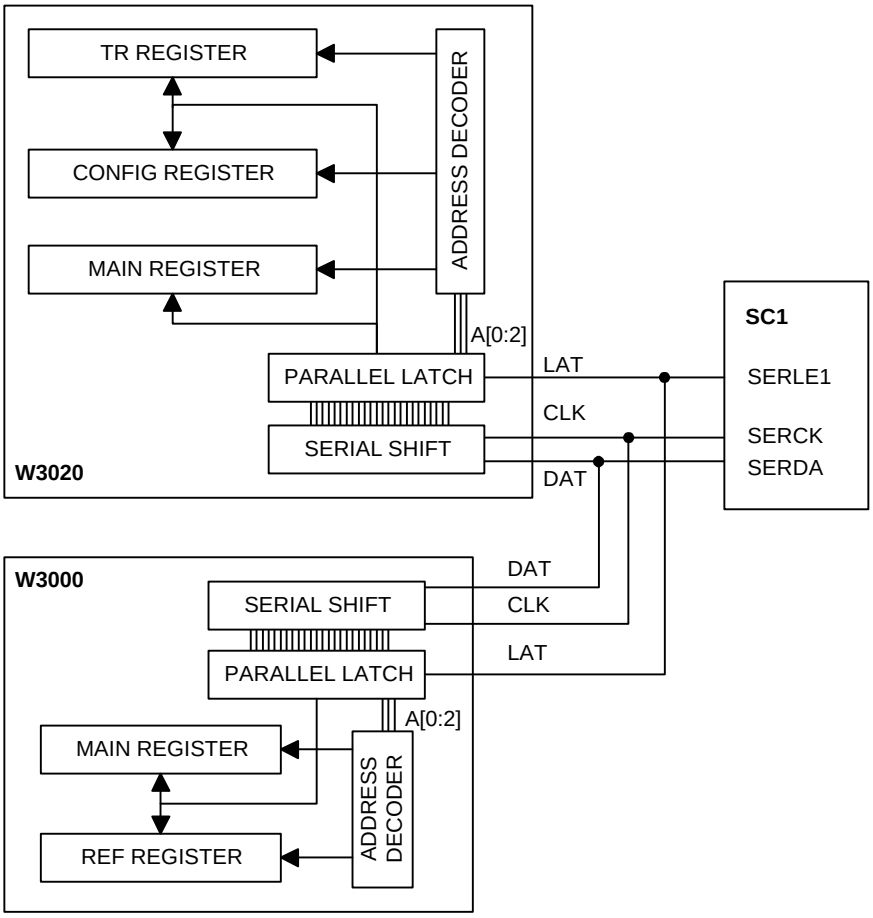


Figure 7. Diagram of W3020, W3000, and SC1 Interconnection

Programming Information (continued)

Serial Bus Timing Information

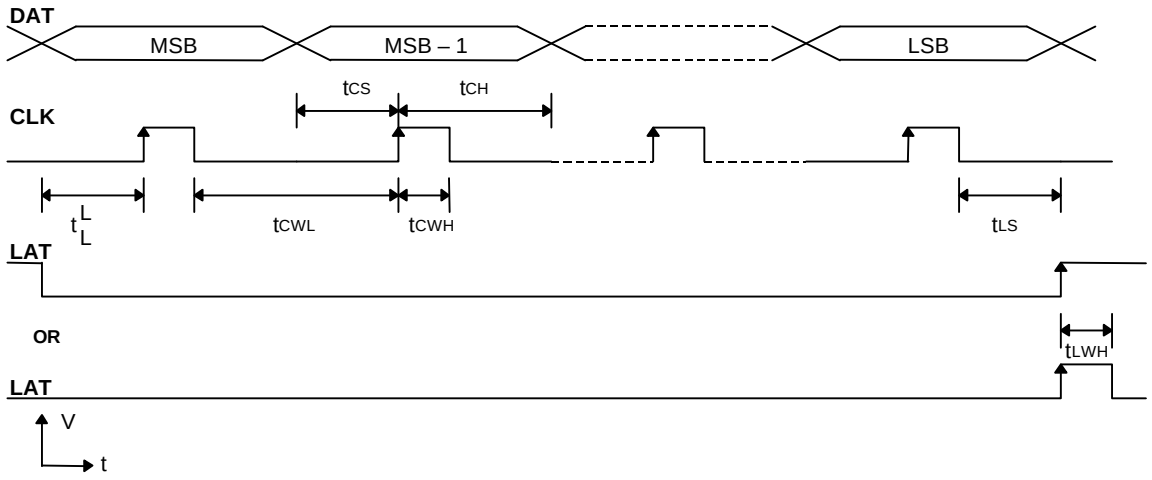


Figure 8. Serial Bus Timing Diagram

Table 11. Serial Bus Timing Information

V_{DD} = 2.7 V; T_A = 25 °C ± 3 °C

Symbol	Parameter	Min	Typ	Max	Unit
T_{CS}	Data to Clock Setup Time	33	—	—	ns
T_{CH}	Data to Clock Hold Time	10	—	—	ns
T_{CWH}	Clock Pulse Width High	33	—	—	ns
T_{CWL}	Clock Pulse Width Low	33	—	—	ns
T_{LS}	Clock Falling Edge to Latch High Setup Time	0	—	—	ns
T_{LWH}	Latch Pulse Width	50	—	—	ns
T_{LL}	Latch to Clock Setup Time	33	—	—	ns
F_{CLK}	Clock Input Frequency	—	—	10	MHz

Programming Information (continued)

The Data Word

The W3020 and W3000 chips are addressed through the bit content of the 24-bit serial word. Some words for time-critical interactions address both W3020 and W3000 at the same time, while some words for initialization address W3020 and W3000 separately.

The W3020 gets all of its control information via a three-wire serial bus from the baseband IC. Serial data transfers always consist of 24 bits: 3 bits of address to select one of five control registers, and up to 21 bits of data. The data is shifted first into a shift register and then parallel-loaded into the proper control register after the completion of the transfer when the latch enable signal goes high. The last bit is that which immediately precedes a low-to-high latch input transition occurring while the CLOCK input is low. Bit 24 is loaded first, and bit 1 is loaded last. The four control registers are defined as follows:

- **TR:** Transmit/receive register for W3020. Contains bits for setting various transmit and receive modes, setting receive gain, etc. It is expected that this register would be written several times during a frame.
- **CONFIG:** Contains bits to control various options for dc offset correction, filter-tuning, lock detect, and overload outputs, etc. It is expected that this register would be written once at initialization and then rarely updated. Since it is not affected by the power-on reset circuit, a write to this register should be the first operation performed when accessing the W3020 chip. Also, it is advisable never to update the configuration register while a critical operation is in progress.
- **MAIN:** Main counter and prescaler values for W3000 chip. Used to set mode and band bit functions for the W3020 while programming the W3000.
- **REF:** Reference counter values for W3000. Not relevant to W3020.

Table 12. Register Addressing

A2	A1	A0	Register	Device
1	0	0	TR	W3020
1	0	1	CONFIG	W3020
1	1	0	RESERVED	W3020
1	1	1	RESERVED	W3020
0	X	0	M MAIN	W3000
0	X	1	M REF	W3000

Note: X indicates that the bit does not affect addressing for the given combination of A2 and A0 that addresses the W3000. In the W3000, the A1 bit is used for data content.

Programming Information (continued)

TR Register

The TR register is the transmit/receive register for W3020. It contains bits for setting various transmit and receive modes, setting receive gain, etc. It is expected that this register would be written several times during a frame.

Last bit in serial sequence — First bit in serial sequence

Bit No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Bit	A0=0	A1=0	G0	G1	G2	G3	G4	G5	G6	T0	T1	T2	DS	DP	FTR	T3	T4	T5	T6	MO1	MO2	MO3	B	A2=1

Table 13. TR Register

Bit Number	Bit	SC1 Standard Setting	Function
24	A2	1	Address Bit
23	B	0	Band Select (See Table 14.)
22 21 20	MO3 MO2 MO1	—	RX, TX, Synthesizer Mode (See Table 15.)
19	T6	0	Disable LO2 Circuitry in All Modes (See Table 16.)
18	T5	0	Disable LO1 Circuitry (W3000 excluded) (See Table 17.)
17	T4	0	RX IF Duty Cycle Corrector Disable (See Table 18.)
16	T3	0	GSM1800 TX IF LO Divide-by-3 Duty Cycle Corrector Disable (See Table 19.)
15	FTR	1	LPF Tune Filter Request (See Table 20.)
14	DP	0	dc Precharge Only (See Table 21.)
13	DS	0	dc Correction Skip (See Table 22.)
12	T2	0	LO2 Divide by 2 or Divide-by-3 Select for TX IF (See Table 23.)
11	T1	0	TX IF LO Divide-by-6 Select (See Table 24.)
10	T0	0	TX IF Duty-Cycle Corrector Disable (See Table 25.)
9 8 7 6 5 4	G6 G5 G4 G3 G2 G1	—	Digital Gain Control RX IF/IQ-Baseband (See Table 26.)
3	G0	1	Digital Gain Control LNA On/Off (See Table 26.)
2 1	A1 A0	0 0	Address Bits

Note: The TR register is reset to an all-zero state after the reset bit in the CONFIG register has been set high.

Programming Information (continued)

TR Register (continued)

B: Band Select

When set low, the GSM900 transceiver circuits are enabled and the GSM1800 transceiver circuits are disabled. When set high, the GSM1800 transceiver circuits are enabled and the GSM900 transceiver circuits are disabled. The transceiver circuits that change with the setting of the band bit B are the LNA, the RF mixer, the receive UHF LO1 buffer, the transmit UHF LO1 buffer, and the LO2 divider for the modulator IF LO phase shifter circuit. The normal LO2 division factor for GSM900 is divide-by-2; for GSM1800, the normal LO2 division factor is divide-by-3. Note that bits T2 and T1 also affect the transmitter LO2 division factor when set high (see Table 23 and Table 24).

Table 14. B: Band Select

B Bit 23	Function
0	GSM900 Path On
1	GSM1800/1900 Path On

Note: When programmed via the same three-wire bus as the W3000, updating this bit in W3020 also updates it in W3000, and vice versa.

MO[3:1]: Mode Control

The various system modes of the W3020 are set by the mode control bits. These are active in both the TR and MAIN registers. The W3000 will also power up with the W3020 in any of the valid modes set by the mode bits in the TR or MAIN registers. The mode bit settings for each W3020 system mode are given in Table 15. The corresponding typical supply current for the IC in each mode is shown in the Supply Currents table on page 9.

In sleep mode, both the W3020 and W3000 are powered down, and the supply current is in the µA range. The transmit PLL settling mode is used prior to a transmit burst in order to power up and lock the LO1 and LO2 VCO/PLL synthesizers and the respective RF and IF LO buffers connecting to the modulator circuit. The LO2 divide-by circuits remain off during this mode. Similarly, the receive PLL settling mode is used prior to the receive dc calibration time slot and subsequent receive burst in order to power up and lock the LO1 and LO2 VCO/PLL synthesizers and the respective RF and IF LO buffers connecting to the RF mixer and IF strip. The RF mixer can be turned on in this mode by setting the C9 (RF mixer on during settling) bit high in the CONFIG register (see Table 30). The transmitter ON mode turns on all the same circuits as the transmit PLL settling mode along with the I/Q modulator and up-conversion mixer.

The receiver ON mode turns on all the same circuits as the receive PLL settling mode along, with the LNA (if enabled by the G0 bit—see Table 26), RF mixer, and IF amplifiers and demodulator. When first going into receive mode, a baseband LP filter tune is performed, if requested, by setting the FTR (filter tune request) bit high in the TR register and the C6 (filter tune disable) bit low in the CONFIG register (see Table 20 and Table 35, respectively, and the Low-Pass Filter Tuning section). Next, a dc offset calibration cycle is performed if the DS (dc correction skip) bit is low in the TR register and the C5 (dc correction disable) bit is low in the CONFIG register (see Table 22 and Table 36, respectively). The default condition is that the LNA turns off during the dc calibration if the C2 (LNA mode during dc calibration) bit is low in the CONFIG register (see Table 37). The other default condition is that the RF mixer LO1 buffer turns off during the dc calibration if the C3 (RX LO1 buffer mode during dc calibration) bit is low in the CONFIG register (see Table 38).

During this event, the transmit LO1 buffer will turn on to act as a load stage for the UHF LO1 buffer. (For additional information on the dc offset calibration, see the dc Offset Correction Timing section.) After the dc calibration cycle, all the receive circuits turn on as mentioned above for the receive burst.

Programming Information (continued)

TR Register (continued)

Table 15. MO[3:1]: Mode Control

MO3 Bit 22	MO2 Bit 21	MO1 Bit 20	Function
0	0	0	Sleep: All Modules Powerdown
0	0	1	Reserved
0	1	0	Reserved
0	1	1	Reserved
1	0	0	TX PLL Settling Mode (LO1, LO2, TX LO1, and TX LO2 buffers on)
1	0	1	RX PLL Settling Mode (LO1, LO2, RX LO1, and RX LO2 buffers on)
1	1	0	TX ON (TX modulator and mixer, LO1, LO2, TX LO1, and TX LO2 buffers on)
1	1	1	RX ON (RX mixer; LNA, if enabled; IF amplifier; LO1; LO2; RX LO1; and RX LO2 buffers on)*

*If MO bits are set to 111 with the dc correction skip bit low, a dc offset calibration cycle is performed automatically.

Table 16. T6: LO2 Disable

If this bit is set high, the 540 MHz LO2 input buffer and LO2 PLL will be turned off. This bit will also disable the 13 MHz clock buffer going to the baseband amplifier correction circuits. This bit is provided for testing purposes.

T6 Bit 19	Function
0	LO2 Circuit Enabled
1	LO2 Circuit Disabled

Table 17. T5: LO1 Disable

The T5 bit disables the LO1 circuitry including the UHF LO1 buffer and bias circuit. This bit is provided for testing purposes.

T5 Bit 18	Function
0	LO1 Circuitry Enabled
1	LO1 Circuitry Disabled

Table 18. T4: Receive IF Duty Cycle Corrector Disable

When high, disables duty cycle correction circuit in the LO2 divide-by-2 circuit for the receive IF demodulator. This is provided for testing purposes.

T4 Bit 17	Function
0	Divide-by-2 Duty Cycle Corrector Enabled
1	Divide-by-2 Duty Cycle Corrector Disabled

Table 19. T3: Divide-by-3 Duty Cycle Corrector Disable

When high, disables duty cycle correction circuit in the GSM1800/1900 transmit IF LO divide-by-3 circuit. This is provided for testing purposes.

T3 Bit 16	Function
0	Divide-by-3 Duty Cycle Corrector Enabled
1	Divide-by-3 Duty Cycle Corrector Disabled

Programming Information (continued)

TR Register (continued)

Table 20. FTR: LPF Tune Filter Request

This requests tuning operation of baseband low-pass filter (see the Low-Pass Filter Tuning section for details). If the filter tune is enabled in CONFIG register, the FTR bit must be programmed high before the first following receive mode is active. Filter tune can only be done in a mode where LO2 is active, e.g., receive mode.

FTR Bit 15	Function
0	Use Default Tuning Value
1	Perform New Tuning

Table 21. DP: dc Precharge Only

When dc offset calibration is performed, only the precharge portion is done. This reduces the amount of time required for dc offset calibration, but gives higher levels of dc offset. (See the dc Offset Calibration section for details.)

DP Bit 14	Function
0	Standard dc Offset Correction Cycle
1	dc Precharge Cycle Only

Table 22. DS: dc Correction Skip

DS Bit 13	Function
0	Insert dc Correction Cycle (See Table 41.)
1	Skip dc Offset Calibration (with retained dc correction setting)

Table 23. T2: TX IF LO Division Select Switch

Reverses the LO2 frequency division factor in the transmitter for both bands. This is provided for testing purposes. This bit works with the band bit B as follows.

T2 Bit 12	B Bit 23	Function
0	0	Divide by 2 (270 MHz): Normal GSM900 Division
0	1	Divide by 3 (180 MHz): Normal GSM1800/1900 Division
1	0	Divide by 3 (180 MHz): Reversed Band 0 Division
1	1	Divide by 2 (270 MHz): Reversed Band 1 Division

Table 24. T1: TX IF LO Divide-by-6 Select

This bit will change the divide-by-3 circuit to a divide-by-6 circuit. This bit is provided for testing purposes.

T1 Bit 11	Function
0	Divide by 3 when 1/3 Path Is Active
1	Divide by 6 when 1/3 Path Is Active

Table 25. T0: TX IF Duty Cycle Corrector Disable

When high, disables duty cycle correction circuit into the transmit IF phase splitter. This bit is provided for testing purposes.

T0 Bit 10	Function
0	TX IF LO Duty Cycle Corrector Enabled
1	TX IF LO Duty Cycle Corrector Disabled

Programming Information (continued)

TR Register (continued)

Table 26. G[0:6]: Digital Gain Control

Digital RX gain control with bits defined as follows:

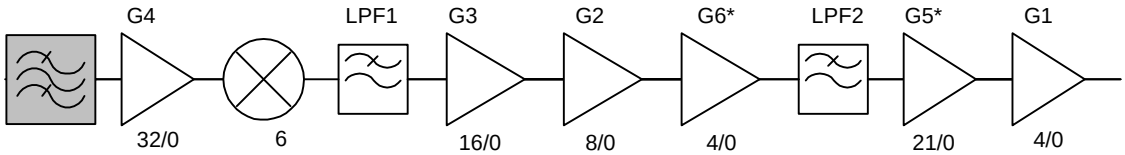
G0: When high, enables GSM900 or GSM1800/1900 LNA according to which band is selected by band bit B. (See Table 14.)
G4: IF gain: 0 = 0 dB, 1 = 32 dB.
G1: 0 = add 0 dB to baseband gain, 1 = add 4 dB to baseband gain in second amplifier.
G2: 0 = add 0 dB to baseband gain, 1 = add 8 dB to baseband gain in first amplifier.
G3: 0 = add 0 dB to baseband gain, 1 = add 16 dB to baseband gain in first amplifier.
G5: 0 = add 0 dB to baseband gain, 1 = add 21 dB to baseband gain in second amplifier.
G6: 0 = add 0 dB to baseband gain, 1 = add 4 dB to baseband gain in first amplifier.

The nominal demodulator mixer conversion gain is 4 dB; hence, total gain is always 4 dB higher than the DGC setting.

Voltage gain is differential assuming input matching network to 50 Ω source impedance. (See Table 6.)

G6 Bit 9	G5 Bit 8	G4 Bit 7	G3 Bit 6	G2 Bit 5	G1 Bit 4	DGC Gain (dB)	Total Gain (dB)
0	0	0	0	0	0	0	4
1	0	0	0	0	0	4	8
0	0	0	0	1	0	8	12
1	0	0	0	1	0	12	16
0	0	0	1	0	0	16	20
1	0	0	1	0	0	20	24
0	0	0	1	1	0	24	28
1	0	0	1	1	0	28	32
0	0	1	0	0	0	32	36
1	0	1	0	0	0	36	40
0	0	1	0	1	0	40	44
1	0	1	0	1	0	44	48
0	0	1	1	0	0	48	52
1	0	1	1	0	0	52	56
0	0	1	1	1	0	56	60
1	0	1	1	1	0	60	64
1	0	1	1	1	1	64	68
0	1	0	0	0	0	21	25*
1	1	1	1	1	0	81	85*
1	1	1	1	1	1	85	89*

* Not tested or recommended for use.



*Not tested.

Figure 9. IF and I/Q Gain Distribution (dB)

Programming Information (continued)

CONFIG Register

The CONFIG register contains bits to control various options for dc offset correction, filter-tuning, lock detect, and overload outputs, etc. It is expected that this register would be written once at initialization and then rarely updated. Since it is not affected by the power-on reset circuit, a write to this register should be the first operation performed when accessing the W3020 chip. Also, it is advisable never to update the configuration register while a critical operation is in progress.

Last bit in serial sequence ← → First bit in serial sequence

Bit No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Bit	A0=1	A1=0	RS	DT0	DT1	DT2	C1	C2	C3	C4	C5	C6	C7	LD2	C8	VO	C9	OLD	C10	F1	F2	F3	F4	A2=1

Table 27. CONFIG Register

Bit No.	Bit	SC1 Standard Setting	Function
24	A2	1	Address Bit 2
23	F4	0	Reserved
22	F3	0	
21	F2	0	
20	F1	0	
19	C10	1	Enable of LO2 PLL (See Table 28.)
18	OLD	0	Disable of Overload Pin Output Signal, When High (See Table 29.)
17	C9	0	Force RF Mixer On When RX LO1 Buffer Is On, When High (See Table 30.)
16	VO	1	Reserved; Always High (See Table 31.)
15	C8	0	LO2 Charge Pump Output Off (high impedance), When High (See Table 32.)
14	LD2	1	Enable LO2 Lock Detect Output, When High (See Table 33.)
13	C7	0	Select dc Offset Correction/Fine Tune, When High (See Table 34.)
12	C6	0	Disable LP Filter Bandwidth Tune and Use Default Value, When High (See Table 35.)
11	C5	0	Disable dc Offset Correction and Use Default Setting, When High (See Table 36.)
10	C4	1	High Bandwidth Setting of Baseband Path, When High (See Table 37.)
9	C3	0	RX LO1 Buffer On During dc Calibration When High (See Table 38.)
8	C2	0	LNA On During dc Calibration, When High (See Table 39.)
7	C1	1	LO2 Phase Detector Polarity, Positive Slope, When High (See Table 40.)
6	DT[2]	0	dc Offset Correction Time (See Table 41.)
5	DT[1]	1	
4	DT[0]	1	
3	RS	1*	Resets Bit Content in Other Registers, When High (See Table 42.)
2	A1	0	Address Bit 1
1	A0	1	Address Bit 0

* It is recommended that a reset be programmed after power-on. Reset does not affect the content of the CONFIG register.

Programming Information (continued)

CONFIG Register (continued)

Table 28. C10: LO2 PLL Enable

When low, disables counters, phase detector, and charge pump of the LO2 PLL. This mode is provided for applications utilizing an external programmable IF PLL.

C10 Bit 19	Function
0	LO2 PLL Disabled
1	LO2 PLL Operational (normal)

Table 29. OLD: Overload Output Disable

When high, forces overload output pin to be a logic low level. Otherwise, overload pin indicates overload.

OLD Bit 18	Function
0	Overload Detect Output for IF/Baseband Enabled
1	Overload Detect Output for IF/Baseband Disabled

Table 30. C9: RF Mixer On During Settling

When high, enables receive RF mixer during receive PLL settling mode. In default operation, this bit should be set to 0. If there were a problem with the VCO kicking when going from settling mode to full receive mode, it could be set high.

C9 Bit 17	Function
0	Default: RX Mixer Off During RX Settling Mode (MO[3:1] = 101)
1	RX Mixer On During RX Settling Mode (MO[3:1] = 101)

Table 31. VO: LO1 Buffer Mode

VO Bit 16	Function
0	Not Allowed
1	LO1 Buffer Mode

Table 32. C8: LO2 Charge Pump Off

C8 Bit 15	Function
0	Normal LO2 Charge Pump Operation
1	Charge Pump Off (high impedance) or CP2 Test Mode

Programming Information (continued)

CONFIG Register (continued)

Table 33. LD2: Lock Detect Enable

LD2 Bit 14	Function
0	Lock Detect Output for LO2 Disabled
1	Lock Detect Output for LO2 Enabled

Note: When disabled, the lock detect output is a logic level high. When lock detect is enabled but 540 MHz PLL is not locked, LD output is pulsing low. When lock detect is enabled and 540 MHz PLL is locked, LD output is high.

Table 34. C7: dc Coarse/Fine Correction

When this bit is low, coarse offset calibration is done such that the SC1's offset calibration can be done simultaneously. When this bit is high, a fine calibration is done, but this is not compatible with the SC1.

C7 Bit 13	Function
0	Coarse dc Correction Tuning (for interface with baseband with calibration function) with Output Buffer dc Connection Retained
1	Fine Tune (no baseband calibration required), No Output Available During Calibration

Table 35. C6: Filter Tune Disable

Disable LP filter bandwidth tune and use default value.

C6 Bit 12	Bandwidth Setting	Function
0	Use Calibration	Requires LPF Tune Request Cycle to Be Executed
1	Use Default	Always Use Default Noncorrected Value (less accurate)

Table 36. C5: dc Correction Disable

C5 Bit 11	Function
0	Correction Cycle Before Each RX
1	Always Use Default Noncorrected Value

Table 37. C4: Low-Pass Filter Bandwidth

C4 Bit 10	Function
0	Low Bandwidth (115 kHz)*
1	High Bandwidth (168 kHz) for Use with SC1, etc.

* Not tested or recommended for use.

Programming Information (continued)

CONFIG Register (continued)

Table 38. C3: Receive LO1 Buffer Mode During dc Calibration

C3 Bit 9	Function
0	RX LO1 Buffer Off During dc Offset Calibration
1	RX LO1 Buffer On During dc Offset Calibration

Table 39. C2: LNA Mode During dc Calibration

C2 Bit 8	Function
0	LNA Off During dc Offset Calibration*
1	LNA On During dc Offset Calibration

*Recommended to meet GSM sensitivity requirement.

Table 40. C1: 540 MHz LO2 Phase Detector Polarity

C1 Bit 7	Function (See Figure 10.)
0	Negative Charge Pump Polarity (VCO2 Frequency Decrease with CP2 Voltage)
1	Positive Charge Pump Polarity (VCO2 Frequency Increase with CP2 Voltage)

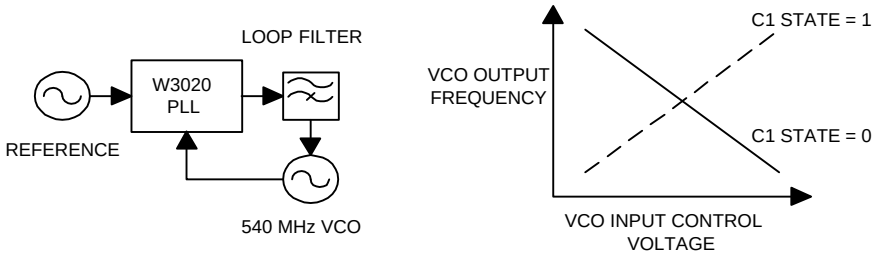


Figure 10. Programming the LO2 Phase Detector Slope

Programming Information (continued)

CONFIG Register (continued)

Table 41. DT[2:0]: dc Correction Time

Total dc offset calibration time is determined according to the table below. For further information, see the discussion in the dc Offset Calibration section.

DT[2] Bit 6	DT[1] Bit 5	DT[0] Bit 4	T (RX_Valid) (µs)
0	0	0	72
0	0	1	131
0	1	0	190
0	1	1	249
1	0	0	309
1	0	1	368
1	1	0	427
1	1	1	486
X	X	X	42 (DP = 1)*

* See Table 21.

Table 42. RS: Reset Bit Content

When set high, all registers except for the CONFIG register are reset to 0. When set low, no action occurs.

RS Bit 3	Function
0	No Function
1	Reset Other Registers One Time

MAIN Register

Last bit in serial sequence ← → First bit in serial sequence

Bit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Bit No.	A0=0	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	MO1	MO2	MO3	B	A2=0

Note: Bits designated **x** do not apply to W3020.

Programming the MAIN register affects the states of both the W3000 and the W3020. The MO bits (see Table 15) and band bit B (see Table 14) have the same functions as described in the TR Register section. The W3020 state is determined by the most recent programming event to either the MAIN register or the TR register.

Programming Information (continued)

Filter Tune and dc Offset Correction Timing

Low-Pass Filter Tuning

The W3020 has an internal calibration to improve the accuracy of the low-pass filter bandwidth. The filter tune operation should be performed each time supply voltage is applied to the device and after restart.

The low-pass filter tuning operation is controlled by 3 bits in the control logic:

- FTR: filter tune request, in the TR register
- C4: low-pass filter bandwidth, in the CONFIG register
- C6: filter tune disable, in the CONFIG register

If the filter tune disable bit (C6) is programmed high, the filter bandwidth is set to the programmed (nominal) value (see Table 35), and any request for filter tuning from the FTR bit is ignored.

The accuracy of the filter bandwidth can be improved by performing a filter tune calibration. A filter tune can be performed by setting the filter tune request (FTR) bit in the TR register high and the filter tune disable bit (C6) in the CONFIG register low. This enables a 13/4 MHz (3.25 MHz) clock to the filter tuning state machine, which then runs until the tuning is complete and the new filter tune values are stored. The filter tune operation itself takes
16.5 cycles of the 3.25 MHz clock, or 5.1 µs.

The filter tune operation should be done in receive mode. The receive mode needs to be held active for at least 20 µs to allow for bias start-up.

The dc offset calibration, if requested, is performed after the filter tune is complete. The filter tune operation adds 5.1 µs to the total calibration time when requested at the same time as a dc offset calibration. If a filter tune is requested while the MOD bits are not set to 111, only the receive bias circuitry is turned on; the rest of the receive channel remains powered down.

Programming Information (continued)

Filter Tune and dc Offset Correction Timing (continued)

dc Offset Calibration

The dc offset calibration operation is controlled by several bits in the CONFIG and TR registers:

- DS: dc correction skip, in the TR register
- DP: dc precharge only, in the TR register
- C5: dc correction disable, in the CONFIG register
- C7: dc coarse/fine correction, in the CONFIG register
- DT: dc correction time, in the CONFIG register

When the dc correction disable bit (C5) in the CONFIG register is written high, the dc offset correction circuitry charges to a default value, corresponding to 0 dc offset, and any request for dc offset calibration is ignored. If dc correction disable = 0, the dc offset calibration is initiated by writing the MO bits in the TR (or MAIN) register to a value of 111 while dc correction skip (DS) and dc precharge only (DP) are both low. As in the case of the filter tune, start of dc offset calibration is held off for about 15 μs while the bias circuits and input clock buffer start-up.

If the FTR bit was also written high coincident with entering RX mode, a filter tune is performed first, after which dc offset calibration begins automatically.

The dc offset calibration runs for a time determined by the dc offset correction time bits DT[0:2] in the CONFIG register. There are three of these bits, giving the user a choice of eight different correction times.

Upon completion of the dc offset calibration, the 3.25 MHz baseband clock stops and full receive mode is entered automatically, with the LO1 buffer and LNA (if G0 = 1) being enabled automatically.

If RX mode is entered with dc precharge only (DP = 1) set high, dc offset circuitry runs through a much shorter calibration routine, after which normal receive mode is entered automatically. The precharge-only operation functions much the same as the normal calibration operation in that the LO1 buffer and LNA is disabled until completion of the precharge operation. The 15 μs bias start-up time is still incurred.

The receive circuitry conditions during dc calibration are also controlled by two other bits in the CONFIG register:

- C2: LNA on during dc calibration, when high
- C3: receive LO1 buffer on during dc, calibration when high

For both the standard dc offset calibration cycle and the dc precharge-only operation, it is possible to perform dc offset calibration with the LNA and/or LO1 buffer on by setting the C2 and C3 bits in the CONFIG register.

Programming Example

This programming example shows how the W3020 can be programmed after power-on and how it can be programmed prior to receive and transmit bursts. The reference register for the W3000 is initialized separately with the reference divider ratio, as described in the W3000 data sheet.

Table 43. Initialize CONFIG Register (Reset W3020)

To reset all registers to their default state and put the device into a low-power sleep mode, one write to the CONFIG register is necessary. This will also reset W3000 if it is connected on the same three-wire bus. Normally, the device will be both reset and configured in the same programming as follows:

CONFIG register: reset device, set dc calibration time to max value (486 µs), set phase detector polarity for the positive slope VCO, use high BW and coarse dc offset tune.

Bit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Bit No.	A0	A1	RS	DT0	DT1	DT2	C1	C2	C3	C4	C5	C6	C7	LD2	C8	VO	C9	OLD	C10	F1	F2	F3	F4	A2
Setting	1	0	1	1	1	1	1	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0	1

Note: Hex value = 84827d.

Table 44. Initialize TR Register

The reset operation will set the TR register to the following content:

Bit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Bit No.	A0	A1=0	G0	G1	G2	G3	G4	G5	G6	T0	T1	T2	DS	DP	FTR	T3	T4	T5	T6	MO1	MO2	MO3	B	A2
Setting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Note: Hex value = 800000.

A filter tune request with this TR content, setting FTR = 1 and MO[1:3] = 111, could be done as a second initialize followed by a third programming that powers the IC in idle mode.

Table 45. Settle PLL to GSM1800 Band for Receive Mode (W3020/W3000)

Main register: switch to W3020 receive settling mode to allow LO2 to settle; band bit B = 1 for GSM1800. (W3000 is programmed at the same time to settle LO1 to 1572 MHz frequency with N = 7860 to receive at 1842 MHz.)

Bit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Bit No.	A0=0	*A1*	*A2*	*A3*	*A4*	*A5*	*A6*	*A7*	*M1*	*M2*	*M3*	*M4*	*M5*	*M6*	*M7*	*M8*	*M9*	*M10*	*M11*	MO1	MO2	MO3/EN	B	A1=0
Setting	0	*0*	*0*	*1*	*0*	*1*	*1*	*0*	*0*	*1*	*0*	*1*	*1*	*1*	*1*	*0*	*0*	*0*	*0*	1	0	1	1	0

Notes:
Hex value = 687A68.
Italics indicate W3000 bits.

Programming Example (continued)

Table 46. Perform Receive (W3020)

TR register: full receive mode; set DGC gain to 60 dB gain setting with LNA on (G0 = 1) and with normal dc offset calibration; band bit B = 1.

Bit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Bit No.	A0	A1	G0	G1	G2	G3	G4	G5	G6	T0	T1	T2	DS	DP	FTR	T3	T4	T5	T6	MO1	MO2	MO3	B	A2
Setting	0	0	1	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	1	1

Note: Hex value = f8407C.

To change gain settings and remain in receive mode without redoing dc offset calibration, repeat the bus transaction above with dc skip bit high (DS = 1). It should be noted that as dc offset is gain-dependent, dc skip mode can be used only for receive signal levels where dc offset is insignificant.

Table 47. Settle PLL in GSM1800 Band for Transmit Mode (W3020/W3000)

MAIN register: switch W3020 to transmit settling mode to allow LO2 to settle; band bit B = 1.
(W3000 is programmed at the same time to settle LO1 to 1567 MHz frequency with N = 7835 to transmit at 1747 MHz.)

Bit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Bit No.	A0	*A1*	*A2*	*A3*	*A4*	*A5*	*A6*	*A7*	*M1*	*M2*	*M3*	*M4*	*M5*	*M6*	*M7*	*M8*	*M9*	*M10*	*M11*	MO1	MO2	MO3/EN	B	A1
Setting	0	*1*	*1*	*0*	*1*	*1*	*0*	*0*	*0*	*1*	*0*	*1*	*1*	*1*	*1*	*0*	*0*	*0*	*0*	0	0	1	1	0

Notes:
Hex value = 607A36.
Italics indicate W3000 bits.

Table 48. Basic GSM1800 Transmit Burst (W3020)

TR register: full transmit mode; band bit B = 1.

Bit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Bit No.	A0	A1=0	G0	G1	G2	G3	G4	G5	G6	T0	T1	T2	DS	DP	FTR	T3	T4	T5	T6	MO1	MO2	MO3	B	A2
Setting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1

Note: Hex value = f00000.

To change to the GSM900 MHz band for the example above, band bit B must be changed to B = 0 and the appropriate channel programming must be set up for the W3000 synthesizer.

Application Information

S-Parameters

V_{CC} = 3.0 Vdc; T_A = 25 °C ± 3 °C.

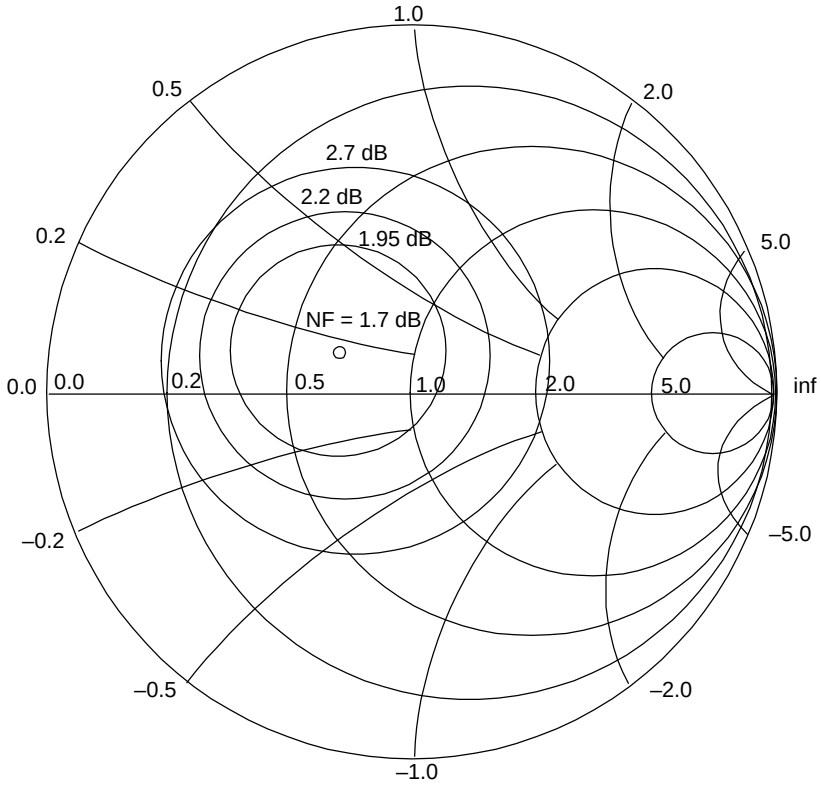


Figure 11. GSM900 Smith Chart Noise Circles

Application Information (continued)

S-Parameters (continued)

V_{CC} = 3.0 Vdc; T_A = 25 °C ± 3 °C.

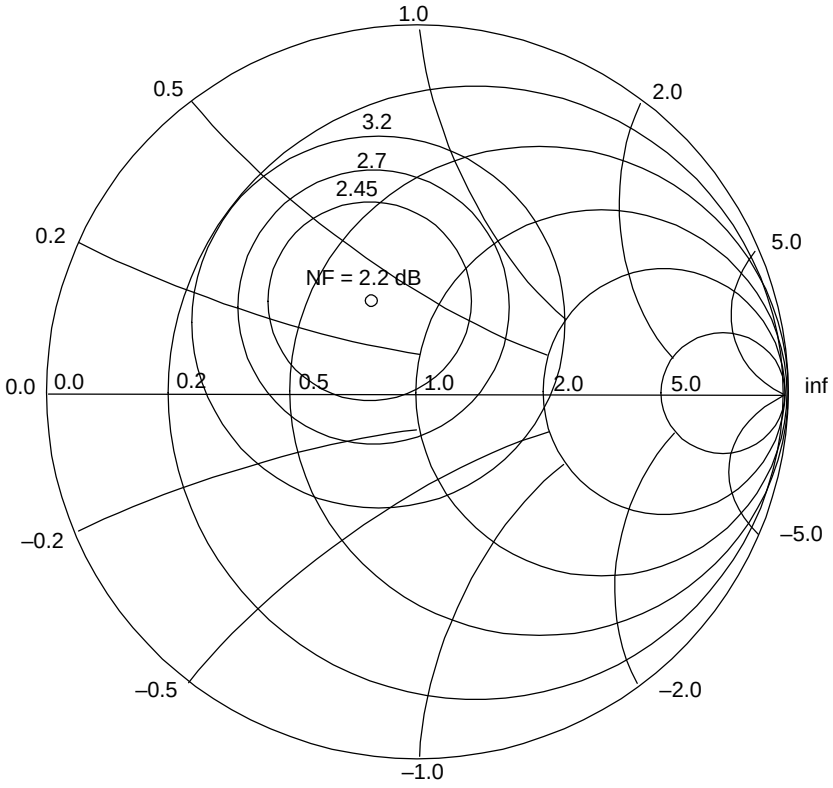


Figure 12. GSM1800 Smith Chart Noise Circles

Application Information (continued)

S-Parameters (continued)

Table 49. GSM900 LNA S-Parameters

V_{CC} = 3.0 Vdc; T_A = 25 °C ± 3 °C.

Frequency (MHz)	S11 M	S11 A (°)	S21 M	S21 A (°)	S12 M	S12 A (°)	S22 M	S22 A (°)
100	0.73697	–18.1202	10.1130	167.024	0.00063	108.261	0.88093	–3.17707
200	0.71547	–35.3615	9.63213	155.803	0.00148	98.4551	0.87849	–6.79066
300	0.68868	–52.1150	9.01626	145.198	0.00181	86.3048	0.87674	–10.1757
400	0.65380	–66.8624	8.26280	135.689	0.00251	83.6600	0.87160	–13.5508
500	0.62345	–80.3837	7.61255	127.596	0.00276	84.1787	0.86700	–17.0460
600	0.59518	–92.3966	6.98581	119.590	0.00299	83.1737	0.86409	–20.5497
700	0.57246	–103.370	6.42038	112.981	0.00260	80.3089	0.85979	–24.1577
800	0.55250	–113.144	5.84999	106.650	0.00290	92.0429	0.85520	–27.6815
900	0.53472	–121.776	5.41191	100.661	0.00302	105.246	0.84782	–31.3605
1000	0.52449	–129.730	4.96497	94.9959	0.00318	108.434	0.84282	–35.1238
1100	0.51695	–136.927	4.54764	90.8171	0.00267	105.419	0.84045	–38.9134
1200	0.51169	–143.454	4.20028	85.6440	0.00324	107.600	0.83653	–42.4718
1300	0.51068	–149.415	3.87755	81.5583	0.00288	125.081	0.83142	–46.2154
1400	0.51096	–154.979	3.68374	76.8340	0.00341	135.968	0.82654	–50.0614
1500	0.51414	–159.764	3.34692	72.0844	0.00397	161.841	0.82332	–53.6481
1600	0.52308	–164.732	3.08327	68.7585	0.00471	168.714	0.81938	–57.3655
1700	0.53386	–169.326	2.88980	64.9867	0.00534	167.996	0.81513	–60.9721
1800	0.54681	–173.677	2.67055	61.2486	0.00616	179.682	0.81137	–64.5700
1900	0.56327	–177.995	2.52768	59.2405	0.00689	–176.113	0.80540	–68.4487
2000	0.58655	177.870	2.36696	50.8883	0.00956	–172.396	0.79940	–72.1942
2100	0.61055	173.358	2.01609	47.7366	0.01148	–162.142	0.78856	–75.9597
2200	0.63890	169.100	1.90730	45.7805	0.01420	–163.127	0.77498	–79.9530
2300	0.67279	164.540	1.67030	40.2674	0.01902	–164.360	0.75985	–83.7696
2400	0.70166	157.738	1.43980	42.2038	0.02325	–172.911	0.72803	–87.5333
2500	0.69801	152.694	1.43414	42.1508	0.02096	176.062	0.71022	–89.7521

Application Information (continued)

S-Parameters (continued)

Table 50. GSM1800/GSM1900 LNA S-Parameters

V_{CC} = 3.0 Vdc; T_A = 25 °C ± 3 °C.

Frequency (MHz)	S11 M	S11 A (°)	S21 M	S21 A (°)	S12 M	S12 A (°)	S22 M	S22 A (°)
100	0.72049	–10.3679	9.36459	174.651	0.00071	89.4532	0.88784	–3.00579
200	0.71626	–19.1839	9.21437	169.174	0.00049	99.1328	0.88789	–5.98988
300	0.71044	–28.3682	9.03450	164.561	0.00098	87.1197	0.88873	–9.06578
400	0.70201	–37.4979	8.83372	159.108	0.00114	87.1865	0.88615	–12.3322
500	0.69282	–46.3680	8.55083	154.851	0.00135	94.1083	0.88441	–15.3451
600	0.68120	–54.9675	8.30631	150.462	0.00150	96.8748	0.88354	–18.3246
700	0.67035	–63.3538	8.05458	146.384	0.00165	100.411	0.88348	–21.4507
800	0.65592	–71.2914	7.58639	142.145	0.00175	104.474	0.88423	–24.6622
900	0.64597	–79.0065	7.46492	138.393	0.00183	111.176	0.88429	–27.7779
1000	0.63456	–86.4313	7.13151	133.917	0.00195	117.300	0.88418	–30.8038
1100	0.62423	–93.6246	6.81838	130.585	0.00201	122.491	0.88425	–34.0814
1200	0.61403	–100.327	6.67615	127.321	0.00208	126.815	0.88393	–37.2883
1300	0.60385	–106.845	6.29544	123.748	0.00204	133.665	0.88415	–40.5591
1400	0.59482	–112.987	6.01260	119.859	0.00205	142.947	0.88476	–43.8425
1500	0.58684	–118.926	5.65650	118.200	0.00208	152.563	0.88424	–47.3427
1600	0.57814	–124.639	5.21175	112.564	0.00204	162.947	0.88146	–50.8879
1700	0.57105	–129.931	5.07085	111.847	0.00207	174.520	0.87975	–54.4046
1800	0.56477	–134.970	4.89004	110.382	0.00220	–169.811	0.87879	–58.0057
1900	0.55982	–139.548	4.80069	104.700	0.00240	–146.913	0.87737	–61.7517
2000	0.55777	–143.939	4.51916	102.377	0.00341	–132.600	0.87559	–65.6357
2100	0.55688	–148.071	4.25839	99.0766	0.00465	–124.298	0.87125	–69.5440
2200	0.56016	–151.973	3.94905	92.5373	0.00625	–118.045	0.86413	–73.7550
2300	0.56820	–155.843	3.59528	93.4844	0.00829	–118.835	0.85277	–78.2931
2400	0.57964	–160.100	3.28148	87.5410	0.01021	–119.685	0.83323	–82.8408
2500	0.58945	–165.135	2.93579	86.2816	0.01275	–125.117	0.80091	–87.1585

Application Information (continued)

S-Parameters (continued)

Table 51. Receive IF Amplifier Input (0 dB Setting)

Port 1 = IFIN (pin 34).
Port 2 = IFIP (pin 35).

Frequency (MHz)	S11 M	S11 A (º)	S21 M	S21 A (º)	S12 M	S12 A (º)	S22 M	S22 A (º)
265.00	0.9531	–149.48	0.0582	–74.34	0.0574	–73.08	0.9490	–156.92
268.00	0.9560	–151.10	0.0590	–75.38	0.0583	–74.27	0.9510	–158.53
269.00	0.9526	–151.61	0.0591	–76.10	0.0584	–75.11	0.9527	–159.09
269.80	0.9555	–152.17	0.0595	–77.08	0.0585	–75.44	0.9502	–159.68
269.85	0.9545	–152.42	0.0594	–76.46	0.0592	–75.33	0.9511	–159.70
269.90	0.9572	–152.36	0.0595	–76.78	0.0584	–75.82	0.9501	–159.87
269.95	0.9546	–152.15	0.0594	–76.57	0.0585	–76.25	0.9498	–159.73
270.00	0.9541	–152.20	0.0599	–76.78	0.0588	–75.51	0.9513	–159.83
270.05	0.9540	–152.47	0.0595	–76.99	0.0587	–76.01	0.9530	–159.74
270.10	0.9540	–152.47	0.0597	–76.92	0.0592	–75.82	0.9484	–159.96
270.15	0.9563	–152.47	0.0599	–76.98	0.0585	–75.25	0.9465	–159.92
270.20	0.9532	–152.44	0.0595	–76.88	0.0585	–75.54	0.9501	–159.87
271.00	0.9522	–152.82	0.0599	–77.26	0.0590	–76.27	0.9510	–160.59
272.00	0.9539	–153.41	0.0602	–77.81	0.0596	–76.62	0.9510	–160.97
275.00	0.9553	–155.31	0.0606	–80.02	0.0600	–79.05	0.9483	–162.83

Table 52. Receive IF Amplifier Input (32 dB Setting)

Port 1 = IFIN (pin 34).
Port 2 = IFIP (pin 35).

Frequency (MHz)	S11 M	S11 A (º)	S21 M	S21 A (º)	S12 M	S12 A (º)	S22 M	S22 A (º)
265.00	0.9295	–152.17	0.1161	–88.39	0.1095	–84.71	0.9150	–159.66
268.00	0.9285	–154.07	0.1180	–90.37	0.1112	–86.54	0.9177	–161.45
269.00	0.9278	–154.73	0.1180	–90.72	0.1122	–86.90	0.9180	–161.98
269.80	0.9284	–155.09	0.1190	–91.33	0.1131	–87.61	0.9159	–162.59
269.85	0.9279	–155.15	0.1190	–91.27	0.1131	–87.67	0.9191	–162.59
269.90	0.9302	–155.14	0.1191	–91.60	0.1131	–87.85	0.9170	–162.81
269.95	0.9279	–155.15	0.1191	–91.65	0.1131	–87.73	0.9163	–162.73
270.00	0.9279	–155.01	0.1190	–91.39	0.1141	–87.72	0.9172	–162.55
270.05	0.9293	–155.26	0.1190	–91.53	0.1131	–87.72	0.9154	–162.71
270.10	0.9267	–155.32	0.1190	–91.56	0.1131	–87.90	0.9161	–162.99
270.15	0.9294	–155.39	0.1201	–91.82	0.1131	–87.93	0.9170	–162.81
270.20	0.9298	–155.34	0.1191	–91.66	0.1131	–87.74	0.9167	–162.87
271.00	0.9251	–155.68	0.1191	–92.14	0.1141	–88.32	0.9150	–163.43
272.00	0.9278	–156.36	0.1202	–92.92	0.1150	–88.83	0.9152	–163.82
275.00	0.9289	–158.13	0.1224	–94.78	0.1160	–90.99	0.9149	–165.83

Application Information (continued)

S-Parameters (continued)

Table 53. Transmit Modulator IF Output

Port 1 = TIFON (pin 52).
Port 2 = TIFOP (pin 53).

Frequency (MHz)	S11 M	S11 A (º)	S21 M	S21 A (º)	S12 M	S12 A (º)	S22 M	S22 A (º)
100	0.3614	–27.344	0.0243	60.57	0.0268	60.283	0.3613	–27.514
150	0.3733	–40.987	0.0323	60.738	0.0311	59.72	0.374	–41.233
160	0.3769	–43.517	0.0342	66.64	0.0337	66.158	0.3783	–43.974
170	0.3744	–46.346	0.0361	57.289	0.0356	59.268	0.3754	–47.12
175	0.377	–47.403	0.0358	62.482	0.0357	62.455	0.3792	–48.032
180	0.3749	–45.193	0.0135	91.599	0.0273	8.782	0.3517	–47.861
185	0.3788	–49.751	0.0335	65.218	0.0354	64.219	0.3795	–50.619
190	0.3769	–51.342	0.035	61.298	0.0362	62.918	0.3821	–52.245
200	0.382	–54.288	0.0371	64.049	0.037	65.059	0.3834	–55.193
250	0.3975	–68.232	0.041	75.557	0.0415	76.118	0.3863	–70.582
260	0.4021	–70.805	0.0441	81.698	0.0452	80.66	0.3834	–73.645
265	0.4019	–72.266	0.0442	81.769	0.0452	80.355	0.3796	–75.134
270	0.4383	–72.519	0.0741	93.489	0.073	104.612	0.4018	–73.513
275	0.4032	–74.838	0.0475	84.667	0.048	83.377	0.373	–76.937
280	0.4055	–76.144	0.0509	85.227	0.0509	83.407	0.3714	–77.711
290	0.4081	–78.499	0.0534	89.07	0.053	86.162	0.3704	–78.464
300	0.4112	–81.034	0.0579	85.089	0.058	84.222	0.3759	–80.773
400	0.4493	–105.378	0.0868	88.627	0.0852	88.783	0.414	–104.91
500	0.4882	–126.562	0.1277	85.741	0.1249	85.452	0.4541	–125.138
540	0.5075	–134.57	0.1452	79.56	0.1366	83.826	0.4585	–131.438
600	0.5292	–145.148	0.1667	78.41	0.1663	77.442	0.5014	–142.17
700	0.5667	–161.717	0.2189	72.108	0.2237	72.385	0.545	–157.555
800	0.5908	–176.224	0.2803	64.602	0.2802	62.116	0.5721	–171.84
900	0.5954	170.318	0.3422	50.1	0.3124	47.809	0.5935	175.837
1000	0.5885	160.18	0.3312	29.167	0.3307	33.106	0.6026	166.077
1100	0.5781	152.142	0.3281	21.204	0.3481	21.367	0.6105	157.826

Application Information (continued)

S-Parameters (continued)

Table 54. Transmit IF Input to Up-Conversion Mixer

Port 1 = TIFIP (pin 5).
Port 2 = TIFIN (pin 6).

Frequency (MHz)	S11 M	S11 A (°)	S21 M	S21 A (°)	S12 M	S12 A (°)	S22 M	S22 A (°)
100	0.5058	–177.126	0.1947	–12.79	0.1905	–14.311	0.5111	–177.728
150	0.5585	179.286	0.1493	–11.292	0.1419	–12.859	0.5639	178.853
160	0.5628	178.676	0.1435	–9.56	0.1367	–11.135	0.5696	178.017
170	0.5695	178.13	0.1396	–8.09	0.1339	–9.466	0.5751	177.39
175	0.5721	177.643	0.1388	–6.754	0.1323	–8.312	0.5785	177.012
180	0.5749	177.301	0.1388	–6.249	0.1315	–7.386	0.5828	176.539
185	0.5773	176.912	0.137	–5.325	0.1307	–6.864	0.5844	176.248
190	0.5806	176.598	0.1361	–4.71	0.1302	–6.347	0.5887	175.806
200	0.5864	175.696	0.1355	–3.398	0.1282	–5.664	0.5932	175.063
250	0.6139	172.103	0.1242	4.719	0.1116	4.718	0.6189	171.255
260	0.6172	171.533	0.1248	7.467	0.1121	8.158	0.6255	170.441
265	0.6193	171.176	0.1254	8.698	0.1129	9.86	0.6264	170.083
270	0.6218	170.811	0.1264	9.558	0.1149	11.102	0.6288	169.611
275	0.6207	170.529	0.1285	10.647	0.1164	12.686	0.6291	169.403
280	0.6241	170.217	0.1306	11.307	0.1187	13.716	0.6322	168.935
290	0.6278	169.479	0.1339	12.027	0.1229	14.746	0.6362	168.072
300	0.6299	168.857	0.1359	12.22	0.1265	15.109	0.6407	167.231
400	0.6625	161.336	0.1695	26.49	0.166	30.695	0.673	159.047
500	0.6744	153.87	0.2253	24.951	0.218	28.653	0.6769	151.351
540	0.6733	152.146	0.2198	17.441	0.2269	20.962	0.6518	149.735
600	0.6762	147.871	0.2566	17.566	0.2493	18.903	0.6683	145.629
700	0.6837	143.115	0.2774	11.42	0.2733	11.823	0.6688	141.363
800	0.6847	137.965	0.3153	6.357	0.297	6.915	0.6708	136.953
900	0.6863	133.307	0.3279	–3.477	0.2932	2.598	0.6741	133.532
1000	0.6872	128.201	0.2798	–8.735	0.2868	–4.204	0.6827	130.017
1100	0.6822	123.088	0.304	–10.551	0.3094	–11.399	0.6846	126.018

Application Information (continued)

S-Parameters (continued)

Table 55. Transmit RF Output from Up-Conversion Mixer

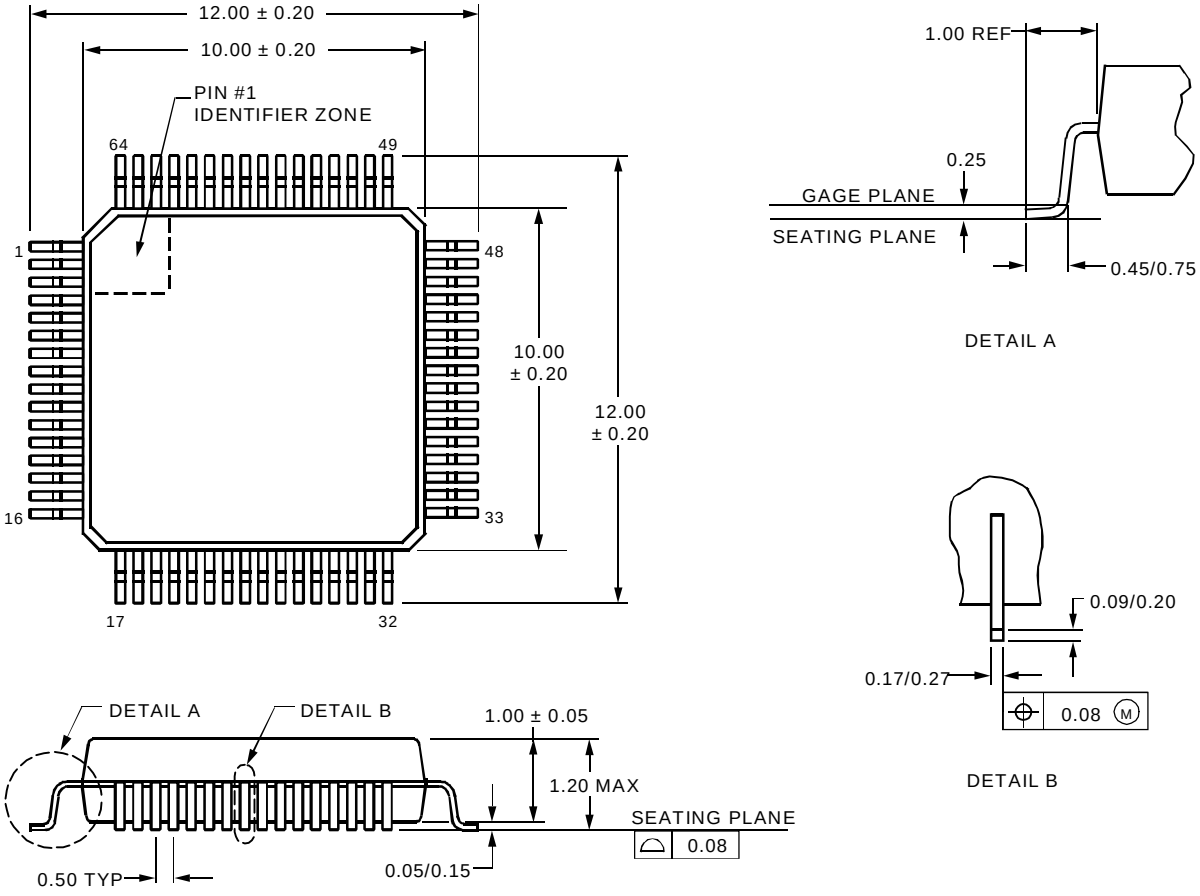
Port 1 = TOV (pin 60).
Port 2 = TOUT (pin 59).

Frequency (MHz)	S11 M	S11 A (º)	S21 M	S21 A (º)	S12 M	S12 A (º)	S22 M	S22 A (º)
500	0.963	–21.042	0.0583	45.382	0.0628	49.126	0.971	–22.198
800	0.9463	–37.236	0.075	23.36	0.0831	27.071	0.9318	–38.288
850	0.9478	–39.572	0.0553	36.857	0.0597	39.225	0.9477	–40.772
875	0.9471	–41.282	0.0552	34.713	0.0684	37.846	0.9468	–42.597
887.5	0.9445	–42.042	0.0546	31.41	0.0643	28.659	0.947	–43.555
900	0.9384	–42.822	0.0422	11.154	0.0955	30.339	0.9413	–46.025
912.5	0.9465	–43.326	0.0452	20.131	0.0503	7.264	0.9534	–45.052
925	0.9575	–44.836	0.0318	37.41	0.0672	34.909	0.9616	–46.123
937.5	0.9434	–45.632	0.0398	35.47	0.0405	34.066	0.9476	–46.268
950	0.9377	–46.171	0.0348	36.164	0.0354	32.187	0.9485	–46.354
962.5	0.928	–47.687	0.0459	30.299	0.0395	65.541	0.9557	–47.636
975	0.9352	–48.135	0.0464	48.624	0.0336	37.71	0.9373	–49.303
1000	0.9349	–50.069	0.0408	25.125	0.037	23.964	0.9416	–51.094
1700	0.7367	–118.813	0.4566	116.282	0.4121	109.367	0.7109	–120.942
1712.5	0.7233	–122.78	0.4859	115.896	0.4365	108.44	0.7242	–122.438
1725	0.7136	–124.997	0.5398	112.112	0.4616	110.187	0.7327	–124.948
1737.5	0.6994	–126.458	0.5611	107.372	0.5147	105.261	0.7049	–126.805
1750	0.6936	–128.343	0.5605	101.527	0.5603	98.485	0.7156	–128.63
1762.5	0.6797	–128.292	0.5618	95.946	0.566	94.77	0.6903	–130.228
1775	0.6685	–129.811	0.5338	94.272	0.5441	89.296	0.6812	–131.56
1787.5	0.6494	–131.842	0.5326	97.176	0.5036	84.854	0.6886	–134.751
1800	0.6503	–131.754	0.5302	96.268	0.474	88.133	0.6673	–132.553
1812.5	0.6449	–133.665	0.5662	96.331	0.4714	91.439	0.6571	–133.945
1825	0.6533	–137.305	0.5723	95.889	0.5172	90.876	0.677	–134.916
1837.5	0.6292	–136.07	0.6464	90.019	0.5245	93.345	0.6257	–135.788
1850	0.6203	–136.917	0.6377	83.438	0.5592	92.612	0.6252	–137.496
1862.5	0.6168	–138.04	0.6126	78.826	0.5844	89.189	0.6202	–139.816
1875	0.6189	–142.061	0.5349	76.428	0.6301	85.411	0.6217	–138.545
1887.5	0.6011	–140.385	0.5379	77.397	0.5842	81.177	0.6097	–142.359
1900	0.6145	–139.843	0.5299	76.41	0.5801	77.016	0.6516	–143.578
1912.5	0.6003	–142.012	0.5398	81.318	0.5563	79.922	0.6114	–143.639
1925	0.5666	–142.51	0.5718	82.52	0.526	77.979	0.6145	–147
1937.5	0.5857	–145.342	0.5901	80.549	0.5728	81.259	0.5934	–145.589
1950	0.5789	–146.191	0.6116	78.454	0.5932	80.357	0.5818	–146.725
1962.5	0.5597	–146.175	0.611	75.563	0.6214	78.699	0.5749	–148.368
1975	0.5359	–151.61	0.6008	74.456	0.6711	75.726	0.5676	–149.154
1987.5	0.555	–147.335	0.6359	70.535	0.6292	72.372	0.5566	–154.653
2000	0.555	–150.321	0.6123	71.054	0.6364	71.938	0.5537	–153.236

Outline Diagram

64-Pin TQFPT

Dimensions are in millimeters.



5-3080.a

Manufacturing Information

This device will be assembled in one of the following locations: assembly codes K or M.

Evaluation Board Note

The EVB3020A Evaluation Board is available for customer demonstration (see Ordering Information) of device performance characteristics. The board allows full characterization with RF laboratory bench equipment. Various applications of the device can be demonstrated on the evaluation board.

Ordering Information

Device Code	Description	Package	Comcode
LUCW3020CCS	GSM Transceiver	64TQFPT Bulk	108417734
LUCW3020CCS-DB		64TQFPT Dry Pack	108417742
EVB3020A	Evaluation Board	Evaluation Board	108100611
EVB3020A-IFBD	Interface Board	Interface Kit	108100629

Note: Contact your Lucent Technologies Microelectronics Group Account Manager for minimum order requirements.

For additional information, contact your Microelectronics Group Account Manager or the following:
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E-MAIL: **docmaster@micro.lucent.com**
N. AMERICA Microelectronics Group, Lucent Technologies Inc., 555 Union Boulevard, Room 30L-15P-BA, Allentown, PA 18103
1-800-372-2447, FAX 610-712-4106 (In CANADA: **1-800-553-2448**, FAX 610-712-4106)
ASIA PACIFIC: Microelectronics Group, Lucent Technologies Singapore Pte. Ltd., 77 Science Park Drive, #03-18 Cintech III, Singapore 118256
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CHINA: Microelectronics Group, Lucent Technologies (China) Co., Ltd., A-F2, 23/F, Zao Fong Universe Building, 1800 Zhong Shan Xi Road, Shanghai 200233 P.R. China **Tel. (86) 21 6440 0468, ext. 316**, FAX (86) 21 6440 0652
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